



# SIM7912G-M2\_R2 Hardware Design (2x2MIMO in DL direction)

LTE Module

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|------------------------|------------------------------------------|
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## Version History

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# 1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom M.2 card. With the help of this document and other software application notes/user guides, users can understand and use SIM7912G-M2 to design and develop mobile and laptop applications quickly.

## 1.1 Product Outline

Aimed at the global market, SIM7912G-M2 supports WCDMA, LTE-TDD and LTE-FDD. SIM7912G-M2 support DL 2CA, 3CA. The supported radio frequency bands are described in the table1.

**Table 1: SIM7912A/E/G-M2 frequency bands**

| Standard | Frequency | A:1NN0 | A:1NN0 | A:1NN0 | E:1NN0 | E:1NN0 | E:1NN0 | G:1NN0 | G:1NN0 | G:1NN0 |
|----------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|          |           | G0AA   | G0AB   | G0AC   | G0AA   | G0AB   | G0AC   | G0AA   | G0AB   | G0AC   |
| WCDMA    | B1        |        |        |        | √      | √      | √      | √      | √      | √      |
|          | B2        | √      | √      | √      |        |        |        | √      | √      | √      |
|          | B3        |        |        |        | √      | √      | √      | √      | √      | √      |
|          | B4        | √      | √      | √      |        |        |        | √      | √      | √      |
|          | B5        | √      | √      | √      | √      | √      | √      | √      | √      | √      |
|          | B8        |        |        |        | √      | √      | √      | √      | √      | √      |
|          | B9        |        |        |        |        |        |        | √      | √      | √      |
|          | B19       |        |        |        |        |        |        | √      | √      | √      |
| LTE      | FDD B1    |        |        |        | √      | √      | √      | √      | √      | √      |
|          | FDD B2    | √      | √      | √      |        |        |        | √      | √      | √      |
|          | FDD B3    |        |        |        | √      | √      | √      | √      | √      | √      |
|          | FDD B4    | √      | √      | √      |        |        |        | √      | √      | √      |
|          | FDD B5    | √      | √      | √      | √      | √      | √      | √      | √      | √      |
|          | FDD B7    | √      | √      | √      | √      | √      | √      | √      | √      | √      |
|          | FDD B8    |        |        |        | √      | √      | √      | √      | √      | √      |
|          | FDD B12   | √      | √      | √      |        |        |        | √      | √      | √      |
|          | FDD B13   | √      | √      | √      |        |        |        | √      | √      | √      |
|          | FDD B14   | √      | √      | √      |        |        |        | √      | √      | √      |
|          | FDD B17   | √      | √      | √      |        |        |        | √      | √      | √      |
|          | FDD B18   |        |        |        |        |        |        | √      | √      | √      |
|          | FDD B19   |        |        |        |        |        |        | √      | √      | √      |

|                 |         |       |       |       |       |       |       |       |       |       |
|-----------------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                 | FDD B20 |       |       |       | √     | √     | √     | √     | √     | √     |
|                 | FDD B25 | √     | √     | √     |       |       |       | √     | √     | √     |
|                 | FDD B26 | √     | √     | √     |       |       |       | √     | √     | √     |
|                 | FDD B28 | √     | √     | √     | √     | √     | √     | √     | √     | √     |
|                 | FDD B29 |       |       |       |       |       |       | √     | √     | √     |
|                 | FDD B30 |       |       |       |       |       |       | √     | √     | √     |
|                 | FDD B32 |       |       |       | √     | √     | √     | √     | √     | √     |
|                 | FDD B66 | √     | √     | √     |       |       |       | √     | √     | √     |
|                 | TDD B38 |       |       |       | √     | √     | √     | √     | √     | √     |
|                 | TDD B40 | √     | √     | √     | √     | √     | √     | √     | √     | √     |
|                 | TDD B41 | √     | √     | √     | √     | √     | √     | √     | √     | √     |
|                 | TDD B42 | √     |       | √     | √     | √     | √     | √     |       | √     |
|                 | TDD B43 | √     |       | √     | √     | √     | √     | √     |       | √     |
|                 | TDD B46 | √     |       |       | √     |       | √     | √     |       |       |
|                 | TDD B48 | √     |       | √     | √     | √     | √     | √     |       | √     |
| <b>GNSS</b>     |         | √     | √     | √     | √     | √     | √     | √     | √     | √     |
| <b>Category</b> |         | CAT12 | CAT12 | CAT12 | CAT12 | CAT12 | CAT12 | CAT12 | CAT12 | CAT12 |

#### NOTE

1. B29 & B32 & B46 are only for secondary component carrier
2. GNSS function is optional.

With a physical dimension of 30.0\*42.0\*2.3 mm, SIM7912G-M2 can meet PCI Express M.2 Specification, and can meet almost any space requirement in users' applications.

With M.2 Type 3042-S3-B, SIM7912G-M2 has almost all common interface integrated, such as USB2.0, PCIe, USIM card, UART, I2C, DRP, LED#, MAIN\_ANT and AUX\_ANT etc.

With all the interfaces, SIM7912G-M2 can also be utilized in the industrial handheld, machine-to-machine laptop application and especially the router.

## 1.2 Hardware Block Diagram

The block diagram of SIM7912G-M2 is shown as below:

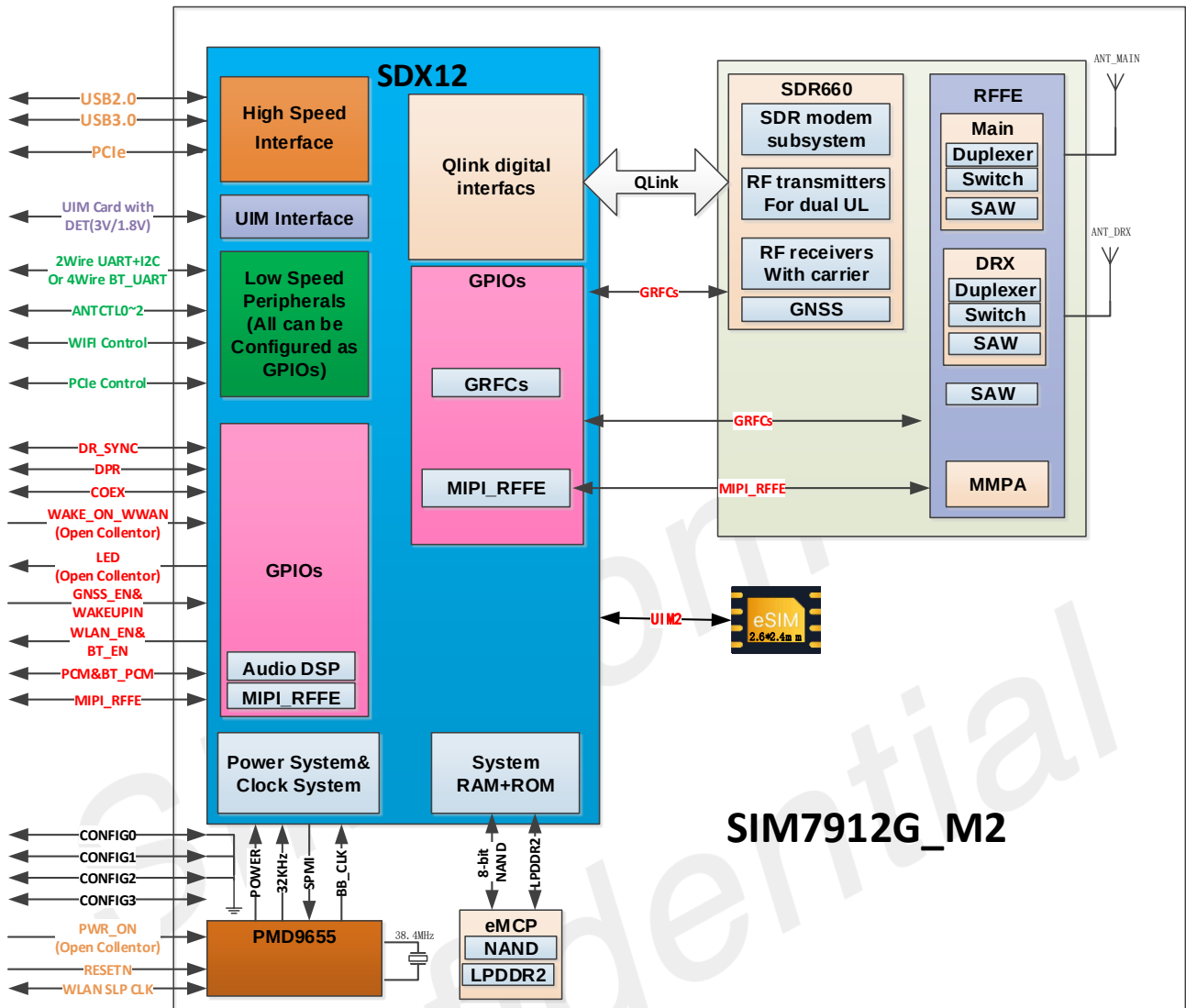


Figure 1: SIM7912G-M2 block diagram

### 1.3 Functional Overview

Table 2: SIM7912G-M2 General features

| Feature           | Implementation                                                         |
|-------------------|------------------------------------------------------------------------|
| Power supply      | VBAT:3.135~4.4V<br>Typical supply voltage: 3.3V                        |
| Power consumption | Power off current: <100uA<br>Current in sleep mode : TBD (USB suspend) |

|                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Radio frequency bands</b>    | Please refer to the table 1                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Transmitting power</b>       | Class 3 (23dBm±2dB) for LTE-TDD bands<br>Class 3 (23dBm±2dB) for LTE-FDD bands<br>Class 3 (24dBm+1/-3dB) for WCDMA bands                                                                                                                                                                                                                                                                                                            |
| <b>LTE Features</b>             | Support FDD/TDD LTE Category 12 with DL CA and DL MIMO<br>Support uplink QPSK and 16-QAM and 64-QAM modulation<br>Support downlink QPSK, 16-QAM and 64-QAM and 256-QAM modulation<br>Support 1.4MHz to 60MHz (3×CA) RF bandwidth<br>Support 2×2 MIMO in DL direction<br>FDD: Max 600Mbps (DL)/150Mbps (UL)<br>TDD: Max 430Mbps (DL)/90Mbps (UL)                                                                                     |
| <b>Antenna</b>                  | Main antenna (MAIN)<br>Rx-diversity antenna & GNSS(AUX & GNSS)                                                                                                                                                                                                                                                                                                                                                                      |
| <b>SMS</b>                      | MT, MO, CB, Text and PDU mode<br>SMS storage: USIM card or ME(default)<br>Transmission of SMS alternatively over CS or PS.                                                                                                                                                                                                                                                                                                          |
| <b>USIM interface</b>           | Dual SIM(one build-in eSIM 2.6*2.4mm),Support identity card: 1.8V/ 3V                                                                                                                                                                                                                                                                                                                                                               |
| <b>USIM application toolkit</b> | Support SAT class 3, GSM 11.14 Release 98<br>Support USAT                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Phonebook management</b>     | Support phonebook types: DC,MC,RC,SM,ME,FD,ON,LD,EN                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>PCIe interface</b>           | <ul style="list-style-type: none"> <li>● Compliant with the PCI Express Base 2.0 Specification, Revision 1.0.</li> <li>● Dual mode PCIe controller, working as Root Complex or Endpoint</li> <li>● Support PCI Express Gen1 2.5Gb/s raw bandwidth</li> <li>● Support link width x1</li> <li>● Embedded DMA engine with up to 250MB/s throughout</li> <li>● AXI Master/Slave interface for inbound/outbound data transfer</li> </ul> |
| <b>UART interface</b>           | <ul style="list-style-type: none"> <li>● Baud rate: 300bps to 921600bps(default:115200bps)</li> <li>● Can be used as the AT commands or data stream channel</li> <li>● Multiplex ability according to GSM 07.10 Multiplexer Protocol</li> </ul>                                                                                                                                                                                     |
| <b>I2C interface</b>            | <ul style="list-style-type: none"> <li>● Apply to the "I2C Specification, version 3.0"</li> <li>● Clock up to 400Kbps</li> </ul>                                                                                                                                                                                                                                                                                                    |
| <b>USB</b>                      | One USB 3.0 SuperSpeed and high-speed (for backward compatibility)                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Firmware upgrade</b>         | Firmware upgrade over USB interface                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Physical characteristics</b> | Size:30*42*2.3mm<br>Weight: 5.8g                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Temperature range</b>        | Normal operation temperature: -30°C to +70°C 3GPP compliant<br>Non operation temperature: -40°C to +85°C*<br>Storage temperature -40°C to +90°C 72 hours                                                                                                                                                                                                                                                                            |

#### NOTE

Module is able to make and receive voice calls, data calls, SMS and make GPRS/UMTS/HSPA+/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 extended operating temperature range.

## 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)

#### NOTE

The above is the design effect drawing of the module for reference, and the actual appearance shall prevail in kind.

## 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.

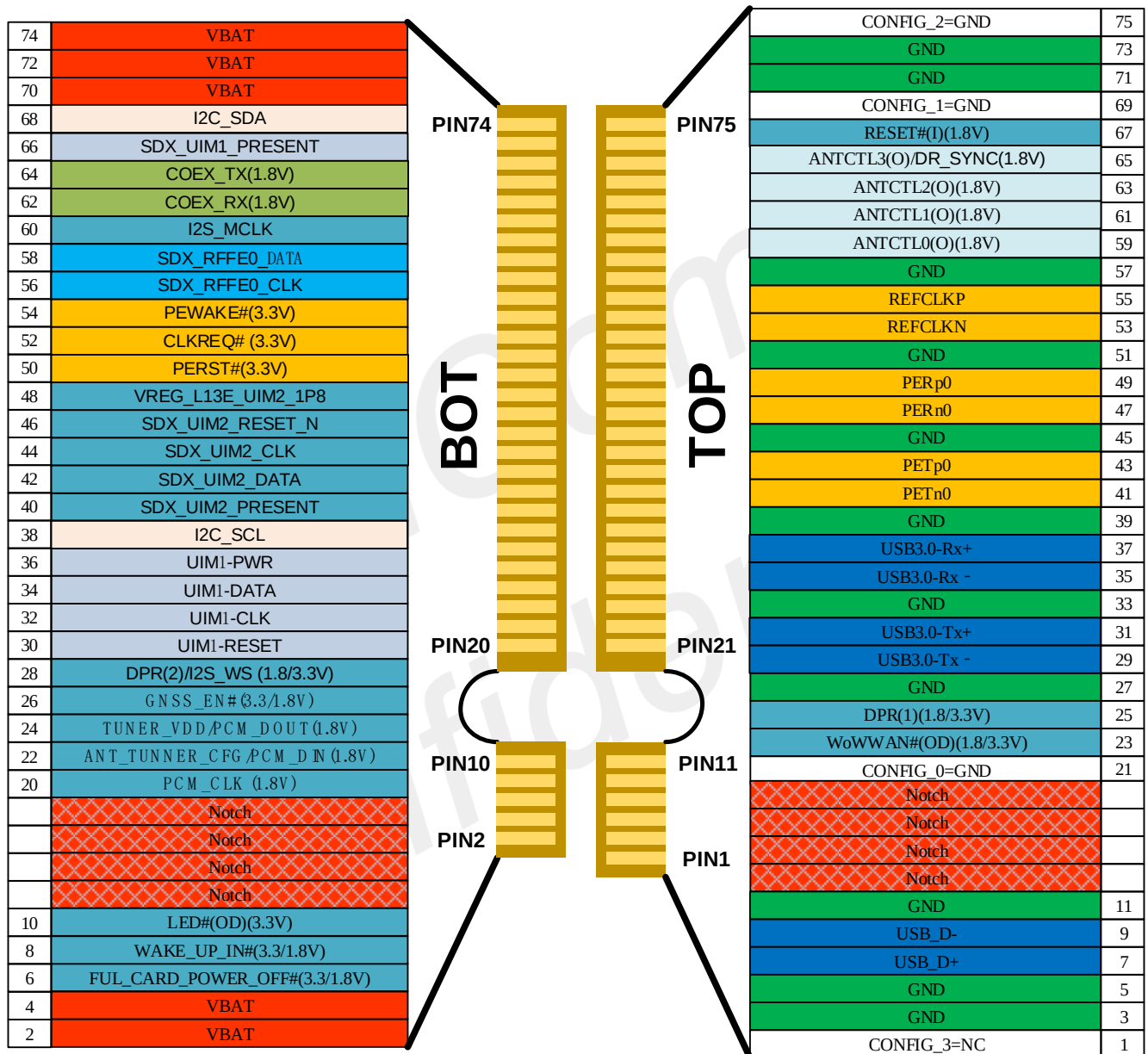


Figure 3: Pin assignment

### 2.2.1 WLAN ZIF Connector

SIM7912G-M2 provide a WLAN ZIF connector for WIFI function, the connector is position bottom side of the module and it no assembly on the module by default, about this connector and WIFI function more details, please contact SIMCom support teams, the following figure is pin map of the WLAN ZIF connector.

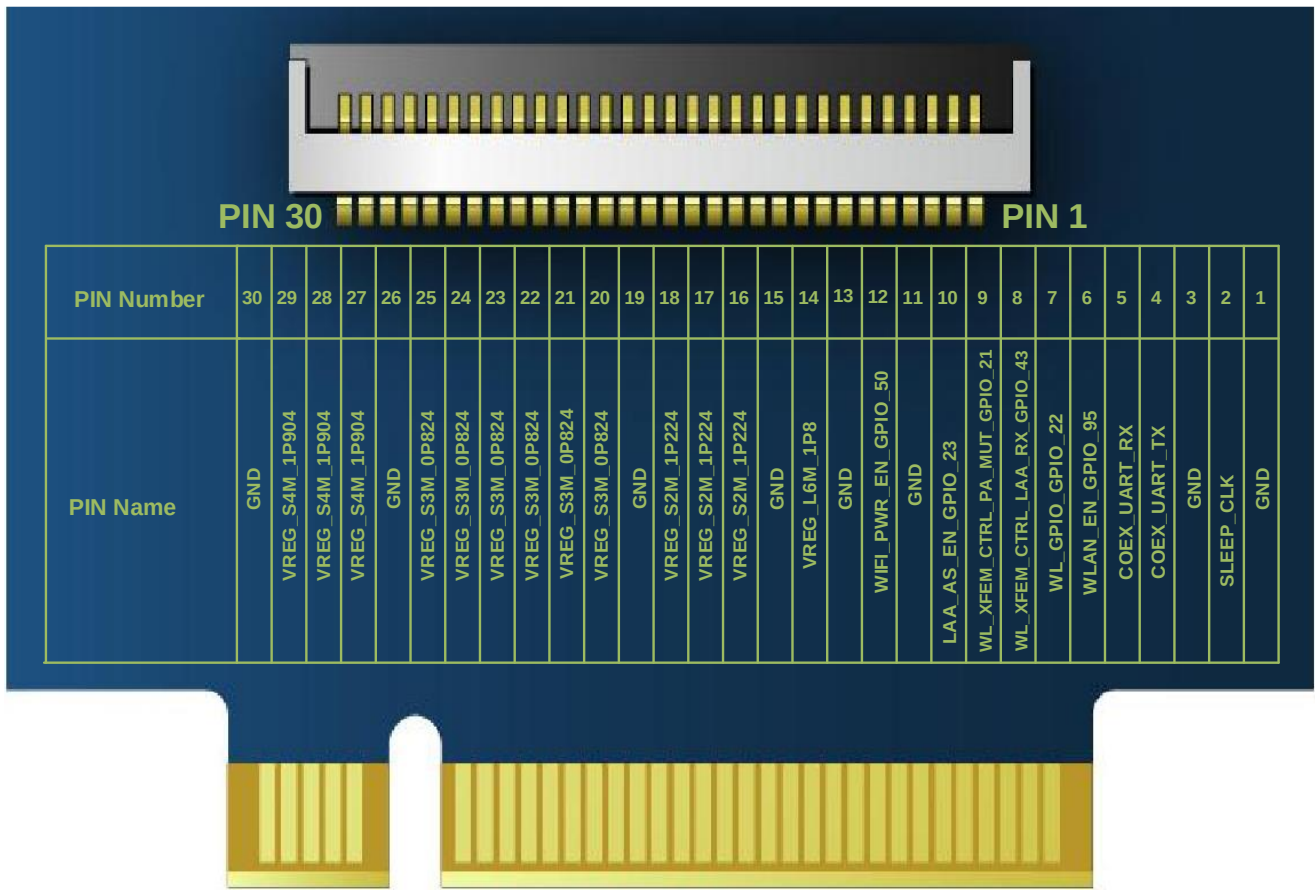


Figure 4: Pin map of WLAN ZIF connector interface

## 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 definition

| 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 | 20K ohm | -    | 60K 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 | 10K ohm | -    | 100K 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 | 10K ohm | -    | 100K ohm |
| P5             | VDD_P5=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 | 10K ohm |      | 100K ohm |

Table 5: Pin description

| Pin name     | Pin no.                              | Electrical description |    | Description                                        | Comment                                                                 |
|--------------|--------------------------------------|------------------------|----|----------------------------------------------------|-------------------------------------------------------------------------|
| Power supply |                                      |                        |    |                                                    |                                                                         |
| VBAT         | 2,4,70,<br>72,74                     |                        | PI | Power supply<br>Range: 3.135~4.4V<br>Typical: 3.3V | These pins should be connected together to withstand sufficient current |
| GND          | 3,5,11,<br>27,33,<br>39,45,<br>51,57 |                        |    | Ground                                             |                                                                         |

|                          |       |    |       |                                                                    |                                                                                                 |
|--------------------------|-------|----|-------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
|                          | 71,73 |    |       |                                                                    |                                                                                                 |
| System control           |       |    |       |                                                                    |                                                                                                 |
| FULL_CARD_POWER_OFF#     | 6     |    | DI,PD | High level: the module power on<br>Low level: the module power off | 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<br>Active low                           | RESET# has been pulled up to 1.8V internally                                                    |
| W_DISABLE1#              | 8     |    | DI    | WWAN RF disable<br>Active low                                      | 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO                                     |
| W_DISABLE2#              | 26    |    | DI    | W_DISABLE2# GNSS disable<br>Active low                             | 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO                                     |
| WoWWAN#                  | 23    |    | OD    | Wake on the host<br>Active low                                     |                                                                                                 |
| Configuration pins       |       |    |       |                                                                    |                                                                                                 |
| CONFIG_0                 | 21    |    | GND   | Connected to ground internally                                     | The module is configured as the WWAN USB3.0 interface type                                      |
| CONFIG_1                 | 69    |    | GND   | Connected to ground internally                                     |                                                                                                 |
| CONFIG_2                 | 75    |    | GND   | Connected to ground internally                                     |                                                                                                 |
| CONFIG_3                 | 1     |    | NC    | Not connected                                                      |                                                                                                 |
| USB2.0/USB3.0            |       |    |       |                                                                    |                                                                                                 |
| USB_D+                   | 7     |    | AIO   | Differential USB bi-directional data positive                      | Main communication interface<br>USB3.0 data rate up to 10Gbps<br>USB2.0 data rate up to 480Mbps |
| USB_D-                   | 9     |    | AIO   | Differential USB bi-directional data negative                      |                                                                                                 |
| USB3.0_Tx-               | 29    |    | AO    | USB3.0 transmit data negative                                      |                                                                                                 |
| USB3.0_Tx+               | 31    |    | AO    | USB3.0 transmit data positive                                      |                                                                                                 |
| USB3.0_Rx-               | 35    |    | AI    | USB3.0 receive data negative                                       |                                                                                                 |
| USB3.0_Rx+               | 37    |    | AI    | USB3.0 receive data positive                                       |                                                                                                 |
| PCIe interface           |       |    |       |                                                                    |                                                                                                 |
| PETn0                    | 41    |    | AO    | PCIe transmit data negative                                        | Support One port; PCIe Gen 2 (PCIe Gen 1 compatible)<br>If unused, please keep open             |
| PETp0                    | 43    |    | AO    | PCIe transmit data positive                                        |                                                                                                 |
| PERn0                    | 47    |    | AI    | PCIe receive data negative                                         |                                                                                                 |
| PERp0                    | 49    |    | AI    | PCIe receive data positive                                         |                                                                                                 |
| REFCLKN                  | 53    |    | AIO   | PCIe reference clock negative                                      |                                                                                                 |
| REFCLKP                  | 55    |    | AIO   | PCIe reference clock positive                                      |                                                                                                 |
| PCIe assistant interface |       |    |       |                                                                    |                                                                                                 |
| PERST#                   | 50    |    | DI    | PCIe reset signal<br>Active low                                    | VBAT~3.3V voltage domain, CLKREQ# and PEWAKE# required pull up external.                        |
| CLKREQ#                  | 52    |    | DIO   | PCIe reference clock request signal<br>Active low                  |                                                                                                 |

|                                             |    |    |     |                                                                                                                 |                                                                                                                                                                        |
|---------------------------------------------|----|----|-----|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PEWAKE#                                     | 54 |    | DIO | PCIe wake up control<br>Active low                                                                              | Default as EP mode,<br>If unused, please keep<br>open                                                                                                                  |
| (U)SIM interface                            |    |    |     |                                                                                                                 |                                                                                                                                                                        |
| (U)SIM1_PWR                                 | 36 |    | PO  | Power supply for (U)SIM1<br>card                                                                                | 1.8/3.0V voltage<br>domain,<br>(U)SIM interfaces<br>should be protected<br>against ESD ,<br>If unused, please keep<br>open.                                            |
| (U)SIM1_DATA                                | 34 | P4 | DIO | (U)SIM1 card data, which<br>has been pulled up to<br>(U)SIM1_VDD via a 20KR<br>resistor internally              |                                                                                                                                                                        |
| (U)SIM1_CLK                                 | 32 | P4 | DO  | (U)SIM1 clock signal                                                                                            |                                                                                                                                                                        |
| (U)SIM1_RESET                               | 30 | P4 | DO  | (U)SIM1 reset control                                                                                           |                                                                                                                                                                        |
| (U)SIM1_DET                                 | 66 | P3 | DI  | (U)SIM1 card detect, which<br>has been pulled up to<br>VDD_P3 via a 470KR<br>resistor internally                |                                                                                                                                                                        |
| (U)SIM2_PWR                                 | 48 |    | PO  | Power supply for (U)SIM2<br>card                                                                                | The eSIM has been<br>reserved internal.<br>1.8/3.0V voltage<br>domain,<br>(U)SIM interfaces<br>should be protected<br>against ESD ,<br>If unused, please keep<br>open  |
| (U)SIM2_DATA                                | 42 | P5 | DIO | (U)SIM2 card data, which<br>has been pulled up to<br>(U)SIM2_VDD via a 20KR<br>resistor internally              |                                                                                                                                                                        |
| (U)SIM2_CLK                                 | 44 | P5 | DO  | (U)SIM2 clock signal                                                                                            |                                                                                                                                                                        |
| (U)SIM2_RESET                               | 46 | P5 | DO  | (U)SIM2 reset control                                                                                           |                                                                                                                                                                        |
| (U)SIM2_DET                                 | 40 | P3 | DI  | (U)SIM2 card detect, which<br>has been pulled up to<br>VDD_P3 via a 470KR<br>resistor internally                |                                                                                                                                                                        |
| Antenna control interface <sup>2</sup>      |    |    |     |                                                                                                                 |                                                                                                                                                                        |
| ANTCTL0                                     | 59 | P3 | DO  | Antenna tuner control0                                                                                          | 1.8V voltage domain. If<br>unused, please keep<br>open                                                                                                                 |
| ANTCTL1                                     | 61 | P3 | DO  | Antenna tuner control1                                                                                          |                                                                                                                                                                        |
| ANTCTL 2                                    | 63 | P3 | DO  | Antenna tuner control2                                                                                          |                                                                                                                                                                        |
| ANTCTL3 <sup>2</sup><br>(DR_SYNC)           | 65 | P3 | DO  | Antenna tuner control3<br>(Dead reckoning<br>synchronization signal)                                            |                                                                                                                                                                        |
| RFFE_SDATA                                  | 58 | P3 | DIO | Antenna tuner MIPI DATA                                                                                         |                                                                                                                                                                        |
| RFFE_SCLK                                   | 56 | P3 | DO  | Antenna tuner MIPI CLK                                                                                          |                                                                                                                                                                        |
| I2S interface                               |    |    |     |                                                                                                                 |                                                                                                                                                                        |
| I2S_CLK                                     | 20 | P3 | DO  | I2S clock output                                                                                                | 1.8V voltage domain,<br>also can be used as<br>PCM interface, If need<br>audio function, please<br>contact SIMCom<br>support teams.<br>If unused, please keep<br>open. |
| ANT_TUNNER_<br>CFG<br>(I2S_RX) <sup>3</sup> | 22 | P3 | DI  | ANT_TUNNER_CFG_1.8V<br>(I2S data input)                                                                         |                                                                                                                                                                        |
| TUNER_VDD<br>(I2S_TX) <sup>3</sup>          | 24 | P3 | DO  | Tuner_VDD_1.8V<br>(I2S data output)                                                                             |                                                                                                                                                                        |
| I2S_WA <sup>3</sup>                         |    |    | DO  | I2S word alignment select<br>(L/R)                                                                              |                                                                                                                                                                        |
| DPR2 <sup>3 *</sup>                         | 28 | P3 | DI  | DPR (Dynamic Power<br>Reduction) signal is used for<br>SAR (Specific Absorption<br>Rate) sensor interrupt input |                                                                                                                                                                        |

|                             |                                         |    |     |                                                                                                                 |                                                                                                |
|-----------------------------|-----------------------------------------|----|-----|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| I2S_MCLK                    | 60                                      | P3 | DO  | I2S master clock                                                                                                |                                                                                                |
| I2C interface               |                                         |    |     |                                                                                                                 |                                                                                                |
| I2C_SDA                     | 68                                      | P3 | DIO | I2C data signal                                                                                                 | 1.8V voltage domain,<br>Internal pulled up to<br>1.8V. If unused, please<br>keep open          |
| I2C_SCL                     | 38                                      | P3 | DO  | I2C clock signal                                                                                                |                                                                                                |
| Coex interface <sup>4</sup> |                                         |    |     |                                                                                                                 |                                                                                                |
| COEX1*<br>(UART_TX*)        | 64                                      | P3 | DO  | SIM7906G-M2 hardware<br>configures as coexistence<br>signal function by default                                 | If need normal<br>communication<br>UART(AT command),<br>please contact SIMCom<br>support teams |
| COEX2*<br>(UART_RX*)        | 62                                      | P3 | DI  |                                                                                                                 |                                                                                                |
| Other pins                  |                                         |    |     |                                                                                                                 |                                                                                                |
| LED1#                       | 10                                      |    | OD  | The module status indicator<br>via LED devices<br>Active low                                                    |                                                                                                |
| DPR1*                       | 25                                      | P3 | DI  | DPR (Dynamic Power<br>Reduction) signal is used for<br>SAR (Specific Absorption<br>Rate) sensor interrupt input |                                                                                                |
| Notch                       |                                         |    |     |                                                                                                                 |                                                                                                |
| Notch                       | 12, 13,<br>14, 15,<br>16, 17,<br>18, 19 |    |     | Notch                                                                                                           |                                                                                                |

**NOTE**

1. "\*" means under development.
2. The RF FE signals are multiplexed with ANTCTL3 and DR\_SYNC.
3. SIM7912G-M2 hardware configures as DPR2、Tuner\_VDD\_1.8V and ANT\_TUNNER\_CFG output function by default.If need I2S data, please contact SIMCom support teams.
4. SIM7912G-M2 interface the pin of 62 and 64 hardware support COEX\_UART function by default.

**Table 6: Pin description of WLAN ZIF connector interface**

| Pin name                    | PIN no. | Electrical description |    | Discription                        |
|-----------------------------|---------|------------------------|----|------------------------------------|
| SLEEP_CLK                   | 2       | P3                     | DO | Sleep clock output for W80 only    |
| COEX_UART_TX                | 4       | P3                     | DO | LTE&WLAN coexistence data transmit |
| COEX_UART_RX                | 5       | P3                     | DI | LTE&WLAN coexistence data receive  |
| WL_EN_GPIO_52               | 6       | P3                     | DO | W80 RF coexistence signals         |
| WL_GPIO_GPIO_94             | 7       | P3                     | DO |                                    |
| WL_XFEM_CTRL_LAA_RX_GPIO_26 | 8       | P3                     | DO |                                    |
| WL_XFEM_CTRL_PA_MUT_GPIO_41 | 9       | P3                     | DO |                                    |

|                   |                                   |    |    |                                  |
|-------------------|-----------------------------------|----|----|----------------------------------|
| LAA_AS_EN_GPIO_40 | 10                                | P3 | DO |                                  |
| WL_SW_CTRL        | 12                                | P3 | DO |                                  |
| VREG_L6E_1P8      | 14                                |    | PO | Output power supply for W80 only |
| VREG_S2E_1P224    | 16,17,<br>18                      |    | PO | Output power supply for W80 only |
| VREG_S3E_0P824    | 20,21,<br>22,23,<br>24,25         |    | PO | Output power supply for W80 only |
| VREG_S4E_1P904    | 27,28,<br>29                      |    | PO | Output power supply for W80 only |
| GNG               | 1,3,11,<br>13,15,<br>19,26,<br>30 |    |    | Ground                           |

## 2.4 Package Dimensions

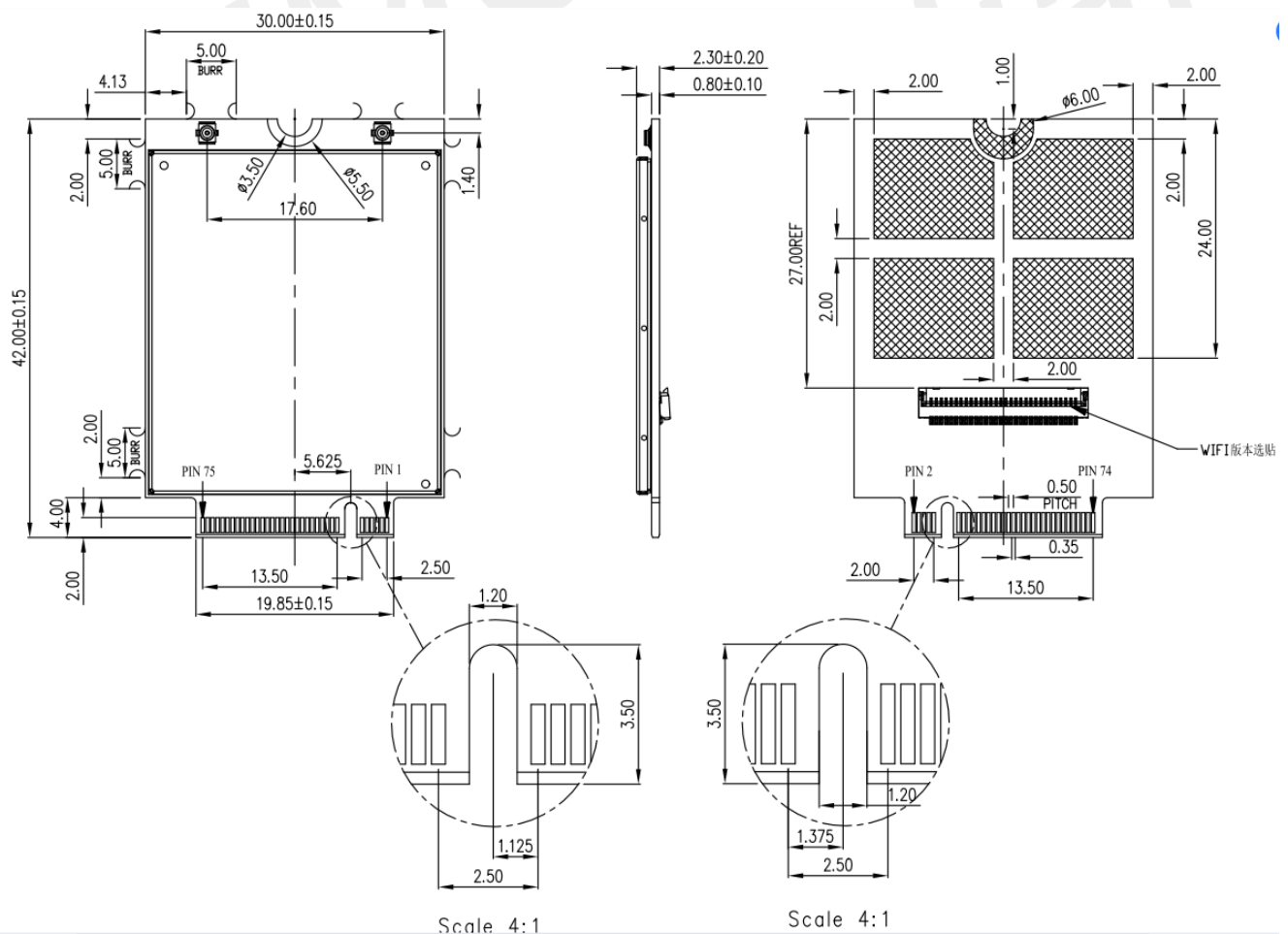


Figure 5: Dimensions of SIM7912G-M2 (Unit: mm)

## 2.5 Label information

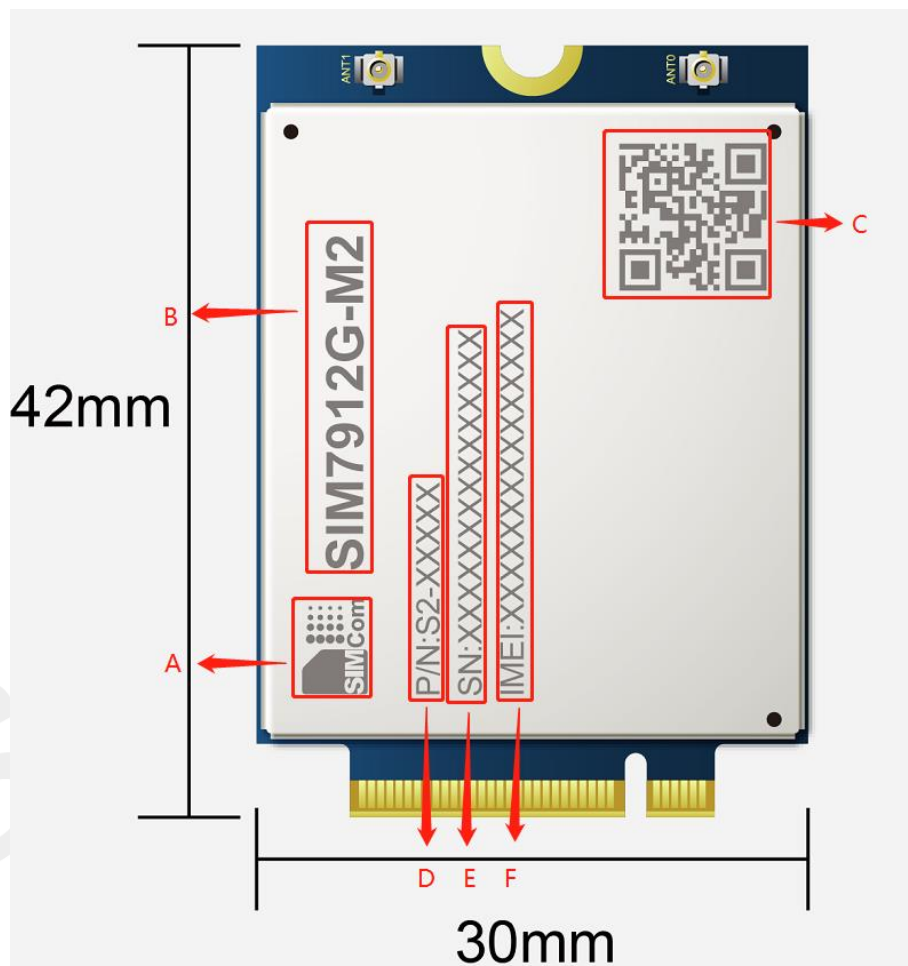


Figure 6: Label information

Table 7: 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 SIM7912G-M2 is 3.3V and the voltage ranges from 3.135 V to 4.4 V. The SIM7912G-M2 has 5 power pins and 11 ground pins, to ensure the SIM7912G-M2 card works normally, all the pins must be connected. The connector pin is defined to support 500mA current per pin continuously.

Table 8: VBAT pins electronic characteristic

| Symbol                             | Description                               | Min.  | Typ. | Max. | Unit |
|------------------------------------|-------------------------------------------|-------|------|------|------|
| <b>VBAT</b>                        | Module power voltage.                     | 3.135 | 3.3  | 4.4  | V    |
| <b>I<sub>VBAT(peak)</sub></b>      | Module power peak current in normal mode. | -     | 1.0  | 2.0  | A    |
| <b>I<sub>VBAT(power-off)</sub></b> | Module power current in power off mode.   | 50    | 80   | 100  | uA   |

#### 3.1.1 Power Supply Design Guide

Make sure that the voltage on the VBAT pins will never drop below 3.135V, even during a transmit event, when current consumption may rise up to 1.0A. If the voltage drops below 3.135V, the module might 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 330uF 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.

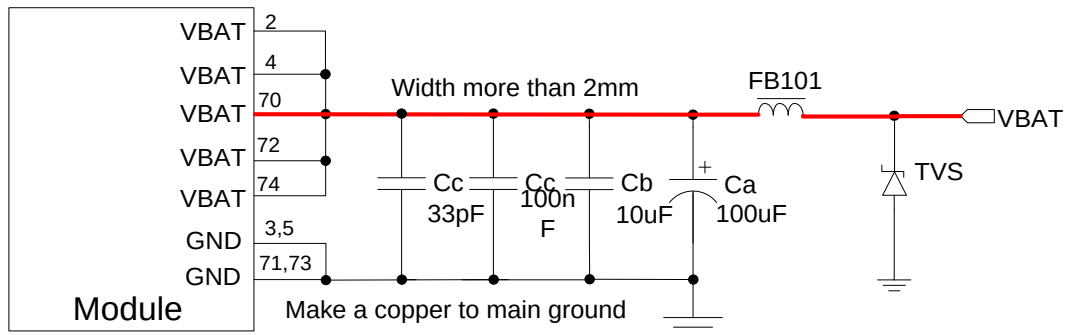


Figure 7: Power supply application circuit

#### NOTE

The test condition: The voltage of power supply for VBAT is 3.3V, Ca is a 100  $\mu$ F tantalum capacitor (ESR=0.7 $\Omega$ ).

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 9: 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 1A.

The following figure shows the linear regulator reference circuit with 5V input and 3.3V output.

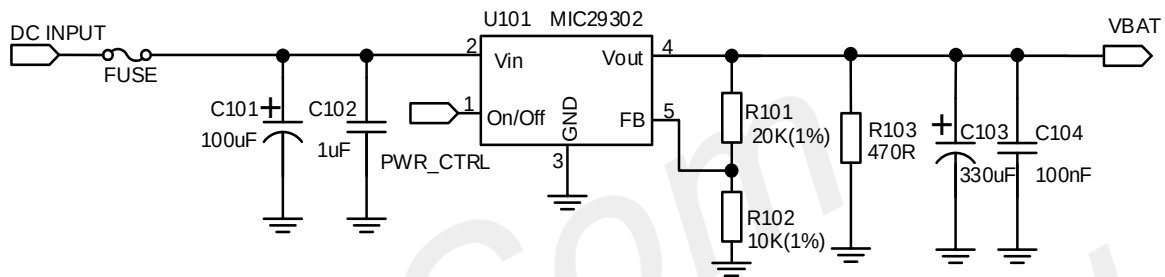


Figure 8: Linear regulator reference circuit

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 3.3V output.

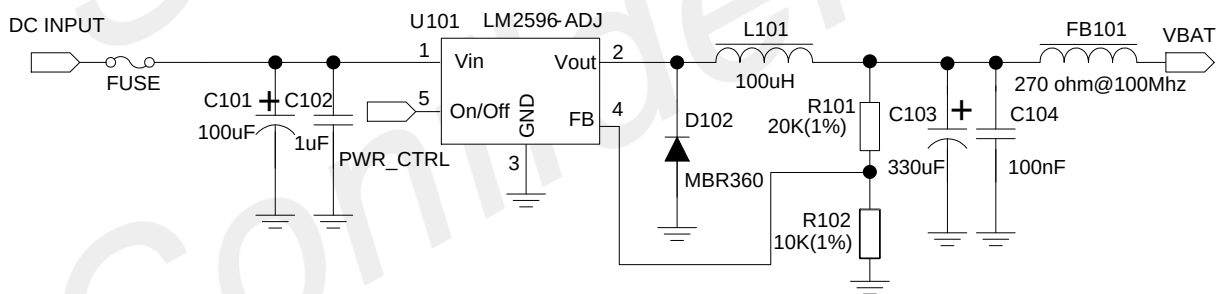


Figure 9: Switching mode power supply reference circuit

#### 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 ( $\geq 1.7$  V) and will force the module to shut down when asserted low ( $\leq 0.2$  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.

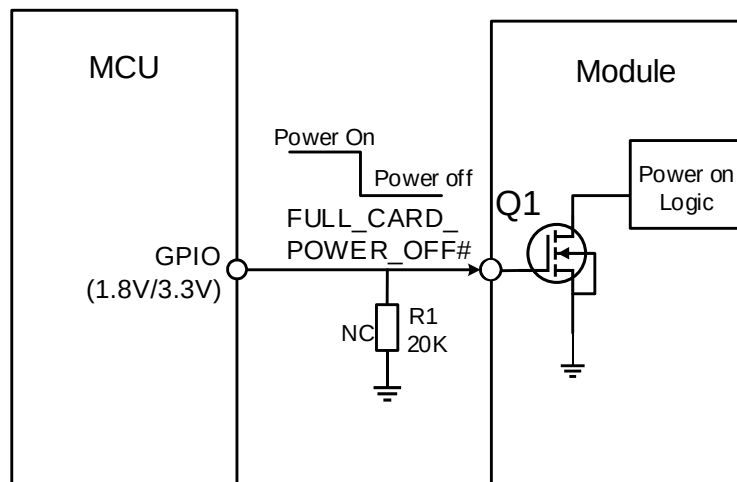


Figure 10: Reference power on/off circuit

#### 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.

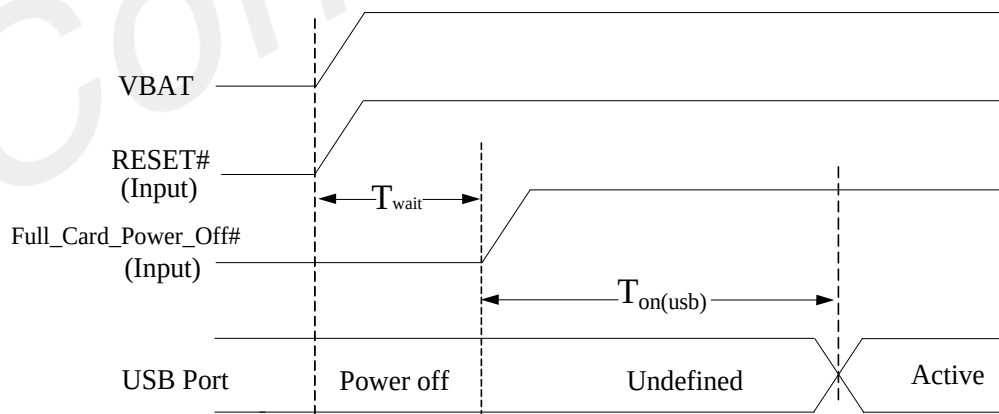


Figure 11: Power on timing sequence

Table 10: 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  | 50   | s    |
| $V_{IH}$      | Input high level voltage on Full_Card_Power_Off# pin  | 1.0  | 1.8  | 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  $-30\sim+70^{\circ}\text{C}$ , some warnings will be reported via AT port. If the temperature is outside the range of  $-40\sim+85^{\circ}\text{C}$ , 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.

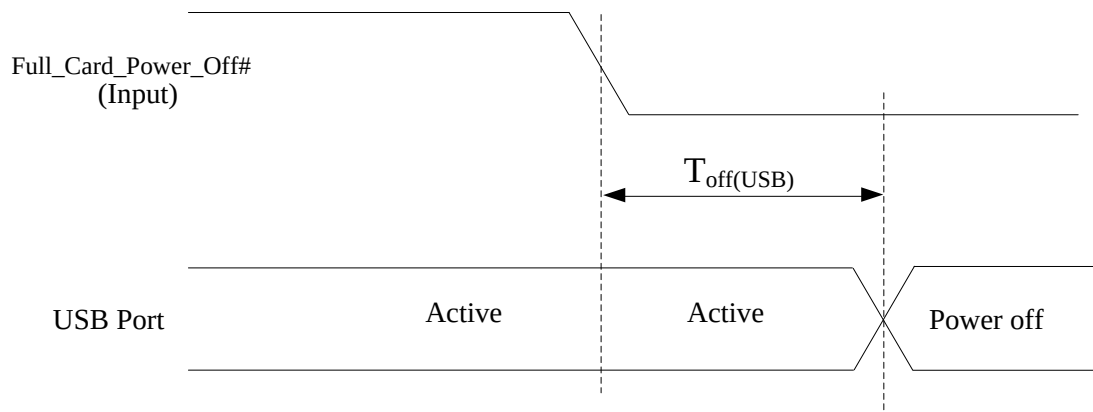


Figure 12: Power off timing sequence

Table 11: 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 | -          | TBD  | 20   | 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.

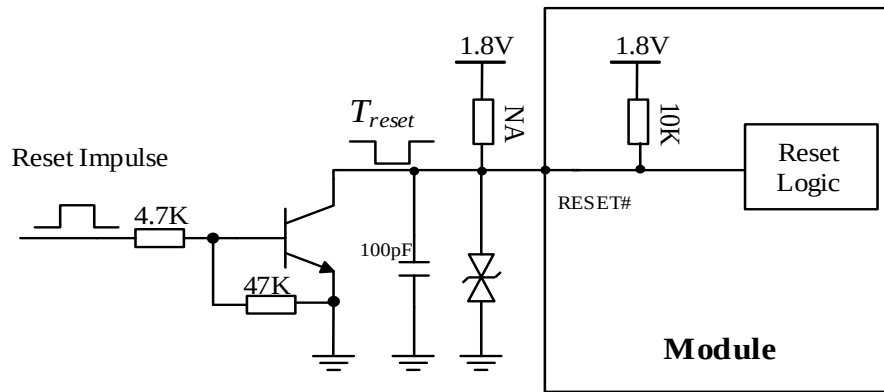


Figure 13: Reference reset circuit

Table 12: 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 | 250  | -    | 600  | ms   |
| $V_{IH}$    | Input high level voltage                                         | 1.2  | -    | 1.9  | V    |
| $V_{IL}$    | Input low level voltage                                          | 0    | -    | 0.4  | V    |

### 3.4 UART interface

Module provides a 2-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.

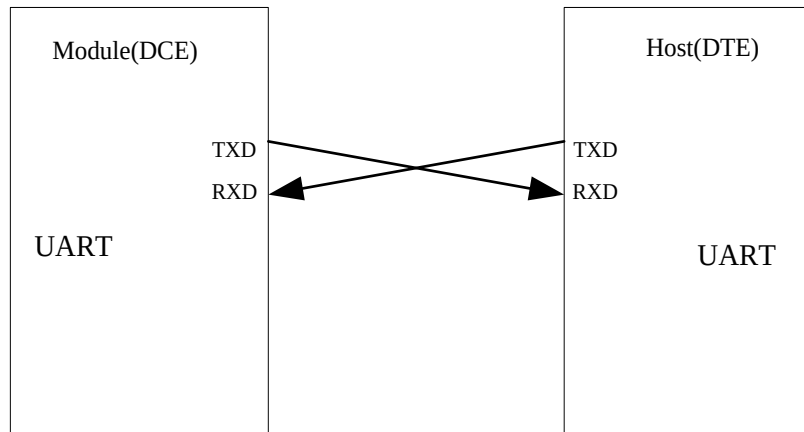


Figure 14: UART modem

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.

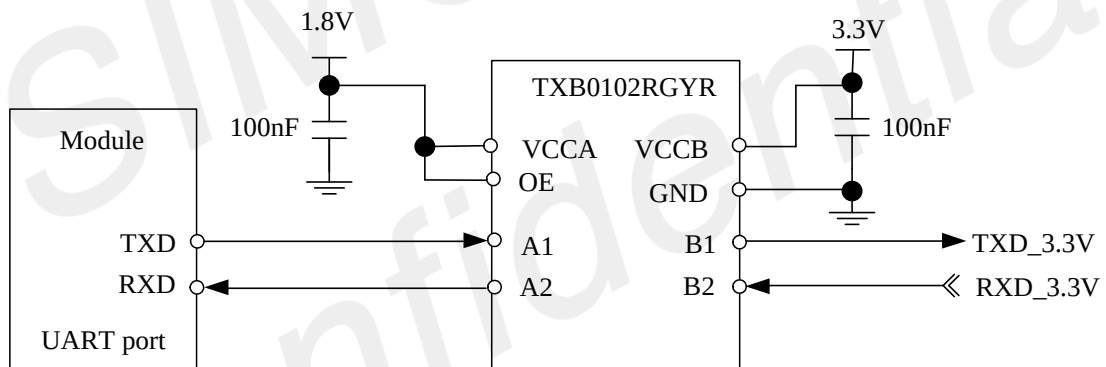


Figure 15: Reference circuit of level shift

Customers can use another level shifter circuits as follow.

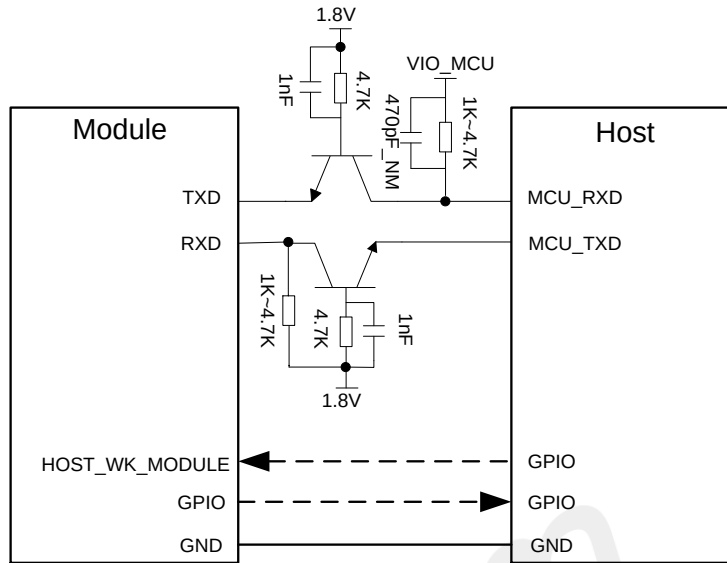


Figure 16: Level matching circuit with triode

#### 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. HOST\_WK\_MODULE function please refer chapter 3.17.

## 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.

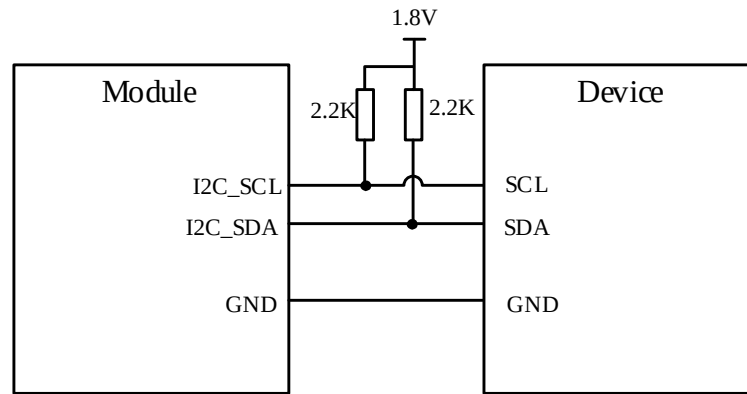


Figure 17: I2C reference circuit

#### 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.

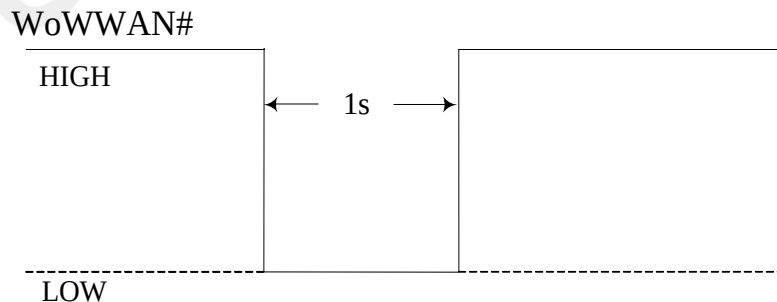


Figure 18: WoWWAN# behavior (SMS and URC report etc.)

WoWWAN# Reference circuit is recommended in the following figure.

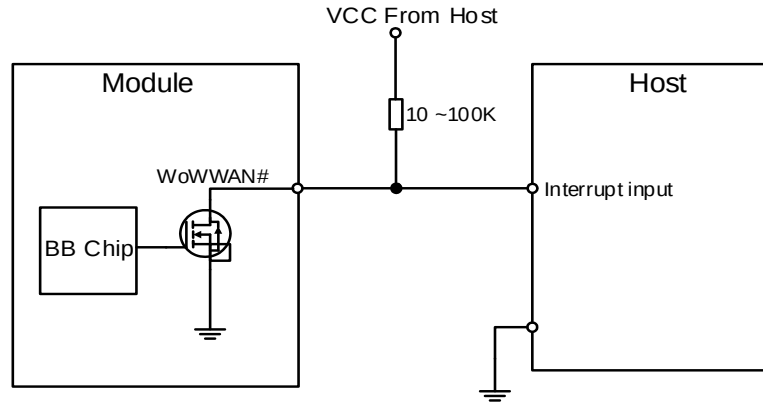


Figure 19: WoWWAN# reference circuit

### 3.7 USB Interface

SIM7912G-M2 supports one USB interface which complies with the USB3.0 and 2.0 specifications. Customers can choose USB3.0 or USB2.0 for their needs. USB 3.0 data rate up to 10Gbps.

The USB interface is used for AT command communication, data transmission, GNSS NMEA output, firmware upgrade and software debugging.

The module supports USB suspend and resume mechanism which can save power consumption. If there is no data transmission on the USB bus, the module will enter suspend mode automatically.

The following figure is the USB reference circuit.

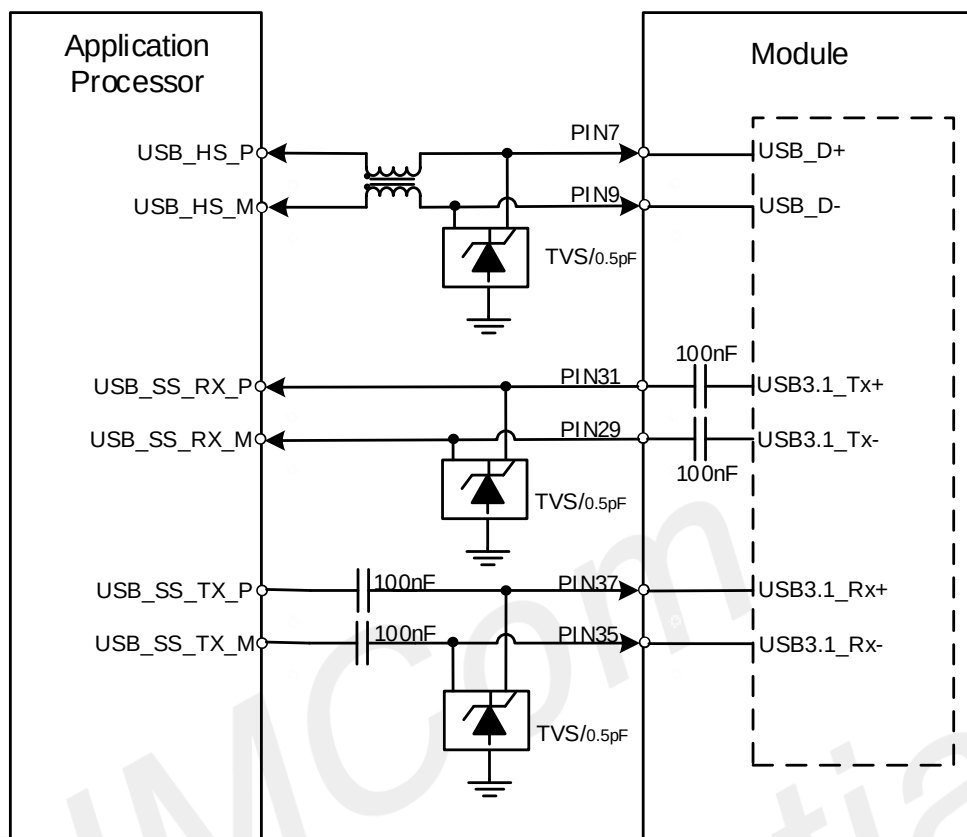


Figure 20: USB reference circuit

Table 13: Definition of USB interface

| Pin name   | Pin no. | Electrical description | Description                                   | Comment                                                         |
|------------|---------|------------------------|-----------------------------------------------|-----------------------------------------------------------------|
| USB_D+     | 7       | AIO                    | Differential USB bi-directional data positive | USB3.0 data rate up to 10Gbps<br>USB2.0 data rate up to 480Mbps |
| USB_D-     | 9       | AIO                    | Differential USB bi-directional data negative |                                                                 |
| USB3.0_Tx- | 29      | AO                     | USB3.0 transmit data negative                 |                                                                 |
| USB3.0_Tx+ | 31      | AO                     | USB3.0 transmit data positive                 |                                                                 |
| USB3.0_Rx- | 35      | AI                     | USB3.0 receive data negative                  |                                                                 |
| USB3.0_Rx+ | 37      | AI                     | USB3.0 receive data positive                  |                                                                 |

Table 14: USB interface TVS diode list

| No. | Manufacturer | Part number   | Package    |
|-----|--------------|---------------|------------|
| 1   | WILL         | ESD5302N-3/TR | DFN1006-3L |

USB HS D+/D- layout guidelines:

- Require differential trace impedance is  $90\pm 10\% \Omega$ .
- The intra-lane length mismatch of the differential signal lanes is less than 1mm.
- Gap from other signals keeps 3xline width.
- External components should be placed near the USB connector.
- Trace routes away from other sensitive signals (RF, audio, and 38.4M XO).
- The TVS diode should be placed close to the USB pins of M.2 connector.
- Maximum PCB trace length cannot exceed 100mm outside of module, the shorter trace and more better.

USB SS TX/RX layout guidelines:

- Require differential trace impedance is  $90\pm 10\% \Omega$ .
- The intra-lane length mismatch of the differential signal lanes is less than 500um.
- Gap from other signals keeps 4xline width.
- Gap between Rx-to-Tx keeps 4xline width.
- External components should be placed near the USB connector.
- Trace routes away from other sensitive signals (RF, especially 2.4 GHz).
- The TVS diode should be placed close to the USB pins of M.2 connector.
- Route differential pairs in the inner layers with a solid GND reference to have good impedance control and to minimize discontinuities.
- Keep isolation between the Tx pair, Rx pair, and DP/DM to avoid crosstalk.
- If core vias are used, use no more than two core vias per signal line to limit stubs.

### 3.8 PCIe Interface

SIM7912G-M2 supports PCIe Gen 2 (PCIe Gen 1 compatible) , and can be used as Root Complex or Endpoint mode. CLKREQ# and PEWAKE# needs pull up to 3.3V by 100K resesitor in customers' design.

The following figure is the PCIe reference circuit.

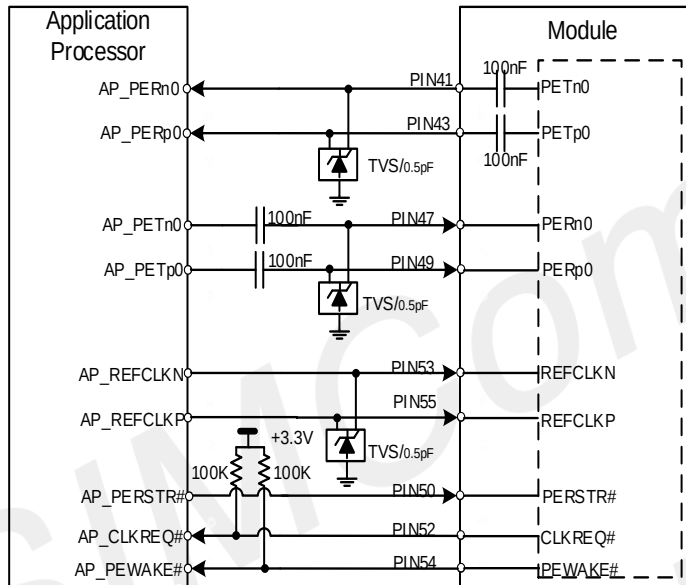


Figure 21: PCIe interface reference circuit (EP Mode)

#### NOTE

1. "\*" means under development.
2. The AC capacitors of AP\_PETn0 and AP\_PETp0 should be closed to AP.
3. The voltage domain of PCIe assistant signals is VBAT~3.3V.

Table 15: Definition of PCIe interface

| Pin Name | Pin No. | Electrical Description | Functional Description                                                     | Comment |
|----------|---------|------------------------|----------------------------------------------------------------------------|---------|
| PETn0    | 41      | AIO                    | PCI Express Lane 0, Transmit Pair, Negative Signal 2.5GHz serial interface |         |
| PETp0    | 43      | AIO                    | PCI Express Lane 0, Transmit Pair, Positive Signal 2.5GHz serial interface |         |

|                     |    |     |                                                                                   |                                                                                                                          |
|---------------------|----|-----|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| PERn0               | 47 | AIO | PCI Express Lane 0, Receive Pair, Negative Signal 2.5GHz Serial interface         | VBAT~3.3V voltage domain, CLKREQ# and PEWAKE# required pull up external, Default as EP mode. If unused, please keep open |
| PERp0               | 49 | AIO | PCI Express Lane 0, Receive Pair, Positive Signal 2.5GHz Serial interface         |                                                                                                                          |
| REFCLKN             | 53 | AIO | 100MHz PCI Express platform reference Clock Negative signal of differential pair  |                                                                                                                          |
| REFCLKP             | 55 | AIO | 100MHz PCI Express platform Reference Clock. Positive signal of differential pair |                                                                                                                          |
| PERST# <sup>1</sup> | 50 | DI  | PERSTR# is a functional reset to the Add-In module active low                     |                                                                                                                          |
| CLKREQ#             | 52 | DIO | PCIe reference clock request signal active low                                    |                                                                                                                          |
| PEWAKE#             | 54 | DIO | PCIe wake up signal active low                                                    |                                                                                                                          |

#### NOTE

1.SIM7912G-M2 interface the pin of PCIe endpoint(EP) mode by default. Support root complex(RC) mode of the module , for more details, please contact SIMCom support teams.

**Table 16: PCIe interface recommended TVS diode list**

| No. | Manufacturer | Part Number   | Package    |
|-----|--------------|---------------|------------|
| 1   | WILL         | ESD5302N-3/TR | DFN1006-3L |

PCIe interface layout guidelines:

- Require differential trace impedance is  $90 \pm 10\% \Omega$ .
- The intra-lane length mismatch of the differential signal lanes is less than 700um (5ps).
- Gap from other signals keeps 4xline width.
- Gap between Rx-to-Tx keeps 4xline width.
- Should be routed away from sensitive signals.
- The TVS diode should be placed close to the PCIe pins of M.2 connector.

### 3.9 USIM Interface

Module supports both 1.8V and 3.0V USIM Cards. The eSIM has been reserved internal, which is compatible with USIM2 signal, and it has no assembly on the module by default.

**Table 17: 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 <sub>IH</sub> | High-level input voltage  | 0.65*USIM_VDD  | -    | USIM_VDD +0.3 | V    |
| V <sub>IL</sub> | Low-level input voltage   | -0.3           | 0    | 0.35*USIM_VDD | V    |
| V <sub>OH</sub> | High-level output voltage | USIM_VDD -0.45 | -    | USIM_VDD      | V    |
| V <sub>OL</sub> | Low-level output voltage  | 0              | 0    | 0.45          | V    |

**Table 18: 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 <sub>IH</sub> | High-level input voltage  | 0.65*USIM_VDD  | -    | USIM_VDD +0.3 | V    |
| V <sub>IL</sub> | Low-level input voltage   | -0.3           | 0    | 0.25*USIM_VDD | V    |
| V <sub>OH</sub> | High-level output voltage | USIM_VDD -0.45 | -    | USIM_VDD      | V    |
| V <sub>OL</sub> | Low-level output voltage  | 0              | 0    | 0.45          | V    |

#### 3.9.1 USIM Application Guide

It is recommended to use an ESD protection component such as ESDA6V1-5W6 produced by ST ([www.st.com](http://www.st.com)) or SMF12C produced by ON SEMI ([www.onsemi.com](http://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.

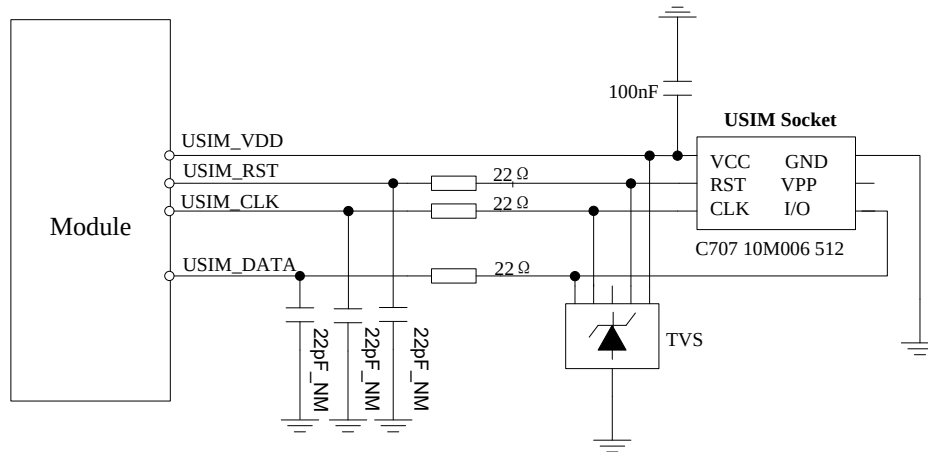


Figure 22: USIM interface reference circuit

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.

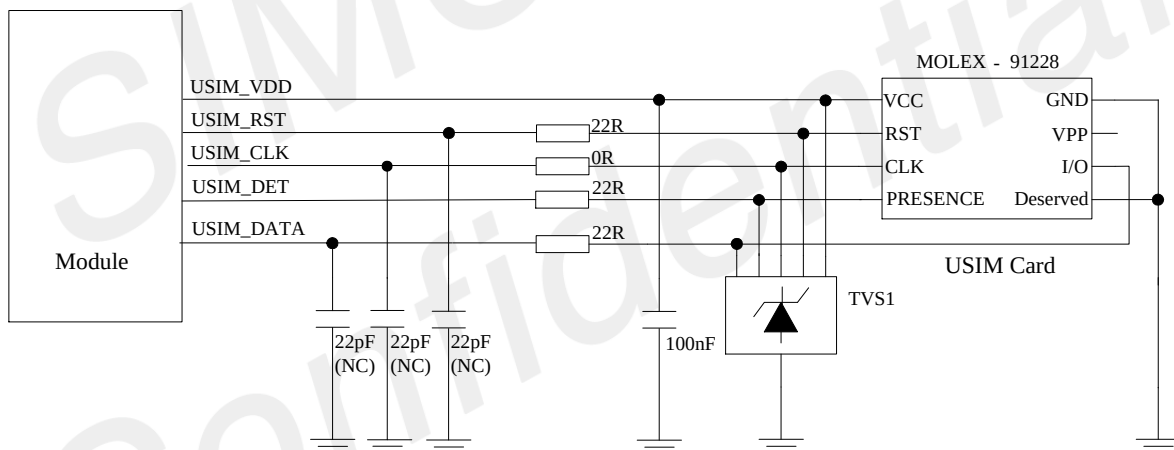


Figure 23: USIM interface reference circuit with USIM\_DET

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

#### NOTE

The eSIM has been reserved internal, which is compatible with USIM2 signal, and it no assembly on the module by default

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

### 3.9.2 USIM layout guide

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 60pF.

### 3.10 I2S Interface

The SDX device supports two (primary and secondary) bidirectional multiple inter-IC sound (MI2S) interfaces and two (primary and secondary) PCM interfaces to support I2S/PCM devices.

The following figure is the external codec reference design circuit.

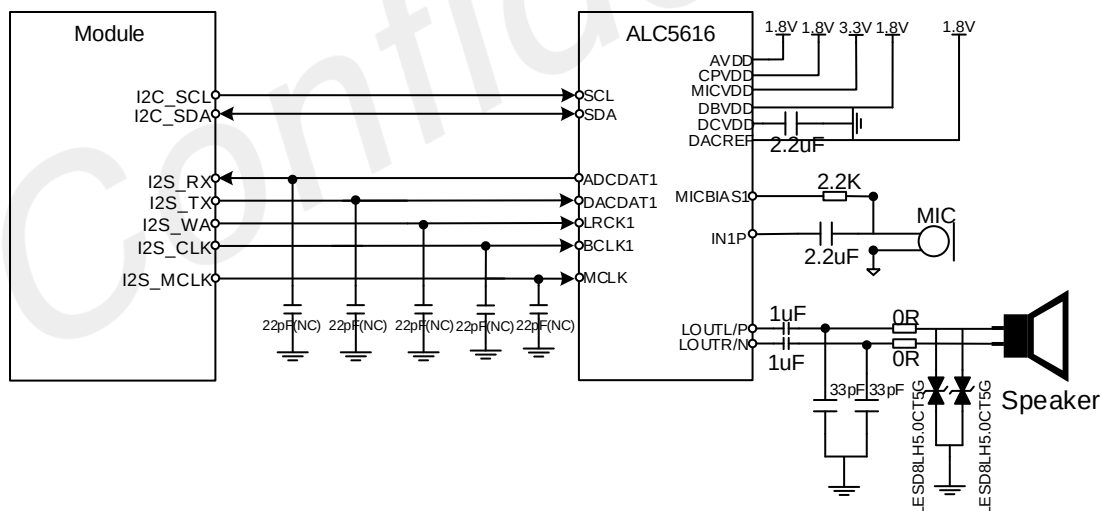


Figure 24: Audio codec diagram circuit

#### NOTE

1、 “\*” The module configures as DPR2、 Tuner\_VDD\_1.8V and ANT\_TUNNER\_CFG output function on the same interfaces with PCM interfaces by default, If need PCM audio function, please contact SIMCom support teams.

**Table 19: Definition of I2S interface**

| Pin name | Pin no. | Electrical description | Description                     | Comment                                                                             |
|----------|---------|------------------------|---------------------------------|-------------------------------------------------------------------------------------|
| I2S_CLK  | 20      | DO                     | I2S clock output                | 1.8V voltage domain, also can be used as PCM interface, If unused, please keep open |
| I2S_RX   | 22      | DI                     | I2S data input                  |                                                                                     |
| I2S_TX   | 24      | DO                     | I2S data output                 |                                                                                     |
| I2S_WA   | 28      | DO                     | I2S word alignment select (L/R) |                                                                                     |
| I2S_MCLK | 60      | DO                     | I2S master clock                |                                                                                     |

The PCM interface is multiplexing with I2S interface. The default audio interface of the module is I2S.

**Table 20: The PCM interface is multiplexing with I2S interface**

| Pin name | PCM interface |
|----------|---------------|
| I2S_RX   | PCM_DIN       |
| I2S_TX   | PCM_OUT       |
| I2S_WA   | PCM_SYNC      |
| I2S_CLK  | PCM_CLK       |
| I2S_MCLK | -             |

Audio layout guidelines:

Analog input

- 0.2mm trace widths; 0.2mm spacing between other signals trace.
- Pseudo differential route for MIC.
- Isolate from noise sources, such as antenna, RF signals, SMPS, clocks, and other high speed signals.

Analog output

- Isolate from noise sources such as antenna, RF signals, SMPS, clocks, and other high speed signals.
- Speaker output signal – route as differential pair with 0.5mm trace widths.

Audio power and GND

- Recommend add magnetic bead on AVDD net reserved for debug.
- VDD cannot directly use VBAT as the power supply.
- AGND need add GND via to the main GND plane directly.

### 3.11 DPR

DPR (Dynamic Power Reduction) signal is used by SIM7912G-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 21: 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                       |
| 28     | DPR2     | DI         | SAR solution: In case of HW only solution.                       |

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

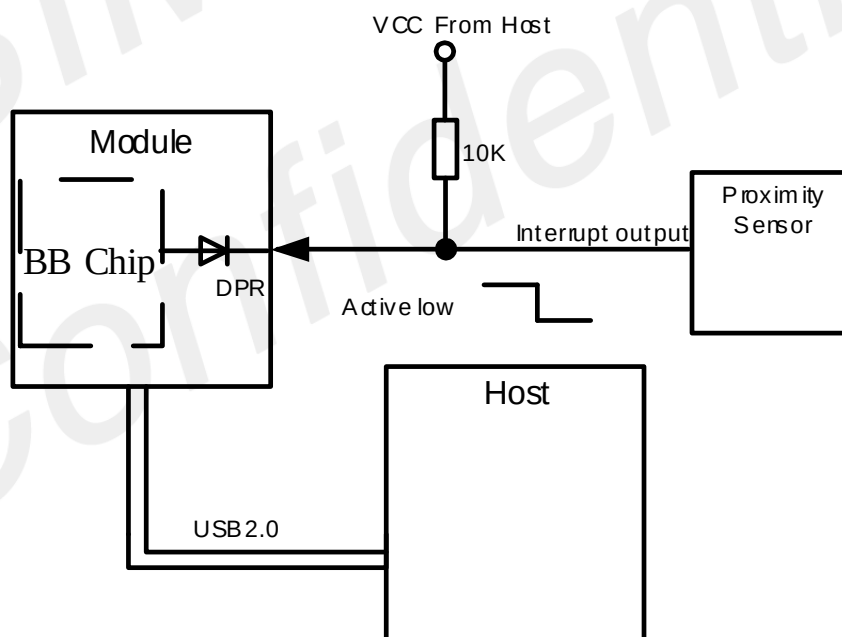


Figure 25: Connection of DPR pin

#### NOTE

The DPR function is under developing.

### 3.12 CONFIG Pins

These signals provide the means to indicate the specific configuration of the module. SIM7912G-M2 is configured as WWAN-USB3.0 .

**Table 22: 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 23: CONFIG interface definition**

| CONFIG_0<br>(Pin 21) | CONFIG_1<br>(Pin 69) | CONFIG_2<br>(Pin 75) | CONFIG_3<br>(Pin 1) | Module type and<br>main host interface | Comments       |
|----------------------|----------------------|----------------------|---------------------|----------------------------------------|----------------|
| GND                  | GND                  | GND                  | NC                  | WWAN – USB 3.0                         | Vender defined |

### 3.13 LED1#

LED1# is open drain output and is used to allow SIM7912G-M2 to provide network status via LED which will be provided by the host.

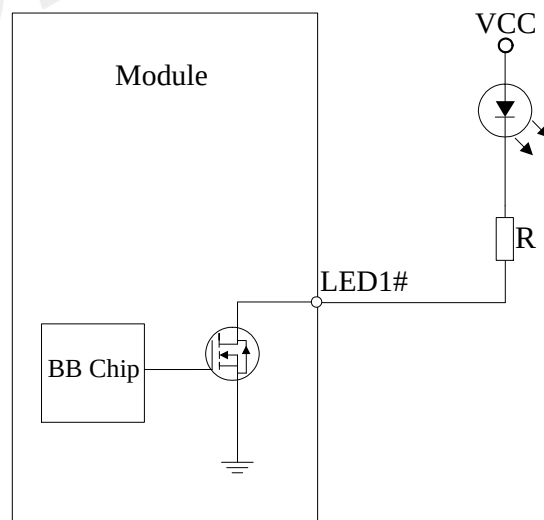


Figure 26: LED1# reference circuit

**NOTE**

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

The timing sequence is as followed:

**Table 24: 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 SIM7912G-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.

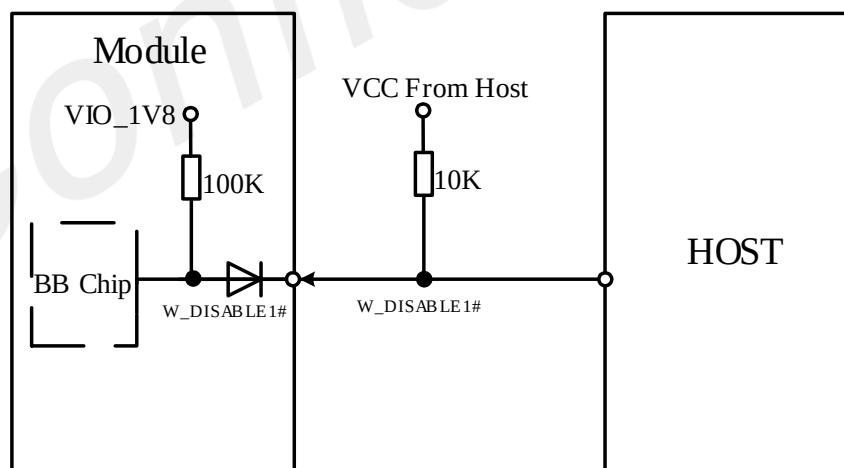


Figure 27: Flight mode switch reference circuit

W\_DISABLE1# pin status as below:

**Table 25: 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<br>AT+CFUN=1: RF is working (default) |

### 3.15 ANTCTRL interface

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

The following table are the definitions for antenn control interfaces.

**Table 26: Definition of antenna control interface**

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

#### NOTE

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

### 3.16 W\_DISABLE2#

The W\_DISABLE2# pin controls SIM7912G-M2 to disable the GNSS function. When the W\_DISABLE2# signal is pulled to low level, the GNSS function would be disabled. The following figure shows the reference circuit of W\_DISABLE2#.

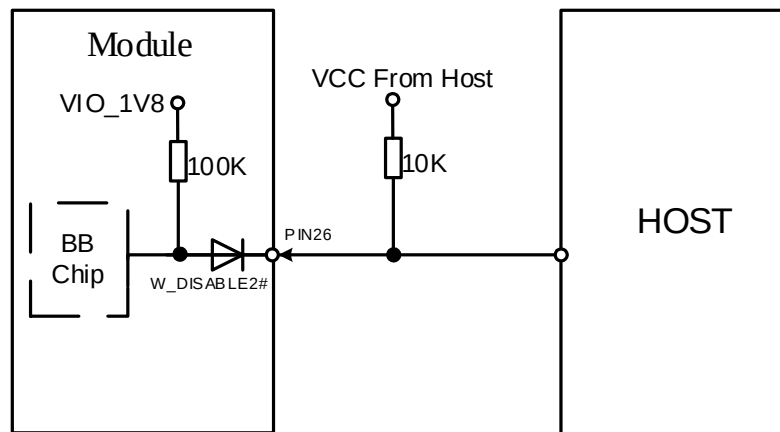


Figure 28: W\_DISABLE2#pin reference circuit

Table 27: Definition of W\_DISABLE2# pin

| Pin name    | Pin no. | Electrical description | Description                | Comments                                                             |
|-------------|---------|------------------------|----------------------------|----------------------------------------------------------------------|
| W_DISABLE2# | 26      | DI                     | GNSS disable<br>Active low | 3.3V tolerant but<br>can be driven by<br>either 1.8V or 3.3V<br>GPIO |

Table 28: W\_DISABLE2# pin status

| W_DISABLE2# pin status | Module operation                                                                     |
|------------------------|--------------------------------------------------------------------------------------|
| Input Low Level        | GNSS function is disabled                                                            |
| Input High Level       | AT+CGPS=0: GNSS function is disabled<br>AT+CGPS=1: GNSS function is enabled(default) |

### 3.17 FORCE DOWNLOAD & GET DEBUG LOG

SIM7912G-M2 reserve test points to facilitate customers to use the forced download function. At the same time, we can also read the debugging log.

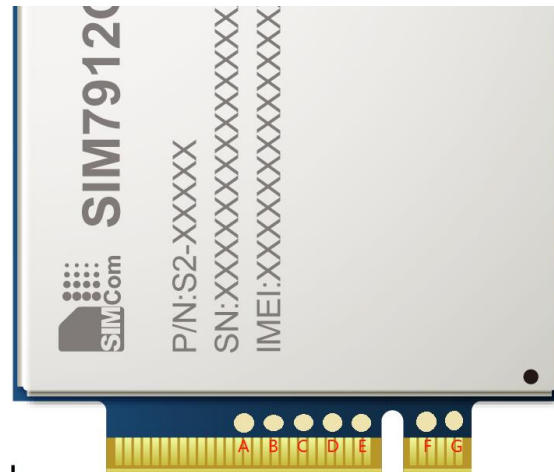


Figure 29: Test point location

Table 29: Test point status

| Test point | Pin name       | Electrical description | Description                                          | Comments                                     |
|------------|----------------|------------------------|------------------------------------------------------|----------------------------------------------|
| A          | RESET#         | DI,PU                  | System reset control input<br>Active low             | RESET# has been pulled up to 1.8V internally |
| B          | VOUT1.8V       | DO,PU                  | pulled up to 1.8V internally                         | 1.8V voltage domain                          |
| C          | FORCE_USB_BOOT | DI                     | Connect to VOUT1.8V enter to force download function |                                              |
| D          | DEBUG_TX       | DO                     | Debug UART TX                                        |                                              |
| E          | DEBUG_RX       | DI                     | Debug UART RX                                        |                                              |
| F          | USB_D-         | DIO                    | Differential USB bi-directional data negative        |                                              |
| G          | USB_D+         | DIO                    | Differential USB bi-directional data positive        |                                              |

### 3.17.1 Forcing USB Boot

During development or factory production, a boot from the USB 2.0 port can be forced by using test point of FORCED\_USB\_BOOT. FORCED\_USB\_BOOT always takes precedence, regardless of the state of the BOOT\_CONFIG GPIOs or FAST\_BOOT\_SEL fuses. We can short circuit test points B and C of the module forces the SDX device to boot from the USB\_HS port.

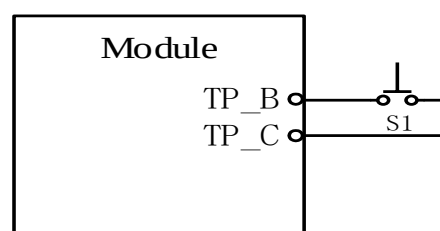


Figure 30: Forcing USB Boot

### 3.17.2 Get UART log

During development we need get UART LOG to analyze problems. We can obtain log on PC through serial port tool. The default band rate is 115200bps.

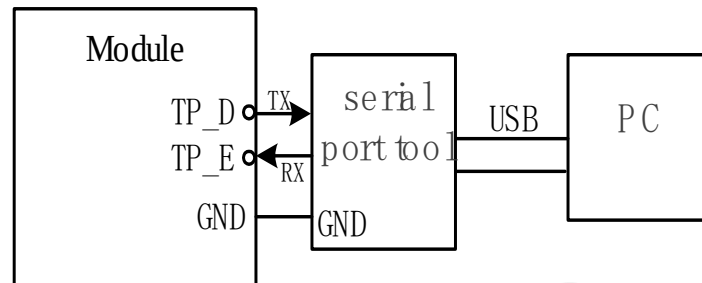


Figure 31: UART LOG

## 4 Antenna Interfaces

SIM7912G-M2 provides two antennas for 3G/4G and GNSS. The antenna ports have an RF impedance of 50Ω.

### 4.1 Antenna Definitions

For detailed designs about antenna, please refer to the antenna design guide [Document \[14\]](#) "SIM7912G-M2 Antenna Port Mapping and Design Guide" in the appendix.

Table 30: Antenna port definitions

| FUNCTIONS        | MAIN | AUX<br>GNSS |
|------------------|------|-------------|
| 3G/4G LB/MHB TRX | ✓    |             |
| 3G/4G LB/MHB DIV |      | ✓           |
| GNSS             |      | ✓           |

#### 4.1.1 WCDMA/LTE Operating Frequency

The following table shows WCDMA/LTE Operating frequencies

Table 31: SIM7912G-M2 WCDMA/LTE Operating frequencies

| Band      | Uplink (UL)        | Downlink (DL)      | Duplex Mode |
|-----------|--------------------|--------------------|-------------|
| WCDMA B1  | 1920 ~1980 MHz     | 2110 ~2170 MHz     | FDD         |
| WCDMA B2  | 1850 ~1910 MHz     | 1930 ~1990 MHz     | FDD         |
| WCDMA B3  | 1710 ~1785 MHz     | 1805 ~1880 MHz     | FDD         |
| WCDMA B4  | 1710 ~1755 MHz     | 2110 ~2155 MHz     | FDD         |
| WCDMA B5  | 824~849 MHz        | 869~894MHz         | FDD         |
| WCDMA B6  | 832.4~837.6 MHz    | 877.4~882.6MHz     | FDD         |
| WCDMA B8  | 880 ~915 MHz       | 925 ~960 MHz       | FDD         |
| WCDMA B9  | 1749.9 ~1784.9 MHz | 1844.9 ~1879.9 MHz | FDD         |
| WCDMA B19 | 830 ~845 MHz       | 875 ~890 MHz       | FDD         |
| LTE B1    | 1920 ~1980 MHz     | 2110 ~2170 MHz     | FDD         |
| LTE B2    | 1850 ~1910 MHz     | 1930 ~1990 MHz     | FDD         |

|                |                  |                  |     |
|----------------|------------------|------------------|-----|
| <b>LTE B3</b>  | 1710 ~1785 MHz   | 1805 ~1880 MHz   | FDD |
| <b>LTE B4</b>  | 1710 ~1755 MHz   | 2110 ~2155 MHz   | FDD |
| <b>LTE B5</b>  | 824~849 MHz      | 869~894MHz       | FDD |
| <b>LTE B7</b>  | 2500~2570MHz     | 2620~2690MHz     | FDD |
| <b>LTE B8</b>  | 880 ~915 MHz     | 925 ~960 MHz     | FDD |
| <b>LTE B12</b> | 699 ~716 MHz     | 729 ~746 MHz     | FDD |
| <b>LTE B13</b> | 777 ~787 MHz     | 746 ~756 MHz     | FDD |
| <b>LTE B14</b> | 788 ~798 MHz     | 758 ~768 MHz     | FDD |
| <b>LTE B17</b> | 704 ~716 MHz     | 734 ~746 MHz     | FDD |
| <b>LTE B18</b> | 815 ~830 MHz     | 860 ~875 MHz     | FDD |
| <b>LTE B19</b> | 830 ~845 MHz     | 875 ~890 MHz     | FDD |
| <b>LTE B20</b> | 832~862MHz       | 791~ 821MHz      | FDD |
| <b>LTE B25</b> | 1850 ~1915 MHz   | 1930 ~1995 MHz   | FDD |
| <b>LTE B26</b> | 814 ~849 MHz     | 859 ~894 MHz     | FDD |
| <b>LTE B28</b> | 703~748 MHz      | 758~803 MHz      | FDD |
| <b>LTE B29</b> | N/A              | 717 ~728 MHz     | FDD |
| <b>LTE B30</b> | 2305 ~2315 MHz   | 2350 ~2360 MHz   | FDD |
| <b>LTE B32</b> | N/A              | 1452~1492MHz     | FDD |
| <b>LTE B38</b> | 2570 ~2620 MHz   | 2570 ~2620 MHz   | TDD |
| <b>LTE B40</b> | 2300 ~2400 MHz   | 2300 ~2400 MHz   | TDD |
| <b>LTE B41</b> | 2555 ~2655 MHz   | 2555 ~2655 MHz   | TDD |
| <b>LTE B42</b> | 3400 ~3599.9 MHz | 3400 ~3599.9 MHz | TDD |
| <b>LTE B43</b> | 3600 ~3799.9 MHz | 3600 ~3799.9 MHz | TDD |
| <b>LTE B46</b> | 5150 ~5925 MHz   | 5150 ~5925 MHz   | LAA |
| <b>LTE B48</b> | 3550 ~3700 MHz   | 3550 ~3700 MHz   | TDD |
| <b>LTE B66</b> | 1710 ~1780 MHz   | 2110 ~2200 MHz   | FDD |

**NOTE**

LTE-FDD B29 & B32 & B46 supports Rx only and are only for secondary component carrier.

### 4.1.2 GNSS Frequency

The following table shows frequency specification of GNSS antenna interface.

**Table 32: GNSS frequency**

| Type                | Frequency         |
|---------------------|-------------------|
| GPS L1/Galileo/QZSS | 1575.42±1.023MHz  |
| GPS L5              | 1176.45±10.23MHz  |
| GLONASS             | 1597.5~1605.8MHz  |
| BeiDou/Compass      | 1561.098±2.046MHz |

## 4.2 Antenna Installation

### 4.2.1 Antenna Requirements

The following table shows the requirements on 3G/4G and GNSS antennas.

Recommended Antenna Characteristics

Table 33: WCDMA/LTE antenna

| Item                               | Requirements     |
|------------------------------------|------------------|
| Direction                          | Omni directional |
| Gain                               | > -3dBi (Avg)    |
| Impedance                          | 50 $\Omega$      |
| Efficiency                         | > 50 %           |
| VSWR                               | < 2              |
| Cable insertion Loss <1GHz         | <1dB             |
| Cable insertion Loss 1GHz~2.2GHz   | <1.5dB           |
| Cable insertion Loss 2.3GHz~2.7GHz | <2dB             |

#### 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.

### 4.2.2 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 SIM7912G-M2. The dimension of the connector on SIM7912G-M2 is 2.0\*2.0\*0.6mm, which is from I-PEX, and the Part Number is 20449-001E-03.

Shows the RF connector dimension in the following figure:

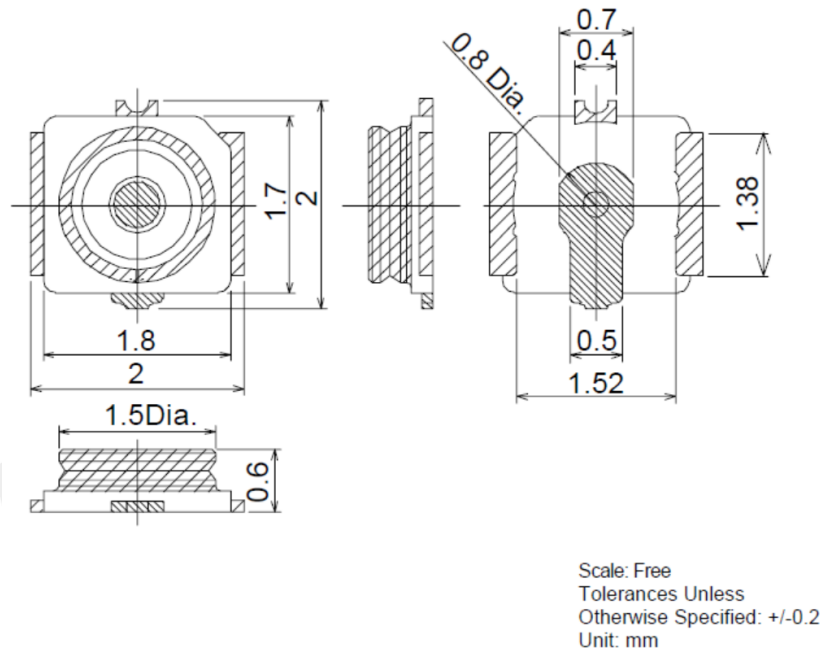


Figure 32: RF connector

The major specifications of the RF connector as below:

Table 34: the major specifications of the RF connector

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

There are two kinds of coaxial cables mating the RF connector in the SIM7912G-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 35: 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 | -    | VBAT | V    |

### 5.2 Operating conditions

Table 36: Recommended operating ratings

| Parameter       | Min.  | Typ. | Max. | Unit |
|-----------------|-------|------|------|------|
| Voltage at VBAT | 3.135 | 3.3  | 4.4  | V    |

Table 37: 1.8V Digital I/O characteristics\*

| Parameter       | Description               | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|------|------|------|------|
| V <sub>IH</sub> | High-level input voltage  | 1.17 | 1.8  | 2.1  | V    |
| V <sub>IL</sub> | Low-level input voltage   | -0.3 | 0    | 0.63 | V    |
| V <sub>OH</sub> | High-level output voltage | 1.35 | -    | 1.8  | V    |
| V <sub>OL</sub> | 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 pull down resistor) | -  | -  | 1 | uA |
| $I_{IL}$ | 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 38: 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 39: 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 RF Output Power/Current Consumption

The current consumption is listed in the table below.

Table 40: SIM7912G-M2 Current consumption on VBAT Pins (VBAT=3.3V)

| UMTS sleep/idle mode                                         |                   |                 |                 |
|--------------------------------------------------------------|-------------------|-----------------|-----------------|
| WCDMA supply current<br>(GNSS off, without USB connection)   | Sleep mode @DRX=9 | Typical:TBD mA  |                 |
|                                                              | Idle mode @DRX=9  | Typical: TBD mA |                 |
| LTE sleep/idle mode                                          |                   |                 |                 |
| LTE FDD supply current<br>(GNSS off, without USB connection) | Sleep mode        | Typical:TBD mA  |                 |
|                                                              | Idle mode         | Typical: TBD mA |                 |
| LTE TDD supply current<br>(GNSS off, without USB connection) | Sleep mode        | Typical: TBD mA |                 |
|                                                              | Idle mode         | Typical: TBD mA |                 |
| HSDPA data                                                   |                   |                 |                 |
| WCDMA B1                                                     | @Power            | 23.54 dBm       | Typical: 683 mA |
| WCDMA B2                                                     | @Power            | 23.49dBm        | Typical: 616 mA |
| WCDMA B3                                                     | @Power            | 23.25 dBm       | Typical: 693 mA |
| WCDMA B4                                                     | @Power            | 24.2 dBm        | Typical: 595 mA |
| WCDMA B5                                                     | @Power            | 23.45 dBm       | Typical: 637 mA |
| WCDMA B6                                                     | @Power            | 23.48 dBm       | Typical: 642 mA |
| WCDMA B8                                                     | @Power            | 23.86 dBm       | Typical: 659 mA |
| WCDMA B9                                                     | @Power            | 23.37 dBm       | Typical: 733 mA |
| WCDMA B19                                                    | @Power            | 23.53 dBm       | Typical: 636 mA |
| LTE data                                                     |                   |                 |                 |
| LTE-FDD B1                                                   | @5MHz             | 22.87 dBm       | Typical: 700 mA |
|                                                              | @10MHz            | 22.85 dBm       | Typical: 715 mA |
|                                                              | @20MHz            | 22.96 dBm       | Typical: 729 mA |
| LTE-FDD B2                                                   | @1.4MHz           | 23.04 dBm       | Typical: TBD mA |
|                                                              | @5MHz             | 23.07 dBm       | Typical: 627 mA |
|                                                              | @10MHz            | 23.03 dBm       | Typical:643 mA  |
| LTE-FDD B3                                                   | @20MHz            | 23.06 dBm       | Typical: 685 mA |
|                                                              | @1.4MHz           | 22.98 dBm       | Typical: 691 mA |
|                                                              | @5MHz             | 23.04 dBm       | Typical: 710 mA |
| LTE-FDD B4                                                   | @10MHz            | 23.03 dBm       | Typical: 723 mA |
|                                                              | @20MHz            | 23.06 dBm       | Typical: 754 mA |
|                                                              | @1.4MHz           | 22.97 dBm       | Typical: 658 mA |
| LTE-FDD B5                                                   | @5MHz             | 23.18 dBm       | Typical: 662 mA |
|                                                              | @10MHz            | 23.03 dBm       | Typical: 665 mA |
|                                                              | @20MHz            | 23.09dBm        | Typical: 676 mA |
| LTE-FDD B5                                                   | @1.4MHz           | 23.84 dBm       | Typical: 703 mA |
|                                                              | @5MHz             | 23.88 dBm       | Typical: 720 mA |
|                                                              | @10MHz            | 23.87 dBm       | Typical: 752 mA |

|                    |         |           |                  |
|--------------------|---------|-----------|------------------|
| <b>LTE-FDD B7</b>  | @5MHz   | 22.43 dBm | Typical: 642 mA  |
|                    | @10MHz  | 22.59 dBm | Typical: 662 mA  |
|                    | @20MHz  | 22.67 dBm | Typical: 731 mA  |
| <b>LTE-FDD B8</b>  | @1.4MHz | 24.04 dBm | Typical: 715 mA  |
|                    | @5MHz   | 24.07 dBm | Typical: 761 mA  |
|                    | @10MHz  | 24.16 dBm | Typical: 808 mA  |
| <b>LTE-FDD B12</b> | @1.4MHz | 23.89 dBm | Typical: 746 mA  |
|                    | @5MHz   | 24.03 dBm | Typical: 701 mA  |
|                    | @10MHz  | 23.97 dBm | Typical: 655 mA  |
| <b>LTE-FDD B13</b> | @5MHz   | 24.09 dBm | Typical: 827 mA  |
|                    | @10MHz  | 24.06 dBm | Typical: 772 mA  |
| <b>LTE-FDD B14</b> | @5MHz   | 24.01 dBm | Typical: 795 mA  |
|                    | @10MHz  | 23.97 dBm | Typical: 803 mA  |
| <b>LTE-FDD B17</b> | @5MHz   | 23.99 dBm | Typical: 766 mA  |
|                    | @10MHz  | 24.02 dBm | Typical: 730 mA  |
| <b>LTE-FDD B18</b> | @5MHz   | 24.07 dBm | Typical: 729 mA  |
|                    | @10MHz  | 24.03 dBm | Typical: 740 mA  |
|                    | @15MHz  | 24.06 dBm | Typical: 777 mA  |
| <b>LTE-FDD B19</b> | @5MHz   | 24.13 dBm | Typical: 706 mA  |
|                    | @10MHz  | 24.06 dBm | Typical: 736 mA  |
|                    | @15MHz  | 24.01 dBm | Typical: 793 mA  |
| <b>LTE-FDD B20</b> | @5MHz   | 23.98 dBm | Typical: 730 mA  |
|                    | @10MHz  | 23.98 dBm | Typical: 688 mA  |
|                    | @20MHz  | 23.97 dBm | Typical: 671 mA  |
| <b>LTE-FDD B25</b> | @1.4MHz | 23.01 dBm | Typical: 637 mA  |
|                    | @5MHz   | 22.91 dBm | Typical: 632 mA  |
|                    | @10MHz  | 23.03 dBm | Typical: 636 mA  |
|                    | @20MHz  | 22.93dBm  | Typical: 684 mA  |
| <b>LTE-FDD B26</b> | @1.4MHz | 24.15 dBm | Typical: 762 mA  |
|                    | @5MHz   | 24.18 dBm | Typical: 787 mA  |
|                    | @10MHz  | 24.10 dBm | Typical: 794 mA  |
|                    | @15MHz  | 24.07 dBm | Typical: 790 mA  |
| <b>LTE-FDD B28</b> | @3MHz   | 24.05 dBm | Typical: 756 mA  |
|                    | @5MHz   | 23.98 dBm | Typical: 752 mA  |
|                    | @10MHz  | 24.01 dBm | Typical: 790 mA  |
|                    | @20MHz  | 23.92 dBm | Typical: 886 mA  |
| <b>LTE-FDD B30</b> | @5MHz   | 22.56 dBm | Typical: 778 mA  |
|                    | @10MHz  | 22.45 dBm | Typical: 810 mA  |
| <b>LTE-FDD B66</b> | @1.4MHz | 22.96 dBm | Typical: 585 mA  |
|                    | @5MHz   | 22.98 dBm | Typical: 586 mA  |
|                    | @10MHz  | 23.03 dBm | Typical: 608 mA  |
|                    | @20MHz  | 23.1 dBm  | Typical: 647 mA  |
| <b>LTE-TDD B38</b> | @5MHz   | 23.16 dBm | Typical :355 mA  |
|                    | @10MHz  | 23.11 dBm | Typical :362 mA  |
|                    | @20MHz  | 23.14 dBm | Typical :387 mA  |
| <b>LTE-TDD B40</b> | @5MHz   | 23.09 dBm | Typical : 300 mA |
|                    | @10MHz  | 23.14 dBm | Typical : 312 mA |
|                    | @20MHz  | 23.10 dBm | Typical : 344 mA |
| <b>LTE-TDD B41</b> | @5MHz   | 22.97 dBm | Typical : 383 mA |
|                    | @10MHz  | 23.02 dBm | Typical : 414 mA |
|                    | @20MHz  | 23.08 dBm | Typical : 416 mA |
| <b>LTE-TDD B42</b> | @5MHz   | 22.49 dBm | Typical : 363 mA |
|                    | @10MHz  | 22.41 dBm | Typical : 365 mA |
|                    | @20MHz  | 22.37 dBm | Typical : 382 mA |
| <b>LTE-TDD B43</b> | @5MHz   | 21.85 dBm | Typical :392 mA  |
|                    | @10MHz  | 21.81 dBm | Typical : 395 mA |
|                    | @20MHz  | 21.92 dBm | Typical : 413 mA |
| <b>LTE-TDD B48</b> | @5MHz   | 23.23 dBm | Typical : 395 mA |

|        |           |                  |
|--------|-----------|------------------|
| @10MHz | 23.26 dBm | Typical : 398 mA |
| @20MHz | 23.13 dBm | Typical : 410 mA |

## 5.5 Conducted Receive Sensitivity

The following tables show conducted RF receiving sensitivity of SIM7912G-M2 module.

Table 41: SIM7912G-M2 Conducted RF Receiving Sensitivity

| Frequency        | SIM7906G-M2            |                             |
|------------------|------------------------|-----------------------------|
|                  | 3GPP Requirement (dBm) | Rx Sensitivity Typical(dBm) |
| WCDMA B1         | -106.7                 | -112.1                      |
| WCDMA B2         | -104.7                 | -113.5                      |
| WCDMA B3         | -103.7                 | -112.5                      |
| WCDMA B4         | -106.7                 | -111.7                      |
| WCDMA B5         | -104.7                 | -113.5                      |
| WCDMA B6         | -106.7                 | -113.5                      |
| WCDMA B8         | -103.7                 | -113.6                      |
| WCDMA B9         | -105.7                 | -113                        |
| WCDMA B19        | -106.7                 | -113.5                      |
| LTE-FDD B1(10M)  | -96.3                  | -99.2                       |
| LTE-FDD B2(10M)  | -94.3                  | -100.5                      |
| LTE-FDD B3(10M)  | -93.3                  | -100.3                      |
| LTE-FDD B4(10M)  | -96.3                  | -99.3                       |
| LTE-FDD B5(10M)  | -94.3                  | -101.2                      |
| LTE-FDD B7(10M)  | -94.3                  | -100.6                      |
| LTE-FDD B8(10M)  | -93.3                  | -100.8                      |
| LTE-FDD B12(10M) | -93.3                  | -100.7                      |
| LTE-FDD B13(10M) | -93.3                  | -100.3                      |
| LTE-FDD B14(10M) | -93.3                  | -96.5                       |
| LTE-FDD B17(10M) | -93.3                  | -100.6                      |
| LTE-FDD B18(10M) | -96.3                  | -101.2                      |
| LTE-FDD B19(10M) | -96.3                  | -101.1                      |
| LTE-FDD B20(10M) | -93.3                  | -100.8                      |

|                     |       |        |
|---------------------|-------|--------|
| LTE-FDD<br>B25(10M) | -92.8 | -100.3 |
| LTE-FDD<br>B26(10M) | -93.8 | -101.3 |
| LTE-FDD<br>B28(10M) | -94.8 | -100.7 |
| LTE-FDD<br>B30(10M) | -93.3 | -99.8  |
| LTE-FDD<br>B66(10M) | -95.8 | -99.8  |
| LTE-TDD<br>B38(10M) | -96.3 | -101.5 |
| LTE-TDD<br>B40(10M) | -96.3 | -101.3 |
| LTE-TDD<br>B41(10M) | -94.3 | -101.1 |
| LTE-TDD<br>B42(10M) | -95   | -101.8 |
| LTE-TDD<br>B43(10M) | -95   | -101.4 |
| LTE-TDD<br>B48(10M) | -95   | -101.5 |

#### NOTE

The data in above table are gotten at static condition.

SIMO is a smart antenna technology that uses a single antenna at the transmitter side and multiple (two for SIM7912G-M2) antennas at the receiver side, which can improve Rx performance.

Per 3GPP specification.

## 5.6 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 42: The ESD performance measurement table (Temperature: 25°C, Humidity: 45%)**

| Part                 | Contact discharge | Air discharge |
|----------------------|-------------------|---------------|
| VBAT,GND             | +/-5K             | +/-10K        |
| Antenna port         | +/-5K             | +/-10K        |
| Full_Card_Power_Off# | +/-2K             | +/-4K         |
| USB                  | +/-1K             | +/-2K         |
| RESET_N              | +/-1K             | +/-2K         |
| USIM Card            | +/-1K             | +/-2K         |
| Other PADS           | +/-1K             | +/-2K         |

## 6 Connect SIM7912G-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.

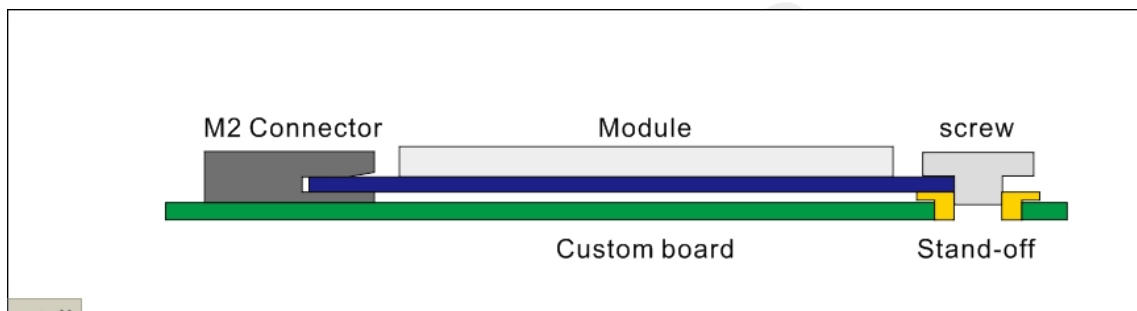


Figure 33: Equipment diagram

## 7 Thermal Design

Customer should pay attentions to the thermal design of SIM7912G-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 mm<sup>2</sup>. For better thermal performance, customer could use a heat sink device to conduct the heat to the air.

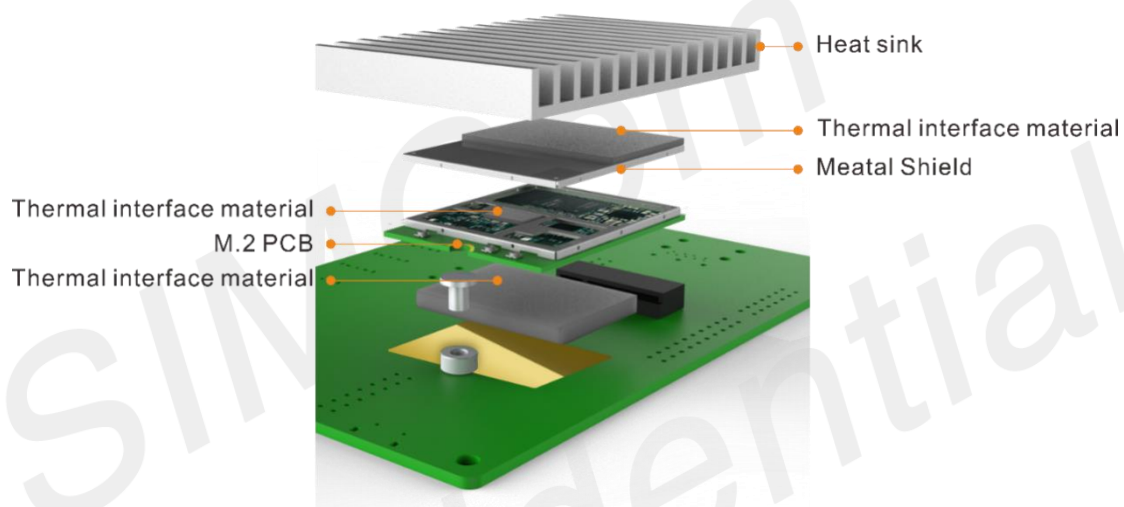


Figure 34: Thermal design diagram

Table 43: 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 <sup>11</sup> | 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.

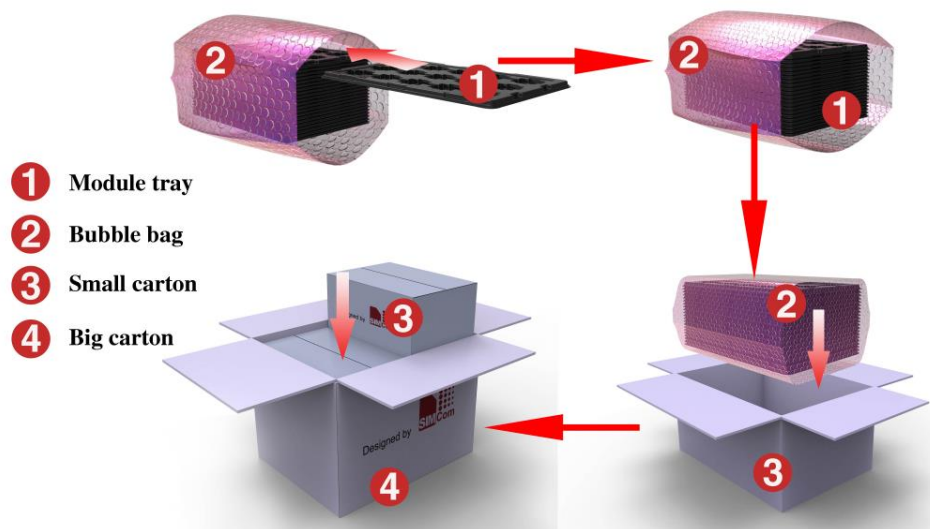


Figure 35: packaging diagram

Module tray drawing:

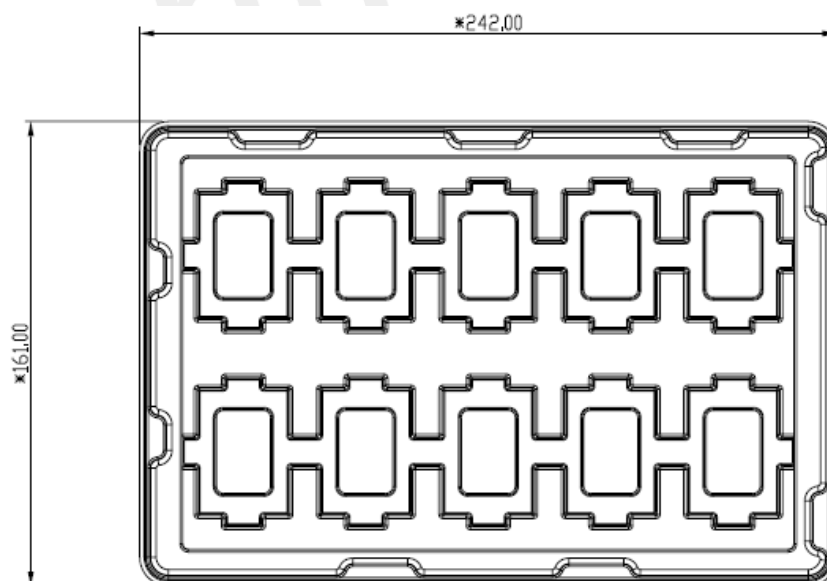


Figure 36: Tray drawing

Table 44: Tray size

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

Small carton drawing:

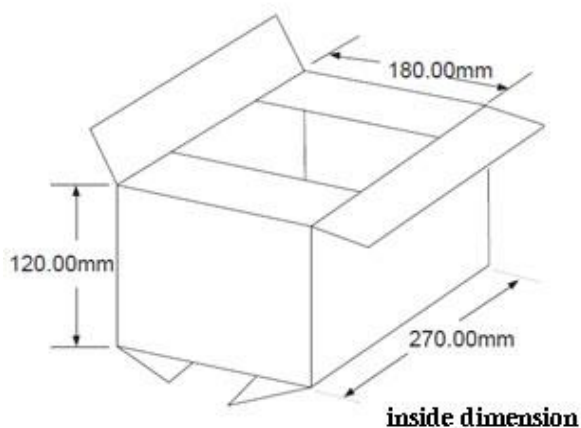


Figure 37: Small carton drawing

Table 45: 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:

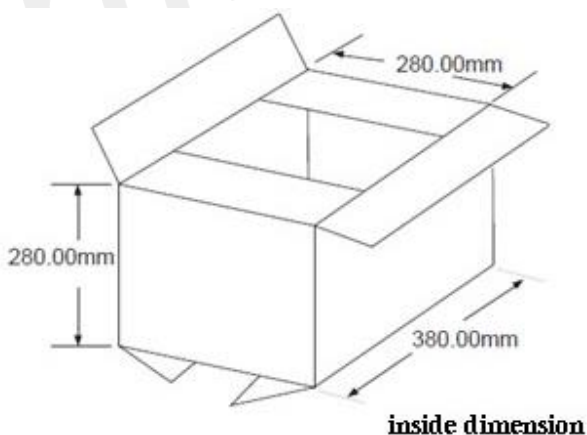


Figure 38: Big carton drawing

Table 46: Big Carton size

| Length (±10mm) | Width (±10mm) | Height (±10mm) | Number    |
|----------------|---------------|----------------|-----------|
| 380            | 280           | 280            | 200*4=800 |

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## 9 Appendix

### 9.1 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 47: 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                    |
| <b>LTE-FDD device category (Downlink)</b> | <b>Max data rate (peak)</b> | <b>Modulation type</b>  |
| 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        |
| Category 12                               | 600Mbps                     | QPSK/16QAM/64QAM/256QAM |
| <b>LTE-FDD device category (Uplink)</b>   | <b>Max data rate (peak)</b> | <b>Modulation type</b>  |
| 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              |
| Category 12                               | 100 Mbps                    | QPSK/16QAM/64QAM        |

## 9.2 Related Documents

Table 48: Related Documents

| NO. | Title                                      | Description                                                                                                                                                                                                |
|-----|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1] | SIM7912G-M2 Series_AT Command Manual_V1.xx | AT Command Manual                                                                                                                                                                                          |
| [2] | ITU-T Draft new recommendation V.25ter     | 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]  | <b>GSM 11.11</b>                                                   | Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface                                                                                                                                                            |
| [8]  | <b>GSM 03.38</b>                                                   | Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information                                                                                                                                                                                                        |
| [9]  | <b>GSM 11.10</b>                                                   | Digital cellular telecommunications system (Phase 2) ; Mobile Station (MS) conformance specification ; Part 1: Conformance specification                                                                                                                                                                  |
| [10] | <b>3GPP TS 51.010-1</b>                                            | Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification                                                                                                                                                                                                     |
| [11] | <b>3GPP TS 34.124</b>                                              | Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.                                                                                                                                                                                                                         |
| [12] | <b>3GPP TS 34.121</b>                                              | Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.                                                                                                                                                                                                                         |
| [13] | <b>3GPP TS 34.123-1</b>                                            | Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)                                                                                                                                                                            |
| [14] | <b>3GPP TS 34.123-3</b>                                            | User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.                                                                                                                                                                                                                              |
| [15] | <b>EN 301 908-02 V2.2.1</b>                                        | 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] | <b>EN 301 489-24 V1.2.1</b>                                        | 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] | <b>IEC/EN60950-1(2001)</b>                                         | Safety of information technology equipment (2000)                                                                                                                                                                                                                                                         |
| [18] | <b>3GPP TS 51.010-1</b>                                            | Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification                                                                                                                                                                                                     |
| [19] | <b>GCF-CC V3.23.1</b>                                              | Global Certification Forum - Certification Criteria                                                                                                                                                                                                                                                       |
| [20] | <b>2002/95/EC</b>                                                  | 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] | <b>SIM7X00<br/>Series_UART_Application<br/>Note_V1.xx</b>          | This document describes how to use UART interface of SIMCom modules.                                                                                                                                                                                                                                      |
| [22] | <b>SIM7X00<br/>Series_GPS_Application<br/>Note_V1.xx</b>           | GPS Application Note                                                                                                                                                                                                                                                                                      |
| [23] | <b>Antenna design guidelines<br/>for diversity receiver system</b> | Antenna design guidelines for diversity receiver system                                                                                                                                                                                                                                                   |

## 9.3 Terms and Abbreviations

Table 49: 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                                        |

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

## 9.4 Safety Caution

Table 50: Safety Caution

| Marks                                                                               | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|    | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|   | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|  | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|  | 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>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> |

#### Declaration of conformity

Herby, SIMCom Wireless Solutions Limited declares that this MODULE, SIM7912G-M2 is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.



Use the MODULE in the environment with the temperature between -30°C and 70°C.

The device complies with RF specifications when the device used at 5mm from your body.

#### FCC MODULAR APPROVAL INFORMATION EXAMPLES for Manual

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.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

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

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

#### FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

**OEM INTEGRATION INSTRUCTIONS:**

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

The module must be installed in the host equipment such that 20 cm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 conditions above are met, further transmitter test will not be required.

However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

**Validity of using the module certification:**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

**Upgrade Firmware:**

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

**End product labeling:**

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: 2AJYU-8XM0003".

**Information that must be placed in the end user manual:**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

"CAUTION: Exposure to Radio Frequency Radiation.

Antenna shall be mounted in such a manner to minimize the potential for human contact during normal operation. The antenna should not be contacted during operation to avoid the possibility of exceeding the FCC radio frequency exposure limit.

**Requirement per KDB996369 D03****2.2 List of applicable FCC rules**

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.<sup>3</sup>

Explanation: This module meets the requirements of FCC part 22, part 24, part 27, part90,part 96.

**2.3 Summarize the specific operational use conditions**

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The EUT has a Rubber Duck Antenna, and the antenna use a permanently attached antenna which is not replaceable.

**2.4 Limited module procedures**

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval. This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

## 2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s),

dielectric constant, and impedance as applicable for each type of antenna);

b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);

c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;

d) Appropriate parts by manufacturer and specifications;

e) Test procedures for design verification; and

f) Production test procedures for ensuring compliance.

The module grantee shall provide a notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify the module grantee that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout of trace design, antenna, connectors, and isolation requirements.

## 2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: 2AJYU-8XM0003.

## 2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

**Explanation:** The EUT has a Rubber Duck Antenna, and the antenna use a permanently attached antenna which is not replaceable.

## 2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

**Explanation:** The host system using this module, should have label in a visible area indicated the following texts: “Contains FCC ID: 2AJYU-8XM0003”

## 2.9 Information on test modes and additional testing requirements<sup>5</sup>

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

**Explanation:** Top band can increase the utility of our modular transmitters by providing instructions that simulates or characterizes a connection by enabling a transmitter.

## 2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

**Explanation:** The module without unintentional-radiator digital circuitry, so the module does not

require an evaluation by FCC Part 15 Subpart B. The host should be evaluated by the FCC Subpart B.

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