Overview

The UHF 1 port RFID module SIMX100 with high-performance, designed by SILION R&D team. It based on IMPINJ New Generation RF chip E710/E510/E310.

Output power can be set from 5dBm to 33dBm adjustable. Tag reading distance is more than 12m (depending on antenna gain and tag size), And has excellent multi-label inventory performance.

SIMX100 module has stable and reliable performance, it adopts advanced multi-tag recognition algorithm. Tags can be quickly identified whether moving or stationary.

Superior anti-interference design and carrier cancellation function, can work stably in various environments.

A variety of configuration modes, can be widely used in various applications such as warehousing, logistics, production lines, and patrol.

Application

● **Handheld reader**	● **Desktop reader**
● **Printer**	● **Integrated reader**

Features

- ARMv7-M architecture 32bit Cortex-M4 CPU, integrated FPU, MPU, DSP, the highest work main frequency is 200MHz, 512KByte Flash
- Support UHF EPC Class1 Gen2/ISO 18000-6C
- Provide Windows，Linux and Android SDK, and API based on C, C#/.NET, JAVA
- Support inventory of temperature tags, the output parameters include the RSSI and phase value of the tag return signal
- With max power output of 33dBm
- Excellent anti-collision algorithm and high sensitivity. The fastest speed of inventory tags is greater than 1000tag/s
- Multiple inventory mode
- UART serial communication baud rate can be set to 9600bps ~ 921600bps
- 2 inputs 2 outputs,GPIO port.
- North America and Europe frequency bands, the maximum power is 30dBm with a power consumption of 5W. In the Chinese frequency

band, the maximum power is 33dBm with a power consumption of 6.75W.

- Aluminum alloy matte shell, weighing 21g, Dimension 55.9mm x 35.6mm x 6.0mm.
- SRRC,CE,FCC and other certifications
- ROHS

Model	Sensitivity @PER 10%	The speed of inventory tag @96 bit EPC)
SIM7100	-87dbm	>1000
SIM5100	-80dbm	>600
SIM3100	-73dbm	>350

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	℃
Storage temperature	TS	-55		100	℃

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 1.5.

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	5.5	V
					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	AVCC		10		mA
Antenna port (ANT) standing wave ratio[1]	VSWR			2.5	/
Operating humidity (non-condensing)	RH	5		95	%
Operating temperature	TC	-25		65	℃
Storage temperature	TS	-40		85	℃

General Electrical 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		33	dBm
	Power step			1		dB
	Output power accuracy	5dBm~33dBm	-1		1	dB
	Output power flatness	5dBm~33dBm	-1		1	dB
	Adjacent channel leakage ratio*	1st adjacent channel		-45		dB
		2nd adjacent channel		-65		dB
	20dB occupied bandwidth*	RF_MODE 7		110		KHz
		RF_MODE 11		215		KHz
	Emission spectrum template*[3]	margin	2			dB
	Spurious Emissions (Conducted)[4]	2nd harmonic		-55		dBm
		3rd harmonic		-38		dBm
Measure	Module temperature accuracy	-25℃~115℃[5]	-4		4	℃
	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			0.00025		W
	low consumption standby mode			0.1		W
	Normal standby			0.6		W

	mode					
	Operating mode[6]	North America、Europe @30dBm		5		W
		China @33dBm		6.75		W

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	-64.0	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	-70.3	-65.2	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	-76.4	-71.2	-63	>350
12	PR-ASK	15	320	Miller M=2	-76.6	-71.4	-63	>350
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. Test instrument CISC XPLORER 200， PER 10%, output power 30dBm, antenna port echo less than -20dB.
2. Test antenna gain 12dBi, 4000 tags.
3.N/A indicate this mode is not supported.

From the above table, SIMX100 provides up to 11 configuration methods, listing the two most important indicators for measuring the reader module: sensitivity and multi-tag reading speed. There is a trade-off between sensitivity and multi-tag speed. When the sensitivity is better, the reading speed rate of tags is lower. Between reading better and reading more, need to choose the appropriate mode based on customer application needs. Another thing to note is that when multiple readers work at the same time, there will be interference. Although a smaller TARI speeds up the communication connection with the tag, it will increase the bandwidth of the emission channel, which is easier to interfere with other readers. Higher BLF of the tag will increase the speed of the tag's reverse transmission signal. The tag return signal will fall in the adjacent channel. When other readers happen to be working in this channel, the reader is likely to

be unable to demodulate the return signal of the label.

Inventory Mode Parameters

For different application scenarios, SIMX100 provides multiple working modes. Except for the temperature-controlled multi-tag inventory mode, other function are automatically completed by the reader module. This not only saves the command interaction time between the host and the reader module, but the excellent processing algorithm also greatly enhances the application adaptability of the product.

Application	Operating Mode	Description
Few tags, remote inventory	Normal mode	Recommend RF_MODE 13, session 0, with a customization read duration based on the reporting cycle, preferably 50ms or more. The minimum read interval can be set to 0ms.
	Fast mode	Recommend RF_MODE 13, session0, Target: A
Few tags multi-times inventory	Fast mode	Recommend RF_MODE 11/103(E710)、RF_MODE 1/120(E510)、RF_MODE 12/345(E310), session1, Target A-B, static Q value (2^Q≥number of tags) can even be read at a single frequency point
Multi-tag inventory	EX10 fast mode	Gen2 parameter devices such as RF_MODE、session are dynamically adjusted and the tag reading speed is fast. Related parameters configured in this mode do not take effect. This mode is recommended for multi-tag testing.
Read all multi-tag	Fast mode	Recommend RF_MODE 7/13, session1, can use the full frequency band 860-960MHz when conditions permit.
Temperature controlled multi-tag inventory	E7 temperature control mode	RF_MODE auto-adjustable. When the number of new tags is less than the specified number, the working duty cycle is auto-adjusted; when the number of new tags exceeds the specified number, the full speed mode is restored.Recommended for long-term battery life test/low power consumption test Use this mode.

High read rate inventory multi-tag	Fast mode	Recommended mode RF_MODE 11/103（E710）、RF_MODE 1/120（E510）、RF_MODE 12/345（E310），session2/3, Target A, static Q value (2^Q≥number of tag).

※ If the above mode is supported by the motherboard and communication interface, it will be better to increase the baud rate to 921600bps (the default baud rate is 115200bps).

PIN Configuration and Function

erface			
			Description
1	VCC	Power supply	Power supply voltage, input range: 3.6V-5.25V.
2	VCC	Power supply	Power supply voltage, input range: 3.6V-5.25V.
3	GND	Power supply	Ground
4	GND	Power supply	Ground
5	EN	Digital input	Module enable pin, the module is enabled when connected to a high level or left floating; the module is powered off when connected to a low level.
6	OUT2	Digital I/O	General-purpose I/O port output, push-pull output.
7	IN1	Digital I/O	General-purpose I/O input
8	IN2	Digital I/O	General-purpose I/O output
9	RXD	Digital input	Module UART input, 3.3V TTL voltage
10	TXD	Digital output	Module UART output, 3.3V TTL voltage
11	NRST	Digital input	Module reset, pull low to reset the module, can be left floating when not in use.
12	OUT1	Digital I/O	General-purpose I/O port output, push-pull output.
	ANT	RF	RF antenna port (50Ω)

Module bottom solder pads.			
PIN No.	**PIN name**	**Type**	**Description**
1	GND	Power supply	Ground
2	GND	Power supply	Ground
3	VCC	Power supply	Power supply voltage, input range: 3.6V-5.25V.
4	VCC	Power supply	Power supply voltage, input range: 3.6V-5.25V.
5	EN	Digital input	Module enable pin, the module is enabled when connected to a high level or left floating; the module is powered off when connected to a low level.
6	RXD	Digital input	Module UART input, 3.3V TTL voltage
7	TXD	Digital output	Module UART output, 3.3V TTL voltage
8	NRST	Digital input	Module reset, pull low to reset the module, can be left floating when not in use.
9	OUT1	Digital I/O	General-purpose I/O port output, push-pull output.

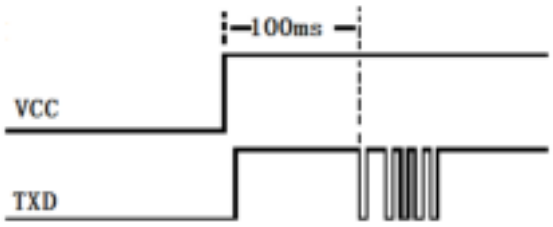
* Interface FFC/FPC connector: Pitch 1mm, P number: 12P, Drawer type, Bottom connection.

*RF antenna port connector: MMCX.

Application Description

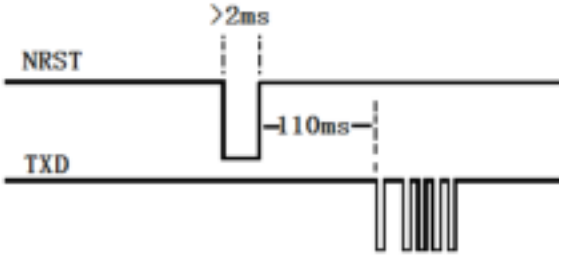
Power-on Boot and IO Interface

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.



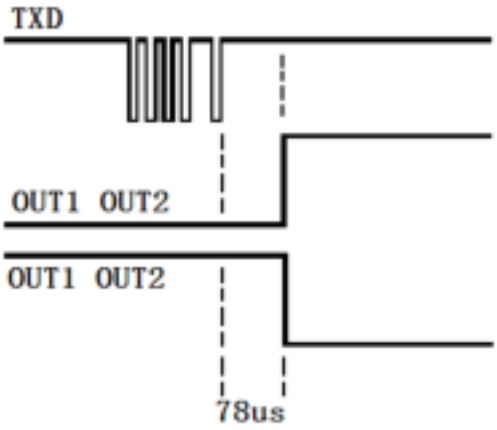
Power-on boot time

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.

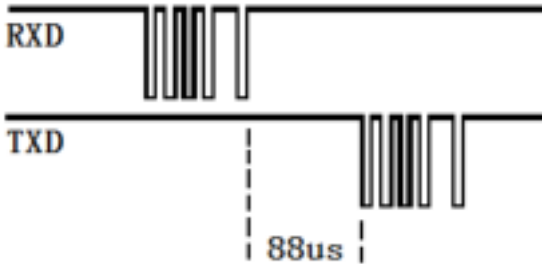


Reset waiting time

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).

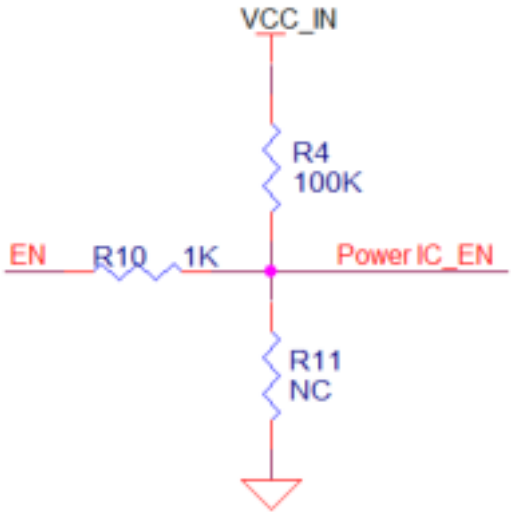


OUT1，OUT2 action time



IN1，IN2 action time

The EN pin has a built-in 100K 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).

During serial communication, the signal frequency aligns closely with the Backscatter Link Frequency (BLF) from tags, potentially causing interference with the RF chip module's reception. To mitigate this, if serial PCB traces are lengthy, consider placing them in inner PCB layers or on the layer opposite to the antenna. Additionally, include series-matching resistors and parallel

capacitors to ground to minimize signal ringing. For inter-board connections, route lines close to the ground.

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.

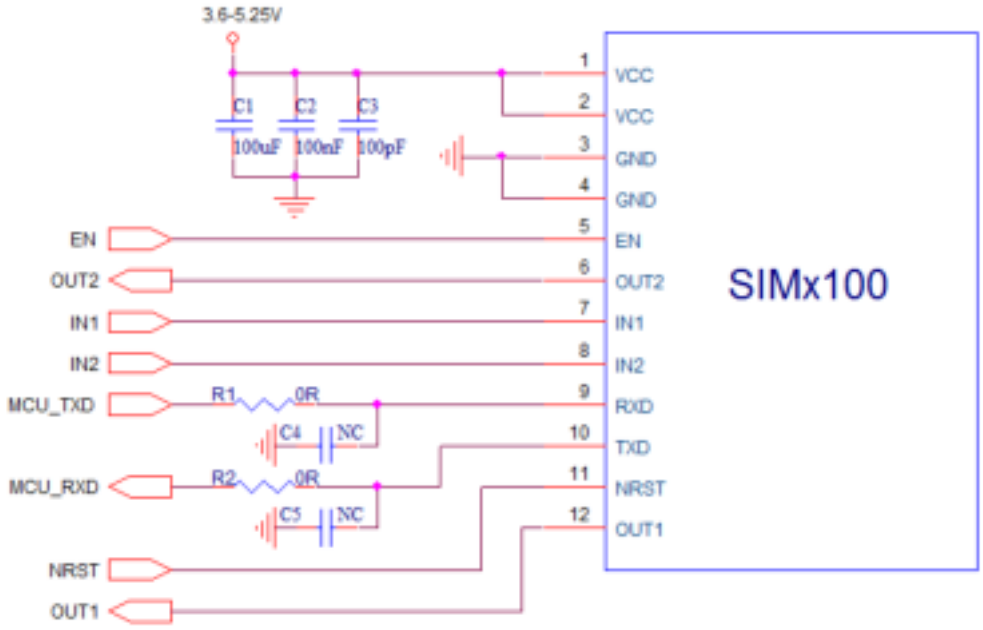
Since there is no RF isolator or RF circulator used between the power amplifier chip in the module

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.

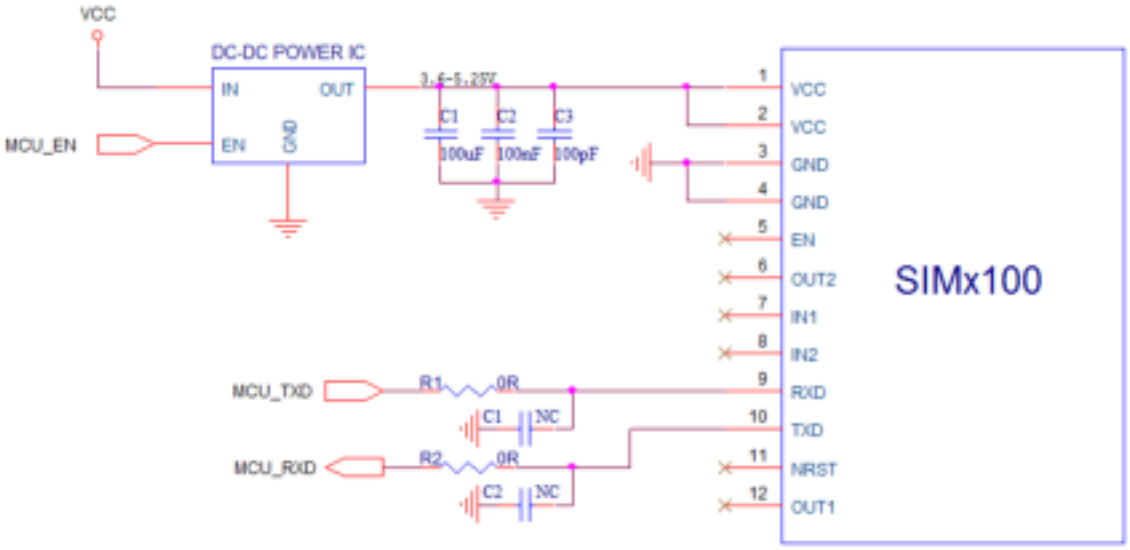
Heat Dissipation

SIMx100 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



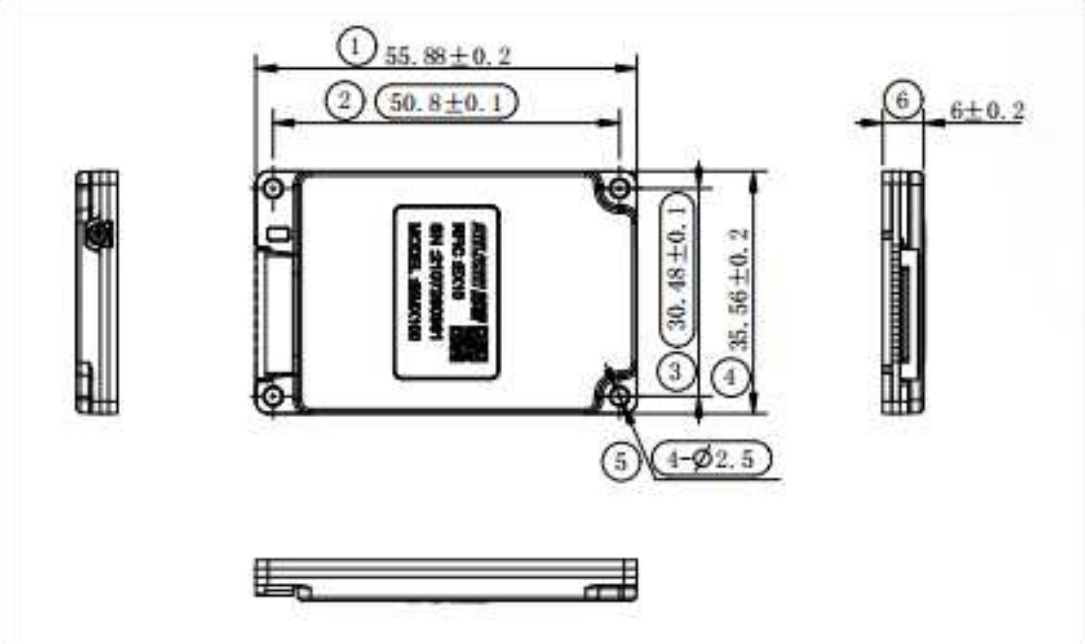
Simplified Reference Circuit



● Label Explanation

Dimension

55.9mm x 35.6mm x 6.0mm， weight 21g

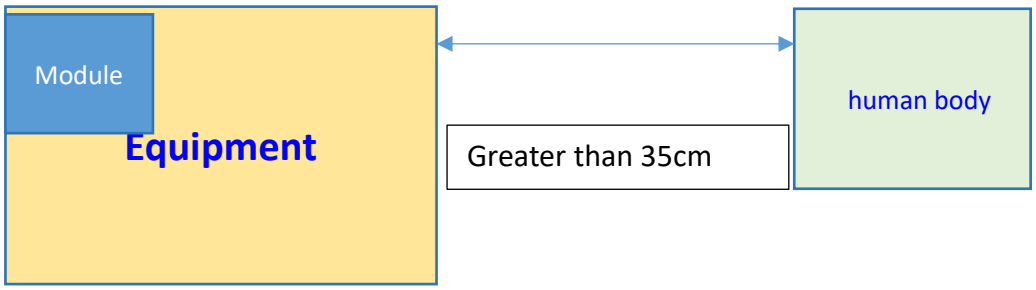


Appearance

Version

Version	Date	Modify content
V1.0	2023/7/6	First edition
V1.1	2023/11/16	Add application scenario parameter configuration
……		

The RFID module is installed inside the user's device. Since the maximum power output of this product can be close to the standard limit(30dBm), the device must be at least 35cm away from the human body.



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, pursua nt to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful inte rference in a residential installation. This equipment generates uses and can radiate radio frequency energy a nd, if not installed and used in accordance with the instructions, may cause harmful interference to radio com munications. 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 turn ing 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 important announcement Important Note:

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 35cm 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 35 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-SIM710002** "

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 35cm between the radiator & your body.

2.7 Antennas

This radio transmitter **FCC ID: 2AQ9M-SIM710002** 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	/	External antenna	6.0dBi	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-SIM710002".

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.