

WT0132C5-S6/WT0132C5-S6U Datasheet



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Revision History

Version	Modifier By	Date	Reason	Main changes
V1.0	Pail	2024. 8. 15	Creation	Creat Document



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1. Overview

WT0132C5-S6 series module is an integrated dual-band Wi-Fi & BLE module designed based on Espressif ESP32-C5 series chipset launched by Wireless-Tag Technology Co., Limited. WT0132C5-S6 supports 2.4 & 5G dual-band Wi-Fi6 (802.11ax), Bluetooth® 5 (LE), Zigbee and Thread (802.15.4), with powerful features, rich peripheral interfaces, and antenna support for on-board PCB antenna or I-PEX (3rd generation) RF coaxial connector, designed for Internet of Things (IoT), industrial automation, healthcare, and consumer electronics applications.

The WT0132C5-S6 utilizes a PCB mounted antenna and the WT0132C5-S6U utilizes a connector to attach an external antenna. Both modules are available in a variety of models, as shown in Tables 1 and 2.

Table 1: WT0132C5-S6 Series Model Comparison

Module Model	Flash	PSRAM	Module Size (mm)
WT0132C5-S6-N4	4 MB	—	27.00*16.00
WT0132C5-S6-N8	8 MB	—	
WT0132C5-S6-N16	16 MB	—	
WT0132C5-S6-N4R4	4 MB	4 MB	
WT0132C5-S6-N8R4	8 MB	4 MB	
WT0132C5-S6-N16R4	16 MB	4 MB	

Table 2: WT0132C5-S6U Series Model Comparison

Module Model	Flash	PSRAM	Module Size (mm)
WT0132C5-S6U-N4	4 MB	—	27.00*16.00
WT0132C5-S6U-N8	8 MB	—	
WT0132C5-S6U-N16	16 MB	—	
WT0132C5-S6U-N4R4	4 MB	4 MB	
WT0132C5-S6U-N8R4	8 MB	4 MB	
WT0132C5-S6U-N16R4	16 MB	4 MB	

CPU and On-Chip Memory

- Built-in ESP32-C5 series chip, 32-bit RISC-V single-core processor, supporting 240MHz clock frequency
- 320KB ROM
- 384KB HP SRAM
- 16KB LP SRAM
- SIP flash

Wi-Fi

- Operates in 2.4 & 5 GHz Dual Band, 1T1R
- Operating channel center frequency range:
2.4G WIFI:2412-2472MHz (for EU), 2412-2462MHz (for FCC)
5G WIFI:5180-5240MHz & 5725-5850MHz
- Compatible with IEEE 802.11ax protocol: 20MHz non-access point mode of operation only
- Compatible with IEEE 802.11ac protocol: supports 20MHz bandwidth
- Fully compatible with IEEE 802.11a/b/g/n protocols: supports 20 MHz and 40 MHz bandwidths with 150 Mbps data rate

Please note that when the ESP32-C5 series is scanning in Station mode, the SoftAP channel will change at the same time.

Bluetooth®

- Bluetooth Low Power (Bluetooth LE): Bluetooth 5
- BLE Mesh
- High power mode (20 dBm)
- Rate support 125 kbps, 500 kbps, 1 Mbps, 2 Mbps
- Broadcast Extension
- multibroadcast
- channel selection
- power control
- Bluetooth and 2.4GHz WiFi coexist and share the same antenna

IEEE 802.15.4

- Compatible with IEEE802.15.4-2015 protocols
- Operates in 2.4GHz band, supports OQPSK PHY
- Data rate: 250 Kbps
- Support for Thread 1.3
- Supports Zigbee 3.0

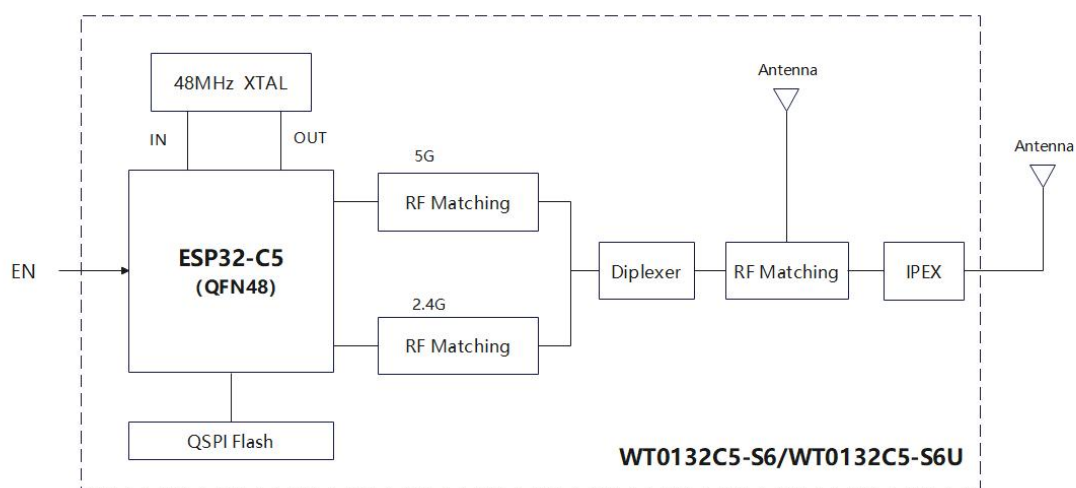
Peripherals

- GPIO, SPI, Parallel IO, UART, I2C, I2S, RMT, LED PWM, ADC, USB Serial/JTAG Controller, etc.

Antenna

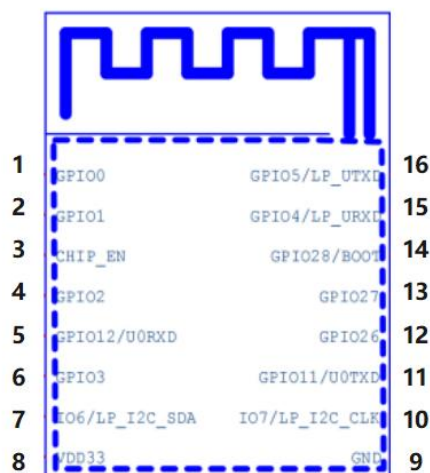
- On-board PCB antenna or external antenna with connectors

2. Functional Block Diagram



3. Hardware Specifications

3.1 WT0132C5-S6/WT0132C5-S6U Pinout & Description



Pinout	Name	Function
1	I00	GPIO0, XTAL_32K_P, LP_GPIO0, LP_UART_DTRN
2	I01	GPIO1, XTAL_32K_N, LP_GPIO1, LP_UART_DSRN, ADC1_CHO
3	EN	High: on, enable the chip; Low: off, the chip powers off; Note: Do not leave the EN pin floating.
4	I02	GPIO2, MTMS, LP_GPIO2, LP_UART_RTSN, ADC1_CH1, FSPIQ
5	RXD0/I012	UORXD, GPIO12
6	I03	GPIO3, MTDI, LP_GPIO3, LP_UART_CTSN, ADC1_CH2
7	LP_I2C/IO6	LP_I2C_SDA, LP_GPIO6, GPIO6, ADC1_CH5, FSPICLK
8	3V3	electricity supply
9	GND	grounding
10	LP_I2C/IO7	LP_I2C_SCL, LP_GPIO7, GPIO7, FSPID
11	TXD0/I011	UOTXD, GPIO11
12	I026	GPIO26
13	I027	GPIO27
14	BOOT/I028	GPIO28
15	LP_RXD/I04	LP_UART_RXD, LP_GPIO4, GPIO4, MTCK, ADC1_CH3, FSPIHD
16	LP_TXD/I05	LP_UART_TXD, LP_GPIO5, GPIO5, MTDO, ADC1_CH4, FSPIWP

3.2 Strapping Pins

At each startup or reset, a module requires some initial configuration parameters, such as in which boot mode to load the module, voltage of flash memory, etc. These parameters are passed over via the strapping pins. After reset, the strapping pins operate as regular I/O pins.

The parameters controlled by the given strapping pins at module reset are as follows:

- **Chip boot mode** – GPIO27 and GPIO28
- **ROM messages printing** – GPIO27
- **JTAG signal source** – GPIO7
- **Crystal frequency selection** – MTMS (only available in Joint Download Boot mode)

GPIO28 connects to the chip's internal weak pull-up resistor during chip reset. If the GPIO28 pin has no external connection or the connected external line is in high impedance state, the internal weak pull-up will determine the default value of GPIO28.

Strapping Pin Default Configuration

Strapping Pins	Default Configuration	Bit Value
GPIO27	Floating	–
GPIO28	Pull-up	1
GPIO7	Floating	–
MTMS	Floating	–

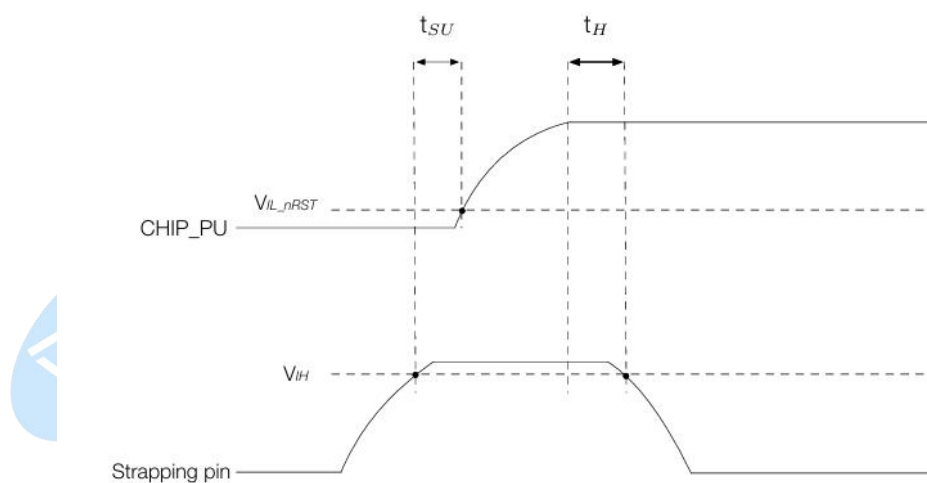
To change the value of the strapping pin, connect an external pull-down/pull-up resistor.

All strapping pins have latches. Upon system reset, the latches sample and store the values of the strapping pins and hold them until the chip is powered down or turned off. The state of the latch cannot be changed in any other way. Therefore, the value of the strapping pin is always

readable while the chip is in operation and can be used as a normal IO pin after a chip reset.

The signal timing of the strapping pins needs to follow the build-up and hold times shown in the table below and in the figure below.

Parameters	Description	Min(ms)
t_{SU}	Establishment time, the time it takes for the power rails to stabilize before pulling up CHIP_PU to activate the chip	0
t_H	Holding time, i.e., the time when the value of the strapping pin can be read before CHIP_PU is pulled high and the strapping pin is changed to a normal IO pin.	3



3.3 Chip Boot Mode Control

GPI027 and GPI028 control the boot mode after the reset is released. See the following table for details.

Boot Mode	GPI027	GPI028
default configuration	-(Floating)	1 (Pull-up)
SPI Boot (default)	Any value	1
Joint Download Boot	1	0

Joint Download Boot mode supports the following download methods:

- USB-Serial-JATG Download Boot
- UART Download Boot
- SPI Slave Download Boot

In SPI Boot mode, the ROM bootloader boots the system by reading the program from the SPI flash.

In Joint Download Boot mode, users can download the binary file to flash via UART0, USB or SPI Slave interface, or download the binary file to SRAM and run the program in SRAM.

4. Peripheral Application Design and Considerations

The WT0132C5-S6 module needs to be used to meet basic operating requirements. This chapter describes how to perform each functional interface circuit design, precautions, and provides a design reference.

4.1 Power Interface

Power supply circuit design and layout, is a very important part of the whole product design, power supply design good or bad affect the performance of the whole product. Please read the power supply design requirements carefully and follow the correct power supply design principles to ensure optimal circuit performance.

Power connector

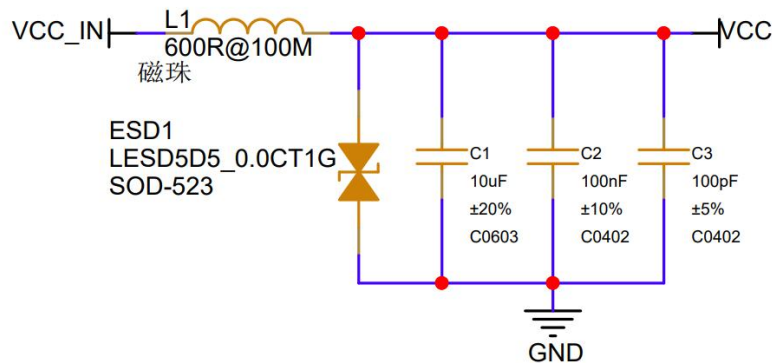
Pin Name	Pin Number	Functional Description	note
VCC	8	Module power input	3.0–3.6V (Default: 3.3V)
GND	9	Module power supply input ground	Make sure all ground pins are well grounded!

4.2 Power Supply Design

The WT0132C5-S6 power supply power supply supports 3.0–3.6V power input (3.3V typical). The power supply recommended design suggestions are

shown below:

POWER



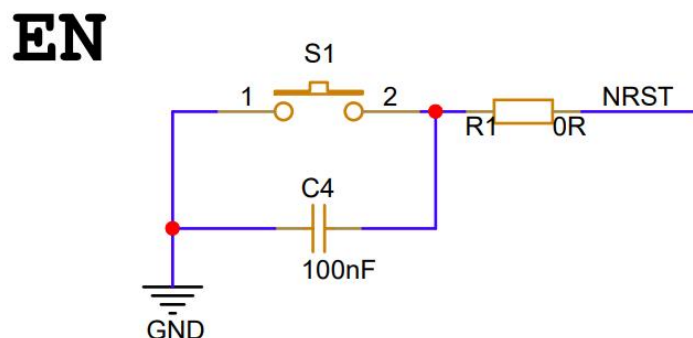
Power Supply Design Considerations :

- It is recommended to place a magnetic bead L1 on the power input to filter out power supply high frequency noise.
- Module power supply maximum input voltage 3.6V, typical value is 3.3V; VCC recommended alignment width $\geq 0.5\text{mm}$ or more.
- It is recommended to increase the ESD tube at the module power supply, ESD clamp operating voltage VRWM = 5V, need to be placed close to the power input interface to ensure that the power supply surge voltage into the back-end circuits before that is clamped, to protect the back-end devices and modules;
- C1 can choose 10uF aluminum electrolytic capacitor or ceramic capacitor, can improve the power supply instantaneous high-current current capacity, capacitance withstand voltage value should be greater than the input power supply voltage of more than 1.5 times;
- Place low ESR bypass capacitors C2 and C3 near the module position to filter out high frequency interference in the power supply;

4.3 Enabling Interfaces

The enable EN pin of the module is 3 pins, which is connected to the chip CHIP_PU, and the module has an internal 10K pull-up, which can also be used to realize reset through the enable pin. After the module is powered on, the EN pin is enabled high by default, and the module can be reset

when the EN pin input is low under the normal working condition of the module. If you need to press the key to reset, please refer to the following figure, it is recommended to connect a 100nF capacitor in parallel with the key to filter out the level jitter after the key is triggered.



4.4 Peripheral Interfaces

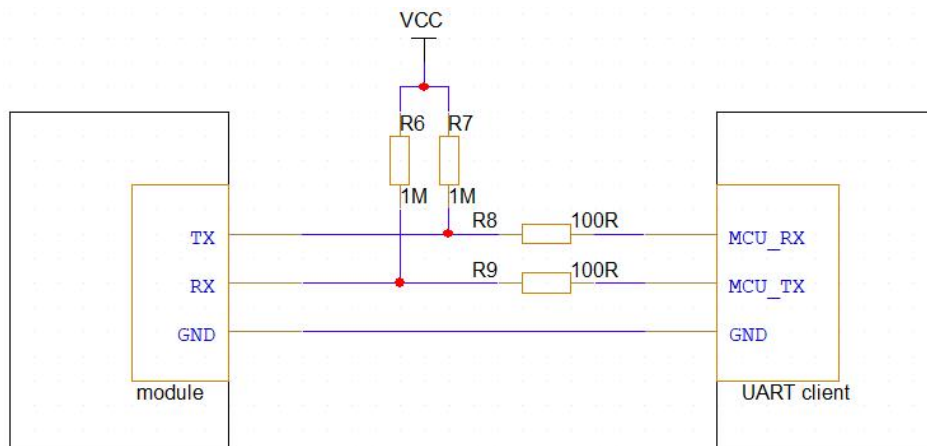
Module provides a variety of commonly used peripheral interfaces

Serial Port Interface

Pin Name	Pin Number	Functional Description	note
RXD0	5	serial port reception	Firmware Download
TXD0	11	serial port sending	Firmware Download
LP_RXD/I04	15	serial port reception	Low Power Serial Port
LP_TXD/I05	16	serial port sending	Low Power Serial Port

The module can realize data communication and debugging and other functions through the serial port. Customers can choose to use it according to their needs. The recommended serial port connection circuit is shown in Figure 5. It is recommended to reserve the pull-up resistor to prevent the chip from insufficient serial communication drive capability, and it is recommended to connect 100 ohm current limiting resistors in series with RXD and TXD signal lines to prevent pulse current and burn the chip.

Serial Connection Reference Design



Serial Port Schematic Design Considerations:

- Note the correspondence of the signal flow to the connection.
- Module serial port level is 3.3V, if the UART and MCU logic level does not match, you need to do level conversion

4.5 RF Design Considerations

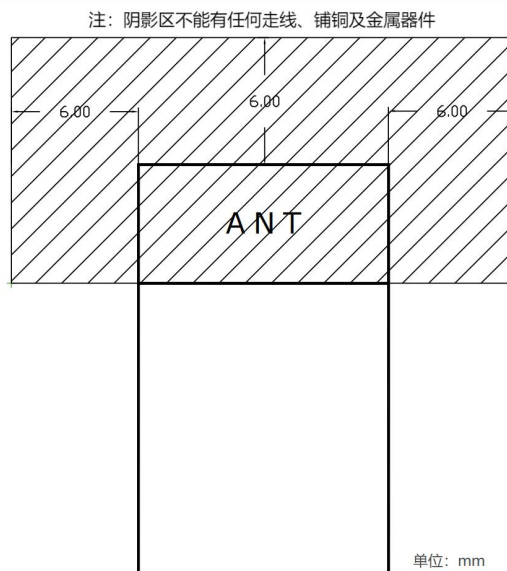
The WT0132C5-S6 module uses an on-board PCB antenna, and the WT0132C5-S6U module uses an antenna connector with a third-generation IPEX base, both of which are in an area outside the shield. The module antenna area should be near the edge of the product.

The on-board antenna will be affected by the customer's base plate, resulting in resonance frequency shift, if the communication distance requirements are very high, the customer needs to prepare a finished product that has already been finalized with modules, and submit it to our company for testing and verification. The reference layout is shown in the figure below:

RF Reference Layout Diagram 1



RF Reference Layout Diagram 2



5. Electrical Characteristics

5.1 Absolute Maximum Ratings

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 that exceed the recommended operating conditions specifications. Prolonged exposure to absolute maximum rating conditions may affect module reliability.

notation	parameters	minimum value	maximum values	unit (of measure)
VDD33	Power Pin Voltage	-0.3	3.6	V
T _{STORE}	Storage temperature	-40	85	°C

5.2 Recommended Working Conditions

notation	parameters	minimum value	typical value	maximum values	unit (of measure)
VDD33	Power Pin Voltage	3.0	3.3	3.6	V
I _{VDD}	Supply current from external power supply	0.5	—	—	A
T _A	Operating Temperature	-40	—	85	°C

EU MAX POWER OUTPUT:

BLE: ANT 1: 5.39 dBm, ANT 2: 5.68 dBm

Zigbee: ANT 1: 5.68 dBm, ANT 2: 4.54 dBm

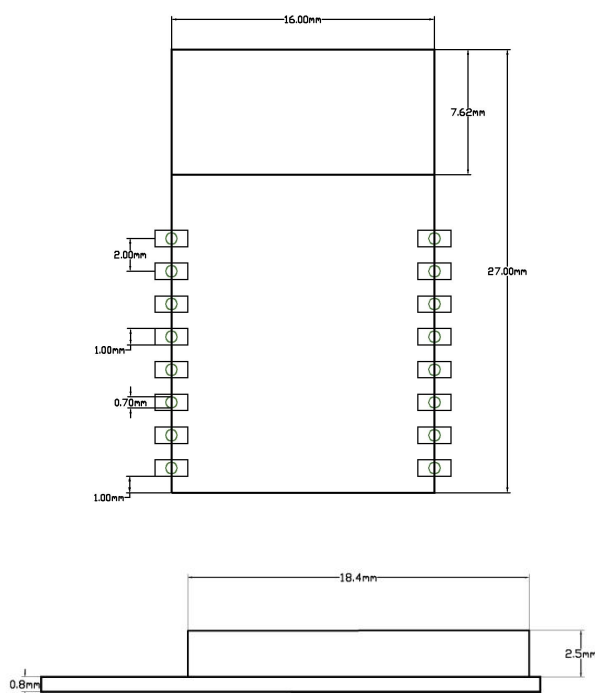
2. 4G WIFI: ANT 1: 12.16 dBm, ANT 2: 14.45 dBm

5G WIFI: UNII-1: ANT 1: 11.07 dBm, ANT 2: 14.78 dBm

U-NII-3: ANT 1: 7.95 dBm, ANT 2: 11.17 dBm

6. Module Dimension Drawing

6.1 Module WT0132C5-S6/WT0132C5-S6U Dimension Drawing



7. Manufacturer's name and address

Wireless-Tag Technology Co., Ltd

801, Block A, Building 6, Shenzhen International Innovation Valley, Dashi Road, Xili Community, Xili Street, Nanshan District, Shenzhen

EU:

This device was tested for uncontrolled environment operations. To comply with RF exposure requirements, a minimum separation distance of 20cm must be maintained between the user's body and the product.

Declaration of Conformity

Hereby, Wireless-Tag Technology Co., Ltd declares that the product is in compliance with Directives 2014/53/EU & 2011/65/EU. The full text of the EU declaration of conformity is available at the following internet address: <http://www.wireless-tag.com>.

Federal Communication Commission Statement (FCC, U.S.)

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.

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.

FCC Caution:

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

FCC 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 20cm between the radiator & your body.

IMPORTANT NOTES

Co-location warning:

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the 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 (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module 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 authorization.

End product labeling:

The final end product must be labeled in a visible area with the following:

“Contains Transmitter Module FCC ID: 2AFOS-WT0132C5-S6” .

Information that must be placed in the end user manual:

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.

Integration instructions for host product manufacturers according to KDB 996369 D03

OEM Manual v01

List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.207 & 15.209&15E **15.407**

Specific operational use conditions

The module is a module with BLE, WIFI 2.4G , WIFI 5G and Zigbee function.

BLE Specification:

Operation Frequency: 2402~2480MHz

Number of Channel: 40

Modulation: GFSK

Zigbee Specification:

Operation Frequency: 2405~2480MHz

Number of Channel: 16

Modulation: GFSK

WiFi 2.4G Specification:

Operation Frequency: 2412-2472MHz (for EU), 2412-2462MHz (for FCC)

Number of Channel: 13 (for EU), 11 (for FCC)

Modulation: DSSS, OFDM

WiFi 5G Specification:

Operation Frequency: 5G (UINII-1): 5180-5240MHz &

5G (UINII-3): 5745-5825MHz

Number of Channel: 5

Modulation: OFDM

The module can be used for mobile or applications with a maximum antenna.

The host manufacturer 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. The host manufacturer 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.

Limited module procedures

Not applicable.

Trace antenna designs

Not applicable. The module has its own antenna, and doesn't need a host's printed board microstrip trace antenna etc.

RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization

Antennas

Antenna Specification are as follows:

Type: ANT 1:PCB Antenna, ANT2:FPC Antenna

Gain:

2.4G Gain:ANT 1:-1.1 dBi, ANT2:-0.25 dBi

5G(UINII-1) Gain:ANT 1:0.03 dBi, ANT2: 2 dBi

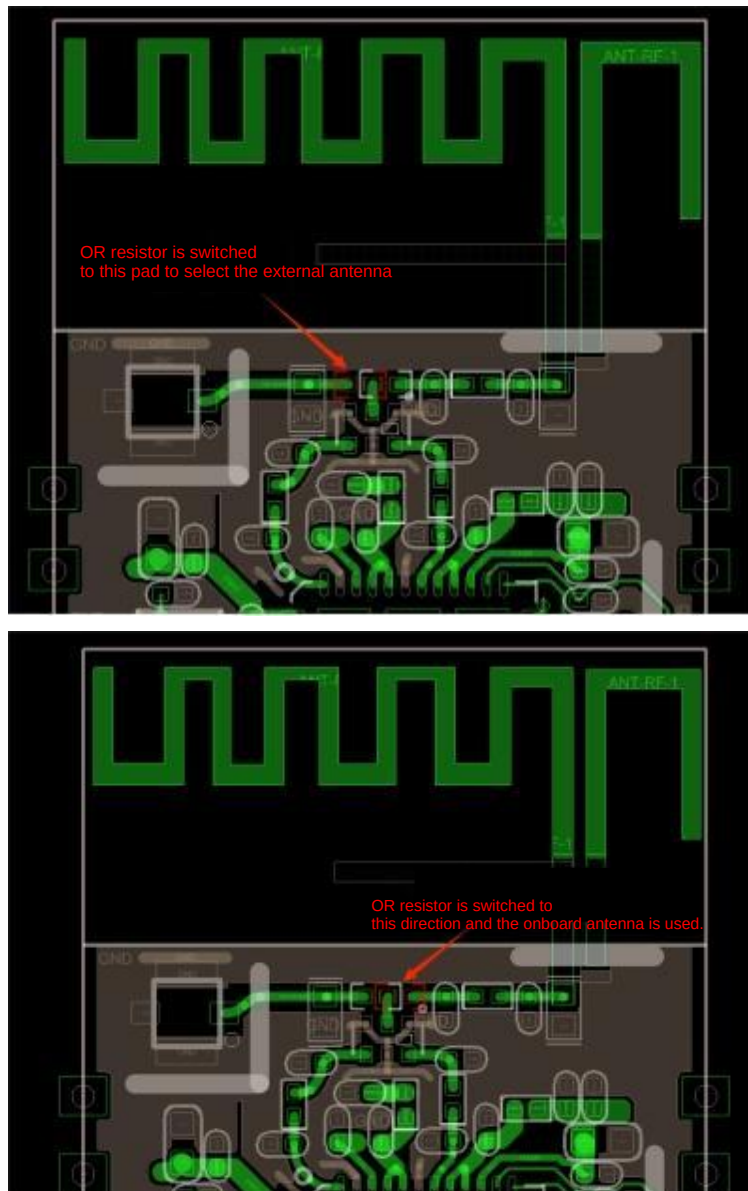
5G(UINII-3) Gain:ANT 1:-2.1 dBi, ANT2:1dBi

Antenna 1 & Antenna 2 Manufacturer:
Wireless-Tag Technology Co., Ltd

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna;

The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).



The position of the resistor as shown in the figure is switched on the module to select the onboard antenna or external antenna.

Information on test modes and additional testing requirements

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 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 circuitry), 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.

When the 5G WIFI function operating in the 5150 to 5250 MHz frequency range, this device restricted to indoor use only. 5150 to 5250 MHz WLAN band is restricted for indoor use in the following countries

EU/UK Caution

5G / Wi-Fi Restrictions

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