MG2636 Module User Manual

Version: V1.0

ZTE Corporation

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3. Provide evaluations and technical diagnosis for principle diagram, PCB, test scenarios;

4. Provide test environment;

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Preface

Summary

This user manual is for MG2636 modules. It takes MG2636 modules for example to give the reference to the relevant hardware design and instruct the users how to quickly and conveniently design different kinds of wireless terminals based on this type of module.

Target Readers

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

Brief Introduction

This manual contains 5 chapters. See the table below:

Chapter	Contents
1 General description	Introduces MG2636 module's basic technical specification, the relevant documents for reference and the acronyms.
2 Product introduction	Introduces MG2636 module's principle diagram.
3 PIN definitions	Introduces the name and function of MG2636 module's Pins.
4 Description of hardware interfaces	Introduces the design of the hardware interface on each part of MG2636 module.
5 Mechanical Design	Introduces MG2636 module's appearance diagram, assembly diagram and PCB layout diagram.
6 Antenna Interface	Introduce MG2636 Antenna Interface.

Update History

V1.0（2010-10-09）

This is the first time to officially release the document.

Contents

Graphics

Tables

1 General Description

This manual is applicable for MG2636 modules. With the function of voice, SMS and data service, ZTE MG2636 module is a type of GSM/GPRS module developed by ZTE Corporation. MG2636 module could be easily applied in modem, U-modem, embedded module, wireless phone, intelligent mobile phone, multimedia mobile phone and touch screen telecom devices, etc.

Taking MG2636 module for example, this manual describes the module's logic structure, hardware interface & major functions, and provides references to the hardware and mechanical design.

1.1 Technical Specification

1.1.1 Module's Specification

Please refer to table 1-1 for the module's specification.

Table 1-1 Module's specification

Models	Format	Frequency(MHz)
MG2636	GSM/GPRS	GSM/GPRS： GSM850/EGSM900/DCS1800/PCS1900*

*Note: EGSM900 and DCS1800 not support for North American market model, both band have been closed in firmware.

1.1.2 Basic Functions

Please refer to Table 1-2 for the basic functions.

Table 1-2 Basic functions

Item	Description
Voice call	Circuit-switching service
Packet data	Packet data service
SMS	Support TEXT

1.1.3 Module's Interfaces

Please refer to Table 1-3 for the module's interfaces.

Table 1-3 Interfaces of the modules

Interfaces	**Descriptions**
Power interface	Supply power to the module, reset the module or turn on/off the module
Audio interface	Double audio I/O channel, one for differential, one for single end
SIM interface	R-UIM
USB interface	USB2.0 High Speed
UART interface	Hardware full flow control port, customized by software
PCM interface	Transmit voice data for Bluetooth applications
Antenna interface	50 Ohm input resistance control

1.1.4 Technical parameters

Please refer to Table 1-4 for the module's technical parameters.

Table 1-4 Technical parameters

Items	**Descriptions**
Working temperature	-30°C ~ +75°C
Input voltage	3.4V-4.25V
Maximum current	1800mA @ -102 dBm
Standby current (average)	10mA @ -75 dBm
Call current	230mA @ -75 dBm
Rx. Sensitivity	-106.5dBm
Max. Tx power	GSM850，EGSM900：33dBm(2W) GSM1800，PCS1900：30dBm(1W)
Frequency range	GSM850： Tx: 824~849 MHz Rx: 869~894 MHz
	EGSM900 Tx: 880~915 MHz Rx: 925~960MHz
	DCS1800 Tx: 1710~1785MHz Rx: 1805~1880MHz
	PCS1900 Tx: 1850~1910MHz Rx: 1930~1990MHz
Antenna Gain	2dBi

2. GSM/GPRS

Item	GSM 850MHz/900MHz	GSM 1800MHz/1900MHz
Out Power （GSM）	2W (+33dBm)	1W (+30dBm)

Out Power（EDGE）		500mW (+27dBm)	400mW (+26dBm)
Sensitivity		＜-102dBm	＜-102dBm
Frequency Error		＜0.1 PPM	＜0.1 PPM
Phane Error	Max（°）	≤20	≤20
	RMS（°）	≤5	≤5

1.2 Relevant Documents

- 《AT Command Manual for ZTE Corporation's MG2636 Modules》
- 《Wireless Module Test References》

1.3 Acronyms

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		
EFR	Enhanced Full Rate	

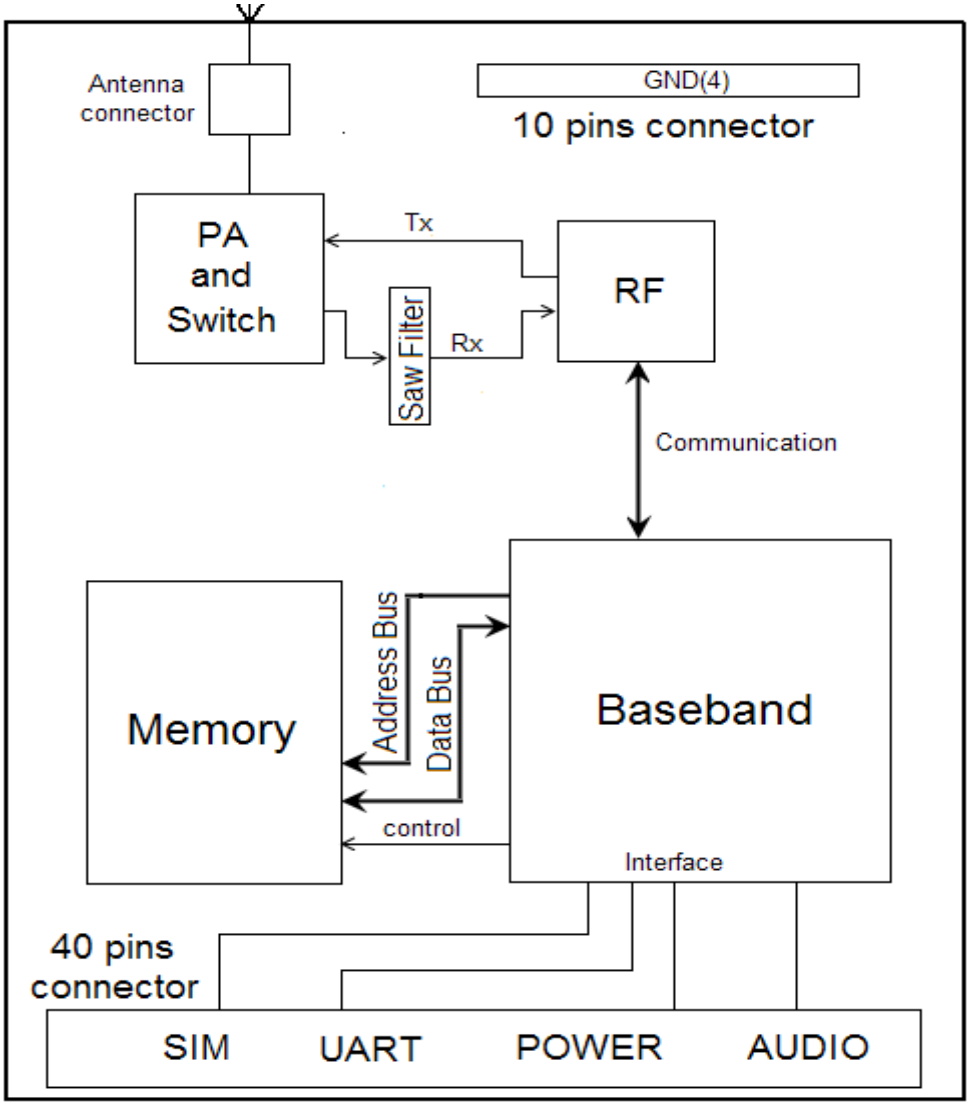
EGSM	Enhanced GSM	
EMC	Electromagnetic Compatibility	
EMI	Electro Magnetic Interference	
ESD	Electronic Static Discharge	
ETS	European Telecommunication Standard	
F		
FDMA	Frequency Division Multiple Access	
FR	Full Rate	
G		
GPRS	General Packet Radio Service	
GSM	Global Standard for Mobile Communications	
H		
HR	Half Rate	
HSDPA	High Speed Downlink Packet Access	
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	
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
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
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
V	
VSWR	Voltage Standing Wave Ratio
W	
WCDMA	Wide band Code Division Multiple Access
Z	
ZTE	ZTE Corporation

2 Product Introduction

Please refer to Figure 2-1 for the function block diagram of MG2636.

Figure 2-1 MG2636 Function Block Diagram

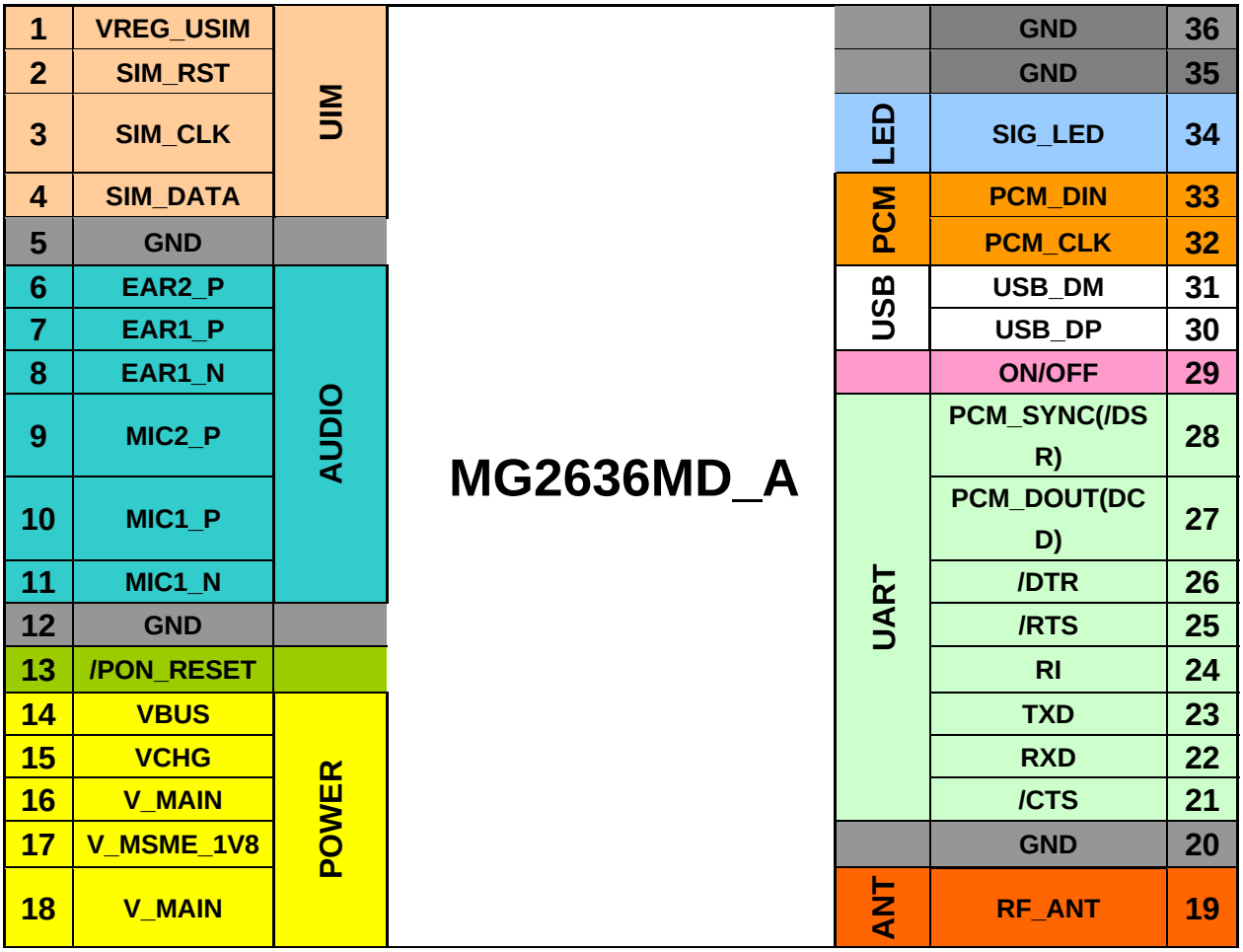


MG2636 module is GSM/GPRS wireless module, MG2636 module adopts a 36PIN stamp hole, which is applicable for GSM network. It supports 850/900/1800/1900 frequency band.

3 PIN Definitions

MG2636 module adopts a 40PIN stamp hole and the distance between PINs is 0.5mm. Refer to table 3-1 below for PIN definitions. Refer to table 3-2 for the key voltage of each pin.

Table 3-1 PIN definitions



Refer to table 3-1 below for PIN definitions of MG2636 module.

Table 3-2 PIN definitions

Function	Pin No.	Signal name	I/O	Basic functions	Remarks
SIM card interface	1	VREG_USIM	O	2.85V/1.8V	
	2	SIM_RST	O	USIM card reset signal	
	3	SIM_CLK	O	USIM card clock	
	4	SIM_DATA	I/O	USIM card data cable	
Audio	6	EAR2_P	O	Single-end audio output channel 2	
	7	EAR1_P	O	Differential audio output channel 1, anode	
	8	EAR1_N	O	Differential audio output channel 1, cathode	
	9	MIC2_P	I	Single-end audio input channel 2	

	10	MIC1_P	I	Differential audio input channel 1, anode	
	11	MIC1_N	I	Differential audio input channel 1, cathode	
Reset	13	/PON_RESET	I	Reset signal	Low level valid
Power	14	VBUS	I	USB power	+5V
	15	VCHG	I	Charge power	
	16	V_MAIN	I	Module's main power	3.3V-4.2V
	17	V_MSME_1V8	O	Digital power	Voltage output, 1.8V
	18	V_MAIN	I	Module's main power	3.3V-4.2V
	29	ON/OFF	I	Power on/off control	1.8V, Low level valid
UART	21	/CTS	I	Clear to send	1.8V, Low level valid
	22	RXD	I	Receive data	1.8V
	23	TXD	O	Transmit data	1.8V
	24	RI	O	Ring tone	1.8V
	25	RTS	O	Request to send	1.8V, Low level valid
	26	/DTR	I	Data terminal ready	1.8V, Low level valid
PCM	27	PCM_DOUT（DCD）	O	PCM data output	1.8V, duplex with DCD
	28	PCM_SYNC（/DSR）	O	PCM frame SYNC clock	1.8V, duplex with /DSR
	32	PCM_CLK	O	PCM data clock	1.8V
	33	PCM_DIN	I	PCM data input	1.8V
USB interface	30	USB_DP	I/O	USB data+	
	31	USB_DM	I/O	USB data-	
LED	34	SIG_LED	O	Module's working status LED	
Antenna	19	RF_ANT	I/O	Antenna interface	
GND	5、12、20、35、36	GND			

4 Decription of Hardware Interfaces

4.1 Summary

This chapter introduces each logic function interfaces of MG2636 module & its operation descriptions, and provides the designing sample.

- Power and Reset Interface
- COM Port
- SIM Card Interface
- Audio Interface
- PCM interface
- USB2.0 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

4.2.1 Power Design

The module could work under two power modes: 1. Power adaptor; 2. Battery
The power could directly be supplied externally, the external power is added directly to V_MAIN and meets the voltage requirements in table 4-1. The external power could be supplied by the power adaptor with constant output, battery, USB power converter, etc. It's recommended to design 2A current to meet the requirements of GSM/GPRS.

Table 4-1 Voltage characteristics

Classification	MIN.	Typical	Max.
Input voltage	3.3 V	3.8 V	4.25 V

- Power on

The module will be turned off after power-on normally. To turn on the module, provide a 2000-2500mS low level pulse to ON/OFF PIN.

- Power off

To turn off the module, provide a 2500-4000mS low level pulse to ON/OFF PIN.

- Reset

To reset the module, provide a 2500-4000mS low level pulse to ON/OFF PIN
After reset, the module will be turned off. To turn on the module, provide a 2000-2500mS low level pulse to ON/OFF PIN.

- V_MSME_1V8

There is a voltage output pin with current adjuster on MG2636 module, 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 1.8V, 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 for pull-up when matching the level.

- **Other Advice**

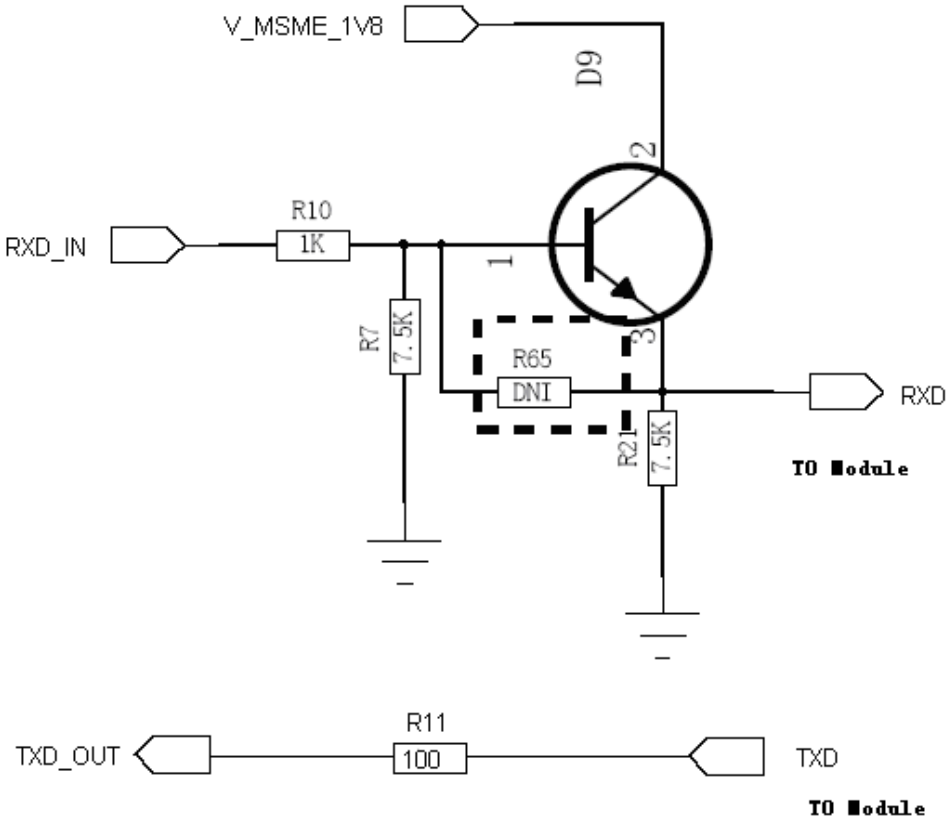
In order to make sure the data is saved safely, please don't cut off the power when the module is on. It's strongly recommended to use ON/OFF pin or AT command to turn off the mobile phone.

4.3 COM Port

The module provides a full duplex UART interface, whose maximal data rate is 230.4kbps and typical data rate is 11.5kbps. External interface is 1.8VCMOS level signal, which could be used for upgrade, port communication, etc.

When using MG2636 module's UART port to communicate with PC or MCU, please pay attention to the direction of TX, RX. It's specially noted that MG2636 module's UART port only supports 1.8V, therefore for non 1.8V external UART, it needs to convert the level. Normally a dynatron is used to realize the level conversion. As shown in figure 4-1, the resistance is just for your information, please calculate again during the design.

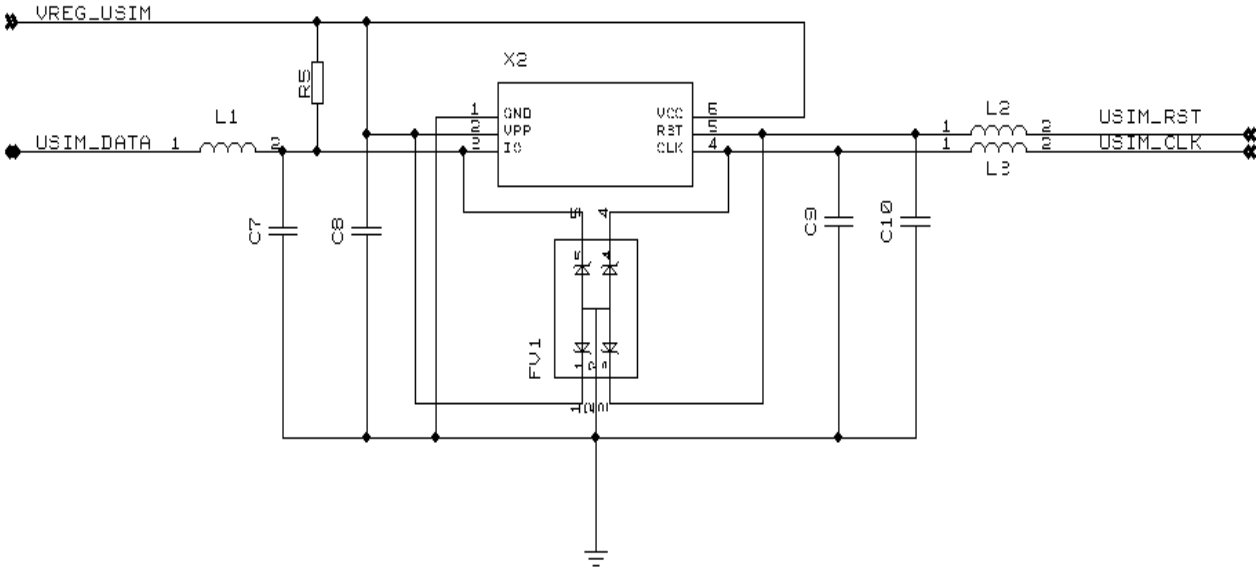
Figure 4-1 UART Interface Reference Design Diagram



4.4 SIM Card Interface

The module supports 2.85V/1.8V SIM card, and it's strongly recommended to add ESD component to protect UIM card as shown in figure 4-2.

Figure 4-2 SIM Card Circuit Reference Design Diagram



Note: The clock data rate of UIM card circuit is 4M, and the card socket should be laid closely around the module and the wiring should be as short and thick as possible.

4.5 Audio Interface

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

- **Microphone**

The two microphone interfaces MIC_N and MIC_P are differential interface, which could also be used for single end input. It's recommended to use differential mode to reduce the noises and it is directly connected with the receiver. MIC_P is single ended interface, which could be directly connected to the microphone since the offset voltage is internally provided.

- Earpiece

The earpiece interface EAR1_P and EAR1_N are both differential interfaces with 32Ω resistance; EAR2_P is single-ended interface with 32Ω resistance and no coupling of capacitor is required.

- Design of audio interface on the receiver

Select the microphone with the sensitivity lower than -52dB since EAR1's output power is 35mW and the max. gain inside MIC1 reaches 52dB.

Note: *if other kind of audio input method is adopted, the input signal should be within 1V. If the signal voltage is lower than 1V, then the pre-amplifier should be added. If the signal voltage is higher than 1V, then network attenuation should be added*

- Design of audio interface on the earpiece

Select the microphone with the sensitivity lower than -52dB since EAR2's output power is 10.8mW and the max. gain inside MIC2 reaches 52dB. The level of MIC2_P PIN is about 1.8V. The receiver's design is just the same as the receiver's.

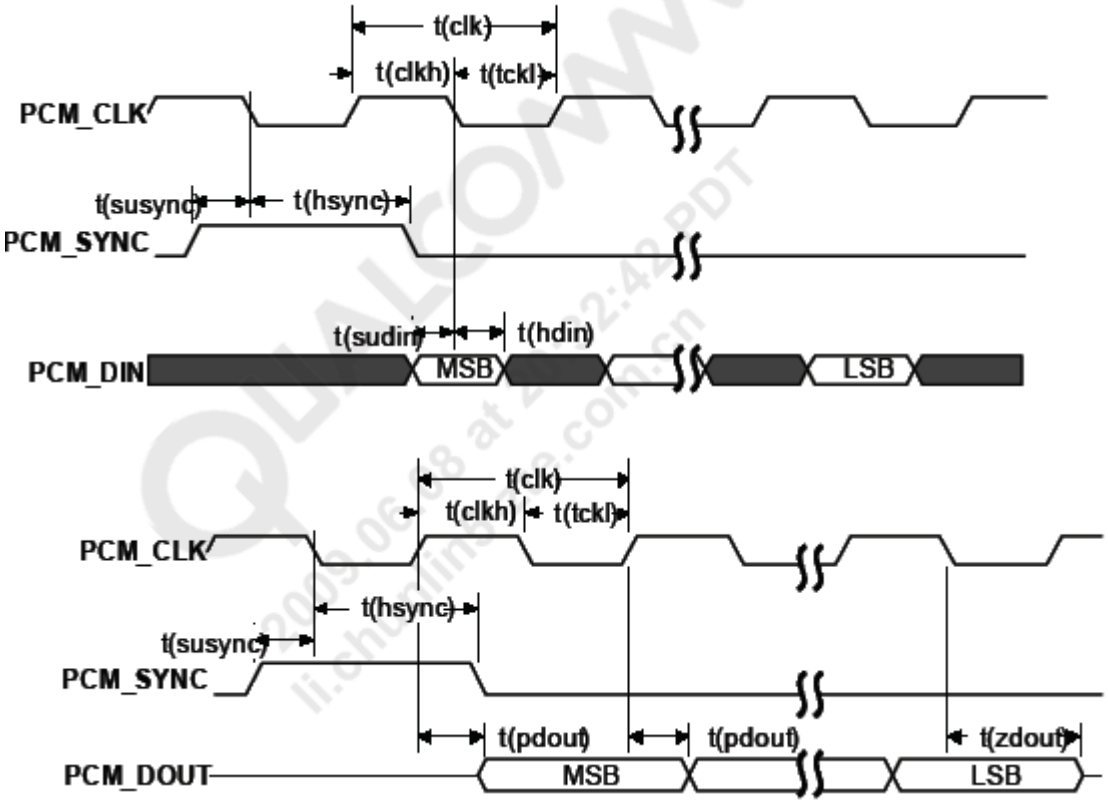
4.6 PCM Interface

The module's PCM interface provides PCM_CLK, PCM_SYNC, PCM_DIN, PCM_DOUT，and it supports 2.048MHz PCM clock data rate and 8K frame data rate. PCM clock will stop the output when it enters the dormant mode.

The module's PCM interface must work under Master mode, and the clock and SYNC signal must be sent by the module. The device connected with the interface can word under Slave mode only.

See the time sequence of PCM interface in figure 4-3.

Figure 4-3 Time Sequence of PCM Interface



Parameter	Description	Min	Typ	Max	Unit
T(sync)	PCM_SYNC cycle time		125		μs
T(synch)	PCM_SYNC high time	400	500		ns
T(syncl)	PCM_SYNC low time		124.5		μs
T(clk)	PCM_CLK cycle time		488		ns
T(clkh)	PCM_CLK high time		244		ns
T(clkl)	PCM_CLK low time		244		ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	60			ns
T(hsync	PCM_SYNC Hold time after falling edge of PCM_CLK	60			ns

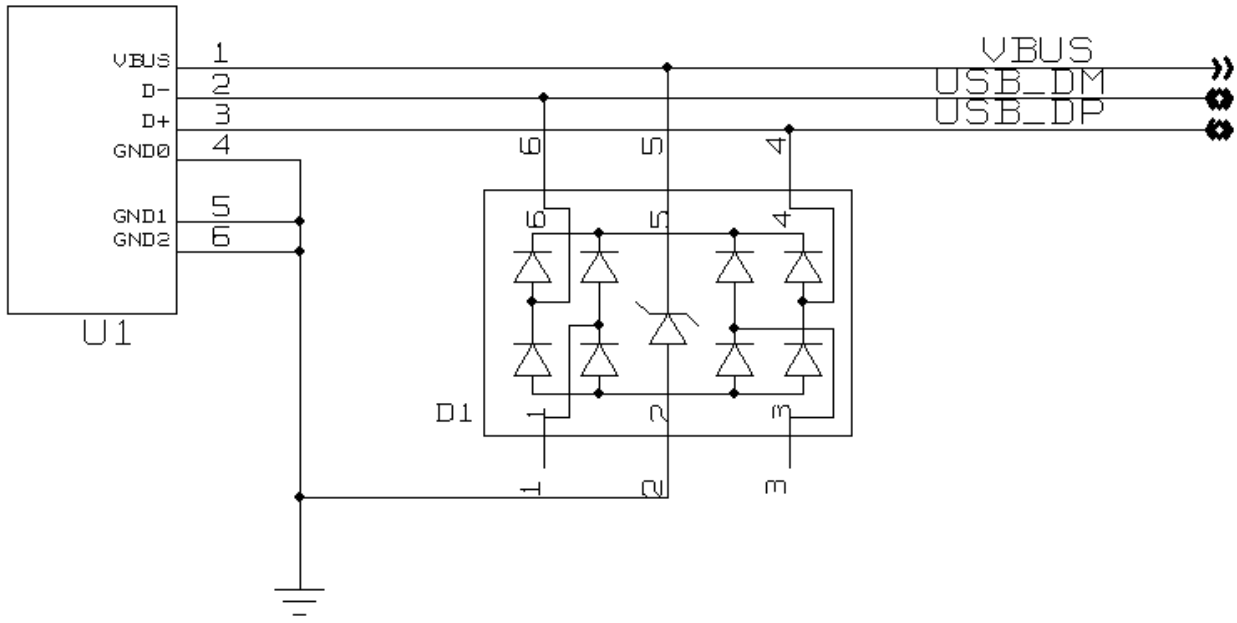
Parameter	Description	Min	Typ	Max	Unit
T(sudin)	PCM_DIN setup time before falling edge of PCM_CLK	50			ns
T(hdin)	PCM_DIN hold time after falling edge of PCM_CLK	10			ns
T(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid			350	ns
T(zdout)	Delay from PCM_CLK falling to PCM_DOUT HIGH-Z		160		ns

4.7 USB2.0 Interface

The module provides USB2.0 HS interface with 480Mbps, which is composed of VBUS, D+ and D-. You can directly connect USB signal interface when designing the module's external circuit, but try to add ESD protector during the design to avoid damaging the module.

D1 is USB2.0 ESD protector in the figure, and the Junction capacitance is small than 3P. VBUS is connected to the external host VBUS. The USB operating voltage is: 4.75—5.25V with the typical value of 5V. See figure 4-4.

Figure 4-4 USB Interface Circuit Reference Design Diagram



5 Mechanical Design

5.1 Appearance Diagram

See the appearance of MG2636 module in figure 5-1.

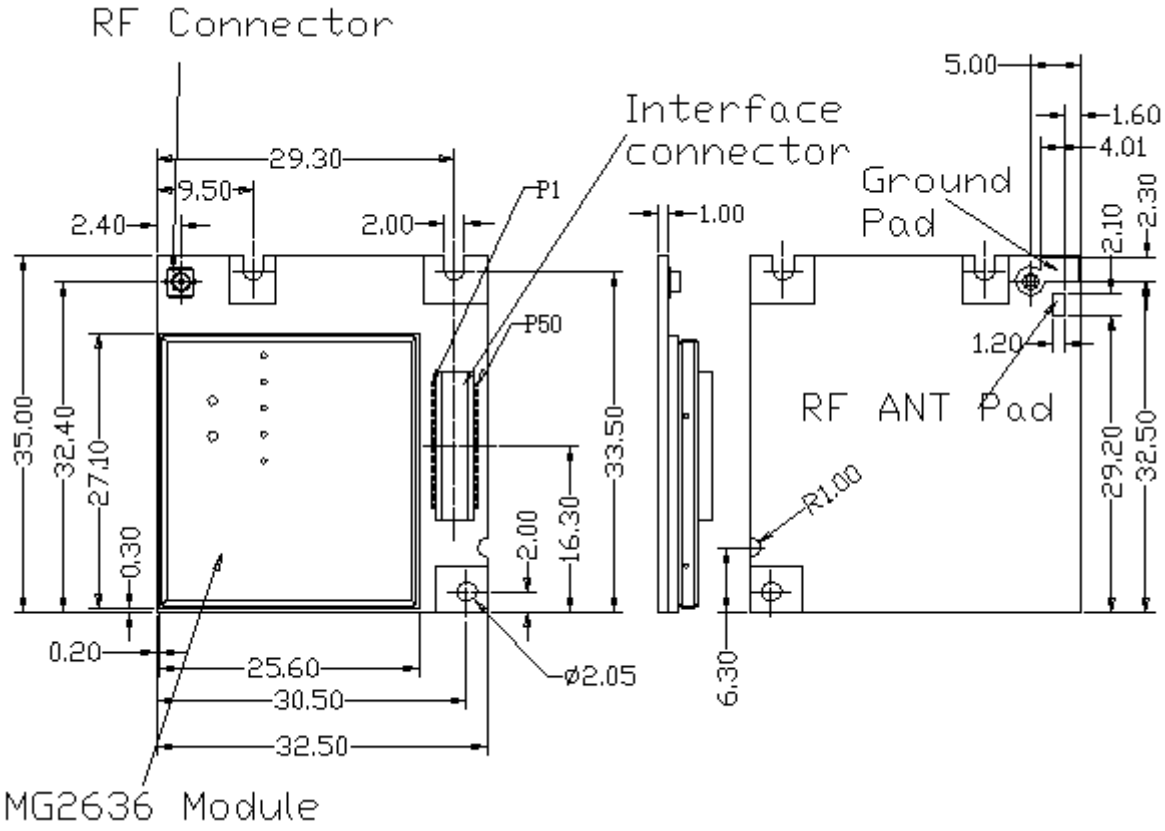
Figure 5-1 MG2636 Module's Appearance

- Dimensions:（LxWxH）：35 mm x 32.5mm x2.65mm
- Weight: 7g

5.2 Module Assembly Diagram

See the assembly diagram of MG2636 module in figure 5-2.

Figure 5-2 Module's Assembly Diagram



5.3 Module's Fixing Method

The module's fastening method adopts direct manual soldering to avoid second-time soldering. It's strongly recommend to use the manual soldering because MG2636 module board is just 0.8mm thick and MT6223BGA space is too small.

6. Antenna Interface

The RF interface of the MG2636 Module has an impedance of 50 . The module is capable of sustaining a total mismatch at the antenna connector or pad without any damage, even when transmitting at maximum RF power.

The external antenna must be matched properly to achieve best performance regarding radiated power, DC-power consumption, modulation accuracy and harmonic suppression. Antenna matching networks are not included on the MG2636 Module PCB and should be placed in the host application.

Regarding the return loss, the Module provides the following values in the active band:

Table 6-1 Return Loss in the Active Band

State of Module	Return Loss of Module	Recommended Return Loss of Application
Receive	≥ 8dB	≥ 12dB
Transmit	not applicable	≥ 12dB

The connection of the antenna or other equipment must be de coupled from DC voltage. This is necessary because the antenna connector is DC coupled to ground via an inductor for ESD protection.

6.1 Antenna Installation

To suit the physical design of individual applications, the MC2261 offers two alternative approached to connecting the antenna:

- Recommended approach: MM9329-2700B antenna connector manufactured by MURATA assembled on the component side of the PCB (top view on Module). See Section 4.3 for details.
- Antenna pad and grounding plane placed on the bottom side. See Section 4.2 for details.
  The MM9329-2700B connector has been chosen as antenna reference point (ARP) for the ZTEMT reference equipment submitted to type approve the MG2636 Module. All RF data specified throughout this manual are related to the ARP. For compliance with the test results of the ZTEMT type approval you are advised to give priority to the connector, rather than using the antenna pad.

Note: Both solutions can be applied alternatively. This means,if the antenna is connected to the pad, then the connector on the Module must be left empty,and when the antenna is connected to the Module connector, the pad is useless,

6.2 Antenna Pad

The antenna pad of the module is soldered to the board on the customer design to connect with RF line.

For proper grounding connect the RF line to the ground plane on the bottom of the MG2636 Module which must be connected to the ground plane of the application.

Consider that according to GSM recommendations as 50Ω connector is mandatory for type approval measurements. It must be ensured that the RF line which is connected to antenna pad should be controlled on 50Ω.

Notes on soldering

- To prevent damage to the Module and to obtain long-term solder joint properties, you are advised to maintain the standards of good engineering practice for soldering.

Material Properties

- MG2636 Module PCB: FR4
- Antenna pad: Gold plated pad

6.3 Antenna connector

The MG2636 Module uses a microwave coaxial connector supplied by Murata Ltd. The product name is MM9329-2700B. The position of the antenna connector on the Module PCB can be seen in Figure 6-3.

Figure 6-3 Specification of MM9329-2700B connector

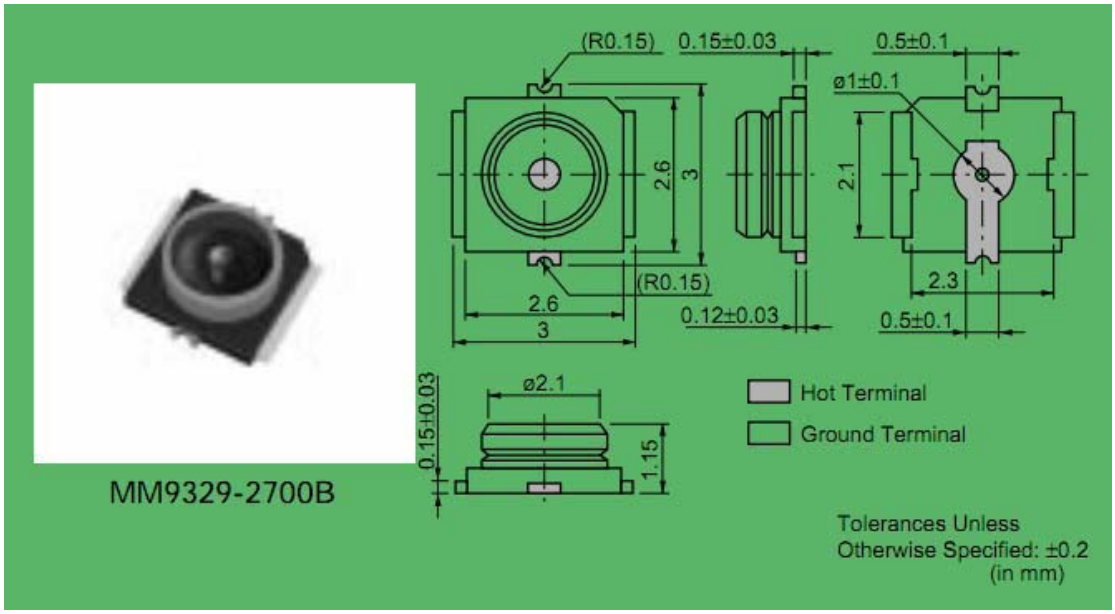


Table 6-2 Product specifications of MM9329-2700B connector

Part Number	Rated Voltage (V)	Contact Resistance (ohm)	Withstanding Voltage (rms)	Insulation Resistance (M ohm)	Durability (cycles)	Frequency Rating (GHz)	Temperature Range (degree C)	VSWR	Center Contact	Outer Contact	Insulator
MM9329-2700B	250	0.015 max.	300 (AC)	500 min.	100	DC - 6.0	-40~+90.	1.2 max. (DC~3GHz)	Copper Alloy Gold plated	Copper Alloy Silver plated	Engineering plastic

6.4 Antenna Subsystem

The antenna sub-system and its design is a major part of the final product integration. Special attention and care should be taken in adhering to the following guidelines.

6.4.1 Antenna Specifications

Choice of the antenna cable (type, length, performance, RF loss, etc) and antenna connector (type + losses) can have a major impact on the success of the design.

6.4.2 Cable Loss

All cables have RF losses. Minimizing the length of the cable between the antenna and the RF connectors on

the module will help obtain superior performance. High Quality/Low loss co-axial cables should be used to connect the antenna to the RF connectors. Contact the antenna vendor for the specific type of cable that interfaces with their antenna and ask them to detail the RF losses of the cables supplied along with the antenna. Typically, the cable length should be such that they have no more than 1-2dB of loss. Though the system will work with longer (lossy) cables, this will degrade GSM system performance. Care should also be taken to ensure that the cable end
connectors/terminations are well assembled to minimize losses and to offer a reliable, sturdy connection to the Module sub-system. This is particularly important for applications where the module is mounted on a mobile or portable environment where it is subject to shock and vibration.

6.4.3 Antenna Gain Maximum Requirements

Our FCC Grant imposes a maximum gain for the antenna subsystem: 2 dBi for the GSM850 band and 2dBi for the 1900 band.
Warning: Excessive gain could damage sensitive RF circuits and void the warranty.

6.4.4 Antenna Matching

The module's RF connectors are designed to work with a 50-ohm subsystem. It is assumed that the antenna chosen has matching internal to it to match between the 50-ohm RF connectors and the antenna impedance.

6.4.5 PCB Design Considerations

• The antenna subsystem should be treated like any other RF system or component. It should be isolated as much as possible from any noise generating circuitry including the interface signals via filtering and shielding.
• As a general recommendation all components or chips operating at high frequencies such as micro controllers, memory, DC/DC converts and other RF components should not be placed too close to the module. When such cases exist, correct supply and ground de-coupling areas should be designed and validated.
• Avoid placing the components around the RF connection and close to the RF line between the RF antenna and the module.
• RF lines and cables should be as short as possible.
• If using coaxial cable it should not be placed close to devices operating at low frequencies. Signals like charger circuits may require some EMI/RFI decoupling such as filter capacitors or ferrite beads.
• Adding external impedance matching to improve the match to your cable and antenna assemblies is optional. Please contact the antenna vendor for matching requirements.
• For better ESD protection one can implement a shock coil to ground and place it close to the RF connector.

Antenna Interface

Proper measures should be taken to reduce the access loss of effective bands, and good shielding should be established between the external antenna and the RF connector. Besides, the 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.

Important compliance information for North American users

The MG2636 Module has been granted modular approval for mobile applications. Integrators may use the MG2636 Module in their final products without additional FCC certification if they meet the following conditions. Otherwise, additional FCC approvals must be obtained.

1. At least 20cm separation distance between the antenna and the user's body must be maintained at all times.

2. To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed 2dBi in the cellular band and 2dBi in the PCS band.

3. The MG2636 Module and its antenna must not be co-located or operating in conjunction with any other transmitter or antenna within a host device.

4. A label must be affixed to the outside of the end product into which the MG2636 Module is incorporated, with a statement similar to the following: For MG2636: This device contains FCC ID: Q78-MG2636.

5. A user manual with the end product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

The end product with an embedded MG2636 Module may also need to pass the FCC Part 15 unintentional emission testing requirements and be properly authorized per FCC Part 15.

Note: If this module is intended for use in a portable device, you are responsible for separate approval to satisfy the SAR requirements of FCC Part 2.1093.