FIBOCOM
Perfect Wireless Connection

G510 Hardware User Manual

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Revision History

Version	Date	Remarks
V1.0.0	2013-02-04	The initial revision
V1.0.1	2013-04-03	Update the LPG, UART
V1.0.2	2013-04-26	Update some parameters
V1.0.3	2013-05-09	Update chapter3.7, add UART2 and HOST UART
V1.0.4	2013-06-03	Delete 2 channel ADC (not supported); Update Application Interface Specification
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V1.0.6	2013-07-31	Update the name of the document
V1.0.7	2013-08-12	Add section 3.6.3
V1.0.8	2013-11-26	Add G510-A20-00

Applicability Table

No.	Type	Note
1	G510	
2	G510S	

Contents

1 Introduction

1.1 Scope

This document describes the hardware application interfaces that are provided when FIBOCOM G510 GPRS module is used.

This document helps you to understand the interface specifications, electrical features and related product information of the G510 module.

1.2 Audience

This manual is intended for all members of the integration team who are responsible for integrating the G510 module into the host OEM device, including representatives from hardware, software and RF engineering disciplines.

1.3 Applicable Documents

- G510 Hardware Design Application Note

- AT Commands User Manual

- G510 SMT Application Note

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 G510 module.

2.1 Description

G510 GPRS Module supports G510 Q50-00: Quad Band 850/900/1800/1900 MHz. With GPRS multi-slot class 10, G510 can operate on any GSM/GPRS network to provide data communications.

The G510 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 G510 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 G510 operation.

The G510 control and indication interface extends its capabilities beyond GSM communications. This includes a regulated output voltage for supplying external circuits. With these interfaces, the G510 can operate and control external applications and receive feedback from external environment and circuits.

The G510 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 G510 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	G510-Q50-00: Quad Band 850/900/1800/1900 MHz
	G510-A20-00: Dual Band 900/1800 MHz
Operating Voltage	3.3 – 4.5 V (4.0V is recommended)
Tx power	2 W, 850/900 MHz
	1 W, 1800/1900 MHz
Rx Sensitivity (Typical Value)	850/900MHz: -109dBm
	1800/1900MHz: -108dBm
Dimensions	20.2mm x 22.2mm x 2.5 mm
Weight	<2.5g
Mounting	LCC
Environmental	
Operating Temperature	-40℃ to +85℃
Storage Temperature	-40℃ to +85℃
Interfaces	
SIM Card	External SIM connectivity
	1.8V / 3.0 V
Serial Ports	3 UART ports: UART1, UART2 and HOST UART
	Baud Rate Range: from 2400 bps to 460800 bps
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 G510 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.
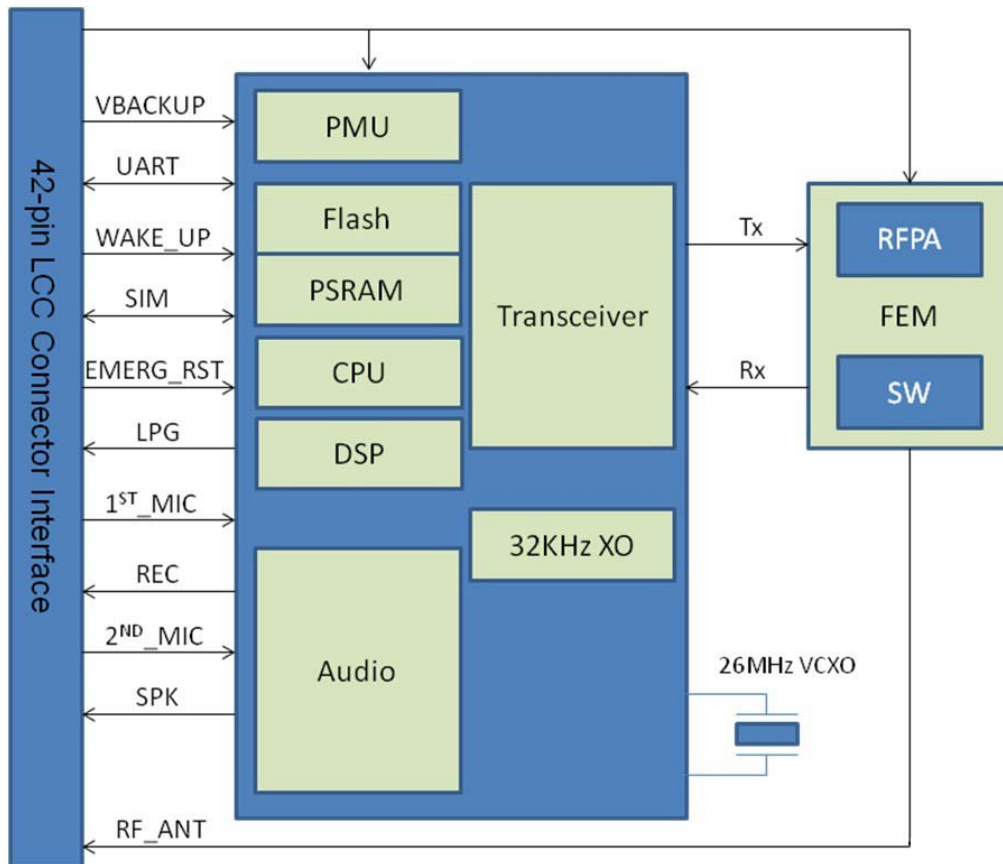

Figure 3-1 Block Diagram

Digital Baseband Block

- Integrated Flash on chip

- Integrated PSRAM on chip

- Serial communications interfaces

- SIM card port

- Real Time Clock (RTC) subsystem

Analog Block

- Power management inside

- PLL generates 624MHz from 26MHz

- Analog audio interface management

GSM Transceiver Block

- Support GSM850/900/1800/1900 bands

- RF receiver, which includes LNAs, Mixers, PLL, I/Q outputs and buffers

- Signal processing IC for transmit and receive GSM data processing

- RF FEM control , which includes RFPA and antenna switch

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	VBAT & 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 VBAT supply but not power on. After reset module, VBCAKUP output and VDD is off.	The module MCU/BB/RF is Off. The PMU is operating in RTC mode. Any signals connected to the interface connector must be set low or tri-state.
RTC Mode	Power off mode VBAT supply is disconnected. But valid VBACKUP supply	The module MCU/BB/RF is Off. The PMU is operating in RTC mode. Any signals connected to the interface connector must be set low or tri-state.
Idle Mode	Power on is succeeded and VDD output. UART1_CTS and UART1_DSR 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, G510 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
9	VBAT	DC power supply. VBAT = 3.3 V to 4.5 V 4.0V is recommended
10		
1	GND	Ground
2		
4		
5		
7		
8		
32		
42		

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

8.2 pF, 10 pF	1800/1900 MHz GSM bands	Filters transmission EMI.
33 pF, 39 pF	850/900 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 VBAT supply.

Measurements were taken under the following conditions:

- VBAT= 4.0 V

- Operating temperature 25℃

- 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	Typ	Max	Unit
I off	Power off mode			120		μA

I idle	Idle mode	GSM only,
		  DRX=2,
		  Cell power=
		-85dBm
		GSM900
				22		mA

I sleep	Low power mode	GSM900
		DRX=2
		   5
		   9
				1.8
				1.3
				1.0
						mA

I gsm-avg	Average current
	GSM voice
	1 TX slot 1 Rx slot
		GSM850
		PCL=5
		  10
		  15
		  19
		GSM900
		PCL=5
		   10
		   15
		   19
		DCS1800
		PCL=0
				225.0
				115.3
				82.5
				72.8
				
				239.1
				121.5
				83.5
				73.8
				
				154.0
						mA

				5		94.5		
			10		75.2		
			15		70.2		
		PCS1900				
		PCL=0		176.3		
		5		100.5		
		10		75.5		
		15		70.3		

I gsm-max	Average current GSM voice 1 TX slot 1 Rx slot	GSM850				mA
		PCL=5		1506.1		
		10		581.3		
		15		270.1		
		19		185.0		
		GSM900				
		PCL=5		1629.4		
		10		629.5		
		15		284.5		
		19		195.1		
		DCS1800				
		PCL=0		873.8		
		5		361.2		
		10		195.0		
		15		145.0		
		PCS1900				
		PCL=0		1078.0		
		5		433.0		
		10		223.0		
		15		158.3		

I gprs-avg	Average current GPRS Class 10 2 TX slot 2 Rx slot	GSM850 PCL=5 19 GSM900 PCL=5 19 DCS1800 PCL=0 15 PCS1900 PCL=0 15		376.2 84.5 403.7 86.7 245.2 78.8 283.2 79.4		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
14	POWER_ON	Power on and off module Low level activated
13	VDD	Illustrating module start up LDO power output 0V : module is power off LDO power output 2.85V : module is start up

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.

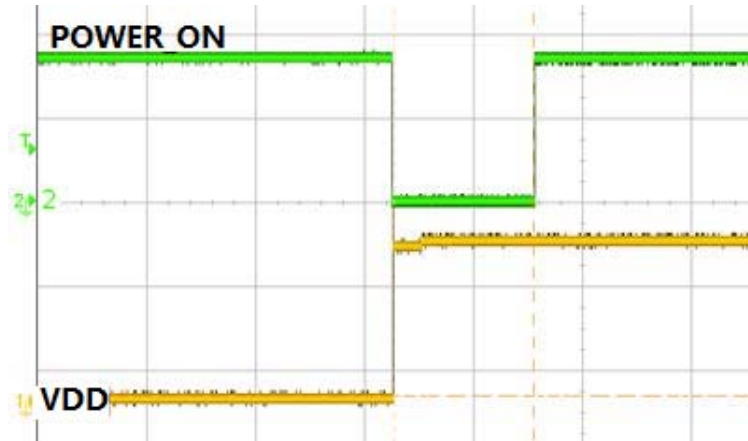The following figure shows power on succeeded.

Figure 3-2 Power on succeed

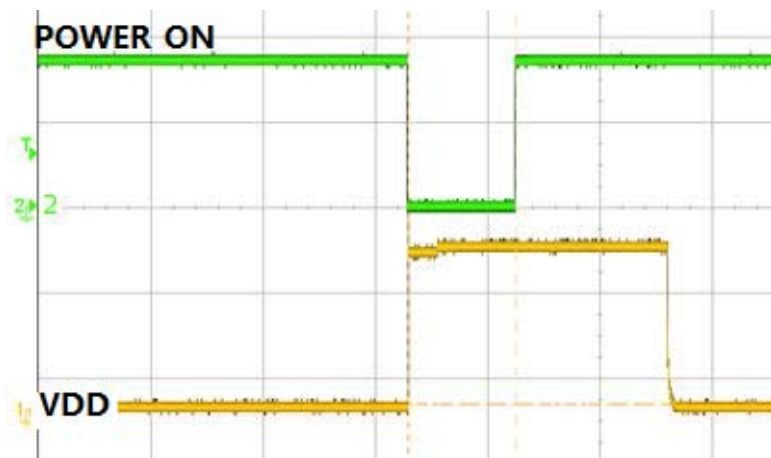The following figure illustrates the module power on is failed when asserting the POWER_ON signal low for a minimum of 600 milliseconds.

Figure 3-3 Failed to power on

3.4.2 Turning off the Module

There are two ways to Turn OFF the G510: 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 <G5-Family 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 seconds will 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.
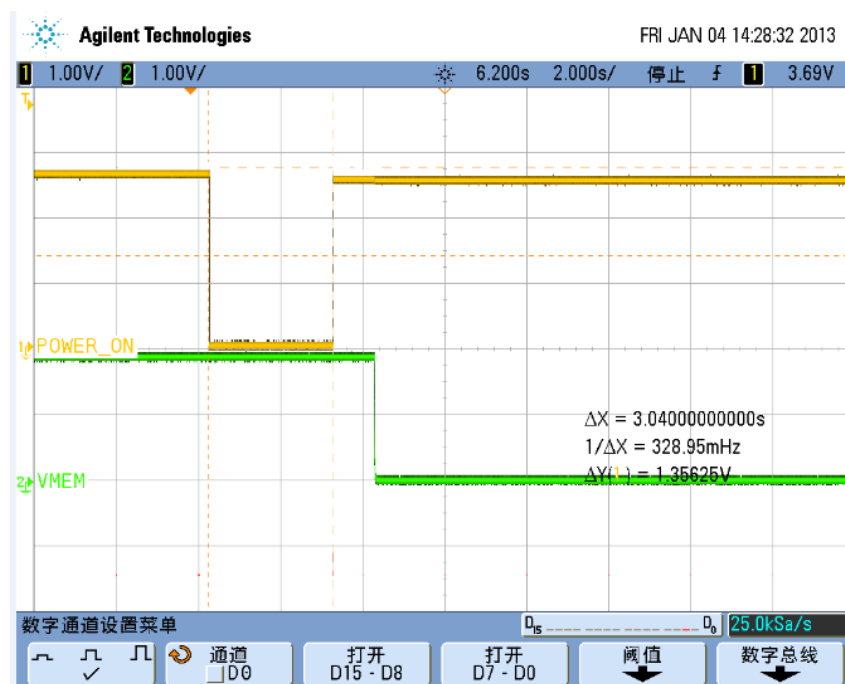

Figure 3-4 Power off succeed

2. AT command

+MRST

The AT+MRST command initiates a G510 power off operation, which powers off directly.

+CFUN

The AT+CFUN=0 command initiates a G510 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 G510 interface signals are inactive and are kept in their previous state, prior to activating low power mode. To save power, all the G510 internal clocks and circuits are shut down, and therefore serial communications is limited.

G510 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, G510 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.
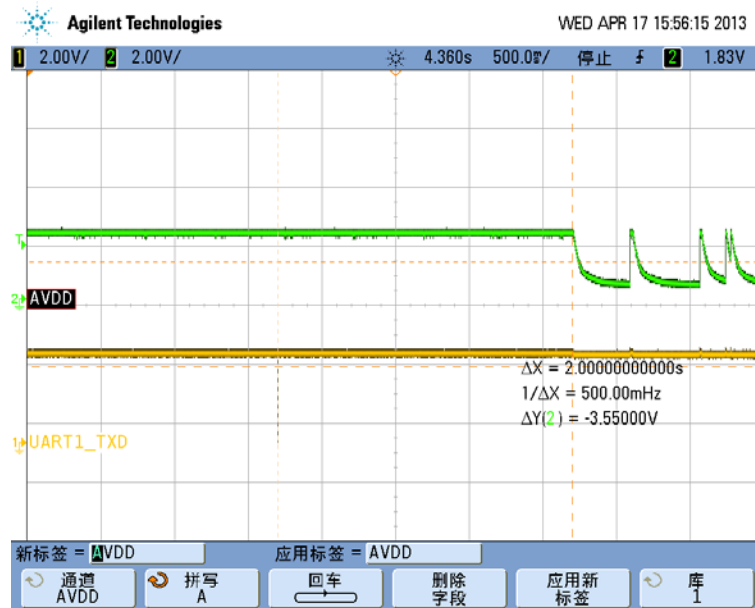

Figure 3-5   ats24=2, set module to sleep Mode after 2s

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 G510 internal clocks and circuits are disabled, in order to minimize power consumption. When terminating the Sleep mode, and switching to Idle mode, G510 requires a minimal delay time to reactivate and stabilize its internal circuits before it can respond to application data. This delay is typically of 5 ms. 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.

Depending on the type of network indication and the application settings, module may operate in several methods, which are configurable by AT commands, to alert the application of the incoming data:

a) Send data to the application over the serial interface.

b) Enable the serial interface's Ring Indicator (UART1_RING) signal.

c) LPG status indicator

➢ **Control WAKE_UP level by external circuit**

WAKE_UP connects to a GPIO on CPU; the external circuit can wake up module by controlling this GPIO. Please refer to chapter 3.10.4 for details.

➢ **UART1_DTR**

Pull UART1_DTR to VDD externally, the same methods as WAKE_UP. Set the module to sleep mode by AT commands, the duration is determined by <value> in command ats24= [<value>].

Send AT command: ats24=2, set the module to sleep mode after 2s (If there is no data interaction in UART).
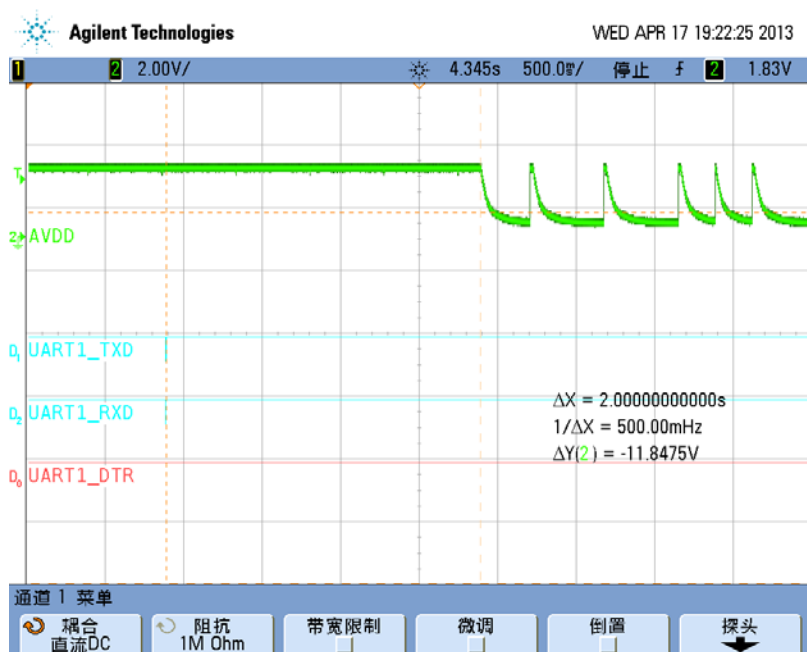

Figure 3-6   ats24=2, set module to sleep mode after 2s

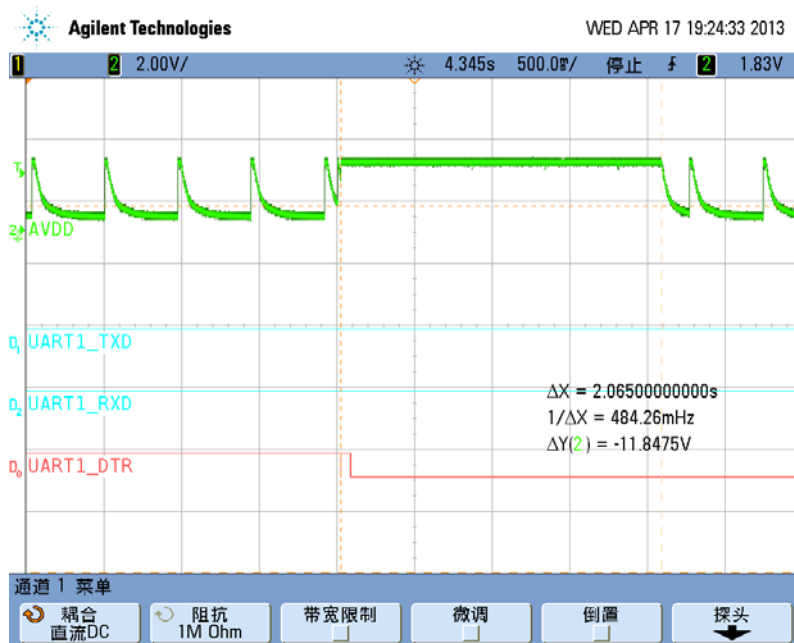Pull down DTR to wake up the module, as shown in the following figure:

Figure 3-7　　Pull down DTR, module wakes up 2s

3.5.3.2 Permanent Termination of Sleep Mode

The module Sleep mode is enabled and disabled by the ATS24 command. Before the command, G510 must be temporarily awaked.

◆　ATS24:　ATS24 = 0 disables Sleep mode. The value of ATS24 (>0) will be saved but the mode will not be save by restarting G510.

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 was not supply, the backup battery or capacitor can be supplied to RTC by interface connector RTC pin.

When the main power supply and VBCKUP is disconnected from module, the timer will reset and the current time and date will be lost. When G510 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
6	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
19	UART1_TXD	Module Transmitted Data	G510 Transmitted Data
18	UART1_RXD	Module Received Data	G510 Received Data
21	UART1_CTS	Module Clear To Send	G510 Switch To Received Mode
20	UART1_RTS	Request To Send	G510 Notice DTE Requested To Send
15	UART1_DTR	Data Terminal Ready	DTE Was Ready

16	UART1_DSR	Module Data Set Ready	G510 Was Ready
22	UART1_RING	Module Ring indicator	G510 Notice DTE Remote Call
17	UART1_DCD	Data Carrier Detect	G510 Notice DTE that Data Carrier Was Online

Recommended connection:

Application MCU	Direction	Module	
TXD	→	Pin 18	UART1_RXD
RXD	←	Pin 19	UART1_TXD
RI	←	Pin 22	UART1_RING
DSR	←	Pin 16	UART1_DSR
RTS	→	Pin 21	UART1_CTS
DTR	→	Pin 15	UART1_DTR
CTS	←	Pin 20	UART1_RTS
DCD	←	Pin 17	UART1_DCD

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
40	UART2_TXD	Module Transmitted Data	G510 Transmitted Data
39	UART2_RXD	Module Received Data	G510 Received Data

Application MCU	Direction	Module	
TXD	→	Pin 39	UART2_RXD
RXD	←	Pin 40	UART2_TXD

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 11	HST_RXD
RXD	←	Pin 12	HST_TXD

3.7.4 Ring Indicate

The UART1_RING signal serves to indicate incoming calls and other types of URCs (Unsolicited Result Code). 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.
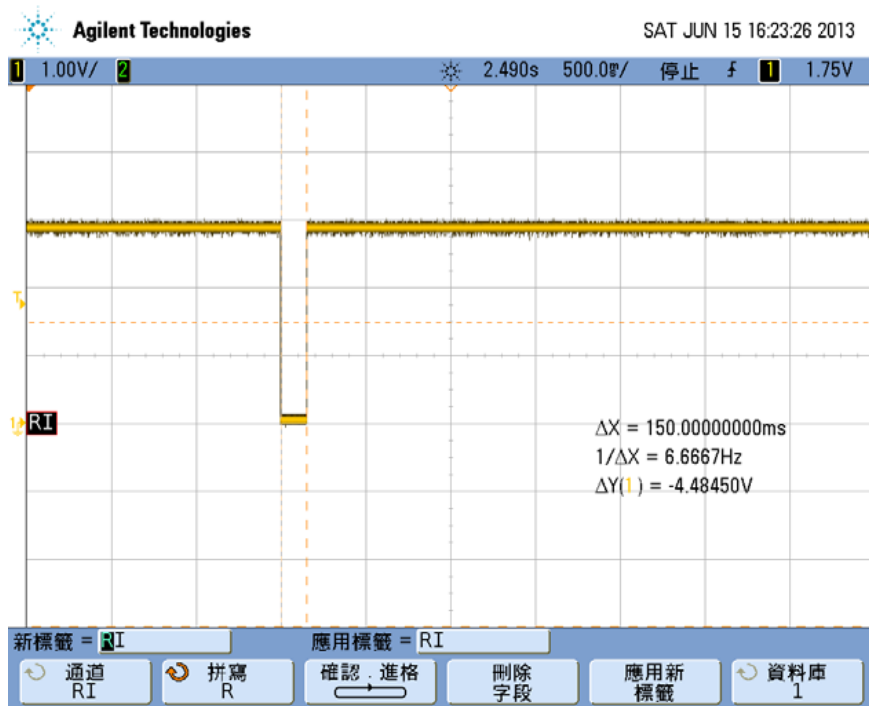

Figure 3-8   The Module gets a message

The following figure shows the UART1_RING signal status when there is an incoming call.
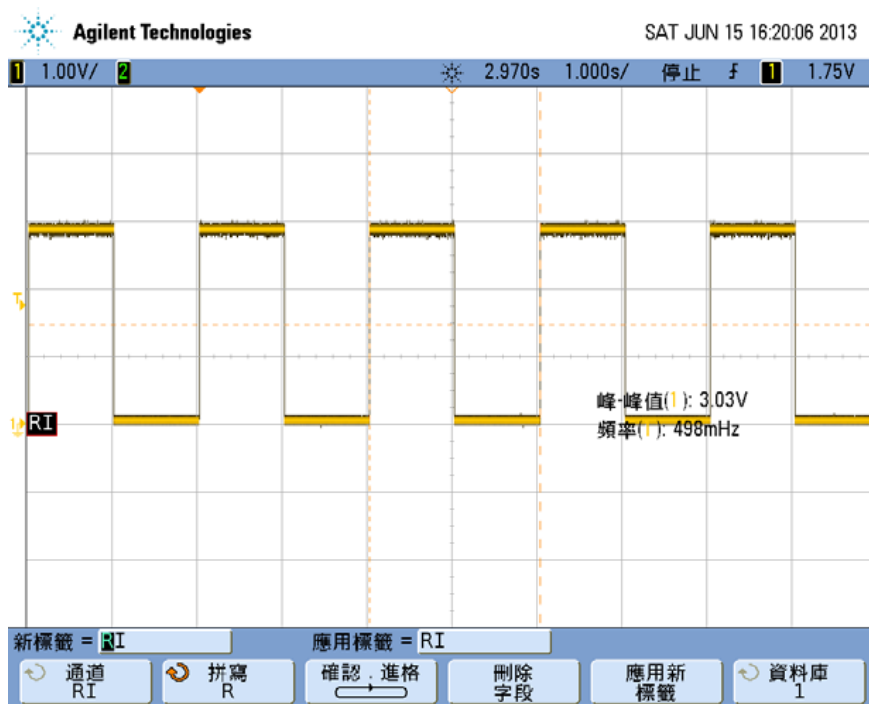

Figure 3-9   An incoming call

3.7.5 DCD Indicate

The UART1_DCD 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 G510. 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 by POWER_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.

Note: If SIM_VCC is supplied, remove SIM card is prohibited. In case, it would cause damage to SIM card and G510.

Pin No.	Signal Name	Description
24	SIM_CLK	Serial 3.25 MHz clock
26	VSIM	2.85V Supply to the SIM
23	SIM_DATA	Serial input and output data
25	SIM_RST	Active low SIM reset signal
27	SIM_CD	SIM card hot-plug

3.8.1 SIM Connection

The following figure illustrates a typical SIM interface connection to G510. This connection type is implemented on the module Developer Board, using an MOLEX SIM tray, PN 912283001 & 912360001.

To ensure the stability of SIM card, SIM_CD has to be pulled up no matter it's been used or not. You don't need to pull up SIM_DATA.
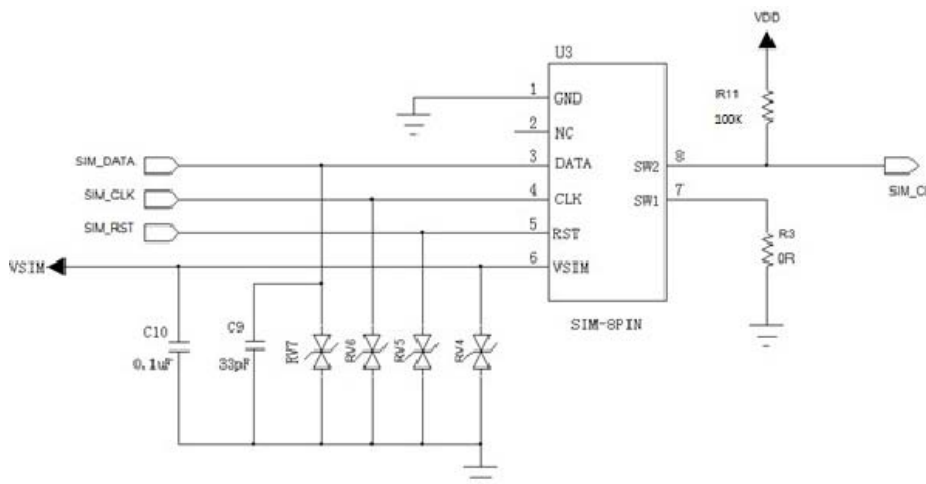

Figure 3-10   SIM card reference design

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 is AVR-M1005C270MAAB (TDK) We also recommended the ESD component should layout with SIM hold closely.

3.9 Audio 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
31	AU_MIC_P	1st Audio channel
30	AU_MIC_N	Balanced microphone input
29	AU_AUXMIC_P	2nd Audio channel
28	AU_AUXMIC_N	Balanced microphone input
35	SPEAKER_P	2nd Audio channel
36	SPEAKER_N	Output is balanced and can directly operate a hand free speaker
33	AU_RCV_P	1st Audio channel
34	AU_RCV_N	Output is balanced and can directly operate a head set

3.9.1　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. The impedance is higher than 5M Ω.

3.9.2　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 16Ω impedance.

3.9.3   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. The impedance is higher than 5M Ω.

3.9.4   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.

3.9.5   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 interferences, 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.

3.10 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
13	VDD	LDO power output Illustrating module start up
38	LPG	Module work status indicator
37	EMERG_RST	Emergency Reset
41	WAKE_UP	Wake up the module

3.10.1 VDD Reference Regulator

The module incorporates a regulated voltage output VDD. The regulator provides a 2.8V output for use by the customer application. This regulator can source up to 200mA of current to power any external digital circuits.

When the module started up by power on signal, The VDD is output. So it can be Illustrating module start up.

Note: The VDD regulator is powered from the G510's main power supply, and therefore any current sourced through this regulator originates from the G510 VBAT supply. The overall VBAT current consumed by G510 is directly affected by the VDD operation. The G510 current consumption raises with respect to the current sourced through VDD.

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

3.10.2 EMERG_RST

EMERG_RST means Emergency Reset, the system will powered off when pin is low.
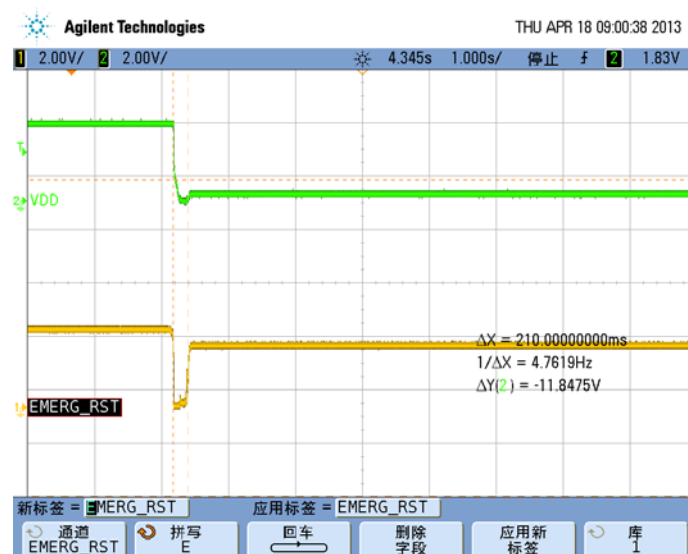
Note: only used for emergency.

Figure 3-11   EMERG_RST pull low, G510 reset peremptorily

3.10.3 LPG

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.
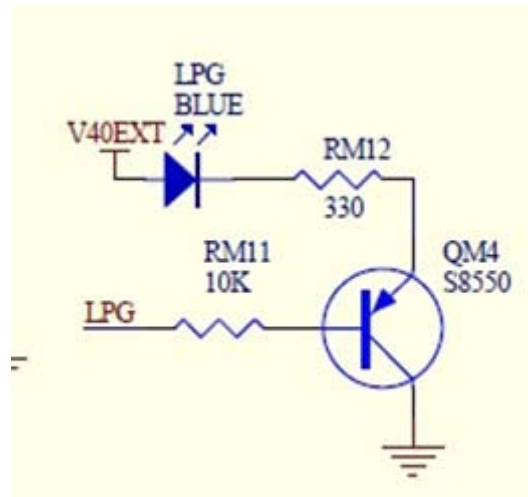
Referenced circuits:

Figure 3-12   LPG reference design

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

LED state	Operating status of the module
Permanently off	The module is in one of the following modes: • Power off mode • SLEEP mode
600 ms off / 600 ms on	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	The module is in one of the following status: • IDLE mode
75 ms off / 75 ms on	The module is in one of the following status: • One or more GPRS contexts activated.
Permanently on	The module is in one of the following status: • Voice call

3.10.4 WAKE_UP

This pin is used for waking up the module which is in sleep mode, edge trigger. The command ats24= [value], for example, send a command ats24=2, the module would be in sleep mode after 2s, supposing that you wake up the module by WAKE_UP pin temporarily, if the module doesn't receive any command or data in 2s, the module would be in sleep mode as well.

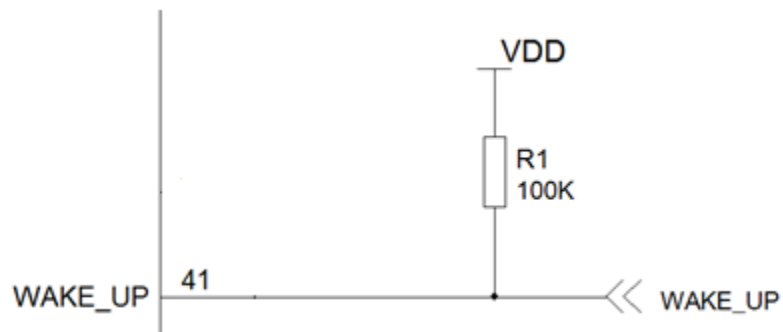The following figure shows the recommended circuit:
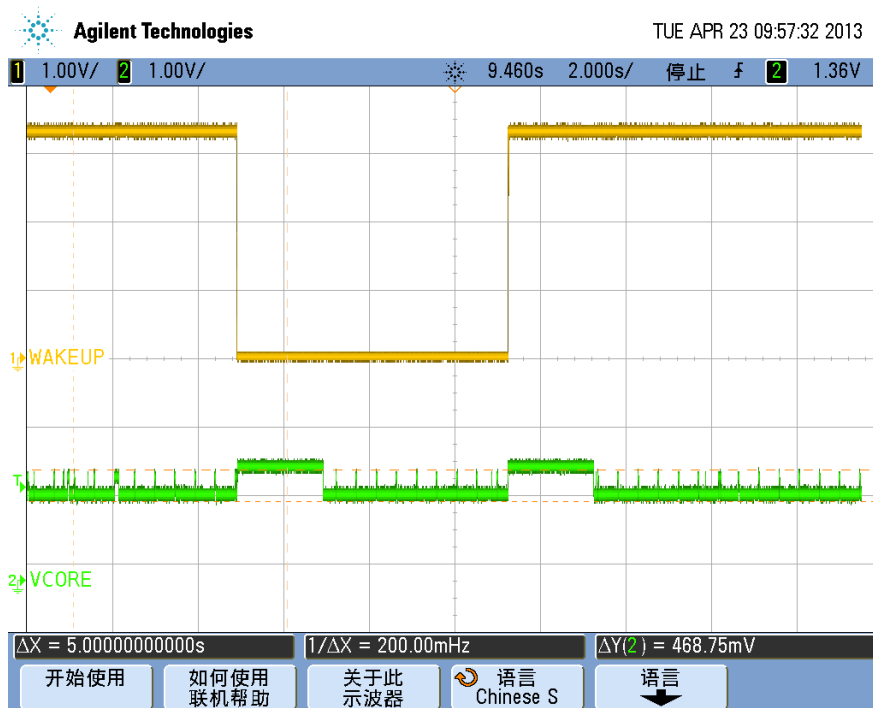

Figure 3-13   Recommended circuit for WAKE_UP

Figure 3-14   ats24=2, edge trigger, if no data after wake up, set to sleep mode again after 2s

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 G510 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	module powered on VDD Domain	-0.2	3.3	V
Analog Input Signals (Audio interfaces)	module powered on	-0.2	2.75	V

4.2 Environmental Specifications

The table gives the environmental operating conditions of the G510 module.

Note: Using the G510 module beyond these conditions may result in permanent damage to the module.

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

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. The module incorporates the necessary internal circuitry to keep unconnected signal in their default state. Do not connect any components to, or apply any voltage on, signals that are not used by the application.

G510 Pin#	G510 Signal Name	Description	I/O	Reset level	Idle level	Level Character
Power						
9	VBAT	DC power supply	I			3.3V ~ 4.5V
10						
1	GND	Ground				
2						
4						
5						
7						
8						
32						
42						
6	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						
38	LPG	Work mode indicator	O			VOL_{MAX}=0.3V VOH_{MIN}=VDD-0.35V
13	VDD	LDO power output Illustrating start up	O	2.8V	2.8V	
37	EMERG_RST	Emergency Power Off	I	PU	H	
14	POWER_ON	Turn on module Low level activated	I	PU	H	2.5V~3.3V
41	WAKE_UP	Wake up the module	I		L	VIL_{MAX}=0.2*VDD VIH_{MIN}=0.7*VDD
UART (Modem DCE)						
18	UART1_RXD	Received Data	I		L	VOL_{MAX}=0.3V VOH_{MIN}=VDD-0.35V VIL_{MAX}=0.2*VDD VIH_{MIN}=0.7*VDD
19	UART1_TXD	Transmitted Data	O		H	
22	UART1_RING	Ring indicator	O		H	
16	UART1_DSR	Data Set Ready	O		L	
20	UART1_RTS	Request To Send	O		L	
15	UART1_DTR	Data Terminal Ready	I		L	
21	UART1_CTS	Clear To Send	I		L	
17	UART1_DCD	Data Carrier Detect	O		L	
40	UART2_TXD	Transmitted Data	O		H	
39	UART2_RXD	Received Data	I		L	
Trace						
12	HST_TXD	Transmitted Data	O		H	
11	HST_RXD	Received Data	I		H	

SIM Interface						
26	VSIM	SIM power	O	0.3V	1.8V or 2.85V	
24	SIM_CLK	SIM clock	O	T	3.25MHz	VOL_{MAX}=0.3V VOH_{MIN}=VSIM-0.35V VIL_{MAX}=0.2*VSIM VIH_{MIN}=0.7*VSIM
23	SIM_DATA	SIM data	I/O			
25	SIM_RST	SIM reset	O	T	L	
27	SIM_CD	SIM card hot-plug	I			
Audio						
31	AU_MIC_P	1st Audio channel (default) Balanced input	I			
30	AU_MIC_N		I			
29	AU_AUXMIC_P	2nd Audio channel Balanced input	I			
28	AU_AUXMIC_N		I			
35	SPEAKER_P	2nd Audio channel Balanced output	O			
36	SPEAKER_N		O			
33	AU_RCV_P	1st Audio channel (default) Balanced output	O			
34	AU_RCV_N		O			
Others						
3	RF_ANT	RF antenna port				

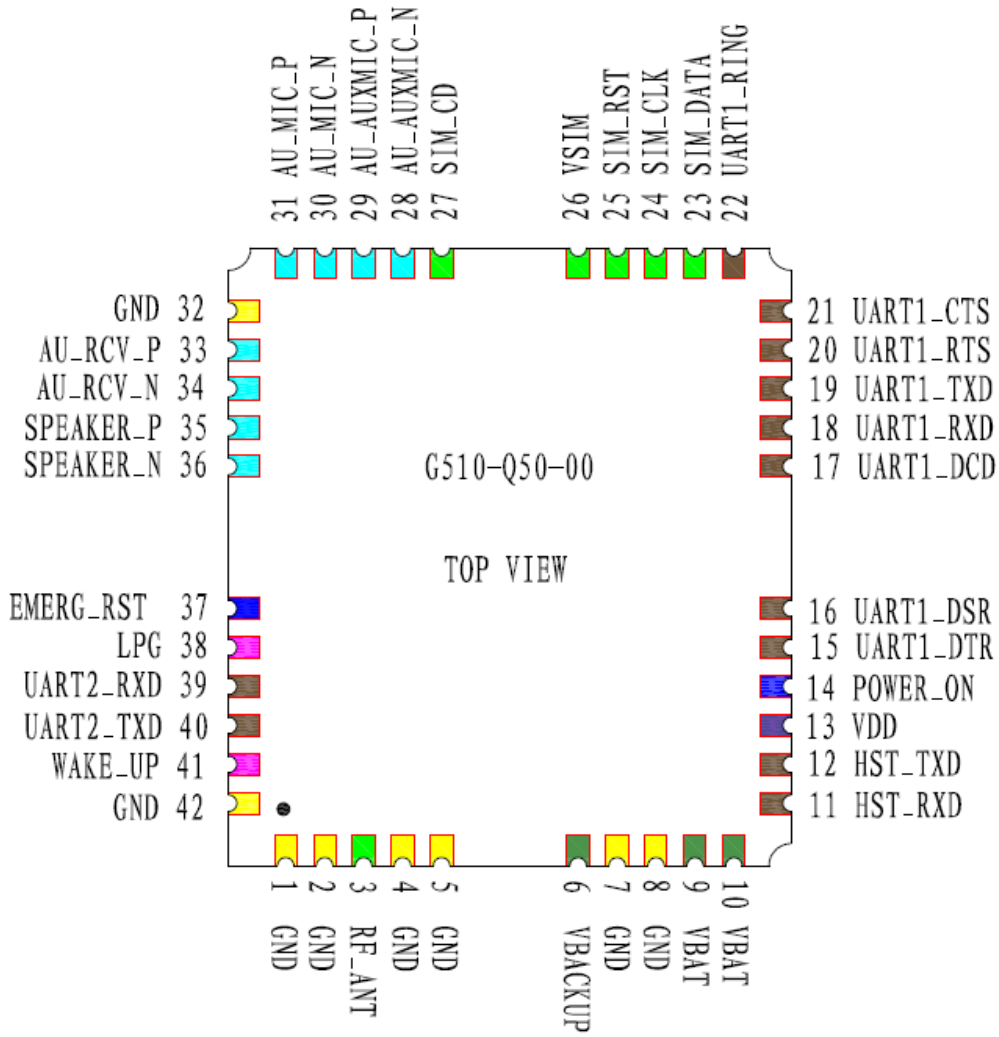**Note:** T= 3 Status

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:
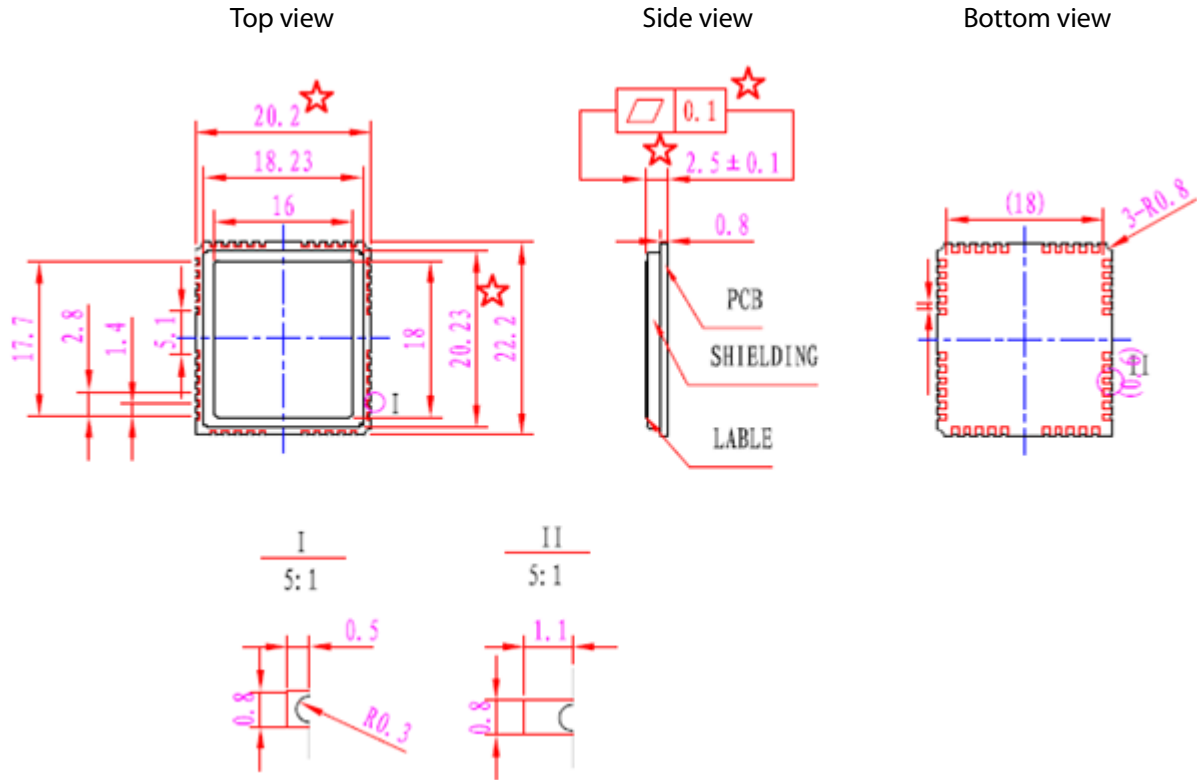

Figure 5-1 Mechanical Specifications

5.2 Recommended PCB Layout

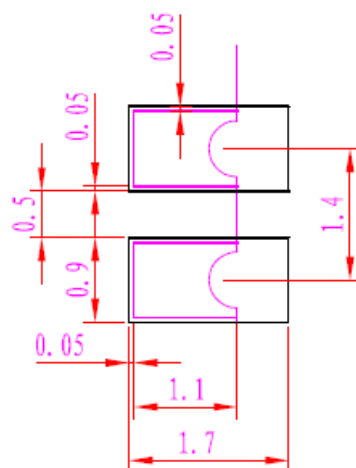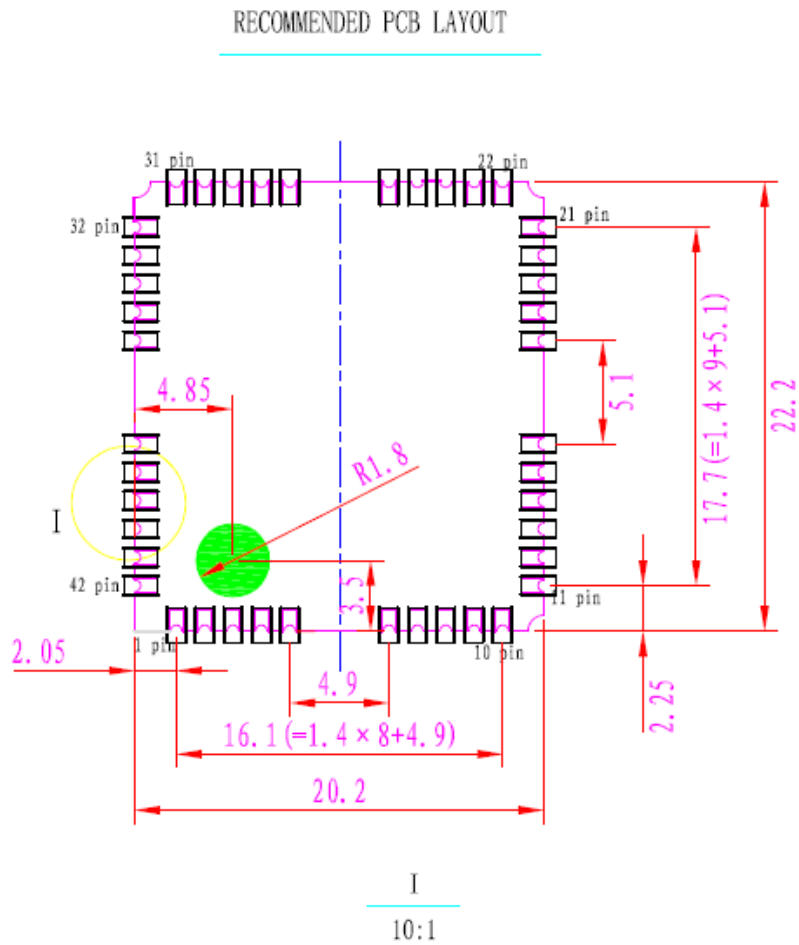The following figure shows recommended PCB layout:

Figure 5-2   Recommended PCB layout

6 Ordering Information

Product Name: G510S

Ordering Name: G510S-XXX-YY

XXX: Technical feature, ex: Q50=Quad 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

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