QuecPi Alpha

Specification

Smart MOB Development Board

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Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

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Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal or mobile incorporating the module. Manufacturers of the terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.

	Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.
	Switch off the terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.
	Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.
	Terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.
	The terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other terminals. Areas with explosive or potentially explosive atmospheres include fueling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders.

About the Document

Revision History

Version	Date	Author	Description
-	2025-01-07	Keahn ZHANG	Creation of the document
1.0	2025-06-19	Anton HU/ Elliot LI/ Weida LIU	First official release

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1 Introduction

This document defines Quectel QuecPi Alpha Smart MOB Development Board and its hardware interfaces, electrical features, mechanical specifications and other information, to help you better understand and use the product.

NOTE

1. Please operate the product in a well-ventilated environment. In case of using the product within an outer shell, please also make sure the outer shell has not been covered by any other items, so that the heat dissipation of the product will not be affected.
2. Do not make the product exposed to any water or heat sources, i.e., do not use the product in a moist environment or at an abnormal ambient temperature.
3. Please firmly place and carefully use the product on a steady, flat and non-conductive surface without contacting any conductive items to avoid causing any mechanical or electrical damages to the PCB and connectors.
4. Operation of the PCB while powered on should be avoided. If absolutely necessary, operation should be restricted to the edges of the PCB to prevent damage from the electrostatic discharge.
5. Connecting the product to any incompatible device may affect regulatory compliance, damage the device or invalidate the warranty.
6. All peripherals used with the product should comply with the corresponding standards in the country/region of use, so that they meet the corresponding safety and performance requirements.
7. The product should be stored in a dry and cool environment.

1.1. Special Mark

Table 1: Special Mark

Marks	Definitions
*	Unless otherwise specified, an asterisk (*) after a function, feature, interface, pin name, command, argument, and so on indicates that it is under development and currently not supported; and the asterisk (*) after a model indicates that the model sample is currently unavailable.

2 Product Overview

QuecPi Alpha is Quectel's smart MOB development board based on Qualcomm QCS6490 high-performance 64-bit octa-core processor with up to 12 TOPS computing power and Qualcomm Adreno™ 643L GPU. With the memory of 8 GB LPDDR4X and the capability of being used with external eMMC and SSD, the product comes with a USB Type-C power supply interface, and supports Wi-Fi 2.4 & 5 GHz, IEEE 802.11a/b/g/n/ac, Bluetooth 5.0, dual displays (DP and LCM or DP and Micro HDMI) and abundant multimedia functions, which makes the product as capable as to meet customer needs for high data rate, multimedia functions and computing power in industrial and consumer applications.

QuecPi Alpha integrates abundant interfaces, significantly extending its applicability to the use cases in M2M industry, such as edge computing, robotics, industrial control, multimedia terminals, digital billboards, smart safety and industrial-grade PDA, which cover almost every industry in AIoT.

QuecPi Alpha supports Linux/Ubuntu* operating system, which meets the needs of most algorithm prototype verification and reasoning application development.

Table 2: Basic Information

QuecPi Alpha	
Packaging type	PCBA
Dimensions (mm)	(108.99 ±0.2) × (68.70 ±0.2) × (20.77 ±0.2)
Weight (g)	68 ±0.5

2.1. Key Features

Table 3: Key Features

Categories	Descriptions
Application processor	● High-performance 64-bit octa-core processor with up to 12 TOPS computing power ● 1 × A78 @ 2.7 GHz + 3 × A78 @ 2.4 GHz + 4 × A55 @ 1.9 GHz

	● 32 KB L1I cache, 32 KB L1D cache and 512 KB L2 cache
GPU	Adreno™ 643L @ up to 812 MHz
Memory	8 GB LPDDR4X + 128 GB UFS
Operating System	Linux/Ubuntu*
USB Interfaces	● 1 × USB 3.1 Type-C interface, compatible with USB 2.0, with up to 5 Gbps data rate ● 2 × standard USB 2.0 Type-A interfaces, host mode only, with up to 480 Mbps data rate ● 1 × USB Type-C interface, as the main power supply interface
Display Interfaces	● 1 × USB Type-C interface (DP Over USB Type-C), DisplayPort 1.4, with up to 4K (3840 × 2160) @ 60 fps ● 1 × Micro HDMI interface [1], HDMI 2.0 (the frame rate is to be determined*), decoding: 4K (H.264/H.265/VP9) @ 60 fps ● 1 × FPC connector [1], 4-lane MIPI DSI D-PHY 1.2; 1280 × 800 @ 60 fps
Audio Interfaces	● 1 × 3.5 mm headphone connector, OMTP and CTIA audio output interface ● 1 × Micro HDMI interface for audio output ● 1 × onboard DMIC
Camera Interfaces	2 × FPC connectors, 4-lane MIPI CSI, with up to 2.5 Gbps/lane data rate
Ethernet Interface	1 × standard RJ45 interface; 10/100/1000 Mbps ethernet
PCIe Interface	1 × FPC connector, 1-lane PCIe 3.0, with up to 8 Gbps data rate
SD Card Interface [2]	1 × SD 3.0, 4-bit SDIO
UART Interface	1 × DBG_UART interface, only for debugging
ADC Interfaces	3 × ADC pins, with 1.8 V maximum input voltage
Expansion Interfaces	● 6 × I2C interfaces (multiplexed with other interfaces) ● 1 × I2S interface (multiplexed with other interfaces) ● 4 × SPI interfaces (multiplexed with other interfaces) ● 4 × UART interfaces (multiplexed with other interfaces) ● 3 × PWM interfaces (multiplexed with other interfaces) ● 28 × GPIO interfaces (multiplexed with other interfaces) ● 1 × SDIO interface [2] (switching)
Keypad Interfaces	● 1 × PWRKEY, internally pulled up ● 1 × KEY1, a functional keypad, whose function can be customized by customers

[1] Either Micro HDMI interface or MIPI display can be used every time. They cannot be used concurrently.
[2] SD card interface function can be implemented by either the SD card connector or the 2 × 20 pins SDIO interface. You can only switch between them via a switch to use one every time. They cannot be used concurrently.

	● 1 × KEY2, a functional keypad, whose function can be customized by customers ● 1 × USB_BOOT, a functional keypad, which can be used to force the product to enter download mode
LED Indicators	Red, blue and green
Antenna Interface	● 1 × Wi-Fi & Bluetooth PCB onboard antenna ● 1 × RF coaxial connector (ECT818000500), which can be used with ECT 818003008 RF coaxial cable [3]
Temperature Range	● Normal operating temperature: -20 to +70 °C ● Storage temperature: -40 to +85 °C
Power Supply Requirement	Power supply through USB Type-C, which is recommended to be a 27 W power adapter supporting PD protocol
Shielding case	-
Firmware upgrade	● USB0 ● OTA*
RoHS	All components fully comply with EU RoHS directive

[3] Quectel provides two optional antenna solutions for the product. For details, please contact Quectel Technical Support.

2.2. Functional Diagram

The product's functional diagram is as follows:

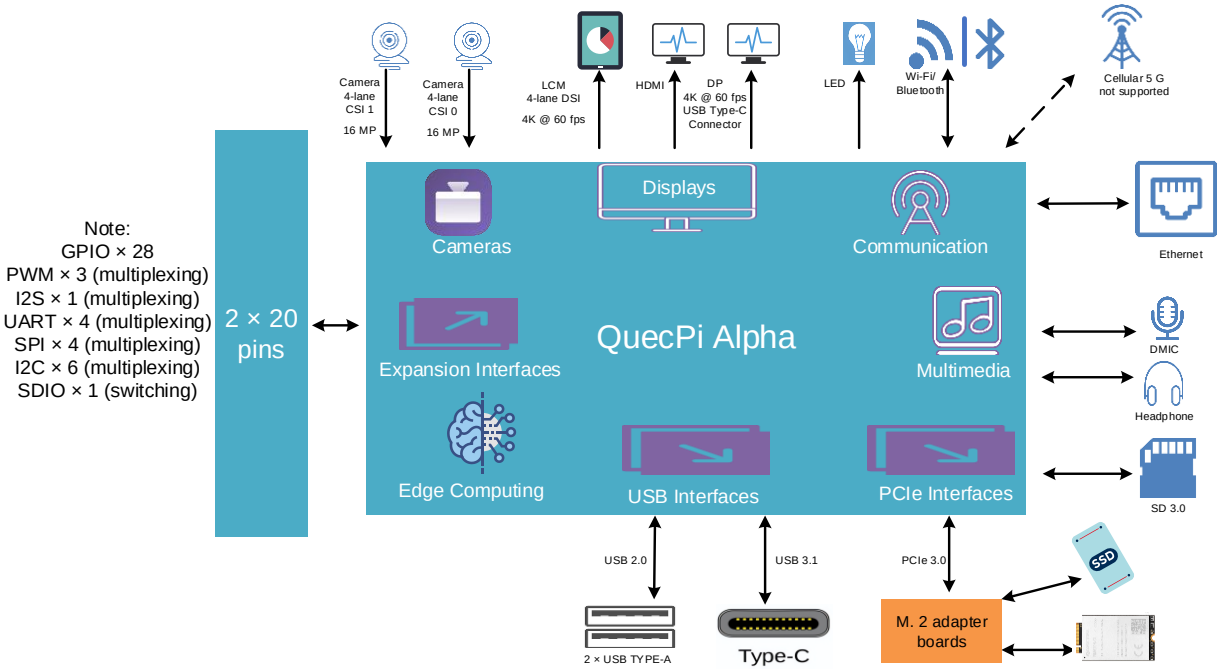

Figure 1: Functional Diagram

3 Interface Illustration & Description

3.1. Detailed Interface Illustration

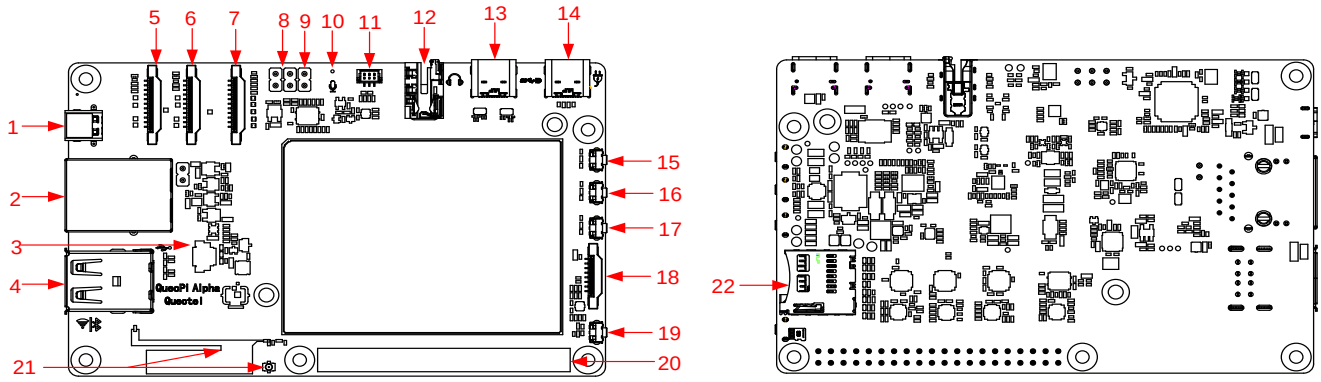

Figure 2: Detailed Interface Illustration

3.2. Interface Description

Table 4: Interface Description

No.	Interface Name	Description
Expansion Interface		
20	Pin Header (2 × 20 pins)	GPIOs that can be multiplexed as many other interfaces such as I2C, SPI and PWM
PCIe Interface		
18	PCIe	PCIe 3.0 interface used for high-speed peripherals, with up to 8 Gbps data rate

Storage Interface		
22	SD card Interface	Push-push SD card connector, compliant with SD 3.0 specification
Display Interfaces		
13	USB Type-C	USB Type-C interface (DP Over USB Type-C), DisplayPort 1.4, with up to 4K (3840 × 2160) @ 60 fps
7	DSI Display Interface	1 × 4-lane MIPI DSI D-PHY 1.2, 1280 × 800 @ 60 fps, with up to 2.5 Gbps/lane data rate
1	Micro HDMI Interface	Micro HDMI interface for video output, with 4K @ 60 fps
Camera Interfaces		
5, 6	Camera Interface	2 × 4-lane MIPI CSI, up to 2.5 Gbps/lane data rate
UART Interface		
11	UART Interface	UART interface only for debugging
Audio Interfaces		
12	Headphone	3.5 mm audio interface for audio output
10	DMIC	Digital microphone
USB Interfaces		
13	USB Type-C	USB 3.1 Type-C interface, compatible with USB 2.0
4	USB Type-A	2 × standard USB 2.0 Type-A interfaces
Antenna Interface		
21	Wi-Fi/Bluetooth PCB onboard antenna RF Coaxial Connector	Wi-Fi/Bluetooth PCB onboard antenna or RF coaxial connector ECT818000500 [4]
Ethernet Interface		
2	Ethernet	10/100/1000 Mbps ethernet
Other Interfaces		
19	USB_BOOT	Force the product to enter download mode
17	KEY2	You can customize the function of this keypad
16	KEY1	You can customize the function of this keypad

[4] Quectel provides two antenna solutions for the product, i.e., Wi-Fi/Bluetooth PCB onboard antenna or RF coaxial connector. When PCB onboard antenna is selected, RF coaxial connector will not be soldered on the product.

15	PWRKEY	Keypad for turning on or turning off the product. When automatic turn-on over power-up is not enabled, long press this keypad to turn on the product.
14	Power supply through USB Type-C	Power supply through USB Type-C, supporting PD
9	Automatic turn-on switch	Switch for automatic turn-on over power-up
8	ADC	3 × ADC testing interface pins, with 1.8 V maximum input voltage
3	Fan connector	A fan device with 5 V power supply

3.3. Input Power Supply

The product comes with 1 USB Type-C connector, which cannot be used for data transmission but only as the interface for supplying input power for the entire PCBA system. To ensure the reliability of the entire PCBA system, please make sure the power adapter or the external power source, used for power supply, can provide at least 25 W output power.

3.4. Micro HDMI Interface

The product comes with 1 Micro HDMI interface with up to 6 Gbps data rate, which can provide sufficient bandwidth for 4K @ 60 fps videos.

3.5. Ethernet Interface

The product comes with 1 standard RJ45 interface, supporting 10/100/1000 Mbps ethernet.

3.6. USB 2.0 and USB 3.1 Interfaces

The product comes with 2 standard USB 2.0 Type-A interfaces, and 1 USB 3.1 Type-C interface that is compatible with USB 2.0. USB 2.0 interface can provide up to 480 Mbps data rate, while USB 3.1 can provide up to 5 Gbps data rate.

3.7. Pin Header (2 × 20 Pins)

The product comes with 1 pin header (2 × 20 pins) with the pitch of 2.54 mm, providing access to the product's 28 GPIOs. These GPIOs can be controlled through software, and some of them can be multiplexed as other interfaces such as I2C, UART and SPI.

The following table shows the pin definitions of the pin header (2 × 20 pins):

Table 5: Pin Definitions of Pin Header (2 × 20 Pins)

Pin No.	Pin Name	Pin No.	Pin Name
1	3V3	2	5V
3	I2C0_SDA	4	5V
5	I2C0_SCL	6	GND
7	GPIO_77	8	UART_TXD
9	GND	10	UART_RXD
11	GPIO_16	12	GPIO_101
13	GPIO_17	14	GND
15	GPIO_18	16	GPIO_32
17	3V3	18	GPIO_33
19	SPI_MOSI	20	GND
21	SPI_MISO	22	GPIO_19
23	SPI_CLK	24	SPI_CE0
25	GND	26	SPI_CE1
27	I2C1_SDA	28	I2C1_SCL
29	GPIO_49	30	GND
31	GPIO_48	32	GPIO_76
33	GPIO_78	34	GND
35	GPIO_103	36	GPIO_34
37	GPIO_35	38	GPIO_104
39	GND	40	GPIO_102

3.8. DSI Display Interface

The product comes with one 22-pin 4-lane MIPI DSI display interface with the pitch of 0.5 mm. The DSI display interface complies with MIPI DSI D-PHY 1.2 standard and supports 1280 × 800 @ 60 fps, with data rate up to 2.5 Gbps/lane.

3.9. CSI Camera Interfaces

The product comes with two 22-pin 4-lane MIPI CSI camera interfaces with the pitch of 0.5 mm, which supports up to 2.5 Gbps/lane data rate.

3.10. PCIe Interface

The product comes with one 16-pin PCIe 3.0 interface with the pitch of 0.5 mm, which is used for high-speed peripherals and supports up to 8 Gbps data rate.

3.11. SD Card Interface

The product comes with one push-push SD card connector, which complies with SD 3.0 specification.

4 Electrical Characteristics and Reliability

4.1. Absolute Maximum Ratings

Table 6: Absolute Maximum Ratings

Parameters	Min.	Max.	Unit
Voltage of the power supply through USB Type-C	-0.3	20.0	V
Voltage on the digital pins of the expansion ports	-0.3	3.6	V

NOTE

Exceeding the conditions of use as shown above may cause permanent damage to the product.

4.2. Power Supply Ratings

The product can be powered through its POWER IN Type-C interface, which supports USB PD3.0 fast charge protocol. The power adapter for supplying power for the product should be capable of providing more than 9 V voltage and 2.5 A current.

4.3. Digital I/O Characteristics

Table 7: 2 × 20 Pins I/O Characteristics (Unit: V)

Parameters	Description	Min.	Max.
V_{IH}	High-level input voltage	2.81	3.30
V_{IL}	Low-level input voltage	0	0.66
V_{OH}	High-level output voltage	3.00	3.30
V_{OL}	Low-level output voltage	0	0.30

4.4. ESD Protection

Static electricity occurs naturally and it may damage the product. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly and testing of the product; add ESD protection components to the ESD sensitive interfaces and points in the product design.

Table 8: ESD Characteristics (Temperature: 25–30 °C, Humidity: 40 ±5 %; Unit: kV)

Test Points	Contact Discharge	Air Discharge
VBUS and GND	±5	±10
Other Interfaces	±0.5	±1

4.5. Operating and Storage Temperatures

Table 9: Operating and Storage Temperatures (Unit: °C)

Parameters	Min.	Typ.	Max.
Normal Operating Temperature	-20	+25	+70
Storage Temperature	-40	-	+85

5 Mechanical Information

This chapter outlines the product's mechanical dimensions (unit: mm) and the dimensional tolerances are ±0.2 mm unless otherwise specified.

5.1. Mechanical Dimensions

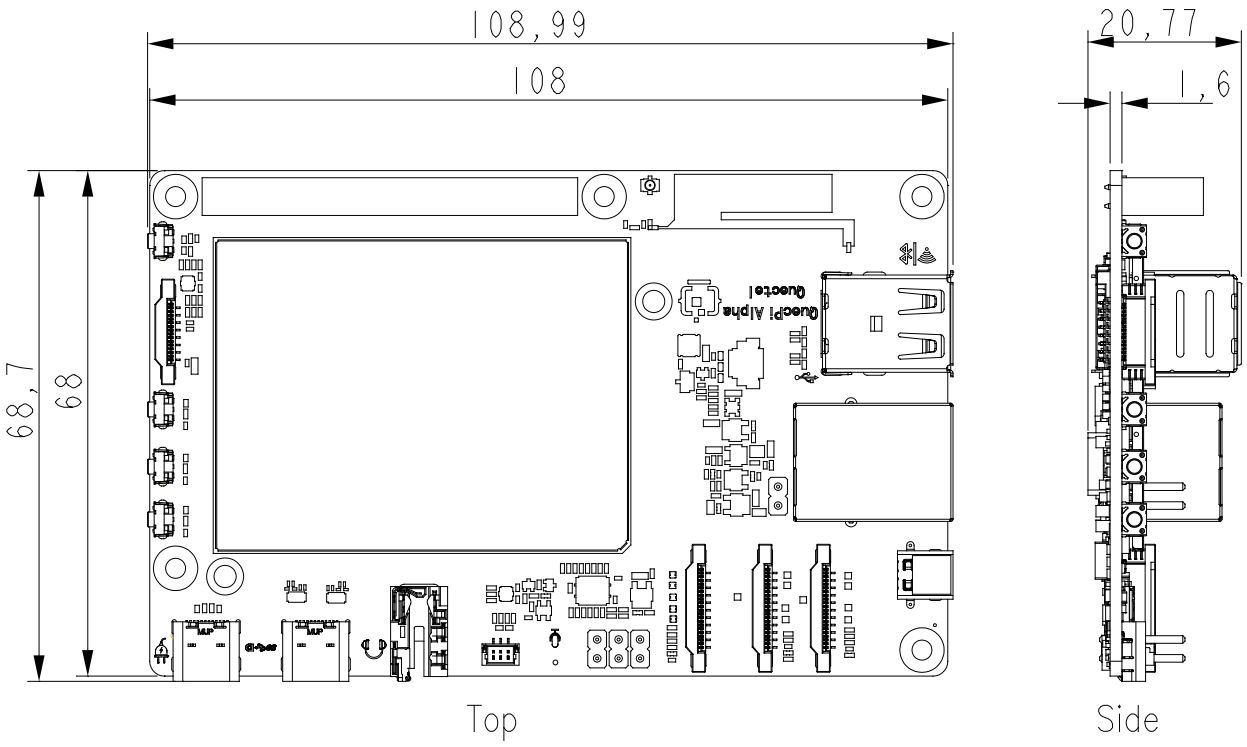

Figure 3: Top and Side Dimensions

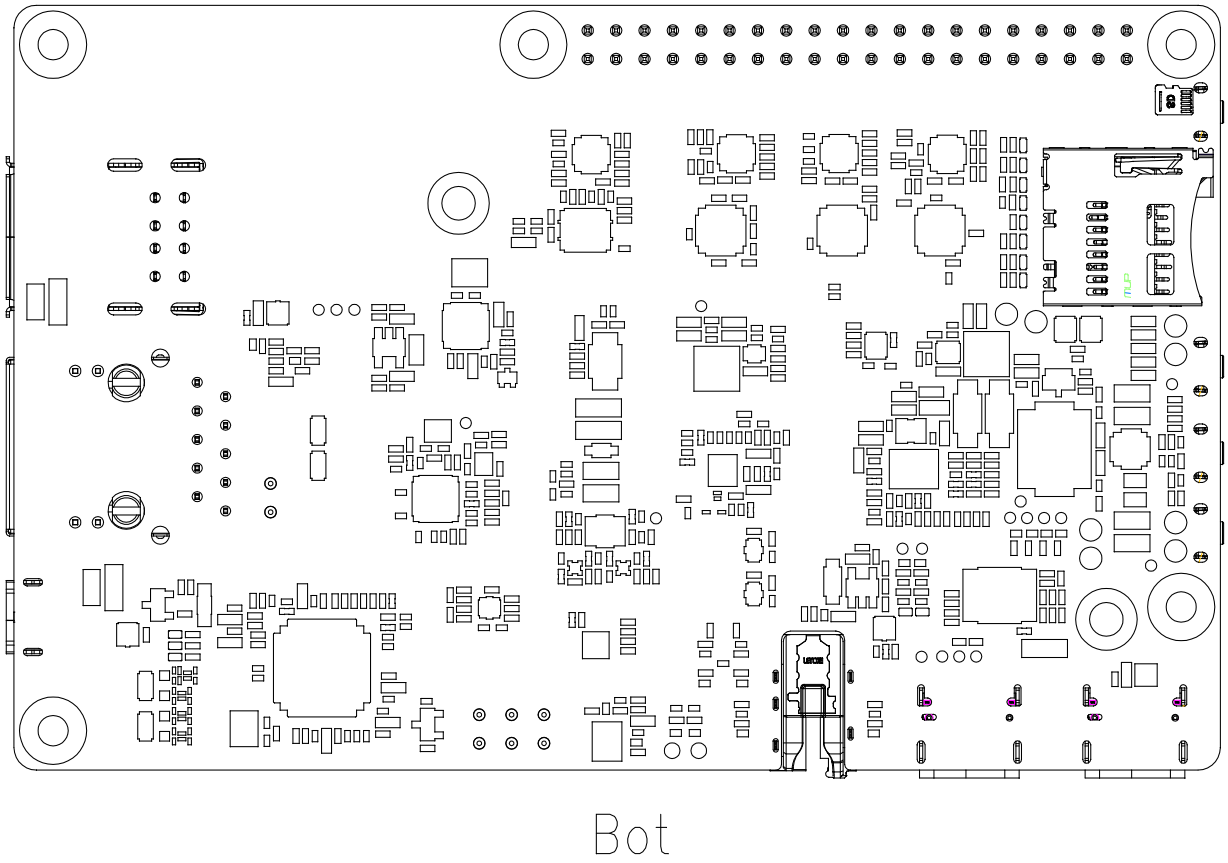

Figure 4: Bottom Dimension

5.2. Top and Bottom Views

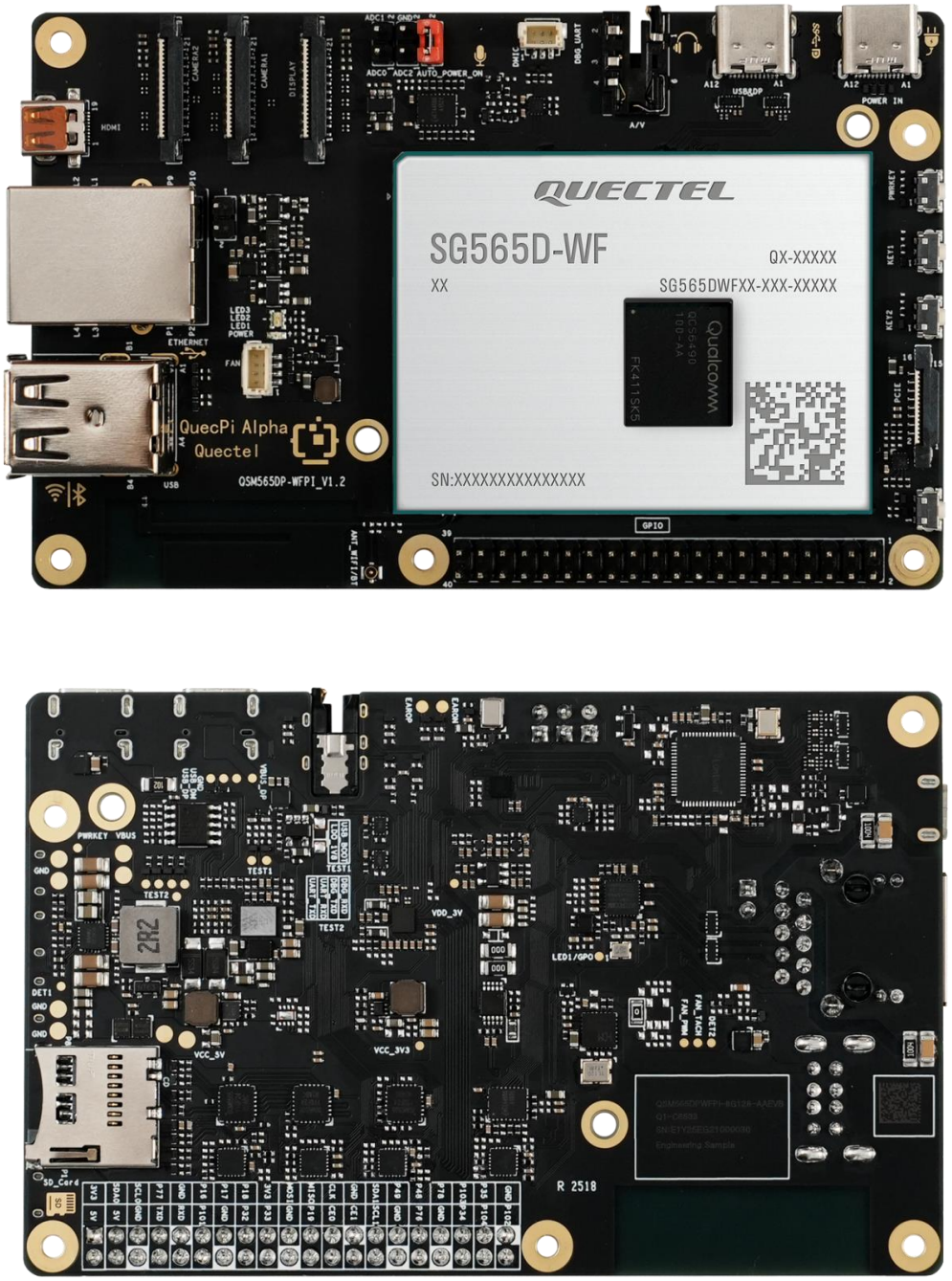

Figure 5: Top and Bottom Views

NOTE

Images above are for illustration purpose only and may differ from the actual product. For authentic appearance and label, please refer to the product received from Quectel.

6 Appendix References

Table 10: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AIoT	Artificial Intelligence of Things
CSI	Camera Serial Interface
DMIC	Digital Microphone
DP	DisplayPort
eMMC	Embedded Multimedia Card
ESD	Electrostatic Discharge
FHD+	Full High Definition
FPC	Flexible Printed Circuit
fps	Frames Per Second
Gbps	Gigabits per second
GND	Ground
GPIO	General-Purpose Input/Output
GPU	Graphics Processing Unit
HDMI	High Definition Multimedia Interface
I2C	Inter-Integrated Circuit
I2S	Inter-IC Sound
I/O	Input/Output
LCM	Liquid Crystal Module

LPDDR4X	Low Power Double Data Rate 4 Extended
Mbps	Megabits per second
M2M	Machine to Machine
MIPI	Mobile Industry Processor Interface
MOB	Module-on-Board
OTA	Over-the-Air Programming
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PCIe	Peripheral Component Interconnect Express
PD	Power Delivery
PDA	Personal Digital Assistant
PHY	Physical
PWM	Pulse Width Modulation
RF	Radio Frequency
RJ45	Registered Jack 45
RoHS	Restriction of Hazardous Substances
RXD	Receive Data (Pin)
SD	Secure Digital
SDIO	Secure Digital Input and Output
SPI	Serial Peripheral Interface
SSD	Solid State Drive
TOPS	Tera Operations Per Second
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
UFS	Universal Flash Storage

USB	Universal Serial Bus
VBAT	Voltage at Battery (Pin)