ME3630 mini-PCIE

Hardware Development Guide

Version: V1.0
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LTE Module Series

Revision History

Version	Date	Description
V1.0	2023-08-03	1st published

About This Document

A. Application Range

This document is the Product Technical Specification for the ME3630 GSM/CDMA/WCDMA/ TD-SCDMA/LTE TDD/LTE FDD module. It defines the high level product features and illustrates the interface for these features. This document is intended to cover the hardware aspects of the product, including electrical and mechanical.

B. Reading Note

The symbols below are the reading notes you should pay attention on:

 : Warning or Attention

 : Note or Remark

C. Purpose

This document provides the hardware solutions and development fundamentals for a product with the module. By reading this document, the user can have an overall knowledge of the module and a clear understanding of the technical parameters. With this document, the user can successfully fulfill the application and development of wireless Internet product or equipment.

Besides the product features and technical parameters, this document also provides the product reliability tests and related testing standards, RF performance indexes and a guide on the design of user circuits, to provide the user with a complete design reference.

D. Abbreviations

Table below is a list of abbreviations involved in this document, as well as the English full names.

Abbreviations	Full Name
3GPP	Third Generation Partnership Project
AP	Another name of DTE
CHAP	Challenge Handshake Authentication Protocol
CE	European Conformity
CMOS	Complementary Metal Oxide Semiconductor
DCE	Data Communication Equipment
DL	Downlink
DTE	Data Terminal Equipment
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
ESD	Electro-Static discharge
ESR	Equivalent Series Resistance
FDD	Frequency Division Duplex
GPIO	General-purpose I/O
LCC	Leadless Chip Carrier
LDO	Low-Dropout
LED	Light Emitting Diode
LTE	Long Term Evolution
ME	Mobile Equipment
MO	Mobile Origination Call
MT	Mobile Termination Call
MSB	Most Significant Bit
PC	Personal Computer
PCB	Printed Circuit Board
PDA	Personal Digital Assistant
PDU	Protocol Data Unit
PAP	Password Authentication Protocol
PPP	Point to Point Protocol
RTC	Real Time Clock
SMS	Short Messaging Service
SMT	Surface Mount Technology
SPI	Serial Peripheral Interface
TBD	To Be Determined
TCP	Transmission Control Protocol

TIS	Total Isotropic Sensitivity
TRP	Total Radiated Power
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver-Transmitter
UDP	User Datagram Protocol
UL	Up Link
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
URC	Unsolicited result code
VIH	Logic High level of input voltage
VIL	Logic Low level of input voltage
VOH	Logic High level of output voltage
VOL	Logic Low level of output voltage

Safety Information

The following safety precautions must be observed during all phases of the operation, such as usage, service or repair of any cellular terminal or mobile incorporating ME3610 module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. If not so, GOSUNCN does not take on any liability for customer failure to comply with these precautions.

	Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a hands free kit) cause distraction and can lead to an accident. You must comply with laws and regulations restricting the use of wireless devices while driving.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Consult the airline staff about the use of wireless devices on boarding the aircraft, if your device offers a Airplane Mode which must be enabled prior to boarding an aircraft.
	Switch off your wireless device when in hospitals or clinics or other health care facilities. These requests are designed to prevent possible interference with sensitive medical equipment.
	GSM cellular terminals or mobiles operate over radio frequency signal and cellular network and cannot be guaranteed to connect in all conditions, for example no mobile fee or an invalid SIM card. While you are in this condition and need emergent help, please remember using emergency call. In order to make or receive call, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.
	Your cellular terminal or mobile contains a transmitter and receiver. When it is on, it receives and transmits radio frequency energy. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.
	In locations with potentially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potentially explosive atmospheres including fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders.

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1 About This Document

1.1 Application Scope

This document is applicable as the hardware development guide of GOSUNCN ME3630 mini-PCIe modules (hereinafter referred to as the ME3630 module).

ME3630 mini-PCIE is one module of GOSUNCN mini-PCIE Series currently.

This document is intended for GOSUNCN customers to quickly understand ME3630 module interface specifications, electrical and mechanical details.

1.2 Purpose

This document provides the hardware solutions and development fundamentals for a product with the module. By reading this document, the user can have an overall knowledge of module and a clear understanding of the technical parameters. With this document, the user can successfully fulfill the application and development of wireless 4G Internet product or equipment.

Besides the product features and technical parameters, this document also provides the product reliability tests and related testing standards, service function implementation flow, RF performance indexes, and guide on the design of user circuits, to provide the user with a complete design reference.

1.3 Evaluation Board

In order to help you to develop applications with ME3630-PCIe, GOSUNCN supplies an evaluation board GE2015, RS-232 to USB cable, USB data cable, power adapter, antenna and other peripherals to control or test the module. For details, please refer to the related document ***[GOSUNCN GE2015 Dev Board User Guide].***

2 Product Overview

ME3630 mini-PCIe is LTE wireless Internet modules with PCI Express Mini Card interface. It is widely applied to but not limited the various products and equipment such as laptops, vehicle-mounted terminals, and electric devices, by providing data services.

Customer can choose the dedicated type based on the wireless network and function configuration. The following table shows the entire radio band configuration of the ME3630 mini-PCIe series.

Table 2- 1 Information of ME3630 mini-PCIE

ME3630 PCIe PID	RF support	RF Band	Transmit Frequency (TX)	Receive Frequency (RX)
J2A-V3A_MP0(Cat 4)	LTE	B1	1920 to 1980 MHz	2110 to 2170 MHz
		B3	1710 to 1785 MHz	1805 to 1880 MHz
		B8	880 to 915 MHz	925 to 960 MHz
		B18	815 to 830 MHz	860 to 875 MHz
		B19	830 to 845 MHz	875 to 890 MHz
		B26	814 to 849 MHz	859 to 894 MHz
		B39	1880 to 1920 MHZ	1880 to 1920 MHZ
		B41	2555 to 2655 MHZ	2555 to 2655 MHZ
	WCDMA	B1	1920 to 1980 MHz	2110 to 2170 MHz
		B6	830 to 840 MHz	875 to 885 MHz
		B8	880 to 915 MHz	925 to 960 MHz
		B19	830 to 845 MHz	875 to 890 MHz

2.1 Technical Parameters

The major features of ME3630 mini-PCIE can be described from the aspects of mechanic feature, base band, radio frequency, technical standard and environment feature. The table below is a list of the major technical parameters and features supported by products.

Table 2- 2 Major Technical Parameters

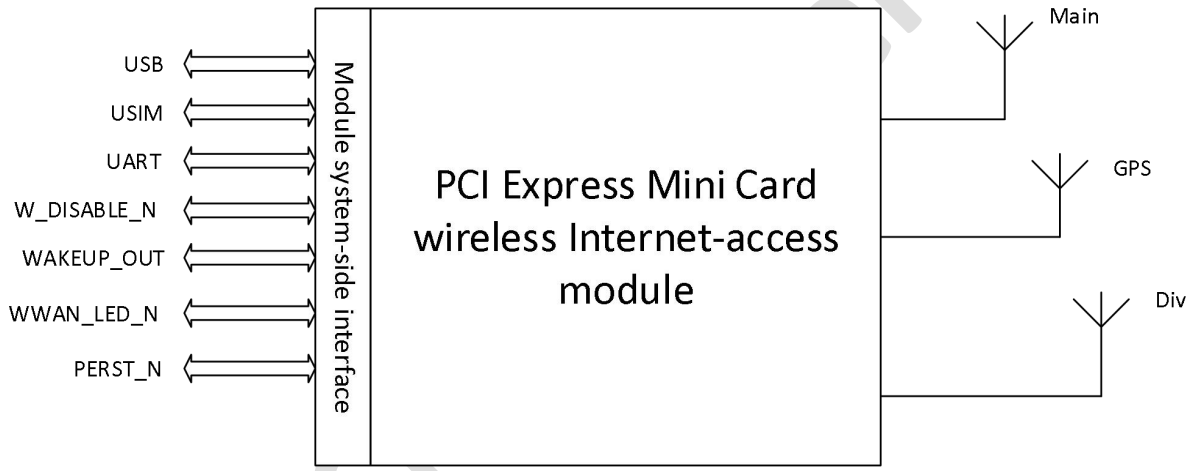
Name	Parameter Item	Specifications
Mechanical Feature	Dimensions	About 51mm×31mm×3.4 mm
	Weight	About 10.0g
	Form Factor	PCI Express Mini Card
Baseband	USIM/SIM	3V SIM card and 1.8V SIM card
	USB Version	USB 2.0 HIGH SPEED, the data transfer rate can reach up to 480 Mbps.
	Power supply	3.0~4.0V(Typ.3.3V/3.8V)
	LED pin	Support
RF	Max. transmitter power	WCDMA Bands: 24 +1/-3dBm (Power Class 3) LTE: +23dBm +2.7/-2.7dB (Power Class 3)

	Main Antenna interface	Support, Provide Antenna Connector
	Receive Diversity Antenna	Support, Provide Antenna Connector
	GPS Antenna	Support, Provide Antenna Connector

2.2 Baseband Function

The baseband part of module mainly includes the following signal groups: USB signal, SIM card signal, Analog Voice signal, WAKEUP_OUT wakeup (PC) signal, working status indicator signal WWAN_LED_N, RF switch control signal W_DISABLE_N, whole-set reset signal PERST_N, power and grounding. Meanwhile, the product also provides the main antenna, GPS antenna and the Dx antenna. Figure below is a system connection diagram.

Figure 2–1 System Connection Diagram



3 Mechanic Features

3.1 Dimensions

The product employs the standard PCI Express Mini Card interface type, with its dimensions designed according to F2 type. Figure 3-1 illustrates the dimensions and slot compatibility of PCI Express Mini Card (Unit: mm).

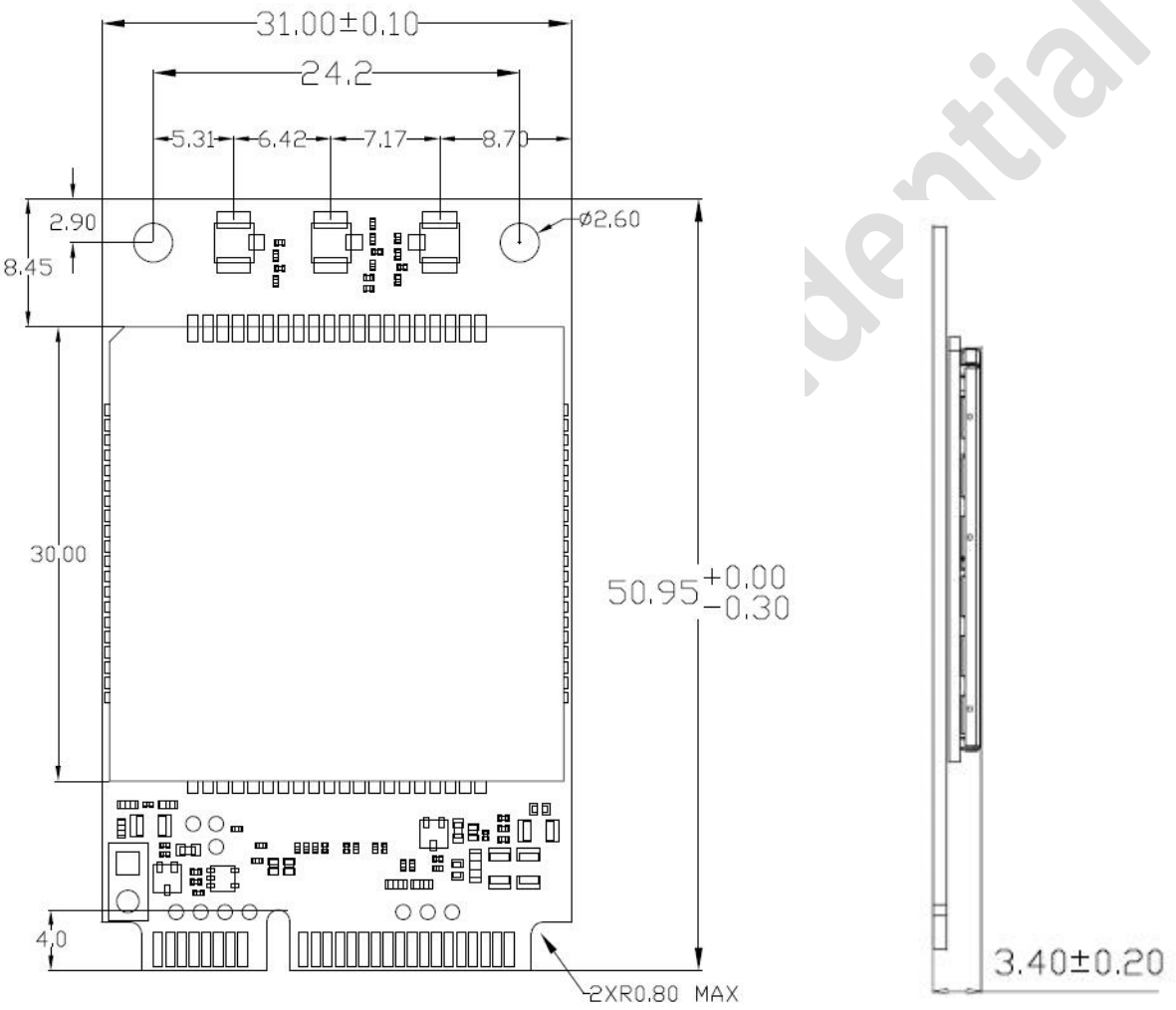


Figure 3–1 PCI Express Mini Card Dimensions

3.2 Heat-dissipation Design

The heat-dissipation design of ME3630 mini-PCIE strictly complies with PCI Express Mini Card Electromechanical Specification Revision 1.2, October 26 2007. The heat sources are evenly distributed, and the product has a very excellent heat-dissipation design. To ensure that the product performance is fully played out, it is recommended to design the main board as follows:

- Locate the module far away from the switch power and high-speed signal cable as much as possible. Well protect the wiring of the interference sources.
- The antenna, and the coaxial cable connecting the network cable and the antenna, cannot be located close the interference sources.
- Do not locate the module close to devices with large heat dissipation, such as CPU, south bridge, etc. The high temperature will affect the RF performance.

4 Description of PINs

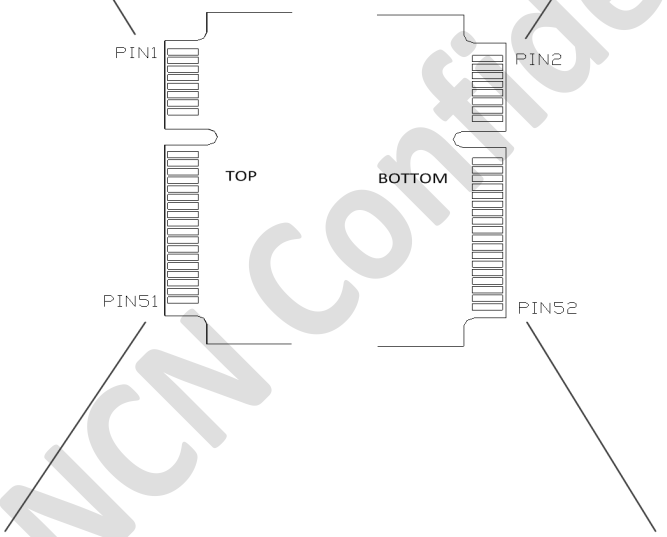
4.1 Definition of PIN Signals

4.1.1 PIN Configuration Diagram

The products are designed according to PCI Express Mini Card Electromechanical Specification Revision 1.2, October 26 2007. Figure below illustrates the PIN sequence, and Table 4-2 describes the detailed PIN definitions.

Figure 4–1 PIN Distribution Diagram

PIN定义	PIN
WAKEUP_OUT	1
NC	3
NC	5
NC	7
GND	9
UART_RXD	11
UART_TXD	13
GND	15
UART_RI	17
WAKEUP_IN	19
GND	21
UART_CTS	23
UART_RTS	25
GND	27
GND	29
UART_DTR	31
UART_DCD	33
GND	35
GND	37
V_MAIN	39
V_MAIN	41
GND	43
PCM_CLK	45
PCM_DIN	47
PCM_DOUT	49
PCM_SYNC	51



PIN	PIN定义
2	V_MAIN
4	GND
6	NC
8	USIM_VCC
10	USIM_DATA
12	USIM_CLK
14	USIM_RST
16	UART_DSR
18	GND
20	W_DISABLE_N
22	RESET_IN
24	V_MAIN
26	GND
28	1.8V
30	NC
32	NC
34	GND
36	USB_DM
38	USB_DP
40	GND
42	LED_WWAN_N
44	USIM_DET
46	NC
48	NC
50	GND
52	V_MAIN

4.1.2 PIN Description

Table 4- 1 I/O Parameters Definition

Type	Description
IO	Bidirectional
DI	Digital Input
DO	Digital Output
PI	Power Input
PO	Power Output
AI	Analog Input
AO	Analog Output
OC	Open Collector

The table below describes the pins of module ME3630_MP0.

Table 4- 2 PIN Definitions

PIN	ME3630_MP0 PCIE Signal	Pin Voltage (VDD_PX)	I/O	Description of Pins
1	WAKEUP_OUT		OC	Module wakes up external AP, need to pull up externally. Active low
2	V_MAIN		PI	Power supply 3.0~4.0V(Typ.3.3V/3.8V)
3	NC			Not connected
4	GND			Ground
5	NC			Not connected
6	NC			Not connected
7	NC			Not connected
8	USIM_VCC	1.8V/3V	PO	Power supply for USIM
9	GND			Ground
10	USIM_DATA	1.8V/3V	IO	USIM data
11	UART_RXD	1.8V	DI	UART Receive Data
12	USIM_CLK	3V	DO	USIM clock
13	UART_TXD	1.8V	DO	UART Transmit Data
14	USIM_RST	1.8V/3V	DO	USIM reset
15	GND			Ground
16	UART_DSR	1.8V	DO	Module set ready
17	UART_RI	1.8V	DO	UART Ring Indicator
18	GND			Ground
19	WAKEUP_IN	1.8V	DI	External AP to set the module into sleep or wake up the module from sleep
20	W_DISABLE_N		DI	Active low signal for RF disable (Airplane mode)
21	GND			Ground
22	RESET_IN		DI	Module's reset signal, active low
23	UART_CTS	1.8V	DI	UART Clear to Send
24	V_MAIN	3.3V	PI	Power supply 3.0~4.0V(Typ.3.3V/3.8V)
25	UART_RTS	1.8V	DO	UART Request to send
26	GND			Ground
27	GND			Ground
28	1.8V		PO	Reference Voltage Output current must be lower than 10mA

29	GND			Ground
30	NC			Not connected
31	UART_DTR	1.8V	DI	UART DTE get ready
32	NC			Not connected
33	UART_DCD	1.8V	DI	UART Carrier detects, Output.
34	GND			Ground
35	GND			Ground
36	USB_DM		IO	USB data signal D-
37	GND			Ground
38	USB_DP		IO	USB data signal D+
39	V_MAIN	3.3V	PI	Power supply 3.0~4.0V(Typ.3.3V/3.8V)
40	GND			Ground
41	V_MAIN	3.3V	PI	Power supply 3.0~4.0V(Typ.3.3V/3.8V)
42	LED_WWAN_N		OC	LED pin, Work status indication
43	GND			Ground
44	USIM_DET	1.8V	DI	SIM card detect.
45	PCM_CLK		IO	PCM clock
46	NC			Not connected
47	PCM_DIN		DI	PCM data input
48	NC			Not connected
49	PCM_DOUT		DO	PCM data output
50	GND			Ground
51	PCM_SYNC		IO	PCM frame synchronization
52	V_MAIN	3.3V	PI	Power supply 3.0~4.0V(Typ.3.3V/3.8V)

🕮 **NOTE: "NC" indicates Not Connected.**

4.2 Feature of Digital Power Level

The following table shows logic level specifications used in the module's interface circuits:

Table 4- 3 Power Level of IO Interface

Parameter	Description	Minimum	Maximum	Unit

VIH	High-level input voltage	0.65*VDD_PX	VDD_PX+0.3	V
VIL	Low-level input voltage	-0.3	0.35*VDD_PX	V
VOH	High-level output voltage	VDD_PX-0.45	VDD_PX	V
VOL	Low-level output voltage	0	0.45	V

NOTE:

1. High and low level of input voltage must locate within the ranges specified in the above table.

2. High and low level of external interface signals must match interface level of this product.

3. VDD_PX=1.8V/3.3V, which indicates the pin voltage, the concrete value please refer to the table 4-1

4.3 Description of Major PIN Signals

The following section describes the common pins of module, including the functions of each interface, its default input and output features, and its matched circuits. The user can reasonably design the application circuits on the system board according to the PIN descriptions.

The module provides the interfaces/signals as follows:

- Power and Reset Interface
- UART Interface
- USIM Card Interface
- USB2.0 interface
- Antenna Interface
- LED Interface
- WAKEUP_OUT & W_DISABLE_N Signal

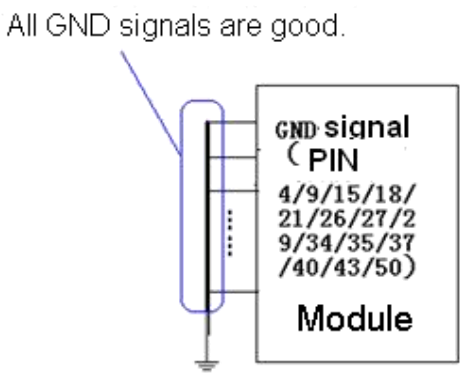
4.4 Power Supply

The host provides power to the module through multiple ground and power pins as summarized in 4.4.1 and 4.4.2. The host must provide safe and continuous power at all times; the module does not have an independent power supply.

4.4.1 GND Interface

The GND signal (PIN No: 4/9/15/18/21/26/27/29/34/35/37/40/43/50). This is the power grounding and signal grounding of module. They need to be all connected to the ground level of system boards. The incomplete connection of GND signals will affect the performance of the module.

Figure 4–2 GND Signal Connection



4.4.2 Power Supply

The 3.3Vaux signal (PIN No: 2/24//39/41/52, Power Interface). This is the positive signal of 3.3V/3.8V power, and is also the input signaling of module's power. The power supply is recommended to be within the range of 3.0~4.0V(Typ.3.3V/3.8V)

4.5 WAKEUP_IN Signal

WAKEUP_IN pin is the authorization signal of module entering sleep state.

If the signal is pulled up to high level (1.8 V), module cannot enter sleep mode. If this pin is not connected, it will keep in low level by default.

Table below shows the definition of the WAKEUP_IN signal.

Table 4- 4 WAKEUP_IN definition

Signal	No.	I/O	Description of Pins	Note
WAKEUP_IN	19	DI	Input signal	1.8V domain, drop-down default. it triggers the action only when level change Rising edge wake up module; Falling edge modules can enter sleep.

Figure 4–3 WAKEUP_IN input sequence

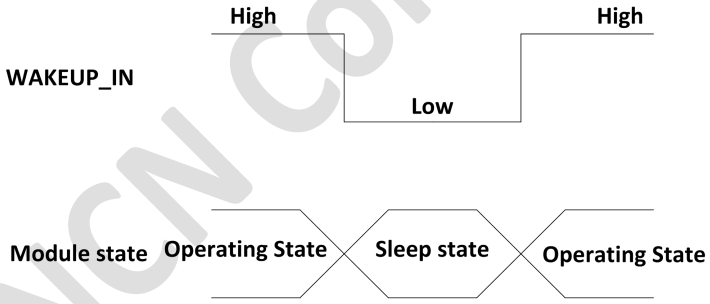
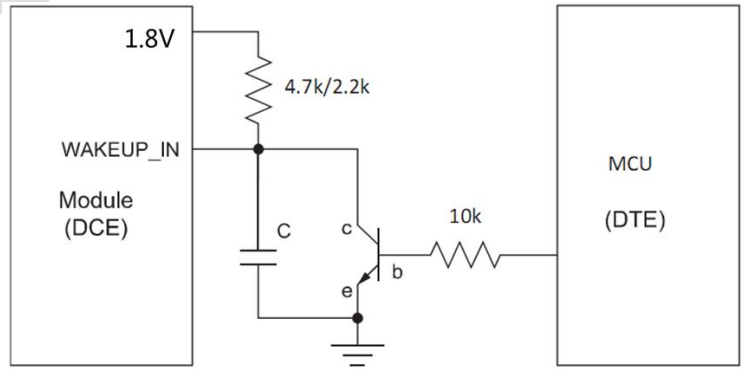


Figure 4–4 Reference Connection Circuit of WAKEUP_IN Signal



NOTE:

The resistors in Figure above is only the recommended value and they need to adjust according to the actual situation.

There is anti-shake design with pin WAKEUP_IN internal, external processor need to pull-up or pull-down the pin last for at least 500ms.

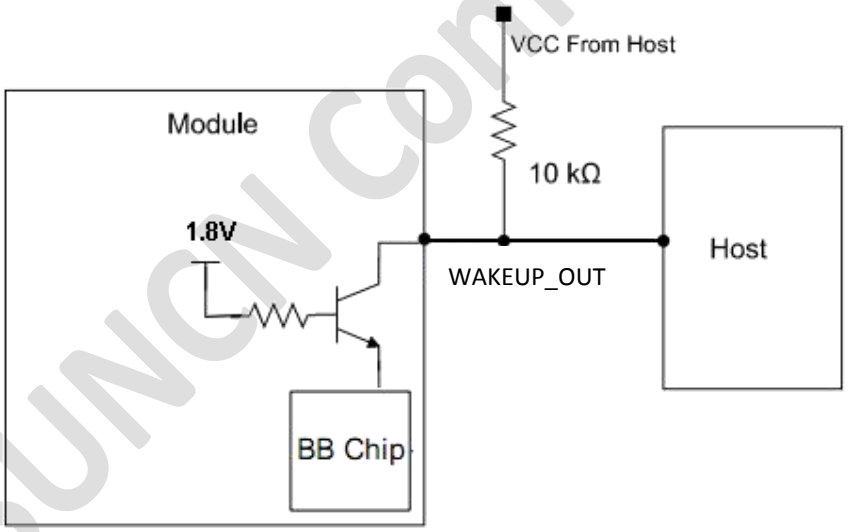
4.6 WAKEUP_OUT Signal

The WAKEUP_OUT signal (PIN No. 1) is an output signal, active low. This signal is used for module to wake up the host. It is designed as an OC gate, so it should be pulled up by the host and it is active-low. Figure 4-3 illustrates the reference connection circuit of WAKEUP_OUT signal.

Table 4- 5 WAKEUP_OUT definition

Signal	No.	I/O	Description of Pins	Note
WAKEUP_OUT	1	OC	Module wakes up external AP, need to pull up externally. Active low	This pin outputs a high-level voltage by default. When a wake-up source arrives, such as new SMS, call or network data arrives, this pin outputs a low-level-voltage pulse lasting for 1s.

Figure 4–5 Reference Connection Circuit of WAKEUP_OUT Signal



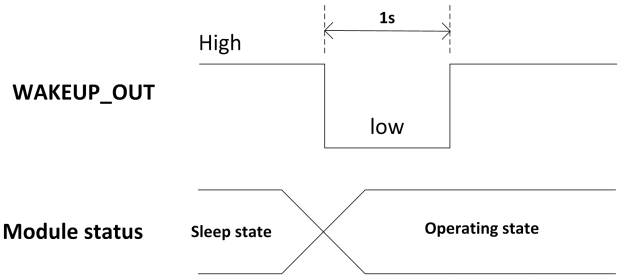
NOTE:

The resistors in Figure above is only the recommended value and they need to adjust according to the actual situation.

Do not directly connect this signal to the positive end of the power supply.

When there is a call/SMS received by the module, it will output the level shown as the figure below through WAKEUP_OUT pin to wake the host.

Figure 4–6 PIN1(WAKEUP_OUT) output sequence



4.7 W_DISABLE_N Signal

The W_DISABLE_N signal (PIN No: 20) -- Active low, pulled up internally, input from a hardware switch to the module that disables the main RF radio. Table below describes its control logic.

Table 4- 6 Definition and Description of W_DISABLE_N Signal

W_DISABLE_N	Module Status
'1'	RF is enabled.
'0'	RF is disabled.

The reference circuit design of W_DISABLE_N signal can refer to the interface of RESET_IN signal.

🕮 NOTE: Do not directly connect this signal to the positive end of the power supply.

4.8 RESET_IN Signal

The RESET_IN signal (PIN No: 22) is the system reset signal of the module, active low. Table below illustrates its control logic. Figure below shows that pull down the reset key (RESET_IN) more than 1s will reset the module.

🕮 NOTE: Do not directly connect this signal to the positive end of the power supply.

Table 4- 7 Definition and Description of RESET_IN Signal

RESET_IN	Module Status
'1'	Module is in the normal working status.
'0' and t≥1s	RF is in the OFF mode, Module will reset.

Figure 4–7 Reference Circuit Design of RESET_IN Signal

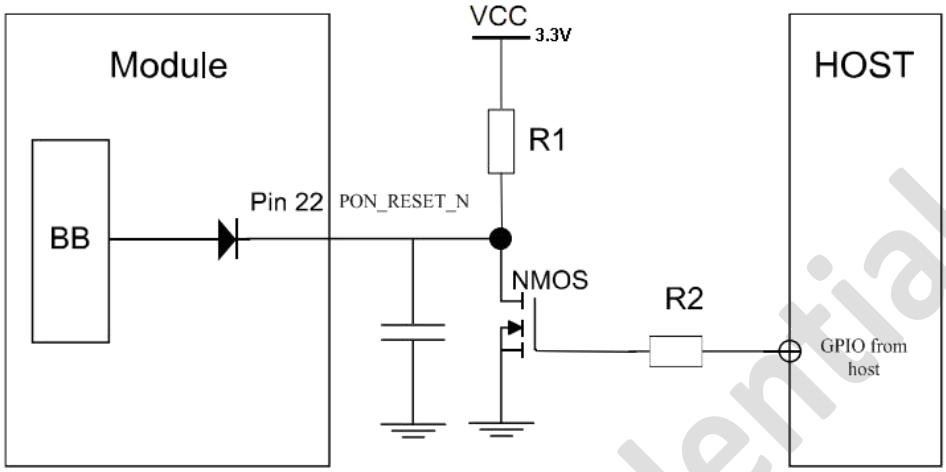
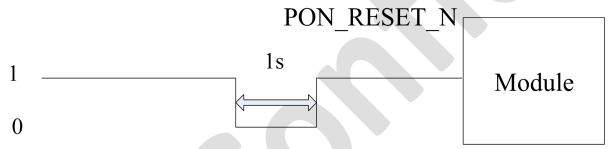


Figure 4–8 Resetting signal



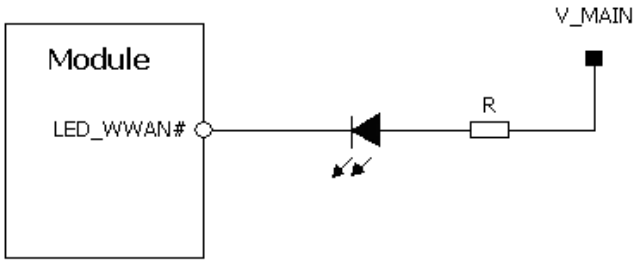
4.9 LED_WWAN_N Signal

The LED_WWAN_N signal (PIN No: 42, Status Indication PIN) is the signal indicating the current working status of the module, which is generated by the module. The LED indicator need to be equipped on the system side for this feature, and the LED indicator is ON when this signal generates the low power level. Table below illustrates the indicator status, and Figure below illustrates the reference circuit design of LED_WWAN_N signal.

Table 4- 8 Description of LED_WWAN_N Status

LED_WWAN_N Signal Status	Status of Module	Expected Indicator Status
High power level '1', 3.3V	Not registered to the network	The indicator is OFF.
Low power level '0', 0V	Registered to the network	The indicator is always on.

Figure 4–9 Reference Design Circuit of LED_WWAN_N



4.10 (U)SIM Card Interface

SIM -- supported through the interface connector. The USIM connector must be placed on the host device for this feature. The signal group of USIM card is as follows: PIN No: 8/10/12/14/44). Table below is a detailed description of each signal. Voltage levels over this interface comply with 3GPP standards.

Table 4- 9 Definition and Description of USIM Card Signal

PIN	Signal Definition	Signal Description
8	USIM_VCC	USIM card power, output by Module
10	USIM_DATA	USIM card DATA signal, two-way signal
12	USIM_CLK	USIM card clock signal, output by Module
14	USIM_RST	USIM card reset signal, output by Module
44	USIM_DET	SIM card detection, the default is active low. If this function is not required, leave this pin open. The level logic can be configured, for details, please refer to the AT command + ZSDT

To comply with the requirements of 3GPP TS 51.010-1 and EMC authentication, it is recommended to place (U)SIM card console close to the (U)SIM card interface, to prevent the wiring from being too long, which might seriously distort the waveform and thus affect the signal integrity.

The following Figure shows the reference design of as well as the recommended circuit of the USIM card. ESD circuit protection and UIM_DATA pull-up have been added in the board of ME3630 mini-PCIE.

Figure 4–10 Connection Circuit of U(S)IM Card Signal

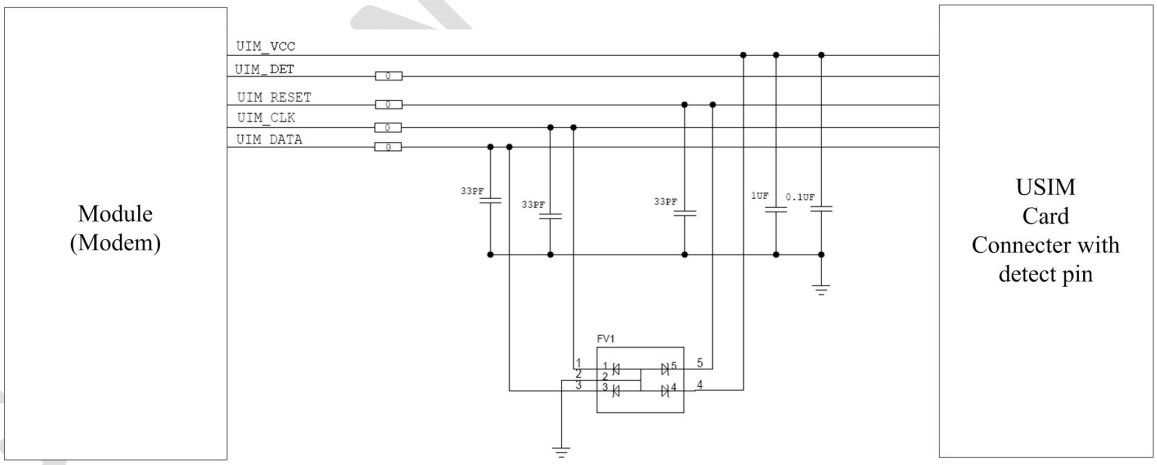
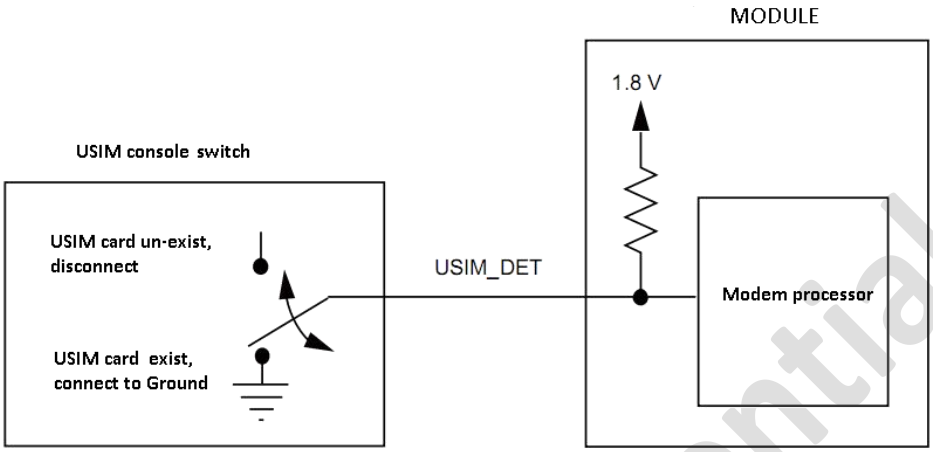


Figure 4–11 USIM_DET pin logic



4.11 USB Interface

The module has a high-speed USB2.0 interface, which supports both the full-speed (12 Mbps) mode and the high-speed (480 Mbps) mode. It is connected to the system board side by the PIN 36 (USD_DM) and 38 (USB_DP). The USB interface is the path for communication between the host and module and it is mainly used in data transmission.

Table 4- 10 Definition and Description of USB Interface

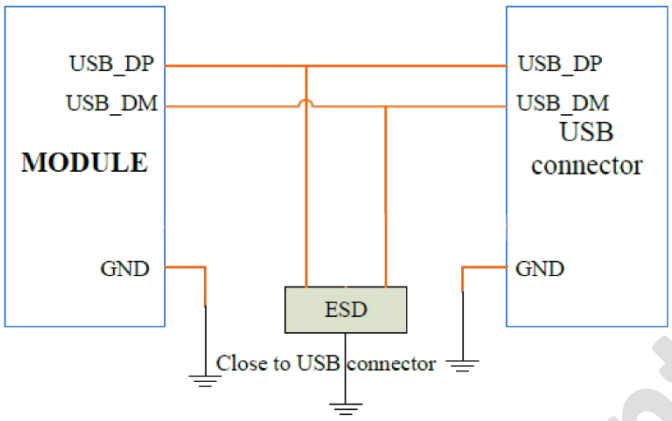
Name	Pin	Description
USB_DM	36	USB data negative
USB_DP	38	USB data positive

The USB interface complies with the USB2.0 specifications and the electric features. When designing the host device, careful PCB layout practices must be followed. USB_DP, USB_DM should be wired strictly according to the differential mode, and the length difference between the two cables should be restricted within 1mm.

It is important to route the USB signal traces as differential pairs with total grounding. The impedance of USB differential trace is 90ohm.

Pay attention to the influence of junction capacitance of ESD component on USB data lines. Typically, the capacitance value should be less than 2pF.

Figure 4–12 Connection Circuit of USB Signal



NOTE: The differential impedance should be controlled within 90ohm.

4.12 UART Interface

4.12.1 Description of PINs

The wireless module supports the full UART interface with flow control function, which complies with the RS-232 interface protocol. This UART port supports the programmable data width; programmable data stop bit and programmable parity check, and has an independent TX and RX FIFOs (512 bytes for each). For the normal UART application (non-Bluetooth), the maximum baud rate is 230400bps, and the default baud rate is 115200bps. The PINs are defined as shown in Table below.

Table 4- 11 Definition of UART Signal

Signal Name	I/O	Description
UART_RX	DI	UART port RX receive data
UART_TX	DO	UART port TX transmit data
UART_DSR	DO	Data is ready
UART_RI	DO	Ringtone indicator
UART_CTS	DI	UART port CTS clear to send
UART_RTS	DO	preparing to receive
UART_DTR	DI	Data terminal is ready
UART_DCD	DO	Carrier detection

4.12.2 Electric Feature

It is recommended that this UART interface be kept during the design and the testing point be reserved for the software interconnection. If the module's UART interface is connected with the host device, and the UART PWL of host device matches with 1.8V, the connection mode is as shown in figure below.

Figure 4–13 Module Serial Port & AP Application Processor

If it does not match the PWL of AP interface, it is recommended to add the PWL conversion circuit. Otherwise, it might cause unstable com ports because the level is not matched or cause damage to the module because it is at high level for long time. The

connection of module UART port and standard RS-232-C interface can be through the chip like class 232. The design involves the transformation of TTL level and EIA level. We recommend to use the chip of NLSX5014MUTAG. If using the 2-wire serial bus interface, MAX3232 is recommended, and if using the 8-wire serial bus interface, SP3238 or MAX3238 is recommended. The connection mode is as shown in Figure below.

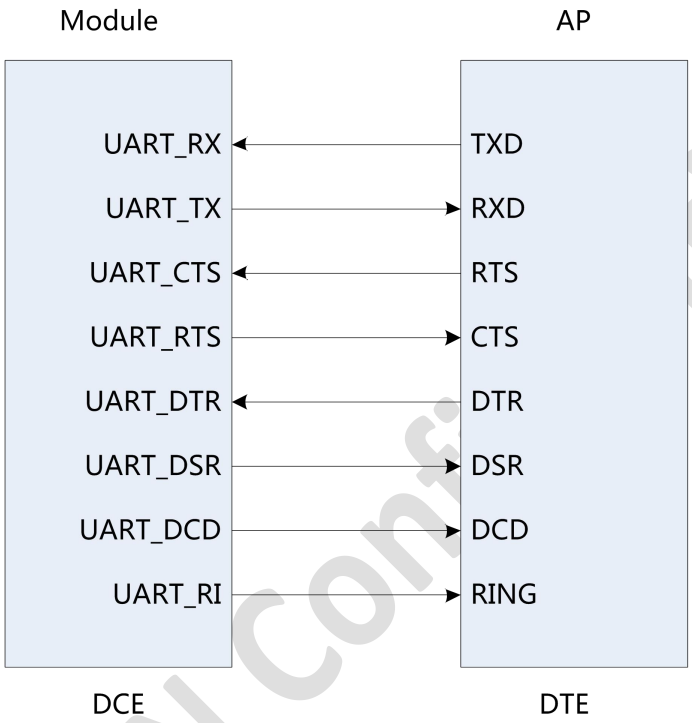
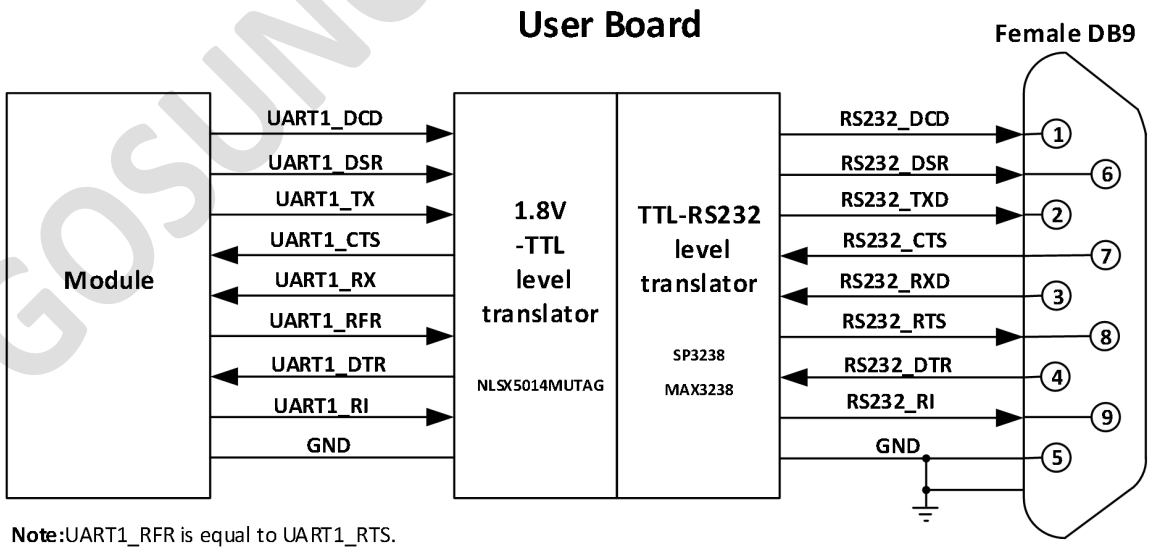


Figure 4–14 The connection of UART and Standard RS-232-C interface



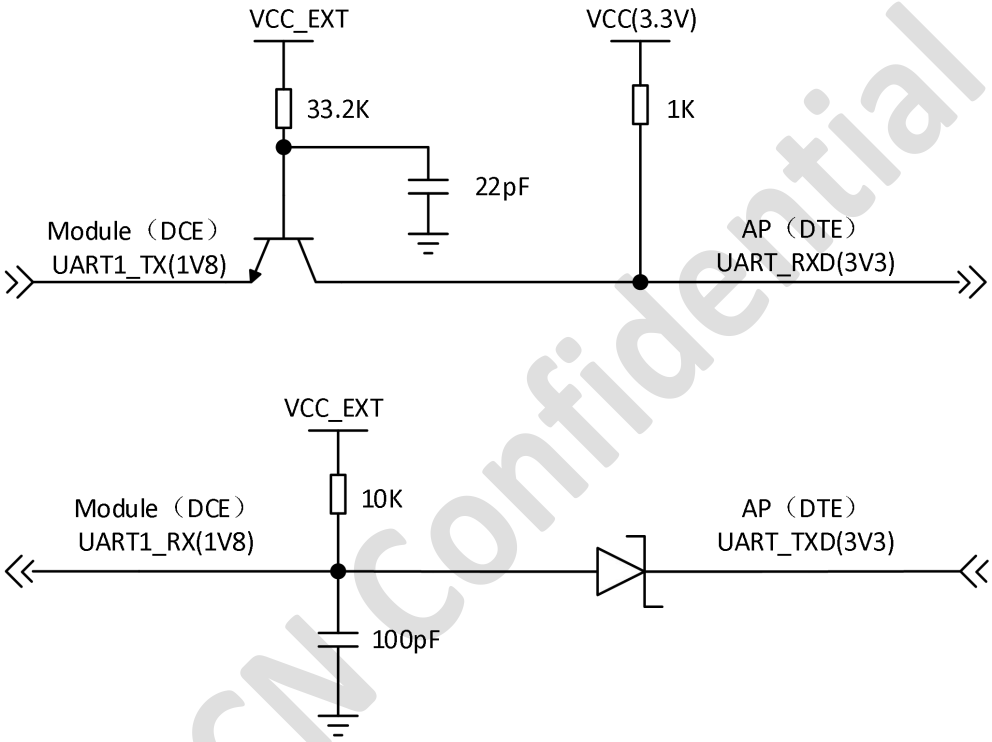
Note:UART1_RFR is equal to UART1_RTS.

If customer wants to connect a 3.3V application system, a level shifter should be used. The following figure shows the reference design. The diode in this Figure is Schottky diode (forward voltage drop is 0.3V). If you select other diodes, please select one with lower forward voltage drop to make sure UART_RXD is below the threshold when inputting low level.

NOTE:

The resistors in Figure below is only the recommended value and they need to adjust according to the actual situation.

Figure 4–15 UART level shifter from 1.8V to 3.3V



5 Power Interface Design Guideline

This chapter provides the power supply requirements, general design rules. Users can design the power supply of module to achieve stable and well working performance according to this document.

5.1 General Design Rules

When the module is used for different external applications, pay special attention to the design for the power supply.

In the process of peripheral circuit designing, users of this Module product should ensure that the external power supply circuit is capable of providing sufficient power supply capacity firstly, and control the supply range between 3.0~4.0V(Typ.3.3V/3.8V) strictly. If the value above module voltage range, it will lead the main chip burned, while below required voltage range, it will affect the RF circuit's performance or cause shutdown and restart occurred. For the design of high-speed USB signal lines, it requires to control the differential impedance at 90ohm. The voltage design of external circuit interfaces should match that of the module PINs, and the detailed value can be got in Chapter 4. The module product has a good RF indicator; customers can refer to Chapter 6 in the process of antenna circuit designing.

5.2 Power Supply Requirement

The power supply of PCIE Type module is usually recommended to be within the range of 3.0~4.0V(Typ.3.3V/3.8V). According to the requirement of mobile terminal device, the power supply voltage of module is 3.3V under normal working condition.

If the network is in poor situation, the antenna will transmit at the maximum power, and the transient maximum peak current can reach as high as 2.3A. So the power supply capacity for peak current on the main board needs to be above 2.3A to satisfy the requirement of module peak current; and the average current on the system side needs to be above 2.0A. Meanwhile, consider the voltage drop of power supply on the side of main board. If the network is in a poor situation or under 2G, the module peak current will be great. Therefore the power supply has to be designed in order to withstand with these current peaks without big voltage drops; this means that both the electrical design and the board layout must be designed for this current flow. If the layout of the PCB is not well designed a strong noise floor is generated on the ground and the supply; and exceptions such as restart of the module may occur.

The peak current of module under the GSM BURST mode is different due to the differences in actual network environments. And its transient current under different powers will be various as well. The greater the power is, the greater the transient current is. The network quality also directly affects the work current of the module. If the network is in well situation, the peak work current on the module will be small. But if the network is in poor situation, its peak current will be great as shown in Figure 5-1 (when the module works under the EDGE/GPRS Time Slot (2-high 6-low) and CLASS10). If the module works under the 2-high work Time Slot, it requires greater current, and the voltage drop will occur accordingly.

5.3 Circuit Requirements of Power Supply Output

Requirement:

The electrical design for the Power supply should be made ensuring it will be capable of a peak current output of at least 2.5 A.

The average current supplied by the system host needs to be above 2.0A.

When designing the PCB line, the power cable on the system board should be thick enough, and should form a good reflux with the ground.

In the power supply circuit design, the user needs to add the large storage capacitor, to guarantee the transient power supply capability as well as the system instantaneous power capacity, and to prevent the module from resetting and shutting down caused by voltage fluctuation.

5.4 Recommended Power Reference Circuit

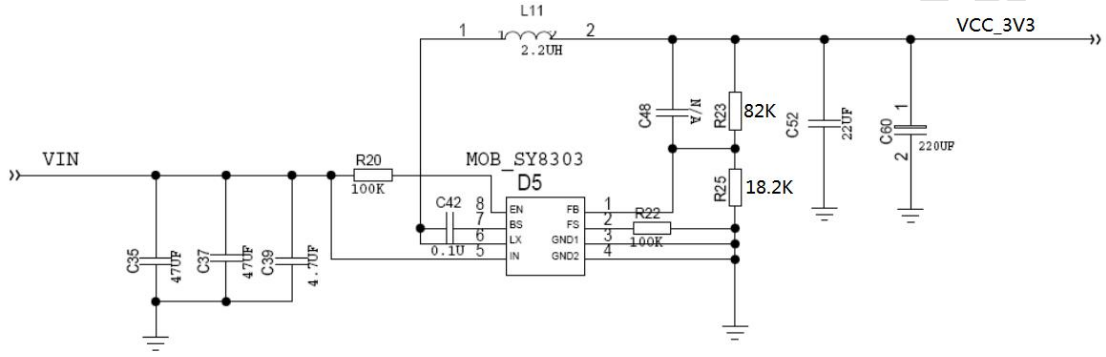
Option one:

Use DCDC switching power supply and large storage capacitor to ensure the normal operation of the RF power amplifier.

The over-current capability requirement of DC/DC switching power supply need to be above 3A, for example, SY8303, ZI1153, AAT2138 and so on.

The following figure shows a reference design of power supply where R23 and R25 are 1% tolerance resistors and C60 is a low-ESR capacitor.

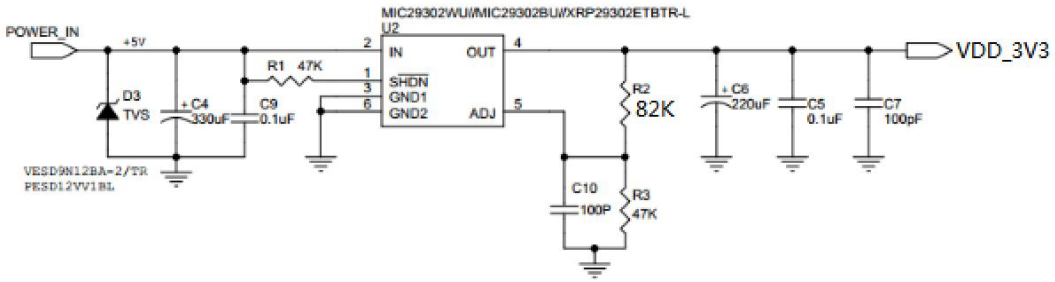
Figure 5–1 DC/DC Switching Power Supply



Option two:

Use LDO as the buck chip. The over-current capability of LDO is above 3A. The following figure shows a reference design of power supply where R2 and R3 are 1% tolerance resistors and C60 is a low-ESR capacitor.

Figure 5–2 LDO Power Supply



📖 NOTE: The resistor and capacitor in the Figure 5-3 and Figure 5-4 is just for example, the use need to choose the proper ones `according to the output voltage level.

6 RF Antenna Design Guide

The antenna connection is one of the most important aspect in the full product design as it strongly affects the product overall performances, hence read carefully and follow the requirements and the guidelines for a proper design.

6.1 Antenna Interface

The Mini PCIE adapter is equipped with three RF antenna connectors: the main antenna interface, GPS antenna interface and Diversity antenna interface, as shown in Figure 6-1. The antennal connector employs the U.FL-R-SMT1 (80) RF console from HRS Corporation, as shown in Figure 6-2. For the specified cables on the RF interface, it is recommended to use U.FL_LP_088 of HRS Corporation, as shown in Figure 6-3. Profile Dimensions of RF antenna console is shown in Figure 6-4 (Unit: mm).

For more information about mating connectors visit the website ***http://www.hirose-connectors.com/.***

Figure 6–1 Antennal Interface Diagram

Figure 6–2 RF Interface Testing Console (U.FL-R-SMT1 (80) of HRS Corporation)

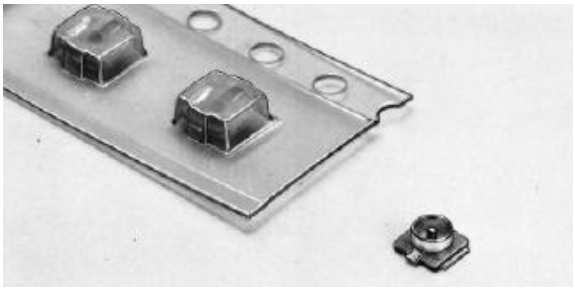


Figure 6–3 Testing Cable

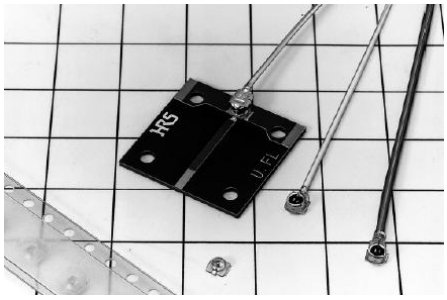
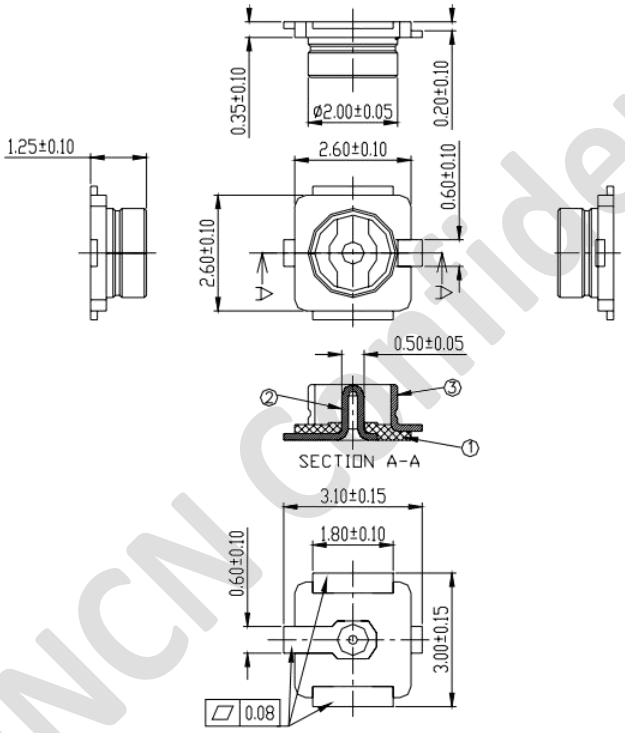


Figure 6–4 Profile Dimensions of RF antenna console



6.2 Antenna Indexes

The module supports the AGPS/GPS function, so the system equipment needs to add the GPS antenna. The design of GPS antenna is consistent with that of the main antenna, and its efficiency can be 3dB lower. The isolation between the main antenna and the diversity antenna is required to be greater than 12dB. The difference between Rx TIS and the TIS of main antenna should be within 6dB.

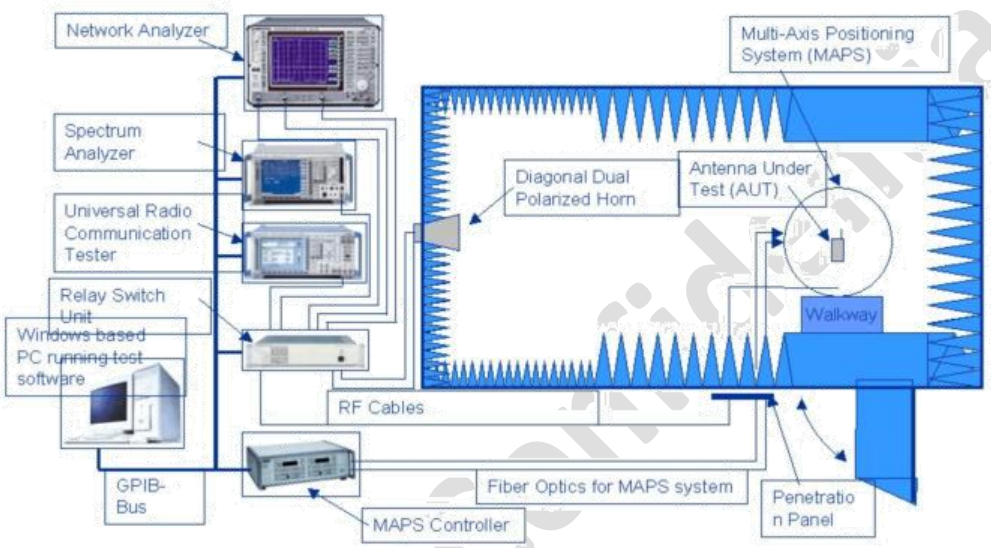
The antenna index is divided into the Passive index and Active index. The Passive index includes S11, efficiency, gains, radiation pattern and polarity, which can be used as the parameter measuring the performance of the antenna itself. The Active index is also called the OTA index, including TRP (all-round radiation power), TIS (all-round receiving sensitivity), radiation pattern, which is an important index measuring the radiation performance of the whole set (including the antenna, module, main board).

6.3 Test Methods for Whole-Set Antenna OTA

Figure 6-5 is the diagram of OTA test system of CTIA. The system is mainly composed of test chamber, high-precision positioning system and its controller, Windows based PC running test software and RF test instruments with automatic test program. The main RF instruments are integrated RF test equipment, Spectrum Analyzer, Network Analyzer.

The radio equipment, Relay Switch Unit and PC with automatic test software are communicated via GPIB interface.

Figure 6–5 The OTA test system of CTIA



7 Related Test

7.1 Operating & Storage Temperature

The working temperature range of the module is divided into the normal working temperature range and the extreme working temperature range. Under the normal working temperature range, the testing result of RF complies with the requirements of 3GPP specifications, and its function is normal. Under the extreme temperature range, the RF index basically complies with the 3GPP specifications, and the quality of data communication is affected to a certain extent, but its normal function is not affected. The table below is the requirement for the testing environment.

Table 7- 1 Product Temperature Range

Working Condition	Min Temperature	Max Temperature	Remark
Normal working condition	-30°C	75°C	All the indexes are good.
Extreme working condition	-40°C~ -30°C	+75°C~ +85°C	Some indexes become poorer.
Storage	-40°C	85°C	Storage environment of module

🕮 NOTE: Table above lists the extreme working conditions for the module. Using the module beyond these conditions may result in permanent damage to the module.

7.2 GNSS Technical Parameters

The following table shows the GNSS technical parameters of ME3630-mini PCIE module.

Table 7- 2 GNSS Technical Parameters

GNSS (GPS/GLONASS)	Technical specification
GPS Frequency	1575.42±1.023 MHz
Tracking sensitivity	-155dbm
Cold-start sensitivity	-143dbm
TTFF (Open Sky)	Hot start: 4s
	Cold start: 55s
Receiver Type	Qualcomm GPS Gen8C
GPS L1 Frequency	1575.42MHz
Update rate	2-4 HZ
GNSS (GPS/GLONASS) data format	GOSUNCN Loc API/GOSUNCN auto-negotiation
GNSS (GPS/GLONASS) Current consumption	65mA
GNSS (GPS/GLONASS) antenna	Passive/Active antenna

7.3 Electrostatic Discharge

The module is not protected against electrostatics discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the module.

The following table shows the module electrostatics discharge characteristics.

Table 7- 3 ESD characteristic

Tested Points	Contact discharge	Air Discharge	Unit
V_BAT	± 5	± 10	kV
All antenna interfaces	± 4	± 8	kV
Other interfaces	± 0.5	± 1	kV

7.4 ME3630-J2A-V3A Test

7.4.1 Current Consumption

The values of current consumption in different operating mode are shown below.

Table 7- 4 Averaged standby DC power consumption [1]

Parameter	Condition	Typical Value	Unit
Sleep state	Sleep mode (LTE)	2.5	mA
	Sleep mode (WCDMA)	1.8	mA

Table 7- 5 Averaged working current [1]

Parameter	Condition	Typical Value	Unit
LTE	LTE FDD Band 1, Pout=23dBm	627	mA
	LTE FDD Band 3, Pout=23dBm	683	mA
	LTE FDD Band 8,Pout=23dBm	701	mA
	LTE FDD Band 18,Pout=23dBm	734	mA
	LTE FDD Band 19,Pout=23dBm	729	mA
	LTE FDD Band 26, Pout=23dBm	740	mA
	LTE FDD Band 39, Pout=23dBm	328	mA
	LTE FDD Band 41, Pout=23dBm	424	mA

Table 7- 6 Averaged working current [2]

Parameter	Condition	Typical Value	Unit
WCDMA	Band1, Pout=24dBm	548	mA
	Band6, Pout=24dBm	617	mA
	Band8, Pout=24dBm	581	mA
	Band19, Pout=24dBm	609	mA

7.4.2 RF Output Power

The following table shows the RF output power of ME3630 module.

Table 7- 7 Conducted RF Output Power

Frequency	Max	Min

LTE FDD Band 1	23±2.7dBm	-39dBm
LTE FDD Band 3	23 ±2.7dBm	-39dBm
LTE FDD Band 8	23 ±2.7dBm	-39dBm
LTE FDD Band 18	23 ±2.7dBm	-39dBm
LTE FDD Band 19	23 ±2.7dBm	-39dBm
LTE FDD Band 26	23 ±2.7dBm	-39dBm
LTE FDD Band 39	23 ±2.7dBm	-39dBm
LTE FDD Band 41	23 ±2.7dBm	-39dBm
WCDMA Band 1	24+1/-3 dBm	-50dBm
WCDMA Band 6	24+1/-3 dBm	-50dBm
WCDMA Band 8	24+1/-3 dBm	-50dBm
WCDMA Band 19	24+1/-3 dBm	-50dBm

7.4.3 RF Receiving Sensitivity

The following table shows the conducted RF receiving sensitivity typical value of ME3630 module.

Table 7- 8 Conducted RF Receiving Sensitivity Typical Value [1]

Band	5 MHz(dBm)	10 MHz(dBm)	15 MHz(dBm)	20 MHz(dBm)
LTE FDD Band 1	-99.6			-94.1
LTE FDD Band 3	-99.8			-94.4
LTE FDD Band 8	-101.2	-98.7		
LTE FDD Band18	-100.9		-96.2	
LTE FDD Band 19	-101		-96.5	
LTE FDD Band 26	-101		-96.2	
LTE FDD Band 39	-100	-97		-94
LTE FDD Band 41	-100	-97		-94

Table 7- 9 Conducted RF Receiving Sensitivity Typical Value [2]

Band	Sensitivity(dBm)
WCDMA Band 1	-110.6
WCDMA Band6	-110.3
WCDMA Band 8	-110.1
WCDMA Band 19	-110.2