



# Air208\_Hardware Design Manual\_V1.03





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## 2. Introduction

This document defines the Air208 module and hardware interface specification, electrical and mechanical details. With the help of this document, combining with the application manual and user guide, customers can quickly apply Air208 module for wireless applications.

### 2.1. Related documents

Table 1: Related documents

Item	File name	Remarks
1	Detailed explanation of Air208_AT instruction set	Has been published
2	Air208 Reference design	Has been published
3	Air208 module encapsulation	Has been published
4	Luat_AIR2XX upgrading tool1.1	Has been published
5	Trace Reference design	Has been published
6	LuaForWindows_v5.1.5-51	Has been published
7	Coolwatcher debugging tools and instructions _V1.1	Has been published
8	Platform compilation environment and installation steps	Has been published
9	CSDTK3.7_Cygwin1.5.25_Svn_1.5.4_Full_Setup	Has been published

### 3. Summary

Air208 module is the two band GSM/GPRS module, its working frequency bands are:

GSM850MHz, hCo 900MHz. Air208 supports GPRS multi slot level 12 and GPRS encoding formats CS-1, CS-2, CS-3 and CS-4.

With the ultra small size of 17.6mm \* 15.7mm \* 2.3mm, Air208 is able to meet all the needs of M2M, including cars and personal tracking services, wireless POS, smart metering, industrial PDA and other M2M applications.

Air208 is built-in 32MbNorFlash + 32MbSRAM.

Air208 is a chip-on-module, with a LCC package that can be embedded in customer applications with its pin-on-land, providing a rich hardware interface between the module and the customer's motherboard.

Air208 module uses a power-saving technology, current consumption in sleep mode DRX = 5, as low as 1.14mA.

Air208 embeds protocols such as TCP UDP PPP HTTPS SSL and built-in extended AT commands to make it easier for users to use these Internet protocols.

Air208 complies with the RoHS standard.

Table 2: Main features of the module

Feature	Description
Band	<ul style="list-style-type: none"> <li>◆ Quad-band: GSM850, DCS</li> <li>◆ Automatic frequency band search</li> <li>◆ Band selection can be set by AT command</li> <li>◆ Meets GSM Phase 2/2+</li> </ul>
Transmitting power	<ul style="list-style-type: none"> <li>◆ Class 4 (2W): GSM850</li> <li>◆ Class 1 (1W): hCS1 00</li> </ul>
Power supply	<ul style="list-style-type: none"> <li>◆ DC 3.8V</li> </ul>
Power saving mode current consumption	<ul style="list-style-type: none"> <li>◆ 1.40mA@DRX=2</li> <li>◆ 1.14 mA@ DRX=5</li> <li>◆ 1.03 mA@ DRX=9</li> </ul>
GPRS Connection characteristic	<ul style="list-style-type: none"> <li>◆ GPRS multi slot level is 12 (default)</li> <li>◆ GPRS mobile level B</li> </ul>





GPRS Data characteristics	<ul style="list-style-type: none"> <li>◆ Downlink GPRS data transmission: maximum 85.6 kbps</li> <li>◆ GPRS data uplink transmission: maximum 85.6 kbps</li> <li>◆ Coding format: CS-1, CS-2, CS-3 and CS-4</li> <li>◆ Support PAP (cryptographic authentication protocol) protocols commonly used for PPP connections</li> <li>◆ Embedded protocol: TCP/UDP/FTP/PPP and so on</li> </ul>
Temperature range	<ul style="list-style-type: none"> <li>◆ Normal working temperature: -40°C ~ +85°C</li> <li>◆ storagetemperature: -45°C ~ +90°C</li> </ul>
SMS	Text and PDU modes
SIM CARD INTERFACE	SupportsSIM/USIM card: 1.8V, 3V
Characteristic	50 Ω
Audio interface	Supports call, recording and playback function, can directly drive 8 ohm horn
Serial port	<ul style="list-style-type: none"> <li>◆ Full function serial port <ul style="list-style-type: none"> <li>■ For AT command and GPRS data</li> <li>■ Adaptive baud rate: From 2400 bps to 921600 bps</li> </ul> </li> <li>◆ Debug serial port <ul style="list-style-type: none"> <li>■ For software upgrade</li> <li>■ For software debugging</li> </ul> </li> </ul>
Real time clock	Real time clock
Dimension	17.6×15.7×2.3mm Weight: 1.25g

### 3.1. Function Chart

Following is Air208Functional block diagram, describing its main function:

- ◆ storage
- ◆ GSM RF
- ◆ Power Management
- ◆ Interface section
  - SIM card interface
  - Audio interface
  - UART interface
  - Power supply
  - RF interface
  - Boot and shutdown

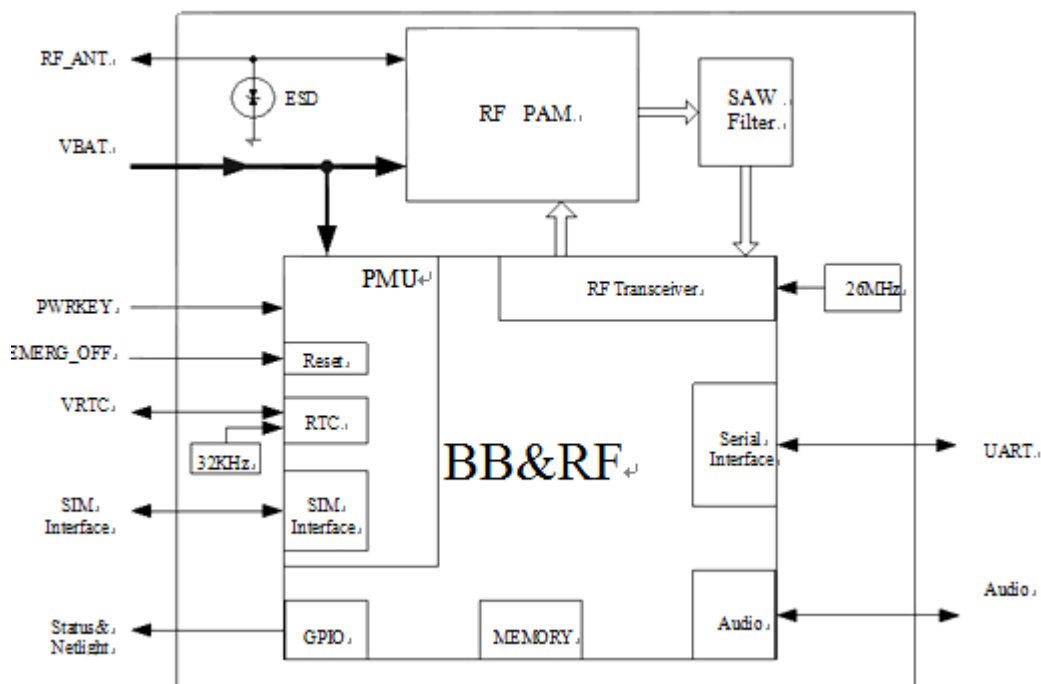


Chart 1: Functional block diagram

## 3.2. Evaluation Board

In order to help test and use Air208, Airm2m provides a set of evaluation boards. They includes Air208 module, EVB\_Air208, UART to USB cable and so on.

## 4. Application interface

The module uses LCC package, 42 SMT welding coil pins, and the following chapter details the functions of the following interfaces:

- ◆ power supply (refer to power supply section)
- ◆ Switch machine (refer to switch section)
- ◆ power saving technology (refer to power saving technology section)
- ◆ Serial port (refer to serial section)
- ◆ Audio interface(refer to audio section)
- ◆ SIM CARD INTERFACE(refer to SIM card section)

### 4.1. Pin description

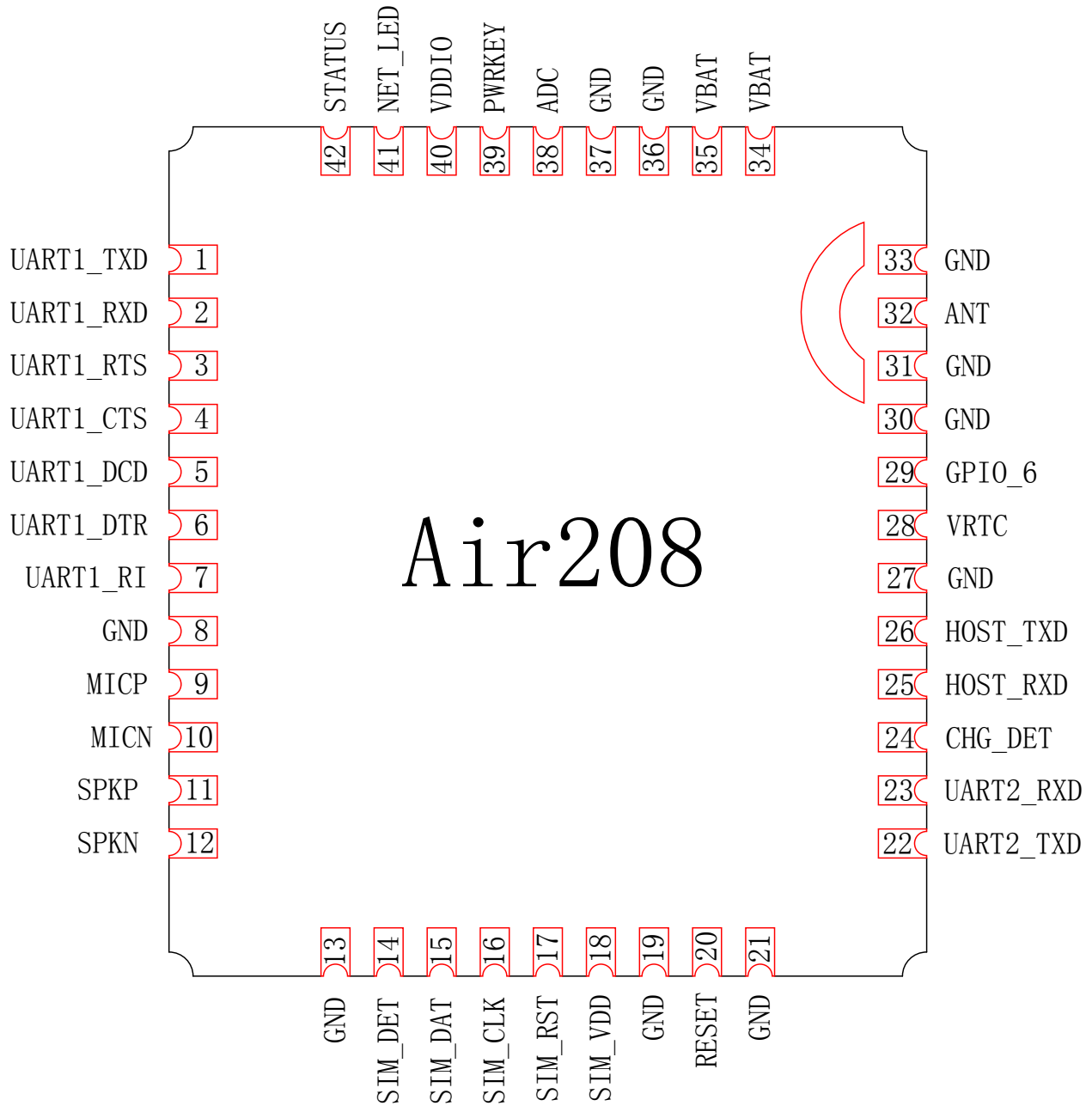


Chart 2: Pin arrangement (front view)

Table 3: Air208 Pin allocation

Pin	Pin name	Input/Output	Pin No.	Pin name	Input/Output
1	UART1_TXD/GPIO_1	I	22	UART2_TXD/GPIO_5	O
2	UART1_RXD/GPIO_0	O	23	UART2_RXD/GPIO_4	I
3	UART1_RTS/GPIO_2	O	24	CHG_DET	I
4	UART1_CTS/GPIO_3	I	25	HOST_RXD	I
5	UART1_DCD/GPIO_31	O	26	HOST_TXD	O
6	UART1_DTR/GPIO_29	I	27	GND	
7	UART1_RI/GPIO_30	O	28	GPIO_6	I/O
8	GND		29	VRTC	I
9	MICP	I	30	GND	
10	MICN	I	31	GND	
11	SPKP	O	32	ANT	I/O
12	SPKN	O	33	GND	
13	GND		34	VBAT	I
14	SIM_DET/GPIO_7	I	35	VBAT	I
15	SIM_DAT	I/O	36	GND	
16	SIM_CLK	I/O	37	GND	
17	SIM_RST	O	38	ADC	I
18	SIM_VDD	O	39	PWRKEY	I
19	GND		40	VDDIO	O
20	RESET	I	41	NET_LED/GPIO_33	O
21	GND		42	STATUS/GPIO_11	O

Table 4: Pin descriptio

Power Supply					
Pin name	Pin No.	I/O	Pin description	Electrical characteristics	Remark
VBAT	34 35	I	Module's main power supply VBAT=3.4V~4.2V	Vmax= 4.2V Vmin=3.4V Vnorm=3.8V	The module has a maximum load current of 1.6A in burst mode
VDDIO	41	O	Output 2.8V, 10mA	Vmax=2.95V	1. Hang when not in usage 2. If this pin is used for external power supply, it is recommended to shunt a 2~4.7uF decoupling capacitor, and the load current should not exceed 10mA
GND	8 13 19 21 27 30 31 33 36		Module GND		
Power button					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
PWRKEY	39	I	Internal pull-up, pull the pin lower than 1.5s module boot	VILmax=0.4V	
RESET	20	I	Hardware shutdown pin, active low. The module shutdown after pulldown more than 200ms	Vmax= 1.5V Vmin=1.1V Vnorm=1.35V	No external pull-ups are required
Audio interface					
Pin name	Pin no.	I	Pin description	Electrical characteristics	Remark
MICP MICN	9 10	I	Differential audio input		
SPKP SPKN	11 12	O	Differential audio output, you can directly drive the 8 ohm speaker		
The main serial port					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark



UART1_TXD (GPIO_1) (SPI2_CS0)	1	O	Module to send data	VILmin=-0.3V VILmax=0.25×VDDIO VIHmin=0.75×VDDIO VIHmax=VDDIO+0.3 VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	RXD needs external 10K ohm resistor to pull to VDDIO. If communication is used only in TXD, RXD and GND, it is recommended that RTS be grounded through 10K ohm resistance; The module defaults to sleep and power saving. If you want to send AT instructions to the module during hibernation, you need to lower the DTR to wake up the module; If you do not want the module to go to sleep, you can ground the DTR through a 10K resistor. Other pins can be hang when is not in usage.
UART1_RXD (GPIO_0) (SPI2_CLK)	2	I	The module receives the data		
UART1_CTS (GPIO_3) (SPI2_DO)	4	O	Clear send		
UART1_RTS (GPIO_2) (SPI2_CS1)	3	I	The DTE requests to send data to the module		
UART1_DTR (GPIO_29)	6	I	DTE is ready		
UART1_DCD (GPIO_31)	5	O	Carrier detection (this pin represents the communication link)		
UART1_RI (GPIO_30)	7	O	Module output ringing hint		
<b>UART2</b>					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
UART2_RXD (GPIO_4) (SPI2_DI) (LPG)	23	I	Hardeare UART2	VILmin=-0.3V VILmax=0.25×VDDIO VIHmin=0.75×VDDIO VIHmax=VDDIO+0.3 VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	Hang when not in usage
UART2_TXD (GPIO_5) (PWM)	22	O			
<b>Debug serial port</b>					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
HOST_RXD	25	I	For software debugging and firmware download	VILmin=-0.3V VILmax=0.25×VDDIO VIHmin=0.75×VDDIO VIHmax=VDDIO+0.3 VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	Hang when not in usage
HOST_TXD	26	O			
<b>SIM CARD INTERFACE</b>					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
SIM_VDD	18	O	Power supply voltage of SIM card	The module automatically selects 1.8V or 3.0V	SIM CARD INTERFACEIt is recommended to use TVS tube for ESD



SIM_RST	17	O	SIM card Reset	3V: VOLmax=0.36 VOHmin=0.9×SIM_VDD 1.8V: VOLmax=0.2×SIM_VDD VOHmin=0.9×SIM_VDD	
SIM_DAT	15	I/O	SIM card data cable	3V: VOLmax=0.4 VOHmin= SIM_VDD-0.4 1.8V: VOLmax=0.15×SIM_VDD VOHmin=SIM_VDD-0.4	
SIM_CLK	16	O	SIM card clock cable	3V: VOLmax=0.4 VOHmin=0.9×SIM_VDD 1.8V: VOLmax=0.12×SIM_VDD VOHmin=0.9×SIM_VDD	
SIM_DET (GPIO_7) (UART2_CTS) (I2C_SDA)	14	I	SIM card in position detection	VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	Hang when not in usage
<b>ADC</b>					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
ADC0	38	I	Analog to digital converter	Input range 0~1.85V 10bit tolerance scope +—20mv	Hang when not in usage
<b>GPIO</b>					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
NET_LED (GPIO_33) (32K_OUT)	41	O	Network status indication	VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	Hang when not in usage
STATUS (GPIO_11)	42	O	Operating status detection	VOHmin=0.85×VMMC VOLmax=0.15×VMMC	Hang when not in usage
GPIO_6 (UART2_RTS) (I2C_CLK)	29	I/O	Reserved	VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	Hang when not in usage
<b>Radio interface</b>					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
ANT	32	I/O	GPRS RF signal input and output	50 ohm characteristic impedance	





## 4.2. Working mode

The table below briefly describes the various modes of work mentioned in the next few chapters.

Table 6: Work mode

Mode	Function	
Normal work	GSM/GPRS SLEEP	If the DTR pin is high and there is no interrupt (for example, GPIO interrupt or serial data wake-up interrupt), the module will automatically enter the sleep mode. Sleep mode, the module is still able to receive packets, short messages and calls.
	GSM IDLE	Software running normally. Module registration on GSM network, no data, voice and SMS interaction.
	GSM TALK	GSM connection to work properly. Have data or voice or SMS interaction. In this mode, the power consumption of the module depends on the strength of the environmental signal, dynamic DTX control and the working frequency of the radio.
	GPRS IDLE	Module is not registered to GPRS network. Modules cannot be accessed through GPRS channels.
	GPRS STANDBY	The module registers on the GPRS network, but does not activate the PDP context (the module does not get the IP address).
	GPRS READY	The PDP context is successfully activated (the module has acquired the IP address), but no data is transferred. In this state, the module can send or receive data.
	GPRS DATA	GPRS data transfer. In this mode, the power dissipation of the module depends on the power control level, the working RF frequency band and the GPRS multi slot configuration.
Shutdown mode	By sending the "AT+CPOWD=1" command, using the PWRKEY pin or using "RESET" 1 "pins to achieve the normal shutdown. The Power Supply management chip turns off the baseband power supply and retains only the RTC power supply. The software is not running, the serial port can not access. Maintain VBATPower Supply power supply.	
Minimum function mode (keep power supply voltage)	Without power down, the "AT+CFUN" command can be used to set the module into the least functional mode. In this mode, the radio doesn't work, or the SIM card doesn't work, or both of them don't work, but the serial port is still accessible. The power consumption is very low in this mode.	

## 4.3. Power Supply

### 4.3.1. Module power supply working characteristics

Power Supply design is a very important part of GSM / GPRS module design. Since there is a burst of 577us (ie 1/8 TDMA cycle (4.615ms)) every 4.615ms when GSM is transmitting. During the burst phase, Power Supply must be able to provide high peak currents to ensure that the voltage does not drop to the module's minimum operating voltage.

For the Air202 module, the peak current of the module will reach 1.6A at the maximum transmit power level, which will cause the VBAT terminal voltage to drop. In order to ensure stable and normal operation of the module, it is recommended that the maximum voltage drop at the module VBAT terminal should not exceed 400mV.

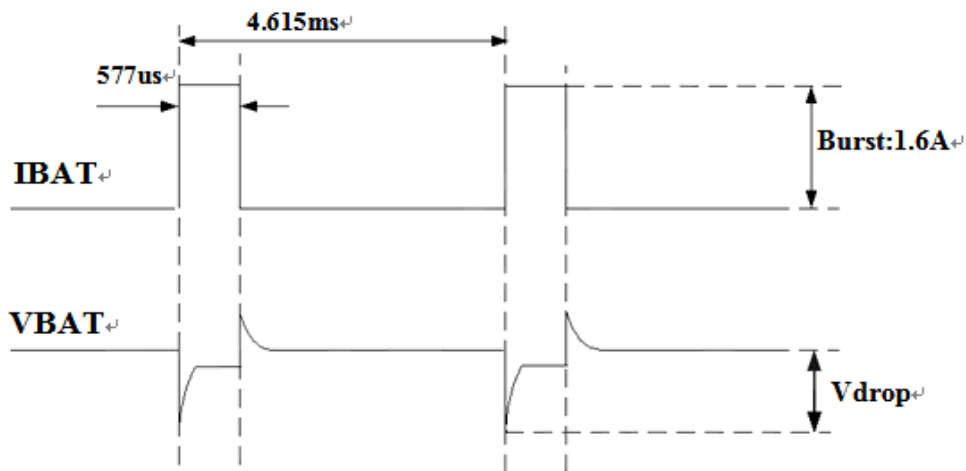


Chart 3: Voltage and current waveforms of module emission

### 4.3.2. Reduce voltage drop

Module's power supply VBAT input voltage range is 3.4V~4.2V, but in the RF module usually produces Power Supply voltage drop phenomenon in VBATPower Supply, this is due to the impedance of the Power Supply and routing path, is difficult to avoid. Therefore, special attention must be paid to the power supply design of the module to ensure that the VBAT voltage will not drop below 3.0V. When the voltage drops below 3.0V, the power-down may be shut down or restarted. At the VBAT input, it is recommended to connect a 100uF tantalum capacitor with low ESR (ESR = 0.7Ω) and a 100nF, 33pF, 10pF filter capacitor (0603 package) in parallel with the VBAT input reference circuit. And recommend that VBAT PCB traces as short and wide enough, the equivalent impedance decreases VBAT line, ensuring the maximum transmit power at high current will not produce too big voltage drop, voltage drop generally controlled within 400mV. Recommended VBAT alignment width of not less than 2mm, and the longer the alignment, the wider the line width.

**Note: The module's hardware shutdown voltage is 3.0V.**

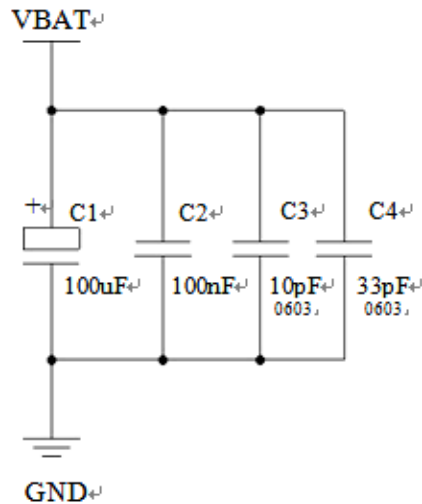


Chart 4: VBAT INPUT REFERENCE CIRCUIT

### 4.3.3. Power supply reference circuit

The power supply design is crucial to the power supply to the module and must be selected with Power Supply capable of delivering at least 2A current capability. If the input voltage and the voltage difference between the supply voltage of the module is not very large, it is recommended to select the LDO as the Power Supply. If there is a large pressure difference between the input and output, then use the switch Power Supply converter.

#### LDO power supply:

The following figure is +5V Reference design powered by Micrel's LDO, model MIC29302WU. Its output voltage is 4.16V, and the peak load current is 3A. In order to ensure the stability of the output Power Supply, it is recommended to reserve a voltage regulator at the output terminal, and close to the module VBAT pin. It is suggested that the voltage regulator with reverse breakdown voltage of 5.1V and dissipation power of more than 1W is selected.

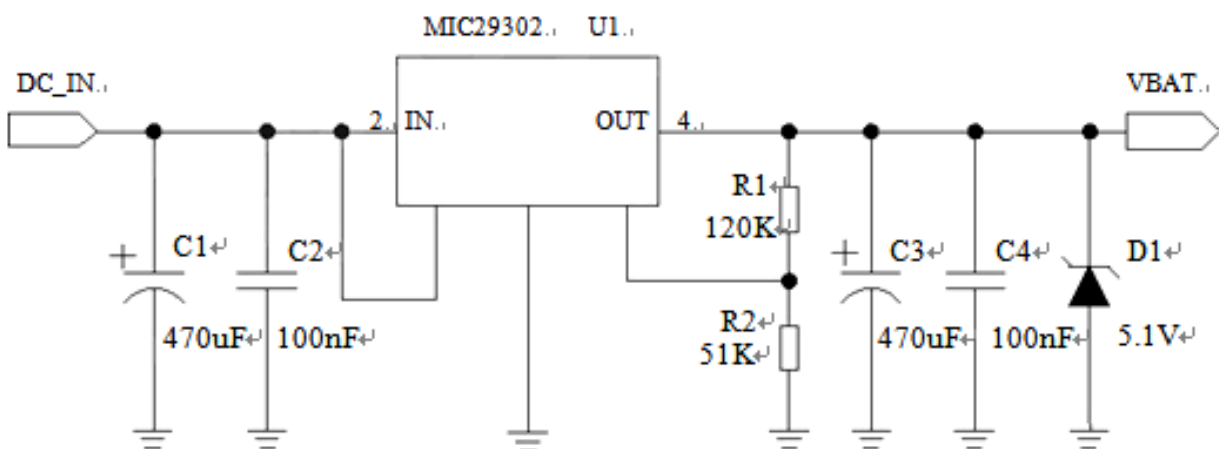


Chart 5: Power Input Reference Design

**DC-DC power supply:**

Below is the DCDC Power Supply Reference design switch, the JW5033H switch is Power Supply chip Jiehuate company, its maximum output current at 2A, while the input voltage range. Note that the selection of C25 depends on the input voltage to select the withstand voltage.

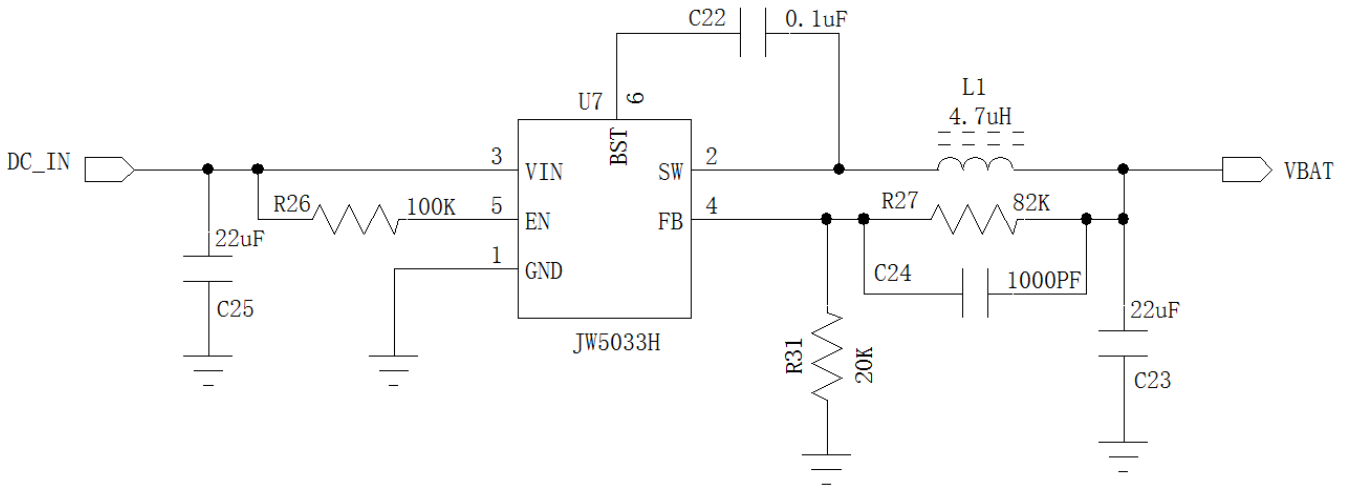


Chart 6: DCDCPower Input Reference Design

**4.4. Boot and shutdown**

**4.4.1. Boot**

Air208 module can be powered on via the PWRKEY pin. The off state long press the power button above 2S module will enter the boot process, the software will detect the VBAT pin voltage if VBAT pin voltage is greater than the software set the boot voltage (default 3.55V), will continue to boot up until the system boot is complete; otherwise, will stop the execution of the boot operation, the system will shut down.

By default, the AT command version is adaptive baud rate (AT + IPR = 0). In adaptive baud rate mode, the boot initialization message "RDY" will not be sent back to the master. After the module is powered on, you can send an AT command to the module to train the baud rate to be the same as the master. The master needs to send the "at" character to the module to train it (be careful to lower the "at"). Generally send a at the baud rate can be trained over, the module will be reported initialization information. Since then you can use the normal AT command, uppercase and lowercase can be.

**4.4.1.1 PWRKEY Pin boot**

After VBAT is powered on, the PWRKEY pin can start the module. After PWRKEY pin is pulled low for 2s, the PWRKEY pin can be released. You can determine whether the module is powered on by detecting the level of the

VDDIO pin. It is recommended to use an open collector driver to control the PWRKEY pin. The picture below is Reference circuit:

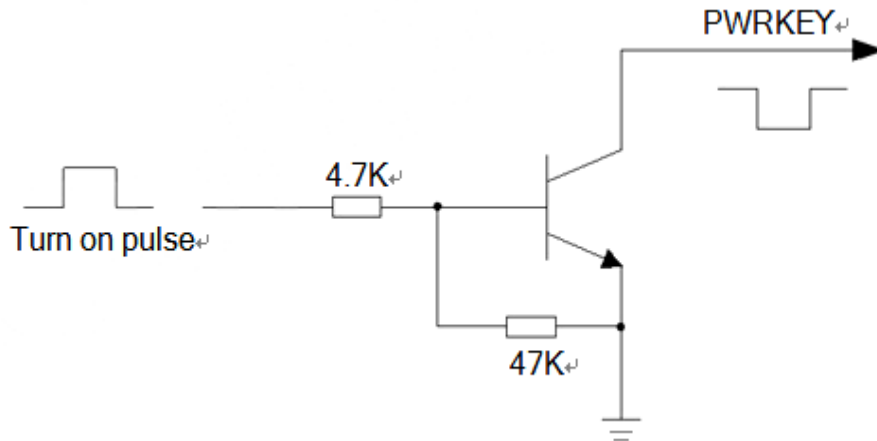


Chart 6: Open set driver reference boot circuit

Another way to control the PWRKEY pin is to use a button switch directly. A TVS should be placed near the button to protect the ESD. The picture below is Reference circuit:

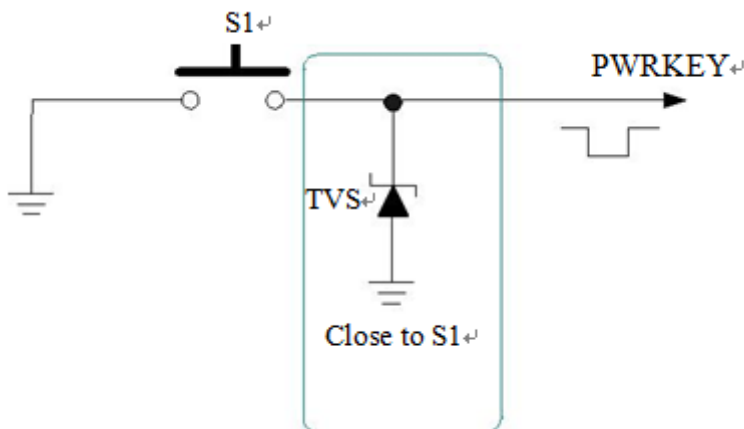


Chart 7: Button bootReference circuit

#### 4.4.2. Shutdown

The following ways can shut down the module:

- ◆ Normal shutdown: Use the PWRKEY pin to shut down.
- ◆ Low-voltage automatic shutdown: shutdown when the module detects low voltage.
- ◆ Emergency shutdown: shut down by RESET pin.
- ◆ AT command shutdown.

#### 4.4.2.1 PWRKEY Pin shutdown

When the PWRKEY pin is pulled down for more than 2S, the module will perform shutdown operation.

During the shutdown process, the module needs to log off the GSM network. The logout time is related to the current network status. The measured time is about 2s ~ 12s. Therefore, it is recommended to extend the system by 12s before powering off or restarting, so as to ensure that the software to save important data before complete power-off.

#### 4.4.2.2 Low voltage automatic shutdown

When the module is in running state When the VBAT pin voltage is lower than the software set shutdown voltage (the default setting is 3.0V), the software will shut down the module to prevent various abnormal running under the condition of low voltage.

#### 4.4.2.3 AT command shutdown

The user can close the module with "AT + CPOWD = 1". After the module is shut down, the module enters shutdown mode and no further AT commands can be executed. Power-down mode can be used to indicate VDDIO pin, low indicates that the module has entered shutdown mode

#### 4.4.2.4 RESET emergency shutdown

The thirty-fourth pin of Air208 module is reset pin, and its function is hardware shutdown.

It can be shutdown by pulling down the RESET pin 200ms or so. The OC driver circuit is recommended to control the RESET pin. The picture below is Reference circuit:

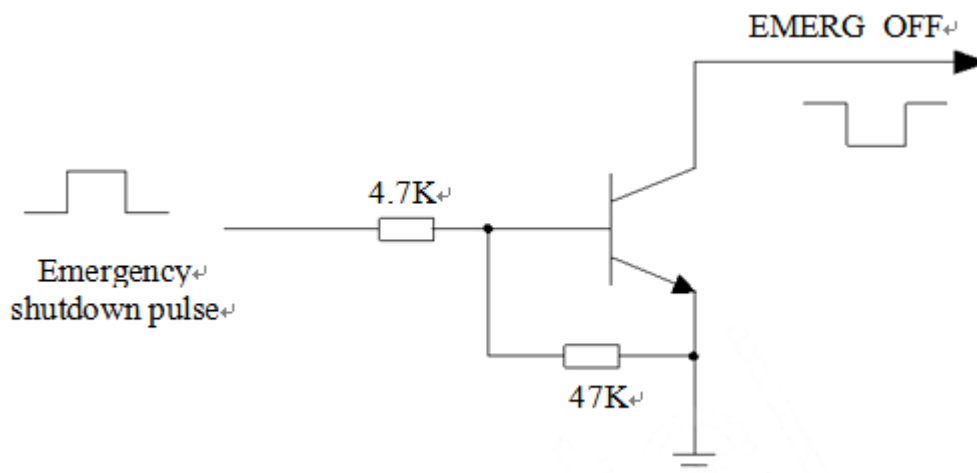


Chart 8: Open driver reference emergency shutdown circuit

Another way to control the RESET pin for emergency shutdown is to use a pushbutton switch directly. Place a TVS tube near the button for ESD protection. The picture below is Reference circuit:

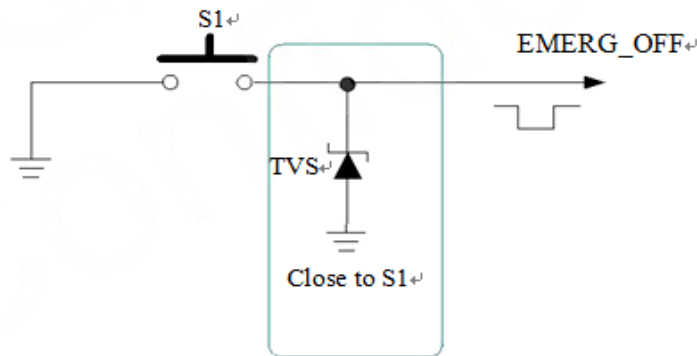


Chart 9: Button emergency shutdownReference circuit

## 4.5. Power saving technology

According to the system requirements, there are two ways to make the module into a low power state. For the AT version, the "AT+CFUN" command enables the module to enter the least functional state.

### 4.5.1. Least functional mode

Minimal function mode can minimize the module function, this mode can be set by sending "AT + CFUN = <fun>" command. <fun> parameters can choose 0,1,4

- ◆ 0: Minimum function (turn off RF and SIM card);
- ◆ 1: Full function (default);
- ◆ 4: Turn off the RF sending and receiving functions;

If the module is set to the least functional mode with "AT + CFUN = 0", the functions of the radio section and the SIM card section will be switched off. The serial port is still valid, but the RF part and the SIM card part related to the AT command is not available.

If the module is set using "AT + CFUN = 4", the RF section will be turned off and the serial port will still be active. All RF commands related to the RF section are not available.

After the module is set by "AT + CFUN = 0" or "AT + CFUN = 4", the module can be returned to the full function by the "AT + CFUN = 1".

### 4.5.2. Sleep Mode (Slow Clock Mode)

Air202 Supports sleep mode. For AT version, the sleep mode is controlled by the DTR pin. When DTR is high level, the module is allowed to sleep. When DTR is high, the module enters sleep mode at about 30s when no action is taken. DTR is high level When the module goes low, the module wakes up. At the same time, the AT command can be woken up continuously by the main serial port, but some AT commands will be lost.



### 4.5.3. Sleep wake

When the module is in sleep mode, the following method can wake up the module.

- ◆ The AT version pulls the DTR pin down and wakes the module. The 20ms port is activated after the DTR pin is pulled down
- ◆ Receive calls or GPRS data to wake up the module.
- ◆ Receive SMS to wake up module.

### 4.6. Mode switching summary

Table 7: Mode switching summary

Current mode	Next mode		
	Shutdown	Normal mode	Sleep mode
Shutdown		Use PWRKEY boot	
Normal mode	Use the PWRKEY pin, or use the RESET pin, or the VBAT voltage is lower than the shutdown voltage		Software call sleep interface, AT version does not do action for 30s it will sleep automatically
Sleep mode	Use PWRKEY or RESET pin or VBAT voltage is lower than shutdown voltage	GPIO pin interrupt, timer, receive SMS or GPRS data	

### 4.7. Serial port

The module provides two general asynchronous transceivers: the main serial port UART1 and the auxiliary serial port UART2. Module Supports fixed baud rate and adaptive baud rate. Adaptive baud rate Supports range 4800bps to 115200bps.

#### Main serial port

- ◆ UART1\_TXD: Send data to the RXD end of the DTE device
- ◆ UART1\_RXD: Receive data from the TXD end of the DTE device
- ◆ UART1\_RTS: The DTE requests to send data to DCE
- ◆ UART1\_CTS: Clear send
- ◆ UART1\_DTR: DTE is ready and notify DCE (this pin can be used to wake up the module)
- ◆ UART1\_RI: Ringing (DCE has incoming call or URC or short message will send signal to notify DTE)
- ◆ UART1\_DCD: Carrier detection (when the communication link between DCE and DTE is established)

- ◆ By default, the hardware flow control of the module is closed. When the client needs hardware flow control, pins RTS, CTS must be connected to the client, and the AT command "AT+IFC=2,2" can be used to open the hardware flow control. The AT command "AT+IFC=0,0" can be used to shut down the flow control. Please refer to document [AT]

### Auxiliary serial port UART2

- ◆ UART2\_TXD: Send data to the serial port of DTE
- ◆ UART2\_RXD: Receive data from serial port of DTE
- ◆

Serial logic level is shown as the following table:

Table8: Serial logic level

Parameter	Minimum value	Maximum value	Unit
V <sub>IL</sub>	0	0.25×VDDIO	V
V <sub>IH</sub>	0.75×VDDIO	VDDIO +0.3	V
V <sub>OL</sub>	0	0.15×VDDIO	V
V <sub>OH</sub>	0.85×VDDIO	VDDIO	V

Table 9: Definition of serial port pins

Interface	Name	pin	Function
Main serial port UART1	UART1_DTR	12	DTE is ready
	UART1_TXD	8	Send data by serial port
	UART1_RXD	9	Serial port receives data
	UART1_CTS	6	Clear send
	UART1_RTS	7	DTE requests to send data
	UART1_DCD	10	Carrier detection
	UART1_RI	11	Ring indication
Auxiliary serial port UART2	UART2_RXD	27	Serial port receives data
	UART2_TXD	28	Serial port sends data

## 4.7.1. Main serial port

### 4.7.1.1 Main serial port features

- ◆ It includes data line TXD and RXD, hardware flow control line RTS and CTS, other control lines DTR, DCD and RI.
- ◆ 8 data bits, no parity, a stop bit.
- ◆ Hardware flow control is turned off by default.
- ◆ To send AT commands, GPRS data transmission, CSD fax and so on.
- ◆ Supports baud rate as follows:  
1200,2400,4800,9600,14400,19200,28800,38400,57600,115200,230400,460800,921600
- ◆ AT command version By default, the module is adaptive baud rate (AT + IPR = 0). In adaptive baud rate mode, initialization information (beginning with "RDY") will not be sent back to the master after booting. 2-3 seconds after the module is powered on, AT commands can be sent to the module. The host computer needs to send the "AT" character to the module to train the baud rate of the host computer first. At this moment, the module will report the initialization information indicating that the training is successful. The user can send an "AT + IPR = x: & W" command to the module (x is the baud rate, such as 9600). The function of this command is to set a fixed baud rate and save it. After completing these configurations, Module boot, the serial port will automatically return URC initialization information (beginning with "RDY") .

### Synchronization between the module and the host computer: :

When the module is powered on with adaptive baud rate turned on, it is best to wait 2 ~ 3 seconds before sending "AT" character. When the module reports the initialization information, it indicates that the training of baud rate is successful and the synchronization is completed with the host computer.

In adaptive baud rate mode, the master must first synchronize if it needs a power-on message. Otherwise, the initialization information will be omitted:

- ◆ Serial port configuration is 8 data bits, no parity, 1 stop bit (factory configuration)
- ◆ Only the string "AT" when the module is switched on can train the baud rate. ("At", "At" or "aT" can not be recognized) .
- ◆ Baud rate training is successful, you can identify the uppercase, lowercase or uppercase and lowercase AT command combination.
- ◆ In adaptive baud rate mode, URC information such as "RDY", "+ CFUN: 1" and "+ CPIN: READY" will not be reported if the module is powered on without synchronization.
- ◆ It is not recommended to switch to adaptive baud rate mode when fixed baud rate mode.
- ◆ In adaptive baud rate mode, it is not recommended to switch to software multiplex mode

### 4.7.1.2 Main serial port connection mode

Main serial portThe main serial port connection mode is more flexible, as follows are three commonly used connection mode.

Full-featured serial port in accordance with the following connection, this mode is mainly used in modem mode (PPP dial-up).

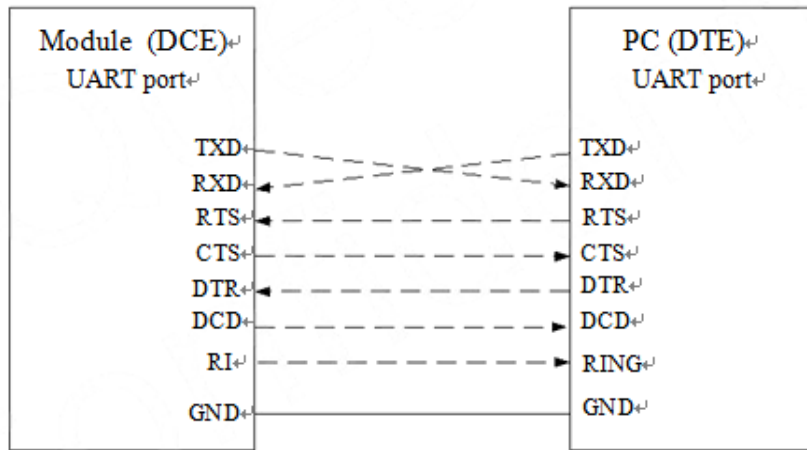


Chart 10: Full-featured serial port connection diagram

Please refer to the following connection mode for three wire serial port:

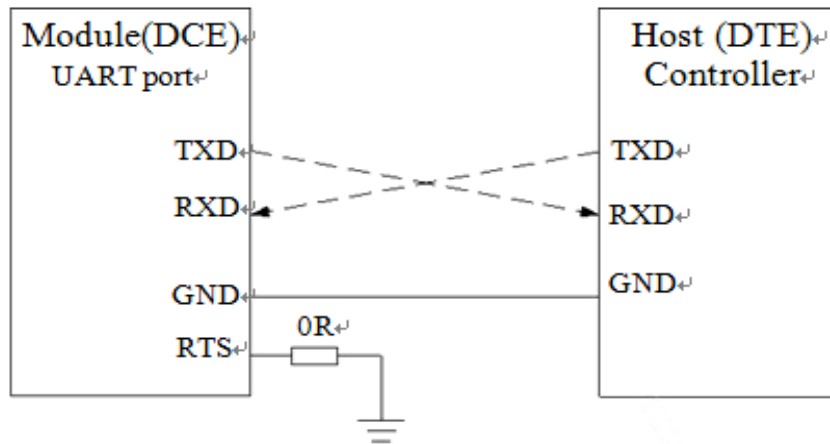


Chart 11: Serial three-wire connection diagram

Please refer to the following circuit connection with flow control serial port connection, this connection can increase the reliability of large amounts of data transmission, to prevent data loss.

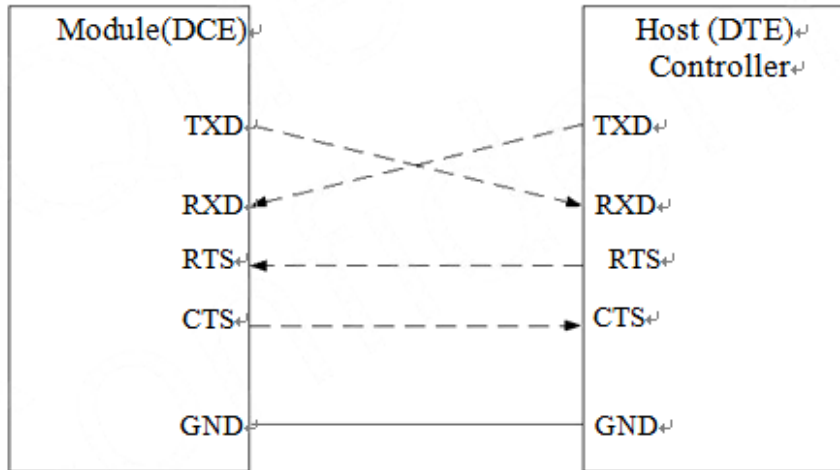


Chart 12: Schematic diagram of serial connection mode with flow control

#### 4.7.2. Debug serial port

- ◆ Data cable: HOST\_TXD and HOST\_RXD
- ◆ Debug port is for software debugging only, baud rate is configured to 921600bps
- ◆ The serial port will automatically output log information to the outside

Please refer to following ways to debug serial port connection:

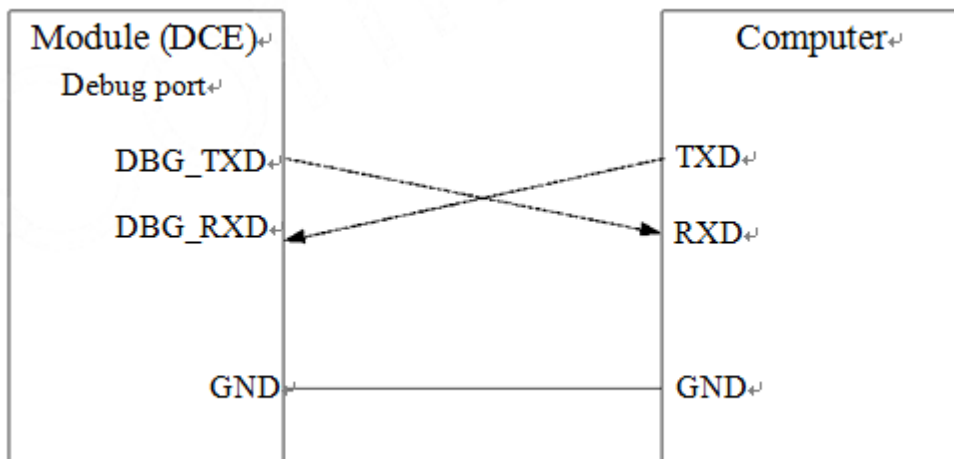


Chart 13: Software debugging connection diagram

### 4.7.3. Serial port application

For the 3.3V voltage system in the case of the serial port level matching circuit reference is as follows, it is strongly recommended to use RXD modules such as the input port on the resistor divider, the voltage is divided to 2.8V.

If it is 3V system, according to the principle of partial pressure, it is recommended to change the 5.6K resistance to the 10K resistor. It is also suggested that 1K resistors must be connected in series when customers don't allow partial pressure.

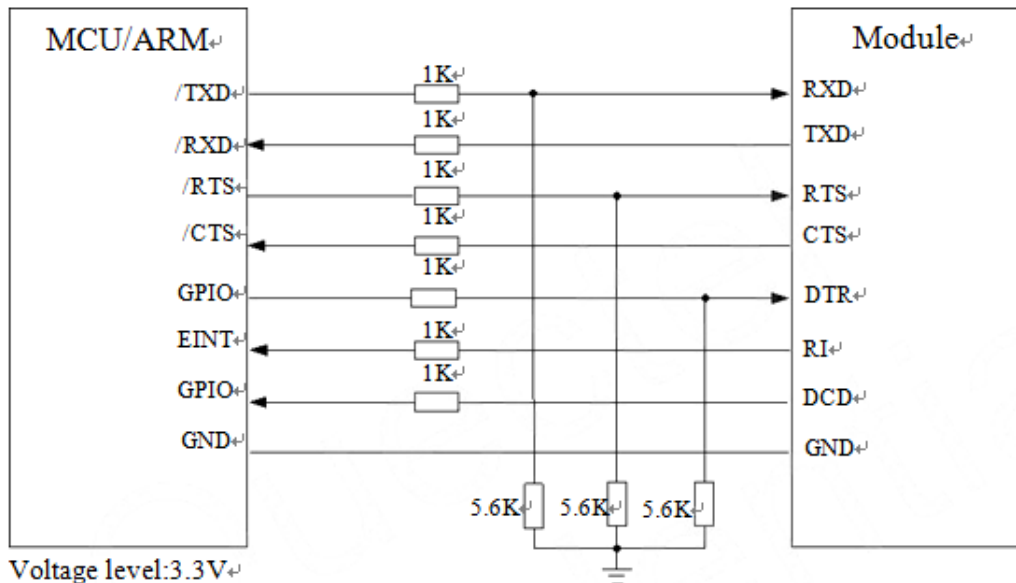


Chart 14: 3.3V Level conversion circuit

5V system level matching, level matching between the module and peripherals can refer to the following connections, the dotted line below can refer to the above solid line circuit (the dotted line module to send the reference module TXD circuit design, the dotted line module Receive reference module RXD circuit design).

VCC\_MCU is the client's I / O voltage level. VDDIO is the module output I / O voltage level.

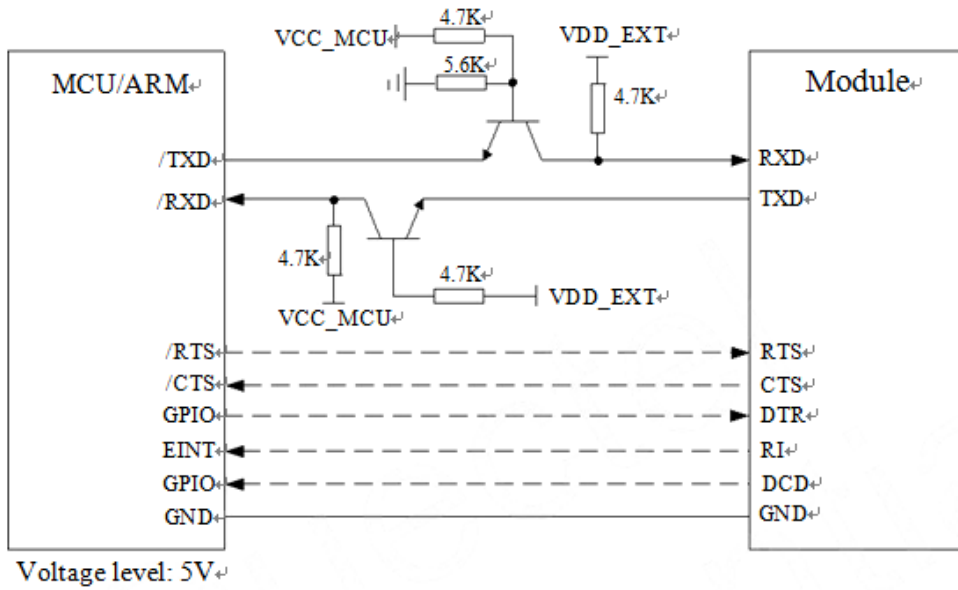


Chart 15: 5VLevel conversion circuit

When the module communicates with the PC, you need to add an RS232Level conversion circuit between them. Because the module's serial port configuration is not RS232 level, only SupportsCMOS level. The following figure shows the module with PC communication, serial port level conversion circuit.

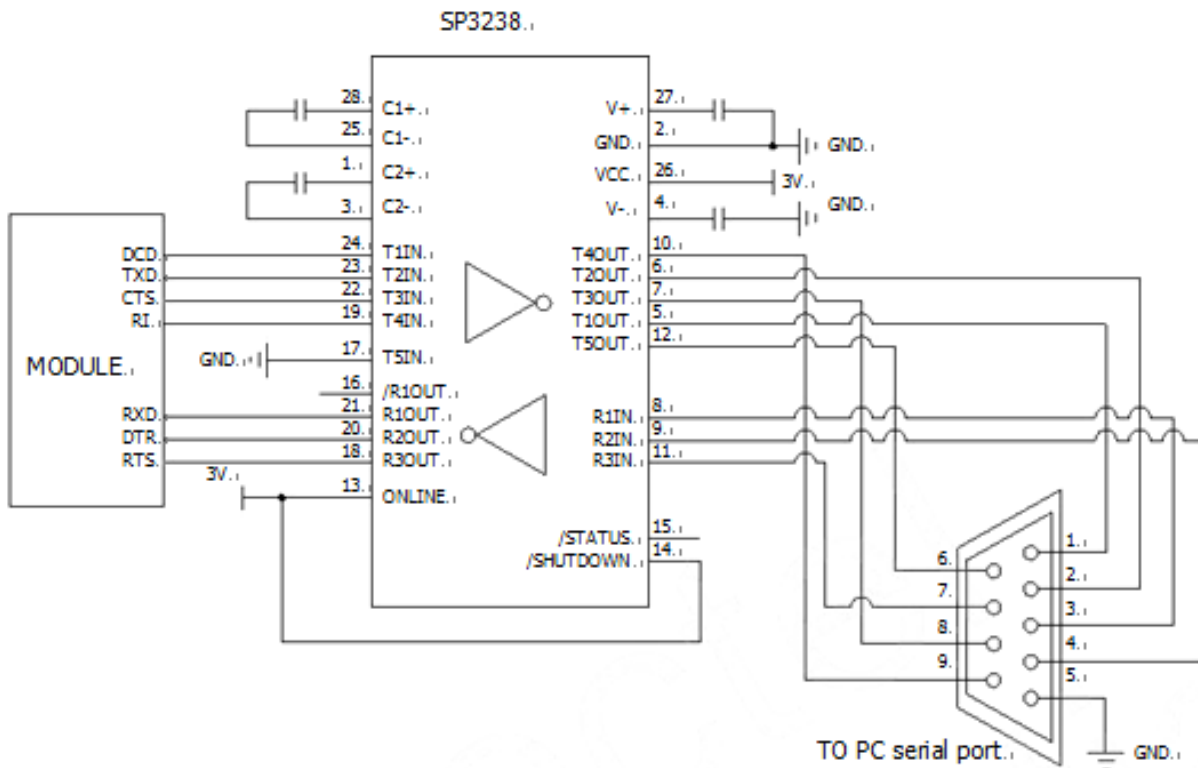


Chart 16: RS232 Level conversion circuit

## 4.8. Audio interface

The module provides an analog audio input channel and a channel analog output channel, Supports call, recording and playback functions.

Table10: Audio interfacePin definition

Interface	Interface name	Interface no.	Function
AIN	MICP	9	Audio input positive end
	MICN	10	Audio input negative end
AOUT	SPKP	11	Audio output positive end
	SPKN	12	Audio output negative end

AIN can be used as a microphone input or an analog audio signal input. Microphones usually use electret microphones. AIN1 is a differential input.

AOUT channels can directly drive 8 ohm speakers. The AOUT channel is differential output.

### 4.8.1. Preventing TDD noise and other noises

As for handheld speakerphone and handsfree microphones It is recommended to use a built-in RF filter dual capacitor (such as 10pF and 33pF) electret microphone to filter out radio frequency interference from the interference source will greatly improve the coupling TDD noise. The 33pF capacitor is used to filter out high-frequency interference when the module is operating at 900MHz. If you do not add this capacitor, you may hear TDD noise during the call. At the same time 10pF capacitor is used to filter out the work in the 1800MHz frequency high frequency interference. It should be noted that, because the capacitance of the resonance point depends largely on the material of the capacitor and the manufacturing process, so the choice of capacitor, you need to consult the capacitor suppliers, select the most suitable value to filter out work in GSM900MHz, High frequency noise at DCS1800MHz.

The severity of high frequency interference at GSM transmission usually depends mainly on the customer application design. In some cases, GSM900 TDD noise is more serious, and in some cases, DCS1800 TDD noise is more serious. Therefore, customers can filter the results of the election according to the needs of the filter capacitor, and sometimes do not need to paste this type of filter capacitor.

PCB RF filter capacitor placed on the position as close as possible to Audio devices or Audio interface, alignment as short as possible, to go through the filter capacitor and then to other points.

Position the antenna away from the Audio component and the Audio traces as far as possible to reduce radiated interference. The Power Supply traces should not be parallel to the Audio traces. The Power Supply traces should be as far away as possible from the Audio lines.

Differential Audio traces must follow the Layout rules for differential signals.



### 4.8.2. Microphone interface reference circuit

AIN channel built-in electret microphone bias voltage. Microphone channel reference circuit shown below:

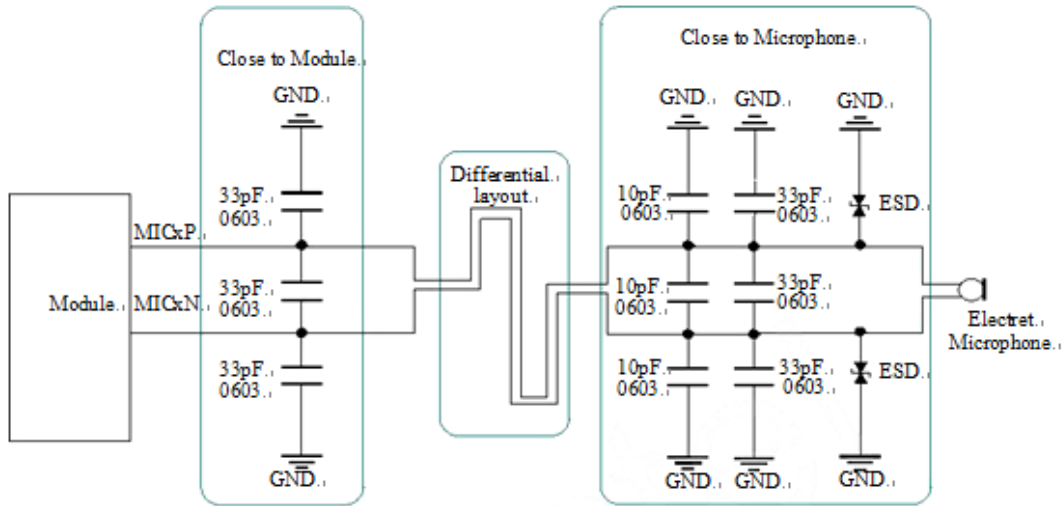


Chart 17: AIN MICROPHONE CHANNEL INTERFACE CIRCUIT

### 4.8.3. Audio output interface reference circuit

SPKAudio Output Interface can be directly driven with 8 ohm speaker.

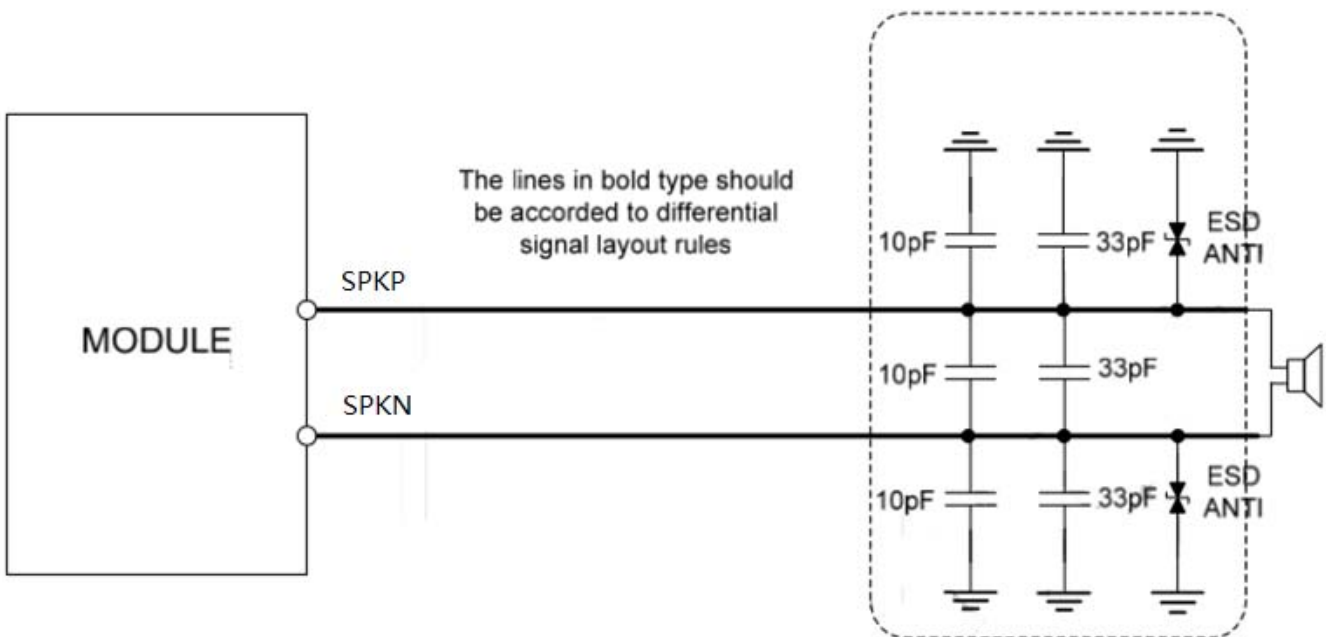


Chart 18: Reference line

#### 4.8.4. Audio Electrical characteristics

Table 11: Typical characteristics of electret microphones

Parameter	Minimum	Typical	Maximum	Unit
Working voltage	1.0	1.25	2.0	V
Working current			500	Ma
Impedance		2.2		K $\Omega$

Table 12: Audio interface Typical characteristic parameters

Parameter		Minimum	Typical	Maximum	Unit
AOUT	Single-ended output	Load		8	$\Omega$
		Reference level	0		2.4 Vpp
	Differential output	Load		8	$\Omega$
		Reference level	0		4.8 Vpp

## 4.9. SIM CARD INTERFACE

The SIM card interface supports the functions of the GSM Phase1 specification, as well as the functions of the GSM Phase 2+ specification and the FAST64 kbps SIM card (used in the SIM application toolkit).

The SIM card is powered by the internal power supply of the module to support 1.8V and 3.0V power supply.

### 4.9.1. SIM INTERFACE

The following table describes the SIM interface pin definitions.

Table13: SIM CARD INTERFACE Pin definition

Pin name	Pin no.	Function
SIM_VDD	18	SIM card power supply automatic detects SIM card operating voltage. The accuracy is $3.0V \pm 10\%$ and $1.8V \pm 10\%$ . The maximum supply current is 10mA.
SIM_RST	17	SIM card Reset pin
SIM_DATA	15	SIM card data cable
SIM_CLK	16	SIM card clock line
SIM_DET	14	SIM card in position detection

The figure below is the reference circuit SIM interface, using of 6pin SIM card connector.

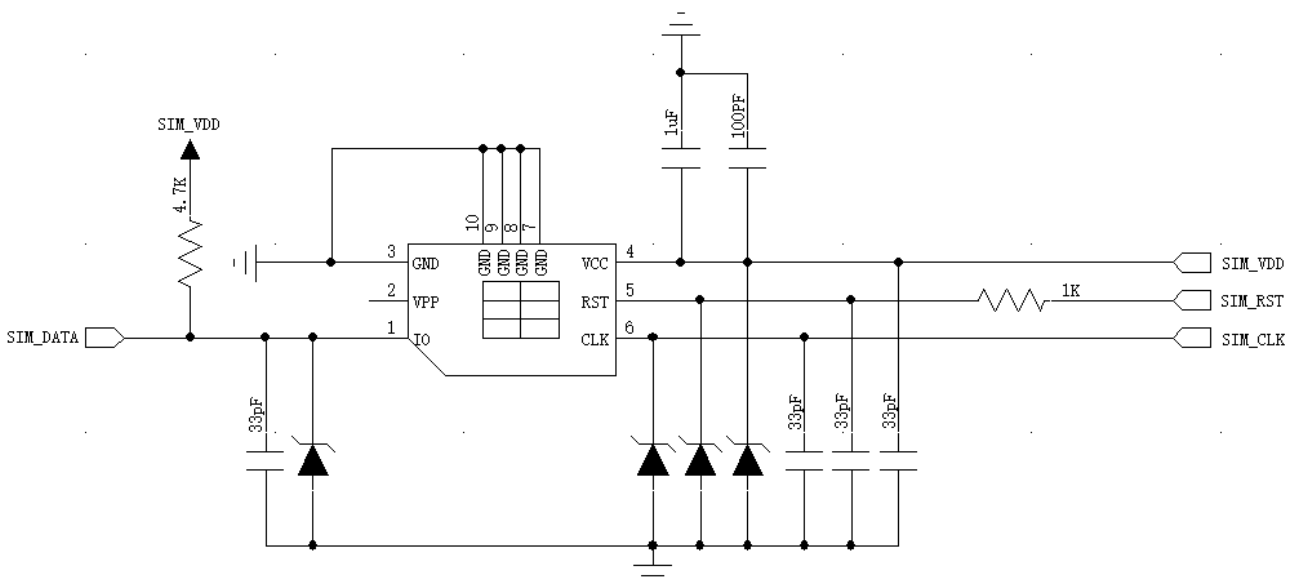


Chart 19: Using a 6pin SIM Card Reference Schematic (SIM)

If you need to use sim card in place detection, the recommended circuit is as follows.

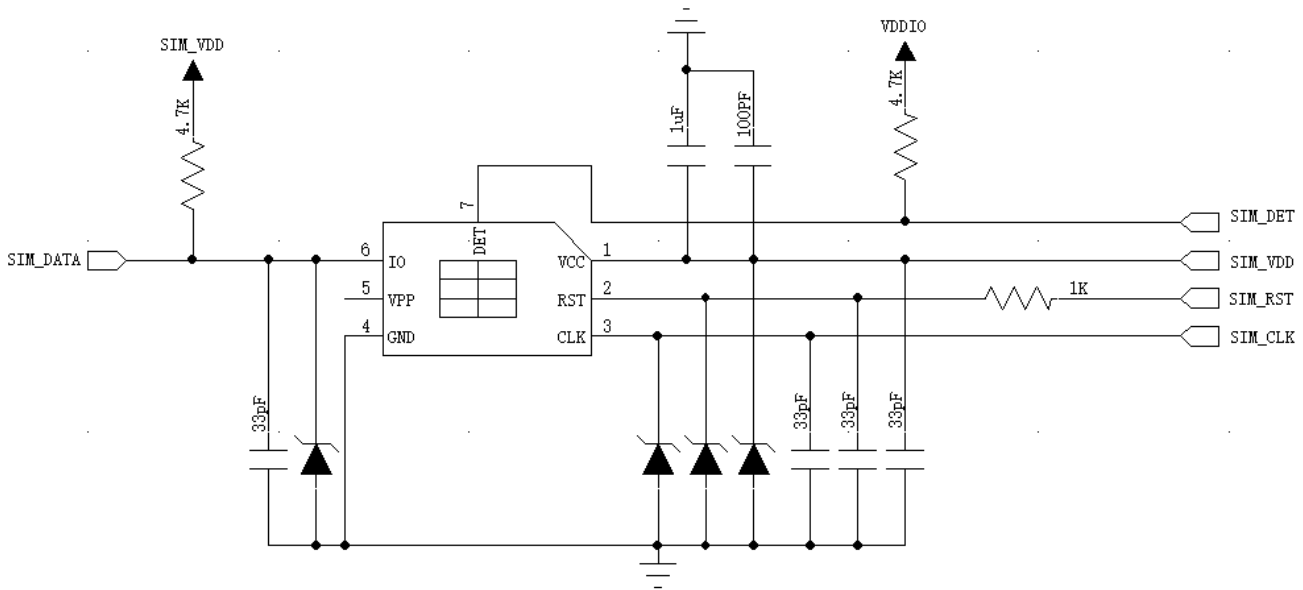


Chart 20: With the detection of PIN SIM card reference circuit diagram

In SIM CARD INTERFACE circuit design, in order to ensure the SIM card's good functional performance and is not damaged, the circuit design is recommended to follow the following design principles:

- ◆ SIM card holder and the module can not be too far away from the ornaments, the closer the better, try to ensure that SIM card signal cable is not exceed 20cm.
- ◆ The SIM card signal cable is routed away from the RF cable and the VBAT power cable.
- ◆ The wiring width of SIM\_VDD is not less than 0.3mm and the bypass circuit between SIM\_VDD and SIM\_GND should not exceed 1uF and be placed close to the SIM card holder.
- ◆ In order to prevent possible SIM\_CLK signal crosstalk on the SIM\_DATA signal, the two wiring should not be too close, increase the shielding between the two traces. And SIM\_RST signal also needs protection.
- ◆ In order to ensure good ESD protection, it is recommended to add TVS tube, and placed near SIMcassette. The selected ESD device has a parasitic capacitance of no more than 50pF, such as WILL (<http://www.willsemi.com>) ESDA6V8AV6. A 22 ohm resistor can be connected in series between the module and the SIM card to suppress stray EMI and enhance ESD protection. The SIM card's peripheral circuitry must be as close as possible to SIMcassette.

### 4.9.2. 6-pin SIM card holder

Using a 6-pin SIM card holder, Amphenol's C70710M0065122 is recommended. Visit <http://www.amphenol.com> for more information.

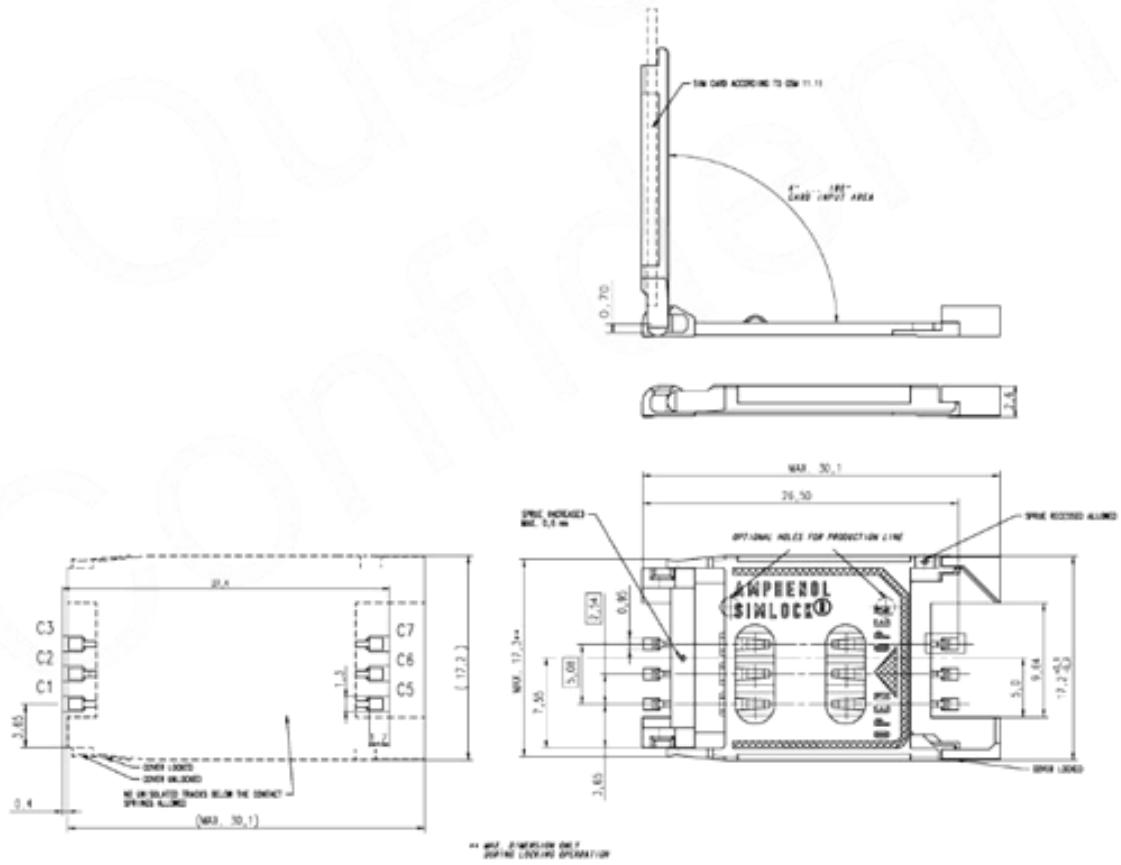


Chart 21: Amphenol C707 10M006 512 2 SIM cassette



### 4.10. RI SIGNAL ACTION

Table 14: RI SIGNAL ACTION

Status	RI response
Standby	High level
Voice call	After switching to low level: <ol style="list-style-type: none"> <li>(1) When the call is switched on to a high level</li> <li>(2) Use the AT command ATH hang up the voice, RI goes high</li> <li>(3) The caller hangs up, RI first goes high, then pulls low for 120ms, receives an auto-reply URC message "NO CARRIER" and then goes high</li> <li>(4) When SMS is received, it becomes high level</li> </ol>
Data transmission	After switching to low level: <ol style="list-style-type: none"> <li>(1) It changes to high level when data connection is set up.</li> <li>(2) Use the AT command ATH to suspend data connections, and RI to a high level</li> <li>(3) The caller hangs up, RI first into high level, then pull to a low level for 120ms, received automatic reply message "NO URC CARRIER", and then into high level</li> <li>(4) When SMS is received, it becomes high level</li> </ol>
SMS	When a new message is received, RI goes low for 120ms and then goes high.
URC	Some URC information can trigger RI to pull low 120ms

If the module is used as a calling party, the RI remains high except when receiving URC messages or text messages. When the module is used as the called party, the timing of RI is as follows:

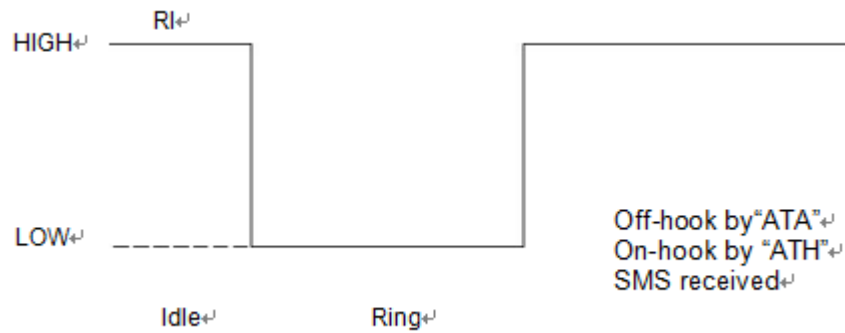


Chart 22: The module is used as called party RI timing for voice call



Chart 23: The module is used as called party RI timing for data call

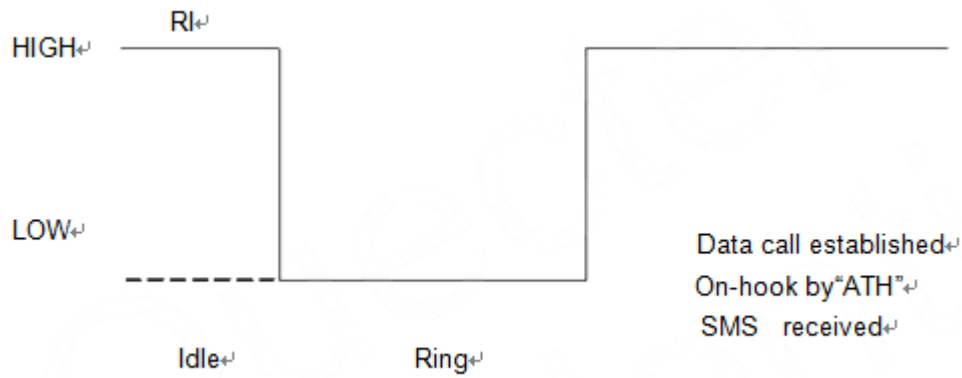


Chart 24: RI timing of module calling

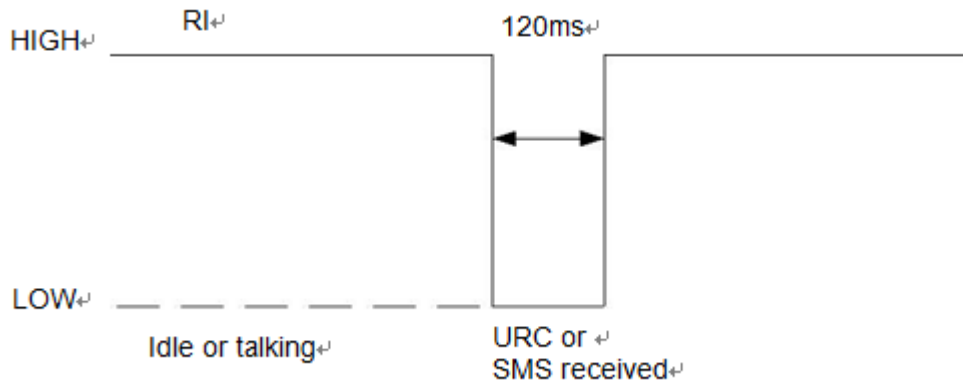


Chart 25: RI timing when receiving URC message or SMS

### 4.11. Network status indication

NET\_LEDpin signal can be used to indicate the status of the network lights. The working status of this pin is shown in the following table:

Table 15: NET\_LED working status

Status	Module function
Shutdown	The module is not running
Bright 64ms, off 800ms	Can not find the network
Bright 64ms, off 3000ms	Registered on network
Bright 64ms, off 300ms	GPRS cimmunication

not registered on the GSM network:

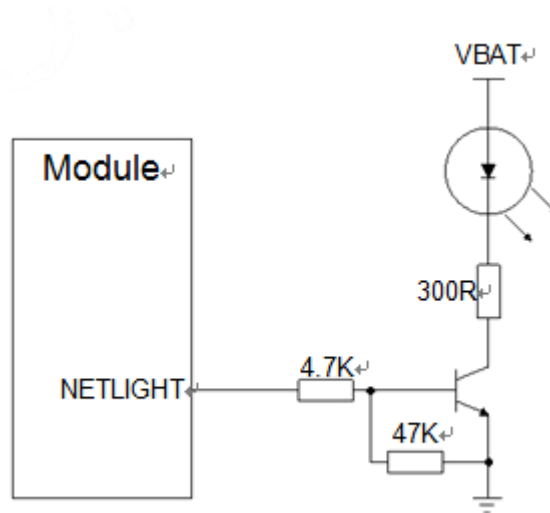


Chart 26: NETLIGHTReference circuit



## 4.12. PWM

Air208 supports 2 PWM outputs: PWM, LPG, multiplexed by UART2\_RX and UART2\_TXD respectively.

UART2					
Pin name	Pin no.	I/O	Pin description	Electrical characteristics	Remark
UART2_RXD (LPG)	23	I	Hardware UART2	VILmin=-0.3V VILmax=0.25×VDDIO VIHmin=0.75×VDDIO VIHmax=VDDIO+0.3 VOHmin=0.85×VDDIO VOLmax=0.15×VDDIO	Hang when not in usage
UART2_TXD (PWM)	22	O			

LPG (Light Pulse Generation) For low frequency applications such as driving LED flashes, only a fixed seven kinds of cycle (Unitms) can be set: 125,250,500,1000,1500,2000,2500,3000. And 15 kinds of high time.

PWM, frequency range (80-65535HZ), and various duty cycles can be set.

Please refer to the corresponding AT command document.

## 5. Radio interface

pin 32 is the RF antenna input. RFInterface50 ohm impedance matching.

Table 16: RF\_ANTPin definition

Pin name	Pin no.	Function
RF_ANT	32	RF pad

## 5.1. RF reference circuit

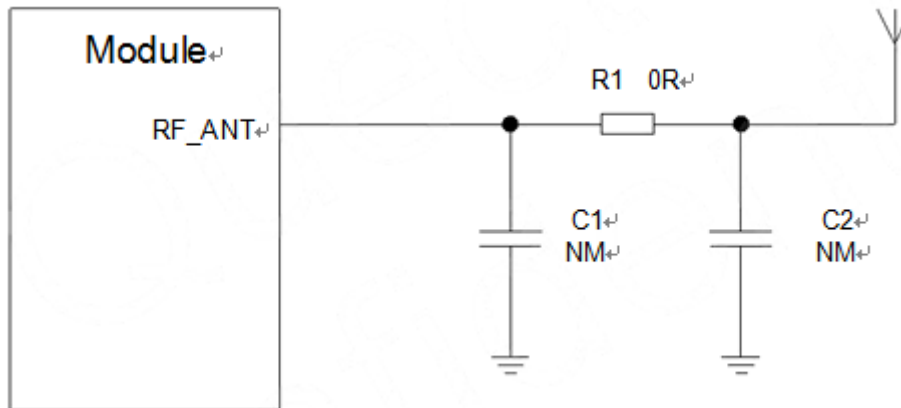


Chart 27: RF reference circuit

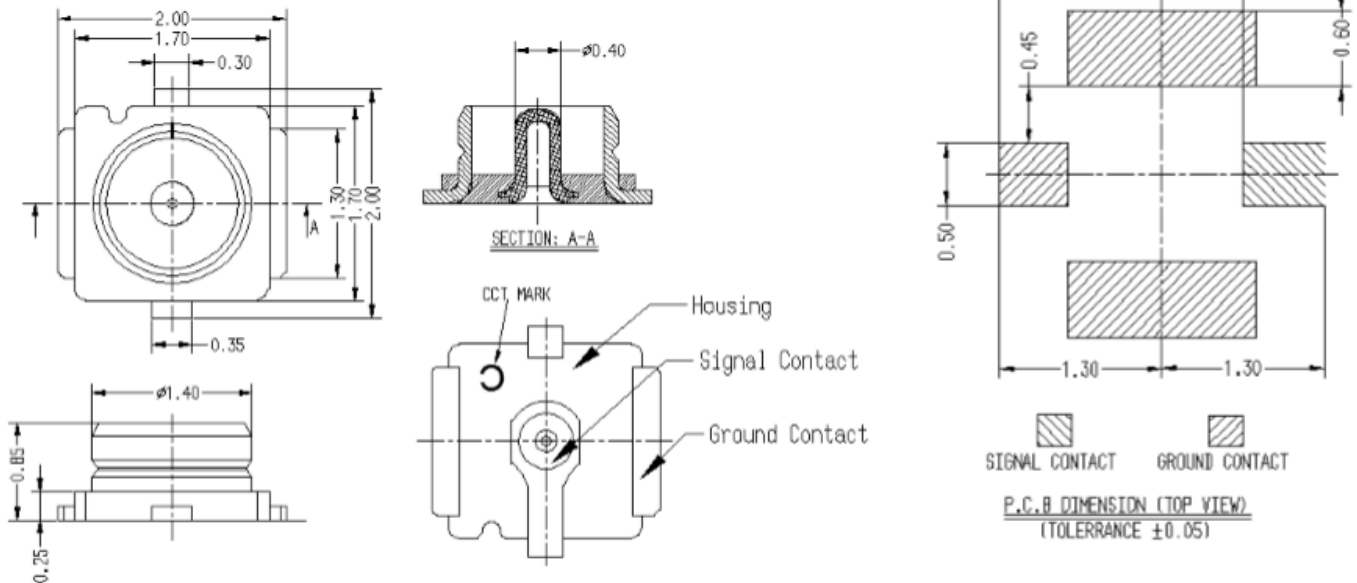
Air208 pads must be microstrip or other types of RF traces and the impedance must be controlled to about 50 ohms. For better RF performance, ground pads are on each side of the RF input port.

Care must be taken to minimize the losses on the RF traces or RF cables. The recommended insertion loss must meet the following conditions:

- ◆ EGSM850<1dB
- ◆ DCS1900<1.5dB

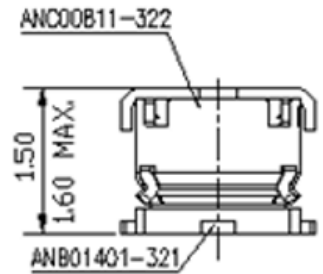
Air208 also built an RF connector to facilitate users to directly connect the module RF coaxial antenna, and save the board on the RF routing:

◆RF Series \_RF III Receptacle:



Material and Finish

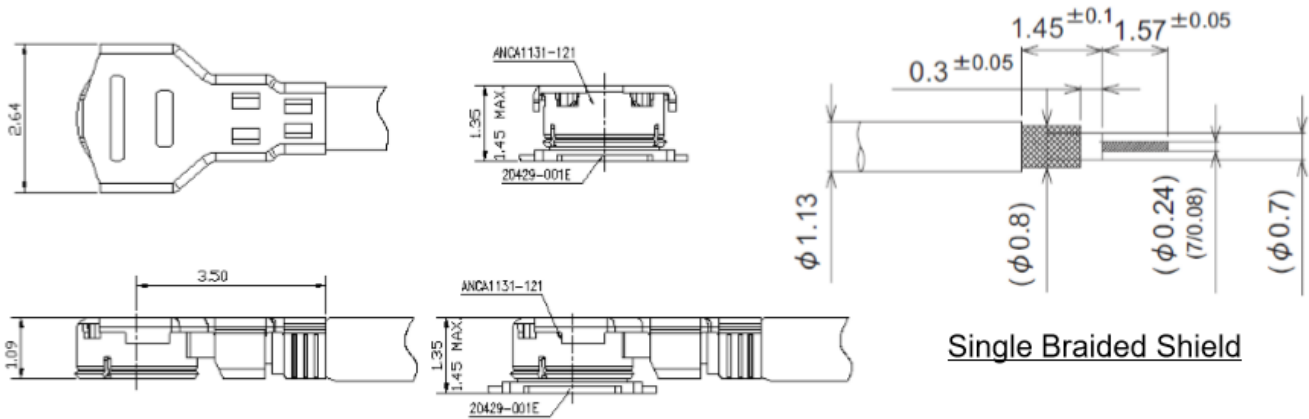
Parts	Material	Plating /Color	Note
HOUSING	LCP UL94V-0	Black	
CONTACT	COPPER ALLOY	Au	Gold Flash
GROUND CONTACT	COPPER ALLOY	Au	Gold Flash



Corresponding coaxial connector as shown below:

◆RF Series \_RF-A13 C Type 1.13:

Applicable Cable gauge



Material and Finish

Parts	Material	Plating /Color	Note
HOUSING	PBT UL94V-0	Black	
CONTACT	COPPER ALLOY	Au	Gold Flash
GROUND CONTACT	COPPER ALLOY	Au	Gold Flash

5.2. RF CONDUCTION SENSITIVITY

Table 18: RF CONDUCTION SENSITIVITY

Band	Receiving sensitivity
EGSM850	< -108.5dBm
DCS1900	< -108.5dBm

### 5.3. Recommended RF welding method

If the RF connector for connecting the external antenna is connected to the module by soldering, be sure to pay attention to the stripping method and soldering method of the connecting wire. In particular, if the soldering is sufficient, follow the correct soldering method shown in the figure below, In order to avoid due to poor welding caused by line loss increases.

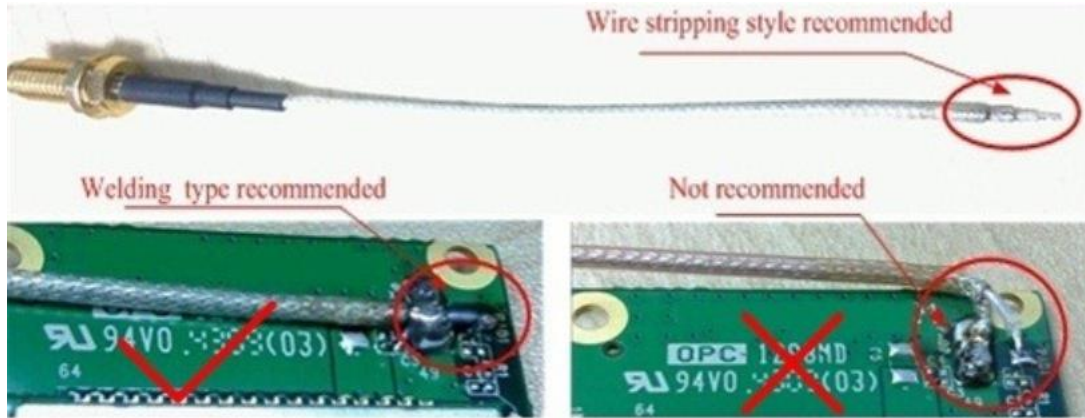


Chart 28: Suggestion on RF welding method

## 6. Electrical characteristics, reliability, RF characteristics

### 6.1. Absolute Maximum

The following table shows the module digital, analog pin Power Supply supply voltage and current Maximum tolerance value.

Table20: Absolute Maximum

Parameter	Minimum	Maximum	Unit
$V_{BAT}$	-0.3	4.2	V
Power supply peak current	0	2	A
Power supply average current (TDMA one frame time)	0	0.7	A
Digital pin voltage	-0.3	3.3	V
Analog pin voltage	-0.3	3.0	V
Off / Off mode digital / analog pin voltage	-0.25	0.25	V

### 6.2. working temperature

Table 21: working temperature

Temperature	Minimum	Typical	Maximum	Unit
Nornal working temperature	-40	25	85	°C
storagetemperature	-45		90	°C

### 6.3. Voltage limit value

Table 22: Module power limit value

Paramet	Description	Condition	Minimum	Typical	Maximum	Unit	
V <sub>BAT</sub>	Supply voltage	The voltage must be within this range, including voltage drops, ripple, and spikes	3.4	3.8	4.2	V	
	Burst voltage drop at launch	GSM900 MaximumTransmit power level			400	mV	
I <sub>BAT</sub>	Average supply current	Shutdown mode	Power on for the first time		34		uA
			Shutdown after boot(RTC works normally)		101		uA
		Bottom current			0.8		mA
		Standby current	DRX=2		1.4		mA
			DRX=5		1.14		mA
			DRX=9		1.03		mA
		Flight Mode	AT+CFUN=4		0.896		mA
		Minimum function mode	AT+CFUN=0		0.763		mA
		GPRS mode (2 send, 2 receive)	EGSM 900 1)		315.9		mA
			DCS1800 2)		208.7		mA
		GPRS mose (4 receive, 1 send)	EGSM 900 1)		203.5		mA
			DCS1800 2)		150.1		mA
Peak current / GSM900 transmit	GSM900 MaximumTransmit power level			1.8	2	A	



time slot)					
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1) 1) power level **5** 2) power level **0**



## 6.4. Current consumption

Table 23: Module's current consumption

Condition	Current consumption
<b>GPRS data transmission</b>	
Data transmission mode, GPRS ( 2 receive, 2 send) CLASS8 & CLASS 12	
EGSM850	@Power level5, <550mA, Typicalvalue 315.9mA @Power level10, Typicalvalue 158.2mA @Power level19, Typicalvalue 83.5mA
DCS1900	@Power level0, <450mA, Typicalvalue208.7mA @Power level5, Typicalvalue125mA @Power level15, Typicalvalue78.4mA
Data transfer mode, GPRS ( 4 receive, 1send) CLASS8 & CLASS 12	
EGSM850	@Power level5, <350mA, Typicalvalue203.5mA @Power level10, Typicalvalue101.3mA @Power level19, Typicalvalue62.4mA
DCS1900	@Power level0, <300mA, Typicalvalue150.1mA @Power level5, Typicalvalue79.4mA @Power level15, Typicalvalue55.8mA

## 6.5. Static Protection

In the module application, due to the human body static electricity, static electricity generated between the microelectronic electrostatic friction, through various means of discharge to the module, may cause some damage to the module, so ESD protection must pay attention to, whether in the production assembly, testing, R & D process, especially in product design, should take ESD protection measures. For example ESD protection should be added in circuit design at the Interface or vulnerable to ESD point. To wear anti-ESD gloves in production and so on.

The following table shows the ESD withstand voltage of the module PIN pin.

Table 24: ESDP erformance parameters (temperature: 25 C, humidity: 45%)

Pin name	Contact discharge	Air discharge
VBAT,GND	±5KV	±10KV
RF_ANT	±5KV	±10KV
TXD, RXD	±2KV	±4KV
Others	±0.5KV	±1KV



## 7. physical dimension

This section describes the module's physical dimension and the recommended package dimensions for the customer's design using the module.

### 7.1. Module physical dimension

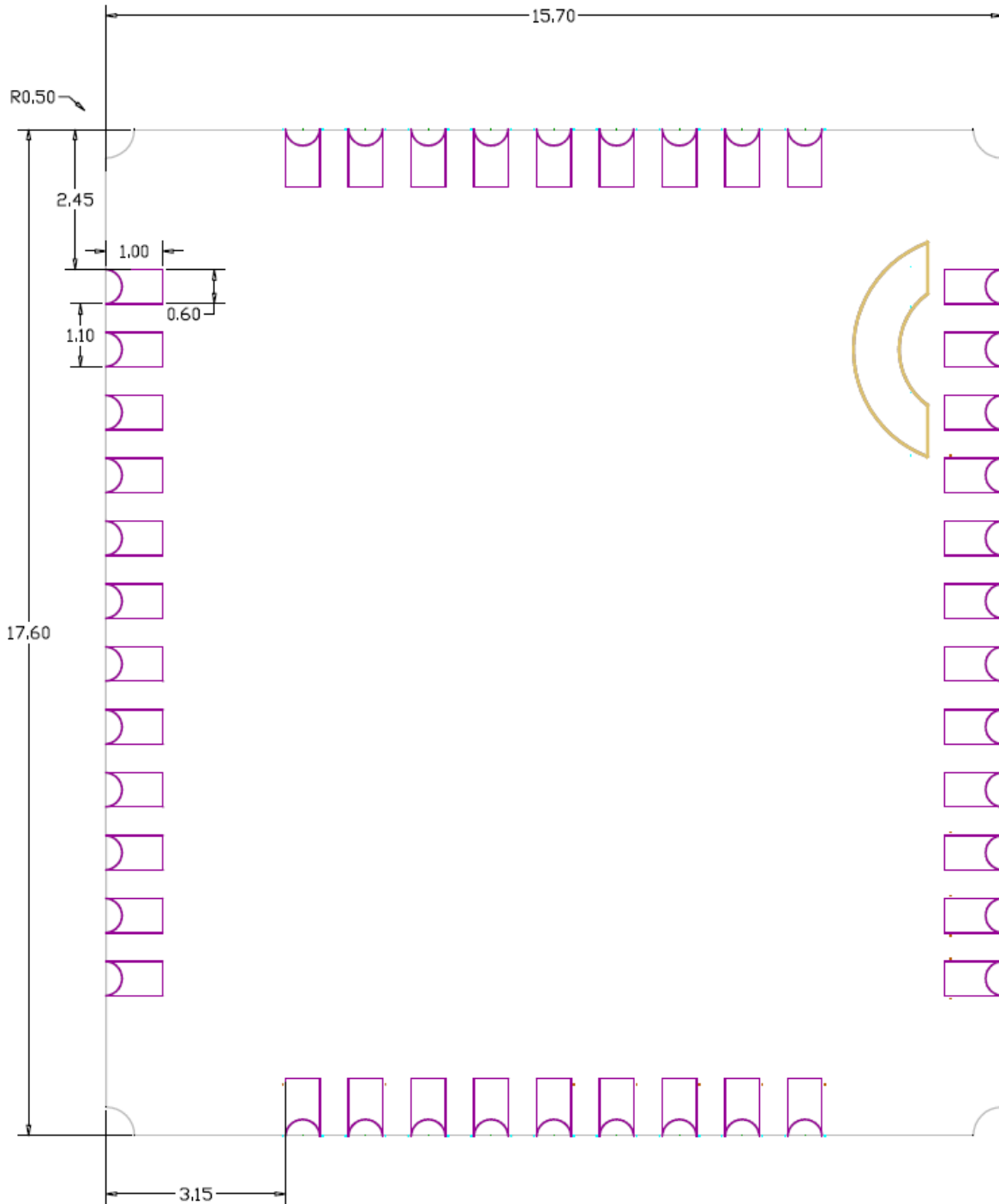


Chart 29: Air208 Front view (unit: mm)

## 7.2. Recommended PCB encapsulation

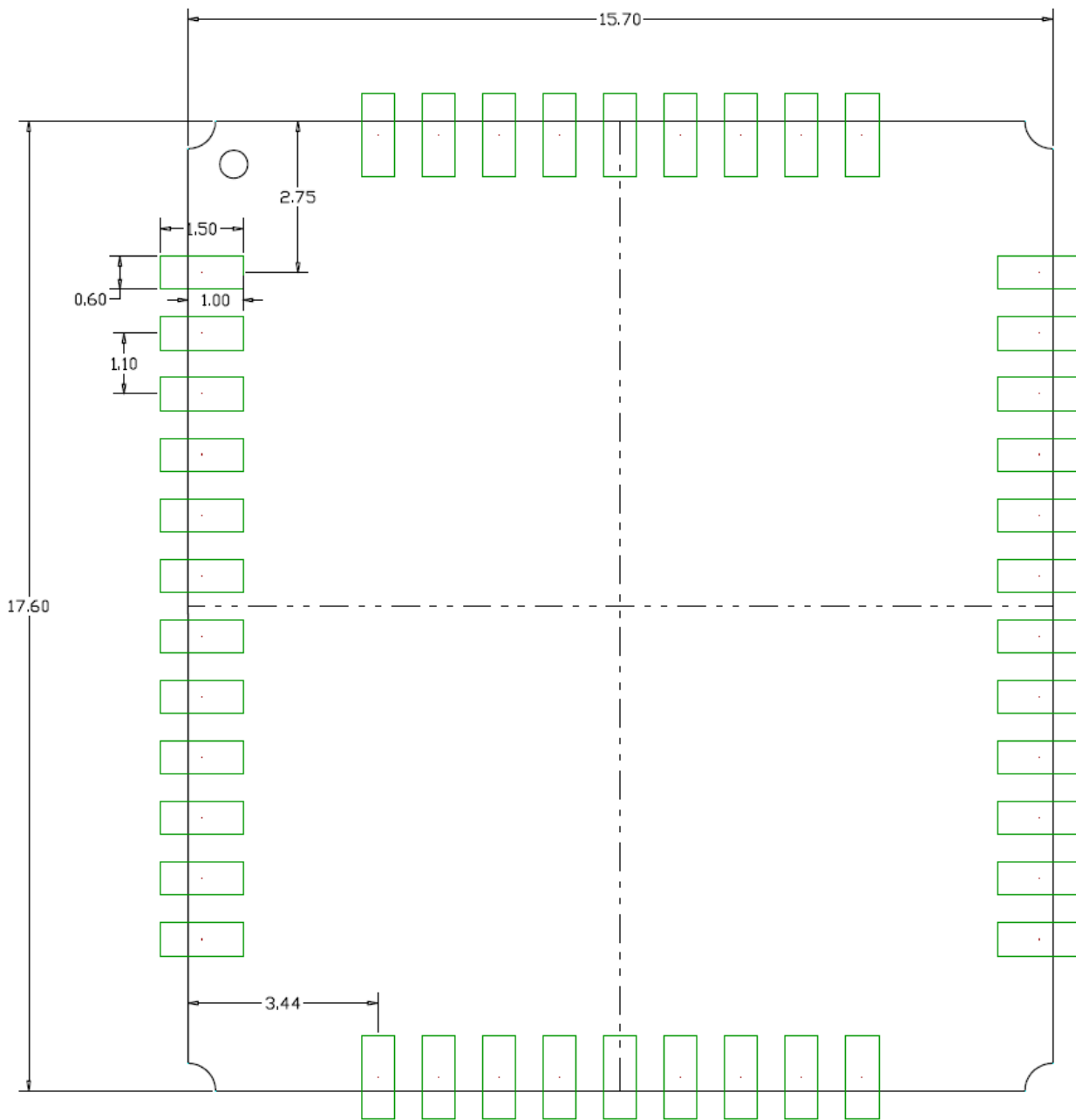


Chart 30: Recommended encapsulation (Unit: mm)

Note: make sure the spacing between module on the PCB and other components is 3mm at least.

### 7.3. Module front view

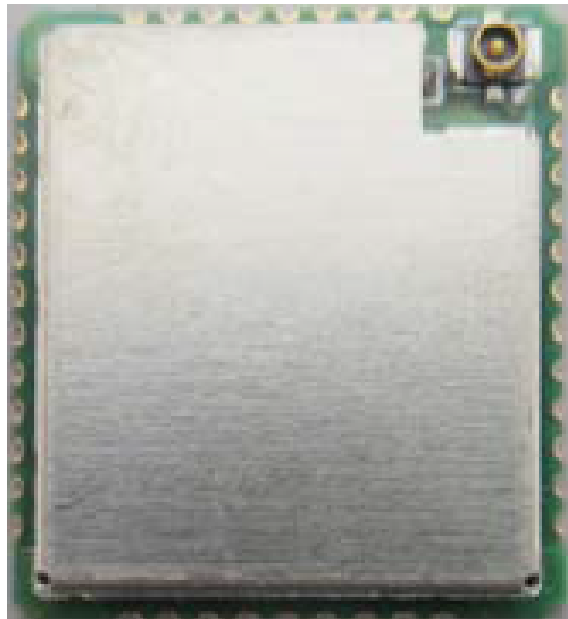


Chart 31: Module front view

## 7.4. Module bottom view

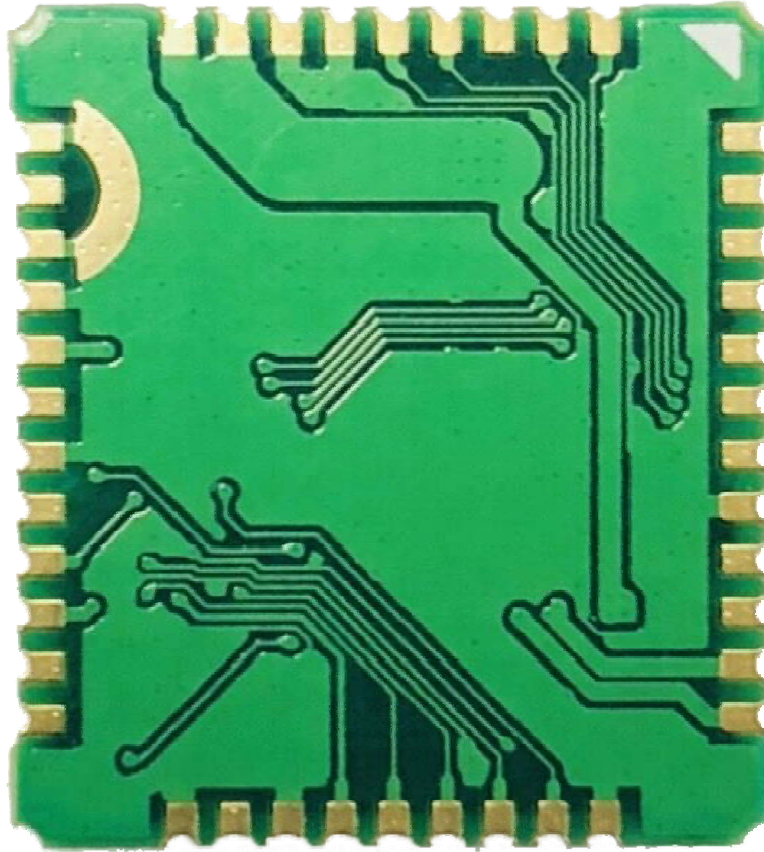


Chart 32: Module bottom view

## 8. Storage and production

### 8.1. Storage

Air208 shipped in vacuum sealed bags. The storage of the module needs to follow the following conditions:  
The module can be stored in a vacuum-sealed bag for 12 months at ambient temperatures below 40 ° C and air humidity less than 90%.

When the vacuum sealed bags open, if the following conditions are met, the module can be directly reflow or other high-temperature processes:

- ◆ Module ambient temperature below 30 degrees Celsius, air humidity less than 60%, the factory completed patch within 72 hours.  
Air humidity is less than 10%.

If the module is in the following conditions, it is necessary to bake before the patch:

- ◆ When the ambient temperature is 23 degrees Celsius (5 degrees Celsius allowed fluctuations), the humidity indicator shows humidity greater than 10%
- ◆ When the vacuum sealed bag is opened, the module ambient temperature is below 30 degrees Celsius and the air humidity is less than 60%, but the factory failed to complete the patch within 72 hours

When the vacuum sealed bag is opened, the module storage air humidity is greater than 10%.

If the module needs to be baked, please bake for 48 hours at 125 degrees Celsius (allowing 5 degrees Celsius fluctuation).

Note: The module packaging can not withstand such a high temperature, remove the module package before the module is baked. If you only need a short baking time, please refer to the IPC / JEDECJ-STD-033 specification.

## 8.2. Production welding

Printed scraper on the screen printing solder paste, solder paste through the screen openings to the PCB on the leakage, printing scraper strength needs to be adjusted properly, in order to ensure the quality of module paste, Air202 module pad part of the corresponding stencil thickness should be 0.2mm.

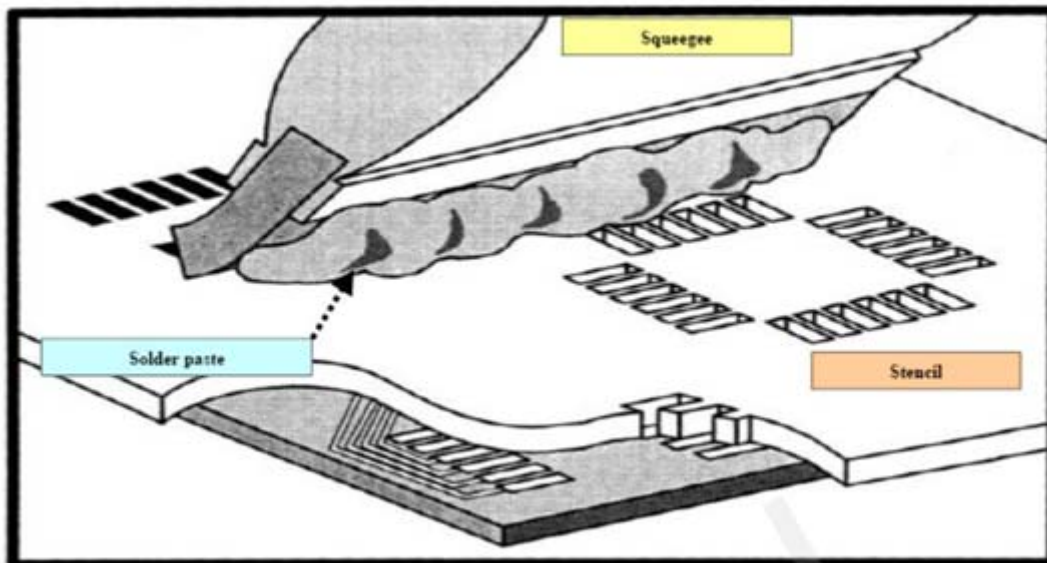


Chart 33: Paste map

To avoid repeated heating damage to the module, it is recommended that the customer PCB board be reflowed after the first side of the module. The recommended Furnace temperature curve is shown below:



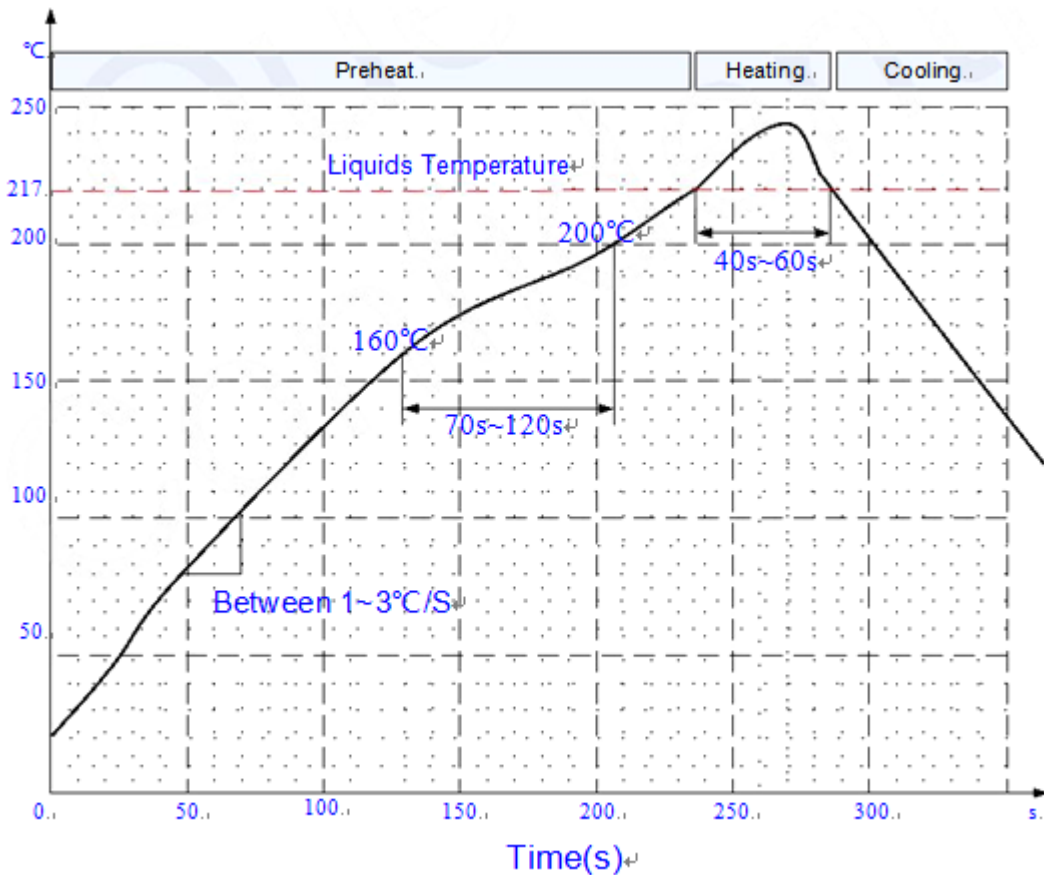


Chart 34: Furnace temperature curve

**FCC Statement**

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

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.

**FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

**FCC Label Instructions**

The outside of final products that contains this module device must display a label referring to the enclosed module. This exterior label can use wording such as: "Contains Transmitter Module FCC ID: 2AEGG-AIR208 or "Contains FCC ID:2AEGG-AIR208 , Any similar wording that expresses the same meaning may be used.