FRAMERY

User Manual

Module

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GENERAL NOTES

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Table Index

Figure Index

1 Introduction

This document defines EG21-G module and describes its air interfaces and hardware interfaces which are connected with Framery applications.

This document can help quickly understand module interface specifications, electrical and mechanical details as well as other related information of EG21-G module. To facilitate its application in different fields, relevant design. Associated with application note and user guide, Framery can use the module to design and set up mobile applications easily.

1.1. Safety Information

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 EG21-G module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel and incorporate these guidelines into all manuals supplied with the product. If not so, Framery assumes no liability for customers' failure to comply with these precautions.

	Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. 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 the device offers an Airplane Mode, then it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on boarding the 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 signals and cellular network cannot be guaranteed to connect in all possible conditions (for example, with unpaid bills or with an invalid (U)SIM card). When emergent help is needed in such conditions, please remember using emergency call. 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.
	The cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.
	In locations with potentially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potentially explosive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders, etc.

1.2 FCC and IC Compliance information

Certification Requirements.
According to the definition of mobile and fixed device is described in FCC Part 2.1093, this device is a portable device. The following conditions must be met:
1. This Modular Approval is limited to OEM installation for portable 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 Requirements of 2.1093.
2. The EUT is a portable device and may 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: 2AX4J201906EG21G

4.To comply with FCC and IC regulations limiting both maximum RF output power and human exposure general public use body exposure limits the integration should be such the end user body is prevented from approaching the unit closer than 10 mm and following RF radiation,maximum antenna gain (including cable loss) must not exceed:

Operating Band	FCC Max Antenna Gain （dBi）	IC Max Antenna Gain （dBi）
GSM850	8.60	7.44
GSM1900	10.19	10.19
WCDMA BAND II	8.00	8.00
WCDMA BAND IV	5.00	5.00
WCDMA BAND V	9.42	8.26
LTE BAND 2	8.00	8.00
LTE BAND 4	5.00	5.00
LTE BAND 5	9.41	8.25
LTE BAND 7	8.00	8.00
LTE BAND 12	8.70	7.76
LTE BAND 13	9.16	8.09
LTE BAND 25	8.00	8.00
LTE BAND 26(814-824)	9.36	NA
LTE BAND 26(824-849)	9.41	8.25
LTE BAND 38	8.00	8.00
LTE BAND 41	8.00	8.00

5. 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 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093

If this device is used for other equipment a 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: 2AX4J201906EG21G" or "Contains FCC ID: 2AX4J201906EG21G" 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 followingtwo conditions: (1) This device may not cause interference; and (2) This device must accept anyinterference, including interference that may cause undesired operation of the device." Or
"Le present 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."

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: 26702-201903EG25G” or “where: 26702-201903EG25G 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: 26702-201903EG25G " ou "où: 26702-201903EG25G est le numéro de certification du module".

2 Product Concept

2.1. General Description

EG21-G is an LTE-FDD/LTE-TDD/UMTS/GSM wireless communication module with receive diversity. It provides data connectivity on LTE-FDD, LTE-TDD, DC-HSDPA, HSPA+, HSDPA, HSUPA, UMTS, EDGE and GPRS networks. The following table shows the frequency bands of EG21-G module.

Table 1 Frequency Bands of EG21-G

Network Mode/GNSS	EG21-G
LTE-FDD (with receive diversity)	B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28
LTE-TDD (with receive diversity)	B38/B39/B40/B41
UMTS (with receive diversity)	B1/B2/B4/B5/B6/B8/B19
GSM	850/900/1800/1900MHz

With a compact profile of 29.0mm × 32.0mm × 2.4mm, EG21-G can meet almost all requirements for M2M applications such as automotive, metering, tracking system, security, router, wireless POS, mobile computing device, PDA phone, tablet PC, etc.

EG21-G is an SMD type module which can be embedded into applications through its 144-pin LAG pads.

2.2. Key Features

The following table describes the detailed features of EG21-G module.

Table 2 Key Features of EG21-G

Feature	Details
Power Supply	Supply voltage: 3.3V~4.3V Typical supply voltage: 3.8V
Transmitting Power	Class 4 (33dBm±2dB) for GSM850 Class 4 (33dBm±2dB) for EGSM900 Class 1 (30dBm±2dB) for DCS1800 Class 1 (30dBm±2dB) for PCS1900 Class E2 (27dBm±3dB) for GSM850 8-PSK Class E2 (27dBm±3dB) for EGSM900 8-PSK Class E2 (26dBm±3dB) for DCS1800 8-PSK Class E2 (26dBm±3dB) for PCS1900 8-PSK Class 3 (24dBm+1/-3dB) for WCDMA bands Class 3 (23dBm±2dB) for LTE FDD bands Class 3 (23dBm±2dB) for LTE TDD bands
LTE Features	Support up to non-CA Cat 1 FDD and TDD Support 1.4MHz~20MHz RF bandwidth Support MIMO in DL direction LTE-FDD: Max 10Mbps (DL), Max 5Mbps (UL) LTE-TDD: Max 8.96Mbps (DL), Max 3.1Mbps (UL)
UMTS Features	Support 3GPP R8 DC-HSDPA, HSPA+, HSDPA, HSUPA and WCDMA Support QPSK, 16-QAM and 64-QAM modulation DC-HSDPA: Max 7.2Mbps (DL) HSUPA: Max 5.76Mbps (UL) WCDMA: Max 384Kbps (DL), Max 384Kbps (UL)
GSM Features	**GPRS:** Support GPRS multi-slot class 33 (33 by default) Coding scheme: CS-1, CS-2, CS-3 and CS-4 Max 107Kbps (DL), Max 85.6Kbps (UL) **EDGE:** Support EDGE multi-slot class 33 (33 by default) Support GMSK and 8-PSK for different MCS (Modulation and Coding Scheme) Downlink coding schemes: CS 1-4 and MCS 1-9 Uplink coding schemes: CS 1-4 and MCS 1-9 Max 296Kbps (DL), Max 236.8Kbps (UL)

Internet Protocol Features	Support TCP/UDP/PPP/FTP/HTTP/NTP/PING/QMI/NITZ/CMUX*/HTTPS*/ SMTP/MMS*/FTPS*/SMTPS*/SSL*/FILE* protocols Support PAP (Password Authentication Protocol) and CHAP (Challenge Handshake Authentication Protocol) protocols which are usually used for PPP connections
SMS	Text and PDU mode Point to point MO and MT SMS cell broadcast SMS storage: ME by default
(U)SIM Interface	Support USIM/SIM card: 1.8V, 3.0V
Audio Features	Support one digital audio interface: PCM interface GSM: HR/FR/EFR/AMR/AMR-WB WCDMA: AMR/AMR-WB LTE: AMR/AMR-WB Support echo cancellation and noise suppression
PCM Interface	Used for audio function with external codec Support 16-bit linear data format Support long frame synchronization and short frame synchronization Support master and slave modes, but must be the master in long frame synchronization
USB Interface	Compliant with USB 2.0 specification (slave only); the data transfer rate can reach up to 480Mbps Used for AT command communication, data transmission, GNSS NMEA output, software debugging, firmware upgrade and voice over USB* Support USB serial drivers for: Windows 7/8/8.1/10, Windows CE 5.0/6.0/7.0*, Linux 2.6/3.x/4.1~4.14, Android 4.x/5.x/6.x/7.x/8.x, etc.
UART Interfaces	**Main UART:** Used for AT command communication and data transmission Baud rates reach up to 921600bps, 115200bps by default Support RTS and CTS hardware flow control **Debug UART:** Used for Linux console and log output 115200bps baud rate
SD Card Interface	Support SD 3.0 protocol
Rx-diversity	Support LTE/WCDMA Rx-diversity
GNSS Features	Gen8C Lite of Qualcomm Protocol: NMEA 0183
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and Quectel enhanced AT commands
Network Indication	Two pins including NET_MODE and NET_STATUS to indicate network connectivity status

Antenna Interfaces	Including main antenna interface (ANT_MAIN), Rx-diversity antenna interface (ANT_DIV) and GNSS antenna interface (ANT_GNSS)
Physical Characteristics	Size: (29.0±0.15) mm × (32.0±0.15)mm × (2.4±0.2)mm Weight: approx. 4.9g
Temperature Range	Operation temperature range: -35°C ~ +75°C [1)] Extended temperature range: -40°C ~ +85°C [2)] Storage temperature range: -40°C ~ +90°C
Firmware Upgrade	USB interface or DFOTA*
RoHS	All hardware components are fully compliant with EU RoHS directive.

NOTES

1. [1)] Within operation temperature range, the module is 3GPP compliant.
2. [2)] Within extended temperature range, the module remains the ability to establish and maintain a voice, SMS, data transmission, emergency call, etc. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like P_{out} might reduce in their value and exceed the specified tolerances. When the temperature returns to normal operation temperature levels, the module will meet 3GPP specifications again.
3. "*" means under development.

2.3. Functional Diagram

The following figure shows a block diagram of EG21-G and illustrates the major functional parts.

- Power management
- Baseband
- DDR+NAND flash
- Radio frequency
- Peripheral interfaces

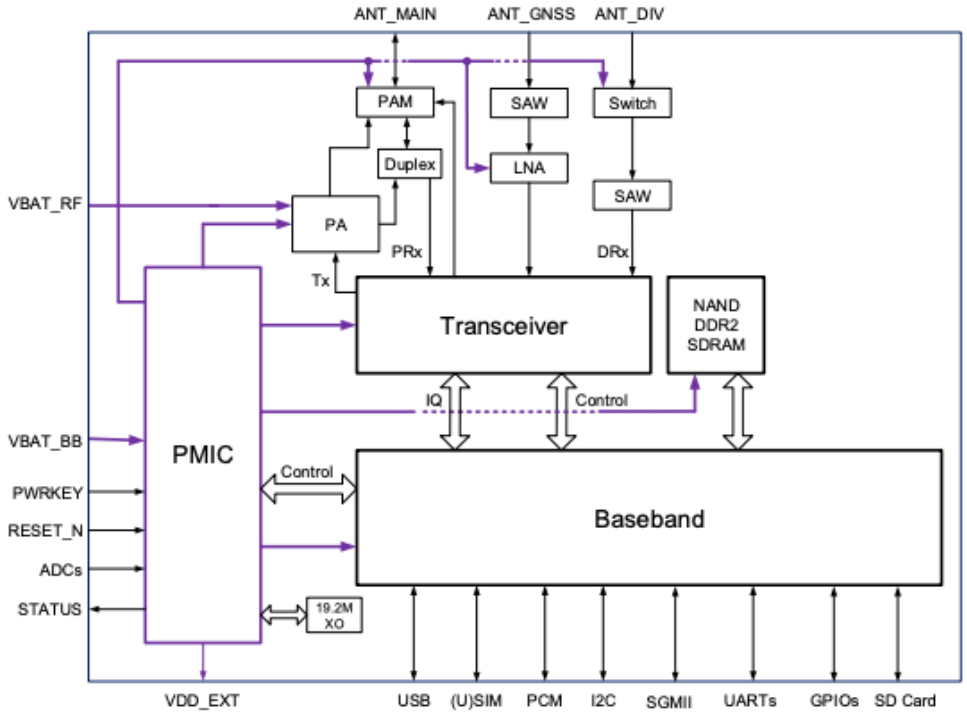

Figure 1 Functional Diagram

3 Application Interfaces

3.1. General Description

EG21-G is equipped with 144 LGA pads that can be connected to cellular application platform. Sub-interfaces included in these pads are described in detail in the following chapters:

- Power supply
- (U)SIM interface
- USB interface
- UART interfaces
- PCM and I2C interfaces
- SD card interface
- ADC interfaces
- Status indication
- USB_BOOT interface

3.2. Pin Assignment

The following figure shows the pin assignment of EG21-G module.

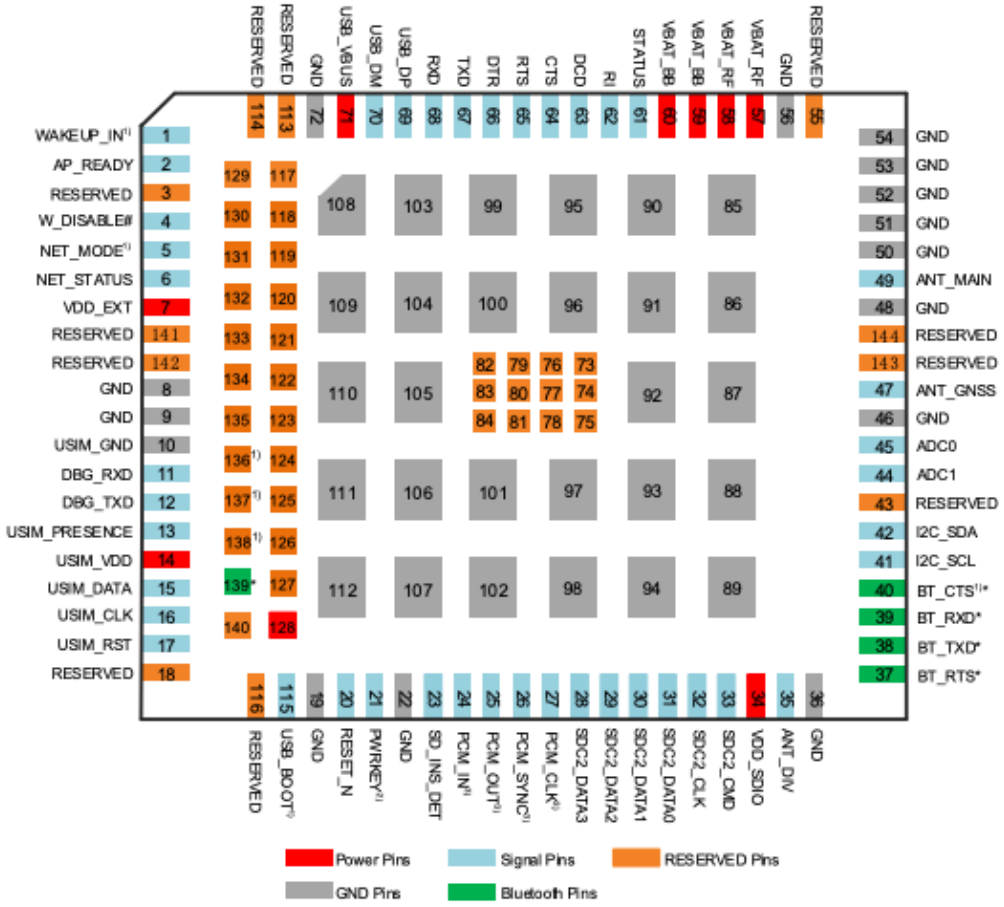

Figure 2 Pin Assignment (Top View)

3.3. Pin Description

The following tables show the pin definition of EG21-G.

Table 3 I/O Parameters Definition

Type	Description
AI	Analog input
AO	Analog output
DI	Digital input
DO	Digital output
IO	Bidirectional
OD	Open drain
PI	Power input
PO	Power output

Table 4 Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VBAT_BB	59, 60	PI	Power supply for module's baseband part	Vmax=4.3V Vmin=3.3V Vnorm=3.8V	It must be able to provide sufficient current up to 0.8A.
VBAT_RF	57, 58	PI	Power supply for module's RF part	Vmax=4.3V Vmin=3.3V Vnorm=3.8V	It must be able to provide sufficient current up to 1.8A in a burst transmission.
VDD_EXT	7	PO	Provide 1.8V for external circuit	Vnorm=1.8V Iomax=50mA	Power supply for external GPIO's pull up circuits. If unused, keep it open.
GND	8, 9, 19, 22, 36, 46, 48, 50~54, 56, 72, 85~112		Ground		

Turn on/off					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
PWRKEY	21	DI	Turn on/off the module	V_{IH}max=2.1V V_{IH}min=1.3V V_{IL}max=0.5V	The output voltage is 0.8V because of the diode drop in the Qualcomm chipset.
RESET_N	20	DI	Reset the module	V_{IH}max=2.1V V_{IH}min=1.3V V_{IL}max=0.5V	If unused, keep it open.
Status Indication					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
STATUS	61	OD	Indicate the module operating status	The drive current should be less than 0.9mA.	An external pull-up resistor is required. If unused, keep it open.
NET_MODE	5	DO	Indicate the module network registration mode	V_{OH}min=1.35V V_{OL}max=0.45V	1.8V power domain. Cannot be pulled up before startup. If unused, keep it open.
NET_ STATUS	6	DO	Indicate the module network activity status	V_{OH}min=1.35V V_{OL}max=0.45V	1.8V power domain. If unused, keep it open.
USB Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
USB_VBUS	71	PI	USB power supply, used for USB detection	Vmax=5.25V Vmin=3.0V Vnorm=5.0V	Typical: 5.0V If unused, keep it open.
USB_DP	69	IO	USB differential data bus (+)	Compliant with USB 2.0 standard specification.	Require differential impedance of 90Ω. If unused, keep it open.
USB_DM	70	IO	USB differential data bus (-)	Compliant with USB 2.0 standard specification.	Require differential impedance of 90Ω. If unused, keep it open.
(U)SIM Interface					

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
USIM_GND	10		Specified ground for (U)SIM card		Connect (U)SIM card connector GND.
USIM_VDD	14	PO	Power supply for (U)SIM card	For 1.8V (U)SIM: Vmax=1.9V Vmin=1.7V For 3.0V (U)SIM: Vmax=3.05V Vmin=2.7V $I_O$max=50mA	Either 1.8V or 3.0V is supported by the module automatically.
USIM_DATA	15	IO	Data signal of (U)SIM card	For 1.8V (U)SIM: V_{IL}max=0.6V V_{IH}min=1.2V V_{OL}max=0.45V V_{OH}min=1.35V For 3.0V (U)SIM: V_{IL}max=1.0V V_{IH}min=1.95V V_{OL}max=0.45V V_{OH}min=2.55V	
USIM_CLK	16	DO	Clock signal of (U)SIM card	For 1.8V (U)SIM: V_{OL}max=0.45V V_{OH}min=1.35V For 3.0V (U)SIM: V_{OL}max=0.45V V_{OH}min=2.55V	
USIM_RST	17	DO	Reset signal of (U)SIM card	For 1.8V (U)SIM: V_{OL}max=0.45V V_{OH}min=1.35V For 3.0V (U)SIM: V_{OL}max=0.45V V_{OH}min=2.55V	
USIM_ PRESENCE	13	DI	(U)SIM card insertion detection	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
Main UART Interface					

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
RI	62	DO	Ring indicator	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
DCD	63	DO	Data carrier detection	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
CTS	64	DO	Clear to send	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
RTS	65	DI	Request to send	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
DTR	66	DI	Data terminal ready, sleep mode control	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. Pull-up by default. Low level wakes up the module. If unused, keep it open.
TXD	67	DO	Transmit data	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
RXD	68	DI	Receive data	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
Debug UART Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
DBG_TXD	12	DO	Transmit data	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
DBG_RXD	11	DI	Receive data	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
ADC Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
ADC0	45	AI	General purpose	Voltage range:	If unused, keep it

			analog to digital converter	0.3V to VBAT_BB	open.
ADC1	44	AI	General purpose analog to digital converter	Voltage range: 0.3V to VBAT_BB	If unused, keep it open.
PCM Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
PCM_IN	24	DI	PCM data input	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
PCM_OUT	25	DO	PCM data output	V_{OL}max=0.45V V_{OH}min=1.35V	
PCM_SYNC	26	IO	PCM data frame synchronization signal	V_{OL}max=0.45V V_{OH}min=1.35V V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. In master mode, it is an output signal. In slave mode, it is an input signal. If unused, keep it open.
PCM_CLK	27	IO	PCM clock	V_{OL}max=0.45V V_{OH}min=1.35V V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	
I2C Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
I2C_SCL	41	OD	I2C serial clock. Used for external codec.		An external pull-up resistor is required. 1.8V only. If unused, keep it open.
I2C_SDA	42	OD	I2C serial data. Used for external codec.		An external pull-up resistor is required. 1.8V only. If unused, keep it open.
SD Card Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
SDC2_ DATA3	28	IO	SD card SDIO bus DATA3	**1.8V signaling:** V_{OL}max=0.45V	SDIO signal level can be selected

				V_{OH}min=1.4V V_{IL}min=-0.3V V_{IL}max=0.58V V_{IH}min=1.27V V_{IH}max=2.0V **3.0V signaling:** V_{OL}max=0.38V V_{OH}min=2.01V V_{IL}min=-0.3V V_{IL}max=0.76V V_{IH}min=1.72V V_{IH}max=3.34V	according to SD card supported level, please refer to SD 3.0 protocol for more details. If unused, keep it open.
SDC2_ DATA2	29	IO	SD card SDIO bus DATA2	**1.8V signaling:** V_{OL}max=0.45V V_{OH}min=1.4V V_{IL}min=-0.3V V_{IL}max=0.58V V_{IH}min=1.27V V_{IH}max=2.0V **3.0V signaling:** V_{OL}max=0.38V V_{OH}min=2.01V V_{IL}min=-0.3V V_{IL}max=0.76V V_{IH}min=1.72V V_{IH}max=3.34V	SDIO signal level can be selected according to SD card supported level, please refer to SD 3.0 protocol for more details. If unused, keep it open.
SDC2_ DATA1	30	IO	SD card SDIO bus DATA1	**1.8V signaling:** V_{OL}max=0.45V V_{OH}min=1.4V V_{IL}min=-0.3V V_{IL}max=0.58V V_{IH}min=1.27V V_{IH}max=2.0V **3.0V signaling:** V_{OL}max=0.38V V_{OH}min=2.01V V_{IL}min=-0.3V V_{IL}max=0.76V V_{IH}min=1.72V V_{IH}max=3.34V	SDIO signal level can be selected according to SD card supported level, please refer to SD 3.0 protocol for more details. If unused, keep it open.

SDC2_DATA0	31	IO	SD card SDIO bus DATA0	**1.8V signaling:** V_{OL}max=0.45V V_{OH}min=1.4V V_{IL}min=-0.3V V_{IL}max=0.58V V_{IH}min=1.27V V_{IH}max=2.0V **3.0V signaling:** V_{OL}max=0.38V V_{OH}min=2.01V V_{IL}min=-0.3V V_{IL}max=0.76V V_{IH}min=1.72V V_{IH}max=3.34V	SDIO signal level can be selected according to SD card supported level, please refer to SD 3.0 protocol for more details. If unused, keep it open.
SDC2_CLK	32	DO	SD card SDIO bus clock	**1.8V signaling:** V_{OL}max=0.45V V_{OH}min=1.4V **3.0V signaling:** V_{OL}max=0.38V V_{OH}min=2.01V	SDIO signal level can be selected according to SD card supported level, please refer to SD 3.0 protocol for more details. If unused, keep it open.
SDC2_CMD	33	IO	SD card SDIO bus command	**1.8V signaling:** V_{OL}max=0.45V V_{OH}min=1.4V V_{IL}min=-0.3V V_{IL}max=0.58V V_{IH}min=1.27V V_{IH}max=2.0V **3.0V signaling:** V_{OL}max=0.38V V_{OH}min=2.01V V_{IL}min=-0.3V V_{IL}max=0.76V V_{IH}min=1.72V V_{IH}max=3.34V	SDIO signal level can be selected according to SD card supported level, please refer to SD 3.0 protocol for more details. If unused, keep it open.
SD_INS_DET	23	DI	SD card insertion detect	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.

VDD_SDIO	34	PO	SD card SDIO bus pull-up power	$I_O$max=50mA	1.8V/2.85V configurable. Cannot be used for SD card power. If unused, keep it open.
BT UART Interface*					
BT_RTS*	37	DI	BT UART request to send	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
BT_TXD*	38	DO	BT UART transmit data	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
BT_RXD*	39	DI	BT UART receive data	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
BT_CTS*	40	DO	BT UART clear to send	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. Cannot be pulled up before startup. If unused, keep it open.
BT_EN*	139	DO	BT function control via FC20 module	V_{OL}max=0.45V V_{OH}min=1.35V	1.8V power domain. If unused, keep it open.
RF Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
ANT_DIV	35	AI	Diversity antenna	50Ω impedance	If unused, keep it open.
ANT_MAIN	49	IO	Main antenna	50Ω impedance	
ANT_GNSS	47	AI	GNSS antenna	50Ω impedance	If unused, keep it open.
GPIO Pins					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
WAKEUP_IN	1	DI	Sleep mode control	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. Cannot be pulled up before startup. Low level wakes up

					the module. If unused, keep it open.
W_DISABLE#	4	DI	Airplane mode control	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. Pull-up by default. In low voltage level, module can enter into airplane mode. If unused, keep it open.
AP_READY	2	DI	Application processor sleep state detection	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. If unused, keep it open.
USB_BOOT Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
USB_BOOT	115	DI	Force the module to enter into emergency download mode	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	1.8V power domain. Active high. It is recommended to reserve test point.
RESERVED Pins					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RESERVED	3, 18, 43, 55, 73~84, 113, 114, 116, 117, 118~138, 140~144		Reserved		Keep these pins unconnected.

3.4. Operating Modes

The table below briefly summarizes the various operating modes referred in the following chapters.

Table 5 Overview of Operating Modes

Mode	Details	
Normal Operation	Idle	Software is active. The module has registered on the network, and it is ready to send and receive data.
	Talk/Data	Network connection is ongoing. In this mode, the power consumption is decided by network setting and data transfer rate.
Minimum Functionality Mode	**AT+CFUN** command can set the module to a minimum functionality mode without removing the power supply. In this case, both RF function and (U)SIM card will be invalid.	
Sleep Mode	In this mode, the current consumption of the module will be reduced to the minimal level. During this mode, the module can still receive paging message, SMS, voice call and TCP/UDP data from the network normally.	
Power Down Mode	In this mode, the power management unit shuts down the power supply. Software is not active. The serial interface is not accessible. Operating voltage (connected to VBAT_RF and VBAT_BB) remains applied.	

3.5. Power Supply

3.5.1. Power Supply Pins

EG21-G provides four VBAT pins to connect with the external power supply, and there are two separate voltage domains for VBAT.

- Two VBAT_RF pins for module's RF part
- Two VBAT_BB pins for module's baseband part

The following table shows the details of VBAT pins and ground pins.

Table 6 VBAT and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VBAT_RF	57, 58	Power supply for module's RF part	3.3	3.8	4.3	V
VBAT_BB	59, 60	Power supply for module's baseband part	3.3	3.8	4.3	V
GND	8, 9, 19, 22, 36, 46, 48, 50~54, 56, 72, 85~112	Ground	-	0	-	V

3.5.2. Design for Power Supply

Power design for the module is very important, as the performance of the module largely depends on the power source. The power supply should be able to provide sufficient current up to 2A at least. If the voltage drop between the input and output is not too high, it is suggested that an LDO should be used to supply power for the module. If there is a big voltage difference between the input source and the desired output (VBAT), a buck converter is preferred to be used as the power supply.

The following figure shows a reference design for +5V input power source. The typical output of the power supply is about 3.8V and the maximum load current is 3A.

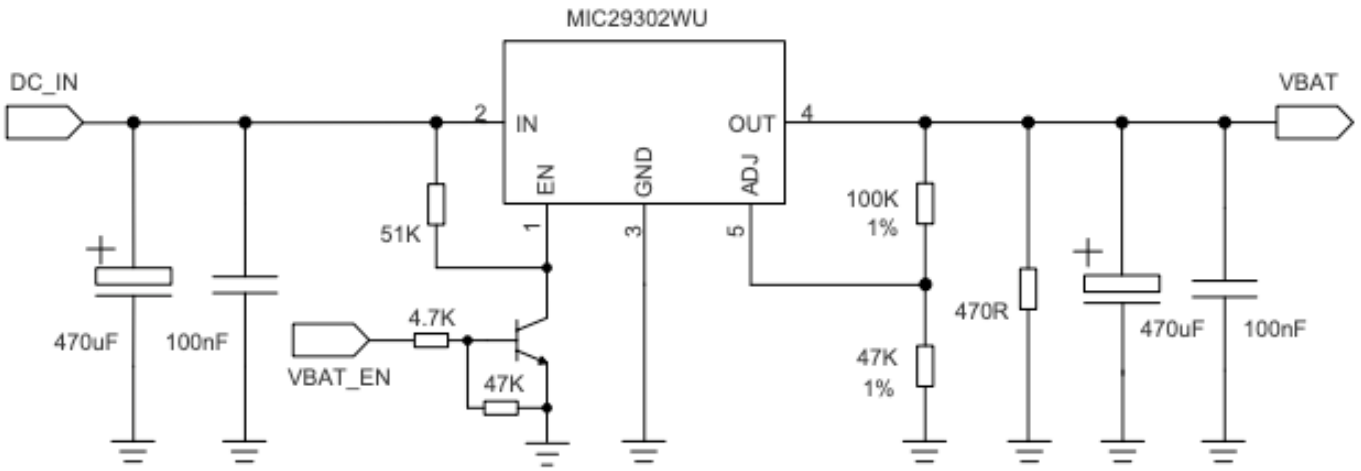

Figure 3 Circuit of Power Supply

3.6. Power-on and off Scenarios

3.6.1. Turn on Module Using the PWRKEY

The following table shows the pin definition of PWRKEY.

Table 7 Pin Definition of PWRKEY

Pin Name	Pin No.	I/O	Description	Comment
PWRKEY	21	DI	Turn on/off the module	The output voltage is 0.8V because of the diode drop in the Qualcomm chipset.

When EG21-G is in power-down mode, it can be turned on to normal mode by driving the PWRKEY pin to a low level for at least 500ms. It is recommended to use an open drain/collector driver to control the PWRKEY. After STATUS pin (require external pull-up) outputs a low level, PWRKEY pin can be released. A simple reference circuit is illustrated in the following figure.

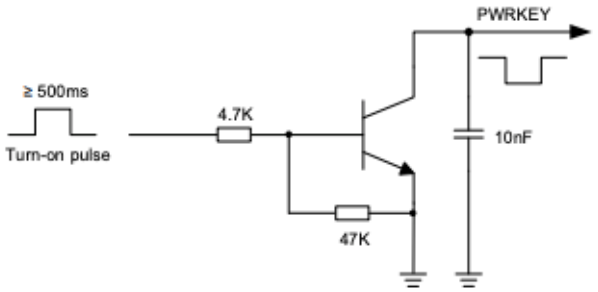

Figure 4 Turn on the Module by Using Driving Circuit

The other way to control the PWRKEY is using a button directly. When pressing the key, electrostatic strike may generate from finger. Therefore, a TVS component is indispensable to be placed nearby the button for ESD protection. A reference circuit is shown in the following figure.

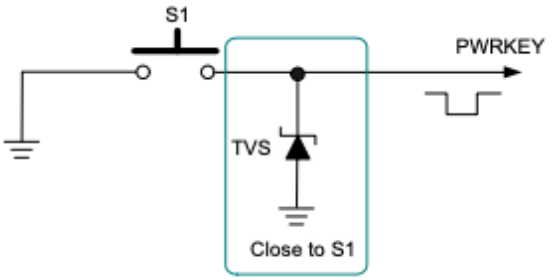

Figure 5 Turn on the Module by Using Keystroke

3.6.2. Turn off Module

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

- Normal power-down procedure: Turn off the module using the PWRKEY pin.
- Normal power-down procedure: Turn off the module using **AT+QPOWD** command.

3.7. Reset the Module

The RESET_N pin can be used to reset the module. The module can be reset by driving RESET_N to a low level voltage for time between 150ms and 460ms.

Table 8 RESET_N Pin Description

Pin Name	Pin No.	I/O	Description	Comment
RESET_N	20	DI	Reset the module	1.8V power domain

3.8. (U)SIM Interface

The (U)SIM interface circuitry meets ETSI and IMT-2000 requirements. Both 1.8V and 3.0V (U)SIM cards are supported.

Table 9 Pin Definition of (U)SIM Interface

Pin Name	Pin No.	I/O	Description	Comment
USIM_VDD	14	PO	Power supply for (U)SIM card	Either 1.8V or 3.0V is supported by the module automatically.
USIM_DATA	15	IO	Data signal of (U)SIM card	
USIM_CLK	16	DO	Clock signal of (U)SIM card	
USIM_RST	17	DO	Reset signal of (U)SIM card	
USIM_ PRESENCE	13	DI	(U)SIM card insertion detection	1.8V power domain. If unused, keep it open.

USIM_GND	10	Specified ground for (U)SIM card

EG21-G supports (U)SIM card hot-plug via the USIM_PRESENCE pin. The function supports low level and high level detections and is disabled by default.

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

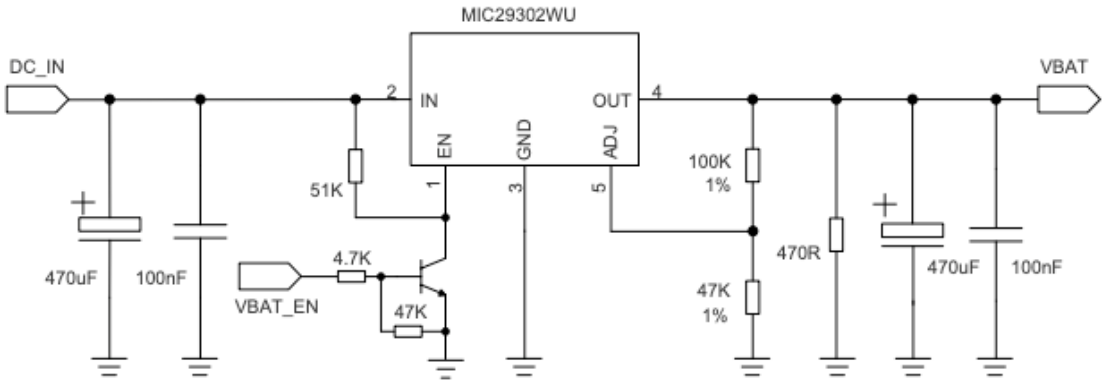

Figure 6 Reference Circuit of (U)SIM Interface with an 8-Pin (U)SIM Card Connector

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

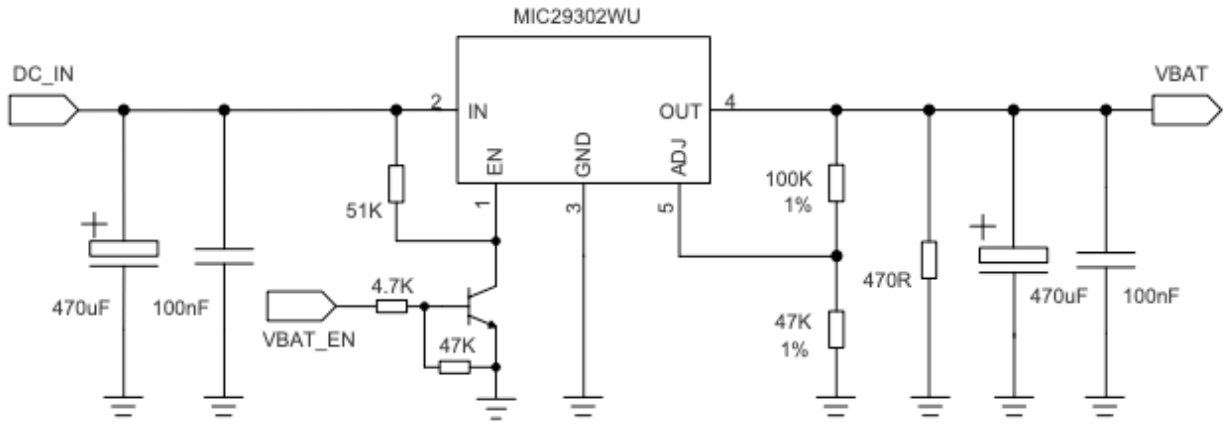

Figure 7 Reference Circuit of (U)SIM Interface with a 6-Pin (U)SIM Card Connector

3.9. USB Interface

EG21-G contains one integrated Universal Serial Bus (USB) interface which complies with the USB 2.0 specification and supports high-speed (480Mbps) and full-speed (12Mbps) modes. The USB interface is used for AT command communication, data transmission, software debugging, firmware upgrade and voice over USB*. The following table shows the pin definition of USB interface.

Table 10 Pin Description of USB Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_DP	69	IO	USB differential data bus (+)	Require differential impedance of 90Ω
USB_DM	70	IO	USB differential data bus (-)	Require differential impedance of 90Ω
USB_VBUS	71	PI	USB connection detection	Typical 5.0V
GND	72		Ground	

The USB interface is recommended to be reserved for firmware upgrade in customers' designs. The following figure shows a reference circuit of USB interface.

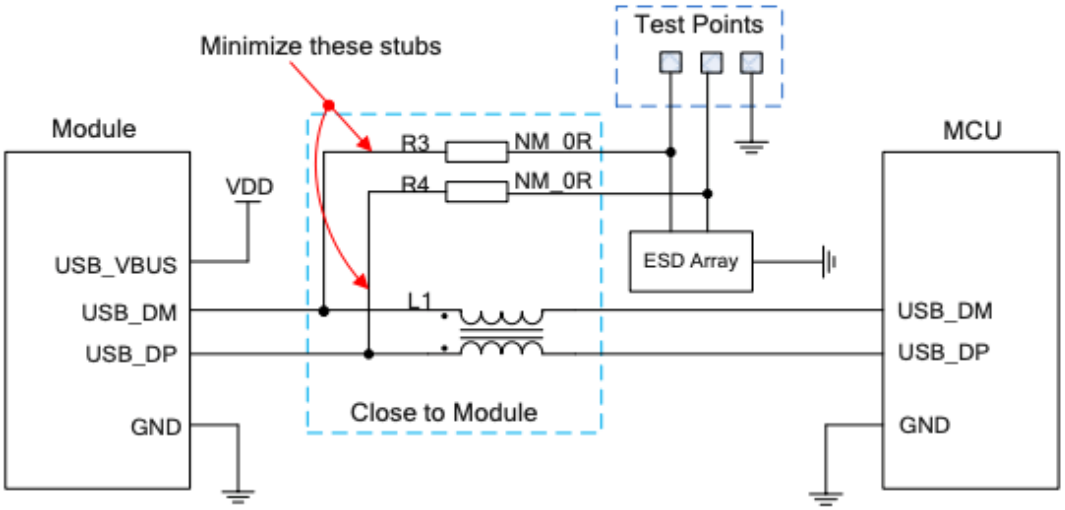

Figure 8 Reference Circuit of USB Application

A common mode choke L1 is recommended to be added in series between the module and customer's MCU in order to suppress EMI spurious transmission. Meanwhile, the 0Ω resistors (R3 and R4) should be added in series between the module and the test points so as to facilitate debugging, and the resistors are not mounted by default. In order to ensure the integrity of USB data line signal, L1/R3/R4 components must be placed close to the module, and also these resistors should be placed close to each other. The extra stubs of trace must be as short as possible.

The following principles should be complied with when design the USB interface, so as to meet USB 2.0 specification.

- It is important to route the USB signal traces as differential pairs with total grounding. The impedance of USB differential trace is 90Ω.
- Do not route signal traces under crystals, oscillators, magnetic devices and RF signal traces. It is important to route the USB differential traces in inner-layer with ground shielding on not only upper and lower layers but also right and left sides.
- Pay attention to the influence of junction capacitance of ESD protection components on USB data lines. Typically, the capacitance value should be less than 2pF.
- Keep the ESD protection components to the USB connector as close as possible.

3.10. UART Interfaces

The module provides two UART interfaces: the main UART interface and the debug UART interface. The following shows their features.

- The main UART interface supports 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, 230400bps, 460800bps and 921600bps baud rates, and the default is 115200bps. This interface is used for data transmission and AT command communication.
- The debug UART interface supports 115200bps baud rate. It is used for Linux console and log output.

The following tables show the pin definition of the UART interfaces.

Table 11 Pin Definition of Main UART Interface

Pin Name	Pin No.	I/O	Description	Comment
RI	62	DO	Ring indicator	1.8V power domain
DCD	63	DO	Data carrier detection	
CTS	64	DO	Clear to send	
RTS	65	DI	Request to send	
DTR	66	DI	Data terminal ready, sleep mode control	
TXD	67	DO	Transmit data	
RXD	68	DI	Receive data	

Table 12 Pin Definition of Debug UART Interface

Pin Name	Pin No.	I/O	Description	Comment
DBG_TXD	12	DO	Transmit data	1.8V power domain
DBG_RXD	11	DI	Receive data	

The logic levels are described in the following table.

Table 13 Logic Levels of Digital I/O

Parameter	Min.	Max.	Unit
V_{IL}	-0.3	0.6	V
V_{IH}	1.2	2.0	V
V_{OL}	0	0.45	V
V_{OH}	1.35	1.8	V

The module provides 1.8V UART interface. A level translator should be used if customers' application is equipped with a 3.3V UART interface. A level translator TXS0108EPWR provided by *Texas Instruments* is recommended. The following figure shows a reference design.

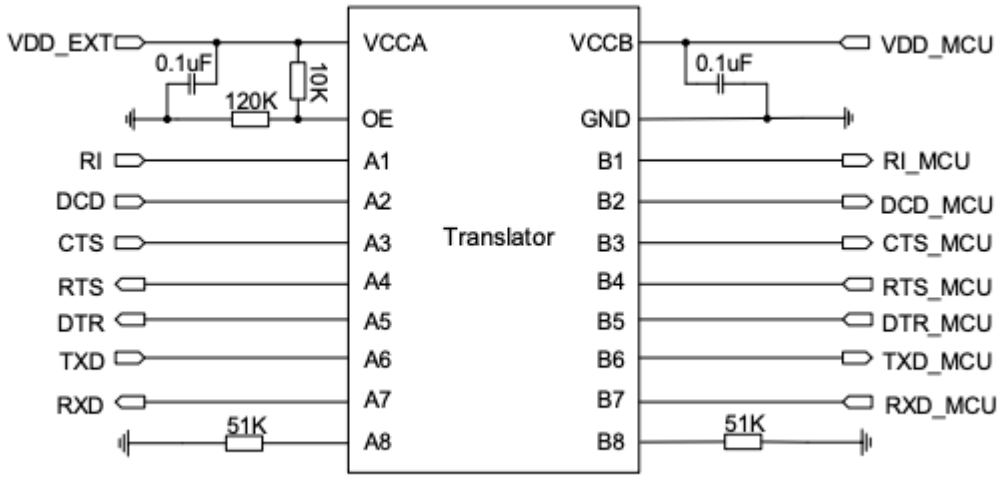

Figure 9 Reference Circuit with Translator Chip

3.11. PCM and I2C Interfaces

EG21-G provides one Pulse Code Modulation (PCM) digital interface for audio design, which supports the following modes and one I2C interface:

- Primary mode (short frame synchronization, works as both master and slave)
- Auxiliary mode (long frame synchronization, works as master only)

In primary mode, the data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge. The PCM_SYNC falling edge represents the MSB. In this mode, the PCM interface supports 256kHz,

512kHz, 1024kHz or 2048kHz PCM_CLK at 8kHz PCM_SYNC, and also supports 4096kHz PCM_CLK at 16kHz PCM_SYNC.

In auxiliary mode, the data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge. The PCM_SYNC rising edge represents the MSB. In this mode, the PCM interface operates with a 256kHz, 512kHz, 1024kHz or 2048kHz PCM_CLK and an 8kHz, 50% duty cycle PCM_SYNC.

EG21-G supports 16-bit linear data format. The following figures show the primary mode's timing relationship with 8KHz PCM_SYNC and 2048KHz PCM_CLK, as well as the auxiliary mode's timing relationship with 8KHz PCM_SYNC and 256KHz PCM_CLK

The following table shows the pin definition of PCM and I2C interfaces which can be applied on audio codec design.

Table 14 Pin Definition of PCM and I2C Interfaces

Pin Name	Pin No.	I/O	Description	Comment
PCM_IN	24	DI	PCM data input	1.8V power domain
PCM_OUT	25	DO	PCM data output	1.8V power domain
PCM_SYNC	26	IO	PCM data frame synchronization signal	1.8V power domain
PCM_CLK	27	IO	PCM data bit clock	1.8V power domain
I2C_SCL	41	OD	I2C serial clock	Require external pull-up to 1.8V
I2C_SDA	42	OD	I2C serial data	Require external pull-up to 1.8V

Clock and mode can be configured by AT command, and the default configuration is master mode using short frame synchronization format with 2048KHz PCM_CLK and 8KHz PCM_SYNC. Please refer to ***document [2]*** for more details about **AT+QDAI** command.

3.12. ADC Interfaces

The module provides two analog-to-digital converter (ADC) interfaces. **AT+QADC=0** command can be used to read the voltage value on ADC0 pin. **AT+QADC=1** command can be used to read the voltage value on ADC1 pin.

In order to improve the accuracy of ADC, the trace of ADC should be surrounded by ground.

Table 15 Pin Definition of ADC Interfaces

Pin Name	Pin No.	Description
ADC0	45	General purpose analog to digital converter
ADC1	44	General purpose analog to digital converter

The following table describes the characteristic of the ADC function.

Table 16 Characteristic of ADC

Parameter	Min.	Typ.	Max.	Unit
ADC0 Voltage Range	0.3		VBAT_BB	V
ADC1 Voltage Range	0.3		VBAT_BB	V
ADC Resolution		15		Bits

3.13. USB_BOOT Interface

EG21-G provides a USB_BOOT pin. Customers can pull up USB_BOOT to VDD_EXT before powering on the module, thus the module will enter into emergency download mode when powered on. In this mode, the module supports firmware upgrade over USB interface.

Table 17 Pin Definition of USB_BOOT Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_BOOT	115	DI	Force the module to enter into emergency download mode	1.8V power domain. Active high. It is recommended to reserve test point.

4 Antenna Interfaces

EG21-G antenna interfaces include a main antenna interface, an Rx-diversity antenna interface which is used to resist the fall of signals caused by high speed movement and multipath effect, and a GNSS antenna interface. The impedance of the antenna port is 50Ω.

4.1. Main/Rx-diversity Antenna Interfaces

4.1.1. Pin Definition

The pin definition of main antenna and Rx-diversity antenna interfaces is shown below.

Table 18 Pin Definition of the RF Antenna

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN	49	IO	Main antenna pad	50Ω impedance
ANT_DIV	35	AI	Receive diversity antenna pad	50Ω impedance. If unused, keep it open.

4.1.2. Operating Frequency

Table 19 Module Operating Frequencies

3GPP Band	Transmit	Receive	Unit
GSM850	824~849	869~894	MHz
EGSM900	880~915	925~960	MHz
DCS1800	1710~1785	1805~1880	MHz
PCS1900	1850~1910	1930~1990	MHz
WCDMA B1	1920~1980	2110~2170	MHz

WCDMA B2	1850~1910	1930~1990	MHz
WCDMA B4	1710~1755	2110~2155	MHz
WCDMA B5	824~849	869~894	MHz
WCDMA B6	830~840	875~885	MHz
WCDMA B8	880~915	925~960	MHz
WCDMA B19	830~845	875~890	MHz
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 B7	2500~2570	2620~2690	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 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 B28	703~748	758~803	MHz
LTE-TDD B38	2570~2620	2570~2620	MHz
LTE-TDD B39	1880~1920	1880~1920	MHz
LTE-TDD B40	2300~2400	2300~2400	MHz
LTE-TDD B41	2496~2690	2496~2690	MHz

4.1.3. Reference Design of RF Antenna Interface

A reference design of ANT_MAIN and ANT_DIV antenna pads is shown as below. A π-type matching circuit should be reserved for better RF performance. The capacitors are not mounted by default.

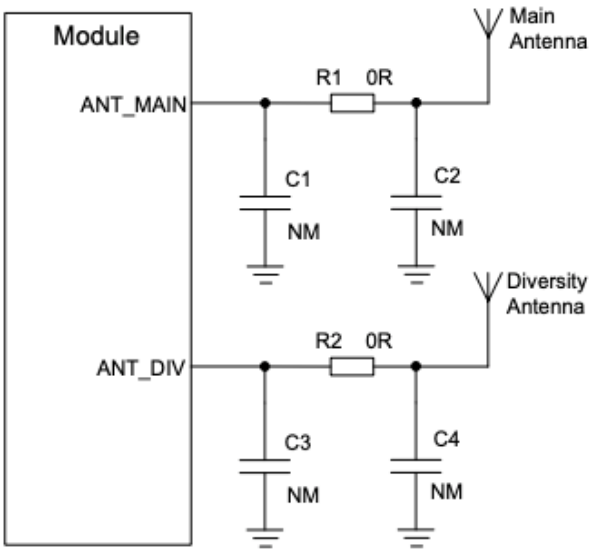

Figure 30: Reference Circuit of RF Antenna Interface

4.2. Antenna Installation

4.2.1. Antenna Requirement

The following table shows the requirements on main antenna and Rx-diversity antenna.

Table 20 Antenna Requirements

Type	Requirements
GSM/UMTS/LTE	VSWR: ≤2 Gain (dBi): 1 Max input power (W): 50 Input impedance (Ω): 50 Polarization type: Vertical Cable insertion loss: <1dB (GSM850, EGSM900, WCDMA B5/B6/B8/B19, LTE B5/B8/B12/B13/B18/B19/B20/B26/B28) Cable insertion loss: <1.5dB (DCS1800, PCS1900, WCDMA B1/B2/B4, LTE B1/B2/B3/B4/B25/B39) Cable insertion loss <2dB (LTE B7/B38/B40/B41)

5 Electrical, Reliability and Radio Characteristics

5.1. 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 21 Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT_RF/VBAT_BB	-0.3	4.7	V
USB_VBUS	-0.3	5.5	V
Peak Current of VBAT_BB	0	0.8	A
Peak Current of VBAT_RF	0	1.8	A
Voltage at Digital Pins	-0.3	2.3	V
Voltage at ADC0	0	VBAT_BB	V
Voltage at ADC1	0	VBAT_BB	V

5.2. Power Supply Ratings

Table 22 The Module Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VBAT	VBAT_BB and VBAT_RF	The actual input voltages must stay between the minimum and maximum values.	3.3	3.8	4.3	V
	Voltage drop during burst transmission	Maximum power control level on EGSM900.			400	mV
I_{VBAT}	Peak supply current (during transmission slot)	Maximum power control level on EGSM900.		1.8	2.0	A
USB_VBUS	USB detection		3.0	5.0	5.25	V

5.3. Operation and Storage Temperatures

The operation and storage temperatures are listed in the following table.

Table 23 Operation and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operation Temperature Range [1)]	-35	+25	+75	ºC
Extended Operation Range [2)]	-40		+85	ºC
Storage Temperature Range	-40		+90	ºC

5.4. RF Output Power

The following table shows the RF output power of EG21-G module.

Table 24 RF Output Power

Frequency	Max.	Min.
GSM850/EGSM900	33dBm±2dB	5dBm±5dB
DCS1800/PCS1900	30dBm±2dB	0dBm±5dB
DCS1800/PCS1900 (8-PSK)	26dBm±3dB	0dBm±5dB
GSM850/EGSM900	33dBm±2dB	5dBm±5dB
WCDMA B1/B2/B4/B5/B6/B8/B19	24dBm+1/-3dB	<-49dBm
LTE-FDD B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28	23dBm±2dB	<-39dBm
LTE-TDD B38/B39/B40/B41	23dBm±2dB	<-39dBm

5.5. RF Receiving Sensitivity

The following tables show conducted RF receiving sensitivity of EG21-G module.

Table 25 EG21-G Conducted RF Receiving Sensitivity

Frequency	Primary	Diversity	SIMO	3GPP (SIMO)
GSM900MHz	-108dBm	NA	NA	-102dBm
GSM850MHz	-108dBm	NA	NA	-102dBm
DCS1800MHz	-107.4dBm	NA	NA	-102dBm

PCS1900MHz	-107.5dBm	NA	NA	-102dBm
WCDMA B1	-108.2dBm	-108.5dBm	-109.2dBm	-106.7dBm
WCDMA B2	-109.5dBm	-109dBm	-110dBm	-104.7dBm
WCDMA B4	-109.5dBm	NA	NA	-106.7dBm
WCDMA B5	-109.2dBm	-109.5dBm	-110.4dBm	-104.7dBm
WCDMA B6	-109dBm	-109.5dBm	-110.5dBm	-106.7dBm
WCDMA B8	-109.5dBm	NA	NA	-103.7dBm
WCDMA B19	-109dBm	-109.5dBm	-110.1dBm	-106.7dBm
LTE-FDD B1 (10M)	-97.3dBm	-98.3dBm	-99.5dBm	-96.3dBm
LTE-FDD B2 (10M)	-98dBm	-99dBm	-99.9dBm	-94.3dBm
LTE-FDD B3 (10M)	-97.5dBm	-98.1dBm	-99.7dBm	-93.3dBm
LTE-FDD B4 (10M)	-97.8dBm	-98.2dBm	-99.7dBm	-96.3dBm
LTE-FDD B5 (10M)	-98dBm	-98.5dBm	-99.9dBm	-94.3dBm
LTE-FDD B7 (10M)	-97.3dBm	-97.6dBm	-99.2dBm	-94.3dBm
LTE-FDD B8 (10M)	-98dBm	-98dBm	-99.8dBm	-93.3dBm
LTE-FDD B12 (10M)	-98dBm	-98.3dBm	-99.8dBm	-93.3dBm
LTE-FDD B13 (10M)	-98dBm	-98dBm	-99.5dBm	-93.3dBm
LTE-FDD B18 (10M)	-98dBm	-99.4dBm	-100dBm	-96.3dBm
LTE-FDD B19 (10M)	-98dBm	-98.8dBm	-99.9dBm	-96.3dBm
LTE-FDD B20 (10M)	-98dBm	-98.8dBm	-99.8dBm	-93.3dBm
LTE-FDD B25 (10M)	-98dBm	-98.4dBm	-100dBm	-92.8dBm
LTE-FDD B26 (10M)	-98dBm	-98.3dBm	-99.5dBm	-93.8dBm
LTE-FDD B28 (10M)	-98.1dBm	-98.5dBm	-99.6dBm	-94.8dBm
LTE-TDD B38 (10M)	-97.5dBm	-97.5dBm	-99dBm	-96.3dBm
LTE-TDD B39 (10M)	-98dBm	-98.2dBm	-99.5dBm	-96.3dBm

LTE-TDD B40 (10M)	-97.8dBm	-97.5dBm	-99.2dBm	-96.3dBm
LTE-TDD B41 (10M)	-97.3dBm	-97.4dBm	-99dBm	-94.3dBm

5.6. Electrostatic Discharge

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.

The following table shows the module's electrostatic discharge characteristics.

Table 26 Electrostatics Discharge Characteristics (25ºC, 45% Relative Humidity)

Tested Points	Contact Discharge	Air Discharge	Unit
VBAT, GND	±10	±16	kV
All Antenna Interfaces	±10	±16	kV
Other Interfaces	±0.5	±1	kV

5.7. Thermal Consideration

In order to achieve better performance of the module, it is recommended to comply with the following principles for thermal consideration:

- On customers' PCB design, please keep placement of the module away from heating sources, especially high power components such as ARM processor, audio power amplifier, power supply, etc.
- Do not place components on the opposite side of the PCB area where the module is mounted, in order to facilitate adding of heatsink when necessary.
- Do not apply solder mask on the opposite side of the PCB area where the module is mounted, so as to ensure better heat dissipation performance.
- The reference ground of the area where the module is mounted should be complete and add ground vias as many as possible for better heat dissipation.
- Make sure the ground pads of the module and PCB are fully connected.
- According to customers' application demands, the heatsink can be mounted on the top of the module, or the opposite side of the PCB area where the module is mounted, or both of them.

- The heatsink should be designed with as many fins as possible to increase heat dissipation area. Meanwhile, a thermal pad with high thermal conductivity should be used between the heatsink and module/PCB.

6 Mechanical Dimensions

This chapter describes the mechanical dimensions of the module. All dimensions are measured in mm. The tolerances for dimensions without tolerance values are ±0.05mm.

6.1. Mechanical Dimensions of the Module

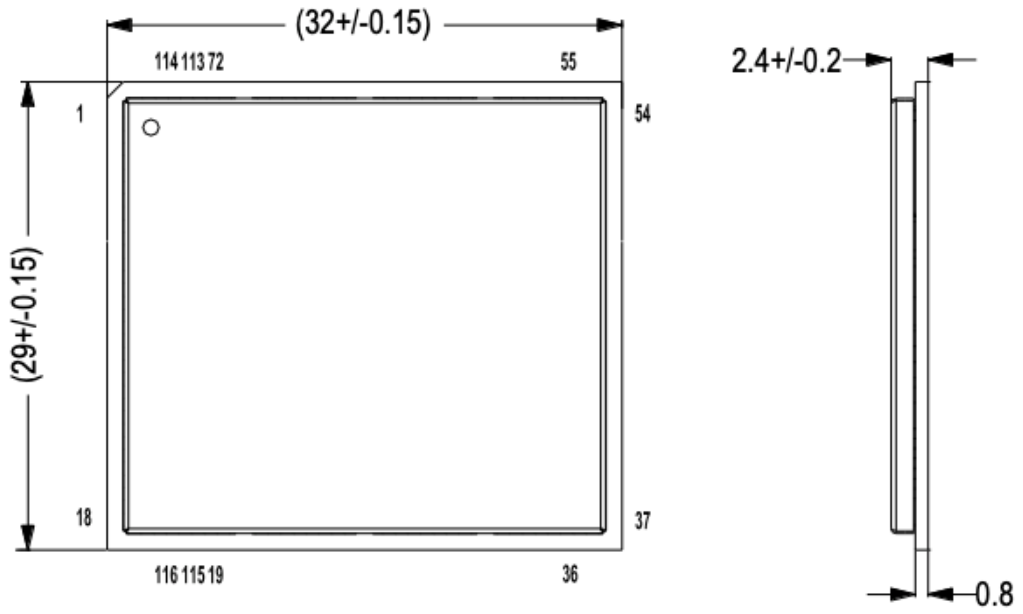

Figure 41: Module Top and Side Dimensions

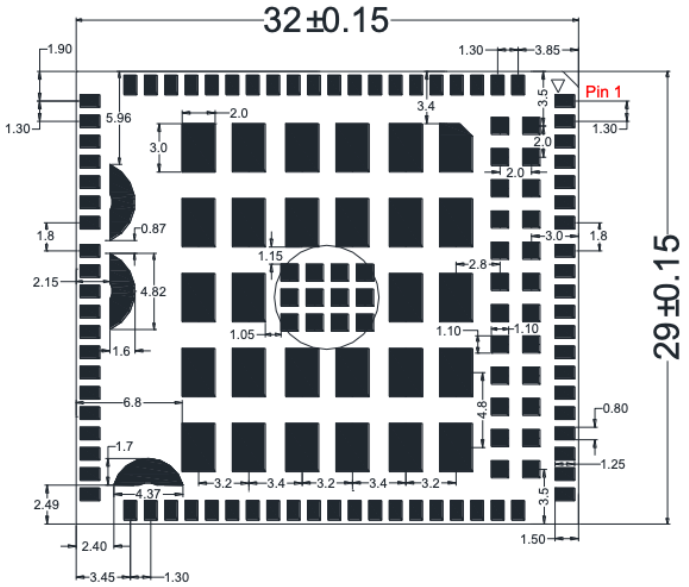

Figure 42: Module Bottom Dimensions (Bottom View

7.2. Recommended Footprint

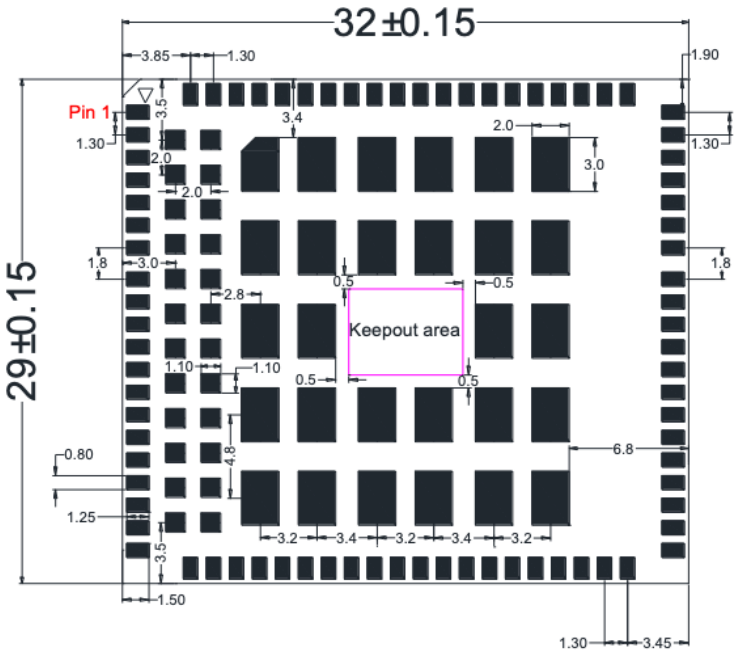

Figure 43: Recommended Footprint (Top View)

7.3. Design Effect Drawings of the Module

Figure 44: Top View of the Module

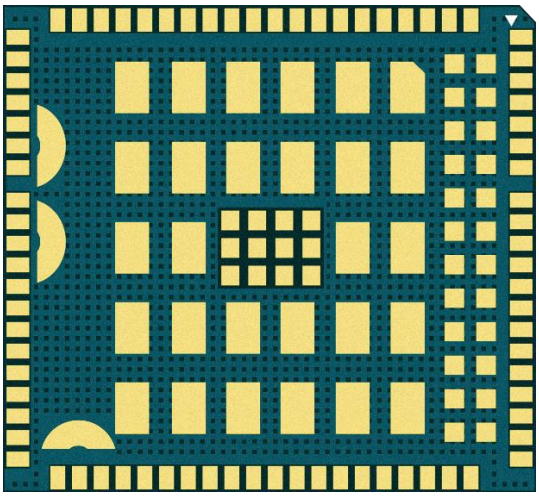

Figure 45: Bottom View of the Module

7 Storage, Manufacturing and Packaging

7.1. Storage

EG21-G is stored in a vacuum-sealed bag. It is rated at MSL 3, and its storage restrictions are listed below.

1. Shelf life in vacuum-sealed bag: 12 months at <40ºC/90%RH.

2. After the vacuum-sealed bag is opened, devices that will be subjected to reflow soldering or other high temperature processes must be:

    - Mounted within 168 hours at the factory environment of ≤30°C/60%RH.
    - Stored at <10% RH.

3. Devices require bake before mounting, if any circumstances below occurs:

    - When the ambient temperature is 23ºC±5ºC and the humidity indicator card shows the humidity is >10% before opening the vacuum-sealed bag.
    - Device mounting cannot be finished within 168 hours at factory conditions of ≤30°C/60%RH.

4. If baking is required, devices may be baked for 8 hours at 120ºC±5ºC.

7.2. 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. The force on the squeegee should be adjusted properly so as to produce a clean stencil surface on a single pass. To ensure the module soldering quality, the thickness of stencil for the module is recommended to be 0.13mm~0.15mm.

It is suggested that the peak reflow temperature is 240ºC ~245ºC, and the absolute maximum reflow temperature is 245ºC. To avoid damage to the module caused by repeated heating, it is strongly recommended that the module should be mounted 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.

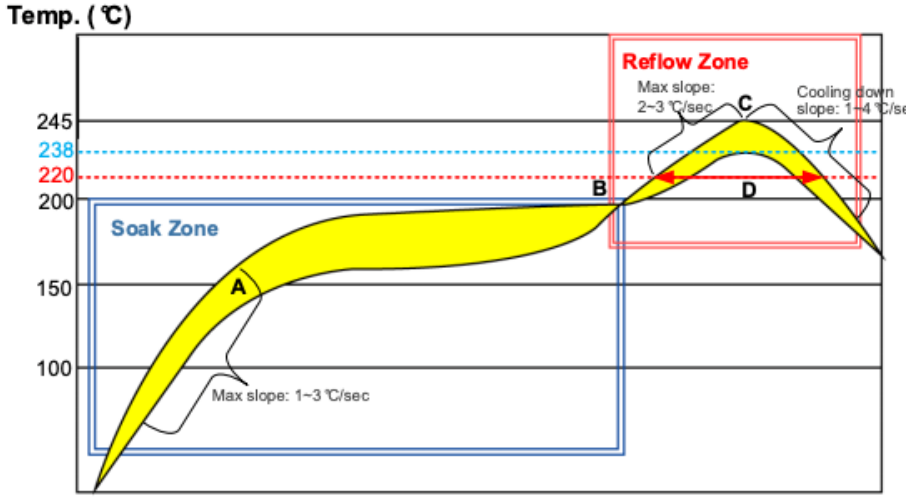

Figure 10 Reflow Soldering Thermal Profile

Table 27 Recommended Thermal Profile Parameters)

Factor	Recommendation
Soak Zone	
Max slope	1 to 3°C/sec
Soak time (between A and B: 150°C and 200°C)	60 to 120 sec
Reflow Zone	
Max slope	2 to 3°C/sec

Reflow time (D: over 220°C)	40 to 60 sec
Max temperature	240°C ~ 245°C
Cooling down slope	1 to 4°C/sec
Reflow Cycle	
Max reflow cycle	1

NOTES

During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.

The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the 2D barcode is still readable, although white rust may be found.

7.3. Packaging

EG21-G is packaged in tap and reel carriers. Each reel is 11.88m long and contains 250pcs modules. The figure below shows the package details, measured in mm.

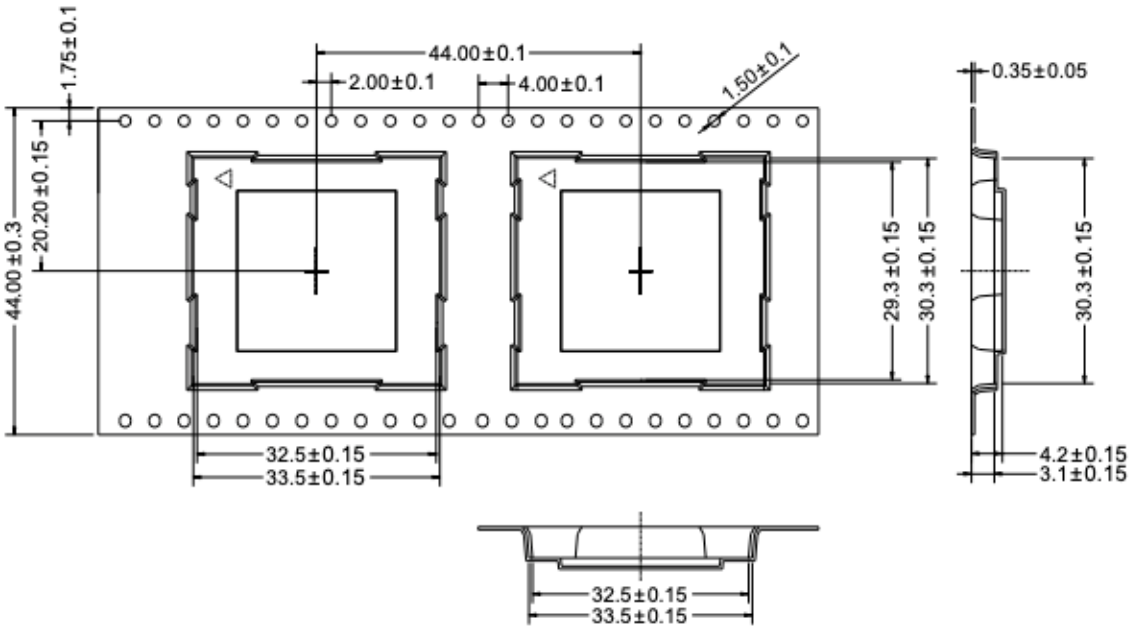

Figure 11 Tape Specifications

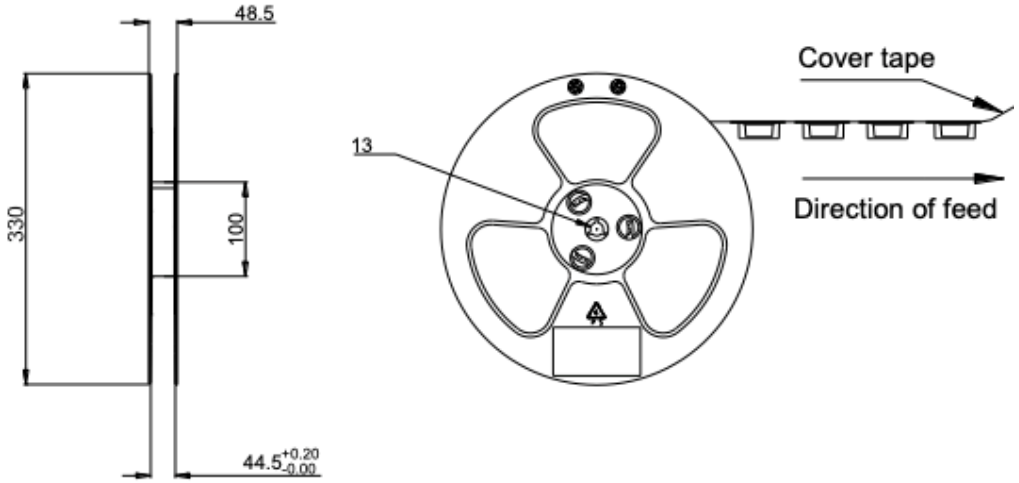

Figure 12 Tape and Reel Specifications

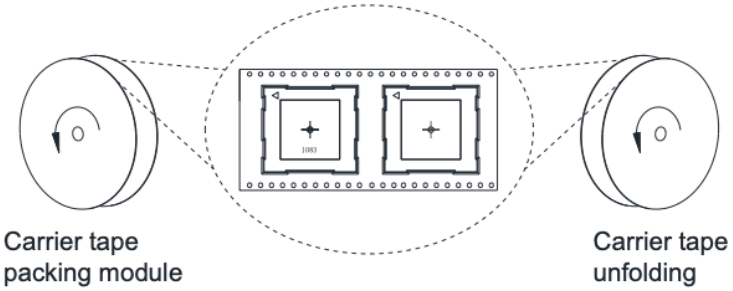

Figure 13 Tape and Reel Directions

8 Appendix A References

Table 28 Terms and Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CHAP	Challenge Handshake Authentication Protocol
CS	Coding Scheme

CSD	Circuit Switched Data
CTS	Clear To Send
DC-HSPA+	Dual-carrier High Speed Packet Access
DFOTA	Delta Firmware Upgrade Over The Air
DL	Downlink
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
ESD	Electrostatic Discharge
FDD	Frequency Division Duplex
FR	Full Rate
GSM	Global System for Mobile Communications
HR	Half Rate
HSPA	High Speed Packet Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
I/O	Input/Output
Inorm	Normal Current
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LTE	Long Term Evolution

MIMO	Multiple Input Multiple Output
MO	Mobile Originated
MS	Mobile Station (GSM engine)
MT	Mobile Terminated
PAP	Password Authentication Protocol
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PF	Paging Frame
PPP	Point-to-Point Protocol
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RHCP	Right Hand Circularly Polarized
Rx	Receive
SGMII	Serial Gigabit Media Independent Interface
SIM	Subscriber Identification Module
SIMO	Single Input Multiple Output
SMS	Short Message Service
TDD	Time Division Duplexing
TDMA	Time Division Multiple Access
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
TX	Transmitting Direction
UL	Uplink
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code

(U)SIM	(Universal) Subscriber Identity Module
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
V_{IH}max	Maximum Input High Level Voltage Value
V_{IH}min	Minimum Input High Level Voltage Value
V_{IL}max	Maximum Input Low Level Voltage Value
V_{IL}min	Minimum Input Low Level Voltage Value
V_{I}max	Absolute Maximum Input Voltage Value
V_{I}min	Absolute Minimum Input Voltage Value
V_{OH}max	Maximum Output High Level Voltage Value
V_{OH}min	Minimum Output High Level Voltage Value
V_{OL}max	Maximum Output Low Level Voltage Value
V_{OL}min	Minimum Output Low Level Voltage Value
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Network