A7672X/A7670X Series Hardware Design

LTE Module

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Version History

Date	Version	Description of change	Author
2021-03-30	1.00	Initial	Zhongyou.chen Xuefeng.liu
2021-09-28	1.01	Add part of description for A7672 Add GNSS_VBKP data consumption Modified schematic diagrams of two GNSS recommended wiring schemes Add the options of AP-Flash software hot start /GNSS_VBKP hardware hot start	Zhongyou Chen/Junxi Liu

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1 Introduction

This document describes the hardware interface of the module, which can help users quickly understand the interface definition, electrical performance and structure size of the module. Combined with this document and other application documents, users can understand and use A7672X/A7670X module to design and develop applications quickly. SIMCom provides a set of evaluation boards to facilitate A7672X/A7670X module testing and use. The evaluation board tools include an EVB board, a USB cable, an antenna, and other peripherals.

1.1 Product Outline

Aimed at the global market, the module supports GSM, LTE-TDD and LTE-FDD. Users can choose the module according to the wireless network configuration. The supported radio frequency bands are described in the following table.

Table 1: Module frequency bands

Standard	Frequency	A7672S	A7672E A7670E	A7672SA A7670SA
GSM	900MHz	✓	✓	✓
	1800MHz	✓	✓	✓
LTE-FDD	LTE-FDD B1	✓	✓	✓
	LTE-FDD B2			✓
	LTE-FDD B3	✓	✓	✓
	LTE-FDD B4			✓
	LTE-FDD B5	✓	✓	✓
	LTE-FDD B7		✓	✓
	LTE-FDD B8	✓	✓	✓
	LTE-FDD B20		✓	
	LTE-FDD B28			✓
	LTE-FDD B66			✓
LTE-TDD	LTE TDD B34	✓		
	LTE TDD B38	✓		
	LTE TDD B39	✓		
	LTE TDD B40	✓		
	LTE TDD B41	✓		
Category		CAT1	CAT1	CAT1
GNSS		Optional	Optional	Optional
BlueTooth		Optional	Optional	Optional

With a small physical dimension of 24*24*2.4mm and with the functions integrated, the module can meet almost any space requirement in users' applications, such as smart phone, PDA, industrial handhold, machine-to-machine and vehicle application, etc.
A7672X/A7670X provides 124 pins, including 80 LCC pins in the outer ring and 44 LGA pins in the inner ring. This document will introduce all the functional pins.

1.2 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:

- Power Supply
- USB 2.0 Interface
- Three UART Interface, one full function serial port, one ordinary serial port and one debug serial port
- USIM Interface
- General ADC Interface
- VBAT ADC Interface
- 4*4 matrix keyboard
- Analog audio MIC input interface
- Analog audio SPK output interface
- SPI Interface
- LDO Power Output
- I2C Interface
- General input and output interfaces (GPIO)
- SPI LCD Interface
- SPI Camera Interface
- Antenna Interface
- USB_BOOT interface
- Network status indication interface
- Module operation status indication interface

1.3 Hardware Block Diagram

The block diagram of the A7672X/A7670X module is shown in the figure below.

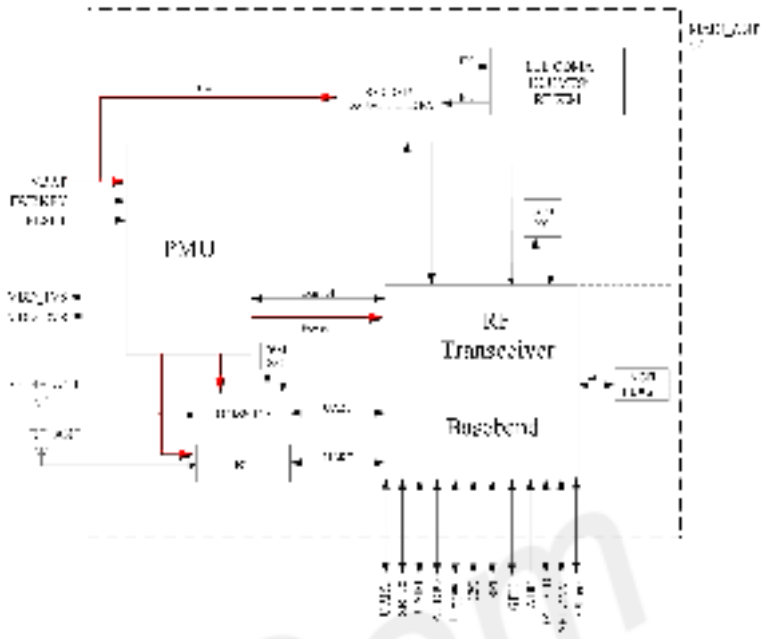

Figure 1: A7672X/A7670X block diagram

1.4 Functional Overview

Table 2: General features

Feature	Implementation
Power supply	VBAT: 3.4V ~4.2V, Recommended VBAT: 3.8V
Power saving	Current in sleep mode: TBD
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power level: -- EGSM900: 4 (33dBm±2dB) -- DCS1800: 1 (30dBm±2dB) EDGE power level: -- EGSM900: E2 (27dBm±3dB) -- DCS1800 : E1 (26dBm+3dB/-4dB) LTE power level: 3 (23dBm±2.7dB)
Data Transmission Throughput	GPRS Multiple time slot level 12 EDGE Multiple time slot level 12 TDD/FDD-LTE category 1 : 10 Mbps (DL),5 Mbps (UL)
Antenna	GSM/LTE antenna interface GNSS antenna interface(optional) Bluetooth antenna interface(optional)
SMS	MT, MO, CB, Text, PDU mode Short Message (SMS)storage device: USIM Card, CB does not support saving in SIM Card

	Support CS domain and PS domain SMS
USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Phonebook management	Support phonebook types: SM/FD/ON/AP/SDN
Audio feature	Support analog audio interface
UART interface	●Full function serial port Baud rate support from 300bps to 3686400bps AT command and data can be sent through serial port Support RTS/CTS Hardware flow control Support serial port multiplexing function conforming to GSM 07.10 protocol ●Debug serial port Support debug usage ●UART3 serial port Ordinary serial port
USB	USB 2.0 compliant, host mode not supported. This interface can be used for AT command sending, data transmission, software debugging and upgrading.
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	Size:24*24*2.4m Weight:2.8±0.1g
Temperature range	Normal operation temperature: -10°C to +50°C Extended operation temperature: -40°C to +85°C* Storage temperature -45°C to +90°C

NOTE

Module is able to make and receive voice calls, data calls, SMS and make GPRS/LTE traffic in -40℃ ~ +85℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

2 Package Information

2.1 Pin Assignment Overview

The following Figure is a high-level view of the pin assignment of the module for A7672X/A7670X.

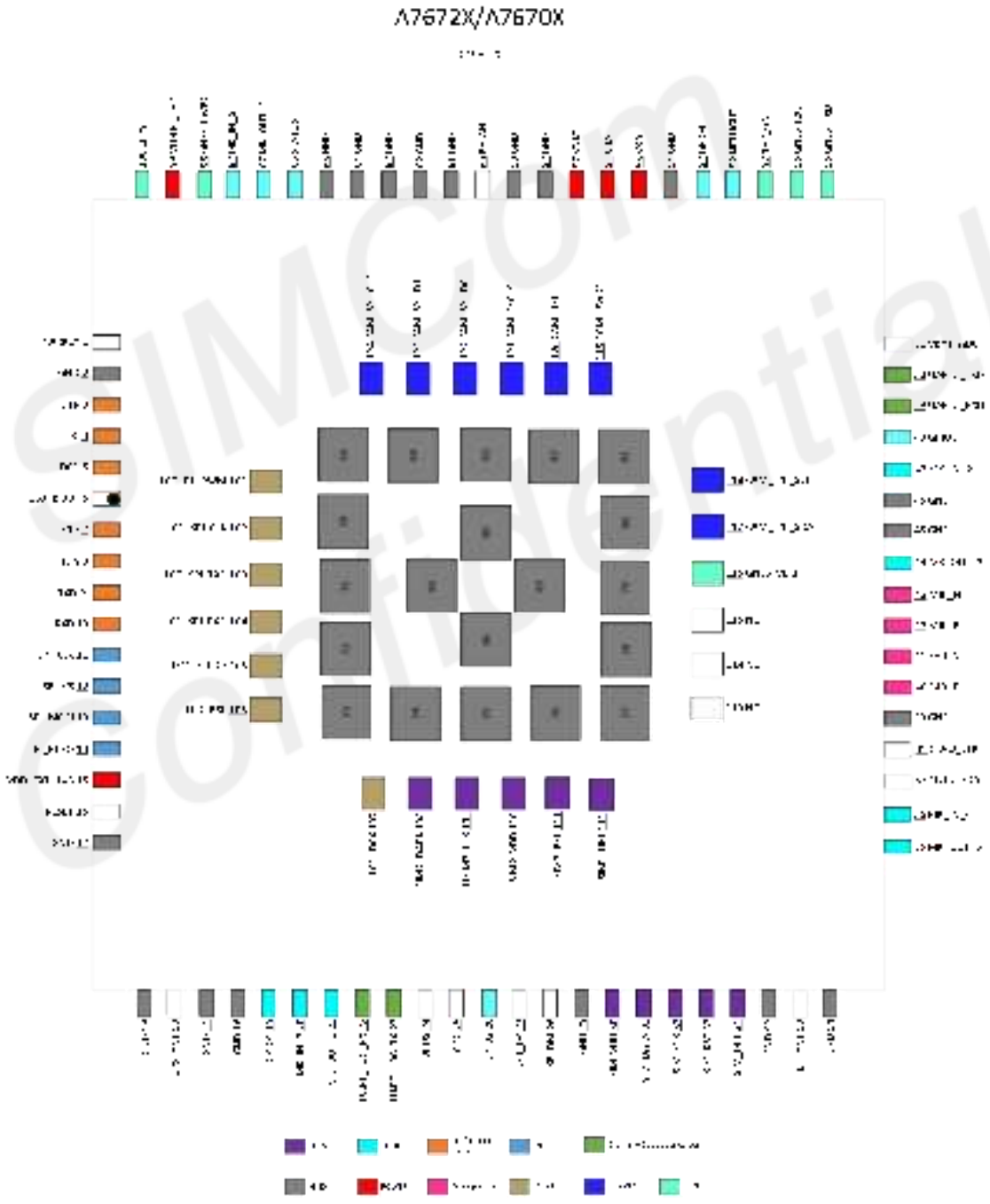

Figure 2: Pin assignment overview for A7672X/A7670X

Table 3: Pin Description

PIN NO	PIN NAME	PIN NO	PIN NAME
1	PWRKEY	2	GND
3	DTR	4	RI
5	DCD	6	USB_BOOT●
7	CTS	8	RTS
9	TXD	10	RXD
11	SPI_CLK	12	SPI_CS
13	SPI_MOSI	14	SPI_MISO
15	VDD _1V8	16	RESET
17	GND	18	GND
19	GPIO1	20	MK_IN_3
21	MK_OUT_3	22	UART_LOG_RX
23	UART_LOG_TX	24	VBUS
25	ADC	26	GPIO2
27	USB_DP	28	USB_DM
29	GND	30	USIM1_VDD
31	USIM1_DATA	32	USIM1_CLK
33	USIM1_RST	34	USIM1_DET
35	MK_OUT_6/I2C3_SDA	36	MK_IN_6/I2C3_SCL
37	I2C_SDA	38	I2C_SCL
39	GND	40	EAR_P
41	EAR_N	42	MIC_P
43	MIC_N	44	MK_OUT_2
45	GND	46	GND
47	MK_IN_2	48	GPIO3
49	UART3_RXD	50	UART3_TXD
51	VBAT_ADC	52	NETLIGHT
53	GPIO4	54	GND
55	VBAT	56	VBAT
57	VBAT	58	GND
59	GND	60	RF_ANT
61	GND	62	GND
63	GND	64	GND
65	GND	66	STATUS
67	MK_OUT_5	68	MK_IN_5
69	GND	70	GND
71	GND	72	GND
73	GND	74	GND
75	GND	76	GND

77	GND	78	GND
79	GND	80	GND
81	GND	82	GND
83	GND	84	GND
85	GND	86	GND
87	GND	88	GND
89	GND	90	GNSS_ANT
91	GND	92	GND
93	BT_ANT	94	GND
95	GNSS_TXD	96	GNSS_RXD
97	1V8_GNSS	98	GNSS_PWRCTL
99	VDD_2V8	100	1PPS
101	LCD_BL_PWM	102	LCD_SPI_CLK
103	LCD_SPI_TXD	104	LCD_SPI_RXD
105	LCD_SPI_CS	106	LCD_RST
107	LCD_DCX	108	USIM2_DATA
109	USIM2_CLK	110	USIM2_VDD
111	USIM2_RST	112	USIM2_DET
113	NC	114	NC
115	NC	116	GNSS_VBKP
117	CAM_I2C_SDA	118	CAM_I2C_SCL
119	CAM_PWDN	120	CAM_RST
121	CAM_MCLK	122	CAM_SPI_D0
123	CAM_SPI_D1	124	CAM_SPI_CLK

NOTE

'●' Indicates that these Pins cannot be pulled down before the module powered up, otherwise it will affect the normal start-up of the module.

2.2 Pin Description

Table 4: Pin parameter abbreviation

Pin type	Description
PI	Power input
PO	Power output
AI	Analog input
AIO	Analog input/output

I/O	Bidirectional input /output
DI	Digital input
DO	Digital output
DOH	Digital output with high level
DOL	Digital output with low level
PU	Pull up
PD	Pull down

Table 5: 1.8V IO parameters definition

Power Domain	Parameter	Description	Min	Typ.	Max
	VIH	High level input	VCC * 0.7	1.8V	VCC + 0.2
	VIL	Low level input	-0.3V	0V	VCC *0.3
	Rpu	Pull up resistor	55KΩ	79 KΩ	121 KΩ
	Rpd	Pull down resistor	51 KΩ	87 KΩ	169 KΩ
	IIL	Input leakage current	-	-	10uA
	VOH	Output level range	VCC - 0.2	-	-
	VOL	Output low range	-	-	0.2V
	IOL	Maximum current driving capacity at low level output	-	-	13mA
	IOH	Maximum current driving capacity at high level output Vpad=VCC-0.2V	-	-	11mA

Table 6: 3.3V IO parameters definition

Power Domain	Parameter	Description	Min	Typ.	Max
3.3V	VIH	High level input	2V	1.8V	VCC + 0.3
	VIL	Low level input	-0.3V	0V	0.8V
	Rpu	Pull up resistor	26KΩ	47 KΩ	72 KΩ
	Rpd	Pull down resistor	27 KΩ	54 KΩ	267 KΩ
	IIL	Input leakage current	-	-	10uA
	VOH	Output level range	2.4V	-	-
	VOL	Output low range	-	-	0.4V
	IOL	Maximum current driving capacity at low level output	-	-	7mA
	IOH	Maximum current driving capacity at high level output Vpad=VCC-0.5V	-	-	7mA

Table 7: Pin description

Pin name	Pin No.	Pin parameter		Description	Note
		Power domain	Type		
Power supply					
VBAT	55,56, 57	-	PI	Module input voltage ranges from 3.4V to 4.2V, Typical values is 3.8V. and the peak current value can reach 2A.	
VDD_1V8	15	-	PO	1.8V power output, output current up to 50 mA. Cannot provide to high power load, can provide power for level conversion circuit, etc.	Can provide 1V8 power supply for GNSS. If unused, keep it open.
VDD_2V8	99	-	PO	Internal 2.8V power output, output current up to 50 mA. Cannot provide to high power load.	Can provide 2V8 power supply for LCD VCC_2V8. If unused, keep it open.
GND	2,17,18, 29,39, 45,46, 54,58, 59,61, 62,63, 64,65, 69,70, 71,72, 73,74, 75,76, 77,78, 79,80, 81,82, 83,84, 85,86, 87,88, 89,91, 92,94	-	-	Ground	
System Control					
PWRKEY	1	-	DI,PU	Power ON/OFF input, active low. VIH: 0.7*VBAT VIL: 0.3*VBAT	PWRKEY has been internally pulled-up to VBAT with 50KΩ resistor, default high.
RESET	16	-	DI,PU	System reset control input, active low. VIH: 0.7*VBAT VIL: 0.3*VBAT	RESET has been pulled-up to VBAT with 50KΩ (typical) resistor, default high.
USIM interface					
USIM1_DATA	31	1.8/3.0V	I/O,PU	USIM bus data, this pin	

				has been pull-up with 4.7KΩ resistor to USIM1_VDD.	
USIM1_RST	33	1.8/3.0V	I/O,PU	USIM bus reset output.	
USIM1_CLK	32	1.8/3.0V	I/O,PU	USIM bus clock output.	
USIM1_VDD	30	1.8/3.0V	PO	USIM card power supply output, supports 1.8v/3.0v output according to the card type, its output current is up to 50mA.	
USIM1_DET	34	1.8V	I/O,PU	USIM insert detect, it can be set to high/low active with the AT command, refer to Document [25]	
USIM2_DATA	108	1.8/3.0V	I/O,PU	USIM bus data, this pin need pull-up with 4.7KΩ resistor to USIM2_VDD externally.	
USIM2_RST	111	1.8/3.0V	I/O,PU	USIM bus reset output.	
USIM2_CLK	109	1.8/3.0V	I/O,PU	USIM bus clock output.	
USIM2_VDD	110	1.8/3.0V	PO	USIM card power supply output, supports 1.8v/3.0v output according to the card type, its output current is up to 50mA.	
USIM2_DET	112	1.8V	DI,PD	USIM insert detect, it can be set to high/low active with the AT command, refer to Document [25]	
USB interface					
VBUS	24	-	AI	Valid USB detection input. Active high, Vmax(valid)=3.0V, Vmax(detection)=5.2V	
USB_DM	28	-	I/O	Negative line of the differential, bi-directional USB signal.	
USB_DP	27	-	I/O	Positive line of the differential, bi-directional USB signal.	
Full function UART interface					
RTS	8	1.8V	DI	RTS input	If unused, keep it open.
CTS	7	1.8V	DO	CTS output	
RXD	10	1.8V	DI	Data input	
TXD	9	1.8V	DOH	Data output	
RI	4	1.8V	DO	Ringing indicator	
DCD	5	1.8V	DO	Carrier detection	
DTR	3	1.8V	DI	DTE Ready	
Debug UART					
UART_LOG_TXD	23	1.8V	DOH	Log output	Default used as

UART_LOG_RXD	22	1.8V	DI	Log input	debug port.
Serial Port UART3					
UART3_TXD	50	1.8V	DOH	Log output	Two-wire serial port
UART3_RXD	49	1.8V	DI	Log input	
I2C interface					
I2C_SCL	38	1.8V	DO	I2C clock output	If unused, keep it open. Need pull up to VDD_1V8 externally.
I2C_SDA	37	1.8V	I/O	I2C data I/O	
SPI interface					
SPI_CLK	11	1.8V	I/O,PD	SPI clock	If unused, keep it open.
SPI_CS	12	1.8V	I/O,PD	SPI chip selection	
SPI_MOSI	13	1.8V	DO,PD	SPI Main output slave input	
SPI_MISO	14	1.8V	DI,PD	SPI Main input slave output	
Analog audio interface					
EAR_P	40	1.8V	AIO	Earphone output positive	If unused, keep it open.
EAR_N	41	1.8V	AIO	Earphone output negative	
MIC_P	42	1.8V	AIO	MIC input positive	
MIC_N	43	1.8V	AIO	MIC input negative	
GPIO					
GPIO1	19	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GPIO2	26	1.8V	IO,PD	General purple I/O	If unused, keep it open.
GPIO3	48	1.8V	IO,PD	General purple I/O	If unused, keep it open.
GPIO4	53	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GNSS Interface					
GNSS_PWRCTL	98	1.8V	DI	The enable control PIN of GNSS power supply.	Active high.
1V8_GNSS	97	-	PI	The power input for GNSS, the input voltage must not be less than 1.8V.	Module VDD_1V8 (PIN 15) can be used for this power supply
GNSS_VBKP	116	-	PI	GNSS VRTC power input, input voltage 1.4V~3.6V	If unused, keep it open.
1PPS	100	1.8V	DO	1PPS signal output	If unused, keep it open.
GNSS_RXD	96	1.8V	DI	GNSS UART RX	Connect to MCU UART_TX; Or use 1K resistors in series in module

					UART3_TX (pin 50).
GNSS_TXD	95	1.8V	DO	GNSS UART TX	Connect to MCU UART_RX; Or use 1K resistors in series in module UART3_RX (pin 49).
SPI LCD Interface					
LCD_BL_PWM	101	1.8V	DO	LCD backlight adjusting PWM	If unused, keep it open.
LCD_SPI_CLK	102	1.8V	DO	SPI clock	
LCD_SPI_TXD	103	1.8V	DI，DO	SPI DATA(Bidirectional)	
LCD_SPI_RXD	104	1.8V	DI	SPI DATA	
LCD_SPI_CS	105	1.8V	DO	SPI CS	
LCD_RST	106	1.8V	DO	LCD Reset	
LCD_DCX	107	1.8V	DO	Command/parameter selection	
SPI CAMERA Interface					
CAM_I2C_SDA	117	1.8V	DI, DO	Camera I2C data	If unused, keep it open.
CAM_I2C_SCL	118	1.8V	DO	Camera I2C clock	
CAM_PWDN	119	1.8V	DO	Camera power down	
CAM_RST	120	1.8V	DO	Camera reset	
CAM_MCLK	121	1.8V	DO	Camera main clock	
CAM_SPI_D0	122	1.8V	DI	Camera SPI D0	
CAM_SPI_D1	123	1.8V	DI	Camera SPI D1	
CAM_SPI_CLK	124	1.8V	DO	Camera SPI clock	
ANT interface					
RF_ANT	60	-	AIO	Main antenna	
GNSS_ANT	90	-	AIO	GNSS antenna	
BT_ANT	93	-	AIO	Bluetooth antenna	
Keyboard interface					
MK_IN2	47	1.8V	DI	Keyboard input	If unused, keep it
MK_IN3	20	1.8V	DI	Keyboard input	If unused, keep it
MK_IN5	68	1.8V	DI	Keyboard input	If unused, keep it
MK_IN6	36	1.8V	DI	Keyboard input	If unused, keep it
MK_OUT2	44	1.8V	DO	Keyboard output	If unused, keep it
MK_OUT3	21	1.8V	DO	Keyboard output	If unused, keep it
MK_OUT5	67	1.8V	DO	Keyboard output	If unused, keep it
MK_OUT6	35	1.8V	DO	Keyboard output	If unused, keep it
Other pins					
ADC	25	-	AI	General Purpose ADC	If unused, keep it

					open.
VBAT_ADC	51	-	AI	VBAT ADC	If unused, keep it open.
NETLIGHT	52	1.8V	DO	Network registration status indicator (LED). For more detail, please refer the chapter 3.12.	
STATUS	66	1.8V	DO	Module status indicator (LED).	
USB_BOOT	6	1.8V	DI	Firmware download guide control input. when pull-up to GND and press PWRKEY,module will access in USB download mode.	Do place 2 test points for debug. Do not pull down USB_BOOT during normal power up !

NOTE

Please reserve a test point for USB_BOOT, VDD_EXT and UART_LOG_TX. If there is no USB connector, please also reserve a test point for USB_VBUS, USB_DP, and USB_DM for Firmware upgrade.

2.3 Mechanical Information

The following figure shows the package outline drawing of A7672X/A7670X.

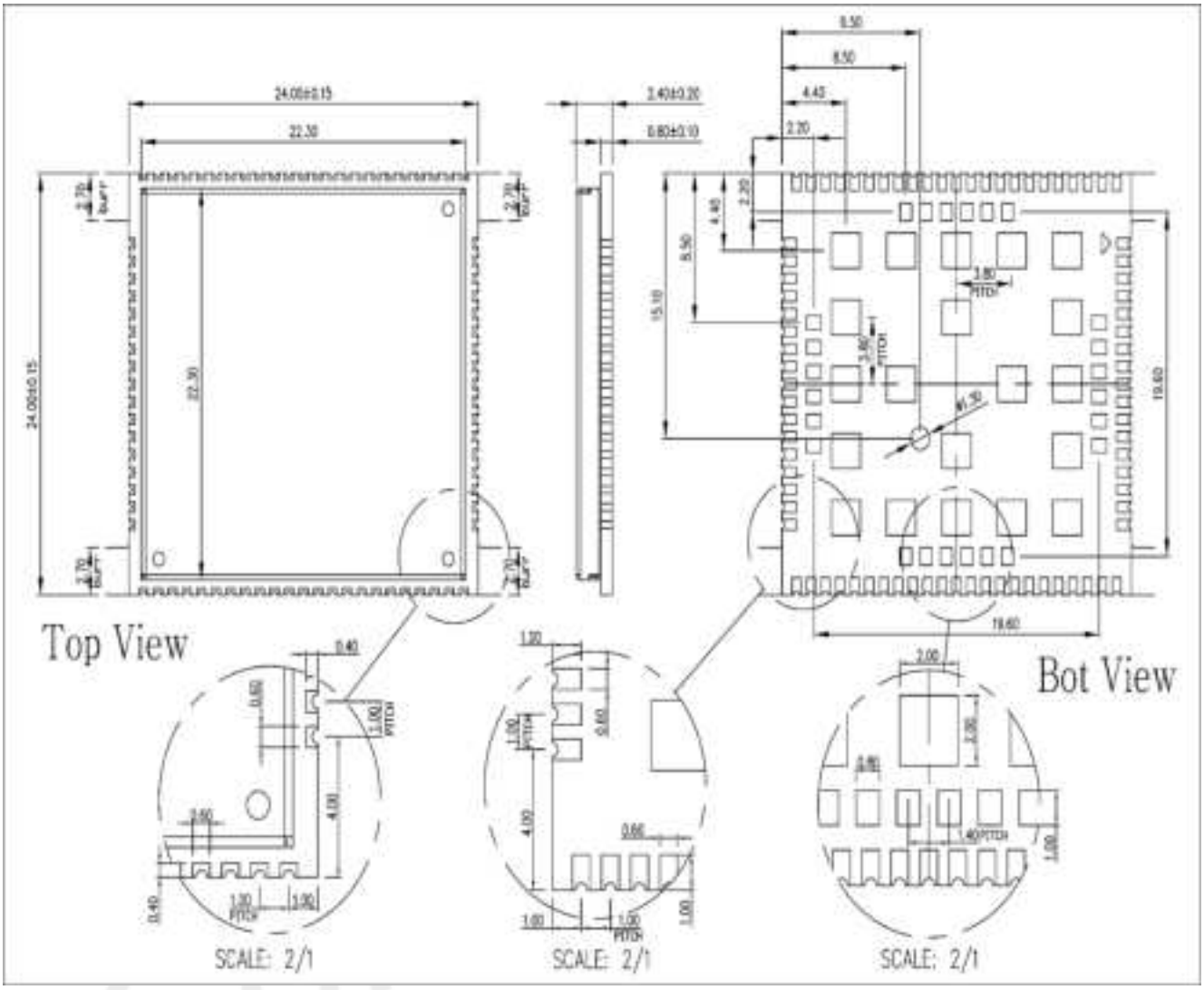

Figure 3: Dimensions (Unit: mm)

NOTE

The side length dimension is 24.00±0.15mm excluding the burr area.

2.4 Footprint Recommendation

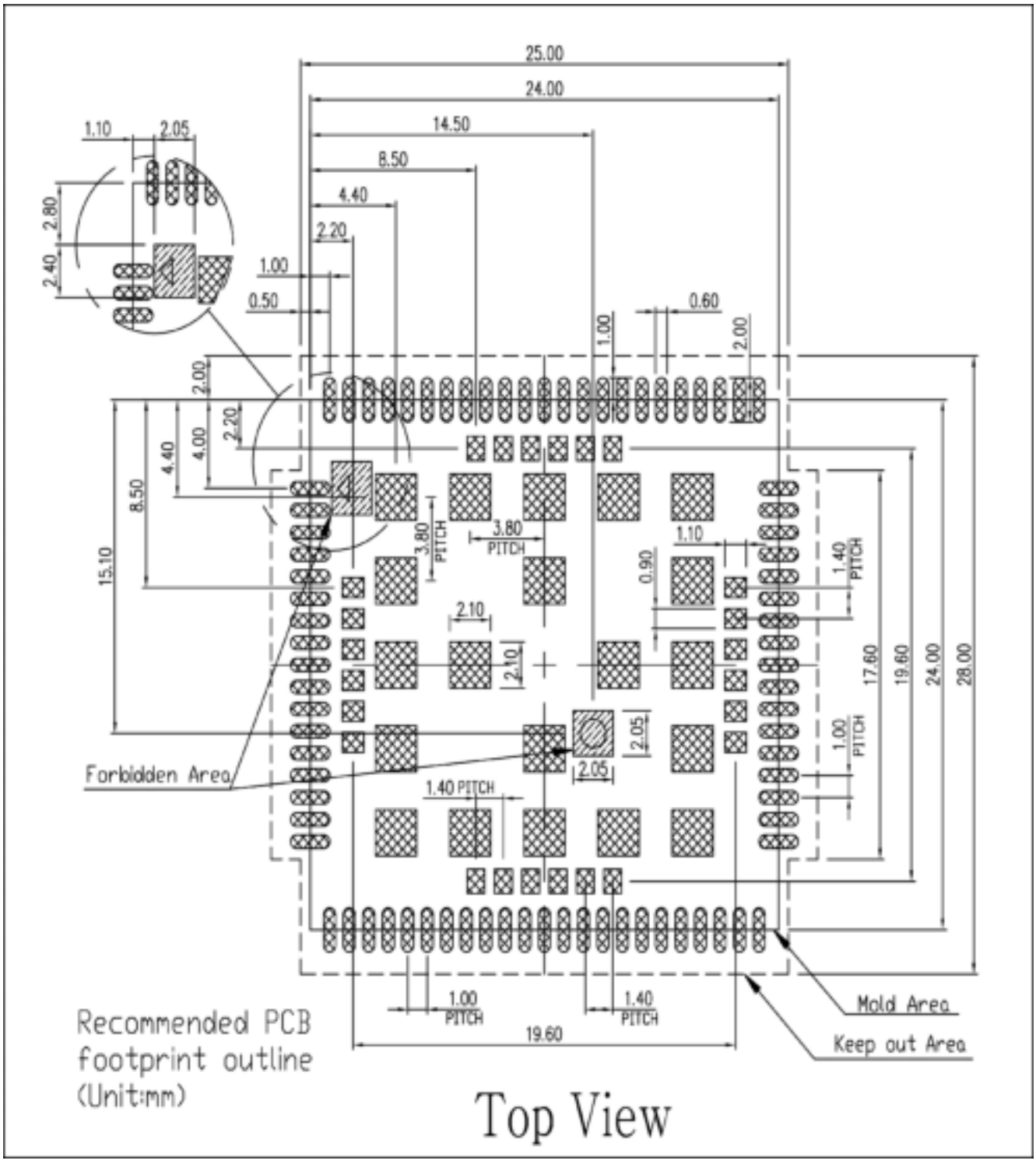

Figure 4: Footprint recommendation (Unit: mm)

2.5 Recommend Stencil Size

Recommend stencil thickness≥0.12mm and <0.15mm.

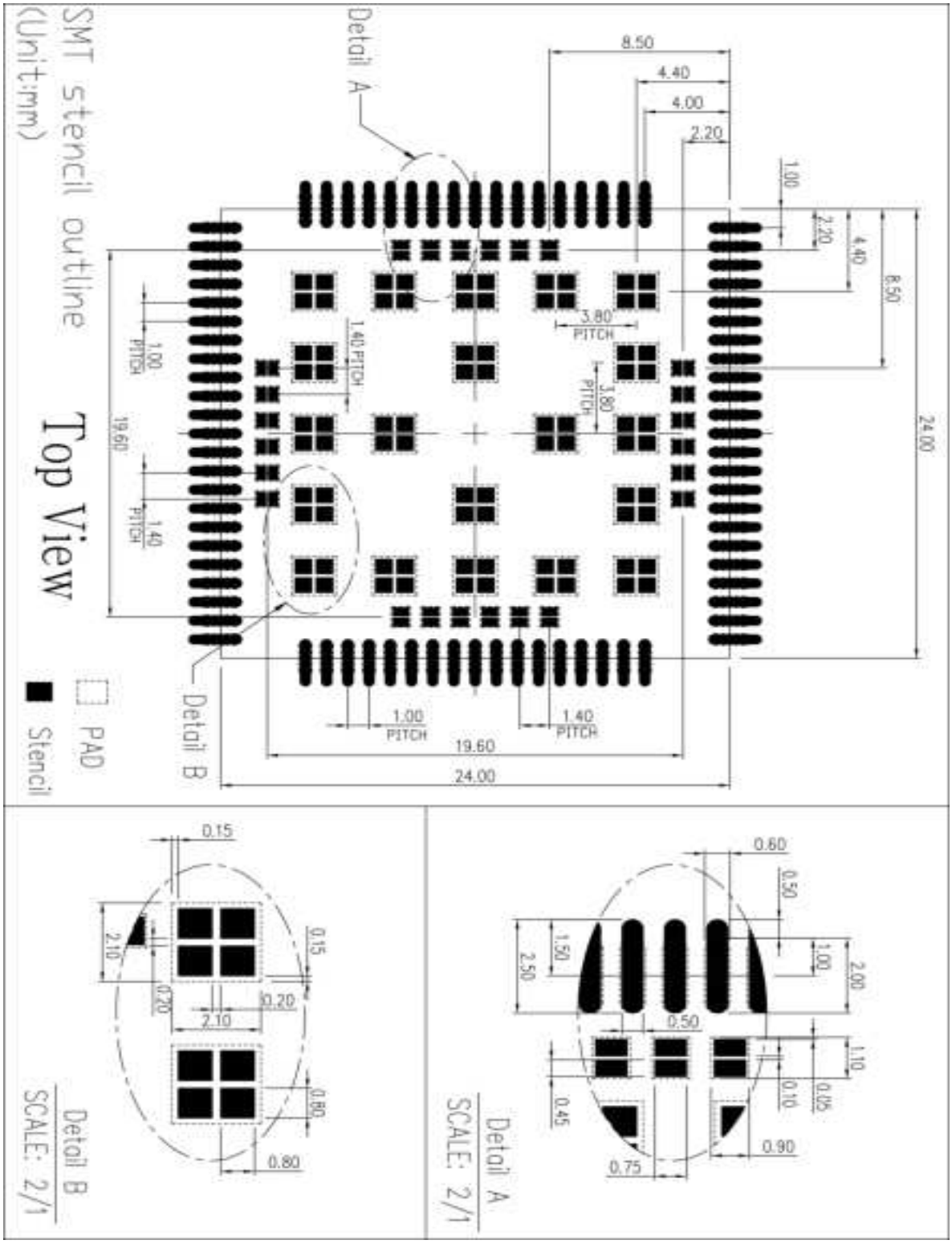

Figure 5: Recommend stencil dimension (Unit: mm)

3 Interface Application

3.1 Power Supply

A7672X/A7670X offers 3 power supply pins (55, 56, 57) as VBAT power input pin. A7672X/A7670X use these three pins supply the internal RF and baseband circuit.
When the module is at the maximum power in GSM TX mode, the peak current can reach 2A (peak current), which results in a large voltage drop on Vbat. In order to ensure that the voltage drop is less than 300mV, the power supply capacity of external power supply must be no less than 2A.

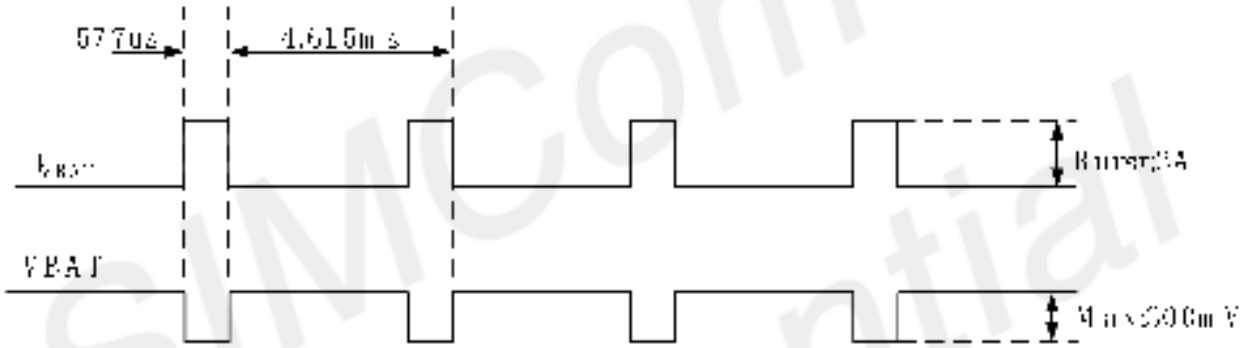

Figure 6: VBAT voltage drop during burst emission (EDGE/GPRS)

NOTE

Test condition: VBAT power supply 3.8V, the module is tested on EVB board, and the power input has a 330UF tantalum capacitor.

Table 8: VBAT pins electronic characteristic

Parameter	Description	Min	Typ.	Max	Unit
VBAT	Module supply voltage	3.4	3.8	4.2	V
IVBAT (peak)	Module consumption peak current	-	2	-	A
IVBAT (average)	Module average consumption current (normal mode)	Refer to Table 46			
IVBAT (sleep)	Module average consumption current (sleep mode)				
IVBAT (power-off)	Module average consumption current (off leakage current)	-	20	-	uA

3.1.1 Power Supply Design Guide

In the user's design, special attention must be paid to the design of the power supply. If the voltage drops below 3.4V, the RF performance of the module will be affected, the module will shut down if the voltage is too low. It is recommended to select an LDO or DC-DC chip with an enable pin, and the enable pin is controlled by the MCU.

NOTE

When the power supply can provide a peak current of 2A, the total capacity of the external power supply capacitance is recommended to be no less than 300uf. If the peak current of 2A cannot be provided, the total capacity of the external capacitance is recommended to be no less than 600uf to ensure that the voltage drop on the Vbat pin at any time is not more than 300mV.

It is recommended to place four 33PF/10PF/0.1UF/1UF ceramic capacitors near Vbat to improve RF performance and system stability. At the same time, it is recommended that the Vbat layout routing width from the power supply on the PCB to the module be at least 3mm. Reference design recommendations are as follows:

If the Vbat input contains high-frequency interference, it is recommended to add magnetic beads for filtering. The recommended types of magnetic beads are BLM21PG300SN1D and MPZ2012S221A.

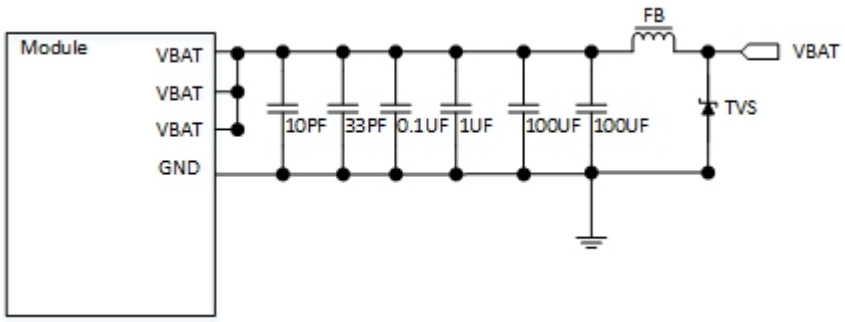

Figure 7: Power supply application circuit

In addition, in order to prevent the damage of A7672X/A7670X caused by surge and overvoltage, it is recommended to parallel one TVS on the Vbat pin of the module.

Table 9: Recommended TVS diode list

No.	Manufacturer	Part Number	VRWM	Package
1	JCET	ESDBW5V0A1	5V	DFN1006-2L
2	WAYON	WS05DPF-B	5V	DFN1006-2L
3	WILL	ESD5611N	5V	DFN1006-2L

4	WILL	ESD56151W05	5V	SOD-323

NOTE

When selecting TVS by customer, it is necessary to pay attention to the clamping voltage in the case of surge protection. The clamping voltage should not be higher than 10V when 100V surge input.

3.1.2 Recommended Power Supply Circuit

The MCU must have the function to power off the module, but the module cannot be shut down or restarted normally. Only when the module is abnormal and cannot be shut down or restarted normally can the module be powered off. When the input power is greater than 9V, the DCDC chip is recommended. When the input is less than 9V, it is recommended to use LDO power supply. If you use the module's OPEN LINUX secondary development function, because there is no MCU, you can add a low-cost single-chip microcomputer to play the role of hardware watchdog to pull POWERKEY to boot and can be powered off.
It is recommended that a switching mode power supply or a linear regulator power supply is used. The following figure shows the linear regulator reference circuit:

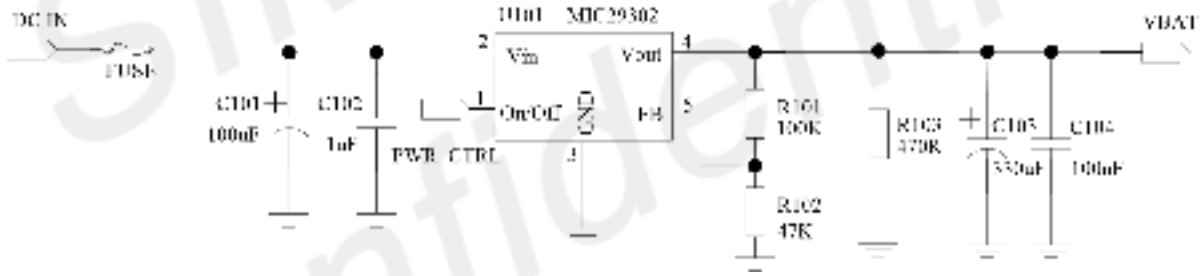

Figure 8: Linear regulator reference circuit

The following figure shows the DC-DC regulator reference circuit:

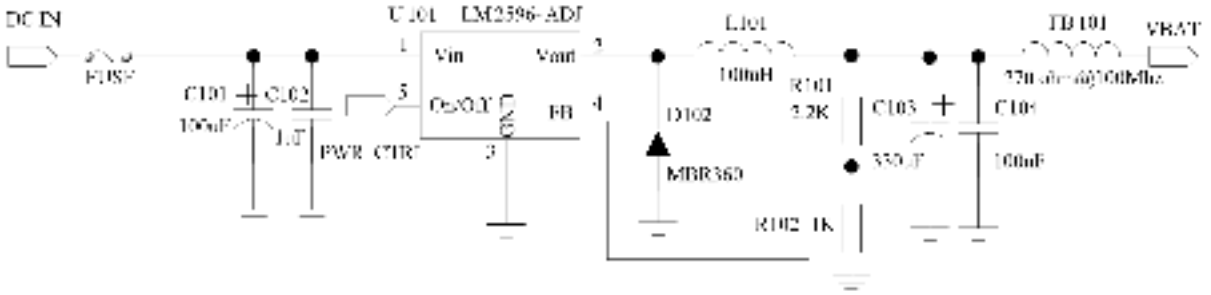

Figure 9: power supply reference circuit

3.1.3 Voltage Monitor

AT command 'AT+CBC' can be used to monitor VBAT voltage.
AT command 'AT+CVALARM' can be used to set high/low voltage alarm, When the actual voltage exceeds the preset range, a warning message will be reported through the AT port.
AT command 'AT+CPMVT' can be used to set high/low voltage power off, When the actual voltage exceeds the preset range, the module will shut down automatically.

NOTE

Voltage monitor function under debugging, Overvoltage alarm and overvoltage shutdown are off by default. For details of at commands, please refer to document [1].

3.2 Power On/ Off and Reset

3.2.1 Power on

Customer can power on the module by pulling down the PWRKEY pin. This pin has been pulled up inside the module to Vbat.
It is recommended that when using the module, adding TVS diode at the module pin can effectively enhance the ESD performance.
The recommended circuit is as follows:

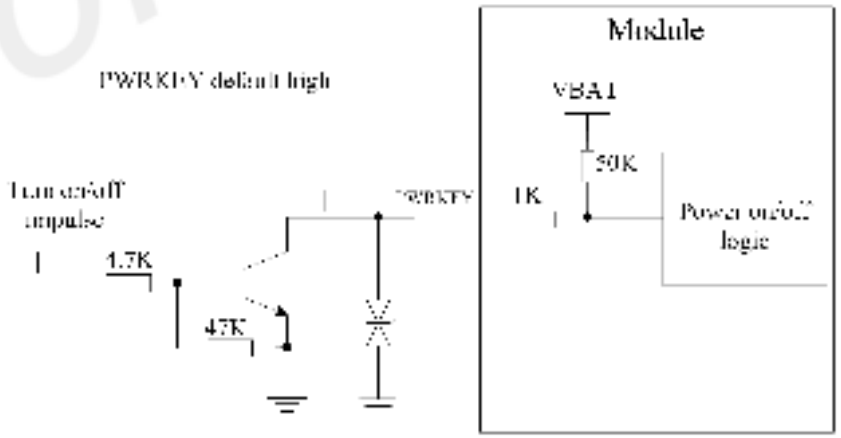

Figure 10: Reference power on/off circuit

NOTE

Do not parallel capacitors which the value is exceed 100nF on PWRKEY or RESET pin. It will cause module power on automatically when VBAT powered.
It is forbidden to pull down both RESET key and PWRKEY to power on the module at the same time.

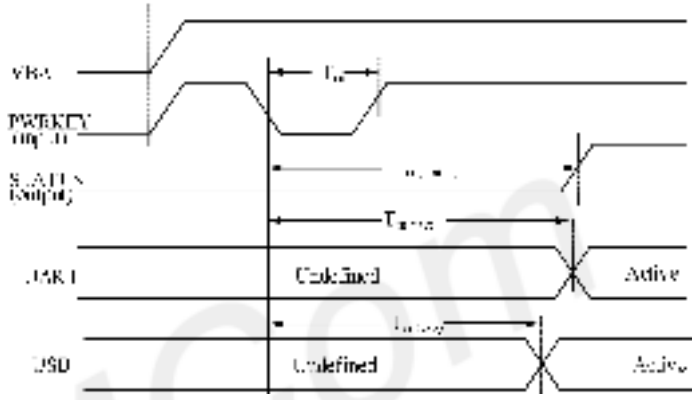

Figure 11: Power on timing sequence

Table 10: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
Ton	The time of active low-level impulse of PWRKEY pin to power on module	-	50	-	ms
Ton(status)	The time from power-on issue to STATUS pin output high level (indicating power up ready)	-	7	-	s
Ton(uart)	The time from power-on issue to UART port ready	-	8	-	s
Ton(usb)	The time from power-on issue to USB port ready	-	9	-	s
VIH	Input high level voltage on PWRKEY pin	0.7* VABT	-	VBAT	V
VIL	Input low level voltage on PWRKEY pin	0	0	0.3* VBAT	V

3.2.2 Power off

A7672X/A7670X has the following shutdown methods:

- Power off by pulling the PWRKEY# pin down to a low level.
- Power off Module by AT command 'AT+CPOF'.
- Over-voltage or under-voltage automatic power off.
- Over-temperature or under-temperature automatic power off.

It is strongly recommended that the customer use PWRKEY or 'AT+CPOF' to shut down, and then power off Vbat (especially when the module does not need to work). In addition, the customer cannot shut down Vbat by disconnecting it, which may cause damage to flash.

NOTE

when the temperature exceeds the range of - 10 ~ + 50 ℃, A7672X/A7670X will report warning information through AT port. When the temperature exceeds the range of - 40 ~ + 85 ℃, A7672X/A7670X will shut down automatically. For a detailed description of 'AT+ CPOF' and 'AT+ CPMVT', please refer to document [1].

PWRKEY can be used to power off the module, power off sequence see the following figure:

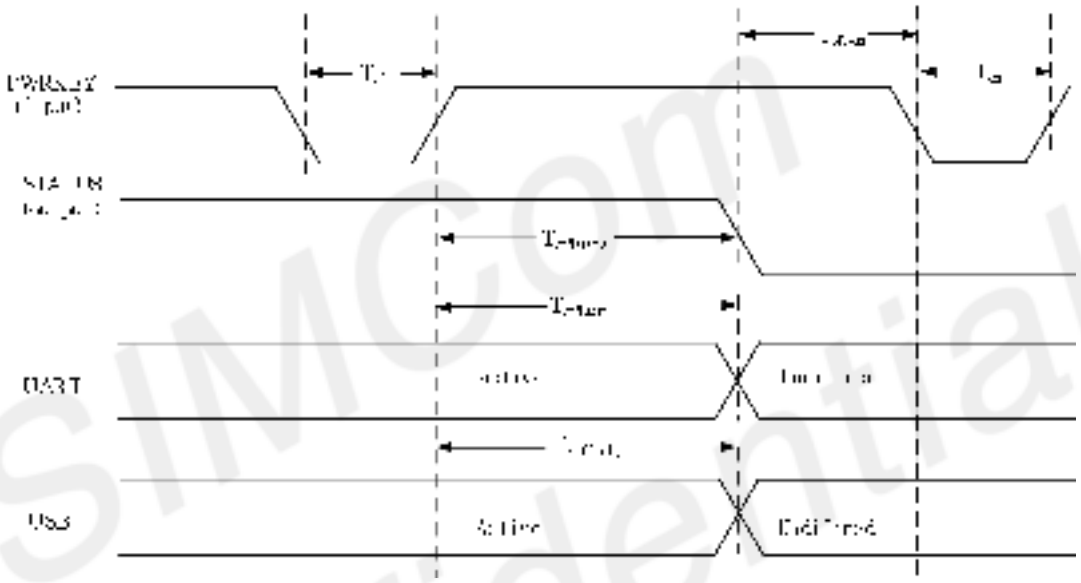

Figure 12: Power off timing sequence

Table 11: Power off sequence parameters

Symbol	Parameter	Min.	Typ.	Max.	Unit
Toff	Power off low level pulse width	2.5	-	-	s
Toff(status)	Power off time (according to status interface)	-	2	-	s
Toff(uart)	Power off time (according to UART interface)	-	2	-	s
Toff(usb)	Power off time (according to USB interface)	-	2	-	s
Toff-on	Power off - power on buffer time	2	-	-	s

NOTE

The status pin can be used to judge whether the module is powered on or not. When the module is powered on and initialization is completed, the status outputs a high level, otherwise the low level will be maintained all the time.

3.2.3 Reset Function

A7672X/A7670X can restart the module by pulling down the reset pin of the module. Reset pin also has the function of power on when PMU first time be given a valid supply voltage (active low, but this key has no shutdown function). After first time power on, some register of this pin will be written then it will lose this function, so it is recommended to use PWRKEY to power on the module and RESET key only used as reset function.

A 50K Ω resistor is used to pull-up to VBAT inside the module, so it is no need to add pull-up resistor outside. The recommended circuit is showed as follows:

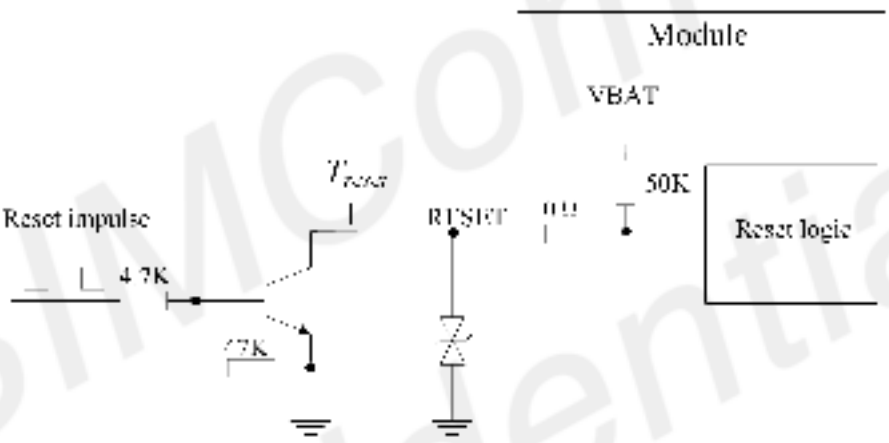

Figure 13: Reference reset circuit

Table 12: RESET pin electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
Treset	The active low level time impulse on RESET pin to reset module	2	2.5	-	S
VIH	Input high level voltage	0.7* VBAT	-	VBAT	V
VIL	Input low level voltage	0	0	0.3* VBAT	V

NOTE

It is recommended to use the reset pin only in case of emergency, such as the module is not responding. The reset time is recommended to be 2.5s.

3.3 UART Interface

A7672X/A7670X provides three serial ports, the main communication serial port is UART, one ordinary serial port, and the UART_LOG dedicate to printing log.

3.3.1 UART Design Guide

When using uses full-function serial port, please refer to the following connection mode:

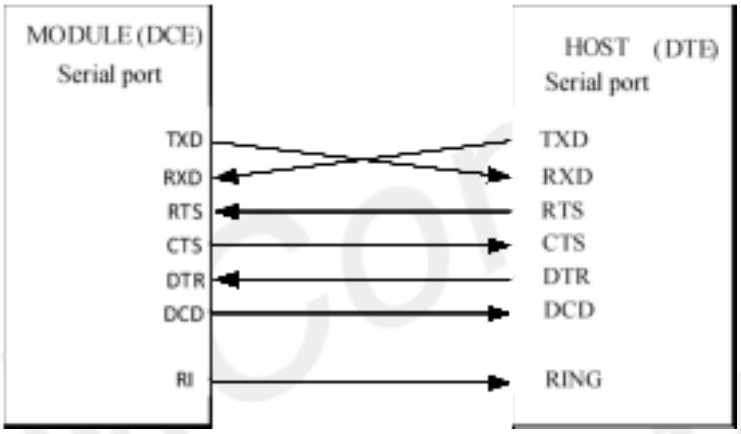

Figure 14: Serial port connection diagram (full-function mode)

When using 2-wire serial port, please refer to the following connection mode:

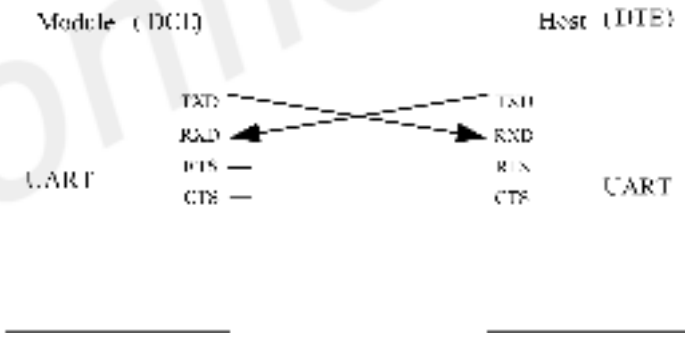

Figure 15: Serial port connection diagram (NULL mode)

The following figure shows the use of triode for level shifter circuits. The circuit with dotted line can refer to the circuit with solid line TXD and RXD, and attention shall be paid to the direction of signal.
The recommended triode model is MMBT3904.

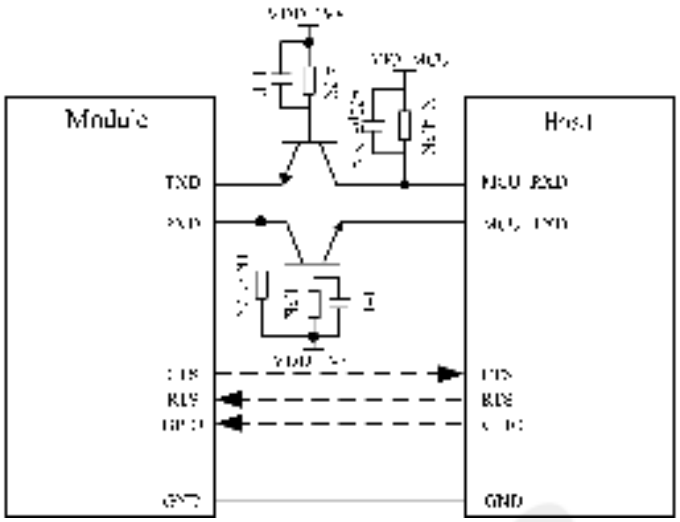

Figure 16: Triode level conversion circuit

NOTE

1. Main UART supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 1842000, 3686400. The default baud rate is 115200bps.
2. The maximum baud rate supported by A7672X/A7670X ordinary serial port is 921600.
3. The parasitic capacitance of the transistor will affect the edge of the high-speed digital signal. It is not recommended to use this circuit when the signal speed is higher than 115200bps.

3.3.2 RI and DTR Behavior

RI usually keeps high level output. When receiving a short message or URC report, RI outputs a low level for 120ms (short message)/60ms (URC), and then returns to a high-level state; RI will output a low level, when receiving a phone call as the called party. After outputting low level, RI will remain low until the host accepts the call using the "ATA" command or the caller stops calling RI, in the end, it will become high level.

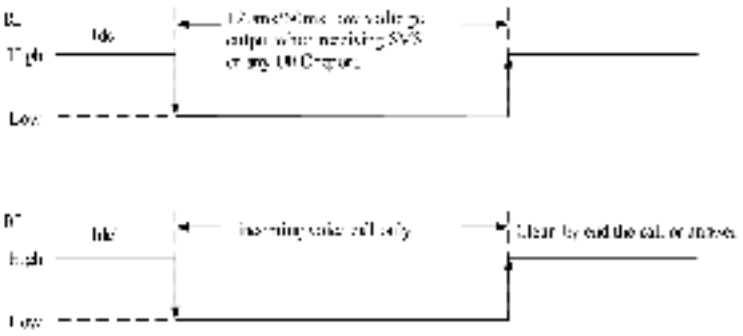

Figure 17: RI behaviour (SMS and URC report)

After setting the AT command “AT+CSCLK=1”, and then pulling up the DTR pin, Module will enter sleep

mode when module is in idle mode. In sleep mode, the UART is unavailable. When A7672X/ enters sleep mode, pulling down DTR can wakeup module.
After setting the AT command “AT+CSCLK=0”, A7672X/A7670X Series will do nothing when the DTR pin is pulling up.

3.4 USB Interface

The A7672X/7670X contains a USB interface compliant with the USB2.0 specification as a peripheral, but does not support USB charging function and does not support USB HOST mode.

USB is the main debugging port and software upgrade interface. It is recommended that customers reserve USB test points during design. If a main control chip is connected, 0R resistors must be reserved for switching external test points during design, as shown in the figure below.

3.4.1 USB Reference Design

A7672X/7670X can be used as a USB slave device. The recommended connection circuit diagram is as follows:

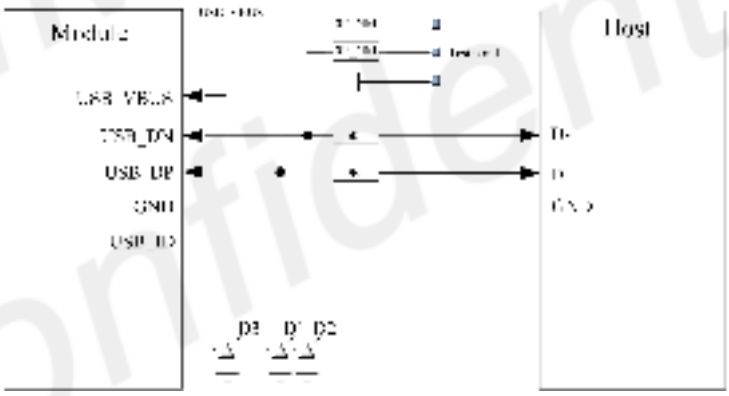

Figure 18: USB circuit diagram

Because of the high bit rate on USB bus, more attention should be paid to the influence of the junction capacitance of the ESD component on USB data lines. On USB_VBUS line, customers should pay attention to the selection of the D3 device when using it. It is recommended to choose an anti-static and anti-surge two-in-one device.

NOTE

1. The USB data cable must be strictly routed in 90Ω +/- 10% differential. The TVS devices D1 and D2 on the data line must be selected with equivalent capacitance less than 1pF. The TVS device should be placed near the USB connector or test point, recommended models ESD73011N and WS05DUCFM.

2. The detection of USB2.0 speed is determined automatically by the USB protocol. The customer does not need to pull up the DP external, otherwise it may affect the device USB enumeration.

3.4.2 USB_BOOT Interface

A7672X/7670X provides one forced download boot interface 'USB_BOOT'.

Table 13: USB_BOOT description

Pin number	Pin name	I/O	Description	Power domain	Default state	Remark
6	USB_BOOT	DI	Force downloads boot port	1.8V	B-PU	

If the module upgrade fails to boot, you can force upgrade through the USB_BOOT port.
Before the module is powered on, pull the USB_BOOT pin to GND, then apply VBAT power to the module, and press RESET to enter the download mode. After entering the download mode, you need to release USB_BOOT and remove the pull-up.

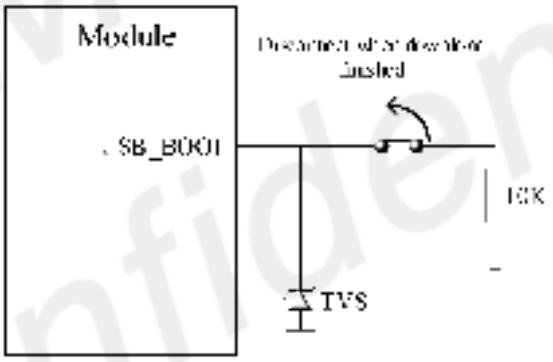

Figure 19: Reference USB_BOOT circuit

Customers will see the download port in the device manager port of the windows system.

Figure 20: Force-download port

NOTE

USB_BOOT only has the function of forcing download and booting before booting (it cannot be pulled down).

3.5 USIM Interface

A7672X/A7670X supports both 1.8V and 3.0V USIM Cards. The interface power of the USIM card is provided by the voltage regulator inside the module, and the normal voltage value is 3V or 1.8V.

Table 14: USIM electronic characteristic in 1.8V mode (USIM_VDD=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	1.62	1.8	1.98	V
VIH	High-level input voltage	0.7*USIM_VDD	-	USIM_VDD +0.4	V
VIL	Low-level input voltage	-0.4	0	0.25*USIM_VDD	V
VOH	High-level output voltage	USIM_VDD -0.4	-	USIM_VDD	V
VOL	Low-level output voltage	0	0	0.2	V

Table 15: USIM electronic characteristic 3.0V mode (USIM_VDD=3V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	2.7	3	3.3	V
VIH	High-level input voltage	0.7*USIM_VDD	-	USIM_VDD +0.4	V
VIL	Low-level input voltage	-0.4	0	0.25*USIM_VDD	V
VOH	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
VOL	Low-level output voltage	0	0	0.3	V

3.5.1 SIM Application Guide

It is recommended to use an ESD protection component such as ESDA6V1W5 produced by ST (www.st.com) or SMF15C produced by ON SEMI (www.onsemi.com). Note that the USIM peripheral circuit should be close to the USIM card socket. The following figure shows the 6-pin SIM card holder reference circuit.

The following figure shows the 6-pin SIM card holder reference circuit.

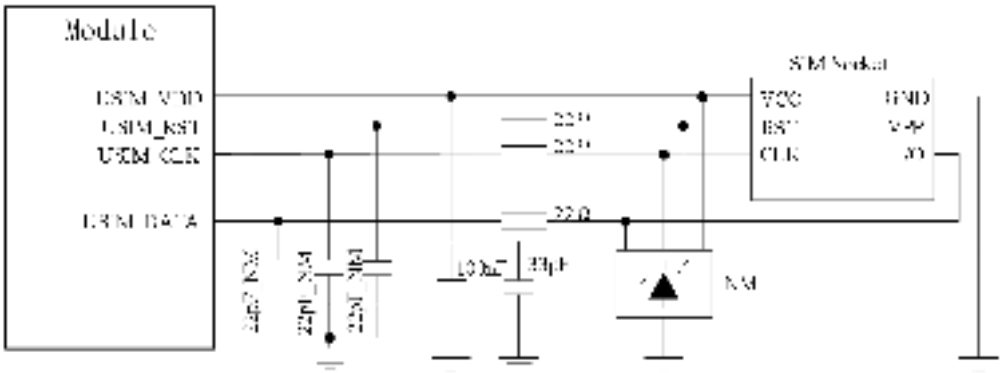

Figure 21: SIM interface reference circuit

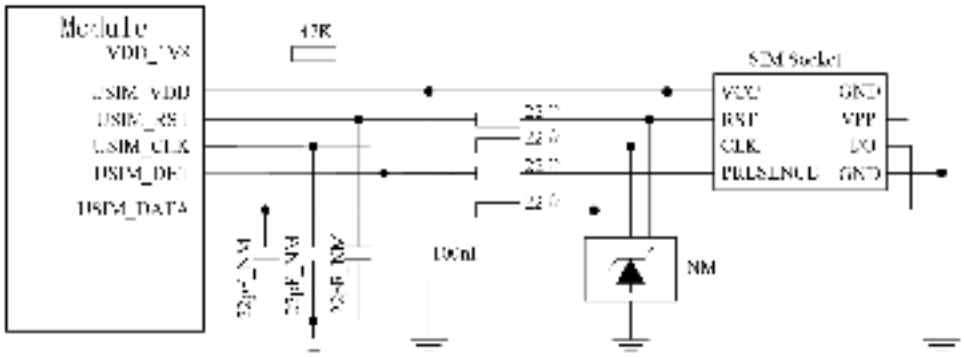

Figure 22: SIM interface reference circuit (8PIN)

NOTE

1. USIM1_DATA has been pulled up with a 4.7KΩ resistor to USIM1_VDD in module. A 100nF capacitor on USIM_VDD is used to reduce interference. For more details of AT commands about USIM, please refer to document [1].

2. USIM2_DATA has no pull resistor, need to add 4.7KΩ resistor pulled up to USIM2_VDD externally.

3.5.2 Recommend USIM Card Holder

It is recommended to use the 6-pin USIM socket such as C707 10M006 512 produced by Amphenol. User can visit http://www.amphenol.com for more information about the holder.

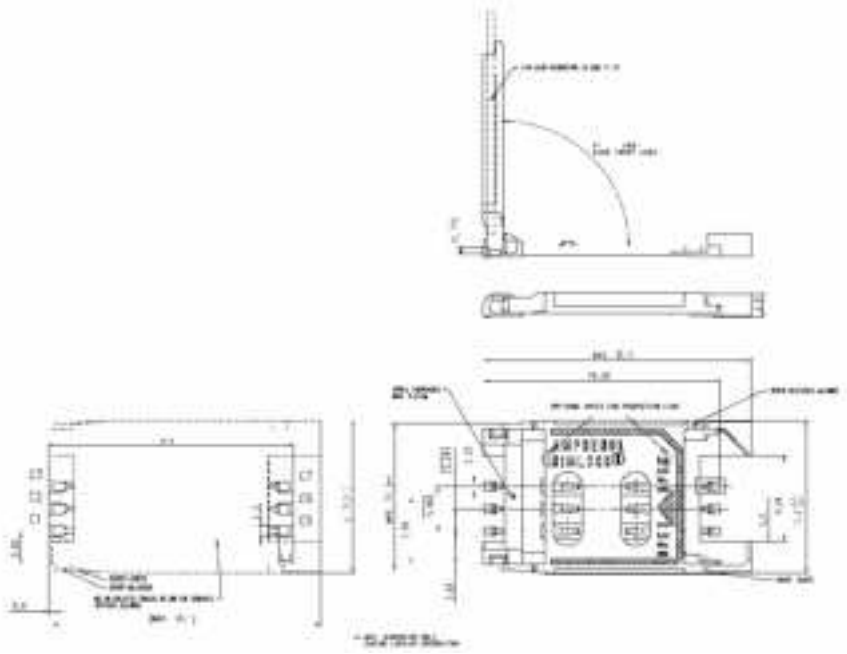

Figure 23: Amphenol C707 10M006 512 USIM card socket