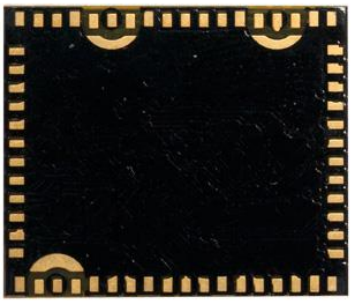
GGB-1916

GNSS/2.5G GSM/GPRS/Bluetooth Module

Hardware User Guide



Document history

Version	Date	Updates
1.0	October 4, 2016	Creation.

Contents

1. Introduction

This document is the description of GGB-1916 hardware interface. It is useful for quickly developing products with GGB-1916 module.

2. Package

2.1 Pin-out

Please refer to the chapter 2 of GGB-1916 datasheet.

2.2 Dimension and PCB layout pattern

Please refer to the chapter 4 of GGB-1916 datasheet.

3. Design-in

3.1 Power supply

The module has three power supply input pins named VBAT. The power supply input range is from 3.4V to 4.2V. The rise time must be smaller than 100ms. Because of the GSM burst, the power supply must be able to provide current up to 2A.

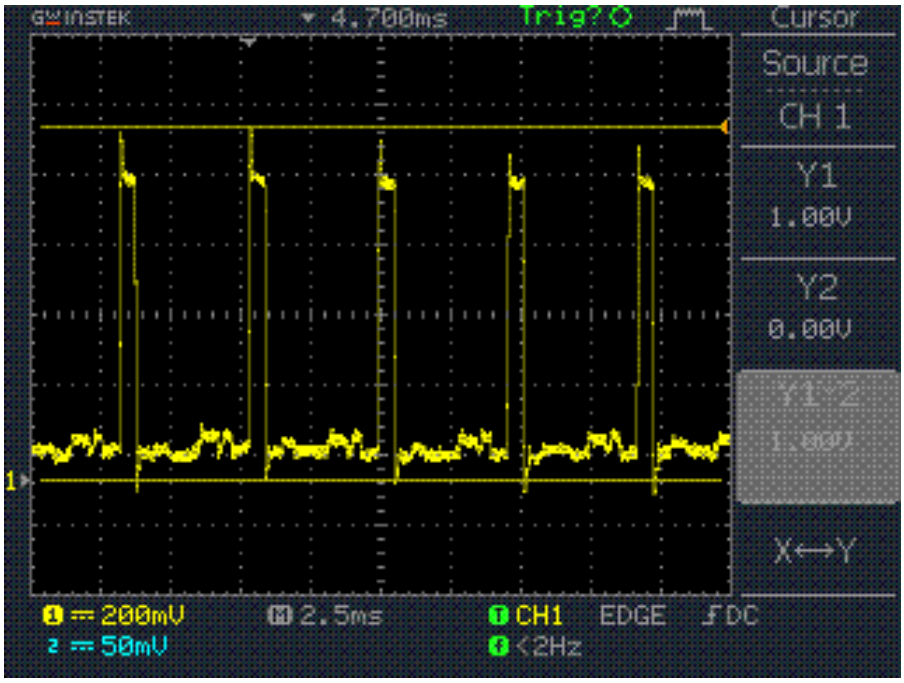


Figure 1: The GSM burst peak current of GGB-1916 is 1A in this case. The pulse is 577uS.

Besides, a low ESR 220uF bypass capacitor close to the module's VBAT pins is required. If the power supply is directly from an adjacent Li polymer battery, a 22uF bypass capacitor is enough.

Adding an extra 100pF capacitor can improve the high frequency interference. The bypass capacitor has to be as close to VBAT pins of GGB-1916 as possible. When doing PCB layout, the trace from the power supply to the VBAT pins must be wider than 60mil and routes in the same layer. If this trace changes to the other PCB layer, at least 6 transition vias are needed.

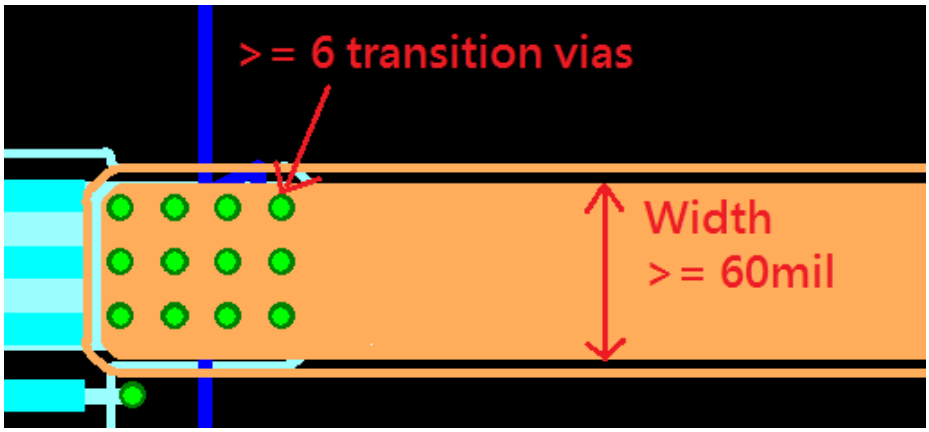


Figure 2: PCB layout requirement of power supply input.

3.2 Power on/off and reset

3.2.1 Power on

The module can be turned on by pulling the PWRKEY pin from high to the low level for at least 1 second. Because PWRKEY is internally pulled up to VBAT pin with about 54 KΩ resistor, an open-drain circuit is suggested to control PWRKEY. Reference circuit is shown as below.

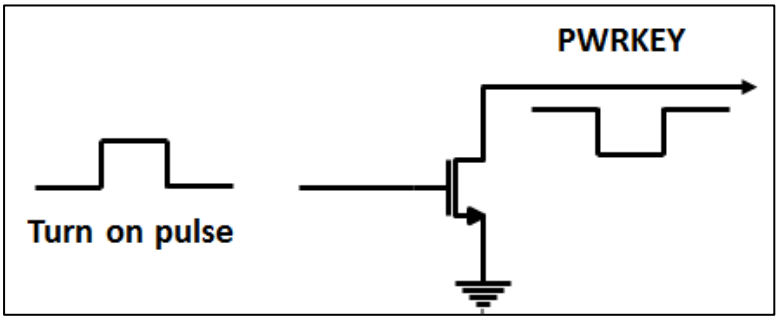


Figure 3: Turn on the module with a N-channel MOSFET.

The other way to control PWRKEY is to use a button. The reference circuit is shown as below.

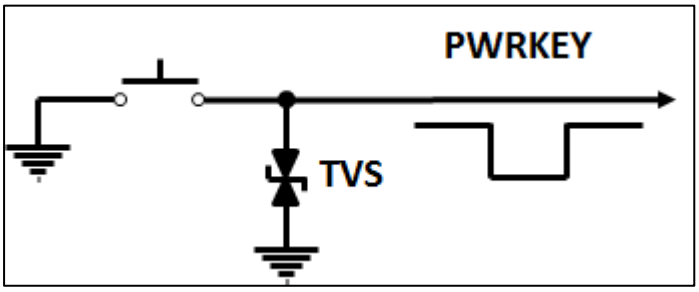


Figure 4: Turn on the module with a button.

The power on timing is illustrated as in the following figure.

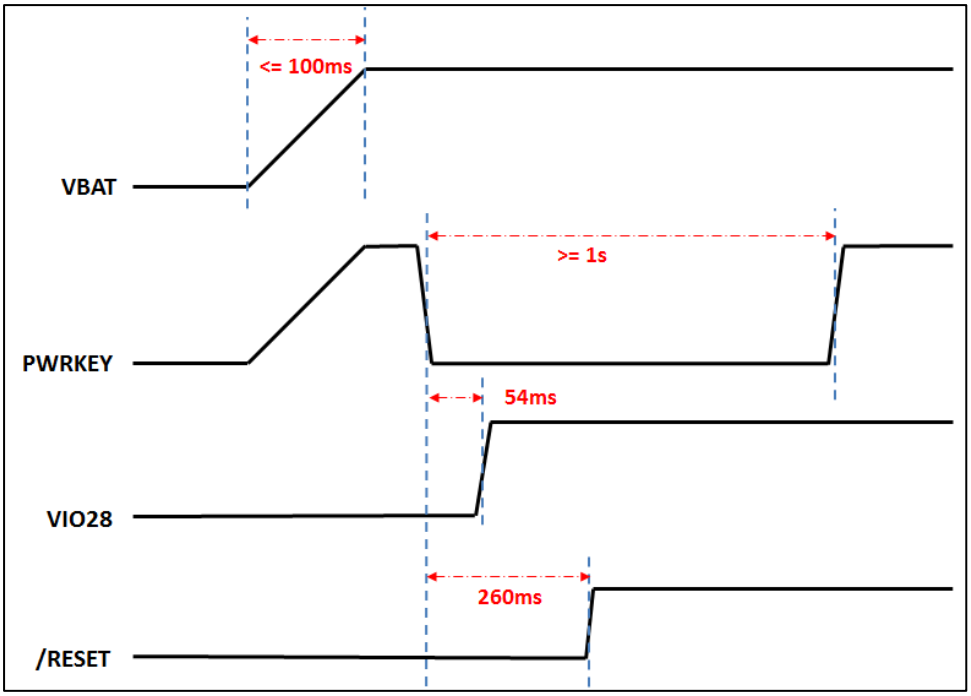


Figure 5: Turn-on timing

3.2.2 Power off

Either of the following procedures can turn off the module.

- Normal power off procedure: Turn off the module by AT command.
- Under-voltage automatic power off.

3.2.2.1 Turn off the module by AT command

The module can be powered off by AT command. This makes the module detach the network and save data before completely power off.

3.2.2.2 Under-voltage automatic power off

The module has the function of under-voltage lockout. Its upper and lower thresholds are 3.2V and 3.0V. This prevents startup if the initial voltage of VBAT pin is below the upper threshold. If the VBAT voltage is getting below the lower threshold, it will automatically turn off the module.

3.2.3 Reset

The module has a hardware reset pin named /RESET. It outputs high level (1.8V) after the module is powered on. In case the module does not reply to AT commands, the user can reset the module by pulling /RESET pin to ground and then release. For normal reset, user can use AT command, such as “AT+CFUN=1,1” or “AT+CFUN=4,1”.

3.3 Operation modes

3.3.1 Sleep mode

Sleep mode is default disabled. User can use AT+LSSLEEP=1 command to allow the module to enter sleep mode. In sleep mode, the module can still receive phone call, SMS, GPRS paging, Bluetooth data or GNSS data, and report the status by sending out AT commands. However, it cannot respond to the input AT commands in sleep mode. A low pulse on /WAKE pin of the module can clear the sleep mode and then the module can respond to the input AT commands. User can use AT+LSSLEEP=1 command to allow sleep mode again, clear it by a low pulse on /WAKE pin and so on.

3.3.2 GSM functionality modes

User can use AT command to control the GSM functionality. Three GSM functionalities are available as below.

- AT+CFUN=0: turn off GSM radio and SIM card.
- AT+CFUN=1: full GSM functionality. This is default mode.
- AT+CFUN=4: turn off GSM radio.

3.3.3 GNSS operation

The power of GNSS is default off. User can use AT+EGPSC=1 command to turn it on, and AT+EGPSC=0 to turn it off. When GNSS is on, its data will be output via AT command interface regardless of the sleep mode described in section 3.3.1.

3.3.4 Bluetooth operation

The power of Bluetooth is default off. User can use AT+EBTPWR=0 command to turn it on, and AT+EBTPWR=1 to turn it off. When Bluetooth is on, its data will be output via AT command interface regardless of the sleep mode described in section 3.3.1.

3.4 Antenna interfaces

The module has three pads for GSM, GNSS and Bluetooth antenna, respectively. The module's pin 57 named GSM_ANT is GSM antenna pad. Pin 28 named GNSS_ANT is GNSS antenna pad. Pin 48 named BT_ANT is Bluetooth antenna pad. All of them have the nominal characteristic impedance of 50 Ω.

3.4.1 GSM antenna interface

Because GSM_ANT pad of the module is internally DC coupled to ground, the connection to the antenna must be decoupled from DC voltage. For proper RF signal reception and transmission, keep the RF trace as 50 Ω impedance. A reference circuit is shown as below picture. There is a π-

network matching circuit reserved for adjusting RF performance. This matching circuit should be placed close to GSM antenna.

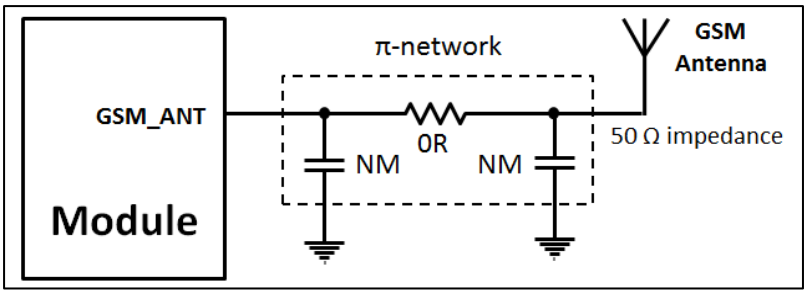


Figure 6: Reference design for GSM antenna interface

Table 1: GSM RF output power

Frequency	Maximum	Minimum
GSM 850	33dBm±2dBm	5dBm±5dBm
E-GSM 900	33dBm±2dBm	5dBm±5dBm
DSC 1800	30dBm±2dBm	0dBm±5dBm
PCS 1900	30dBm±2dBm	0dBm±5dBm

3.4.2 GNSS antenna interface

Both passive and active GNSS antenna are supported by the module. The impedance of GNSS RF trace should be controlled as 50 Ω. The trace length should be kept as short as possible. Because of the weakness of GNSS signals, keep the trace and GNSS antenna away from the noise source and RF transmitters, such as switching regulator, high speed line, clock signal and GSM antenna.

3.4.2.1 Passive antenna

A reference circuit is shown as below picture. There is a π-network matching circuit reserved for adjusting RF performance. This matching circuit should be placed close to GNSS antenna. GNSS_ANT pad of the module is internally DC decoupled. If ESD protection is required, a 100nH inductor or TVS diode of smaller than 0.5pF can be mounted in the position marked as NM in below picture.

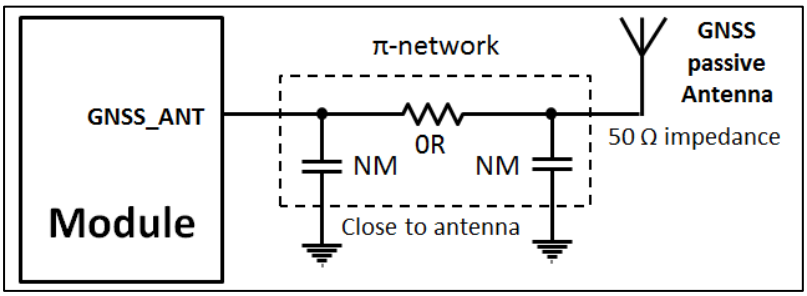


Figure 7: Reference design for GNSS passive antenna interface

3.4.2.2 Active antenna

A reference circuit is shown as below picture. The output voltage GNSS_TLDO28 of the module is 2.8V. It is powered by an internal regulator in the module. Do not use it for other purposes, otherwise GNSS functionality may not work properly. The current consumption of the active antenna should be smaller than 20mA. The capacitance of TVS must be lower than 0.5pF to control the impedance as 50Ω.

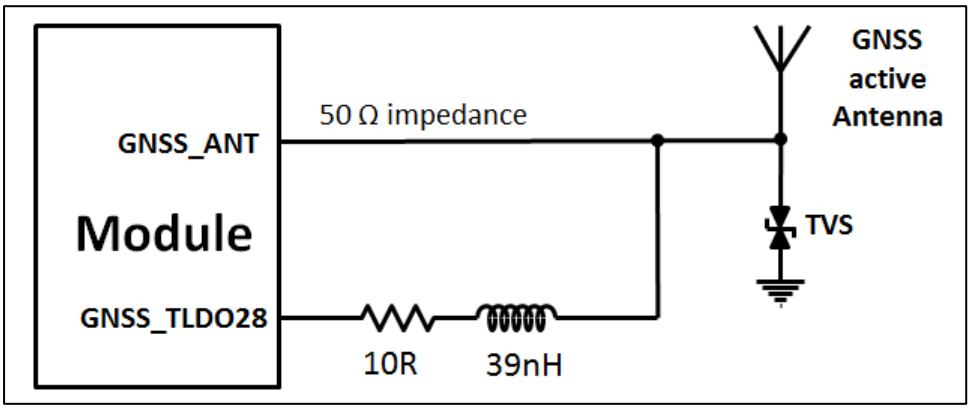


Figure 8: Reference design for GNSS active antenna interface

3.4.3 Bluetooth antenna interface

Because BT_ANT pad of the module is internally DC coupled to ground, the connection to the antenna must be decoupled from DC voltage. For proper RF signal reception and transmission, keep the RF trace as 50 Ω impedance. A reference circuit is shown as below picture. There is a π-network matching circuit reserved for adjusting RF performance. This matching circuit should be placed close to Bluetooth antenna. If the product equips both GSM and Bluetooth antenna, please place them as far as possible.

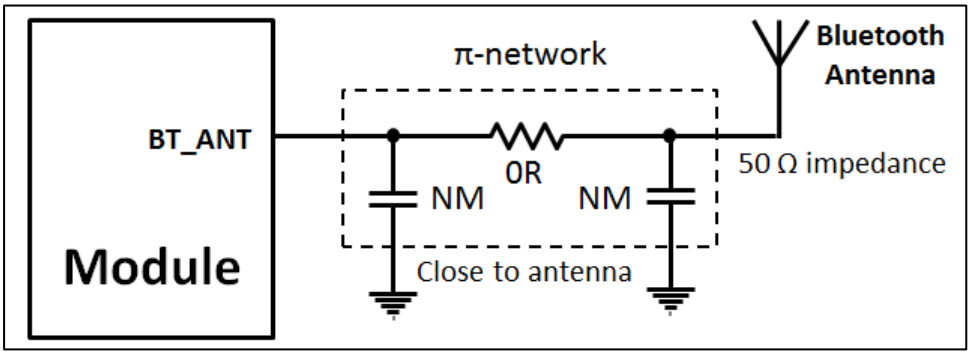


Figure 9: Reference design for Bluetooth antenna interface

The maximum Bluetooth RF output power of the module is 4dBm±3dBm.

3.5 SIM interface

The SIM interface is powered by an internal regulator in the module. It automatically supplies the right voltage (1.8V or 3V) to SIM card. A reference circuit of 6-pin SIM socket is shown in the following figure.

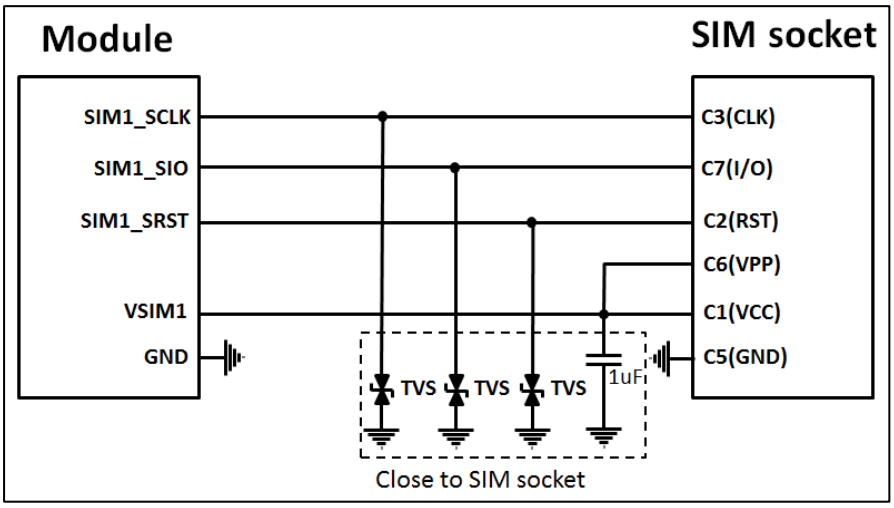
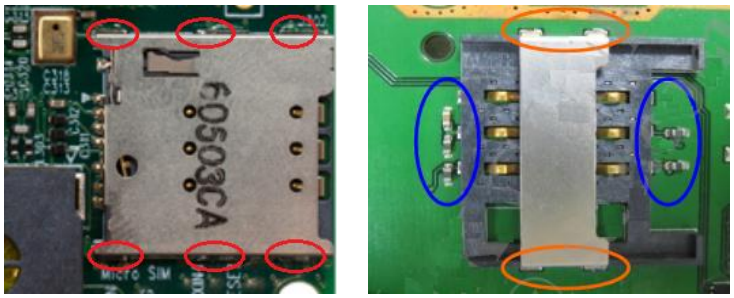


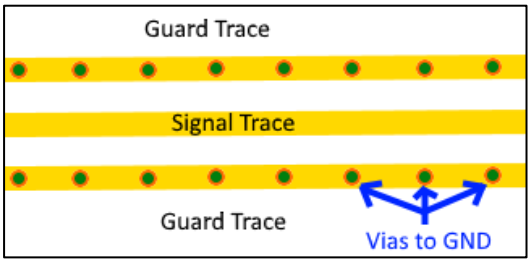
Figure 10: Reference design for SIM interface.

The following criteria should be conformed.

- Place the SIM socket as far away from both GSM and Bluetooth antennas as possible.
- SIM socket must be grounded well.



- Add 1uF bypass capacitor close to the VCC pin of SIM socket.
- ESD protection components should be placed close to SIM socket.
- The equivalent capacitance on SIM1_SCLK, SIM1_SIO and SIM1_SRST must be under 60pF respectively.
- The PCB trace width of VSIM1 is at least 8mil.
- SIM1_SCLK is not close to SIM1_SIO to avoid cross talk.
- Use guard traces to protect SIM1_SCLK.



3.6 Serial interfaces

3.6.1 UART

The module provides one asynchronous serial port, i.e. UTXD1 and URXD1 pins, to communicate with the external microprocessor. The protocol format is AT command with the baud rate 115200 and configuration 8-N-1.

The electrical characteristics of UTXD1 and URXD1 pins are in the following table. The external microprocessor with 2.8V, 3.0V or 3.3V UART can connect to the module directly.

Table 2: Electrical characteristics of UART pins

Parameter	Symbol	Min.	Typical	Max.	Unit
High level input voltage	V_{IH}	2.1		3.6	V
Low level input voltage	V_{IL}	-0.3		0.7	V
High level output voltage	V_{OH}	2.38	2.8	2.94	V
Low level output voltage	V_{OL}	0		0.42	V

A reference circuit of the UART interface connection is shown as below. The test points are reserved for the firmware upgrade of the GGB-1916 module.

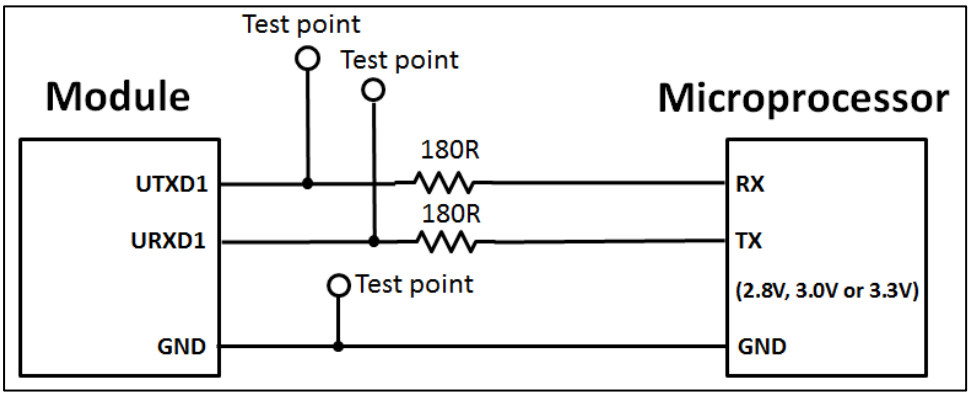


Figure 11: UART interface reference circuit.

3.6.2 USB

The module has a built-in USB interface consists of USB_DP, USB_DM and VCHG pins. This interface is for internal debug. Please leave them unconnected.

3.6.3 I^2C

The module provides an I^2C interface which is reserved for customization. The default firmware does not include this interface. If it is not used, please leave them unconnected.

3.7 Audio interface

The module provides one analog microphone input and one analog speaker output. The built-in class-AB amplifier with 8ohm 0.8W output power at 3.7V VBAT voltage can directly drive 8 Ω speaker. The audio signals have to be routed according to differential signal to improve the audio performance.

If the audio interface is not used, please leave them unconnected.

3.7.1 Speaker interface configuration

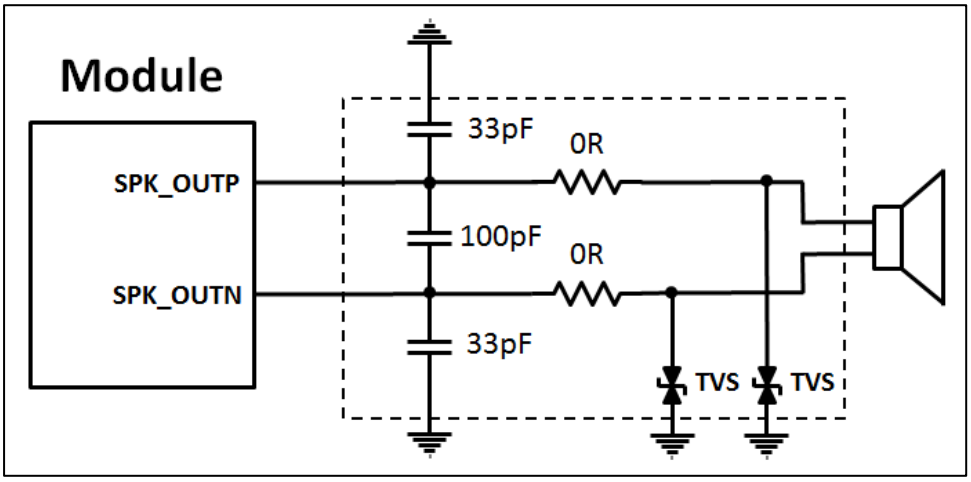


Figure 12: Speaker interface reference circuit.

- The ESD components marked as TVS are optional for better ESD performance.
- Working voltage of ESD components must be greater than 6V.
- Total capacitance load between SPK_OUTP and SPK_OUTN must be smaller than 330pF.
- All components in the dashed line rectangle have to be close to the speaker.
- The layout of SPK_OUTP and SPK_OUTN must be routed according to the differential signal.

3.7.2 Microphone interface configuration

The typical and maximum microphone biasing voltage of MICBIAS0 pin are 1.9V and 2.2V, respectively. The maximum current draw from MICBIAS0 pin is 2mA. The module supports two kinds of microphones including ECM and MEMS analog microphones.

3.7.2.1 ECM microphone

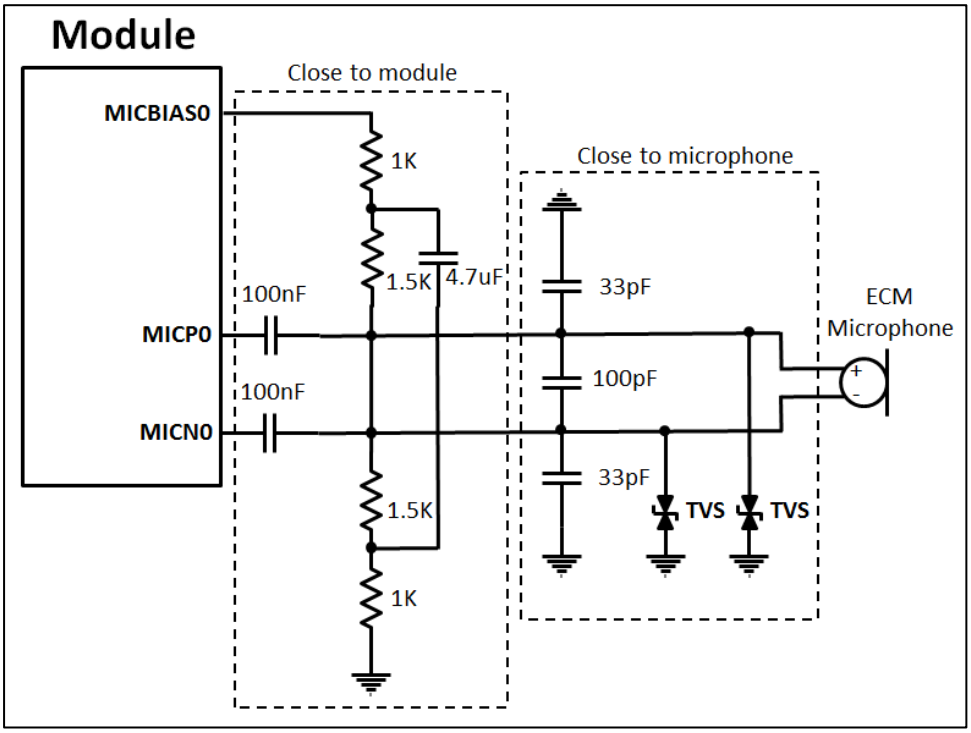


Figure 13: Reference circuit for the ECM microphone.

- Don't put any bypass capacitor on the MICBIAS0 pin.
- The total capacitance on MICBIAS0 must be smaller than 100pF.
- The ESD components marked as TVS are optional for better ESD performance.
- The layout of MICP0 and MICN0 must be routed according to the differential signal.
- Put the microphone away from RF transmitters, such as GSM and Bluetooth antenna.
- Do not choose the microphone with wire leads, otherwise the wires must be shielded to avoid noise.

3.7.2.2 MEMS analog microphone

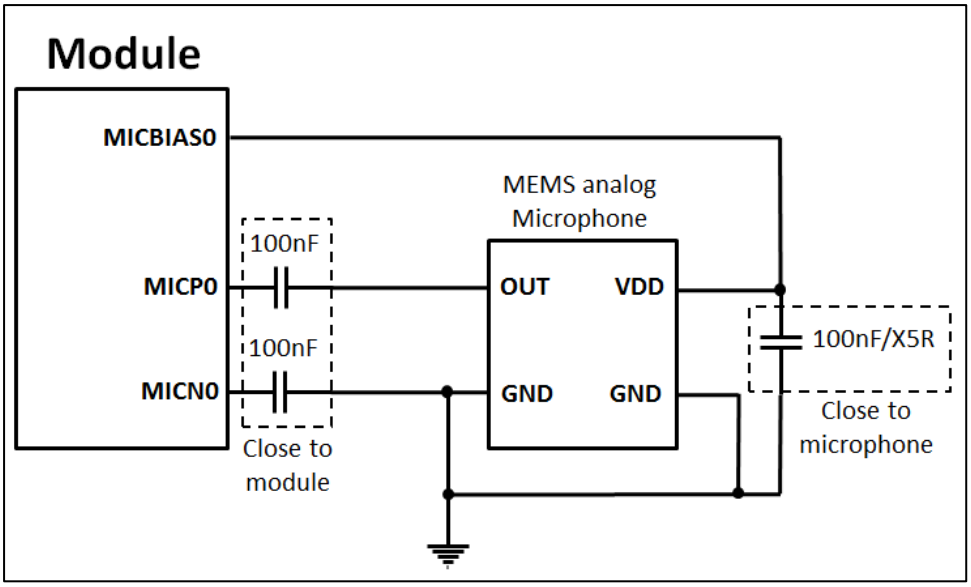


Figure 14: Reference circuit for the MEMS analog microphone.

- Add a X5R 100nF capacitor close to the VDD pin of MEMS analog microphone.
- The total capacitance on MICBIAS0 must range between 50nF and 150nF.
- Route the ground pins together on PCB mounted side, then through a via to the system ground.
- The layout of MICP0 and MICN0 must be routed according to the differential signal.

3.8 General Purpose Input Output (GPIO)

The module provides 5 GPIO pins named GPIO_4, GPIO_5, GPIO_6, GPIO_7 and GPIO_9. All of them can be individually configured as either input pin or output pin by AT command AT+LSGPIOC. User can use AT command to enable or disable the internal pull-up or pull-down resister. If the GPIO pins are not used, please leave them unconnected.

Table 3: Electrical characteristics of GPIO pins

Parameter	Symbol	Min.	Typical	Max.	Unit
High level input voltage	V_{IH}	2.1		3.08	V
Low level input voltage	V_{IL}	-0.3		0.7	V
High level output voltage	V_{OH}	2.38	2.8	2.94	V
Low level output voltage	V_{OL}	0		0.42	V
High level output current	I_{OH}	-16	-	-	mA
Low level output current	I_{OL}	-	-	16	mA
Pull-up resistance	DRPU	40	85	190	KΩ
Pull-down resistance	DRPD	40	85	190	KΩ

Table 4: State of GPIO pins

Name	Reset		Termination when not used
	State	Pull-Up/Pull-Down	
GPIO_4	Input	Pull-Down	No need
GPIO_5	Output Low	Pull-Down	No need
GPIO_6	Output Low	Pull-Down	No need
GPIO_7	Output Low	Pull-Down	No need
GPIO_9	Input	Pull-Down	No need

3.9 ADC

The module provides an auxiliary ADC named AUXIN4. It can be used to measure the external voltage. The power of ADC is default off. User can use AT commands to switch the power of ADC and read the voltage value.

Table 5: Functional specifications of auxiliary ADC

Parameter	Symbol	Min.	Typical	Max.	Unit
Input voltage range	V_{ADC}	0		2.8	V
Resolution	N		10		bits
Input capacitance	CIN		4		pF
Input resistance	RIN	1			MΩ
Offset error	OE		±10		mV
Full swing error	FSE		±10		mV
Current consumption	I_{ADC}		280		μA

4. Product handling

Please refer to the chapter 5 of GGB-1916 datasheet for ESD precaution, baking requirement and reflow soldering profile.

5. Appendix

5.1 Reference documents

[1]	GGB-1916 datasheet
[2]	GGB-1916 AT Commands Manual
[3]	GGB-1916 EVB User's Manual

5.2 Abbreviations

ADC	Analog-to-Digital Converter
DC	Direct Current
ECM	Electret Condenser Microphone
ESD	Electro-Static Discharge
ESR	Equivalent Series Resistance
GNSS	Global Navigation Satellite Systems
GPRS	General Packet Radio Service
GSM	Global System for Mobile (communications)
I^2C	Inter-Integrated Circuit
MEMS	Micro-Electro-Mechanical Systems
MOSFET	Metal-Oxide Semiconductor Field-Effect Transistor
PCB	Printed Circuit Board
RF	Radio Frequency
SIM	Subscriber Identification Module
SMS	Short Message Service
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver and Transmitter
USB	Universal Serial Bus