Hardware Design

SIM20_HD_V2.02
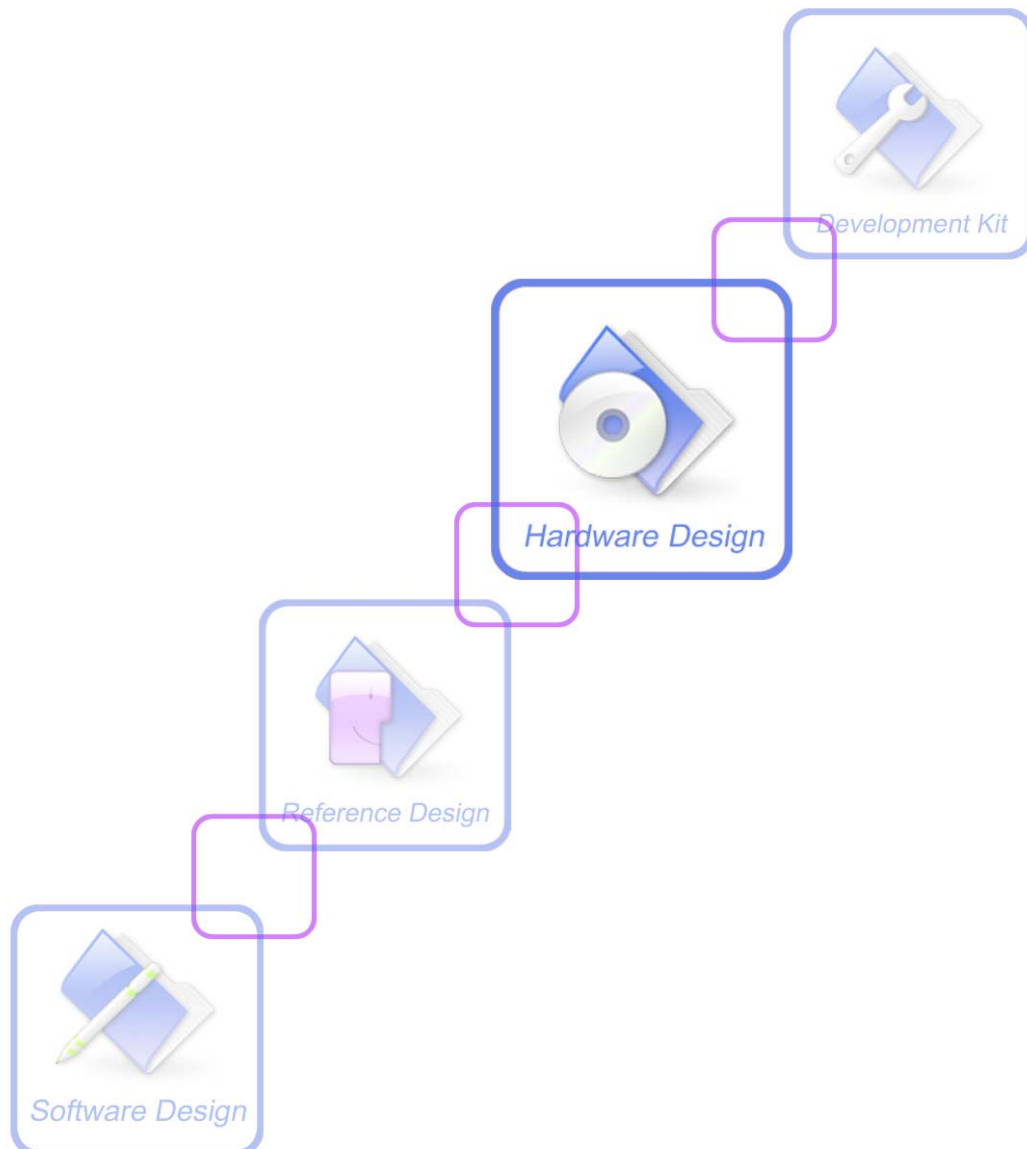
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Version History

Data	Version	Description of change	Author
2009-09-16	02.01	Origin	Jirang.Feng, Liya
2009-12-02	02.02	Page 10: Figure 2: Top view of SIM20 EVB and TE Page 11: Figure 3: SIM20 pads configuration Table 4: Pad name and description Page 18:Table 11: SIM20 operating temperature Page 20:Figure 10, Figure 11，Figure 12	Qunhui.tan, Liya

Scope of the document

This document is intended for the following versions of the SIMCom modules

● SIM20-A: SRD RF 433MHz– 434.79MHz Version

● SIM20-B: SRD RF 863MHz – 870MHz Version

● SIM20-C: SRD RF 902MHz – 928MHz Version

1 Introduction

This document describes the hardware interface of the SIMCom SIM20 module, which can be used in the specific applications and the air interface fields. As SIM20 module can be integrated to products in a wide range of applications, functional components of SIM20 are described in details as following chapters.

This document helps users to understand SIM20 interface's specifications, electrical and mechanical details quickly. With the help of this document and the other notes or documents, users can use SIM20 module to design and set up wireless applications quickly.

1.1 Related documents

Table 1: Related documents

SN	Document name	Remark
[1]	NDA_SIM20-EVB_U GD_V2.02	SIM20-EVB application note helps the users to develop their product
[2]	SIM20_SPEC	The module's parameters are described in this document

1.2 Terms and abbreviations

Table 2: Terms and abbreviations

Abbreviation	Description
RF	Radio Frequency
IIC	Inter-Integrated Circuit
UART	Universal Asynchronous Receiver & Transmitter
SPI	Serial Peripheral interface
SRD	Short Range Devices
ISP	In System Program
DTE	Data Terminal Equipment

2 SIM20 overview

SIM20 designed for global market is a highly-integrated, semi-duplex, multi-channel, low power and wireless communication module. It includes high speed MCU and perfect performance RF chip, so it has the perfect receiving sensitivity、 programmable transmitting power and data rate. SIM20 supports the multi-channel choice, transparent date transfer without complex user settings, it also supports UART、IIC、SPI interface. With a tiny configuration of 21mm×13.8mm×2.6mm, SIM20 can fit almost all space requirements in user application, such as Low cost wireless data transfer, Wireless sensor, Wireless metering, Wireless medical telemetry service, Process and building control, Remote control, security systems, Home automation, Keyless entry and so on. SIM20 is designed with power saving technique, so the typical sleep current is as low as 16uA.

The physical interface of SIM20 as following:
- One power pad and ten ground pads.
- UART interface
- SPI interface (reserved).
- IIC interface (reserved).
- Two lines download
- One antenna interface.

SIM20 is integrated with the Error Detection and Correction algorithm, which is very useful for those data transfer applications.

2.1 SIM20 key features

Table 3: SIM20 key features

Feature	Implementation
Standard	ETSI EN 300-200, FCC Part 15, Chinese SRD regulatory standards
Frequency	SIM20-A: 433MHz– 434.79MHz SIM20-B: 863MHz – 870MHz SIM20-C: 902MHz – 928MHz
Modulation schemes	GFSK
Frequency interval	100KHz
Max Transmit power	18dBm
Receive sensitivity	-118dBm@2400bps
Air date rate	2400 – 128000bps
UART interface date rate	115200bps
Interface check mode	8E1/8N1/801

Interface buffer size	512bytes
Sleep current consumption	16uA
TX current consumption	80mA@18dBm (peak value)
RX current consumption	26mA
Input voltage of the module	3.0V～3.6V(±50mV)
Connectors of the module	UART,SPI, IIC
Length × Width × Height	21mm×13.8mm×2.6mm
Weight	1.5g
Operation temperature	-20℃ ～ 70℃
Storage temperature	-40℃ ～ 85℃
Operation humidity	10%～90%

2.2 SIM20 functional diagram

The following figure shows a functional diagram of SIM20, and it illustrates the main functional parts:
- Digital baseband engine
  SIM20 module selects Silicon Lab's 8 bit MCU for current use, this MCU can run up to 24.5MIPS.
- RF engine
  SIM20 module selects Silicon Lab's short distance RF chip for current use, and this chip provides programmable power controller, high performance data detect, and users can improve the detection performance by selecting higher correlation sequence
- Module interface.
  SIM20 provides 22 SMD pads, which contain UART, IIC, SPI, Antenna, Power supply, ground, download interface.
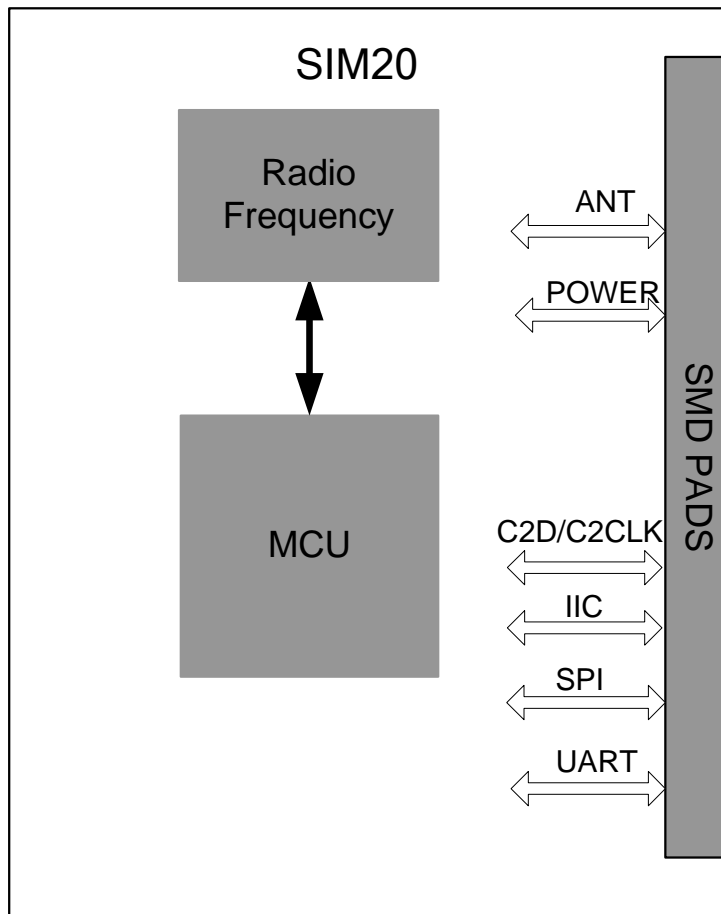
Figure 1: SIM20 functional diagram

2.3 SIM20 evaluation board

In order to help users to develop SIM20, SIMCom supplies an evaluation board (EVB), with appropriate power supply, UART interface, IIC interface and SPI interface.
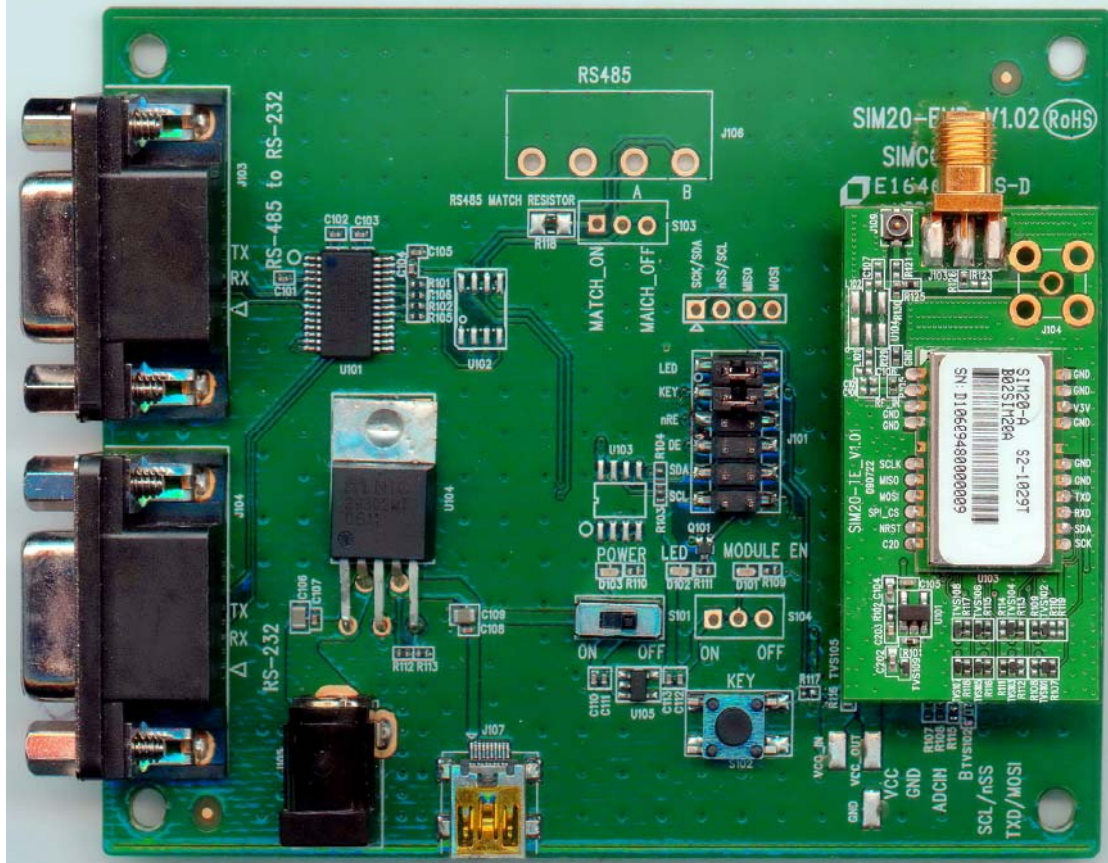
Figure 2: Top view of SIM20 EVB and TE

Note: For details please refer to the NDA_SIM20-EVB_UGD_V2.02 document.

3 Application Interface

3.1 SIM20 Pads description

The following figure shows SIM20 pads assignment. And more descriptions are contained in the following table.
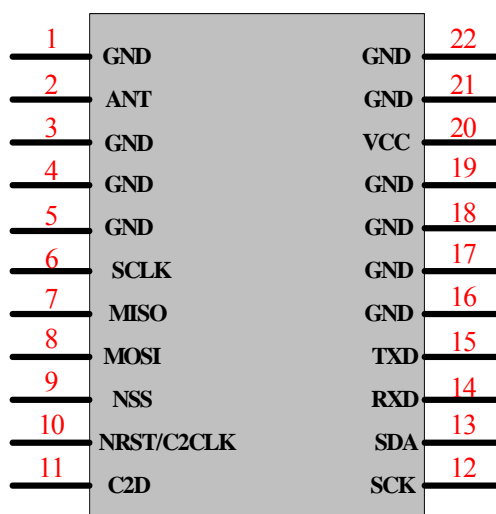
Figure 3: SIM20 pads configuration

Table 4: Pad name and description

Pads	Name	I/O	Description	DC Characteristics
20	VCC	power	The power supply of SIM20 has to be a single voltage source of VCC= 3.3V.	Vmax= 3.6V Vmin=3.0V
2	ANT	antenna	Antenna interface	
1,3,4,5, 16,17,18, 19,21,22	GND	ground	ground	
6	SCLK	O	SPI clock	
7	MISO	I	SPI master in slave out	
8	MOSI	O	SPI master out slave in	
9	NSS	O	SPI slave selected output signal	
10	NRST /C2CLK	I	reset input/ Clock signal for the C2 Debug Interface	
11	C2D	I/O	Bi-directional data signal for the C2 Debug Interface	
12	SCK	O	IIC clock	In the IIC Mode, Users must pull up a resistor to high voltage
13	SDA	I/O	IIC data	
14	RXD	I	Receive Data	
15	TXD	O	Transmit Data	

3.2 Power supply

The power supply of SIM20 is between 3.0V to 3.6V. It is better that the power supply to the EVB is 1V lager than the power supply to SIM20. So users should calculate the appropriate value when users validate the power system for SIM20.

The circuit design of the power supply depends strongly from the power source where this power is drained. As in the following figure, the power supply of the EVB is 5V, and the designed output for the power supply is 4.2V. Thus a linear regulator can be used. The 4.2V is dropped to 3.3V by LDO supply for SIM20 module.

The single 4.2V Li-Ion cell battery type can be connected to the power supply of the SIM20-EVB directly.
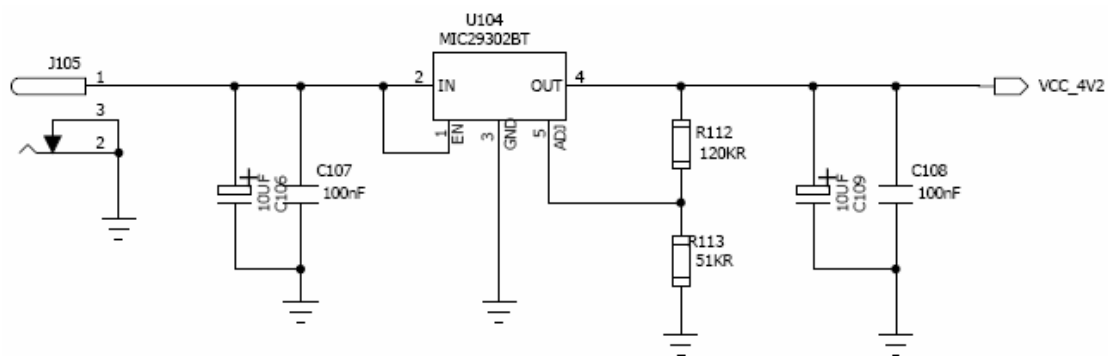
Figure 4: Reference circuit of the source power supply input

Power supply pads on SIM20.

One VCC pad of SIM20 is used for power supply. Ten GND pads are used for ground.

3.3 Turn-on and Turn-off the SIM20

3.3.1 Turn on SIM20

SIM20 can be turned on automatically when power is supplied.

3.3.2 Turn off SIM20

Users can turn off SIM20 module by cutting off supply power.

3.4 Peripheral interface

SIM20 provides three asynchronous interfaces: URAT, IIC and SPI. All hardware interfaces are described in detail in following chapters.

3.4.1 Communicate Connection Interface

UART interface:

The default UART can be used as communication interface. The UART interface supports 115200 bps by default, the typical use as following figure.

- TXD: Send data to the RXD signal line of the DTE
- RXD: Receive data from the TXD signal line of the DTE
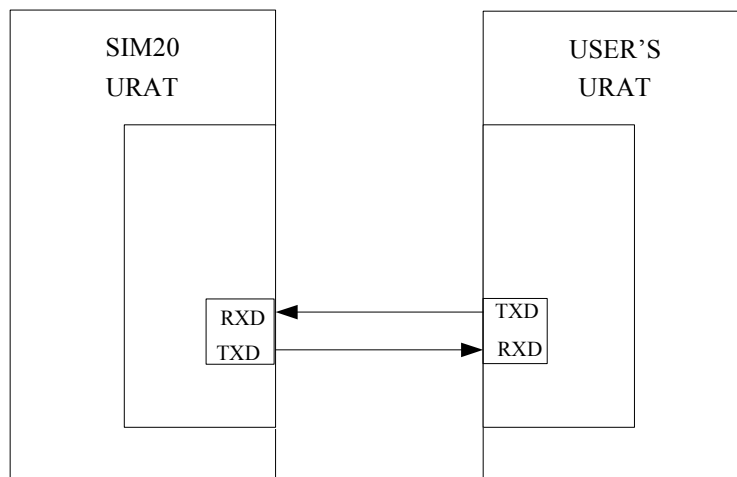
Figure 5: UART interface

IIC interface:

The reserved IIC interface, in the application IIC (SDA & SCK) lines need to be connected to VCC（3.3V）via 4.7K pull-up resistor.

The IIC works in host mode usually, but the IIC interface can be configured to master or slave according to the user requirement, the typical use as following figure.
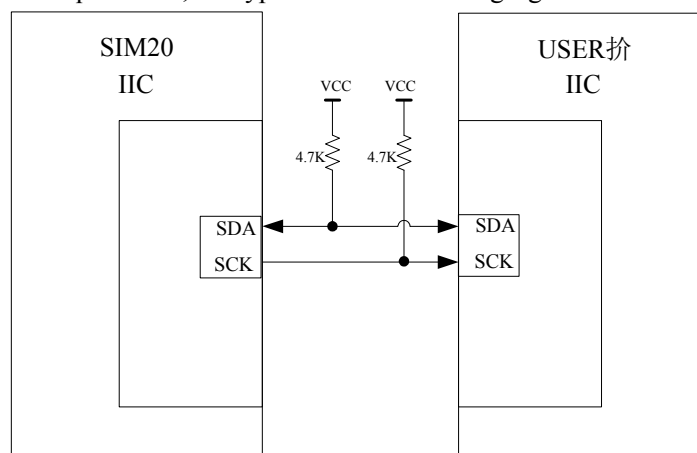
Figure 6: IIC interface

SPI interface:

The reserved SPI interface can be used as communication interface also. The module works in host mode usually, but the SPI can be configured master or slave according to the user requirement, the typical use as following figure.
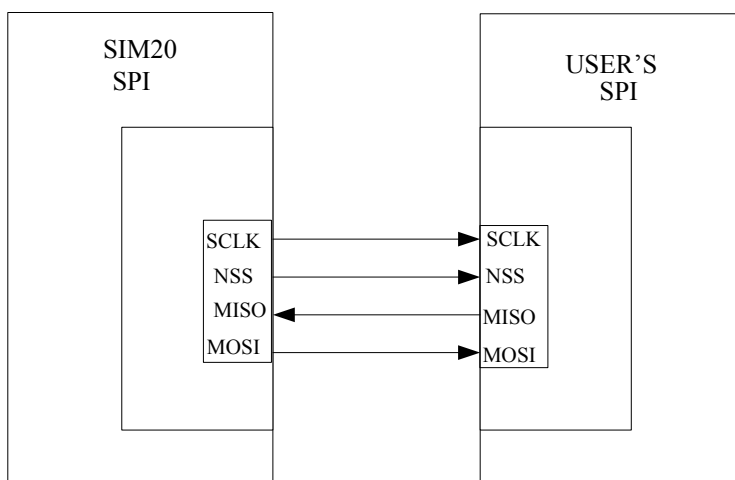
Figure 7: SPI interface

Note:

- TXD: Transmit Data
- RXD: Receive data
- SDA: IIC data
- SCK: IIC clock
- SCLK: clock of SPI
- NSS: slave select input of SPI
- MISO: Master in slave out of SPI
- MOSI: Master out slave in of SPI

3.4.2 Logic levels of peripheral interfaces

Table 5: Logic levels of serial interfaces

Parameter	Min	Max	Unit
Logic low input	—	0.6V	V
Logic high input	VCC－0.6V	—	V
Logic low output	—	0.6V	V
Logic high output	VCC－0.7V	—	V

(1).The operation voltage VCC is 3.3V.

3.4.3 Software upgrade

SM20 software can be upgraded by C2 interface, as following figure.
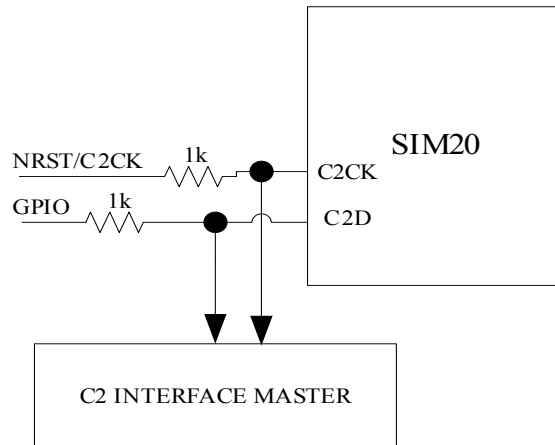
**Figure 8: C2 interface software upgrade**

3.5 General purpose input and output

SIM20 provides three asynchronous interfaces: URAT, IIC and SPI. All hardware interfaces are described in detail in following chapters.

Table 6: GPIO of SIM20

Pad	Name	I/O	Typical	Alternate	Description
6	SCLK	I/O	GPIO	Clock of SPI	General purpose input and output
7	MISO	I/O	GPIO	Master in slave out of SPI	
8	MOSI	I/O	GPIO	Master out slave in of SPI	
9	NSS	I/O	GPIO	Slave select input of SPI	
11	C2D	I/O	Data signal for the C2 debug interface	GPIO	
12	SCK	I/O	GPIO	IIC clock	General purpose input and output
13	SDA	I/O	GPIO	IIC data	
14	RXD	I	Receive data	GPIO	
15	TXD	O	Transmit Data	GPIO	

4 Antenna interface

4.1 Antenna installation

The RF interface has an impedance of 50Ω. To suit the physical design of individual applications SIM20 has ANT pad which can be connected to antenna or antenna connector, as following figure.
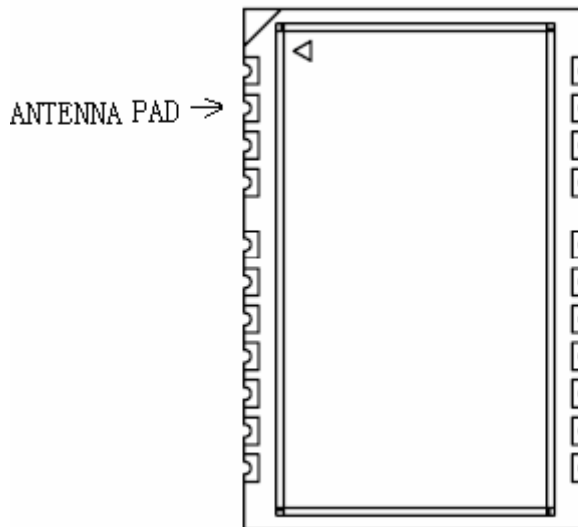
Figure 9: ANTENNA PAD

When you layout the lines to antenna, keep the impedance of the microstrip-line to be 50Ω. And also keep the antenna input impedance to be 50Ω. To minimize the loss, keep the ground out of the microstrip-line at least twice the width of the microstrip-line.

When you layout the line to an antenna connector, using RF cable to connect antenna, it needs to be very careful to choose RF cable. It is recommended that the insertion loss should meet the following requirement:

433 MHz-434.79 MHz <0.3 dB

863 MHz-870 MHz< 0.5 dB

902 MHz-928 MHz<0.5 dB

4.2 Module RF output power

The output power can be programmable from 9dbm to 18dBm in 4 levels. It can be easily set in SIM20's demon software. And the power can be set as the following table.

Table 7: SIM20 RF output power

Frequency	Power
433MHz	18dBm Max Output Power, configurable 9 to 18dBm
863MHz	Level 0: 9dBm Level 1: 12dBm
902MHz	Level 2: 15dBm Level 3: 18dBm

4.3 Module RF receive sensitivity

Table 8: SIM20 RF receive sensitivity

Frequency	Conductive Receive sensitivity
433MHz	
863MHz	-118dBm@2400bps,GFSK
902MHz	

4.4 Module related frequencies

Table 9: SIM20 receive/transmit frequency

Crystal Frequency	Receive Frequency	IF Frequency
30MHz	433MHz – 434.79MHz	937.5KHz
	863MHz – 870MHz	
	902MHz – 928MHz	

5 Electrical, reliability and radio characteristics

5.1 Absolute maximum ratings

Absolute maximum rating for power supply and voltage on digital and analog pads of SIM20 are listed in following table.

Table 10: Absolute maximum ratings

Parameter	Min	Max	Unit
Peak current of power supply	0	80	mA
RMS current of power supply	0	30	mA
Voltage at digit pads	0	5.8	V
Voltage at analog pads	0	5.8	V

5.2 Operating temperatures

The operating temperature is listed in following table:

Table 11: SIM20 operating temperature

Parameter	Min	Typ	Max	Unit
Operation temperature	-20	25	70	℃
Storage temperature	-40	25	85	℃

5.3 Power supply rating

Table 12: SIM20 power supply rating

Parameter	Description	Conditions	Min	Typ	Max	Unit
VCC	Supply voltage	Voltage must stay within the min/max values, including voltage drop, ripple, and spikes.	3.0	3.3	3.6	V
	Voltage drop during transmit burst	Normal condition, power output max		14		mV
I_{VCC}	TX mode	RMS current		35		mA
	RX mode	RMS current		26		mA
	Peak supply current	80mA@18dBm (peak value)		80		mA

5.4 Electro-Static discharge

The SIM20 module is subjected to ESD handing precautions that typically apply to ESD sensitive components. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application using a SIM20 module.

It is strongly recommended that equipping some clamp diodes to protect most peripheral interfaces of SIM20 from over voltage. And the measured values are shown as the following table:

Table 13: The ESD endure statue measured table

Part	Contact discharge	Air discharge
VBAT,GND, Antenna interface	±5KV	±10KV
NSS, MOSI, MISO, SCLK, SDA, SCK, RXD, TXD, NRST, C2D.	±2KV	±4KV

Note：Temperature: 25℃, Humidity: 45%

6 Mechanical dimensions of module

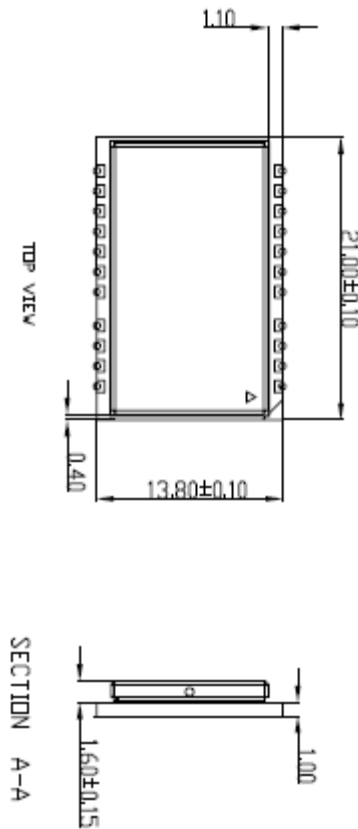Following diagrams show the mechanical dimensions of SIM20.

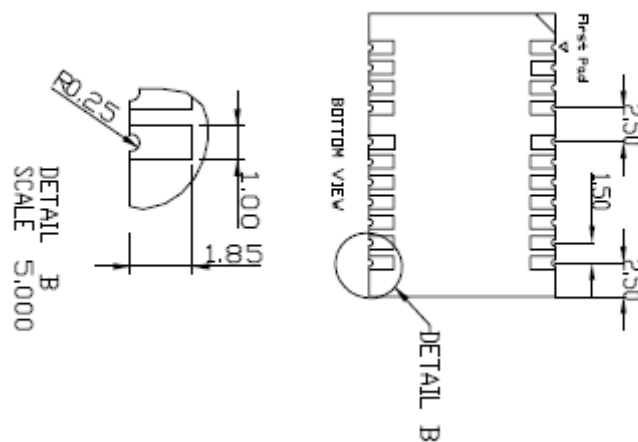**Figure 10: Mechanical drawings of SIM20（Unit: mm）**

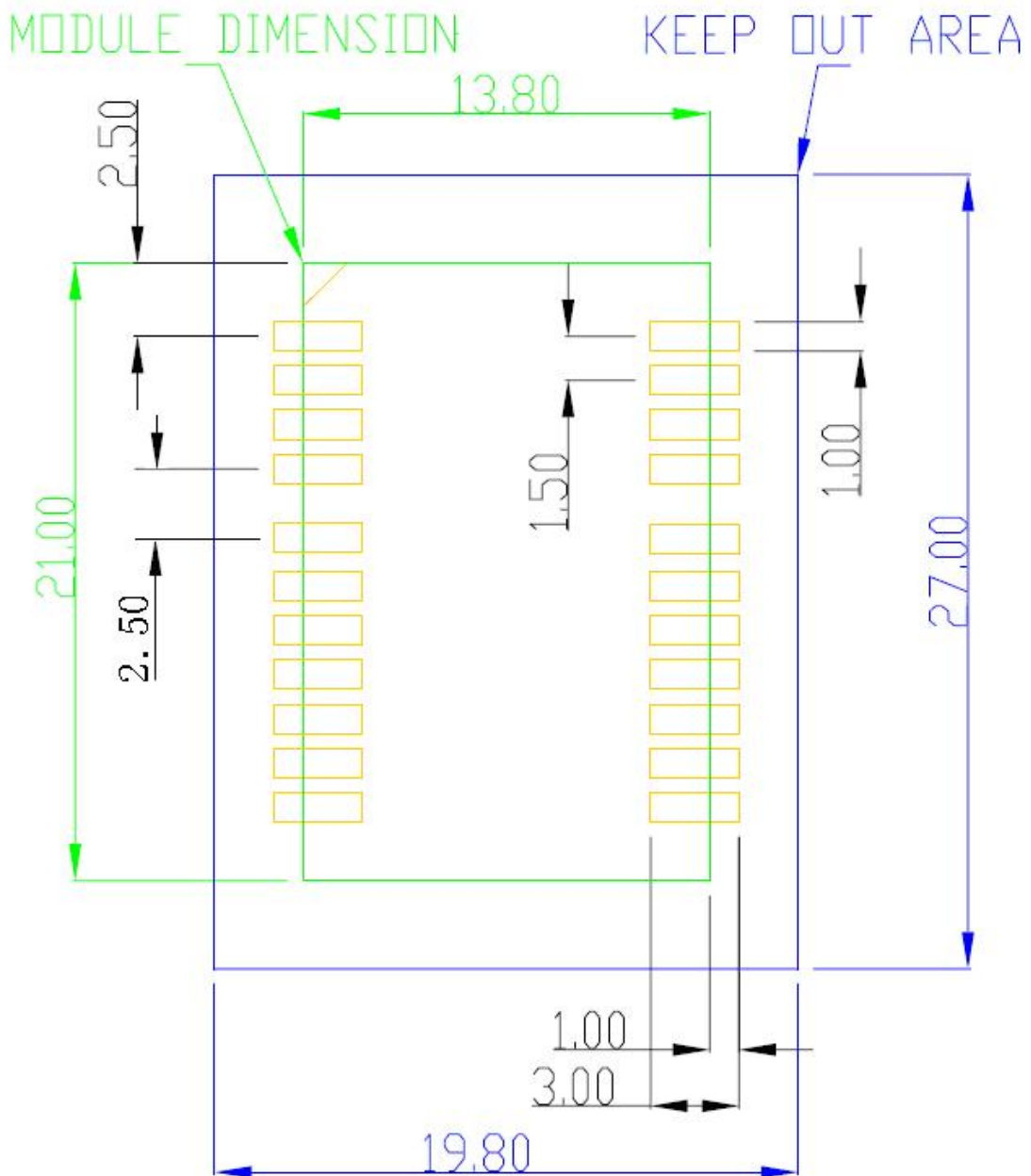**Figure 11: SIM20 bottom view（Unit: mm）**

Figure 12: Footprint recommendation （**Unit: mm**）

Note：To maintain this module, the placement must be kept a distance between the module and other component for about 3 mm, and the height of near components must be less than 16mm.
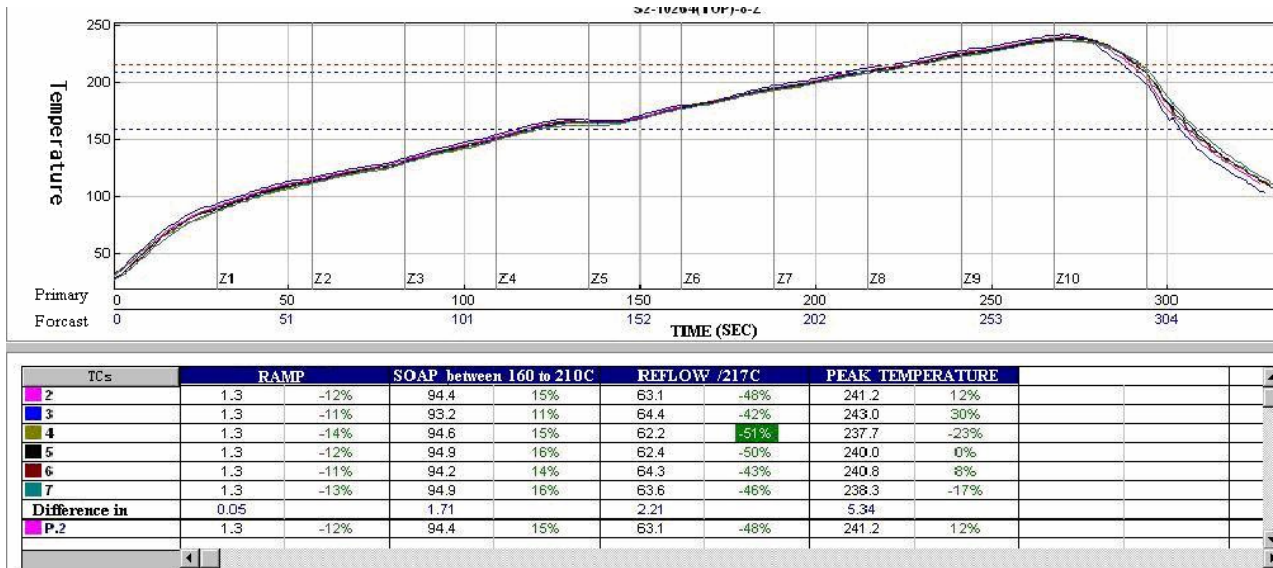
7 The ramp-soak-spike reflow profile of SIM20

TCs	RAMP		SOAP between 160 to 210C		REFLOW /217C		PEAK TEMPERATURE			
2	1.3	-12%	94.4	15%	63.1	-48%	241.2	12%		
3	1.3	-11%	93.2	11%	64.4	-42%	243.0	30%		
4	1.3	-14%	94.6	15%	62.2	-51%	237.7	-23%		
5	1.3	-12%	94.9	16%	62.4	-50%	240.0	0%		
6	1.3	-11%	94.2	14%	64.3	-43%	240.8	8%		
7	1.3	-13%	94.9	16%	63.6	-46%	238.3	-17%		
Difference in	0.05		1.71		2.21		5.34			
P.2	1.3	-12%	94.4	15%	63.1	-48%	241.2	12%		

Figure 13: The ramp-soak-spike reflow profile of SIM20

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