# BG950A-GL&BG951A-GL
# Hardware Design

**LPWA Module Series**

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Status: Preliminary

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

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The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating the module. Manufacturers of the cellular terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.

Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.

Switch off the cellular terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.

Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.


Cellular terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergent help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.

The cellular terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.

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

# About the Document

## Revision History

| Version | Date | Author | Description |
|---|---|---|---|
| - | 2021-07-07 | Lex LI/Ben JIANG | Creation of the document |
| 1.0.0 | 2021-07-07 | Lex LI/Ben JIANG | Preliminary |

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# 1 Introduction

This document defines BG950A-GL & BG951A-GL modules and describes their air interfaces and hardware interfaces which relate to customers' applications.

It can help customers quickly understand interface specifications, electrical and mechanical details, as well as other related information of the module. Associated with application notes and user guides, customers can use this module to design and to set up mobile applications easily.

Hereby, [Quectel Wireless Solutions Co., Ltd.] declares that the radio equipment type [BG950A-GL] is in compliance with Directive 2014/53/EU.
The full text of the EU declaration of conformity is available at the following internet address: http://www.quectel.com

The device could be used with a separation distance of 20cm to the human body.

FCC Certification Requirements.
According to the definition of mobile and fixed device is described in Part 2.1091(b), this device is a mobile device.
And the following conditions must be met:
1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based timeaveraging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.
2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.
3. A label with the following statements must be attached to the host end product: This device contains FCC ID: XMR2021BG950AGL
4. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:

| radiation, maximum antenna gain (including cable loss) must not exceed: Operating Band | FCC Max Antenna Gain（dBi） | IC Max Antenna Gain（dBi） |
|---|---|---|
| LTE Band 2 | 7.30 | 7.30 |
| LTE Band 4 | 4.30 | 4.30 |
| LTE Band 5 | 8.84 | 5.40 |
| LTE Band 12 | 8.10 | 4.91 |
| LTE Band 13 | 8.51 | 5.23 |
| LTE Band 25 | 7.30 | 7.30 |
| LTE Band 26 | 8.84 | 5.36 |
| LTE Band 66 | 4.30 | 4.30 |
| NB-IOT Band 2 | 7.30 | 7.30 |
| NB-IOT Band 4 | 4.30 | 4.30 |
| NB-IOT Band 5 | 8.84 | 5.40 |
| NB-IOT Band 12 | 8.10 | 4.91 |
| NB-IOT Band 13 | 8.51 | 5.23 |
| NB-IOT Band 17 | 8.02 | 4.93 |
| NB-IOT Band 25 | 7.30 | 7.30 |
| NB-IOT Band 66 | 4.30 | 4.30 |
| | | |

5. This module must not transmit simultaneously with any other antenna or transmitter
6. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.
For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093
If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.
For this device, OEM integrators must be provided with labeling instructions of finished products.
Please refer to KDB784748 D01 v07, section 8. Page 6/7 last two paragraphs:
A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labeled with an FCC ID - Section 2.926 (see 2.2 Certification (labeling requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labeling requirements, options and OEM user manual instructions that are required (see next paragraph).
For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module FCC ID: XMR2021BG950AGL" or "Contains FCC ID: XMR2021BG950AGL" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.
The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.
To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Supplier's Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements.

**Manual Information To the End User**

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

### IC Statement

IRSS-GEN
"This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device." or "Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
1) l'appareil ne doit pas produire de brouillage; 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."
Déclaration sur l'exposition aux rayonnements RF
L'autre utilisé pour l'émetteur doit être installé pour fournir une distance de séparation d'au moins 20 cm de toutes les personnes et ne doit pas être colocalisé ou fonctionner conjointement avec une autre antenne ou un autre émetteur.
The host product shall be properly labeled to identify the modules within the host product.
The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word "Contains" or similar wording expressing the same meaning, as follows: "Contains IC: 10224A-2021BG950A" or "where: 10224A-2021BG950A is the module's certification number".
Le produit hôte doit être correctement étiqueté pour identifier les modules dans le produit hôte.

L'étiquette de certification d'Innovation, Sciences et Développement économique Canada d'un module doit être clairement visible en tout temps lorsqu'il est installédans le produit hôte; sinon, le produit hôte doit porter une étiquette indiquant le numéro de certification d'Innovation, Sciences et Développement économique Canada pour le module, précédé du mot «Contient» ou d'un libellé semblable exprimant la même signification, comme suit:
"Contient IC: 10224A-2021BG950A " ou "où: 10224A-2021BG950A est le numéro de certification du module".

## 1.1. Special Mark

**Table 1: Special Mark**

| Mark | Definition |
|---|---|
| * | Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, or argument, it indicates that the function, feature, interface, pin, AT command, or argument is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of such model is currently unavailable. |

# 2 Product Overview

The module is an embedded IoT (LTE Cat M1, LTE Cat NB1/NB2*) wireless communication module. It provides data connectivity on LTE-FDD network, and supports half-duplex operation in LTE network. It also provides GNSS and voice* [1] functionality to meet your specific application demands.

The module is an SMD type module which is engineered to meet the demanding requirements in M2M applications such as smart metering, tracking system, security, wireless POS, etc. Related information and details are listed in the table below:

BG950A-GL & BG951A-GL modules are industrial-grade modules for industrial and commercial applications only.

**Table 2: Brief Introduction of BG950A-GL & BG951A-GL Modules**

| Categories | |
|---|---|
| Packaging and pins number | LGA;102 pieces |
| Dimensions | (23.6 ±0.2) mm × (19.9 ±0.2) mm × (2.2 ±0.2) mm |
| Weight | TBD |
| Wireless functions | LTE and GNSS |
| Variants | BG950A-GL/BG951A-GL |

[1] BG950A-GL & BG951A-GL supports VoLTE* (Voice over LTE) under LTE Cat M1.

## 2.1. Frequency Bands and Functions

**Table 3: Wireless Network Type**

| Module | Supported Bands [2] | LTE Bands Power Class | GNSS |
|---|---|---|---|
| BG950A-GL | **Cat M1 [3]:**<br>LTE-FDD:<br>B1/B2/B3/B4/B5/B8/B12/B13/B18/<br>B19/B20/B25/B26/B27/B28/B66<br>**Cat NB1/NB2* [4]:**<br>LTE-FDD:<br>B1/B2/B3/B4/B5/B8/B12/B13/B17/<br>B18/B19/B20/B25/B28/B66 | Power Class 3<br>(23 dBm ± 2.7 dB) | GPS,<br>GLONASS |
| BG951A-GL | **Cat M1:**<br>LTE-FDD:<br>B1/B2/B3/B4/B5/B8/B12/B13/B18/<br>B19/B20/B25/B26/B27/B28/B66<br>**Cat NB1/NB2*:**<br>LTE-FDD:<br>B1/B2/B3/B4/B5/B8/B12/B13/B17/<br>B18/B19/B20/B25/B28/B66 | Power Class 3<br>(23 dBm ± 2.7 dB) | TBD |

[2] LTE-FDD B26 and B27 are supported by LTE Cat M1 only.
[3] BG950A-GL& BG951A-GL support VoLTE* (Voice over LTE) under LTE Cat M1.
[4] LTE Cat NB2* is backward compatible with LTE Cat NB1.

## 2.2. Key Features

**Table 4: Key Features**

| Features | Details |
|---|---|
| Power Supply | ● Supply voltage: 2.2–4.5 V<br>● Typical supply voltage: 3.3 V |
| SMS* | ● Text and PDU mode<br>● Point-to-point MO and MT<br>● SMS cell broadcast<br>● SMS storage: ME by default |
| (U)SIM Interface | Supports USIM/SIM card: 1.8 V only |
| Audio Features | ● Supports one digital audio interfaces: PCM and I2C<br>● LTE: VoLTE* under LTE Cat M1 |
| PCM Interface* | ● Support one digital audio interface: PCM interface for VoLTE* only<br>● Used for audio function with external codec |
| I2C Interface* | ● One I2C interface<br>● Multi-master mode is not supported |
| USB Interface* | ● Compliant with USB 2.0 specifications, with transmission rates up to 12 MHz on USB Full-speed<br>● Used AT command communication, data transmission, software debugging and firmware upgrade<br>● USB serial driver:<br>– Windows 7/8/8.1/10<br>– Linux 2.6–5.4<br>– Android 4.x/5.x/6.x/7.x/8.x/9.x system |
| UART Interfaces | **Main UART:**<br>● Used for AT command communication and data transmission<br>● Baud rate: 115200 bps baud by default<br>● The default frame format is 8N1 (8 data bits, no parity, 1 stop bit)<br>● Supports RTS and CTS hardware flow control<br>**Debug UART:**<br>● Used for firmware upgrade, software debugging and log output<br>● 115200 bps baud rate by default<br>● The default frame format is 8N1 (8 data bits, no parity, 1 stop bit)<br>● Support RTS and CTS hardware flow control<br>**Auxiliary UART:**<br>● Used for RF calibration debugging and log output<br>● 961200 bps baud rate by default<br>● The default frame format is 8N1 (8 data bits, no parity, 1 stop bit)<br>● Support RTS and CTS hardware flow control |

| | |
|---|---|
| Network Indication* | NET_STATUS to indicate network connectivity status. |
| AT Commands | ● *3GPP TS 27.007* and *3GPP TS 27.005* AT commands<br>● Quectel enhanced AT commands |
| Antenna Interface | ● ANT_MAIN<br>● ANT_GNSS<br>● 50 Ω impedance. |
| Transmitting Power | LTE-FDD: Class 3 (23 dBm ±2.7 dB) |
| LTE Features | ● Support 3GPP Rel-14*<br>● Supports LTE Cat M1 and LTE Cat NB1/NB2*<br>● Supports 1.4 MHz RF bandwidth for LTE Cat M1<br>● Support 200 kHz RF bandwidth for LTE Cat NB1/NB2*<br>● Cat M1: 588 kbps (DL)/1119 kbps (UL)<br>● Cat NB1: 27.2 kbps (DL)/62.5 kbps (UL)<br>● Cat NB2*: 127 kbps (DL)/158 kbps (UL) |
| Internet Protocol Features | ● Support IPv4/IPv6/PPP/TCP/UDP/SSL/TLS/DTLS/FTP(S)/HTTP(S)/ MQTT/LwM2M/CoAP protocols<br>● Supports PAP and CHAP protocols for PPP connections |
| GNSS Features | ● BG950A-GL: supports GPS, GLONASS<br>● BG951A-GL: TBD |
| Temperature Range | ● Operating temperature range: -35 to +75 °C [5]<br>● Extended temperature range: -40 to +85 °C [6]<br>● Storage temperature range: -40 to +90 °C |
| Firmware Upgrade | ● Debug UART interface<br>● USB 2.0 interface*<br>● DFOTA |
| RoHS | All hardware components are fully compliant with EU RoHS directive. |

[5] Within operating temperature range, the module is 3GPP compliant.
[6] Within extended operating temperature range, proper mounting, heating sinks and active cooling may be required to make certain functions of the module such as voice*, SMS*, data transmission to be realized. Only one or more parameters like $P_{out}$ might reduce in their value and exceed the specified tolerances. When the temperature returns to normal operating temperature levels, the module will meet 3GPP specifications again.

## 2.3. Functional Diagram

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

- Power management
- Baseband
- Radio frequency
- Peripheral interface

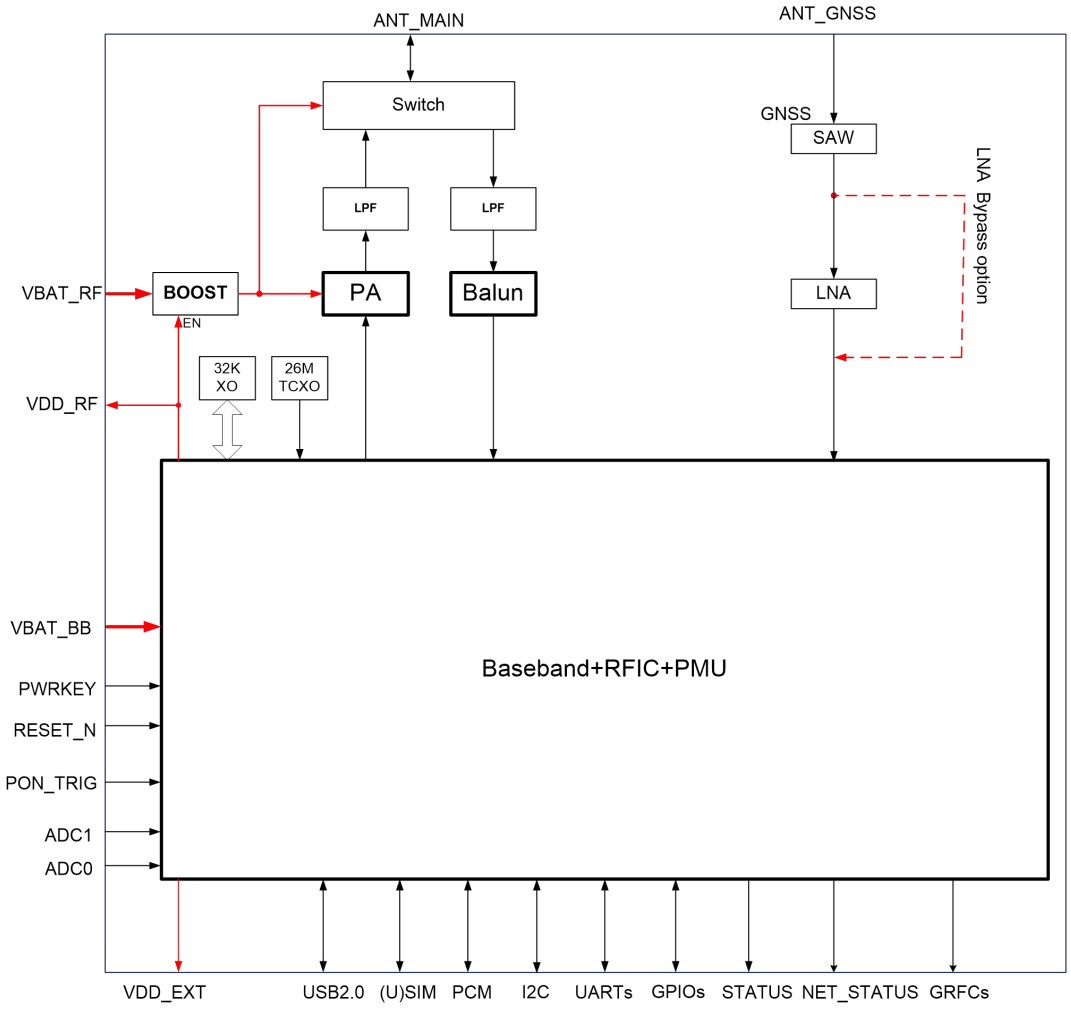



**Figure 1: Functional Diagram of BG950A-GL**

**NOTE**

1. PCM and I2C interfaces are for VoLTE* only.
2. The related information of BG951A-GL will be added in the future version.

## 2.4. Pin Assignment

The following figure illustrates the pin assignment of BG950A-GL.

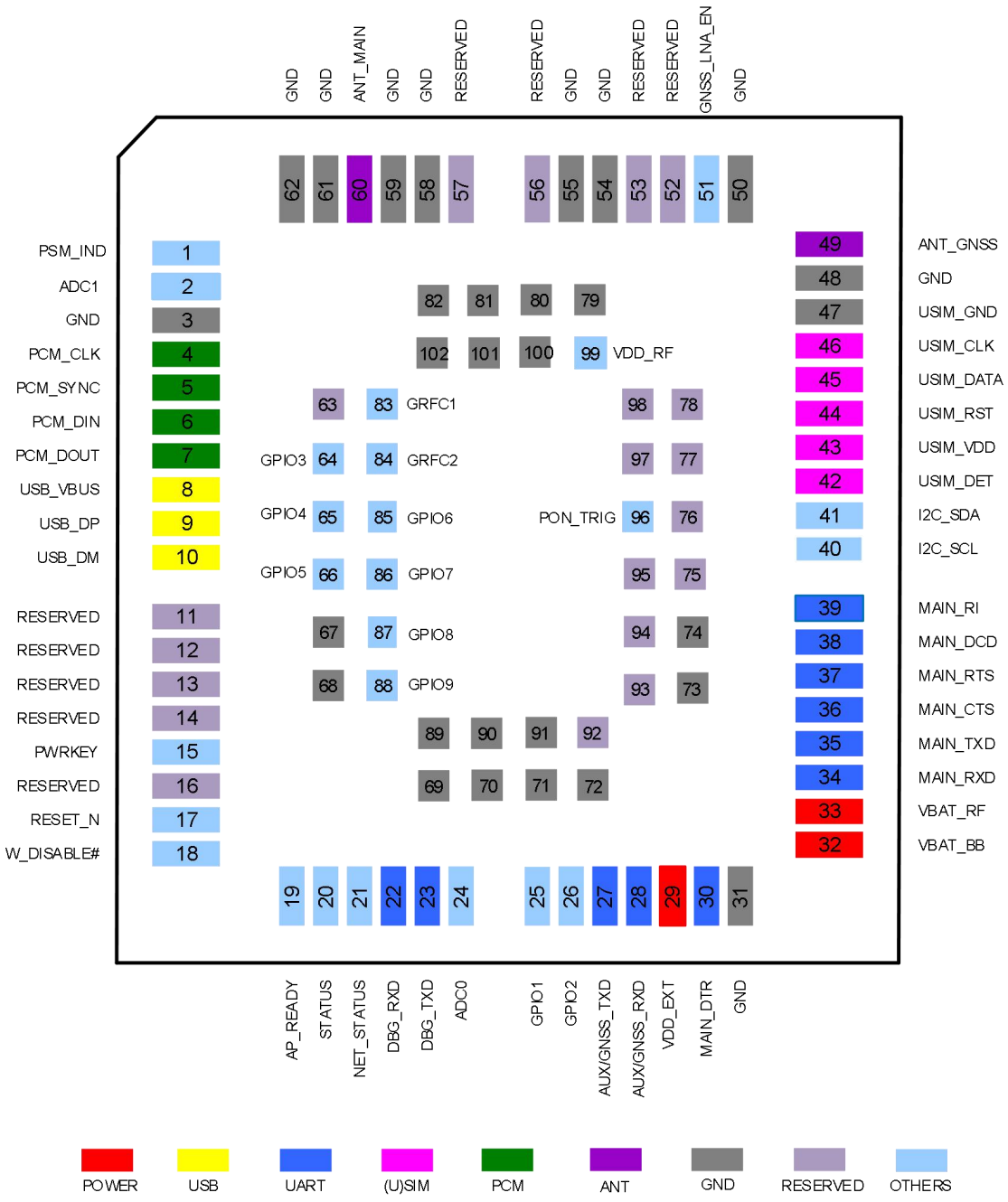



**Figure 2: Pin Assignment of BG950A-GL (Top View)**

**NOTE**

1. ADC input voltage must not exceed 1.8 V.
2. Keep all RESERVED pins and unused pins unconnected.
3. GND pins should be connected to ground in the design.
4. PCM and I2C interfaces are for VoLTE* only.
5. Only BG950A-GL supports GNSS_LNA_EN (pin 51) and VDD_RF (pin 99).
6. For BG950A-GL, pin27 and pin28 can only be used as AUX_TXD and AUX_RXD.
7. The pin assignment of BG951A-GL will be added in the future version.

## 2.5. Pin Description

The following table shows the DC characteristics and pin descriptions.

**Table 5: I/O Parameters Definition**

| Type | Description |
|---|---|
| AI | Analog Input |
| AIO | Analog Input/Output |
| DI | Digital Input |
| DO | Digital Output |
| DIO | Digital Input/Output |
| OD | Open Drain |
| PI | Power Input |
| PO | Power Output |

**Table 6: Pin Description**

| **Power Supply** | | | | | |
|---|---|---|---|---|---|
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| VBAT_BB | 32 | PI | Power supply for the module's baseband part | Vmax = 4.5 V<br>Vmin = 2.2 V<br>Vnom = 3.3 V | See NOTE 1 |
| VBAT_RF | 33 | PI | Power supply for the module's RF part | | See NOTE 1 |
| VDD_EXT | 29 | PO | Provide 1.8 V for external circuits | Vnom = 1.8 V<br>$I_O$max = 50 mA | If unused, keep this pin open. |
| GND | 3, 31, 48, 50, 54, 55, 58, 59, 61, 62, 67–74, 79–82, 89–91, 100–102 | | | | |
| **Turn on/off** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| PWRKEY* | 15 | DI | Turn on/off the module | $V_{IL}$max = 0.3 V<br>$V_{IH}$min = 1.0 V | |
| **Reset** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| RESET_N | 17 | DI | Reset the module | $V_{IL}$max = 0.3 V<br>$V_{IH}$min = 1.3 V | |
| **Status Indication** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| PSM_IND* | 1 | DO | Indicate the module's power saving mode | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| STATUS | 20 | DO | Indicate the module's operation status | | |
| NET_STATUS* | 21 | DO | Indicate the module's network activity status | | |
| **USB Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| USB_VBUS | 8 | AI | USB connection detect | Vnom = 5.0 V | Typical 5.0 V |
| USB_DP | 9 | AIO | USB differential data (+) | | Compliant with USB 2.0 standard specification. Require |
| USB_DM | 10 | AIO | USB differential data | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | (-) | | differential impedance of 90 Ω. |
| **(U)SIM Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| USIM_DET* | 42 | DI | (U)SIM card hot-plug detect | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| USIM_VDD | 43 | PO | (U)SIM card power supply | Vmax = 1.9 V<br>Vmin = 1.7 V | Only 1.8 V (U)SIM card is supported. |
| USIM_RST | 44 | DO | (U)SIM card reset | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | 1.8 V power domain. |
| USIM_DATA | 45 | DIO | (U)SIM card data | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V<br>$V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | |
| USIM_CLK | 46 | DO | (U)SIM card clock | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | |
| USIM_GND | 47 | | Specified ground for (U)SIM card | | |
| **Main UART Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| MAIN_DTR | 30 | DI | Main UART data terminal ready | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| MAIN_RXD | 34 | DI | Main UART receive | | |
| MAIN_TXD | 35 | DO | Main UART transmit | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | |
| MAIN_CTS | 36 | DO | Main UART clear to send | | |
| MAIN_RTS | 37 | DI | Main UART request to send | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | |
| MAIN_DCD | 38 | DO | Main UART data carrier detect | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | |
| MAIN_RI* | 39 | DO | Main UART ring indication | | |

| Debug UART Interface | | | | | |
|---|---|---|---|---|---|
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| DBG_RXD | 22 | DI | Debug UART receive | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| DBG_TXD | 23 | DO | Debug UART transmit | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | |
| **Auxiliary/GNSS UART Interface** [7] | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| AUX/GNSS_TXD | 27 | DO | Auxiliary/GNSS UART transmit | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| AUX/GNSS_RXD | 28 | DI | Auxiliary/GNSS UART receive | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | |
| **PCM Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| PCM_CLK | 4 | DO | PCM clock | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| PCM_SYNC | 5 | DO | PCM data frame sync | | |
| PCM_DIN | 6 | DI | PCM data input | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | |
| PCM_DOUT | 7 | DO | PCM data output | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | |
| **I2C Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| I2C_SCL | 40 | OD | I2C serial clock (for external codec) | | External pull-up resistor is required.<br>1.8 V only.<br>If unused, keep this pin open. |
| I2C_SDA | 41 | OD | I2C serial data (for external codec) | | |

[7] For BG950A-GL module, pin 27 and pin 28 can only be used as auxiliary UART interface.

| Antenna Interface | | | | | |
|---|---|---|---|---|---|
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| ANT_MAIN | 60 | AIO | Main antenna interface | | 50 Ω impedance |
| ANT_GNSS | 49 | AI | GNSS antenna interface | | 50 Ω impedance. If unused, keep this pin open. |
| **GPIO Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| GPIO1 | 25 | DIO | General-purpose input/output | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V<br>$V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain. If unused, keep this pin open. |
| GPIO2 | 26 | DIO | | | |
| GPIO3 | 64 | DIO | | | |
| GPIO4 | 65 | DIO | | | |
| GPIO5 | 66 | DIO | | | |
| GPIO6 | 85 | DIO | | | |
| GPIO7 | 86 | DIO | | | |
| GPIO8 | 87 | DIO | | | |
| GPIO9 | 88 | DIO | | | |
| **ADC Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| ADC0 | 24 | AI | General-purpose ADC interface | Voltage range: 0–1.8 V | If unused, keep this pin open. |
| ADC1 | 2 | AI | General-purpose ADC interface | Voltage range: 0–1.8 V | |
| **Other Interfaces*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| W_DISABLE# | 18 | DI | Airplane mode control | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain. Pulled up by default. When it is at low |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | level, the module can enter airplane mode.<br>If unused, keep this pin open. |
| AP_READY | 19 | DI | Application processor sleep state detect | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.57 V<br>$V_{IH}$min = 1.19 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| PON_TRIG | 96 | DI | Wake up the module from PSM | $V_{IL}$min = -0.2 V<br>$V_{IL}$max = 0.3 V<br>$V_{IH}$min = 1.2 V<br>$V_{IH}$max = 2.0 V | 1.8 V power domain. |
| **GRFC Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| GRFC1 | 83 | DO | Generic RF controller | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V<br>$V_{OH}$max = 2.0 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| GRFC2 | 84 | DO | Generic RF controller | | |
| **External GNSS LNA Interface** [8] | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristics** | **Comment** |
| GNSS_LNA_EN | 51 | DO | External GNSS LNA enable | $V_{OL}$max = 0.38 V<br>$V_{OH}$min = 1.36 V | 1.8 V power domain.<br>If unused, keep this pin open. |
| VDD_RF [9] | 99 | PO | Can be used for external GNSS LNA power supply | Vnom = 1.9 V<br>$I_O$max = 50 mA | If unused, keep this pin open. |
| **RESERVED Pins** | | | | | |
| **Pin Name** | **Pin No.** | | | | **Comment** |
| RESERVED | 11–14, 16, 52, 53, 56, 57, 63, 75, 76, 77, 78, 92–94, 95, 97, 98 | | | | Keep these pins open. |

1. For every VBAT transition/re-insertion from 0 V, VBAT slew rate < 25 mV/μs. After the module starts

**NOTE**

[8] Only BG950A-GL supports GNSS_LNA_EN (pin 51) and VDD_RF (pin 99).
[9] It is forbidden to connect high-power loads to VDD_RF, which will cause the system to crash.

up normally, in order to ensure full-function mode, the minimum power supply voltage should be higher than 2.2 V.
2. ADC input voltage must not exceed 1.8 V.
3. Keep all RESERVED pins and unused pins unconnected.
4. PCM and I2C interfaces are for VoLTE* only.

## 2.6. Evaluation Board

To help customers to develop applications with the module conveniently, Quectel supplies an evaluation board (EVB), USB to RS-232 converter cables, USB data cables, earphone, antennas, and other peripherals to control or to test the module. For more details, refer to ***document [1]***.

# 3 Operating Characteristics

## 3.1. Operating Modes

The table below outlines operating modes of the module.

**Table 7: Overview of Operating Modes**

| Mode | Details | |
|---|---|---|
| Normal Operation | Idle | Software is active. The module has registered on network, and it is ready to send and receive data. |
| | Talk/Data | Network is connected. In this mode, the power consumption is decided by network setting and data transfer rate. |
| Extended Idle Mode DRX (e-I-DRX) | The module and the network may negotiate over non-access stratum signaling the use of e-I-DRX for reducing power consumption, while being available for mobile terminating data and/or network originated procedures within a certain delay dependent on the DRX cycle value. | |
| Airplane Mode | **AT+CFUN=4** or W_DISABLE#* pin can set the module into airplane mode where the RF function is invalid. | |
| Minimum Functionality Mode | **AT+CFUN=0** can set the module into a minimum functionality mode without removing the power supply. In this mode, both RF function and (U)SIM card are invalid. | |
| Sleep Mode* | The module remains the ability to receive paging message, SMS* and TCP/UDP data from the network normally. In this mode, the current consumption is reduced to a low level. | |
| Power OFF Mode | The module's power supply is shut down by its power management unit. In this mode, the software is inactive, the serial interfaces are inaccessible, while the operating voltage (connected to VBAT_BB and VBAT_RF) remains applied. | |
| Power Saving Mode (PSM)* | PSM is similar to power-off, but the module remains registered on the network and there is no need to re-attach or re-establish PDN connections. The current consumption is reduced to a minimized level. | |

**NOTE**

During e-I-DRX, it is recommended to use UART interface for data communication, as the use of USB interface will increase power consumption.

## 3.2. Sleep Mode*

BG950A-GL & BG951A-GL can reduce their current consumption to a lower value during the sleep mode. The following sub-chapters describe the power saving procedure of BG950A-GL & BG951A-GL.

### 3.2.1. UART Application Scenario

If the host communicates with the module via UART interface, the following preconditions can let the module enter sleep mode:

- Execute **AT+QSCLK=2** to enable sleep mode.
- Drive MAIN_DTR high.
- Pull the PON_TRIG pin low.

The figure illustrates the connection between the module and the host.

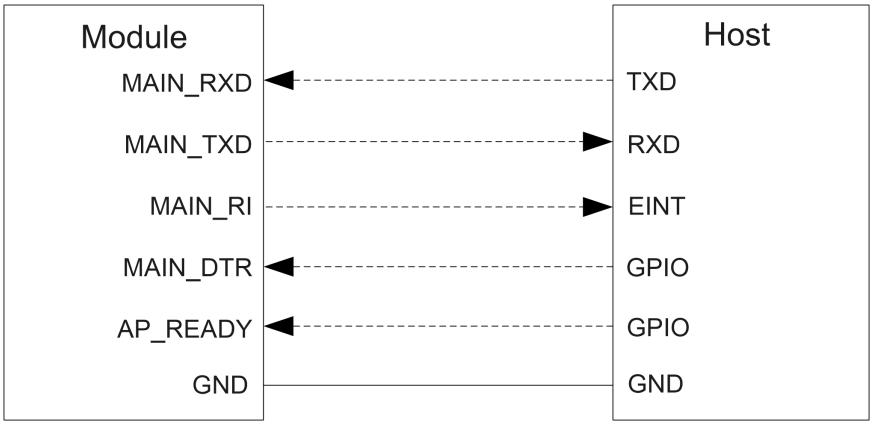



**Figure 3: Sleep Mode Application via UART Interface**

- Driving the module's MAIN_DTR low will wake up the module.
- When the module has a URC to report, MAIN_RI* signal will wake up the host. See ***Chapter 4.6.4*** for details about MAIN_RI* behavior.
- AP_READY* will detect the sleep state of the host (can be configured to high voltage level or low voltage level detection). See **AT+QCFG="apready"** in ***document [2]*** for details.

## 3.3. Power Saving Mode (PSM)*

BG950A-GL & BG951A-GL module can enter 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 PDN connections. So BG950A-GL & BG951A-GL module in PSM cannot immediately respond users' requests.

When the module wants to use the PSM, it shall request an Active Time value during every Attach and TAU procedures. If the network supports PSM and accepts that the module uses PSM, it will confirm the usage of PSM by allocating an Active Time value to the module. If the module wants to change the Active Time value, e.g. when the conditions are changed in the module, the module consequently requests the value it wants in the TAU procedure.

If PSM is supported by the network, then it can be enabled via **AT+CPSMS***.

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

- Drive PWRKEY low will wake up the module.
- When the T3412_EXT timer expires, the module will be automatically woken up.
- When PON_TRIG is pulled high and maintains its level statue, the module will wake up from PSM (Power Saving Mode). PON_TRIG is pulled down by default.

**NOTE**

See ***document [3]*** for details about **AT+CPSMS***.

## 3.4. Extended Idle Mode DRX (e-I-DRX)

The module (UE) and the network may negotiate over non-access stratum signalling the use of e-I-DRX for reducing its power consumption, while being available for mobile terminating data and/or network originated procedures within a certain delay dependent on the DRX cycle value.

Applications that want to use e-I-DRX need to consider specific handling of mobile terminating services or data transfers, and in particular, they need to consider the delay tolerance of mobile terminated data.

In order to negotiate the use of e-I-DRX, the UE requests e-I-DRX parameters during attach procedure and RAU/TAU procedure. The EPC may reject or accept the UE request for enabling e-I-DRX. In case the EPC accepts e-I-DRX, the EPC based on operator policies and, if available, the e-I-DRX cycle length value in the subscription data from the HSS, may also provide different values of the e-I-DRX parameters than what was requested by the UE. If the EPC accepts the use of e-I-DRX, the UE applies e-I-DRX based on the received e-I-DRX parameters. If the UE does not receive e-I-DRX parameters in the

relevant accept message because the EPC rejected its request or because the request was received by EPC not supporting e-I-DRX, the UE shall apply its regular discontinuous reception.

If e-I-DRX is supported by the network, then it can be enabled by **AT+CEDRXS=1**.

**NOTE**

See ***document [3]*** for details about **AT+CEDRXS**.

## 3.5. Airplane Mode

When the module enters airplane mode, the RF function will be disabled, and all AT commands correlative with RF function will be inaccessible. This mode can be set via the following ways.

**Hardware:**

W_DISABLE#* pin is pulled up by default. Driving it low will let the module enter airplane mode.

**Software:**

**AT+CFUN=<fun>** provides choices of the functionality level through setting **<fun>** into 0, 1 or 4.

- **AT+CFUN=0:** Minimum functionality (Both RF function and (U)SIM function are disabled).
- **AT+CFUN=1:** Full functionality (by default).
- **AT+CFUN=4:** Airplane mode (RF function is disabled).

**NOTE**

1. Airplane mode control via W_DISABLE#* is disabled in firmware by default. It can be enabled by **AT+QCFG="airplanecontrol"***. More details about the command will be provided in ***document [2].***
2. The execution of **AT+CFUN** will not affect GNSS function.

For every VBAT transition/re-insertion from 0 V, VBAT slew rate < 25 mV/μs. After the module starts up normally, in order to ensure full-function mode, the minimum power supply voltage should be higher than 2.2 V.

## 3.6. Power Supply

### 3.6.1. Power Supply Pins

The module provides two VBAT pins dedicated to the connection with the external power supply.

| Pin Name | Pin No. | Description | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| VBAT_BB | 32 | Power supply for the module's baseband part | 2.2 | 3.3 | 4.5 | V |
| VBAT_RF | 33 | Power supply for the module's RF part | 2.2 | 3.3 | 4.5 | V |
| GND | 3, 31, 48, 50, 54, 55, 58, 59, 61, 62, 67–74, 79–82, 89–91, 100–102 | | - | - | - | - |

- One VBAT_RF pin for RF part.
- One VBAT_BB pin for baseband part.

**Table 8: Pin Definition of Power Supply**

**NOTE**

### 3.6.2. Power Supply Monitoring

**AT+CBC*** can monitor the VBAT_BB voltage value. For more details, see ***document [3].***

### 3.6.3. Requirements for Voltage Stability

The power supply range of the module is from 2.2 V to 4.5 V. Make sure the input voltage will never drop below 2.2 V.

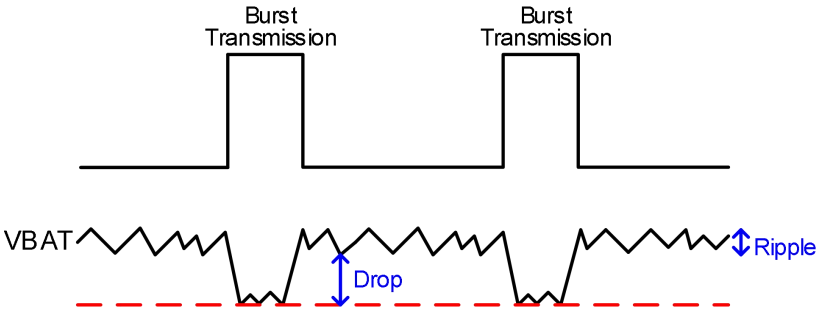



**Figure 4: Power Supply Limits During Burst Transmission**

To decrease voltage ‘s drop, a bypass capacitor of about 100 μF with low ESR should be used, and a multi-layer ceramic chip (MLCC) capacitor array should also be reserved due to its ultra-low ESR. It is recommended to use three ceramic capacitors for composing the MLCC array (100 nF, 33 pF, 10 pF), and place these capacitors close to VBAT pins. The main power supply from an external application must be a single voltage source and can be expanded to two sub paths with the star structure. The width of VBAT_BB trace should be no less than 1 mm. The width of VBAT_RF trace should be no less than 1 mm. In principle, the longer the VBAT trace is, the wider it will be.

In addition, to ensure the stability of the power supply, it is necessary to add two high-power TVSs at the front end of each power supply. Reference circuit of power supply is shown as below:

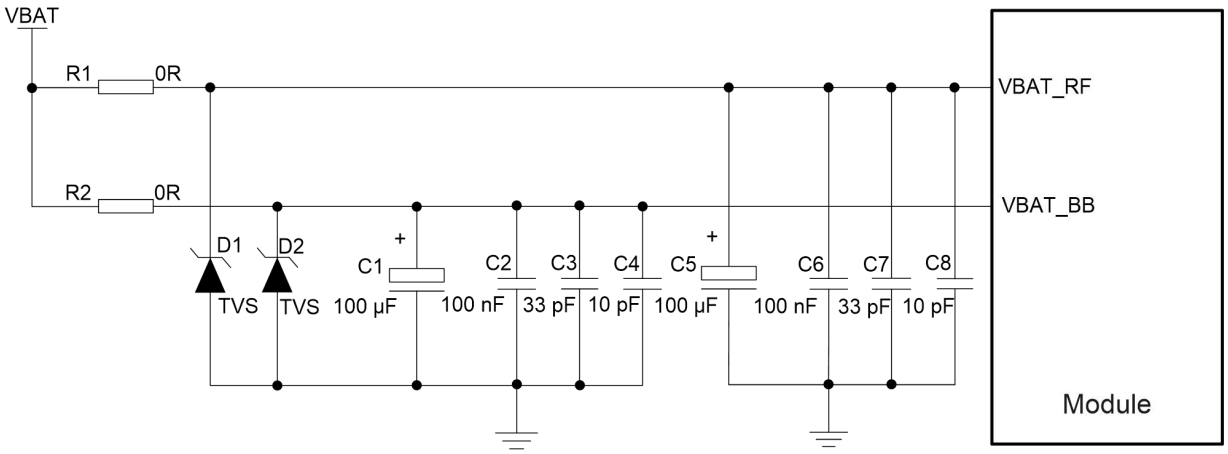



**Figure 5: Star Structure of the Power Supply**

## 3.7. Turn On

### 3.7.1. Turn on the Module with PWRKEY*

**Table 9: Pin Definition of PWRKEY**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PWRKEY | 15 | DI | Turn on/off the module | Internally pulled up resistor is 470 kΩ. |

When the module is in power off mode, it can be turned on and enter normal operation mode by driving the PWRKEY low for 500–1000 ms. It is recommended to use an open drain/collector driver to control the PWRKEY.

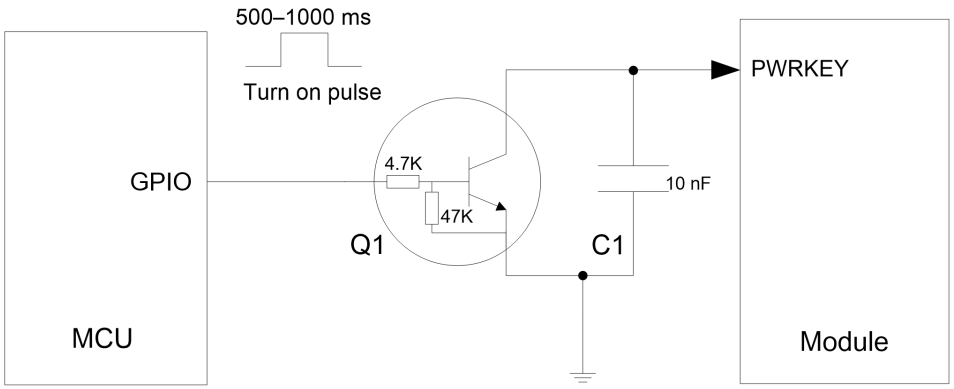



**Figure 6: Turn on the Module by Using Driving Circuit**

Another way to control the PWRKEY is by using a button directly. When pressing the button, an electrostatic strike may generate from finger. Therefore, a TVS component shall be placed near the button for ESD protection.

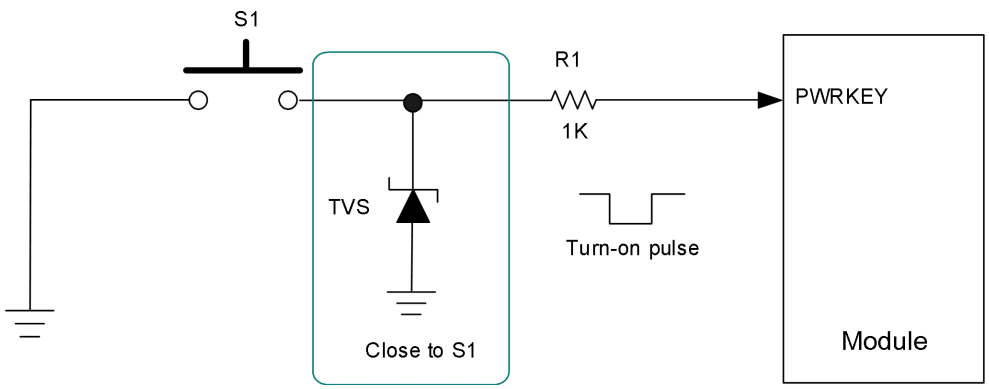



**Figure 7: Turn on the Module by Using Keystroke**

The power-up scenario is illustrated in the following figure.

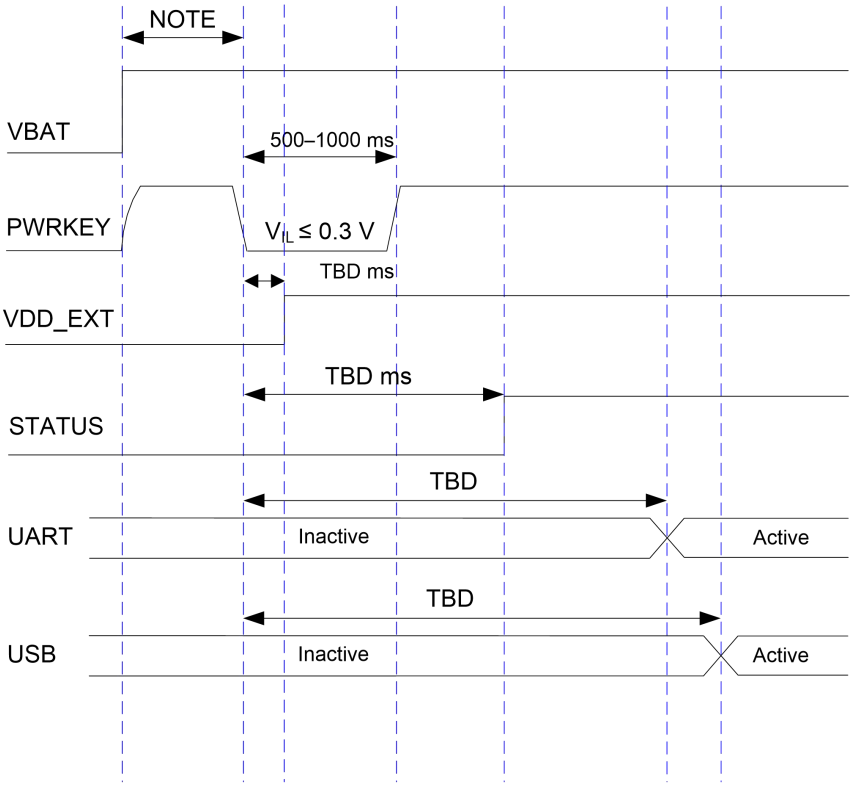



**Figure 8: Power-up Timing**

**NOTE**

Ensure that VBAT is stable for at least 30 ms before pulling down the PWRKEY.

## 3.8. Turn Off

The following procedures can be used to turn off the module:

### 3.8.1. Turn off the Module with PWRKEY*

When the module is in power on mode, driving the PWRKEY low for at least 650–1500 ms, then the module will execute power-down procedure after the PWRKEY is released.

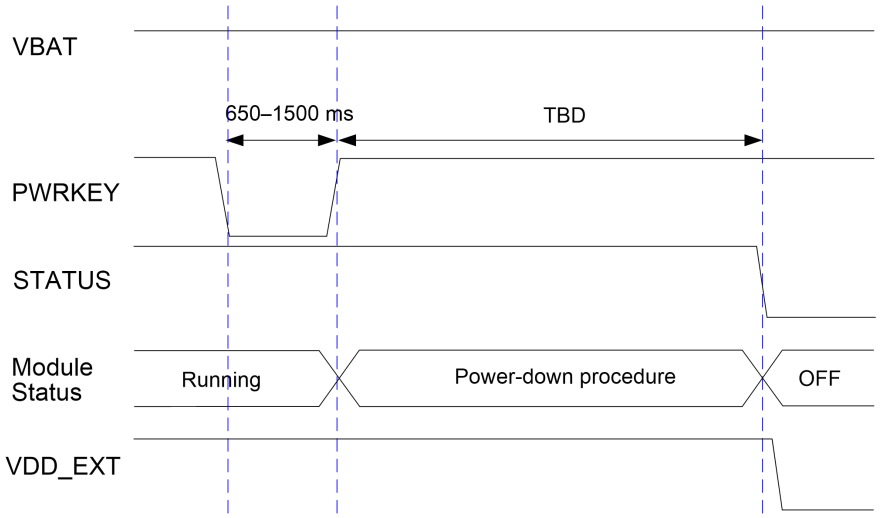



**Figure 9: Power-down Timing**

### 3.8.2. Turn off the Module with AT Command

It is safe to use **AT+QPOWD*** to turn off the module, which is equal to turn off the module via PWRKEY pin.

Refer to ***document [3]*** for details about **AT+QPOWD***.

**NOTE**

1. To avoid damaging the internal flash, do not switch off the power supply when the module works normally. Only after the module is turned off by PWRKEY or AT command, the power supply can be cut off.
2. When turning off module with AT command, keep PWRKEY at a high level after the execution of power-off command. Otherwise, the module will be turned on again after turned off.

## 3.9. Reset

The module can be reset by driving the RESET_N low for a certain time (TBD) and then releasing it. The RESET_N signal is sensitive to interference, so it is recommended to route the trace as short as possible and surround it with ground.

**Table 10: Pin Definition of RESET_N**

| Pin Name | Pin No. | I/O | Description |
|---|---|---|---|

| | | | |
|---|---|---|---|
| RESET_N | 17 | DI | Reset the module |

The recommended circuit is similar to the PWRKEY control circuit. An open drain/collector driver or button can be used to control RESET_N.

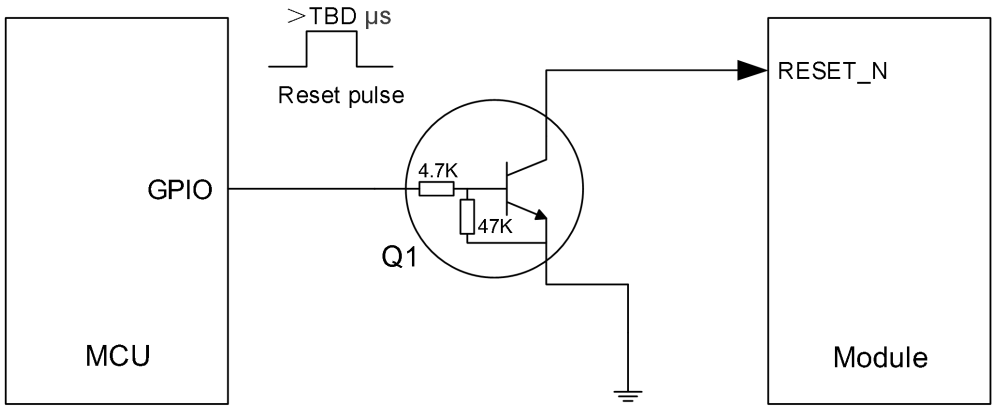



**Figure 10: Reference Circuit of RESET_N with Driving Circuit**

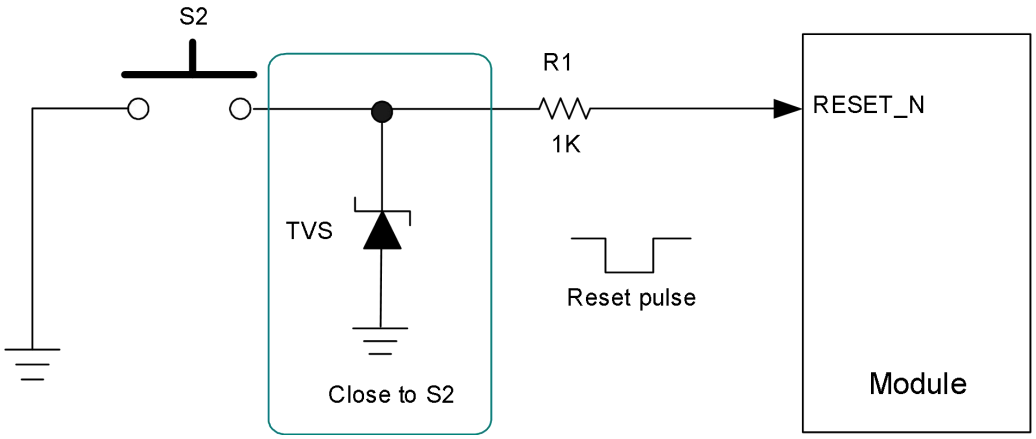



**Figure 11: Reference Circuit of RESET_N with A Button**

The reset timing is illustrated in the following figure.

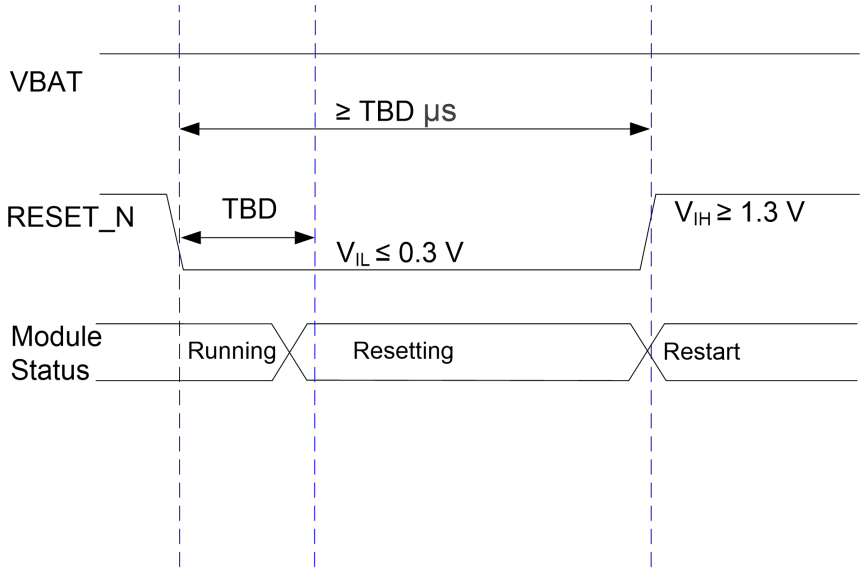



**Figure 12: Reset Timing**

## 3.10. PON_TRIG*

BG950A-GL & BG951A-GL modules provide one PON_TRIG pin which is used to wake up the module from PSM*.

**Table 11: Pin Definition of PON_TRIG**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PON_TRIG | 96 | DI | Wake up the module from PSM | 1.8 V power domain. |

A reference circuit is shown in the following figure.

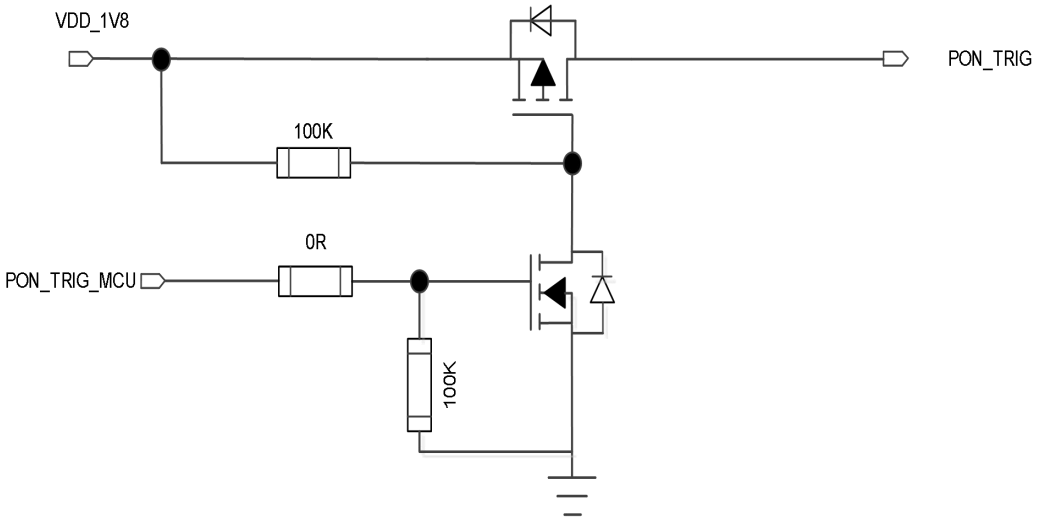



**Figure 13: Reference Circuit of PON_TRIG**

**NOTE**

1. VDD_1V8 is provided by an external LDO.
2. The PON_TRIG pin is pulled down by default. After the module starts up, the PON_TRIG pin must be pulled up so that the main UART interface can communicate. In normal operation mode, the PON_TRIG pin is recommended to be pulled up all the time.
3. After sending the AT command that makes the module enter PSM mode, drive PON_TRIG low can let the module enter PSM mode. When you need to wake up the module from PSM mode, PON_TRIG should be pulled up all the time, otherwise the module will re-enter PSM mode.
4. Send **AT+QSCLK** first, and then drive PON_TRIG low after pulling down MAIN_DTR can make the module enter sleep mode, otherwise the module cannot enter sleep mode normally. When you need to wake up the module from sleep mode, PON_TRIG pin also should be pulled up all the time before pulling up MAIN_DTR, otherwise the main UART interface cannot communicate.

# 4 Application Interfaces

## 4.1. (U)SIM Interface

The circuitry of (U)SIM interfaces meet *ETSI* and *IMT-2000* requirements. BG950A-GL & BG951A-GL support 1.8 V (U)SIM card only.

**Table 12: Pin Definition of (U)SIM Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| USIM_DET* | 42 | DI | (U)SIM card hot-plug detection | 1.8 V power domain.<br>If unused, keep this pin open. |
| USIM_VDD | 43 | PO | (U)SIM card power supply | Only 1.8 V (U)SIM card is supported. |
| USIM_RST | 44 | DO | (U)SIM card reset | 1.8 V power domain. |
| USIM_DATA | 45 | DIO | (U)SIM card data | |
| USIM_CLK | 46 | DO | (U)SIM card clock | |
| USIM_GND | 47 | | Specified ground for (U)SIM card | |

The module supports (U)SIM card hot-plug via the USIM_DET* pin, and both high-level and low-level detections are supported. The function is disabled by default, and refer to **AT+QSIMDET** in ***document [3]*** for more details.

The following figure illustrates a reference design for (U)SIM card interface with an 8-pin (U)SIM card connector.

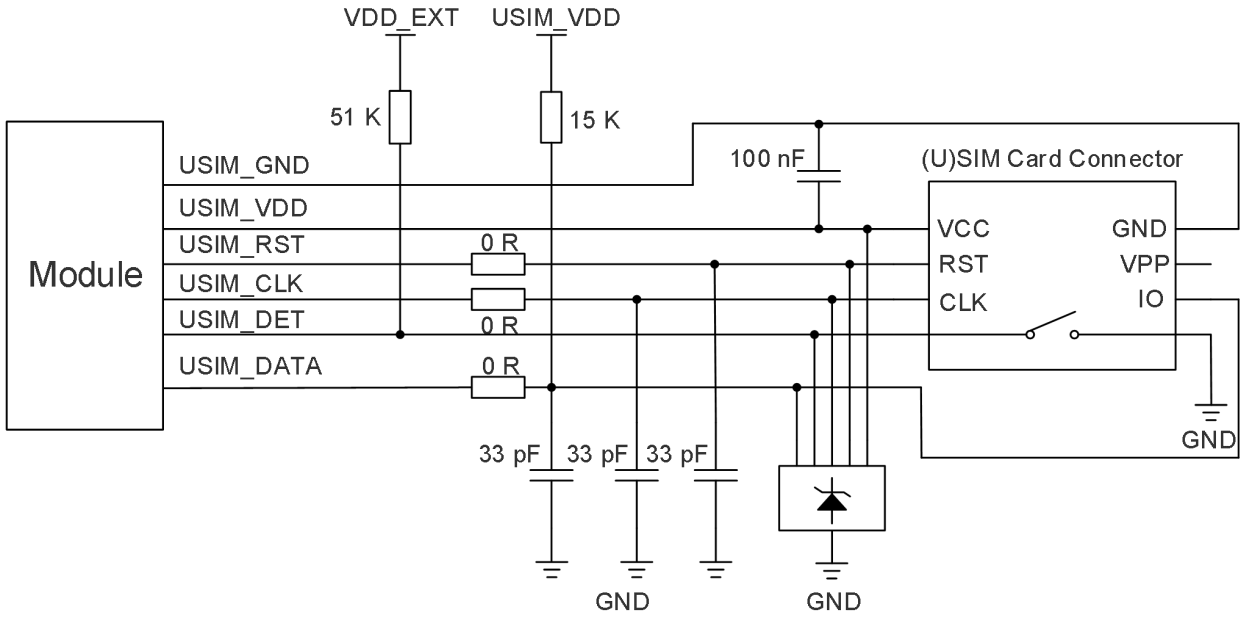



**Figure 14: Reference Circuit of (U)SIM Interface with an 8-Pin (U)SIM Card Connector**

If (U)SIM card detection function is not needed, keep USIM_DET* disconnected. A reference circuit for (U)SIM interface with a 6-pin (U)SIM card connector is illustrated in the following figure.

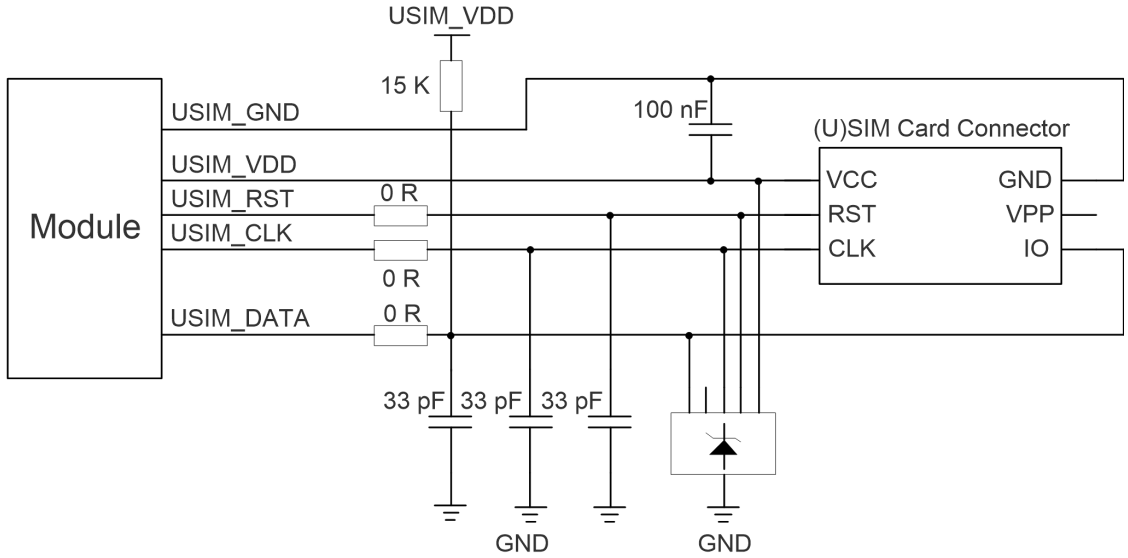



**Figure 15: Reference Circuit of (U)SIM Interface with a 6-Pin (U)SIM Card Connector**

To enhance the reliability and availability of the (U)SIM card in applications, please follow the criteria below in the (U)SIM circuit design:

- Keep the placement of (U)SIM card connector as close to the module as possible.
- Keep the trace length as less than 200 mm as possible.
- Keep (U)SIM card signals away from RF and VBAT traces.
- Assure the ground between the module and the (U)SIM card connector short and wide. Keep the trace width of ground and USIM_VDD no less than 0.5 mm to maintain the same electric potential. If the ground is complete on customers' PCB, USIM_GND can be connected to PCB ground directly.
- Make sure the bypass capacitor between USIM_VDD and USIM_GND less than 1 μF, and place it as close to (U)SIM card connector as possible.
- To avoid cross-talk between USIM_DATA and USIM_CLK, keep them away from each other and shield them with surrounded ground.
- To offer good ESD protection, it is recommended to add a TVS diode array of which parasitic capacitance should not be more than 15 pF. The 0 Ω resistors should be added in series between the module and the (U)SIM card to facilitate debugging. The 33 pF capacitors are used for filtering interference of EGSM900. Please note that the (U)SIM peripheral circuit should be close to the (U)SIM card connector.
- The pull-up resistor on USIM_DATA trace can improve anti-jamming capability when long layout trace and sensitive occasions are applied, and should be placed close to the (U)SIM card connector.

## 4.2. USB Interface*

The module provides one USB interface. The USB interface complies with the USB 2.0 specifications, and supports Full-speed (12 Mbps) and Low-speed (1.5 Mbps) for USB 2.0.

USB interface is used AT command communication, data transmission, software debugging and firmware upgrade.

**Table 13: Pin Definition of USB Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| USB_VBUS | 8 | AI | USB connection detect | Typ. 5.0 V |
| USB_DP | 9 | AIO | USB differential data (+) | Compliant with USB 2.0 standard specification. Require differential impedance of 90 Ω. |
| USB_DM | 10 | AIO | USB differential data (-) | |

It is recommended to reserve test points for debugging and firmware upgrading in customers' designs.

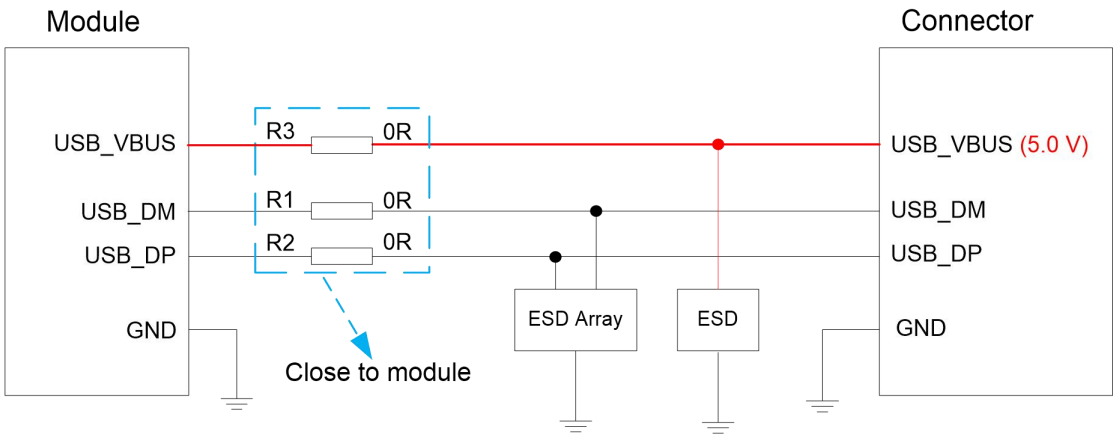



**Figure 16: Reference Circuit of USB Application**

To ensure the integrity of USB data trace signal, resistors R1 and R2 should be placed close to the module, and these resistors should be placed close to each other. The extra stubs of trace must be as short as possible.

To meet USB 2.0 specification, comply with the following principles while designing the USB interface.

- It is important to route the USB signal traces as differential pairs with ground surrounded. The impedance of USB differential trace is 90 Ω.
- Do not route signal traces under crystals, oscillators, magnetic devices, PCIe and RF signal traces. It is important to route the USB differential traces in inner-layer of the PCB, and surround the traces with ground on that layer and with ground planes above and below.
- Junction capacitance of the ESD protection device might cause influences on USB data traces, so pay attention to the selection of the device. Typically, the stray capacitance should be less than 2 pF .
- Keep the ESD protection devices as close to the USB connector as possible.
- If possible, reserve a 0 Ω resistor on USB_DP and USB_DM traces respectively.

For more details about the USB specifications, visit http://www.usb.org/home.

## 4.3. PCM and I2C Interfaces*

The module provides one Pulse Code Modulation (PCM) digital interface and one I2C interface for VoLTE* only. The PCM interface supports the following modes:

**Table 14: Pin Definition of PCM Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PCM_CLK | 4 | DO | PCM clock | 1.8 V power domain.<br>If unused, keep this pin open. |
| PCM_SYNC | 5 | DO | PCM data frame sync | |
| PCM_DIN | 6 | DI | PCM data input | |
| PCM_DOUT | 7 | DO | PCM data output | |

**Table 15: Pin Definition of I2C Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| I2C_SCL | 40 | OD | I2C serial clock (for external codec) | External pull-up resistor is required.<br>1.8 V only.<br>If unused, keep this pin open. |
| I2C_SDA | 41 | OD | I2C serial data (for external codec) | |

The reference design is illustrated as follows:

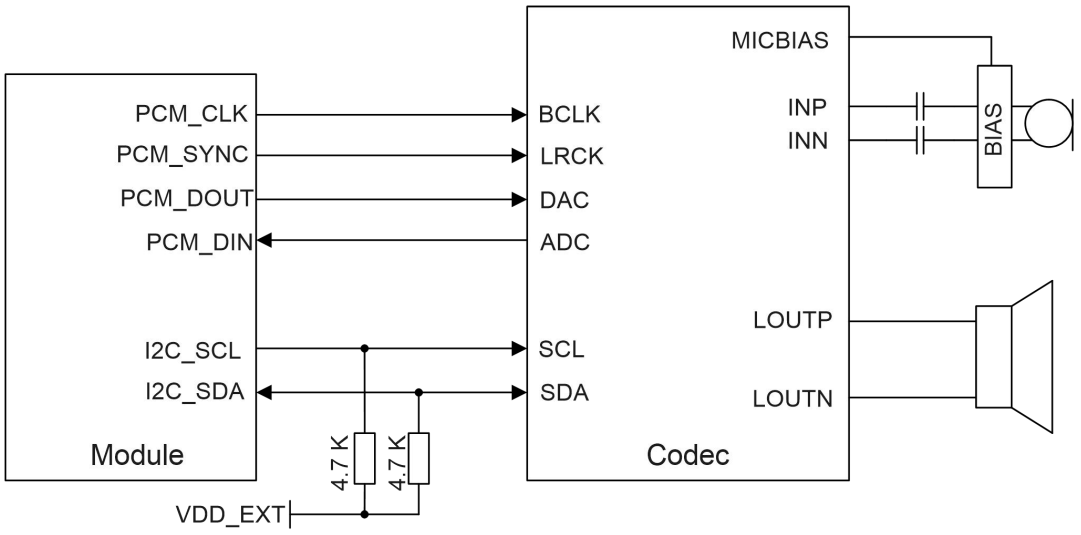



**Figure 17: Reference Circuit of PCM Interface**

## 4.4. UART Interfaces

Pin definition of the UART interface is shown as follows:

**Table 16: Pin Definition of Main UART Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| MAIN_DTR | 30 | DI | Main UART data terminal ready | 1.8 V power domain<br>If unused, keep this pin open. |
| MAIN_RXD | 34 | DI | Main UART receive | |
| MAIN_TXD | 35 | DO | Main UART transmit | |
| MAIN_CTS | 36 | DO | Main UART clear to send | |
| MAIN_RTS | 37 | DI | Main UART request to send | |
| MAIN_DCD | 38 | DO | Main UART data carrier detect | |
| MAIN_RI | 39 | DO | Main UART ring indication | |

The module provides three UART interfaces and the following shows their features:

**Table 17: UART Information**

| Parameters | Main UART Interface | Debug UART Interface | Auxiliary UART Interface |
|---|---|---|---|
| Supported Baud Rate | 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps, 921600 bps and 3000000 bps | 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200 bps, 230400 bps, 460800 bps, 921600 bps and 3000000 bps | - |
| Default Baud Rate | 115200 bps | 115200 bps | 921600 bps |
| Default frame format | 8N1 (8 data bits, no parity, 1 stop bit) | 8N1 (8 data bits, no parity, 1 stop bit). | 8N1 (8 data bits, no parity, 1 stop bit). |
| Functions | ● Data transmission<br>● AT command communication<br>● RTS and CTS hardware flow control | ● Firmware upgrade<br>● Software debugging<br>● Log output | ● RF calibration<br>● Log output |

**NOTE**

**AT+IPR*** can be used to set the baud rate of the main UART interface, and **AT+IFC*** can be used to set the hardware flow control (the function is disabled by default). See ***document [3]*** for more details about these AT commands.

**Table 18: Pin Definition of Debug UART Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| DBG_TXD | 23 | DO | Debug UART transmit | 1.8 V power domain<br>If unused, keep this pin open. |
| DBG_RXD | 22 | DI | Debug UART receive | |

**Table 19: Pin Definition of Auxiliary UART Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| AUX/GNSS_TXD | 27 | DO | Auxiliary/GNSS UART transmit | 1.8 V power domain<br>If unused, keep this pin open. |
| AUX/GNSS_RXD | 28 | DI | Auxiliary/GNSS UART receive | |

The module provides 1.8 V UART interfaces. A voltage-level translator should be used if the application is equipped with a 3.3 V UART interface. The following figure shows a reference design of the main UART interface:

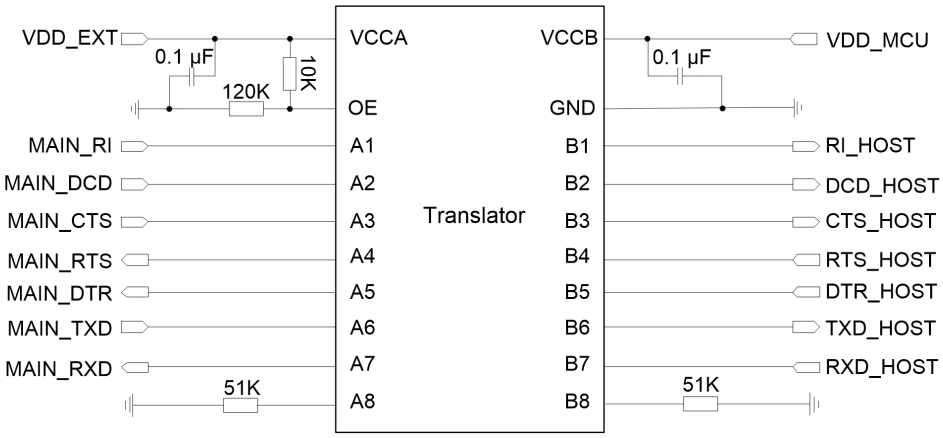



**Figure 18: Reference Circuit with Translator Chip**

Visit *http://www.ti.com* for more information.

Another example with transistor circuit is shown as below. For the design of circuits shown in dotted lines, refer to that shown in solid lines, but pay attention to the direction of connection.

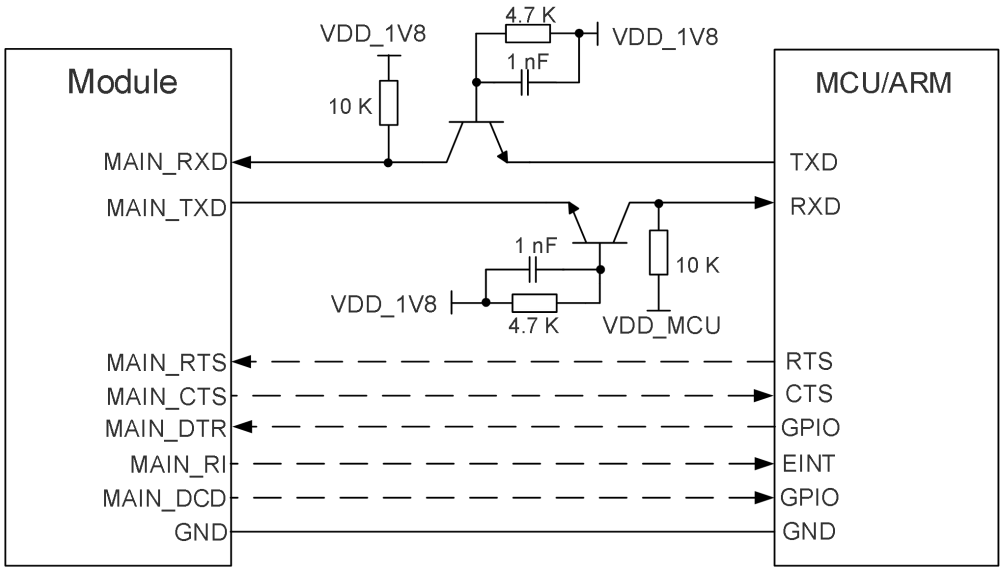



**Figure 19: Reference Circuit with Transistor Circuit**

**NOTE**

1. Transistor circuit solution is not suitable for applications with high baud rates exceeding 460 kbps.
2. The main UART of the module shouldn't be asserted high during BG950A-GL & BG951A-GL enter PSM.
3. Please note that the module CTS is connected to the host CTS, and the module RTS is connected to the host RTS.

## 4.5. ADC Interface

The module provides two Analog-to-Digital Converter (ADC) interfaces. To improve the accuracy of ADC, the trace of ADC interfaces should be surrounded by ground.

**Table 20: Pin Definition of ADC Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| ADC0 | 24 | AI | General-purpose ADC interface | Voltage range: 0–1.8 V |
| ADC1 | 2 | AI | General-purpose ADC interface | |

The voltage value on ADC pins can be read via **AT+QADC=<port>**:

- **AT+QADC=0:** read the voltage value on ADC0
- **AT+QADC=1:** read the voltage value on ADC1

For more details about the AT command, see ***document [3]***.

The resolution of the ADC is up to 12 bits. The following table describes the characteristic of the ADC interface.

**Table 21: Characteristics of ADC Interface**

| Name | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Voltage Range | 0 | - | 1.8 | V |
| Resolution | 6 | - | 12 | bit |
| Input Resistance | - | - | TBD | KΩ |

**NOTE**

1. ADC input voltage must not exceed 1.8 V.
2. It is prohibited to supply any voltage to ADC pin when VBAT is removed.
3. It is recommended to use resistor divider circuit for ADC application, and the divider's resistor accuracy should be no less than 1 %.

## 4.6. Indication Signal

### 4.6.1. PSM Status Indication*

**Table 22: Pin Definition of PSM_IND**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PSM_IND | 1 | DO | Indicate the module's power saving mode | 1.8 V power domain.<br>If unused, keep this pin open. |

When PSM is enabled, the function of PSM_IND pin will be activated after the module is rebooted. When PSM_IND is in high voltage level, the module is in normal operation state. When it is in low level, the module is in PSM.

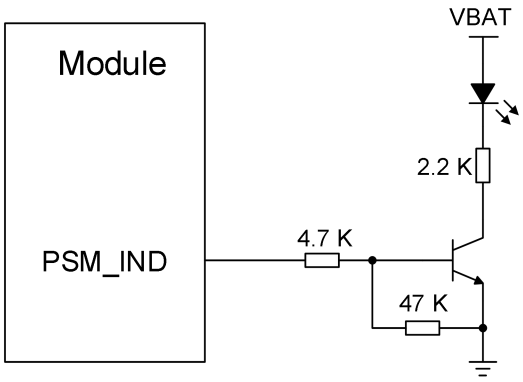



**Figure 20: Reference Circuit of the PSM Status Indication**

### 4.6.2. Network Status Indication*

**Table 23: Pin Definition of NET_STATUS**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| NET_STATUS | 21 | DO | Module network activity status indication | 1.8 V power domain.<br>If unused, keep this pin open. |

The network indication pins can be used to drive network status indication LEDs. The module provides two network indication pins: NET_MODE and NET_STATUS. The following tables describe pin definition and logic level changes in different network status.

**Table 24: Working State of Network Connection Status Indication**

| Pin Name | Status | Description |
|---|---|---|
| NET_STATUS | Flicker slowly (200 ms High/1800 ms Low) | Network searching |
| | Flicker slowly (1800 ms High/200 ms Low) | Idle |
| | Flicker quickly (125 ms High/125 ms Low) | Data transfer is ongoing |
| | Always high | Voice calling |

A reference circuit is shown in the following figure.

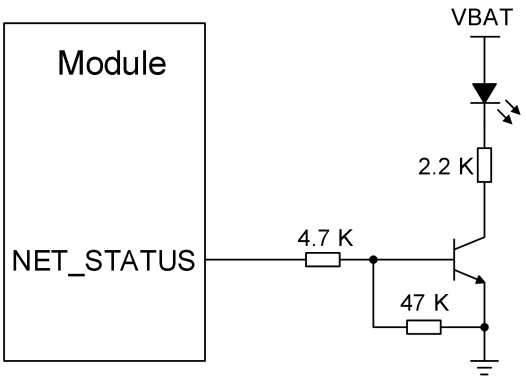



**Figure 21: Reference Circuit of Network Status Indication**

### 4.6.3. STATUS

The STATUS pin is an open drain output for indicating the module's operation status. It will output high level when module is powered on successfully.

**Table 25: Pin Definition of STATUS**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| STATUS | 20 | DO | Indicate the module's operation status | 1.8 V power domain |

A reference circuit is shown as below.

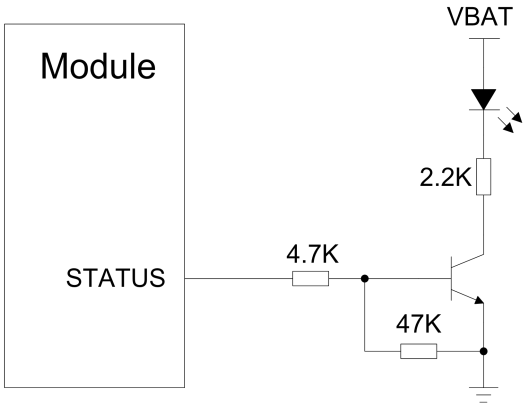



**Figure 22: Reference Circuits of STATUS**

### 4.6.4. Behaviors of MAIN_RI*

**AT+QCFG= "risignaltype","physical"** can be used to configure MAIN_RI behavior. No matter on which port a URC is presented, the URC will trigger the behavior of MAIN_RI pin.

**Table 26: Pin Definition of MAIN_RI**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| MAIN_RI | 39 | DO | Main UART ring indication | 1.8 V power domain.<br>If unused, keep this pin open. |

**NOTE**

The URC can be outputted via UART port, USB AT port and USB modem port, which can be set by **AT+QURCCFG**. The default port is USB AT port.

In addition, MAIN_RI behaviors can be configured flexibly. The default behavior of the MAIN_RI is shown as below.

**Table 27: Default Behaviors of MAIN_RI**

| State | Response |
|---|---|
| Idle | MAIN_RI keeps at high level. |
| URC | MAIN_RI outputs 120 ms low pulse when new URC returns. |

The MAIN_RI behavior can be changed via **AT+QCFG="urc/ri/ring"***. See ***document [2]*** for details.

**NOTE**

URC can be outputted from UART port, USB AT port and USB modem port, through configuration via **AT+QURCCFG**. The default port is USB AT port.

## 4.7. GRFC Interface*

The module provides two generic RF control interfaces for the control of external antenna tuners.

**Table 28: Pin Definition of GRFC Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| GRFC1 | 83 | DO | Generic RF controller | 1.8 V power domain. |
| GRFC2 | 84 | DO | Generic RF controller | |

**Table 29: Truth Table of GRFC Interface**

| GRFC1 Level | GRFC2 Level | Frequency Range (MHz) | Band |
|---|---|---|---|
| Low | Low | TBD | TBD |
| Low | High | TBD | TBD |
| High | Low | TBD | TBD |
| High | High | TBD | TBD |

## 4.8. GPIO Interface*

The module provides nine general-purpose input and output (GPIO) interfaces. **AT+QCFG="gpio"** command can be used to configure the status of GPIO pins. For more details about the AT command, see ***document [2].***

**Table 30: Pin Definition of GPIO Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| GPIO1 | 25 | DIO | General-purpose input/output | 1.8 V power domain. |
| GPIO2 | 26 | DIO | General-purpose input/output | |
| GPIO3 | 64 | DIO | General-purpose input/output | |
| GPIO4 | 65 | DIO | General-purpose input/output | |

| | | | |
|---|---|---|---|
| GPIO5 | 66 | DIO | General-purpose input/output |
| GPIO6 | 85 | DIO | General-purpose input/output |
| GPIO7 | 86 | DIO | General-purpose input/output |
| GPIO8 | 87 | DIO | General-purpose input/output |
| GPIO9 | 88 | DIO | General-purpose input/output |

# 5 RF Specifications

## 5.1. Cellular Network

### 5.1.1. Antenna Interface & Frequency Bands

The pin definition is shown as below:

**Table 31: Pin Definition of Cellular Network Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| ANT_MAIN | 60 | AIO | Main antenna interface | 50 Ω impedance |

**NOTE**

Only passive antennas are supported.

**Table 32: Operating Frequency of BG950A-GL & BG951A-GL**

| Operating Frequency | Transmit (MHz) | Receive (MHz) | Unit |
|---|---|---|---|
| LTE-FDD B1 | 1920–1980 | 2110–2170 | MHz |
| LTE-FDD B2 | 1850–1910 | 1930–1990 | MHz |
| LTE-FDD B3 | 1710–1785 | 1805–1880 | MHz |
| LTE-FDD B4 | 1710–1755 | 2110–2155 | MHz |
| LTE-FDD B5 | 824–849 | 869–894 | MHz |
| LTE-FDD B8 | 880–915 | 925–960 | MHz |
| LTE-FDD B12 | 699–716 | 729–746 | MHz |

| | | | |
|---|---|---|---|
| LTE-FDD B13 | 777–787 | 746–756 | MHz |
| LTE-FDD B17 [10] | 704–716 | 734–746 | MHz |
| LTE-FDD B18 | 815–830 | 860–875 | MHz |
| LTE-FDD B19 | 830–845 | 875–890 | MHz |
| LTE-FDD B20 | 832–862 | 791–821 | MHz |
| LTE-FDD B25 | 1850–1915 | 1930–1995 | MHz |
| LTE-FDD B26 | 814–849 | 859–894 | MHz |
| LTE-FDD B27 | 807–824 | 852–869 | MHz |
| LTE-FDD B28 | 703–748 | 758–803 | MHz |
| LTE-FDD B66 | 1710–1780 | 2110–2180 | MHz |

### 5.1.2. RF Output Power

The following table shows the RF output power of the module.

**Table 33: RF Output Power**

| Frequency Bands | Max. RF Output Power | Min. RF Output Power |
|---|---|---|
| LTE-FDD:<br>B1/B2/B3/B4/B5/B8/B12/B13/B17/B18/B19/B20/<br>B25/B26/B27/B28/B66 | 23 dBm ±2.7 dB | < -39 dBm |

[10] LTE-FDD B17 is supported by Cat NB2* only.

### 5.1.3. Receiving Sensitivity

The following table shows conducted RF receiving sensitivity of the module.

**Table 34: Conducted RF Receiving Sensitivity of BG950A-GL**

| Network | Frequency Band | Primary | Diversity | Sensitivity (dBm) | |
|---|---|---|---|---|---|
| | | | | Cat M1/3GPP | Cat NB2 [11]/3GPP |
| LTE | LTE-FDD B1 | Supported | - | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B2 | | | TBD/-100.3 | TBD/-107.5 |
| | LTE-FDD B3 | | | TBD/-99.3 | TBD/-107.5 |
| | LTE-FDD B4 | | | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B5 | | | TBD/-100.8 | TBD/-107.5 |
| | LTE-FDD B8 | | | TBD/-99.8 | TBD/-107.5 |
| | LTE-FDD B12 | | | TBD/-99.3 | TBD/-107.5 |
| | LTE-FDD B13 | | | TBD/-99.3 | TBD/-107.5 |
| | LTE-FDD B17 [12] | | | - | TBD/-107.5 |
| | LTE-FDD B18 | | | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B19 | | | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B20 | | | TBD/-99.8 | TBD/-107.5 |
| | LTE-FDD B25 | | | TBD/-100.3 | TBD/-107.5 |
| | LTE-FDD B26 [13] | | | TBD/-100.3 | - |
| | LTE-FDD B27 [16] | | | TBD/-100.8 | - |
| | LTE-FDD B28 | | | TBD/-100.8 | TBD/-107.5 |
| | LTE-FDD B66 | | | TBD/-101.8 | TBD/-107.5 |

[11] LTE Cat NB2* receiving sensitivity without repetitions.
[12] LTE-FDD B17 is supported by Cat NB2* only.
[13] LTE-FDD B26 and B27 are supported by Cat M1 only.

**Table 35: Conducted RF Receiving Sensitivity of BG951A-GL**

| Network | Frequency Band | Primary | Diversity | Sensitivity (dBm) | |
|---|---|---|---|---|---|
| | | | | Cat M1/3GPP | Cat NB2 [14]/3GPP |
| LTE | LTE-FDD B1 | Supported | - | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B2 | | | TBD/-100.3 | TBD/-107.5 |
| | LTE-FDD B3 | | | TBD/-99.3 | TBD/-107.5 |
| | LTE-FDD B4 | | | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B5 | | | TBD/-100.8 | TBD/-107.5 |
| | LTE-FDD B8 | | | TBD/-99.8 | TBD/-107.5 |
| | LTE-FDD B12 | | | TBD/-99.3 | TBD/-107.5 |
| | LTE-FDD B13 | | | TBD/-99.3 | TBD/-107.5 |
| | LTE-FDD B17 [15] | | | - | TBD/-107.5 |
| | LTE-FDD B18 | | | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B19 | | | TBD/-102.3 | TBD/-107.5 |
| | LTE-FDD B20 | | | TBD/-99.8 | TBD/-107.5 |
| | LTE-FDD B25 | | | TBD/-100.3 | TBD/-107.5 |
| | LTE-FDD B26 [16] | | | TBD/-100.3 | - |
| | LTE-FDD B27 [20] | | | TBD/-100.8 | - |
| | LTE-FDD B28 | | | TBD/-100.8 | TBD/-107.5 |
| | LTE-FDD B66 | | | TBD/-101.8 | TBD/-107.5 |

### 5.1.4. Reference Design

[14] LTE Cat NB2* receiving sensitivity without repetitions.
[15] LTE-FDD B17 is supported by Cat NB2* only.
[16] LTE-FDD B26 and B27 are supported by Cat M1 only.

The module provides one RF antenna interface for antenna connection.

It is recommended to reserve a π-type matching circuit for better RF performance, and the π-type matching components (R1, C1 and C2) should be placed as close to the antenna as possible. The capacitors are not mounted by default.

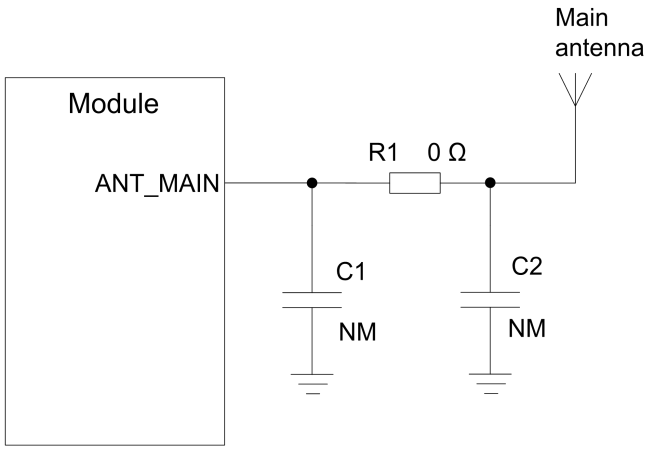



**Figure 23: Reference Circuit for Main Antenna Interface**

## 5.2. GNSS Network

The module includes a fully integrated global navigation satellite system solution that supports GPS, GLONASS.

The module supports standard *NMEA-0183* protocol, and outputs NMEA sentences via debug UART interface (data update rate: 1–10 Hz, 1 Hz by default).

By default, the module's GNSS function is switched off. It must be switched on via AT command. For more details about GNSS function's technology and configurations, see ***document [4]***.

### 5.2.1. Antenna Interface & Frequency Bands

The following table shows the pin definition, frequency bands, and performance of GNSS antenna interface.

**Table 36: Pin Definition of GNSS Antenna Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| ANT_GNSS | 49 | AI | GNSS antenna interface | 50 Ω impedance |

**Table 37: GNSS Frequency**

| Type | Frequency | Unit |
|---|---|---|
| GPS | 1575.42 ±1.023 | MHz |
| GLONASS | 1597.5–1605.8 | MHz |

### 5.2.2. GNSS Performance

**Table 38: GNSS Performance**

| Parameter | Description | Conditions | Typ. | Unit |
|---|---|---|---|---|
| Sensitivity (GNSS) | Cold start | Autonomous | TBD | dBm |
| | Reacquisition | Autonomous | TBD | |
| | Tracking | Autonomous | TBD | |
| TTFF (GNSS) | Cold start @ open sky | Autonomous | TBD | s |
| | | XTRA enabled | TBD | |
| | Warm start @ open sky | Autonomous | TBD | |
| | | XTRA enabled | TBD | |
| | Hot start @ open sky | Autonomous | TBD | |
| | | XTRA enabled | TBD | |
| Accuracy (GNSS) | CEP-50 | Autonomous @ open sky | TBD | M |

NOTE

1. Tracking sensitivity: the lowest GNSS signal value at the antenna port on which the module can keep on positioning for 3 minutes.
2. Re-acquisition sensitivity: the lowest GNSS signal value at the antenna port on which the module can fix position again within 3 minutes after loss of lock.
3. Cold start sensitivity: the lowest GNSS signal value at the antenna port on which the module fixes position within 3 minutes after executing cold start commands.

### 5.2.3. Reference Design

The following is the reference circuit of GNSS antenna.

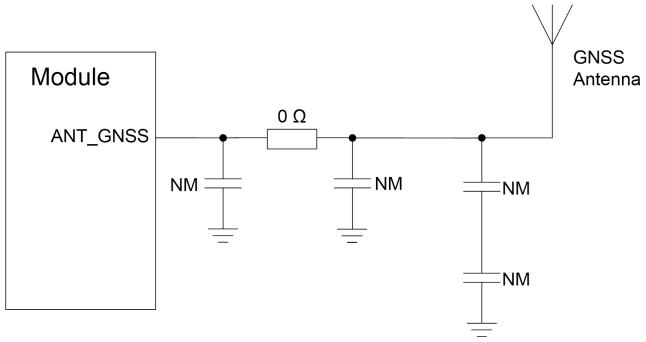



**Figure 24: Reference Circuit of GNSS Antenna**

**NOTE**

The module of BG950A-GL & BG951A-GL are designed with a passive antenna.

## 5.3. Reference Design of RF Routing

For user's PCB, the characteristic impedance of all RF traces should be controlled to 50 Ω. The impedance of the RF traces is usually determined by the trace width (W), the materials' dielectric constant, the height from the reference ground to the signal layer (H), and the spacing between RF traces and grounds (S). Microstrip or coplanar waveguide is typically used in RF layout to control characteristic impedance. The following are reference designs of microstrip or coplanar waveguide with different PCB structures.

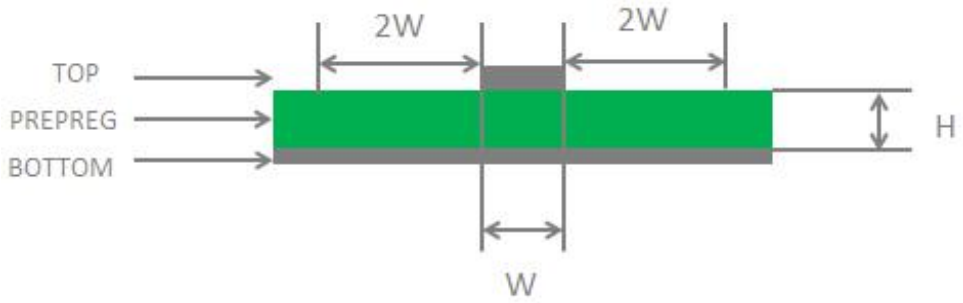



**Figure 25: Microstrip Design on a 2-layer PCB**

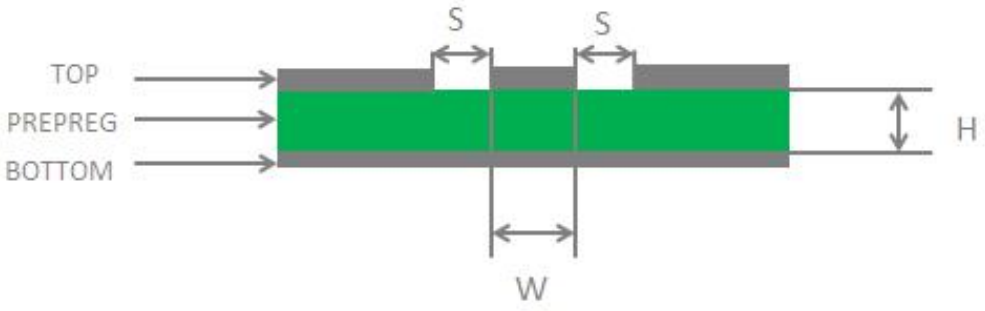



**Figure 26: Coplanar Waveguide Design on a 2-layer PCB**

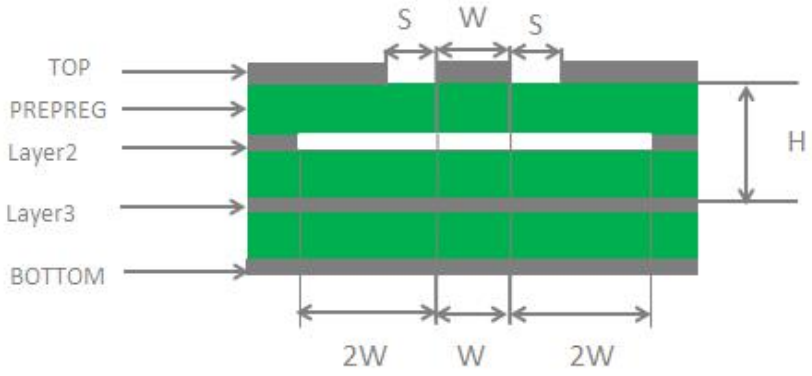


**Figure 27: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)**

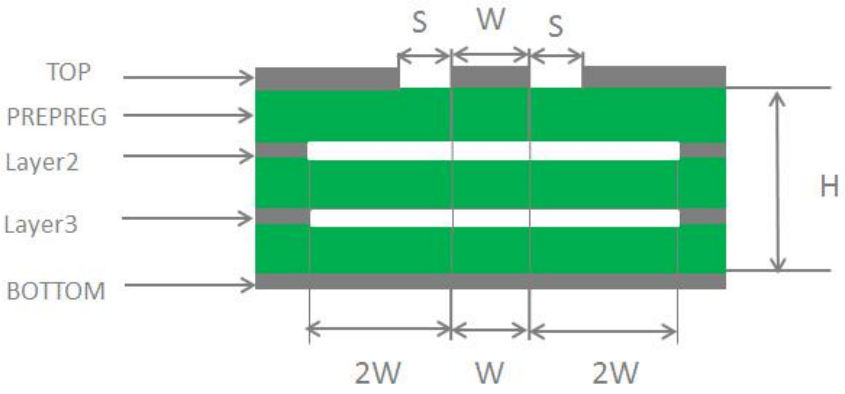



**Figure 28: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)**

To ensure RF performance and reliability, follow the principles below in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω.
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be no less than two times the width of RF signal traces (2 × W).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see ***document [5].***

## 5.4. Requirements for Antenna Design

**Table 39: Requirements for Antenna Design**

| Antenna Type | Requirements |
|---|---|
| GNSS [17] | Frequency range: 1559–1609 MHz |

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

| | |
|---|---|
| | Polarization: RHCP or linear<br>VSWR: < 2 (Typ.)<br>Passive antenna gain: > 0 dBi<br>Active antenna noise figure: < 1.5 dB<br>Active antenna gain: > 0 dBi<br>Active antenna embedded LNA gain: 17 dB |
| LTE | VSWR：≤ 2<br>Efficiency: > 30 %<br>Gain: 1 dBi<br>Max input power: 50 W<br>Input impedance: 50 Ω<br>Polarization: vertical<br>Cable insertion loss:<br>< 1 dB: LB (<1 GHz)<br>< 1.5 dB: MB (1–2.3 GHz) |

## 5.5. RF Connector Recommendation

The receptacle dimensions are illustrated as below.

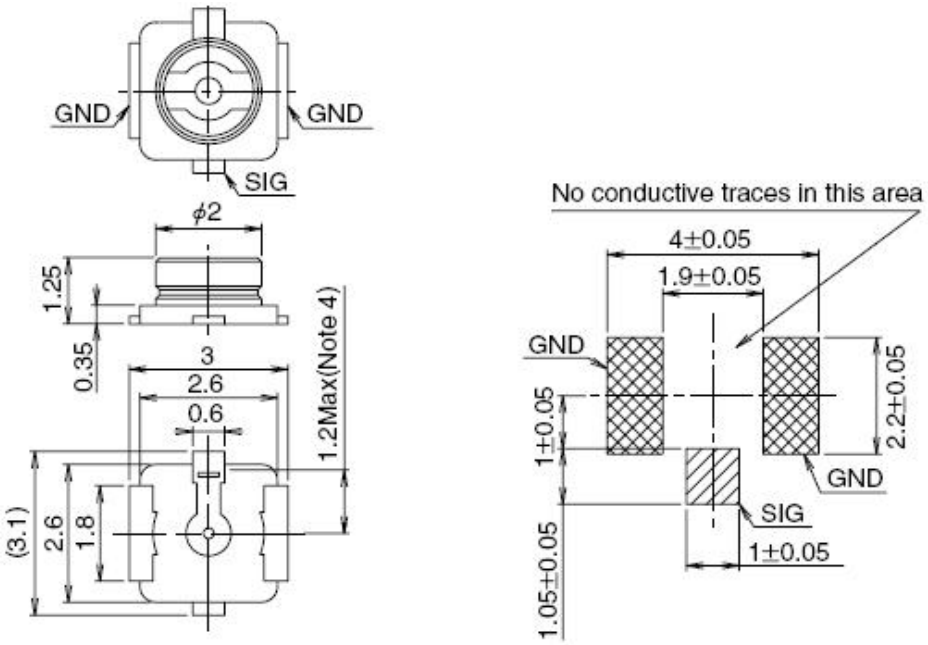



**Figure 29: Dimensions of the U.FL-R-SMT Connector (Unit: mm)**

U.FL-LP serial connectors listed in the following figure can be used to match the U.FL-R-SMT.

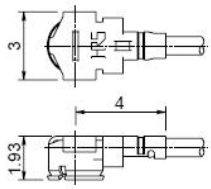
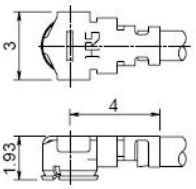
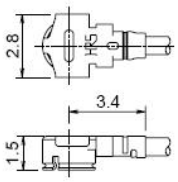
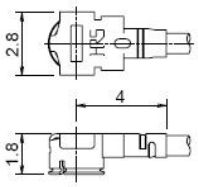
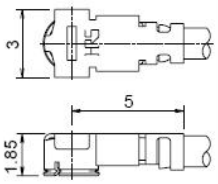
| Part No. | U.FL-LP-040 | U.FL-LP-066 | U.FL-LP(V)-040 | U.FL-LP-062 | U.FL-LP-088 |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Mated Height | 2.5mm Max. (2.4mm Nom.) | 2.5mm Max. (2.4mm Nom.) | 2.0mm Max. (1.9mm Nom.) | 2.4mm Max. (2.3mm Nom.) | 2.4mm Max. (2.3mm Nom.) |
| Applicable cable | Dia. 0.81mm Coaxial cable | Dia. 1.13mm and Dia. 1.32mm Coaxial cable | Dia. 0.81mm Coaxial cable | Dia. 1mm Coaxial cable | Dia. 1.37mm Coaxial cable |
| Weight (mg) | 53.7 | 59.1 | 34.8 | 45.5 | 71.7 |
| RoHS | YES | | | | |

**Figure 30: Mechanicals of U.FL-LP Connectors**

The following figure describes the space factor of mated connector.

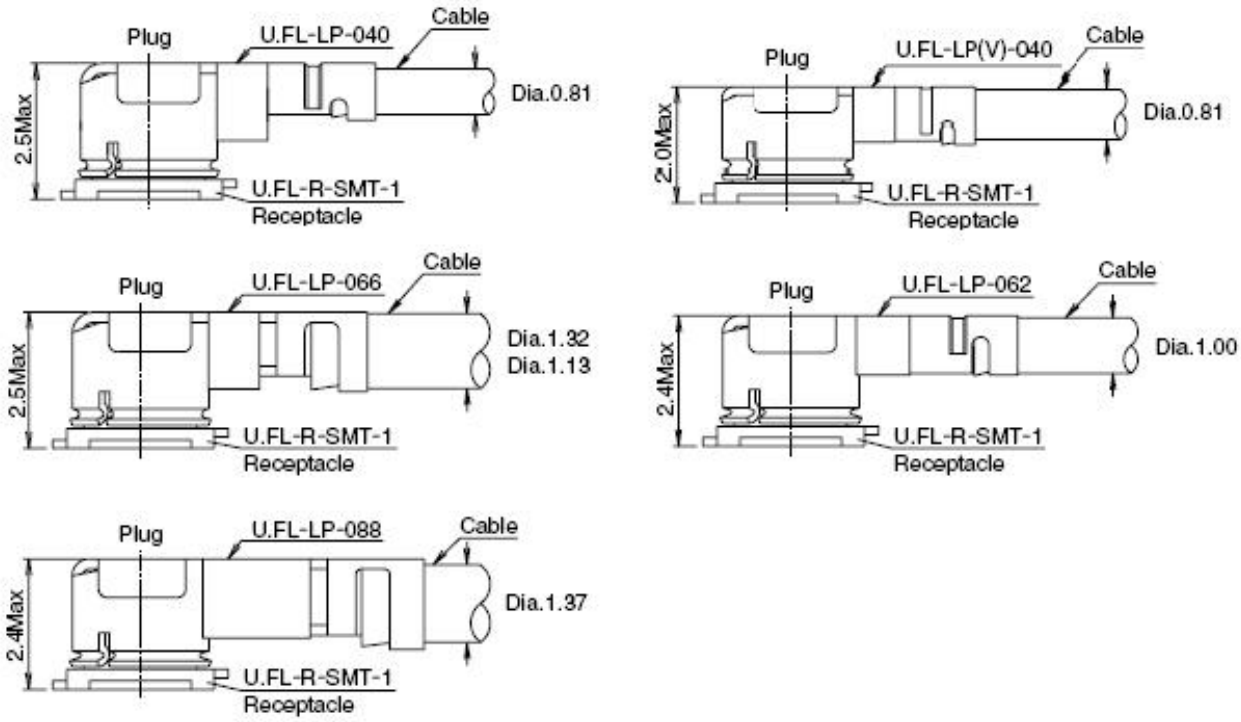



**Figure 31: Space Factor of Mated Connector (Unit: mm)**

For more details, visit http://www.hirose.com.

# 6 Reliability and Electrical

# 7 Characteristics

## 7.1. Absolute Maximum Ratings

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

**Table 40: Absolute Maximum Ratings**

| Parameter | Min. | Max. | Unit |
|---|---|---|---|
| VBAT_RF/VBAT_BB | -0.2 | 4.5 | V |
| USB_VBUS | -0.3 | 6.0 | V |
| Voltage on Digital Pins | -0.3 | 2.0 | V |

## 7.2. Power Supply Ratings

**Table 41: The Module's Power Supply Ratings**

| Parameter | Description | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| VBAT_BB/ VBAT_RF | Power supply for the module's baseband part/Power supply for the module's RF part | The actual input voltages must stay between the minimum and maximum values. | 2.2 | 3.3 | 4.5 | V |
| USB_VBUS | USB connection | | - | 5.0 | - | V |

| | |
|---|---|
| | detect |

## 7.3. Power Consumption

**Table 42: BG950A-GL Power Consumption**

| BG950A-GL (Power Supply: 3.3 V, Room Temperature) | | | | |
|---|---|---|---|---|
| **Description** | **Conditions** | **Avg.** | **Max.** | **Unit** |
| Leakage | Power-off @ USB/UART disconnected | 2.1 | - | μA |
| PSM | PSM @ USB/UART disconnected | TBD | - | μA |
| Rock bottom | **AT+CFUN=0** @ Sleep mode | TBD | - | mA |
| Sleep mode (USB disconnected) | LTE Cat M1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat M1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| Idle state | LTE Cat M1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat M1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| LTE Cat M1 data transfer (GNSS OFF) | LTE-FDD B1 @ dBm | TBD | TBD | mA |
| | LTE-FDD B2 @ dBm | TBD | TBD | mA |
| | LTE-FDD B3 @ dBm | TBD | TBD | mA |

| | | | | |
|---|---|---|---|---|
| | LTE-FDD B4 @ dBm | TBD | TBD | mA |
| | LTE-FDD B5 @ dBm | TBD | TBD | mA |
| | LTE-FDD B8 @ dBm | TBD | TBD | mA |
| | LTE-FDD B12 @ dBm | TBD | TBD | mA |
| | LTE-FDD B13 @ dBm | TBD | TBD | mA |
| | LTE-FDD B18 @ dBm | TBD | TBD | mA |
| | LTE-FDD B19 @ dBm | TBD | TBD | mA |
| | LTE-FDD B20 @ dBm | TBD | TBD | mA |
| | LTE-FDD B25 @ dBm | TBD | TBD | mA |
| | LTE-FDD B26 @ dBm | TBD | TBD | mA |
| | LTE-FDD B27 @ dBm | TBD | TBD | mA |
| | LTE-FDD B28 @ dBm | TBD | TBD | mA |
| | LTE-FDD B66 @ dBm | TBD | TBD | mA |
| LTE Cat NB1 data transfer (GNSS OFF) | LTE-FDD B1 @ dBm | TBD | TBD | mA |
| | LTE-FDD B2 @ dBm | TBD | TBD | mA |
| | LTE-FDD B3 @ dBm | TBD | TBD | mA |
| | LTE-FDD B4 @ dBm | TBD | TBD | mA |
| | LTE-FDD B5 @ dBm | TBD | TBD | mA |
| | LTE-FDD B8 @ dBm | TBD | TBD | mA |
| | LTE-FDD B12 @ dBm | TBD | TBD | mA |
| | LTE-FDD B13 @ dBm | TBD | TBD | mA |
| | LTE-FDD B17 @ dBm | TBD | TBD | mA |
| | LTE-FDD B18 @ dBm | TBD | TBD | mA |
| | LTE-FDD B19 @ dBm | TBD | TBD | mA |
| | LTE-FDD B20 @ dBm | TBD | TBD | mA |
| | LTE-FDD B25 @ dBm | TBD | TBD | mA |

| | | | | |
|---|---|---|---|---|
| | LTE-FDD B28 @ dBm | TBD | TBD | mA |
| | LTE-FDD B66 @ dBm | TBD | TBD | mA |

**Table 43: BG951A-GL Power Consumption**

| BG951A-GL (Power Supply: 3.3 V, Room Temperature) | | | | |
|---|---|---|---|---|
| **Description** | **Conditions** | **Avg.** | **Max.** | **Unit** |
| Leakage | Power-off @ USB/UART disconnected | 2.1 | - | μA |
| PSM | PSM @ USB/UART disconnected | TBD | - | μA |
| Rock bottom | **AT+CFUN=0** @ Sleep mode | TBD | - | mA |
| Sleep mode (USB disconnected) | LTE Cat M1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat M1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| Idle state | LTE Cat M1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1 DRX = 1.28 s | TBD | - | mA |
| | LTE Cat M1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| | LTE Cat NB1<br>e-I-DRX = 81.92 s<br>@ PTW = 2.56 s, DRX = 1.28 s | TBD | - | mA |
| LTE Cat M1 data transfer (GNSS OFF) | LTE-FDD B1 @ dBm | TBD | TBD | mA |
| | LTE-FDD B2 @ dBm | TBD | TBD | mA |
| | LTE-FDD B3 @ dBm | TBD | TBD | mA |
| | LTE-FDD B4 @ dBm | TBD | TBD | mA |
| | LTE-FDD B5 @ dBm | TBD | TBD | mA |
| | LTE-FDD B8 @ dBm | TBD | TBD | mA |

| | | | | |
|---|---|---|---|---|
| | LTE-FDD B12 @ dBm | TBD | TBD | mA |
| | LTE-FDD B13 @ dBm | TBD | TBD | mA |
| | LTE-FDD B18 @ dBm | TBD | TBD | mA |
| | LTE-FDD B19 @ dBm | TBD | TBD | mA |
| | LTE-FDD B20 @ dBm | TBD | TBD | mA |
| | LTE-FDD B25 @ dBm | TBD | TBD | mA |
| | LTE-FDD B26 @ dBm | TBD | TBD | mA |
| | LTE-FDD B27 @ dBm | TBD | TBD | mA |
| | LTE-FDD B28 @ dBm | TBD | TBD | mA |
| | LTE-FDD B66 @ dBm | TBD | TBD | mA |
| LTE Cat NB1 data transfer (GNSS OFF) | LTE-FDD B1 @ dBm | TBD | TBD | mA |
| | LTE-FDD B2 @ dBm | TBD | TBD | mA |
| | LTE-FDD B3 @ dBm | TBD | TBD | mA |
| | LTE-FDD B4 @ dBm | TBD | TBD | mA |
| | LTE-FDD B5 @ dBm | TBD | TBD | mA |
| | LTE-FDD B8 @ dBm | TBD | TBD | mA |
| | LTE-FDD B12 @ dBm | TBD | TBD | mA |
| | LTE-FDD B13 @ dBm | TBD | TBD | mA |
| | LTE-FDD B17 @ dBm | TBD | TBD | mA |
| | LTE-FDD B18 @ dBm | TBD | TBD | mA |
| | LTE-FDD B19 @ dBm | TBD | TBD | mA |
| | LTE-FDD B20 @ dBm | TBD | TBD | mA |
| | LTE-FDD B25 @ dBm | TBD | TBD | mA |
| | LTE-FDD B28 @ dBm | TBD | TBD | mA |
| | LTE-FDD B66 @ dBm | TBD | TBD | mA |

**Table 44: BG950A-GL GNSS Current Consumption**

| BG950A-GL | | | |
|---|---|---|---|
| **Description** | **Conditions** | **Typ.** | **Unit** |
| Searching **(AT+CFUN=0)** | Cold start @ Passive antenna | TBD | mA |
| | Hot start @ Passive antenna | TBD | mA |
| | Lost state @ Passive antenna | TBD | mA |
| Tracking **(AT+CFUN=0)** | Instrument environment @ Passive antenna | TBD | mA |
| | Open sky @ Real network, Passive antenna | TBD | mA |
| | Open sky @ Real network, Active antenna | TBD | mA |

**Table 45: BG951A-GL GNSS Current Consumption**

| BG951A-GL | | | |
|---|---|---|---|
| **Description** | **Conditions** | **Typ.** | **Unit** |
| Searching **(AT+CFUN=0)** | Cold start @ Passive antenna | TBD | mA |
| | Hot start @ Passive antenna | TBD | mA |
| | Lost state @ Passive antenna | TBD | mA |
| Tracking **(AT+CFUN=0)** | Instrument environment @ Passive antenna | TBD | mA |
| | Open sky @ Real network, Passive antenna | TBD | mA |
| | Open sky @ Real network, Active antenna | TBD | mA |

## 7.4. ESD

The module is not protected against electrostatics discharge (ESD) in general. Consequently, it is subject

to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the module, for example, ESD protection should be added at the interface of circuit design and the points that are vulnerable to electrostatic discharge damage or influence; anti-static gloves should be worn during production, etc.

ESD characteristics of the module's pins are as follows:

**Table 46: Electrostatics Discharge Characteristics (Temperature: 25 °C, Humidity: 45 %)**

| Tested Interfaces | Contact Discharge | Air Discharge | Unit |
|---|---|---|---|
| VBAT, GND | TBD | TBD | kV |
| All Antenna Interfaces | TBD | TBD | kV |

## 7.5. Operating and Storage Temperatures

**Table 47: Operating and Storage Temperatures**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Operating Temperature Range [18] | -35 | +25 | +75 | °C |
| Extended Operating Temperature Range [19] | -40 | - | +85 | °C |
| Storage temperature range | -40 | - | +95 | °C |

[18] Within operating temperature range, the module is 3GPP compliant.
[19] Within extended operating temperature range, proper mounting, heating sinks and active cooling may be required to make certain functions of the module such as voice*, SMS*, data transmission to be realized. Only one or more parameters like $P_{out}$ might reduce in their value and exceed the specified tolerances. When the temperature returns to normal operating temperature levels, the module will meet 3GPP specifications again.

# 8 Mechanical Information

This chapter describes the mechanical dimensions of the module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.2 mm unless otherwise specified.

## 8.1. Mechanical Dimensions

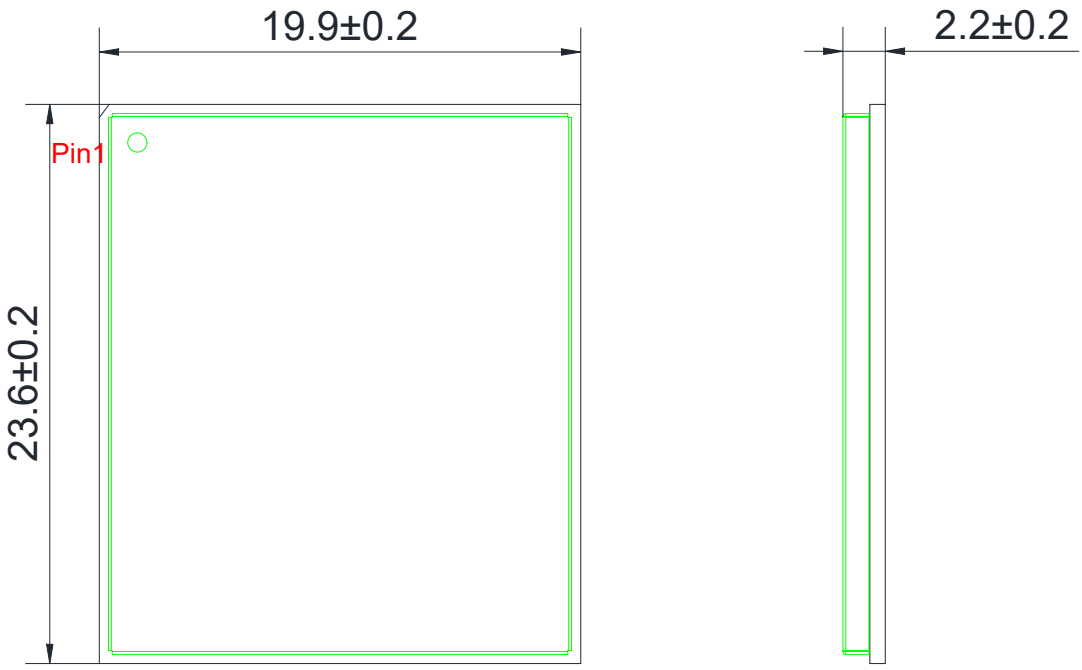



**Figure 32: Module Top and Side Dimensions (Unit: mm)**

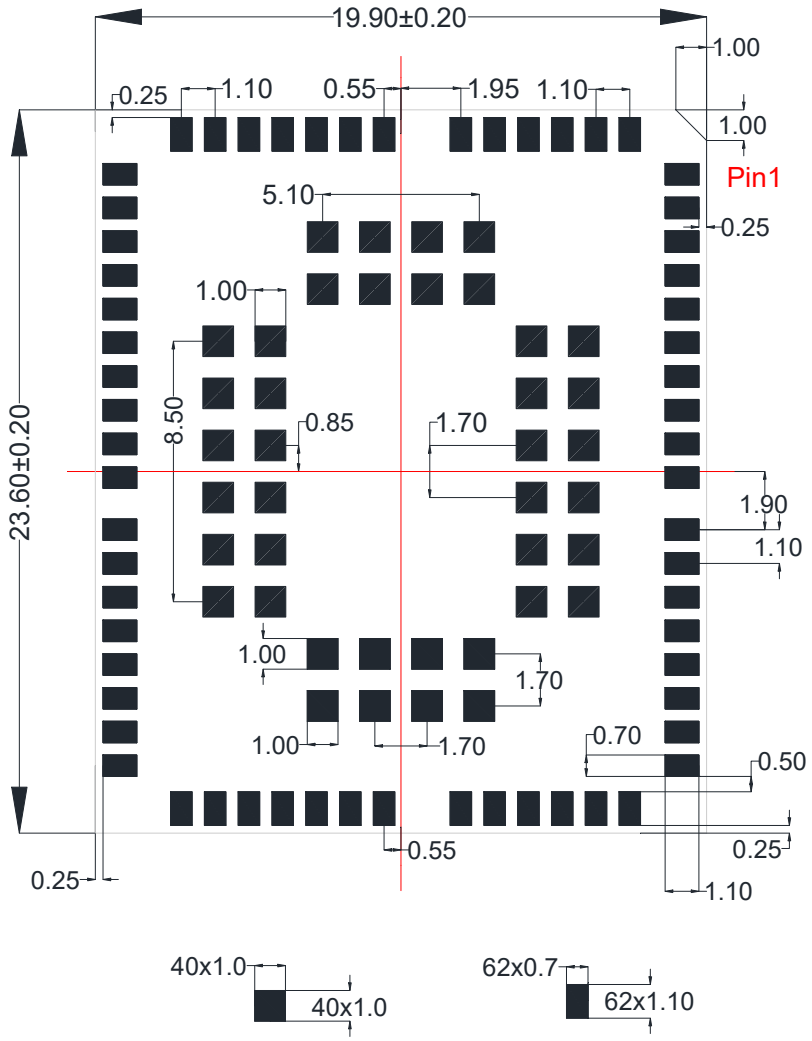



**Figure 33: Module Bottom Dimensions (Bottom View, Unit: mm)**

**NOTE**

The package warpage level of the module conforms to the *JEITA ED-7306* standard.

## 8.2. Recommended Footprint

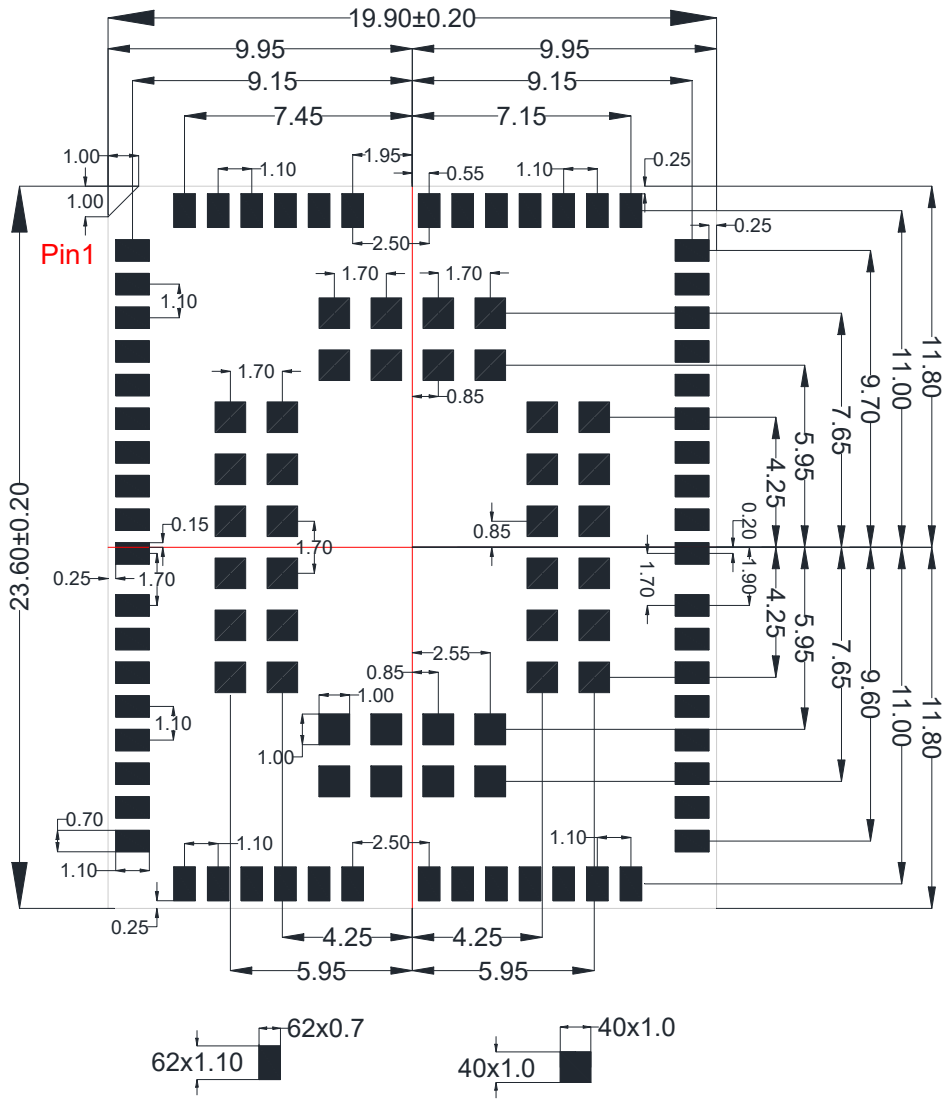



**Figure 34: Recommended Footprint (Top View)**

**NOTE**

1. For easy maintenance of the module, keep about 3 mm between the module and other components on the motherboard.
2. All reserved pins must be kept open.
3. For stencil design requirements of the module, see ***document [6].***

## 8.3. Top and Bottom Views


**Figure 35: Top & Bottom Views of the Module**

**NOTE**

1. Images above are for illustration purpose only and may differ from the actual module. For authentic appearance and label, please refer to the module received from Quectel.
2. The top and bottom views of BG951A-GL module will be provided in the future version.

# 9 Storage, Manufacturing & Packaging

## 9.1. Storage Conditions

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

1. Recommended Storage Condition: The temperature should be 23 ±5 °C and the relative humidity should be 35–60 %.

2. The storage life (in vacuum-sealed packaging) is 12 months in Recommended Storage Condition.

3. The floor life of the module is 168 hours [20] in a plant where the temperature is 23 ±5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g. a drying cabinet).

4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:

   - The module is not stored in Recommended Storage Condition;
   - Violation of the third requirement above occurs;
   - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
   - Before module repairing.

5. If needed, the pre-baking should follow the requirements below:

   - The module should be baked for 8 hours at 120 ±5 °C;
   - All modules must be soldered to PCB within 24 hours after the baking, otherwise they should be put in a dry environment such as in a drying oven.

**NOTE**

[20] This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. And do not remove the packages of tremendous modules if they are not ready for soldering.

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. All modules must be soldered to PCB within 24 hours after the baking, otherwise put them in the drying oven. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

## 9.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.13–0.15 mm. For more details, see ***document [6].***

The peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is strongly recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

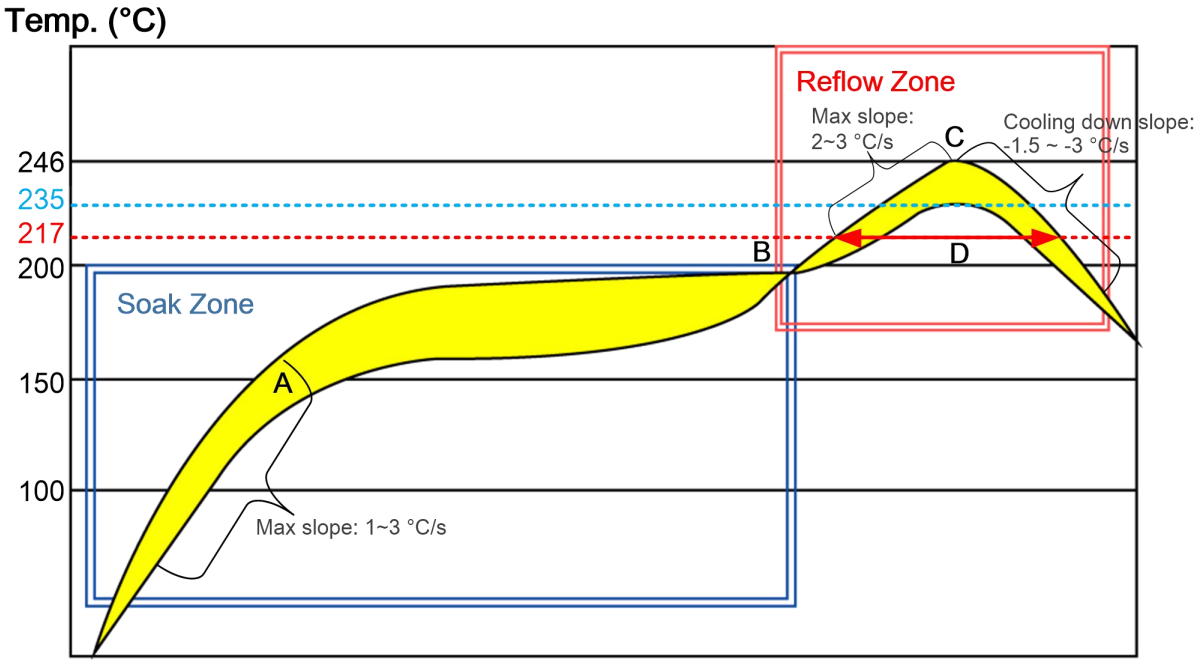



**Figure 36: Recommended Reflow Soldering Thermal Profile**

**Table 48: Recommended Thermal Profile Parameters**

| Factor | Recommendation |
|---|---|
| **Soak Zone** | |
| Max slope | 1–3 °C/s |
| Soak time (between A and B: 150 °C and 200 °C) | 70–120 s |
| **Reflow Zone** | |
| Max slope | 2–3 °C/s |
| Reflow time (D: over 217 °C) | 40–70 s |
| Max temperature | 235 °C to 246 °C |
| Cooling down slope | -1.5 to -3 °C/s |
| **Reflow Cycle** | |
| Max reflow cycle | 1 |

**NOTE**

If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.

## 9.3. Packaging Specifications

The module is packaged in tape and reel carriers. One reel is 330 mm long and contains 500 modules. The figures below show the package details, measured in mm.

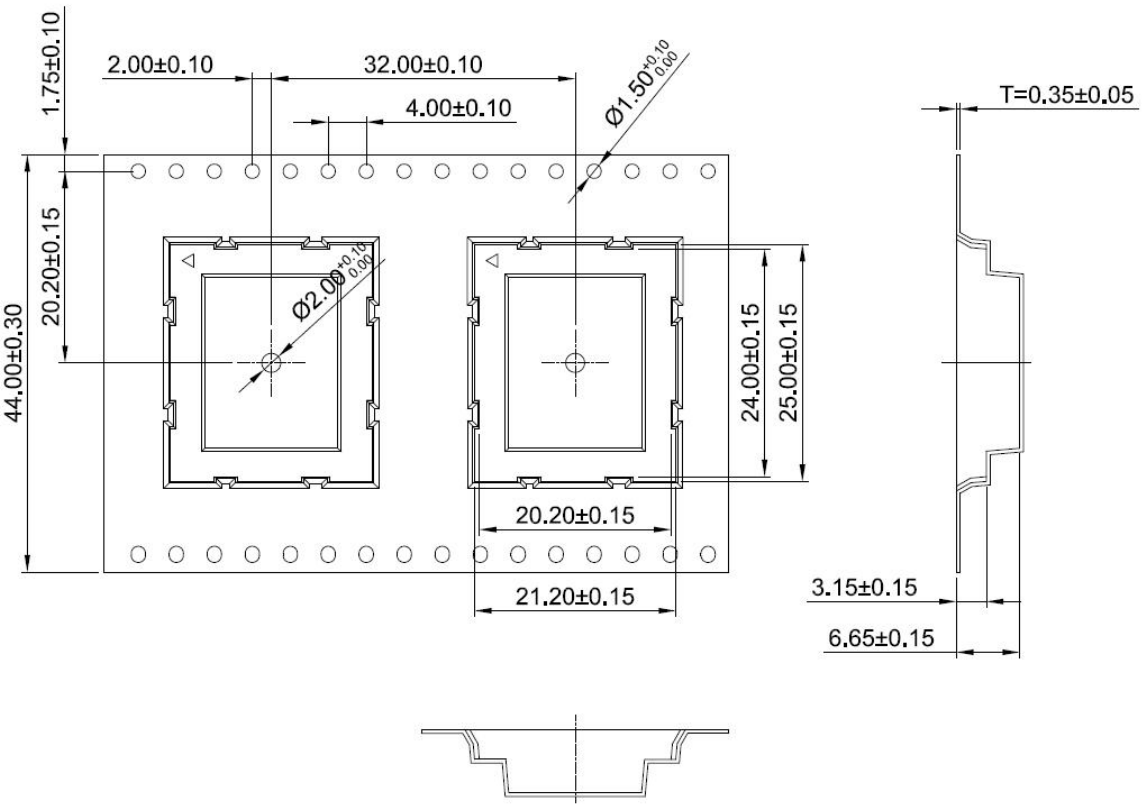



**Figure 37: Tape Specifications**

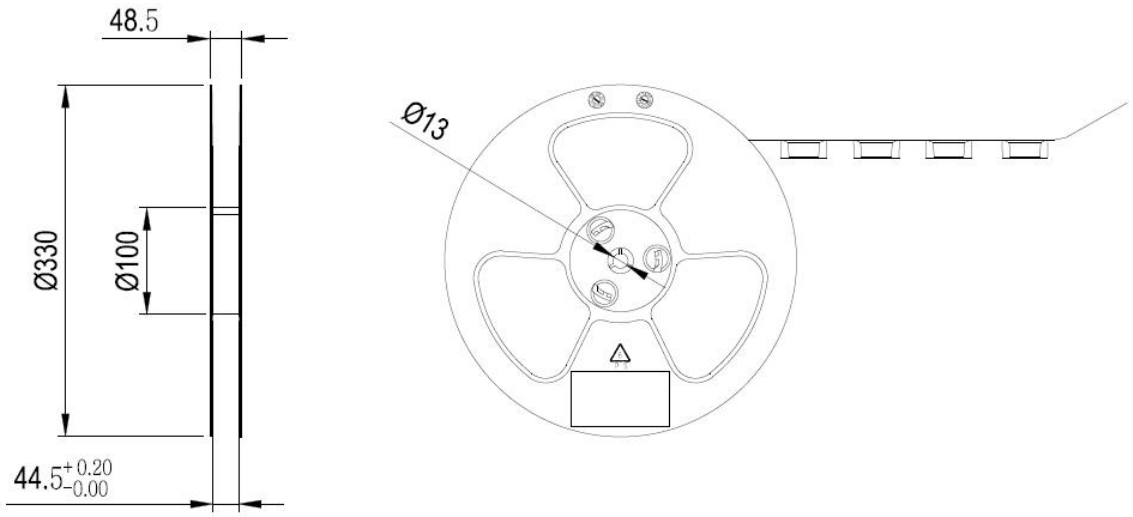



**Figure 38: Reel Specifications**

**Table 49: Packaging Specifications**

| MOQ for MP | Minimum Package: 500 | Minimum Package x 4 = 2000 pcs |
|---|---|---|
| 500 pieces | Size: 370 mm × 350 mm × 56 mm<br>N.W: TBD kg<br>G.W: TBD kg | Size: 380 mm × 250 mm × 365 mm<br>N.W: TBD kg<br>G.W: TBD kg |

# 10 Appendix References

**Table 50: Related Documents**

| Document Name |
|---|
| [1] Quectel_UMTS&LTE_EVB_User_Guide |
| [2] Quectel_BG770A-GL&BG95xA-GL_QCFG_AT_Commands_Manual |
| [3] Quectel_BG770A-GL&BG95xA-GL_AT_Commands_Manual |
| [4] Quectel_BG770A-GL&BG95xA-GL_GNSS_Application_Note |
| [5] Quectel_RF_Layout_Application_Note |
| [6] Quectel_Module_Secondary_SMT_Application_Note |

**Table 51: Terms and Abbreviations**

| Abbreviation | Description |
|---|---|
| ADC | Analog to Digital Converter |
| Balun | Balanced to Unbalanced |
| bps | Bits Per Second |
| CHAP | Challenge Handshake Authentication Protocol |
| CTS | Clear to Send |
| DFOTA | Delta Firmware Upgrade Over the Air |
| DL | Downlink |
| DRX | Discontinuous Reception |
| EGSM | Extended GSM (Global System for Mobile Communications) |
| e-I-DRX | Extended Idle Mode Discontinuous Reception |

| | |
|---|---|
| EPC | Evolved Packet Core |
| ESD | Electrostatic Discharge |
| FDD | Frequency Division Duplex |
| HSS | Home Subscriber Server |
| I/O | Input/Output |
| Inom | Nominal Current |
| LNA | Low Noise Amplifier |
| LPF | Low Pass Filter |
| LTE | Long Term Evolution |
| MO | Mobile Originated |
| MT | Mobile Terminated |
| PA | Power Amplifier |
| PAP | Password Authentication Protocol |
| PCB | Printed Circuit Board |
| PDU | Protocol Data Unit |
| PPP | Point-to-Point Protocol |
| PSM | Power Saving Mode |
| RF | Radio Frequency |
| RFIC | Radio Frequency Integrated Circuit |
| RHCP | Right Hand Circularly Polarized |
| RTS | Request to Send |
| SAW | Surface Acoustic Wave |
| SMS | Short Message Service |
| Tx | Transmit |
| UL | Uplink |

| | |
|---|---|
| UE | User Equipment |
| URC | Unsolicited Result Code |
| (U)SIM | (Universal) Subscriber Identity Module |
| Vmax | Maximum Voltage |
| Vnom | Nominal Voltage |
| Vmin | Minimum Voltage |
| $V_{IH}$max | Maximum High-level Input Voltage |
| $V_{IH}$min | Minimum High-level Input Voltage |
| $V_{IL}$max | Maximum Low-level Input Voltage |
| $V_{IL}$min | Minimum Low-level Input Voltage |
| $V_{I}$max | Absolute Maximum Input Voltage |
| $V_{I}$min | Absolute Minimum Input Voltage |
| $V_{OH}$max | Maximum High-level Output Voltage |
| $V_{OH}$min | Minimum High-level Output Voltage |
| $V_{OL}$max | Maximum Low-level Output Voltage |
| $V_{OL}$min | Minimum Low-level Output Voltage |
| VoLTE | Voice over LTE. |
| VSWR | Voltage Standing Wave Ratio |

**CE Statement**

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

Hereby, We, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type BG95-M5 is in compliance with the Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address:

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai

200233, China

https://www.quectel.com/support/downloadb/TechnicalDocuments.htm

The device operates with the following frequency bands and transmitting power:

**FCC Certification Requirements.**

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

And the following conditions must be met:

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time-averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.

2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.

3.A label with the following statements must be attached to the host end product: This device contains FCC ID: XMR2021BG950AGL.

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

- GSM850 :≤8.571dBi
- GSM1900 :≤10.03dBi
- Catm LTE Band2/25:≤11.000dBi
- Catm LTE Band4/66:≤8.000dBi

- ❒ Catm LTE Band5/26:≤12.541dBi
- ❒ Catm LTE Band12:≤11.798dBi
- ❒ Catm LTE Band13:≤12.214dBi
- ❒ Catm LTE Band85:≤11.798dBi
- ❒ NB LTE Band2/25:≤11.000dBi
- ❒ NB LTE Band4/66:≤8.000dBi
- ❒ NB LTE Band5:≤12.541 dBi
- ❒ NB LTE Band12:≤11.798dBi
- ❒ NB LTE Band13:≤12.214dBi
- ❒ NB LTE Band71:≤11.687dBi
- ❒NB LTE Band85:≤11.798 dBi

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

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

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

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

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

A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labeled with an FCC ID - Section 2.926 (see 2.2 Certification (labeling requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labeling requirements, options and OEM user manual instructions that are required (see next paragraph).

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible;

then an additional permanent label referring to the enclosed module:“Contains Transmitter Module FCC ID: XMR2021BG950AGL” or “Contains FCC ID: XMR2021BG950AGL” must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

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

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

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

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

## IC Statement

IRSS-GEN

"This device complies with Industry Canada’s licence-exempt RSSs. Operation is subject to the following two conditions: (1) This device may not cause interference; and (2) This device must accept any interference, including interference that may cause undesired operation of the device." or "Le présent appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes :

1) l’appareil ne doit pas produire de brouillage; 2) l’utilisateur de l’appareil doit accepter tout brouillage

radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Déclaration sur l'exposition aux rayonnements RF

The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.

L'autre utilisé pour l'émetteur doit être installé pour fournir une distance de séparation d'au moins 20 cm de toutes les personnes et ne doit pas être colocalisé ou fonctionner conjointement avec une autre antenne ou un autre émetteur.

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

❒ GSM850 :≤8.571dBi

❒ GSM1900 :≤10.03dBi

❒ Catm LTE Band2/25:≤11.000dBi

❒ Catm LTE Band4/66:≤8.000dBi

❒ Catm LTE Band5/26:≤12.541dBi

❒ Catm LTE Band12:≤11.798dBi

❒ Catm LTE Band13:≤12.214dBi

❒ Catm LTE Band85:≤11.798dBi

❒ NB LTE Band2/25:≤11.000dBi

❒ NB LTE Band4/66:≤8.000dBi

❒ NB LTE Band5:≤12.541 dBi

❒ NB LTE Band12:≤11.798dBi

❒ NB LTE Band13:≤12.214dBi

❒ NB LTE Band71:≤11.687dBi

❒NB LTE Band85:≤11.798 dBi

The host product shall be properly labelled to identify the modules within the host product.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word “Contains” or similar wording expressing the same meaning, as follows:

“Contains IC: 10224A-2021BG950A” or “where: 10224A-2021BG950A is the module’s certification number”.

Le produit hôte doit être correctement étiqueté pour identifier les modules dans le produit hôte.

L'étiquette de certification d'Innovation, Sciences et Développement économique Canada d'un module doit être clairement visible en tout temps lorsqu'il est installédans le produit hôte; sinon, le produit hôte doit porter une étiquette indiquant le numéro de certification d'Innovation, Sciences et Développement économique Canada pour le module, précédé du mot «Contient» ou d'un libellé semblable exprimant la même signification, comme suit:"Contient IC: 10224A-2020BG95M5 " ou "où: 10224A-2020BG95M5 est le numéro de certification du module.