

# MeiG Product Manual of SLM750

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## Revising History

Table 1: Revising records

| REVISION | DATE       | DESCRIPTION                             |
|----------|------------|-----------------------------------------|
| V1.0     | 2018-04-01 | Initial                                 |
| V1.1     | 2018-12-14 | Modify power consumption, RF, packaging |

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# 1 Introduction

This document defines SLM750 modules and describes its air interface and hardware interface which are connected with your application.

The document can help you quickly understand SLM750 interface specifications, electrical and mechanical details and other related product information. Associated with application notes and user guide, you can apply SLM750 in wireless applications easily.

SLM750 wireless module is a broadband wireless vehicle-mounted product used for various network standards like TD-LTE/FDD LTE/WCDMA/TD-SCDMA/EVDO/CDMA/GSM.

Supported access rate of SLM750:

- TD-LTE: 130Mbps/35Mbps
- FDD LTE: 150Mbps/50Mbps
- WCDMA reaches DC HSPA+: 42Mbps/5.76Mbps
- EVDO reaches EVDO RevA: 3.1Mbps/1.8Mbps
- TD-SCDMA reaches HSPA: 4.2Mbps/2.2Mbps
- CDMA1x: 153.6kbps/153.6kbps
- GSM reaches EDGE: 236.8kbps/236.8kbps

SLM750 provides high-speed broadband data access. In addition, it provides voice, SMS, address book, GPS/Beidou and other functions, which can be used in mobile broadband access, video surveillance, security, vehicle equipment and other products.

## 1.1 Safety Information

Observing the following safety information can keep you safe and protect the product and its working environment from potential damage.



Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Stop the car before you make a call.



Switch off the mobile terminal devices before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden, so as to prevent interference with communication systems. Ignore the note will threaten flight safety or even break the law.



Pay attention to restrictions on the use of mobile terminal device in hospitals or health care facilities. RF interference can cause medical equipment to run out of order, so it is necessary to turn off the mobile terminal devices.



Mobile terminal device cannot be guaranteed to connect in all conditions, for example no mobile fee or with an invalid SIM card. While you are in this condition and need emergent help, remember to use emergency call. The mobile terminal device must be switched on and in a service area with adequate signal strength in order to make or receive a call.



Your mobile terminal device receives and transmits radio frequency signal when it is on. RF interference can occur if it is use to close to TV set, radio, computer or other electronic equipment.



Please keep the mobile device away from areas with potentially explosive atmospheres. When you are near a gas station, oil depot, chemical plant or an explosion site, please turn off your mobile terminal. There is a potential safety hazard to operate electronic equipment at any potential explosion hazardous locations.

## 1.2 Purpose

This document describes basic functions and main features of SLM750 wireless module, as well as hardware interface and its application, features of structure and electronics, and power index, in order to guide you to embed SLM750 in various application terminals.

## 1.3 Content list

The document includes:

- Chapter 1 introduces safety information, purpose of the document and revised records;
- Chapter 2 describes basic functions and main features of SLM750 wireless module;
- Chapter 3 describes functions, features, and applications of each hardware interface of SLM750;
- Chapter 4 describes related features of GNSS;
- Chapter 5 introduces related information and notes of antenna interface;
- Chapter 6 describes electronic features of SLM750;
- Chapter 7 describes structure features and notes of SLM750;
- Chapter 8 describes storage and production notes of SLM750;
- Chapter 9 Appendix A: Reference documents and abbreviations;
- Chapter 10 Appendix B: GPRS encoding scheme

## 2 Product Overview

### 2.1 Basic Description

SLM750 is a wireless communication module of TD-LTE/FDD LTE/TD-SCDMA/WCDMA/EVDO/CDMA/GSM with diversity receiving function. It supports TD-LTE and FDD LTE, and downwards compatible with DC-HSPA+ of WCDMA, TD-HSPA of TD-SCDMA, network data connection of EVDO RevB, which provides functions of voice, analog voice, SMS, and communication for your applications. The module has 3 sub-modes: SLM750VC, SLM750VE, SLM750VA. The following table shows the supported bands of the module.

Table 2: Supported band of SLM750

| Network  | SLM750VC        | SLM750VE           | SLM750VA                     |
|----------|-----------------|--------------------|------------------------------|
| TD-LTE   | B38/B39/B40/B41 | B40                | B41                          |
| FDD LTE  | B1/B3/B5/B8     | B1/B3/B5/B7/B8/B20 | B2/B4/B5/B12/B13/B17/B25/B26 |
| WCDMA    | B1/B8           | B1/B5/B8           | B2/B4/B5                     |
| TD-SCDMA | B34/B39         | Not supported      | Not supported                |
| EVDO     | Not supported   | Not supported      | Not supported                |
| CDMA     | BC0             | Not supported      | BC0/BC1                      |
| GSM      | 900/1800        | 900/1800           | 850/1800                     |
| GPS L1   | Supported       | Supported          | Supported                    |

Using advanced highly integrated design, SLM750 integrates RF and baseband on a piece of PCB which has functions of wireless reception and transmission, baseband signal processing and audio signal processing. It uses double side layout and the size is: 32.0×29.0×2.4mm. The module can meet most M2M application requirements like mobile broadband access, video surveillance, handheld terminals, on-board equipment, ultra-books and other products. In addition, SLM750 is compatible with Qualcomm MDM9628 main chip, which can be used in vehicle-mounted application.

### 2.2 Main performance

The following table describes the performance of the SLM750 in detail.

Table 3: List of main features of the module

| Parameter         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power supply      | <ul style="list-style-type: none"> <li>VBAT supply voltage range: 3.3V~4.2V</li> <li>Typical supply voltage: 3.8V</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Transmit power    | <ul style="list-style-type: none"> <li>Class 4 (33dBm±2dB) for GSM850</li> <li>Class 4 (33dBm±2dB) for GSM900</li> <li>Class 1 (30dBm±2dB) for DCS1800</li> <li>Class 1 (30dBm±2dB) for PCS1900</li> <li>Class E2 (27dBm±3dB) for GSM850 8-PSK</li> <li>Class E2 (27dBm±3dB) for GSM900 8-PSK</li> <li>Class E2 (26dBm±3dB) for DCS1800 8-PSK</li> <li>Class E2 (26dBm±3dB) for PCS1900 8-PSK</li> <li>Class 3 (24dBm±1dB) for CDMA BC0</li> <li>Class 3 (23dBm±2dB) for WCDMA bands</li> <li>Class 3 (23dBm±2dB) for TD-SCDMA bands</li> <li>Class 3 (23dBm±2dB) for LTE FDD bands</li> <li>Class 3 (23dBm±2dB) for TD-LTE bands</li> </ul> |
| LTE features      | <ul style="list-style-type: none"> <li>Maximum support non-CA CAT4</li> <li>Support 1.4 ~ 20MHz RF bandwidth</li> <li>Downlink supports multi-user MIMO</li> <li>FDD: maximum uplink rate 50Mbps,maximum downlink rate 150Mbps</li> <li>TDD: maximum uplink rate 35Mbps,maximum downlink rate 130Mbps</li> </ul>                                                                                                                                                                                                                                                                                                                             |
| WCDMA features    | <ul style="list-style-type: none"> <li>Support 3GPP R8 DC-HSPA+</li> <li>Support 16-QAM,64-QAM and QPSK modulation</li> <li>3GPP R6 CAT6 HSUPA: maximum uplink rate 5.76Mbps</li> <li>3GPP R8 CAT24 DC-HSPA+: maximum uplink rate 42Mbps</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                          |
| TD-SCDMA features | <ul style="list-style-type: none"> <li>Support CCSA Release3</li> <li>Maximum uplink rate 2.2Mbps,maximum downlink rate 4.2Mbps</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| CDMA features     | <ul style="list-style-type: none"> <li>Support CDMA 1X Advanced,1XEV-DORev0/-DORevA</li> <li>maximum uplink rate 1.8Mbps,maximum downlink rate 3.1Mbps</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| GSM features      | <p>R99:</p> <ul style="list-style-type: none"> <li>CSD transmission rate: 9.6kbps,14.4kbps</li> </ul> <p>GPRS:</p> <ul style="list-style-type: none"> <li>Support GPRS multi-slot class 12(default 12)</li> <li>Coding format: CS-1/CS-2/CS-3 and CS-4</li> <li>Maximum 4 RX slots per frame</li> </ul> <p>EDGE:</p>                                                                                                                                                                                                                                                                                                                         |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | <ul style="list-style-type: none"> <li>● Support EDGE multi-slot class 12(default 12)</li> <li>● Support GMSK and 8-PSK</li> <li>● Downlink coding format: CS 1-4 and MCS 1-9</li> <li>● Uplink coding format: CS 1-4 and MCS 1-9</li> </ul>                                                                                                                                                             |
| Network protocol features  | <ul style="list-style-type: none"> <li>● Support TCP/UDP/PPP/FTP/HTTP/SMTP/MMS/NTP/PING/QMI protocol</li> <li>● Support PAP(Password Authentication Protocol)and CHAP(Challenge Handshake Authentication Protocol)</li> </ul>                                                                                                                                                                            |
| Short message service      | <ul style="list-style-type: none"> <li>● Text and PDU mode</li> <li>● Point to point MO and MT</li> <li>● Short message cell broadcast</li> <li>● Short message storage: default stored in module</li> </ul>                                                                                                                                                                                             |
| Multimedia message service | <ul style="list-style-type: none"> <li>● AP terminal is required to realize MMS protocol</li> </ul>                                                                                                                                                                                                                                                                                                      |
| USIM card interface        | <ul style="list-style-type: none"> <li>● Support USIM/SIM card: 1.8V and 3V</li> </ul>                                                                                                                                                                                                                                                                                                                   |
| Audio features             | <ul style="list-style-type: none"> <li>● Support 1 channel digital audio interface: PCM interface</li> <li>● GSM: HR/FR/EFR/AMR/AMR-WB</li> <li>● WCDMA: AMR/AMR-WB</li> <li>● LTE: AMR/AMR-WB</li> <li>● Support echo cancellation and noise suppression</li> </ul>                                                                                                                                     |
| PCM interface              | <ul style="list-style-type: none"> <li>● For audio use, need to connect the codec chip</li> <li>● Support 8 bit A-law, u-law and 16 bit Linear coding format</li> <li>● Support long frame mode and short frame mode</li> <li>● Support master mode and slave mode, but in the long frame it can only be used as the master mode</li> </ul>                                                              |
| USB interface              | <ul style="list-style-type: none"> <li>● Compatible USB2.0 features (only support slave mode),maximum data transfer rate reaches 480Mbps</li> <li>● Used for AT command, data transmission, GNSS NMEA output, software debugging and software upgrading</li> <li>● USB drive: support Windows7, Windows8/8.1, Windows10, Linux 2.6 or higher version, Android 2.3/4.0/4.2/4.4/5.0/5.1/6.0/7.0</li> </ul> |
| Serial port                | <p>Main serial port:</p> <ul style="list-style-type: none"> <li>● Used for AT commands and data transfer</li> <li>● Maximum baud rate is 3000000bps,default 115200bps</li> <li>● Support RTS and CTS hardware flow control</li> </ul> <p>Debug serial port:</p> <ul style="list-style-type: none"> <li>● Used for Linux control, log output</li> <li>● Baud rate is 115200bps</li> </ul>                 |
| RX-diversity               | <ul style="list-style-type: none"> <li>● Support LTE/WCDMA/CDMA RX-diversity</li> </ul>                                                                                                                                                                                                                                                                                                                  |
| AT command                 | <ul style="list-style-type: none"> <li>● Confirm to 3GPP TS 27.007, 27.005 and added new MeiG AT commands</li> </ul>                                                                                                                                                                                                                                                                                     |
| Network indication         | <ul style="list-style-type: none"> <li>● The two pins NET_STATUS,NET_MODE indicate the network status</li> </ul>                                                                                                                                                                                                                                                                                         |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Antenna interface      | <ul style="list-style-type: none"> <li>● Include main antenna(ANT_MAIN),RX-D diversity antenna(ANT_DIV) and GNSS antenna(ANT_GNSS)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Physical features      | <ul style="list-style-type: none"> <li>● Size: 32.0×29.0×2.4mm</li> <li>● Weight: &lt;5 g</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Temperature range      | <ul style="list-style-type: none"> <li>● Normal operating temperature: -30℃～+75℃</li> <li>● Limited operating temperature: -40℃～+85℃</li> <li>● Storage temperature: -45℃～+90℃</li> </ul>                                                                                                                                                                                                                                                                                                                                                                              |
| Software upgrade       | <ul style="list-style-type: none"> <li>● USB interface</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| RoHS                   | <ul style="list-style-type: none"> <li>● All hardware components fully comply with the EU RoHS standard</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Ambient humidity       | <ul style="list-style-type: none"> <li>● 5%~95%</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| ESD                    | <ul style="list-style-type: none"> <li>● VBAT,GND: Air discharge ±10KV,Contact discharge ±5KV</li> <li>● Antenna interface: Air discharge ±8KV,Contact discharge ±4KV</li> <li>● Other interface: Air discharge ±1KV,Contact discharge ±0.5KV</li> </ul>                                                                                                                                                                                                                                                                                                               |
| Interface              | <ul style="list-style-type: none"> <li>● 144Pin LCC interface</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| LCC function interface | <ul style="list-style-type: none"> <li>● Power interface</li> <li>● USB2.0 High-Speed interface</li> <li>● UART interface</li> <li>● USIM/SIM card interface (support 3V、1.8V)</li> <li>● PCM interface</li> <li>● Hardware reset interface</li> <li>● Indicator light interface</li> <li>● Sleep control interface</li> <li>● Flight mode control interface</li> <li>● ADC interface</li> <li>● I2C interface</li> <li>● SGMII interface</li> <li>● SD card interface</li> <li>● WLAN interface</li> <li>● BT_UART interface</li> <li>● USB_BOOT interface</li> </ul> |

## 2.3 Functional diagram

The following figure shows a block diagram of SLM750 and illustrates the major functional parts.

- Power management
- Baseband chip
- DDR+NAND storage

- Radio frequency
- Peripheral interface

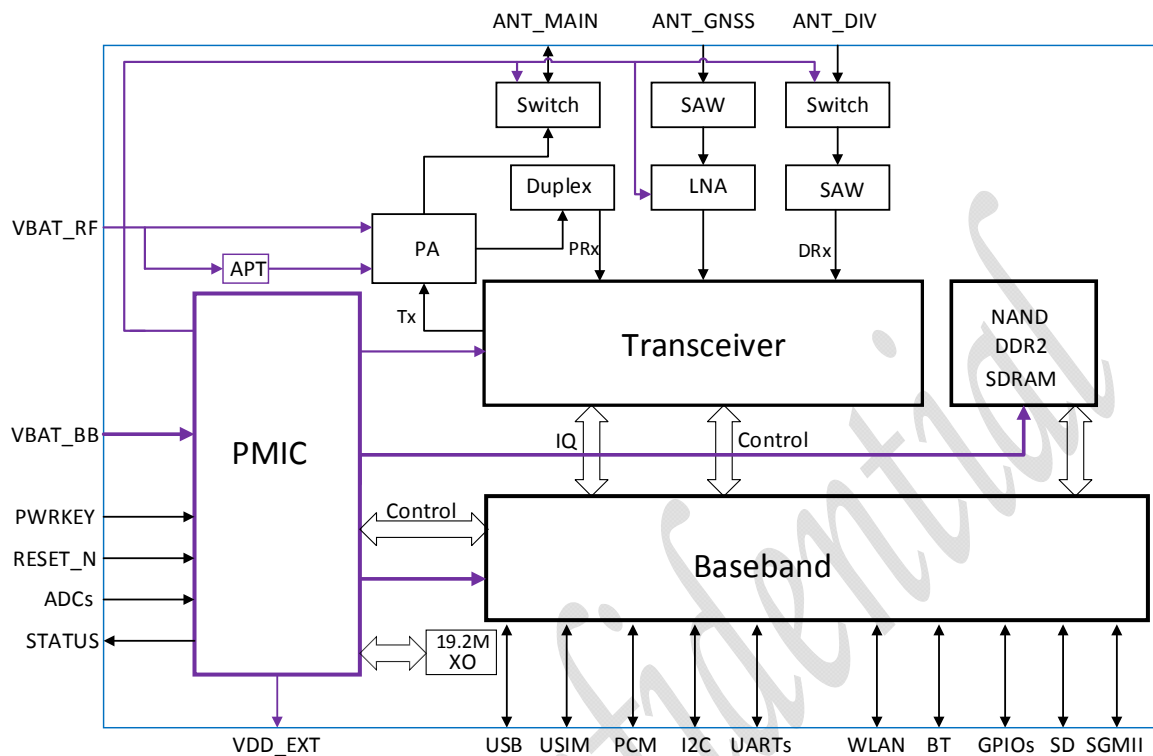


Figure 1 Functional Diagram

## 2.4 Evaluation Board

In order to help you develop applications with SLM750, MeiG supplies an evaluation board, Which contains USB data cable, antenna and other peripherals to control or test the module.

See MeiG\_U\_EVB User Guide for specific usage of evaluation board.

## 3 Application Interface

### 3.1 General Description

SLM750 uses LCC+LGA interface with a total of 144 PIN among which there are 80 LCC pins and 64 LGA pins, providing the following function interface:

- Power interface
- USIM/SIM interface
- USB interface
- UART interface
- PCM interface
- I2C interface
- Hardware reset interface
- Status indication interface
- Sleep control interface
- Flight mode control interface
- ADC interface
- SGMII interface
- SD card interface
- WLAN interface
- BT\_UART interface
- USB\_BOOT interface

## 3.2 LCC Card Interface Definition



## 3.3 Pin Description

The following table shows the SLM750's pin definition.

Table 4: IO Parameters Definition

| Type | Description |
|------|-------------|
|------|-------------|

|    |                |
|----|----------------|
| IO | Input output   |
| DI | Digital input  |
| DO | Digital output |
| PI | Power input    |
| PO | Power output   |
| AI | Analog input   |
| AO | Analog output  |
| OD | Open drain     |

Table 5: Pin description

| Power Supply             |                                       |     |                                  |                                                                                     |                                                                            |
|--------------------------|---------------------------------------|-----|----------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Pin name                 | Pin number                            | I/O | Description                      | DC features                                                                         | Note                                                                       |
| VBAT_BB                  | 59,60                                 | PI  | Power supply for module baseband | V <sub>max</sub> =4.2V<br>V <sub>min</sub> =3.3V<br>V <sub>norm</sub> =3.8V         | It must be able to provide sufficient current up to 1A                     |
| VBAT_RF                  | 57,58                                 | PI  | Power supply for module RF       | V <sub>max</sub> =4.2V<br>V <sub>min</sub> =3.3V<br>V <sub>norm</sub> =3.8V         | It must be able to provide sufficient current up to 2A                     |
| VDD_EXT                  | 7                                     | PO  | 1.8V output                      | V <sub>norm</sub> =1.8V<br>I <sub>o,max</sub> =80mA                                 | Power supply for external GPIO's pull up circuits; If unused, keep it open |
| GND                      | 8,9,19,22,36,46,48,50~54,56,72,85~112 | -   | Ground                           | -                                                                                   | -                                                                          |
| Turn on/off              |                                       |     |                                  |                                                                                     |                                                                            |
| Pin name                 | Pin number                            | I/O | Description                      | DC features                                                                         | Note                                                                       |
| RESET_N                  | 20                                    | DI  | Reset the module                 | V <sub>IH,max</sub> =2.1V<br>V <sub>IH,min</sub> =1.3V<br>V <sub>IL,max</sub> =0.5V | 1.8V power domain; active low level. If unused, keep it open               |
| PWRKEY                   | 21                                    | DI  | Turn on/Standby                  | V <sub>IH,max</sub> =2.1V<br>V <sub>IH,min</sub> =1.3V<br>V <sub>IL,max</sub> =0.5V | Diode voltage drop inside Qualcomm chip results in 0.8V output of the pin  |
| Module status indication |                                       |     |                                  |                                                                                     |                                                                            |
| Pin name                 | Pin number                            | I/O | Description                      | DC features                                                                         | Note                                                                       |

|                            |                   |            |                                                 |                                                                                                                                                                                                                                                                                 |                                                                      |
|----------------------------|-------------------|------------|-------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| STATUS                     | 61                | OD         | Indicate the module operating status            | Driving current should be less than 0.9mA                                                                                                                                                                                                                                       | Require external pull-up. If unused, keep it open                    |
| NET_MODE                   | 5                 | OD         | Indicate the module network registration status | VOHmin=1.35V<br>VOLmax=0.45V                                                                                                                                                                                                                                                    | 1.8V power domain, require external pull-up. If unused, keep it open |
| NET_STATU<br>S             | 6                 | OD         | Indicate the module network running status      | VOHmin=1.35V<br>VOLmax=0.45V                                                                                                                                                                                                                                                    | 1.8V power domain, require external pull-up. If unused, keep it open |
| <b>USB interface</b>       |                   |            |                                                 |                                                                                                                                                                                                                                                                                 |                                                                      |
| <b>Pin name</b>            | <b>Pin number</b> | <b>I/O</b> | <b>Description</b>                              | <b>DC features</b>                                                                                                                                                                                                                                                              | <b>Note</b>                                                          |
| USB_VBUS                   | 71                | PI         | USB detection                                   | Vmax=5.25V<br>Vmin=3.0V<br>Vnorm=5.0V                                                                                                                                                                                                                                           |                                                                      |
| USB_DP                     | 69                | IO         | USB differential data positive signal           | Compliant with USB2.0 standard specification                                                                                                                                                                                                                                    | Require differential impedance of 90Ω                                |
| USB_DM                     | 70                | IO         | USB differential data negative signal           | Compliant with USB2.0 standard specification                                                                                                                                                                                                                                    | Require differential impedance of 90Ω                                |
| <b>USIM card interface</b> |                   |            |                                                 |                                                                                                                                                                                                                                                                                 |                                                                      |
| <b>Pin name</b>            | <b>Pin number</b> | <b>I/O</b> | <b>Description</b>                              | <b>DC features</b>                                                                                                                                                                                                                                                              | <b>Note</b>                                                          |
| USIM_DATA                  | 15                | IO         | USIM card data bus                              | <b>1.8V USIM:</b><br>V <sub>IL</sub> max=0.6V<br>V <sub>IH</sub> min=1.2V<br>V <sub>OL</sub> max=0.45V<br>V <sub>OH</sub> min=1.35V<br><br><b>3.0V USIM:</b><br>V <sub>IL</sub> max=1.0V<br>V <sub>IH</sub> min=1.95V<br>V <sub>OL</sub> max=0.45V<br>V <sub>OH</sub> min=2.55V | -                                                                    |
| USIM_CLK                   | 16                | DO         | USIM card clock line                            | <b>1.8V USIM:</b><br>V <sub>OL</sub> max=0.45V<br>V <sub>OH</sub> min=1.35V<br><br><b>3.0V USIM:</b><br>V <sub>OL</sub> max=0.45V                                                                                                                                               | -                                                                    |

|                         |            |     |                               | $V_{OHmin}=2.55V$                                                                                                                   |                                                                         |
|-------------------------|------------|-----|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| USIM_RST                | 17         | DO  | USIM card reset line          | <b>1.8V USIM:</b><br>$V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$<br><br><b>3.0V USIM:</b><br>$V_{OLmax}=0.45V$<br>$V_{OHmin}=2.55V$      | -                                                                       |
| USIM_PRESENCE           | 13         | DI  | USIM card detection           | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.6V$<br>$V_{IHmin}=1.2V$<br>$V_{IHmax}=2.0V$                                                       | 1.8V power domain, require external pull-up to 1.8V                     |
| USIM_VDD                | 14         | PO  | USIM card supply voltage      | <b>1.8V USIM:</b><br>$V_{max}=1.9V$<br>$V_{min}=1.7V$<br><b>3.0V USIM:</b><br>$V_{max}=3.05V$<br>$V_{min}=2.7V$<br>$I_{o,max}=50mA$ | Either 1.8V or 3.0V USIM card is identified by the module automatically |
| USIM_GND                | 10         |     | USIM card ground              |                                                                                                                                     | Connect with module ground                                              |
| <b>Main serial port</b> |            |     |                               |                                                                                                                                     |                                                                         |
| Pin name                | Pin number | I/O | Description                   | DC features                                                                                                                         | Note                                                                    |
| RI                      | 62         | DO  | Ring indicator                | $V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$                                                                                              | 1.8V power domain.<br>If unused, keep it open.                          |
| DCD                     | 63         | DO  | Carrier detect                | $V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$                                                                                              | 1.8V power domain.<br>If unused, keep it open.                          |
| DTR                     | 66         | DI  | DTE ready, sleep mode control | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.6V$<br>$V_{IHmin}=1.2V$<br>$V_{IHmax}=2.0V$                                                       | 1.8V power domain.<br>If unused, keep it open.                          |
| RXD                     | 68         | DI  | Receive data                  | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.6V$<br>$V_{IHmin}=1.2V$<br>$V_{IHmax}=2.0V$                                                       | 1.8V power domain.<br>If unused, keep it open.                          |
| TXD                     | 67         | DO  | Transmit data                 | $V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$                                                                                              | 1.8V power domain.<br>If unused, keep it open.                          |
| CTS                     | 64         | DI  | Clear to send                 | $V_{OLmax}=0.45V$                                                                                                                   | 1.8V power                                                              |

|                           |            |     |                                              | VOHmin=1.35V                                              | domain.<br>If unused, keep it open.                                           |
|---------------------------|------------|-----|----------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------------|
| RTS                       | 65         | DO  | DTE requires to transmit data                | VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax=2.0V | 1.8V power domain.<br>If unused, keep it open.                                |
| <b>Debug serial port</b>  |            |     |                                              |                                                           |                                                                               |
| Pin name                  | Pin number | I/O | Description                                  | DC features                                               | Note                                                                          |
| DBG_TXD                   | 12         | DO  | Transmit data                                | VOLmax=0.45V<br>VOHmin=1.35V                              | 1.8V power domain.<br>If unused, keep it open.                                |
| DBG_RXD                   | 11         | DI  | Receive data                                 | VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax=2.0V | 1.8V power domain.<br>If unused, keep it open.                                |
| <b>ADC interface</b>      |            |     |                                              |                                                           |                                                                               |
| Pin name                  | Pin number | I/O | Description                                  | DC features                                               | Note                                                                          |
| ADC0                      | 45         | AI  | General purpose analog to digital converter. | Voltage range: 0.05V~1.8V                                 | If unused, keep it open.                                                      |
| ADC1                      | 44         | AI  | General purpose analog to digital converter. | Voltage range: 0.05V~1.8V                                 | If unused, keep it open.                                                      |
| <b>USB_BOOT interface</b> |            |     |                                              |                                                           |                                                                               |
| Pin name                  | Pin number | I/O | Description                                  | DC features                                               | Note                                                                          |
| USB_BOOT                  | 115        | DI  | Forced download mode control                 | VOLmax=0.45<br>VOHmin=1.35V                               | 1.8V power domain. Active high level.<br>Suggested reservation of test point. |
| <b>PCM interface</b>      |            |     |                                              |                                                           |                                                                               |
| Pin name                  | Pin number | I/O | Description                                  | DC features                                               | Note                                                                          |
| PCM_IN                    | 24         | DI  | PCM data input                               | VILmin=-0.3V<br>VILmax=0.6V                               | 1.8V power domain.                                                            |

|              |     |    |                             |                                                                                                                         |                                                                                                                           |
|--------------|-----|----|-----------------------------|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
|              |     |    |                             | $V_{IHmin}=1.2V$<br>$V_{IHmax}=2.0V$                                                                                    | If unused, keep it open.                                                                                                  |
| PCM_OUT      | 25  | DO | PCM data output             | $V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$                                                                                  | 1.8V power domain.<br>If unused, keep it open.                                                                            |
| PCM_CLK      | 27  | IO | PCM clock                   | $V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$<br>$V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.6V$<br>$V_{IHmin}=1.2V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain. In master mode, it is an output signal. In slave mode, it is an input signal. If unused, keep it open. |
| PCM_SYNC     | 26  | IO | PCM data synchronous signal | $V_{OLmax}=0.45V$<br>$V_{OHmin}=1.35V$<br>$V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.6V$<br>$V_{IHmin}=1.2V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain. In master mode, it is an output signal. In slave mode, it is an input signal. If unused, keep it open. |
| CDC_I2S_MCLK | 116 | DO | 19.2MHz signal clock        |                                                                                                                         | Module outputs 19.2MHz clock signal, which is used to provide to the external CODEC, If unused, keep it open.             |

#### I2C interface

| Pin name | Pin number | I/O | Description      | DC features | Note                                                       |
|----------|------------|-----|------------------|-------------|------------------------------------------------------------|
| I2C_SCL  | 41         | OD  | I2C serial clock |             | Require external pull-up to 1.8V. If unused, keep it open. |
| I2C_SDA  | 42         | OD  | I2C serial data  |             | Require external pull-up to 1.8V. If unused, keep it open. |

#### RF Interface

| Pin name | Pin number | I/O | Description       | DC features      | Note                     |
|----------|------------|-----|-------------------|------------------|--------------------------|
| ANT_DIV  | 35         | AI  | Diversity antenna | 50 ohm impedance | If unused, keep it open. |
| ANT_MAIN | 49         | IO  | Main antenna      | 50 ohm           |                          |

|                       |            |     |                                             | impedance                                                                                                     |                                                                                                                                |
|-----------------------|------------|-----|---------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| ANT_GNSS              | 47         | AI  | GNSS antenna                                | 50 ohm impedance                                                                                              | If unused, keep it open.                                                                                                       |
| <b>GPIO Pin</b>       |            |     |                                             |                                                                                                               |                                                                                                                                |
| Pin name              | Pin number | I/O | Description                                 | DC features                                                                                                   | Note                                                                                                                           |
| WAKEUP_IN             | 1          | DI  | Sleep mode input control                    | V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.6V<br>V <sub>IH</sub> min=1.2V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain.<br>High level wakes up the module; in low level the module enters into sleep mode. If unused, keep it open. |
| AP_READY              | 2          | DI  | Application processor sleep state detection | V <sub>OL</sub> max=0.45V<br>V <sub>OH</sub> min=1.35V                                                        | 1.8V power domain.<br>If unused, keep it open.                                                                                 |
| WAKEUP_OUT_N          | 3          | DO  | Sleep mode output                           | V <sub>OL</sub> max=0.45V<br>V <sub>OH</sub> min=1.35V                                                        | 1.8V power domain.<br>If unused, keep it open.                                                                                 |
| W_DISABLE#            | 4          | DI  | Flight mode control                         | V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.6V<br>V <sub>IH</sub> min=1.2V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain.<br>In low level the module enters into flight mode. If unused, keep it open.                                |
| <b>WLAN interface</b> |            |     |                                             |                                                                                                               |                                                                                                                                |
| Pin name              | Pin number | I/O | Description                                 | DC features                                                                                                   | Note                                                                                                                           |
| BT_RTS*               | 37         | DO  | Bluetooth serial port request to send data  | V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.6V<br>V <sub>IH</sub> min=1.2V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain.<br>If unused, keep it open.                                                                                 |
| BT_TXD*               | 38         | DO  | Bluetooth serial port sends data            | V <sub>OL</sub> max =0.45V<br>V <sub>OH</sub> min =1.35V                                                      | 1.8V power domain.<br>If unused, keep it open.                                                                                 |
| BT_RXD*               | 39         | DI  | Bluetooth Serial Port receives data         | V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.6V                                                         | 1.8V power domain.                                                                                                             |

|              |     |    |                                       |                                                                                            |                                                |
|--------------|-----|----|---------------------------------------|--------------------------------------------------------------------------------------------|------------------------------------------------|
|              |     |    |                                       | VIHmin=1.2V<br>VIHmax=2.0V                                                                 | If unused, keep it open.                       |
| BT_CTS*      | 40  | DI | Bluetooth serial sending clearance    | VOLmax =0.45V<br>VOHmin =1.35V                                                             | 1.8V power domain.<br>If unused, keep it open. |
| BT_EN*       | 139 | DO | Bluetooth enables                     | VOLmax =0.45V<br>VOHmin =1.35V                                                             | 1.8V power domain.<br>If unused, keep it open. |
| WLAN_SLP_CLK | 118 | DO | WLAN sleep clock                      |                                                                                            | If unused, keep it open.                       |
| PM_ENABLE    | 127 | DO | External power supply enables control | VOLmax =0.45V<br>VOHmin =1.35V                                                             | 1.8V power domain.<br>If unused, keep it open. |
| SDC1_DATA3   | 129 | IO | WLAN SDIO signal data line 3          | VOLmax=0.45V<br>VOHmin=1.35V<br>VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V | 1.8V power domain.<br>If unused, keep it open. |
| SDC1_DATA2   | 130 | IO | WLAN SDIO signal data line 2          | VOLmax=0.45V<br>VOHmin=1.35V<br>VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V | 1.8V power domain.<br>If unused, keep it open. |
| SDC1_DATA1   | 131 | IO | WLAN SDIO signal data line 1          | VOLmax=0.45V<br>VOHmin=1.35V<br>VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V | 1.8V power domain.<br>If unused, keep it open. |
| SDC1_DATA0   | 132 | IO | WLAN SDIO signal data line 0          | VOLmax=0.45V<br>VOHmin=1.35V<br>VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V | 1.8V power domain.<br>If unused, keep it open. |
| SDC1_CLK     | 133 | DO | WLAN SDIO signal clock                | VOLmax=0.45V<br>VOHmin=1.35V                                                               | 1.8V power domain.<br>If unused, keep it open. |
| SDC1_CMD     | 134 | DO | WLAN SDIO                             | VOLmax=0.45V                                                                               | 1.8V power                                     |

|                          |            |     | instruction signal              | VOHmin=1.35V                                                                                                                                                                                                                   | domain.<br>If unused, keep it open.                               |
|--------------------------|------------|-----|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| WAKE_ON_WIRELESS         | 135        | DI  | WLAN wakes the module           | V ILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V                                                                                                                                                                    | 1.8V power domain. Active low level.<br>If unused, keep it open.  |
| WLAN_EN                  | 136        | DO  | WLAN enables                    | VOLmax=0.45<br>VOHmin=1.35V                                                                                                                                                                                                    | 1.8V power domain. Active high level.<br>If unused, keep it open. |
| COEX_UART_RXD            | 137        | DI  | LTE/WLAN&BT coexistence signal  | V ILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V                                                                                                                                                                    | 1.8V power domain.<br>If unused, keep it open.                    |
| COEX_UART_TXD            | 138        | DO  | LTE/WLAN&BT coexistence signal  | VOLmax=0.45<br>VOHmin=1.35V                                                                                                                                                                                                    | 1.8V power domain.<br>If unused, keep it open.                    |
| <b>SD card Interface</b> |            |     |                                 |                                                                                                                                                                                                                                |                                                                   |
| Pin name                 | Pin number | I/O | Description                     | DC features                                                                                                                                                                                                                    | Note                                                              |
| SD_INS_DET               | 23         | DI  |                                 | VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax =2.0V                                                                                                                                                                     | 1.8V power domain.<br>If unused, keep it open                     |
| VDD_SDIO                 | 34         | PO  |                                 | IOmax =50mA                                                                                                                                                                                                                    |                                                                   |
| SD_CMD                   | 33         | IO  | SD card SDIO instruction signal | 1.8V SD card:<br>VOLmax=0.45<br>VOHmin=1.4V<br>V ILmin=-0.3V<br>VILmax=0.58V<br>VIHmin=1.27V<br>VIHmax =2.0V<br>3.0V SD card:<br>VOLmax=0.38V<br>VOHmin=2.01V<br>V ILmin=-0.3V<br>VILmax=0.76V<br>VIHmin=1.72V<br>VIHmax=3.34V | Refer to SD3.0 protocol. If unused, keep it open.                 |
| SD_CLK                   | 32         | DO  | SD card SDIO signal clock       | 1.8V SD card:<br>VOLmax=0.45V                                                                                                                                                                                                  | Refer to SD3.0 protocol. If                                       |

|          |    |    |                                 |                                                                                                                                                                                                                                |                                                   |
|----------|----|----|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
|          |    |    |                                 | VOHmin =1.4V<br>3.0V SD card:<br>VOLmax=0.38V<br>VOHmin=2.01V                                                                                                                                                                  | unused, keep it open.                             |
| SD_DATA3 | 28 | IO | SD card SDIO signal data line 3 | 1.8V SD card:<br>VOLmax=0.45<br>VOHmin=1.4V<br>V ILmin=-0.3V<br>VILmax=0.58V<br>VIHmin=1.27V<br>VIHmax =2.0V<br>3.0V SD card:<br>VOLmax=0.38V<br>VOHmin=2.01V<br>V ILmin=-0.3V<br>VILmax=0.76V<br>VIHmin=1.72V<br>VIHmax=3.34V | Refer to SD3.0 protocol. If unused, keep it open. |
| SD_DATA2 | 29 | IO | SD card SDIO signal data line 2 | 1.8V SD card:<br>VOLmax=0.45<br>VOHmin=1.4V<br>V ILmin=-0.3V<br>VILmax=0.58V<br>VIHmin=1.27V<br>VIHmax =2.0V<br>3.0V SD card:<br>VOLmax=0.38V<br>VOHmin=2.01V<br>V ILmin=-0.3V<br>VILmax=0.76V<br>VIHmin=1.72V<br>VIHmax=3.34V | Refer to SD3.0 protocol. If unused, keep it open. |
| SD_DATA1 | 30 | IO | SD card SDIO signal data line 1 | 1.8V SD card:<br>VOLmax=0.45<br>VOHmin=1.4V<br>V ILmin=-0.3V<br>VILmax=0.58V<br>VIHmin=1.27V<br>VIHmax =2.0V<br>3.0V SD card:<br>VOLmax=0.38V<br>VOHmin=2.01V<br>V ILmin=-0.3V<br>VILmax=0.76V<br>VIHmin=1.72V                 | Refer to SD3.0 protocol. If unused, keep it open. |

|                  |            |     |                                 | VIHmax=3.34V                                                                                                                                                                                                                 |                                                       |
|------------------|------------|-----|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| SD_DATA0         | 31         | IO  | SD card SDIO signal data line 0 | 1.8V SD card:<br>VOLmax=0.45V<br>VOHmin=1.4V<br>VILmin=-0.3V<br>VILmax=0.58V<br>VIHmin=1.27V<br>VIHmax=2.0V<br>3.0V SD card:<br>VOLmax=0.38V<br>VOHmin=2.01V<br>VILmin=-0.3V<br>VILmax=0.76V<br>VIHmin=1.72V<br>VIHmax=3.34V | Refer to SD3.0 protocol. If unused, keep it open.     |
| <b>SGMII Pin</b> |            |     |                                 |                                                                                                                                                                                                                              |                                                       |
| Pin name         | Pin number | I/O | Description                     | DC features                                                                                                                                                                                                                  | Note                                                  |
| EPHY_RST_N*      | 119        | DO  | Ethernet PHY reset              | For 1.8V:<br>VOLmax=0.45V<br>VOHmin=1.4V<br>For 2.85V:<br>VOLmax=0.35V<br>VOHmin=2.14V                                                                                                                                       | 1.8V /2.85V power domain.<br>If unused, keep it open. |
| EPHY_INT_N*      | 120        | DI  | Ethernet PHY interruption       | VILmin=-0.3V<br>VILmax=0.6V<br>VIHmin=1.2V<br>VIHmax=2.0V                                                                                                                                                                    | 1.8V /2.85V power domain.<br>If unused, keep it open. |
| SGMII_MDATA*     | 121        | IO  | SGMII MDIO data                 | For 1.8V:<br>VOLmax=0.45V<br>VOHmin=1.4V<br>VILmax=0.58V<br>VIHmin=1.27V<br>For 2.85V:<br>VOLmax=0.35V<br>VOHmin=2.14V<br>VILmax=0.71V<br>VIHmin=1.78V                                                                       | 1.8V/2.85V power domain.<br>If unused, keep it open.  |
| SGMII_MCLK*      | 122        | DO  | SGMII MDIO clock                | For 1.8V:<br>VOLmax=0.45V<br>VOHmin=1.4V<br>For 2.85V:<br>VOLmax=0.35V<br>VOHmin=2.14V                                                                                                                                       |                                                       |
| USIM2_VDD        | 128        | PO  | SGMII MDIO                      | -                                                                                                                                                                                                                            | 1.8V/2.85V power                                      |

|                      |                                           |    |                                      |   |                                                           |
|----------------------|-------------------------------------------|----|--------------------------------------|---|-----------------------------------------------------------|
| *                    |                                           |    | power supply                         |   | domain, require external pull-up level for SGMII SDIO Pin |
| SGMII_TX_M*          | 123                                       | AO | SGMII data transmit negative signals | - | If unused, keep it open.                                  |
| SGMII_TX_P*          | 124                                       | AO | SGMII data transmit positive signals | - | If unused, keep it open.                                  |
| SGMII_RX_P*          | 125                                       | AI | SGMII data receive positive signals  | - | If unused, keep it open.                                  |
| SGMII_RX_M*          | 126                                       | AI | SGMII data receive negative signals  | - | If unused, keep it open.                                  |
| <b>Reserved Pins</b> |                                           |    |                                      |   |                                                           |
| RESERVED             | 18, 43, 55, 73~84, 113, 114, 117, 140~144 |    | Reserved                             |   | Keep it open                                              |

### 3.4 Operating Mode

Table 6: Overview of Operating Modes

| Mode      | Description |                                                                                                                                                                                                                          |
|-----------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GSM mode  | GSM IDLE    | The module is in idle state and has registered to the GSM network, and it is ready to send and receive data(SMS and voice service).                                                                                      |
|           | GSM TALK    | The module is ready for voice talk service; the power consumption is decided by net setting.                                                                                                                             |
| GPRS mode | GPRS IDLE   | The module is ready for GPRS data transfer. No data sending or receiving at this time. The power consumption is decided by net setting and related settings of GPRS. (For example, multi slot Class level settings)      |
|           | GPRS DATA   | In GPRS data sending and receiving, the power consumption is decided by net setting (eg. Power control level), data uplink and downlink rat and related settings of GPRS. (For example, multi slot Class level settings) |
| EDGE Mode | EDGE IDLE   | The module is ready for EDGE data transfer. No data sending or receiving at this time. The power                                                                                                                         |

|               |               |                                                                                                                                                                                                                          |
|---------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |               | consumption is decided by net setting and related settings of EDGE. (For example, multi slot Class level settings)                                                                                                       |
|               | EDGE DATA     | In EDGE data sending and receiving, the power consumption is decided by net setting (eg. Power control level), data uplink and downlink rat and related settings of EDGE. (For example, multi slot Class level settings) |
| CDMA Mode     | CDMA IDLE     | The module is ready for CDMA voice and data transfer. No data sending or receiving at this time.                                                                                                                         |
|               | CDMA DATA     | CDMA data transfer is ongoing.                                                                                                                                                                                           |
| EVDO Mode     | EVDO IDLE     | The module is ready for EVDO voice and data transfer. No data sending or receiving at this time.                                                                                                                         |
|               | EVDO DATA     | EVDO data transfer is ongoing.                                                                                                                                                                                           |
| WCDMA Mode    | WCDMA IDLE    | The module system is in idle state and the module has been registered to the WCDMA network, and it is ready to send and receive services at this time                                                                    |
|               | WCDMA TALK    | The module is in WCDMA voice service, the power consumption is decided by net setting.                                                                                                                                   |
|               | WCDMA DATA    | WCDMA data transfer is ongoing. The power consumption is decided by net setting (eg. Power control level), data uplink and downlink rate and related settings of WCDMA.                                                  |
| HSPA Mode     | HSPA IDLE     | The module is ready for HSPA voice and data transfer. No data sending or receiving at this time. The power consumption is decided by net setting.                                                                        |
|               | HSPA DATA     | HSPA data transfer is ongoing. The power consumption is decided by net setting (eg. Power control level), data uplink and downlink rate and related settings of HSPA.                                                    |
| TD-SCDMA Mode | TD-SCDMA IDLE | The module system is in idle state and the module has been registered to the TD-SCDMA network, and it is ready to send and receive services at this time.                                                                |
|               | TD-SCDMA TALK | The module TD-SCDMA is in voice service, and the power consumption is decided by network settings                                                                                                                        |
|               | TD-SCDMA DATA | TD-SCDMA data transfer is ongoing, the power consumption is decided by net settings (eg. Power control level), data uplink and downlink rate and related settings of TD-SCDMA                                            |
| TD-HSPA Mode  | TD-HSPA IDLE  | The module system is in idle state and the module has been registered to the TD-HSPA network, and it is ready to send and receive services at this time.                                                                 |
|               | TD-HSPA       | TD-HSPA data transfer is ongoing, the power                                                                                                                                                                              |

|                            |                                                                                                                                                                                                                                                                                |                                                                                                                                                                             |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | DATA                                                                                                                                                                                                                                                                           | consumption is decided by net settings(eg. Power control level), data uplink and downlink rate and related settings of TD-HSPA.                                             |
| TD-LTE Mode                | TD-LTE IDLE                                                                                                                                                                                                                                                                    | The module is ready for TD-LTE data transfer. No data sending or receiving at this time. The power consumption is decided by net setting.                                   |
|                            | TD-LTE DATA                                                                                                                                                                                                                                                                    | TD-LTE data transfer is ongoing; the power consumption is decided by net setting(eg. Power control level), data uplink and downlink rate and related settings of TD-LTE.    |
| FDD LTE Mode               | FDD LTE IDLE                                                                                                                                                                                                                                                                   | The module is ready for FDD LTE data transfer. No data sending or receiving at this time. The power consumption is decided by net setting.                                  |
|                            | FDD LTE DATA                                                                                                                                                                                                                                                                   | FDD LTE data transfer is ongoing; the power consumption is decided by net setting (eg. Power control level), data uplink and downlink rate and related settings of FDD LTE. |
| Minimum functionality mode | AT+CFUN=0 command can set the module to enter into a minimum functionality mode without removing the power supply of VBAT. At this time RF is closed. Use AT+CFUN=1command the module reopens sending and receiving service and registers network to the normal function mode. |                                                                                                                                                                             |
| Flight mode                | W_DISABLE_N pin can set the module to enter into flight mode. In this mode FR function will be invalid.                                                                                                                                                                        |                                                                                                                                                                             |
| Sleep mode                 | In this mode, the consumption of the module will be reduced to the minimum level. During the mode, the module can still receive paging message, SMS, voice call and TCP/UDP data from the network normally.                                                                    |                                                                                                                                                                             |
| Power down mode            | VBAT shuts down in the low power supply mode. In this mode, PMU stops supplying power to baseband and RF; software is inactive and the serial interface is not accessible.                                                                                                     |                                                                                                                                                                             |

## 3.5 Power Saving

### 3.5.1 Sleep Mode

In sleep mode SLM750 is able to reduce its current consumption to a minimum value. The following part describes the sleep mode of SLM750.

#### 3.5.1.1 USB Application (with USB remote waking-up function)

If host supports USB suspend/resume and remote waking-up function, the following

preconditions can let the module enter into sleep mode.

- Execute AT+SLEEPEN=1 command to enable sleep mode.
- Keep WAKEUP\_IN to high level.
- Host USB interface connecting to the module enters into suspend state.
- Sending data to SLM750 from USB will wake up the module.

Connections between the module and the host are as follows:

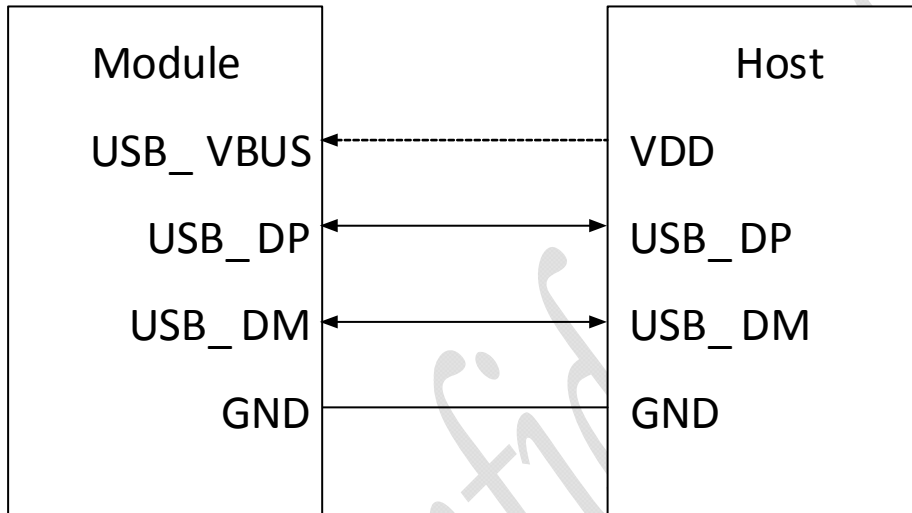


Figure 3 Sleep mode application with USB remote waking-up function

### 3.5.1.2 USB Application (without USB Suspend function)

If host does not support suspend function, you should disconnect VCC with external control circuit to let the module enter into the sleep mode:

- Execute command AT+SLEEPEN=1 to enable the sleep mode.
- Disconnect USB\_VDD.
- Restoring the USB\_VDD power supply can wake up the module.

### 3.5.1.3 Hardware I/O control sleep mode

The WAKEUP\_IN (Pin1) pin is the pin that triggers sleep in the module. When the sleep function of the module is enabled, the pin is pulled down (initially at a high level), and the module triggers the sleep process after detecting the descent edge of the pin. In the case of full release of sleep locks, the module will smoothly enter the sleep state.

Whether the sleep function of the module is enabled can be checked by at+ sleepen? via the AT query, when the query returns a result of 0 indicating the current state of sleep function is forbidden and the sleep function is enabled by 1. Similarly, you can use the AT query at + sleepen=1,

or at + sleepen=0 to enable or disable sleep function of the module. When the module sleep function is disabled, the module sleep related pin will be invalid, USB PHY will not enter the low power (LPM) when the USB bus is suspended.

When the module is in a sleep state (WAKEUP\_IN pin pulls down to trigger module sleep), the pin should be pulled up, and at the same time, WAKEUP\_IN will produce a rising edge, the module will trigger a wake-up after detecting break in the rising edge, after that, the WAKEUP\_IN will remain high, and the module keeps awake.

The module control signal level supports 1.8 V logic level.

### **3.5.2 Flight Mode**

When the module enters into flight mode, the RF function will not work, and all AT commands correlative with RF function will be inaccessible. You can use the following ways to let the module enter into flight mode:

#### **3.5.2.1 Hardware I/O interface controls flight mode**

The W\_DISABLE\_N pin (PIN4) of SLM750 gives the module a low level signal. The module enters into flight mode and RF sending and receiving unit stops working. Pull up PIN4 and the module will enter into normal mode.

Module control signal level supports 1.8V logical level.

#### **3.5.2.2 AT command controls flight mode**

Send AT+CFUN=4 command to let the module enter into flight mode, and RF sending and receiving unit stops working at the time. Send AT+CFUN=1 command to let the module enter into normal mode again.

## **3.6 Power Supply**

### **3.6.1 Power supply pins**

SLM750 has four VBAT pins to connect to external power and can be divided into two power fields:

- Two VBAT\_RF pins are used to supply RF power.
- Two VBAT\_BB pins are used to supply Baseband power.

Below table shows the assignment of power and ground pins:

Table 7: Related power supply interfaces

| Pin name | Pin No.                                           | Description                      | Min value | Typical value | Max value | Unit |
|----------|---------------------------------------------------|----------------------------------|-----------|---------------|-----------|------|
| VBAT_BB  | 59,60                                             | Power supply for module baseband | 3.3       | 3.8           | 4.2       | V    |
| VBAT_RF  | 57,58                                             | Power supply for module RF       | 3.3       | 3.8           | 4.2       | V    |
| GND      | 8,9,19,<br>22,36,46,48,50~54,<br>56,72,<br>85~112 | Ground                           | -         | 0             | -         | V    |

### 3.6.2 Decrease voltage drop

The power supply range of SLM750 is from 3.3V to 4.2V. During data transmission or conversation, instantaneous high-power emission will form a peak current up to 2A, which will lead to a large ripple of VBAT. If instantaneous voltage drop leads to too low VBAT power supply voltage, the module will shut down. Make sure there are sufficient power supply capabilities and the input voltage will never drop below 3.3V to make the module work well.

The following figure shows the voltage drop during transmitting burst in 2G network. The voltage drop will be less in 3G and 4G networks.

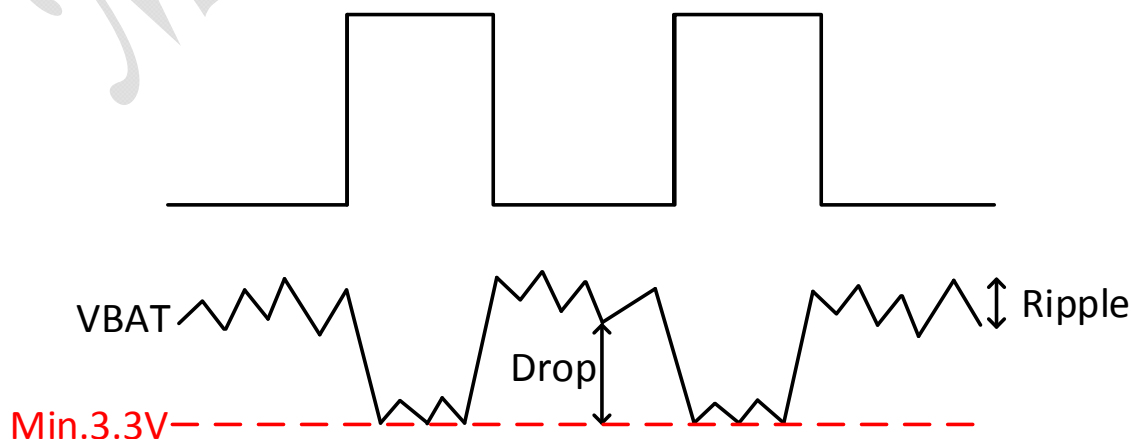


Figure 4 Power requirements for burst transmission

In order to reduce voltage drop, a low ESR 100uF filter capacitor is needed. The multilayer ceramic capacitor (MLCC) has the best ESR, suggestion to add three ceramic capacitors (100nF, 33pF, 10pF) to VBAT\_BB and VBAT\_RF pins, and the capacitors should be placed close to the VBAT pin. When external power supply makes connection to module, VBAT\_BB and VBAT\_RF need to apply star line. VBAT\_BB line width should not be less than 1 mm, and VBATRF line width should not be less than 2 mm. In principle, the longer the VBAT line, the wider the line width.

In addition, in order to ensure the stability of the power supply, it is recommended to add a Zener diode at the front end of the power supply with a power of 5.1V and a work and power of 0.5W or higher. The reference circuit is as follows:

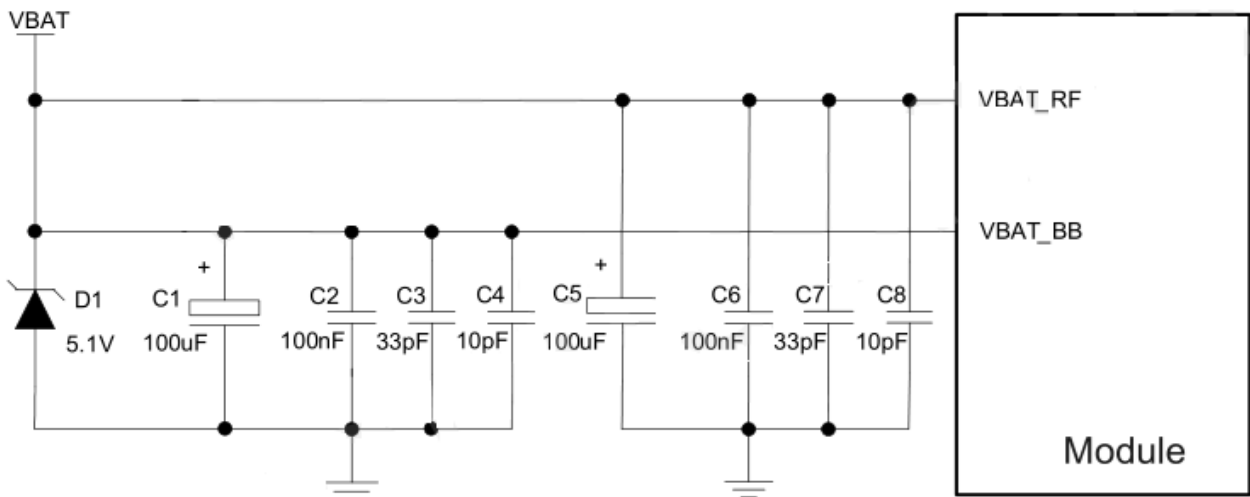


Figure 5 Star structure of power supply

### 3.6.3 Reference design for power supply

The power design for the module is very important as the performance of the module largely depends on the power supply. The power supply is capable of providing sufficient current up to 2A at least. If the voltage drop between the input and output is not too high, it is recommended that you use a LDO to supply power for the module. If there is a big voltage difference between the input and the output, DCDC is preferred to be used as a power supply.

The following figure shows a reference design for +5V input power supply. The designed output for the power supply is +3.3V (typical value 3.8V) and the maximum load current is 3A.

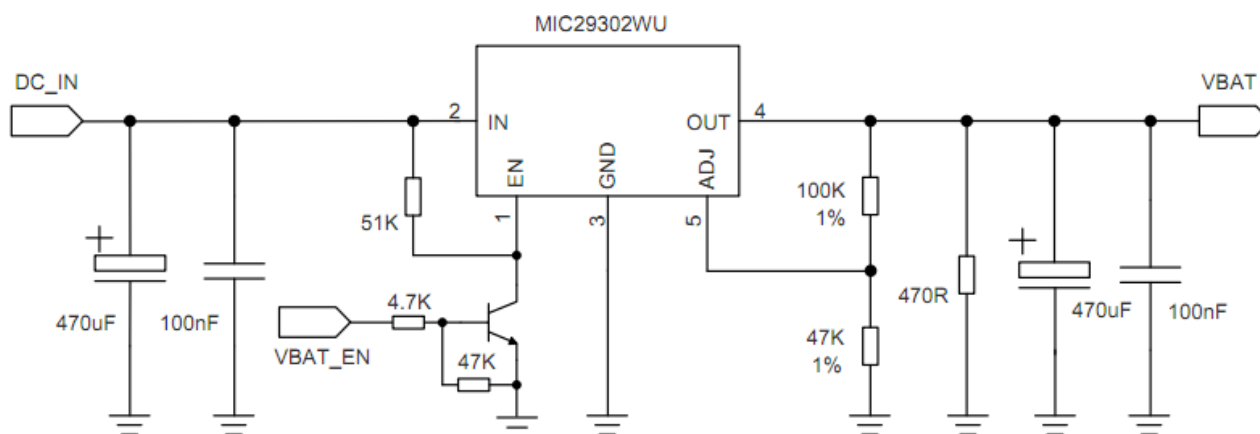


Figure 6 DC power supply circuit

### 3.6.4 VDD\_EXT voltage output

If SLM750 module turns on normally, there is a voltage output of 1.8V, current load 80mA in PIN7. You can use the output voltage as external power supply, for example level reference, and judge if the module is turned on by reading pin level status.

## 3.7 Turn On and Off

### 3.7.1 Turn on module using the PWRKEY

Table 7.1: Description of PWR\_KEY pin

| Pin name | Pin number | Function               | DC features                                              | Description |
|----------|------------|------------------------|----------------------------------------------------------|-------------|
| PWR_KEY  | 21         | Turn on/off the module | $V_{IHmax}=2.1V$<br>$V_{IHmin}=1.3V$<br>$V_{ILmax}=0.5V$ |             |

When SLM750 is in power down mode, it can be turned on to normal mode by driving the PWRKEY pin to a low level for at least 100ms. It is suggested that you use an open set driver circuit to control PWRKEY pin. After STATUS pin (require external pull-up) outputting a low level, PWRKEY pin can be released. Reference circuit is illustrated in the following figure:

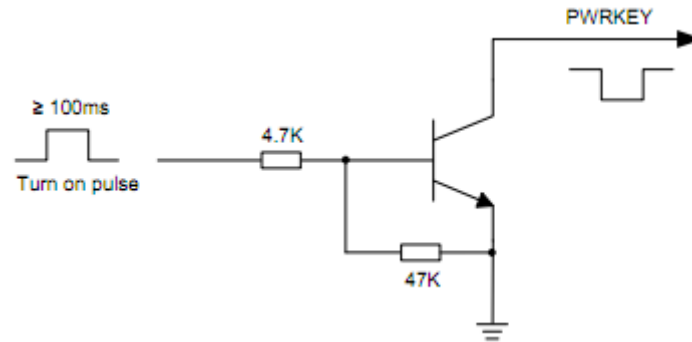


Figure 7 Turn on the module using driving circuit

The other way to control the PWRKEY is using a button directly. A TVS component is indispensable to be placed nearby the button for ESD protection. A reference circuit is shown in the following figure:

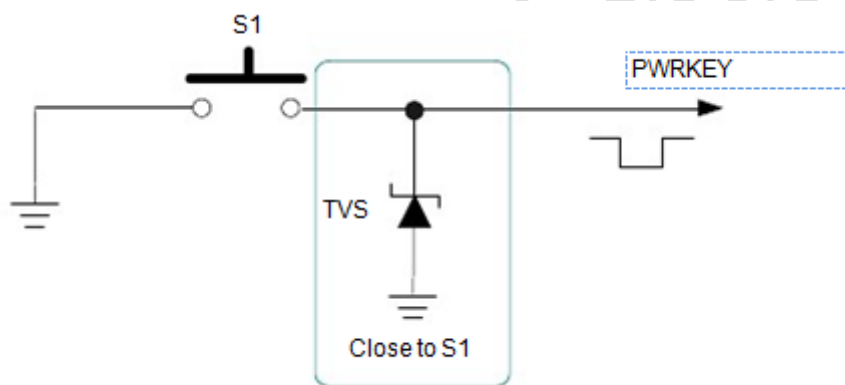


Figure 8 Turn on the module using keystroke

Turning on time is illustrated as follows:

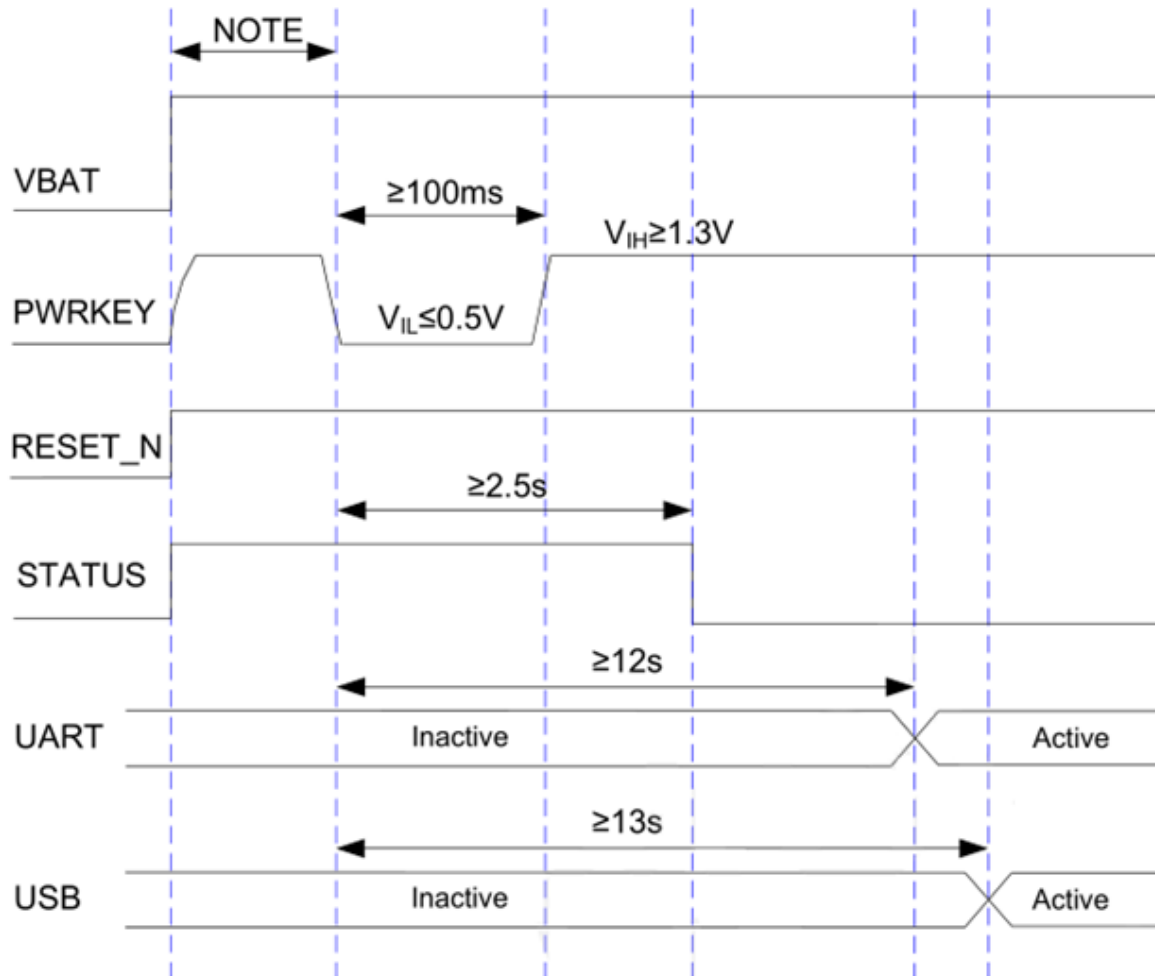


Figure 9 Timing of turning on module

Note:

1.  $T_{note} > 30ms$ .

2. If the external pull up design of PWRKEY pin is added, it is recommended that the pull-up level range is 1.3V~2.1V

### 3.7.2 Turn off module using the PWRKEY pin

Modules can be shut down in the following ways:

- normal shutdown: shutdown through PWRKEY pin control module;
- normal shutdown: shutdown through AT command

#### 3.7.2.1 PWRKEY pin shutdown

When the module is on, the PWRKEY pin is pulled down and released after holding at least 2s,

then the module will perform the shutdown process. The shutdown sequence is shown in the following figure:

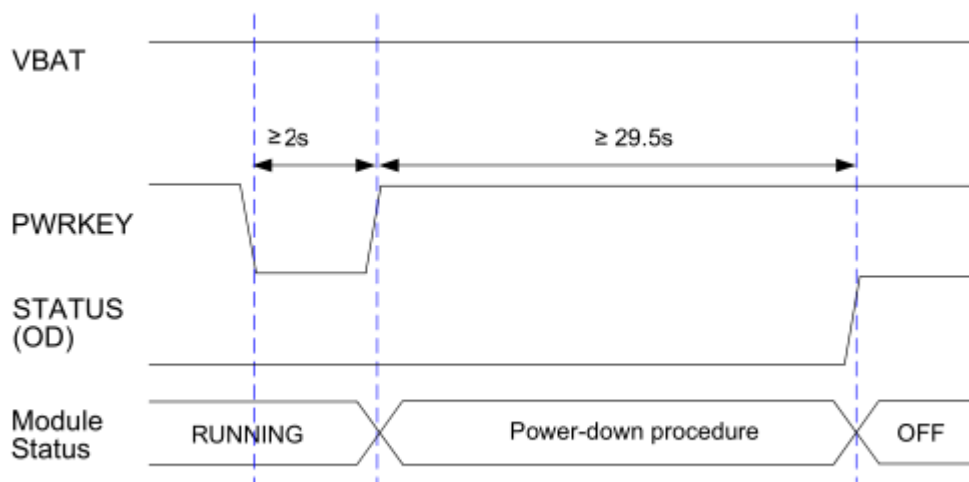


Figure 10 Timing of turning off module

### 3.7.2.2 AT command shutdown

The AT + Poweroff command can be used to control the shutdown of module. This shutdown process is equivalent to a pulled-down PWRKEY pin shutdown process.

NOTES: 1. When the module works properly, do not immediately cut off the module power to avoid damage to the module internal Flash data. It is strongly recommended to turn off the module by using the PWRKEY or AT command before disconnecting the power.

2. When using the AT command to shut down, make sure that the PWRKEY is always in a high level state after the shutdown command execution, otherwise the module will automatically boot again after shutdown.

## 3.8 Reset the Module

Hardware and AT command can be used to reset SLM750.

### 3.8.1 Hardware reset

When the module is in operation, puling down 150~460ms of the RESET\_N pin to reset module. The RESET\_N signal is sensitive to interference.

Table 8: RESET\_N pin description

| Pin name | Pin number | Function     | DC features                                              | Description |
|----------|------------|--------------|----------------------------------------------------------|-------------|
| RESET_N  | 20         | Reset module | $V_{IHmax}=2.1V$<br>$V_{IHmin}=1.3V$<br>$V_{ILmax}=0.5V$ |             |

Reference circuit is as follows: you can use open set driver circuit or button to control RESET\_N pin.

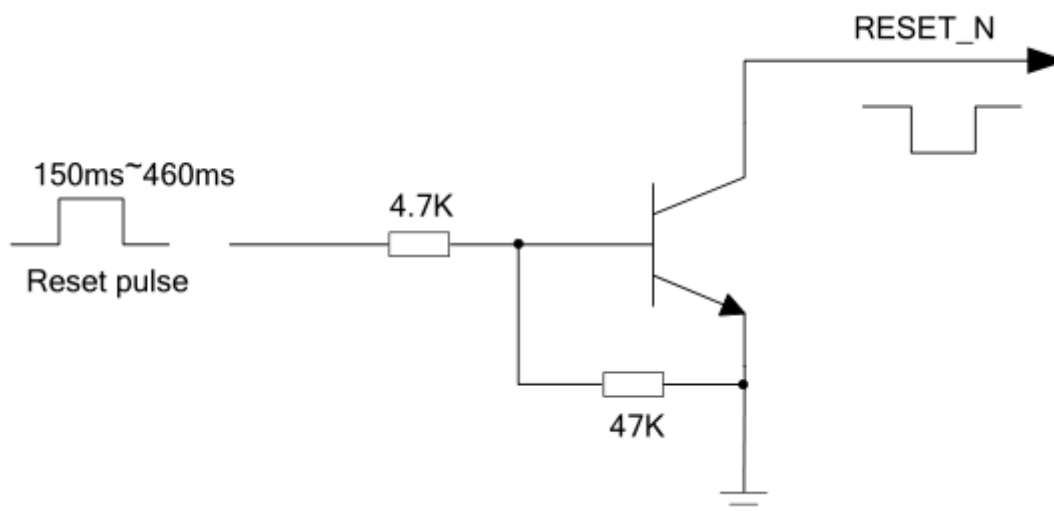


Figure 11 Reference circuit of RESET\_N by using driving circuit

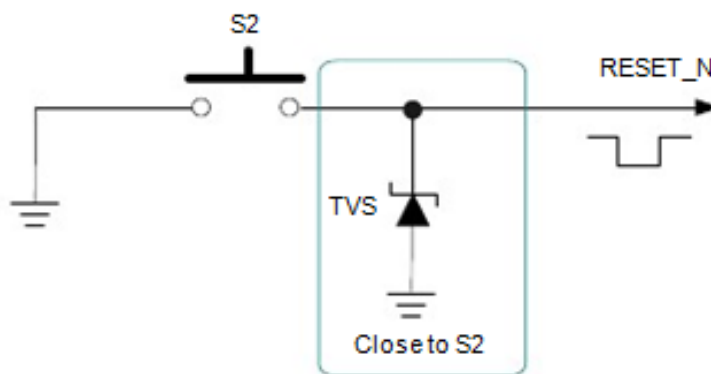


Figure 12 Reference circuit of RESET\_N by using button

The reset timing figure is as follows:

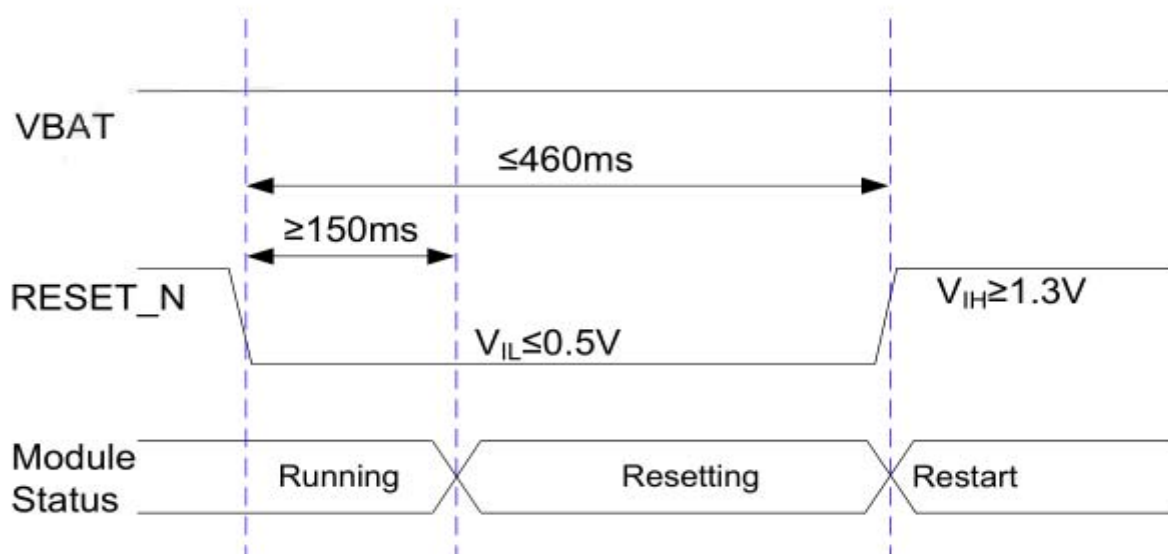


Figure 13 Reset timing of RESET\_N

### 3.8.2 AT command reset

Enter AT+RESET command in SLM750VUART or USB AT interface to reset and restart SLM750.

## 3.9 USIM/SIM Card Interface

USIM card interface meets ETSI and IMT-2000 SIM interface requirements. Both 1.8V and 3.0V USIM cards are supported by SLM750

Table 9: USIM/SIM card interface description

| Pin name      | Pin number | I/O | Description              | Note                            |
|---------------|------------|-----|--------------------------|---------------------------------|
| USIM_DATA     | 15         | IO  | USIM card data signal    |                                 |
| USIM_CLK      | 16         | DO  | USIM card clock signal   |                                 |
| USIM_RST      | 17         | DO  | USIM card reset signal   |                                 |
| USIM_VDD      | 14         | PO  | USIM card power supply   | Support 1.8V and 3.0V USIM card |
| USIM_PRESENCE | 13         | DI  | USIM card plug detection | Require to pull up to 1.8V      |
| GND           | 10         | -   |                          |                                 |

SLM750 supports USIM hot plugging function through the USIM\_PRESENCE pin, support high-level detection, and the default hot-plugging function is turned off by default. The USIM\_PRESENCE pin level is in high voltage after the SIM card is inserted as shown in below figure, The USIM\_PRESENCE pin level is in low voltage when no card is detected.



The diagram shows the electrical connections for the USIM module. The Module's pins are connected to the USIM\_CARD\_CONNECTOR pins as follows:

- USIM\_GND** is connected to **GND**.
- USIM\_VDD** is connected to **VCC** (with a 100nF capacitor to USIM\_VDD) and **VPP**.
- USIM\_RST** is connected to **RST** (with a 22R resistor).
- USIM\_CLK** is connected to **CLK** (with a 22R resistor).
- USIM\_DATA** is connected to **IO** (with a 22R resistor).

Additional components include a 15K resistor between USIM\_VDD and the connector's VCC, and three 33PF capacitors connected to ground from the USIM\_DATA line.

Figure 15 Reference circuit for 6-pin USIM/SIM connector

In order to enhance the reliability and availability of the USIM card in your application, please follow the criteria below in the USIM circuit design:

- USIM\_DATA requires a pull-up resistor of 15k $\Omega$  to USIM\_VCC; the pull-up resistor helps to increase SIM card's anti-interference ability. When USIM card trace is too long or it is close to the interference source, it is recommended that you add a pull-up resistor near the card.
- In order to suppress stray EMI and enhance ESD protection, it is recommended to connect a resistance of 22 $\Omega$  on USIM\_DATA, USIM\_CLK and USIM\_RST line.
- In order to improve the antistatic ability and offer good ESD protection, it is recommended to add TVS whose parasitic capacitance should be less than 15pF on USIM\_VDD, USIM\_DATA, USIM\_CLK and USIM\_RST line.
- In order to filter GSM900 interference, add a parallel 33pF resistance on USIM\_VDD, USIM\_DATA, USIM\_CLK and USIM\_RST line.
- Keep layout of USIM card as close as possible to the module. Assure the length of signal wiring is less than 200mm.
- Keep USIM card signal away from RF and VBAT power line.
- To avoid cross-talk between USIM\_CLK and USIM\_DATA, keep them away from each other and shield them with surrounded ground.
- Complete hot plugging of USIM/SIM card by using the DETECT pin of hot plug card slot and the 13pin of the module. The default setting does not support hot plug function. Contact us if you need more information about the function.

**Note: Hot plug of SIM Connectors is not supported. Hot plug to USIM and SIM card can cause damages to USIM /SIM card or SLM750V USIM /SIM card interfaces.**

### 3.10 USB Interface

SLM750 provides a USB interface which complies with USB 2.0 specification and supports high-speed (480Mbps) and full-speed (12Mbps) modes. The USB interface is used for AT command communication, data transmission, software debugging and version upgrade.

### 3.10.1 USB pin description

SLM750 module provides a USB2.0 High-Speed interface.

Table 10: USB interface description

| Name     | Pin name | I/O | Description                              | Note                               |
|----------|----------|-----|------------------------------------------|------------------------------------|
| USB_DM   | 70       | IO  | USB differential data signal-            | Require 90Ω differential impedance |
| USB_DP   | 69       | IO  | USB differential data signal+            | Require 90Ω differential impedance |
| GND      | 72       | -   | Ground                                   |                                    |
| USB_VBUS | 71       | PI  | USB power supply, used for USB detection | Typical value 5.0V                 |

### 3.10.2 USB reference circuit

USB interface application reference circuit of SLM750 is shown in the following figure.

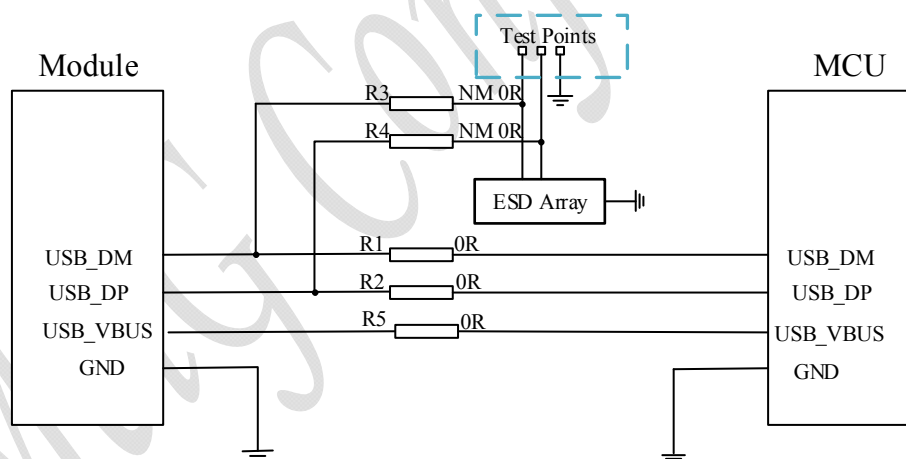


Figure 16 USB reference circuit

In order to meet the signal integrity requirements of the USB data line, the resistors R1/ R2/ R3/ R4 must be placed close to the module, and the resistors need to be placed close to each other. The connection point branch must be as short as possible.

In the design of USB interface circuit, in order to ensure the performance of USB, the following principles are recommended in circuit design:

- The module USB\_VBUS is not used to power the module, but is used to detect the insertion and pull-out of the USB.
- In order to reduce the signal interference of USB high speed data transmission, connect R1 and R2 between USB\_DM and USB\_DP interface circuit to improve the data transmission rate. It is recommended that you use R1 and R2 of 0Ω.
- In order to improve the antistatic performance of USB interface, it is recommended to add ESD protection components on USB\_DP and USB\_DM interface circuit. It is recommended that you use ESD components with junction capacitance less than 2pF.
- In order to ensure that the USB is reliable, consider more about the protection of USB when designing, such as the protection of USB on Layout requires impedance control of 90Ω for USB\_DP, USB\_DM, tracing strictly according to differential requirements, and keeping away from the interference signal as far as possible.
- Do not trace the USB line in the crystal oscillator, oscillator, magnetic device and RF signal; it is recommended to trace inner differential line and up and down around the package.

### 3.10.3 USB driver

SLM750 supports various operation systems, such as PC operation systems: Windows 10, Windows 7/8, embedded operation system, Linux2.6 or higher, Android 2.3/4.0/4.2/4.4/5.0/5.1/6.0/7.0, which requires private USB driver support.

For different operating systems and different VID and PID, USB driver provides different driver files. Contact supporting staff if you have specific requirements.

## 3.11 UART Interface

SLM750 provides two UART interfaces: main UART interface and debug UART interface. The features of them are illustrated as below:

- Main UART interface supports 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600bps and 3000000bps baud rate, the default is 115200bps. The interface can be used for data transmission and AT command communication.

- Debug UART interface supports 115200bps baud rate. It can be used for Linux console, log print.

Table 11: Main UART pin description

| Pin name | Pin number | I/O | Description                   | Note                                                                           |
|----------|------------|-----|-------------------------------|--------------------------------------------------------------------------------|
| RXD      | 68         | DI  | Receive data                  | 1.8V power domain                                                              |
| TXD      | 67         | DO  | Transmit data                 | 1.8V power domain                                                              |
| CTS      | 64         | DI  | Clear to send                 | 1.8V power domain. If unused, keep it open                                     |
| RTS      | 65         | DO  | DTE requires to transmit data | 1.8V power domain. If unused, keep it open                                     |
| RI       | 62         | DO  | Ring indicator                | 1.8V power domain. If unused, keep it open. The function is to be development. |
| DCD      | 63         | DO  | Output carrier detect         | 1.8V power domain. If unused, keep it open. The function is to be development. |
| DTR      | 66         | DI  | DTE ready, sleep mode control | 1.8V power domain. If unused, keep it open. The function is to be development. |

Table 12: Debug UART pin description

| Pin name | Pin number | I/O | Description   | Note                     |
|----------|------------|-----|---------------|--------------------------|
| DBG_RXD  | 11         | DI  | Receive data  | 1.8V power supply domain |
| DBG_TXD  | 12         | DO  | Transmit data | 1.8V power supply domain |

Table 13: UART logical level

| Parameter       | Min  | Max  | Unit |
|-----------------|------|------|------|
| V <sub>IL</sub> | -0.3 | 0.6  | V    |
| V <sub>IH</sub> | 1.2  | 2.0  | V    |
| V <sub>OL</sub> | 0    | 0.45 | V    |
| V <sub>OH</sub> | 1.35 | 1.8  | V    |

SLM750 provides 1.8V serial port. If your application serial port is 3.3V, you need to add level converter. It is recommended that you use TXB0104PWR from TI Company. Reference design is shown as follows:

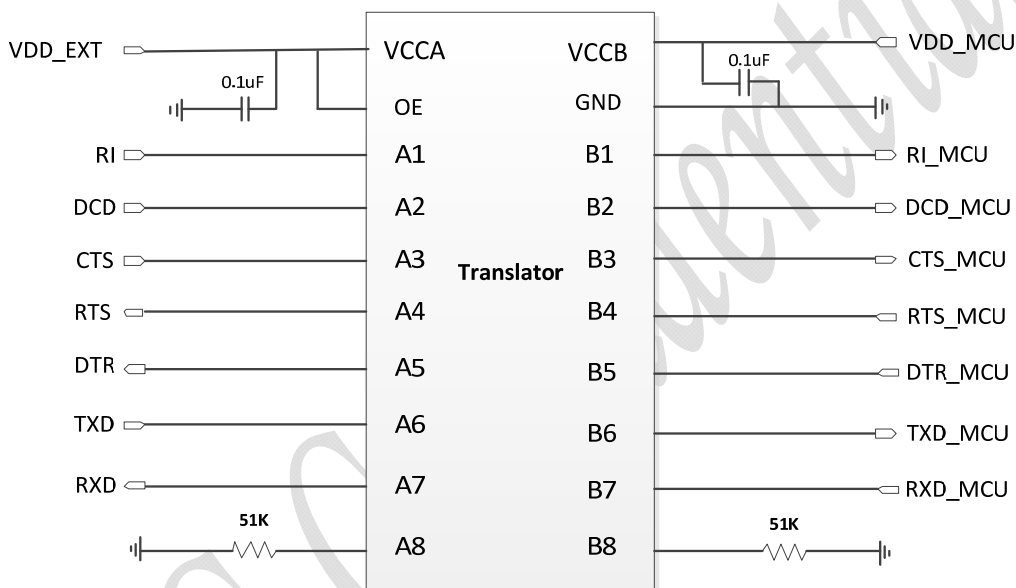


Figure 17 Reference circuit of level conversion chip

### 3.12 PCM and I2C Interface

SLM750 provides one PCM interface which supports the following two modes:

- Short frame mode: the module works as both master and slave
- Long frame mode: the module works as master only

In short frame mode, the data is sampled on the falling edge of the PCM\_CLK and transmitted on the rising edge; the PCM\_SYNC falling edge represents the more significant bit. PCM\_CLK supports 128, 256, 512, 1024 and 2048kHz speech codes.

In long frame mode, the data is sampled on the falling edge of the PCM\_CLK and transmitted

on the rising edge; the PCM\_SYNC rising edge represents the more significant bit. The mode only supports 128 kHz PCM\_CLK and 8kHz, 50% duty cycle PCM\_SYNC.

SLM750 supports 8-bit A-law, u-law and 16-bit linear encoding formats. The following figures show the timing relationship in short frame mode with PCM\_SYNC=8 kHz and PCM\_CLK=2048kHz, as well as the timing relationship in long frame mode with PCM\_SYNC=8 kHz and PCM\_CLK=128kHz.

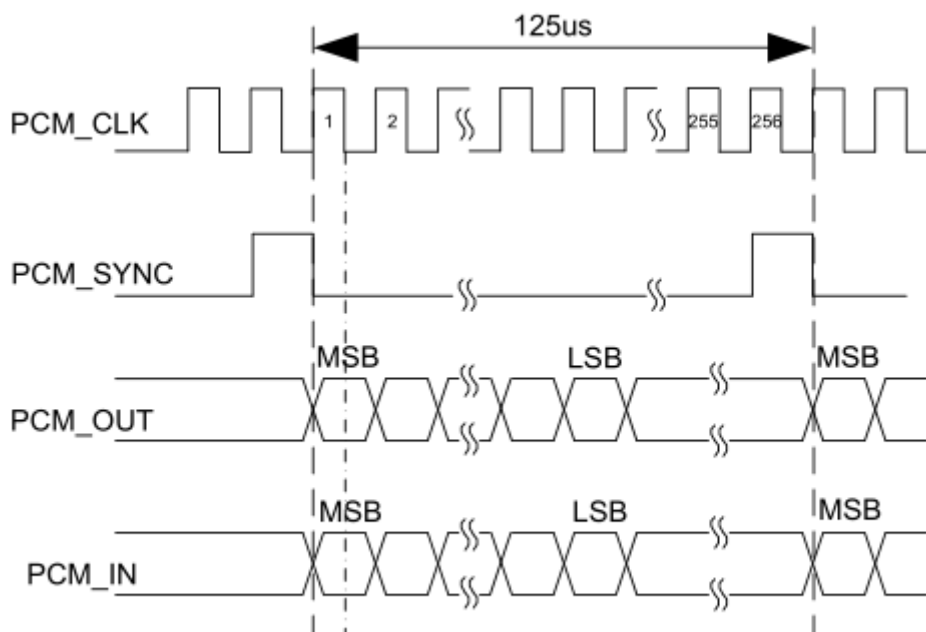


Figure 18 Timing in short frame mode

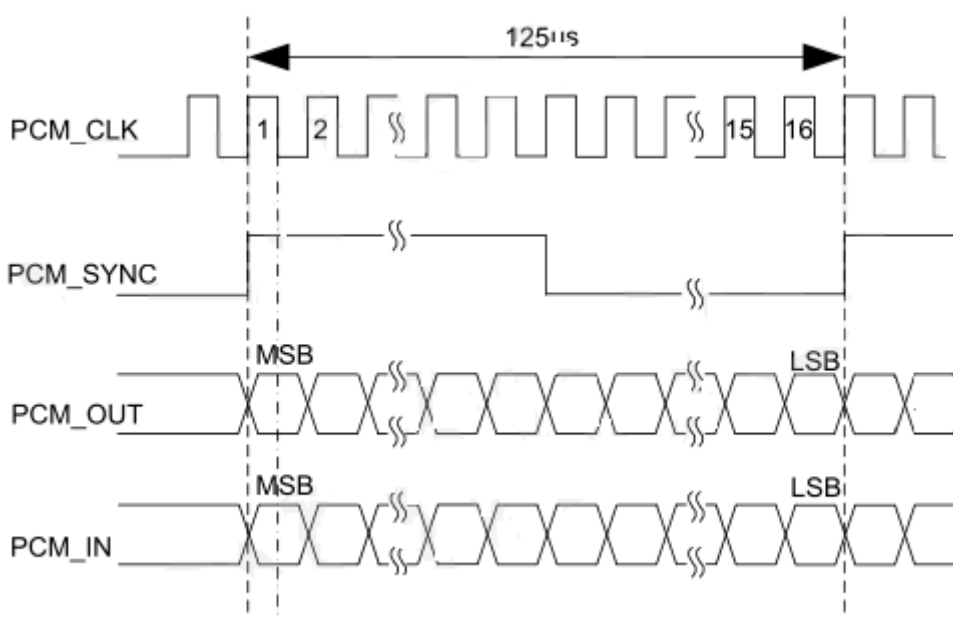


Figure 19 Timing in long frame mode

Table 14: Pin description for PCM interface

| Pin name | Pin number | I/O | Description                 | Note                             |
|----------|------------|-----|-----------------------------|----------------------------------|
| PCM_CLK  | 27         | IO  | PCM clock                   | 1.8V power supply domain         |
| PCM_OUT  | 25         | DO  | PCM data output             | 1.8V power supply domain         |
| PCM_IN   | 24         | DI  | PCM data input              | 1.8V power supply domain         |
| PCM_SYNC | 26         | IO  | PCM data synchronous signal | 1.8V power supply domain         |
| I2C_SCL  | 41         | OD  | I2C clock                   | Require 1.8V external pulling-up |
| I2C_SDA  | 42         | OD  | I2C data                    | Require 1.8V external pulling-up |

The following figure shows a reference design of PCM interface with an external codec IC.

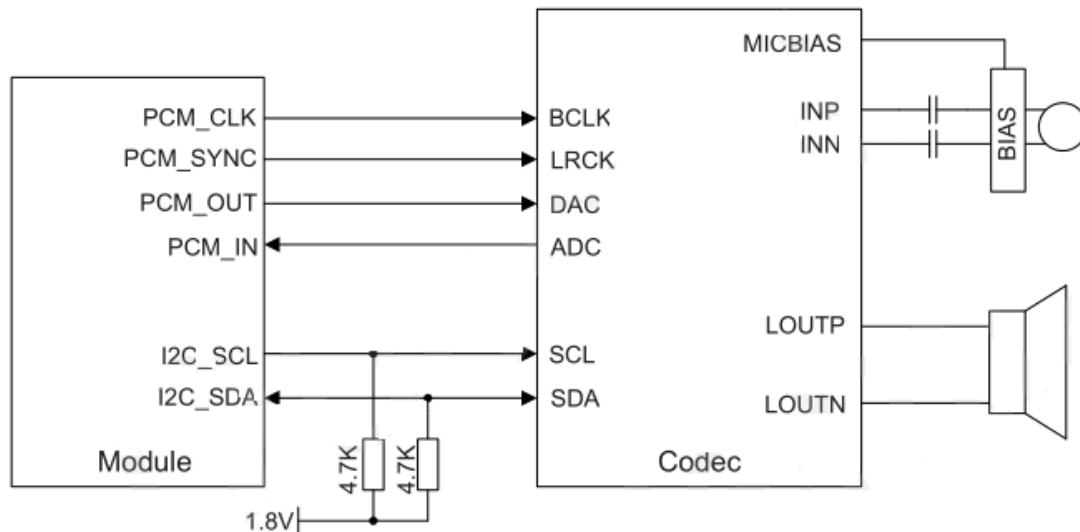


Figure 20 Reference design for PCM circuit

### 3.13 Network Status Indication

The network indication pins can be used to drive a network status indicator LED. SLM750 provides two network indication pins: NET\_MODE and NET\_STATUS. The following tables describe pin definition and logic level changes in different network status.

Table 15: Pin Definition of Network Indicator

| Pin name | Pin number | I/O | Description | Note |
|----------|------------|-----|-------------|------|
|----------|------------|-----|-------------|------|

|            |   |    |                                                |                          |
|------------|---|----|------------------------------------------------|--------------------------|
| NET_STATUS | 6 | DO | Indicate the module network activity status.   | 1.8V power supply domain |
| NET_MODE   | 5 | DO | Indicate the module network registration mode. | 1.8V power supply domain |

Table 16: Working State of the Network Indicator

| Mode       | Status                        | Description                 |
|------------|-------------------------------|-----------------------------|
| NET_MODE   | High level                    | Register LTE network status |
|            | Low level                     | Others                      |
| NET_STATUS | Flicker (200ms OFF/1400ms ON) | Data transfer status        |
|            | High level                    | Registration success        |
|            | Low level                     | Others                      |

### 3.14 Status

The STATUS pin is an open drain output for indicating the module's operation status. You can connect it to a GPIO of DTE with a pull up resistor, or as the LED indication circuit shown below. When the module is turned on normally, the STATUS will present high level.

Table 17: STATUS pin description

| Pin name | Pin no. | Description                          | I/O | Note                        |
|----------|---------|--------------------------------------|-----|-----------------------------|
| STATUS   | 61      | Indicate the module operation status | OD  | Require external pulling-up |

The following figure shows different design circuits of STATUS, you can choose either one according to your application demands.

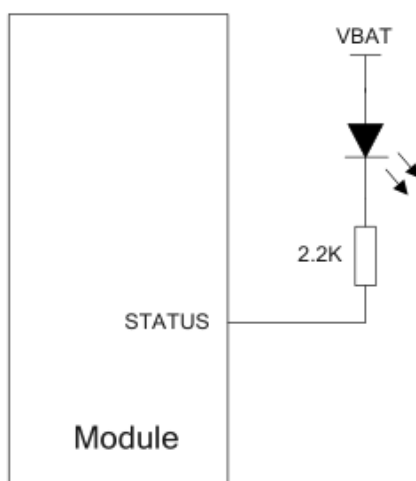


Figure 21 Reference circuit of STATUS

### 3.15 ADC Function

SLM750 provides two analogy- to-digital converters. Using AT+ADCREAD=1 to read the voltage value of ADC0. Using AT+ADCREAD=6 read the voltage value of ADC1.

Table 18: ADC pin description

| Pin name | Pin no. | Description                              | Voltage range | Resolution |
|----------|---------|------------------------------------------|---------------|------------|
| ADC0     | 45      | Analogy to digital converter interface 0 | 0.05 – 1.8V   | 15bits     |
| ADC1     | 44      | Analogy to digital converter interface 1 | 0.05 – 1.8V   | 15bits     |

NOTES: 1. The ADC interface cannot directly connect to any input voltage when the module is not powered by VBAT.

2. It is recommended that the ADC pin adopt the input of the voltage divider circuit.

### 3.16 SGMII Interface

SLM750 includes an integrated Ethernet MAC with an SGMII interface and two management interfaces (MDIO) , key features of the SGMII interface are shown below:

- IEEE802.3 compliance
- Full duplex at 1000Mbps
- Half/full duplex for 10/100Mbps
- Support VLAN tagging
- Support IEEE1588 and Precision Time Protocol (PTP)
- Can be used to connect to external Ethernet PHY like AR8033, or to an external switch
- MDIO supports dual voltage 1.8V/2.85V

Pin definitions of SGMII interface are as bellow:

Table 19: Pin definition of SGMII interface

| Pin name   | Pin no. | I/O | Description        | Comment                   |
|------------|---------|-----|--------------------|---------------------------|
| EPHY_RST_N | 119     | DO  | Ethernet PHY reset | 1.8V /2.85V power domain. |

|             |     |    |                                      |                                                                            |
|-------------|-----|----|--------------------------------------|----------------------------------------------------------------------------|
| EPHY_INT_N  | 120 | DI | Ethernet PHY interruption            | 1.8V /2.85V power domain.                                                  |
| SGMII_MDATA | 121 | IO | SGMII MDIO data                      | 1.8V/2.85V power domain.                                                   |
| SGMII_MCLK  | 122 | DO | SGMII MDIO clock                     |                                                                            |
| USIM2_VDD   | 128 | PO | SGMII MDIO power supply              | 1.8V/2.85V power domain, require external pull-up level for SGMII SDIO Pin |
| SGMII_TX_M  | 123 | AO | SGMII data transmit negative signals | Connect with a 0.1uF capacitor, close to the PHY side.                     |
| SGMII_TX_P  | 124 | AO | SGMII data transmit positive signals | Connect with a 0.1uF capacitor, close to the PHY side.                     |
| SGMII_RX_P  | 125 | AI | SGMII data receive positive signals  | Connect with a 0.1uF capacitor, close to the PHY side.                     |
| SGMII_RX_M  | 126 | AI | SGMII data receive negative signals  | Connect with a 0.1uF capacitor, close to the PHY side.                     |

The following figure shows the simplified block diagram for Ethernet application.

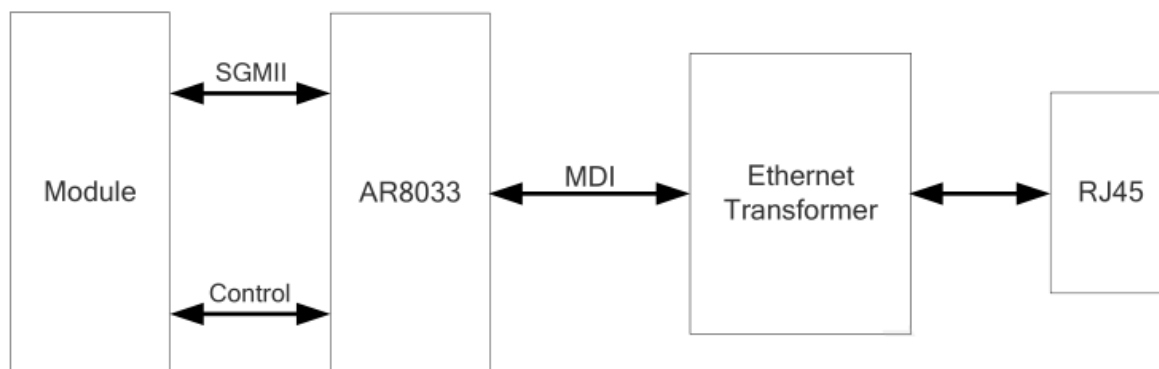


Figure 22 Simplified Block Diagram for Ethernet Application

The following figure shows a reference design of SGMII interface with PHY AR8033 application.

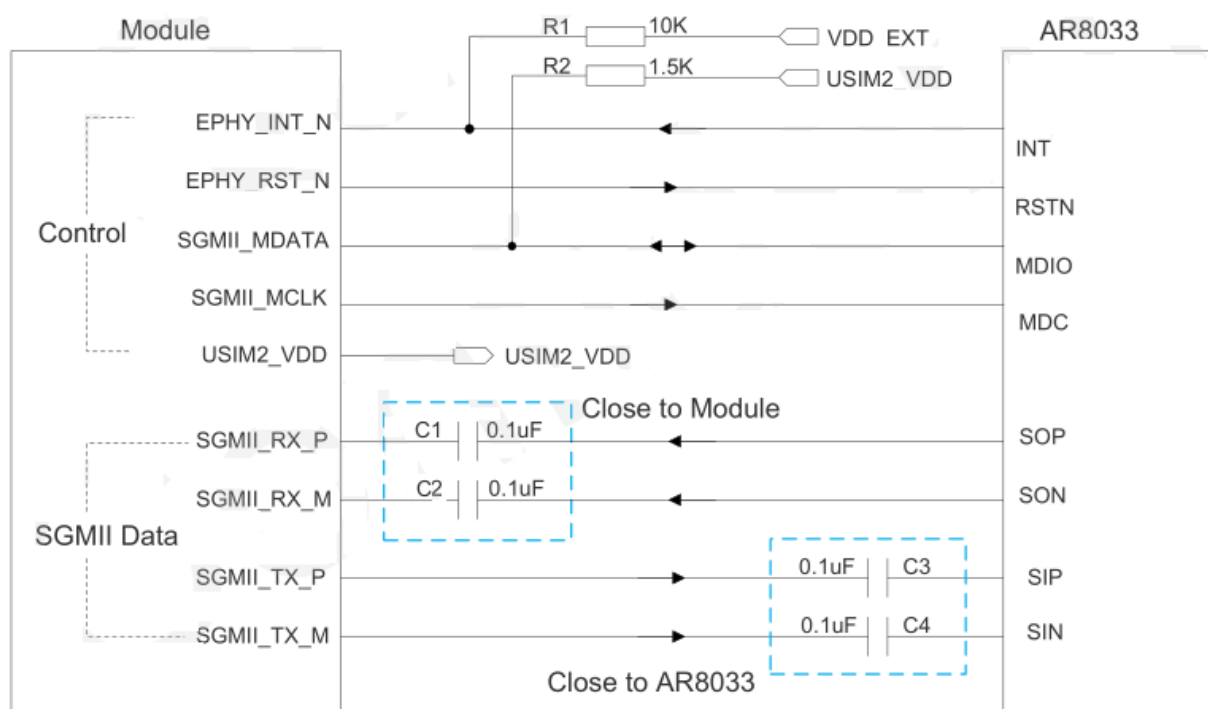


Figure 23 Reference Circuit of SGMII Interface with PHY AR8033 Application

In order to enhance the reliability and availability in your application, please follow the criteria below in the Ethernet PHY circuit design:

- Keep SGMII data and control signals away from RF and VBAT trace.
- Keep the maximum trace length less than 25.4cm and keep skew on the differential pairs less than 0.7mm.
- The differential impedance of SGMII data trace is 100 ohm $\pm$ 10%.
- SGMII RX/TX line spacing is at least 3 times width, SGMII signal distance from other signal lines is to maintain at least 3 times line width.
- SGMII RX modules already have 0.1uf capacitors and do not need to be added externally

### 3.17 Wireless Connectivity Interfaces

SLM750 supports a low-power SDIO 3.0 interface for WLAN and a PCM interface for BT. The following table shows the pin definition of wireless connectivity interfaces.

Table 20: Pin Definition of Wireless Connectivity Interfaces

| WLAN part                    |            |     |                                |                                           |
|------------------------------|------------|-----|--------------------------------|-------------------------------------------|
| Pin name                     | Pin number | I/O | Description                    | Note                                      |
| SDC1_DATA3                   | 129        | IO  | WLAN SDIO signal data line 3   | 1.8V power domain.                        |
| SDC1_DATA2                   | 130        | IO  | WLAN SDIO signal data line 2   | 1.8V power domain.                        |
| SDC1_DATA1                   | 131        | IO  | WLAN SDIO signal data line 1   | 1.8V power domain.                        |
| SDC1_DATA0                   | 132        | IO  | WLAN SDIO signal data line 0   | 1.8V power domain.                        |
| SDC1_CLK                     | 133        | DO  | WLAN SDIO signal clock         | 1.8V power domain.                        |
| SDC1_CMD                     | 134        | IO  | WLAN SDIO instruction signal   | 1.8V power domain.                        |
| WLAN_EN                      | 136        | DO  | WLAN enables                   | 1.8V power domain.                        |
| Coexistence and control part |            |     |                                |                                           |
| Pin name                     | Pin number | I/O | Description                    | Note                                      |
| PM_ENABLE                    | 127        | DO  | External 3.3V power control    | 1.8V power domain.                        |
| WLAN_SLP_CLK                 | 118        | DO  | WLAN sleep clock               | Output 32kHz clock                        |
| WAKE_ON_WIRELESS*            | 135        | DI  | WLAN wakes up the module       | 1.8V power domain, pending development    |
| COEX_UART_RX                 | 137        | DI  | LTE/WLAN&BT coexistence signal | 1.8V power domain.                        |
| COEX_UART_TX                 | 138        | DO  | LTE/WLAN&BT coexistence signal | 1.8V power domain.                        |
| BT part                      |            |     |                                |                                           |
| Pin name                     | Pin number | I/O | Description                    | Note                                      |
| BT_EN                        | 139        | DO  | Bluetooth enables.             | 1.8V power domain. Active high level.     |
| BT_RTS*                      | 37         | DO  | Request sending data           | 1.8V power domain, suspend it when unused |
| BT_TXD*                      | 38         | DO  | Bluetooth sends data           | 1.8V power domain.                        |
| BT_RXD*                      | 39         | DI  | Bluetooth receives data        | 1.8V power domain.                        |
| BT_CTS*                      | 40         | DI  | Bluetooth sending clearance    | 1.8V power domain.                        |
| PCM_IN                       | 24         | DI  | PCM data input                 | 1.8V power domain.                        |
| PCM_OUT                      | 25         |     | PCM data output                | 1.8V power domain.                        |
| PCM_CLK                      | 27         | IO  | PCM clock.                     | 1.8V power domain.                        |
| PCM_SYNC                     | 26         | IO  | PCM data synchronous           | 1.8V power domain.                        |

|  |  |  |         |  |
|--|--|--|---------|--|
|  |  |  | signal. |  |
|--|--|--|---------|--|

The following figure shows a reference design of Wireless Connectivity interfaces with SLM158 module.

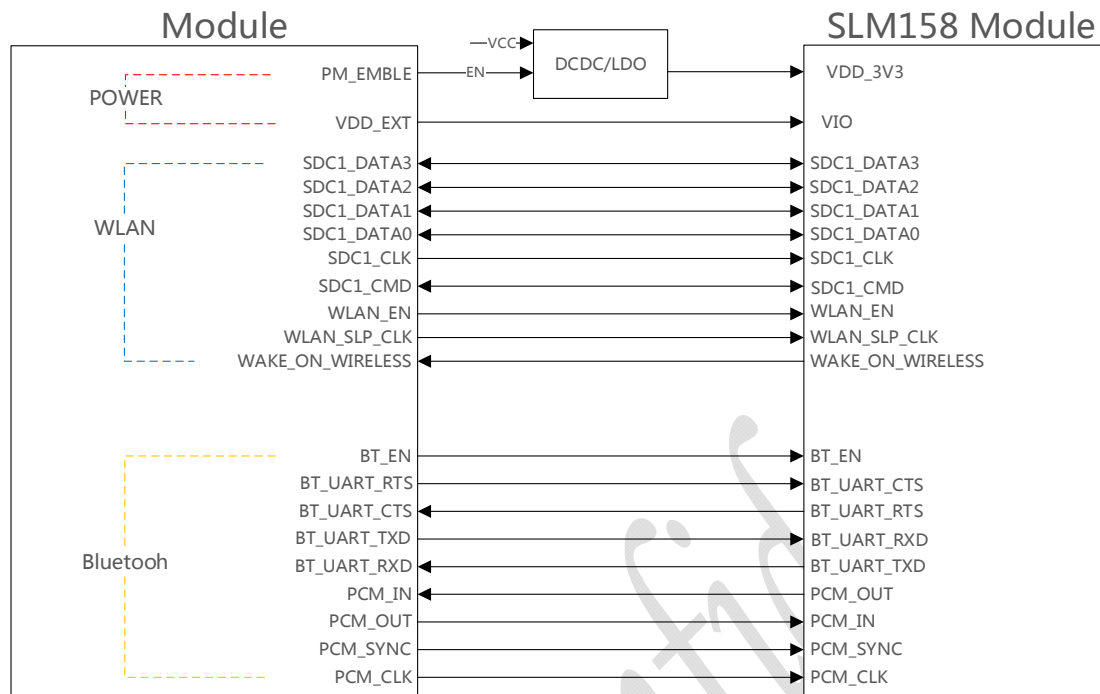


Figure 24 Reference Circuit of Wireless Connectivity Interfaces with SLM158

#### Note:

1. SLM158 can only be used as slave equipment.
2. When SLM750 modules enable Bluetooth, PCM\_SYNC and PCM\_CLK are used only for signal output.
3. The 24~27 pin is a multiplexed pin, which can be used for Codec voice or PCM connected to SLM750V to realize Bluetooth voice communication.
4. \*functionality is pending for development

### 3.17.1 WLAN Interface

SLM750 provides a low power SDIO 3.0 interface and control interface for WLAN design.

SDIO interface supports Single data rate mode, it maximum frequency is 50MHz.

As SDIO signals are very high-speed, in order to ensure the SDIO interface design corresponds with the SDIO 3.0 specification, please comply with the following principles:

- It is important to route the SDIO signal traces with total grounding. The impedance of SDIO

signal trace is 50 ohm ( $\pm 10\%$ ).

- Protect other sensitive signals/circuits (RF, analog signals, etc.) from SDIO corruption and protect SDIO signals from noisy signals (clocks, DCDCs, etc.).
- It is recommended to keep matching length between CLK and DATA/CMD less than 1mm and total routing length less than 50mm.
- Keep termination resistors within 15~24 ohm on clock lines near the module and keep the route distance from the module clock pins to termination resistors less than 5mm.

### 3.17.2 BT Interface

SLM750 supports UART and PCM interface for BT application. Further information about BT interface will be added in future version of this document.

## 3.18 SD Card Interface

SLM750 provides a SD card interface which supports SD 3.0 protocol. The following tables show the pin definition.

Table 21: Pin Definition of the SD Card Interface

| Pin name | Pin number | I/O | Description                         | Note                                                                                                                                                      |
|----------|------------|-----|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| SD_CMD   | 33         | IO  | SD card SDIO bus instruction signal | SDIO signal level can be selected according to the signal level supported by SD card. Please refer to SD3.0 protocol for details. suspend it when no used |
| SD_CLK   | 32         | DO  | SD card SDIO bus clock signal       | SDIO signal level can be selected according to the signal level supported by SD card. Please refer to SD3.0 protocol for details. suspend it when no used |
| SD_DATA3 | 28         | IO  | SD card SDIO signal data line 3     | SDIO signal level can be selected according to the signal level supported by SD card. Please refer to SD3.0 protocol for details. suspend it when no used |
| SD_DATA2 | 29         | IO  | SD card SDIO signal data line 2     | SDIO signal level can be selected according to the signal level supported by SD card. Please refer to SD3.0 protocol for details. suspend it when no used |

|            |     |    |                                         |                                                                                                                                                           |
|------------|-----|----|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| SD_DATA1   | 30  | IO | SD card SDIO signal data line 1         | SDIO signal level can be selected according to the signal level supported by SD card. Please refer to SD3.0 protocol for details. suspend it when no used |
| SD_DATA0   | 130 | IO | SD card SDIO signal data line 0         | SDIO signal level can be selected according to the signal level supported by SD card. Please refer to SD3.0 protocol for details. suspend it when no used |
| VDD_SDIO   | 34  | PO | SD card SDIO bus pulled up power supply | The output 2.85V/1.8V is configurable. Cannot be used for SD card power supply, suspend it when no used                                                   |
| SD_INS_DET | 23  | DI | SD card insert detection                | 1.8V power domain, suspend it when unused                                                                                                                 |

The following figure shows a reference design of SD card interface.

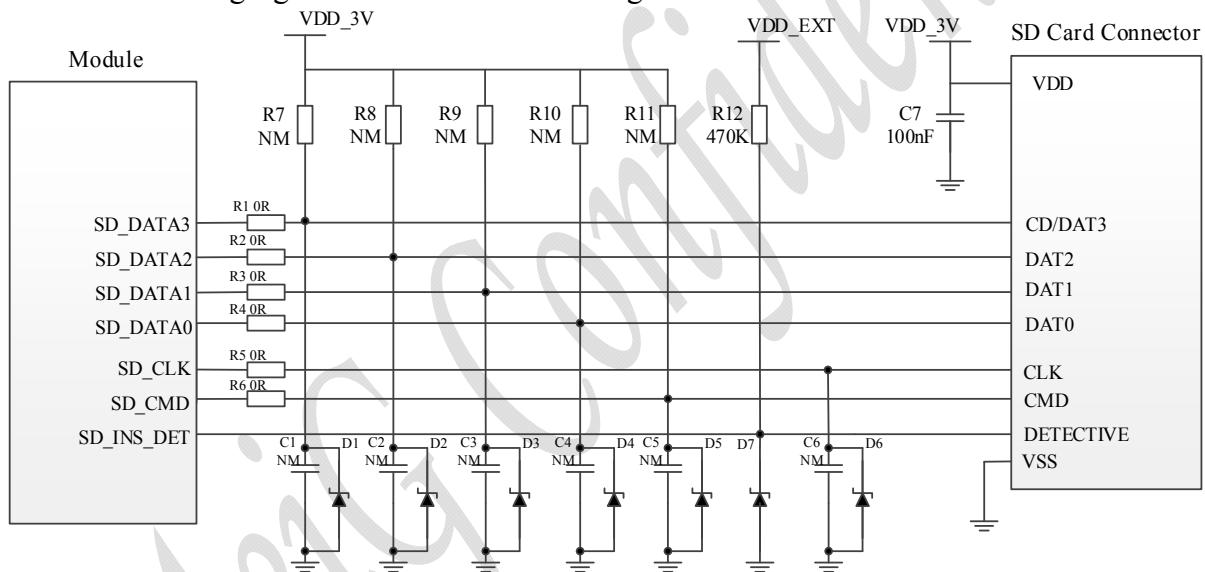


Figure 25 Reference Circuit of SD Card Application

In the circuit design of SD card interface, in order to ensure the good performance and reliability of SD card, the following principles are recommended in circuit design:

- The voltage range of SD card power supply VDD\_3V is 2.7~3.6V and a sufficient current up to 0.8A should be provided. As the maximum output current of VDD\_SDIO is 50mA which can only be used for SDIO pull-up resistors, an externally power supply is needed for SD card.
- To maximally limit the surge current caused by SD card insertion, the bypass capacitor (C7) of SD card power source should not exceed 5uF.
- To avoid jitter of bus, resistors R7~R11 are needed to pull up the SDIO to VDD\_SDIO. Value of these resistors is among 10~100kohm and the recommended value is 100kohm.
- In order to improve signal quality, it is recommended to add 0 ohm resistors R1~R6 in series

between the module and the SD card. The bypass capacitors C1~C6 are reserved with no mounting by default. All resistors and bypass capacitors should be placed close to the module.

- In order to offer good ESD protection, it is recommended to add TVS on SD card pins.
- It is important to route the SDIO signal traces with total grounding. The impedance of SDIO data trace is 50 ohm ( $\pm 10\%$ ).
- Keep SDIO signals far away from other sensitive circuits/signals such as RF circuits, analog signals, etc., as well as noisy signals such as clock signals, DCDC signals, etc.
- It is recommended to keep the trace length difference between CLK and DATA/CMD less than 1mm and the total routing length less than 50mm. The total trace length inside the module is 27mm, so the exterior total trace length should be less than 23mm.
- Make sure the adjacent trace spacing is two times of the trace width and the bus capacitance is less than 15pF.

### 3.19 USB\_BOOT Interface

SLM750 supports USB\_BOOT functionality. The customer can pull the USB\_BOOT to VDD\_EXT (1.8 V) before the module is turned on, and the module will enter mandatory download mode when boots. In this mode, the module can be upgraded through the USB interface.

Table 22: Pin Definition of USB\_BOOT Interface

| Pin name | Pin number | I/O | Description                                        | Note                                                                                      |
|----------|------------|-----|----------------------------------------------------|-------------------------------------------------------------------------------------------|
| USB_BOOT | 115        | DI  | Emergency download mode control, high level active | 1.8V power supply domain, it is recommended to reserve test points; suspend when no used. |

The following figure shows reference Circuit of USB\_ROOT Interface:

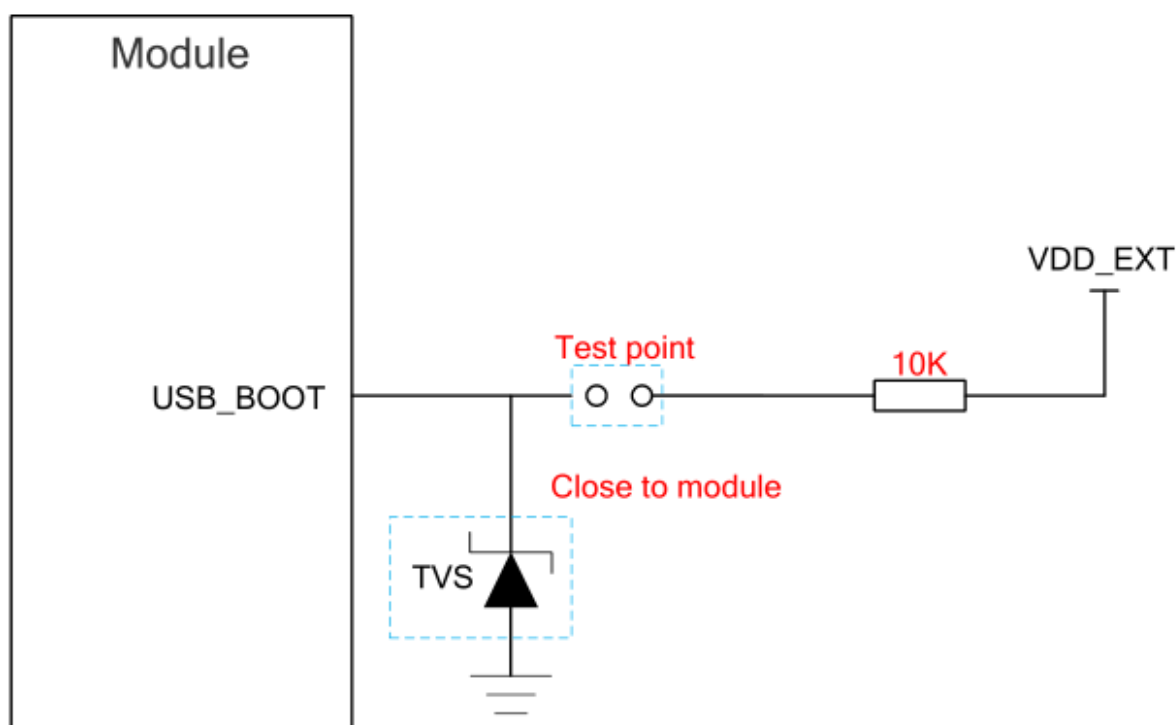


Figure 26 Circuit of USB\_ROOT Interface

## 4 GNSS

### 4.1 General Description

SLM750 includes an integrated embedded GNSS solution that supports Gen8C-Lite of Qualcomm (GPS, GLONASS, BeiDou).

SLM750 supports standard NMEA-01830183 protocol, and outputs NMEA sentences with 1Hz via USB interface by default.

### 4.2 GNSS Performance

The following table shows SLM750 GNSS performance.

Table 23: GNSS performance

| Parameter            | Description | Performance index   |
|----------------------|-------------|---------------------|
| Positioning accuracy | Horizon     | <2m(50%); <5m (90%) |

|                                |                                        |                      |
|--------------------------------|----------------------------------------|----------------------|
| (open)                         | Altitude                               | <4m (50%); <8m (90%) |
| Speed accuracy                 | Speed                                  | <0.2m/s              |
| First positioning time<br>TTFF | Cold start                             | 32s                  |
|                                | Warm start                             | 29s                  |
|                                | Hot start                              | 2s                   |
| Sensitivity                    | Capturing                              | -154dBm              |
|                                | Tracking                               | -156dBm              |
| Serial output baud rate        | 300bit/s~230400bit/s                   |                      |
| GPS receiving                  | 12 channel,GPS L1(1575.42MHz),C/A code |                      |
| Data update rate               | 1Hz                                    |                      |
| Data format                    | NMEA 0183                              |                      |

### 4.3 Layout Guideline

You need to follow the layout guidelines in the below when designing:

- Maximize the distance between the GNSS antenna, the main antenna and the diversity antenna.
- Noisy digital circuits such as the USIM card, USB interface, Camera module, Display connector and SD card should be kept away from the antenna.
- Use ground vias around the GNSS trace and sensitive analog signal traces to provide isolation and protection.
- Keep 50ohm characteristics impedance of the ANT\_GNSS trace.

See Chapter 5 for GNSS reference design and antenna consideration.

## 5 Antenna Interface

Table 24: RF antenna pin definition

| Pin name | Pin no. | Description       | I/O | Note          |
|----------|---------|-------------------|-----|---------------|
| ANT_MAIN | 49      | Main antenna      | IO  | 50Ω impedance |
| ANT_DIV  | 35      | Diversity antenna | AI  | 50Ω impedance |
| ANT_GNSS | 47      | GNSS antenna      | AI  | 50Ω impedance |

### 5.1 Antenna Interface

SLM750 provides 3 antenna pins: ANT\_MAIN, ANT\_DIV, ANT\_GNSS. Select connection

diversity antenna to improve WCDMA/TDD-LTE/FDD-LTE receiving performance of the product.

It is recommended that you use a 50Ω impedance antenna that matches the RF connector of the module.

**Special note: In order to ensure the communication ability of all frequency bands, connect both the main and the auxiliary antennas.**

It is suggested that you chose RF adapter carefully on application end. It is necessary to select the smallest possible loss of the RF adapter, and the recommended RF adapters are as follows:

- GSM900/850<1.5dB
- DCS1800/PCS1900<1.5dB
- CDMA/EVDO<1dB
- WCDMA<1.5dB
- TD-SCDMA<1.5dB
- TD-LTE<1.5dB
- FDD LTE<1.5dB

## 5.2 RF Reference Circuit

ANT\_MAIN and ANT\_DIV antenna connection reference design circuit are shown as below. In order to gain better RF performance, you need to reserve n type matching circuit without mounting capacitor.

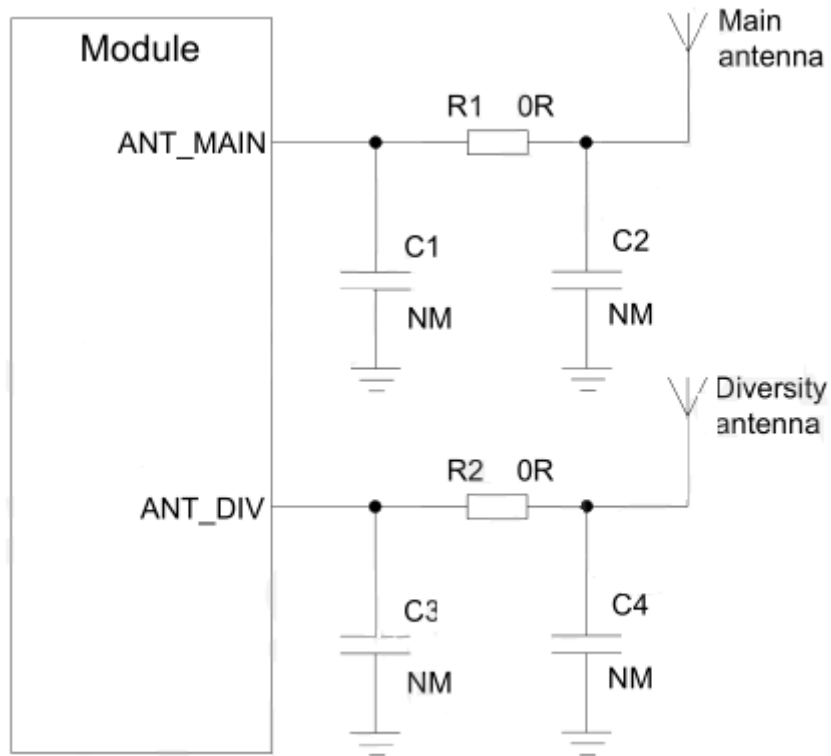


Figure 27 RF reference circuit

GNSS antenna reference design is shown as below:

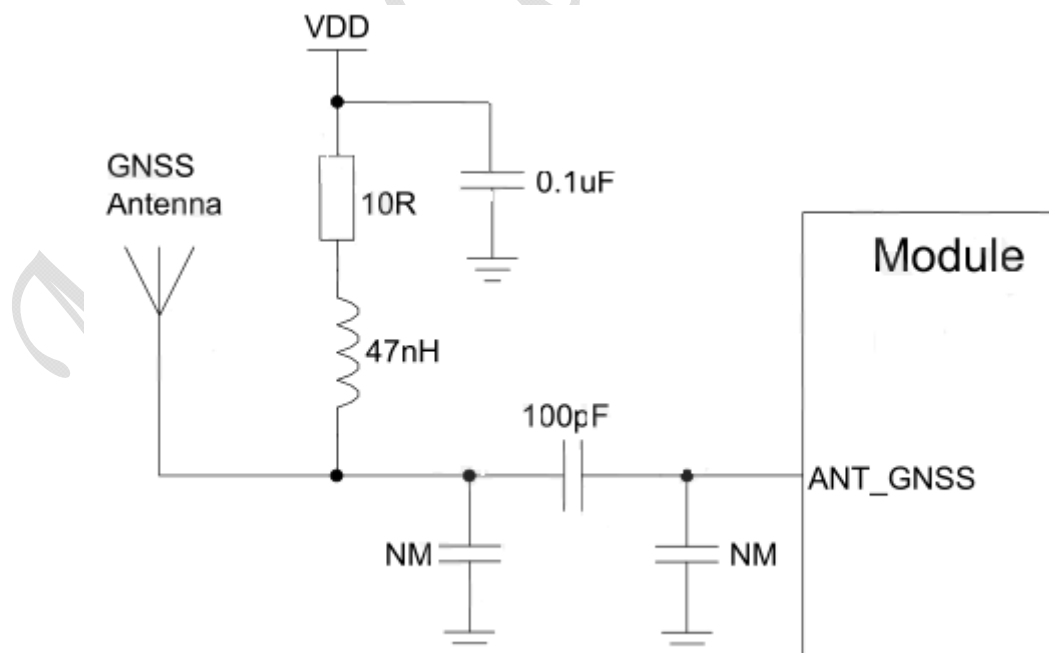


Figure 28 GNSS antenna reference circuit

### Note:

1. You can choose external LDO power supply according to active antenna.
2. You can choose passive antenna design so you do not need to design VDD circuit.

## 5.3 Antenna Installation

### 5.3.1 Antenna requirements

The main antenna, diversity antenna and GNSS antenna requirements are as follows:

Table 25: Antenna requirements

| Type                                           | Requirement                                                                                                            |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| GNSS                                           | Frequency range: 1561-1615MHz                                                                                          |
|                                                | Polarization: RHCP or linear                                                                                           |
|                                                | VSWR: < 2(Typ.)                                                                                                        |
|                                                | Passive antenna gain: > 0 dBi                                                                                          |
|                                                | Active antenna noise coefficient: < 1.5 dB                                                                             |
|                                                | Active antenna gain: < -2 dBi                                                                                          |
|                                                | Active antenna embedded LNA gain: 18.5dB(Typical value)                                                                |
|                                                | Active antenna total gain: > 18.5 dB(Typical value)                                                                    |
| GSM/WCDMA<br>/TD-SCDMA/CDMA /TD-LTE/FDD<br>LTE | VSWR: < 2                                                                                                              |
|                                                | Gain(dBi): 1                                                                                                           |
|                                                | Maximum input power(W): 50                                                                                             |
|                                                | Input impedance(ohm): 50                                                                                               |
|                                                | Polarization type: vertical                                                                                            |
|                                                | Cable insertion loss: < 1.5dB<br>(GSM850/900,WCDMA B5/B8, CDMA BC0,<br>LTE B5/ B8/B12/B13/B17/B20/B26)                 |
|                                                | Cable insertion loss: < 1.5dB<br>(GSM1800/1900,WCDMA B1/B2/B4, TD-SCDMA B34/B39,<br>LTE B1/B2/B3/B4/B25/B39, CMDA BC1) |
|                                                | Cable insertion loss: < 2dB<br>(LTE B7/B38/B40/B41)                                                                    |

### 5.3.2 RF output power

RF output power of **SLM750** is shown as below:

Table 26: RF output power

| Network mode | Band        | Max                | Min                    |
|--------------|-------------|--------------------|------------------------|
| GSM          | 900(GMSK)   | 33dBm $\pm$ 2dB    | 5dBm $\pm$ 5dB         |
|              | 1800(GMSK)  | 30dBm $\pm$ 2dB    | 0dBm $\pm$ 5dB         |
|              | 900(8-PSK)  | 27dBm $\pm$ 3dB    | 5dBm $\pm$ 5dB         |
|              | 1800(8-PSK) | 26dBm +3/-4dB      | 0dBm $\pm$ 5dB         |
| CDMA         | BC0         | 23-30dBm           | $\leq$ -50 dBm/1.23MHz |
| EVDO         | BC0         | 23-30dBm           | $\leq$ -50 dBm/1.23MHz |
| WCDMA        | Band1       | 24dBm +1/-3dB      | -56dBm $\pm$ 9dB       |
|              | Band8       | 24dBm +1/-3dB      | -56dBm $\pm$ 9dB       |
| TD-SCDMA     | Band34      | 24dBm +1/-3dB      | $\leq$ -40 dBm         |
|              | Band39      | 24dBm +1/-3dB      | $\leq$ -40 dBm         |
| TD-LTE       | Band38      | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band39      | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band40      | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band41      | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
| FDD LTE      | Band1       | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band3       | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band5       | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band8       | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |
|              | Band28      | 23dBm $\pm$ 2.7 dB | $\leq$ -40 dBm         |

### 5.3.3 RF receiving sensitivity

Table 27: RF receiving sensitivity

| Network mode | Band         | Main     | Diversity     |
|--------------|--------------|----------|---------------|
| GSM          | 900          | -109dBm  | Not Supported |
|              | 1800         | -108dBm  | Not Supported |
| WCDMA        | Band1        | -109dBm  | Not Supported |
|              | Band5        | -110dBm  | Not Supported |
|              | Band8        | -110dBm  | Not Supported |
| TD-SCDMA     | Band34       | -109dBm  | Not Supported |
|              | Band39       | -109dBm  | Not Supported |
| TD-LTE       | Band38 (10M) | -98dBm   | -98dBm        |
|              | Band39 (10M) | -98dBm   | -98dBm        |
|              | Band40 (10M) | -98dBm   | -98dBm        |
|              | Band41 (10M) | -96.5dBm | -97dBm        |
| FDD LTE      | Band1        | -98dBm   | -99dBm        |
|              | Band3        | -98dBm   | -98dBm        |
|              | Band5        | -99dBm   | -99dBm        |
|              | Band8        | -99dBm   | -99dBm        |

### 5.3.4 Operating frequency

Table 28: Operating frequency

| Network mode | Band      | Receive      | Transmit     |
|--------------|-----------|--------------|--------------|
| GSM          | 850       | 869~894MHz   | 824~849MHz   |
|              | 900       | 925~960MHz   | 880~915MHz   |
|              | 1800(DCS) | 1805~1880MHz | 1710~1785MHz |
|              | 1900(PCS) | 1930~1990MHz | 1850~1910MHz |
| WCDMA        | Band1     | 2110~2170MHz | 1920~1980MHz |
|              | Band8     | 926~960MHz   | 880~915MHz   |
| TD-SCDMA     | Band34    | 2010~2025MHz | 2010~2025MHz |
|              | Band39    | 1880~1920MHz | 1880~1920MHz |
| TD-LTE       | Band38    | 2570~2620MHz | 2570~2620MHz |
|              | Band39    | 1880~1920MHz | 1880~1920MHz |
|              | Band40    | 2300~2400MHz | 2300~2400MHz |
|              | Band41    | 2555~2655MHz | 2550~2650MHz |
| FDD LTE      | Band1     | 2110~2170MHz | 1920~1980MHz |
|              | Band3     | 1805~1880MHz | 1710~1785MHz |
|              | Band5     | 869~894MHz   | 824~849MHz   |
|              | Band28    | 925~960MHz   | 880~915MHz   |
| CDMA         | BC0       | 758~803MHz   | 703~748MHz   |
| EVDO         | BC0       | 869~894MHz   | 824~849MHz   |

### 5.3.5 Antenna requirements

Table 29: Antenna requirements

| Network Mode | Band      | VSWR    | Gain  |        | Effi. | SAR       | TRP (dBm) | TIS (dBm) |
|--------------|-----------|---------|-------|--------|-------|-----------|-----------|-----------|
|              |           |         | Peak  | Avg.   |       |           |           |           |
| GSM          | 850       | <2.5: 1 | >0dBi | >-4dBi | >40%  | <1.6 W/Kg | 29        | <-102     |
|              | 900       |         |       |        |       |           | 26        | <-102     |
|              | 1800(DCS) |         |       |        |       |           |           | <-102     |
|              | 1900(PCS) |         |       |        |       |           |           | <-102     |
| WCDMA        | Band1     |         |       |        |       |           | 19        | <-102     |
|              | Band8     |         |       |        |       |           | 19        | <-104     |
| CDMA         | BC0       |         |       |        |       |           | 19        | <-104     |
| EVDO         | BC0       |         |       |        |       |           | 19        | <-104     |
| TD-SCDMA     | Band34    |         |       |        |       |           | 19        | <-104     |
|              | Band39    |         |       |        |       |           | 19        | <-104     |
| TD-LTE       | Band38    |         |       |        |       |           | 19        | <-94      |

|         |        |  |  |  |  |  |    |      |
|---------|--------|--|--|--|--|--|----|------|
| FDD LTE | Band39 |  |  |  |  |  | 19 | <-94 |
|         | Band40 |  |  |  |  |  | 19 | <-94 |
|         | Band41 |  |  |  |  |  | 19 | <-94 |
|         | Band1  |  |  |  |  |  | 19 | <-92 |
|         | Band3  |  |  |  |  |  | 19 | <-93 |
|         | Band5  |  |  |  |  |  | 19 | <-92 |
|         | Band8  |  |  |  |  |  | 19 | <-92 |
|         | Band28 |  |  |  |  |  | 19 | <-92 |

Table 30: Diversity antenna requirements

| Mode    | Band   | VSWR    | Gain /Avg. | Efficiency | $\rho$ | Isolation |
|---------|--------|---------|------------|------------|--------|-----------|
| WCDMA   | Band1  | <2.5: 1 | >-7dBi     | >20%       | <0.5   | <-8dB     |
|         | Band8  |         |            |            |        |           |
| TD-LTE  | Band38 |         |            |            |        |           |
|         | Band39 |         |            |            |        |           |
|         | Band40 |         |            |            |        |           |
|         | Band41 |         |            |            |        |           |
| FDD LTE | Band1  |         |            |            |        |           |
|         | Band3  |         |            |            |        |           |
|         | Band5  |         |            |            |        |           |
|         | Band8  |         |            |            |        |           |
|         | Band28 |         |            |            |        |           |

## 6 Electrical characteristics

### 6.1 Limit voltage range

Limit voltage range refers to the maximum voltage range of the module's power supply voltage as well as the digital and analog input/output interfaces. Operate beyond the range may cause damage to the product.

Limit voltage range of SLM750 are shown as below:

Table 31: Limit voltage range

| Parameter | Description                         | Min | Type | Max | Unit |
|-----------|-------------------------------------|-----|------|-----|------|
| VBAT      | SLM750V power supply                | 3.3 | 3.8  | 4.2 | V    |
|           | Average power supply current of RMS | 0   |      | 0.9 | A    |
|           | VBAT_BB maximum current             | 0   |      | 0.8 | A    |

|          |                                                                          |       |     |      |    |
|----------|--------------------------------------------------------------------------|-------|-----|------|----|
|          | VBAT_RF maximum current                                                  | 0     |     | 1.8  | A  |
|          | Instantaneous voltage drop<br>(GSM 900 Maximum transmission power level) |       |     | 400  | mV |
| USB_VBUS | USB detection                                                            | 3.0   | 5.0 | 5.25 | V  |
| GPIO     | Level power supply voltage of digital IO                                 | -0.3  | 1.8 | 2.0  | V  |
|          | Power supply voltage of shutdown mode                                    | -0.25 |     | 0.25 | V  |

## 6.2 Temperature range

It is recommended that you use SLM750 at  $-30^{\circ}\text{C}\sim+75^{\circ}\text{C}$  and take temperature control measures when applications are in the harsh environment conditions. At the same time, a limited operating temperature range of the module should be provided. Under this temperature conditions, some of the indicators may exceed. It is suggested that you store the applications under certain temperature conditions. Modules beyond this range may not work or are damaged.

Table 32: Temperature range

| Parameter                     | Min     | Type | Max    | Unit               |
|-------------------------------|---------|------|--------|--------------------|
| Operation temperature         | -30     | +25  | +75    | $^{\circ}\text{C}$ |
| Limited operation temperature | -40~-30 |      | 75~+85 | $^{\circ}\text{C}$ |
| Storage temperature           | -45     |      | +90    | $^{\circ}\text{C}$ |

## 6.3 Electrical Characteristics of Interface Operation Status

VL: logical low level

VH: logical high level

Table 33: Logical level of normal digital IO signal

| Signal         | VL   |                                  | VH                               |                       | Unit |
|----------------|------|----------------------------------|----------------------------------|-----------------------|------|
|                | Min  | Max                              | Min                              | Max                   |      |
| Digital input  | -0.3 | $0.3 \times V_{\text{pin\_min}}$ | $0.3 \times V_{\text{pin\_max}}$ | $V_{\text{pin\_max}}$ | V    |
| Digital output | GND  | 0.2                              | $V_{\text{pin\_min}} - 0.2$      | $V_{\text{pin}}$      | V    |

Note:  $V_{\text{pin\_min}}=1.45\text{V}$ ,  $V_{\text{pin\_max}}=2.0\text{V}$  ( $V_{\text{pin}}$  is high level digital interface,  $V_{\text{pin}}=1.8\text{V}$ )

Table 34: Electrical characteristics in power supply status

| Parameter | I/O | Min      | Type     | Max      | Unit |
|-----------|-----|----------|----------|----------|------|
| VBAT      | I   | 3.3      | 3.8      | 4.2      | V    |
| USIM_VDD  | O   | 1.7/2.75 | 1.8/2.85 | 1.9/2.95 | V    |

## 6.4 Module Power Consumption Range

The following table shows the consumption of SLM750 in various modes. Contact us if you need more information about the band.

Table 35: Consumption

| PARAMETER | DESCRIPTION    | CONDITION                             | VALUE | UNIT |
|-----------|----------------|---------------------------------------|-------|------|
| IVBAT     | Shut Down mode | Module shutdown leakage               | 12    | uA   |
|           | Sleep mode     | AT+CFUN=0 (USB disconnected)          | 2.2   | mA   |
|           |                | GSM 900 DRX=2 (USB disconnected)      | 2.1   | mA   |
|           |                | GSM 900 DRX=9 (USB disconnected)      | 2.25  | mA   |
|           |                | DCS1800 DRX=2 (USB disconnected)      | 2.2   | mA   |
|           |                | DCS1800 DRX=9 (USB disconnected)      | 2.3   | mA   |
|           |                | GSM 850 DRX=2 (USB disconnected)      | 2.3   | mA   |
|           |                | GSM 850 DRX=9 (USB disconnected)      | 2.35  | mA   |
|           |                | WCDMA Band 1 PF=128(USB disconnected) | 2.2   | mA   |
|           |                | WCDMA Band 5 PF=128(USB disconnected) | 2.01  | mA   |
|           |                | WCDMA Band 8 PF=128(USB disconnected) | 2.06  | mA   |
|           |                | WCDMA Band 1 PF=51 (USB disconnected) | 2.3   | mA   |
|           |                | WCDMA Band 5 PF=512(USB disconnected) | 2.13  | mA   |
|           |                | WCDMA Band 8 PF=512(USB disconnected) | 2.2   | mA   |

|  |           |                                             |              |    |
|--|-----------|---------------------------------------------|--------------|----|
|  |           | LTE-TDD Band 38<br>PF=128(USB disconnected) | 2.3<br>2.1   | mA |
|  |           | LTE-TDD Band 39<br>PF=128(USB disconnected) | 2.15<br>2.26 |    |
|  |           | LTE-TDD Band 40<br>PF=128(USB disconnected) |              |    |
|  |           | LTE-TDD Band 41<br>PF=128(USB disconnected) |              |    |
|  |           | LTE-TDD Band 38<br>PF=256(USB disconnected) | 2.1<br>2.12  | mA |
|  |           | LTE-TDD Band 39<br>PF=256(USB disconnected) | 2.2<br>2.34  |    |
|  |           | LTE-TDD Band 40<br>PF=256(USB disconnected) |              |    |
|  |           | LTE-TDD Band 41<br>PF=256(USB disconnected) |              |    |
|  |           | LTE-FDD Band 1<br>PF=128(USB disconnected)  | 2.02<br>2.1  | mA |
|  |           | LTE-FDD Band 3<br>PF=128(USB disconnected)  | 2.16<br>2.1  |    |
|  |           | LTE-FDD Band 5<br>PF=128(USB disconnected)  | 2.2          |    |
|  |           | LTE-FDD Band 8<br>PF=128(USB disconnected)  |              |    |
|  |           | LTE-FDD Band 20<br>PF=128(USB disconnected) |              |    |
|  |           | LTE-FDD Band 1<br>PF=256(USB disconnected)  | 1.98<br>2    |    |
|  |           | LTE-FDD Band 3<br>PF=256(USB disconnected)  | 2.13<br>2.25 |    |
|  |           | LTE-FDD Band 5<br>PF=256(USB disconnected)  | 2.06         |    |
|  |           | LTE-FDD Band 8<br>PF=256(USB disconnected)  |              |    |
|  |           | LTE-FDD Band 20<br>PF=256(USB disconnected) |              |    |
|  | Idle mode | GSM 900 DRX=5 (USB disconnected)            | 19.2<br>32   | mA |
|  |           | GSM 900 DRX=5 (USB connected)               |              |    |
|  |           | DCS1800 DRX=5 (USB disconnected)            | 20<br>35.2   | mA |
|  |           | DCS1800 DRX=5 (USB connected)               |              |    |

|  |  |                                          |      |    |
|--|--|------------------------------------------|------|----|
|  |  | GSM 850 DRX=5 (USB disconnected)         | 19.8 | mA |
|  |  | GSM 850 DRX=5 (USB connected)            | 38.6 |    |
|  |  | WCDMA Band 1 PF=64(USB disconnected)     | 19.2 | mA |
|  |  | WCDMA Band 1 PF=64(USB connected)        | 39.2 |    |
|  |  | WCDMA Band 5 PF=64(USB disconnected)     | 20.2 | mA |
|  |  | WCDMA Band 5 PF=64(USB connected)        | 39.6 |    |
|  |  | WCDMA Band 8 PF=64(USB disconnected)     | 18.6 | mA |
|  |  | WCDMA Band 8 PF=64(USB connected)        | 38.7 |    |
|  |  | TD-SCDMA Band 34 PF=64(USB disconnected) | 21   | mA |
|  |  | TD-SCDMA Band 34 PF=64(USB connected)    | 33.6 |    |
|  |  | TD-SCDMA Band 39 PF=64(USB disconnected) | 25   | mA |
|  |  | TD-SCDMA Band 39 PF=64(USB connected)    | 36.8 |    |
|  |  | LTE-TDD Band 38 PF=64(USB disconnected)  | 20.9 | mA |
|  |  | LTE-TDD Band 38 PF=64(USB connected)     | 45.1 |    |
|  |  | LTE-TDD Band 39 PF=64(USB disconnected)  | 21.3 | mA |
|  |  | LTE-TDD Band 39 PF=64(USB connected)     | 43.6 |    |
|  |  | LTE-TDD Band 40 PF=64(USB disconnected)  | 23   | mA |
|  |  | LTE-TDD Band 40 PF=64(USB connected)     | 45.8 |    |
|  |  | LTE-TDD Band 41 PF=64(USB disconnected)  | 20.5 | mA |
|  |  | LTE-TDD Band 41 PF=64(USB connected)     | 43.2 |    |
|  |  | LTE-FDD Band 1 PF=64(USB disconnected)   | 22.8 | mA |
|  |  | LTE-FDD Band 1 PF=64(USB connected)      | 46.9 |    |

|  |                                     |                         |       |    |
|--|-------------------------------------|-------------------------|-------|----|
|  |                                     | LTE-FDD Band 3          | 28    | mA |
|  |                                     | PF=64(USB disconnected) | 48.5  |    |
|  |                                     | LTE-FDD Band 3          |       |    |
|  |                                     | PF=64(USB connected)    |       |    |
|  |                                     | LTE-FDD Band 5          | 27.6  | mA |
|  |                                     | PF=64(USB disconnected) | 49.2  |    |
|  |                                     | LTE-FDD Band 5          |       |    |
|  |                                     | PF=64(USB connected)    |       |    |
|  |                                     | LTE-FDD Band 8          | 24.9  | mA |
|  |                                     | PF=64(USB disconnected) | 48.6  |    |
|  |                                     | LTE-FDD Band 8          |       |    |
|  |                                     | PF=64(USB connected)    |       |    |
|  |                                     | LTE-FDD Band 20         | 22.7  | mA |
|  |                                     | PF=64(USB disconnected) | 49.8  |    |
|  |                                     | LTE-FDD Band 20         |       |    |
|  |                                     | PF=64(USB connected)    |       |    |
|  | GPRS data transfer(GNSS shut down)  | GSM900 4DL/1UL@30.4dBm  | 154.4 | mA |
|  |                                     | GSM900 3DL/2UL@30.4dBm  | 228.7 | mA |
|  |                                     | GSM900 2DL/3UL@30.3dBm  | 295.2 | mA |
|  |                                     | GSM900 1DL/4UL@30.1dBm  | 379.3 | mA |
|  |                                     | DCS1800 4DL/1UL@25.2dBm | 269.4 | mA |
|  |                                     | DCS1800 3DL/2UL@23.7dBm | 176.9 | mA |
|  |                                     | DCS1800 2DL/3UL@23.8dBm | 224.1 | mA |
|  |                                     | DCS1800 1DL/4UL@23.7dBm | 264.8 | mA |
|  |                                     | GSM850 4DL/1UL@30.9dBm  | 156.2 | mA |
|  |                                     | GSM850 3DL/2UL@30.8dBm  | 230   | mA |
|  |                                     | GSM850 2DL/3UL@30.8dBm  | 305.3 | mA |
|  |                                     | GSM850 1DL/4UL@30.7dBm  | 388.2 | mA |
|  | EDGE data transfer (GNSS shut down) | GSM900 4DL/1UL@27.4dBm  | 175.9 | mA |
|  |                                     | GSM900 3DL/2UL@27.2dBm  | 277.7 | mA |
|  |                                     | GSM900 2DL/3UL@27.1dBm  | 367.7 | mA |
|  |                                     | GSM900 1DL/4UL@26.9dBm  | 479.8 | mA |
|  |                                     | DCS1800 4DL/1UL@24.8dBm | 151.8 | mA |
|  |                                     | DCS1800                 | 222.1 | mA |

|  |                   |      |                             |         |       |    |
|--|-------------------|------|-----------------------------|---------|-------|----|
|  |                   |      | 3DL/2UL@28.8dBm             |         |       |    |
|  |                   |      | DCS1800<br>2DL/3UL@24.63dBm |         | 295.5 | mA |
|  |                   |      | DCS                         | 1800    | 363.2 | mA |
|  |                   |      | 1DL/4UL@23.6dBm             |         |       |    |
|  |                   |      | GSM                         | 850     | 186.3 | mA |
|  |                   |      | 4DL/1UL@25.7dBm             |         |       |    |
|  |                   |      | GSM                         | 850     | 282.3 | mA |
|  |                   |      | 3DL/2UL@25.3dBm             |         |       |    |
|  |                   |      | GSM                         | 850     | 381.1 | mA |
|  |                   |      | 2DL/3UL@25.3dBm             |         |       |    |
|  |                   |      | GSM                         | 850     | 482.7 | mA |
|  |                   |      | 1DL/4UL@25.3dBm             |         |       |    |
|  | WCDMA<br>transfer | data | WCDMA                       | Band 1  | 434.7 | mA |
|  |                   |      | HSDPA@23.274dBm             |         |       |    |
|  |                   |      | WCDMA                       | Band 1  | 426   | mA |
|  |                   |      | HSUPA@23.273dBm             |         |       |    |
|  |                   |      | WCDMA                       | Band 5  | 529.6 | mA |
|  |                   |      | HSDPA@23.197dBm             |         |       |    |
|  | LTE<br>transfer   | data | WCDMA                       | Band 5  | 512.9 | mA |
|  |                   |      | HSUPA@23.197dBm             |         |       |    |
|  |                   |      | WCDMA                       | Band 8  | 508.2 | mA |
|  |                   |      | HSDPA@23.374dBm             |         |       |    |
|  |                   |      | WCDMA                       | Band 8  | 495   | mA |
|  |                   |      | HSUPA@23.374dBm             |         |       |    |
|  |                   |      | FDD- LTE                    | Band 1  | 497.2 | mA |
|  |                   |      | 10M@22.20dBm                |         |       |    |
|  |                   |      | FDD- LTE                    | Band 3  | 600.3 | mA |
|  |                   |      | 10M@22.30dBm                |         |       |    |
|  |                   |      | FDD- LTE                    | Band 5  | 585.8 | mA |
|  |                   |      | 10M@23.00dBm                |         |       |    |
|  |                   |      | FDD- LTE                    | Band 8  | 590.6 | mA |
|  |                   |      | 10M@23.10dBm                |         |       |    |
|  |                   |      | FDD- LTE                    | Band 20 | 600.3 | mA |
|  |                   |      | 10M@22.90dBm                |         |       |    |
|  |                   |      | TDD- LTE                    | Band 38 | 412.5 | mA |
|  |                   |      | 10M@23.10dBm                |         |       |    |
|  |                   |      | TDD- LTE                    | Band 39 | 394.8 | mA |
|  |                   |      | 10M@23.10dBm                |         |       |    |
|  |                   |      | TDD- LTE                    | Band 40 | 376.8 | mA |
|  |                   |      | 10M@23.30dBm                |         |       |    |
|  |                   |      | TDD- LTE                    | Band 41 | 392   | mA |
|  |                   |      | 10M@23.10dBm                |         |       |    |

|  |                  |                         |       |    |
|--|------------------|-------------------------|-------|----|
|  | GSM voice call   | GSM900 PCL=5 @32.21dBm  | 237.1 | mA |
|  |                  | DCS1800 PCL=0 @28.14dBm | 200.7 | mA |
|  |                  | GSM850 PCL=5 @32.12dBm  | 243.9 | mA |
|  | CDMA voice call  | BC0 @20.31dBm           | 556   | mA |
|  | WCDMA voice call | WCDMA Band 1@23.1dBm    | 461.8 | mA |
|  |                  | WCDMA Band 5@22.0dBm    | 574.3 | mA |
|  |                  | WCDMA Band 8@22.8dBm    | 559   | mA |

## 6.5 Environmental Reliability Requirements

Table 36: Environmental reliability requirements

| Test item                           | Test condition                                                                                                                                                                                                                                                              |                                                                            |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Low temperature storage test        | -45℃, last for 24 hours in shutdown mode                                                                                                                                                                                                                                    |                                                                            |
| High temperature storage test       | +90℃, last for 24 hours in shutdown mode                                                                                                                                                                                                                                    |                                                                            |
| Temperature impact test             | In shutdown mode, last for 1 hour in -45℃ and +90℃. Temperature conversion time is <3min, total 24 cycles.                                                                                                                                                                  |                                                                            |
| High temperature high humidity test | +85℃,95%RH,last for 48 hours in shutdown mode                                                                                                                                                                                                                               |                                                                            |
| Low temperature operation test      | -30℃,last for 24 hours in operation mode                                                                                                                                                                                                                                    |                                                                            |
| High temperature operation test     | +75℃,last for 24 hours in operation mode                                                                                                                                                                                                                                    |                                                                            |
| Vibration test                      | Perform vibration tests as required in the following table:                                                                                                                                                                                                                 |                                                                            |
|                                     | Frequency                                                                                                                                                                                                                                                                   | Random vibration ASD(Acceleration spectral density)                        |
|                                     | 5~20Hz                                                                                                                                                                                                                                                                      | 0.96m <sup>2</sup> /s <sup>3</sup>                                         |
|                                     | 20~500Hz                                                                                                                                                                                                                                                                    | 0.96m <sup>2</sup> /s <sup>3</sup> (20Hz),other frequency range -3dB/times |
| Connector life test                 | Board to board connector interface plugging 50 times; RF antenna interface cable plugging 30 times                                                                                                                                                                          |                                                                            |
| ESD test                            | 1、The module tests the power PAD and the large area in the call state, ESD meets:<br>1) Contact discharge shall pass ±4KV、±5KV test grade<br>2) Air discharge shall pass ±8KV、±10KV test grade<br>2、the module tests SIM card connector of EVB in shutdown mode, ESD meets: |                                                                            |

|  |                                                                                                                                                                                                                                                                                                   |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | 1) Contact discharge shall pass $\pm 4\text{KV}$ test grade<br>2) Air discharge shall pass $\pm 8\text{KV}$ test grade<br>3、the module tests other interfaces, ESD meets:<br>1) Air discharge shall pass $\pm 0.5\text{KV}$ test grade<br>2) Air discharge shall pass $\pm 1\text{KV}$ test grade |
|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 6.6 ESD Characteristics

SLM750 is a consumer terminal product. Although we have considered possible problems of ESD and took some protections, considering problems in the transport and secondary development, we need to consider the protection of final product ESD, including the anti electrostatic packaging processing. You can refer to the recommended circuit of interface design in the document when using in applications.

The following table shows the discharge range of SLM750 ESD:

Table 37: ESD performance parameters (Temperature: 25°C, Humidity: 45%)

| Test point         | Contact discharge | Air discharge | Unit |
|--------------------|-------------------|---------------|------|
| VBAT, GND          | $\pm 5$           | $\pm 10$      | KV   |
| Antenna interfaces | $\pm 4$           | $\pm 8$       | KV   |
| Other interfaces   | $\pm 0.5$         | $\pm 1$       | KV   |

## 7 Mechanical Dimensions

### 7.1 Mechanical Dimensions of the Module

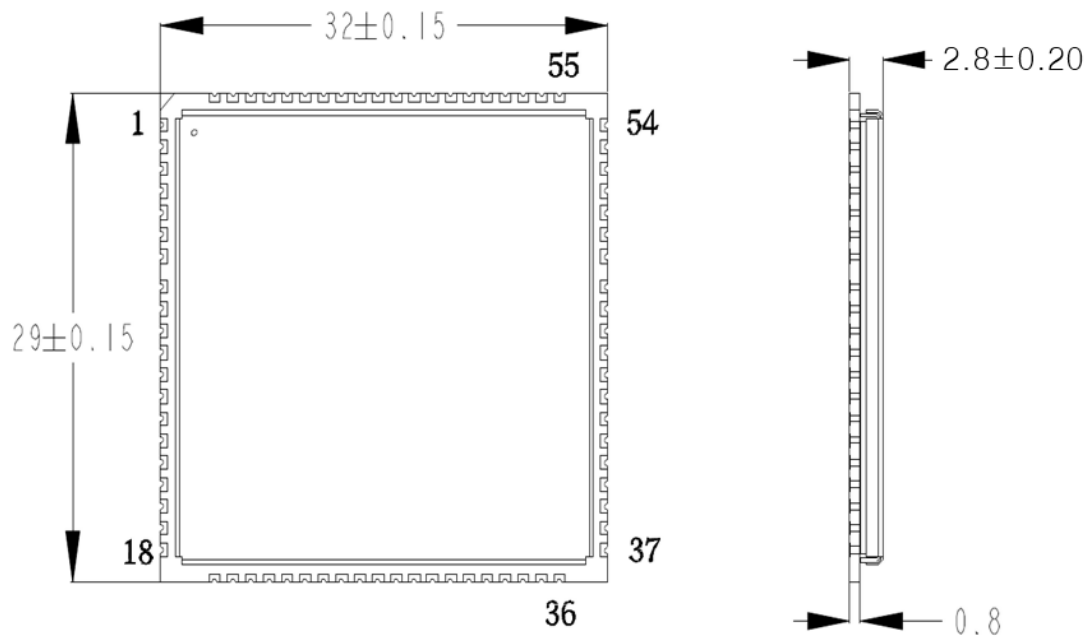


Figure 29 Module top and side dimension (unit: mm)

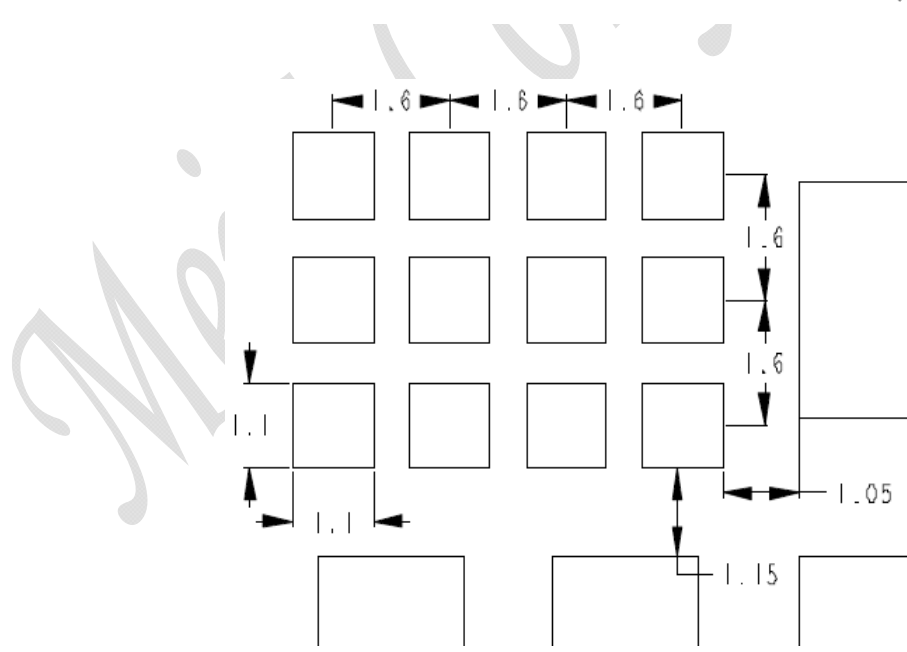


Figure 30 Module bottom dimensions (unit: mm)

## 7.2 Recommended Packaging

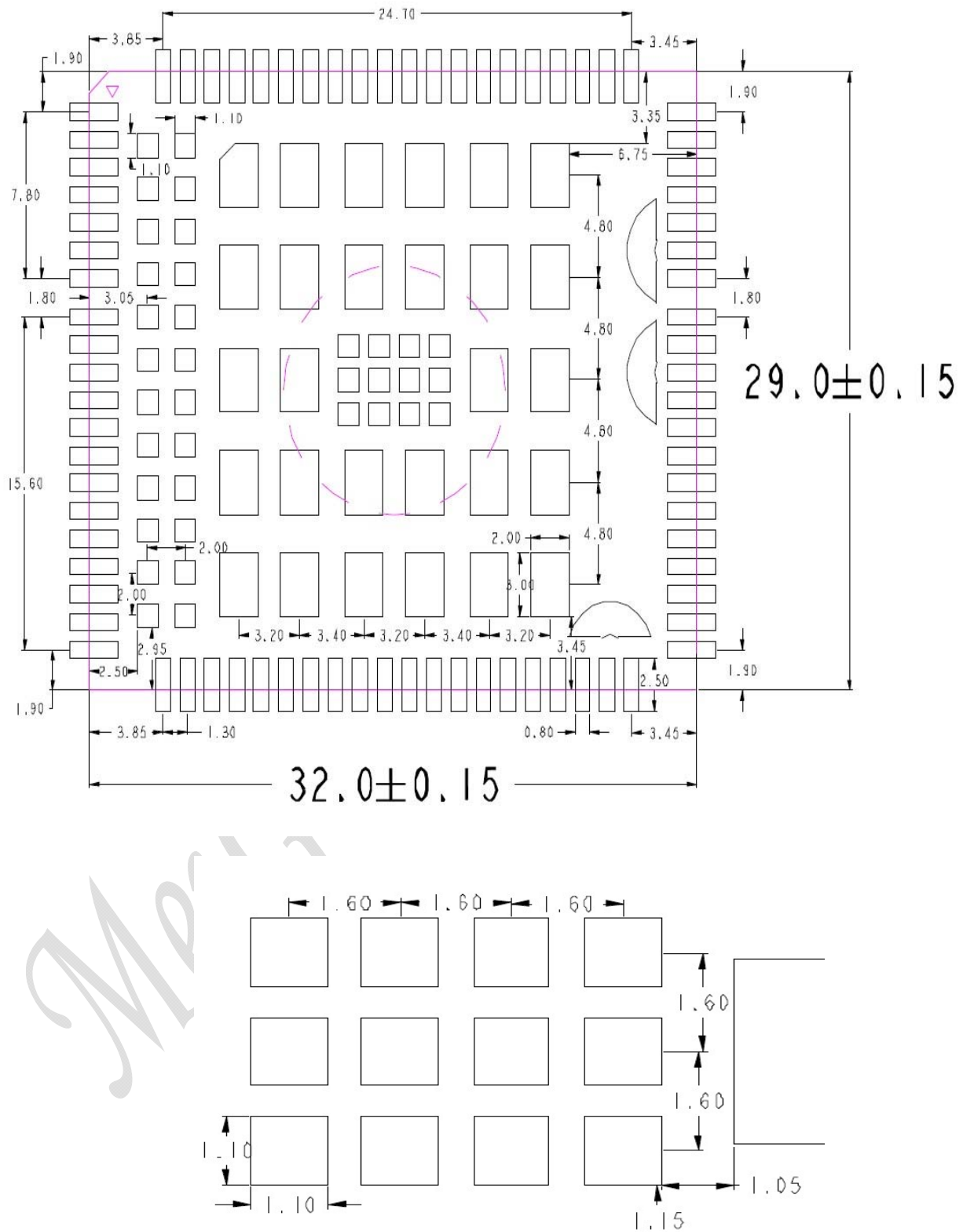


Figure 31 Top view of recommended packaging (unit: mm)

### 7.3 Top View of the Module



Figure 32 Top view of the module

### 7.4 Bottom View of the Module

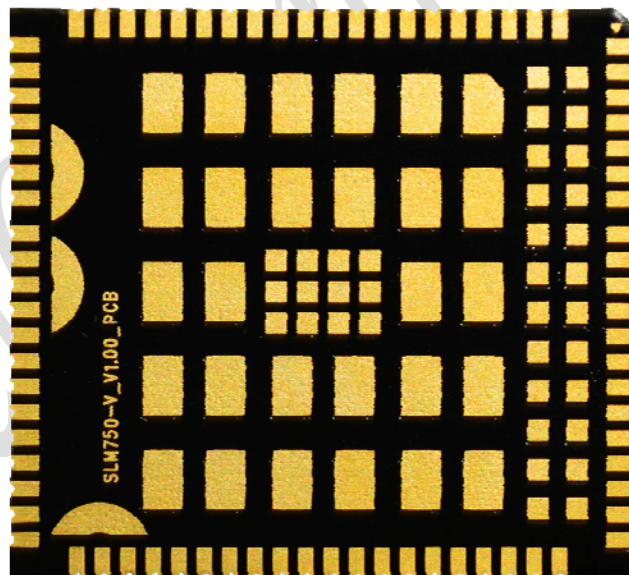


Figure 33 Bottom view of the module

## 8 Storage and Manufacturing

### 8.1 Storage

SLM750 is stored in sealed vacuum bag. The restrictions of storage condition are shown as below:

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

**Note:** As plastic packaging cannot stand the high temperatures, the package must be removed from devices before baking.

8.2 Manufacturing and Welding



Figure 34 Reflow soldering temperature profile

8.3 Packing

SLM750 uses pallet packaging. Specifications are as follows:



Figure 35 Pallet packaging(Unit: mm)

## 9 Appendix A References

### 9.1 Related Documents

- SLM750 specifications;
- SLM750 AT command set;
- SLM750 EVB user manual;
- SLM750 reference design circuit;
- SLM750 application service process manual.

### 9.2 Terms and Abbreviations

Table 38: Terms and abbreviations

| Abbreviations | Descriptions                              |
|---------------|-------------------------------------------|
| AMR           | Adaptive Multi-rate                       |
| BER           | Bit Error Rate                            |
| BTS           | Base Transceiver Station                  |
| PCI           | Peripheral Component Interconnect         |
| CS            | Circuit Switched (CS) domain              |
| CSD           | Circuit Switched Data                     |
| DCE           | Data communication equipment              |
| DTE           | Data terminal equipment                   |
| DTR           | Data Terminal Ready                       |
| EDGE          | Enhanced Data rates for GSM Evolution     |
| EFR           | Enhanced Full Rate                        |
| EGSM          | Enhanced GSM                              |
| EMC           | Electromagnetic Compatibility             |
| ESD           | Electrostatic Discharge                   |
| FR            | Frame Relay                               |
| GMSK          | Gaussian Minimum Shift Keying             |
| GPIO          | General Purpose Input Output              |
| GPRS          | General Packet Radio Service              |
| GSM           | Global Standard for Mobile Communications |
| HR            | Half Rate                                 |
| HSDPA         | High Speed Downlink Packet Access         |
| HSUPA         | High Speed Uplink Packet Access           |
| HSPA          | HSPA High-Speed Packet Access             |
| HSPA+         | HSPA High-Speed Packet Access+            |

|                    |                                                         |
|--------------------|---------------------------------------------------------|
| IEC                | International Electro-technical Commission              |
| IMEI               | International Mobile Equipment Identity                 |
| MEID               | Mobile Equipment Identifier                             |
| I/O                | Input/Output                                            |
| ISO                | International Standards Organization                    |
| ITU                | International Telecommunications Union                  |
| bps                | bits per second                                         |
| LED                | Light Emitting Diode                                    |
| M2M                | Machine to machine                                      |
| MO                 | Mobile Originated                                       |
| MT                 | Mobile Terminated                                       |
| NTC                | Negative Temperature Coefficient                        |
| PC                 | Personal Computer                                       |
| PCB                | Printed Circuit Board                                   |
| PCS                | Personal Cellular System                                |
| PCM                | Pulse Code Modulation                                   |
| PCS                | Personal Communication System                           |
| PDU                | Packet Data Unit                                        |
| PPP                | Point-to-point protocol                                 |
| PS                 | Packet Switched                                         |
| QPSK               | Quadrature Phase Shift Keying                           |
| SIM                | Subscriber Identity Module                              |
| TCP/IP             | Transmission Control Protocol/ Internet Protocol        |
| UART               | Universal asynchronous receiver-transmitter             |
| USIM               | Universal Subscriber Identity Module                    |
| UMTS               | Universal Mobile Telecommunications System              |
| USB                | Universal Serial Bus                                    |
| WCDMA              | Wideband Code Division Multiple Access                  |
| TD-SCDMA           | Time Division-Synchronous Code Division Multiple Access |
| TD-LTE             | Time Division Long Term Evolution                       |
| FDD LTE            | Frequency Division Duplexing Long Term Evolution        |
| V <sub>max</sub>   | Maximum Voltage Value                                   |
| V <sub>norm</sub>  | Normal Voltage Value                                    |
| V <sub>min</sub>   | Minimum Voltage Value                                   |
| V <sub>IHmax</sub> | Maximum Input High Level Voltage Value                  |
| V <sub>IHmin</sub> | Minimum Input High Level Voltage Value                  |
| V <sub>ILmax</sub> | Maximum Input Low Level Voltage Value                   |
| V <sub>ILmin</sub> | Minimum Input Low Level Voltage Value                   |
| V <sub>OHmax</sub> | Maximum Output High Level Voltage Value                 |
| V <sub>OHmin</sub> | Minimum Output High Level Voltage Value                 |
| V <sub>OLmax</sub> | Maximum Output Low Level Voltage Value                  |
| V <sub>OLmin</sub> | Minimum Output Low Level Voltage Value                  |

## 10 Appendix B GPRS Coding Scheme

Table 39: Description of coding schemes

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

### EU DECLARATION OF CONFORMITY



Hereby, MeiG Smart Technology Co., Ltd declares that the radio equipment type SLM750 is in compliance with Directive 2014/53/EU.

The most recent and valid version of the DoC (Declaration of Conformity) can be viewed at [www.meigsmart.com/en/product-certification](http://www.meigsmart.com/en/product-certification).

### FCC Certification Requirements.

According to the definition of mobile and fixed device is described in Part 2.1091(b), this device is a mobile device.

And the following conditions must be met:

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time- averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.
2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.

3. A label with the following statements must be attached to the host end product: This device contains FCC ID:

2APJ4-SLM750VA.

4. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:

- ☐ GSM850 :  $\leq 9.438$  dBi
- ☐ GSM1900 :  $\leq 10.010$  dBi
- ☐ WCDMAII:  $\leq 8.500$  dBi
- ☐ WCDMAIV:  $\leq 5.500$  dBi
- ☐ WCDMAV:  $\leq 9.908$  dBi
- ☐ LTE Band2/7/25/41:  $\leq 8.500$  dBi
- ☐ LTE Band4/66:  $\leq 5.500$  dBi
- ☐ LTE Band5:  $\leq 9.908$  dBi
- ☐ LTE Band7:  $\leq 5.000$  dBi
- ☐ LTE Band12:  $\leq 9.197$  dBi
- ☐ LTE Band13:  $\leq 9.656$  dBi
- ☐ LTE Band17:  $\leq 9.224$  dBi
- ☐ LTE Band26:  $\leq 9.861$  dBi

5. This module must not transmit simultaneously with any other antenna or transmitter

6. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093

If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

For this device, OEM integrators must be provided with labeling instructions of finished products. Please refer to KDB784748 D01 v07, section 8. Page 6/7 last two paragraphs:

A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labeled with an FCC ID - Section 2.926 (see 2.2 Certification (labeling

requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labeling requirements, options and OEM user manual instructions that are required (see next paragraph).

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module FCC ID: 2APJ4-SLM750VA" or "Contains FCC ID: 2APJ4-SLM750VA" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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