Fibocom

Perfect Wireless Experience
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G610 Hardware User Manual

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V1.0.1	2014-04-25	Update product type
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Applicability Type

No.	Type	Note
1	G610-A20-00	Auto on
2	G610-A20-01	Non-auto off
3	G610-Q20-00	

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1 Introduction

1.1 Scope

This document describes the hardware application interfaces that are provided when FIBOCOM G610 GPRS module is used.

This document helps you to understand the interface specifications, electrical features and related product information of the G610 module.

1.2 Audience

This manual is intended for all members of the integration team who are responsible for integrating the G610 module into the host OEM device, including representatives from hardware, software and RF engineering disciplines.

1.3 Applicable Documents

- G610 Hardware Design Application Note
- AT Commands User Manual
- G610 SMT Application Note
- EVK-GT8629 User Manual

1.4 Standards

ETSI ETS 300 916 (GSM 07.07 version 5.9.1 Release 1996)

ETSI TS 100 585 (GSM 07.05 version 7.0.1 Release 1998)

ETSI ETS 300 901 (GSM 03.40 version 5.8.1 Release 1996)

ETSI TS 100 900 (GSM 03.38 version 7.2.0 Release 1998)

ETSI EN 300 607-1 (GSM 11.10-1 version 8.1.1 Release 1999)

ETSI TS 100 907 (GSM 02.30 version 6.1.0 Release 1997)

ETSI TS 100 549 (GSM 03.90 version 7.0.0 Release 1998)

ETSI TS 101 267 (GSM 11.14 version 6.3.0 Release 1997)

ETSI TS 100 977 (GSM 11.11 version 6.3.0 Release 1997)

ETSI EN 300 908 (GSM 05.02 version 8.5.1 Release 1999)

ETSI TS 101 356 (3GPP TS 07.60 version 7.2.0 Release 1998)

2 Overview

This chapter gives a general description of the G610 module.

2.1 Description

G610-Q20-00 module supports GSM Quad Band 850/900/1800/1900 MHz, G610-A20-00 module supports GSM Dual Band 900/1800MHz. With GPRS multi-slot class 10, G610 can operate on any GSM/GPRS network to provide data communications.

The G610 is similar to a condensed cellular phone core, which can be integrated into any system or product that needs to transfer voice or data information over a cellular network. Thus, it significantly enhances the system's capabilities, transforming it from a standalone, isolated product to a powerful high-performance system with global communications capabilities.

Built around a cost effective 32-bit XCPU RISC core running at up to 312MHz with 4k of Instruction cache and 4k of Data cache, RDA8851BL offers plenty of processing power for multimedia applications. A high performance proprietary 16/32-bit digital signal processing engine can further improve overall performance and user experience when performing complex multimedia tasks.

The G610 is designed as a complete GSM/GPRS communications solution with all the controls, interfaces and features to support a broad range of applications:

- Low cost
- Mini size
- A variety set of indicators and control signals
- Lower power consumption

All these features and interfaces are easily controlled and configured using a versatile AT command interface that provides full control over the G610 operation.

The G610 control and indication interface extends its capabilities beyond GSM communications. This includes a regulated output voltage for supplying external circuits. With these interfaces, the G610 can operate and control external applications and receive feedback from external environment and circuits.

The G610 interface design, using a single 42 pin SMT, through which all application interfaces are managed, facilitates fast and easy integration. It significantly shortens the development process, and minimizes the product's time to market.

The G610 is extremely compact in size with a slim mechanical design, which makes it space saving on

the application board and easily fitted into any board design.

The advanced power supply management significantly reduces power consumption to a necessary minimum and prolongs battery life.

2.2 Specifications

Product Features	
Operating Bands	G610-A20-00: Dual Band 900/1800 MHz G610-Q20-00:Quad Band850/900/1800/1900 MH
Operating Voltage	3.3 – 4.5 V (4.0V is recommended)
Tx power	2 W, 900 MHz
	1 W, 1800 MHz
Rx Sensitivity (Typical Value)	900MHz: -108dBm 1800MHz: -107dBm
Dimensions	31.3mm x 20.2mm x 3.0 mm
Weight	3.5g
Mounting	LCC
Environmental	
Operating Temperature	-40°C to +85°C
Storage Temperature	-40°C to +85°C
Interfaces	
SIM Card	External SIM connectivity
	1.8V / 3.0 V
Serial Ports	UART1: 8 wire serial bus interface. Baud rate range: 2400bps~460800bps
	UART2: 2 wire serial bus interface. The default baud rate is 115200bps; it supports a few AT commands.
	HOST UART: 2 wire serial bus interface for debugging.

Data Features	
GPRS	Multi-slot class 10 (4Rx / 2 Tx / 5 Sum)
	Coding scheme CS1-CS4 Class B GSM 07.10 multiplexing protocol
SMS	MO/MT Text and PDU modes
	Cell broadcast

3 Hardware Interface Description

The following section describes in details the hardware requirements for properly interfacing and operating the G610 module.

3.1 Block Diagram

Figure 3-1 shows the block diagram of the module. The module contains the following parts: Digital block, analog block and GSM transceiver block.

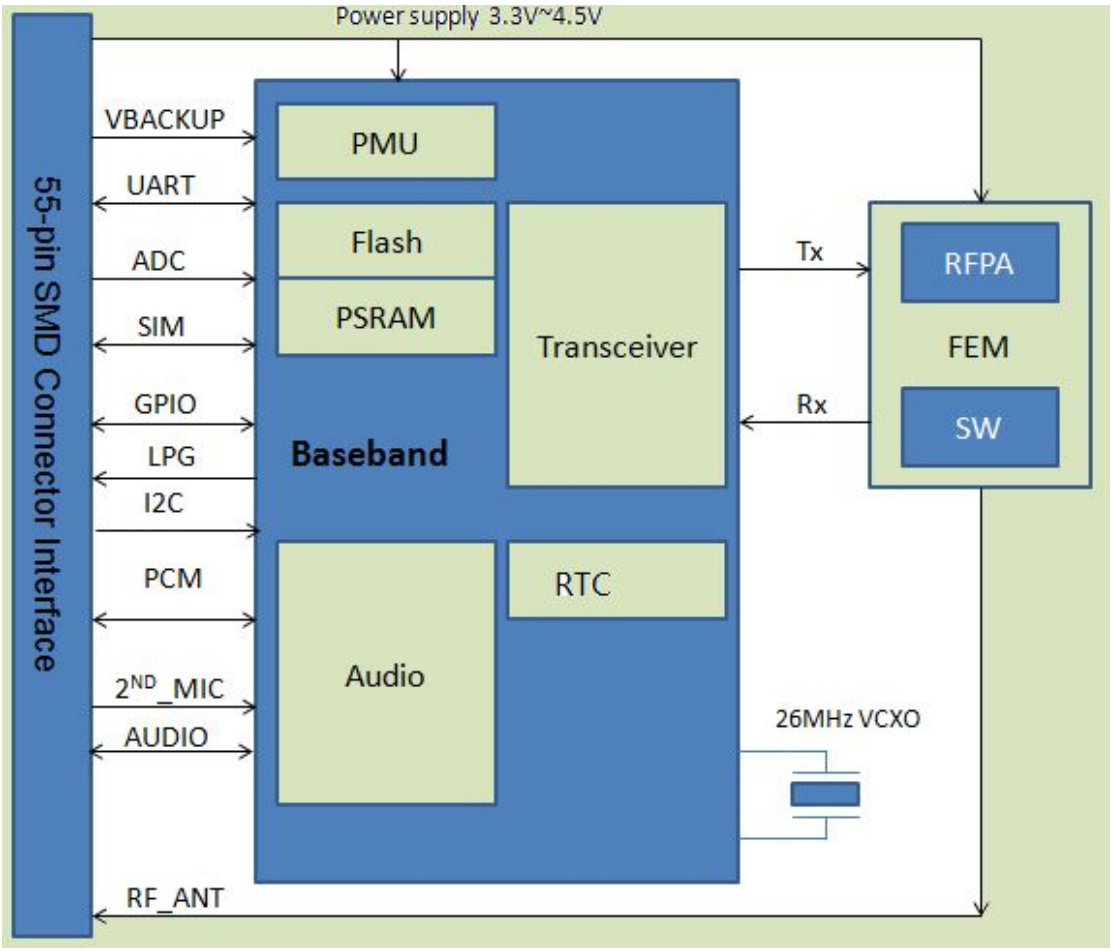

Figure 3- 1 Block Diagram

Digital Baseband Block

- Integrated Flash
- Integrated PSRAM
- Serial communications interfaces
- SIM card
- Real Time Clock (RTC) subsystem

- DSP
- CPU

Analog Block

- Power management
- Analog audio interface management
- ADC

GSM Transceiver Block

- Transceiver: RF receiver, which includes Mixers, PLL, I/Q inputs and outputs(baseband part)
- FEM: RF front end circuit, which includes antenna switch circuit, Receive low noise amplifier and filter circuit, matched transmitted signal and power amplification circuit.(PA and RF signal input and output part)

3.2 Operating Modes

The module incorporates several operating modes. Each operating mode is different in the active features and interfaces. The following table summarizes the general characteristics of the module operating modes and provides general guidelines for operation.

Operating Modes	Description	Features
Not Powered	BATT & VBACKUP supply is disconnected.	The module is off. Any signals connected to the interface connector must be set low or tri-state.
Power off Mode	Valid BATT supply but not power on. VBCAKUP output 2.8Vand VDD is off.	The power management circuit of the module turns off the RF power and part of baseband power, only supplies power for RTC circuit. Any signals connected to the interface connector must be set low or tri-state.

RTC Mode	VBACKUP connects to backup battery, after the module is off; disconnect BATT, backup battery supplies power for RTC circuit.	VBACKUP supplies the power for RTC circuit. Any signals connected to the interface connector must be set low or tri-state.
Idle Mode	Power on is succeeded and VDD output. CTS_N and DSR_N signals are enabled (low).	The module is fully active, registered to the GSM/GPRS network and ready to communicate. This is the default power-on mode.
Sleep Mode	The module is in low power mode.	The application interfaces are disabled, but, module continues to monitor the GSM network.
Call or GPRS data	LPG signal is toggling.	A GSM voice or data call is in progress. When the call terminates, the module returns to the last operating state (Idle or Sleep).

3.3 Power Supply

The module power supply must be a single external DC voltage source of 3.3V to 4.5V. The power supply must be able to sustain the voltage level during a GSM transmit burst current serge, which may reach 2.0A.

The module interface connector has 2 pins for the main power supply, as described in the table. All these contacts must be used for proper operation.

The following table shows the definitions of the pins on the power supply interfaces:

Pin No.	Signal Name	Description
26	BATT	DC power supply. BATT = 3.3 V to 4.5 V 4.0V is recommended
27		
1	GND	Ground
21		
22		
24		

25		
28		
46		

3.3.1 Power Supply Design

Special care must be taken when designing the power supply of the module. The single external DC power source indirectly supplies all the digital and analog interfaces, but also directly supplies the RF power amplifier (PA). Therefore, any degradation in the power supply performance, due to losses, noises or transients, will directly affect the module performance.

The burst-mode operation of the GSM transmission and reception draws instantaneous current surges from the power supply, which causes temporary voltage drops of the power supply level. The transmission bursts consume the most instantaneous current, and therefore cause the largest voltage drop. If the voltage drops are not minimized, the frequent voltage fluctuations may degrade the module performance.

It is recommended that the voltage drops during a transmit burst will not exceed 300mV, measured on the module interface connector. In any case, the module supply input must not drop below the minimum operating level during a transmit burst. Dropping below the minimum operating level may result in a low voltage detection, which will initiate an automatic power-off.

To minimize the losses and transients on the power supply lines, please follow these guidelines:

- Use a 1000 uF, or greater, low ESR capacitor on the module supply inputs. The capacitor should be located as near to the module interface connector as possible.
- Use low impedance power source, cabling and board routing.
- Use cabling and routing as short as possible.
- Filter the module supply lines using filtering capacitors, as described in the table.

Recommended Capacitor	**Usage**	**Description**
1000uF	GSM Transmit current serge	Minimizes power supply losses during transmit bursts. Use maximum possible value.
10nF, 100nF	Digital switching noise	Filters digital logic noises from clocks.

8.2 pF, 10 pF	DCS1800/PCS1900 MHz GSM bands	Filters transmission EMI.
33 pF, 39 pF	GSM850/GSM900 MHz GSM bands	Filters transmission EMI.

3.3.2 Power Consumption

The table specifies typical module current consumption ratings in various operating modes. The current ratings refer to the overall module current consumption over the BATT supply.

Measurements were taken under the following conditions:

- BATT= 4.0 V
- Operating temperature 25°C
- Registered to a GSM/GPRS network

The actual current ratings may vary from the listed values due to changes in the module's operating and environment conditions. This includes temperature, power supply level and application interface settings.

Parameter	Description	Conditions	Min	Typical	Max	Unit
I off	Connect power to the module, but not power on the module			120	150	μA
I off	Connect power to the module, power on the module and then power it off			310	350	μA
I idle	Idle mode	GSM only, DRX=2, Cell power= -85dBm GSM900		21		mA
I sleep	Low power mode	GSM900 DRX=2		2.3		mA

		5 9		2.0 1.4		
I gsm-avg	Average current GSM voice 1 TX slot 1 Rx slot	GSM900 PCL=5 10 15 19 DCS1800 PCL=0 5 10 15		 225.0 118.3 87.5 79.8 172.0 112.5 93.7 87.5		mA
I gsm-max	GSM voice	GSM900 PCL=5 10 15 19 DCS1800 PCL=0 5 10 15		 1569.1 610.3 305.1 220.0 1013.8 456.8 267.8 219.3		mA

I gprs-avg	Average current GPRS Class 10 2 TX slot 2 Rx slot	GSM900 PCL=5 19 DCS1800 PCL=0 15		 343.2 78.8 237.0 75.7		mA

3.4 Power On/Off Operation

The module power on and off is the two primary phases, which are related at the interface connector by the hardware signals POWER_ON, VDD. The POWER_ON signal is main controller.

The VDD level indicates whether module is powered on or off. When this signal is disabling (0V), module is powered-off. When it is output (2.85V), module is powered-on.

The following table shows definitions of the pins for Power on/off.

Pin No.	Signal Name	Description
10	POWER_ON	Power on and off module Low level activated
9	VDD	Illustrating module start up LDO power output 0V : module is power off LDO power output 2.85V : module is start up

Note: By default, G610-A20-00 automatically powered on after BATT is loaded, G610-A20-01can be powered on after Power_ON pin is pulled down.

3.4.1 Turning on the Module

When the module is powered off, the PMU operates at low power mode, with only the RTC timer active. The module will power on again when the POWER_ON signal is falling edge. Asserting the POWER_ON signal low for a minimum of 800 milliseconds will turn module on.

The following figure shows power on succeeded.

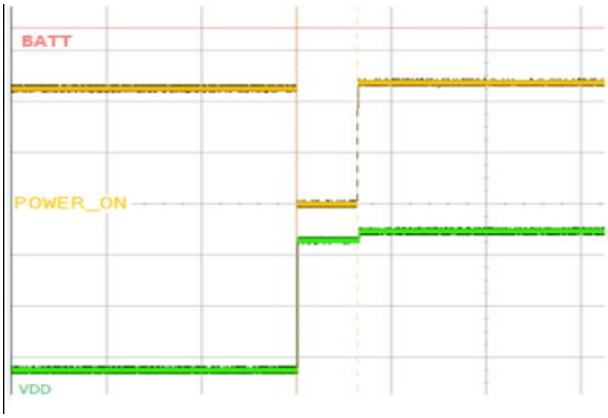

Figure 3- 2 Power on succeed

3.4.2 Turning off the Module

There are two ways to turn off G610: Asserting the POWER_ON signal to low state for at least 3 Seconds then the module will Power Down automatically. Or alternatively the module can be Power OFF using AT Command, please refer to *AT Commands User Manual*.

1. POWER_ON Signal

The POWER_ON signal is set high using an internal pull up resistor when power is applied to module. When the POWER_ON signal is falling edge and keeping low for a minimum of 3 secondswill turn module off. This will initiate a normal power-off process, which includes disabling of all applications interfaces (UART, SIM card, etc.) and logout the network connection.

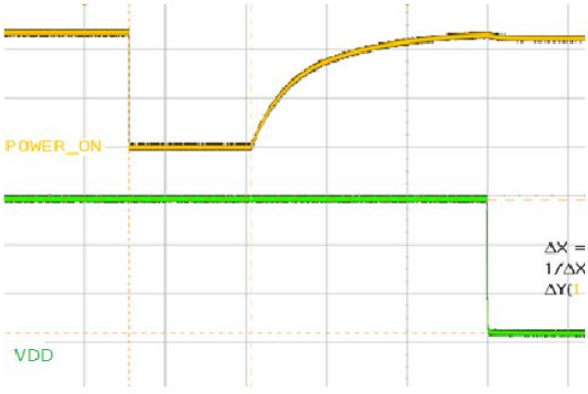

Figure 3- 3 Power off succeed

2. AT command

+MRST

The AT+MRST command initiates a G610 power off operation, which powers off directly.

+CFUN

The AT+CFUN=0 command initiates a G610 power off operation, which De-Registration first, and then powers off .

3.5 Sleep Mode

The module incorporates an optional low power mode, called Sleep Mode, in which it operates in minimum functionality, and therefore draws significantly less current.

During Sleep Mode the module network connection is not lost. The module will be waked up cycled and monitored the GSM network constantly for any incoming calls or data. During Sleep mode, all of the G610 interface signals are inactive and are kept in their previous state, prior to activating low power mode. To save power, all the G610 internal clocks and circuits are shut down, and therefore serial communications is limited.

G610 will not enter Sleep mode in any case when there is data present on the serial interface or incoming from the GSM network or an internal system task is running. Only when processing of any external or internal system task has completed, G610 will enter Sleep mode according to the ATS24 command settings.

3.5.1 Activating Sleep Mode

By default, the module powers on in Idle Mode. The ATS24 default is 0. In this mode the module interfaces and features are functional and the module is fully active. Sleep mode is activated by the ATS24 command. Such as ATS24=2 would be activated Sleep mode at soon.

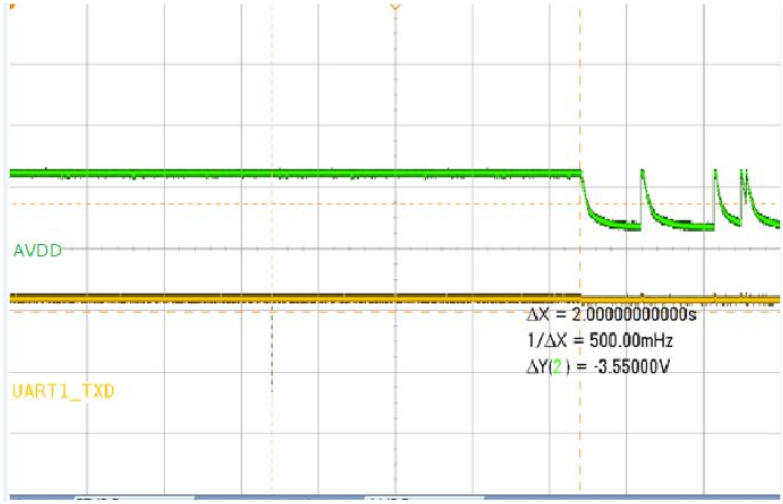

Figure 3-4 ats24=2, set module to sleep Mode after 2s

Note: In sleep mode, AVDD voltage switches to low power consumption mode, subsequent sleep status can be referenced by this pin. AVDD is the internal signal of the module.

3.5.2 Serial Interface during Sleep Mode

The module wakes up periodically from Sleep mode to page the GSM network for any incoming calls or data. After this short paging is completed, module returns to sleep mode. In the Sleep Mode, the UART is limited.

3.5.3 Terminating Sleep Mode

Terminating the Sleep mode, or wake-up, is defined as the transition of the module operating state from Sleep mode to Idle mode. There are several ways to wake-up module from Sleep mode as described below.

During Sleep mode the G610 internal clocks and circuits are disabled, in order to minimize power consumption. When terminating the Sleep mode, and switching to Idle mode, G610 requires a minimal delay time to reactivate and stabilize its internal circuits before it can respond to application data. This delay is typically of 5ms. The delay guarantees that data on the serial interface is not lost or misinterpreted.

3.5.3.1 Temporary Termination of Low Power Mode

Temporary termination of Sleep mode occurs when module switches from Sleep mode to Idle mode for a defined period, and then returns automatically to Sleep mode.

Low power mode may be terminated temporarily by several sources, some of which are user initiated and others are initiated by the system.

- **Incoming Network Data**

During Sleep mode, module continues monitoring the GSM network for any incoming data, message or voice calls. When module receives an indication from the network that an incoming voice call, message or data is available, it automatically wakes up from Sleep mode to alert the application. When module wakes up to Idle mode all its interfaces are enabled.

- **DTR_N Signal**

DTR_N connects to a GPIO on CPU; the external circuit can wake up module by controlling this GPIO, when DTR_N receives external interruption (input signal changes), the module wakes up.

Pull down DTR_N, wake up module, as shown in the following figure:

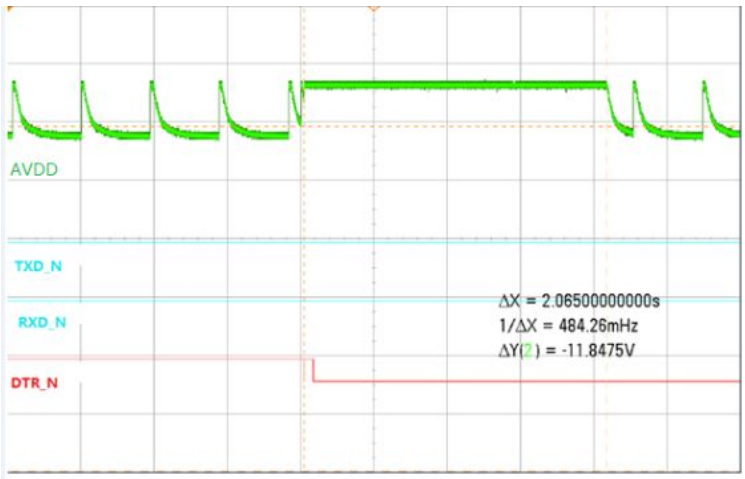

Figure 3-5 Pull down DTR_N, wake up the module for 2 seconds

3.5.3.2 Permanent Termination of Sleep Mode

If the module is in sleep mode already, please wake it up temporarily, otherwise you cannot send any AT command. After you wake up the module, send AT command “ATS24 = 0”, the module exit from sleep mode.

3.6 Real Time Clock

The main function of Real Time Clock (RTC) is keeping time. The RTC subsystem is embedded in the PMU and operates in the entire module operating modes (Off, Idle, Sleep), as long as power is supplied above the minimum operating level. If the main power is not available, the backup battery or capacitor can be supplied to RTC by the connector RTC pin.

When the main power and RTC power of VBACKUP are disconnected, the timer will reset and the current

time and date will be lost. When the module power on again, please reconfigure the time and date.

3.6.1 RTC Description

The following table shows the definitions of the pins for RTC:

Pin No.	Signal Name	Description
8	VBACKUP	Real time clock power

3.6.2 RTC Application

Here are the methods to set the time and date of the module:

- Automatically retrieved from the GSM network. In case module is operated in a GSM network that supports automatic time zone updating, it will update the RTC with the local time and date upon connection to the network. The RTC will continue to keep the time from that point.
- Using the AT+CCLK command. Setting the time and date manually by this AT commands overrides the automatic network update. Once the time and date are manually updated, the RTC timer will keep the time and date synchronized regardless of the module operating state.
- VBACKUP (pin6) input voltage range: 2.0V~3.3V. If the VBACKUP voltage is lower than 2.0V, the current time and date will be lost.

3.6.3 RTC Consumption

The following table shows the consumption of the module when the power is supplied by RTC only.

VBACKUP Voltage	Consumption Value
VBACKUP=2.0V	190uA
VBACKUP=3.3V	260uA

3.7 UART

The module has 3 UART ports.

UART1 is a completely independent 8 wire serial bus interface. This is the main UART.

UART2 is a 2 wire serial bus interface, it only supports a few AT commands.

HOST UART is a debug UART, which is used for downloading, calibrating, trace and so on, it doesn't support any AT command.

3.7.1 UART1

The module UART1 is the main UART. It is a standard 8 wire serial bus interface. This UART is used for all the communications with module - AT commands interface, GPRS data programming and software upgrade.

The module is defined as a DCE device, and the user application is defined as the DTE device. These definitions apply for the UART signals naming conventions, and the direction of data flow, as described in the figure.

Pin No.	Signal Name	Description	Notes
44	TXD_N	Module Received Data	G610 Received Data
45	RXD_N	Module Transmitted Data	G610 Transmitted Data
43	CTS_N	Module Clear To Send	G610 Switch To Received Mode
42	RTS_N	Request To Send	G610 Notice DTE Requested To Send
40	DTR_N	Data Terminal Ready	DTE Was Ready
38	DSR_N	Module Data Set Ready	G610 Was Ready
39	RING_N	Module Ring indicator	G610 Notice DTE Remote Call
41	DCD_N	Data Carrier Detect	G610 Notice DTE that Data Carrier Was Online

Recommended connection:

Application MCU	Direction	Module	
TXD	→	Pin 44	TXD_N
RXD	←	Pin 45	RXD_N
RI	←	Pin 39	RING_N
DSR	←	Pin 38	DSR_N
RTS	→	Pin 42	RTS_N
DTR	→	Pin 40	DTR_N
CTS	←	Pin 43	CTS_N
DCD	←	Pin 41	DCD_N

All flow control handshakes are supported: hardware or none.

The UART1 default port configuration is 8 data bits, 1 stop bit and no parity, with none flow control and auto baud rate detect enabled.

3.7.2 UART2

UART2 supports a few AT commands, please refer to AT Command User Manual for details.

Pin No.	Signal Name	Description	Feature
30	UART2_TXD	Module Received Data	G610 Received Data
29	UART2_RXD	Module Transmitted Data	G610 Transmitted Data

Application MCU	Direction	Module	
TXD	→	Pin 30	UART2_TXD
RXD	←	Pin 29	UART2_RXD

3.7.3 HOST UART

HOST UART is a debug UART, which is used for downloading, calibrating, trace and so on; it doesn't support any AT command. This interface is only used when debugging, users only need to connect to the test point.

Application MCU	Direction	Module	
TXD	→	Pin 48	HST_TXD
RXD	←	Pin 55	HST_RXD

3.7.4 Ring Indicate

The UART1_RING signal serves to indicate incoming calls and other data (such as SMS). It can also be used to send pulses to the host application, for example to wake up the application from power saving state. The following figure illustrates the module gets a message.

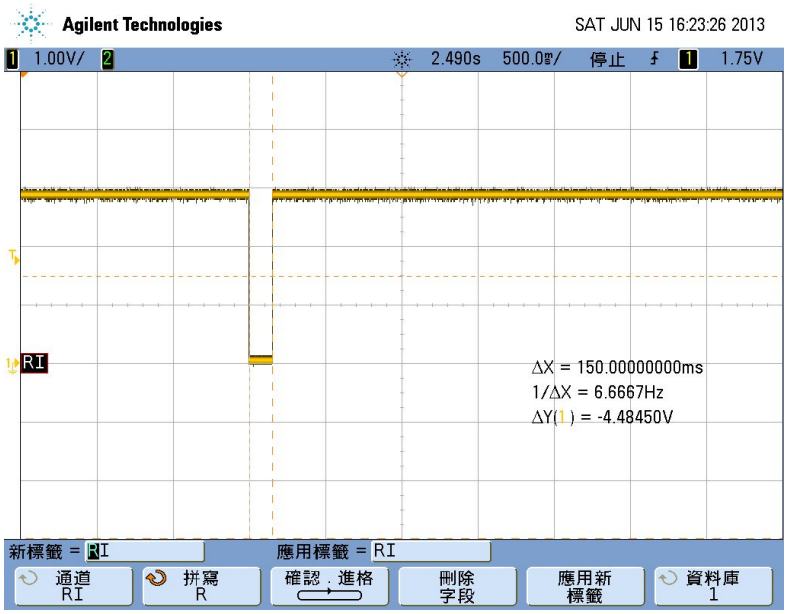

Figure 3-6 Module gets a message

The following figure shows the RING_N signal status when there is an incoming call.

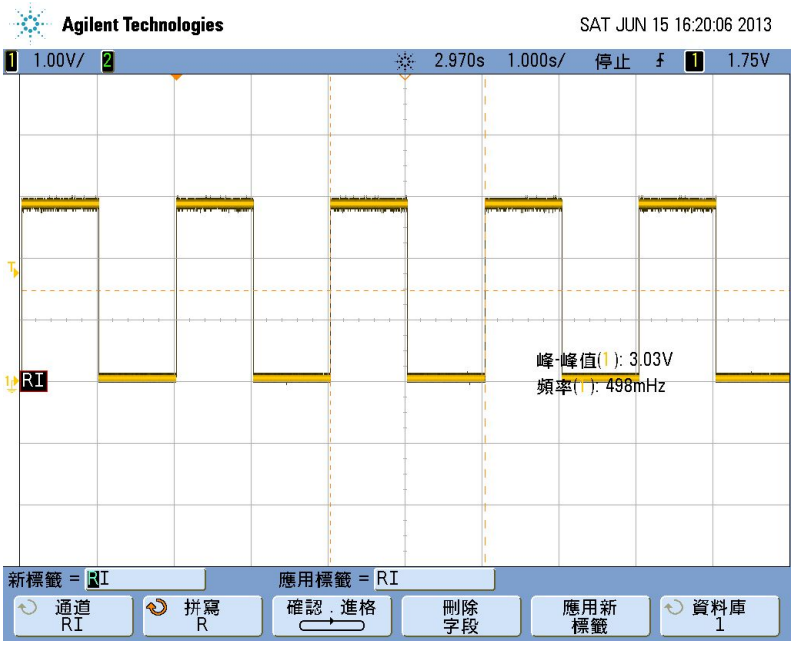

Figure 3-7 An incoming call

3.7.5 DCD Indicate

The DCD_N signal serves to indicate GPRS data mode. The detail definition refers to AT&C command.

3.8 SIM Interface

The SIM interface follows the GSM 11.11 and GSM 11.12 standards, which are based on the ISO/IEC 7816 standard. These standards define the electrical, signaling and protocol specifications of a GSM SIM

card.

The module does not incorporate an on-board SIM card tray for SIM placement. The SIM must be located on the user application board, external to the G610. The module SIM interface includes all the necessary signals, which are routed to the interface connector, for a direct and complete connection to an external SIM.

The module supports 1.8V or 2.85V SIM card automatic. While the module turn on. At first SIM_VCC output 1.8V voltage for external SIM card communication. If it is not successful SIM_VCC output 2.85V voltage and communicated SIM card again.

Pin No.	Signal Name	Description
5	SIM_CLK	Serial 3.25 MHz clock
2	SIM_VCC	2.85V Supply to the SIM
4	SIM_DATA	Serial input and output data
6	SIM_RST	Active low SIM reset signal
3	SIM_CD	SIM card hot-plug

3.8.1 SIM Connection

The following figure illustrates a typical SIM interface connection to G610. This connection type is implemented on the module Developer Board, using an MOLEX SIM tray, PN 912283001 & 912360001.

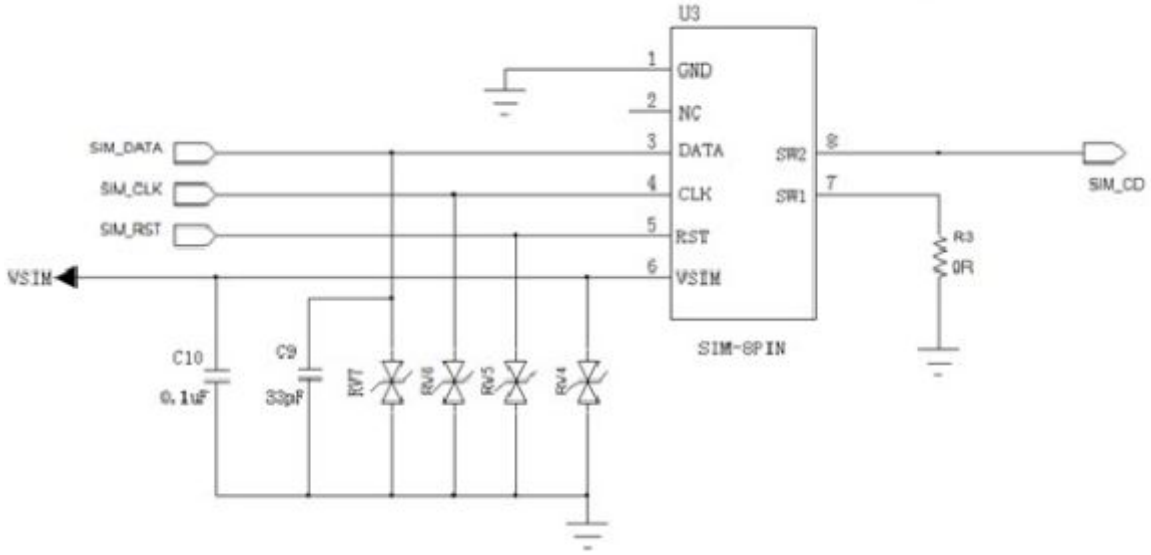

Figure 3- 8 SIM card reference design

3.8.2 SIM Design Guidelines

The SIM interface and signals design is extremely important for proper operation of module and the SIM card. There are several design guidelines that must be followed to achieve a robust and stable design that meets the required standards and regulations.

- The SIM should be located, and its signals should be routed, away from any possible EMI sources, such as the RF antenna and digital switching signals.
- The SIM interface signals length should not exceed 100 mm between the module interface connector and the SIM tray. This is to meet with EMC regulations and improve signal integrity.
- To avoid crosstalk between the SIM clock and data signals (SIM_CLK and SIM_DATA), it is recommended to rout them separately on the application board, and preferably isolated by a surrounding ground plane.
- The SIM card signals should be protected from ESD using very low capacitance protective elements (zener diodes, etc.). The recommended part no of ESD isAVR-M1005C270MAAB (TDK) We also recommended the ESD component should layout with SIM hold closely.

3.9 I2C Interface

G610 supports I2C interface, two lines: one serial data line SDA, one serial clock line SCL.

Features:

- Reaches up to 400kbit/s
- Open drain output
- Generate start bit and stop bit automatically
- Response and confirm automatically
- Application hardware I2C protocol

Pin No.	Signal Name	Description
36	SDA/GPIO19	I2C data signal
37	SCL/GPIO18	I2C clock signal

Note: If the customer needs this function, please adjust the software based on the specific device.

3.10 PCM Interface

G610 supports PCM (Pulse Code Modulation) function.

Pulse Code modulation is a method used to digitally represent sampled analog signals. It is the standard form of digital audio in computers, Compact Discs, digital telephony and other digital audio applications. In a PCM stream, the amplitude of the analog signal is sampled regularly at uniform intervals, and each sample is quantized to the nearest value within a range of digital steps. PCM samples the signal 8000 times a second; each sample is represented by 8 bits for a total of 64 kbps.

Pin No.	Signal Name	Description
50	PCM_FS	Digital voice sync signal
51	PCM_DOUT	Module Digital voice data output
53	PCM_DIN	Digital voice data input
52	PCM_CLK	Digital voice clock signal

Recommended connection:

Application MCU	Direction	Module	
PCM_SYNC	←	Pin 50	PCM_FS
PCM_OUT	→	Pin 53	PCM_DIN
PCM_DIN	←	Pin 51	PCM_DOUT
PCM_CLK	←	Pin 52	PCM_CLK

3.11Audio Interface

The module audio interface supports two channel audio devices and operating modes. The audio interface's operating modes, active devices, amplification levels and speech processing algorithms are fully controlled by the host application, through advanced programming options and a versatile AT commands set.

Pin No.	Signal Name	Description
14	MIC1+	1st Audio channel

13	MIC1-	Balanced microphone input
11	AUXI+	2nd Audio channel
12	AUXI-	Balanced microphone input
18	AUXO+	2nd Audio channel
17	AUXO-	Output is balanced and can directly operate a hand free speaker
15	EAR+	1st Audio channel
16	EAR-	Output is balanced and can directly operate a head set

3.11.1 1st Audio Channel: Microphone

This channel is the module power-up default active audio channel.

The microphone input includes all the necessary circuitry to support a direct connection to an external microphone device. It incorporates an internal bias voltage which can be adjusted by AT command. We recommended you choose microphone with 2k Ω impedance.

3.11.2 1st Audio Channel: Receiver

This channel is the module power-up default active output for voice calls and DTMF tones. It is designed as a differential output with 32Ω impedance.

3.11.3 2nd Audio Channel: Microphone

This channel can be switched by AT Command.

The microphone input includes all the necessary circuitry to support a direct connection to an external microphone device. It incorporates an internal bias voltage which can be adjusted by AT command. We recommended you choose microphone with 2k Ω impedance.

3.11.4 2nd Audio Channel: Speaker

This channel can be switched by AT Command. It is designed as a differential output and can be droved an 8Ω speaker directly.

3.11.5 Audio Design

The audio quality delivered by module is highly affected by the application audio design, particularly when using the analog audio interface. Therefore, special care must be taken when designing the module audio interface. Improper design and implementation of the audio interface will result in poor audio quality.

Poor audio quality is a result of electrical interference, or noises, from circuits surrounding the audio interface. There are several possible sources for the audio noise:

- Transients and losses on the power supply
- EMI from antenna radiations
- Digital logic switching noise

Most of the audio noise originates from the GSM transmit burst current surges (217 Hz TDMA buzz), which appear on the main power supply lines and antenna, but also indirectly penetrate the internal application's supplies and signals. The noises are transferred into the module 's audio circuits through the microphone input signals and then are amplified by the module 's internal audio amplifiers.

To minimize the audio noise and improve the audio performance the microphone and speaker signals must be designed with sufficient protection from surrounding noises.

The following guidelines should be followed to achieve best audio performance:

1. Keep the audio circuits away from the antenna.
2. Use RF filtering capacitors on the audio signals.
3. The audio signals should not be routed adjacent to digital signals.
4. Isolate the audio signals by a surrounding ground plane or shields.

3.12 Controls and Indicators Interface

The module incorporates several interface signals for controlling and monitoring the module's operation. The following paragraph describes these signals and their operation.

Pin No.	Signal Name	Description
9	VDD	LDO power output Illustrating module start up
49	LPG	Module work status indicator
7	RESET_N	Reset
40	DTR_N	Wake up the module
47	HS_DET	Headphone detect input, when the headphone is accessed, low level

3.12.1VDD Reference Regulator

After the module is powered on, VDD outputs 2.8V voltage (you can test the voltage of VDD to see the module is powered on or not) , this power can be used as reference regulator.

Note: The VDD regulator is powered from the G610's main power supply, and therefore any current sourced through this regulator originates from the G610 BATT supply. The overall current consumed by G610 is directly affected by the VDD operation. The G610 current consumption raises with respect to the

current sourced through VDD.

Parameter	Conditions	Min	Typical	Max	Unit
Vout	Lout=30mA	2.6	2.8	3.0	V
Imax	The MAX Current	-	-	200	mA

3.12.2RESET_N

RESET_N is high when G610 is running, and it is low when G610 is disconnected from power. When G610 is working, pull down RESET_N externally, G610 is reset.

Note: This signal is used only when the system has serious problems, such as when there is no response from software for a long time, reset by sending AT commands doesn't take effect (By sending "AT+CFUN=15" can reset the module).

For G610-A20-01, when you pull down RESET_N, the module is powered off.

Parameter	Conditions	Min	Typical	Max	Unit
T width		100	200	400	mS

3.12.3LPG

As an alternative to generating the synchronization signal, the control pin can be used to drive a status LED on application platform. The timing of LPG, it can be indicated the module status straight.

Referenced circuits:

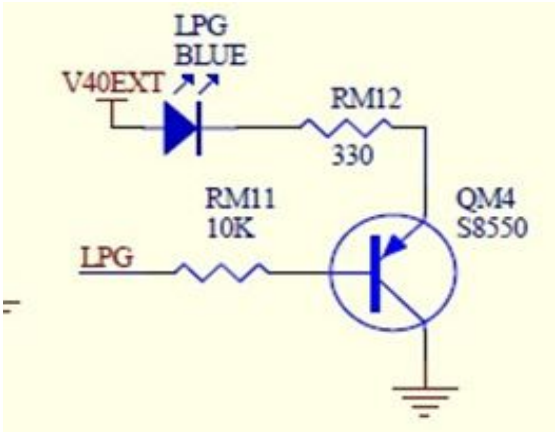

Figure 3-9 LPG reference design

States of the LED vs PIN: LED Off = HIGH. LED On = LOW.

LED state	LPG Level	Operating status of the module
Permanently off	High level	The module is in one of the following modes: • SLEEP mode
600 ms off / 600 ms on	600 ms high level /600 ms low level	The module is in one of the following status: • NO SIM card • SIM PIN • Register network (T<15S) • Register network failure (always)
3 s off / 75 ms on	3 s high level / 75 ms low level	The module is in one of the following status: • IDLE mode
75 ms off / 75 ms on	75 ms high level / 75 ms low level	The module is in one of the following status: • One or more GPRS contexts activated.
Permanently on	Low level	The module is in one of the following status: • Voice call • Power off mode

3.12.4HS_DET

G610 provides a HS_DET pin to detect whether headphone is plugged in, when the headphone is plugged in, it is low level, when unplugged, it is high.

Pin No.	Signal Name	Description
47	HS_DET	Headphone detect interrupt input, low level when headphone is plugged in.

Note: If the customer needs this function, please pull up external resistor100K to VDD.

3.12.5General ADC

G610 provides an auxiliary ADC (analog to digital converter) channel. When input voltage to this pin, the module can measure the corresponding voltage value, and then obtain some related input analog signal parameters (such as voltage and temperature). Users can read the voltage value on the pin by sending AT command “at+mmad”.

Pin No.	Signal Name	Description
20	ADC1	General ADC

Parameter	Conditions	Min	Typical	Max	Unit
Input voltage	range	0		1.8	V
Resolution			0.5		%
Sampling resolution			10bit		

3.12.6General-purpose I/O

G610 integrated 6 GPIO, users can control it through AT commands, the GPIO can be input or output, and you can set the input level or read the external input level by AT commands.

Pin No.	Signal Name	Description
35	GPIO01	
34	GPIO02	
33	GPIO03	
32	GPIO04	
31	GPIO07	
54	GPIO36	

4 Electrical and Environmental Features

4.1 Absolute Maximum Ratings

The table gives the maximum electrical characteristics of the module interface signals.

Note: Using the module beyond these conditions may result in permanent damage to the module.

Parameter	Conditions	Min	Max	Unit
BATT Supply		-0.2	4.5	V
Digital Input Signals (UART, GPIOM PCM and so on)	module powered on VDD	-0.2	3.3	V
Audio interfaces ,Analog Input Signals	module powered on	-0.2	2.75	V

4.2 Environmental Specifications

The table gives the environmental operating conditions of the module.

Note: Using the module beyond these conditions may result in permanent damage to the module.

Parameter	Conditions	Min	Max	Unit
Operating Temperature		-40	85	°C
Storage Temperature		-40	85	°C
ESD	(Contact) Antenna connector		± 8	KV
	(Air) Antenna connector		± 15	

4.3 Application Interface Specifications

The table summarizes the DC electrical specifications of the application interface connector signals.

Note: Interface signals that are not used by the customer application must be left unconnected. Do not connect any components to, or apply any voltage on, signals that are not used by the application.

Pin#	Signal Name	Description	I/O	Reset level	Idle level	Level Character
Power						
26 27	BATT	DC power supply	I			3.3V ~ 4.5V
1 21 22 24 25 28 46	GND	Ground				
8	VBACKUP	Real time clock power	I/O	2.8V	2.8V	Input voltage: 2.0V~3.3V Output voltage: 2.5V~3.3V
Control & Status						
49	LPG	Work mode indicator	O			VOL_{MAX}=0.3V VOH_{MIN}=VDD-0.35V
9	VDD	LDO outputs high level, Illustrating start up	O	2.85V	2.85V	VOL_{MAX}=0.3V VOH_{MIN}=VDD-0.35V
7	RESET_N	Emergency Power Off	I	H	H	VIL_{MAX}=0.2*VDD VIH_{MIN}=0.7*VDD
10	POWER_ON	Turn on module Low level activated	I	H	H	2.5V~3.3V
UART (Module DCE)						
45	RXD_N	Transmitted Data	O	T	H	VOL_{MAX}=0.3V VOH_{MIN}=VDD-0.35V
44	TXD_N	Received Data	I	H	H/100k PU	

39	RING_N	Ring indicator	O	L	H	
38	DSR_N	Data Set Ready	O	H	L	
42	RTS_N	Request To Send	I	H	H/51k PU	
40	DTR_N	Data Terminal Ready	I	H	H/51k PU	
43	CTS_N	Clear To Send	O	L	L	
41	DCD_N	Data Carrier Detect	O	H	H	
UART2						
30	UART2_TXD	Received Data	I	H	H/100k PU	
29	UART2_RXD	Transmitted Data	O	H	H	
HOST						
48	HST_TXD	Received Data	I		H	
55	HST_RXD	Transmitted Data	O		H	
SIM Interface						
2	SIM_VCC	SIM power	O	0.3V	1.8V or 2.85V	
5	SIM_CLK	SIM clock	O	T	3.25MHz	VOL_{MAX}=0.3V
4	SIM_DATA	SIM data	I/O			VOH_{MIN}=VSIM-0.35V
6	SIM_RST	SIM reset	O	T	L	VIL_{MAX}=0.2*VSIM
3	SIM_CD	SIM card hot-plug	I	T		VIL_{MAX}=0.2*VDD
Audio						
14	MIC1+	1st Audio channel (default) Balanced input	I			
13	MIC1-		I			
11	AUXI+	2nd Audio channel Balanced input	I			
12	AUXI-		I			
18	AUXO+	2nd Audio channel Balanced output	O			
17	AUXO-		O			
15	EAR+	1st Audio channel (default) Balanced output	O			
16	EAR-		O			
20	ADC1	General A / D	I	0V	0V	0V ~ 1.800V

19	NC					
53	PCM_DIN	Module PCM data input	I	0V	0V	
50	PCM_FS	Module PCM Synchronous clock	O	0V	0V	
52	PCM_CLK	Module PCM clock output	O	0V	0V	
51	PCM_DOUT	Module PCM data output	O	0V	0V	
Others						
23	RF_ANT	RF antenna port	I/O			
47	HS_DET	Headphone detection	I			VILMAX=0.2*VDD VIHMIN=0.7*VDD VIHMAX=1.1*VDD
36	SDA/GPIO19	I2C_SDA	I/O	OD	OD	
37	SCL/GPIO18	I2C_SCL	I/O	OD	OD	
31	GPIO07	General-purpose IO	I	T	T	VOLMAX=0.35V VOHMIN=VDD-0.35V VILMAX=0.2V VIHMIN=0.7*VDD VIHMAX=1.1VDD
35	GPIO01	General-purpose IO	IO	T	T	
34	GPIO02	General-purpose IO	IO	T	T	
33	GPIO03	General-purpose IO	IO	T	T	
32	GPIO04	General-purpose IO	IO	T	T	
54	GPIO36	General-purpose IO	IO	T	T	

Note:

T=Tristate I=Input O=Output L=Low level H=High level	OD=Open Drain PU=Pull up PD=Pull down

4.4 Pin Definitions

Figure 4- 1 Pin Definitions

5 Mechanical Design

5.1 Mechanical Specifications

The following figure shows the mechanical specifications of the module in details:

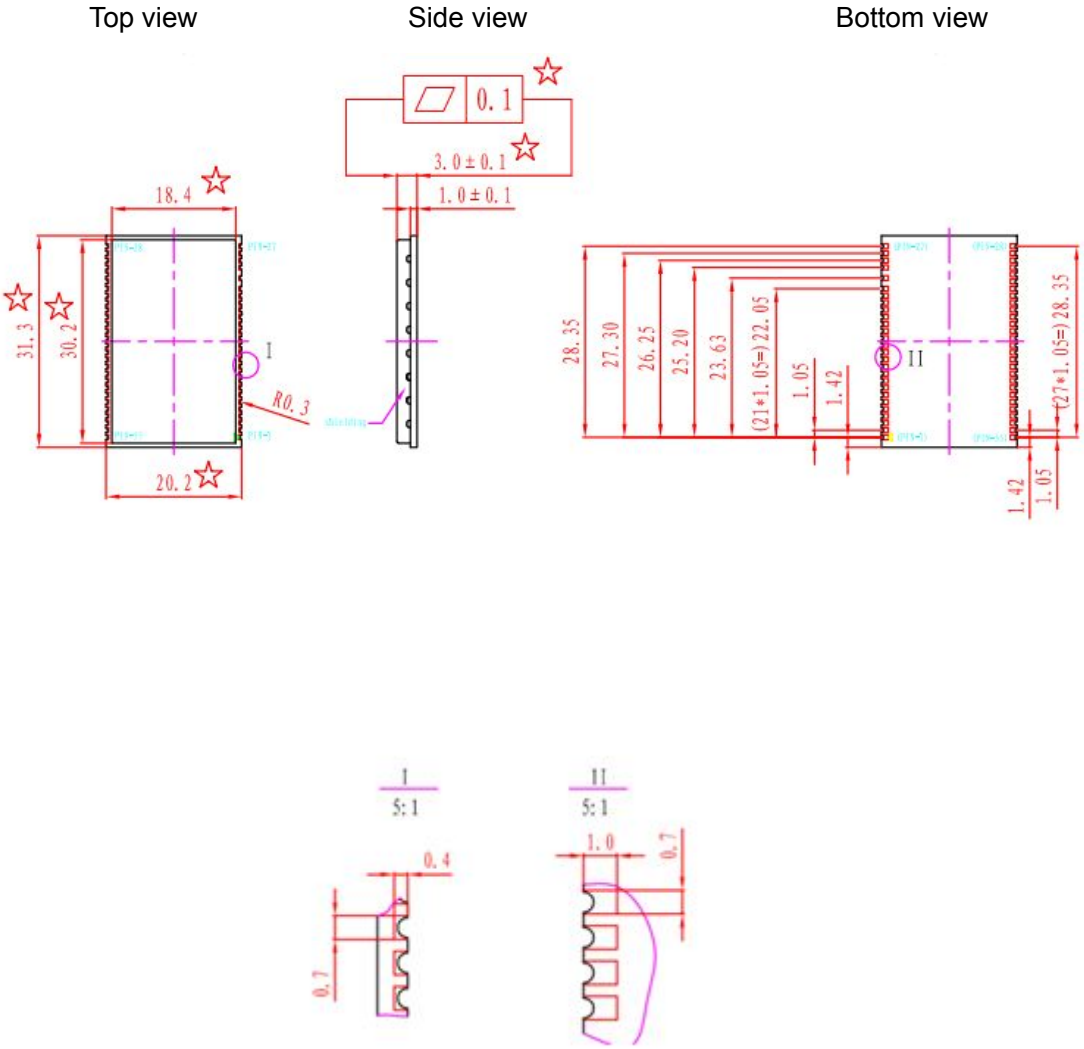

Figure 5- 1 Mechanical Specifications

5.2 Recommended PCB Layout

The following figure shows recommended PCB layout:

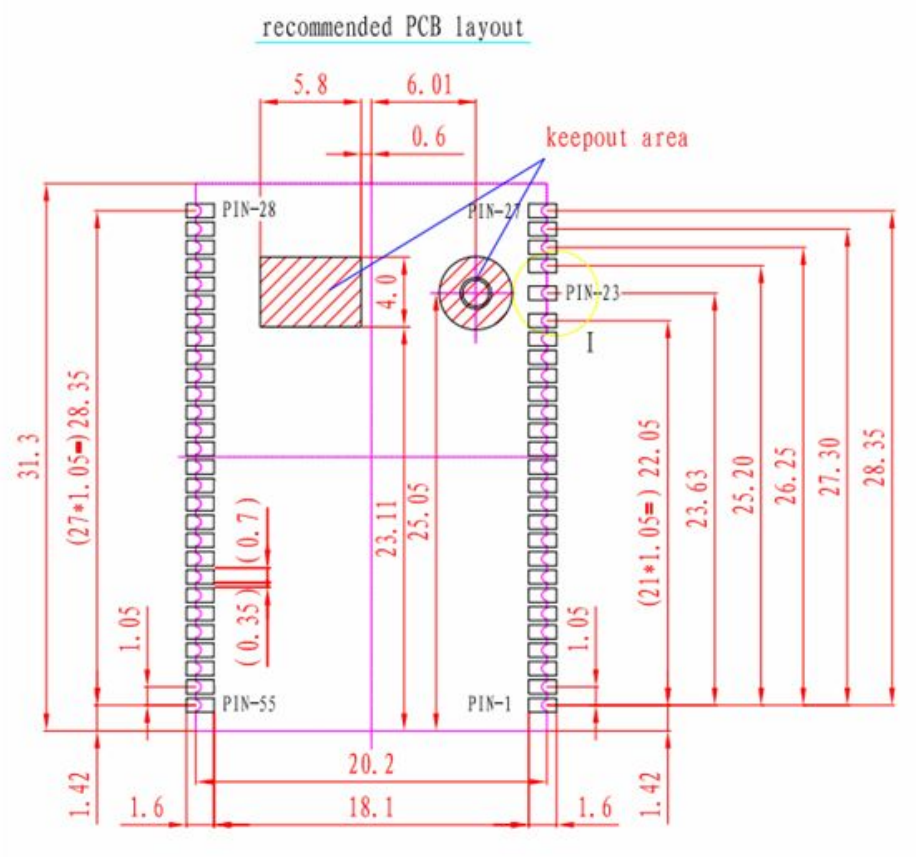

Figure 5-2 Recommended PCB layouts

(Top View)

6 Ordering Information

Product Name: G610

Ordering Name: G610-XXX-YY

XXX: Technical feature, ex: A20=Dual Band

YY: Detail feature, ex: 00=Normal

For more information, please contact with sales or technical support engineers.

Appendix: Glossary

Name	Description
AFC	Automatic Frequency Control
ETS	European Telecommunication Standard
ESD	Electronic Static Discharge
EMC	Electromagnetic Compatibility
EMI	Electro Magnetic Interference
FEM	Front end module
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
LNA	Low Noise Amplifier
PCB	Printed Circuit Board
PCL	Power Control Level
PLL	Phase-Locked Loop
PMU	Power manager unit
RTC	Real Time Clock
RFPA	Radio frequency power amplifier
SIM	Subscriber Identification Module
SMS	Short Message Service
SMD	Surface Mounted Devices
UART	Universal Asynchronous Receiver Transmitter, asynchronous serial port
VSWR	Voltage Standing Wave Ratio
VCO	Voltage Controlled Oscillator