

EX731 Product Guide

Table of Contents

1. Scope & Product Outline
2. EX731AA Carrier Board standard and custom expansion connectors
3. EX731N Daughter Board standard and custom expansion connectors
4. Miscellaneous
5. Buttons, Indicators
6. Power Monitors
7. Power
8. CN311H M.2-PCIe HDMI frame grabber card
9. Thermal Specification
10. EMI Specification
11. Firmware
12. ME Specification
13. Reliability Specification
14. SW Specification

1. Scope & Product outline

This document describes the detailed specifications and design parameters of Tegra TX1/TX2 Carrier Board with Multiple Video Sources Support. AVerMedia internal product model name is EX731AA and current PCB revision is D. It can operate with NVIDIA Tegra TX1/TX2 module to build up a high performance embedded system.

EX731AA is a small size (Pico-ITX) multi-Stack design to fully support NVIDIA Tegra TX1 and TX2. The first Stack is for TX1/TX2 module and standard I/O. The second Stack is for PCIe, MIPI, and Audio...I/O interface. The second Stack has multiple versions by changing the PCIe Bridge to support miniPCIe, M.2, and USB3.0.

EX731AA is fully compliance with RoHS. All components and all production procedures have already followed current RoHS rule to produce.

1.1 Jetson Module Feature List

1.1.1. Applications Processor

- Tegra X2

1.1.2. Memory

- LPDDR4 DRAM & eMMC 5.1
- Memory sizes for DDR & eMMC vary depending on module - Check relevant Data Sheet

1.1.3. Network

- 10/100/1000 BASE-T Ethernet

1.1.4. Connectivity

- Jetson TX1/TX2 only: Dual U.FL RF connectors: Connects to 802.11a/b/g/n/ac WLAN/Bluetooth enabled devices.

1.1.5. Advanced power management

- Dynamic voltage and frequency scaling
- Multiple clock and power domains
- Thermal Transfer Plate & optional Fan/Heatsink

1.2 Carrier Board Feature List

1.2.1 Main Board (EX731AA)

The first Stack is for TX1/TX2 module and standard I/O, the main functions are described below.

Connection to Jetson Module

- 400-pin (8x50) Board-Board Connector

Storage

- Micro SD Card Slot

-The Specification is follow Jetson TX1/TX2, Supports addressing larger capacity SD 3.0 or SD-XC cards up to 2 TB.

USB

- USB 2.0 Micro B (Host & Device)
- USB 3.1 Gen1 Type A X1 (Host only)

Wired Network

- Gigabit Ethernet (RJ45 Connector w/LEDs) , Optional support for IEEE 802.3 at (POE+) up to 30W.

HDMI Type A

- 2X HDMI 2.0 output up to 4096 x 2160 p60

Expansion Header

- 40-pin (2x20) header
- I2C, SPI, UART, I2S, Audio Clock/Control

UI & Indicators

- Power, Reset (Optional) & Force Recovery Buttons
- LEDs: Power indication, Status indication

Miscellaneous

- Fan Connector: 5V, PWM & Tach
- Built-in Mini-51 MCU for Auto power on control

Power

- DC Jack: OD 5.5/2.5 with Lock, support 6V-19V input voltage

Compliance with Pico-ITX dimension

ROHS Compliant

1.2.2 Daughter Board

The second Stack has multiple versions by changing the PCIe Bridge to support miniPCIe, M.2, and USB3.0 etc., the main functions are described below.

- **M.2 (EX731-N1)**

Current PCB version is C

2X M.2 (B+M Key) expandability of connecting AVerMedia frame grabbers

SATA Connector (Power & TX/RX), (Optional)

3.5mm Microphone input (Optional)

RS485 interface

CAN Bus interface

1.3 EX731AA Board Block Diagram

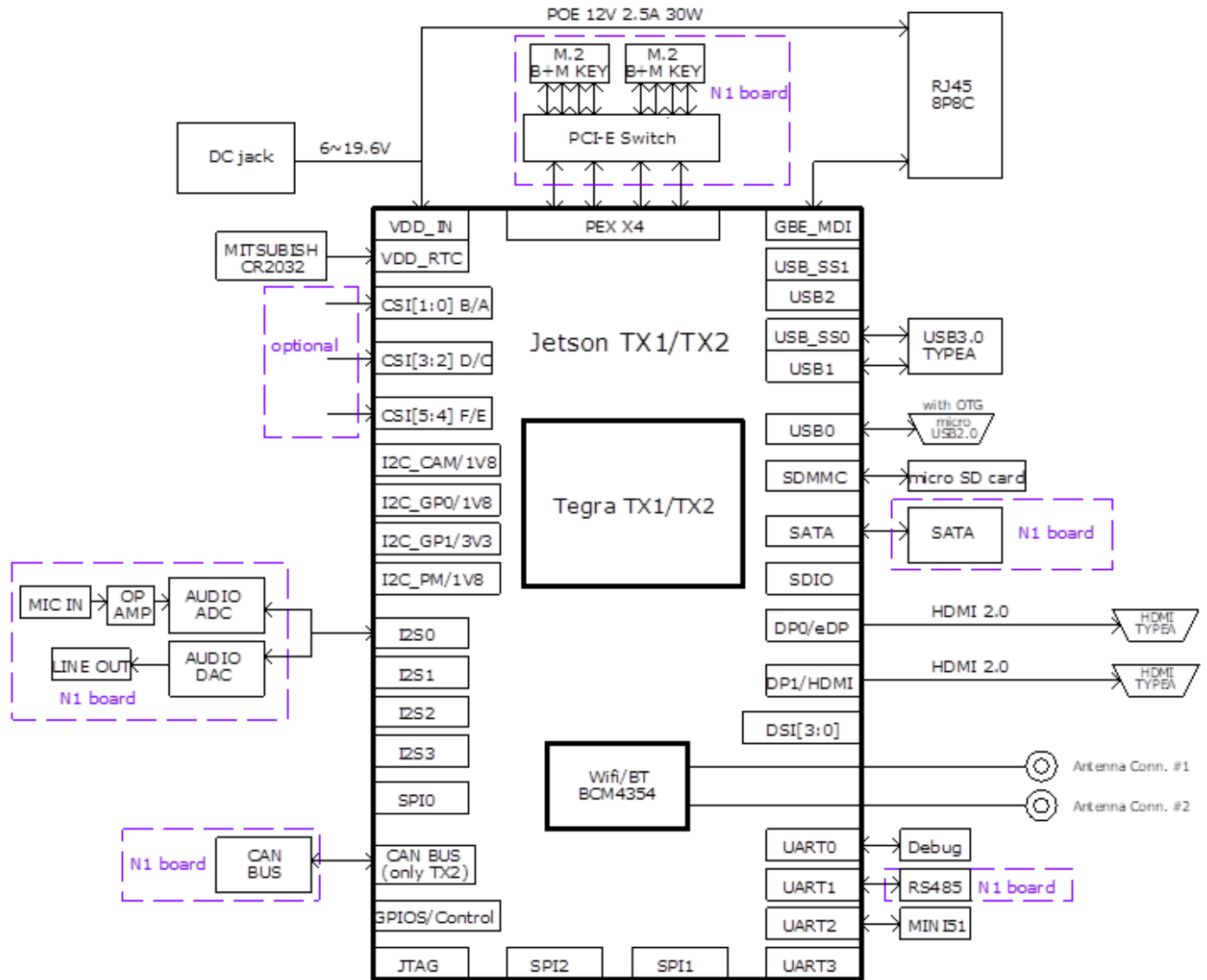


Figure 1. EX731AA Block Diagram.

1.4 EX731N1 Block Diagram

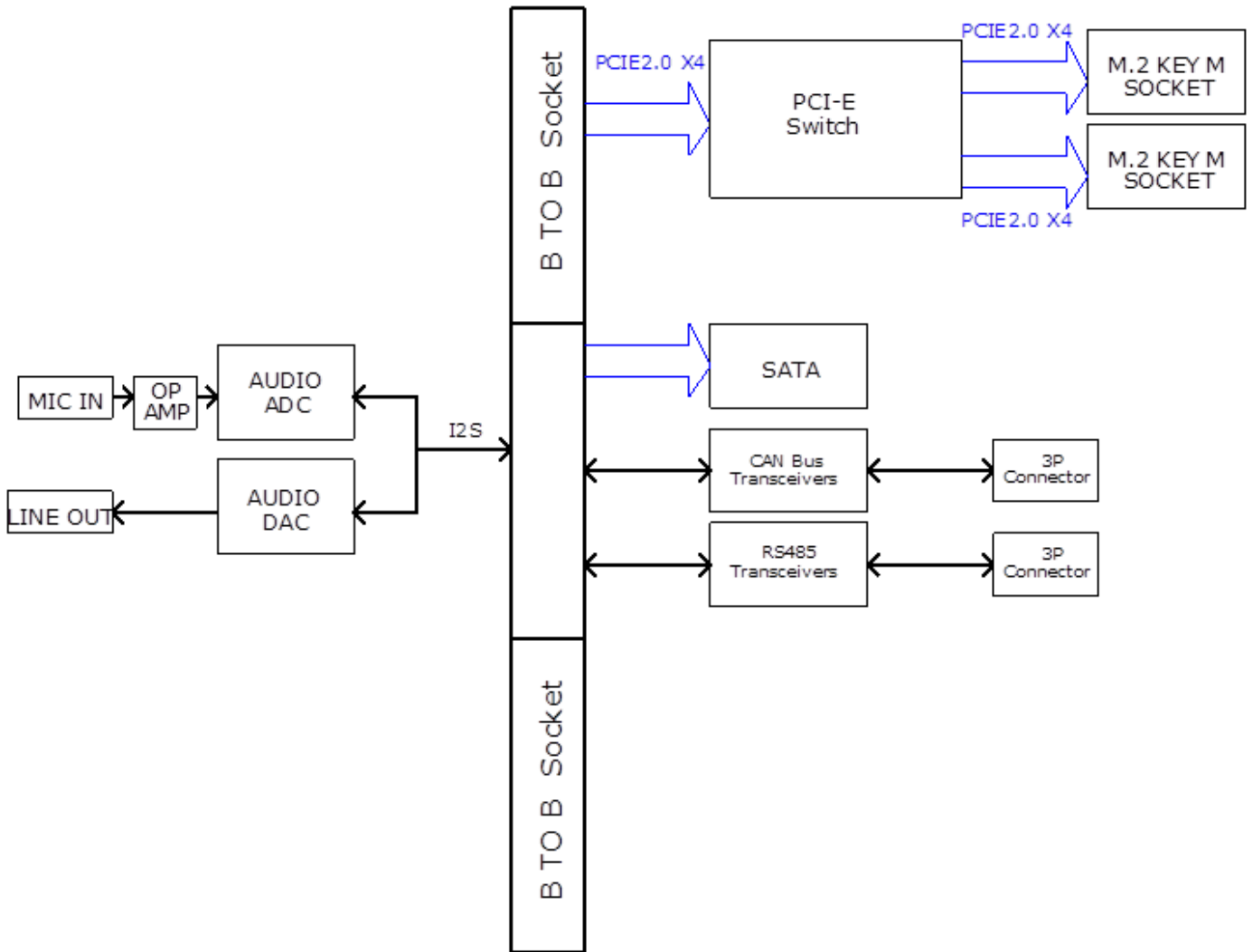


Figure 2. EN731N1 Block Diagram

1.5 EX731AA Carrier Board Placement

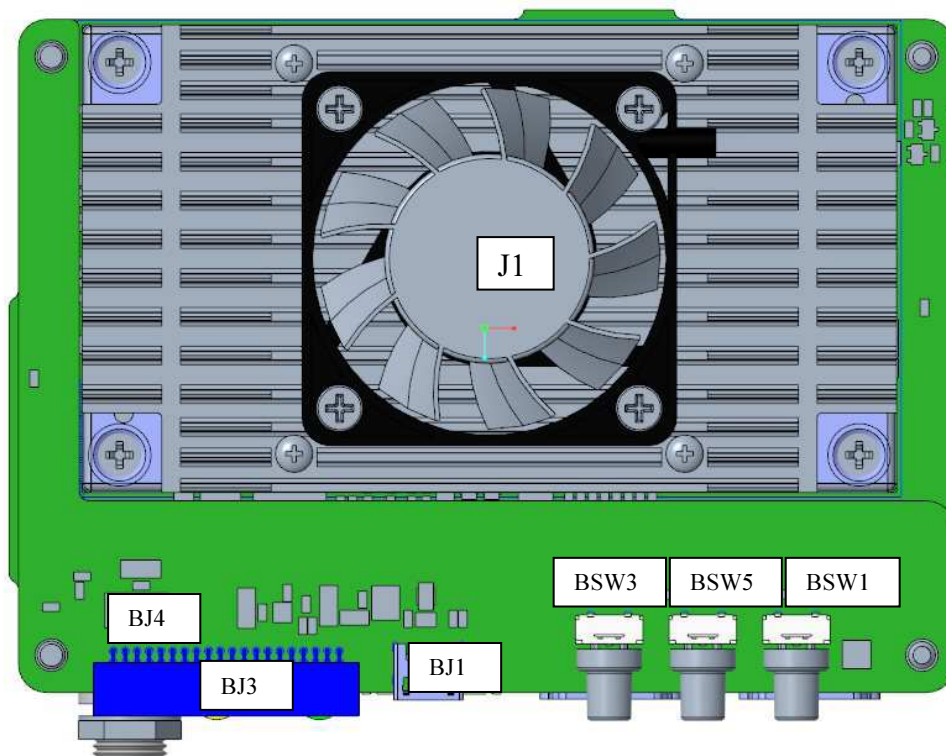


Figure 3. EX731AA Carrier Board + EX731B1 I/O Board Top View.

J1	Heat Sink + FAN Module
BSW1	Power button & Power LED Indication
BSW5	Recovery (Volume up) button & Status LED Indication
BSW3	Reset button (Option)
BJ1	USB 2.0 connector (Micro USB)
BJ3	GPIO EXPAND (Option)
BJ4	CPU_Fan

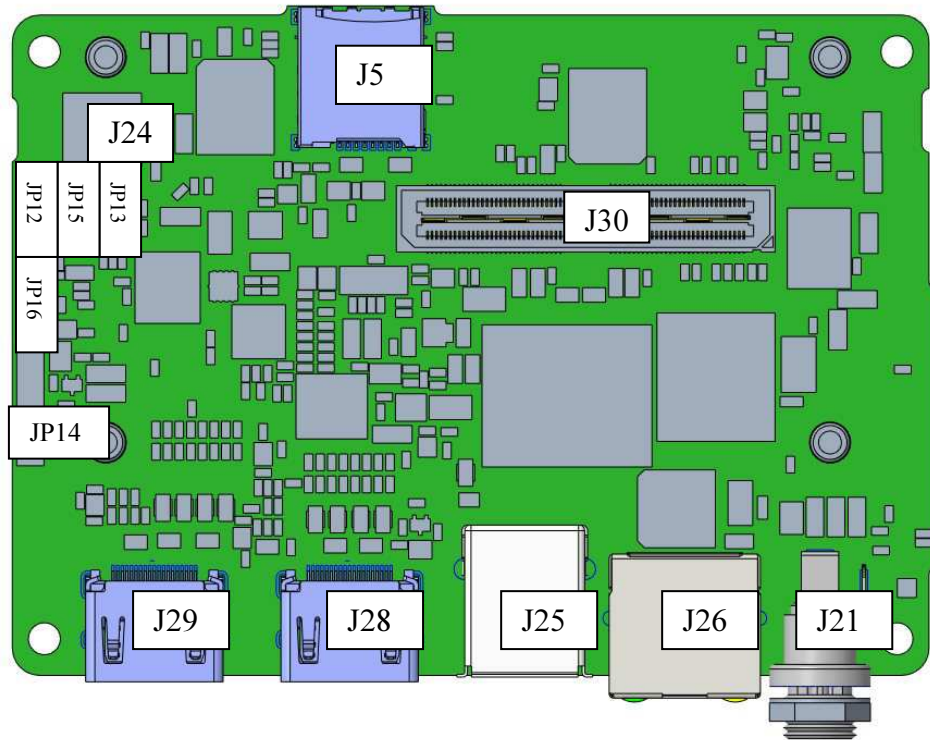


Figure 4. EX731AA Carrier Board bottom view.

J21	DC Jack with Lock	J24	RTC Battery wafer
J26	Gigabit Ethernet (RJ45 Connector w/LEDs)	JP13	Power Button pin header
J25	USB3.0 Type A	JP15	Force Recovery pin header
J28	HDMI-1 connector (CEC pass-through, Optional)	JP12	Reset Button pin header
J29	HDMI-2 connector	JP16	Power LED pin header
J30	Board to Board connector for Daughter Board expanded	JP14	MCU update pin header
J5	Micro SD Socket		

1.6 EX731N1 Daughter Board Placement

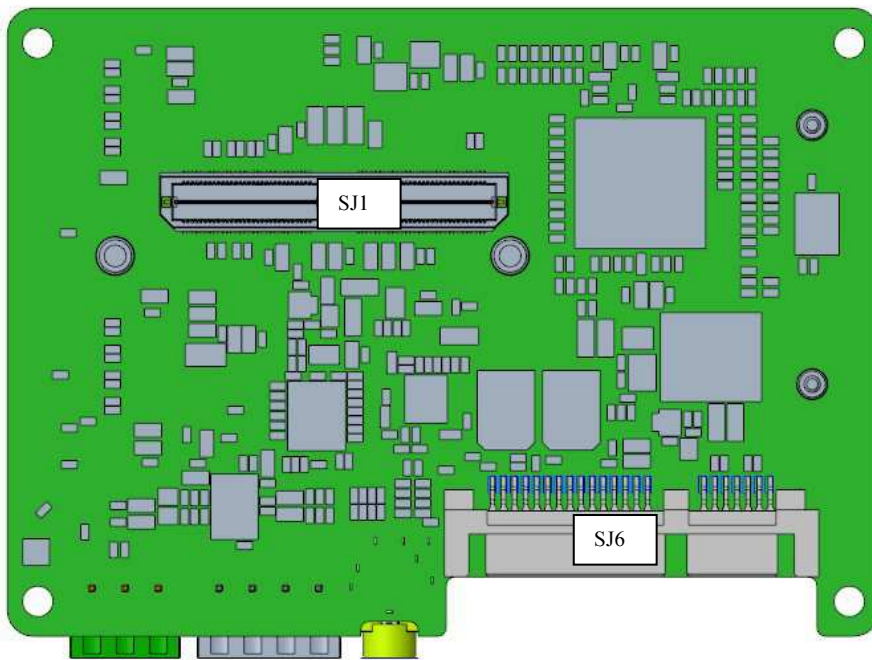


Figure 5. EX731N1 Daughter Board top view

SJ1	Board to Board connector for Carrier Board connection
SJ6	SATA Connector(7+15P Male) (Option)

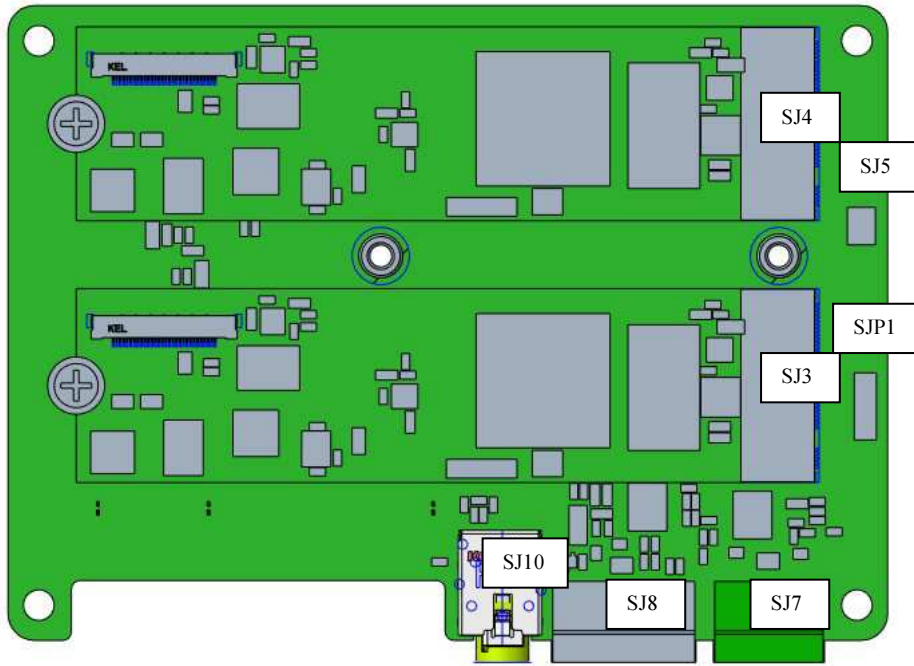


Figure 6. EX731N1 Daughter Board bottom view.

- SJ7 Can Bus
- SJ8 RS485
- SJ10 3.5mm Phone Jack for Microphone Input or Line in(Optional) or Line Out(Optional)
- SJP1 Microphone input pre-amplifier Gain Adjust
- SJ5 System FAN
- SJ3 M.2 Slot-1 (B+M Key)
- SJ4 M.2 Slot-2 (B+M Key)

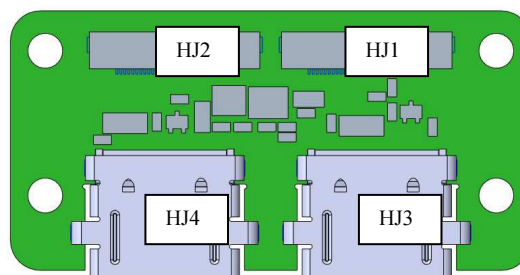


Figure 7. EX731H1 Daughter Board I/O bottom view.

- HJ3 HDMI-1 Input Connector (Type A)
- HJ4 HDMI-2 Input Connector (Type A)
- HJ1 30pin 0.4mm wafer for micro coaxial cable
- HJ2 30pin 0.4mm wafer for micro coaxial cable

Table1: Board Dimension

Form Factor	Pico-ITX
PCB Size	100mm x 72mm
Thickness	1.6 mm (PCB)

2. EX731AA CARRIER BOARD STANDARD and CUSTOM EXPANSION CONNECTORS

2.1 EX731AA STANDARD CONNECTORS

The EX731AA carrier board provides a number of standard expansion connectors to support additional functionality beyond what is integrated on the main platform board. This includes:

- USB 2.0 Micro B (Host & Device)
- USB 3.1 Gen1 Type A (Host only)
- Gigabit Ethernet (RJ45 Connector w/LEDs) Optional support for IEEE 802.3 at (POE+) up to 30W.
- Micro SD Card Connector
- 2X HDMI 2.0 output up to 4096 x 2160 p60
- DC Jack With Lock (OD 5.5/2.5)

2.1.1 USB Ports

The carrier board supports two USB Connectors. One is a USB 2.0 Micro B connector (BJ1) supporting Device/Host modes as well as USB Recovery mode. The other is a USB 3.0 Type A connector (J25) supporting Host mode only.

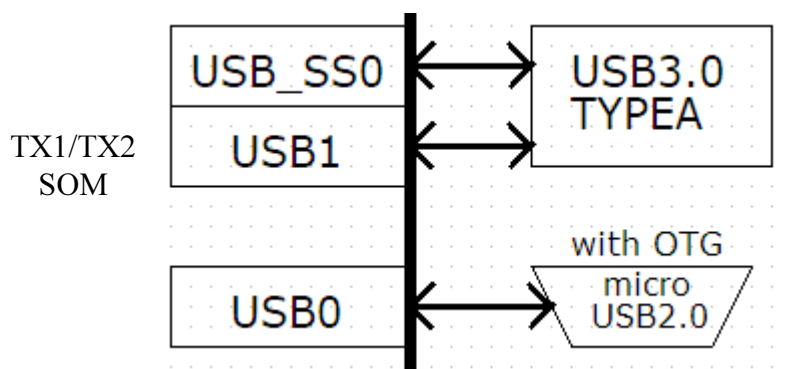


Table 2:

I/O Connector	External		
		BJ1	USB OTG x1 (USB 2.0 Micro B) , the current limit is 0.7A
		J25	USB3.1 Gen1 type A x1 , the current limit is 1.4A

USB3.1 Gen1 (Type A)

USB 2.0 (Micro B)

2.1.2 Gigabit Ethernet (Optional support for IEEE 802.3 at (POE+) up to 30W)

2.1.3 Micro SD Card

A Micro SD Card (J5) is implemented, supporting up to SDR104 mode (UHS-1).

2.1.4 HDMI Output

The carrier board supports two standard HDMI type A Connectors. J28/J29 is connecting from TX2 SOM.

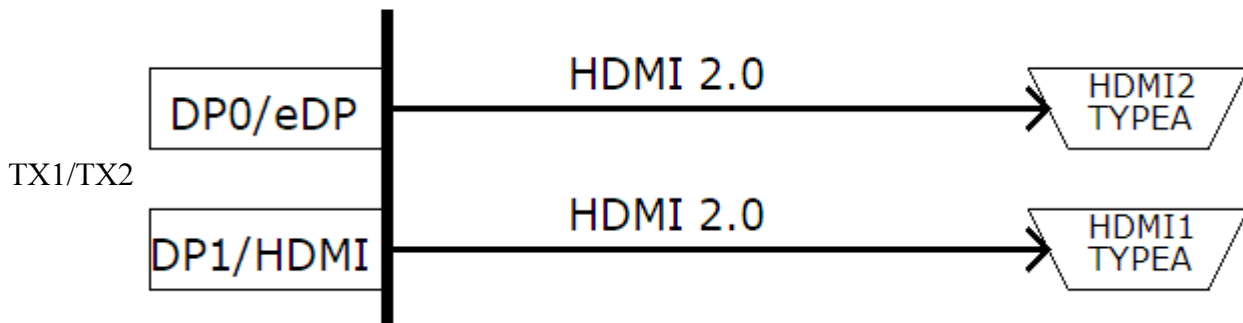


Table 3:

J28 (HDMI-1)	HDMI 2.0 Output (Type A) from TX1/TX2
J29 (HDMI-2)	HDMI 2.0 Output (Type A) from TX2 , Not supported with TX1 SOM

2.2 EX731AA CUSTOM EXPANSION CONNECTORS

The EX713AA carrier board supports several custom expansion headers

- Expansion Header, 2x20, 1.27mm pitch
- Fan Header, 4-pin, 1.25mm pitch
- RTC Battery Wafer

2.2.1 GPIO Expand (BJ3) Pin Descriptions

The carrier board includes a 40-pin (2x20, 1.27mm pitch) Expansion Header (BJ3). The connector used on the carrier board is a CHAMPWAY **CB25-G4024H010-03**. The GPIO Level Shift voltage is fixed on 3.3V.

The expansion connector includes various audio & control interfaces including:

- I2S(See Note)
- Audio Clock/Control
- Digital Microphone IF
- I2C (x2) (See Note)
- SPI (See Note)
- UART (See Note)

Table 4:

BJ3	GPIO Expand 40pin (2x20 1.27mm pitch Box header)
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Note: The GPIO Level Shift voltage is fixed on 3.3V

Table 5:

Wafer type : CHAMPWAY CB25-G4024H010-03							
Pin	Signal Name	Device Directly Connected to Signal	Associated Jetson Module Pin Name	Usage/Description	Type/Direction	GPIO Max Drive or Power Pin Current Capability	Notes
1	+3V3_SYSTEM	TPS51220 3.3V Supply	-	Main 3.3V Supply	Power	1A	1
2	+5V_SYSTEM	TPS51220 5V Supply	-	Main 5.0V Supply	Power	1A	1
3	I2C_GP0_DATA_3V3	25K3019	I2C_GP0_DATA	General I2C #0 Data (3.3V)	Bidir/OD	3.3mA	2
4	+5V_SYSTEM	TPS51220 5V Supply	-	Main 5.0V Supply	Power	1A	1
5	I2C_GP0_CLK_3V3	25K3019	I2C_GP0_CLK	General I2C #0 Clock (3.3V)	Bidir/OD	3.3mA	2
6	GND	-	-	Ground	Ground	-	-
7	I2S_3V3_MCK	TXB0108	AUDIO_MCLK	Audio Master Clock (1.8/3.3V)	Bidir	20uA	3
8	UART0_TX_3V3	74LVC2T45	UART0_TX	UART #0 Transmit	Output	24mA/-24mA	4
9	GND	-	-	Ground	Ground	-	-
10	UART0_RX_3V3	74LVC2T45	UART0_RX	UART #0 Receive	Input	24mA/-24mA	4
11	UART0_RTS_3V3	74LVC2T45	UART0_RTS#	UART #0 Request to Send	Output	24mA/-24mA	4
12	I2S0_3V3_BCLK	TXB0108	I2S0_SCLK	Audio I2S #0 Clock	Bidir	20uA	3
13	AUDIO_CODEC_3V3_IRQ	TXB0108	GPIO_PE6	Audio Codec Interrupt	Bidir	20uA	3
14	GND	-	-	Ground	Ground	-	-
15	GPIO_EXP_P17_3V3	PCA9539A	-	From GPIO Expander (P17)	Bidir	-10mA Hi / 25mA Lo	5
16	AO_DMIC_IN_3V3_DAT	TXB0108	AO_DMIC_IN_DAT	Digital Mic Input	Input	20uA	8
17	+3V3_SYSTEM	TPS51220 3.3V Supply	-	Main 3.3V Supply	Power	1A	1
18	MDM_WAKE_3V3_AP	TXB0108	GPIO16_MDM_WAKE_AP	Modem Wake AP GPIO	Input	20uA	3,8
19	SPI1_3V3_MOSI	TXB0108	SPI1_MOSI	SPI #1 Master Out/Slave In	Bidir	20uA	3

				(1.8/3.3V)			
20	GND	-	-	Ground	Ground	-	
21	SPI1_3V3_MISO	TXB0108	SPI1_MISO	SPI #1 Master In/Slave Out (1.8/3.3V)	Bidir	20uA	3
22	GPIO_EXP_P16_3V3	PCA9539A	-	From GPIO Expander (P16)	Bidir	-10mA Hi / 25mA Lo	5
23	SPI1_3V3_CLK	TXB0108	SPI1_CLK	SPI #1 Shift Clock (1.8/3.3V)	Bidir	20uA	3
24	SPI1_3V3_CS0	TXB0108	SPI1_CS0#	SPI #1 Chip Select #0 (1.8/3.3V)	Bidir	20uA	3
25	GND	-	-	Ground	Ground	-	
26	SPI1_3V3_CS1	TXB0108	SPI1_CS1#	SPI #1 Chip Select #1 (1.8/3.3V)	Bidir	20uA	3
27	I2C_GP1_DATA_3V3M	Tegra	I2C_GP1_DAT	General I2C #1 Data (3.3V)	Bidir/OD		6
28	I2C_GP1_CLK_3V3M	Tegra	I2C_GP1_CLK	General I2C #1 Clock (3.3V)	Bidir/OD		6
29	AUDIO_CODEC_3V3_RST	TXB0108	GPIO19_AUD_RST	Audio Reset (1.8/3.3V)	Output	20uA	3,8
30	GND	-	-	Ground	Ground	-	
31	MOTION_3V3_INT	TXB0108	GPIO9_MOTION_INT	Motion Interrupt (3.3V)	Input/OD	20uA	3
32	AO_DMIC_IN_3V3_CLK	TXB0108	AO_DMIC_IN_CLK	Digital Mic Clock	Output	20uA	3,8
33	AP_WAKE_3V3_BT	TXB0108	GPIO11_AP_WAKE_BT	AP Wake Bt GPIO	Bidir	20uA	3,8
34	GND	-	-	Ground	Ground	-	
35	I2S0_3V3_LRCK	TXB0108	I2S0_LRCLK	AUDIO I2S #0 Left/Right Clock	Bidir	20uA	3
36	UART0_CTS_3V3	74LVC2T45	UART0_CTS#	UART #0 Clear to Send (3.3V)	Input	24mA/-24mA	4
37	ALS_PROX_3V3_INT	TXB0108	GPIO8_ALS_PROX_INT		Output/OD	20uA	3
38	I2S0_3V3_DIN	TXB0108	I2S0_SDIN	Audio I2S #0 Data in	Input	20uA	3,8
39	GND	-	-	Ground	Ground	-	
40	I2S0_3V3_DOUT	TXB0108	I2S0_SDOUT	Audio I2S #0 Data Out	Output	20uA	3,8

Legend

Ground	Power	Not available on Jetson TX1	Not available on Jetson TX2	Reserved	Unassigned on carrier board
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Notes:

1. This is current capability per power pin.
2. These pins are connected to Tegra signals through either an I2C or FET level shifter.
3. Due to the design of these level translators, the output drivers are very weak so they can be overdriven by another connected device output for bidirectional support.
4. The buffer is powered at 3.3V on the Expansion Header side.
5. These signals come from the GPIO expanders.
6. These pins are directly connected to Tegra. The max drive that meets full Data Sheet V_{OL}/V_{OH} is 1mA. 2mA drive is supported at restricted V_{OL}/V_{OH} levels. See the associated OEM Product Design Guide Pads section for details.
7. In the Type/Dir column, Output is to Expansion Module. Input is from Expansion Module. Bidir is for Bidirectional signals.
8. The direction indicated matches that indicated in the reference design schematics. These signals can be bidirectional.

2.2.2 Fan connector (BJ4) Pin Descriptions

Table 6:

Wafer type : Joint Tech_A1250WV-04PNLNT1N00B			
Pin#	Signal Name	Usage/Description	Type/Dir Default
1	GND	Ground	Ground
2	VCC	5V Power Supply	Power
3	FAN_TACH	Fan Tachometer signal	Input
4	FAN_PWM	Fan Pulse Width Modulation signal	Output

2.2.3 RTC Battery (J24) 1*2pin 2mm pitch wafer

Table 7:

Wafer type : PINREX TECHNOLOGYCORP 721-94-02TWR9			
Pin#	Signal Name	Usage/Description	Type/Dir Default
1	RTC_BAT	3V Lithium battery CR2032 input for RTC	Power
2	GND		Ground

2.3 EX731H1 Daughter Board I/O

HDMI Input X2

3. EX731N1 DAUGHTER BOARD STANDARD and CUSTOM EXPANSION CONNECTIONS

3.1 EX731N1 STANDARD CONNECTORS

The EX731N1 daughter board provides a number of standard expansion connectors to support additional functionality beyond what is integrated on the main platform board. This includes:

- SATA: Standard SATA Connector, 22-pin including power
- 2X M.2 Slot with pcie x4 lanes expandability of connecting AVerMedia frame grabbers
- Microphone Input

3.1.1 SATA

The daughter board has a standard SATA connector (male) (SJ6 - both Data & Power) as shown below.

3.1.2 M.2 Slot x2 Connector

The daughter board supports two standard 2280 M.2 Slot (B+M Key).

Table 8:

SJ3	4 lanes B+M Key 2280
SJ4	4 lanes B+M Key 2280

3.1.3 Microphone Input

The daughter board supports 3.5mm phone jack microphone input, the Pre-Amplifier design 2-steps Gain, use SJP1 can select High gain (46.5dB) or low gain(40.5dB), the pre-amplifier bandwidth is 60Hz~8KHz@low gain.

3.2 EX731N1 CUSTOM EXPANSION CONNECTORS

The EX713AA daughter board supports several custom expansion headers

- Fan Header, 2-pin, 1.25mm pitch

3.2.1 Fan connector (SJ5) Pin Descriptions

Table 9:

Wafer type : MOLEX_53047-0210			
Pin#	Signal Name	Usage/Description	Type/Dir Default
1	VCC	5V Power Supply	Power
2	GND	Ground	Ground

4. MISCELLANEOUS

4.1 GPIO Expanders

The carrier board design includes two I2C interface controlled GPIO expander ICs. One operates at 1.8V and the other at 3.3V. The GPIO pins on the expanders are either used to interface to onboard devices/supplies or are routed to several of the expansion connectors. The connections are shown in the figures & tables below. The I2C address for the 1.8V GPIO Expander is strapped to be 7'h77, while the address for the 3.3V GPIO expander is strapped to 7'h74.

5. Buttons, Indicators

Table 10: Buttons (Switches)

Button	Description	Usage
BSW1	Power button & power indication	1. Used to power system up if off, or power down if on. If held for >7 seconds, will force a full system power cycle. 2. Indicates when the carrier board is powered on
BSW5	Recovery button & Status indication LED	1. Used to enter Force Recovery Mode. Button is held down while either system is first powered on, or by pressing & releasing reset button while Recovery button is pressed. 2. Status indication RGB LED,
BSW3	Reset button (Option)	Used to force a full system reset.

Gigabit Ethernet (LAN Port LEDs)

The following shows the RJ45 LED operating states

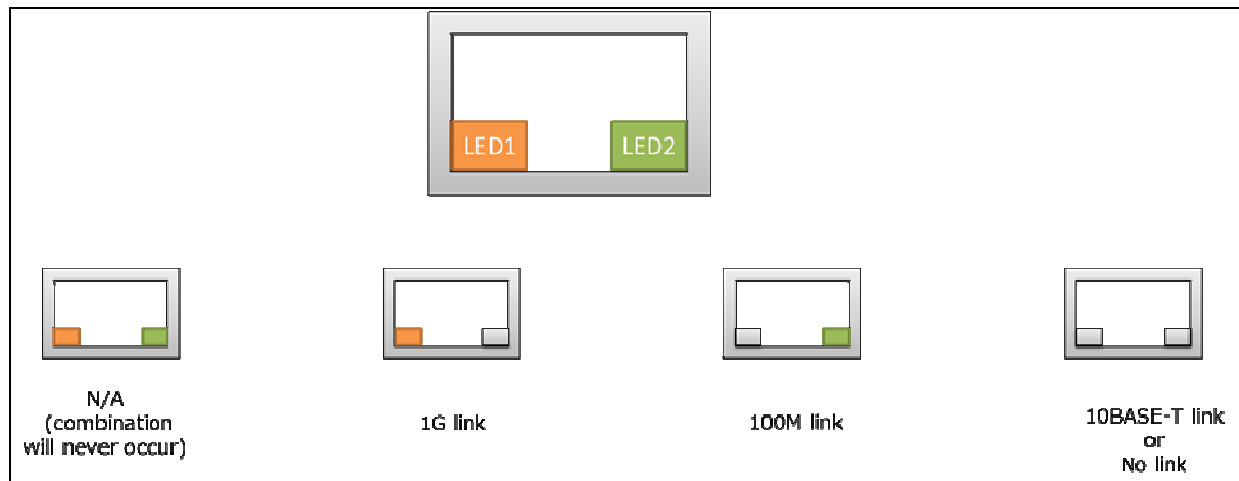


Table 11:

	Color	Description
LED1	Orange	1G speed Link indication
LED2	Green	100M speed Link indication

6. Power Monitors

There are two Power monitors on the carrier board. One monitors the main DC input (+12V_SYSTEM), the main 5V IO supply (+5V_SYSTEM) and the main 3.3V system supply (+3V3_SYSTEM). The other monitors the 3.3V Run Supply (+3V3_SLP), the main 1.8V system supply (+1V8_SYSTEM) and the MimiCard 3.3V supply (+3V3_MINIPCIE). The I2C interface used for both monitors is I2C_GP1. The I2C address for the first power monitor is 7'h42 and for the second power monitor is 7'h43.

7. POWER

7.1 Ability of providing power

The ability of carrier board to provide power is listed in Table 14.

Table 12:

symbol	Min.	Max.	Total Power
DC jack input	6V	19V	60W(Max.)

8. CN311H M.2-PCIe HDMI frame grabber card

CN311H is a M.2-PCIe HDMI frame grabber with the capability of video capturing up to 4096x2160p@30. With AVerMedia Video Engine technology inside, it can help to do kinds of video processing like frame rate convert, de-interlacing, scaling and so on without consuming the computing power of the target platform.

The current PCB revision is B.

Features

- PCI Express M.2 form factor (2280)
- HDMI 1.4a input
- Max capturing/recording up to 4096x2160 30fps
- AVerMedia Video Engine technology inside
- Support multi card ID selection
- Support CEC Pass-through (Option)

HDMI Input I/O Schematic

Connector Definite

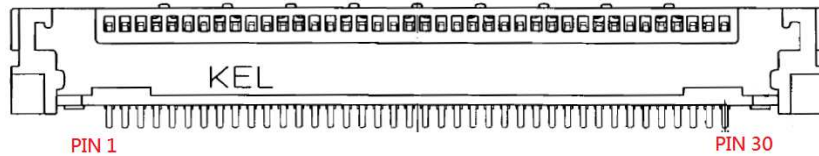


Table 13:

Pin No.	Function	Pin No	Function
1	HDMI_RXC-	16	DDC_CLK
2	HDMI_RXC+	17	GND
3	GND	18	HPD
4	HDMI_RX0-	19	VCC5_HDMI
5	HDMI_RX0+	20	VCC5_HDMI
6	GND	21	(+3V3_PCIE)
7	HDMI_RX1-	22	(+3V3_PCIE)
8	HDMI_RX1+	23	(+3V3_PCIE)
9	GND	24	N/A
10	HDMI_RX2-	25	N/A
11	HDMI_RX2+	26	N/A
12	GND	27	N/A
13	CEC	28	N/A
14	GND	29	N/A
15	DDC_Data	30	N/A

DC Input Specification

In order to keep excellent power delivery to frame grabber card, AVerMedia recommend customers submitting PCI Express M.2 Electromechanical Specification Revision 1.1 for power budget design.

Table 14:

POWER RAILS	3.3V
TOLERANCE	+/- 5%
CURRENT (MAX)	1.25A(MAX)

Support Resolution

Table 15:

Input Video Format	Capture Video Format
640x480p @ 59.94/60/72/75/85 720x480p @ 59.94/60 720x576p @ 50/100 800x600p @ 56/60/72/75/85/120 1024x768p @ 60/70/75/85/120 1152x864p @ 75 1280x720p @ 50/59.94/60/100/120 1280x768p @ 60/75/85/120 1280x800p @ 60/75/85/120 1280x960p @ 60/85 1280x1024p @ 60/75/85 1360x768p @ 60/120 1366x768p @ 60 1400x1050p @ 60/75/85 1440x900p @ 60/75/85 1600x1200p @ 60 1680x720p @ 24/25/30/50/60 1680x1050p @ 60 1920x1080i @ 50/59.94/60 1920x1080p @ 23.98/24/25/29.97/30/50/59.94/60/120 1920x1200p @ 60/75/85 2048x1152p @ 60 1792x1344p @ 60/75 1856x1392p @ 60/75 1920x1440p @ 60/75 2560x1080 @ 24/25/30/50/60 2560x1440 @ 60 2560x1600 @ 60RB 3840x2160 @ 24/25/30 4096x2160 @ 24/25/30	640x480 @ 59.94/60 720x480 @ 59.94/60 720x576 @ 50 1280x720 @ 50/59.94/60 1920x1080@ 23.98/24/25/29.97/30/50/59.94/60 (Bypass Mode) 1920x1200p @ 60/75/85 2048x1152p @ 60 1792x1344p @ 60/75 1856x1392p @ 60/75 1920x1440p @ 60/75 2560x1080 @ 24/25/30/50/60 2560x1440 @ 60 2560x1600 @ 60RB 3840x2160 @ 24/25/30 4096x2160 @ 24/25/30

9. Thermal Specification

The case temperature of key components is listed in Table 16.

Table 16:

Components	Components Case Temperature Specifications
PI7C9X2G312GP (SU1)	TA :85 °C
AD12250A (SU8)	TA :85 °C
MC33078DR (SU12)	TA :85 °C

10. EMI Specification

EMI/EMS test specification are listed in Table 17

Table 17:

Criteria	Specification	Reference
EMI	EN55032 standard	CE
EMS	ESD test standard	EN61000-4-2

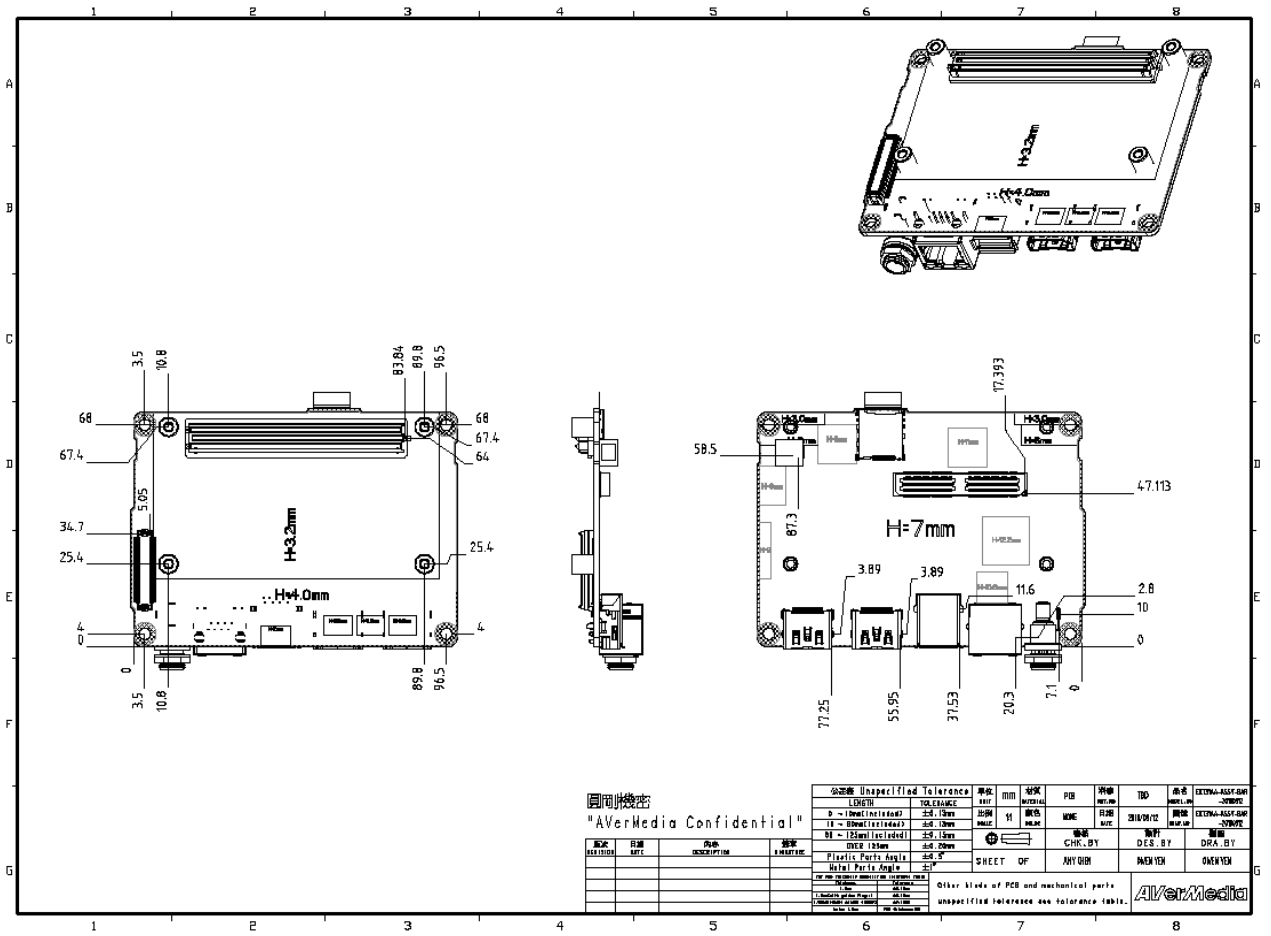
11. Firmware Specification

Table 18:

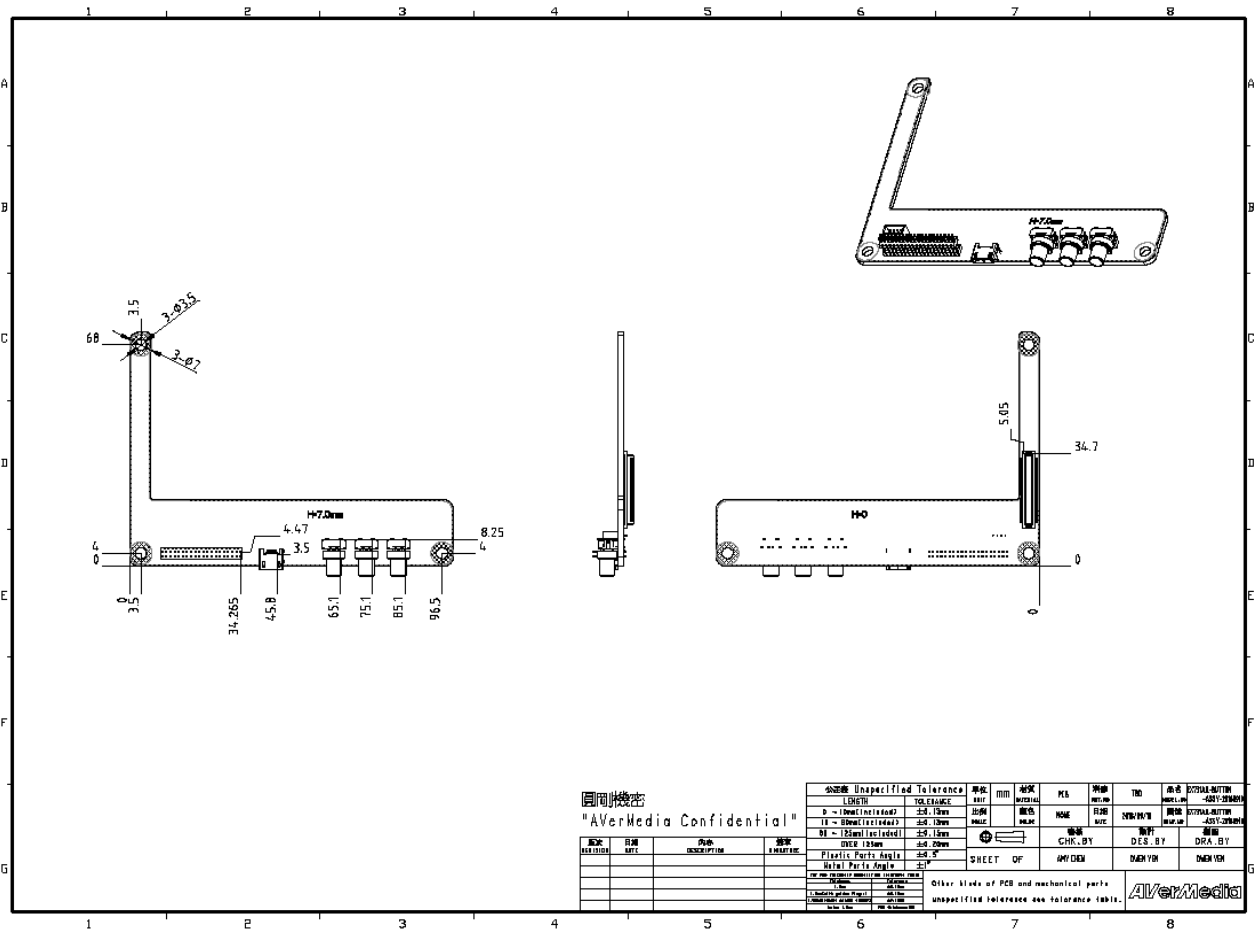
Item	Location	Firmware Version	Noted
Mini51	U54	18051710	Auto Power on Function

12. ME Specification

EX731AA Carrier Board



Button board: Recovery button is optional



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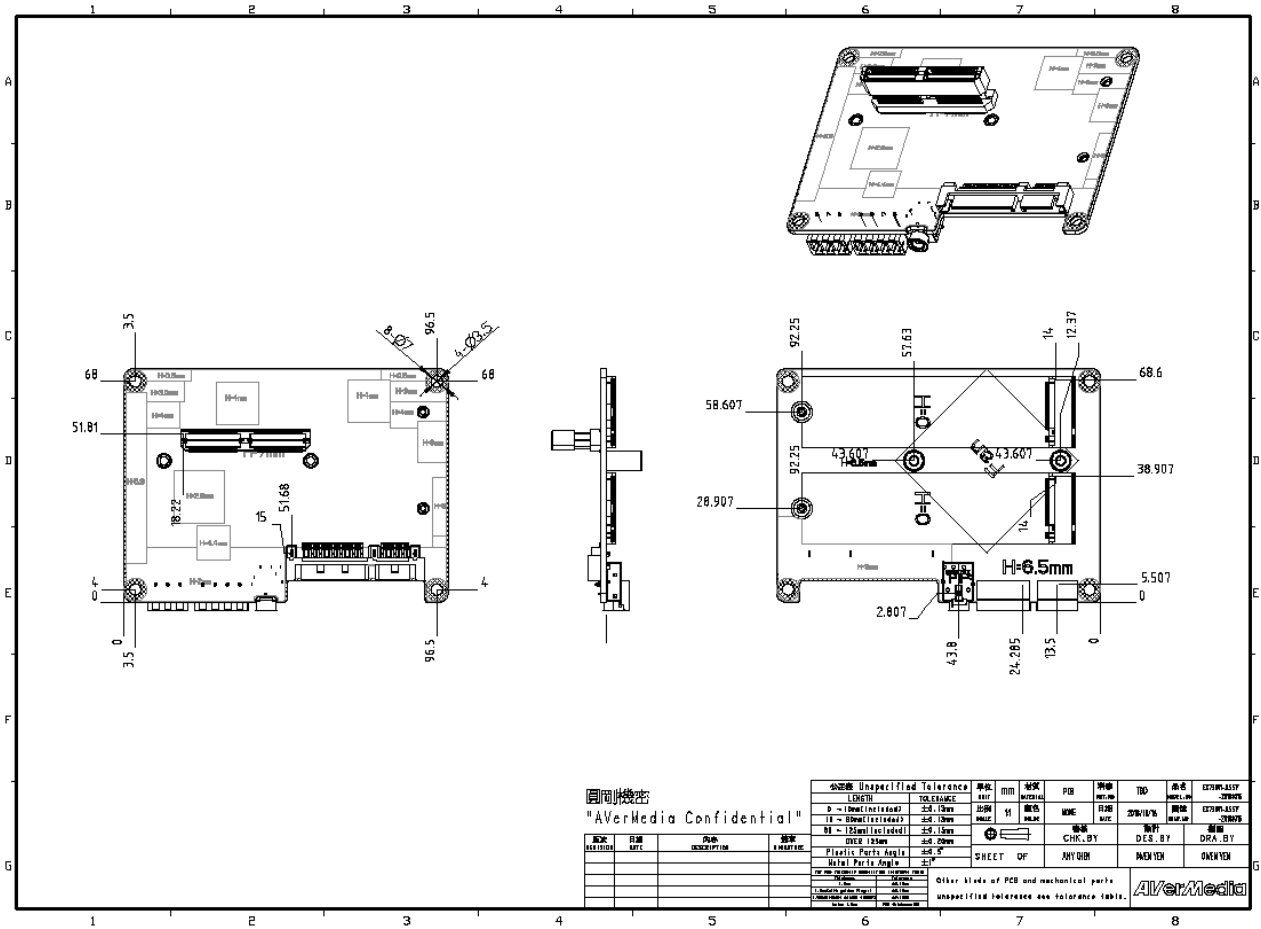
公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差	公差
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Unspecified Tolerance: ±0.15mm

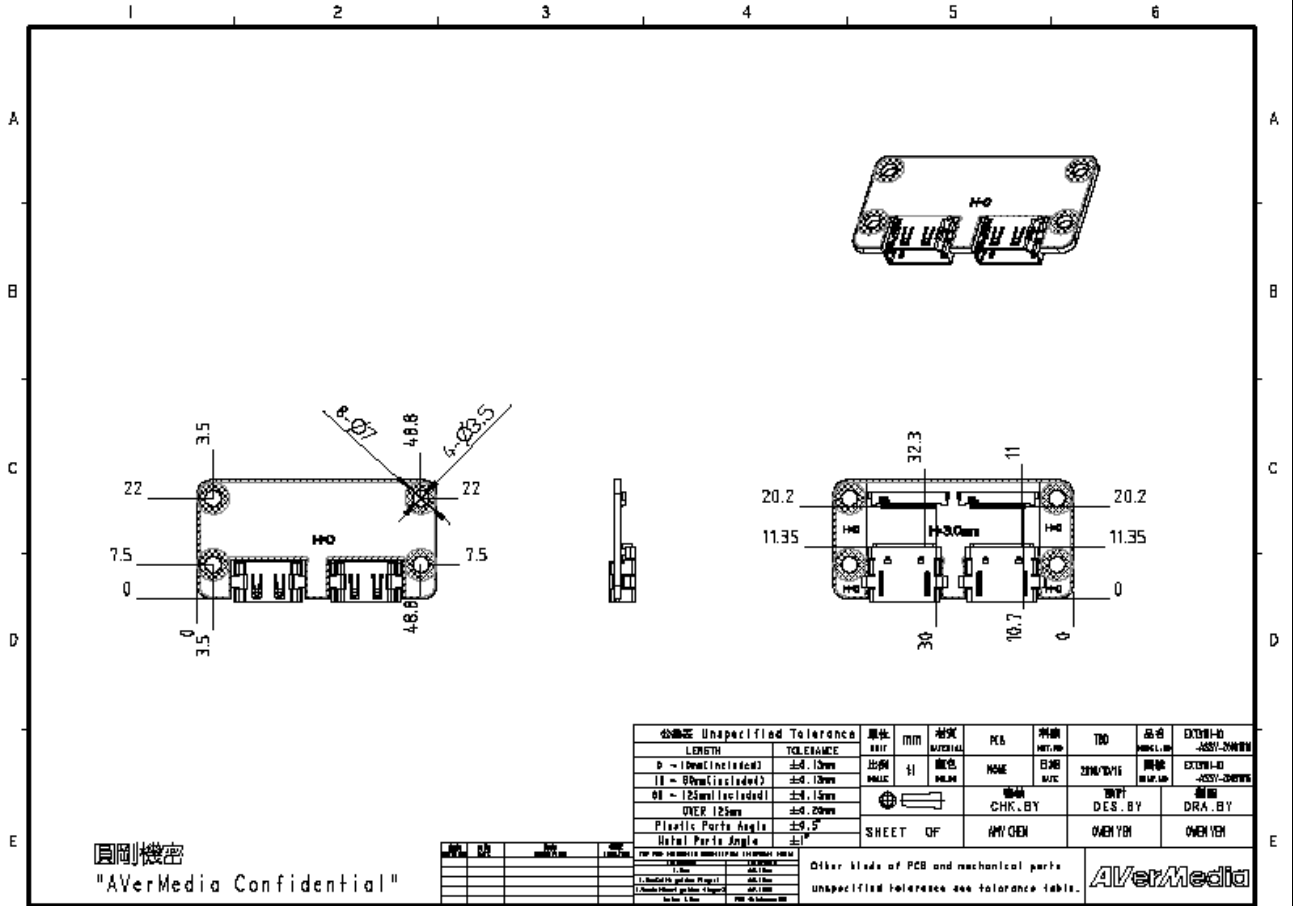
Other kinds of PCB and mechanical parts: unspecified tolerance see tolerance table.

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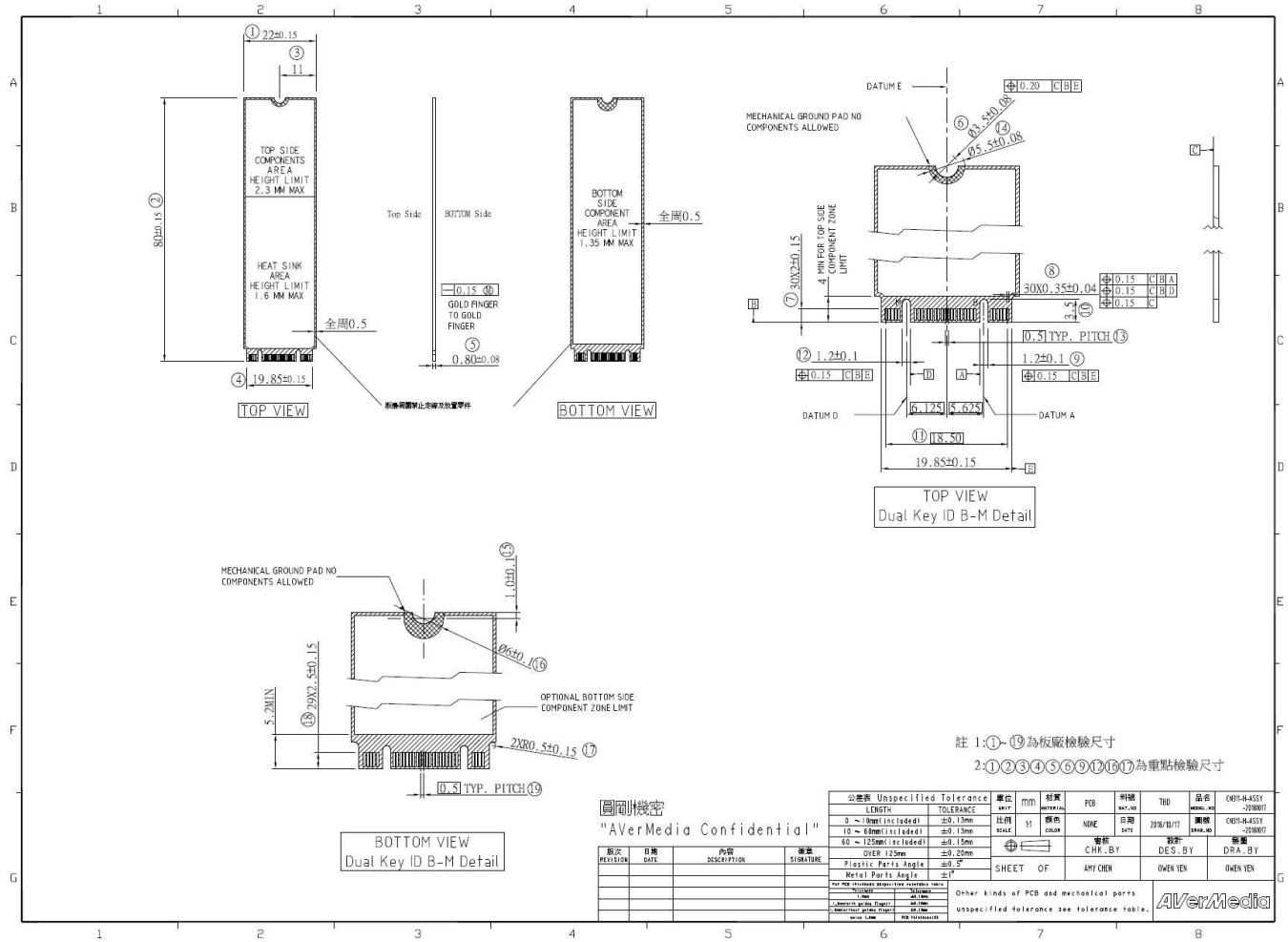
EX731N1 Daughter Board: Can bus and Rs485 are optional



EX731H1 Daughter Board I/O



CN311H Capture Card



13. Reliability Specification

Table 19:

Criteria	Specification	Reference
Low Temperature	Operating: 0°C / 48 hrs	IEC 60068-2
	Storage: -20°C / 24 hrs	
High Temperature	Operating: 55°C / 48 hrs	IEC 60068-2
	Storage: 80°C / 24 hrs	
High Humidity	Operating: 55°C, 95%RH/48 hrs	IEC 60068-2
	Storage: 80°C, 95%RH/24 hrs	
Cold Start	Operating: 0°C / 1hr	IEC 60068-2
Hot Start	Operating: 55°C, 95%RH/1hr	IEC 60068-2
Package Drop	According to the ISTA 2A test standard	ISTA 2A

14. Software Specification

BSP (board support package) : NVIDIA JETSON JETPACK 3.2 (L4T R28.2)