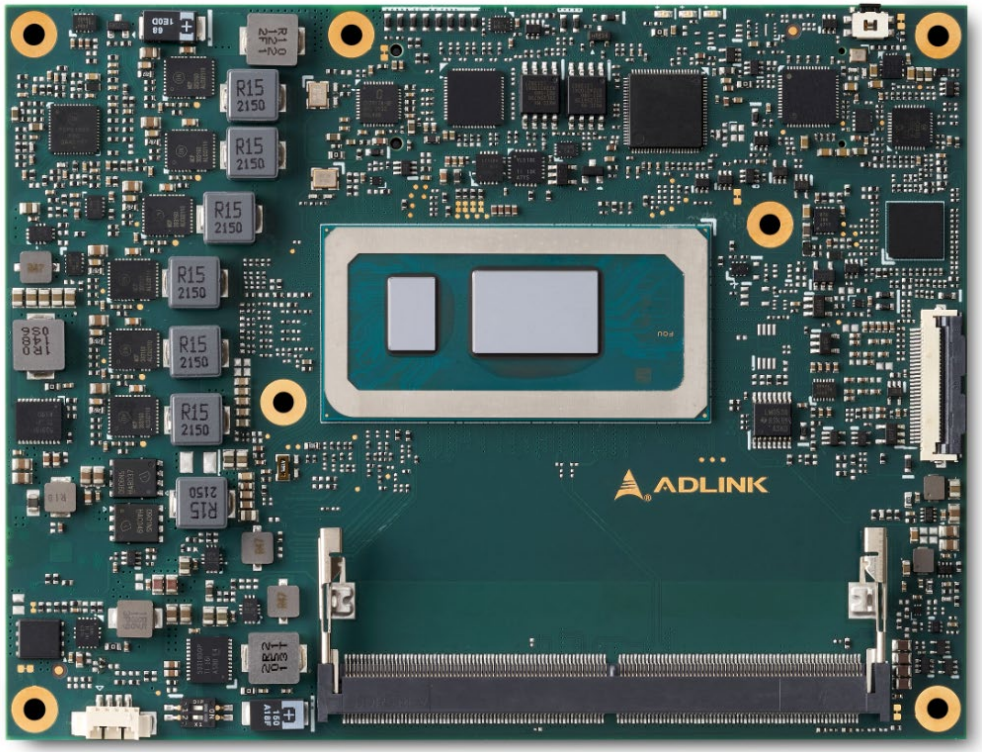
Express-RLP

User's Guide

intel



COM Express®

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ADLINK
LEADING EDGE COMPUTING

Revision History

Revision	Description	Date	Author
1.0	Initial release	2023-04-11	CC

Preface

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Safety Instructions

For user safety, please read and follow all Instructions, **WARNING**s, **CAUTION**s, and **NOTE**s marked in this manual and on the associated equipment before handling/operating the equipment.

Read these safety instructions carefully.

- Keep this manual for future reference.
- Read the specifications section of this manual for detailed information on the operating environment of this equipment.
- Turn off power and unplug any power cords/cables when installing/mounting or un-installing/removing equipment.
- To avoid electrical shock and/or damage to equipment:
- Keep equipment away from water or liquid sources;
- Keep equipment away from high heat or high humidity;
- Keep equipment properly ventilated (do not block or cover ventilation openings);
- Make sure to use recommended voltage and power source settings;
- Always install and operate equipment near an easily accessible electrical socket outlet;
- Secure the power cord (do not place any object on/over the power cord);
- Only install/attach and operate equipment on stable surfaces and/or recommended mountings;
- If the equipment will not be used for long periods of time, turn off the power source and unplug the equipment.

Conventions

The following conventions may be used throughout this manual, denoting special levels of information

Note: This information adds clarity or specifics to text and illustrations.

Caution: This information indicates the possibility of minor physical injury, component damage, data loss, and/or program corruption.

Warning: This information warns of possible serious physical injury, component damage, data loss, and/or program corruption.

Getting Service

Ask an Expert: http://askanexpert.adlinktech.com

ADLINK Technology, Inc.
No. 66, Huaya 1st Rd., Guishan District, Taoyuan City 333411, Taiwan
Tel: +886-3-216-5088
Fax: +886-3-328-5706
Email: service@adlinktech.com

Ampro ADLINK Technology, Inc.
6450 Via Del Oro, San Jose, CA 95119-1208, USA
Tel: +1-408-360-0200
Toll Free: +1-800-966-5200 (USA only)
Fax: +1-408-600-1189
Email: info@adlinktech.com

ADLINK Technology (China) Co., Ltd.
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

ADLINK Technology GmbH
Hans-Thoma-Strasse 11, D-68163 Mannheim, Germany
Tel: +49-621-43214-0
Fax: +49-621 43214-30
Email: emea@adlinktech.com

Please visit the Contact page at www.adlinktech.com for information on how to contact the ADLINK regional office nearest you.

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1. Introduction

The Express-RLP is a COM.0 R3.1 compliant COM Express® Basic Size Type 6 module based on 13th Gen Intel® Core™ and Intel® Celeron® SoC utilizing Intel's advanced hybrid architecture (formerly "Raptor Lake-P"). It features up to 6 Performance-cores (P-cores) for IoT workloads, maximum responsiveness and 8 Efficient-cores (E-cores) for offload multi-tasking at background, and is integrated with up to 96 Intel® Iris® Xe high performance graphics cores that boost productivity and fueling IoT innovation across a wide variety of deployments. Typical industries in need of such high performance, low power characteristics include industrial automation and control, medical ultra sound, image processing and analysis, high-speed video encoding and streaming, predictive traffic analysis, and multi camera-based AI.

The Express-RLP supports up to 64GB (2x 32GB) DDR5 memory, maximum 4800 MT/s memory frequency at two SODIMM sockets, and suits power envelopes ranging across 15, 28, and 45W, making it well suited for mission-critical applications for both stationary and mobile edge use cases.

The integrated Intel® Iris® Xe Graphics includes features such as OpenGL 4.5, DirectX 12, OpenCL 2.1/2.0/1.2, Intel® Clear Video HD Technology, and DirectX Video Acceleration (DXVA) support for full H.265/HEVC 10-bit, VP9 hardware codecs. In addition, High Dynamic Range is supported for enhanced picture color and quality, and digital content protection has been upgraded to HDCP 2.3. Graphics outputs include LVDS and three DDI ports supporting HDMI/DVI/DisplayPort and eDP/VGA as a build option, with a maximum of four 4K displays supported. In addition, maximum 2x USB4 that can transfer media and data through a single tunnel is a build option supported by project basis in place of DDI 1/2. The Express-RLP is specifically designed for customers with high-performance processing graphics requirements who want to outsource the custom core logic of their systems for reduced development time. Adding to the onboard integrated graphics, a multiplexed 16 PCIe Gen4 graphics bus at one x8 plus two x4 configuration is available for discrete graphics expansion.

Input/output features include up to eight PCIe Gen3 lanes via PCIe switch that can be used for NVMe SSD, allowing application access to the highest speed storage solutions, as well as a single onboard 2.5Gigabit Ethernet port with optional Time Sensitive Network (TSN) support, four USB 3.2 Gen2/2.0 ports, four USB 2.0 ports, and two SATA 6 Gb/s ports. Optional onboard PCIe NVMe SSD is offered by project basis. Support is provided for SMBus and I2C. The module is equipped with SPI AMI EFI BIOS with CMOS backup, supporting embedded features such as remote console, hardware monitor, and watchdog timer.

2. Specifications

2.1. Core System

CPU

13th Gen Intel® Core™ Processor (formerly Raptor Lake-P)

- Intel® Core™ i7-13800HE, 6P+8E/20T, 24MB, 45W(35W cTDP), Iris Xe 96EU
- Intel® Core™ i5-13600HE, 4P+8E/16T, 18MB, 45W(35W cTDP), Iris Xe 80EU
- Intel® Core™ i3-13300HE, 4P+4E/12T, 12MB, 45W(35W cTDP), UHD 48EU
- Intel® Core™ i7-1370PE, 6P+8E/20T, 24MB, 28W(20W cTDP), Iris Xe 96EU
- Intel® Core™ i5-1350PE, 4P+8E/16T, 12MB, 28W(20W cTDP), Iris Xe 80EU
- Intel® Core™ i3-1320PE, 4P+4E/12T, 12MB, 28W(20W cTDP), UHD 48EU
- Intel® Core™ i7-1365UE, 2P+8E/12T, 12MB, 15W(12W cTDP), Iris Xe 96EU
- Intel® Core™ i5-1345UE, 2P+8E/12T, 12MB, 15W(12W cTDP), Iris Xe 80EU
- Intel® Core™ i3-1315UE, 2P+4E/8T, 10MB, 15W(12W cTDP), UHD 64EU
- Intel® Celeorn™ U300E, 1P+4E/5T, 8MB, 15W(12W cTDP), UHD 48EU
- Intel® Core™ i7-13800HRE, 6P+8E/20T, 24MB, 45W(35W cTDP), Iris Xe 96EU (TCC/TSN, IBECC capable)
- Intel® Core™ i5-13600HRE, 4P+8E/16T, 18MB, 45W(35W cTDP), Iris Xe 80EU (TCC/TSN, IBECC capable)
- Intel® Core™ i3-13300HRE, 4P+4E/12T, 12MB, 45W(35W cTDP), UHD 48EU (TCC/TSN, IBECC capable)
- Intel® Core™ i7-1365URE, 2P+8E/12T, 12MB, 15W(12W cTDP), Iris Xe 96EU (TCC/TSN, IBECC capable)
- Intel® Core™ i5-1345URE, 2P+8E/12T, 12MB, 15W(12W cTDP), Iris Xe 80EU (TCC/TSN, IBECC capable)
- Intel® Core™ i3-1315URE, 2P+4E/8T, 10MB, 15W(12W cTDP), UHD 64EU (TCC/TSN, IBECC capable)

Supporting: Intel® VT (including VT-x, VT-d, VT-x with Extended Page Tables), Intel® HT Technology, Intel® SSE4.2, Intel® 64 Architecture, Intel® Turbo Boost Technology 2.0, Intel® AVX512-VNNI, Intel® TXT, Execute Disable Bit, Intel® Data Protection Technology with Intel® Secure Key, Intel®

AES-NI (availability of features may vary between processor SKUs)

Note: Standard offering will be based on 45W SKU. SKUs with other power envelopes and with TCC/TSN-, IBECC-capabilities will be available by project basis. Please contact your local ADLINK representative for details.

Memory

Up to 64GB (2x 32GB) non-ECC DDR5 in two SODIMM sockets (one on top, one on bottom), maximum 32GB per socket, maximum 4800 MT/s.

Note: It is recommended to check that the bottom side specifications are suitable for your application purposes.

Embedded BIOS

AMI Aptio V UEFI with CMOS backup in 32 MB SPI BIOS, dual BIOS by build option

2.2. Video

GPU

Intel® Iris Xe Graphics architecture with up to 96 execution units

Feature Support

- 4 independent and simultaneous combinations of DisplayPort/HDMI/LVDS/eDP/VGA and display alternative mode through USB4/Thunderbolt4 graphics outputs (4x 4K @60Hz, up to 8K@60Hz)
- (eDP optional in place of LVDS, VGA optional in place of DDI 3)
- Playback of high-definition content including Blu-ray Disc and Blu-ray Disc 3D content using HDMI (1.4a spec compliant with 3D)
- DirectX Video Acceleration (DXVA) support for accelerated video processing
- HEVC/H.265, H.264, M/JPEG, MPEG2, AV1, WMV9, VP9 HW decode
- HEVC/H.265, H.264, JPEG, VP9 HW encode, up to 8K60 HEVC

- Advanced Scheduler 2.0, 1.0, XPDM support
- DirectX up to 12
- OpenGL up to 4.6 and ES 2.0 support
- OpenCL up to 2.1 support

Note: Availability of features is dependent on the operating system used (Windows 10 64-bit, Linux 64-bit).

2.2.1 Display Interface Support

LVDS: Single/dual channel 18/24-bit LVDS through eDP to LVDS IC, supports DE mode and Hsync/Vsync mode.
Max. resolution 1920x1200@60Hz in dual mode. Pixel clock frequency up to 112 MHz. VESA and JEIDA panel data formats supported.

eDP: eDP 1.4b up to 4 lane support, in place of LVDS (BOM option), up to 4096x2304@60Hz bpp with DSC

DDI x3: Digital Display Ports (DDI) support DisplayPort 1.4a, HDMI 2.0b or DVI

VGA: VGA BOM option support in place of DDI 3; max. resolution 1920x1200@60Hz

Note: USB4 is a build option (HW and BIOS) supported by project basis in place of DDI channels. Maximum 2x USB4 by using DDI 1 and DDI 2 channels. USB4 support also requires re-timer and PD on carrier.

2.3. Audio

Intel® HD Audio integrated

Located on carrier Express-BASE6 or Express-BASE6 R3.1 (ALC886 standard support)

2.4. Expansion Busses

1 PCI Express x8 Gen4 (45W CPU only): PEG0-7 (configurable to 1 x8). Gen4 support dependent on carrier design.

2 PCI Express x4 Gen4 : PEG8-11 and PEG12-15 (configurable to 2 x4). Gen4 support dependent on carrier design.

8 PCI Express x1 Gen3: Lanes 0-3 (configurable to 4 x1, 2 x2, 1 x4, 1 x2 + 2 x1) and Lanes 4-7 (configurable to 4 x1, via PCIe switch)

Other: SMBus (system), I^2C (user), LPC bus (via eSPI to LPC bridge IC)

2.5. Ethernet

2.5GbE Intel® Ethernet Controller I225 Series (V, IT or LM version)

Supports up to 2.5GbE and 1000/100/10 Mbit/s connections

IT version supports TSN feature on Linux OS, GbE0_SDP available if TSN support enabled

2.6. Multi I/O and Storage

USB 4

2x USB4: build option (HW and BIOS) supported by project basis in place of DDI channels. Maximum 2x USB4 by using DDI 1 and DDI 2 channels. USB4 support also requires re-timer and PD on carrier.

Note: Capable of **TBT4**. Please contact your local ADLINK representative for details.

USB

4x USB 3.2 Gen2/2.0/1.1 (USB 0,1,2,3), 4x USB 2.0/1.1 (USB 4,5,6,7)

SuperSpeedPlus, SuperSpeed, High-Speed, Full-Speed and Low-Speed USB signaling

Note: Carrier board must be designed for Gen2 operation.
USB 0,1,2,3 are backward compatible with USB 2.0/1.1.

SATA

2x SATA 6Gb/s (SATA 0,1)

Note: For SATA 6Gb/s compatibility, it is strongly recommended to use a SATA redriver on the carrier board

GPIO ~~or SD~~

4 GPO and 4 GPI (GPI with interrupt)

On-board Storage

Soldered type PCIe NVMe SSD, available capacities: 60GB/120GB/240GB. Build option support by project basis

PCIe NVMe SSD co-lay 1 PCI Express x4 Gen4 : PEG12-15

Note: For the NVMe SSD build option, DIMM support is limited to 2 slots. Please contact your local ADLINK representative for details.

UART

Two UART interfaces SER0 and SER1 RX/TX on module

Console Redirection via COM 1 or COM 2 selectable in BIOS

Up to 4 serial ports supported by standard BIOS, including Super I/O on carrier board

COM Port	Description	IRQ	Address	Console Redirection Support
COM 1	Supported by module (SER0, A98/A99), via embedded controller	4	0x3F8	Yes
COM 2	Supported by module (SER1, A101/A102), via embedded controller	3	0x2F8	Yes
COM 3	Supported by Super I/O (W83627DHG) on carrier board	5	0x240	Yes
COM 4	Supported by Super I/O (W83627DHG) on carrier board	7	0x248	Yes

Note: SER0, SER1 from SoC HSUART are BOM option support by project basis

2.7. Trusted Platform Module (TPM)

Chipset: Infineon solution

Type: TPM 2.0 (SPI bus based)

2.8. SEMA Board controller

Supports: Voltage/current monitoring, power sequence debug support, AT/ATX mode control, logistics and forensic information, flat panel control, general purpose I^2C, failsafe BIOS (dual BIOS, opt. support), watchdog timer and fan control.

2.9. Debug

30-pin flat cable connector for use with DB-30 x86 debug module

Supports embedded controller access, SPI BIOS flashing, internal power rail test points, debug LEDs

2.10. Power

Power Modes: AT and ATX mode (AT mode startup controlled by SEMA Board Controller)

Standard Voltage Input:	ATX: 12V±5% / 5Vsb ±5%	or	AT: 12V±5%
Wide Voltage Input:	ATX: 8.5-20V, 5Vsb ±5%	or	AT: 8.5-20V

Power Management: ACPI 5.0 compliant, Smart Battery support
Power States: C1-C6, S0, S1, S3, S4, S5, S5 ECO mode (Wake-on-USB S3/S4, WoL S3/S4/S5)
ECO Mode support for deep S5 for 5Vsb power saving

Power Consumption
Please contact your ADLINK representative for the document "COM Express Module Power Consumption".

2.11. Mechanical and Environmental

Form Factor and specification

PICMG COM Express Rev 3.1 (COM.0 R3.1), Type 6, Basic size 125 x 95 mm

Operating Temperature

Standard	0°C to 60°C (wide voltage input)	Storage: -20°C to 80°C
Extreme Rugged	-40°C to 85°C (selected SKUs, TBC)	Storage: -40°C to 85°C

Humidity

5-90% RH operating, non-condensing, 5-95% RH storage (and operating with conformal coating)

Shock and Vibration

IEC 60068-2-64 and IEC-60068-2-27
MIL-STD-202F, Method 213B, Table 213-I, Condition A and Method 214A, Table 214-I, Condition D

HALT tested

Thermal Stress, Vibration Stress, Thermal Shock and Combined Test

3. Block Diagram

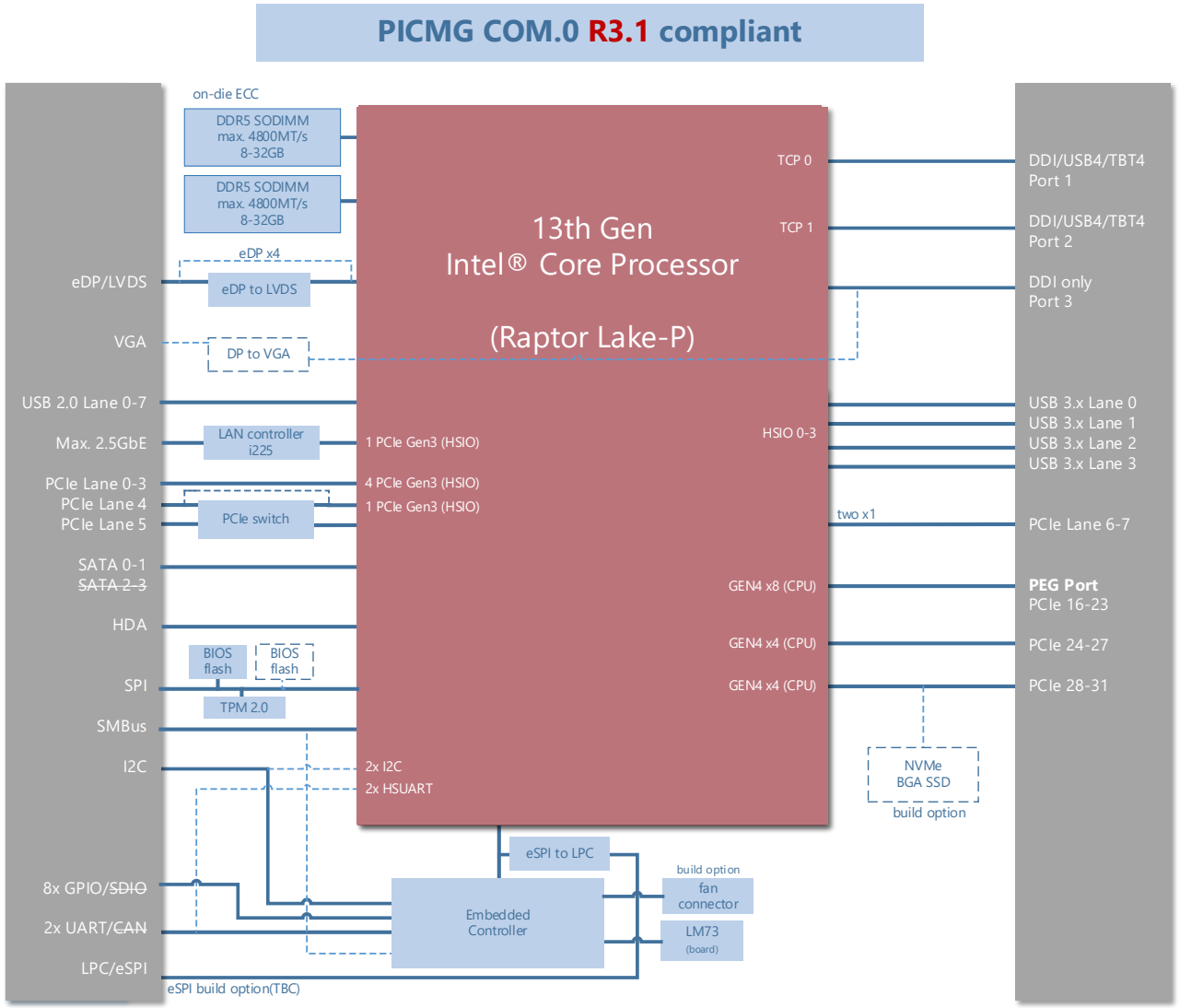


Figure 1 – Module function diagram

4. Pinout and Signal Descriptions

4.1. Pin Summary

The table below is a comprehensible list of all signal pins supported on the dual 220-pin COM Express connectors as defined for Type 6 in the PICMG COM.0 R3.1 specification. Signals described in the specification but not supported on the Express-RLP are marked with ~~strikethrough.~~

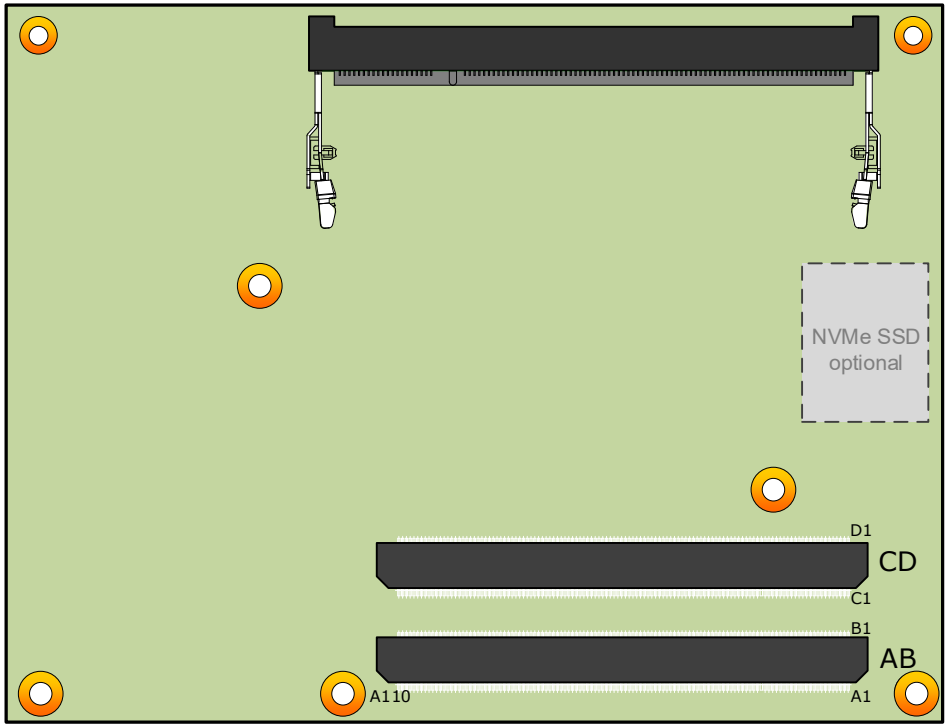


Figure 2 - Module rear side row and pin numbering

Row A			Row B			Row C			Row D	
A1	GND (FIXED)		B1	GND (FIXED)		C1	GND FIXED)		D1	GND FIXED)
A2	GBE0_MDI3-		B2	GBE0_ACT#		C2	GND		D2	GND
A3	GBE0_MDI3+		B3	LPC_FRAME#/ESPI_CS0#[1]		C3	USB_SSRX0-		D3	USB_SSTX0-
A4	GBE0_LINK_MID#		B4	LPC_AD0/ESPI_IO_0[1]		C4	USB_SSRX0+		D4	USB_SSTX0+
A5	GBE0_LINK_MAX#		B5	LPC_AD1/ESPI_IO_1[1]		C5	GND		D5	GND
A6	GBE0_MDI2-		B6	LPC_AD2/ESPI_IO_2[1]		C6	USB_SSRX1-		D6	USB_SSTX1-
A7	GBE0_MDI2+		B7	LPC_AD3/ESPI_IO_3[1]		C7	USB_SSRX1+		D7	USB_SSTX1+
A8	GBE0_LINK#		B8	~~LPC_DRQ0#/ESPI_ALERT0#~~		C8	GND		D8	GND
A9	GBE0_MDI1-		B9	~~LPC_DRQ1#/ESPI_ALERT1#~~		C9	USB_SSRX2-		D9	USB_SSTX2-
A10	GBE0_MDI1+		B10	LPC_CLK/ESPI_CK[1]		C10	USB_SSRX2+		D10	USB_SSTX2+
A11	GND (FIXED)		B11	GND (FIXED)		C11	GND (FIXED)		D11	GND (FIXED)
A12	GBE0_MDI0-		B12	PWRBTN#		C12	USB_SSRX3-		D12	USB_SSTX3-
A13	GBE0_MDI0+		B13	SMB_CK		C13	USB_SSRX3+		D13	USB_SSTX3+
A14	GBE0_CTREF		B14	SMB_DAT		C14	GND		D14	GND
A15	SUS_S3#		B15	SMB_ALERT#		C15	USB4_1_LSTX[1]		D15	DDI1_CTRLCLK_AUX+ /USB4_1_AUX+[1]
A16	SATA0_TX+		B16	SATA1_TX+		C16	USB4_1_LSRX[1]		D16	DDI1_CTRLDATA_AUX- /USB4_1_AUX-[1]
A17	SATA0_TX-		B17	SATA1_TX-		C17	USB4_RT_ENA[1]		D17	USB4_PD_I2C_ALERT#[1]
A18	SUS_S4#		B18	SUS_STAT#/ESPI_RESET#[1]		C18	GND		D18	PMCALERT#[1]
A19	SATA0_RX+		B19	SATA1_RX+		C19	PCIE_RX6+[1]		D19	PCIE_TX6+
A20	SATA0_RX-		B20	SATA1_RX-		C20	PCIE_RX6-[1]		D20	PCIE_TX6-
A21	GND (FIXED)		B21	GND (FIXED)		C21	GND (FIXED)		D21	GND (FIXED)
A22	~~SATA2_TX+~~		B22	~~SATA3_TX+~~		C22	PCIE_RX7+[1]		D22	PCIE_TX7+
A23	~~SATA2_TX-~~		B23	~~SATA3_TX-~~		C23	PCIE_RX7-[1]		D23	PCIE_TX7-
A24	SUS_S5#		B24	PWR_OK		C24	DDI1_HPD		D24	GND
A25	~~SATA2_RX+~~		B25	~~SATA3_RX+~~		C25	SML0_CLK[1]		D25	GND
A26	~~SATA2_RX-~~		B26	~~SATA3_RX-~~		C26	SML0_DAT[1]		D26	DDI1_PAIR0+ /USB4_1_SSTX0+[1]
A27	BATLOW#		B27	WDT		C27	SML1_CLK[1]		D27	DDI1_PAIR0- /USB4_1_SSTX0-[1]
A28	(S)ATA_ACT#		B28	~~HDA_SDIN2~~/SNDW0_CLK[2]		C28	SML1_DAT[1]		D28	GND
A29	HDA_SYNC		B29	HDA_SDIN1/SNDW0_DAT[2]		C29	USB4_PD_I2C_CLK[1]		D29	DDI1_PAIR1+ /USB4_1_SSRX0+[1]
A30	HDA_RST#		B30	HDA_SDIN0		C30	USB4_PD_I2C_DAT[1]		D30	DDI1_PAIR1- /USB4_1_SSRX0-[1]

Row A			Row B			Row C			Row D	
A31	GND (FIXED)		B31	GND (FIXED)		C31	GND (FIXED)		D31	GND (FIXED)
A32	HDA_BITCLK		B32	SPKR		C32	DDI2_CTRLCLK_AUX+ /USB4_2_AUX+[1]		D32	DDI1_PAIR2+ /USB4_1_SSTX1+[1]
A33	HDA_SDOUT		B33	I2C_CK		C33	DDI2_CTRLDATA_AUX- /USB4_2_AUX-[1]		D33	DDI1_PAIR2- /USB4_1_SSTX1-[1]
A34	BIOS_DIS0#/ESPI_SAFS[1]		B34	I2C_DAT		C34	DDI2_DDC_AUX_SEL		D34	DDI1_DDC_AUX_SEL
A35	THRMTRIP#		B35	THRM#		C35	USB4_2_LSTX[1]		D35	USB4_2_LSRX[1]
A36	USB6-		B36	USB7-		C36	DDI3_CTRLCLK_AUX+		D36	DDI1_PAIR3+ /USB4_1_SSRX1+[1]
A37	USB6+		B37	USB7+		C37	DDI3_CTRLDATA_AUX-		D37	DDI1_PAIR3- /USB4_1_SSRX1-[1]
A38	USB_6_7_OC#		B38	USB_4_5_OC#		C38	DDI3_DDC_AUX_SEL		D38	GND
A39	USB4-		B39	USB5-		C39	DDI3_PAIR0+		D39	DDI2_PAIR0+ /USB4_2_SSTX0+[1]
A40	USB4+		B40	USB5+		C40	DDI3_PAIR0-		D40	DDI2_PAIR0- /USB4_2_SSTX0-[1]
A41	GND (FIXED)		B41	GND (FIXED)		C41	GND (FIXED)		D41	GND (FIXED)
A42	USB2-		B42	USB3-		C42	DDI3_PAIR1+		D42	DDI2_PAIR1+ /USB4_2_SSRX0+[1]
A43	USB2+		B43	USB3+		C43	DDI3_PAIR1-		D43	DDI2_PAIR1- /USB4_2_SSRX0-[1]
A44	USB_2_3_OC#		B44	USB_0_1_OC#		C44	DDI3_HPD		D44	DDI2_HPD
A45	USB0-		B45	USB1-		C45	GP_SPI_CS#[2]		D45	GND
A46	USB0+		B46	USB1+		C46	DDI3_PAIR2+		D46	DDI2_PAIR2+ /USB4_2_SSTX1+[1]
A47	VCC_RTC		B47	ESPI_EN#[1]		C47	DDI3_PAIR2-		D47	DDI2_PAIR2- /USB4_2_SSTX1-[1]
A48	~~RSMRST_OUT#~~		B48	~~USB0_HOST_PRSNT~~		C48	RSVD		D48	GND
A49	GBE0_SDP[1]		B49	SYS_RESET#		C49	DDI3_PAIR3+		D49	DDI2_PAIR3+ /USB4_2_SSRX1+[1]
A50	LPC_SERIRQ/ESPI_CS1#[1]		B50	CB_RESET#		C50	DDI3_PAIR3-		D50	DDI2_PAIR3- /USB4_2_SSRX1-[1]
A51	GND (FIXED)		B51	GND (FIXED)		C51	GND (FIXED)		D51	GND (FIXED)
A52	PCIE_TX5+[1]		B52	PCIE_RX5+[1]		C52	PEG_RX0+		D52	PEG_TX0+
A53	PCIE_TX5-[1]		B53	PCIE_RX5-[1]		C53	PEG_RX0-		D53	PEG_TX0-
A54	GPI0		B54	GPO1		C54	TYPE0#		D54	PEG_LANE_RV#
A55	PCIE_TX4+		B55	PCIE_RX4+		C55	PEG_RX1+		D55	PEG_TX1+

Row A			Row B			Row C			Row D	
A56	PCIE_TX4-		B56	PCIE_RX4-		C56	PEG_RX1-		D56	PEG_TX1-
A57	GND		B57	GPO2		C57	TYPE1#		D57	TYPE2#
A58	PCIE_TX3+		B58	PCIE_RX3+		C58	PEG_RX2+		D58	PEG_TX2+
A59	PCIE_TX3-		B59	PCIE_RX3-		C59	PEG_RX2-		D59	PEG_TX2-
A60	GND (FIXED)		B60	GND (FIXED)		C60	GND (FIXED)		D60	GND (FIXED)
A61	PCIE_TX2+		B61	PCIE_RX2+		C61	PEG_RX3+		D61	PEG_TX3+
A62	PCIE_TX2-		B62	PCIE_RX2-		C62	PEG_RX3-		D62	PEG_TX3-
A63	GPI1		B63	GPO3		C63	GND		D63	GND
A64	PCIE_TX1+		B64	PCIE_RX1+		C64	GND		D64	GND
A65	PCIE_TX1-		B65	PCIE_RX1-		C65	PEG_RX4+		D65	PEG_TX4+
A66	GND		B66	WAKE0#		C66	PEG_RX4-		D66	PEG_TX4-
A67	GPI2		B67	WAKE1#		C67	~~RAPID_SHUTDOWN~~		D67	GND
A68	PCIE_TX0+		B68	PCIE_RX0+		C68	PEG_RX5+		D68	PEG_TX5+
A69	PCIE_TX0-		B69	PCIE_RX0-		C69	PEG_RX5-		D69	PEG_TX5-
A70	GND (FIXED)		B70	GND (FIXED)		C70	GND (FIXED)		D70	GND (FIXED)
A71	LVDS_A0+ / eDP_TX2+[1]		B71	LVDS_B0+		C71	PEG_RX6+		D71	PEG_TX6+
A72	LVDS_A0- / eDP_TX2-[1]		B72	LVDS_B0-		C72	PEG_RX6-		D72	PEG_TX6-
A73	LVDS_A1+ / eDP_TX1+[1]		B73	LVDS_B1+		C73	GND		D73	GND
A74	LVDS_A1- / eDP_TX1-[1]		B74	LVDS_B1-		C74	PEG_RX7+		D74	PEG_TX7+
A75	LVDS_A2+ / eDP_TX0+[1]		B75	LVDS_B2+		C75	PEG_RX7-		D75	PEG_TX7-
A76	LVDS_A2- / eDP_TX0-[1]		B76	LVDS_B2-		C76	GND		D76	GND
A77	LVDS_VDD_EN / eDP_VDD_EN[1]		B77	LVDS_B3+		C77	GND		D77	GND
A78	LVDS_A3+		B78	LVDS_B3-		C78	PEG_RX8+		D78	PEG_TX8+
A79	LVDS_A3-		B79	LVDS_BKLT_EN		C79	PEG_RX8-		D79	PEG_TX8-
A80	GND (FIXED)		B80	GND (FIXED)		C80	GND (FIXED)		D80	GND (FIXED)
A81	LVDS_A_CK+ / eDP_TX3+[1]		B81	LVDS_B_CK+		C81	PEG_RX9+		D81	PEG_TX9+
A82	LVDS_A_CK- / eDP_TX3-[1]		B82	LVDS_B_CK-		C82	PEG_RX9-		D82	PEG_TX9-
A83	LVDS_I2C_CK / eDP_AUX+[1]		B83	LVDS_BKLT_CTRL / eDP_BKLT_CTRL[1]		C83	GND		D83	GND
A84	LVDS_I2C_DAT / eDP_AUX-[1]		B84	VCC_5V_SBY		C84	GND		D84	GND
A85	GPI3		B85	VCC_5V_SBY		C85	PEG_RX10+		D85	PEG_TX10+
A86	GP_SPI_MOSI[2]		B86	VCC_5V_SBY		C86	PEG_RX10-		D86	PEG_TX10-
A87	eDP_HPD		B87	VCC_5V_SBY		C87	GND		D87	GND
A88	PCIE_CK_REF+		B88	BIOS_DIS1#		C88	PEG_RX11+		D88	PEG_TX11+
A89	PCIE_CK_REF-		B89	VGA_RED[1]		C89	PEG_RX11-		D89	PEG_TX11-
A90	GND (FIXED)		B90	GND (FIXED)		C90	GND (FIXED)		D90	GND (FIXED)
A91	SPI_POWER		B91	VGA_GRN[1]		C91	PEG_RX12+		D91	PEG_TX12+
A92	SPI_MISO		B92	VGA_BLU[1]		C92	PEG_RX12-		D92	PEG_TX12-

Row A			Row B			Row C			Row D	
A93	GPO0		B93	VGA_HSYNC[1]		C93	GND		D93	GND
A94	SPI_CLK		B94	VGA_VSYNC[1]		C94	PEG_RX13+		D94	PEG_TX13+
A95	SPI_MOSI		B95	VGA_I2C_CK[1]		C95	PEG_RX13-		D95	PEG_TX13-
A96	TPM_PP		B96	VGA_I2C_DAT[1]		C96	GND		D96	GND
A97	TYPE10#		B97	SPI_CS#		C97	GND		D97	GND
A98	SER0_TX		B98	GP_SPI_MISO[2]		C98	PEG_RX14+		D98	PEG_TX14+
A99	SER0_RX		B99	GP_SPI_CK[2]		C99	PEG_RX14-		D99	PEG_TX14-
A100	GND (FIXED)		B100	GND (FIXED)		C100	GND (FIXED)		D100	GND (FIXED)
A101	SER1_TX~~/CAN_TX~~		B101	FAN_PWMOUT		C101	PEG_RX15+		D101	PEG_TX15+
A102	SER1_RX~~/CAN_RX~~		B102	FAN_TACHIN		C102	PEG_RX15-		D102	PEG_TX15-
A103	LID#		B103	SLEEP#		C103	GND		D103	GND
A104	VCC_12V		B104	VCC_12V		C104	VCC_12V		D104	VCC_12V
A105	VCC_12V		B105	VCC_12V		C105	VCC_12V		D105	VCC_12V
A106	VCC_12V		B106	VCC_12V		C106	VCC_12V		D106	VCC_12V[1]
A107	VCC_12V		B107	VCC_12V		C107	VCC_12V		D107	VCC_12V
A108	VCC_12V		B108	VCC_12V		C108	VCC_12V		D108	VCC_12V
A109	VCC_12V		B109	VCC_12V		C109	VCC_12V		D109	VCC_12V
A110	GND (FIXED)		B110	GND (FIXED)		C110	GND (FIXED)		D110	GND (FIXED)

Note: ~~Strike-through~~ entries are not supported functions on this product.

PEG 0-7 are available only for 45W CPU SKUs.

1. eDP (in place of LVDS), VGA (in place of DDI 3), eSPI (in place of LPC), PCIe lane5-7 (via PCIe switch), USB4_1/2 (in place of DDI 1/2), and GBE0_SDP (for selected LAN controller versions) are BOM options supported by project basis.
2. GP_SPI and SNDW0 support TBC.

4.2. Signal Terminology Descriptions

Meaning of the terms used for signal description tables

Term	Description
I	Input to the module
O	Output from the module
I/O	Bi-directional Input / Output
OD	Open drain output from the module
I 3.3V	Input 3.3V tolerant
I 5V	Input 5V tolerant
O 3.3V	Output 3.3V signal level
O 5V	Output 5V signal level
I/O 3.3V	Bi-directional signal 3.3V tolerant
I/O 5V	Bi-directional signal 5V tolerant
I/O $3.3V_{SB}$	Input or output 3.3V tolerant active in standby state
DDC	Display Data Channel
PCIE	PCI Express compatible differential signal
PEG	PCI Express Graphics
SATA	Serial ATA specification Revision 2.6 and 3
LVDS	Low Voltage Differential Signal - 330 mV nominal; 450 mV maximum differential signal
P	Power Input / Output
REF	Reference voltage output. May be sourced from a Module power plane.
PDS	Pull-down strap. A Module output pin that is either tied to GND or is not connected. Used to signal Module capabilities to the Carrier Board.
PU	PU (pull-up) resistor on module
PD	PD (pull-down) resistor on module

4.3. AB Connector Signal Descriptions

4.3.1 Audio

Name	Pin #	Description	I/O	PU / PD	Comment
AC_RST# / HDA_RST#	A30	Reset output to CODEC, active low.	O 3.3VSB		
AC_SYNC / HDA_SYNC	A29	Sample-synchronization signal to the CODEC(s).	O 3.3VSB		PCH internal PD 20Kohm
AC_BITCLK / HDA_BITCLK	A32	Serial data clock generated by the external CODEC(s).	I/O 3.3VSB		
AC_SDOUT / HDA_SDOUT	A33	Serial TDM data output to the CODEC.	O 3.3VSB		PCH internal PD 20Kohm
AC_SDIN[2:0] / HDA_SDIN[2:0]	~~B28~~ B29 B30	Serial TDM data inputs from up to 3 CODECs.	I/O 3.3VSB		PCH internal PD 20Kohm AC_SDNI2/HDA_SDIN2 not supported

4.3.2 Analog VGA

Name	Pin #	Description	I/O	PU / PD	Comment
VGA_RED	B89	Red for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	
VGA_GRN	B91	Green for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	
VGA_BLU	B92	Blue for monitor. Analog DAC output, designed to drive a 37.5-Ohm equivalent load.	O Analog	PD 150R	
VGA_HSYNC	B93	Horizontal sync output to VGA monitor	O 3.3V		
VGA_VSYNC	B94	Vertical sync output to VGA monitor	O 3.3V		
VGA_I2C_CK	B95	DDC clock line (I^2C port dedicated to identifying VGA monitor capabilities)	I/O OD 3.3V	PU 2k2 3.3V	
VGA_I2C_DAT	B96	DDC data line.	I/O OD 3.3V	PU 2k2 3.3V	

Note: VGA is BOM option support (in place of DDI 3) by project basis

4.3.3 LVDS or eDP

The module default supports a single or dual channel LVDS display panel with up to 24-bit colors. A BOM option that removes the eDP to LVDS bridge IC and outputs the eDP signals directly is available. eDP vs LVDS pin mapping is described below.

Pin #	LVDS mode	eDP mode
A71	LVDS_A0+	eDP_TX2+
A72	LVDS_A0-	eDP_TX2-
A73	LVDS_A1+	eDP_TX1+
A74	LVDS_A1-	eDP_TX1-
A75	LVDS_A2+	eDP_TX0+
A76	LVDS_A2-	eDP_TX0-
A78	LVDS_A3+	-
A79	LVDS_A3-	-
A81	LVDS_A_CK+	eDP_TX3+
A82	LVDS_A_CK-	eDP_TX3-
B71	LVDS_B0+	-
B72	LVDS_B0-	-
B73	LVDS_B1+	-
B74	LVDS_B1-	-
B75	LVDS_B2+	-
B76	LVDS_B2-	-
B77	LVDS_B3+	-
B78	LVDS_B3-	-
B81	LVDS_B_CK+	-
B82	LVDS_B_CK-	-
A77	LVDS_VDD_EN	eDP_VDD_EN
B79	LVDS_BKLT_EN	eDP_BKLT_EN
B83	LVDS_BKLT_CTRL	eDP_BKLT_CTRL
A83	LVDS_I2C_CK	eDP_AUX+
A84	LVDS_I2C_DAT	eDP_AUX-
A87	-	eDP_HPD

Note: LVDS is the default mode and eDP is a BOM option

4.3.3.1. Single/Dual Channel LVDS (default)

Name	Pin #	Description	I/O	PU / PD	Comment
LVDS_A0+ LVDS_A0- LVDS_A1+ LVDS_A1- LVDS_A2+ LVDS_A2- LVDS_A3+ LVDS_A3-	A71 A72 A73 A74 A75 A76 A78 A79	LVDS Channel A differential pairs	O LVDS		
LVDS_A_CK+ LVDS_A_CK-	A81 A82	LVDS Channel A differential clock	O LVDS		
LVDS_B0+ LVDS_B0- LVDS_B1+ LVDS_B1- LVDS_B2+ LVDS_B2- LVDS_B3+ LVDS_B3-	B71 B72 B73 B74 B75 B76 B77 B78	LVDS Channel B differential pairs	O LVDS		
LVDS_B_CK+ LVDS_B_CK-	B81 B82	LVDS Channel B differential clock	O LVDS		
LVDS_VDD_EN	A77	LVDS panel power enable	O 3.3V	PD 100K	
LVDS_BKLT_EN	B79	LVDS panel backlight enable	O 3.3V	PD 100K	
LVDS_BKLT_CTRL	B83	LVDS panel backlight brightness control	O 3.3V	PD 100K	
LVDS_I2C_CK	A83	DDC lines used for flat panel detection and control.	O 3.3V	PU 2k2 3.3V	
LVDS_I2C_DAT	A84	DDC lines used for flat panel detection and control.	I/O 3.3V	PU 2k2 3.3V	

4.3.3.2. 4-lane eDP

Name	Pin #	Description	I/O	PU / PD	Comment
eDP_TX3+ eDP_TX3- eDP_TX2+ eDP_TX2- eDP_TX1+ eDP_TX1- eDP_TX0+ eDP_TX0-	A81 A82 A71 A72 A73 A74 A75 A76	eDP differential pairs	O PCIE		AC coupled off module
eDP_VDD_EN	A77	eDP power enable	O 3.3V	PD 100K	
eDP_BKLT_EN	B79	eDP backlight enable	O 3.3V	PD 100K	
eDP_BKLT_CTRL	B83	eDP backlight brightness control	O 3.3V	PD 100K	
eDP_AUX+	A83	eDP AUX+	I/O PCIE		AC coupled off module
eDP_AUX-	A84	eDP AUX-	I/O PCIE		AC coupled off module
eDP_HPD	A87	Detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	PD 100K on this pin when eDP is supported

4.3.4 Gigabit Ethernet

Name	Pin #	Description	I/O	PU / PD	Comment
GBE0_MDI0+ GBE0_MDI0- GBE0_MDI1+ GBE0_MDI1- GBE0_MDI2+ GBE0_MDI2- GBE0_MDI3+ GBE0_MDI3-	A13 A12 A10 A9 A7 A6 A3 A2	Gigabit Ethernet Controller 0: Media Dependent Interface Differential Pairs 0, 1, 2, 3. The MDI can operate in 1000, 100, and 10Mbit/sec modes. Some pairs are unused in some modes according to the following: **1000 / 100 / 10** MDI[0]+/- B1_DA+/- TX+/- TX+/- MDI[1]+/- B1_DB+/- RX+/- RX+/- MDI[2]+/- B1_DC+/- MDI[3]+/- B1_DD+/-	I/O Analog		Twisted pair signals for external transformer.
GBE0_ACT#	B2	Gigabit Ethernet Controller 0 activity indicator, active low.	OD 3.3VSB		
GBE0_LINK#	A8	Gigabit Ethernet Controller 0 link indicator, active low.	OD 3.3VSB		
GBE0_LINK100# *	A4	Gigabit Ethernet Controller 0 100Mbit/sec link indicator, active low.	OD 3.3VSB		
GBE0_LINK1000# *	A5	Gigabit Ethernet Controller 0 1000Mbit/sec link indicator, active low.	OD 3.3VSB		
~~GBE0_CTREF~~	~~A14~~	~~Reference voltage for Carrier Board Ethernet channel 1 and 2 magnetics center tap. The reference voltage is determined by the requirements of the Module PHY and may be as low as 0V and as high as 3.3V. The reference voltage output shall be current limited on the Module. In the case in which the reference is shorted to ground, the current shall be 250 mA or less.~~	~~REF GND min 3.3V max~~		Not supported
GBE0_SDP	A49	Gigabit Ethernet Controller 0 Software-Definable Pin. Can also be used for IEEE1588 support such as 1pps signal.	IO 3.3VSB	GBE0_SDP	Depends on the selection of LAN controller. i225-IT support this pin

Note: This product supports up to 2.5GbE. The LAN LED behavior is optimized for maximum 2.5GbE speed.
GBE0_LINK1000# will be active for 2.5GbE speed indication.
GBE0_LINK100# will be active for 1GbE speed indication or lower.
GBE0_ACT# and GBE0_LINK# share the same source from the LAN controller.
For 100Mbit/sec and 10Mbit/sec speed, the LAN LED will be OFF.

4.3.5 SATA

Name	Pin #	Description	I/O	PU / PD	Comment
SATA0_TX+ SATA0_TX-	A16 A17	Serial ATA channel 0, Transmit Output differential pair.	O SATA		AC coupled on Module
SATA0_RX+ SATA0_RX-	A19 A20	Serial ATA channel 0, Receive Input differential pair.	I SATA		AC coupled on Module
SATA1_TX+ SATA1_TX-	B16 B17	Serial ATA channel 1, Transmit Output differential pair.	O SATA		AC coupled on Module
SATA1_RX+ SATA1_RX-	B19 B20	Serial ATA channel 1, Receive Input differential pair.	I SATA		AC coupled on Module
~~SATA2_TX+ SATA2_TX-~~	~~A22 A23~~	~~Serial ATA channel 2, Transmit Output differential pair.~~	~~O SATA~~		Not supported
~~SATA2_RX+ SATA2_RX-~~	~~A25 A26~~	~~Serial ATA channel 2, Receive Input differential pair.~~	~~I SATA~~		Not supported
~~SATA3_TX+ SATA3_TX-~~	~~B22 B23~~	~~Serial ATA channel 3, Transmit Output differential pair.~~	~~O SATA~~		Not supported
~~SATA3_RX+ SATA3_RX-~~	~~B25 B26~~	~~Serial ATA channel 3, Receive Input differential pair.~~	~~I SATA~~		Not supported
(S)ATA_ACT#	A28	ATA (parallel and serial) or SAS activity indicator, active low.	O 3.3V	PU 10K 3.3V	AC coupled on Module

4.3.5.1. PCH HSIO Lane Assignments

Name	HSIO name on SOC	Comment
SATA0	HSIO 26	
SATA1	HSIO 27	
~~SATA2~~	~~HSIO 28~~	Not supported
~~SATA3~~	~~HSIO 29~~	Not supported

4.3.6 PCI Express

Name	Pin #	Description	I/O	PU / PD	Comment
PCIE_TX0+ PCIE_TX0-	A68 A69	PCI Express channel 0, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX0+ PCIE_RX0-	B68 B69	PCI Express channel 0, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_TX1+ PCIE_TX1-	A64 A65	PCI Express channel 1, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX1+ PCIE_RX1-	B64 B65	PCI Express channel 1, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_TX2+ PCIE_TX2-	A61 A62	PCI Express channel 2, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX2+ PCIE_RX2-	B61 B62	PCI Express channel 2, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_TX3+ PCIE_TX3-	A58 A59	PCI Express channel 3, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX3+ PCIE_RX3-	B58 B59	PCI Express channel 3, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_TX4+ PCIE_TX4-	A55 A56	PCI Express channel 4, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX4+ PCIE_RX4-	B55 B56	PCI Express channel 4, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_TX5+ PCIE_TX5-	A52 A53	PCI Express channel 5, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX5+ PCIE_RX5-	B52 B53	PCI Express channel 5, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_CLK_REF+ PCIE_CLK_REF-	A88 A89	PCI Express Reference Clock output for all PCI Express and PCI Express Graphics Lanes.	O PCIE		

4.3.6.1. PCH HSIO Lane Assignments

Name	HSIO name on SOC / Switch IC	Comment
PCIE0	HSIO 22	
PCIE1	HSIO 23	
PCIE2	HSIO 24	
PCIE3	HSIO 25	
PCIE4	PCIe SW DPE_0	
PCIE5	PCIe SW DPE_1	
PCIE6	PCIe SW DPE_6	
PCIE7	PCIe SW DPE_14	

4.3.7 LPC Bus

Name	Pin #	Description	I/O	PU / PD	Comment
LPC_AD0 LPC_AD1 LPC_AD2 LPC_AD3	B4 B5 B6 B7	LPC multiplexed address, command and data bus	I/O 3.3VSB		
LPC_FRAME#	B3	LPC frame indicates the start of an LPC cycle	O 3.3VSB		
LPC_DRQ0# LPC_DRQ1#	B8 B9	LPC serial DMA request	I 3.3V		Not connected
LPC_SERIRQ	A50	LPC serial interrupt	I/O 3.3VSB	PU 8.2K 3.3VSB	
LPC_CLK	B10	LPC clock output –33MHz nominal	O 3.3VSB		The LPC_CLK frequency is 24MHz on this platform

Note: LPC Bus is supported by an eSPI to LPC bridge IC

4.3.8 USB

Name	Pin #	Description	I/O	PU / PD	Comment
USB0+ USB0-	A46 A45	USB differential data pairs for Port 0	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB1+ USB1-	B46 B45	USB differential data pairs for Port 1	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB2+ USB2-	A43 A42	USB differential data pairs for Port 1	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB3+ USB3-	B43 B42	USB differential data pairs for Port 2	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB4+ USB4-	A40 A39	USB differential data pairs for Port 3	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB5+ USB5-	B40 B39	USB differential data pairs for Port 4	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB6+ USB6-	A37 A36	USB differential data pairs for Port 5	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB7+ USB7-	B37 B37	USB differential data pairs for Port 6	I/O 3.3VSB		USB 1.1/ 2.0 compliant
USB_0_1_OC#	B44	USB over-current sense, USB ports 0 and 1 (see *Note)	I 3.3VSB	PU 10K 3.3VSB	Do not pull high on carrier
USB_2_3_OC#	A44	USB over-current sense, USB ports 2 and 3 (see *Note)	I 3.3VSB	PU 10K 3.3VSB	Do not pull high on carrier
USB_4_5_OC#	B38	USB over-current sense, USB ports 4 and 5 (see *Note)	I 3.3VSB	PU 10K 3.3VSB	Do not pull high on carrier
USB_6_7_OC#	A38	USB over-current sense, USB ports 6 and 7 (see *Note)	I 3.3VSB	PU 10K 3.3VSB	Do not pull high on carrier
USB0_HOST_PRSNT	B48	Module USB client may detect the presence of a USB host on USB0. A high value indicates that a host is present.	I 3.3VSB		Not supported

***Note**: 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.

4.3.9 SPI Bus (BIOS only)

Name	Pin #	Description	I/O	PU / PD	Comment
SPI_CS#	B97	Chip select for Carrier Board SPI BIOS Flash.	O 3.3VSB	PU 10K 3.3VSB	
SPI_MISO	A92	Data in to module from carrier board SPI BIOS flash.	I 3.3VSB		
SPI_MOSI	A95	Data out from module to carrier board SPI BIOS flash.	O 3.3VSB		
SPI_CLK	A94	Clock from module to carrier board SPI BIOS flash.	O 3.3VSB		
SPI_POWER	A91	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	O P 3.3VSB		
BIOS_DIS0#	A34	Selection strap to determine the BIOS boot device.	I	PU 10K 3.3VSB	Carrier shall pull to GND or leave not- connected.
BIOS_DIS1#	B88	Selection strap to determine the BIOS boot device.	I	PU 10K 3.3VSB	Carrier shall pull to GND or leave not- connected

4.3.10 Miscellaneous

Name	Pin #	Description	I/O	PU / PD	Comment
SPKR	B32	Output for audio enunciator, the "speaker" in PC-AT systems	O 3.3V		
WDT	B27	Output indicating that a watchdog time-out event has occurred.	O 3.3V	PU 10K 3.3V	
THRM#	B35	Input from off-module temp sensor indicating an over-temp situation.	I 3.3VSB		
THRMTRIP#	A35	Active low output indicating that the CPU has entered thermal shutdown.	O 3.3VSB	PU 100K 3.3VSB	
FAN_PWMOUT	B101	Fan speed control. Uses the Pulse Width Modulation (PWM) technique to control the fan's RPM.	O OD 3.3V		There shall be PD on carrier board
FAN_TACHIN	B102	Fan tachometer input for a fan with a two-pulse output.	I OD 3.3V	PU 47K 3.3V	
TPM_PP	A96	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.	I 3.3V	PD 100K	PD only when TPM on module. Modules implementing a TPM shall pull down

4.3.11 SMBus

Name	Pin #	Description	I/O	PU / PD	Comment
SMB_CK	B13	System Management Bus bidirectional clock line. Power sourced through 3.3V standby rail and main power rails.	I/O OD 3.3VSB	PU 4.7K 3.3VSB	
SMB_DAT#	B14	System Management Bus bidirectional data line. Power sourced through 3.3V standby rail and main power rails.	I/O OD 3.3VSB	PU 4.7K 3.3VSB	
SMB_ALERT#	B15	System Management Bus Alert – active low input can be used to generate an SMI# (System Management Interrupt) or to wake the system. Power sourced through 3.3V standby rail and main power rails.	I 3.3VSB	PU 10K 3.3VSB	

4.3.12 I^2C Bus

Name	Pin #	Description	I/O	PU / PD	Comment
I2C_CK	B33	General purpose I^2C port clock output/input	I/O OD 3.3VSB	PU 2.2K 3.3VSB	Source SEMA BMC as default (chipset by BOM option)
I2C_DAT	B34	General purpose I^2C port data I/O line	I/O OD 3.3VSB	PU 2.2K 3.3VSB	Source SEMA BMC as default (chipset by BOM option)

4.3.13 General Purpose I/O (GPIO)

Name	Pin #	Description	I/O	PU / PD	Comment
GPO[0]	A93	General purpose output pins.	O 3.3V	PD 10K	After hardware RESET output low
GPO[1]	B54	General purpose output pins.	O 3.3V	PD 10K	After hardware RESET output low
GPO[2]	B57	General purpose output pins.	O 3.3V	PD 10K	After hardware RESET output low
GPO[3]	B63	General purpose output pins.	O 3.3V	PD 10K	After hardware RESET output low
GPI[0]	A54	General purpose input pins. Pulled high internally on the module.	I 3.3V	PU 10K 3.3V	
GPI[1]	A63	General purpose input pins. Pulled high internally on the module.	I 3.3V	PU 10K 3.3V	
GPI[2]	A67	General purpose input pins. Pulled high internally on the module.	I 3.3V	PU 10K 3.3V	
GPI[3]	A85	General purpose input pins. Pulled high internally on the module.	I 3.3V	PU 10K 3.3V	

4.3.14 Serial Interface Signals

Name	Pin #	Description	I/O	PU / PD	Comment
SER0_TX	A98	General purpose serial port transmitter	O CMOS 3.3V		Power rail tolerance 5V, 12V There shall be PD on carrier board
SER0_RX	A99	General purpose serial port receiver	I CMOS 3.3V	PU 10K 3.3V	Power rail tolerance 5V, 12V
SER1_TX	A101	General purpose serial port transmitter	O CMOS 3.3V		Power rail tolerance 5V, 12V There shall be PD on carrier board
SER1_RX	A102	General purpose serial port receiver	I CMOS 3.3V	PU 10K 3.3V	Power rail tolerance 5V, 12V

4.3.15 Power and System Management

Name	Pin #	Description	I/O	PU / PD	Comment
PWRBTN#	B12	Power button to bring system out of S5 (soft off), active on falling edge.	I 3.3VSB	PU 10K 3.3VSB	
SYS_RESET#	B49	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.	I 3.3VSB	PU 10K 3.3VSB	
CB_RESET#	B50	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.	O 3.3V		
PWR_OK	B24	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.	I 3.3VSB	PU 10K 3.3VSB	Should have weak pull up.
SUS_STAT#	B18	Indicates imminent suspend operation; used to notify LPC devices.	O 3.3VSB		
SUS_S3#	A15	Indicates system is in Suspend to RAM state. Active-low output. An inverted copy of SUS_S3# on the carrier board (also known as "PS_ON") may be used to enable the non-standby power on a typical ATX power supply.	O 3.3VSB	PD 100K	
SUS_S4#	A18	Indicates system is in Suspend to Disk state. Active low output.	O 3.3VSB	PD 100K	
SUS_S5#	A24	Indicates system is in Soft Off state.	O 3.3VSB	PD 100K	
WAKE0#	B66	PCI Express wake up signal.	I 3.3VSB	PU 10K 3.3VSB	
WAKE1#	B67	General purpose wake-up signal. May be used to implement wake-up on PS/2 keyboard or mouse activity.	I 3.3VSB	PU 10K 3.3VSB	Connect to WAKE 0#
BATLOW#	A27	Battery low input. This signal may be driven low by external circuitry to signal that the system battery is low or may be used to signal some other external power-management event.	I 3.3VSB	PU 10K 3.3VSB	
LID#	A103	LID button. Low active signal used by the ACPI operating system for a LID switch.	I OD 3.3VSB	PU 47K 3.3VSB	Emulated on GPIO (BIOS)
SLEEP#	B103	Sleep button. Low active signal used by the ACPI operating system to bring the system to sleep state or to wake it up again.	I OD 3.3VSB	PU 47K 3.3VSB	Emulated on GPIO (BIOS)
RAPID_ SHUTDOWN	C67	~~Trigger for Rapid Shutdown. Must be driven to 5V though a <=50-ohm source impedance for ≥ 20 µs.~~	I CMOS 5VSB		Not supported

4.3.16 Power and Ground

Name	Pin #	Description	I/O	PU / PD	Comment
VCC_12V	A104, A105, A106, A107, A108, A109, B104, B105, B106, B107, B109	Primary power input supports wide range 5— 20V input. All available VCC_12V pins on the connector(s) shall be used.	P		8.5-20 V
VCC_5V_SBY	B84, B85, B86, B87	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.	P		5Vsb ±5%
VCC_RTC	A47	Real-time clock circuit-power input. Nominally +3.0V.	P		
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	Ground - DC power and signal and AC signal return path.	P		

4.4. CD Connector Signal Descriptions

4.4.1 USB 3.0 Extensions

Name	Pin #	Description	I/O	PU / PD	Comment
USB_SSRX0- USB_SSRX0+	C3 C4	Additional Receive signal differential pairs for the SuperSpeed USB data path on USB0	I PCIE		AC coupled off module
USB_SSTX0- USB_SSTX0+	D3 D4	Additional Transmit signal differential pairs for the SuperSpeed USB data path on USB0	O PCIE		AC coupled on module
USB_SSRX1- USB_SSRX1+	C6 C7	Additional Receive signal differential pairs for the SuperSpeed USB data path on USB1	I PCIE		AC coupled off module
USB_SSTX1- USB_SSTX1+	D6 D7	Additional Transmit signal differential pairs for the SuperSpeed USB data path on USB1	O PCIE		AC coupled on module
USB_SSRX2- USB_SSRX2+	C9 C10	Additional Receive signal differential pairs for the SuperSpeed USB data path on USB2	I PCIE		AC coupled off module
USB_SSTX2- USB_SSTX2+	D9 D10	Additional Transmit signal differential pairs for the SuperSpeed USB data path on USB2	O PCIE		AC coupled on module
USB_SSRX3- USB_SSRX3+	C12 C13	Additional Receive signal differential pairs for the SuperSpeed USB data path on USB3	I PCIE		AC coupled off module
USB_SSTX3- USB_SSTX3+	D12 D13	Additional Transmit signal differential pairs for the SuperSpeed USB data path on USB3	O PCIE		AC coupled on module

4.4.1.1. USB Root Segmentation

All USB interfaces are derived from the xHCI controller.

4.4.2 PCI Express

Name	Pin #	Description	I/O	PU / PD	Comment
PCIE_TX6+ PCIE_TX6-	D19 D20	PCI Express channel 6, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX6+ PCIE_RX6-	C19 C20	PCI Express channel 6, Receive Input differential pair.	I PCIE		AC coupled off Module
PCIE_TX7+ PCIE_TX7-	D22 D23	PCI Express channel 7, Transmit Output differential pair.	O PCIE		AC coupled on Module
PCIE_RX7+ PCIE_RX7-	C22 C23	PCI Express channel 7, Receive Input differential pair.	I PCIE		AC coupled off Module

4.4.2.1. PCH HSIO Lane Assignments

Refer to Section 4.3.6.1 PCH HSIO Lane Assignments on page 34.

4.4.3 DDI1 Port

Name	Pin #	DisplayPort (DP)	HDMI
DDI1_PAIR0+ DDI1_PAIR0-	D26 D27	DP1_LANE0+ DP1_LANE0-	TMDS1_DATA2+ TMDS1_DATA2-
DDI1_PAIR1+ DDI1_PAIR1-	D29 D30	DP1_LANE1+ DP1_LANE1-	TMDS1_DATA1+ TMDS1_DATA1-
DDI1_PAIR2+ DDI1_PAIR2-	D32 D33	DP1_LANE2+ DP1_LANE2-	TMDS1_DATA0+ TMDS1_DATA0-
DDI1_PAIR3+ DDI1_PAIR3-	D36 D37	DP1_LANE3+ DP1_LANE3-	TMDS1_CLK+ TMDS1_CLK-
DDI1_PAIR4+ DDI1_PAIR4-	C25 C26	-	-
DDI1_PAIR5+ DDI1_PAIR5-	C29 C30	-	-
DDI1_PAIR6+ DDI1_PAIR6-	C15 C16	-	-
DDI1_HPD	C24	DP1_HPD	HDMI1_HPD
DDI1_CTRLCLK_AUX+	D15	DP1_AUX+	HMDI1_CTRLCLK
DDI1_CTRLCLK_AUX-	D16	DP1_AUX-	HMDI1_CTRLDATA
DDI1_DDC_AUX_SEL	D34	DDI1_DDC_AUX_SEL	DDI1_DDC_AUX_SEL

Note: Dual Mode (HDMI and DisplayPort on the same pins) implementations may be realized. This is desirable for SOCs that natively implement this capability. With such SOCs, the primary Dual Mode implementation challenge is that the HDMI_CTRL_DAT and HDMI_CTRL_CK lines are DC coupled, but the DP_AUX+ /- pair must be AC coupled. A set of FET switches is usually used to sort this out. The FET gates can be controlled by the AUX_SEL pin function.

4.4.3.1. DisplayPort (DP) Mode

Name	Pin #	Description	I/O	PU / PD	Comment
DP1_LANE0+ DP1_LANE0- DP1_LANE1+ DP1_LANE1- DP1_LANE2+ DP1_LANE2- DP1_LANE3+ DP1_LANE3-	D26 D27 D29 D30 D32 D33 D36 D37	DP Port 1, differential pair data lines	O PCIE		AC coupled off Module 100 nF DC blocking capacitors shall be placed on the Carrier
DP1_HPD	C24	DP Port 1, detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	Module must tolerate high level in stand-by mode. The carrier board shall include a blocking FET on DP1_HPD to prevent back-drive current from damaging the Module.
DP1_AUX+	D15	DP Port 1, Bidirectional Channel used for Link Management and Device Control	I/O PCIE	PD 100K	AC coupled on Module
DP1_AUX-	D16	DP Port 1, Bidirectional Channel used for Link Management and Device Control	I/O PCIE	PU 100K	AC coupled on Module
DDI1_DDC_AUX_SEL	D34	Strapping Signal to select HDMI or DP output 1M pull-down to logic ground enables HDMI Floating enables DisplayPort mode	I 3.3V	PD 1M	DP mode enabled

4.4.3.2. HDMI Mode

Name	Pin #	Description	I/O	PU / PD	Comment
TMDS1_DATA2+ TMDS1_DATA2- TMDS1_DATA1+ TMDS1_DATA1- TMDS1_DATA0+ TMDS1_DATA0-	D26 D27 D29 D30 D32 D33	HDMI / DVI Port, Differential Pair Data Lines	O PCIE		AC coupled off Module 100 nF DC blocking capacitors shall be placed on the Carrier
TMDS1_CLK+ TMDS1_CLK-	D36 D37	HDMI Port, Differential Pair Clock Lines			
HDMI_HPD	C24	Detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	
HDMI1_CTRLCLK	D15	I2C_CLK Line for HDMI	I/O PCIE	PU 2.2K	AC couple on Module
HDMI1_CTRLDATA	D16	I2C_DAT Line for HDMI	I/O PCIE	PU 2.2K	AC couple on Module
DDI1_DDC_AUX_SEL	D34	Strapping Signal to select HDMI or DP output 1M pull-down to logic ground enables HDMI Leve this signal floating enables DisplayPort mode	I 3.3V	PD 1M	HDMI mode enabled

4.4.4 DDI2 Port

Name	Pin #	DisplayPort (DP)	HDMI
DDI2_PAIR0+ DDI2_PAIR0-	D39 D40	DP2_LANE0+ DP2_LANE0-	TMDS2_DATA2+ TMDS2_DATA2-
DDI2_PAIR1+ DDI2_PAIR1-	D42 D43	DP2_LANE1+ DP2_LANE1-	TMDS2_DATA1+ TMDS2_DATA1-
DDI2_PAIR2+ DDI2_PAIR2-	D46 D47	DP2_LANE2+ DP2_LANE2-	TMDS2_DATA0+ TMDS2_DATA0-
DDI2_PAIR3+ DDI2_PAIR3-	D49 D50	DP2_LANE3+ DP2_LANE3-	TMDS2_CLK+ TMDS2_CLK-
DDI2_HPD	D44	DP2_HPD	HDMI2_HPD
DDI2_CTRLCLK_AUX+	C32	DP2_AUX+	HMDI2_CTRLCLK
DDI2_CTRLCLK_AUX-	C33	DP2_AUX-	HMDI2_CTRLDATA
DDI2_DDC_AUX_SEL	C34	DDI2_DDC_AUX_SEL	DDI2_DDC_AUX_SEL

Note:
Dual Mode (HDMI and DisplayPort on the same pins) implementations may be realized. This is desirable for SOCs that natively implement this capability. With such SOCs, the primary Dual Mode implementation challenge is that the HDMI_CTRL_DAT and HDMI_CTRL_CK lines are DC coupled, but the DP_AUX+ /- pair must be AC coupled. A set of FET switches is usually used to sort this out. The FET gates can be controlled by the AUX_SEL pin function.

4.4.4.1. DisplayPort (DP) Mode

Name	Pin #	Description	I/O	PU / PD	Comment
DP2_LANE0+ DP2_LANE0- DP2_LANE1+ DP2_LANE1- DP2_LANE2+ DP2_LANE2- DP2_LANE3+ DP2_LANE3-	D39 D40 D42 D43 D46 D47 D49 D50	DP Port 2, differential pair data lines	O PCIE		AC coupled off Module 100 nF DC blocking capacitors shall be placed on the Carrier
DP2_HPD	D44	DP Port 2, detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	Module must tolerate high level in stand-by mode. The carrier board shall include a blocking FET on DP1_HPD to prevent back-drive current from damaging the Module.
DP2_AUX+	C32	DP Port 2, Bidirectional Channel used for Link Management and Device Control	I/O PCIE	PD 100K	AC coupled on Module
DP2_AUX-	C33	DP Port 2, Bidirectional Channel used for Link Management and Device Control	I/O PCIE	PU 100K	AC coupled on Module
DDI2_DDC_AUX_SEL	C34	Strapping Signal to select HDMI or DP output 1M pull-down to logic ground enables HDMI Floating enables DisplayPort mode	I 3.3V	PD 1M	DP mode enabled

4.4.4.2. HDMI Mode

Name	Pin #	Description	I/O	PU / PD	Comment
TMDS2_DATA2+ TMDS2_DATA2- TMDS2_DATA1+ TMDS2_DATA1- TMDS2_DATA0+ TMDS2DATA0-	D39 D40 D42 D43 D46 D47	HDMI / DVI Port, Differential Pair Data Lines	O PCIE		AC coupled off Module 100 nF DC blocking capacitors shall be placed on the Carrier
TMDS2_CLK+ TMDS2_CLK-	D49 D50	HDMI Port, Differential Pair Clock Lines			
HDM2_HPD	D44	Detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	
HDMI2_CTRLCLK	C32	I2C_CLK Line for HDMI	I/O PCIE	PU 2.2K	AC couple on Module
HDMI2_CTRLDATA	C33	I2C_DAT Line for HDMI	I/O PCIE	PU 2.2K	AC couple on Module
DDI2_DDC_AUX_SEL	C34	Strapping Signal to select HDMI or DP output 1M pull-down to logic ground enables HDMI Leve this signal floating enables DisplayPort mode	I 3.3V	PD 1M	HDMI mode enabled

4.4.5 DDI3 Port

Name	Pin #	DisplayPort (DP)	HDMI
DDI3_PAIR0+ DDI3_PAIR0-	C39 C40	DP3_LANE0+ DP3_LANE0-	TMDS3_DATA2+ TMDS3_DATA2-
DDI3_PAIR1+ DDI3_PAIR1-	C42 C43	DP3_LANE1+ DP3_LANE1-	TMDS3_DATA1+ TMDS3_DATA1-
DDI3_PAIR2+ DDI3_PAIR2-	C46 C47	DP3_LANE2+ DP3_LANE2-	TMDS3_DATA0+ TMDS3_DATA0-
DDI3_PAIR3+ DDI3_PAIR3-	C49 C50	DP3_LANE3+ DP3_LANE3-	TMDS3_CLK+ TMDS3_CLK-
DDI3_HPD	C44	DP3_HPD	HDMI3_HPD
DDI3_CTRLCLK_AUX+	C36	DP3_AUX+	HMDI3_CTRLCLK
DDI3_CTRLCLK_AUX-	C37	DP3_AUX-	HMDI3_CTRLDATA
DDI3_DDC_AUX_SEL	C38	DDI3_DDC_AUX_SEL	DDI3_DDC_AUX_SEL

Note:
Dual Mode (HDMI and DisplayPort on the same pins) implementations may be realized. This is desirable for SOCs that natively implement this capability. With such SOCs, the primary Dual Mode implementation challenge is that the HDMI_CTRL_DAT and HDMI_CTRL_CK lines are DC coupled, but the DP_AUX+ /- pair must be AC coupled. A set of FET switches is usually used to sort this out. The FET gates can be controlled by the AUX_SEL pin function.

4.4.5.1. DisplayPort (DP) Mode

Name	Pin #	Description	I/O	PU / PD	Comment
DP3_LANE0+ DP3_LANE0- DP3_LANE1+ DP3_LANE1- DP3_LANE2+ DP3_LANE2- DP3_LANE3+ DP3_LANE3-	C39 C40 C42 C43 C46 C47 C49 C50	DP Port 3, differential pair data lines	O PCIE		AC coupled off Module 100 nF DC blocking capacitors shall be placed on the Carrier
DP3_HPD	C44	DP Port 3, detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	Module must tolerate high level in stand-by mode. The carrier board shall include a blocking FET on DP1_HPD to prevent back-drive current from damaging the Module.
DP3_AUX+	C36	DP Port 3, Bidirectional Channel used for Link Management and Device Control	I/O PCIE	PD 100K	AC coupled on Module
DP3_AUX-	C37	DP Port 3, Bidirectional Channel used for Link Management and Device Control	I/O PCIE	PU 100K	AC coupled on Module
DDI3_DDC_AUX_SEL	C38	Strapping Signal to select HDMI or DP output 1M pull-down to logic ground enables HDMI Floating enables DisplayPort mode	I 3.3V	PD 1M	DP mode enabled

4.4.5.2. HDMI Mode

Name	Pin #	Description	I/O	PU / PD	Comment
TMDS3_DATA2+ TMDS3_DATA2- TMDS3_DATA1+ TMDS3_DATA1- TMDS3_DATA0+ TMDS3_DATA0-	C39 C40 C42 C43 C46 C47	HDMI / DVI Port, Differential Pair Data Lines	O PCIE		AC coupled off Module 100 nF DC blocking capacitors shall be placed on the Carrier
TMDS3_CLK+ TMDS3_CLK-	C49 C50	HDMI Port, Differential Pair Clock Lines			
HDM3_HPD	C44	Detection of Hot Plug / Unplug and notification of the link layer	I 3.3V	PD 100K	
HDMI3_CTRLCLK	C36	I2C_CLK Line for HDMI	I/O PCIE	PU 2.2K	AC couple on Module
HDMI3_CTRLDATA	C37	I2C_DAT Line for HDMI	I/O PCIE	PU 2.2K	AC couple on Module
DDI3_DDC_AUX_SEL	C38	Strapping Signal to select HDMI or DP output 1M pull-down to logic ground enables HDMI Leve this signal floating enables DisplayPort mode	I 3.3V	PD 1M	HDMI mode enabled

4.4.6 PCIe Graphics Port (PEG)

Name	Pin #	Description	I/O	PU / PD	Comment
PEG_TX0+ PEG_TX0-	D52 D53	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX0+ PEG_RX0-	C52 C53	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX1+ PEG_TX1-	D55 D56	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX1+ PEG_RX1-	C55 C56	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX2+ PEG_TX2-	D58 D59	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX2+ PEG_RX2-	C58 C59	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX3+ PEG_TX3-	D61 D62	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX3+ PEG_RX3-	C61 C62	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX4+ PEG_TX4-	D65 D66	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX4+ PEG_RX4-	C65 C66	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX5+ PEG_TX5-	D68 D69	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module

Name	Pin #	Description	I/O	PU / PD	Comment
PEG_RX5+ PEG_RX5-	C68 C69	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX6+ PEG_TX6-	D71 D72	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX6+ PEG_RX6-	C71 C72	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX7+ PEG_TX7-	D74 D75	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX7+ PEG_RX7-	C74 C75	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX8+ PEG_TX8-	D78 D79	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX8+ PEG_RX8-	C78 C79	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX9+ PEG_TX9-	D81 D82	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX9+ PEG_RX9-	C81 C82	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX10+ PEG_TX10-	D85 D86	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX10+ PEG_RX10-	C85 C86	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module

Name	Pin #	Description	I/O	PU / PD	Comment
PEG_TX11+ PEG_TX11-	D88 D89	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX11+ PEG_RX11-	C88 C89	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX12+ PEG_TX12-	D91 D92	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX12+ PEG_RX12-	C91 C92	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX13+ PEG_TX13-	D94 D95	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX13+ PEG_RX13-	C94 C95	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX14+ PEG_TX14-	D98 D99	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX14+ PEG_RX14-	C98 C99	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_TX15+ PEG_TX15-	D101 D102	PCI Express Graphics transmit differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	O PCIE		AC coupled on Module
PEG_RX15+ PEG_RX15-	C101 C102	PCI Express Graphics receive differential pairs. These are the same lines as PCIE_TX[16:31]+ and – in Module pin-out Type 6	I PCIE		AC coupled off Module
PEG_LANE_RV#	D54	PCI Express Graphics lane reversal input strap. Pull low on the Carrier Board to reverse lane order.	I 3.3V		

4.4.7 Module Type Definition

Name	Pin #	Description	I/O	PU / PD	Comment
TYPE0# TYPE1# TYPE2#	C54 C57 D57	The TYPE pins indicate to the Carrier Board the Pin-out Type that is implemented on the Module. The pins are tied on the Module to either ground (GND) or are no-connects (NC). For Pin-out Type 1 and Type 10 that lack a CD connector, these pins are not present (X) **TYPE2# TYPE1# TYPE0#** X X X Pinout Type 1 X X X Pinout Type 10 NC NC NC Pinout Type 2 NC NC GND Pinout Type 3 NC GND NC Pinout Type 4 NC GND GND Pinout Type 5 GND NC NC Pinout Type 6 GND NC GND Pinout Type 7 The Carrier Board should implement combinatorial logic that monitors the module TYPE pins and keeps power off (e.g. deactivates the ATX_ON signal for an ATX power supply) if an incompatible module pin-out type is detected. The Carrier Board logic may also implement a fault indicator such as an LED.			Type 6
TYPE10#	A97	In case of a type 10 module this pin signal is tied to GND through a 47K resistor on the module.			No PD

4.4.8 Power and Ground

Name	Pin #	Description	I/O	PU / PD	Comment
VCC_12V	C104, C105, C106, C107, C108, C109, D104, D105, D106, D107, D108, D109	Primary power input supports wide range 5~ 20V input. All available VCC_12V pins on the connector(s) shall be used.	P		8.5-20 V
GND	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, D41, D51, D60, D67, D70, D73, D76, D80, D84, D87, D90, D93, D96, D100, D103, D110	Ground - DC power and signal and AC signal return path.	P		

5. Additional Features

This chapter describes connectors, LEDs, switches and additional items located on the module and not necessarily included in the PICMG standard specification. The locations of these items are as below:

5.1. Module Feature Locations

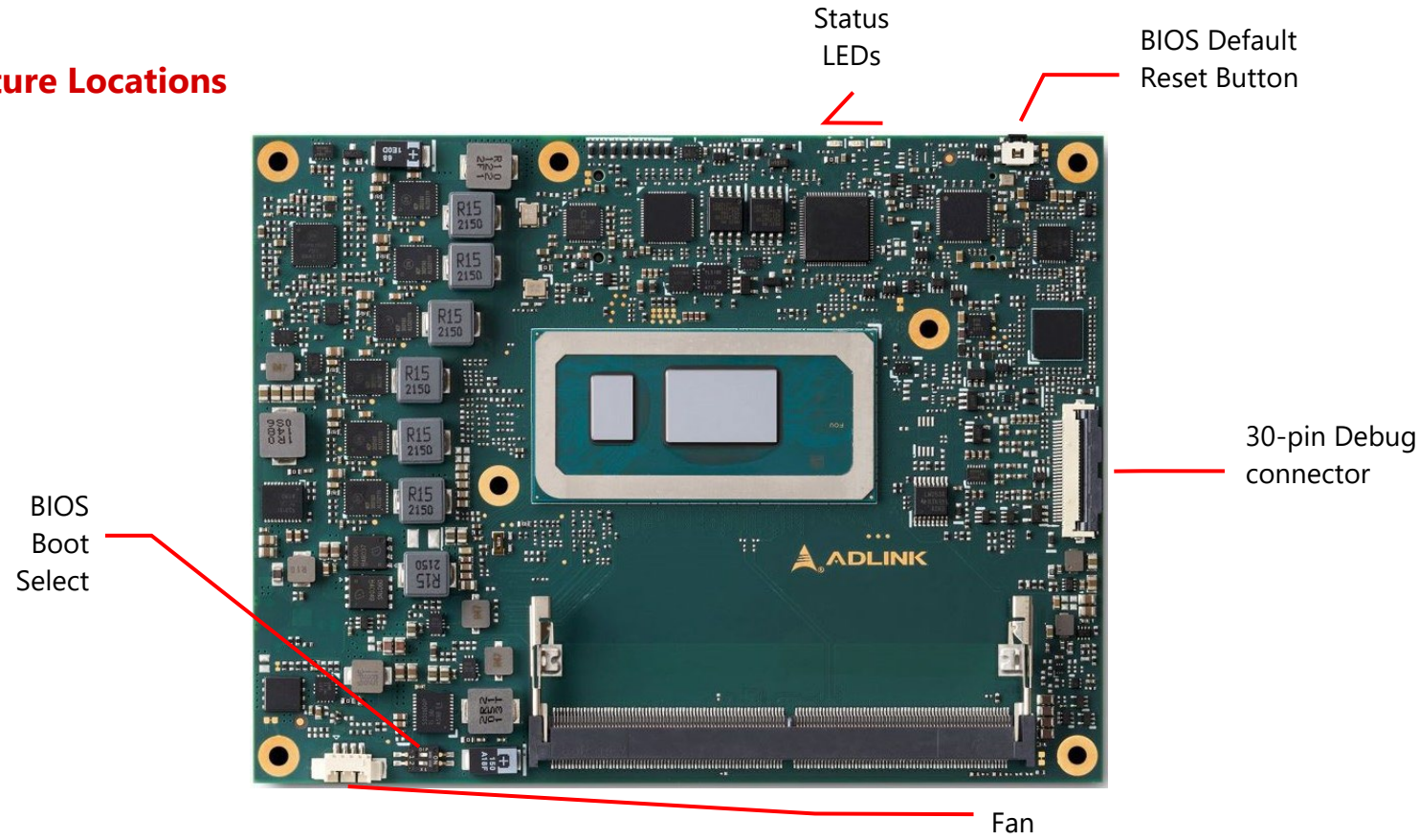


Figure 3 – Module feature locations (top side)

5.2. Debug Connector

This connector is particular useful during carrier design and bring up phase. It offers access to the following critical parts of the module:

- Test points measurement of internal power rails
- SPI BIOS programming interface
- Embedded Controller programming interface

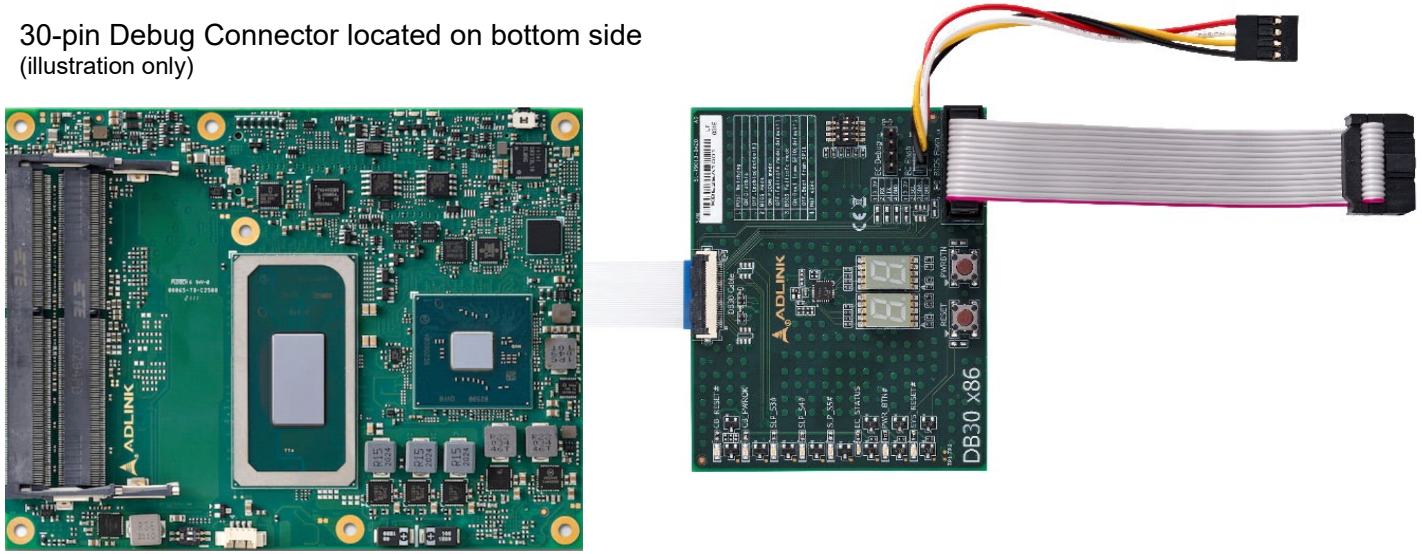
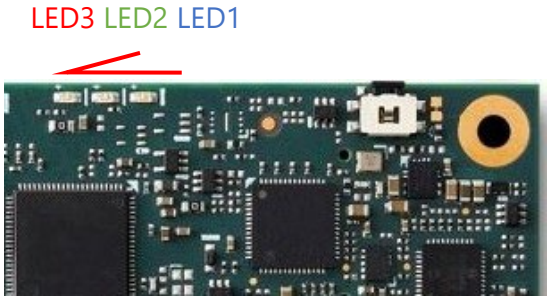


Figure 4 – Express-RLP and Debug Module

5.3. Status LEDs

Status LED's are mounted on the module to facilitate easier maintenance.



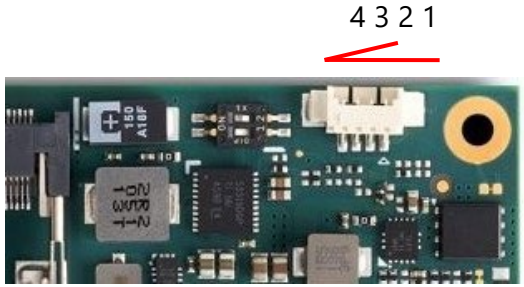
Name	Color	Connection	Function
LED1	Blue	EC output	Power Sequence Status Code (EC) Power Changes, RESET (see Exception Codes below)
LED2	Green	Power Source 3Vcc	S0 LED ON S3/S4/S5 LED OFF ECO mode LED OFF
LED3	Red	EC output and same signal as WDT (B27) on BtB connector	Module power up WD LED = LED OFF Watchdog counting WD LED = Keep Last State Watchdog timed out WD LED = LED ON Watchdog RESET WD LED = LED ON Rebooted after WD RESET WD LED = LED ON Rebooted after PWRBTN WD LED = LED OFF Rebooted after RESET BTN WD LED = LED OFF Note: only a RESET not initiated by the BMC can clear the WD LED (user action)

5.4. Exception Codes

Exception Code	Error Message
0	NOERROR
3	NO_SLP_S5
4	NO_SLP_S4
5	NO_SLP_S3
6	BIOS_FAIL
7	RESET_FAIL
9	NO_CB_PWROK
10	CRITICAL_TEMP
11	POWER_FAIL
12	VOLTAGE_FAIL
13	RSMRST_FAIL
14	NO_VDDQ_PG
16	NO_VCORE_PG
17	NO_SYS_GD
19	NO_V3P3A
21	NO_PWRSRC_GD

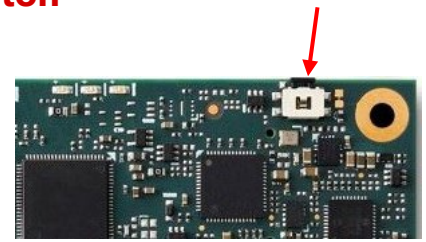
5.5. Fan Connector

Connector type: JVE 24W1125A-04M00



Name	Description
1	FAN_PWMOUT
2	FAN_TACHIN
3	GND
4	12V

5.6. BIOS Default Reset Button



To perform a hardware reset of BIOS default settings, perform the following steps:

1. Shut down the system.
2. Keep the BIOS Setup Defaults Reset Button pressed and boot up the system. You can release the button when the BIOS prompt screen appears
3. The BIOS prompt screen will display a confirmation that BIOS defaults have been reset and request that you reboot the system.

5.7. BIOS Boot Select

The module has two BIOS chips (BOM option) and BIOS operation can be configured to "PICMG" and dual-BIOS "Failsafe" modes using BIOS Select and Mode Configuration Switch, Pin 2.

Setting the module to PICMG mode will configure the BIOS chips on the module as SPI0 and SPI1. In PICMG mode, a BIOS chip cannot be placed in the SPI0 slot on the carrier.

In dual-BIOS Failsafe mode, both BIOS chips on the module are configured as SPI1. Only one of the two is connected to the SPI bus at any given time. In case of failure of the primary SPI1 BIOS, the system will reboot and switch to the secondary SPI1 BIOS on the module. In Failsafe mode, the SPI0 BIOS socket on the carrier can be populated.

In either mode, BIOS Select and Mode Configuration Switch Pin 1 is used to select whether to boot from SPI0 or SPI1.

Mode	Pin 1	Pin 2
Boot from SPI0 (default)	On	-
Boot from SPI1	Off	-
Set BIOS to PICMG mode (default)	-	On
Set BIOS to Failsafe BIOS mode	-	Off

6. BIOS Checkpoints, Beep Codes

A status code is a data value used to provide diagnostic information about the boot process. Progress codes are status codes that signify successful progression to a following initialization step. Error codes signify error conditions encountered in the process of system initialization. The Aptio 5.x core can be configured to send status codes to a variety of sources. The two most commonly used types of status codes are checkpoint codes and beep codes. Checkpoint codes are byte length data values. Checkpoints are typically output to I/O port 80h, but the Aptio 5.x core can be configured to send checkpoints to a variety of sources. The Aptio 5.x core outputs checkpoints throughout the boot process to indicate the task the system is currently executing. Checkpoints are very useful in aiding software developers or technicians in debugging problems that occur during the pre-boot process on production hardware. A beep code is a series of short sound signals. Beep codes are typically error codes that do not occur during normal boot process.

Note: Beep codes are not the only sounds generated during the boot process. Some firmware components may use sounds to notify the user about other events such as detection of a hot-pluggable device. These sounds are typically generated using a frequency that is different from the frequency of the beep codes

Viewing Checkpoints

Checkpoints generated by the Aptio firmware can be viewed using a PCI checkpoint card, also referred to as a "POST Card" or "POST Diagnostic Card". These PCI add-on cards show the value of I/O port 80h on an LED display.

Aptio V Checkpoint and Beep Codes

Download the Aptio V Checkpoint and Beep Codes from the AMI website at: www.ami.com/download/aptio-v-checkpoint-and-beep-codes

7. Software Support

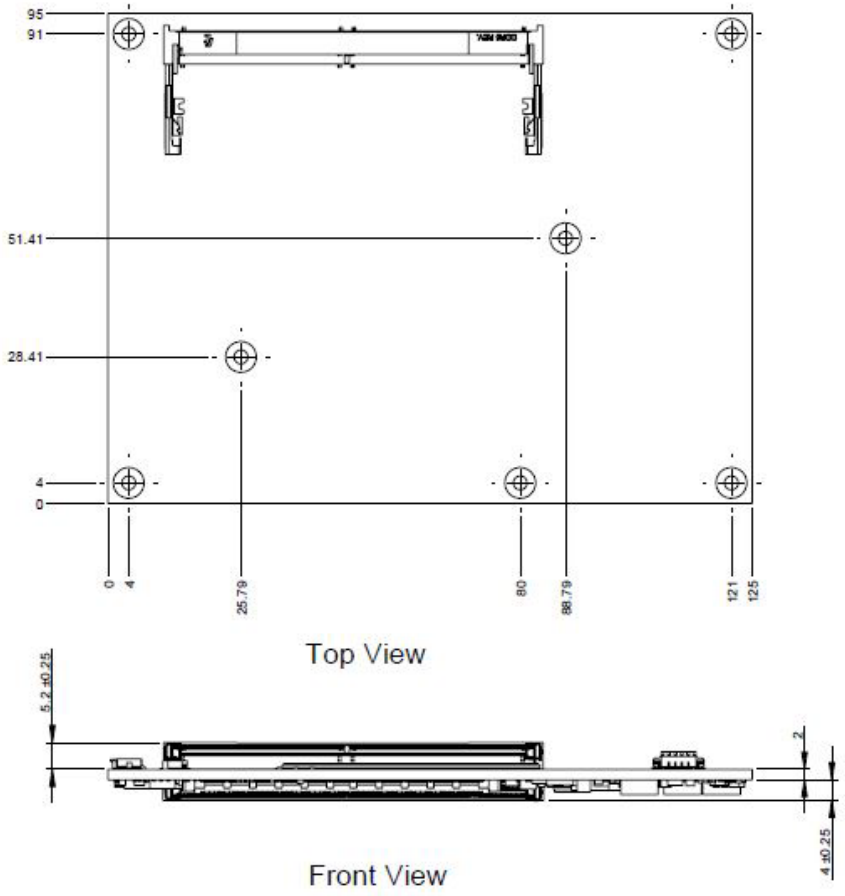
7.1. Windows 10 IoT Enterprise 64-bit

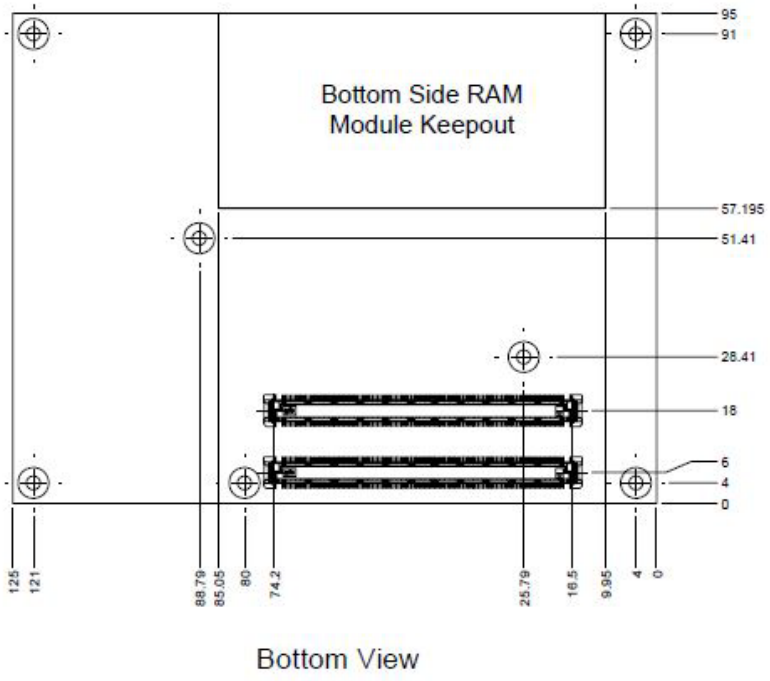
7.2. Yocto Linux 64-bit

https://github.com/ADLINK/meta-adlink-x86-64bit (TBC)

8. Mechanical and Thermal

8.1. Module Dimensions





All dimensions are shown in millimeters. Tolerances should be ± 0.25mm, unless otherwise noted.
The tolerances on the module connector locating peg holes (dimensions [16.50, 6.00]&[16.50,18.00]) should be ± 0.10mm.

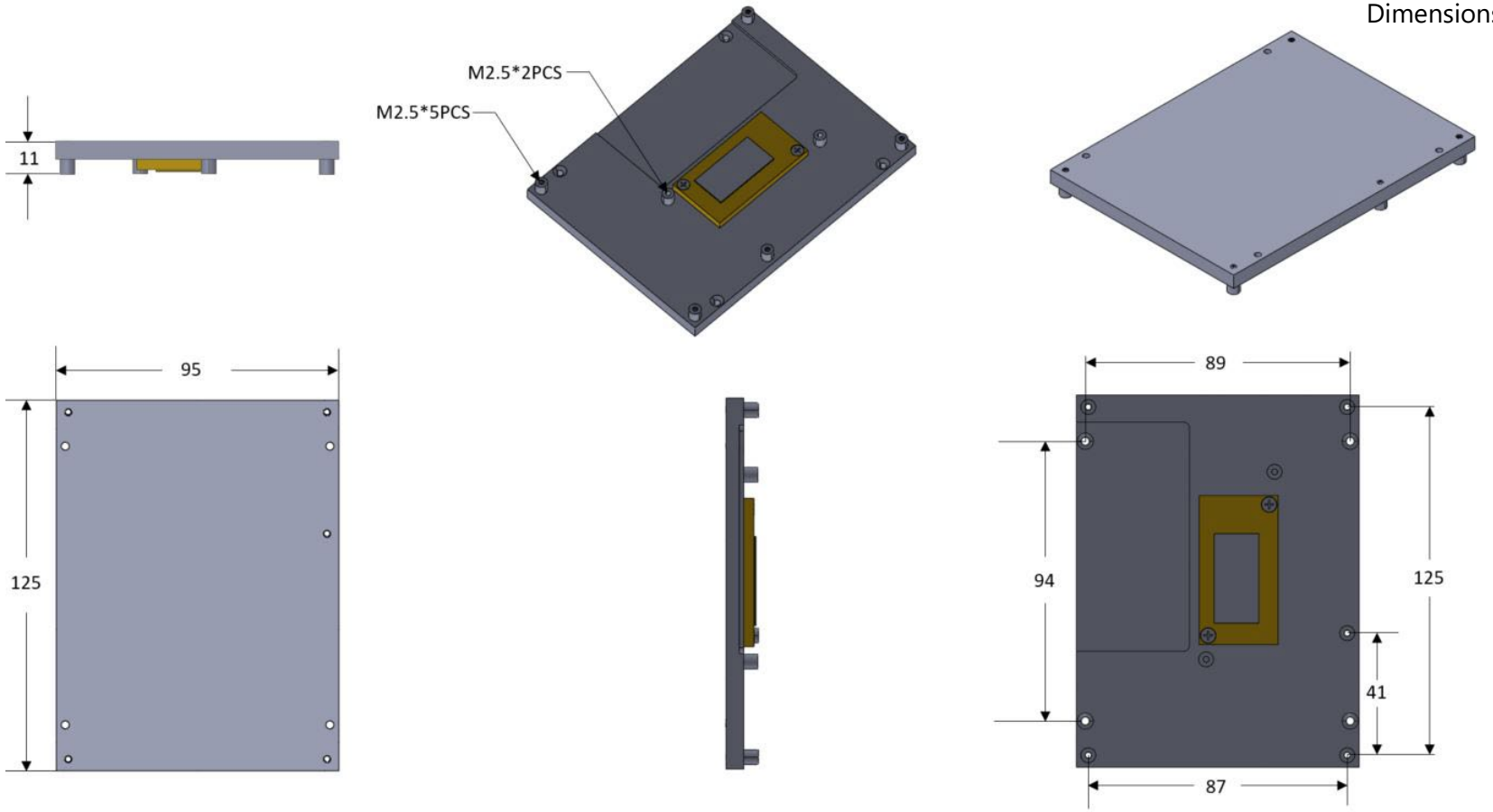
Dimensions: mm

Figure 5 – Module mechanical dimensions

8.2. Thermal Solutions

8.2.1 Heatspreader: HTS

Dimensions: mm



Heatspreader: HTS

Figure 6 – Heatspreader: HTS

8.2.2 Heatsink: THS

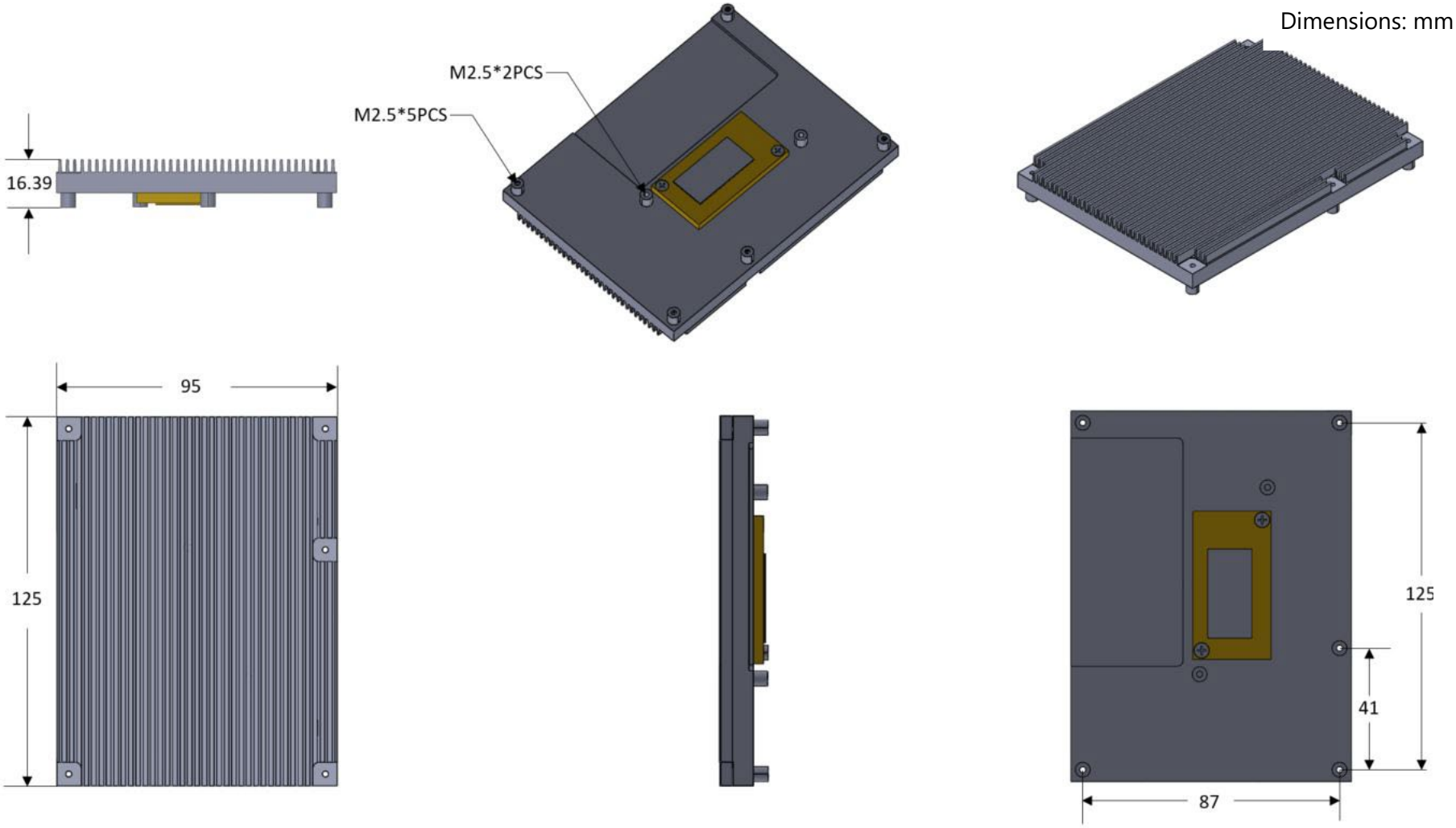
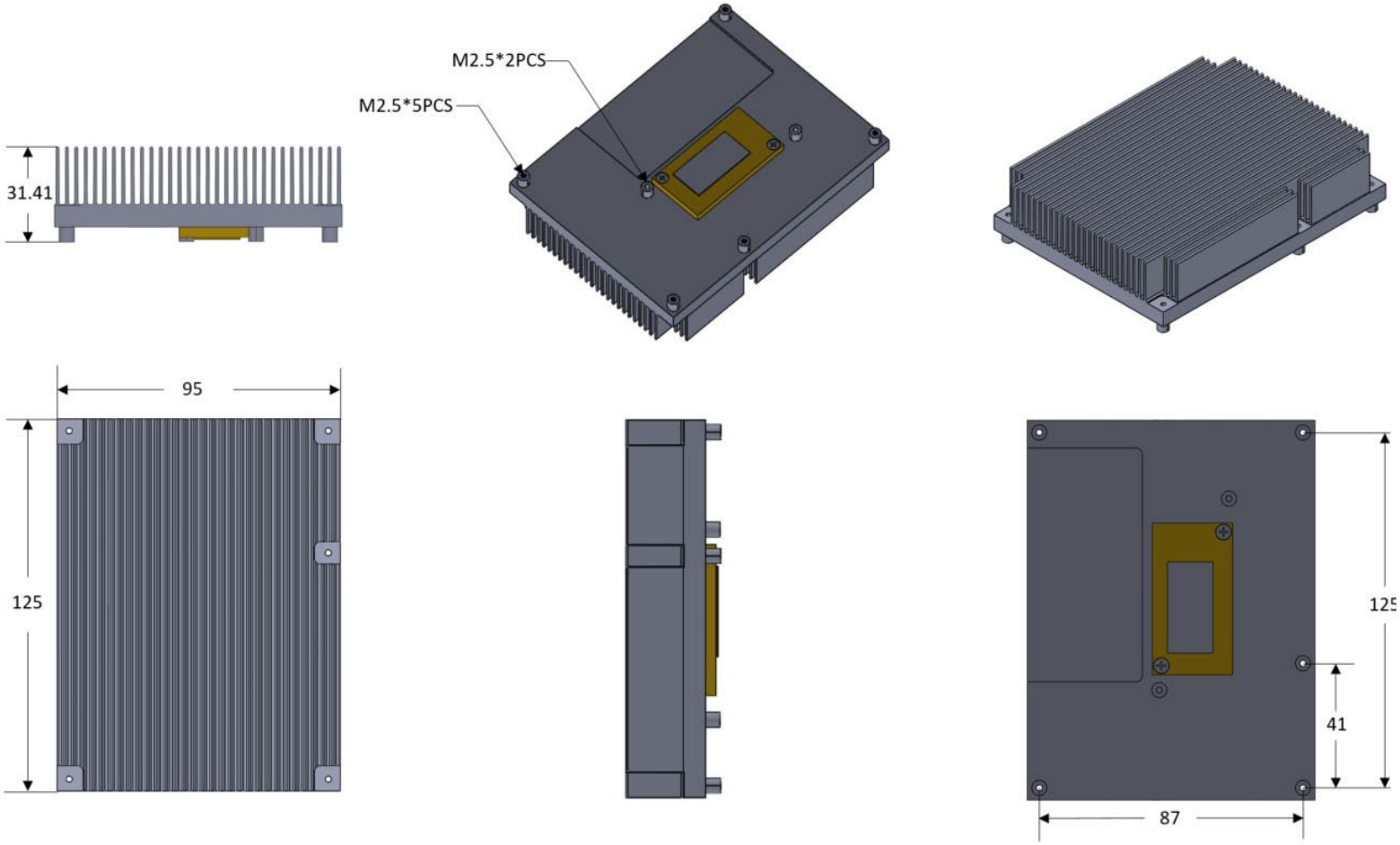


Figure 7 – Heatsink: THS

8.2.3 Heatsink High Profile: THSH

Dimensions: mm

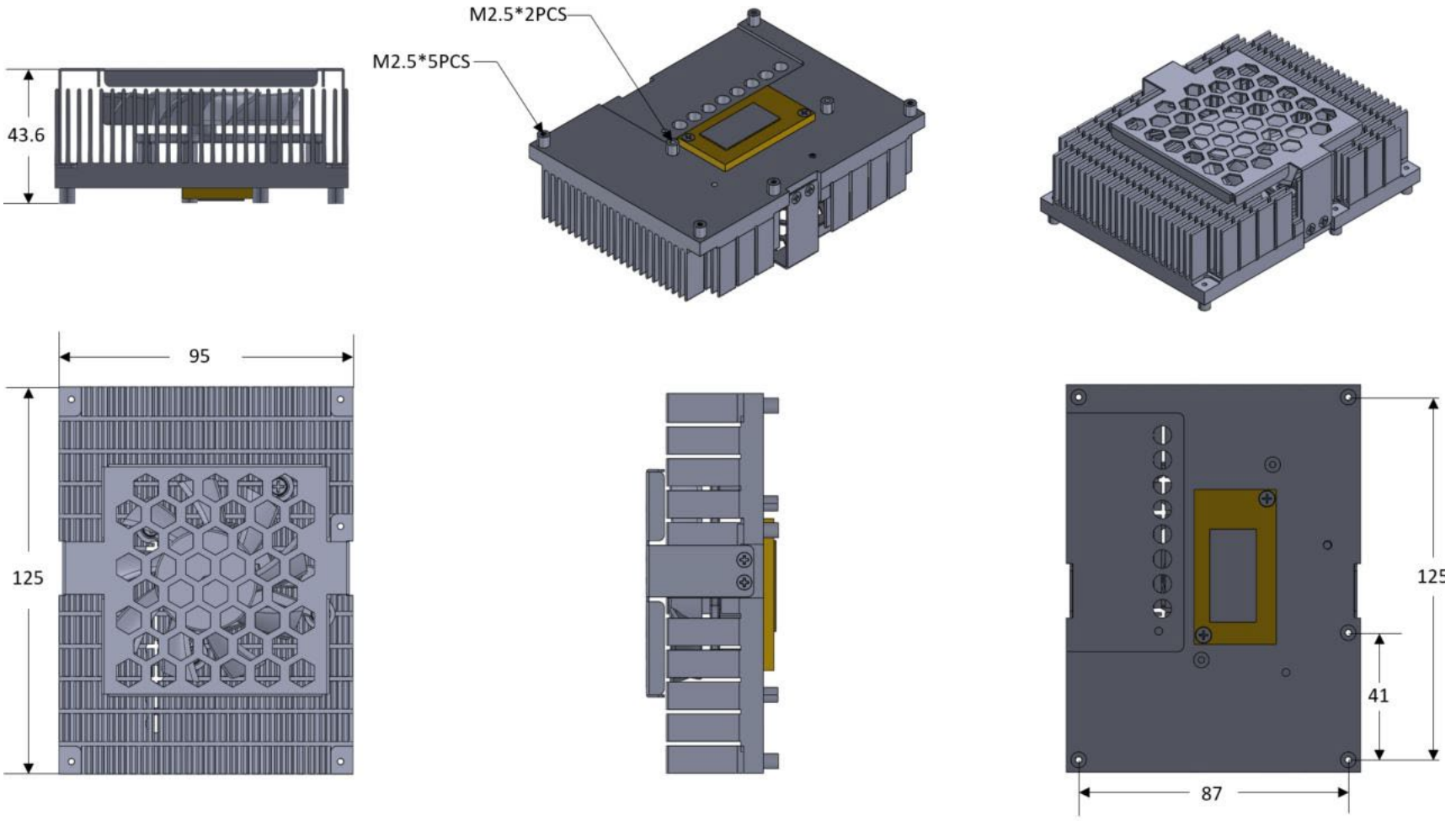


Heatsink: THSH

Figure 8 – Heatsink High Profile: THSH

8.2.4 Heatsink with Fan: THSF

Dimensions: mm



Heatsink with Fan: THSF

Figure 9 – Heatsink with Fan: THSF