



SIM7600X-M2

Hardware Design

LTE Module

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Date	Version	Description of change	Author
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2020-10-19	1.01	Add SIM7600NA-H-M2,SIM7600G-H-M2,SIM7600JC-H -M2 and SIM7600CE-T-M2 module.	Honggang Ma Qiang Zhang

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1. Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the LTE M.2 card. With the help of this document and other software application notes/user guides, users can understand and use SIM7600X-M2 to design and develop mobile and laptop applications quickly.

1.1 Product Outline

Aimed at the global market, SIM7600X-M2 supports GSM, WCDMA, LTE-TDD and LTE-FDD, . The supported radio frequency bands are described in the table1.

Table 1: SIM7600X-M2 frequency bands (* stands for SIM7600)

Standard	Frequency	*A-H-M 2	*SA-H- M2	*E-H-M2	*NA-H- M2	*G-H-M 2	JC-H-M 2	*CE-T-M 2
GSM	850MHz		√			√		
	900MHz		√	√		√		√
	1800M Hz		√	√		√		√
	1900M Hz		√			√		
EVDO/CD MA	BC0							√
TD-SCDM A	B34							√
	B39							√
WCDMA	B1		√	√		√		√
	B2	√	√			√		
	B4					√		
	B5	√	√	√		√		
	B6					√		
	B8			√	√	√		√
	B19					√		
LTE	FDD B1		√	√		√	√	√
	FDD B2	√	√		√	√		
	FDD B3		√	√		√	√	√
	FDD B4	√	√		√	√		

FDD B5		√	√	√	√		√
FDD B7		√	√		√		
FDD B8		√	√		√	√	√
FDD B12	√			√	√		
FDD B13				√	√		
FDD B14				√			
FDD B18					√	√	
FDD B19					√	√	
FDD B20			√		√		
FDD B25				√	√		
FDD B26				√	√	√	
FDD B28		√			√		
FDD B66		√		√	√		
FDD B71				√			
TDD B34					√		√
TDD B38			√		√		√
TDD B39					√		√
TDD B40			√		√		√
TDD B41			√	√	√		√
GNSS Category	Optional CAT4	Optional CAT4	Optional CAT4	Optional CAT4	Optional CAT4	Optional CAT4	Optional CAT4

SIM7600X-M2 had almost all common interface integrated, such as USB2.0, UIM card, digital audio(PCM), UART, I2C, GPIOs, MAIN ANT, DIV ANT and GNSS ANT, etc.

With all the interfaces, SIM7600X-M2 can also be utilized in the industrial hand held, machine-to-machine laptop application and especially the router.

1.2 Hardware Block Diagram

The block diagram of SIM7600X-M2 is shown as below:

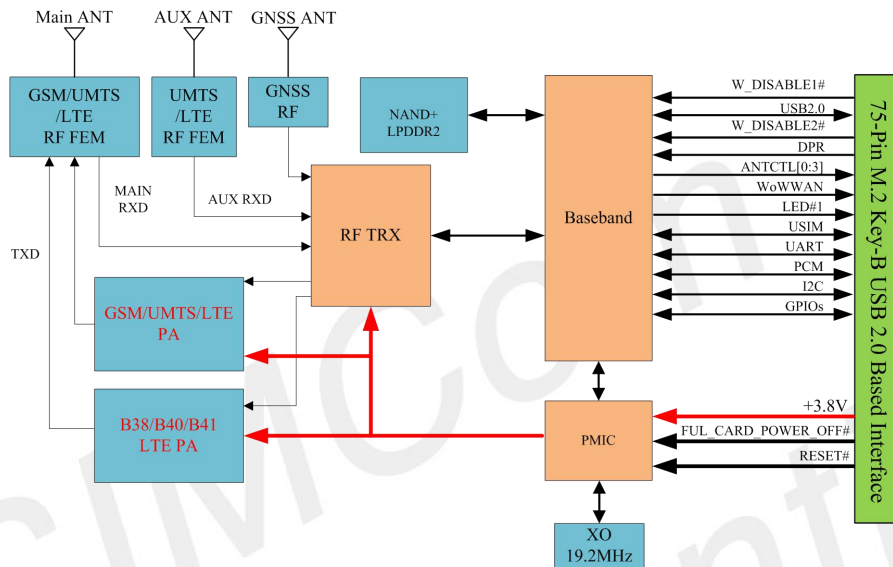


Figure 1: SIM7600X-M2 block diagram

1.3 Functional Overview

Table 2: General features

Feature	Implementation
Power supply	VBAT: 3.4~4.2 Typical supply voltage: 3.8V
Power consumption	Power off current: <30uA Current in sleep mode: <4mA (USB suspend) Current in sleep mode: <3mA (USB disabled by AT command through UART interface)
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power class: --GSM850: 4 (2W) --EGSM900: 4 (2W) --DCS1800: 1 (1W) --PCS1900: 1 (1W) EDGE power class:

	<p>--GSM850: E2 (0.5W) --EGSM900: E2 (0.5W) --DCS1800: E1 (0.4W) --PCS1900: E1 (0.4W) CDMA 1X power class: 3 (0.25W) TD-SCDMA: 2 (0.25W) UMTS power class: --WCDMA :3 (0.25W) LTE power class: 3 (0.25W)</p>
Data Transmission Throughput	<p>Main antenna. Diversity antenna GNSS antenna</p>
Antenna	<p>GNSS engine (GPS, GLONASS and BD) Protocol: NMEA</p>
SMS	<p>MT, MO, CB, Text and PDU mode SMS storage: USIM card or ME(default) Transmission of SMS alternatively over CS or PS.</p>
USIM interface	<p>Support identity card: 1.8V/ 3V Support USIM detect function</p>
USIM application toolkit	<p>Support SAT class 3, GSM 11.14 Release 98 Support USAT</p>
Phonebook management	<p>Support phonebook types: DC,MC,RC,SM,ME,FD,ON,LD,EN</p>
Digital Audio feature	<p>One PCM digital audio interface</p> <ul style="list-style-type: none"> ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● CLK frequency: 2.048MHz (2G/3G), 4.096MHz (4G) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● WCDMA AMR-NB ● VoLTE AMR-WB ● Echo Cancellation ● Noise Suppression
UART interface	<p>UART:</p> <ul style="list-style-type: none"> ● Baud rate: 300bps to 921600bps(default:115200bps) ● Can be used as the AT commands or data stream channel ● Multiplex ability according to GSM 07.10 Multiplexer Protocol ● Could be configured as GPIOs.
I2C interface	<ul style="list-style-type: none"> ● Apply to the "I2C Specification, version 3.0" ● Clock up to 400Kbps
USB	<p>USB2.0 high speed interface, support USB operations at low-speed and full-speed, which refer to USB1.0 and USB1.1.</p>
Firmware upgrade	<p>Firmware upgrade over USB interface or FOTA</p>
Physical characteristics	<p>Size:32*42*2.3mm Weight:6.3g</p>
Temperature range	<p>Normal operation temperature: -30°C to +70°C 3GPP compliant Non operation temperature: -40°C to +85°C* Storage temperature -40°C to +90°C 72 hours</p>

NOTE

Module is able to make and receive voice calls, data calls, SMS and make GPRS/UMTS/HSPA+/LTE traffic in $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extended operating temperature range.

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2. Package Information

2.1 Top and Bottom View of Module

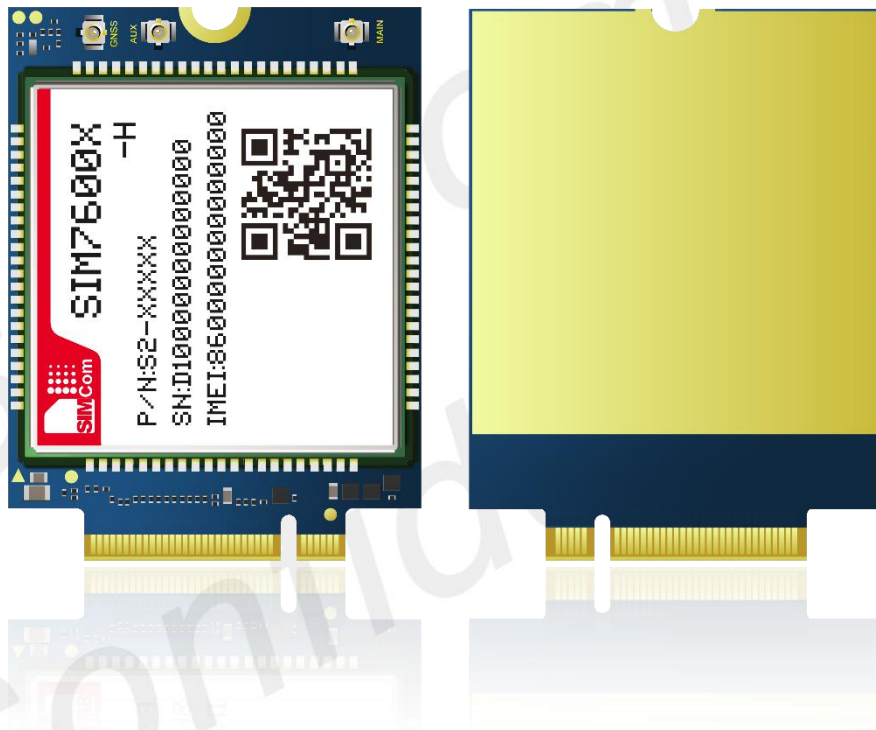


Figure 2: Top and bottom view of module (bottom side reserved ground plane for thermal)

2.2 Pin Assignment Overview

All functions of the M.2 card will be provided through 75 (including 8 notch pins) pads that will be connected to the customers' platform. The following table is the high-level view of the pin assignment of the card.

74	VBAT	CONFIG_2=GND	75
72	VBAT	GND	73
70	VBAT	GND	71
68	NC	CONFIG_1=GND	69
66	USIM_DET(I)(1.8V)	RESET#(I)(1.8V)	67
64	GPIO3(IO)(1.8V)	ANTCTL3(O)(1.8V)	65
62	GPIO77(IO)(1.8V)	ANTCTL2(O)(1.8V)	63
60	UART_TXD(O)(1.8V)	ANTCTL1(O)(1.8V)	61
58	UART_RXD(I)(1.8V)	ANTCTL0(O)(1.8V)	59
56	UART_CTS(O)(1.8V)	GND	57
54	UART_RTS(I)(1.8V)	NC	55
52	UART_DTR(I)(1.8V)	NC	53
50	GPIO40(IO)(1.8V)	GND	51
48	GPIO41(IO)(1.8V)	NC	49
46	GPIO43(IO)(1.8V)	NC	47
44	GPIO44(IO)(1.8V)	GND	45
42	I2C_SDA(IO/OD)(1.8V)	NC	43
40	I2C_SCL(O/OD)(1.8V)	NC	41
38	NC	GND	39
36	USIM_VDD	NC	37
34	USIM_DATA	NC	35
32	USIM_CLK	GND	33
30	USIM_RST	NC	31
28	PCM_CLK(O)(1.8V)	NC	29
26	W_DISABLE2_N(I)(3.3V)	GND	27
24	PCM_OUT(O)(1.8V)	DPR(I)(1.8V)	25
22	PCM_IN(I)(1.8V)	WoWWAN(OD)(1.8V/3.3V)	23
20	PCM_SYNC(O)(1.8V)	CONFIG_0=GND	21
	Notch	Notch	
	Notch	Notch	
	Notch	Notch	
	Notch	Notch	
	Notch	GND	11
10	LED1#(OD)(3.3V)	USB_D-	9
8	W_DISABLE1_N(I)(3.3V)	USB_D+	7
6	FUL_CARD_POWER_OFF#(I)(1.8/3.3V)	GND	5
4	VBAT	GND	3
2	VBAT	CONFIG_3=NC	1

Figure 3: Pin assignment

2.3 Pin Description

Table 3: IO parameters definition

Pin type	Description
PI	Power input
PO	Power output
AI	Analog input
AIO	Analog input/output
DIO	Bidirectional digital input /output
DI	Digital input
DO	Digital output
DOH	Digital output with high level
DOL	Digital output with low level
PU	Pull up
PD	Pull down
OD	Open Drain
OC	Open collector

Table 4: IO parameters description

Voltage domain	Parameter	Min	Typ	Max	
P3	VDD_P3=1.8V				
	VOH	High level output	1.35V	-	1.8V
	VOL	Low level output	0V	-	0.45V
	VIH	High level input	1.2V	1.8V	2.1V
	VIL	Low level input	-0.3V	-	0.6V
	Rp	Pull up/down resistor	80K ohm	-	240K ohm
P4	VDD_P4=1.8V				
	VOH	High level output	1.44V	-	1.8V
	VOL	Low level output	0V	-	0.4V
	VIH	High level input	1.26V	1.8V	2.1V
	VIL	Low level input	-0.3V	-	0.36V
	Rp	Pull up/down resistor	360K ohm	-	
	VDD_P4=2.85V				
	VOH	High level output	2.28V	-	2.85V
	VOL	Low level output	0V	-	0.4V
	VIH	High level input	2.0V	-	3.15V
	VIL	Low level input	-0.3V	-	0.57V
	Rp	Pull up/down resistor	285K ohm		

Table 5: Pin description

Pin name	Pin No.	Electrical Description		Description	Comment
Power supply					
VBAT	2,4,70,72,74	-	PI	M.2 card power supply, voltage range: 3.4~4.2V, typical 3.8V.	User should connect these pins together.
GND	3,5,11,27,33,39,45,51,57,71,73	-	PI	Ground	
System Control					
FUL_CARD_POWER_OFF#	6		DI,PD	H: WWAN powers on. L: WWAN powers off.	It's internally pulled to Low. It's 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO.
Reset#	67	P3	DI,PU	System reset control input, active low.	RESET_N has been pulled up to 1.8V via resistor internally.
W_DISABLE1#	8	P3	DI	WWAN RF Disable, active low	It's 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO.
Configuration pins					
CONFIG0	21	-	GND	Connect to ground	
CONFIG1	69	-	GND	Connect to ground	SIM7600X-M2 module is configured as the WWAN USB2.0 interface type
CONFIG2	75	-	GND	Connect to ground	
CONFIG3	1	-	NC	Not connected	
USB2.0					
USB_D+	7	-	AIO	Positive line of the differential, bi-directional USB signal.	Main communication interface. USB2.0 is up to 480Mbps.
USB_D-	9	-	AIO	Negative line of the differential, bi-directional USB signal.	
USIM interface					
USIM_VDD	36	P4	PO	Power output for USIM card, the voltage depends on the USIM card type. Its output current is up to 50mA.	All lines of USIM interface should be protected against ESD.
USIM_DATA	34	P4	DIO	USIM Card data I/O, which has been pulled up via a 10KR resistor to USIM_VDD internally. Do not pull it up or down externally.	
USIM_CLK	32	P4	DO	USIM clock output	

USIM_RST	30	P4	DO	USIM Reset output	
USIM_DET	66	P3	DI	USIM card detecting input signal which has been pulled up via a 10KR resistor to VDD_P3 internally.	
ANTCTL signals					
ANTCTL0	59	P3	DO	Tunable ANT CTRL0	In developing
ANTCTL1	61	P3	DO	Tunable ANT CTRL1	
ANTCTL2	63	P3	DO	Tunable ANT CTRL2	
ANTCTL3	65	P3	DO	Tunable ANT CTRL3	
UART interfaces					
UART_RTS	54	P3	DO	UART request to send	These signals are 1.8V voltage domain. If unused, keep them open.
UART_CTS	56	P3	DI	UART clear to send	
UART_RX	58	P3	DI	UART receive data	
UART_TX	60	P3	DO	UART transmit data	
UART_DTR	52	P3	DI	DTE get ready	
I2C interfaces					
I2C_SCL	40		OD,DO	I2C clock	OD output, if need this function, it should be pulled up.
I2C_SDA	42		OD,DIO	I2C data	
Audio interface					
PCM_SYNC	20	P3	DO	PCM synchronous signal ; I2S word select	These signals are 1.8V voltage domain. If unused, keep them open.
PCM_IN	22	P3	DI	PCM data input; I2S data input	
PCM_OUT	24	P3	DO	PCM data output; I2S data output	
PCM_CLK	28	P3	DO	PCM clock output I2S clock output	
GPIO interfaces					
GPIO44	44	P3	DIO	GPIO	If unused, keep them open.
GPIO43	46	P3	DIO	GPIO	
GPIO41	48	P3	DIO	GPIO	
GPIO40	50	P3	DIO	GPIO	
GPIO77	62	P3	DIO	GPIO	
GPIO3	64	P3	DIO	GPIO	
Other pins					
LED#1	10	P3	OC	It is an open collector, active low signal, used to allow the M.2 card to provide status indicators via LED devices that will be provided by the system.	These signals are open-drain output. If unused, keep them open.
WAKE_ON_WWAN	23	P3	OC	WWAN to wake up the host.	

				It is open collector and active low.	
DPR	25	P3	DI	Hardware Pin for BodySAR Detection, active low. H: Max transmitting power will not be reduced (default) L: Max transmitting power will be reduced	In developing
Not Connected pins					
NC	29,31,35,37,38,56,68.				Keep unconnected.
Notch					
Notch	12,13,14,15,16,17,18,19			Notch	

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2.4 Package Dimensions

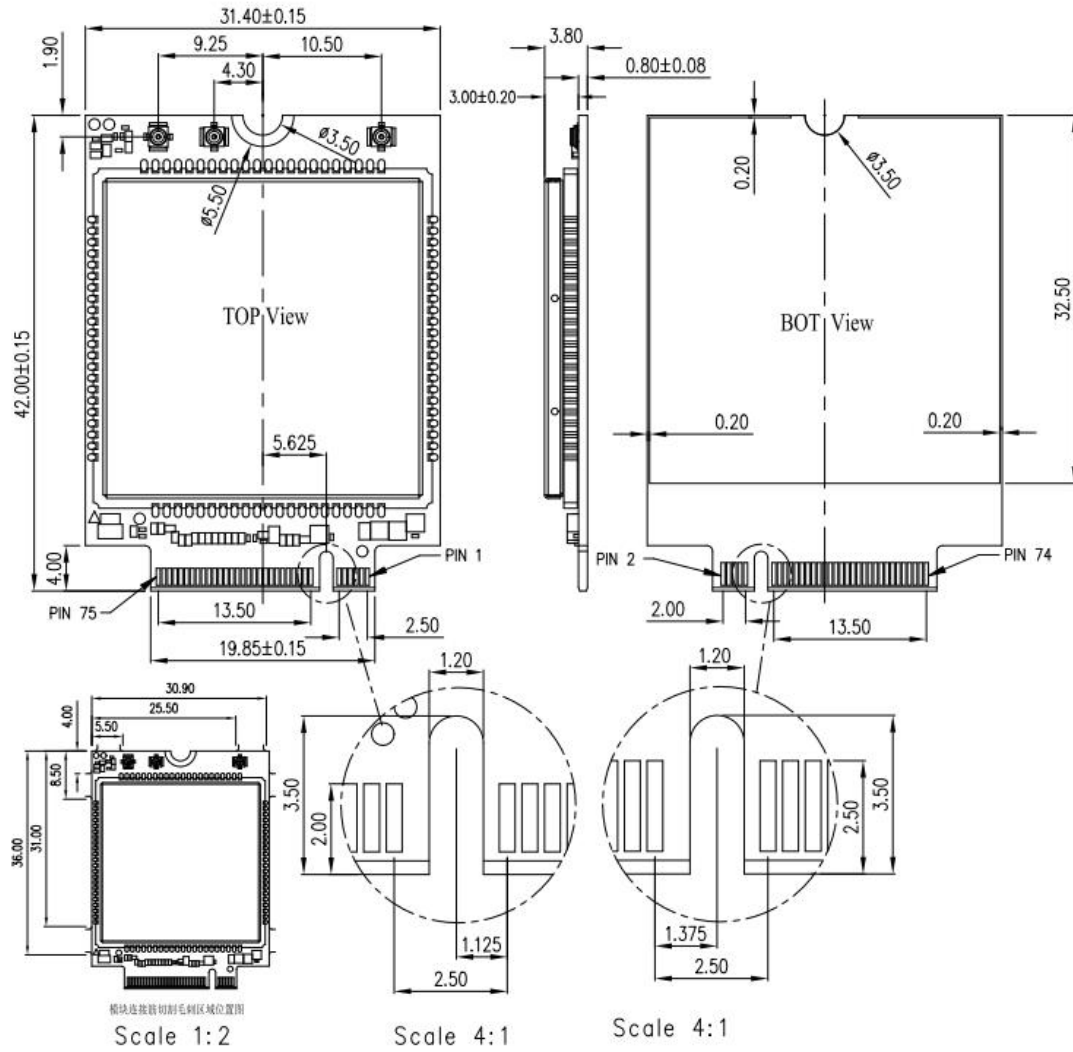


Figure 4: Dimensions of SIM7600X-M2 (Unit: mm)

2.5 Label information

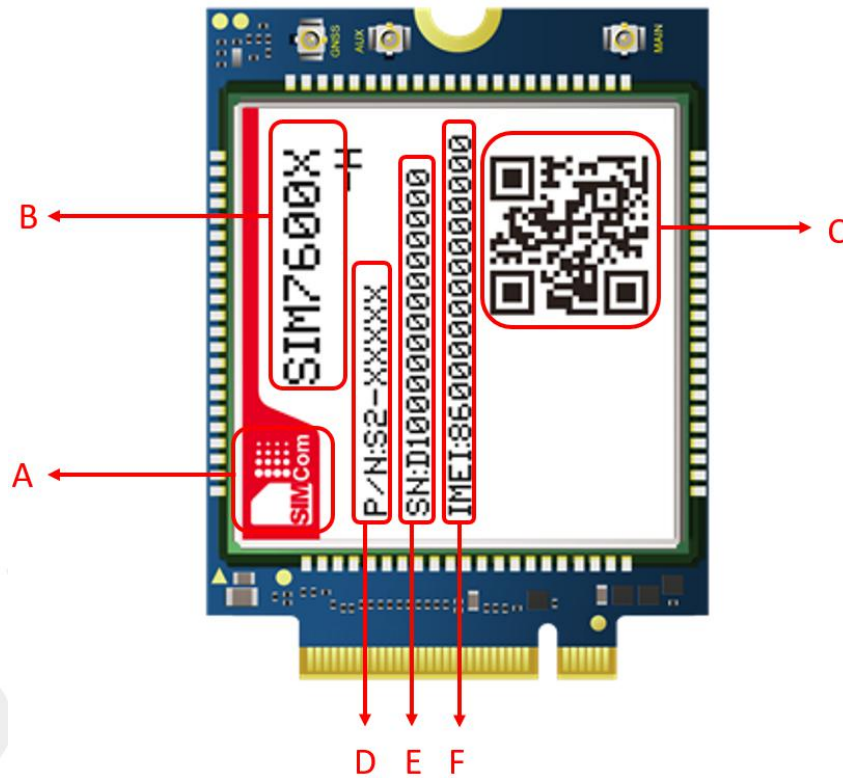


Figure 5: Label information

Table 6: The description of label information

No.	Description
A	SIMCom logo
B	Project name
C	QR code
D	Module part number
E	Serial number
F	International mobile equipment identity

3. Interface Application

3.1 Power Supply

The recommended power supply of SIM7600X-M2 is 3.8V and the voltage ranges from 3.3 V to 4.2 V. The SIM7600X-M2 has 5 power pins and 11 Ground pins, to ensure the SIM7600X-M2 card works normally, all the pins must be connected. The connector pin is defined to support 500mA current per pin continuously.

Table 7: VBAT pins electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VBAT	Module power voltage.	3.3	3.8	4.2	V
I _{VBAT(peak)}	Module power peak current in normal mode.	-	2.0	-	A
I _{VBAT(power-off)}	Module power current in power off mode.	-	10	-	uA

3.1.1 Power Supply Design Guide

Make sure that the voltage on the VBAT pins will never drop below 3.2V, even during a transmit event, when current consumption may rise up to 2.0A. If the voltage drops below 3.2V, the module may be powered off automatically.

NOTE

Be sure the power supply for VBAT pins can support more than 1.0A, using a total of more than 100uF capacitors is recommended, in order to avoid the voltage dropping to lower than 3.135V.

Some multi-layer ceramic chip (MLCC) capacitors (0.1/1uF) with low ESR in high frequency band can be used for EMC.

These capacitors should be put as close as possible to VBAT pads. Also, users should keep VBAT trace on circuit board wider than 1.0 mm to minimize PCB trace impedance. The following figure shows the recommended circuit.

If the VBAT generated by a switch mode power supply, it is suggested to add a bead to suppress the Interference. Recommend part of FB101 is BLM21PG300SN1D or MPZ2012S221A.

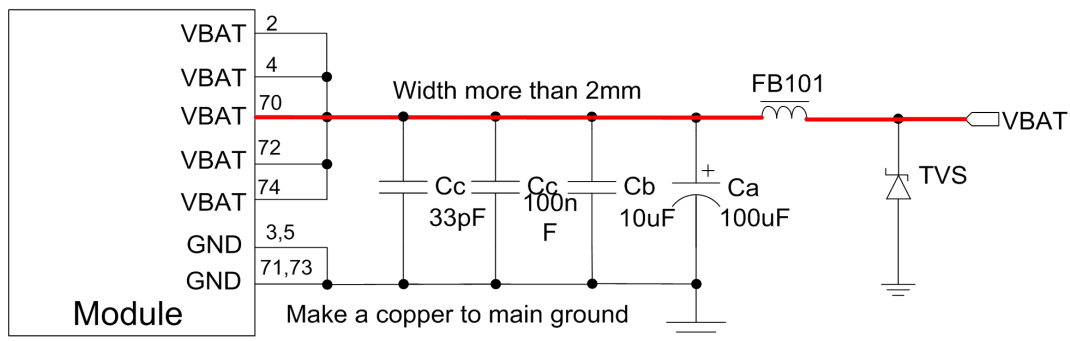


Figure 6: Power supply application circuit

NOTE

The test condition: The voltage of power supply for VBAT is 3.7V, Ca is a 100 μ F tantalum capacitor (ESR=0.7 Ω).

PIN3,5,71,73 are the main return current path of module, these pins should be coppered by a ground plane to main ground.

All other GND pins also need connect to ground.

In addition, in order to guard for over voltage protection, it is suggested to use a TVS diode to protect the M.2 card. TVS diode should be placed near VBAT pins.

Table 8: Recommended TVS diode list

No.	Manufacturer	Part Number	VRWM	Package
1	JCET	ESDBW5V0A1	5V	DFN1006-2L
2	WAYON	WS05DPF-B	5V	DFN1006-2L
3	WILL	ESD5611N	5V	DFN1006-2L
4	WILL	ESD56151W05	5V	SOD-323

3.1.2 Recommended Power Supply Circuit

It is recommended that a switching mode power supply or a linear regulator power supply is used. It is important to make sure that all the components used in the power supply circuit can resist the current which could be more than 2A.

The following figure shows the linear regulator reference circuit with 5V input and 3.8V output.

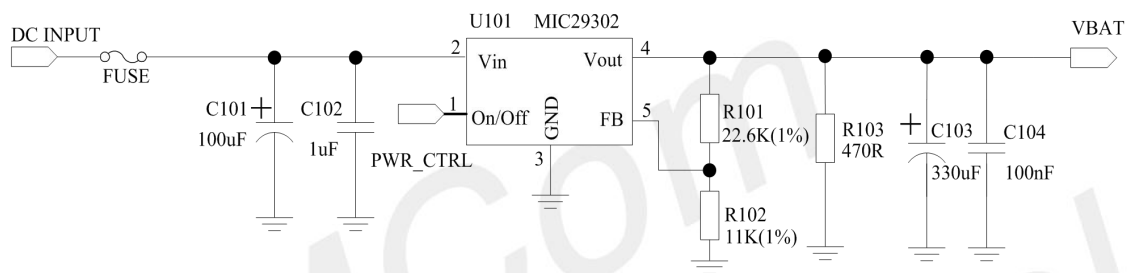


Figure 7: Linear regulator reference circuit

If there is a high dropout between input and VBAT, or the efficiency is extremely important, then a switching mode power supply will be preferable. The following figure shows the switching mode power supply reference circuit with 12V input and 3.8V output.

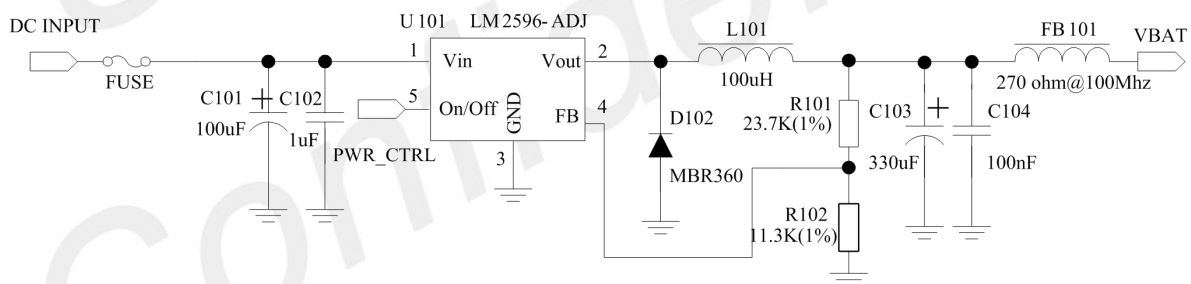


Figure 8: Switching mode power supply reference circuit

NOTE

The Switching Mode power supply solution for VBAT must be chosen carefully against Electro Magnetic Interference and ripple current from depraving RF performance.
PWR_CTRL must connect to host in case that the module system crash.

3.1.3 Voltage Monitor

To monitor the VBAT voltage, the AT command “AT+CBC” can be used.

For monitoring the VBAT voltage outside or within a special range, the AT command “AT+CVALARM” can be used to enable the Over-voltage warning function.

If users need to power off module when the VBAT voltage is out of a range, the AT command “AT+CPMVT” can be used to enable over-voltage power-off function.

NOTE

Over-voltage warning function and over-voltage power-off function are disabled by default. For more information about these AT commands, please refer to [Document \[1\]](#).

The module will power on automatically after the under-voltage power off procedure if the Full_Card_Power_Off# signal keeps at high level.

3.2 Full_Card_Power_Off#

Module can be powered on by pulling the Full_Card_Power_Off# pin up to high level through GPIO, which is 3.3V tolerant.

Full_Card_Power_Off# signal is an active **low** input signal and will turn the module on when asserted high (≥ 1.7 V) and will force the module to shut down when asserted low (≤ 0.2 V). This pin is 3.3V tolerant and can be driven by either 1.8V or 3.3V GPIO and has been pulled down internal.

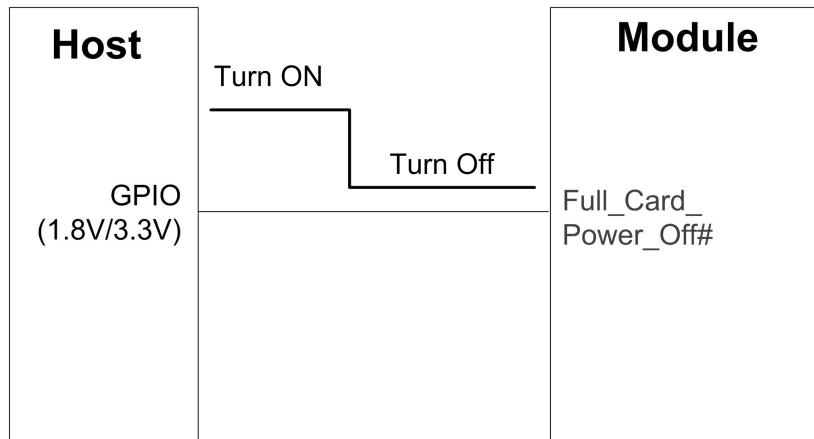


Figure 9: Reference power on/off circuit

NOTE

Module could be automatically power on by connecting Full_Card_Power_Off# pin to VBAT via 0R resistor directly.

3.2.1 Power on

The power-on scenarios are illustrated in the following figure.

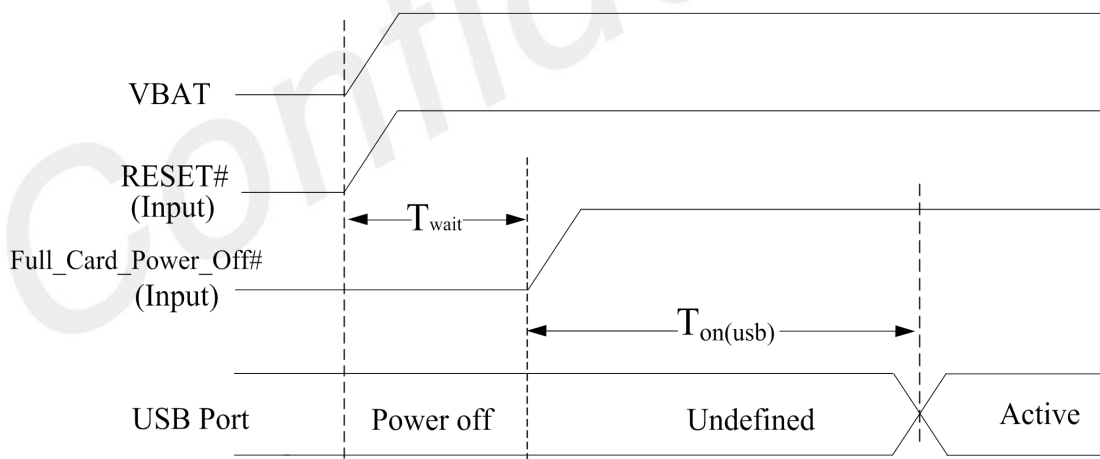


Figure 10: Power on timing sequence

Table 9: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T _{wait}	The time which is used to wait the VBAT to be stable.	100	-	-	ms
T _{on(usb)}	The time from power-on issue to USB port ready	-	TBD	-	s
V _{IH}	Input high level voltage on Full_Card_Power_Off# pin	1.0	1.7	4.4	V
V _{IL}	Input low level voltage on Full_Card_Power_Off# pin	-0.3	0	0.2	V

3.2.2 Power off

The following conditions could make the module power off.

- Condition 1: Power off module by holding the Full_Card_Power_Off# pin to a low level.
- Condition 2: Power off module by removing the VBAT.
- Condition 3: Power off module by AT command “AT+CPOF”.
- Condition 4: Over-voltage or under-voltage automatic power off.
- Condition 5: Over-temperature or under-temperature automatic power off.

NOTE

The over-temperature and over-voltage function is disabled by default.

If the temperature is outside the range of -30~+70°C, some warnings will be reported via AT port. If the temperature is outside the range of -40~+85°C, module will be powered off automatically. (if the function is enabled)

The module will power on automatically after the condition 3 ~ 4 power off procedure if the Full_Card_Power_Off# signal keeps at high level.

These procedures under condition 1~3 will make the M.2 card disconnect from the network and allow the software to enter a safe state, and save data before the card be powered off completely.

The power off scenario by pulling down the Full_Card_Power_Off# pin is illustrated in the following figure.

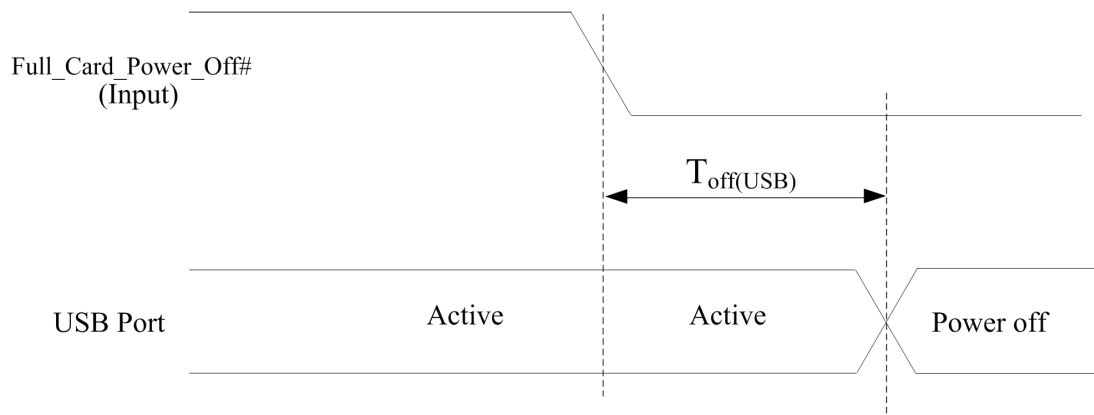


Figure 11: Power off timing sequence

Table 10: Power off timing and electronic characteristic

Symbol	Parameter	Time value			Unit
		Min.	Typ.	Max.	
$T_{off(usb)}$	The time from power-off issue to USB port off	-	28	-	s
T_{on-off}	The buffer time from power-off issue to power-on issue	30	-	-	s

3.3 Reset Function

Module can be reset by pulling the RESET# pin down to ground.

NOTE

This function is only used as an emergency reset, when both AT command “AT+CPOF” and the Full_Card_Power_Off# pin have lost efficacy.

The RESET# need a pull up with a resistor to 1.8V or 3.3V, it is strongly recommended to put a 100pF capacitor and an ESD protection diode close to the RESET# pin. Please refer to the following figure for the recommended reference circuit.

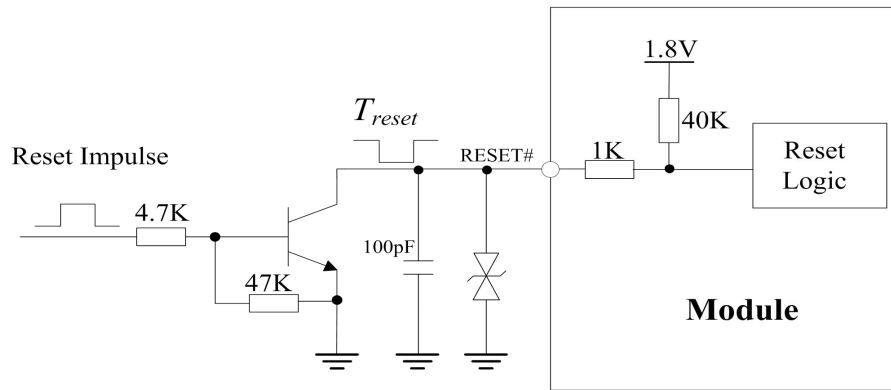


Figure 12: Reference reset circuit

Table 11: RESET pin electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset}	The active low level impulse time on RESET_N pin to reset module	100	200	500	ms
V_{IH}	Input high level voltage	1.17	1.8	2.1	V
V_{IL}	Input low level voltage	-0.3	0	0.8	V

3.4 UART interface

Module provides a 5-wire UART (universal asynchronous serial transmission) interface as DCE (Data Communication Equipment). AT commands and data transmission can be performed through UART interface.

The following figures show the reference design.

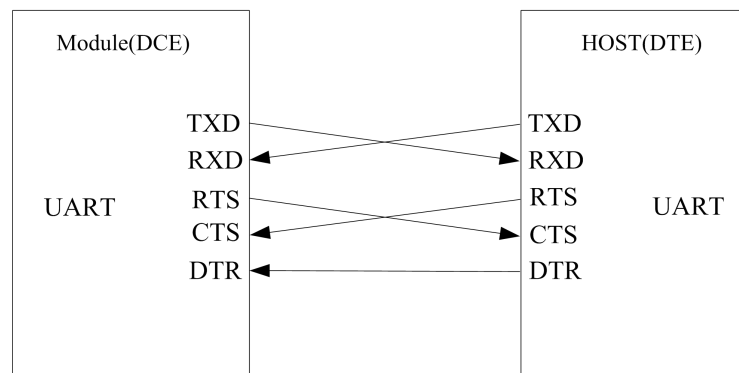


Figure 13: UART modem

The module UART is 1.8V voltage interface. If user's UART application circuit is 3.3V voltage interface, the level shifter circuits should be used for voltage matching. The TXB0102RGYR provided by Texas Instruments is recommended. The following figure shows the voltage matching reference design.

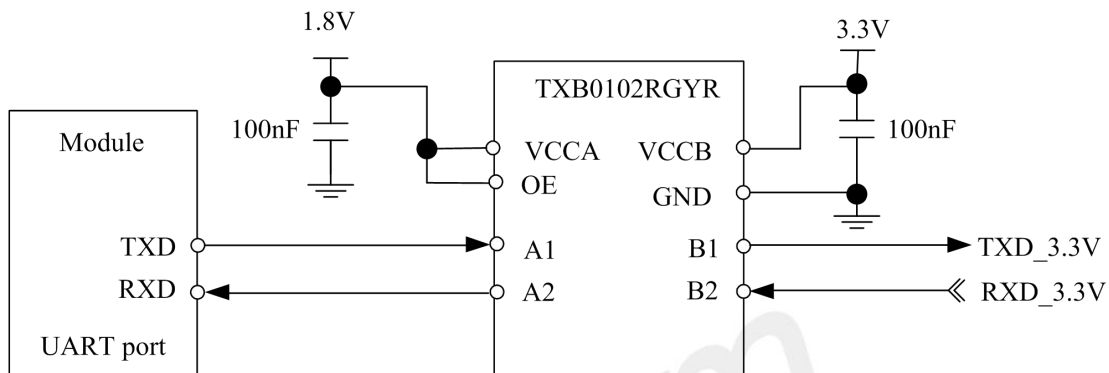


Figure 14: Reference circuit of level shift

Customers can use another level shifter circuits as follow.

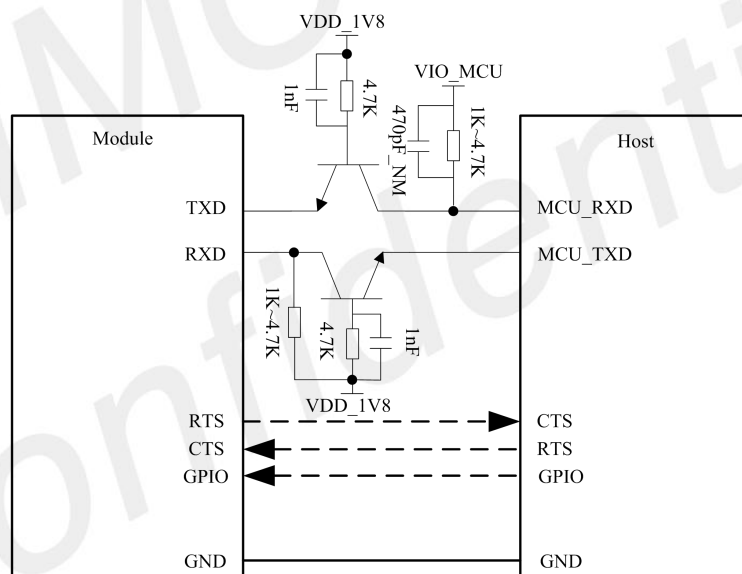


Figure 15: Level matching circuit with triode

NOTE

User need to use high speed transistors such as MMBT3904, or use NMOS such as 2SK3541T2L. Module supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600. The default band rate is 115200bps. Dotted line signal should refer to the TXD and RXD circuit.

3.5 I2C Interface

Module provides an I2C interface compatible with I2C specification, version 3.0, with clock rate up to 400 kbps. Its operation voltage is 1.8V.

The following figure shows the I2C bus reference design.

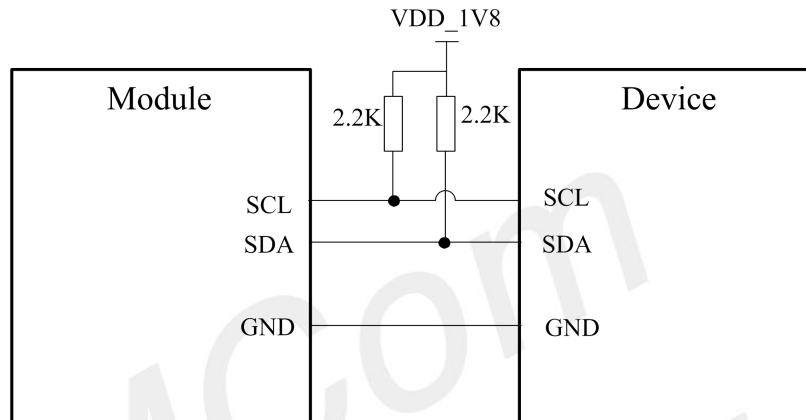


Figure 16: I2C reference circuit

NOTE

I2C_SDA and I2C_SCL have no pull-up resistors in module. So, 2 external pull up resistors are necessary in application circuit.

For more details about AT commands please refer to document [1].

3.6 WoWWAN#

The WoWWAN# pin is an open drain signal which can be used as an interrupt signal to the host. Normally it will keep high logic level until certain conditions such as receiving SMS, voice call (CSD, video) or URC reporting, then WoWWAN# will change to low logic level to inform the host (client PC), the pulse time is 1 second.

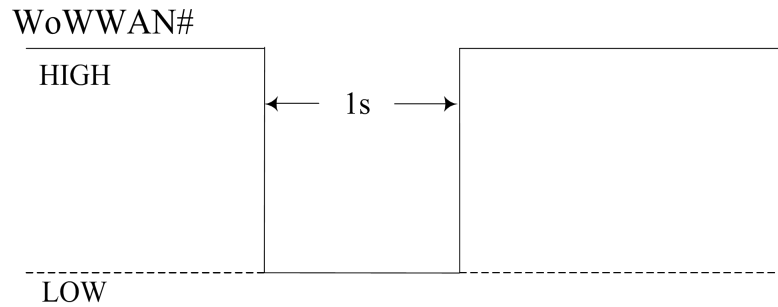


Figure 17: WoWWAN# behavior (SMS and URC report etc.)

WoWWAN# Reference circuit is recommended in the following figure.

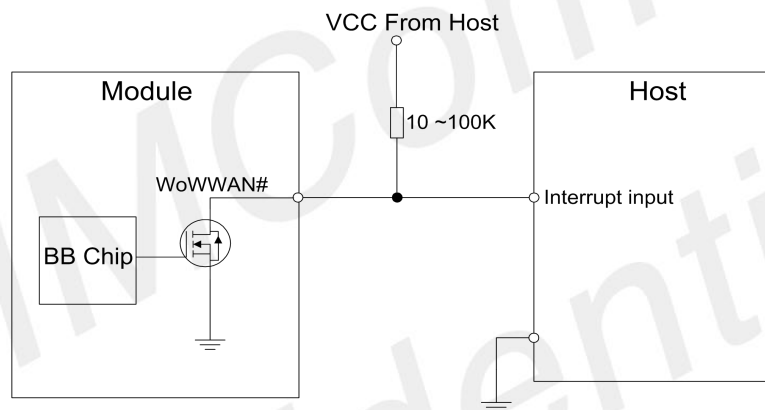


Figure 18: WoWWAN# reference circuit

3.7 USB2.0 Interface

The module implements a USB interface compliant with the USB2.0 specification. The module supports three USB speeds: low-speed (1.5Mbps), full-speed (12Mbps) and high-speed (480Mbps). But the OTG function and USB charging function are not supported.

NOTE

The USB_D- and USB_D+ nets must be traced by 90Ohm \pm 10% differential impedance.

Module is used as a USB device by default. Module supports the USB suspend and resume mechanism which can reduce power consumption. If there is no data transmission on the USB bus, module will enter

suspend mode automatically, and will be resumed by some events such as voice call, receiving SMS, etc. The reference schematic is as following:

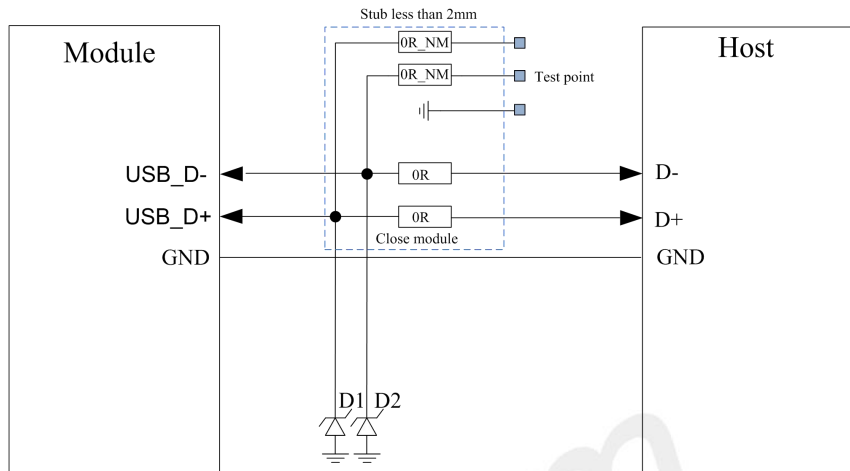


Figure 19: USB reference circuit

Because of the high bit rate on USB bus, more attention should be paid to the influence of the junction capacitance of the ESD component on USB data lines.

Typically, for the USB2.0 signals (USB_D- and USB_D+), the capacitance should not be more than 3pF. It is recommended to use an ESD protection component such as ESD9M5.0ST5G provided by On Semiconductor (www.onsemi.com).

3.8 USIM Interface

Module supports both 1.8V and 3.0V USIM Cards.

Table 12: USIM electronic characteristic in 1.8V mode (USIM_VDD=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	1.75	1.8	1.95	V
V _{IH}	High-level input voltage	0.65*USIM_VDD	-	USIM_VDD +0.3	V
V _{IL}	Low-level input voltage	-0.3	0	0.35*USIM_VDD	V
V _{OH}	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V _{OL}	Low-level output voltage	0	0	0.45	V

Table 13: USIM electronic characteristic 3.0V mode (USIM_VDD=2.85V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	2.75	2.85	3.05	V
V _{IH}	High-level input voltage	0.65*USIM_VDD	-	USIM_VDD +0.3	V
V _{IL}	Low-level input voltage	-0.3	0	0.25*USIM_VDD	V
V _{OH}	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V _{OL}	Low-level output voltage	0	0	0.45	V

3.8.1 USIM Application Guide

It is recommended to use an ESD protection component such as ESDA6V1-5W6 produced by ST (www.st.com) or SMF12C produced by ON SEMI (www.onsemi.com). Note that the USIM peripheral circuit should be close to the USIM card socket. The following figure shows the 6-pin SIM card holder reference circuit.

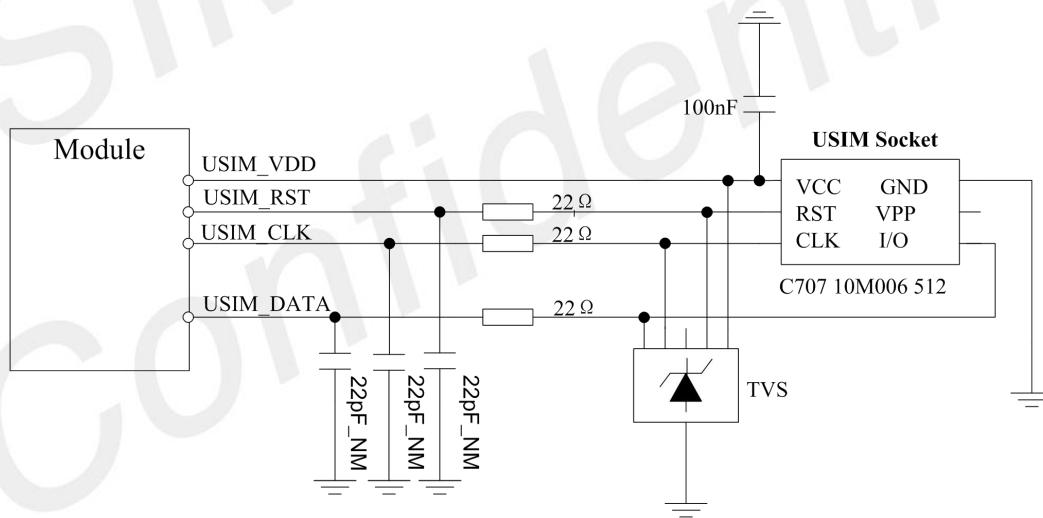


Figure 20: USIM interface reference circuit

The SIM Detect pin is used for detection of the USIM card hot plug in. User can select the 8-pin USIM card holder to implement USIM card detection function.

The following figure shows the 8-pin SIM card holder reference circuit.

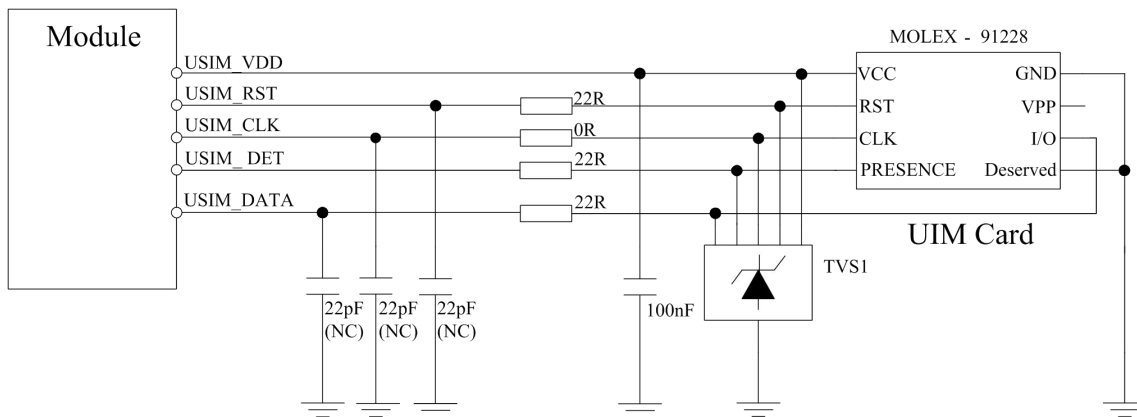


Figure 21: USIM interface reference circuit with USIM_DET

If the USIM card detection function is not used, user can keep the SIM Detect pin open.

3.8.2 USIM layout guide

If the UIM card detection function is not used, user can keep the SIM Detect pin open.

SIM card circuit is susceptible, the interference may cause the SIM card failures or some other situations, so it is strongly recommended to follow these guidelines while designing:

- Make sure that the SIM card holder should be far away from the antenna while in PCB layout.
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines.
- The traces should be as short as possible.
- Keep SIM holder's GND connect to main ground directly.
- Shielding the SIM card signal by ground.
- Recommended to place a 0.1~1uF capacitor on USIM_VDD line and keep close to the holder.
- The rise/fall time of USIM_CLK should not be more than 40ns.
- Add some TVS and the parasitic capacitance should not exceed 50pF.

3.9 PCM Interface

Module provides a PCM interface for external codec, which can be used in master mode with short sync and 16 bits linear format.

Table 14: PCM format

Characteristics	Specification
Line Interface Format	Linear(Fixed)
Data length	16bits(Fixed)
PCM Clock/Sync Source	Master Mode(Fixed)
PCM Clock Rate	2048 KHz (Fixed)
PCM Sync Format	Short sync(Fixed)
Data Ordering	MSB

NOTE

For more details about PCM AT commands, please refer to document [1].

3.9.1 PCM timing

Module supports 2.048 MHz PCM data and sync timing for 16 bits linear format codec.

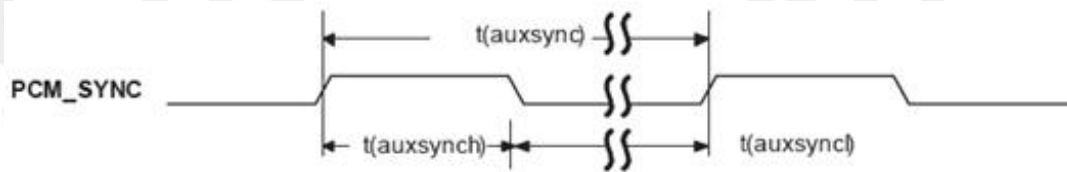


Figure 22: PCM_SYNC timing

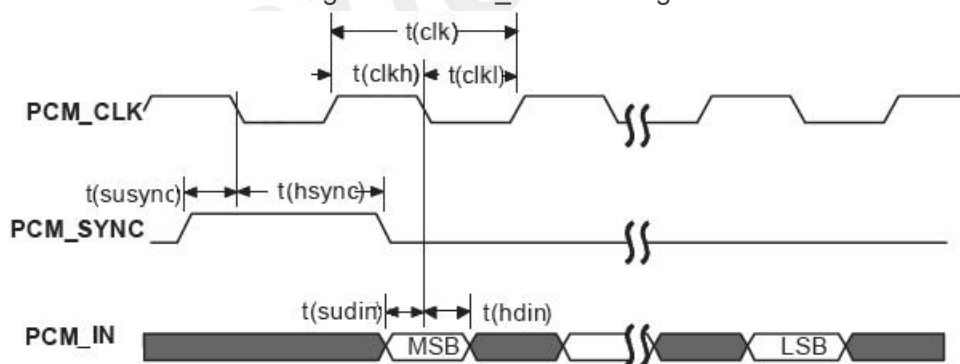


Figure 23: EXT codec to module timing

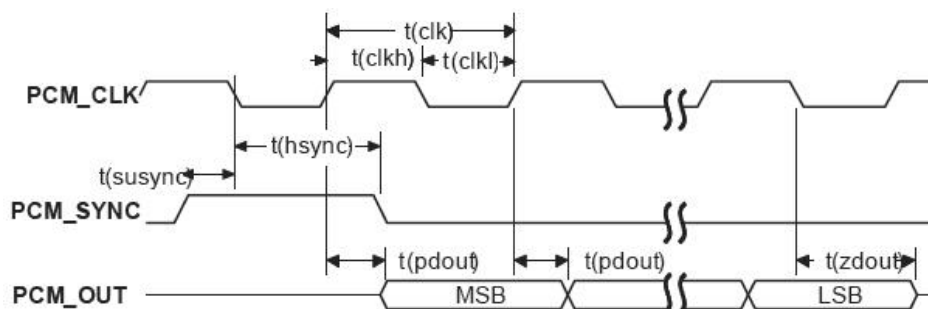


Figure 24: Module to codec timing

Table 15: PCM timing parameters(2G/3G mode)

Parameter	Description	Min.	Typ.	Max.	Unit
T(sync)	PCM_SYNC cycle time	–	125	–	µs
T(synch)	PCM_SYNC high level time	–	488	–	ns
T(sync _l)	PCM_SYNC low level time	–	124.5	–	µs
T(clk)	PCM_CLK cycle time	–	488	–	ns
T(clk _h)	PCM_CLK high level time	–	244	–	ns
T(clk _l)	PCM_CLK low level time	–	244	–	ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	–	244	–	ns
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	–	244	–	ns
T(sudin)	PCM_IN setup time before falling edge of PCM_CLK	60	–	–	ns
T(hdin)	PCM_IN hold time after falling edge of PCM_CLK	10	–	–	ns
T(pdout)	Delay from PCM_CLK rising to PCM_OUT valid	–	–	60	ns
T(zdout)	Delay from PCM_CLK falling to PCM_OUT HIGH-Z	–	160	–	ns

Table 16: PCM timing parameters(4G mode)

Parameter	Description	Min.	Typ.	Max.	Unit
T(sync)	PCM_SYNC cycle time	–	62.5	–	µs
T(synch)	PCM_SYNC high level time	–	244	–	ns
T(sync _l)	PCM_SYNC low level time	–	62.25 6	–	µs
T(clk)	PCM_CLK cycle time	–	244	–	ns
T(clk _h)	PCM_CLK high level time	–	122	–	ns
T(clk _l)	PCM_CLK low level time	–	122	–	ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	–	122	–	ns
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	–	122	–	ns
T(sudin)	PCM_IN setup time before falling edge of PCM_CLK	122	–	–	ns
T(hdin)	PCM_IN hold time after falling edge of PCM_CLK	122	–	–	ns
T(pdout)	Delay from PCM_CLK rising to PCM_OUT valid	–	–	122	ns
T(zdout)	Delay from PCM_CLK falling to PCM_OUT HIGH-Z	–	–	122	ns

3.9.2 PCM Application Guide

The following figure shows the external codec reference design.

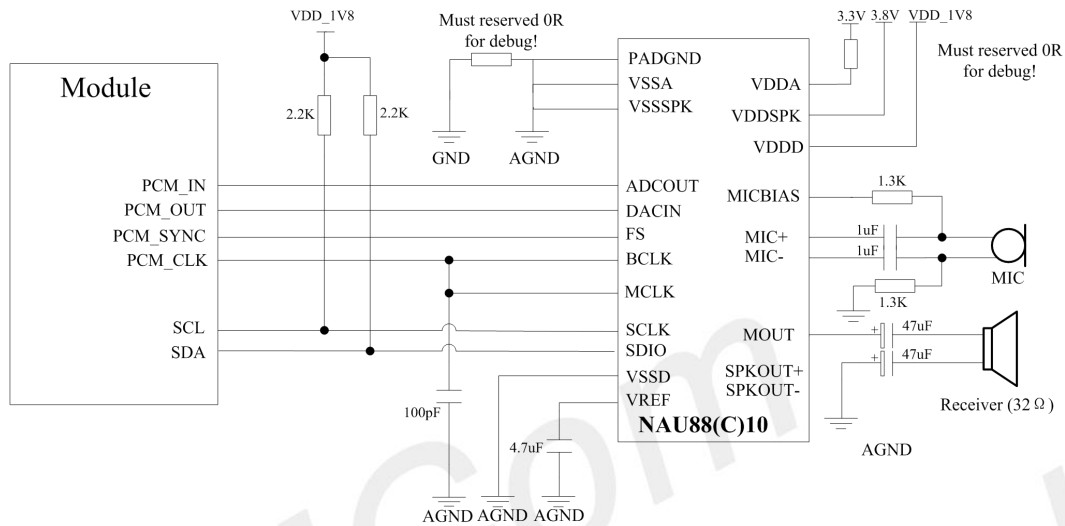


Figure 25: Audio codec reference circuit

3.10 GPIO

Module provides 7 GPIOs for customer use.

Table 17: GPIO resources

Pin No	PIN Name	GPIO in command	No AT INT	Power Domain	Default status	Default Function	Multiplex Function
44	GPIO44	44	√	1.8V	B-PD	GPIO	44
46	GPIO43	43		1.8V	B-PD	GPIO	46
48	GPIO41	41	√	1.8V	B-PD	GPIO	48
50	GPIO40	40	√	1.8V	B-PD	GPIO	50
62	GPIO77	77		1.8V	B-PD	GPIO	62
64	GPIO3	3		1.8V	B-PD	GPIO	64

3.11 DPR

DPR (Dynamic Power Reduction) signal is used by SIM7600X-M2 to assist in meeting regulatory SAR

(Specific Absorption Rate) requirements for RF exposure. The signal is provided by a host system proximity sensor to module to provide an input trigger causing a reduction in the radio transmit output power.

User can use AT command to active this function, if do not need this function, this pin can be keep floating.

Table 18: DPR interface

Pin no	Pin Name	Pin status	Function
25	DPR	Low	Max transmitting power will be reduced by set through AT command
		High	Max transmitting power will not be reduced (default)
		Floating	Max transmitting power will not be reduced

The proximity sensor should be controlled by host, following figure shows the connection relationship between module and sensor.

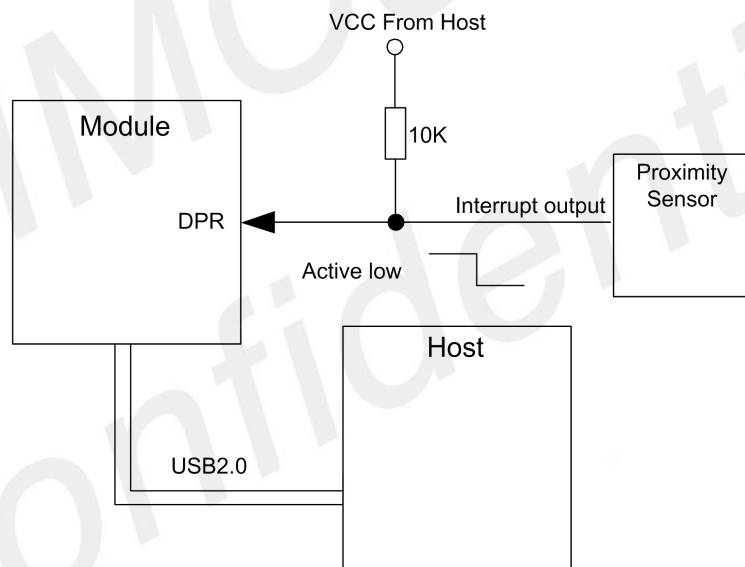


Figure 26: Connection of DPR pin

NOTE

The DRP function is under developing.

3.12 CONFIG Pins

These signals provide the means to indicate the specific configuration of the module. SIM7600X-M2 is configured as WWAN-USB2.0 (SIM7600X-M2 do not support USB3.0).

Table 19: CONFIG Pins

Pin no	Pin Name	Description
21	CONFIG_0	Connected to GND internally.
69	CONFIG_1	Connected to GND internally.
75	CONFIG_2	Connected to GND internally.
1	CONFIG_3	No Connect internally.

In the M.2 specification, the 4 pins are defined as below:

Table 20: Config interface

Config_0 (Pin 21)	Config_1 (Pin 69)	Config_2 (Pin 75)	Config_3 (Pin 1)	Module type and Main host interface	Port Configuration
GND	GND	GND	GND	SSD – SATA	N/A
GND	NC	GND	GND	SSD – PCIe	N/A
GND	GND	NC	GND	WWAN – PCIe	0
GND	NC	NC	GND	WWAN – PCIe	1
GND	GND	GND	NC	WWAN – USB 3.0	0
GND	NC	GND	NC	WWAN – USB 3.0	1
GND	GND	NC	NC	WWAN – USB 3.0	2
GND	NC	NC	NC	WWAN – USB 3.0	3
NC	GND	GND	GND	WWAN – SSIC	0
NC	NC	GND	GND	WWAN – SSIC	1
NC	GND	NC	GND	WWAN – SSIC	2
NC	NC	NC	GND	WWAN – SSIC	3
NC	GND	GND	NC	WWAN – PCIe	2
NC	NC	GND	NC	WWAN – PCIe	3
NC	GND	NC	NC	RFU	N/A
NC	NC	NC	NC	No module Present	N/A

3.13 LED1#

LED1# is open drain output and is used to allow SIM7600X-M2 to provide network status via LED which will be provided by the host.

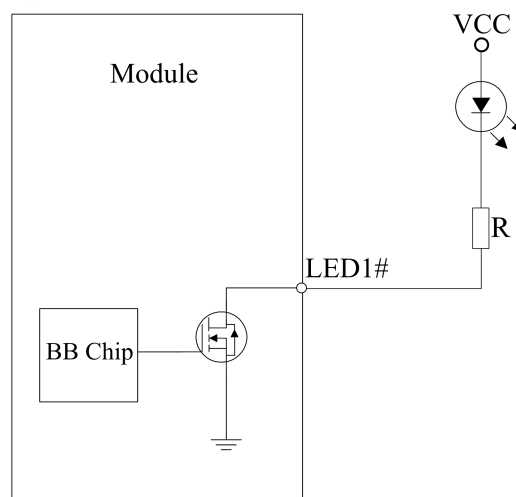


Figure 27: LED1# reference circuit

NOTE

The value of the resistor named “R” depends on the LED characteristic.

The timing sequence is as followed:

Table 21: LED1# pin status

LED1# pin status	Module status
Always On	Searching Network; Call Connect (include VOLTE, SRLTE)
200ms ON, 200ms OFF	Data Transmit; 4G registered;
800ms ON, 800ms OFF	3G registered network
OFF	Power off; Sleep

3.14 W_DISABLE1#

The W_DISABLE1# pin controls SIM7600X-M2 to enter or exit the flight mode, when the W_DISABLE1# signal is asserted to low level, all RF functions would be disabled. When the W_DISABLE1# signal is not asserted, the RF function will be active if it was not disabled by other means such as software.

Its reference circuit is shown in the following figure.

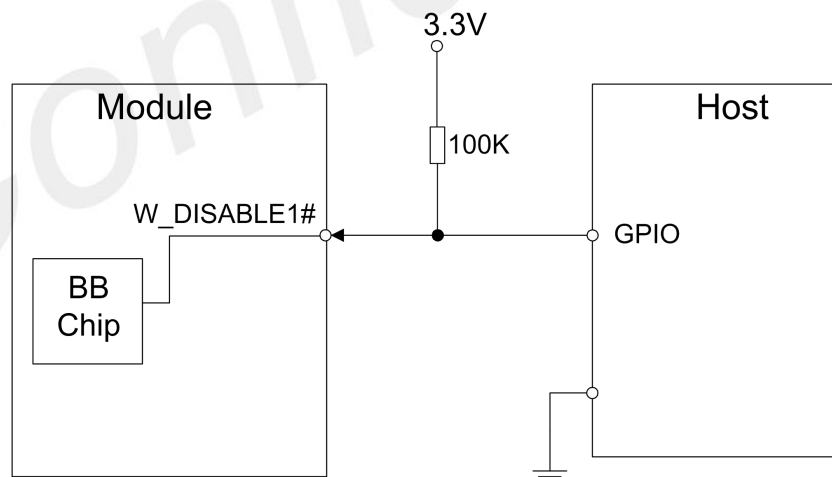


Figure 28: Flight mode switch reference circuit

W_DISABLE1# pin status as below:

Table 22: W_DISABLE1# pin status

W_DISABLE1# pin status	Module operation
Input Low Level	Flight Mode: RF is closed
Input High Level	AT+CFUN=4: RF is closed AT+CFUN=1: RF is working (default)

3.15 ANTCTRL interface

ANTCTL[0:3] are used for tun-able antenna control and should be routed to an appropriate antenna control circuitry.

The following table are the definitions for antenna control interfaces.

Table 23: Definition of antenna control interface

Pin Name	Pin No.	Electrical Description	Description	Comments
ANTCTL0	59	DO	Antenna tuner control0	
ANTCTL1	61	DO	Antenna tuner control1	1.8V voltage domain. If unused, please keep open
ANTCTL 2	58	DO	Antenna tuner control2	
ANTCTL3	56	DO	Antenna tuner control3	

NOTE

This function is under development, for details please contact SIMCom support teams.

4. Antenna Interfaces

SIM7600X-M2 provides a main antenna interface, a diversity antenna interface and a GNSS antenna interface. The antenna ports have an RF impedance of 50Ω.

4.1 WCDMA/LTE Operating Frequency

The following table shows WCDMA/LTE Operating frequencies

Table 24: SIM7600X-M2 WCDMA/LTE Operating frequencies

Band	Uplink (UL)	Downlink (DL)	Duplex Mode
GSM850	824~849 MHz	869~894MHz	TDD
EGSM900	880~915 MHz	925~960MHz	TDD
DCS1800	1710~1785 MHz	1805~1880 MHz	TDD
PCS1900	1850~1910 MHz	1930~1990 MHz	TDD
CDMA BC0	824~849 MHz	869~894 MHz	FDD
TDSCDMA B34	1880~1920 MHz	1880~1920 MHz	TDD
TDSCDMA B39	2010~2025 MHz	2010~2025 MHz	TDD
WCDMA B1	1920 ~1980 MHz	2110 ~2170 MHz	FDD
WCDMA B2	1850~1910 MHz	1930~1990 MHz	FDD
WCDMA B4	1710~1755MHz	2110~2155MHz	FDD
WCDMA B6	832~837MHz	877~882MHz	FDD
WCDMA B19	835~845MHz	875~890MHz	FDD
WCDMA B5	824~849 MHz	869~894MHz	FDD
WCDMA B8	880 ~915 MHz	925 ~960 MHz	FDD
LTE B1	1920 ~1980 MHz	2110 ~2170 MHz	FDD
LTE B2	1930~1990 MHz	1850~1910 MHz	FDD
LTE B3	1710 ~1785 MHz	1805 ~1880 MHz	FDD
LTE B4	2110~2155MHz	1710~1755MHz	FDD
LTE B5	824~849 MHz	869~894MHz	FDD
LTE B7	2500~2570MHz	2620~2690MHz	FDD
LTE B8	880 ~915 MHz	925 ~960 MHz	FDD
LTE B12	728~746MHz	699~716MHz	FDD
LTE B13	746~757MHz	777~787MHz	FDD

LTE B14	788-798MHZ	758-768MHZ	FDD
LTE B71	633-698MHZ	617-652MHZ	FDD
LTE B18	860~875MHz	815~830MHz	FDD
LTE B19	875~890MHz	830~845MHz	FDD
LTE B20	832~862MHz	791~ 821MHz	FDD
LTE B25	1930~1995MHz	1850~1915MHz	FDD
LTE B26	859~894MHz	814~849MHz	FDD
LTE B28	703~748MHz	758~803MHz	FDD
LTE B66	2110~2200MHz	1710~1780MHz	FDD
LTE B34	2010~2025MHz	2010~2025MHz	TDD
LTE B39	1880~1920MHz	1880~1920MHz	TDD
LTE B38	2570 ~2620 MHz	2570 ~2620 MHz	TDD
LTE B40	2300 ~2400 MHz	2300 ~2400 MHz	TDD
LTE B41	2555 ~2655 MHz	2555 ~2655 MHz	TDD

NOTE

SIM7600G,SIM7600NA B41 support 200M

4.2 GNSS Operating Frequency

The following table shows GNSS Operating frequencies

Table 25: GNSS Operating frequencies

Type	Frequency
GPS/Galileo/QZSS	1575.42±1.023MHz
GLONASS	1597.5~1605.8MHz
BeiDou/Compass	1561.098±2.046MHz

4.3 Antenna Installation

4.3.1 Antenna Requirements

The following table shows the requirements on main antenna, Diversity antenna and GNSS antenna.

Recommended Antenna Characteristics

Table 26: WCDMA/LTE antenna

Item	Requirements
Direction	Omni directional
Gain	> -3dBi (Avg)
Input impedance	50 Ω
Efficiency	> 30 %
VSWR	< 2
Cable insertion Loss <1GHz	<1dB
Cable insertion Loss 1GHz~2.2GHz	<1.5dB
Cable insertion Loss 2.3GHz~2.7GHz	<2dB

Table 27: GNSS antenna

Item	Requirements
Frequency Range	1559~1609MHZ
Direction	RHCP or liner, RHCP is the first choice
VSWR	< 2
Passive antenna gain	> 0 dBi
Active antenna NF	< 1.5
Active antenna gain	> 0 dBi
Active antenna Embedded LNA gain	< 17 dB

NOTE

It is recommended to use a passive GNSS antenna when LTE B13 or B14 is supported, as the use of active antenna may generate harmonics which will affect the GNSS performance.

4.3.2 Recommended RF Connector for Antenna Installation

When choosing antennas, user should pay attentions to the connector on antenna which should match with the connector on the module.

The standard 2x2 mm size RF receptacle connectors have been used on SIM7600X-M2. The dimension of the connector on SIM7600X-M2 is 2.0*2.0*0.6mm, which is from Murata, and the Part Number is MM4829-2702B/ RA4/ RB0.

Shows the RF connector dimension in the following figure:

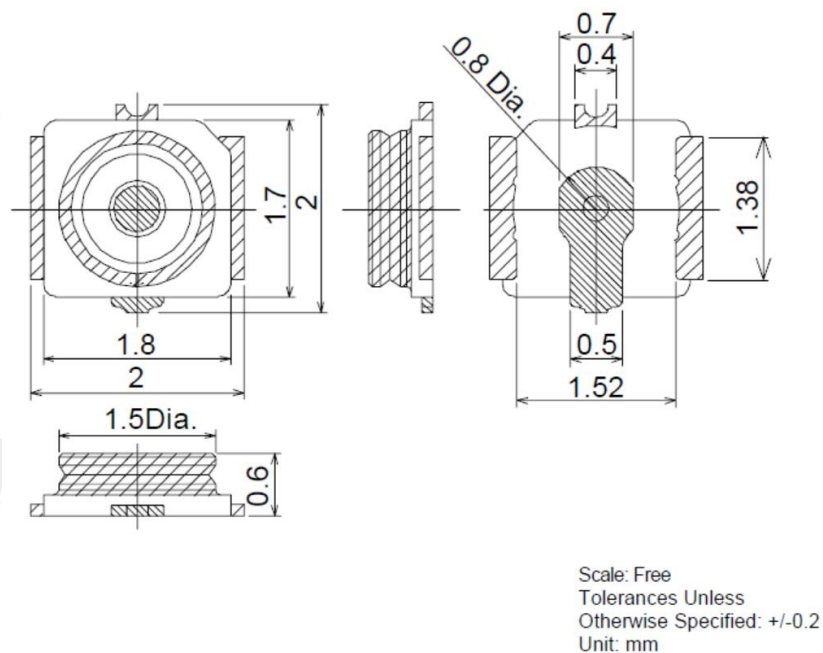


Figure 29: RF connector

The major specifications of the RF connector as below:

Table 28: the major specifications of the RF connector

Item	Specification
Nominal Frequency Range	DC to 6 GHz
Nominal Impedance	50Ω
Temperature Rating	-40°C to + 85°C
Initial Contact Resistance (without conductor resistance)	Center contact 20.0mΩmax. Outer contact 20.0mΩmax.
Voltage Standing Wave Ratio (V.S.W.R.)	Meet the requirements of 1.3max.(DC ~ 3GHz) 1.45max.(3GHz ~ 6GHz)

There are two kinds of coaxial cables mating the RF connector in the SIM7600X-M2, SIMCom recommend use Murata and SUZHOU KELI, and the Part Number is MXFR32HP1000 of the Murata and KLC-2058 of the KELI.

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5. Electrical Specifications

5.1 Absolute maximum ratings

Absolute maximum rating for digital and analog pins of module are listed in the following table:

Table 29: Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT pins	-0.3	-	4.7	V
Voltage at digital pins (GPIO,I2C,UART, I2S)	-0.3	-	2.1	V
Voltage at digital pins (USIM)	-0.3	-	3.05	V
Voltage at FULCARD_POWER_OFF#	-0.3	-	4.7	V
Voltage at RESET#	-0.3	-	2.1	V

5.2 Operating conditions

Table 30: Recommended operating ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	3.4	3.8	4.2	V

Table 31: 1.8V Digital I/O characteristics*

Parameter	Description	Min.	Typ.	Max.	Unit
V _{IH}	High-level input voltage	1.17	1.8	2.1	V
V _{IL}	Low-level input voltage	-0.3	0	0.63	V
V _{OH}	High-level output voltage	1.35	-	1.8	V
V _{OL}	Low-level output voltage	0	-	0.45	V
I _{OH}	High-level output current(no pull down resistor)	-	2	-	mA
I _{OL}	Low-level output current(no pull up resistor)	-	-2	-	mA
I _{IH}	Input high leakage current (no	-	-	1	uA

	pull down resistor)				
I_{IL}	Input low leakage current(no pull up resistor)	-1	-	-	uA

NOTE

These parameters are for digital interface pins, such as UART, I2C, ANTCTL and GPIOs (DPR, SIM DETECT).

The operating temperature of module is listed in the following table.

Table 32: Operating temperature

Parameter	Min.	Typ.	Max.	Unit
Normal operation temperature(3GPP compliant)	-30	25	70	°C
Extended operation temperature*	-40	25	85	°C
Storage temperature	-40	25	90	°C

NOTE

Module is able to make and receive voice calls, data calls, SMS and make UMTX/LTE traffic in -40°C ~ +85°C . The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

5.3 Operating Mode

5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of module product.

Table 33: Operating mode Definition

Mode		Function
Normal operation	UMTS/LTE Sleep	AT command "AT+CSCLK=1" can be used to set the module to a sleep mode. In this case, the current consumption of module will be reduced to a very low level and the module can still receive paging message and SMS.
	UMTS/LTE Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	UMTS/LTE Talk	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, and antenna.
	UMTS/LTE Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	UMTS/LTE Data transmission	There is data transmission in progress. In this case, power consumption is related to network settings (e.g. power control level); uplink/downlink data rates, etc.
Minimum functionality mode		AT command "AT+CFUN=0" can be used to set the module to a minimum functionality mode without removing the power supply. In this mode, the RF part of the module will not work and the USIM card will not be accessible, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Flight mode		AT command "AT+CFUN=4" or pulling down the W_disable1# pin can be used to set the module to flight mode without removing the power supply. In this mode, the RF part of the module will not work, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Power off		Module will go into power off mode by pull down the Full_Card_Power_Off# pin, normally. In this mode the power management unit shuts down the power supply, and software is not active. The serial port and USB are is not accessible.

5.3.2 Sleep mode

In sleep mode, the current consumption of module will be reduced to a very low level, and module can still receive paging message and SMS.

Several hardware and software conditions must be satisfied in order to let module enter into sleep mode:

1. UART condition
2. USB condition
3. Software condition

NOTE

Before designing, pay attention to how to realize sleeping/waking function.

5.3.3 Minimum functionality mode and Flight mode

Minimum functionality mode ceases a majority function of module, thus minimizing the power consumption. This mode is set by the AT command which provides a choice of the functionality levels.

AT+CFUN=0: Minimum functionality

AT+CFUN=1: Full functionality (Default)

AT+CFUN=4: Flight mode

If module has been set to minimum functionality mode, the RF function and USIM card function will be closed. In this case, the serial port and USB are still accessible, but RF function and USIM card will be unavailable.

If module has been set to flight mode, the RF function will be closed. In this case, the serial port and USB are still accessible, but RF function will be unavailable.

When module is in minimum functionality or flight mode, it can return to full functionality by the AT command "AT+CFUN=1".

5.4 Current Consumption

The current consumption is listed in the table below.

Table 34: Current consumption on VBAT Pins (VBAT=3.8V)

GNSS		
GNSS supply current (AT+CFUN=0,with USB connection)	@ -140dBm, Tracking Typical:52mA	
UMTS sleep/idle mode		
WCDMA supply current (GNSS off, without USB connection)	Sleep mode @DRX=9 Typical: 2.2mA Idle mode @DRX=9 Typical: 22mA	
LTE sleep/idle mode		
LTE FDD supply current (GNSS off, without USB connection)	Sleep mode Typical: 2.4mA Idle mode Typical: 22mA	
LTE TDD supply current (GNSS off, without USB connection)	Sleep mode Typical: 2.4mA Idle mode Typical: 22mA	
GSM Talk		
GSM850	@power level #5 Typical: 307ma	
EGSM900	@ power level #5 Typical: 295ma	
DCS1800	@power level #5 Typical: 200 ma	
PCS1900	@power level #5 Typical: 227 ma	
UMTS Talk		
WCDMA B1	@Power 24dBm	Typical: 661ma
WCDMA B2	@Power 24dBm	Typical: 668 ma
WCDMA B4	@Power 24dBm	Typical: 599 ma
WCDMA B5	@Power 24dBm	Typical: 558 ma
WCDMA B6	@Power 24dBm	Typical: 554 ma
WCDMA B8	@Power 24dBm	Typical: 634ma
WCDMA B19	@Power 24dBm	Typical: 561 ma
TD-SDMA 1900	@Power 24 dBm	Typical: 118mA
TD-SDMA 2000	@Power 24 dBm	Typical: 117mA
CDMA BC0	@Power 24 dBm	Typical: 400mA
EVDO data		
BC0	@Power 24 dBm	Typical: 490mA
TD-SCDMA data		
TDSCDMA1900	@Power 24 dBm	Typical: 141mA
TDSCDMA2100	@Power 24 dBm	Typical: 150mA

GPRS

GSM850(1 Rx,4 Tx)	@power level #5 Typical: 586 ma
EGSM900(1 Rx,4 Tx)	@power level #5 Typical: 540 ma
DCS1800(1 Rx,4 Tx)	@power level #0 Typical: 382 ma
PCS1900(1 Rx,4 Tx)	@power level #0 Typical: 416 ma
GSM850(3Rx, 2 Tx)	@power level #5 Typical: 438 ma
EGSM900(3Rx, 2 Tx)	@power level #5 Typical: 419 ma
DCS1800(3Rx, 2 Tx)	@power level #0 Typical: 291 ma
PCS1900(3Rx, 2 Tx)	@power level #0 Typical: 328 ma

EDGE

GSM850(1 Rx,4 Tx)	@power level #8 Typical: 523ma
EGSM900(1 Rx,4 Tx)	@power level #8 Typical: 477ma
DCS1800(1 Rx,4 Tx)	@power level # 2 Typical: 380ma
PCS1900(1 Rx,4 Tx)	@power level #2 Typical: 414ma
GSM850(3Rx, 2 Tx)	@power level #8 Typical: 298ma
EGSM900(3Rx, 2 Tx)	@power level #8 Typical: 273ma
DCS1800(3Rx, 2 Tx)	@power level #2 Typical: 246ma
PCS1900(3Rx, 2 Tx)	@power level #2 Typical: 268ma

LTE data

LTE-FDD B1	@5MHz	22.3dBm	Typical: 711 ma
	@10MHz	22.4dBm	Typical: 718 ma
	@20MHz	22.4dBm	Typical: 756 ma
LTE-FDD B2	@5MHz	22.1dBm	Typical: 676 ma
	@10MHz	22.4dBm	Typical: 723 ma
	@20MHz	22.3dBm	Typical: 759 ma
LTE-FDD B3	@5MHz	22.2dBm	Typical: 666 ma
	@10MHz	22.1dBm	Typical: 662 ma
	@20MHz	22.1dBm	Typical: 682 ma
LTE-FDD B4	@5MHz	22.0dBm	Typical: 709 ma
	@10MHz	22.1dBm	Typical: 769 ma
	@20MHz	22.6dBm	Typical: 896 ma
LTE-FDD B5	@5MHz	22.2dBm	Typical: 619 ma
	@10MHz	22.1dBm	Typical: 628 ma
LTE-FDD B7	@5MHz	22.2dBm	Typical: 599 ma
	@10MHz	22.1dBm	Typical: 611 ma
	@20MHz	22.1dBm	Typical: 680ma
LTE-FDD B8	@5MHz	22.8dBm	Typical: 699 ma
	@10MHz	22.8dBm	Typical: 751 ma
LTE-FDD B12	@5MHz	22.7dBm	Typical: 600 ma
	@10MHz	22.7dBm	Typical: 607 ma
LTE-FDD B13	@5MHz	21.9dBm	Typical: 685 ma
	@10MHz	22.0dBm	Typical: 653 ma
LTE-FDD B14	@5MHz	22.0dBm	Typical: 632 ma
	@10MHz	22.0dBm	Typical: 610 ma
LTE-FDD B18	@5MHz	21.3dBm	Typical: 702 ma
	@10MHz	22.5dBm	Typical: 711 ma
	@15MHz	22.6dBm	Typical: 747 ma
LTE-FDD B19	@5MHz	22.4dBm	Typical: 616 ma
	@10MHz	22.3dBm	Typical: 622 ma
	@15MHz	22.5dBm	Typical: 679 ma

LTE-FDD B20	@5MHz	21.8dBm	Typical: 658 ma
	@10MHz	21.8dBm	Typical: 668 ma
	@20MHz	21.8dBm	Typical: 767 ma
LTE-FDD B25	@5MHz	22dBm	Typical: 634 ma
	@10MHz	22dBm	Typical: 702 ma
	@20MHz	22dBm	Typical: 781 ma
LTE-FDD B26	@5MHz	22.4dBm	Typical: 615 ma
	@10MHz	22.7dBm	Typical: 664 ma
	@15MHz	22.3dBm	Typical: 713 ma
LTE-FDD B28	@5MHz	22.4dBm	Typical: 811ma
	@10MHz	22.5dBm	Typical: 879 ma
	@20MHz	22.4dBm	Typical: 773 ma
LTE-FDD B66	@5MHz	22dBm	Typical: 707ma
	@10MHz	22dBm	Typical: 728ma
	@20MHz	22dBm	Typical: 795 ma
LTE-FDD B71	@5MHz	22Bm	Typical: 541ma
	@10MHz	22dBm	Typical: 558ma
	@20MHz	22dBm	Typical: 641ma
LTE-TDD B34	@5MHz	22dBm	Typical: 555 ma
	@10MHz	22dBm	Typical: 546 ma
LTE-TDD B38	@5MHz	21.8dBm	Typical: 799ma
	@10MHz	21.8dBm	Typical: 759ma
	@20MHz	21.8dBm	Typical: 779ma
LTE-TDD B39	@5MHz	22dBm	Typical: 575 ma
	@10MHz	22dBm	Typical: 627 ma
	@20MHz	22dBm	Typical: 681 ma
LTE-TDD B40	@5MHz	21.5dBm	Typical: 727 ma
	@10MHz	21.7dBm	Typical: 715 ma
	@20MHz	21.7dBm	Typical: 703 ma
LTE-TDD B41	@5MHz	21.6dBm	Typical: 803 ma
	@10MHz	21.7dBm	Typical: 771 ma
	@20MHz	21.7dBm	Typical: 793 ma

5.5 RF Output Power

The following table shows the RF output power of SIM7600X-M2 module.

Table 35: Conducted Output Power

Frequency	Power	Min.
GSM850	33dBm ±2dB	5dBm ± 5dB
EGSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
EGSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
PCS1900 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB

WCDMA B1	24dBm +/-3dB	<-50dBm
WCDMA B2	24dBm +/-3dB	<-50dBm
WCDMA B4	24dBm +/-3dB	<-50dBm
WCDMA B5	24dBm +/-3dB	<-50dBm
WCDMA B6	24dBm +/-3dB	<-50dBm
WCDMA B8	24dBm +/-3dB	<-50dBm
WCDMA B19	24dBm +/-3dB	<-50dBm
TDSCDMA B34	24dBm +/-3dB	<-50dBm
TDSCDMA B39	24dBm +/-3dB	<-50dBm
CDMA BC0	24dBm +/-3dB	<-50dBm
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B2	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B4	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B7	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B12	23dBm +/-2.7dB	<-40dBm
LTE-FDD B13	23dBm +/-2.7dB	<-40dBm
LTE-FDD B14	23dBm +/-2.7dB	<-40dBm
LTE-FDD B18	23dBm +/-2.7dB	<-40dBm
LTE-FDD B19	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-FDD B25	23dBm +/-2.7dB	<-40dBm
LTE-FDD B26	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +/-2.7dB	<-40dBm
LTE-FDD B66	23dBm +/-2.7dB	<-40dBm
LTE-FDD B71	23dBm +/-2.7dB	<-40dBm
LTE-TDD B34	23dBm +/-2.7dB	<-40dBm
LTE-TDD B38	23dBm +/-2.7dB	<-40dBm
LTE-TDD B39	23dBm +/-2.7dB	<-40dBm
LTE-TDD B40	23dBm +/-2.7dB	<-40dBm
LTE-TDD B41	23dBm +/-2.7dB	<-40dBm

5.6 Conducted Receive Sensitivity

The following tables show conducted RF receiving sensitivity of SIM7600X-M2 module.

Table 36: SIM7600X-M2 Conducted RF Receiving Sensitivity

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
GSM850	< -109dBm	3GPP
EGSM900	< -109dBm	3GPP
DCS1800	< -109dBm	3GPP
PCS1900	< -109dBm	3GPP
TDSCDMA 1900	< -110dBm	3GPP
TDSCDMA 2100	< -110dBm	3GPP
CDMA BC0	< -110dBm	3GPP
WCDMA B1	< -110dBm	3GPP
WCDMA B2	< -110dBm	3GPP
WCDMA B4	< -110dBm	3GPP
WCDMA B5	< -110dBm	3GPP
WCDMA B6	< -110dBm	3GPP
WCDMA B8	< -110dBm	3GPP
WCDMA B19	< -110dBm	3GPP

E-UTR A band	1.4 MHz Standard	3 MHz Standard	5 MHz Standard	10 MHz Standard	15 MHz Standard	20 MHz Standard	Duplex Mode
LTE B1	-	-	-100	-97	-95.2	-94	FDD
LTE B2	-102.7	-99.7	-98	-95	-93.2	-92	FDD
LTE B3	-101.7	-98.7	-97	-94	-92.2	-91	FDD
LTE B4	-104.7	-101.7	-100	-97	-95.2	-94	FDD
LTE B5	-103.2	-100.2	-98	-95			FDD
LTE B7			-98	-95	-93.2	-92	FDD
LTE B8	-102.2	-99.2	-97	-94			FDD
LTE B12	-101.7	-98.7	-97	-94			FDD
LTE B13			-97	-94			FDD
LTE B14			-97	-94			FDD
LTE B18			-100	-97	-95.2		FDD
LTE B19			-100	-97	-95.2		FDD
LTE B20			-97	-94	-91.2	-90	FDD
LTE B25	-101.2	-98.2	-96.5	-93.5	-91.7	-90.5	FDD

LTE B26	-102.7	-99.7	-97.5	-94.5	-92.7		FDD
LTE B28		-100.2	-98.5	-95.5	-93.7	-91	FDD
LTE B71			-97.2	-94.2	-92	-87.5	
LTE B66	-104.7	-101.7	-100	-97	-95.2	-94	FDD
LTE B34			-100	-97	-95.2		TDD
LTE B38	-	-	-100	-97	-95.2	-94	TDD
LTE B39			-100	-97	-95.2		TDD
LTE B40	-	-	-100	-97	-95.2	-94	TDD
LTE B41	-	-	-99	-96	-94.2	-93	TDD

NOTE

The data in above table are gotten at static condition.

5.7 ESD

Module is sensitive to ESD in the process of storage, transporting, and assembling. When module is mounted on the users' mother board, the ESD components should be placed beside the connectors which human body may touch, such as USIM card holder, SD card holder, audio jacks, switches, USB interface, etc. The following table shows the module ESD measurement performance without any external ESD component.

Table 37: The ESD performance measurement table (Temperature: 25°C, Humidity: 45%)

Part	Contact discharge	Air discharge
VBAT,GND	+/-4K	+/-8K
Antenna port	+/-4K	+/-8K
FUL_CARD_POWER_OFF#	+/-3K	+/-6K
USB	+/-1K	+/-2K
RESET_N	+/-1K	+/-2K
UIM Card	+/-1K	+/-2K
Other PADs	+/-1K	+/-2K

6. Connect SIM7600X-M2 to board

The module should be equipped well by the connector and screw as the following figure illustration. The module Stand-off and mounting screw also serve as part of the module Electrical Ground path. The Stand-off should be connected directly to the ground plane on the platform. So that when the module is mounted and the mounting screw is screwed on to hold the module in place, this will make the electrical ground connection from the module to the platform ground plane.

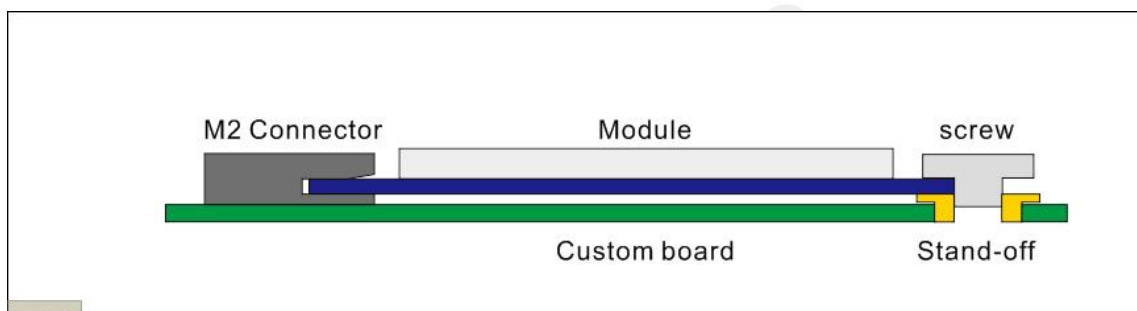


Figure 30: Equipment diagram

7. Thermal Design

Customer should pay attentions to the thermal design of SIM7600X-M2, for the mass data application scenario, the module would work in max power status and last long time, the temperature of module would increase quickly, especially in high temperature environment.

Module reserved a ground plane on the bottom side for the heat dissipating, customer could conduct the heat to the large board by the silica gel, and the surface area on large board should be more than 460 mm². For better thermal performance, customer could use a heat sink device to conduct the heat to the air.

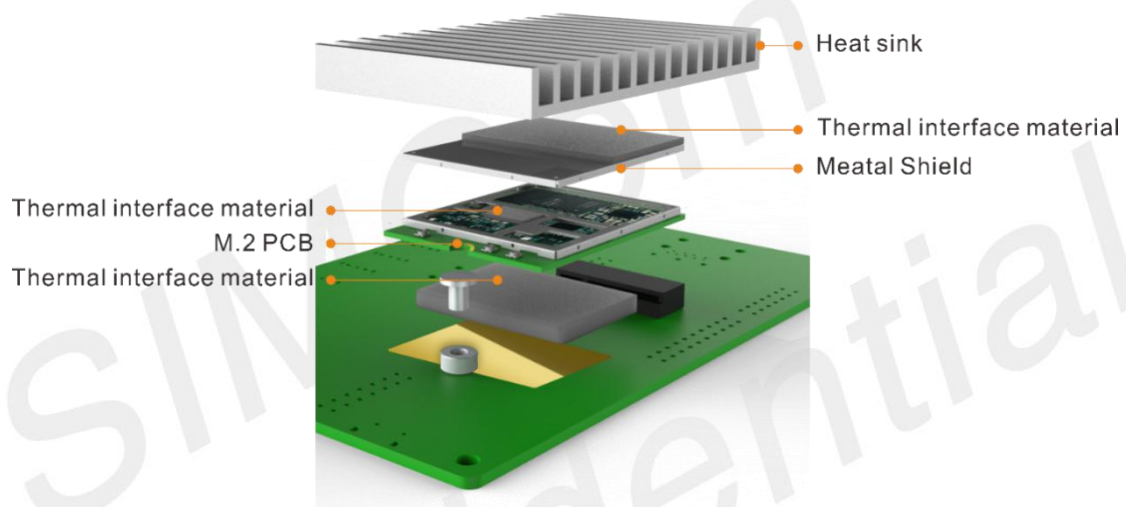


Figure 31: Thermal design diagram

Table 38: The silica gel selection guide

Item	Test method	Recommend value	Unit
Specific Gravity	ASTMD792	3.2±0.1	g/cc
Continuous use Temp	EN344	-40~+220	°C
Volume Resistivity	ASTMD257	1.0*10 ¹¹	Ω-CM
Voltage Endurance	ASTMD149	4	KV/mm
Flame Rating	UL-94	V-0	
Conductivity	ASTMD5470	8	w/m-k

8. Packaging

Module support tray packaging.

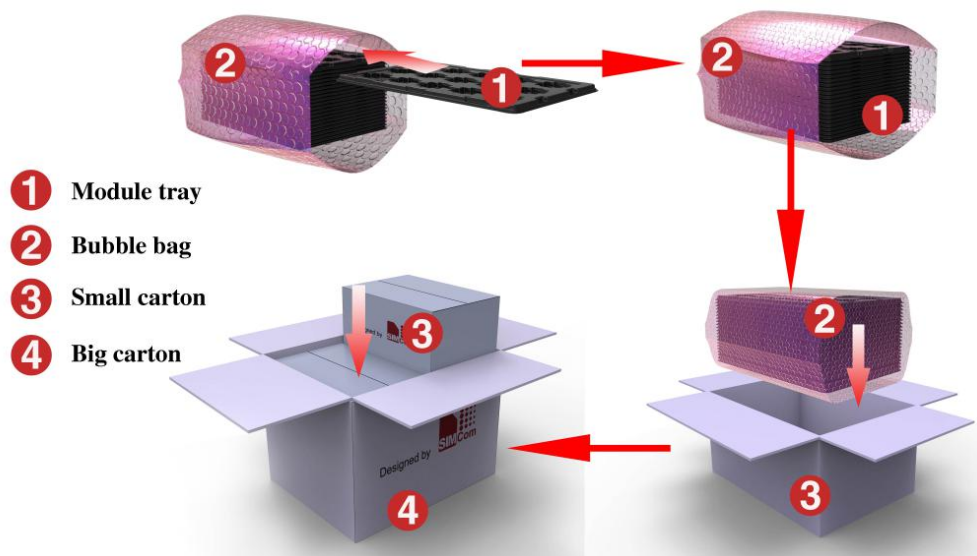


Figure 32: packaging diagram

Module tray drawing:

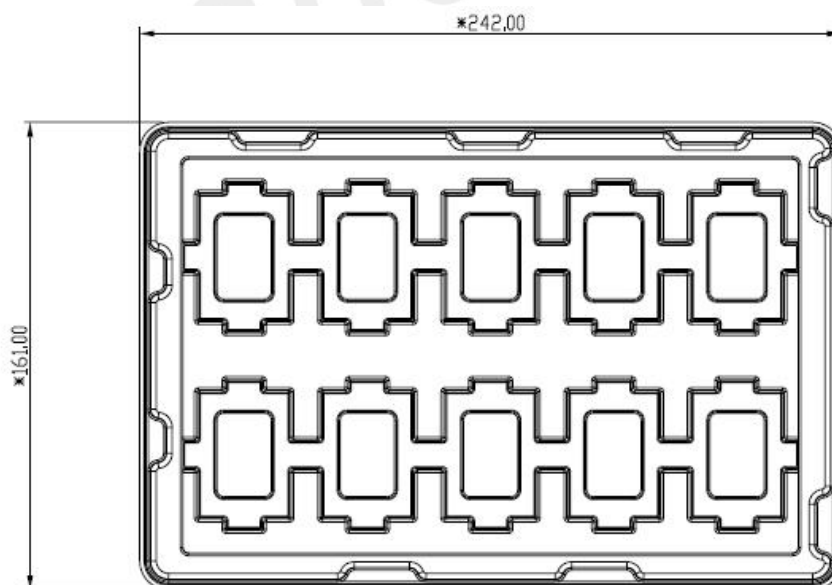


Figure 33: Tray drawing

Table 39: Tray size

Length ($\pm 3\text{mm}$)	Width ($\pm 3\text{mm}$)	Number
245.0	165.0	10

Small carton drawing:

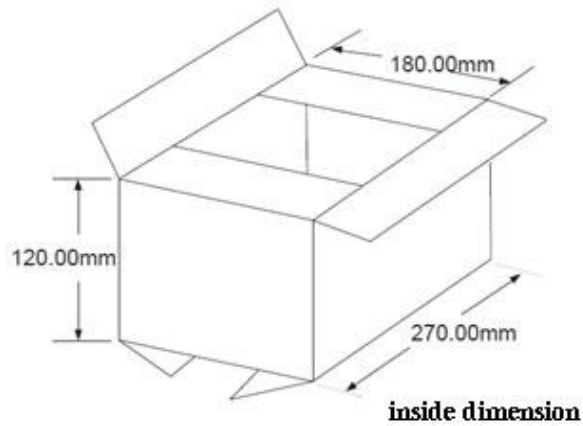


Figure 34: Small carton drawing

Table 40: Small Carton size

Length ($\pm 10\text{mm}$)	Width ($\pm 10\text{mm}$)	Height ($\pm 10\text{mm}$)	Number
270	180	120	10*20=200

Big carton drawing:

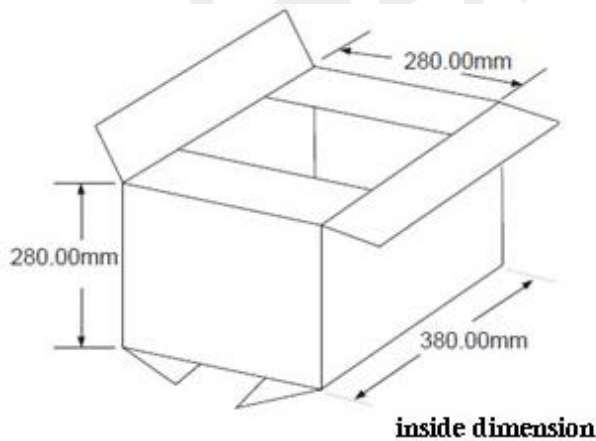


Figure 35: Big carton drawing

Table 41: Big Carton size

Length ($\pm 10\text{mm}$)	Width ($\pm 10\text{mm}$)	Height ($\pm 10\text{mm}$)	Number
380	280	280	200*4=800

9. Appendix

A. Coding Schemes and Maximum Net Data Rates over Air Interface

Table 42: Coding Schemes and Maximum Net Data Rates over Air Interface

HSDPA device category	Max data rate (peak)	Modulation type
Category 1	1.2Mbps	16QAM,QPSK
Category 2	1.2Mbps	16QAM,QPSK
Category 3	1.8Mbps	16QAM,QPSK
Category 4	1.8Mbps	16QAM,QPSK
Category 5	3.6Mbps	16QAM,QPSK
Category 6	3.6Mbps	16QAM,QPSK
Category 7	7.2Mbps	16QAM,QPSK
Category 8	7.2Mbps	16QAM,QPSK
Category 9	10.2Mbps	16QAM,QPSK
Category 10	14.4Mbps	16QAM,QPSK
Category 11	0.9Mbps	QPSK
Category 12	1.8Mbps	QPSK
Category 13	17.6Mbps	64QAM
Category 14	21.1Mbps	64QAM
Category 15	23.4Mbps	16QAM
Category 16	28Mbps	16QAM
Category 17	23.4Mbps	64QAM
Category 18	28Mbps	64QAM
Category 19	35.5Mbps	64QAM
Category 20	42Mbps	64QAM
Category 21	23.4Mbps	16QAM
Category 22	28Mbps	16QAM
Category 23	35.5Mbps	64QAM
Category 24	42.2Mbps	64QAM
HSUPA device category	Max data rate (peak)	Modulation type
Category 1	0.96Mbps	QPSK
Category 2	1.92Mbps	QPSK
Category 3	1.92Mbps	QPSK
Category 4	3.84Mbps	QPSK

Category 5	3.84Mbps	QPSK
Category 6	5.76Mbps	QPSK
LTE-FDD device category (Downlink)	Max data rate (peak)	Modulation type
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
Category 5	300Mbps	QPSK/16QAM/64QAM
Category 6	300Mbps	QPSK/16QAM/64QAM
LTE-FDD device category (Uplink)	Max data rate (peak)	Modulation type
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM
Category 5	75Mbps	QPSK/16QAM/64QAM
Category 6	50Mbps	QPSK/16QAM

B. Related Documents

Table 43: Related Documents

NO.	Title	Description
[1]	SIM7600X-M2 Series_AT Command Manual_V1.xx	AT Command Manual
[2]	ITU-T Draft recommendation V.25ter ^{new}	Serial asynchronous automatic dialing and control
[3]	GSM 07.07	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10	Support GSM 07.10 multiplexing protocol
[5]	GSM 07.05	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6]	GSM 11.14	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2) ; Mobile Station (MS) conformance specification ; Part 1: Conformance specification

[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[14]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[15]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
[16]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
[17]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[18]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[19]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
[20]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
[21]	SIM7X00 Series_UART_Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.
[22]	SIM7X00 Series_GPS_Application Note_V1.xx	GPS Application Note
[23]	Antenna design guidelines for diversity receiver system	Antenna design guidelines for diversity receiver system

C. Terms and Abbreviations







Table 44: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ARP	Antenna Reference Point
BER	Bit Error Rate
BTS	Base Transceiver Station
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
EVDO	Evolution Data Only
FCC	Federal Communications Commission (U.S.)
FD	SIM fix dialing phonebook
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global Standard for Mobile Communications
HR	Half Rate
HSPA	High Speed Packet Access
HSIC	High-speed Inter-chip
I2C	Inter-Integrated Circuit
IMEI	International Mobile Equipment Identity
LTE	Long Term Evolution

MDIO	Management Data Input/Output
MMD	MDIO manageable device
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
NMEA	National Marine Electronics Association
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCS	Personal Communication System, also referred to as GSM 1900
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
SIM	Subscriber Identification Module
SMS	Short Message Service
SPI	serial peripheral interface
SMPS	Switched-mode power supply
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
VSWR	Voltage Standing Wave Ratio
SM	SIM phonebook
SGMII	Serial gigabit media independent interface
NC	Not connect
EDGE	Enhanced data rates for GSM evolution
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
ZIF	Zero intermediate frequency
WCDMA	Wideband Code Division Multiple Access
VCTCXO	Voltage control temperature-compensated crystal oscillator
USIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter

D. Safety Caution

Table 45: Safety Caution

Marks	Requirements
	<p>When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.</p>
	<p>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 to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.</p>
	<p>Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.</p>
	<p>Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.</p>
	<p>Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.</p>
	<p>GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.</p> <p>Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call.</p> <p>Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.</p>