BOXER-8645AI

AI@Edge Fanless Embedded AI System
with NVIDIA® Jetson AGX Orin™

User's Manual 2nd Ed

Last Updated: June 4, 2024

Copyright Notice

Acknowledgements

Packing List

Before setting up your product, please make sure the following items have been shipped:

Item	Quantity
● BOXER-8645AI	1
● HDMI Cable Holder	1
● Screw Package	1
● Power Connector	1
● Power Adapter (Optional)	1
● Power Cord (Optional)	1

If any of these items are missing or damaged, please contact your distributor or sales representative immediately.

About this Document

This User's Manual contains all the essential information, such as detailed descriptions and explanations on the product's hardware and software features (if any), its specifications, dimensions, jumper/connector settings/definitions, and driver installation instructions (if any), to facilitate users in setting up their product.

Users may refer to the product page at AAEON.com for the latest version of this document.

Safety Precautions

Please read the following safety instructions carefully. It is advised that you keep this manual for future references

1. All cautions and warnings on the device should be noted.
2. All cables and adapters supplied by AAEON are certified and in accordance with the material safety laws and regulations of the country of sale. Do not use any cables or adapters not supplied by AAEON to prevent system malfunction or fires.
3. Make sure the power source matches the power rating of the device.
4. Position the power cord so that people cannot step on it. Do not place anything over the power cord.
5. Always completely disconnect the power before working on the system's hardware.
6. No connections should be made when the system is powered as a sudden rush of power may damage sensitive electronic components.
7. If the device is not to be used for a long time, disconnect it from the power supply to avoid damage by transient over-voltage.
8. Always disconnect this device from any power supply before cleaning.
9. While cleaning, use a damp cloth instead of liquid or spray detergents.
10. Make sure the device is installed near a power outlet and is easily accessible.
11. Keep this device away from humidity.
12. Place the device on a solid surface during installation to prevent falls
13. Do not cover the openings on the device to ensure optimal heat dissipation.
14. Watch out for high temperatures when the system is running.
15. Do not touch the heat sink or heat spreader when the system is running
16. Never pour any liquid into the openings. This could cause fire or electric shock.

17. As most electronic components are sensitive to static electrical charge, be sure to ground yourself to prevent static charge when installing the internal components. Use a grounding wrist strap and contain all electronic components in any static-shielded containers.

18. If any of the following situations arises, please the contact our service personnel:

    i. Damaged power cord or plug
    ii. Liquid intrusion to the device
    iii. Exposure to moisture
    iv. Device is not working as expected or in a manner as described in this manual
    v. The device is dropped or damaged
    vi. Any obvious signs of damage displayed on the device

19. DO NOT LEAVE THIS DEVICE IN AN UNCONTROLLED ENVIRONMENT WITH TEMPERATURES BEYOND THE DEVICE'S PERMITTED STORAGE TEMPERATURES (SEE CHAPTER 1) TO PREVENT DAMAGE.

FCC Statement

This device complies with Part 15 FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received including interference that may cause undesired operation.

Caution:

There is a danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions and your local government's recycling or disposal directives.

Attention:

Il y a un risque d'explosion si la batterie est remplacée de façon incorrecte.
Ne la remplacer qu'avec le même modèle ou équivalent recommandé par le constructeur.
Recycler les batteries usées en accord avec les instructions du fabricant et les directives gouvernementales de recyclage.

China RoHS Requirements (CN)

产品中有毒有害物质或元素名称及含量

AAEON System QO4-381 Rev.A0

部件名称	有毒有害物质或元素					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚(PBDE)
印刷电路板及其电子组件	×	○	○	○	○	○
外部信号连接器及线材	×	○	○	○	○	○
外壳	○	○	○	○	○	○
中央处理器与内存	×	○	○	○	○	○
硬盘	×	○	○	○	○	○
液晶模块	×	×	○	○	○	○
光驱	×	○	○	○	○	○
触控模块	×	○	○	○	○	○
电源	×	○	○	○	○	○
电池	×	○	○	○	○	○

本表格依据 SJ/T 11364 的规定编制。

○：表示该有毒有害物质在该部件所有均质材料中的含量均在GB/T 26572标准规定的限量要求以下。

×：表示该有害物质的某一均质材料超出了GB/T 26572的限量要求，然而该部件仍符合欧盟指令2011/65/EU 的规范。

备注：

一、此产品所标示之环保使用期限，系指在一般正常使用状况下。

二、上述部件物质中央处理器、内存、硬盘、光驱、电源为选购品。

三、上述部件物质液晶模块、触控模块仅一体机产品适用。

China RoHS Requirement (EN)

Hazardous and Toxic Materials List

AAEON System QO4-381 Rev.A0

Component Name	Hazardous or Toxic Materials or Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated biphenyls (PBBs)	Polybrominated diphenyl ethers (PBDEs)
PCB and Components	X	O	O	O	O	O
Wires & Connectors for Ext.Connections	X	O	O	O	O	O
Chassis	O	O	O	O	O	O
CPU & RAM	X	O	O	O	O	O
HDD Drive	X	O	O	O	O	O
LCD Module	X	X	O	O	O	O
Optical Drive	X	O	O	O	O	O
Touch Control Module	X	O	O	O	O	O
PSU	X	O	O	O	O	O
Battery	X	O	O	O	O	O

This form is prepared in compliance with the provisions of SJ/T 11364.

O: The level of toxic or hazardous materials present in this component and its parts is below the limit specified by GB/T 26572.

X: The level of toxic of hazardous materials present in the component exceed the limits specified by GB/T 26572, but is still in compliance with EU Directive 2011/65/EU (RoHS 2).

Notes:

1. The Environment Friendly Use Period indicated by labelling on this product is applicable only to use under normal conditions.
2. Individual components including the CPU, RAM/memory, HDD, optical drive, and PSU are optional.
3. LCD Module and Touch Control Module only applies to certain products which feature these components.

Table of Contents

Chapter 1

Product Specifications

1.1 Specifications

System	
AI Accelerator	NVIDIA® Jetson AGX Orin™
CPU	AGX Orin 32GB: 8-core Arm® Cortex®-A78AE CPU
	AGX Orin 64GB: 12-core Arm® Cortex®-A78AE CPU
System Memory	32GB LPDDR5
	64GB LPDDR5
Storage Device	64GB eMMC 5.1
	M.2 2280 M-Key x 1 (NVMe)
	2.5" SATA x 2
Display Interface	HDMI 2.0 (Type-A) x 1
Ethernet	RJ-45 for 10G LAN x 1
	RJ-45 for GbE LAN x 1
	Additional LAN x 8 (By request)
I/O	GMSL2 with FAKRA x 8
	USB 3.2 Gen 2 (Type-A) x 4
	Micro USB x 1 for OS Flash
	Line-Out x 1
	DB-9 x 1 for Isolated CANBus x 2
	DB-9 x 2 for RS-232 (Rx/Tx/CTS/RTS)/RS-485 x 2
	DB-9 x 1 for DIO x 8
	Switch x 2 for Ignition Delay On/Off
	3-pin Terminal Block x 1 for Power Input
	Power Button x 1
	Recovery Button x 1
	Antenna Hole x 7
	TPM Support

System

I/O	GNSS Support
	9-Axis Sensor Support
Expansion	M.2 2230 E-Key x 1 (Wi-Fi/BT)
	M.2 3052 B-Key x 1 (LTE)
	M.2 2280 M-Key x 1 (NVMe)
	2.5″ SATA x 2
	SIM Slot x 2
	MicroSD Slot x 1
Indicator	Power LED x 1
OS Support	Linux (NVIDIA JetPack™ 5.0 and above)

Power Supply

Power Requirement	9V ~ 36V via 3-pin Terminal Block x 1
	ACC Ignition Delay On/Off

Mechanical

Mounting	Wall Mount (default)
Dimensions (W x D x H)	11.26″ x 7.95″ x 3.54″ (286mm x 202mm x 90mm)
Gross Weight	11 lb. (5Kg)
Net Weight	13 lb. (5.9Kg)

Environmental

Operating Temperature	-13°F ~ 149°F (-25°C ~ 65°C with 0.5 m/s airflow)
Storage Temperature	-40°F ~ 185°F (-40°C ~ 85°C)
Storage Humidity	5 ~ 95% @ 40°C, non-condensing

Environmental

Anti-Vibration	MIL-STD-810G, 514.6C Procedure 1, Category 4 Trucker/Semitrailer on US highway (Figure 514.6C-1-Category 4-Common carrier)
Anti-Shock	MIL-STD-810G, Method 516.6, Procedure I, flight vehicle equipment
Certification	E-Mark, CE/FCC Class A

Note: The real USB, LAN and COM transmission rate depends on the user scenario and HW design.

Note: AAEON recommends using industrial wide-temperature Gen 3 storage.

If using Gen 4 storage, a thermal solution is required for adequate heat dissipation. Please check the suggestion of Gen 4 storage in section 2.5.5.

Note: Helps to record vehicle movement status, providing flexible connectivity and scalability.

Note: GMSL2 Camera:

a) Standard GMSL2 cameras supported: e-con Systems NileCAM25

Brand	Model	Resolution
e-con Systems	NileCAM25	2MP camera

b) Please note that GMSL2 cameras do not support Hot plug. Please make sure to plug GMSL2 cameras prior to starting the system

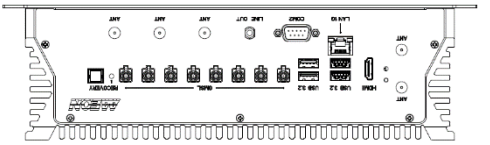
Note: For information regarding other GMSL2 cameras supported, please contact your AAEON representative.

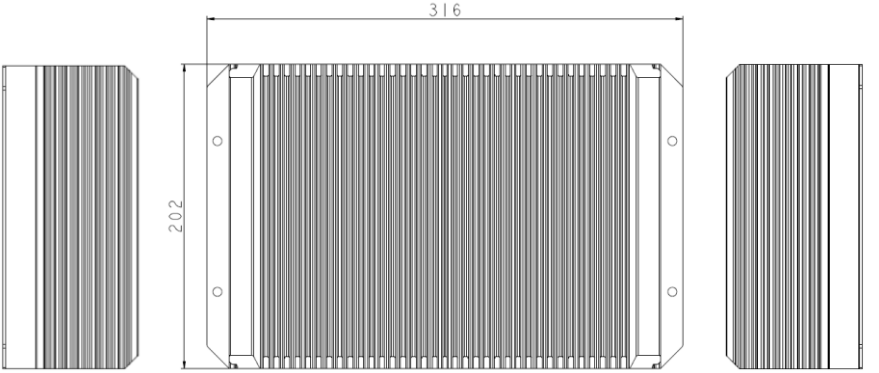
Chapter 2

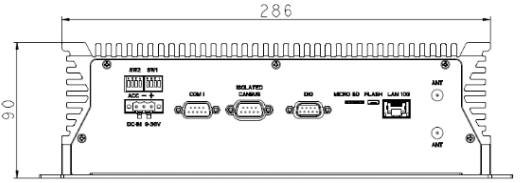
Hardware Information

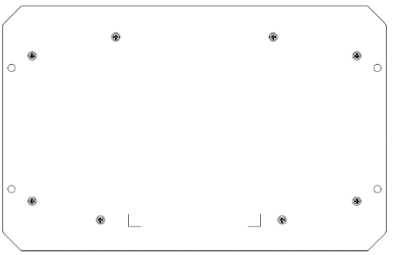
2.1 Dimensions

System



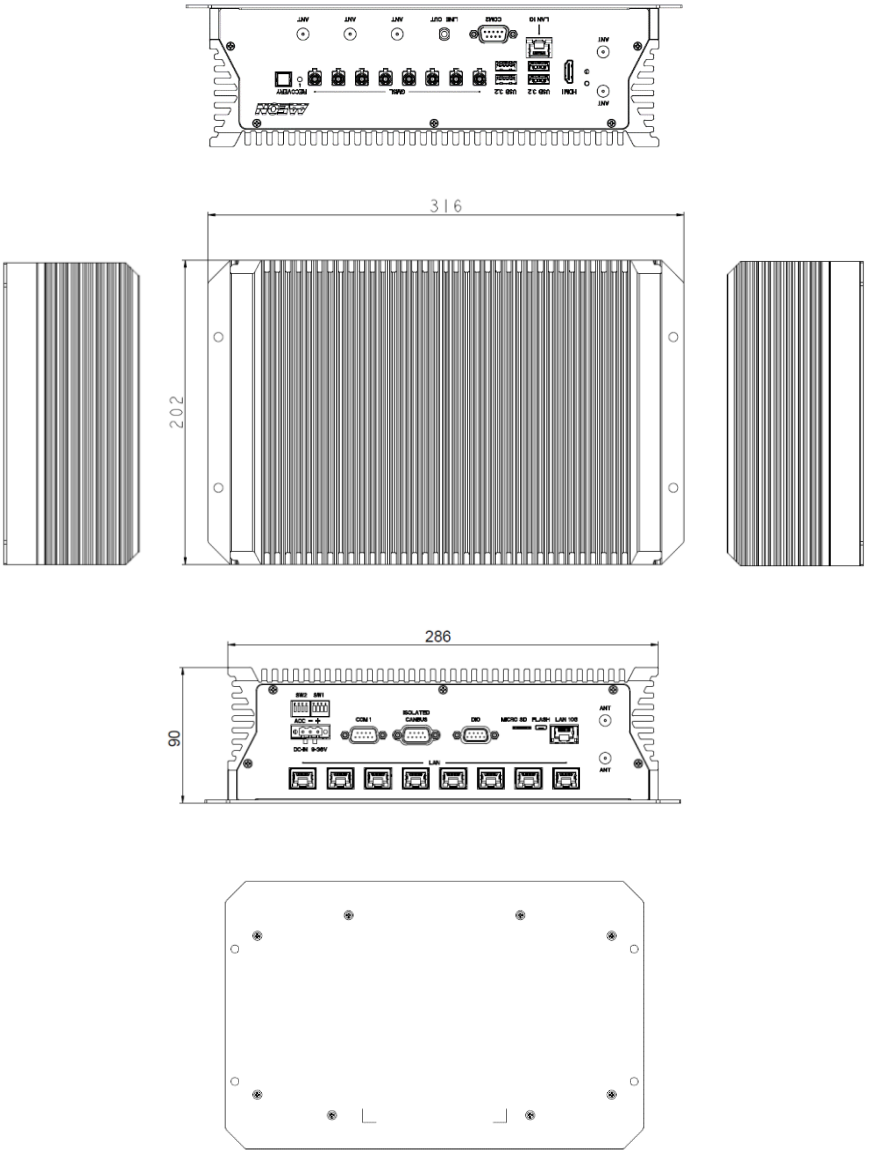






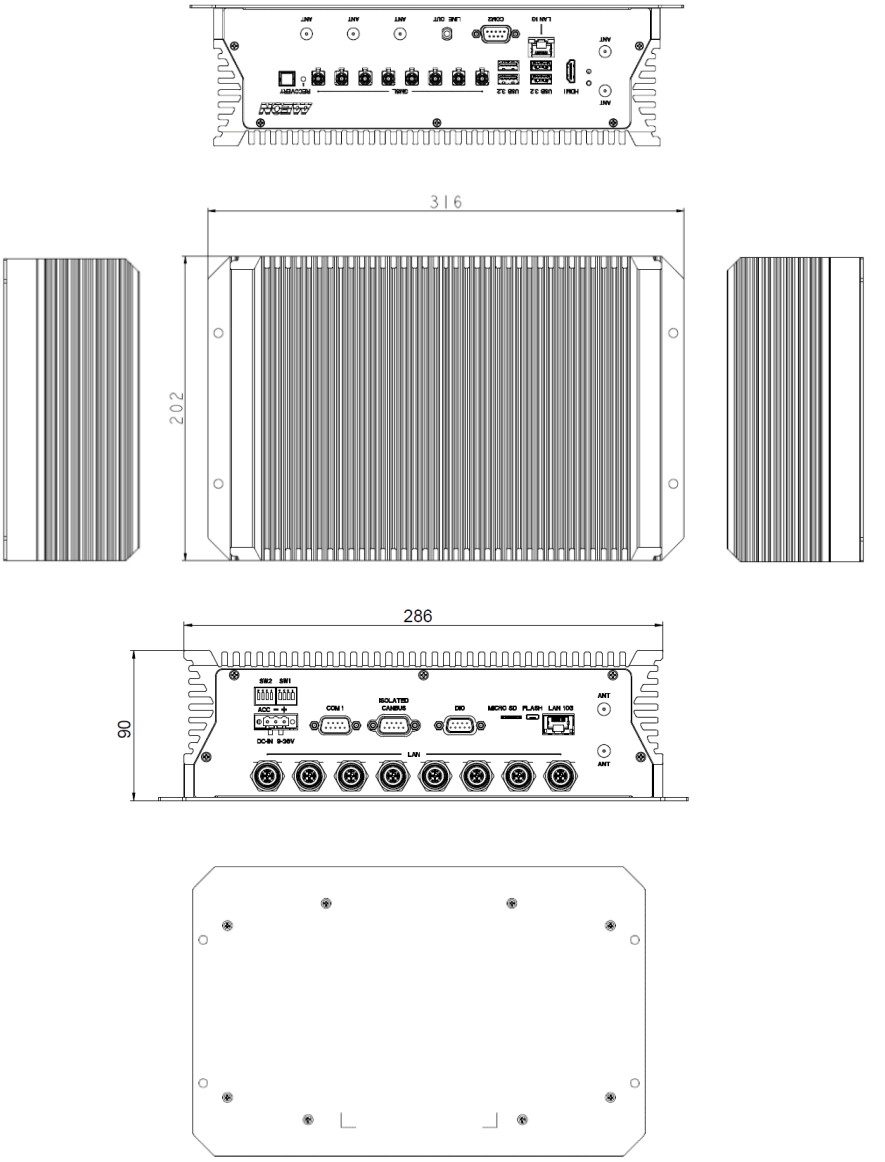
Non-standard Version Dimension (Additional RJ-45 x 8)

Note: Available upon request with MOQ.



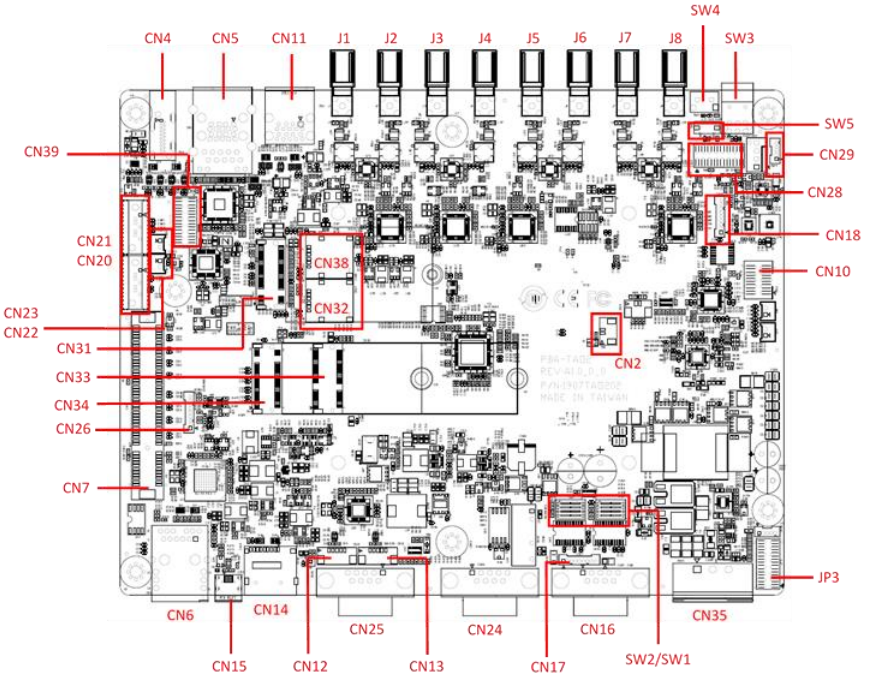
Non-standard Version Dimension (Additional M12 x 8)

Note: Available upon request with MOQ.

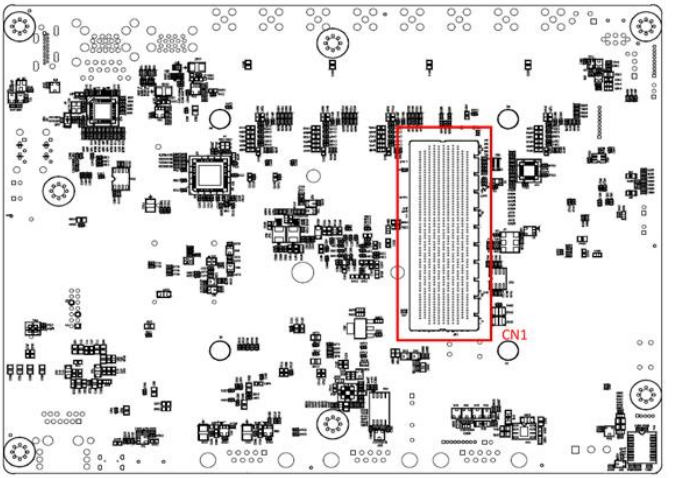


2.2 Jumpers and Connectors

Component Side



Solder Side



2.3 List of Jumpers

The board has a number of jumpers that allow you to configure your system to suit your application.

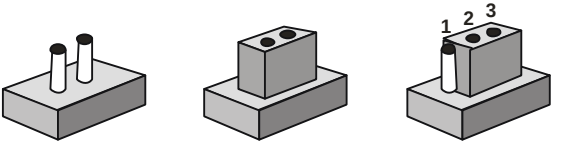
The table below shows the function of each of the board's jumpers

Label	Function
CN28	Automation Header
JP3	MCU Control Delay ON/OFF Setting

2.3.1 Jumper Settings

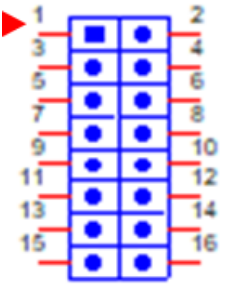
You configure your card to match the needs of your application by setting jumpers. A jumper is the simplest kind of electric switch. It consists of two metal pins and a small metal clip (often protected by a plastic cover) that slides over the pins to connect them. To "close" a jumper you connect the pins with the clip.

To "open" a jumper you remove the clip. Sometimes a jumper will have three pins, labeled 1, 2 and 3. In this case you would connect either pins 1 and 2 or 2 and 3.



A pair of needle-nose pliers may be helpful when working with jumpers.
If you have any doubts about the best hardware configuration for your application, contact your local distributor or sales representative before you make any change. Generally, you simply need a standard cable to make most connections.

2.3.2 Automation Header (CN28)



Pin	Function
1	GND
2	FORCE_RECOVERY
3	SYS_RST
4	BUTTON_POWER
5-6	SHORT: AUTO POWER ON ENABLE
5-6	OPEN: AUTO POWER ON DISABLE
7	CVB_STBY(SLEEP)
8	SYSTEM_OC_N
9-10	OPEN: WOL DISABLE
9-10	SHORT: WOL ENABLE
11-12	Scandump
13	3V3_AO
14	5V_AO

2.3.3 MCU Control Delay ON/OFF Setting (JP3)

ACC ON Delay Minutes Setting Table

SW8 PIN NUMBER 5, 6	3, 4	1, 2	Delay Time
OFF	OFF	OFF	
OPEN	OPEN	OPEN	1 sec.
OFF	OFF	ON	
OPEN	OPEN	SHORT	3 sec.
OFF	ON	OFF	
OPEN	SHORT	OPEN	5 sec.
OFF	ON	ON	
OPEN	SHORT	SHORT	10 sec.
ON	OFF	OFF	
SHORT	OPEN	OPEN	15 sec.
ON	OFF	ON	
SHORT	OPEN	SHORT	20 sec.
ON	ON	OFF	
SHORT	SHORT	OPEN	25 sec.
ON	ON	ON	
SHORT	SHORT	SHORT	30 sec.

ACC OFF Delay Minutes Setting Table

SW8 PIN NUMBER 11, 12	9, 10	7, 8	Delay Time
OFF	OFF	OFF	
OPEN	OPEN	OPEN	1 min.
OFF	OFF	ON	
OPEN	OPEN	SHORT	3 min.
OFF	ON	OFF	
OPEN	SHORT	OPEN	5 min.
OFF	ON	ON	
OPEN	SHORT	SHORT	10 min.
ON	OFF	OFF	
SHORT	OPEN	OPEN	30 min.
ON	OFF	ON	
SHORT	OPEN	SHORT	60 min.
ON	ON	OFF	
SHORT	SHORT	OPEN	120 min.
ON	ON	ON	
SHORT	SHORT	SHORT	0min.

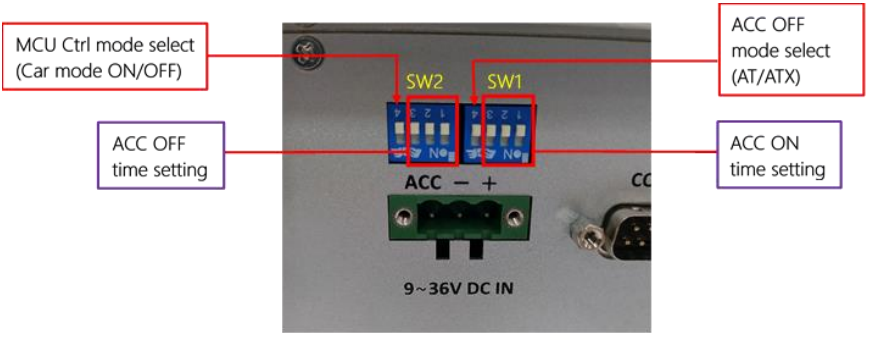
AT/ATX MODE Selection

SW8 PIN NUMBER 13, 14	MODE_SEL
ON	
SHORT	ATX System
OFF	
OPEN	AT System

MCU control setting

SW8 PIN NUMBER 15, 16	
ON	
SHORT	MCU control
OFF	
OPEN	Non MCU control

2.3.4 The Chassis Mark (SW1/SW2)



SW1 ACC ON time setting			
3	2	1	Delay time
OFF	OFF	OFF	1 sec
OFF	OFF	ON	3 sec
OFF	ON	OFF	5 sec
OFF	ON	ON	10 sec
ON	OFF	OFF	15 sec
ON	OFF	ON	20 sec
ON	ON	OFF	25 sec
ON	ON	ON	30 sec

SW2 ACC OFF time setting			
3	2	1	Delay time
OFF	OFF	OFF	1 min
OFF	OFF	ON	3 min
OFF	ON	OFF	5 min
OFF	ON	ON	10 min
ON	OFF	OFF	30 min
ON	OFF	ON	60 min
ON	ON	OFF	120 min
ON	ON	ON	0 min

SW2 MCU Ctrl mode select	
ON	MCU Ctrl (Car mode ON)
OFF	Non MCU Ctrl (Car mode OFF)

SW1 ACC OFF mode select (AT/ATX)	
ON	AT (Cut power source directly)
OFF	ATX (Normal power off)

2.4 List of Connectors

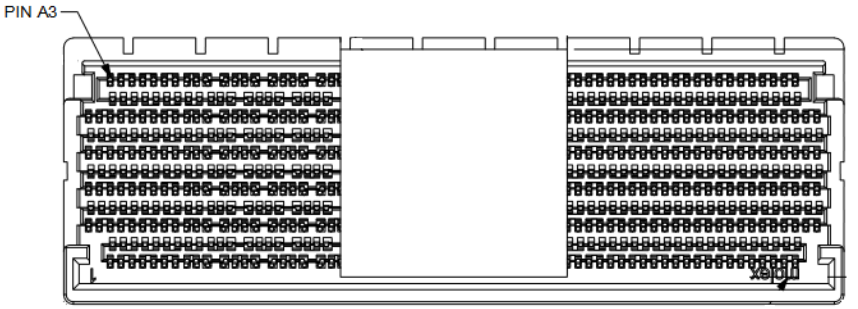
The board has a number of connectors that allow you to configure your system to suit your application.

The table below shows the function of each of the board's connectors

Label	Function
CN1	NVIDIA Jetson AGX Orin Module Connector
CN2	RTC Battery Connector
CN4	HDMI Port
CN5	GbE LAN + Dual USB 3.2 Ports
CN6	10G LAN Port
CN7	PCIe [x8] Slot
CN10	Audio Header
CN11	Dual USB 3.2 Ports
CN12/CN13	USB 2.0 Wafer Box
CN14	Micro SD Card Slot
CN15	Micro USB Connector
CN16	COM Connector RS-232/485
CN17	COM Wafer Box RS-232/485
SW1	COM Connector Mode Selection
SW2	COM Wafer Box Mode Selection
CN18	UART Debug Wafer Box
CN20/CN21	SATA 1/2
CN22/CN23	5V SATA Power Connector 1/2
CN24	CANBus FD Isolated Connector
CN25	8-bit DIO Connector
CN26	GPS & IMU Sensor Board
CN29	Reserve Connector

Label	Function
CN31	M.2 3052 B-Key Slot
CN32/CN38	SIM Slot
CN33	M.2 2230 E-Key Slot
CN34	M.2 2280 M-Key Slot
CN35	Phoenix Connector
SW3	Power Button
SW4	Recovery Button
SW5	Reset Button
J1~J8	GMSL2 Camera FAKRA Connector
CN39	NCSI Header for OOB Module

2.4.1 NVIDIA Jetson AGX Orin Module Connector (CN1)



	A	B	C	D	E	F
01			SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV
02			SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV
03	PRSNT0/GND_LOOP_0	SYS_VIN_HV	GND	SYS_VIN_HV	GND	SYS_VIN_HV
04	SDCARD_D2	GND	RGMII_RD0	GND	I2S2_FS	GND
05	SDCARD_CMD	RGMII_TXC	RGMII_RXC	RGMII_RX_CTL	RGMII_RD3	I2S2_DOUT
06	UFS0_REF_CLK	SDCARD_CLK	UFS0_RST_N	SDCARD_D3	RGMII_SMA_MDC	I2S2_DIN
07	GPIO29	GND	I2S1_SDOUT	GND	RGMII_SMA_MDIO	GND
08	PEX_WAKE_N	GPIO11	PEX_C5_CLKREQ_N	I2S1_FS	SDCARD_D0	SDCARD_D1
09	GND	PEX_C1_RST_N	GND	PEX_C1_CLKREQ_N	GND	GPIO16
10	USB2_P	RSVD	USB1_N	PEX_C0_RST_N	GPIO12	GPIO15
11	USB2_N	GND	USB1_P	GND	PEX_C0_CLKREQ_N	GND
12	GND	UPHY_RX10_P	GND	UPHY_RX11_P	GND	USB0_P
13	GND	UPHY_RX10_N	GND	UPHY_RX11_N	GND	USB0_N
14	UPHY_RX8_N	GND	UPHY_RX9_N	GND	PEX_CLK0_N	GND
15	UPHY_RX8_P	GND	UPHY_RX9_P	GND	PEX_CLK0_P	GND
16	GND	UPHY_RX6_P	GND	UPHY_RX7_P	GND	PEX_CLK1_P
17	GND	UPHY_RX6_N	GND	UPHY_RX7_N	GND	PEX_CLK1_N
18	UPHY_RX4_P	GND	UPHY_RX5_N	GND	PEX_CLK2_N	GND
19	UPHY_RX4_N	GND	UPHY_RX5_P	GND	PEX_CLK2_P	GND
20	GND	UPHY_RX2_N	GND	UPHY_RX3_P	GND	PEX_CLK3_P
21	GND	UPHY_RX2_P	GND	UPHY_RX3_N	GND	PEX_CLK3_N
22	UPHY_RX0_P	GND	UPHY_RX1_N	GND	PEX_CLK4_N	GND
23	UPHY_RX0_N	GND	UPHY_RX1_P	GND	PEX_CLK4_P	GND
24	GND	UPHY_RX13_N	GND	UPHY_RX12_P	GND	PEX_CLK5_P
25	GND	UPHY_RX13_P	GND	UPHY_RX12_N	GND	PEX_CLK5_N
26	UPHY_RX15_P	GND	UPHY_RX14_N	GND	UPHY_REFCLK1_N	GND
27	UPHY_RX15_N	GND	UPHY_RX14_P	GND	UPHY_REFCLK1_P	GND
28	GND	UPHY_RX17_N	GND	UPHY_RX16_P	GND	UPHY_REFCLK2_P
29	GND	UPHY_RX17_P	GND	UPHY_RX16_N	GND	UPHY_REFCLK2_N
30	UPHY_RX19_P	GND	UPHY_RX18_N	GND	UPHY_REFCLK0_P	GND
31	UPHY_RX19_N	GND	UPHY_RX18_P	GND	UPHY_REFCLK0_N	GND
32	GND	UPHY_RX21_N	GND	UPHY_RX22_N	GND	UPHY_REFCLK3_P
33	GND	UPHY_RX21_P	GND	UPHY_RX22_P	GND	UPHY_REFCLK3_N
34	UPHY_RX23_P	GND	UPHY_RX20_P	GND	RSVD	GND
35	UPHY_RX23_N	GND	UPHY_RX20_N	GND	RSVD	GND
36	GND	PEX_C7_RST_N	GND	RSVD	GND	RSVD
37	GND	PEX_C7_CLKREQ_N	GND	PMIC_BBATT	GND	RSVD
38	PEX_C8_CLKREQ_N	GND	UPHY_REFCLK4_N	GND	CSI0_D1_N	GND
39	PEX_C8_RST_N	GND	UPHY_REFCLK4_P	GND	CSI0_D1_P	GND

40	GND	RSVD	GND	RSVD	GND	RSVD
41	CSI2_D0_P	GND	CSI2_D1_N	GND	CSI0_D0_N	GND
42	CSI2_D0_N	CSI2_CLK_N	CSI2_D1_P	CSI5_D0_P	CSI0_D0_P	CSI0_CLK_N
43	GND	CSI2_CLK_P	GND	CSI5_D0_N	GND	CSI0_CLK_P
44	CSI7_D0_P	GND	CSI5_CLK_P	GND	CSI3_D0_N	GND
45	CSI7_D0_N	CSI7_CLK_P	CSI5_CLK_N	CSI5_D1_N	CSI3_D0_P	CSI3_CLK_N
46	GND	CSI7_CLK_N	GND	CSI5_D1_P	GND	CSI3_CLK_P
47	GPIO38	GND	CSI7_D1_P	GND	CSI4_D1_P	GND
48	GPIO37	RSVD	CSI7_D1_N	PEX_CLK6_N	CSI4_D1_N	CSI4_CLK_P
49	GND	RSVD	GND	PEX_CLK6_P	GND	CSI4_CLK_N
50	HDMI_DP2_TX2_N	GND	HDMI_DP2_TX3_N	GND	RSVD	GND
51	HDMI_DP2_TX2_P	HDMI_DP2_TX1_P	HDMI_DP2_TX3_P	HDMI_DP2_TX0_P	RSVD	DP0_AUX_CH_N
52	GND	HDMI_DP2_TX1_N	GND	HDMI_DP2_TX0_N	GND	DP0_AUX_CH_P

53	I2C5_CLK	GND	I2C5_DAT	GND	I2C3_DAT	I2C3_CLK
54	GPIO17	WDT_RESET_OUT_N	GPIO33	GPIO03	FAN_TACH	GPIO22
55	GPIO34	GPIO30	GPIO18	SPI1_MOSI	SPI1_CS0_N	SPI3_CLK
56	SPI1_MISO	SPI1_CS1_N	UART2_RX	SPI3_MISO	SPI3_CS1_N	GPIO36
57	UART2_CTS	GND	SPI3_CS0_N	GND	GND	GND
58	GPIO20	GPIO21	UART2_TX	JTAG_TDO	JTAG_TMS	CAN0_DIN
59	GPIO05	GPIO04	I2S3_SCLK	CAN0_DOUT	GPIO06	GPIO07
60	JTAG_TCK	JTAG_TDI	I2S3_FS	SPI2_CS0_N	I2C4_DAT	SPI2_MOSI
61	SYSTEM_OC_N	CAN1_DIN	GPIO09	I2C4_CLK	SPI2_CLK	VCOMP_ALERT_N
62	GPIO10	GPIO08	GND	SPI2_MISO	GND	GND
63	GND	SYS_VIN_HV	SYS_VIN_HV	GND	SYS_VIN_HV	SYS_VIN_HV
64			SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV
65			SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV

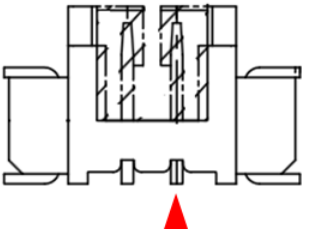
	G	H	J	K	L
01	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV		
02	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV		
03	GND	SYS_VIN_HV	GND	SYS_VIN_HV	GND
04	I2S2_CLK	GND	GPIO01	GND	UART4_RTS
05	RGMII_TD1	ENET_RST_N	ENET_INT	I2C1_CLK	UART4_TX
06	RGMII_TD3	RGMII_RD2	RGMII_TD0	RGMII_RD1	GPIO02
07	GPIO13	GND	RGMII_TD2	RGMII_TX_CTL	GND
08	PEX_C4_CLKREQ_N	I2S1_SDIN	GND	GND	I2C1_DAT
09	GND	MCLK01	PEX_C4_RST_N	PEX_C3_RST_N	GPIO28
10	USB3_N	PEX_C5_RST_N	PEX_C3_CLKREQ_N	PEX_C2_RST_N	FORCE_RECOVERY_N
11	USB3_P	GND	PEX_C2_CLKREQ_N	GND	SLEEP_REQ_N
12	GND	UPHY_TX11_P	GND	UPHY_TX10_N	GND
13	GND	UPHY_TX11_N	GND	UPHY_TX10_P	GND
14	UPHY_TX9_N	GND	UPHY_TX8_P	GND	I2S1_CLK
15	UPHY_TX9_P	GND	UPHY_TX8_N	GND	GPIO14
16	GND	UPHY_TX7_P	GND	UPHY_TX6_N	GND
17	GND	UPHY_TX7_N	GND	UPHY_TX6_P	GND
18	UPHY_TX5_N	GND	UPHY_TX4_P	GND	PEX_C6_RST_N
19	UPHY_TX5_P	GND	UPHY_TX4_N	GND	PEX_C6_CLKREQ_N
20	GND	UPHY_TX3_P	GND	UPHY_TX2_N	GND
21	GND	UPHY_TX3_N	GND	UPHY_TX2_P	GND
22	UPHY_TX1_N	GND	UPHY_TX0_P	GND	SYS_VIN_MV
23	UPHY_TX1_P	GND	UPHY_TX0_N	GND	SYS_VIN_MV
24	GND	UPHY_TX12_P	GND	UPHY_TX13_N	GND
25	GND	UPHY_TX12_N	GND	UPHY_TX13_P	GND

26	UPHY_TX14_N	GND	UPHY_TX15_P	GND	SYS_VIN_MV
27	UPHY_TX14_P	GND	UPHY_TX15_N	GND	SYS_VIN_MV
28	GND	UPHY_TX16_P	GND	UPHY_TX17_N	GND
29	GND	UPHY_TX16_N	GND	UPHY_TX17_P	GND
30	UPHY_TX18_N	GND	UPHY_TX19_P	GND	SYS_VIN_MV

31	UPHY_TX18_P	GND	UPHY_TX19_N	GND	SYS_VIN_MV
32	GND	UPHY_TX23_P	GND	UPHY_TX20_P	GND
33	GND	UPHY_TX23_N	GND	UPHY_TX20_N	GND
34	UPHY_TX21_N	GND	UPHY_TX22_N	GND	SYS_VIN_MV
35	UPHY_TX21_P	GND	UPHY_TX22_P	GND	SYS_VIN_MV
36	GND	RSVD	GND	RSVD	GND
37	GND	RSVD	GND	RSVD	GND
38	RSVD	GND	RSVD	GND	SYS_VIN_MV
39	RSVD	GND	RSVD	GND	SYS_VIN_MV
40	GND	MID1	GND	MID0	GND
41	CSI1_D0_P	GND	CSI1_D1_P	GND	RSVD
42	CSI1_D0_N	CSI1_CLK_N	CSI1_D1_N	GND	RSVD
43	GND	CSI1_CLK_P	GND	CSI6_D0_N	GND
44	CSI3_D1_P	GND	CSI6_CLK_P	CSI6_D0_P	RSVD
45	CSI3_D1_N	CSI6_D1_N	CSI6_CLK_N	GND	RSVD
46	GND	CSI6_D1_P	GND	RSVD	GND
47	CSI4_D0_N	GND	RSVD	RSVD	RSVD
48	CSI4_D0_P	RSVD	RSVD	GND	UART4_RX
49	GND	RSVD	GND	GPIO25	UART4_CTS
50	RSVD	GND	HDMI_CEC	DP2_HPD	GPIO35
51	RSVD	GPIO26	GPIO24	DP1_HPD	UART1_RTS
52	GND	GPIO27	DP1_AUX_CH_P	DP0_HPD	MODULE_SHDN_N
53	DP2_AUX_CH_P	MCLK03	DP1_AUX_CH_N	UART1_TX	RSVD
54	DP2_AUX_CH_N	UART1_CTS	MCLK02	UART1_RX	MODULE_POWER_ON
55	GPIO23	MCLK04	GPIO32	GND	VDDIN_PWR_BAD_N
56	SPI3_MOSI	GND	GND	GPIO19	THERM_ALERT_N
57	GND	UART5_CTS	SPI1_CLK	PWM01	MCLK05

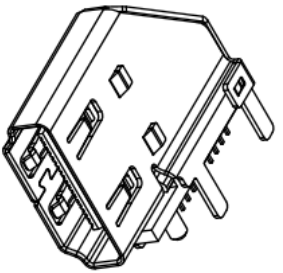
58	UART2_RTS	UART5_RX	UART5_TX	UART5_RTS	PERIPHERAL_RESET_N
59	RSVD	NVJTAG_SEL	I2S3_DIN	I2S3_DOUT	RSVD
60	NVDBG_SEL	GPIO31	MODULE_SLEEP_N	UART3_RX_DEBUG	SYS_RESET_N
61	JTAG_TRST_N	CAN1_DOUT	I2C2_CLK	I2C2_DAT	POWER_BTN_N
62	GND	UART3_TX_DEBUG	RSVD	FAN_PWM	CARRIER_POWER_ON
63	SYS_VIN_HV	GND	SYS_VIN_HV	GND	PRSNT1/GND_LOOP_1
64	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV		
65	SYS_VIN_HV	SYS_VIN_HV	SYS_VIN_HV		

2.4.2 RTC Battery Connector (CN2)



Pin	Pin Name	Signal Type	Signal Level
1	+V3P3A_RTC	PWR	+3.3V
2	GND	GND	

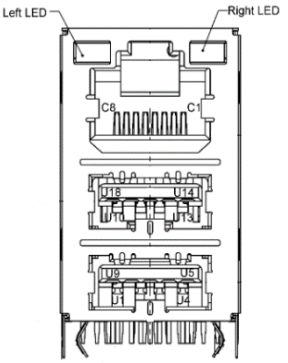
2.4.3 HDMI Port (CN4)



Pin	Pin Name	Signal Type	Signal Level
1	HDMI_TXD2_CON_P	DIFF	
2	GND	GND	
3	HDMI_TXD2_CON_N	DIFF	
4	HDMI_TXD1_CON_P	DIFF	
5	GND	GND	
6	HDMI_TXD1_CON_N	DIFF	
7	HDMI_TXD0_CON_P		
8	GND	GND	

Pin	Pin Name	Signal Type	Signal Level
9	HDMI_TXD0_CON_N		
10	HDMI_TXC_CON_P	DIFF	
11	GND	GND	
12	HDMI_TXC_CON_N	DIFF	
13	HDMI_CEC_CON		3.3V
14	NC		
15	HDMI_DDC_SCL_5V0		
16	HDMI_DDC_SDA_5V0		
17	GND	GND	
18	VDD_5V0_HDMI_CON	PWR	5V
19	HDMI_HPD_CON		5V

2.4.4 GbE LAN + Dual USB 3.2 Ports (CN5)

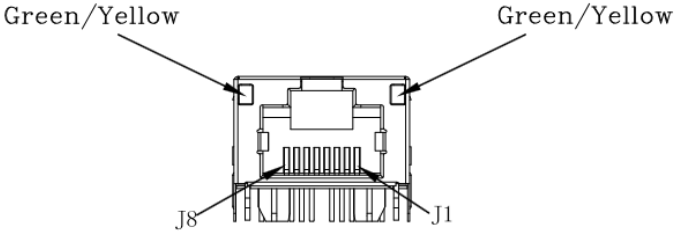


Pin	Pin Name	Signal Type	Signal Level
C1	LAN1_MDI0+	DIFF	
C2	LAN1_MDI0-	DIFF	
C3	LAN1_MDI1+	DIFF	
C4	LAN1_MDI1-	DIFF	

Pin	Pin Name	Signal Type	Signal Level
C5	LAN1_MDI2+	DIFF	
C6	LAN1_MDI2-	DIFF	
C7	LAN1_MDI3+	DIFF	
C8	LAN1_MDI3-	DIFF	
U1	VCC_USB3	PWR	+5V
U2	USB3-	DIFF	
U3	USB3+	DIFF	
U4	GND	GND	
U5	USB3_RX3_N_C	DIFF	
U6	USB3_RX3_P_C	DIFF	
U7	GND	GND	
U8	USB3_TX3_N_C	DIFF	
U9	USB3_TX3_P_C	DIFF	
U10	VCC_USB4	PWR	+5V
U11	USB4-	DIFF	
U12	USB4+	DIFF	
U13	GND	GND	
U14	USB3_RX4_N_C	DIFF	
U15	USB3_RX4_P_C	DIFF	
U16	GND	GND	
U17	USB3_TX4_N_C	DIFF	
U18	USB3_TX4_P_C	DIFF	

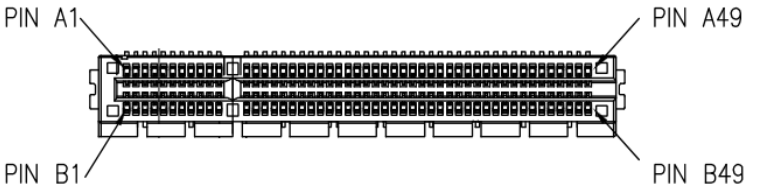
	Link/Speed		Active
LAN speed	Green	Orange	Yellow
10M			Blinking
100M	Solid		Blinking
1G		Solid	Blinking

2.4.5 10G LAN Port (CN6)



Pin	Pin Name	Signal Type	Signal Level
J1	MGBE1_PHY_A_N_CN	DIFF	
J2	MGBE1_PHY_A_P_CN	DIFF	
J3	MGBE1_PHY_B_P_CN	DIFF	
J4	MGBE1_PHY_B_N_CN	DIFF	
J5	MGBE1_PHY_C_P_CN	DIFF	
J6	MGBE1_PHY_C_N_CN	DIFF	
J7	MGBE1_PHY_D_N_CN	DIFF	
J8	MGBE1_PHY_D_P_CN	DIFF	

2.4.6 PCIe [x8] Slot (CN7)

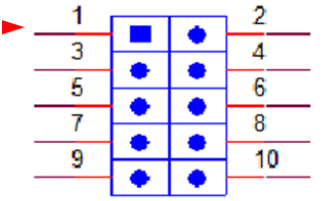


Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
A1	GND	GND		B1	+12V	PWR	+12V
A2	+12V	PWR	+12V	B2	+12V	PWR	+12V
A3	+12V	PWR	+12V	B3	+12V	PWR	+12V
A4	GND	GND		B4	GND	GND	
A5	NC			B5	I2C_GP3_CLK_PEX_3V3	IN	+3.3V
A6	NC			B6	I2C_GP3_DAT_PEX_3V3	IN/OUT	+3.3V
A7	NC			B7	GND	GND	
A8	NC			B8	VDD_3V3	PWR	+3.3V
A9	VDD_3V3	PWR	+3.3V	B9	GND	GND	
A10	VDD_3V3	PWR	+3.3V	B10	3V3_AO	PWR	+3.3V
A11	PCIE5_RST_N_CON	IN	+3.3V	B11	PEX_WAKE_N_CON	OUT	+3.3V
A12	GND	GND		B12	PEX_L5_CLKREQ_N_CON	OUT	+3.3V
A13	PEX_REFCLK_P	IN	DIFF	B13	GND	GND	
A14	PEX_REFCLK_N	IN	DIFF	B14	UPHY1_TX0_P_C	IN	DIFF
A15	GND	GND		B15	UPHY1_TX0_N_C	IN	DIFF
A16	UPHY1_RX0_P	OUT	DIFF	B16	GND	GND	
A17	UPHY1_RX0_N	OUT	DIFF	B17	PCIE_PRSNT_CON_L	IN	+3.3V
A18	GND	GND		B18	GND	GND	
A19	NC			B19	UPHY1_TX1_P_C	IN	DIFF

Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
A20	GND	GND		B20	UPHY1_TX1_N_C	IN	DIFF
A21	UPHY1_RX1_P	OUT	DIFF	B21	GND	GND	
A22	UPHY1_RX1_N	OUT	DIFF	B22	GND	GND	
A23	GND	GND		B23	UPHY1_TX2_P_C	IN	DIFF
A24	GND	GND		B24	UPHY1_TX2_N_C	IN	DIFF
A25	UPHY1_RX2_P	OUT	DIFF	B25	GND	GND	
A26	UPHY1_RX2_N	OUT	DIFF	B26	GND	GND	
A27	GND	GND		B27	UPHY1_TX3_P_C	IN	DIFF
A28	GND	GND		B28	UPHY1_TX3_N_C	IN	DIFF
A29	UPHY1_RX3_P	OUT	DIFF	B29	GND	GND	
A30	UPHY1_RX3_N	OUT	DIFF	B30	NC		
A31	GND	GND		B31	PCIE_PRSNT_CON_L	IN	+3.3V
A32	IO_PWR_EN	IN	+3.3V	B32	GND	GND	
A33	NC			B33	UPHY1_TX4_P_C	IN	DIFF
A34	GND	GND		B34	UPHY1_TX4_N_C	IN	DIFF
A35	UPHY1_RX4_P	OUT	DIFF	B35	GND	GND	
A36	UPHY1_RX4_N	OUT	DIFF	B36	GND	GND	
A37	GND	GND		B37	UPHY1_TX5_P_C	IN	DIFF
A38	GND	GND		B38	UPHY1_TX5_N_C	IN	DIFF
A39	UPHY1_RX5_P	OUT	DIFF	B39	GND	GND	
A40	UPHY1_RX5_N	OUT	DIFF	B40	GND	GND	
A41	GND	GND		B41	UPHY1_TX6_P_C	IN	DIFF
A42	GND	GND		B42	UPHY1_TX6_N_C	IN	DIFF
A43	UPHY1_RX6_P	OUT	DIFF	B43	GND	GND	
A44	UPHY1_RX6_M	OUT	DIFF	B44	GND	GND	
A45	GND			B45	UPHY1_TX7_P_C	IN	DIFF
A46	GND			B46	UPHY1_TX7_N_C	IN	DIFF
A47	UPHY1_RX7_P	OUT	DIFF	B47	GND	GND	

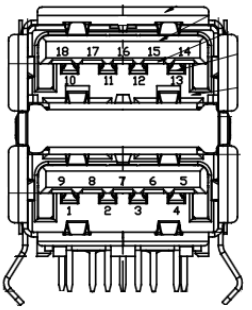
Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
A48	UPHY1_RX7_N	OUT	DIFF	B48	PCIE_PRSNT_CON_L	IN	+3.3V
A49	GND			B49	GND	GND	

2.4.7 Audio Header (CN10)



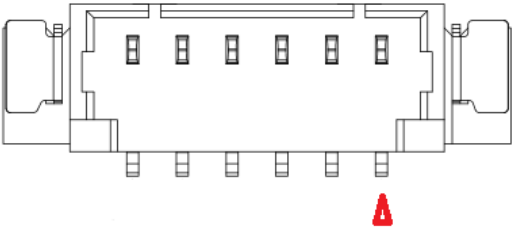
Pin	Pin Name	Signal Type	Signal level	Pin	Pin Name	Signal Type	Signal level
1	IN1P	IN		2	GND	GND	
3	IN2P	IN		4	AUD_GPIO4	IN/OUT	
5	AUD_HPOR	OUT		6	AUD_MIC_JD	IN	
7	SENSE_SEND	GND		8	NC		
9	AUD_HPOL	OUT		10	AUD_HP_JD	IN	

2.4.8 Dual USB 3.2 Ports (CN11)



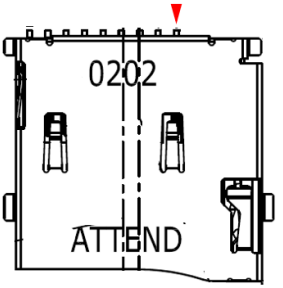
Pin	Pin Name	Signal Type	Signal Level
1	VCC_USB1	PWR	+5V
2	USB1-	DIFF	
3	USB1+	DIFF	
4	GND	GND	
5	USB3_RX1_N_C	DIFF	
6	USB3_RX1_P_C	DIFF	
7	GND	GND	
8	USB3_TX1_N_C	DIFF	
9	USB3_TX1_P_C	DIFF	
10	VCC_USB2	PWR	+5V
11	USB2-	DIFF	
12	USB2+	DIFF	
13	GND	GND	
14	USB3_RX2_N_C	DIFF	
15	USB3_RX2_P_C	DIFF	
16	GND	GND	
17	USB3_TX2_N_C	DIFF	
18	USB3_TX2_P_C	DIFF	

2.4.9 USB 2.0 Wafer Box (CN12/CN13)



Pin	Pin Name	Signal Type	Signal Level
1	+5V	GND	+5V
2	USBD-	DIFF	
3	USBD+	DIFF	
4	GND	GND	
5	GND	GND	

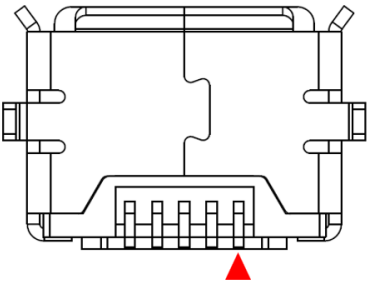
2.4.10 Micro SD Card Slot (CN14)



Pin	Pin Name	Signal Type	Signal Level
1	SDMMC1_D2		+1.8V
2	SDMMC1_D3		+1.8V
3	SDMMC1_CMD	IN	+1.8V

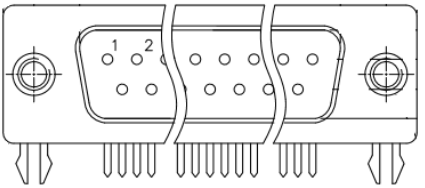
Pin	Pin Name	Signal Type	Signal Level
4	VDD_3V3_SD	PWR	+3.3V
5	SDMMC1_CLK	IN	
6	GND	GND	
7	SDMMC1_D0		+1.8V
8	SDMMC1_D1		+1.8V
9	GPIO2_SD_DET	OUT	+1.8V
10	GND	GND	

2.4.11 Micro USB Connector (CN15)



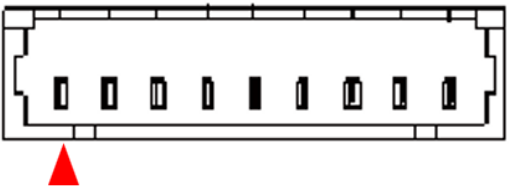
Pin	Pin Name	Signal Type	Signal Level
1	VDD_VBUS_CONN_L	PWR	+5V
2	USB0_D_N	DIFF	
3	USB0_D_P	DIFF	
4	NC		
5	GND	GND	

2.4.12 COM Connector RS-232/485 (CN16)



Pin	RS-232	Signal Type	RS-485
1		IN	RS485_D-
2	RX	IN	RS485_D+
3	TX	OUT	
4			
5	GND	GND	GND
6			
7	RTS	OUT	
8	CTS	IN	
9			

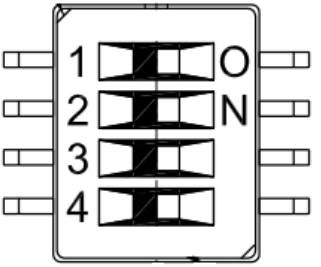
2.4.13 COM Wafer Box RS-232/485 (CN17)



Pin	RS-232	Signal Type	RS-485
1		IN	RS485_D-
2			
3	RX	IN	RS485_D+

Pin	RS-232	Signal Type	RS-485
4	RTS	OUT	
5	TX	OUT	
6	CTS	IN	
7			
8			
9	GND	GND	GND

2.4.14 COM Connector Mode Selection (SW1)

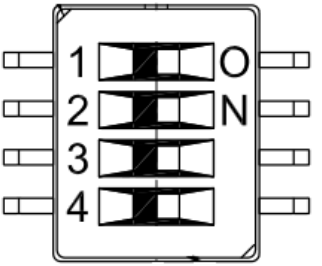


Pin	Pin Name	Signal Type	Signal Level
1	UART1_SD	IN	+3.3V
2	UART1_MODE_1	IN	+3.3V
3	UART1_MODE_2	IN	+3.3V
4	UART1_SLEW	IN	+3.3V
ON	GND	GND	

Maximum Slew Rate Control		
SLEW	RS-232	RS-485
0	1Mbps	10Mbps
1	250Kbps	250Kbps

Serial Port Mode Selection			
SD	MODE_1	MODE_2	MODE
0	0	1	RS-232
0	1	0	RS-485 (Driver Half Duplex)
0	1	1	RS-485 (Receiver Half Duplex)
1	X	X	Shutdown Mode

2.4.15 COM Wafer Box Mode Selection (SW2)

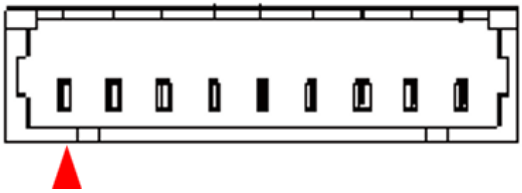


Pin	Pin Name	Signal Type	Signal Level
1	UART4_SD	IN	+3.3V
2	UART4_MODE_1	IN	+3.3V
3	UART4_MODE_2	IN	+3.3V
4	UART4_SLEW	IN	+3.3V
ON	GND	GND	

Maximum Slew Rate Control		
SLEW	RS-232	RS-485
0	1Mbps	10Mbps
1	250Kbps	250Kbps

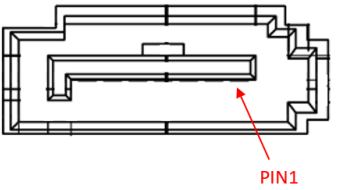
Serial Port Mode Selection			
SD	MODE_1	MODE_2	MODE
0	0	1	RS-232
0	1	0	RS-485 (Driver Half Duplex)
0	1	1	RS-485 (Receiver Half Duplex)
1	X	X	Shutdown Mode

2.4.16 UART Debug Wafer Box (CN18)



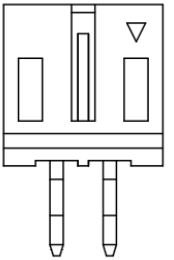
Pin	Pin Name	Signal Type	Signal Level
1	UART3_TXD_HDR	OUT	+3.3V
2	UART3_RXD_HDR	IN	+3.3V
3	RXC_3	IN	+3.3V
4	NC		
5	TXC_3	OUT	+3.3V
6	NC		
7	I2C_GP2_CLK_3V3	OUT	+3.3V
8	I2C_GP2_DAT_3V3	IN/OUT	+3.3V
9	GND	GND	

2.4.17 SATA 1/2 (CN20/CN21)



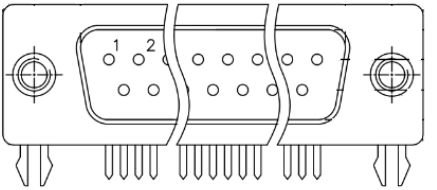
Pin	Pin Name	Signal Type	Signal Level
1	GND	GND	
2	SATA_TXP	DIFF	
3	SATA_TXN	DIFF	
4	GND	GND	
5	SATA_RXN	DIFF	
6	SATA_RXP	DIFF	
7	GND	GND	

2.4.18 5V SATA Power Connector 1/2 (CN22/CN23)



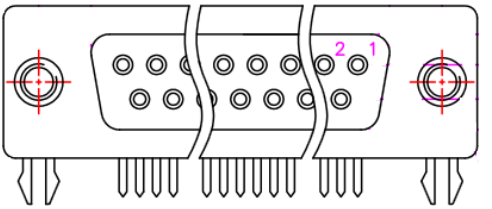
Pin	Pin Name	Signal Type	Signal Level
1	+V5_SATA	PWR	+5V
2	GND	GND	

2.4.19 CANBus FD Isolated Connector (CN24)



Pin	Pin Name	Signal Type	Signal Level
1			
2	CAN1L	DIFF	
3	GND	GND	GND
4	CAN2L	DIFF	
5	GND	GND	GND
6			
7	CAN1H	DIFF	
8	CAN2H	DIFF	
9	5VCC_CAN	PWR	+5V

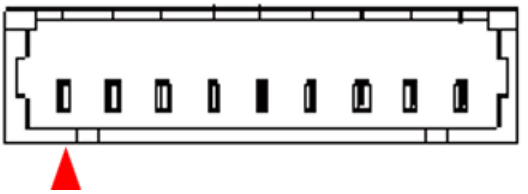
2.4.20 8-bit DIO Connector (CN25)



Pin	Pin Name	Signal Type	Signal Level
1	GPIO14_CAM_ERROR1_3V3	I/O	+3.3V
2	GPIO16_CAM1_RST_3V3	I/O	+3.3V
3	GPIO17_40PIN_3V3	I/O	+3.3V

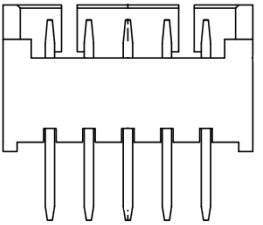
Pin	Pin Name	Signal Type	Signal Level
4	GPIO19_XFI1_MDC_3V3	I/O	+3.3V
5	GND	GND	GND
6	GPIO08_40PIN_3V3	I/O	+3.3V
7	PWM1_40PIN_3V3	I/O	+3.3V
8	GPIO06_CAM_FR3_3V3	I/O	+3.3V
9	GPIO35_PWM3_40PIN_3V3	I/O	+3.3V

2.4.21 GPS & IMU Sensor Board (CN26)



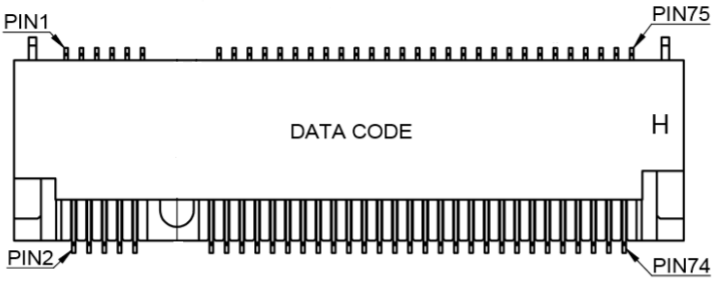
Pin	Pin Name	Signal Type	Signal Level
1	VDD_3V3	PWR	+3.3V
2	VDD_3V3	PWR	+3.3V
3	I2C_GP3_CLK_PEX_3V3	IN	+3.3V
4	I2C_GP3_DAT_PEX_3V3	I/O	+3.3V
5	GPIO07_CAM_FR2_3V3	OUT	+3.3V
6	UART2_TX_3V3	IN	+3.3V
7	UART2_RX_3V3	OUT	+3.3V
8	GND	GND	GND
9	GND	GND	GND

2.4.22 Reserve Connector (CN29)



Pin	Pin Name	Signal Type	Signal Level
1	BUTTON_POWER_ON_N		
2	FORCE_RECOVERY_N		
3	SYS_RST_IN_N		
4	GND	GND	GND
5	GND	GND	GND

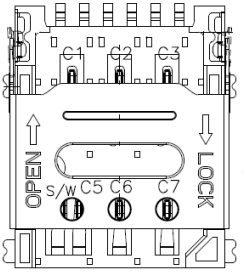
2.4.23 M.2 3052 B-Key Slot (CN31)



Pin	Pin Name	Signal Type	Signal level	Pin	Pin Name	Signal Type	Signal level
1	NC			2	VDD_3V3	PWR	+3.3V
3	GND	GND		4	VDD_3V3	PWR	+3.3V
5	GND	GND		6	FULL_CARD_POWER	OUT	+3.3V
7	USB1_DN	DIFF		8	3GPW_EN	IN	+3.3V
9	USB1_DP	DIFF		10	NC		
11	GND	GND		12			
				20	NC		
21	NC			22	NC		
23	NC			24	NC		
25	NC			26	NC		
27	GND	GND		28	NC		
29	USB31_RX0_N	DIFF		30	UIM1_RESET	OUT	
31	USB31_RX0_P	DIFF		32	UIM1_CLK	OUT	
33	GND	GND		34	UIM1_DATA	I/O	
35	USB31_TX0_N	DIFF		36	UIM_PWR1	PWR	+3.3V
37	USB31_TX0_P	DIFF		38	NC		
39	GND	GND		40	UIM2_DET	IN	
41	DPE_RXN0_R	DIFF		42	UIM2_DATA	OUT	

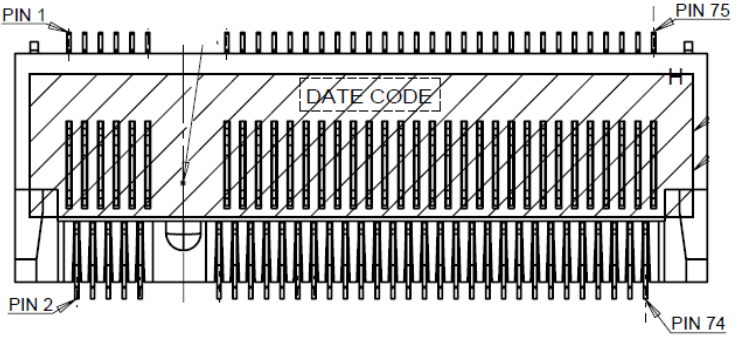
Pin	Pin Name	Signal Type	Signal level	Pin	Pin Name	Signal Type	Signal level
43	DPE_RXP0_R	DIFF		44	UIM2_CLK	OUT	
45	GND	GND		46	UIM2_RESET	OUT	
47	DPE_TXN0	DIFF		48	UIM_PWR2	PWR	+3.3V
49	DPE_TXP0	DIFF		50	DPE_RSTN_R	IN	+3.3V
51	GND	GND		52	DPE_CLKREQN0_B	OUT	+3.3V
53	DPE_CLKN0_R	DIFF		54	PEX_WAKE_N	OUT	+3.3V
55	DPE_CLKP0_R	DIFF		56	NC		
57	GND	GND		58	NC		
59	NC			60	NC		
61	NC			62	NC		
63	NC			64	NC		
65	NC			66	UIM1_DET	IN	
67	M2B_PERST#	IN	+3.3V	68	M2B_SSCLK		
69	NC			70	VDD_3V3	PWR	+3.3V
71	GND	GND		72	VDD_3V3	PWR	+3.3V
73	GND	GND		74	VDD_3V3	PWR	+3.3V
75	GND	GND					

2.4.24 SIM Slot (CN32/CN38)



Pin	Pin Name	Signal Type	Signal Level
C1	UIM_PWR	PWR	+3.3V
C2	UIM_RESET	IN	
C3	UIM_CLK	IN	
C5	GND	GND	GND
C6			
C7	UIM_DATA	I/O	
S/W	UIM_DET	OUT	

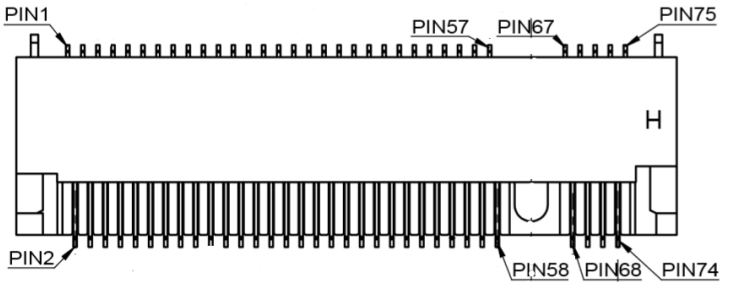
2.4.25 M.2 2230 E-Key Slot (CN33)



Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
1	GND	GND		2	VDD_3V3	PWR	+3.3V
3	USB2_HUB_DP1	DIFF		4	VDD_3V3	PWR	+3.3V
5	USB2_HUB_DN1	DIFF		6	NC		
7	GND	GND		8	I2S3_SCLK	I/O	
9	NC			10	I2S3_FS	I/O	
11	NC			12	I2S3_DIN	OUT	
13	NC			14	I2S3_DOUT	IN	
15	NC			16	NC		
17	NC			18	GND	GND	
19	NC			20	BT_WAKE_AP_M2E_CON	OUT	+3.3V
21	NC			22	UART5_RX	OUT	
23	NC			32	UART5_TX	IN	
33	GND	GND		34	UART5_CTS	OUT	
35	DPE_TXP1	DIFF		36	UART5_RTS	IN	
37	DPE_TXN1	DIFF		38	M2E_AP_WAKE_BT	IN	+3.3V
39	GND	GND		40	NC		
41	DPE_RXP1_R	DIFF		42	M2E_AP_WAKE_BT_CON	IN	+3.3V
43	DPE_RXN1_R	DIFF		44	NC		

Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
45	GND	GND		46	NC		
47	DPE_CLKP1_R	DIFF		48	NC		
49	DPE_CLKN1_R	DIFF		50	M2E_SUSCLK	IN	+3.3V
51	GND	GND		52	DPE_RSTN_R	IN	+3.3V
53	DPE_CLKREQN1_E	OUT		54	BT_RST_N_M2E_CON	IN	+3.3V
55	M2E_WIFI_WAKE	OUT		56	WIFI_RST_N_M2E_CON	IN	+3.3V
57	GND	GND		58	I2C_GP9_DAT	I/O	
59	M2E_SAR_TOUT	IN		60	I2C_GP9_CLK	IN	
61	M2E_AP_WAKE_BT	IN	+3.3V	62	M2E_ALERT_N	OUT	
63	GND	GND		64	NC		
65	NC			66	NC		
67	NC			68	NC		
69	GND	GND		70	NC		
71	NC			72	VDD_3V3	PWR	+3.3V
73	NC			74	VDD_3V3	PWR	+3.3V
75	GND	GND					

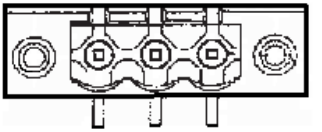
2.4.26 M.2 2280 M-Key Slot (CN34)



Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
1	GND	GND		2	VDD_3V3	PWR	+3.3V
3	GND	GND		4	VDD_3V3	PWR	+3.3V
5	UPHY0_RX4_N	DIFF		6	NN		
7	UPHY0_RX4_P	DIFF		8	NC		
9	GND	GND		10	NC		
11	UPHY0_TX4_N	DIFF		12	VDD_3V3	PWR	+3.3V
13	UPHY0_TX4_P	DIFF		14	VDD_3V3	PWR	+3.3V
15	GND	GND		16	VDD_3V3	PWR	+3.3V
17	UPHY0_RX5_N	DIFF		18	VDD_3V3	PWR	+3.3V
19	UPHY0_RX5_P	DIFF		20	NC		
21	GND	GND		22	NC		
23	UPHY0_TX5_N	DIFF		24	NC		
25	UPHY0_TX5_P	DIFF		26	NC		
27	GND	GND		28	NC		
29	UPHY_RX10_N	DIFF		30	NC		
31	UPHY_RX10_P	DIFF		32	NC		
33	GND	GND		34	NC		
35	UPHY_TX10_N	DIFF		36	NC		
37	UPHY_TX10_P	DIFF		38	NC		

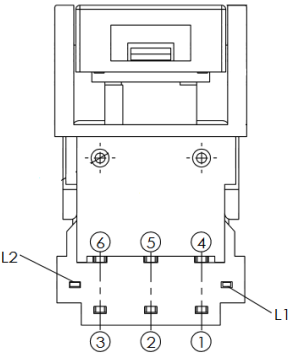
Pin	Pin Name	Signal Type	Signal Level	Pin	Pin Name	Signal Type	Signal Level
39	GND	GND		40	I2C_GP2_CLK	IN	+1.8V
41	UPHY_RX11_N	DIFF		42	I2C_GP2_DAT	I/O	+1.8V
43	UPHY_RX11_P	DIFF		44	M2M_ALERT_N	IN	
45	GND	GND		46	NC		
47	UPHY_TX11_N	DIFF		48	NC		
49	UPHY_TX11_P	DIFF		50	PCIE4_RST_N	IN	+3.3V
51	GND	PWR		52	PCIE4_CLKREQ_N	OUT	+3.3V
53	PCIE4_CLK_N	DIFF		54	PEX_WAKE_N	OUT	+3.3V
55	PCIE4_CLK_P	DIFF		56	NC		
57	GND	GND		58	NC		
67	NC			68	SUSCLK_32KHZ_NVME	IN	
69	NC			70	VDD_3V3	PWR	+3.3V
71	GND	GND		72	VDD_3V3	PWR	+3.3V
73	GND	GND		74	VDD_3V3	PWR	+3.3V
75	GND	GND					

2.4.27 Phoenix Connector (CN35)



Pin	Pin Name	Signal Type	Signal Level
1	VIN	PWR	+9V ~ +36V
2	GND	GND	
3	ACC_IN	IN	+9V ~ +36V

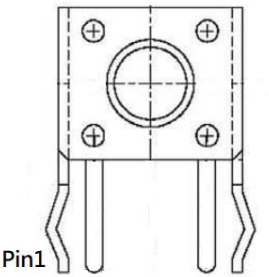
2.4.28 Power Button (SW3)



Pin	Pin Name	Signal Type	Signal Level
1	NC		
2	CVM_PRSNT	IN	+3.3V
3	BUTTON_POWER_ON_N	OUT	
4	NC		

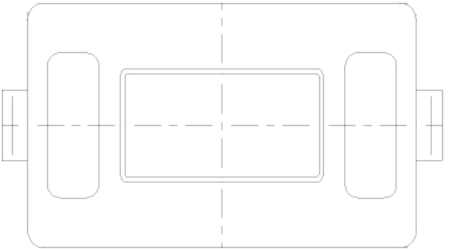
Pin	Pin Name	Signal Type	Signal Level
5	CVM_PRSNT	IN	
6	BUTTON_POWER_ON_N	OUT	
L1	VDD_5V	PWR	+5V
L2	GND	GND	

2.4.29 Recovery Button (SW4)



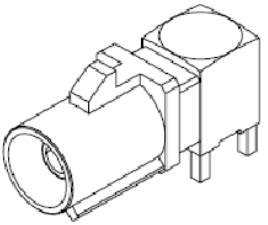
Pin	Pin Name	Signal Type	Signal Level
1	GND	GND	
2	GND	GND	
3	FORCE_RECOVERY_N	OUT	
4	GND	GND	

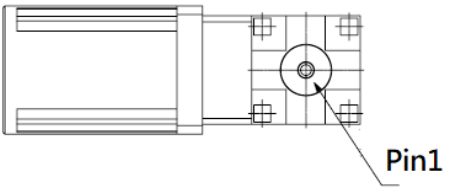
2.4.30 Reset Button (SW5)



Pin	Pin Name	Signal Type	Signal Level
1	GND	GND	
2	SYS_RST_IN_N	OUT	

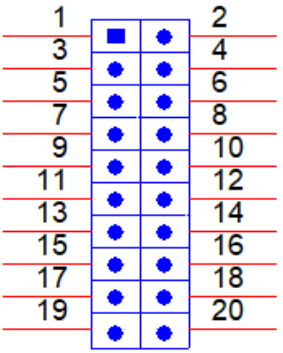
2.4.31 GMSL2 Camera FAKRA Connector (J1~J8)





Pin	Pin Name	Signal Type	Signal Level
1	CAMERA_IN+	I/O	
2	GND	GND	
3	GND	GND	
4	GND	GND	
5	GND	GND	

2.4.32 NCSI Header for OOB Module (CN39)



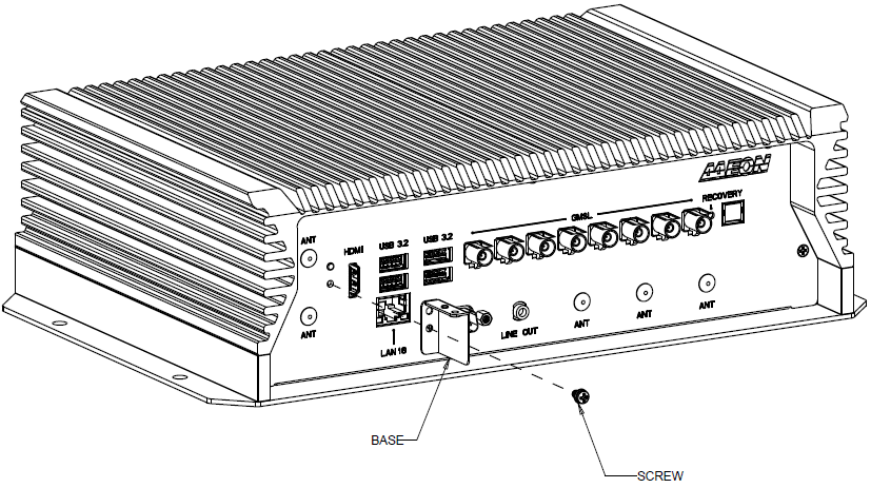
Pin	Pin Name	Signal Type	Signal Level
1	3V_AO_PGD	IN	+3.3V
2	3V_LAN1_CN	PWR	+3.3V
3	UART3_TX_HDR	IN	+3.3V
4	NC1_SI_TXD0		
5	UART3_RX_HDR	OUT	+3.3V
6	NC1_SI_TXD1		
7	OOB_I2C_SCL		
8	NC1_SI_RXD0		
9	OOB_I2C_SDA		
10	NC1_SI_RXD1		
11	SYS_RST_IN_N	OUT	+1.8V
12	OOB_SI_CLK_IN		
13	BUTTON_POWER_ON_N	OUT	
14	NC1_SI_CRB_DV		
15	GND	GND	GND

Pin	Pin Name	Signal Type	Signal Level
16	NC1_SI_TX_EN		
17	NA		
18	NA		
19	NA		
20	NA		

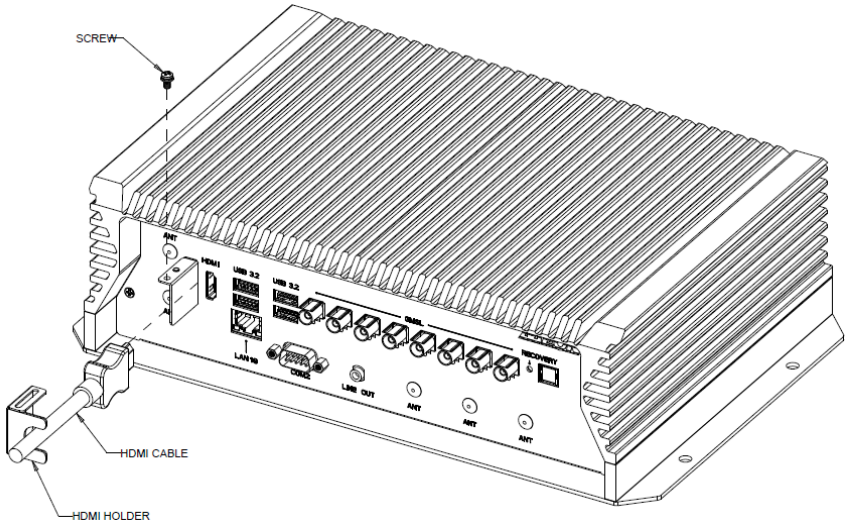
2.5 Hardware Installation

2.5.1 HDMI Cable Lock Installation

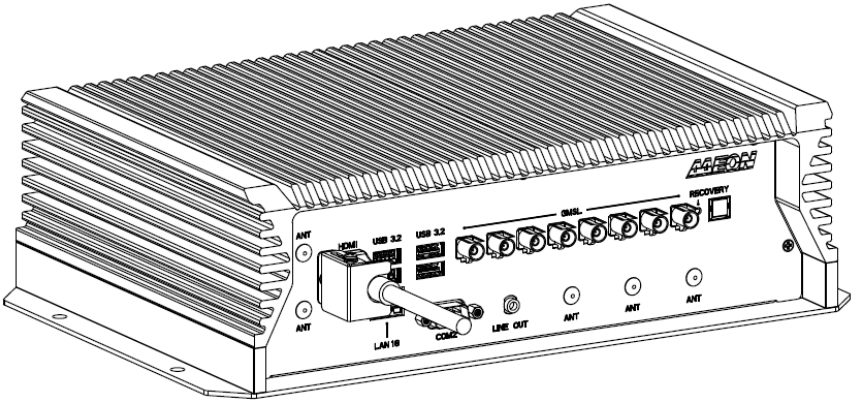
Step 1: Affix the HDMI cable lock base to the corresponding hole on the chassis with one (1) screw.



Step 2: Input the HDMI and affix the HDMI cable holder from above using one (1) screw.



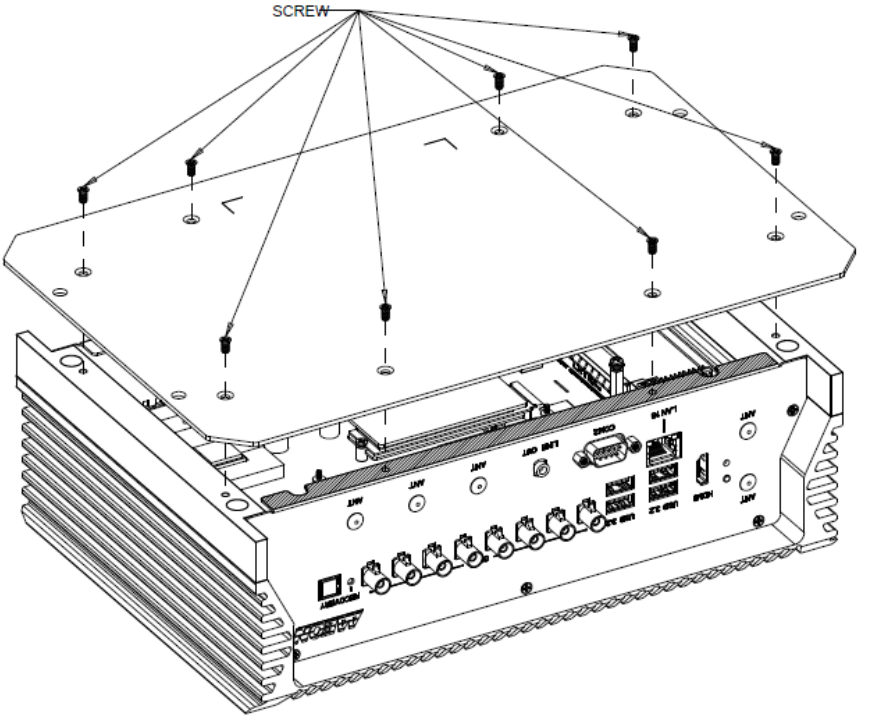
Step 3: HDMI cable lock installation is complete.



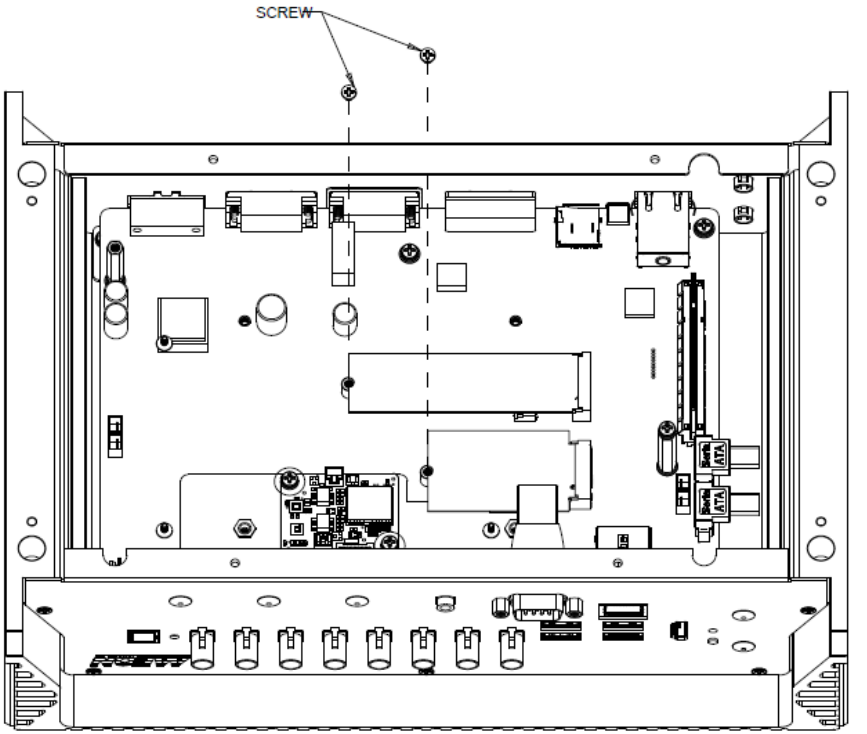
2.5.2 M.2 Expansion Card Installation

Before installing your M.2 expansion module(s), ensure the system is powered down and disconnect the power cord from the system. Make sure you have the module(s) ready to install.

Step 1: Remove the bottom cover of the chassis by removing the eight (8) screws, as shown.

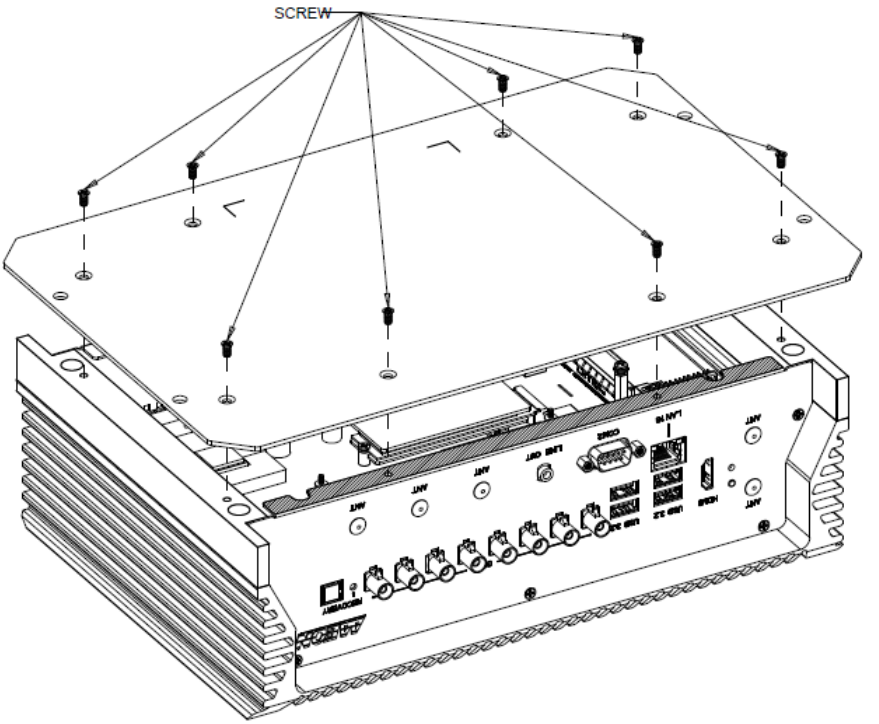


Step 2: Note the location of each M.2 Key slot. Follow standard installation procedures, inserting the module at a 45° angle, then affixing the module(s) using the screw(s) as shown.

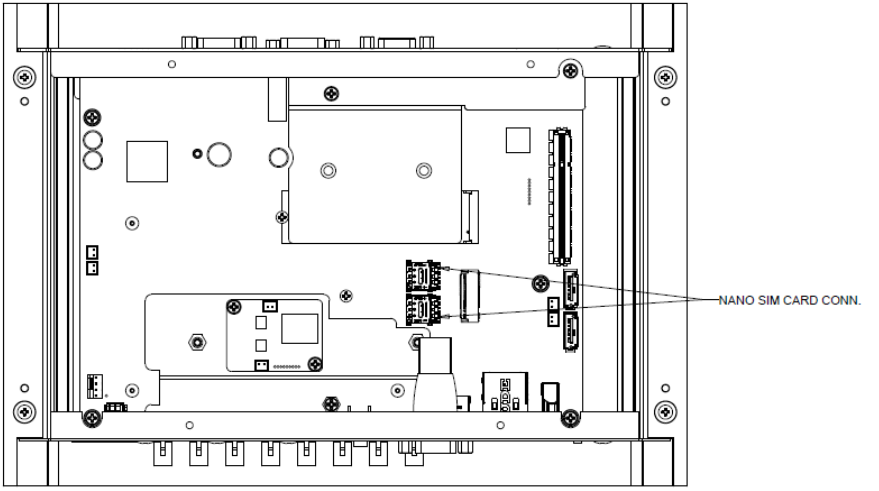


2.5.3 Nano SIM Card Installation

Step 1: Remove the bottom cover of the chassis by removing the eight (8) screws, as shown.



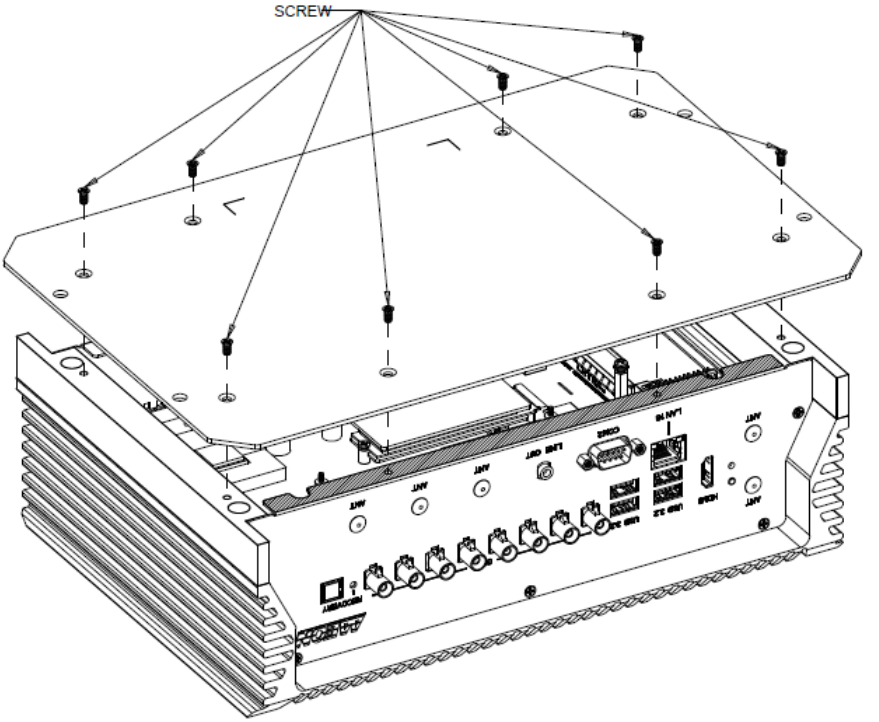
Step 2: Insert the Nano SIM card(s) into the connector slots as shown.



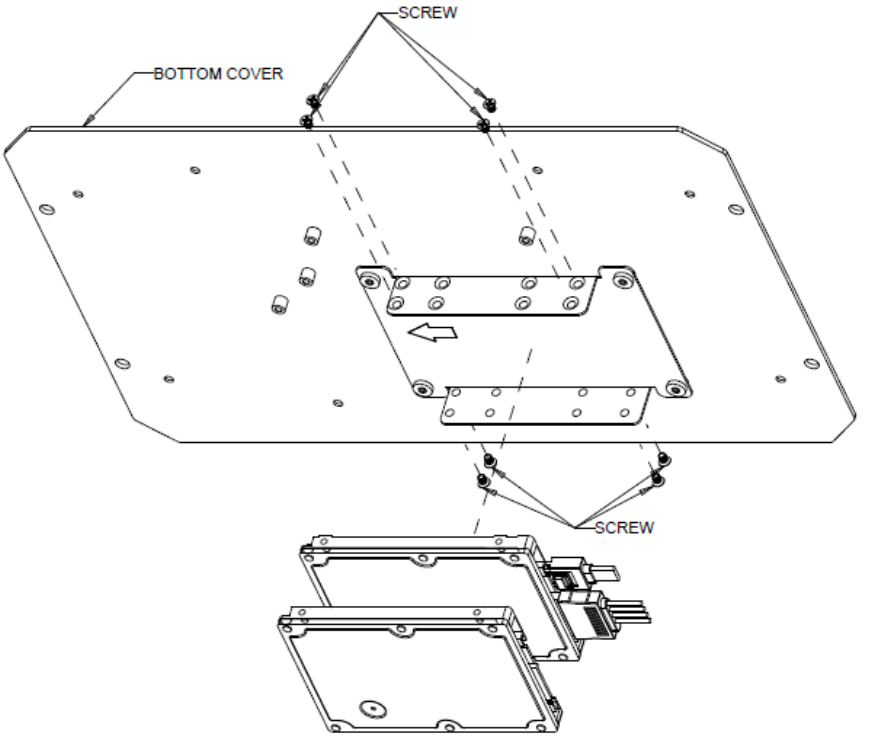
2.5.4 2.5" SATA Drive Installation

Before installing the SATA Drive, ensure the system is powered down and disconnect the power cord from the system. Make sure you have the SATA Drive ready to install.

Step 1: Remove the bottom cover of the chassis by removing the eight (8) screws, as shown.



Step 2: Attach the SATA drives to the HDD Bracket using the eight (8) screws provided. Then, affix the bracket to the bottom cover of the chassis using four (4) screws.



2.5.5 M.2 2280 M-Key Heatsink Installation

If you are populating the system's M.2 2280 M-Key slot, the installation of a heatsink is required. The installation method and heatsink part number is dependent on the PCIe SSD speed.

M.2 2280 M-Key SSD Expansion support lists

PCIe Gen 3 Heatsink support list:

Brand	AAEON P/N	Description
Phison	9C3128G006	(TF)M.2 2280 M Key PCIe Gen3 x4, 128GB NvME SSD.3D TLC W/Kioxia BiCS5.-25~85C,Gold+,Phison.ESMP128GKB 5G2-E13TI
Phison	9C3256G009	(TF)M.2 2280 M Key PCIe Gen3 x4,256GB NvME SSD.3D TLC W/Kioxia BiCS5.-25~85C,Gold+P,Phison.ESMP256 GKB5G2-E13TI
Phison	9C3512G005	(TF)M.2 2280 M Key PCIe Gen3 x4,512GB NvME SSD.3D TLC W/Kioxia BiCS5.-25~85C,Gold+P,Phison.ESMP512GK B5G2-E13TI
Phison	9C3001T004	(TF)M.2 2280 M Key PCIe Gen3 x4,1TB NvME SSD.3D TLC W/Kioxia BiCS5.-25~85C,Gold+P,Phison.ESMP001TKB5G2-E13TI

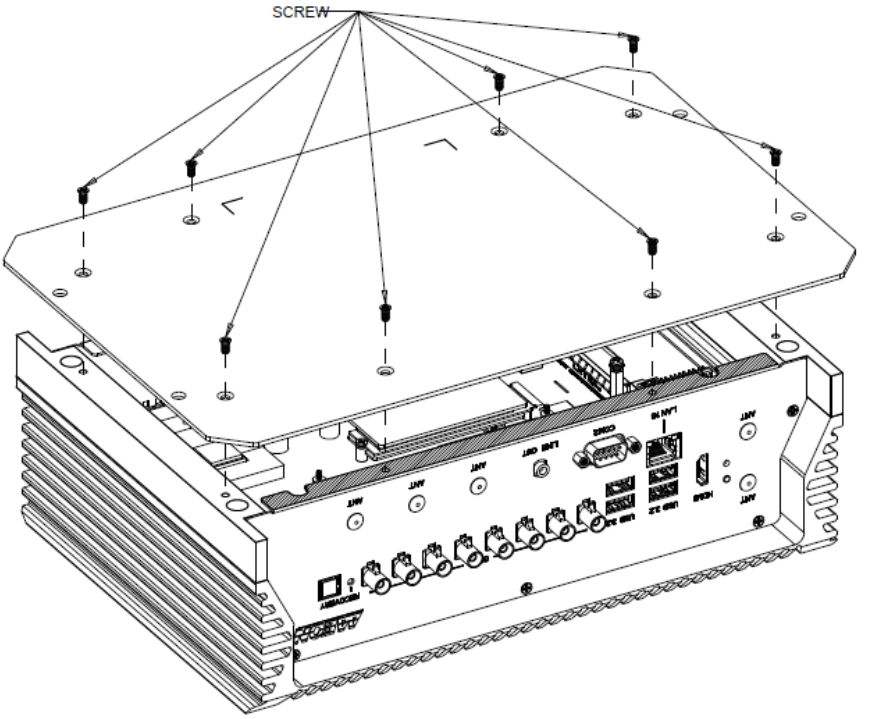
PCIe Gen 4 Heatsink support list:

Brand	AAEON P/N	Description
Transcend	9C3256G007	PCIe SSD.M.2 2280 M Key NvME,PCIe Gen4 x4.256GB,4CH.-40~85C,3D TLC W/WD BiCS5,FW:82B2W2AA.Transcend.TS256GMTE710TI-AEN
Transcend	9C3512G006	PCIe SSD.M.2 2280 M Key.512GB.PCIe Gen4 x 4,3D TLC W/WD BiCS5,-40~85C,FW:82B2W2AA.Transcend.TS512 GMTE710TI-AEN

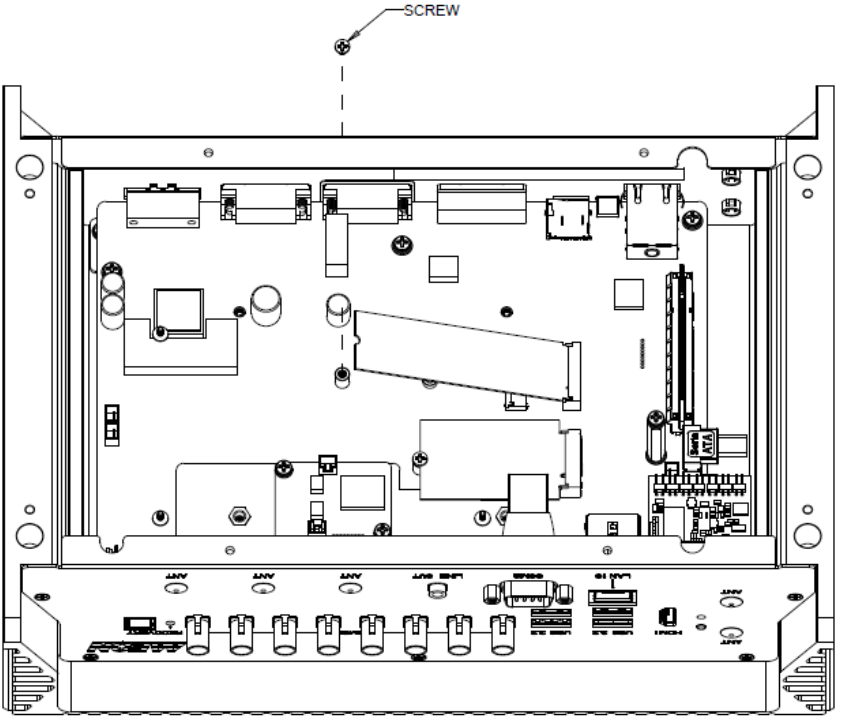
Brand	AAEON P/N	Description
Transcend	9C2001T007	M.2 SSD.M.2 2280 M key PCIe Gen4 x4.1TB.3D TLC W/WD BiCS5,-40~85C,FW:82B2W2AA.Transcend. TS1MTE710TI-AEN
Transcend	9C3002T002	PCIe SSD.M.2 2280 M Key NvME SSD.2TB.PCIe Gen 4 x4,-40~85C,3D TLC W/WD BiCS5,FW:82B2W2AA. Transcend.TS2TMTE710TI-AEN

2.5.5.1 PCIe Gen 3 Heatsink Installation

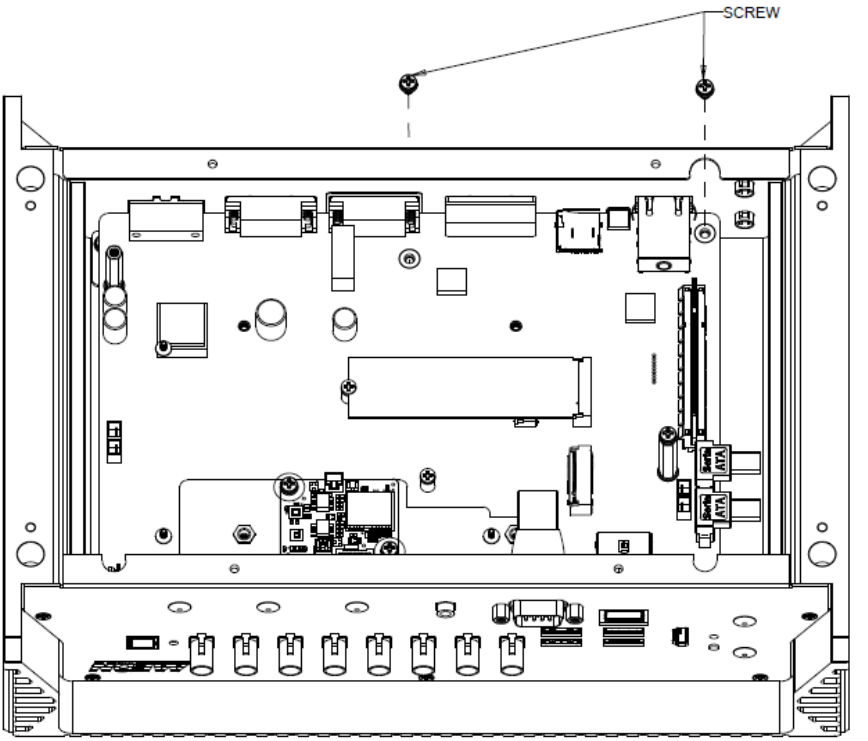
Step 1: Remove the bottom cover of the chassis by removing the eight (8) screws, as shown.



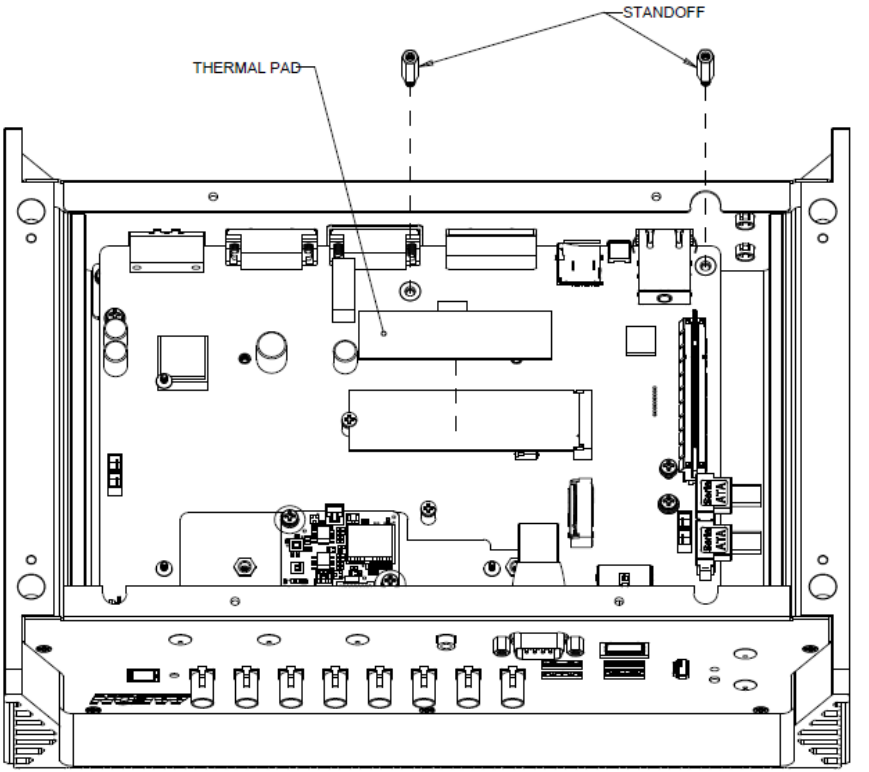
Step 2: Note the location of the M.2 2280 M-Key slot. Follow standard installation procedures, inserting the module at a 45° angle, then affixing the module using the screw as shown.



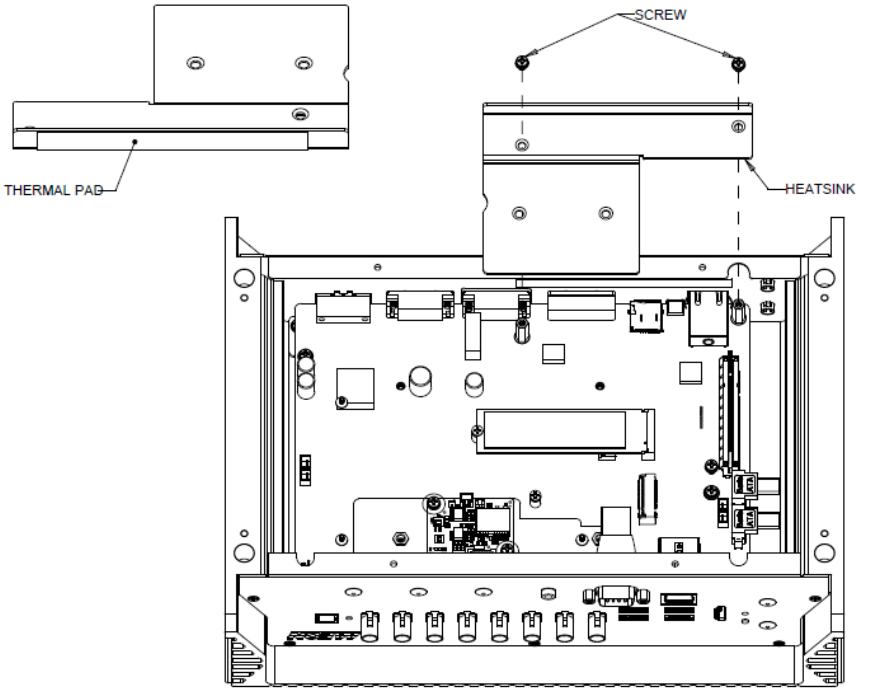
Step 3: Remove the heatsink screws from the motherboard. For screw location, please see the below.



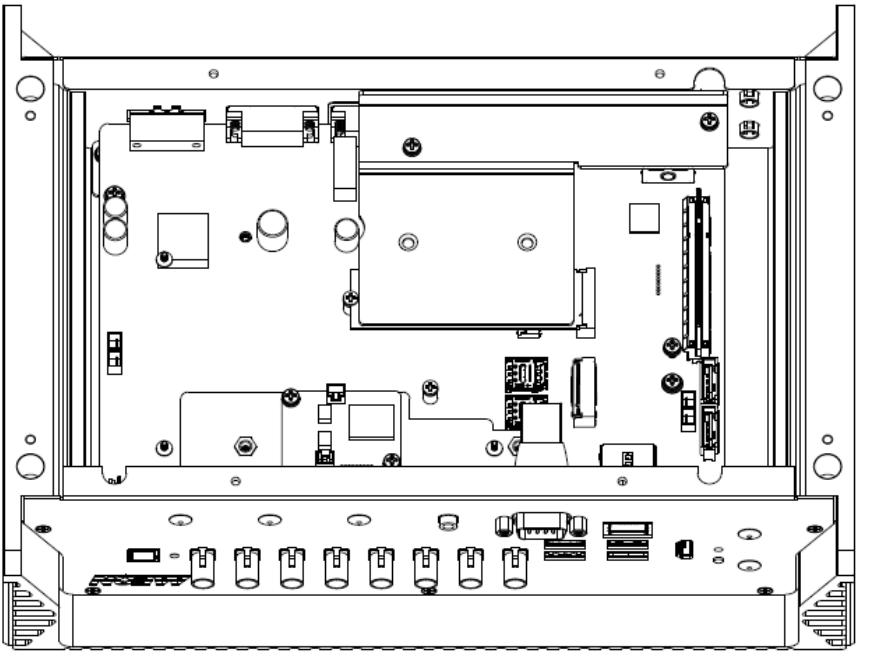
Step 4: Place the heatsink standoffs in the screw holes on the chassis, as below.



Step 5: Affix the heatsink to the heatsink standoffs using the screws you removed in step 3. Please ensure the thermal pad is placed on the underside of the heatsink when installing.

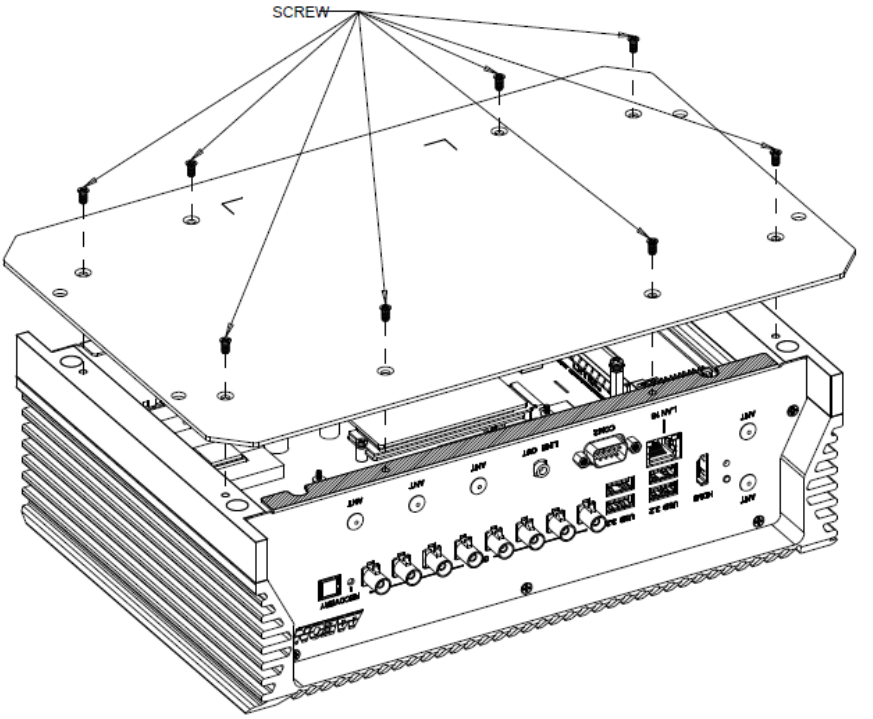


Step 6: Heatsink installation is complete. Please see below diagram for reference.

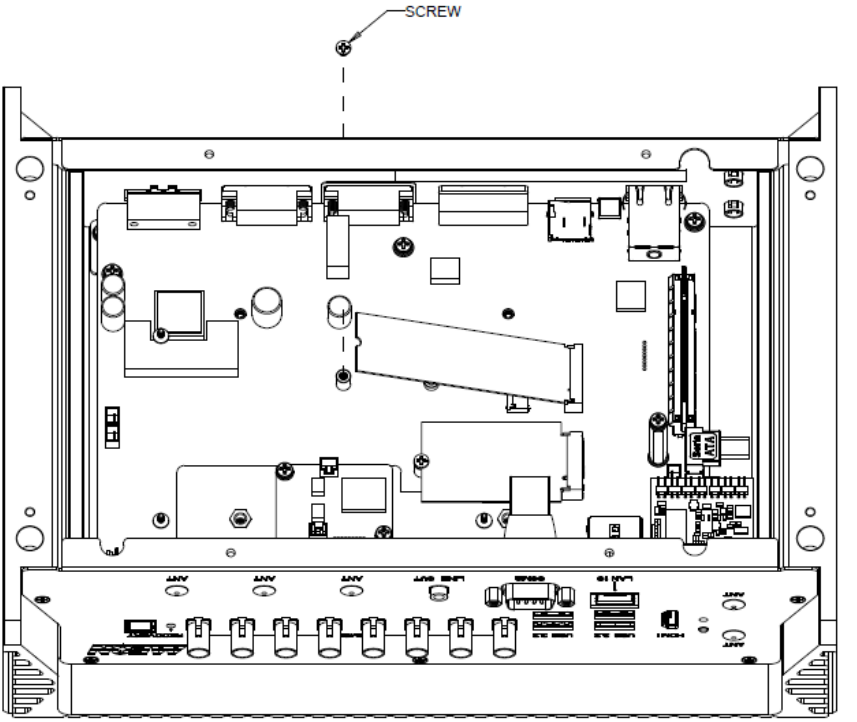


2.5.5.2 PCIe Gen 4 Heatsink Installation

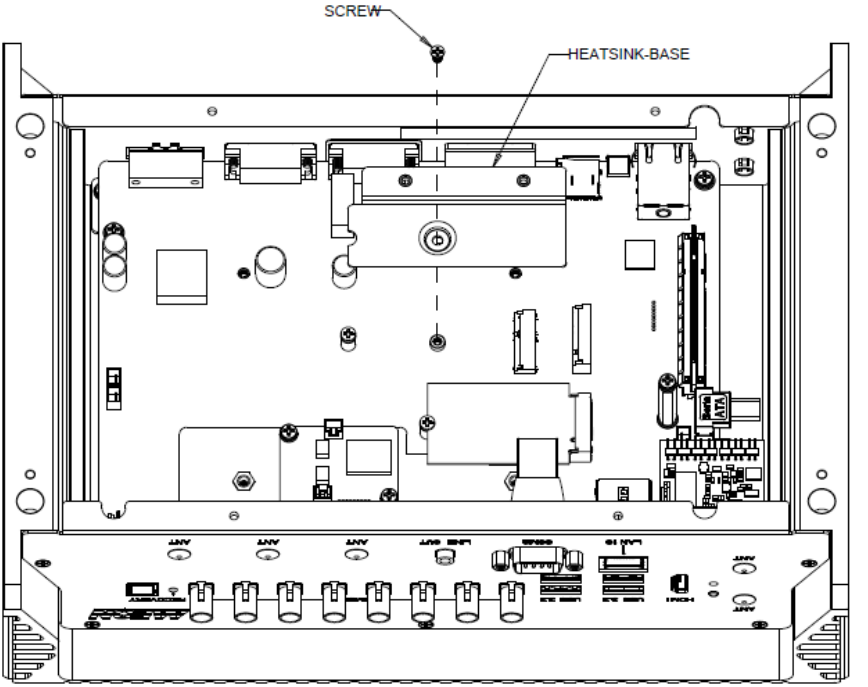
Step 1: Remove the bottom cover of the chassis by removing the eight (8) screws, as shown.



Step 2: Note the location of the M.2 2280 M-Key slot. Follow standard installation procedures, inserting the module at a 45° angle, then affixing the module using the screw as shown.

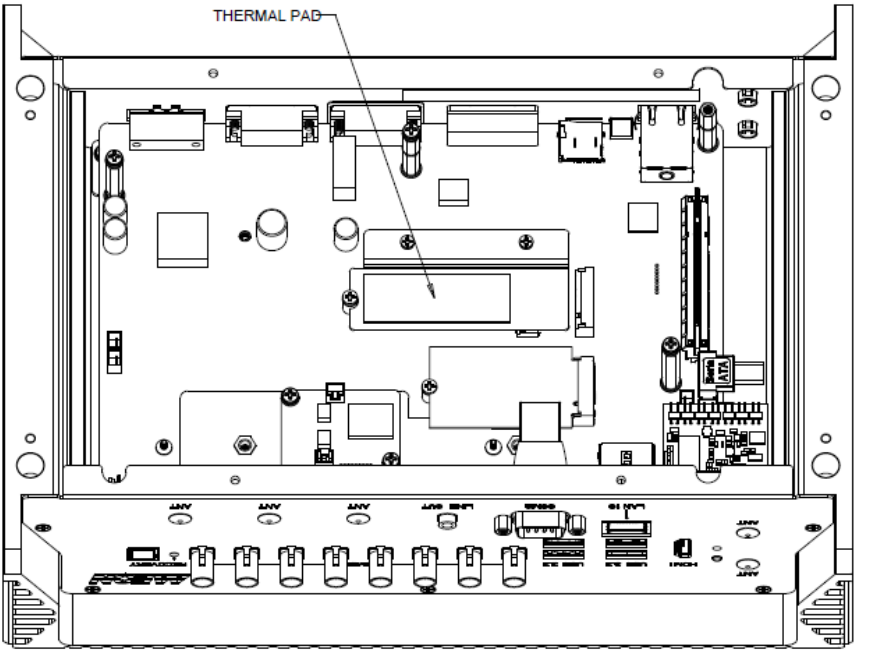


Step 3: Affix the heatsink base to the motherboard using the screws as shown.

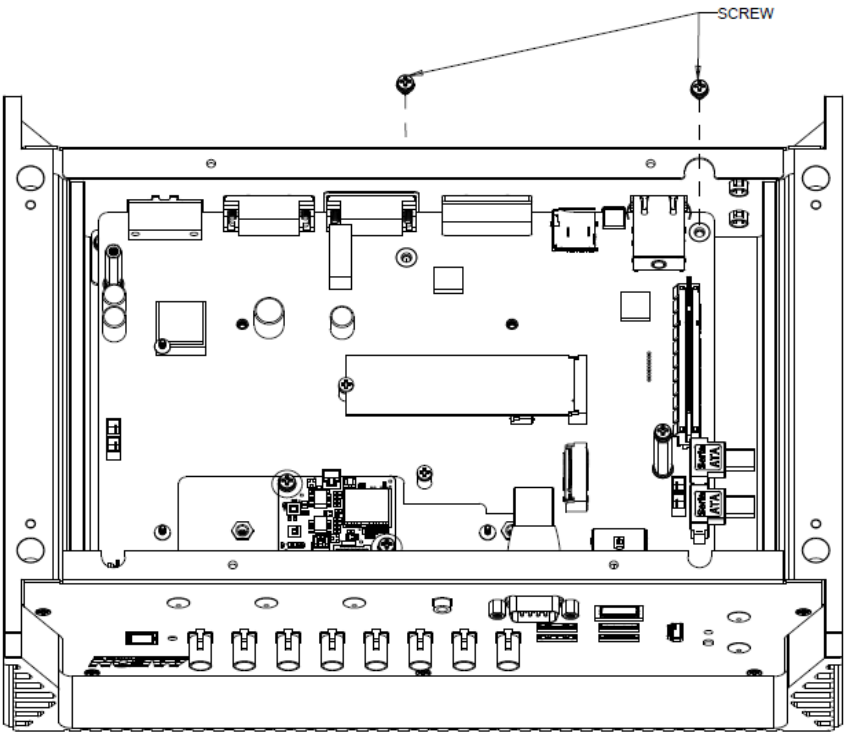


Step 4: Apply the thermal pad to the heatsink base.

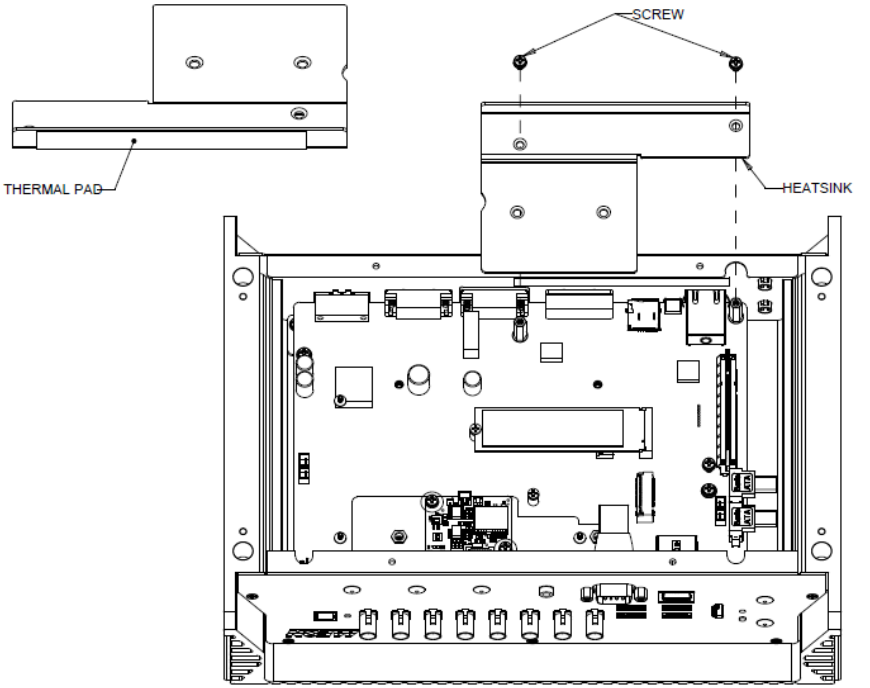
Note: If Gen 4 SSD has chips on only one side, please skip Step 4.



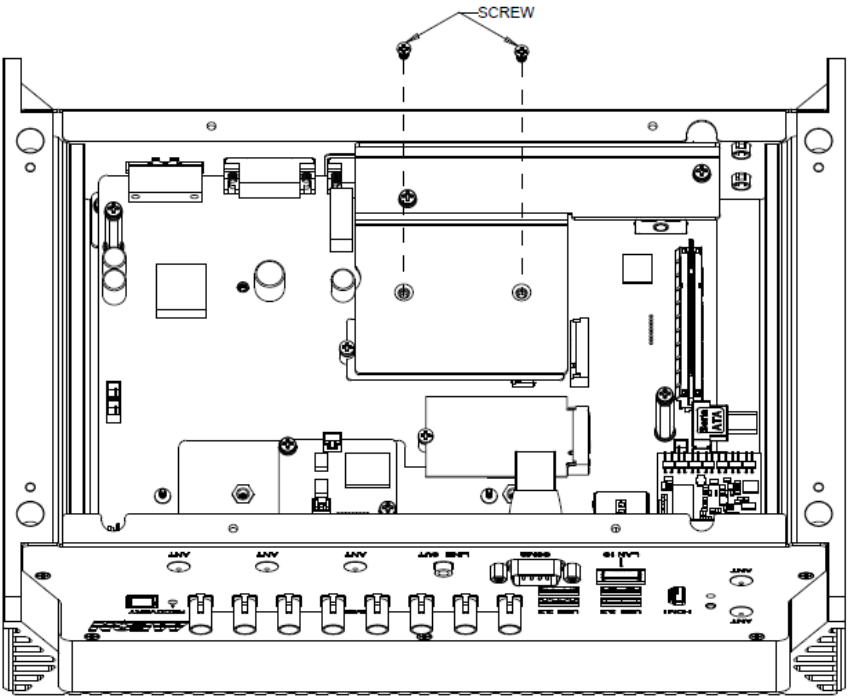
Step 5: Remove the heatsink screws from the motherboard. For screw location, please see the below.



Step 6: Affix the heatsink to the heatsink standoffs using the screws previously removed. Please ensure the thermal pad is placed on the underside of the heatsink when installing.



Step 7: Secure heatsink to heatsink base using two (2) screws, as shown.



Note: When Gen 4 heatsink is installed, M.2 2230 E-Key will be not available.

Chapter 3

BSP Flash Guide

3.1 Before Installation

Before starting the process, make sure your BOXER-8645AI system is turned off and the power in is disconnected. You will need a Host PC running Ubuntu 18.04/20.04, and make sure the NVIDIA Jetson AGX Orin module is installed on the BOXER-8645AI carrier board system.

Note: Do not use a virtual machine as a host PC, as some virtual machines may have unstable USB connections which can cause the flash procedure to fail.

Download the compressed BSP image file "BOXER_8645AI_J5.1.1_A00_1.0.3_20231211.tar.gz" into the Host Ubuntu 18.04/20.04 PC directory.

Note: No spaces, special characters, or non-English characters can be used for the name of the folder where the file is stored, or its parent folder.

Note: Ensure the language settings of Ubuntu 18.04/20.04 are set to English, and the format setting is the United States, to prevent flash failure.

3.2 Connecting to PC/Force Recovery Mode

Step 1:

On the Host computer, open Linux terminal and enter the following command to extract the compressed BSP image files (BSP file name may vary):

```
$ sudo tar -zxvf BOXER_8645AI_J5.1.1_A00_1.0.3_20231211.tar.gz
```

Note: Do not decompress the file (Internal.tar.gz) using a Windows OS, BSP should only be decompressed in a Linux EXT3/4 file system.

Step 2:

Perform the following actions to force the system to start in USB Recovery Mode:

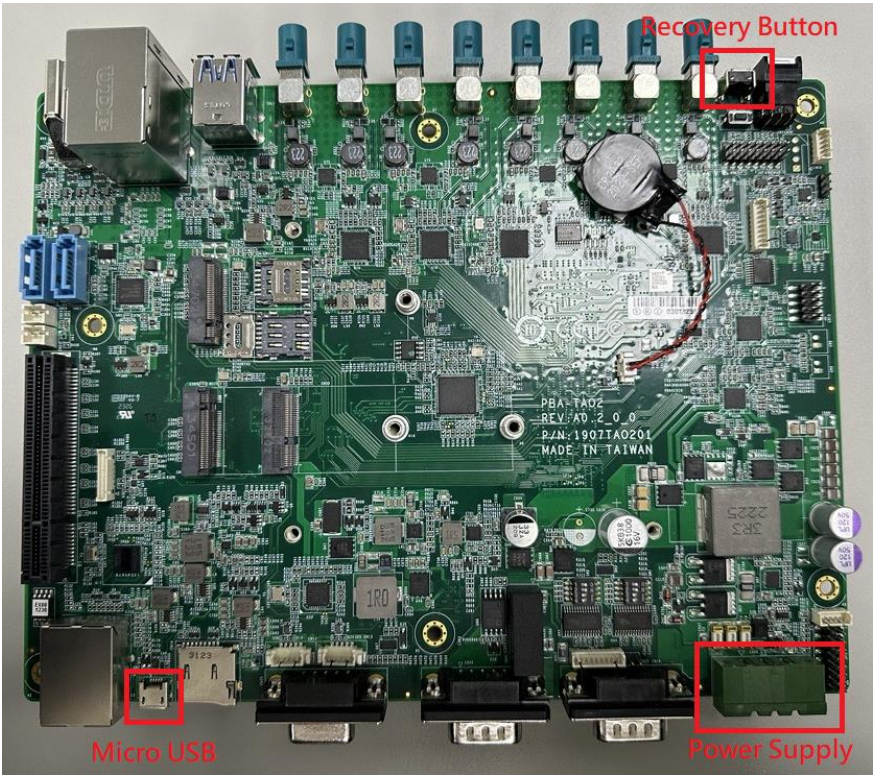
1. Connect the Micro-USB plug on the USB cable to the Recovery Port on the BOXER-8645AI, and the other end to an available USB port on the Host PC.
2. Connect the BOXER-8645AI power supply.
3. Press and hold the recovery key button. While holding the recovery key button, power on the system, and continue to hold the recovery key button for two seconds, then release. The BOXER-8645AI should then enter recovery mode.
4. To check if device is in recovery mode, enter the command lsusb in terminal on Host.

```
$ lsusb | grep "NVidia"
```

If successful, the command will return "0955:7223 Nvidia Corp"

```
Bus 001 Device 030: ID 0955:7223 NVidia Corp.
```

Note: Recovery mode can't be initiated while Jetson AGX Orin module is disassembled. Ensure the NVIDIA Jetson AGX Orin module is installed and refer to the image below to perform the force recovery mode steps:



3.3 Flash Image to Board

Use the following steps to flash the OS to the BOXER-8645AI.

1) Open terminal on the Ubuntu Host PC, then access the folder you extracted in the previous section.

2) Enter the following command in terminal to flash the image:

```
$ ./flashboxer.sh emmc
```

3) Wait as the image is installed. Once complete you should see the following:

```
writing item=16, 9:0:secondary_gpt, 32088902144, 16896, gpt_secondary_9_0.bin, 16896, fixed-<reserved>-0, 59012273e727e6a457684ff7805a26ed6cf1c4fa
[ 309]: l4t_flash_from_kernel: Successfully flash the external device
[ 309]: l4t_flash_from_kernel: Flashing success
[ 309]: l4t_flash_from_kernel: The device size indicated in the partition layout xml is smaller than the actual size. This utility will try to fix the GPT.
Flash is successful
Reboot device
Cleaning up...
```

4) After Steps 2 and 3, mass-flash image is built up internally, so you can flash up to 10 targets at once by using the following command:

```
$ ./flashboxer.sh -m emmc
```

3.4 Check BSP Version

Once the flash image is successfully installed, the BOXER-8622AI will reboot automatically, then check the BSP version to see if the system is flashing the correct version of BSP.

Open a Terminal, and type command "cat /proc/product"

You will see the product name with version and date

BOXER-8645AI_J5.1.1_A00_1.0.3_20231211

The version name will follow the format of:

{PJ_IF}_{JPV_IF}_A00_{IMGV_IF}_{BD_IF}

For example:

BOXER-8645AI_J5.1.1_A00_1.0.3_20231211

Note: Filename may differ from this example.

{PJ_IF} is Project Information; e.g. BOXER-8645AI

{IMGV_IF} is Build Version; e.g. 1.0.1

{JPV_IF} is Jetpack Version; e.g. J5.1.1

{BD_IF} is Build Date; e.g. 20231211

Chapter 4

OS User Guide

4.1 Introduction

The BOXER-8645AI Ubuntu/Linux OS version and preinstalled SDK components are as follows:

For Jetpack 5.1.1 (l4t 35.3.1)

1. Ubuntu/Linux version
    a. Ubuntu version: 20.04.6
    b. Kernel version: 5.10.104-tegra
    c. UEFI version: 3.1-32827747
2. Built-in all Jetson SDK Components
    a. CUDA Toolkit for L4T 11.4.19
    b. cuDNN 8.6.0
    c. TensorRT 8.5.2
    d. OpenCV 4.5.4
    e. VPI 2.2
    f. NVIDIA Container Runtime 1.11
    g. Multimedia API 35.3
    h. Nsight Systems 2023.1
    i. Nsight Graphics 2022.6
    j. Nsight Compute 2022.2
    k. Compute Sanitizer 2022.2
    l. Nsight DL Designer 2022.2
    m. Deepstream 6.2
3. Built-in Allxon DMS
    a. Please refer to https://www.allxon.com/solutions

Default login user/password is:

Account: aaeon

Password: aaeon

4.2 Update Note

Running **$** sudo apt upgrade command in terminal will overwrite the Aaeon kernel device tree(.dtb)/kernel image(Image)/bootloader in OS, which can lead to unexpected results including losing I/O ports.

So Aaeon default disable Nvidia apt Repo for updating Nvidia apt package.

AAEON maintains updated versions of BSP on the product page, which follow updates to the NVIDIA Jetpack software. Contact your AAEON representative or visit the product page to download the latest version of Aaeon BSP for your system:

https://www.aaeon.com/en/

4.3 Power Mode for BOXER-8645AI

NVIDIA Jetson AGX Orin power mode can be selected and monitored via GUI, pls refer following picture:

Note: Power mode is dependent on DRAM size. For more detailed information please visit: https://developer.nvidia.com/embedded/jetson-modules

4.4 DIO/GPIO Setting Command

Pin	Pin Name	GPIO ID
1	GPIO14_CAM_ERROR1_3V3	PAC.03
2	GPIO16_CAM1_RST_3V3	PAC.01
3	GPIO17_40PIN_3V3	PP.04
4	GPIO19_XFI1_MDC_3V3	PN.02
5	GND	
6	GPIO08_40PIN_3V3	PBB.01
7	PWM1_40PIN_3V3	PR.00
8	GPIO06_CAM_FR3_3V3	PAA.04
9	GPIO35_PWM3_40PIN_3V3	PH.00

1. GPIO test command:

Please refer HW DIO/GPIO section for PIN Number and GPIO ID mapping. Take "PIN 2 <-> GPIO ID:PY.02" as an example on JP511 :

1. Export PY.02

   $ echo PY.02 > /sys/class/gpio/export

2. Set GPIO direction to output mode

   $ echo "out" > /sys/class/gpio/PY.02/direction

3. Set the output value

   High: $ echo 1 > /sys/class/gpio/PY.02/value

   Low: $ echo 0 > /sys/class/gpio/PY.02/value

4. Set GPIO direction to input mode

   $ echo "in" > /sys/class/gpio/PY.02/direction

5. Read the input value of GPIO

   $ cat /sys/class/gpio/PY.02/value

6. Unexport PY.02

$ echo PY.02 > /sys/class/gpio/unexport

2. FAN PWM test command:

   For customer want to use FAN PWM as Normal PWM control

   1. Stop NV fan control daemon

      $ sudo systemctl stop nvfancontrol

   2. Set PWM value

      $ echo [PWM_duty_cycle] >

   /sys/devices/platform/pwm-fan/hwmon/hwmon<x>/pwm1

Where: [PWM_duty_cycle] is a value in the range [0,255]. <x> is a kernel enumerated number for fan hwmon.

4.5 GNSS Sensor

Default of 35ms sample rate from the GNSS sensor.

UART Interface	
Device	/dev/ttyTHS4
Baud rate	38400

4.6 IMU Sensor

Default of 40ms sample rate from the 9 axis IMU.

I2C Interface	
I2C Bus	/dev/i2c-2

Sensor I2C Address	
ASM330LHH	0x6b
LIS2MDL	0x1e

How to access IMU sensors

1. Sensor Registers : asm330lhh_reg.h, lis2mdl_reg.h
2. Read the values of the registers through Implementing I2C device drivers in userspace.
3. Example:

```
#include <stdio.h>
#include <stdint.h>
#include <errno.h>
#include <err.h>
#include <fcntl.h>
```

```
#include <sys/stat.h>
#include <sys/ioctl.h>

#include <linux/i2c.h>
#include <linux/i2c-dev.h>

#define ASM330LHH_I2C_ADDR                    0x6bU

#define ASM330LHH_OUTX_L_A                    0x28U /* linear acceleration
sensor X-axis output regiser */
#define ASM330LHH_OUTX_H_A                    0x29U /* linear acceleration
sensor X-axis output regiser */

const char *path = "/dev/i2c-2";
uint8_t addr = ASM330LHH_I2C_ADDR;
int file;

static inline __s32 i2c_smbus_access(int file, char read_write, __u8 command,
                                     int size, union i2c_smbus_data *data)
{
        struct i2c_smbus_ioctl_data args;
        args.read_write = read_write;
        args.command = command;
        args.size = size;
        args.data = data;
        return ioctl(file,I2C_SMBUS,&args);
}

static inline __s32 i2c_smbus_read_byte_data(int file, __u8 reg_addr)
{
        union i2c_smbus_data data;
        if (i2c_smbus_access(file, I2C_SMBUS_READ, reg_addr,
I2C_SMBUS_BYTE_DATA, &data))
                return -1;
        else
                return 0x0FF & data.byte;
}

float get_in_anglacc_x_raw()
{
        uint8_t value_l= 0x0 , value_h = 0x0;
        float x_raw = 0;
```

```
        value_l = i2c_smbus_read_byte_data(file, ASM330LHH_OUTX_L_A);
        value_h = i2c_smbus_read_byte_data(file, ASM330LHH_OUTX_H_A);

        x_raw = ((value_h << 8) | value_l) * 0.002392822;

        return x_raw;
}

int main(int argc, char **argv)
{
        int rc;
        float get_value = 0;

        file = open(path, O_RDWR);
        if (file < 0)
                err(errno, "Tried to open '%s'", path);
        rc = ioctl(file, I2C_SLAVE_FORCE, addr);
        if (rc < 0)
                err(errno, "Tried to set device address '0x%02x'", addr);

        get_value = get_in_anglacc_x_raw();
        printf("acceleration sensor X-axis output: %f\n", get_value);

        return 0;
}
```

4.7 Nilecam25

Provides Full HD resolution in UYVY format at 30 FPS – with synced images and a latency of 1 millisecond.

Note: The frame sync for 60fps is currently not supported.

Run the following command to check for the presence of video node.

```
$ ls /dev/video*
```

The output message appears as shown below:

```
/dev/video0 /dev/video1 ...
```

The output message should list the number of video nodes similar to the number of cameras connected to the BOXER-AI board.

Tested Gstreamer commands:

Example: Streaming 2 MP at 30 fps (HW accelerated):

Run the following command to stream video in 2 MP resolution.

```
$ gst-launch-1.0 v4l2src device=/dev/video<n> ! "video/x-raw, \
format=(string)UYVY, width=(int)1920, height=(int)1080" ! \
nvvidconv ! "video/x-raw(memory:NVMM), format=(string)I420, \
width=(int)1920, height=(int)1080" ! fpsdisplaysink text-overlay=0 \
video-sink=nv3dsink
```

Note: Replace <n> with the number of video device node from which you need to stream.