

Overview

The ultra small RFID module SIM3900 is a cost-effective ultra-high frequency RFID read-write module developed by the Xinlian Chuangzhan technology team based on the new generation of IMPINJ RF chips E710/E510/E310.

The output power can be set from 5dBm to 27dBm, the tag reading distance is greater than 5 meters (depending on antenna gain and tag size), and it has excellent multi tag inventory performance.

The SIM3900 module has low power consumption, small size, and is stable and reliable. It adopts advanced multi tag recognition algorithms, and tags can be quickly recognized in both moving and stationary states.

Superior anti-interference design and carrier cancellation function enable stable operation in various environments.

Multiple configuration modes can be widely used in various applications such as warehousing, logistics, production lines, inspections, etc.

The external dimensions of the SIM3900 module are only the size of a coin, with a half hole stamp package and a weight of only 1.8 grams,

making it easy to embed into mobile portable devices.

Features

- ARMv7-M architecture 32-bit Cortex-M4 CPU, integrated FPU, MPU, DSP, maximum operating frequency of 200MHz, 512KByte Flash
- Supports UHF EPC Class1 Gen2/ISO 18000-6C
- Provide Windows, Linux, Android SDKs, as well as APIs based on C, C #/. NET, and JAVA
- Support temperature tag inventory, with output parameters including RSSI, phase value, etc
- Maximum 27dBm power output
- Excellent anti-collision algorithm, high sensitivity, and the fastest inventory tag speed is greater than 1000tag/s
- Multiple inventory modes suitable for most applications
- Can set UART serial communication baud rate from 9600bps to 921600bps
- Two input two output GPIO
- Full power consumption of 3 W in the North American frequency band
- Surface Mount Technology (SMT), half hole stamp design, weighing 1.2 grams,

dimensions 21mm x 10.5mm x 2.4mm

- Obtained certifications such as CE and FCC
- Compliant with ROHS requirements

型号	灵敏度 @PER 10%	读标签速度 @96 bit EPC)
SIM7900	-86dbm	>1000
SIM5900	-79dbm	>600
SIM3900	-72dbm	>300

Absolute Max Ratings Value

Parameter	Sign	Mini	Typical	Max	Unit
Input voltage	VCC	-0.3		6	V
Enable voltage	VEN	-0.3		6	V
Reset (NRST) GPI(IN1 IN2) input low voltage	VIL			0.6	V
Reset (NRST) GPI(IN1 IN2) input high voltage	VIH	2.7			V
GPO (OUT1 OUT2) output current	IOH			15	mA
Module output current	AVCC			20	mA
ESD protection voltage ¹	VESD	-2		2	kV
Antenna port (ANT) standing wave ratio ²	VSWR			8	/
Operating temperature ³	TC	-30		75	°C
Storage temperature	TS	-55		100	°C



ESD Precautions

Proper precautions must be followed when transporting, packaging and testing the equipment.

1. Antenna port test conditions IEC61000-4-2 level 1, contact discharge; other interfaces are HBM model, contact discharge.
2. The maximum allowable standing wave ratio to prevent damage to the power amplifier chip. To ensure performance, it is recommended that the antenna standing wave ratio be less than 2.0.
3. Ambient temperature. The max temperature limit is related to the module heat dissipation conditions.

General Operating Conditions

Parameter	Sign	Mini	Typical	Max	Unit
Input voltage	VCC	3.6		5.25	V
Disabling voltage	VEN			0.4	V
Enable voltage		1.5			V
Reset (NRST) GPI(IN1 IN2) input low voltage	VIL			0.3	V
Reset (NRST) GPI(IN1 IN2) input high voltage	VIH	3			V
GPO(OUT1 OUT2) output current	IOH		10		mA
Module output current	VIL		10		mA
Antenna port (ANT) standing wave ratio ²	VIH			2.5	/
Operating humidity (non-condensing)	AVCC	5		95	%
Operating temperature	VSWR	-25		65	°C
Storage temperature	RH	-40		85	°C

General Electrical Parameters

Parameters		Condition	Mini	Typical	Max	Unit
Frequency	Range ¹		860		960	MHz
	Step value ²			250/500		KHz
	Deviation	@25℃	-10		10	ppm
Output	Output power		5		27	dBm
	Power step			1		dB
	Output power accuracy	5dBm~27dBm	-1		1	dB
	Output power flatness	5dBm~27dBm	-1		1	dB
	Adjacent channel leakage ratio*	1 st adjacent channel		-50		dB
		2 nd adjacent channel		-65		dB
	20dB occupied bandwidth*	RF_MODE 7		125		KHz
		RF_MODE 11		225		KHz
	Emission spectrum template* ³	裕量	2			dB
	Spurious Emissions (Conducted) ⁴	2 nd harmonic		-60		dBm
		3 rd harmonic		-65		dBm
Measure	Tag RSSI test accuracy	@-60dBm	-3		3	dB
	Tag PHASE test accuracy	@-60dBm	-5		5	degrees
	Load return loss test accuracy	RL>18dB Connect the attenuator	-4		4	dB
UART	Default baud rate	Data format: 8N1		115200		bps
	Configurable baud rate		9600		921600	bps
Consumption	Power down mode			0.035		W
	low consumption standby mode			0.75		W

	Normal standby mode	27dBm		3		W
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1. Select the frequency band by frequency range, can't support multiple frequency areas at the same time.
 2. The required frequency step can be configured according to the frequency range.
 3. Refer to 《ETSI EN 302 208》 4.3.5 Transmitter spectrum masks.
 4. Test under full frequency range conditions.
 5. When temperature exceeds 90℃, the module will forcefully stop inventory, then need to manually resend the command to start inventory.
 6. The operating power consumption of the module is determined based on the matching of the load antenna.
- Mark* Indicates that the inventory mode RF_MODE 7 is used during testing and the spectrum analyzer is set to MAXHOLD.

Air Interface Mode Parameters and Performance

RF_MODE ID	Forward Link Modulation	Tari (us)	BLF (KHz)	Reverse Link Modulation	Receive Sensitivity Minimum ¹ (dBm)			Read Rate ² (tags/s)
					E710	E510	E310	
103	DSB-ASK	6.25	640	FM0	-64	N/A	N/A	>1000
11	PR-ASK	7.5	640	FM0	-64.1	N/A	N/A	>1000
120	DSB-ASK	6.25	640	Miller M=2	-69.5	-65	N/A	>600
1	PR-ASK	7.5	640	Miller M=2	-70.4	-65.4	N/A	>600
15	PR-ASK	7.5	640	Miller M=4	-76.2	-70.2	N/A	>450
345	PR-ASK	7.5	640	Miller M=4	-76.5	-70.8	N/A	>300
12	PR-ASK	15	320	Miller M=2	-76.6	-71.4	-63	>300
3	PR-ASK	20	320	Miller M=2	-76.1	-71.4	-63	>300
5	PR-ASK	20	320	Miller M=4	-81.5	-75.5	-66.7	>200
7	PR-ASK	20	250	Miller M=4	-81.4	-76	-68	>150
13	PR-ASK	20	160	Miller M=8	-87.4	-80	-73.4	>70

1. Testing instrument CISC XPLOER 200, PER 10%, output power 27dBm, antenna port echo less than -20dB
2. Test antenna gain of 14dBi with 4000 tags
3. N/A indicates that this mode is not supported

From the above table, it can be seen that SIM3900 provides up to 11 configuration options,

listing the two most important indicators for measuring the reader module: sensitivity and multi

label read speed. A trade-off needs to be made between sensitivity and multi label speed, as the mode with better sensitivity has a lower tag reading rate. Between reading better and reading more, it is necessary to choose the appropriate mode according to the application requirements. Another thing to note is that there may be interference when multiple readers are working simultaneously. Although a smaller TARI speeds up the communication connection with the tag, it increases the bandwidth of the transmission channel and is more likely to interfere with other readers. The higher backscatter link frequency (BLF) of the tag increases the speed of the tag's reverse transmission signal, and the tag's return signal will fall into adjacent channels. When other readers are working in this channel, the readers may not be able to demodulate the tag's return signal.

Inventory Mode Parameters

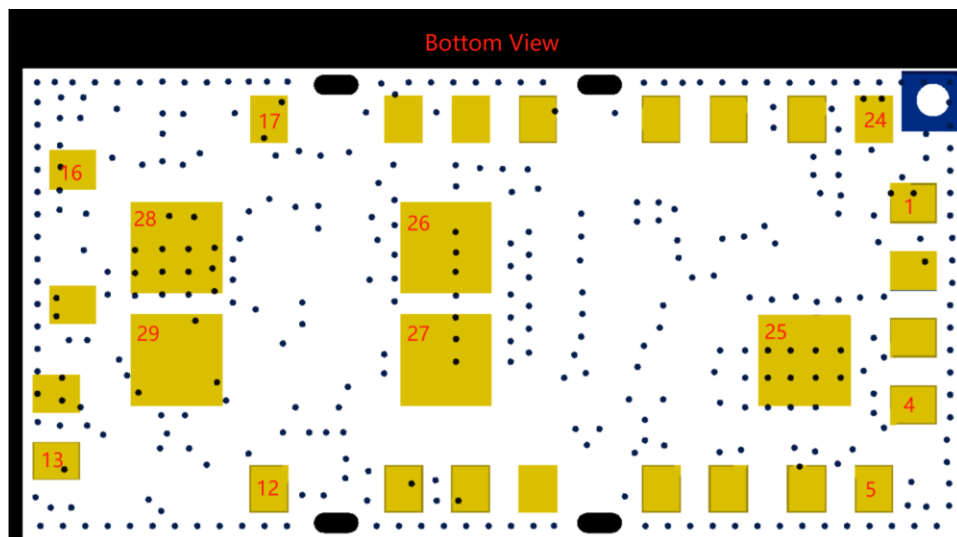
SIM3900 provides multiple working modes for different application scenarios. Except for the temperature controlled multi label inventory mode, everything else is automatically completed by the reader module, which not only saves the command interaction time between the host and the reader module, but also greatly enhances the application adaptability of the product with excellent processing algorithms.

Application	Operating Mode	Description
Few tags, remote inventory	Normal mode	The reading duration is 100-800ms, with a reading interval of 0ms. RF-PODE 13, Session0, Target A, Q automatic.
	Fast mode	RF-PODE 13, Session0, Target A, Q automatic.
少量标签 多次重复	快速/ 多标签快速	RFVNet: E710=103, E510=120, E310=12 (refer to the table). Session1, Target A-B.

		Optional: Static Q (e.g. four labels Q=3/4), fixed frequency.
Read a large number of tags in full (Supported by domestic version)	EX10 Fast/ E7 New Quick	RF-PODE/Session/Target/Q module automatic adjustment (configuration invalid) Optional: Full frequency band, baud rate 921600, power 3300, pay attention to heat dissipation.
Read a large number of tags in full	Quickly/ Multi tag Quick	Manually attempt to switch between RF-PODE 11/7/13, Session2, and manual Q. Optional: Full frequency band, baud rate 921600, power 3300, pay attention to heat dissipation.
Temperature control/low power consumption Multi label inventory	E7 Intelligent (Temperature Control)	RF-PODE automatically adjusts, reducing the duty cycle when there are fewer new tags added, and restoring full speed reading when there are more new tags added. Used for long-term endurance testing/low-power testing.
Extremely large number of labels Try to read as much as possible in the first few seconds	Quickly/ Multi tag Quick	RFVNet: E710=103, E510=120, E310=12 (refer to the table). Session2/3, Target A, Static Q (e.g. 10000 tags Q=14).

The above modes do not support overseas versions. With the support of the motherboard and communication interface, increasing the baud rate to 921600bps (default baud rate of 115200bps) will have a better effect. Please consult our technical personnel for details.

引脚配置及功能



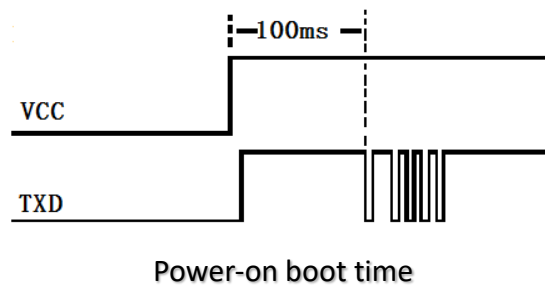
引脚	定义	描述
1	VCC	Supply voltage, 3.6V~5V input
2	GND	GND
3	SWCLK	SWD burning interface, clock cable, suspended when not in use
4	SWDIO	SWD burning interface, data transmission cable, suspended when not in use
5	OUT2	GPO, Push pull output, 3.0V level
6	IN1	Module UART input, 3.3V TTL voltage
7	IN2	Module UART output, 3.3V TTL voltage
8	OUT1	GPO, Push pull output, 3.0V level
9	GND	GND
10	NC	NC
11	NC	NC
12	AVCC	3.3V output, recommended driving current not exceeding 20mA
13	ANT	ANT
14~19	GND	GND
20	NRST	Module reset, low level resets the module, can be suspended when not in use
21	TXD	Module UART output, 3.3V TTL voltage
22	RXD	Module UART input, 3.3V TTL voltage

23	EN	EN module power: LOW & Disconnect (ACTIVE) HIGH (POWER DOWN)
24	GND	GND
25~29	GND	GND

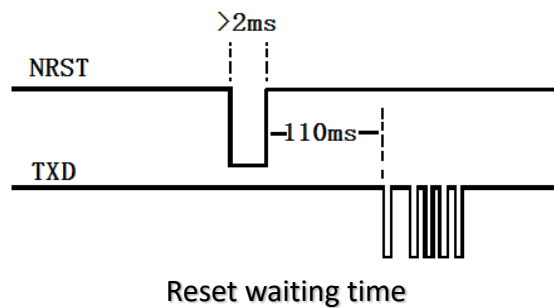
Application Description

● Power-on Boot and IO Interface

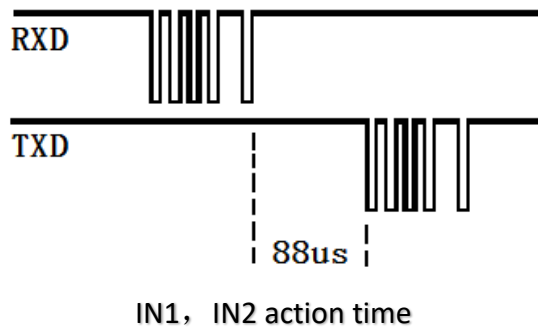
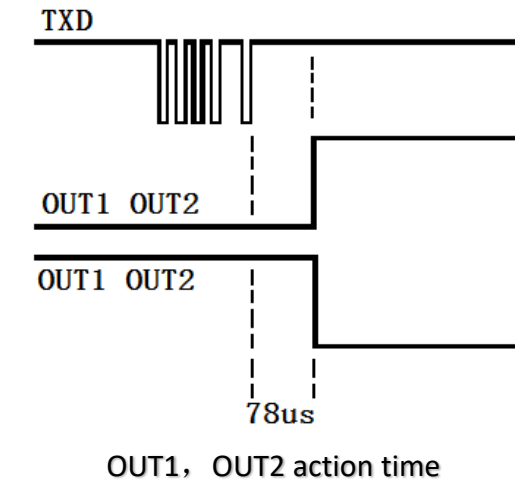
After the module is powered on, it takes 100ms to initialize. Do not pull the reset pin low during this time, and the reader module will not respond to the received commands.



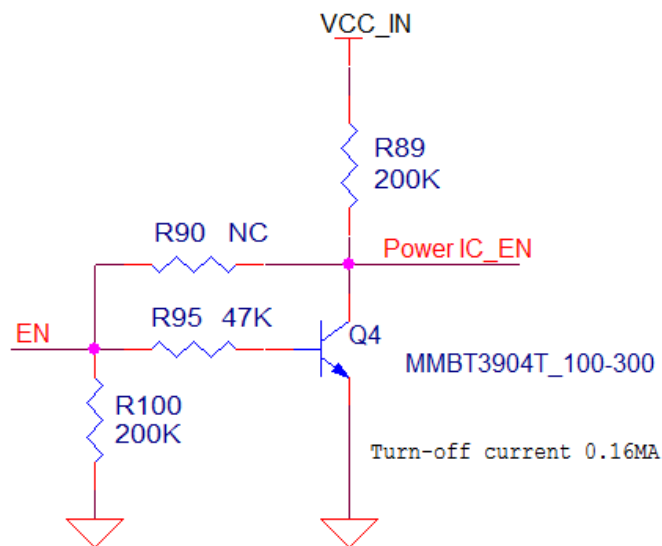
The NRST power-on reset release time is less than 3ms. After the module is powered on, pulling the NRST level low will cause the MCU of the internal module to restart. The NRST in the module has been connected to a 100K pull-up resistor. If the module is powered on, the low-level holding time that triggers the reset needs to be greater than 2ms. When reset occurs, the actual waiting time for reset needs to be greater than 110ms.



The response time is measured by the time difference between sending the GPIO command and the response. The command action time set by OUT1 and OUT2 is greater than 78us (not including command time). IN1, IN2 set command action time is greater than 88us (not including command time).



The EN pin has a built-in 200K pull-down resistor. When the EN pin is connected to low level or left floating, the module is powered on. When the EN pin is connected to high level, the module is powered down.



● Input Power

It is recommended to use a 22-100uF tantalum capacitor for the VCC power input. If the size is limited, it can be changed to a small-sized ceramic capacitor, and at least a 0.1uF and a 100pF ceramic capacitor are connected in parallel. When inventory tag, the power magnifier inside the module will be turned on and off frequently, which will cause the power supply voltage at the input end of the module to fluctuate accordingly. Add large-capacity capacitors can reduce the fluctuation amplitude of these voltages and filter out the interference of low-frequency signals, but it will also cause large instantaneous currents. According to the driving capability of the module power supply circuit, select an appropriate large-capacity decoupling capacitor. The 0.1uF and 100pF capacitors can be used to filter out the power supply ripple in the high-frequency band. Because the interference signal in the high-frequency band, especially the interference signal in the working frequency band, will enter the module, it will degrade the module's tag reading performance. And the addition of ceramic capacitors It can also prevent high-frequency signals generated when the module is working from passing through the power path and interfering with other circuit systems.

Due to the large operating current of the module, the cable connecting the module must be thick enough, otherwise there will be an excessive voltage difference at both ends of the connecting cable, which will make the module unable to work properly; too thin connecting cables are also more likely to produce radiated interference signals.

If the power input is a DC-DC conversion circuit, it is best to choose a power conversion chip with a switching frequency exceeding 1.5MHz to avoid interference with the weak signal returned by the tag.

● Communication Serial Port

The reader module adapts a 3.3V UART serial port for data communication. The data format is configured as 1 bit start, 8 bits data, 1 bit stop, and no check bit (8N1).

The baud rate of the serial port needs to meet the transmission rate requirements of the

module for uploading tag data. When inventory large number of tags, the recommended baud rate is as shown in the following table:

RF_MODE ID	Forward Link Modulation	BLF (KHz)	Reverse Link Modulation	Baud Rate Select
103	DSB-ASK	640	FM0	921600
11	PR-ASK	640	FM0	921600
120	DSB-ASK	640	Miller M=2	>460800
1	PR-ASK	640	Miller M=2	>460800
345	PR-ASK	640	Miller M=4	>230400
15	PR-ASK	640	Miller M=4	>230400
12	PR-ASK	320	Miller M=2	>230400
3	PR-ASK	320	Miller M=2	>230400
5	PR-ASK	320	Miller M=4	>115200
7	PR-ASK	250	Miller M=4	>57600
13	PR-ASK	160	Miller M=8	>57600

● Antenna Port

Mismatch between the module and antenna can lead to excessive signal reflection from the antenna to the reader module, causing a degradation in receiver sensitivity. It is recommended to maintain an antenna VSWR (Voltage Standing Wave Ratio) below 1.5. In applications requiring rapid reading of a large number of tags, especially when using modules based on the E710 chip, a high antenna VSWR that degrades receiver sensitivity can significantly increase the time required for reading all tags. For applications with fewer tags at closer distances, choosing modules based on the E510 or E310 may be more suitable.

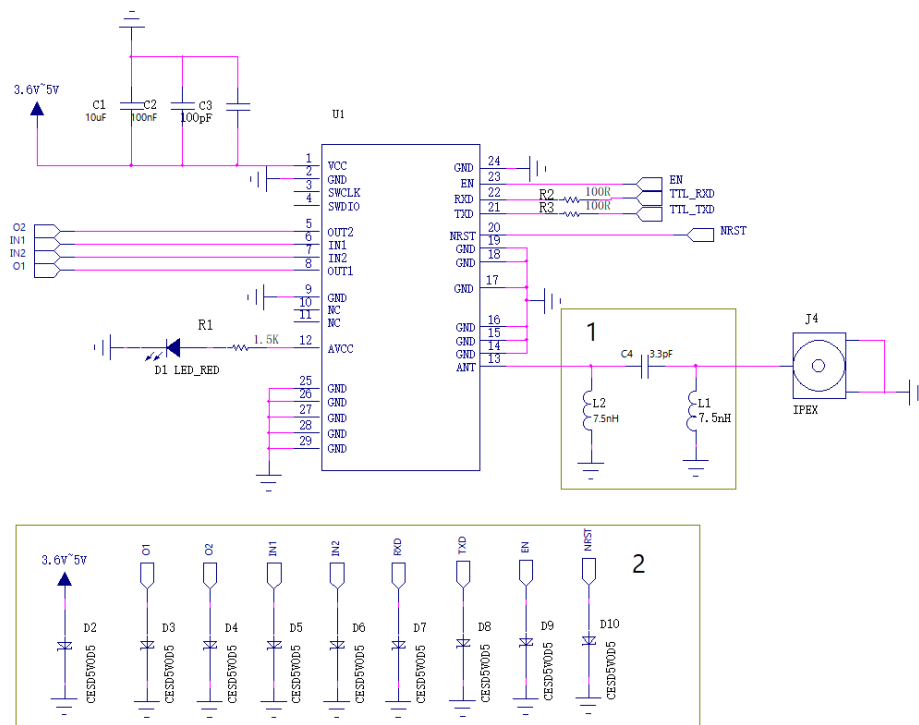
Since there is no RF isolator or RF circulator used between the power amplifier chip in the module and the antenna, mismatches between the power amplifier chip and the antenna can affect linearity and conversion efficiency. The former can result in changes in transmission performance, such as

reduced power output, radiation of spurious signals, and non-compliance with local radio regulations regarding spectrum masks. The latter can increase the module's power consumption, operating temperature, and reduce its lifespan. In the worst-case scenario, the power amplifier chip may operate in an unstable region due to mismatches, leading to self-excitation, which can easily damage the power amplifier chip. To ensure optimal module performance and stability, it is recommended to install the antenna in the application environment and use testing software to measure the VSWR after connecting the antenna. The VSWR should ideally be below 1.5.

● Heat Dissipation

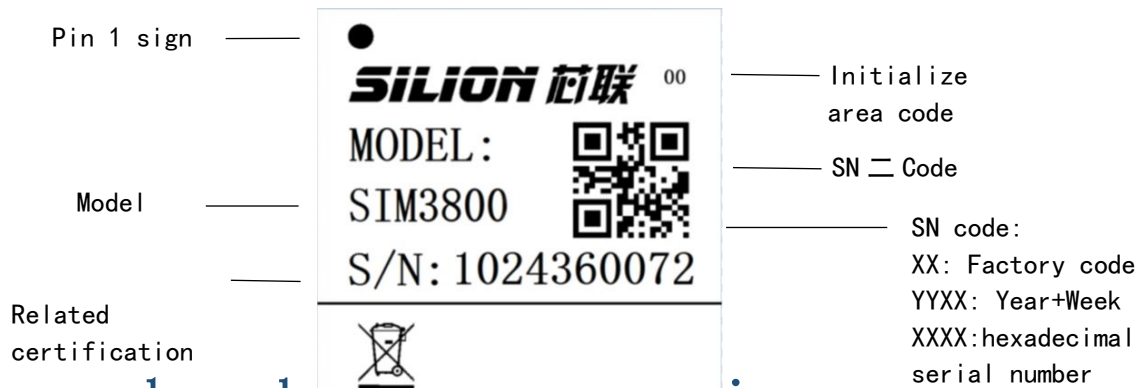
The SIMx200 module generates significant heat during fast mode operation, and its built-in aluminum alloy casing may not provide adequate heat dissipation. To ensure effective heat conduction, it is necessary to mount the module on a larger metal heat sink. Additionally, thermal conductive silicone grease or compound should be applied at the contact points between the module and the heat sink. To protect the module from overheating, it will automatically cease tag inventory when the detected temperature reaches 90°C. In such cases, you will need to resend the inventory command to resume tag inventory.

● Reference



1. Increased ESD protection capability introduces additional insertion loss and changes in antenna port matching. If ESD meets the requirements, try not to add this circuit as much as possible.
2. Choose the appropriate ESD protection diode according to actual needs. If the SIM3900 communication and power interfaces are not connected to the external connectors of the product, the ESD protection diode can generally be omitted.
3. In order to operate at a lower power supply voltage, the microcontroller uses a power supply voltage of 3.3V. It is recommended to reserve a series resistor on the interface.

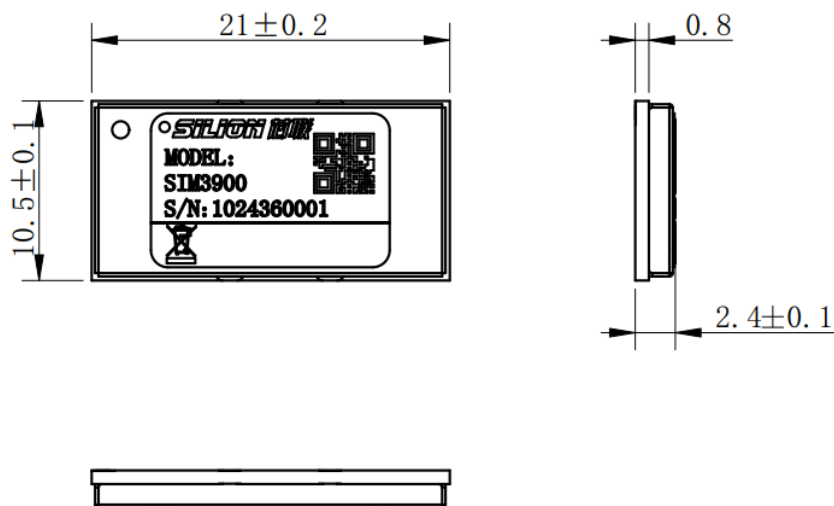
● Label Explanation



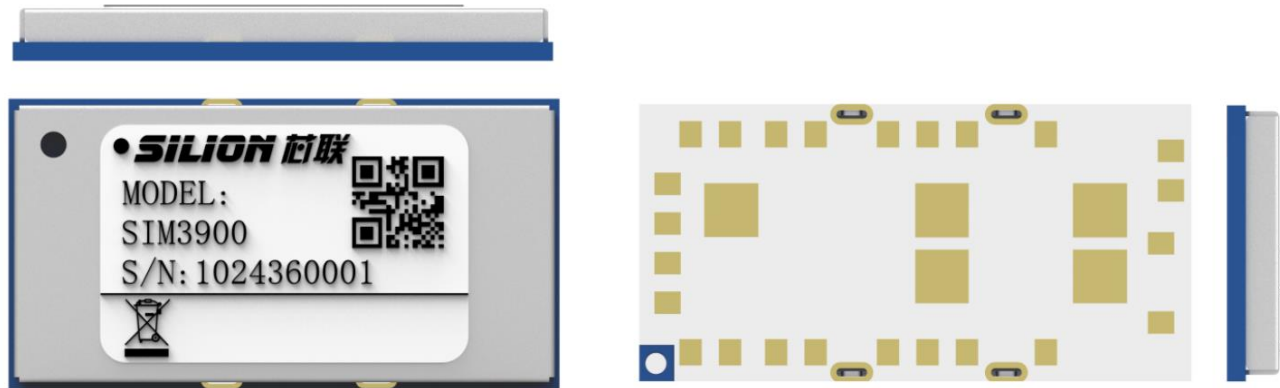
Size and packaging information

Package size

21mm x 10.5mm x 2.4mm (长 x 宽 x 高), 重 1.2g



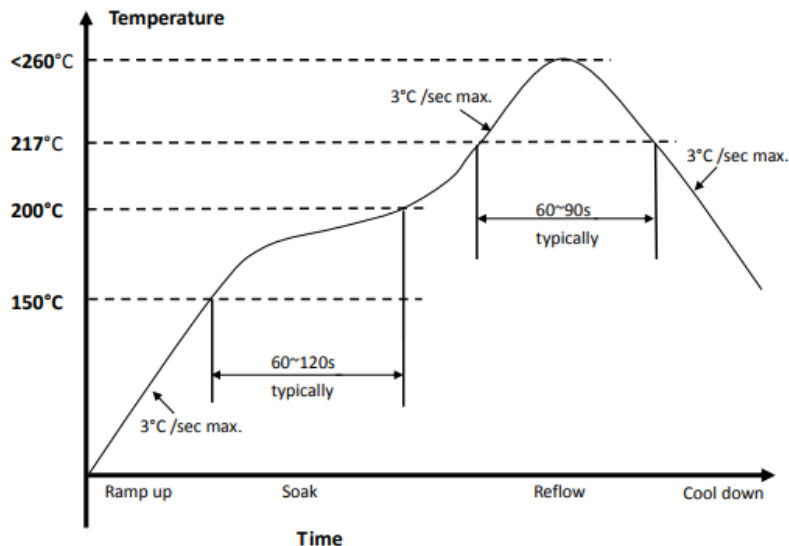
● PCB



The inner hole of the circular solder pad is for RF wiring, and copper is not laid at the position where the module is attached to the bottom plate. The next layer of the bottom plate should be laid on the ground.

Suggest using the provided module packaging to reduce circuit design time.

SMT reflow soldering information



It is recommended to use the temperature control shown in the above figure for surface mount reflow soldering

1. Refer to IPC/JEDEC standards.
2. Peak temperature: <260 °C.
3. Reflow soldering cycle times: maximum 2 times.

4. Add nitrogen (N₂) during the reflow soldering process to achieve an oxygen concentration requirement of 2000ppm or lower.

5. The baking temperature requirement is $125\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$, and the baking time requirement is:

A. For baking time of 4H within three to six months.

B. For baking for more than six months, the baking time is 24 hours.

FCC Statement

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.

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

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

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 and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Country Code selection feature to be disabled for products marketed to the US/Canada.

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

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,

As long as the two conditions above are met, further transmitter testing 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.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID 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 FCC ID: **2AQ9M-SIM3900** "

Manual Information to the End User

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 v01r01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

Not applicable

2.6 RF exposure considerations

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.

2.7 Antennas

This radio transmitter **FCC ID: 2AQ9M-SIM3900** has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
RFID	/	Ceramic Antenna	2.0dBi	902-928MHz

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains **FCC ID: 2AQ9M-SIM3900**".

2.9 Information on test modes and additional testing requirements

Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

2.11 Note EMI Considerations

Host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.