

EX713AA Product Guide

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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 EX713AA and current PCB revision is A. It can operate with NVIDIA Tegra TX1/ TX2 module to build up a high performance embedded system. EX713AA is fully compliance with RoHS. All components and all production procedures have already followed current RoHS rule to produce.

2. Features

Jetson Module Feature List

Applications Processor

- Tegra X1 or Tegra X2

Memory

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

Network

- 10/100/1000 BASE-T Ethernet

Connectivity

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

Advanced power management

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

Carrier Board Feature List

Connection to Jetson Module

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

Storage

- Full Size SD Card Slot
- SATA Connector (Power & TX/RX)

USB

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

Wired Network

- Gigabit Ethernet (RJ45 Connector w/LEDs)

PCIe

- 2 x full-height miniPCIe expandability of connecting AVerMedia frame grabbers

HDMI Type A

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

Expansion Header

- 40-pin (2x20) header

- I2C, SPI, UART, I2S, Audio Clock/Control

UI & Indicators

- Power, Reset & Force Recovery Buttons
- LEDs: Main DC input, Main 3.3V (Power)/SOC

Debug/Serial

- JTAG Connector (Standard 20-pin header)
- Serial Port Signals (1x6 header)

Miscellaneous

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

Power

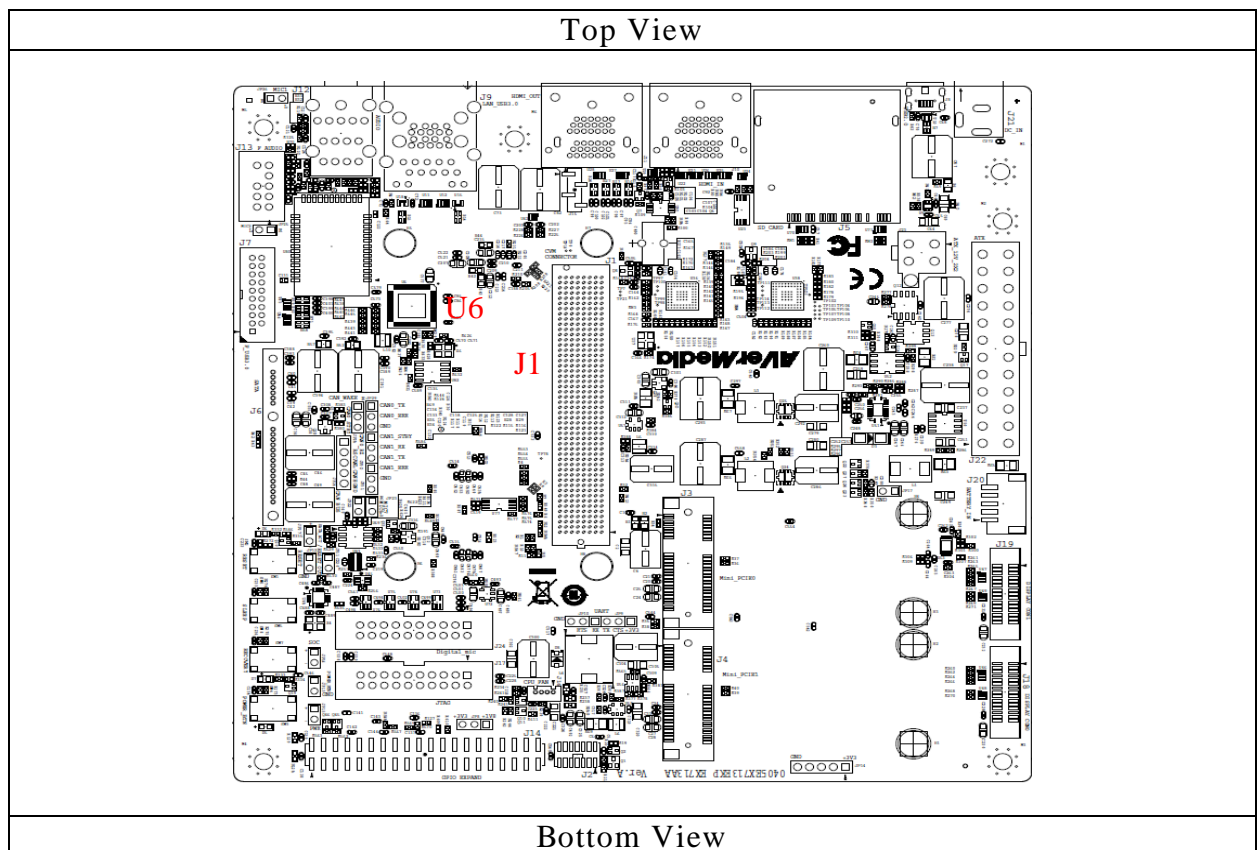
- DC Jack: 6V-14.9V
- ATX power 24 + 4 Pin

Compliance with Mini-ITX dimension
ROHS Compliant

3. Hardware

3.1 Key Component List

Table 1:



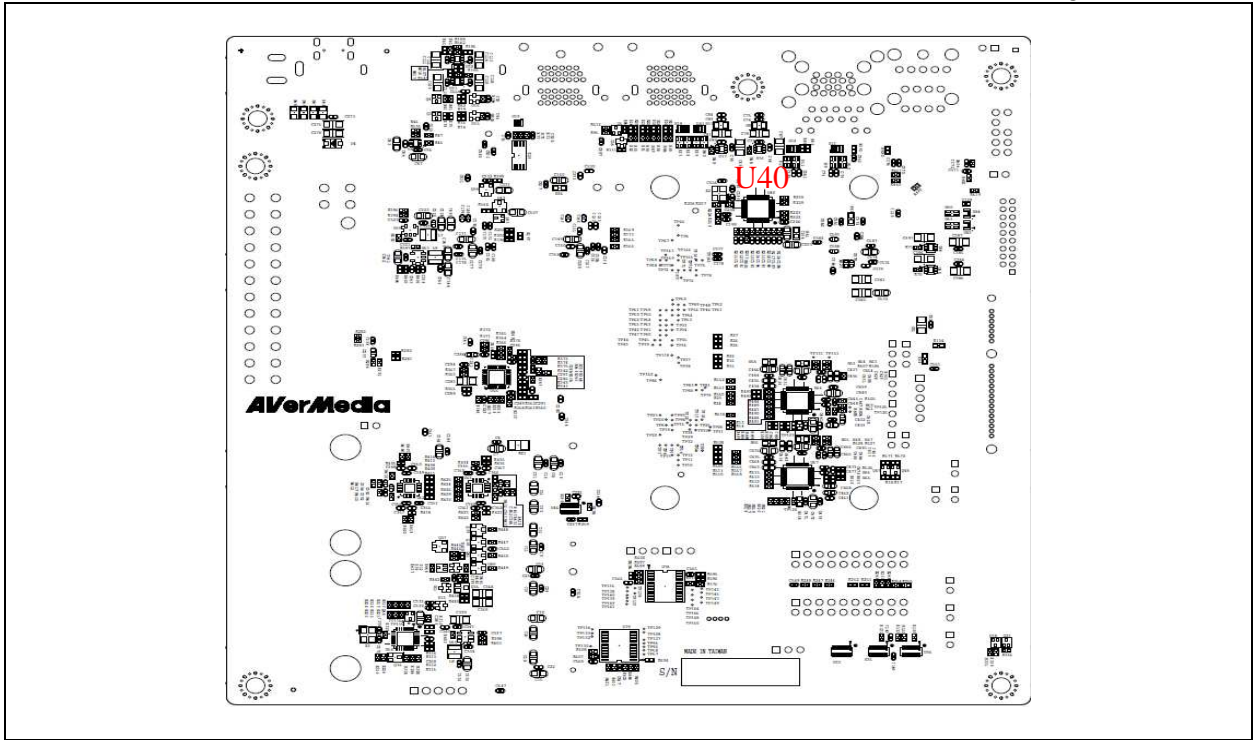


Table 2:

| Locations | Descriptions of Components |
|-----------|---|
| J1 | SOCKET_OPEN PIN FIELD_400PIN_180° for NVIDIA Jetson TX1/ TX2 System-on-Module |
| U6 | USB 3.1 Gen 1 Hub Controller |
| U40 | DP to HDMI Protocol Converter |

3.2 Block Diagram

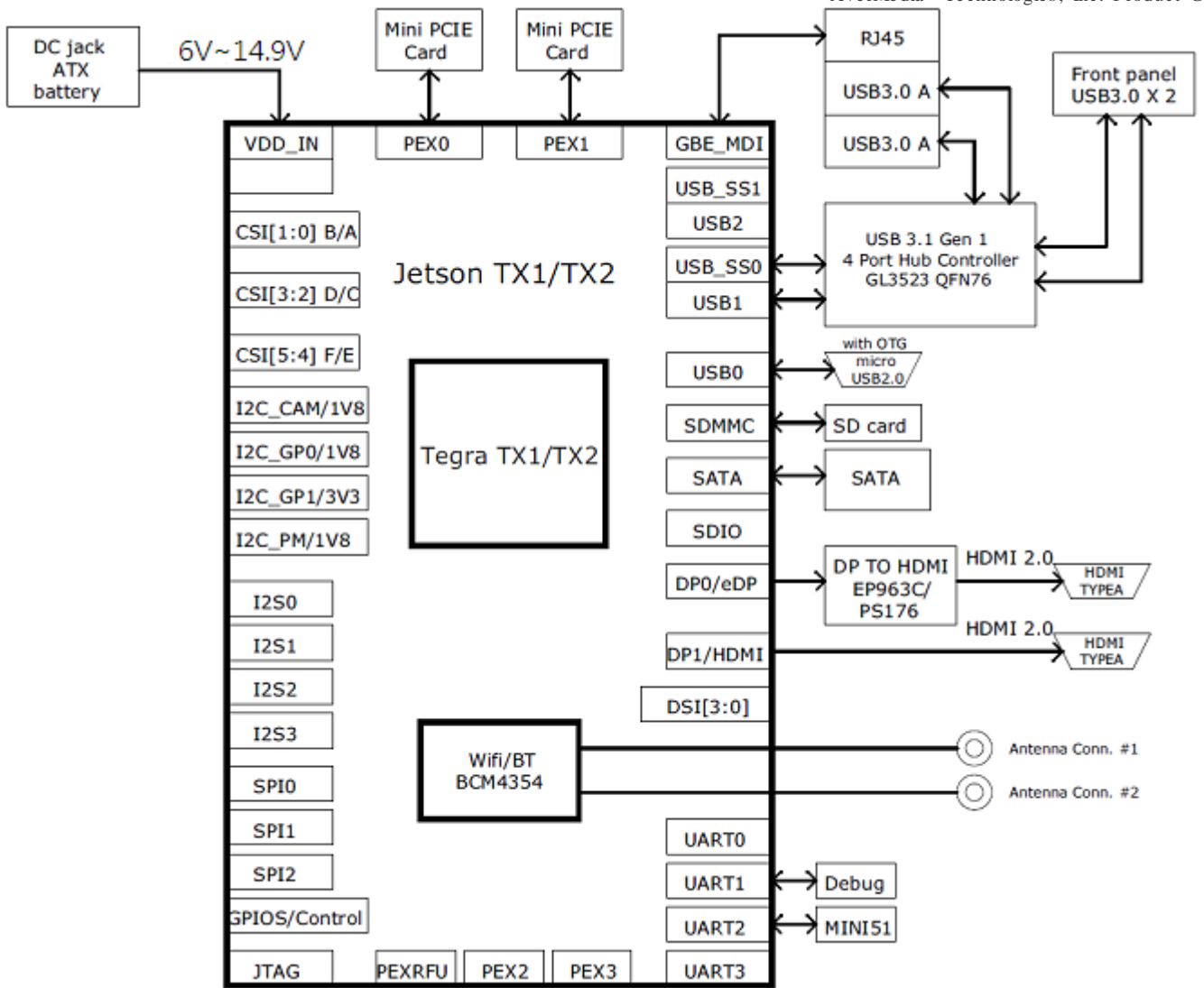


Figure1. Block Diagram.

3.3 Board Dimensions

Table 3:

| | |
|-------------|----------------|
| Form Factor | Mini-ITX |
| PCB Size | 170 mm x 170mm |
| Thickness | 1.6 mm |

3.4 I/O Connector

Table 4: (Please refer to mechanical drawing for more detail)

| I/O Connector | | External | |
|---------------|-------------|-----------|---|
| | | Connector | Description |
| | J21 | | DC jack (OD 5.5/ 2.5) x1 |
| | J8 | | USB OTG x1 (USB 2.0 Micro B) |
| | J5 | | SD card slot x1 |
| | J11-1(top) | | HDMI 2.0 Output (Type A) from TX1/ TX2 |
| | J11-2(down) | | HDMI 2.0 Output (Type A) from DP to HDMI (PS176 chip) |
| | J9-1(top) | | Gigabit Ethernet X1 (RJ45) |
| | J9-2, J9-3 | | USB3.1 Gen1 type A x2 from USB 3.1 Gen 1 Hub Controller |
| | J22 | | ATX 24Pin (ATX Power input) |
| | J23 | | ATX 4Pin (ATX Power Input) |
| | J3 | | MiniPCIe0 Gen2.0 (TX1 Default Config 1; TX2 Default Config 2) |
| | J4 | | MiniPCIe1 Gen2.0 (TX1 Default Config 1 ; TX2 Not support) |
| | J7 | | USB 3.1 Gen1 X2 through 20pin (2.0mm pitch 2x10) USB 3.1 Gen1 Front Panel ; from USB 3.1 Gen 1 Hub Controller |
| | J13 | | Audio front Panel |
| | J6 | | SATA 2.0 with power 7+15P male |
| | J14 | | GPIO Expand 40pin (2x20 2.54mm pitch Pin header) |
| | JP8 | | GPIO Level shift voltage selection (Must be use Jumper select 1.8V or 3.3V) |
| | J16 | | FAN 1*4pin 1.25mm pitch wafer (Joint Tech _A1250WV-04PNLNT1N00B) |
| | J20 | | Battery 1*5pin 2mm pitch wafer (Option) (Aquatech 2016WRS-05-LPSNHF) |

Fan connector (J16) Pin Descriptions

| 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 |

Battery 1*5 pin 2mm Pitch Wafer

| Wafer Type : Aquatech 2016WRS-05-LPSNHF ; Housing: JST PHR 5P | | | |
|---|-------------|--|------------------|
| Pin# | Signal Name | Usage/Description | Type/Dir Default |
| 1 | VDD_BAT | Battery + ,Support 2 Series Cells Li-ion/Li-Polymer Battery, Max Charge Current 4A | Power |
| 2 | VDD_BAT | | Power |
| 3 | TS | Connect to Battery Thermistor (10K NTC resistor) | Input |
| 4 | BAT_GND | Ground | Ground |
| 5 | BAT_GND | | Ground |

GPIO Expand (J14) Pin Descriptions

Wafer type : PINREX Tech_ 212-92-20GBEL

| 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 | 2SK3019 | 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 | 2SK3019 | 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 | TXB0108 | UART0_TX | UART #0 Transmit | Output | 20uA | 3 |
| 9 | GND | - | - | Ground | Ground | - | |
| 10 | UART0_RX_3V3 | TXB0108 | UART0_RX | UART #0 Receive | Input | 20uA | |
| 11 | UART0_RTS_3V3 | TXB0108 | UART0_RTS# | UART #0 Request to Send | Output | 20uA | 3 |
| 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 (1.8/3.3V) | Bidir | 20uA | 3 |
| 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 | TXB0108 | UART0_CTS# | UART #0 Clear to Send (3.3V) | Output/OD | 20uA | 3 |
| 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 |
|--------|-------|-----------------------------|-----------------------------|----------|-----------------------------|

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. (Not use)
5. These signals come from the GPIO expanders.
6. These pins are directly connected to Tegra. The max drive that meets full Data Sheet VOL/VOH is 1mA. 2mA drive is supported at restricted VOL/VOH 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.

3.5 Component Characteristics

3.5.1 DP to HDMI Protocol Converter (Parade PS176)

- Compliant with HDMI 2.0 specification with data rate up to 6Gbps.
- supports HDCP 1.4 and HDCP 2.2 repeater for downstream sink with an embedded key
- Integrated an on-chip microcontroller for system configuration purposes.
- Supports multiple color formats:
- - DP: RGB 6/ 8/ 10/ 12-bit per component (bpc) and YCbCr4:4:4, YCbCr4:2:2 bpc 8/ 10/ 12 bpc
- - HDMI: RGB 8/ 10/ 12 bpc; YCbCr4:4:4, YCbCr4:2:2 and YCbCr4:2:0 8/ 10/ 12 bpc
- Supports up to 8-channel LPCM, compressed audio (AC-3, DTS) and HBR audio formats
- Supports up to 192kHz audio frame rate and up to 24-bit audio sample size

DISPLAY RESOLUTIONS FOR TMDS OUTPUT

Following tables provide the popular video modes that PS176 may support. PS176 will also support other video modes as long as they are within available DisplayPort™ bandwidth, TMDS clock frequency range of 25MHz to 340MHz (HDMI Specification 1.4b) and TMDS character rate (1/4 of TMDS clock frequency) range of 85MHz to 150MHz (HDMI Specification 2.0).

Table 1. Video clock table for monitors

| Resolution | Refresh Rate | Horizontal Frequency | Pixel Frequency | Standard Type | Original Document | Date |
|------------|--------------|----------------------|-----------------|-------------------|-------------------|---------|
| 640 x 350 | 85 Hz | 37.9 kHz | 31.500 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 640 x 400 | 85 Hz | 37.9 kHz | 31.500 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 720 x 400 | 85 Hz | 37.9 kHz | 35.500 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 640 x 480 | 60 Hz | 31.5 kHz | 25.175 MHz | Industry Standard | n/a | n/a |
| | 72 Hz | 37.9 kHz | 31.500 MHz | VESA Standard | VS901101 | 12/2/92 |
| | 75 Hz | 37.5 kHz | 31.500 MHz | VESA Standard | VDMT75HZ | 10/4/93 |
| | 85 Hz | 43.3 kHz | 36.000 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 800 x 600 | 56 Hz | 35.1 kHz | 36.000 MHz | VESA Guidelines | VG900601 | 8/6/90 |
| | 60 Hz | 37.9 kHz | 40.000 MHz | VESA Guidelines | VG900602 | 8/6/90 |
| | 72 Hz | 48.1 kHz | 50.000 MHz | VESA Standard | VS900603A | 8/6/90 |
| | 75 Hz | 46.9 kHz | 49.500 MHz | VESA Standard | VDMT75HZ | 10/4/93 |
| | 85 Hz | 53.7 kHz | 56.250 MHz | VESA Standard | VDMTPROP | 3/1/96 |

| | | | | | | |
|-------------|------------------|------------|-------------|-------------------|------------|----------|
| 848 x 480 | 60 Hz | 31.0 kHz | 33.750 MHz | VESA Standard | AddDMT | 3/4/03 |
| 1024 x 768 | 43 Hz Interlaced | 35.5 kHz | 44.900 MHz | Industry Standard | n/a | n/a |
| | 60 Hz | 48.4 kHz | 65.000 MHz | VESA Guidelines | VG901101A | 9/10/91 |
| | 70 Hz | 56.5 kHz | 75.000 MHz | VESA Standard | VS910801-2 | 8/9/91 |
| | 75 Hz | 60.0 kHz | 78.750 MHz | VESA Standard | VDMT75HZ | 10/4/93 |
| | 85 Hz | 68.7 kHz | 94.500 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 1152 x 864 | 75 Hz | 67.5 kHz | 108.000 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 1280 x 768 | 60 Hz | 47.4 kHz | 68.250 MHz | CVT Red. Blanking | AddDMT | 3/4/03 |
| | 60 Hz | 47.8 kHz | 79.500 MHz | CVT | AddDMT | 3/4/03 |
| | 75 Hz | 60.3 kHz | 102.250 MHz | CVT | AddDMT | 3/4/03 |
| | 85 Hz | 68.6 kHz | 117.500 MHz | CVT | AddDMT | 3/4/03 |
| 1280 x 960 | 60 Hz | 60.0 kHz | 108.000 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| | 85 Hz | 85.9 kHz | 148.500 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 1280 x 1024 | 60 Hz | 64.0 kHz | 108.000 MHz | VESA Standard | VDMTREV | 12/18/96 |
| | 75 Hz | 80.0 kHz | 135.000 MHz | VESA Standard | VDMT75HZ | 10/4/93 |
| | 85 Hz | 91.1 kHz | 157.500 MHz | VESA Standard | VDMTPROP | 3/1/96 |
| 1360 x 768 | 60 Hz | 47.7 kHz | 85.500 MHz | VESA Standard | AddDMT | 3/4/03 |
| 1400 x 1050 | 60 Hz | 64.7 kHz | 101.000 MHz | CVT Red. Blanking | AddDMT | 5/13/03 |
| | 60 Hz | 65.3 kHz | 121.750 MHz | CVT | AddDMT | 3/4/03 |
| | 75 Hz | 82.3 kHz | 156.000 MHz | CVT | AddDMT | 3/4/03 |
| | 85 Hz | 85.0 kHz | 179.500 MHz | CVT | AddDMT | 3/4/03 |
| 1440 x 900 | 60 Hz | 55.5 kHz | 88.750 MHz | CVT Red. Blanking | CVT 1.30MA | 7/14/04 |
| | 60 Hz | 59.9 kHz | 106.500 MHz | CVT | CVT 1.30MA | 7/14/04 |
| | 75 Hz | 75.0 kHz | 136.750 MHz | CVT | CVT 1.30MA | 7/14/04 |
| 1600 x 1200 | 85 Hz | 84.8 kHz | 157.000 MHz | CVT | CVT 1.30MA | 7/14/04 |
| | 60 Hz | 75.0 kHz | 162.000 MHz | VESA Standard | VDMTREV | 12/18/96 |
| | 65 Hz | 81.3 kHz | 175.500 MHz | VESA Standard | VDMTREV | 12/18/96 |
| | 70 Hz | 87.5 kHz | 189.000 MHz | VESA Standard | VDMTREV | 12/18/96 |
| | 75 Hz | 93.8 kHz | 202.500 MHz | VESA Standard | VDMTREV | 12/18/96 |
| | 85 Hz | 106.3 kHz | 229.500 MHz | VESA Standard | VDMTREV | 12/18/96 |
| 1680 x 1050 | 60 Hz | 64.7 kHz | 119.000 MHz | CVT Red. Blanking | CVT 1.76MA | 7/14/04 |
| | 60 Hz | 65.3 kHz | 146.250 MHz | CVT | CVT 1.76MA | 7/14/04 |
| | 75 Hz | 74.9 kHz | 187.000 MHz | CVT | CVT 1.76MA | 7/14/04 |
| | 85 Hz | 93.9 kHz | 214.75 MHz | CVT | CVT 1.76MA | 7/14/04 |
| 1792 x 1344 | 60 Hz | 83.64 kHz | 204.750 MHz | VESA Standard | VDMTREV | 9/17/98 |
| 1856 x 1392 | 60 Hz | 86.33 kHz | 218.250 MHz | VESA Standard | VDMTREV | 9/17/98 |
| 1920 x 1200 | 60 Hz | 74.0 kHz | 154.000 MHz | CVT Red. Blanking | AddDMT | 3/4/03 |
| | 60 Hz | 74.6 kHz | 193.250 MHz | CVT | AddDMT | 3/4/03 |
| | 75 Hz | 94.0 kHz | 245.250 MHz | CVT | AddDMT | 3/4/03 |
| 1920 x 1440 | 60 Hz | 90.000 kHz | 234.000 MHz | VESA Standard | VDMTREV | 9/17/98 |

3.5.2 USB 3.1 Gen 1 Hub Controller

- Compliant with the USB 3.1 specification.
- Fully backward compatible to all USB 2.0 and USB 1.1 hosts.

3.6 Ability of Power Provision

The ability of carrier board to provide power is listed in Table 5.

Table 5:

| Symbol | Min. | Max. | Total Power |
|---------------|------|-------|-------------|
| DC Jack Input | 6V | 14.9V | 60W(Max.) |

3.7 Thermal Specifications

The case temperature of key components is listed in Table 6.

Table 6:

| Components | Components Case Temperature Specifications |
|-------------------------------------|--|
| USB 3.1 Gen 1 Hub Controller (U6) | Tcase = 95 |
| DP to HDMI Protocol Converter (U40) | Tcase = 95 |

3.8 EMI Specifications

EMI/ EMS test specification are listed in Table 7

Table 7 :

| Criteria | Specification | Reference |
|----------|-------------------|--------------|
| EMI | EN 55022 standard | CE |
| EMS | ESD test standard | EN 61000-4-2 |

3.9 Buttons and Indicators

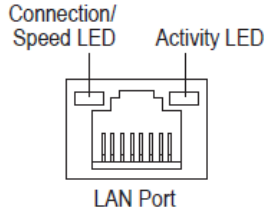
Buttons (Switches)

| Button | Description | Usage |
|--------|----------------------------|---|
| SW2 | Reset button | Used to force a full system reset. |
| SW5 | Volume down (Sleep) button | Used to put system into sleep mode. |
| SW7 | Recovery button | 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. |
| SW3 | Power button | Used to power system up if off, or power down if on. If held for >10 seconds, will force a full system power cycle. |

Indicators (LEDs)

| LEDs | Description | Usage |
|------|------------------------|---|
| D7 | SOC Enable LED (Green) | Indicates when the VDD_CORE (SOC) supply is active. |
| D5 | Power LED (Green) | Indicates when the carrier board is powered on (VDD_1V8 & VDD_3V3_SYS rails are valid). |

Gigabit Ethernet (LAN Port LEDs)



| Connection LED: | | Activity LED (Yellow): | |
|-----------------|-------------|------------------------|--|
| Status | Description | State | Description |
| Green | Link | Yellow Blinking | Data transmission or receiving is occurring |
| | | Off | No data transmission or receiving is occurring |

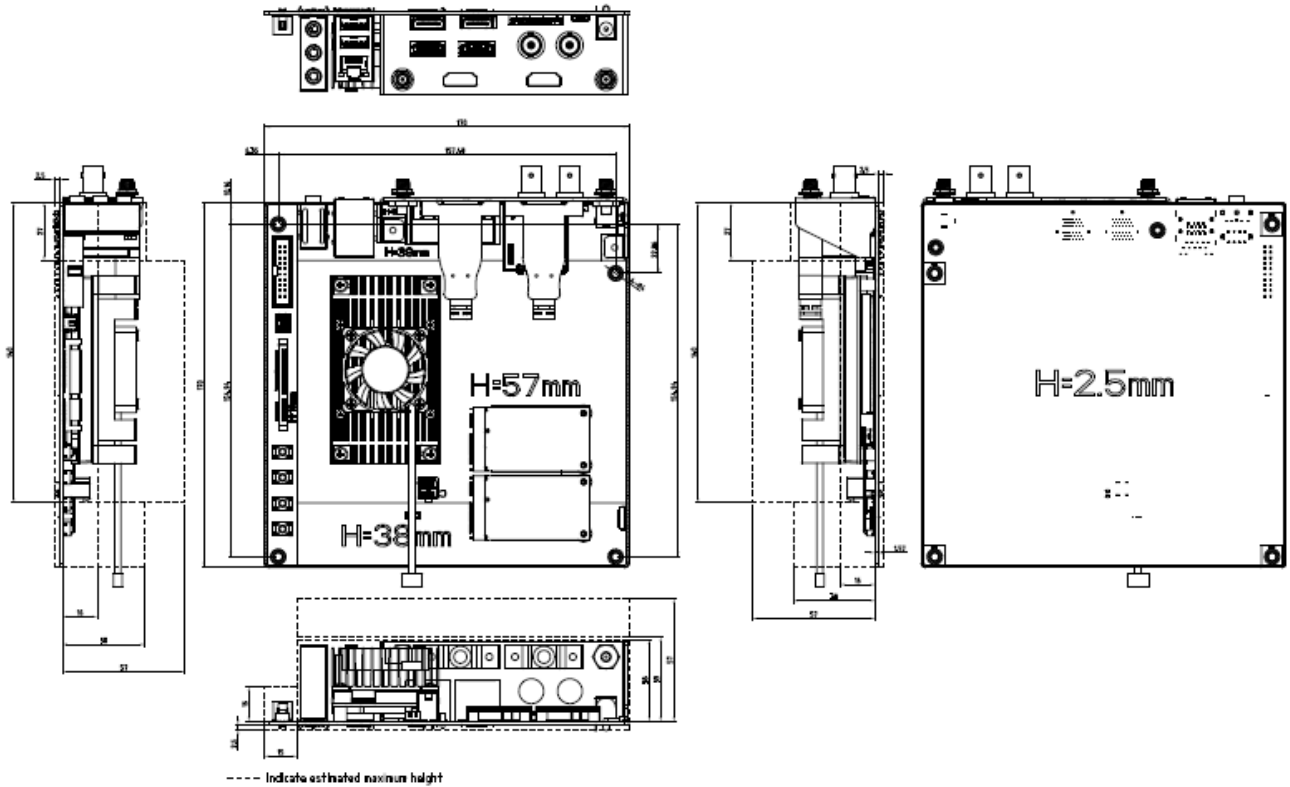
4. Software

BSP (board support package) : NVIDIA JETSON JETPACK 3.3 (R28.2)

5. Firmware

| Item | Location | Firmware Version | Noted |
|--------|----------|------------------|-----------|
| Mini51 | U54 | 180331 | Own brand |

6. ID Specifications



7. Reliability

Table 8:

| Criteria | Specification | Reference |
|------------------|--|-------------|
| Low Temperature | Operating: 0 C/48 hrs | IEC 68-2-1 |
| | Storage: -20 C/24 hrs | |
| High Temperature | Operating: 55 C/48 hrs | IEC 68-2-2 |
| | Storage: 80 C /24 hrs | |
| High Humidity | Operating: 55C, 95% RH/48 hrs | IEC 68-2-30 |
| | Storage: 80C, 95% RH/24 hrs | |
| Cold Start | Operating: 0 C/1hr | IEC 68-2-1 |
| Hot Start | Operating: 55C, 95% RH/1hr | IEC 68-2-2 |
| Package Drop | According to the ISTA 2A test standard | ISTA 2A |