ShangHai Ehong Technology Co.,Ltd.

QCA4020 Module (WL501)

Product Specification

WL501

October 31, 2018

ShangHai Ehong
Technology Co.,Ltd.

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Revision history

Revision	Date	Description
A	October 2018	Initial release

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1 Introduction

The WL501 module provides a highly-integrated and flexible platform for developing and evaluating products and applications based on the QCA4020 SoC. The WL501 module can be either used with CDB20 development kit for software development or incorporated into OEM products to enable rapid deployment of Wi-Fi connected systems.

The WL501 module includes the following components:

- QCA4020 chip (WLAN/BLE/15.4)
- A printed antenna
- 32 Mb NOR flash memory

The QCA4020 is a dual band 1x1 802.11 a/b/g/n device optimized for low-power embedded applications with single-stream capability for both Tx and Rx. It has an integrated network processor with a large set of TCP/IP with IPv4/IPv6-based services.

WL501 module features

- Dual-Band IEEE 802.11 a/b/g/n, single stream 1x1
- BLE 5.0
- ZigBee 802.15.4
- Green Tx power saving mode
- Low -power listen mode
- Four-layer PCB design
- Rich set of GPIO(s) and interfaces: I2C, HSUART, UART, SPI, QSPI, SDIO 2.0, I2S, JTAG, Sensor ADC (up to 8 channels, 12bit, 1Msps). Up to 8 PWM optimized for LED lighting applications.
- Secure boot and support for application-level AES encryption and image authentication hash function (SHA256)
- Advancement power management scheme to minimize power dissipation for each use case

WL501 manufacturing interface

- USB 2.0 interface with integrated controller and PHY for manufacturing test and configuration

WL501 host interfaces

- UART host interface to a remote microcontroller with an AT style command set

2 Hardware specification

2.1 WL501 module pinout

Figure 2-1 WL501 front view

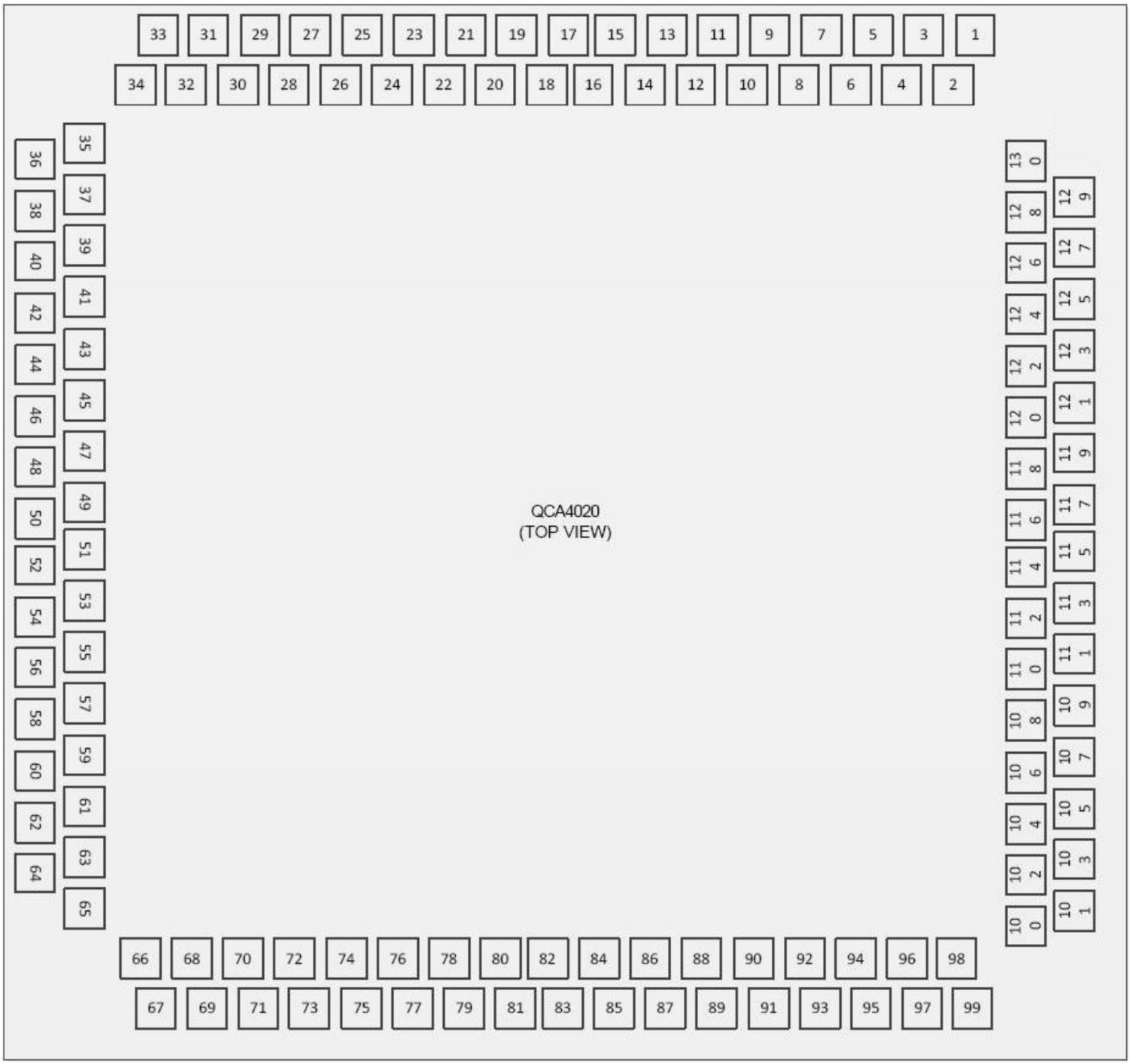

Figure 2-3 WL501 pinout definition

Table 2-1 WL501 module non-GPIO pinout definition

Pin #	Pin Name	Description
Power		
2-4	VBATT_BE	3.3V Input Power
Input Signals		
22	USB20_DM_BE	USB Differential Negative
23	USB20_DP_BE	USB Differential Positive

Pin #	Pin Name	Description
27	SENSEADC_0_BE	12bit ADC, ADC 0 input
24	SENSEADC_1_BE	12bit ADC, ADC 1 input
37	CHIP_PWD_L_BE	BLE/802.15.4 Reset Pin
Ground		
1, 5, 33, 38, 42, 45, 67-69, 71, 76, 85, 98-101, 104, 109, 111, 115, 119, 124, 127, 130	GND	Ground
No Connect		
43,44	VDDIO18_BE	Not used, NC
39-41	VDD11_SWREG_OUT	Not used, NC
128, 129	VDDIO18_WL	Not used, NC
117	PWRDWN_OUT_N	Not used, NC
17	BYPASS_INT_PMU_MSK	Not used, NC
126	IOT_MODE_EN_WL	Not used, NC
7	WAKEUP_N	Not used, NC
13	USB_DPOS	USB Differential Positive, WLAN interface, Not used, NC
14	USB_DNEG	USB Differential Negative, WLAN interface, Not used, NC

Table 2-2 WL501 module pinout definition and QCA4024 GPIO assignment

Pin #	Pin Name	Primary Function	SPI or I2C or QSPI	SDIO	*SD Memory Card*	UART	JTAG	PWMADC or SenseADC	PTA	Codec
84	GPIO4_BE	WL_WKUP_BE								
83	GPIO5_BE	GPIO_5							BT_ACTIVE	
81	GPIO6_BE	GPIO_6							WLAN_ACTIVE	
79	GPIO7_BE	GPIO_7							BT_PRIORITY	
61	GPIO8_BE	GPIO_8				M0&M4_UART0_RX	JTAG1_BE_TCK			
58	GPIO9_BE	GPIO_9				M0&M4_UART0_TX	JTAG1_BE_TDO			
59	GPIO10_BE	GPIO_10	I2C0_Master_SCL				JTAG1_BE_TMS			
56	GPIO11_BE	GPIO_11	I2C0_Master_SDA				JTAG1_BE_TDI			
32	GPIO12_BE	GPIO_12						pwm_out_0		

Pin #	Pin Name	Primary Function	SPI or I2C or QSPI	SDIO	*SD Memory Card*	UART	JTAG	PWMADC or SenseADC	PTA	Codec
54	GPIO13_BE	GPIO_13						pwm_out_7		
52	GPIO14_BE	GPIO_14				HS_UART0_DM_CTS				
55	GPIO15_BE	GPIO_15				HS_UART0_DM_TXD				
53	GPIO16_BE	SPI0_CS2_N	I2C1_Master_SCL			HS_UART0_DM_RFR			BT_ACTIVE	
51	GPIO17_BE	SPI0_CS1_N	I2C1_Master_SDA			HS_UART0_DM_RXD			WLAN_ACTIVE	
16	GPIO18_BE	GPIO_18	SPI_Slave_CLK	SDIO_Slave_CLK	SD_Master_CLK (O)	HS_UART1_DM_CTS		pwm_out_6		
11	GPIO19_BE	GPIO_19	SPI_Slave_CS_N	SDIO_Slave_CMD	SD_Master_CMD (B)	HS_UART1_DM_TXD		pwm_out_1		
15	GPIO20_BE	GPIO_20	SPI_SLAVE_MISO	SDIO_Slave_DATA_0	SD_Master_DATA_0 (B)	HS_UART1_DM_RXD		pwm_out_2		
19	GPIO21_BE	GPIO_21		SDIO_Slave_DATA_1	SD_Master_DATA_1 (B)			pwm_out_4		
26	GPIO22_BE	GPIO_22		SDIO_Slave_DATA_2	SD_Master_DATA_2 (B)			pwm_out_3		
21	GPIO23_BE	GPIO_23	SPI_SLAVE_MOSI	SDIO_Slave_DATA_3	SD_Master_DATA_3 (B)	HS_UART1_DM_RFR		pwm_out_5		
29	GPIO24_BE	GPIO_24	SPI0_Master_CS_N			M0&M4_UART2_RX	JTAG2_BE_TCK			
31	GPIO25_BE	GPIO_25	SPI0_Master_CLK			M0&M4_UART2_TX	JTAG2_BE_TDO			
28	GPIO26_BE	GPIO_26	SPI0_Master_MOSI				JTAG2_BE_TMS			
30	GPIO27_BE	GPIO_27	SPI0_Master_MISO				JTAG2_BE_TDI			
46	GPIO28_BE	GPIO_28								I2S_BCLK
47	GPIO29_BE	GPIO_29								I2S_RXD
48	GPIO30_BE	GPIO_30								I2S_TXD
50	GPIO31_BE	GPIO_31								I2S_FSYNC

Pin #	Pin Name	Primary Function	SPI or I2C or QSPI	SDIO	*SD Memory Card*	UART	JTAG	PWMADC or SenseADC	PTA	Codec
49	GPIO32_BE	GPIO_32								I2S_MCLK
10	GPIO33_BE	CHIP_PWD_L_WL								
80	GPIO41_BE	PWR_STATUS								
57	GPIO48_BE	Ext_32K_IN								
64	GPIO49_BE	GPIO_49								
78	GPIO50_BE	GPIO_50					JTAG3_BE_TCK			
63	GPIO51_BE	GPIO_51					JTAG3_BE_TDO			
62	GPIO52_BE	GPIO_52					JTAG3_BE_TMS			
60	GPIO53_BE	GPIO_53					JTAG3_BE_TDI			
25	GPIO54_BE	GPIO_54						SENSEADC2		
20	GPIO55_BE	GPIO_55						SENSEADC3		
18	GPIO56_BE	GPIO_56						SENSEADC4		
12	GPIO57_BE	GPIO_57						SENSEADC5		
9	GPIO58_BE	GPIO_58						SENSEADC6		
8	GPIO59_BE	GPIO_59				HS_UART2_DM_CTS (I)		SENSEADC7		
82	GPIO60_BE	GPIO_60				HS_UART2_DM_TXD (O)			BT_PRIORITY	

2.2 WL501 interface summary

- 2x I2C Master Interface
- 1x High speed UART
- Up to 3Mbps data rate
- 1x UART
- Up to 115200 kbps data rate

- 1x I2S
- 1x JTAG
- 1x ADC Sense
- 1x USB2.0 interface
- 1x SPI Interface

2.3 Bootstrap signals

Table 2-3 Bootstrap mode

GPIO9_BE	GPIO22_BE	Description
0	0	Force M4 to load image from flash memory (Default)
0	1	Force M4 to boot in EDL (Emergency Download Mode).

Table 2-4 JTAG mode

GPIO9_BE	GPIO25_BE	GPIO18_BE	Description
0	0	0	No JTAG enabled
0	0	1	JTAG Pins on GPIO[53:50]_BE
0	1	0	JTAG Pins on GPIO[11:8]_BE
0	1	1	JTAG Pins on GPIO[27:24]_BE
1	X	X	Not Allowed

Table 2-5 XTAL mode

GPIO23_BE	Description
0	40MHz Xtal
1	Not Allowed

Table 2-6 32.768KHz Sleep Clock Mode

GPIO21_BE	GPIO20_BE	Description
0	0	Chip Internal LPO
0	1	External Crystal 32.768KHz
1	0	External 32.768KHz TCXO Clock connected to GPIO_48_BE
1	1	Not Allowed

2.4 Electrical characteristics

2.4.1 General DC electrical characteristics

These conditions apply to all DC characteristics unless otherwise specified: T_{amb} = 25 C, VBATT BE = 3.3 V

Table 2-7 DC electrical characteristics for digital I/Os

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{IH}	High level I voltage	–	2.4	–	3.6	V
V_{IL}	Low level I voltage	–	-0.3	–	0.3	V
V_{OH}	High level O voltage	–	3.0	–	3.3	V
V_{OL}	Low level O voltage	–	-0.3	–	0.4	V

2.4.2 WL501 2.4 GHz power measurements

Table 2-8 2.4 GHz power measurements at antenna port at 25 C, 3.3V nominal

Standard	Typical Tx Compliant Power[1]	Rx Sensitivity	Unit
802.11b	22.86	-87	dBm
			dBm
			dBm
			dBm
802.11g	23.53	-91.5	dBm
			dBm
802.11n HT20	23.35	-92	dBm
			dBm
802.11n HT40	21.62	-89.5	dBm
			dBm

2.4.3 WL501 5 GHz power measurements

Table 2-9 5 GHz power measurements at antenna port at 25 C, 3.3V nominal

Standard	Typical Tx Compliant Power[2]	Rx Sensitivity	Unit
802.11a	B1:21.16 B4:18.57	-89.5	dBm
			dBm
802.11n HT20	B1:21.98 B4:18.46	-89.5	dBm
			dBm
802.11n HT40	B1:21.44 B4:18.73	-86.5	dBm
			dBm

[1] Numbers shown based on OLPC per board calibration
[2] Numbers shown based on OLPC per board calibration

2.4.4 BLE power measurements

Table 2-10 BLE power measurements at antenna port at 25 C, 3.3V nominal with external PA

Parameter	Description	Typical	Unit
Tx Power	BT LE 1M	2.10	dBm
	BT LE 2M	1.11	dBm
Rx Sensitivity	BT LE 1M	-93	dBm
	BT LE 2M	-93	dBm

2.4.5 802.15.4 power measurements

Table 2-11 802.15.4 power measurements at antenna port at 25 C, 3.3V nominal with external PA

Parameter	Description	Typical	Unit
Tx power	O-QPSK DSSS	1.98	dBm
Rx Sensitivity	O-QPSK DSSS	-101	dBm

3 Mechanical interface specification

3.1 WL501 module dimensions

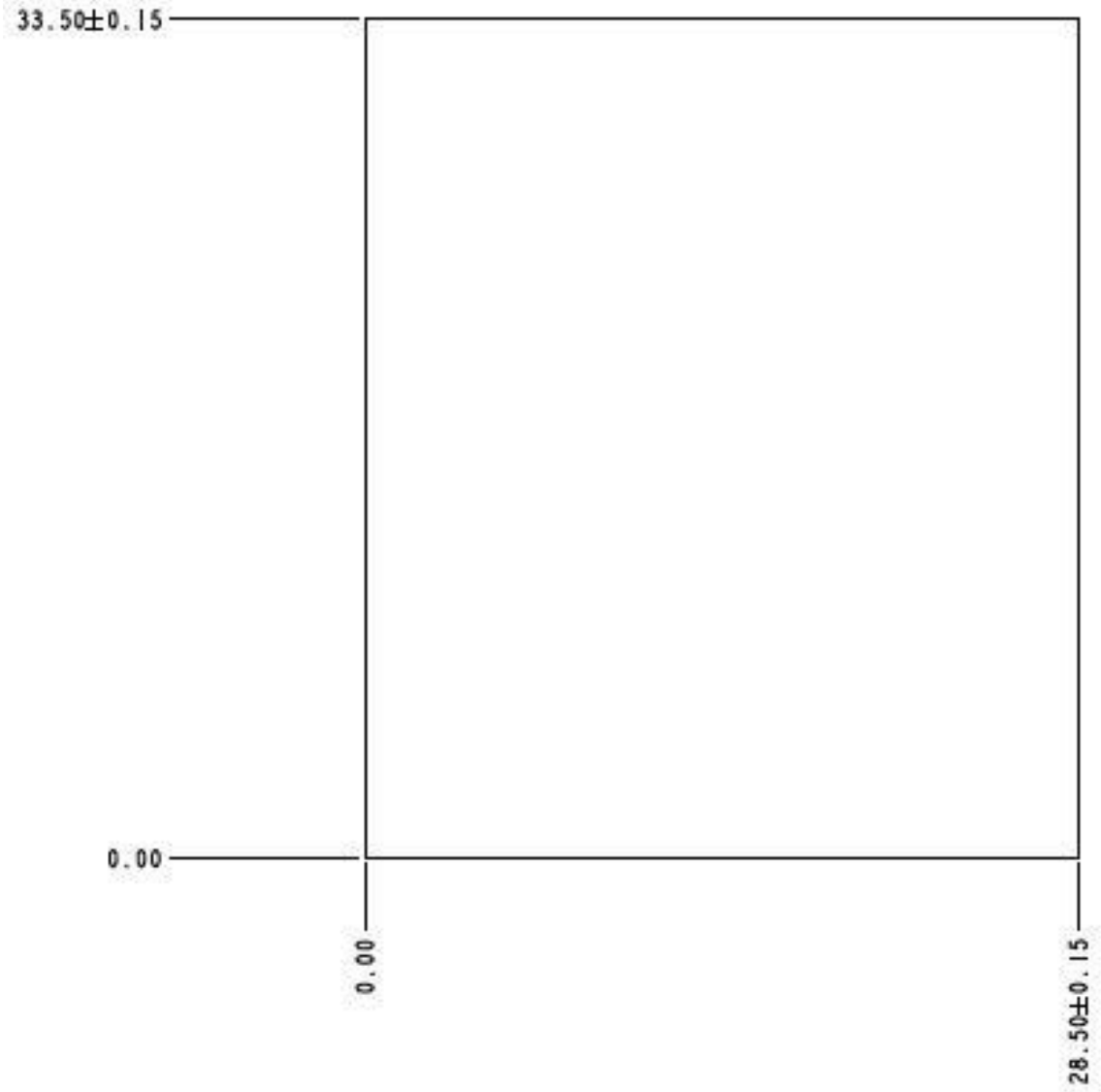

Figure 3-1 WL501 module dimensions

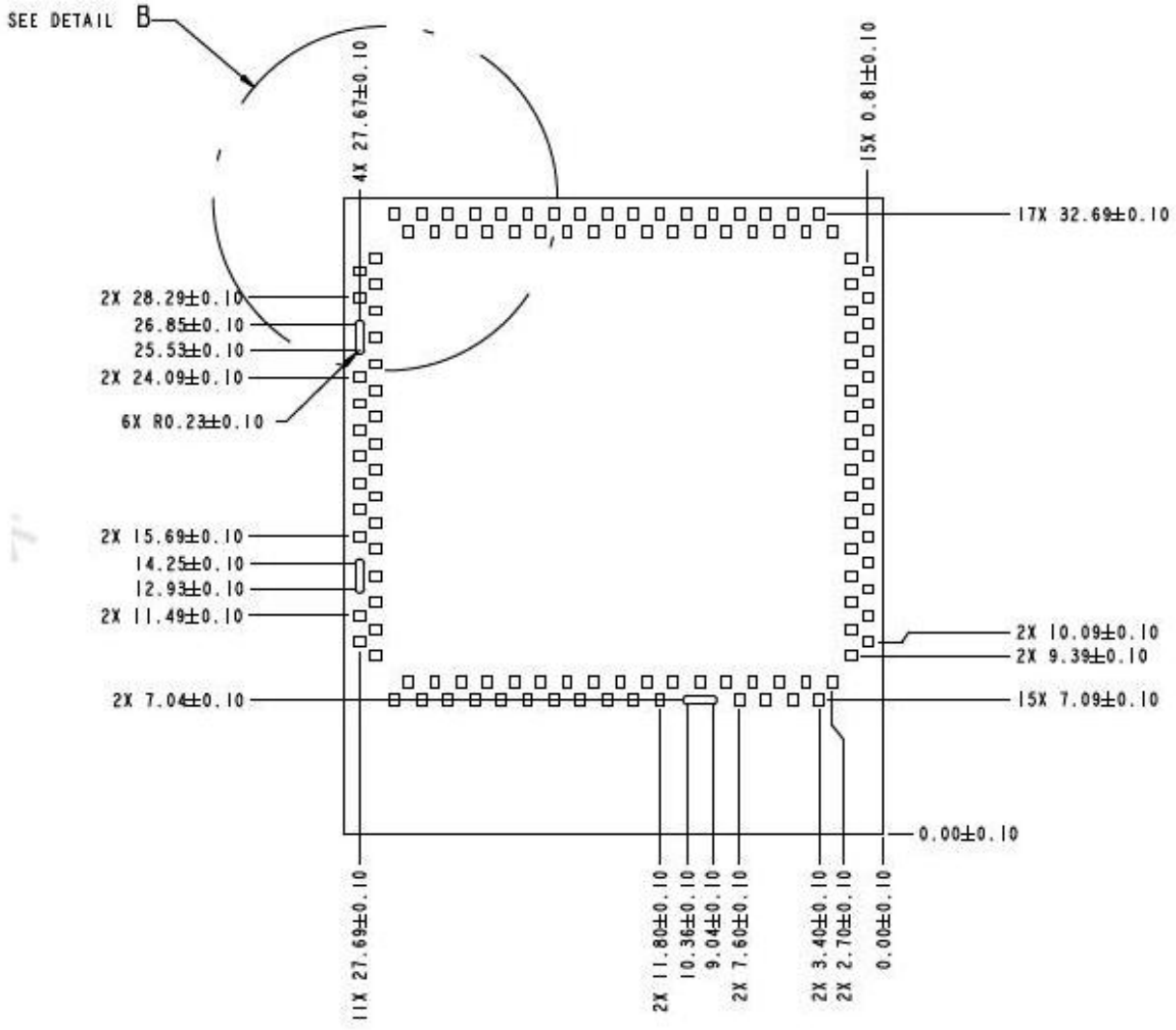

Figure 3-2 WL501 module pinout dimensions (in mm)

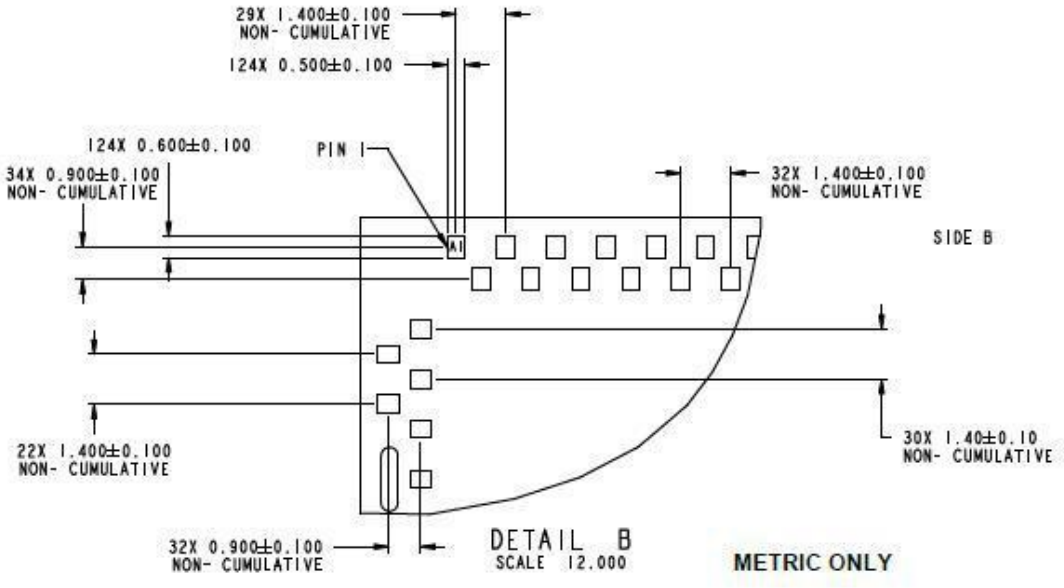

Figure 3-3 WL501 module pinout dimensions-Detail B (in mm)

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

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.

OEM Guidance

1. Applicable FCC rules

   This device complies with part 15.247/15.407 of the FCC Rules.

2. The specific operational use conditions

   This module can be used in IoT devices. The input voltage to the module is nominally 3.3 V DC. The operational ambient temperature of the module is 0 °C ~ 85 °C. the embedded PCB antenna is allowed. Any other external antenna is prohibited.

3. Limited module procedures

   N/A

4. Trace antenna design

   N/A

5. RF exposure considerations

   The 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 and your body. If the equipment built into a host as a portable usage, the additional RF exposure evaluation may be required as specified by 2.1093.

6. Antenna

   Antenna type: PCB antenna Peak gain : 1.0dBi

7. Label and compliance information

   An exterior label on OEM's end product can use wording such as the following: "Contains Transmitter Module FCC ID: 2ACCRWL501" or "Contains FCC ID: 2ACCRWL501"

8. Information on test modes and additional testing requirements

a)The modular transmitter has been fully tested by the module grantee on the required number of channels,modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter,perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).

b)The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.

c)If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference have been corrected .

9. Additional testing, Part 15 Sub part B disclaimer The final host / module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369. For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation

When testing the host product, all the transmitters must be operating.The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. In certain conditions it might be appropriate to use a technology-specific call box (test set) where accessory 50 devices or drivers are not available. When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4, ANSI C63.10 and ANSI C63.26 for further general testing details.

The product under test is set into a link/association with a partnering device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media content.