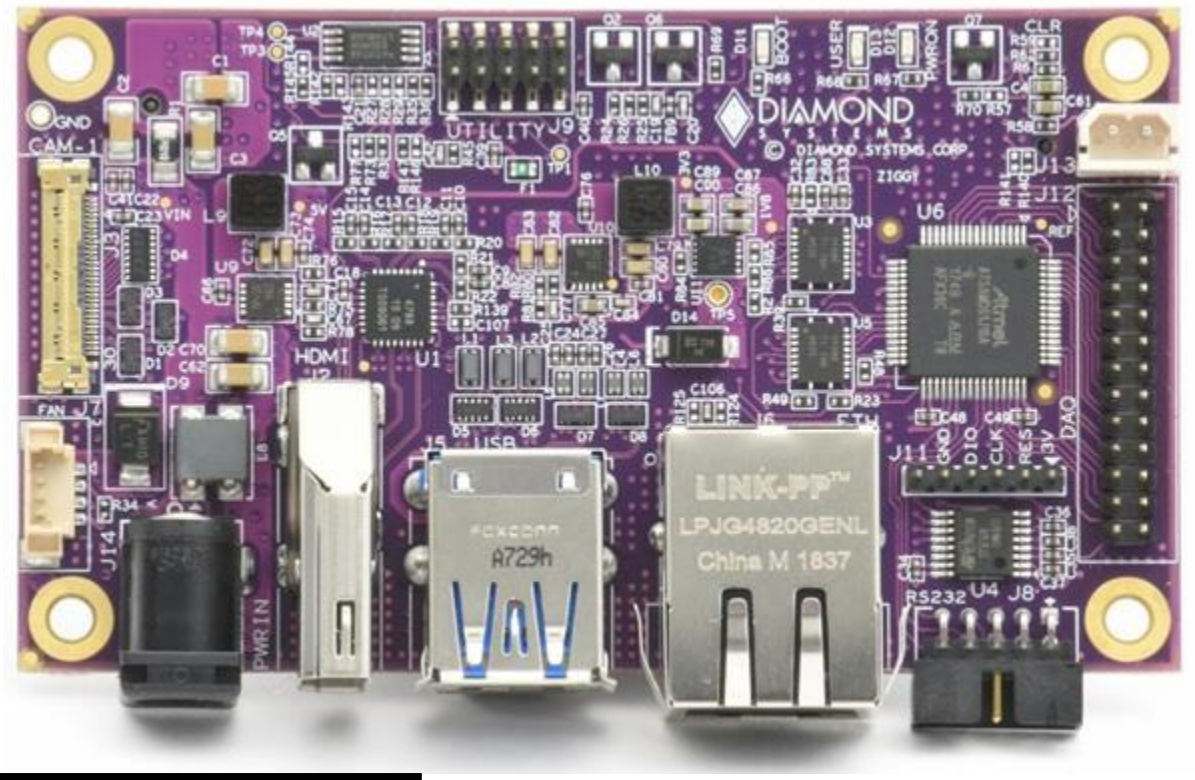
Ziggy Baseboard

NVIDIA Jetson TX2 Base Board



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1. IMPORTANT SAFE HANDLING INFORMATION

WARNING!

ESD-Sensitive Electronic Equipment

Observe ESD-safe handling procedures when working with this product.

Always use this product in a properly grounded work area and wear appropriate ESD-preventive clothing and/or accessories.

Always store this product in ESD-protective packaging when not in use.

Safe Handling Precautions

The Venus SBC contains a high number of I/O connectors with connection to sensitive electronic components. This creates many opportunities for accidental damage during handling, installation and connection to other equipment. The list here describes common causes of failure found on boards returned to Diamond Systems for repair. This information is provided as a source of advice to help you prevent damaging your Diamond (or any vendor's) embedded computer boards.

ESD damage – This type of damage is usually almost impossible to detect, because there is no visual sign of failure or damage. The symptom is that the board eventually simply stops working, because some component becomes defective. Usually the failure can be identified and the chip can be replaced.

To prevent ESD damage, always follow proper ESD-prevention practices when handling computer boards.

Damage during handling or storage – On some boards we have noticed physical damage from mishandling. A common observation is that a screwdriver slipped while installing the board, causing a gouge in the PCB surface and cutting signal traces or damaging components.

Another common observation is damaged board corners, indicating the board was dropped. This may or may not cause damage to the circuitry, depending on what is near the corner. Most of our boards are designed with at least 25 mils clearance between the board edge and any component pad, and ground / power planes are at least 20 mils from the edge to avoid possible shorting from this type of damage. However these design rules are not sufficient to prevent damage in all situations.

A third cause of failure is when a metal screwdriver tip slips, or a screw drops onto the board while it is powered on, causing a short between a power pin and a signal pin on a component. This can cause overvoltage / power supply problems described below. To avoid this type of failure, only perform assembly operations when the system is powered off.

Sometimes boards are stored in racks with slots that grip the edge of the board. This is a common practice for board manufacturers. However our boards are generally very dense, and if the board has components very close to the board edge, they can be damaged or even knocked off the board when the board tilts back in the rack. Diamond recommends that all our boards be stored only in individual ESD-safe packaging. If multiple boards are stored together, they should be contained in bins with dividers between boards. Do not pile boards on top of each other or cram too many boards into a small location. This can cause damage to connector pins or fragile components.

Power supply wired backwards – Our power supplies and boards are not designed to withstand a reverse power supply connection. This will destroy each IC that is connected to the power supply (i.e. almost all ICs). In this case the board will most likely will be unrepairable and must be replaced. A chip destroyed by reverse power or by excessive power will often have a visible hole on the top or show some deformation on the top surface due to vaporization inside the package. **Check twice before applying power!**

Board not installed properly in PC/104 stack – A common error is to install a PC/104 board accidentally shifted by 1 row or 1 column. If the board is installed incorrectly, it is possible for power and ground signals on the bus to make contact with the wrong pins on the board, which can damage the board. For example, this can damage components attached to the data bus, because it puts the ±12V power supply lines directly on data bus lines.

Overvoltage on analog input – If a voltage applied to an analog input exceeds the design specification of the board, the input multiplexor and/or parts behind it can be damaged. Most of our boards will withstand an erroneous connection of up to ±35V on the analog inputs, even when the board is powered off, but not all boards, and not in all conditions.

Overvoltage on analog output – If an analog output is accidentally connected to another output signal or a power supply voltage, the output can be damaged. On most of our boards, a short circuit to ground on an analog output will not cause trouble.

Overvoltage on digital I/O line – If a digital I/O signal is connected to a voltage above the maximum specified voltage, the digital circuitry can be damaged. On most of our boards the acceptable range of voltages connected to digital I/O signals is 0-5V, and they can withstand about 0.5V beyond that (-0.5 to 5.5V) before being damaged. However logic signals at 12V and even 24V are common, and if one of these is connected to a 5V logic chip, the chip will be damaged, and the damage could even extend past that chip to others in the circuit.

Bent connector pins – This type of problem is often only a cosmetic issue and is easily fixed by bending the pins back to their proper shape one at a time with needle-nose pliers. The most common cause of bent connector pins is when a PC/104 board is pulled off the stack by rocking it back and forth left to right, from one end of the connector to the other. As the board is rocked back and forth it pulls out suddenly, and the pins at the end get bent significantly. The same situation can occur when pulling a ribbon cable off of a pin header. If the pins are bent too severely, bending them back can cause them to weaken unacceptably or even break, and the connector must be replaced.

2. INTRODUCTION

This product is a Jetson TX2 module-based board with rich graphics and camera input capability. This base board converts Jetson TX2 module into a complete embedded system by providing interface circuitry, I/O connectors for all the major features of the module, camera interface, power supply and additional I/O capability.
Ziggy TX2 Base Board redefines possibility; a combination of performance, power efficiency, integrated deep learning capabilities and rich I/O remove the barriers to a new generation of products
The base board also contains a Micro SD card for storage option with all key I/O connectors placed along one edge for cable-free installation.

2.1 Features

- Module NVIDIA Jetson TX2
  - SoC Parker Series SoC
  - GPU NVIDIA Pascal™, 256 CUDA cores
  - CPU HMP Dual Denver 2/2MB L2 + Quad ARM A57/2MB L2
  - VIDEO 4K x 2K 60Hz Encode (HEVC)
  - 4K x 2K 60Hz Decode (12-Bit Support)
  - MEMORY 8 GB 128-Bit LPDDR4
  - 4K x 2K 60Hz Encode (HEVC)
  - 4K x 2K 60Hz Decode (12-Bit Support)
  - 58.2 GB/s (51.2 GB/s TX2i)
- Memory 1x microSD slot
- Connectivity 1 10/100/100 Mbps directly from module
- USB 2 USB 3.0 ports to standard header
  1x USB micro with OTG support
- HDMI HDMI 2.0a/b directly from processor
- Serial ports 2 ports with RS-232 capability
- DAQ 13 digital IO
  6x ADC Input
  2x DAC Output
- Utility 1x I2C, 1xUART, 1x SPI, Reset

2.2 Operating System Support

- Linux Kernel version 4.4.38, Ubuntu 16.04 aarch64

2.3 Mechanical, Electrical, Environmental

- Form factor 3.43” x 1.97” (87mm x 50mm)
- Cooling Conduction cooling, heat spreader
- Power +9V /+5.5V to +18VDC; +12V Typical
- Operating Temp -40°C to +85°C at outer surface of heat spreader

Environmental Designed to meet the following conditions:

- Shock: MIL-STD-202G, Method 213-B, Table 213-1 Condition A, 50G / 11ms half sine, non-operational
- Vibration: MIL-STD-202G, Method 214A, Table 214-1, Condition D, 11.95G random vibration, 15 minutes per axis, operational

3. FUNCTIONAL BLOCK DIAGRAM

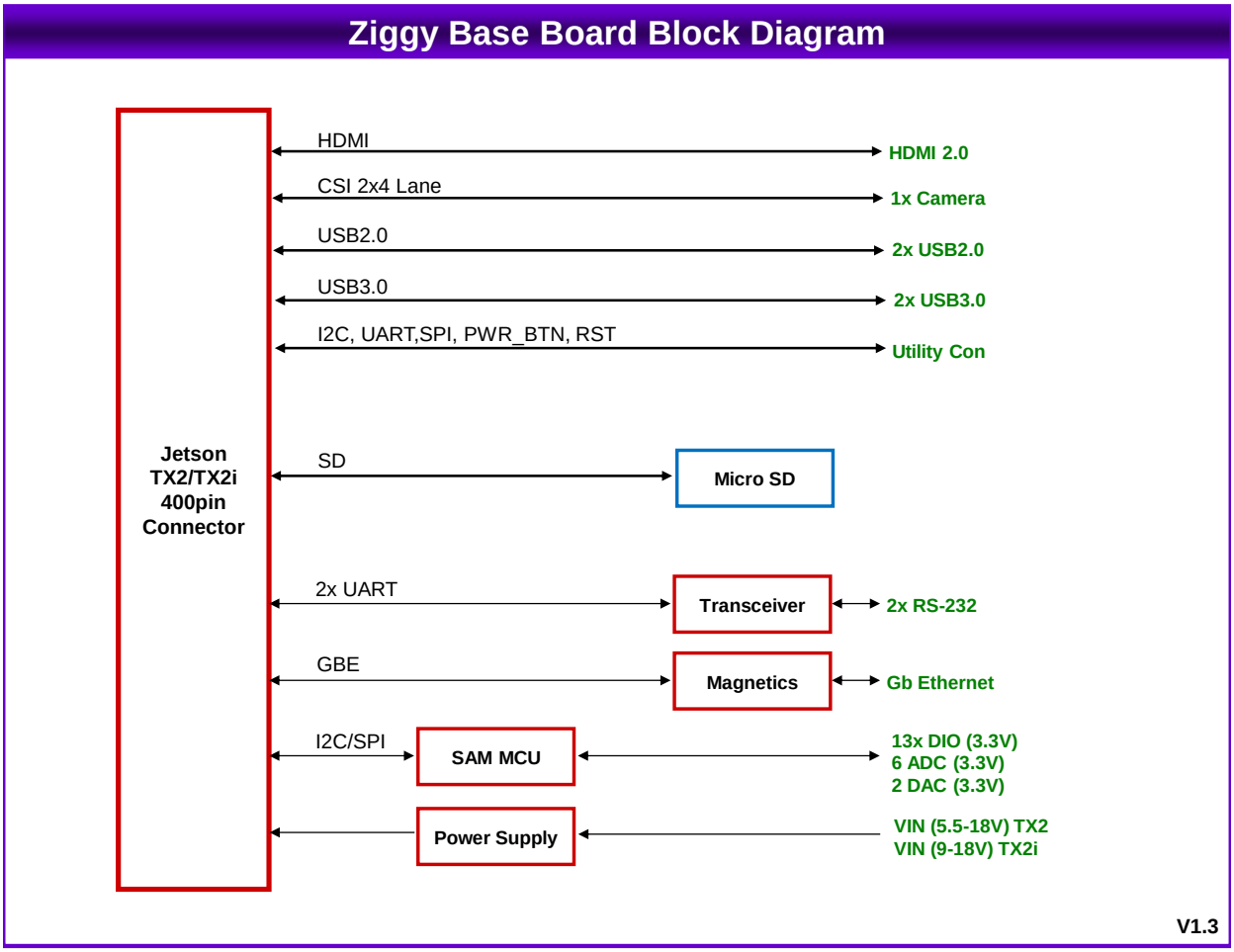


Figure 1 Functional Block Diagram

3.1 Feature Descriptions

This section describes the key subsystems of Ziggy.

3.1.1 Processor Module

The baseboard supports Jetson TX2 / TX2i modules. Jetson TX2 is the fastest, most power-efficient embedded AI computing device. The latest addition to the industry-leading Jetson embedded platform, this 7.5-watt supercomputer on a module brings true AI computing at the edge. It's built around an NVIDIA Pascal™-family GPU and loaded with 8 GB of memory and 59.7 GB/s of memory bandwidth. It features a variety of standard hardware interfaces that make it easy to integrate it into a wide range of products and form factors.

3.1.2 Backup Battery

A 2x1 input connector is provided for connecting the external backup battery.

3.1.3 Ethernet

The board provide one 10/100/1000 Ethernet port directly from the module The MDIx signals from the module are terminated to standard RJ45 connector with integrated magnetics.

LEDs for Link, Activity, and Speed Indication are available on RJ45 jack

3.1.4 Display

Ziggy offers HDMI2.0 a/b video output. The HDMI port is directly from the processor and is made available on a standard HDMI header. Integrated audio support is provided along with HDMI display.

3.1.5 Camera

The board supports one MIPI CSI x2 camera interface through 30pin I-PEX connector. Supporting signals like I2C and control signals are available through connector so that user can directly interface the camera to the board.

3.1.6 USB

2x USB3.0 (with USB2.0) ports are available from the Jetson module. These ports are available on the standard USB3.0 connector on the Ziggy. Note that only bottom port on the dual USB3.0 connector supports USB3.0 due to the current software mapping.
1 x USB2.0 from the module is interfaced to micro USB with OTG support

3.1.7 Audio

Audio interface is integrated with HDMI interface. No separate audio analog outputs are provided.

3.1.8 Micro SD

The board offers one micro SD connector with 4-bit data 3.3V for an additional low-cost storage option

3.1.9 Serial Ports

The board provides 2 serial ports from the module.

Two serial ports are available on 2x5 header through MAX3232 transceiver with RS232 protocol support. Jumpers for Termination Control circuit is incorporated to enable termination resistor (120 Ohm) for RS422 and

3.1.10 DAQ

The board has a SAM microcontroller, through which 13 Digital I/O signals, 6 Analog Inputs and 2 DAC output are made available through 2x13 header. All the IOs are 3.3V level.

SAM microcontroller is interfaced to the Jetson Module via SPI interface. An EEPROM is connected to the controller for storing the calibration values of ADC/DAC.

3.1.11 **Connectivity**

Jetson module supports WLAN/Bluetooth integrated with Male I-PEX antenna connectors for WLAN/ BT are located on the module.

WLAN:

- 2x2 MIMO
- 802.11ac compliant (backwards compatible with legacy 802.11b/g/a/n devices)

Bluetooth:

- Bluetooth 4.1 ready (can connect to Bluetooth 4.1 enabled devices)
- HIDP
- Audio – A2DP (advanced audio distribution profile)
- RFKILL

The board supports socket for plugging the Skywire LTE CAT1 module from NimbeLink. 2x10 socket is provided on the board with USB and UART to support the LTE module.

3.1.12 **LED Indicators**

The board provides the following LED indicators. All LEDs are located near to board edge or their respective features. All LEDs are labeled in silkscreen with their function.

Power In:	Green LED for Power IN
Power Good	Green LED for Power Good indication.
Host LED	Green LED to indicate Module is booted successfully
Ethernet:	Green LED for Link, activity, and speed for each port
User LED	Green LED for DAQ activity

3.1.13 **Power Supply**

Ziggy supports wide range +9VDC to 18VDC. Typical input voltage is +12VDC

All required supply voltages for the board are derived from the input. These power supplies are sized to support the highest capacity of the module plus have enough reserve capacity to support the below add-on features:

12V	5V	3.3V	Feature
1.6A			Jetson TX2/TX2i Module
	1A		USB Ports
	0.1A	0.1A	Camera circuit

4. MECHANICAL BOARD DRAWING

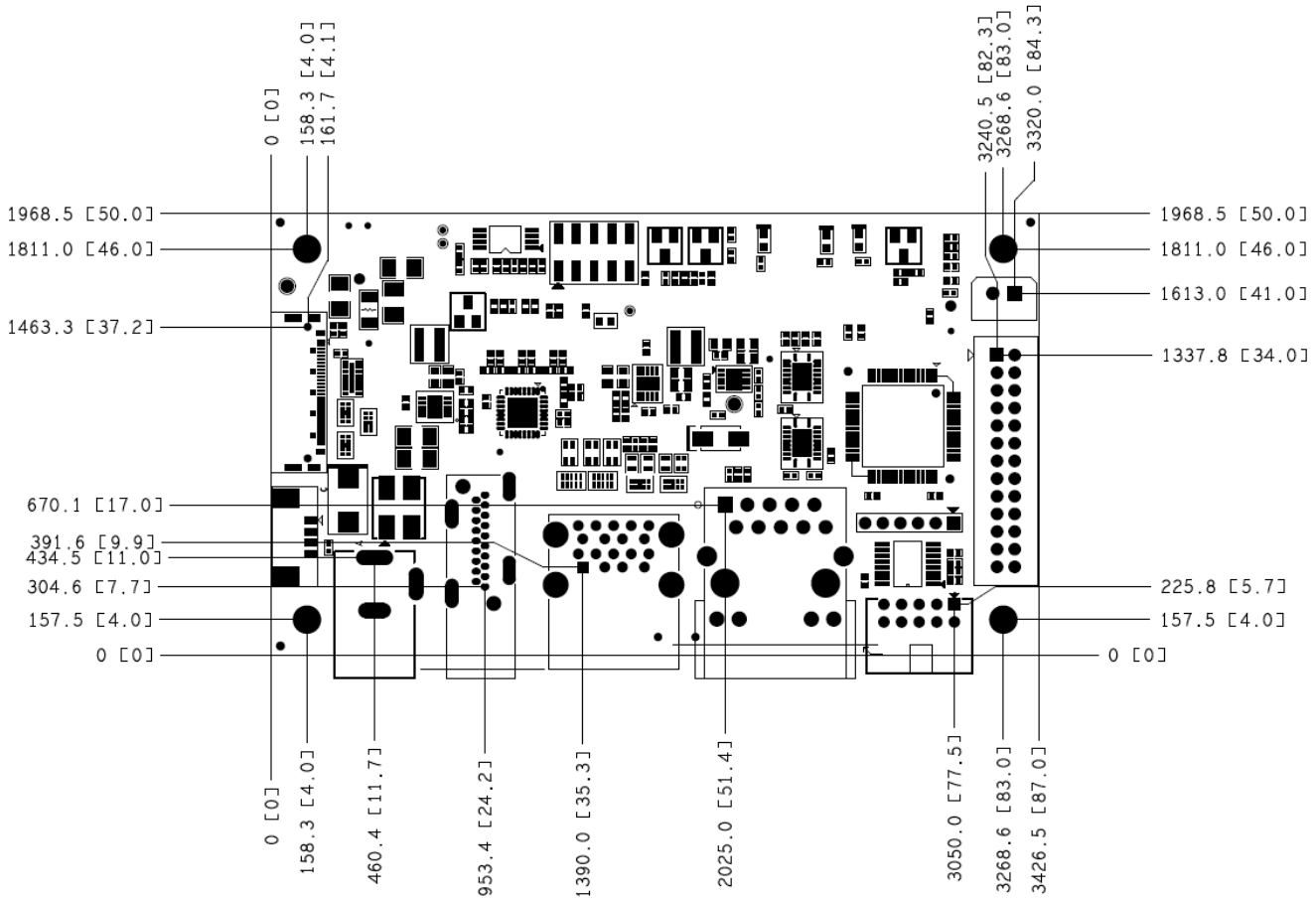


Figure 2: Mechanical Board Drawing

5. BOARD LAYOUT (CONNECTOR AND JUMPER LOCATIONS)

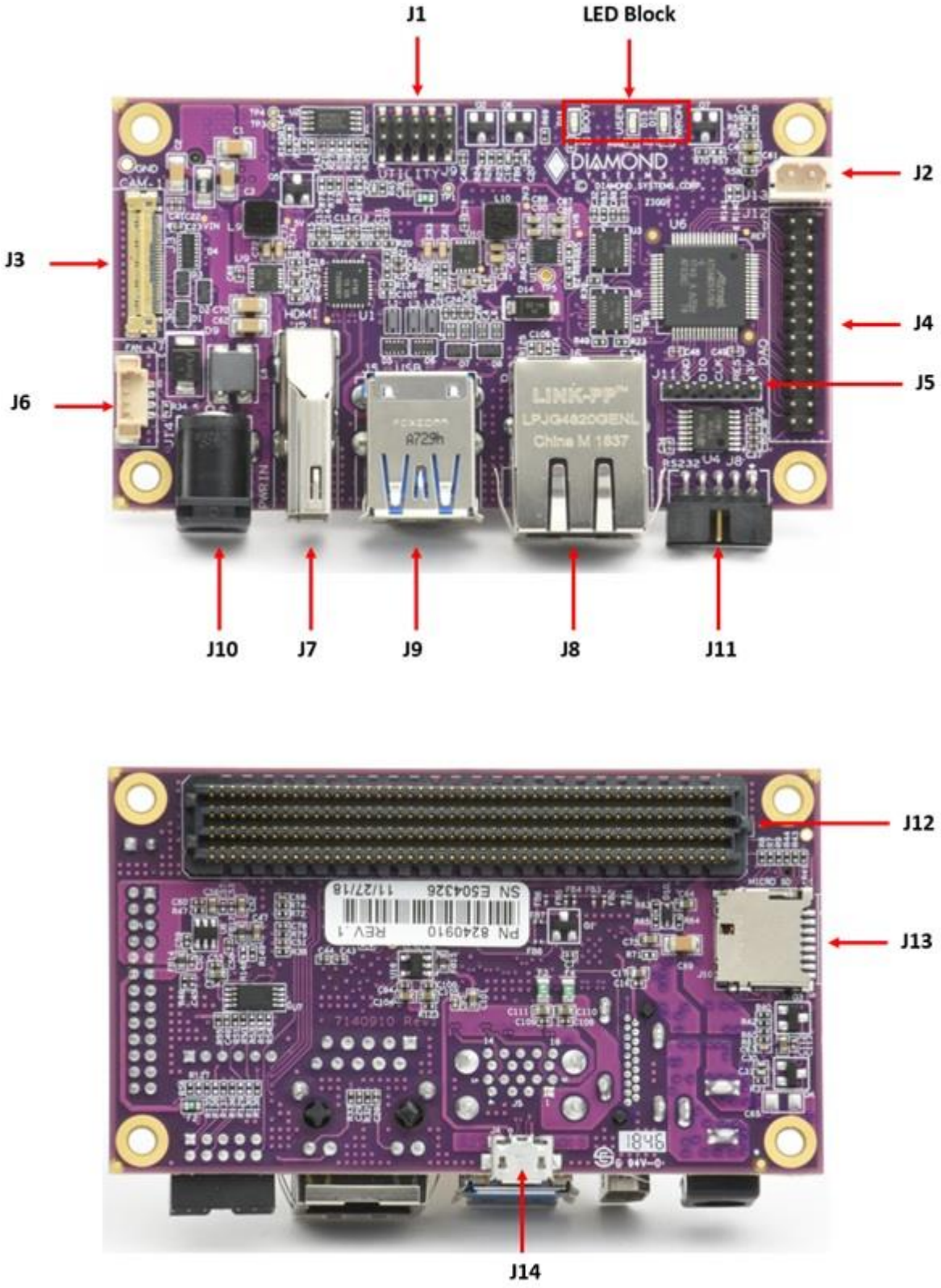


Figure 2 Board Layout, Top view and bottom view

Connector	*Function*	*LED Block*	
J1	Utility	1st LED (Left most in the block)	Host LED
J2	External Battery	2nd LED (Middle one in the block)	DAQ User LED
J3	MIPI Camera	3rd LED	Power OK
J4	DAQ		
J5	SAM Programming Header		
J6	FAN		
J7	HDMI		
J8	GbE port		
J9	USB3.0 Dual		
J10	Power In		
J11	Serial ports 1,2		
J12	Jetson TX2 module		
J13	microSD		
J14	USB2.0 OTG		

6. I/O CONNECTORS

6.1 Connector Pin-out and Signal Description

6.1.1 Utility (J1)

3.3V fused	1	2	I2C GP1 Clk
WDT_TIME_OUT#	3	4	I2C GP1 Data
FORCE_RECOVERY	5	6	UART7_TX_3P3
POWER_BTN	7	8	UART7_RX_3P3
RESET_IN	9	10	GND

Signal Name	Definition
Power Button	Use switch / Drive using open collector (5V level)
Force Recovery	Use switch / Drive using open collector (1.8V level)
Reset In	Use switch / Drive using open collector (1.8V level)
I2C GP1	I2C interface 3.3V level
UART7	UART7 Interface 3.3V level

Connector type: Standard 2mm dual row straight pin header.

Mating Cable part number: TBD

6.1.2 External Battery (J2)

1	VBAT
2	Ground

VBAT = +3.0V Min. 1.65V to 5.5V

Connector used is 2x1 Header
Mating Cable: 6980524

6.1.3 **Camera (J3)**

30pin I-PEX connector is used to directly plug the camera modules.

1	3.3V
2	3.3V
3	3.3V
4	5V-
5	NC
6	NC
7	NC
8	NC
9	PWR#
10	NC
11	NC
12	NC
13	NC
14	FLASH
15	MCLK
16	RST#
17	SDA
18	SCL
19	NC
20	DATA2-
21	DATA2+
22	DATA0-
23	DATA0+
24	CLK-
25	CLK+
26	GND
27	DATA1-
28	DATA1+
29	DATA3-
30	DATA3+

Connector: 20525-030E-02C.

Mating Cable: FAW-1233-03 (Pinouts are reversed in cable)

Camera supported: LI-IMX274-MIPI-CS and LI-IMX185-MIPI-CS

6.1.4 **DAQ I/O (J4)**

ADC0	1	2	ADC1
ADC2	3	4	ADC3
ADC4	5	6	ADC5
DAC0	7	8	DAC1
AGND	9	10	AGND
DGND	11	12	DGND
DIO 0	13	14	DIO 1
DIO 2	15	16	DIO 3
DIO 4	17	18	DIO 5
DIO 6	19	20	DIO 7
DIO 8	21	22	DIO 9
DIO 10	23	24	DIO11
DIO 12 /RESET_IN	25	26	DGND

Signal Name	Definition
ADC 5-0	Analog Inputs (3.3V level)
DAC 1-0	DAC outputs (3.3V level)
DIO 11-0	Digital I/O port; programmable direction (3.3V level)
DIO 12 /RESET_IN	Digital IO (3.3V level) / Reset In Signal (1.8V level)
DGND	Digital ground;
AGND	Analog ground

Connector type: Standard 2mm dual row header

Mating cable part No: 6980516

6.1.5 **SAM Programming Header (J5)**

1	3V3
2	SAM_RESET
3	SWCLK
4	SWDIO
5	GND
6	NC

Connector: 1x6 2mm pitch header

6.1.6 **Fan Connector (J6)**

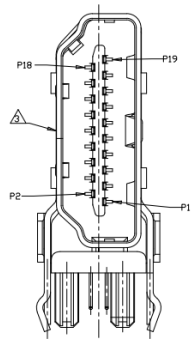
A 4 pin 1.25mm pitch Vertical SMD connector is used for Heatsink Fan connection Pinout is shown below.

1	FAN PWM (5V level)
2	FAN TACH (1.8V level)
3	VDD 5V
4	GND

Connector part number: 533980471

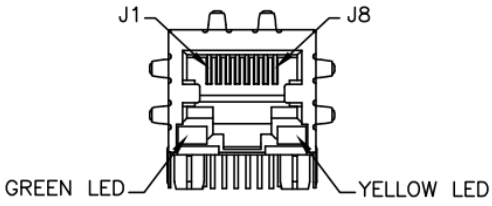
6.1.7 **HDMI (J7)**

Standard HDMI Receptacle Connector 19 Position Panel Mount, Through Hole, Right Angle is used for HDMI interface. Standard HDMI pinouts are followed.



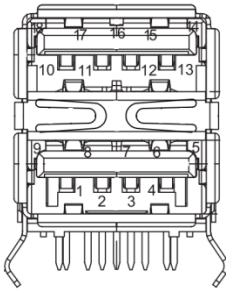
6.1.8 **Ethernet (J8)**

Standard RJ45 Magjack Connector Through Hole 10/100/1000 Base-T, AutoMDIX is used for GbE port. Standard Ethernet pinouts are followed.



6.1.9 **USB 3.0 Ports (J9)**

Standard USB - A, Stacked USB 3.0 Receptacle Connector 18 Position Through Hole, Right Angle is used for USB3.0/USB2.0 port. Standard USB3.0/USB2.0 pinouts are followed.



Note: USB3.0 port is available only on the bottom connector due to software limitations.

6.1.10 **Power In (J10)**

+VIN = +9V to +18V

Connector used is Power Jack.
DC Power Plug Jack 2.5mm x 5.5mm

6.1.11 **Serial Ports (J11)**

Connector supports 2 RS232 (Tx, Rx only) serial ports. Additional 4 GPIOs are provided from SAM controller as options. Pinouts are as follows based on the configuration Option to use 8 GPIOs instead of Serial ports are provided.

RS-232 +GPIO (Default)

TX1	1	2	TX2
RX1	3	4	RX2
GND	5	6	GND
GPIO_5	7	8	GPIO_6
GPIO_7	9	10	GPIO_8

GPIO

GPIO_1	1	2	GPIO_2
GPIO_3	3	4	GPIO_4
GND	5	6	GND
GPIO_5	7	8	GPIO_6
GPIO_7	9	10	GPIO_8

6.1.12 **Micro SD (J13)**

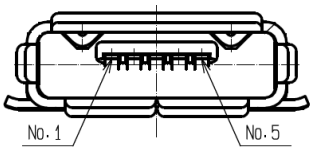
Standard Micro SD connector will be used for additional storage option. The pinout is shown below.

1	DAT2
2	CD/DAT3
3	CMD
4	VDD 3.3V
5	CLK
6	Ground
7	DAT0
8	DAT1

Connector part number: 114-00841-68

6.1.13 **USB 2.0 OTG (J14)**

Standard USB 2.0 Micro AB 5 Positions SMD RA is used for USB2.0 OTG port. This port is also used for programming purpose. Standard USB OTG pinouts are followed.



6.2 List of Connectors

The following table provides a summary of all I/O connectors on the board.

Function	Manufacturer	Part no.	Description	DSC Mating Cable
Power in	CUI Inc.	PJ-202B	PWR JACK 2.5X5.5MM SOLDER	NA
External battery	Molex	22-03-5025	2 pos. TH VERT HDR, .1” pitch shrouded	6980524
GbE Ethernet	LINK PP	LPJG4820GENL	Magnetic RJ45 Jack	NA
HDMI	TE	2007435-1	HDMI RCPT TYPE A R/A TH	NA
Camera	I-PEX	20525-030E-02C	30pIn I-PEX RA SMD	FAW-1233-03
Serial Ports	MLX	878331020	Conn, Hdr 2x5 2mm RA TH, Box Hdr	TBD
USB 3.0	Molex	0484060003	USB 3.0 RA DUAL REC TH TYPE A	NA
USB 2.0 OTG	Hirose	ZX62-AB-5PA(31)	USB2.0 MICRO AB SMD RA	NA
SD	Amphenol	114-00841-68	10 (8 + 2) Position Card Connector Secure Digital - microSD™ Surface Mount, RA	NA
DAQ	FCI	98414-F06-26ULF	2x13, 2mm pitch, TH Header	6980516
Utility	OUP	2115-2X05G00DN	Pin Hdr,2x5,2mm,ST,4mm,SMT	TBD
Module Connector	Samtec	SEAM-50-03.0-S-08-2-A-K-TR	400-pin board-to-board connector, 8mm B2B	NA

7. I/O CABLES

CK-ZIGGY-01 with non-latching cables

Photo No:	Cable Part No:	Description	Ziggy Connector
1	6980516	DAQ	J1
2	6980524	External battery	J17
3	TBD	Serial Ports/GPIO	J2
4	TBD	Utility	J7

<Image>

8. GETTING STARTED

This section describes the steps needed to get Ziggy board up and running and assumes that user also has a Ziggy Cable Kit. The Cable Kit includes all cables needed for the I/Os and Power. The Development Kit includes the Cable Kit, an AC adapter to power the board.

8.1 Development Kit

Model Number	*Description*
TO BE UPDATED?	

8.2 Quick Setup

1. Attach HDMI display, USB keyboard, and mouse to the cables.
2. Connect power (12V) to power input connector J10 using external power supply. Check the polarity of the cable before inserting.

   WARNING: Attaching the power connector incorrectly will destroy the Ziggy!

   On plugging the power cable, the board will boot to Linux.

9. INSTALLING DSC IMAGE IN MODULE

To update the image, Ziggy board needs to be in recovery mode. This can be achieved by connecting J1.pin 5 (FORCE RECOVERY pin) to GND (J1 pin 10) and Power ON the board.

Connect USB0 port (J14) to Host PC using USB Micro B cable.

To verify that board is in recovery mode, in Host PC (running Ubuntu 16.04) terminal, type ***lsusb*** and it should show a NVIDIA device in list of USB devices.

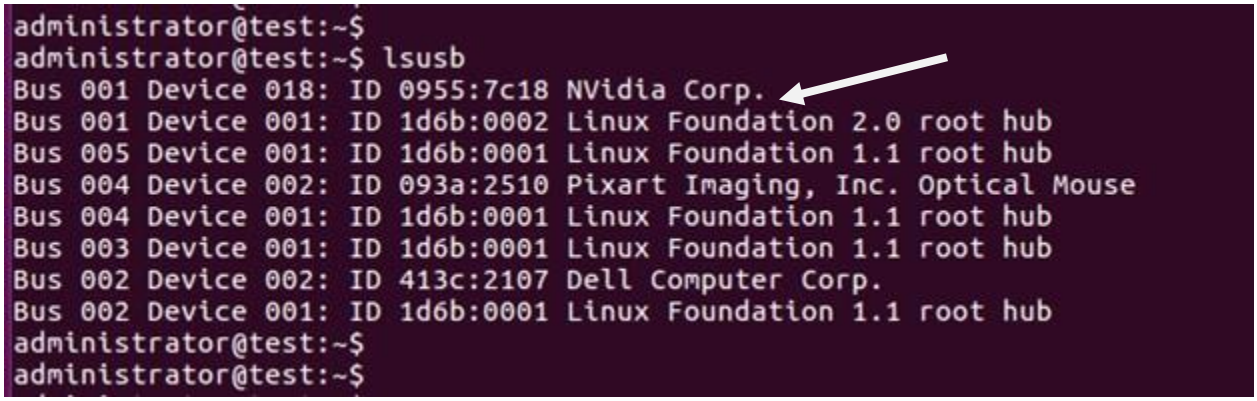


Figure 3 Recovery mode – USB detected

Steps to Program:

1. Unzip the image file

   sudo tar -pxvf dsc-tx2-tx2i-wdeb-jethro-20190204.tar.gz

2. Switch to extracted directory

   cd Linux_for_Tegra

3. Programming Jetson TX2,

   sudo ./flash.sh jetson-tx2 mmcblk0p1

4. Programming Jetson TX2,

   sudo ./flash.sh jetson-tx2i mmcblk0p1

5. After updating, module will reboot itself. It will take around 15-20mins for programming.

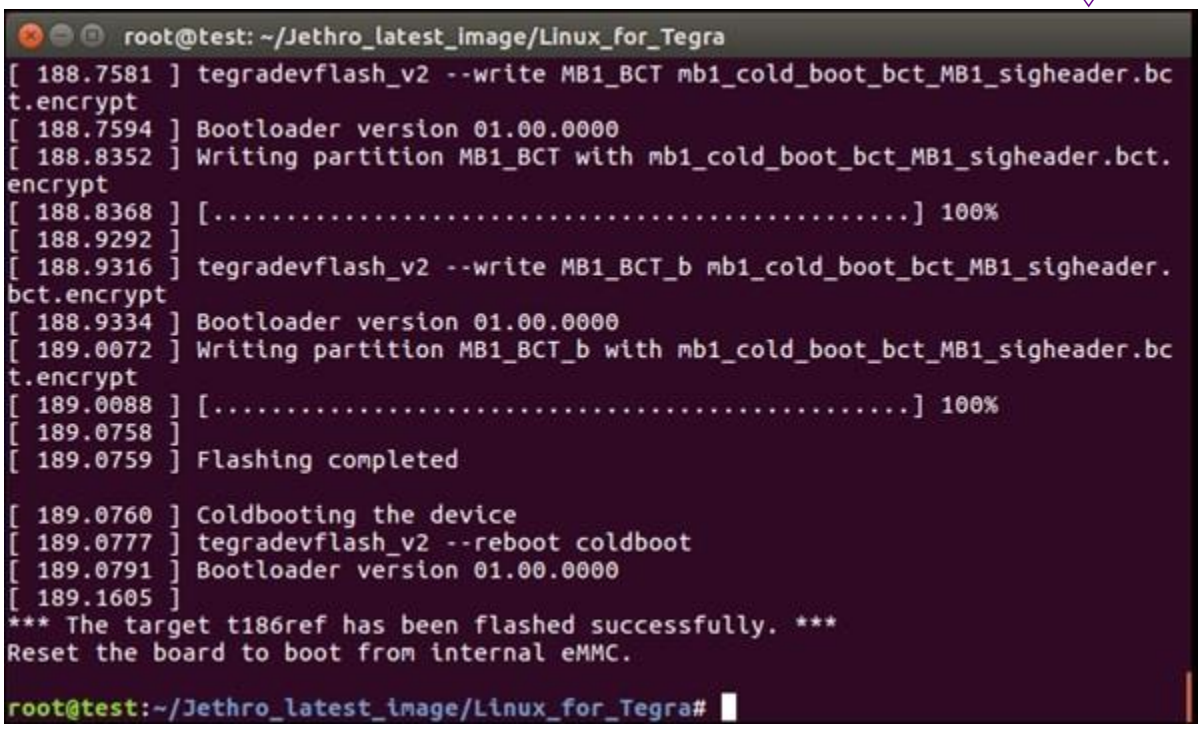


Figure 4 Recovery mode- After Programming

6. Switch off the board and remove the recovery mode connection.

10. DAQ

The 13 digital I/Os ,6 ADC inputs and 2 DAC outputs are realized using the SAM controller and are available on external header (J1). The digital I/O voltage is 3.3V. The ADC and DAC voltage level is 3.3V.

<Add DAQ spec details>

11. THERMAL SOLUTIONS

Ziggy board is designed to operate from -40C to +85C temperature range.

However, the Jetson TX2 module operating temperature is -25C to +80C and Jetson TX2i module operating temperature is -40C to +85C.
The Jetson TX2/TX2i product is designed for integration with a product-level thermal solution which could be a passive heat sink, an active heat sink, a cold plate, a chassis mount, etc. The thermal solution must attach to the top surface of the Thermal Transfer Plate (TTP).
Customer responsibility requires proper implementation of a thermal solution that maintains the TX2/TX2i SoC and Thermal Transfer Plate (TTP) temperatures below the specified temperatures (shown in the tables below) under the maximum thermal load and system conditions for their use case.

Parameter	Value			Units
	Jetson TX2	Jetson TX2 4GB	Jetson TX2i	
Maximum TTP operating temperature[1]	80	80	85	°C
Recommended Tegra X2 operating temperature limit[2]	T.cpu = 95.5	T.cpu = 95.5	T.cpu = 95.5	°C
	T.gpu[4] = 95.5	T.gpu[4] = 95.5	T.gpu[4] = 95.5	°C
Tegra X2 maximum operating temperature limit[3]	T.cpu = 101	T.cpu = 101	T.cpu = 101	°C
	T.gpu = 101	T.gpu = 101	T.gpu = 101	°C

Nvidia provides the thermal design guide is to provide the system-level thermal, mechanical and qualification requirements for the Jetson TX2 and TX2i, which can be downloaded using below link.

http://developer.nvidia.com/embedded/dlc/jetson-tx2-series-thermal-design-guide

12. SPECIFICATIONS

Item	
Module	Jetson TX2/TX2i
CPU	HMP Dual Denver 2/2MB L2 + Quad ARM A57/2MB L2
Cooling	Heat Spreader
SDRAM memory	8 GB 128-Bit LPDDR4
Display	HDMI
USB ports	1x USB2.0 OTG 2xUSB3.0*/USB2.0
Serial ports	2 RS-232 ports
DAQ	13 digital IO 6x ADC Input 2x DAC Output
Camera	1x MIPI CSI-2 4 Lane up to 2.5Gbps
Connectivity	1 10/100/100 Mbps directly from module
Mass storage	1 Micro SD
Utility	1x I2C, 1x UART, Reset
Mechanical / Environmental	
System input voltage	+9VDC to + 18VDC
Power consumption	~10W
Dimensions	1.96”x3.42” (50mm x 87mm)
Weight	41.8gms
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Shock	MIL-STD-202G compatible
Vibration	MIL-STD-202G compatible
RoHS	Compliant