



# R7082

## Hardware Design

LPWA Module

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At all stages of operation, such as during use, maintenance, or repair of any terminal device containing this module, the following safety precautions must be observed. Terminal manufacturers should inform users and operators of these safety guidelines by including them in the product manual. Our company shall not be held responsible for any consequences arising from the customer's failure to comply with these precautions.

| Marks                                                                               | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | When in hospitals or near medical equipment, observe whether there are prompts restricting the use of mobile terminals. If such prompts exist, turn off the terminal; otherwise, radio frequency interference may cause abnormal operation of medical equipment                                                                                                                                                                                                                                                                                                                                                      |
|    | Turn off the mobile terminal before boarding. To prevent interference with on-board communication systems, do not enable the wireless functions of the terminal on the aircraft; otherwise, it may violate the law and even cause flight accidents.                                                                                                                                                                                                                                                                                                                                                                  |
|  | Do not operate the mobile terminal in or near areas containing flammable gases. Turn off the mobile terminal when near blasting sites, chemical plants, fuel depots, or gas stations. Operating the mobile terminal in any area with an explosion risk poses a safety hazard.                                                                                                                                                                                                                                                                                                                                        |
|  | Mobile terminals emit or receive radio frequency signals when turned on. They may interfere with each other when near televisions, radios, computers, or other electrical devices                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|  | Road traffic safety comes first! Do not use the mobile terminal while operating a vehicle, even with a hands-free function. Use the mobile terminal only after parking in a safe area.                                                                                                                                                                                                                                                                                                                                                                                                                               |
|  | When a mobile terminal operates via RF signals and cellular networks, network connectivity cannot be guaranteed under all circumstances, such as when there is an outstanding bill or an invalid SIM card is inserted. In such cases, if the mobile terminal supports an emergency call function, emergency calls can be made. The mobile terminal must be powered on and within an area with sufficient cellular signal strength. Since network connectivity cannot be ensured in all situations, do not rely solely on a device with emergency call capability as the only means of communication in an emergency. |

## Version History

| Date       | Version | Description of Change | Author                     |
|------------|---------|-----------------------|----------------------------|
| 2026-04-26 | 1.00    | Original version.     | Du yuankai<br>Hu chenglang |

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# Contents

|                                              |           |
|----------------------------------------------|-----------|
| <b>Safety Information .....</b>              | <b>7</b>  |
| <b>Version History.....</b>                  | <b>8</b>  |
| <b>Contents .....</b>                        | <b>9</b>  |
| <b>Table Index .....</b>                     | <b>11</b> |
| <b>Figure Index.....</b>                     | <b>13</b> |
| <b>1 Introduction .....</b>                  | <b>14</b> |
| 1.1 Documentation Overview .....             | 14        |
| 1.2 Product Outline .....                    | 14        |
| 1.3 Hardware Interface Overview .....        | 16        |
| 1.4 Hardware Block Diagram .....             | 17        |
| 1.5 Functional Overview .....                | 17        |
| <b>2 Package Information.....</b>            | <b>19</b> |
| 2.1 Pin Assignment Overview .....            | 19        |
| 2.2 Pin Description .....                    | 21        |
| 2.3 Mechanical Information .....             | 24        |
| <b>3 Interface Application.....</b>          | <b>25</b> |
| 3.1 Power Supply .....                       | 25        |
| 3.1.1 Power Supply Reference Design .....    | 26        |
| 3.1.2 Recommended Power Supply Circuit ..... | 27        |
| 3.2 Power On/ Off and Reset .....            | 28        |
| 3.2.1 Power on .....                         | 28        |
| 3.2.2 Module Power off .....                 | 30        |
| 3.2.3 Module Reset .....                     | 32        |
| 3.3 UART Interface .....                     | 33        |
| 3.3.1 RI Description .....                   | 36        |
| 3.4 SIM Interface .....                      | 37        |
| 3.4.1 SIM Application Guide .....            | 38        |
| 3.5 Analog Audio Interface* .....            | 39        |
| 3.5.1 Analog Audio Reference Design .....    | 39        |
| 3.6 GPIO Interface.....                      | 40        |
| 3.7 I2C Interface .....                      | 40        |
| 3.8 SPI Interface* .....                     | 41        |
| 3.9 Network Status* .....                    | 42        |
| 3.10 Other Interface.....                    | 44        |
| 3.10.1 ADC .....                             | 44        |
| 3.10.2 LDO .....                             | 45        |

|                                                  |           |
|--------------------------------------------------|-----------|
| <b>4 RF Specifications</b>                       | <b>46</b> |
| 4.1 GSM/LTE                                      | 46        |
| 4.2 GSM/ LTE Antenna Reference Design            | 47        |
| 4.3 Antenna Reference Design                     | 48        |
| 4.4 PCB Layout                                   | 48        |
| <b>5 Electrical Specifications</b>               | <b>50</b> |
| 5.1 Absolute Maximum Ratings                     | 50        |
| 5.2 Operating Conditions                         | 50        |
| 5.3 Operating Mode                               | 52        |
| 5.3.1 Operating Mode Definition                  | 52        |
| 5.3.2 Sleep Mode                                 | 53        |
| 5.3.3 Minimum Functionality Mode and Flight Mode | 53        |
| 5.3.4 Power Saving Mode (PSM)                    | 54        |
| 5.3.5 Extended Mode DRX (e-DRX)                  | 54        |
| 5.4 Current Consumption                          | 55        |
| 5.5 ESD Notes                                    | 56        |
| <b>6 SMT Production Guide</b>                    | <b>58</b> |
| 6.1 Top and Bottom View of R7082                 | 58        |
| 6.2 Label Information                            | 59        |
| 6.3 Recommend PCB Footprint Dimension            | 60        |
| 6.4 Recommend Stencil Size                       | 61        |
| 6.5 Typical SMT Reflow Profile                   | 62        |
| 6.6 Moisture Sensitivity Level (MSL)             | 63        |
| 6.7 Baking Requirements                          | 65        |
| <b>7 Packaging</b>                               | <b>66</b> |
| <b>8 Appendix</b>                                | <b>69</b> |
| 8.1 Related Documents                            | 69        |
| 8.2 Terms and Abbreviations                      | 70        |

## Table Index

|                                                                                          |    |
|------------------------------------------------------------------------------------------|----|
| Table 1: R7082 Documents Overview .....                                                  | 14 |
| Table 2: R7082 Frequency Bands .....                                                     | 15 |
| Table 3: General Features .....                                                          | 17 |
| Table 4: Pin Description .....                                                           | 20 |
| Table 5: IO Parameters Definition.....                                                   | 21 |
| Table 6: Pin Description .....                                                           | 21 |
| Table 7: VBAT Pin Electrical Parameters .....                                            | 26 |
| Table 8: Recommended TVS Diode List.....                                                 | 27 |
| Table 9: Power on Sequence Parameters.....                                               | 29 |
| Table 10: Power off Sequence Parameters.....                                             | 31 |
| Table 11: Reset Electric Parameter .....                                                 | 33 |
| Table 12: UART Electronic Characteristic .....                                           | 35 |
| Table 13: SIM Electronic Characteristic in 1.8V Mode ( $V_{SIM\_VDD}=1.8V$ ).....        | 37 |
| Table 14: SIM Electronic Characteristic in 3.0V Mode ( $V_{SIM\_VDD}=3V$ ).....          | 37 |
| Table 15: SIM Card AT Command Switching Table .....                                      | 37 |
| Table 16: GPIO Electronic Characteristic .....                                           | 40 |
| Table 17: I2C Electronic Characteristic .....                                            | 41 |
| Table 18: Multiplex Function of the SPI .....                                            | 42 |
| Table 19: 2G Mode NETLIGHT Pin Status .....                                              | 43 |
| Table 20: LTE Mode NETLIGHT Pin Status .....                                             | 43 |
| Table 21: ADC Electronic Characteristics .....                                           | 44 |
| Table 22: VDD_EXT Electrical Characteristics .....                                       | 45 |
| Table 23: Conducted Emission Power.....                                                  | 46 |
| Table 24: GSM Operating Bands.....                                                       | 46 |
| Table 25: E-UTRA Operating Bands.....                                                    | 46 |
| Table 26: Conducted Receive Sensitivity .....                                            | 47 |
| Table 27: Reference Sensitivity (QPSK).....                                              | 47 |
| Table 28: GSM/LTE Antenna Requirements.....                                              | 47 |
| Table 29: TVS Recommended Part List .....                                                | 48 |
| Table 30: Absolute Maximum Ratings .....                                                 | 50 |
| Table 31: Recommended Operating Ratings .....                                            | 50 |
| Table 32: 1.8V Digital I/O Characteristics* .....                                        | 51 |
| Table 33: Operating Temperature .....                                                    | 51 |
| Table 34: Operating Mode Definition .....                                                | 52 |
| Table 35: Current Consumption on VBAT Pins ( $V_{BAT}=3.8V$ ) .....                      | 55 |
| Table 36: The ESD Performance Measurement Table (Temperature: 25°C, Humidity: 45%) ..... | 56 |
| Table 37: The Description of Label Information.....                                      | 59 |
| Table 38: The Main Board Reflux Temperature Curve Requirements (Lead-Free) .....         | 62 |
| Table 39: Moisture Sensitivity Level .....                                               | 63 |
| Table 40: Baking Requirements.....                                                       | 65 |
| Table 41: Tray Size .....                                                                | 67 |

Table 42: Small Carton Size .....67

Table 43: Big Carton Size .....68

Table 44: Related Documents .....69

Table 45: Terms and Abbreviations.....70

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## Figure Index

|                                                                           |    |
|---------------------------------------------------------------------------|----|
| Figure 1: R7082 Block Diagram .....                                       | 17 |
| Figure 2: Module Pin Diagram (Top View) .....                             | 19 |
| Figure 3: Dimension Drawing (Unit: mm) .....                              | 24 |
| Figure 4: Burst Current Cause VBAT Drop .....                             | 25 |
| Figure 5: VBAT Input Reference Circuit .....                              | 26 |
| Figure 6: Power Supply Reference Circuit .....                            | 27 |
| Figure 7: Power on/off Reference Circuit .....                            | 28 |
| Figure 8: PWRKEY Power on Sequence .....                                  | 29 |
| Figure 9: PWRKEY Power off Sequence .....                                 | 31 |
| Figure 10: Reference Reset Circuit .....                                  | 32 |
| Figure 11: Reset Timing .....                                             | 32 |
| Figure 12: Serial Port Connection Diagram (Full Function Mode) .....      | 34 |
| Figure 13: Serial Port Connection Diagram (NULL Mode) .....               | 34 |
| Figure 14: Reference Circuit with Level Shifter IC .....                  | 35 |
| Figure 15: Reference Circuit with Transistor .....                        | 35 |
| Figure 16: Level Change on RI (SMS, URC, Incoming Call) .....             | 36 |
| Figure 17: SIM Interface Reference Circuit .....                          | 38 |
| Figure 18: Analog Audio Interface Reference Circuit .....                 | 39 |
| Figure 19: I2C Reference Circuit .....                                    | 41 |
| Figure 20: SPI Master Mode Circuit .....                                  | 42 |
| Figure 21: NETLIGHT Reference Circuit .....                               | 43 |
| Figure 22: Passive Antenna Connection Circuit .....                       | 48 |
| Figure 23: IPEX Reference for PCB Traces .....                            | 49 |
| Figure 24: SMA Reference for PCB Traces .....                             | 49 |
| Figure 25: e-DRX Diagrammatic Sketch .....                                | 55 |
| Figure 26: Top and Bottom View of R7082 .....                             | 58 |
| Figure 27: Label Information .....                                        | 59 |
| Figure 28: Recommend PCB Footprint Dimension (Unit: mm) .....             | 60 |
| Figure 29: Recommend Stencil Dimension (Unit: mm) .....                   | 61 |
| Figure 30: Recommended Reflow Furnace Temperature Curve (Lead-Free) ..... | 62 |
| Figure 31: Humidity Card .....                                            | 64 |
| Figure 32: Packaging Diagram .....                                        | 66 |
| Figure 33: Tray Drawing .....                                             | 66 |
| Figure 34: Small Carton Drawing .....                                     | 67 |
| Figure 35: Big Carton Drawing .....                                       | 67 |

# 1 Introduction

This document describes the hardware interface of the module, which can help users quickly understand the interface definition, electrical performance and structure size of the module. Combined with this document and other application documents, users can understand and use R7082 module to design and develop applications quickly.

## 1.1 Documentation Overview

Technical information for the module is primarily covered by the documents listed in Table 1. All documents must be studied for a thorough understanding of the device and its applications.

Table 1: R7082 Documents Overview

| No. | Document                             | Description                                                                                                                                                 |
|-----|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1] | R7082_Hardware_Design(This document) | Mainly introducing interface functions, Recommend circuit, PCB layout guideline, packaging and other hardware components, as well as the use of AT commands |
| [2] | R7082 Series_AT Command Manual       | R7082 Series AT Command Manual                                                                                                                              |
| [3] | A7682E-TE kit User Guide             | A7682E-TE kit User Guide Document                                                                                                                           |
| [4] | SIMCOM_EVB_User Guide                | SIMCOM-EVB User Guide Document                                                                                                                              |

## 1.2 Product Outline

R7082 module supports NB, GSM, GPRS. With a small physical dimension of 19.6 \* 19.6 \* 2.4 mm. It is designed for applications that need low latency, Low throughput data communication in a variety of radio propagation conditions. Due to the unique combination of performance, security and flexibility, this module is ideally suited for M2M applications, such as metering, asset tracking, remote monitoring and E-health etc. Please refer to the following table for detailed frequency band description:

Table 2: R7082 Frequency Bands

| Network Type | Band    | R7082 |
|--------------|---------|-------|
| GSM/GPRS     | EGSM900 | ✓     |
|              | DCS1800 | ✓     |
| NB           | 1       |       |
|              | 2       |       |
|              | 3       | ✓     |
|              | 4       |       |
|              | 5       | ✓     |
|              | 8       | ✓     |
|              | 12      |       |
|              | 13      |       |
|              | 17      |       |
|              | 18      |       |
|              | 19      |       |
|              | 20      | ✓     |
|              | 25      |       |
|              | 26      |       |
|              | 28      | ✓     |
|              | 66      |       |
|              | 70      |       |
|              | 71      |       |

## 1.3 Hardware Interface Overview

R7082 provides the following hardware interfaces.

- Power Supply
- UART Interface
- SIM Interface
- ADC
- LDO Power Output
- Audio Receiver Output
- I2C Interface
- SPI Interface
- GPIOs
- NETLIGHT Interface
- Antenna Interface

## 1.4 Hardware Block Diagram

The block diagram of the R7082 module is shown in the figure below.

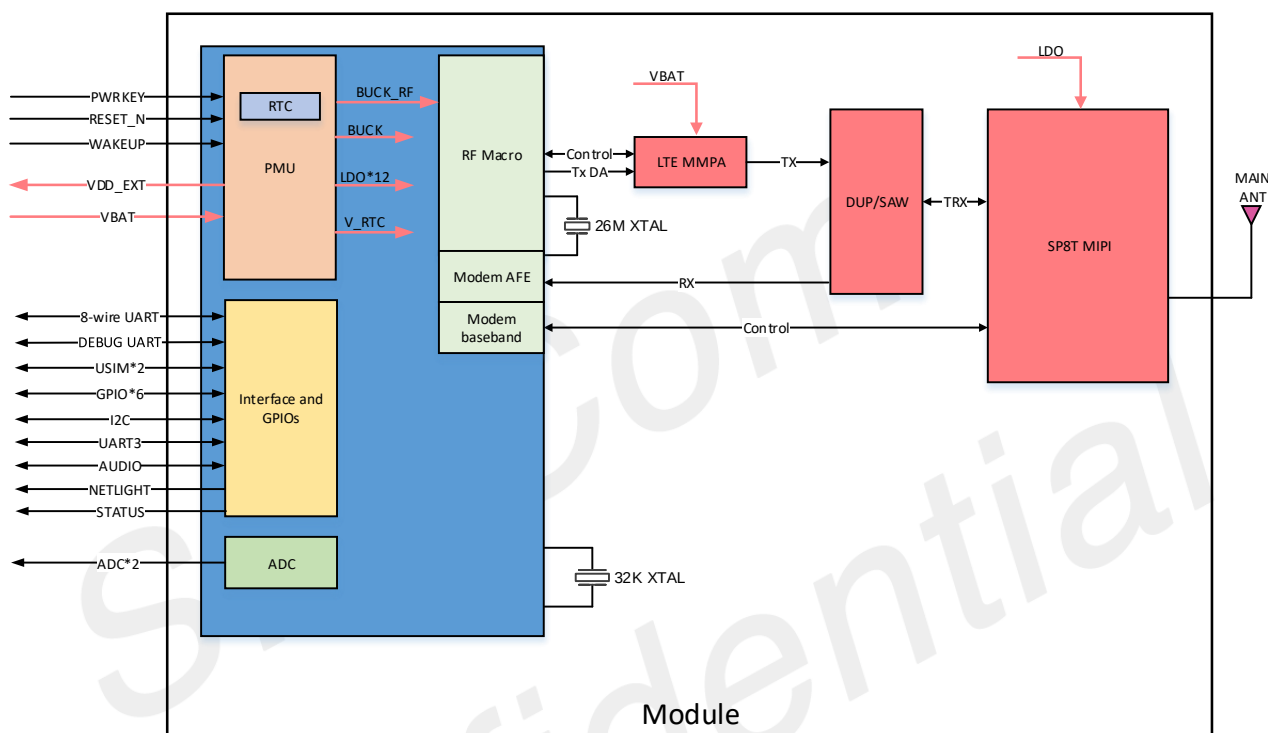


Figure 1: R7082 Block Diagram

## 1.5 Functional Overview

Table 3: General Features

| Feature               | Implementation                                                                                  |
|-----------------------|-------------------------------------------------------------------------------------------------|
| Power supply          | Power supply voltage 3.4V~4.2V. Default :3.8V                                                   |
| Power saving          | Current in PSM mode: 6uA                                                                        |
| Radio frequency bands | Please refer to the table 1                                                                     |
| Transmitting power    | GSM/GPRS power class:<br>-- EGSM900: 4 (2W)<br>-- DCS1800: 1 (1W)<br>LTE power level: 3 (0.25W) |

|                              |                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Transmission Throughput | GPRS:<br>85.6Kbps(UL)<br>85.6Kbps(DL)<br>NB-IOT: NB1/NB2 : 127Kbps (DL)<br>NB1/NB2 : 158.5Kbps (UL)                                                                                                                                                                                                                                                                                      |
| Antenna                      | Main antenna.                                                                                                                                                                                                                                                                                                                                                                            |
| SIM interface                | Support 1.8V or 3V card, Supports hot swap, dual card single standby                                                                                                                                                                                                                                                                                                                     |
| Analog audio feature         | Support REC interface.( Audio features are not yet developed)                                                                                                                                                                                                                                                                                                                            |
| SPI interface                | Support for serial data bus SPI, only used during DAM application secondary development.                                                                                                                                                                                                                                                                                                 |
| UART interface               | One channel full-function UART1 by default can be used for AT communication. Support 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200bps, default rate is 115200 bps, can use AT command to set rate. R7082 not support auto rate. Support RTS/CTS hardware handshake.<br>Two channel 2-wire UART2 and UART3 only used as UART in DAM application when secondary development. |
| Firmware upgrade             | Firmware upgrade over DEBUGE UART interface                                                                                                                                                                                                                                                                                                                                              |
| Physical characteristics     | Size:(19.6±0.15)*(19.6±0.15)*(2.4±0.20)mm<br>Weight:2.1±0.1g                                                                                                                                                                                                                                                                                                                             |
| Temperature range            | Operation temperature:-20℃~+70℃<br>Extended operation temperature:-40℃~+85℃*<br>Storage temperature:-45℃~+125℃                                                                                                                                                                                                                                                                           |

#### NOTE

- Module is able to make and receive voice calls, data calls, SMS and make GPRS/LTE traffic in -20℃ ~ +70℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extended operating temperature range.

## 2 Package Information

### 2.1 Pin Assignment Overview

All functions of the module will be provided through 85 pads that will be connected to the customers' platform. The following Figure is a high-level view of the pin assignment of the module.

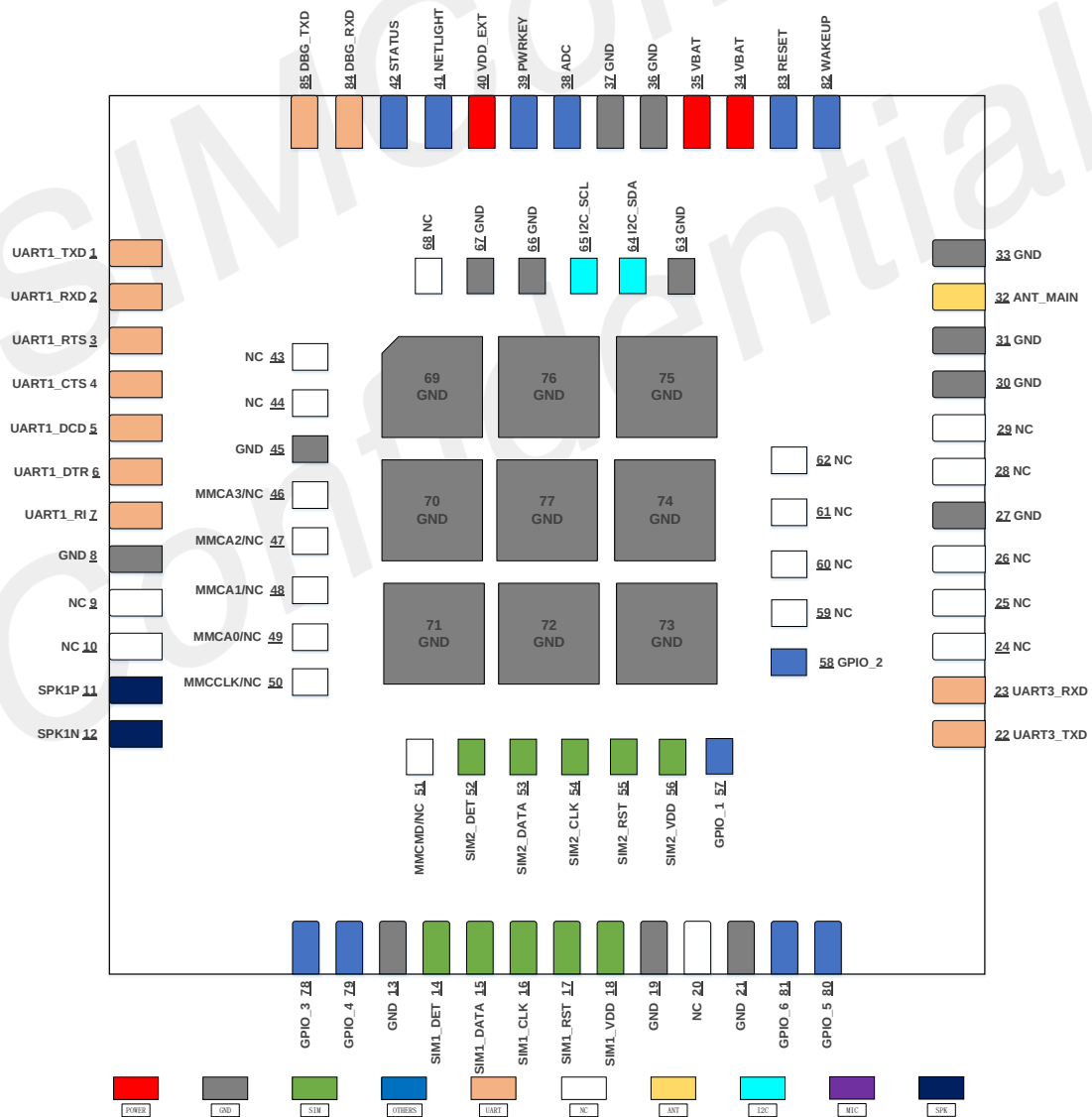


Figure 2: Module Pin Diagram (Top View)

Table 4: Pin Description

| Pin No. | Pin Name  | Pin No. | Pin Name  |
|---------|-----------|---------|-----------|
| 1       | UART1_TXD | 2       | UART1_RXD |
| 3       | UART1_RTS | 4       | UART1_CTS |
| 5       | UART1_DCD | 6       | UART1_DTR |
| 7       | UART1_RI  | 8       | GND       |
| 9       | NC        | 10      | NC        |
| 11      | SPK1P     | 12      | SPK1N     |
| 13      | GND       | 14      | SIM1_DET  |
| 15      | SIM1_DATA | 16      | SIM1_CLK  |
| 17      | SIM1_RST  | 18      | SIM1_VDD  |
| 19      | GND       | 20      | NC        |
| 21      | GND       | 22      | UART3_TXD |
| 23      | UART3_RXD | 24      | NC        |
| 25      | NC        | 26      | NC        |
| 27      | GND       | 28      | NC        |
| 29      | NC        | 30      | GND       |
| 31      | GND       | 32      | ANT_MAIN  |
| 33      | GND       | 34      | VBAT      |
| 35      | VBAT      | 36      | GND       |
| 37      | GND       | 38      | ADC       |
| 39      | PWRKEY    | 40      | VDD_EXT   |
| 41      | NETLIGHT  | 42      | STATUS    |
| 43      | NC        | 44      | NC        |
| 45      | GND       | 46      | NC        |
| 47      | NC        | 48      | NC        |
| 49      | NC        | 50      | NC        |
| 51      | NC        | 52      | SIM2_DET  |
| 53      | SIM2_DATA | 54      | SIM2_CLK  |
| 55      | SIM2_RST  | 56      | SIM2_VDD  |
| 57      | GPIO1     | 58      | GPIO2     |
| 59      | NC        | 60      | NC        |
| 61      | NC        | 62      | NC        |
| 63      | GND       | 64      | I2C_SDA   |
| 65      | I2C_SCL   | 66      | GND       |
| 67      | GND       | 68      | NC        |
| 69      | GND       | 70      | GND       |
| 71      | GND       | 72      | GND       |
| 73      | GND       | 74      | GND       |

|    |         |    |         |
|----|---------|----|---------|
| 75 | GND     | 76 | GND     |
| 77 | GND     | 78 | GPIO3   |
| 79 | GPIO4   | 80 | GPIO5   |
| 81 | GPIO6   | 82 | WAKE UP |
| 83 | RESET   | 84 | DBG_RXD |
| 85 | DBG_TXD |    |         |

## 2.2 Pin Description

Table 5: IO Parameters Definition

| Pin Type | Description                    |
|----------|--------------------------------|
| PI       | Power input                    |
| PO       | Power output                   |
| AI       | Analog input                   |
| AO       | Analog output                  |
| I/O      | Input/output                   |
| DI       | Digital input                  |
| DO       | Digital output                 |
| DOH      | Digital output with high level |
| DOL      | Digital output with low level  |
| PU       | Pull up                        |
| PD       | Pull down                      |
| OD       | Open Drain                     |

Table 6: Pin Description

| Pin Name       | Pin NO.                                                             | Pin Parameter |      | Description                                                                      | Note                     |
|----------------|---------------------------------------------------------------------|---------------|------|----------------------------------------------------------------------------------|--------------------------|
|                |                                                                     | Power Domain  | Type |                                                                                  |                          |
| Power Supply   |                                                                     |               |      |                                                                                  |                          |
| VBAT           | 34,35                                                               | -             | PI   | R7082 input voltage ranges from 3.4V to 4.2V. typical voltage: 3.8V              |                          |
| VDD_EXT        | 40                                                                  | -             | PO   | LDO power output 1.8V for other external circuits with Max 200mA current output. | If unused, keep it open. |
| GND            | 8,13,19,21,27,30,31,33,36,37,45,63,66,67,69,70,71,72,73,74,75,76,77 |               |      |                                                                                  |                          |
| System Control |                                                                     |               |      |                                                                                  |                          |

|        |    |   |       |                                         |                                               |
|--------|----|---|-------|-----------------------------------------|-----------------------------------------------|
| PWRKEY | 39 | - | DI,PU | Power ON/OFF input, active low.         | The level is 1.05V when this PIN is floating; |
| RESET  | 83 | - | DI,PU | System reset control input, active low. | The level is 1.05V when this PIN is floating; |

### SIM interface

|           |    |          |        |                                                                                       |                                                         |
|-----------|----|----------|--------|---------------------------------------------------------------------------------------|---------------------------------------------------------|
| SIM1_DET  | 14 | 1.8V     | I/O,PU | SIM1 card hot swap detection                                                          | It need pull up via a 10KR resistor to 1.8V internally. |
| SIM1_DATA | 15 | 1.8/3.0V | I/O,PU | SIM1 Card data I/O                                                                    | It need pull up via a 10KR resistor to 1.8V internally. |
| SIM1_RST  | 17 | 1.8/3.0V | I/O,PO | SIM1 Card reset output.                                                               |                                                         |
| SIM1_CLK  | 16 | 1.8/3.0V | I/O,PO | SIM1 Card clock output.                                                               |                                                         |
| SIM1_VDD  | 18 | 1.8/3.0V | PO     | Power output for SIM card, its output voltage depends on SIM card type automatically. | Its output current is up to 50mA.                       |
| SIM2_DET  | 52 | 1.8V     | I/O,PU | SIM2 card hot swap detection                                                          | It need pull up via a 10KR resistor to 1.8V internally. |
| SIM2_DATA | 53 | 1.8/3.0V | I/O,PU | SIM1 Card data I/O                                                                    | It need pull up via a 10KR resistor to 1.8V internally. |
| SIM2_RST  | 55 | 1.8/3.0V | I/O,PO | SIM2 Card reset output.                                                               |                                                         |
| SIM2_CLK  | 54 | 1.8/3.0V | I/O,PO | SIM2 Card clock output.                                                               |                                                         |
| SIM2_VDD  | 56 | 1.8/3.0V | PO     | Power output for SIM card, its output Voltage depends on SIM card type automatically. | Its output current is up to 50mA.                       |

### Full-function UART interface

|           |   |      |       |                   |                          |
|-----------|---|------|-------|-------------------|--------------------------|
| UART1_TXD | 1 | 1.8V | DOH   | Data output       | If unused, keep it open. |
| UART1_RXD | 2 | 1.8V | DI,PU | Data input        |                          |
| UART1_RTS | 3 | 1.8V | DI,PD | RTS input         |                          |
| UART1_CTS | 4 | 1.8V | DOL   | CTS output        |                          |
| UART1_DCD | 5 | 1.8V | DOH   | Carrier detection |                          |
| UART1_DTR | 6 | 1.8V | DI,PU | DTE Ready         |                          |
| UART1_RI  | 7 | 1.8V | DOH   | Ringing indicator |                          |

### Debug UART

|         |    |      |     |                |                             |
|---------|----|------|-----|----------------|-----------------------------|
| DBG_TXD | 85 | 1.8V | DOH | CP_UART output | Default used as debug port. |
| DBG_RXD | 84 | 1.8V | DI  | CP_UART input  |                             |

### UART3

|           |    |      |     |              |                                                              |
|-----------|----|------|-----|--------------|--------------------------------------------------------------|
| UART3_TXD | 22 | 1.8V | DOH | UART3 output | Reserved serial port and used only for secondary development |
| UART3_RXD | 23 | 1.8V | DI  | UART3 input  |                                                              |

### I2C interface

|     |    |      |    |                  |                                |
|-----|----|------|----|------------------|--------------------------------|
| SCL | 65 | 1.8V | DO | I2C clock output | If unused, keep it open. If it |
|-----|----|------|----|------------------|--------------------------------|

|                        |    |      |       |                                                                                                |                                                                           |
|------------------------|----|------|-------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| SDA                    | 64 | 1.8V | I/O   | I2C data I/O                                                                                   | is necessary to use please use VDD_EXT (40 PIN of the module) for pull-up |
| SPI interface          |    |      |       |                                                                                                |                                                                           |
| SPI_MOSI               | 58 | 1.8V | PD    | Main Controller DATA output.<br>Multiplexed by GPIO2                                           | The SPI function is only available in software secondary development.     |
| SPI_MISO               | 78 | 1.8V | PD    | Main Controller DATA input.<br>Multiplexed by GPIO3                                            |                                                                           |
| SPI_CLK                | 57 | 1.8V | PD    | Bus clock output,<br>Multiplexed by GPIO1                                                      |                                                                           |
| SPI_CS                 | 79 | 1.8V | PD    | Chip Select,<br>Multiplexed by GPIO4                                                           |                                                                           |
| Analog audio interface |    |      |       |                                                                                                |                                                                           |
| SPK1P                  | 11 | 1.8V | AIO   | Audio output positive                                                                          | If unused, keep it open.                                                  |
| SPK1N                  | 12 | 1.8V | AIO   | Audio output negative                                                                          |                                                                           |
| GPIO                   |    |      |       |                                                                                                |                                                                           |
| GPIO1                  | 57 | 1.8V | IO,PD | General purple I/O                                                                             | If unused, keep it open.                                                  |
| GPIO2                  | 58 | 1.8V | IO,PD | General purple I/O                                                                             | If unused, keep it open.                                                  |
| GPIO3                  | 78 | 1.8V | IO,PD | General purple I/O                                                                             | If unused, keep it open.                                                  |
| GPIO4                  | 79 | 1.8V | IO,PD | General purple I/O                                                                             | If unused, keep it open.                                                  |
| GPIO5                  | 80 | 1.8V | IO,PD | General purple I/O                                                                             | If unused, keep it open.                                                  |
| GPIO6                  | 81 | 1.8V | IO,PD | General purple I/O                                                                             | If unused, keep it open.                                                  |
| ANT interface          |    |      |       |                                                                                                |                                                                           |
| ANT_MAN                | 32 | -    | AIO   | Main ANT interface                                                                             |                                                                           |
| Other pins             |    |      |       |                                                                                                |                                                                           |
| ADC                    | 38 | -    | AI    | Analog-digital converter input voltage range:0V~1.7V.                                          | If unused, keep it open.                                                  |
| NETLIGHT               | 41 | 1.8V | DO    | Network registration status indicator (LED).<br>For more detail, please refer the chapter 3.9. |                                                                           |
| STATUS                 | 42 | 1.8V | DO    | Power on status indicator                                                                      |                                                                           |
| WAKE UP                | 82 | 1.8V | DI    | Module wake up input, high active                                                              |                                                                           |

#### NOTE

- SIM card support 1.8V or 3V card and hot swap, dual card single standby
- The SPI function is only available in software secondary development.

- UART3 only used as UART in DAM (Downloadable Application Module) application when secondary development

## 2.3 Mechanical Information

The following figure shows the package outline drawing of R7082 module.

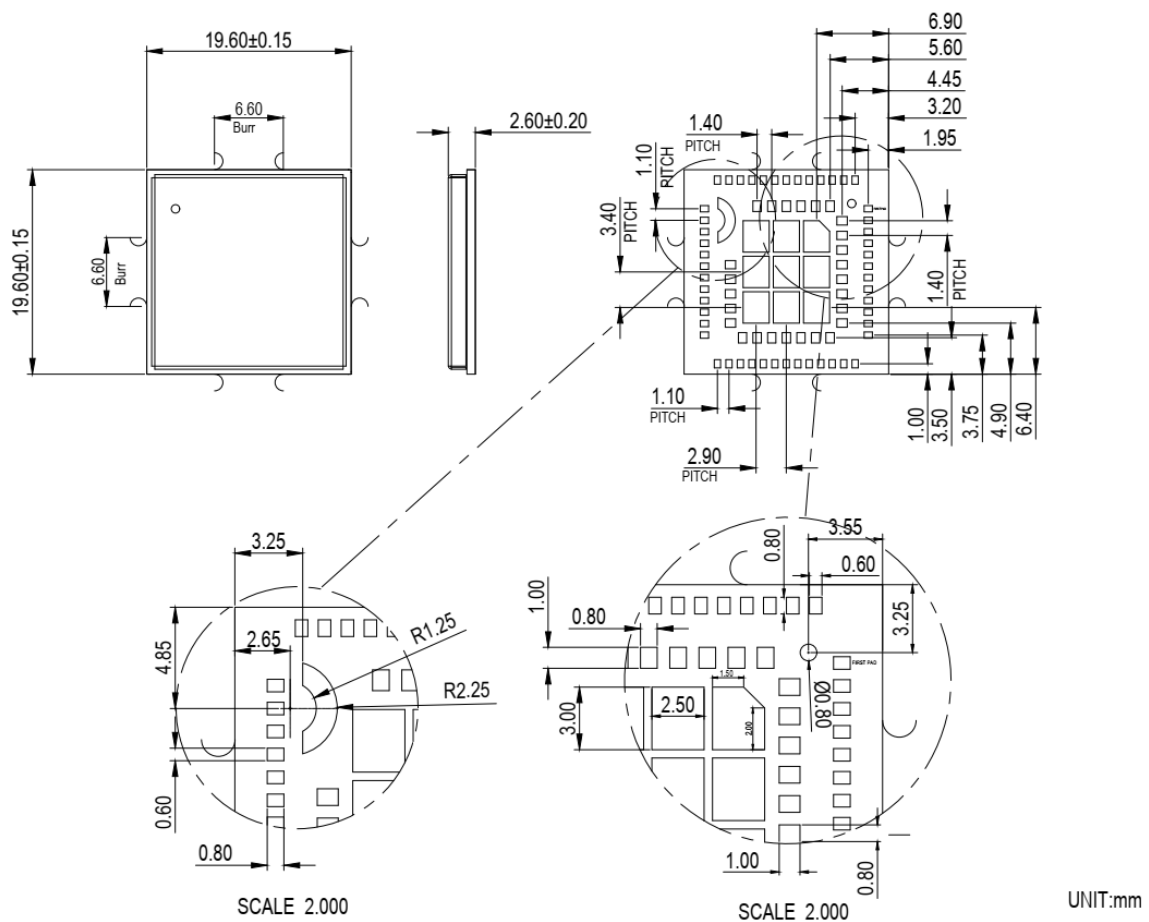


Figure 3: Dimension Drawing (Unit: mm)

### NOTE

- The burr area is not included in the 0.15mm tolerance and customers should avoid the burr area when making the fixture.

## 3 Interface Application

### 3.1 Power Supply

R7082 offers two power supply PINs (34, 35) as VBAT power input PIN. R7082 use these PINs supply the internal RF and baseband circuit.

On VBAT pads, when module works on NB-IoT mode, the ripple current is up to 500mA typically. For steady voltage, the power supply capability must be up to 500mA.

On VBAT pads, when module works on EDGE or GPRS mode, the ripple current is up to 2.1A typically. For steady voltage, the power supply capability must be up to 2.1A. In order to avoid the voltage dropped down more than 300mV, the load capacitor on VBAT pads must be up to 300uF.

The following figure shows the VBAT voltage drop.

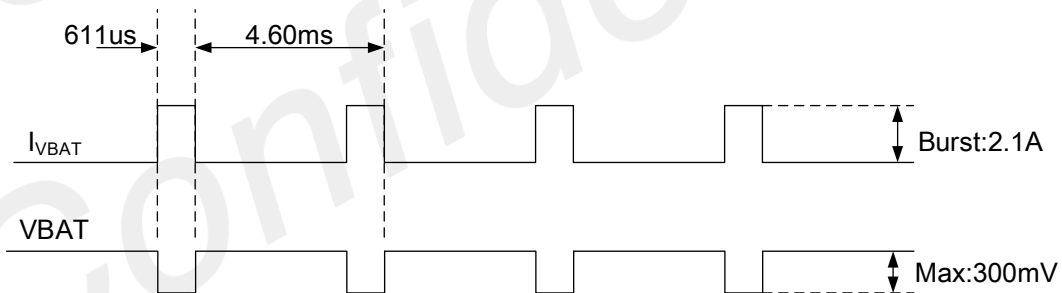


Figure 4: Burst Current Cause VBAT Drop

#### NOTE

- Test condition: VBAT power supply 3.8V, SIMCom TE board is used for test, add 330μF tantalum capacitor to VBAT power supply terminal.

Table 7: VBAT Pin Electrical Parameters

| Symbol                       | Description                                        |                                 | Min | Typ  | Max | Unit |
|------------------------------|----------------------------------------------------|---------------------------------|-----|------|-----|------|
| VBAT                         | Module power voltage.                              | R7082                           | 3.4 | 3.8  | 4.2 | V    |
| I <sub>VBAT(peak)</sub>      | Module power peak current in GPRS emission mode.   |                                 |     | 2.1  |     | A    |
| I <sub>VBAT(peak)</sub>      | Module power peak current in NB-IoT emission mode. |                                 | -   | 0.45 | -   | A    |
| I <sub>VBAT(average)</sub>   | Module power average current in normal mode.       | Please refer to the chapter 5.4 |     |      |     |      |
| I <sub>VBAT(sleep)</sub>     | Power supply current in sleep mode.                |                                 |     |      |     |      |
| I <sub>VBAT(power-off)</sub> | Module power current in power off mode.            |                                 | -   | -    | 6   | uA   |
| I <sub>VBAT(PSM)</sub>       | Module power current in PSM mode.                  |                                 | -   | -    | 6   | uA   |

### 3.1.1 Power Supply Reference Design

In the user's design, special attention must be paid to the design of the power supply section to ensure that the VBAT drop cannot be lower than the minimum voltage 3.4V even when the module current consumption reaches the instantaneous maximum. If the VBAT voltage drops below the minimum input voltage, the module may shut down due to low voltage.

The figure 5 shows the recommended circuit.

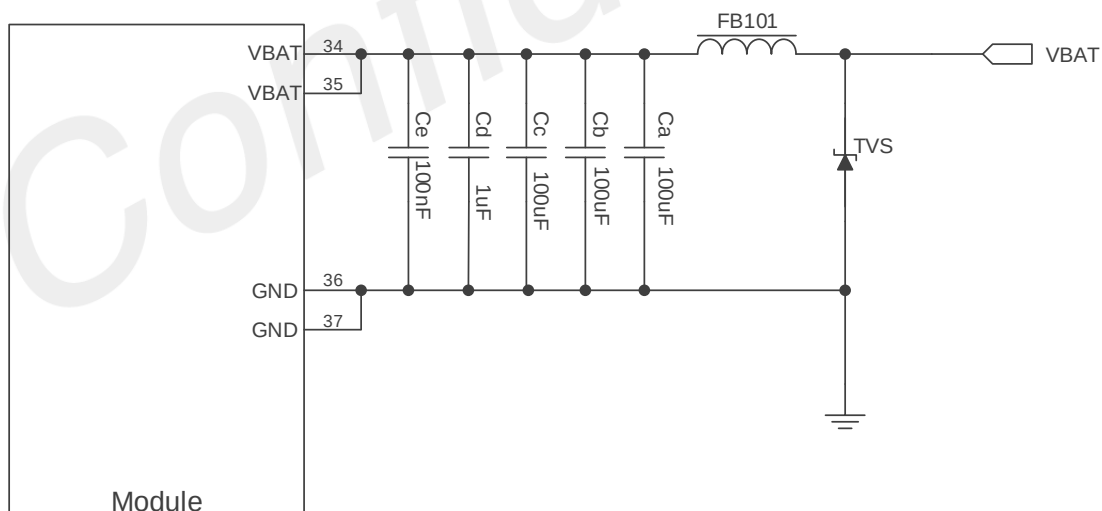


Figure 5: VBAT Input Reference Circuit

In addition, for ESD protection, it is suggested to add a TVS diode near the VBAT PINs. These capacitors should be put as close as possible to VBAT pads. Also, users should keep VBAT trace on circuit board wider than 0.8 mm to minimize PCB trace impedance.

Table 8: Recommended TVS Diode List

| No. | MFR.  | Part Num.        | $V_{RWM}$ | $V_{C(MAX)}$ | $P_{PP(max)}$ | $C_{J(max)}$ | Package |
|-----|-------|------------------|-----------|--------------|---------------|--------------|---------|
| 1   | WILL  | ESD56301D05      | 5V        | 9.5V         | 1500W         | 700pF        | DFN1610 |
| 2   | WILL  | ESD56301D04-2/TR | 4.85V     | 11V          | 2000W         | 480pF        | DFN1610 |
| 3   | WAYON | WS2057KP         | 5V        | 12V          | 2040W         | 700pF        | DFN1610 |
| 4   | WAYON | WS4.5DPHXM       | 4.85V     | 11V          | 2255W         | 700pF        | DFN1610 |

### NOTE

- The customer's circuit design must have the function that the master can control the power off of the module. The module can be shut down or restarted normally. Only when the module is abnormal and cannot be shut down or restarted normally can the power be turned off.
- When the module is working normally, do not cut off the power supply of the module VBAT directly to avoid damage to the internal flash of the module. It is strongly recommended to turn off the module through AT command before disconnecting the module VBAT power.

### 3.1.2 Recommended Power Supply Circuit

If the supply voltage exceeds the supply range of VBAT, the buck circuit should be used to meet the demand of power supply. When choosing buck chip, besides considering the maximum current output capability of IC to meet the demand of R7082 module, it is also necessary to consider the low static power consumption of IC in PSM.

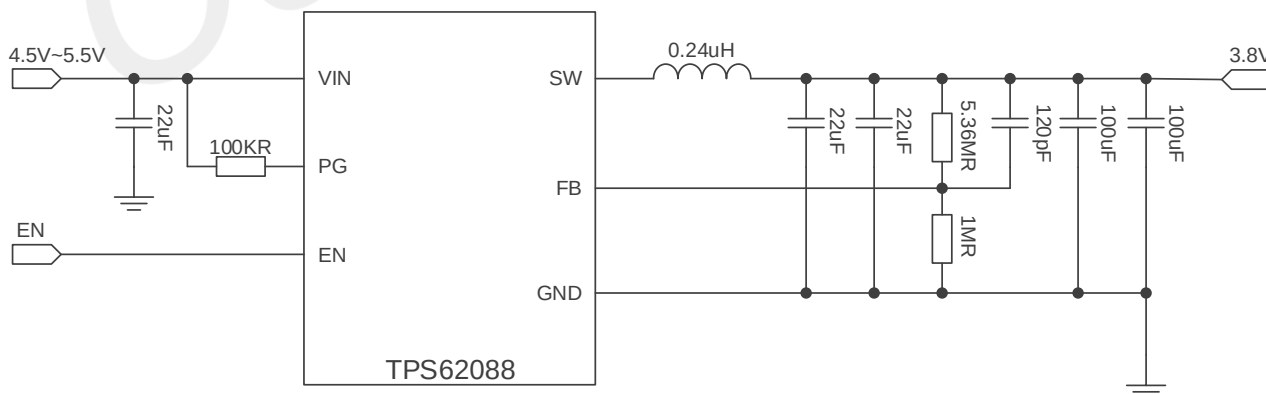


Figure 6: Power Supply Reference Circuit

## 3.2 Power On/ Off and Reset

### 3.2.1 Power on

The PWRKEY pin has a default voltage of 1.05V. R7082 module can be powered on by pulling the PWRKEY pin to ground. It is strongly recommended to put an ESD protection diode close to the PWRKEY pin, as it would strongly enhance the ESD performance of PWRKEY pin. Please refer to the following figure for the recommended reference circuit.

The recommended circuit is as follows:

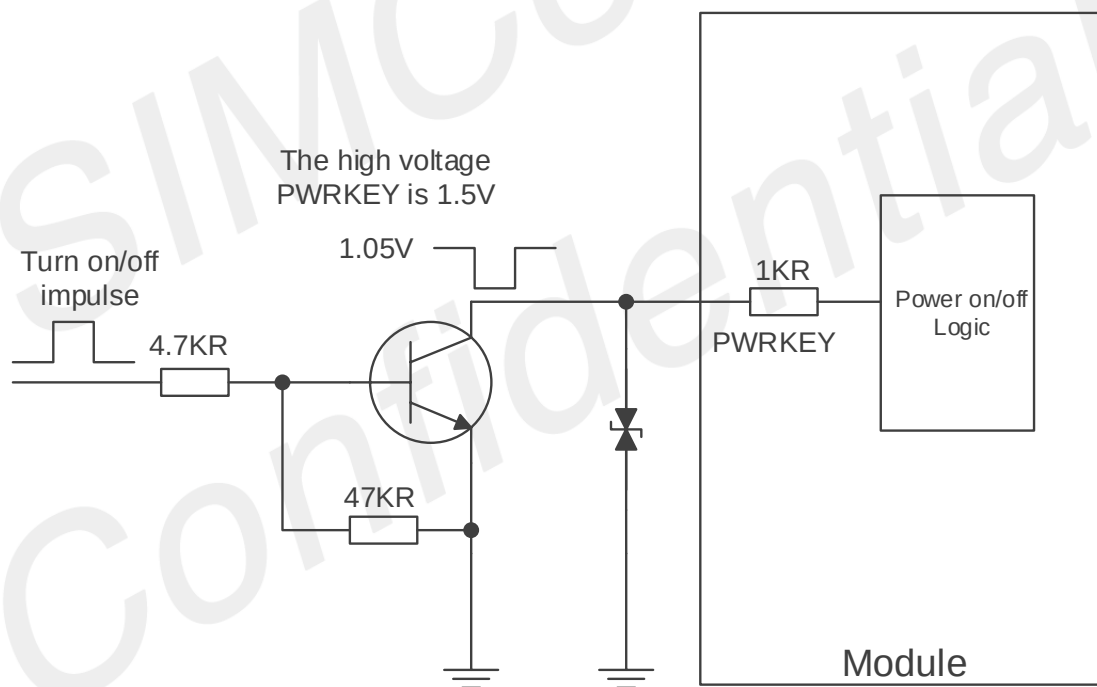


Figure 7: Power on/off Reference Circuit

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

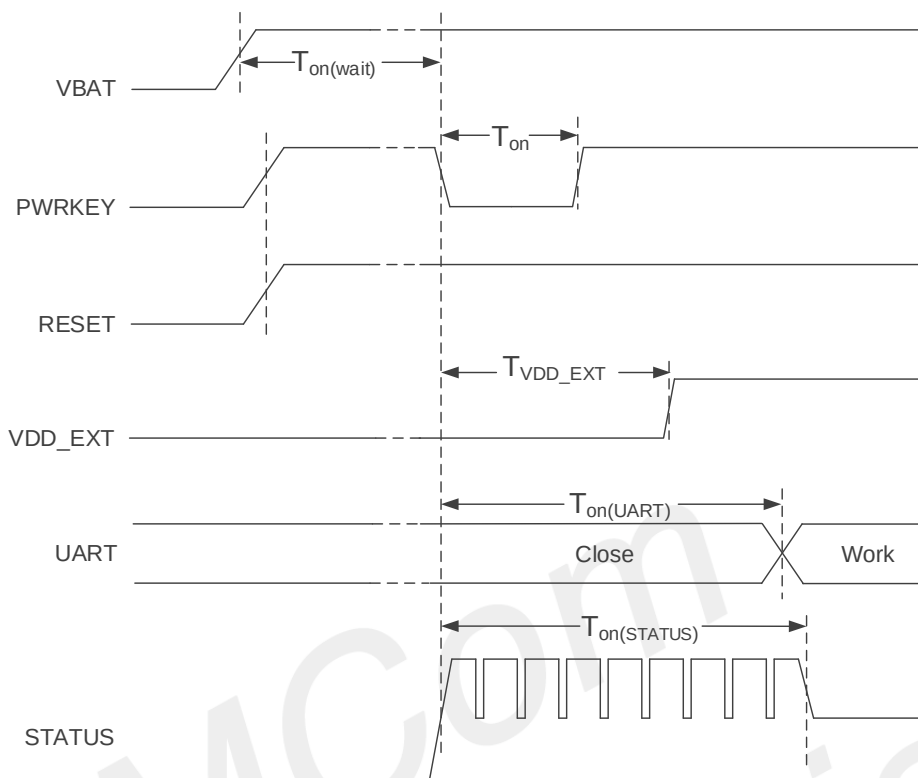


Figure 8: PWRKEY Power on Sequence

Table 9: Power on Sequence Parameters

| Symbol             | Parameter                                                                                | Min. | Typ. | Max. | Unit |
|--------------------|------------------------------------------------------------------------------------------|------|------|------|------|
| $T_{on(wait)}$     | The wait time when the power-on is stable until the start button is valid                | 1    |      |      | S    |
| $T_{on}$           | The time of active low level impulse of PWRKEY pin to power on module                    | 500  | -    | -    | ms   |
| $T_{on(VDD\_EXT)}$ | The time from power-on issue to VDD_EXT pin output high level.                           | -    | 510  | -    | ms   |
| $T_{on(STATUS)}$   | The time from power-on issue to STATUS pin output high level(indicating power up ready ) | 2.5  | -    | -    | s    |
| $T_{on(UART)}$     | The time from power-on issue to UART port ready                                          | 2.5  | -    | -    | s    |
| $V_{IH}$           | Input high level voltage on PWRKEY pin                                                   | 0.68 | 1.05 | 1.41 | V    |
| $V_{IL}$           | Input low level voltage on PWRKEY pin                                                    | -0.3 | 0    | 0.3  | V    |

**NOTE**

- It is recommended to ensure that the VBAT voltage rises and stabilizes before pulling down the PWRKEY pin to start up.
- Before turning on the module, be sure to pay attention to the maximum conditions (such as voltage and temperature range) allowed by the module, otherwise exceeding the absolute maximum value of the module may cause permanent damage to the module.

### 3.2.2 Module Power off

R7082 has the following shutdown methods:

- Power off by pulling the PWRKEY pin down to a low level.
- Power off Module by AT command “AT+CPOF”.

It is strongly recommended that the customer use PWRKEY or “AT+CPOF” to shut down, and then power off VBAT (especially when the module does not need to work). In addition, the customer cannot shut down VBAT by disconnecting it, which may cause damage to FLASH.

**NOTE**

- For a detailed description of “AT+ CPOF”, please refer to document [1].

PWRKEY can be used to power off the module, power off sequence see the following figure:

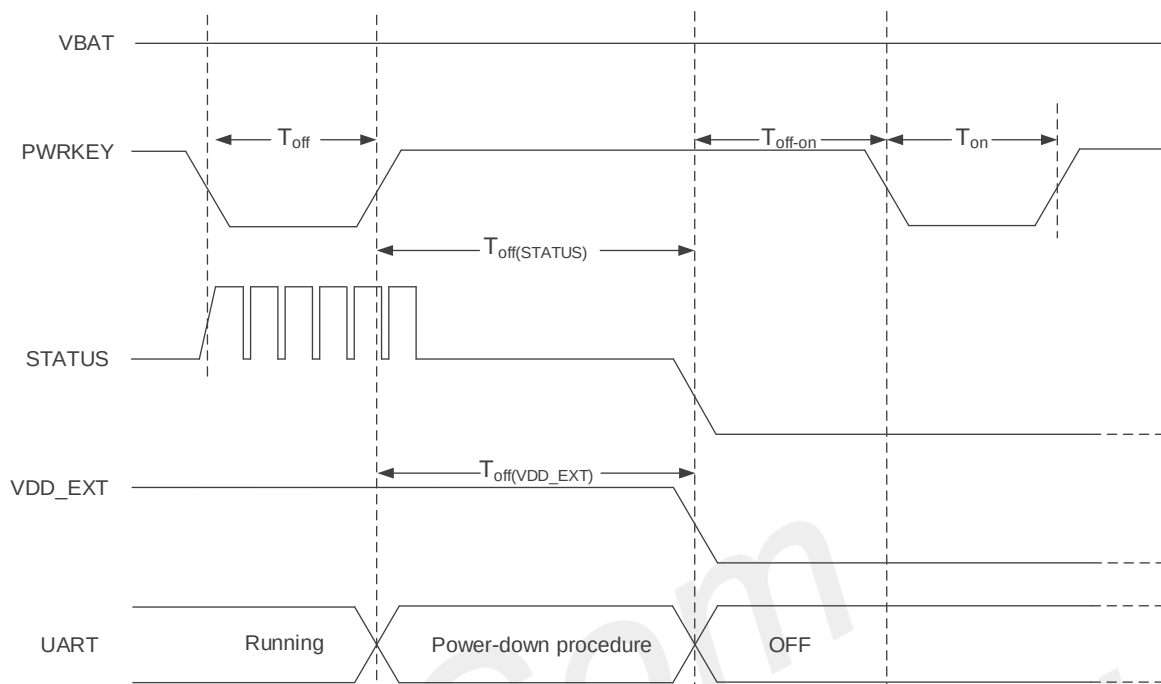


Figure 9: PWRKEY Power off Sequence

Table 10: Power off Sequence Parameters

| Symbol            | Parameter                                                                            | Time value |      |      | Unit |
|-------------------|--------------------------------------------------------------------------------------|------------|------|------|------|
|                   |                                                                                      | Min.       | Typ. | Max. |      |
| $T_{off}$         | The active low level time pulse on PWRKEY pin to power off module                    | 2          |      | -    | s    |
| $T_{off(vdd)}$    | The time from power-off issue to VDD_EXT pin output low level                        |            | 3    | -    | s    |
| $T_{off(status)}$ | The time from power-off issue to STATUS pin output low level(indicating power off )* |            | 3    | -    | s    |
| $T_{off-on}$      | Power-on and power-off buffer time                                                   | 1          | -    | -    | s    |

#### NOTE

- The STATUS pin can be used to detect whether module is powered on or not. When module has been powered on and firmware goes ready, STATUS will be high level, or else STATUS will still low level.
- When the PWRKEY goes low, the module will power on. At this time, the status will show a pulse, which is a normal phenomenon and does not affect the usage.

### 3.2.3 Module Reset

R7082 can restart the module by pulling down the reset pin of the module. It is strongly recommended to put a 100nF capacitor and an ESD protection diode close to the RESET pin. Please refer to the following figure for the recommended reference circuit.

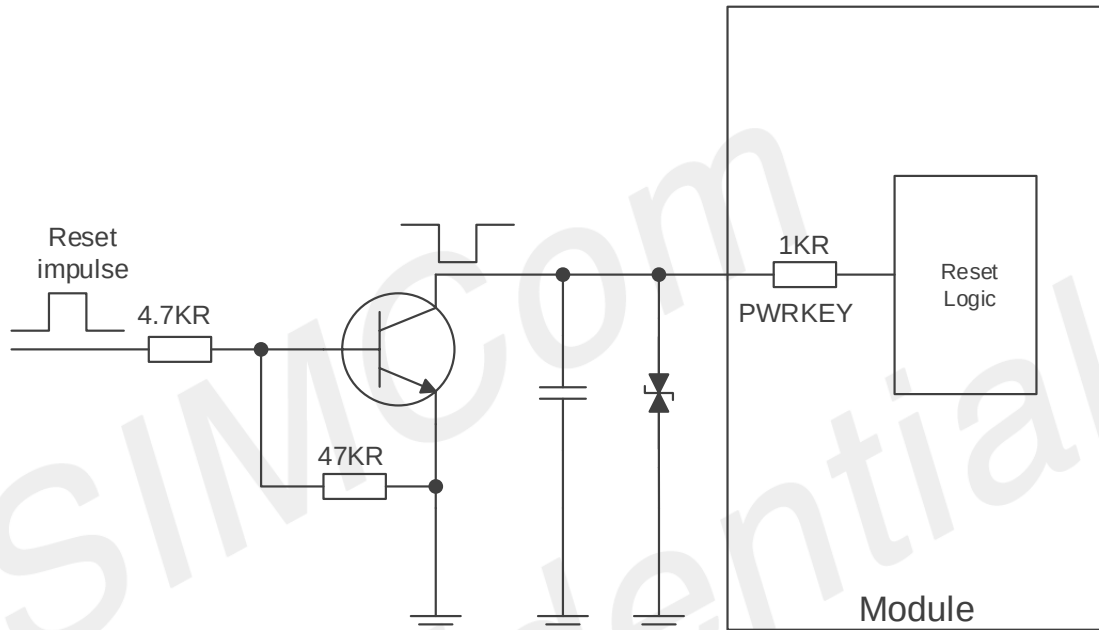


Figure 10: Reference Reset Circuit

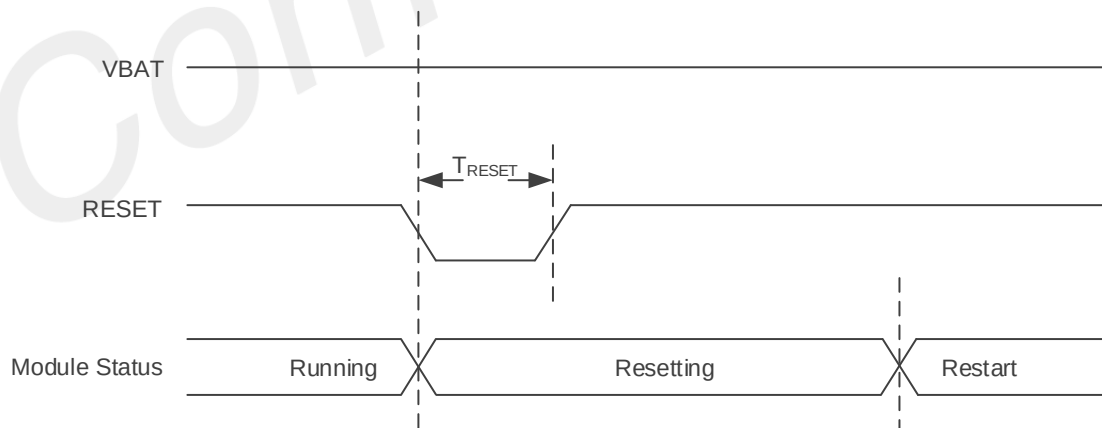


Figure 11: Reset Timing

Table 11: Reset Electric Parameter

| Symbol             | Parameter                     | Min. | Typ. | Max. | Unit |
|--------------------|-------------------------------|------|------|------|------|
| $T_{\text{reset}}$ | Restart low level pulse width | 2    | 2.5  | -    | S    |
| $V_{\text{IH}}$    | Reset pin input high voltage  | 0.7  | 1.05 | 1.25 | V    |
| $V_{\text{IL}}$    | Reset pin input low voltage   | 0    | 0    | 0.3  | V    |

#### NOTE

- It is recommended to use the reset pin only in case of emergency, such as the module is not responding. The reset time is recommended to be 1s.

### 3.3 UART Interface

R7082 module provides 3 channels serial ports:

One channel full-function serial port UART1, it can be used for AT command communication between the module and the peripheral MCU.

One channel 2-wire serial port UART3, the default function after booting is GPIO. It can be configured as a UART function, and can be used for AT command communication, but cannot be used with UART1. It is only used as UART in DAM (Downloadable Application Module) application when secondary development.

One channel serial port DBG\_UART, can Download, RF Calibration and Trace through DBG\_UART,

The UART1 supports 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200bps, default rate is 115200 bps, it does not support auto baud rate, but you can use "AT +IPR" to set and read the rate.

When using the full function serial port, the connection method below can be used for reference:

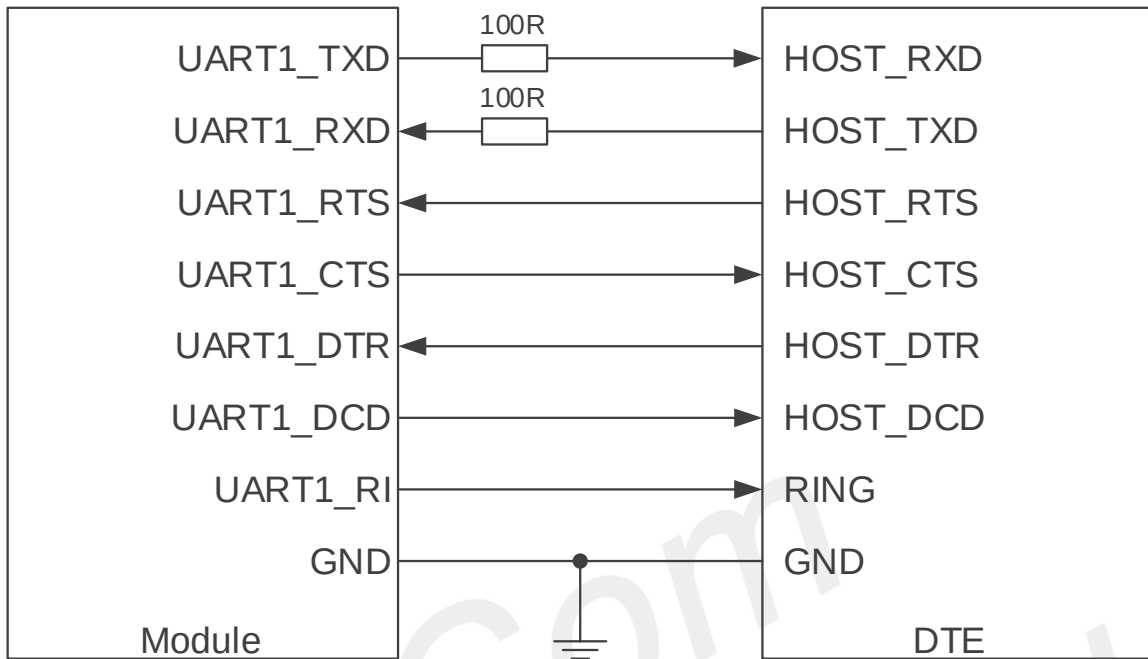


Figure 12: Serial Port Connection Diagram (Full Function Mode)

When using 2-wire serial port, please refer to the following connection mode:

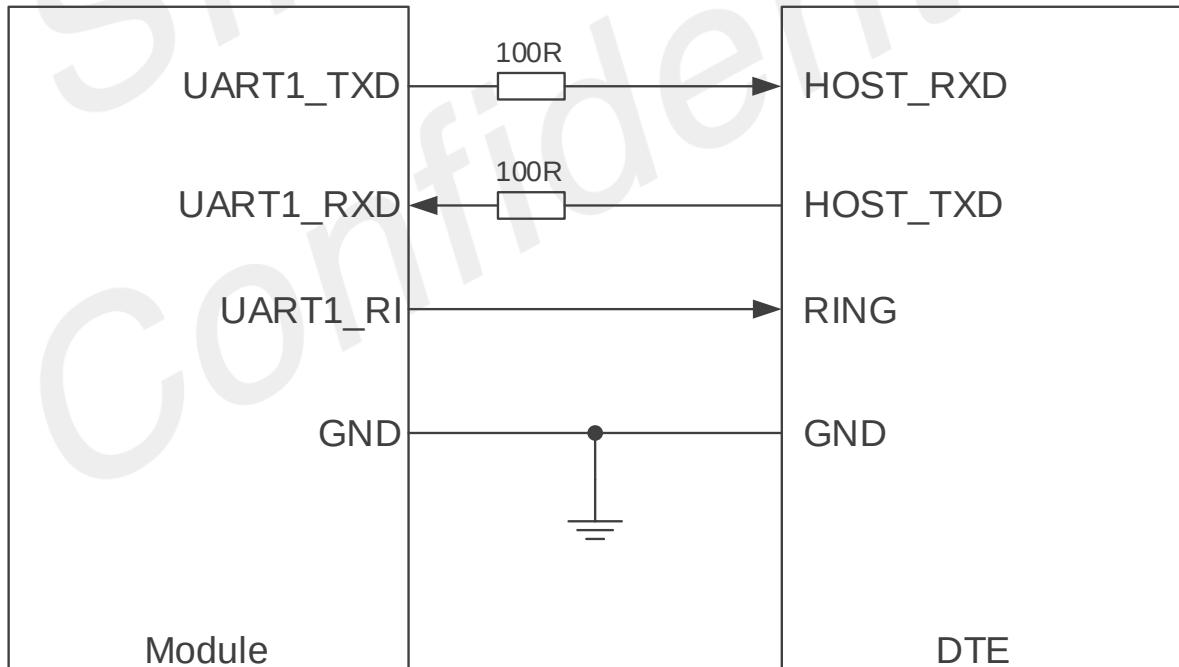


Figure 13: Serial Port Connection Diagram (NULL Mode)

Table 12: UART Electronic Characteristic

| Symbol   | Description                    | Min. | Typ. | Max. | Unit |
|----------|--------------------------------|------|------|------|------|
| $V_{IH}$ | UART input high level voltage  | 1.17 | 1.8  | 2.1  | V    |
| $V_{IL}$ | UART input low level voltage   | -0.3 | 0    | 0.63 | V    |
| $V_{OH}$ | UART output high level voltage | 1.35 | 1.8  | 1.8  | V    |
| $V_{OL}$ | UART output low level voltage  | 0    | 0    | 0.45 | V    |

The R7082 module UART is 1.8V voltage interface. If user's UART application circuit is 3.3V voltage interface, the level shifter circuits should be used for voltage matching. The following figure shows the voltage matching reference design.

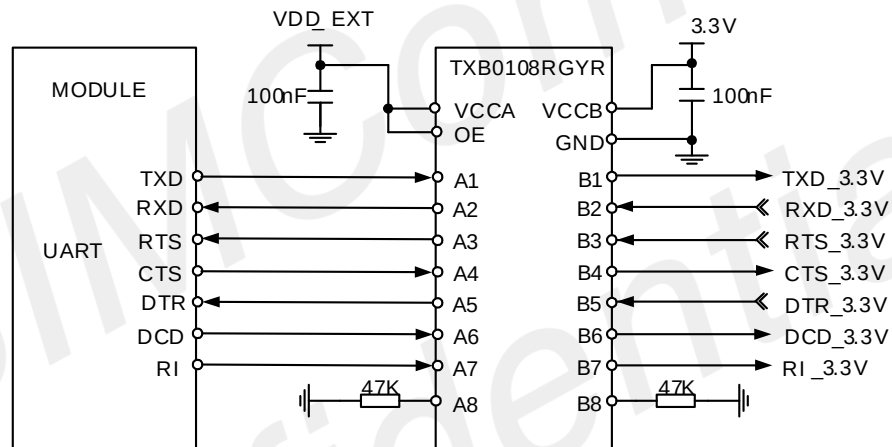


Figure 14: Reference Circuit with Level Shifter IC

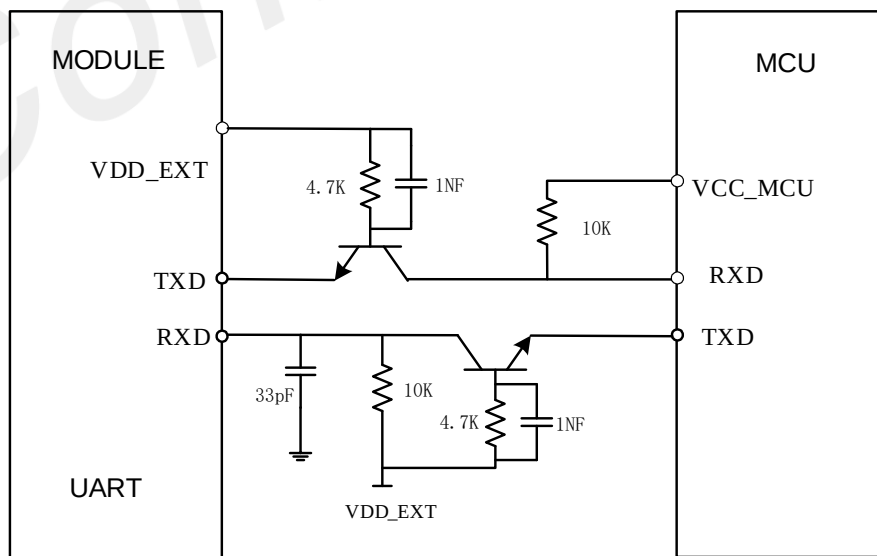


Figure 15: Reference Circuit with Transistor

### NOTE

- When it uses the level shifter IC, the pull up resistance on TXD\_3.3V, RTS\_3.3V, DCD\_3.3V and RI\_3.3V should not be less than 47KΩ.
- When it uses the transistor, the selection of the transistor must be a high-speed transistor, and the model MMBT3904 is recommended.

### 3.3.1 RI Description

The RI pin can be used as an interrupt to wake up the host. Normally, it maintains a high voltage output. When a short message or URC report is received, RI outputs a low voltage for 120ms (SMS)/60ms (URC), and then returns to a high voltage state; RI will output low voltage. When receiving a telephone call as the called party, RI outputs low voltage, and then it will remain low voltage until the host accepts the call using the "ATA" command, or the caller stops calling RI will resume outputting high level.

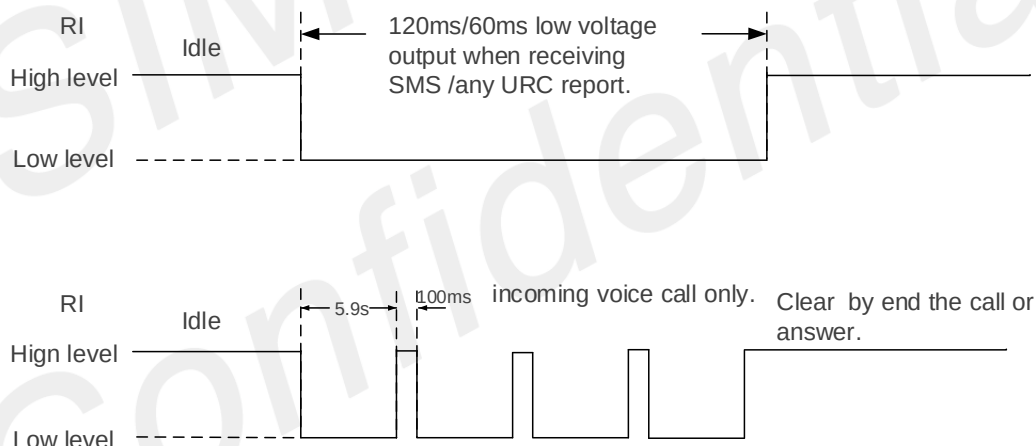


Figure 16: Level Change on RI (SMS, URC, Incoming Call)

### NOTE

- For more details of AT commands about UART, please refer to document [1].

### 3.4 SIM Interface

R7082 supports both 1.8V and 3.0V SIM Cards. The interface power of the SIM card is provided by the voltage regulator inside the module, and the normal voltage value is 3V or 1.8V.

Table 13: SIM Electronic Characteristic in 1.8V Mode ( $V_{SIM\_VDD}=1.8V$ )

| Symbol         | Parameter                               | Min.                      | Typ. | Max.                      | Unit |
|----------------|-----------------------------------------|---------------------------|------|---------------------------|------|
| $V_{SIM\_VDD}$ | Power supply voltage output to SIM card | 1.75                      | 1.8  | 1.93                      | V    |
| $V_{IH}$       | High-level input voltage                | $0.65 \cdot V_{SIM\_VDD}$ | -    | $V_{SIM\_VDD} + 0.3$      | V    |
| $V_{IL}$       | Low-level input voltage                 | -0.3                      | 0    | $0.35 \cdot V_{SIM\_VDD}$ | V    |
| $V_{OH}$       | High-level output voltage               | $V_{SIM\_VDD} - 0.45$     | -    | $V_{SIM\_VDD}$            | V    |
| $V_{OL}$       | Low-level output voltage                | 0                         | 0    | 0.45                      | V    |

Table 14: SIM Electronic Characteristic in 3.0V Mode ( $V_{SIM\_VDD}=3V$ )

| Symbol         | Parameter                               | Min.                      | Typ. | Max.                      | Unit |
|----------------|-----------------------------------------|---------------------------|------|---------------------------|------|
| $V_{SIM\_VDD}$ | Power supply voltage output to SIM card | 2.95                      | 3    | 3.15                      | V    |
| $V_{IH}$       | High-level input voltage                | $0.65 \cdot V_{SIM\_VDD}$ | -    | $V_{SIM\_VDD} + 0.3$      | V    |
| $V_{IL}$       | Low-level input voltage                 | -0.3                      | 0    | $0.35 \cdot V_{SIM\_VDD}$ | V    |
| $V_{OH}$       | High-level output voltage               | $V_{SIM\_VDD} - 0.45$     | -    | $V_{SIM\_VDD}$            | V    |
| $V_{OL}$       | Low-level output voltage                | 0                         | 0    | 0.45                      | V    |

The R7082 supports dual card single standby, and uses "AT+RSIMSWITCH=<sim\_id>" to switch cards. The module needs to be restarted after the command is executed. The value of <sim\_id> is 0 or 1.

Table 15: SIM Card AT Command Switching Table

| AT Instruction  | SIM Card Switching Result |
|-----------------|---------------------------|
| AT+RSIMSWITCH=0 | SIM1                      |
| AT+RSIMSWITCH=1 | SIM2                      |

#### NOTE

- For more details of AT commands about SIM, please refer to document [1].

### 3.4.1 SIM Application Guide

Note that the SIM peripheral circuit should be close to the SIM card socket. If you want the module supports SIM card hot swap function, you should connect the module SIM\_DET pin to the SIM card's hot swap pin. Otherwise keep the SIM\_DET pin open. The following figure shows the reference circuit with the hot swap function.

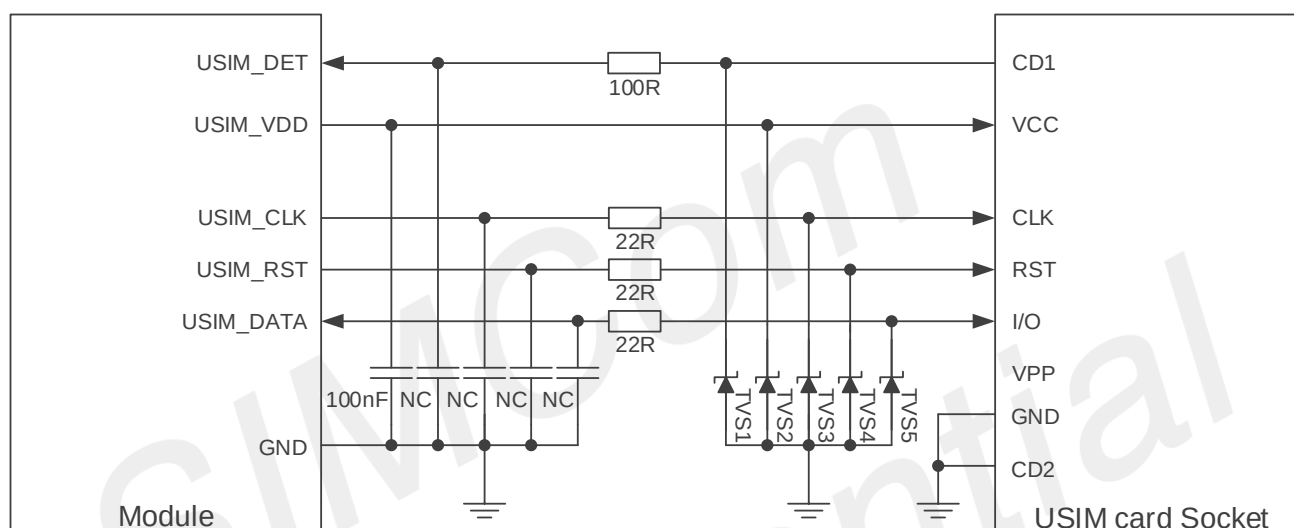


Figure 17: SIM Interface Reference Circuit

When the (U)SIM card is inserted, the (U)SIM\_DET will change from low to high level. The rising edge will indicate insertion of the (U)SIM card. When the (U)SIM card is removed, the (U)SIM\_DET will change from high to low level. This falling edge will indicate unplug the (U)SIM card.

SIM\_DATA has been pulled up with a 10KR resistor to SIM\_VDD in module, so it no need pulled up resistor anymore. SIM\_VDD needs a 100nF capacitor close to SIM socket.

SIM\_CLK is very important signal, the rise time and fall time of SIM\_CLK should be less than 40ns. So the junction capacity of the TVS need to less 15pF.

Because the SIM card circuit is susceptible to interference, causing the card not to be recognized or dropped, please follow the following principles when designing:

- During the PCB layout stage, keep the SIM card holder away from the main antenna.
- The SIM card wiring should be kept away from RF lines, VBAT and high-speed signal lines as much as possible, and the SIM card wiring should not be too long.
- The GND of the SIM card holder and the GND of the module maintain good connectivity, so that the GNDs of the two are equal in potential.
- To prevent SIM\_CLK from interfering with other signals, it is recommended to protect SIM\_CLK separately.

- It is recommended to place a 220nF capacitor on the SIM\_VDD signal line close to the SIM card socket.
- It is recommended to place a 3.3V TVS close to the SIM card socket to enhance the ESD protection performance. The parasitic capacitance of TVS should not be greater than 15pF.
- Connecting a 22Ω resistor in series between the SIM card socket and the module can enhance the ESD protection performance.
- In order to make the wiring smooth, it is recommended to use a single-channel TVS, placed close to each pin of the card socket.
- The SIM\_CLK signal is very important. Customers should ensure that the rising edge and falling edge time of the SIM\_CLK signal are less than 40ns, otherwise, abnormal card recognition may occur.

### 3.5 Analog Audio Interface\*

R7082 integrates audio codec and audio front-end, provides 1 set of SPK analog audio interface. Customers can connect the phone handle for voice calls.

#### 3.5.1 Analog Audio Reference Design

The recommended circuit for analog audio is shown below:

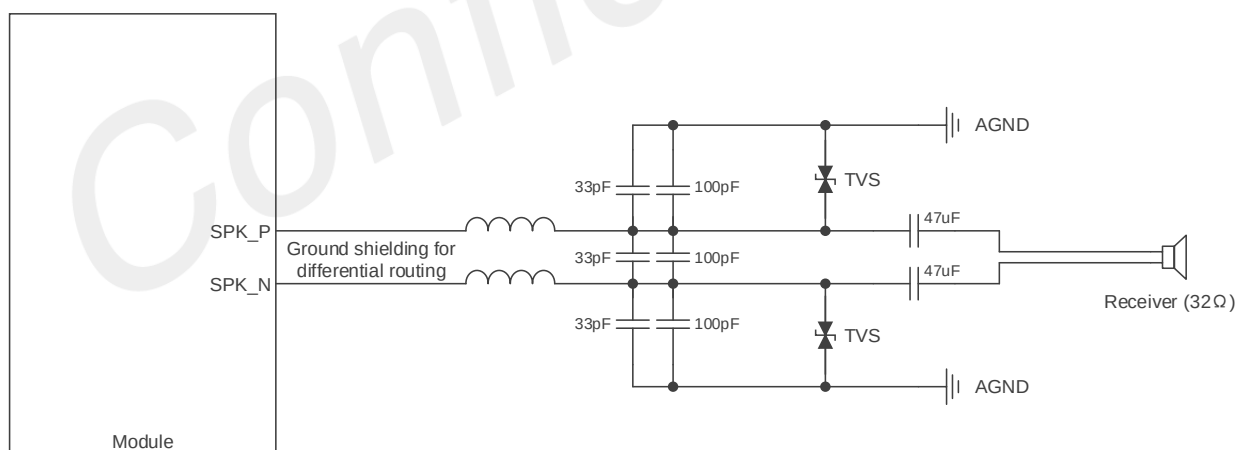


Figure 18: Analog Audio Interface Reference Circuit

#### NOTE

- Audio features are not yet developed

### 3.6 GPIO Interface

The R7082 module provides 6 groups of GPIOs.

Table 16: GPIO Electronic Characteristic

| Pin No. | Pin Name | Pin Typ. | Power Domain | Pad Edge Wakeup |
|---------|----------|----------|--------------|-----------------|
| 57      | GPIO1    | IO,PD    | 1.8V         | Yes             |
| 58      | GPIO2    | IO,PD    | 1.8V         | Yes             |
| 78      | GPIO3    | IO,PD    | 1.8V         | Yes             |
| 79      | GPIO4    | IO,PD    | 1.8V         | Yes             |
| 80      | GPIO5    | IO,PD    | 1.8V         | Yes             |
| 81      | GPIO6    | IO,PD    | 1.8V         | Yes             |

#### NOTE

- GPIO1-GPIO4 can be configured as SPI interface by software

### 3.7 I2C Interface

The module provides a sets of I2C interface, supports standard speed clock rate 100Kbps, support high speed clock rate 400Kbps, its operation voltage is 1.8V.

I2C is open-drain output, and the reference circuit is as follows:

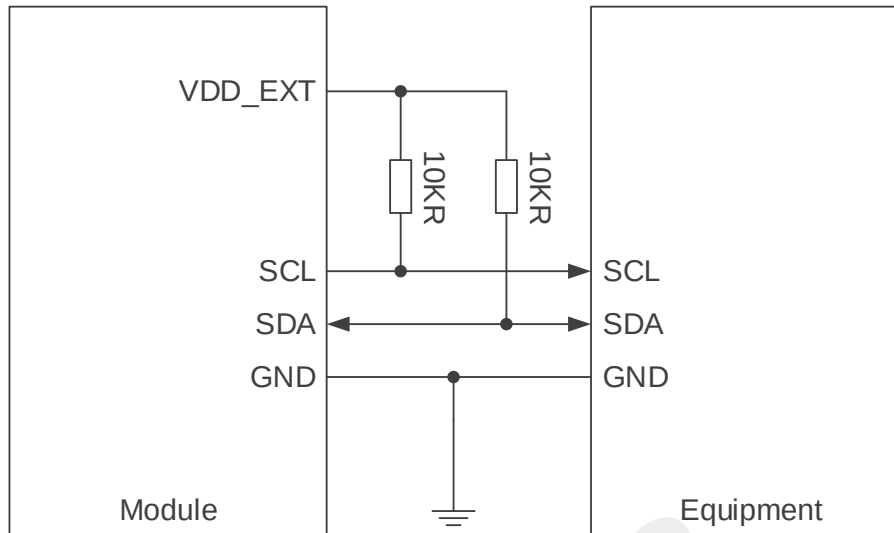


Figure 19: I2C Reference Circuit

#### NOTE

- The I2C signal has no pull-up resistors in module. So the pulling up resistors 10KΩ to VDD\_EXT is necessary in application circuit.

Table 17: I2C Electronic Characteristic

| Symbol          | Parameter                 | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|------|------|------|------|
| V <sub>IH</sub> | High-level input voltage  | 1.17 | 1.8  | 2.1  | V    |
| V <sub>IL</sub> | Low-level input voltage   | -0.3 | 0    | 0.63 | V    |
| V <sub>OH</sub> | High-level output voltage | 1.35 | 1.8  | 1.8  | V    |
| V <sub>OL</sub> | Low-level output voltage  | 0    | 0    | 0.45 | V    |

### 3.8 SPI Interface\*

R7082 module supports a set of 4-wire (MISO, MOSI, CS and CLK) SPI interface. The default function of the SPI interface is GPIO. The SPI function is only available in software secondary development.

The SPI only supports the master mode. The maximum clock frequency is up to 26MHz when operating in SPI master mode.

The SPI function of R7082 series is multiplexed by GPIO1, GPIO2, GPIO3 and GPIO4.

Table 18 describes the multiplex function of the SPI.

Table 18: Multiplex Function of the SPI

| Pin No. | Pin Name | Multiplex Function |
|---------|----------|--------------------|
| 11      | GPIO1    | SPI_CLK            |
| 12      | GPIO4    | SPI_MOSI           |
| 13      | GPIO3    | SPI_MISO           |
| 14      | GPIO2    | SPI_CS             |

The following figure shows the SPI bus reference design.

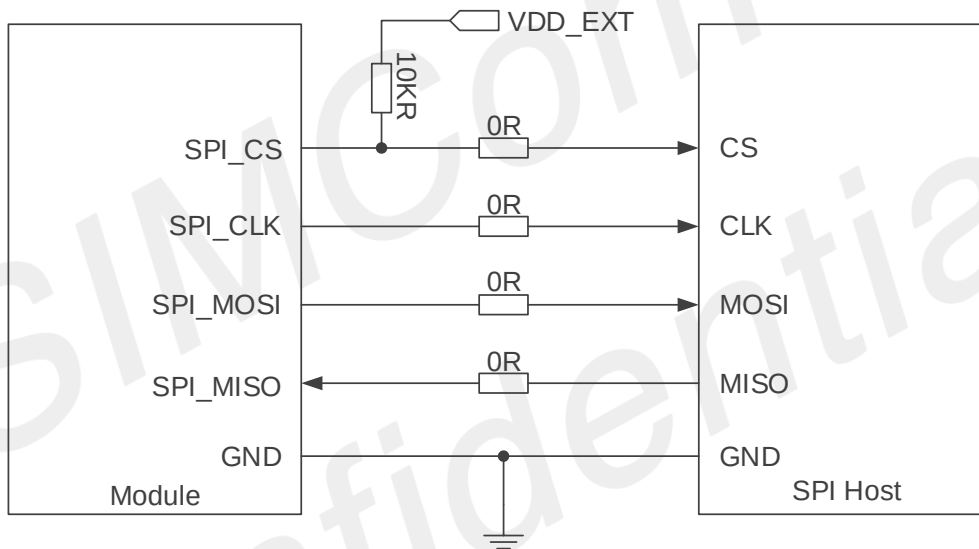


Figure 20: SPI Master Mode Circuit

#### NOTE

- The default function of the SPI interface is GPIO. The SPI function is only available in software secondary development.

## 3.9 Network Status\*

The NETLIGHT pin is used to control network status LED, its reference circuit is shown in the following figure.

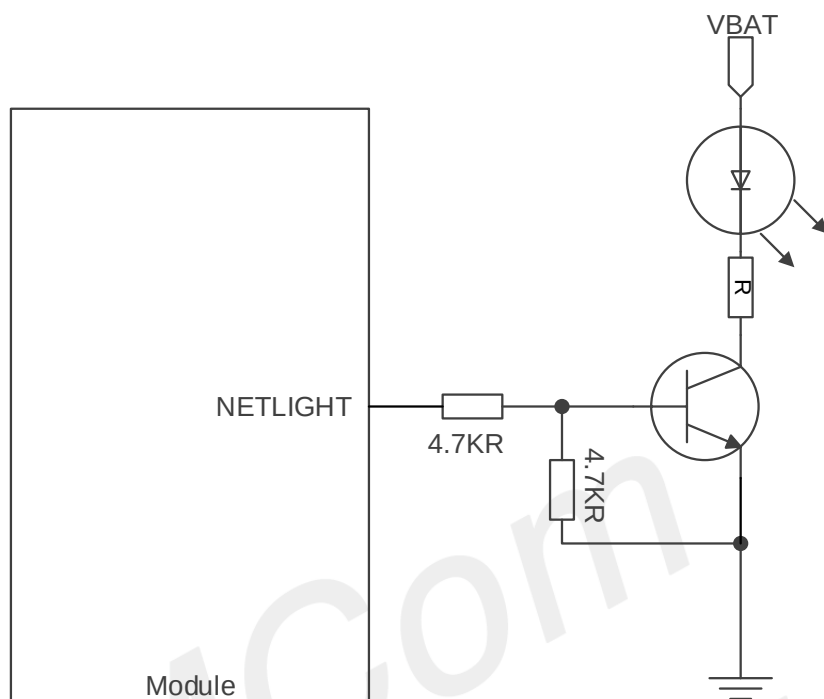


Figure 21: NETLIGHT Reference Circuit

#### NOTE

- The value of the resistor named 'R' depends on the LED characteristic.

The NETLIGHT signal is used to control the LED lights that indicate the status of the network. The working status of this pin is shown in the table below.

Table 19: 2G Mode NETLIGHT Pin Status

| NETLIGHT Pin Status | Module Status        |
|---------------------|----------------------|
| Always On           | Searching Network    |
| 200ms ON, 200ms OFF | Data Transmit        |
| 800ms ON, 800ms OFF | Registered network   |
| OFF                 | Power off / PSM mode |

Table 20: LTE Mode NETLIGHT Pin Status

| NETLIGHT Pin Status | Module Status     |
|---------------------|-------------------|
| Always On           | Searching Network |

|                     |                          |
|---------------------|--------------------------|
| 200ms ON, 200ms OFF | Data Transmit/Registered |
| OFF                 | Power off / PSM mode     |

#### NOTE

- NETLIGHT function software development

## 3.10 Other Interface

### 3.10.1 ADC

R7082 module provides a 10-bit high sample rate (ADC) interface. Its input voltage range is from 0V to 1.7V. The maximum measurement range of ADC cannot exceed 1.7V. If the input voltage of ADC PIN exceeds its range, it is necessary to implement the resistance partial pressure on the hardware.

The electronic specifications of the ADC are shown in the following table.

Table 21: ADC Electronic Characteristics

| Characteristics         | Min. | Typ. | Max. | Unit |
|-------------------------|------|------|------|------|
| Input Range             | 0    |      | 1.7  | V    |
| Input serial resistance | 1    | —    | —    | MΩ   |
| Resolution              |      | 10   |      | bits |

#### NOTE

- The function of using "AT+TESTADC=0" to read the voltage value of the ADC pin is under debugging. For more information, please refer to document [1].

### 3.10.2 LDO

R7082 module has a LDO power output named VDD\_EXT. The output voltage is 1.8V. This voltage can only be used for pull up for the external GPIO or power supply for the level conversion circuit.

Table 22: VDD\_EXT Electrical Characteristics

| Symbol               | Description    | Min. | Typ. | Max. | Unit |
|----------------------|----------------|------|------|------|------|
| V <sub>VDD_EXT</sub> | Output voltage | 1.7  | 1.8  | 3.6  | V    |
| IO                   | Output current | -    | -    | 200  | mA   |

#### NOTE

- The VDD\_EXT is used to the IO power in the module. The Output voltage is not supported to adjust.

## 4 RF Specifications

### 4.1 GSM/LTE

Table 23: Conducted Emission Power

| Frequency       | Power              | Minimum Power  |
|-----------------|--------------------|----------------|
| EGSM900(GMSK)   | 33dBm $\pm$ 2dB    | 5dBm $\pm$ 5dB |
| DCS1800(GMSK)   | 30dBm $\pm$ 2dB    | 0dBm $\pm$ 5dB |
| EGSM900 (8-PSK) | 27dBm $\pm$ 3dB    | 5dBm $\pm$ 5dB |
| DCS1800 (8-PSK) | 26dBm $\pm$ 3/-4dB | 0dBm $\pm$ 5dB |
| NB-IoT B3       | 23dBm $\pm$ 2.7dB  | <-40dBm        |
| NB-IoT B5       | 23dBm $\pm$ 2.7dB  | <-40dBm        |
| NB-IoT B8       | 23dBm $\pm$ 2.7dB  | <-40dBm        |
| NB-IoT B20      | 23dBm $\pm$ 2.7dB  | <-40dBm        |
| NB-IoT B28      | 23dBm $\pm$ 2.7dB  | <-40dBm        |

Table 24: GSM Operating Bands

| Frequency | DL            | UL            |
|-----------|---------------|---------------|
| EGSM900   | 925~960MHz    | 880~915 MHz   |
| DCS1800   | 1805~1880 MHz | 1710~1785 MHz |

Table 25: E-UTRA Operating Bands

| E-UTRA BAND | UL             | DL             | Duplex Mode |
|-------------|----------------|----------------|-------------|
| 3           | 1710 ~1785 MHz | 1805 ~1880 MHz | HD-FDD      |
| 5           | 824 ~849 MHz   | 869 ~894MHz    | HD-FDD      |
| 8           | 880 ~915 MHz   | 925 ~960 MHz   | HD-FDD      |
| 20          | 832~862MHz     | 791~ 821MHz    | HD-FDD      |
| 28          | 703~748MHz     | 758~803MHz     | HD-FDD      |

Table 26: Conducted Receive Sensitivity

| Frequency | Sensitivity (TYP) | Sensitivity (MAX) |
|-----------|-------------------|-------------------|
| EGSM900   | < -109dBm         | 3GPP              |
| DCS1800   | < -108dBm         | 3GPP              |
| NB-IoT    | See table 27.     | 3GPP              |

Table 27: Reference Sensitivity (QPSK)

| Frequency      | 3GPP       | Actual |
|----------------|------------|--------|
| Band3(NB-IoT)  | <-107.5dBm | -115   |
| Band5(NB-IoT)  | <-107.5dBm | -116   |
| Band8(NB-IoT)  | <-107.5dBm | -117   |
| Band20(NB-IoT) | <-107.5dBm | -116   |
| Band28(NB-IoT) | <-107.5dBm | -116   |
| GSM900         | <-102 dBm  | -111   |
| GSM1800        | <-102 dBm  | -109   |

## 4.2 GSM/ LTE Antenna Reference Design

For better overall performance, it is recommended that the antenna design refer to the index requirements in the following table.

Table 28: GSM/LTE Antenna Requirements

| Parameter                         | Requirement               |
|-----------------------------------|---------------------------|
| operating band                    | See table 25 and table 26 |
| Direction                         | omnidirectional           |
| Gain                              | > -3dBi (Avg)             |
| Input impedance                   | 50 ohm                    |
| Efficiency                        | > 50 %                    |
| Maximum input power               | 50W                       |
| VSWR                              | < 2                       |
| Isolation                         | >20dB                     |
| PCB insertion loss(<1GHz)         | <0.5dB                    |
| PCB insertion loss(1GHz~2.2GHz)   | <1dB                      |
| PCB insertion loss(2.3GHz~2.7GHz) | <1.5dB                    |

### 4.3 Antenna Reference Design

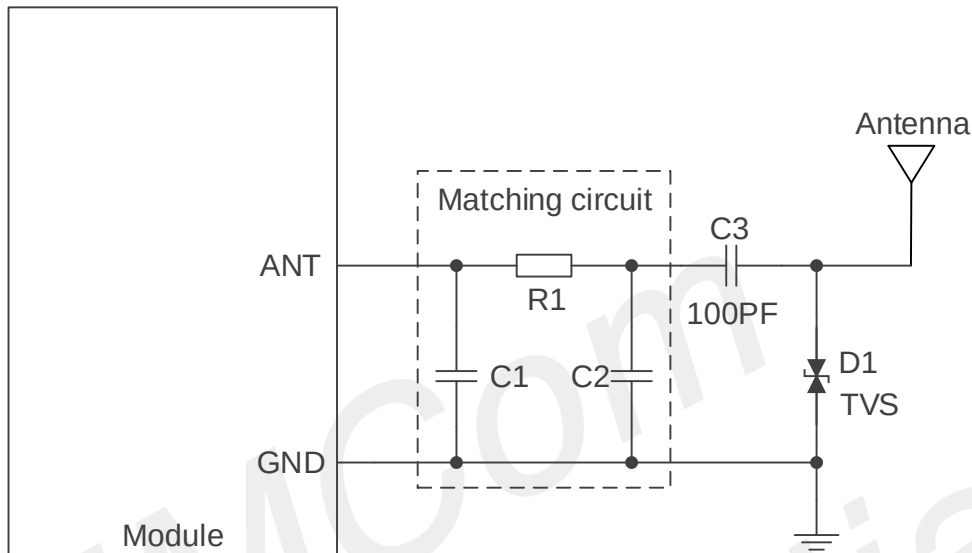


Figure 22: Passive Antenna Connection Circuit

In above figure, the component R1/R2/C1/C2 is reserved for antenna matching, the value of components can only be got after the antenna tuning, usually provided by the antenna factory. Among them, R1 and R2 paste 0Ω, C1 and C2 do not paste by default. The component D1 is a Bidirectional ESD Protection device, which is suggested to add to protection circuit, the recommended Part Numbers of the TVS are listed in the following table:

Table 29: TVS Recommended Part List

| Package | Part          | Vendor  |
|---------|---------------|---------|
| 0201    | CE0201S05G01R | SOCAY   |
| 0402    | PESD0402-03   | PRISEMI |

### 4.4 PCB Layout

When making PCB traces, users should pay attention to the impedance design of the connection between the module's ANT port and the antenna mounting PCB trace, maintaining a 50Ω impedance. The trace length is recommended to be within 20mm and should be kept away from interference signals such as power and clock.

If using IPEX connectors for impedance control, it is necessary to ensure that the projection area is hollowed out and there is a layer reference.

If using SMA connectors for impedance control, it is necessary to ensure that the edge of the RF signal pad and the GND copper foil are at least 1.2mm apart.

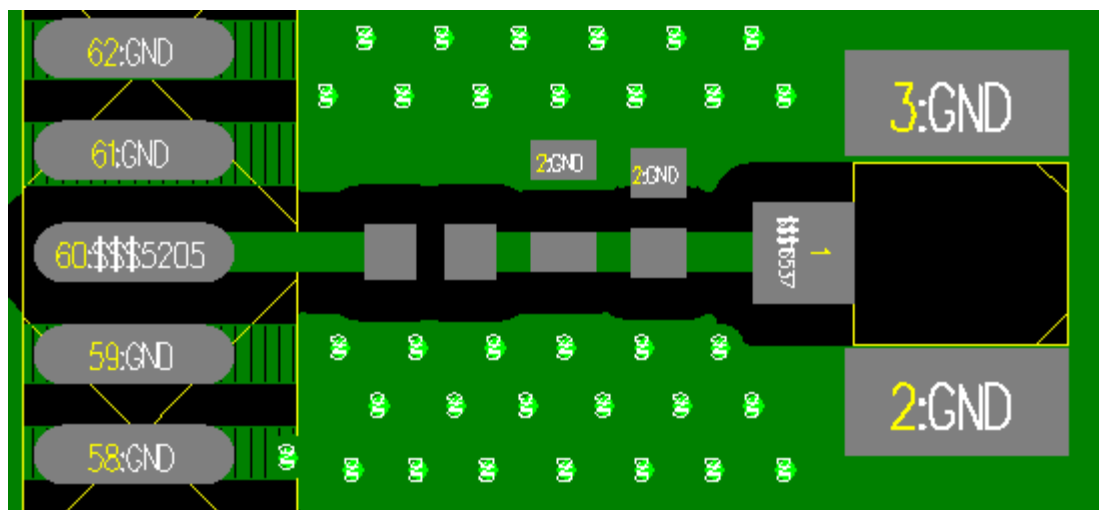


Figure 23: IPEX Reference for PCB Traces

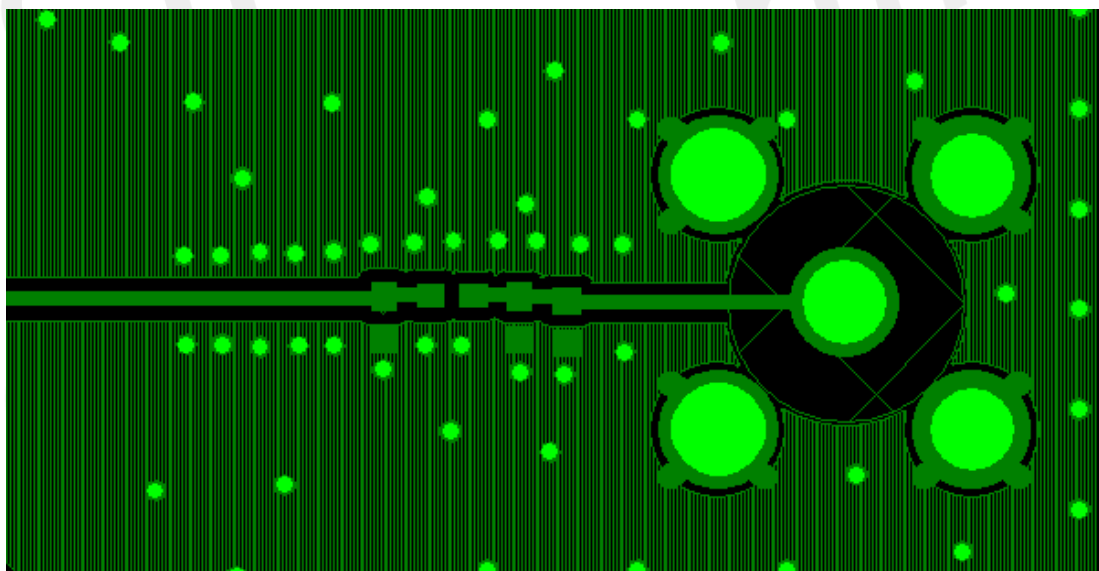


Figure 24: SMA Reference for PCB Traces

## 5 Electrical Specifications

### 5.1 Absolute Maximum Ratings

Absolute maximum rating for digital and analog pins of R7082 are listed in the following table, exceeding these limits may cause permanent damage to the module.

Table 30: Absolute Maximum Ratings

| Parameter                               | Min. | Typ. | Max. | Unit |
|-----------------------------------------|------|------|------|------|
| Voltage on VBAT                         | 0.3  | -    | 4.35 | V    |
| Voltage at digital pins (GPIO,I2C,UART) | 0.3  | -    | 3.65 | V    |
| Voltage at PWRKEY                       | 0.3  | -    | 1.41 | V    |
| ADC at PWRKEY                           | 0.3  | -    | 1.8  | V    |
| RESET at PWRKEY                         | 0.3  |      | 1.41 | V    |

#### NOTE

- The absolute parameter is tested when VBAT has the power but the PWRKEY has no pulled down. If it is over the range, the module will be damage. If the power supply on VBAT pin had been shut down, and the other pin should not have the voltage. Otherwise, it may lead to abnormally boot up or damage the module.

### 5.2 Operating Conditions

Table 31: Recommended Operating Ratings

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

Table 32: 1.8V Digital I/O Characteristics\*

| Parameter       | Description                                        | Min. | Typ. | Max. | Unit |
|-----------------|----------------------------------------------------|------|------|------|------|
| V <sub>IH</sub> | High-level input voltage                           | 1.6  | 1.8  | 2    | V    |
| V <sub>IL</sub> | Low-level input voltage                            | -0.3 | 0    | 0.54 | V    |
| V <sub>OH</sub> | High-level output voltage                          | 1.26 | -    | 1.8  | V    |
| V <sub>OL</sub> | Low-level output voltage                           | 0    | -    | 0.45 | V    |
| I <sub>OH</sub> | High-level output current(no pull down resistor)   | -    | 2    |      | mA   |
| I <sub>OL</sub> | Low-level output current(no pull up resistor)      | -    | 2    |      | mA   |
| I <sub>IH</sub> | Input high leakage current (no pull down resistor) | -    | -    | 1    | uA   |
| I <sub>IL</sub> | Input low leakage current(no pull up resistor)     | 1    | -    | -    | uA   |

#### NOTE

- These parameters are for digital interface pins, such as GPIOs (including NETLIGHT and STATUS), I2C, UART.

Table 33: Operating Temperature

| Parameter                      | Min. | Typ. | Max. | Unit |
|--------------------------------|------|------|------|------|
| Normal operation temperature   | -20  | 25   | 70   | °C   |
| Extended operation temperature | -40  | 25   | 85   | °C   |
| Storage temperature            | -40  | 25   | +125 | °C   |

#### NOTE

- Module is able to make and receive voice calls, data calls, SMS and make GPRS traffic in -20°C ~ +70°C. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

## 5.3 Operating Mode

### 5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of R7082 product.

Table 34: Operating Mode Definition

| Mode                       |                   | Function                                                                                                                                                                                                                                                                                                                                                     |
|----------------------------|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Normal operation           | Sleep             | In this case, the current consumption of module will be reduced to the minimal level and the module can still receive paging message and SMS.                                                                                                                                                                                                                |
|                            | Idle              | Software is active. Module is registered to the network, and the module is ready to communicate.                                                                                                                                                                                                                                                             |
|                            | Voice Call        | Connection between two subscribers is in progress. In this case, the power consumption depends on network settings .                                                                                                                                                                                                                                         |
|                            | Standby           | Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.                                                                                                                                                                                                               |
|                            | Data transmission | There is data transmission in progress. In this case, power consumption is related to network settings (e.g. power control level); uplink/downlink data rates, and the network configuration (e.g. multi-slot configuration).                                                                                                                                |
| Minimum functionality mode |                   | AT command “AT+CFUN=0” and “AT+CSCLK=2” can be used to set the module to a minimum functionality mode without removing the power supply. In this mode, the RF part of the module will not work and the SIM card will not be accessible, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode. |
| Flight mode                |                   | AT command “AT+CFUN=4” or pulling down the FLIGHTMODE pin can be used to set the module to flight mode without removing the power supply. In this mode, the RF part of the module will not work, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.                                        |
| Power Saving Mode (PSM)    |                   | Set the AT command “AT+CPSMS=1”, “AT+NVSETPM=2”, “AT+CSCLK=2”, “AT+VERCTRL=2”, and then restart the command and set “AT+CSCLK=2” to enable the PSM mode. This mode is similar to the power-off mode. However, the module is still registered on the network and does not need to be                                                                          |

|                           |                                                                                                                                                                                                               |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | reconnected or re-established to the network.                                                                                                                                                                 |
| Extended Mode DRX (e-DRX) | In idle or sleep mode, module and the network may negotiate over non-access stratum signaling the use of extended mode DRX for reducing power consumption.                                                    |
| Power off                 | Module will go into power off mode by sending the AT command "AT+CPOF" or pull down the PWRKEY pin, normally. In this mode the power management unit shuts down the power supply, and software is not active. |

### 5.3.2 Sleep Mode

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

Several hardware and software conditions must be satisfied together in order to let R7082 enter into sleep mode:

- Software condition: If module wants to enter into sleep mode, AT command "AT+CSCLK=2" must be set to close some clock in the module. If the value "AT+CSCLK" is "0", module will never enter into sleep mode.
- UART condition: If module wants to enter into sleep mode, don't communicate with R7082 through UART interface.

If it meets all the conditions at the same time, module will enter into sleep mode.

### 5.3.3 Minimum Functionality Mode and Flight Mode

The command "AT+CFUN=<fun>" can set the module to this mode. This command provides three options for setting different functions.

- AT+CFUN=0: Minimum functionality
- AT+CFUN=1: Full functionality (Default)
- AT+CFUN=4: Flight mode

If R7082 has been set to minimum functionality mode, the RF function and SIM card function will be closed. In this case, the serial port is still accessible, but RF function and SIM card and some AT commands will be unavailable.

If R7082 has been set to flight mode, the RF function will be closed. In this case, the serial port is still accessible, but RF function and some AT commands will be unavailable.

When R7082 is in minimum functionality or flight mode, it can return to full functionality by the AT command "AT+CFUN=1".

**NOTE**

- For detailed information about the "AT+CFUN=<fun>" command, please refer to the document [1].
- AT+CFUN=0 and AT+CFUN=4 have the same function

### 5.3.4 Power Saving Mode (PSM)

R7082 module can enter into PSM for reducing its power consumption. The mode is similar to power-off, but the module remains registered on the network and there is no need to re-attach or re-establish the network connections. So in PSM all the functions will be unavailable except the RTC function, module cannot immediately respond users' requests.

To use PSM, run the "AT+CPSMS=1", "AT+NVSETPM=2", "AT+CSCLK=2", "AT+VERCTRL=2,0" to enable PSM. This command takes effect after the module is restarted, after which you enter "AT+CSCLK=2" If the network supports PSM and accepts that the module uses PSM, the network confirms that the module uses PSM by assigning an active time value. The module will enter the PSM according to the network command.

Either of the following methods will wake up the module from PSM:

- Send AT command through UART1 interface to wake up module.
- When the timer expires, the module will be automatically woken up.
- Pull the WAKEUP pin and the module will wake up.

### 5.3.5 Extended Mode DRX (e-DRX)

In idle or sleep mode, module and the network may negotiate over non-access stratum signaling the use of extended mode DRX for reducing power consumption.

e-DRX diagrammatic sketch refer to the following figure.

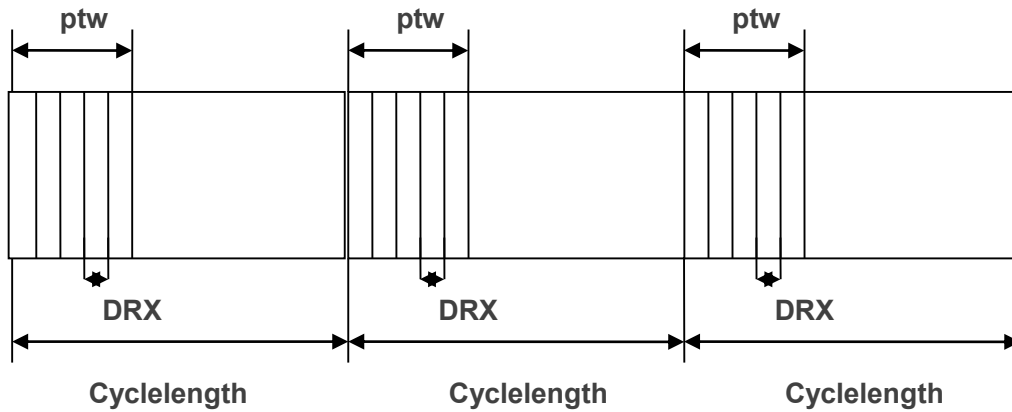


Figure 25: e-DRX Diagrammatic Sketch

When module and the network negotiate stratum signaling in idle mode or sleep mode, extended mode DRX can decrease the times of paging time window (PTW) and increase the cycle length. For this reason it had reduced the times of DRX, and had reduced the frequency of DRX between module and the network. So that can reduce power consumption for module.

If e-DRX is supported by the network, then it can be enabled by “AT+CEDRXS” command.

#### NOTE

- For details about “AT+CEDRXS”, please refer to Document [1]

## 5.4 Current Consumption

The current consumption is listed in the table below.

Table 35: Current Consumption on VBAT Pins (VBAT=3.8V)

| Shutdown Current                                 |                     |
|--------------------------------------------------|---------------------|
| Normal shutdown current                          | 6uA                 |
| Idle Mode                                        |                     |
| Standby power current<br>(AT+CSCLK=0; AT+CFUN=1) | GSM:11mA/NB-IOT:9mA |
| Seelp                                            |                     |

|                                              |                                                                |
|----------------------------------------------|----------------------------------------------------------------|
| GSM (AT+CSCLK=2; AT+CFUN=0)                  | Typical: 0.72mA                                                |
| NB-IOT(AT+CSCLK=2; AT+CFUN=0)                | Typical: 0.78mA                                                |
| <b>PSM</b>                                   |                                                                |
| PSM current                                  | Typical: 6uA                                                   |
| <b>e-DRX</b>                                 |                                                                |
| e-DRX pattern current flow test (sleep mode) | @PTW=40.96s; e-1DRX=81.92s; DRX=2.56s<br>Typical: 1.1mA        |
|                                              | @PTW=25.6s; e-DRX=163.84s; DRX=2.56s<br>Typical: 0.9mA         |
| <b>GSM Data Transmission</b>                 |                                                                |
| GSM900 CH62                                  | @ #5 Typical: 194                                              |
| DCS1800 CH698                                | @ #0 Typical: 150                                              |
| <b>LTE Cat-NB 15KHz Single Tone)</b>         |                                                                |
| LTE-FDD B3                                   | @23dbm Typical: 101<br>@10dbm Typical: 53<br>@0dbm Typical: 32 |
| LTE-FDD B5                                   | @23dbm Typical: 93<br>@10dbm Typical: 53<br>@0dbm Typical: 30  |
| LTE-FDD B8                                   | @23dbm Typical: 103<br>@10dbm Typical: 55<br>@0dbm Typical: 30 |
| LTE-FDD B20                                  | @23dbm Typical: 93<br>@10dbm Typical: 53<br>@0dbm Typical: 30  |
| LTE-FDD B28                                  | @23dbm Typical: 120<br>@10dbm Typical: 57<br>@0dbm Typical: 30 |

## 5.5 ESD Notes

R7082 is an electrostatic sensitive device. Users must pay attention to electrostatic protection when producing, assembling and operating the module. The electrostatic performance parameters of the module are as follows:

Table 36: The ESD Performance Measurement Table (Temperature: 25°C, Humidity: 45%)

| Part         | Contact Discharge | Air Discharge |
|--------------|-------------------|---------------|
| VBAT,GND     | ± 4 kV            | ± 8 kV        |
| Antenna port | ± 4 kV            | ± 8 kV        |
| Other PADs   | ± 0.5 kV          | ± 1 kV        |

**NOTE**

- Test condition is module pasted on SIMcom Development board (With ESD components).

SIMCom  
Confidential

## 6 SMT Production Guide

### 6.1 Top and Bottom View of R7082



Figure 26: Top and Bottom View of R7082

#### NOTE

- The above is the design effect diagram of the module for reference. The actual appearance is subject to the actual product.

### 6.2 Label Information



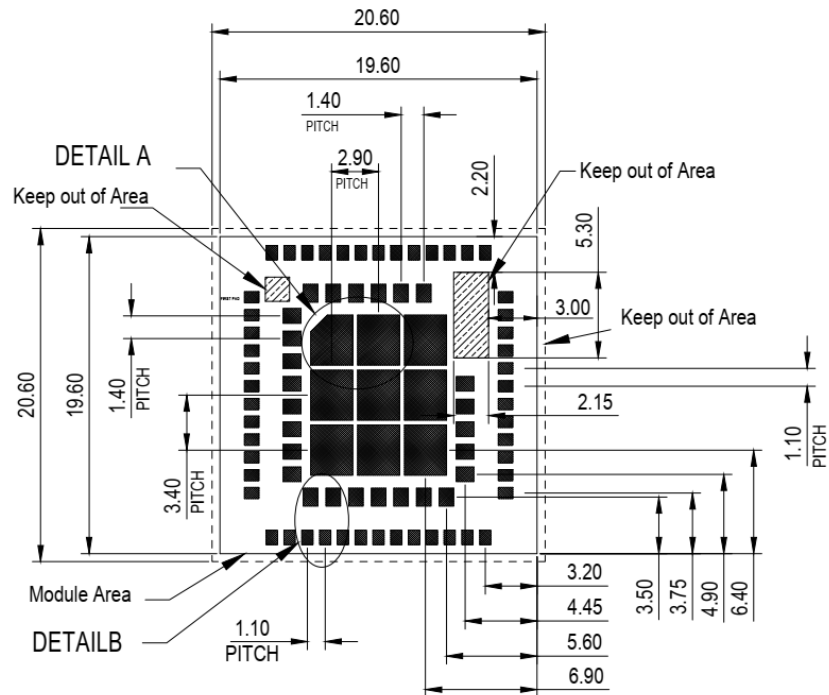
Figure 27: Label Information

Table 37: The Description of Label Information

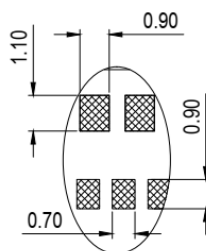
| No. | Description        |
|-----|--------------------|
| A   | Project name       |
| B   | Product code       |
| C   | Serial number      |
| D   | Module IMEI number |
| E   | QR code            |

### 6.3 Recommend PCB Footprint Dimension

Recommended PCB  
Footprint outline

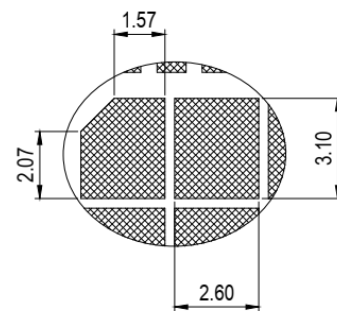


UNIT:mm



DETAIL B  
SCALE: 2/1

UNIT:mm



DETAIL A  
SCALE: 2/1

UNIT:mm

Figure 28: Recommend PCB Footprint Dimension (Unit: mm)

## 6.4 Recommend Stencil Size

The recommended thickness of the steel mesh is 0.15mm.

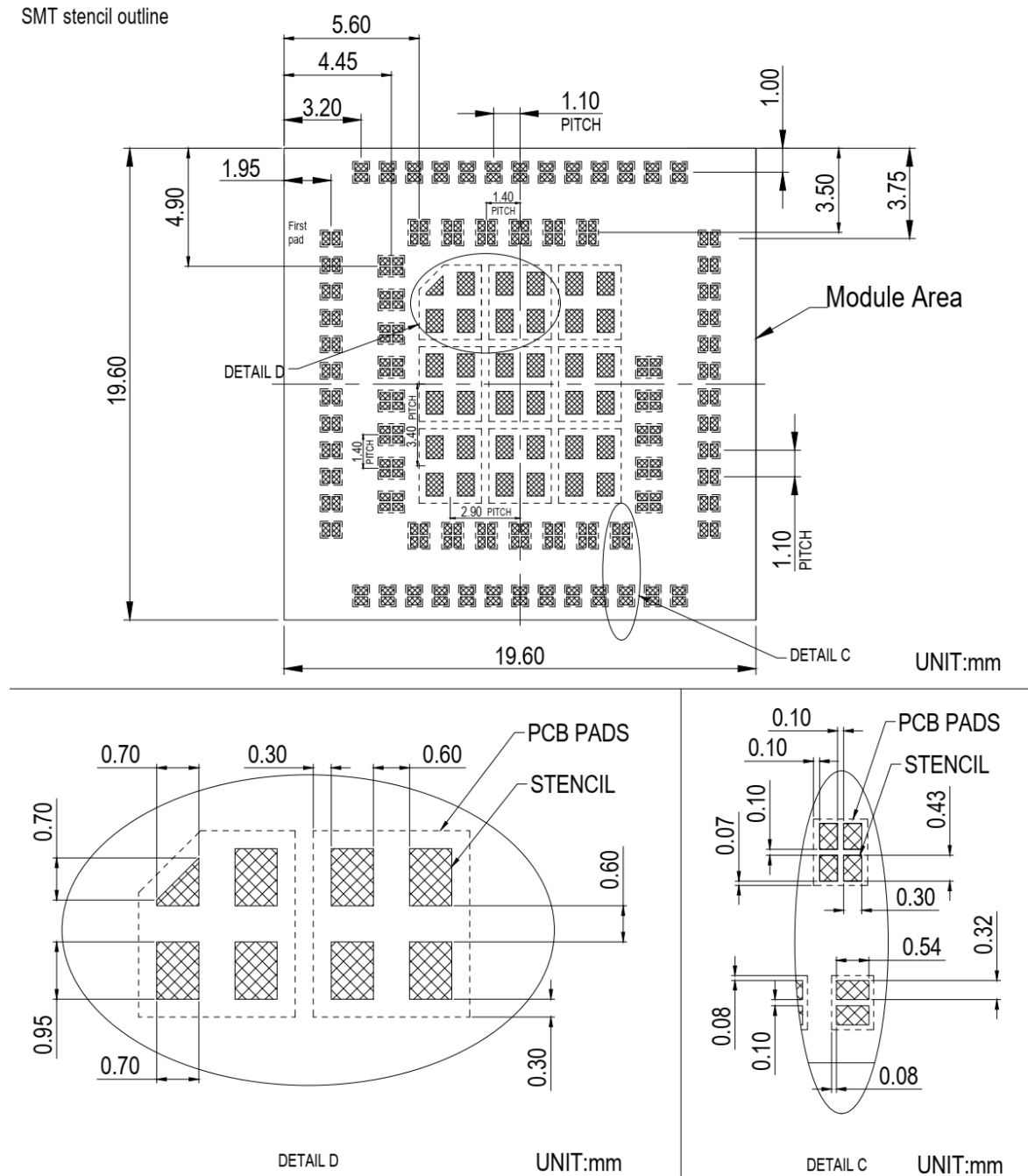


Figure 29: Recommend Stencil Dimension (Unit: mm)

## 6.5 Typical SMT Reflow Profile

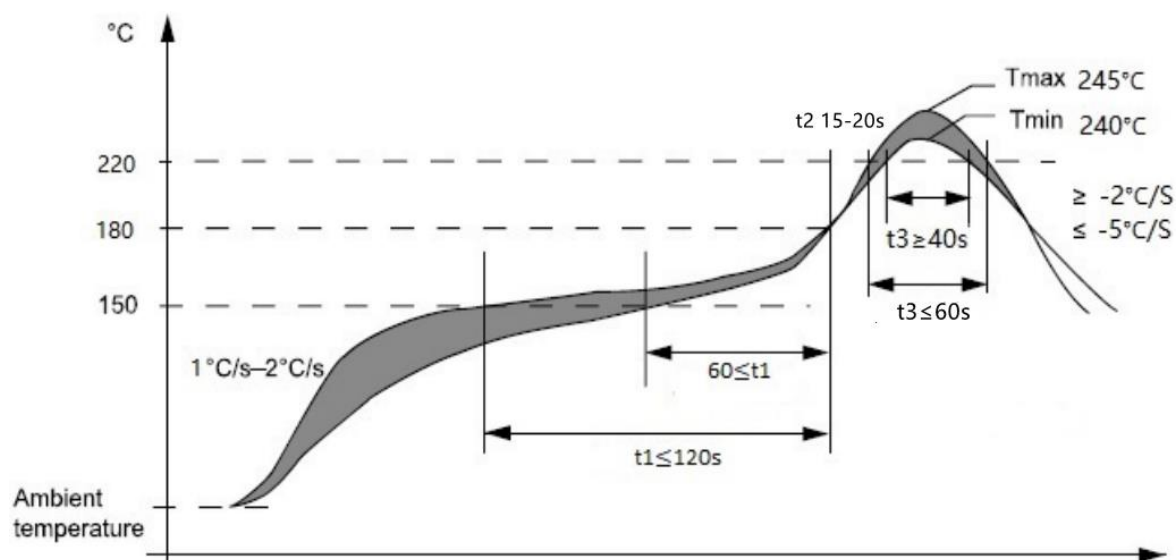


Figure 30: Recommended Reflow Furnace Temperature Curve (Lead-Free)

Table 38: The Main Board Reflux Temperature Curve Requirements (Lead-Free)

| Zone                                  | Time    | Parameter                   |
|---------------------------------------|---------|-----------------------------|
| Preheat Zone (Room temperature~150°C) | NA      | Heating rate: 1~2°C/s       |
| T1 (150~180°C)                        | 60~120s | /                           |
| T2 (180~220°C)                        | 15~20s  | /                           |
| T3 (≥220°C)                           | 40~60s  | Peak temperature: 240~245°C |
| Cooling Zone                          | NA      | Cooling rate: -2~-5°C/s     |

### NOTE

- The maximum times of refluxes for the 5G module is once.
- Recommended lead-free process.
- In the table above, the temperature testing location includes the solder mask of the module MCU pins, bottom LGA pins, and external LCC pins.
- The actual welding temperature is affected by other external factors, such as the presence of furnace carriers, solder paste, size and thickness of the substrate, and component resistance. Thermal requirements and panel design, etc. Please confirm with our engineering and technical personnel in time if the recommended parameters cannot be reached. Otherwise, the module may be damaged.

- For boards with thickness less than 1.2mm, it is recommended to use board supported by furnace carrier or materials with high Tg to prevent warping when heated. Deformation, thus affecting module welding. For modules larger than 35.0 mm \*35.0 mm and 5G products, it is recommended to use the furnace carrier to pass through the furnace to reduce the cause of the bottom plate and mold. Due to the difference of Tg value of block, the phenomenon of unbalanced thermal stress appears in the process of high temperature welding reflow, resulting in the defect rate of virtual welding and little tin.
- After the module is welded, X-ray and optical inspection methods shall be used to check the welding quality. For specific standards, please refer to relevant standards of IPC-A-610H.
- For more information about shipping and manufacturing, please refer to Module Secondary SMT Process User Guide.
- Due to the complexity of the SMT process, in case of uncertainty or processes not mentioned in this document (such as selective wave soldering, ultrasonic welding), please contact SIMCom support team before SMT process starts.

## 6.6 Moisture Sensitivity Level (MSL)

Modules are shipped in vacuum-sealed aluminum foil bag bags, vacuum packaging according to IPC/JEDEC standard J-STD-020C specification.

- Recommended storage conditions: temperature  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$ , and relative humidity 35%~60%.
- Storage period: 12 months (Under recommended storage conditions and in sealed vacuum packaging).

The module meets the humidity sensitivity level 3 (MSL-3), and the storage period after unpacking is shown in table below.

The out-of-bag floor life of the module with MSL-3 is 168 hours. If the workshop temperature is  $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$  and the relative humidity is less than 60%, the module needs to be unpacked within 168 hours of reflow production or other high temperature operations. Otherwise, the module shall be stored in an environment with relative humidity less than 10% (for example, a moisture-proof cabinet) to keep the product dry.

Table 39: Moisture Sensitivity Level

| MSL | Out-of-Bag Floor Life | Comment                                    |
|-----|-----------------------|--------------------------------------------|
| 1   | Unlimited             | $\leq +30^{\circ}\text{C}/85\% \text{ RH}$ |
| 2   | 1 year                | $\leq +30^{\circ}\text{C}/60\% \text{ RH}$ |
| 2a  | 4 weeks               |                                            |
| 3   | 168 hours             |                                            |
| 4   | 72 hours              |                                            |
| 5   | 48 hours              |                                            |

|    |                                                                                                          |  |
|----|----------------------------------------------------------------------------------------------------------|--|
| 5a | 24 hours                                                                                                 |  |
| 6  | Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label. |  |

Before use, it is necessary to confirm whether the package is in good condition; After unpacking, check the status of humidity indicator card in vacuum bag (Figure 31). The module needs to be baked before use if any of the following conditions occur.

- Explanation Humidity indicator card: 30%, 40%, and 50% of any indicator circle has discoloring.
- The module has been un-packed and the module exceeds the humidity sensitivity level corresponding to the exposed workshop time. For example, MSL=3 is 168.
- Packed, but the Shelf Life exceeds 12 months;
- Exceeds the Floor Life;
- Unable to track and determine the status of the module;

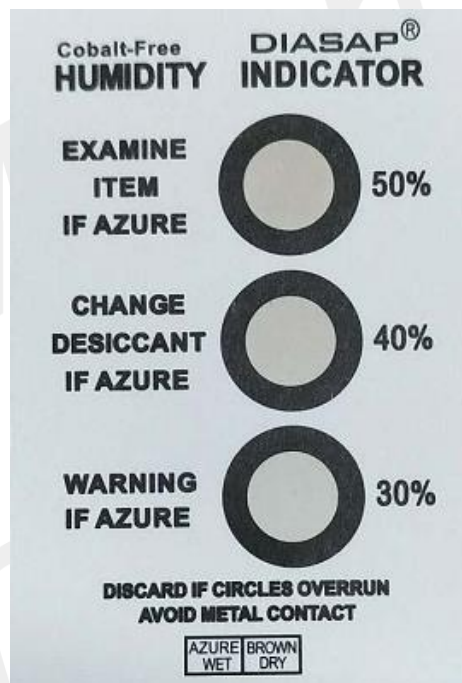


Figure 31: Humidity Card

The following conditions also need to be pre-baked.

- The storage temperature and humidity do not meet the recommended storage conditions.
- Vacuum sealed bag leak, bulk materials
- Before repairing the module.
- After unpacking, the module failed to complete production or storage under the control of humidity sensitive level 3.

## 6.7 Baking Requirements

If baking is required, proceed according to the requirements in the table below. Preferentially choose a nitrogen-filled oven.

Table 40: Baking Requirements

| Baking conditions | Baking time | Comment                                      |
|-------------------|-------------|----------------------------------------------|
| 120°C±5°C, <5% RH | 8 hours     | Not applicable to original packaging pallets |

### NOTE

- In order to prevent and reduce the occurrence of poor welding caused by moisture, such as foaming and delamination, the module should be strictly controlled. It is not recommended to expose the module to air for a long time after unpacking the vacuum package.
- Before baking, it is necessary to remove the module from the package and place the bare module on the high temperature resistant device to avoid high temperature damage to the plastic tray or coil; The modules for secondary baking must be welded within 24 hours after baking, otherwise they need to be stored in vacuum packaging or in a drying oven.
- Please pay attention to ESD protection when unpacking and placing modules, such as wearing anti-static gloves.

## 7 Packaging

R7082 support tray packaging and reel packaging.

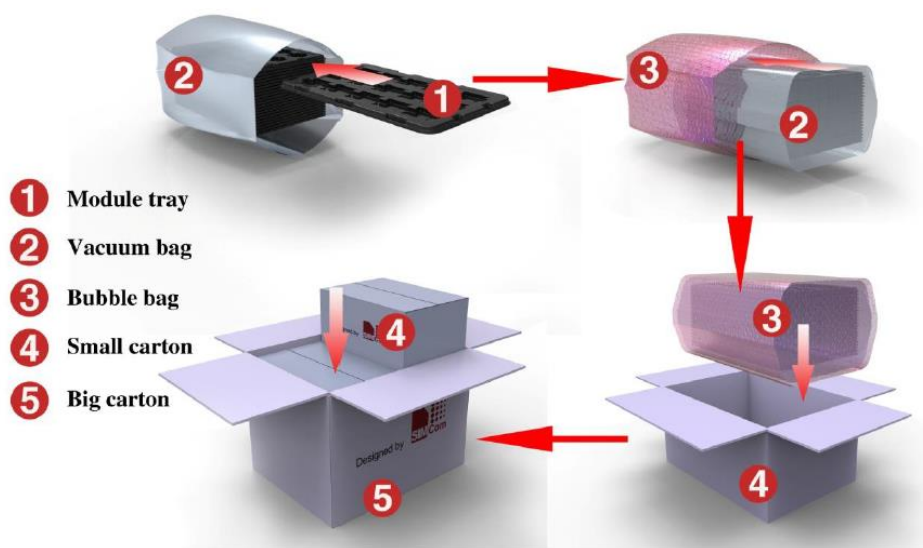


Figure 32: Packaging Diagram

Module tray drawing:

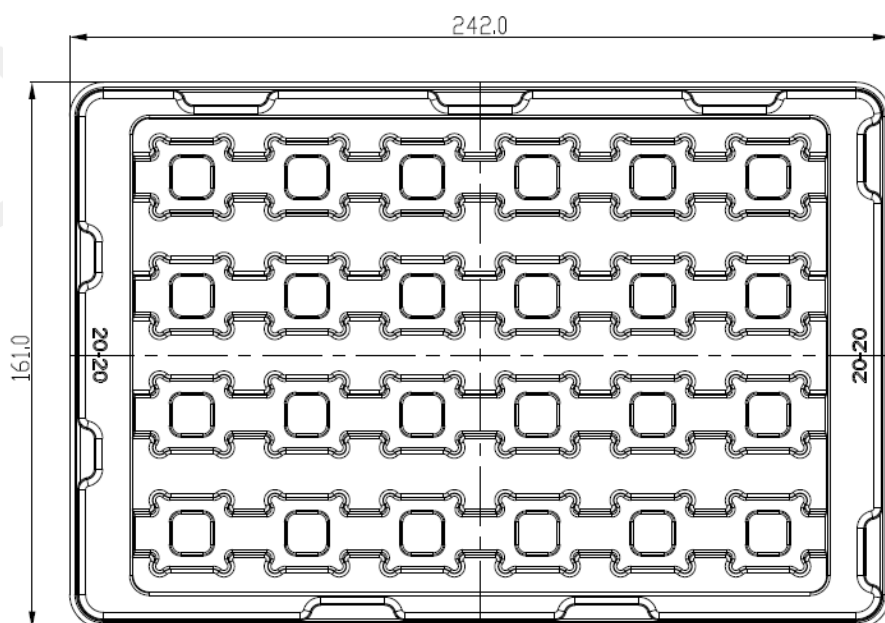


Figure 33: Tray Drawing

Table 41: Tray Size

| Length( $\pm 3\text{mm}$ ) | Width( $\pm 3\text{mm}$ ) | Number |
|----------------------------|---------------------------|--------|
| 242.0                      | 161.0                     | 24     |

Small carton drawing:

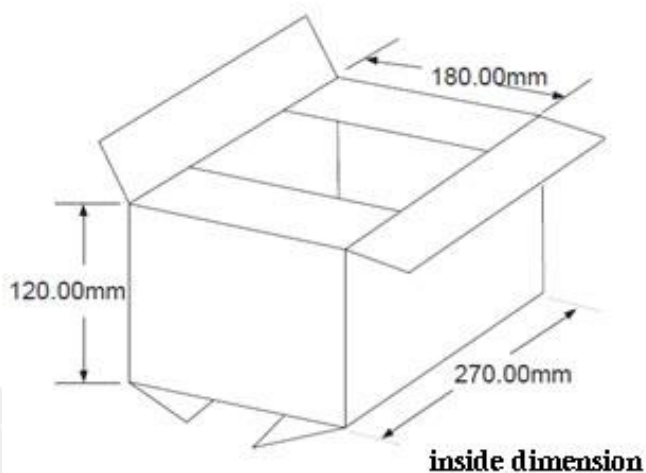


Figure 34: Small Carton Drawing

Table 42: Small Carton Size

| Length( $\pm 10\text{mm}$ ) | Width( $\pm 10\text{mm}$ ) | Height( $\pm 10\text{mm}$ ) | Number    |
|-----------------------------|----------------------------|-----------------------------|-----------|
| 270                         | 180                        | 120                         | 24*20=480 |

Big carton drawing:

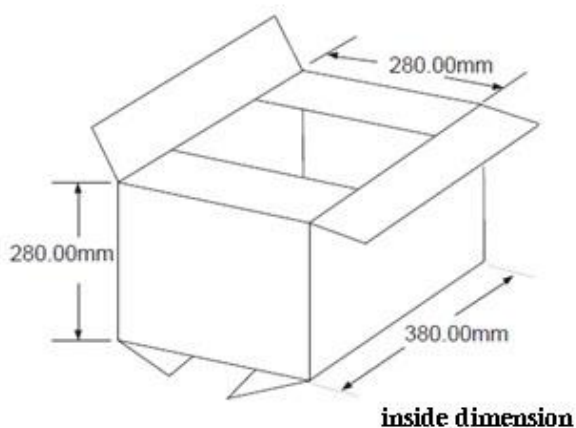


Figure 35: Big Carton Drawing

Table 43: Big Carton Size

| Length( $\pm 10\text{mm}$ ) | Width( $\pm 10\text{mm}$ ) | Height( $\pm 10\text{mm}$ ) | Number     |
|-----------------------------|----------------------------|-----------------------------|------------|
| 380                         | 280                        | 280                         | 480*4=1920 |

## 8 Appendix

### 8.1 Related Documents

Table 44: Related Documents

| NO.  | Title                                | Description                                                                                                                                                                                                |
|------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1]  | R7082 Series AT Command Manual_V1.xx | AT Command Manual                                                                                                                                                                                          |
| [2]  | GSM 07.07                            | Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)                                                                                                               |
| [3]  | GSM 07.10                            | Support GSM 07.10 multiplexing protocol                                                                                                                                                                    |
| [4]  | GSM 07.05                            | Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS) |
| [5]  | GSM 11.14                            | Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface                             |
| [6]  | GSM 11.11                            | Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface                                                             |
| [7]  | GSM 03.38                            | Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information                                                                                                         |
| [8]  | GSM 11.10                            | Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification                                                                     |
| [9]  | 3GPP TS 51.010-1                     | Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification                                                                                                      |
| [10] | 3GPP TS 34.124                       | Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.                                                                                                                          |
| [11] | 3GPP TS 34.121                       | Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.                                                                                                                          |
| [12] | 3GPP TS 34.123-1                     | Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)                                                                             |
| [13] | 3GPP TS 34.123-3                     | User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.                                                                                                                               |

|      |                                                          |                                                                                                                                                                                                                                                                                                           |
|------|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [14] | EN 301 908-02 V2.2.1                                     | Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive |
| [15] | EN 301 489-24 V1.2.1                                     | Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment                             |
| [16] | IEC/EN60950-1(2001)                                      | Safety of information technology equipment (2000)                                                                                                                                                                                                                                                         |
| [17] | 3GPP TS 51.010-1                                         | Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification                                                                                                                                                                                                     |
| [18] | 2002/95/EC                                               | Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)                                                                                                                    |
| [19] | Module secondary-SMT-UGD-V1.xx                           | Module secondary SMT Guidelines                                                                                                                                                                                                                                                                           |
| [20] | R7082 Series UART Application Note_V1.xx                 | This document describes how to use UART interface of SIMCom modules.                                                                                                                                                                                                                                      |
| [21] | ETSI EN 301 908-13 (ETSI TS 136521-1 R13.4.0)            | IMT cellular networks; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive; Part 13                                                                                                                                                                                   |
| [22] | ANTENNA DESIGN GUIDELINES FOR MULTI-ANTENNA SYSTEM V1 01 | Design notice for multi-antenna.                                                                                                                                                                                                                                                                          |

## 8.2 Terms and Abbreviations

Table 45: Terms and Abbreviations

| Abbreviation | Description                                                     |
|--------------|-----------------------------------------------------------------|
| ADC          | Analog-to-Digital Converter                                     |
| AMR          | Adaptive Multi-Rate                                             |
| CS           | Coding Scheme                                                   |
| CSD          | Circuit Switched Data                                           |
| CTS          | Clear to Send                                                   |
| DTE          | Data Terminal Equipment (typically computer, terminal, printer) |
| DTX          | Discontinuous Transmission                                      |

|        |                                                             |
|--------|-------------------------------------------------------------|
| EFR    | Enhanced Full Rate                                          |
| EGSM   | Enhanced GSM                                                |
| ESD    | Electrostatic Discharge                                     |
| ETS    | European Telecommunication Standard                         |
| FR     | Full Rate                                                   |
| GPRS   | General Packet Radio Service                                |
| GSM    | Global Standard for Mobile Communications                   |
| HR     | Half Rate                                                   |
| IMEI   | International Mobile Equipment Identity                     |
| Li-ion | Lithium-Ion                                                 |
| MO     | Mobile Originated                                           |
| MS     | Mobile Station (GSM engine), also referred to as TE         |
| MT     | Mobile Terminated                                           |
| PAP    | Password Authentication Protocol                            |
| PBCCH  | Packet Broadcast Control Channel                            |
| PCB    | Printed Circuit Board                                       |
| PCL    | Power Control Level                                         |
| PCS    | Personal Communication System, also referred to as GSM 1900 |
| PDU    | Protocol Data Unit                                          |
| PPP    | Point-to-point protocol                                     |
| RF     | Radio Frequency                                             |
| RMS    | Root Mean Square (value)                                    |
| RTC    | Real Time Clock                                             |
| RX     | Receive Direction                                           |
| SIM    | Subscriber Identification Module                            |
| SMS    | Short Message Service                                       |
| TE     | Terminal Equipment, also referred to as DTE                 |
| TX     | Transmit Direction                                          |
| UART   | Universal Asynchronous Receiver & Transmitter               |
| URC    | Unsolicited Result Code                                     |
| USSD   | Unstructured Supplementary Service Data                     |

### PB Abbreviation

|    |                                                                   |
|----|-------------------------------------------------------------------|
| FD | SIM fix dialing phonebook                                         |
| LD | SIM last dialing phonebook (list of numbers most recently dialed) |
| MC | Mobile Equipment list of unanswered MT calls (missed calls)       |
| ON | SIM (or ME) own numbers (MSISDNs) list                            |
| RC | Mobile Equipment list of received calls                           |
| SM | SIM phonebook                                                     |
| NC | Not connect                                                       |