MG3732 Module User Manual

Version: V1.0

ZTE Corporation

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Preface

Summary

This user manual is for MC3732 modules. It takes MC3732 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 MG3732 module's basic technical specification, the relevant documents for reference and the acronyms.
2 Product introduction	Introduces MG3732 module's principle diagram.
3 PIN definitions	Introduces the name and function of MG3732 module's Pins.
4 Description of hardware interfaces	Introduces the design of the hardware interface on each part of MG3732 module.
7 Mechanical design	Introduces MG3732 module's appearance diagram, assembly diagram and PCB layout diagram.

Update History

V1.0（2010-09-01）

This is the first time to officially release the document.

Contents

Graphics

Tables

1 General Description

This manual is applicable for MG3732 modules. With the function of voice, SMS and data service, ZTE MG3732 module is a type of WCDMA/HSDPA/GSM/GPRS/EDGE module developed by ZTE Corporation. With the downlink peak data rate up to 3.6 Mbit/s and the uplink peak data rate up to 384 Kbit/s, the module could provide economic high-speed Internet access and wireless data service. MG3732 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 MG3732 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)
MG3732	WCDMA/HSDPA/GSM/GPRS/EDGE	GSM/GPRS/EDGE： GSM850/EGSM900/DCS1800/PCS1900 WCDMA/HSDPA: 2100M（band I）, 1900M（band II）, 850M（band V）

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
USIM 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	-10°C ~ +50°C
Input voltage	3.3V-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) WCDMA：23dBm
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
	WCDMA 2100： Tx: 1920-1980MHz Rx: 2110-2170MHz

	WCDMA 1900： Tx: 1850-1910MHz Rx: 1930-1990MHz
	WCDMA 850： Tx: 824-849MHz Rx: 869-894MHz

：

1.2.1 Maximum Output Power

Operating Band	Power Class 1		Power Class 2		Power Class 3		Power Class 4	
	Power (dBm)	Tol (dB)	Power (dBm)	Tol. (dB)	Power (dBm)	Tol (dB)	Power (dBm)	Tol (dB)
Band I	+33	+1/-3	+27	+1/-3	+24	+1/-3	+21	+2/-2
Band II	-	-	-	-	+24	+1/-3	+21	+2/-2
Band V	-	-	-	-	+24	+1/-3	+21	+2/-2

1.2.2 Frequency Error

Operating Band	Frequency Error
Band I	＜0.1 PPM
Band II	＜0.1 PPM
Band V	＜0.1 PPM

1.2.3 Minimum Output Power

Operating Band	Minimum Output Power（dBm）
Band I	＜-50
Band II	＜-50
Band V	＜-50

1.2.4 Error Vector Magnitude（EVM）

Parameter	Level / Status	EVM
Output power	≥ −20 dBm	＜17.5 %
Operating conditions	Normal conditions	
Power control step size	1 dB	

1.2.5 Peak Code Domain Error

Parameter	Level / Status	Peak Code Domain Error
Output power	≥ −20 dBm	＜-15dB
Operating conditions	Normal conditions	
Power control step size	1 dB	

1.2.6 Occupied Bandwidth

Operating Band	Occupied Bandwidth	Chip Rate
Band I		
Band II	＜5MHz	3.84Mcps
Band V		

1.2.7 Adjacent Channel Leakage Power Ratio（ALCR）

Power Class	UE channel	ACLR limit
3	+5 MHz or –5 MHz	33 dB
3	+10 MHz or –10 MHz	43 dB
4	+5 MHz or –5 MHz	33 dB
4	+10 MHz or –10 MHz	43 dB

1.2.1 Reference Sensitivity Level（BER≤0.001）

Operating Band	Unit	DPCH_Ec <REFSENS>	<REFÎor>
Band I	dBm/3.84 MHz	-117	-106.7
Band II	dBm/3.84 MHz	-115	-104.7
Band V	dBm/3.84 MHz	-115	-104.7
1. For Power class 3 this shall be at the maximum output power			
2. For Power class 4 this shall be at the maximum output power			

1.2.2 Maximum Input Level（BER≤0.001）

Parameter	Level / Status	Unit
$\hat{I}_{or}$	−25.7	dBm / 3,84MHz
$\dfrac{DPCH\_E_c}{I_{or}}$	−19	dB
UE transmitted mean power	20 (for Power class 3) 18 (for Power class 4)	dBm

2.GSM/GPRS/EDGE

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
Phane Error — RMS（°）	≤5	≤5

1.2 Relevant Documents

- 《AT Command Manual for ZTE Corporation's MG3732 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 MG3732.

Figure 2-1 MG3732 Function Block Diagram

MG3732 module is WCDMA 3G wireless module developed based on Qualcomm's QSC6270 platform. MG3732 module adopts a 36PIN stamp hole, which is applicable for both WCDMA and GSM network. It supports 850/900/1800/1900/2100 frequency band.

3 PIN Definitions

MG3732 module adopts a 36PIN 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

1	VREG_USIM	UIM				GND	36
2	USIM_RST					GND	35
3	USIM_CLK				LED	SIG_LED	34
4	USIM_DATA				PCM	PCM_DIN	33
5	GND					PCM_CLK	32
6	EAR2_P	AUDIO			USB	USB_DM	31
7	EAR1_P					USB_DP	30
8	EAR1_N					ON/OFF	29
9	MIC2_P				UART	PCM_SYNC(/DSR)	28
10	MIC1_P					PCM_DOUT(DCD)	27
11	MIC1_N					/DTR	26
12	GND					/RTS	25
13	/PON_RESET					RI	24
14	VBUS	POWER				TXD	23
15	VCHG					RXD	22
16	V_MAIN					/CTS	21
17	V_MSME_1V8					GND	20
18	V_MAIN				ANT	RF_ANT	19

MG3732MD_A

Refer to table 3-1 below for PIN definitions of MG3732 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	USIM_RST	O	USIM card reset signal	
	3	USIM_CLK	O	USIM card clock	
	4	USIM_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 MG3732 module & its operation descriptions, and provides the designing sample.

- Power and Reset Interface
- COM Port
- UIM 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 MG3732 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 MG3732 module's UART port to communicate with PC or MCU, please pay attention to the direction of TX, RX. It's specially noted that MG3732 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.
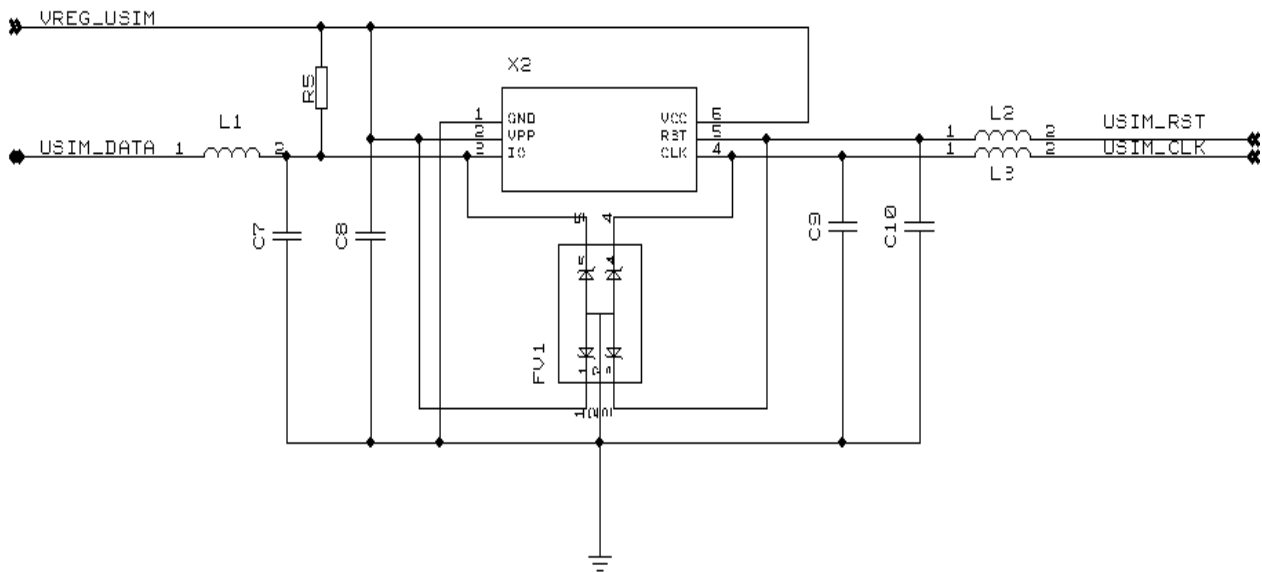
Figure 4-1 UART Interface Reference Design Diagram
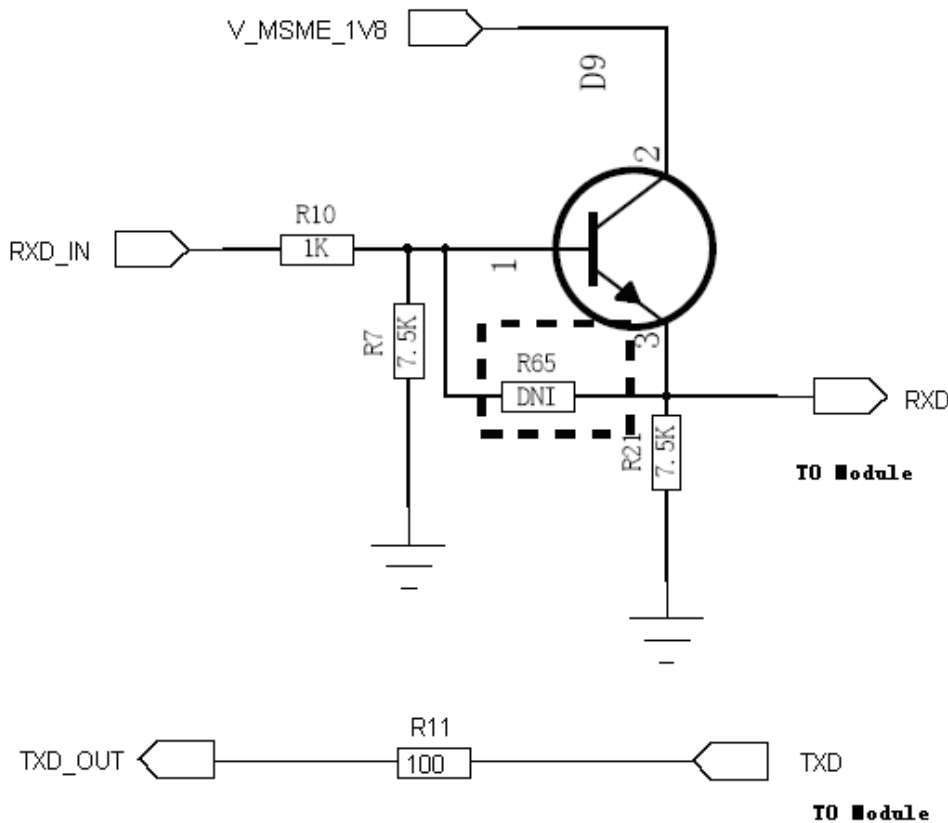
4.4 UIM Card Interface

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

Figure 4-2 UIM 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. See the audio interface circuit in figure 4-3.

Figure 4-3 Audio Interface Circuit Reference Design Diagram
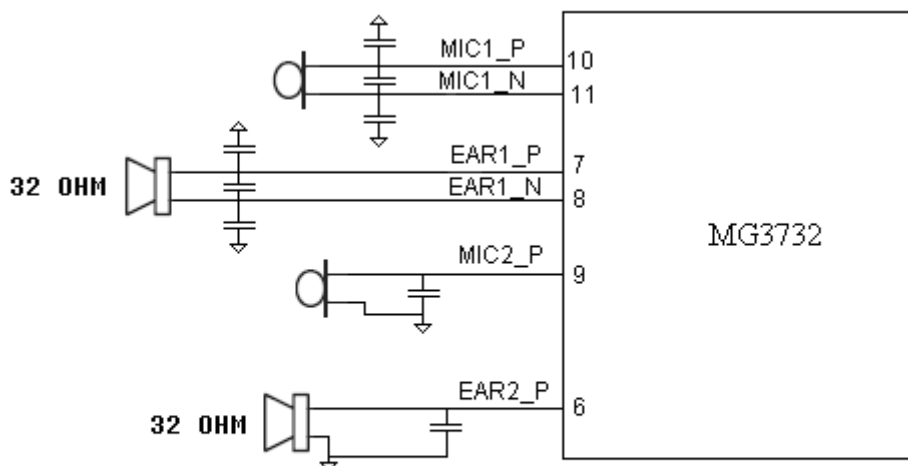
● **Microphone**

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 4-4.

Figure 4-4 Time Sequence of PCM Interface
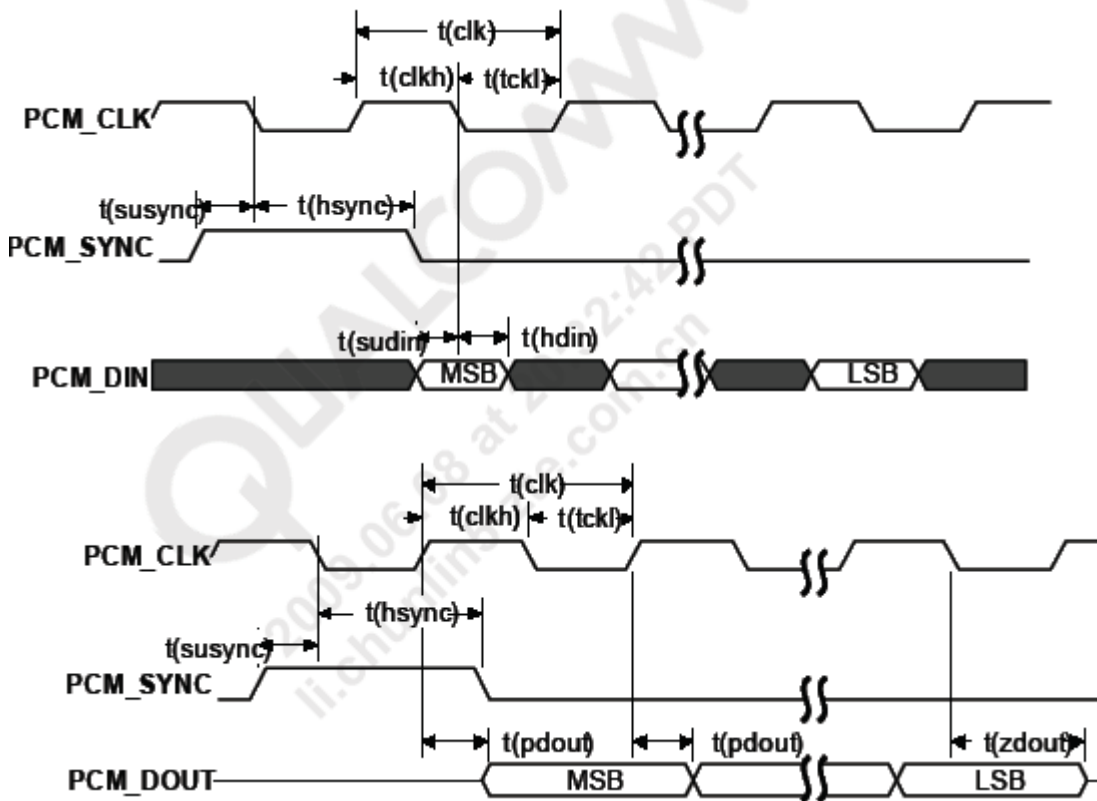
Parameter	Description	Min	Typ	Max	Unit
T(sync)	PCM_SYNC cycle time		125		µs
T(synch)	PCM_SYNC high time	400	500		ns
T(syncl)	PCM_SYNC low time		124.5		µs
T(clk)	PCM_CLK cycle time		488		ns
T(clkh)	PCM_CLK high time		244		ns
T(clkl)	PCM_CLK low time		244		ns
T(susync)	PCM_SYNC setup time high before falling 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 4-5.

Figure 4-5 USB Interface Circuit Reference Design Diagram
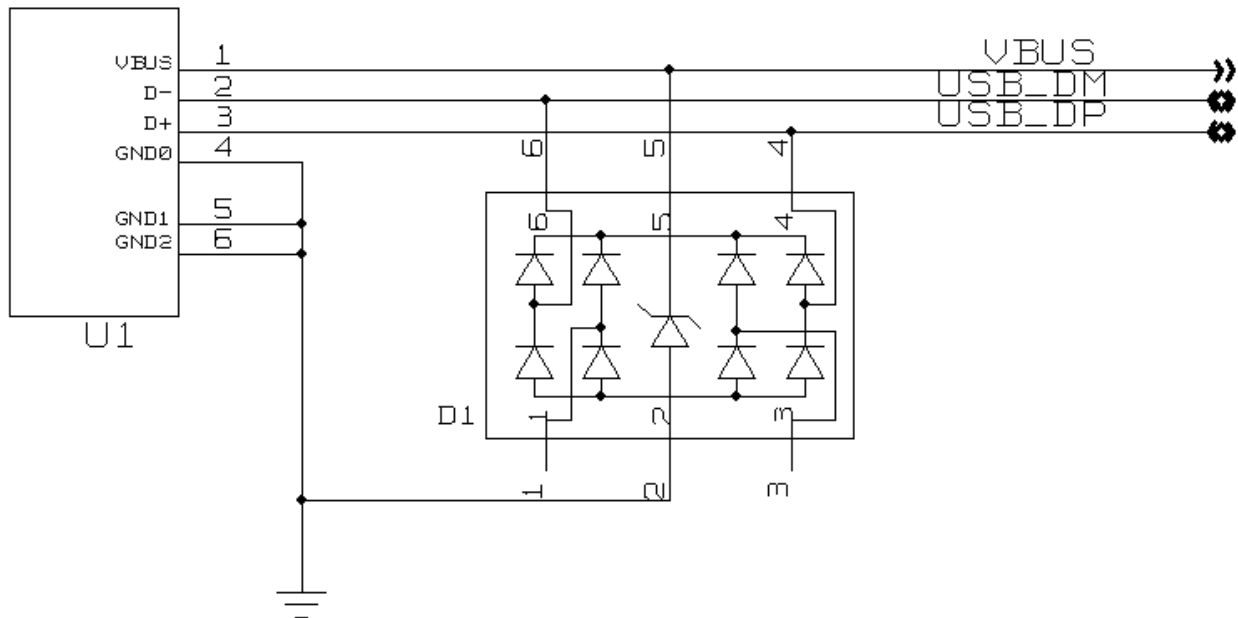
4.8 Antenna Interface

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.

5 Mechanical Design

5.1 Appearance Diagram

See the appearance of MG3732 module in figure 5-1.
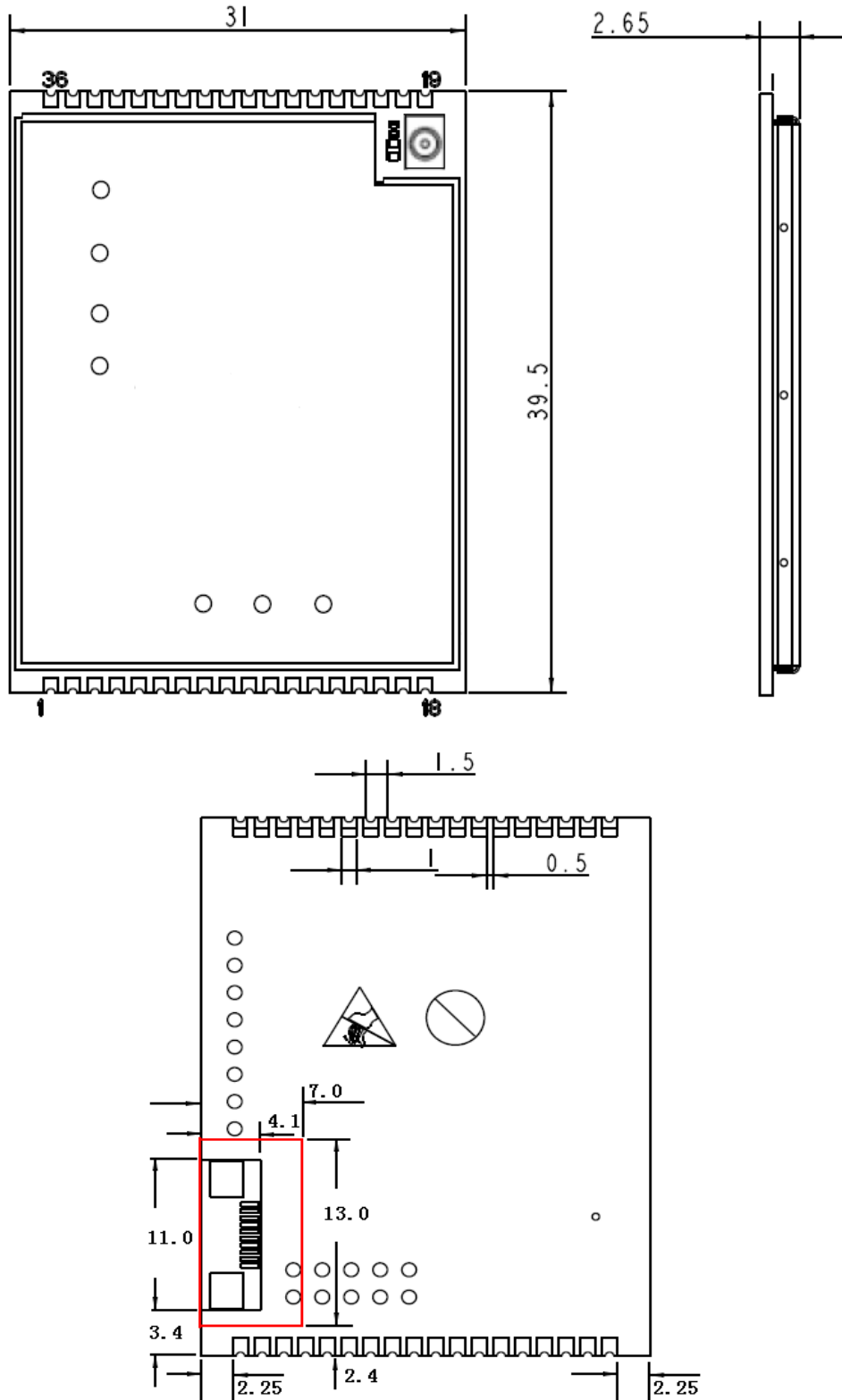
Figure 5-1 MG3732 Module's Appearance

- Dimensions:（LxWxH）：39.5 mm x 31.0mm x2.65mm
- Weight: 7g

5.2 Module Assembly Diagram

See the assembly diagram of MG3732 module in figure 5-2.

Figure 5-2 Module's Assembly Diagram

Note: it's recommended to open a window in the relevant position of the red area on the bottom layer for the convenience of maintenance. The red box is made manually and doesn't exist on the actual object. See the dimensions for the hole in the figure above.

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 MC3732 module board is just 0.8mm thick and QSC6270 BGA space is too small. The second-time soldering would cause the melting of soldering tin and lead to short circuit of QSC6270 main chip, such as USB disconnected, large current, etc.

FCC Regulations:

●This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

●This device has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiated radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

▶ RF Exposure Information

This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time-averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of §2.1091.

The antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons, must not be collocated or operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

The end user has no manual instructions to remove or install the device and a separate approval is required for

all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

Maximum antenna gain allowed for use with this device is 2 dBi.

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: Q78-MG3732.

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