BOXER-8221AI

Compact Fanless Embedded AI@Edge Box PC with NVIDIA® Jetson Nano™

User's Manual 4th Ed

Last Updated: August 28, 2020

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Packing List

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

Item	Quantity
● BOXER-8221AI	1
● Wall mount bracket	2
● Power Connector	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 AC 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.

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Chapter 1

Product Specifications

1.1 Specifications

System

CPU	Quad Core ARM® Cortex®-A57 MPCore Processor
Chipset	—
System Memory	4GB LPDDR4
AI Solution	Nvidia Jetson Nano
Display Interface	HDMI 2.0
Storage Device	16GB/32GB Micro-SD or 16GB eMMC
Ethernet	10/100/1000Base-TX x 1
I/O	USB 3.2 Gen 1 x 4 LAN x 1 RS-232 x 2 HDMI x 1 Micro USB for Flash OS x 1 MicroSD x 1 DC Power Input x 1 Recovery Button x 1
Expansion	M.2 E-Key 2230 (for Wi-Fi)
Indicator	Power LED x 1
OS Support	Linux (AAEON ACLinux 4.9, Compliance with Ubuntu 18.04)

Power Supply

Power Requirement	12Vdc w/ 2-pin terminal block

Mechanical

Mounting	Wallmount
Dimensions (W x D x H)	3.46" x 2.95" x 1.53" (88 mm x 75 mm x 39 mm)
Gross Weight	1.10 lbs. (0.5 kg)
Net Weight	0.66 lbs. (0.3 kg)

Environmental

Operating Temperature	-4°F ~ 122°F (-20°C ~ 50°C, according to IEC60068-2 with 0.5 m/s airflow)
Storage Temperature	-49°F ~176°F (-45°C ~ 80°C)
Storage Humidity	95% @ 40°C, non-condensing
Anti-Vibration	3 Grms/ 5 ~ 500Hz/ operation – MicroSD or eMMC
Certification	CE/FCC class A

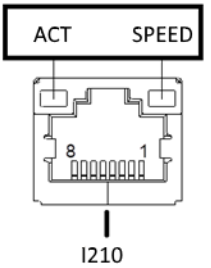
1.2 Product Notice

Micro-USB: Micro-USB port is ideally for flashing image only.

USB ports: USB ports do not support USB DVD ROM because of file system.

USB 3.2 Gen 1: USB 3.2 Gen 1 is the current name for 5Gbps specification, formerly USB 3.0.

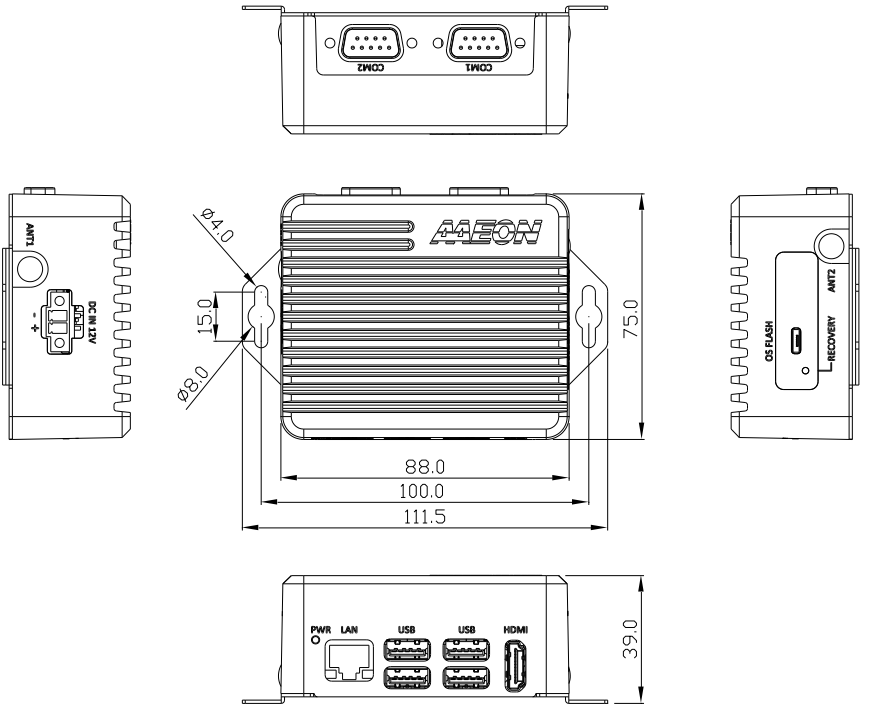
LAN Indicator Behavior



Chapter 2

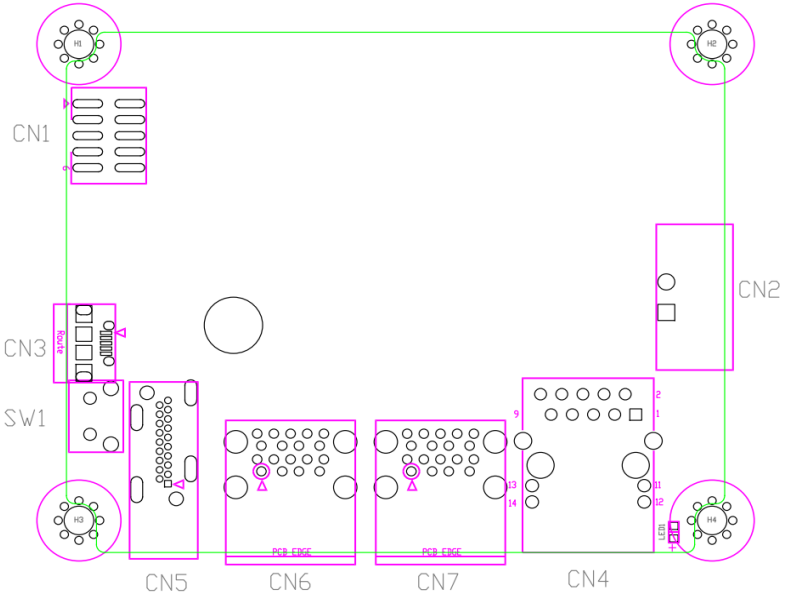
Hardware Information

2.1 Dimensions

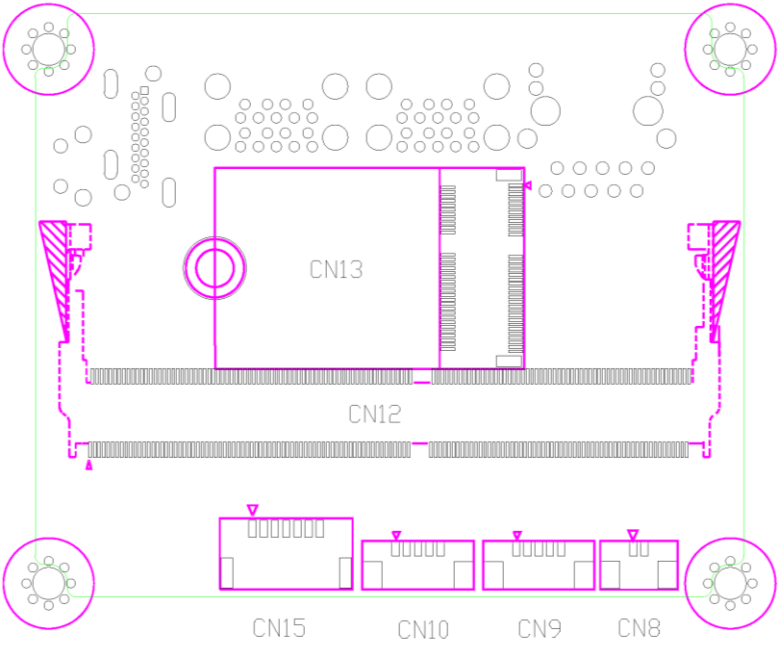


2.2 Jumpers and connectors

Component Side



Module Side



2.3 List of Jumpers

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

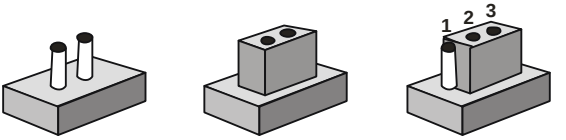
The table below shows the function of each of the board's jumpers

Label	Function
CN1 (Pin 7-8)	AT/ATX mode select

2.3.1 Setting Jumpers

You can configure your system 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.



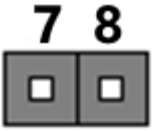
Open **Closed** **Closed 2-3**

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

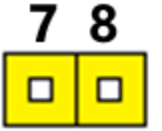
If you have any questions about the best hardware configuration for your application, contact your local distributor or sales representative before you make any changes. Generally, you simply need a standard cable to make most connections.

2.3.2 AT/ATX Mode Select (CN1 Pins 7-8)

The AT/ATX Mode Select functions by connecting pins 7 and 8 of CN1. To prevent damage to the system, do not connect pins 7 and 8 to any other pin.



Open – AT Mode



Closed – ATX Mode
(Default)

CN1 pins 7-8	Function
7-8 Open	AT Power Mode
7-8 Closed	ATX Power Mode (Default)

2.4 List of Connectors

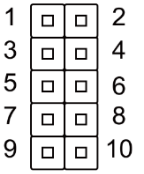
The board has a number of connectors that allow you to configure your system to suit your application.

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

Label	Function
CN1	Front Panel Connector
CN2	DC Power In connector
CN3	Micro USB for Flash image
CN4	Giga LAN Connector
CN5	HDMI Connector
CN6	Dual USB 3.2 Gen 1 Connector
CN7	Dual USB 3.2 Gen 1 Connector
CN8	RTC Connector
CN9	COM1 Connector
CN10	COM2 Connector
CN12	Jetson NANO CPU module connector
CN13	M.2 E key
CN15	UART for Debug
SW1	Recovery switch

Note: USB 3.2 Gen 1 uses the same specifications as USB 3.0 (transfer rate 5Gbs).

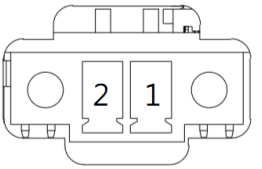
2.4.1 Front Panel Connector (CN1)



Pin	Signal	Pin	Signal
1	Button power	2	GND
3	Recovery	4	GND
5	Reset	6	GND
7	Latch set	8	Latch set
9	PWR LED	10	+5V

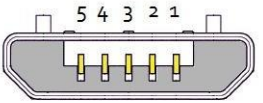
Note: Pin 7 and 8 are used for setting AT/ATX Power Mode. See **Chapter 2.3.2** for information. To prevent damage to your system, do not connect Pins 7 and 8 with any other pin.

2.4.2 DC Power In Connector (CN2)



Pin	Signal	Pin	Signal
1	PWR_IN	2	GND

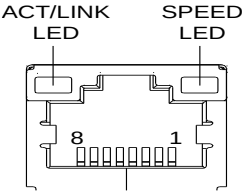
2.4.3 USB 2.0 Connector for Flash Image (CN3)



USB Micro-B

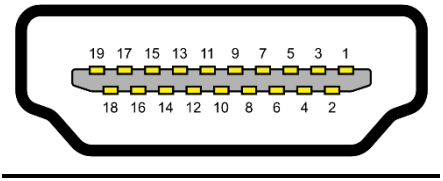
Pin	Signal	Pin	Signal
1		2	USB1-
3	USB1+	4	
5	GND		

2.4.4 LAN RJ45 Port (CN4)



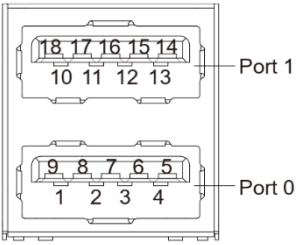
Pin	Signal	Pin	Signal
1	MDI0+	2	MDI0-
3	MDI1+	4	MDI1-
5	MDI2+	6	MDI2-
7	MDI3+	8	MDI3-

2.4.5 HDMI Connector (CN5)



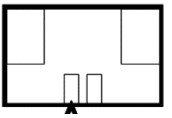
Pin	Signal	Pin	Signal
1	HDMI_DATA2_P	2	GND
3	HDMI_DATA2_N	4	HDMI_DATA1_P
5	GND	6	HDMI_DATA1_N
7	HDMI_DATA0_P	8	GND
9	HDMI_DATA0_N	10	HDMI_CLK_P
11	GND	12	HDMI_CLK_N
13	NC	14	NC
15	HDMI_SCL	16	HDMI_SDA
17	GND	18	HDMI_PWR
19	HDMI_HDP		

2.4.6 Dual USB 3.2 Gen 1 Connector (CN6/CN7)



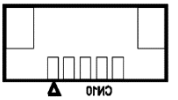
Pin	Signal	Pin	Signal
U1	VBUS_1	U10	VBUS_2
U2	(A)D-	U11	(B)D-
U3	(A)D+	U12	(B)D+
U4	GND	U13	GND
U5	(A)SSRX-	U14	(B)SSRX-
U6	(A)SSRX+	U15	(B)SSRX+
U7	GND	U16	GND
U8	(A)SSTX-	U17	(B)SSTX-
U9	(A)SSTX+	U18	(B)SSTX+

2.4.7 RTC Battery Connector (CN8)



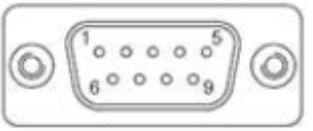
Pin	Signal	Pin	Signal
1	+3V	2	GND

2.4.8 COM Port Connector (CN9/CN10)



Pin	RS-232	UART (3.3V)
1	TXD	
2	RXD	
3		UART TXD
4		UART RXD
5	GND	
6		
7		
8		
9		

2.4.9 COM Port Connector (System)



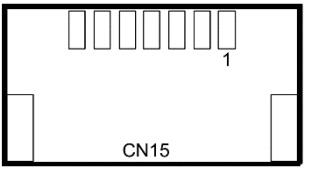
Pin	RS-232	UART (3.3V)
1		
2	RXD	
3	TXD	
4		
5	GND	
6		
7		UART RXD
8		UART TXD
9		

2.4.10 Jetson Nano CPU Module Connector (CN12)

Signal Name	Pin # Top Odd	Pin # Bottom Even	Signal Name
GND	1	2	GND
CSI1_D0_N	3	4	CSI0_D0_N
CSI1_D0_P	5	6	CSI0_D0_P
GND	7	8	GND
RSVD	9	10	CSI0_CLK_N
RSVD	11	12	CSI0_CLK_P
GND	13	14	GND
CSI1_D1_N	15	16	CSI0_D1_N
CSI1_D1_P	17	18	CSI0_D1_P
GND	19	20	GND
CSI3_D0_N	21	22	CSI2_D0_N
CSI3_D0_P	23	24	CSI2_D0_P
GND	25	26	GND
CSI3_CLK_N	27	28	CSI2_CLK_N
CSI3_CLK_P	29	30	CSI2_CLK_P
GND	31	32	GND
CSI3_D1_N	33	34	CSI2_D1_N
CSI3_D1_P	35	36	CSI2_D1_P
GND	37	38	GND
DP0_TXD0_N	39	40	CSI4_D2_N
DP0_TXD0_P	41	42	CSI4_D2_P
GND	43	44	GND
DP0_TXD1_N	45	46	CSI4_D0_N
DP0_TXD1_P	47	48	CSI4_D0_P
GND	49	50	GND
DP0_TXD2_N	51	52	CSI4_CLK_N
DP0_TXD2_P	53	54	CSI4_CLK_P
GND	55	56	GND
DP0_TXD3_N	57	58	CSI4_D1_N
DP0_TXD3_P	59	60	CSI4_D1_P
GND	61	62	GND
DP1_TXD0_N	63	64	CSI4_D3_N
DP1_TXD0_P	65	66	CSI4_D3_P
GND	67	68	GND
DP1_TXD1_N	69	70	DSI_D0_N
DP1_TXD1_P	71	72	DSI_D0_P
GND	73	74	GND
DP1_TXD2_N	75	76	DSI_CLK_N
DP1_TXD2_P	77	78	DSI_CLK_P
GND	79	80	GND
DP1_TXD3_N	81	82	DSI_D1_N
DP1_TXD3_P	83	84	DSI_D1_P
GND	85	86	GND
GPIO00	87	88	DP0_HPD
SPI0_MOSI	89	90	DP0_AUX_N
SPI0_SCK	91	92	DP0_AUX_P
SPI0_MISO	93	94	HDMI_CEC
SPI0_CS0*	95	96	DP1_HPD
SPI0_CS1*	97	98	DP1_AUX_N
UART0_TXD	99	100	DP1_AUX_P
UART0_RXD	101	102	GND
UART0_RTS*	103	104	SPI1_MOSI
UART0_CTS*	105	106	SPI1_SCK
GND	107	108	SPI1_MISO
USB0_D_N	109	110	SPI1_CS0*
USB0_D_P	111	112	SPI1_CS1*
GND	113	114	CAM0_PWDN
USB1_D_N	115	116	CAM0_MCLK
USB1_D_P	117	118	GPIO01
GND	119	120	CAM1_PWDN
USB2_D_N	121	122	CAM1_MCLK
USB2_D_P	123	124	GPIO02
GND	125	126	GPIO03
GPIO04	127	128	GPIO05
GND	129	130	GPIO06
PCIE0_RX0_N	131	132	GND

Signal Name	Pin # Top Odd	Pin # Bottom Even	Signal Name
PCIE0_RX0_P	133	134	PCIE0_TX0_N
GND	135	136	PCIE0_TX0_P
PCIE0_RX1_N	137	138	GND
PCIE0_RX1_P	139	140	PCIE0_TX1_N
GND	141	142	PCIE0_TX1_P
RSVD	143	144	GND
KEY	KEY	KEY	KEY
RSVD	145	146	GND
GND	147	148	PCIE0_TX2_N
PCIE0_RX2_N	149	150	PCIE0_TX2_P
PCIE0_RX2_P	151	152	GND
GND	153	154	PCIE0_TX3_N
PCIE0_RX3_N	155	156	PCIE0_TX3_P
PCIE0_RX3_P	157	158	GND
GND	159	160	PCIE0_CLK_N
USBSS_RX_N	161	162	PCIE0_CLK_P
USBSS_RX_P	163	164	GND
GND	165	166	USBSS_TX_N
RSVD	167	168	USBSS_TX_P
RSVD	169	170	GND
GND	171	172	RSVD
RSVD	173	174	RSVD
RSVD	175	176	GND
GND	177	178	MOD_SLEEP*
PCIE_WAKE*	179	180	PCIE0_CLKREQ*
PCIE0_RST*	181	182	RSVD
RSVD	183	184	GBE_MDI0_N
I2C0_SCL	185	186	GBE_MDI0_P
I2C0_SDA	187	188	GBE_LED_LINK
I2C1_SCL	189	190	GBE_MDI1_N
I2C1_SDA	191	192	GBE_MDI1_P
I2S0_DOUT	193	194	GBE_LED_ACT
I2S0_DIN	195	196	GBE_MDI2_N
I2S0_FS	197	198	GBE_MDI2_P
I2S0_SCLK	199	200	GND
GND	201	202	GBE_MDI3_N
UART1_TXD	203	204	GBE_MDI3_P
UART1_RXD	205	206	GPIO07
UART1_RTS*	207	208	GPIO08
UART1_CTS*	209	210	CLK_32K_OUT
GPIO09	211	212	GPIO10
CAM_I2C_SCL	213	214	FORCE_RECOVERY*
CAM_I2C_SDA	215	216	GPIO11
GND	217	218	GPIO12
SDMMC_DAT0	219	220	I2S1_DOUT
SDMMC_DAT1	221	222	I2S1_DIN
SDMMC_DAT2	223	224	I2S1_FS
SDMMC_DAT3	225	226	I2S1_SCLK
SDMMC_CMD	227	228	GPIO13
SDMMC_CLK	229	230	GPIO14
GND	231	232	I2C2_SCL
SHUTDOWN_REQ*	233	234	I2C2_SDA
PMIC_BBAT	235	236	UART2_TXD
POWER_EN	237	238	UART2_RXD
SYS_RESET*	239	240	SLEEP/WAKE*
GND	241	242	GND
GND	243	244	GND
GND	245	246	GND
GND	247	248	GND
GND	249	250	GND
VDD_IN	251	252	VDD_IN
VDD_IN	253	254	VDD_IN
VDD_IN	255	256	VDD_IN
VDD_IN	257	258	VDD_IN
VDD_IN	259	260	VDD_IN

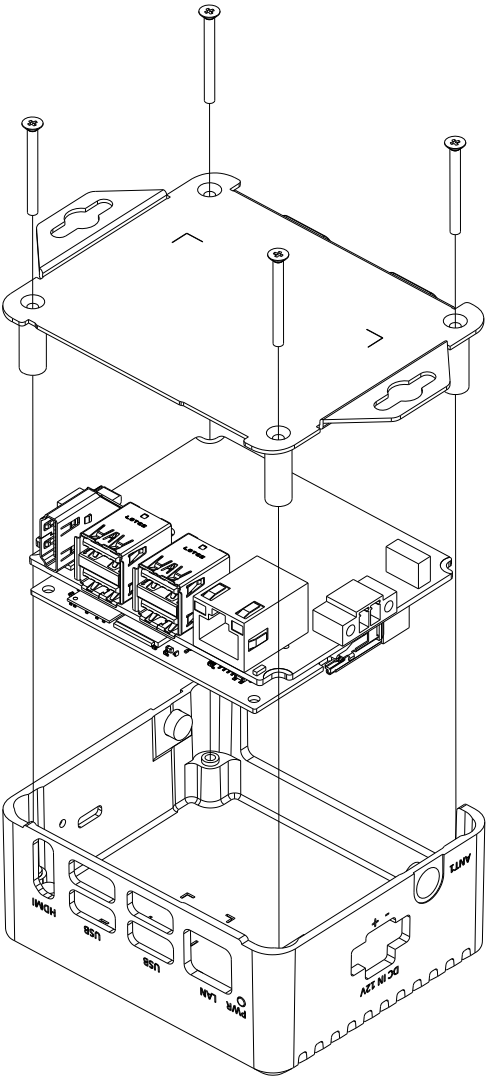
2.4.11 UART Debug Port Connector (CN15)



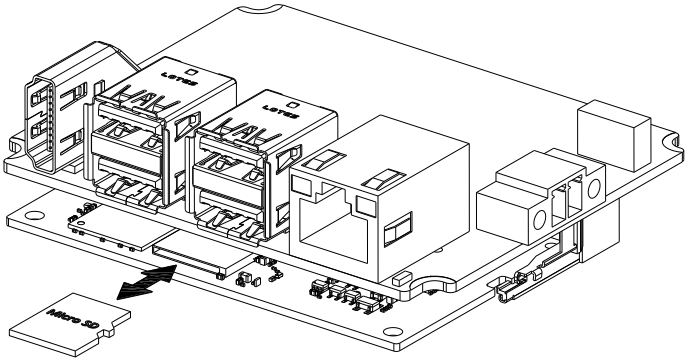
Pin	
1	3.3V
2	UART0 TXD
3	UART0 RXD
4	GND
5	I2C SCL
6	I2C SDA
7	GND

2.5 Hardware Assembly

Chassis Assembly



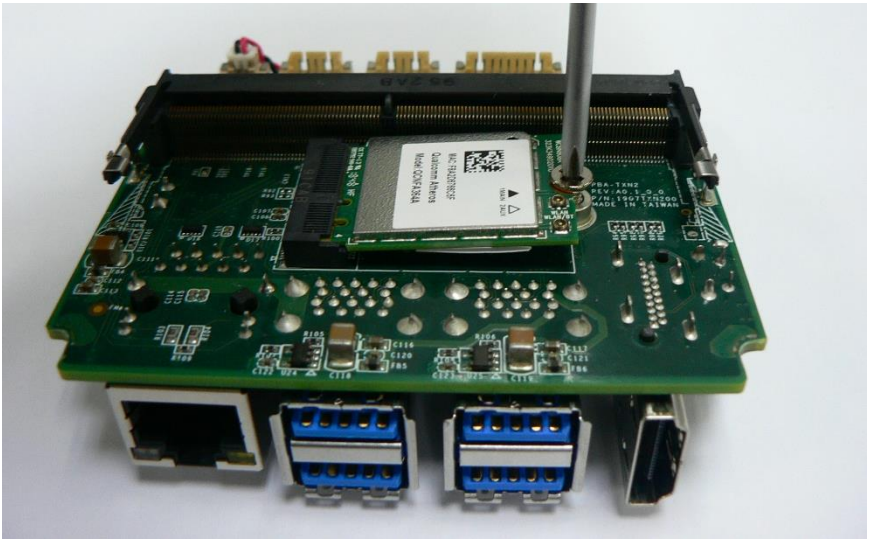
Micro-SD Installation



Micro-SD card installs directly onto NVIDIA Jetson Nano module. Check diagram for correct orientation before inserting card.

M.2 Module Installation

M.2 module attaches to the BOXER-8221AI board. NVIDIA Jetson Nano module must be removed prior to installing M.2 module.



Chapter 3

OS Flash guide

3.1 Flash OS Image to SD-Card

3.1.1 Introduction

This chapter details the steps to flashing the AAEON ACLinux OS to your BOXER-8221AI NVIDIA Jetson Nano system. The ACLinux image can be downloaded from the product page at:

https://www.aaeon.com/en/p/nvidia-jetson-nano-embedded-box-pc-boxer-8221ai

The instructions in this chapter are only applicable to ACLinux build number 3 or later. To identify the build number, check the file name of the download. It should be formatted as follows, with {BN} being the build number

```
ACLinux_4.9_ACLNX49D.NV03.BOXER-8221AI.{BN}.tar.gz
```

For example, build number 4 will be named as:

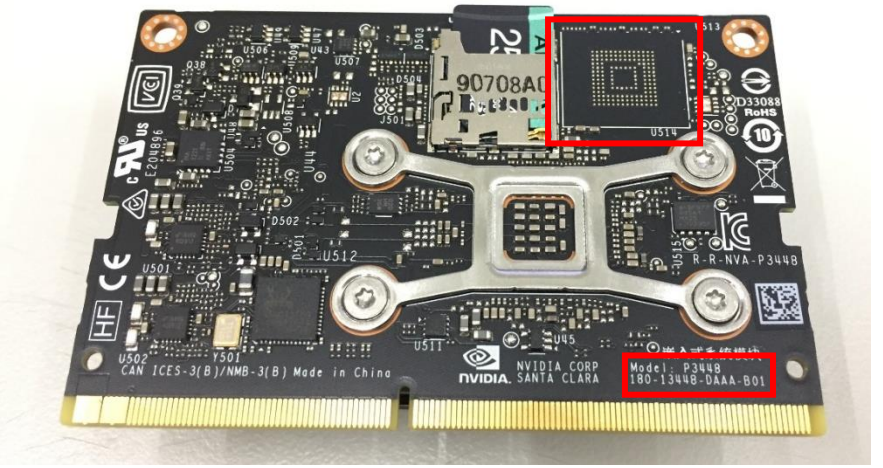
```
ACLinux_4.9_ACLNX49D.NV03.BOXER-8221AI.4.tar.gz
```

If you have any questions or are unsure which build number you have, or need help installing an older build, please contact AAEON support or your AAEON representative for assistance.

3.1.2 Before You Begin

Before beginning the process ensure you have the following:

- ACLinux Image Build 3 or later
- One host PC with operating system Ubuntu 16.04 or 18.04
- Micro-SD Card 16GB or larger
- Micro-SD Card USB adapter/reader (if host PC does not have a Micro-SD Slot)
- Jetson Nano Development Kit B01 module (no onboard eMMC storage); see image below for reference



AAEON recommends downloading balenaEtcher for the image flash process. You can download Etcher from the balena website: https://www.balena.io/etcher/

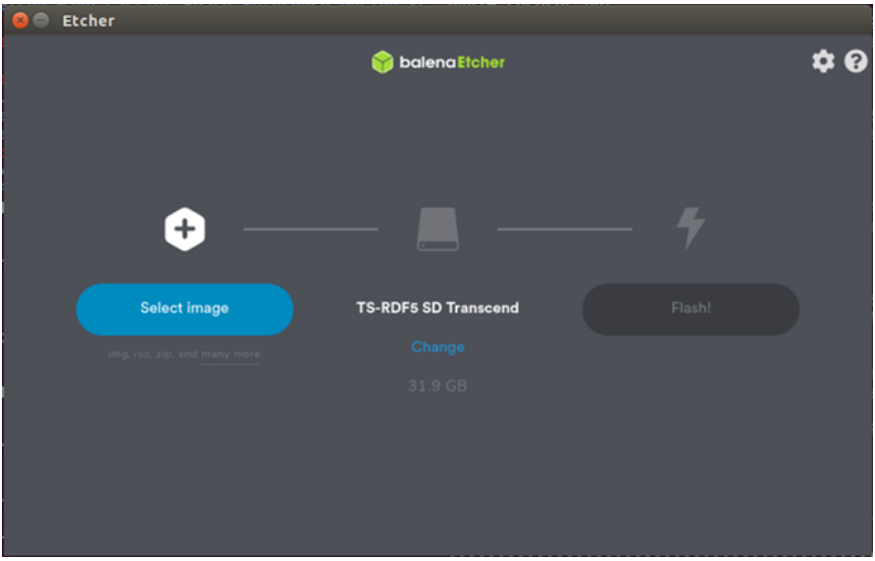
Finally, before starting, on the Linux host PC, extract the image file you downloaded using the following command in terminal (remember to replace {BN} with the actual build number in the file name):

```
$ tar xzf ACLinux_4.9_ACLNX49D.NV03.BOXER-8221AI.{BN}.tar.gz
```

3.1.3 Flash Image to Micro SD Card

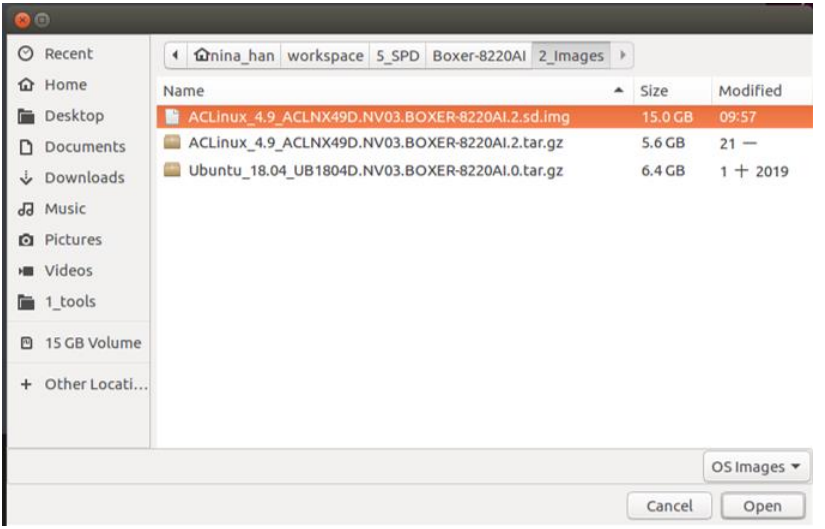
Step 1: Insert the Micro-SD card you want to flash into the host PC.

Step 2: Run the Etcher flash tool.

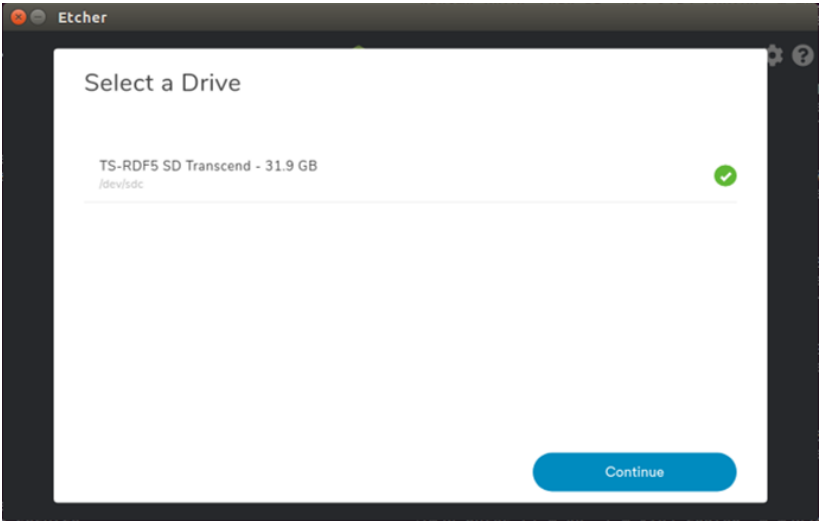


Step 3: Click "Select image" and choose the image file you extracted. File name should look like:

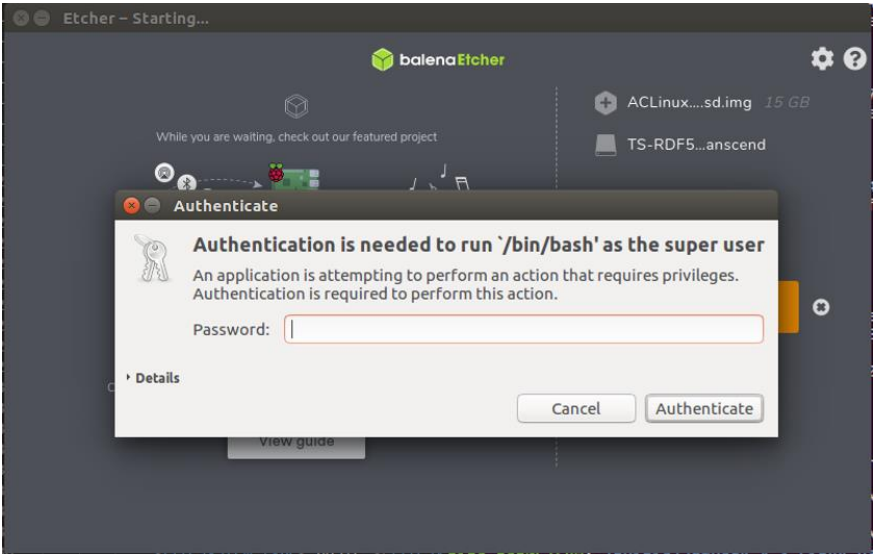
`ACLinux_4.9_ACLNX49D.NV03.BOXER-8221AI.{BN}.sd.img`



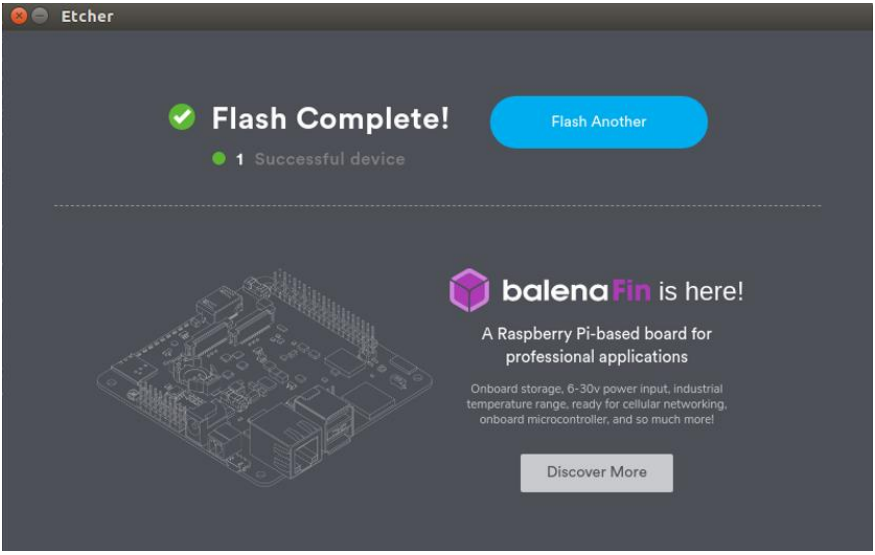
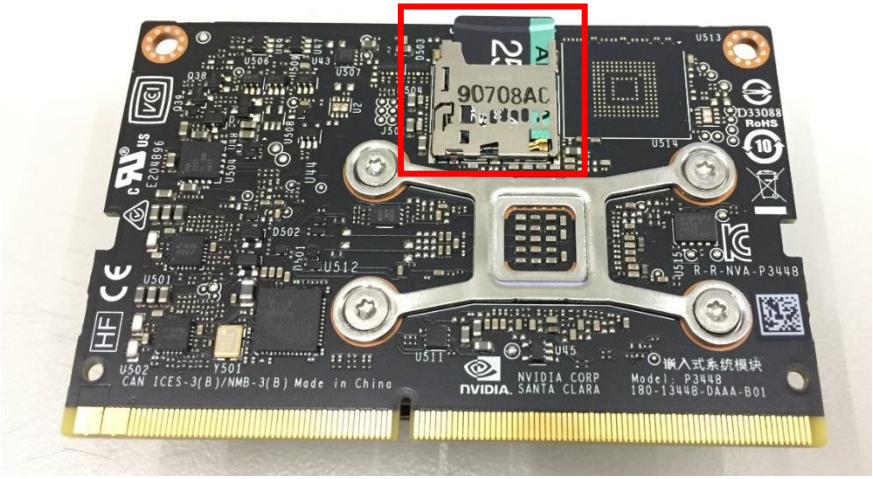
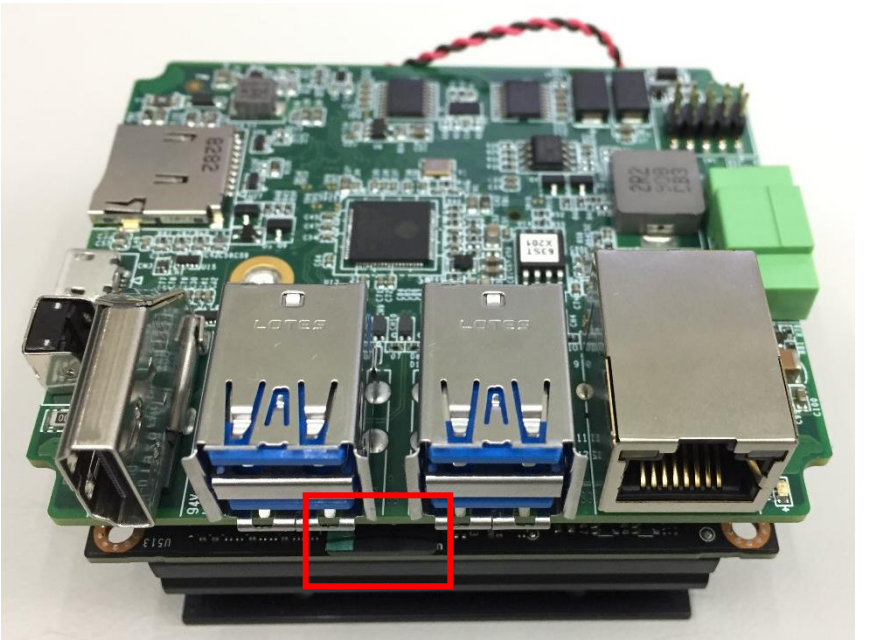
Step 4: Etcher will automatically choose a USB device to write to. Click "Change" to select the correct device if Etcher has not defaulted to the SD Card.



Step 5: Click "Flash!" to flash image to your SD Card. Ubuntu may ask for a password to continue the operation. Enter your password to continue.



Step 6: Wait for Etcher to complete the process.



Step 7: After Etcher successfully finishes, remove the SD Card from the host PC, insert the Micro-SD card into the NVIDIA Jetson Nano SOC, then insert the Jetson Nano SOC into the BOXER-8221AI board if you have not already done so.