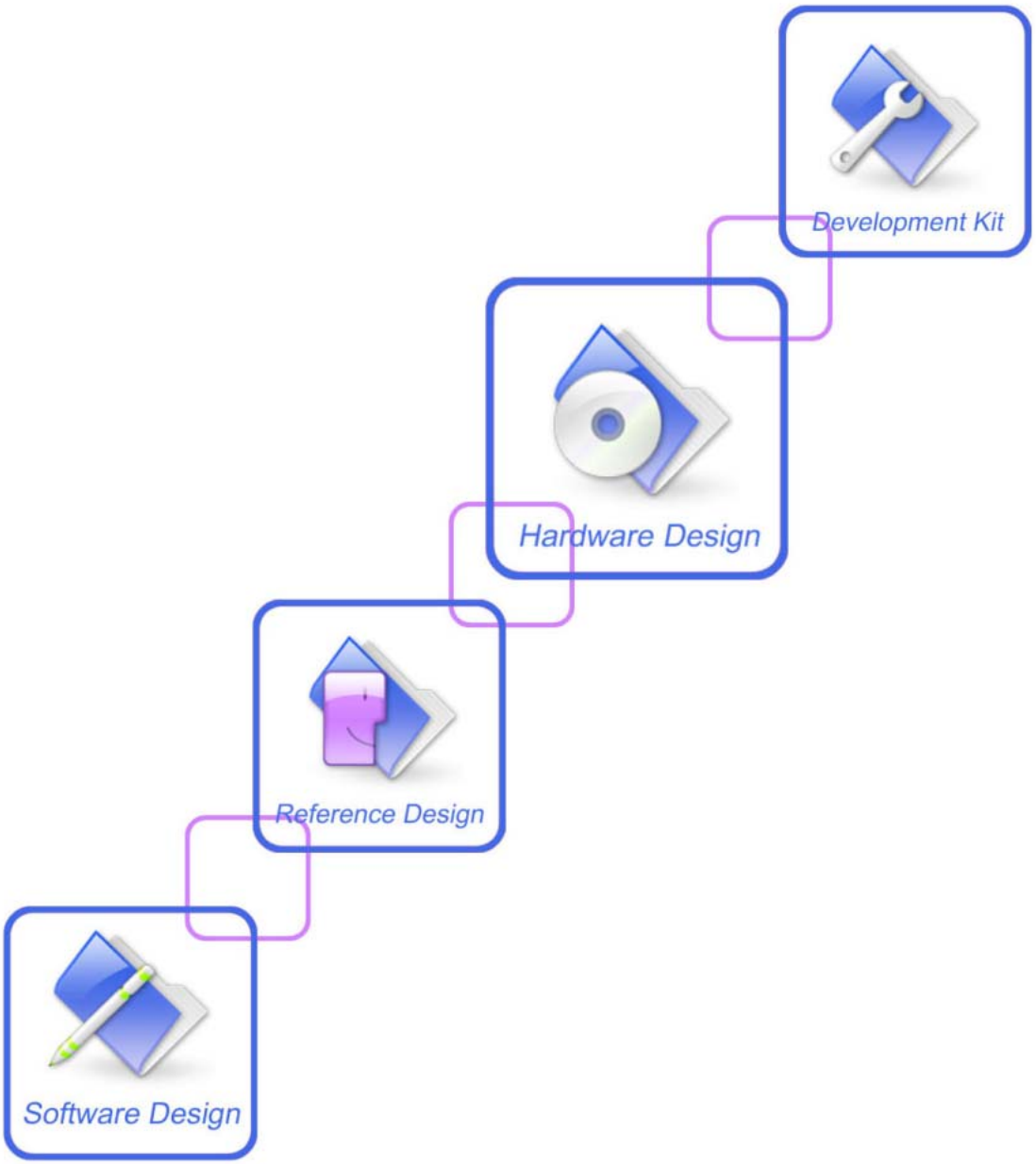
Hardware Design

SIM5215E_HD_V1.01



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General Notes

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Version history

Data	Version	Description of change	Author
2010-1-15	01.01	Origin	

Contents

1 Introduction

This document describes the hardware interface of the SIMCOM SIM5215E module that connects to the specific application and the air interface. As SIM5215E can be integrated with a wide range of applications, all functional components of SIM5215E are described in great detail.

This document can help you quickly understand SIM5215E interface specifications, electrical and mechanical details. With the help of this document and other SIM5215E application notes, user guide, you can use SIM5215E module to design and set-up mobile applications quickly.

1.1 Related documents

Table 1: Related documents

SN	Document name	Remark
[1]	SIM5215E_ATC_V1.00	SIM5215E_ATC_V1.00
[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
[10]	3GPP TS51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station(MS) conformance specification
[11]	3GPP TS34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[14]	3GPP TS34.123-3	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 TS51.010-1	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
HSUPA	High Speed Uplink 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
A-GPS	Assisted Global positioning system
GPS	Global positioning system
S-GPS	Simultaneous Global positioning system

2 Product concept

Designed for global market, SIM5215E is a tri-band GSM/GPRS/EDGE and dual-band UMTS engine that works on frequencies of GSM 850MHz, EGSM 900 MHz, DCS 1800 MHz, and WCDMA 2100M/900M. SIM5215E 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: MCS1-9, UL coding schemes: MCS1-9.

With a tiny configuration of 36mm × 26mm × 4.5mm, SIM5215E can fit almost all the space requirements in your applications, such as AMR, POS, Telematics 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 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, also can be multiplex as a PCM interface.
- Three audio channels include two microphones inputs and three audio outputs. This can be easily configured by AT command.
- A camera interface is provided, all pins of camera interface can be configured as GPIOs..
- An I2C interface is provided.
- An ADC interface
- A LDO power output
- A 4 bit SD card interface
- A PCM interface

The SIM5215E 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 SIM5215E 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. FTP/HTTP/ SMTP/POP3/ MMS/ LUA Script is intergrated in SIM5215E too.

Note: The SIM5215E has two kinds of interface (UART and USB) to connect to host CPU.

USB interface is mapped to five virtual ports: "SIMTECH USB Modem", "SIMTECH NMEA Device", "SIMTECH ATCOM Device", "SIMTECH Diagnostics interface" and "SIMTECH Wireless Ethernet Adapter". UART, "SIMTECH USB Modem" and "SIMTECH ATCOM Device" could respond to AT command, and URC report to these three ports at the same time, but user could set dedicated port to receive URC (Unsolicited Result Code).

The SIM5215E also provides a PCM interface. The PCM interface is a 4 pin, digital interface that enables PCM communication between the Module and an external codec. PCM interface pins are multiplex on GPIOs. Use AT+CPCM command to enable PCM function and configure the mode that you want. SIM5215E supports 3 PCM formats: 8 bits (υ-law or A-law) and 16 bits (linear). Please refer to section 3.18 and 3.8.5.5.

SIM5215E key features at a glance:

Table 3: SIM5215E key features

Feature	Implementation
Power supply	Single supply voltage 3.3V – 4.2V
Power saving	Please refer to Table 38
Frequency bands	● GSM: 850M/ 900M/ DCS 1800M ● WCDMA: 2100M/900M ● The SIM5215E can worked in GSM and WCDMA mode ● The frequency bands also can be set by AT COMMAND.
Transmit power	●Class 4 (+33dBm ±2dB) for GSM850 ●Class 4 (+33dBm ±2dB) for EGSM900 ●Class 1 (+30dBm ±2dB) for GSM1800 ●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 3 (+24dBm +1.7/-3.7dB) for WCDMA 2100, WCDMA FDD BDI ●Class 3 (+24dBm +1.7/-3.7dB) for WCDMA 900, WCDMA FDD BDVIII
GPRS/EDGE connectivity	● GPRS/EDGE multi-slot is up to class 12 ● GPRS mobile station class B
Temperature range	● Operating Temperature: -30°C to +80°C ● Storage temperature -40°C to +85°C
DATA *GPRS:* *CSD:*	● 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 ● SIM5215E supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections. ● The SIM5215E 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 – MCS 1-9 ● Uplink coding schemes – MCS 1-9 ● BEP reporting and test mode B ● 8-bit, 11-bit RACH ● PBCCH support ● phase/2 phase access procedures
DATA WCDMA	● R99
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 (ETS06.20) ● Full Rate (ETS06.10) ● Enhanced Full Rate (ETS06.50 / 06.60 / 06.80) ● AMR(WCDMA) ● AMR+QCP(GSM) ● A5/1, A5/2, and A5/3 ciphering
Serial interface	● Serial Port 8-line or 3-line mode 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: 36 mm ×26mm ×4.5 mm Weight: 7g
Firmware upgrade	Firmware upgrade over USB interface
PCM	Multiplex on GPIOs. 3 formats: 8 bit (υ-law or A-law) and 16 bit (linear).

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 SIM5215E to the customers' cellular application platform is through a 70-pin 0.4mm pitch board-to-board connector. Figure 1 is SIM5215E system overview. Figure 2 is SIM5215E block diagram. Sub-interfaces included in this board-to-board connector are described in detail in following chapters:

- Power supply
- USB interface
- Serial interface
- Analog audio interfaces
- SIM interface
- GPIO
- ADC
- LDO Power output
- PCM interface
- MMC/SD interface
- Camera interface
- RTC
- I2C interface

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

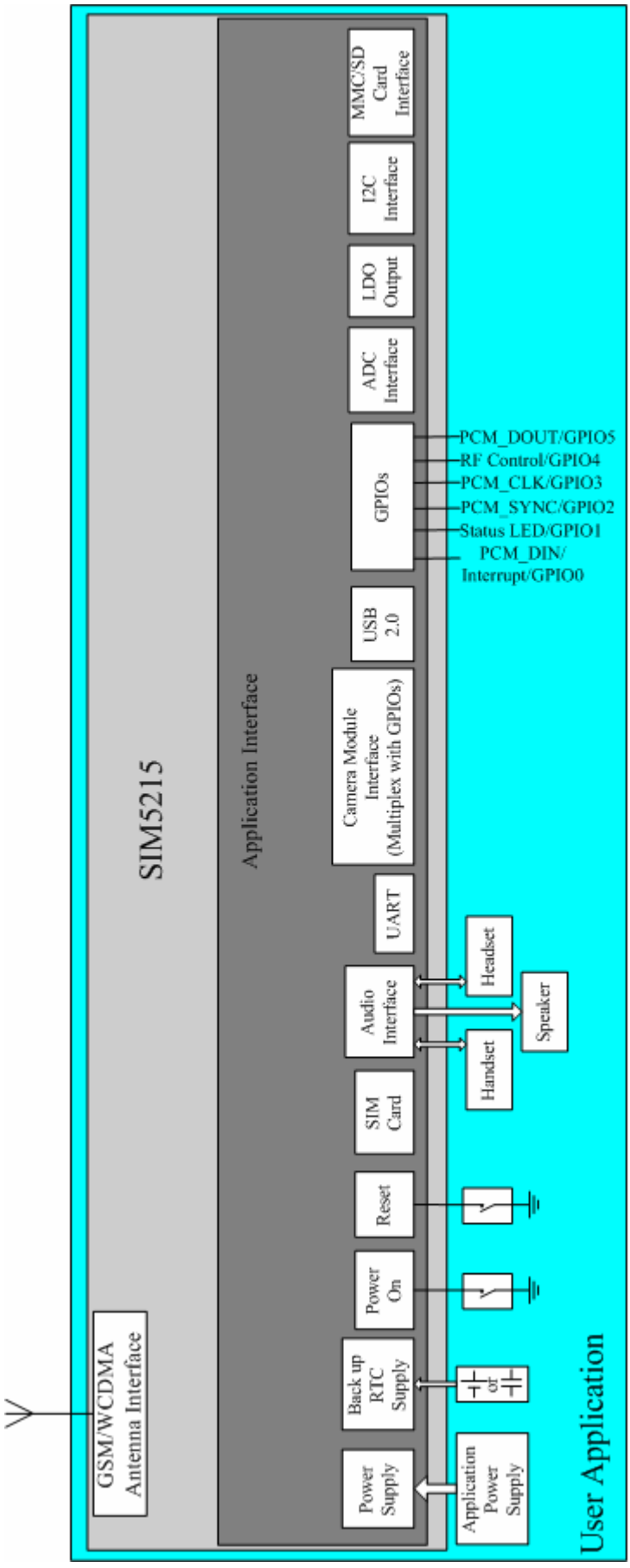


Figure 1: SIM5215 system view

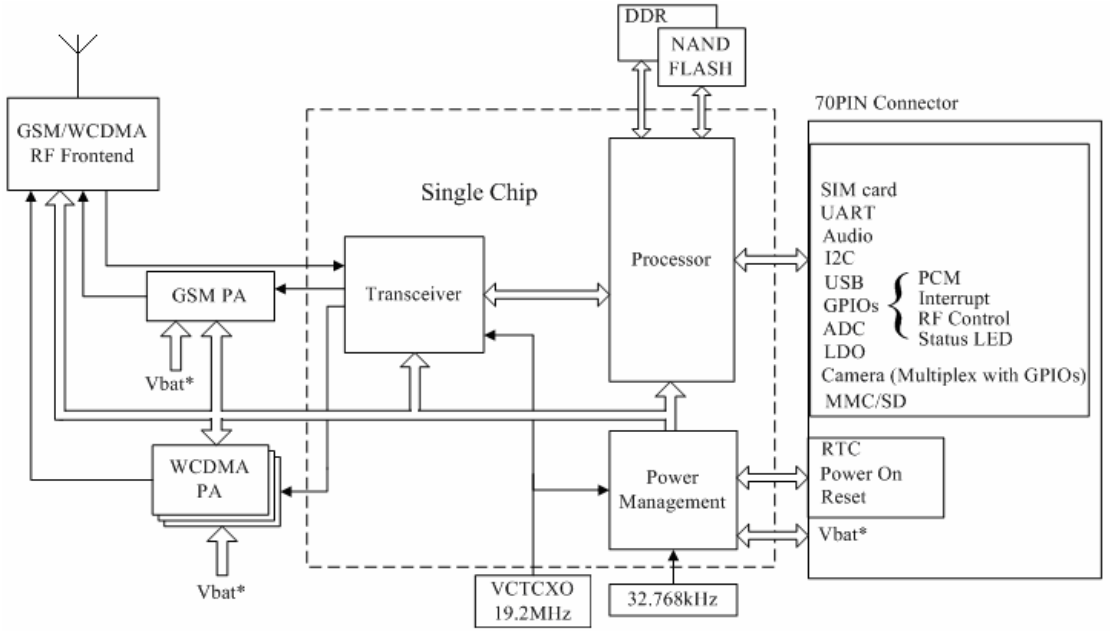


Figure 2: SIM5215E block diagram

3.1 SIM5215E 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 SIM5215E has to be a single voltage source of VBAT= 3.3V...4.4V. It must be able to provide sufficient current in a transmit burst which typically rises to 2A. Mostly, these six pins are voltage input	Vmax=4.2V Vmin=3.3 V Vnorm=3.8V
VRTC		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. If not in use, left it open.	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 the system. It has been pulled up to	VILmax=0.2*VBAT VIHmin=0.6*VBAT VImax=VBAT

		VBAT in module. The user should keep it to low level for at least 64mS when power on or power off the system because the system needs margin time to assert the software.	
Audio interfaces			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
MIC_P MIC_N	I	Positive and negative voice-band input If not in use, connect to ground through a 100N capacitor.	Audio DC Characteristics refer to chapter 3.8.4
HP_MICP	I	Auxiliary positive voice-band input, if not in use, connect to ground through a 100N capacitor.	
EAR_P EAR_N	O	Positive and negative voice-band output, if not in use ,left open	
HPR HPL	O	Auxiliary right channel and left channel voice-band output, if not in use, left open.	
SPK_P SPK_N	O	Loud Speaker Output, if not in use ,left open	
HKADC	I	Analog Digital Converter Input	
VREG_AUX	O	LDO power output	This LDO default output voltage is 2.85V, and driver current is rated for 250mA.
USB			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
USB_VBUS	I	USB power supply input, if not in use, left open.	Vmax=5.25V Vmin=4.4V Vnorm=5.0V
USB_DP	I/O	Plus (+) line of the differential, bi-directional USB signal to/from the peripheral device. If not in use, left open.	They are compliant with the USB 2.0 specification.
USB_DM	I/O	Minus (-) line of the differential, bi-directional USB signal to/from the peripheral device. If not in use, left open.	
Serial interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
UART_DTR	I	Data Terminal Ready, if not in use, left open.	VILmin=0V VILmax=0.3*VDD_EXT* VIHmin=0.7*VDD_EXT VIHmax=VDD_EXT+0.3 VOLmin=GND VOLmax=0.2V
UART_RXD	I	Receive Data, which has been pulled down with a 15kR resistor to ground in module, if not in use, left open. So please don't pull up or pull down in your application circuit.	

UART_TXD	O	Transmit Data, if not in use, left open.	
UART_RTS	O	Request to Send, if not in use, left open.	
UART_CTS	I	Clear to Send, if not in use, left open.	
UART_RI	O	Ring Indicator, if not in use, left open.	
UART_DCD	O	Data Carrier detection, if not in use, left open.	
Camera interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
CAM_D2	I	Bit 2 of RGB or YUV D0 video component input	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 All camera pins can be configured as GPIOs. Detail description refer to chapter 3.16.
CAM_D3	I	Bit 3 of RGB or YUV D1 video component input	
CAM_D4	I	Bit 4 of RGB or YUV D2 video component input	
CAM_D5	I	Bit 5 of RGB or YUV D3 video component input	
CAM_D6	I	Bit 6 of RGB or YUV D4 video component input	
CAM_D7	I	Bit 7 of RGB or YUV D5 video component input	
CAM_D8	I	Bit 8 of RGB or YUV D6 video component input	
CAM_D9	I	Bit 9 of RGB or YUV D7 video component input	
CAM_HSYNC	I	Video horizontal line synchronization signal input	
CAM_VSYNC	I	Vertical sync input	
CAM_CLK	O	master clock output	
CAM_PCLK	I	Pixel clock input	
CAM_RESET	O	Master reset out, active low	
CAM_STANDBY	O	Power-down mode selection “0”=Normal mode, “1”=Power-down mode	
USIM interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
V_USIM	O	Voltage Supply for SIM card	The voltage can be selected by software to be either 1.8V or 3V
USIM_DATA	I/O	SIM Data Output/Input, which has been pulled up with a 22kR resistor to V_USIM in module. So please do not pull up or pull down in your application circuit.	VILmin=0V VILmax=0.3*V_USIM VIHmin=0.7* V_USIM VIHmax=V_USIM +0.3

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 in use, left open. It has been pulled up with a 2.2kR resistor to 2.6V in module. So there is no need to pull up it in your application circuit.	
IIC_SCL	O	I2C clock output, if not in use, left open. It has been pulled up with a 2.2kR resistor to 2.6V in module. So there is no need to pull up it in your application circuit.	
Other interface			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
Reset	I	System reset in, active low.	Reset pin has been pulled up in SIM5215E. Detail description refer to chapter 3.12.
GPIO0/PCM_DIN	I	General Input PIN with interrupt. If not in use, left open. It also can be multiplexed as the PCM_DIN pin.	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/PCM_SYNC	I	General Input PIN. If not in use, left open. It also can be multiplexed as the PCM_SYNC pin.	
GPIO3/PCM_CLK	O	General Output PIN. If not in use, left open. It also can be multiplexed as the PCM_CLK pin.	
GPIO4	I	RF Control: Flight Modem switch	
GPIO5/PCM_DOUT	O	General Output PIN. If not in use, left open. It also can be multiplexed as the PCM_DOUT pin.	

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 will be referred to in the following chapters.

Table 6: Overview of operating modes

Mode	Function	
Normal operation	Module Power Off mode	Module will go to Power off mode when the Power_on pin has been pushed low for 2 Seconds.
	Module sleep	Module will automatically go into sleep mode when there is no interrupt input or other operation. In this case, the current consumption of module will be reduced 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.
POWER DOWN	Normal shutdown is by sending the "AT+CPOF" 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 of 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 SIM5215E is from a single voltage source of VBAT= 3.3V...4.2V. In some cases, the ripple in a transmit burst may cause voltage drops when current consumption rise typically to peak 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 one uses a Li battery. When you use a DC supply the Capacitor must be a 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 SIM5215E VBAT pins. The following figure is the recommended circuit.

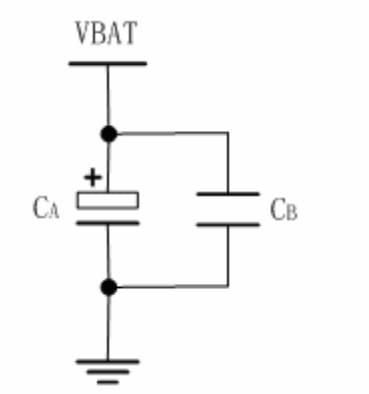


Figure 3: VBAT input

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=1 μF.

Figure 4: VBAT voltage drop at the maximum power transmit phase (GSM)

And make sure that the capacitor is close to VBAT pins of 70 pins connector. If a DC/DC or LDO is used for power supply of the module, you should make sure that the peak current of power supply can rise up to 2A(4.2V). The reference design is putting one big capacitor at the output of the DC/DC or LDO, and another big capacitor beside the 70 pins connector.

Note: If a DC/DC or LDO is used as power supply, besides a big capacitor close to the 70-pin

connector, another big capacitor (typically a 100 µF tantalum capacitor) is suggested to be put at the output pin of the DC/DC or LDO.

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 3.3V even in a transmit burst during which the current consumption may rise up to 2A. If the power voltage drops below 3.3V, 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.

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 of 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 SIM5215E

SIM5215E can be turned on by various ways, which are described in the following chapters:

- Via POWER_ON pin: starts normal operating mode;

POWER_ON has been pulled up to VBAT in module. You can turn on the SIM5215E by driving the POWER_ON to a low level voltage for period time. The power on scenarios illustrate as following figure.

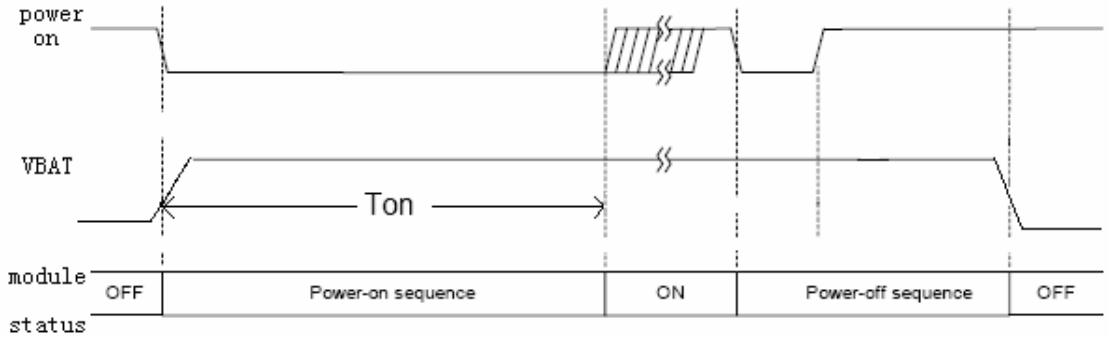


Figure 5: Timing of turn on system

Note1: Ton >= 64ms.

Note2: Commonly, the AT command can be set 2-3S after the SIM5215E is powered on.

If VBAT was supplied to SIM5215E, SIM5215E could be automatically powered on by connecting the Power ON pin to Low level directly. In automatically powering on mode, it is suggested that the SIM5215E should reset by RESET pin after power on. Below is the reference circuit.

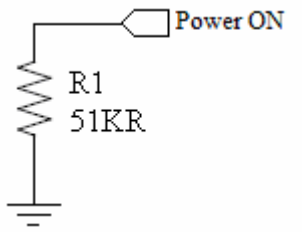


Figure 6: Automatic power on

Note: The POWER_ON has been pulled up with a 250kR resistor to VBAT in module. Make sure that VILmax=0.2*VBAT, and the value of R1 above can be changed as you want.
In automatically powering on mode, it is suggested that the SIM5215E should reset by RESET pin after power on. If SIM5215E

3.4.2 Turn off SIM5215E

Following procedure can be used to turn off the SIM5215E:

- Normal power down procedure: Turn off SIM5215E using the POWER_ON pin
- Normal power down procedure: Turn off SIM5215E using AT command

3.4.2.1 Turn off SIM5215E using the POWER_ON pin (Power down)

You can turn off the SIM5215E by driving the POWER_ON to a low level voltage for period time. The low level period of the POWER_ON is about 64mS.

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

3.4.2.2 Turn off SIM5215E using AT command

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

Please refer to AT command manual for details of the AT command "AT+CPOF".

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 3.4V, the following URC will be presented:

POWER LOW WARNNING

If the measured battery voltage is no more than 3.3V, the following URC will be presented:

POWER LOW DOWN

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

3.5 Power saving

There are two methods to achieve SIM5215E 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, 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 both transmit and receive RF circuits of the phone;

If SIM5215E 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 SIM5215E 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 SIM5215E 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 SIM5215E module to enter or exit the Flight mode in customer applications. In Flight mode, SIM5215E closes RF function. If GPIO4 is left open, SIM5215E enters normal mode. But it is suggested that GPIO4 should not be left open. Because GPIO4 is sensitive to ESD, so bidirectional ESD protection component is suggested to add on GPIO4.

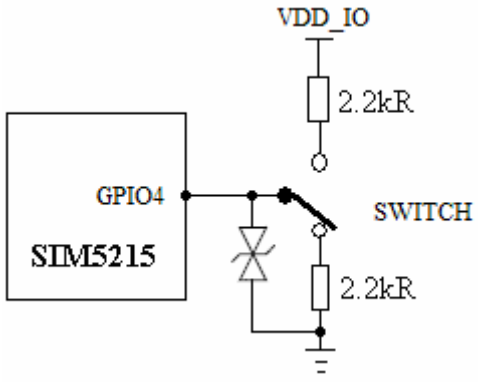


Figure 7: Flight mode switch

Table 7: logic of flight mode switch

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 stops working, and there is no on air or audio activity required and no hardware interrupt (such as GPIO interrupt or data on serial port), SIM5215E will enter SLEEP mode automatically. In this mode, SIM5215E can still receive paging or SMS from network. If USB interface of SIM5215E is connecting with host CPU,and host CPU support USB suspend mode, SIM5215E could enter sleep mode. Otherwise SIM5215E could not enter sleep mode.

3.5.4 Wake up SIM5215E from Sleep Mode

When SIM5215E is in SLEEP mode, the following method can wake up the module.

- USB interface active
- Receive a voice or data call from network to wake up SIM5215E.
- Receive a SMS from network to wake up SIM5215E.
- Receive a interrupt signal from GPIO0
- GPIO4 state change.
- Receive AT command from UART.
- UART DTR signal changed.

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. The module could update local time based on universal time and time zone from network. (This feature must be supported by the network). If this feature is used, please refer to AT command AT+CTZU and AT +CTZR.

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.

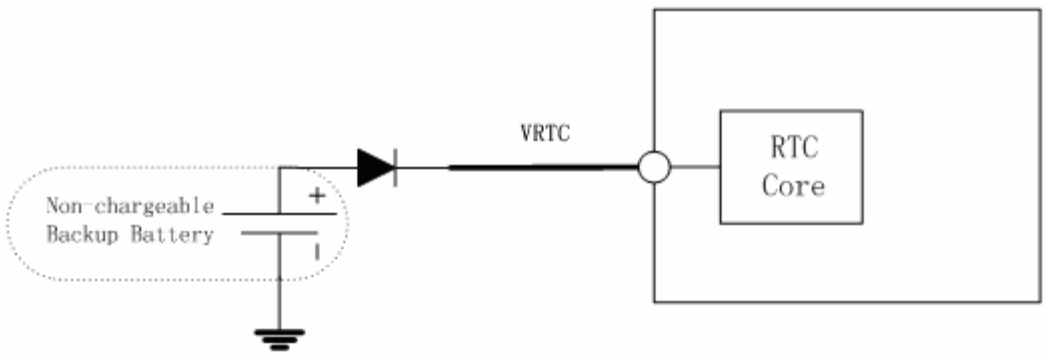


Figure 8: RTC supply from non-chargeable battery

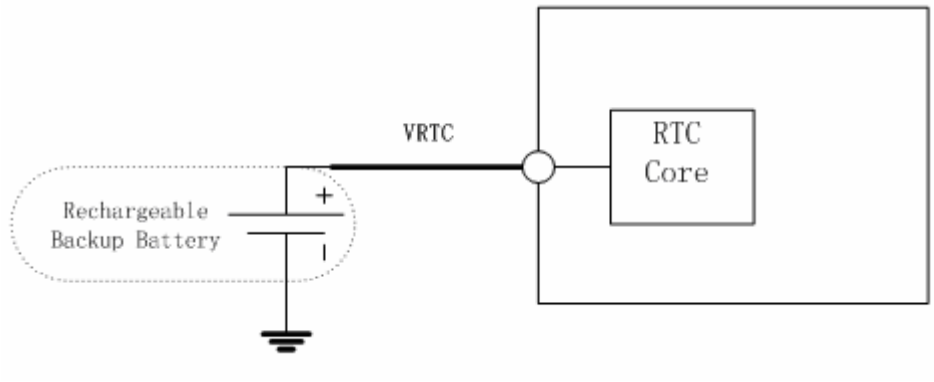


Figure 9: RTC supply from rechargeable battery

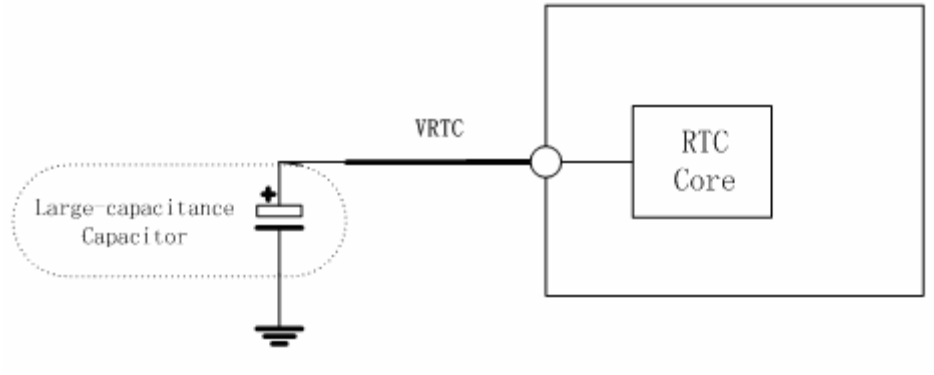


Figure 10: RTC supply from capacitor

- **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 cell 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 are generally pre-charged from the vendor.

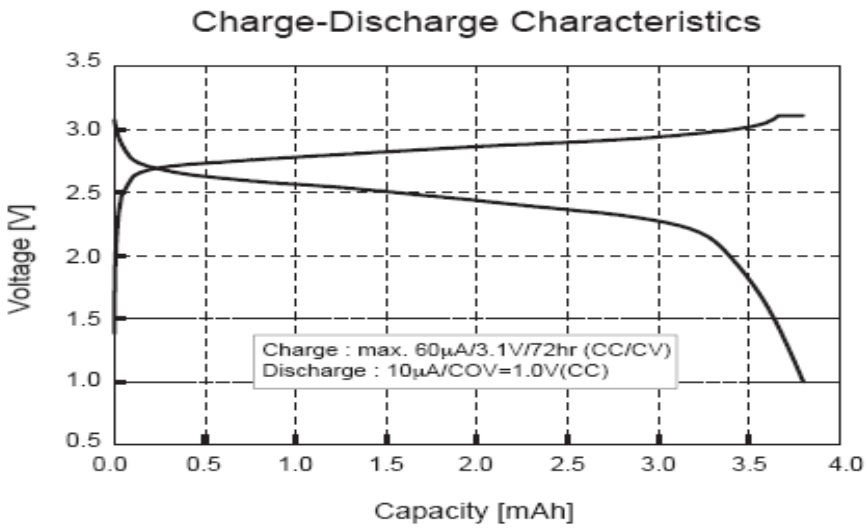


Figure 11: Seiko MS518 Charge and discharge Characteristic

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 interface

SIM5215E 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).

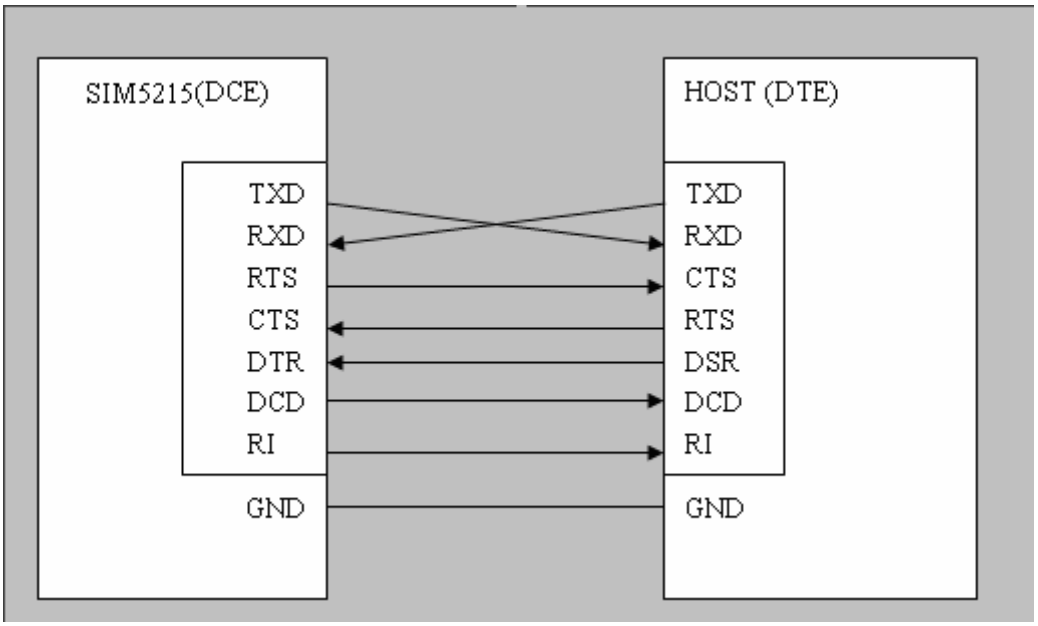


Figure 12: Interface of serial ports

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 the following table

Table 8: 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.			

SIM5215E provides an AT command to support Null modem. Null modem mode uses two lines (RXD, TXD(GND not comprised)) to setup communication between devices. The lines connection is shown as below.

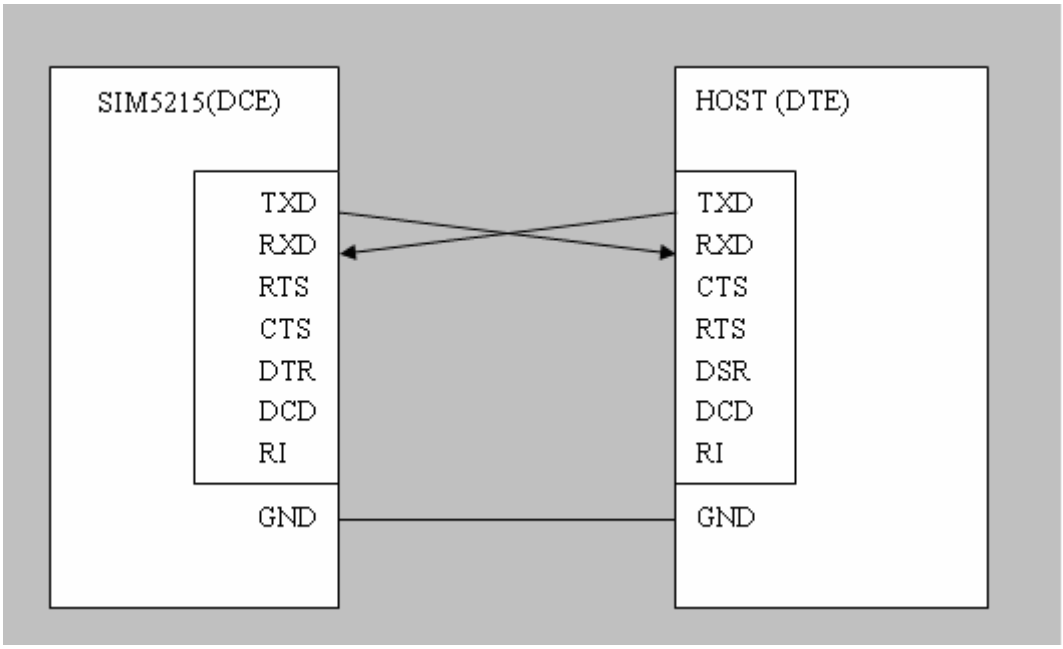


Figure 13: Null modem mode of serial ports

If serial port is used in Null Modem, the pin "RI" can be used as an interrupt pin. Normally it will stay high but in certain condition such as SMS receiving, incoming voice (CSD, video) call or URC reported, the pin "RI" will be set low to inform the master, and it will stay low until the

master clear this interrupt with AT command (AT+CRIRS). If using seven lines to setup communication between devices, the pin "RI" is different. First it stays high, when a voice (CSD) call coming, the pin "RI" is set to low for about 5900ms, then it is set high again about 100ms. The situation will repeat until that the call is answered or hung up. After the call is answered or hung up, the pin "RI" is set high.

Functions of serial port supporting on SIM5215E are as following:

- four-line/two-line mode on Serial Port Interface.
- Contains Data lines TXD and RXD, State lines RTS and CTS
- Serial Port can be used for CSD, PS service and send AT command for controlling module.
- Serial Port is a high-speed port. It supports the communication rate as following:
  300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400, 4000000
  Default band rate is 115200bps. And Data bits=8, Parity=None, Stop bits=1, Flow control=None.

NOTE:

1. ***If you need to use a speed higher than 115200, you should consider the length of RS232 line and the speed support on your RS232 port.***
2. ***Though the connector has seven lines for serial port, but the line: DCD, DTR are not implemented and reserved for future use.***
3. ***The line RI behaves the same as the standard when using four-line mode, but in two-line mode its action is not standard which is depicted above.***

Default setting in HyperTerminal software is as the following figure.

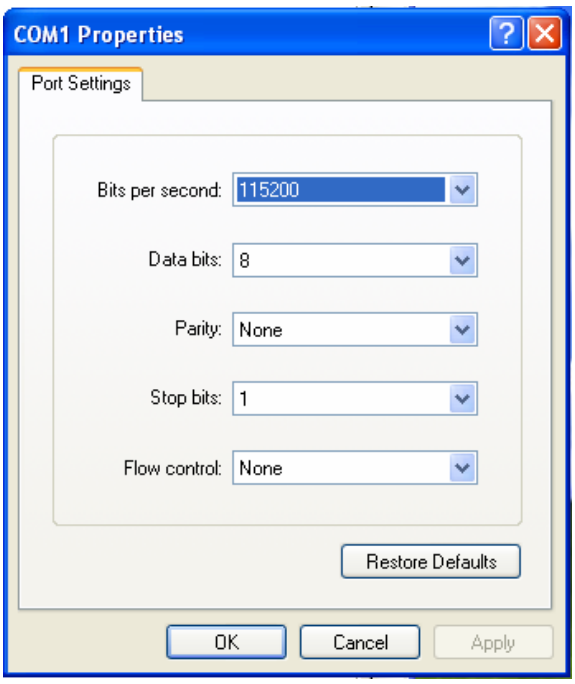


Figure 14 : settings of serial ports

3.8 Audio interfaces

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.

Table 9: 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

It is suggested that you adopt one of two following reference circuits in order to get well speaker effect. The different audio signals have to be routed according to different signal layout rules as in following figures:

3.8.1 Speaker interface configuration

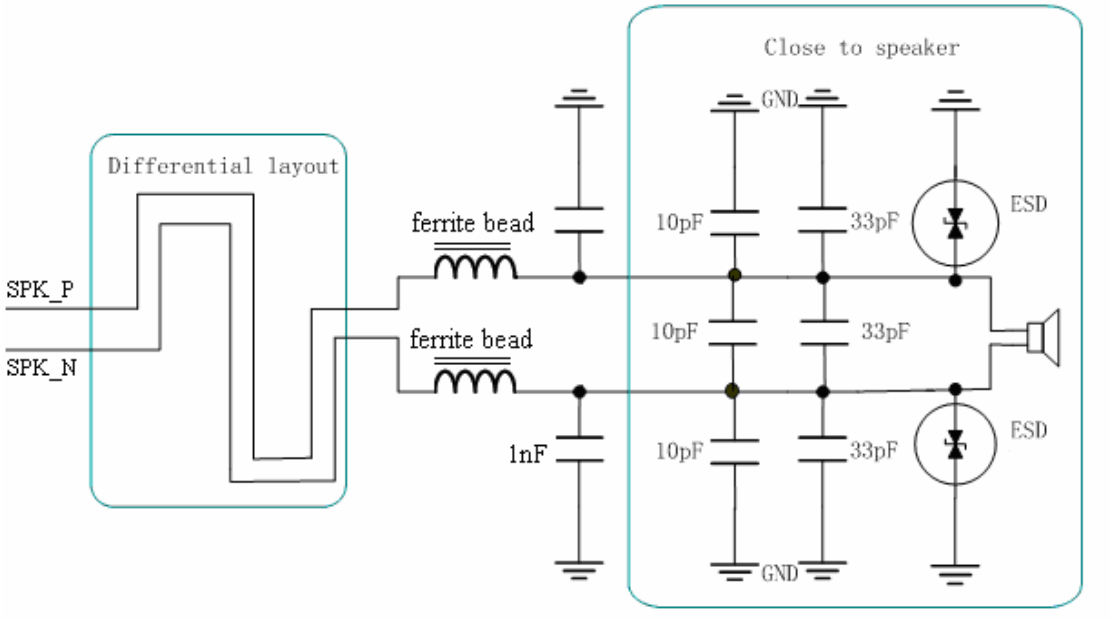


Figure 15: Speaker interface configuration

Because SPK_P and SPK_N are outputs of Class-D audio amplifier, optional EMI filtering is shown at Figure 15; these components (two ferrite beads and two capacitors) can be added to reduce electromagnetic interference. If used, they should be located near the SPK_P and SPK_N. Considerable current flows between the audio output pins and the speaker, so wide PCB traces are recommended (~ 20 mils).

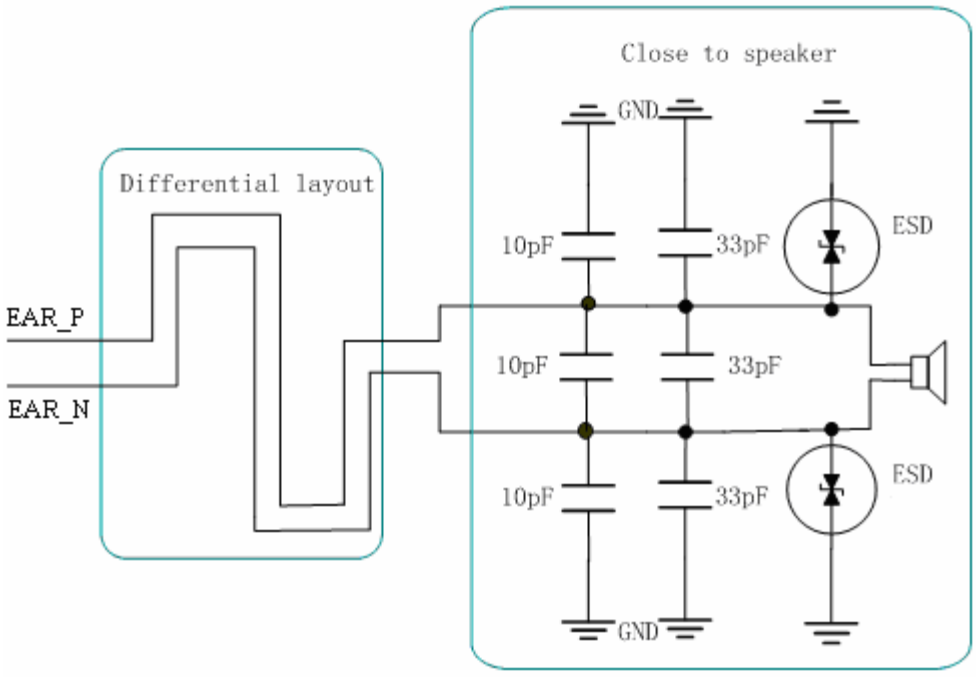


Figure 16: Receiver interface configuration

3.8.2 Microphone interfaces configuration

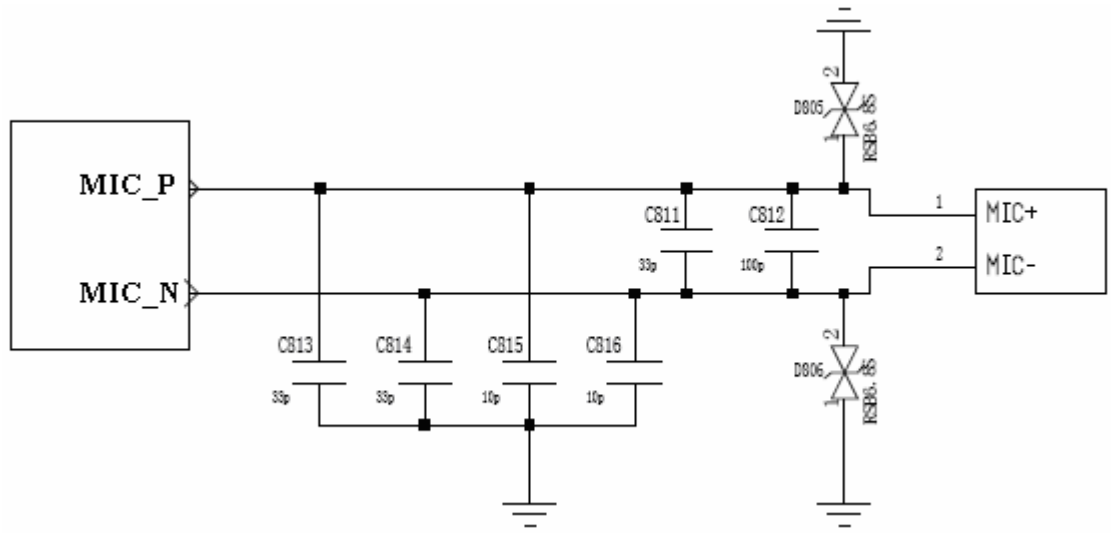


Figure 17: Microphone interface configuration

NOTE : There is no need to pull the MIC_P and MIC_N up to the external power, because they have been pulled up in the Module.

3.8.3 Earphone interface configuration

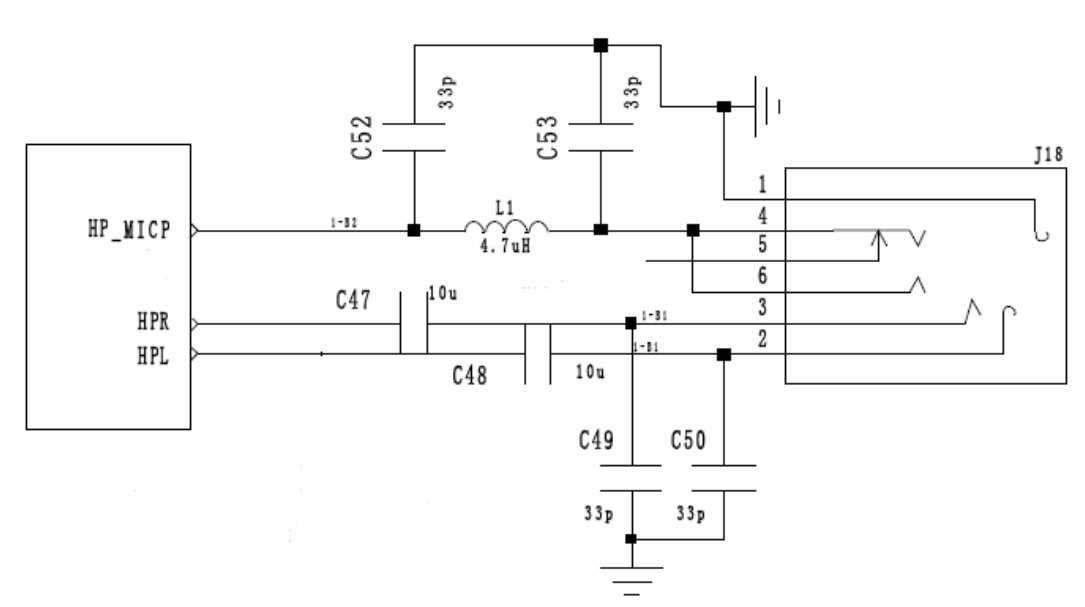


Figure 18: Earphone interface configuration

3.8.4 Referenced electronic characteristic

Table 10: 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 11: 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 12: 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+CMICAMP1, AT+SIDET, AT+CTXGAIN, AT+CRXGAIN, AT+CTXVOL, AT+CTXFTR, AT+CRXFTR as well as AT+CLVL,AT+CVLVL, AT+VMUTE, AT+MICMUT, AT+CSDVC, and AT+CPTONE. For a model of how the parameters influence the audio signal path see Section 3.8.5.2.

Table 13: Audio parameters adjustable by AT command

Parameter	Influence to	Range	Gain range	Calculation	AT command
micAmp1	MICP/MICN analogue amplifier gain before ADC	0…1	0…24dB	2 steps	AT+CMICAMP1
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+CLVL AT+CVLVL 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.

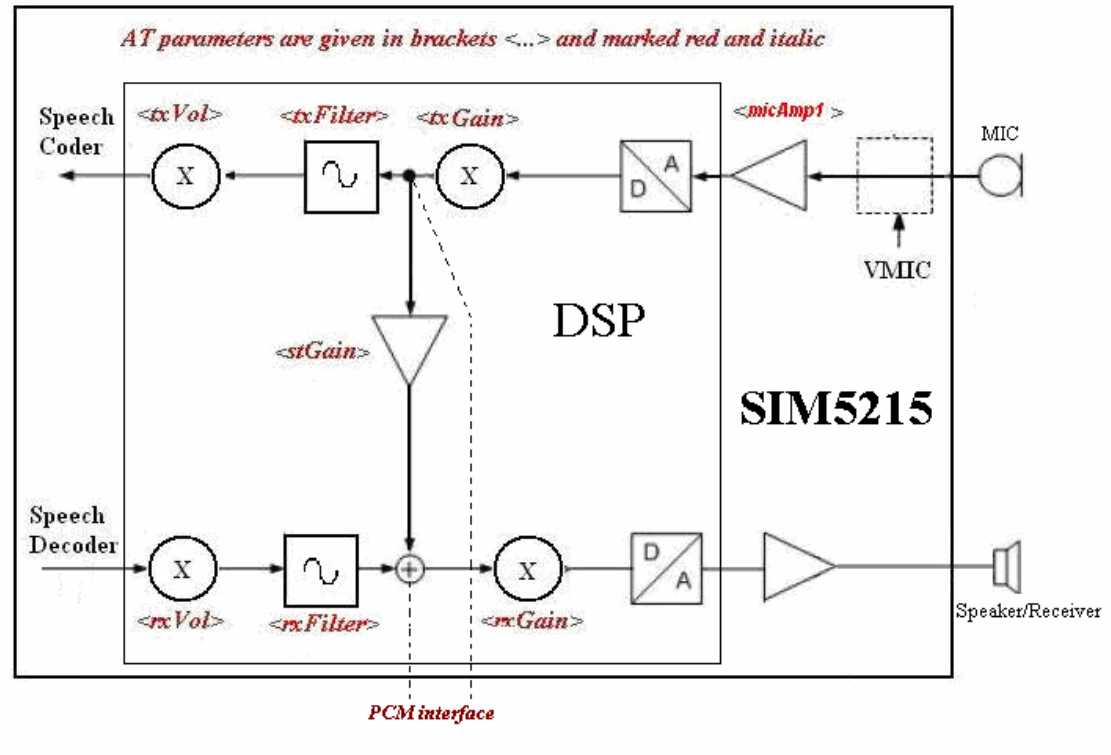


Figure 19: Audio programming model

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 14: Audio Characteristics

Audio Device no. AT+CSDVC=		**1**	**2**	**3**
Name		Handset	Headset	Speaker phone
Purpose		Default 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	micAmp1	0 (0 dB)	0 (0 dB)	0 (0 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

3.8.5.4 Adjust the sound level by AT+CVLVL

There are two adjustable amplifiers on audio signal output path: <rxVol>, <rxGain>. Four AT commands are provided for tune them..

<rxVol>: AT+CLVL, AT+CVLVL, AT+CRXVOL

<rxGain>: AT+CRXGAIN

AT+CRXVOL is used for fine tuning for <rxVol>. AT+CLVL and AT+CVLVL are used for coarse tuning for <rxVol>. AT+CVLVL changes the sound level values of the command CLVL. Now we provide 5 levels for each audio channel. The level 0 is muted and it can not be changed by CVLVL. Levels 1 to 4 are supported to change the value of sound level. CVLVL command

could let you change these four levels. The bigger the number presents the louder the voice. And the range of each level is -5000 to 5000.

NOTE: This command influences digital volume of output signal after speech decoder. Please check the reference document [1] for detailed information of each AT command.

3.8.5.5 External codec on PCM interface

SIM5215E provides PCM interface for external codec. PCM interface pins are multiplex on GPIOs. Use AT+CPCM command to enable PCM function and configure the mode you want.

The PCM interface is a 4 pin, digital interface that enables PCM communication between the Module and an external codec. SIM5215E supports 3 PCM formats: 8 bits (υ-law or A-law) and 16s bit (linear). Also the slot of PCM can be configured by AT+CPCMSLOT. Table below describes the pins.

Table 15: PCM pins

Pins	Pin No. on 70 pins	Description
PCM_CLK/GPIO3	31	PCM clock for PCM communication to external codec
PCM_SYNC/GPIO2	30	PCM data strobe for PCM communication to external codec
PCM_DIN/GPIO0	65	PCM data input to the Module (Tx)
PCM_DOUT/GPIO5	33	PCM data output from the Module (Rx)

PCM Interface can be operated in Master and Slave mode. When the PCM interface is configured, PCM Tx data will be routed from the external codec mic through the DSP encode path in the Module. PCM Rx data will be routed through the DSP decode path to the external codec speaker. When using the PCM Interface, the Module can be set either into Master Mode or Slave Mode. SIM5215E supports 3 PCM formats: 8 bit (υ-law or A-law) and 16 bit (linear).

In Master Mode, the Module drives the clock and sync signals that are sent out to the external codec via the PCM Interface. When in Slave Mode, the external codec drives the clock and sync signals that are sent to the Module.

Configuration Mode can be selected either primary or auxiliary. Primary configuration mode uses 2.048MHz clock and 8 kHz short sync clock, and auxiliary configuration mode uses 2.048MHz clock and 8 kHz long sync clock. One important consideration is that Slave mode is only available for use with Primary configuration Mode.

In the default configuration, Module is the Auxiliary Master.

Many parameters of external codec audio channel are not available. Only Rx Volume, FIR, are still available after enabling PCM.

Table 16: PCM external codec Characteristics

Audio Device no. AT+CSDVC=		4
Name		External Codec
Default MIC path Parameters	micAmp	No available
	txGain	No available
	txVol	No available
	txFilter [tap0~6]	0xff33, 0x05d8, 0xf488, 0x0af3, 0x24bb, 0xca42, 0x7c95
Default Output path Parameters	rxGain	No available
	rxVol	-100
	stGain	No available
	rxFilter [tap0~6]	0xff00, 0xfac9, 0x0571, 0xf365, 0x0bc2, 0xf2bb, 0x533a
Default values of sound level (level 1 to 4)		0 0 0 0

NOTE: Please check the reference document [1] for detailed information of each AT command. More information on PCM interface is in section 3.18.

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 the table below.

Table 17: USIM interface

Pin	Signal	Description
57	V_USIM	USIM Card Power output depends automatically 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, which has been pulled up with a 22kR resistor to V_USIM in module. So please do not pull up or pull down in your application circuit.
12	USIM_CLK	USIM Card Clock
13	USIM_RESET	USIM Card Reset

Table 18: Signal of USIM interface (board-to-board connector)

Following is the reference circuit of the USIM interface. We recommend to use 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. 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 in the following figure.

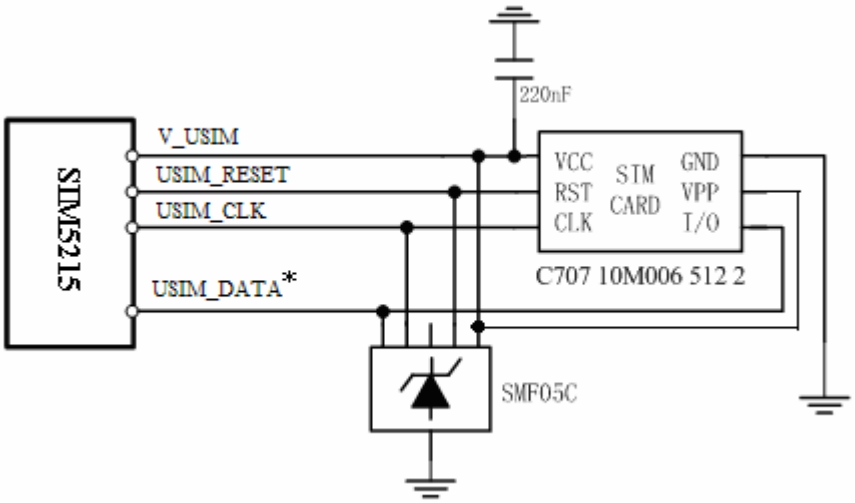


Figure 20: USIM interface reference circuit with 6 pins USIM card

Note: USIM_DATA has been pulled up with a 22kR resistor to V_USIM in module. So please do not pull up or pull down in your application circuit. As shown in above figure, SMF05C is used for ESD protection for SIM interface. And 220nF capacitor on V_USIM is used to reduce interference

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.

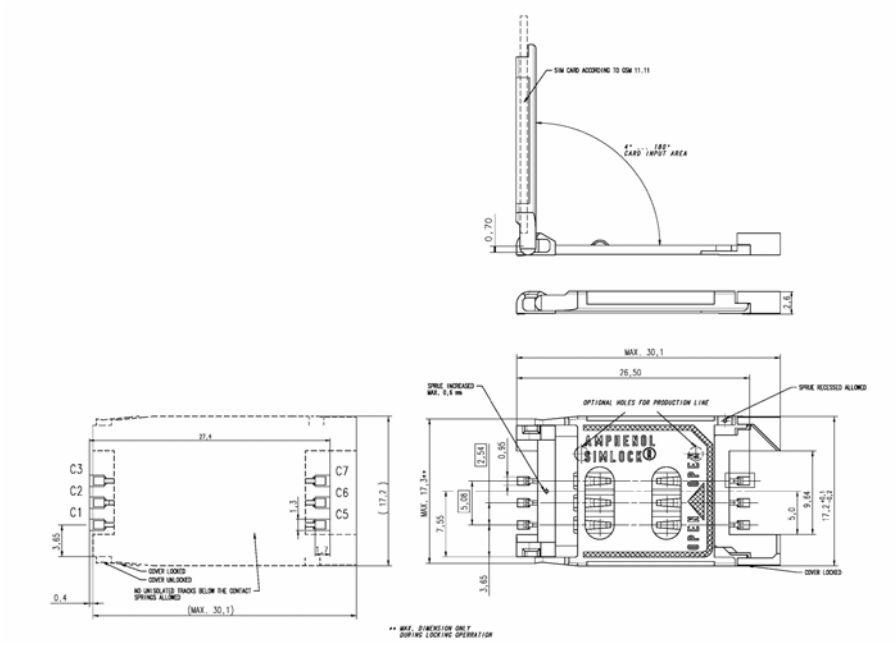


Figure 21: Amphenol C707 10M006 512 2 SIM card holder

Table 19: 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

SIM5215E contains an I2C interface. It is used for connecting peripheral equipment. Use AT Command to read/write values of I2C peripheral equipment. Because I2C has been pulled up in SIM5215E, there is no need to be pulled up by customer.

Table 20: 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	

Note: IIC_SDA and IIC_SCL have been pulled up with two 2.2kR resistors to 2.6V in module. So there is no need to pull them up in your application circuit.

3.11 USB interface

SIM5215E supports high and full speed universal serial bus (USB) interface, and mode of USB can be switched by AT command (AT+CUSBSPD) This interface is compliant with the USB 2.0 specification. The high speed is up to 480Mbps. so please pay attention to influence of junction capacitance of ESD component on USB data lines. Typically, the capacitance value should be less than 4pF @1MHz.
Links to these and related specifications can be found at www.usb.org

Table 21: 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	They are compliant with the USB 2.0 specification.		
USB_DM	59			
GND	58			

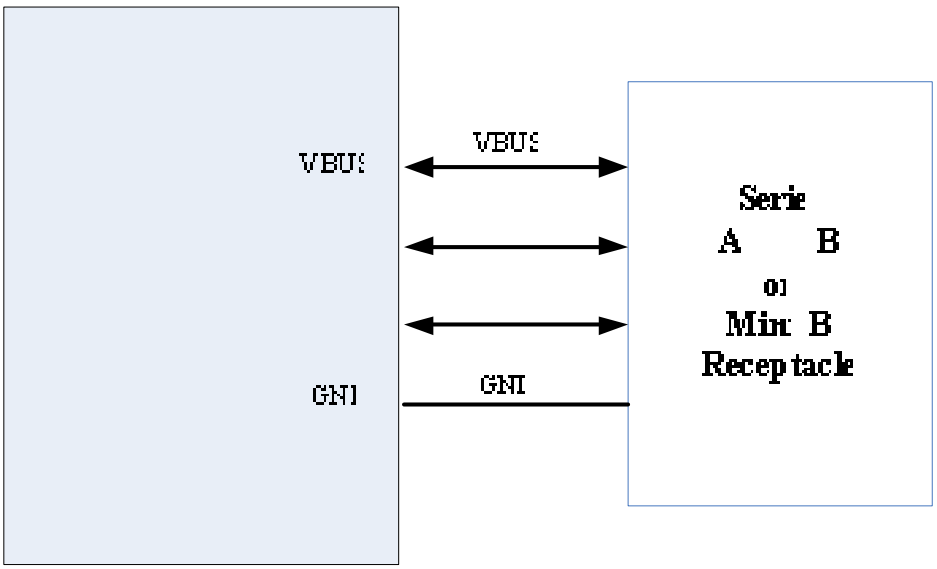


Figure 22: USB interface

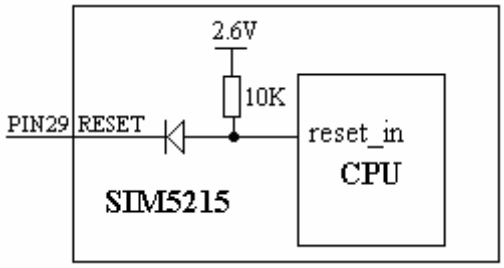
Currently SIM5215E supports the USB suspend & resume mechanism which can help to save

much current. If no transaction on USB bus then SIM5215E will enter to suspend mode and when some events happens (such as incoming call or SMS received) during the suspend mode then SIM5215E will resume automatically.

Note: when use the Mini-B it has no ID line.
Note: Two limitations on ESD protection: less than 4 pF and VBUS not to rail.

3.12 Module Reset

SIM5215E also have a RESET pin (PIN29) input, When should reset the module, one can push the RESET pin to low and the module reset. Because the Reset pin has been pulled up in SIM5215E, so there is no need to pull it up in application circuit. The internal circuit about RESET pin is shown below.



In order to improve the ESD of Reset pin, the bidirectional ESD component is suggested to be used on Reset pin.
NOTE: In automatically powering on mode, it is suggested that the SIM5215E should reset by RESET pin after power on.If SIM5215E.

3.13 General purpose input & output (GPIO)

SIM5215E provides a limited number of General Purpose Input/Output signal pin. Please check the following table:

Pin	Name	Direction	Function
65	GPIO0	Input, interrupt	Input Port with interrupt/PCM_DIN Use AT Command to set interrupt triggering mechanism & polarity .
10	GPIO1	Output	used as status LED driver
30	GPIO2	Input	General Purpose Input Port without interrupt/PCM_SYNC
31	GPIO3	Output	General Purpose Output Port (default value: Low Level)/PCM_CLK
32	GPIO4	Input	RF Control Interrupt：Flight Mode Switch
33	GPIO5	Output	General Purpose Output Port (default value: Low Level)/PCM_DOUT

Table 22: GPIO Pins of SIM5215E

GPIO0 is used for interrupt pin, default triggering mechanism is level trigger, and low level will trigger interrupt. After interrupt, SIM5215E would send out Alarm information to host CPU. Please Refer to "AT Command Manual".

GPIO1 is used to control Status LED, the LED driving circuit of GPIO1 is shown below, and status table is Table 23.

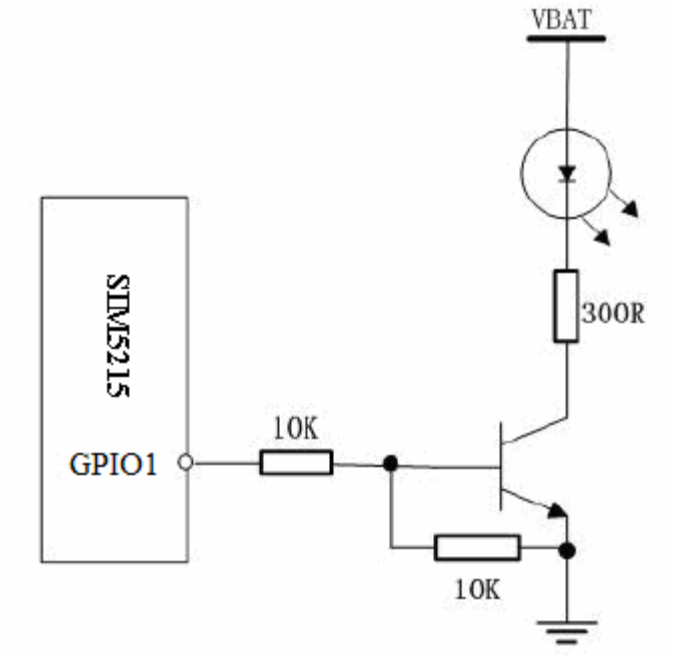


Figure 23: status LED circuit

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

And status indicating table is as follow.

Table 23: meanings of status LED

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 can be used to control RF close or on, the Flight Mode Switch logic table is shown below. You can use AT Command to read or to write GPIO2, GPIO3, GPIO5 status (High or Low level).

Table 24: logic of GPIO4

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).

NOTE: For SIM5215E, GPIO0, GPIO2, GPIO3 and GPIO5 can be multiplex function, you can use them as PCM interface to connect extend codec. Please refer section 3.8.5.5 and document [1] for detail information.

3.14 ADC interface

SIM5215E has an analog-to-digital converter (ADC) that is available for digitizing analog signals such as battery voltage, temperature and so on, it is on PIN30, namely HKADC0, This HKADC0 is 8 bit successive-approximation circuit, and performance specification is shown in the following table:

Table 25: ADC Characteristics

Specification	Min	Typ	Max	Unit	Comments/Conditions
Resolution		8		Bits	
differential nonlinearity	-4		+4	LSB	. Analog Vdd = ADC reference 300 kHz - 1.2 MHz sample rate
Integral nonlinearity	-8		+8	LSB	
Gain Error	-2.5		+2.5	%	
Offset Error	-4		+40	LSB	
Input Range	GND		2.65	V	
3dB input bandwidth		2500			Source resistance = 50 Ω
Input serial resistance		2		kΩ	Sample and hold switch resistance
Input capacitance		53		pF	
Power-down to wakeup		9.6	19.2	μs	

We implement two channels on this pin, one is to read raw type ADC value, and the other is to read 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 an application sample:

You can use it as a temperature ADC channel, too. The reference design of a temperature ADC circuit is 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.

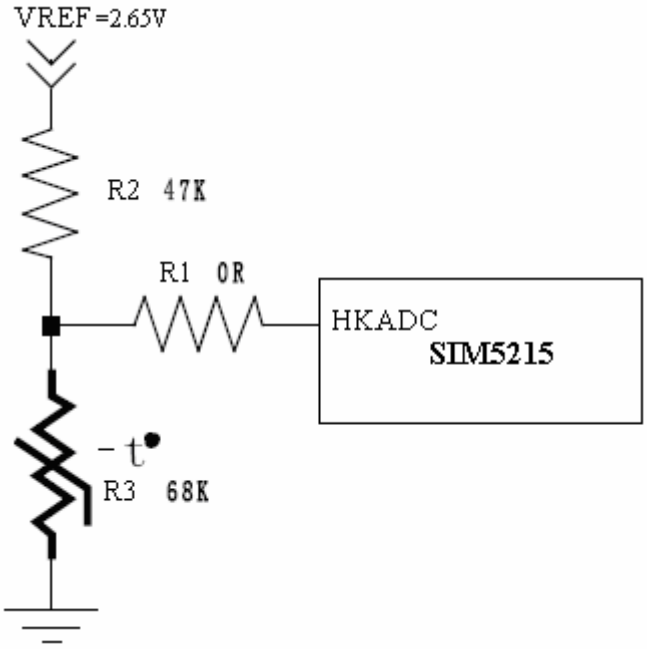


Figure 24: ADC interface used for temperature sampling reference circuit

3.15 LDO power output

SIM5215E has a LDO power output, it is PIN 40, namely VREG_AUX. This LDO default output voltage is 2.85V, and the driver current is rated for 250mA. This LDO could be used as a power supply for SD card, and the SD card data/command lines can also been pulled up by it.
NOTE: SIM5210 has no such pin. This is a difference between SIM5215E and SIM5210.

3.16 Camera module interface

SIM5215E provides a camera module interface for supporting camera and video phone functions. If you do not use the camera interface you can configure these pins to configurable GPIOs. Please refer the AT command Document (AT+CCGSWT).
SIM5215E can support both digital and analog sensor (NTSC or PAL composite signals output), YUV and RGB data format. When using analog sensor you needs to use AK8856 (currently we supported) to decode NTSC or PAL composite signals into digital data first and then transmit the digital data into camera interface.
Note: When you use a YUV output sensor, you should connect the output data0~data7 to SIM5215E out PIN CAM_D2~CAM_D9.
The camera module interface consists of the following:
■ 8 bit data bus for the pixel data information
■ Horizontal and vertical synchronization signals

■ 2 wire I2C bus as a control path between the SIM5215E module device and the camera module

The following table is the pin definition.

Table 26: PIN define of sensor interface

Pin	Name	Function
15	CAM_D2	Bit 0 of RGB or YUV D0 video component output
54	CAM_D3	Bit 1 of RGB or YUV D1 video component output
16	CAM_D4	Bit 2 of RGB or YUV D2 video component output
53	CAM_D5	Bit 3 of RGB or YUV D3 video component output
17	CAM_D6	Bit 4 of RGB or YUV D4 video component output
52	CAM_D7	Bit 5 of RGB or YUV D5 video component output
18	CAM_D8	Bit 6 of RGB or YUV D6 video component output
51	CAM_D9	Bit 7 of RGB or YUV D7 video component output
19	CAM_HSYNC	Video horizontal line synchronization signal
50	CAM_VSYNC	Vertical sync output
21	CAM_CLK	master clock input
49	CAM_PCLK	Pixel clock output
48	CAM_RESET	Master 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 “0”=Normal mode, “1”=Power-down mode

We have tested several kinds of digital sensors, such as OV2640, OV7670，OV7725 and a NTSC/PAL digital video decoder named AK8856 (it can decode NTSC or PAL composite video signals into digital video data, and with AK8856 you can use analog sensor as video source) . Software must be adjusted when use other kinds of sensors. Customer can contact us and give us your request. The power supply of the sensor should be supplied by customer.

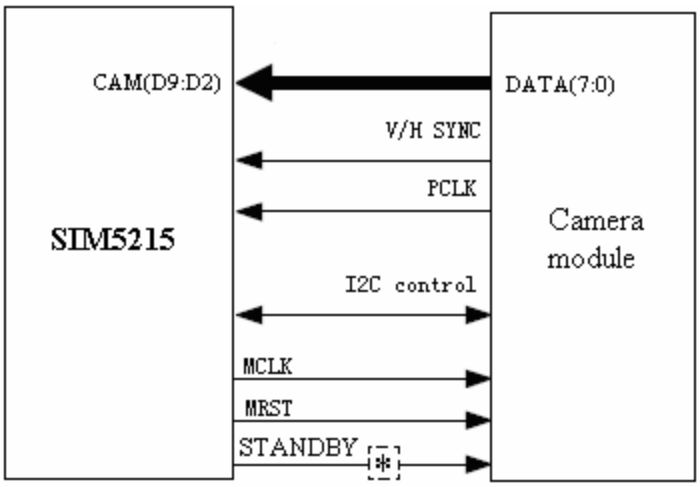


Figure 25: Camera module interface

NOTE: The data and clock lines of camera are sensitive for the capacitors. Generally the capacitance of the ESD component is too big, if those ESD components are put on to the parallel line then the signal will fade a lot. In order to improve the ESD performance, some 10pF capacitor can be put on data and clock lines for ESD. If one like to choose smaller capacitance ESD component, it should be smaller than 10pF.

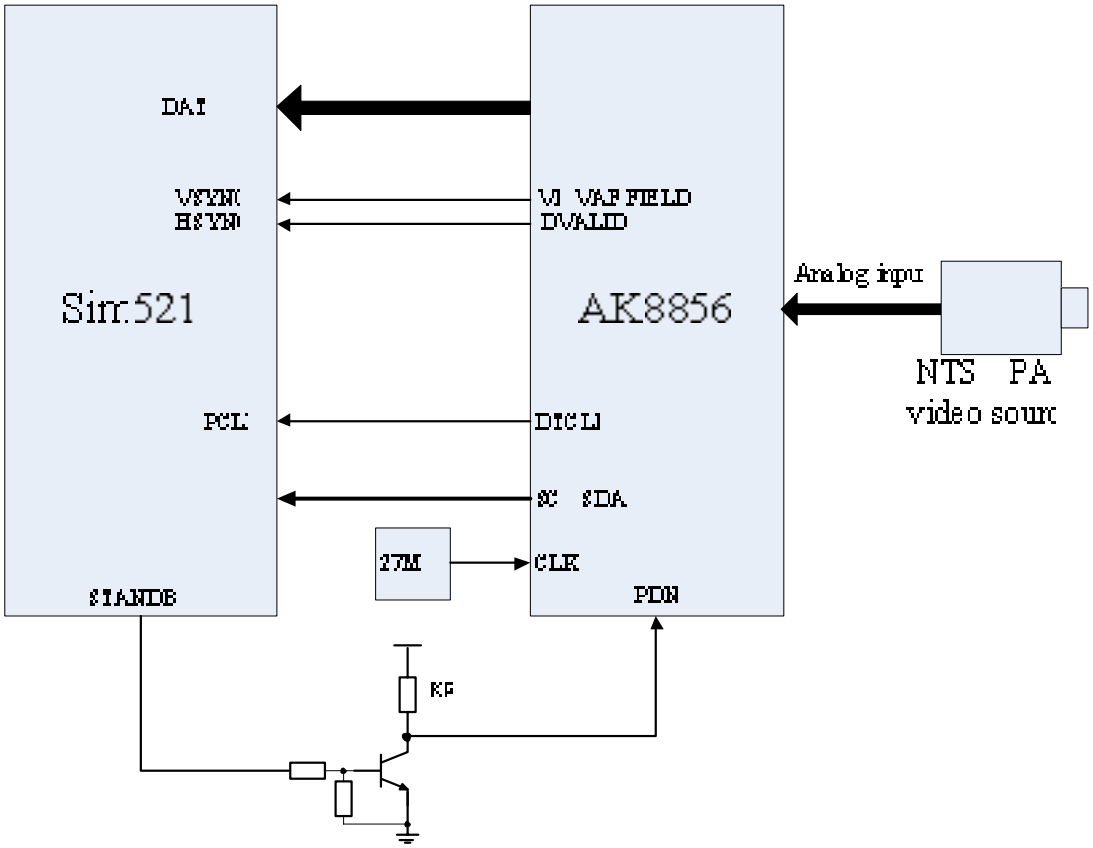


Figure 26: Camera module interface with analog sensor

****NOTE: STANDBY pin of SIM5215E is used to control the powering down or on of camera module. So when one designs application circuit, one should pay attention to the polarity of STANDBY. Default polarity of SIM5215E is shown below:***
LOW: normal operation
HIGH: power-down
In Figure 26, the polarity of AK8856 power down is contrary to that of SIM5215E STANDBY, so one must use a NPN triode to reverse the polarity of SIM5215E and connect AK8856.
If you do not use the camera interface you can configure these pins to configurable GPIOs. Please refer the AT command Document (AT+CCGSWT).

3.17 MMC/SD card interface

SIM5215E provides one MMC/SD card interface. The SIM5215E acts as a HOST. The

SIM5215E 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 SIM5215E to be used as SD_CLK, or MMC_CLK. This clock is designed to be used with the MMC/SD interface and is what customers should use with the MMC/SD cards. A LDO power output is provided by the SIM5215E for the power supply of MMC/SD card, it is PIN 40, name VREG_AUX. This LDO default output voltage is 2.85V, and driver current is rated for 250mA. Meanwhile data lines can be pulled up by VREG_AUX. The reference circuit of MMC/SD card interface is shown in Figure 27. The 10KR pull-up resistors on data and clk lines are necessary. The 33pF capacitor is used to reduce RF interference. To get good ESD performance, some ESD components should be added beside the SD/MMC card holder.

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 50 MHz

Following figure illustrate and describe the MMC/SD interface.

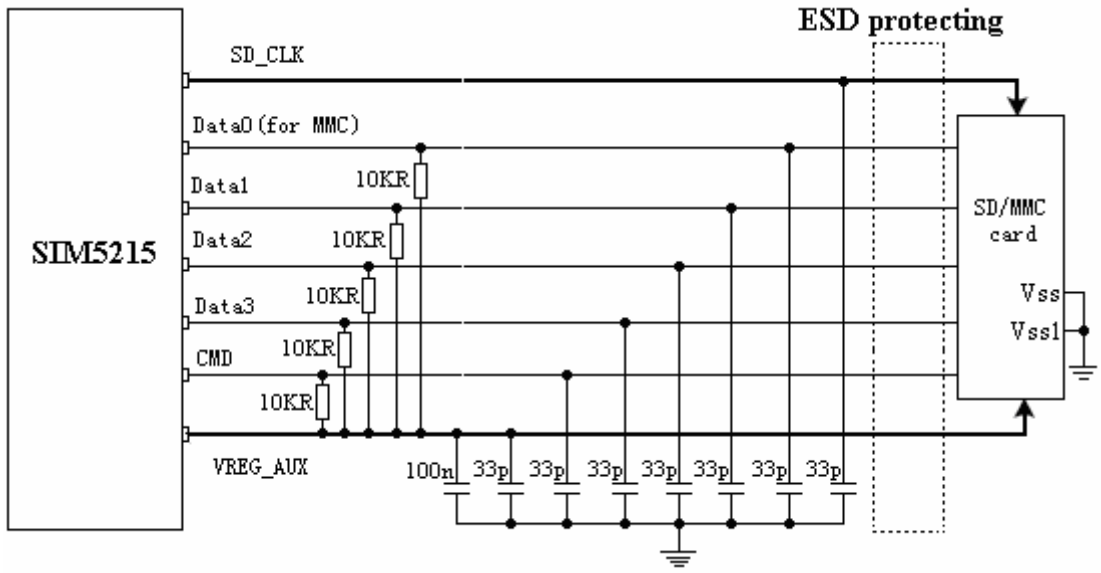


Figure 27: MMC/SD interface

As mentioned, the MMC/SD 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. SIM5215E will auto-detect which card is inserted (SD or MMC, or no card) and will proceed accordingly.

Table 27: MMC/SD pin of SIM5215E

Name	Direction	Pin On board-to-board connector	voltage scope(V)		
			Min	Type	Max
SD_DATA0	Input /Output	36	2.7	2.85	3.0
SD_DATA1	Input /Output	37	2.7	2.85	3.0
SD_DATA2	Input /Output	38	2.7	2.85	3.0
SD_DATA3	Input /Output	39	2.7	2.85	3.0
SD_CLK	Output	34	2.7	2.85	3.0
SD_CMD	Output	35	2.7	2.85	3.0
VREG_AUX	Output	40	2.7	2.85	3.0

Table 28 : MMC/SD pin connector

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
VREG_AUX	SD_VDD	MMC_VDD

Note: SD card interface function is supported by SIM5215E software. You can use VREG_AUX for power supply of SD card and as the pull up power for data lines.

3.18 PCM Interface

SIM5215E provides PCM interface. The SIM5215E PCM interface can be used in two modes: 1) the default mode is its auxiliary PCM (8 kHz long sync mode at 128kHz clk); 2) the other mode is its primary PCM (8 kHz short sync mode at 2048 kHz clk). In short-sync (primary PCM) mode, the SIM5218E can be a master or a slave. In long-sync (auxiliary PCM) mode, the SIM5218E is always a master; there is no slave support. SIM5215E support 3 PCM formats: 8 bits (υ-law or A-law) and 16 bits (linear).
Both the PCM interface modes, auxiliary and primary, use the same SIM5215E pins. The PCM pin assignment is shown in the table below.

Table 29 : PCM pin assignment

Pins	Pin No. on 70 pins	AUX_PCM functionality	Primary PCM interface functionality

PCM_CLK/GPIO3	31	AUX_PCM_CLK	PCM_CLK
PCM_SYNC/GPIO2	30	AUX_PCM_SYNC	PCM_SYNC
PCM_DIN/GPIO0	65	AUX_PCM_DIN	PCM_DIN
PCM_DOUT/GPIO5	33	AUX_PCM_DOUT	PCM_DOUT

The default PCM interface on power up is the auxiliary PCM interface. Under PCM, the data is output on the rising edge of PCM_CLK and sampled at the falling edge of PCM_CLK. Primary PCM is disabled at power up or when RESET is asserted, but you can use AT command to enable the primary PCM mode.

PCM Interface can be operated in Master and Slave mode. When the PCM interface is configured, PCM Tx data will be routed from the external codec Mic through the DSP encode path in the Module. PCM Rx data will be routed through the DSP decode path to the external codec speaker. When using the PCM Interface, the Module can be set either into Master Mode or Slave Mode.

In Master Mode, the Module drives the clock and sync signals that are sent out to the external codec via the PCM Interface. When in Slave Mode, the external codec drives the clock and sync signals that are sent to the Module.

Configuration Mode can be selected either primary or auxiliary. Primary configuration mode uses 2.048MHz clock and 8kHz short sync clock, and auxiliary configuration mode uses 2.048MHz clock and 8kHz long sync clock. One important consideration is that Slave mode is only available for use with Primary configuration Mode. PCM formats can also be chosen by AT command.

Both PCM modes are discussed in this section, followed by additional PCM topics.

3.19.1 Auxiliary PCM (128kHZ PCM clock)

The auxiliary PCM interface enables communication with an external codec to support hands-free applications. υ-law codec are supported by the auxiliary PCM interface.

The auxiliary codec port operates with standard long-sync timing and a 128 kHz clock. The AUX_PCM_SYNC runs at 8 kHz with 50% duty cycle. Most υ-law codec support the 128 kHz clock.

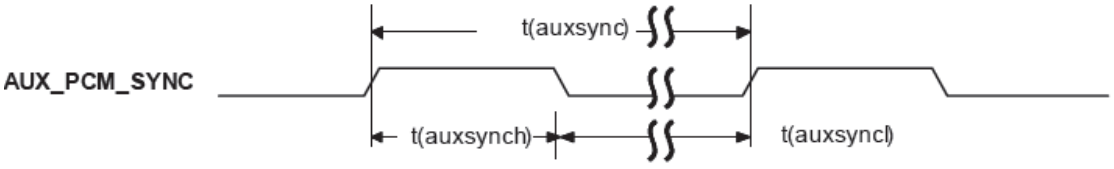


Figure 28: AUX_PCM_SYNC timing

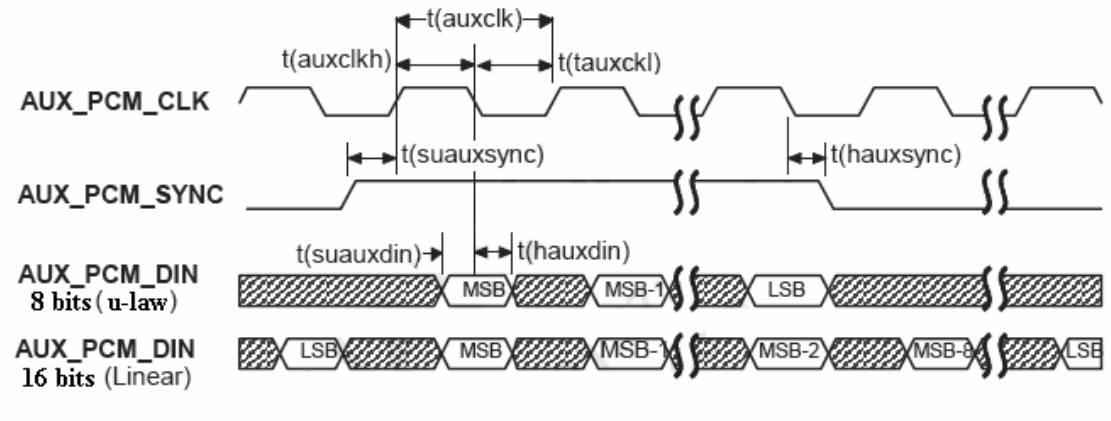


Figure 29: EXT_CODEC to SIM5215E timing

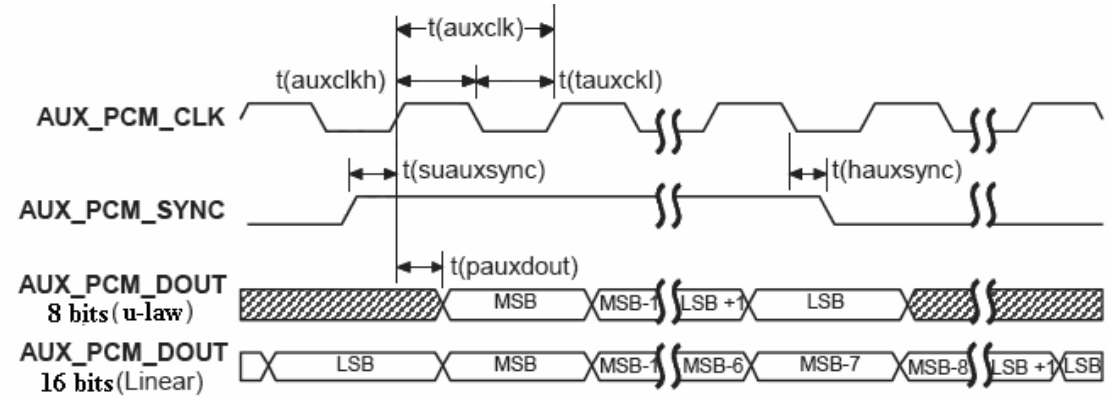


Figure 30: SIM5215E to EXT_CODEC timing

Table 30 : Auxiliary PCM mode timing parameters

Parameter	Description	Min	Typical	Max	Unit	Note
T(auxsync)	AUX_PCM_SYNC cycle time	–	125	-	µs	
T(auxsynch)	AUX_PCM_SYNC high time	62.4	62.5	-	µs	
T(auxsyncl)	AUX_PCM_SYNC low time	62.4	62.5	-	µs	
T(auxclk)	AUX_PCM_CLK cycle time	-	7.8	–	µs	*
T(auxclkh)	AUX_PCM_CLK high time	3.8	3.9	–	µs	
T(auxclkl)	AUX_PCM_CLK low time	3.8	3.9	–	µs	
T(suauxsync)	AUX_PCM_SYNC setup time high before falling edge of PCM_CLK	1.95	–	–	µs	
T(hauxsync)	AUX_PCM SYNC hold time after falling edge of PCM_CLK	1.95	–	–	µs	
T(suauxdin)	AUX_PCM_DIN setup time before falling edge of AUX_PCM_CLK	70	–	–	ns	

T(hauxdin)	AUX_PCM_DIN hold time after falling edge of AUX_PCM_CLK	20	–	–	ns	
T(pauxdout)	Delay from AUX_PCM_CLK rising to AUX_PCM_DOUT valid	–	–	50	ns	

***Note: t(auxdk) = 1/(128 kHz).**

3.19.2 Primary PCM (2048 kHz PCM clock)

The aux codec port also supports 2.048 MHz PCM data and sync timing for υ-law codec that matches the sync timing — this is called the primary PCM interface (or just PCM interface). You can use AT+CPCM command to change the mode you want.

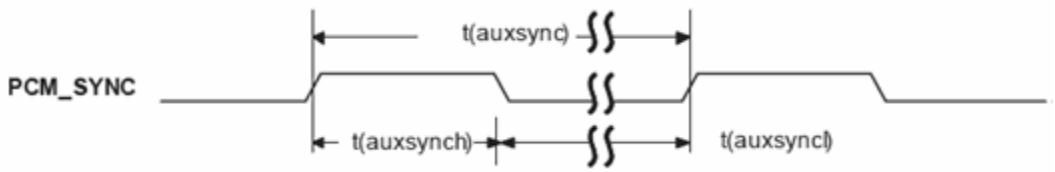


Figure 31: PRIM_PCM_SYNC timing

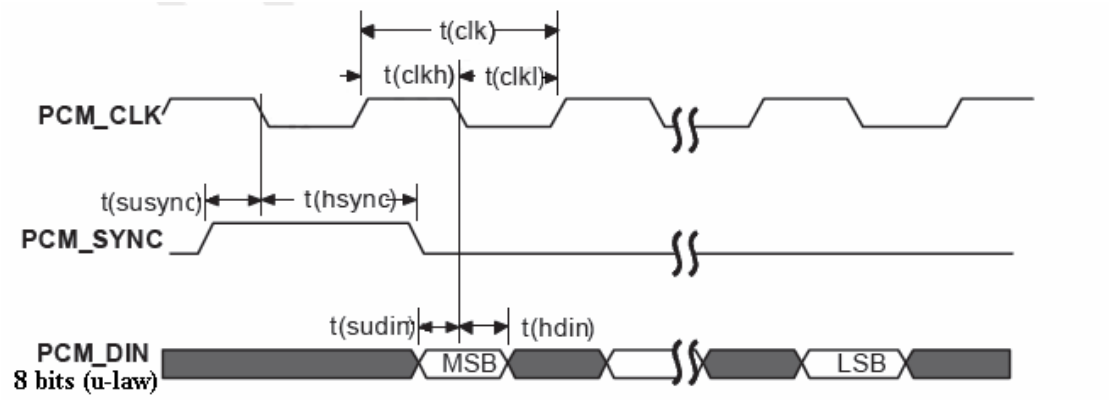


Figure 32: EXT_CODEC to SIM5215E timing

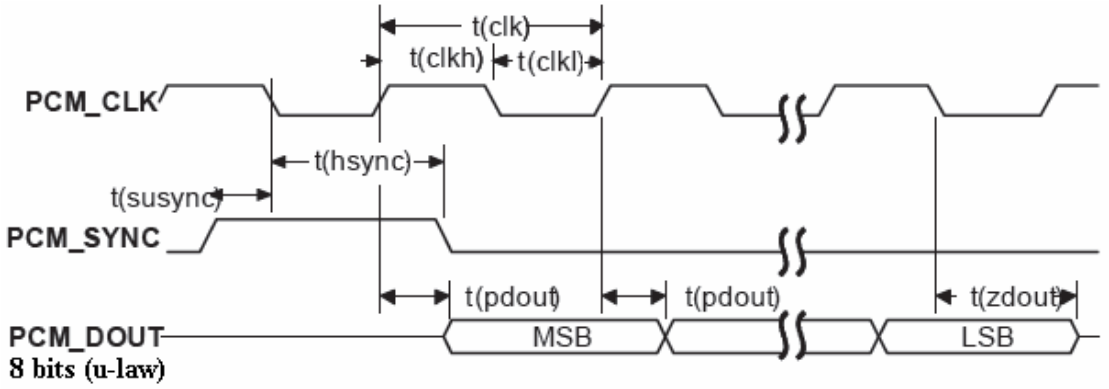


Figure 33: SIM5215E to EXT_CODEC timing

Table 31 : Primary PCM mode timing parameters

Parameter	Description	Min	Typical	Max	Unit	Note
T(sync)	PCM_SYNC cycle time	–	125	–	µs	
T(synch)	PCM_SYNC high time	400	500	–	ns	
T(syncl)	PCM_SYNC low time	–	124.5	–	µs	
T(clk)	PCM_CLK cycle time	–	488	–	ns	
T(clkh)	PCM_CLK high time	–	244	–	ns	
T(clkl)	PCM_CLK low time	–	244	–	ns	
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	60	–	–	ns	
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	60	–	–	ns	
T(sudin)	PCM_DIN setup time before falling edge of PCM_CLK	50	–	–	ns	
T(hdin)	PCM_DIN hold time after falling edge of PCM_CLK	10	–	–	ns	
T(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid	–	–	350	ns	
T(zdout)	Delay from PCM_CLK falling to PCM_DOUT HIGH-Z	–	160	–	ns	

4 Antenna interface

The RF interface has an impedance of 50Ω. To suit the physical design of individual applications SIM5215E 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 needs to be very careful to choose RF cable. We recommend that the insertion loss should meet the following requirement:

- GSM900/GSM850<1dB
- DCS1800 <1.5dB
- WCDMA2100<1.5dB
- WCDMA900<1dB

4.1 Antenna installation

4.1.1 Antenna connector

SIM5215E use MURATA's MM9329-2700 RF connector on the module side, we recommend that user uses MURATA's MXTK88XXXXX as matching connector on the application side. Please refer to appendix for detailed information about MURATA's MXTK88XXXXX.

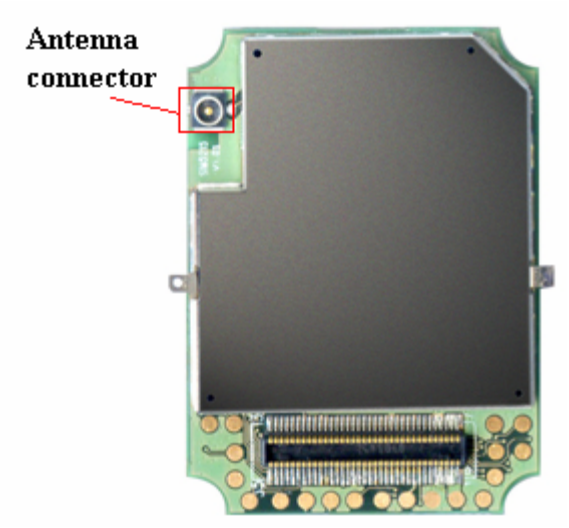


Figure 34: Antenna Connector

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, SIM5215E comes with a grounding plane located close to the antenna pad.

Figure 35: Antenna pad

SIM5215E material properties:

SIM5215E PCB Material: FR4

Antenna pad: Gold plated pad

4.2 Module RF output power

Table 32: SIM5215E conducted RF output power

Frequency	Max	Min
GSM850	33dBm ±2db	5dBm±5db
E-GSM900	33dBm ±2db	5dBm±5db
DCS1800	30dBm ±2db	0dBm±5db
GSM850(8-PSK)	27dBm ±3db	5dBm±5db
E-GSM900(8-PSK)	27dBm ±3db	5dBm±5db
DCS1800(8-PSK)	26dBm ±3db	0dBm±5db
WCDMA2100	24dBm+1/-3db	<-50dBm
WCDMA900	24dBm+1/-3db	<-50dBm

4.3 Module RF receiver sensitivity

Table 33: SIM5215E conducted RF receive sensitivity

Frequency	Receive sensitivity
GSM850	< -107dBm
E-GSM900	< -107dBm
DCS1800	< -107dBm
WCDMA2100	< -108dBm
WCDMA900	< -107dBm

4.4 Module operating frequencies

Table 34: SIM5215E operating frequencies

Frequency	Receive	Transmit
GSM850	869 ～ 894MHz	824 ～ 849MHz
E-GSM900	925 ～ 960MHz	880 ～ 915MHz
DCS1800	1805 ～ 1880MHz	1710 ～ 1785MHz
WCDMA2100	2110 ～ 2170MHz	1920 ～ 1980MHz
WCDMA900	925 ～ 960MHz	880 ～ 915 MHz

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 SIM5215E are list in following table:

Table 35: 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 36: SIM5215E operating temperature

Parameter	Min	Max	Unit	Note
Operating temperature	-30	+80	℃	The module is functional in all the temperature range, and it fully meets the ETSI specifications.
Storage temperature	-40	+85	℃	

5.3 Power supply ratings

Table 37: SIM5215E 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.	3.3	3.8	4.2	V

	Voltage drop during transmit burst	Normal condition, power control level for Pout max			300	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 4.7ms)	Power control level for Pout max.		2	3	A

5.4 Current consumption

The values for current consumption in no suspended status are listed in Table 38. Here, "suspended" means that SIM5215E is connected with USB BUS but don't transfer data.

Table 38: SIM5215E current consumption in no suspended status

GSM IDLE mode (without USB suspend)	
GSM850	Sleep @DRX=2 3.0mA Sleep @DRX=5 1.8mA Sleep @DRX=9 1.4mA
GSM900	Sleep @DRX=2 3.0mA Sleep @DRX=5 1.86mA Sleep @DRX=9 1.4mA
DCS1800	Sleep @DRX=2 3.1mA Sleep @DRX=5 1.7mA Sleep @DRX=9 1.4mA
GSM IDLE Mode(with USB suspend)	
GSM850	Sleep @DRX=2 4.3mA Sleep @DRX=5 2.8mA Sleep @DRX=9 2.2mA
GSM900	Sleep @DRX=2 4.3mA Sleep @DRX=5 2.7mA Sleep @DRX=9 2.1mA
DCS1800	Sleep @DRX=2 4.4mA Sleep @DRX=5 2.8mA Sleep @DRX=9 2.3mA
Voice Call	
GSM850	@power level #5 <300mA,Typical 270mA
GSM 900	@power level #5 <310mA,Typical 280mA
DCS1800	@power level #0 <200mA,Typical 180mA

GPRS Data	
DATA mode, GPRS (1 Rx,4 Tx) CLASS 12	
GSM 850	@power level #5 <550mA,Typical 520mA
GSM 900	@power level #5 <560mA,Typical 530mA
DCS1800	@power level #0 <380mA,Typical 350mA
DATA mode, GPRS (3Rx, 2 Tx) CLASS 12	
GSM 850	@power level #5 <440mA,Typical 410mA
GSM 900	@power level #5 <430mA,Typical 400mA
DCS1800	@power level #0 <290mA,Typical 260mA
EDGE Data	
DATA mode, EDGE(1 Rx,4 Tx) CLASS 12	
GSM 850	@power level #8 <380mA,Typical 350mA
GSM 900	@power level #8 <380mA,Typical 350mA
DCS1800	@power level #2 <310mA,Typical 280mA
DATA mode, EDGE(3Rx, 2 Tx) CLASS 12	
GSM 850	@power level #8 <280mA,Typical 240mA
GSM 900	@power level #8 <280mA,Typical 240mA
DCS1800	@power level #2 <230mA,Typical 200mA
UMTS IDLE Mode (without USB suspend)	
WCDMA 2100	Sleep @DRX=9 1.2mA Sleep @DRX=8 2.1mA Sleep @DRX=6 4.2mA
WCDMA 900	Sleep @DRX=9 1.2mA Sleep @DRX=8 2.0mA Sleep @DRX=6 4.4mA
UMTS IDLE Mode (with USB suspend)	
WCDMA 2100	Sleep @DRX=9 1.9mA Sleep @DRX=8 2.6mA Sleep @DRX=6 4.6mA
WCDMA 900	Sleep @DRX=9 1.9mA Sleep @DRX=8 2.7mA Sleep @DRX=6 4.8mA
UMTS Voice call	
WCDMA 2100	@Power 23dBm Typical 510mA @Power 10dBm Typical 200mA @Power-55dBm Typical 140mA
WCDMA 900	@Power 23dBm Typical 490mA @Power 10dBm Typical 190mA @Power-55dBm Typical 130mA

5.5 Electro-Static discharge

Normally SIM5215E is mounted on customer host board, although some ESD components have been added in SIM5215E, to improve ESD, one should put some ESD components on customer host board. The ESD components should be placed beside the connectors which the human body might touch, such as SIM card holder, T-flash card holder, audio jacks, switches, keys, etc..

Below is the SIM5215E ESD performance measurement table, the results are got from our EVB

board test.

Table 39: The ESD performance measurement table (Temperature: 25℃, Humidity: 45%)

Part	Contact discharge	Air discharge
VBAT,GND	±4KV	±10KV
UART,USB	±4KV	±8KV
Antenna port	±4KV	±10KV
Other port	±3KV	±8KV

In order to get the best ESD performance, one must deal carefully with ground of SIM5215E on host board, which is most important. Here are some advices:

1.Bare the copper on the host board.

Figure 36 is SIM5215E PCB decal. There is a big area which is poured with copper. When one mounts the SIM5215E on host board, the bottom shield of SIM5215E can be connected to ground well through this copper area. The SIM5215E PCB decal can be got from our FAE or sales people.

2.Choose 2.0mm height 70-pin socket for host board.

Because the height of 70-pin plug on SIM5215E is 1.5mm, in order to better connecting the SIM5215E to the ground of the host board, it is suggested to choose 2.0mm height 70-pin socket for host board. NAS AXK770247G is suitable. 2.5mm will be too high, it will be suspending above host board. 1.5mm will be too tight.

3.Fill some conductors between the bottom of SIM5215E and host board.

Figure 37 shows the conductor material we use. Other conductor material can be used as well.

4.Solder SIM5215E to ground through 2 out-feet of bottom shield.

There are 2 out-feet of SIM5215E bottom shield. One can solder them to bare cooper on host board, so that SIM5215E can be connected to the ground well.

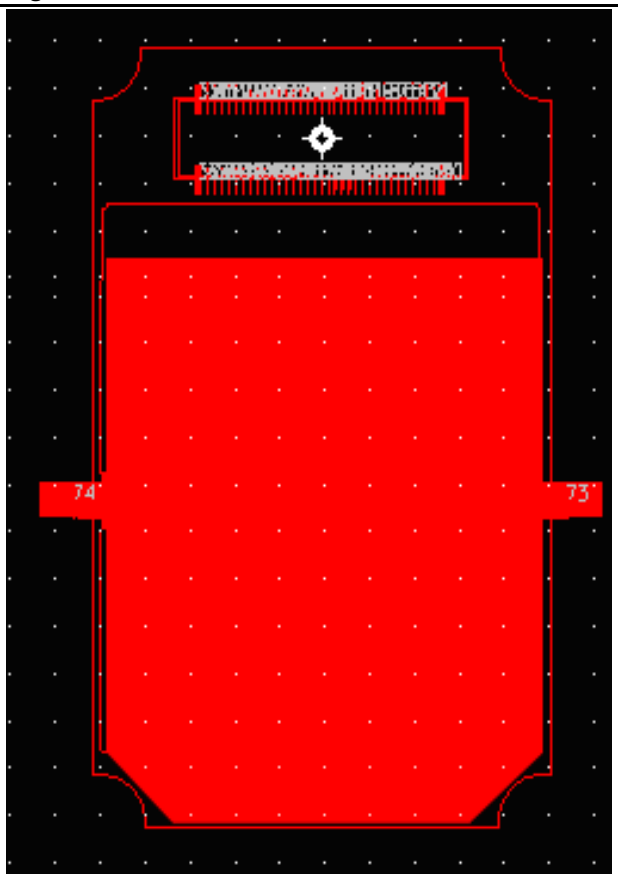


Figure 36: SIM5215E PCB decal

6 Mechanics

This chapter describes the mechanical dimensions of SIM5215E.

6.1 Mechanical dimensions of SIM5215E

Following are SIM5215E top view, side view and bottom view. These show you Mechanical dimensions of SIM5215E.

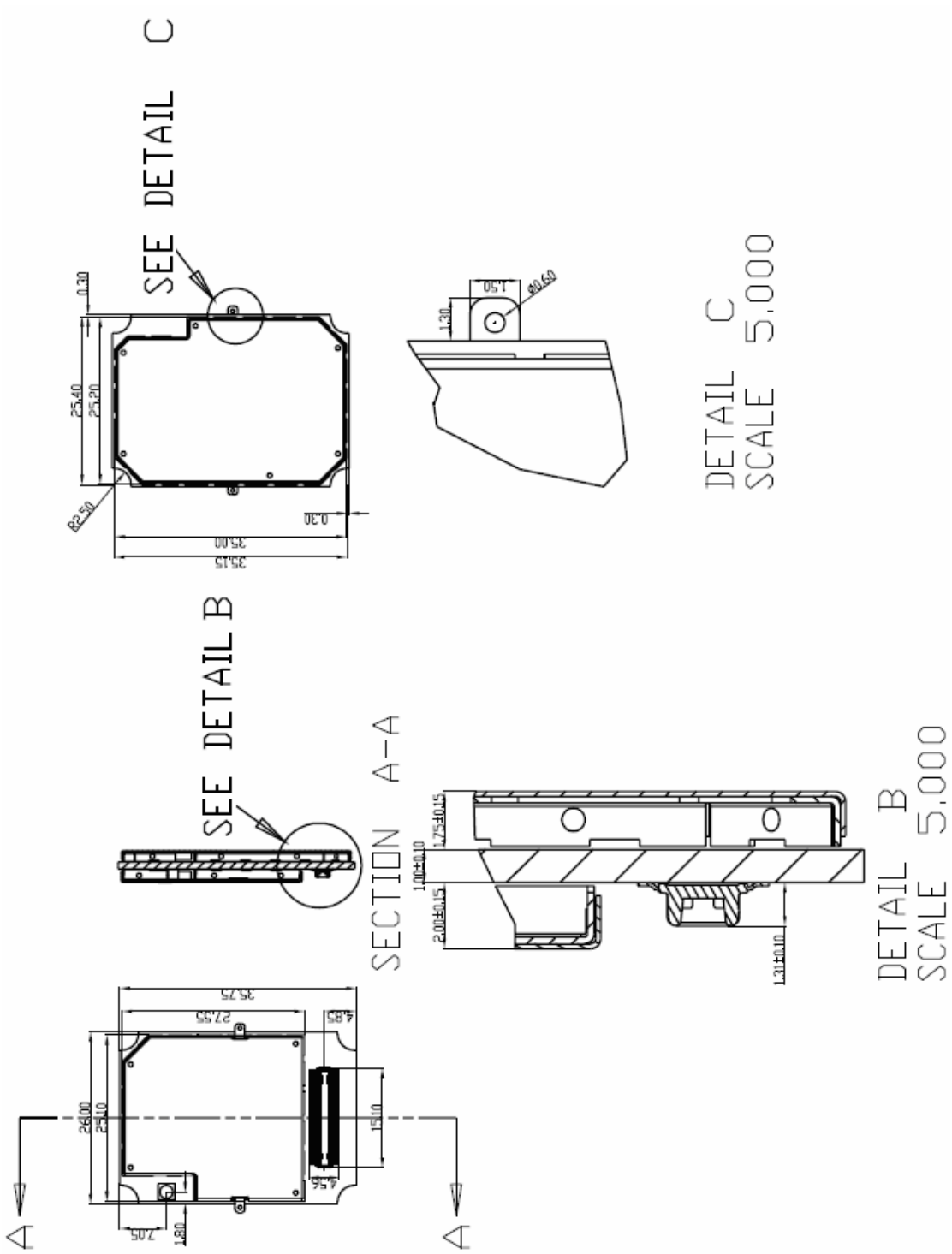


Figure 38: Mechanical dimensions of SIM5215E（Unit: mm）

6.2 Mounting SIM5215E onto the application platform

Use the connector AXK870145WG and four mounting pads to fix the SIM5215E onto the customer platform.

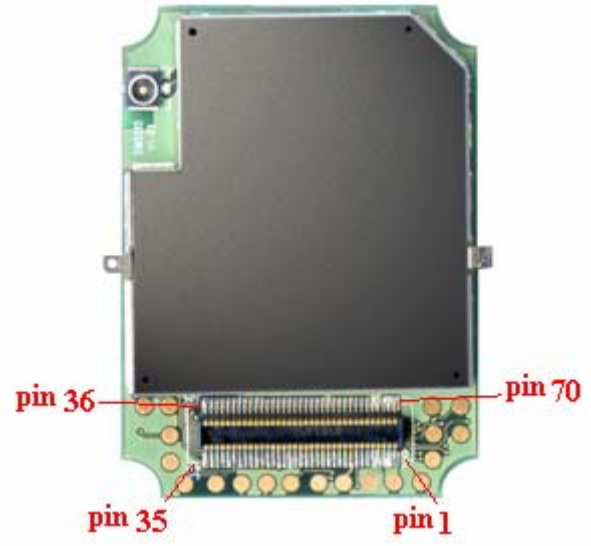


Figure 39: PIN sequence of SIM5215E

When one mounts SIM5215E on host board, please pay attention to that the pin sequence of SIM5215E is mirror image of pin sequence of 70-pin socket connector on host.

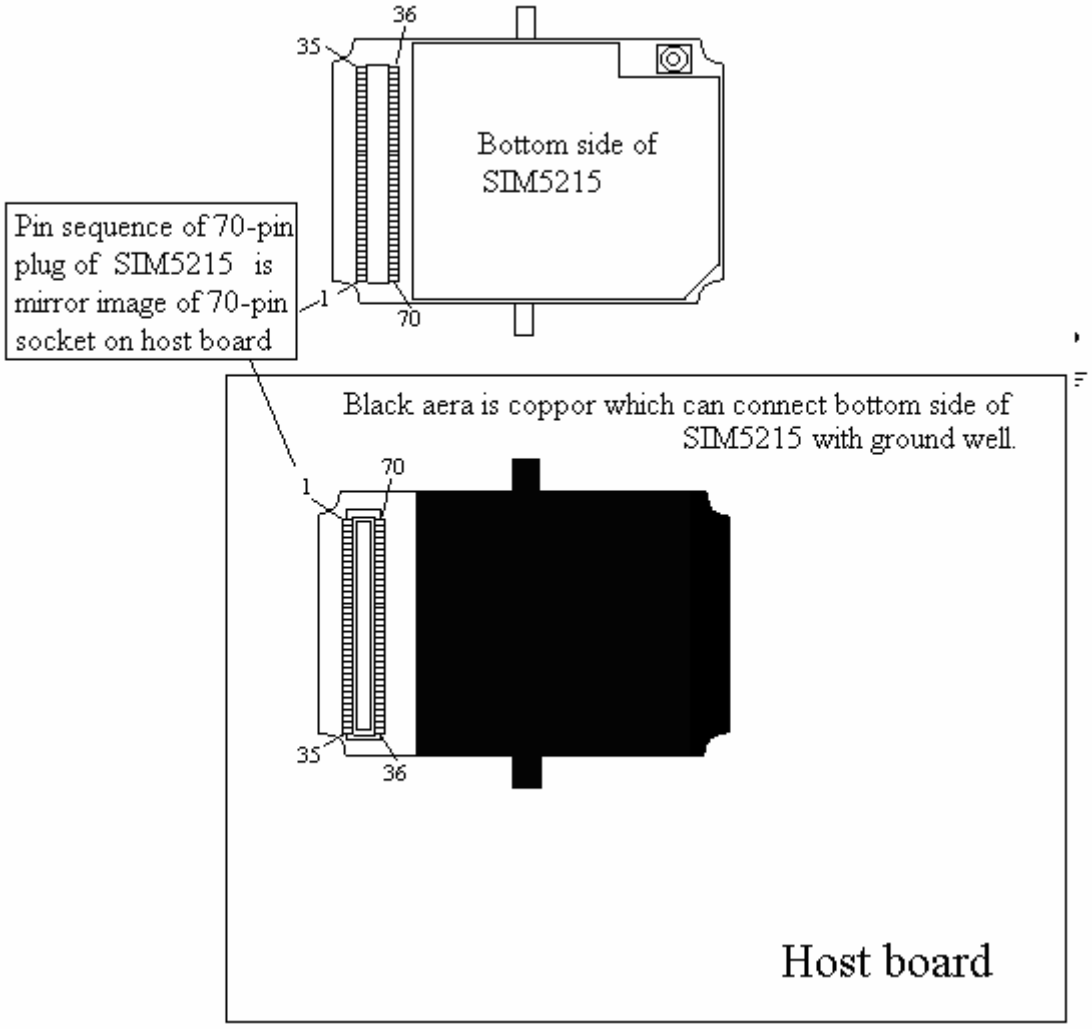


Figure 40: Mirror image of pin sequence

6.3 Board-to-board connector

We recommend users to adopt NAIS AXK770247G as the board to board connector in their own PCB to connect with SIM5215E. These high density SMT connectors are designed for parallel PCB-to-PCB applications. They are ideal for using in VCRs, notebook PCs, cordless telephones, mobile phones, audio/visual and other telecommunications equipment where reduced size and weight are important. The height of AXK770247G is 2.0mm.
Following are parameters of AXK770247G for more details, you can login http://www.NAIS-E.com for more information.

Mechanical dimensions of the NAIS 70pin connector

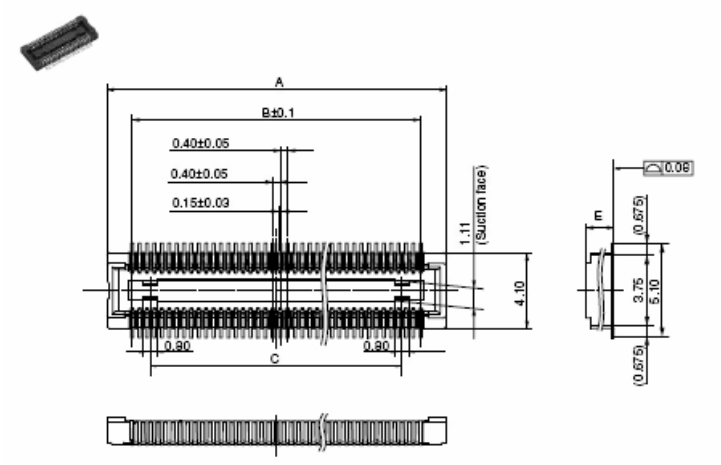


Figure 41: NAIS AXK770247G board-to-board connector pin side

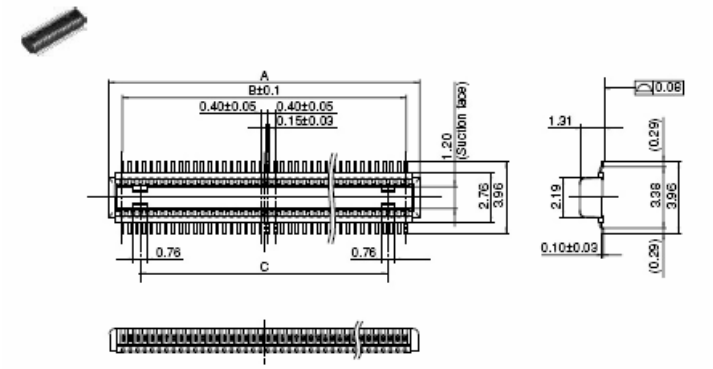


Figure 42: NAIS AXK870145WG board-to-board connector pin side

NOTE: The connector NAIS AXK870145WG is used in SIM5215E side and NAIS AXK770247G is used in pin side (host board 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 are parameters. Certainly you can visit http://www.murata.com/ for more information.

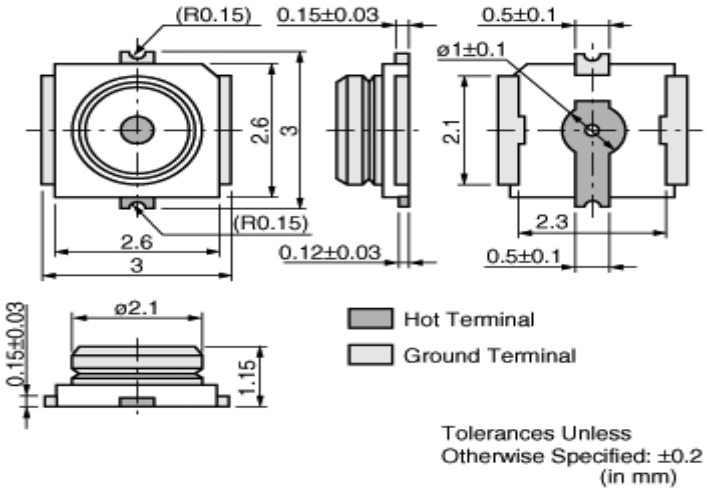


Figure 43: RF connector MM9329-2700

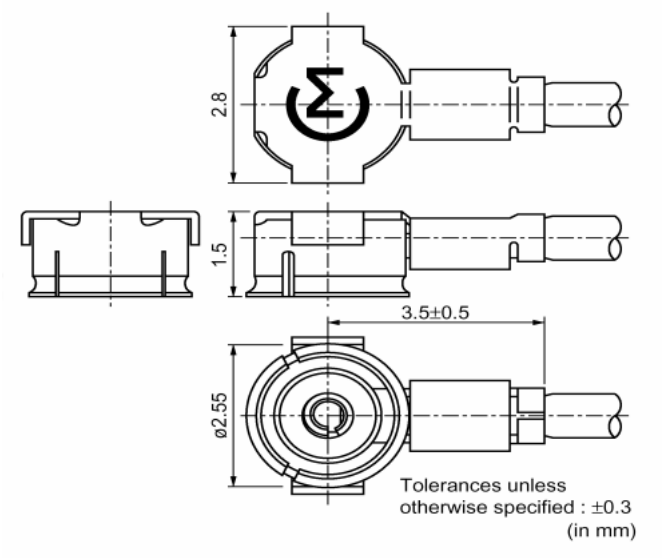
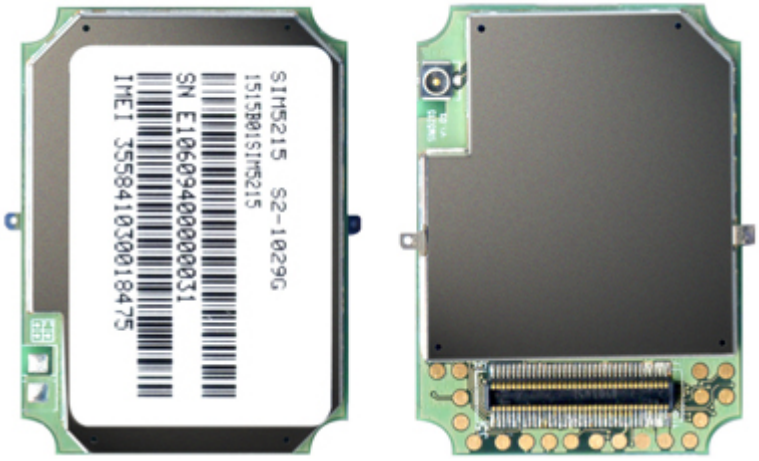


Figure 44: RF adapter cable MXTK88TK2000

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

6.5 View of the SIM5215E



Top View Bottom View

Figure 45: Top and Bottom View of SIM5215E

6.6 PIN assignment of board-to-board connector of SIM5215E

Table 40 : 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(See Note)
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	Reserved	NC	57	V_USIM	NC
15	CAM_D2	NC	56	USIM_DATA	NC(See Note)
16	CAM_D4	NC	55	Reserved	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_P	NC	48	CAM_RESET	NC
24	SPK_N	NC	47	IIC_SDA	NC(See Note)
25	EAR_P	NC	46	IIC_SCL	NC(See Note)
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

Note: UART_RXD has been pulled down with a 15kR resistor to ground in module.
USIM DATA has been pulled up with a 22kR resistor to V_USIM in module.
IIC_SDA and IIC_SCL have been pulled up with two 2.2kR resistors to 2.6V in module.
So there is no need to pull them up or down in your application circuit.

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