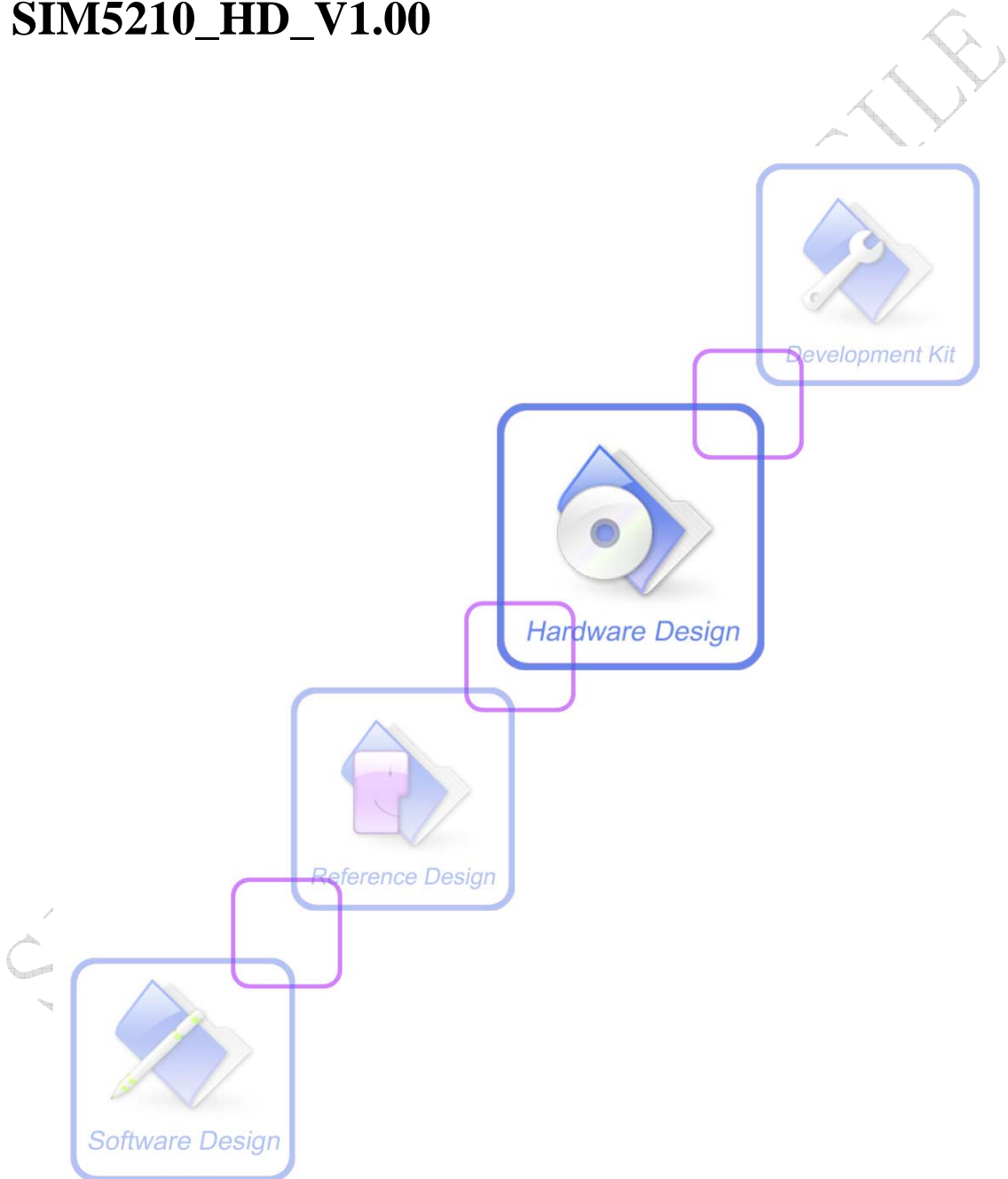




# Hardware Design

**SIM5210\_HD\_V1.00**



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## 1 Introduction

This document describes the hardware interface of the SIMCOM SIM5210 module that connects to the specific application and the air interface. As SIM5210 can be integrated with a wide range of applications, all functional components of SIM5210 are described in great detail.

This document can help you quickly understand SIM5210 interface specifications, electrical and mechanical details. With the help of this document and other SIM5210 application notes, user guide, you can use SIM5210 module to design and set-up mobile applications quickly.

### 1.1 Related documents

**Table 1: Related documents**

SN	Document name	Remark
[1]	SIM5210_ATC_V01.06	SIM5210_ATC_V01.06
[2]	ITU-T Draft new recommendation V.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

## 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

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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

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## 2 Product concept

Designed for global market, SIM5210 is a quad-band GSM/GPRS /EDGE and UMTS engine that works on frequencies of GSM 850MHz, EGSM 900 MHz, DCS 1800 MHz, PCS1900 MHz. and UMTS2100MHz. SIM5210 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.SIM5210 also support UMTS HSDPA up to 3.6Mbps.

With a tiny configuration of 35mm x 35mm x 4.5 mm, SIM5210 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 port can help you easily develop your applications.
- Three audio channels include two microphones inputs and Three speaker outputs. This can be easily configured by AT command.
- A camera interface can help you to develop your video used application, such as Video phone etc.
- A 4bit SD card interface and a I2C interface are provided.
- PCM digital interface.

The SIM5210 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 SIM5210 is designed with power saving technique, the current consumption to as low as 4.0mA in SLEEP mode.

The SIM5210 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.

## 2.1 SIM5210 key features at a glance

**Table 3: SIM5210 key features**

Feature	Implementation
Power supply	Single supply voltage 3.4V – 4.5V
Power saving	Typical power consumption in SLEEP mode to 4.0mA ( BS-PA-MFRMS=2 )
Frequency bands	<ul style="list-style-type: none"> <li>● GSM: 850M/ 900M/ DCS 1800M/ PCS 1900M.</li> <li>● UMTS: 2100M</li> <li>● The SIM5210 can worked in GSM and WCDMA mode</li> <li>● The frequency bands also can be set by AT COMMAND.</li> <li>● Compliant to GSM Phase 2/2+,and 3GPP R99</li> </ul>
GSM class	Small MS
Transmit power	<ul style="list-style-type: none"> <li>● Class 4 (2W) at EGSM900</li> <li>● CLASS( )at GSM850</li> <li>● Class 1 (1W) at DCS1800 and PCS 1900</li> <li>● (0.25W) UMTS 2100M</li> </ul>
GPRS connectivity	<ul style="list-style-type: none"> <li>● GPRS multi-slot class 12 ( default )</li> <li>● GPRS multi-slot class 10 (option)</li> <li>● GPRS mobile station class B</li> </ul>
Temperature range	<ul style="list-style-type: none"> <li>● Normal operation: -20°C to +55°C</li> <li>● Restricted operation: -30°C to -20°C and +55°C to +80°C</li> <li>● Storage temperature -40°C to +85°C</li> </ul>
DATA GPRS:	<ul style="list-style-type: none"> <li>● GPRS data downlink transfer: max. 85.6 kbps</li> <li>● GPRS data uplink transfer: max. 42.8 kbps</li> <li>● Coding scheme: CS-1, CS-2, CS-3 and CS-4</li> <li>● SIM5210 supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections.</li> <li>● The SIM5210 integrates the TCP/IP protocol.</li> <li>● Support Packet Switched Broadcast Control Channel (PBCCH)</li> </ul>
CSD:	<ul style="list-style-type: none"> <li>● CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent</li> <li>● Unstructured Supplementary Services Data (USSD) support</li> </ul>
DATA EDGE	<ul style="list-style-type: none"> <li>● EDGE E2 power class for 8 PSK</li> <li>● DTM (simple class A), multi-slot class 12</li> <li>● Downlink coding schemes – CS 1-4, MCS 1-9</li> <li>● Uplink coding schemes – CS 1-4, MCS 1-9</li> <li>● BEP reporting</li> <li>● SRB loopback and test mode B</li> <li>● 8-bit, 11-bit RACH</li> <li>● PBCCH support</li> </ul>

	<ul style="list-style-type: none"> <li>● phase/2 phase access procedures</li> </ul>
DATA HSDPA	<ul style="list-style-type: none"> <li>● Supports HS-DSCH (HS-SCCH, HS-PDSCH and HS-DPCCH)</li> <li>● Supports a maximum of four simultaneous HS-SCCH channels</li> <li>● Supports a maximum of 10 HS-PDSCH channels</li> <li>● Supports both QPSK and 16 QAM modulation.</li> <li>● Supports CQI, and ACK/NACK on HS-DPCCH channel</li> <li>● Supports all incremental redundancy versions for HARQ</li> <li>● Can switch between HS-PDSCH and DPCH channel resources as directed by the network.</li> <li>● Can be configured to support any of the two power classes 3 or 4</li> <li>● 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.</li> <li>● STTD on both associated DPCH and HS-DSCH is supported simultaneously.</li> <li>● CLTD mode 1 is supported on the DPCH when the HS-PDSCH is active.</li> <li>● STTD on HS-SCCH is supported when either STTD or CLTD Mode 1 are configured on the associated DPCH.</li> <li>● Supports TFC selection limitation on the UL factoring in the transmissions on the HS-DPCCH as required in TS 25.133.</li> </ul>
SMS	<ul style="list-style-type: none"> <li>● MT, MO, CB, Text and PDU mode</li> <li>● SMS storage: SIM card</li> <li>● Support transmission of SMS alternatively over CSD or GPRS. User can choose preferred mode.</li> </ul>
FAX	Group 3 Class 1
SIM interface	Support SIM card: 1.8V ,3V
External antenna	Connected via 50 Ohm antenna connector or antenna pad
Audio features	Speech codec modes: <ul style="list-style-type: none"> <li>● Half Rate (ETS 06.20)</li> <li>● Full Rate (ETS 06.10)</li> <li>● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80)</li> <li>● AMR</li> <li>● A5/1, A5/2, and A5/3 ciphering</li> <li>● Echo suppression</li> </ul>
Serial interface and Debug interface	<ul style="list-style-type: none"> <li>● Serial Port Seven lines on Serial Port Interface</li> <li>● Serial Port can be used for CSD FAX, GPRS service and send AT command of controlling module.</li> <li>● Serial Port can use multiplexing function.</li> </ul>
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.

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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: 35±0.15 x 35±0.15 x 4.5±0.2 mm Weight: TBD
Firmware upgrade	Firmware upgrade over serial 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

### 3 Application interface

All hardware interfaces except RF interface that connects SIM5210 to the customers' cellular application platform is through a 70-pin 0.5mm pitch board-to-board connector. Sub-interfaces included in this board-to-board connector are described in detail in following chapters:

- Power supply
- Serial interfaces
- Analog audio interfaces
- SIM interface
- Camera interface
- SD card interface
- PCM interface
- Other interface

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 SIM5210 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 SIM5210 has to be a single voltage source of VBAT= 3.4V...4.5V. 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= 4.5V Vmin=3.4V Vnorm=4.0V
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=2.0V Vmin=1.2V Vnorm=1.8V Inorm= 20uA
VDD_EXT	O	Supply 2.60V voltage for external	Vmax=2.70V

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		circuit. By measuring this pin, user can judge whether the system is power on or off. When the voltage is low, the system is power off. Otherwise, the system is power on. If not use ,left open	Vmin=2.0V Vnorm=2.4V Imax=20mA
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 the system. The user should keep it to low level for at least 80mS when power on or power off the system. Because the system need margin time assert the software.	VILmax=0.2*VBAT VIHmin=0.6*VBAT 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	
LINE_IN_L LINE_IN_R	I	Left and right line in, If not use, connect to ground through a 100N cap.	

### USB

PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
USB_VBUS	O	USB power supply input, if not use ,left open.	
USB_DP	I	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.	
<b>Serial interface</b>			
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
UART_RXD	I	Receive Data, if not use, pull up.	VIHmin=0.7*VDD_EXT
UART_TXD	O	Transmit Data, if not use ,left open.	VIHmax= VDD_EXT+0.3
UART_RTS	I	Request to Send, if not use, pull up.	VOLmin=GND
UART_CTS	O	Clear to Send, if not use ,left open.	VOLmax=0.2V
UART_RI	O	Ring Indicator, if not use ,left open.	VOHmin= VDD_EXT-0.2
UART_DCD	O	Data Carrier detection, if not use ,left open.	VOHmax= VDD_EXT
<b>USIM interface</b>			
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
USIM_CLK	O	SIM Clock	VILmax=0.3*V_USIM
USIM_RESET	O	SIM Reset	VIHmin=0.7* V_USIM VIHmax= V_USIM +0.3 VOLmin=GND VOLmax=0.2V VOHmin= V_USIM -0.2 VOHmax= V_USIM
<b>Camera interface</b>			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
CAM_DO~CAM_D9	I	Data of the camera sensor, if not use ,left open.	VIHmin=0.7*VDD_EXT VILmax=0.3*VDD_EXT
CAM_HSYNC	I	Video horizontal line synchronization signal, image data is valid, when HSYNC is high, if not use ,left open.	
CAM_VSYNC	I	<b>Video frame synchronization signal VSYNC is active at start of image data frame</b> , if not use ,left open.	

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CAM_CLK	O	Master input CLK, if not use ,left open.	
CAM_PCLK	I	<b>Pixel clock</b> , if not use ,left open.	
CAM_RESET	O	Sensor reset output, active low, if not use ,left open.	
CAM_STANDBY	O	Sensor sleep mode control. active low, if not use ,left open.	
IIC_SDA	I/O	I2C data, if not use ,left open.	
IIC_SCL	O	I2C clock output, if not use ,left open.	
<b>SD card interface</b>			
SD_DATA0~SD_DATA 3	I/O	SD card data , if not use ,left open.	
SD_CLK	O	SD card clock out, if not use ,left open.	
SD_CMD	O	SD command, if not use ,left open.	
<b>PCM interface</b>			
PCM_SYNC	I/O		
PCM_CLK	I/O		
PCM_DIN	I		
PCM_DOUT	O		
<b>Other interface</b>			
Reset	I	System reset in ,active low,	
GPIO	I/O	General I/O PIN, This PIN can be set as an interrupt input. if not use ,left open.	

## 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 SLEEP	Module will automatically go into SLEEP mode if DTR is set to high level and there is no on air or audio activity is required and no hardware interrupt (such as GPIO interrupt or data on serial port). In this case, the current consumption of module will reduce to the minimal level. During sleep mode, the module can still receive paging

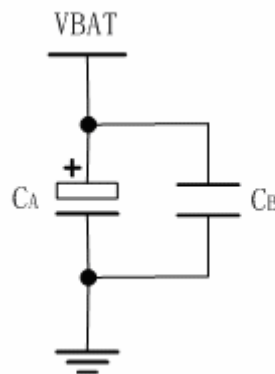
		message and SMS from the system normally.
GSM mode	GSM IDLE	Software is active. Module has registered to the GSM network, and the module is ready to send and receive.
	GSM TALK	CSD connection is going on between two subscribers. In this case, the power consumption depends on network settings such as 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	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	

remove power supply)	will be closed all, the serial interface is still accessible. The power consumption in this case is very low.
Alarm mode	RTC alert function launches this restricted operation while the module is in POWER DOWN mode. SIM5210 will not be registered to GSM network and only parts of AT commands can be available.

### 3.3 Power supply

The power supply of SIM5210 is from a single voltage source of  $V_{BAT}= 3.4V...4.5V$ . 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  $V_{BAT}$  input, a local bypass capacitor is recommended. A capacitor (about  $100\mu F$ , low ESR) is recommended. 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  $100\mu F$  tantalum capacitor (low ESR) with a small ( $0.1\mu F$  to  $1\mu F$ ) ceramic in parallel, which is illustrated as following figure. And the capacitors should put as closer as possible to the SIM5210  $V_{BAT}$  pins. The following figure is the recommended circuit.



**Figure 1: VBAT input**

The following figure is the  $V_{BAT}$  voltage ripple wave at the maximum power transmit phase, the test condition is  $V_{BAT}=4.0V$ ,  $V_{BAT}$  maximum output current =2A,  $C_A=100\mu F$  tantalum capacitor (ESR= $0.7\Omega$ ) and  $C_B=1\mu F$ .



**Figure 2: VBAT voltage drop at the maximum power transmit phase**

### 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 three parameters: voltage percent 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 SIM5210

SIM5210 can be turned on by various ways, which are described in following chapters:

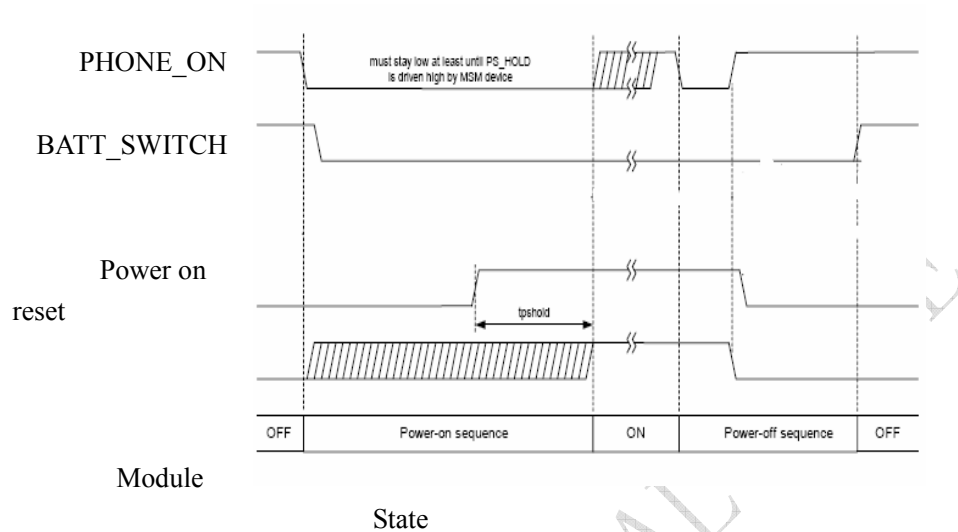
- Via POWER\_ON pin: starts normal operating mode;
- Via RTC interrupt: starts ALARM modes

*Note: The AT command must be set after the SIM5210 is power on and Unsolicited Result Code “RDY” is received from the serial port. But if the SIM5210 was set autobauding, the serial port received nothing, the AT command can be set after 2-3S from the SIM5210 is power on. You can use AT command to set a fix baud rate and save the configuration to non-volatile flash memory. After the configuration was saved as fix baud rate, the Code “RDY” should be received from the serial port all the time when the SIM5210 was power on. See Chapter AT command in other document*

#### 3.4.1.1 Turn on SIM5210 using the POWER\_ON pin (Power on)

You can turn on the SIM5210 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**

#### 3.4.1.2 Turn on SIM5210 using the RTC (Alarm mode) (design on going)

Alarm mode is a power-on approach by using the RTC. The alert function of RTC makes the SIM5210 wake up while the module is power off. In alarm mode, SIM5210 will not register to GSM network and the software protocol stack is closed. Thus the parts of AT commands related with SIM card and Protocol stack will not accessible, and the others can be used as well as in normal mode.

Use the AT+CALARM command to set the alarm time. The RTC remains the alarm time if SIM5210 was power down by "AT\$QCPWRDN" or by PWRKEY pin. Once the alarm time is expired and executed, SIM5210 goes into the Alarm mode. In this case, SIM5210 will send out an Unsolicited Result Code (URC) when set as fixed baud rate:

***RDY***

#### ***ALARM MODE***

During Alarm mode, use AT+CFUN command to query the status of software protocol stack; it will return 0 which indicates that the protocol stack is closed. Then after 90s, SIM5210 will power down automatically. However, during Alarm mode, if the software protocol is started by AT+CFUN=1 command, the process of automatic power down will not be available. In ALARM mode, driving the PWRKEY to a low level voltage for a period will cause SIM5210 to power down (Please refer to the power down scenarios).

The table follow briefly summarizes the AT commands that are used usually during alarm mode, for details of the instructions refer to *document [1]*:

**Table 7: AT commands used in Alarm mode**

AT command	USE
AT+CALARM	Set alarm time
AT+CCLK	Set data and time of RTC
AT\$QCPWRDN	Power down
AT+CFUN	Start or close the protocol stack

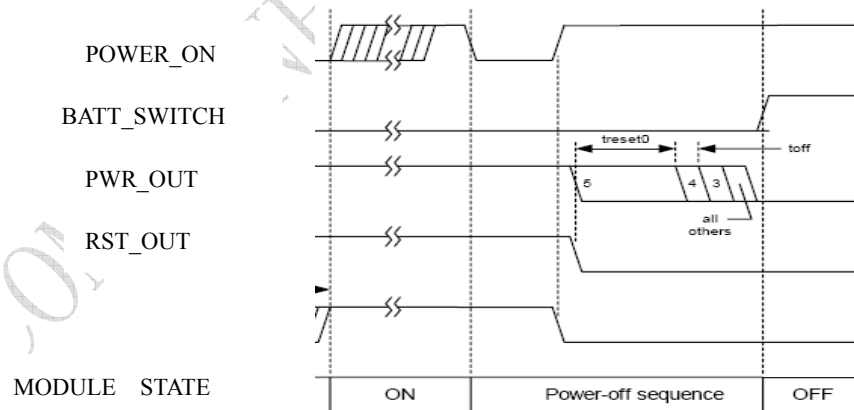
### 3.4.2 Turn off SIM5210

Following procedure can be used to turn off the SIM5210:

- Normal power down procedure: Turn off SIM5210 using the POWER\_ON pin
- Normal power down procedure: Turn off SIM5210 using AT command
- Under-voltage automatic shutdown: Take effect if Under-voltage is detected
- Over-temperature automatic shutdown: Take effect if Over-temperature is detected

#### 3.4.2.1 Turn off SIM5210 using the POWER\_ON pin (Power down)

You can turn off the SIM5210 by driving the POWER\_ON to a low level voltage for period time. The power down scenarios illustrate as following Figure.

**Figure 4: Timing of turn off system**

**Note:**

*The low level period of the POWER\_ON is about 2000mS*

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.

Before the completion of the switching off procedure the module will send out result code:

**NORMAL POWER DOWN**

After this moment, the AT commands can't be executed. The module enters the POWER DOWN mode, only the RTC is still active. POWER DOWN can also be indicated by VDD\_EXT pin, which is a low level voltage in this mode.

#### 3.4.2.2 Turn off SIM5210 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. POWER DOWN can also be indicated by VDD\_EXT pin, which is a low level voltage in this mode.

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

#### 3.4.2.3 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 WARNING**

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. POWER DOWN can also be indicated by VDD\_EXT pin, which is a low level voltage in this mode.

#### 3.4.2.4 Over-temperature automatic shutdown ( design on going)

Software will constantly monitor the temperature of the module, if the measured temperature  $\geq 80^{\circ}\text{C}$ , the following URC will be presented:

**+CMTE:1**

If the measured temperature  $\leq -30^{\circ}\text{C}$ , the following URC will be presented:

**+CMTE:-1**

The uncritical temperature range is  $-35^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ . If the measured temperature  $\geq 85^{\circ}\text{C}$  or  $\leq -35^{\circ}\text{C}$ , the module will be automatic shutdown soon.

If the measured temperature  $\geq 85^{\circ}\text{C}$ , the following URC will be presented:

**+CMTE:2**

If the measured temperature  $\leq -35^{\circ}\text{C}$ , the following URC will be presented:

**+CMTE:-2**

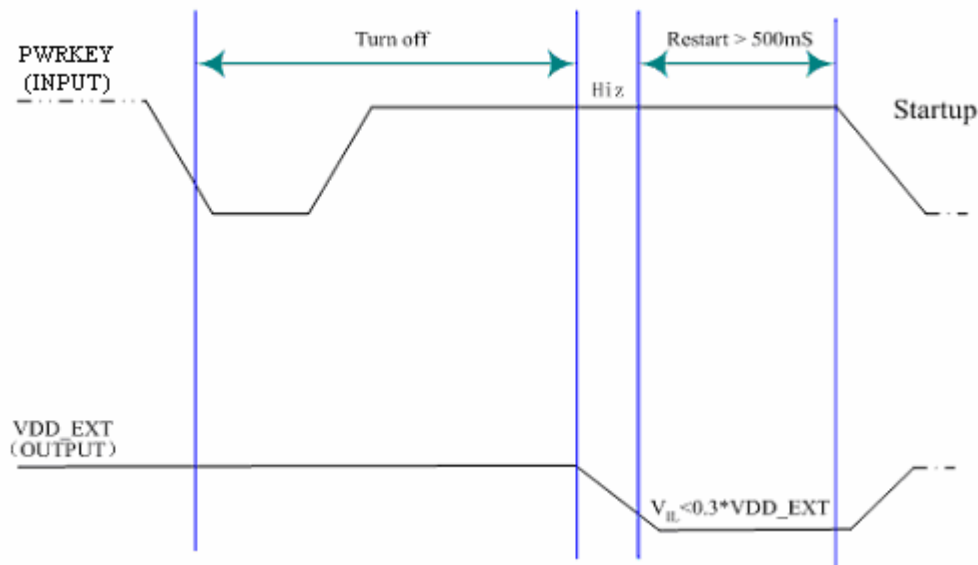
After this moment, the AT commands can't be executed. The module will log off from network and enter POWER DOWN mode, only the RTC is still active. POWER DOWN can also be indicated by VDD\_EXT pin, which is a low level voltage in this mode.

To monitor the temperature, you can use the "AT+CMTE" command to measure the temperature when the module is power on.

For details please refer to *document [1]*

### 3.4.3 Restart SIM5210 using the POWER\_ON pin

You can restart SIM5210 by driving the POWER\_ON to a low level voltage for period time, same as turn on SIM5210 using the POWER\_ON pin. Before restart the SIM5210, you need delay at least 500ms from detecting the VDD\_EXT low level on. The restart scenarios illustrate as the following figure.



**Figure 5: Timing of restart system**

### 3.5 Power saving

There are two methods to achieve SIM5210 module extreme low power. "AT+CFUN" is used to set module into minimum functionality mode and DTR hardware interface signal can be used to set system to be SLEEP mode (or Slow clocking mode).

### 3.5.1 Minimum functionality mode

Minimum functionality mode reduces the functionality of the module to a minimum and, thus, minimizes the current consumption to the lowest level. This mode is set with the “AT+CFUN” command which provides the choice of the functionality levels <fun>=0, 1, 4

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

If SIM5210 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 SIM5210 has disable 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 SIM5210 is in minimum functionality or has been disable all RF functionality by “AT+CFUN”, it can return to full functionality by “AT+CFUN”.

### 3.5.2 Sleep mode (slow clock mode)

Through DTR signal control SIM5210 module to enter or exit the SLEEP mode in customer applications.

When DTR is in high level, at the same time there is no on air or audio activity is required and no hardware interrupt (such as GPIO interrupt or data on serial port), SIM5210 will enter SLEEP mode automatically. In this mode, SIM5210 can still receive paging or SMS from network.

In SLEEP mode, the serial port is not accessible.

### 3.5.3 Wake up SIM5210 from SLEEP mode

When SIM5210 is SLEEP mode, the following method can wake up the module.

- Enable DTR pin to wake up SIM5210.  
If DTR Pin is pull down to a low level, this signal will wake up SIM5210 from power saving mode. The serial port will be active after DTR change to low level about 20ms.
- Receive a voice or data call from network to wake up SIM5210.
- Receive a SMS from network to wake up SIM5210.
- RTC alarm expired to wake up SIM5210.

### 3.6 Summary of state transitions (except SLEEP mode)

**Table 8: Summary of state transitions**

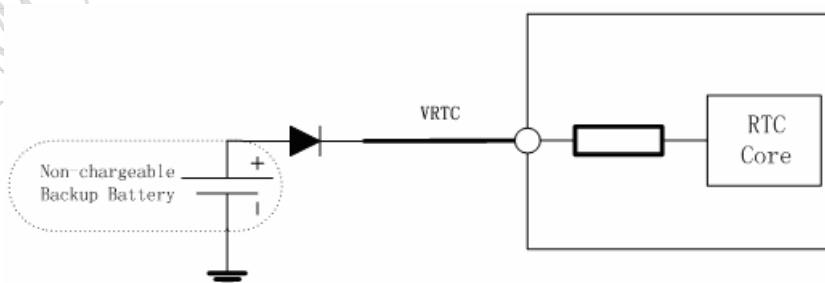
Further mode	POWER DOWN	Normal mode	Alarm mode
Current mode			
POWER DOWN		Use POWER_ON	Switch on from POWER DOWN mode by RTC
Normal mode	AT\$QCPWRDN or use POWER_ON pin		Set alarm by “AT+CALARM”, and then switch off the module. When the timer expire, the module turn on and enter Alarm mode
Alarm mode	Use POWER_ON pin or wait module switch off automatically	Use AT+CFUN	

### 3.7 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 couldn't be designed to a NC pin in your circuit. You should 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 6: RTC supply from non-chargeable battery**

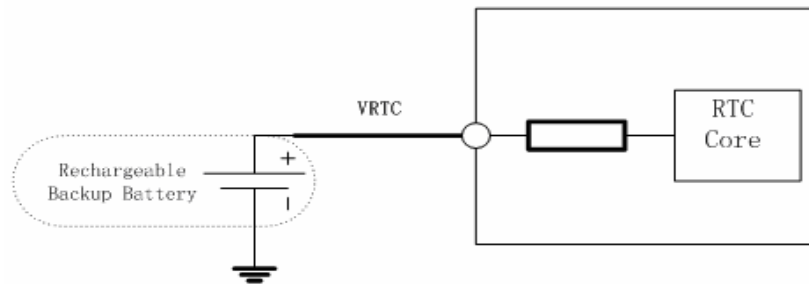


Figure 7: RTC supply from rechargeable battery

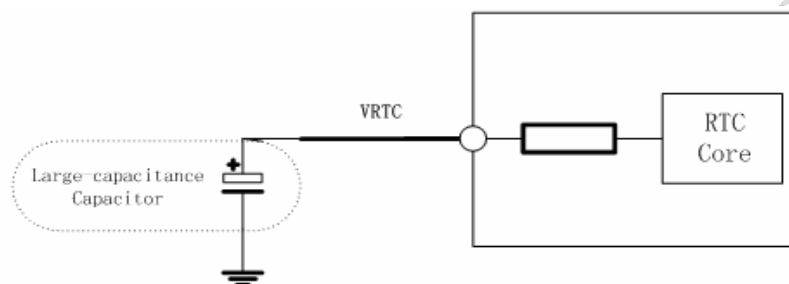
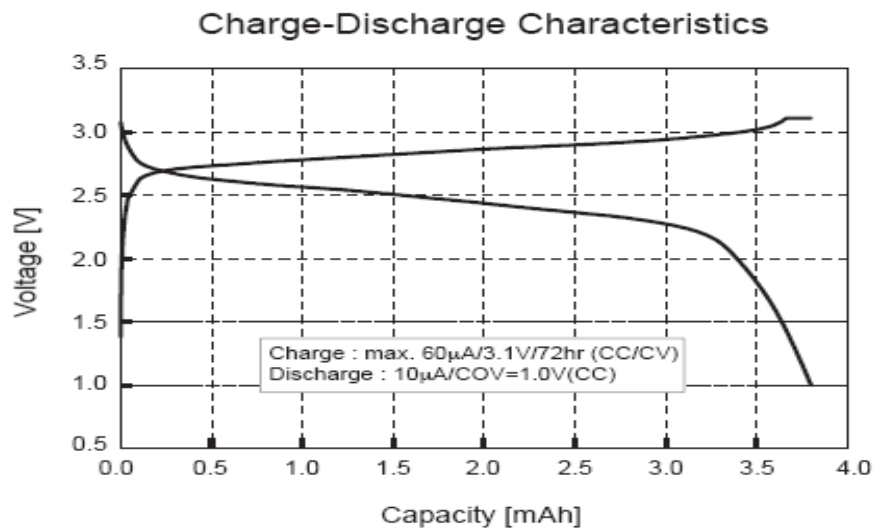


Figure 8: RTC supply from capacitor

- **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 9: 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.*

### 3.8 Serial interfaces

SIM5210 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). Autobauding supports baud rate from 1200 bps to 115200bps.

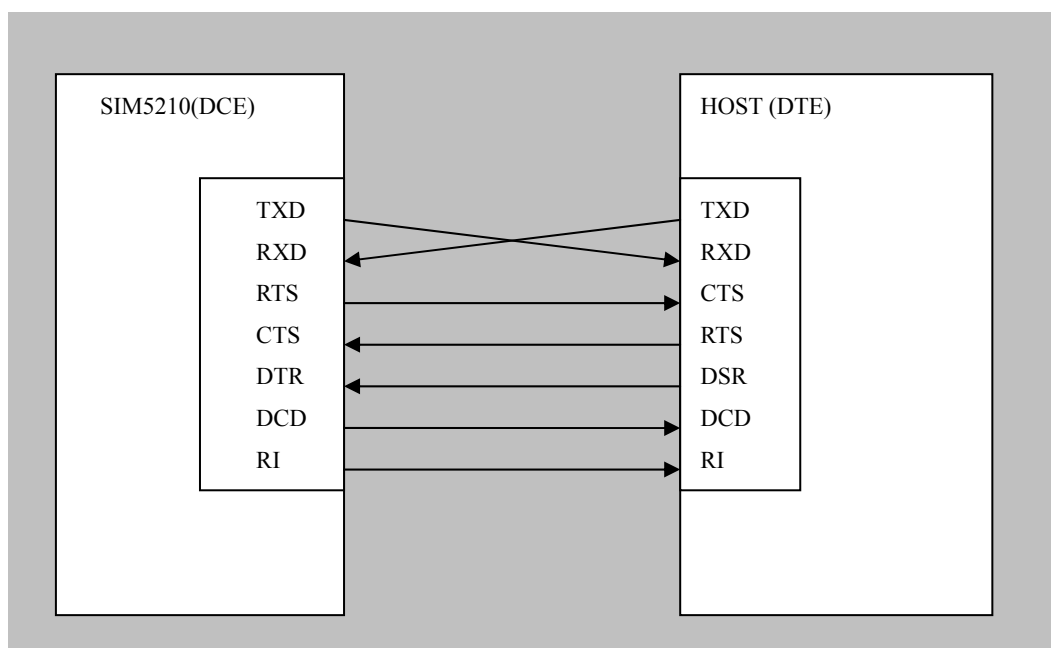
Serial port

- 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 9: 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



**Figure 10: Interface of serial ports**

### 3.8.1 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 FAX, GPRS service and send AT command of controlling module. Serial Port can use multiplexing function.
- Serial Port supports the communication rate as following:  
300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default as 115200bps.
- Autobauding supports the communication rate as following  
1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200bps.

( design on going)

Autobauding allows the GSM engine to automatically detect the baud rate configured in the host application. The serial interface of the GSM engine supports autobauding for the following baud rates: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200. Factory setting is autobauding enabled. This gives you the flexibility to put the GSM engine into operation no matter what baud rate your host application is configured to. To take advantage of autobaud mode specific attention must be paid to the following requirements:

#### Synchronization between DTE and DCE.

Ensure that DTE and DCE are correctly synchronized and the baud rate used by the DTE is

detected by the DCE (= ME). **To allow the baud rate to be synchronized simply issue an "AT" or "at" string. This is necessary.**

- after you have activated autobauding
- when you start up the GSM engine while autobauding is enabled. It is recommended to wait 3 to 5 seconds before sending the first AT character. Otherwise undefined characters might be returned.

### **Restrictions on autobauding operation**

- The serial interface has to be operated at 8 data bits, no parity and 1 stop bit (factory setting).
- The Unsolicited Result Codes like "RDY", "+CFUN: 1" and "+CPIN: READY" are not indicated when you start up the ME while autobauding is enabled. This is due to the fact that the new baud rate is not detected unless DTE and DCE are correctly synchronized as described above.

*Note: You can use AT+IPR=x;&W to set a fixed baud rate and save the configuration to non-volatile flash memory. After the configuration was saved as fix baud rate, the Unsolicited Result Codes like "RDY" should be received from the serial port all the time when the SIM5210 was power on.*

## **3.9 Audio interfaces**

**Table 10: 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
Line in	LINE_IN_L	41	Left line in
	LINE_IN_R	40	Right line in

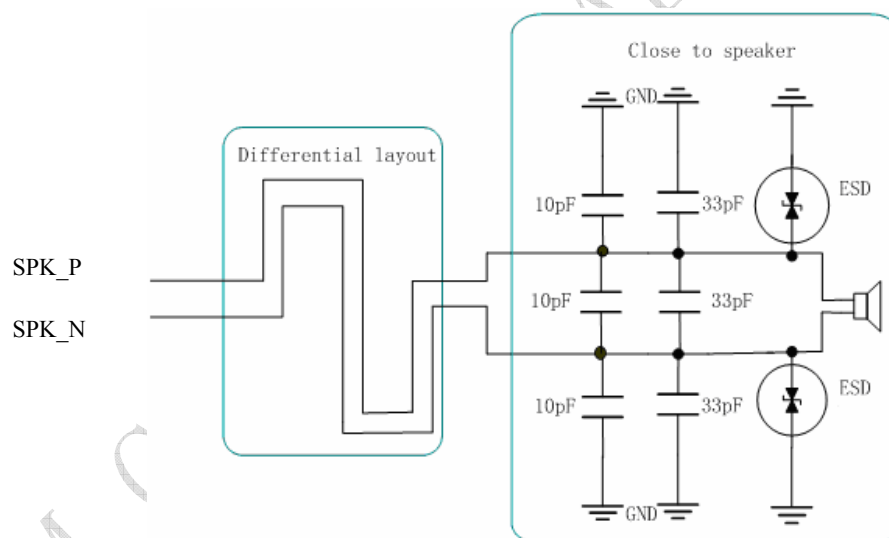
## SIM5210 Hardware Design

The module provides four analog audio channels, AIN1 and AIN2, which may be used for both microphone and line inputs. The AIN1 and AIN2 channels are identical. One of the two channels is typically used with a microphone built into a handset. The other channel is typically used with an external microphone or external line input. The Module analog input configuration is determined by control register settings and established using analog multiplexers.

For each channels, you can use AT+CMIC to set the input gain level of microphone, use AT+ECHO to set the parameters for echo suppression. Also, you can use AT+SIDET to set the side-tone level. For details, please refer to *document [1]*. (design on going)

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 show in following Figures (Note: all components package are 0603) .

### 3.9.1 Speaker interface configuration



**Figure 11: Speaker interface configuration**

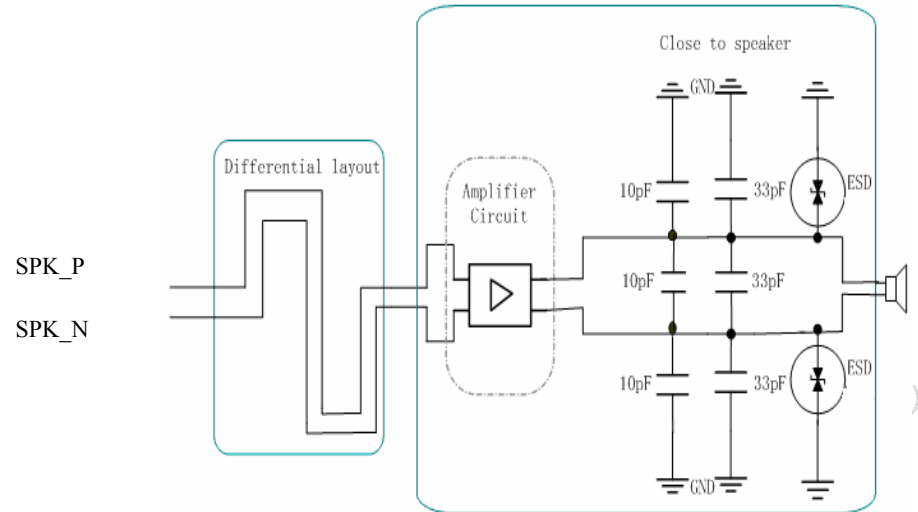


Figure 12: Speaker interface with amplifier configuration

### 3.9.2 Microphone interfaces configuration

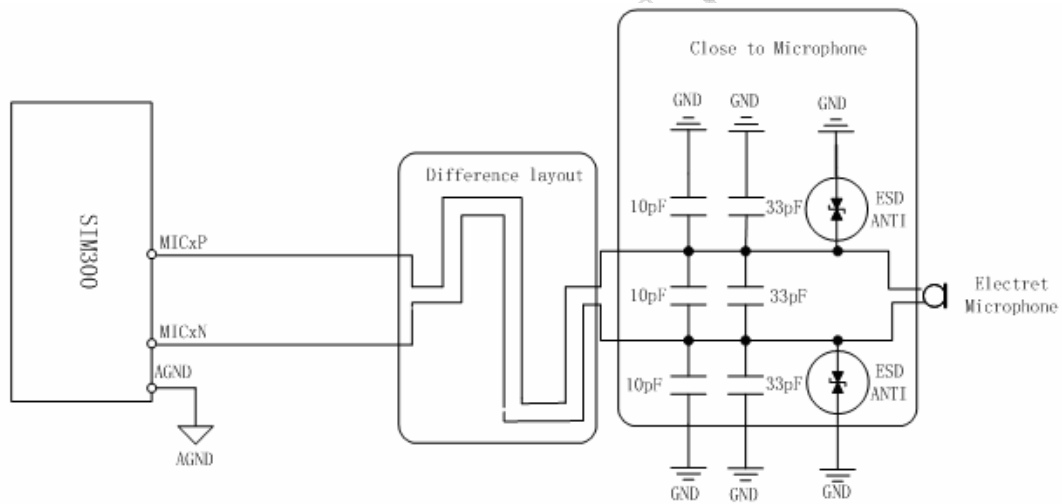


Figure 13: Microphone interface configuration

### 3.9.3 Earphone interface configuration

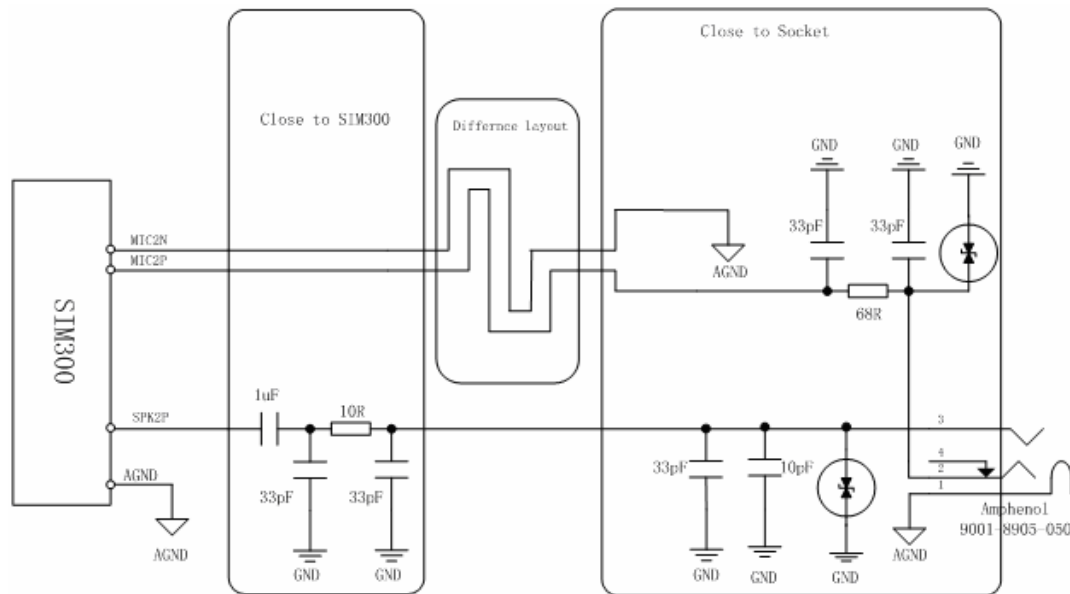


Figure 14: Earphone interface configuration

### 3.9.4 Referenced electronic characteristic

Table 11: MIC Input Characteristics

Parameter	Min	Typ	Max	Unit
Working Voltage		1.60	2.2	V
Working Current	70		300	uA
External Microphone Load Resistance	1.2	2.2		k Ohms

Table 12: 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,H)	Single Ended	load Resistance	12	16		Ohm

**SIM5210 Hardware Design**

PL)	Differential	load Resistance	27	32		Ohm
	Single Ended	Output power		22		mW

**Table 13: Speaker Output Characteristics**

Parameter	Min	Typ	Max	Unit
Working Current		8		mA
Output power(1KHz)		500		mW

### 3.10 USIM card interface

#### 3.10.1 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

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

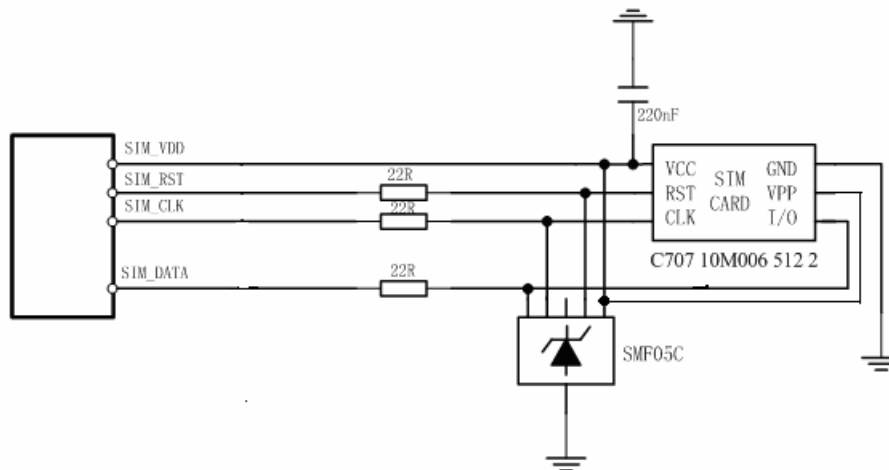
Pin	Signal	Description
19	V_USIM	USIM Card Power output automatic output on USIM mode, one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
21	USIM_DATA	USIM Card data I/O
23	USIM_CLK	USIM Card Clock
25	USIM_RESET	USIM Card Reset

Following is the reference circuit about USIM interface. We recommend an Electro-Static

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discharge device ST ([www.st.com](http://www.st.com)) ESDA6V1W5 or ON SEMI ([www.onsemi.com](http://www.onsemi.com)) SMF05C for “ESD ANTI”. 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. The pull up resistor (about 10KΩ) must be added on the USIM\_DATA line. Note that the USIM peripheral circuit close to the USIM card socket.

You can select the 8 pins USIM card. The reference circuit about 8 pins USIM card illustrates as following figure.



**Figure 15: USIM interface reference circuit with 6 pins USIM card**

### 3.10.2 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.

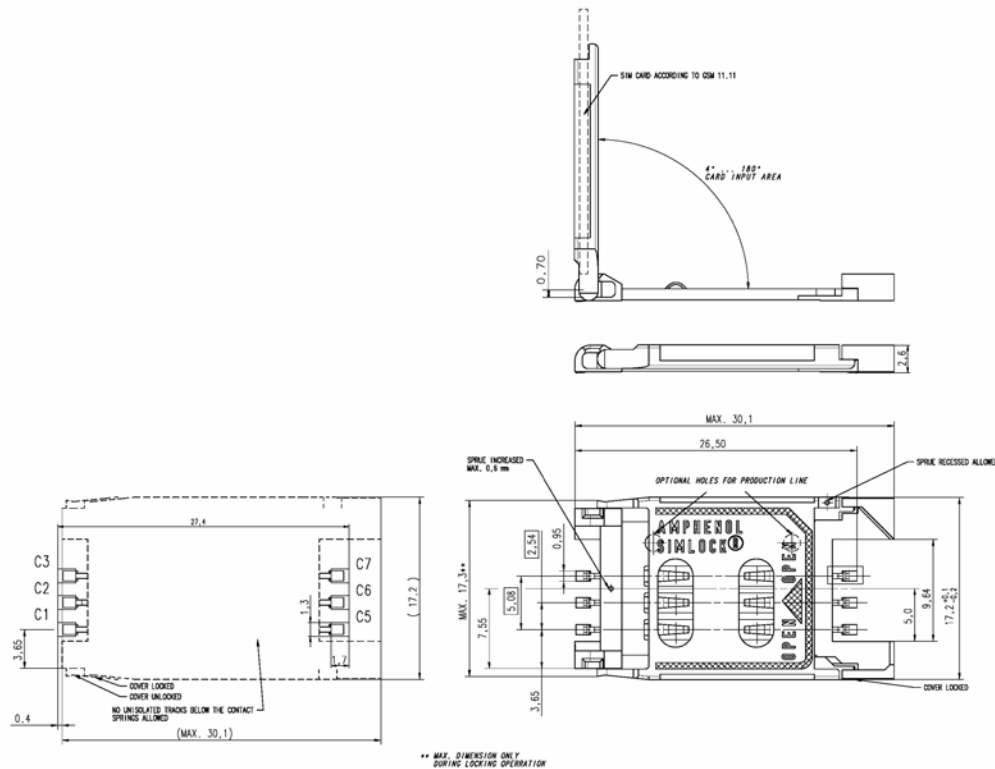


Figure 16: Amphenol C707 10M006 512 2 SIM card holder

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.

### 3.11 Sensor interface

SIM5210 provides a Sensor interface for supporting Video function. The interface both support YUV format and RAW data sensor. The following table is the pin define. The power supply of the sensor should be supplied by custom.

SIM5210 can support both YUV and RGB data format. When you use a YUV output sensor ,you

## SIM5210 Hardware Design

should connect the output data0~data7 to SIM5210 out PIN CAM\_D2~CAM\_D9.

We have tested several kinds of sensor , such as OV9650,OV2640, OV7670. MICRON 2020. Software must be adjusted when use other kinds of sensor. Custom can contact us to test the sensor.

**Table 16: PIN define of sensor interface**

Pin	Name	Function	Lever
14	CAM_D0	Bit 0 of RGB video component output	
55	CAM_D1	Bit 1 of RGB video component output	
15	CAM_D2	Bit 2 of RGB or YUV D0 video component output	
54	CAM_D3	Bit 3 of RGB or YUV D1video component output	
16	CAM_D4	Bit 4 of RGB or YUV D2video component output	
53	CAM_D5	Bit 5 of RGB or YUV D3video component output	
17	CAM_D6	Bit 6 of RGB or YUV D4video component output	
52	CAM_D7	Bit 7 of RGB or YUV D5video component output	
18	CAM_D8	Bit 8 of RGB or YUV D6video component output	
51	CAM_D9	Bit 9 of RGB or YUV D7video component output	
19	CAM_HSYNC	Video horizontal line synchronization signal	
50	CAM_VSYNC	Vertical sync output	
21	CAM_CLK	Sensor main CLK in	
49	CAM_PCLK	Pixel clock output	
48	CAM_RESET	Sensor reset input, active low	
47	IIC_SDA	Serial interface data input and output	
46	IIC_SCL	Serial interface clock input	
20	GND	Ground	
22	CAM_STANDBY	Power-down mode selection “1”=Normal mode, “0”=Power-down mode	

### 3.12 SD/MMC card interface

SIM5210 provides one SD/MMC card interface. The SIM5210 act as a HOST. The MSM6280 device has a 4-bit SD interface. It supports 4 bits of data and a command signal. In addition, a clock output is provided by the SIM5210 to be used as SD\_CLK, or MMC\_CLK. This clock is designed to be used with the SD/MMC interface and is what customers should use with the SD/MMC cards. [Figure 2-12](#) illustrate and describe the SD/MMC interface.

As mentioned, the SD/MMC interface supports SD according to the SD physical layer specification 2.0, up to 4-bit data mode. It is also capable of supporting 1-bit MMC according to MCC specification 3.31. While the same hardware controller is used , the initialization for SD cards and MMCs are different. SIM5210 will auto-detect which card is inserted (SD or MMC, or

## SIM5210 Hardware Design

no card) and will proceed accordingly. The following features are implemented:

- Supports 4-bit SD, 1-bit SD, and 1-bit MMC interface
- SW-configurable edge latching (falling or rising)
- SW-configurable data and command values change (rising or falling edge)
- Clock-gating for power saving (and a power-saving option to always turn the clock off when bus is idle)
- Flow control option to prevent overflow and underflow
- SD\_CLK output up to 25 MHz

**Table 17: SD/MMC pin of SIM5210**

Name	Pin (On board-to-board connector)	Input voltage scope( V )		
		Min	Type	Max
SD_DATA0	36	2.7	2.85	3.0
SD_DATA1	37	2.7	2.85	3.0
SD_DATA2	38	2.7	2.85	3.0
SD_DATA3	39	2.7	2.85	3.0
SD_CLK	34	2.7	2.85	3.0
SD_CMD	35	2.7	2.85	3.0

**Table 18 :SD/MMC pin connect**

Name	SD card	MMC card
SD_DATA0	SD_DATA0	MMC_data
SD_DATA1	SD_DATA1	NC
SD_DATA2	SD_DATA2	NC
SD_DATA3	SD_DATA3	NC
SD_CLK	SD_CLK	MMC_CLK
SD_CMD	SD_CMD	MMC_CMD

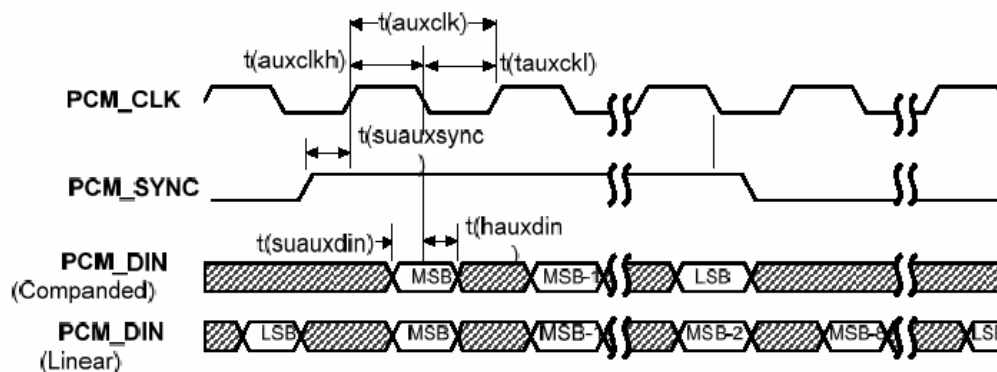
### 3.13 PCM/I2S interface

SIM5210 has a PCM /I2S interface which may be used to connect to a auxiliary codec. This function can be used in several case , such as Bluetooth,MP3,MP4 codec.

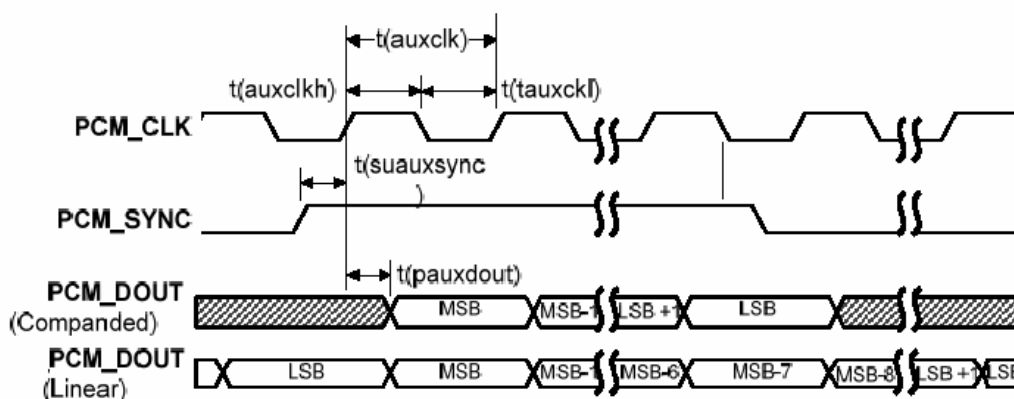
#### 3.13.1 PCM interface

The PCM/I2S interface enables communication with an external codec to support hands-free applications. Linear, U-law, and A-law codecs are supported by the PCM interface.

The auxiliary codec port operates with standard long-sync timing and a 128 kHz clock. The PCM\_SYNC runs at 8 kHz with 50% duty cycle. Most u-law and A-law codecs support the 128



PCM data IN



PCM data out

### 3.13.2 I2S interface

**DOUT** – The serial PCM data stream for both channels is output from the SIM5210 through this pin. The data is transmitted in two's complement with the MSB first. This minimizes the loss of data when the transmitter word length (16 bits) is different than the receiver device's word length, and is handled in one of two ways:

- When the transmitted word length is greater than the receiver word length, the bits after the receiver's LSB are ignored – the rest of the transmitter LSBs are ignored.
- When the transmitted word length is less than the receiver word length, the receiver's missing LSB will be set to zero initially, so they will remain at zero.

It is important to note that the above scenarios are true specifically when the system consists of just one transmitter (the master). In a complex system where there are several transmitters, it is possible that the system word length will be greater than a specific transmitter's word length. In that case, the LSBs of the system word will be set to '0' for data transmission.

**L/R** – this signal specifies the present data stream's intended stereo channel: 1 specifies the left channel, 0 specifies the right.

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**CLK** – this is the bit clock that can be generated by the SIM5210, and then supplied to the external stereo DAC. Alternatively, it can be generated by the external stereo DAC and then provided to SIM5210.

The CLK frequency is dependent upon the number of bits per channel and the selected sampling rate. For example, for two channels, 16-bits each, and a chosen 48 kHz sampling frequency, the frequency would be:

$$\text{FSDAC\_CLK} = 16 * 16 * 48\text{k} = 1536000 \text{ b/s} = 1.536 \text{ MHz}$$

**Table 19: PCM /I2S PIN connect**

NAME		PIN (B to B connector)	Input voltage scope( V )		
PCM	I2S		Min	Type	Max
PCM_SYNC	L/R	30	2.5	2.6	2.7
PCM_CLK	CLK	31	2.5	2.6	2.7
PCM_DIN	MCLK	32	2.5	2.6	2.7
PCM_DOUT	Dout	33	2.5	2.6	2.7

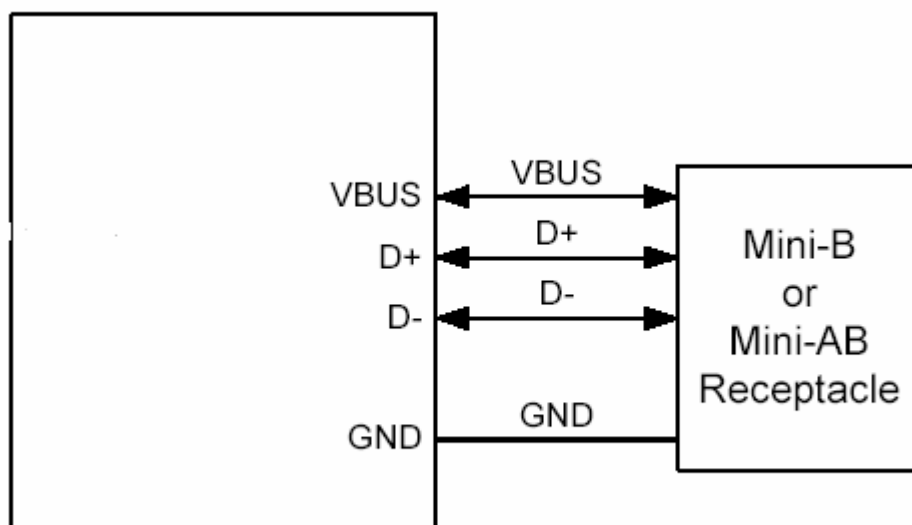
### 3.14 USB interface

SIM5210 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](http://www.usb.org)

**Table 20: 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			



### 3.15 MODULE RESET

SIM5210 also have a RESET pin(PIN29) input, When should reset the module ,one can push the RESET pin to low and the module reset.

### 3.16 Behaviors of the RI line (serial port interface)

Table 21: Behaviours of the RI line (PIN48)

State	RI respond
Standby	HIGH
Voice calling	Change LOW, then: <ol style="list-style-type: none"> <li>(1) Change to HIGH when establish calling.</li> <li>(2) Use AT command ATH, the RI pin changes to HIGH.</li> <li>(3) Sender hangs up, change to HIGH.</li> </ol>
Data calling	Change LOW, then: <ol style="list-style-type: none"> <li>(1) Change to HIGH when establish calling.</li> <li>(2) Use AT command ATH, the RI changes to HIGH.</li> </ol>
SMS	When receive SMS, The RI will change to LOW and hold low level about 120 ms, then change to HIGH.

If the module is used as caller, signal RI will maintain high. But when it is used as receiver, following is timing of ring.

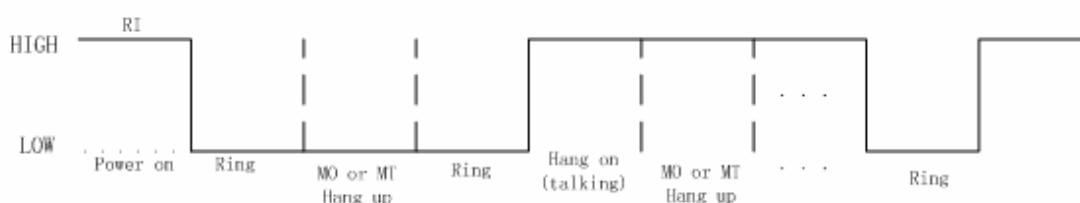


Figure 17: SIM5210 Services as Receiver

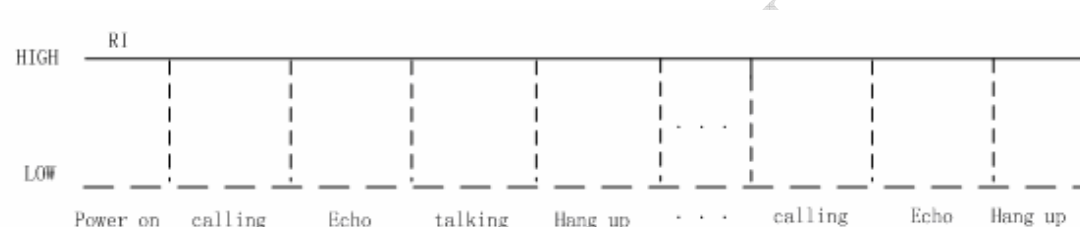


Figure 18: SIM5210 Services as caller

### 3.17 General purpose input & output (GPIO)

SIM5210 provides a limited number of General Purpose Input/Output signal pin.

The GPIO pin can be set as a general IO PIN, in this mode, it can be set as input or output. This pin also can be set as a interrupt input PIN, Custom want to use this function, Please contact us for detail.

Table 22: GPIO Pins of SIM5210

Pin	Name	Function
65	GPIO0	1:General Purpose Input/Output Port 2:Interrupt input

## 4 Antenna interface

The RF interface has an impedance of 50Ω. To suit the physical design of individual applications SIM5210 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

### 4.1 Antenna installation

#### 4.1.1 Antenna connector

SIM5210 use MURATA's MM9329-2700 RF connector on the module side, we recommend user use MURATA's MXTK92XXXXX as matching connector on the application side. Please refer to appendix for detail info about MURATA's MXTK92XXXXX.

#### 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, SIM5210 comes with a grounding plane located close to the antenna pad.

SIM5210 material properties:

SIM5210 PCB Material: FR4

Antenna pad: Gold plated pad

### 4.2 Module RF output power

**Table 23: SIM5210 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

WCDMA 2100	24dBm+1/-3db	-56dBm±9db
------------	--------------	------------

### 4.3 Module RF receive sensitivity

Table 24: SIM5210 conducted RF receive sensitivity

Frequency	Receive sensitivity
E-GSM900	< -106dBm
DCS1800	< -106dBm
PCS1900	< -106dBm
UMTS 2100	<-106dBm

### 4.4 Module operating frequencies

Table 25: SIM5210 operating frequencies

Frequency	Receive	Transmit
E-GSM900	925 ~ 960MHz	880 ~ 915MHz
DCS1800	1805 ~ 1880MHz	1710 ~ 1785MHz
PCS1900	1930 ~ 1990MHz	1850 ~ 1910MHz
UMTS 2100	2112.4~2167.6MHz	1922.4~ 1977.6MHz

## 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 SIM5210 are list in following table:

**Table 26: 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	0.7	A
Voltage at digit pins	-0.3	3.3	V
Voltage at analog pins	-0.3	3.0	V
Voltage at digit/analog pins in POWER DOWN mode	-0.25	0.25	V

### 5.2 Operating temperatures

The operating temperature is listed in following table:

**Table 27: SIM5210 operating temperature**

Parameter	Min	Typ	Max	Unit
Ambient temperature	-20	25	60	°C
Restricted operation*	-30 to -20		60 to 80	°C
Storage temperature	-40		+85	°C

\* SIM5210 can work, but the deviation from the GSM specification may occur.

### 5.3 Power supply ratings

**Table 28: SIM5210 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	4.0	4.4	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<200kHz @ f>200kHz			50 2	mV	
I <sub>VBAT</sub>	Average supply current	POWER DOWN mode SLEEP mode ( BS-PA-MFRMS=2 )		35 3.4		uA mA	
		IDLE mode EGSM 900 DCS1800/ PCS1900 UMTS		23 23		mA	
		TALK mode EGSM 900 DCS1800/ PCS1900 UMTS			280 190	mA	
		DATA mode, GPRS (3 Rx,2Tx) EGSM 900 DCS1800/ PCS1900		490 340		mA	
		DATA mode, GPRS (4 Rx,1Tx) EGSM 900 DCS1800/ PCS1900		290 220		mA	
		DATA mode,EDGE EGSM 900 DCS1800/PCS 1900		TBD			
		DATA mode HSDPA					

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Peak supply current (during transmission slot every 4.6ms)	Power control level for Pout max.		2	3	A
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**5.4 Current consumption**

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

**Table 29: SIM5210 current consumption**

<b>Voice Call</b>	
GSM 900	@power level #5 <350mA, Typical 260mA @power level #10, Typical 130mA @power level #19, Typical 86mA
DCS1800/ PCS1900	@power level #0 <300mA, Typical 200mA @power level #10, Typical 87mA @power level #15, Typical 80mA
WCDMA 2100	TBD
<b>GPRS Data</b>	
<b>DATA mode, GPRS ( 1 Rx,1 Tx ) CLASS 8</b>	
GSM 900	@power level #5 <350mA, Typical 260mA @power level #10, Typical 125mA @power level #19, Typical 84mA
DCS1800/ PCS1900	@power level #0 <300mA, Typical 200mA @power level #10, Typical 83mA @power level #15, Typical 76mA
HSDPA 2100	TBD
<b>DATA mode, GPRS ( 3 Rx, 2 Tx ) CLASS 10</b>	
GSM 900	@power level #5 <550mA, Typical 470mA @power level #10, Typical 225mA @power level #19, Typical 142mA
DCS1800/ PCS1900	@power level #0 <450mA, Typical 340mA @power level #10, Typical 140mA @power level #15, Typical 127mA
<b>DATA mode, GPRS ( 4 Rx,1 Tx ) CLASS 8</b>	
GSM 900	@power level #5 <350mA, Typical 270mA @power level #10, Typical 160mA @power level #19, Typical 120mA
DCS1800/ PCS1900	@power level #0 <300mA, Typical 220mA @power level #10, Typical 120mA @power level #15, Typical 113mA

Class 10 is default set when the module work at data translation mode, the module can also work at class 8 set by AT command.

### 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, so the user should consider in the final product, and therefore, they are only protected according to the Human Body Model requirements.

**Table 30: The ESD endure statue measured table (Temperature: 25°C, Humidity:45% )**

Part	Contact discharge	Air discharge
VBAT,GND	±4KV	±8KV
KBR0-4, DTR, RXD, TXD, RTS, DISP_DATA, DISP_CLK	±2KV	±4KV
Antenna port	±2KV	±4KV
Other port	±1KV	

## 6 Mechanics

This chapter describes the mechanical dimensions of SIM5210.

### 6.1 Mechanical dimensions of SIM5210

Following are SIM5210 top view, side view and bottom view. These show you Mechanical dimensions of SIM5210.

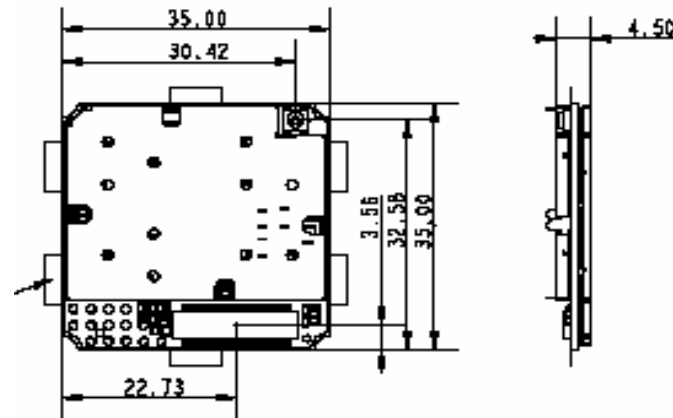


Figure 19: Mechanical dimensions of SIM5210 (Unit: mm)

### 6.2 Mounting SIM5210 onto the application platform

Use the connector AXK770347WG and four mounting pads fix the SIM5210 onto customer platform.

### 6.3 Board-to-board connector

We recommend user adopt NAIS AXK870145WG as the Board to board connector. 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. Following is parameter of AXK770347WG and AXK870145WG, For more details, you can login <http://www.NAIS-E.com> for more information.

### 6.3.1 Mechanical dimensions of the NAIS AXK770347WG

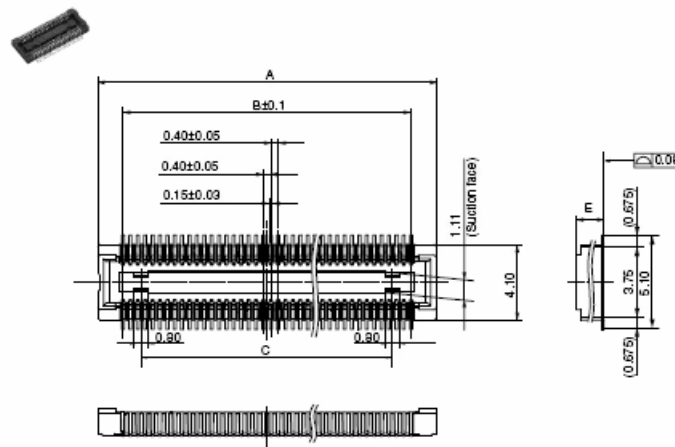


Figure 20: NAIS AXK770347WG board-to-board connector pin side

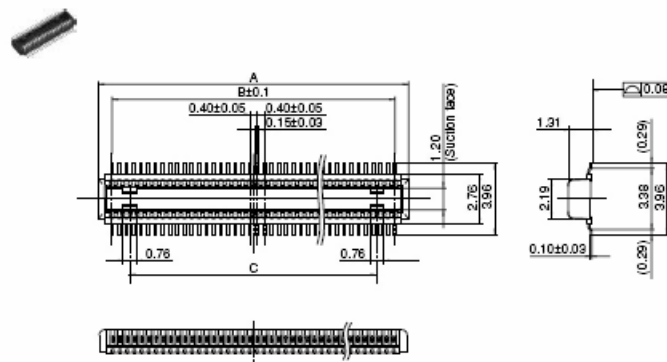


Figure 22: NAIS AXK870145WG board-to-board connector pin side

**NOTE:**

The connector NAIS AXK770347WG is used in socket side (SIM5210 module) and NAIS AXK870145WG is used pin side (user side).

## 6.4 RF adapter cabling

The RF connector in module side is Murata Company Microwave Coaxial Connectors MM8430-2610RB3, it makes a pair with Murata Company RF connector MXTK. 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.

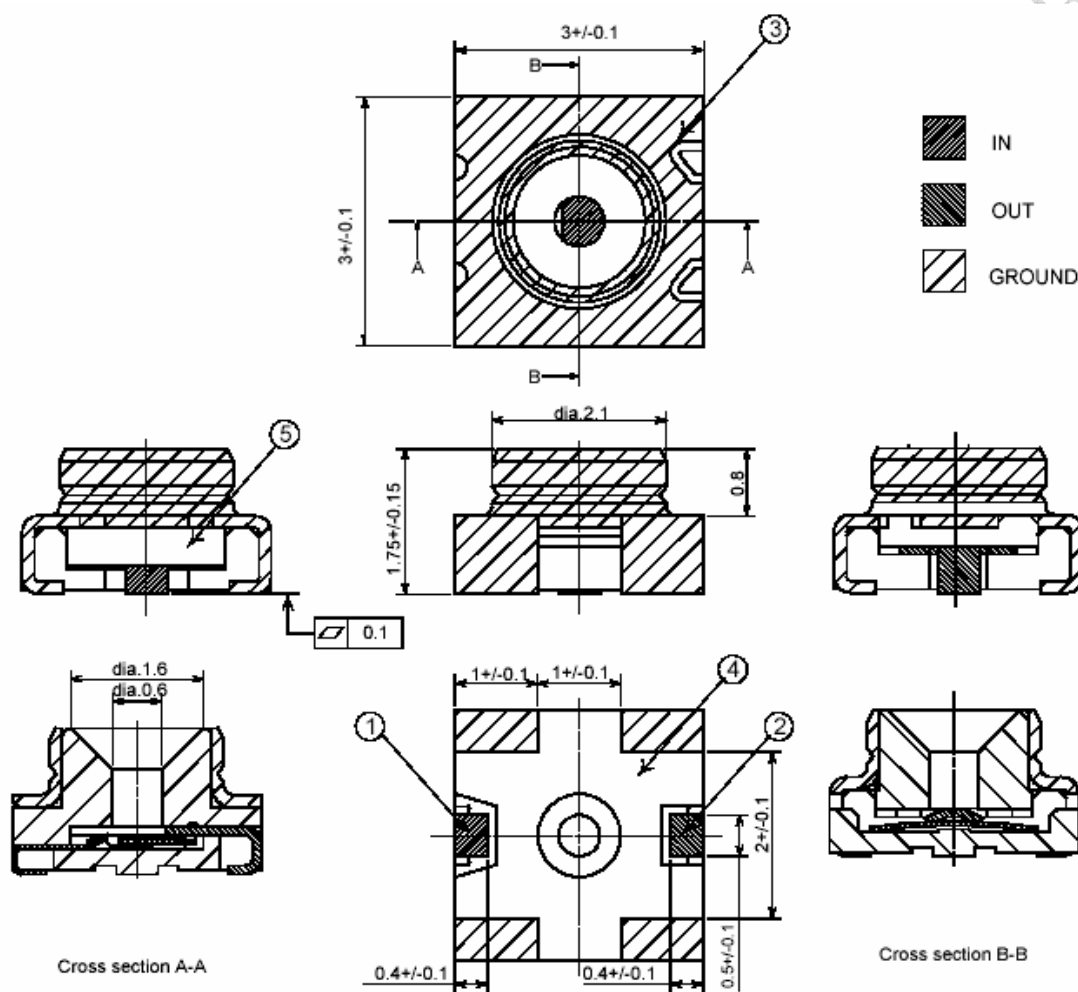


Figure 21: MM8430-2610RB3

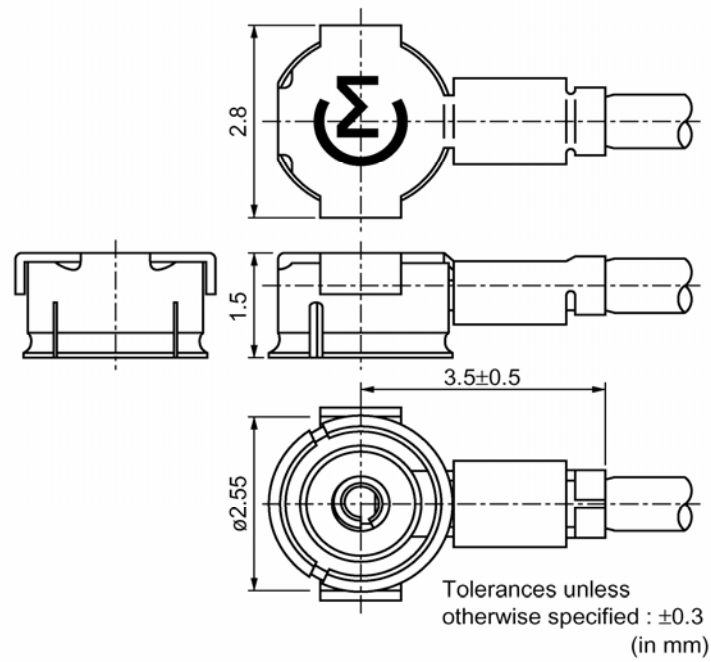
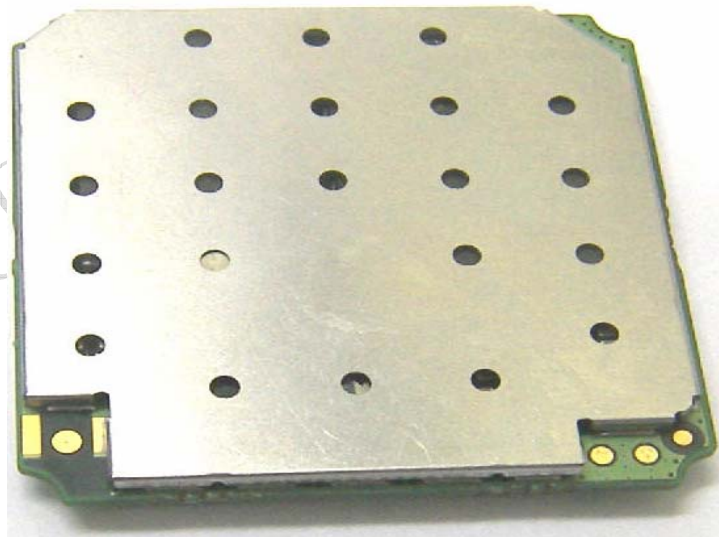


Figure 22: RF connector MXTK

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

#### 6.5 view of the SIM5210

Top view:



Bottom View



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## 6.6 PIN assignment of board-to-board connector of SIM5210

Table 31 : Connection diagrams

引脚号	定义	引脚号	定义
1	VBAT	70	VBAT
2	VBAT	69	VBAT
3	VBAT	68	VBAT
4	GND	67	GND
5	GND	66	GND
6	URAT_TXD	65	GPIO
7	UART_CTS	64	UART_RXD
8	UART_DCD	63	UATR_RTS
9	USB_VBUS	62	UART_DTR
10	VDD_EXIT	61	UART_RI
11	VRTC	60	USB_DP
12	USIM_CLK	59	USB_DM
13	USIM_RESET	58	GND
14	CAM_D0	57	V_USIM
15	CAM_D2	56	USIM_DATA
16	CAM_D4	55	CAM_D1
17	CAM_D6	54	CAM_D3
18	CAM_D8	53	CAM_D5
19	CAM_HSYNC	52	CAM_D7
20	GND	51	CAM_D9
21	CAM_CLK	50	CAM_VSYNC
22	CAM_STANDBY	49	CAM_PCLK
23	SPK_P	48	CAM_RESET
24	SPK_N	47	IIC_SDA
25	EAR_P	46	IIC_SCL
26	EAR_N	45	POWER_ON
27	HPR	44	MIC_N
28	HPL	43	MIC_P
29	Reset	42	HP_MICP
30	PCM_YNC	41	LINE_IN_L
31	PCM_CLK	40	LINE_IN_R
32	PCM_DIN	39	SD_DATA3
33	PCM_DO	38	SD_DATA2
34	SD_CLK	37	SD_DATA1
35	SD_CMD	36	SD_DATA0

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