Thundercomm

Empowering Every IoT Device with Our Technology

Thundercomm TurboX C6125 Development Kit

Hardware User Manual

Rev. V1.0
Sep 29, 2021

DN: tc-h1-22110

Revision History

Revision	Date	Description
1.0	Sep 29, 2021	Initial release.

Table List

About This Document

- Illustrations in this documentation might look different from your product.
- Depending on the model, some optional accessories, features, and software programs might not be available on your device.
- Depending on the version of operating systems and programs, some user interface instructions might not be applicable to your device.
- Documentation content is subject to change without notice. Thundercomm makes constant improvements on the documentation of your computer, including this guidebook.
- Button, tool, and key names appear in bold font, for example, click **Save** or press **Enter**.
- Folders and files are formatted in italic, for example, *turbox_flash_flat.sh*.

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Chapter 1. Introduction

This document introduces the features of TurboX C6125 EVB (Evaluation Verification Board), aiming to guide the developer on product design and verification based on Thundercomm TurboX C6125 SOM (System On Module).

➲ **NOTE:** "TurboX" referred to herein is the English text of our registered trademark **TURƎOX**.

- **Version Identification:**

  You can find the following information on your EVB, for example: **C6125 IO BOARD Ver. 02**, which means the hardware version number of your board is 02.

- **Safety Precautions:**

  Required output of the power adaptor is 12V, with the current greater than or equal to 2A. The power adaptor provided by Thundercomm is recommended.

  As PCB (Printed circuit board) and hardware components are completely exposed to open environment, it is required to wear anti-static wrist strap or heel grounder as an electrostatic protection during daily use.

Chapter 2. Overview

Turbox QCM6125 platform is one of the most powerful boards with high-performance Thundercomm C6125 SOM, rich peripherals, and flexible interfaces. With integrated Android OS (Operating System), it fits for evaluating, optimizing, testing, and releasing intelligent hardware products for developers, OEM (Original Equipment Manufacturer), consumer businesses, and producers of hardware modules (such as: smart speaker, smart assistant, mesh router, and soundbar producers).
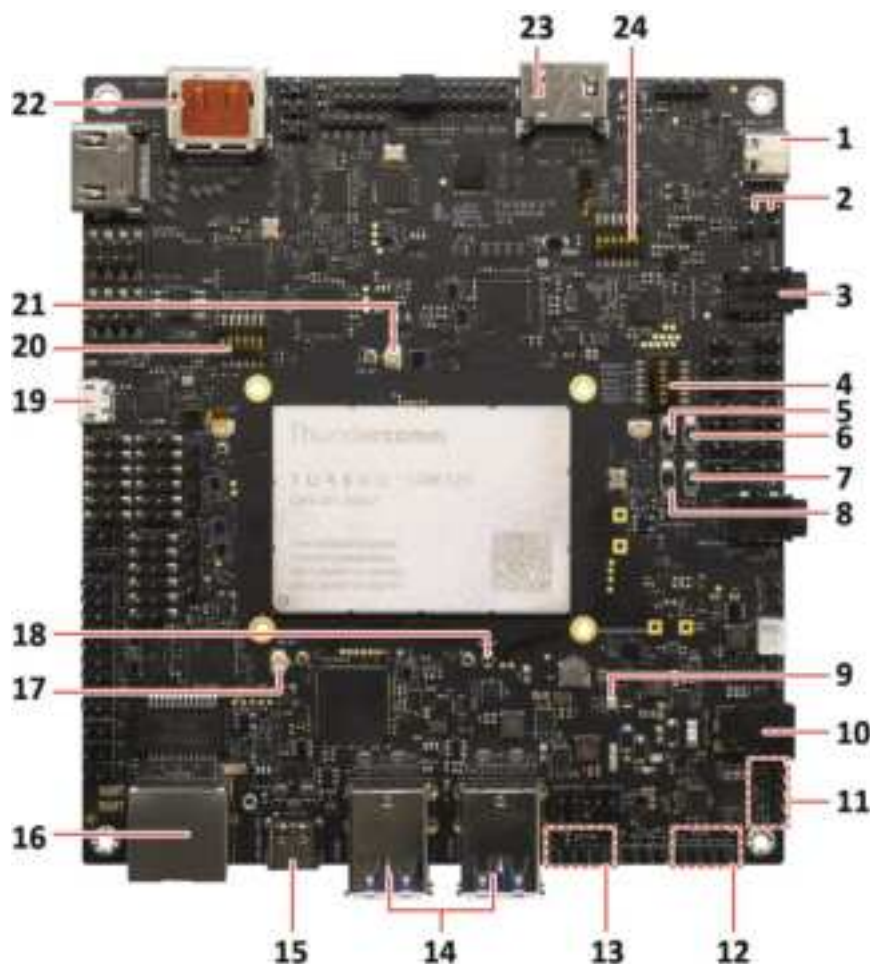
Figure 2-1.TurboX C6125 Development Kit Top View
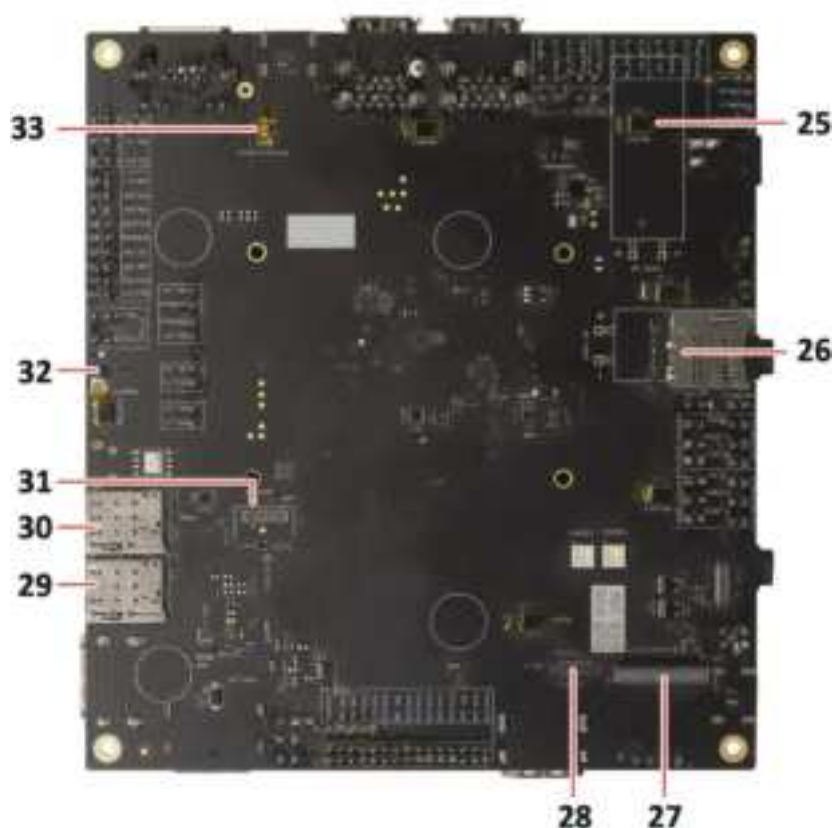
Figure 2-2.TurboX C6125 Development Kit Bottom View

Table 2-1. Interface list

1. Type-C USB 3.1 connector 1 (for UART debug)	18.Wi-Fi antenna slot
2. Speaker connector	19.Micro USB connector
3. Headset connector	20.Switch 3
4. Switch 1	21.Diversity antenna slot
5. Volume down button	22.DisplayPort connector
6. Power on button	23.HDMI IN connector
7. Volume up button	24.Switch 2
8. Force_USB_Boot button	25.Integrated microphone
9. LEDs	26.SD card slot
10.Power input connector	27.Camera module connector 2
11.Rs485 connector	28.Camera module connector 1
12.Rs232 connector	29.SIM card slot 1
13.Fan connector	30.SIM card slot 2
14.Type-A USB 3.1 connector	31.MIPI LCD touch panel connector
15.Type-C USB 3.1 connector 2	32.Magnetometer sensor
16.Gb Ethernet connector (RJ45)	33.Barometer sensor
17.Primary antenna slot	

2.1. Features

Table 2-2. General features and specifications

Item	Specification
Processor	**CPU:** • Customized 64-bit Arm v-8.0 compliant applications processor (Qualcomm® Kryo™ 260 CPU) • Kryo Gold: quad-core (2.0 GHz high-performance) • Kryo Silver: quad-core (1.8 GHz low-power) **GPU:** Qualcomm® Adreno™ GPU 610 at 950 MHz graphics processing unit (GPU) with 64-bit addressing **DSP:** Qualcomm® Hexagon™ DSP with Qualcomm® Hexagon™ Vector eXtensions (dual HVX 512)
Memory	eMCP (eMMC 5.1 + LPDDR4X), uMCP (UFS + LPDDR4X)
Multimedia	• Alternative of 4-lane MIPI DSI interface or LVDS interface. • Three 4-lane MIPI CSI interfaces. • HDMI in and HDMI out 2.0 (TBD) • Native DisplayPort 1.4 • FM (WCN3950/WCN3980)
USB	• 1 x USB 3.0 Type-C device port • 1 x Micro USB 2.0 connector (for UART debug) • Onboard HUB: • 1 x USB host Type-C • 4 x USB Type-A
Ethernet	10BASE-Te/100BASE-Tx/1000BASE-T IEEE 802.3 compliant
SDIO	1 x TF Card
Sensor	• 1 x IMU • 1 x ALS + Proximity • 1 x barometer • 1 x Mag sensor
Power supply	DC-Jack: 1 x 12 V DC in
Audio	• WCD9335 audio codec • 1 x 3.5 mm audio jack HP jack • 2 x WSA8815 audio amplifiers • 8x DMIC IN
Charge	PMI632 + SMB1355
Button	• 1 x Power on • 2 x Volume • 1 x Force_USB_boot
SIMs	2x UIM interface
Air interface	• WLAN • BT
Operating temperature	-20℃ to +70℃
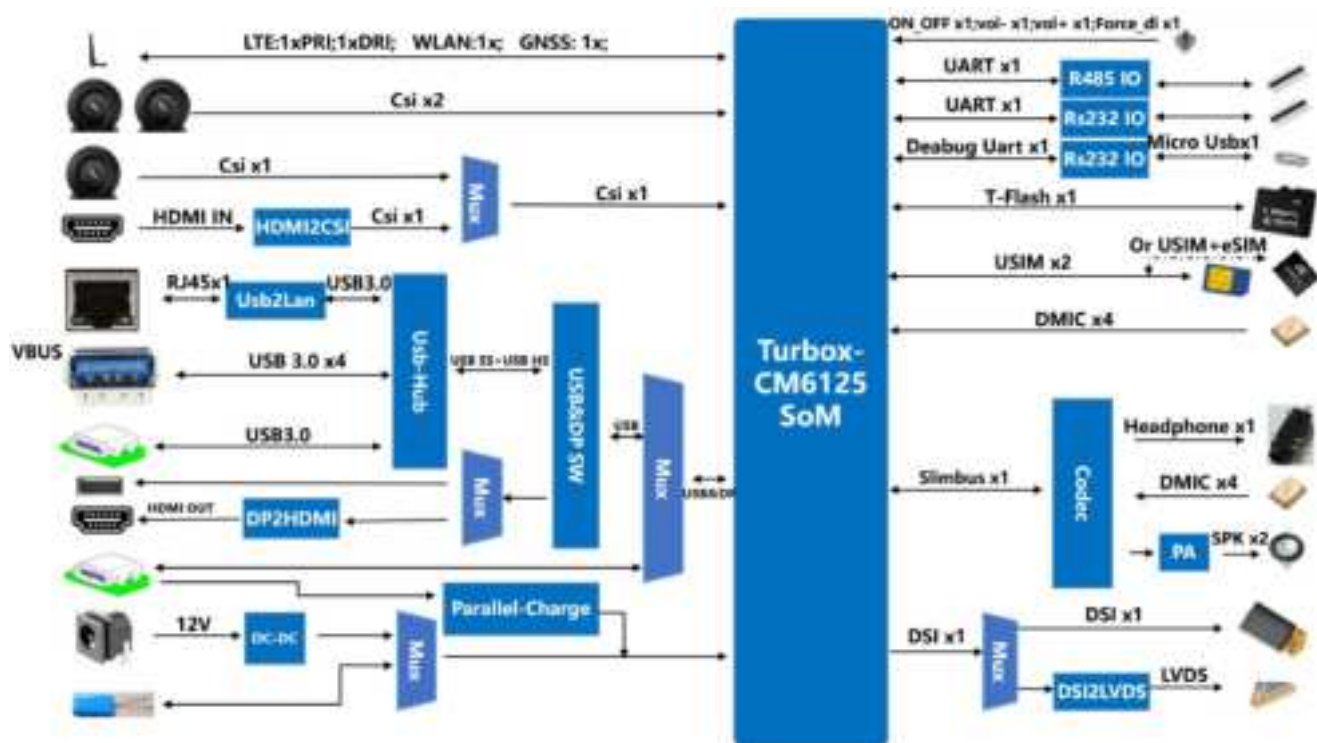
2.2. Block diagram

Figure 2-3. Block Diagram

2.3. Components

The Thundercomm TurboX C6125 EVB includes following hardware components:

- Camera module
- RF antenna (x2)
- Power adapter (12V/2.5A)
- EVB
- Wi-Fi antenna

Chapter 3. Specifications

This chapter introduces the detailed hardware specifications of various features on board.

3.1. Switch

3.1.1. SWITCH 1 (SW2706)

Figure 3-1. Locate Switch 1

Table 3-1. Pin specifications for switch 1

Pin	Function	Comments
1	CSI selection	ON: Camera CSI0 OFF: HDMI IN
2	DSI LCD/LVDS LCD	ON: LVDS OFF: DSI LCD
3	DisplayPort/HDMI	ON: HDMI out OFF: DisplayPort
4	EXT CODEC SEL/FM	ON: EXT CODEC OFF: FM
5	EXT SPI/NFC	ON: EXT SPI OFF: NFC
6	Unused	-

3.1.2. SWITCH 2 (SW2707)

Figure 3-2. Locate Switch 2

Table 3-2. Pin specifications for switch 2

Pin	Function	Comments
1	USB function selection	ON: Type-C OFF: DP/HUB
2	LVDS enable	ON: enable OFF disable
3	Ethernet	ON: enable OFF disable
4	FM_EN	ON: enable OFF disable
5	SWITCH_MI2S2_MUX_SEL1	ON means H OFF means L
6	SWITCH_MI2S2_MUX_SEL2	ON means H OFF means L

For detailed configuration for Pin 5 and Pin 6, refer to the table below.

Table 3-3. Specifications of Pin 5 and Pin 6 in SW2707

Pin	EXT	HDMI	FM	NC
SWITCH_MI2S2_MUX_SEL1	H	H	L	L
SWITCH_MI2S2_MUX_SEL2	H	L	H	L

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3.1.3. SWITCH 3 (SW2705)

Figure 3-3.   Locate Switch 3

Table 3-4. Pin specifications for switch 3

Pin	Function	Comments
1	BOOT_CONFIG_1	Keep off
2	BOOT_CONFIG_2	Keep off
3	BOOT_CONFIG_3	ON: UFS OFF: eMMC
4	WDOG_DISABLE	Keep off
5	CBL_PWR_N	Keep off
6	ONBOARD_DEBUG_UART_EN_N	OFF: Enable UART debug

3.2. Interface

3.2.1. Type-C USB connector

Figure 3-4.   Locate Type-C USB 3.1 Connector

Major functions:

- USB 3.1/2.0 device mode
- ADB debug port

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- Download and transmit data by connecting with computer.

- Be compatible with both USB 3.1 connectors and USB 2.0 connectors standard.

3.2.2. Micro USB connector/UART debug connector

The connector converts UART debug port of SOM by chip FT23XQ-R.

Figure 3-5.   Locate Micro USB Connector

3.2.3. Type-C USB 3.1 connector (based on HUB)

It is a downstream port supporting to connect the general USB devices.

Figure 3-6.   Locate Type-C USB 3.1 Connector

3.2.4. Type-A USB 3.1 connectors (based on HUB)

It is a downstream port supporting to connect the general USB devices.

Figure 3-7. Locate Type-A USB 3.1 Connector

3.2.5. Ethernet connector (RJ45)

Figure 3-8. Locate Ethernet Connector

The Ethernet connecter can be converted to transfer USB data stream and communicate with another device via USB hub connection.

3.2.6. Power input connector

The connector supports to connect the power supply of 12V and 2A in minimum.
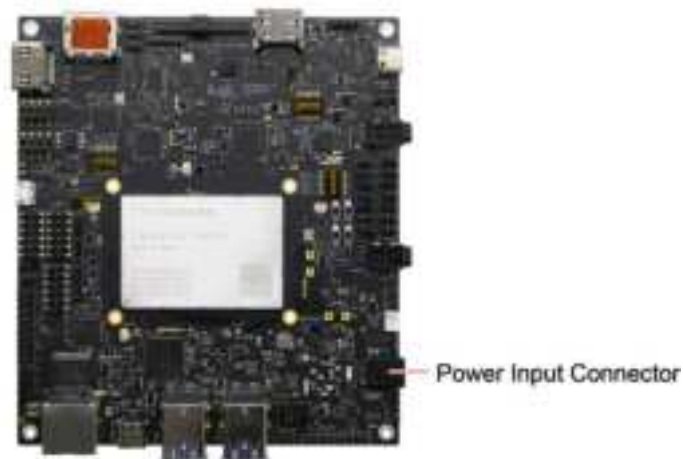
Figure 3-9.   Locate Power Input Connector

3.2.7. Speaker connectors (SPKR901, SPKR902)

Support 2 x WSA8815 Class-D smart speaker amplifiers, with stereo audio up to 4W/8Ω.
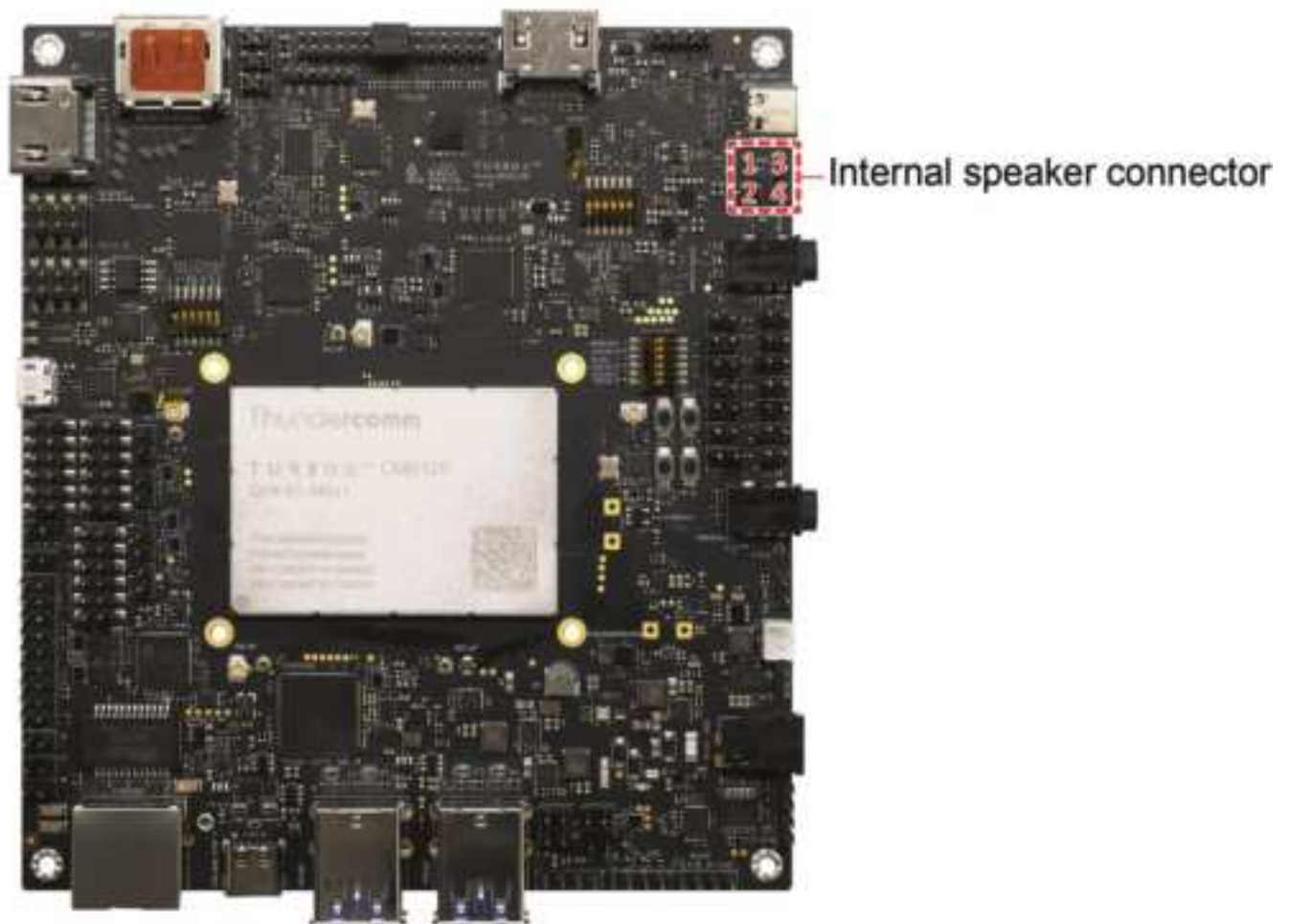
Figure 3-10. Locate Internal Speaker Connector

Table 3-5. Pin specifications for speaker connectors

Pin	Pin Definition	Type	Description
1	SPK_L_OUT_P	Left channel output	Left speaker positive output
2	SPK_L_OUT_M		Left speaker negative output
3	SPK_R_OUT_P	Right channel output	Right speaker positive output
4	SPK_R_OUT_M		Right speaker negative output

3.2.8. DSI board-to-board connector for LCM

Figure 3-11. Locate DSI B2B Connector

3.2.9. Camera connectors (CSI0, CSI1, and CSI2)

Figure 3-12. Locate Camera Connectors

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3.2.10. Headphone connector (WCD9335)

The board supports to connect 4-pole CTIA (Cellular Telecommunications Industry Association) standard headsets.

Figure 3-13. Locate Headset Connector

3.2.11. Digital microphones (DMICs)

There are 8 DMICs on the DK board, 4 DMICs input to the external audio codec (refer to DMIC (a) in Figure 3-18), and others are used directly by QCM6125 inside SOM (refer to DMIC (b) in Figure 3-18). Either solution can be selected.
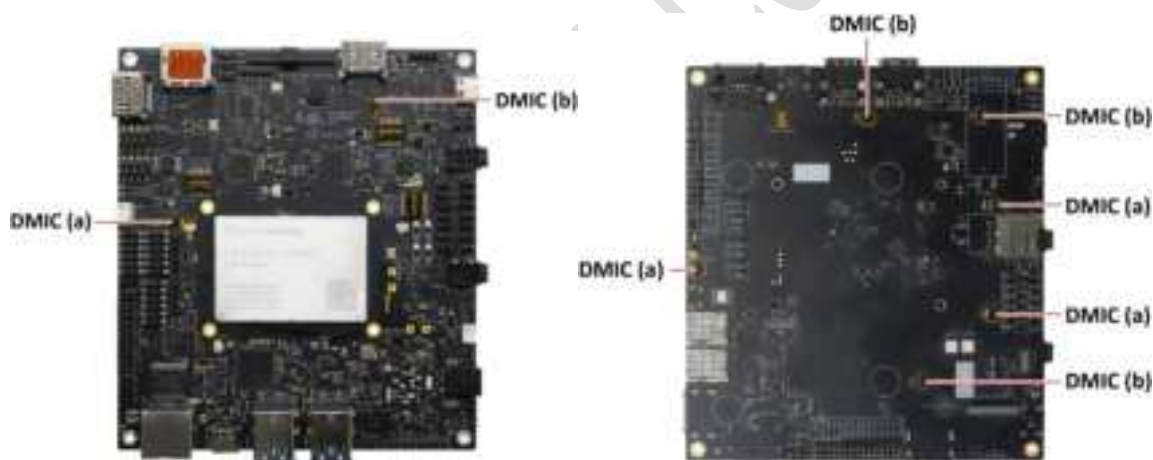
Figure 3-14. Locate DMICs

3.2.12. Antenna slots
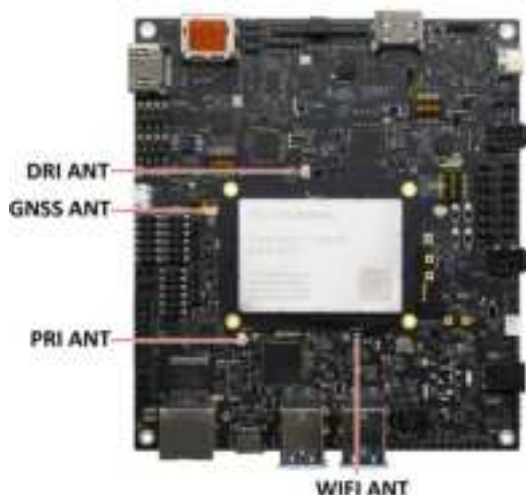
Figure 3-15. Locate Wi-Fi Antenna Slots

- **PRI ANT** is an antenna slot used for connecting the primary antenna.

- **DRI ANT** is an antenna slot used for connecting the diversified auxiliary antenna.

- **GNSS ANT** is an antenna slot used for connecting the GNSS signal-receiving antenna.

- **WIFI ANT** is an antenna slot used for connecting antennas to receive 2.4G/5G Wi-Fi network.

3.2.13. Jumpers for UART
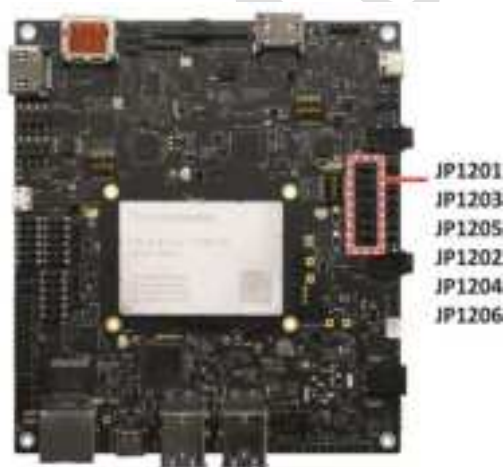
Figure 3-16. Locate Pins for UART

Table 3-6. Pin specifications for UART

Jumper No.	Function	Comments
JP1202	UART_TX to RS232	Alternative, just one head can be shorten to active the function.
JP1204	UART_TX to RS485	
JP1206	UART_TX_TTL	
JP1201	UART_TX_RS232	Alternative, just one head can be shorten to active the function
JP1203	UART_TX_RS485	
JP1205	UART_TX_TTL	

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3.2.14. Jumpers for debug UART
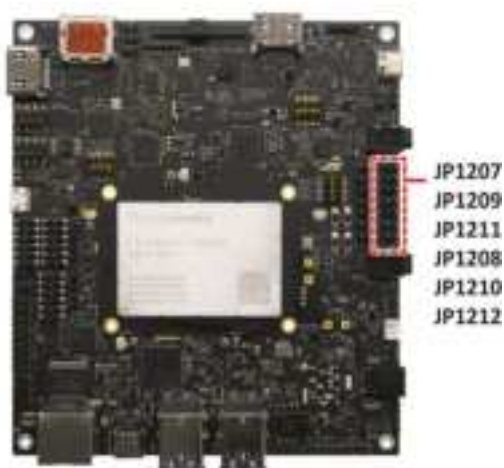
Figure 3-17. Locate Pins for Debug UART

Table 3-7. Pin specifications for Debug UART

Jumper No.	Function	Comments
JP1207	UART_TX to RS232	Alternative, just one head can be shorten to active the function.
JP1209	UART_TX to RS485	
JP1211	UART_TX_TTL	
JP1208	UART_TX_RS232	Alternative, just one head can be shorten to active the function
JP1210	UART_TX_RS485	
JP1212	UART_TX_TTL	

To realize the above function, you can configure the debug UART as the general UART by tying the jumper wires.

3.2.15. Main battery
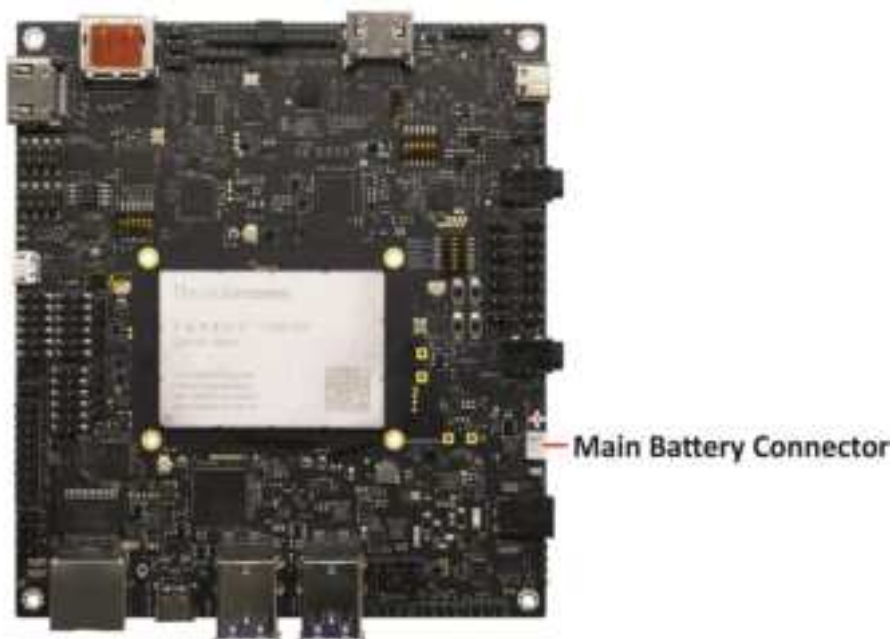
Figure 3-18. Locate Main Battery

The connector supports to connect general lithium battery up to 4.4V according to the software settings.

3.2.16. Rs485 connector (J1201)

The UART signals can be converted to Rs485 by tying jumpers to pins for UART. Refer to Figure 3-19 to tie jumpers.
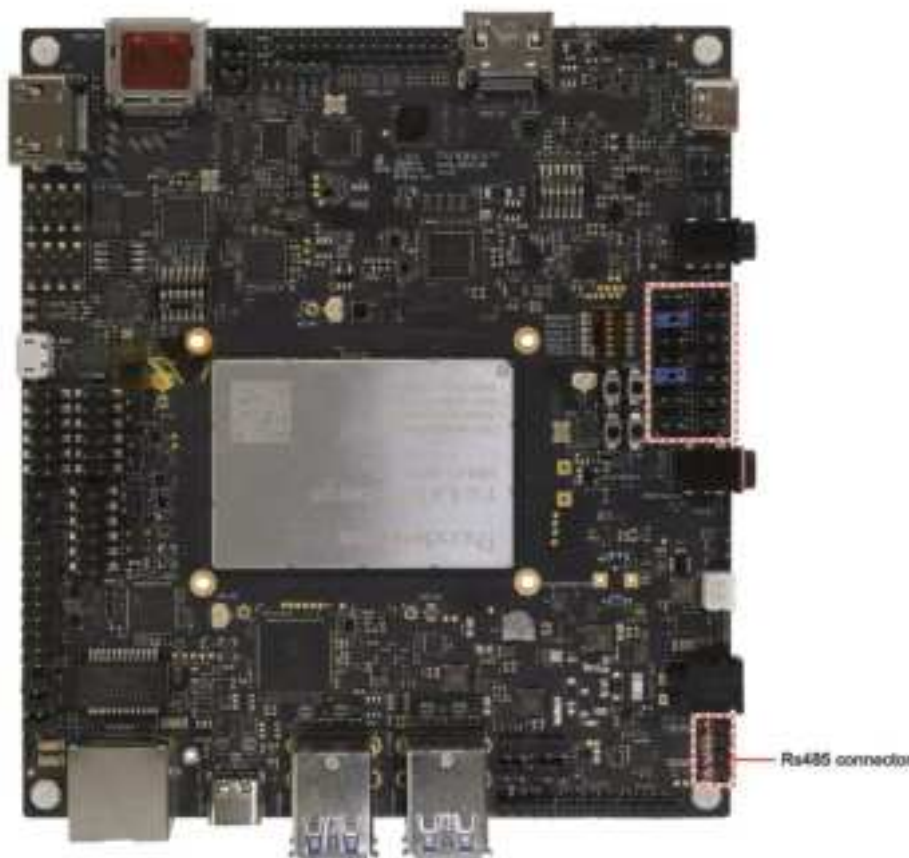
Figure 3-19. Locate Rs485 Connector

Table 3-8. Pin specifications for Rs485 connector

Pin	Function	Comments
1	VDC_3V3	
2	RS485_A	-
3	RS485_B	
4	GND	

3.2.17. Rs232 connector (J1200)

The UART signals can be converted to Rs485 by tying jumpers to pins for UART. Refer to Figure 3-20 to tie jumpers.

Figure 3-20.Locate Rs232 Connector

Table 3-9. Pin specifications for Rs232 connector

Pin	Function	Comments
1	VDC_3V3	
2	RS232_TX	
3	RS232_RX	-
4	GND	

3.2.18. UART connector (TTL_120 J1201)

Figure 3-21.Locate UART Connector

Table 3-10. Pin specifications for TTL_120 connector

Pin	Function	Comments
1	VDC_3V3	
2	TTL_3V3_TX	-
3	TTL_3V3_RX	

Pin	Function	Comments
4	GND	

3.2.19. Fan connector (J2703)
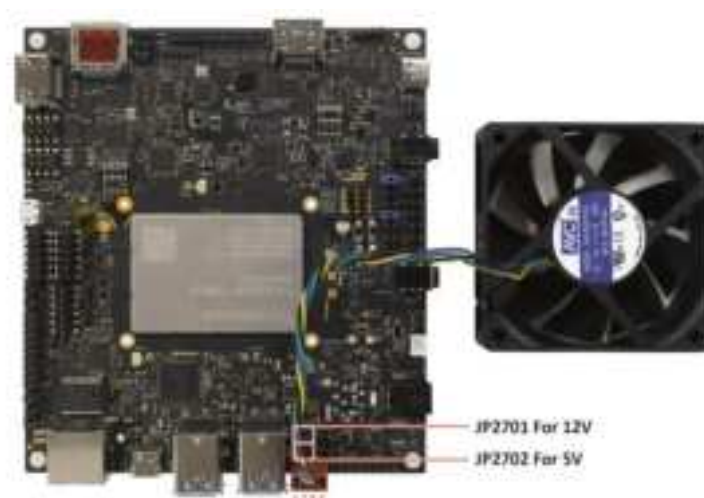
Figure 3-22. Locate Fan Connector

Table 3-11. Pin specifications for fan connector

Pin	Function	Comments
1	GND	
2	DC12V/VDC_5V	DC12V current rate: 50mA;
3	FAN_SENSE	VDC_5V current rate: 100mA
4	FAN_PWM	

JP2701 and JP2702 are alternative jumpers tied to respectively supply 5V or 12V power supply for Fan. JP2701 is tied for connecting fan of 12V, while JP2702 is tied for connecting fan of 5V.

3.2.20. External CODEC connector (J3511)
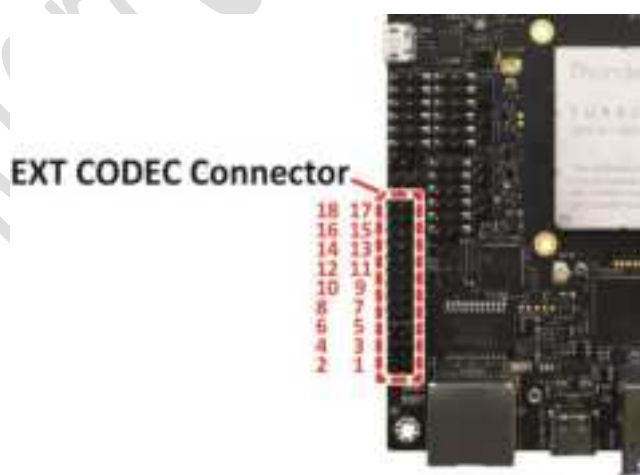
Figure 3-23. Locate EXT CODEC Connector

Table 3-12. Pin specifications for external codec connector

Pin	Function	Comments
1	GND	-
2	CON_EXT_CDC_PWR	The voltage of power supply can be adjusted by tying jumper to different pins.
3	EXT_CDC_RST_N	RESET
4	CON_EXT_CDC_PWR	-
5	CON_EXT_CDC_PWR divided	Half voltage of CON_EXT_CDC_PWR.
6	NC	-
7	MI2S_1_SCK_EXT_LS	I2S
8	MI2S_1_WS_EXT_LS	I2S
9	MI2S_1_D0_EXT_LS	I2S
10	MI2S_1_D1_EXT_LS	I2S
11	EXT_CDC_I2C_SCL	I2C
12	EXT_CDC_I2C_SDA	I2C
13	GND	-
14	GND	-
15	DC12V	-
16	DC12V	-
17	MI2S_1_MCLK_EXT_LS	MCLK
18	CON_EXT_CDC_PWR	-

The power domain of IO is dependent on CON_EXT_CDC_PWR setting.

3.2.21. CON_EXT_CDC_PWR pins

Figure 3-24. Locate Pins for CON_EXT_CDC_PWR

Table 3-13. Pin specifications for CON_EXT_CDC_PWR

Jumper No.	Function	Comments
JP3501	VDC_1V8 (output)	Alternative power selection

Jumper No.	Function	Comments
JP3502	VDC_3V3 (output)	
JP3503	VDC_5V (output)	

3.2.22. External sensor connector (J3512)
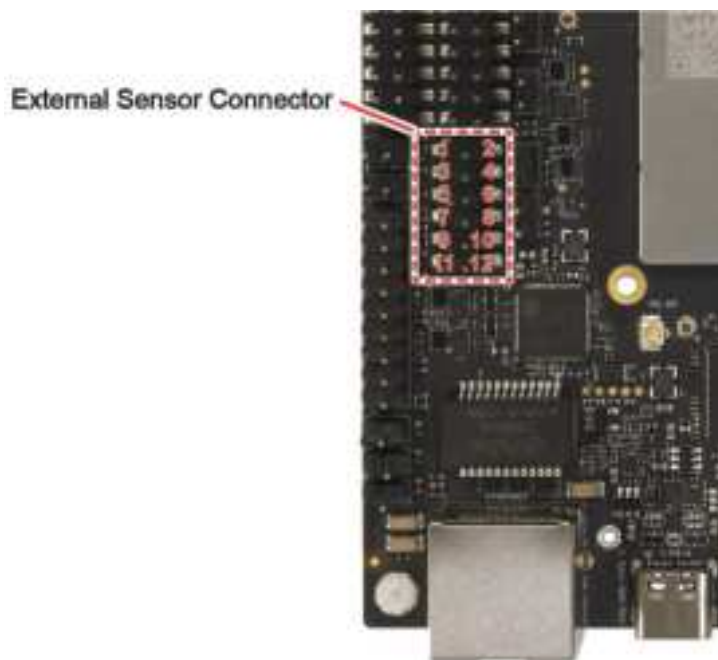
Figure 3-25. Locate EXT Sensor Connector

Table 3-14. Pin specifications for EXT sensor connector

Pin	Function	Comments
1	SENSOR_CON_LS_PWR	The voltage of power supply can be adjusted by tying jumper to different
2	SENSOR_SPI_CS0_N_CON	-
3	SENSOR_SPI_MISO_CON	-
4	SENSOR_SPI_MOSI_CON	-
5	SENSOR_SPI_CLK_CON	-
6	GND	-
7	ACCL_INT_CON	-
8	ALSP_INT_N_CON	-
9	SENSOR_I2C_SDA_CON	-
10	SENSOR_I2C_SCL_CON	-
11	GND	-
12	GND	-

The power domain of IO is dependent with SENSOR_CON_LS_PWR setting.

3.2.23. SENSOR_CON_LS_PWR pins

Figure 3-26. Locate Pins of SENSOR_CON_LS_PWR

Table 3-15. Pin specifications for SENSOR_CON_LS_PWR

Jumper No.	Function	Comments
JP3505	VDC_1V8	Alternative power selection
JP3506	VDC_3V3	

3.2.24. SPI&MI2S2 connector (J3513)

Figure 3-27. Locate SPI&MI2S2 Connector

Table 3-16. Pin specifications for SPI&MI2S2 connector

Pin	Function	Comments
1	SPI1_LS_PWR	Power supply is dependent with Jumper selection

Pin	Function	Comments
2	SPI1_ESE_CLK_CON	-
3	SPI1_ESE_MOSI_CON	-
4	SPI1_CS_N_0_CON	-
5	SPI1_ESE_MISO_CON	-
6	SPI1_CS1_CON	-
7	MI2S_2_WS_CON	-
8	MI2S_2_SCK_CON	-
9	PRI_MI2S_MCLK_CON	-
10	MI2S_2_D0_CON	-
11	GND	-
12	GND	-

The power domain of IO is dependent with SPI1_LS_PWR setting.

3.2.25. SPI1_LS_PWR jumpers

Figure 3-28. Locate Pins for SPI1_LS_PWR

Table 3-17. Pin specifications for SPI1_LS_PWR

Jumper No.	Function	Comments
JP3507	VDC_1V8	Alternative power selection
JP3508	VDC_3V3	

3.2.26. SPI Interface connector (J3514)

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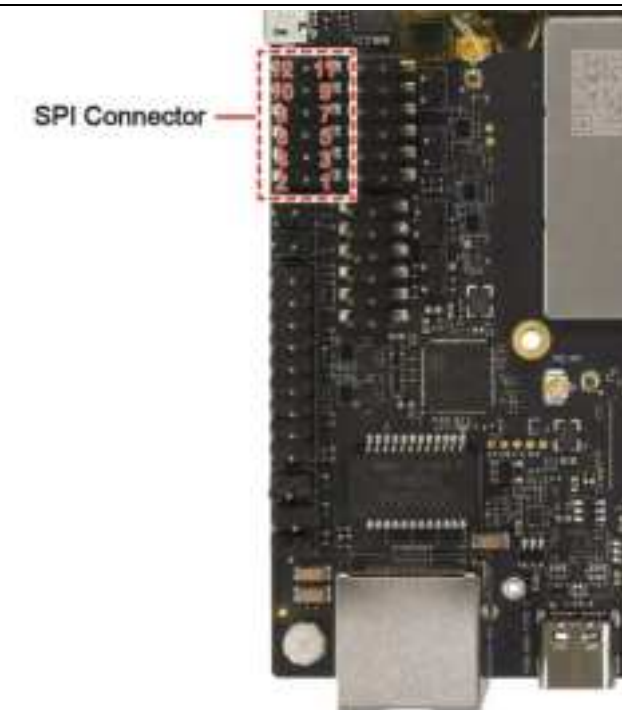
Figure 3-29. Locate SPI Interface Connector

Table 3-18. Pin specifications for SPI interface connector

Pin	Function	Comments
1	SPI5_MOSI_CON	-
2	SPI5_MISO_CON	-
3	SPI5_CS_CON	-
4	SPI5_CLK_CON	-
7,8,9	SPI5_LS_PWR	The voltage of power supply can be adjusted by tying jumper to different pins.
5,6,10,11,12	GND	-

The power domain of IO is dependent with SPI5_LS_PWR setting.

3.2.27. SPI5_LS_PWR jumpers

Figure 3-30. Locate Pins for SPI5_LS_PWR

T U R 3 O X

Table 3-19. Pin specifications for SPI5_LS_PWR

Jumper No.	Function	Comments
JP3509	VDC_1V8	Alternative power selection
JP3510	VDC_3V3	

3.2.28. SIM card slots

Figure 3-31. Locate SIM Card Slot

The board supports 2 Nano SIM card slots.

3.2.29. TF (Tans-Flash) card slot

Figure 3-32. Locate TF Card Slot

Maximum storage capacity: 128GB.

Power supply voltage: 1.8V/2.95V.

3.3. Button

Figure 3-33. Locate Buttons

- **PWR_ON:** press to power on the device. When the board is running, press the button to enter sleep mode.

- **VOL_DOWN:** press for volume down.

- **VOL_UP:** press for volume up.

- **USBBOOT:** when this button is pressed, the board will be forced to enter the downloading mode and boot from the **USB_HS** port during development or factory production

3.4. LED power status indicator

Figure 3-34. Locate LED Power Status Indicator

Blue light: valid 12V DC power.

Yellow light: valid battery power on the SOM.

Appendix 1. Compliance and Certificate Information

FCC Statements:

<div align="center">OEM/Integrators Installation Manual</div>

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.

2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).

3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations

4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part

15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).

The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note

Notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to XXXX that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: XXXXXXX"

The FCC ID can be used only when all FCC compliance requirements are met.

Antenna Installation

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,

(2) The transmitter module may not be co-located with any other transmitter or antenna.

(3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

Antenna type	2.4GHz band Peak Gain (dBi)	5.2GHz band Peak Gain (dBi)	5.3GHz band Peak Gain (dBi)	5.5GHz band Peak Gain (dBi)	5.8GHz band Peak Gain (dBi)
Dipole	3.2	4.2	4.25	4	4

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Federal Communication Commission Interference Statement

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.

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 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.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

List of applicable FCC rules

This module has been tested and found to comply with 15.247 and 15.407 requirements for Modular Approval.

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

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

EU Regulatory Conformance

Hereby, Thundercomm Technology Co., Ltd declares that this device is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

$C\epsilon$

The device for operation in the band 5150–5350 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	CH
	IS	LI	NO	TR	UK(NI)		

The device could be used with a separation distance of 20 cm to the human body.

The device is operated with the following RF bands power in different operation modes:

Operating Mode	Operating Frequency Range		Maximum Transmit Power (EIRP) dBm
	TX(MHz)	RX(MHz)	
Bluetooth	2402 - 2480		15.70
WLAN 2.4GHz	2412 - 2472		19.00
WLAN 5GHz Band 1	5150 - 5250		19.79
WLAN 5GHz Band 2	5250 - 5350		19.61
WLAN 5GHz Band 3	5470 - 5725		19.57
WLAN 5GHz Band 4	5725 - 5850		13.56

Appendix 2. Contact Information of EU Local Agency

Company: Thundercomm Europe GmbH

Address: 20, Oskar-von-Miller-Ring, 80333 München, c/o WeWork

Contact person: Daodong Zhang

E-mail: zhangdd0913@thundercomm.com

Appendix 3. Contact Information of US Local Agency

Company: Thundercomm America Corporation

Address: 10180 Telesis Court, Suite 120, San Diego, CA 92121

Contact person: Weiqin Bai

E-mail:
- weiqin.bai@thundercomm.com
- baiwq@thundersoft.com

Mobile:
- +1-8585315328
- +86-18618401680

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