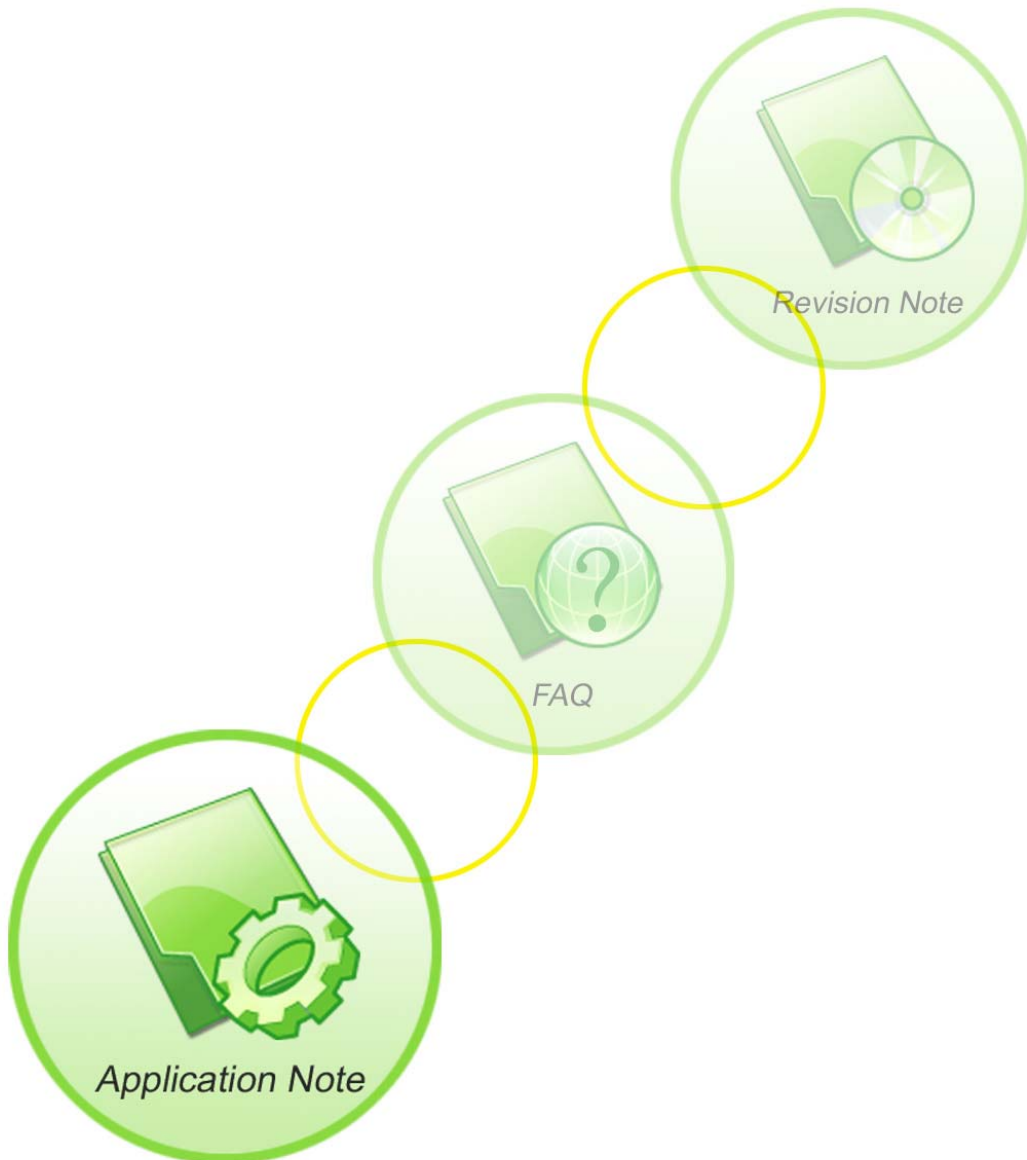




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Version history

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2011-08-10	1.00	First Release	Ma Honggang

1. Introduction

This document describes how to design peripheral interface of SIMCom module provided in your application.

1.1 Reference Documents

SN	Document name	Remark
[1]	SIM908_ATC	SIM908 AT command Set
[2]	SIM908_HD	SIM908 Hardware Specification
[3]	SIM908_EVB_UGD	SIM908 EVB User Guide

2 Application Interface

2.1 Power Supply Design

2.1.1 VBAT design

The power supply of SIM908 is from a single voltage source of VBAT, its normal operating voltage is from 3.2V to 4.8V. The peak working current can rise up to 2A during maximum power transmitting period, which will cause a voltage drop. So the power supply must be able to provide sufficient peak current, if not, the voltage may drop lower than 3.1V, and the module will automatically power down. Typically, VBAT can be set to 4V.

SIM908 can be used in a wide range of applications, the power supply design is deeply depending on the power source.

When the input is a 5V/2A adapter, a LDO linear regulator can be used in the design because the drop between input and output is not so big. Figure 1 shows the recommended circuit with MIC29302. Please also pay attention to the heat dissipation of the LDO. Usually, pouring a copper plane on the PCB is an effective way to the heat sink problem of the power IC.

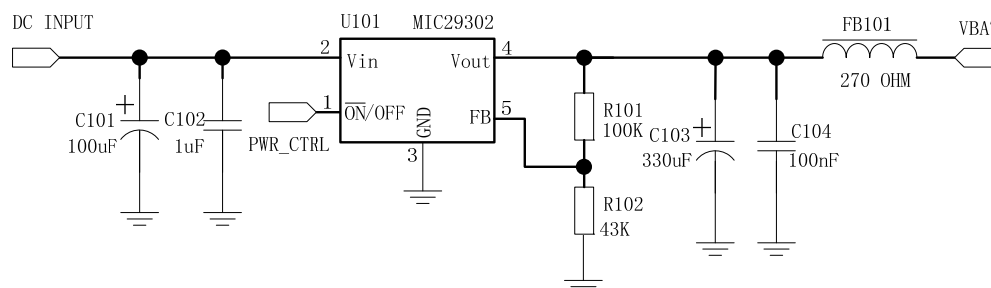


Figure 1: LDO Power Supply

NOTE 1:

The bypass capacitor C103 in Figure 1 is selected strongly depending on the rated current of the power source and the power IC. If both of the rated current are 2A, a low ESR tantalum capacitor (220uF or smaller) close to the VBAT pin is enough. Or user should change C103 to a bigger value according to the practical application. The rated current of the adaptor should not be less than 800mA (5V output).

The power IC and the bypass capacitor should be placed near the module, and the VBAT trace should be routed as wide and short as possible to reduce the PCB copper resistance when layout.

If the power supply is 12V or higher, a DC-DC converter is the best choice for its high efficiency.

When the module is powered by a DC-DC converter, user should pay more attention to the

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switching noise suppression design, otherwise the RF performance of SIM908 will be interfered by the switching noise of DC-DC, and it will cause some RF performance degradation, for example, modulation spectrum or switching spectrum will exceed the limit. As a solution, a large current ferrite bead FB101 (0805 size package, rated current > 2A, low DC resistance) can be added between the DC-DC output and the VBAT input. By default, FB101 can be mounted with a 0 ohm resistor, and when necessary, it can be substituted with a large current ferrite bead. For a typical application in automotive device, following Figure 2 shows a reference circuit.

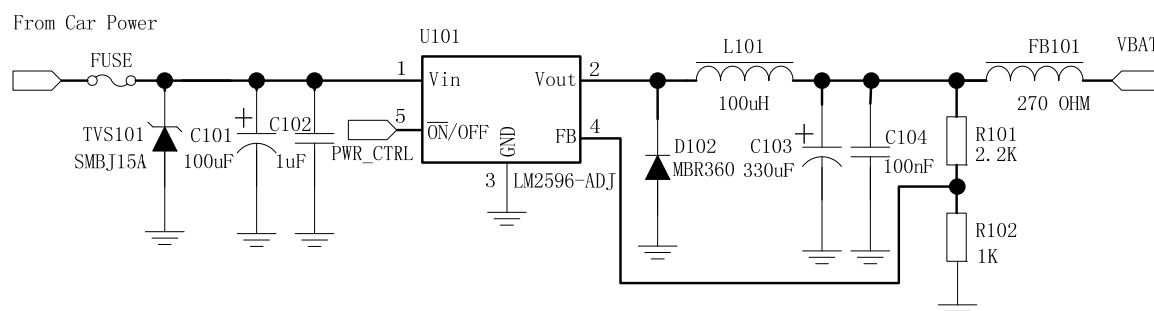


Figure 2: DC-DC Power Supply

NOTE 2:

When the input is from the USB port of a computer, the average current is 500mA according to the USB specification, so a super capacitor must be added near the module VBAT pins to compensate the peak current in transmit burst. A low ESR tantalum capacitor is usually used. The value for the capacitor should be more than 470uF.

2.1.2 Battery Charge design

SIM908 supports the Li-ion battery charge function. There's no need any charger IC to assist with this function for SIM908 module has integrated with PMU. Customers should connect the VCHG pin with a DC source, inside the SIM908 module, these pins has been bypassed with relevant capacitances, VBAT pin and VCHG pin add TVS diode for ESD protection inside the module, the following figure 3 shows the reference circuit.

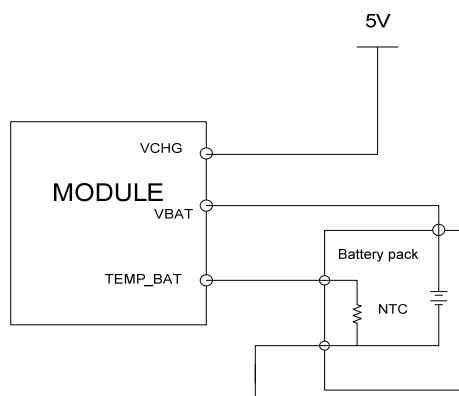


Figure 3: Battery Charge design

2.1.3 Power On/Off design

The simplest way to turn on/off SIM908 is to drive the PWRKEY to a low level for 1second then release. PWRKEY pin has been pulled up to 3V inside the module. Following figure is the recommended connection circuit with a NPN transistor. User can choose a GPIO of the MCU to control the POWER ON/OFF process. Please note that do not add a capacitor on PWRKEY pin, since it may cause some unexpected problems during the power on/off process.

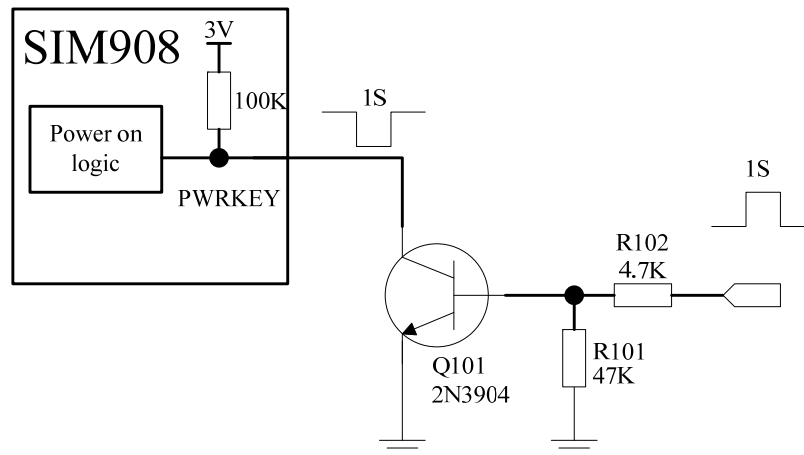


Figure 4: Turn on/off module using transistor

Another way to power on/off SIM908 is to connect PWRKEY and PWRKEY_OUT together. In this way, a P-channel MOSFET is needed. Therefore the first way of power on/off is recommended. In this way, PWRKEY_OUT should be kept open.

2.1.4 RTC backup design

SIM908 integrates a RTC backup interface which can be connected to a backup battery or a capacitor. The rated voltage of the battery should be 3V. The RTC current consumption is about 2uA when the VBAT is removed. Please note that do not keep this pin floating, if the back up time is not taken care of, a 4.7uF ceramic capacitor is recommended to be added between the VRTC pin of the module and GND.

Refer document [2] for more information.

2.2. UART interface

2.2.1 UART interface design

- SIM908 integrates two UART ports, one is called Serial Port (UART1), and the other is called Debug Port (UART0). Serial port is used for firmware updating and receiving AT

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command from the MCU, while Debug port used for debugging and upgrading firmware. If hardware flow control is not used ,DCD、 DSR can be left floating. Please refer to the following figure. DTR can be used to wake up the module from sleep mode and RI can be used to detect a coming call or SMS. These two pins should be connected to GPIO of the MCU.

NOTE 3:

Please note that the UART level is 2.8V, if the level is not matching, a level shift circuit is needed.

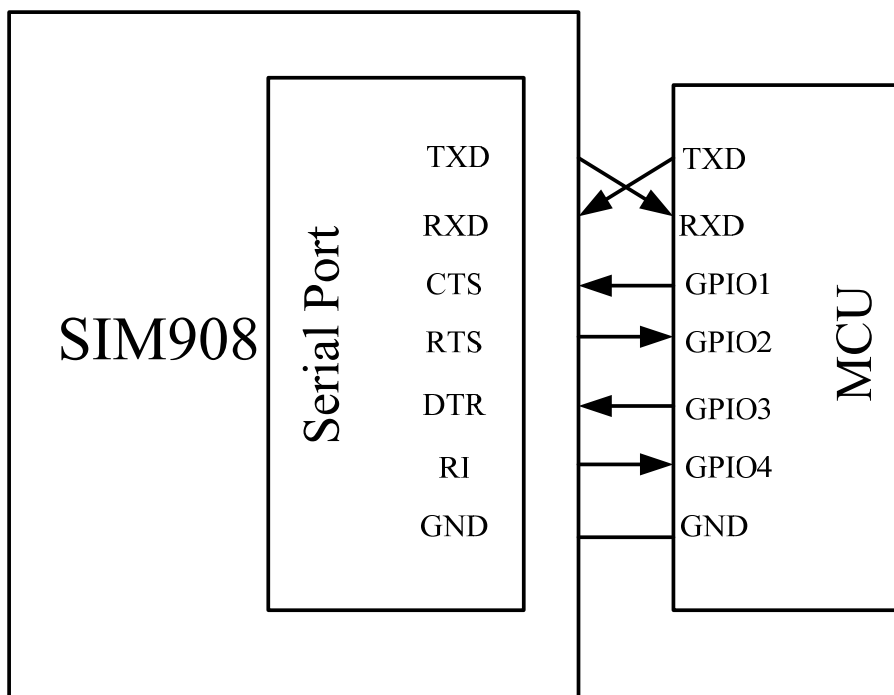


Figure 5: Serial Port Connection

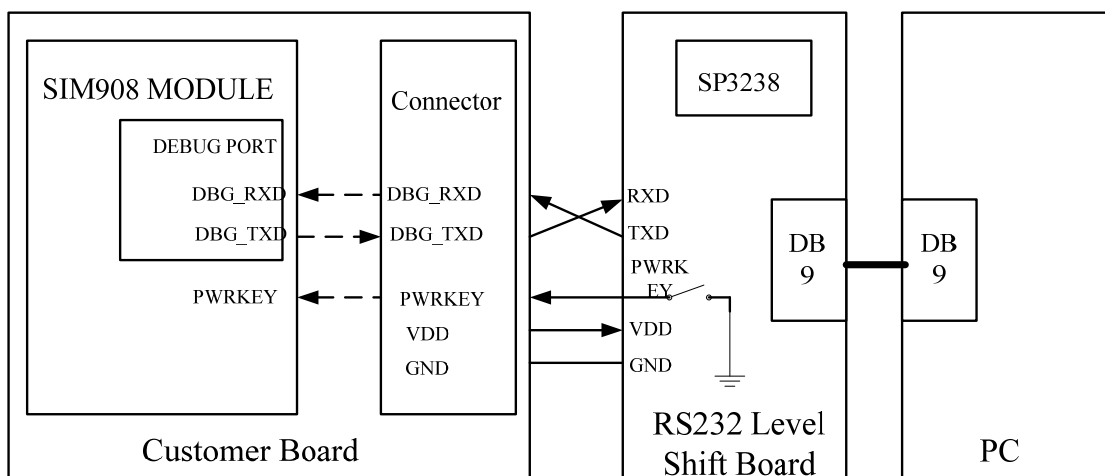


Figure 6: Debug Port Connection

2.3 GPIO selection

2.3.1 STATUS and NETLIGHT

STATUS pin can be used to monitor the module status during the power on/off process. After power up, AT commands will not respond till the STATUS pin change to high, and STATUS pin will change to low after the module is logged off from the base station in a power down procedure. Status pin can be connected to a GPIO of the MCU.

NETLIGHT is a net status indicator. It can drive a transistor to control a LED which will blink slowly or quickly according to different states. Please note that it can not drive a LED directly. Both STATUS and NETLIGHT pins are dedicated in SIM908, they can not be used as a GPIO for customers.

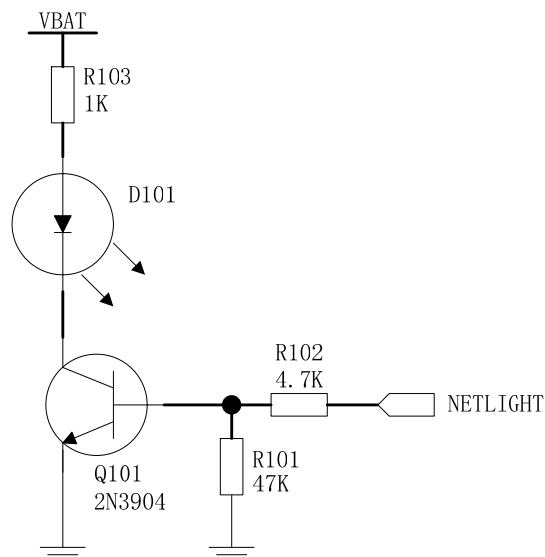


Figure 7: NETLIGHT indicator

2.3.2 GPIO

SIM908 provides 6 GPIOs which can be controlled by customer. As a GPI, the status can be read by the AT command and as a GPO, it can also be controlled by the AT command. The customer can use this GPIO to achieve some simple control. For more details, please refer to Document [2].

2.4 Audio interfaces

SIM908 provides two analog inputs, MIC1P/1N and MIC2P/2N, which could be used for electret microphone. The module also provides two analog outputs, SPK1P/1N and SPK2P/2N. The output can directly drive 32Ω receiver.

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MIC1P & MIC1N can be connected to an electro-condenser microphone directly, for the bias voltage has been implemented inside the module, and SPK1P & SPK1N can drive a 32 Ohm speaker. The maximum output power is 96mW. If the speaker impedance is 8 Ohm, user should add an audio amplifier between the module output and the speaker. We recommend National Semiconductor's LM4890.

MIC2P&MIC2N and SP2KP&SPK2N usually used as headset MIC, and the MIC does not need external bias voltage either, can be directly connected to the auxiliary MIC. SPK2 can directly drive 8/16/32Ω speakers.

Also, the microphone input channel can be configured to a single ended mode. In this mode, the MICN can be left open. The negative terminal of the microphone can be connected to GND in the customer's board.

For adjustment, customers can use AT+CMIC to set the input gain level of microphone, AT+CLVL to change the volume of the speaker. For details, please refer to Document [1],[2].

2.4.1 Referenced circuit of headset design (differential mode)

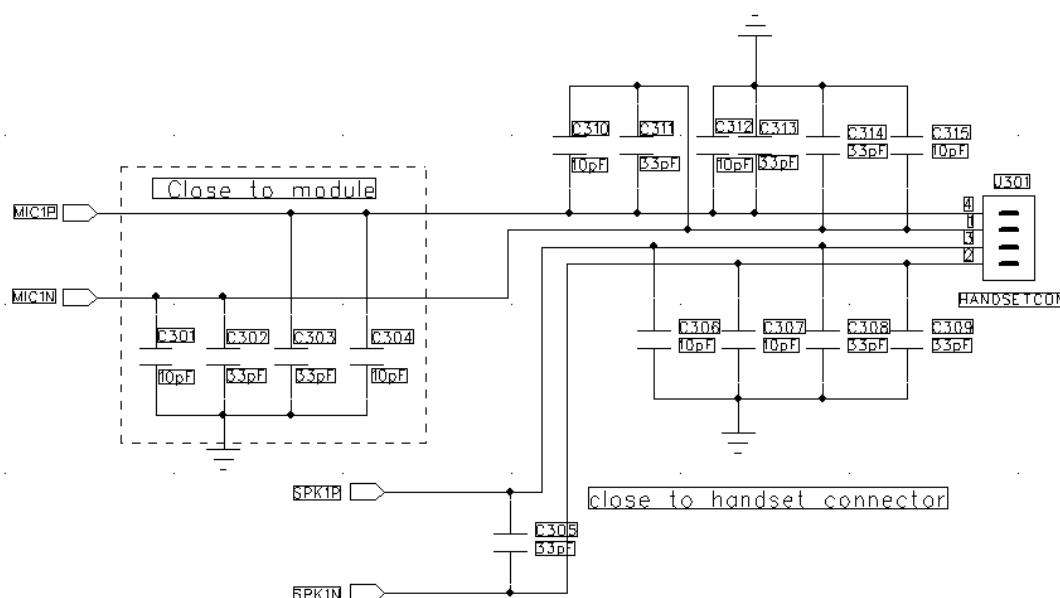


Figure 8: Referenced circuit of headset (differential mode)

2.4.2 Referenced circuit of headset design (single ended mode)

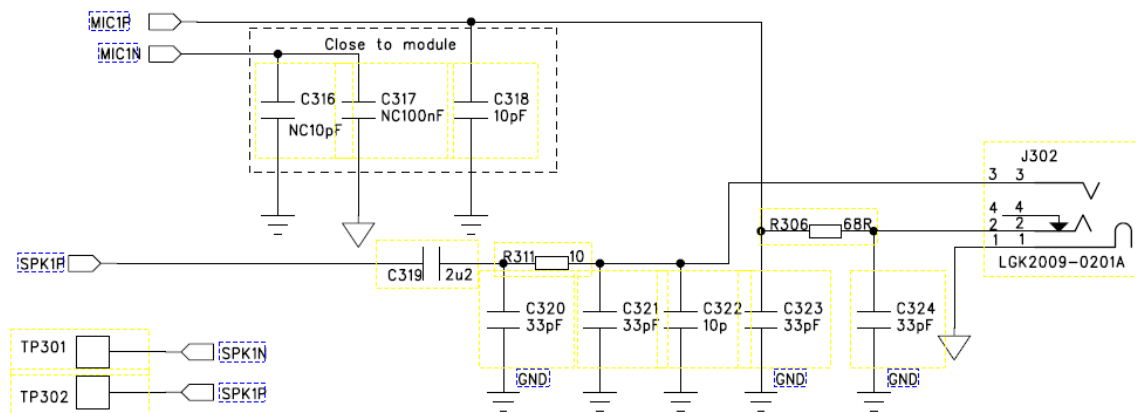


Figure 9: Referenced circuit of headset (single ended mode)

2.4.3 Referenced circuit of hand free design

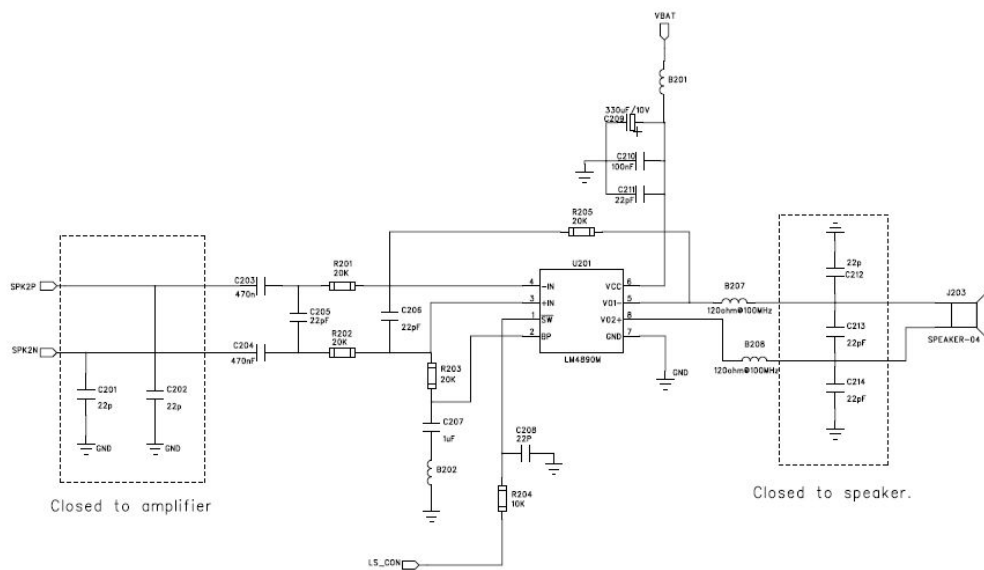


Figure 10: Referenced circuit of audio PA

2.5 GSM Antenna matching circuit design

Because the module is working under 50ohm system in RF part, so, to get the best RF performance, the SMT module's load impedance should be tuned to 50ohm. But in fact, the most antenna's port impedance is not a purely 50ohm, so, to meet the 50ohm requirement, an additional antenna matching circuit should be needed. Furthermore, to facilitate the antenna debugging and certification testing of RF performance, we suggested the customer add a RF test connector in series between the module's RF port and the antenna matching circuit. The recommended antenna matching circuit is shown as below:

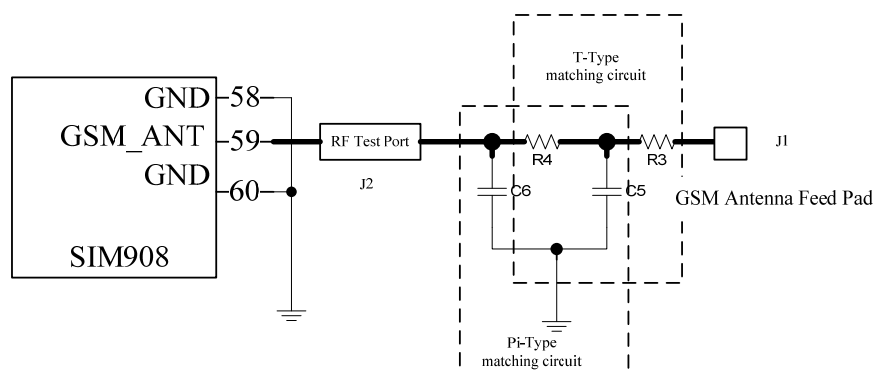


Figure 11: GSM Antenna Matching Circuit

In the Figure10, the components, R4, C5 and C6 make up a pi-type matching circuit structure. If add the optional component R3, then a T-type matching circuit structure will be made up with another two components R4 and C5. But usually, a pi-type matching circuit is enough in antenna tuning process. The component J2 is a RF test Port, used for conduct RF test. The traces in Bold type must be 50 ohm impedance controlled when layout a design.

For the RF test connector, we suggested the customer use the part vended by Murata, its part number is MM8430-2610. For detail information about this part, the customer can visit Murata's website: <http://www.murata.com>.

Refer document [2] for more information.

2.6 GPS Antenna matching circuit design

Because the module is working under 50ohm system in RF part, so, to get the best RF performance, the SMT module's load impedance should be tuned to 50ohm. But in fact, the most antenna's port impedance is not a purely 50ohm, so, to meet the 50ohm requirement, an additional antenna matching circuit should be needed. Furthermore, to facilitate the antenna debugging and certification testing of RF performance, we suggested the customer add a RF test connector in series between the module's RF port and the antenna matching circuit. The recommended antenna matching circuit is shown as below:

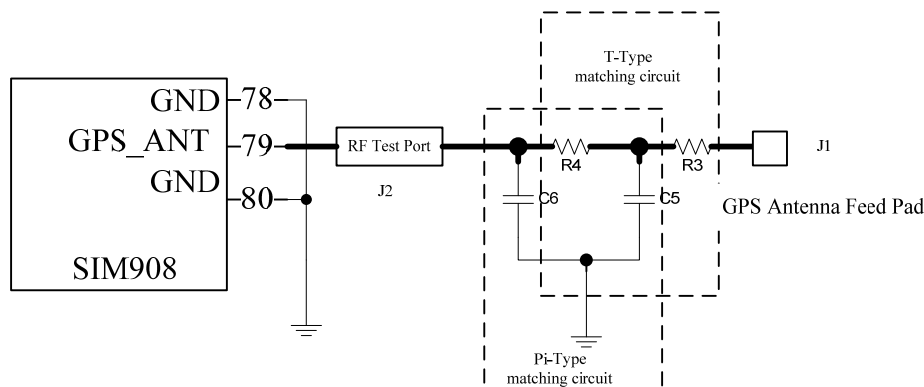


Figure 12: GPS Antenna Matching Circuit

In the Figure10, the components, R4, C5 and C6 make up a pi-type matching circuit structure. If add the optional component R3, then a T-type matching circuit structure will be made up with another two components R4 and C5. But usually, a pi-type matching circuit is enough in antenna tuning process. The component J2 is a RF test Port, used for conduct RF test. The traces in Bold type must be 50 ohm impedance controlled when layout a design.

For the RF test connector, we suggested the customer use the part vended by Murata, its part number is MM8430-2610. For detail information about this part, the customer can visit Murata's website: <http://www.murata.com>.

SIM908 module support active antenna, if the active external antenna works at 2.8V voltage supply domain, user can connect the GPS-VANT-OUT and GPS-VANT-IN directly. If the antenna's power is not 2.8V, a proper voltage should be provided to the pin GPS-VANT-IN depending on the active antenna, and the pin GPS-VANT-OUT should be kept open. For passive antennas, both the pin GPS-VANT-OUT and the pin GPS-VANT-IN should be kept open. Refer document [2] for more information.

2.7 SIM card interface

The SIM interface is powered from an internal regulator in the module. Both 1.8V and 3.0V SIM Cards are supported. You can select the 8-pin SIM card holder. The reference circuit with 8-pin SIM card holder illustrates as in the following figure 12. We recommend an Electro-Static discharge device ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C for ESD protection. The 22Ω resistor shown in the following figure should be added in series on the IO line between the module and the SIM card for matching the impedance. The SIM peripheral circuit should be closed to the SIM card socket.

The SIM_PRESENCE (can be implemented by a GPIO) pin is used for detecting the SIM card. There is a 100k pull down resistor in SIM908 module. So the pull up resistor R110 should not be bigger than 10K. If user does not use the SIM card detection function, this pin can be kept open.

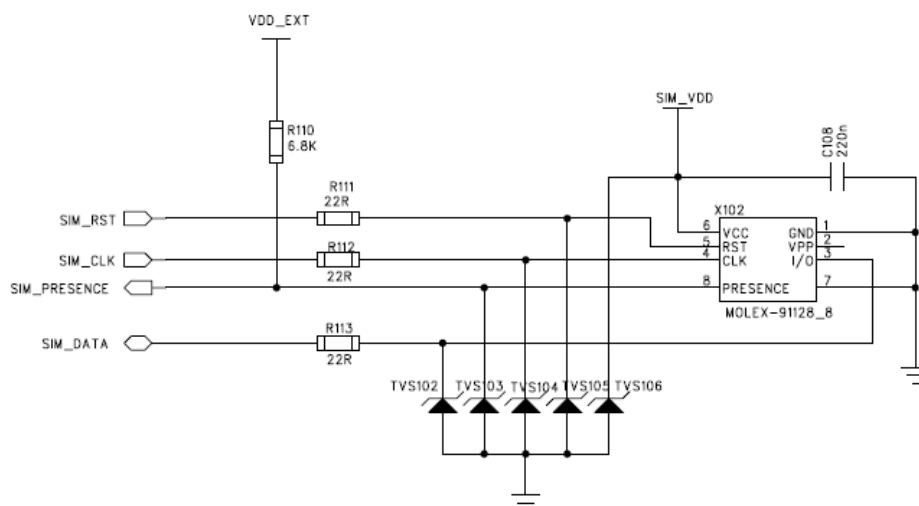


Figure 13: Reference circuit with 8-pin SIM card holder

NOTE 4:

Please note that SIM_DATA has already been pulled up to SIM_VDD in SIM908, so external pull up resistor is not necessary.

2.8 ESD protection

It is suggested that it's better to do some ESD protection in user's application to improve the ESD character of the module, especially for the signal connecting to external interface, for example: MIC, SPK, PWRKEY, VBAT, UARTs, SIMCARD, GPS_ANT, GPS_VCC_ANT and GPS_VREF_2V8.

It is suggested that customers in serials with 100ohm resistances on UART lines for ESD consideration.

In the ESD testing laboratorial, GPS_VANT, GPS_VCC_ANT, GPS_VREF_2V8 were damaged fatally, and the GPS function can not work normal again, the TVS-equipped module, however, proved has a high performance in the ESD testing, SIM908 passed the testing of air-discharge +/-10KV and contact-discharge +/-5KV. So SIMCom strongly recommend the ESD protection on pins mentioned above.

The following table shows the ESD-equipped module ESD testing:

Pin	Contact discharge	Air discharge
GPS_VANT	±5KV	±10KV
GPS_VREF_2V8	±5KV	±10KV
GPS_VCC_ANT	±5KV	±10KV

2.9 Consideration on PCB layout

In SIM908's PCB design, a good PCB layout will help the improvement of the whole product performance, including reliability, EMC performance, etc. The following are some consideration for referenced:

- 1) The power trace should be short and wide, it is recommended to be routed above 80mil.
- 2) The layout of GROUND is very important. A whole ground layer is the best for module performance if it is possible. Some noise sensitive signal trace, e.g. audio traces and reset trace should be shielded by ground.
- 3) The audio traces (MIC & SPK) should be better protected with ground. The width of MIC traces should be 6-8 mil and the SPK traces should be 10-12 mil. A differential pair routing is strongly recommended for these traces and keep parallel.
- 4) RF trace between SMT module RF pad with the RF test connector, RF trace between RF test connector with the antenna matching circuit, RF trace between the antenna matching circuit with the antenna feed PAD all should be controlled to 50 Ohm
- 5) Do not layout RF trace in orthogonal
- 6) When layout surface Micro-strip Transmission Line or offset Strip line Transmission Line, 3W rule should be followed, that means the distance between reference GND with RF trace should be three times more than the width of RF trace.

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