MG3030 Module Hardware Design User Manual

Version：V1.3

ZTE Corporation

This manual is also applicable for MG3036 module.

Preface

Summary

This manual is applicable for MG3030/MG3036 modules. ZTE Corporation's MG3030 is a type of small module with contraption that customized for thick handsets. This manual takes MG3030 as examples to instruct the users how to design the hardware and how to quickly and conveniently design different kinds of wireless terminals based on the modules.

Target Readers

- System designing engineers
- Mechanical engineers
- Hardware engineers
- Software engineers
- Test engineers

Brief Introduction

Chapter	Contents
1 General Description	Introduces technical specs of the modules and relevant documents and abbreviations.
2 Product Introduction to MG3030	Introduces the principle charts and relevant standards of both MG3030.
3 PIN Definitions	Introduces the name and function of PIN.
4 Hardware Interfaces and design reference	Introduces the hardware interface designing of MG3030.
5 Mechanical	Introduces the module's appearance, assembly line, main board PCB layout and fixing.
6 Peripherals components	Introduces the peripherals components.

Update History

V1.3 (Aug-17-2007)

This is the fourth time to release the version. The update contents include:

Change ME for MG

Modify 3 PIN definition

V1.2 (July-12-2007)

This is the third time to release the version. The update contents include:

Add this manual is also applicable for ME3006

Modify ME3006's frequency.

1.1 modify the maximum current

Modify 4.3 description of Serial Port

V1.1 （June-21-2007）

The update contents include:

1.4 technical parameters—modify maximum current

3 pin definitions—add description of PCM pin

4.3 serial port—add advice for using download pins

4.6 Antenna Interface—consummate contents

5.1 Apperance—revise description of weight

V1.0 （May-31-2007）

This is the first to formally release the document.

Table of Contents

Table of figures

Tables

1 General Description

This manual is applicable for MG3030/MG3036 modules With the function of voice, SMS and data service, the module could be widely applied in handsets, wireless data cards, USB modem, trackers, etc.

Taking MG3030 module as examples, this manual describes the module's logic structure, hardware interface and main functions, and provides reference design for the hardware and mechanics.

1.1 Technical Specification

1.1.1 Module Specification

Please refer to table 1-1 for the specifications of modules MG3030, MG3036.

Table 1-1 module specification

Module Models	Standard	Frequency(MHz)
MG3030	GSM/GPRS	Dual Band: EGSM 900/DCS 1800
MG3036	GSM/GPRS	Quad Band: GSM 850/EGSM 900/DCS 1800/PCS 1900

Remarks: *The modules are compatible on hardware and mechanical design except for frequency. Below is just an example for MG3030 module.*

1.1.2 Main Functions and Features

Please refer to Table 1-2 for the Main Functions and Features.

Table 1-2 Main functions and features

Item	Description
Voice	Double channels and High-quality voice
SMS	Support TEXT and PDU
Data	✓ Support internal TCP/IP stack ✓ GSM maximum up-link data rate 42.8kbps, maximum down-link data rate 85.6kbps.

1.1.3 Interfaces

Please refer to Table 1-3 for the Interfaces.

Table 1-3 Interfaces of the modules

Item	Description
UART interface	Download software to update Data communication Maximum data rate 230.4kbps through the port
Audio interface	Double audio I/O channel.
SIM card interface	SIM card interface
Antenna interface	50 Ohm input impedance control

1.1.4 Technical parameters

Please refer to Table 1-4 for the Technical parameters

Table 1-4 Technical parameters

Item	Description
Working temperature	-20°C ~ +55°C
Input voltage	3.3V-4.25V
Maximum current	1800mA @ -102 dBm
Idle current	10mA @ -75 dBm
Call current	150mA @ -75 dBm
Sensitivity	-102dBm
Tx power	GSM850,EGSM900:Class4(2W) GSM1800, PCS1900:Class1(1W)
Frequency range	GSM850 Tx：824~849 MHz Rx：869~894MHz
	EGSM900 Tx：880~915 MHz Rx：925~960MHz
	DCS1800 Tx：1710~1785MHz Rx 1805~1880MHz
	PCS1900 Tx：1850~1910MHz Rx：1930~1990MHz

1.2 Relevant Documents

- 《ZTE Cicada wing module series product catalog》
- 《AT Command Manual for ZTE Corporation's ME3000 Modules》
- 《ZTE MG815+ Module Development Board User Guide》
- 《FAQ for ZTE Corporation's GSM/GPRS Modules》
- 《Test References of ZTE Corporation's CDMA Wireless Modules》

1.3 Abbreviations

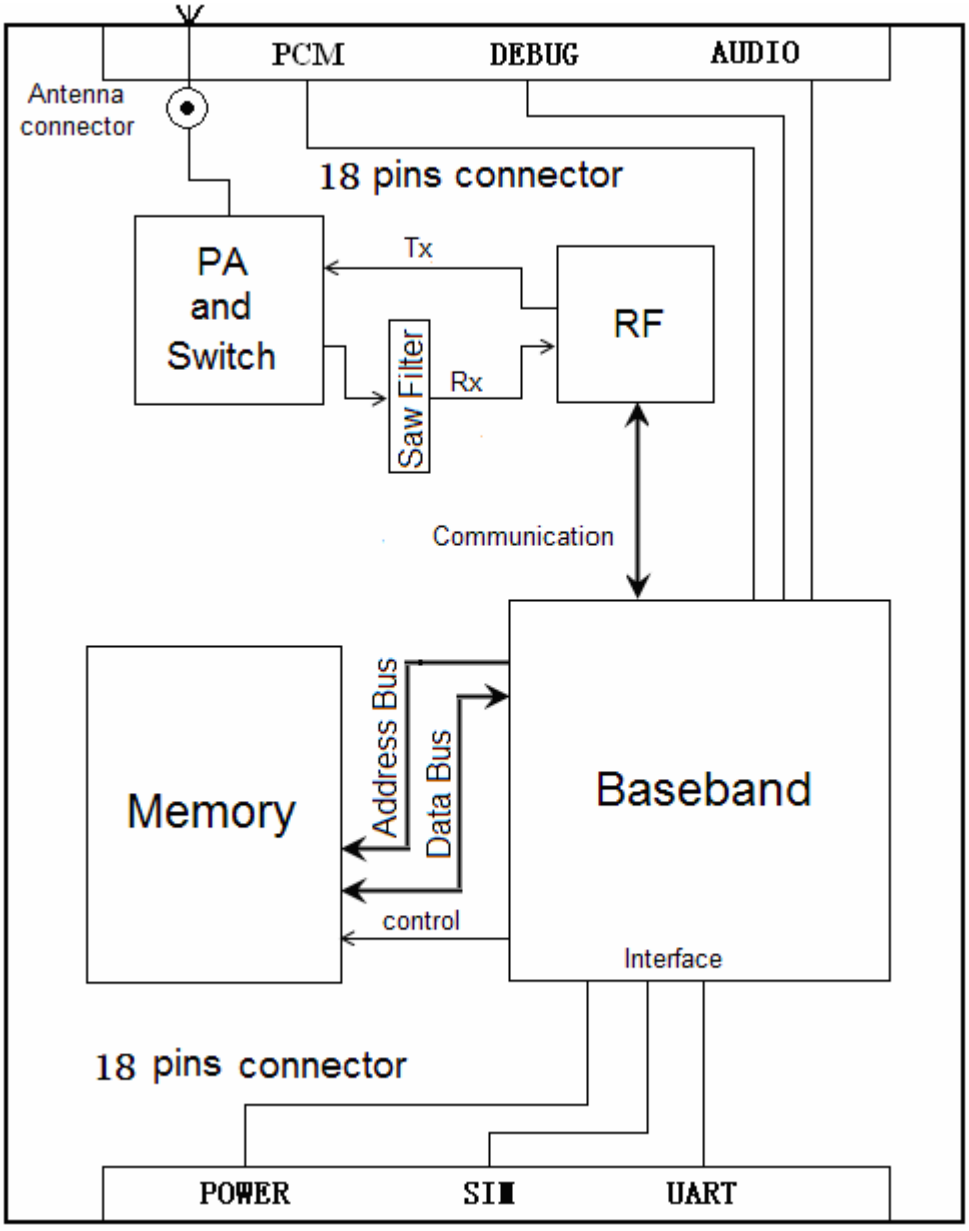
Abbr.	Full name
ADC	Analog-Digital Converter
AFC	Automatic Frequency Control
AGC	Automatic Gain Control
ARFCN	Absolute Radio Frequency Channel Number
ARP	Antenna Reference Point
ASIC	Application Specific Integrated Circuit
BER	Bit Error Rate
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CDG	CDMA Development Group
CS	Coding Scheme
CSD	Circuit Switched Data
CPU	Central Processing Unit
DAI	Digital Audio interface
DAC	Digital-to-Analog Converter
DCE	Data Communication Equipment
DSP	Digital Signal Processor
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
EMI	Electro Magnetic Interference
ESD	Electronic Static Discharge
ETS	European Telecommunication Standard
FDMA	Frequency Division Multiple Access
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
IC	Integrated Circuit
IMEI	International Mobile Equipment Identity
ISO	International Standards Organization
ITU	International Telecommunications Union
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MCU	Machine Control Unit
MMI	Man Machine Interface

MS	Mobile Station
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System
PDU	Protocol Data Unit
PLL	Phase Locked Loop
PPP	Point-to-point protocol
RAM	Random Access Memory
RF	Radio Frequency
ROM	Read-only Memory
RMS	Root Mean Square
RTC	Real Time Clock
SIM	Subscriber Identification Module
SMS	Short Message Service
SRAM	Static Random Access Memory
TA	Terminal adapter
TDMA	Time Division Multiple Access
TE	Terminal Equipment also referred it as DTE
UART	Universal asynchronous receiver-transmitter
UIM	User Identifier Management
USB	Universal Serial Bus
VSWR	Voltage Standing Wave Ratio
ZTE	ZTE Corporation

2 Brief Introduction to MG3030

Please refer to Figure 2-1 for the principle of MG3030.

Figure 2-1 MG3030 principle



3 PIN definition

The lands are distributed at both short sides since MG3030 module adopts stamp-hole connection. There are 18 pins at each side. Refer to table 3-1 below for PIN definitions:

Table 3-1 PIN definitions of 40 PIN connector

Category	SN	Definition	I/O	Description	Remark
POWER	1-2	VCHG	I	Charge voltage	
	3	ON/OFF	I	Power on/off	

	4	BAT_TEMP	I	Battery detection	
	5	V_MAIN	I	Work voltage	
	6	V_MSM	O	2.85V	
	7	V_MAIN	I	Work voltage	
GND	8	GND			
	13	GND			
	25	GND			
	31	GND			
	35	GND			
SIM	9	V_CARD	O	Card voltage	
	10	CARD_RST	O	Card reset	
	11	CARD_CLK	O	Card clock	
	12	CARD_DATA	I/O	Card data	
UART	14	RXD	I	Receive data	
	15	/RTS	O	Request to send	
	16	TXD	O	Transmit data	
	17	/DTR	I	Data terminal ready _WAKEUP	
	18	/CTS	I	Clear to send	
	26	RI	O	Ring, SMS/call	
	27	/DSR	O		
	28	DCD	O		
	32	GPIO1		Obligate currency GPIO	Obligate currency GPIO
DEBUG	29	DEBUG_TX	O		
	30	DEBUG_RX	I		
AUDIO	19	MIC_1N	I	Host receiver	
	20	MIC_1P	I	Host receiver	
	21	MIC_2P	I	Earpiece receiver	
	22	SPK_1N	O	Host speaker	
	23	SPK_1P	O	Host speaker	
	24	SPK_2P	O	Earpiece speaker	
GPIO	33	RISS_LED	O	Network signal indication	Obligate currency GPIO
	34	SMS_LED	O	SMS, telephone indication	Obligate currency GPIO
Antenna	36	RF_ANT	O	RF antenna	

4 Hardware Interfaces and Design Reference

4.1 Summary

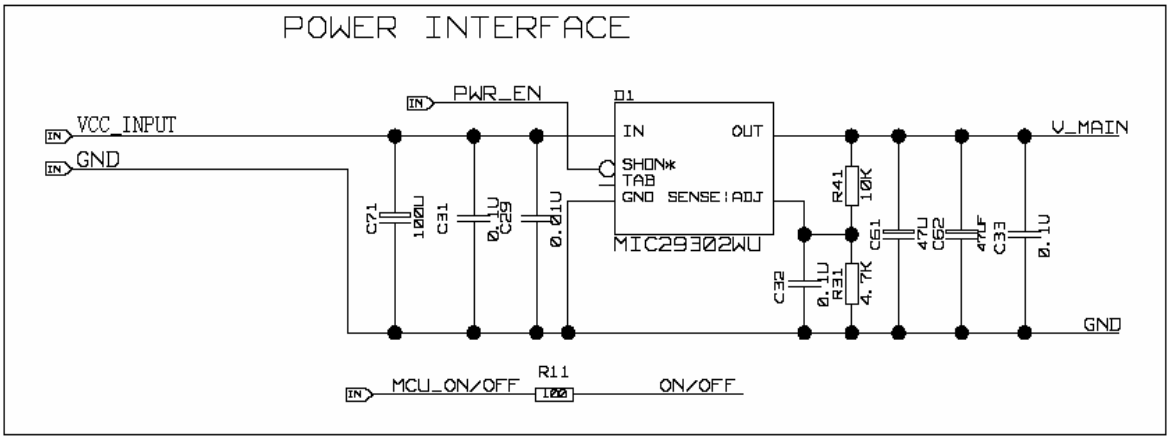
This section describes the function interfaces and usage of MG3030 modules in details, and provides the designing sample.

- Power and Reset Interface
- Serial Port
- SIM Card Interface
- Audio Interface
- Antenna Interface

Remarks: *In the system, the module layout should be far away from high-speed circuit, switch power, power transformer, large power inductor, or single chip microcomputer's clock circuit.*

4.2 Power and Reset

Figure 4-1 power and reset circuit design reference



- **Power design**

The module is powered by V-MAIN, and the voltage feature is below:

Table 4-1 Voltage features

Category	Min.	Typical	Max.
Input voltage	3.3 V	3.9 V	4.25 V

D1 is a LDO with low-valid control, making V_MAIN supplies power to module through adjusting R31and R41 at 3.9V. Modules have very high requirements on power and ground processing, signals must be filtered. Power ripple needs to be controlled under 50Mv. Do not supply power to any other part of system, otherwise RF performance will be compromised. Finally, select the power cables with at least 40mil traces during the layout and keep the integrality of ground line.

- **Power ON**

The module will be turned off after power-on normally. To turn on the module, provide a 1500-2000mS low level pulse to ON/OFF PIN. /Reset needs to connect an open collector or open drain gate.

- **Power OFF**

To turn off the module, provide a 1500-2000mS low level pulse to ON/OFF PIN,.

- **V_MSM**

There is a voltage output pin with current adjuster, which can be used to supply external power to the board. The voltage of this pin and the voltage of baseband processor/memory come from the same voltage adjuster. The voltage output is available only when the module is on. The normal output voltage is 2.85V, and the user should absorb the current from this pin as little as possible (less than 10mA). Generally, it is recommended to use this pin to match the level. When the module is off, the output voltage for this pin remains unchanged, but the impedance is rather high. Therefore, it's not recommended to use this pin for other purposes.

- **Other Advice**

In order to make sure the data is saved safely, please don't cut off the power when the module is on. It's strongly recommended to add battery or soft switch like the power key on the mobile phone.

4.3 Serial Port

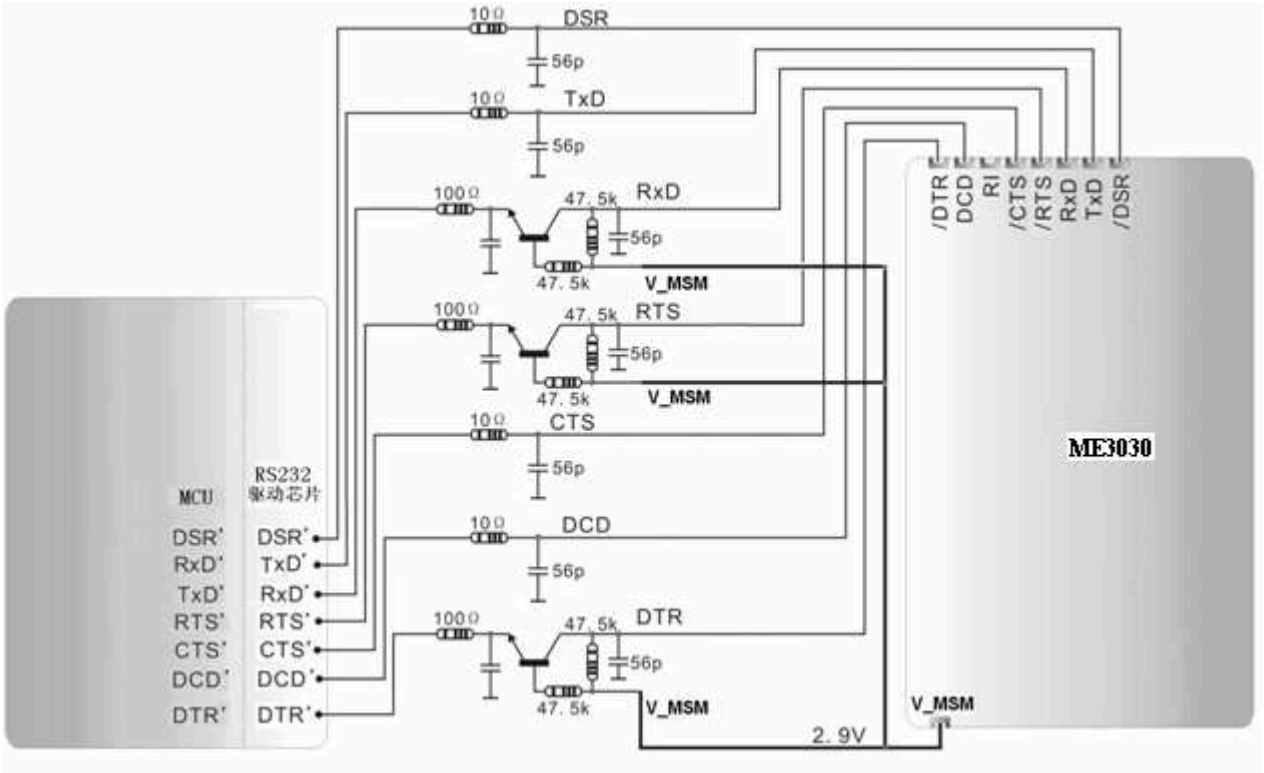
The module provides an integrated full duplex UART interface and an accessorial full duplex UART interface, whose maximal data rate is 115200bps. External interface is 2.9VCMOS level signal, their logic functions conform to RS-232 interface standard. These two UART could be used as serial port data interfaces, usually UART1 is used for AT commands, data transmission and updating software of module, UART2 is used to provide test and debug channel.

Note: users need to extend UART1 to update software, if they'd like to connect module to DTE in the design phase.

The module's output IO level is 2.9VTTL，it needs to transfer the level when connect with standard 3.3V or 5V logic circuit（such as MCU or RS232 drive chip MAX3238 etc）, Figure 4-2 shows the serial port level transfer circuit. The converted signal should connect with MCU or RS232 drive chip directly. Common low power switch triode should be applied as the crystal triode shown in Figure 4-2.

Note: when the RxD signal is at high level, the module will not be in dormant state.

Figure 4-2 UART Signal Diagram



The corresponding PINS of UART 2 are for both UART and USB. GSM modules support UADT（**notes**：*not include RTS2 and CTS2*）,but not USB; while CDMA modules support USB and UART both. Please refer to table 4-2 for details.

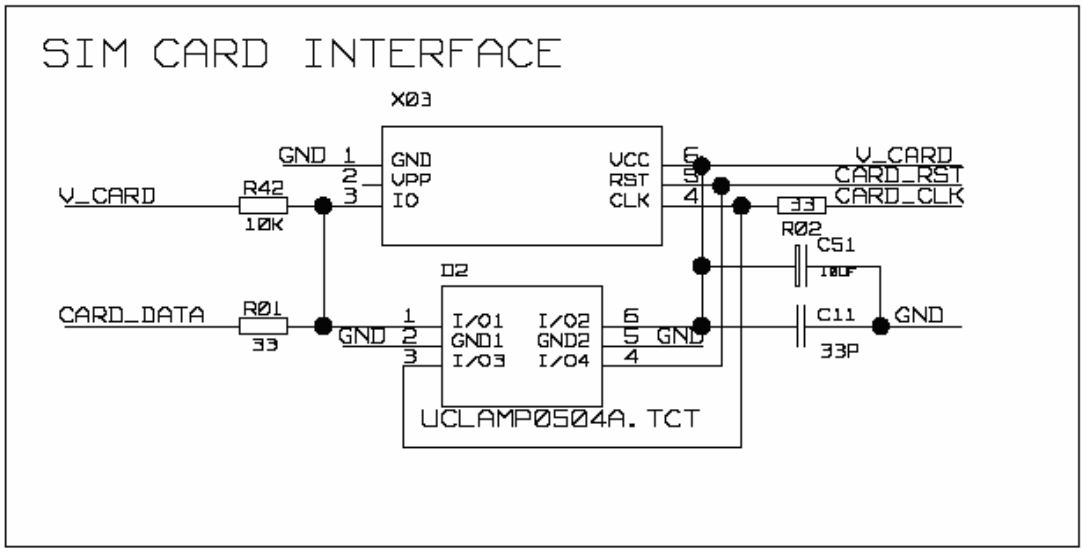
Table 4-2 USB and UART-2 Pin SN and Name

Signal name	UART	USB	pin
USB_ OE/TXD2	TXD2	USB_ OE	1
USB_DATA/RXD2	RXD2	USB_DATA	3
USB_VMO/ RTS2	RTS2	USB_VMO	5
USB_VPO/ CTS2	CTS2	USB_VPO	7
USB_SUS		USB_SUS	9

4.4 SIM Card Interface

Modules support 3V SIM card, SIM terminal includes 4 pins. V_CARD is used to supply SIM card. It's strongly recommended to add ESD to protect SIM card in hostile environments. D2 in the following layout is for ESD:

Figure 4-3 SIM card interface design reference

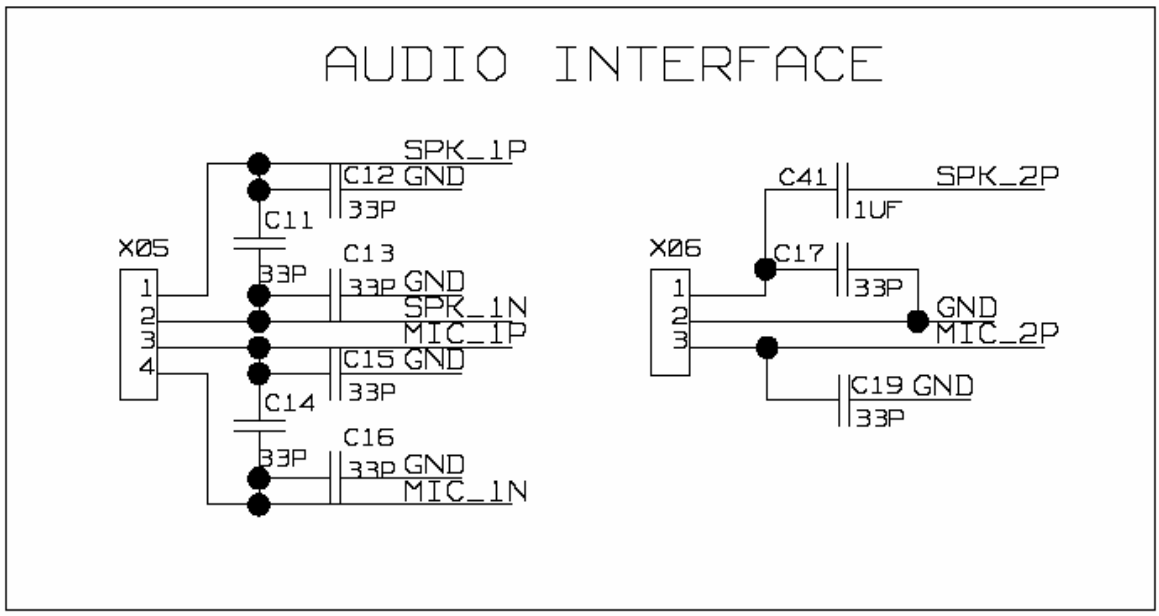


NOTE: *A 10k resistor is required for CARD_DATA pin to be draw up to V_CARD pin, because there are different SIM cards with quite different output currents. SIM card PCB circuit should be laid closely around the module as possible as you can, to avoid the interference of reading/writing from other sources.*

4.5 Audio Interface

The module provides audio input and output. There are 2 speaker interfaces and 2 microphone interfaces. Only one pair I/O works at the same time.

Figure 4-4 audio interface circuit design reference



- **Microphone**

The system connector provides two microphone interfaces MIC_1 and MIC_2, MIC_1 is differential interface,

its impedance is 32 ohm; MIC_2 is single ended interface. It's recommended that MIC_1 should use differential mode to reduce the noises. These two input are coupled in AC domain and added a 1.8V offset voltage inside, and they should directly connect with the receiver. If the line is too long, you should deal it with a filter.

- **Speaker**

The system connector provides two speakers, SPK_1 & SPK_2. The former is differential interface, and the latter is single-ended interface, usually used for earphone. They both have 32 ohm impedance.

GSM/GPRS module audio interface is designed as below:

- Design of the first channel audio interface

Select the microphone with the sensitivity lower than -51.5dB since the output impedance for SPK_1 is 32 ohm and the max. gain in MIC_1 reaches 51.5dB. The level of MIC_1P PIN is about 2.5V.

Note: *if other kind of audio input method is adopted, the input signal should be within 0.5V. If the signal voltage is lower than 0.5V, then the pre-amplifier should be added. If the signal voltage is higher than 0.5V, then network attenuation should be added.*

- Design of the second channel audio interface on the earphone

Select the microphone with the sensitivity lower than -51.5dB since the output impedance for SPK_2 is 32 ohm and the max. gain in MIC_2 reaches 51.5dB. The level of MIC_2P PIN is about 2.5V. The receiver's design is just the same as the handset's.

4.6 Antenna Interface

The module provides antenna interface through PIN36 or testing land on the backside.

The module provides two types of RF connector, if connect to the main board through PIN36:

- Directly solder with land
- RF testing socket

PCB land is used to connect module with antenna by 50 ohm RF shielding cable to cut down the cost. But it's not a complete way to shield EMI, and RF signal quality may be trivially affected. So if you decide to use this method, intense radiation must keep far away from PCB land. At the same time, you must ensure that core line of RF shielding cable has been jointed to PCB land, and the shielding metal wire netting on the RF cable has been jointed to GND of module. According to the figure below, the grounding part must be jointed firmly, otherwise, the core cable may be ruptured caused by shielding cable shaking. Users should control the distance between the PIN36 and the main board land, the distance is shorter the RF impact is smaller.

Proper measures should be taken to reduce the access loss of effective bands, and good shielding should be established between external antenna and RF connector. Besides, external RF cables should be kept far away from all interference sources such as high-speed digital signal or switch power supply.

According to mobile station standard, stationary wave ratio of antenna should be between1.1 to 1.5, and input impedance is 50 ohm. Different environments may have different requirements on the antenna's gain. Generally, the larger gain in the band and smaller outside the band, the better performance the antenna has. Isolation degree among ports must more than 30dB when multi-ports antenna is used. For example, between two different polarized ports on dual-polarized antenna, two different frequency ports on dual-frequency antenna, or among four ports on dual-polarized dual-frequency antenna, isolation degree should be more than

30dB.Considering there is a RF testing land on the backside of module, the area on where it covers user's main board is forbidden to layout.

5 Mechanical

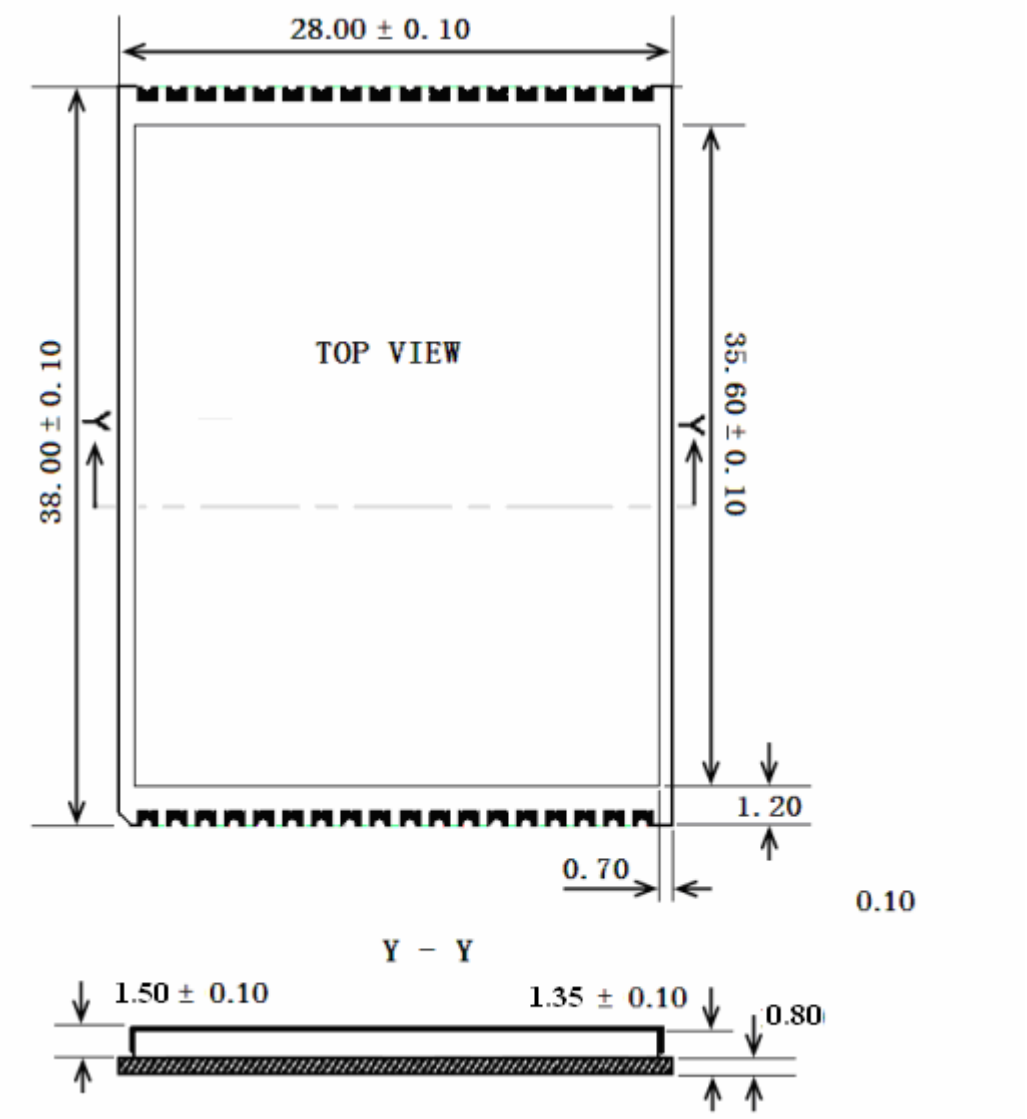
5.1 Appearance

Figure 5-1 module appearance of MG3030

- **Dimensions:** 38.0 mm（length）x 28.0mm（width）x 2.3mm（height）
- **Weight:** 8g

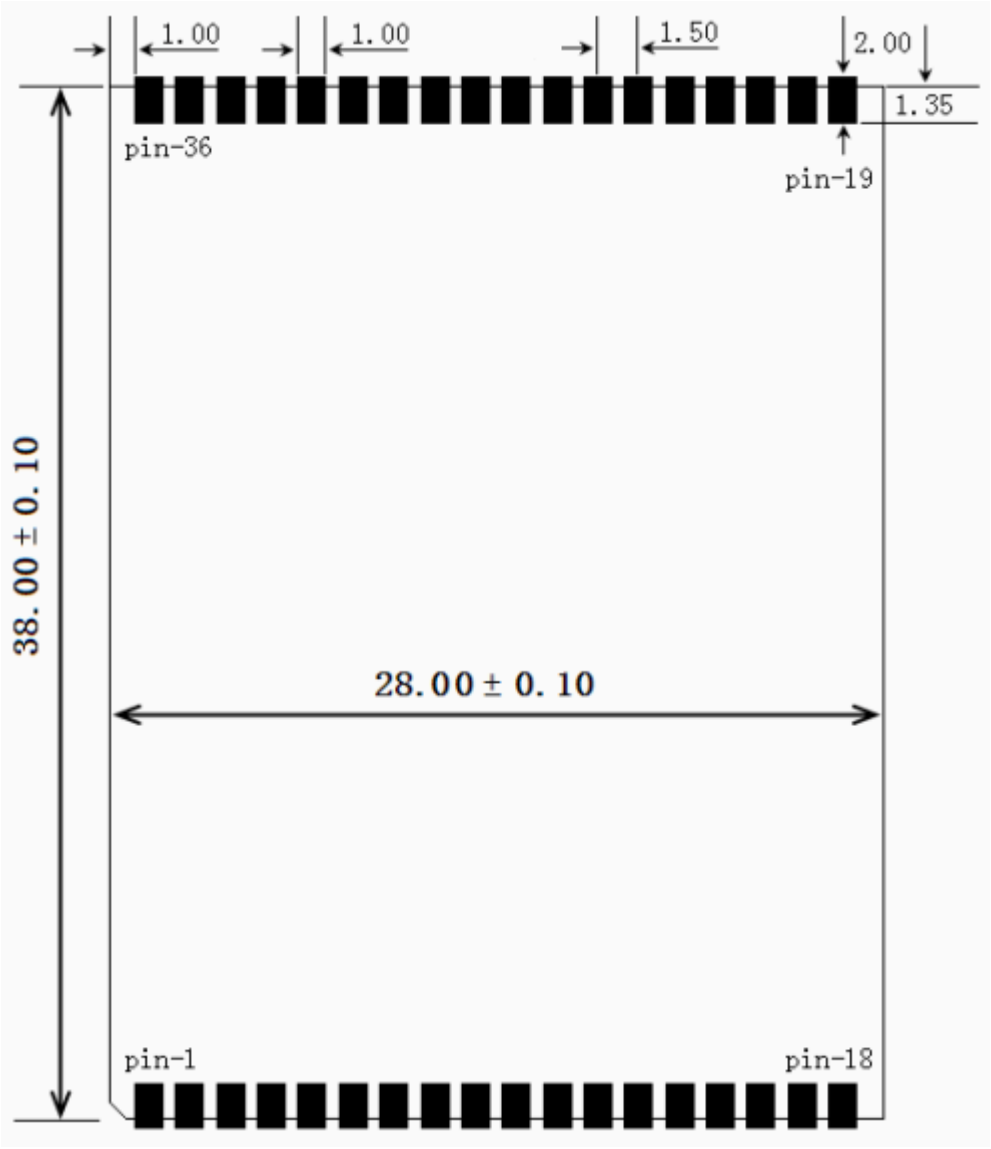
5.2 Module Assembly Line

Figure 5-2 Module assembly line



5.3 Main board PCB layout

Figure 5-3 main board PCB layout



6 Peripherals components

Table 6-1 Peripherals components

Models	SN	Supplier	Website
MIC29302WU	D1	MICREL	www.micrel.com
UCLAMP0504A.TCT// NZQA5V6XV5T1G	D2	SEMTECH// ON	www.semtech.com www.onsemi.com
IDT74FCT3244Q8// PI74FCT3244Q	D3	PERICOM// IDT	www.pericom.com www.idt.com
M-C707 10M006 097 2	X03	AMPHENOL	www.amphenol.com
MM9329-2700B		murata	www.murata.com