MG2639 Module Hardware Design User Manual

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Descriptions of version update

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With strong technical force, ZTE Corporation can provide CDMA/GPRS/WCDMA module customers with the following all-around technical support:

1. Provide complete technical documentation;
2. Provide the development board used for R&D, test, production, after-sales, etc.;
3. Provide evaluations and technical diagnosis for principle diagram, PCB, test scenarios;
4. Provide test environment;

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Preface

Summary

This document introduces MG2639 module's product principle diagram, PINs, hardware interface and module's mechanical design, which can instruct the users how to quickly and conveniently design different kinds of wireless terminals based on this type of module.

Target Readers

This document mainly applies to the following engineers:

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

Contents

Figures

Tables

1 General description of module

This chapter mainly provides a general description of the module, including basic functions and logic block diagram.

1.1 Introduction of module's functions

Table 1-1 Module's functions

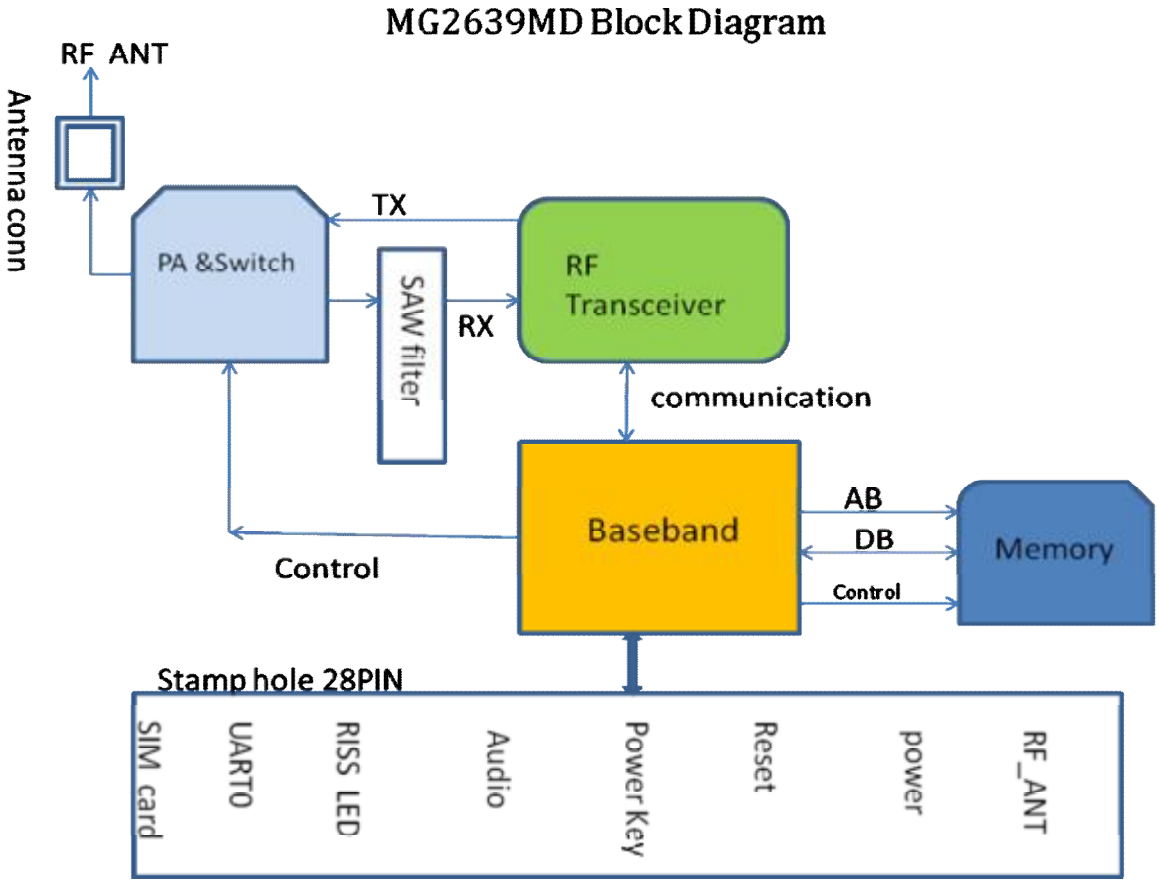
Parameter	MG2639
General Features	
Frequency Bands	GSM850/EGSM900/DCS1800/PCS1900
Dimensions	30.0×25.0x2.68mm
Weight	7g
Operating Temperature Range	-30°C~+70°C
Storage Temperature Range	-40°C~+85°C
Performance	
Operating Voltage Range	3.4V~4.25V/Typical: 3.9V
Current Consumption Typically	Idle Current: 2mA
	Call Current: 128mA
	Max Current: 300mA
TX Power	GSM850/EGSM900: Class 4 (2W)
	DCS1800/PCS1900: Class 1 (1W)
RX Sensitivity	<-106dBm
Interfaces	
Connector	28Pin Stamp Holes
Antenna	SMT 50Ω Antenna Connector
	Antenna Solder Pad
Integrated Full Duplex UART	AT/Data
SIM Card Interface	1.8V/3.0V
Data Features	
GPRS	Class 10
Mobile Station	Class B
Max Downlink	85.6kbps
Max Uplink	42.8kbps
Protocol	Internal TCP/IP&UDP
	Embedded FTP
SMS Features	
	Support TEXT/PDU Mode
	Point-to-point MO/MT
	SMS Cell Broadcast

Parameter	MG2639
Voice Features	
	Vocoders HR/FR/EFR/AMR
	Echo Cancellation/Volume Control/DTMF
AT Command Set	
	GSM 07.05/GSM 07.07/ZTE Proprietary AT Commands

1.2 Module's principle diagram

The block diagram is used to describe the module's major logic functions:

Figure 1-1 Module's principle diagram



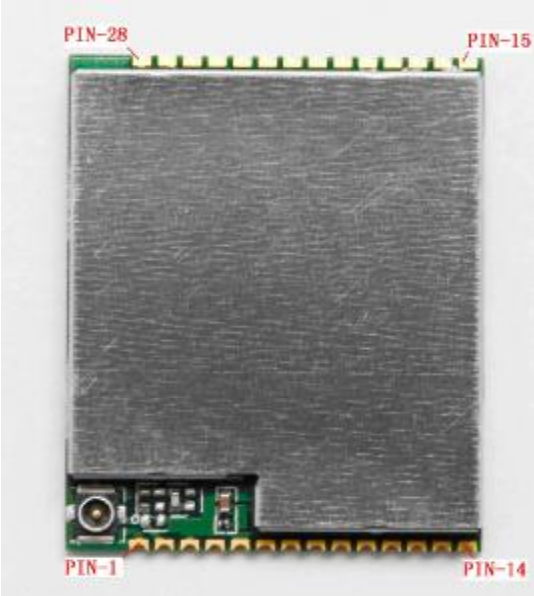
1.3 Abbreviations

A		
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	
B		
BER	Bit Error Rate	
BTS	Base Transceiver Station	
C		
CDMA	Code Division Multiple Access	
CDG	CDMA Development Group	
CS	Coding Scheme	
CSD	Circuit Switched Data	
CPU	Central Processing Unit	
D		
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	
E		
EDGE	Enhanced Data Rate for GSM Evolution	
EFR	Enhanced Full Rate	
EGSM	Enhanced GSM	
EMC	Electromagnetic Compatibility	
EMI	Electro Magnetic Interference	
ESD	Electronic Static Discharge	
ETS	European Telecommunication Standard	
F		
FDMA	Frequency Division Multiple Access	
FR	Full Rate	
G		
GPRS	General Packet Radio Service	
GSM	Global Standard for Mobile Communications	
H		
HR	Half Rate	
I		
IC	Integrated Circuit	
IMEI	International Mobile Equipment Identity	
ISO	International Standards Organization	
ITU	International Telecommunications Union	
L		
LCD	Liquid Crystal Display	
LED	Light Emitting Diode	
M		
MCU	Machine Control Unit	

MMI	Man Machine Interface	
MS	Mobile Station	
MTBF	Mean Time Before Failure	
P		
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	
R		
RAM	Random Access Memory	
RF	Radio Frequency	
ROM	Read-only Memory	
RMS	Root Mean Square	
RTC	Real Time Clock	
S		
SIM	Subscriber Identification Module	
SMS	Short Message Service	
SMT	Surface Mount Technology	
SRAM	Static Random Access Memory	
T		
TA	Terminal adapter	
TDMA	Time Division Multiple Access	
TE	Terminal Equipment also referred it as DTE	
U		
UART	Universal asynchronous receiver-transmitter	
UIM	User Identifier Management	
USB	Universal Serial Bus	
USIM	Universal Subscriber Identity Module	
V		
VSWR	Voltage Standing Wave Ratio	
Z		
ZTE	ZTE Corporation	

2 Descriptions of module's external interfaces

This chapter mainly describes the module's external interfaces, such as B2B connector, MINI PCI-E, stamp-hole connector, etc.



2.1 Definitions of module's interfaces

Table 1-1 28Pin stamp-hole definition

No.	Definition	I/O	Description	Remarks
1	GND		GND	
2	RF_ANT	I/O	RF antenna	
3	GND		GND	
4	RING	O	Ring signal indication	Level varies upon an incoming call or receipt of text message.
5	GND		GND	
6	VBAT	I	Work voltage	
7	RSSI_LED	O	Network signal indication	Internal pull-down, LED on at high level, need add triode driver externally. -power-on status: LED off; -network searching status: LED blinks at 3Hz -Idle status: LED blinks at 1Hz -Traffic status (call, data): LED blinks at 5Hz.
8	RTS	I	Request to send	
9	CTS	O	Clear to send	
10	DCD	O	Carrier detection	
11	CARD_RST	O	card reset	
12	CARD_CLK	O	card clock	

13	CARD_DATA	I/O	card data	
14	V_CARD	O	Card voltage	
15	RXD	I	Receive data	
16	TXD	O	Transmit data	
17	SYSRST_N	I	Reset signal	Valid at low level, need connect an open collector/drain switch.
18	SPK_2P	O	Headset Speaker +	
19	SPK_1P	O	Microphone speaker +	
20	SPK_1N	O	Microphone speaker -	
21	MIC_2P	I	Headset microphone +	
22	MIC_1P	I	Receiver microphone +	
23	MIC_1N	I	Receiver microphone -	
24	PWRKEY_N	I	power on-off	Valid at low level, need connect an open collector/drain switch.
25	DTR	I	Data terminal ready _WAKEUP	
26	DSR	O	Data set ready	
27	V_MSM	O	2.8V	
28	GND		GND	

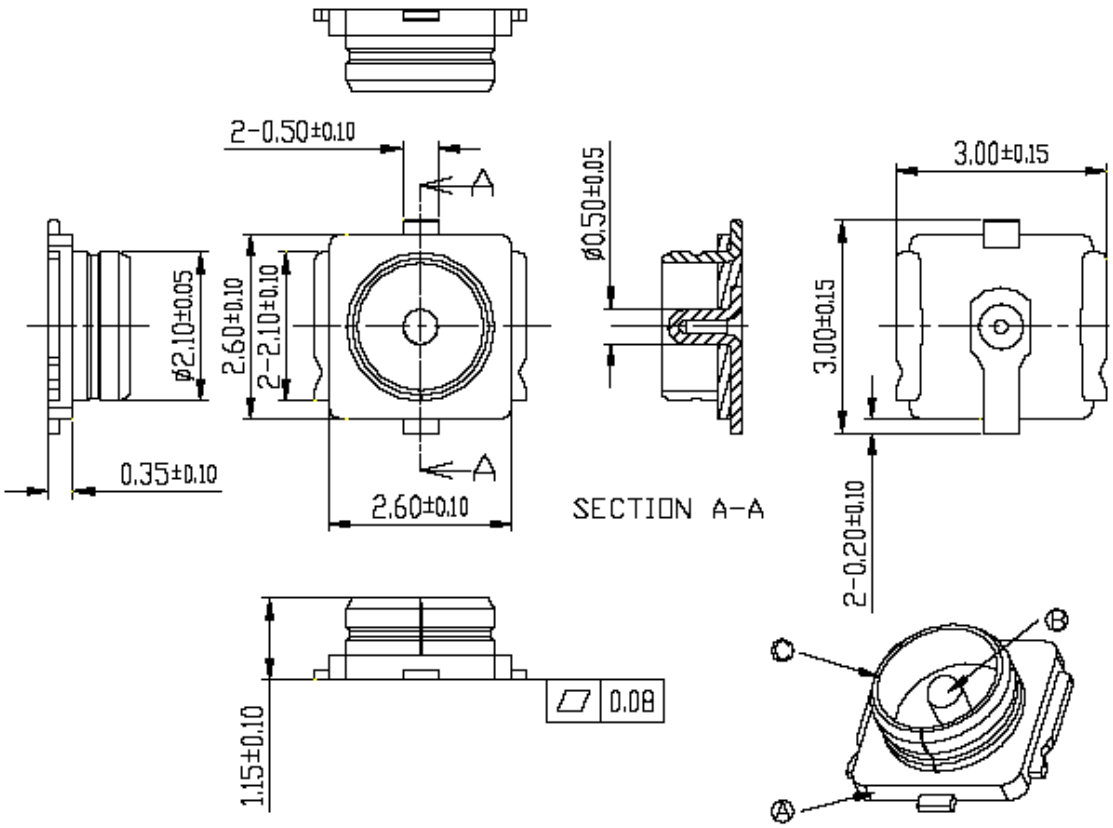
2.2 Antenna interface

MG2639 module provides two kinds of antenna interface:

- PCB welding pad
- Antenna test socket

PCB welding pad adopts 50Ω RF shield cable to connect the module and the antenna, in order to reduce the cost. However, using this method can't completely shield the electromagnets, which might have slight influence on RF signal quality. Please note that there should not be strong radiation near the welding pad. Meantime, during the welding, make sure the core of RF shield cable must connect with RF welding pad, and RF shield cable's shield metal mask must be welded to the module's GND. During the welding, the GND must be welding securely, otherwise the core is easily broken due to the shaking of shield cable. See figure 2-1 for RF welding pad antenna.

Figure 2-1 Antenna interface diagram



3 Module's electrical characteristics

This chapter mainly introduces the module's electrical characteristics, including the level, power consumption, reliability of module's interfaces.

3.1 Descriptions of levels of interface signals

It describes the MAX, MIN and typical value of the level of module's external interfaces.

3.1.1 Reset

SYSRST_N PIN is used to reset the module's main chip, and SYSRST_N signal needs to be pulled down 500ms to reset the module. Likewise, this pin is required to pull up 2.8V (Max: 2.9V, Min: 2.7V, typical: 2.8V) through 4.7K resistor inside the module, and pull down 0.1uF capacitance to GMD filtering, and it's required to externally connect dynatron driver.

MG2639 module provides 1CH serial interface, supports 8-wire serial BUS interface or 4-wire serial BUS interface or 2-wire serial interface. The module communicates with the external devices and inputs AT commands through UART interface.

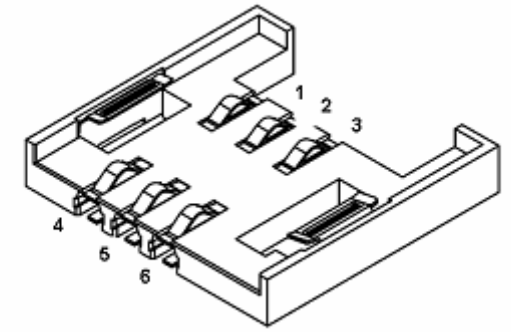
Classification	Definition	I/O	Description	Min. voltage	Typical voltage	Max. voltage
UART	RXD	I	Receive data	2.4V	2.8V	3.1V
	/RTS	I	Request to send	2.4V	2.8V	3.1V
	TXD	O	Transmit data	2.4V	2.8V	3.1V
	/DTR	I	Data terminal ready_WAKEUP	2.4V	2.8V	3.1V
	/CTS	O	Clear to send	2.4V	2.8V	3.1V
	RING	O	Ring signal indication	2.4V	2.8V	3.1V
	/DSR	O	Data set ready	2.4V	2.8V	3.1V
	DCD	O	Carrier detection	2.4V	2.8V	3.1V

3.1.2 SIM Card Interface

MG2639 module baseband processor integrates SIM card interface conforming to ISO 7816-3 standard, and it's compatible with SIM card with two voltages 1.8V/3.0V and reserves SIM card interface signal on the stamp-hole PIN.

Users should note that SIM card's electrical interface definitions are the same as SIM card socket's definitions.

Figure 3-1 Standard SIM card PIN Definitions Diagram



Classification	Definition	I/O	Description	Remarks
SIM	V_CARD	O	Card voltage	1.8V/3V; maximum output current 20mA
	CARD_RST	O	Card reset	
	GND		GND	
	CARD_CLK	O	Card clock	
	CARD_DATA	I/O	Card data	

3.1.3 Audio Interface

MG2639 module supports 2CH audio signal inputs/outputs. It features in handheld microphone, handheld receiver or hands-free speaker and earpiece microphone/receiver function. These two MIC inputs are coupled in AC domain and the offset voltage is added inside, and they should directly connect with the receiver. The two receiver interfaces SPK_1 and SPK_2 are both differential interfaces with 32Ωresistance; SPK_2 is single-ended interface with 32Ω resistance. See the audio interface signals in the table below:

Classification	Definition	I/O	Description	Remarks
AUDIO	MIC_1N	I	Receiver's Microphone-	The first differential receiver used for the default audio input/output and the second receiver used for headset audio input/output.
	MIC_1P	I	Receiver's Microphone+	
	MIC_2P	I	Headset microphone +	
	SPK_1N	O	Receiver's speaker-	
	SPK_1P	O	Receiver's speaker+	
	SPK_2P	O	Headset speaker +	

3.1.4 Network Signal Indication

RSSI_LED Internal pull-down, LED turns on at high level, and need add triode driver externally.
-Power-on status: LED off;
-Network searching status: LED blinks at 3Hz
-Idle status: LED blinks at 1Hz

-Traffic status (call, data): LED blinks at 5Hz.

SIG_LED PIN output status is defined according to the software protocol, and users could judge the module's work status according to SIG_LED status. SIG_LED PIN is common I/O port, which can't directly drive LED, and it needs to work with dynatron.

3.2 Module Power Consumption

It describes the module's power consumption under each status:

No.	Test items	Typical value（mA）
1	Power-off leakage current (Normal power-off)	50uA
2	Average standby current (no operation after power-on)	2mA
3	Average standby current (after talk)	2mA
4	Talk current	128mA

3.3 Reliability Characteristics

It describes the temperature, including working temperature and storage temperature.

Working temperature: -30°C~+70°C

Storage temperature: -40°C~+85°C

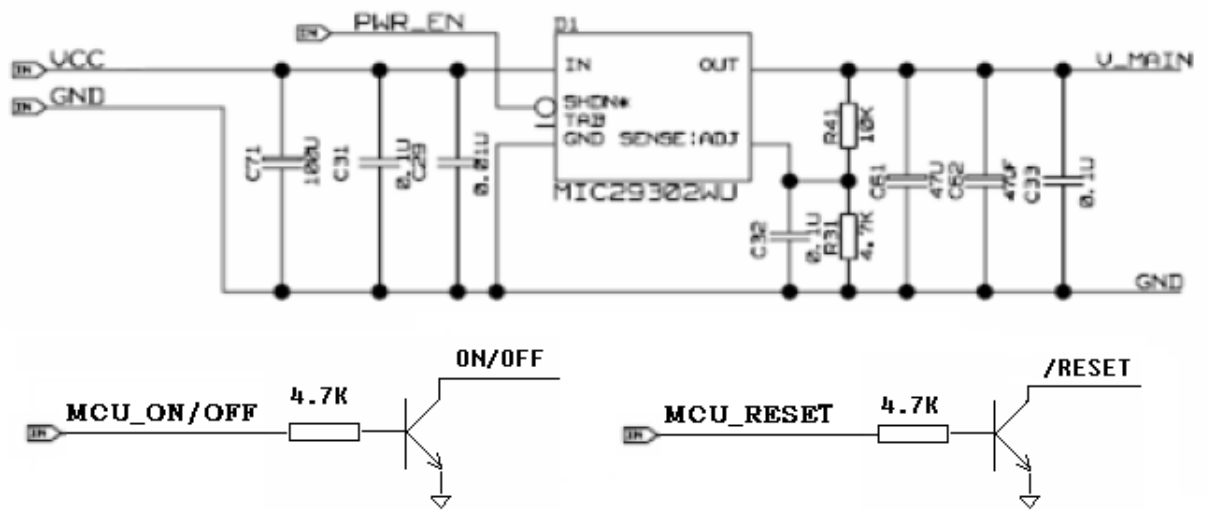
4 Interface circuit design

It provides the reference design circuit of the interface and precautions according to the module's functions.

4.1 Reset and power design

See the reference design principle of power and reset circuit in figure 4-1:

Figure 4-1 Power and reset circuit reference design principle diagram



- Power design

MG2639 module is powered by VBAT. See the voltage characteristics in table 4-1.

Table 4-1 Voltage characteristics

Classification	MIN	Typical	MAX
Input voltage	3.4V	3.9V	4.25V
Input current	2mA（average）	--	300mA（depends on the network signal）

D1 is an enabled LDO with 6V~9V input voltage. Through adjusting R31and R41, it could make V_MAIN at 3.9V to power the module, and it's required to place at least one 1000uF tantalum capacitor at V-Main input pin. The module is very strict with the requirements on power and GND, therefore it's requested that filtering must be performed to power and GND, and the power ripple must be controlled under 50Mv. Do not use LDO to power any other part in the system because it might affect the RF performance. Finally, select the power cables with at least 80mil traces during the layout and keep the integrality of ground line.
If MG2639 module uses other LDO, make sure the output current is larger than 2A.

- Power on

The module is under power-off status after it's normally powered on. To turn on the module, provide a 2s-5s low level pulse to PWRKEY_N pin when the module is OFF. If one 1K resistance is connected with PWRKEY_N, the module can be turned on after power supply.
Note: ON/OFF and /Reset need to connect an open collector/drain gate.
It's not required to operate /RESET signal upon power-on.

- Power off

To turn off the module, use AT command “AT+ZPWROFF” or provide a 2s~5s low level pulse to PWRKEY_N PIN.

- Reset

Use the above method to firstly “power-off” and then “power-on” to hard reset the module.
If the external reset function has to be used, low level pulse lasting at least 500ms should be provided to /RESET Pin within 2 seconds after the module is turned on. Before that, the external I/O signal must be kept at low level. See the reset circuit design in figure 4-1.
If SYSRST_N Pin is not used, suspend the pin.
See the module’s power-on/off time sequence in the diagram below:

Figure 4-1 Power-on/off time sequence

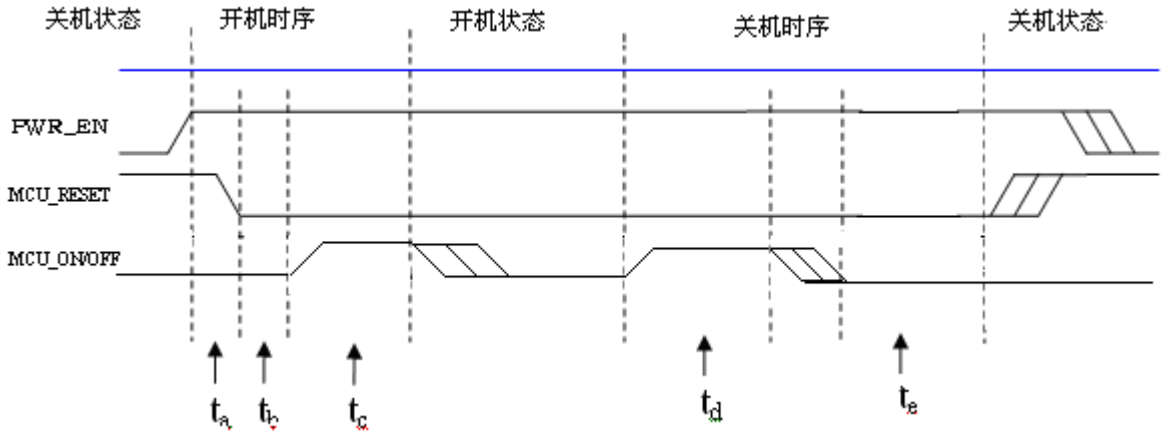


Table 4-2 Power-on/off circuit time characteristics

t_a	t_b	t_c	t_d	t_e
20ms	10ms	3s	3s	6s

- 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

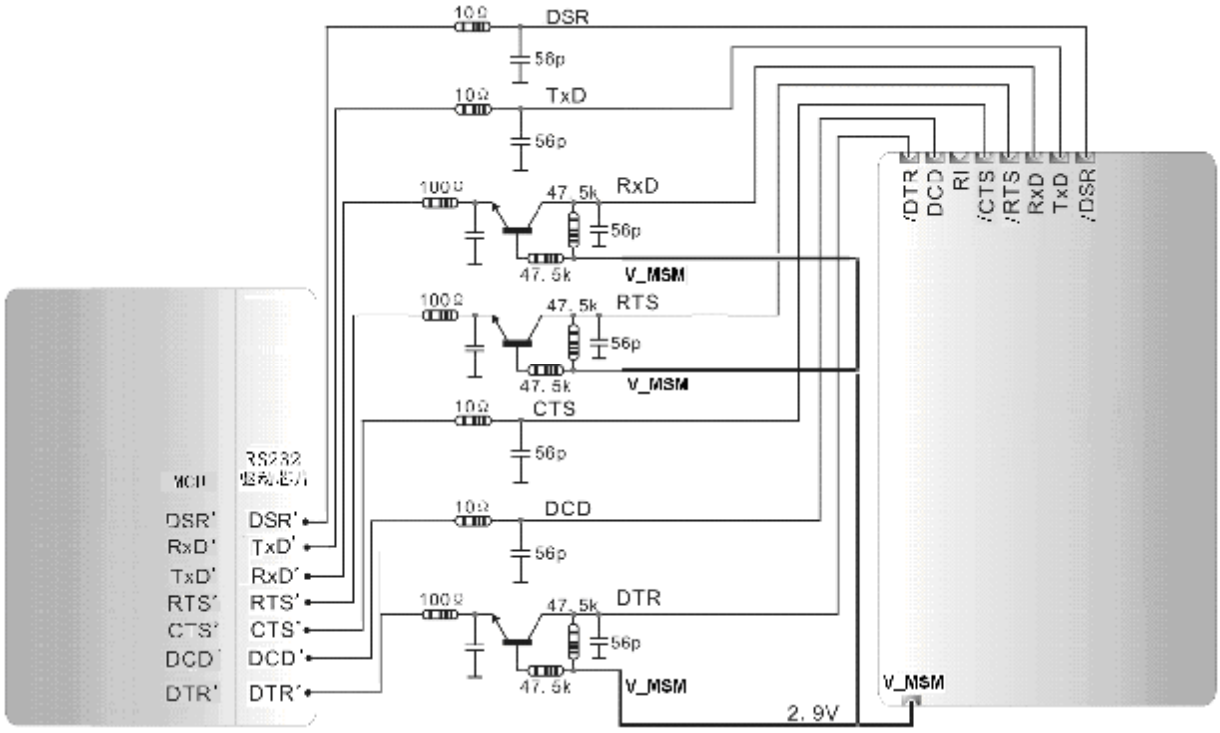
In order to make sure the data is saved safely, please don’t cut off the power when the module is on. It’s strongly recommended to add battery or soft switch like the power key on the module.

4.2 UART interface

Note: when using the module for overall design, the users should export UART for module’s software upgrade.
MG2639 module provides an integrated full duplex UART interface and an accessorial full duplex UART interface, whose maximal data rate is 115200bps. External interface is 2.8VCMOS 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.
The module’s output IO level is 2.8V，it needs to transfer the level when connecting with standard 3.3V or 5V logic circuit（such as MCU or RS232 drive chip MAX3238 etc）, Figure 4-3 shows the COM 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 4-3. Please note that the module won't enter sleep mode as RXD is at high level.

Figure 4-3 UART interface reference design block diagram

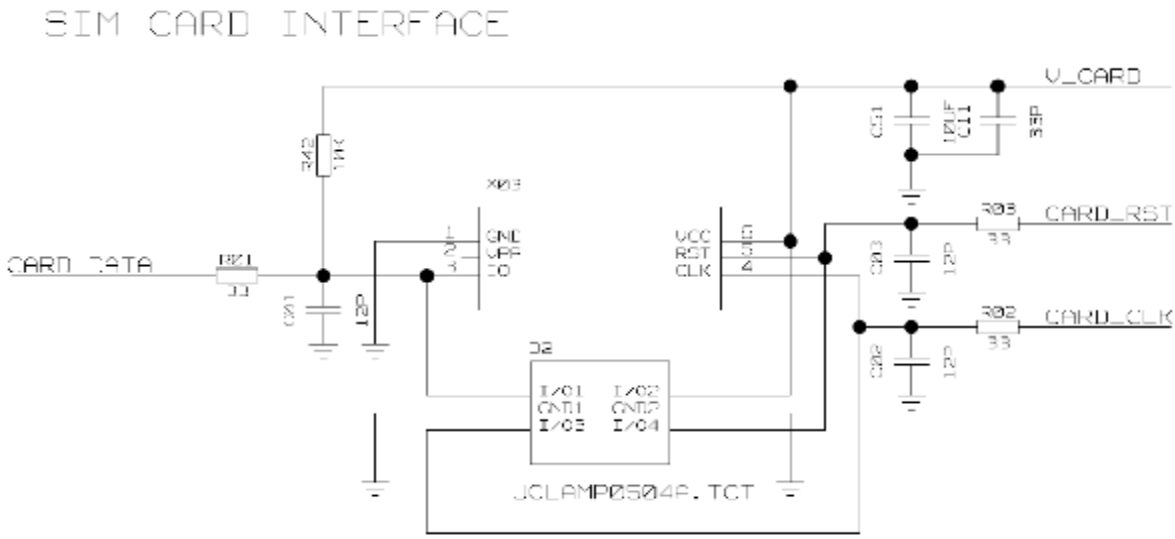


Remarks: the module doesn't support USB.

4.3 SIM card interface

MG2639 module supports 1.8V or 3V SIM card, and there are 4 pins at the terminal of the card. V_CARD is used to supply SIM card. It's strongly recommended to add ESD to protect SIM card in hostile environments.

Figure 4-4 SIM card circuit reference design diagram

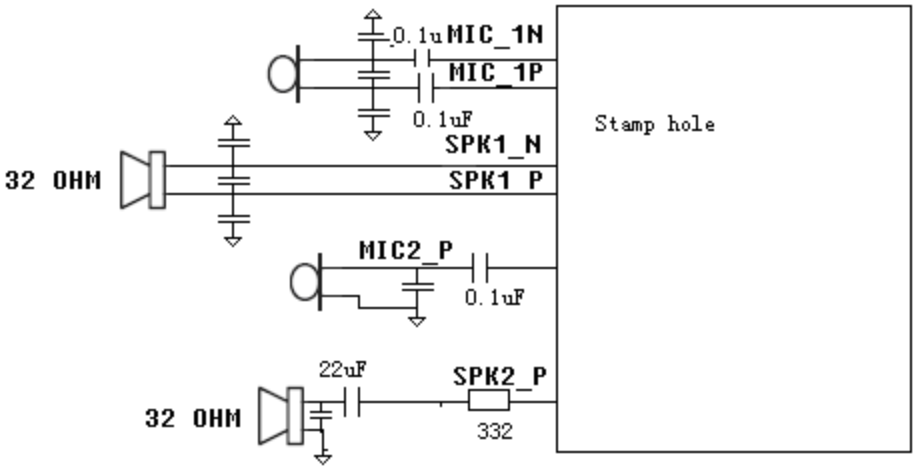


NOTE: *The SIM card PCB wiring should be laid closely around the module as much as possible to prevent the interference sources from affecting the SIM card's reading/writing. Besides, Since the SIM card needs to be designed to meet the requirements of ESD performance and avoid the damage of the SIM card caused by ESD, it's recommended to add TVS components on 4-CH SIM card signals, meanwhile, the signal wires need go through TVS component before entering the module's baseband processor during the layout.*

4.4 Audio interface

MG2639 module provides audio input and output interfaces through its PINs. There are 2 Speaker interfaces and 2 Microphone interfaces. Only one pair I/O works at the same time. See the audio interface circuit in figure 4-5.

Figure 4-5 Audio interface circuit reference design principle diagram



注：未标注的电容值均为33pF

- **Microphone**

The system connector provides two microphone interfaces MIC_1 and MIC_2, MIC_1 is differential interface; while MIC_2 is single ended interface. These two inputs are coupled in AC domain and 2.0V offset voltage are added inside, therefore they should directly connect to the microphone.

- **Speaker**

The system connector provides two speakers, SPK_1 & SPK_2. SPK_1 is differential interface, while SPK_2 is single-ended interface. They both have 32 ohm impedance.

GSM/GPRS module audio interface is designed as below:

- Design of the audio interface on the receiver

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 2.2V.

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 audio interface on the headset

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 2.2V. The design is just the same as that on the receiver

5 Mechanical dimensions

It introduces the module's mechanical dimensions.

5.1 Appearance Diagram

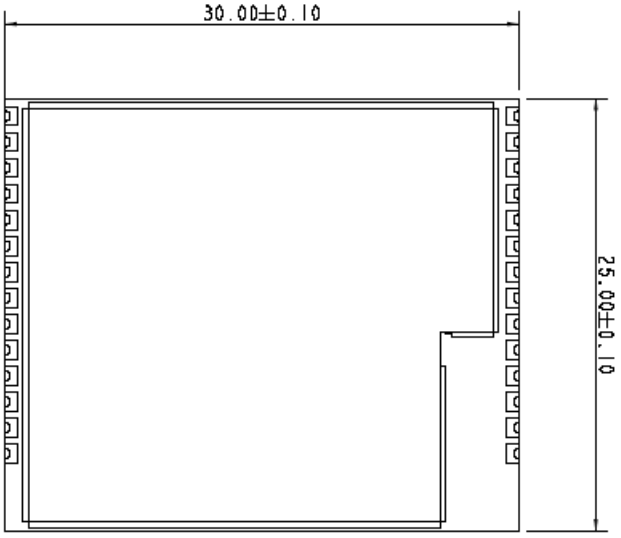
Figure 5-1 MG2639 module's appearance

- Dimensions（L×W×H）：30.0×25.0×2.68mm
- Weight：7g

5.2 Module Assembly Diagram

See the module assembly diagram in figure 5.2.

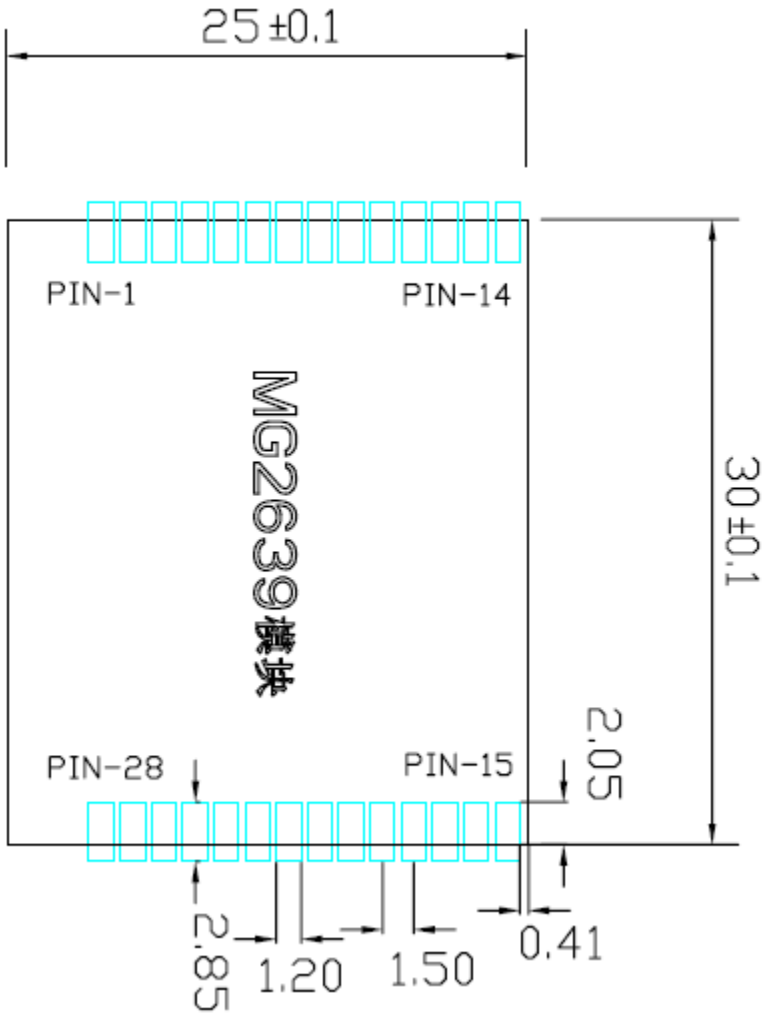
Figure 5-2 Module's assembly diagram



5.3 PCB Dimensions

See the module's PCB dimensions in figure 5-3.

Figure 5-3 Relevant PCB dimensions



Precautions while designing PCB:

1）Copper-clad and wiring are forbidden at the area below the RF test points.

2）For the convenience of testing and maintenance, it might be necessary to drill holes on the PCB.