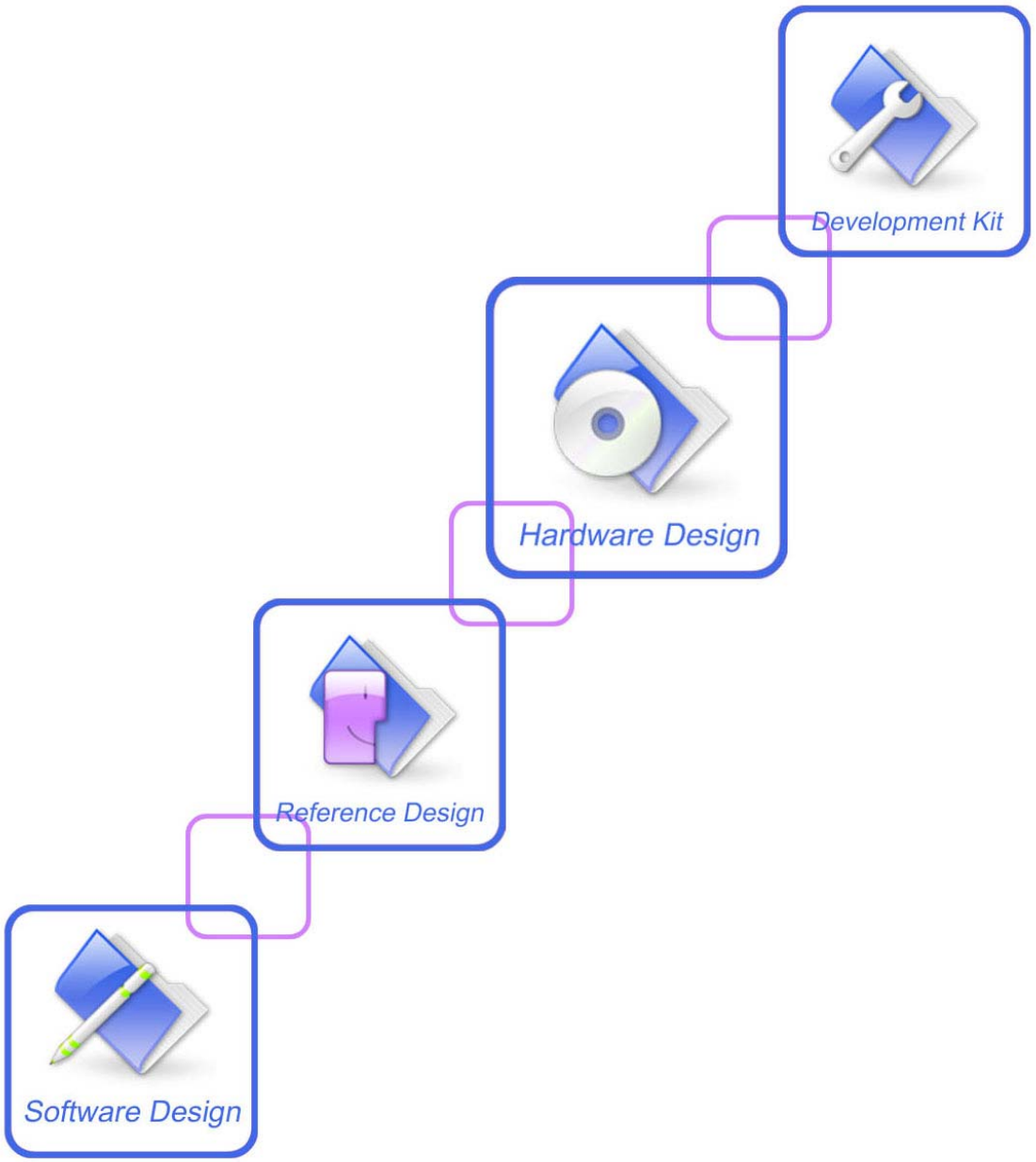
Hardware Design

SIM5212_HD_V1.21



Document Title:	SIM5212 Hardware Design
Version:	1.21
Date:	2008-9-3
Status:	Release
Document Control ID:	SIM5212_HD_V1.21

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Version history

Data	Version	Description of change	Author
2008-04-12	01.00	Origin	Dingyiru
2008-04-26	01.00	Modify ADC and fix some errors.	Wu Bin
2008-05-23	01.01	Renew 70 pins definition.	Wu Bin
2008_05_29	01.10	Add voice band characteristics. 3.8.5	wubin
2008_06_25	01.11	Modified the USB receptacle	aaron
2008_07_8	01.12	Modified pin 40 and 41 wrong definition Description error modification in 3.3.3. two parameters Modified pin 23 and pin 24 definition	Wubin
2008_08_27	01.20	USB definition error in table 5.	wubin
2008_09_03	01.21	UART RTS/CTS direction error in table 5.	Wubin

Contents

1 Introduction

This document describes the hardware interface of the SIMCOM SIM5212 module that connects to the specific application and the air interface. As SIM5212 can be integrated with a wide range of applications, all functional components of SIM5212 are described in great detail.

This document can help you quickly understand SIM5212 interface specifications, electrical and mechanical details. With the help of this document and other SIM5212 application notes, user guide, you can use SIM5212 module to design and set-up mobile applications quickly.

1.1 Related documents

Table 1: Related documents

SN	Document name	Remark
[1]	SIM5212_ATC_V1.00	SIM5212_ATC_V1.00
[2]	ITU-T Draft new recommendationV.25ter :	Serial asynchronous automatic dialing and control
[3]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[5]	GSM 07.05:	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6]	GSM 11.14:	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification
[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)

[14]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[15]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM Stations (BS) and User Equipment (UE) for IMT-2000 Third Gene cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Spread (UTRA FDD) (UE) covering essential requirements of arti of the R&TTE Directive
[16]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
[17]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[18]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[19]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
[20]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment(RoHS)

1.2 Terms and abbreviations

Table 2: Terms and abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ARP	Antenna Reference Point
BER	Bit Error Rate
BTS	Base Transceiver Station
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
FDMA	Frequency Division Multiple Access
FR	Full Rate

GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
IMEI	International Mobile Equipment Identity
Inorm	Normal Current
Imax	Maximum Load Current
kbps	Kilo bits per second
Li-Ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCS	Personal Communication System, also referred to as GSM 1900
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
Rx	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
VSWR	Voltage Standing Wave Ratio
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value
FD	SIM fix dialing phonebook

SM	SIM phonebook
NC	Not connect
EDGE	Enhanced data rates for GSM evolution
HSDPA	High Speed Downlink Packet Access
ZIF	Zero intermediate frequency
WCDMA	Wideband Code Division Multiple Access
VCTCXO	Voltage control temperature-compensated crystal oscillator
USIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter

2 Product concept

Designed for global market, SIM5212 is a quad-band GSM/GPRS/EDGE and UMTS engine that work on frequencies of GSM 850MHz, EGSM 900 MHz, DCS 1800 MHz, PCS1900 MHz, and WCDMA 2100M/1900M/850M. SIM5212 provides GPRS multi-slot class 12/class10/class 8 (optional) capability and EDGE, supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. EDGE: 8 PSK, DTM (class A) multi-slot class 12, DL coding schemes: CS1～4, CS1-9, UL coding schemes: CS1～4, MCS1-9.SIM5212 also support WCDMA HSDPA up to 7.2Mbps. SIM5212 support antenna diversity at WCDMA 2100M & 850M.

With a tiny configuration of 58mm x 30.5mm x 4.5 mm, SIM5212 can fit almost all the space requirements in your applications, such as Smart phone, PDA phone and other mobile devices.

The physical interface to the mobile application is made through a 70 pins board-to-board connector, which provides all hardware interfaces between the module and customers' boards except the RF antenna interface.

- Serial port and USB 2.0(full speed) port can be alternatively used as data port.
- USIM interface: support SIM cards: 3V & 1.8V
- Power on/ff and reset signal
- Backup RTC interface.
- Six GPIOs: 1 for interrupt, 1 for flight mode, 1 for status LED, 2 for output control, 1 for input.
- Three audio channels include two microphones inputs and three audio outputs. This can be easily configured by AT command.
- A camera interface is provided.*
- An I2C interface is provided.
- An ADC interface
- A LDO power output
- A 4 bit SD card interface is provided.*

Note：Camera interface and SD card interface functions will be supported by customization software.

The SIM5212 provides RF antenna interface with two alternatives: antenna connector and antenna pad. The antenna connector is MURATA MM9329-2700. And customer's antenna can be soldered to the antenna pad.

The SIM5212 is integrated with the TCP/IP protocol，Extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

Note: The SIM5212 have two kinds of interface (UART and USB) to connect to host CPU. USB interface is mapped to 3 virtual UART: "SIMTECH USB Modem", "SIMTECH NMEA Device" and "SIMTECH Diagnostics interface". UART, "SIMTECH USB Modem" and "SIMTECH NMEA Device" could response AT command, normally we recommend UART or "SIMTECH USB Modem" to control SIM5212 module.

SIM5212 key features at a glance:

Table 3: SIM5212 key features

Feature	Implementation
Power supply	Single supply voltage 3.4V – 4.2V
Power saving	Typical power consumption in SLEEP mode to 4.0mA (DRX=2)
Frequency bands	● GSM: 850M/ 900M/ DCS 1800M/ PCS 1900M. ● WCDMA: 2100M/1900M/850M ● The SIM5212 can worked in GSM and WCDMA mode ● The frequency bands also can be set by AT COMMAND.
Transmit power	●Class 4 (+33dBm ±2dB) for EGSM850 ●Class 4 (+33dBm ±2dB) for EGSM900 ●Class 1 (+30dBm ±2dB) for GSM1800 ●Class 1 (+30dBm ±2dB) for GSM1900 ●Class E2 (+27dBm ± 3dB) for GSM 850 8-PSK ●Class E2 (+27dBm ± 3dB) for GSM 900 8-PSK ●Class E2 (+26dBm +3 /-4dB) for GSM 1800 8-PSK ●Class E2 (+26dBm +3 /-4dB) for GSM 1900 8-PSK ●Class 3 (+24dBm +1.7/-3.7dB) for WCDMA 2100, WCDMA FDD BDI ●Class 3 (+24dBm +1.7/-3.7dB) for WCDMA 1900, WCDMA FDD BDII ●Class 3 (+24dBm +1.7/-3.7dB) for WCDMA 850, WCDMA FDD BDV
GPRS/EDGE connectivity	● GPRS/EDGE multi-slot is up to class 12 ● GPRS mobile station class B
Temperature range	● Normal operation: -15°C to +55 °C ● Extended operation: -20°C to -15°C and +55 °C to +70 °C GSM,GPRS/EDGE Class 12(2 up): under RF MAXPOWER， operation durati hours WCDMA FDD BDI/II/V under <10dBm ,operation duration >12 h WCDMA FDD BDI/II/V under RF MAXPOWER ,operation duration <30mins ● Storage temperature -40°C to +85°C
DATA *GPRS:*	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 42.8 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● SIM5212 supports the protocols PAP (Password Authentication

CSD:	Protocol) usually used for PPP connections. ● The SIM5212 integrates the TCP/IP protocol. ● Support Packet Switched Broadcast Control Channel (PBCCH) ● CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent ● Unstructured Supplementary Services Data (USSD) support
DATA EDGE	● EDGE E2 power class for 8 PSK ● DTM (simple class A), multi-slot class 12 ● Downlink coding schemes – CS 1-4, MCS 1-9 ● Uplink coding schemes – CS 1-4, MCS 1-9 ● BEP reporting and test mode B ● 8-bit, 11-bit RACH ● PBCCH support ● phase/2 phase access procedures
DATA UMTS/HSDPA	● Supports HS-DSCH (HS-SCCH, HS-PDSCH and HS-DPCCH) ● Supports a maximum of four simultaneous HS-SCCH channels ● Supports a maximum of 10 HS-PDSCH channels ● Supports both QPSK and 16 QAM modulation. ● Supports CQI, and ACK/NACK on HS-DPCCH channel ● Supports all incremental redundancy versions for HARQ ● Can switch between HS-PDSCH and DPCH channel resources as directed by the network. ● Can be configured to support any of the two power classes 3 or 4 ● Supports network activation of compressed mode by SF/2 or HLS on the DPCH for conducting inter-frequency or inter-RAT measurements when the HS-DSCH is active. ● STTD on both associated DPCH and HS-DSCH is supported simultaneously. ● CLTD mode 1 is supported on the DPCH when the HS-PDSCH is active. ● STTD on HS-SCCH is supported when either STTD or CLTD Mode 1 are configured on the associated DPCH. ● Supports TFC selection limitation on the UL factoring in the transmissions on the HS-DPCCH as required in TS 25.133.
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card ● Support transmission of SMS alternatively over CSD or GPRS. User can choose preferred mode.
SIM interface	Support SIM card: 1.8V ,3V
External antenna	Connected via 50 Ohm antenna connector or antenna pad

Audio features	Speech codec modes: ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● AMR ● A5/1, A5/2, and A5/3 ciphering
Serial interface	● Serial Port Seven lines on Serial Port Interface ● Serial Port can be used to control module by sending AT command.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM Application Toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Real time clock	Implemented
Timer function	Programmable via AT command
Physical characteristics	Size: 58±0.15 x 30.5±0.15 x 4.5±0.2 mm Weight: 15g
Firmware upgrade	Firmware upgrade over USB interface

Table 4：Coding schemes and maximum net data rates over air interface

Coding scheme	1 Timeslot	2 Timeslot	4 Timeslot
CS-1:	9.05kbps	18.1kbps	36.2kbps
CS-2:	13.4kbps	26.8kbps	53.6kbps
CS-3:	15.6kbps	31.2kbps	62.4kbps
CS-4:	21.4kbps	42.8kbps	85.6kbps
MCS-1	8.80kbps	17.60kbps	35.20kbps
MCS-2	11.2kbps	22.4kbps	44.8kbps
MCS-3-	14.8kbps	29.6kbps	59.2kbps
MCS-4	17.6kbps	35.2kbps	70.4kbps
MCS-5	22.4kbps	44.8kbps	89.6kbps
MCS-6	29.6kbps	59.2kbps	118.4kbps
MCS-7	44.8kbps	89.6kbps	179.2kbps
MCS-8	54.4kbps	108.8kbps	217.6kbps
MCS-9	59.2kbps	118.4kbps	236.8kbps

3 Application interface

All hardware interfaces except RF interface that connects SIM5212 to the customers' cellular application platform is through a 70-pin 0.4mm pitch board-to-board connector. Sub-interfaces included in this board-to-board connector are described in detail in following chapters:

- Power supply
- USB interfaces
- Serial interfaces
- Analog audio interfaces
- SIM interface
- GPIO
- ADC
- LDO Power output

Electrical and mechanical characteristics of the board-to-board connector are specified in *Chapter 6*. There we also order information for mating connectors.

3.1 SIM5212 pin description

Table 5：Board-to-Board Connector pin description

Power Supply			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
VBAT		Six BAT pins of the board-to-board connector are dedicated to connect the supply voltage. The power supply of SIM5212 has to be a single voltage source of VBAT= 3.4V...4.4V. It must be able to provide sufficient current in a transmit burst which typically rises to 2A.mostly, these 6 pins are voltage input	Vmax= 4.2V Vmin=3.4V Vnorm=3.8V
VRTC	I/O	Current input for RTC when the battery is not supplied for the system. Current output for backup battery when the main battery is present and the backup battery is in low voltage state.	Vmax=3.2V Vnorm=3.0V Vmin=1.5V Inorm= 1.1uA
GND		Digital ground	
Power on or power off			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
POWER_ON	I	Voltage input for power on key. POWER_ON get a low level Voltage for user to power on or power off	VILmax=0.2*VBAT VIHmin=0.6*VBAT

		the system. The user should keep it to low level for at least 64mS when power on or power off the system. Because the system need margin time assert the software.	VImax=VBAT
Audio interfaces			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
MIC_P MIC_N	I	Positive and negative voice-band input	Audio DC Characteristics refer to chapter 3.9.4
HP_MICP	I	Auxiliary positive voice-band input, If not use, connect to ground through a 100N cap	
EAR_P EAR_N	O	Positive and negative voice-band output, if not use ,left open	
HPR HPL	O	Auxiliary right channel and left channel voice-band output, if not use, left open.	
SPK_P SPK_N	O	Loud Speaker Output, if not use ,left open	
ADC	I	Analog Digital Converter Input	
VREG_AUX1	O	LDO power output	
USB			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
USB_VBUS	I	USB power supply input, if not use, left open.	
USB_DP	I/O	Plus (+) line of the differential, bi-directional USB signal to/from the peripheral device. If not use, left open.	
USB_DM	I/O	Minus (-) line of the differential, bi-directional USB signal to/from the peripheral device. If not use, left open.	
Serial interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
UART_DTR	I	Data Terminal Ready, if not use, pull up.	VILmin=0V VILmax=0.3*VDD_EXT* VIHmin=0.7*VDD_EXT VIHmax= VDD_EXT+0.3 VOLmin=GND VOLmax=0.2V VOHmin= VDD_EXT-0.2 VOHmax= VDD_EXT
UART_RXD	I	Receive Data, if not use, pull up.	
UART_TXD	O	Transmit Data, if not use, left open.	
UART_RTS	O	Request to Send, if not use, pull up.	

UART_CTS	I	Clear to Send, if not use, left open.	
UART_RI	O	Ring Indicator, if not use, left open.	
UART_DCD	O	Data Carrier detection, if not use, left open.	
USIM interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
V_USIM	O	Voltage Supply for SIM card	The voltage can be select by software either 1.8v or 3V
USIM_DATA	I/O	SIM Data Output	VILmin=0V VILmax=0.3*V_USIM VIHmin=0.7* V_USIM VIHmax= V_USIM +0.3 VOLmin=GND VOLmax=0.2V VOHmin= V_USIM -0.2 VOHmax= V_USIM
USIM_CLK	O	SIM Clock	
USIM_RESET	O	SIM Reset	
IIC interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
IIC_SDA	I/O	I2C data, if not use, left open.	
IIC_SCL	O	I2C clock output, if not use, left open.	
Other interface			
Reset	I	System reset in, active low.	
GPIO0	I	General Input PIN with interrupt. If not use, left open	VIHmin=0.7*VDD_EXT* VIHmax= VDD_EXT+0.3 VOLmin=GND VOLmax=0.2V VOHmin= VDD_EXT-0.2 VOHmax= VDD_EXT
GPIO1	O	Status Indicating LED Control..	
GPIO2	I	General Input PIN. If not use, left open	
GPIO3	O	General Output PIN. If not use, left open	
GPIO4	I	RF Control: Flight Modem switch	
GPIO5	O	General Output PIN. If not use, left open	

Note: module internal reference supply power: VDD_Ext=2.6V

3.2 Operating modes

The following table summarizes the various operating modes, each operating modes is referred to in the following chapters.

Table 6：Overview of operating modes

Mode	Function	
Normal operation	MODULE Power Off mode	Module will go into Power off mode when the Power_on pin has been pushed to low for 2 Seconds.
	Module sleep	Module will automatically go into sleep mode when no interrupt input or other operation. In this case, the current consumption of module will reduce to the minimal level.
GSM mode	GSM IDLE	Software is active. Module has registered to the GSM network, and the module is ready to send and receive.
	GSM TALK	CSD connection is going on between two subscribers. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
GPRS mode	GPRS IDLE	Module is ready for GPRS data transfer, but no data is currently sent or received. In this case, power consumption depends on network settings and GPRS configuration (e.g. multi-slot settings).
	GPRS DATA	There is GPRS data in transfer (PPP or TCP or UDP). In this case, power consumption is related with network settings (e.g. power control level), uplink / downlink data rates and GPRS configuration (e.g. used multi-slot settings).
EDGE mode	EDGE IDLE	Module is ready for data transfer in EDGE mode, but no data is currently sent or received. In this case, power consumption depends on network settings and EDGE configuration
EDGE mode	EDGE DATA	There is data in transfer (PPP or TCP or UDP) in EDGE mode. In this case, power consumption is related with network settings (e.g. power control level), uplink / downlink data rates and EDGE configuration.
WCDMA mode	WCDMA IDLE	Module has registered to the WCDMA network, and the module is ready to send and receive.
	WCDMA talk	Module is active in WCDMA mode. The power consumption depends on network settings.
HSDPA mode	HSDPA IDLE	Module is ready for data transfer in HSDPA mode, but no data is currently sent or received. Power consumption depends on network settings and HSDPA configuration
	HSDPA DATA	There is data in transfer (PPP or TCP or UDP) in HSDPA mode. In this case, power consumption is related with network settings (e.g. power control level), uplink / downlink data rates and HSDPA configuration
POWER DOWN	Normal shutdown by sending the “AT$QCPWRDN” command or using the POWER_ON pin. The power management ASIC disconnects the power supply from the base band part of the module, only the power supply for the RTC is	

	remained. Software is not active. The serial interfaces are not accessible. Operating voltage (connected to VBAT) remains applied.
Minimum functionality mode (without remove power supply)	Use the "AT+CFUN" command can set the module to a minimum functionality mode without remove the power supply. In this case, the RF part of the module will not work or the SIM card will not be accessible, or RF part and SIM card will be closed all, the serial interface is still accessible. The power consumption in this case is very low.

3.3 Power supply

The power supply of SIM5212 is from a single voltage source of VBAT= 3.4V...4.2V. In some case, the ripple in a transmit burst may cause voltage drops when current consumption rise to typical peaks of 2A. So the power supply must be able to provide sufficient current up to 2A.

For the VBAT input, a local bypass capacitor is recommended. A capacitor (about 100μF, low ESR) is recommended when use a Li battery. When you use a DC supply the Capacitor must be larger one (for example 2200u/10V), Multi-layer ceramic chip (MLCC) capacitors can provide the best combination of low ESR and small size but may not be cost effective. A lower cost choice may be a 100 μF tantalum capacitor (low ESR) with a small (0.1 μF to 1μF) ceramic in parallel, which is illustrated as following figure. And the capacitors should put as closer as possible to the SIM5212 VBAT pins. The following figure is the recommended circuit.

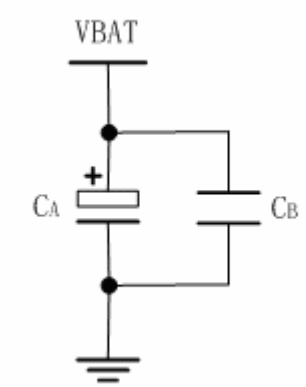


Figure 1：VBAT input

The following figure is the VBAT voltage ripple wave at the maximum power transmit phase, the test condition is VBAT=4.0V, VBAT maximum output current =2A, C_A=100 μF tantalum capacitor (ESR=0.7Ω) and C_B=1μF.

Figure 2：VBAT voltage drop at the maximum power transmit phase (GSM)

3.3.1 Power supply pins on the board-to-board connector

Six VBAT pins of the board-to-board connector are dedicated to connect the supply voltage; six GND pins are recommended for grounding. VRTC pin can be used to back up the RTC.

3.3.2 Minimizing power losses

Please pay special attention to the supply power when you are designing your applications. Please make sure that the input voltage will never drop below 3.4V even in a transmit burst during which the current consumption may rise up to 2A. If the power voltage drops below 3.4V, the module may be switched off. Using the board-to-board connector will be the best way to reduce the voltage drops. You should also remove the resistance from the power supply lines on the host board or from battery pack into account.

3.3.3 Monitoring power supply

To monitor the supply voltage, you can use the AT command which include two parameters: voltage supply status and voltage value (in mV). It returns the battery voltage 1-100 percent of capacity and actual value measured at VBAT and GND.
The voltage is continuously measured at intervals depending on the operating mode. The displayed voltage (in mV) is averaged over the last measuring period before the AT command was executed.

3.4 Power up and power down scenarios

3.4.1 Turn on SIM5212

SIM5212 can be turned on by various ways, which are described in following chapters:

- Via POWER_ON pin: starts normal operating mode;

You can turn on the SIM5212 by driving the POWER_ON to a low level voltage for period time. The power on scenarios illustrate as following figure.

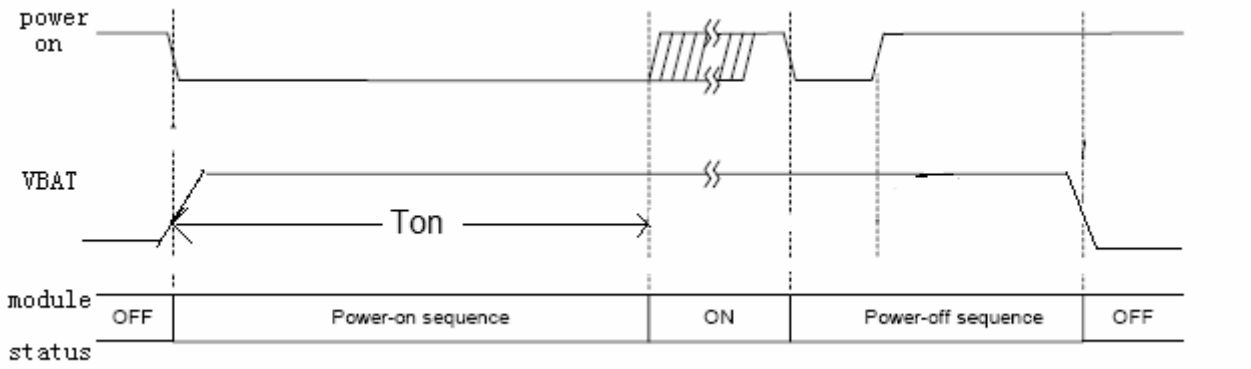


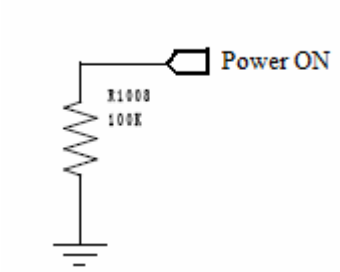
Figure 3: Timing of turn on system

Note1: Ton >= 64ms.

Note2: Commonly, the AT command can be set after 2-3S from the SIM5212 is power on.

3.4.2 SIM5212 Auto Power ON

If VBAT was supply to SIM5212, there are two ways to control SIM5212 power on automatically: SIM5212 could be automatically power on by connecting Power ON pin to Low level directly.



SIM5212 could be automatically power on while USB is connecting with host CPU, even if POWER_ON PIN is open. USB VBUS (+5V) signal could trigger SIM5212 power on, so, before power off SIM5212, please disconnect USB interface.

3.4.3 Turn off SIM5212

Following procedure can be used to turn off the SIM5212:

- Normal power down procedure: Turn off SIM5212 using the POWER_ON pin
- Normal power down procedure: Turn off SIM5212 using AT command

Note: Before power off SIM5212, please disconnect USB interface.

3.4.3.1 Turn off SIM5212 using the POWER_ON pin (Power down)

You can turn off the SIM5212 by driving the POWER_ON to a low level voltage for period

time. The power down scenarios illustrate as following Figure. The low level period of the POWER_ON is about 64mS

This procedure will let the module to log off from the network and allow the software to enter into a secure state and save data before completely disconnect the power supply.

3.4.3.2 Turn off SIM5212 using AT command

You can use an AT command "AT$QCPWRDN" to turn off the module. This command will let the module to log off from the network and allow the software to enter into a secure state and save data before completely disconnect the power supply.
After this moment, the AT commands can't be executed. The module enters the POWER DOWN mode, only the RTC is still active.

Please refer to for detail about the AT command of "AT$QCPWRDN".

3.4.3.3 Under-voltage automatic shutdown

Software will constantly monitor the voltage applied on the VBAT, if the measured battery voltage is no more than 3.5V, the following URC will be presented:

POWER LOW WARNNING

If the measured battery voltage is no more than 3.4V, the following URC will be presented:

POWER LOW DOWN

After this moment, no further more AT commands can be executed. The module will log off from network and enters POWER DOWN mode, only the RTC is still active (if backup battery is connected to VRTC pin).

Notes: This feature is disable default, Use AT command to enable this feature, please refer to AT command manual.

3.5 Power saving

There are two methods to achieve SIM5212 module extreme low power. "AT+CFUN" is used to set module into minimum functionality mode and GPIO4 hardware interface signal can be used to set system to be Flight mode (Close RF).

3.5.1 Minimum functionality mode

Minimum functionality mode reduces the functionality of the module to a minimum and, thus,

- 0: minimum functionality;
- 1: full functionality (Default);
- 4: disable phone both transmit and receive RF circuits;

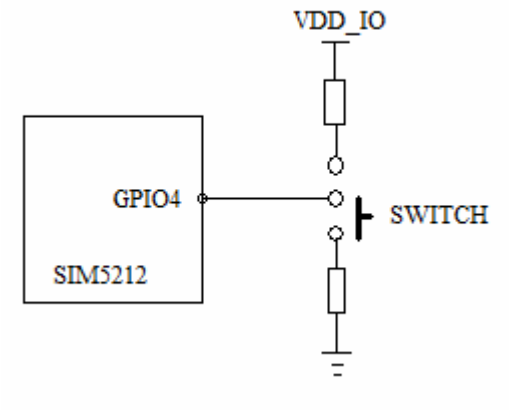
If SIM5212 has been set to minimum functionality by "AT+CFUN", then the RF function and SIM card function will be closed, in this case, the serial port is still accessible, but all AT commands need RF function or SIM card function will not be accessible.

If SIM5212 has disabled all RF function by "AT+CFUN", then RF function will be closed, the serial port is still active in this case but all AT commands need RF function will not be accessible.

When SIM5212 is in minimum functionality or has disabled all RF functionality by "AT+CFUN", it can return to full functionality by "AT+CFUN".

3.5.2 Flight mode

Through GPIO4 signal control SIM5212 module to enter or exit the Flight mode in customer applications. In Flight mode, SIM5212 close RF function. If left GPIO4 open, SIM5212 enter normal mode.



GPIO4 Status	Module Action
Low Level	Flight Mode: RF is closed.
High Level	Normal Mode: RF is working.

3.5.3 Sleep mode

If periphery equipment stop work, and there is no on air or audio activity is required and no hardware interrupt (such as GPIO interrupt or data on serial port), SIM5212 will enter SLEEP mode automatically. In this mode, SIM5212 can still receive paging or SMS from network. If USB interface of SIM5212 is connecting with host CPU, SIM5212 don't enter sleep mode, after USB disconnecting, SIM5212 could enter sleep mode after several minutes.

3.5.4 Wake up SIM5212 from SLEEP mode

When SIM5212 is SLEEP mode, the following method can wake up the module.

- USB interface active
- Receive a voice or data call from network to wake up SIM5212.
- Receive a SMS from network to wake up SIM5212.
- Receive a interrupt signal from GPIO0
- GPIO4 state change.

3.6 RTC backup

The RTC (Real Time Clock) power supply of module can be provided by an external battery or a battery (rechargeable or non-chargeable) through the VRTC (PIN11) on the board-to-board connector. You need only a coin-cell battery or a super-cap to VRTC to backup power supply for RTC. The discharge current is smaller than 10uA.

Note: The VRTC default state can be designed to a NC pin in your circuit. If you need to use the VRTC, You may connect the VRTC pin to a battery or a capacitor.

The following figures show various sample circuits for RTC backup. The series resistor is programmable from 800 OU to 2100 OU

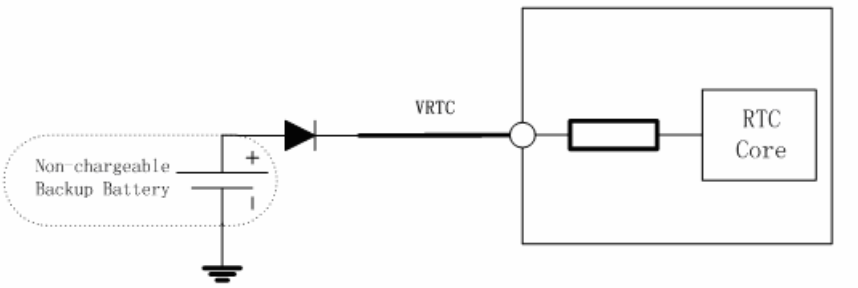


Figure 4: RTC supply from non-chargeable battery

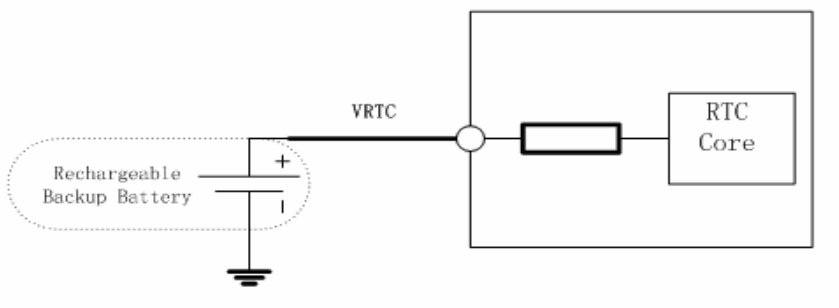


Figure 5: RTC supply from rechargeable battery

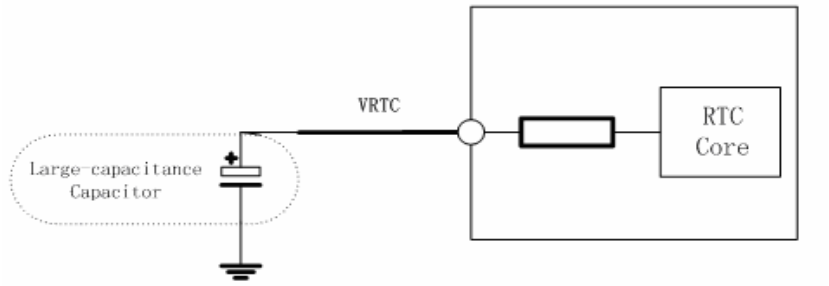


Figure 6: RTC supply from capacitor

- **Li-battery backup**

Rechargeable Lithium coin cells are also small in size, but have higher capacity than the double layer capacitors resulting in longer backup times. The coin normal voltage should be 3.0V

Typical charge curves for each cell type are shown in following figures. Note that the rechargeable Lithium type coin cells generally come pre-charged from the vendor.

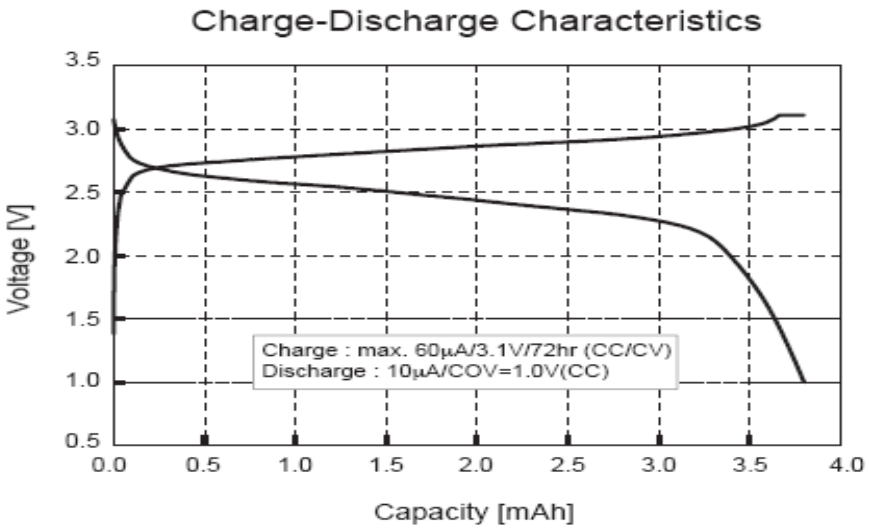


Figure 7: Seiko MS518 Charge and discharge Characteristic

Note:

Gold-capacitance backup

Some suitable coin cells are the electric double layer capacitors. They have a small physical size (6.8 mm diameter) and a nominal capacity of 0.2 F to 0.3 F, giving hours of backup time.

3.7 Serial interfaces

SIM5212 provides an unbalanced asynchronous serial port. The module is designed as a DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection, the module and the client (DTE) are connected through the following signal (as following figure shows).

Serial port

- Port/TXD @ Client sends data to the RXD signal line of module
- Port/RXD @ Client receives data from the TXD signal line of module

All pins of all serial ports have 8mA driver, the logic levels are described in following table

Table 7: Logic levels of serial ports pins

Parameter	Min	Max	Unit
Logic low input	0	0.3*VDD_EXT	V
Logic high input	0.7 *VDD_EXT	VDD_EXT +0.3	V
Logic low output	GND	0.2	V
Logic high output	VDD_EXT -0.2	VDD_EXT	V
Note: VDD_EXT=2.6V, is module internal IO reference voltage.			

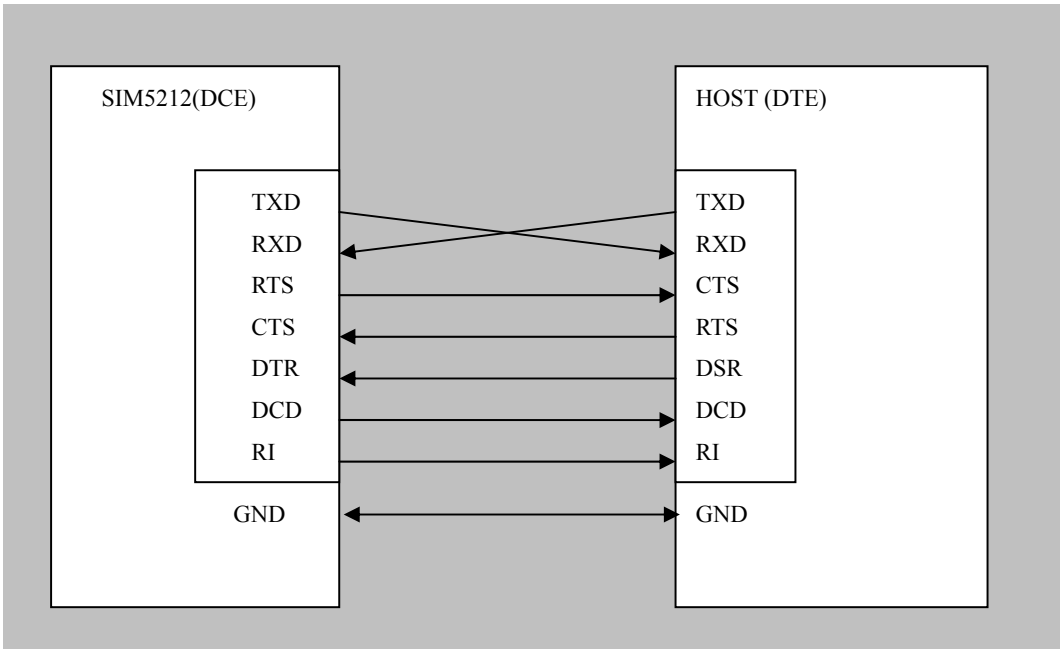


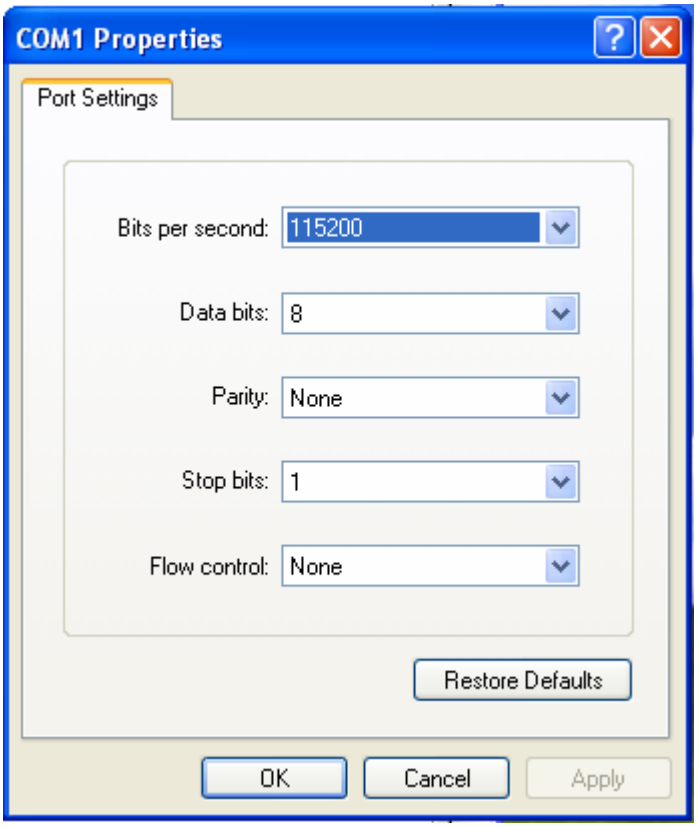
Figure 8: Interface of serial ports

3.7.1 Function of serial port supporting

Serial port

- Seven lines on Serial Port Interface.
- Contains Data lines TXD and RXD, State lines RTS and CTS, Control lines DTR, DCD and RI.
- Serial Port can be used for CSD, PS service and send AT command of controlling module.
- Serial Port supports the communication rate as following:
  300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800
  Default band rate is 115200bps. And Data bits=8, Parity=None, Stop bits=1, Flow control=None.

NOTE: If you need use a speed higher than 115200, you should consider the length of rs232 line and the speed support of your rs232 port.



Default setting in HyperTerminal software.

3.8 Audio interfaces

Table 8: Audio interface signal

Audio channel	Pin name	Pin No	Function
NORMAL (default)	MIC_P	43	MIC anode input
	MIC_N	44	MIC cathode input
	EAR_P	25	Receiver output anode
	EAR_N	26	Receiver output cathode
HEADSET	HP_MICP	42	Headset MIC anode input
	HPR	27	Headset right speaker
	HPL	28	Headset left speaker
Hand free	MIC_P	43	MIC anode input
	MIC_N	44	MIC cathode input
	SPK_P	23	Loudspeaker anode
	SPK_N	24	Loudspeaker cathode

The module provides three analogy audio output channels and two analogy audio input channels. MIC_P/N and HP_MICP, are used for microphone (two analogy audio input channels), EAR_P/N, HPR/HPR and SPK_P/N are used for audio output (three analogy audio output channels). There

are some AT Commands to control audio channel switch and other parameters, please refer to ATC manual.

It is suggested that you adopt the one of following two matching circuits in order to satisfy speaker effect. The difference audio signals have to be layout according to difference signal layout rules. As following figures:

3.8.1 Speaker interface configuration

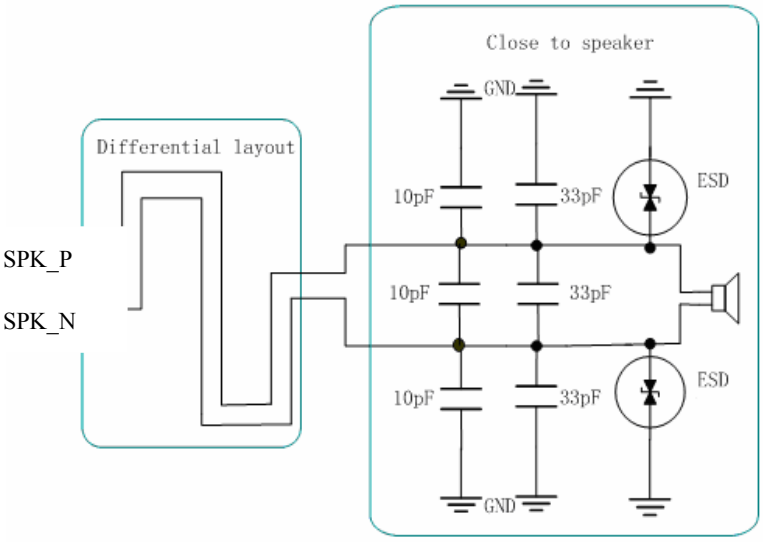


Figure 9: Speaker interface configuration

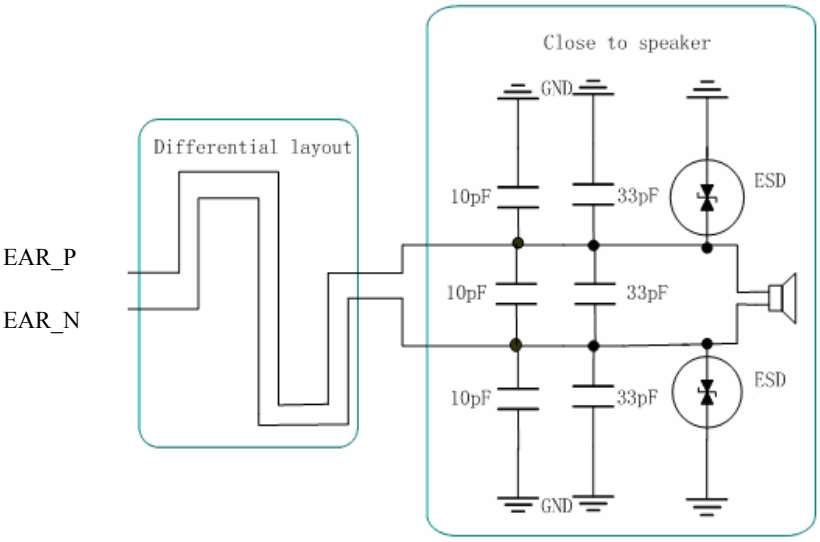


Figure 10: Receiver interface configuration

3.8.2 Microphone interfaces configuration

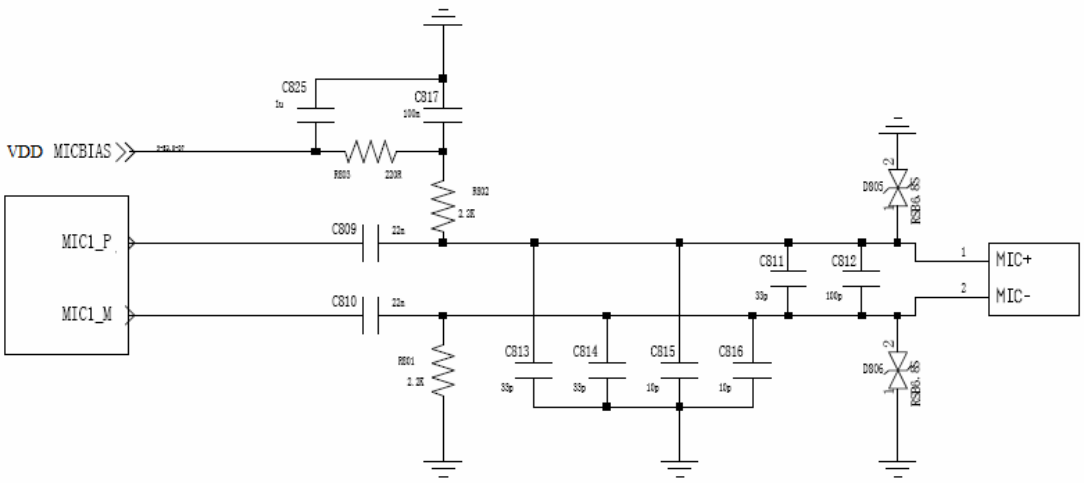


Figure 11: Microphone interface configuration

3.8.3 Earphone interface configuration

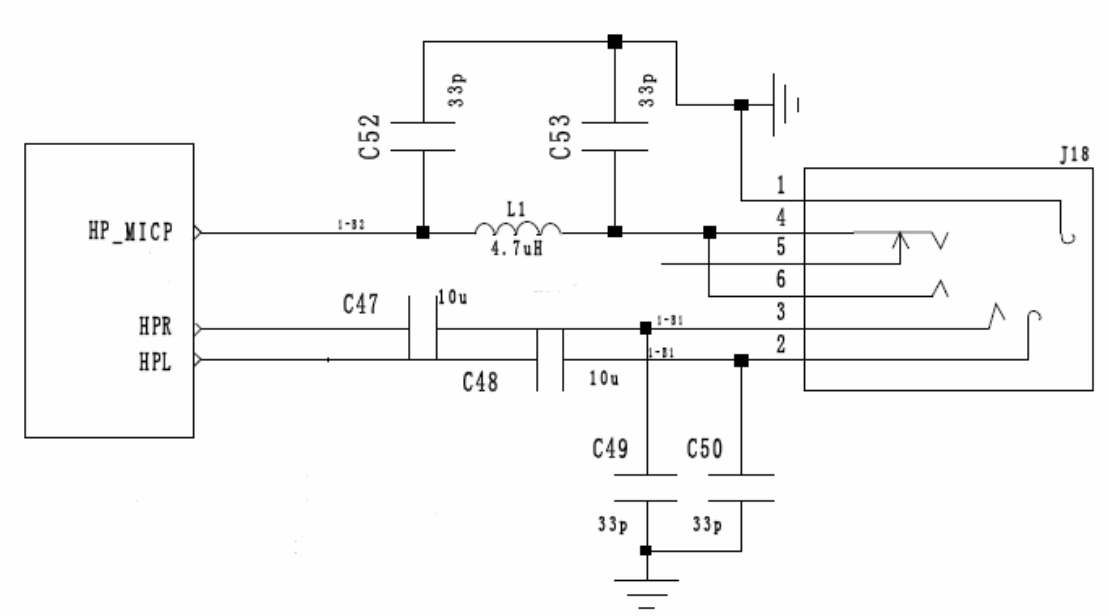


Figure 12: Earphone interface configuration

3.8.4 Referenced electronic characteristic

Table 9: MIC Input Characteristics

Parameter	Min	Typ	Max	Unit
Working Voltage	1.2	1.60	2.2	V
Working Current	70		400	uA
External Microphone Load Resistance	1.2	2.2		k Ohms

Table 10: Audio Output Characteristics

Parameter			Min	Typ	Max	Unit
Normal Output(EAR_P, EAR_N)	Differential	load Resistance	27	32		Ohm
		Output power		70		mW
Auxiliary Output(HPR,HPL)	Single Ended	load Resistance	12	16		Ohm
	Differential	load Resistance	27	32		Ohm
	Single Ended	Output power		21.6		mW

Table 11: Speaker Output Characteristics

Parameter	Min	Typ	Max	Unit
Quiescent Current		6.2		mA
Output power(1KHz)		500		mW

3.8.5 Programming characteristic

3.8.5.1 Setting Audio Parameters by AT Commands

The audio modes 1 to 3 can be temporarily adjusted according to the AT command parameters listed in the table below. The audio parameters are set with the AT commands AT+CMIC, AT+SIDET, AT+CTXGAIN, AT+CRXGAIN, AT+CTXVOL, AT+CTXFTR, AT+CRXFTR as well as AT+VGR, AT+VMUTE, AT+MICMUT, AT+CSDVC, AT+CPTONE. For a model of how the parameters influence the audio signal path see Section 3.8.5.2.

Table 12: Audio parameters adjustable by AT command

Parameter	Influence to	Range	Gain range	Calculation	AT command
micAmp	MICP/MICN analogue amplifier gain of before ADC	0…15	0…22.5dB	1.5 dB steps	AT+CMIC
txVol	Digital gain of input signal after ADC	0, 1...65535	Mute, -84...+12 dB	20 * log (txVol/ 16384)	AT+CTXVOL
txGain	Digital gain of input signal after summation of sidetone	0, 1...65535	Mute, -84...+12 dB	20 * log (txGain/ 16384)	AT+CTXGAIN
txFilter	Input PCM 13-tap filter parameters, 7 values	0...65535	---	MATLAB calculate	AT+CTXFTR
rxGain	Digital gain of output signal after summation of sidetone	0, 1...65535	Mute, -84...+12 dB	20 * log (rxGain/ 16384)	AT+CRXGAIN
rxVol	Digital Volume of output signal after speech decoder, before summation of sidetone and DAC	-300…300	dbm	-300…300dbm	AT+CRXVOL
stGain	Digital attenuation of sidetone	0, 1...65535	Mute, -96...0dB	20 * log (stGain/ 16384) -12	AT+CSIDET
rxFilter	Output PCM 13-tap filter parameters, 7 values	0...65535	---	MATLAB calculate	AT+CRXFTR

NOTE: if you want to better experience on audio, you should modify these parameters for your own electronic and mechanical design of audio part. The 13-tap filter parameter could be debugged and calculated by MATLAB.

3.8.5.2 Audio Programming Model

The audio programming model shows how the signal path can be influenced by varying AT command parameters. Parameters <micAmp>, <txGain> , <txVol>, <txFilter>,<rxGain>, <stGain> ,<rxVol> and <rxFilter> can be adjusted with corresponding AT commands. For more information on the AT commands and parameters see Section 3.8.5.1.

NOTE: Please reference document [1] for detailed information of each AT command.

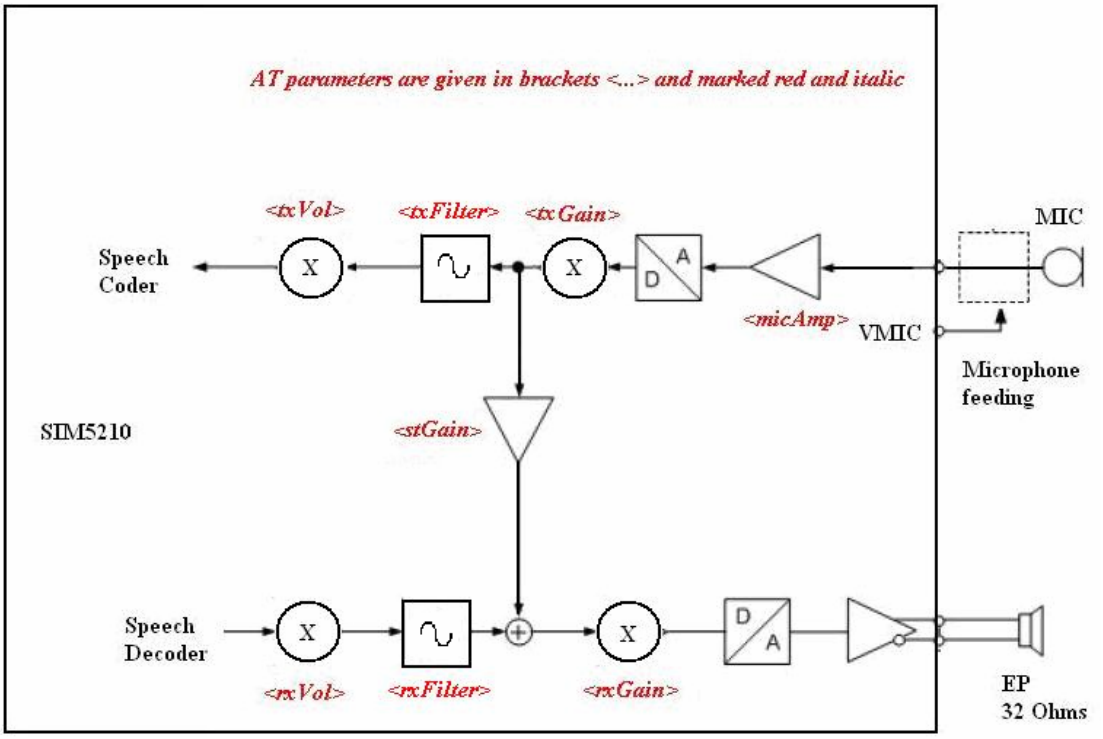


Figure 13: Audio programming model

3.8.5.3 Audio characteristics

The electrical characteristics of the voiceband part depend on the current audio mode (device number) set with the AT+CSDVC command. All values are noted for default gains.

Table 13: Audio Characteristics

Audio Device no. AT+CSDVC=		**1**	**2**	**3**
Name		Handset	Headset	Speaker phone
Purpose		Defaullt for DSB with Votronic handset	Mono Headset	handheld speaker-phone
TX-Filters		Adjustable	Adjustable	Adjustable
RX-Filters		Adjustable adjusted to fit artificial ear type 3.2 low leakage	Adjustable	Adjustable 500 Hz HP
Gain setting:		Adjustable	Adjustable	Adjustable
Default MIC path Parameters	micAmp	7（10.5 dB）	7（10.5 dB）	4（6 dB）
	txGain	23143	51811	32690
	txVol	16384	16384	16384

	txFilter [tap0~6]	0xff33, 0x05d8, 0xf488, 0x0af3, 0x24bb, 0xca42, 0x7c95	0,0,0, 0,0,0,0	0xfff3, 0x001d, 0xffb9, 0x016b, 0xfa71, 0x0c08, 0x309a
Default Output path Parameters	rxGain	11599	6523	41155
	rxVol	-100	-100	0
	stGain	2304	1024	0
	rxFilter [tap0~6]	0xff00, 0xfac9, 0x0571, 0xf365, 0x0bc2, 0xf2bb, 0x533a	0,0,0, 0,0,0,0	0xfd3f, 0xfc4f, 0xfb60, 0xfa27, 0xf97c, 0xf920, 0x3934
Power supply VMIC		ON during call	ON during call	ON during call
Sidetone		Adjustable	Adjustable	Adjustable
Volume control		Adjustable	Adjustable	Adjustable
Echo canceller Filter length Behaviour optimized for		ON 16ms low echo	ON 16ms moderate echo	ON 64ms high echo
Non Linear Processor with Comfort Noise Generator		ON	ON	ON
Noise Reduction		-12dB	-12dB	-12dB
MIC input signal for 0dBm0, 1 f = 1024 Hz		17.5mV	5mV	5mV
EP output signal in mV rms. @ 0dBm0, 1024 Hz, no load (default gain) / @ 3.14 dBm0		508mV 2.1Vpp	407mV 1.68Vpp	1220mV 4.5Vpp
Sidetone gain at default settings		25.0dB	25.3 dB	-∞ dB

3.9 USIM card interface

3.9.1 USIM card application

You can use AT Command to get information in USIM card. For more information, please refer to *document [1]*.

The universal subscriber identification module (USIM) is a smart card for UMTS/GSM cellular

applications. The USIM provides the required subscription information to allow the mobile equipment to attach to a GSM or UMTS network. The USIM also provides the subscriber's verification procedures as well as authentication methods for network authentication during the attach procedures. The USIM card can be inserted into any UMTS/GSM USIM equipped handset, allowing the user to receive or make calls, and receive other subscribed services from any USIM equipped handset, thus enabling more handset independence for the user.

Both 1.8V and 3.0V SIM Cards are supported.

The SIM interface is powered from an internal regulator in the module having nominal voltage 2.8V. All pins reset as outputs driving low. Logic levels are as described in table

Pin	Signal	Description
57	V_USIM	USIM Card Power output automatic output on USIM mode，one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
56	USIM_DATA	USIM Card data I/O
12	USIM_CLK	USIM Card Clock
13	USIM_RESET	USIM Card Reset

Table 14: Signal of USIM interface (board-to-board connector)

Following is the reference circuit about USIM interface. We recommend an Electro-Static discharge device ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C for “ESD ANTI”. If you remove ESD components, please replace them with 33pF and 10pF capacitors, it’s good for EMI performance. The 22Ω resistors showed in the following figure should be added in series on the IO line between the module and the USIM card for matching the impedance. Note that the USIM peripheral circuit close to the USIM card socket.

You can select the 6 pins USIM card. The reference circuit about 6 pins USIM card illustrates as following figure.

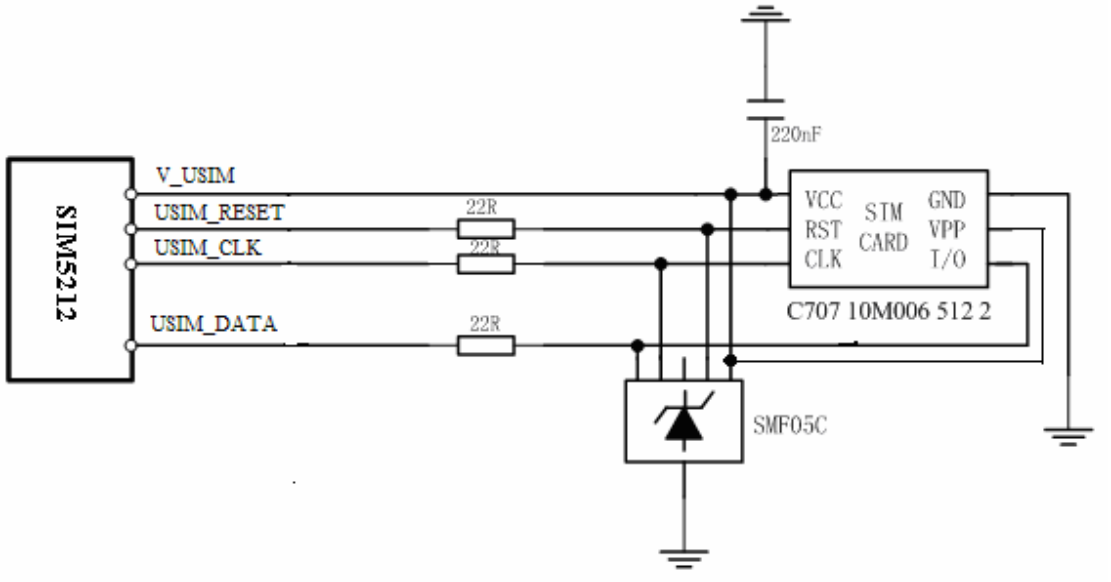


Figure 14: USIM interface reference circuit with 6 pins USIM card

3.9.2 Design considerations for USIM card holder

For 6 pins USIM card, we recommend to use Amphenol C707 10M006 512 2 .You can visit http://www.amphenol.com for more information about the holder.

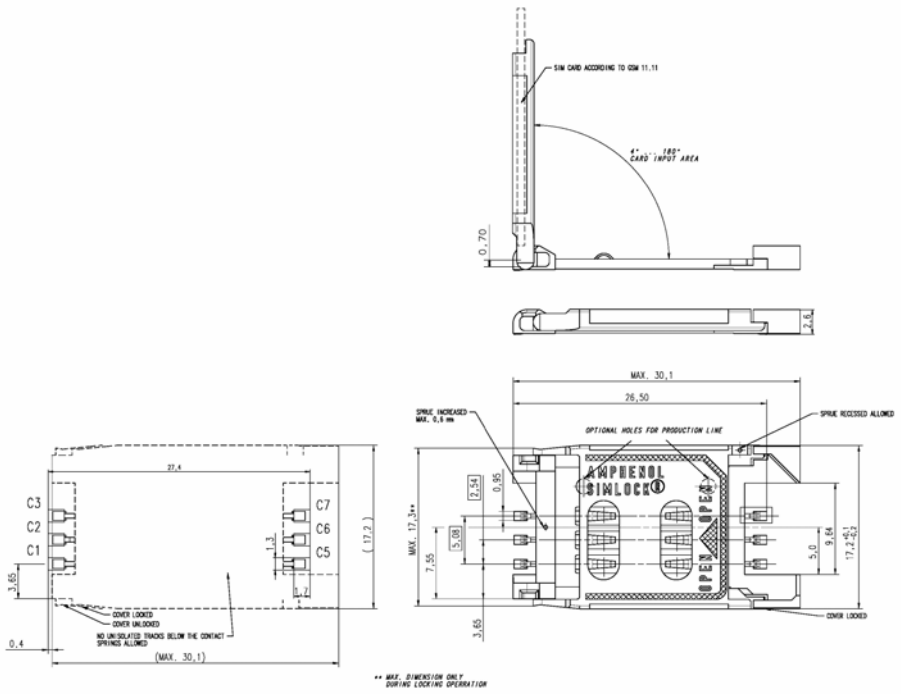


Figure 15: Amphenol C707 10M006 512 2 SIM card holder

Table 15: Pin description (Amphenol SIM card holder)

Pin	Signal	Description
C1	USIM_VDD	SIM Card Power supply, it can identify automatically the SIM Card power mode，one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
C2	USIM_RST	SIM Card Reset.
C3	USIM_CLK	SIM Card Clock.
C5	GND	Connect to GND.
C6	VPP	Connect to USIM_VDD
C7	USIM_DATA	SIM Card data I/O.

3.10 I2C interface

SIM5212 contains an I2C interface. It is used for connecting peripheral equipment. Use AT Command to read/write value of I2C peripheral equipment.

Table 16: PIN define of IIC interface

Pin	Name	Function	Lever
47	IIC_SDA	Serial interface data input and output	
46	IIC_SCL	Serial interface clock input	

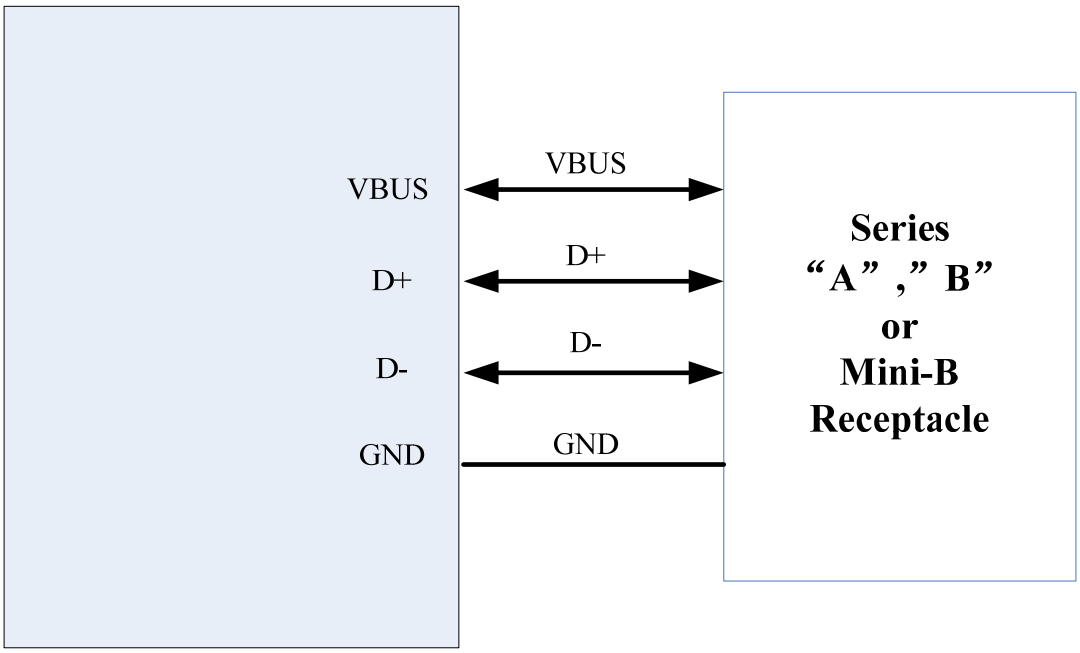
3.11 USB interface

SIM5212 contains a universal serial bus (USB) interface. This interface is compliant with the USB 2.0 specification

Links to these and related specifications can be found at www.usb.org

Table 17: USB PIN connect

Name	PIN(B to B)	Input voltage scope(V)		
		Min	Type	Max
USB_VBUS	9	4.4	5.0	5.25
USB_DP	60			
USB_DM	59			
GND	58			



Notes: when use the Mini-B it has no ID line.

3.12 MODULE RESET

SIM5212 also have a RESET pin (PIN29) input, When should reset the module, one can push the RESET pin to low and the module reset.

3.13 General purpose input & output (GPIO)

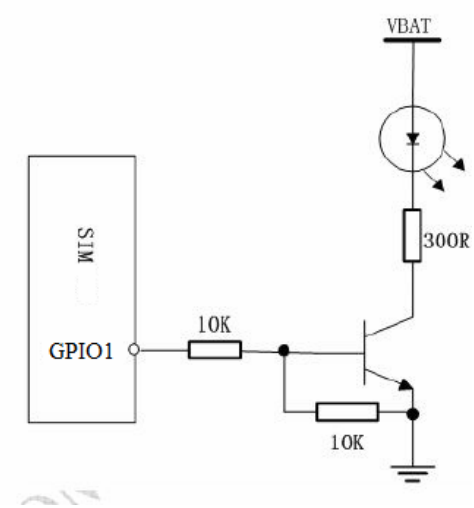
SIM5212 provides a limited number of General Purpose Input/Output signal pin. Please check the following table:

Table 18: GPIO Pins of SIM5212

Pin	Name	Direction	Function
6	GPIO0	Input, interrupt	Input Port with interrupt, Use AT Command to set interrupt triggering mechanism & polarity .
61	GPIO1	Output	used as status LED driver
41	GPIO2	Input	General Purpose Input Port without interrupt.
40	GPIO3	Output	General Purpose Output Port (default value: Low Level)
39	GPIO4	Input	RF Control Interrupt：Flight Mode Switch
38	GPIO5	Output	General Purpose Output Port (default value: Low Level)

GPIO0 is used for interrupt pin, default triggering mechanism is level trigger, and low level will trigger interrupt. After interrupt, SIM5212 would send out Alarm information to host CPU. Please Refer to "AT Command Manual".

GPIO1 be used to control Status LED,



Notes: 300R Resistor's value depends on LED.

And status indicating table is:

Status	Data	Voice
Always On	Searching Network	Searching Network/Call Connect
200ms ON, 200ms OFF	Data Transmit	
800ms ON, 800ms OFF	Registered network	Registered Network
Off	Power Off	

GPIO4 be used to control RF close or on, Flight Mode Switch logic table is:

GPIO4 Status	Module Action
L	Flight Mode: RF is closed.
H	Normal Mode: RF is working.

Use AT Command to read or write GPIO2, GPIO3, GPIO5 status (High or Low level).

3.14 ADC interface

SIM5212 has an analog-to-digital converter (ADC) that is available for digitizing analog signals representing parameters such as battery voltage, temperature and so on, it's on PIN 30, name HKADC0, This HKADC0 is 8 bit successive-approximation circuit, and performance specification is shown as following table:

Specification	Min	Typ	Max	Unit	Comments/Conditions
Resolution		8		Bits	

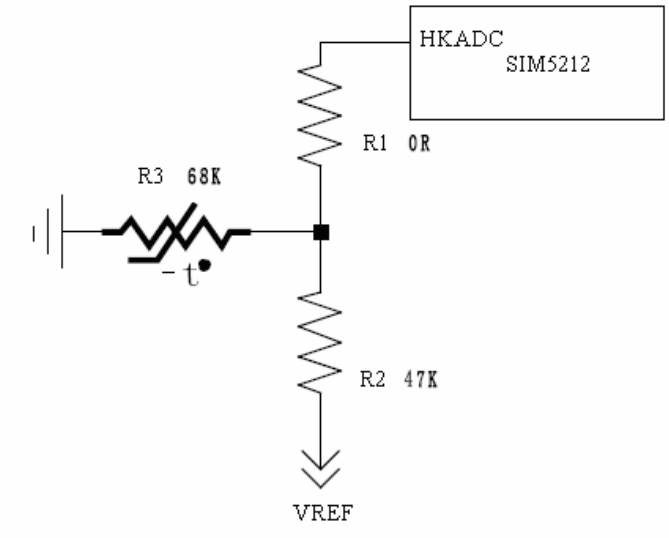
differential nonlinearity	-0.75		+0.75	LSB	. Analog Vdd = ADC reference 300 kHz - 1.2 MHz sample rate
Integral nonlinearity	-1.5		+1.5	LSB	
Gain Error	-2.5		+2.5	%	
Offset Error	-3		+3	LSB	
Input Range	GND		2.65	V	
3dB input bandwidth		2500			Source resistance = 50 Ω
Input serial resistance			1	kΩ	Sample and hold switch resistance
Input capacitance		12		pF	
Power-down to wakeup			5	μ s	
Throughput rate	40.95	67.58		kHz	

We implement two channels on this pin, one is read in raw type ADC value, and the other is read in temperature type ADC value.

You can put a voltage range from 0 to 2.65V on the pin directly using it as a raw type ADC channel. The range of the return value is from 0 to 255.

Show a application sample:

You can use it as a temperature ADC channel, too. The reference design of a temperature ADC circuit is such as the figure below. R1 is 0Ω, R2 is 47 kΩ and R3 is 68 kΩ for reference. The VREF should be 2.65V. The range of the return value is from -30 to 150.



3.15 LDO power output

SIM5212 has a LDO power output, it is PIN 40, name VREG_AUX1.This LDO default output voltage is 2.85V, and driver current is rated for 150mA.

4 Antenna interface

The RF interface has an impedance of 50Ω. To suit the physical design of individual applications SIM5212 offers two alternatives:

- Recommended approach: antenna connector on the component side of the PCB
- Antenna pad and grounding plane placed on the bottom side.

To minimize the loss on the RF cable, it need be very careful to choose RF cable. We recommend the insertion loss should be meet following requirement:

- GSM900/GSM850<1dB
- DCS1800/PCS1900<1.5dB
- WCDMA 2100<1.5dB
- WCDMA 1900<1.5dB
- WCDMA 850<1dB

4.1 Antenna installation

4.1.1 Antenna connector

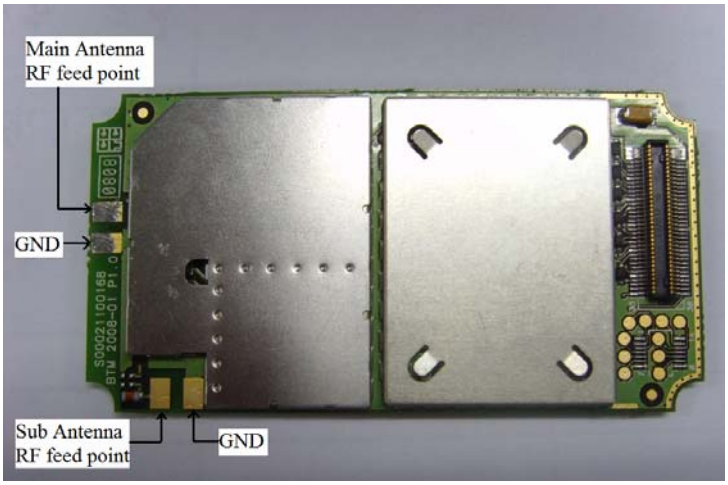
SIM5212 use MURATA's MM9329-2700 RF connector on the module side, we recommend user use MURATA's MXTK88XXXXX as matching connector on the application side. Please refer to appendix for detail info about MURATA's MXTK88XXXXX.

4.1.2 Antenna pad

The antenna can be soldered to the pad, or attached via contact springs. To help you to ground the antenna, SIM5212 comes with a grounding plane located close to the antenna pad.

SIM5212 material properties:
SIM5212 PCB Material: FR4
Antenna pad: Gold plated pad

Note: Sub antenna just for WCDMA 2100M and 850M band



4.2 Module RF output power

Table 19: SIM5212 conducted RF output power

Frequency	Max	Min
E-GSM850	33dBm ±2db	5dBm±5db
E-GSM900	33dBm ±2db	5dBm±5db
DCS1800	30dBm ±2db	0dBm±5db
PCS1900	30dBm ±2db	0dBm±5db
E-GSM850(8-PSK)	27dBm ±3db	5dBm±5db
E-GSM900(8-PSK)	27dBm ±3db	5dBm±5db
DCS1800(8-PSK)	26dBm +3/-4db	0dBm±5db
PCS1900(8-PSK)	26dBm+3/-4db	0dBm±5db
WCDMA 2100	24dBm+1/-3db	-56dBm±9db
WCDMA 1900	24dBm+1/-3db	-56dBm±9db
WCDMA 850	24dBm+1/-3db	-56dBm±9db

4.3 Module RF receive sensitivity

Table 20: SIM5212 conducted RF receive sensitivity

Frequency	Receive sensitivity
GSM850	< -106dBm
E-GSM900	< -106dBm
DCS1800	< -106dBm
PCS1900	< -106dBm
WCDMA 2100	< -108dBm
WCDMA 1900	< -108dBm
WCDMA 850	< -106dBm

4.4 Module operating frequencies

Table 21: SIM5212 operating frequencies

Frequency	Receive	Transmit
GSM850	869 ～ 894MHz	824 ～ 849MHz
E-GSM900	925 ～ 960MHz	880 ～ 915MHz
DCS1800	1805 ～ 1880MHz	1710 ～ 1785MHz
PCS1900	1930 ～ 1990MHz	1850 ～ 1910MHz
WCDMA 2100	2110 ～ 2170MHz	1920 ～ 1980MHz
WCDMA1900	1930 ～ 1990MHz	1850 ～ 1910MHz
WCDMA 850	869 ～ 894MHz	824 ～ 849MHz

5 Electrical, reliability and radio characteristics

5.1 Absolute maximum ratings

Absolute maximum rating for power supply and voltage on digital and analog pins of SIM5212 are list in following table:

Table 22: Absolute maximum ratings

Parameter	Min	Max	Unit
Peak current of power supply	0	3.0	A
RMS current of power supply (during one TDMA- frame)	0	0.9	A
Voltage at digit pins	-0.3	3.0	V
Voltage at analog pins	-0.3	3.0	V
Voltage at digit/analog pins in POWER DOWN mode	-0.25	0.25	V
Voltage at VBAT	-0.3	4.4	V

5.2 Operating temperatures

The operating temperature is listed in following table:

Table 23: SIM5212 operating temperature

Parameter	Min	Typ	Max	Unit
Ambient temperature	-15	25	55	℃
Restricted operation*	-20 to -15		55 to 70	℃
Storage temperature	-40		+85	℃

* GSM/GPRS/EDGE work fine at Ambient & Restricted temperature

WCDMA work fine at ambient temperature (at any power class)

WCDMA could work about 12 hours at restricted temperature (output power less than 10dBm)

WCDMA could work about half hours at restricted temperature (output power bigger than 10dBm)

Note: we recommend adding heat sink on module shielding case while SIM5212 work on WCDMA band.

5.3 Power supply ratings

Table 24: SIM5212 power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
VBAT	Supply voltage	Voltage must stay within the min/max values, including voltage drop, ripple, and spikes.	3.4	3.8	4.2	V
	Voltage drop during transmit burst	Normal condition, power control level for Pout max			400	mV
	Voltage ripple	Normal condition, power control level for Pout max @ f<400kHz @ f>400kHz			 50 10	 mV
I_{VBAT}	Average supply current	POWER DOWN mode		35		uA
	Peak supply current (during transmission slot every 4.6ms)	Power control level for Pout max.		2	3	A

5.4 Current consumption

The values for current consumption listed below refer to Table 29.

Table 25: SIM5212 current consumption

GSM Sleep Mode	
GSM Quad-band	Sleep(not connect USB) @DRX=9 2.4mA Sleep(not connect USB) @DRX=5 2.6mA Sleep(not connect USB) @DRX=2 4.0mA
Voice Call	
GSM850	@power level #5 <314mA,Typical 320mA
GSM 900	@power level #5 <311mA,Typical 300mA
DCS1800	@power level #0 <290mA,Typical 280mA
PCS1900	@power level #0 <310mA,Typical 300mA
GPRS Data	
DATA mode, GPRS (4 Rx,1 Tx) CLASS 12	
GSM 850	@power level #5 <360mA,Typical 330mA
GSM 900	@power level #5 <300mA,Typical 270mA
DCS1800	@power level #0 <270mA,Typical 255mA
PCS1900	@power level #0 <300mA,Typical 270mA
DATA mode, GPRS (3Rx, 2 Tx) CLASS 12	
GSM 850	@power level #5 <520mA,Typical 540mA
GSM 900	@power level #5 <510mA,Typical 500mA

DCS1800	@power level #0 <470mA,Typical 435mA
PCS1900	@power level #0 <470mA,Typical 435mA
EDGE Data	
DATA mode, EDGE(4 Rx,1 Tx) CLASS 12	
GSM 850	@power level #5 <260mA,Typical 240mA
GSM 900	@power level #5 <230mA,Typical 215mA
DCS1800	@power level #0 <230mA,Typical 220mA
PCS1900	@power level #0 <250mA,Typical 235mA
DATA mode, EDGE(3Rx, 2 Tx) CLASS 12	
GSM 850	@power level #5 <356mA,Typical 375mA
GSM 900	@power level #5 <333mA,Typical 325mA
DCS1800	@power level #0 <288mA,Typical 300mA
PCS1900	@power level #0 <270mA,Typical 300mA
UMTS Sleep Mode	
WCDMA 2100	Sleep(not connect USB) @DRX=9 1.9mA Sleep(not connect USB) @DRX=8 2.2mA Sleep(not connect USB) @DRX=6 4.2mA
UMTS Talk	
WCDMA 2100	@Power 23dBm Typical 615mA @Power 21dBm Typical 560mA @Power 10dBm Typical 340mA
HSDPA Data	
WCDMA 2100	@Power 23dBm Typical 650mA @Power 21dBm Typical 555mA @Power 10dBm Typical 370mA
UMTS Sleep Mode	
WCDMA 1900	Sleep(not connect USB) @DRX=9 2.0mA Sleep(not connect USB) @DRX=8 2.3mA Sleep(not connect USB) @DRX=6 4.3mA
UMTS Talk	
WCDMA 1900	@Power 23dBm Typical 610mA @Power 21dBm Typical 560mA @Power 10dBm Typical 385mA
HSDPA Data	
WCDMA 1900	@Power 23dBm Typical 640mA @Power 21dBm Typical 550mA @Power 10dBm Typical 360mA
UMTS Sleep Mode	
WCDMA 850	Sleep(not connect USB) @DRX=9 2.3mA Sleep(not connect USB) @DRX=8 2.5mA Sleep(not connect USB) @DRX=6 4.5mA
UMTS Talk	
WCDMA 850	@Power 23dBm Typical 600mA @Power 21dBm Typical 565mA @Power 10dBm Typical 380mA
HSDPA Data	
WCDMA 850	@Power 23dBm Typical 650mA @Power 21dBm Typical 555mA @Power 10dBm Typical 365mA

5.5 Electro-Static discharge

Normally the module is designed inside customer terminal, so about Electro-Static Discharge (ESD) should be considered base on the requirement of terminal product. But for the module is protected against Electro-Static Discharge in conveyance and customer production, and some second level ESD protect design inside module.

The remaining ports are not special ESD protection in module, and therefore, they are only protected according to the Human Body Model requirements.

Table 26: The ESD endure statue measured table (Temperature: 25℃, Humidity:45%)

Part	Contact discharge	Air discharge
VBAT,GND	±1KV	±1KV
UART,USB	±1KV	±1KV
Antenna port	±1KV	±1KV
Other port	±0.5KV	

So the user should adopt some measure to protect module against ESD

1 .Add ESD components to protect SIM5212 in the final product

2. Connect directly the module to ground through four mounting fix pads

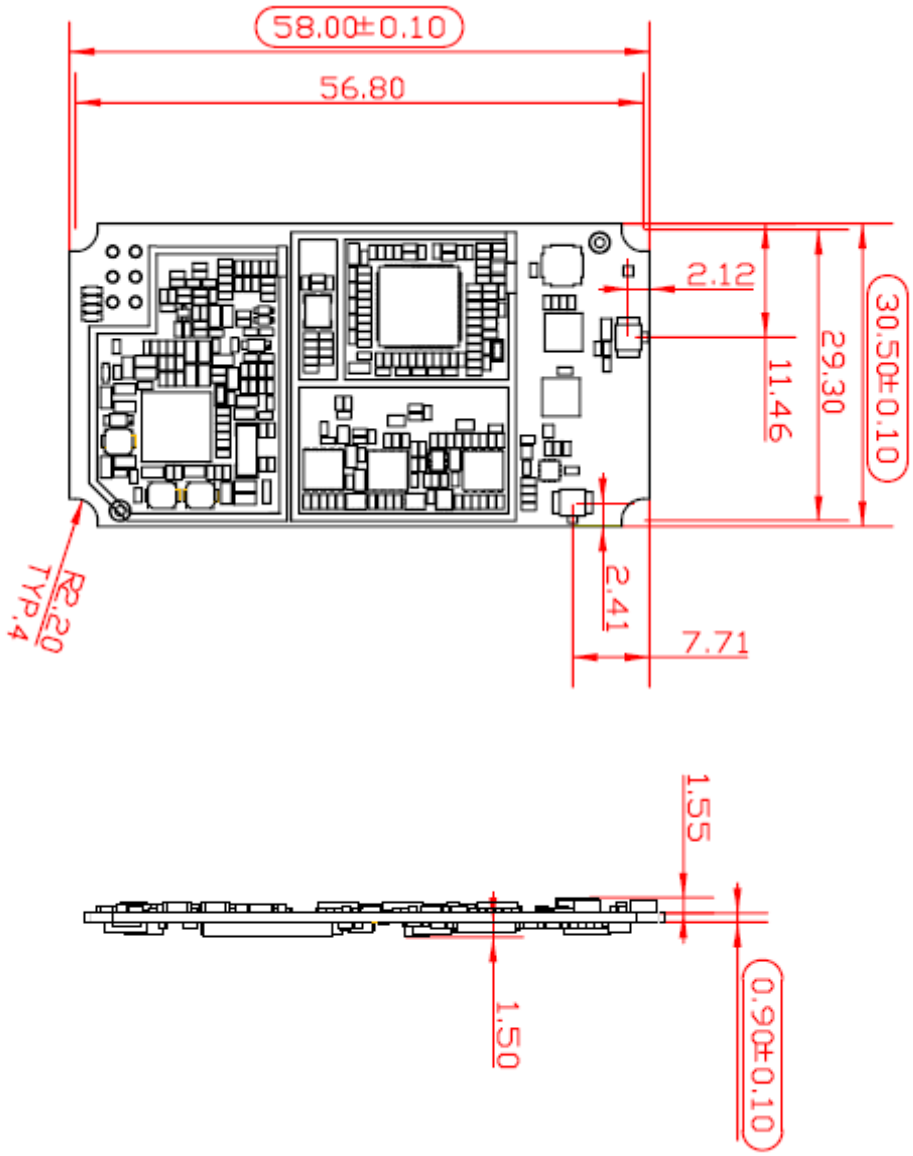
3. Bare the copper and connect directly module shielding case through some conduct material

6 Mechanics

This chapter describes the mechanical dimensions of SIM5212.

6.1 Mechanical dimensions of SIM5212

Following are SIM5212 top view, side view and bottom view. These show you Mechanical dimensions of SIM5212.



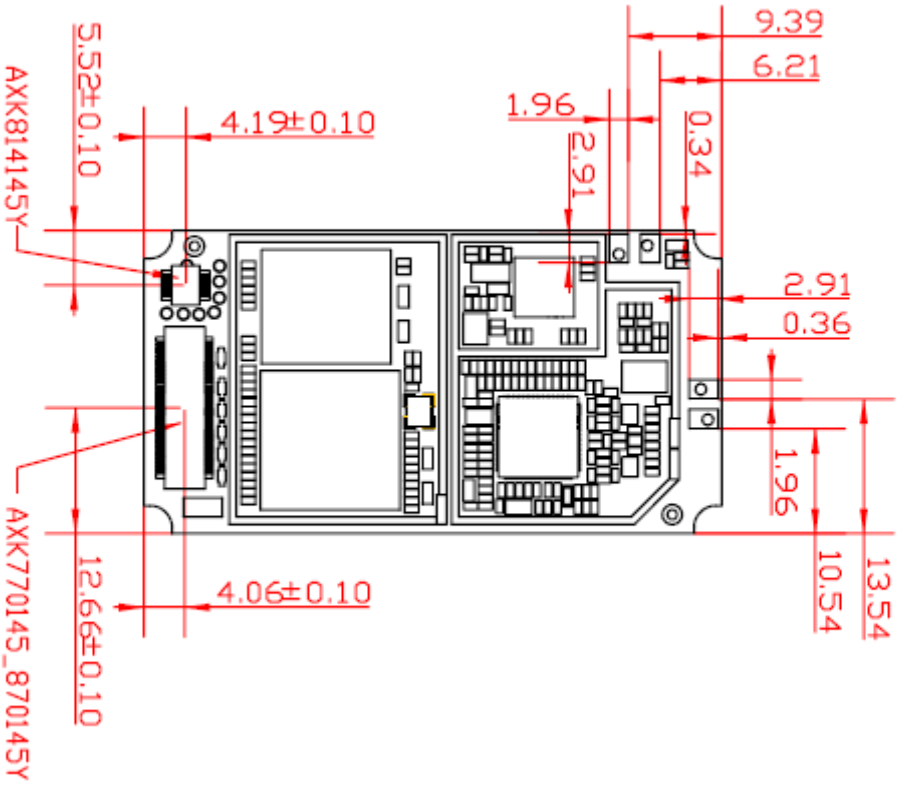
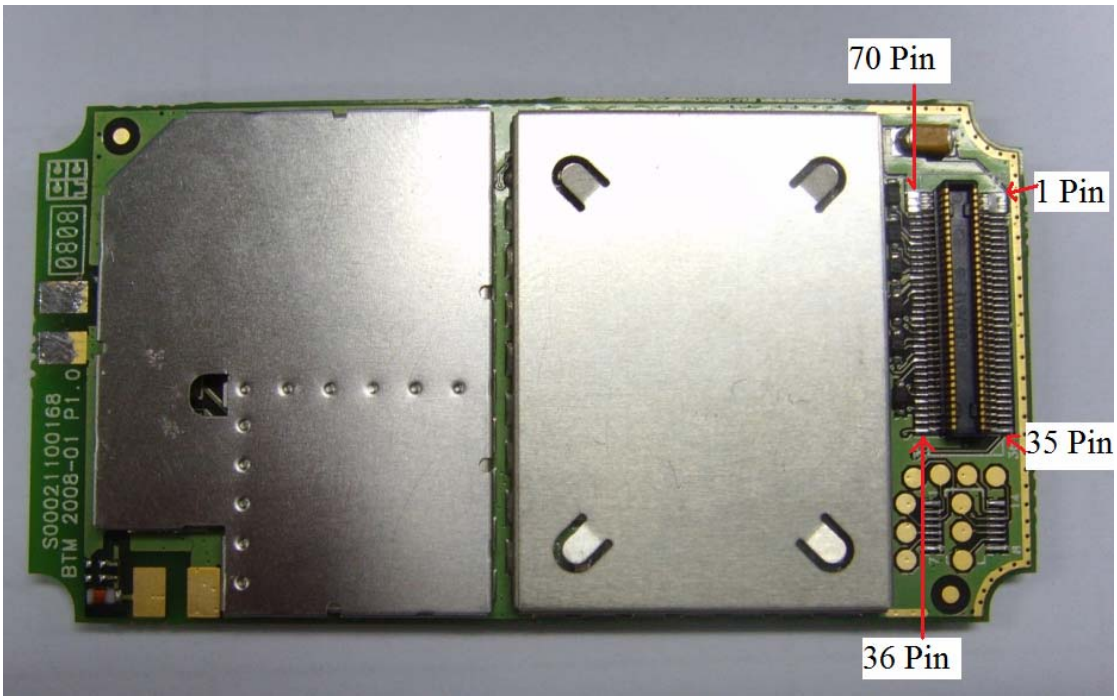


Figure 16: Mechanical dimensions of SIM5212（Unit: mm）

6.2 Mounting SIM5212 onto the application platform

Use the connector AXK870145WG and four mounting pads fix the SIM5212 onto customer platform.



6.3 Board-to-board connector

We recommend user adopt NAIS AXK770347G/AXK770247G/AXK770147G as the Board to board connector in their own PCB to connect with SIM5212. These high density SMT connectors are designed for parallel PCB-to-PCB applications. They are ideal for use in VCRs, notebook PCs, cordless telephones, mobile phones, audio/visual and other telecommunications equipment where reduced size and weight are important. The height of AXK770347G AXK770247G AXK770147G is 2.5mm 2.0mm 1.5mm; please select suit one base on your PCB height design. Following is parameter of AXK770347WG/AXK770247G/AXK770147G and AXK870145WG, for more details, you can login http://www.NAIS-E.com for more information.

Mechanical dimensions of the NAIS 70pin connector

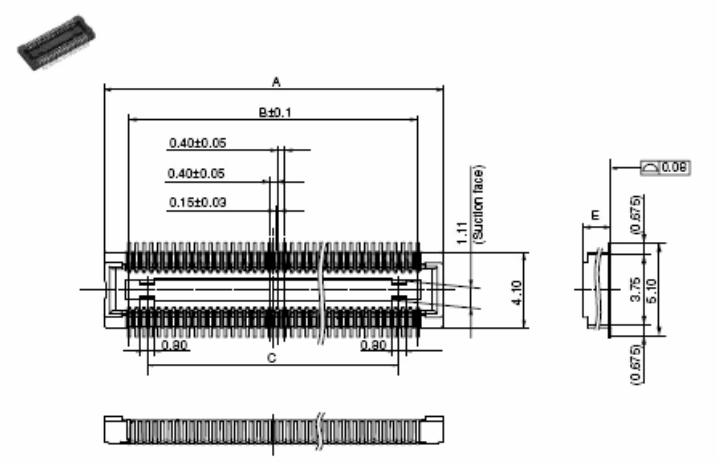


Figure 17: NAIS AXK770347WG board-to-board connector pin side

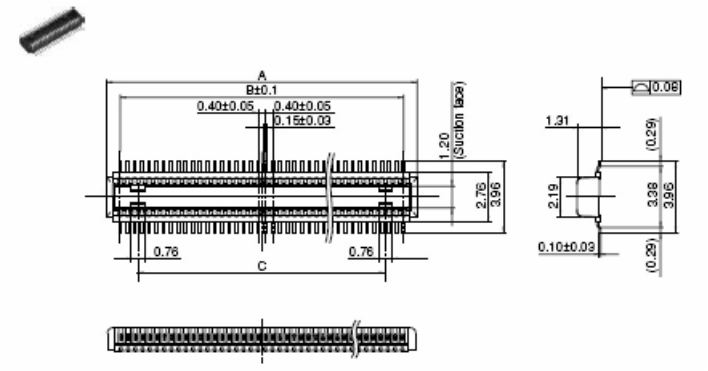


Figure18: NAIS AXK870145WG board-to-board connector pin side

NOTE：

The connector NAIS AXK870145WG is used in socket side (SIM5212 module) and NAIS AXK770347G/AXK770247G/AXK770147G is used pin side (user side).

6.4 RF connector and adapter cable

The RF connector in module side is Murata Company RF Connectors MM9329-2700, it makes a pair with Murata Company RF cable MXTK88TK2000. It has high performance with wide frequency range, surface mountable and reflow solderable. Following is parameter. Certainly you can visit http://www.murata.com/ for more information.

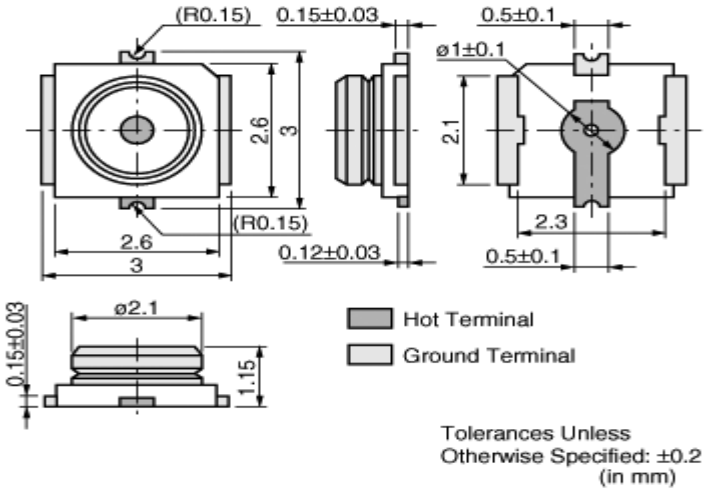


Figure 19: RF connector MM9329-2700

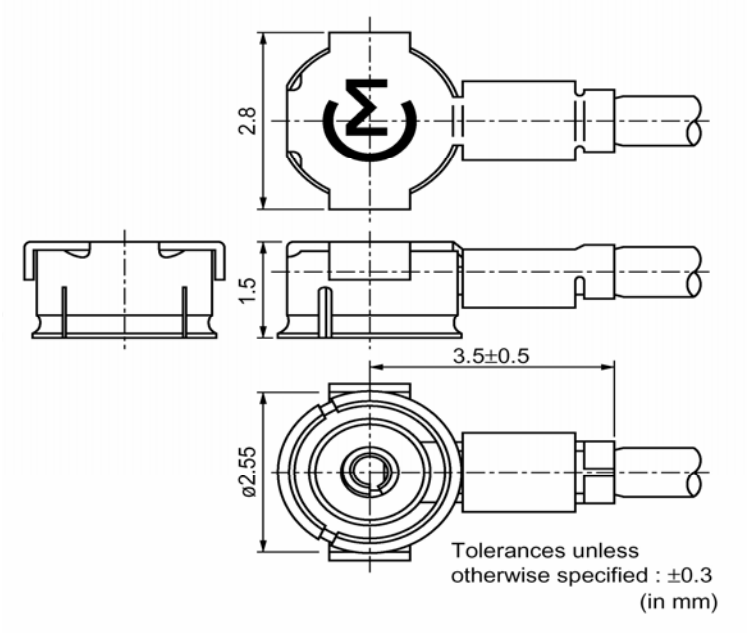
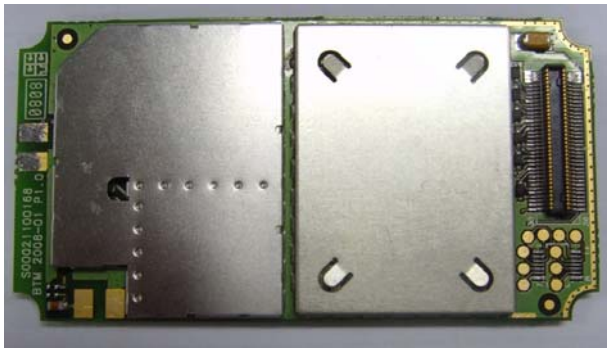


Figure 20: RF adapter cable MXTK88TK2000

For more information about the connector, please visit http://www.murata.com/

6.5 view of the SIM5212



Top View Bottom View

6.6 PIN assignment of board-to-board connector of SIM5212

Table 27 : Connection diagrams

Pin No	Define	Measure without usage	Pin No	Define	Measure without usage
1	VBAT	VBAT	70	VBAT	VBAT
2	VBAT	VBAT	69	VBAT	VBAT
3	VBAT	VBAT	68	VBAT	VBAT
4	GND	GND	67	GND	GND
5	GND	GND	66	GND	GND
6	UART_TXD	NC	65	GPIO0	NC
7	UART_CTS	NC	64	UART_RXD	NC
8	UART_DCD	NC	63	UART_RTS	NC
9	USB_VBUS	NC	62	UART_DTR	NC
10	GPIO1	NC	61	UART_RI	NC
11	VRTC	NC	60	USB_D_P	NC
12	USIM_CLK	NC	59	USB_D_M	NC
13	USIM_RESET	NC	58	GND	GND
14	CAM_D0	NC	57	V_USIM	NC
15	CAM_D2	NC	56	USIM_DATA	NC
16	CAM_D4	NC	55	CAM_D1	NC
17	CAM_D6	NC	54	CAM_D3	NC
18	CAM_D8	NC	53	CAM_D5	NC
19	CAM_HSYNC	NC	52	CAM_D7	NC
20	GND	GND	51	CAM_D9	NC

21	CAM_CLK	NC	50	CAM_VSYNC	NC
22	CAM_STANDBY	NC	49	CAM_PCLK	NC
23	SPK_N	NC	48	CAM_RESET	NC
24	SPK_P	NC	47	IIC_SDA	NC
25	EAR_P	NC	46	IIC_SCL	NC
26	EAR_N	NC	45	POWER_ON	NC
27	HPR	NC	44	MIC_N	0.1u cap to ground
28	HPL	NC	43	MIC_P	0.1u cap to ground
29	RESET	NC	42	HP_MICP	NC
30	GPIO2	NC	41	HKADC	NC
31	GPIO3	NC	40	VREG_AUX	NC
32	GPIO4	NC	39	SD_DATA3	NC
33	GPIO5	NC	38	SD_DATA2	NC
34	SD_CLK	NC	37	SD_DATA1	NC
35	SD_CMD	NC	36	SD_DATA0	NC

Contact us:
Shanghai SIMCom Wireless Solutions Ltd.
Add: SIM Technology Building, No. 700, Yishan Road, Shanghai,P. R. China 200233
Tel: +86 21 5427 8900
Fax: +86 21 5427 6035
URL: www.sim.com/wm