WT018684-S5
Datasheet

Version 1.0.1

July 8, 2022

Wireless-Tag

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2.4GHz Wi-Fi(802.11b/g/n) + Bluetooth 5(LE) module

Built around ESP8684 of SoCs, 32-bit RISC-V single-core processor

Flash up to 4 MB, rich set of peripherals

On-board PCB antenna and external antenna connector

Ordering Code	Chip Embedded	Flash(MB)	PSRAM(MB)	Antenna
WT018684-S5-N1	ESP8684	1	0	PCB
WT018684-S5-N2	ESP8684	2	0	PCB
WT018684-S5-N4	ESP8684	4	0	PCB

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About the Document

This document provides users with WT018684-S5 specification.

Document Version

Please go to the official website of wireless-tag to download the latest version of the document.

Revision History

Please go to the Revision History page to view the revisions.

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Revision History

No.	Version	Changes	Notes	Editor	Date
1	V1.0.0	C	First release	GUO	April 27, 2022
2	V1.0.1	M	Errata, correction 5.1	GUO	July.8,2022

*Changes：C——create，A——add，M——modify，D——delete

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1 Module Overview

1.1 Features

MCU

- ESP8684 SoC embedded, 32-bit RISC-V single-core processor, up to 120 MHz
- 576 KB ROM
- 272 KB SRAM （16KB for cache）
- SIP flash
- Flash controller with cache
- Supports flash in Circuit Programming (ICP)

Wi-Fi

- IEEE 802.11 b/g/n compliant
- Supports 20MHz bandwidth in 2.4GHz band
- 1T1R mode with data rates up to 72.2Mbps
- Data rates up to 72.2 Mbps in 802.11n mode
- Frame aggregation (TX/RX A-MPDU, TX/RX A-MSDU)
- Immediate Block ACK
- Fragmentation and defragmentaion
- Transmit opportunity(TXOP)
- Automatic Beacon monitoring（hardware TSF)
- Wireless multimedia（WMM）
- 3 × virtual Wi-Fi interfaces
- Antenna diversity
- Supports external power amplifier
- Simultaneous support for Infrastructure BSS in Station mode, SoftAP mode, Station + SoftAP mode, and promiscuous mode
- NBCE power:14.68dbm

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Note that when ESP8684 scans in Station mode, the SoftAP channel will change along with the Station channel.

Bluetooth

- Bluetooth low energy（Bluetooth LE）:Bluetooth 5
- High power mode
- Speed: 125kbps, 500kbps, 1Mbps, 2Mbps
- Advertising Extensions
- Multiple Advertisement Sets
- Channel Selection Algorithm #2
- Internal co-existence mechanism between Wi-Fi and Bluetooth to share the same antenna
- NBCE power:5.34dbm

Hardware

- Peripheral interfaces: 14xGPIO, 3xSPI, 2xUART, I2C master, LED PWM controller with up to 6 channels, General DMA controller (GDMA) with 1 receive channel and 1 transmit channel
- Analog interfaces: 1×12-bit SAR ADCs with up to 5 channels, 1x temperature sensor
- Timers: 1x54-bit general-purpose timer, 2x watchdog timers, 1x52-bit system timer

1.2 Description

The WT018684-S5 module is based on ESP8684, which is a highly integrated and low-power system-on-chip (SoC) supporting Wi-Fi and Bluetooth, designed for Internet of Things (IoT), mobile devices, wearable electronics, smart homes, such as wake word detection, speech recognition, face recognition, smart control panels, smart speakers, etc. The ESP8684 chip features state- of -the -art power and RF

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performance, complying with the Wi-Fi IEEE802.11b/g/n protocol and BLE 5.0. The chip integrates a 32-bit RISC-V single-core processor, up to 120 MHz. You can power off the CPU and make use of the low-power co-processor to constantly monitor the peripherals for changes or crossing of thresholds. It supports a secondary development without the need for additional microcontrollers or processors. The chip supports a variety of low-power working states, which can meet the power consumption requirements of various application scenarios. The unique features of the chip, such as fine-grained clock gating, dynamic voltage and frequency scaling, and RF output power adjustment, can achieve the best balance between communication distance, communication rate and power consumption. The WT018684-S5 module integrate a rich set of peripherals, ranging from UART，SPI，I2S，I2C， ADC， temperature sensor, GPIO, LED PWM controller, GDMA, general-purpose timer, watchdog timer.

The WT018684-S5 module have a variety of unique hardware security features ensured by the cryptographic hardware accelerators that support AES, SHA and RSA algorithms. RNG, HMAC and digital signature modules provide more security performance. Other security features include flash encryption, secure boot, signature verification. Reliable security features make the SoC perfect for a variety of encryption products. The WT8684-S5 module supports Bluetooth Low Energy: Bluetooth5, Bluetooth mesh. Bluetooth speed supports: 125kbps, 500kbps, 1Mbps, 2Mbps. It aslo supports advertising extensions, multiple advertisement, channel selection. WT018684-S5 is generic Wi-Fi+Bluetooth LE MCU-based module, integrated with ESP8684 of SoCs.

1.3 Applications

- Generic Low-power IoT Sensor Hubs
- Generic Low-power IoT Data Loggers
- Cameras for Video Streaming
- Over-the-top (OTT) devices
- Speech recognition
- Image recognition

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- Mesh network
- Home automation
- Smart home control panel
- Smart building
- Industrial automation
- Smart agriculture
- Audio device
- Health/Medical/Nursing
- Wi-Fi enabled toys
- Wearable electronics
- Retail & Catering Applications
- Smart POS machines
- Smart door lock

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2 Block Diagram

Figure 1 Block Diagram

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3 Pin Definitions

3.1 Pin Layout

Figure 2 Pin Layout

3.2 Pin Description

Table 1 Pin Definition and Description

Index	Name	Type	Power Domain	Function
1	IO0	I/O/T	VDD3P3_RTC	GPIO0,ADC1_CHO
2	IO1	I/O/T	VDD3P3_RTC	GPIO0,ADC1_CH1
3	EN	I	VDD3P3_RTC	High: on, enables the chip. Low: off, the chip powers off. Note: Do not leave the CHIP_EN pin floating.
4	IO2	I/O/T	VDD3P3_RTC	GPIO2,ADC1_CH2，FSPIQ
5	IO4	I/O/T	VDDP3_CPU	GPIO4，ADC1_CH4,FSPIHD,MTMS
6	IO5	I/O/T	VDDP3_CPU	GPIO5,FSPIWP,MTDI
7	IO6	I/O/T	VDDP3_CPU	GPIO6,FSPICLK,MTCK

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8	3V3	PA	-	Analog power supply
9	GND	G	-	Ground,FSPID,MTDP
10	IO7	I/O/T	VDDP3_CPU	GPIO7
11	IO8	I/O/T	VDDP3_CPU	GPIO8
12	IO9	I/O/T	VDDP3_CPU	GPIO9
13	IO10	I/O/T	VDDP3_CPU	GPIO10,FSPICSO
14	IO3	I/O/T	VDDP3_CPU	GPIO3,ADC1_CH3
15	RXDO	I/O/T	VDDP3_CPU	GPIO19,U0RXD
16	TXDO	I/O/T	VDDP3_CPU	GPIO20,U0TXD
17	GPIO18	I/O/T	VDD3P3_CPU	GPIO18
18	NC	I/O/T	-	Dangling pins

PA: Analog power supply
PD: Digital IO power supply
I: Input
O: Output
T: High impedance
The pin function in this table refers only to some fixed settings and do not cover all cases for signals that can be input and output through the GPIO matrix.

3.3 Strapping Pins

ESP8684 has two strapping pins:

- GPIO8
- GPIO9

Software can read the values of GPIO8 and GPIO9 from GPIO_STRAPPING field in GPIO_STRAP_REG register.
During the chip's system reset, the latches of the strapping pins sample the voltage level as strapping bits of "0" or "1", and hold these bits until the chip is powered down or shut down.

There are several types of system resets:

- Power-on reset
- RTC watchdog reset
- Brownout reset
- analog super watchdog reset

By default, GPIO9 is connected to the internal weak pull-up resistor. If GPIO9 is not connected or connected to an external high-impedance circuit, the latched bit value will be "1".
To change the strapping bit values, you can apply the external pull-down/pull-up resistances, or use the host MCU's GPIOs to control the voltage level of these pins when powering on ESP8684 series.
After reset, the strapping pins work as normal-function pins.

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See Table 2 for detailed booting configurations of the strapping pins

Table 2 Strapping Pins

Booting Mode			
Pin	Default	SPI Boot	Download Boot
GPIO8	N/A	Don't care	1
GPIO9	Internal weak pull-up	1	0
Enabling/Disabling ROM Messages Print During Booting			
Pin	Default	Function	
GPIO8	N/A	When the value of eFuse field EFUSE_UART_PRINT_CONTROL is 0 (default), print is enabled and not controlled by GPIO8. 1, if GPIO8 is 0, print is enabled; if GPIO8 is 1, it is disabled. 2, if GPIO8 is 0, print is disabled; if GPIO8 is 1, it is enabled. 3, print is disabled and not controlled by GPIO8.	

The strapping combination of GPIO8=0 and GPIO9=0 is invalid.

Figure 3 shows the setup and holding times of the strapping pins before and after the CHIP_EN signal goes high. Details about the parameters are listed in Table 3.

Table 3 Parameter Descriptions of Setup and Hold Times for the Strapping Pins

Parameter	Description	Min（ms）
t_0	Setup time befor CHIP_EN goes from low to high	0
t_1	Hold time after CHIP_EN goes high	3

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4 Electrical Characteristics

4.1 Absolute Maximum Ratings

Stresses above those listed in *Absolute Maximum Ratings* may result in permanent damage to the device. These are stress ratings only and functional operation of the device is not implied.

Table 4 Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDDA3P3, VDDA, VDD3P3_RTC, VDD3P3_CPU	Power pin voltage	-0.3	3.6	V
TSTORE	Storage temperature	-40	150	℃

4.2 Recommended Operating Conditions

Table 5 Recommended Operating Conditions

Symbol	Parameter	Min	Typ	Max	Unit
VDDA3P3,VDDA,VDD3P3_RTC,VDD3P3_CPU	Power pin voltage	3.0	3.3	3.6	V
IVDD 2	Current delivered by external power supply	0.5	-	-	A
TA	Operating ambient temperature	-40	-	105	℃

When writing eFuse, VDD3P3_CPU should not exceed 3.3v.

When powered by a single power supply, the output current should reach 500mA and above.

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5 Application Notes

5.1 Module Dimensions

Figure 4 Module Dimensions(Front view)

5.2 Reflow Profile

Figure 5 Reflow Profile

5.3 Module Schematics

Figure 6 Module Schematics

5.4 Peripheral Schematics

This is the typical application circuit of the module connected with peripheral components (for example, reset button, JTAG interface, UART interface, etc).

Figure 7 Peripheral Schematics

6 Product Trial

·Sales Mailbox：sales@wireless-tag.com
·Technical Support Mailbox：technical@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:

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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-WT018684-S5”.

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 manufactures according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247

2.3 Specific operational use conditions

The module is a Bluetooth module with WiFi & BLE 2.4G function.

WiFi Specification：

Operation Frequency: 2412~2462MHz

Number of Channel: 11

Modulation: DSSS

Type: PCB Antenna

Gain: 1 . 7 dBi

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BLE Specification：

Operation Frequency: 2402~2480MHz

Number of Channel: 40

Modulation: GFSK

Type: PCB Antenna

Gain: 1 . 7 dBi

The module can be used for mobile or applications with a maximum 1.7dBi antenna. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operaition. 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.

2.4 Limited module procedures

Not applicable.

2.5 Trace antenna designs

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

2.6 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

2.7 Antennas

Antenna Specification are as follows:

Type: PCB Antenna

Gain: 1 . 7 dBi

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.)

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2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating “Contains Transmitter Module

FCC ID: 2AFOS-WT018684-S5” with their finished product.

2.9 Information on test modes and additional testing requirements

BLE

Operation Frequency: 2402~2480MHz
Number of Channel: 40
Modulation: GFSK

WIFI

Operation Frequency: 2412~2462MHz
Number of Channel: 11
Modulation: DSSS

Host manufacturer must perfom 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.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 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.

Manufacturer's Name: WIRELESS-TAG TECHNOLOGY

CO., LIMITED

Sample Description: WIFI BLE Module
Trade Mark: Wireless-tag
Model number: WT018684-S5

This device was tested for operations. To comply with RF exposure requirements, a minimum separation distance of 20cm must be maintained between the user’s body and the charger, including the antenna. Accessories that do not meet these requirements may not comply with RF exposure requirements and should be avoided. Use only the supplied or an approved antenna.

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This device in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU. All essential radio test suites have been carried out. This restriction will be applied to all Member States of European Union.

1. The device complies with RF specifications when the device used at 20cm form your body

Declaration of Conformity

Hereby, WIRELESS-TAG TECHNOLOGY CO., LIMITED declares that the product type WT018684-S5 is in compliance with Directives 2014/53/EU.

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