ZTE Corporation's ME3000_V2 Module Hardware Design User Manual

Version: V1.0

This manual is applicable for ME3000_V2 module.

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1.0-TY, March 2010

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Preface

Summary

This manual is applicable for ME3000_V2 module. It takes ME3000_V2 module 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.
ME3000_V2 modules are the replacement of ME3000 modules and their technical parameters are basically identical.

Target Readers

The manual is suitable for the following engineers:

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

Brief Introduction

This manual contains 6 chapters. See the table below:

Chapter	Contents
1 General description	Introduces ME3000_V2 module's basic technical specification, the relevant documents for reference and the acronyms.
2 Product introduction	Introduces ME3000_V2 module's principle charts and relevant standards of the module.
3 PIN definitions	Introduces ME3000_V2 module's Pin name and functions.
4 Description of hardware interfaces	Introduces the design of the hardware interface on each part of ME3000_V2 module.
5 Mechanical design	Introduces ME3000_V2 module's appearance diagram, assembly diagram, PCB layout diagram and fixing method.
6 Summary of peripheral components	Introduces the peripheral components.

Update History

The update history records the document's update descriptions every time. The updates of all previous versions will be contained in the latest version.

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1 General Description

This manual is applicable for ME3000_V2 modules. Refer to this manual to make your hardware, mechanical design completely compatible with GSM/GPRS applications except for antenna design. ME3000_V2 module could be widely applied in data transmission, wireless POS, security, lottery terminals, intelligent metering, wireless fax, branch exchange, tobacco network, campus network, wireless AD, wireless media, medical surveillance, relay station surveillance, railway terminals, intelligent home appliances, vehicle-mounted surveillance, etc.

Taking ME3000_V2 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 ME3000_V2 module's specification.

Table 1-1 Table 1-2 Module's specification

Models	Format	Frequency(MHz)
MG3000_V2	GSM/GPRS	Dual Band: EGSM 900/DCS 1800

Remarks: *Except for work frequency band, the modules are completely compatible on hardware and mechanical design. Below is just an example of* ME3000_V2 module.

1.1.2 Basic Functions

Please refer to Table 1-3 for the basic functions.

Table 1-3 Basic functions

Basic Functions	Descriptions
Voice call	EVRC and 13kQCELP high quality voice call
SMS	Support TEXT and PDU
Data	● Support embedded TCP/IP ● Support virtual online ● GSM uplink rate 42.8 kbps, downlink rate 85.6 kbps.

1.1.3 Module's Interface

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

Table 1-4 Interfaces of the modules

Module's interfaces	Descriptions
UART interface	● Software download upgrade; ● Data communication; ● Up to 921.6kbps data rate provided by COM port;

Audio interface	Double audio I/O channel.
SIM card interface	Standard SIM card interface
Antenna interface	50 Ohm input resistance control
RTC	Real time clock interface

1.1.4 Technical parameters

Please refer to Table 1-5 for the module's technical parameters.

Table 1-5 Technical parameters

Technical parameters	Descriptions
Working temperature	-20°C ~ +70°C
Input voltage	3.3V-4.25V
Maximum current	1800mA @ -102 dBm
Idle current	10mA @ -75 dBm
Call current	150mA @ -75 dBm
Rx 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

- 《AT Command Manual for ZTE Corporation's ME3000_V2 Modules》
- 《ZTE MG815+ Module Development Board User Guide》
- 《FAQ for ZTE Corporation's GSM/GPRS Modules》
- 《Wireless Modules' 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		
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	

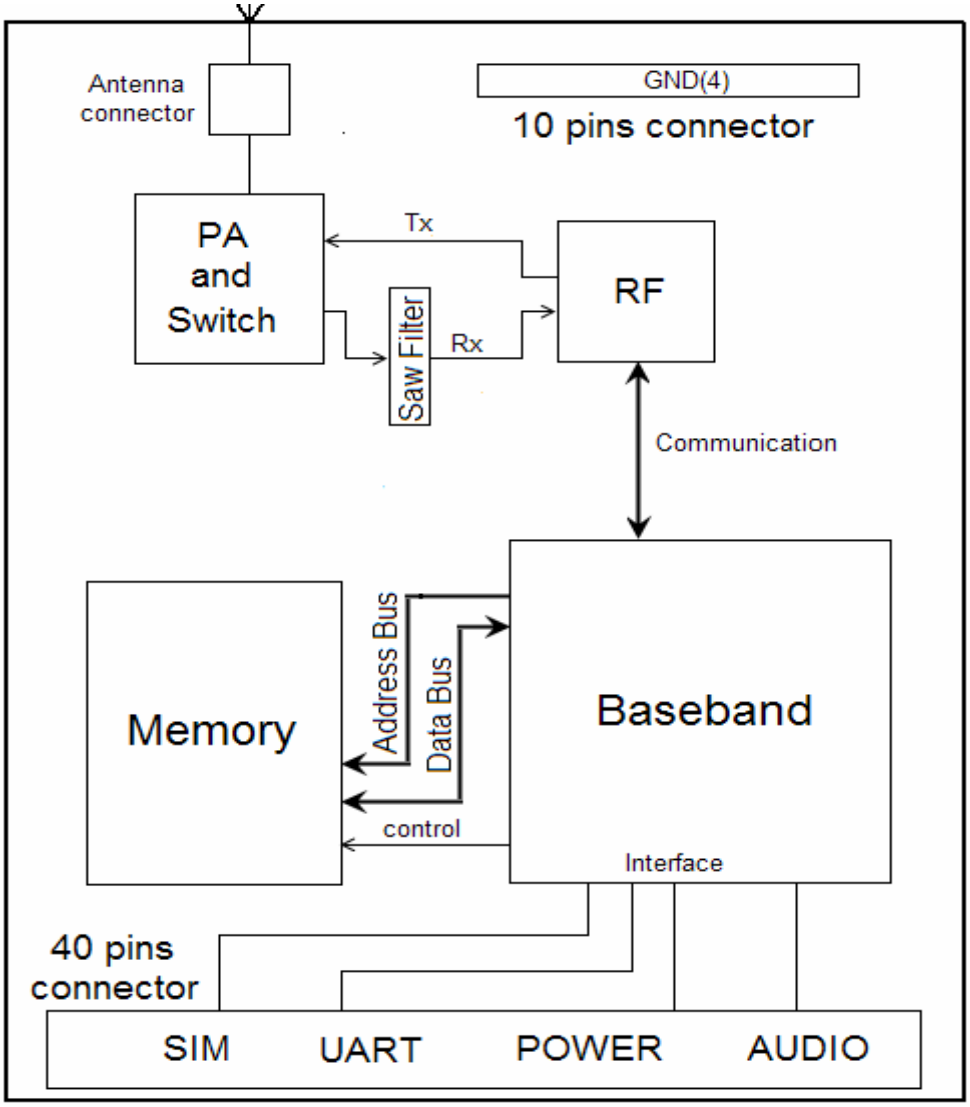
G		
GPRS	General Packet Radio Service	
GSM	Global Standard for Mobile Communications	
H		
HR	Half Rate	
I		
IC	Integrated Circuit	
IMEI	International Mobile Equipment Identity	
ISO	International Standards Organization	
ITU	International Telecommunications Union	
L		
LCD	Liquid Crystal Display	
LED	Light 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 Product Introduction

Please refer to Figure 2-1 for the principle diagram of ME3000_V2 module.

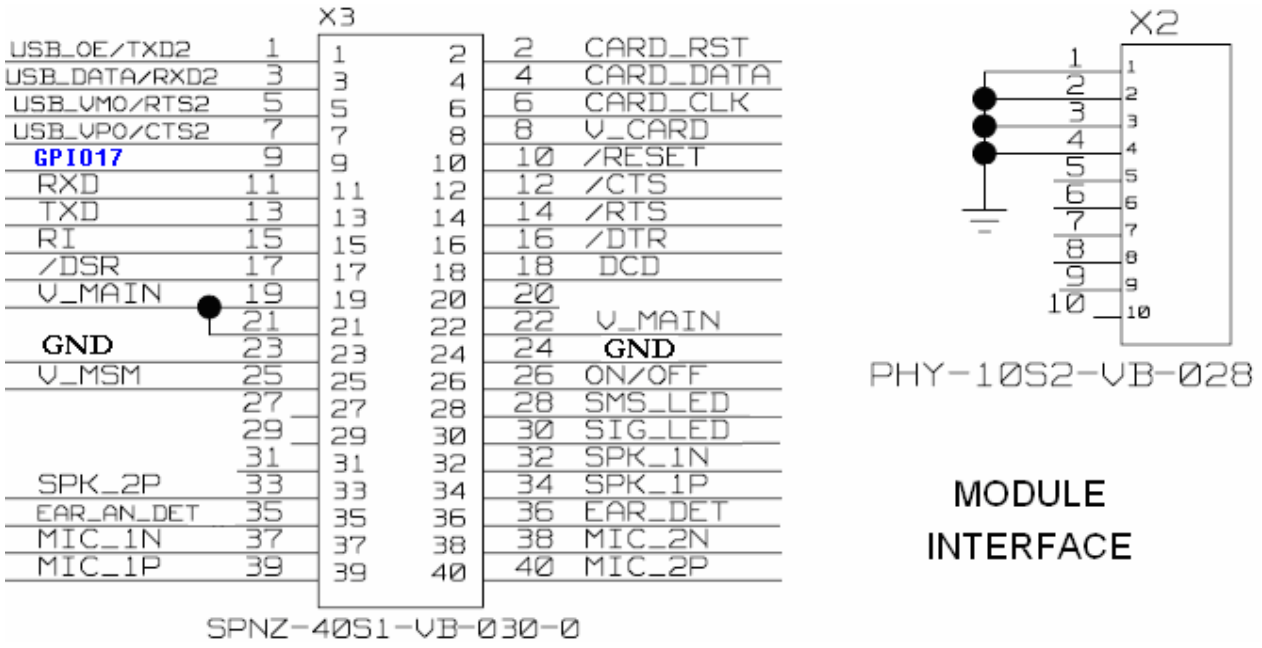
Figure 2-1 Principle diagram



3 PIN Definitions

The main connectors used for ME3000_V2 module include 40-PIN connector and 10-PIN connector. The distance between the pins is 1.27mm. Refer to figure 3-1 below for PIN definitions.

Figure 3-1 PIN definitions



3.1 40PIN Connector

See the definitions of 40PIN conbector in table 3-1.

Table 3-2 40PIN connector definitions

Function	Pin No.	Signal name	I/O	Basic functions	Remarks
Audio	39	MIC_1P	I	1st audio input anode	Default audio input/output as 1st channel. Usually 1st used for handset, 2nd userd for earpiece.
	37	MIC_1N	I	1st audio input cathode	
	34	SPK_1P	O	1st audio output anode	
	32	SPK_1N	O	1st audio output cathode	
	40	MIC_2P	I	2nd audio input anode	
	38	MIC_2N	I	2nd audio output cathode	
	33	SPK_2P	O	2nd audio output anode	
	35	EAR_AN_DET	I	Earpiece key detection	Internal pull-up, valid at low level
	36	EAR_DET	I	Earpiece insert detection	Internal pull-up, valid at low level
COM 1	12	/CTS	O	Clear to send	Valid at low level
	14	/RTS	I	Request to send	Valid at low level
	13	TXD	O	Transmit data	
	11	RXD	I	Receive data	

Function	Pin No.	Signal name	I/O	Basic functions	Remarks
	15	RI—GPIO42 /EINT2	O	Ringer indication signal	TTL level. High level when initialized: Low level after receiving ringer signal and the incoming call rings; high level at any other time. No level change upon the receipt of SMS; 1s low level and 4s high level as the incoming call rings; the process repeats; high level at any other time. Generate 1s low level upon the receipt of SMS.
	17	/DSR	O	Data Set Ready	Valid at low level
	18	DCD	O	Data Carrier Detect	
	16	/DTR	I	Data Terminal Ready	Valid at low level
SIM card interface	4	CARD_DATA	I/O	Data cable	
	6	CARD_CLK	O	Clock cable	
	8	V_CARD	O	CARD power supply	
	2	CARD_RST	O	Reset signal	
COM 2	1	TXD2	O	Transmit data	The GSM module does not support USB function, but it supports UART2 only. Low level valid for PIN 5 and PIN 7.
	3	RXD2	I	Receive data	
	5	/RTS2	I	Request to send	
	7	/CTS2	O	Clear to send	
	9	GPIO17	-	GPIO	Hang up when reserved
LED	28	SMS_LED——GPIO25	O	Incoming call and SMS LED	Internal pull-down, LED on at high level. Need externally add the driver. 4-5S low level upon the receipt of SMS.
	30	SIG_LED	O	Network signal LED	Internal pull-up, LED on at high level. Need externally add the driver. -Power on status: LED off. -Network status: LED flashes. LED is on for 50ms, and off for uncertain time. -IDLE status: LED flashes at 1Hz. -Traffic status (Call, network): LED flashes at 5Hz.
Reset	26	ON/OFF	I	Power on/off control	Internal pull-up, valid at low level. Externally connect with a

Function	Pin No.	Signal name	I/O	Basic functions	Remarks
					switch with Open Collector（Open Drain）. Please refer to 4.2 power and reset for details.
	10	/RESET	I	Reset signal	Valid at low level. Need externally connect a switch with Open Collector（Open Drain）. Please refer to 4.2 power and reset for details.
Power	19	V_MAIN	I	Main power supply	
	21	V_MAIN	I	Main power supply	
	22	V_MAIN	I	Main power supply	
	23	GND	GND		
	24	GND	GND		
	25	V_MSM	O	Digital power	Generally, it's recommended to use this pin for pull-up. As the module is powered off, the output voltage of the pin remains unchanged, but the internal resistance is very high. Therefore, it's not recommended to use this pin for any other control purpose.
Reserved	20	NC	—		For module's internal use, need hang up.
	27	NC	—		For module's internal use, need hang up.
	29	NC	—		For module's internal use, need hang up.
	31	NC	—		For module's internal use, need hang up.

3.2 10PIN Connector

See 10PIN connector definitions in table 3-2.

Table 3-3 10PIN connector PIN definitions

Function	Pin No.	Signal name	I/O	Basic functions
1	GND	GND	Power	
2	GND	GND		
3	GND	GND		
4	GND	GND		
5	NC		Reserved	For module's internal use, need hang up.
6	NC			
7	NC			
8	NC			
9	NC			
0	NC			

4 Decription of Hardware Interfaces

4.1 Summary

This chapter introduces each logic function interfaces of ME3000_V2 module & its operation descriptions, and provides the designing sample.

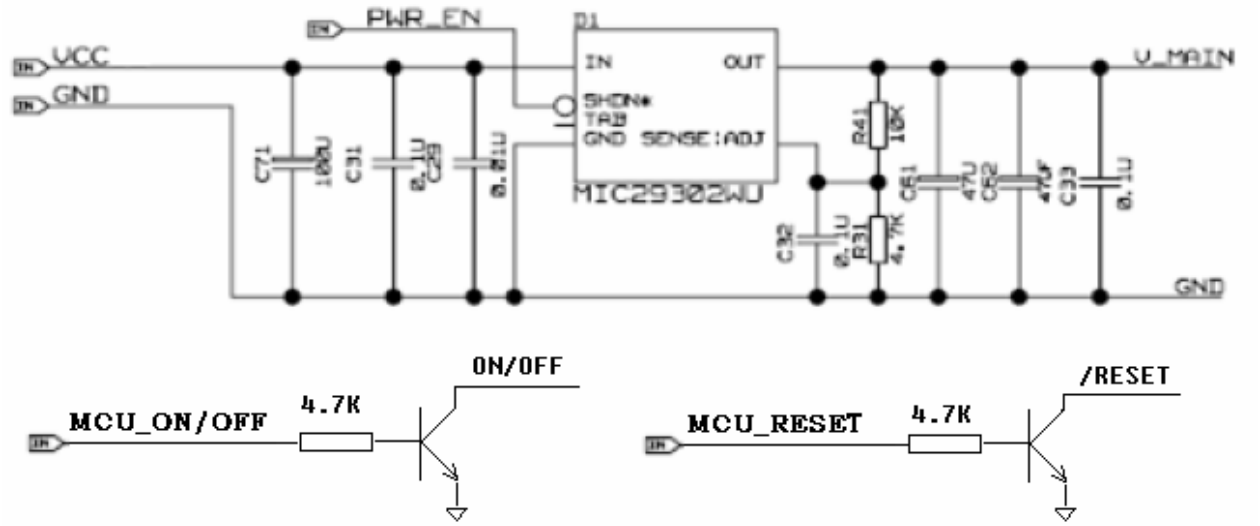
- Power and Reset Interface
- COM Port
- SIM Card Interface
- Audio Interface
- Antenna Interface

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

See the power and reset circuit design principle diagram in figure 4-1.

Figure 4-1 Power and reset circuit design principle diagram



- **Power design**

The module is powered by V-MAIN. See the voltage features in figure 4-1.

Table 4-1 Voltage features

Category	Min.	Typical	Max.
Input voltage	3.3 V	3.9 V	4.25 V
Inpput current	10mA (average)	---	2A (depending on 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 ME3000_V2 module, and it's required to place at lease 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 you use other LDO, make sure the output current is larger than 2A.

- **Power ON**

The module will be turned off after power-on normally. To turn on the module, provide a 2000-5000mS low level pulse to ON/OFF PIN. If connecting to GND at ON/OFF pin with 1K resistance, the module could be automatically powered on.
Note: ON/OFF, /Reset need to connect an open collector or open drain gate.
The /RESET signal is not required when the module is turned on.

- **Power OFF**

To turn off the module, provide a 2000-5000mS low level pulse to ON/OFF PIN or use AT command "AT+ZPWROFF".

- **Reset**

The module could be reset by using the method above to "Turn off" and then "Turn on".
If the external reset function has to be used, one 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. Refer to figure 4-2 Reset circuit design reference.
If the /RESET Pin is not used, hang it up.
See the module's power-on/off time sequence diagram.

Figure 4-2 Power-on/off time sequence diagram

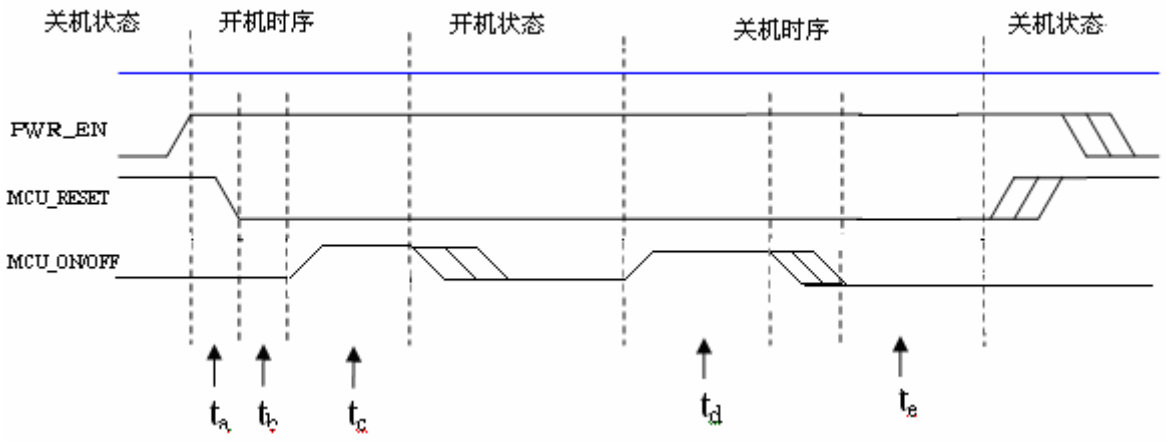


Table 4-2 Power on/off ciruict time characteristics

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 any other control purposes.

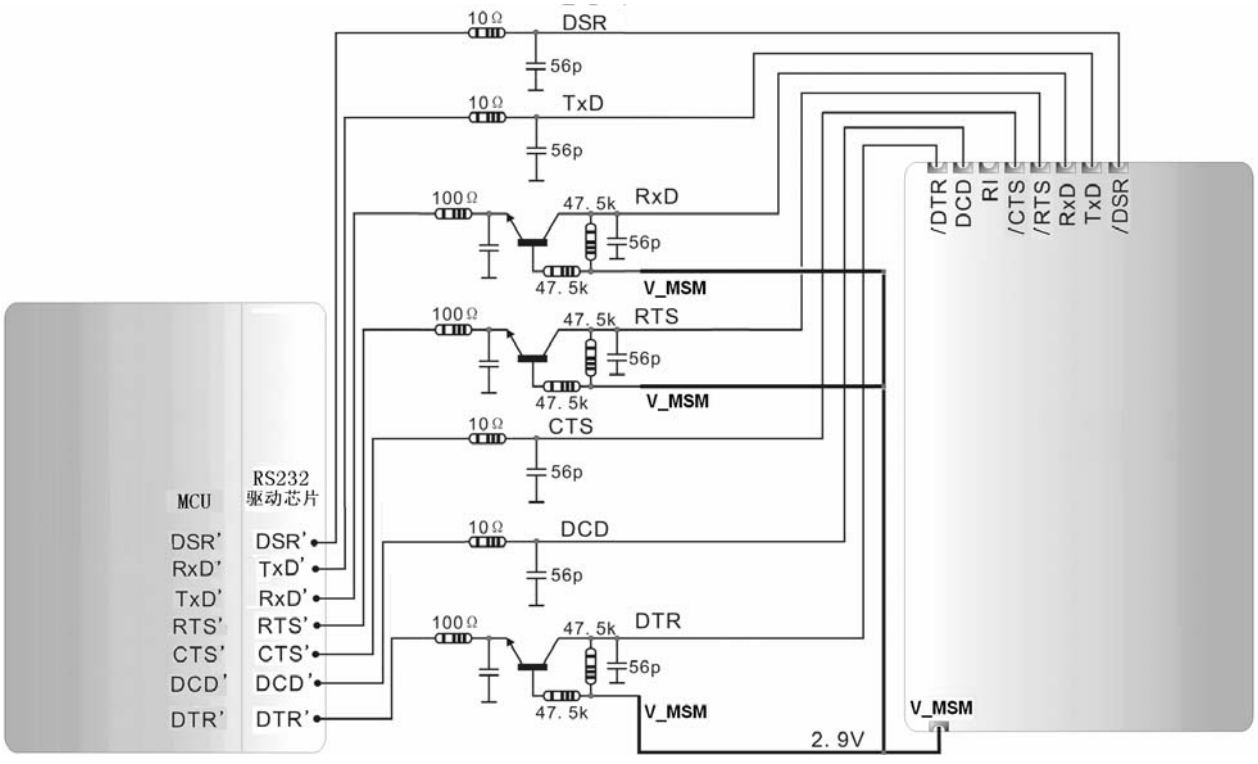
- **Other Advice**

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 COM 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 2.85VCMOS 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: during the overall unit's design, the customers need lead out UART1 for software upgrade.
The module's output IO level is 2.85VTTL, and 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 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 4-2.
Note: the module won't enter the sleep mode when RxD is at high level. Please pay attention to it during the design.

Figure 4-2 UART Interface Design Diagram

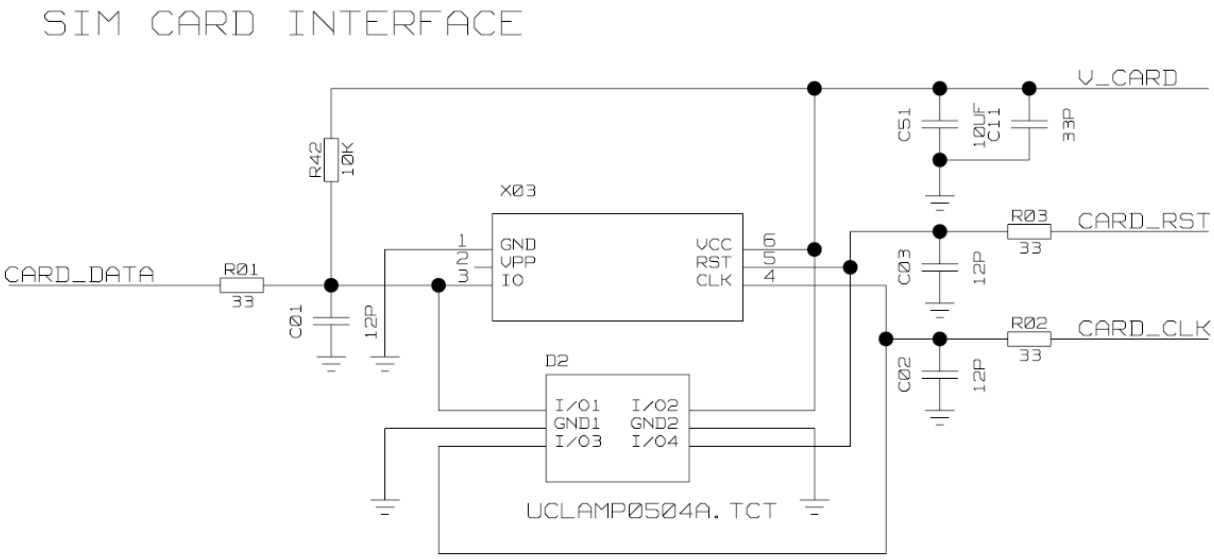


Note: The GSM module supports UART2 (note: including RTS2 and CTS2), but it does not support USB.

4.4 SIM Card Interface

ME3000_V2 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. D2 in figure 4-3 is ESD protection device:

Figure 4-4 SIM Card Circuit Reference Design Diagram

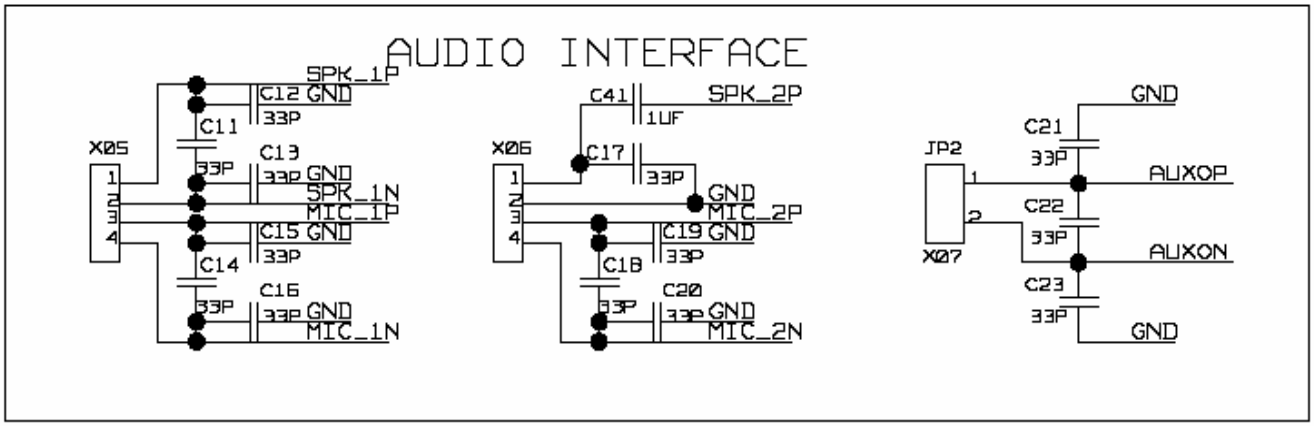


NOTE: A 10k resistor is required for DATA pin to be draw up to V_CARD power, because there are different SIM cards with quite different output currents. The PCB wiring of SIM card should be laid closely around the module as possible as you can, to avoid the interference of reading/writing from other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

4.5 Audio Interface

The module provides audio input and output. There are 2 speaker interfaces, 2 microphone interfaces and one linear output. Only one pair I/O works at the same time. See the audio interface circuit in figure 4-4.

Figure 4-5 Audio interface circuit design diagram



- Microphone

The system connector provides two microphone interfaces MIC_1 and MIC_2, which are both differential interface and can be used for single ended input. It's recommended to use the differential mode to reduce the noises. These two microphone inputs are coupled in AC domain and added a 2.0V offset voltage inside, and they should directly connect with the receiver.

- **Speaker**

The system connector provides two speakers, SPK_1 & SPK_2. The former is differential interface, and the latter is single-ended interface. 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 2.2V.

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 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 2.2V. The receiver's design is just the same as the handset's.

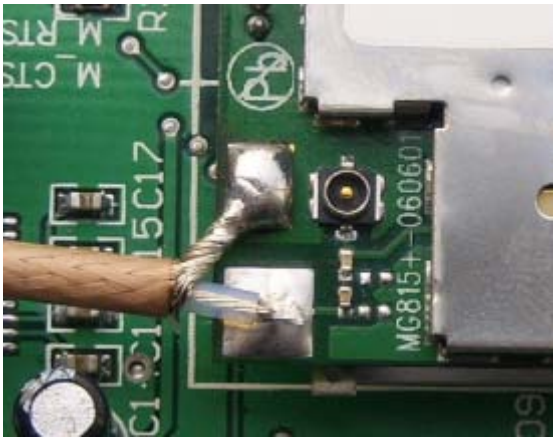
4.6 Antenna Interface

The module provides two kinds of external interfaces:

- Directly solder with PCB land
- Antenna testing socket

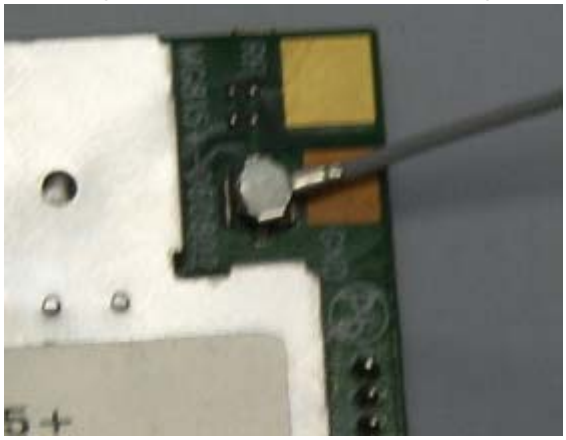
PCB land is used to connect module with antenna by 50 ohm RF shielding cable to cut down the cost. But it's not a complete way to shield EMI, and RF signal quality may be trivially affected. So if you decide to use this method, intense radiation must keep far away from PCB land. At the same time, you 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. As shown in figure 4-5, the grounding part must be jointed firmly, otherwise, the core cable may be ruptured caused by shielding cable shaking. 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.

Figure 4-6 Antenna Interface Diagram



The antenna test socket is used for the module's calibration and test. It can easily connect the module to the antenna because of its small contact impedance, good shielding and exclusive 50Ω connection cable. The antenna test socket's impedance is 50Ω. The antenna test socket's part number is MM9329-2700B. Please refer to the user manual of socket's supplier and select the relevant antenna connection plug to connect the module. See figure 4-6.

Figure 4-7 Antenna Interface Diagram



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.

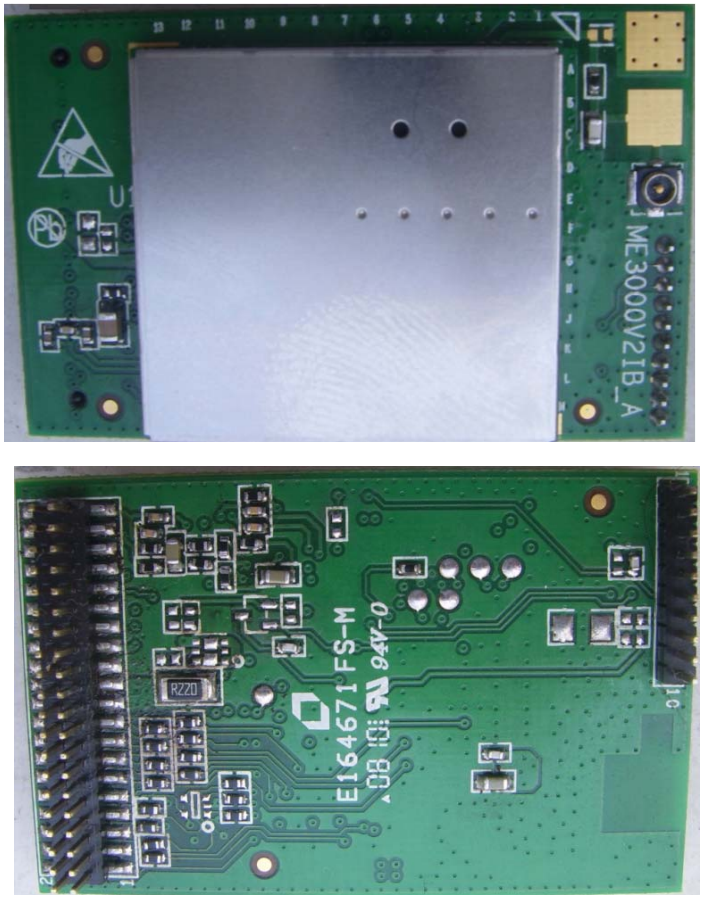
According to mobile station standard, stationary wave ratio of antenna should be between1.1 to 1.5, and input impedance is 50 ohm. Different environments may have different requirements on the antenna's gain. Generally, the larger gain in the band and smaller outside the band, the better performance 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.

5 Mechanical Design

5.1 Appearance Diagram

See ME3000_V2 module's appearance in figure 5-1.

Figure 5-1 Module's Appearance Diagram

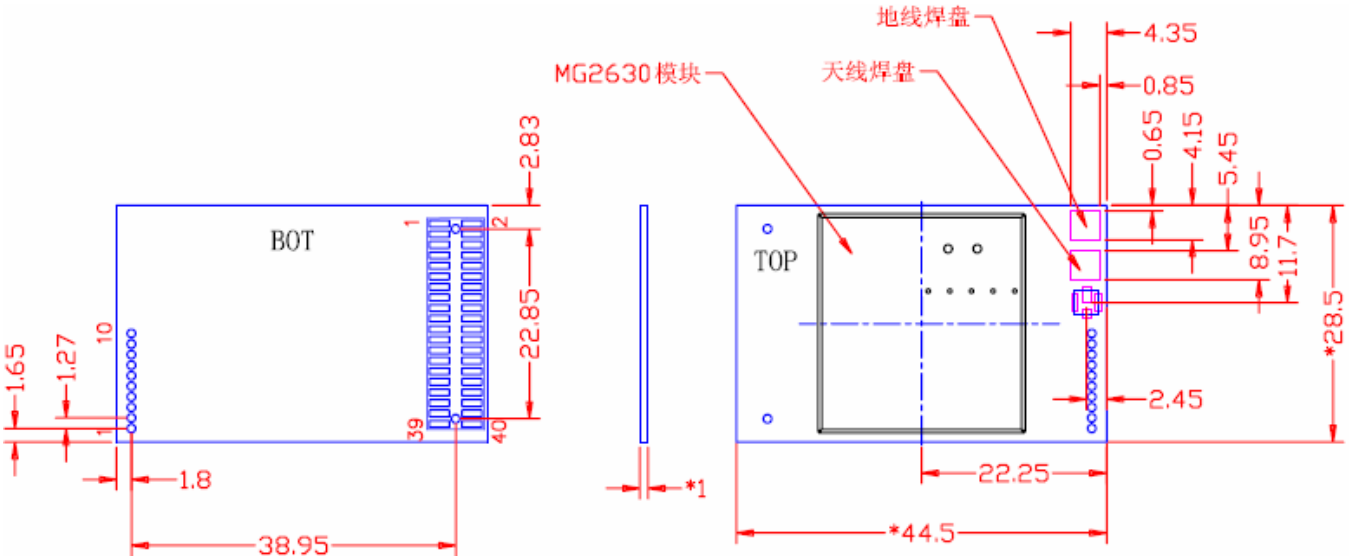


- Dimensions (LxWxH): 44.50 mm（length）x 28.50mm（width）x 8.25mm (±0.2mm)
- Weight: 8g

5.2 Assembly Diagram

See the module's assembly diagram in figure 5-2.

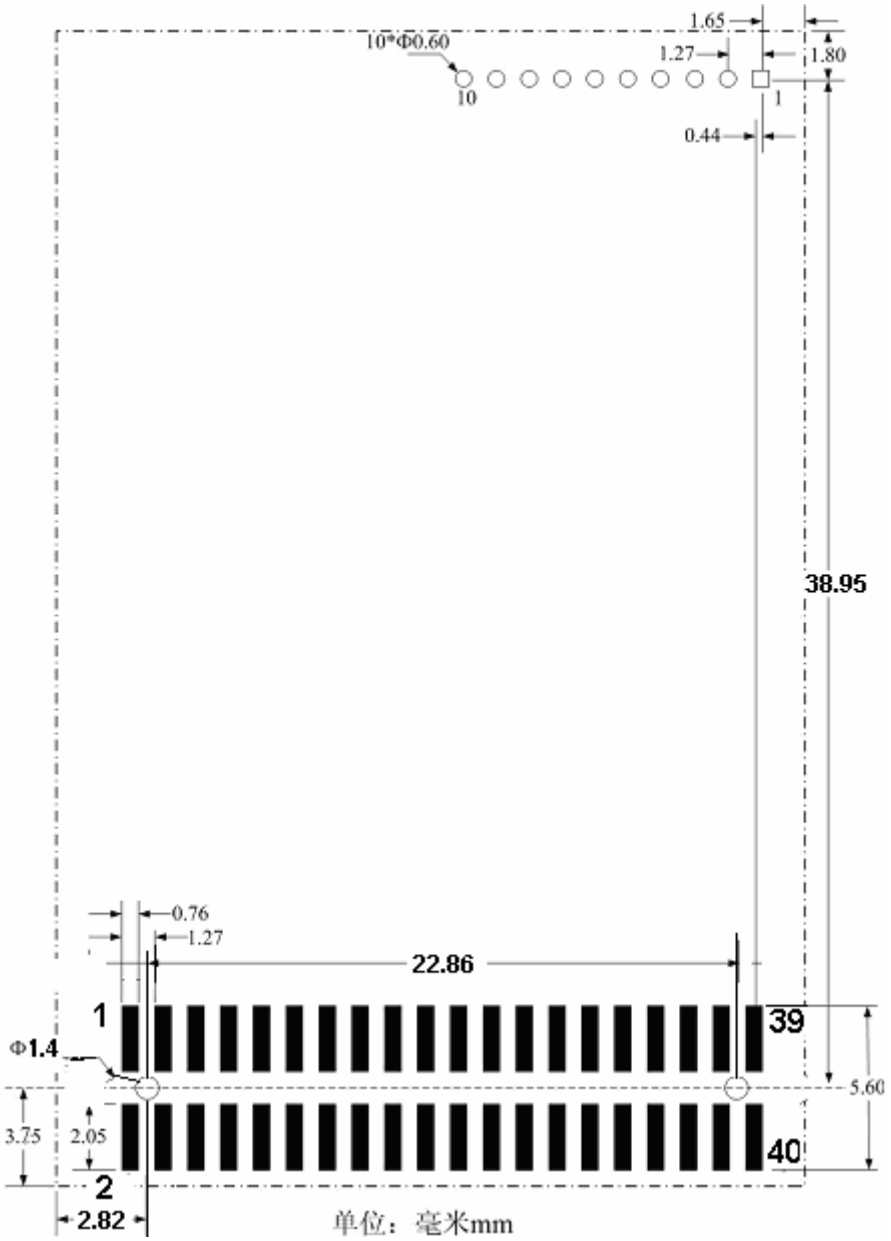
Figure 5-2 Module's Assembly Diagram



5.3 PCB Layout Diagram

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

Figure 5-3 Relevant PCB Layout Diagram (top side)

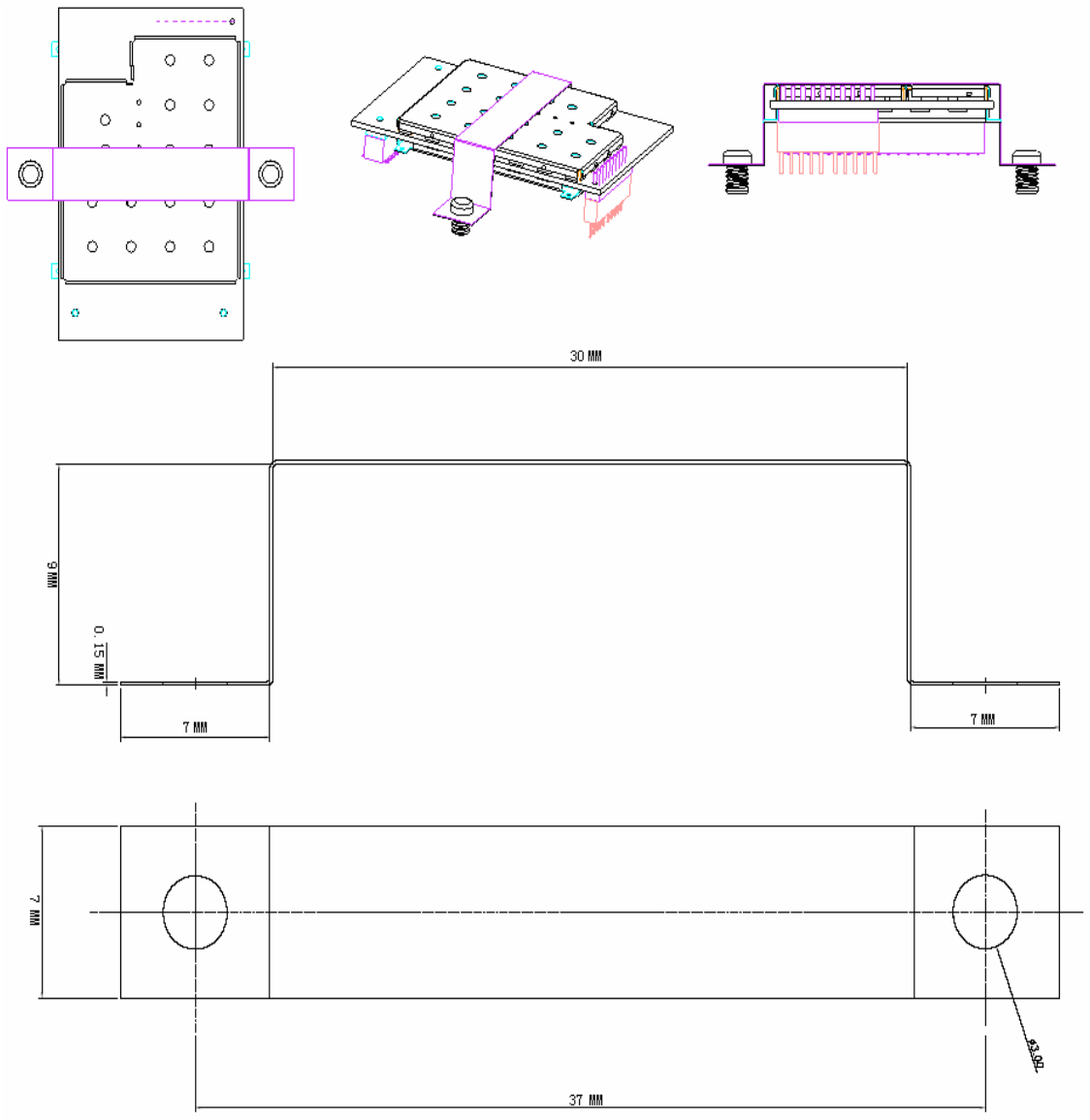


5.4 Fixing Method

The material of the metal plate used for the module's fixing part is

There are two fixing methods: welding or mounting screws. See the module's fixing methods in figure 5-4.

Figure 5-4 Module's Fixing Methods



6 Summary of Peripheral Components

See the summary of peripheral components in table 6-1.

Table 6-1 Summary of Peripheral Components

Part Number	Location No.	Supplier	Contact method
MIC29302WU	D1	MICREL	www.micrel.com
SPNZ-40S1-VB-030-1-R	X1	Shenzhen Shentaiweixiang	www.stwxe.com.cn
PNY-10S2-VB-028（020）	U1	Shenzhen Shentaiweixiang	www.stwxe.com.cn
C707 10M006 5122	U05	AMPHENOL	www.amphenol.com
VC060303A100RP	ESD3-6	AVX	www.avx.com