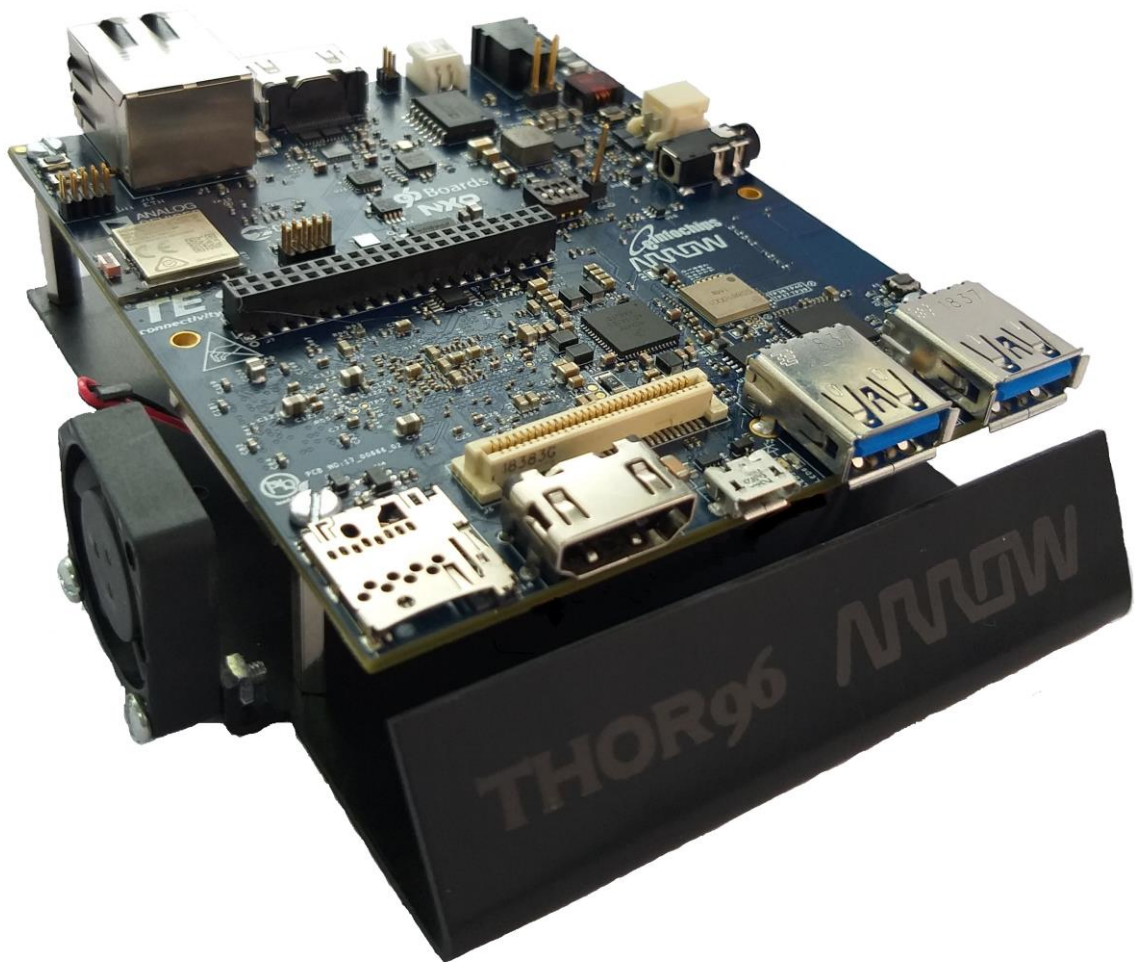


# THOR96

## Hardware Manual

FCC ID: 2AFQA-IMX-THOR96



Powered by:



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## 1 DOCUMENT DETAIL

### 1.1 Document History

| Version | Author     |             | Description Of Changes |
|---------|------------|-------------|------------------------|
|         | Name       | Date        |                        |
| 1.0     | eInfochips | 28-Aug-2019 | Initial release        |

Table 1: Document History

### 1.2 Acronyms and abbreviation definitions

| Acronym / Abbreviation | Definition                                  |
|------------------------|---------------------------------------------|
| A2B                    | Automotive Audio Bus                        |
| BOM                    | Bill of Materials                           |
| BT                     | Bluetooth                                   |
| BLE                    | Bluetooth Low Energy                        |
| CLK                    | CLK Clock                                   |
| CPU                    | Central Processing Unit                     |
| CS                     | Chip Select                                 |
| CSI                    | Camera Serial Interface                     |
| DSI                    | Display Serial Interface                    |
| EMC                    | Electro-Magnetic Compatibility              |
| EMI                    | Electro-Magnetic Interference               |
| EN                     | Enable                                      |
| ESD                    | Electro-Static Discharge                    |
| GND                    | Ground                                      |
| GPIO                   | General Purpose I/O                         |
| GPS                    | Global Positioning System                   |
| HDMI                   | High Definition Multimedia Interface        |
| HMI                    | Human Machine Interface                     |
| I2C                    | Inter-Integrated Circuit                    |
| I2S                    | Inter-IC Sound                              |
| INT                    | Interrupt                                   |
| LDO                    | Low Drop-Out                                |
| LPDDR                  | Low Power Double Data Rate                  |
| LTE                    | Long-Term Evolution                         |
| MIC IN                 | Microphone Input                            |
| MIPI                   | Mobile Industry Processor Interface         |
| PCB                    | Printed Circuit Board                       |
| PCIE                   | Peripheral Component Interconnect Express   |
| PMIC                   | Power Management IC                         |
| PWM                    | Pulse-Width Modulation                      |
| RAM                    | Random Access Memory                        |
| RGMII                  | Reduced Gigabit Media Independent Interface |
| RF                     | Radio Frequency                             |
| RoHS                   | Restriction of Hazardous Substances         |
| RTC                    | Real Time Clock                             |
| RX                     | Receive                                     |
| SCL                    | Serial Clock                                |
| SD                     | Secure Digital                              |

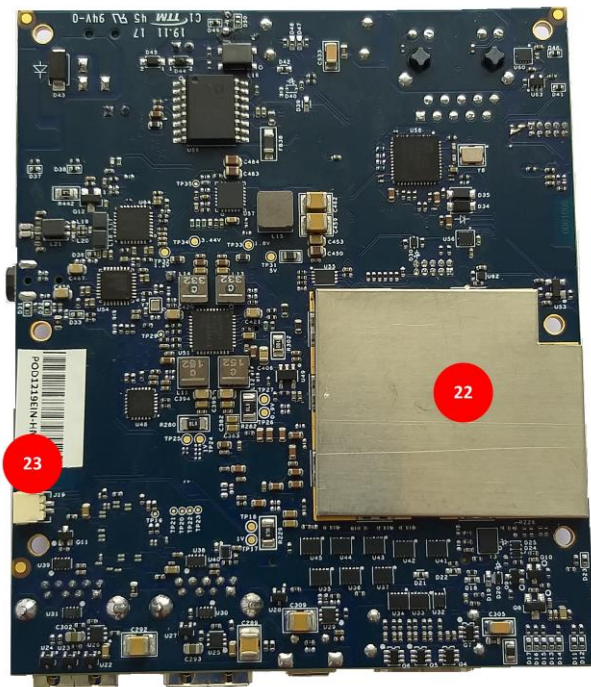
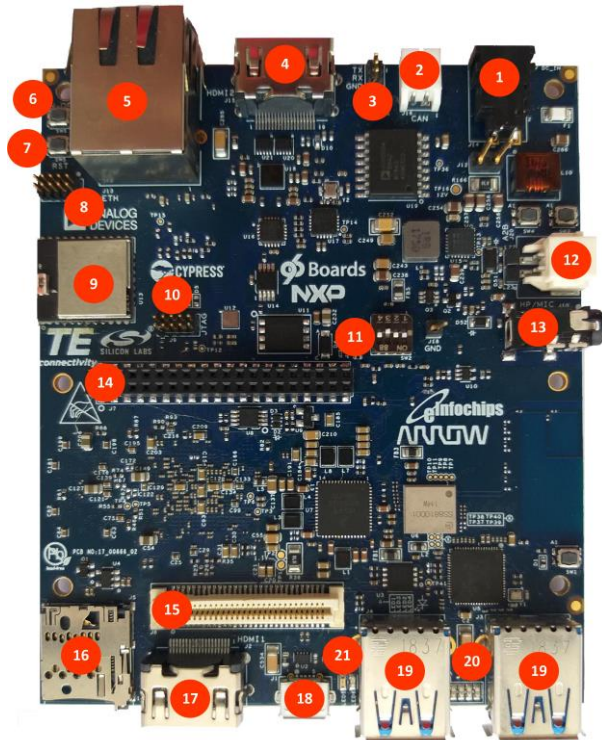
|      |                                             |
|------|---------------------------------------------|
| SDA  | Serial Data                                 |
| SDI  | Secure Digital Interface                    |
| SOM  | System On Module                            |
| SPI  | Serial Peripheral Interface                 |
| TX   | Transmit                                    |
| UART | Universal Asynchronous Receiver/Transmitter |
| USB  | Universal Serial Bus                        |
| WLAN | Wireless Local Area Network                 |

## 2 KEY FEATURES

The THOR96 board is a 96Boards compliant community board based on NXP iMX8M QUAD Core Processor. The following table lists its key features of Thor96:

| Device                              | Specification                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CPU                                 | iMX8M QUAD NXP<br>Internal core operation:<br>Four ARM Cortex-A53 (1.3 GHz)<br>One ARM Cortex-M4 (266 MHz)                                                                                                                                                                                                                                                                                                                |
| Memory / Storage                    | 2GB LPDDR4 1600 MHz<br>SD 3.0 (UHS-I)<br>256 Mb NOR FLASH<br>128 Kb EEPROM                                                                                                                                                                                                                                                                                                                                                |
| Video                               | 4K UltraHD@30fps video playback and capture with H.265 (HEVC) on HDMI port -J2<br>1080p HD video play on HDMI port - J15 (DSI to HDMI using MIPI Switch)                                                                                                                                                                                                                                                                  |
| Camera Support                      | 4 lane MIPI port<br>2 lane MIPI port                                                                                                                                                                                                                                                                                                                                                                                      |
| Audio                               | Audio Codec (MIC IN + Headphone Out)<br>Automotive Audio Bus (A2B) in Master Mode                                                                                                                                                                                                                                                                                                                                         |
| Connectivity                        | <ul style="list-style-type: none"> <li>• Wi-Fi 5 GHz &amp; 2.4GHz IEEE 802.11a/b/g/n/ac (Trace Antenna)</li> <li>• Bluetooth® V4.2 (BLE)</li> <li>• ZigBee &amp; Thread IEEE 802.15.4</li> <li>• RGMII 10/100/1000 Mbit/s IEEE 802.3</li> <li>• CAN 5kV isolation in transceiver mode</li> <li>• 1 x USB 2.0 micro AB OTG</li> <li>• 2 x USB 3.0 type A</li> </ul>                                                        |
| Debug                               | <ul style="list-style-type: none"> <li>• UART (3 pin)</li> <li>• JTAG (10 pin)</li> </ul>                                                                                                                                                                                                                                                                                                                                 |
| I/O Interfaces                      | One 40-pin Low Speed (LS) expansion connector <ul style="list-style-type: none"> <li>• UARTx2, SPI, I2S, I2C x2, GPIO x12, DC power</li> </ul> One 60-pin High Speed (HS) expansion connector <ul style="list-style-type: none"> <li>• 4L-MIPI DSI, 4L+2L-MIPI CSI, SPI, USB, I2C x2</li> </ul> THOR96 board can be made compatible with Camera, Display, Sensors, LTE Module and Audio interface as an add-on mezzanine. |
| User Interface                      | Switches <ul style="list-style-type: none"> <li>• Power ON/OFF</li> <li>• Processor RESET</li> <li>• Boot Mode (x4) selection</li> </ul> 6 LED Indicators <ul style="list-style-type: none"> <li>• 4 - user controllable</li> <li>• 2 - for radios (BT and WLAN activity)</li> </ul>                                                                                                                                      |
| OS-support                          | Linux                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Power, Mechanical and Environmental | Input voltage: +8V to +18V ( <u>typ. 12V@4A</u> as per 96Boards specification)<br>Dimensions: 85 x 100 mm meeting 96Boards™ Consumer Edition 'extended' B Form Factor<br>Number of Layers: 12 Layers<br>Operating Temp: 0°C to +55°C<br>RoHS and Reach compliant                                                                                                                                                          |

## Board overview

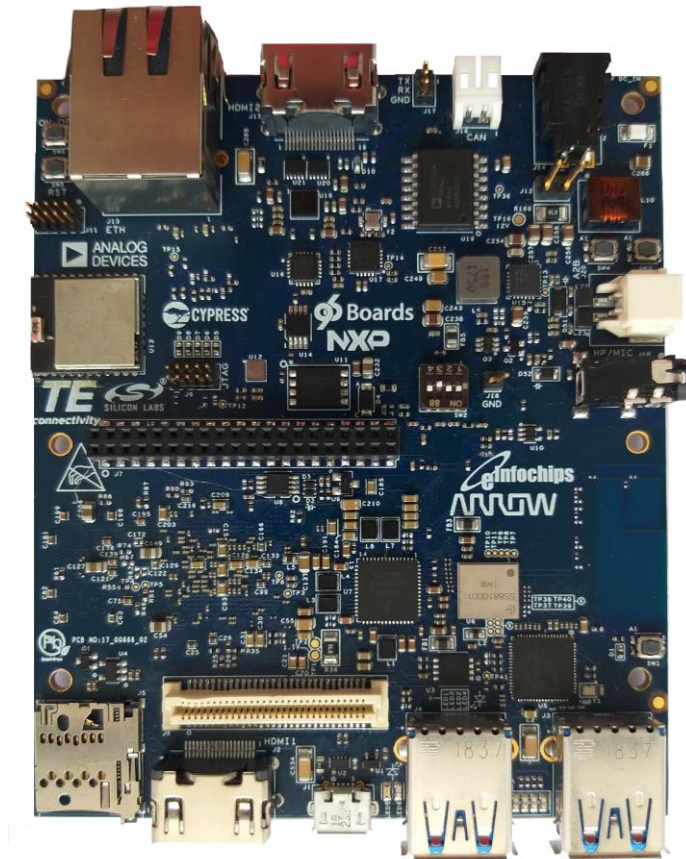


|    |                                                           |
|----|-----------------------------------------------------------|
| 1  | Power Jack                                                |
| 2  | CAN connector                                             |
| 3  | Debug UART connector                                      |
| 4  | HDMI2 connector (DSI to HDMI)                             |
| 5  | Ethernet connector                                        |
| 6  | ON/OFF Switch                                             |
| 7  | RESET Switch                                              |
| 8  | ZigBee connector                                          |
| 9  | ZigBee Module                                             |
| 10 | Debug JTAG connector                                      |
| 11 | Boot Mode Selection Switch                                |
| 12 | A2B connector                                             |
| 13 | MIC IN + Headphone out jack                               |
| 14 | LS Expansion connector                                    |
| 15 | HS Expansion connector                                    |
| 16 | micro SD Card connector                                   |
| 17 | HDMI1 connector                                           |
| 18 | Micro AB USB OTG connector                                |
| 19 | USB Type A connector                                      |
| 20 | User LEDs 1-4                                             |
| 21 | Wi-Fi & BT LEDs                                           |
| 22 | Shield Compartment containing iMX8M QUAD Processor/LPDDR4 |
| 23 | FAN connector                                             |



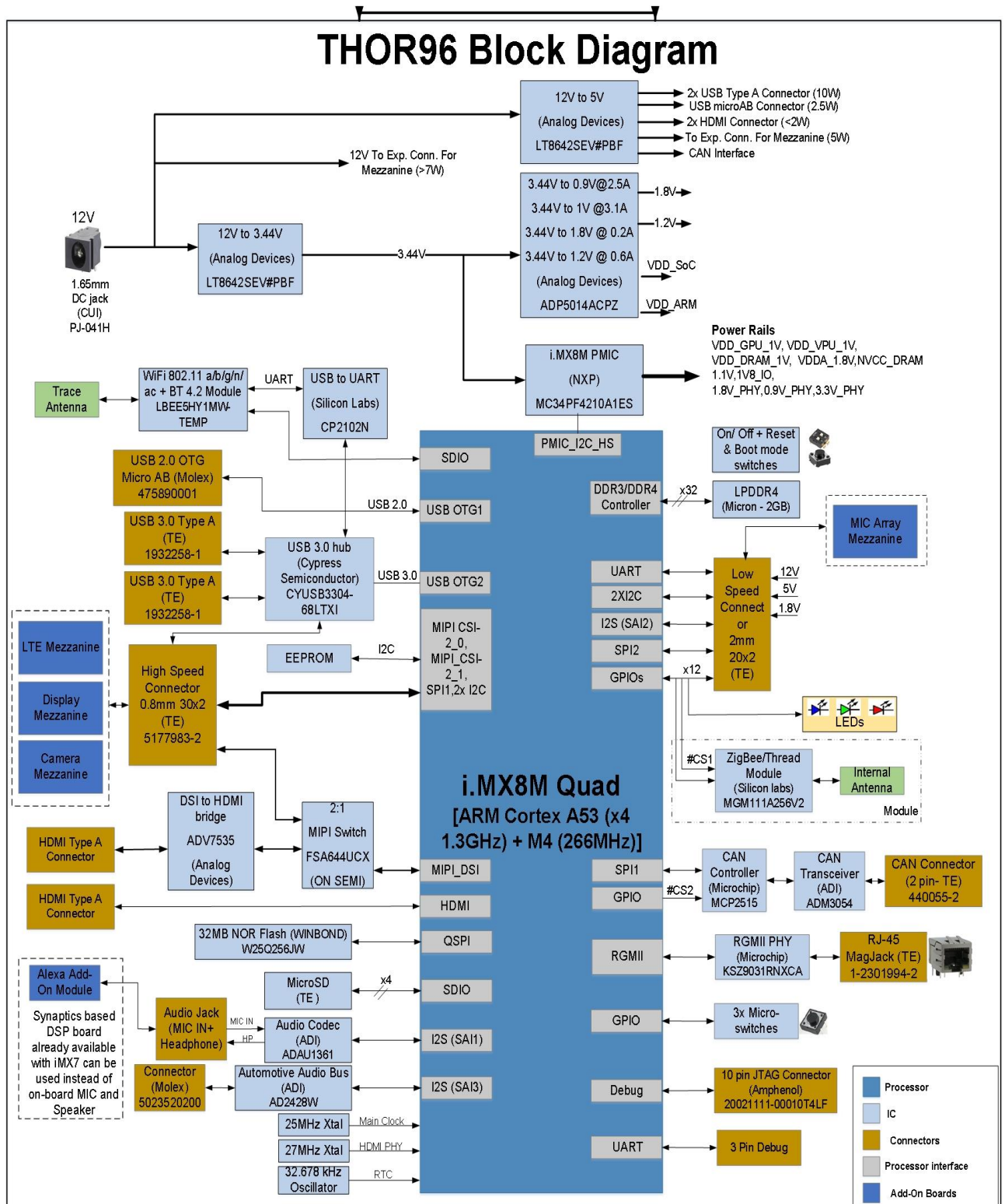
### 3 WHAT'S IN THE BOX

The box contains one THOR96 development board assembled with Base Plate, FAN, Heatsink and EMI Shield.



## 4 THOR96 BOARD OVERVIEW

### 4.1 System Block Diagram





## 4.2 Processor

iMX8M QUAD processor is a 64-bit ARM Cortex-A53 compliant 1.3 GHz Quad-core application processor from NXP, supports 64-bit Armv8-A architecture, supports Arm Cortex-M4 core platform, Video Processing Unit (VPU), Graphics Processing Unit (GPU), HDMI Display, MIPI DSI Display, Audio, Camera inputs.

## 4.3 Memory

- The LPDDR4 2GB (512Mbit x 32) is a 16bit width bus implementation interfacing directly to the iMX8M Processor build-in LPDDR controller. The maximum DDR clock is 533MHz (1066Mbps).
- The 96Boards specification calls for micro SD port to be on the board. The micro SD card is used to flash the board interfacing with iMX8M QUAD Core Processor SD2 interface supporting SDIO 3.0 specifications. The size supports up to 64 GB. The maximum SDIO clock is 200 MHz.
- The NOR flash is given as option to flash the board in absence of micro SD card. NOR flash is interfacing directly to iMX8M QUAD Core Processor QSPI interface. The size supports 256Mb. The maximum QSPI clock is 25 MHz.
- The EEPROM is interfacing directly to iMX8M QUAD Core Processor I2C interface. The size supports 128Kb.

## 4.4 Video

- HDMI: The 96Boards specification calls for an HDMI port to be on the board. The THOR96 provides native support for an HDMI interface. It supports a resolution up to 4K Ultra HD resolution at 30Hz.
- In THOR96, DSI0 port is connected to HS connector and using MIPI switch(FSA644UCX) it is converted into DSI to HDMI converter
  1. DSI0 port of processor is routed to High speed connector
  2. DSI\_HDMI converted to HDMI for display (through ADV7535)
- **DSIO:** It supports a resolution from 480i to 1080p at 30Hz.
- **DSI to HDMI:** It supports a resolution 1080P via DSI to HDMI Bridge Chip.

## 4.5 Camera Support

- THOR96 supports one 4-lane CSI1 port and one 2-lane CSI2 port which used to connect camera mezzanine.

## 4.6 Audio

- THOR96 supports the audio codec with MIC IN + Headphone Out 3.5 mm jack connector.
- THOR96 supports Automotive Audio Bus interfaces in Master mode with 2 pin connector.

## 4.7 Connectivity

### 4.7.1 Wi-Fi

- The 96Boards specification calls for Wi-Fi module to be on the board.
- THOR96 supports Wi-Fi (802.11 a/b/g/n/ac, 2.4GHz and 5GHz) over LBEE5HY1MW-230 module.
- Wi-Fi will be mainly used for cloud connectivity.
- The Wi-Fi module is interfaced with iMX8M Processor SD1 interface supporting SDIO 3.0 specifications.
- The maximum SDIO clock is 200 MHz.
- Module is certified with PCB trace antenna.

### 4.7.2 Bluetooth

- The 96Boards specification calls for Bluetooth to be on the board.
- THOR96 supports Bluetooth 4.2 over LBEE5HY1MW-230 module.
- Bluetooth is used for audio streaming and BLE sensor communication.
- UART communication is used to transfer data between processor and connected Bluetooth device.
- UART interface is used for audio streaming over Bluetooth.
- BLE is also supported in the Module.

### 4.7.3 ZigBee & Thread

- THOR96 supports ZigBee and Thread protocol using MGM111 module for connecting to sensors.

- Flash memory: 256 kB, RAM: 32 kB
- Module has integrated antenna for wireless communication.
- Application is to control and communicate with the external ZigBee sensors/end devices over SPI interface.
- Module supports data rate of up to 250kbps.

#### 4.7.4 RGMII

- THOR96 supports 1Gbps Ethernet connection.
- Single chip 10/100/1000 Mbps Ethernet Transceiver Suitable for IEEE 802.3 Applications.
- Programmable LED Outputs for Link, Activity and Speed.
- Power-Down and Power-Saving Modes.

#### 4.7.5 CAN

- THOR96 supports CAN interface for industrial application using CAN controller and CAN transceiver with 5kV isolation.
- SPI protocol is used for communication. Maximum SPI clock is 10MHz

#### 4.7.6 USB 2.0

- THOR96 supports USB2.0 OTG port with micro-AB connector.
- USB OTG supports either USB as Host or USB as Device.

#### 4.7.7 USB 3.0

- THOR96 have one USB 3.0 HUB (CYUSB3304-68LTXI - Cypress) connected to USB 3.0 port of iMX8M Processor.
- Two downstream port used as USB 3.0 Host port with a USB 3.0 Type-A connector.
- Separate load switches on the board will limit USB current on USB 3.0 ports as per USB specifications.
- USB bandwidth will be shared between devices if more than one devices are attached to USB HUB.

### 4.8 Debug

#### 4.8.1 Debug UART

- THOR96 console is supported through debug UART using 3 pin connector.

#### 4.8.2 Debug JTAG

- THOR96 can be programmed through JTAG emulator.
- JTAG 10 pin connector is provided for JTAG debug and programming.

### 4.9 I/O Interfaces

#### 4.9.1 40-pin Low Speed (LS) expansion connector

The following tables show the Low Speed Expansion Connector pin out:

| Pin No. | 96Boards Signals | THOR96 Signals | Remarks |
|---------|------------------|----------------|---------|
| 1       | GND              | GND            |         |
| 2       | GND              | GND            |         |
| 3       | UART0_CTS        | UART2_CTS      |         |
| 4       | PWR_BTN_N        | ONOFF_LS       |         |
| 5       | UART0_TxD        | UART2_TXD      |         |
| 6       | RST_BTN_N        | RST_LS         |         |
| 7       | UART0_RxD        | UART2_RXD      |         |
| 8       | SPI0_SCLK        | E CSPI2_SCLK   |         |
| 9       | UART0_RTS        | UART2_RTS      |         |
| 10      | SPI0_DIN         | ECSPi2_MISO    |         |
| 11      | UART1_TxD        | UART3_TXD      |         |
| 12      | SPI0_CS          | ECSPi2_SS0     |         |
| 13      | UART1_RxD        | UART3_RXD      |         |
| 14      | SPI0_DOUT        | E CSPI2_MOSI   |         |

|    |          |             |      |
|----|----------|-------------|------|
| 15 | I2C0_SCL | I2C1_SCL    |      |
| 16 | PCM_FS   | SAI2_TXFS   |      |
| 17 | I2C0_SDA | I2C1_SDA    |      |
| 18 | PCM_CLK  | SAI2_TXC    |      |
| 19 | I2C1_SCL | I2C2_SCL    |      |
| 20 | PCM_DO   | SAI2_TXD    |      |
| 21 | I2C1_SDA | I2C2_SDA    |      |
| 22 | PCM_DI   | SAI2_RXD    |      |
| 23 | GPIO-A   | LS_GPIO2_A  |      |
| 24 | GPIO-B   | LS_GPIO3_B  |      |
| 25 | GPIO-C   | LS_GPIO3_C  |      |
| 26 | GPIO-D   | LS_GPIO3_D  |      |
| 27 | GPIO-E   | LS_GPIO2_E  |      |
| 28 | GPIO-F   | LS_GPIO3_F  |      |
| 29 | GPIO-G   | LS_GPIO2_G  |      |
| 30 | GPIO-H   | LS_GPIO3_H  |      |
| 31 | GPIO-I   | LS_GPIO2_I  |      |
| 32 | GPIO-J   | LS_GPIO3_J  |      |
| 33 | GPIO-K   | LS_GPIO3_K  |      |
| 34 | GPIO-L   | LS_GPIO3_L  |      |
| 35 | +1V8     | VCC_1V8_EXT | 1.8V |
| 36 | SYS_DCIN | VCC_12V0    | 12V  |
| 37 | +5V      | VCC_5V      | 5V   |
| 38 | SYS_DCIN | VCC_12V0    | 12V  |
| 39 | GND      | GND         |      |
| 40 | GND      | GND         |      |

**UART {0/1}**

- The 96Boards specifications calls for a 4-wire UART implementation (UART2) and an optional second 2-wire UART (UART3) on the Low Speed Expansion Connector.
- The THOR96 implements UART2 as a 4-wire UART that connects directly to the IMX8M Processor. These signals are driven at 1.8V.
- The THOR96 implements UART3 as a 2-wire UART that connects directly to the IMX8M Processor. These signals are driven at 1.8V.

**I2C {0/1}**

- The 96Boards specification calls for two I2C interfaces to be implemented on the Low Speed Expansion Connector.
- The THOR96 implements both interfaces, I2C1 and I2C2 that connects directly to the IMX8M Processor.
- A 2.2K resistor is provided as pull-up for each of the I2C lines per the I2C specifications, these pull-ups are connected to the 1.8V voltage rail.

**GPIO {A-L}**

- The 96Boards specifications calls for 12 GPIO lines to be implemented on the Low Speed Expansion Connector.
- These signals are driven at 1.8V.

**SPI 0**

- The 96Boards specification calls for one SPI bus master to be provided on the Low Speed Expansion Connector.
- The THOR96 implements a full SPI master with 4 wires, CLK, CS, MOSI and MISO all connect directly to the IMX8M Processor. These signals are driven at 1.8V.

**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 THOR96 implements a PCM/I2S with 4 wires, TXFC, TXC, TXD and RXD. The I2S signals are connected directly to the IMX8M Processor. These signals are driven at 1.8V.

**4.9.2 60-pin High Speed (HS) expansion connector**

The following table shows the High Speed Expansion Connector pin out:

| Pin No. | 96Boards Signals  | THOR96 Signals | Remarks |
|---------|-------------------|----------------|---------|
| 1       | SD_DAT0/SPI1_DOUT | ECSPI1_MOSI    |         |
| 2       | CSI0_C+           | CSI_MCP_CONN   |         |
| 3       | SD_DAT1           | NC             |         |
| 4       | CSI0_C-           | CSI_MCN_CONN   |         |
| 5       | SD_DAT2           | NC             |         |
| 6       | GND               | GND            |         |
| 7       | SD_DAT3/SPI1_CS   | ECSPI1_SS0     |         |
| 8       | CSI0_D0+          | CSI_MDP0_CONN  |         |
| 9       | SD_SCLK/SPI1_SCLK | ECSPI1_SCLK    |         |
| 10      | CSI0_D0-          | CSI_MDNO_CONN  |         |
| 11      | SD_CMD/SPI1_DIN   | ECSPI1_MISO    |         |
| 12      | GND               | GND            |         |
| 13      | GND               | GND            |         |
| 14      | CSI0_D1+          | CSI_MDP1_CONN  |         |
| 15      | CLK0/CSI0_MCLK    | CSI0_CLK       |         |
| 16      | CSI0_D1-          | CSI_MDN1_CONN  |         |
| 17      | CLK1/CSI1_MCLK    | CSI1_CLK       |         |
| 18      | GND               | GND            |         |
| 19      | GND               | GND            |         |
| 20      | CSI0_D2+          | CSI_MDP2_CONN  |         |
| 21      | DSI_CLK+          | DSI_MCP_CONN   |         |
| 22      | CSI0_D2-          | CSI_MDN2_CONN  |         |
| 23      | DSI_CLK-          | DSI_MCN_CONN   |         |
| 24      | GND               | GND            |         |
| 25      | GND               | GND            |         |
| 26      | CSI0_D3+          | CSI_MDP3_CONN  |         |
| 27      | DSI_D0+           | DSI_MDP0_CONN  |         |
| 28      | CSI0_D3-          | CSI_MDN3_CONN  |         |
| 29      | DSI_D0-           | DSI_MDNO_CONN  |         |
| 30      | GND               | GND            |         |
| 31      | GND               | GND            |         |
| 32      | I2C2_SCL          | I2C3_SCL       |         |
| 33      | DSI_D1+           | DSI_MDP1_CONN  |         |
| 34      | I2C2_SDA          | I2C3_SDA       |         |
| 35      | DSI_D1-           | DSI_MDN1_CONN  |         |
| 36      | I2C3_SCL          | I2C4_SCL       |         |
| 37      | GND               | GND            |         |
| 38      | I2C3_SDA          | I2C4_SDA       |         |
| 39      | DSI_D2+           | DSI_MDP2_CONN  |         |
| 40      | GND               | GND            |         |
| 41      | DSI_D2-           | DSI_MDN2_CONN  |         |
| 42      | CSI1_D0+          | CSI_MD2P0_CONN |         |
| 43      | GND               | GND            |         |
| 44      | CSI1_D0-          | CSI_MD2N0_CONN |         |
| 45      | DSI_D3+           | DSI_MDP3_CONN  |         |
| 46      | GND               | GND            |         |
| 47      | DSI_D3-           | DSI_MDN3_CONN  |         |
| 48      | CSI1_D1+          | CSI_MD2P1_CONN |         |
| 49      | GND               | GND            |         |
| 50      | CSI1_D1-          | CSI_MD2N1_CONN |         |
| 51      | USB_D+            | USBDN_DP1      |         |
| 52      | GND               | GND            |         |
| 53      | USB_D-            | USBDN_DM1      |         |
| 54      | CSI1_C+           | CSI_MC2P_CONN  |         |

|    |           |               |  |
|----|-----------|---------------|--|
| 55 | GND       | GND           |  |
| 56 | CSI1_C-   | CSI_MC2N_CONN |  |
| 57 | HSIC_STR  | NC            |  |
| 58 | GND       | GND           |  |
| 59 | HSIC_DATA | NC            |  |
| 60 | RESERVED  | VCC_1V8_EXT   |  |

**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 THOR96 implementation supports a full four lane MIPI-DSI interface that is routed to the High Speed Expansion Connector.

**MIPI CSI {0/1}**

- The 96Boards specification calls for one 4-Lane MIPI-CSI interfaces to be present on the High Speed Expansion Connector. MIPI-CSI interface is optional.
- In Thor96 we have given support for other 2-lane MIPI-CSI interface. All MIPI-CSI signals are routed directly to/from the Processor.

**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. Then an I2C interface shall be implemented.
- The current THOR96 implementation supports two MIPI-CSI interfaces and therefore must support two I2C interfaces.
- For MIPI-CSI1 the companion I2C2 is routed directly from the Processor. For MIPI-CSI2, the companion I2C is I2C3.

**HSIC**

- The 96Boards specification calls for an optional MIPI-HSIC interface to be present on the High Speed Expansion Connector. The THOR96 implementation doesn't support this optional requirement.

**Reserved**

- The 96Boards specification calls for a 100K pull-up to 1.8V to be connected to pin 60 of the High Speed Expansion Connector.
- The THOR96 utilizes a 100K pull-up (R220) on pin 60.

**SD/SPI**

- The 96Boards specification calls for an SD interface or a SPI port to be part of the High Speed Expansion Connector.
- The THOR96 implements a full SPI master with 4 wires (96Boards SPI Configuration), CLK, CS, MOSI and MISO connected directly from the Processor. These signals are operated at 1.8V.

**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. These signals are driven at 1.8V.

**USB**

- The 96Boards specification calls for a USB Data line interface to be present on the High Speed Expansion Connector.
- The THOR96 implements this requirement by routing USB channel 3 from the USB HUB to the High Speed Expansion Connector.

**4.10 Power management**

THOR96 supports 12VDC (+8V to 18V @60W) for the input supply to power up processor and all its peripherals.

Below two accessories can be used to power-up the Thor96:



| Sr.no | Description                                                                      | Manufacturer | MFR part no.                 |
|-------|----------------------------------------------------------------------------------|--------------|------------------------------|
| 1     | AC-DC Industrial desktop adaptor; Output 12Vdc at 5A; 3 pole AC inlet IEC320-C14 | meanwell     | GST60A12-P1J                 |
| 2     | 5.5/2.1mm to 4.75/1.7mm cable DC plug converter                                  | 96Boards     | 2.1mm to 1.7mm power adapter |

The processor and peripherals requires different voltage supplies and current for their normal functionality. The power supply section is designed to generate all required voltage rails with respective current requirements.

#### 4.10.1 Input Power Supply

For protection of input power supply, below components are used

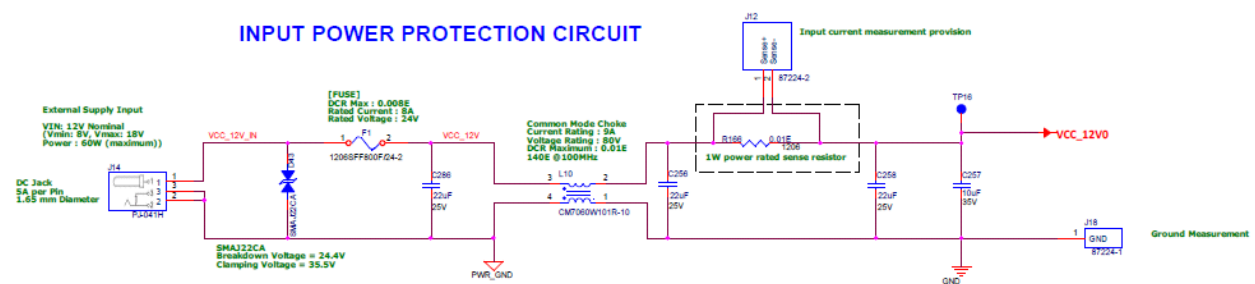
1. Fuse
2. TVS Diodes

For EMI EMC protection, below components are used

1. Common mode choke

For Input current sensing, below components are used

1. 0.01E Sense Resistor in series of input supply path
2. Two pins header across sense resistor



#### 4.10.2 12V to 5V@4A Regulator LT8642SEV#PBF

- Regulator LT8642SEV#PBF is selected to convert 5V from 8-18V input power supply.
- This Regulator is in always in ON condition.

#### 4.10.3 12V to 3.44V@6A Regulator LT8642SEV#PBF

- Regulator LT8642SEV#PBF is selected to convert 3.44V from 8-18V input power supply.
- This Regulator is in always in ON condition.

#### 4.10.4 Regulator ADP5014ACPZ-R7

- Regulator ADP5014ACPZ-R77 is selected to generate four Low Noise Current through Buck Regulator for processor.
- Enable of two power supply is provided by PMIC and enable of two power supply is provided by 1.8V supply.

#### 4.10.5 PMIC (MC34PF4210A1ES)

- PF4210 is used to provide sequencing to the processor and it is controlled through I2C.
- PMIC provides a highly programmable/configurable architecture with fully integrated power devices and minimal external components.
- PMIC provides up to six buck converters, six linear regulators, RTC supply, and a coin cell charger.
- PMIC designed as per datasheet.

Below are the features of PF4210:

- Four to six buck converters, depending on configuration
  - Single/dual phase/parallel options
  - DDR termination tracking mode option
- Boost regulator to 5.0 V output
- Six general purpose linear regulators
- Programmable output voltage, sequence, and timing
- OTP (one-time programmable) memory for device configuration

#### 4.10.6 Linear Regulator ADP1710AUJZ-R7

- Two ADP1710 is used in design for low noise output voltage.
- One LDO is used for processor supply VDD\_SNVS\_0.9V and other for SD card voltage selection option
- Maximum output current is 150mA.
- Input voltage range is 2.5V to 5.5V

#### 4.10.7 CAN Supply isolator ADUM5020-5BRWZ

- ADUM5020 is used for isolation of voltage supply for CAN interface.
- 5V for CAN interface is isolated with DC-DC converter

### 4.11 Switches and status LED's

#### 4.11.1 Switches

- **ON-OFF Switch**
  - Option 1: Long press/hold
    - While the device is awake, pressing and holding the ONOFF Switch for longer than 7 seconds will result in the device powering off.
  - Option 2: Short press/hold
    - Once powered off, pressing and holding the ONOFF Switch for longer than 3 seconds will result in the device powering on.
- **RESET Switch**
  - While the device is awake, pressing the RESET Switch will force a hard reset of THOR96 Board.
- **User Switch**
  - Three Micro switches are used to give user inputs.

#### 4.11.2 Status LED's

- **User LED 1-4**
  - The four user LEDs are surface mount Green LEDs, 0603 size, located next to the two USB type A connector and labeled 'USER LEDS 3 2 1 0'.
- **Bluetooth status**
  - The BT LED on the THOR96 is located next to the USBOTG connector, this LED reflects the status of the Bluetooth device.
- **WiFi status**
  - The WiFi LED on the THOR96 is located beside the BT LED, this LED reflects the status of the Wi-Fi device.

### 4.12 Other Parts

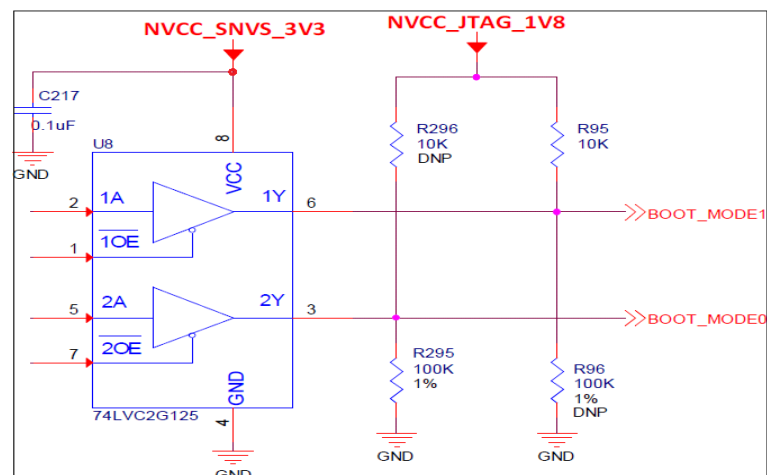
- FAN and Heatsink are used to overcome thermal issue
- RF Shield is used to overcome the EMI/EMC issues

## 4.13 Boot Configuration

### 4.13.1 CPU Boot Mode settings

- Below are the CPU boot mode settings option.
- Board is designed for boot configuration for Internal Boot.

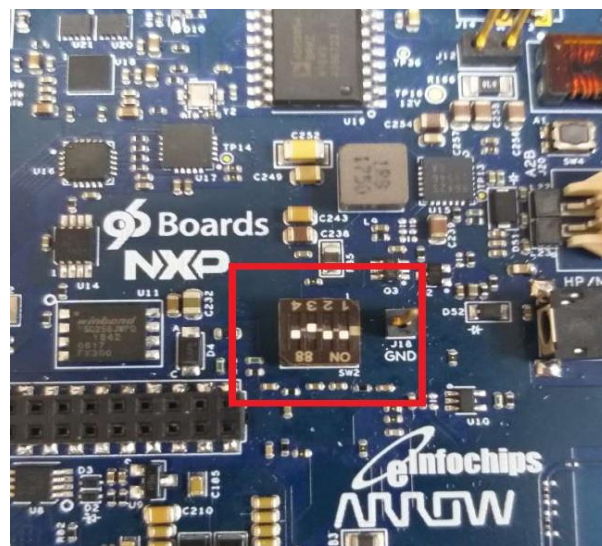
| BOOT_MODE1 | BOOT_MODE 0 | Boot Source       |
|------------|-------------|-------------------|
| 0          | 0           | Boot from fuses   |
| 0          | 1           | Serial downloader |
| 1          | 0           | Internal boot     |
| 1          | 1           | Reserved          |



### 4.13.2 Boot Mode Selection Switch

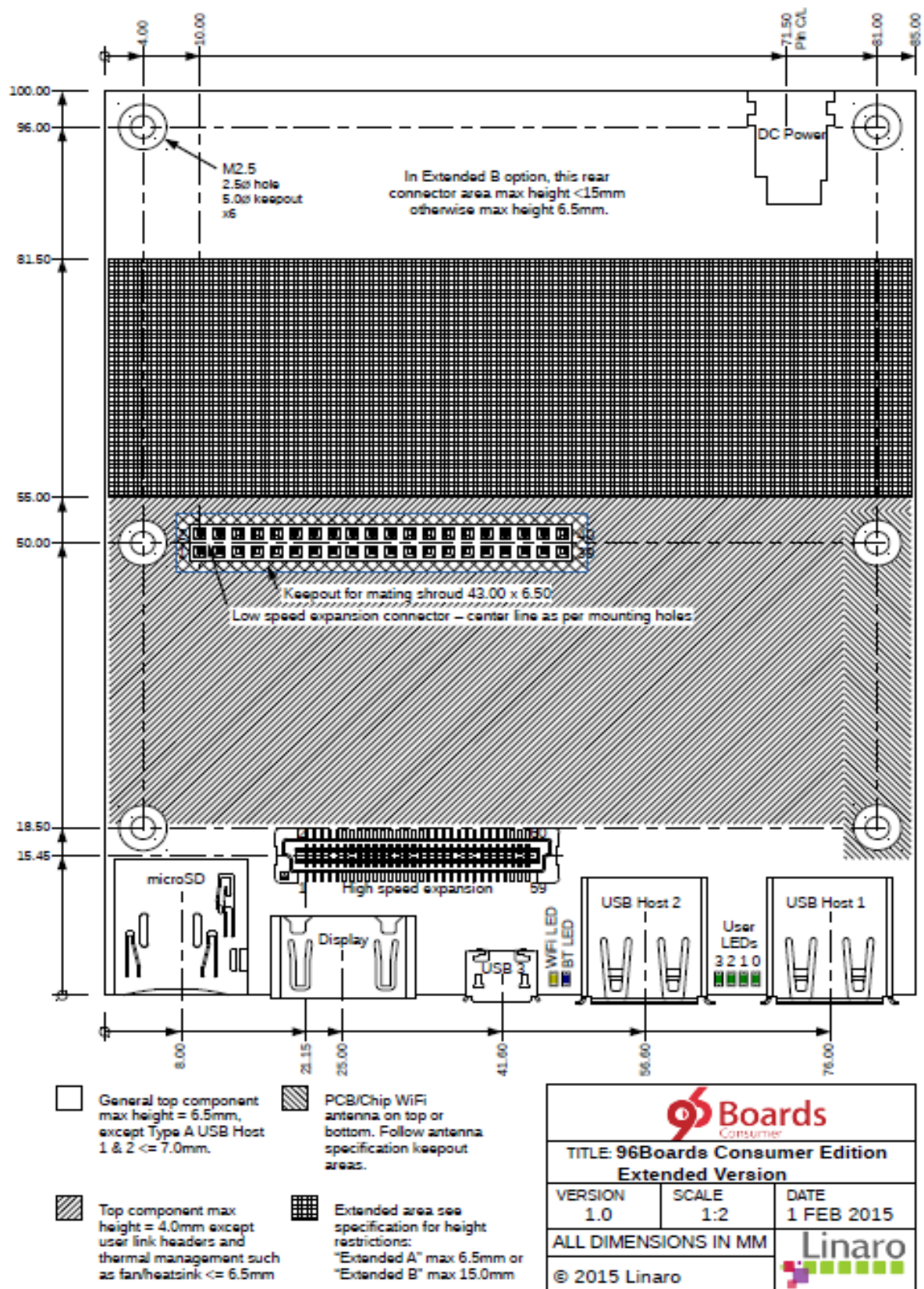
- Below are the Boot mode switch selection settings to boot the board.
- Board is designed for boot configuration with microSD card.

| BMODE [3:0] | Boot Configuration |
|-------------|--------------------|
| x011        | Boot from SD2      |
| x100        | Boot from QSPI     |





## 5 MECHANICAL SPECIFICATION

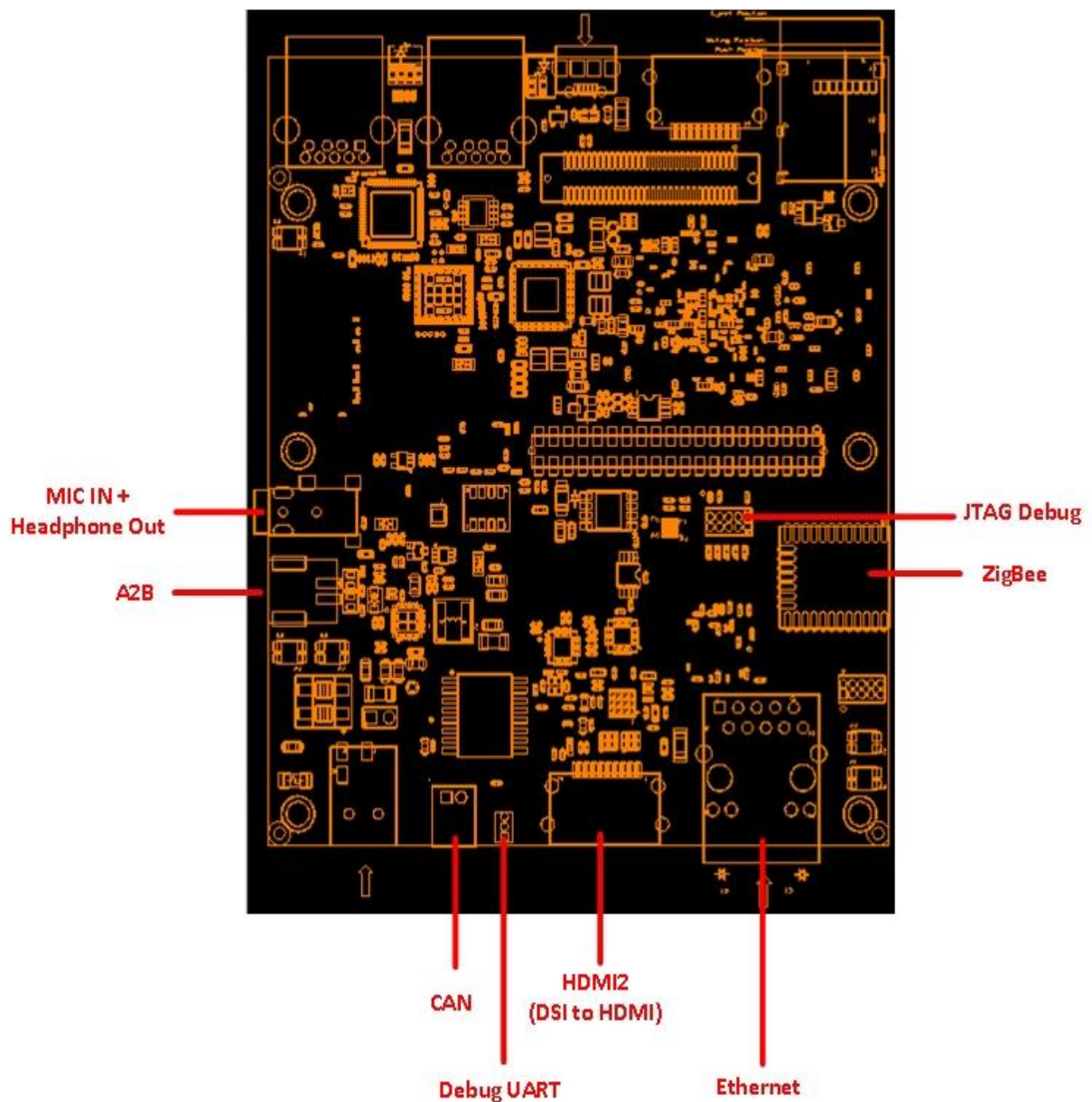


## Additional interfaces

THOR96 includes interfaces which are in addition to the base 96boards CE Extended B specification. These include below mentioned interfaces.

- Audio Codec (MIC IN + Headphone Out)
- Automotive Audio Bus (A2B)
- CAN Interface
- Debug UART
- JTAG Debug
- HDMI2 (DSI to HDMI)
- RGMII Ethernet
- ZigBee

Locations of these connectors are noted on the following drawing.





## FCC Warning

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**Note:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

\*RF warning for Mobile device:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.