FIBOCOM

Perfect Wireless Connection

G610 GPRS Module

Hardware User Manual

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Revision History

Version	Date	Remarks
V1.1.1	2011-11-25	Fix few typing error
V1.1.2	2012-03-29	Fix spell mistakes
V1.1.3	2012-05-16	Modify table style
V1.1.4	2013-01-07	Add reliability features in specifications; update product picture
V1.1.5	2013-05-23	Change pin 29 and pin 30 definition
V1.1.6	2013-06-04	Update Figure3-3

Contents

1 Introduction

1.1 Scope

This manual provides the electrical, mechanical and environmental requirements for properly integrating the G610 GPRS module in a host application.

This manual gives a complete set of hardware features and functions that may be provided by G610. The availability of any feature or function, which is described in this manual, depends on the hardware revision and software version of a specific G610 GPRS 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 GPRS Module brief
- G610 GPRS Module Hardware User Manual
- G610 GPRS Module AT Command User Manual
- G610 GPRS Module AT Command Examples and Steps
- G610 GPRS Module Developer's Kit
- G610 GPRS Module Developer's Kit User Manual
- G610 GPRS Module Developer's Kit Schematics
- G610 Flash Tool Software (for Windows XP)
- G610 Mobile Analyzer Software (for Windows XP)
- G610 Modem Demo Software (for Windows XP)

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)

ITU-T V.25ter

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 GPRS Module supports GSM bands 850/900/1800/1900 MHz, with GPRS multi-slot class 10, G610 can operate on any GSM/GPRS network to provide voice and data communications.

- G610 Q50-00: Quad band (850/900/1800/1900 MHz)
- G610 A50-00 & G610 A50-01: Dual band (900/1800 MHz)

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.

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:

- A variety set of indicators and control signals
- More lower power consumption
- A variety of serial communications solutions.

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 an A/D and GPIO interface, and 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 is an SMD module, 55 pin. The G610 is extremely compact in size with a slim mechanical design, which makes its 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	Quad band (Model: G610 Q50-00):
	850/900/1800/1900 MHz
	Dual band (Model: G610 A50-00 & G610 A50-01)
	900/1800 MHz
Physical Characteristics	
Dimensions	31.3 mm x 20.2 mm x 3.0 mm
Mounting	SMT, 55 pin
Weight	3.5grams
Operational Temperature	-40°C to +85°C
Storage Temperature	-40°C to +85°C
Performance	
Operating Voltage	3.3 – 4.5V (4.0V is recommended)
Current Consumption	1.6mA @ Sleep mode
	24mA @ Idle mode
	260mA @ on call or CSD
	420mA @ on GPRS data
	MAX 2.0A @ Burst
	80uA@ Power off
	12uA @ RTC only
Tx Power	2W, 850/900 MHz
	1W, 1800/1900 MHz
Rx Sensitivity	850/900MHz: -108dBm 1800/1900MHz: -107dBm
Interfaces	
SIM Card	External SIM connectivity
	1.8V / 3.0V
Serial Ports	UART: BR from 1200bps to 230400bps Auto BR from 1200bps to 230400bps
Data Features	
GPRS	Multi-slot class 10 (4 Rx / 2 Tx / 5 Sum) Max Downlink BR 85.6kbps
	Coding scheme CS1-CS4 Class B GSM 07.10 multiplexing protocol

CSD	Max BR 9.6kbps	
SMS	MO/MT Text and PDU modes	
	Cell broadcast	
FAX	Group3 Class 2 (TS 61/62)	
Voice Features		
Differential analog audio lines	Two channel	
Vocoders	EFR/HR/FR/AMR	
DTMF Support		
Audio Control	Echo suppression, noise suppression, side tone and gain control	
Reliability Features		
Item	Test Condition	Standard
Low-temperature Storage	Temperature: –40±2ºC Test Duration: 24 h	IEC60068
High-temperature Storage	Temperature: 85±2ºC Test Duration: 24 h	IEC60068
Low-temperature Working	Temperature: –40±2ºC Test Duration: 24 h	IEC60068
High-temperature Working	Temperature: 85±2ºC Test Duration: 24 h	IEC60068
Damp Heat Cycling	High Temperature: 55±2ºC Low Temperature: 25±2ºC Humidity: 95% Repetition Times: 4 Test Duration: 12 h + 12 h	IEC60068
Temperature Shock	Low Temperature: –40±2ºC High Temperature: 85±2ºC Temperature Change Interval: < 30s Test Duration: 15 min Repetition Times: 100	IEC60068
Sine Vibration	Frequency Range: 5 Hz to 200 Hz Acceleration: 10 m/s2 Frequency Scan Rate: 1 oct/min Test Period: 3 axial directions. Five circles for each axial direction.	IEC60068
Shock Test	Half-sine Wave Shock Peak Acceleration: 300 m/s2 Shock Duration: 11 ms	IEC60068

	Test Period: 6 axial directions. One shock for each axial direction.	
Clash Test	Half-sine Wave Peak Acceleration: 180 m/s2 Pulse Duration: 6 ms Repetition Time: 6 directions. 1000 times for each direction.	IEC60068
Others		
ADC	Detect BATT voltage Detect extend analog voltage	
RTC Inside		
Flexible Status Indicator		
Extend Reset		

3 Hardware Interface Description

The following paragraphs describe in details the hardware requirements for properly interfacing and operating the G610 module.

3.1 Block Diagram

The G610 consists of the following blocks:

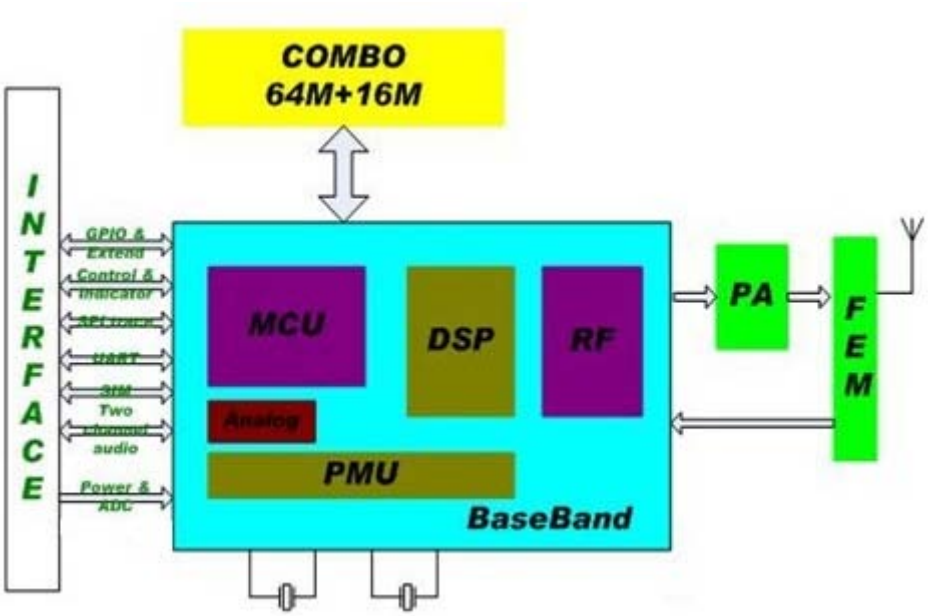


Figure 3-1

Digital Block

- Micro-controller Unit (MCU) for system and application code execution
- Digital Signal Processor (DSP) for voice and data processing
- Serial communications interfaces
- SPI for trace debug or PCM audio (option)
- SIM card
- General purpose IO signals
- Real Time Clock (RTC) subsystem

Analog Block

- Power management inside
- Internal regulators
- Analog audio interface management
- General purpose dedicated A/D signals
- BATT voltage A/D inside

GSM Transceiver Block

- 3 gain stages for the low GSM band and high GSM band
- 850/900/1800/1900 MHz
- RF receiver, which includes LNAs, Mixers, VCOs, I/Q outputs and buffers
- Signal processing IC for transmit and receive GSM data processing
- FEM - Front End Module
- Includes a harmonic filter and antenna switch
- Filter - Quad-band SAW filter that selects the required receive band

3.2 Operating Modes

The module incorporates several operating modes. Each operating mode is different in the active features and interfaces. The 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 G610 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. After reset module. Vbackup output and VDD is off.	The G610 MCU/DSP/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 BATT supply is disconnected. But valid Vbackup supply	The G610 MCU/DSP/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. CTS_N and DSR_N signals are enabled (low).	The G610 is fully active, registered to the GSM/GPRS network and ready to communicate. **Note:** This is the default power-on mode.
Sleep Mode	CTS_N signal is wave.	The G610 is in low power mode. The application interfaces are disabled, but, G610 continues to monitor the GSM network.
Call or CSD call or GPRS data	LPG signal is toggling.	A GSM voice or data call is in progress. When the call terminates, G610 returns to the last operating state (Idle or Sleep).

3.3 Power Supply

The G610 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 G610 interface connector has 2 pins for the main power supply, as described in the table. All these contacts must be used for proper operation.

Pin#	Signal Name	Description
26	BATT	DC power supply. BATT = 3.3V to 4.5V, 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.

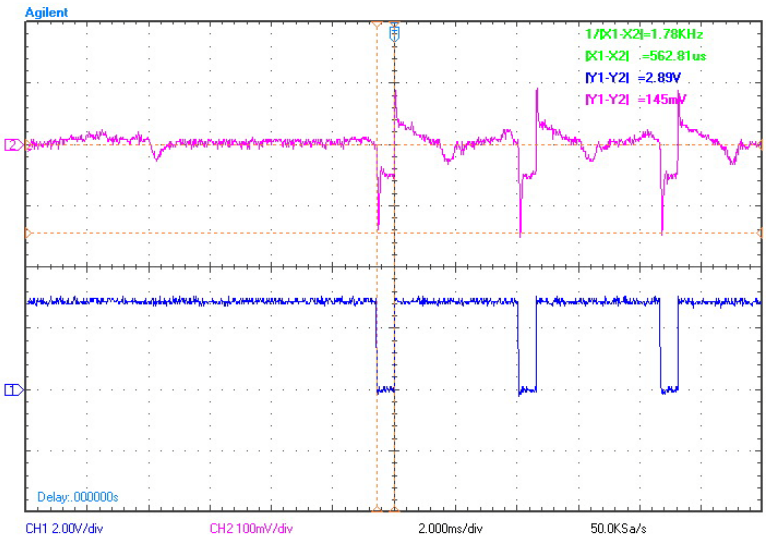


Figure 3-2

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, it is recommended to follow these guidelines:

- Use a 1000uF 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 and data sources.
8.2pF, 10pF	1800/1900 MHz GSM bands	Filters transmission EMI.
33pF, 39pF	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 BATT supply.

Measurements were taken under the following conditions:

- BATT = 4.0V
- 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	Power off mode			80	90	μA
I idle	Idle mode	GSM only, DRX=2, -85dBm GSM850/900 DSC/PCS		24		mA
I sleep	Low power mode	DRX=2 5 9		3.6 2.0 1.6		mA
I gsm-avg	Average current GSM voice 1 TX slot 1 Rx slot	GSM850/900 PCL=5 10 15 19 DCS/PCS PCL=0 5 10 15		260 150 115 110 230 140 115 110		mA

I gsm-max	Average current GSM voice	GSM850/900 PCL=5		1800	2000	mA
	1 TX slot 1 Rx slot	19 DCS/PCS PCL=0 15		300 1400 300		
I gprs-avg	Average current GPRS Class 10 2 TX slot 2 Rx slot	GSM850/900 PCL=5 19 DCS/PCS PCL=0 15		420 150 380 150		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 signal indicates whether module is powered on or off. When this signal is disabled (0V), module is powered-off. When it is output (2.85V), module is powered-on.

Note:

- When the VBAT power supplied, the module will be turn on automatically. It's the default power on mode.
- The VDD would be flowed backwards by other IOs which be connected extend voltage. So DSR/CTS/LPG can be indicated the powered on process replaced.
- Because of the BOOT feature, the TXD_N should be pulled up continuously between the module turn on process.

Pin#	Signal Name	Description
10	POWER_ON	Power on and off module, low level activated
9	VDD	Illustrating module start up LDO power output 0V : G610 is power off LDO power output 2.85V : G610 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 the module on in default power on mode.

Note: The G610 A50-01 module will not be turned on automatically. The POWER_ON signal should be low for 1600-1800 milliseconds to turn G610 A50-01 on.

The following figure illustrates power on succeeded.

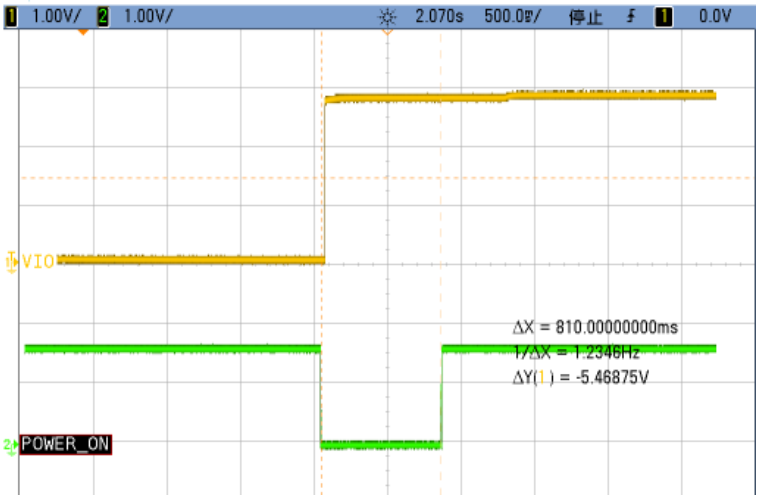


Figure 3-3

The following figure illustrates power on is failed.

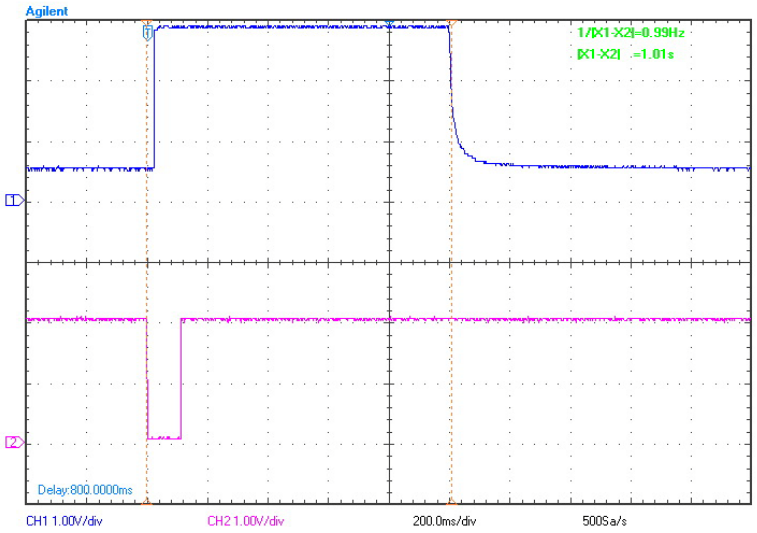


Figure 3-4

3.4.2 Turning off the Module

There are several ways to turn off the module: Asserting the POWER_ON signal low for a minimum of 3 seconds. Under voltage automatic shutdown or the module can be powered off using AT command, please refer to *G600&G610 GPRS Module AT Command User Manual*.

1. POWER_ON Signal

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

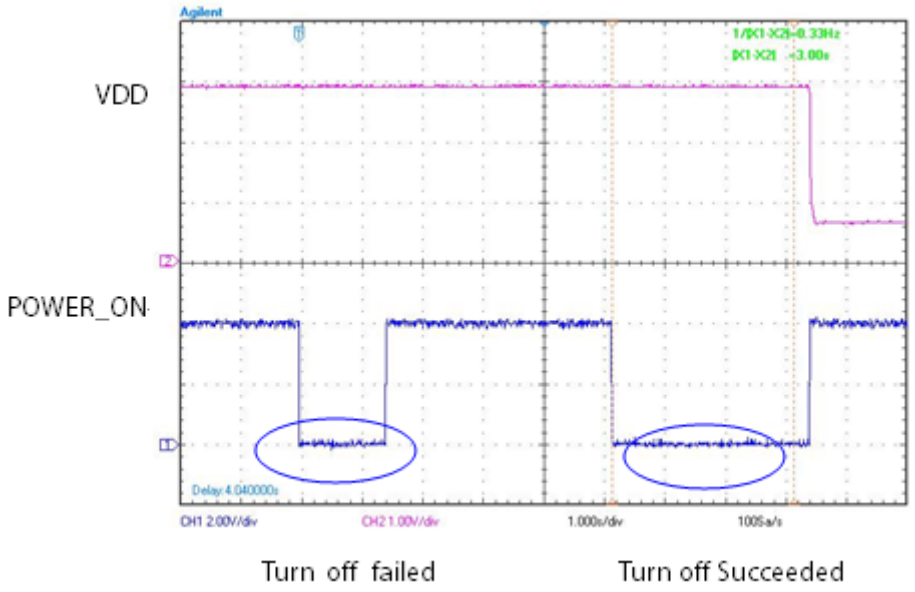


Figure 3-5

2. Under Voltage automatic shutdown

A low power shut down occurs when G610 senses the external power supply is below the minimal operating limit (VBAT≤3.2V). The module will respond by powering down automatically without notice.

This form of power-down is not recommended for regular use since the unexpected power loss may result in loss of data.

3. 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 module internal clocks and circuits are shut down, and therefore serial communications is limited.

The CTS_N signal is alternately enabled (LOW level) and disabled (HIGH level) synchronously with Sleep Mode and Idle mode. At the same time this indicates the module serial interfaces are active.

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.

All of the description about CTS_N, it must be set the UART to HARDWARE FLOW control by AT command.

3.5.1 Activating Sleep Mode

By default, the G610 powers on in Idle Mode. The ATS24 default is 0. In this mode the G610 interfaces and features are functional and the module is fully active. Sleep mode is activated by the ATS24 command. Such as ATS24 would be activated Sleep mode at soon.

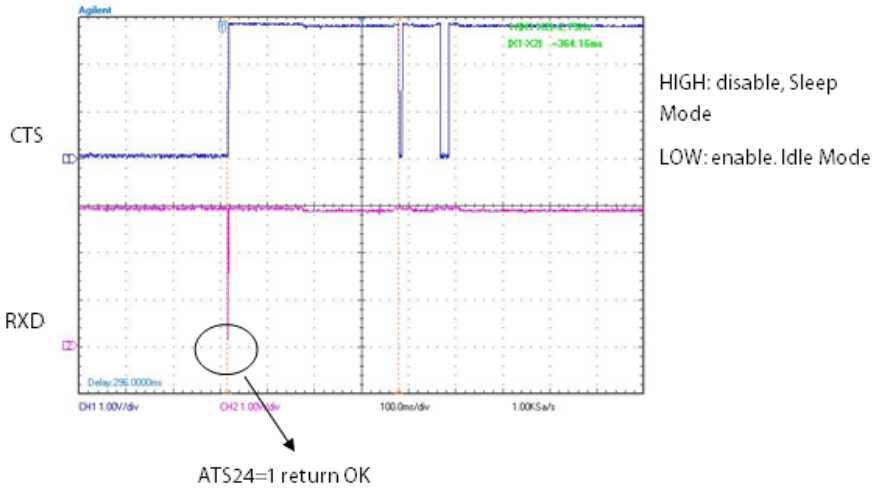


Figure 3-6

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. During this short awake period, the serial interfaces are enabled and communications with the module is possible.

The CTS_N signal is alternately enabled and disabled synchronously with the network paging cycle. CTS_N is enabled whenever module awakes to page the network. The period based on the DRX parameter of the network.

4.615ms (TDMA frame duration) * 51 (number of frames) * DRX value

At the same time, the CTS_N indicates the G610 serial interfaces are active or inactive.

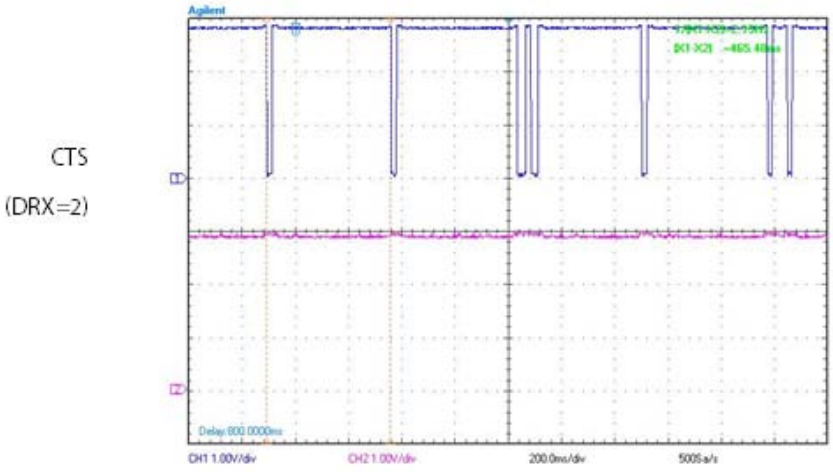


Figure 3-7

3.5.3 Terminating Sleep Mode

Terminating the Sleep mode, or wake-up, is defined as the transition of the G610 operating state from Sleep mode to Idle mode. There are several ways to wake-up G610 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, and is also indicated by the CTS_N signal inactive (high) state. 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 G610 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, G610 continues monitoring the GSM network for any incoming data, message or voice calls. When G610 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 G610 wakes up to Idle mode all its interfaces are enabled.

Depending on the type of network indication and the application settings, G610 may operate in several methods, which are configurable by AT commands, to alert the application of the incoming data:

1) Enable the serial interface's CTS_N
2) Send data to the application over the serial interface.
3) Enable the serial interface's Ring Indicator (RING_N) signal.
4) LPG status indicator

Data on the Serial interface

During Sleep mode, serial communications is limited to short periods, while G610 is paging the network. When the serial interface is active, data can be exchanged between the application and the G610. The G610 will not return to Sleep mode until the serial interface transmission is completed and all the data is processed.

Only when the serial interface transfer is completed and the data is processed, G610 will return to Sleep mode automatically, according to the ATS24 settings.

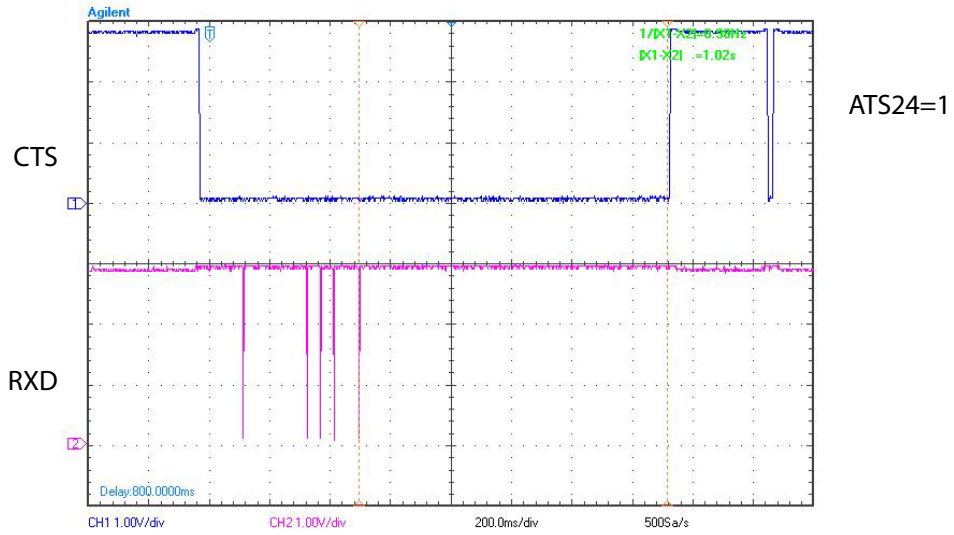


Figure 3-8

1) The G610 serial interface is set HARDWARE FLOW (AT+IFC=2,2)

When the following conditions are true, the G610 will receive the data from a DTE (Data Terminal Equipment) and go back to Idle mode for response.

a) G610 serial interface is set HARDWARE FLOW by AT+IFC command.

b) The RTS/CTS of G610 were connected to the DTE (Data Terminal Equipment).

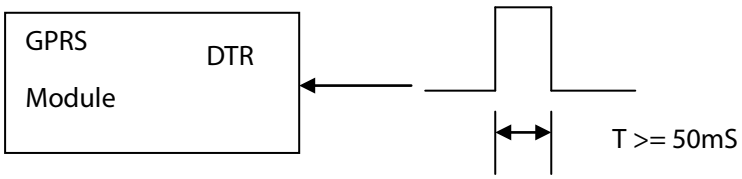
c) The DTE serial interface is running with HARDWARE FLOW.

2) The G610 serial interface is set NONE FLOW (AT+IFC=0,0)(The default value)

Most of serial data from DTE to G610 will be lost when the G610 serial interface is set NONE FLOW (default value). The G610 will receive the data and make responses after it go back to Idle mode.

DTR signal trigger

During Sleep mode, DTR signal can be triggered the module back to Idle mode.



It recommends that the serial data should better be sent to module 20mS later when DTR triggered.

If there isn't any other termination status the module will go back to Sleep mode depend on ATS24 value.

3.5.3.2 Permanent termination of Sleep Mode

The module Sleep mode is enabled and disabled by the ATS24 command.

- ATS24 : ATS24 = 0 disables Sleep mode. The value of ATS24 (>0) will be saved but the mode will not be save by re-power G610.

3.6 Real Time Clock

G610 incorporates a Real Time Clock (RTC) mechanism that performs many internal functions, one of which is keeping time. The RTC subsystem is embedded in the PMU and operates in all of the G610 operating modes (Off, Idle, Sleep), as long as power is supplied above the minimum operating level.

When the main power was not supply, the backup battery or capacitor can be supplied to RTC by interface connector VBACKUP.

When the main power supply and VBACKUP is disconnected from G610, the RTC timer will reset and the current time and date will be lost. On the next G610 power-up the time and date will need to be set again automatically or manually.

3.6.1 VBACKUP Description

Pin#	Signal Name	Description
8	VBACKUP	Real time clock power

- When main power BATT is supplied. The VBACKUP output 2.0V for external battery or capacitor charging. The charging current base on external resistor.
- When main power BATT is disconnected. The VBACKUP supply the RTC by External battery or capacitor. The RTC power consumption is about 12uA. The voltage cannot be over 2.2V.
- The VBACKUP is supplied by a capacitor. The backup time can be calculated by capacitance approximately.

$T(s) \approx C(uF)/1.3$

3.6.2 RTC Application

The G610 time and date can be set using the following methods:

- Automatically retrieved from the GSM network. In case G610 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 G610 operating state.

3.7 UART

G610 has a completely independent serial communications interface (UART).

The G610 UART is a standard 8-signal bus. This UART is used for all the communications with G610 - AT commands interface, GPRS/EGPRS data and CSD data, programming and software upgrades.

The UART signals are active low CMOS level signals. For standard RS232 communications with a PC, an external transceiver is required.

G610 is defined as a DCE (Data Communications Equipment) 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#	Signal Name	Description	Feature	Direction
45	RXD_N	Module Transmitted Data	DTE Received Data	DCE→DTE
44	TXD_N	Module Received Data	DTE Transmitted Data	DTE→DCE
39	RING_N	Module Ring indicator	Notice DTE Remote Call	DCE→DTE
38	DSR_N	Module Data Set Ready	DCE Was Ready	DCE→DTE
42	RTS_N	Request To Send	DTE Notice DCE Requested To Send	DTE→DCE
40	DTR_N	Data Terminal Ready	DTE Was Ready	DTE→DCE
43	CTS_N	Module Clear To Send	DCE Switch To Received Mode	DCE→DTE
41	DCD_N	Data Carrier Detect	Data Carrier Was Online	DCE→DTE

Recommended connection:

Application MCU	Direction	Module	
RXD	←	Pin 45	RXD_N
TXD	→	Pin 44	TXD_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

The G610 UART supports baud rates 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400bps. Auto baud rate detection is supported for baud rates up to 230400bps.

All flow control handshakes are supported: hardware or none.

The UART default port configuration is 8 data bits, 1 stop bit and no parity, with NONE FLOW control and auto baud rate detect enabled.

Note: The auto baud will be availability at the first time after power on. The UART will be no answer probably if switch to another baud rate at working.

3.7.1 Ring Indicate

The RING_N 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. In IDLE mode, the RING_N is high. It is only indicating a type of event at a time:

1) When a voice call comes in, the RING_N line goes low for 1 second and high for another 4 seconds. Every 5 seconds as a cycle.

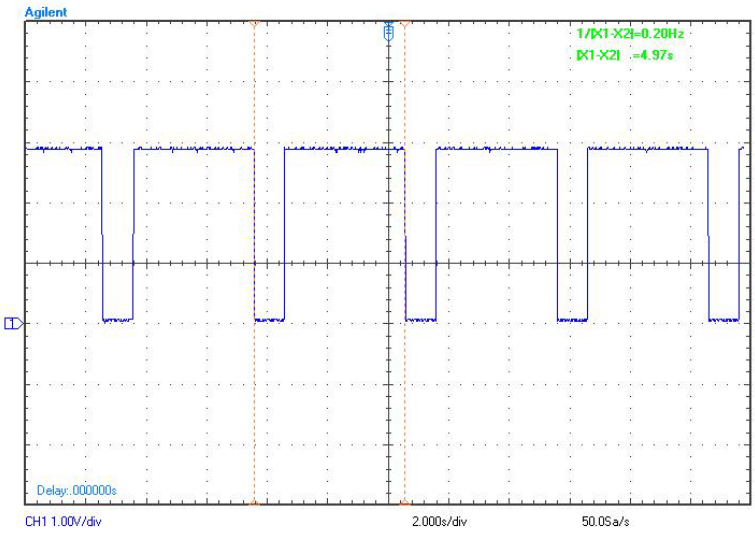


Figure 3-9

2) When a FAX call comes in, the RING_N line low for 1s and high for another 4s. Every 5 seconds as a cycle.

3) When a Short massage comes in, the RING_N line to low for 150mS, and always high.

3.7.2 DCD Indicate

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

3.8 SIM Interface

The G610 incorporates a SIM interface, which conforms to 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 G610 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 3.0V 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 damage both SIM card and G610.

Pin#	Signal Name	Description
5	SIM_CLK	Serial 3.25MHz clock
2	SIM_VCC	1.8V or 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 on site detected

3.8.1 SIM Connection

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

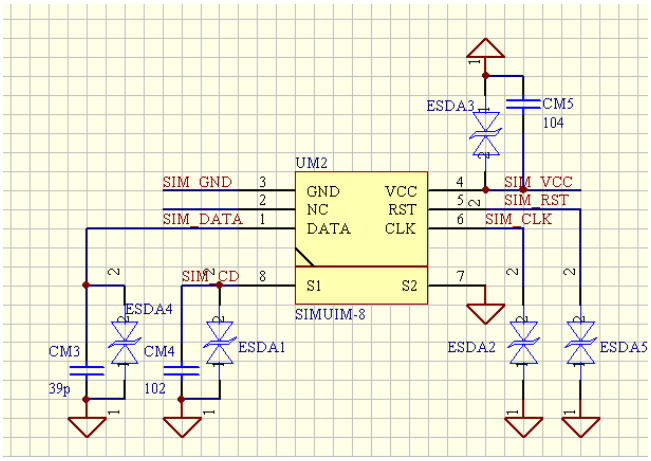


Figure 3-10

3.8.2 SIM Design Guidelines

The SIM interface and signals design is extremely important for proper operation of the 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 100mm 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-M1005C080MTAAB (TDK). We also recommended the ESD component should layout with SIM hold closely.

3.8.3 SIM Detected Feature

When set AT+MSMPD=1, the SIM detected feature will be actives. The SIM card is on site or not will be detected with SIM_CD pin.

SIM_CD=Low level, SIM card is onsite and register the network automatically.

SIM_CD=High or NC, SIM card is off site and G610 drop out the network.

Note: The default value of MSMPD parameter is “0”. And also, the SIM detected feature was disabled correspondingly.

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#	Signal Name	Description
13	MIC-	1st Audio channel Balanced microphone input
14	MIC+	
11	AUXI+	2nd Audio channel Balanced microphone input
12	AUXI-	
16	EAR-	1st Audio channel Output is balanced and can directly operate an head set
15	EAR+	
18	AUXO+	2nd Audio channel Output is balanced and can directly operate an hand free speaker
17	AUXO-	

3.9.1 The First 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. It has an impedance of 2kΩ.

The bias voltage would be supplied after a voice call establish.

Parameter	Conditions	Min	Typical	Max	Unit
Bias Voltage	No load	1.8	2.0	2.2	V
Gain	Programmable in 3dB steps	0		45	dB
AC Input Impedance			2		kΩ

3.9.2 The First Audio Channel: Speaker

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.

Parameter	Conditions	Min	Typical	Max	Unit
Output Voltage	No load Single ended			200	mVPP
AC Output Impedance			32		Ω
DC Voltage			1.38		V

3.9.3 The Second Audio Channel: Microphone

This channel is switched on 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. It has an impedance of 2kΩ.

The bias voltage would be supplied after G610 powered on.

Parameter	Conditions	Min	Typical	Max	Unit
Bias Voltage	No load			2.5	V
Gain	Programmable in 3dB steps	0		45	dB
AC Input Impedance			2		kΩ

3.9.4 The Second Audio Channel: Speaker

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

Parameter	Conditions	Min	Typical	Max	Unit
Output Voltage	No load Single ended			500	mVPP
AC Output Impedance			8		Ω
DC Voltage			1.38		V

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 (217Hz 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 G610's audio circuits through the microphone input signals and then are amplified by the G610'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:

- Reference the microphone input circuits to the G610 AGND interface signal.
- If using single-ended audio outputs, they should be referenced to the G610 AGND interface signal.
- Keep the audio circuits away from the antenna.
- Use RF filtering capacitors on the audio signals.
- The audio signals should not be routed adjacent to digital signals.
- Isolate the audio signals by a surrounding ground plane or shields.
- Filter internal supplies and signals that may indirectly affect the audio circuits, from noises and voltage drops.

3.9.6 Switch Audio Channel by IO

The module support switch audio channel by IO pin. The default level of this pin is high. This IO pin is took effect under 1st channel is activated.

When the IO is pulled low, the audio channel will be switched from 1st channel to 2nd channel automatically. When the IO level is back to High, the audio channel will be back to 1st channel.

If the audio 2nd channel is activated, this PIN will not do any effect at all.

Pin#	Signal Name	Description
47	HS_DET	1st channel is activated. Level = Low, the 2nd channel is activated Level = High, back to the 1st channel

Note: After the MAPATH command was switch the audio channel, this PIN does not effect at all.

3.10 A/D Interface

The G610 includes 3 Analog to Digital Converter (ADC) (2 ADC and 1 BATT ADC) signals with 12-bit resolution, for environmental and electrical measurements. The ADC signals accept an analog DC voltage level on their inputs and convert it to a 12-bit digital value for further processing by G610 or the user application.

In Idle mode, the ADC input is sampled consecutive times by sampling time interval, and the lasted 8 samples are compared and averaged to provide a stable and valid result.

In Sleep mode, the ADC is stopped. When the G610 switch to Idle mode, the ADC should be stable after 5mS.

3.10.1 Power Supply ADC

The main power supply (BATT) is sampled internally by the G610 ADC interface through a dedicated input, which is not accessible on the interface connector. The G610 constantly monitors the power supply for any low or high voltage.

Parameter	Conditions	Min	Typical	Max	Unit
Supply Range	Operating range	3.20		4.50	V
Resolution			1.0		%
Sampling Time				16	KHz

The ADC signals operation and reporting mechanism is defined by the AT+CBC command.

3.10.2 General Purpose ADC

The G610 provides 2 general purpose ADC signal for customer application use. The ADC signal can monitor a separate external voltage and report its measured level independently to the application, through the AT command interface.

Pin#	Signal Name	Description
19	ADC2	General purpose ADC
20	ADC1	General purpose ADC

Parameter	Conditions	Min	Typical	Max	Unit
Input Voltage	Operating range	0		1.00	V
Resolution			0.5		%
Sampling Time				16	KHz

The ADC signals operation and reporting mechanism is defined by the AT+MMAD command.

3.11 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#	Signal Name	Description
9	VDD	LDO power output Illustrating module start up
49	LPG	Module work status indicator
7	RESET_N	Extend reset module Low level activated

3.11.1 VDD Reference Regulator

The G610 incorporates a regulated voltage output VDD. The regulator provides a 2.85V output for use by the customer application. This regulator can source up to 10mA of current to power any external digital circuits.

When the G610 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 G610's main power supply, and therefore any current sourced through this regulator originates from the G610 BATT supply. The overall BATT 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	Iout=30mA	-3%	2.85	3%	V
Iout			10	30	mA
Imax	Current pulled down from LDO to GND until LDO voltage is 50% of nominal value			150	mA
External Capacitor		-35%	1	35%	uF
PSRR	50Hz - 20kHz		35		dB

3.11.2 External Reset

The RESET_N input signal would be power off the G610 immediately. This signal is set high after power up, when G610 is operating. It is set low when G610 is powered off.

When the RESET_N signal is low, the G610 is powered off without the work net logging out.

Note: It's recommended that it should connect the 1nF capacitor to GND on external circuit.

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

3.11.3 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 G610 status straight.

Referenced circuits about LED driver see below.

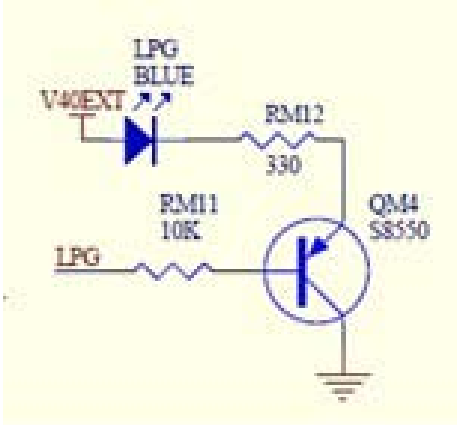
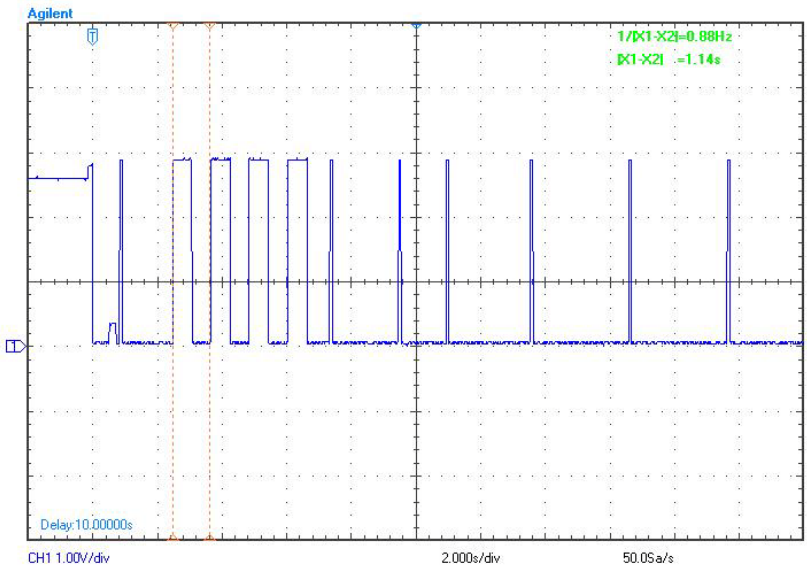


Figure 3-11

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

LED State	Operating Status of G610
Permanently off	G610 is in one of the following modes: • Power off mode • SLEEP mode
600ms on / 600ms off	G610 is in one of the following status: • NO SIM card • SIM PIN • Register network (T<15S) • Register network failure (always)
3s on / 75ms off	G610 is in one of the following status: • IDLE mode
75ms on / 75ms off	G610 is in one of the following status: • One or more GPRS contexts activated.
Permanently on	G610 is in one of the following status: • Voice call • CSD or FAX call

When the G610 POWER ON, the LPG timing see as below:



POWER_ON Register network IDLE mode

Figure 3-12

3.11.4 Trace Ports

The GSM/GPRS network and the module is incorporated a complicated system. The module prepared the trace function for debugged or acquired the data of the system. The module transfers these data from SPI port. It can be operated on the PC software and execute by SPI adaptor to RS232.

Note: It's recommend that reserved these ports and connected to a socket in any design.

Pin#	Signal Name	Description
53	PCM_DIN TR_MISO	Trace data input
50	PCM_FS TR_MOSI	Trace data output
52	PCM_CLK TR_CLK	Trace clock output
51	PCM_DOUT TR_CS	General purpose I/O
48	TR_INT	Trace Interrupt Input

3.11.5 General Purpose I/O

The G610 incorporates 8 general purpose IO signals for the user application. Each GPIO signal may be configured and controlled by AT command. These signals may be used to control or set external application circuits, or to receive indications from the external application.

Pin#	Signal Name	Description
35	GPIO01	Bit1
34	GPIO02	Bit2
33	GPIO03	Bit3
32	GPIO04	Bit4
37	SCL/GPIO18	Bit5
36	SDA/GPIO19	Bit6
31	GPIO07	Bit7
54	GPIO36	Bit8

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 G610 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	G610 powered on VDD Domain	-0.2	3.3	V
Analog Input Signals (Audio, A/D interfaces)	G610 powered on	-0.2	2.75	V

4.2 Environmental Specifications

The table gives the environmental operating conditions of the module.

Note: Using the G610 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		± 4 ± 8	KV 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. G610 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.

G610 Pin#	G610 Signal Name	Description	I/O	Reset level	Idle level	Level Character
Power						
26	BATT	DC power supply	I			3.3V ~ 4.5V
27						
1	GND	Ground				
21						
22						
24						
25						
28						
46						
8	VBACKUP	Real time clock power	I/O	2.0V	2.0V	1.86V ~ 2.14V, Output current <3mA, Input current <12uA
29	NC	No connect				_
30	NC	No connect				_
Control & Status						
49	LPG	Work mode indicator	O	CP	Wave	VOL_{MAX}=0.35V VOH_{MIN}=VDD-0.35V
9	VDD	LDO power output Illustrating start up	O	0.3V	2.85V	±3% Output current <10mA
7	RESET_N	Extend reset** Low level activated	I	PU/HZ	H	VIL_{MAX}=0.2V VIH_{MIN}=0.7*VDD
10	POWER_ON	Turn on module Low level activated	I	PU/HZ	H	VIL_{MAX}=0.2V VIH_{MIN}=0.7*VDD 220K PU to VBACKUP
Uart (Modem DCE)						
45	RXD_N	DTE: Received Data DCE: Transmitted Data	O	CP	H	VOL_{MAX}=0.35V VOH_{MIN}=VDD-0.35V VIL_{MAX}=0.2V VIH_{MIN}=0.7*VDD
44	TXD_N	DTE: Transmitted Data DCE: Received Data	I	CP	H	
39	RING_N	Ring indicator	O	CP	H	
38	DSR_N	Data Set Ready	O	CP	H	
42	RTS_N	Request To Send	I	CP	H	
40	DTR_N	Data Terminal Ready	I	CP	H	
43	CTS_N	Clear To Send	O	CP	L	

41	DCD_N	Data Carrier Detect	O	CP	H	
SIM Interface (3.0V)						
2	SIM_VCC	SIM power	O	0.3V	1.8V 2.85V	±3% Output current <10mA
5	SIM_CLK	SIM clock	O	T	3.25MHz	VOL_{MAX}=0.35V VOH_{MIN}=VSIM-0.35V VIL_{MAX}=0.2V VIH_{MIN}=0.7*VSIM
4	SIM_DATA	SIM data	I/O	OD/PD	Wave	
6	SIM_RST	SIM reset	O	T	L	
3	SIM_CD	SIM on site detect High level is on site	I	T	L	
PCM audio / Trace (SPI)						
53	PCM_DIN	Trace data input	I	CP	H	VOL_{MAX}=0.35V VOH_{MIN}=VDD-0.35V VIL_{MAX}=0.2V VIH_{MIN}=0.7*VDD
50	PCM_FS	Trace data output	O	CP	H	
52	PCM_CLK	Trace clock output	O	CP	L	
51	PCM_DOUT	General purpose I/O	O	CP	H	
48	TR_INT	Trace Interrupt Input	I	CP	H	
Audio						
13	MIC-	1st Audio channel (default) Balanced input	I	0V	0V	
14	MIC+					
11	AUXI+	2nd Audio channel Balanced input	I	0V	2.85V	
12	AUXI-				0V	
16	EAR-	1st Audio channel (default) Balanced output	O	0V	0V	
15	EAR+					
18	AUXO+	2nd Audio channel Balanced output	O	0V	1.0V	
17	AUXO-					
Discrete						
23	RF_ANT	RF antenna port				
47	HS_DET	Headset detect				
19	ADC2	General purpose A/D	I	0V	0V	0V ~ 1.000V
20	ADC1	General purpose A/D	I	0V	0V	0V ~ 1.000V
36	SDA/GPIO19	I2C_SDA	I/O	OD	OD	Extend voltage
37	SCL/GPIO18	I2C_SCL	I/O	OD	OD	
31	GPIO07	General purpose IO	I	T	T	VOL_{MAX}=0.35V VOH_{MIN}=VDD-0.35V VIL_{MAX}=0.2V VIH_{MIN}=0.7*VDD
35	GPIO01	General purpose IO	O	T	T	
34	GPIO02	General purpose IO	O	T	T	
33	GPIO03	General purpose IO	O	T	T	
32	GPIO04	General purpose IO	O	T	T	
54	GPIO36	General purpose IO	O	CP	H	
55	NC					

Note:

- CP=Center Pin; T= 3 Status; PD= Pull Down; PU=Pull Up; OD=Open Drain
- The sum of sank or sourced currents in the connection between the IO cannot exceed 10mA @ 3.3V.

4.4 Pin Definitions

Figure 4-1

Pin No.	Signal Name	Pin No.	Signal Name
1	GND	55	NC
2	SIM_VCC	54	GPIO36
3	SIM_CD	53	PCM_DIN
4	SIM_DATA	52	PCM_CLK
5	SIM_CLK	51	PCM_DOUT
6	SIM_RST	50	PCM_FS
7	RESET_N	49	LPG
8	VBACKUP	48	TR_INT
9	VDD	47	HS_DET
10	POWER_ON	46	GND
11	AUXI+	45	RXD_N
12	AUXI-	44	TXD_N
13	MIC-	43	CTS_N
14	MIC+	42	RTS_N

Pin No.	Signal Name	Pin No.	Signal Name
15	EAR+	41	DCD_N
16	EAR-	40	DTR_N
17	AUXO-	39	RING_N
18	AUXO+	38	DSR_N
19	ADC2	37	SCL/GPIO18
20	ADC1	36	SDA/GPIO19
21	GND	35	GPIO01
22	GND	34	GPIO02
23	RF_ANT	33	GPIO03
		32	GPIO04
24	GND	31	GPIO07
25	GND	30	NC
26	BATT	29	NC
27	BATT	28	GND

5 Mechanical Design

5.1 Mechanical Specifications

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

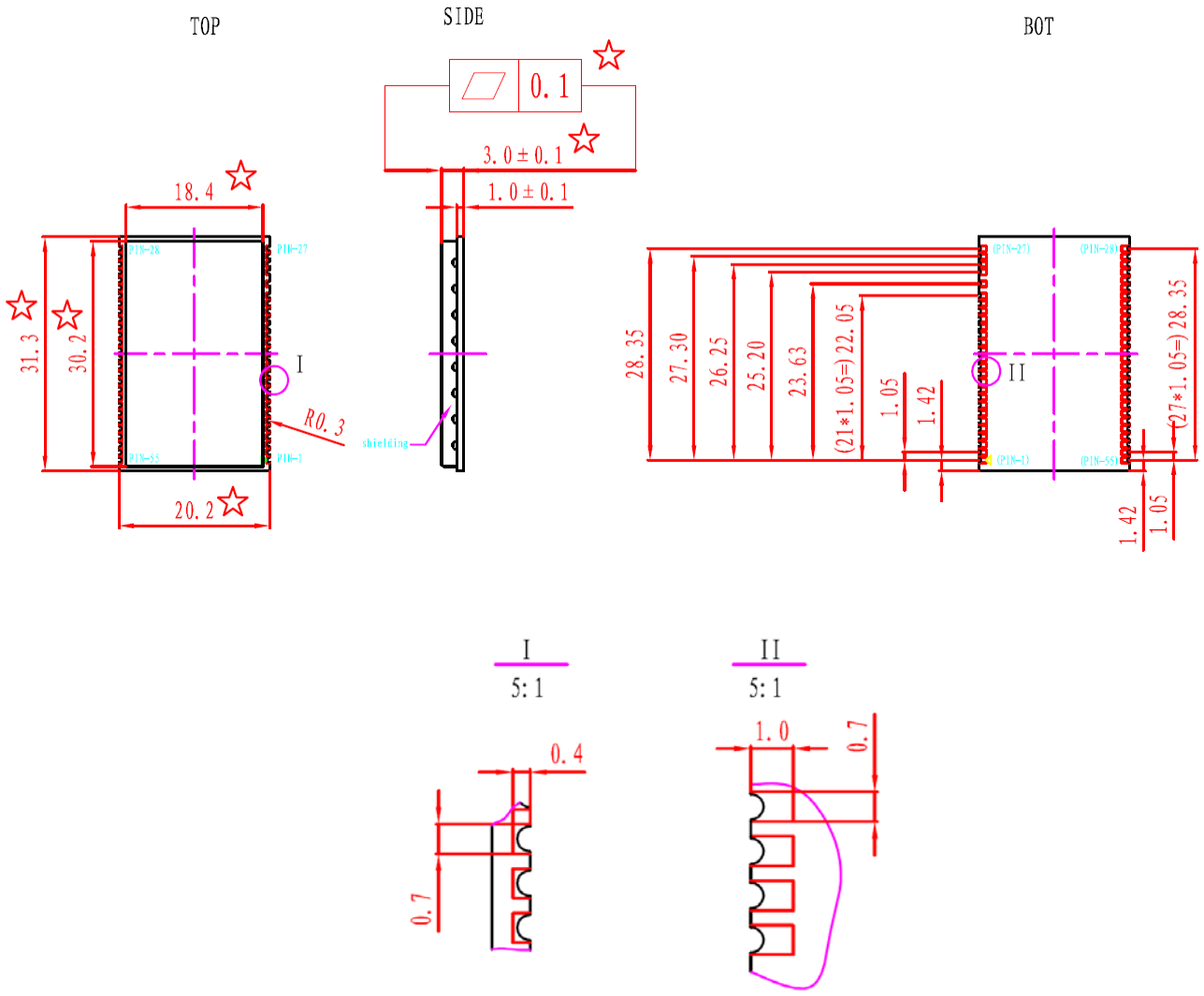


Figure 5-1

5.2 Recommended PCB Layout

The following figure shows recommended PCB Layout.

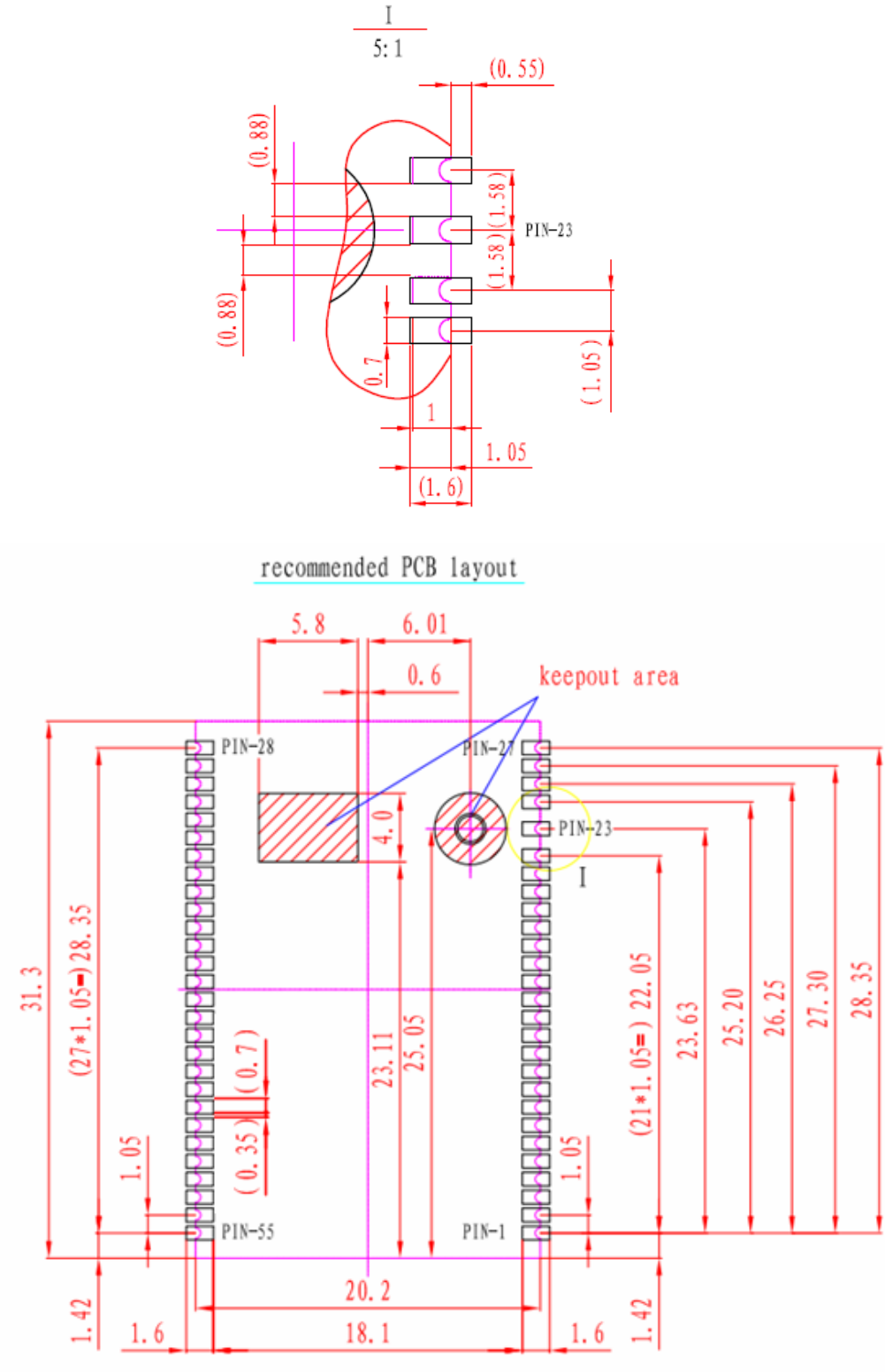


Figure 5-2

5.3 Antenna Design

The RF I/O Antenna signal is by default provided to 50ohm antenna interface. In user's main board, the Antenna layout should be design 50ohm Microstrip Transmission Line.

The Microstrip Transmission Line is better handled by PCB vendor. We also provide a sample 50ohm unbalanced transmission system.

Here are some PCB parameters which will affect impedance:

- Track width (W)
- PCB substrate thickness (H)
- PCB substrate permittivity (εr)
- To a lesser extent, PCB copper thickness (T) and proximity of same layer ground plane.

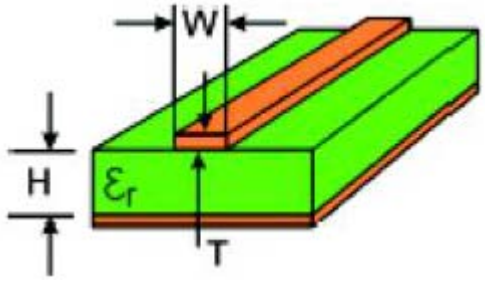


Figure 5-3

Typical Track Widths for an FR4 material PCB Substrate in Microstrip Topology

Substrate Material	Permittivity ε_r	Substrate Thickness H (mm)	Track Width W (MM)
FR4	4.6	1.6	2.91
		1.2	2.12
		1.0	1.81
		0.8	1.44
		0.6	1.07
		0.4	0.71
		0.2	0.34

Antenna characteristics are essential for good functionality of the module. The radiating performance of antennas has direct impact on the reliability of connection over the Air Interface. Bad termination of the antenna can result in poor performance of the module.

The antenna should fulfill the following requirements:

Antenna Requirements	
Impedance	50Ω
Frequency Range	Depends on the Mobile Network used. GSM900: 880~960 MHz GSM1800: 1710~1880 MHz GSM850: 824~894 MHz GSM1900: 1850~1990 MHz
Input Power	>2W peak
V.S.W.R	<2:1 recommended, <3:1 acceptable
Return Loss	S11<-10dB recommended, S11<-6dB acceptable
Gain	<3dBic

Typically GSM antennas are available as:

Linear monopole: typical for fixed application. The antenna extends mostly as a linear element with a dimension comparable to lambda/4 of the lowest frequency of the operating band. Magnetic base may be available. Cable or direct RF connectors are common options. The integration normally requires the fulfillment of some minimum guidelines suggested by antenna manufacturer.

Patch-like antenna: better suited for integration in compact designs (e.g. mobile phone). They are mostly custom designs where the exact definition of the PCB and product mechanical design is fundamental for tuning of antenna characteristics.

For integration observe these recommendations:

Ensure 50Ω antenna termination minimize the V.S.W.R. or return loss, as this will optimize the electrical performance of the module.

Select antenna with best radiating performance.

If a cable is used to connect the antenna radiating element to application board, select a short cable with minimum insertion loss. The higher the additional insertion loss due to low quality or long cable, the lower the connectivity will be.

Follow the recommendations of the antenna manufacturer for correct installation and deployment

Do not include antenna within closed metal case.

Do not place antenna in close vicinity to end user since the emitted radiation in human tissue is limited by S.A.R. regulatory requirements.

Do not use directivity antenna since the electromagnetic field radiation intensity is limited in some countries.

Take care of interaction between co-located RF systems since the GSM transmitted power may interact or disturb the performance of companion systems.

Place antenna far from sensitive analog systems or employ countermeasures to reduce electromagnetic

compatibility issues that may arise.

The modules are designed to work on a 50Ω load. However, real antennas have no perfect 50Ω load on all the supported frequency bands. To reduce as much as possible performance degradation due to antenna mismatch, the following requirements should be met:

Measure the antenna termination with a network analyzer: connect the antenna through a coaxial cable to the measurement device; the |S11| indicates which portion of the power is delivered to antenna and which portion is reflected by the antenna back to the modem output.

A good antenna should have a |S11| below -10dB over the entire frequency band. Due to miniaturization, mechanical constraints and other design issues, this value will not be achieved. A value of |S11| of about -6dB - (in the worst case) - is acceptable.

5.4 Reflow Temperature Profile

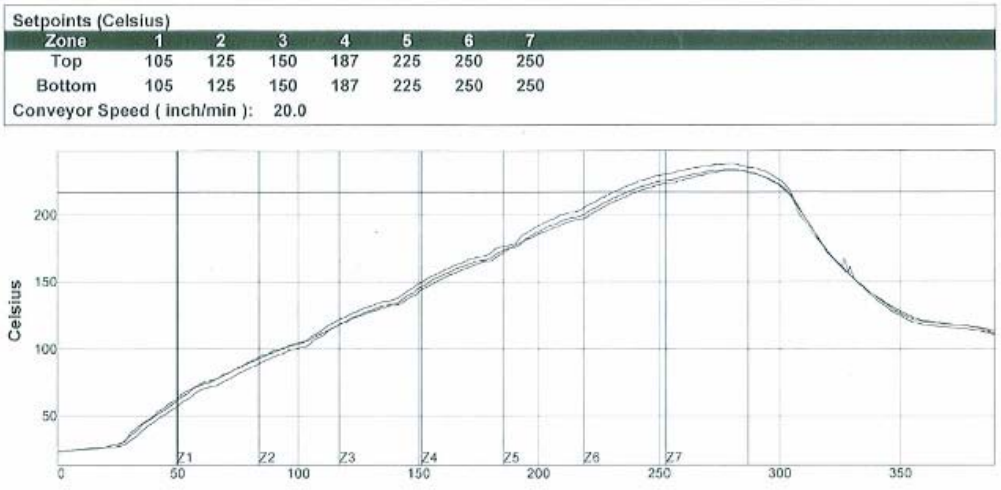


Figure 5-4

Appendix: Glossary

Name	Description
ADC	Analog-Digital Converter
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
PMU	Power manager unit
RTC	Real Time Clock
SIM	Subscriber Identification Module
SMS	Short Message Service
SMD	Surface Mounted Devices
UART	Universal Asynchronous Receiver Transmitter, asynchronous serial port
VCO	Voltage Controlled Oscillator