SC20-A Manual

LTE Module Series

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www.quectel.com

Our aim is to provide customers with timely and comprehensive service. For any assistance, please contact our company headquarters:

Quectel Wireless Solutions Co., Ltd.
7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

Or our local office. For more information, please visit:
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History

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1 Introduction

This document defines the SC20 module and describes its air interface and hardware interface which are connected with your application.

This document can help you quickly understand module interface specifications, electrical and mechanical details as well as other related information of SC20 module. Associated with application notes and user guide, you can use SC20 module to design and set up mobile applications easily.

1.1. Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating SC20 module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. If not so, Quectel assumes no liability for the customer's failure to comply with these precautions.

	Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. You must comply with laws and regulations restricting the use of wireless devices while driving.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden, so as to prevent interference with communication systems. Consult the airline staff about the use of wireless devices on boarding the aircraft, if your device offers an Airplane Mode which must be enabled prior to boarding an aircraft.
	Switch off your wireless device when in hospitals or clinics or other health care facilities. These requests are desinged to prevent possible interference with sentitive medical equipment.

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Cellular terminals or mobiles operating over radio frequency signal and cellular network cannot be guaranteed to connect in all conditions, for example no mobile fee or with an invalid SIM card. While you are in this condition and need emergent help, please remember using emergency call. In order to make or receive a call, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.

Your cellular terminal or mobile contains a transmitter and receiver. When it is ON , it receives and transmits radio frequency energy. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.

In locations with potencially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potencially exposive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders, etc.

Please do not discard. Maybe wireless devices have an impact on the environment so please do not arbitrarily discarded.

The device is restricted to indoor use only when oparating in the 5150 to 5350 Mhz frequency range.

AT	BE	BG	HR	CY	CZ	DK
EE	FI	FR	DE	EL	HU	IE
IT	LV	LT	LU	MT	NL	PL
PT	RO	SK	SI	ES	SE	UK

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2 Product Concept

2.1. General Description

SC20 is a series of 4G smart modules based on Qualcomm platform and Android operating system, with providing industrial grade performance. It supports worldwide LTE-FDD/LTE-TDD/WCDMA/TD-SCDMA/ EVDO/CDMA/GSM coverage, and also supports short-range wireless communication via Wi-Fi 802.11a/b/g/n and BT4.1 LE. Additionally, SC20 integrates GPS/GLONASS/BeiDou satellite positioning systems. Due to multiple speech and audio codecs as well as the built-in high performance Adreno™ 304 graphics processing unit, it enables smooth play of 720P videos. The module also offers multiple audio and video input/output interfaces as well as abundant GPIO interfaces.

The following table shows the supported network types and frequency bands of SC20.
Including a series of product such as:SC20-CE,SC20-A,SC20-AU,SC20-E,SC20-J.

Table 1: SC20-A Frequency Bands

Type	Frequency
LTE-FDD	B2/B4/B5/B7/B12/B13/B25/B26
WCDMA	B1/B2/B4/B5/B8
GSM	850/1900MHz
Wi-Fi 802.11a/b/g/n	2412-2472MHz; 5180-5825MHz
BT4.1 LE	2402-2480MHz
GNSS	GPS/GLONASS/BeiDou

SC20 is an SMD type module, which can be embedded into applications through its 210-pin pads including 146 LCC signal pads and 64 other pads. With a compact profile of 40.5mm × 40.5mm × 2.8mm, SC20 can meet almost all requirements for M2M applications such as CPE,automotive, smart metering, tracking, security, routers, wireless POS, mobile computing devices, PDA phone, tablet PC, etc.

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2.2. Key Features

The following table describes the detailed features of SC20 module.

Table 2: SC20 Key Features

Feature	Details
Applications Processor	ARM Cortex-A7 microprocessor cores (quad-core) up to 1.1 GHz 512KB L2 cache
Modem DSP	QDSP6 v5 core up to 691.2 MHz 768KB L2 cache
Memory	8GB EMMC+8Gb LPDDR3
Operating System	Android OS 5.1
Power Supply	Supply voltage: 3.5V~4.2V Typical supply voltage: 3.8V
LTE Features	Support 3GPP R10 CAT4 FDD and TDD Support 1.4 to 20 MHz RF bandwidth Support DL 2 x 2 MIMO FDD data rate: Max 150Mbps (DL), 50Mbps (UL) TDD data rate: Max 130Mbps (DL), 35Mbps (UL)
WCDMA Features	Support 3GPP R8 DC-HSPA+ Support 16-QAM, 64-QAM and QPSK modulation 3GPP R6 HSUPA: Max 5.76Mbps (UL) 3GPP R8 DC-HSPA+: Max 42Mbps (DL)
TD-SCDMA Features	Support CCSA Release 3 Max 4.2Mbps (DL), 2.2Mbps (UL)
CDMA Features	Max 3.1Mbps (DL), 1.8Mbps (UL)
GSM/GPRS/EDGE Data Features	GPRS Support GPRS multi-slot class 33 Coding scheme: CS-1, CS-2, CS-3 and CS-4 Maximum of four Rx time slots per frame EDGE Support EDGE multi-slot class 33 Support GMSK and 8-PSK
WLAN Features	Support 2.4G and 5G frequency band, (SC20-CE does not support 5G frequency). Support 802.11a/b/g/n, data rate up to 150Mbps Support AP mode;
Bluetooth Feature	BT4.1 LE

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GNSS Features	GPS/GLONASS/BeiDou
SMS	Text and PDU mode Point to point MO and MT SMS cell broadcast SMS storage: ME by default
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and Quectel enhanced AT commands
LCM Interface	4 lanes MIPI_DSI, up to 1.5Gbps each Support WVGA (2 lanes MIPI_DSI), up to 720p (4 lanes MIPI_DSI) 24bit color depth
Camera Interface	Use MIPI_CSI, up to 1.5Gbps per lane, support two cameras 2-lane MIPI_CSI for rear camera, up to 8MP 1-lane MIPI_CSI for front camera, up to 2MP
Audio Interface	Audio input 2 groups analog microphone input, integrate internal bias voltage Audio output Class AB stereo headphone output Class AB earpiece differential output Class D speaker differential amplifier output
USB Interface	Compliant with USB 2.0 specification; the data transfer rate can reach up to 480Mbps Used for AT command communication, data transmission, software debugging and firmware upgrade Support USB OTG (Need additional 5V power supply chip) USB Driver: Support Windows XP, Windows Vista, Windows 7, Windows 8, Windows CE5.0/6.0*, Linux 2.6/3.0, Android 2.3/4.0/4.2
USIM Interface	2 groups of USIM interface Support USIM/SIM card: 1.8V, 3.0V
UART Interface	2 groups of UART interface 4-wire UART interface with RTS and CTS hardware flow control 2-wire UART interface for software debugging Baud rate up to 4Mbps
SDIO Interface	Support SD3.0; 4bit SDIO; SD Card Support hot plug
I2C Interface	3 groups I2C, used for TP, camera, sensor peripherals, etc.
ADC Interface	Support 3 ADC interfaces,used for input voltage sense, battery temperature detection and general purpose ADC
Real Time Clock	Implemented
Antenna Interface	MAIN antenna, DRX antenna, GNSS antenna and Wi-Fi/BT antenna
Physical Characteristics	Size: 40.5±0.15 × 40.5±0.15 × 2.8±0.2 mm Interface: LCC

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	Weight: approx. 9.6g
Temperature Range	Operating temperature range: -35°C~+65°C 1) Extended temperature range : -40°C~+75°C 2)
Firmware Upgrade	Over USB interface
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

1) Within operation temperature range, the module is 3GPP compliant.
2) Within extended temperature range, the module remains the ability to establish and maintain a voice, SMS, data transmission, emergency call, etc. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like Pout might reduce in their value and exceed the specified tolerances. When the temperature returns to the normal operating temperature levels, the module will meet 3GPP compliant again.
* means this feature is under development.

2.3. Functional Diagram

The following figure shows a block diagram of SC20 and illustrates the major functional parts.

- Power management
- Radio frequency
- Baseband
- LPDDR3+EMMC flash
- Peripheral interface
  --USB interface
  --USIM interface
  --UART interface
  --SDIO interface
  --I2C interface
  --ADC interface
  --LCD (MIPI) interface
  --TP interface
  --CAM (MIPI) interface
  --AUDIO interface

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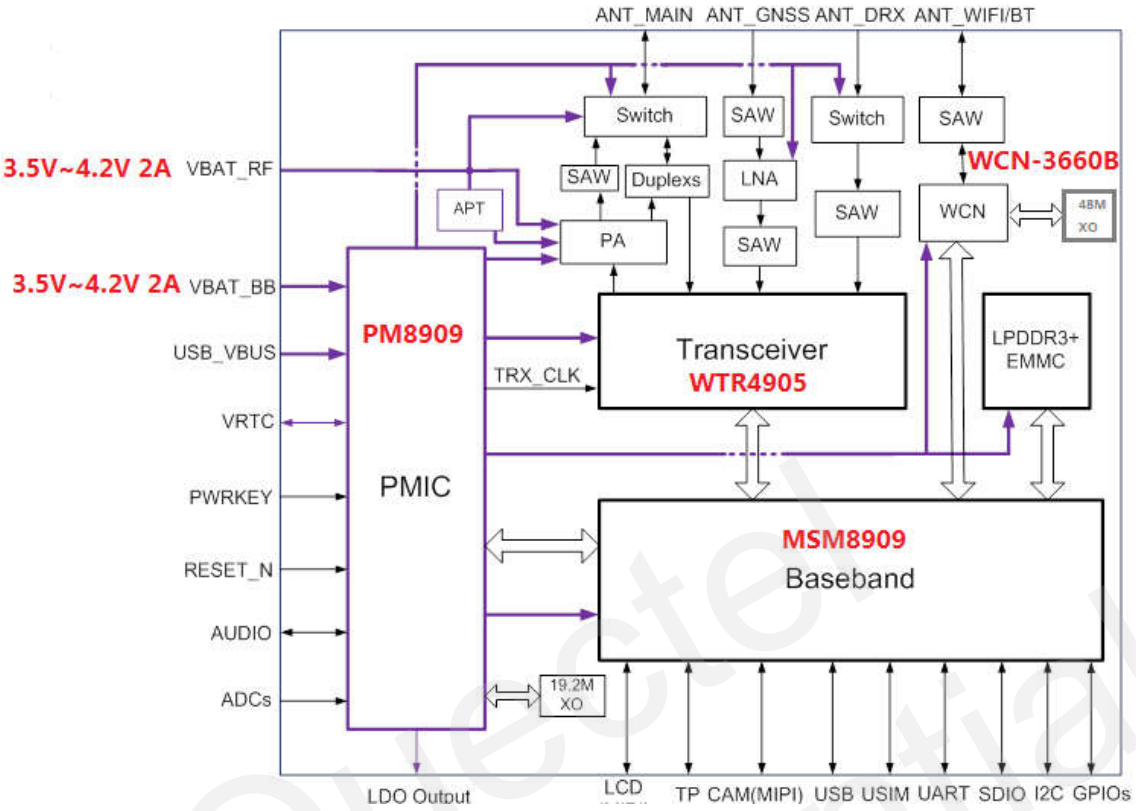

Figure 1: Functional Diagram

2.4. Evaluation Board

In order to help you to develop applications with SC20, Quectel supplies an evaluation board (SMART-EVB), RS-232 to USB cable, USB data cable, power adapter, earphone, antenna and other peripherals to control or test the module. For details, please refer to ***document [1].***

3 Application Interfaces

3.1. General Description

SC20 is equipped with 146-pin 1.0mm pitch SMT pads plus 64-pin ground pads and reserved pads that can be embedded into cellular application platform. The following chapters provide the detailed description of pins/interfaces listed below.

- Power supply
- VRTC interface
- LCM interface
- TP interface
- Camera interface
- Audio interface
- USB interface
- USIM interface
- UART interface
- SDIO interface
- I2C interface
- ADC interface

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3.2. Pin Assignment

The following figure shows the pin assignment of SC20 module.

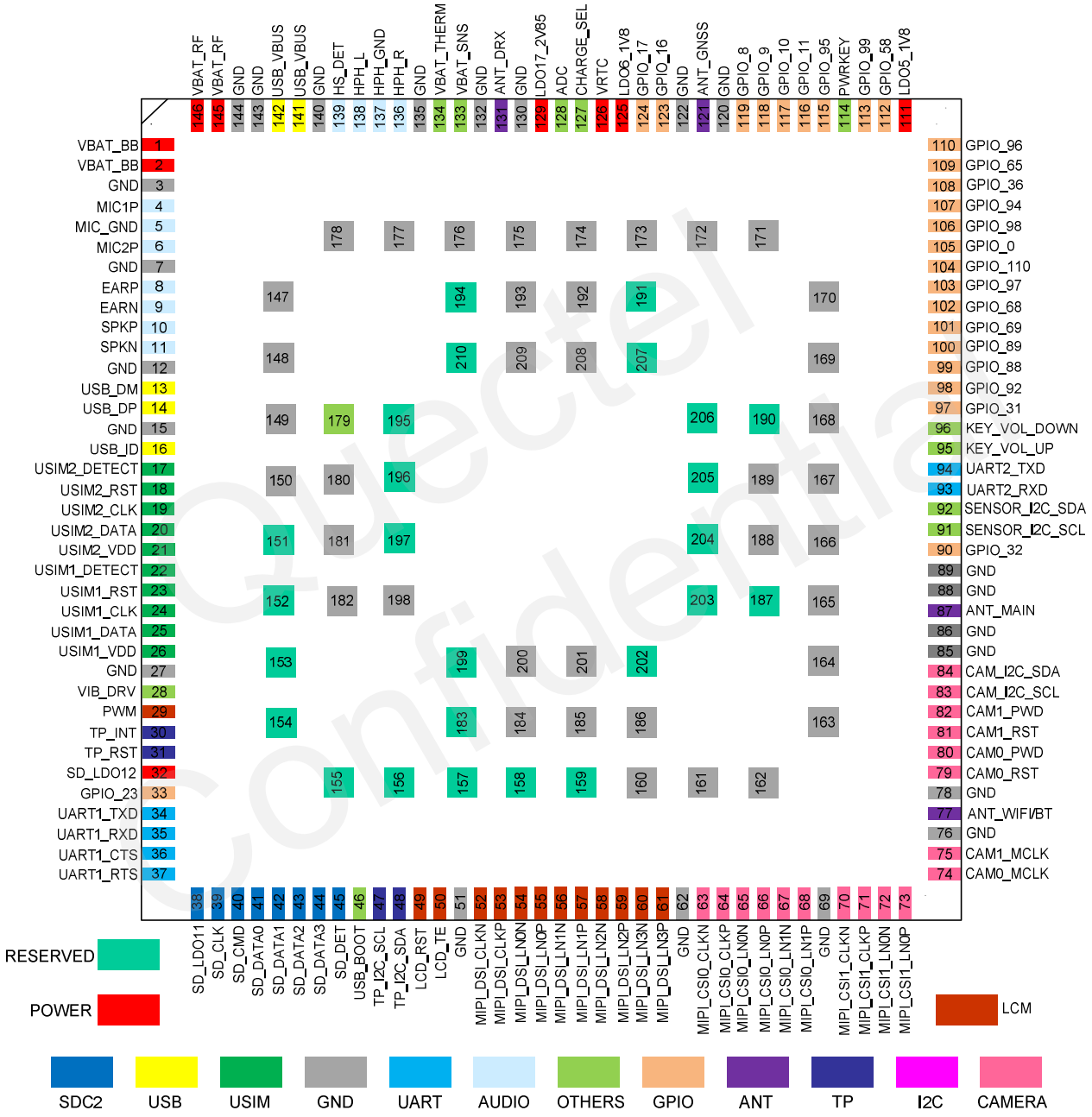

Figure 2: Pin Assignment (Top View)

4 Wi-Fi and BT

SC20 module provides a shared antenna interface ANT_WIFI/BT for Wi-Fi and Bluetooth (BT) functions. The interface impedance is 50Ω. External antennas such as dipole antenna can be connected to the module via the interface, so as to achieve Wi-Fi and BT functions.

4.1. Wi-Fi Overview

SC20 module supports 2.4G and 5G double-band WLAN wireless communication based on IEEE 802.11 a/802.11b/ 802.11g/ 802.11n standard protocols. The maximum data rate is up to 150 Mbps.

The features are as below:

Support Wake-on-WLAN (WoWLAN)
Support ad hoc mode
Support WAPI SMS4 hardware encryption
Support AP mode
Support Wi-Fi Direct
Support MCS 0-7 for HT20 and HT40

NOTE

SC20-CE only supports 2.4G single band WIFI, and does not support 802.11a.

4.1.1. Wi-Fi Performance

The following table lists the Wi-Fi transmitting and receiving performance of SC20 module (SC20-CE does not support 5G frequency band).

Referenced specifications are listed below:

No.	Document
1	IEEE 802.11n WLAN MAC and PHY, October 2009 + IEEE 802.11-2007 WLAN MAC and PHY, June 2007

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2	IEEE Std 802.11b, IEEE Std 802.11d, IEEE Std 802.11e, IEEE Std 802.11g, IEEE Std 802.11i: IEEE 802.11-2007 WLAN MAC and PHY, June 2007

4.2. BT Overview

SC20 module supports BT4.1 (BR/EDR+BLE) specification, as well as GFSK, 8-DPSK, π/4-DQPSK modulation modes.

- Supports max. 7 wireless connections.
- Supports max. 3.5 piconets at the same time.
- Supports one SCO (Synchronous Connection Oriented) or eSCO connection.

The BR/EDR channel bandwidth is 1MHz, and can accommodate 79 channels. The BLE channel bandwidth is 2MHz, and can accommodate 40 channels.

Table 3: BT Data Rate and Version

Version	Data rate	Maximum Application Throughput	Comment
1.2	1 Mbit/s	>80 Kbit/s	
2.0 + EDR	3 Mbit/s	>80 Kbit/s	
3.0 + HS	24 Mbit/s	Reference 3.0 + HS	
4.0	24 Mbit/s	Reference 4.0 LE	

Referenced specifications are listed below:

No.	Document
1	Bluetooth Radio Frequency TSS and TP Specification 1.2/2.0/2.0 + EDR/2.1/2.1+ EDR/3.0/3.0 + HS, August 6, 2009
2	Bluetooth Low Energy RF PHY Test Specification, RF-PHY.TS/4.0.0, December 15, 2009

4.2.1. BT Performance

The following table lists the BT transmitting and receiving performance of SC20 module.

Table 4: BT Transmitting and Receiving Performance

Transmitter Performance

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Packet Types	DH5	2-DH5	3-DH5
Transmitting Power	10dBm	8dBm	8dBm
Receiver Performance			
Packet Types	DH5	2-DH5	3-DH5
Receiving Sensitivity	-92dBm	-91dBm	-86dBm

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5 GNSS

SC20 module integrates a Qualcomm IZat™ GNSS engine (GEN 8C) which supports multiple positioning and navigation systems including GPS, GLONASS and BeiDou. With an embedded LNA, the module provides greatly improved positioning accuracy.

5.1. GNSS Performance

The following table lists the GNSS performance of SC20 module in conduction mode.

Table 5: GNSS Performance

Parameter	Description	Typ.	Unit
Sensitivity (GNSS)	Cold start	-146	dBm
	Reacquisition	-158	dBm
	Tracking	-160	dBm
TTFF (GNSS)	Cold start	32	s
	Warm start	30	s
	Hot start	2	s
Static Drift (GNSS)	CEP-50	6	m

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6 Antenna Interface

SC20 antenna interface includes a main antenna, an Rx-diversity/MIMO antenna, a GNSS antenna and a Wi-Fi/BT antenna. The antenna interface has an impedance of 50Ω.

6.1. Main/Rx-diversity Antenna Interface

6.1.1. Pin Definition

The main antenna and Rx-diversity antenna pins' definition are shown below.

Table 6: Pin Definition of the Main/Rx-diversity Antenna

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN	87	IO	Main antenna	50Ω impedance
ANT_DRX	131	AI	Diversity antenna	50Ω impedance

6.1.2. Operating Frequency

Table 7: SC20 Module Operating Frequencies

3GPP Band	Receive	Transmit	Unit
GSM850	869-894	824-849	MHz
EGSM900	925-960	880-915	MHz
DCS1800	1805-1880	1710-1785	MHz
PCS1900	1930-1990	1850-1910	MHz
WCDMA Band 1	2110-2170	1920-1980	MHz
WCDMA Band 2	1930-1990	1850-1910	MHz

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WCDMA Band 4	2110-2155	1710-1755	MHz
WCDMA Band 5	869-894	824-849	MHz
WCDMA Band 6	875-885	830-840	MHz
WCDMA Band 8	925-960	880-915	MHz
WCDAM Band 19	875-890	830-845	MHz
CDMA BC0	869-894	824-849	MHz
TD-SCDMA Band 34	2010-2025	2010-2025	MHz
TD-SCDMA Band 39	1880-1920	1880-1920	MHz
LTE-FDD Band 1	2110-2170	1920-1980	MHz
LTE-FDD Band 2	1930-1990	1850-1910	MHz
LTE-FDD Band 3	1805-1880	1710-1785	MHz
LTE-FDD Band 4	2110-2155	1710-1755	MHz
LTE-FDD Band 5	869-894	824-849	MHz
LTE-FDD Band 8	925-960	880-915	MHz
LTE-FDD Band 12	729-746	699-716	MHz
LTE-FDD Band 13	746-756	777-787	MHz
LTE-FDD Band 18	860-875	815-830	MHz
LTE-FDD Band 19	875-890	830-845	MHz
LTE-FDD Band 20	791-821	832-862	MHz
LTE-FDD Band 25	1930-1995	1850-1915	MHz
LTE-FDD Band 26	859-894	814-849	MHz
LTE-FDD Band 28	758-803	703-748	MHz
LTE-TDD Band 38	2570-2620	2570-2620	MHz
LTE-TDD Band 39	1880-1920	1880-1920	MHz
LTE-TDD Band 40	2300-2400	2300-2400	MHz

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LTE-TDD Band 41	2555-2655	2555-2655	MHz

NOTE

The bandwidth of LTE-TDD Band 41 for SC20 module is 100MHz (2555 MHz - 2655 MHz), and the corresponding channel range is from 40240 up to 41240.

6.2. Wi-Fi/BT Antenna Interface

The following tables show the Wi-Fi/BT antenna pin's definition and frequency specification.

Table 8: Pin Definition of Wi-Fi/BT Antenna

Pin Name	Pin No.	I/O	Description	Comment
ANT_WIFI/BT	77	IO	Wi-Fi/BT antenna	50Ω impedance

Table 9: Wi-Fi/BT Frequency

Type	Frequency	Unit
Wi-Fi 802.11a/b/g/n	2412-2472MHz; 5180-5825MHz	MHz
BT4.1 LE	2402-2480MHz	MHz

6.3. GNSS Antenna Interface

The following tables show the GNSS antenna pin's definition and frequency specification.

Table 10: Pin Definition of GNSS Antenna

Pin Name	Pin No.	I/O	Description	Comment
ANT_GNSS	121	AI	GNSS antenna	50Ω impedance

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Table 11: GNSS Frequency

Type	Frequency	Unit
GPS	1575.42 ± 1.023	MHz
GLONASS	1597.5 - 1605.8	MHz
BeiDou	1561.098 ± 2.046	MHz

6.4. Antenna Installation

6.4.1. Antenna Requirement

The following table shows the requirement on main antenna, RX-diversity antenna, Wi-Fi/BT antenna and GNSS antenna.

Table 12: Antenna Requirements

Type	Requirements
GSM/WCDMA/TD-SCDMA/LTE	VSWR: ≤ 2 Max Input Power (W): 50 Input Impedance (Ω): 50 Polarization Type: Vertical Cable Insertion Loss: < 1dB (GSM850,EGSM900,WCDMA B5/B6/B8/B19,CDMA BC0,LTE-FDD B5/B8/B12/B13/B18/B19/B20/B26/B28) Cable Insertion Loss: < 1.5dB (DCS1800, PCS1900,WCDMA B1/B2/B4, TD-SCDMA B34/B39, LTE-FDD B1/B2/B3/B4/B25,LTE-TDD B39) Cable Insertion Loss: < 2dB (LTE-FDD B7,LTE-TDDB38/B40/B41)
Wi-Fi/BT	VSWR: ≤ 2 Max Input Power (W): 50 Input Impedance (Ω): 50 Polarization Type: Vertical Cable Insertion Loss: < 1dB
GNSS	Frequency range: 1565 - 1607MHz Polarization: RHCP or linear VSWR: < 2 (Typ.) Passive Antenna Gain: > 0dBi Active Antenna Noise Figure: < 1.5dB

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	Active Antenna Gain: > -2dBi Active Antenna Embedded LNA Gain: 20dB (Typ.) Active Antenna Total Gain: > 18dBi (Typ.)

Table 13: Antenna Gain

Conclusion:

The analysis concludes that this product when transmitting in standalone within a host device, is compliant with the RF exposure requirements in mobile exposure condition, provided the conducted power and antenna gain do not exceed the limits for each given frequency band per wireless technology as follow table:

Technology	Band	Maximum Conducted Power (dBm)	Maximum Antenna Gain (dBi)
GSM	GSM850	33.0	3.0
	GSM1900	30.5	2.5
WCDMA	Band II	24.0	2.5
	Band IV	24.0	5.0
	Band V	24.0	3.0
LTE	Band 2	24.0	2.5
	Band 4	24.5	5.0
	Band 5	24.5	3.0
	Band 7	24.5	8.5
	Band 12	24.0	6.0
	Band 13	24.0	6.0
	Band 25	24.0	2.5
	Band 26	24.0	3.0

Note: The WiFi2.4GHz/WiFi5GHz/Bluetooth dipole antenna information as below:

Manufacturer	Model	Peak gain
INPAQ TECHNOLOGY CO., LTD	DAM-L0-H-N0-000-08-13	WiFi2.4GHz/Bluetooth: 3.0 dBi
		WiFi5GHz: 4.0 dBi

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7 Electrical, Reliability and Radio Characteristics

7.1. Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital and analog pins of the module are listed in the following table.

Table 14: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT	-0.5	6	V
USB_VBUS	-0.5	16	V
Peak Current of VBAT	0	3	A
Voltage on Digital Pins	-0.3	2.3	V

7.2. Power Supply Ratings

Table 15: SC20 Module Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VBAT	VBAT	Voltage must stay within the min/max values, including voltage drop, ripple and spikes.	3.5	3.8	4.2	V
	Voltage drop during transmitting burst	Maximum power control level on EGSM900.			400	mV
I_{VBAT}	Peak supply current (during transmission slot)	Maximum power control level on EGSM900.		1.8	3.0	A

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Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
USB_VBUS	USB detection		4.35	5.0	6.3	V
VRTC	Power supply voltage of backup battery.		2.0	3.0	3.25	V

7.3. Charging Performance Specifications

Table 16: Charging Performance Specifications

Parameter	Min.	Typ.	Max.	Unit
Trickle charging current	81	90	99	mA
Trickle charging threshold voltage range (15.62mV steps)	2.5	2.796	2.984	V
Weak battery threshold voltage range (18.75mV steps)	3.0	3.2	3.581	V
Charge voltage range (25mV steps)	4	4.2	4.775	V
Charge voltage accuracy			+/-2	%
Charge current range (90mA steps)	90		1440	mA
Charge current accuracy			+/-10	%
Charge termination current: when charge current is from 90 to 450mA;		7		%
Charge termination current: when charge current is from 450 to 1440mA;		7.4		%

7.4. Operating Temperature

The operating temperature is listed in the following table.

Table 17: Operating Temperature

Parameter	Min.	Typ.	Max.	Unit
Operating temperature range [1)]	-35	+25	+65	ºC
Extended temperature range [2)]	-40		+75	ºC

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NOTES

1. [1] Operating temperature range ---- 3GPP compliant.
[2] Within extended temperature range, the module remains the ability to establish and maintain a voice, SMS, data transmission, emergency call, etc. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like P_{out} might reduce in their value and exceed the specified tolerances. When the temperature returns to the normal operating temperature levels, the module will meet 3GPP compliant again.

7.5. Current Consumption

The values of current consumption are shown below.

Table 18: SC20-CE Current Consumption

Parameter	Description	Conditions	Typ.	Unit
I_{VBAT}	OFF state	Power down	80	uA
	GSM/GPRS supply current	Sleep @DRX=2	3.85	mA
		Sleep @DRX=5	3.01	mA
		Sleep @DRX=9	2.91	mA
	WCDMA supply current	Sleep @DRX=6	3.30	mA
		Sleep @DRX=7	2.79	mA
		Sleep @DRX=8	2.49	mA
		Sleep @DRX=9	2.33	mA
	LTE-FDD supply current	Sleep @DRX=5	5.60	mA
		Sleep @DRX=6	3.83	mA
		Sleep @DRX=7	3.02	mA
		Sleep @DRX=8	2.65	mA

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Parameter	Description	Conditions	Typ.	Unit
	LTE-TDD supply current	Sleep @DRX=5	5.49	mA
		Sleep @DRX=6	3.87	mA
		Sleep @DRX=7	3.05	mA
		Sleep @DRX=8	2.67	mA
	GSM voice call	GSM900 PCL=5@31.84dBm	253.6	mA
		GSM900 PCL=12@18.49dBm	142.9	mA
		GSM900 PCL=19@4.95dBm	117.8	mA
		DCS1800 PCL=0@28.91dBm	200.9	mA
		DCS1800 PCL=7@15.35dBm	157	mA
		DCS1800 PCL=15@-0.21dBm	138.1	mA
	CDMA voice call	BC0(max power) @23.91dBm	619.8	mA
		BC0(min power) @-60.28dBm	128.7	mA
	WCDMA voice call	Band1(max power) @22.61dBm	430	mA
		Band8(max power) @22.74dBm	392.2	mA
	EDGE data transfer	EDGE900 (1UL/4DL) @26.29dBm	193	mA
		EDGE900 (2UL/3DL) @26.15dBm	277.9	mA
		EDGE900 (3UL/2DL) @26.06dBm	362.2	mA
		EDGE900 (4UL/1DL) @25.92dBm	450.5	mA
		DCS1800 (1UL/4DL) @24.89dBm	183.5	mA
		DCS1800 (2UL/3DL) @24.74dBm	275.2	mA

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Parameter	Description	Conditions	Typ.	Unit
		DCS1800 (3UL/2DL) @24.54dBm	355.9	mA
		DCS1800 (4UL/1DL) @24.44dBm	440.3	mA
	CDMA data transfer	BC0(max power) @23.68dBm	602.5	mA
	WCDMA data transfer	Band 1(HSDPA) @21.64dBm	461.5	mA
		Band 8(HSDPA) @21.61dBm	423.8	mA
		Band 1(HSUPA) @21.36dBm	452.5	mA
		Band 8(HSUPA) @21.56dBm	436	mA
	LTE data transfer	LTE-FDD Band1 @22.96dBm	631.2	mA
		LTE-FDD Band3@22.95dBm	639.6	mA
		LTE-FDD Band8 @23.17dBm	542	mA
		LTE-TDD Band38 @22.02dBm	422.89	mA
		LTE-TDD Band39 @22.13dBm	458	mA
		LTE-TDD Band40 @22.01dBm	392.9	mA
		LTE-TDD Band41 @22.31dBm	441.4	mA

Table 19: SC20-E Current Consumption

Parameter	Description	Conditions	Typ.	Unit
I_{VBAT}	OFF state	Power down	80	uA
	GSM/GPRS supply current	Sleep @DRX=2	3.38	mA
		Sleep @DRX=5	2.31	mA
		Sleep @DRX=9	1.98	mA
	WCDMA supply current	Sleep @DRX=6	2.77	mA

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Parameter	Description	Conditions	Typ.	Unit
		Sleep @DRX=7	2.17	mA
		Sleep @DRX=8	1.90	mA
		Sleep @DRX=9	1.72	mA
	LTE-FDD supply current	Sleep @DRX=5	5.49	mA
		Sleep @DRX=6	3.06	mA
		Sleep @DRX=7	2.37	mA
		Sleep @DRX=8	1.91	mA
	LTE-TDD supply current	Sleep @DRX=5	5.51	mA
		Sleep @DRX=6	3.45	mA
		Sleep @DRX=7	2.40	mA
		Sleep @DRX=8	1.85	mA
	GSM voice call	Sleep PCL=5@32.79dBm	255	mA
		GSM850 PCL=12@19.04dBm	135	mA
		GSM850 PCL=19@5.37dBm	108	mA
		EGSM900 PCL=5@32.95dBm	264	mA
		EGSM900 PCL=12@19.23dBm	137	mA
		EGSM900 PCL=19@5.71dBm	109	mA
		DCS1800 PCL=0@29.74dBm	197	mA
		DCS1800 PCL=7@16.31dBm	153	mA
		DCS1800 PCL=15@0.48dBm	131	mA

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Parameter	Description	Conditions	Typ.	Unit
		PCS1900 PCL=0@29.78dBm	192	mA
		PCS1900 PCL=7@16.73dBm	152	mA
		PCS1900 PCL=15@0.66dBm	130	mA
	WCDMA voice call	Band 1(max power) @23.10dBm	521	mA
		Band 5(max power) @23.32dBm	504	mA
		Band 8(max power) @23.26dBm	536	mA
	GPRS data transfer	GPRS850 (1UL/4DL) @32.83dBm	260	mA
		GPRS850 (2UL/3DL) @32.72dBm	422	mA
		GPRS850 (3UL/2DL) @30.71dBm	491	mA
		GPRS850 (4UL/1DL) @29.59dBM	571	mA
		GPRS900 (1UL/4DL) @33.02dBm	272	mA
		GPRS900 (2UL/3DL) @32.87dBm	443	mA
		GPRS900 (3UL/2DL) @30.84dBm	510	mA
		GPRS900 (4UL/1DL) @29.77dBm	599	mA
		DCS1800 (1UL/4DL) @29.74dBm	204	mA
		DCS1800 (2UL/3DL) @29.63dBm	306	mA
		DCS1800 (3UL/2DL) @29.48dBm	415	mA
		DCS1800 (4UL/1DL) @29.64dBm	517	mA
		PCS1900 (1UL/4DL) @29.75dBm	197	mA
		PCS1900 (2UL/3DL) @29.63dBm	297	mA

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Parameter	Description	Conditions	Typ.	Unit
		PCS1900 (3UL/2DL) @29.48dBm	396	mA
		PCS1900 (4UL/1DL) @29.30dBm	503	mA
	EDGE data transfer	EDGE850 (1UL/4DL) @26.71dBm	175	mA
		EDGE850 (2UL/3DL) @26.73dBm	268	mA
		EDGE850 (3UL/2DL) @26.62dBm	259	mA
		EDGE850 (4UL/1DL) @26.54dBm	451	mA
		EDGE900 (1UL/4DL) @27.05dBm	182	mA
		EDGE900 (2UL/3DL) @26.99dBm	281	mA
		EDGE900 (3UL/2DL) @27.07dBm	374	mA
		EDGE900 (4UL/1DL) @26.84dBm	476	mA
		DCS1800 (1UL/4DL) @25.56dBm	178	mA
		DCS1800 (2UL/3DL) @25.69dBm	263	mA
		DCS1800 (3UL/2DL) @25.56dBm	352	mA
		DCS1800 (4UL/1DL) @25.30dBm	446	mA
		PCS1900 (1UL/4DL) @26.08dBm	120	mA
		PCS1900 (2UL/3DL) @25.91dBm	231	mA
		PCS1900 (3UL/2DL) @25.92dBm	347	mA
		PCS1900 (4UL/1DL) @25.66dBm	464	mA
	WCDMA data transfer	Band 1(HSDPA) @22.23dBm	491	mA
		Band 5(HSDPA) @22.43dBm	476	mA

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Parameter	Description	Conditions	Typ.	Unit
		Band 8(HSDPA) @22.34dBm	491	mA
		Band 1(HSUPA) @21.62dBm	486	mA
		Band 5(HSUPA) @22.12dBm	467	mA
		Band 8(HSUPA) @21.82dBm	492	mA
	LTE data transfer	LTE-FDD Band1 @22.71dBm	690	mA
		LTE-FDD Band3@23.42dBm	699	mA
		LTE-FDD Band5@23.64dBm	684	mA
		LTE-FDD Band7 @22.98dBm	868	mA
		LTE-FDD Band8 @23.59dBm	681	mA
		LTE-FDD Band20 @23.48dBm	692	mA
		LTE-TDD Band38 @23.21dBm	500	mA
		LTE-TDD Band40 @23.28dBm	449	mA
		LTE-TDD Band41 @23.00dBm	481	mA

Table 20: SC20-A Current Consumption

Parameter	Description	Conditions	Typ.	Unit
I_{VBAT}	OFF state	Power down	16	uA
	GSM/GPRS supply current	Sleep @DRX=2	3.45	mA
		Sleep @DRX=5	2.53	mA
		Sleep @DRX=9	2.27	mA
	WCDMA supply current	Sleep @DRX=6	3.16	mA
		Sleep @DRX=7	2.27	mA

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Parameter	Description	Conditions	Typ.	Unit
		Sleep @DRX=8	1.76	mA
		Sleep @DRX=9	1.78	mA
	GSM voice call	GSM850PCL=5@32.48dBm	253.09	mA
		GSM850PCL=12@19.35dBm	138.58	mA
		GSM850PCL=19@5.47dBm	109.84	mA
		PCS1900 PC=L0@30.08dBm	202.50	mA
		PCS1900 PCL=7@16.86dBm	157.92	mA
		PCS1900 PCL=15@1.13dBm	135.44	mA
	WCDMA voice call	Band 1(max power) @23.69dBm	547.75	mA
		Band 2(max power) @23.90dBm	576.08	mA
		Band 4(max power) @23.65dBm	537.20	mA
		Band 5(max power) @23.47dBm	533.06	mA
		Band 8(max power) @23.76dBm	557.79	mA
	GPRS data transfer	GPRS850 (1UL/4DL) @32.38dBm	254.25	mA
		GPRS850 (2UL/3DL) @32.04dBm	411.18	mA
		GPRS850 (3UL/2DL) @30.54dBm	493.74	mA
		GPRS850 (4UL/1DL) @29.54dBm	580.68	mA
		PCS1900 (1UL/4DL) @29.99dBm	205.51	mA
		PCS1900 (2UL/3DL) @29.84dBm	315.56	mA
		PCS1900 (3UL/2DL) @29.16dBm	407.30	mA
		PCS1900 (4UL/1DL) @29.24dBm	509.25	mA

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Parameter	Description	Conditions	Typ.	Unit
	EDGE data transfer	EDGE850 (1UL/4DL) @26.80dBm	173.67	mA
		EDGE850 (2UL/3DL) @26.69dBm	268.78	mA
		EDGE850 (3UL/2DL) @26.52dBm	360.92	mA
		EDGE850 (4UL/1DL) @26.41dBm	459.33	mA
		PCS1900 (1UL/4DL) @25.96dBm	174.92	mA
		PCS1900 (2UL/3DL) @25.80dBm	269.30	mA
		PCS1900 (3UL/2DL) @25.56dBm	360.28	mA
		PCS1900 (4UL/1DL) @25.40dBm	462	mA
	WCDMA data transfer	Band 1(HSDPA) @22.7dBm	487.87	mA
		Band 2(HSDPA) @22.90dBm	539	mA
		Band 4(HSDPA) @22.73dBm	495.49	mA
		Band 5(HSDPA) @22.73dBm	497.11	mA
		Band 8(HSDPA) @22.74dBm	499.5	mA
		Band 1(HSUPA) @22.03dBm	496.03	mA
		Band2(HSUPA) @22.57dBm	534	mA
		Band 4(HSUPA) @22.24dBm	495.66	mA
		Band 5(HSUPA) @22.1dBm	494.12	mA
		Band 8(HSUPA) @22.02dBm	489.2	mA
	LTE data transfer	LTE-FDD Band2 @23.06dBm	765	mA
		LTE-FDD Band4 @23.12dBm	758	mA
		LTE-FDD Band5@23.5dBm	673.55	mA
		LTE-FDD Band7@22.59dBm	790.28	mA
		LTE-FDD Band12 @23.3dBm	674.84	mA

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Parameter	Description	Conditions	Typ.	Unit
		LTE-FDD Band13 @23.3dBm	674.84	mA
		LTE-FDD Band25 @23.1dBm	760	mA
		LTE-FDD Band26 @23.2dBm	731	mA

7.6. Electrostatic Discharge

The module is not protected against electrostatic discharge (ESD) in general. Consequently, it should be subject to ESD handling precautions that are typically applied to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the module.

The following table shows the module electrostatic discharge characteristics.

Table 21: Electrostatic Discharge Characteristics (Temperature: 25℃, Humidity: 45%)

Tested Points	Contact Discharge	Air Discharge	Unit
VBAT, GND	+/-5	+/-10	KV
All Antenna Interfaces	+/-5	+/-10	KV
USB Interfaces	+/-0.5	+/-1	KV
Other Interfaces	+/-0.5	+/-1	KV

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8 Technical Dimensions

This chapter describes the mechanical dimensions of the module. All dimensions are measured in mm.

8.1. Mechanical Dimensions of the Module

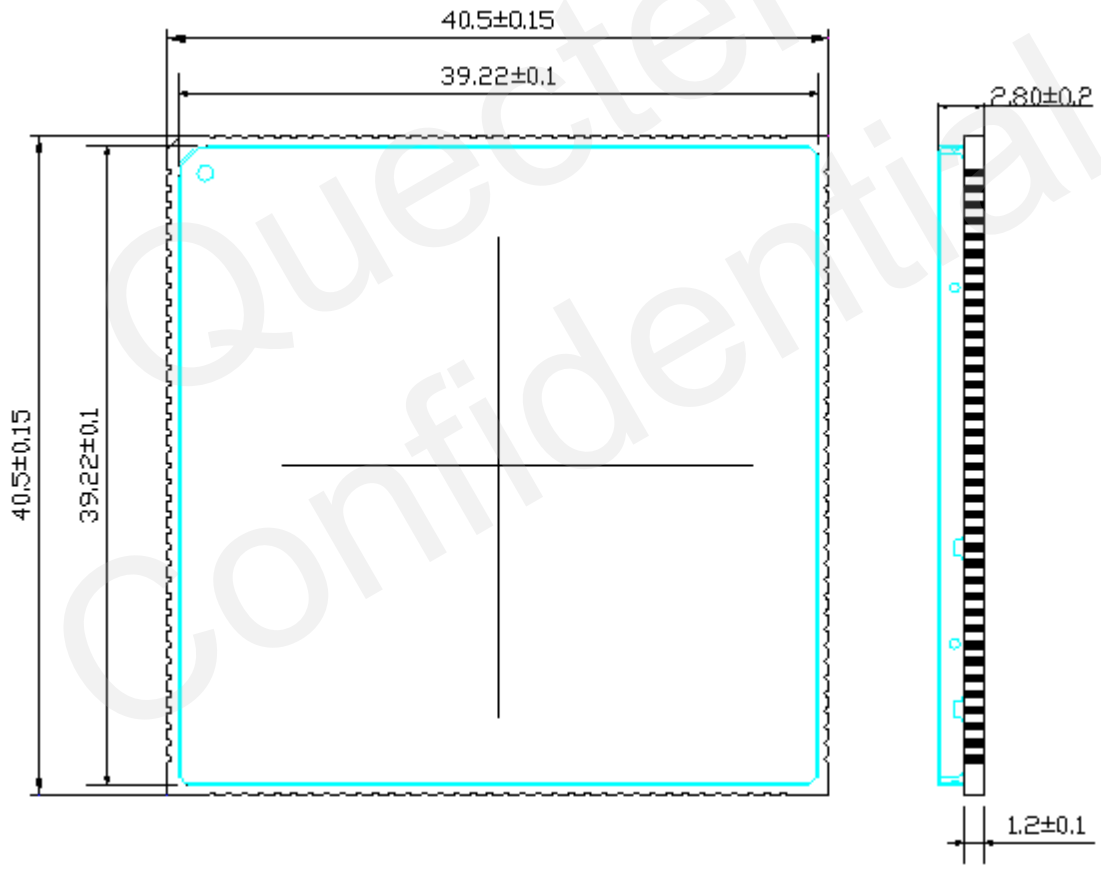

Figure 3: Module Top and Side Dimensions

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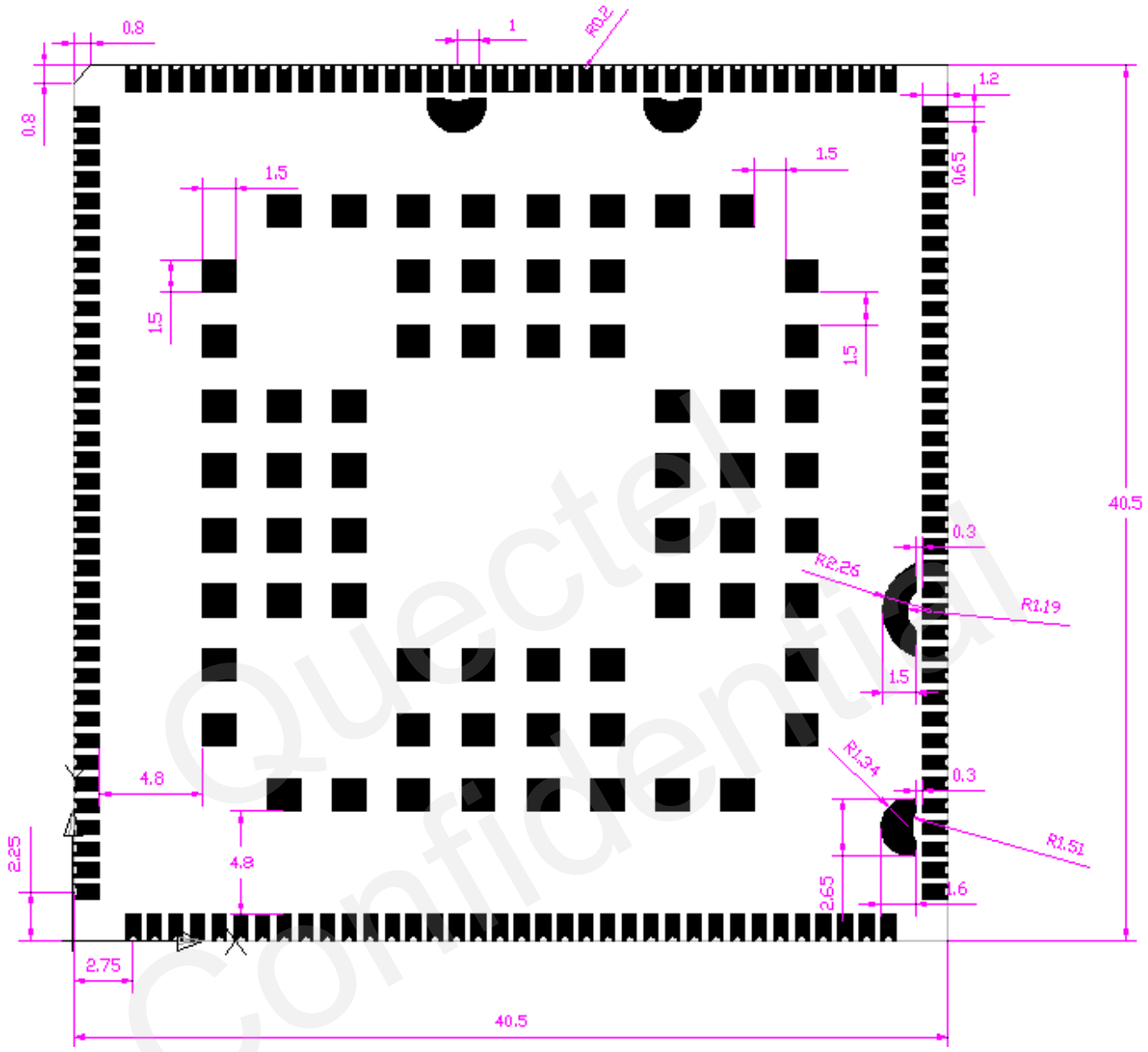

Figure 4: Module Bottom Dimensions (Top View)

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8.2. Recommended Footprint

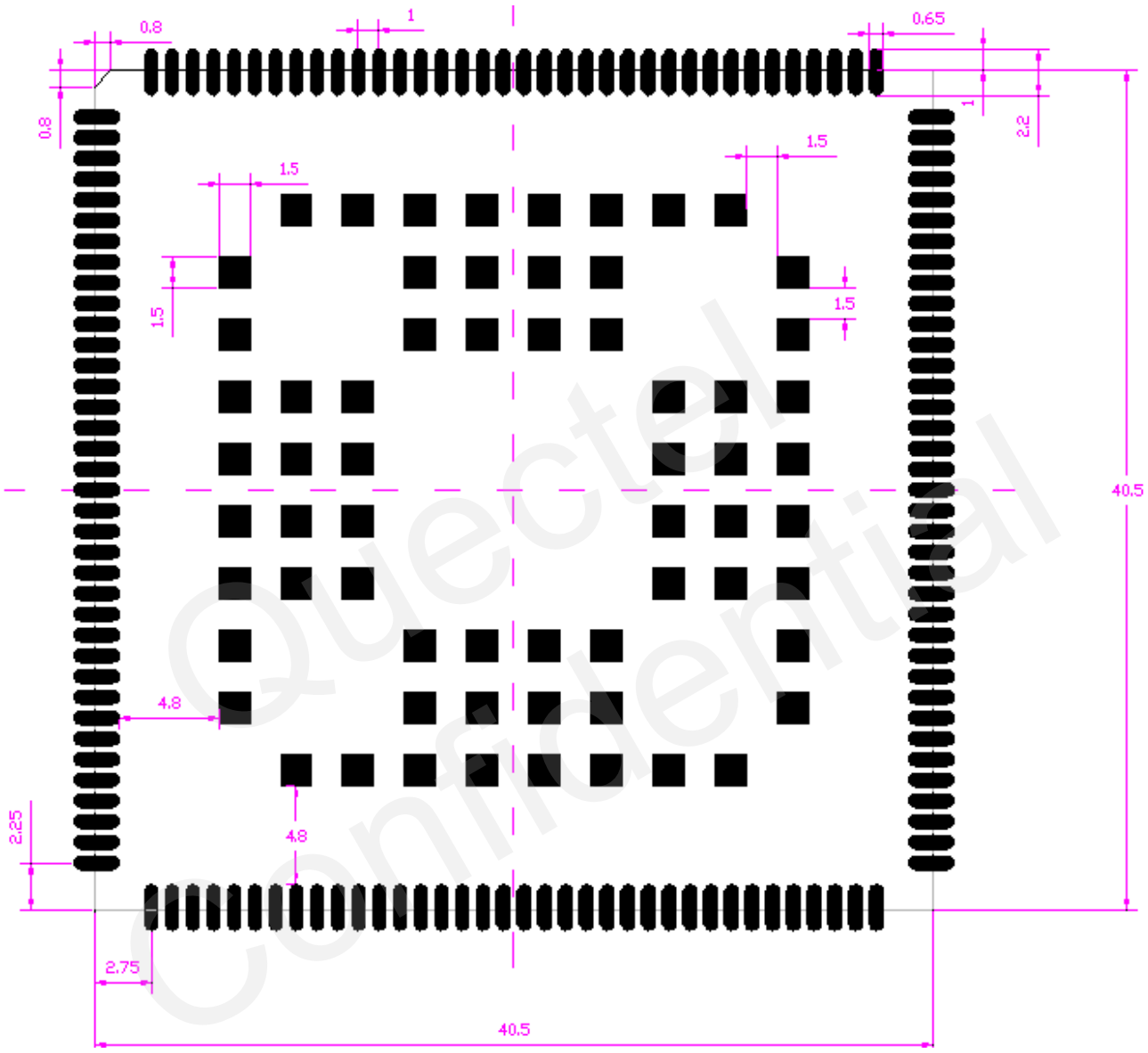

Figure 5: Recommended Footprint (Top View)

NOTES

1. For easy maintenance of the module, keep about 3mm between the module and other components in the host PCB.
2. All RESERVED pins must not be connected to GND.

8.3. Top and Bottom View of the Module

Figure 6: Top View of the Module

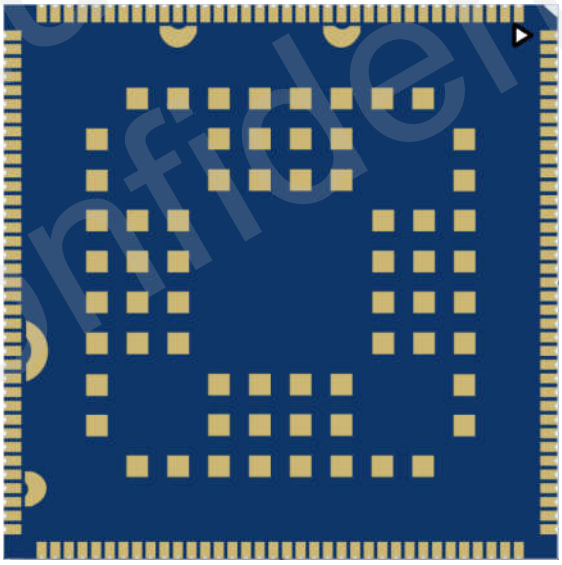

Figure 7: Bottom View of the Module

NOTE

These are design effect drawings of SC20 module. For more accurate pictures, please refer to the module that you get from Quectel.

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9 Storage, Manufacturing and Packaging

9.1. Storage

SC20 is stored in a vacuum-sealed bag. The restrictions of storage condition are shown as below.

1. Shelf life in sealed bag is 12 months at < 40ºC/90%RH.
2. After this bag is opened, devices that will be subjected to reflow soldering or other high temperature process must be:
   - Mounted within 72 hours at factory conditions of ≤ 30ºC/60%RH.
   - Stored at < 10% RH.
3. Devices require baking before mounting, if:
   - Humidity indicator card is > 10% when ambient temperature is 23ºC±5ºC.
   - Mounting cannot be finished within 72 hours at factory conditions of ≤ 30ºC/60% RH.
4. If baking is required, devices may be baked for 48 hours at 125ºC±5ºC.

NOTE

As plastic package cannot be subjected to high temperatures, the package must be removed from devices before high temperature (125ºC) baking. If shorter baking time is desired, please refer to IPC/JEDECJ-STD-033 for baking procedure.

9.2. Manufacturing and Welding

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. The force on the squeegee should be adjusted properly so as to produce a clean stencil surface on a single pass. To ensure the module soldering quality, the thickness of stencil at the hole of the module pads should be 0.18mm. For details, please refer to ***document [3]***.

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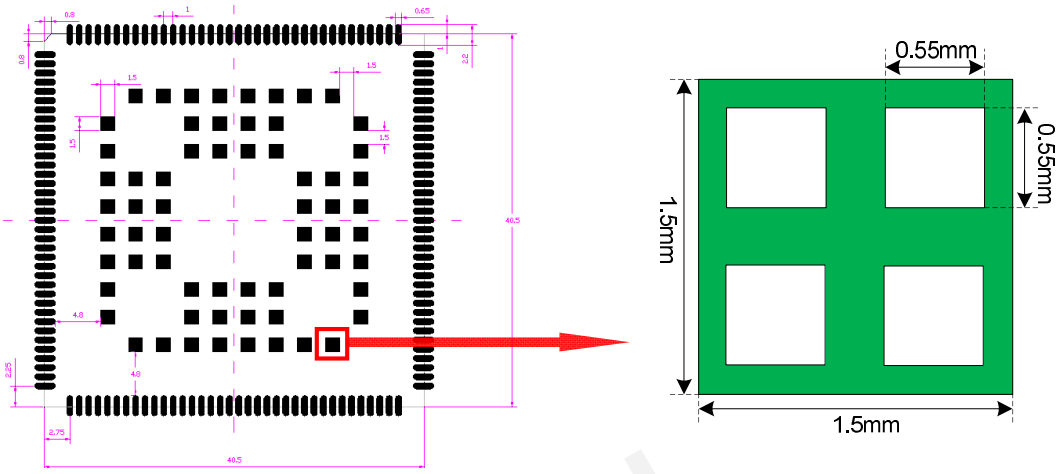

Figure 8: Recommended Stencil Design for LGA Pads

It is suggested that the peak reflow temperature is from 235 to 245ºC (for SnAg3.0Cu0.5 alloy). The absolute maximum reflow temperature is 260ºC. To avoid damage to the module caused by repeated heating, it is suggested that the module should be mounted after reflow soldering for the other side of PCB has been completed. Recommended reflow soldering thermal profile is shown below:

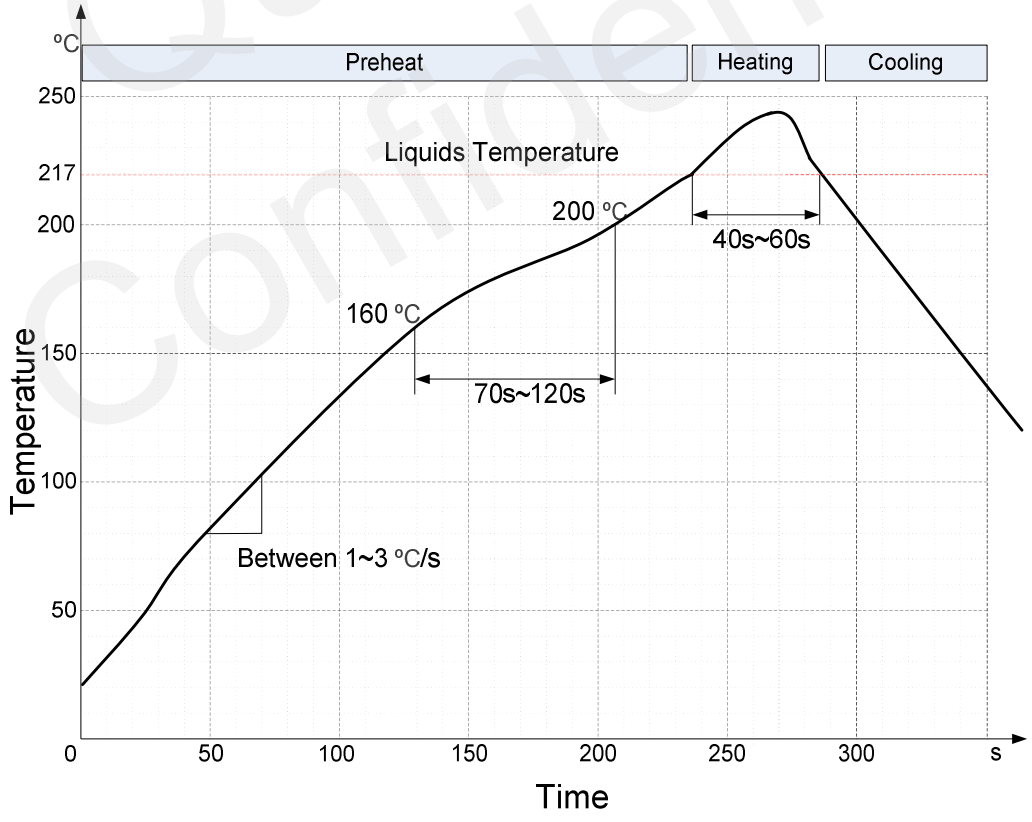

Figure 9: Reflow Soldering Thermal Profile

9.3. Packaging

SC20 is packaged in tape and reel carriers. One reel is 12.32 meters long and contains 200pcs modules. The following figures show the package details, measured in mm.

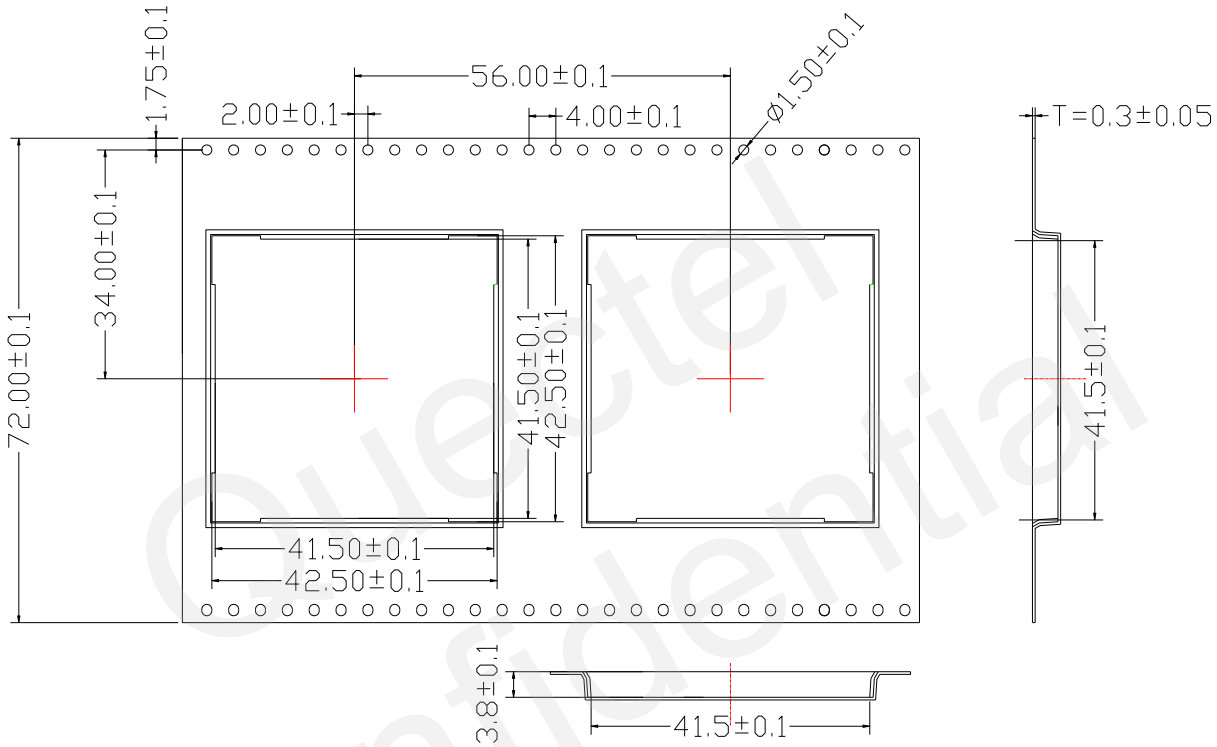

Figure 10: Tape Dimensions

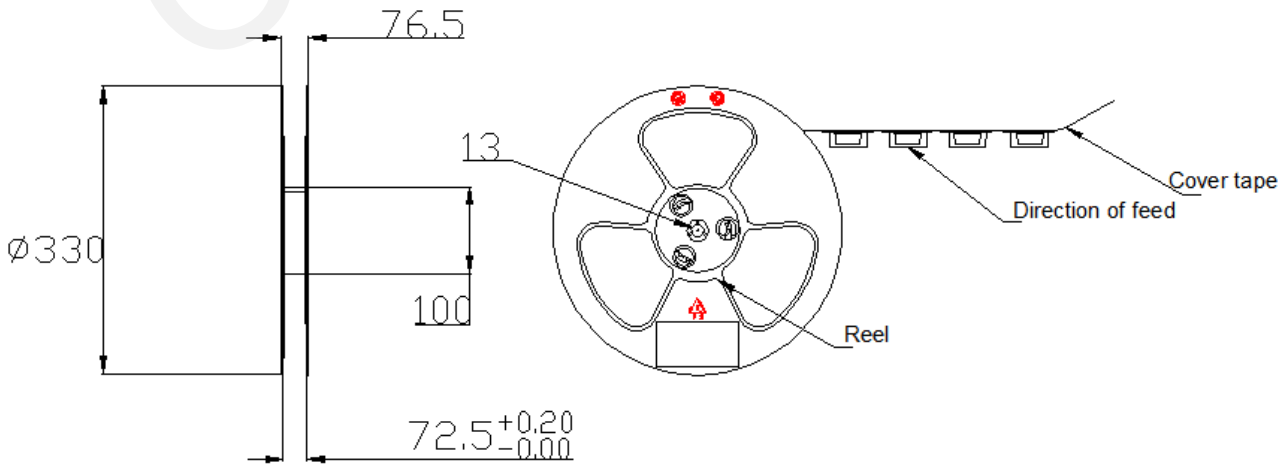

Figure 11: Reel Dimensions

Table 22: Reel Packaging

Model Name	MOQ for MP	Minimum Package: 200pcs	Minimum Package×4=800pcs
SC20	200	Size: 370mm*350mm*85mm N.W: 1.92kg G.W: 3.17kg	Size: 380mm*365mm*365mm N.W:7.68 kg G.W:13.63 kg

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10 Appendix A GPRS Coding Schemes

Table 23: Description of Different Coding Schemes

Scheme	CS-1	CS-2	CS-3	C4-4
Code Rate	1/2	2/3	3/4	1
USF	3	3	3	3
Pre-coded USF	3	6	6	12
Radio Block excl.USF and BCS	181	268	312	428
BCS	40	16	16	16
Tail	4	4	4	-
Coded Bits	456	588	676	456
Punctured Bits	0	132	220	-
Data Rate Kb/s	9.05	13.4	15.6	21.4

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11 Appendix B GPRS Multi-slot Classes

Twenty-nine classes of GPRS multi-slot modes are defined for MS in GPRS specification. Multi-slot classes are product dependent, and determine the maximum achievable data rates in both the uplink and downlink directions. Written as 3+1 or 2+2, the first number indicates the amount of downlink timeslots, while the second number indicates the amount of uplink timeslots. The active slots determine the total number of slots the GPRS device can use simultaneously for both uplink and downlink communications.

The description of different multi-slot classes is shown in the following table.

3. Table 24: GPRS Multi-slot Classes

Multislot Class	Downlink Slots	Uplink Slots	Active Slots
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5

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12 Appendix C EDGE Modulation and Coding Schemes

Table 25: EDGE Modulation and Coding Schemes

Coding Scheme	Modulation	Coding Family	1 Timeslot	2 Timeslot	4 Timeslot
CS-1	GMSK	/	9.05kbps	18.1kbps	36.2kbps
CS-2	GMSK	/	13.4kbps	26.8kbps	53.6kbps
CS-3	GMSK	/	15.6kbps	31.2kbps	62.4kbps
CS-4	GMSK	/	21.4kbps	42.8kbps	85.6kbps
MCS-1	GMSK	C	8.80kbps	17.60kbps	35.20kbps
MCS-2	GMSK	B	11.2kbps	22.4kbps	44.8kbps
MCS-3	GMSK	A	14.8kbps	29.6kbps	59.2kbps
MCS-4	GMSK	C	17.6kbps	35.2kbps	70.4kbps
MCS-5	8-PSK	B	22.4kbps	44.8kbps	89.6kbps
MCS-6	8-PSK	A	29.6kbps	59.2kbps	118.4kbps
MCS-7	8-PSK	B	44.8kbps	89.6kbps	179.2kbps
MCS-8	8-PSK	A	54.4kbps	108.8kbps	217.6kbps
MCS-9	8-PSK	A	59.2kbps	118.4kbps	236.8kbps

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13 CE Requirement

The minimum distance between the user and/or any bystander and the radiating structure of the transmitter is 20cm.

Hereby, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type SC20-E is in compliance with Directive 2014/53/EU.
The full text of the EU declaration of conformity is available at the following internet address:
7th Floor, Hongye Building, No.1801 Hongmei Road, Xuhui District, Shanghai 200233, China
http://www.quectel.com/support/downloadb/TechnicalDocuments.htm

This SC20-E operates with the following frequency bands and maximum radio-frequency power:
GSM850/900 : 35dBm
GSM1800/1900: 32dBm
UMTS Band 1/5/8: 25 dBm
LTE Band 1/3/5/7/8/20/38/40/41: 25.7 dBm

Bluetooth：<20 dBm
WiFi 2.4GHz <20 dBm;
WiFi 5GHz band 1/2/3 <23 dBm

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14 IC & FCC Requirement

14.1. FCC Regulations:

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.

This device 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 radiated 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.

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

14.2. RF Exposure Information

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

14.3. ISED Notice

This device complies with Innovation, Science and Economic Development Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.

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Le présent appareil est conforme aux CNR Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

14.4. ISED Radiation Exposure Statement

This device complies with RSS-102 radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the ISED radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la CNR-102 définies pour un environnement non contrôlé. Afin d'éviter la possibilité de dépasser les limites d'exposition aux fréquences radio de la CNR-102, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm (8 pouces) pendant le fonctionnement normal.

14.5. IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module. 20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

14.6. USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

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14.7. LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains Transmitter Module FCC ID: XMR201706SC20A". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of FCC rules.

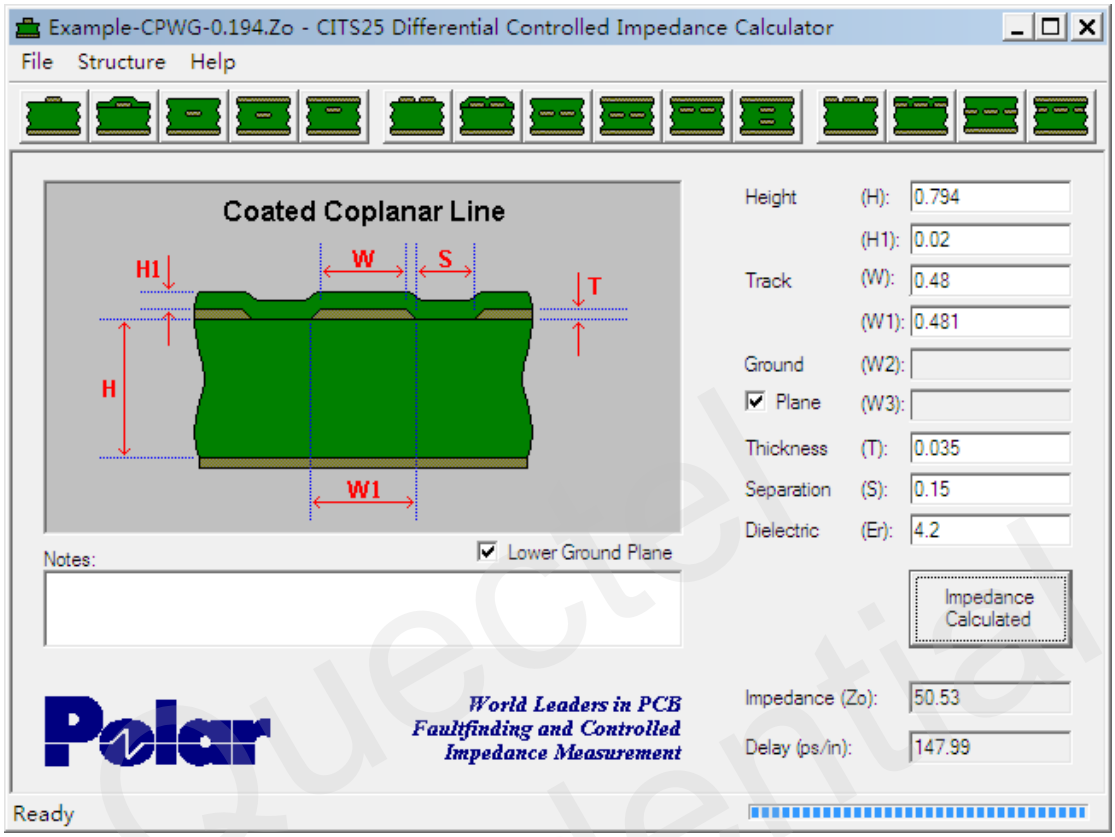
Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host device; otherwise, the host device must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the words “Contains transmitter module IC: 10224A-201707SC20A”.

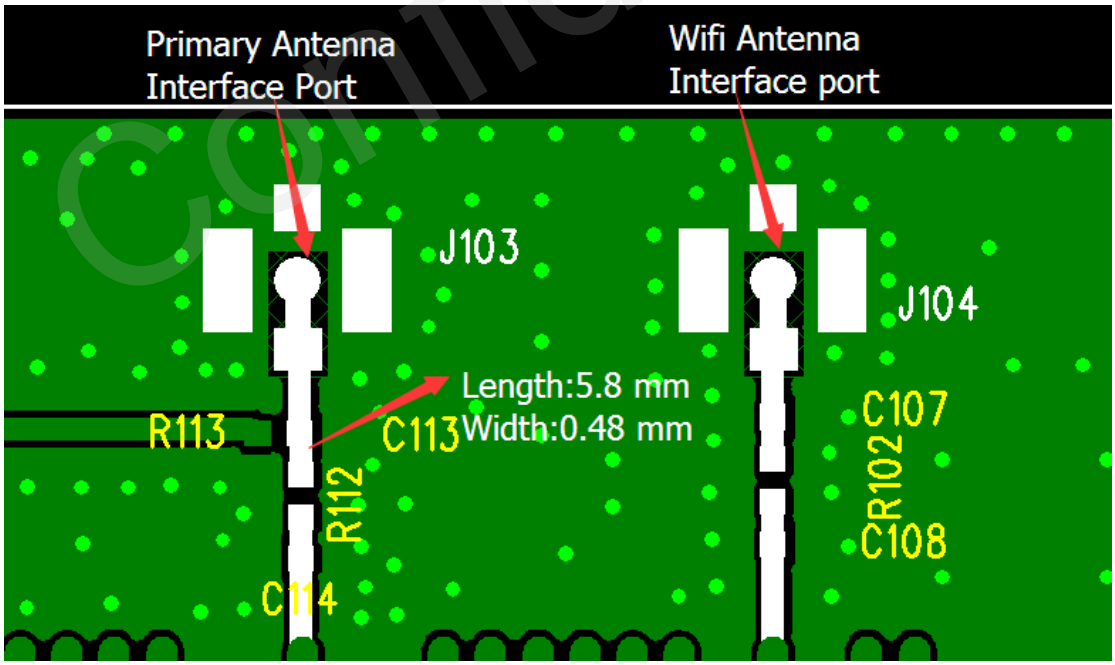
The device is going on be operated in 5150~5250 frequency range. It is restricted indoor environment only in Canada.

Quectel Confidential

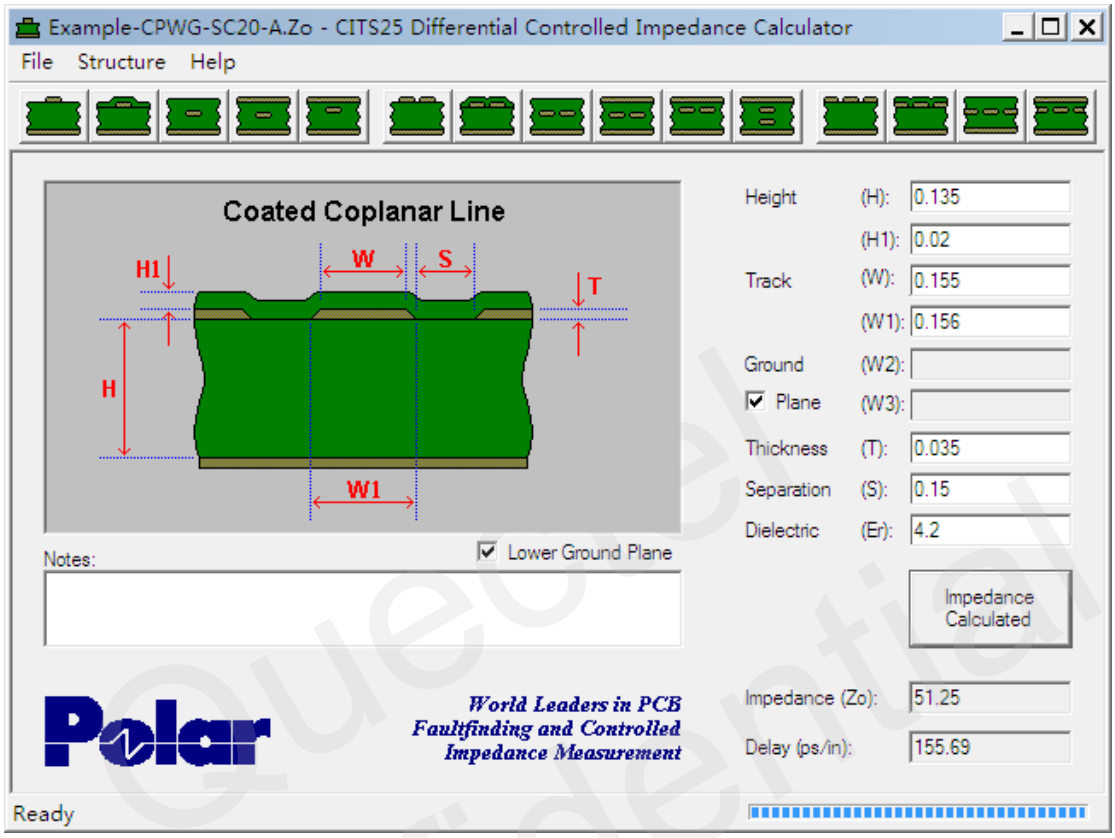
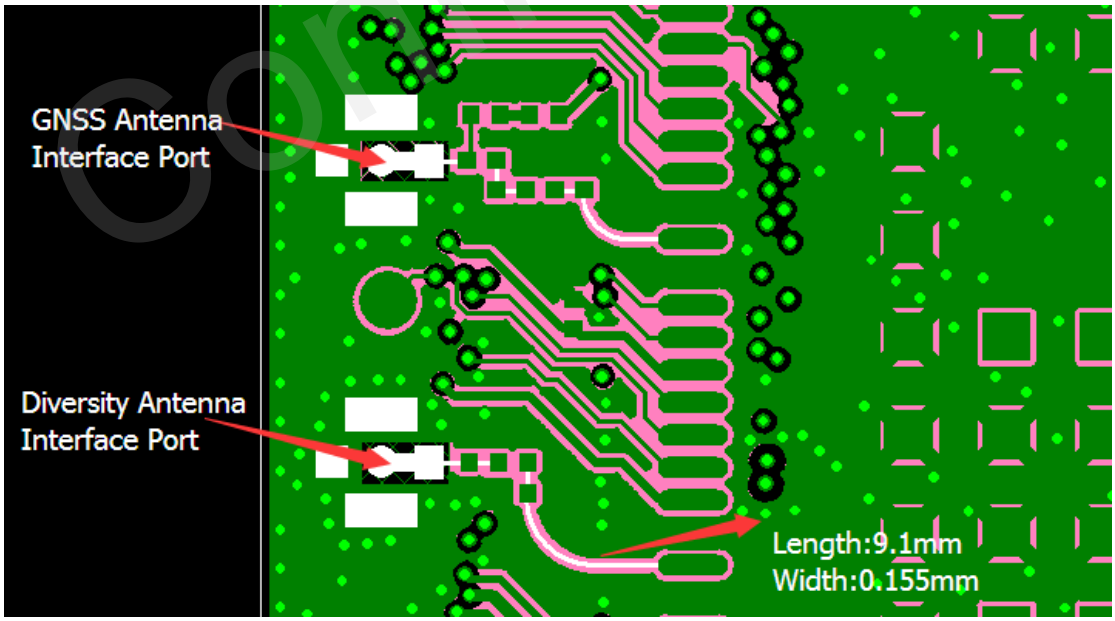
1、the characteristic impedence depends on the dielectric of PCB, the trace width and the grand plane spacing,Coated Coplanar Line is required.the detail simulation as below.



2、the RF trace of the test board which was used in the FCC test is defined as below.



3、the characteristic impedence depends on the dielectric of PCB, the trace width and the grand plane spacing,Coated Coplanar Line is required.the detail simulation as below.



4、the RF trace of the test board which was used in the FCC test is defined as below.