

# BOXER-8654AI-KIT

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AI@Edge Embedded Board with  
NVIDIA<sup>®</sup> Jetson Orin<sup>™</sup> NX

User's Manual 1<sup>st</sup> Ed

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## Packing List

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

Item	Quantity
● BOXER-8654AI-KIT	1
● Screw Package	1
● Power Connector	1

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

## About this Document

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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](http://AAEON.com) for the latest version of this document.

## Safety Precautions

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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.**

### **Warning!**



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 Main Board/ Daughter Board/ Backplane

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	X	X	○	○	○	○
外部信号 连接器及线材	X	X	○	○	○	○

O: 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 SJ/T 11363-2006 标准规定的限量要求以下。

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。

备注: 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。

## China RoHS Requirement (EN)

Poisonous or Hazardous Substances or Elements in Products

AAEON Main Board/ Daughter Board/ Backplane

Component	Poisonous or Hazardous Substances or Elements					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr(VI))	Polybrominated Biphenyls (PBB)	Polybrominated Diphenyl Ethers (PBDE)
PCB & Other Components	X	X	○	○	○	○
Wires & Connectors for External Connections	X	X	○	○	○	○
<p>○: The quantity of poisonous or hazardous substances or elements found in each of the component's parts is below the SJ/T 11363-2006-stipulated requirement.</p> <p>X: The quantity of poisonous or hazardous substances or elements found in at least one of the component's parts is beyond the SJ/T 11363-2006-stipulated requirement.</p> <p><b>Note:</b> The Environment Friendly Use Period as labeled on this product is applicable under normal usage only</p>						

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# Chapter 1

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Product Specifications

## 1.1 Specifications

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### System

<b>AI Accelerator</b>	NVIDIA® Jetson Orin™ NX
<b>CPU</b>	Orin NX 16GB: 8-core Arm® Cortex®-A78AE v8.2 64-bit CPU Orin NX 8GB: 6-core Arm® Cortex®-A78AE v8.2 64-bit CPU
<b>System Memory</b>	16GB LPDDR5 8GB LPDDR5
<b>Storage Device</b>	M.2 2280 M-Key x 1 (NVMe) SATA Connector x 1
<b>Display Interface</b>	HDMI 1.4 (Type-A) x 1
<b>Ethernet</b>	RJ-45 x 4 for GbE LAN (optional: power module for PoE, 25.6W per port)
<b>I/O</b>	MIPI Connector x 2 (4 Lanes for each MIPI Connector, default IMX219) DB-9 x 1 for RS-232(RX/TX/GND)/422/485 DB-9 x 1 for CANBus USB 3.2 Gen 2 (Type-A) x 6 Micro USB for Image Flash x 1 Power Button with LED Indicator x 1 2 pin Phoenix Type x 1 for Power Input Recovery Button x 1 40-pin Header (compliant with NVIDIA Jetson Orin Nano Developer Kit) Pin Header x 1 for RS/232/422/485 (jumper select) UART to 40-pin Box Header x 1 for OOB

## System

I/O Cont.	SATA Connector x 1 SATA Power Connector x 1
Expansion	M.2 2230 E-Key x 1 M.2 2242/3042/3052 B-Key x 1 (SIM onboard) M.2 2280 M-Key x 1 for extending module
Indicator	Power LED x 1
OS Support	Linux (NVIDIA Jetpack™ 6.0 and above)

## Power Supply

Power Requirement	12V ~ 24V DC in with 2-pin Terminal Block x 1
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## Mechanical

Mounting	—
Dimensions (W x D x H)	6.53" x 5.24" (166mm x 133mm)
Gross Weight	0.79 lb. (0.36Kg)
Net Weight	0.42 lb. (0.19Kg)

## Environmental

Operating Temperature	-13°F ~ 158°F (-25°C~70°C) w/ heatsink, according to IEC60068-2 with 0.5 m/s Airflow
Storage Temperature	-40°F ~ 185°F (-40°C ~ 85°C)
Storage Humidity	5 ~ 95% @40°C, non-condensing
Anti-Vibration	—
Anti-Shock	—
Certification	CE/FCC Class A

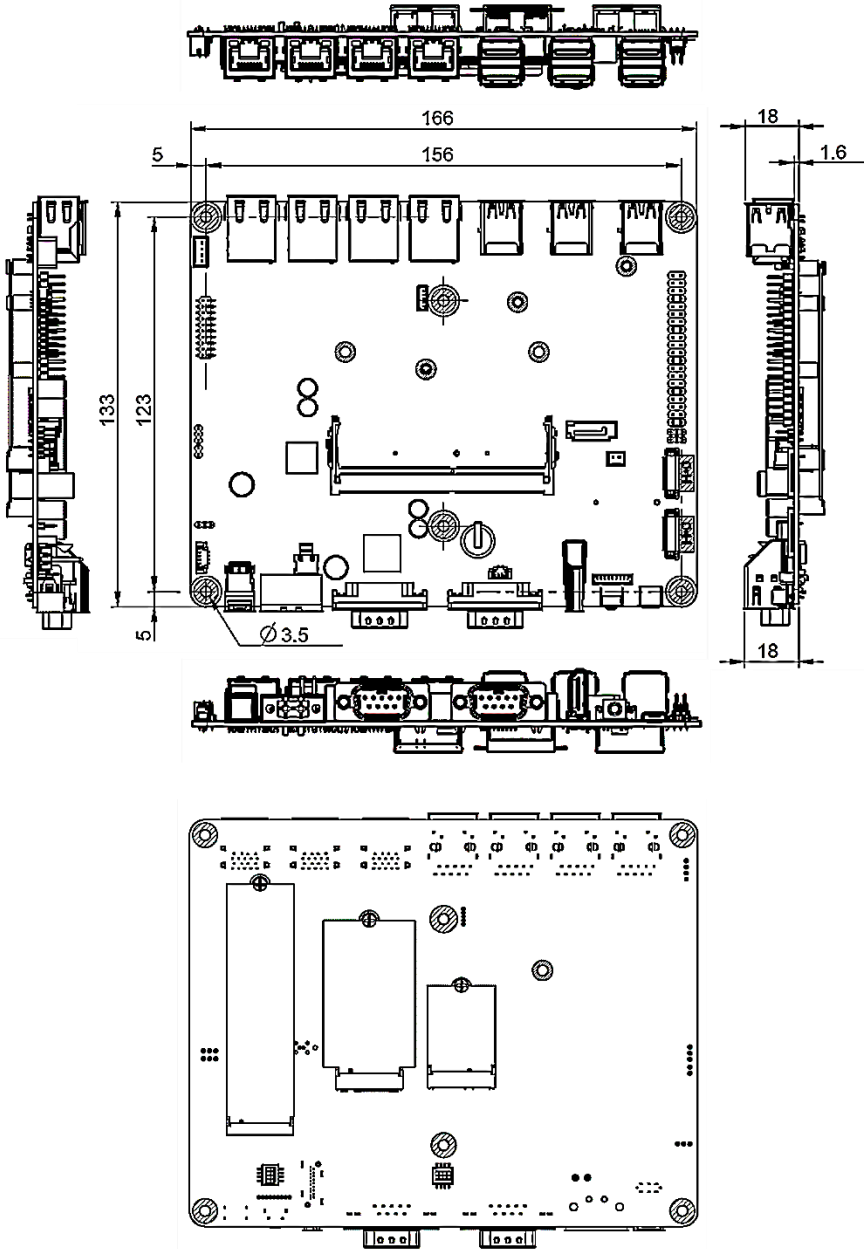
# Chapter 2

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Hardware Information

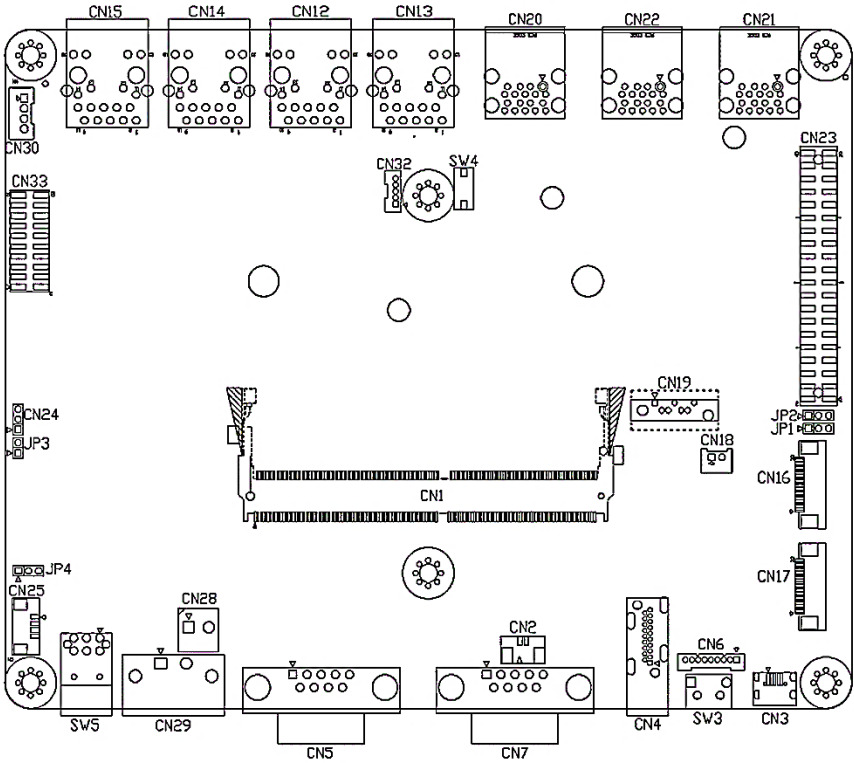


## 2.1 Dimensions

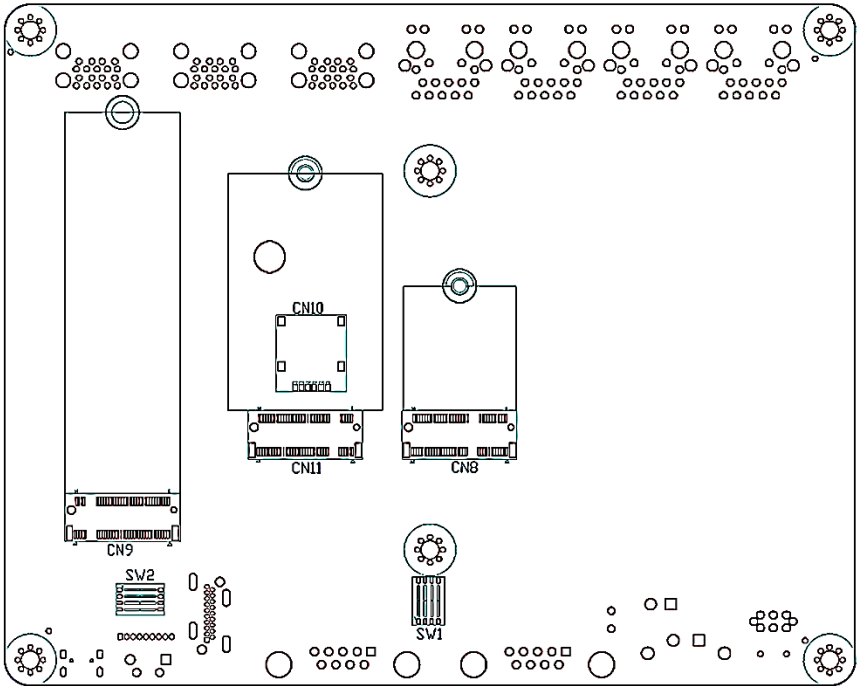


## 2.2 Jumpers and Connectors

Top



# Bottom



## 2.3 List of Jumpers

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

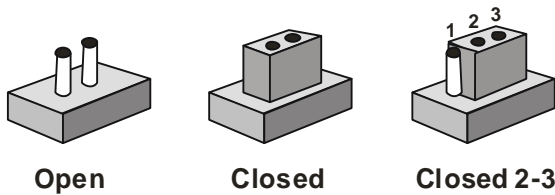
The table below shows the function of each of the board's jumpers

Label	Function
JP1	40-Pin SPI & TPM Select
JP2	40-Pin UART & RS-232 Select
JP3	AT/ATX Select
JP4	Fan 5V/12V Voltage

### 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.

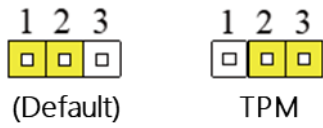
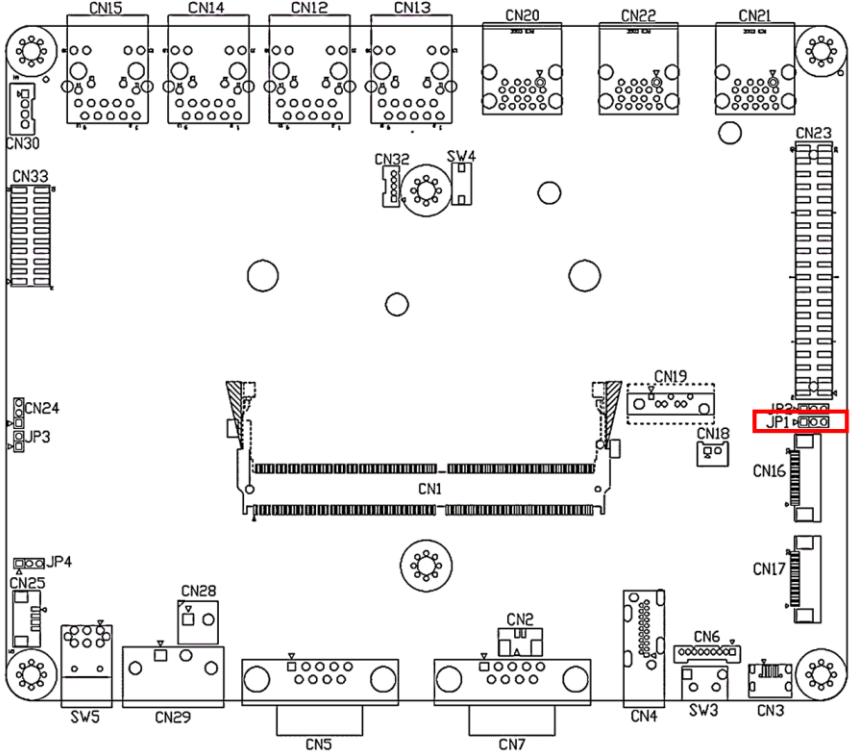


A pair of needle-nose pliers may be helpful when working with jumpers.

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.

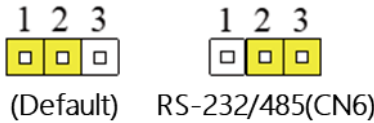
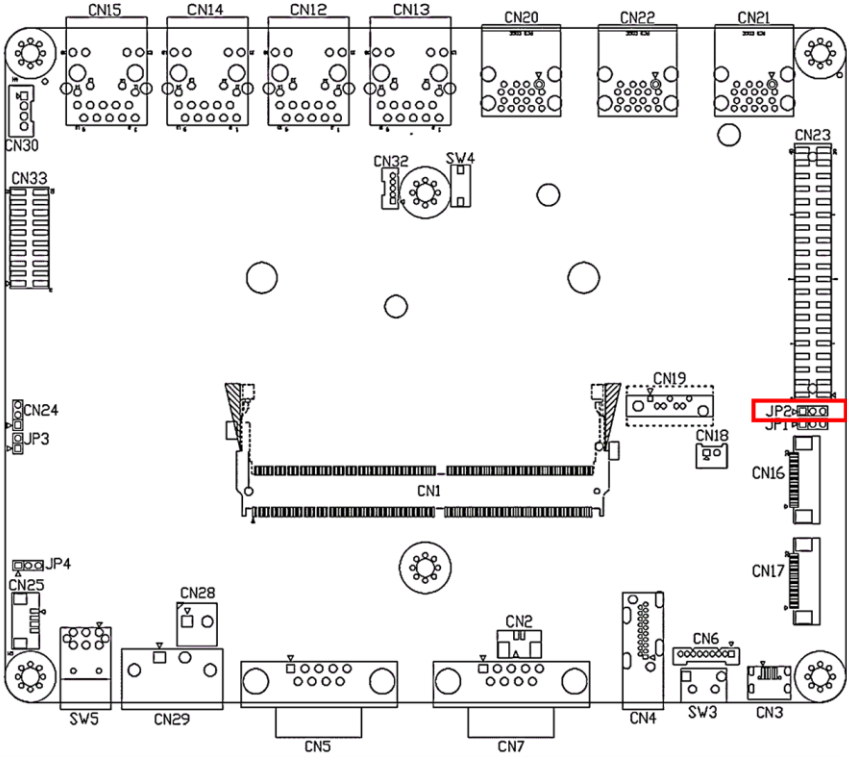
Generally, you simply need a standard cable to make most connections.

### 2.3.2 40-Pin SPI & TPM Select (JP1)



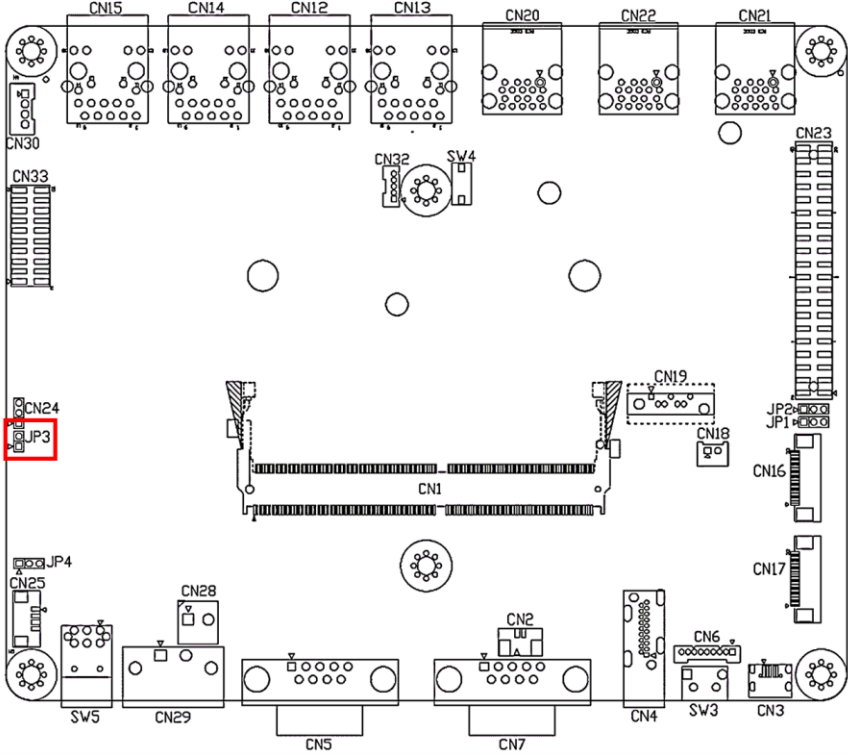
Pin	Function
1-2	40-Pin Extension I/O (Default)
2-3	TPM

### 2.3.3 40-Pin UART & RS-232 Select (JP2)



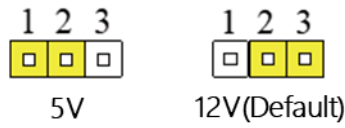
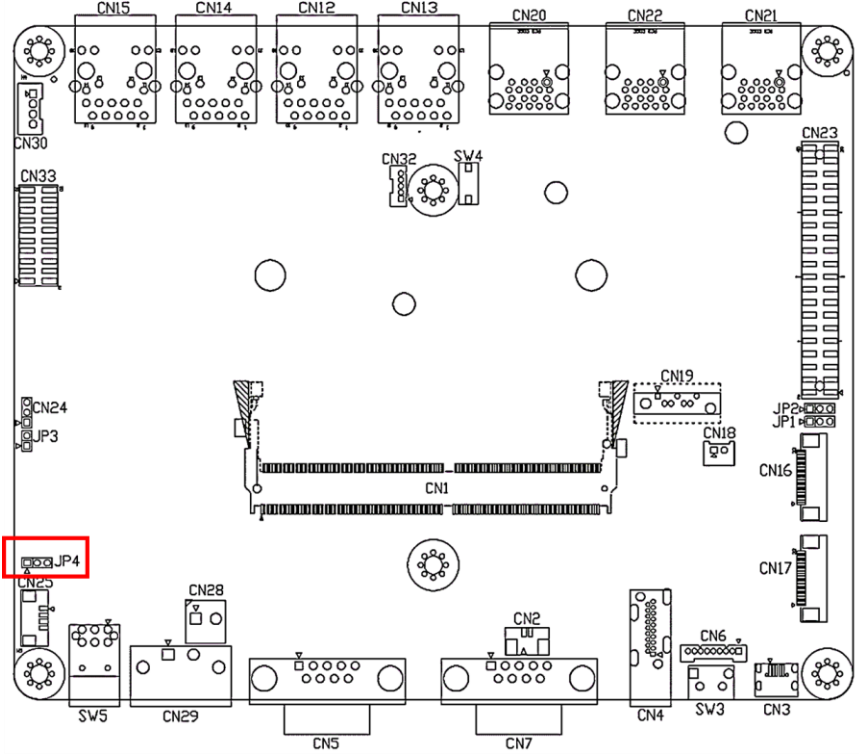
Pin	Function
1-2	40-Pin Extension I/O (Default)
2-3	RS-232/485(CN6)

### 2.3.4 AT/ATX Mode Selection (JP3)



Pin	Function
1-2	Open AT
1-2	Close ATX (Default)

### 2.3.5 Fan 5V/12V Voltage Selection (JP4)



Pin	Function
1-2	5V
2-3	12V(Default)



## 2.4 List of Connectors

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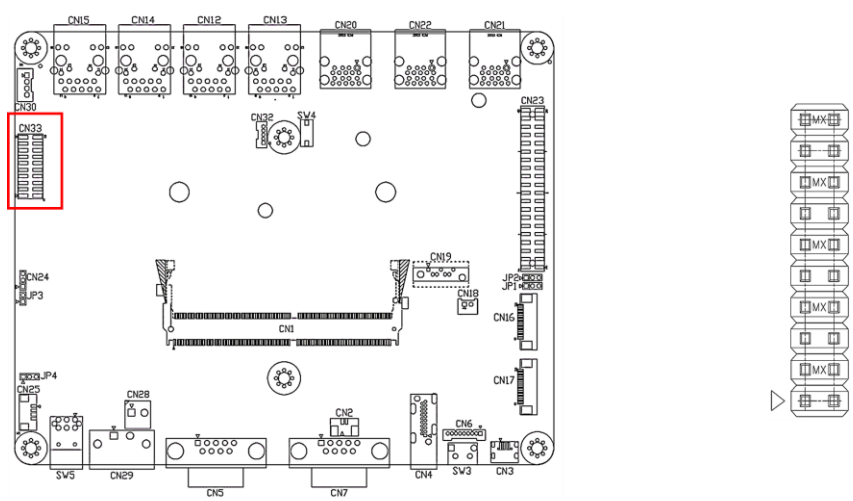
The board has a number of connectors that allow you to configure your system to suit your application.

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

Label	Function
CN1	Jetson Orin NX Connector
CN2	RTC Battery Connector
CN3	Micro USB 2.0 for Flash Connector
CN4	HDMI Connector
CN5	RS-232/422/485 Connector
CN6	RS-232/422/485 Internal Connector
CN7	CANBus Connector
CN8	M.2 2230 E-Key
CN9	M.2 2280 M-Key
CN10	Nano SIM Slot
CN11	M.2 2242/3042/3052 B-Key
CN12	PoE GbE RJ-45 (ETH)
CN13	PoE GbE RJ-45 (ETH)
CN14	PoE GbE RJ-45 (ETH)
CN15	PoE GbE RJ-45 (ETH)
CN16	MIPI CSI-2 FPC Connector (CSI0/1)
CN17	MIPI CSI-2 FPC Connector (CSI2/3)
CN18	SATA 5V Power Connector
CN19	SATA Connector
CN20	USB 3.2 Gen 2 Connector
CN21	USB 3.2 Gen 2 Connector
CN22	USB 3.2 Gen 2 Connector
CN23	40 Pin Extension I/O
CN25	Fan Connector
CN26	Debug UART
CN28	Internal Power Connector
CN29	DC In Connector (5.0mm)
CN30	PoE Power Connector
CN33	NC-SI Connector
SW1	RS-232/422/485 Select
SW2	RS-232/422/485 Select

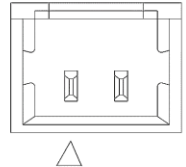
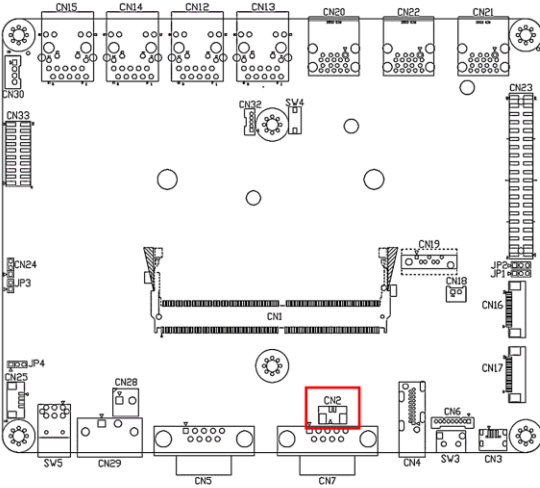
Label	Function
SW3	Recovery Button
SW4	Reset Button
SW5	Power Button

## 2.4.1 NC-SI Connector (CN27)



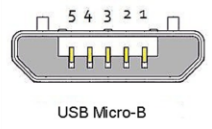
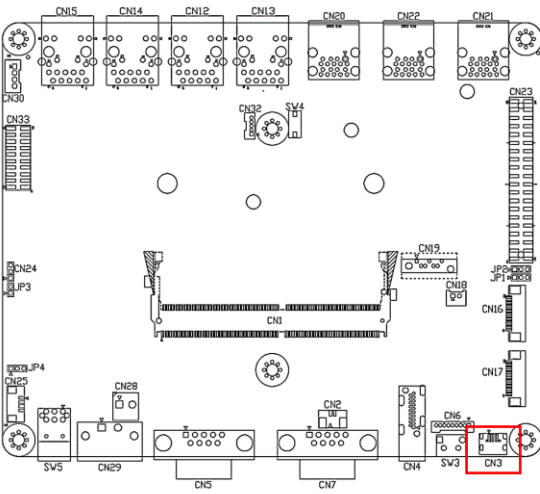
Pin	Signal	Pin	Signal
1	3.3V_AO	2	5V_AO
3	Debug UART TX	4	NC_SI_TXD0
5	Debug UART RX	6	NC_SI_TXD1
7	I2C1 SCL	8	NC_SI_RXD0
9	I2C1 SDA	10	NC_SI_RXD1
11	System Reset	12	NC_SI_CLK_IN
13	GND	14	NC_SI_CRB
15	Button power	16	NC_SI_TX_EN
17	GND	18	OOB_UART_TX
19	5V_SYS	20	OOB_UART_RX

## 2.4.2 RTC Battery Connector (CN2)



Pin	Signal	Pin	Signal
1	Positive	2	Negative

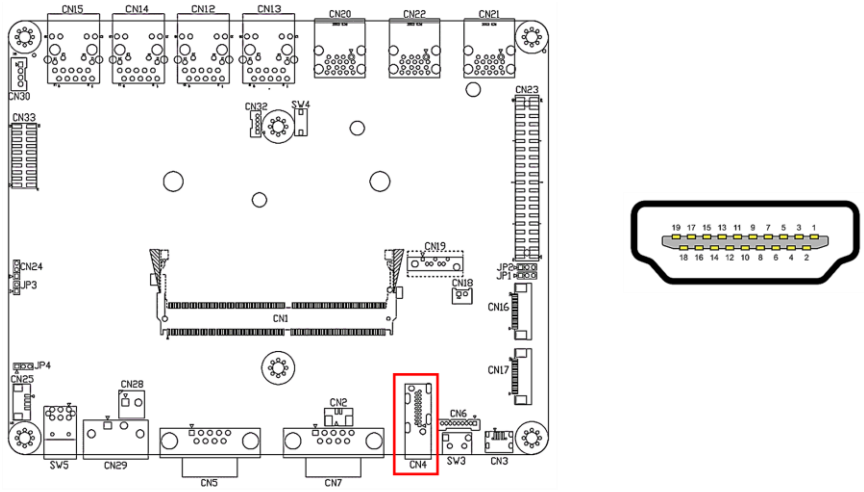
## 2.4.3 Micro USB 2.0 for Flash OS (CN3)



Pin	Signal	Pin	Signal
1	+5V	2	USB1-

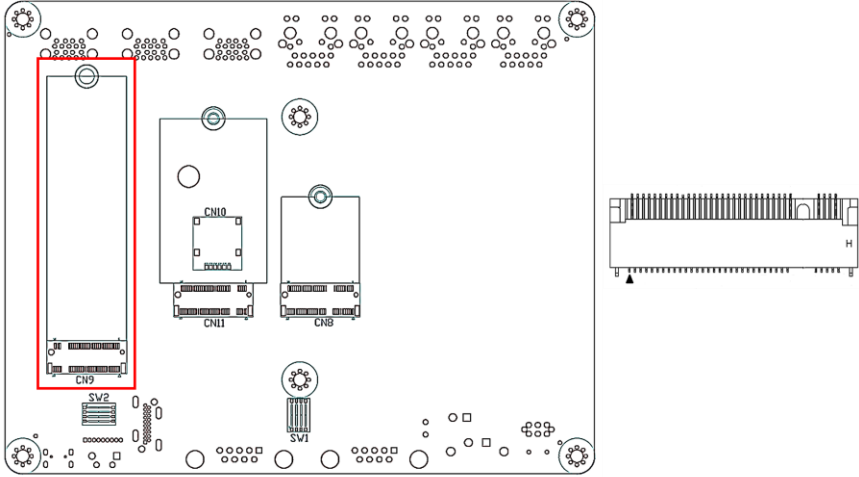
Pin	Signal	Pin	Signal
3	USB1+	4	
5	GND		

## 2.4.4 HDMI Connector (CN5)



Pin	Signal	Pin	Signal
1	HDMI_DATA2_P	2	GND
3	HDMI_DATA2_N	4	HDMI_DATA1_P
5	GND	6	HDMI_DATA1_N
7	HDMI_DATA0_P	8	GND
9	HDMI_DATA0_N	10	HDMI_CLK_P
11	GND	12	HDMI_CLK_N
13	NC	14	NC
15	HDMI_SCL	16	HDMI_SDA
17	GND	18	HDMI_PWR
19	HDMI_HDP		

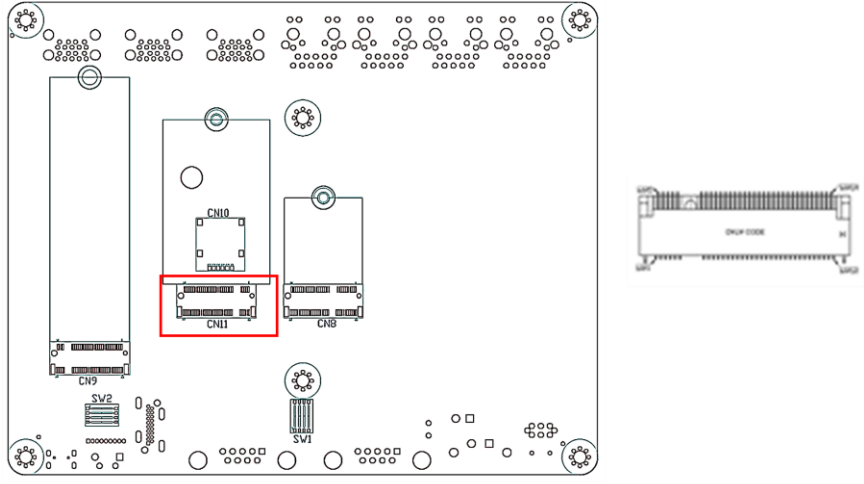
## 2.4.5 M.2 2280 M-Key (CN9)



Pin	Signal	Signal	Pin
74	3.3 V	GND	75
72	3.3 V	GND	73
70	3.3 V	GND	71
68	SUSCLK	PEDET	69
		NC	67
	Key M	Key M	
	Key M	Key M	
	Key M	Key M	
	Key M	Key M	
58	NC	GND	57
56	NC	REFCLKp	55
54	PEWAKE#	REFCLKn	53
52	CLKREQ#	GND	51
50	PERST#	PETp0	49
48	NC	PETn0	47
46	NC	GND	45
44	ALERT#	PERp0	43
42	SMB_DATA	PERn0	41
40	SMB_CLK	GND	39
38	DEVSLP	PETp1	37
36	NC	PETn1	35
34	NC	GND	33

Pin	Signal	Signal	Pin
32	NC	PERp1	31
30	NC	PERn1	29
28	NC	GND	27
26	NC	PETp2	25
24	NC	PETn2	23
22	NC	GND	21
20	NC	PERp2	19
18	3.3 V	PERn2	17
16	3.3 V	GND	15
14	3.3 V	PETp3	13
12	3.3 V	PETn3	11
10	DAS/DSS	GND	9
8	NC	PERp3	7
6	NC	PERn3	5
4	3.3 V	GND	3
2	3.3 V	GND	1

### 2.4.6 M.2 2242/3042/3052 B-Key (CN11)

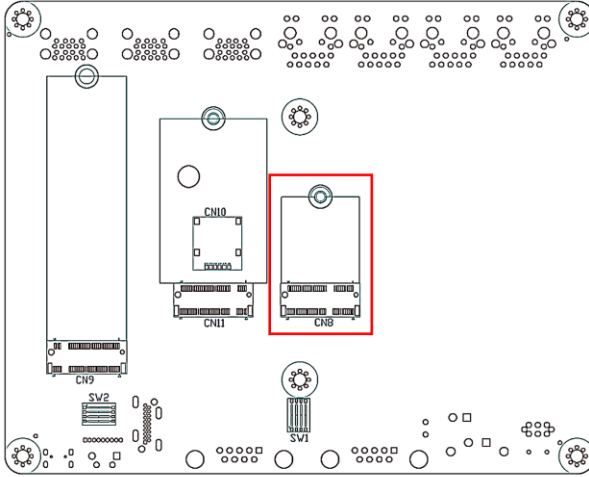


Pin	Signal	Signal	Pin
74	3.3 V	CONFIG_2	75
72	3.3 V	GND	73
70	3.3 V	GND	71
68	SUSCLK(32kHz)	CONFIG_1	69

Pin	Signal	Signal	Pin
66	SIM DETECT	RESET#	67
64	COEX_RXD	ANTCTL3	65
62	COEX_TXD	ANTCTL2	63
60	COEX3	ANTCTL1	61
58	NC	ANTCTL0	59
56	NC	GND	57
54	PEWAKE#	NC	55
52	CLKREQ#	NC	53
50	PERST#	GND	51
48	UIM2-PWR	NC	49
46	UIM2-RESET	NC	47
44	UIM2-CLK	GND	45
42	UIM2-DATA	NC	43
40	GPIO_0/SMB_CLK	NC	41
38	DEVSLP	GND	39
36	UIM1-PWR	USB3.1-Tx+	37
34	UIM1-DATA	USB3.1-Tx-	35
32	UIM1-CLK	GND	33
30	UIM1-RESET	USB3.1-Rx+	31
28	GPIO_8	USB3.1-Rx-	29
26	GPIO_10	GND	27
24	GPIO_7	DPR	25
22	GPIO_6	GPIO_11	23
20	GPIO_5	CONFIG_0	21
		Key B	
		Key B	
		Key B	
		Key B	
		GND	11
10	GPIO_9/DAS/DSS/LED_1#	USB_D-	9
8	W_DISABLE1#	USB_D+	7
6	FULL_CARD_POWER_OFF#	GND	5
4	3.3 V	GND	3
2	3.3 V	CONFIG_3	1



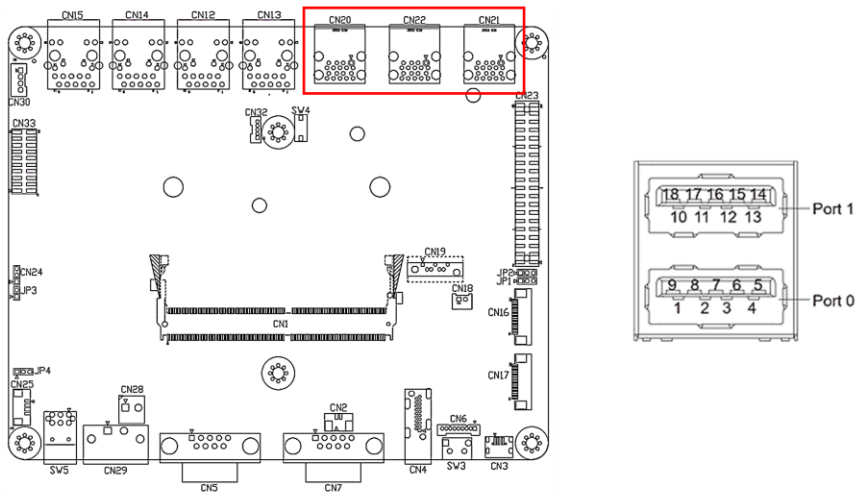
## 2.4.7 M.2 2230 E-Key (CN8)



Pin	Signal	Signal	Pin
74	3.3V	GND	75
72	3.3V	RESERVED/REFCLKn1	73
70	NC	RESERVED/REFCLKp1	71
68	NC	GND	69
66	NC	RESERVED/PERn1	67
64	RESERVED	RESERVED/PERp1	65
62	ALERT#	GND	63
60	I2C_CLK	RESERVED/PETn1	61
58	I2C_DATA	RESERVED/PETp1	59
56	W_DISABLE1#	GND	57
54	W_DISABLE2#	PEWAKE0#	55
52	PERST0#	CLKREQ0#	53
50	SUSCLK(32kHz)	GND	51
48	NC	REFCLKn0	49
46	NC	REFCLKp0	47
44	NC	GND	45
42	NC	PERn0	43
40	NC	PERp0	41
38	NC	GND	39
36	NC	PETn0	37
34	NC	PETp0	35
32	NC	GND	33

Pin	Signal	Signal	Pin
		Key E	
		Key E	
		Key E	
		Key E	
		NC	23
22	NC	NC	21
20	UART_WAKE#	NC	19
18	GND	NC	17
16	NC	NC	15
14	I2S_SD_OUT	NC	13
12	I2S_SD_IN	NC	11
10	I2S_WS	NC	9
8	I2S_SCK	GND	7
6	NC	USB_D-	5
4	3.3V	USB_D+	3
2	3.3V	GND	1

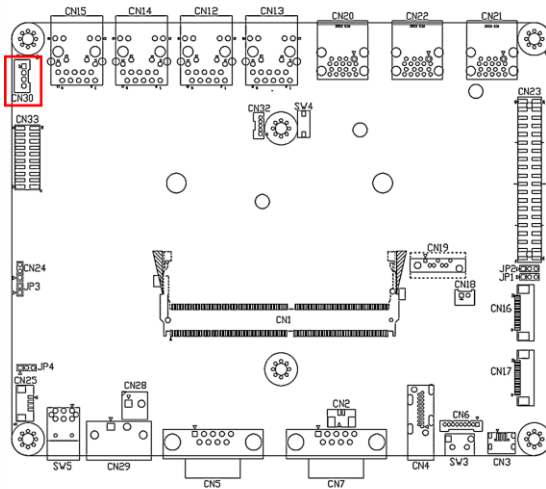
### 2.4.8 USB 3.2 Gen 2 Port (CN20/CN21/CN22)



Pin	Signal	Pin	Signal
U1	VBUS_1	U10	VBUS_2
U2	(A)D-	U11	(B)D-
U3	(A)D+	U12	(B)D+
U4	GND	U13	GND

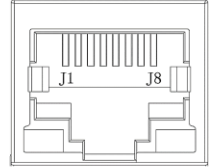
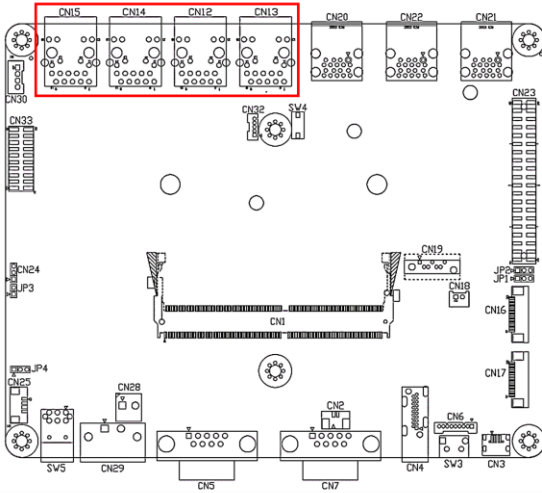
Pin	Signal	Pin	Signal
U5	(A)SSRX-	U14	(B)SSRX-
U6	(A)SSRX+	U15	(B)SSRX+
U7	GND	U16	GND
U8	(A)SSTX-	U17	(B)SSTX-
U9	(A)SSTX+	U18	(B)SSTX+

## 2.4.9 PoE Power Connector for use with PER-P32D (CN30)



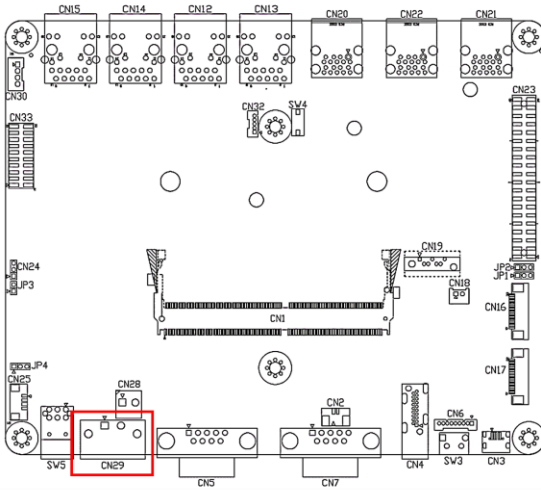
CN30 Pin	Function
1	V+
2	V+
3	V-
4	V-

## 2.4.10 PoE GbE RJ-45 (CN12/CN13/CN14/CN15)



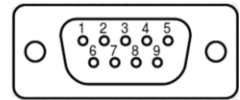
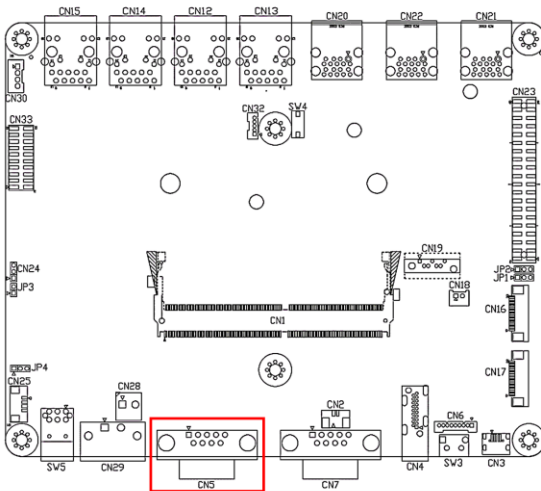
Pin	Signal	Pin	Signal
1	MDI0+	2	MDI0-
3	MDI1+	4	MDI1-
5	MDI2+	6	MDI2-
7	MDI3+	8	MDI3-

## 2.4.11 DC in Connector (5.0mm) (CN29)



Pin	Signal	Pin	Signal
1	DC Positive	2	DC Negative

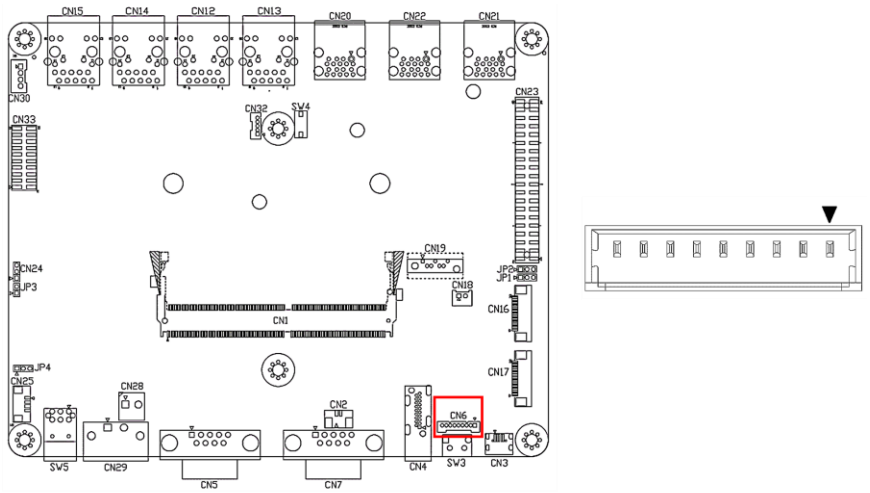
## 2.4.12 COM Port (CN5/SW1)



Pin	RS-232	RS-422	RS-485
1		TX-	D-

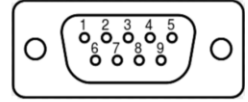
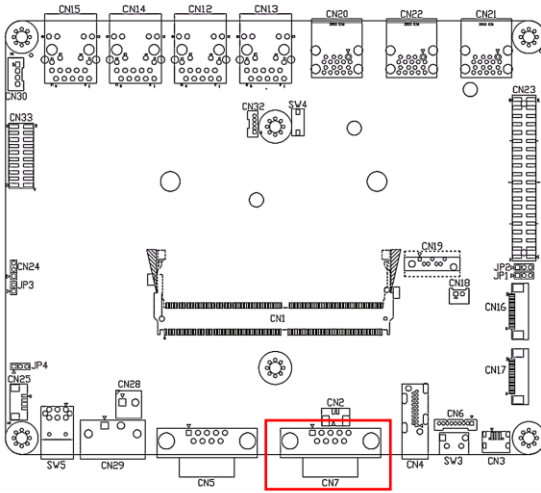
Pin	RS-232	RS-422	RS-485
2	RXD	TX+	D+
3	TXD	RX+	
4		RX-	
5	GND	GND	GND
6			
7			
8			
9			

### 2.4.13 COM Port Connector (/dev/ttyTHS1) (CN6/SW2)



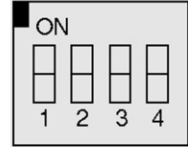
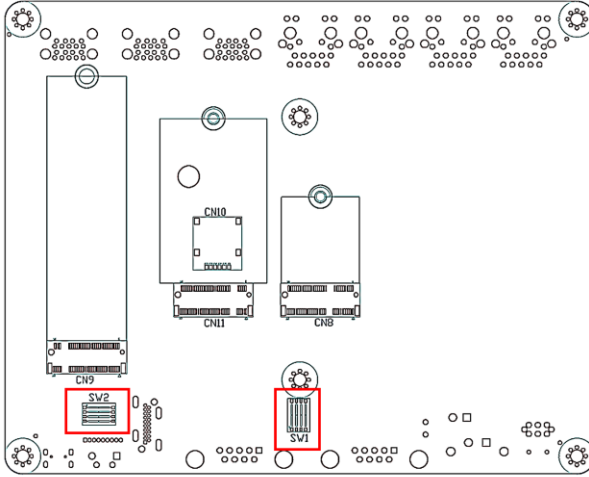
Pin	RS-232	RS-422	RS-485
1		TX-	D-
2		TX+	
3	RXD	RX+	D+
4		RX-	
5	TXD		
6			
7			
8			
9	GND	GND	GND

## 2.4.14 CANBus Connector (CN7)



Pin	Function
1	
2	CAN L
3	GND
4	
5	
6	GND
7	CAN H
8	
9	

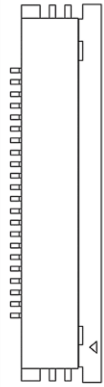
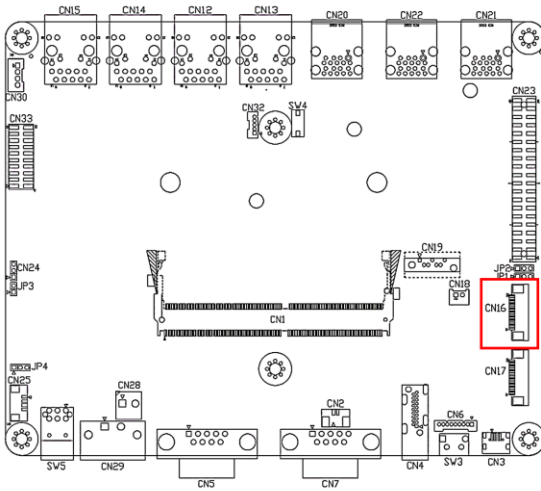
## 2.4.15 RS-232/422/485 Switch (SW1/SW2)



Mode	S-1	S-2	S-3	S-4
1T/1R RS-232	On	On		
1T/1R RS-422	On	Off		
1T/1R RS-485	Off	On		
Low power shutdown	Off	Off		
250kbps for RS-232 and RS-485				On
RS-232 to 3Mbps and RS-485 to 20Mbps				Off
Enable RS-485 bias and termination resistors.			On	
Disable RS-485 bias and termination resistors.			Off	

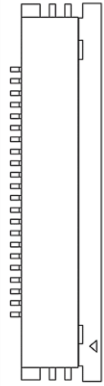
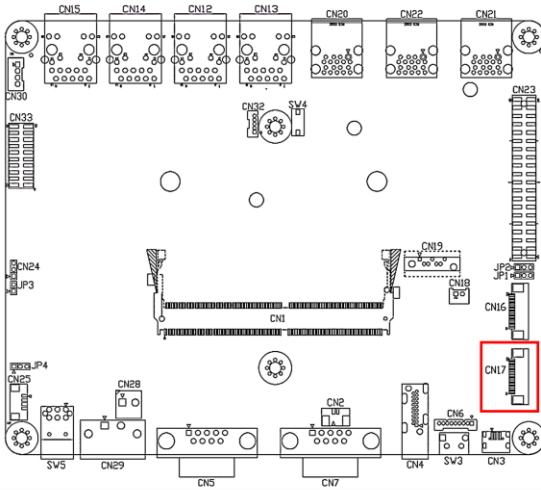


## 2.4.16 MIPI CSI-2 FPC Connector (CSI0/1) (CN16)



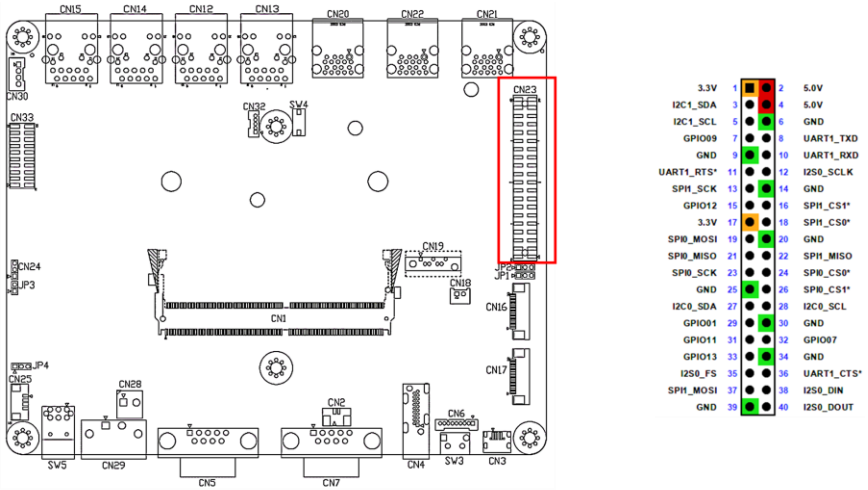
Pin	Signal	Pin	Signal
1	+3.3V	12	CSI0_D0_N
2	CAM0 SDA	13	GND
3	CAM0 SCL	14	CSI1_CLK_P
4	GND	15	CSI1_CLK_N
5	CAM0 MCLK	16	GND
6	CAM0 PWDN	17	CSI1_D1_P
7	GND	18	CSI1_D1_N
8	CSI0_D1_P	19	GND
9	CSI0_D1_N	20	CSI1_D0_P
10	GND	21	CSI1_D0_N
11	CSI0_D0_P	22	GND

## 2.4.17 MIPI CSI-2 FPC Connector (CSI2/3) (CN17)



Pin	Signal	Pin	Signal
1	+3.3V	12	CSI3_D0_N
2	CAM1 SDA	13	GND
3	CAM1 SCL	14	CSI2_CLK_P
4	GND	15	CSI2_CLK_N
5	CAM1 MCLK	16	GND
6	CAM1 PWDN	17	CSI2_D1_P
7	GND	18	CSI2_D1_N
8	CSI3_D1_P	19	GND
9	CSI3_D1_N	20	CSI2_D0_P
10	GND	21	CSI2_D0_N
11	CSI3_D0_P	22	GND

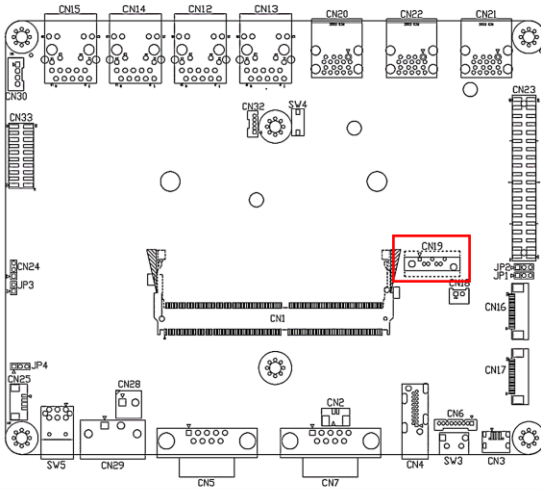
## 2.4.18 Expansion Header Connections (CN23)



Header Pin #	Module Pin Name	Module Pin #	SoC Pin Name	Default Usage / Description	Alternate Functionality	Type/ Dir	Pin Drive or Power Pin Max Current	SoC GPIO Port #	Power-on Default	PU/PD on Module	Notes
1	-	-	-	Main 3.3V Supply	-	Power (input)	1A	-	-	-	1
2	-	-	-	Main 5.0V Supply	-	Power (input/output)	1A	-	-	-	1
3	I2C1_SDA	191	GP16_I2CB_DAT	I2C #1 Data	-	Bidir OD	±2 mA	PDD.02	z	2.2KΩ PU	2
4	-	-	-	Main 5.0V Supply	-	Power	1A	-	-	-	-
5	I2C1_SCL	189	GP15_I2CB_CLK	I2C #1 Clock	-	Bidir OD	±2 mA	PDD.01	z	2.2KΩ PU	2
6	-	-	-	Ground	-	Ground	-	-	-	-	-
7	GPIO09	211	GP167	GPIO	Audio Primary Clock	Bidir/Output	±20µA	PAC.06	pd	-	3
8	UART1_TXD	203	GP70_UART1_TXD_BOOT2_STRAP	UART #1 Transmit	GPIO	Output/Bidir	±20µA	PR.02	pd	-	3
9	-	-	-	Ground	-	Ground	-	-	-	-	-
10	UART1_RXD	205	GP71_UART1_RXD	UART #1 Receive	GPIO	Input/Bidir	±20µA	PR.03	pd	-	3
11	UART1_RTS*	207	GP72_UART1_RTS_N	UART #2 Request to Send	GPIO	Bidir/Output	±20µA	PR.04	pd	-	3
12	I2S0_SCLK	199	GP122	GPIO	Audio I2S #0 Clock	Bidir	±20µA	PH.07	pd	-	3
13	SPI1_SCK	106	GP36_SPI3_CLK	GPIO	SPI #1 Shift Clock	Bidir/Output	±20µA	PY.00	pd	-	3
14	-	-	-	Ground	-	Ground	-	-	-	-	-
15	GPIO12	218	GP88_PWM1	GPIO	-	Bidir	±20µA	PN.01	z	-	3
16	SPI1_CS0*	112	GP40_SPI3_CS1_N	GPIO	SPI #1 Chip Select #1	Bidir/Output	±20µA	PY.04	z	-	3
17	-	-	-	Main 3.3V Supply	-	Power	1A	-	-	-	1
18	SPI1_CS0*	110	GP39_SPI3_CS0_N	GPIO	SPI #0 Chip Select #0	Bidir/Output	±20µA	PZ.06	z	-	3
19	SPI0_MOSI	89	GP49_SPI1_MOSI	GPIO	SPI #0 Primary Out/Secondary In	Bidir/Output	±20µA	PZ.05	pd	-	3
20	-	-	-	Ground	-	Ground	-	-	-	-	-
21	SPI0_MISO	93	GP48_SPI1_MISO	GPIO	SPI #0 Primary In/Secondary Out	Bidir/Input	±20µA	PZ.04	pd	-	3
22	SPI1_MISO	108	GP37_SPI3_MISO	GPIO	SPI #1 Primary In/Secondary Out	Bidir/Input	±20µA	PY.01	pd	-	3
23	SPI0_SCK	91	GP47_SPI1_CLK	GPIO	SPI #0 Shift Clock	Bidir/Output	±20µA	PZ.03	pd	-	3

Header Pin #	Module Pin Name	Module Pin #	SoC Pin Name	Default Usage / Description	Alternate Functionality	Type/ Dir	Pin Drive or Power Pin Max Current	SoC GPIO Port #	Power-on Default	PU/PD on Module	Notes
24	SPIO_CS0*	95	GP50_SPI1_CS0_N	GPIO	SPI #0 Chip Select #0	Bidir/Output	±20uA	PZ.06	z		3
25	-	-	-	Ground	-	Ground	-	-	-	-	-
26	SPIO_CS1*	97	GP51_SPI1_CS1_N	GPIO	SPI #0 Chip Select #1	Bidir/Output	±20uA	PZ.07	pu		3
27	I2C0_SDA	187	GP14_I2C2_DAT	I2C #0 Data	GPIO	Bidir OD/Bidir	±2 mA	PDD.00	z	1.5KΩ PU	2
28	I2C0_SCL	185	GP13_I2C2_CLK	I2C #0 Clock	GPIO	Bidir OD/Bidir	±2 mA	PCC.07	z	1.5KΩ PU	2
29	GPIO01	118	GP65	GPIO	General Purpose Clock #0	Bidir/Output	±20uA	PQ.05	pd		3
30	-	-	-	Ground	-	Ground	-	-	-	-	-
31	GPIO11	216	GP66	GPIO	General Purpose Clock #1	Bidir/Output	±20uA	PQ.06	pd		3
32	GPIO07	206	GP113_PWM7	GPIO	PWM	Bidir/Output	±20uA	PG.06	z		3
33	GPIO13	228	GP115	GPIO	PWM	Bidir/Output	±20uA	PH.00	z		3
34	-	-	-	Ground	-	Ground	-	-	-	-	-
35	I2S0_FS	197	GP125	GPIO	Audio I2S #0 Field Select	Bidir	±20uA	PI.02	pd		3
36	UART1_CTS*	209	GP73_UART1_CTS_N	GPIO	UART #1 Clear to Send	Bidir/Input	±20uA	PR.05	pd		3
37	SPI1_MOSI	104	GP38_SPI3_MOSI	GPIO	SPI #1 Primary Out/Secondary In	Bidir/Output	±20uA	PY.02	pd		3
38	I2S0_DIN	195	GP124	GPIO	Audio I2S #0 Data in	Bidir/Input	±20uA	PI.01	pd		3
39	-	-	-	Ground	-	Ground	-	-	-	-	-
40	I2S0_DOUT	193	GP123	GPIO	Audio I2S #0 Data Out	Bidir/Output	±20uA	PI.00	pd		3

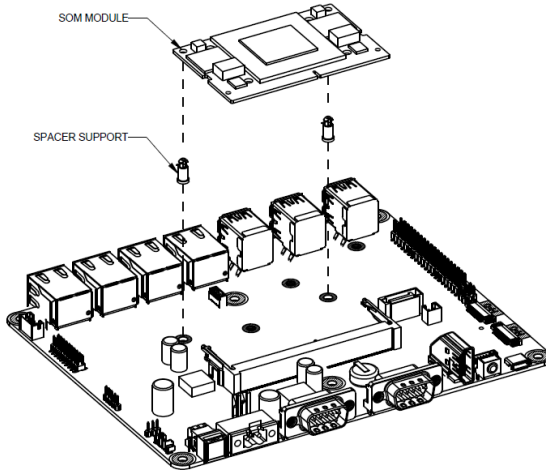
## 2.4.19 SATA Connector (CN19)



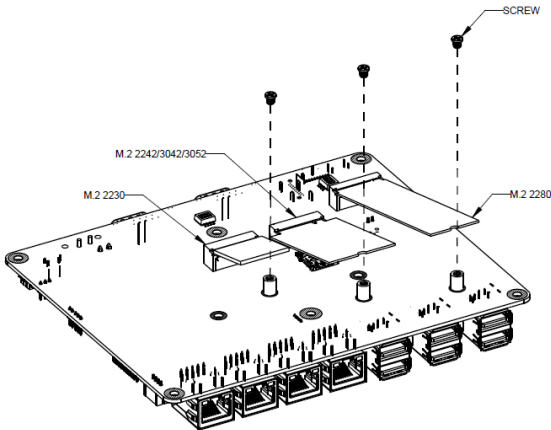
Pin	Function
1	GND
2	TX+
3	TX-
4	GND
5	RX+
6	RX-
7	GND

## 2.5 Hardware Assembly

### 2.5.1 Module Installation



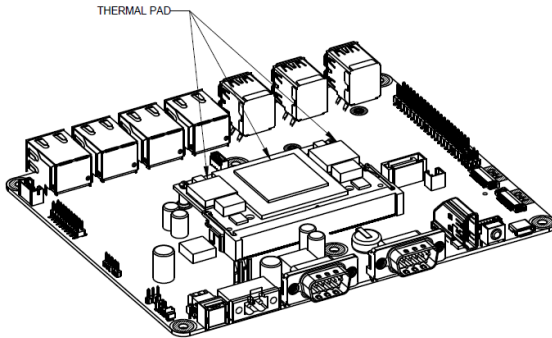
### 2.5.2 M.2 Module Installation



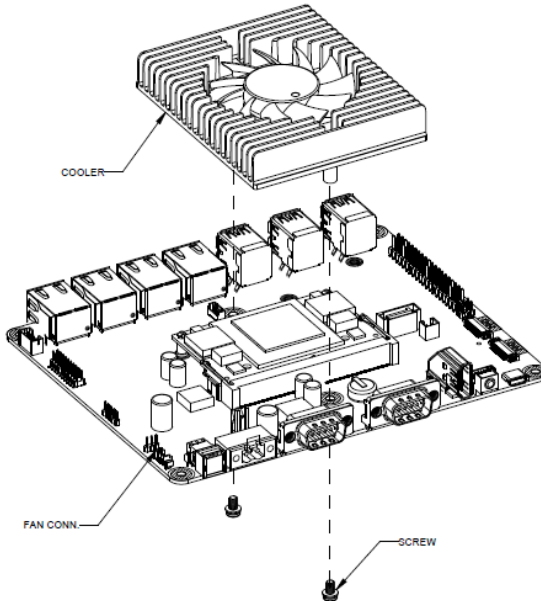
## 2.5.3 Active Cooler Installation

Ensure the SoM module is installed prior to cooler installation. Please also ensure a thermal pad is placed in-between the SoM module and the cooler module when installing.

1.



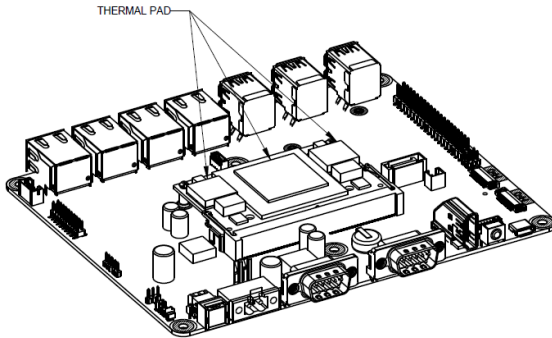
2.



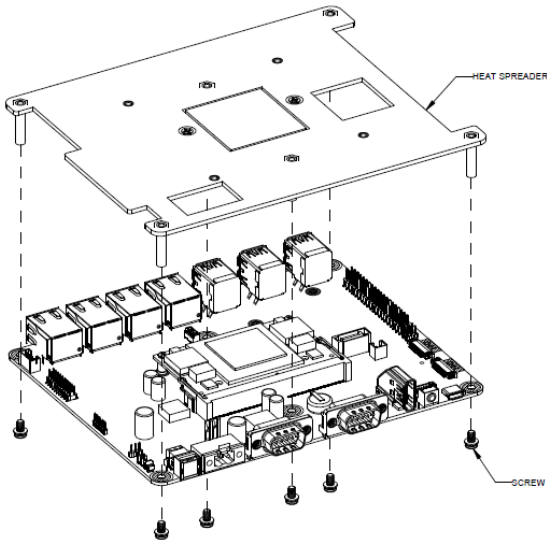
## 2.5.4 Heatspreader Installation

Ensure the SoM module is installed prior to heatspreader installation. Please also ensure a thermal pad is placed in-between the SoM module and the heatspreader when installing.

1.



2.

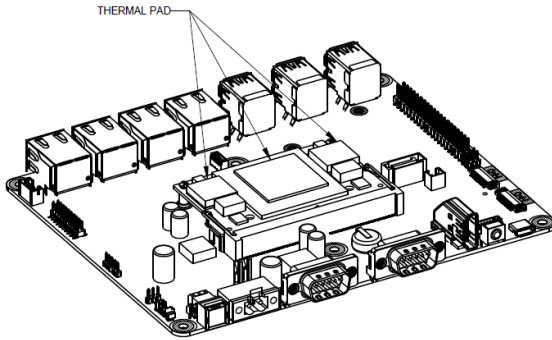




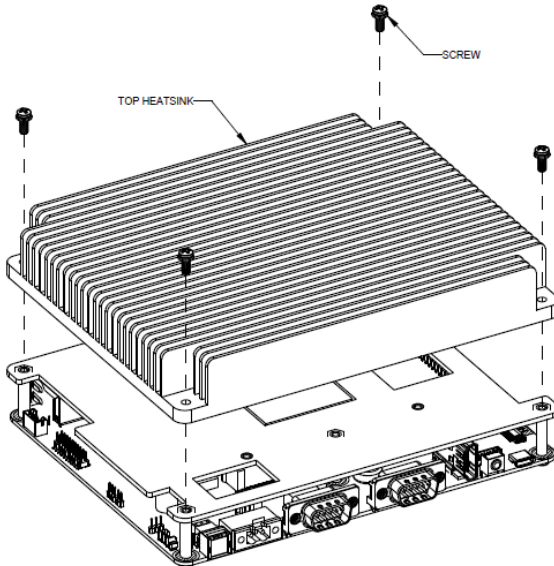
## 2.5.5 Heatsink Installation

Ensure the SoM module is installed prior to heatsink installation. Please also ensure a thermal pad, followed by the heat plate, is placed in-between the SoM module and the top heatsink.

1.



2.



# Chapter 3

---

BSP Flash Guide

### 3.1 Before Installation

---

Before starting the process, make sure your BOXER-8654AI-KIT system is turned off and the power is disconnected. You will need a Host PC running Ubuntu 20.04, and to ensure the NVIDIA Jetson Orin NX module is installed on the BOXER-8654AI-KIT 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\\_8654AI-KIT\\_J6.0\\_A00\\_1.0.1\\_20241008.tar.gz"](#) into Host Ubuntu 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 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 the Linux terminal and enter the following command to extract the compressed BSP image files (BSP file name may vary):

```
$ sudo tar -zxvf BOXER_8654AI-KIT_J6.0_A00_1.0.1_20241008.tar.gz
```

**Note:** Do not decompress the file (i.e. 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:

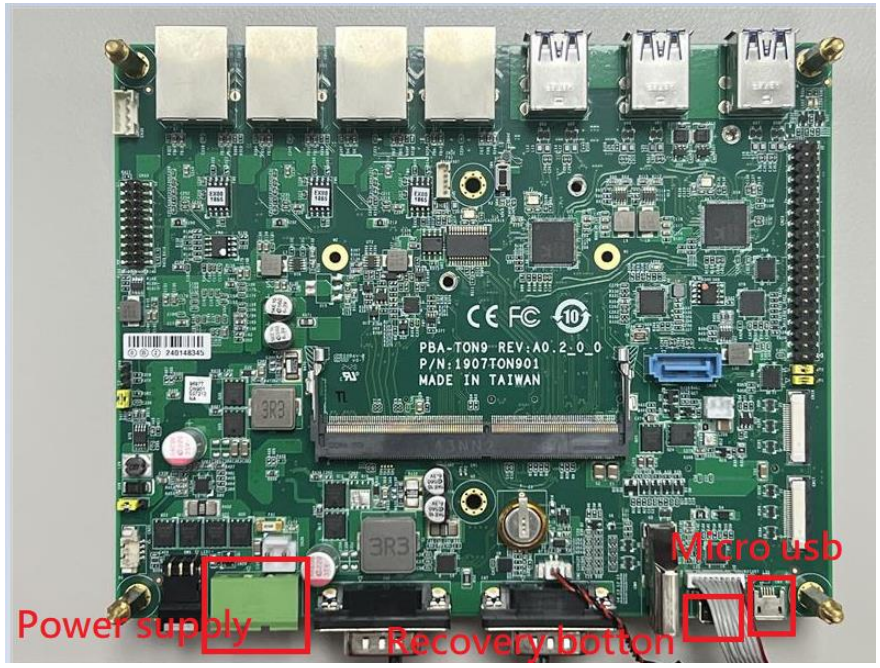
1. Connect the Micro-USB plug on the USB cable to the Recovery Port on the BOXER-8654AI-KIT and the other end to an available USB port on the Host PC..
2. Connect the BOXER-8654AI-KIT power supply.
3. Press and hold the recovery key button. While holding the recovery key button, power on the system and continue to hold the recovery key button for two seconds before release, the BOXER-8654AI-KIT should then enter recovery mode.
4. To check if device is in recovery mode, enter the command `lsusb` in terminal on Host.

```
$ lsusb | grep "0955:7523"
```

If successful, the command will return `"0955:7523 Nvidia Corp"`

```
Bus 001 Device 018: ID 0955:7523 Nvidia Corp.
```

**Note:** Recovery mode cannot be initiated if the NVIDIA Jetson Orin NX module is disassembled. Ensure the NVIDIA Jetson Orin NX 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-8654AI-KIT.

- 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 -s 62517420 nvme
```

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

```
writing iten=16, 9:0:secondary_gpt, 32808902144, 16896, gpt_secondary_9_0.bin, 16896, fixed-<reserved>-0, 59012273e727e6a457684ff7885a26ed6cf1c4fa
[ 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 xnl 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 nvme
```

### 3.4 Check BSP Version

---

Once the flash image is successfully installed, the BOXER-8653AI 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-8654AI-KIT\_J6.0\_A00\_1.0.1\_20241008**

The version name will follow the format of:

**{PJ\_IF}\_{JPV\_IF}\_A00\_{IMGV\_IF}\_{BD\_IF}**

For example:

**BOXER-8654AI-KIT\_J6.0\_A00\_1.0.1\_20241008**

Note: Filename may differ from this example.

**{PJ\_IF}** is Project Information; e.g. BOXER-8654AI-KIT

**{IMGV\_IF}** is Build Version; e.g. 1.0.1

**{JPV\_IF}** is Jetpack Version; e.g. J6.0

**{BD\_IF}** is Build Date; e.g. 20241008

# Chapter 4

---

OS User Guide



## 4.1 Introduction

---

The BOXER-8654AI-KIT's OS, Ubuntu/Linux version, and preinstalled SDK components are as follows:

For **Jetpack 6.0 (L4t 36.3)**

1. Jetpack 6.0, L4T 36.3.0
  - a. Ubuntu version: 22.04.4
  - b. Kernel version: 5.15.136-tegra
  - c. UEFI version: 36.3.0-gcid-36191598
2. Pre-installed NV components, deepstream
  - a. CUDA 12.2.1
  - b. cuDNN 8.9.4
  - c. TensorRT 8.6.2
  - d. OpenCV 4.8
  - e. Vulkan 1.3
  - f. VPI 3.1
  - g. NVIDIA Container Runtime 2.1
  - h. Multimedia API 36.3.0
  - i. Nsight Systems 2024.2
  - j. Nsight Graphics 2023.4
  - k. Nsight Perf SDK 2023.5
  - l. Deepstream 7.0
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-8654AI-KIT

NVIDIA Jetson Orin NX power mode can be selected and monitored by GUI, please refer to the following image:



**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 for BOXER-8654AI-KIT

---

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 JP6 :

1. Set GPIO to 0  
\$ sudo gpiowrite -m time -u 300000 -b \$(sudo gpiofind "PY.02")=0
2. Read the input value of GPIO  
\$ sudo gpioget \$(sudo gpiofind "PY.02")

Note: Jp6 no need to export and set direction of the gpio, when using gpioget, the direction will auto change to input, and vice versa

2. FAN PWM test command:

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.