Qualcomm Technologies, Inc.

Qualcomm® Robotics RB3 Platform

Hardware User Guide

Rev. A

February 19, 2019

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Revision history

Revision	Date	Description
A	February 2019	Initial release

Contents

1 Qualcomm Robotics RB3 Platform

The Qualcomm® Robotics RB3 Platform is a dedicated platform designed to accelerate computing and intelligence capabilities for consumer and industrial robotics.

The platform supports development of smart, power-efficient, cost-effective robots by combining high-performance heterogeneous computing, Qualcomm® Artificial Intelligence (AI) Engine for on-device machine learning, computer vision, voice interface, multimedia, and connectivity.

The platform hardware consists of a Robotics DragonBoard™ 845c development board, Navigation Mezzanine, and Machine Communication Mezzanine.

The Robotics DragonBoard™ 845c development board is a 96Boards-compliant community board based on the Qualcomm® SDA845 processor.

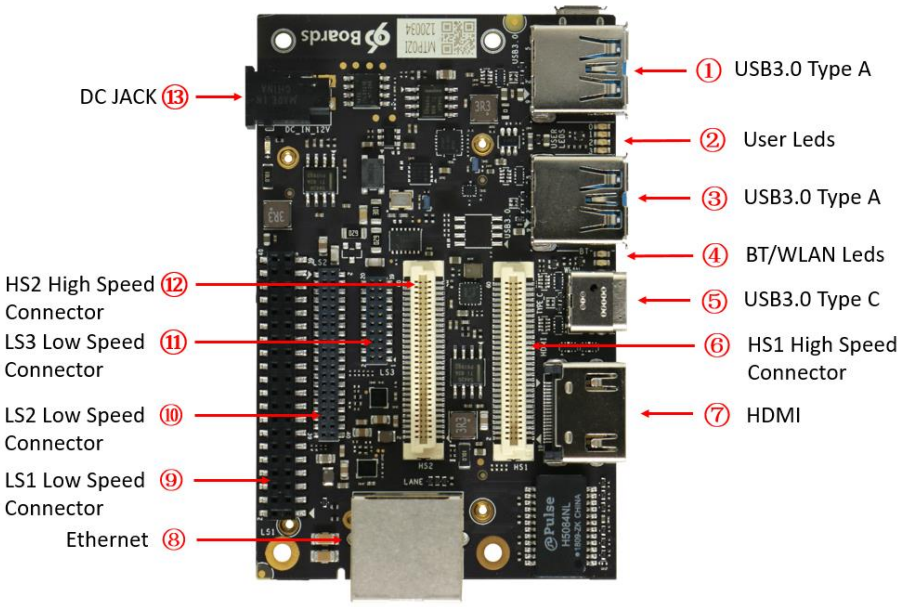
1.1 Key features

Component	Description
SoC	▪ Qualcomm® SDA845 processor
CPU	▪ Custom 64-bit ARM v8-compliant octa-core CPU ▪ Up to 2.8 GHz,10nm LPP FinFET process technology
GPU	▪ Qualcomm® Adreno™ 630 GPU ▪ OpenGL ES 3.2 + AEP, DX next, Vulkan® 1.1 ▪ OpenCL 2.0 full profile, RenderScript
DSP	▪ Qualcomm® Hexagon™ 685 DSP
RAM	▪ 4 GB LPDDR4x SDRAM @ 1866 MHz
Storage	▪ 64 GB UFS 2.1 onboard storage ▪ 1 x MicroSD card slot
Ethernet	▪ 1 x GbE Ethernet
Wireless	▪ WLAN 802.11a/b/g/n/ac 2.4/5GHz 2×2 MIMO ▪ Bluetooth 5.0, onboard WLAN/BT/GPS antennas
USB	▪ 1 x USB 2.0 Micro B (Debug only) ▪ 1 x USB 3.0 Type C (OTG mode) ▪ 2 x USB 3.0 Type A (Host mode only)
Display	▪ Two 4-lane DSI, D-PHY 1.2 or C-PHY 1.0; VESA DSC 1.1 ▪ 1 x HDMI 1.4 (Type A - full) connector
Video	▪ 4K60 decode for H.264 High Profile, H.265 Main 10 Profile and VP9 Profile 2 ▪ 4K60 encode for H.264 High Profile, H.265 Main 10 Profile
Audio	▪ MP3; aacPlus, eAAC; WMA 9/Pro
Camera	▪ Qualcomm Spectra™ 280 ISP, dual 14-bit ISP+one Lite ISP, 32 MP 30 fps ZSL with a dual ISP
Sensor	▪ Accelerometer + Gyro Sensor/ Proximity sensor

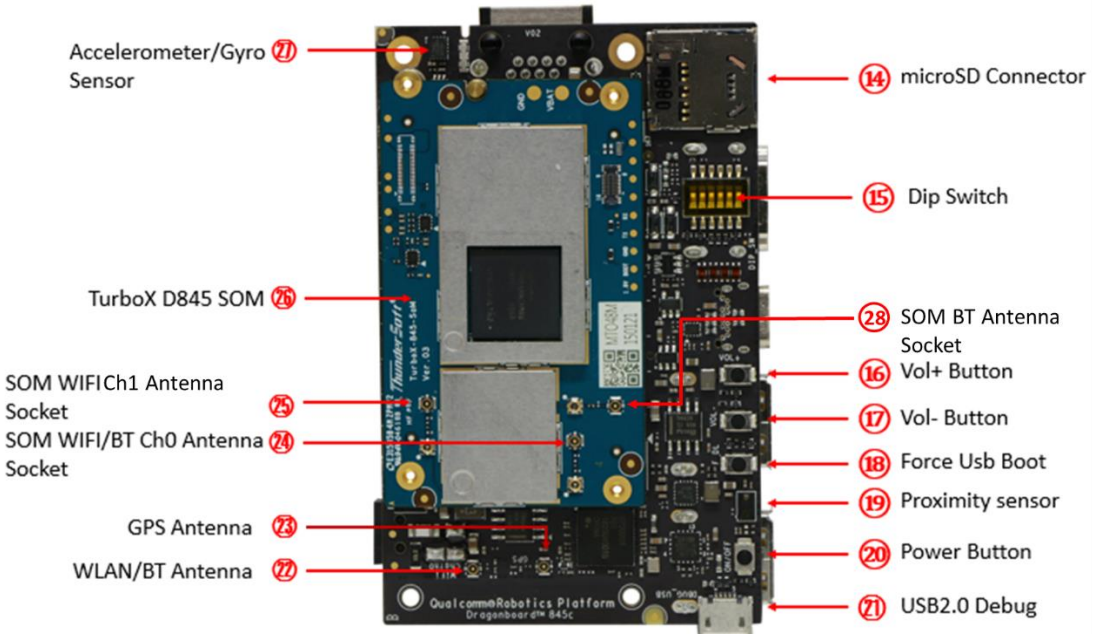
Expansion interfaces	Expansion connectors: ▪ HS1:1 x 60-pin high-speed connector (4L-MIPI DSI, USB 2.0 x2, I2C x2, 2L+4L-MIPI CSI,SDIO) ▪ HS2:1 x 60-pin high-speed connector (4L-MIPI CSI x 2, SSC SPI, PCIe 3.0, USB 3.0 x1, GPIO x 9) ▪ LS1:1 x 96Boards 40-pin low-speed connector (UART x 2, SPI, I2S, I2C x2, GPIO x 12, DC power) ▪ LS2:1 x 96Boards 40-pin low-speed connector (headset, stereo speaker, DMIC I/F x 3, CAN, I2S, GPIO x 7, PWM x 2, ADC x 2) ▪ LS3:1 x 96Boards 20-pin low-speed connector (SSC SPI x 3, SSC I2C, sensor interrupt x 5)
LED	7 LED indicators: ▪ 4 - User controllable ▪ 2 - For radios (BT and WLAN activity) ▪ 1 - Power indicator
Buttons	▪ Power ▪ Volume Up/Down ▪ Force USB Boot ▪ Dip Switch (6 PIN)
Power source	▪ 12 V @2.5A adapter with a DC plug ▪ Plug specification is inner diameter 1.75mm and outer diameter 4.75mm
OS support	▪ Linux Embedded (LE)
Size	▪ 85 mm x 54 mm meeting 96Boards Consumer Edition Standard form dimensions specifications ▪ Operating Temp: -20°C to +70°C ▪ RoHS- and Reach-compliant

1.2 Board views

1.2.1 Top view

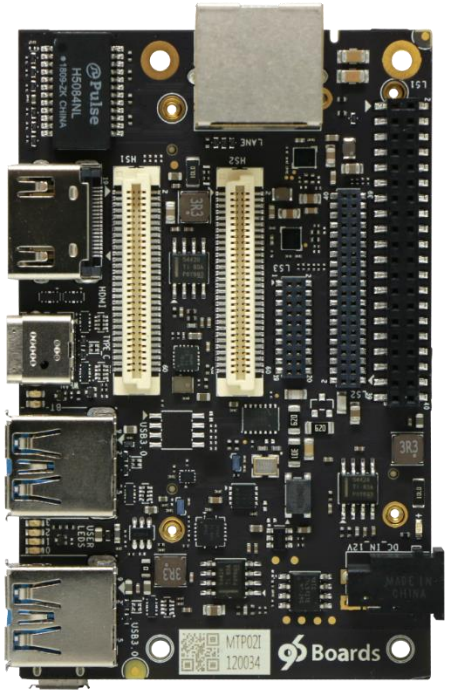


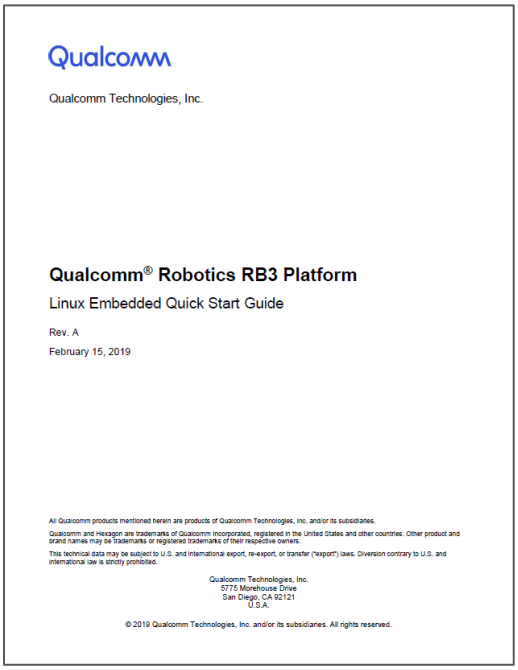
1.2.2 Back view



1.3 Box content

The box contains one Robotics DragonBoard 845c development board and a *Quick Start Guide*.





Qualcomm

Qualcomm Technologies, Inc.

Qualcomm® Robotics RB3 Platform

Linux Embedded Quick Start Guide

Rev. A

February 15, 2019

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1.4 Terms and Definitions

Abbreviations	Description
QUP	Qualcomm Universal Peripheral The QUP engine provides a general-purpose data path that supports multiple mini cores, e.g., UART, I2C and SPI
SSC	SDA845 Sensor Core

2 Start the board

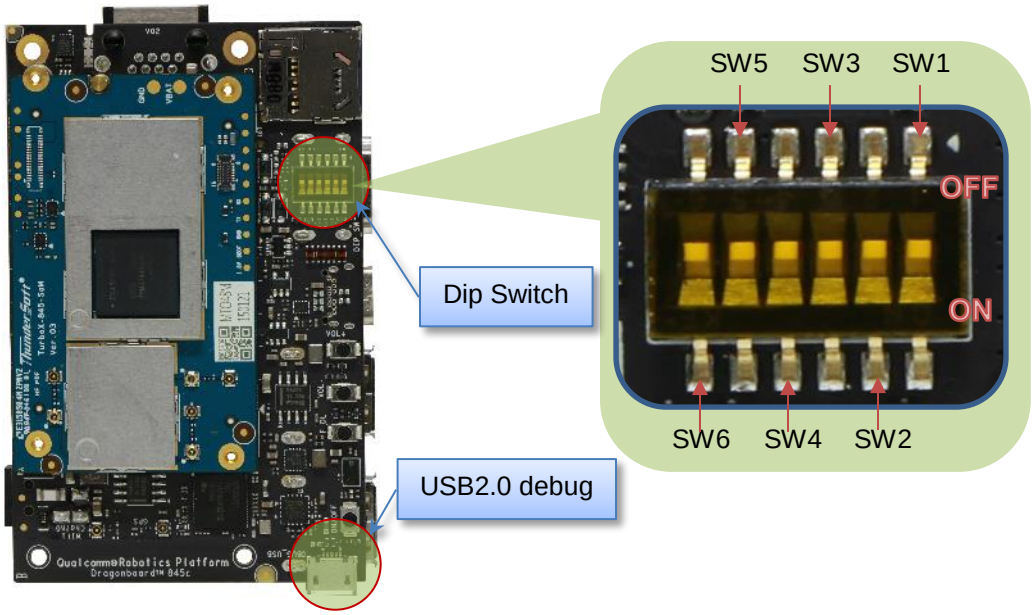
2.1 Required equipment

Equipment	Description
Robotics DragonBoard™ 845c development board	Based on the Qualcomm® SDA845 processor
Power adapter	12 V with 2500 mA required by the 96Boards specification
USB to Micro USB cable	For serial console interface and ADB, Fastboot commands
USB to USB Type C cable	For connecting the USB3.0 Type C port and flashing images
Host PC	For connecting the board and installing Fastboot

2.2 Linux Embedded OS startup process

Display is not supported in the LE OS.

1. Open the serial console tool on the host PC (for example: minicom).
2. Turn on SW2 on the dip switch (see Section 1.2.2, #15) to enable the USB2.0 debug port (see Section 1.2.2, #21).
3. Turn on SW3 on the Dip Switch (see Section 1.2.2, #15) to enable the auto power up on USB-C cable connection(along with power connector).



4. Connect the USB cable Micro-B plug to the USB2.0 debug port (see Section 1.2.2, #21). and connect the other end to an available USB port on the host PC.

   NOTE: Set the Bps/Par/Bits to 115200 8N1

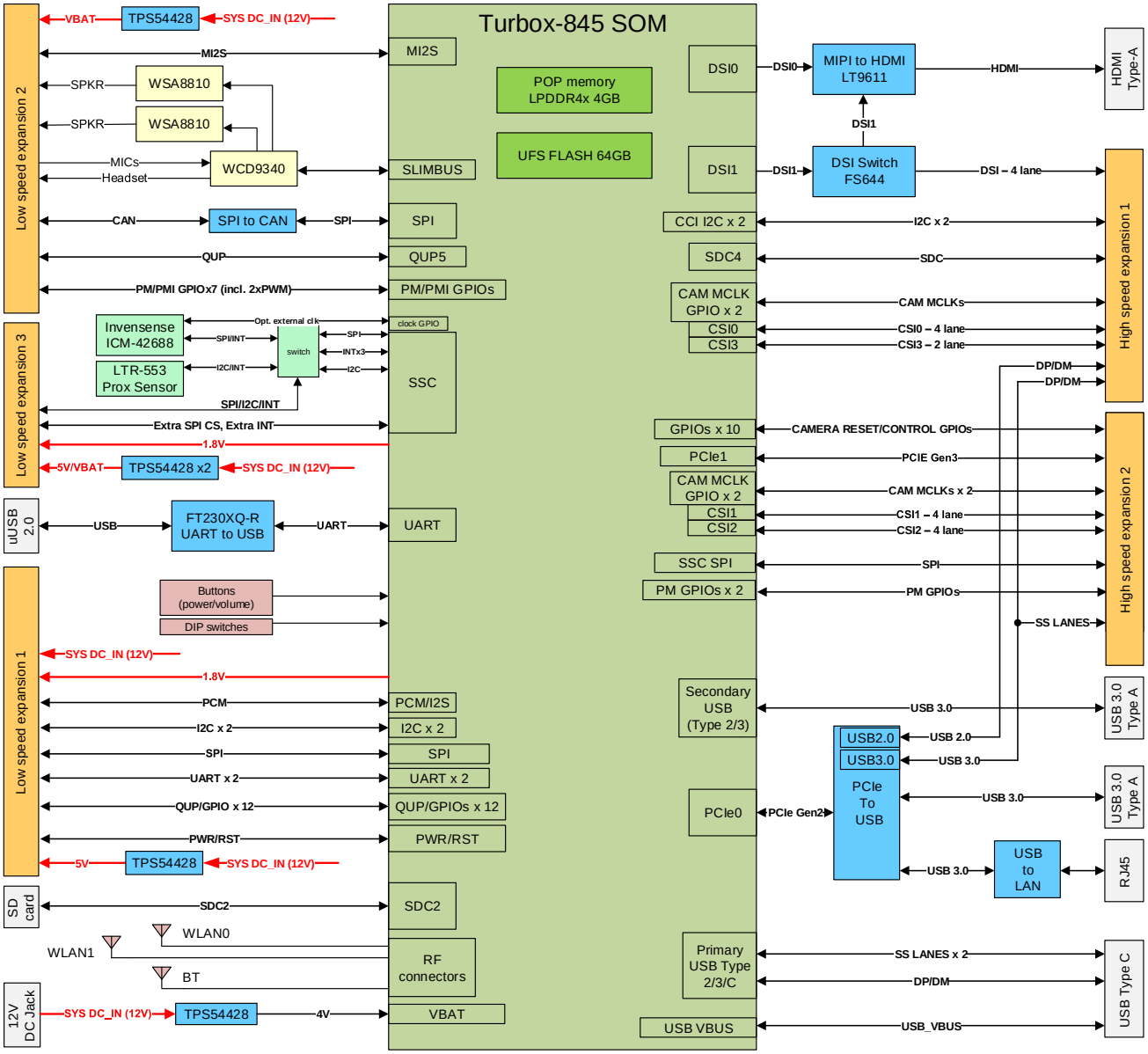
5. Connect the power supply to power connector (see Section 1.2.1, #13).
6. Plug the power supply into a power outlet. The green power-up LED should illuminate.
7. Press and release the power button on the device. The yellow user LED0 should illuminate.
8. The board will start the booting process. Login credentials will display on the host PC:

   sda845 login: root

   Password: 123456

3 Robotics DragonBoard 845c development board

3.1 System block diagram



3.2 Processor

The SDA845 processor features a 64-bit ARM v8-compliant octa-core Qualcomm® Kryo™ 385 CPU. The processor supports LPDDR4X SDRAM interface, compute DSP with Qualcomm® Hexagon™ Vector eXtensions, 32MP camera, Qualcomm® Adreno™ GPU, 4K video encode and decode, and Bluetooth 5.0.

3.3 Memory

The Robotics DragonBoard 845c board uses a package on package (PoP) LPDDR4X RAM configuration and discrete UFS2.1 flash memory.

- LPDDR4X interfaces directly to the SDA845 built-in LPDDR controller. The maximum DDR clock is 1866 Mhz.
- UFS flash memory interfaces with the SDA845 processor over a dedicated UFS PHY bus supporting the UFS 2.1 specification.

3.4 MicroSD

The Robotics DragonBoard 845c microSD slot (see Section 1.2.2, #14) signals are routed directly to the SDA845 SDC2 interface.

The slot is a push-push type with dedicated support for card detect signal (many microSD slots do not have dedicated CD pins, they use DATA3 state as the card detected signal). The Robotics DragonBoard 845c board uses SDA GPIO_126 as the SD_CARD_DET_N.

3.5 WiFi and Bluetooth RF

The Robotics DragonBoard 845c board uses the Qualcomm RF chip WCN3990 solution that integrates two wireless connectivity technologies into a single device.

The interfaces are:

- WLAN-compliant with IEEE 802.11 b/g/n/ac specifications, exceeding 96Boards minimum WiFI requirements
- Bluetooth-compliant with the BT specification version 5.0 (BR/EDT + BLE), meeting the 96Boards BT requirements

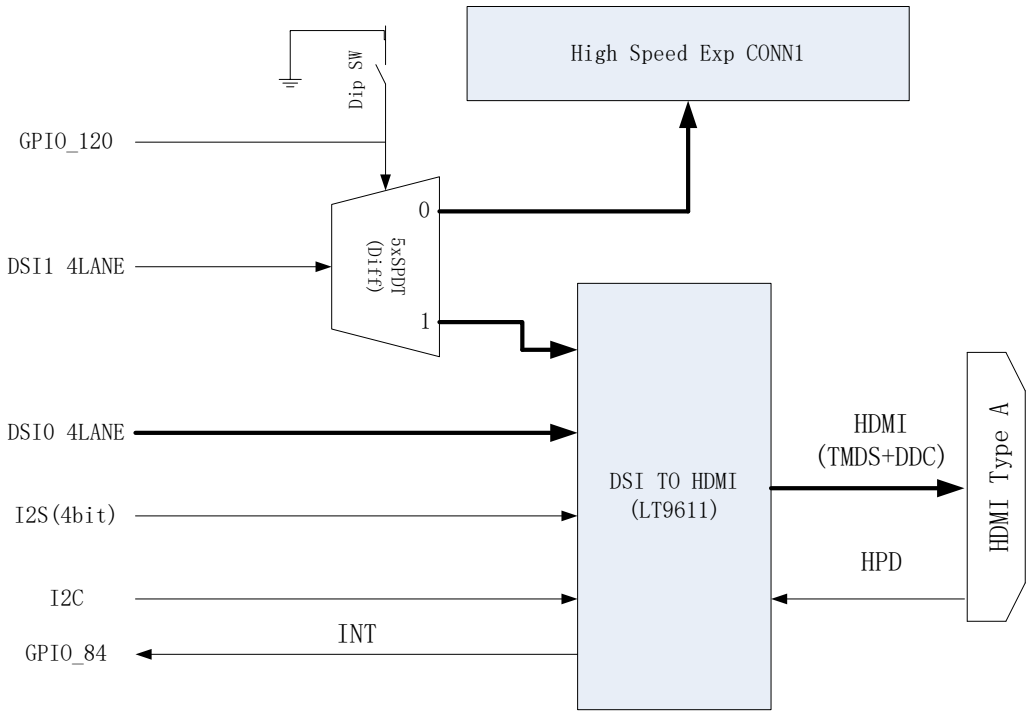
The SOM antenna socket #24 for WiFi chain 0 (and optionally BT) is connected to Robotics DragonBoard 845c onboard antenna #22 (see Section 1.2.2)

The SOM antenna socket #25 for WiFi chain 1 can be connected to the WiFi antenna provided on the Navigation Mezzanine or an external antenna

The SOM antenna socket #28 for BT can be connected to the BT antenna provided on the Navigation Mezzanine or an external antenna

The software can be configurated to route BT through the combined port #23 on the SOM or the dedicated port #28 on the SOM.

3.6 Display interface



3.6.1 HDMI

The SDA845 processor does not include a built-in HDMI interface.

The Robotics DragonBoard 845c board deploys the built-in MIPI-DSI 2x4 lanes interface as the source for HDMI output. A peripheral DSI to HDMI bridge (LONTIUM SEMICONDUCTOR LT9611) performs this task and supports a resolution from 1080p to 4K at 30 Hz.

While the LT9611 supports automatic input video format timing detection (D-PHY1.2,DSI1.3/CSI-2 1.00 and DCS 1.02.00), an I2C channel from the SDA845 processor allows the user to configure the operation of this bridge. The QUP10 I2C interface from the SoC connects to the bridge.

This bridge supports audio as well (meeting the 96Boards requirement to provide audio via HDMI). The Robotics DragonBoard 845c board uses a 4-bit I2S2 interface from the SDA845 processor for this task.

The 96Boards specification calls for a MIPI-DSI interface to be routed to the high-speed expansion connector. Since the SDA845 processor has two MIPI-DSI interfaces for HDMI, a muxing device (FSA644UCX) is used on the board. Only one interface, HDMI, or the expansion MIPI-DSI can be active at a given time. The controlling signal is named GPIO120_DSI_SW_SEL. When this signal is logic high, 1, the MIPI-DSI is routed to the DSI-HDMI bridge. When GPIO120_DSI_SW_SEL is logic level low, 0, the MIPI-DSI is routed to the high-speed expansion connector. This design assigned the GPIO120_DSI_SW_SE’ function to GPIO_120.

The user can override the software control by sliding switch 4 of the dip switch to ON. This action forces the DSI mux to route the MIPI-DSI to the high-speed expansion connector. The overwrite option exists for the high-speed expansion connector only, you cannot software override the mux to DSI-HDMI bridge.

3.6.2 MIPI-DSI

The Robotics DragonBoard 845c board has a 4-lane MIPI_DSI interface meeting this requirement. See Chapter 5 for details.

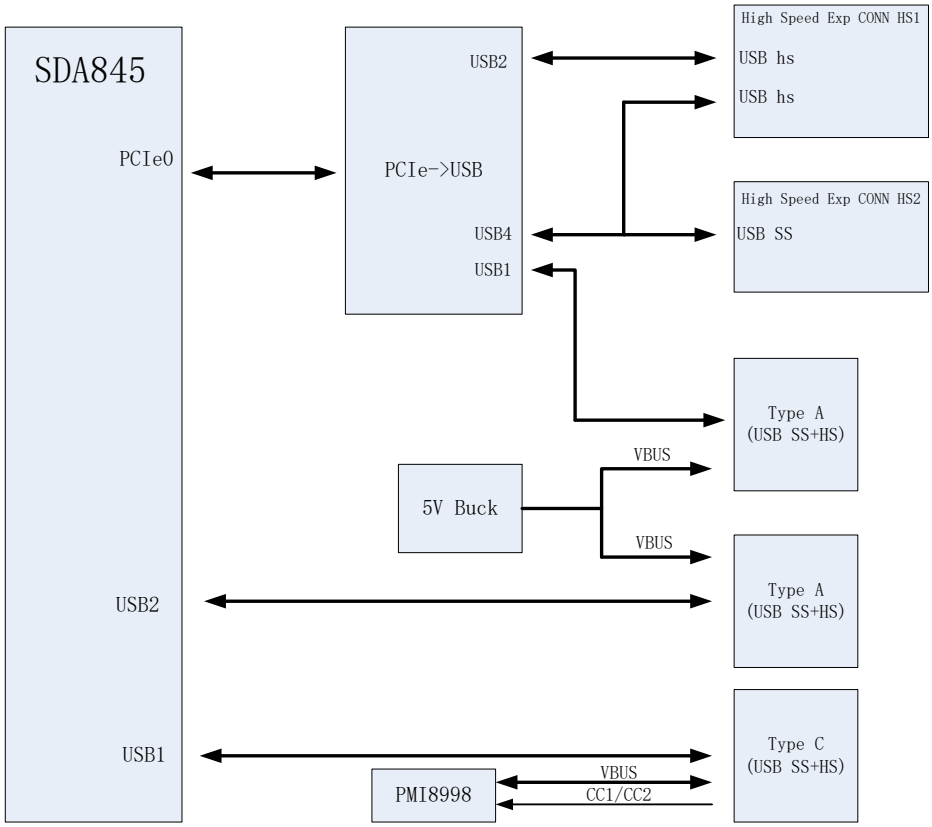
3.7 Camera interfaces

The Robotics DragonBoard 845c board has four camera interfaces.

- 4-lane CSI0 camera on primary high-speed connector (J2000); see Section 1.2.1, #6)
- 4-lane CSI1camera on secondary high-speed connector (J2001); see Section 1.2.1, #12)
- 4-lane CSI2 camera on secondary high-speed connector (J2001) ; see Section 1.2.1, #12)
- 2-lane CSI3 camera on primary high-speed connector (J2000); see Section 1.2.1, #6)

See Chapter 5 for details.

3.8 USB ports



3.8.1 USB host ports

The SDA845 processor includes two USB channels:

- USB1(see Section 1.2.1, #5) is for a Type C port
- USB2 (see Section 1.2.1, #3) is for a normal host port.

The Robotics DragonBoard 845c board supports three USB host ports:

- Port 1 of the SoC USB2 (see Section 1.2.1, #3), a Type A USB Host 3.0 (super-speed) connector. A current limited sets the power current limit to 1.0A.
- Port 2 of the USB HUB (see Section 1.2.1, #1), a Type A USB Host 3.0 (super speed) connector. A current limited sets the power current limit to 1.0A.
- Port 3 of the USB HUB is routed to the high-speed expansion connectors (super-speed to #6 (see Section 1.2.1), high-speed to #12 (see Section 1.2.1). No current limited controller is implemented on the board for this channel.

Another USB HUB port is routed to the high-speed expansion connectors (see Section 1.2.1, #6). No current limited controller is implemented on the board for this channel.

3.8.2 USB device port

The Robotics DragonBoard 845c board implements a USB device port. The port is located at #5 (see Section 1.2.1), a Type C connector.

The Type C connector supports a device or host with different peripherals. The SDA845 processor configures the port based on Type C rules. The board can work in one mode at a time, host mode or device mode, but not both.

NOTE: There is a micro B USB port (see Section 1.2.2, #21). The micro B USB port is only for debug log output from the SDA845 debug UART to USB transformation.

3.9 Audio

The 96Boards specification calls for a minimum of single channel audio through two interfaces, BT and HDMI/MHL/DisplayPort.

The Robotics DragonBoard 845c board meets this requirement with HDMI support, DisplayPort, and has additional audio channels, including support for a headset jack. See Section 4.2 for details about these additional channels.

MHL is not supported.

3.9.1 BT audio

The BT 5.0 implementation (including audio) on the Robotics DragonBoard 845c is with SDA845 and WCN3990.

3.9.2 HDMI audio

A 4-bit (audio out only) I2S channel is routed directly from the SDA845 SoC I2S interface pins to the DSI-HDMI bridge.

3.9.3 DisplayPort audio

The DisplayPort audio is routed directly from the SDA845 SoC EDP interface pins to the Type C USB connector.

3.10 DC and battery power

The Robotics DragonBoard 845c board power is supplied in one of the following ways:

- 8 V to 18 V power from a dedicated DC jack
- 8 V to 18 V power from the SYS_DCIN pins on the low-speed expansion connector
- 5 V power from a USB Type C port

See Section 6 for details on Robotics DragonBoard 845c board DC power implementation.

3.11 DC Power Measurements

The 96Boards specification calls for support for measuring board power consumption.

See Section 6 for details on Robotics DragonBoard 845c board DC power measurement.

3.12 Buttons

The 96Boards specification calls for the presence of two buttons, a power on/sleep button and a reset button. The Robotics DragonBoard 845c board meets these requirements.

See Section 7 for details on the Robotics DragonBoard 845c board buttons.

3.13 External fan connection

The 96Boards specification calls for support of an external fan. The external fan requirement can be achieved using the 5 V or the DC-in. Both are on the low-speed expansion connector.

3.14 UART

The Robotics DragonBoard 845c board supports one SoC UART, and a second UART (optional), both to be routed to the low-speed expansion connector.

One UART is directly from SoC pins to low-speed expansion connector. The other is for the UART debug log port. To use the port for log output, switch dip switch pin2 to OFF.

3.15 System and user LEDs

The Robotics DragonBoard 845c board supports implementation of six LEDs on the board. The 96Boards specification defines the LEDs color and mechanical location on the board.

Two activity LEDs

- WiFi activity LED – The Robotics DragonBoard 845c board drives this Yellow LED via GPIO9 from the PMIC(PM845).
- BT activity LED – The Robotics DragonBoard 845c board drives this Blue LED via GPIO5 from the PMIC(PM845).

Four user LEDs

The four user LEDs are surface mount Green in 0603 size located next to the two USB Type A connectors and labeled *USER LEDS 3 2 1 0*.

The Robotics DragonBoard 845c board drives three LEDs from the red, green, and blue LED drive from power management IC PMI8998.

The fourth user LED is driven by the PM845 via GPIO13.

Power indicator LED

A green LED is included to indicate the presence of input power to the Robotics DragonBoard 845c board.

3.16 Expansion connector

The 96Boards specification calls for two expansion connectors, a low-speed connector and a high-speed connector.

The Robotics DragonBoard 845c board meets this requirement. See Section 4 for details about the low-speed expansion connector and Section 5 for details about the high speed expansion eonnectors.

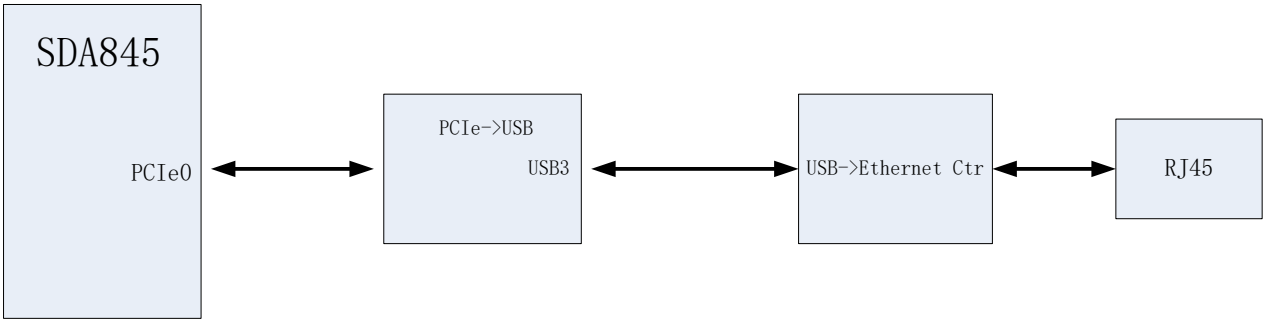
3.17 Additional functionality

The 96Boards specification permits additional functionality provided:

- All mandatory functionality is available
- No impact to the physical footprint specification (including height)
- No impact to the use of 96Boards CE low-speed and high-speed expansion facilities

The Robotics DragonBoard 845c board implements a few additional functions as described in Sections 3.17.1 through 3.17.4.

3.17.1 Ethernet connector



The Robotics DragonBoard 845c board has the translation from PCIe0 to USB and USB to Gigabit Ethernet controller. The Robotics DragonBoard 845c board uses an RJ45 (see Section 1.2.1, #8) as the physical interface.

3.17.2 Inertial sensors

The Robotics DragonBoard 845c board includes the following inertial sensors:

- 6-axis accelerometer/gyroscope: INVENSENSE ICM-42688
- Light sensor and proximity sensor: LITEON LTR-553ALS-WA

3.17.3 Dip switch

The Robotics DragonBoard 845c board has a dip switch (see Section 1.2.2, #15):

- Switch 1 – Reserved (Default OFF)
- Switch 2 – ONBOARD_DEBUG_UART_EN_N: When set to ON position, will force the debug UART log to micro USB port; when set to OFF, will force the debug UART log to low-speed expansion connector.
- Switch 3 – CBL_PWR_N: When set to ON, the SDA845 system will power on automatically; when set to OFF, the SDA845 system will power on by ON-KEY manual press.
- Switch 4 – SW_DSI1_TO_LT9611_N: When set to ON, the SDA845 DSI1 will force to high-speed expansion connector; when set to OF', SDA845 DSI1will force to LT9611 DSI->HDMI bridge.
- Switch 5 – ONBOARD_SENSORS_DISCONNECT: When set to ON, the SDA845 SSC sensor SPI/I2C will be directed to low-speed expansion connector (using off-board sensors); when set to OFF, the SDA845 SSC sensor SPI/I2C will be directed to onboard sensor.
- Switch 6 – IMU_EXT_CLK_TOGGLE: When set to ON, the onboard ICM-42688 sensor will use the external clk of GPIO78 from SoC; when set to OFF, the onboard ICM-42688 sensor will use another interrupt output to SoC GPIO118. These GPIOs need the software configure setting.

3.17.4 Extra low-speed expansion connectors

The Robotics DragonBoard 845c board has two extra low-speed expansion connectors. See Section 4.

3.17.5 Extra high-speed expansion connector

The Robotics DragonBoard 845c board has an extra high-speed expansion connector. See Section 5.

4 Low-speed expansion connector

4.1 Primary low-speed expansion connector, LS1

See Section 1.2.1, #9.

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
1	GND	GND	
3	UART0_CTS	GPIO41_UART0_CTS	
5	UART0_TxD	GPIO43_UART0_TXD	
7	UART0_RxD	GPIO44_UART0_RXD	
9	UART0_RTS	GPIO42_UART0_RTS	
11	UART1_TxD	GPIO4_DEBUG_UART_TX_LS1	
13	UART1_RxD	GPIO5_DEBUG_UART_RX_LS1	
15	I2C0_SCL	GPIO34_I2C0_SCL	
17	I2C0_SDA	GPIO33_I2C0_SDA	
19	I2C1_SCL	GPIO32_I2C1_SCL	
21	I2C1_SDA	GPIO31_I2C1_SDA	
23	GPIO-A	GPIO49_QUP12	
25	GPIO-C	GPIO50_QUP12	
27	GPIO-E	GPIO51_QUP12	
29	GPIO-G	GPIO10	
31	GPIO-I	GPIO9_CAM0_RST_N	
33	GPIO-K	GPIO8_CAM1_RST_N	
35	+1V8	VREG_S4A_1P8	
37	+5V	VDC_5V	
39	GND	GND	

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
2	GND	GND	
4	PWR_BTN_N	PHONE_ON_N	
6	RST_BTN_N	PM_RESIN_N	Volume down button
8	SPI0_SCLK	GPIO29_SPI0_SCLK	
10	SPI0_DIN	GPIO27_SPI0_MISO	
12	SPI0_CS	GPIO30_SPI0_CS	
14	SPI0_DOUT	GPIO28_SPI0_MOSI	
16	PCM_FS	GPIO81_PCM_FS	
18	PCM_CLK	GPIO80_PCM_CLK	

20	PCM_DO	GPIO83_PCM_DO	
22	PCM_DI	GPIO82_PCM_DI	
24	GPIO-B	GPIO79_MI2S1_MCLK	
26	GPIO-D	GPIO52_QUP12	
28	GPIO-F	GPIO7_I2C_SCL	
30	GPIO-H	GPIO6_I2C_SDA	
33	GPIO-J	GPIO26_CAM0_VSYNC_OUT	
34	GPIO-L	GPIO40_CAM1_AFE_GPO	
36	SYS_DCIN	DC12V	
38	SYC_DCIN	DC12V	
40	GND	GND	

4.1.1 UART {0/1}

The 96Boards specification calls for a 4-wire UART implementation, UART0 and an optimal second 2-wire UART, UART1 on the low-speed expansion connector.

The Robotics DragonBoard 845c board implements UART0 as a 4-wire UART that connects directly to the SDA845 SoC. These signals are driven at 1.8 V.

The Robotics DragonBoard 845c board implements UART1 as a 2-wire UART that connects directly to the SDA845 SoC. These signals are driven at 1.8 V.

4.1.2 I2C {0/1}

The 96Boards specification calls for two I2C interfaces to be implemented on the low-speed expansion connector.

The Robotics DragonBoard 845c board has both I2C0 and I2C1 interfaces. The interfaces connect directly to the SDA845 SoC. A resistor is needed to provide pull-up for each of the I2C lines per the I2C specifications. These pull-ups need to be connected to the 1.8 V voltage rail.

4.1.3 GPIO {A-L}

The 96Boards specification calls for twelve GPIO lines to be implemented on the low-speed expansion connector.

The Robotics DragonBoard 845c board implements this requirement. Twelve GPIOs are routed from the SDA845 SoC. The GPIOs are 1.8V voltage rail.

- GPIO A: Connects to GPIO_49 of SDA845 SoC. Can be configured to be an IRQ line.
- GPIO B: Connects to GPIO_79 of SDA845 SoC. Can be configured to be an IRQ line and SEC_MI2S_MCLK.
- GPIO C: Connects to GPIO_50 of SDA845 SoC.
- GPIO D: Connects to GPIO_52 of SDA845 SoC. Can be configured to be an IRQ line.
- GPIO E: Connects to GPIO_51 of SDA845 SoC.
- GPIO F: Connects to GPIO_7 of SDA845 SoC. Can be configured to be I2C SCL.
- GPIO G: Connects to GPIO_10 of SDA845 SoC. Can be configured to be IRQ line.

- GPIO H: Connects to GPIO_6 of SDA845 SoC. Can be configured to be I2C SDA.
- GPIO I: Connects to GPIO_9 of SDA845 SoC. Can be configured to be a CAM0_RST signal.
- GPIO J: Connects to GPIO_26 of SDA845 SoC. Can be configured to be IRQ line and CAM0_VSYNC_OUT.
- GPIO K: Connects to GPIO_8 of SDA845 SoC. Can be configured to be a CAM1_RST signal.
- GPIO L: Connects to GPIO_40 of SDA845 SoC. Can be configured to be IRQ line and CAM1_AFE_GPO signal.

The IRQ lines create a wake-up event for the SoC.

4.1.4 SPI

The 96Boards specification calls for one SPI bus master to be provided on the low-speed expansion connector.

The Robotics DragonBoard 845c board implements a full SPI master with 4 wires: CLK, CS, MOSI, and MISO. All connect directly to the SDA845 SoC. These signals are driven at 1.8 V.

4.1.5 PCM/I2S

The 96Boards specification calls for one PCM/I2S bus to be provided on the low-speed expansion connector.

The CLK, FS, and DO signals are required while the DI is optional.

The Robotics DragonBoard 845c board implements a PCM/I2S with 4 wires: CLK, FS, DO, and DI. The I2S signals are connected directly to the SDA845 SoC. These signals are driven at 1.8 V.

4.1.6 Power and reset

The 96Boards specification calls for a signal on the low-speed expansion connector that can power on/off the board and a signal that serves as a board reset signal.

The Robotics DragonBoard 845c board routes the PWR_BTN_N (named PHONE_ON_N on the Robotics DragonBoard 845c schematic) signal to the KYP_DPWR_N pin of the PM845 PMIC. This signal is driven by SW1301 as well, which is the onboard Power ON push-button switch (see Section 1.2.2, #20). The push button only provides an ON/Sleep function and not OFF functionality.

A mezzanine implementation of this signal should not drive it with any voltage, the only allowed operation is to force it to GND to start the board from a sleep mode. A board shutdown will occur when this signal is held to ground for more than 15 seconds.

The Robotics DragonBoard 845c board routes the RST_BTN_N (named PM_RESIN_N on the Robotics DragonBoard 845c schematic) signal to the RESIN_N pin of the PM845 PMIC. This signal is driven by SW1302, the onboard reset switch (see Section 1.2.2, #17). This signal is dual purpose, the default purpose is Volume down, the second purpose is the Reset function which needs the software configure setting.

4.1.7 Power supplies

The 96Boards specification calls for three power rails to be present on the low-speed expansion connector:

- +1.8 V: Max of 100mA
- +5 V: Able to provide a minimum of 5 W of power (1A).
- SYS_DCIN: 9-18 V input with enough current to support all the board functions or the output DCIN from onboard DC connector able to provide a minimum of 7 W of power.

The Robotics DragonBoard 845c board supports these requirements as follows:

- +1.8 V: Driven by PMIC PM845 VREG_S4A_1P8, which can provide 100mA.
- +5 V: Driven by the 4A 5.0 V DC to DC converter (U0801). This buck switcher powers HDMI and CAN current devices. The remaining capacity provides a max current of 2A to the low-speed expansion connector to meets the 96Boards requirements.
- SYS_DCIN: DC jack input can serve as the main power source.

4.2 Secondary low-speed expansion connector, LS2

See Section 1.2.1, #10).

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
1	DMIC CLK1/AMIC1_P	DMIC_CLK1_OR_AMIC1_P	
3	DMIC DATA1/AMIC1_M	DMIC_DATA1_OR_AMIC1_M	
5	DMIC BIAS1	MIC_BIAS1	
7	DMIC CLK2/AMIC3_P	DMIC_CLK2_OR_AMIC3_P	
9	DMIC DATA2/AMIC3_M	DMIC_DATA2_OR_AMIC3_M	
11	DMIC BIAS3	MIC_BIAS3	
13	DMIC CLK3/HS_MIC_P	DMIC_CLK3_OR_HPH_MIC_P	
15	DMIC DATA3/HS_MIC_M	DMIC_DATA3_OR_HPH_MIC_M	
17	DMIC BIAS4/HS_BIAS(BIAS2)	MIC_BIAS4_OR_HS_MIC_BIAS2	
19	HS_OUT _R	WCD_HPH_R	
21	HS_OUT_REF	WCD_HPH_REF	GND
23	HS_OUT_L	WCD_HPH_L	
25	SPK0_P	WSA0_SPKR_OUT_P	
27	SKP0_M	WSA0_SPKR_OUT_M	
29	SPK1_P	WSA1_SPKR_OUT_P	
31	SPK1_M	WSA1_SPKR_OUT_M	
33	HSDET	WCD_HSDET_L	
35	PM_GPIO-G	PM_GPIO13_GREEN_U4_LED	
37	VBAT	VBAT	DC buck 4.2 V
39	GND	GND	

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
2	CAN_H	LS2_CAN_H	
4	CAN_L	LS2_CAN_L	
6	1.8V-A	VREG_LVS1A_1P8	
8	GND	GND	
10	PM_GPIO-A	PMI_GPIO5	Optional PWM
12	PM_GPIO-B	PMI_GPIO8	Optional PWM
14	GPIO-M/QUP-B0	GPIO85_QUP5	
16	GPIO-N/QUP-B1	GPIO86_QUP5	
18	GPIO-O/QUP-B2	GPIO87_QUP5	
20	GPIO-P/QUP-B3	GPIO88_QUP5	
22	GPIO-Q/I2S1_WS	GPIO76_MI2S2_WS	
24	GPIO-R/I2S1_CLK	GPIO75_MI2S2_SCK	
26	GPIO-S/I2S1_DATA0	GPIO77_MI2S2_DATA0	
28	GPIO-T/I2S1_DATA1	GPIO78_MI2S2_DATA1	
30	PM_GPIO-C	PM_GPIO21	Optional ADC
33	PM_GPIO-D	PM_GPIO8	Optional ADC
34	PM_GPIO-E	PM_GPIO9_YEL_WIFI_LED	
36	PM_GPIO-F	PM_GPIO5_BLUE_BT_LED	
38	USB_VBUS	USB_VBUS	
40	GND	GND	

4.2.1 Headset

The headset signals are routed from the WCD9340 codec, one signal is routed from the connector to the CODEC, the signals are:

- WCD_HPH_R: Headphone PA right channel output
- WCD_HPH_L: Headphone PA left channel output
- WCD_HPH_REF: Headphone PA ground sensing
- WCD_HSDET_L: Headset detection

4.2.2 Stereo speaker

The speaker signals are routed from the stereo WSA8810 (4-ohm or 8-ohm speaker); the signals are:

- WSA0_SPKR_OUT_P: Class-D speaker amplifier output+
- WSA0_SPKR_OUT_M: Class-D speaker amplifier output-
- WSA1_SPKR_OUT_P: Class-D speaker amplifier output+
- WSA1_SPKR_OUT_M: Class-D speaker amplifier output-

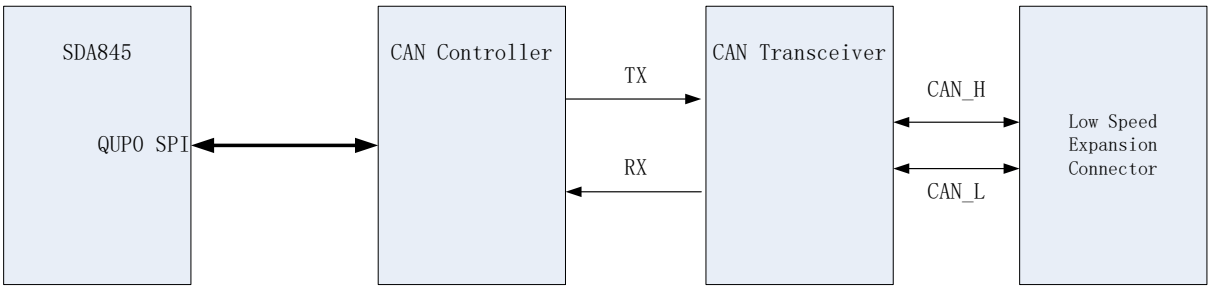
4.2.3 Digital microphones

The expansion connector supports three additional default digital microphone inputs:

- DMIC_1 or AMIC_1
- DMIC_2 or AMIC_2
- DMIC_3 or HPH_MIC: Headset MIC
- MIC_BIAS1
- MIC_BIAS3
- MIC_BIAS4_OR_HS_MIC_BIAS2: Reference micbias4 or headset microphone bias

The analog microphone can be configured by changing the WCD codec audio share resistors. The HPH MIC is for headset microphone input.

4.2.4 CAN



The CAN signals are routed from CAN transceiver which is from SPI translation.

The signals are:

- LS2_CAN_H: CAN high-level voltage I/O
- LS2_CAN_L: CAN low-level voltage I/O

4.2.5 I2S

The Robotics DragonBoard 845c board implements another PCM/I2S with 4 wires, CLK, FS, D0 and DI. The I2S signals are connected directly to the SDA845 SoC. These signals are driven at 1.8 V.

The signals are:

- GPIO Q: GPIO76_MI2S2_WS: TER_MI2S_WS
- GPIO R: GPIO75_MI2S2_SCK: TER_MI2S_SCK
- GPIO S: GPIO77_MI2S2_DATA0: TER_MI2S_DATA0
- GPIO T: GPIO78_MI2S2_DATA1: TER_MI2S_DATA1

4.2.6 GPIOs

The Robotics DragonBoard 845c board implements more GPIOs for low-speed expansion connector. The GPIOs are 1.8V voltage rail.

- GPIO M: Connects to GPIO_85 of SDA845 SoC QUP5. Can be configured to be an IRQ line.
- GPIO N: Connects to GPIO_86 of SDA845 SoC QUP5. Can be configured to be an IRQ line.
- GPIO O: Connects to GPIO_87 of SDA845 SoC QUP5.
- GPIO P: Connects to GPIO_88 of SDA845 SoC QUP5. Can be configured to be an IRQ line.
- PM GPIO A: Connects to GPIO_5 of PMI8998 PMIC. Can be configured to be a PWM.
- PM GPIO B: Connects to GPIO_8 of PMI8998 PMIC. Can be configured to be a PWM.
- PM GPIO C: Connects to GPIO_21 of PM845 PMIC. Can be configured to be ADC.
- PM GPIO D: Connects to GPIO_8 of PM845 PMIC. Can be configured to be ADC.
- PM GPIO E: Connects to GPIO_9 of PM845 PMIC. Can be configured to be WIFI LED enable.
- PM GPIO F: Connects to GPIO_5 of PM845 PMIC. Can be configured to be Bluetooth LED enable.
- PM GPIO G: Connects to GPIO_13 of PM845 PMIC. Can be configured to be USER4 LED enable.

The IRQ lines create a wake-up event for the SoC.

4.2.7 Other signals on secondary low-speed connector

The Robotics DragonBoard 845c board implements more source voltage at the low-speed expansion connector.

The signals are:

- USB_VBUS: Connects to VBUS of PMI8998 PMIC, Can be configured to be an OTG USB VBUS.
- VBAT: Connects to a DC-DC buck of board power, be configured to output 4.2 V source.
- VREG_LVS1A_1P8: Connects to a SOM PMIC PM845 LVS1A LDO, be configured to output 1.8 V source.

4.3 Tertiary low-speed connector, LS3

See Section 1.2.1, #11.

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
1	SPI_CLK	SSC4_SPI_CLK	
3	SPI_MOSI	SSC3_SPI_MOSI	
5	SPI_MISO	SSC2_SPI_MISO	
7	SPI_ACCEL_CS	SSC7_SPI_ACCEL_CS	
9	SPI_GYRO_CS	SSC6_SPI_GYRO_CS	

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
11	SPI_MAG_CS	SSC5_SPI_MAG_CS	
13	1.8V-B	VREG_LVS2A_1P8	
15	5V	VDC_5V	DC buck power 5V
17	VBAT	VBAT	DC buck power 4.2V
19	GND	GND	

PIN	96Boards signals	Robotics DragonBoard 845c signal	Note
2	PS_INT	GPIO124_PS_INT	
4	ACCEL_INT	GPIO117_ACCEL_INT	
6	GYRO_INT	GPIO118_GYRO_INT	
8	MAG_INT	GPIO123_MAG_INT	
10	MAG_DRDY_INT	GPIO119_MAG_DRDY_INT	
12	I2C_SDA	SSC0_I2C_SDA	
14	I2C_SCL	SSC1_I2C_SCL	
16	1.8V-C	VREG_S4A_1P8	
18	GND	GND	
20	GND	GND	

4.3.1 SSC SPI

The Robotics DragonBoard 845c board implements a SSC SPI interface for different sensors that connect to SDA845 processor sensor core. The SPI can support 3 CS signals.

The signals are:

- SSC4_SPI_CLK: Connects to SSC4 of SDA845 SoC, to be configured to CLK.
- SSC3_SPI_MOSI: Connects to SSC3 of SDA845 SoC, to be configured to MOSI.
- SSC2_SPI_MISO: Connects to SSC2 of SDA845 SoC, to be configured to MISO.
- SSC7_SPI_ACCEL_CS: Connects to SSC7 of SDA845 SoC, to be configured to accelerometer CS.
- SSC6_SPI_GYRO_CS: Connects to SSC6 of SDA845 SoC, to be configured to gyroscope CS.
- SSC5_SPI_MAG_CS: Connects to SSC5 of SDA845 SoC, to be configured to magnetometer CS.

The dip switch (see Section 1.2.2, #15) pin5 is used to select between the onboard 6-axis sensor ICM-42688 and offboard expansion connector. Setting the switch to ON will configure the SPI for offboard expansion.

4.3.2 SSC I2C

The Robotics DragonBoard 845c board implements a SSC I2C interface for different sensors that connect to SDA845 processor sensor core. A 2.2k resistor is needed to provide as pull-up for each of the I2C lines per the I2C specifications. These pull-ups need to be connected to the 1.8 V voltage rail.

The signals are:

- SSC0_I2C_SDA: Connects to SSC0 of SDA845 SoC, to be configured to I2C SDA.
- SSC1_I2C_SCL: Connects to SSC1 of SDA845 SoC, to be configured to I2C SCL.

The dip switch (see Section 1.2.2, #15) pin5 is used to select between the onboard onboard I2C sensor LTR-553ALS-WA and offboard expansion connector. Setting the switch to ON will configure the I2C for offboard expansion..

4.3.3 Sensor interrupt

The Robotics DragonBoard 845c board implements a SSC interrupt for sensor interrupts that is the 1.8V voltage rail.

The signals are:

- ACCEL_INT: Connects to GPIO_117 of SDA845 SoC, to be configured to accelerometer INT.
- GYRO_INT: Connects to GPIO_118 of SDA845 SoC, to be configured to gyroscope INT.
- MAG_DRDY_INT: Connects to GPIO_119 of SDA845 SoC, to be configured to magnetometer data INT.
- MAG_INT: Connects to GPIO_123 of SDA845 SoC, to be configured to magnetometer INT.
- PS_INT: Connects to GPIO_124 of SDA845 SoC, to be configured to anproximity INT.

4.3.4 Other signals on tertiary low-speed connector

The Robotics DragonBoard 845c board implements more source voltage at the low-speed expansion connector.

The signals are:

- VREG_LVS2A_1P8: Connects to LVS2 LDO of PM845 PMIC. Can be a sensor IO voltage source.
- VDC_5V: Connects to a board DC buck power 5 V. Can be a 5 V voltage source.
- VBAT: Connects to a board DC buck power 4.2 V. Can be a 4.2 V voltage source.
- VREG_S4A_1P8: Connects to S4A LDO of PM845 PMIC. Can be a 1.8 V voltage and 100mA source.

5 High-speed expansion connectors

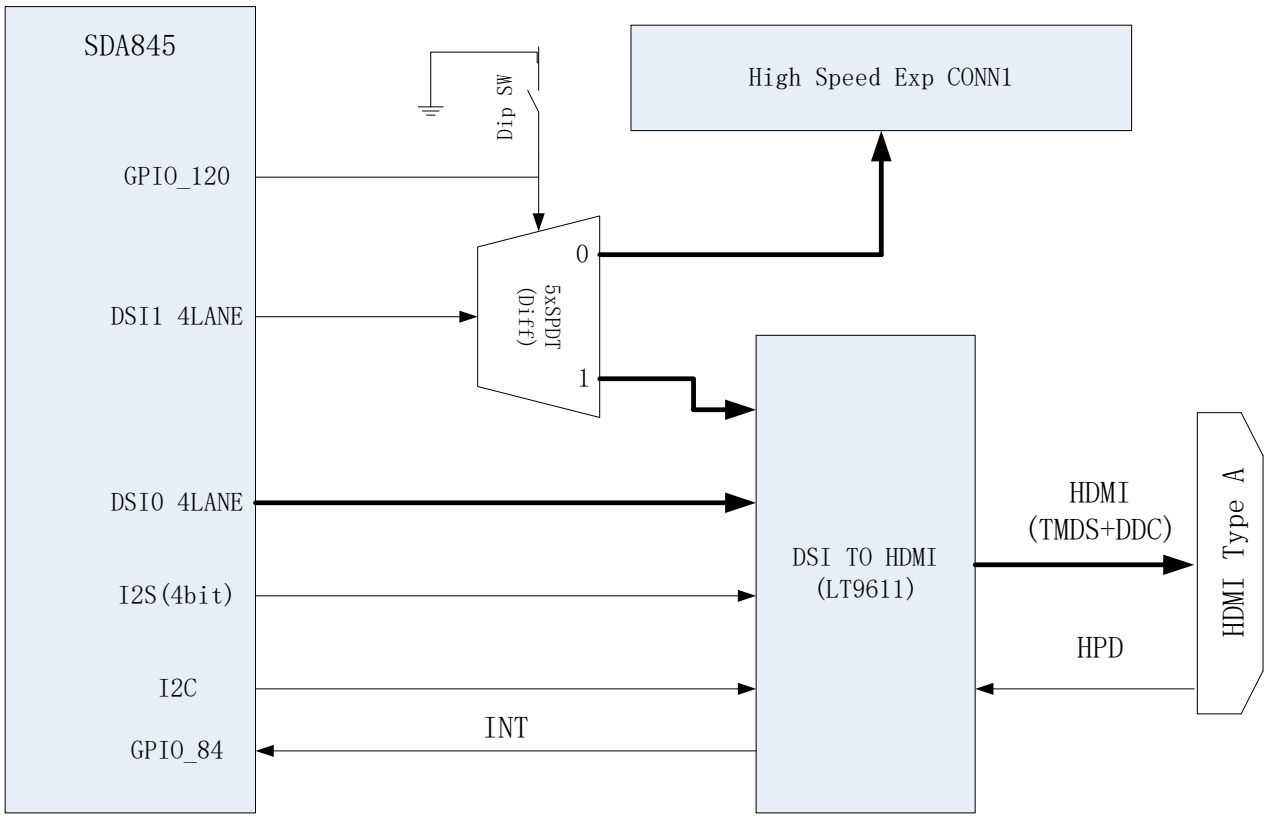
5.1 Primary high-speed expansion connector, HS1

See Section 1.2.1, #6.

PIN	96Boards signals	Robotics DragonBoard 845c signals	Note
1	SD_DAT0/SPI1_DOUT	SDC4_DATA0	
3	SD_DAT1	SDC4_DATA1	
5	SD_DAT2	SDC4_DATA2	
7	SD_DAT3/SPI1_CS	SDC4_DATA3	
9	SD_SCLK/SPI1_SCLK	SDC4_CLK	
11	SD_CMD/SPI1_DIN	SDC4_CMD	
13	GND	GND	
15	CLK0/CSI0_MCLK	CAM0_MCLK	
17	CLK1/CSI1_MCLK	CAM3_MCLK	
19	GND	GND	
21	DSI_CLK+	MIPI_DSI1_CLK_P	
23	DSI_CLK-	MIPI_DSI1_CLK_N	
25	GND	GND	
27	DSI_D0+	MIPI_DSI1_LANE0_P	
29	DSI_D0-	MIPI_DSI1_LANE0_N	
31	GND	GND	
33	DSI_D1+	MIPI_DSI1_LANE1_P	
35	DSI_D1-	MIPI_DSI1_LANE1_N	
37	GND	GND	
39	DSI_D2+	MIPI_DSI1_LANE2_P	
41	DSI_D2-	MIPI_DSI1_LANE2_N	
43	GND	GND	
45	DSI_D3+	MIPI_DSI1_LANE3_P	
47	DSI_D3-	MIPI_DSI1_LANE3_N	
49	GND	GND	
51	USB_D+	PCIE0_USB4_HS_DP	PCIe USB HUB port 4.
53	USB_D-	PCIE0_USB4_HS_DM	
55	GND	GND	
57	HSIC_STR	NC	Res. Option PCIe USB HUB port 5
59	HSIC_DATA	NC	

PIN	96Boards signals	Robotics DragonBoard 845c signals	Note
2	CSI0_C+	MIPI_CSI0_CLK_P	
4	CSI0_C-	MIPI_CSI0_CLK_N	
6	GND	GND	
8	CSI0_D0+	MIPI_CSI0_LANE0_P	
10	CSI0_D0-	MIPI_CSI0_LANE0_N	
12	GND	GND	
14	CSI0_D1+	MIPI_CSI0_LANE1_P	
16	CSI0_D1-	MIPI_CSI0_LANE1_N	
18	GND	GND	
20	CSI0_D2+	MIPI_CSI0_LANE2_P	
22	CSI0_D2-	MIPI_CSI0_LANE2_N	
24	GND	GND	
26	CSI0_D3+	MIPI_CSI0_LANE3_P	
28	CSI0_D3-	MIPI_CSI0_LANE3_N	
30	GND	GND	
32	I2C2_SCL	CCI_I2C_SDA0	
34	I2C2_SCL	CCI_I2C_SCL0	
36	I2C3_SDA	CCI_I2C_SDA1	
38	I2C3_SDA	CCI_I2C_SCL1	
40	GND	GND	
42	CSI1_D0+	MIPI_CSI3_LANE0_P	
44	CSI1_D0-	MIPI_CSI3_LANE0_N	
46	GND	GND	
48	CSI1_D1+	MIPI_CSI3_LANE1_P	
50	CSI1_D1-	MIPI_CSI3_LANE1_N	
52	GND	GND	
54	CSI1_C+	MIPI_CSI3_CLK_P	
56	CSI1_C-	MIPI_CSI3_CLK_N	
58	GND	GND	
60	RESERVED	VREG_S4A_1P8	

5.1.1 MIPI DSI 0



The 96Boards specification calls for a MIPI-DSI to be present on the high-speed expansion connector. A minimum of one lane is required and up to four lanes can be accommodated on the connector.

The Robotics DragonBoard 845c board implementation supports a full 4-lane MIPI-DSI interface that is routed to the primary high-speed expansion connector. Since the SDA845 processor has no HDMI interface, and it is used to drive the DSI-HDMI bridge, DSI muxing is required. A muxing device (FSA644UCX) is used on the board. Only one interface, HDMI, or the expansion MIPI-DSI, can be active at a given time. The signal is named GPIO120_DSI_SW_SEL. When this signal is logic level high, 1, the MIPI-DSI is routed to the DSI-HDMI bridge. When GPIO120_DSI_SW_SEL is logic level low, 0, the MIPI-DSI is routed to the high-speed expansion connector. This design assigned the GPIO120_DSI_SW_SEL function to GPIO_120.

User can override the software control by sliding switch 4 of the dip switch to ON. This action forces the DSI mux to route the MIPI-DSI to the high-speed expansion connector. The override option exists for the high-speed expansion connector only, you cannot software override the mux to DSI-HDMI bridge.

5.1.2 MIPI CSI {0/1}

The 96Boards specification calls for two MIPI-CSI interfaces to be present on the high-speed expansion connector. Both interfaces are optional. CSI0 interface can be up to four lanes while CSI1 is up to two lanes.

The current Robotics DragonBoard 845c board implementation supports a full 4-lane MIPI-CSI interface on CSI0 and two lanes of MIPI-CSI on CSI3. All MIPI-CSI signals are routed directly to and from the SDA845 processor.

5.1.3 I2C {2/3}

The 96Boards specification calls for two I2C interfaces to be present on the high-speed expansion connector. Both interfaces are optional unless a MIPI-CSI interface has been implemented. In this case, an I2C interface shall be implemented.

The current Robotics DragonBoard 845c board implementation supports two MIPI-CSI interfaces and therefore, must support two I2C interfaces. For MIPI-CSI0, the companion I2C2 is routed directly from the SDA845 processor. For MIPI-CSI3, the companion I2C is I2C3.

NOTE: Both interfaces, I2C2 and I2C3, have an onboard 2.2K pull-up resistor pulled-up to the 1.8 V voltage rail.

5.1.4 HSIC

The 96Boards specification calls for an optional MIPI-HSIC interface to be present on the high-speed expansion connector.

The Robotics DragonBoard 845c board implementation does not support this optional requirement.

5.1.5 Reserved

The 96Boards specification calls for a 10K pull-up to 1.8 V to be connected to pin60 of the high-speed expansion connector.

The Robotics DragonBoard 845c board utilizes a 100K pull-up on pin60.

5.1.6 SD/SPI

The 96Boards specification calls for an SD interface or a SPI port to be part of the high-speed expansion connector.

The Robotics DragonBoard 845c board implements a full SD master with SDIO (CLK/CMD/D0~D3) directly to the SDA845 SoC. These signals are driven at 1.8 V.

5.1.7 Clocks

The 96Boards specification calls for one or two programmable clock interfaces to be provided on the high-speed expansion connector. These clocks may have a secondary function of being CSI0_MCLK and CSI1_MCLK. If these clocks cannot be supported by the SoC, then an alternative GPIO or no-connect is allowed by the specification.

The Robotics DragonBoard 845c board implements two CSI clocks, CAM0_MCLK via SDA GPIO_13 for CSI0, and CAM3_MCLK via SDA GPIO_16 for CSI3. These signals are driven at 1.8 V.

5.1.8 USB

The 96Boards specification calls for a USB data line interface to be present on the high-speed expansion connector.

The Robotics DragonBoard 845c board implements this requirement by routing USB channel 2/4 from the PCIe USB HUB to the high-speed expansion connector.

5.2 Secondary high-speed connector, HS2

See Section 1.2.1, #12.

PIN	96Boards signals	Robotics DragonBoard 845c signals	Note
1	PCIE1_REFCLK_M	PCIE1_REFCLK_M	
3	PCIE1_REFCLK_P	PCIE1_REFCLK_P	
4	PCIE1_RX_M	PCIE1_RX_M	
7	PCIE1_RX_P	PCIE1_RX_P	
9	PCIE1_TX_M	PCIE1_TX_M	
11	PCIE1_TX_P	PCIE1_TX_P	
13	GPIO-U	GPIO102_PCIE1_RST_N	
15	GPIO-V	GPIO103_PCIE1_CLK_REQ	
17	GPIO-W	GPIO11_PCIE1_WAKE_N	
19	GPIO-X	GPIO12_CAM2_RST_N	
21	GPIO-Y	GPIO21_CAM3_RST_N	
23	GPIO-Z	GPIO116_CAM3_VSYNC_OUT	
25	GND	GND	
27	CLK1	CAM1_MCLK	
29	CLK2	CAM2_MCLK	
31	GND	GND	
33	CSI2_CLK_P	MIPI_CSI2_CLK_P	
35	CSI2_CLK_N	MIPI_CSI2_CLK_N	
37	GND	GND	
39	CSI2_LANE0_P	MIPI_CSI2_LANE0_P	
41	CSI2_LANE0_N	MIPI_CSI2_LANE0_N	
43	GND	GND	
45	CSI2_LANE1_P	MIPI_CSI2_LANE1_P	

PIN	96Boards signals	Robotics DragonBoard 845c signals	Note
47	CSI2_LANE1_N	MIPI_CSI2_LANE1_N	
49	GND	GND	
51	CSI2_LANE2_P	MIPI_CSI2_LANE2_P	
53	CSI2_LANE2_N	MIPI_CSI2_LANE2_N	
55	GND	GND	
57	CSI2_LANE3_P	MIPI_CSI2_LANE3_P	
59	CSI2_LANE3_N	MIPI_CSI2_LANE3_N	

PIN	96Boards signals	Robotics DragonBoard 845c signals	Note
2	CSI1_CLK_P	MIPI_CSI1_CLK_P	
4	CSI1_CLK_N	MIPI_CSI1_CLK_N	
6	GND	GND	
8	CSI1_LANE0_P	MIPI_CSI1_LANE0_P	
10	CSI1_LANE0_N	MIPI_CSI1_LANE0_N	
12	GND	GND	
14	CSI1_LANE1_P	MIPI_CSI1_LANE1_P	
16	CSI1_LANE1_N	MIPI_CSI1_LANE1_N	
18	GND	GND	
20	CSI1_LANE2_P	MIPI_CSI1_LANE2_P	
22	CSI1_LANE2_N	MIPI_CSI1_LANE2_N	
24	GND	GND	
26	CSI1_LANE3_P	MIPI_CSI1_LANE3_P	
28	CSI1_LANE3_N	MIPI_CSI1_LANE3_N	
30	GND	GND	
32	SPI_CLK	SSC10_SPI2_CLK	
34	SPI_CS	SSC11_SPI2_CS_L	
36	SPI_MOSI	SSC9_SPI2_MOSI	
38	SPI_MISO	SSC8_SPI2_MISO	
40	GPIO-AA	GPIO24_CAM2_SLM_IRQ	
42	GPIO-BB	GPIO22_CAM0_STROBE_OUT	
44	GPIO-CC	GPIO23	
46	GPIO-DD	GPIO69_CAM2_SLM_EN	
48	PM GPIO-H	PM_GPIO12	
50	PM GPIO-I	PM_GPIO10	
52	GND	GND	
54	USB0_SS_TX0_P	PCIE0_USB4_SS_TX_P	PCIe USB HUB PORT4
56	USB0_SS_TX0_M	PCIE0_USB4_SS_TX_M	PCIe USB HUB PORT4
58	USB0_SS_RX0_P	PCIE0_USB4_SS_RX_P	PCIe USB HUB PORT4
60	USB0_SS_RX0_M	PCIE0_USB4_SS_RX_M	PCIe USB HUB PORT4

5.2.1 MIPI CSI {1/2}

The secondary high-speed expansion connector supports a 4-lane MIPI-CSI bus (MIPI-CSI1/MIPI-CSI2).

All MIPI-CSI signals are routed directly to and from the SDA845 processor.

5.2.2 Clock

The Robotics DragonBoard 845c board implements two additional CSI clocks on the secondary high-speed expansion connector, CAM1_MCLK via SDA GPIO_14 for CSI1, and CAM2_MCLK via SDA GPIO_15 for CSI2. These signals are driven at 1.8 V.

5.2.3 SPI {SSC_SPI2}

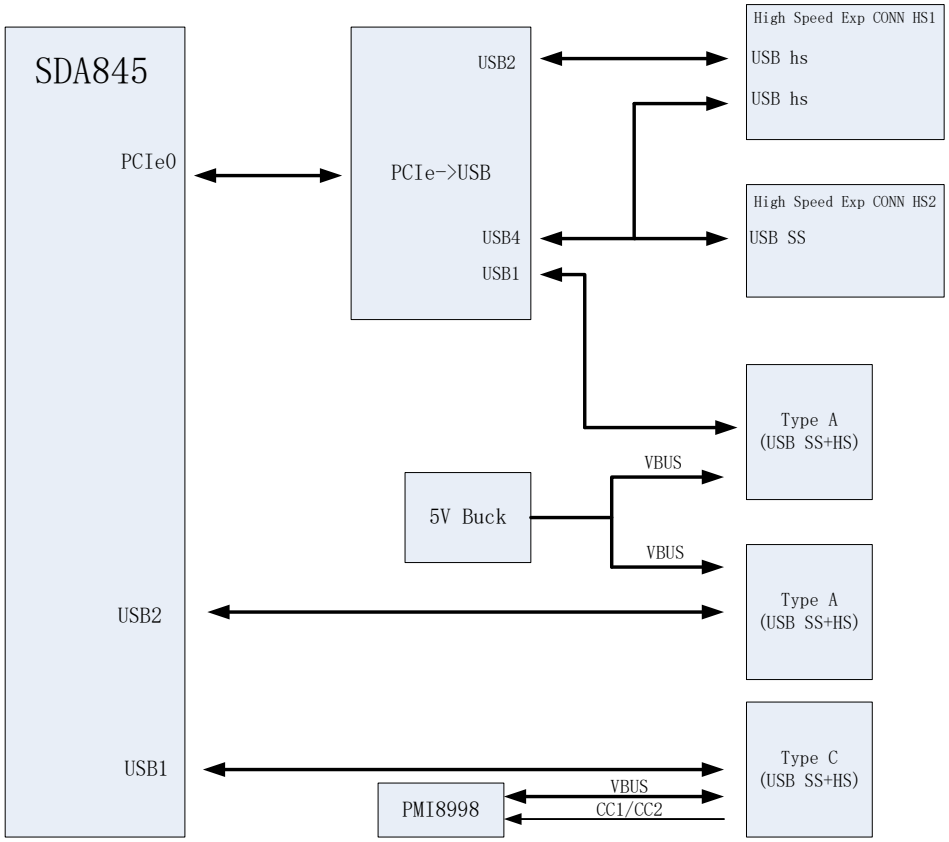
The Robotics DragonBoard 845c board implements an additional SSC SPI interface on the secondary high-speed expansion connector that connect to SDA845 processor sensor core. These signals are driven at 1.8 V.

- SPI_MISO: Connects to SSC8 of SDA845 SoC, to be configured to MISO.
- SPI_MOSI: Connects to SSC9 of SDA845 SoC, to be configured to MOSI.
- SPI_CLK: Connects to SSC10 of SDA845 SoC, to be configured to CLK.
- SPI_CS_L: Connects to SSC11 of SDA845 SoC, to be configured to CS.

5.2.4 PCIe1

The SDA845 processor has two PCIe ports. The Robotics DragonBoard 845c board implements one PCIe1 interface on the secondary high-speed expansion connector that connects to the SDA845 processor.

5.2.5 USB



The Robotics DragonBoard 845c board implements one USB super-speed interface on the secondary high-speed expansion connector.

The super-speed USB of HS2 and high-speed USB of HS1 can be combined to one USB3.0 port.

5.2.6 Other signals on secondary high-speed connector

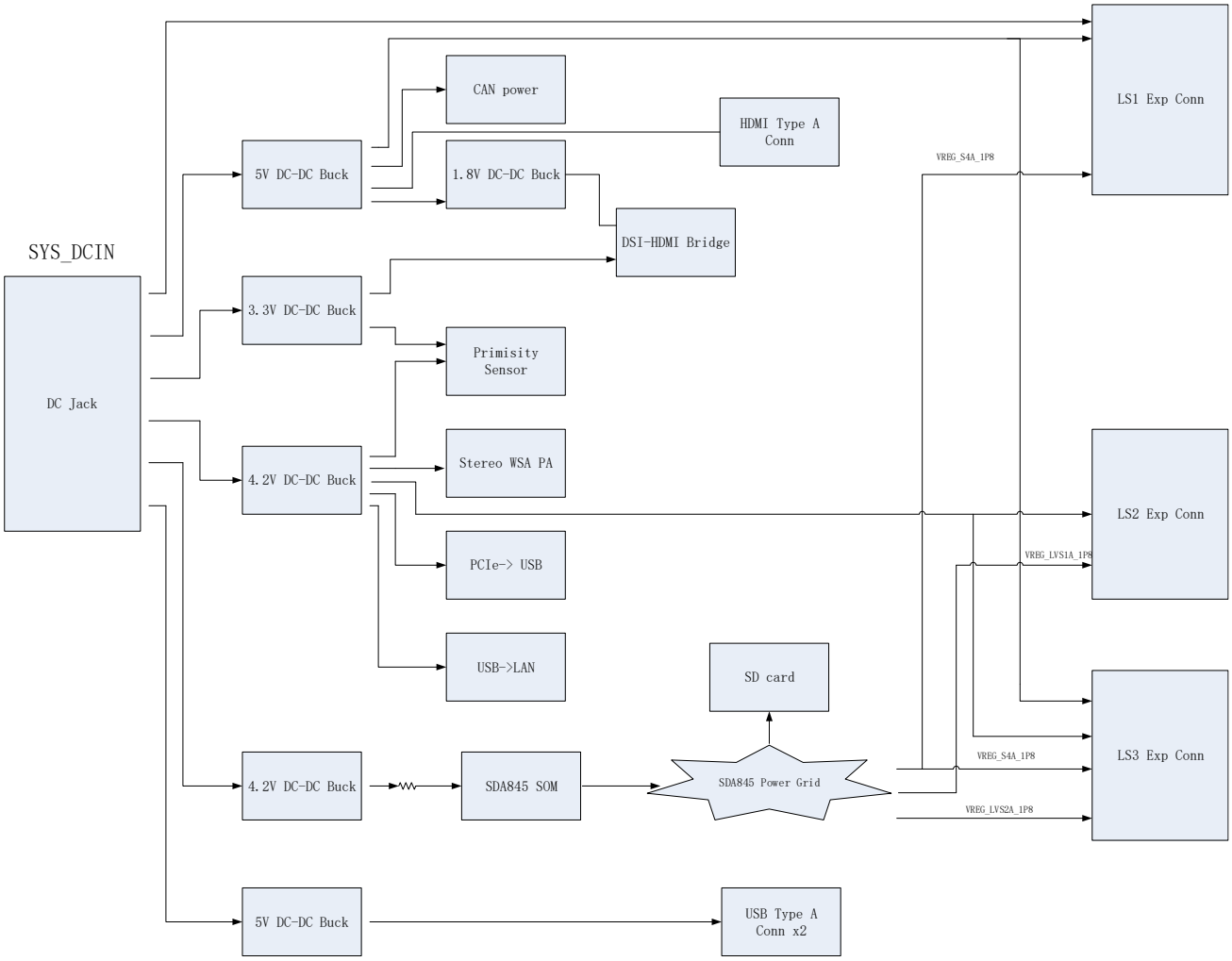
The Robotics DragonBoard 845c board implements more GPIOs on the secondary high-speed expansion connector. The GPIOs are 1.8 V voltage rail.

- GPIO U: Connects to GPIO_102 of SDA845 SoC. Can be configured to be PCIE1 Reset N.
- GPIO V: Connects to GPIO_103 of SDA845 SoC. Can be configured to be PCIE1 Clock Request.
- GPIO W: Connects to GPIO_11 of SDA845 SoC. Can be configured to be PCIE1 Wake N.
- GPIO X: Connects to GPIO_12 of SDA845 SoC. Can be configured to be Camera 2 reset.
- GPIO Y: Connects to GPIO_21 of SDA845 SoC. Can be configured to be Camera 3 reset.
- GPIO Z: Connects to GPIO_116 of SDA845 SoC. Can be configured to be an IRQ line or CAM3 VSYNC.
- GPIO AA: Connects to GPIO_24 of SDA845 SoC. Can be configured to be an IRQ line
- GPIO BB: Connects to GPIO_22 of SDA845 SoC. Can be configured to be IRQ line or camera 0 strobe.

- GPIO CC: Connects to GPIO_23 of SDA845 SoC.
- GPIO DD: Connects to GPIO_69 of SDA845 SoC.
- PM GPIO H: Connects to GPIO_12 of PM845 PMIC.
- PM GPIO I: Connects to GPIO_10 of PM845 PMIC.

The IRQ lines create a wake-up event for the SoC.

6 Power management



The 96Boards specification defines how power arrives to the board and the supplies that the board needs to provide. The onboard power requirement for each 96Boards implementation depends on the SoC and the set of peripherals that are specific to that implementation.

The Robotics DragonBoard 845c board uses five buck regulators: U0700, U0701, U0800, U0801 and U1505 to bring power in to the board.

- U0700 and U0701 generate 4.2 V at 4A. U0700 feeds the WSA power and others. U0701 feeds the SDA845 SOM power.
- U0800 generates 3.3 V at 1A for sensor and HDMI IO voltage.
- U0801 generates 5 V at 2A, feeds the HDMI, CAN and LS1/LS3.

- U1505 generates 5 V at 2A, feeds the USB Type A power.

6.1 DC power input

The 96Boards specification calls for power to be provided to the board in one of the following ways:

- 8 V to 18 V power from a dedicated DC jack
  - The Robotics DragonBoard 845c board supports this requirement through the use of #13 (see Section 1.2.1), SYS_DCIN power connector.
  - The SYS_DCIN can be as low as 6.5 V on the Robotics DragonBoard 845c board.
- 8 V to 18 V power from the SYS_DCIN pins on the low-speed expansion connector
  - The Robotics DragonBoard 845c board supports incoming power through this connector.
  - The SYS_DCIN can be as low as 6.5 V on the Robotics DragonBoard 845c board.
- A USB Type C port at 5 V
  - The Robotics DragonBoard 845c board supports the 5 V from USB Type C port. It cannot support system bring up power on.

6.2 Power source selection

The 96Boards specification calls for only one power source to be applied to the board at any given time.

Following this requirement, the Robotics DragonBoard 845c board user should never apply power to the board from #13 (see Section 1.2.1) and the low-speed expansion connector at the same time.

There is no active or passive mechanism on the Robotics DragonBoard 845c board to prioritize one source over the other.

6.3 Power sequencing

Upon applying power to the Robotics DragonBoard 845c board (from either one of the two sources), both buck regulators will be enabled and will start regulating their target voltages.

When the output of U0701 is on, it will power the onboard PMIC, the PMI8998 power management device. PMI8998 generates VPH_PWR which supplies the PM845.

The sequencing of all power rails is set within the PMIC configuration scheme during the production of this part. The user has no access to alter, modify, or change the PMIC power up sequencing.

6.4 Power measurement

The 96Boards specification calls for a minimum of one current sense resistor to be placed on the board permitting basic power measurement functions.

The Robotics DragonBoard 845c board implements two different power measurements.

6.4.1 DC-in measurement

A 0.01ohm resistor R0719 is placed in line of the DC12V on the DC input. Placing a probe over the resistor pins will provide a voltage measurement of the voltage drop across the resistor. Dividing this measurement by 0.01 will give you the amount of the current flowing into the DC.

6.4.2 PMIC power-in measurement

A 0.01ohm resistor R0709 is placed in line to the VBAT_SOM on the 4.2 V supply on the output of U0701. Placing a probe over the resistor pins will provide a voltage measurement of the voltage drop across the resistor. Dividing this measurement by 0.01 will give you the amount of the current flowing into the SDA PMIC.

7 Buttons and status LEDs

7.1 Buttons

7.1.1 Volume up

The Volume up button (see Section 1.2.2, #16) is used to control the audio volume of the Robotics DragonBoard 845c board.

7.1.2 Volume down

The Volume down button (see Section 1.2.2, #17) is used to control the audio volume of the Robotics DragonBoard 845c board.

7.1.3 Power button

The push-button (see Section 1.2.2, #20) serves as the power ON/OFF/Sleep button. Upon applying power to the board, the boot process will start. Once the board is powered on and booted up:

Sleep/Suspend

- You can put the device to sleep by pressing this button momentarily.
- You can wake the device from sleep by pressing this button momentarily.

Power ON/OFF

- Option 1: Long press/hold
  - While the device is awake, press and hold the Power button #20 (see Section 1.2.2) for longer than 15 seconds to Power OFF the device.
  - Once OFF, press and hold the Power button #20 (see Section 1.2.2) for longer than 3 seconds to Power ON the device.
- Option 2: Short press/hold
  - While the device is awake, press and hold the Power button #20 (see Section 1.2.2) for 2~3 seconds to display the Power OFF notice. Using a mouse, click the notice to Power OFF the device.
  - Once OFF, press and hold the Power button #20 (see Section 1.2.2) for longer than 3 seconds to Power ON the device.

7.1.4 Reset button

The onboard (see Section 1.2.2, #17) push-button has two functions, it serves as a reset button and as a Volume button.

The reset function needs to be a software-configured setting.

7.1.5 Force_USB_BOOT button

The onboard (see Section 1.2.2, #18) push-button is used for emergency USB boot for during development.

7.2 LEDs

There are two status LEDs and four user LEDs on the Robotics DragonBoard 845c board.

The status LEDs report the status of the Bluetooth and Wi-Fi devices onboard.

The user LEDs are driven directly by the SoC.

7.2.1 User LED 1-4

The four user LEDs are surface mount green LEDs, 0603 size, located next to the two USB Type A connectors and labeled USER LEDS 3 2 1 0.

7.2.2 Bluetooth status

The Robotics DragonBoard 845c BT LED is located next to the USB OTG connector. The BT LED reflects the status of the Bluetooth device.

7.2.3 WiFi status

The Robotics DragonBoard 845c WiFi LED is located beside the BT LED. The WiFi LED reflects the status of the WiFi device.

7.2.4 Power indicator LED

The Robotics DragonBoard 845c power indicator is located beside the DC jack. The power indicator LED notifies the user that the power is applied.

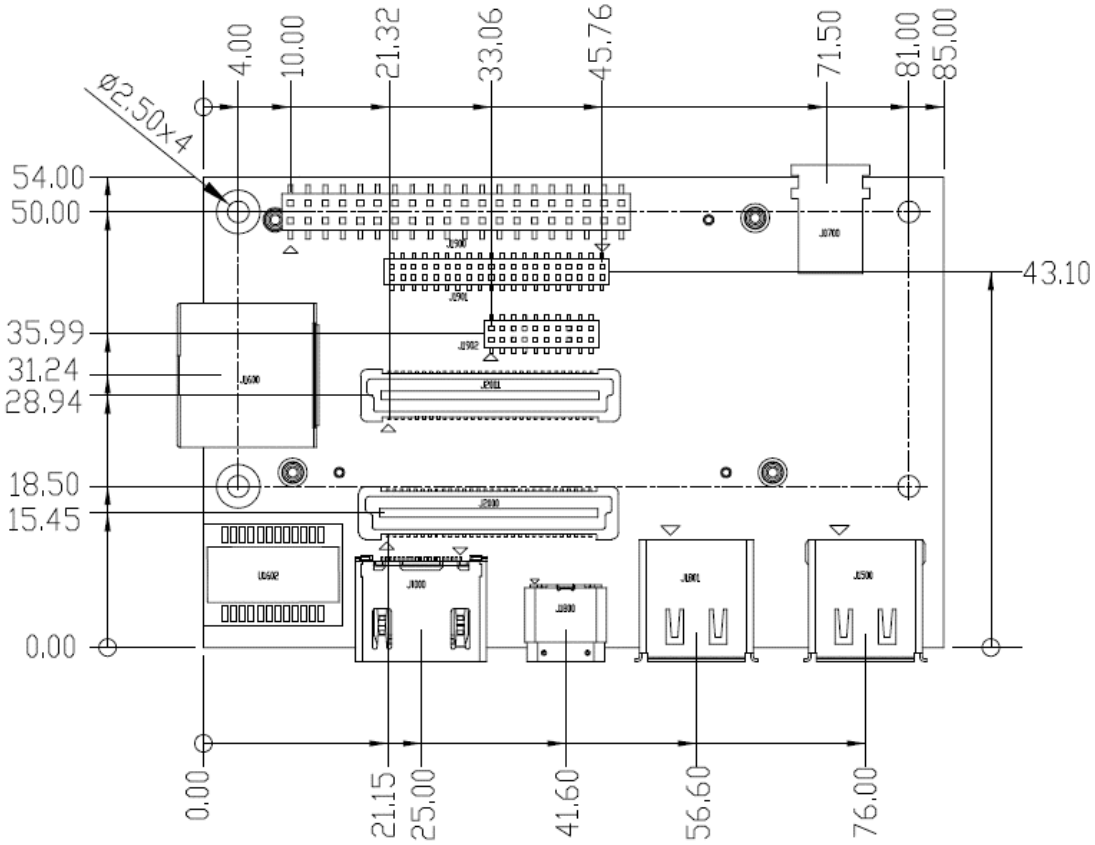
8 Boot configuration

A dip switch is located on the top of the development board (see Section 1.2.2, #15):

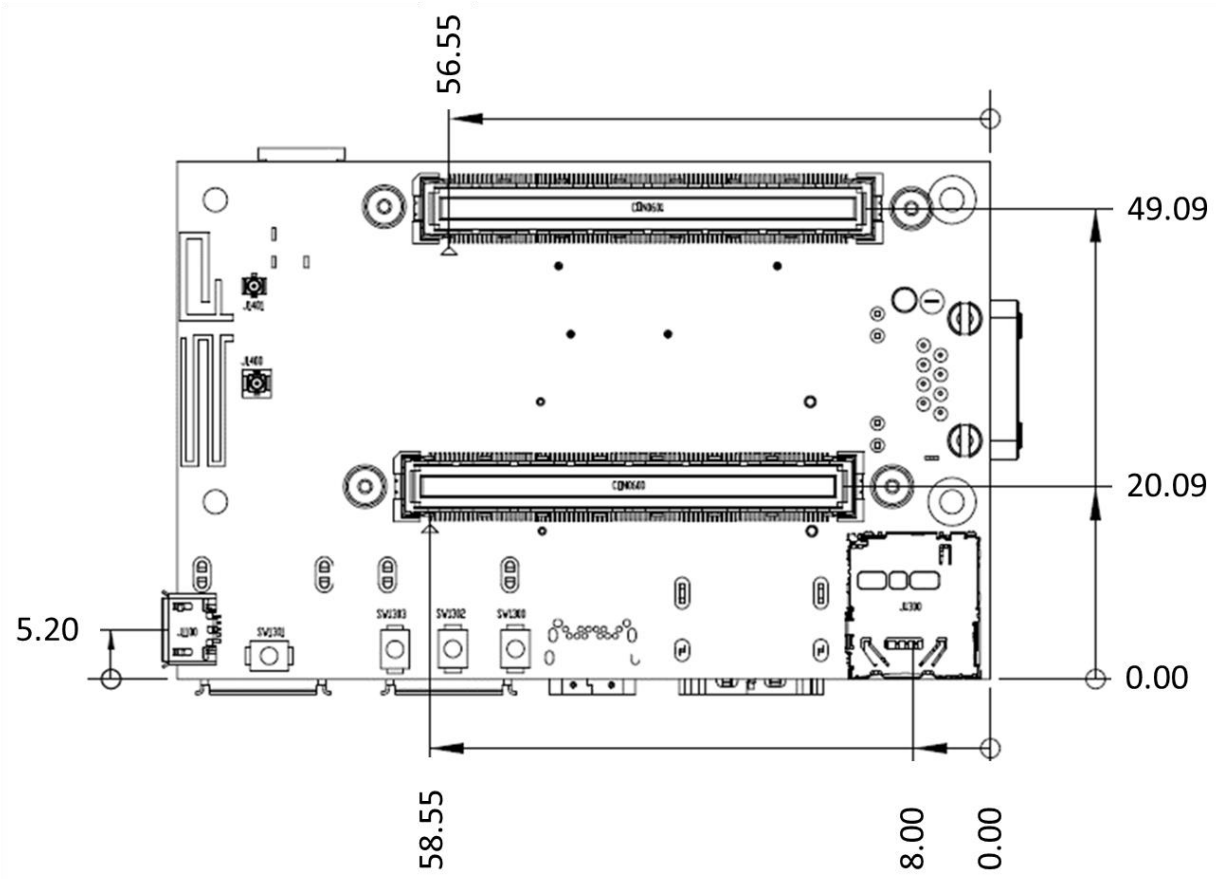
- Switch 1 – NA
- Switch 2 – ONBOARD_DEBUG_UART_EN_N SD BOOT: When set to ON, will force the SDA UART log to USB port; when set to OFF, will force the SDA UART log to low-speed expansion connector LS1.
- Switch 3 – CBL_PWR_N: When set to ON, will force the device to boot up automatically; when set to OFF, will force the device to boot up by manual power button.
- Switch 4 – SW_DSI1_TO_LT9611_N: When set to ON, will force the MIPI-DSI1 to high-speed expansion connector HS1; when set to OFF, the MIPI-DSI1 to LT9611 DSI-HDMI bridge.
- Switch 5 – ONBOARD_SENSOR_DISCONNECT: When set to ON, will force the SDA845 SSC sensor SPI/I2C to low-speed expansion connector; when set to OFF, will force the SSC sensor SPI/I2C to onboard sensor.
- Switch 6 – IMU_EXT_CLK_TOGGLE: When set to ON, the onboard ICM-42688 sensor will use the external clk of GPIO78 from SoC; when set to 'OFF', the onboard ICM-42688 sensor will use another interrupt output to SoC GPIO118. These GPIOs need the software configure setting.

9 Mechanical specification

Top



Bottom



Connector part numbers:

Connector	MPN	MPN of Mate
High speed 1 and 2 (HS1/2)	**FCI: 61082-061409LF**	**FCI: 61083-063400LF**
Low speed 1 (LS1)	**Molex: 87381-4063**	**FCI: 57202-G52-20LF**
Low speed 2 (LS2)	**Samtec: CLP-120-02-L-D-A-K-TR**	**Samtec: FTSH-120-04-L-DV-A-P**
Low speed 3 (LS3)	**Samtec: CLP-110-02-L-D-A-K-TR**	**Samtec: FTSH-110-04-L-DV-A-P**

10 Appendix

10.1 Navigation Mezzanine

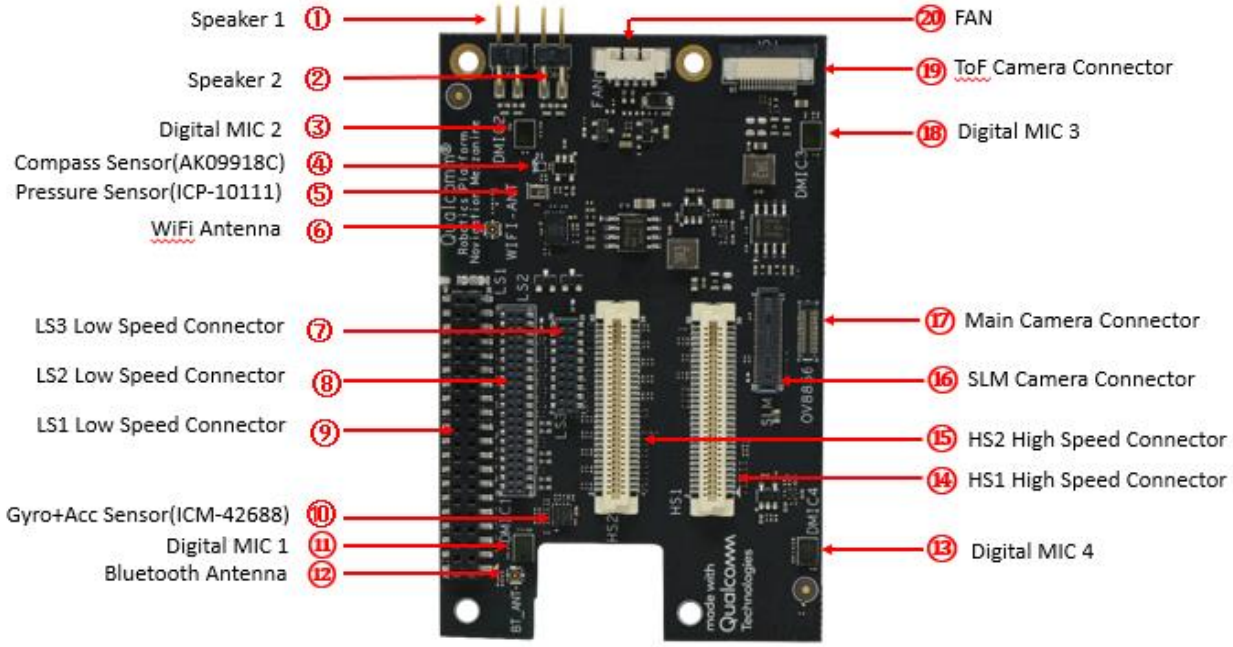
The Navigation Mezzanine development board can be used to connect four different cameras directly by MIPI CSI interface: Main Camera, Tracking Camera, ToF Camera, and SLM Camera.It supports three cameras concurrency.It is ideal for developers to enable rapid development of embedded vision applications.

10.1.1 Technical specifications

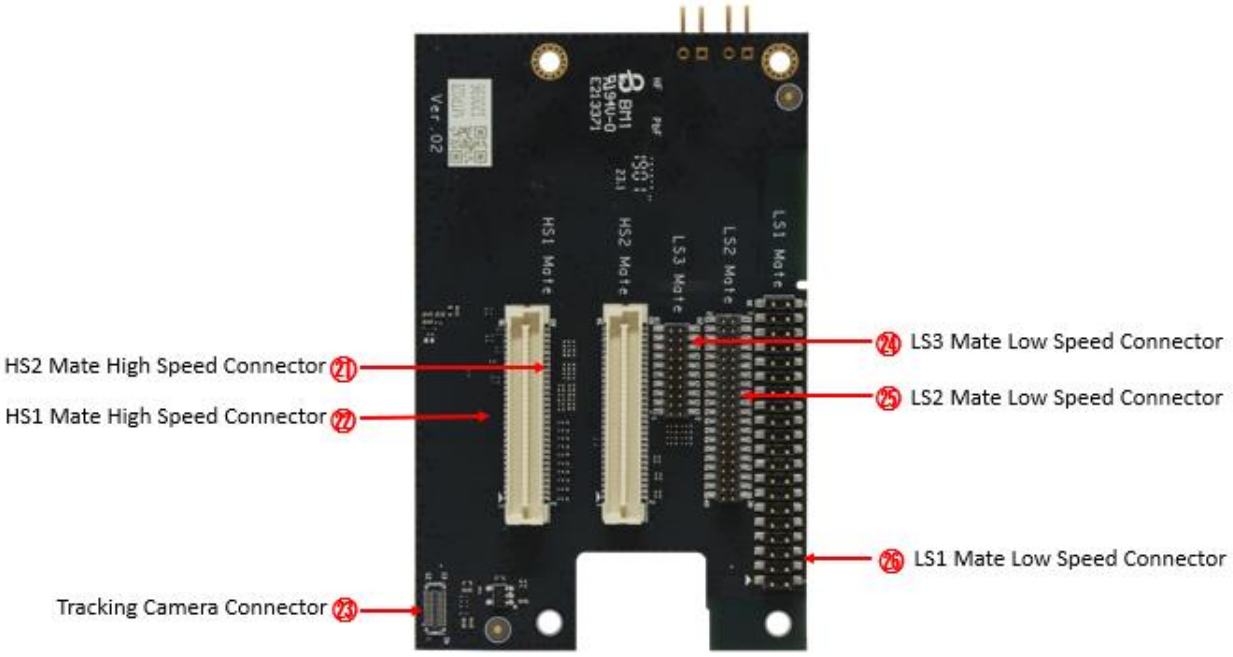
Component	Description
Expansion interfaces	Expansion connectors: ▪ HS1:1 x 60 pin high-speed connector (4L-MIPI DSI, USB 2.0 x2, I2C x 2, SDIO) ▪ HS2:1 x 60 pin high-speed connector (SSC SPI, PCIe 3.0, USB 3.0 x 1, GPIO < 9) ▪ LS1:1 x 96boards 40 pin low-speed connector (UART x 2, I2S, I2C x 2, GPIO x 8, DC power) ▪ LS2:1 x 96boards 40 pin low-speed connector (headset, stereo speaker, DMIC I/F x 1, CAN, I2S, GPIO x 7, PWM x1, ADC x 2) ▪ LS3:1 x 96boards 20 pin Low-Speed connector (SSC I2C, sensor interrupt x 1)
Other Interfaces	▪ Main Camera Connector & Tracking Camera Connector & ToF Camera Connector & SLM Camera Connector ▪ 1 x Fan Connector ▪ 2 x Speaker Connectors ▪ 4 x DMICs on-board
Sensor	▪ 1 x 6-Axis Sensor, 1 x Pressure Sensor, 1 x Compass
Antenna	▪ Dedicated 2.4GHz Bluetooth printed antenna on board
Size	▪ 85 mm x 54 mm meeting 96Boards Consumer Edition Standard form dimensions specifications

10.1.2 Board views

Top view



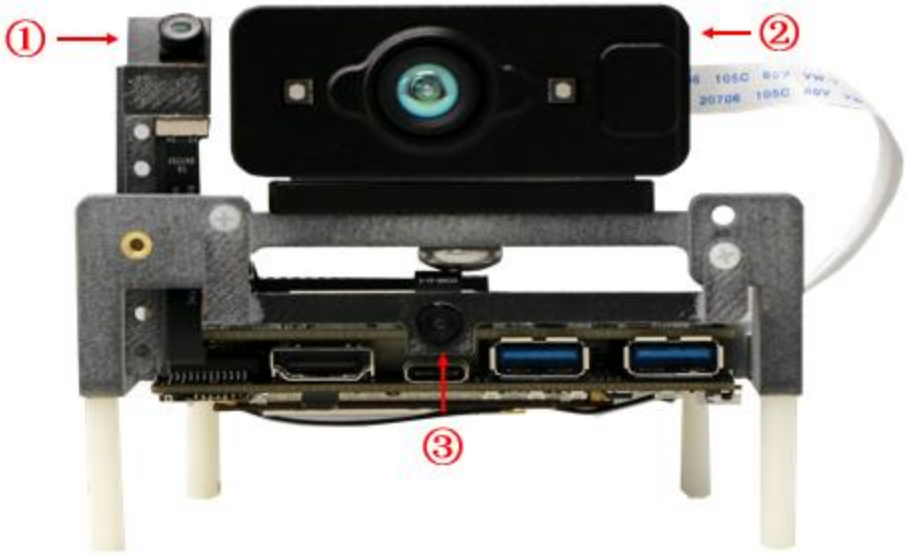
Back view



10.1.3 Three Cameras Concurrency

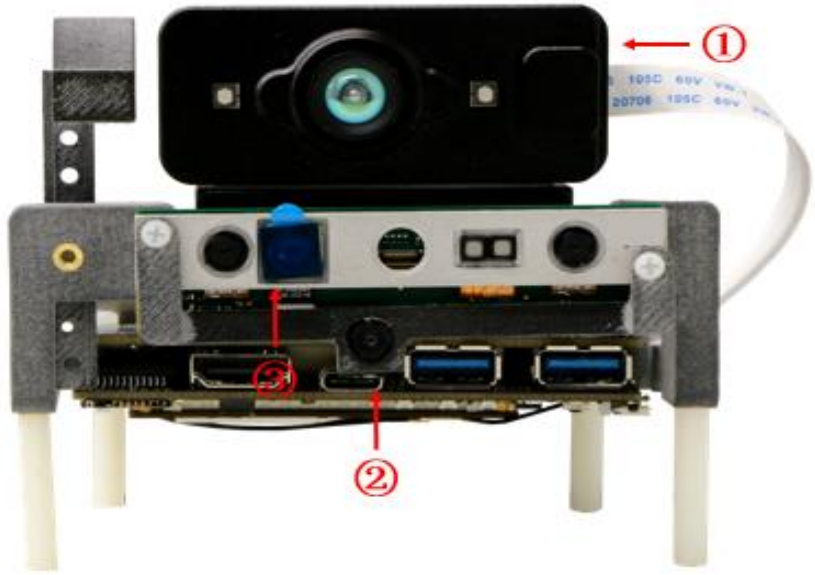
Use Case 1：Main Camera + Tracking Camera + ToF Camera

Note: The red labels instruct the assembly sequence



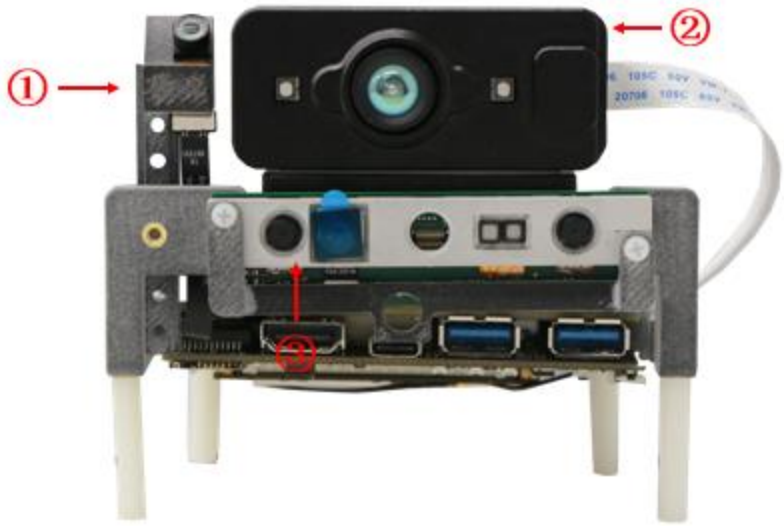
Use Case 2: Main Camera + SLM Camera + ToF Camera

Note: The red labels instruct the assembly sequence



Use Case 3: Tracking Camera + SLM Camera + ToF Camera

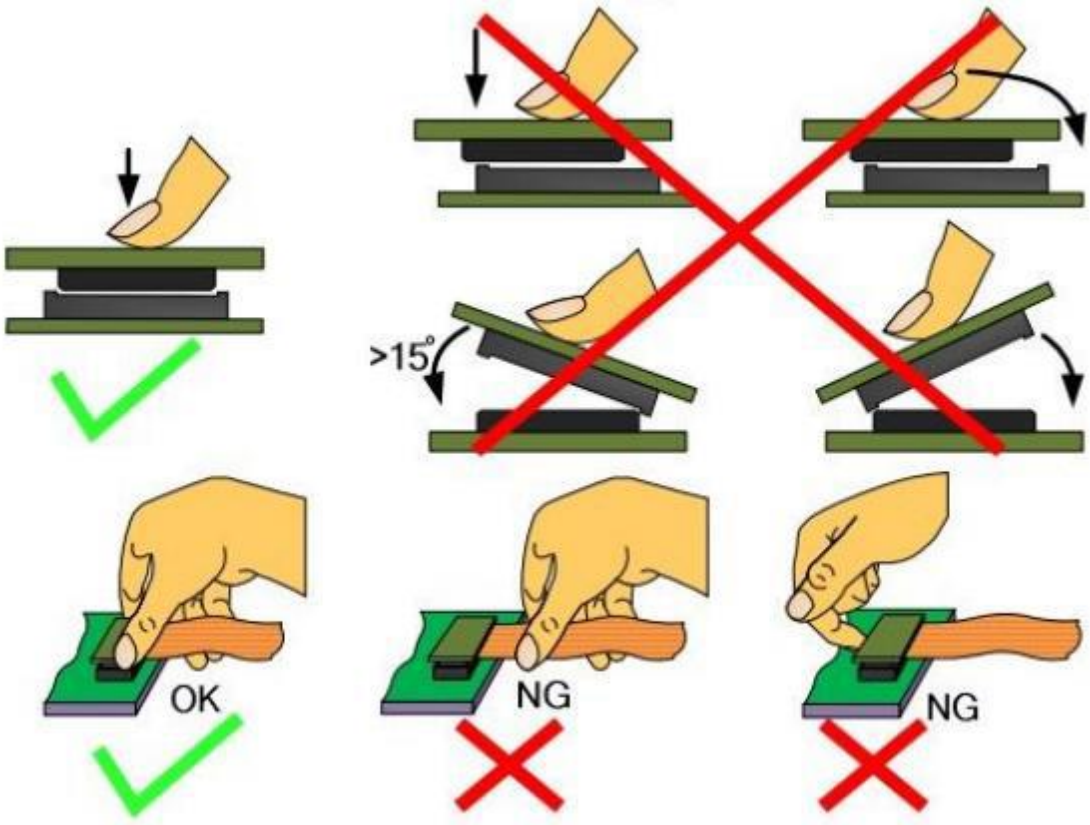
Note: The red labels instruct the assembly sequence



10.1.4 Precaution for assembling the camera

• Do not twist fpc of the camera

• Please note the position of the male and female connector, pulgging in or unplugging needs to be done vertically at the connector.



10.2 Machine Communication Mezzanine

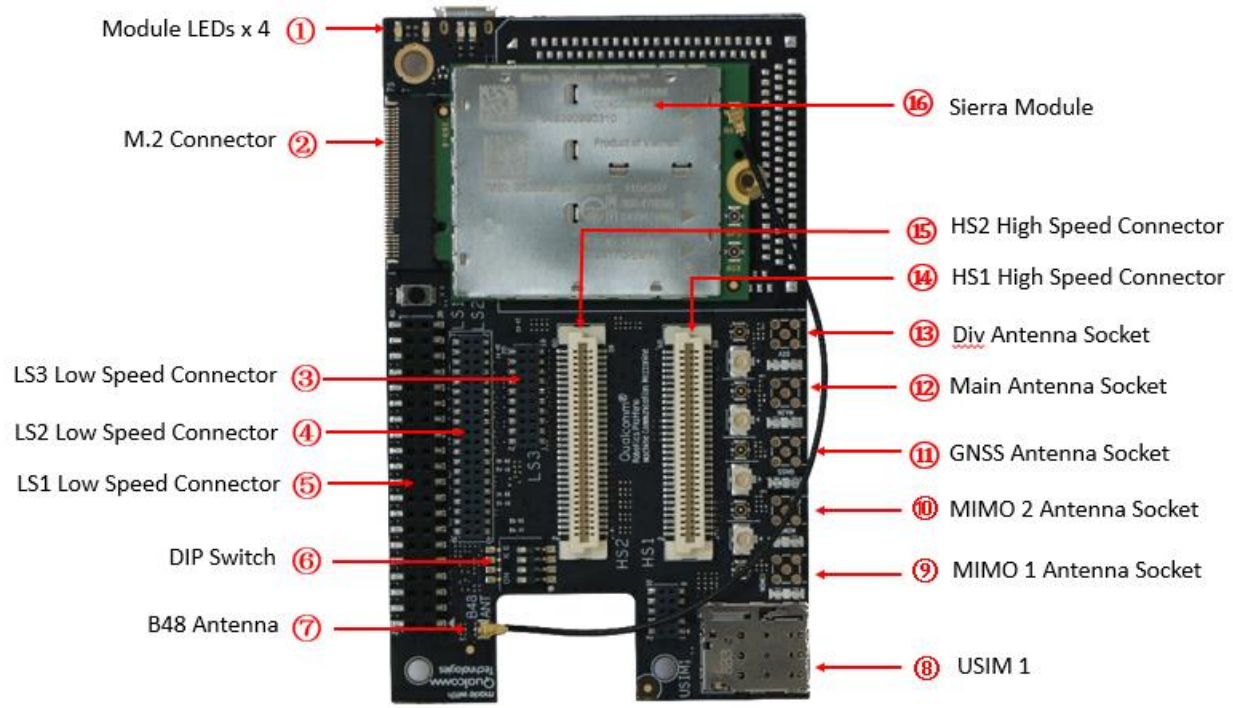
Machine Communication Mezzanine is designed to connect the cellular networks, adopts Sierra Wireless EM7565 Module which offers global 4G coverage, CBRS for private LTE networks, unprecedented LTE speeds, bandwidth, and network performance on the M.2 form factor.A built in Global Positioning System (GPS) device adds location and navigation to your application.

10.2.1 Technical specifications

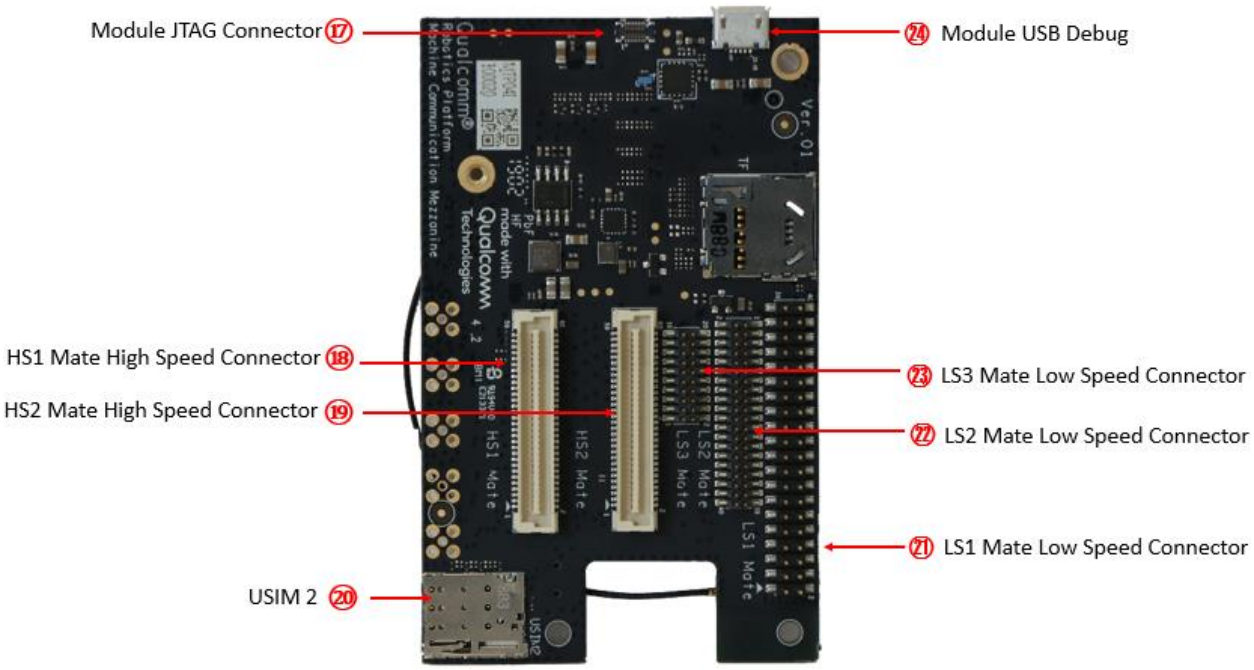
Component	Description
Expansion interfaces	Expansion connectors: HS1:1 x 60 pin High-Speed connector (4L-MIPI DSI, USB 2.0 x2, I2C x2, 2L+4L-MIPI CSI, SDIO) HS2:1 x 60 pin High-Speed connector (4L-MIPI CSI x 2, SSC SPI, PCIe 3.0, USB 3.0 x1, GPIO x 9) LS1:1x 96boards 40 pin Low-Speed connector (UART x 2, SPI, I2S, I2C x2, GPIO x 12, DC power) LS2:1 x 96boards 40 pin low-speed connector (headset, stereo speaker, DMIC I/F x 3, CAN, I2S, GPIO x 7, PWM x 2, ADC x 2) LS3:1 x 96boards 20 pin Low-Speed connector (SSC SPI x 3, SSC I2C, sensor interrupt x 5)
Other Interfaces	2 x USIM 1 x Micro B Debug for LTE 1 x B48 band antenna on board 1 x GNSS antenna connector 1 x main antenna connector 1 x div antenna connector 2 x MIMO antenna connectors 1 x M.2 interface
Cellular components	1 x Sierra Wireless EM7565 M.2 Module 2 x 100mm coax cables 2 x 50mm coax cables 2 x Taoglas FXUB66 antennas
Size	85 mm x 54 mm meeting 96Boards Consumer Edition Standard form dimensions specifications

10.2.2 Board views

Top view



Back view



10.2.3 Cellular Networks Configuration

LTE Band	Machine Communication Mezzanine (Sierra Wireless EM7565 Module)
B1	LTE/3G
B2	LTE/3G
B3	LTE
B4	LTE/3G
B5	LTE/3G
B6	3G
B7	LTE
B8	LTE/3G
B9	LTE/3G
B12	LTE
B13	LTE
B18	LTE
B19	LTE/3G
B20	LTE
B26	LTE
B28	LTE
B29	LTE
B30	LTE
B32	LTE
B41 (TDD) - China	LTE
B42(TDD)	LTE
B43(TDD)	LTE
B46 (TDD unlicenced)	LTE
B48 (TDD) CBRS	LTE
B66 (Cat M1/M2/1Bis/NB1/NB2)	LTE

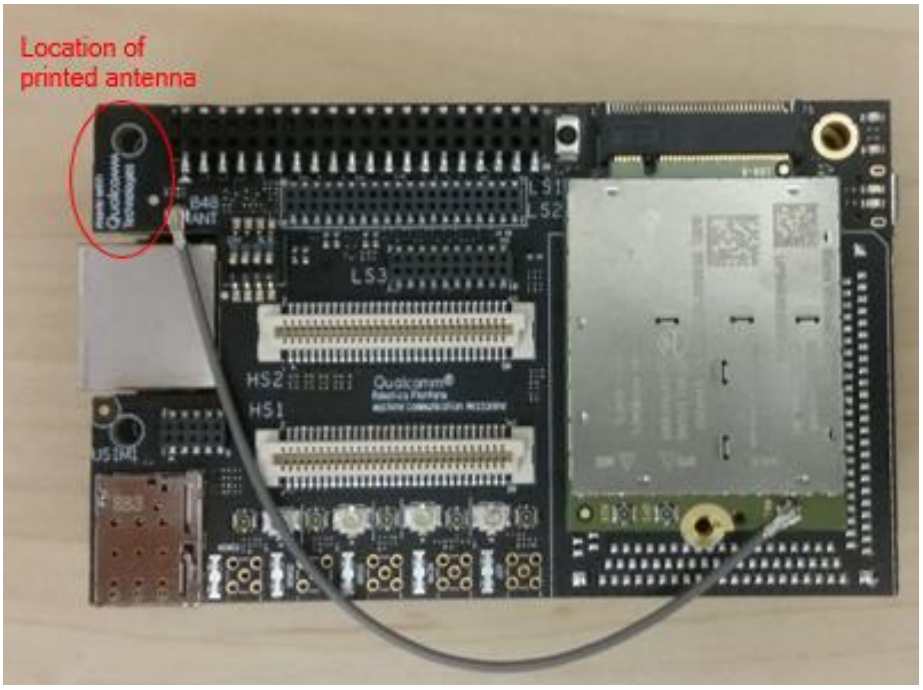
Use Case 1：Full LTE Support

- Single chain RF – LTE Cat 0, LTE Cat M1/M2, LTE Cat NB1/NB2
- Dual chain RF – LTE Cat 1 and higher

Required: 2 x 50mm coax cables, 2 x Taoglas antennas

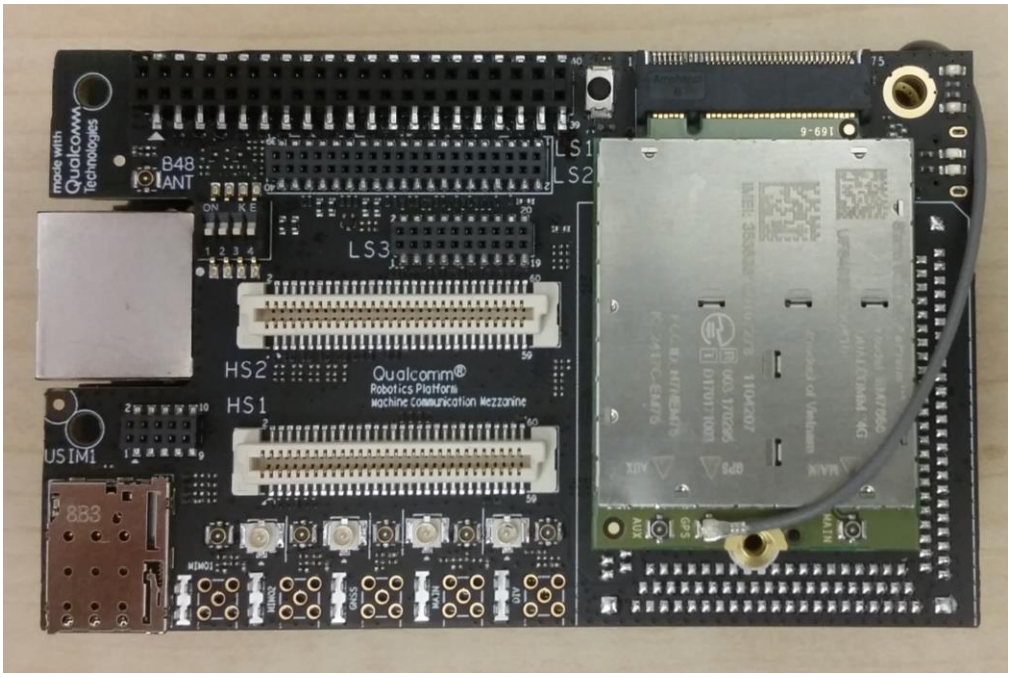
Use Case 2: LTE B48 (CBRS) support, Onboard printed antenna supports LTE B42/B43/B48

Required: 1 x 100mm coax cable

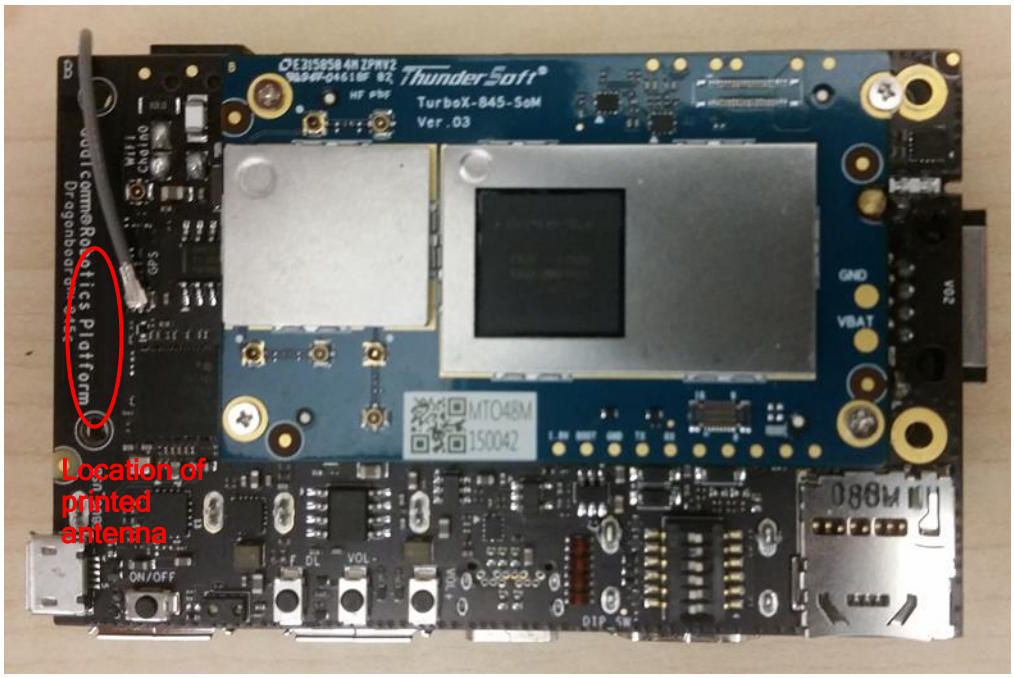


Use Case 3:GPS support

Required: 1 x 100mm coax cable, 1 x Robotics DragonBoard 845c



Top View of assembly



Bottom View of assembly