

U3500_Hardware_User_Guide_V2.0





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This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and



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- ◆ Consult the dealer or an experienced radio/TV technician for help.

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This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device is intended only for OEM integrators under the following conditions:

- 1)The antenna must be installed such that 20 cm is maintained between the antenna and users.
 - 2)The transmitter module may not be co-located with any other transmitter or antenna.
- As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product LabelingThis transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: XHZU3500". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Manual Information To the End UserThe OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.The end user manual shall include all required regulatory information/warning as show in this manual.



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1. Overview

U3500 is a wireless module which is designed for the global market. It is a consumptive product; it can be designed in many kinds of applications which can work on UMTS/EDGE/GPRS/GSM network.

U3500 enables connect to Internet over UMTS at speed up to 384 Kbps or EDGE at speed up to 237Kbps or GPRS at speed up to 85.6Kbps.

U3500 provides Audio, SMS, Phonebook functions as well as high speed access. It can be designed in many kinds of applications. Such as Data card, Video monitor, Tablet, Electric-book, MID, Vehicle equipment, etc.

1.1. Purpose of the document

The document described the basic functions, supported services, the key features, main interfaces and reference design, the mechanics and the electronic characteristics of the module U3500. It will guide the user to design U3500 in their applications.

1.2. Summary

The following lists the contents of this document.

- ✧ Chapter 1: Described the overview, purpose, correlative documents, document's history and abbreviations.
- ✧ Chapter 2: Described the basic functions, key features and hardware interfaces of the module.
- ✧ Chapter 3: Described in detail the module's interfaces and reference design.
- ✧ Chapter 4: Described the mechanical specifications of the module.
- ✧ Chapter 5: Described in detail the power consumptions of the module.
- ✧ Chapter 6: Described in detail electrical specifications of the module.

1.3. Correlative documents

- ✧ U3500_SPEC
- ✧ U3500_ATC
- ✧ U3500_EVB_User_Guide
- ✧ U3500_Reference_Circuit
- ✧ U3500_Application_Guide



1.4. Document's history

Table1: Document's update history

Version	Name	Date	Update description
V2.0	Huaming Zhang	2012-10-24	V2.0 version create

1.5. Abbreviations

Table2: Abbreviation and description

Abbreviations	Description
AMR	Adaptive Multi-rate
BER	Bit Error Rate
BTS	Base Transceiver Station
PCI	Peripheral Component Interconnect
CS	Circuit Switched (CS) domain
CSD	Circuit Switched Data
DCE	Data communication equipment
DTE	Data terminal equipment
DTR	Data Terminal Ready
EDGE	Enhanced Data rates for GSM Evolution
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FR	Frame Relay
GMSK	Gaussian Minimum Shift Keying
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
HSPA	HSPA High-Speed Packet Access
IEC	International Electro-technical Commission



IMEI	International Mobile Equipment Identity
I/O	Input/Output
ISO	International Standards Organization
ITU	International Telecommunications Union
bps	bits per second
LED	Light Emitting Diode
M2M	Machine to machine
MO	Mobile Originated
MT	Mobile Terminated
NTC	Negative Temperature Coefficient
PC	Personal Computer
PCB	Printed Circuit Board
PCS	Personal Cellular System
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PCS	Personal Communication System
PDU	Packet Data Unit
PPP	Point-to-point protocol
PS	Packet Switched
QPSK	Quadrature Phase Shift Keying
SIM	Subscriber Identity Module
TCP/IP	Transmission Control Protocol/ Internet Protocol
UART	Universal asynchronous receiver-transmitter
USIM	Universal Subscriber Identity Module
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
WCDMA	Wideband Code Division Multiple Access



2. Introduction

U3500 is a wireless module which is designed for the global market. It is a consumptive product; it can be designed in many kinds of applications which can work on UMTS/EDGE/GPRS/GSM network.

U3500 support the Bands as the following:

Dual-Band UMTS (WCDMA/FDD): 850/2100 MHz;
Quad-Band GSM : 850/900/DCS1800/PCS1900 MHz。

U3500 integrates the RF and Baseband onto one small PCB. It can fulfill all the functions of RF signal receiving and transmitting, Baseband signal processing and audio signal processing so that the customers can realize all kinds of their own wireless products with very few peripheral components.

Designed on a single-side PCB, U3500 has a tiny dimension of 36.0mm×32.0mm×2.75mm, with a LGA pad, which provides all hardware interfaces between the module and customers' boards. The main hardware interfaces of U3500 consist of power supply interfaces, USB interface, UART interfaces, USIM/SIM interface, Audio interfaces, PCM interface, ADC interface, VRTC interface and GPIO.

U3500 is integrated with the TCP/IP protocol, it not only supports standard AT (Complied with Hayes 3GPP TS 27.007 and 27.005), but also support Longsung extended AT commands, which are very suited for developing all kinds of the customized applications.

U3500 provide main interfaces for applications, the interfaces as the following:

- 1) Power interface
- 2) USB interface
- 3) UART interface
- 4) USIM/SIM interface
- 5) Analog audio interface
- 6) PCM interface
- 7) ADC interface
- 8) GPIO
- 9) RESET input interface
- 10) POWER_ON interface
- 11) PWM interface;



- 12) RTC interface
- 13) IIC interface
- 14) Camera interface
- 15) SD interface
- 16) VCHG interface
- 17) Voltage output
- 18) Antenna interface

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2.1. Key features

Table3: Key features of U3500

Feature		Description
Power supply		3.5V~4.2V (Typical 3.8V)
Frequency Bands		UMTS: Dual-Band, 850/2100MHz EDGE/GPRS/GSM: Quad-Band, 850/900/1800/1900MHz
Data	UMTS	UMTS PS: 384 kbps(DL), 384 kbps(UL)
	EDGE	EDGE: Class12, 236.8kbps(DL), 118kbps(UL) Mobile station class B Coding schemes: MCS1-9
	GPRS	GPRS: Class12, 85.6kbps(DL), 42.8kbps(UL) Mobile station class B Coding schemes: CS1-4 Support Full PBCCH
	CSD	UMTS CSD: 57.6kbps GSM CSD: 14.4kbps
	Special	Integrated with the TCP/IP Protocol
Voice(Optional)		Triple-rate codec for HR, FR and EFR GSM & 3GPP: Adaptive multi-rate (AMR) Support DTMF
SMS		Point-to-point MO and MT SMS cell broadcast Support Text and PDU mode
MMS		Need AP achieve MMS Protocol
Video Phone		Need external CODEC; Video format H.263; Audio format G.723.1; AP achieve H.324M Protocol; H.245 Control Protocol for reliable transmission H.223 for multiplexing/de-multiplexing Protocol
Operation temperature		Normal operation: -20°C~+65°C Restricted Operation: -30°C~+75°C Storage temperature: -40°C~+85°C
ESD		VBAT, GND: Air discharge ±8KV, Contact discharge ±4KV RF interface: Air discharge ±8KV, Contact discharge ±4KV Else ports: Air discharge ±4KV, Contact discharge±2KV
Max power RF transition		Class 4 (2 W) for GSM850/GSM900 Class 1 (1 W) for GSM1800/GSM1900 Class E2 (0.5 W) for EDGE900 Class E2 (0.4 W) for EDGE1800 Class 3 (0.25 W) for UMTS



Current consumption	Off mode: 50μA Sleep mode: <4mA Idle mode: <40mA Voice mode: <300mA Data mode: <600mA
Connector	Stamp hole PAD LGA PAD
Stamp hole PAD	Power interface 1 USB2.0 High-Speed interface 1 UART interface(can be used as GPIO) 1 standard USIM/SIM interface (Support 3V&1.8V USIM/SIM) 1 USIM/SIM detect GPIO 1 analog audio channel 1 PCM interface(can be used as GPIO) 1 hardware Reset 1 ADC interface 1 NETLIGHT interface 3 voltage output (2.6V, 1.8V, 1.5~3.05 adjustable) 1 power on interface 1 VRTC 3 GPIO 1 IIC interface 1 Camera interface 1 SD interface 1 VCHG interface 1 LCD backlight driver 3 sleep and awake GPIO Antenna interface
LGA PAD	1 LCD interface(Reserved) 1 5×5 keypad interface(Reserved) 1 bluetooth 32KHz clock output(Reserved) 1 ADC interface(Reserved) 1 analog audio channel(Reserved)
Dimensions	36.0mm×32.0mm×2.75mm
Weight	<8g
Fixed structure	Stamp hole PAD and LGA PAD
Test points	8 test points: JTAG interface
AT command	Standard AT commands (Hayes 3GPP TS 27.007 and 27.005) Support LongSung Extend AT commands
Approvals	RoHS

2.2. Operating modes

Table4: Overview operating modes

Mode	Function	
Sleep mode	Refer to the method of chapter 3.4.4.1, the module will reduce to 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	Connection is going on between two subscribers. In this case, the power consumption depends on network settings.
GPRS mode	GPRS IDLE	Module is ready for GPRS data transfer, but no data is currently sent or received. Power consumption depends on network settings and GPRS configuration (e.g. multi-slot settings).
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink/downlink data rates and GPRS configuration (e.g. used multi-slot settings).
GPRS mode	EDGE IDLE	Module is ready for EDGE data transfer, but no data is currently sent or received. Power consumption depends on network settings and EDGE configuration (e.g. multi-slot settings).
	EDGE DATA	EDGE data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink/downlink data rates and EDGE configuration (e.g. used multi-slot settings).
WCDMA mode	WCDMA IDLE	Software is active. Module has registered to the WCDMA network, and the module is ready to send and receive.
	WCDMA TALK	Module is serving in audio. The power consumption depends on WCDMA network settings.
	WCDMA DATA	WCDMA data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink/downlink data rates and WCDMA configuration.
Minimum Function mode	VBAT remains applied. Use AT+CFUN=0 to let module go into Minimum Function mode	
Power Down	Module will go to power off mode when use AT+POWEROFF or VBAT to low.	

2.3. Hardware functional block diagram

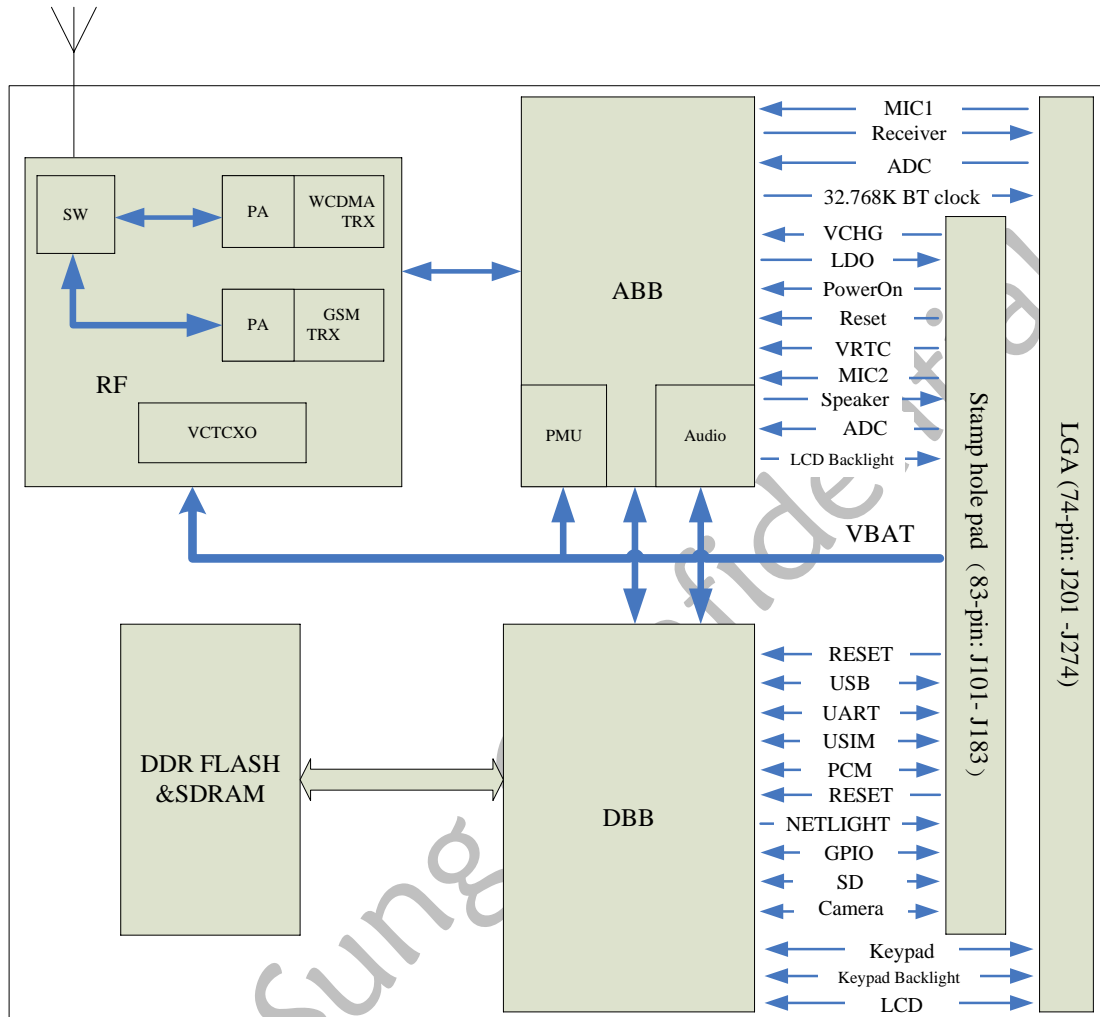


Figure1: U3500 Hardware functional block diagram

☆RF include:

- 1) WCDMA Transceiver
- 2) GSM Transceiver
- 3) SW
- 4) VCTCXO

☆Analog Baseband include:

- 1) PMU
- 2) Audio process unit

☆Digital Baseband include:

- 1) Digital Baseband chip
- 2) NAND FLASH and SDRAM

2.4. Hardware interface

U3500 is a Single-side Layout PCBA.

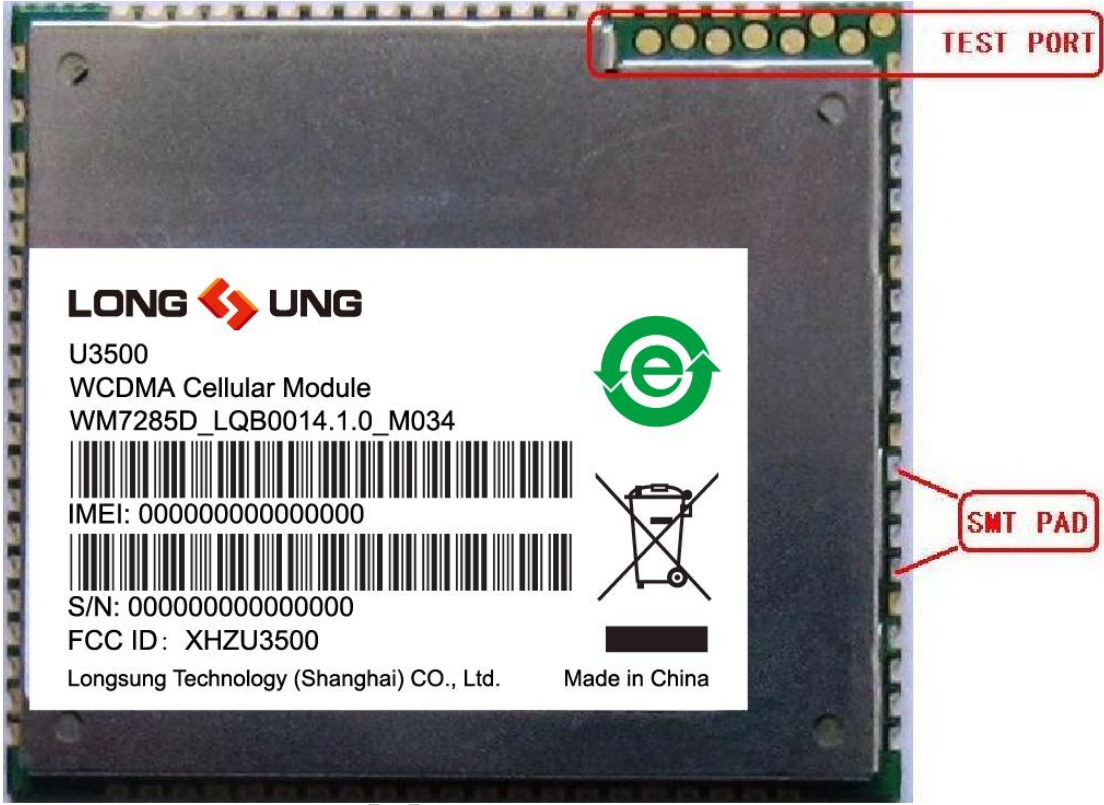


Figure2: U3500 top view



Figure3: U3500 bottom view



U3500 hardware interfaces include: 1 group Test points, an antenna RF connector, a 83-pin stamp hole PAD, a groups LGA PAD.

- ◆ One group Test points: As figure 2 signed "TEST PORT". JTAG debug test points is used when module in abnormal for downloading firmware and debug module. It is only for RD engineers.
- ◆ RF interface: As figure 3 signed "Antenna SMT PAD". Stamp hole antenna SMT PAD is welded in customer mainboard directly, this interface can solder an antenna with impedance of 50Ω .
- ◆ 83-pin stamp hole SMT PAD: As figure 2 signed "SMT PAD". This group provide abundant of interface, the details are describe in chapter 3.
- ◆ 126-pin LGA PAD: As figure 3 signed "LGA PAD". This group is reserved, default is NC.

3. Application interfaces description

3.1. 83-pin Stamp hole SMT PAD and 126-pin LGA PAD

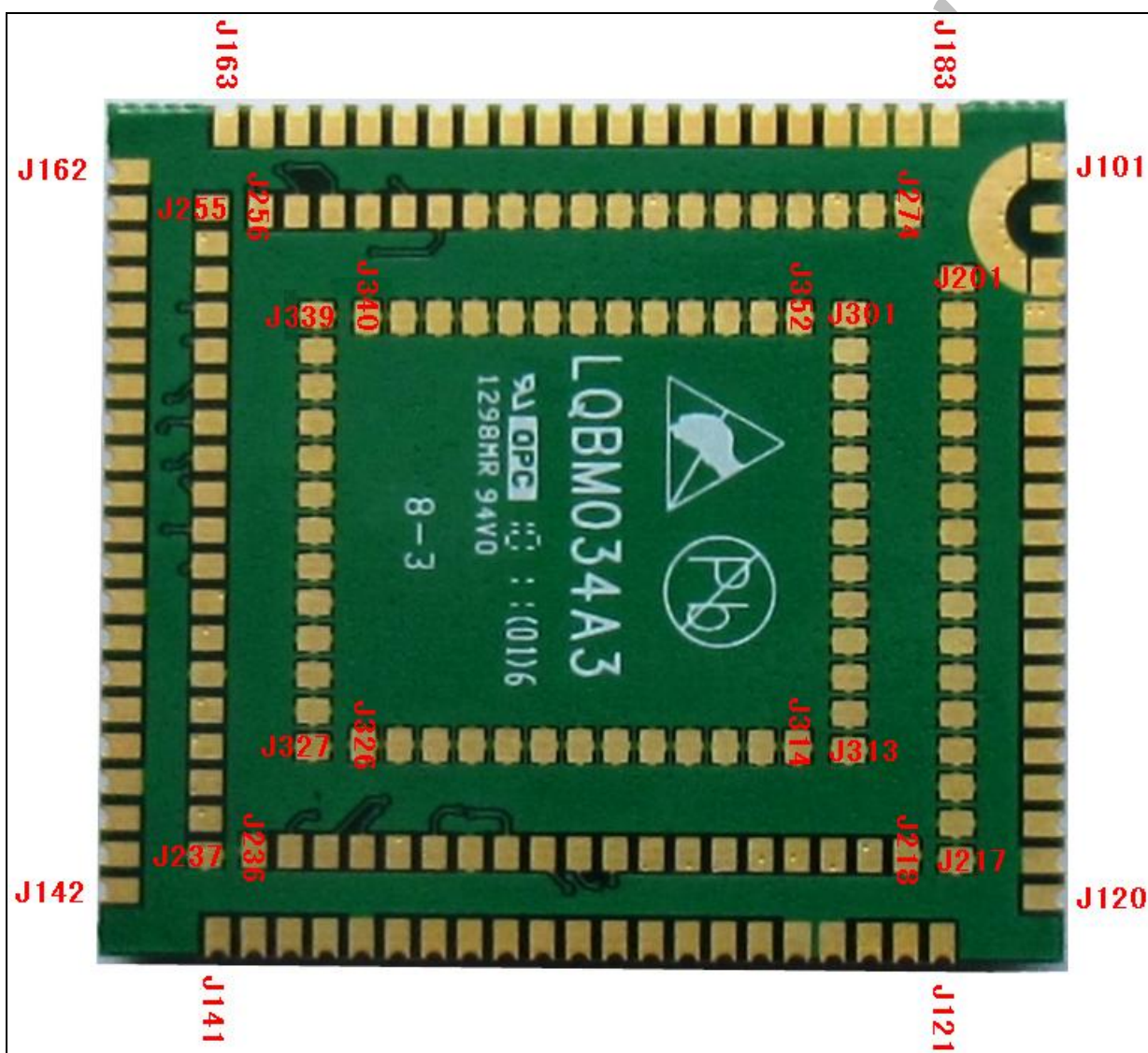


Figure4: U3500 83-pin stamp hole SMT PAD and 126-pin LGA PAD pin location



Table5: U3500 pin definition

83-pin stamp hole SMT PAD

PIN NO.	PIN Name	I/O	Describe
J101	GND		
J102	ANT		Antenna interface
J103	GND		
J104	GND		
J105	GND		
J106	AP_RDY	I	AP awaked and ready for communication
J107	AP_IRQ	I	AP require BP to sleep
J108	BP_IRQ	O	BP require AP to awake
J109	USIM_DET	I	USIM/SIM card detect
J110	GND		
J111	PCM_SYNC	O	PCM interface, can be used as GPIO
J112	PCM_DOUT	O	PCM interface, can be used as GPIO
J113	PCM_DIN	I	PCM interface, can be used as GPIO
J114	PCM_CLK	I	PCM interface, can be used as GPIO
J115	NETLIGHT	O	The GPIO default is NETLIGHT
J116	I2C_SDA	I/O	Serial interface data input and output
J117	I2C_SCL	O	Serial interface clock output
J118	LCD_DRV_N	O	LCD backlight
J119	GND		
J120	ADC0		2.6V, ADC
J121	VREG_GP2	O	1.5~3.05V adjustable voltage output
J122	VREG_MSME	O	1.8V voltage output
J123	VOUT	O	2.6V voltage output
J124	GND		
J125	GND		
J126	VBAT	I	3.5~4.2V, typical 3.8V
J127	VBAT	I	3.5~4.2V, typical 3.8V
J128	VBAT	I	3.5~4.2V, typical 3.8V
J129	VCHG	O	4.5~7.0V, typical 5.0V
J130	VREG_MMC	O	2.6V, the power supply for SD card
J131	SDCC1_DATA0	I/O	SD Interface, can be used as GPIO
J132	SDCC1_DATA1	I/O	SD Interface, can be used as GPIO
J133	SDCC1_DATA2	I/O	SD Interface, can be used as GPIO
J134	SDCC1_DATA3	I/O	SD Interface, can be used as GPIO
J135	SDCC1_CLK	O	SD Interface, can be used as GPIO
J136	SDCC1_CMD	O	SD Interface, can be used as GPIO
J137	GND		
J138	USIM_CLK	O	1.8/3.0V



PIN NO.	PIN Name	I/O	Describe
J139	USIM_RESET	O	1.8/3.0V
J140	USIM_DATA	I/O	1.8/3.0V
J141	USIM_VCC	O	1.8/3.0V
J142	USB_VBUS	I	5.0V
J143	USB_DM	I/O	USB Data-
J144	USB_DP	I/O	USB Data+
J145	GND		
J146	SPK_N	O	Loudspeaker cathode
J147	SPK_P	O	Loudspeaker anode
J148	MIC2_N	I	200mVpp(2.6Vpp,Max)
J149	MIC2_P	I	200mVpp(2.6Vpp,Max)
J150	GND		
J151	CAMIF_DATA0	O	Bit 0 of RGB or YUV D0 video output
J152	CAMIF_DATA1	O	Bit 1 of RGB or YUV D1 video output
J153	CAMIF_DATA2	O	Bit 2 of RGB or YUV D2 video output
J154	CAMIF_DATA3	O	Bit 3 of RGB or YUV D3 video output
J155	CAMIF_DATA4	O	Bit 4 of RGB or YUV D4 video output
J156	CAMIF_DATA5	O	Bit 5 of RGB or YUV D5 video output
J157	CAMIF_DATA6	O	Bit 6 of RGB or YUV D6 video output
J158	CAMIF_DATA7	O	Bit 7 of RGB or YUV D7 video output
J159	CAMIF_DATA8	O	Bit 8 of RGB or YUV D8 video output
J160	CAMIF_DATA9	O	Bit 9 of RGB or YUV D9 video output
J161	CAMIF_PCLK	O	Pixel clock output
J162	GND		
J163	CAMIF_MCLK	I	Master clock input
J164	GND		
J165	CAMIF_HSYNC	O	Video horizontal line synchronization signal
J166	CAMIF_VSYNC	O	Vertical sync output
J167	CAMIF_RESET	O	Master reset input, active low
J168	CAMIF_EN	O	Vidio enable
J169	GND		
J170	VRTC	I	1.5~3.25V, typical 3.0V
J171	POWER_ON	I	4.2V(Active low)
J172	RESET	I	2.6V(Active low)
J173	UART_TX	O	UART_TX, can be used as GPIO
J174	UART_RX	I	UART_RX, can be used as GPIO
J175	UART_CTS	I	UART_CTS, can be used as GPIO
J176	UART_RTS	O	UART_RTS, can be used as GPIO
J177	UART_DTR	I	UART_DTR, can be used as GPIO
J178	UART_DCD	O	UART_DCD, can be used as GPIO
J179	UART_RI	O	UART_RI, can be used as GPIO



PIN NO.	PIN Name	I/O	Describe
J180	GND		
J181	GND		
J182	GND		
J183	GND		

74-pin LGA PAD

PIN NO.	PIN Name	I/O	Describe
J201	GND		
J202	GND		
J203	GND		
J204	GND		
J205	GND		
J206	GND		
J207	GND		
J208	GND		
J209	GND		
J210	GND		
J211	GND		
J212	GND		
J213	GND		
J214	GND		
J215	GND		
J216	GND		
J217	GND		
J218	GND		
J219	KEYOUT4	O	Keypad interface
J220	KEYOUT3	O	Keypad interface
J221	KEYOUT3	O	Keypad interface
J222	KEYOUT1	O	Keypad interface
J223	KEYOUT0	O	Keypad interface
J224	KEYSENSE_N4	I	Keypad interface
J225	KEYSENSE_N3	I	Keypad interface
J226	KEYSENSE_N2	I	Keypad interface
J227	KEYSENSE_N1	I	Keypad interface
J228	KEYSENSE_N0	I	Keypad interface
J229	KPD_DRV_N	O	Keypad backlight
J230	GND		
J231	LCD_RESET	O	LCD interface
J232	LCD_CS	O	LCD interface
J233	LCD_RS	O	LCD interface
J234	LCD_WR	O	LCD interface



PIN NO.	PIN Name	I/O	Describe
J235	LCD_RD	O	LCD interface
J236	GND		
J237	GND		
J238	EARON	O	80mVpp(4.26Vpp,Max)
J239	EAROP	O	80mVpp(4.26Vpp,Max)
J240	MIC_N	I	200mVpp(2.6Vpp,Max)
J241	MIC_P	I	200mVpp(2.6Vpp,Max)
J242	GND		
J243	LCD_DB15	O	LCD interface
J244	LCD_DB14	O	LCD interface
J245	LCD_DB13	O	LCD interface
J246	LCD_DB12	O	LCD interface
J247	LCD_DB11	O	LCD interface
J248	LCD_DB10	O	LCD interface
J249	LCD_DB09	O	LCD interface
J250	LCD_DB08	O	LCD interface
J251	LCD_DB07	O	LCD interface
J252	LCD_DB06	O	LCD interface
J253	LCD_DB05	O	LCD interface
J254	LCD_DB04	O	LCD interface
J255	LCD_DB03	O	LCD interface
J256	LCD_DB02	O	LCD interface
J257	LCD_DB01	O	LCD interface
J258	LCD_DB00	O	LCD interface
J259	GND		
J260	32K_CLK_BT	O	32KHz clock for Bluetooth
J261	ADC1	I	2.6V, ADC
J262	GND		
J263	GND		
J264	GND		
J265	GND		
J266	GND		
J267	GND		
J268	GND		
J269	GND		
J270	GND		
J271	GND		
J272	GND		
J273	GND		
J274	GND		



52-pin LGA PAD

PIN NO.	PIN Name	I/O	Describe
J301	GND		
J302	GND		
J303	GND		
J304	GND		
J305	GND		
J306	GND		
J307	GND		
J308	GND		
J309	GND		
J310	GND		
J311	GND		
J312	GND		
J313	GND		
J314	GND		
J315	GND		
J316	GND		
J317	GND		
J318	GND		
J319	GND		
J320	GND		
J321	GND		
J322	GND		
J323	GND		
J324	GND		
J325	GND		
J326	GND		
J327	GND		
J328	GND		
J329	GND		
J330	GND		
J331	GND		
J332	GND		
J333	GND		
J334	GND		
J335	GND		
J336	GND		
J337	GND		
J338	GND		
J339	GND		



PIN NO.	PIN Name	I/O	Describe
J340	GND		
J341	GND		
J342	GND		
J343	GND		
J344	GND		
J345	GND		
J346	GND		
J347	GND		
J348	GND		
J349	GND		
J350	GND		
J351	GND		
J352	GND		

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3.2. Power supply

U3500 power on and power off correlative interfaces as the following:

Table6: U3500 Power supply correlative interfaces

PIN Name	I/O	PIN Num.	Description
VBAT	I	J126, J127, J128	Power supply, 3.5~4.2V, typical 3.8V
VRTC	I	J170	1.5~3.25V, typical 3.0V
VOUT	O	J123	Voltage output, 2.6V, 80mA
VREG_GP2	O	J121	Adjustable voltage output 1.5V to 3.05V
VREG_MSME	O	J122	Voltage output, 1.8V
VREG_MMC	O	J130	SD interface power supply
POWER_ON	I	J171	Power on, 4.2V, Low active
RESET	I	J172	Reset, 2.6V, Low active
VCHG	O	J129	Li-on battery charger interface 4.5~4.7V
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

3.2.1. Power Supply and reference design

3.2.1.1. VBAT input

The power supply of U3500 should be a single voltage source with VBAT ranged from 3.5V to 4.2V. As a mobile terminal conformed to the HSPA/UTMS/GSM criterions, in some case, the ripple in a transmit burst may cause a maximum voltage drop of 450mV while the current consumption will rise to the typical peak of 2A. So the power supply must be able to provide sufficient current.

The capacitor must be a larger one electrolytic capacity (recommend 2200uF/10V) or two smaller dimension tantalum capacities (470uF/6.3V) in parallel (C_A) is recommended. And with a small (0.1 μ F to 1 μ F) ceramic (C_B) in parallel; the capacitors should put as close as possible to the U3500 VBAT pins.

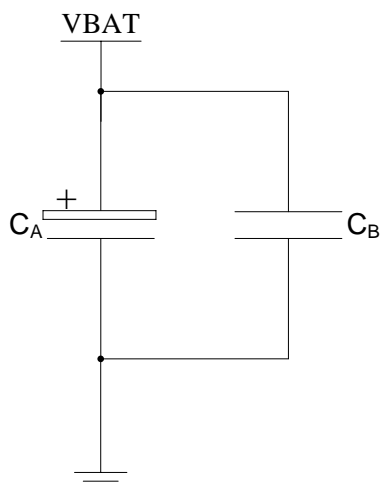


Figure5: U3500 VBAT input

3.2.1.2. VRTC input

PINJ170 of U3500 module is VRTC interface.

VRTC can be used for connecting backup rechargeable battery. When VBAT power supply is not available, the battery supplies the power to RTC core of U3500. When VBAT is available, U3500 can recharge the battery via VRTC pin. If the RTC is useless for you, you can set PINJ170 as NC.

Reference design as the following:

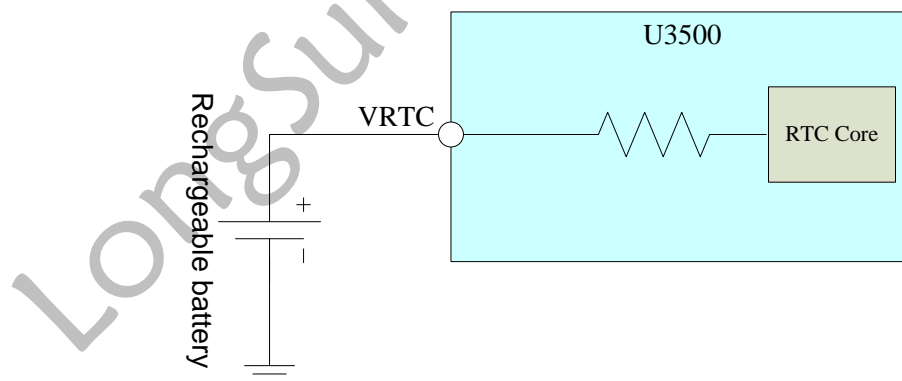


Figure6: VRTC connect to rechargeable battery

If use non-rechargeable battery, the reference design as the following:

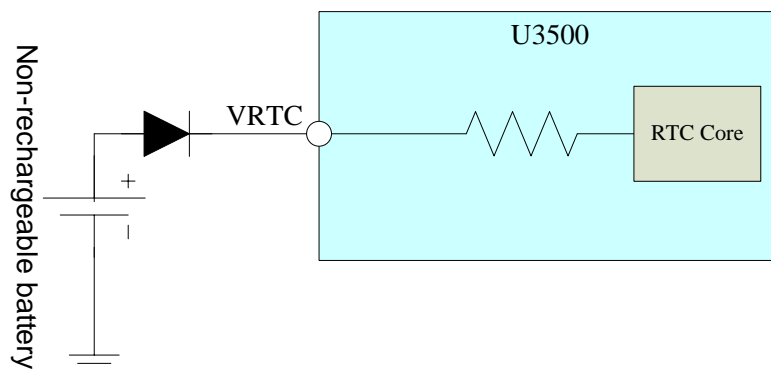


Figure7: VRTC connect to non-rechargeable battery
 If use a large capacitance capacity, the reference design as the following:

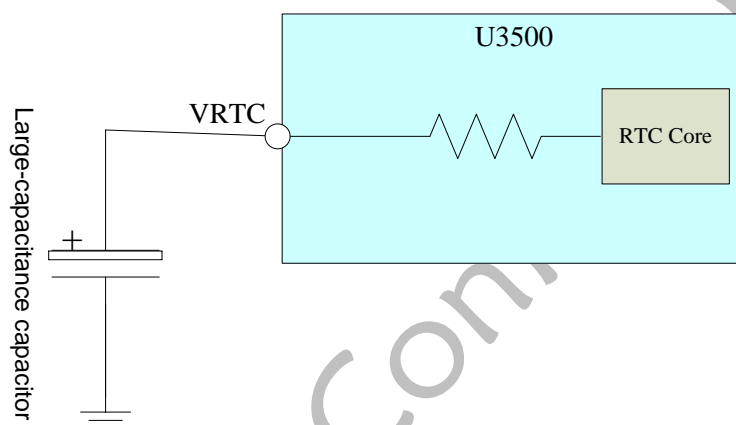


Figure8: VRTC connect to large capacitance capacity

3.2.1.3. VOUT、VREG_GP2、VREG_MMC voltage output

During U3500 working, 2.6V voltage will output through PINJ123 of U3500, it named VOUT. The current is rated for 80mA. VOUT can be used as a power supply of the external device, such as LCD. And you can read the level of VOUT to judge whether the module is working.

Besides, U3500 also provides a adjustable voltage output named VREG_GP2 through PINJ121, the range of voltage is 1.5V to 3.05V.

U3500 can support SD interface, and provide a voltage VREG_MMC for it through PINJ130.

3.2.1.4. POWER_ON input

The POWER_ON (PINJ171) is used to control U3500 power on. When the VBAT

is active, POWER_ON can control U3500 to power on

- ✧ If connect POWER_ON to GND in application, U3500 power on mode will be VBAT active power on mode. When VBAT is active, the module will be power on automatically. In this mode, U3500 just can be power down with VBAT set to low or off.
- ✧ If application can control POWER_ON high or low level, During VBAT is active, first set POWER_ON to low level with 1000mS, U3500 will be power on.

The section reference design of POWER_ON input as the figure below. The AP_PWR_CTRL is the control signal of application; it can control U3500 to power on.

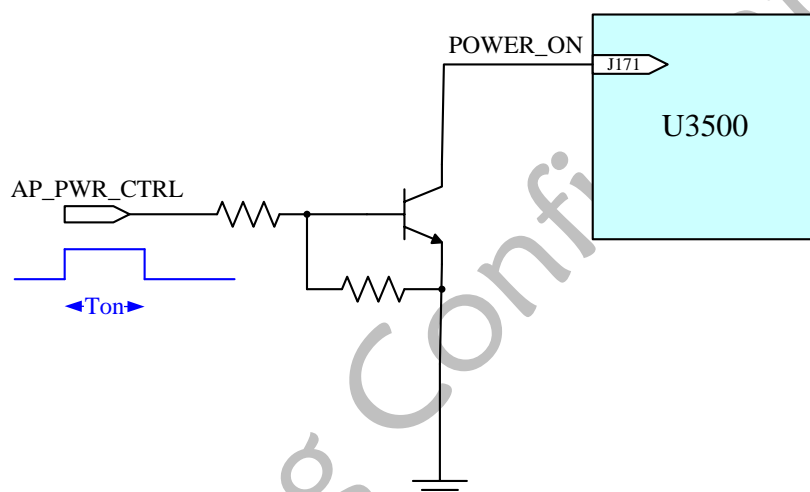


Figure9: POWER_ON control module power on

3.2.1.5. RESET input

The RESET (PINJ172) can control U3500 module to reset. The RESET is active by low level.

- ✧ A low level pulse with 100mS will be used when set module reset.

The part of RESET reference design as the figure below. AP_RESET is the control signal from the application.

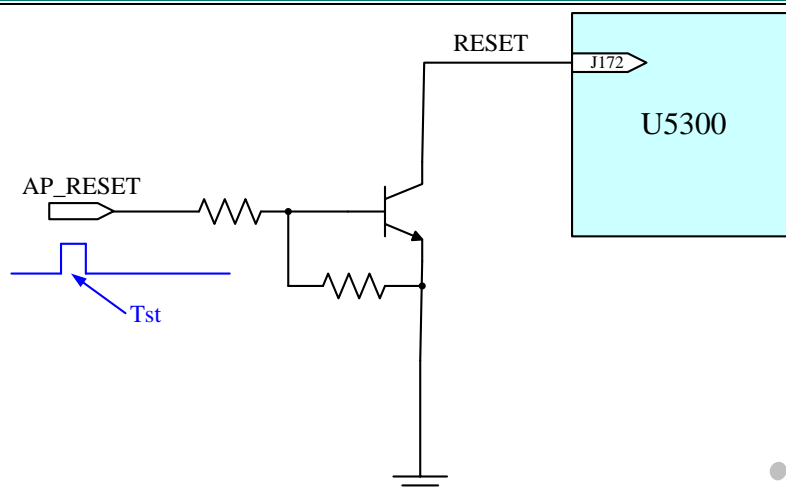


Figure10: AP_RESET control module reset

3.2.2. Power on/off control

There are two methods to power on the module U3500: VBAT active power on, POWR_ON control power on. The method depends on the external circuit of the application (POWER_ON input circuit).

There are two methods to power off the module U3500: AT command to power off, VBAT set to low or off.

3.2.2.1. POWER_ON control module power on

Insure that the power supply of U3500 VBAT is active (3.5~4.2V, typical 3.8V).The POWER_ON must be controlled. The power on timing is as the figure below.

Note: The POWER_ON must be controlled. In this method the module can be power off by AT command and set VBAT to low or off.

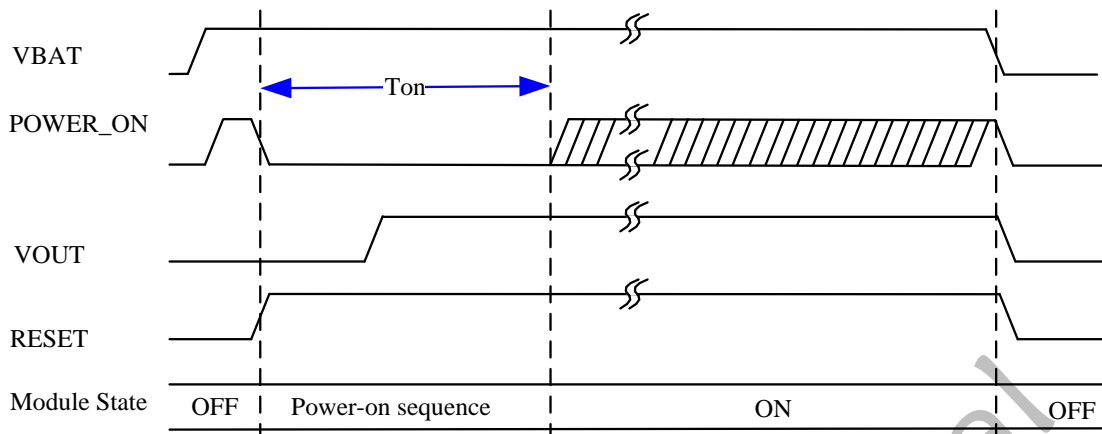


Figure11: POWER_ON control module power on timing

The Ton is 1000mS.

3.2.2.2. VBAT active power on

Insure that the power supply of U3500 VBAT is active (3.5~4.2V, typical 3.8V).When connect POWER_ON to GND, U3500 will be VBAT active power on mode.

Note: When module is VBAT active power on mode, module only can be power off by VBAT set low or off.

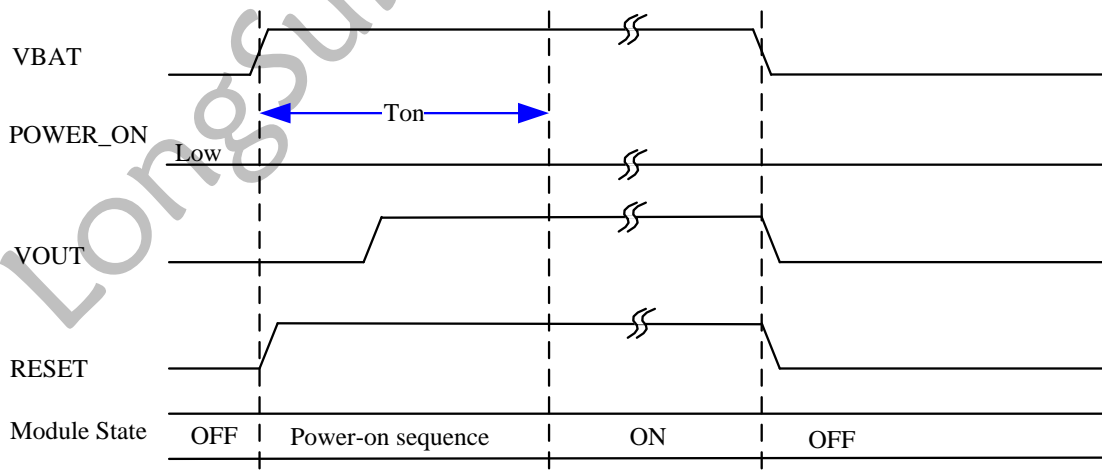


Figure12: VBAT active power on mode timing

3.2.2.3. AT command power off

Only when module is POWER_ON control power on mode, U3500 can use AT command to power off. When module is working, and POWER_ON is high level, use AT command can let U3500 power off.

Power off AT command as the following:

AT+POWEROFF

AT command power off timing as the figure below:

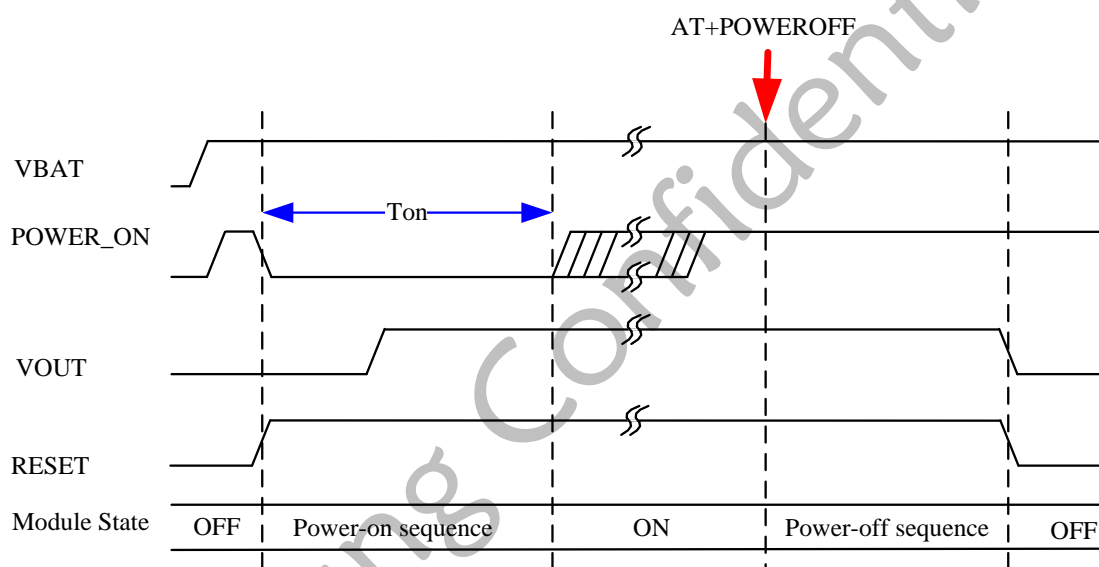


Figure13: AT command power off timing

3.2.2.4. VBAT set low or off to power off mode

When the power supply of U3500 VBAT is too low (include VBAT is off), the module will be power off.

3.2.3. RESET control

Control RESET (PINJ139) to set U3500 reset. The RESET is active by low level. The RESET signal must be a Tst (100ms) low pulse. Send AT+RESET can reset the U3500 too.

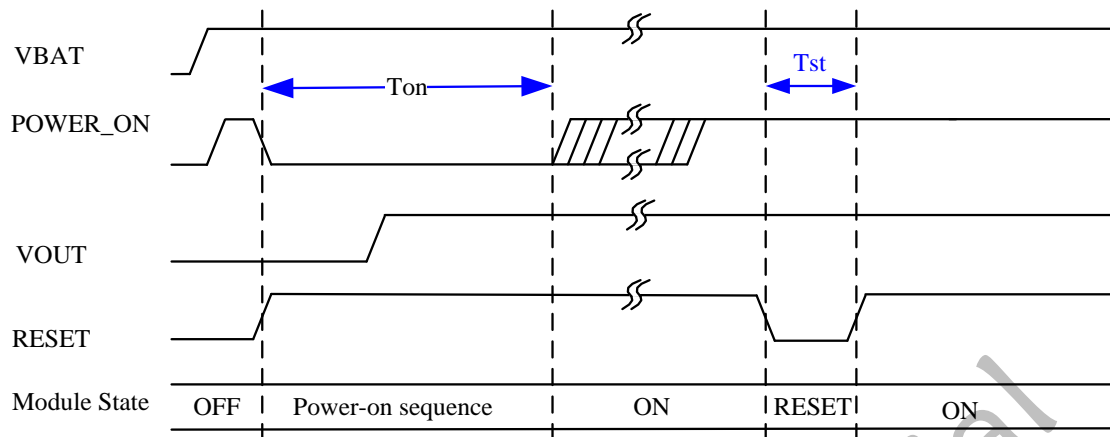


Figure14: U3500 RESET timing

3.3. USB interface

3.3.1. USB interface description

U3500 module supports a USB2.0 High-Speed interface. U3500 default PID is 0X9603. When the USB drivers of U3500 are installed, the OS will detect 3 virtual serial ports: Modem port, Diagnostic port, AT port.

Table7: U3500 USB interface

PIN Name	I/O	PIN Num.	Description
USB_VBUS	I	J142	USB power supply, 5V
USB_DM	I/O	J143	USB data-
USB_DP	I/O	J144	USB data+
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

3.3.2. USB reference circuit

The USB part reference design circuit as the figure below.

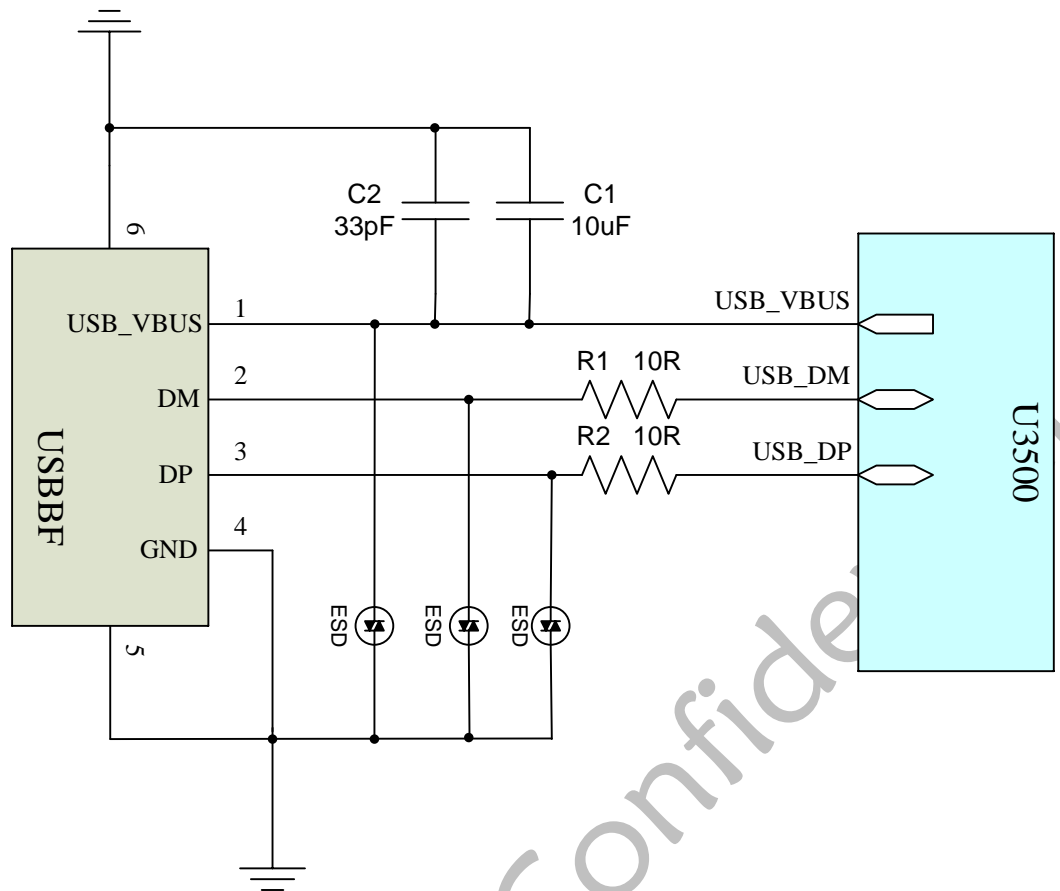


Figure15: U3500 USB interface reference design circuit

- 1) To get the reliable USB power supply, it is recommended to use a 10uF (C1) filter capacitor and a 33pF (C2) filter capacitor. DC rated voltage of the capacitors should be above 10V;
- 2) To reduce the reflection caused by the high frequency alternating signal in the transmission, it is recommended to add a resistor with value below 10Ω to the DM and DP in USB interface to ensure correct transmission for USB data. Just like the resistors R1and R2;
- 3) To avoid static electricity in USB interface, it is recommended to use the ESD protection device. Junction capacitance of the ESD component should be less than 5pF;
- 4) To get the reliable USB data transfer, need protect the USB device. Such as must protect the USB_DP, USB_DM, need 90Ω impedance control, and let



them keep away from the interference signal.

3.3.3. USB driver

U3500 module support many kinds of OS, such as: Windows 2000, Windows XP, Windows Vista32/64, Windows 7, Windows CE5.0/6.0, Windows Mobile5.0/6.0. When use these systems, need special drivers for U3500.

For different OS and VID and PID, the drivers are different. If need them, please contact with FAE of LongSung. The default VID and PID is: VID_1C9E & PID_9603.

For Linux OS, such as Radhat, Ubuntu and Android, need the OS itself USB driver usbserial.ko. You need load the driver usbserial.ko and PID, VID to the system.

3.3.3.1. Linux OS load USB driver for U3500

Make sure there is usbserial.ko driver in your Linux system. Linux2.4.X and Linux2.6.X OS have usbserial.ko, but for some Ubuntu editions must recompile the kernel to get the usbserial.ko.

The following is in PC Linux2.6.X OS load driver process. **(Note: Embed Linux OS may have some difference)**

- 1) Please insert U3500 to the AP with Linux system by USB. And make sure the power supply for U3500 is active and steady and can power on U3500;
- 2) Preparation of lookup USB devices by Linux usbfs filesystem, mount the USB filesystem, type the command like this:

#mount -t usbfs none /proc/bus/usb

- 3) Check the status of AP device, in order to make sure AP is ready, we can



type command like this:

#cat /proc/bus/usb/devices

Then we will get the result as the following:

T: Bus=03 Lev=01 Prnt=01 Port=00 Cnt=01 Dev#=9 Spd=12 MxCh= 0

D: Ver= 1.10 Cls=00(>ifc) Sub=00 Prot=00 MxPS=64 #Cfgs= 1

P: Vendor=1c9e ProdID=9603 Rev= 0.00

S: Manufacturer=Qualcomm, Incorporated

S: Product=Qualcomm CDMA Technologies MSM

C:* #Ifs= 5 Cfg#= 1 Atr=a0 MxPwr=500mA

I:* If#= 0 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=ff Prot=ff Driver=(none)

E: Ad=81(I) Atr=03(Int.) MxPS= 16 IvL=128ms

E: Ad=82(I) Atr=02(Bulk) MxPS= 64 IvL=0ms

E: Ad=02(O) Atr=02(Bulk) MxPS= 64 IvL=0ms

I:* If#= 1 Alt= 0 #EPs= 2 Cls=ff(vend.) Sub=ff Prot=ff Driver=(none)

E: Ad=84(I) Atr=02(Bulk) MxPS= 64 IvL=0ms

E: Ad=04(O) Atr=02(Bulk) MxPS= 64 IvL=0ms

I:* If#= 2 Alt= 0 #EPs= 2 Cls=ff(vend.) Sub=ff Prot=ff Driver=(none)

E: Ad=86(I) Atr=02(Bulk) MxPS= 64 IvL=0ms

E: Ad=06(O) Atr=02(Bulk) MxPS= 64 IvL=0ms

If the USB device is ready, we can see the red characters listed above. From it, the vendor ID and product ID is 1c9e and 9603. Like **Vendor=1c9e ProdID=9603 Rev= 0.00.**

Also, we can see three serial ports displayed by blue characters. They are diagnostic port, AT port and modem port (The ports from the top to the bottom should be like this: DIAG, AT, MODEM).

4) Install USB drivers in AP, type command like this:

#modprobe usbserial vendor=0x1c9e product=0x9603

5) Check the status of device driver, type command like this:

#cat /proc/bus/usb/devices



You may get the result as the following:

T: Bus=03 Lev=01 Prnt=01 Port=00 Cnt=01 Dev#=3 Spd=12 MxCh= 0

D: Ver= 1.10 Cls=00(>ifc) Sub=00 Prot=00 MxPS=64 #Cfgs=1

P: Vendor=1c9e ProdID=9603 Rev= 0.00

S: Manufacturer=Qualcomm, Incorporated

S: Product=Qualcomm CDMA Technologies MSM

C:* #Ifs= 5 Cfg#= 1 Atr=a0 MxPwr=500mA

I:* If#= 0 Alt= 0 #EPs= 3 Cls=ff(vend.) Sub=ff Prot=ff Driver=usbserial_generic

E: Ad=81(I) Atr=03(Int.) MxPS= 16 IvL=128ms

E: Ad=82(I) Atr=02(Bulk) MxPS= 64 IvL=0ms

E: Ad=02(O) Atr=02(Bulk) MxPS= 64 IvL=0ms

I:* If#= 1 Alt= 0 #EPs= 2 Cls=ff(vend.) Sub=ff Prot=ff Driver=usbserial_generic

E: Ad=84(I) Atr=02(Bulk) MxPS= 64 IvL=0ms

E: Ad=04(O) Atr=02(Bulk) MxPS= 64 IvL=0ms

I:* If#= 2 Alt= 0 #EPs= 2 Cls=ff(vend.) Sub=ff Prot=ff Driver=usbserial_generic

E: Ad=86(I) Atr=02(Bulk) MxPS= 64 IvL=0ms

E: Ad=06(O) Atr=02(Bulk) MxPS= 64 IvL=0ms

If the driver is ready, we can see the usbserial_generic on the right side of each port.

- 6) Check the device point in the /dev filesystem:

```
#cd /dev
```

```
# ls ttyUSB*
```

If the AP driver is OK, there should be ttyUSB0~ ttyUSB2.

3.3.3.2. Linux OS AP use AT to control U3500

- 1) Please insert the USIM/SIM card into the application terminal, make sure the USIM/SIM card with Data service already been permitted. Plug the WCDMA/GSM antenna to RF connector of U3500. Power on the module



U3500, load the USB driver, create USB end ports: ttyUSB0~ ttyUSB2.

- 2) Run minicom application in Linux OS:

#minicom -s

In the menu of minicom select "Serial port setup", set "Serial device " as /dev/ttyUSB1 (**Note: AT(ttyUSB1), Modem(ttyUSB2) can response AT commands, Diag (ttyUSB0) can not response AT commands**); Then back to the menu of minicom and select "Save setup as df1 ", save the configuration, then select "exit " to exit minicom.

- 3) Send AT commands by minicom

#minicom

It should prompt as the following:

Welcome to minicom 2.3 OPTIONS: I18n

Compiled on Feb 24 2008, 16:35:15. Port /dev/ttyUSB1

Press CTRL-A Z for help on special keys

Input AT command to open the echo of AT:

ATE

IF the system is running normally, it should prompt as the following:

OK

Input AT command to get the version of firmware:

AT+LCTSW

Will get the following response:

SoftwareVersion: LQA0082.2.3_MG24

InnerVersion: LQA0082_240085_6.0.8W1215_EFS1.5

OK

Input AT command to get the strength and BER:

AT+CSQ

Will get the following response:

+CSQ: 20,74

OK

Input AT command to get the status of registration:

`AT+CREG?`

Will get the following response:

`+CREG: 0,1`

OK

Input AT command to get the information operator:

`AT+COPS?`

Will get the following response:

`+COPS: 0,0,"CHN-CUGSM",2`

OK

3.3.3.2. Linux OS AP dial PPP connection

- 1) Repeat loading USB driver and AT communication with U3500. Make sure U3500 get the normal registration, and the strength of RF signal will be stronger than 13 (The first parameter of CSQ).
- 2) Make sure the Linux OS has pppd application, if it hasn't pppd application, please install kppp, you will get pppd in your OS.
- 3) Create a new file: `/etc/ppp/chat/gprs-connect-chat`

Then add messages as the following:

```
TIMEOUT      15
ABORT        "DELAYED"
ABORT        "BUSY"
ABORT        "ERROR"
ABORT        "NO DIALTONE"
```



```
ABORT          "NO CARRIER"  
TIMEOUT        40  
"              \rAT  
OK             ATSO=0  
OK             ATE0V1  
OK             AT+CGDCONT=1,"IP","3GNET"  
OK             ATDT*99***1#  
CONNECT       "
```

Note: Different USIM/SIM card which you insert in the application terminal, AT+CGDCONT=1,"IP","3GNET" will be different. Please contact the operator to get the APN and replace the parameter "3GNET".

4) Modify the configuration of pppd: /etc/ppp/options
If you find the "auth", modify it as "#auth". The result is there aren't ID verification.

5) Create a new file: /etc/ppp/peer/gprs
Add messages as the following: (The end port must be ttyUSB2):

Usage: root>pppd call gprs

```
/dev/ttyUSB2  
9600  
crtstcts  
modem  
#noauth  
debug  
nodetach  
#hide-password  
usepeerdns  
noipdefault  
defaultroute
```



user "3gnet"

0.0.0.0:0.0.0.0

ipcp-accept-local

ipcp-accept-remote

#lcp-echo-failure 12

#lcp-echo-interval 3

#noccp

#novj

#novjccomp

#persist

connect '/usr/sbin/chat -s -v -f /etc/ppp/chat/gprs-connect-chat'

6) Connect to the Internet:

#pppd call gprs

ifconfig

If you get the ppp0 net port means that PPP is successful.

eth0 Link encap:Ethernet HWaddr 00:1D:09:33:A7:E1

inet addr:172.16.180.105 Bcast:172.16.180.255 Mask:255.255.255.0 inet6

addr: fe80::21d:9ff:fe33:a7e1/64 Scope:Link UP BROADCAST RUNNING

MULTICAST MTU:1500 Metric:1 RX packets:39793 errors:0 dropped:0

overruns:0 frame:0 TX packets:17971 errors:0 dropped:0 overruns:0 carrier:0

collisions:0 txqueuelen:1000 RX bytes:3445057 (3.2 MiB) TX bytes:20088925

(19.1 MiB) Interrupt:169 lo Link encap:Local Loopback inet addr:127.0.0.1

Mask:255.0.0.0 inet6 addr: ::1/128 Scope:Host UP LOOPBACK RUNNING

MTU:16436 Metric:1 RX packets:20 errors:0 dropped:0 overruns:0 frame:0 TX

packets:20 errors:0 dropped:0 overruns:0 carrier:0 collisions:0 txqueuelen:0

RX bytes:1160 (1.1 KiB) TX bytes:1160 (1.1 KiB)

ppp0 Link encap:Point-to-Point Protocol inet addr:10.182.207.113

P-t-P:10.64.64.64 Mask:255.255.255.255 UP POINTOPOINT RUNNING NOARP

MULTICAST MTU:1500 Metric:1 RX packets:5 errors:0 dropped:0 overruns:0

```
frame:0 TX packets:6 errors:0 dropped:0 overruns:0 carrier:0 collisions:0
txqueuelen:3 RX bytes:62 (62.0 b) TX bytes:101 (101.0 b)
```

7) Testing the Internet

```
# ping 119.75.217.56
```

It is the IP address of www.baidu.com. If the ping fails, we need add a route like this:

```
#route add default gw 10.64.64.64
```

Note: 10.64.64.64 is the ISP address as the red character above.

```
# ping www.baidu.com
```

If ping www.baidu.com fails, we should add DNS to the `/etc/resolv.conf`

8) Disconnect the internet

```
# killall pppd
```

3.4. UART interface

U3500 module provides a UART interface.

3.4.1. UART interface description

Table8: U3500 UART interface

PIN Name	I/O	PIN Num.	Description
UART_RX	I	J174	RX in UART
UART_TX	O	J173	TX in UART
UART_CTS	I	J175	CTS in UART
UART_RTS	O	J176	RTS in UART
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

3.4.2. UART interface reference circuit

For an application system, U3500 uses as DCE (Data Communication Equipment)

and application terminal uses as DTE (Data terminal equipment).

- ✧ If AP will use U3500 UART port as data transfer mode, the recommended DCE-DTE connection as the figure below:

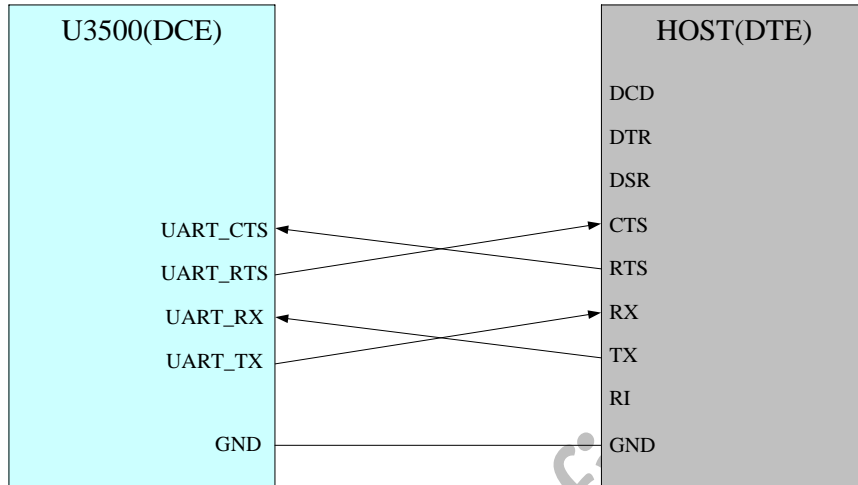


Figure16: U3500 UART is used for data transfer

- ✧ If AP will use U3500 UART port as AT commands mode, the recommended DCE-DTE connection as the figure below:

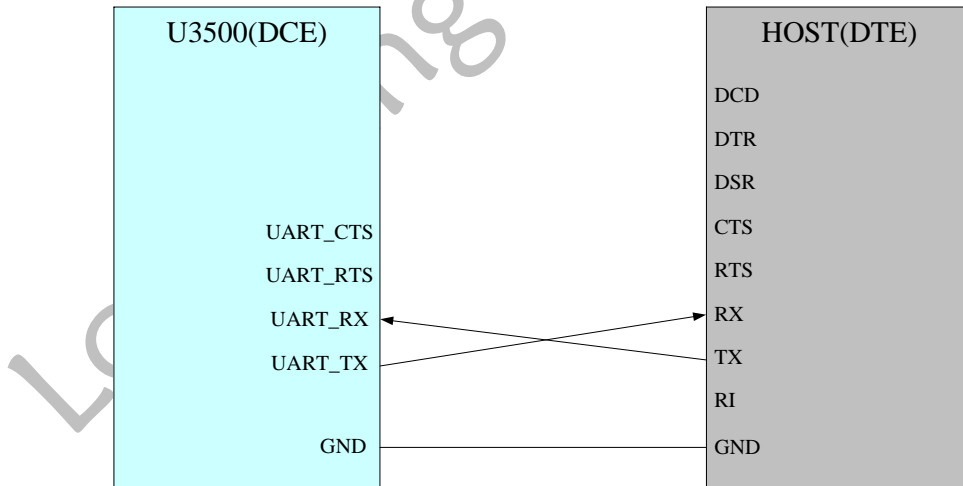


Figure17: U3500 UART is used for AT command

3.4.3. UART interface description

- 1) DATA_RTS/DATA_CTS are the hardware flow control signal, the connection should be crossed as figure 16;

- 2) The baud rate of UART can be set as: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400, 4000000;

Baud rate can be set by AT command. The AT command is:

`AT+IPR=<value>`

`<value>`:

300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400

Note: The default baud rate is 115200, and Data Bits=8, Parity=None, Stop Bits=1, Flow Control=None.

- 3) As the UART interface can only supply TTL level while the PC serial port is RS232 level. Level conversion device (e.g. SP3238EEA) is needed when U3500 communicating with PC;
- 4) It is recommended that UART interface needs ESD protect.

3.4.4. U3500 sleep and awake control

In order to describe easily, it is named U3500 as BP and the MCU of application terminal as AP.

Sleep and awake interface is described in the table below:

Table9: U3500 sleep and awake interface

PIN Name	I/O	PIN Num.	描述
AP_IRQ	I	J107	Set it to high, BP will sleep.
BP_IRQ	O	J108	BP request AP to awake, set low level with 120mS.
AP_RDY	I	J106	AP is ready, active is low level.
UART_RX	I	J174	Set it to high level with 100mS will awake BP.
USB_VBUS	I	J142	4.4~5.25V, typical is 5V
USB_DM	I/O	J143	USB D-
USB_DP	I/O	J144	USB D+
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND



3.4.4.1. The prerequisites for module to sleep

There are 3 prerequisites for module to fall asleep, lack of any of which will cause the module unable to sleep:

- 1) The AP_IRQ pin is high (AP_IRQ pin is high by default when it is float);
- 2) UART_RX pin is kept low (UART_Rx is low by default when it is float);
- 3) USB is suspended by AP (if USB is not used, the prerequisites are two of the above).

3.4.4.2. About sleep and awake questions

Due to the connection mode of BP and AP, may face some questions:

- 1) USB is not connected, nor is UART
Q: How can the module fall asleep and awake up?
A: The module can not fall asleep in this mode.
- 2) Only UART is connected
Q: How can the module fall asleep and awake up?
A: The module is enabled to sleep by setting the AP_IRQ high and the UART_RX to low, and is disabled to sleep by setting the AP_IRQ low or the UART_RX to high.
Note: When the module receives a call/SMS/MMS/Video call, it will wake up automatically.
- 3) Only USB is connected
Q: How can the module fall asleep and awake up?
A: The module is enabled to sleep by setting the AP_IRQ high, and is disabled to sleep by setting the AP_IRQ low.
The USB driver can make the USB suspend by setting the PORT_SUSPEND property, and make the USB resume by clear the PORT_SUSPEND property.
The USB status (suspend resume) and the AP_IRQ status (high low) can decide the module sleep mode.
Note: When the module receives a call/SMS/MMS/Video call, it will wake up automatically.
- 4) USB and UART are all connected
Q: How can the module fall asleep?
A: AP_IRQ is high and put low the UART_RX PIN and suspend the USB.



Q: How can the module wake up?

A: AP_IRQ is low and put high the UART_RX PIN and resume the USB.

Q: How does the USB driver suspend and resume the USB in LINUX?

A: The usbserial of the linux2.6.XX can make the USB suspend by sysfs filesystem, If the USB has been suspended, the module can suspend automatically.

Q: How does the USB driver suspend and resume the USB in WINCE?

A: On wince operating system, 3G module can suspend/resume by setting USB bus power level.

When AP_IRQ pin is high, AP sets USB bus D4/D0 power level, then 3G module go into suspend/resume mode.

When AP sets USB bus D4, 3G module enters sleep mode and USB cdc driver stop to send/receive data.

If 3G module is waked up by coming call, you must set USB bus D0 power level to notify USB cdc driver to start to send/receive data, after getting BP_IRQ signal.

Q: How does the module wake up AP?

A: When the module awake, it will send a BP_IRQ signal (a LOW pulse of 120ms duration) to wake up the AP. If the AP is ready, it will set the AP_RDY active low to tell the module that AP is ready to communicate with the module; if the AP is not ready yet, the module will store the message into buffer until the number of the message is up to 32 and discard the message wherefrom.

Note: AP_RDY must be connected, either to GND, or to AP.



3.5. Analog audio interface

U3500 provide two channels analog audio interface.

3.5.1. Audio interface description

Table10: U3500 analog audio interface

PIN Name	I/O	PIN Num.	Description
SPK_N	O	J146	Loudspeaker output differential signal -
SPK_P	O	J147	Loudspeaker output differential signal +
MIC2_N	I	J148	Audio input channel 2 differential signal -
MIC2_P	I	J149	Audio input channel 2 differential signal +
EARON	O	J238	Audio output channel 1 differential signal -
EAROP	O	J239	Audio output channel 1 differential signal +
MIC_N	I	J240	Audio input channel 1 differential signal -
MIC_P	I	J241	Audio input channel 1 differential signal +

3.5.2. Audio I/O and earphone connection

Table11: The connection between earphone jack and audio I/O

PIN Name	PIN Num.	Earphone jack	Description
EARON	J238	Left Speaker	Audio output channel 1 differential signal -
EAROP	J239	Right Speaker	Audio output channel 1 differential signal +
MIC_N	J240	MIC	Audio input channel 1 differential signal -
MIC_P	J241	PGND	Audio input channel 1 differential signal +

3.5.3. Audio I/O and phone handfree connection

Table12: The connection between phone handle and audio I/O

PIN Name	PIN Num.	Phone handfree	Description
SPK_N	J146	SPK_N	Loudspeaker output differential signal -
SPK_P	J147	SPK_P	Loudspeaker output differential signal +
MIC2_N	J148	MIC_N	Audio input channel 2 differential signal -

MIC2_P	J149	MIC_P	Audio input channel 2 differential signal +
--------	------	-------	---

3.5.4. Audio I/O and phone handset connection

Table13: U3500 analog audio and handset connection

PIN Name	PIN Num.	Phone handset	Description
EAROP	J238	EAR_N	Audio output channel 1 differential signal -
EARON	J239	EAR_P	Audio output channel 1 differential signal +
MIC_P	J240	MIC_N	Audio input channel 1 differential signal -
MIC_N	J241	MIC_P	Audio input channel 1 differential signal +

3.5.5. Analog audio interface reference circuit

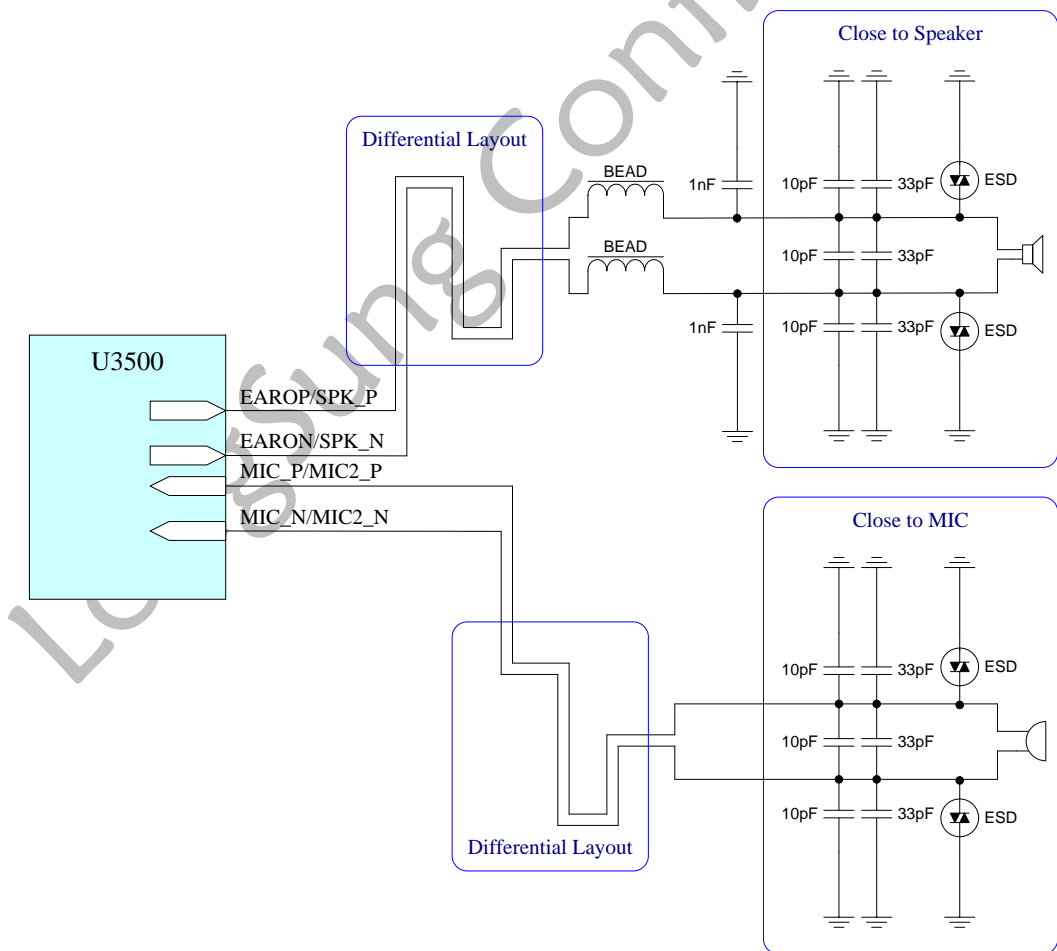


Figure18: Analog audio interface reference circuit

- 1) The audio output signals, a pair of differential signals, output to two speakers. The output signals are not real stereo signals which are different from traditional stereo sound.
- 2) It is recommended to use the filter capacitor or filter circuit to reduce inter frequency interference and improve audio quality. Just like what is shown in the figure above.
- 3) To avoid static electricity, it is recommended to use the ESD protection device.
- 4) It requires connecting audio analog signal ground with the general digital circuit ground, magnetic bead or zero ohm resistance can be used.
- 5) IF use an audio amplifier for speaker, optional EMI filtering is shown at Figure 19, these components (two ferrite beads and two capacitors) can be added to reduce electromagnetic interference. If used, they should be located near the EAROP and EARON.
- 6) Considerable current between the audio output pins and the speaker, the width of PCB traces are recommended: MIC 8mils, Speaker 12mils.

3.6. PCM interface

U3500 module provides a PCM interface. The PCM include 4 pin digital signals. Use PCM interface can support communication between U3500 and external CODEC. These 4 pin signals can also be used as GPIO.

PCM TX data will be routed from the external codec MIC through the DSP encode path in the U3500 module. PCM RX data will be routed through the DSP decode path to the external codec speaker.

The base band of U3500 can be used in two modes:

- 1) Auxiliary PCM, the auxiliary PCM that runs at 128 kHz and uses a 62.5 μ s sync pulse (half a time frame).
- 2) Primary PCM, the primary PCM that runs at 2.048 MHz and uses 488 ns sync pulse (one 2.048 MHz clock tick).

Table14: Auxiliary PCM and Primary PCM configuration

Configuration	SYNC	CLK	Clock source	Format
Auxiliary	8KHz	128KHz	Master	8Bits μ -law, 8Bits A-law, 16Bits Linear (13 bits are valid, the others are blank)
Primary	8KHz	2.048MHz	Master/Slave	

The default configuration of U3500 is Primary PCM, and can use AT command to select Master Mode or Slave Mode.

In Master mode, the U3500 module drives the clock and sync signals that are sent to the external codec via the PCM interface.

In Slave mode, the external codec drives the clock and sync signals that are sent to the U3500 module.

The AT command for Select PCM Master and Slave mode:

```
AT+PCMCONFIG =<value>
<value>:
0:default Master mode
1:change to Slave mode
```

U3500 module supports 3 PCM formats: 8Bits μ -law, 8Bits A-law, 16Bits (Linear), can be set by AT command:

The AT command for set PCM formats:

```
AT+PCMAUDIO=<value>
<value>:
0:default inner channel
1:change the channel to PCM 16 bit linear
2:change the channel to PCM 8 bit  $\mu$ -law
3:change the channel to PCM 8 bit A-law
```

3.6.1. PCM interface description

Table15: U3500 PCM interface

PIN Name	I/O	PIN Num.	Description
PCM_SYNC	O	J111	PCM Synchronous Signal
PCM_CLK	I	J114	PCM CLK
PCM_DIN	I	J113	PCM Input

PCM_DOUT	O	J112	PCM Output
----------	---	------	------------

3.6.2. Auxiliary PCM

The Auxiliary PCM interface enables communication with an external codec to support hands-free applications. The auxiliary codec port operates with standard long-sync timing and a 128 kHz clock. The AUX_PCM_SYNC runs at 8 kHz with a 50% duty cycle. Most μ -law and A-law codecs support the 128 kHz AUX_PCM_CLK bit clock.

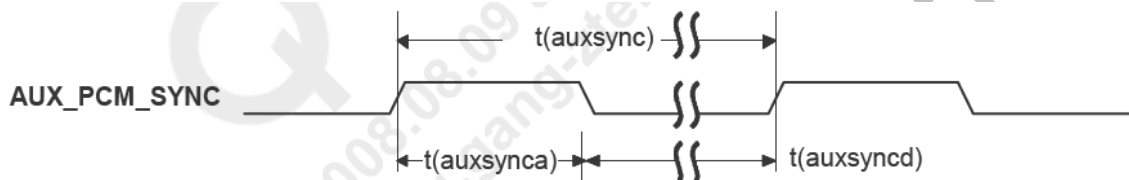


Figure19: AUX_PCM_SYNC timing

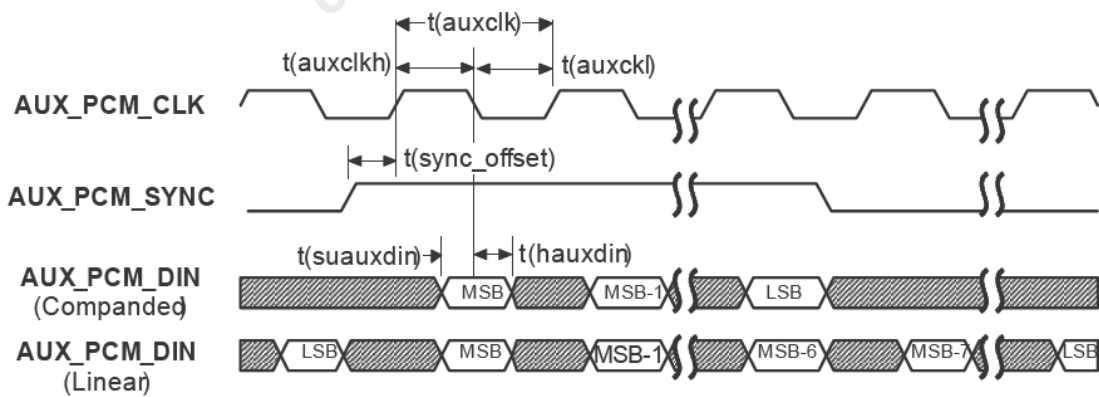


Figure20: AUX_PCM_CODEC to U3500 timing

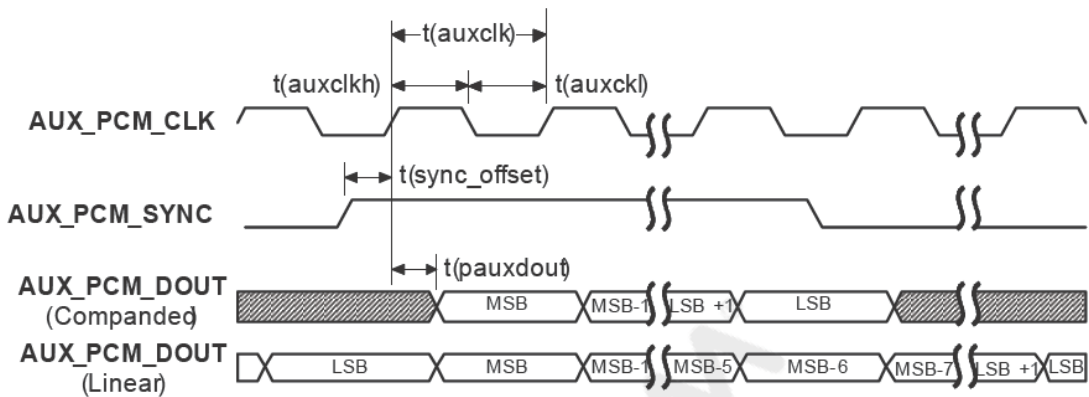


Figure21: U3500 to AUX_PCM_CODEC timing

Table16: AUX_CODEC timing parameters



Parameter	Description	Min	Typical	Max	Unit	Note
t(auxsync)	AUX_PCM_SYNC cycle time	-	125	-	μs	
t(auxsynca)	AUX_PCM_SYNC asserted time	-	62.5	-	μs	1
t(auxsyncd)	AUX_PCM_SYNC de-asserted time	-	62.5	-	μs	1
t(auxclk)	AUX_PCM_CLK cycle time	-	7.8	-	μs	2
t(auxclkh)	AUX_PCM_CLK high time	-	3.9	-	μs	3
t(auxckl)	AUX_PCM_CLK low time	-	3.9	-	μs	3
t(sync_offset)	AUX_PCM_SYNC offset time to AUX_PCM_CLK rising	-	1.95	-	μs	4
t(suauxdin)	AUX_PCM_DIN setup time to AUX_PCM_CLK falling	60	-	-	ns	
t(hauxdin)	AUX_PCM_DIN hold time after AUX_PCM_CLK falling	60	-	-	ns	
t(pauxdout)	Propagation delay from AUX_PCM_CLK AUX_PCM_DOUT valid	-	-	60	ns	

Notes:

1. $t(\text{auxsync})/2 \pm 10 \text{ ns}$.
2. $t(\text{auxclk}) = 1/(128 \text{ kHz})$.
3. $t(\text{auxclk})/2 \pm 10 \text{ ns}$.
4. $t(\text{auxclk})/4 \pm 10 \text{ ns}$.

3.6.3. Primary PCM

U3500 module firmware default configuration is Primary PCM. PRIM_PCM_CLK is 2.048 MHz clock, PRIM_PCM_SYNC is 8 kHz (488nS), and μ-law PCM format.

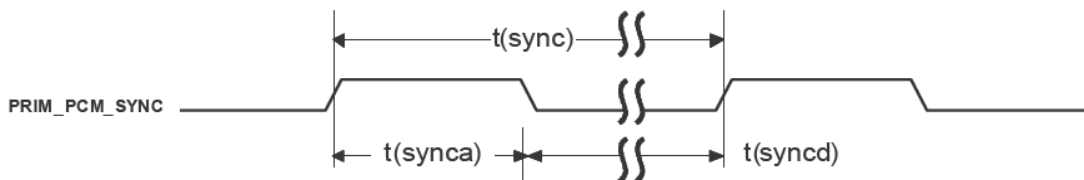


Figure22: PRIM_PCM_SYNC timing

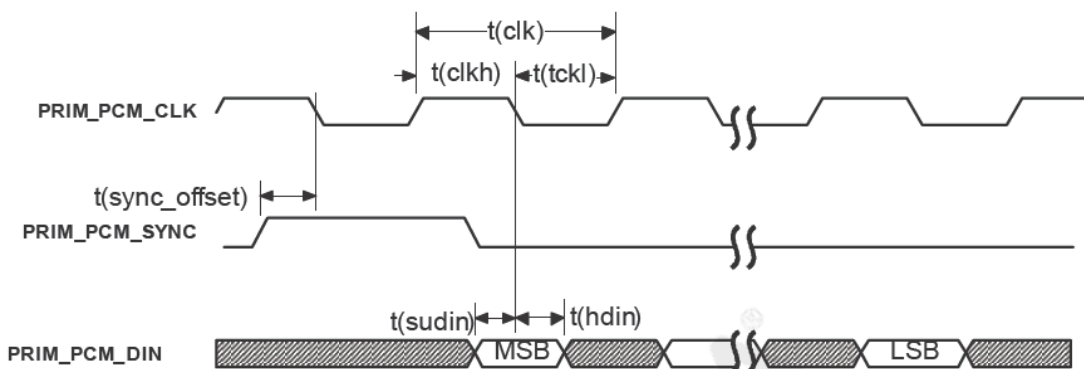


Figure23: PRIM_PCM_CODEEC to U3500 timing

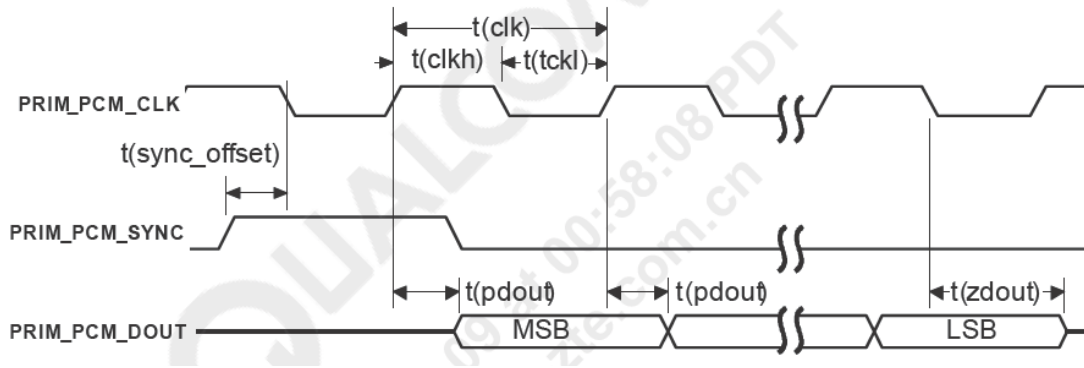


Figure24: U3500 to PRIM_PCM_CODEEC timing

Table17: PRIM_CODEC timing parameters

Parameter	Description	Min	Typical	Max	Unit	Note
t(sync)	PCM_SYNC cycle time (PCM_SYNC_DIR = 1)	-	125	-	µs	
	PCM_SYNC cycle time (PCM_SYNC_DIR = 0)	-	125	-	µs	
t(synca)	PCM_SYNC asserted time (PCM_SYNC_DIR = 1)	-	488	-	ns	2
	PCM_SYNC asserted time (PCM_SYNC_DIR = 0)	-	-	-	ns	
t(syncd)	PCM_SYNC de-asserted time (PCM_SYNC_DIR = 1)	-	124.5	-	µs	3
	PCM_SYNC de-asserted time (PCM_SYNC_DIR = 0)	-	-	-	µs	
t(clk)	PCM_CLK cycle time (PCM_CLK_DIR = 1)	-	488	-	ns	4
	PCM_CLK cycle time (PCM_CLK_DIR = 0)	-	-	-	ns	
t(clkh)	PCM_CLK high time (PCM_CLK_DIR = 1)	-	244	-	ns	1,5
	PCM_CLK high time (PCM_CLK_DIR = 0)	-	-	-	ns	
t(clkl)	PCM_CLK low time (PCM_CLK_DIR = 1)	-	244	-	ns	1,5
	PCM_CLK low time (PCM_CLK_DIR = 0)	-	-	-	ns	
t(sync_offset)	PCM_SYNC offset time to PCM_CLK falling (PCM_SYNC_DIR = 1, PCM_CLK_DIR = 1)	-	122	-	ns	6
	PCM_SYNC offset time to PCM_CLK falling (PCM_SYNC_DIR = 0, PCM_CLK_DIR = 0)	-	-	-	ns	
	PCM_SYNC offset time to PCM_CLK falling (PCM_SYNC_DIR = 1, PCM_CLK_DIR = 0)	-	-	-	ns	
	PCM_SYNC offset time to PCM_CLK falling (PCM_SYNC_DIR = 0, PCM_CLK_DIR = 1)	-	-	-	ns	
t(sudin)	PCM_DIN setup time to PCM_CLK falling	60	-	-	ns	
t(hdin)	PCM_DIN hold time after PCM_CLK falling	60	-	-	ns	
t(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid	-	-	60	ns	
t(zdout)	Delay from PCM_CLK falling to PCM_DOUT High-Z	5	-	60	ns	

Notes:

- t(clkh) and t(clkl) are independent of PCM_CLK_SENSE.
- One t(clk) period.
- PCM_SYNC cycle time minus one t(clk) period.
- t(clk) = 1/(2.048 MHz).
- PCM_CLK high or low time = t(clk)/2 ± 10 ns.
- PCM_SYNC offset time = t(clk)/4.

3.6.4. Audio parameters control

U3500 module provides 3 audio interfaces: analog audio, PCM audio, USB audio.

The application terminal can select one of them to use.

Use AT command can switch the audio channel.

The AT command for switch USB or module audio channel:

AT+AUDIOPATH=<value>

<value>:

0: the audio path is model path

1: the audio path is pc path

At the precondition of AT+AUDIOPATH=0, you can select analog or PCM audio:

AT+PCMAUDIO=<value>

<value>:

0:default inner channel (Select analog audio channel)



- 1:change the channel to PCM 16 bit linear
- 2:change the channel to PCM 8 bit μ -law
- 3:change the channel to PCM 8 bit A-law

U3500 module audio parameters can be adjusted by AT commands.

Table18: The AT commands for control audio parameters

AT	Command description
AT+CLVL	Set Loudspeaker level
AT+CMUT	Disable/enable mute user voice
AT+CMIC	Set MIC PLUS
AT+ RXVOL	Setting RX volume
AT+SIDET	Change the Side Tone Gain Level
AT+ECHO	Config ESEC and Speaker device echo restrain parameter
AT+ECHO1	Config HEADSET and BTHEADSET device echo restrain parameter
AT+ECHOOFF	Control Echo function open or close

Please get reference from the document 《U3500_ATC》

3.7. USIM/SIM interface

U3500 module supports UTMS mode USIM card and GSM/GPRS/EDGE mode SIM card.

3.7.1. USIM/SIM interface description

U3500 module supports 1.8/3.0V USIM/SIM card.

Table19: U3500 USIM/SIM interface

PIN Name	I/O	PIN Num.	Description
USIM_DATA	I/O	J140	USIM/SIM DATA
USIM_CLK	O	J138	Clock Signal
USIM_RESET	O	J139	RESET Signal
USIM_VCC	O	J141	USIM/SIM Power
USIM_DET	I	J109	USIM/SIM detect
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

3.7.2. USIM/SIM interface reference circuit

For 6-pin USIM/SIM card, we recommend to use the Amphenol C707 10M006 512 2 SIM Holder. For more information, you can visit the Amphenol company web: <http://www.amphenol.com/>

The SPEC of C707 10M006 512 2 SIM Holder is as the figure below.

LongSung Confidential

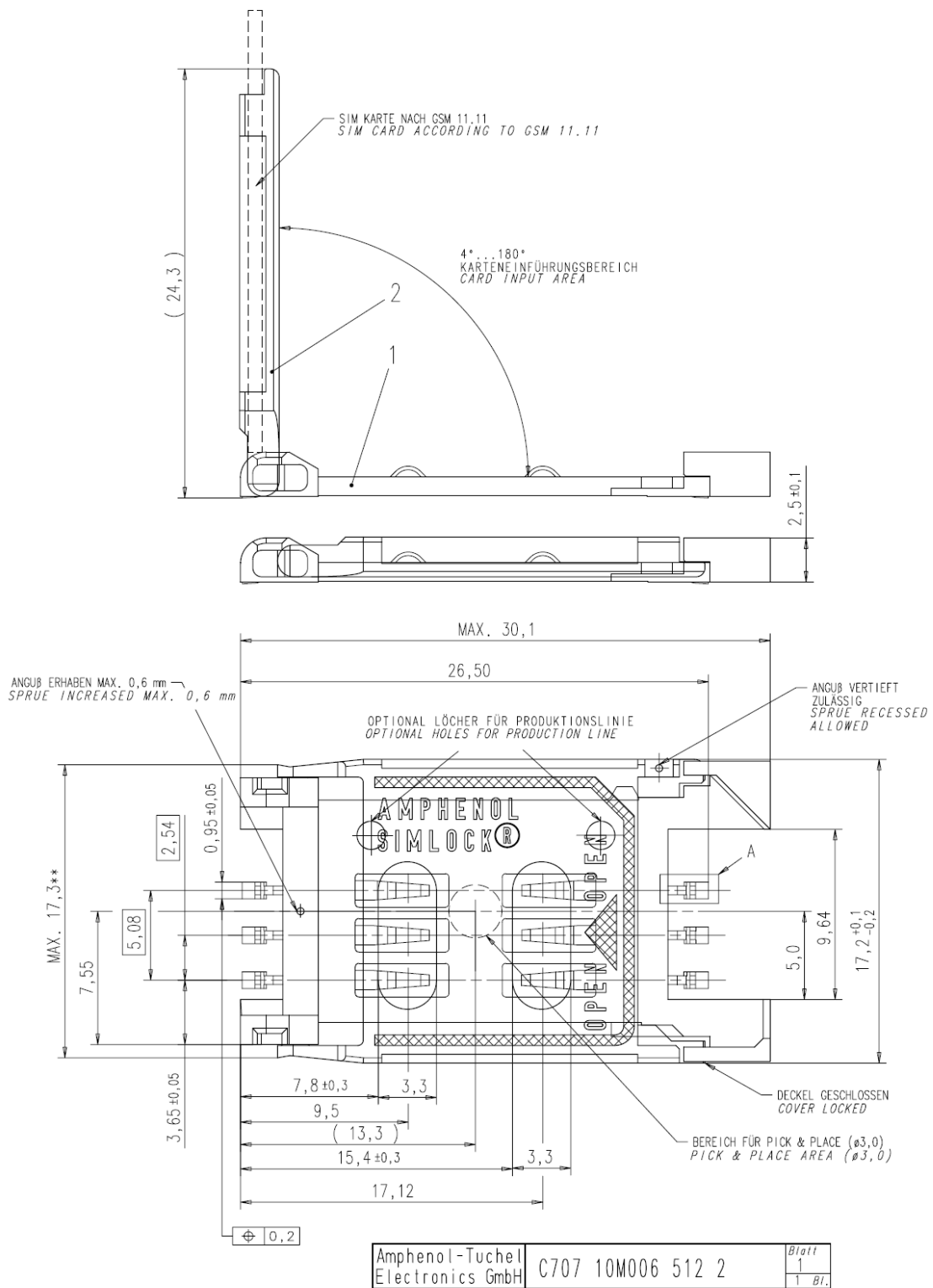


Figure25: C707 10M006 512 2 SIM Holder SPEC

USIM/SIM interface reference design circuit as the the figure below.

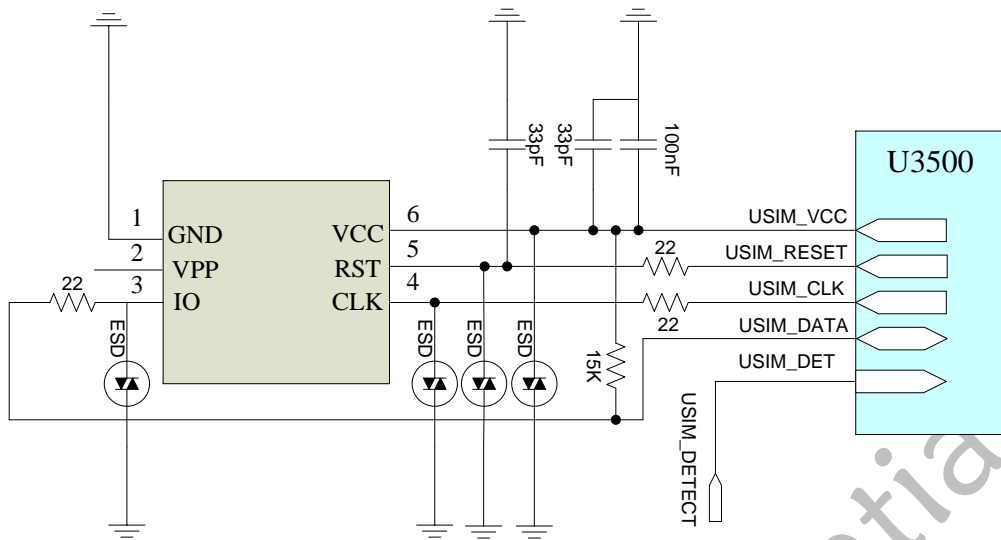


Figure26: U3500 USIM/SIM interface reference circuit

- 1) The USIM_DATA line of USIM is connected to USIM_VCC by a pull-up resistor with reference value 10KΩ.
- 2) To avoid the instantaneous voltage overflowing, the resistor with reference value 22Ω can be used for the USIM_DATA, USIM_CLK and USIM_RESET line.
- 3) To avoid the static electricity in USIM socket, it is recommended to use the ESD protection device for the USIM_DATA, USIM_CLK and USIM_VCC line.
- 4) To get more flat USIM power supply, it is recommended to use the filter capacitors, and reference value 33pF and 100nF.
- 5) To eliminate the peak interference and high frequency interference signal on USIM_RESET line, the filter capacities can be placed in USIM_RESET line, the reference value is 33pF.

Note: The U3500 can not support USIM/SIM card hot-plugging. If you hot-plug the USIM/SIM card, may cause the card or U3500 USIM/SIM interface damage. Please avoid it.

3.8. NETLIGHT output

U3500 module provides 1 NETLIGHT output interface through PINJ115.

3.8.1. NETLIGHT signal description

Table20: U3500 NETLIGHT signal description

PIN Name	I/O	PIN Num.	Description
NETLIGHT	O	J115	Default Netlight

Table21: U3500 net light description

模式	LED Status	Description
1	快闪 (100ms On/800ms Off)	Networks searching
2	慢闪(100ms On/3000ms Off)	Registered in networks
3	速闪(100ms On/300ms Off)	Data connection in networks
4	关闭	Flying mode or Power off or Error(No SIM card or failed in registering networks)

3.8.2. NETLIGHT reference circuit

The NETLIGHT reference circuit is shown in the figure below.

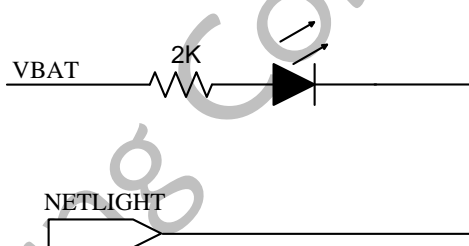


Figure27: U3500 NETLIGHT reference circuit

3.9. ADC interface

U3500 module provides two 8Bits ADC interface, which can be used for battery voltage detect, temperature detector or hardware version detector.

3.9.1. ADC interface description

Table22: U3500 ADC interface description

PIN Name	I/O	PIN Num.	Description
ADC0	I	J120	2.6V
ADC1	I	J261	2.6V

3.9.2. ADC input reference circuit

ADC can be used for battery voltage detector, temperature detector or hardware version detector. The max input to ADC is 2.6V.

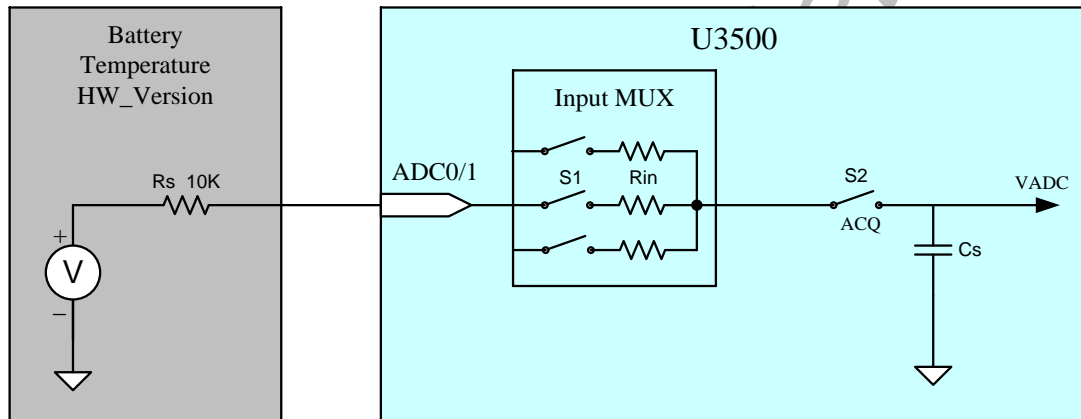


Figure28: U3500 ADC input reference circuit

3.9.3. Temperature detector circuit

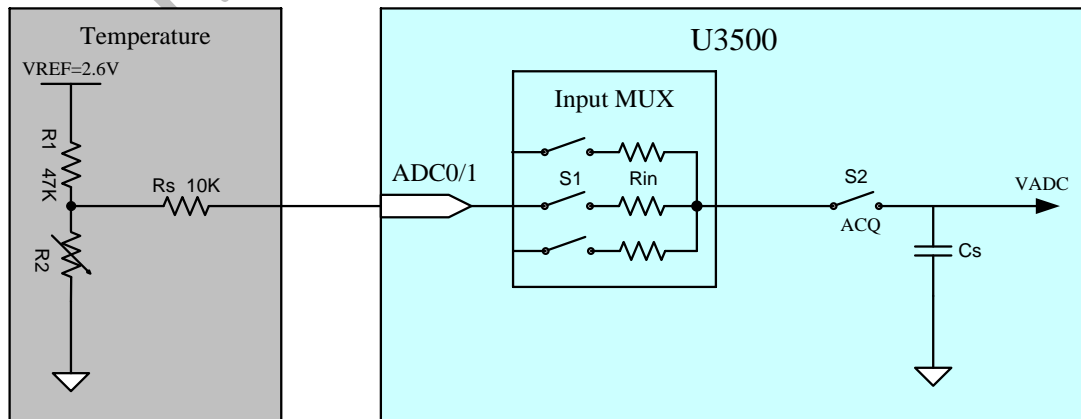


Figure29: U3500 temperature detector circuit

R1 is a precision resistor; R2 is a heat-sensitive resistor. VREF is recommended to 2.6V.

- ✧ If the HKADC is used for battery voltage detector, because the battery voltage exceed 2.6V, so must use two precision resistors to create a voltage divider circuit, make sure the input to ADC is below 2.6V.
- ✧ If the ADC is used for hardware version detector, use several resistors to get different voltage input to ADC.

3.10. GPIO interface

U3500 module provides several GPIO; some of them are defined as special function interface.

Table23: U3500 GPIO interface description

PIN Name	I/O	PIN NO.	Description
PCM_DOUT	O	J112	Default PCM_DOUT
PCM_CLK	I	J114	Default PCM_CLK
PCM_DIN	I	J113	Default PCM_DIN
PCM_SYNC	O	J111	Default PCM_SYNC
AP_IRQ	I	J107	Default AP_RDY
AP_RDY	I	J106	Default AP_RDY
BP_IRQ	O	J108	Default BP_IRQ
UART_TX	O	J173	Default UART_TX
UART_RX	I	J174	Default UART_RX
UART_CTS	I	J175	Default UART_CTS
UART_RTS	O	K176	Default UART_RTS
GPIO1	I/O	J179	Can be used as UART_RI
GPIO2	I/O	J178	Can be used as UART_DCD
GPIO3	I/O	J177	Can be used as UART_DTR
NETLIGHT	O	J115	Default NETLIGHT

3.11. Antenna interface

U3500 provide a stamp hole antenna interface through PINJ102.

Table24: U3500 antenna interface

PIN Name	I/O	PIN Num.	Description
ANT		J102	Antenna
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

U3500 module provides two types antenna interfaces: RF Connector and antenna pad.

- ✧ We recommend customer use RF Connector, and use RF cable to plug an antenna with 50Ω ground impedance.
- ✧ In the bottom side customer can solder an antenna with 50Ω ground impedance.

When you use RF Connector, please select the RF cable carefully; it is required to use RF cable of which the insertion loss should comply with:

- GSM900/GSM850<1dB
- DCS1800/PCS1900<1.5dB
- WCDMA2100<1.5dB
- WCDMA850<1dB

3.11.1. Solder antenna

The reference circuit of U3500 solder antenna is shown in below:

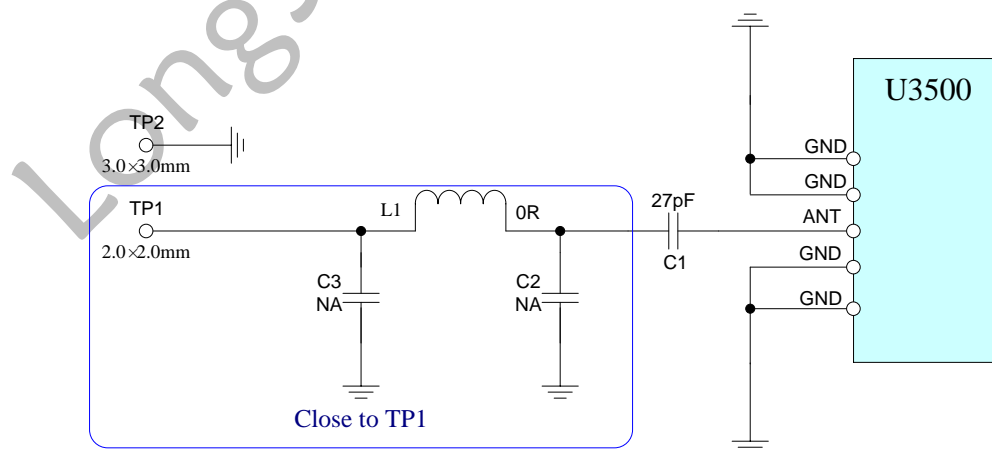


Figure30: U3500 solder antenna reference circuit



3.11.2. RF connector antenna

Portion of the antenna diagram about the antenna using the connector as below:

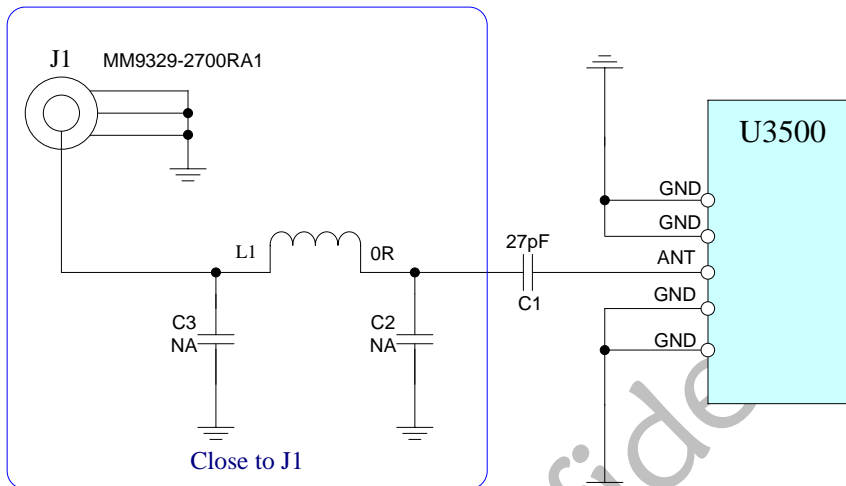


Figure31: The reference design of RF connector and antenna

3.11.2.1. RF cable

When you use RF Connector, please select the RF cable carefully; it is required to use RF cable of which the insertion loss should comply with:

- GSM900/GSM850<1dB
- DCS1800/PCS1900<1.5dB
- WCDMA2100<1.5dB
- WCDMA850<1dB

3.11.3. U3500 RF output power

Table25: U3500 RF output power

Band	Max	Min
GSM850	33dBm ± 2dB	5dBm ± 5dB
E-GSM900	33dBm ± 2dB	5dBm ± 5dB
DCS1800	30dBm ± 2dB	0dBm ± 5dB
PCS1900	30dBm ± 2dB	0dBm ± 5dB
GSM850(8-PSK)	27dBm ± 3dB	5dBm ± 5dB
E-GSM900(8-PSK)	27dBm ± 3dB	5dBm ± 5dB



Band	Max	Min
DCS1800(8-PSK)	26dBm +3/-4dB	0dBm ± 5dB
PCS1900(8-PSK)	26dBm +3/-4dB	0dBm ± 5dB
WCDMA2100	24dBm +1/-3dB	-56dBm ± 9dB
WCDMA850	24dBm +1/-3dB	-56dBm ± 9dB

3.11.4. U3500 RF receiver sensitivity

Table26: U3500 RF receiver sensitivity

Band	Receive sensitivity
GSM850	<-106dBm
E-GSM900	<-106dBm
DCS1800	<-106dBm
PCS1900	<-106dBm
WCDMA2100	<-108dBm
WCDMA850	<-106dBm

3.11.5. U3500 operating frequencies

Table27: U3500 operating frequencies

Band	Receive	Transmit
GSM850	869~894MHz	824~849MHz
E-GSM900	925~960MHz	880~915MHz
DCS1800	1805~1880MHz	1710~1785MHz
PCS1900	1930~1990MHz	1850~1910MHz
WCDMA2100	2110~2170MHz	1920~1980MHz
WCDMA850	869~894MHz	824~849MHz

3.11.6. Antenna parameters requirement

Table28: U3500 antenna parameters requirement

Band	VSWR	Gain		Efficiency	SAR	TRP (dBm)	TIS (dBm)
		Peak	Avg.				
GSM850	<2.5:1	>0dBi	>-4dBi	>40%	<1.6 W/Kg	29	<-102
EGSM900						29	<-102
DCS1800						26	<-102
PCS1900						26	<-102
WCDMA850						19	<-102



WCDMA2100						19	<-104
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3.12. Micro SD card interface

U3500 provide a Micro SD card interface for extending the system storage, this interface can be designed as a T-Flash card and MMC card too.

3.12.1. Micro SD card interface description

Table29: U3500 Micro SD card interface

PIN Name	I/O	PIN Num.	Description
VREG_MMC	O	J130	2.6V, the power supply for SD card
SDCC1_DATA0	I/O	J131	SD Interface, can be used as GPIO
SDCC1_DATA1	I/O	J132	SD Interface, can be used as GPIO
SDCC1_DATA2	I/O	J133	SD Interface, can be used as GPIO
SDCC1_DATA3	I/O	J134	SD Interface, can be used as GPIO
SDCC1_CLK	O	J135	SD Interface, can be used as GPIO
SDCC1_CMD	O	J136	SD Interface, can be used as GPIO
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

3.12.2. Micro SD interface reference circuit

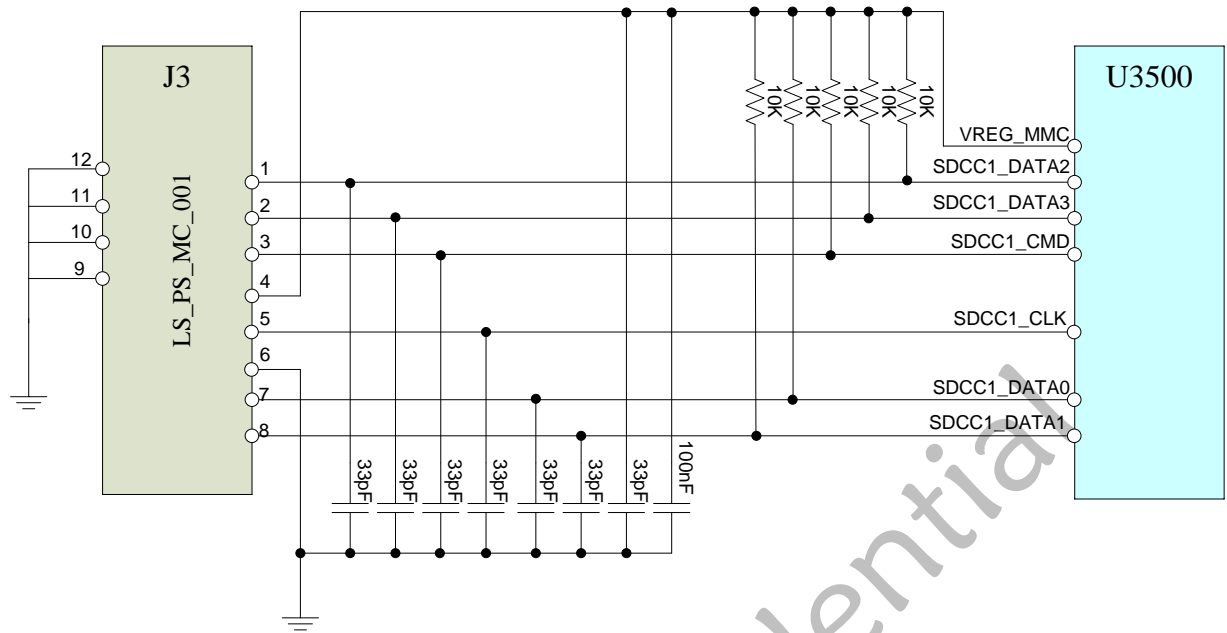


Figure32: U3500 Micro SD card interface reference circuit

- 1) Data line SDCC1_DATA0, SDCC1_DATA1, SDCC1_DATA2, SDCC1_DATA3 and SDCC1_CMD should be pulled-up to VREG_MMC by a 10Kohm resistor;
- 2) For stabling the VREG_MMC, where should connect two filter capacitor to GND with value 33pF and 100nF;
- 3) For eliminating the high frequency disturb, where should connect a filter capacitor to GND with value 33pF;
- 4) For improving the ESD performance, where should connect ESD protect device close the MicroSD connector.

3.13. Camera interface

U3500 provide a camera interface, which include:

- ✧ 10 bits bus data, which are used for video data input;
- ✧ Horizontal and vertical synchronous signals;
- ✧ Two IIC bus, which are used for controlling the U3500 and the camera.

3.13.1. Camera interface description

Table30: U3500 Camera interface

PIN Name	I/O	PIN Num.	Description
CAMIF_DATA0	O	J151	Bit 0 of RGB or YUV D0 video output
CAMIF_DATA1	O	J152	Bit 1 of RGB or YUV D1 video output



CAMIF_DATA2	O	J153	Bit 2 of RGB or YUV D2 video output
CAMIF_DATA3	O	J154	Bit 3 of RGB or YUV D3 video output
CAMIF_DATA4	O	J155	Bit 4 of RGB or YUV D4 video output
CAMIF_DATA5	O	J156	Bit 5 of RGB or YUV D5 video output
CAMIF_DATA6	O	J157	Bit 6 of RGB or YUV D6 video output
CAMIF_DATA7	O	J158	Bit 7 of RGB or YUV D7 video output
CAMIF_DATA8	O	J159	Bit 8 of RGB or YUV D8 video output
CAMIF_DATA9	O	J160	Bit 9 of RGB or YUV D9 video output
CAMIF_PCLK	O	J161	Pixel clock output
CAMIF_MCLK	I	J163	Master clock input
CAMIF_HSYNC	O	J165	Horizontal line synchronization signal
CAMIF_VSYNC	O	J166	Vertical sync output
CAMIF_RESET	O	J167	Master reset input, active low
CAMIF_EN	O	J168	Vidio enable
I2C_SDA	I/O	J116	Serial interface data input and output
I2C_SCL	O	J117	Serial interface clock output
GND		J101, J103~105, J110, J119, J124~125, J137, J145, J150, J162, J164, J169, J180~183, J201~218, J230, J236~237, J242, J259, J262~274, J301~352	GND

3.13.2. Camera interface reference circuit

U3500 provide a camera interface, which support the YUV format, the maximum pixel is 2M, the voltage level is 2.6V.

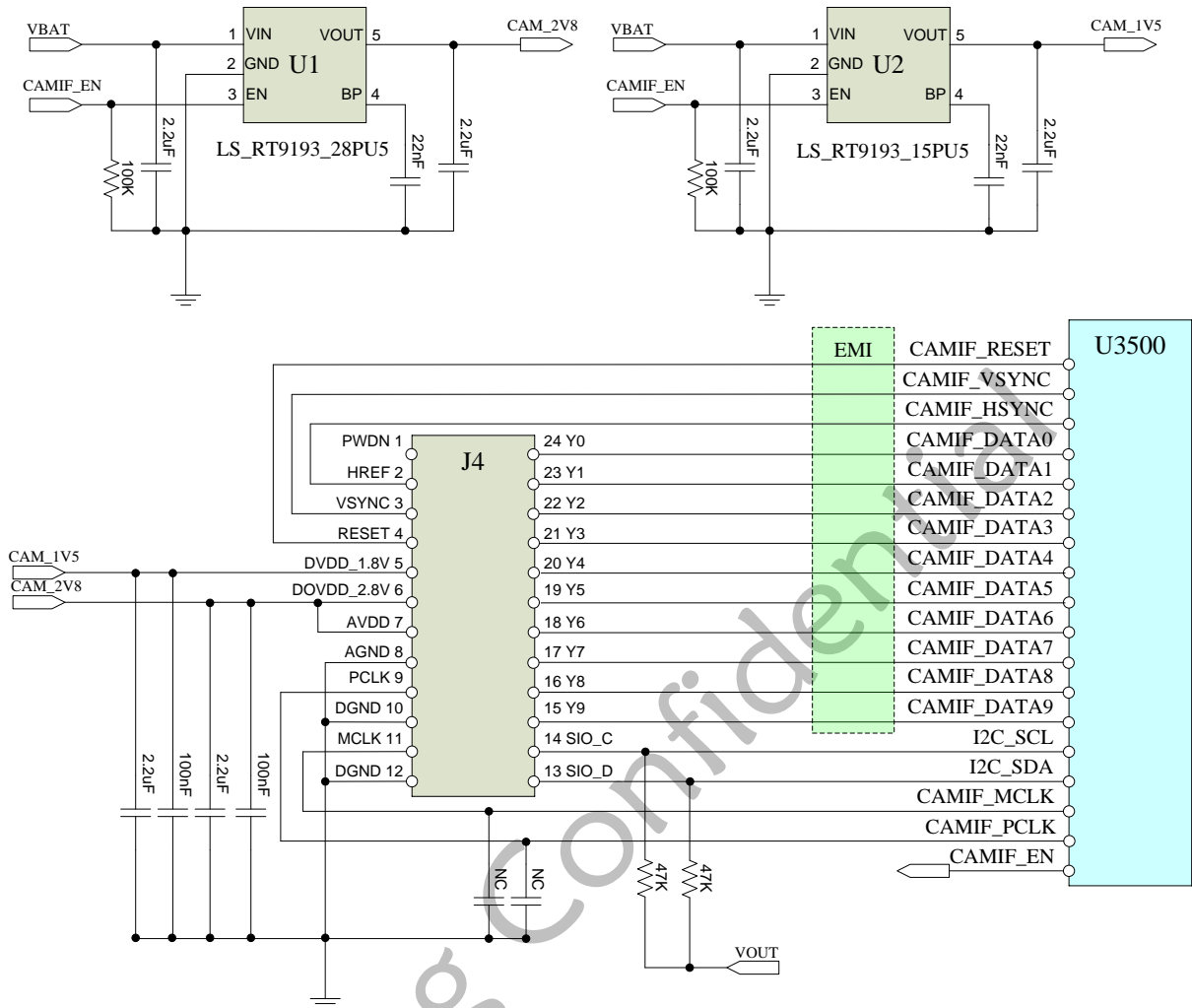


Figure33: U3500 Camera interface reference circuit

3.14. Keypad interface

U3500 provide a 5*5 keypad matrix, for the non-customized customer, these pins can be floated.

3.15. LCD interface

U3500 provide a LCD interface, which support the format of QVGA, the maximum pixel is 320*240, the voltage level is 1.8V, for non-customized customer, these pins can be floated.

3.16. 32K_CLK_BT interface

U3500 provide a 32KHz clock for Bluetooth, for non-customized customer, these pins can be floated.

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4. Mechanics

4.1. The view of U3500



Figure34: The top and bottom view of U3500

4.2. Module 3D stack

If you need the 3D stack of U3500, please contact us to obtain it.

4.3. Module 2D mechanical dimensions

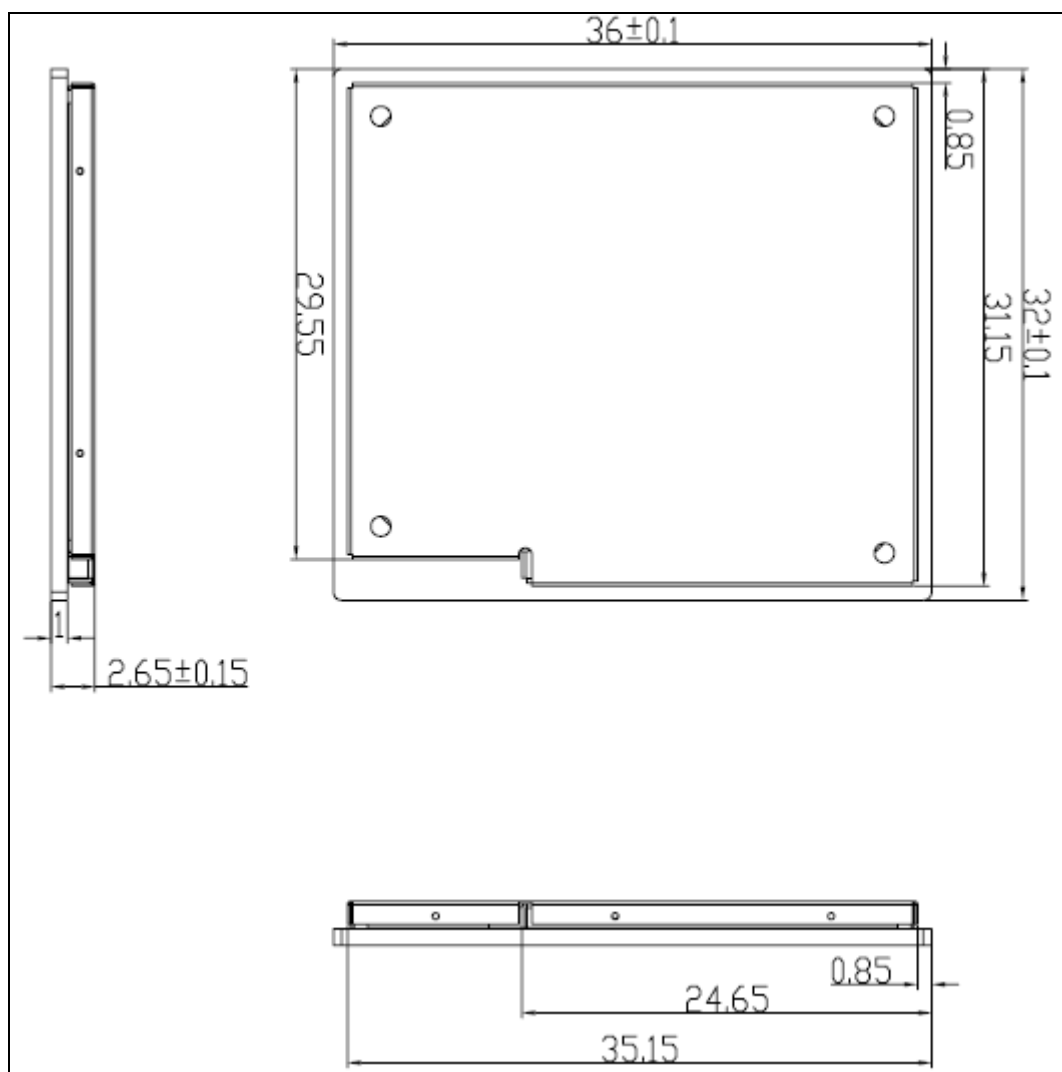


Figure35: U3500 2D mechanical dimensions

4.4. Application side decals of U3500

The decals include schematic decal and PCB decal. Please contact us to obtain them.

4.5. RF connector

U3500 module side uses a RF connector for WCDMA/GSM antenna. The RF connector is MURATA MM9329-2700RA1. We recommend customer select a RF cable with a MURATA MXTK88TK2000 RF connector.



4.5.1. Module side RF connector

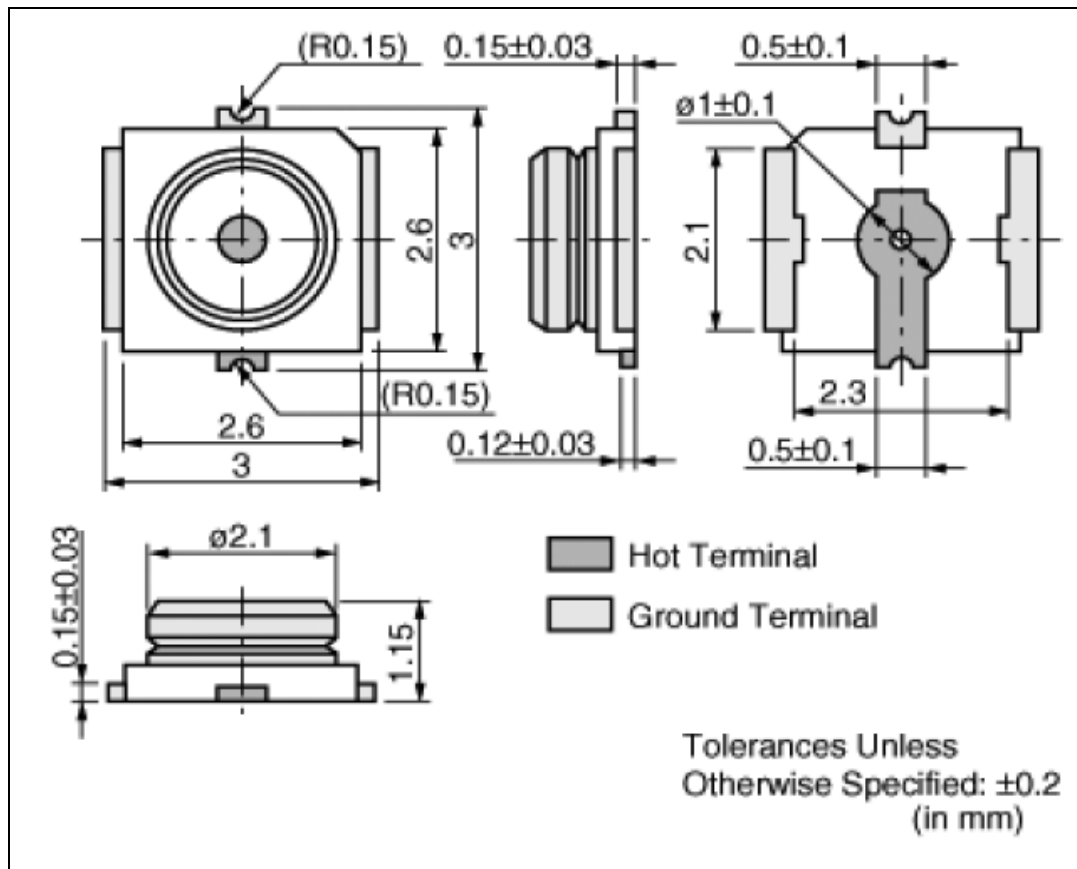


Figure36: The mechanical dimensions of MM9329-2700RA1

4.5.2. Application side RF connector

We recommend customer use MURATA MXTK88TK2000 in application side.

The mechanical dimensions of MURATA MXTK88TK2000 RF connector is shown at figure below.

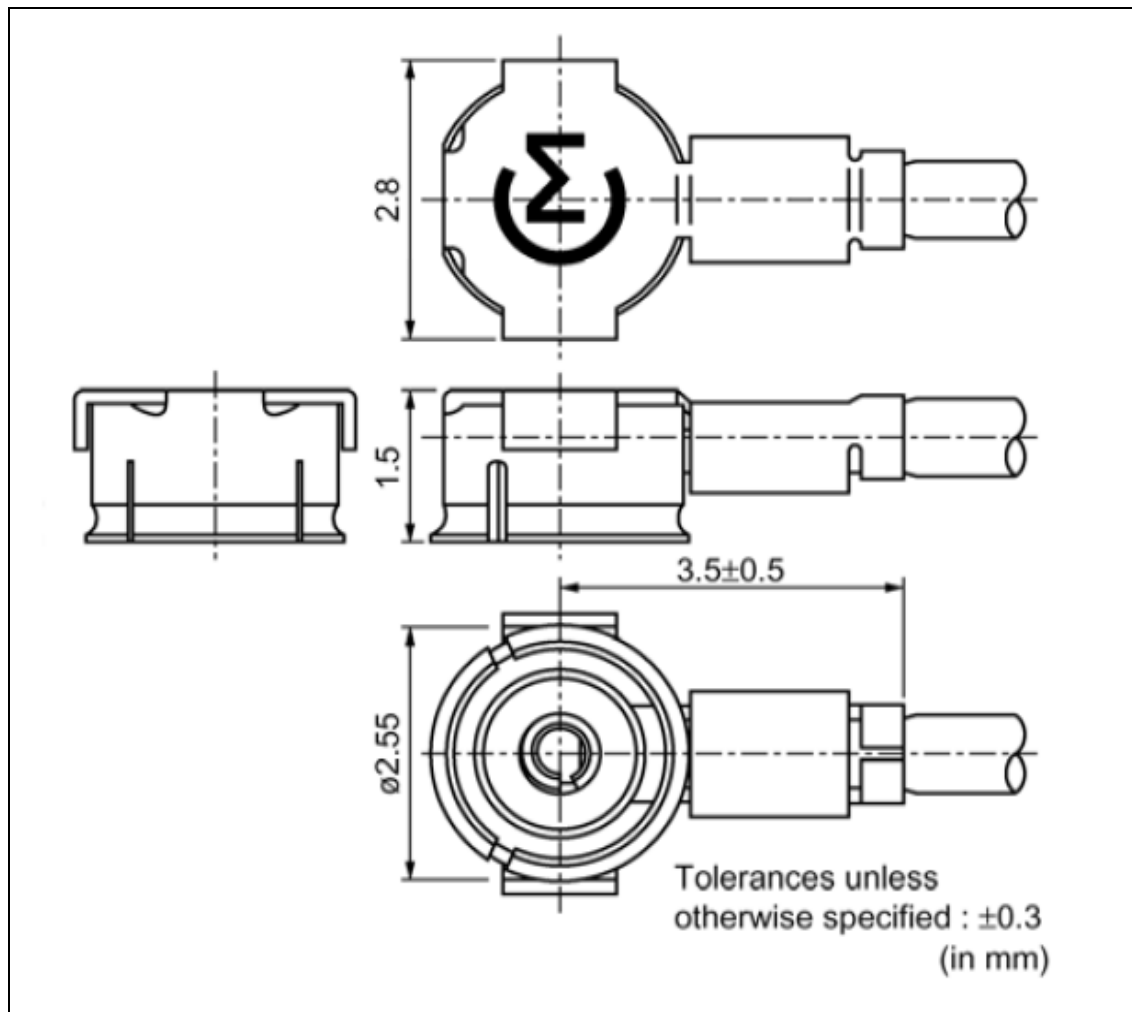


Figure37: The mechanical dimensions of MXTK88TK2000



5. Power consumption

U3500 current consumption (VBAT Power supply: DC3.8V) is shown in Table28.

Table31: U3500 max current consumption in some mode

Band	Channel	Power(dBm)	Current(mA)
TALK mode (GSM)			
GSM850	128	32.1	298
	189	32	296
	251	31.8	294
GSM900	975	32.5	290
	38	32.5	289
	124	32.3	268
DCS1800	512	29.4	241
	698	29.6	232
	885	29.4	219
PCS1900	512	29.5	203
	661	29.3	194
	810	29.4	192
DATA mode GPRS (1Rx, 4Tx)			
GSM850	128	25.9	512
	189	25.7	495
	251	25.5	487
GSM900	975	25.6	495
	38	25.6	471
	124	25.3	432
DCS1800	512	24.2	434
	698	24.2	420
	885	24	392
PCS1900	512	24.2	362
	661	24	345
	810	24.2	343
DATA mode EGPRS (1Rx, 4Tx)			
GSM850	128	22.6	376
	189	22.5	369
	251	22.3	365
GSM900	975	22.3	365
	38	22.1	352
	124	22.1	327
DCS1800	512	22.3	367



	698	22.3	356
	885	22.1	334
PCS1900	512	22.5	311
	661	22.3	297
	810	22.4	295
DATA mode (WCDMA)			
W2100	10562	22.7	545
	10700	22.3	461
	10838	22.2	495
W850	4357	22	461
	4408	22.1	455
	4458	22	488
Sleep mode current consumption			
Band	Setting		Current(mA)
GSM850	2		3.2
	5		2.1
	9		1.5
GSM900	2		3.1
	5		1.9
	9		1.5
DCS1800	2		3.1
	5		1.8
	9		1.5
PCS1900	2		2.9
	5		2
	9		1.4
W2100	6		3.9
	7		2.4
	9		0.8
W850	6		3.9
	7		2.7
	9		0.8

6. Electrical characteristics

6.1. Absolute maximum power ratings

Absolute maximum power ratings for power supply and the voltage on digital and analog pins of U3500 module are listed in the Table29. Out of the range, the module should be damaged.

Table32: Absolute maximum power ratings

Parameter	Description	Min	Typ	Max	Unit
VBAT	U3500 power supply	-0.3	3.8	4.2	V
	RMS average current	0		0.9	A
	Voltage drop during transmit burst, IVBA peak current may up to 2A (Per 4.6ms)			400	mV
USB_VBUS	USB power supply		5.0	5.25	V
GPIO	Digital IO voltage	-0.3	2.6	3.0	V
	Voltage in power off mode	-0.25		0.25	V
ADC	Analog input	-0.3	2.6	3.0	V

6.2. Operating temperatures

U3500 module can normal operate in the environment temperature in -20~+65°C.

If you will use it in the environment which out of the range, we recommend customer has some method to control the temperature around U3500 module.

In the restricted operation temperature, some RF parameter may out of the 3GPP RF standard. The module can work, such as voice, SMS, data.

In the storage temperature, the module may be not able to work, just for storage. The temperature out of the range, the U3500 module should be damaged.

Table33: U3500 module operating temperature



Temperature	Min	Typ	Max	Unit
Normal operation temperature	-20	25	65	°C
Restricted operation temperature	-30 ~ -20		65 ~ 75	°C
Storage temperature	-40		80	°C

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6.3. Interface operating status

V_L: logistic Low level

V_H: logistic High level

Table34: Digital Signal DC Characteristics

Signal	VL		VH		Unit
	Min	Max	Min	Max	
Input	-0.3	0.35* V _{DD-PX}	0.65* V _{DD-PX}	V _{DD-PX} +0.3	V
Output	GND	0.45	V _{DD-PX} -0.45	V _{DD-PX}	V

Note: V_{DD-PX}=2.5~2.7V

Table35: U3500 power supply range

Parameter	I/O	Min	Typ	Max	Unit
VBAT	I	3.5	3.8	4.2	V
USB_VBUS	I	4.4	5.0	5.25	V
USIM_VCC	O	1.7/2.75	1.8/2.85	1.9/2.95	V

6.4. Reliability

Table36: Requirements on the environment reliability

Test case	Test requirement
Low temperature Storage test	-40°C±3°C, power off mode storage 24 hours
High temperature Storage test	+85°C±3°C, power off mode storage 24 hours
Temperature change test	In power off mode, between -40°C and +85°C, stay 0.5h, change time <3min, total 24 times
High temperature high humidity test	Temperature: +85°C±3°C Humidity: 90~95%RH Power off mode storage 24 hours
Low temperature operating	-20°C±3°C, keep operating for 24 hours
High temperature operating	+65°C±3°C, keep operating for 24 hours



Test case	Test requirement	
Vibration test	Vibration test requirement:	
	Frequency	Random Vibration ASD
	5~20Hz	0.96m ² /s ³
20~500Hz	0.96m ² /s ³ (20Hz), else -3dB/times frequency	
Connector Life Test	Board-to-board connector plug 50 times; RF connector plug 30 times	
ESD test	<p>1, When module in voice mode, discharge antenna port, VBAT PAD and GND, ESD must meet the following targets:</p> <ol style="list-style-type: none"> 1) Contact discharge pass: ±2KV、±4KV test class 2) Air discharge pass: ±2KV、±4KV、±8KV test class <p>2, When module in voice mode, discharge SIM card hold of EVB, ESD must meet the following targets:</p> <ol style="list-style-type: none"> 1) Contact discharge pass: ±2KV test class 2) Air discharge pass: ±2KV、±4KV test class 	

6.5. Electrostatic discharge

U3500 module is a consumptive product. Although the module has some ESD protect function, we recommend in application need more ESD protect means to avoid the static electricity from the application environment, please reference to the interface reference design circuit.

In order to improve the antistatic performance of the system, we recommend customer is advised of the following main board: layout an exposed copper under the module U3500, U3500 shield frame solder feet welded to the customer board. The solder feet, copper, solder feet and GND are connected.

The ESD capacity of U3500 is listed in the table below.

Table37: The ESD endure status measured table
(Temperature: 25°C, Humidity: 45%)

Part	Air discharge	Contact discharge
VBAT,GND	±8KV	±4KV
Antenna port	±8KV	±4KV
Other port	±4KV	±2KV