Express-HRR
(Computer-on-Module)
Reference Manual

P/N 50-1Z100-1000

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REVISION HISTORY

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Audience

This manual provides reference only for computer design engineers, including but not limited to hardware and software designers and applications engineers. ADLINK Technology, Inc. assumes you are qualified to design and implement prototype computer equipment.

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Contents

Chapter 1 About This Manual 1
Purpose of this Manual 1
References 1
Chapter 2 Product Overview 3
COM Express Concept 3
COM Express Architecture 4
Product Description 5
Module Features 5
Block Diagram 8
Major Components (ICs) 9
Connectors, Headers, and Sockets 11
Specifications 13
Physical Specifications 13
Power Specifications 14
Environmental Specifications 14
Thermal/Cooling Requirements 15
Mechanical Specifications 16
Chapter 3 Hardware 17
Overview 17
CPU 18
Graphics 18
Memory 18
Interrupt Channel Assignments 19
Memory Map 20
I/O Address Map 21
COM Express A-B Connector 22
LPC Interface 22
SATA Interface 22
USB Interface 22
Power Interface 22
Power Management 23
Video Interfaces 23
Audio Interface 23
Ethernet Interface 23
I²C™ Bus 23
PCI Express™ 24
System Management Bus (SMBus) 24
GPIO 24
COM Express C-D Connector 27
Digital Display Interface (DDI) 27
PCI Express™ 27
PCI Express Graphics (PEG) 28
SDVO 28
Watchdog Timer 31
TPM (Trusted Platform Module) 31
Hardware Voltage and Temperature Monitor 31
System Fan 32

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Chapter 4 BIOS Setup 33
Introduction 33
Entering BIOS Setup (VGA Display) 33
OEM Logo Screen (Splash Screen) 33
Logo Image Requirements 33
BIOS Setup Menus 34
BIOS Main Setup Screen 34
BIOS Advanced Setup Screen 35
BIOS Chipset Setup Screen 39
BIOS Boot Setup Screen 41
BIOS Security Setup Screen 43
BIOS Save & Exit Setup Screen 44
Appendix A Technical Support 47
Index 49

List of Figures

Figure 2-1. Mini, Compact, Basic and Extended Form Factors 4
Figure 2-2. Functional Block Diagram 8
Figure 2-3. Component Locations (Top Side) 10
Figure 2-4. Component Locations (Bottom Side) 11
Figure 2-5. Connector Locations (Top Side) 12
Figure 2-6. Connector Locations (Bottom Side) 13
Figure 2-7. Stack Heights of Cooling Assemblies (Side Views) 15
Figure 2-8. Mechanical Dimensions (Top Side) 16
Figure 4-1. BIOS Main Setup Screen 34
Figure 4-2. BIOS Advanced Setup Screen 35
Figure 4-3. BIOS Chipset Setup Screen 39
Figure 4-4. BIOS Boot Setup Screen 41
Figure 4-5. BIOS Security Setup Screen 43
Figure 4-6. BIOS Save & Exit Setup Screen 44

List of Tables

Table 2-1. COM Express Pin-out Types 3
Table 2-2. Major Integrated Circuit Descriptions and Functions 9
Table 2-3. Module Connector and Socket Descriptions 11
Table 2-4. Weight and Footprint Dimensions 13
Table 2-5. Power Supply Requirements 14
Table 2-6. Environmental Requirements 14
Table 2-7. ADLINK Optional Cooling Solutions 15
Table 3-1. Interrupt Channel Assignments 19
Table 3-2. Memory Map 20
Table 3-3. I/O Address Map 21
Table 3-4. SMBus Reserved Addresses 24
Table 3-5. COM Express A-B Connector Signal Descriptions 24
Table 3-6. COM Express C-D Connector Signal Descriptions 28
Table 3-7. Optional System Fan (FAN1) 32
Table 4-1. BIOS Setup Menus 34
Table A-1. Technical Support Contact Information 47

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Chapter 1 About This Manual

Purpose of this Manual

This manual is for designers of systems based on the Express-HRR Computer-on-Module (COM). This manual contains information that permits designers to create an embedded system based on specific design requirements.

Information provided in this reference manual includes:

- Product Overview
- Hardware Specifications
- BIOS Setup Information
- Technical Support Information

Information not provided in this reference manual includes:

- Detailed chip specifications (refer to References section of this chapter for hyperlinks to chip specifications)
- Internal component operation
- Internal registers or signal operations
- Bus or signal timing for industry standard busses and signals
- Pin-signal definitions for industry-standard interfaces

References

The following list of references may be helpful for you to complete your custom design successfully.

Specifications

- COM Express Specification Revision 2.0

  Web site: http://www.picmg.org/
- PCIe Specification Revision 2.0

  Web site: http://www.pcisig.com/specifications/pciexpress/base
- I^2C Bus Specification Version 2.1

  Specification: http://www.nxp.com/documents/other/39340011.pdf
- USB Specification Version 2.0

  Web site: http://www.usb.org/developers
- SATA Specification Version 3.1

  Web site: http://www.sata-io.org/
- LPC Specification Version 1.1

  Web site: http://www.intel.com/design/chipsets/industry/lpc.htm
- SMBus Specification Version 2.0

  Specification: http://smbus.org/specs/
- ADLINK Intelligent Device Interface (AIDI) Library User's Manual (See Utilities section of Product page)

  Web site: http://www.adlinktech.com/Computer-on-Module/Com-Express/index.html

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- AMI BIOS Aptio TSE User's Guide

  Datasheet: http://www.ami.com/support/doc/AMI_TSE_User_Manual_PUB.pdf

Chip Specifications

- Intel® Corporation and the Core™ i7 2nd Generation Mobile series CPU, featured as the integrated processor core and graphics memory hub

Web site: http://www.intel.com/content/www/us/en/processors/core/CoreTechnicalResources.html

- Intel Corporation and the BD82QM67, 6 Series Express chipset, featured as the Platform Controller Hub (PCH)

  Datasheet: http://www.intel.com/Assets/PDF/datasheet/324645.pdf

- ON Semiconductor and the ADT7490-D chip, featured as the temperature monitor and fan controller

  Datasheet: http://www.onsemi.com/pub_link/Collateral/ADT7490-D.PDF

- Atmel Corporation and the AT97SC3204T-U1A190, featured as the Trusted Platform Module (TPM), integrated security module

  Web site: http://www.atmel.com/products/Embedded/default.asp?category_id=172&family_id=620

- Atmel Corporation and the ATMEGA168V-10AU, featured as the Board Controller

  Datasheet: http://www.atmel.com/dyn/resources/prod_documents/2545S.pdf

- Philips Corporation and the PCA9535BS chip, featured as the GPIO generator

  Datasheet: http://www.datasheetcatalog.org/datasheet/philips/PCA9535.pdf

- Intel Corporation and the 82579LM chip used for the Gigabit Ethernet PHY transceiver

  Datasheet: http://download.intel.com/design/network/datashts/82579.pdf

NOTE	If you are unable to locate the datasheets using the links provided, search the internet to find the manufacturer's web site and locate the documents you need.

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Chapter 2 Product Overview

This introduction presents general information about the COM Express™ architecture and the Express-HRR Computer-on-Module (COM). After reading this chapter you should understand:

- COM Express concept
- COM Express architecture
- Express-HRR Product Description
- Express-HRR Major Components
- Express-HRR Connectors, Headers, and Sockets
- Express-HRR Specifications

COM Express Concept

COM Express is an open-industry standard, defined specifically for COM boards. Its creation provides the ability to make a smooth transition from legacy parallel interfaces to the newest technologies based on serial buses available today. COM Express modules are available in the following form factors:

- Mini 84mm x 55mm
- Compact 95mm x 95mm
- Basic 125mm x 95mm
- Extended 155mm x 110mm

The COM Express specification 2.0 defines seven different pinout types.

Table 2-1. COM Express Pin-out Types

Types	Connector Rows	PCI Express Lanes	PCI	IDE Channels	LAN ports
Type 1	A-B	Up to 6			1
Type 2	A-B C-D	Up to 22	32 bit	1	1
Type 3	A-B C-D	Up to 22	32 bit		3
Type 4	A-B C-D	Up to 32		1	1
Type 5	A-B C-D	Up to 32			3
Type 6	A-B C-D	Up to 24			1
Type 10	A-B	Up to 4			1

The Express-HRR utilizes the Basic form factor and the Type 6 pinout definition, featuring two high performance connectors that ensure stable data throughput. The Type 6 pinout removes the PCI interface signals and replaces them with DisplayPort, and HDMI display signals, thereby expanding the range of potential video peripherals beyond the familiar VGA, LVDS, and SDVO interfaces.

The COM board integrates all core components and is mounted onto an application specific baseboard. COM boards are legacy-free designs (no Super I/O, PS/2 keyboard, and PS/2 mouse) and provide most of the functional requirements for any application. These functions include, but are not limited to a rich complement of contemporary, high-bandwidth serial interfaces such as PCI Express, Serial ATA, USB 2.0, and Gigabit Ethernet. The robust thermal and mechanical concept of the COM board, combined with extended power management capabilities, is perfectly suited for all applications.

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Baseboard designers can utilize as little or as many of the I/O interfaces as necessary. The baseboard can therefore provide all the interface connectors required to attach the system to the application specific peripherals. This versatility allows the designer to create a dense and optimized package, which results in a more reliable product while simplifying system integration. Most importantly, COM Express modules are scalable, which means once an application has been created, the ability to diversify the product range is possible through the use of different performance class modules. Simply unplug one module and replace it with another. No redesign is necessary.

COM Express Architecture

The COM Express specification was developed by the PCI Industrial Computer Manufacturing Group (PICMG) in close collaboration with many leading companies across the embedded industry in order to find an implementation solution to handle upcoming new high-speed serial I/Os, processors, and chipsets. COM Express specifies four form factors, as well as seven different types of connector pinouts.

The four form factors are referred to as Mini, Compact, Basic, and Extended. The Mini form factor targets battery powered, mobile, and handheld system designs and features a footprint of just 84mm x 55mm. The Compact form factor is 95mm x 95mm, designed to match the requirements of small applications. The Basic module footprint is 125mm x 95mm and focuses on space-constrained, low power systems which typically do not contain more than one horizontal mounted SODIMM. The Extended footprint is slightly larger at 155mm x 110mm and supports up to two full-size, vertically mounted DIMM modules to accommodate larger memory configurations for high-performance CPUs, chipsets, and multiprocessor systems. The placement of the shielded 220-pin connectors and the mounting holes are identical between these four footprints.

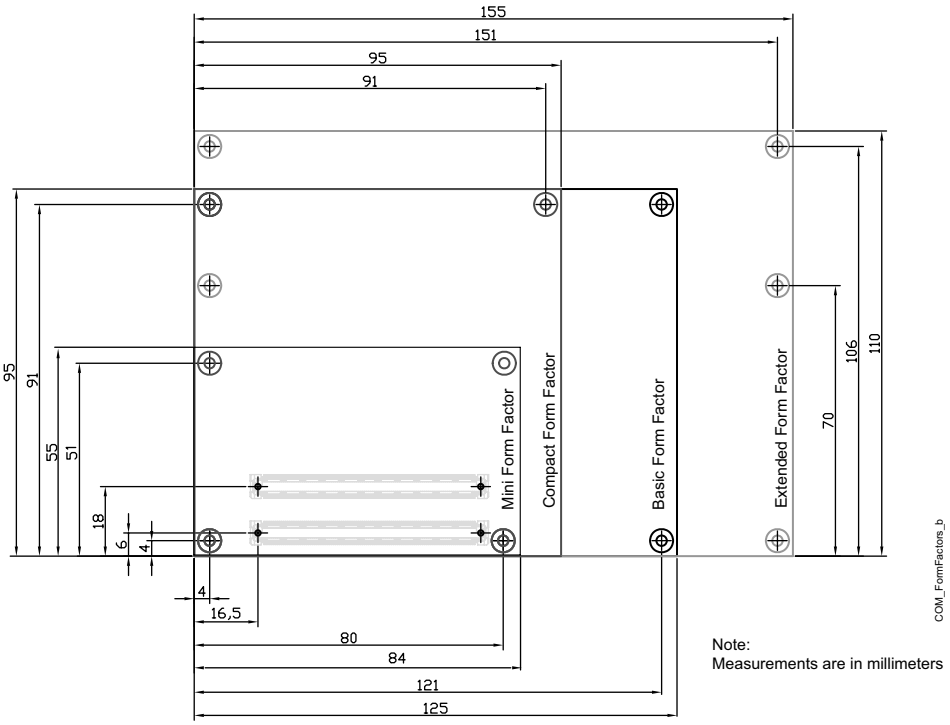


Figure 2-1. Mini, Compact, Basic and Extended Form Factors

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Product Description

The Express-HRR is an exceptionally high integration, high performance, rugged Intel Core™ i7 processor based system compatible with the COM Express standard. This rugged and high quality module system contains all the component subsystems of an ATX motherboard.

The Intel Core i7 incorporates a multi processor core with an integrated Graphics Memory Hub (GMH), providing a high-performance processor, a memory controller for up to 16GB of SODIMM memory, and a graphics controller for LVDS, VGA, PCI Express graphics (PEG), SDVO, DisplayPort, and HDMI signals driven by the PCH.

The Intel BD82QM67 chipset provides controllers for the Platform Controller Hub (PCH) featuring eight USB 2.0 ports, four SATA ports, eight GPIO ports, and one Gigabit Ethernet interface (external magnetics required).

Expansion for additional system functions is possible on the Express-HRR through the PCIe and LPC expansion buses. The PCIe and LPC buses operate at clock speeds of 100MHz and 33MHz, respectively.

The Express-HRR is particularly well suited for either embedded or portable applications and meets the size, power consumption, temperature range, quality, and reliability demands of embedded system applications.

Module Features

- CPU
  - Intel 1.5GHz (2610UE), 2.1GHz (2715QE), or 2.2GHz (2655LE), 2nd Generation Core i7 series processors
  - DMI (Direct Media Interface) with 2 GB/s of bandwidth in each direction
  - FDI (Flexible Display Interface) for carrying display traffic to the PCH
  - Internal 256KB L2 cache
  - Enhanced Intel SpeedStep® Technology (EIST)
- Memory
  - Two standard 204-pin DDR3 SODIMM sockets
  - Supports +1.5V DDR3, 1067/1333MHz RAM up to 16 GB total
  - Supports ECC, unbuffered memory
- Expansion Buses
  - PCIe between CPU/PCH and COM Express connectors
  - LPC (Low Pin Count) for LPC devices
  - I^2C for fast mode I^2C devices
- COM Express Interface
  - SATA Interface
    - Provides four SATA ports
    - Supports up to 6 Gb/s transfer speed on two ports
    - Supports up to 3 Gb/s transfer speed on all ports
    - Supports Native Command Queuing
    - Provides Auto Activate for DMA
    - Supports Hot Plug features

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- HD Audio
  - Provides Intel HD Audio controller
  - Supports Audio Docking
  - Provides 32-bit sample depth
  - Supports sample rates up to 192kHz
- USB Port Interface
  - Supports two root USB hubs
  - Supports eight EHCI USB 2.0 ports
  - Supports legacy UHCI USB 1.1 signals
  - Supports Per-Port-Disable
- Ethernet Interface
  - Provides Intel 82579LM Ethernet PHY transceiver chip
  - Supports one Gigabit Ethernet port
  - Supports IEEE 802.3, 802.3u, 802.3z, and 802.3ab compatible physical layers
  - Supports Auto-negotiation for speed, duplex mode, and flow control
  - Supports half duplex at 10/100Mb/s or full duplex at 10/100/1000Mb/s
    - Full-duplex mode supports transmit and receive frames simultaneously
    - Supports IEEE 802.3x flow control in full duplex mode
    - Half-duplex mode supports enhanced proprietary collision reduction mode
- Video Interfaces (VGA/LVDS/PEG/SDVO/DisplayPort/HDMI)
  - Support the DisplayPort standard
  - Support Graphics Performance Modulation Technology
  - Support Intel Smart 2D Display Technology
  - Support Graphics Render C-State
  - Support Intel Seamless Display Refresh Rate Switching with eDP
  - Provide an integrated RAMDAC with 32-bit color
  - Provide digital HSYNC and VSYNC signals
  - Support one SDVO port through Digital Port B at 200 MP/s (Megapixels/second)
  - Support DisplayPort resolutions up to 2560x1600 at 60 Hz
  - Support HDMI (with reduced blanking) resolutions up to 1920x1200 at 60 Hz
  - Support VGA resolutions up to 2048x1536 bpp at 75Hz
  - Provide 24-bit dual-channel LVDS output
  - Support PCI Express Graphics (PEG)

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- Miscellaneous
  - Real Time Clock (RTC) with external replaceable battery
  - Watchdog Timer (WDT)
  - TPM (Trusted Platform Module)
  - Hardware Voltage and Temperature Monitor
  - Logo Screen (Splash)

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Block Diagram

Figure 2-2 shows the functional components of the module.

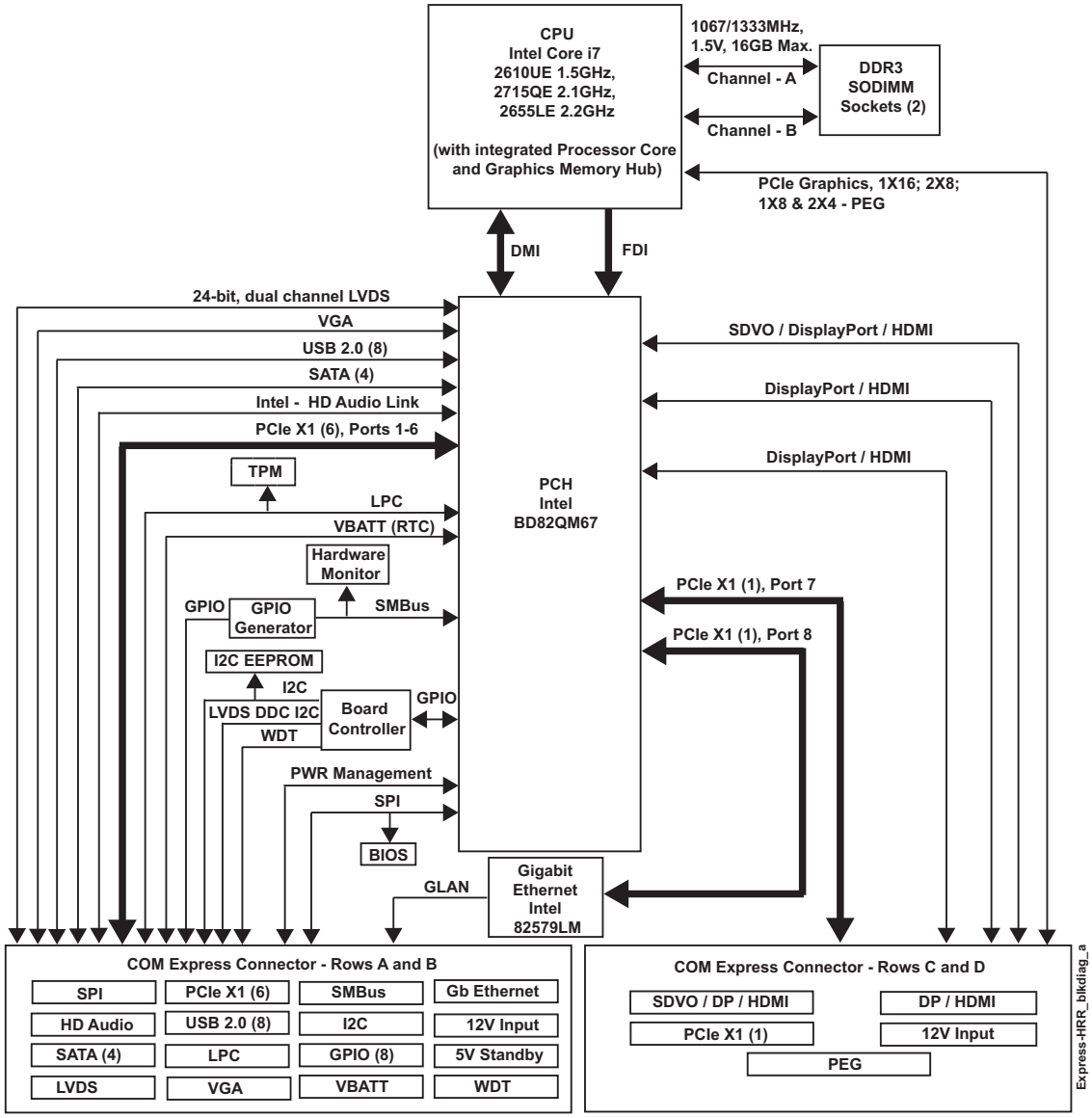


Figure 2-2. Functional Block Diagram

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Major Components (ICs)

Table 2-2 lists the major integrated circuits on the Express-HRR, including a brief description of each IC. Figures 2-3 and 2-4 show the locations of the major ICs.

Table 2-2. Major Integrated Circuit Descriptions and Functions

Chip Type	Mfg.	Model	Description	Function
CPU (U1)	Intel	Core i7 (2610UE, 2715QE, and 2655LE)	1.5GHz, 2.1GHz, or 2.2GHz processors with up to 8MB L3 cache	Provides integrated CPU, memory, and video
PCH (Platform Controller Hub [U3])	Intel	BD82QM67 (PCH)	I/O hub providing Southbridge functions (standard I/O functions)	Provides I/O interfaces such as USB, SATA, and video
Hardware Monitor (U6) [on bottom side; see Figure 2-4 on page 11]	ON Semiconductor	ADT7490-D	Remote Voltage and Temperature Monitor and Fan Controller	Provides system thermal protection
TPM (Trusted Platform Module [U7])	Atmel	AT97SC3204-U1A90	Complete turnkey security solution on a single chip	Provides an integrated, protected, non-volatile solution for strong public key security, intellectual property protection, system integrity, authentication, and secure communications
Board Controller (U8) [on bottom side; see Figure 2-4 on page 11]	Atmel	ATMEGA168V-10AU	Micro controller for board functions including I^2C, Watchdog Timer, and LVDS	Optimizes power consumption versus processor speed
GPIO Generator (U9)	Philips	PCA9535BS	Module providing 16 bits of GPIO expansion for I2C/SMBus applications	Provides additional digital control lines
Gigabit Ethernet PHY Transceiver (U46)	Intel	82579LM	Ethernet PHY transceiver for 10T/100TX/1000T Gigabit Ethernet function	Provides a standard IEEE 802.3 Ethernet interface for Ethernet transfer rate up to 1000 Mb/s

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Key:
U1 - CPU
U3 - PCH
U7 - TPM
U9 - GPIO Generator
U46 - Gb Ethernet

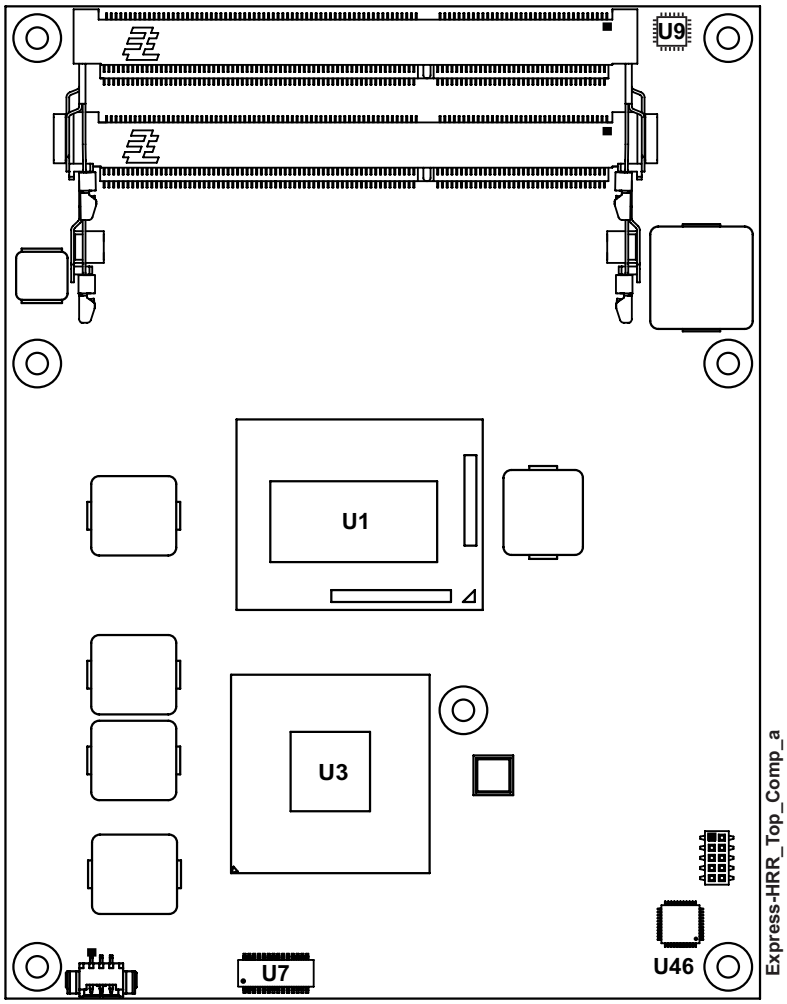


Figure 2-3. Component Locations (Top Side)

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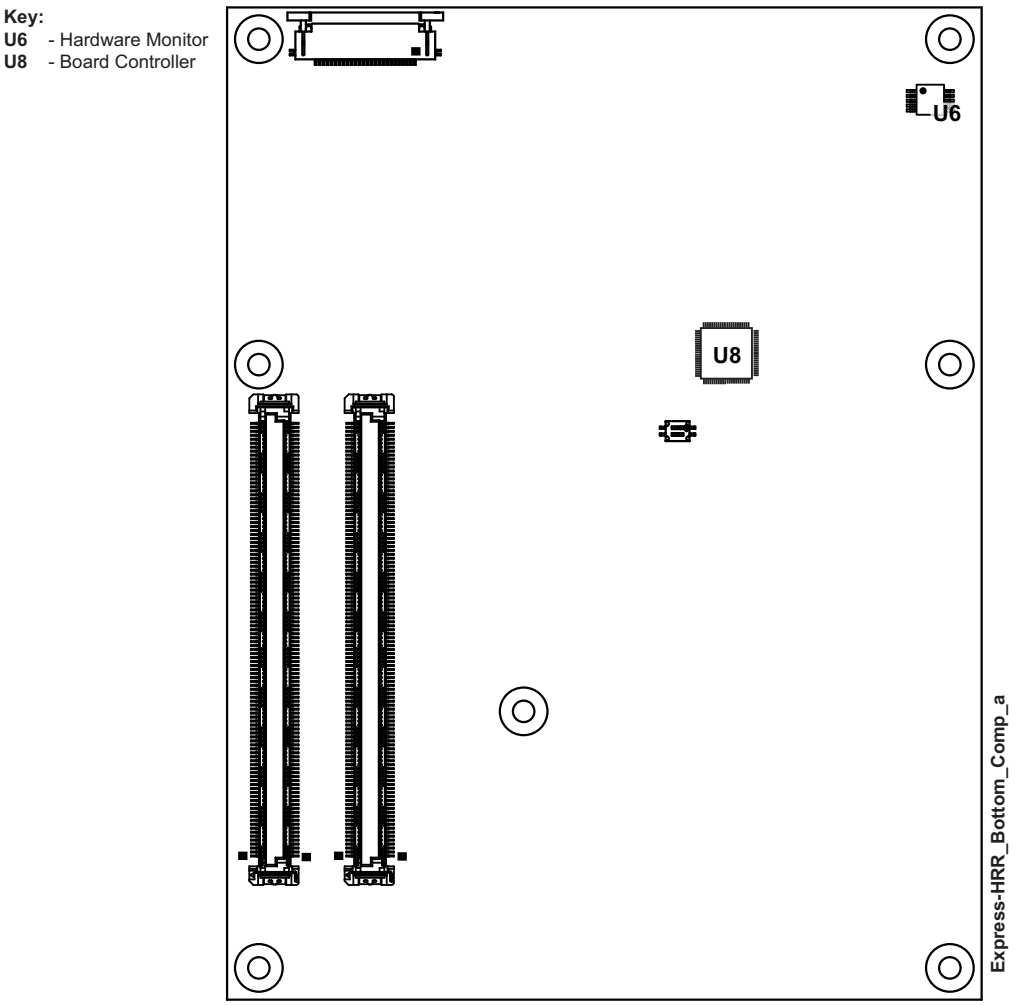


Figure 2-4. Component Locations (Bottom Side)

Connectors, Headers, and Sockets

Table 2-3 describes the connectors, headers, and sockets shown in Figures 2-5 and 2-6.

Table 2-3. Module Connector and Socket Descriptions

Jack/Plug #	Board Access	Description
J6A – Memory	Top	204-pin socket for DDR3 SODIMM - Channel A
J6B – Memory	Top	204-pin socket for DDR3 SODIMM - Channel B
CN1 – XDP Debug (see Figure 2-6 on page 13.)	Bottom	26-pin, 0.020" (0.50mm) right-angle debug port connector for the CPU and PCH
CN4 – LPC Debug	Top	10-pin, .050" (1.27mm) female debug port header for issues such as Port 80 POST errors
CN6 – COM Express A-B (see Figure 2-6 on page 13.)	Bottom	220-pin connector for Northbridge Video and Southbridge I/O functions
CN7 – COM Express C-D (see Figure 2-6 on page 13.)	Bottom	220-pin connector for Northbridge Video and Southbridge I/O functions

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Table 2-3. Module Connector and Socket Descriptions (Continued)

FAN1 – System Fan	Top	3-pin, 0.049" (1.25mm) right-angle shrouded header controlled by the Hardware Monitor for CPU and PCH cooling
SW1 – PCIe Bifurcation Switch (see Figure 2-6 on page 13.)	Bottom	4-pin dip switch for selecting PCIe modes (positions 1,2 = 1x8, 2x4; 1,3 = reserved; 2,4 = 2x8; 3,4 = 1x16 [Default])

Key:
J6A - Channel A SODIMM socket
J6B - Channel B SODIMM socket
FAN1 - CPU Fan
CN4 - LPC

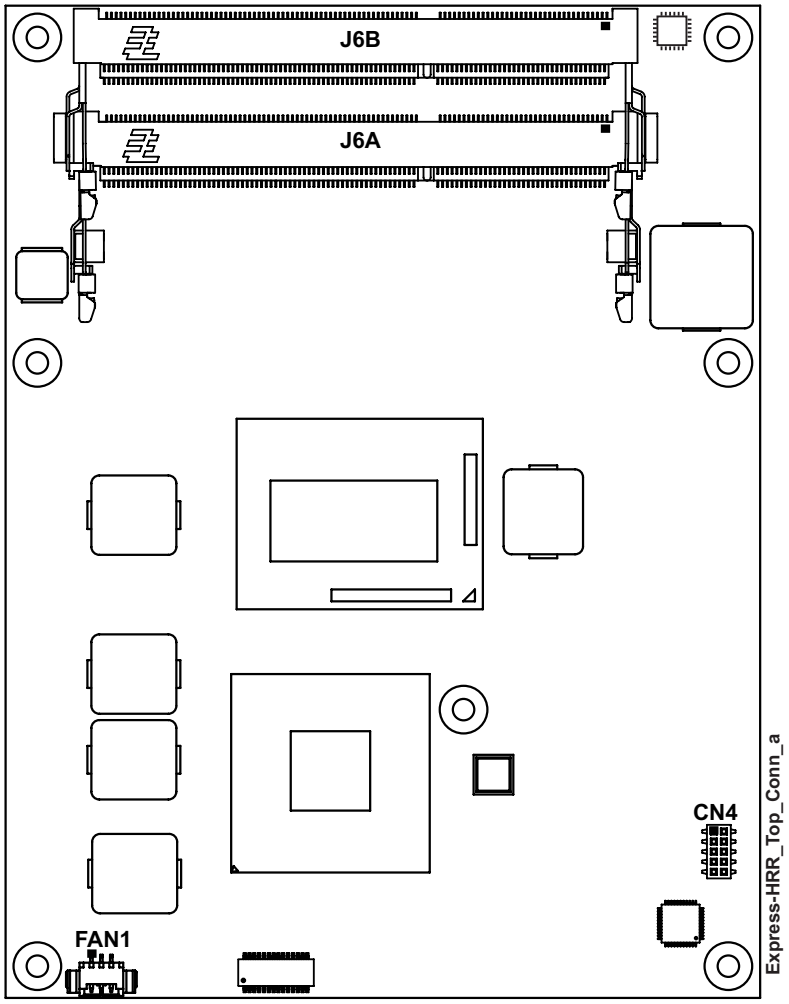


Figure 2-5. Connector Locations (Top Side)

NOTE Pin 1 is shown as a black square on connectors in all illustrations.

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Key:
CN1 - XDP
CN6 - COM Express A1-A110 and B1-B110
CN7 - COM Express C1-C110 and D1-D110
SW1 - PCI Express Bifurcation Switch

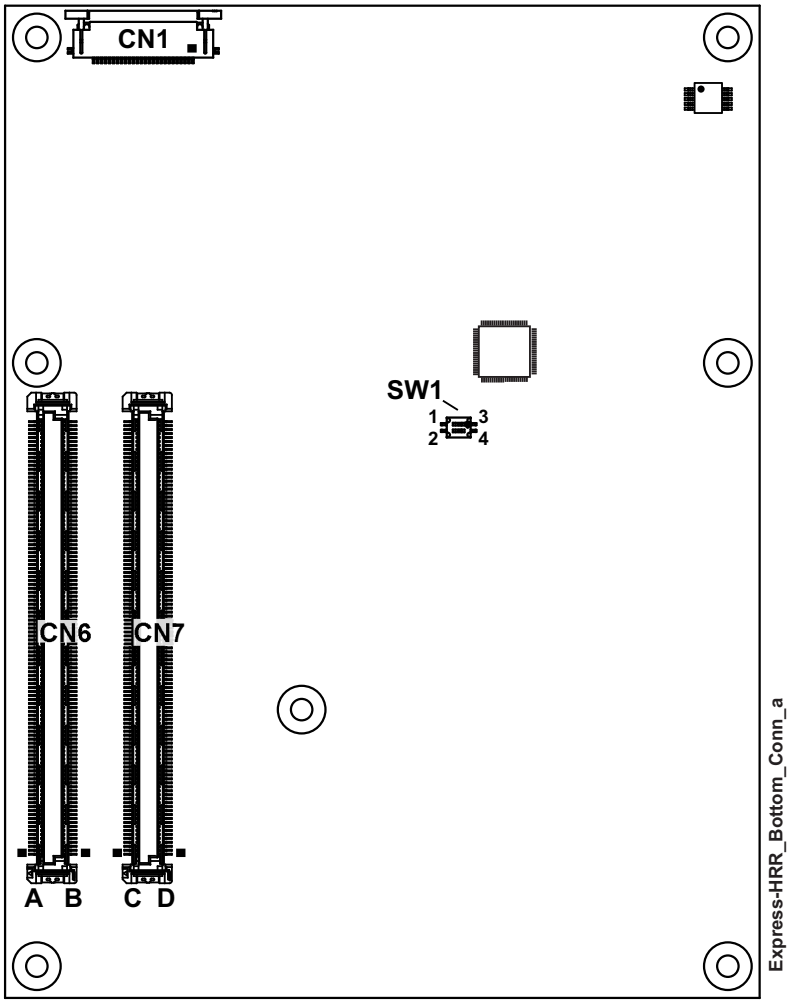


Figure 2-6. Connector Locations (Bottom Side)

Specifications

Physical Specifications

Table 2-4 lists the physical dimensions of the module.

Table 2-4. Weight and Footprint Dimensions

Item	Dimension
Weight	0.09 kg (0.20 lb)
Height (overall)	9.20 mm (0.36 inches)
Board thickness	2.362 mm (0.093 inches)
Width	95.00 mm (3.74 inches)
Length	125.00 mm (4.92 inches)

NOTE Overall height is measured from the upper board surface to the highest permanent component on the upper board surface. This measurement does not include the cooling solutions. The heights of the board with the cooling solutions are 36.50mm for the passive heatsink (without fan), 46.80mm for the active heatsink (with fan) and 11.00mm for the heatspreader.

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Power Specifications

Table 2-5 provides the power requirements for the Express-HRR with 1.5, 2.1, and 2.2 GHz CPUs and a 430 watt power supply.

Table 2-5. Power Supply Requirements

Parameter	1.5 GHz CPU	2.1 GHz CPU	2.2 GHz CPU
Input Type (430 watt power supply)	+12V Regulated DC	+12V Regulated DC	+12V Regulated DC
In-rush Voltage & Current	3.52A (42.24W)	3.76A (45.12W)	7.18A (86.16W)
Typical Idle Voltage & Current (Windows XP)	0.66A (7.90W)	0.65A (7.84W)	0.65A (7.78W)
BIT Voltage & Current	1.89A (22.65W)	4.80A (57.59W)	2.72A (32.63W)
S1 Mode	0.13A (0.64W)	0.11A (0.55W)	0.12A (0.60W)
S3 Mode	0.47A (2.37W)	0.46A (2.32W)	0.47A (2.33W)

Operating configurations:

- In-rush operating configuration includes video, baseboard, and 8GB DDR3 RAM.
- Idle (Windows XP) operating configuration includes the in-rush configuration as well as one SATA drive (external power), boot up from SATA0, keyboard and mouse.
- BIT = Burn-In-Test. Operating configuration includes the Idle configuration as well as a second SATA hard drive, four USB test plugs, two serial port loop backs, one Ethernet loop back, and two USB Compact Flash readers with 64MB Compact Flash modules.
- S1 (Standby) operating configuration is the same as BIT operating configuration.
- S3 (Suspend) operating configuration is the same as BIT operating configuration.

Environmental Specifications

Table 2-6 provides the operating and storage temperature ranges required for this module.

Table 2-6. Environmental Requirements

Parameter	Conditions
Temperature	
Operating	–20° to +70°C (–4° to +158°F)
Extended (Optional)	–40° to +85°C (–40° to +185°F)
Storage	–55° to +85°C (–67° to +185°F)
Humidity	
Operating	5% to 90% relative humidity, non-condensing
Non-operating	5% to 95% relative humidity, non-condensing

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Thermal/Cooling Requirements

The Express-HRR is designed to operate at its maximum CPU speeds of 1.5GHz, 2.1GHz, and 2.2GHz and requires a thermal solution to cool the CPU, PCH, and voltage regulators. ADLINK offers two optional cooling solutions as well as a heat spreader platform on which to build a cooling solution. (See Table 2-7 for descriptions of cooling options)

> **NOTE** The overall system design must keep the ICs within their operating temperature specifications.

Table 2-7. ADLINK Optional Cooling Solutions

Cooling Solution	Description
Passive Heatsink (without fan)	Qualified to maintain optimal performance up to +70°C.
Active Heatsink (with fan)	Qualified to maintain optimal performance up to +85°C. (**Note**: The 2715QE CPU requires a fan and is qualified only for +70°C.)
Heat Spreader	Provides a simple thermal platform on which to build a cooling solution.

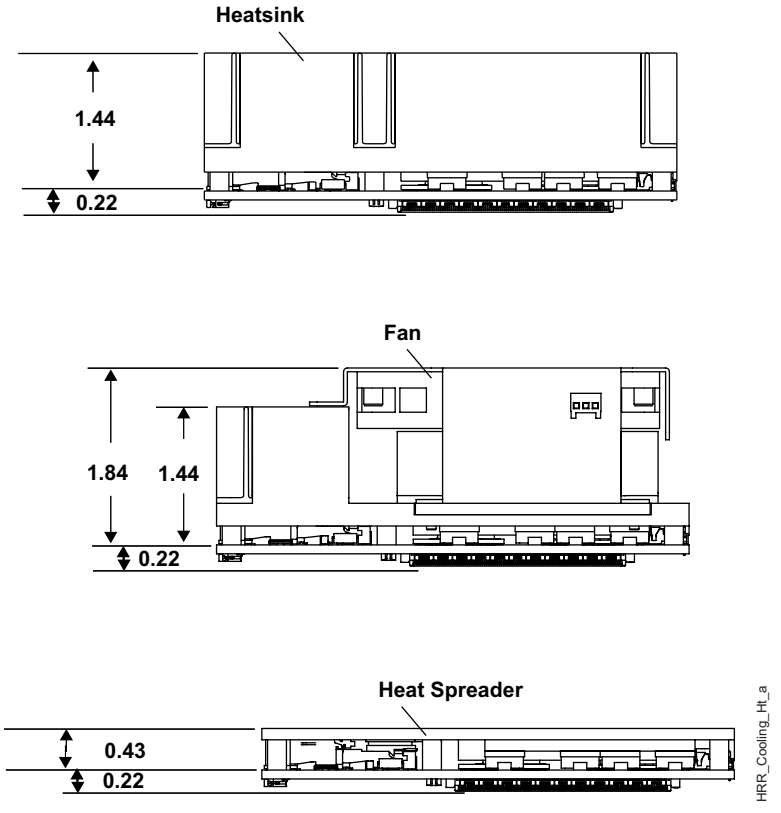


Figure 2-7. Stack Heights of Cooling Assemblies (Side Views)

> **NOTE** All heights are given in inches.

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Mechanical Specifications

The following figure provides mechanical dimensions of the Express-HRR. Figure 2-8 shows the top-side view of the board with measurements between mounting holes.

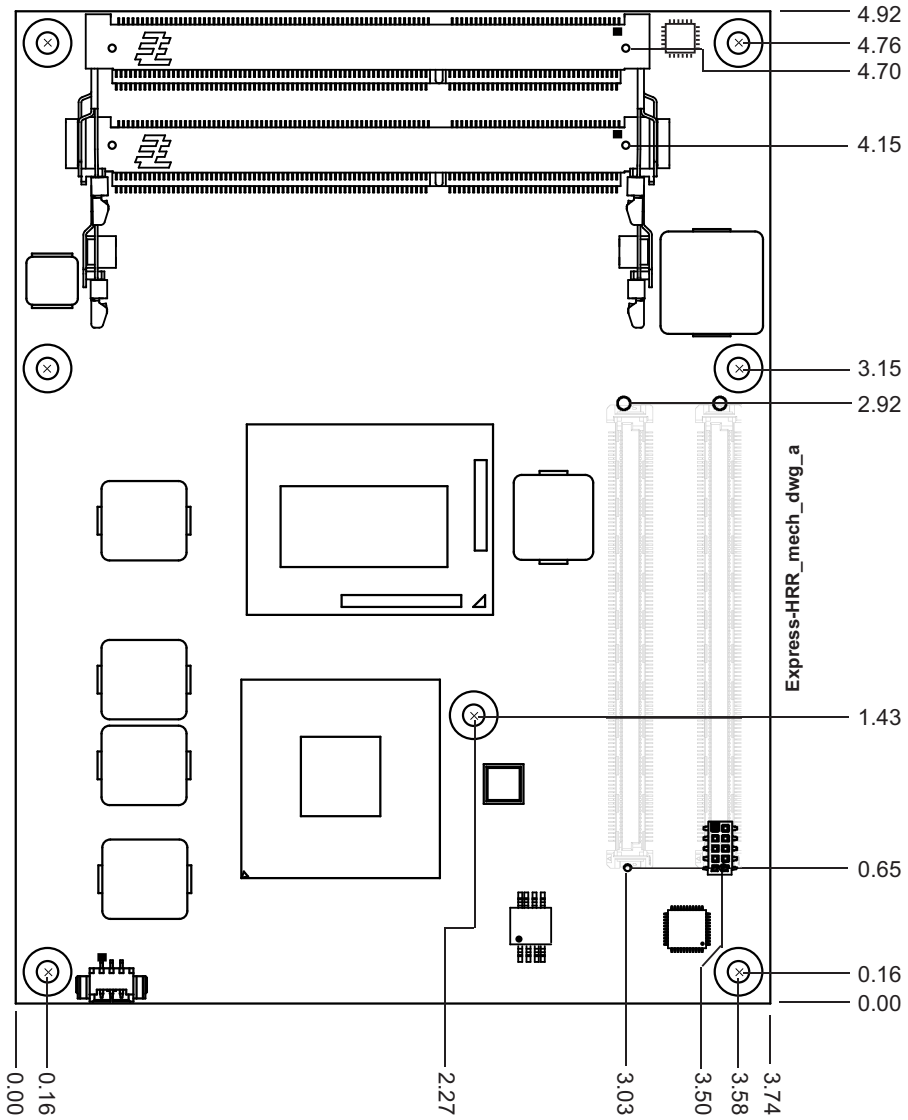


Figure 2-8. Mechanical Dimensions (Top Side)

NOTE	All dimensions are given in inches.

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Chapter 3 Hardware

Overview

This chapter discusses the module features in the following order:

- CPU
- Graphics
- Memory
- Interrupt Channel Assignments
- Memory Map
- I/O Address Map
- COM Express Connector A-B
  - LPC interface
  - SATA interface
  - USB interface
  - Power interface
  - Power Management
  - Video interfaces
  - HD Audio interface
  - Gigabit Ethernet interface
  - I²C interface
  - PCI Express interface
  - SMBus
  - GPIO interface
- COM Express A-B Connector Signals
- COM Express Connector C-D
  - SDVO / DisplayPort / HDMI interface
  - DisplayPort / HDMI interface
  - PCI Express interface
  - PCI Express Graphics (PEG) interface
- COM Express C-D Connector Signals
- Watchdog Timer
- TPM (Trusted Platform Module)
- Hardware (Voltage and Temperature) Monitor
- System Fan interface signals

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> **NOTE** ADLINK Technology, Inc. only supports the features/options tested and listed in this manual. The main chips used in the Express-HRR may provide more features or options than are listed for the Express-HRR, but some of these features/options are not supported on the module and will not function as specified in the chip documentation.

CPU

The Express-HRR offers three versions of the Intel i7 CPU—the 2610UE, 2715QE, and 2655LE—operating at 1.5GHz, 2.1GHz, and 2.2GHz, respectively. The CPU integrates a high-performance, 64-bit, x86 multi Processor Core with Memory Controller and 3D Graphics Engine. This single chip is based on 32-nm process technology and provides an Intel Flexible Display Interface and a Direct Media Interface for high-speed connectivity to the PCH. The CPU also supports Intel Hyper-Threading Technology (4 cores, 8 threads) and up to 16 GB of DDR3 memory at 1066/1333 MHz for high overall performance.

Graphics

The i7 CPU provides a refresh of the sixth generation graphics core, which features a substantial gain in performance and a decrease in power consumption. The next generation Intel Clear Video HD Technology includes a collection of video playback and enhancement features that improve the end user's viewing experience including Encode/Transcode HD content, HD content playback, and superior image quality. Other graphics features of the CPU include support for DirectX 10.1, OpenGL3.0, DirectX Video Acceleration (DXAV), Advanced Scheduler 2.0, 1.0, and XPDM.

Memory

The Express-HRR features dual-stacked SODIMM sockets for up to 16 GB of DDR3 memory. The CPU provides an Integrated Memory Controller (IMC) with DDR3 protocols and two independent, 64-bit wide channels each supporting two unbuffered ECC SODIMMs and employing up to two device ranks per channel.

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Interrupt Channel Assignments

The interrupt channel assignments are shown in Table 3-1.

> **NOTE** Table 3-1 is only for reference. Interrupt channel assignments are tied to the specific legacy Super I/O device residing on the baseboard. This table can be used with the baseboard in ADLINK's Quick Start Kit.

Table 3-1. Interrupt Channel Assignments

Device vs IRQ No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Timer	X															
PS/2 Keyboard*		X														
Secondary Cascade			X													
COM1*				O	D											
COM2*				D	O											
Floppy*							D									
Parallel*						O		D								
RTC									X							
Math Coprocessor														X		
PS/2 Mouse*													X			
SATA Primary*															X	
SATA Secondary*																X
Audio Controller	Automatically Assigned															
PCI INTA	Automatically Assigned															
PCI INTB	Automatically Assigned															
PCI INTC	Automatically Assigned															
PCI INTD	Automatically Assigned															
USB	Automatically Assigned															
Video	Automatically Assigned															
Ethernet	Automatically Assigned															

*Located on the baseboard

Legend: D = Default, X = Fixed, O = Optional

> **NOTE** The IRQs for the Ethernet, Video, and USB are automatically assigned by the BIOS Plug and Play logic. Local IRQs assigned during initialization can not be used by external devices.

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Memory Map

The following table provides the common PC/AT memory allocations. Memory below 000500h is used by the BIOS.

Table 3-2. Memory Map

Base Address			Function
00000000h	-	0009FFFFh	Conventional Memory
000A0000h	-	000AFFFFh	Graphics Memory
000B0000h	-	000B7FFFh	Mono Text Memory
000B8000h	-	000BFFFFh	Color Text Memory
000C0000h	-	000CFFFFh	Standard Video BIOS
000D0000h	-	000DFFFFh	Reserved for Extended BIOS
000E0000h	-	000EFFFFh	Extended System BIOS Area
000F0000h	-	000FFFFFh	System BIOS Area (Storage and RAM Shadowing)
Top 32, 64, or 128MB of Physical Memory			Shared memory of Integrated Graphics enabled
FFE00000h	-	FFFFFFFFh	System Flash

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I/O Address Map

Table 3-3 shows the I/O address map.

> **NOTE** Table 3-3 is only for reference. I/O addresses are tied to the specific legacy Super I/O device residing on the baseboard. This table can be used with the baseboard in ADLINK's Quick Start Kit.

Table 3-3. I/O Address Map

Address (hex)	Subsystem
0000-000F	Primary DMA Controller
0020-0021	Master Interrupt Controller
0040-0043	Programmable Interrupt Timer (Clock/Timer)
004E-004F	TPM (Trusted Platform Module)
0060	Keyboard Controller*
0061	NMI, Speaker control
0063	NMI Controller
0064	Keyboard Controller*
0065	NMI Controller
0067	NMI Controller
0070-007F	CMOS RAM, NMI Mask Reg, RT Clock
0080	System reserved
0081-0083	DMA Page Registers
0084-0086	System reserved
0087	DMA Page Register
0088	System reserved
0089-008B	DMA Page Registers
008C-008E	System reserved
008F	DMA Page Register
0090-0091	System reserved
0092	Fast A20 gate and CPU reset*
0093-009F	System reserved
00A0-00A1	Slave Interrupt Controller
00A2-00BF	System reserved
00C0-00DF	Slave DMA Controller #2
00E0-00EF	System reserved
00F0-00FF	Math Coprocessor
01F0-01F7	SATA Controller
02F8-02FF	Serial Port 2 (COM2)*
03B0-03BB	Video (monochrome)
03C0-03DF	Video (VGA)
03F8-03FF	Serial Port 1 (COM1)*

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Table 3-3. I/O Address Map (Continued)

04D0-04D1	Edge/Level Trigger PIC
0CF9	Reset Control Register

*Located on the baseboard.

COM Express A-B Connector

This section provides descriptions of interfaces within the COM Express A-B connector. The COM Express connector interface comprises two identical 220-pin connectors (A-B and C-D). The COM Express A-B connector provides the following features:

- LPC interface
- SATA interface
- USB interface
- Power interface
- Power Management
- Video interfaces
- HD Audio interface
- Gigabit Ethernet interface
- I²C interface
- PCI Express
- SMBus
- GPIO

LPC Interface

The Express-HRR offers the LPC (Low Pin Count) bus through the Intel® BD82QM67 (PCH). Many devices already exist for this Intel defined bus. The LPC bus corresponds approximately to a serialized ISA bus yet with a significantly reduced number of signals. Because of the software compatibility to the ISA bus, I/O extensions such as additional serial ports can be easily implemented on an application specific baseboard using this bus.

SATA Interface

Four Serial ATA connections are provided through the Intel BD82QM67 (PCH). SATA is an enhancement of parallel ATA therefore offering higher performance. As a result of this enhancement, the traditional restrictions of parallel ATA are overcome with respect to speed and EMI. SATA starts with a transfer rate of 1.5 Gb/s and can be expanded up to 3Gb/s on all ports and up to 6 Gb/s on SATA0 and SATA1 in order to accommodate future developments. SATA is completely protocol and software compatible to parallel ATA.

USB Interface

The PCH offers four UHCI USB host controllers and two EHCI USB host controllers. These controllers comply with USB standard 1.1 and 2.0 and offer a total of eight USB ports through connector A-B. All ports are high-speed, full-speed, and low-speed capable. The port routing logic determines whether a USB port is controlled by one of the UHCI controllers or by one of the EHCI controllers.

Power Interface

A 12V voltage rail on both A-B and C-D COM Express connectors accepts the voltages required for the board. The RTC 3.3V battery feed and 5V standby functions draw power through the A-B connector.

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Power Management

The Express-HRR is ACPI 4.0a compliant. The board supports S0, S1, S3, S4, and S5 sleep states.

> **NOTE** Winbond-based baseboards do not support the S3 sleep state on the Express-HRR.

Video Interfaces

VGA

The Express-HRR graphics are driven by an Intel internal graphics interface which provides the interface for an analog display. A 340-MHz integrated, 32-bit RAM-based, Digital-to-Analog Converter (RAMDAC) converts up to 2048x1536 digital pixels at a maximum refresh rate of 75-Hz. Three 8-bit DACs provide R, G, B signals to the monitor.

LVDS

The Intel BD82QM67 PCH provides direct LVDS output. The output is independent of other panel interfaces. The LVDS interface will support 1 or 2 channels and can support four data pairs and one clock pair of LVDS (18 or 24-bit) in each channel.

Audio Interface

The High Definition (HD) Audio controller resides in the PCH and communicates with external codec(s) (such as audio and modem codecs) over the Intel HD Audio serial link. The PCH implements a single Serial Data Output signal (AC/HDA_SDOUT) that is connected to all external codecs. Four Serial Digital Input signals (AC/HDA_SDIN) support up to four codecs.

Ethernet Interface

The Express-HRR supports one Gigabit Ethernet interface, which can be enabled in BIOS Setup. The Ethernet interface is implemented from the 82579LM Ethernet transceiver and occupies PCI Express port 8. The Ethernet function supports multi-speed operation 10/100/1000 Mbps and operates in full-duplex at all supported speeds or half duplex at 10/100 Mbps while adhering to the IEEE 802.3x flow control specification.

I²C™ Bus

The I²C bus is implemented through the use of the Atmel ATmega168 board controller. The board controller provides a Fast Mode (400kHz max.) multi-master I²C bus that has maximum I²C bandwidth. Use the ADLINK Intelligent Device Interface (AIDI) Library for access to the I²C bus. AIDI driver information is available on the COM Express Product page at: http://www.adlinktech.com. An AIDI demo program and the AIDI User's Manual describing how to use the I²C bus also reside in the Utilities areas of the COM Express Product page.

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PCI Express™

The Express-HRR offers six (6) PCI Express x1 ports (ports 1-6) through the COM Express A-B connector and two PCI Express x1 ports (ports 7-8) through the C-D connector. These ports can be configured to support PCI Express edge cards or ExpressCards. Each x1 port supports up to 5 GT/s bandwidth in each direction. Ports 1-4 and ports 5-8 can be independently configured as four x1s, two x2s, one x2 and two x1s, or one x4 port widths. The eighth x1 port (port 8) is utilized by the onboard Gigabit Ethernet transceiver and is unavailable as a PCIe port. The PCI Express interface is based on the *PCI Express Specification 2.0.*

System Management Bus (SMBus)

The I/O Hub (PCH) contains an integrated SMBus controller with both a host and slave SMBus port; but the host cannot access the slave internally. The slave port allows an external master access to the PCH through the COM Express A-B connector. Table 3-4 lists the device names and corresponding reserved addresses on the SMBus.

Table 3-4. SMBus Reserved Addresses

Component	Address (hex)
SODIMM A	A0h
SODIMM B	A4h
Hardware Temp and Voltage Monitor	2Eh
GPIO Generator	40h
Clock Generator	D2h

GPIO

The Express-HRR provides GPIO (General Purpose I/O) pins for custom use through the COM Express A-B connector. Use the ADLINK Intelligent Device Interface (AIDI) Library to configure the GPIO interface. AIDI driver information is available on the COM Express Product page at: http://www.adlinktech.com. An AIDI demo program and the AIDI User's Manual describing how to use the GPIO pins also reside in the Utilities areas of the COM Express Product page.

For more information about GPIO pin operation, refer to the Intel 6 Series Chipset Datasheet for the PCH (BD82QM67) controller. Refer to "References" on page 1 for a hyper link to the datasheet.

Table 3-5 provides the pin signals for the COM Express A-B connector.

Table 3-5. COM Express A-B Connector Signal Descriptions

Pin #	Row A	Pin #	Row B
A1	GND	B1	GND
A2	GBE0_MDI3-	B2	GBE0_ACT# (PU 10k 3.3V)
A3	GBE0_MDI3+	B3	LPC_FRAME#
A4	GBE0_LINK100# (Ethernet Speed LED)	B4	LPC_AD0
A5	GBE0_LINK1000# (Ethernet Speed LED)	B5	LPC_AD1
A6	GBE0_MDI2-	B6	LPC_AD2
A7	GBE0_MDI2+	B7	LPC_AD3
A8	GBE0_LINK#	B8	LPC_DRQ0# (Int. PU 20k in PCH)
A9	GBE0_MDI1-	B9	LPC_DRQ1# (Int. PU 20k in PCH)
A10	GBE0_MDI1+	B10	LPC_CLK
A11	GND	B11	GND
A12	GBE0_MDI0-	B12	PWRBTN# (PU 10k 3.3V S5 Standby)

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Table 3-5. COM Express A-B Connector Signal Descriptions (Continued)

A13	GBE0_MDI0+	B13	SMB_CK (PU 2.2k 3.3V S5 Standby)
A14	GBE0_CTREF	B14	SMB_DAT (PU 2.2k 3.3V S5 Standby)
A15	SUS_S3#	B15	SMB_ALERT# (PU 10k 3.3V S5 Standby)
A16	SATA0_TX+	B16	SATA1_TX+
A17	SATA0_TX-	B17	SATA1_TX-
A18	SUS_S4#	B18	SUS_STAT#
A19	SATA0_RX+	B19	SATA1_RX+
A20	SATA0_RX-	B20	SATA1_RX-
A21	GND	B21	GND
A22	SATA2_TX+	B22	SATA3_TX+
A23	SATA2_TX-	B23	SATA3_TX-
A24	SUS_S5# (PU 10k 3.3V S5 Standby)	B24	PWR_OK
A25	SATA2_RX+	B25	SATA3_RX+
A26	SATA2_RX-	B26	SATA3_RX-
A27	BATLOW# (PU 8.2k 3.3V S5 Standby)	B27	WDT
A28	ATA_ACT# (PU 10k 3.3V)	B28	AC_SDIN2 (Int. PD 20k in PCH)
A29	AC/HDA_SYNC (Int. PD 20k in PCH)	B29	AC_SDIN1 (Int. PD 20k in PCH)
A30	AC/HDA_RST# (Int. PD 20k in PCH)	B30	AC_SDIN0 (Int. PD 20k in PCH)
A31	GND	B31	GND
A32	AC/HDA_BITCLK (Int. PD 20k in PCH)	B32	SPKR (Int. PD 20k in PCH)
A33	AC/HDA_SDOUT (Int. PD 20k in PCH)	B33	I2C_CK (PU 4.7k 3.3V)
A34	BIOS_DISABLE# (PU 10k 5V S5 Standby)	B34	I2C_DAT (PU 4.7k 3.3V)
A35	THRMTRIP# (PU 330E 3.3V)	B35	THRM#
A36	USB6- (Int. PD 20k in PCH)	B36	USB7- (Int. PD 20k in PCH)
A37	USB6+ (Int. PD 20k in PCH)	B37	USB7+ (Int. PD 20k in PCH)
A38	USB_6_7_OC# (PU 10k 3.3V S5 Standby)	B38	USB_4_5_OC# (PU 10k 3.3V S5 Standby)
A39	USB4- (Int. PD 20k in PCH)	B39	USB5- (Int. PD 20k in PCH)
A40	USB4+ (Int. PD 20k in PCH)	B40	USB5+ (Int. PD 20k in PCH)
A41	GND	B41	GND
A42	USB2- (Int. PD 20k in PCH)	B42	USB3- (Int. PD 20k in PCH)
A43	USB2+ (Int. PD 20k in PCH)	B43	USB3+ (Int. PD 20k in PCH)
A44	USB_2_3_OC# (PU 10k 3.3V S5 Standby)	B44	USB_0_1_OC# (PU 10k 3.3V S5 Standby)
A45	USB0- (Int. PD 20k in PCH)	B45	USB1- (Int. PD 20k in PCH)
A46	USB0+ (Int. PD 20k in PCH)	B46	USB1+ (Int. PD 20k in PCH)
A47	VCC_RTC	B47	EXCD1_PERST# (PU 10k 3.3V S5 Standby)
A48	EXCD0_PERST# (PU 10k 3.3V S5 Standby)	B48	EXCD1_CPPE# (PU 10k 3.3V)
A49	EXCD0_CPPE# (PU 10k 3.3V)	B49	SYS_RESET# (PU 10k 5V S5 Standby)
A50	LPC_SERIRQ (PU 10k 3.3V)	B50	CB_RESET# (PU 10k 3.3V S5 Standby)

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Table 3-5. COM Express A-B Connector Signal Descriptions (Continued)

A51	GND	B51	GND
A52	PCIE6_TX+	B52	PCIE6_RX+
A53	PCIE6_TX-	B53	PCIE6_RX-
A54	GPI0 (PU 10k 3.3V S5 Standby)	B54	GPO1 (PU 10k 3.3V S5 Standby)
A55	PCIE5_TX+	B55	PCIE5_RX+
A56	PCIE5_TX-	B56	PCIE5_RX-
A57	GND	B57	GPO2 (PU 10k 3.3V S5 Standby)
A58	PCIE4_TX+	B58	PCIE4_RX+
A59	PCIE4_TX-	B59	PCIE4_RX-
A60	GND	B60	GND
A61	PCIE3_TX+	B61	PCIE3_RX+
A62	PCIE3_TX-	B62	PCIE3_RX-
A63	GPI1 (PU 10k 3.3V S5 Standby)	B63	GPO3 (PU 10k 3.3V S5 Standby)
A64	PCIE2_TX+	B64	PCIE2_RX+
A65	PCIE2_TX-	B65	PCIE2_RX-
A66	GND	B66	WAKE0# (PU 1k 3.3V S5 Standby)
A67	GPI2 (PU 10k 3.3V S5 Standby)	B67	WAKE1# (PU 10k 3.3V S5 Standby)
A68	PCIE1_TX+	B68	PCIE1_RX+
A69	PCIE1_TX-	B69	PCIE1_RX-
A70	GND	B70	GND
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 (PD 100k)	B77	LVDS_B3+
A78	LVDS_A3+	B78	LVDS_B3-
A79	LVDS_A3-	B79	LVDS_BKLT_EN (PD 100k)
A80	GND	B80	GND
A81	LVDS_A_CK+	B81	LVDS_B_CK+
A82	LVDS_A_CK-	B82	LVDS_B_CK-
A83	LVDS_I2C_CK (PU 2.2k 3.3V)	B83	LVDS_BKLT_CTRL (PD 100k)
A84	LVDS_I2C_DAT (PU 2.2k 3.3V)	B84	VCC_5V_SBY
A85	GPI3 (PU 10k 3.3V S5 Standby)	B85	VCC_5V_SBY
A86	RSVD	B86	VCC_5V_SBY
A87	RSVD	B87	VCC_5V_SBY
A88	PCIE_CK_REF+	B88	BIOS_DS1#
A89	PCIE_CK_REF-	B89	VGA_RED (PD 150E)
A90	GND	B90	GND

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Table 3-5. COM Express A-B Connector Signal Descriptions (Continued)

A91	SPI_POWER	B91	VGA_GRN (PD 150E)
A92	SPI_MISO	B92	VGA_BLU (PD 150E)
A93	GPO0 (PU 10k 3.3V S5 Standby)	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# (Not Connected)	B97	SPI_CS#
A98	SER0_TX (Not Connected)	B98	RSVD
A99	SER0_RX (Not Connected)	B99	RSVD
A100	GND	B100	GND
A101	SER1_TX (Not Connected)	B101	FAN_PWMOUT
A102	SER1_RX (Not Connected)	B102	FAN_TACHIN
A103	LID# (PU 1k 3.3V)	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	B110	GND

COM Express C-D Connector

The COM Express C-D connector is a 220-pin connector providing the following features:

- Digital Display Interface (DDI)
- PCI Express
- PCI Express Graphics (PEG) interface
- SDVO functionality

Digital Display Interface (DDI)

The Digital Display Interface resides in the PCH and is divided into three digital ports (B, C, D). Each of these digital ports can be configured natively to drive HDMI and DisplayPort signals. Digital Port B can also be configured to drive SDVO signals.

PCI Express™

The Express-HRR offers six (6) PCI Express x1 ports (ports 1-6) through the COM Express A-B connector and two PCI Express x1 ports (ports 7-8) through the C-D connector. These ports can be configured to support PCI Express edge cards or ExpressCards. Each x1 port supports up to 5 GT/s bandwidth in each direction. Ports 1-4 and ports 5-8 can be independently configured as four x1s, two x2s, one x2 and two x1s, or one x4 port widths. The eighth x1 port (port 8) is utilized by the onboard Gigabit Ethernet transceiver and is unavailable as a PCIe port. The PCI Express interface is based on the *PCI Express Specification 2.0.* The C-D connector also provides one PCIe x16 port for graphics (PEG) or other PCIe expansion cards and can be configured using the bifurcation switch (SW1).

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PCI Express Graphics (PEG)

The Express-HRR supports the implementation of a x16 link for an external high-performance PCI Express Graphics card. It supports a theoretical bandwidth of up to 5GT/s. Each lane of the PEG Port consists of a receive and transmit differential signal pair designated from PEG_RX8 (+ and -) to PEG_RX15 (+ and -) and correspondingly from PEG_TX8 (+ and -) to PEG_TX15 (+ and -).

SDVO

The PCH provides Serial Digital Video Output (SDVO) functionality and may be alternatively used for one third party SDVO compliant device connected to Digital Port B.

Table 3-6 provides the pin signals for the COM Express C-D connector.

Table 3-6. COM Express C-D Connector Signal Descriptions

Pin #	Row C	Pin #	Row D
C1	GND	D1	GND
C2	GND	D2	GND
C3	USB_SSRX0- (Reserved)	D3	USB_SSTX0- (Reserved)
C4	USB_SSRX0+ (Reserved)	D4	USB_SSTX0+ (Reserved)
C5	GND	D5	GND
C6	USB_SSRX1- (Reserved)	D6	USB_SSTX1- (Reserved)
C7	USB_SSRX1+ (Reserved)	D7	USB_SSTX1+ (Reserved)
C8	GND	D8	GND
C9	USB_SSRX2- (Reserved)	D9	USB_SSTX2- (Reserved)
C10	USB_SSRX2+ (Reserved)	D10	USB_SSTX2+ (Reserved)
C11	GND	D11	GND
C12	USB_SSRX3- (Reserved)	D12	USB_SSTX3- (Reserved)
C13	USB_SSRX3+ (Reserved)	D13	USB_SSTX3+ (Reserved)
C14	GND	D14	GND
C15	DDI1_PAIR6+	D15	DDI1_CTRLCLK_AUX+ (DisplayPanel 1 Aux+ / HDMI1 / SDVO)
C16	DDI1_PAIR6-	D16	DDI1_CTRLDATA_AUX- (DisplayPane11 Aux- / HDMI1 / SDVO)
C17	RSVD	D17	RSVD
C18	RSVD	D18	RSVD
C19	PCIE_RX7+	D19	PCIE_TX7+
C20	PCIE_RX7-	D20	PCIE_TX7-
C21	GND	D21	GND
C22	PCIE_RX8+ (Not Available)	D22	PCIE_TX8+ (Not Available)
C23	PCIE_RX8- (Not Available)	D23	PCIE_TX8- (Not Available)
C24	DDI1_HPD (Hot Plug Detect)	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+

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Table 3-6. COM Express C-D Connector Signal Descriptions (Continued)

C30	DDI1_PAIR5-	D30	DDI1_PAIR1-
C31	GND	D31	GND
C32	DDI2_CTRLCLK_AUX+ (DisplayPanel2 Aux+ / HDMI2)	D32	DDI1_PAIR2+
C33	DDI2_CTRLDATA_AUX- (DisplayPanel2 Aux- / HDMI2)	D33	DDI1_PAIR2-
C34	DDI2_DDC_AUX_SEL (DisplayPanel2 and HDMI2 Select modes; PD 1M GND)	D34	DDI1_DDC_AUX_SEL (DisplayPanel 1 and HDMI1 Select modes; PD 1M GND)
C35	RSVD	D35	RSVD
C36	DDI3_CTRLCLK_AUX+ (DisplayPanel3 Aux+ / HDMI3)	D36	DDI1_PAIR3+ (PU 8.2k 3.3V)
C37	DDI3_CTRLDATA_AUX- (DisplayPanel3 Aux- / HDMI3)	D37	DDI1_PAIR3-
C38	DDI3_DDC_AUX_SEL (DisplayPanel3 and HDMI3 Select modes; PD 1M GND)	D38	RSVD
C39	DDI3_PAIR0+	D39	DDI2_PAIR0+
C40	DDI3_PAIR0-	D40	DDI2_PAIR0-
C41	GND	D41	GND
C42	DDI3_PAIR1+	D42	DDI2_PAIR1+
C43	DDI3_PAIR1-	D43	DDI2_PAIR1-
C44	DDI3_HPD (Hot Plug Detect)	D44	DDI2_HPD (Hot Plug Detect)
C45	RSVD	D45	RSVD
C46	DDI3_PAIR2+	D46	DDI2_PAIR2+ (PU 8.2k 3.3V)
C47	DDI3_PAIR2-	D47	DDI2_PAIR2- (PU 8.2k 3.3V)
C48	RSVD	D48	RSVD
C49	DDI3_PAIR3+	D49	DDI2_PAIR3+
C50	DDI3_PAIR3-	D50	DDI2_PAIR3-
C51	GND	D51	GND
C52	PEG_RX0+	D52	PEG_TX0+
C53	PEG_RX0-	D53	PEG_TX0-
C54	TYPE0# (Not Connected)	D54	PEG_LANE_RV# (Lane reversal)
C55	PEG_RX1+	D55	PEG_TX1+
C56	PEG_RX1-	D56	PEG_TX1-
C57	TYPE1# (Not Connected)	D57	TYPE2# (PD 0E GND)
C58	PEG_RX2+	D58	PEG_TX2+
C59	PEG_RX2-	D59	PEG_TX2-
C60	GND	D60	GND
C61	PEG_RX3+	D61	PEG_TX3+
C62	PEG_RX3-	D62	PEG_TX3-
C63	RSVD	D63	RSVD

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Table 3-6. COM Express C-D Connector Signal Descriptions (Continued)

C64	RSVD	D64	RSVD
C65	PEG_RX4+	D65	PEG_TX4+
C66	PEG_RX4-	D66	PEG_TX4-
C67	RSVD	D67	GND
C68	PEG_RX5+	D68	PEG_TX5+
C69	PEG_RX5-	D69	PEG_TX5-
C70	GND	D70	GND
C71	PEG_RX6+	D71	PEG_TX6+
C72	PEG_RX6-	D72	PEG_TX6-
C73	RSVD	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	D80	GND
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	D90	GND
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	D100	GND
C101	PEG_RX15+	D101	PEG_TX15+
C102	PEG_RX15-	D102	PEG_TX15-
C103	GND	D103	GND

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Table 3-6. COM Express C-D Connector Signal Descriptions (Continued)

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	D110	GND

Watchdog Timer

The Watchdog Timer (WDT) restarts the system if a mishap occurs, ensuring proper start-up after the interruption. Possible problems include failure to boot properly, the application software's loss of control, failure of an interface device, unexpected conditions on the bus, or other hardware or software malfunctions. Use the ADLINK Intelligent Device Interface (AIDI) Library to configure the WDT interface. AIDI driver information is available on the COM Express Product page at: http://www.adlinktech.com. An AIDI demo program and the AIDI User's Manual showing how to use the WDT function also reside in the Utilities areas of the COM Express Product page.

The WDT (Watchdog Timer) can be used both during the boot process and during normal system operation.

- During the Boot process – If the OS fails to boot in the time interval set in the BIOS, the system will reset.

  Enable the WDT in the Custom Configuration Screen of BIOS Setup. Set the WDT for a time-out interval in seconds, between 1 and 255, in one second increments. Ensure you allow enough time for the boot process to complete and for the OS to boot. The OS or application must tickle the WDT as soon as it comes up. This can be done by accessing the hardware directly or through a BIOS call.

- During System Operation – The user can set up the WDT hardware through a BIOS call or by accessing the hardware directly using the AIDI Library. The BIOS call must tickle the WDT in the time set when the WDT is initialized or the system will be reset.

- Watchdog Code example – ADLINK provides a source code example (AIDI demo program) on the Express-HRR Product page of the web site illustrating how to control the WDT. The code example can be easily copied to your development environment to compile and test or make any desired changes before compiling.

TPM (Trusted Platform Module)

The Express-HRR provides a hardware chip called a Trusted Platform Module which is dedicated for security functions. Trusted Computing is an industry standard created for personal computer security. The BIOS allows you to enable or disable the TPM.

Hardware Voltage and Temperature Monitor

The Express-HRR provides a hardware monitor to ensure the health of your embedded system with built-in support for monitoring and control of system temperatures, fan speeds, and critical module voltage levels. The AIDI Library provides simple APIs at the application level to support these functions and adds alarm functions when voltage or temperature levels exceed the upper or lower limits set by the user. AIDI driver information for the Express-HRR is available on the COM Express Product page at: http://www.adlinktech.com. An AIDI demo program and the AIDI User's Manual showing how to use the Hardware Monitor also reside in the Utilities areas of the COM Express Product page.

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System Fan

Table 3-7 lists the pin signals of the System Fan interface, which provides a 3-pin, single-row header with 0.049" (1.25mm) pitch.

Table 3-7. Optional System Fan (FAN1)

Pin #	Signal	Description
1	HWM_PWM2	Modulation – This signal controls the fan speed
2	VCC	+5.0/12.0 volts DC +/- 5%
3	HWM_TACH2	Fan Tachometer – This signal monitors the fan speed

Note: The shaded table cell denotes power or ground.

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Chapter 4 BIOS Setup

Introduction

This section assumes the user is familiar with general BIOS Setup and does not attempt to describe the BIOS functions. Refer to BIOS Setup Menus in this chapter for a map of the BIOS Setup settings. If ADLINK has added to or modified any of the standard BIOS functions, these functions will be described.

Entering BIOS Setup (VGA Display)

To enter BIOS Setup using a VGA display for the Express-HRR:

1. Turn on the VGA monitor and the power supply to the Express-HRR.
2. Start Setup by pressing the [Del] key, when the following message appears on the boot screen.

```
Hit <Del> if you want to run SETUP
```

3. Use the <Enter> key to select the screen menus listed in the Opening BIOS screen.
4. Follow the instructions at the bottom of each screen to navigate through the selections and modify any settings.

OEM Logo Screen (Splash Screen)

The Express-HRR BIOS supports a graphical logo screen, which can be customized by the user and displayed when enabled through the BIOS Setup Utility. The graphical image can be a company logo or any custom image the user wants to display during the POST process.

> **NOTE** The Quiet Boot feature must be set to Enabled in the Boot settings of BIOS Setup for the system to recognize the OEM Logo Screen.

Logo Image Requirements

Please contact your ADLINK Sales Representative for more information on OEM Logo Screen requirements.

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BIOS Setup Menus

This section provides illustrations of the six main setup screens in the Express-HRR BIOS Setup Utility. Below each illustration is a bullet list of the screen's submenus and setting selections. The setting selections are presented in brackets after each submenu or menu item, and the optimal default settings are presented in bold. For more detailed definitions of the BIOS settings, refer to the AMI Aptio TSE User Manual: http://www.ami.com/support/doc/AMI_TSE_User_Manual_PUB.pdf.

Table 4-1. BIOS Setup Menus

BIOS Setup Utility Menu	Item/Topic
Main	BIOS, Memory, and Board information, System Date and Time
Advanced	Launch PXE OpROM, Launch Storage OpROM, ACPI, Trusted Computing, RTC Wake, CPU, USB, SATA, Super IO, Hardware Monitor, Remote Access, and Sandybridge PPM settings
Chipset	System Agent and PCH I/O settings
Boot	Boot Up, GateA20, Option ROM Messages, Interrupt 19 Capture, Boot Order, and Hard Drive BBS Priorities settings
Security	Setting or Changing Passwords
Save & Exit	Exiting, Saving, Resetting, Save Options, Boot Override settings

BIOS Main Setup Screen

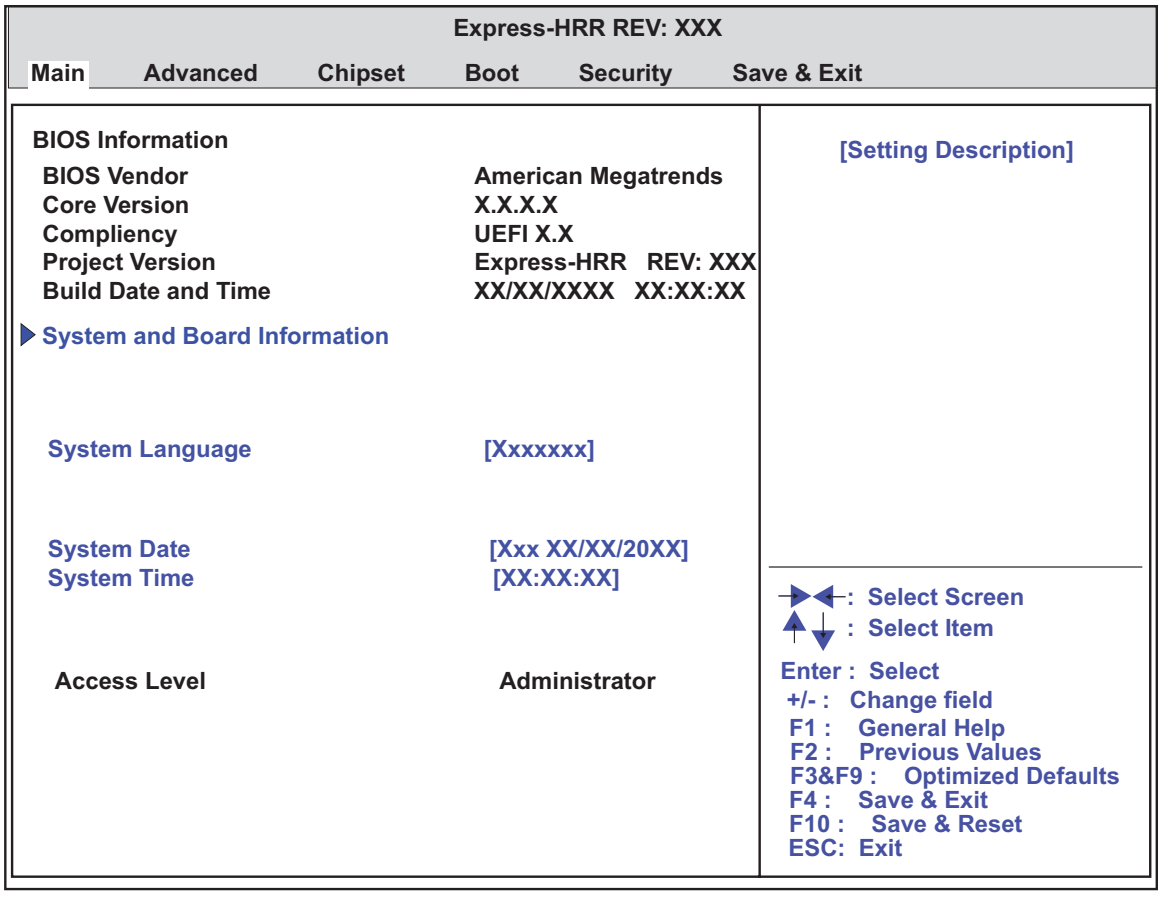


Figure 4-1. BIOS Main Setup Screen

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- **System and Board Information**
  - BIOS Rev. [XXX]
  - BC Firmware Rev. [X.X.X]
  - Manufacture Date [XX/XX/20XX]
  - Last Repair Date [XX/XX/20XX]
  - Serial Number [XXXXXXXXXX]
  - Hardware Rev [XXXXX-XXXX-XXXX]
  - LAN MAC ID [XX-XX-XX-XX-XX-XX]
  - Boot Counter [XXXXXXXX]
  - Running Time [XXXXX HRs]
- **System Date & Time**
  - System Date (day of week, mm:dd:yyyy) – This field requires the alpha-numeric entry of the day of week, day of the month, calendar month, and all 4 digits of the year, indicating the century plus year (*Fri XX/XX/20XX*).
  - System Time (hh:mm:ss) – This is a 24-hour clock setting in hours, minutes, and seconds.

BIOS Advanced Setup Screen

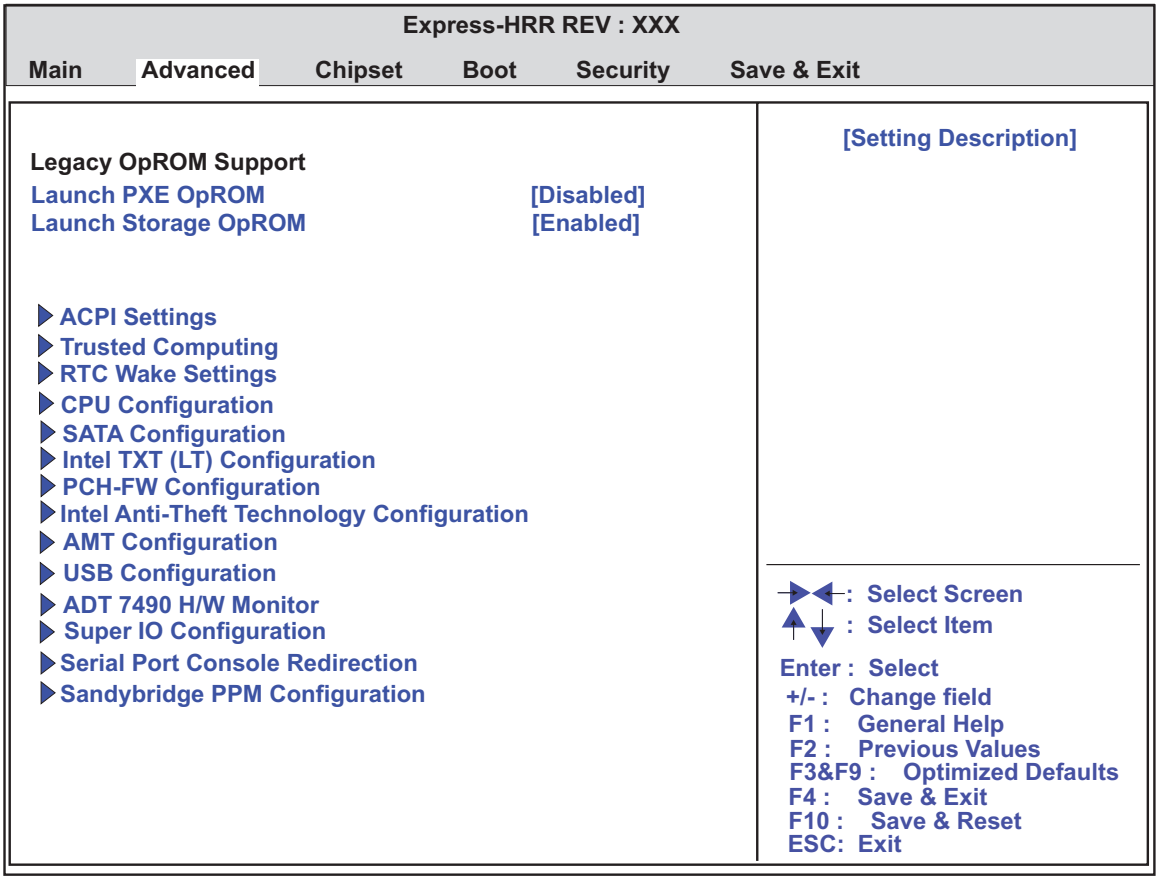


Figure 4-2. BIOS Advanced Setup Screen

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- **Legacy OpROM Support**
  - Launch PXE OpROM [**Disabled**; Enabled]
  - Launch Storage OpROM [Disabled; **Enabled**]
- **ACPI Settings**
  - ACPI Sleep State [Suspend Disabled; S1 (CPU Stop Clock); **S3 (Suspend to RAM**)]
  - Emulation AT/ATX [Emulation AT; **ATX**]
- **Trusted Computing**
  - TPM SUPPORT [**Disabled**; Enabled]
  - Current TPM Status Information [depends on board model]
- **RTC Wake Settings**
  - RTC Wake Function [Enabled; **Disabled**]
- **CPU Configuration**
  - Intel(R) Core(TM) i7 CPU @ X.XXGHz
  - Processor ID XXXxX
  - Microcode Revision 15
  - Max Processor Speed XXXXMHz
  - Min Processor Speed XXXMHz
  - Processor Speed XXXX MHz
  - Processor Cores X
  - Intel HT Technology Supported
  - EMT64 Supported

  - Hyper-Threading [Disabled; **Enabled**]
  - Limit CPUID Maximum [**Disabled**; Enabled]
  - Execute Disable Bit [Disabled; **Enabled**]
  - Hardware Prefetcher [Disabled; **Enabled**]
  - Adjacent Cache Line Prefetch [Disabled; **Enabled**]
  - Intel Virtualization [**Disabled**; Enabled]
- **SATA Configuration**
  - SATA Controller(s) [Disabled; **Enabled**]
  - SATA Mode Selection [**IDE**; AHCI; RAID]
  - Serial ATA Port 0 XXXXXXXXXX (XXX.X)
    - Software Preserve Supported
  - Serial ATA Port 1 Empty
    - Software Preserve Unknown
  - Serial ATA Port 2 Empty
    - Software Preserve Unknown
  - Serial ATA Port 3 Empty
    - Software Preserve Unknown

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- **Intel TXT (LT) Configuration**

  Intel Trusted Execution Technology Configuration

  Intel TXT support only can be enabled/disabled if SMX is enabled and must enable the VT support prior to TXT.

  Secure Mode Extensions (SMX) [Disabled]

  Intel TXT (LT) Support [Disabled]

- **PCH-FW Configuration**
  - ME FW Version X.X.XX.XXXX
  - ME Firmware Mode Normal Mode
  - ME Firmware Type Full Sku Firmware
  - ME Firmware SKU XMB
- **Intel Anti-Theft Technology Configuration**
  - Intel Anti-Theft Technology [**Disabled**; Enabled]
  - Intel Anti-Theft Technology Recovery [3]
  - Enter Intel AT Suspend Mode [**Disabled**; Enabled]
- **AMT Configuration**
  - Intel AMT [Disabled; **Enabled**]
- **USB Configuration**
  - USB Devices:
    - 2 Hubs
  - Legacy USB Support [**Enabled**; Disabled]
  - EHCI Hand-Off [**Disabled**; Enabled]
  - USB Hardware delays and Time outs
    - USB transfer time-out [1 sec; 5 sec; 10 sec; **20 sec**]
    - Device Reset Timeout [10 sec; **20 sec**; 30 sec; 40 sec]
    - Device power-up delay [**Auto**; Manual]
- **ADT 7490 H/W Monitor**
  - Smart Fan Mode Configuration
    - Fan1 Smart Fan Mode [**Manual Mode**; Auto Mode (Module); Auto Mode (ADT 7490); Auto Mode (CPU)]
    - Fan1 expect PWM Output [**255**]
    - Fan2 Smart Fan Mode [**Manual Mode**; Auto Mode (Module); Auto Mode (ADT 7490); Auto Mode (CPU)]
    - Fan2 expect PWM Output/DC Voltage [**255**]
  - Module temperature : +XX C
  - ADT4790 temperature : +XX C
  - CPU temperature (By PECI) : +XX C
  - Module Fan1 Speed (In Module) : N/A
  - Module Fan2 Speed: (In Carrier) : XXXX RPM
  - Vtt : +X.XXX V

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- Vccp : +X.XXX V
- Vcc : +X.XXX V
- +5V : +X.XXX V
- +12V : +XX.XXX V

- **Super IO Configuration**
  - Serial Port 1 Configuration
    - Serial Port [Disabled; **Enabled**]
    - Device Settings IO=3F8h; IRQ=4
  - Serial Port 2 Configuration
    - Serial Port [Disabled; **Enabled**]
    - Device Settings IO=2F8h; IRQ=3
- **Serial Port Console Redirection**
  - COM1
    - Console Redirection [**Disabled**; Enabled]
    - Console Redirection Settings
      - Terminal Type [**VT100**]
      - Bits per second [**115200**]
      - Data Bits [**8**]
      - Stop Bits [**1**]
      - Flow Control [**None**]
      - Recorder Mode [**Disabled**]
      - Resolution 100x31 [**Disabled**]
      - Legacy OS Redirection [80x24]
  - COM2
    - Console Redirection [**Disabled**; Enabled]
    - Console Redirection Settings
      - Terminal Type [**VT100**]
      - Bits per second [**115200**]
      - Data Bits [**8**]
      - Stop Bits [**1**]
      - Flow Control [**None**]
      - Recorder Mode [**Disabled**]
      - Resolution 100x31 [**Disabled**]
      - Legacy OS Redirection [80x24]
- **Sandybridge PPM Configuration**
  - EIST [**Disabled**; MAX Speed; MIN Speed]
  - Turbo Mode [Disabled; **Enabled**]
  - CPU C3 Report [Disabled; **Enabled**]
  - CPU C6 Report [Disabled; **Enabled**]
  - CPU C7 Report [Disabled; **Enabled**]

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BIOS Chipset Setup Screen

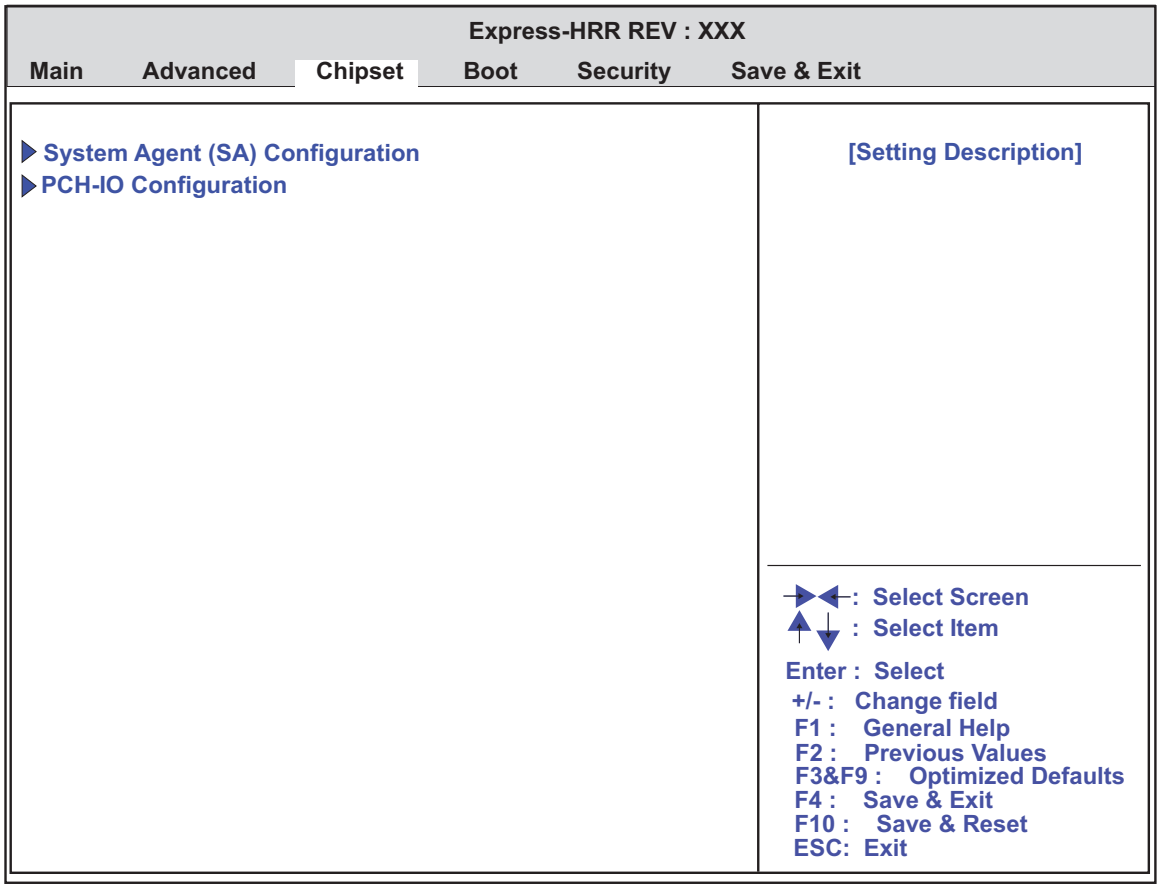


Figure 4-3. BIOS Chipset Setup Screen

- **System Agent (SA) Configuration**
  - System Agent RC Version X.X.X.X
  - VT-d Capability Supported
  - VT-d [Disabled; **Enabled**]
  - Graphics Configuration
    - IGFX VBIOS Version XXXX
    - IGFX Frequency XXX MHz
  - Primary Display [**Auto**; IGFX; PEG]
  - Internal Graphics [Disabled; **Enabled**]
  - GTT Size [1MB; **2MB**]
  - Aperture Size [128MB; **256MB**; 512MB]
  - DVMT Pre-Allocated [0M; 32M; **64M**; 96M; 128M; 160M; 192M; 224M; 256M; 288M; 320M; 352M; 384M; 416M; 448M; 480M; 512M]
  - DVTM Total Gfx Mem [128M; **256M**; MAX]

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- LCD Control
  - Primary IGFX Boot Display [**Auto**; CRT; CRT + LVDS; DDI; DDI2; DDI3; LVDS]
  - DDI function choose [**DisplayPort**; HDMI]
  - LCD Panel Type [640x480 LVDS; 800x600 LVDS; **1024x768 LVDS**; 1280x1024 LVDS; 1400x1050 LVDS1; 1400x1050 LVDS2; 1600x1200 LVDS; 1366x768 LVDS; 1680x1050 LVDS; 1920x1200 LVDS; 1440x900 LVDS; 1600x900 LVDS; 1280x800 LVDS; 1920x1080 LVDS; 2048x1536 LVDS]
  - Active LFP [No LVDS; **Int-LVDS**]
  - Panel Color Depth [**18 Bit**; 24 Bit]
  - GTT LVDS Backlight Controller [0%; 20%; 40%; 60%; 80%; **100%**]
  - GTT LVDS Backlight Inverter [PWM Inverted; PWM Normal]
- NB PCIe Configuration
  - PEG0 Not Present
  - PEG1 Not Present
  - PEG2 Not Present
  - PEG3 Not Present
- Memory Information
  - Memory RC Version X.X.X.X
  - Memory Frequency XXXX Mhz
  - Total Memory XXXX MB (DDR3)
  - DIMM#0 Not Present
  - DIMM#1 Not Present
  - DIMM#2 XXXX MB (DDR3)
  - DIMM#3 Not Present
  - CAS Latency (tCL) X
  - Minimum delay time
    - -CAS to RAS (tRCDmin) X
    - -Row Precharge (tRRmin) X
    - -Active to Precharge (tRASmin) XX

- **PCH-IO Configuration**
  - Intel PCH RC Version X.X.X.X
  - Intel PCH SKU Name QMXX
  - Intel PCH Rev ID XX/XX
  - PCH LAN Controller [**Enabled**; Disabled]
  - Azalia [**Enabled**; Disabled]
  - Restore AC Power Loss [Power Off; Power On; **Last State**]
  - DC I2C Speed Control [**100khz**; 200khz; 400khz]
  - Sleep & LID Button [**Enabled**; Disabled]

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- USB Configuration
  - EHCI1 [**Enabled**; Disabled]
  - EHCI2 [**Enabled**; Disabled]
- PCI Express Configuration
  - Target Link Speed [**GEN1**; GEN2]
  - PCIE Ports 1-4 Configuration [**Four X1 Ports**; One X4 Port]
  - PCI Express Root Port 1 (Main Switch) [Disabled; **Enabled**]
  - PCI Express Root Port 2 [Disabled; **Enabled**]
  - PCI Express Root Port 3 [Disabled; **Enabled**]
  - PCI Express Root Port 4 [Disabled; **Enabled**]
  - PCI Express Root Port 5 [Disabled; **Enabled**]
  - PCI Express Root Port 6 [Disabled; **Enabled**]
  - PCI Express Root Port 7 [Disabled; **Enabled**]
  - PCI Express Port 8 is assigned to LAN

BIOS Boot Setup Screen

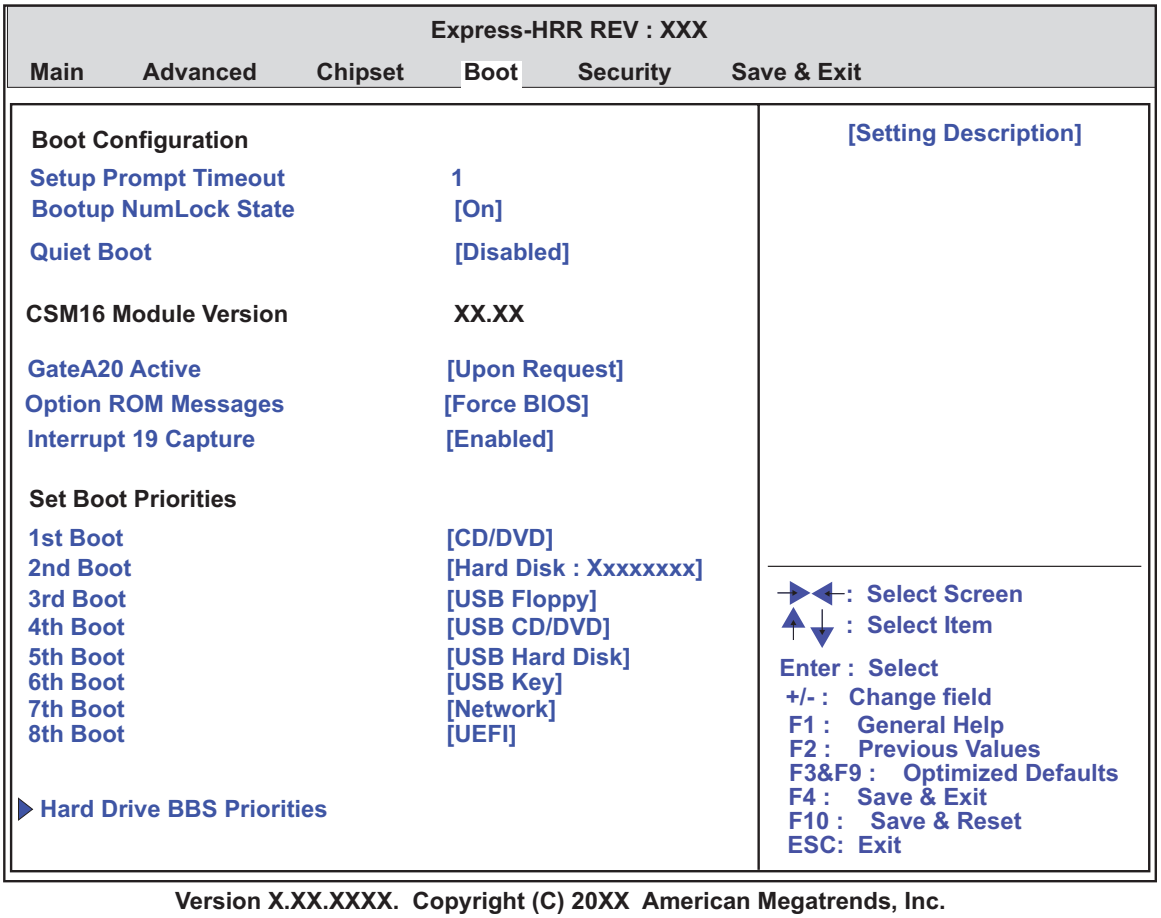


Figure 4-4. BIOS Boot Setup Screen

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- **Boot Configuration**
  - Setup Prompt Timeout 1
  - Bootup NumLock State [**On**; Off]
  - Quiet Boot [**Disabled**; Enabled]
- **CSM16 Module Version XX.XX**
  - Gate A20 Active [**Upon Request**; Always]
  - Option ROM Messages [**Force BIOS**; Keep Current]
  - Interrupt 19 Capture [Disabled; **Enabled**]
- **Set Boot Priority**
  - 1st Boot [**CD/DVD**; Hard Disk : Xxxxxxx; USB Floppy; USB CD/DVD; USB Hard Disk; USB Key; Network; UEFI; Disabled]
  - 2nd Boot [CD/DVD; **Hard Disk : Xxxxxxx**; USB Floppy; USB CD/DVD; USB Hard Disk; USB Key; Network; UEFI; Disabled]
  - 3rd Boot [CD/DVD; Hard Disk : Xxxxxxx; **USB Floppy**; USB CD/DVD; USB Hard Disk; USB Key; Network; UEFI; Disabled]
  - 4th Boot [CD/DVD; Hard Disk : Xxxxxxx; USB Floppy; **USB CD/DVD**; USB Hard Disk; USB Key; Network; UEFI; Disabled]
  - 5th Boot [CD/DVD; Hard Disk : Xxxxxxx; USB Floppy; USB CD/DVD; **USB Hard Disk**; USB Key; Network; UEFI; Disabled]
  - 6th Boot [CD/DVD; Hard Disk : Xxxxxxx; USB Floppy; USB CD/DVD; USB Hard Disk; **USB Key**; Network; UEFI; Disabled]
  - 7th Boot [CD/DVD; Hard Disk : Xxxxxxx; USB Floppy; USB CD/DVD; USB Hard Disk; USB Key; **Network**; UEFI; Disabled]
  - 8th Boot [CD/DVD; Hard Disk : Xxxxxxx; USB Floppy; USB CD/DVD; USB Hard Disk; USB Key; Network; **UEFI**; Disabled]
  - Hard Disk BBS Priorities [SATA: Xxxxxxxx; **Disabled**]

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BIOS Security Setup Screen

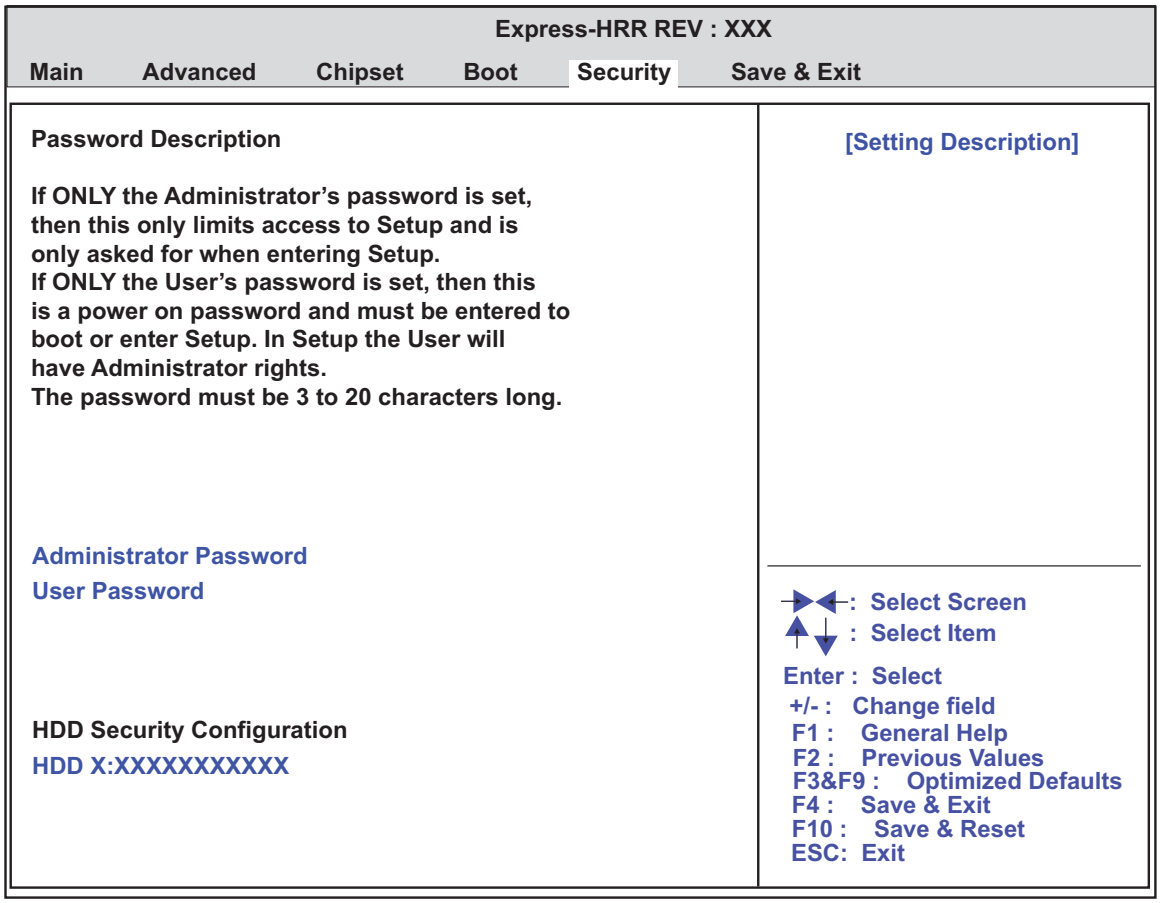


Figure 4-5. BIOS Security Setup Screen

- **Administrator Password** [Create New Password]
- **User Password** [Create New Password]
- **HDD Security Configuration**
  - HDD 0: XXXXXXXXXXX

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BIOS Save & Exit Setup Screen

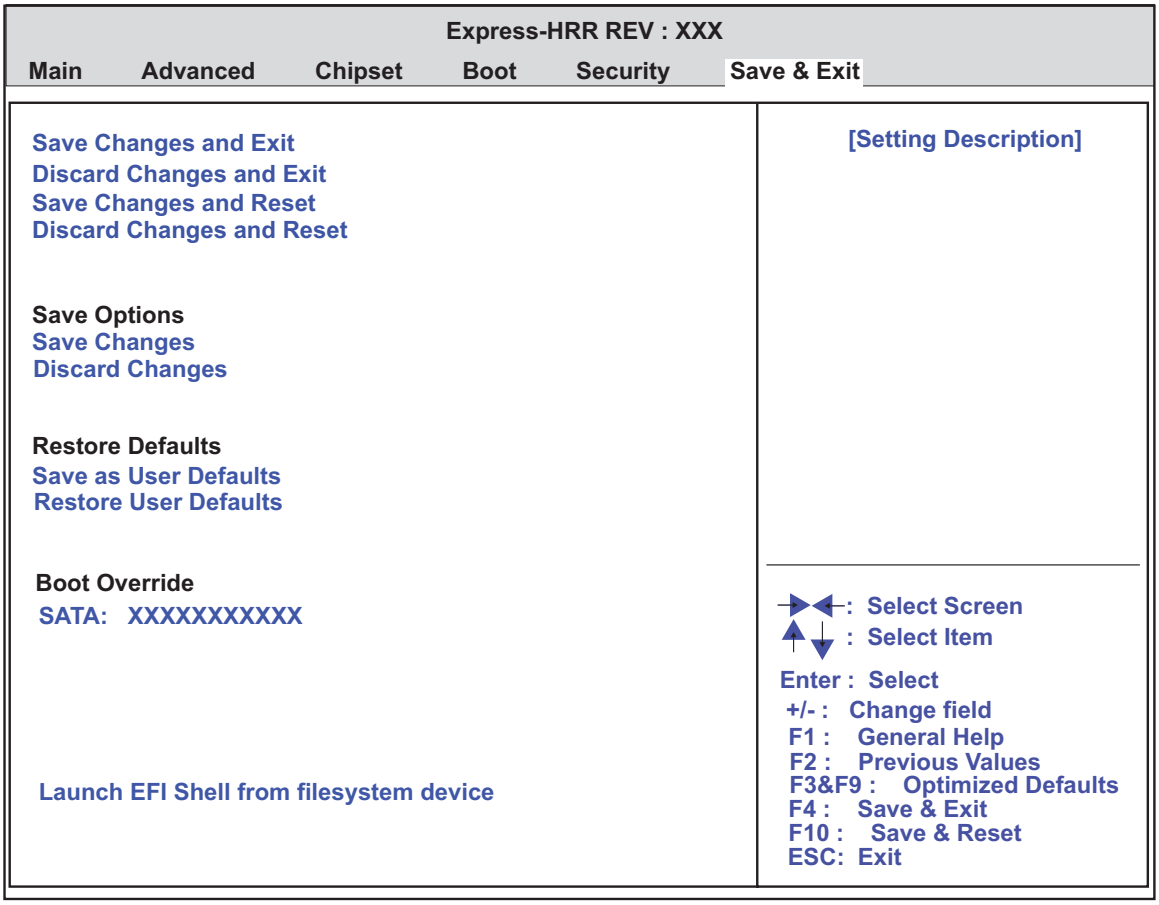


Figure 4-6. BIOS Save & Exit Setup Screen

- Save Changes and Exit
  - Save configuration and exit? [**Yes**; No]
- Discard Changes and Exit
  - Quit without saving? [**Yes**; No]
- Save Changes and Reset
  - Save configuration and reset? [**Yes**; No]
- Discard Changes and Reset
  - Reset without saving? [**Yes**; No]

- **Save Options**
  - Save Changes
    - Save configuration [**Yes**; No]
  - Discard Changes
    - Load Previous Values [**Yes**; No]
  - Restore Defaults
    - Load Optimized Defaults [**Yes**; No]

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- Save as User Defaults
  - Save configuration? [**Yes**; No]
- Restore User Defaults
  - Restore User Defaults? [**Yes**; No]

- **Boot Override**
  - SATA: XXXXXXXXXXX
  - Launch EFI Shell from file system device

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Appendix A Technical Support

ADLINK Technology, Inc. provides a number of methods for contacting Technical Support listed in the Table A-1 below. Requests for support through the Ask an Expert are given the highest priority, and usually will be addressed within one working day.

- ADLINK Ask an Expert – This is a comprehensive support center designed to meet all your technical needs. This service is free and available 24 hours a day through the Ampro By ADLINK web page at http://www.adlinktech.com/AAE/. This includes a searchable database of Frequently Asked Questions, which will help you with the common information requested by most customers. This is a good source of information to look at first for your technical solutions. However, you must register online if you wish to use the Ask a Question feature.

  ADLINK strongly suggests that you register with the web site. By creating a profile on the ADLINK web site, you will have a portal page called "My ADLINK" unique to you with access to exclusive services and account information.

- Personal Assistance – You may also request personal assistance by creating an Ask an Expert account and then going to the Ask a Question feature. Requests can be submitted 24 hours a day, 7 days a week. You will receive immediate confirmation that your request has been entered. Once you have submitted your request, you must log in to go to the My Question area where you can check status, update your request, and access other features.

- Download Service – This service is also free and available 24 hours a day at http://www.adlinktech.com. For certain downloads such as technical documents and software, you must register online before you can log in to this service.

Table A-1. Technical Support Contact Information

Method	Contact Information
Ask an Expert	http://www.adlinktech.com/AAE/
Web Site	http://www.adlinktech.com
Standard Mail	Contact us should you require any service or assistance. **ADLINK Technology, Inc.** Address: 9F, No.166 Jian Yi Road, Zhonghe District New Taipei City 235, Taiwan 新北市中和區建一路 166 號 9 樓 Tel: +886-2-8226-5877 Fax: +886-2-8226-5717 Email: service@adlinktech.com **Ampro ADLINK Technology, Inc.** Address: 5215 Hellyer Avenue, #110, San Jose, CA 95138, USA Tel: +1-408-360-0200 Toll Free: +1-800-966-5200 (USA only) Fax: +1-408-360-0222 Email: info@adlinktech.com **ADLINK Technology (China) Co., Ltd.** Address: 上海市浦东新区张江高科技园区芳春路 300 号 (201203) 300 Fang Chun Rd., Zhangjiang Hi-Tech Park, Pudong New Area, Shanghai, 201203 China Tel: +86-21-5132-8988 Fax: +86-21-5132-3588 Email: market@adlinktech.com

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Table A-1. Technical Support Contact Information (Continued)

	ADLINK Technology Beijing Address: 北京市海淀区上地东路 1 号盈创动力大厦 E 座 801 室(100085) Rm. 801, Power Creative E, No. 1, B/D Shang Di East Rd., Beijing, 100085 China Tel: +86-10-5885-8666 Fax: +86-10-5885-8625 Email: market@adlinktech.com **ADLINK Technology Shenzhen** Address: 深圳市南山区科技园南区高新南七道 数字技术园 A1 栋 2 楼 C 区 (518057) 2F, C Block, Bldg. A1, Cyber-Tech Zone, Gao Xin Ave. Sec. 7, High-Tech Industrial Park S., Shenzhen, 518054 China Tel: +86-755-2643-4858 Fax: +86-755-2664-6353 Email: market@adlinktech.com **ADLINK Technology (Europe) GmbH** Address: Nord Carree 3, 40477 Duesseldorf, Germany Tel: +49-211-495-5552 Fax: +49-211-495-5557 Email: emea@adlinktech.com **ADLINK Technology, Inc. (French Liaison Office)** Address: 15 rue Emile Baudot, 91300 Massy CEDEX, France Tel: +33 (0) 1 60 12 35 66 Fax: +33 (0) 1 60 12 35 66 Email: france@adlinktech.com **ADLINK Technology Japan Corporation** Address: 〒101-0045 東京都千代田区神田鍛冶町 3-7-4 神田 374 ビル 4F KANDA374 Bldg. 4F, 3-7-4 Kanda Kajicho, Chiyoda-ku, Tokyo 101-0045, Japan Tel: +81-3-4455-3722 Fax: +81-3-5209-6013 Email: japan@adlinktech.com **ADLINK Technology, Inc. (Korean Liaison Office)** Address: 서울시 서초구 서초동 1506-25 한도 B/D 2 층 2F, Hando B/D, 1506-25, Seocho-Dong, Seocho-Gu, Seoul 137-070, Korea Tel: +82-2-2057-0565 Fax: +82-2-2057-0563 Email: korea@adlinktech.com **ADLINK Technology Singapore Pte. Ltd.** Address: 84 Genting Lane #07-02A, Cityneon Design Centre, Singapore 349584 Tel: +65-6844-2261 Fax: +65-6844-2263 Email: singapore@adlinktech.com **ADLINK Technology Singapore Pte. Ltd. (Indian Liaison Office)** Address: No. 1357, "Anupama", Sri Aurobindo Marg, 9th Cross, JP Nagar Phase I, Bangalore - 560078, India Tel: +91-80-65605817 Fax: +91-80-22443548 Email: india@adlinktech.com

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Index

A

Advanced BIOS screen 35
AIDI Library user's manual 1
AMI BIOS User's Guide 2
architecture 4
audio 6, 23

B

Basic form factor 3
BIOS Setup Utility 33, 34
block diagram 8
board controller 2, 9
board dimensions 13
Boot BIOS screen 41

C

chip specifications 2
COM Express A-B connector 22
COM Express C-D connector 27
COM Express concept 3
Compact form factor 3
components (ICs) 9
connectors, headers, and sockets 11
Cooling Solution 15
Core i7 ..... 2, 5, 9, 18
CPU description 5, 9, 18
current 14

D

DDI 27
DDR3 SODIMM 5
dimensions 13
DisplayPort 3

E

Environmental specifications 14
Ethernet 6, 23
expansion buses 5
Extended form factor 3

F

fan 32
features list 5
form factors 3

G

Gigabit Ethernet interface 6, 23
GPIO 2, 9, 24
graphics 18

H

hardware overview 17
hardware voltage and temperature monitor 7, 31
HD Audio interface 6, 23
HDMI 3
heatsink 13, 15
height 13

I

I/O address map 21
I2C 23
integrated circuits 9
Interrupt (IRQs) list 19

L

length 13
Logo Screen (Splash) 7
LPC Interface 22
LVDS 3, 23

M

Main BIOS Screen 34
major integrated circuits 9
mechanical diagram 16
memory 5, 18
memory map 20
Mini form factor 3
miscellaneous features 7
module features 5

O

operating configurations 14

P

PCH 2, 9
PCI Express 24, 27
PCI Express Graphics (PEG) 28
PHY transceiver 2, 9
pin-out types 3
power interface 22
power management 23
product description 5

R

Real Time Clock (RTC) 7
references 1

S

SATA interface 5, 22
Save & Exit BIOS screen 44
SDVO 3, 28
Security BIOS screen 43
site preparation
  environmental requirements 14
SMBus 24
SODIMM 18
specification references 1
Splash Screen (Logo Screen) 33
supported features
  Core i7 CPU 5, 18
  CPU fan header 32
  DDR3 SODIMM 5
  expansion buses 5
  Gigabit Ethernet interface 6
  hardware voltage and temperature monitor 7
  HD Audio 6

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IRQ assignments 19
Logo Screen (Splash) 7, 33
memory map 20
Real Time Clock (RTC) 7
SATA 5
TPM (Trusted Platform Module) 7
USB ports 6
video interfaces 6
Watchdog Timer 7, 31
System fan pin-out list 32

T

Technical references 1
Technical Support
Ask an Expert (on-line) 47
contact information 47
temperature monitor 9, 31
thermal cooling
requirements 15
thickness 13
TPM (Trusted Platform Module) 2, 7, 9, 31

U

unsupported features 18
USB interface 6, 22

V

VGA 3, 23
video interfaces 6, 23
voltage 14
voltage monitor 9, 31

W

Watchdog Timer 7, 31
web sites
AMI BIOS 8 user's guide 2
weight 13
width 13

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