WT01C202-AI-S1/S1U Technical Specification

Version 2.2

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Revision History

Version	Date	Developed/changed content	Creator/ Modifier	Auditor
V1.0	2025-1-10	First creation	Lai	Louie
V2.0	2025-2-24	Modify the specification style	Lai	Louie
V2.1	2025-3-28	Increase power consumption data	Lai	Louie
V2.2	2025-8-28	Modify pin definition	Lai	Louie

Contents

1. Overview

1.1.Products Introduction

The WT01C202-AI-S1 series module (hereinafter referred to as "WT01C202-AI-S1") is an intelligent voice AI module designed based on the ESP8684H4 of Espressif ESP32-C2 series chips, launched by Wireless-tag. It supports 2.4 GHz Wi-Fi, Bluetooth LE v5.0, local voice control, and antenna forms that support board-level PCBs, antennas, or I-PEX (3rd generation) RF coaxial connectors.

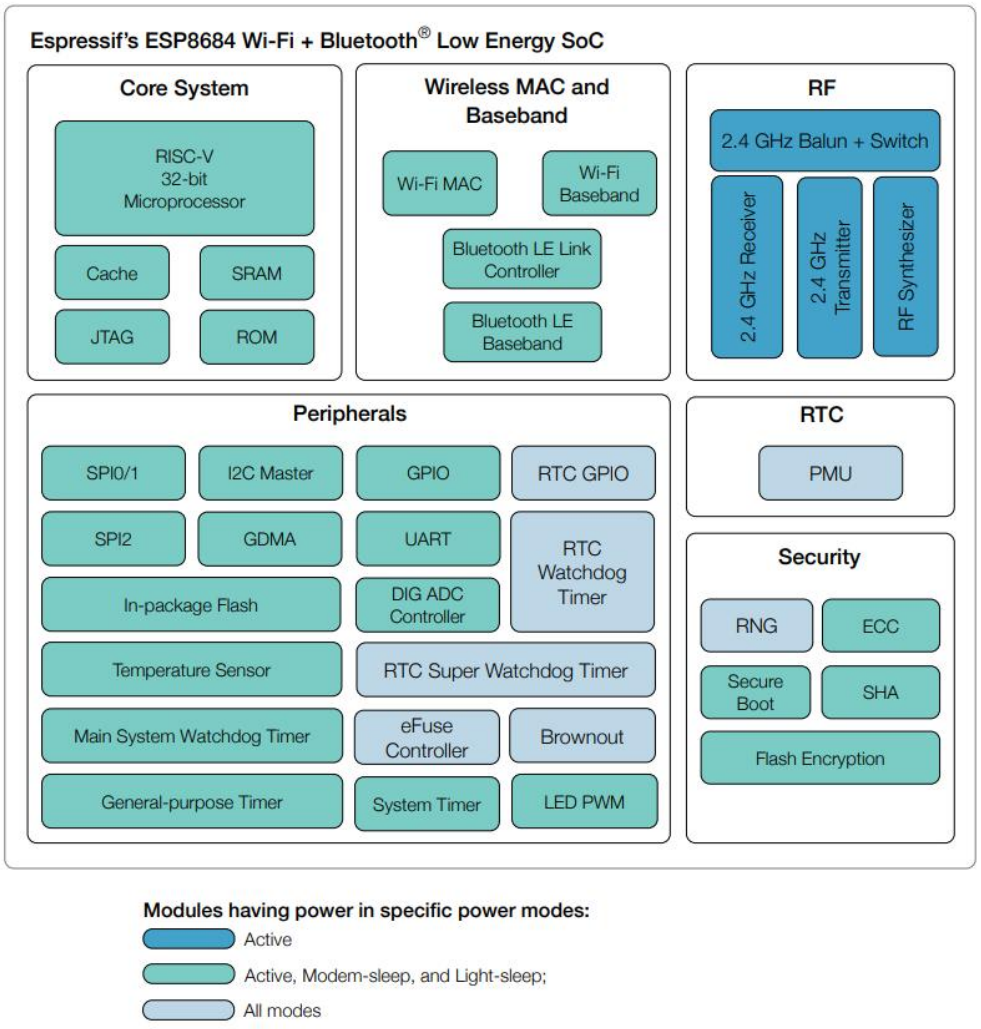

Figure 1: Main Chip Architecture Diagram

There are two antenna forms for the WT01C202 - AI-S1/S1U series modules.For more information, please refer to the following table.

WT01C202-AI-S1/S1U Series Model Number Comparison

Purchase Model	Flash in Package	Ambient temperature (°C)	Module Size (mm)	Antenna version
WT01C202-AI-S1-N4	4 MB	-40 to 85	36.20*18.00*3.00	PCB
WT01C202-AI-S1U-N4	4 MB	-40 to 85	36.20*18.00*3.00	IPEX

1.2.Product Features

- Supports 2.4G Wi-Fi + BLE 5.0
- Small module package size and high integration
- Complete product certification (CE, FCC, SRRC,RoHS, Reach)
- Complete development materials, open source
- Voice print recognition
- Offline voice

1.3.Product Pictures

Figure 2: WT01C202-AI-S1 (front)

Figure 3: WT01C202-AI-S1 (back)

Figure 4: WT01C202-AI-S1U (front)

Figure 5: WT01C202-AI-S1U(back)

1.4.Application Scenarios

- AI toy
- IP toys
- AI Cultural and Creative Industries
- Robot
- Smart home
- Smart lighting

2. Product Specification

2.1.functional block diagram

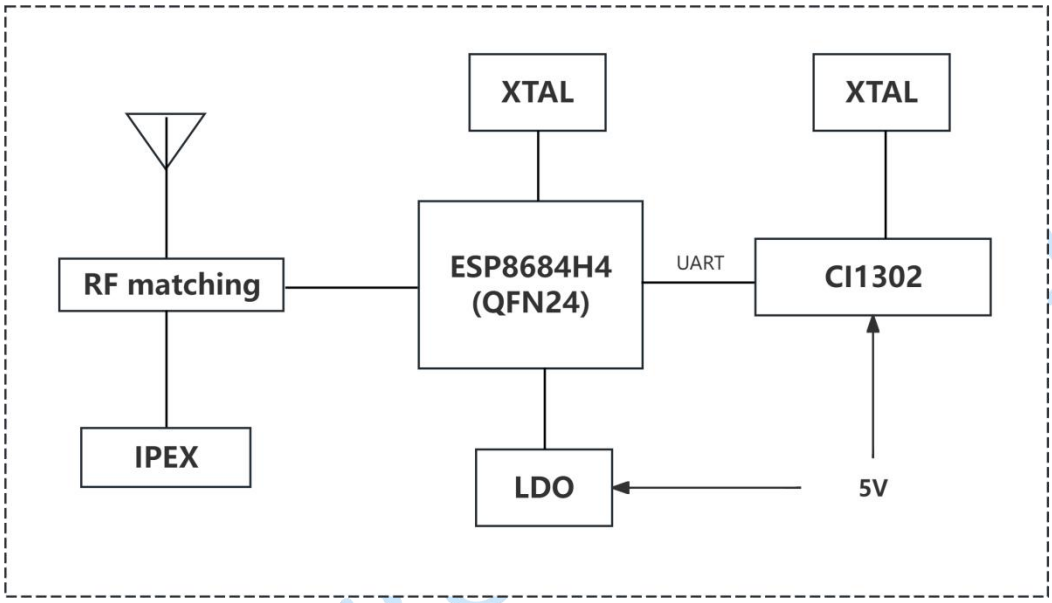

Figure 6: Block diagram of module functions

2.2.Hardware parameters

Controller	CPU	ESP8684H4
	kernel (computer science)	Single-core RISC-V 32bit
	main frequency	120 MHz
Stockpile	ROM	576 KB
	SRAM	273 KB
	Flash	4 MB
Peripheral interface	GPIO	9
	SPI	3
	UART	1
	I2C	1
	LED PWM	1

Other	XTAL	26MHz

2.3.Functional parameters

Wi-Fi	Wi-Fi band	2.4 GHz
	Security	WEP/WPA-PSK/WPA2-PSK
	Protocols	IEEE 802.11 ax/b/g/n
	Support Mode	1T1R
	Data transmission rate	Up to 72.2 Mbps
	Operating mode	STA/AP/STA+AP
Bluetooth	Bluetooth band	2.4 GHz
	Bluetooth version	Bluetooth LE 5.0
	Data transmission rate	125 Kbps, 500 Kbps, 1Mbps, 2 Mbps
Others	Remote OTA	Supported

3. Pin Definitions

3.1.Pin Layout

Figure 7: Pin Layout Diagram

3.2.Pin Description

Pin Function Description

Pin	Name	Descriptive
1	GPIO0	GPIO0，ADC1_CH0
2	CHIP_UP	Enable ESP32-C2 chip (internal 100K pull- up)
3	GPIO20	GPIO20, reuse TXD (ESP32-C2 download serial port, recommended to be reserved by the customer)
4	GPIO19	GPIO19, reuse RXD (ESP32-C2 download serial port, recommended to be reserved by customers)
5	GPIO3	GPIO3，ADC1_CH3
6	GPIO4	GPIO4, TXD (the main communication serial port of the module, connected to customer MCU RXD,3.3V level)
7	GPIO5	GPIO5, RXD (the main communication serial port of the module, connected to the customer MCU TXD,3.3V level)

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Pin	Name	Descriptive
8	NC	/
9	PG_EN	NC, reserved for use. This pin is not connected to the signal and is left floating
10	CI_RX0	(For voice download serial port RXD, it is recommended to draw out customer reservation)
11	CI_TX0	(For voice download serial port TXD, it is recommended to draw out customer reservation)
12	MUTE	GPIO (CI1302 IO port, used for external audio amplifier switch control of the module)
13	HPOUT	Audio output (the audio input pin used for the external audio amplifier of the module, see below for details bright)
14	GND	Power ground (see design guide for details)
15	MIC_PR	AEC echo cancellation feedback signal access end (see design guide for details)
16	MIC_NR	NC
17	MIC_NL	Simulated microphone N input (see design guide for details)
18	MIC_PL	Simulated microphone P input (see design guide for details)
19	GND	Power ground (see design guide for details)
20	GND	Power ground
21	5V	Power supply (main power input of the module, ripple less than 100mV, current 1A)
22	NC	/
23	NC	/
24	GPIO6	GPIO6,MTCK
25	GPIO7	GPIO7,MTDO
26	GPIO8	GPIO8 (internal 10K pull-up)
27	GPIO9	GPIO9 (internal weak pull-up, ESP32-C2 download anduse, it is recommended to draw out and reserve for customers
28	GPIO10	GPIO10 (internal 10K pull-down)
29	GPIO18	GPIO18
30	GND	Power ground

3.3.Startup Item Configuration

3.3.1. Strapping Pins

The WT01C202-AI-S1/S1U module requires some initial configuration parameters each time it is powered up or reset, such as loading the boot mode of the chip. These parameters are controlled by the strapping pin. After reset release, the strapping pin has the same function as the normal IO pin. When the chip is reset, the following startup parameters are controlled by the strapping pin:

- **Chip startup mode** - controlled by GPIO8 and GPIO9

- **ROM Code Log Printing** - Controlled by GPIO8

If the above strapping pin is not connected to any circuit or the connected circuit is in a high impedance state, its default value (i.e., the logic level value) depends on the state of the weak pull-up/pull-down resistor inside the pin at reset.

Strapping Pin Default Configuration

Strapping Pin	Default configuration	Value
GPIO8	Floating	-
GPIO9	pull up	1

To change the value of a strapping pin, you can connect an external pull-down/pull-up resistor.All strapping pins have latches. When the system is reset, the latches sample and store the values of the corresponding strapping pins, maintaining them until power loss or shutdown. The state of the latches cannot be changed in any other way. Therefore, the values of strapping pins can be read continuously while the chip is operating and can be used as regular IO pins after power loss.

The signal timing of the strapping pin should follow the build-up and hold times shown in the table below and in the figure below.

Timing Parameter Description for Strapping Pin

Parameters	Clarification	Minimum (ms)
t0	CHIP_EN Establishment time before power-up	0 ms
t1	CHIP_EN Hold time after power up	3 ms

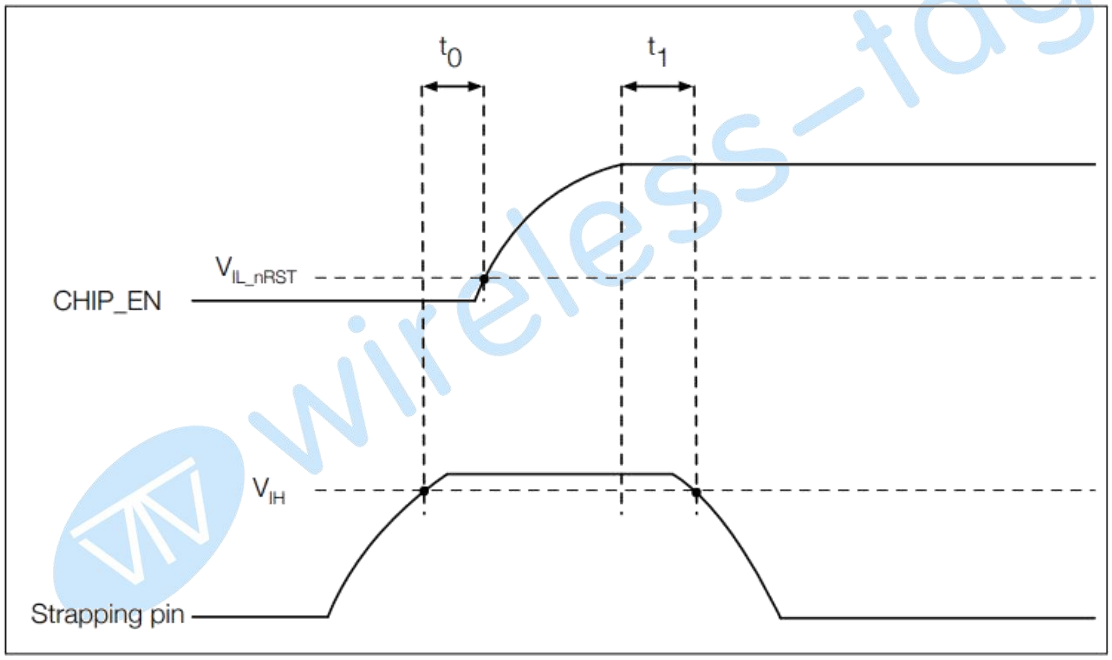

Figure 8: Timing details diagram

3.3.2. Chip startup mode control

After reset release, IO8 and IO9 together determine the startup mode. See the table below for details.

Pin	Default configuration	SPI Boot Mode	Download Launch Mode
GPIO8	(Floating)	Arbitrary value	1
GPIO9	1 (Pull - up)	1	0

Controls ROM Code printing during system startup. See the following table for details.

Pin	Default configuration	Functionality
GPIO8	not have	The UART_PRINT_CONTROL for eFuse is When 0: Power on normal printing, not controlled by GPIO8. 1: If GPIO8 is 0, power-on printing is normal; if GPIO8 is 1, power-on does not print. 2: If GPIO8 is 0, power-on does not print; if GPIO8 is 1, power-on prints normally. 3: No printing on power-up, not controlled by GPIO8.

3.4.Interface description

3.4.1. Enable interface

Module enable foot-CHIP_UP

The enable pin of the module is pin 2, which connects to the chip CHIP_PU. Inside the module, there is a 100K pull-up resistor, allowing reset through the enable pin. After power-on, the CHIP_PU pin defaults to a high level enabling the module. During normal operation of the module, when the CHIP_PU p in receives a low level, it triggers the module to reset.

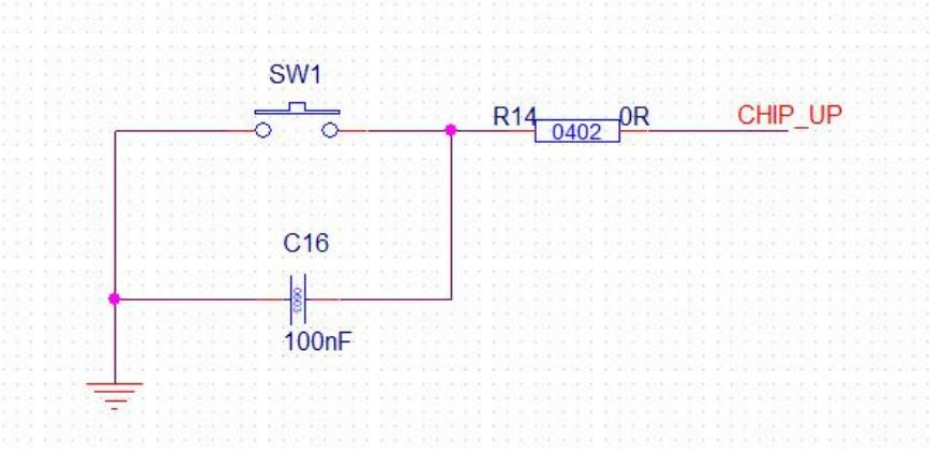

Figure 9 : Button reset reference design

3.4.2. Serial port interface

Pin name	Pin number	Functional description	Remarks

GPIO20	3	C2 U0TXD Serial port transmission	Firmware download serial port
GPIO19	4	C2 U0RXD Serial port reception	

The module can achieve data communication and debugging functions via the serial port. Customers can choose to use it according to their needs. It is recommended to reserve a pull-up resistor to prevent insufficient driving capability of the chips serial port communication. It is suggested to connect a 100-ohm current-limiting resistor in series with the RXD and TXD signal lines to prevent pulse currents from damaging the chip.

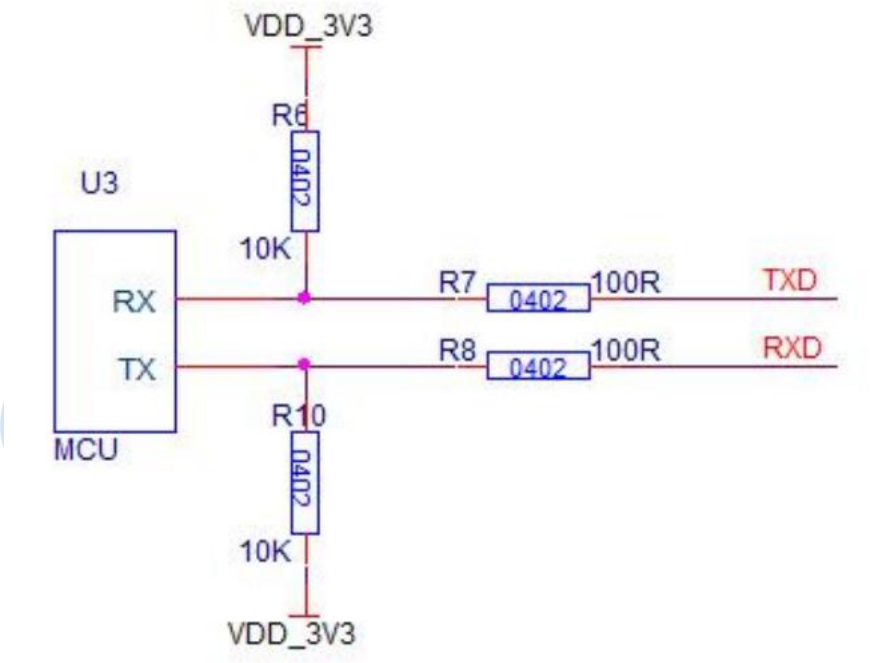

Figure 10 : Communication serial port reference design

Note: The ESP32-C2 inside the module communicates with 1302 through a serial port, and the interface is as follows

Pin name	ESP32-C2 chip Pin number	Functional description
GPIO1	5	ESP32 C2 TXD pin connected to 1302 RXD
GPIO2	6	ESP32 C2 RXD pin connected to 1302 TXD

ESP32C2 Download interface description

Pin name	Pin number	Functional description	Remarks
GPIO20	3	ESP32 C2 U0TXD Serial port transmission	Firmware download
GPIO19	4	ESP32 C2 U0RXD Serial port reception	Firmware download
GPIO9	27	Serial port download Boot	Before power on, pull down this pin serial port to enter download mode

CI1302 Download interface description

Pin name	Pin number	Functional description	Remarks
CI_RX0	10	CI1302 UART0_RX serial port reception	Firmware download
CI_TX0	11	CI1302 UART0 TX serial port transmission	Firmware download
PG_EN	9	Set the startup mode (default pull-up inside)	See below for details

When upgrading the module audio firmware online, it is necessary to determine whether to proceed based on the power level status of the PG_EN when it is powered on. The upgrade starts when the power level is high. The PG_EN has an internal default pull-up. When the power level is judged to be high upon startup, the chip detects an upgrade signal on the UART0 and automatically enters upgrade mode. At this point, you can use the accompanying upgrade tool to program the Nor Flash inside the chip. If no upgrade signal is detected on the UART0, it will enter normal operation mode.

4. Electrical Characteristics

4.1.Absolute maximum limit value

Exceeding the absolute maximum ratings may result in permanent damage to the device. This is an emphasized rating only and does not address the functional operation of the device under these or other conditions beyond those indicated in these specifications. Prolonged exposure to absolute maximum rating conditions may affect module reliability.

4.2.Recommended working conditions

Symbol	Parameters	Minimum value	Typical value	Maximum values	Unit
A5V	Power pin voltage	5.0	5.0	5.5	V
I_{VDD}	Supply current from external power supply	1.0	-	-	A
T_A	Operating Temperature	-40	-	85	℃
VIH	Enter the high voltage range	2.8	-	3.3	V
VIL	Enter the low voltage range	0	-	0.6	V
T_{STORE}	Storage temperature	-40	-	85	℃

4.3.Recommended working conditions

The current consumption measurements are taken with a 5 V supply at 25 °C ambient temperature.
TX current consumption is rated at a 100% duty cycle.
RX current consumption is rated when the peripherals are disabled and the CPU idle.

4.3.1. WIFI power consumption

Current Consumption

WIFI	Work Mode	Description	Peak（mA)
Active(RF Working）	TX	802.11b, 1 Mbps, @22 dBm	435
		802.11g, 54 Mbps, @20 dBm	390
		802.11n, HT20, MCS7, @19 dBm	367
	RX	802.11b/g/n, HT20	95

4.3.2. Bluetooth(LE) power consumption

Current Consumption			
BLE	**Work Mode**	**Description**	**Peak（mA)**
Active(射频工作）	TX	低功耗蓝牙@20.0dBm	443
		低功耗蓝牙@9.0dBm	253
		低功耗蓝牙@0dBm	189
		低功耗蓝牙@－15.0dBm	125
	RX	低功耗蓝牙	94

5. Module Schematic

N#A

6. Module Size and Packaging

Note: The units of the following modules are in millimeters, with a tolerance of ±0.2 mm.

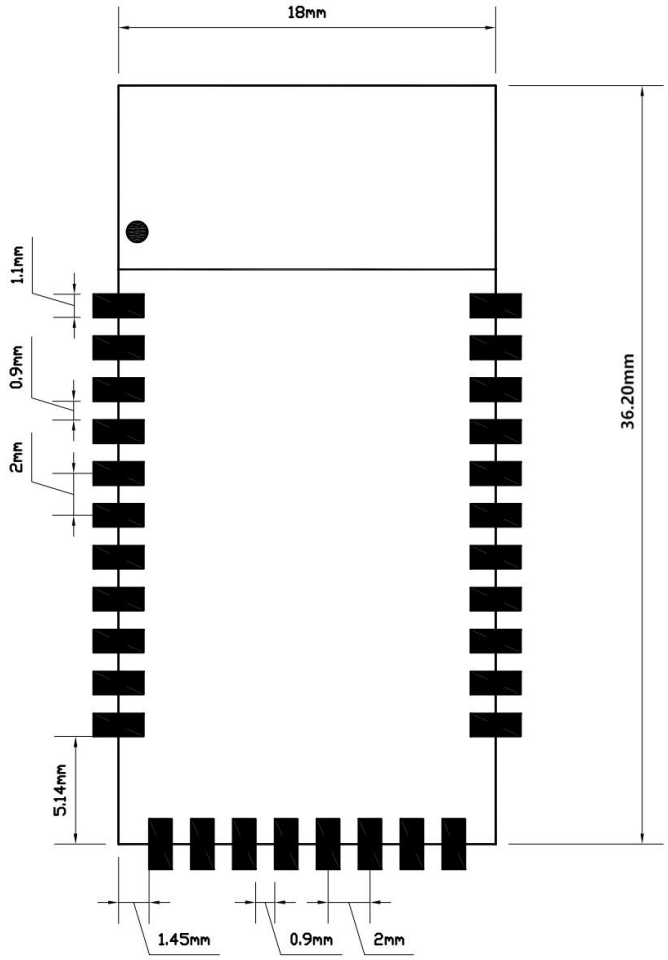

Figure 11: Top view dimensional drawing of the module

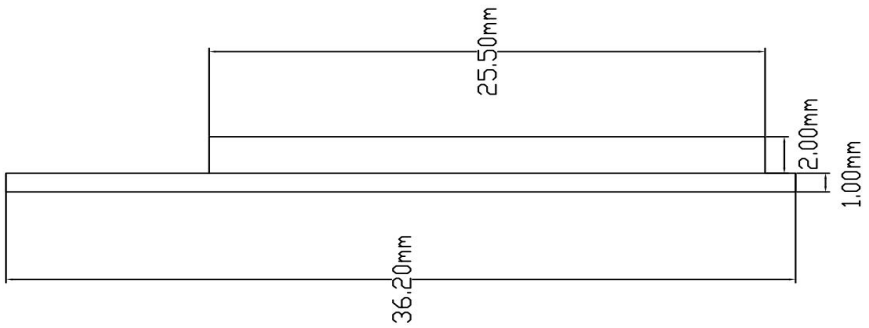

Figure 12: Side view dimensional view of the module

7. Storage Condition

Prerequisite	Parameters
Storage condition	Non-condensing atmosphere < 40℃ /90 %RH in sealed MBBs
Conditions of use	168 hours at 25 ± 5℃ , 60 % RH.
Moisture sensitivity	3 levels

8. Reflow Soldering Curve

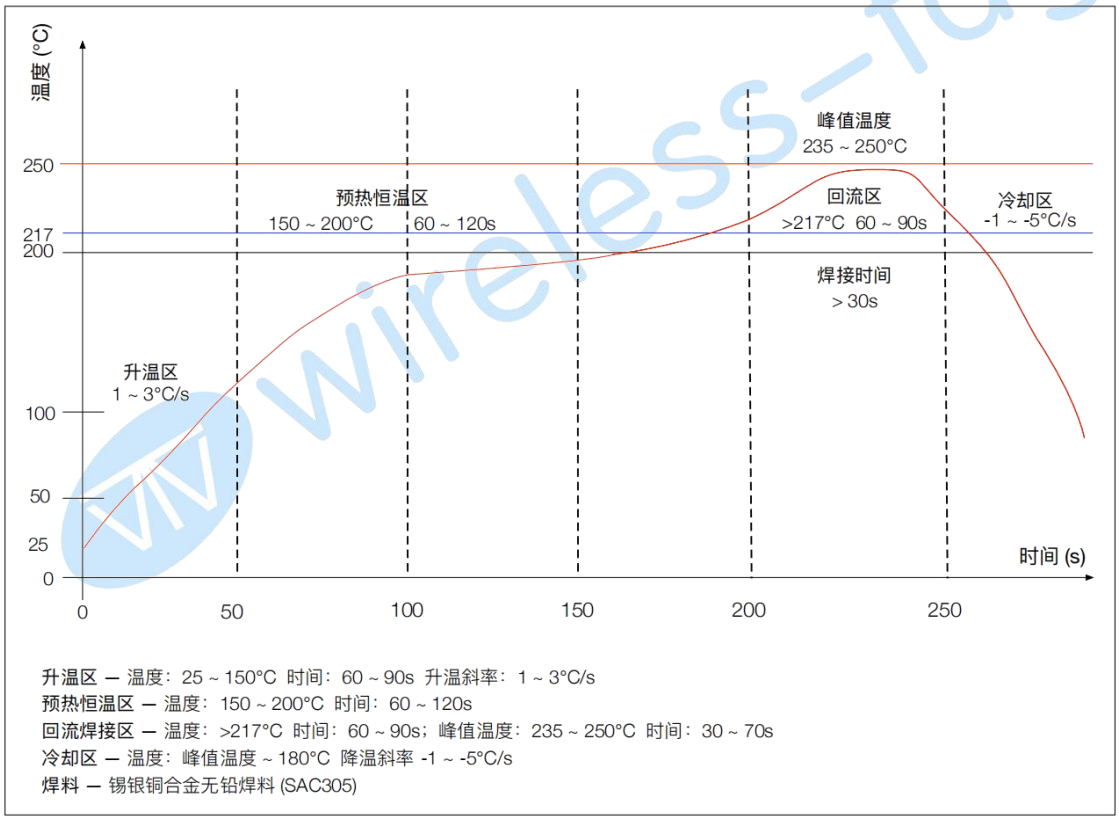

Figure 13: Reflow Soldering Temperature Curve

9. Contact Us

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