RF-WM-3200B3 CC3200R

Low Power Wi-Fi Module

Version 1.1

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May 25th, 2023

1 Device Overview

1.1 Description

RF-WM-3200B3 Wi-Fi module is based on TI Cortex™-M4 core Wi-Fi SoC CC3200R. It is of 63 pin, 17.50 mm x 20.50 mm, and 1.27 mm pitch LGA package, fully pin-to-pin compatible to TI CC3200MOD. This Wi-Fi module features the best-in-class low power consumption performance, integrates powerful crypto engine for fast and secured WLAN connections with 256-bit encryption, and supports WPA2 personal and enterprise security. This module complies with 2.4 GHz 802.11 b/g/n standards. Its TCP/IP stack that runs on chip supports up to 8 simultaneous TCP, UDP, or ROW sockets, or 2 simultaneous TLS v1.2 or SSL 3.0 sockets. It can run in Station, AP or Wi-Fi Direct™ connection modes. This module has integrated an SPI Flash, a sleep clock crystal, and a fast clock crystal. It supports a wide supply voltage range from 2.3 V to 3.6 V. It has a pin-out of peripherals of 8-bit parallel, I²S, SD/MMC, UART, SPI, I²C, ADC, DMA and GPIOs interfaces. It also comes with a preprogrammed data communication protocol over its serial port and AT commands set to simplify customers' operations on Wi-Fi configuration.

1.2 Key Features

- Wi-Fi CERTIFIED™ Chip
- Application microcontroller subsystem:
  - Arm® Cortex® -M4 core at 80 MHz
  - Embedded memory
    - ➢ 256 KB RAM
    - ➢ External serial flash bootloader, and peripheral drivers in ROM
  - 32- Channel Direct Memory Access (μDMA)
  - Hardware crypto engine for advanced fast security, including
    - ➢ AES, DES, and 3DES
    - ➢ SHA2 and MD5
    - ➢ CRC and Checksum
  - 8-bit parallel cameral interface
  - 1 multichannel audio serial port (McASP) interface with support for two I²S channels
  - 1 SD/MMC interface
  - 2 UARTs
  - 1 SPI
  - 1 I²C
  - 4 general-purpose timers with 16-bit PWM mode
  - 1 watchdog timer
  - 4-channel 12-bit ADCs
  - Up to 27 individually programmable, multiplexed GPIO pins
- Dedicated external SPI interface for serial flash
- Wi-Fi network processor subsystem
  - Featuring Wi-Fi internet-on-a-chip™
  - Dedicated ARM MCU
    - ➢ Completely offloads Wi-Fi and internet protocol from the Application microcontroller
  - Wi-Fi and internet protocols in ROM
  - 802.11 b/g/n radio, baseband, medium access control (MAC), Wi-Fi driver, and supplicant
  - TCP/IP stack

➢ Industry-standard BSD socket APIs
➢ 8 simultaneous TCP or UDP sockets
➢ 2 simultaneous TLS and SSL sockets

- Powerful crypto engine for fast, secure Wi-Fi and internet connections with 256-bits AES encryption for TIS and SSL connections
- Station, AP, and Wi-Fi direct® modes
- WPA2 personal and enterprise security
- SimpleLink connection manager for autonomous and fast Wi-Fi connections
- SmartConfig™ technology, AP mode, and WPS2 for easy and flexible Wi-Fi provisioning
- TX power
  ➢ 18.0 dBm @ 1 DSSS
  ➢ 14.5 dBm @ 54 OFDM
- RX sensitivity
  ➢ -95.7 dBm @ 1 DSSS
  ➢ -74.0 dBm @ 54 OFDM
- Application throughput
  ➢ UDP: 16 Mbps
  ➢ TCP: 13 Mbps

• Power-Management Subsystem:
- Integrated DC/DC converters support a wide range of supply voltage:
  ➢ V_{BAT} wide-voltage supply: 2.7 V ~ 3.6 V
  ➢ VIO is always tied with VBAT
  ➢ Preregulated 1.85 V mode
- Advanced low-power modes:
  ➢ Hibernate: 4 μA
  ➢ Low-power deep sleep (LPDS): 250 μA
  ➢ RX traffic (MCU active): 59 mA @ 54 OFDM
  ➢ TX traffic (MCU active): 229 mA @ 54 OFDM, maximum power
  ➢ Idle connected (MCU in LPDS): 825 μA @ DTIM = 1

1.3 Applications

- Cloud connectivity
- Home automation
- Home appliances
- Access control
- Security systems
- Smart energy
- Internet gateway
- Industrial control
- Smart plug
- Smart metering
- Wireless audio
- IP network sensor nodes

1.4 Functional Block Diagram

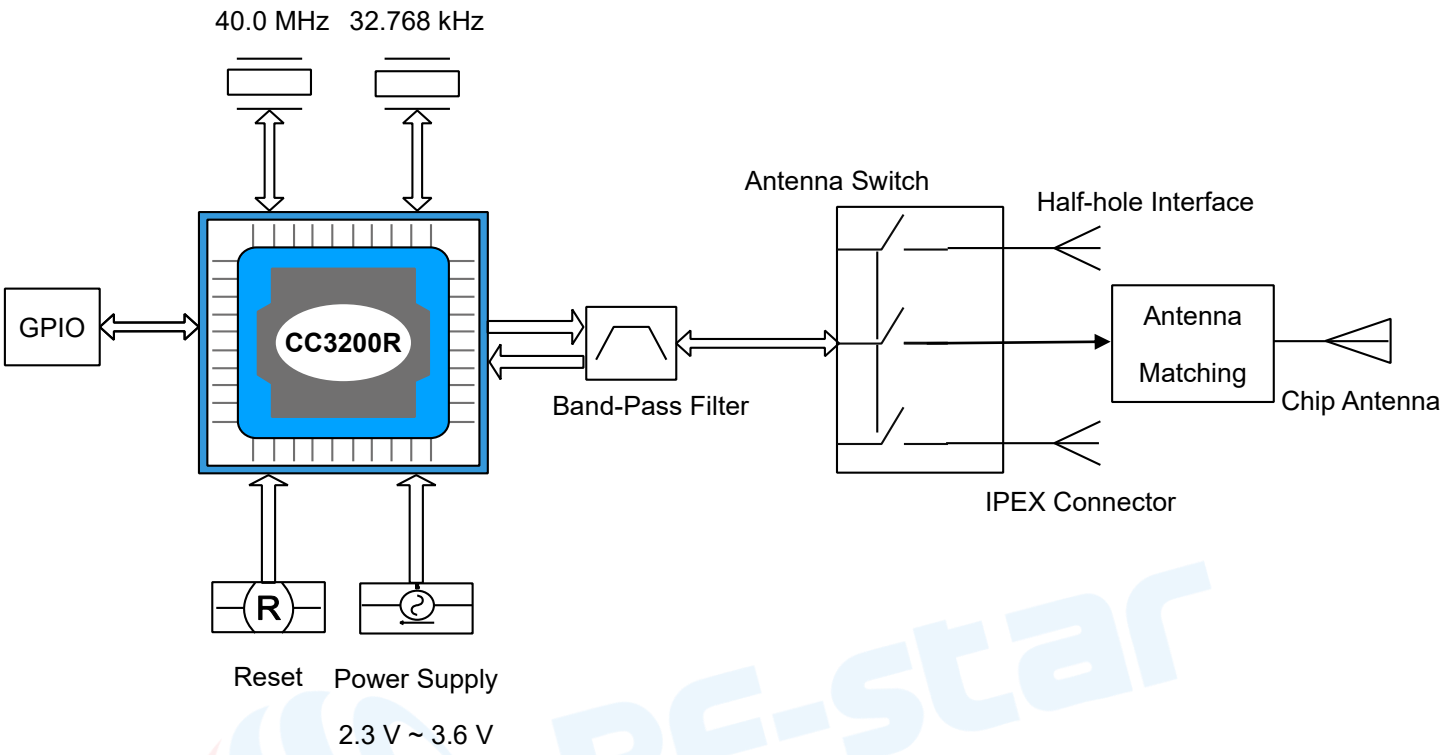

Figure 1. Functional Block Diagram of RF-WM-3200B3

1.5 Part Number Conventions

The part numbers are of the form of RF-WM-3200B3 where the fields are defined as follows:

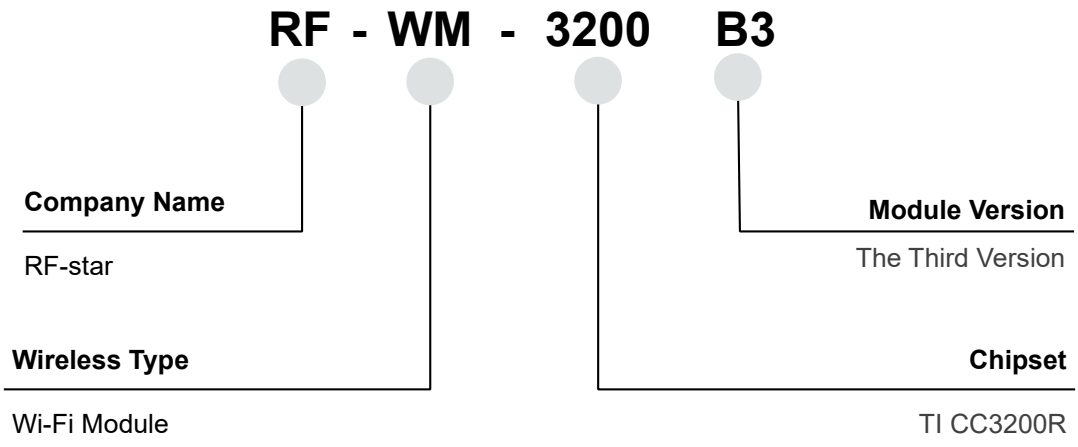

Figure 2. Part Number Conventions of RF-WM-3200B3

Table of Contents

2 Module Configuration and Functions

2.1 Module Parameters

Table 1. Parameters of RF-WM-3200B3

Chipset	CC3200R
Supply Power Voltage	2.3 V ~ 3.6 V, 3.3 V is recommended
Frequency	2.4 GHz
Protocol	802.11 b/g/n
Transmit Power	+18.0 dBm @ 1 DSSS +14.5 dBm @ 54 OFDM
Receiving Sensitivity	-95.7 dBm @ 1 DSSS -74.0 dBm @ 54 OFDM
GPIO	29
Power Consumption	Hibernate: 4 μA Low-power deep sleep (LPDS): 250 μA Idle connected (MCU in LPDS): 825 μA @ DTIM = 1 RX traffic (MCU active): 59 mA @ 54 OFDM TX traffic (MCU active): 229 mA @ 54 OFDM, maximum power
Crystal	40 MHz, 32.768 kHz
Package	LGA Package
Communication Interface	UART, I²S, I²C, SPI, SD/MMC, ADC, DMA, PWM, McASP, Camera interface
Dimension	17.5 mm × 20.5 mm × 2.3 mm
Operating Temperature	-40 ℃ ~ +85 ℃
Storage Temperature	-55 ℃ ~ +125 ℃

2.2 Module Pin Diagram

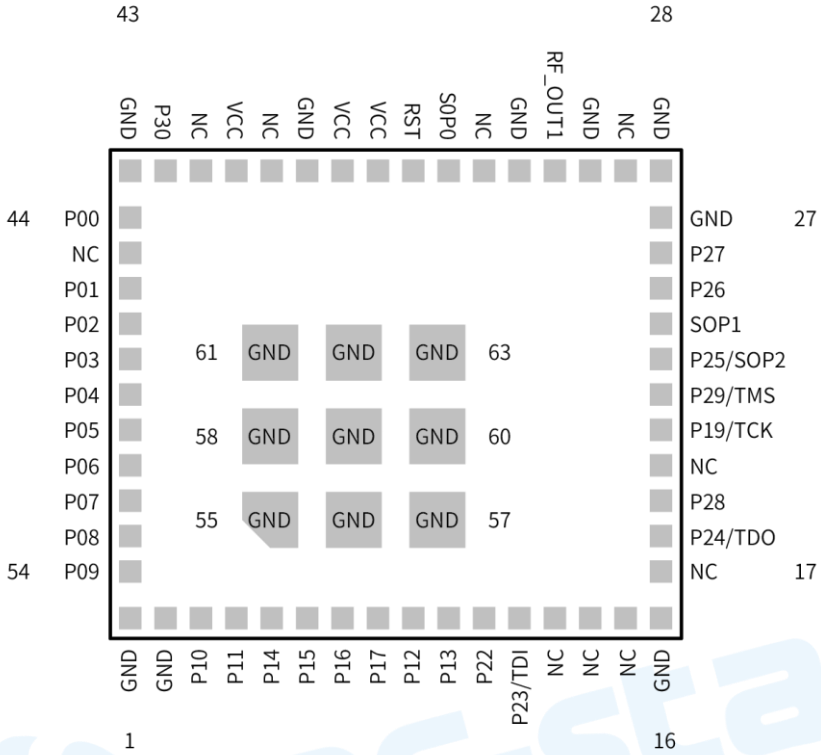

Figure 3. Pin Diagram of RF-WM-3200B3

2.3 Pin Functions

Table 2. Pin Functions of RF-WM-3200B3

Pin	Name	Chip Pin No.	Type	Function
1	GND		-	Ground
2	GND		-	Ground
3	GPIO10	1	I/O	GPIO
4	GPIO11	2	I/O	GPIO
5	GPIO14	5	I/O	GPIO
6	GPIO15	6	I/O	GPIO
7	GPIO16	7	I/O	GPIO
8	GPIO17	8	I/O	GPIO
9	GPIO12	3	I/O	GPIO
10	GPIO13	4	I/O	GPIO
11	GPIO22	15	I/O	GPIO
12	JTAG_TDI / P23	16	I/O	GPIO

13	NC	13	-	Reserved
14	NC	14	-	Reserved
15	NC	11	-	Reserved
16	GND		-	Ground
17	NC	12	-	Reserved
18	JTAG_TDO / P24	17	I/O	GPIO
19	GPIO28	18	I/O	GPIO
20	NC	23	-	Unused
21	JTAG_TCK / P19	19	I/O	JTAG TCK input
22	JTAG_TMS / P29	20	I/O	JTAG TMS input
23	SOP2 / P25	21	I/O	Add pull-down resistor to ground needed for functional mode. Add option to pull-up required for entering the UART load mode for flashing.
24	SOP1	34	-	Reserved. Do not connect.
25	ANTSEL1 / P26	29	I/O	Antenna selection control.
26	ANTSEL2 / P27	30	I/O	Antenna selection control.
27	GND		-	Ground
28	GND		-	Ground
29	NC	27, 28	-	Reserved
30	GND		-	Ground
31	RF_OUT1	31	I/O	2.4GHz RF input/output.
32	GND		-	Ground
33	NC	38	-	Reserved
34	SOP0	35	-	Optional 1-kΩ pull-up if user chooses to use SWD debug mode instead of 4-wire JTAG.
35	RESET	32	I	Power on reset. Does not require external RC circuit.
36	VCC	37	-	Power supply for the device, can be connected to battery (2.7 V to 3.6 V).
37	VCC	39	-	Power supply for the device, can be connected to battery (2.7 V to 3.6 V).
38	GND		-	Ground
39	NC	47	-	Not connected

40	VCC	10, 44, 54	-	Power supply for the device, can be connected to battery (2.7 V to 3.6 V).
41	NC	25, 36, 48	-	Reserved
42	GPIO30	53	I/O	GPIO
43	GND		-	Ground
44	GPIO0	50	I/O	GPIO
45	NC	51	-	Reserved
46	GPIO1	55	I/O	GPIO
47	GPIO2	57	I/O	GPIO
48	GPIO3	58	I/O	GPIO
49	GPIO4	59	I/O	GPIO
50	GPIO5	60	I/O	GPIO
51	GPIO6	61	I/O	GPIO
52	GPIO7	62	I/O	GPIO
53	GPIO8	63	I/O	GPIO
54	GPIO9	64	I/O	GPIO
55	GND		-	Thermal Ground
56	GND		-	Thermal Ground
57	GND		-	Thermal Ground
58	GND		-	Thermal Ground
59	GND		-	Thermal Ground
60	GND		-	Thermal Ground
61	GND		-	Thermal Ground
62	GND		-	Thermal Ground
63	GND		-	Thermal Ground

Table 3. Pin Multiplexing of RF-WM-3200B3

Pin	I/O	Select as Wakeup Source	Function	Description
GPIO10	I/O	No	GPIO10	General-Purpose I/O
			I2C_SCL	I2C Clock
			GT_PWM06	Pulse-Width Modulated O/P
			UART1_TX	UART TX Data
			SDCARD_CLK	SD Card Clock
			GT_CCP01	Timer Capture Port
GPIO11	I/O	Wake-Up Source	GPIO11	General-Purpose I/O
			I2C_SDA	I2C Data
			GT_PWM07	Pulse-Width Modulated O/P
			pXCLK(XVCLK)	Free Clock To Parallel Camera
			SDCARD_CMD	SD Card Command Line
			UART1_RX	UART RX Data
			GT_CCP02	Timer Capture Port
			McAFSX	I2S Audio Port Frame Sync
GPIO12	I/O	No	GPIO12	General-Purpose I/O
			McACLK	I2S Audio Port Clock
			pVS(VSYNC)	Parallel Camera Vertical Sync
			I2C_SCL	I2C Clock
			UART0_TX	UART0 TX Data
			GT_CCP03	Timer Capture Port
GPIO13	I/O	Wake-Up Source	GPIO13	General-Purpose I/O
			I2C_SDA	I2C Data
			pHS(HSYNC)	Parallel Camera Horizontal Sync
			UART0_RX	UART0 RX Data
			GT_CCP04	Timer Capture Port
GPIO14	I/O	No	GPIO14	General-Purpose I/O
			I2C_SCL	I2C Clock
			GSPI_CLK	General SPI Clock
			pDATA8(CAM_D4)	Parallel Camera Data Bit 4

			GT_CCP05	Timer Capture Port
GPIO15	I/O	No	GPIO15	General-Purpose I/O
			I2C_SDA	I2C Data
			GSPI_MISO	General SPI MISO
			pDATA9(CAM_D5)	Parallel Camera Data Bit 5
			GT_CCP06	Timer Capture Port
			SDCARD_DATA0	SD Card Data
GPIO16	I/O	No	GPIO16	General-Purpose I/O
			GSPI_MOSI	General SPI MOSI
			pDATA10(CAM_D6)	Parallel Camera Data Bit 6
			UART1_TX	UART1 TX Data
			GT_CCP07	Timer Capture Port
			SDCARD_CLK	SD Card Clock
GPIO17	I/O	Wake-Up Source	GPIO17	General-Purpose I/O
			UART1_RX	UART1 RX Data
			GSPI_CS	General SPI Chip Select
			pDATA11(CAM_D7)	Parallel Camera Data Bit 7
			SDCARD_CMD	SD Card Command Line
GPIO22	I/O	No	GPIO22	General-Purpose I/O
			McAFSX	I2S Audio Port Frame Sync
			GT_CCP04	Timer Capture Port
TDI	I/O	No	TDI	JTAG TDI. Reset Default PinOut.
			GPIO23	General-Purpose I/O
			UART1_TX	UART1 TX Data
			I2C_SCL	I2C Clock
TDO	I/O	Wake-Up Source	TDO	JTAG TDO. Reset Default Pinout.
			GPIO24	General-Purpose I/O
			PWM0	Pulse Width Modulated O/P
			UART1_RX	UART1 RX Data
			I2C_SDA	I2C Data
			GT_CCP06	Timer Capture Port
			McAFSX	I2S Audio Port Frame Sync

GPIO28	I/O	No	GPIO28	General-Purpose I/O
TCK	I/O	No	TCK	JTAG/SWD TCK Reset Default Pinout
			GT_PWM03	Pulse Width Modulated O/P
TMS	I/O	No	TMS	JTAG/SWD TMS Reset Default Pinout
			GPIO29	General-Purpose I/O
SOP2	O	No	GPIO25	General-Purpose I/O
			GT_PWM02	Pulse Width Modulated O/P
			McAFSX	I2S Audio Port Frame Sync
			TCXO_EN	Enable to Optional External 40 MHz TCXO
			SOP2	Sense-On-Power 2
ANTSEL1	O	No	ANTSEL1	Antenna Selection Control
ANTSEL2	O	No	ANTSEL2	Antenna Selection Control
SOP1	Config Sense	N/A	SOP1	Sense On Power 1
SOP0	Config Sense	N/A	SOP0	Sense On Power 0
GPIO0	I/O	No	GPIO0	General-Purpose I/O
			UART0_CTS	UART0 Clear To Send Input (Active Low)
			McAXR1	I2S Audio Port Data 1 (RX/TX)
			GT_CCP00	Timer Capture Port
			GSPI_CS	General SPI Chip Select
			UART1_RTS	UART1 Request To Send O (Active Low)
			UART0_RTS	UART0 Request To Send O (Active Low)
			McAXR0	I2S Audio Port Data 0 (RX/TX)
GPIO30	I/O	No	GPIO30	General-Purpose I/O
			UART0_TX	UART0 TX Data
			McACLK	I2S Audio Port Clock O
			McAFSX	I2S Audio Port Frame Sync
			GT_CCP05	Timer Capture Port
			GSPI_MISO	General SPI MISO
GPIO1	I/O	No	GPIO1	General-Purpose I/O
			UART0_TX	UART0 TX Data

			pCLK(PIXCLK)	Pixel Clock From Parallel Camera Sensor
			UART1_TX	UART1 TX Data
			GT_CCP01	Timer Capture Port
GPIO2	I/O	Wake-Up Source	ADC_CH0	ADC Channel 0 Input (1.5 V max)
			GPIO2	General-Purpose I/O
			UART0_RX	UART0 RX Data
			UART1_RX	UART1 RX Data
			GT_CCP02	Timer Capture Port
GPIO3	I/O	No	ADC_CH1	ADC Channel 1 Input (1.5 V max)
			GPIO3	General-Purpose I/O
			UART1_TX	UART1 TX Data
			pDATA7(CAM_D3)	Parallel Camera Data Bit 3
GPIO4	I/O	Wake-Up Source	ADC_CH2	ADC Channel 2 Input (1.5 V max)
			GPIO4	General-Purpose I/O
			UART1_RX	UART1 RX Data
			pDATA6(CAM_D2)	Parallel Camera Data Bit 2
GPIO5	I/O	No	ADC_CH3	ADC Channel 3 Input (1.5 V max)
			GPIO5	General-Purpose I/O
			pDATA5(CAM_D1)	Parallel Camera Data Bit 1
			McAXR1	I2S Audio Port Data 1 (RX/TX)
			GT_CCP05	Timer Capture Port
GPIO6	I/O	No	GPIO6	General-Purpose I/O
			UART0_RTS	UART0 Request To Send O (Active Low)
			pDATA4(CAM_D0)	Parallel Camera Data Bit 0
			UART1_CTS	UART1 Clear To Send Input (Active Low)
			UART0_CTS	UART0 Clear To Send Input (Active Low)
			GT_CCP06	Timer Capture Port
GPIO7	I/O	No	GPIO7	General-Purpose I/O
			McACLKX	I2S Audio Port Clock O
			UART1_RTS	UART1 Request To Send O (Active Low)
			UART0_RTS	UART0 Request To Send O (Active Low)
			UART0_TX	UART0 TX Data

GPIO8	I/O	No	GPIO8	General-Purpose I/O
			SDCARD_IRQ	Interrupt from SD Card (Future support)
			McAFSX	I2S Audio Port Frame Sync
			GT_CCP06	Timer Capture Port
GPIO9	I/O	No	GPIO9	General-Purpose I/O
			GT_PWM05	Pulse Width Modulated O/P
			SDCARD_DATA0	SD Card Data
			McAXR0	I2S Audio Port Data (RX/TX)
			GT_CCP00	Timer Capture Port

3 Specifications

3.1 Absolute Maximum Ratings

All measurements are referenced at the device pins, unless otherwise indicated. All specifications are over process and voltage, unless otherwise indicated.

Table 4. Absolute Maximum Ratings

Parameters	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_{BAT} and V_{IO} （Chip pin: 37, 39, 44）	2.3	3.3	3.6	V
	V_{IO} ~ V_{BAT} (differential) （Chip pin: 10, 54）			0.0	V
Digital Inputs	/	-0.5		V_{IO} + 0.5	V
RF Pins	/	-0.5		2.1	V
Analog Pins (XTAL)	/	-0.5		2.1	V
Operating Temperature	/	-40	25	+85	℃
Storage Temperature	/	-55	25	+125	℃

3.2 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted) (1) (2)

Table 5. Recommended Operating Conditions of RF-WM-3200B3

Items	Condition (3) (4)	Min.	Typ.	Max.	Unit
V_{BAT}, V_{IO} (shorted to V_{BAT}) (Chip Pin: 10, 37, 39, 44, 54)	Direct battery connection	2.7	3.3	3.6	V
V_{BAT}, V_{IO} (shorted to V_{BAT}) (Chip Pin: 10, 37, 39, 44, 54)	Preregulated 1.85 V	2.7	1.85	1.9	V
Ambient thermal slew	/	-20	/	20	℃
MSL			3		

Notes:

(1) When operating at an ambient temperature of over 75 °C, the transmit duty cycle must remain below 50% to avoid the auto-protect feature of the power amplifier. If the auto-protect feature triggers, the device takes a maximum of 60 seconds to restart the transmission.

(2) To ensure WLAN performance, ripple on the 2.7 V to 3.3 V supply must be less than ±300 mV.

3.3 RF Parameters

3.3.1 RF Configuration

Wireless Mode	Transmission Rate (Modulation)	Tx Power (Typical)	Rx Sensitivity (Typical)
IEEE802.11 B	11 Mbps @ CCK	17.0 dBm	-80 dBm
IEEE802.11 G	54 Mbps @ OFDM	13.0 dBm	-69 dBm
IEEE802.11 N	HT20 @ MCS7	12.0 dBm	-67 dBm

3.3.2 Transmission Distance Test

The transmission distance test was conducted in the outdoor open area, and four RF-WM-3200B3 modules were divided into two groups for Socket communication. Module A1 operates in STA mode, and module B1 operates in AP mode, and the simultaneous bidirectional communication test was conducted under the modules with on-board chip antenna. Module A2 operates in the STA mode, and module B2 operates in the AP mode, and the simultaneous bidirectional communication test was conducted under the modules with external rod antenna. The test results are as follows:

Transmission distance: 100 meters, data packet: 100 bytes.

- UDP Socket bidirectional communication (chip antenna modules):

Wi-Fi Module	Sending Packet	Receiving Packet	Number of Packet Loss	Packet Loss Rate
A1 Module: UDP Client → B1 Module: UDP Server	1009	1005	4	0.4%
A1 Module: UDP Client ← B1 Module: UDP Server	1000	998	2	0.2%

- TCP Socket bidirectional communication (chip antenna modules):

Wi-Fi Module	Sending Packet	Receiving Packet	Number of Packet Loss	Packet Loss Rate
A1 Module: TCP Client → B1 Module: TCP Server	1379	1379	0	0%
A1 Module: TCP Client ← B1 Module: TCP Server	1005	1005	0	0%

- UDP Socket bidirectional communication (external rod antenna modules):

Wi-Fi Module	Sending Packet	Receiving Packet	Number of Packet Loss	Packet Loss Rate
A2 Module: UDP Client → B2 Module: UDP Server	1392	1351	41	2.9%
A2 Module: UDP Client ← B2 Module: UDP Server	1019	998	21	2%

◆ TCP Socket bidirectional communication (external rod antenna modules):

Wi-Fi Module	Sending Packet	Receiving Packet	Number of Packet Loss	Packet Loss Rate
A2 Module: TCP Client → B2 Module: TCP Server	1392	1392	0	0%
A2 Module: TCP Client ← B2 Module: TCP Server	1003	1003	0	0%

4 Application, Implementation, and Layout

4.1 Module Photos

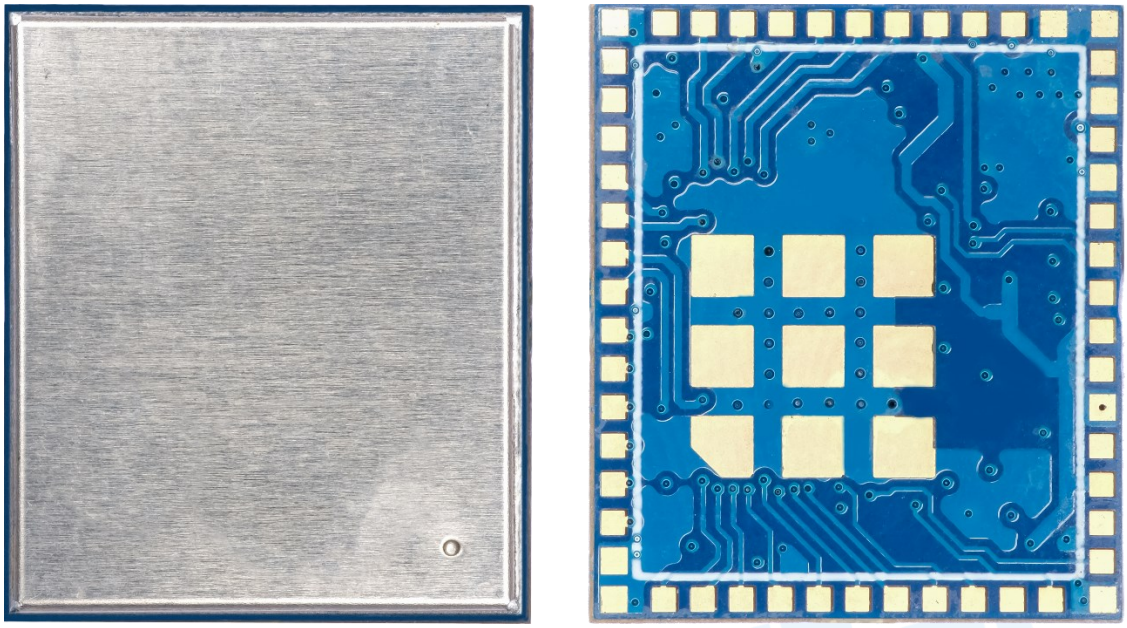

Figure 4. Photos of RF-WM-3200B3

4.2 Recommended PCB Footprint

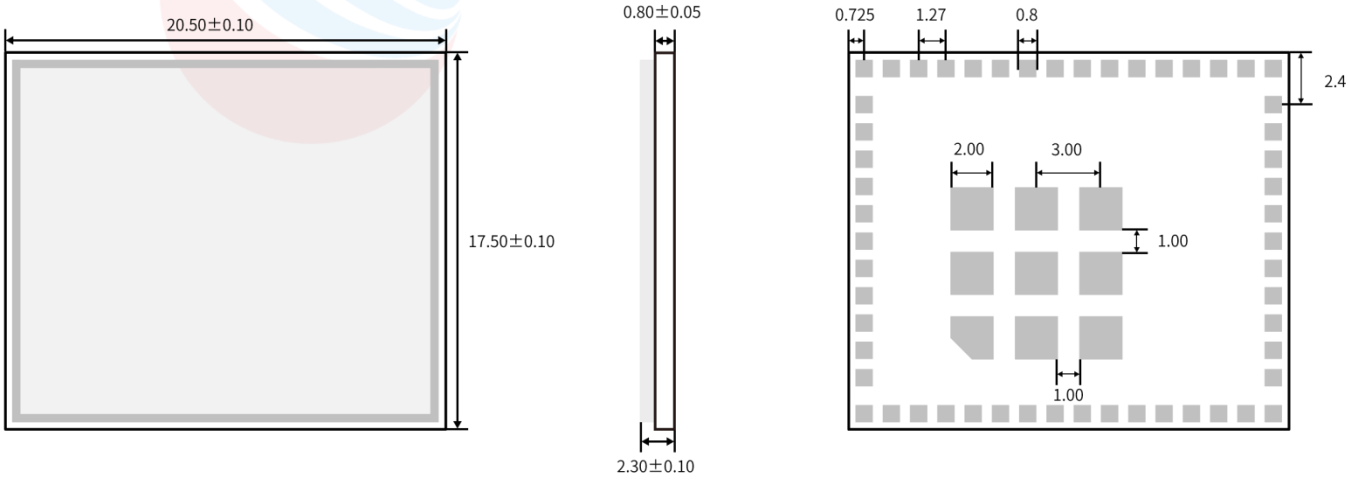

Figure 5. Recommended PCB Footprint of RF-WM-3200B3 (mm)

4.3 Module Operation

4.3.1 SOP Configuration

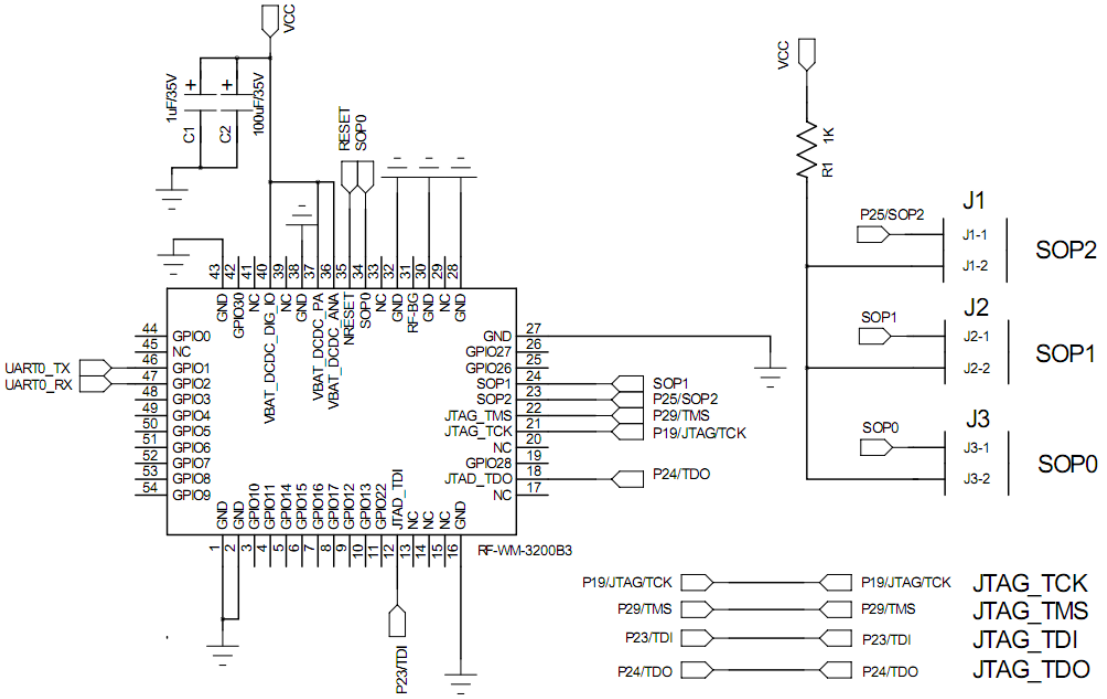

Figure 6. Reference Schematic Diagram of RF-WM-3200B3

Remark:

1) When J1 in SOP2 is shorted, J2 in SOP1 and J3 in SOP0 are disconnected, the module is in Flash Programming mode, and the firmware can be burned into the flash of the module through UART0_TX and UART0_RX using Uniflash.
2) When J1 in SOP2 is disconnected, the module is in running mode.
3) When J1 in SOP2, J2 in SOP1, and J3 in SOP0 are disconnected, the module is in 4-Wire JTAG mode in running mode, and the program can be debugged through CCS.
4) When J3 in SOP0 is shorted, J2 in SOP1 and J1 in SOP2 are disconnected, the module is in the 2-Wire JTAG mode in running mode, and the JTAG_TCK and JTAG_TMS two lines of the JTAG debugging interface are used for debugging.

4.3.2 Pin Configuration

In order to reduce the package size of the chip and the number of pins, CC3200 has many pin multiplexing situations, as shown in pin multiplexing table. In order to better use and configure these multiplexed pins, TI provides a PinMux tool, You can configure the pin according to actual needs and generate related driver code. When developing a project, you only need to add the related code generated by the configuration to the project code. For the download and use of

PinMux tool, you can refer to the following link:

http://processors.wiki.ti.com/index.php/TI_PinMux_Tool

http://processors.wiki.ti.com/index.php/TI_PinMux_Tool_v4

4.4 Basic Operation of Hardware Design

1. It is recommended to offer the module with a DC stabilized power supply, a tiny power supply ripple coefficient and the reliable ground. Please pay attention to the correct connection between the positive and negative poles of the power supply. Otherwise, the reverse connection may cause permanent damage to the module;
2. Please ensure the supply voltage is between the recommended values. The module will be permanently damaged if the voltage exceeds the maximum value. Please ensure the stable power supply and no frequently fluctuated voltage.
3. When designing the power supply circuit for the module, it is recommended to reserve more than 30% of the margin, which is beneficial to the long-term stable operation of the whole machine. The module should be far away from the power electromagnetic, transformer, high-frequency wiring and other parts with large electromagnetic interference.
4. The bottom of module should avoid high-frequency digital routing, high-frequency analog routing and power routing. If it has to route the wire on the bottom of module, for example, it is assumed that the module is soldered to the Top Layer, the copper must be spread on the connection part of the top layer and the module, and be close to the digital part of module and routed in the Bottom Layer (all copper is well grounded).
5. Assuming that the module is soldered or placed in the Top Layer, it is also wrong to randomly route the Bottom Layer or other layers, which will affect the spurs and receiving sensitivity of the module to some degrees;
6. Assuming that there are devices with large electromagnetic interference around the module, which will greatly affect the module performance. It is recommended to stay away from the module according to the strength of the interference. If circumstances permit, appropriate isolation and shielding can be done.
7. Assuming that there are routings of large electromagnetic interference around the module (high-frequency digital, high-frequency analog, power routings), which will also greatly affect the module performance. It is recommended to stay away from the module according to the strength of the interference. If circumstances permit, appropriate isolation and shielding can be done.
8. It is recommended to stay away from the devices whose TTL protocol is the same 2.4 GHz and 5 GHz physical layer, for example: USB 3.0.

4.5 Trouble Shooting

4.5.1 Unsatisfactory Transmission Distance

1. When there is a linear communication obstacle, the communication distance will be correspondingly weakened. Temperature, humidity, and co-channel interference will lead to an increase in communication packet loss rate. The performances of ground absorption and reflection of radio waves will be poor, when the module is tested close to the ground.
2. Seawater has a strong ability to absorb radio waves, so the test results by seaside are poor.
3. The signal attenuation will be very obvious, if there is a metal near the antenna or the module is placed inside of the metal shell.
4. The incorrect power register set or the high data rate in an open air may shorten the communication distance. The higher the data rate, the closer the distance.
5. The low voltage of the power supply is lower than the recommended value at ambient temperature, and the lower the voltage, the smaller the power is.
6. The unmatchable antennas and module or the poor quality of antenna will affect the communication distance.

4.5.2 Vulnerable Module

1. Please ensure the supply voltage is between the recommended values. The module will be permanently damaged if the voltage exceeds the maximum value. Please ensure the stable power supply and no frequently fluctuated voltage.
2. Please ensure the anti-static installation and the electrostatic sensitivity of high-frequency devices.
3. Due to some humidity sensitive components, please ensure the suitable humidity during installation and application. If there is no special demand, it is not recommended to use at too high or too low temperature.

4.5.3 High Bit Error Rate

1. There are co-channel signal interferences nearby. It is recommended to be away from the interference sources or modify the frequency and channel to avoid interferences.
2. The unsatisfactory power supply may also cause garbled. It is necessary to ensure the power supply reliability.
3. If the extension wire or feeder wire is of poor quality or too long, the bit error rate will be high.

4.6 Electrostatics Discharge Warnings

The module will be damaged for the discharge of static. RF-star suggest that all modules should follow the 3 precautions below:

1. According to the anti-static measures, bare hands are not allowed to touch modules.

2. Modules must be placed in anti- static areas.
3. Take the anti-static circuitry (when inputting HV or VHF) into consideration in product design.

   Static may result in the degradation in performance of module, even causing the failure.

4.7 Soldering and Reflow Condition

1. Heating method: Conventional Convection or IR/convection.
2. Solder paste composition: Sn96.5 / Ag3.0 / Cu0.5
3. Allowable reflow soldering times: 2 times based on the following reflow soldering profile.
4. Temperature profile: Reflow soldering shall be done according to the following temperature profile.
5. Peak temperature: 245 ℃.

Table 6. Temperature Table of Soldering and Reflow

Profile Feature	Sn-Pb Assembly	Pb-Free Assembly
Solder Paste	Sn63 / Pb37	Sn96.5 / Ag3.0 / Cu0.5
Min. Preheating Temperature (T_{min})	100 ℃	150 ℃
Max. Preheating Temperature (T_{max})	150 ℃	200 ℃
Preheating Time (T_{min} to T_{max}) (t_1)	60 s ~ 120 s	60 s ~ 120 s
Average Ascend Rate (T_{max} to T_p)	Max. 3 ℃/s	Max. 3 ℃/s
Liquid Temperature (T_L)	183 ℃	217 ℃
Time above Liquidus (t_L)	60 s ~ 90 s	30 s ~ 90 s
Peak Temperature (T_p)	220 ℃ ~ 235 ℃	230 ℃ ~ 250 ℃
Average Descend Rate (T_p to T_{max})	Max. 6 ℃/s	Max. 6 ℃/s
Time from 25 ℃ to Peak Temperature (t_2)	Max. 6 minutes	Max. 8 minutes
Time of Soldering Zone (t_P)	20±10 s	20±10 s

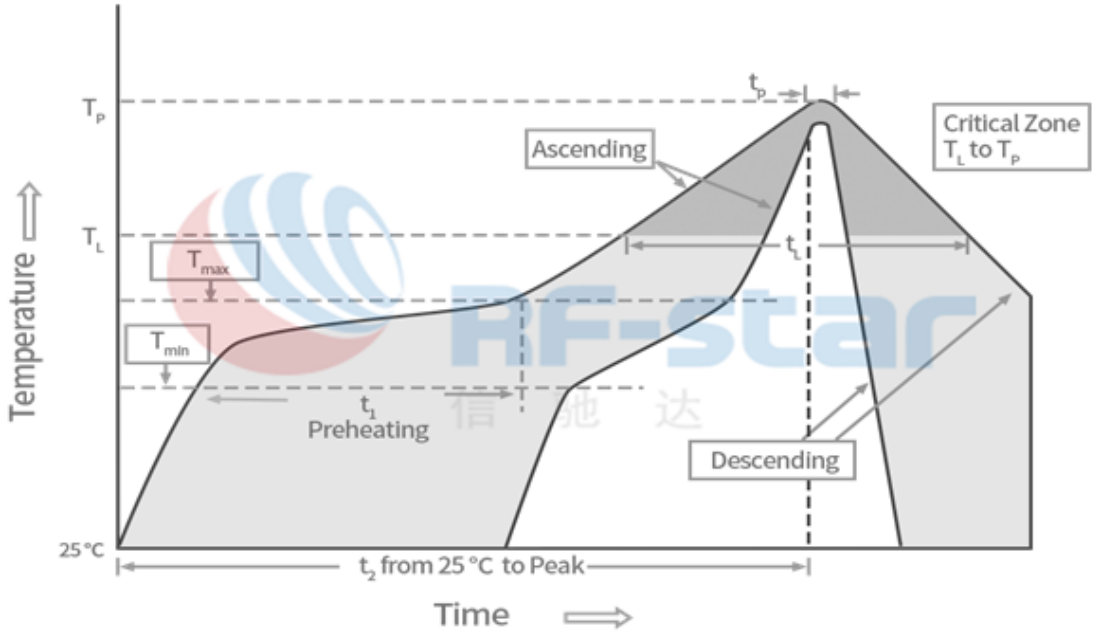

Figure 7. Recommended Reflow for Lead Free Solder

5 Optional Package Specification

The default package method is ***by tray***. If you need the modules to be shipped by tape & reel, pls contact us in advance.

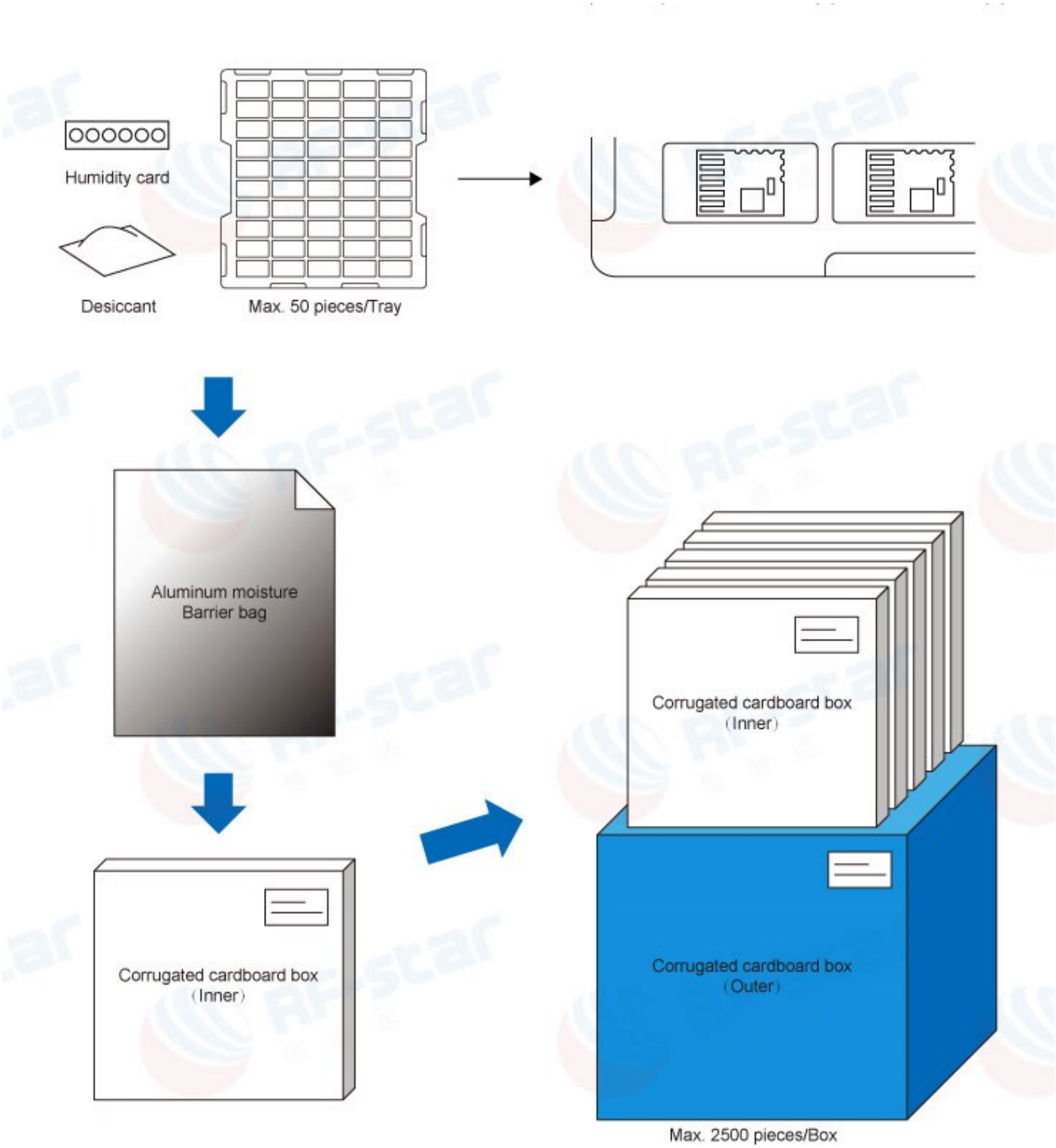

Figure 8. Default Package by Tray

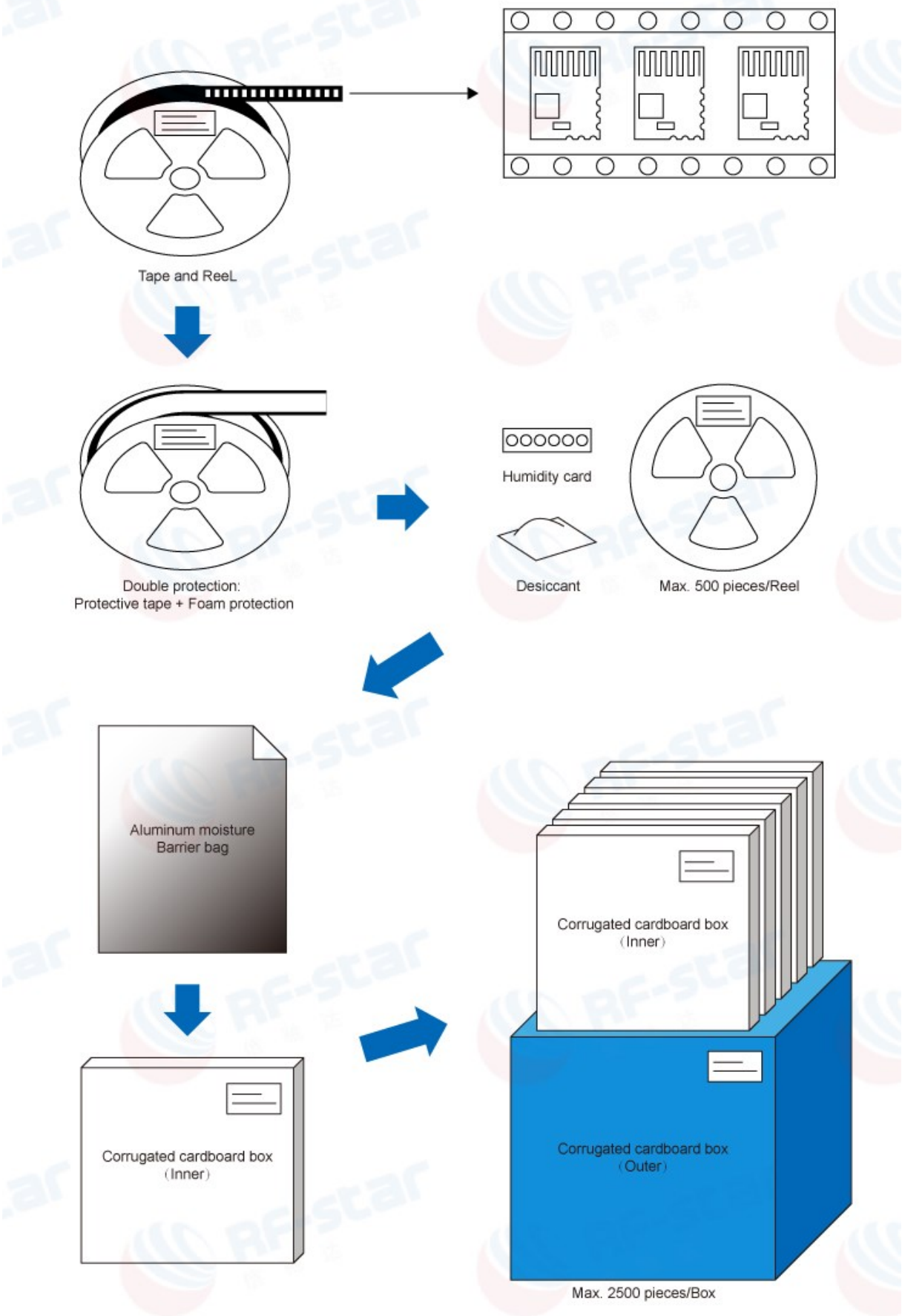

Figure 9. Package by Tape & Reel

6 Revision History

Date	Version No.	Description
2016.09.22	V1.0.0	The initial version is released.
2019.09.20	V1.1	English version rewritten.
2023.05.25	V1.1	Update MSL level. Update the Shenzhen office address.

Note:

1. The document will be optimized and updated from time to time. Before using this document, please make sure it is the latest version.
2. To obtain the latest document, please download it from the official website: www.rfstariot.com and www.szrfstar.com.

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