HUAWEI ME936 LTE M.2 Module

Hardware Guide

Issue 01

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2014-05-08		Creation

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces that are provided when HUAWEI ME936 LTE M.2 Module (hereinafter referred to the ME936 module) is used.

M.2 is the new name for NGFF (Next Generation Form Factor).

This document helps you to understand the interface specifications, electrical features and related product information of the ME936 module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the ME936 module and provides:

- Function Overview
- Circuit Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical Features	• Dimensions (L × W × H): 42 mm × 30 mm × 2.3 mm • Weight: about 6 g
Operating Bands	LTE: BI/B2/B3/B4/B5/B7/B8/B13/B17/B20 WCDMA/HSDPA/HSUPA/HSPA+: 850 MHz/900 MHz/1700 MHz (AWS)/1900 MHz/2100 MHz GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz GPS/GLONASS: L1
Operating Temperature	Normal operating temperature: –10°C to +55°C Extended operating temperature[1]: –20°C to +70°C
Storage Temperature	–40°C to +85°C
Moisture	RH5% to RH95%
Power Voltage	3.135 V to 4.4 V (3.3 V is typical)
AT Commands	See the *HUAWEI ME936 LTE M.2 Module AT Command Interface Specification*
Application	USIM (3.0 V or 1.8 V)

Feature	Description
Interface (75-pin Gold Finger)	USIM Hot Swap Detection
	USB 2.0 (high speed)
	Power_On_Off pin
	RESET# pin
	LED# pin
	W_DISABLE# pin
	GPS_DISABLE# pin
	Tunable Antenna Control (4 GPIOs)
	Wake_On_WWAN# pin
	BodySAR_N pin
	Power supply (5 pins)
Antenna Interface	MAIN and AUX (supports Diversity and GPS simultaneously) MM4829-2702RA4 by MURATA or other equivalent parts
SMS	New message alert
	Management of SMS: read SMS, write SMS, send SMS, delete SMS and SMS list
	Supporting MO and MT
	Point-to-point
Data Services	GPRS: UL 85.6 kbps/DL 107 kbps
	EDGE: UL 236.8 kbps/DL 296 kbps
	WCDMA CS: UL 64 kbps/DL 64 kbps
	WCDMA PS: UL 384 kbps/DL 384 kbps
	HSPA+: UL 5.76 Mbps/DL 21.6 Mbps
	LTE FDD: UL 50 Mbps/DL:100 Mbps @20M BW cat3
Operating System	Windows 7/8/8.1/Android 4.0 or later/Chrome OS

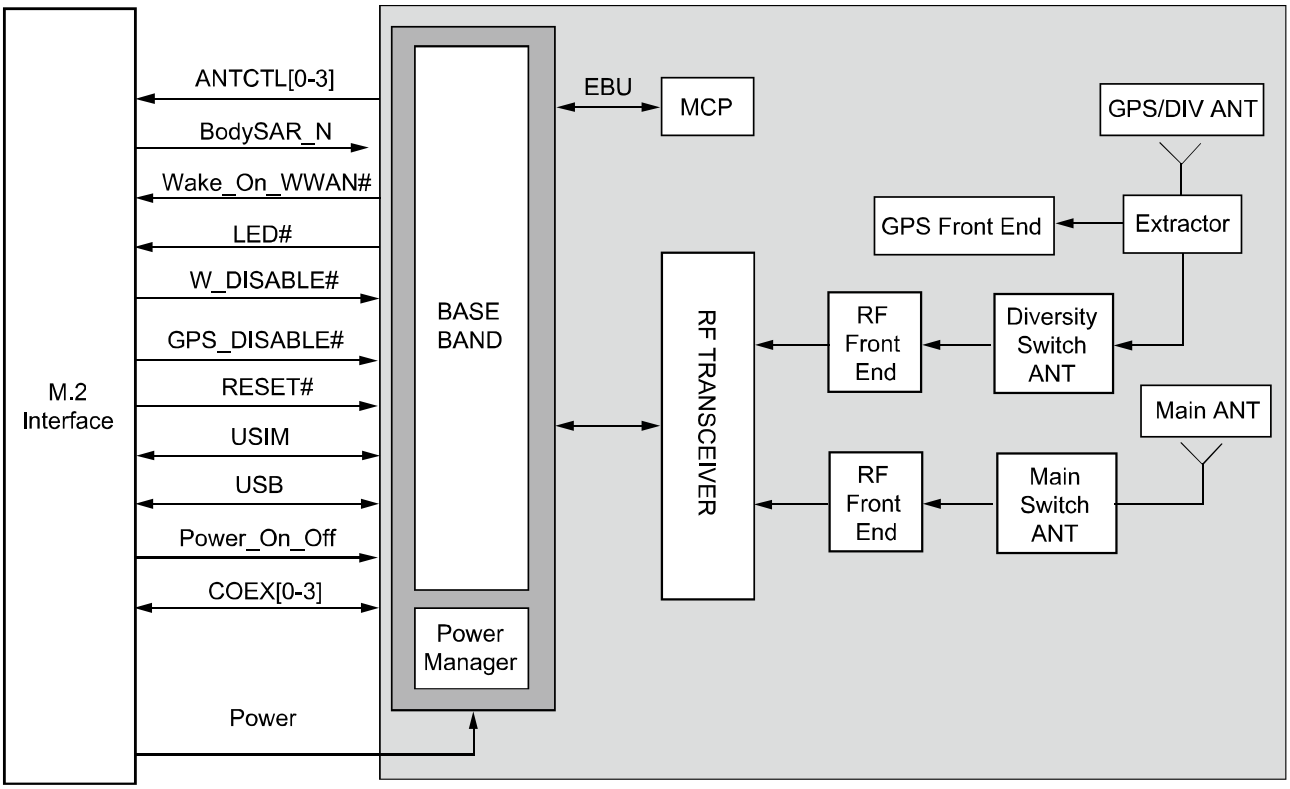
[1]: When the ME936 module works at this temperature, **NOT** all its RF performances comply with the 3GPP TS 45.005 specification.

2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the ME936 module. The application block diagram and major functional units of the ME936 module contain the following parts:

- Baseband controller
- Power manager
- Multi-chip package (MCP) memory
- Radio frequency (RF) transceiver
- RF interface

Figure 2-1 Circuit block diagram of the ME936 module



3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the ME936 module, including:

- 75-pin Gold Finger
- Power Interface
- Signal Control Interface
- USB Interface
- USIM Card Interface
- Tunable Antenna Control
- Config Pins
- NC Pins
- RF Antenna Interface

3.2 75-pin Gold Finger

The ME936 module uses a 75-pin Gold Finger as its external interface. For details about the module and dimensions, see "6.2 Dimensions of ME936".

Figure 3-1 shows the sequence of pins on the 75-pin signal interface of the ME936 module.

Figure 3-1 TOP view of sequence of Gold Finger interface pins

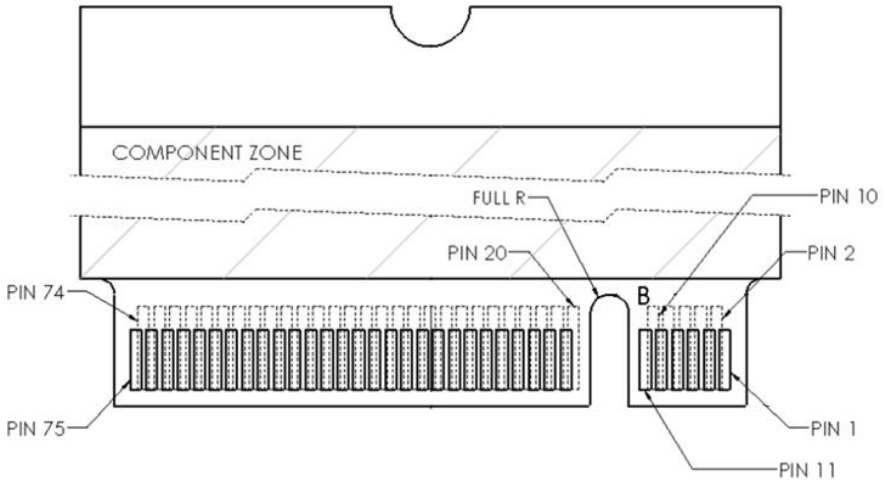


Table 3-1 shows the definitions of pins on the 75-pin signal interface (67 for signals and 8 for notch) of the ME936 module.

As the M.2 naming nomenclature, ME936 is Type 3042-S3-B (30 mm × 42 mm, Component Max Height on top is 1.5 mm and single-sided, Key ID is B.)

Module Nomenclature
Sample type 2242-D2-B-M

Type XX XX - XX - X - X*

Width (mm)
12
16
22
30

Length (mm)
16
26
30
38
42
60
80
110

	Component Max Ht(mm)	
	T Max**	B Max**
S1	1.2	0τ
S2	1.35	0τ
S3	1.5	0τ
D1	1.2	1.35
D2	1.35	1.35
D3	1.5	1.35
D4	1.5	0.7
D5	1.5	1.5

Key ID	Pin	Interface
A	8-15	PCIe x2 / USB / I2C / DP x4
B	12-19	PCIe x2 / SATA / USB / PCM / IUM / SSIC / UART-I2C
C	16-23	Reserved for Future Use
D	20-27	Reserved for Future Use
E	24-31	PCIe / USB / I2C-ME / SDIO / UART / PCM
F	28-35	Future Memory Interface (FMI)
G	39-46	Generic (Not used for M.2)^
H	43-50	Reserved for Future Use
J	47-54	Reserved for Future Use
K	51-58	Reserved for Future Use
L	55-62	Reserved for Future Use
M	59-66	PCIe x4 / SATA

* Use ONLY when a double slot is being specified
** Label included in height dimension
^ Key G is designed for Non-M.2 compliant devices. Intended for custom use. Use at your own risk!
τ Insulating label allowed on connector-based designs

Table 3-1 Definitions of pins on the M.2 interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
1	CONFIG_3	PI	Connected to Ground internally. ME936 is configured as WWAN-SSIC 0	-	-	0	-	-
2	3.3V	PI	Power supply	-	3.135	3.3	4.4	-
3	Ground	PI	Ground	-	-	0	-	-
4	3.3V	PI	Power supply	-	3.135	3.3	4.4	-
5	Ground	PI	Ground	-	-	0	-	-
6	Power_On_Off	I	A single control to turn On/Off WWAN. H: WWAN is powered on. L: WWAN is powered off. It is internally pulled to low.	V_{IH}	1.26	-	4.4	ME936 is pulled down inside.
				V_{IL}	–0.3	-	0.54	
7	USB_D+	I/O	USB Data + defined in the USB 2.0 Specification	-	-	-	-	-
8	W_DISABLE#	I	WWAN disable function H: WWAN function is determined by software AT command. Default High. L: WWAN function is turned off.	V_{IH}	1.26	-	3.6	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0.3	
9	USB_D-	I/O	USB Data - defined in the USB 2.0 Specification	-	-	-	-	-
10	LED#	O	It is an **open drain**, active low signal, used to allow the M.2 card to provide status indicators via LED devices that will be provided by the system.	V_{OL}	0	-	0.48	I_{OL}=75 mA
11	Ground	PI	Ground	-	-	0	-	-
12	Notch	-	-	-	-	-	-	-
13	Notch	-	-	-	-	-	-	-
14	Notch	-	-	-	-	-	-	-
15	Notch	-	-	-	-	-	-	-
16	Notch	-	-	-	-	-	-	-
17	Notch	-	-	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
18	Notch	-	-	-	-	-	-	-
19	Notch	-	-	-	-	-	-	-
20	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-	-	-
21	CONFIG_0	PI	Not Connected internally. ME936 is configured as WWAN-SSIC 0.	-	-	-	-	-
22	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-	-	-
23	Wake_On_WWAN#	O	It is open drain and active low. WWAN to wake up the host.	V_{OL}	0	-	0.48	I_{OL}=75 mA
24	Reserved	-	Reserved for Future Use, please keep it NC in host side.	-	-	-	-	-
25	BodySAR_N	I	Hardware pin for BodySAR Detection, active low. H: No TX power backoff (default). L: TX power backoff.	V_{IH}	1.26	-	3.6	ME936 is pulled up inside.
				V_{IL}	–0.3		0.3	
26	GPS_DISABLE#	I	GPS disable function H: GPS function is determined by software AT command. Default enabled. L: GPS is turned off.	V_{IH}	1.26	-	3.6	ME936 is pulled up inside.
				V_{IL}	–0.3		0.3	
27	Ground	PI	Ground	-	-	0		-
28	NC	-	Not Connected	-	-	-		-
29	NC	-	Not Connected	-	-	-		-
30	UIM_RESET	O	USIM Reset	V_{OH}	0.7 x UIM_PWR	-	3.3	UIM_PWR =1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x UIM_PWR	
31	NC	-	Not Connected	-	-	-		-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
32	UIM_CLK	O	USIM Clock	V_{OH}	0.7 x UIM_PWR	-	3.3	UIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x UIM_PWR	
33	Ground	PI	Ground	-	-	0	-	-
34	UIM_DATA	I/O	USIM DATA	V_{OH}	0.7 x UIM_PWR	-	3.3	UIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x UIM_PWR	
				V_{IH}	0.7 x UIM_PWR	-	3.3	
				V_{IL}	0	-	0.2 x UIM_PWR	
35	NC	-	Not Connected	-	-	-	-	-
36	UIM_PWR	P	USIM POWER	-	1.75	1.8	1.98	UIM_PWR=1.8 V
				-	2.75	2.85	3.3	UIM_PWR=2.85 V
37	NC	-	Not Connected	-	-	-	-	-
38	NC	-	Not Connected	-	-	-	-	-
39	Ground	PI	Ground	-	-	0	-	-
40	I2C_SCL	O	I2C clock, slave This function is under development.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
41	NC	-	Not Connected	-	-	-	-	-
42	I2C_SDA	I/O	I2C data, slave This function is under development.	V_{OH}	1.35	1.8	-	-
				V_{OL}	0	-	0.45	-
				V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
43	NC	-	Not Connected	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
44	I2C_IRQ	I	Interrupt signal to wake up the module. This function is under development.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
45	Ground	PI	Ground	-	-	0	-	-
46	SYSCLK	O	System clock output for external GNSS module. This function is under development.	V_{OH}	1.6	1.8	-	-
				V_{OL}	0	-	0.45	-
47	NC	-	Not Connected	-	-	-	-	-
48	TX_BLANKING	O	TX blanking signal for external GNSS module. This function is under development.	V_{OH}	1.6	1.8	-	-
				V_{OL}	0	-	0.45	-
49	NC	-	Not Connected	-	-	-	-	-
50	NC	-	Not Connected	-	-	-	-	-
51	Ground	PI	Ground	-	-	0	-	-
52	NC	-	Not Connected	-	-	-	-	-
e	NC	-	Not Connected	-	-	-	-	-
54	NC	-	Not Connected	-	-	-	-	-
55	NC	-	Not Connected	-	-	-	-	-
56	NC	-	Not Connected	-	-	-	-	-
57	Ground	PI	Ground	-	-	0	-	-
58	NC	-	Not Connected	-	-	-	-	-
59	ANTCTL0	O	Tunable antenna control signal, bit 0. It is a push-pull type GPIO.	V_{OH}	1.35	1.8	1.9	-
				V_{OL}	0	-	0.45	-
60	COEX3	IO	For coexistence. This function is under development.	V_{OH}	1.35	1.8	1.9	-
				V_{OL}	0	-	0.45	-
				V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
61	ANTCTL1	O	Tunable antenna control signal, bit 1. It is a push-pull type GPIO.	V_{OH}	1.35	1.8	1.9	-
				V_{OL}	0	-	0.45	-
62	COEX2	I/O	For coexistence.	V_{OH}	1.35	1.8	1.9	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
			This function is under development.	V_{OL}	0	-	0.45	-
				V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
63	ANTCTL2	O	Tunable antenna control signal, bit 2. It is a push-pull type GPIO.	V_{OH}	1.35	-	1.8	-
				V_{OL}	0	-	0.45	-
64	COEX1	I/O	For coexistence. This function is under development.	V_{OH}	1.35	1.8	1.9	-
				V_{OL}	0	-	0.45	-
				V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
65	ANTCTL3	O	Tunable antenna control signal, bit 3. It is a push-pull type GPIO.	V_{OH}	1.35	1.8	1.9	-
				V_{OL}	0	-	0.45	-
66	SIM_DET	I	SIM hot swap detection pin. Rising edge for insertion; falling edge for removal. H: SIM is present. L: SIM is absent.	V_{IH}	1.26	1.8	2.1	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0.63	
67	RESET#	I	System reset, active low.	V_{IH}	1.26	-	3.3	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0.3	
68	NC	-	Not Connected	-	-	-	-	-
69	CONFIG_1	O	Connected to Ground internally. ME936 is configured as WWAN-SSIC 0.	-	-	0	-	-
70	3.3V	PI	Power supply	-	3.135	3.3	4.4	-
71	Ground	PI	Ground	-	-	0	-	-
72	3.3V	PI	Power supply	-	3.135	3.3	4.4	-
73	Ground	PI	Ground	-	-	0	-	-
74	3.3V	PI	Power supply	-	3.135	3.3	4.4	-
75	CONFIG_2	O	Connected to Ground internally. ME936 is configured as WWAN-SSIC 0.	-	-	0	-	-

NOTE

- **I** indicates pins for digital signal input; **O** indicates pins for digital signal output; **PI** indicates power input pins; **PO** indicates power output pins.
- V_{IL}: Low-level Input voltage; V_{IH}: High-level Input voltage; V_{OL}: Low-level Output voltage; V_{OH}: High-level Output voltage.
- The **NC** pins are not connected, therefore, before you deal with these pins, please refer to the corresponding hardware guide.
- The **Reserved** pins are internally connected to the module. Therefore, these pins should not be used, otherwise they may cause problems. Please contact with us for more details about this information.

3.3 Power Interface

3.3.1 Overview

The power supply part of the ME936 module contains:

- 3.3V pins for the power supply
- UIM_PWR pin for USIM card power output

Table 3-2 lists the definitions of the pins on the power supply interface.

Table 3-2 Definitions of the pins on the power supply interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
2, 4, 70, 72, 74	3.3V	PI	Power supply for ME936, 3.3 V is recommended	-	3.135	3.3	4.4	-
36	UIM_PWR	P	USIM POWER	-	1.75	1.8	1.98	UIM_PWR =1.8 V
				-	2.75	2.85	3.3	UIM_PWR =2.85 V
3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73	Ground	PI	Ground	-	-	0	-	-

3.3.2 Power Supply 3.3V Interface

When the ME936 module works normally, power is supplied through the 3.3V pins and the voltage ranges from 3.135 V to 4.4 V (typical value is 3.3 V). The ME936 provides 5 power pins, and 11 Ground pins. To ensure that the ME936 module works normally, all these pins must be connected. The M.2 connector pin is defined to support 500 mA/Pin continuously.

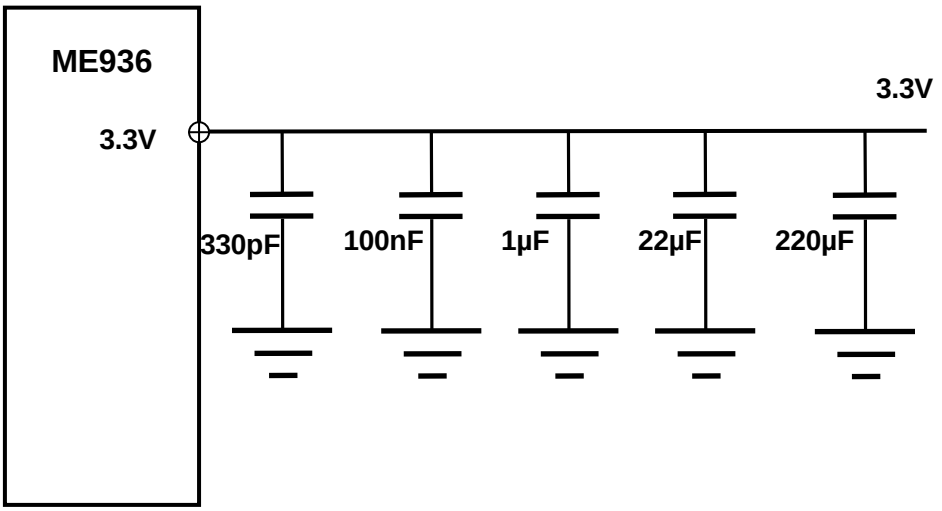
When the ME936 module works at GSM mode, the module transmits at the maximum power, the transient peak current may reach 2.5 A (with a highly unmatched antenna).

In this case, the power pin voltage will drop. Make sure that the voltage does not drop below 3.135 V in any case.

The traces of the power supply should be as short and wide as possible. It is recommended that at least a 220 µF capacitance is added onto the 3.3 V power rails and as close to the M.2 connector as possible. Customer can reduce the capacitance if it can be guaranteed that 3.3V pin does not drop below 3.135 V in any case.

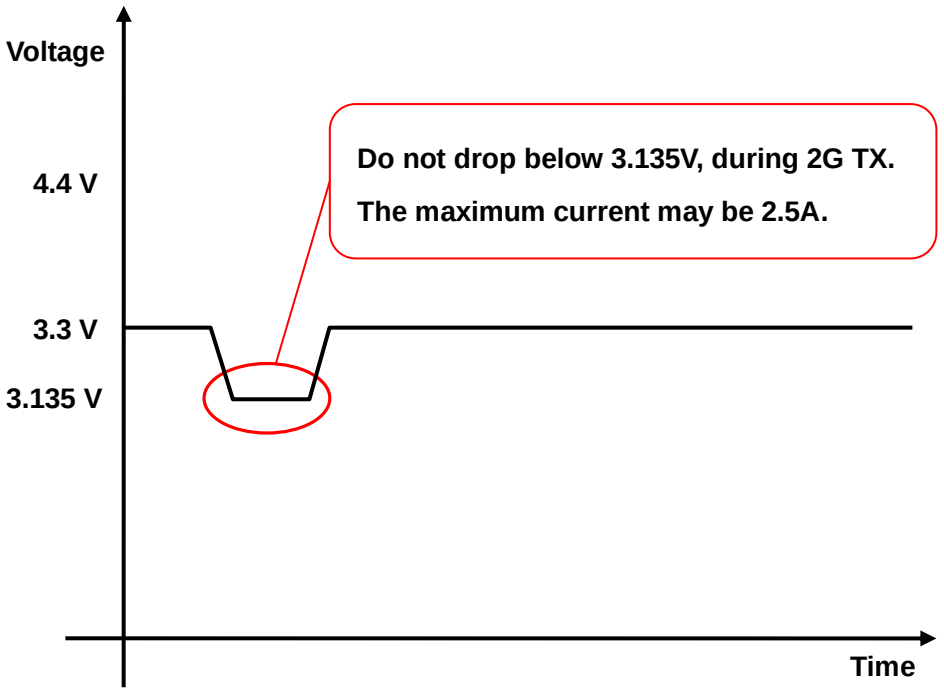
Figure 3-2 shows the recommended power circuit of the ME936 module.

Figure 3-2 Recommended power circuit of the ME936 module



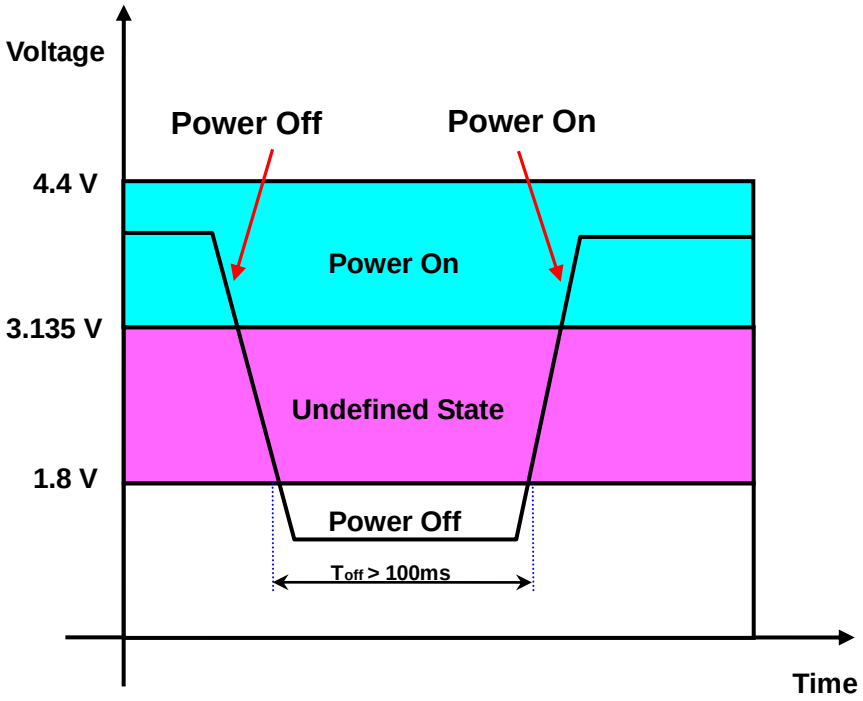
NOTE
3.3V pin must never be under 3.135 V during the 2G transmitting burst, as shown in Figure 3-3 .

Figure 3-3 VCC drop during 2G transmitting



If customer wants to power cycle ME936, the 3.3V pin must stay below 1.8 V for more than 100 ms. The sequence is shown as in Figure 3-4 .

Figure 3-4 ME936 power supply time sequence for power cycling



Parameter	Remarks	Time (Min.)	Unit
T_{off}	Power off time	100	ms

3.3.3 USIM Power Output UIM_PWR

Through the UIM_PWR power supply interface, the ME936 module can supply 1.8 V or 2.85 V power to UIM card.

NOTE

The max. current can reach 200 mA, so special attention on PCB design should be taken at the host side.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the ME936 module consists of the following:

- Power On/Off (Power_On_Off) pin
- System reset (RESET#) pin

- LED control (LED#) pin
- WWAN disable control (W_DISABLE#) pin
- GPS disable control (GPS_DISABLE#) pin
- Wake signal out from module (Wake_On_WWAN#) pin
- BodySAR detection (BodySAR_N) pin
- UIM detection (SIM_DET) pin

Table 3-3 lists the pins on the signal control interface.

Table 3-3 Pins on the signal control interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
6	Power_On_Off	I	A single control to turn On/Off WWAN. H: WWAN is powered on. L: WWAN is powered off. It is internally pulled to low.	V_{IH}	1.26	-	4.4	ME936 is pulled down inside.
				V_{IL}	–0.3	-	0.54	
67	RESET#	I	System reset, active low.	V_{IH}	1.26	-	3.3	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0. 3	
10	LED#	O	It is an open drain, active low signal, used to allow the M.2 card to provide status indicators via LED devices that will be provided by the system.	V_{OL}	0	-	0.48	I_{OL}=75mA
8	W_DISABLE#	I	WWAN disable function H: WWAN function is determined by software AT command. Default High. L: WWAN function is turned off.	V_{IH}	1.26	-	3.6	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0.3	
26	GPS_DISABLE#	I	GPS disable function H: GPS function is determined by software AT command. Default enabled. L: GPS is turned off.	V_{IH}	1.26	-	3.6	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0.3	
23	Wake_On_WWAN#	O	It is open drain and active low. WWAN to wake up the host.	V_{OL}	0	-	0.48	I_{OL}=75mA
25	BodySAR_N	I	Hardware pin for BodySAR Detection, active low.	V_{IH}	1.26	-	3.6	ME936 is pulled up

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
			H: No TX power backoff (default). L: TX power backoff.	V_{IL}	–0.3	-	0.3	inside.
66	SIM_DET	I	SIM hot swap detection pin. Rising edge for insertion; falling edge for removal. H: SIM is present. L: SIM is absent.	V_{IH}	1.26	1.8	2.1	ME936 is pulled up inside.
				V_{IL}	–0.3	-	0.63	

3.4.2 Power_On_Off Control Pin

The ME936 module can be controlled to be powered on/off by the Power_On_Off pin.

Table 3-4 Two states of Power_On_Off pin

Item	Pin state	Description
1	High	ME936 is powered on. **NOTE: If ME936 needs to be powered on automatically, the Power_On_Off pin must be pulled up to 3.3 V.**
2	Low	ME936 is powered off. **It is internally pulled to low.**

ME936 is powered by regulated 3.3 V

If ME936 is powered by 3.3 V voltage regulator (such as notebook or Ultrabook), Power_On_Off pin should be pulled up to 3.3 V through a resistor.

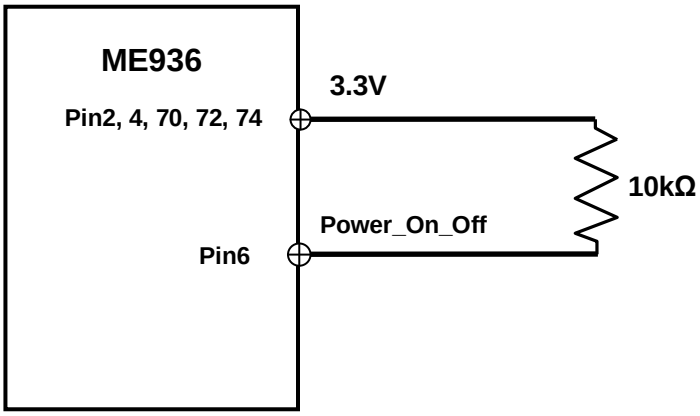
The pull-up resistor should be **not larger than 10 kΩ**.

The following are the power On/Off sequences:

1. The module gets 3.3 V when power supply for the module is switched on.
2. The module is turned on since Power_On_Off pin is pulled up directly to 3.3 V.
3. Host cuts off 3.3 V supply to power off the module.

The recommended circuit is shown as in Figure 3-5 .

Figure 3-5 Recommended connections of Power_On_Off pin (Auto power)

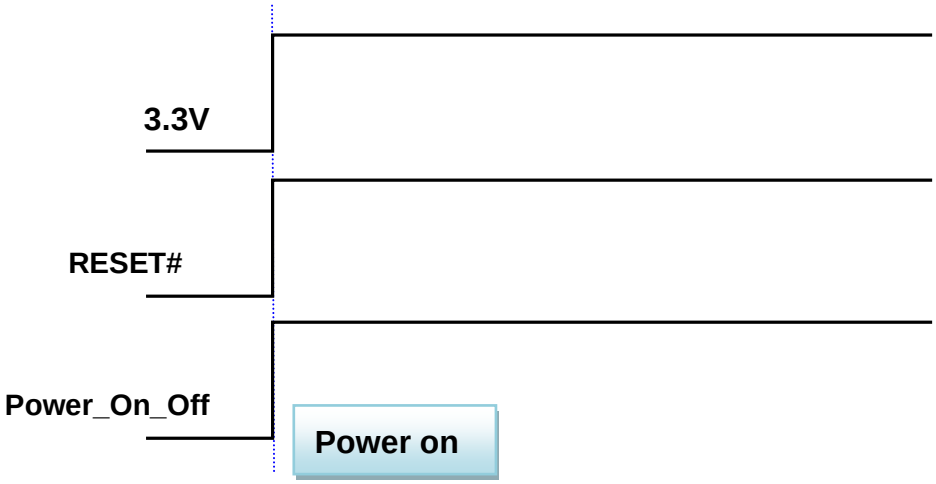


Power on sequence

Do not toggle RESET# pin during the power on sequence. Pulling RESET# pin low will extend time for module startup.

Recommended power on timing is shown as in Figure 3-6 .

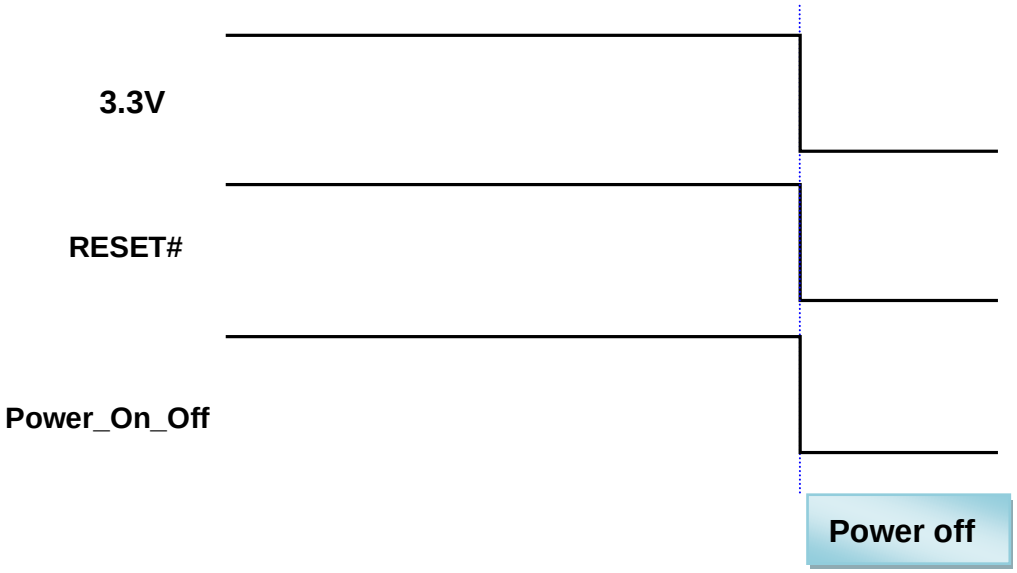
Figure 3-6 Recommended power on timing



Power off sequence

Cutting off 3.3 V will power off the module.

Figure 3-7 Recommended power off timing (cut off 3.3 V)



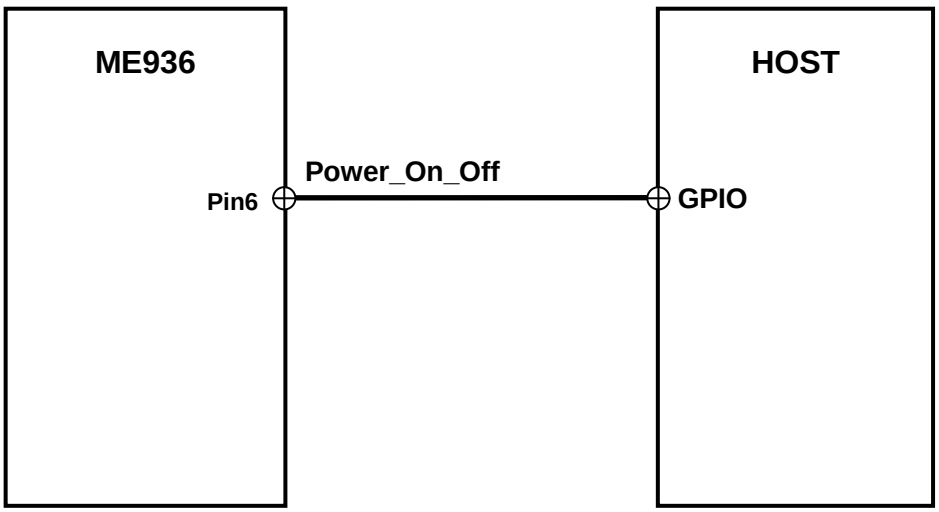
ME936 is powered directly to battery

For use case ME936 is connected directly to battery, such as tablet platforms, Power_On_Off pin should be controlled by a GPIO from host to control ME936 power On/Off.

It is critical to make sure the module is safely powered off when the Tablet SoC is shut off. There will be current leakage if the module is not powered off properly. So it is important to keep Power_On_Off pin logic low for more than **500 ms** to power off the module.

The recommended connections are shown as in Figure 3-8 .

Figure 3-8 Recommended connections of Power_On_Off pin (Control)

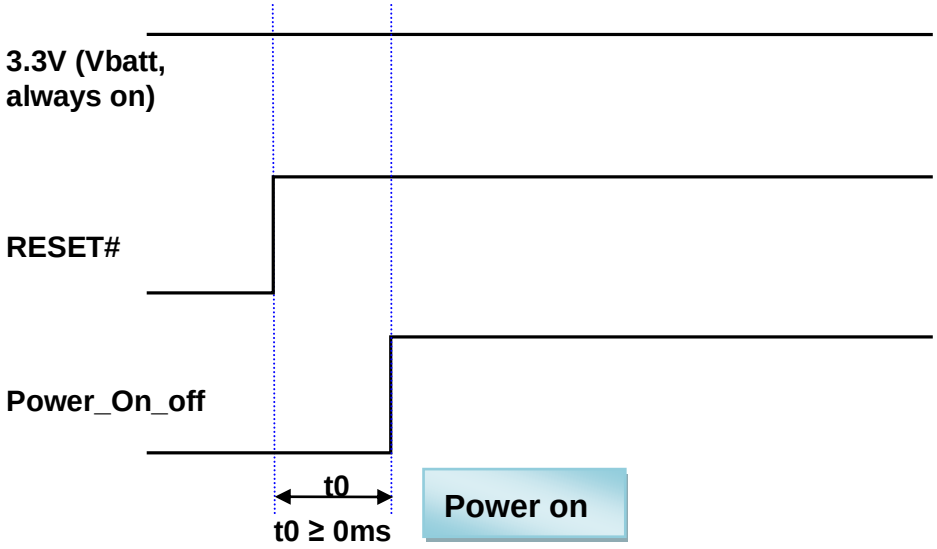


Power on sequence

Do not toggle RESET# pin during power on sequence. Pulling RESET# pin low will extend time for module startup.

Recommended power on timing is shown as in Figure 3-9 .

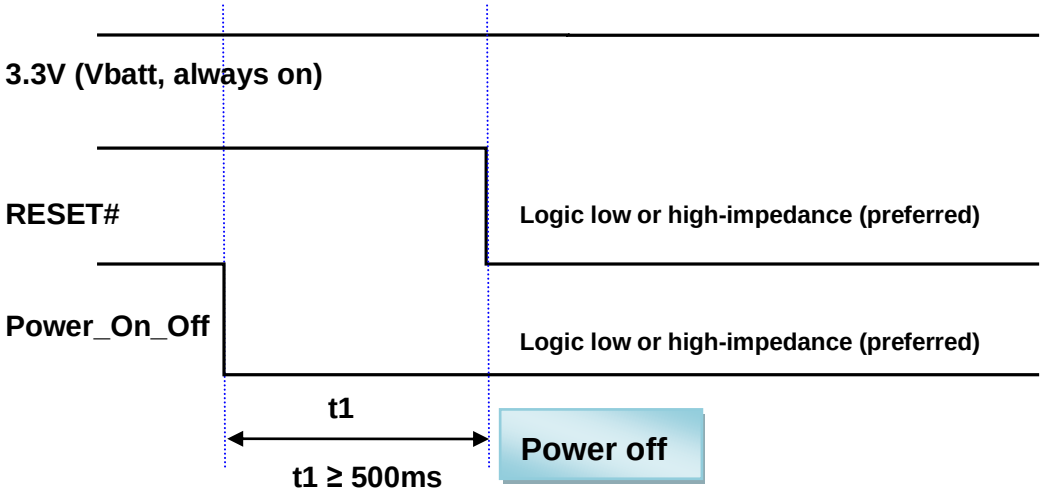
Figure 3-9 Recommended power on timing



Power off Sequence

Keep Power_On_Off pin logic low for more than 500 ms to power off the module.

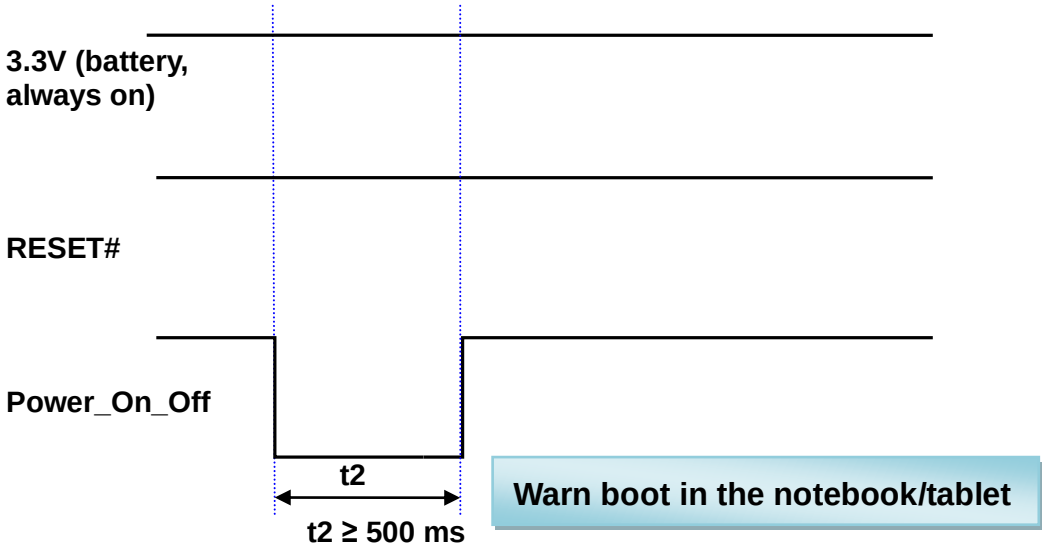
Figure 3-10 Recommended power off timing (connect to battery)



Warn boot (restart) sequence

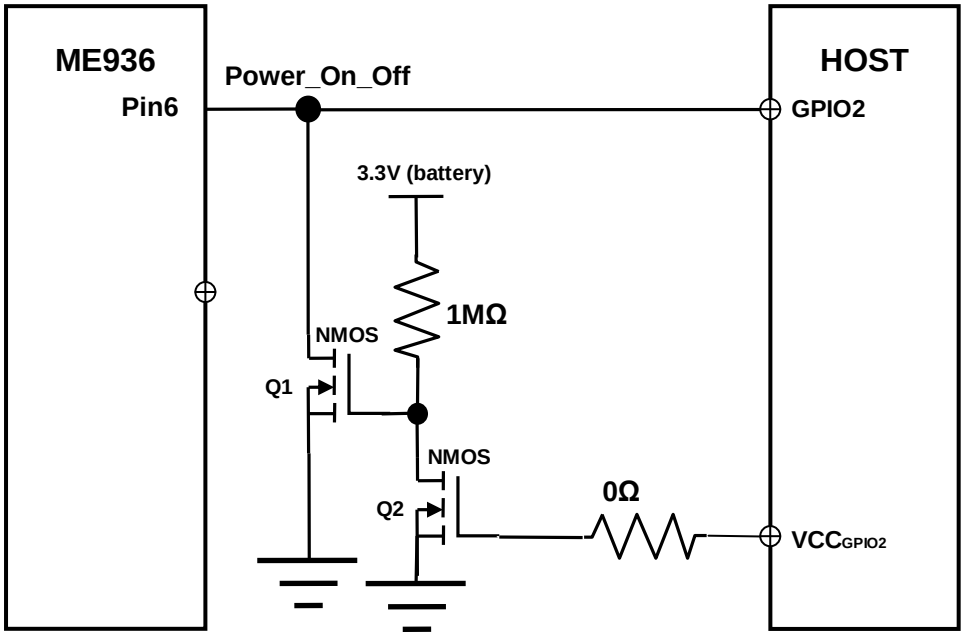
In the notebook/tablet when using the warn boot, followed sequence is recommended.

Figure 3-11 Recommended warn boot timing in the notebook/tablet



If there is a limitation on the controlling GPIO to be programmable 500 ms, the following hardware solution can be used, as shown in Figure 3-12 .

Figure 3-12 Power on/off circuit (hardware solution)



VCC$_{GPIO2}$ is the power domain of the GPIO2.
When **VCC**$_{GPIO2}$ is **ON**, Q2 is on and Q1 is off. So the Pin6 is controlled by GPIO2 of host.
When **VCC**$_{GPIO2}$ is **Off**, Q2 is off and Q1 is on. So the Pin6 is pulled low, then the module is powered off.

3.4.3 RESET# Pins

The ME936 module can be reset through the RESET# pin asynchronous, active low. Whenever this pin is active, the module will immediately be placed in a Power On reset condition. Care should be taken for this pin unless there is a critical failure and all other methods of regaining control and/or communication with the WWAN sub-system have failed.

Pulling RESET# pin low for more than **20 ms** will reset the module.

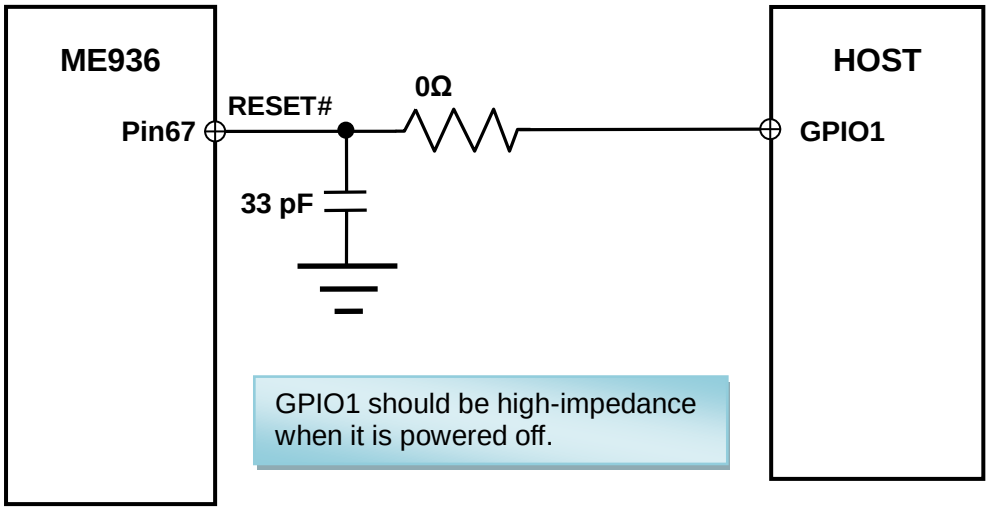
RESET# pin is optional, which cannot be connected. Pulling Power_On_Off pin low for more than **500 ms** can work as a reset.

RESET# pin is internally pulled up to 1.8 V, which is automatically on when 3.3 V is applied even though Power_On_Off pin is low. Cautions should be taken on circuit design otherwise there may be back driving issue.

Option 1: Hardware circuit for RESET#

In this case, the GPIO is high-impedance when the module is powered off.

Figure 3-13 Hardware circuit for RESET# (Option 1)

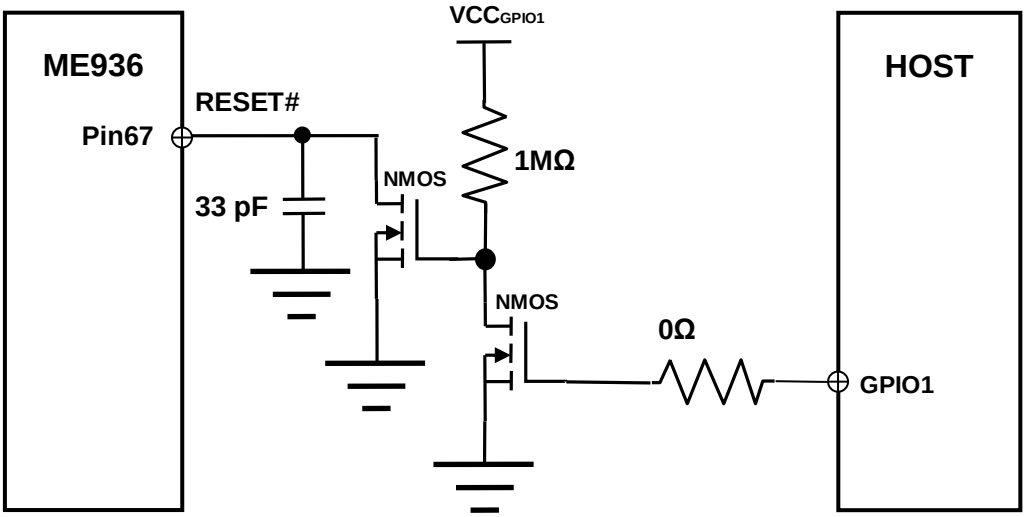


Option 2: Hardware circuit for RESET#

In this case, the GPIO is not high-impedance when it is powered off.

Use 2 NMOSFET so that the logic of RESET# pin and GPIO are the same.

Figure 3-14 Hardware circuit for RESET# (Option 2)

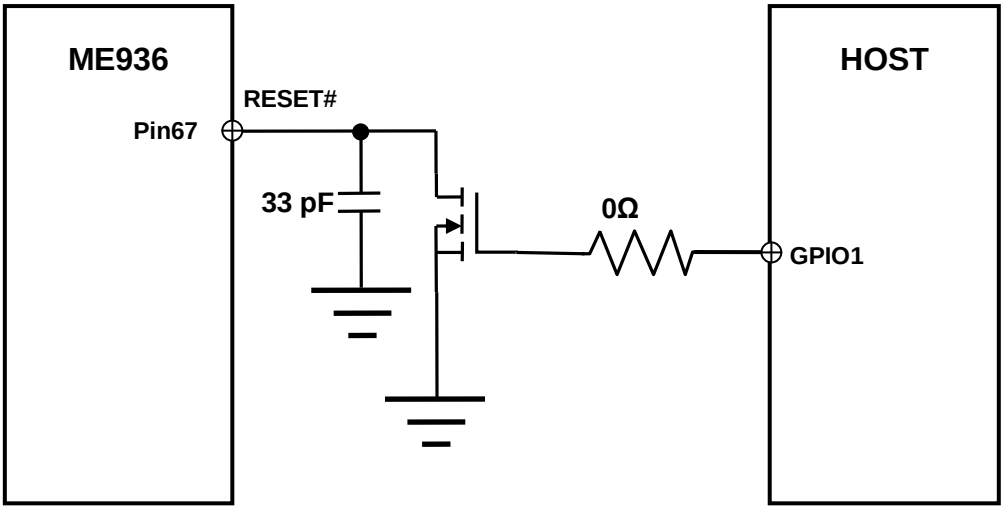


Option 3: Hardware circuit for RESET#

In this case, the GPIO is not high-impedance when the host is powered off.

Use only one NMOSFET, in this case the logic of RESET# pin and GPIO1 is reversed.

Figure 3-15 Hardware circuit for RESET# (Option 3)



CAUTION

- As the RESET# pin signal is relatively sensitive, it is recommended to install a 33 pF capacitor near to the M.2 pin.
- **Triggering the RESET# pin signal will lead to lose all data in the module and remove system drivers. It will also disconnect the module from the network resulting in a call drop.**

3.4.4 LED# Pin

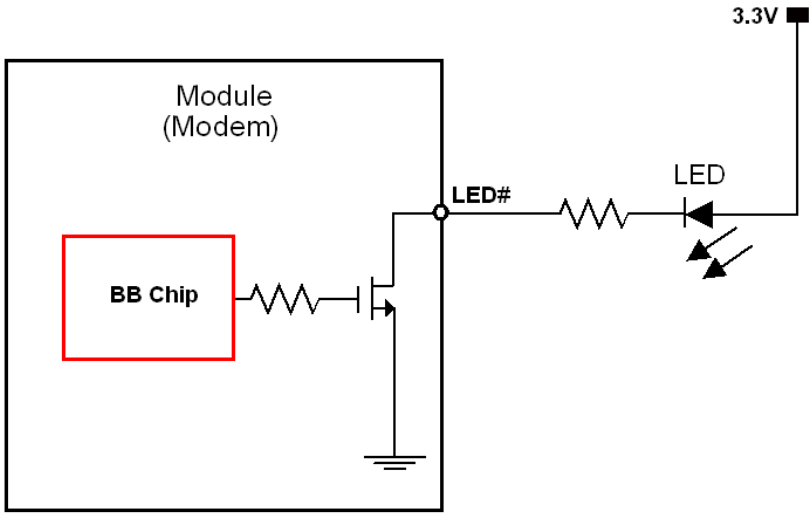
ME936 provides an open drain signal to indicate the RF status.

Table 3-5 State of the LED# pin

No.	Operating Status	LED#
1	RF function is turned on.	Output Low
2	RF function is turned off.	Output High

Figure 3-16 shows the recommended circuits of the LED# pin. The brightness of LED can be adjusted by adjusting the resistance of the series resistor.

Figure 3-16 Driving circuit



CAUTION

LED# pin output is different from HUAWEI MU733 module, because ME936 integrates a MOSFET inside.

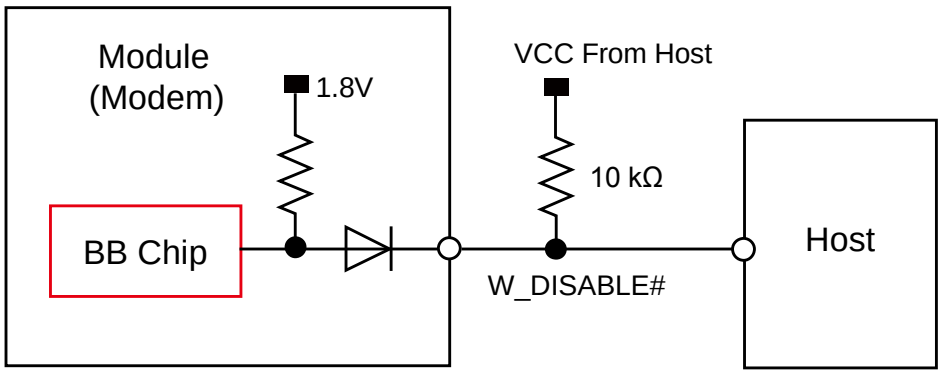
3.4.5 W_DISABLE# Pin

ME936 provides a hardware pin (W_DISABLE#) to enable/disable the radio function. This function also can be implemented by AT command.

Table 3-6 Function of the W_DISABLE# pin

No.	W_DISABLE#	Function
1	Low	WWAN function will be turned off.
2	High	WWAN function is determined by software AT command. Default enabled.
3	Floating	WWAN function is determined by software AT command. Default enabled.

Figure 3-17 Connections of the W_DISABLE# pin



CAUTION

It is not recommended to add a diode on the W_DISABLE# pin outside the ME936 module.

3.4.6 GPS_DISABLE# Pin

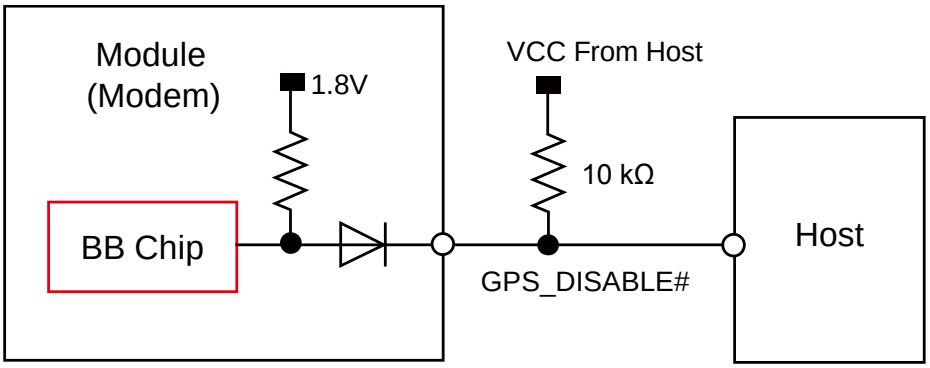
ME936 provides a hardware pin (GPS_DISABLE#) to enable/disable the GPS function.

Table 3-7 Function of the GPS_DISABLE# pin

No.	GPS_DISABLE#	Function
1	Low	GPS function is disabled.
2	High	GPS function is determined by software AT command. Default enabled.

No.	GPS_DISABLE#	Function
3	Floating	GPS function is determined by software AT command. Default enabled.

Figure 3-18 Connections of the GPS_DISABLE# pin



CAUTION

It is not recommended to add a diode on the GPS_DISABLE# pin outside the ME936 module.

3.4.7 Wake_On_WWAN# Pin

ME936 provides an open drain output Wake_On_WWAN# pin to wake host. It is low active.

Figure 3-19 Wave form of the Wake_On_WWAN# pin

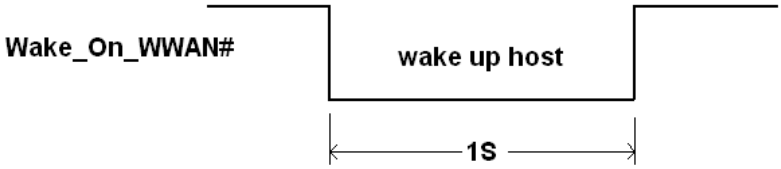
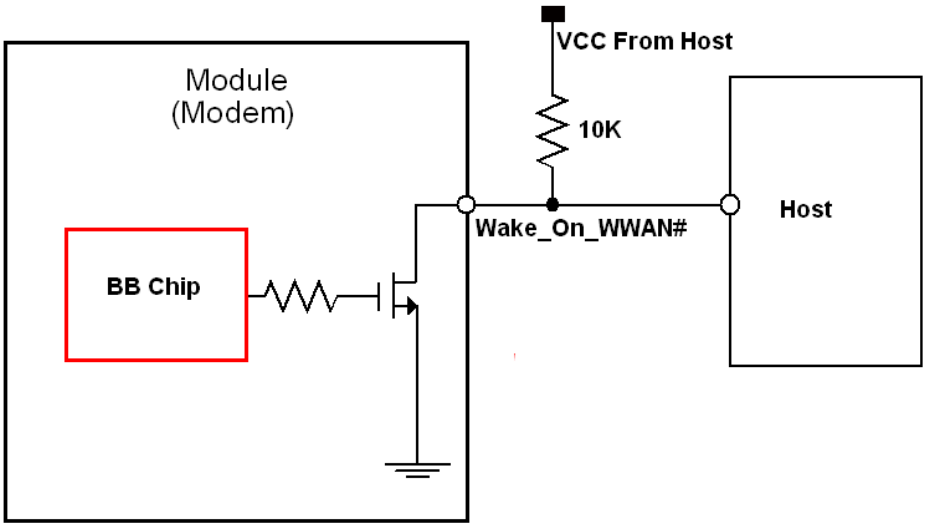


Figure 3-20 Connections of the Wake_On_WWAN# pin



3.4.8 BodySAR_N Pin

ME936 provides an input pin BodySAR_N for BodySAR detection.

It is pulled up internally and when it is pulled low by the proximity sensor output or controlling signal from host systems, the Tx power reduction actions will be triggered.

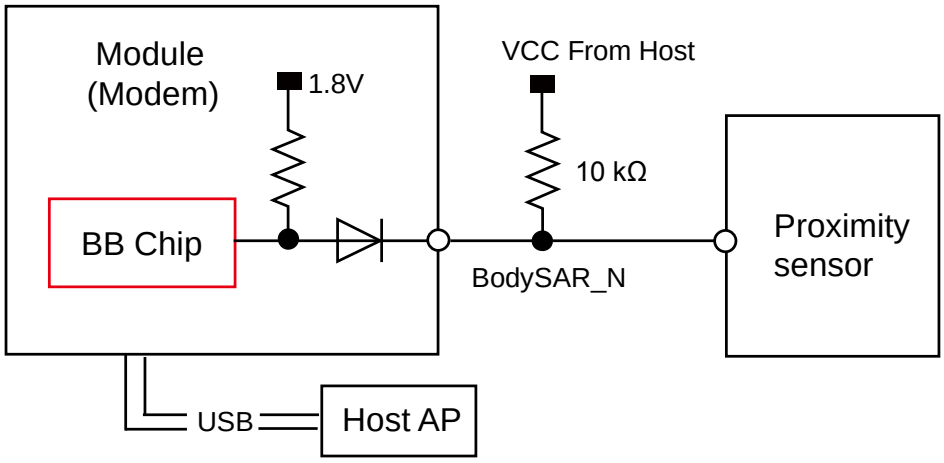
Table 3-8 Function of the BodySAR_N pin

No.	BodySAR_N	Function
1	Low	MAX TX power will be back off by setting through AT command.
2	High	MAX TX power will **NOT** be backed off. (default)
3	Floating	MAX TX power will **NOT** be backed off.

If BodySAR_N pin is used to monitor the proximity sensor output, there are some essential preconditions for this hardware solution.

ME936 cannot provide any control signal for the proximity sensor. Any control or programming required by the proximity sensor should be handled by the host side.

Figure 3-21 Connections of the BodySAR_N pin



CAUTION

It is not recommended to add a diode on the BodySAR_N pin outside the ME936 module.

3.4.9 SIM_DET Pin

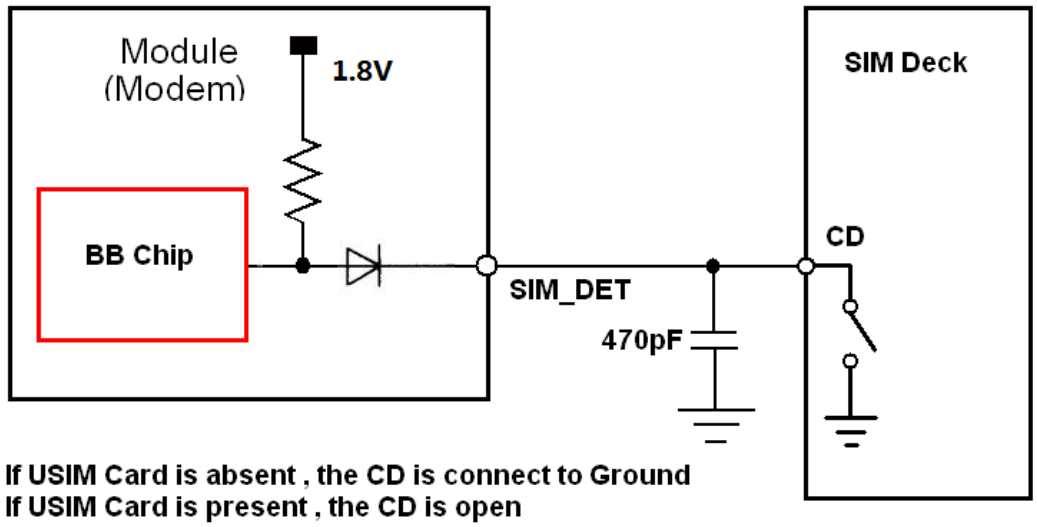
ME936 supports USIM Hot Swap function.

ME936 provides an input pin (SIM_DET) to detect whether the USIM card is present or not. This pin is an edge trigger pin.

Table 3-9 Function of the SIM_DET pin

No.	SIM_DET	Function
1	Rising edge	USIM Card insertion. If the USIM Card is present, SIM_DET pin should be high.
2	Falling edge	USIM Card removal. If the USIM Card is absent, SIM_DET pin should be low.

Figure 3-22 Connections of the SIM_DET pin

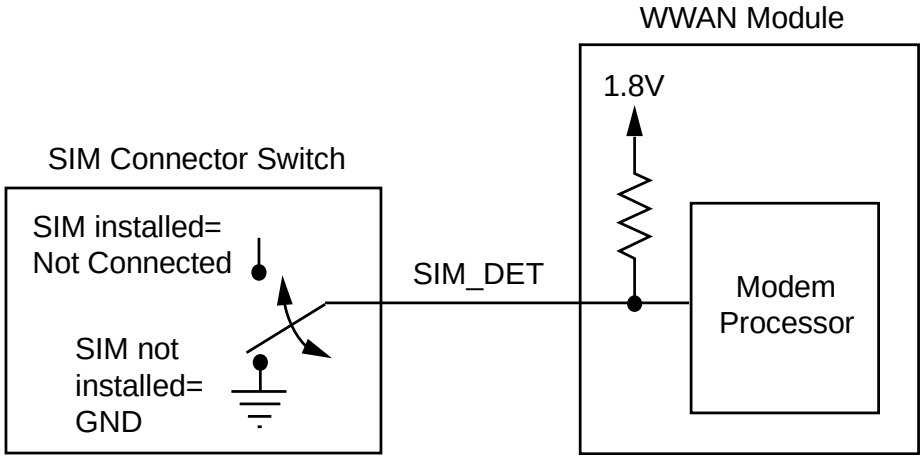


CD is a pin detecting USIM card in the SIM socket, normally, there will be a detect pin in the SIM Socket.

CAUTION

- The normal short SIM connector should be employed. The logic of SIM_DET pin is shown as in Figure 3-23 . High represents that SIM is inserted; Low represents that SIM is removed.
- When SIM is inserted (hot), SIM_DET pin will change from Low to High;
- When SIM is removed (hot), SIM_DET pin will change from High to Low.
- ME936 will detect the rising or falling edge of SIM_DET to react the hot swap.

Figure 3-23 The logic of SIM_DET



3.5 USB Interface

The ME936 is compliant with USB 2.0 high speed protocol. The USB input/output lines are following USB 2.0 specifications. Definition of the USB interface:

Pin No.	Pin Name	Pad Type	Description
7	USB_D+	I/O	USB data signal D+
9	USB_D-	I/O	USB data signal D-

Figure 3-24 Recommended circuit of USB interface

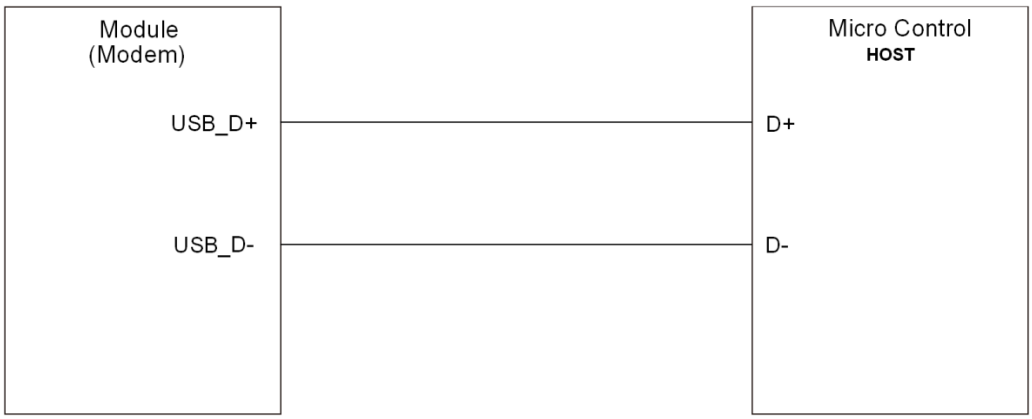
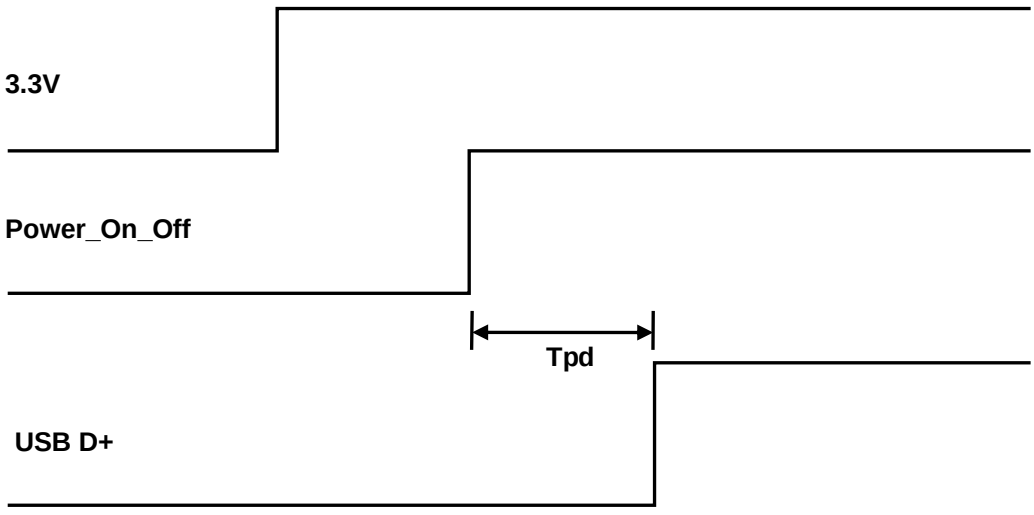


Figure 3-25 shows the timing sequence between 3.3 V and USB D+.

Figure 3-25 ME936 USB D+ and 3.3 V power on timing



Parameter	Remarks	Time (Nominal value)	Unit
T_{pd}	Power valid to USB D+ high	5	s

NOTE
The layout design of this circuit on the host board should comply with the USB 2.0 high speed protocol, with differential characteristic impedance of 90 Ω.

3.6 USIM Card Interface

3.6.1 Overview

The ME936 module provides a USIM card interface complying with the ISO 7816-3 standard and supports both 1.8 V and 3.0 V USIM cards.

Table 3-10 USIM card interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ.(V)	Max.(V)	Comments
30	UIM_RESET	O	USIM Reset	V_{OH}	0.7 x UIM_PWR	-	3.3	UIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x UIM_PWR	UIM_PWR=1.8 V or 2.85 V
32	UIM_CLK	O	USIM Clock	V_{OH}	0.7 x UIM_PWR	-	3.3	UIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x UIM_PWR	
34	UIM_DATA	I/O	USIM DATA	V_{OH}	0.7 x UIM_PWR	-	UIM_PWR	UIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x UIM_PWR	
				V_{IH}	0.7 x UIM_PWR	-	UIM_PWR	
				V_{IL}	0	-	0.2 x UIM_PWR	

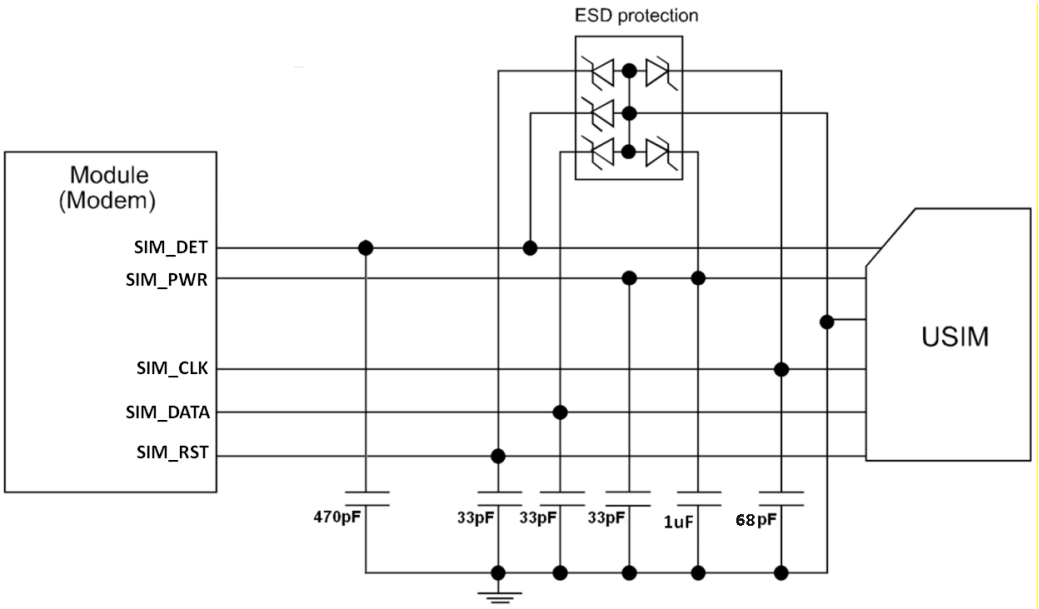
Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ.(V)	Max.(V)	Comments
36	UIM_PWR	PO	USIM POWER	-	1.75	1.8	1.98	UIM_PWR=1.8 V
				-	2.75	2.85	3.3	UIM_PWR=2.85 V

3.6.2 Circuit Recommended for the USIM Card Interface

As the ME936 module is not equipped with an USIM socket, you need to place an USIM socket on the user interface board.

Figure 3-26 shows the circuit of the USIM card interface.

Figure 3-26 Circuit of the USIM card interface



CAUTION

- The ESD protection component should choose low capacitance. The capacitance of the component should be **less than 10 pF.**
- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the USIM socket should be placed near the M.2 interface (it is recommended that the PCB circuit connects the M.2 interface and the USIM socket does not exceed 100 mm), because a long circuit may lead to wave distortion, thus affecting signal quality.
- It is recommended that you wrap the area adjacent to the SIM_CLK and SIM_DATA signal wires with ground. The Ground pin of the USIM socket and the Ground pin of the USIM card must be well connected to the power Ground pin supplying power to the ME936 module.
- A 100 nF capacitor (0402 package is recommended so that larger capacitance such as 1 uF can be employed if necessary) and a 33 pF capacitor are placed between the SIM_PWR and Ground pins in parallel. Two 33 pF capacitors are respectively placed between the SIM_DATA and Ground pins, the SIM_RST and Ground pins. And one 68 pF capacitor is placed between the SIM_CLK and Ground pins in parallel to filter interference from RF signals.
- It is recommended to take electrostatic discharge (ESD) protection measures near the USIM card socket. Transient voltage suppressor diode should be placed as close as possible to the USIM socket, and the Ground pin of the ESD protection component is well connected to the power Ground pin that supplies power to the ME936 module.

3.7 Tunable Antenna Control

Huawei M.2 module provides the tunable antenna function, which uses relevant GPIO interfaces to match the impedance of antenna and transmitter.

According to customer's requirement, Huawei M.2 module provides the tunable antenna solution. The solution contains two parts: hardware section and software section.

3.7.1 Hardware section

Huawei M.2 module provides four GPIO interfaces, which can be set to output high or low level in accordance with the customer's requirement. Through different output levels of four GPIO interfaces, the host can implement tuning the antenna efficiency.

3.7.2 Software section

Huawei M.2 module provides an AT command interface. Customers can use the AT command interface to tune the antenna efficiency and get the configuration of different bands. These configurations can be written into the firmware of the module. The module will control the output level of GPIO interfaces according to these configurations.

Take care that we should use the software section and hardware section together. Software section is used to debug the function and create the GPIO configuration. Hardware section is used to control the antenna.

Table 3-11 List of ANTCTL pins

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
59	ANTCTL0	O	Tunable antenna control signal, bit 0. It is a push-pull type GPIO.	V_{OH}	1.35	1.8		-
				V_{OL}	0	-	0.45	-
61	ANTCTL1	O	Tunable antenna control signal, bit 1. It is a push-pull type GPIO.	V_{OH}	1.35	1.8	-	-
				V_{OL}	0	-	0.45	-
63	ANTCTL2	O	Tunable antenna control signal, bit 2. It is a push-pull type GPIO.	V_{OH}	1.35	-	-	-
				V_{OL}	0	-	0.45	-
65	ANTCTL3	O	Tunable antenna control signal, bit 3. It is a push-pull type GPIO.	V_{OH}	1.35	1.8	-	-
				V_{OL}	0	-	0.45	-

3.8 Config Pins

The module provides 4 config pins. ME936 is configured as WWAN-SSIC 0.

Table 3-12 List of CONFIG pins

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
1	CONFIG_3	PI	**Connected to Ground internally.** ME936 is configured as WWAN-SSIC 0.	-	-	0	-	-
21	CONFIG_0	PI	**Not Connected internally.** ME936 is configured as WWAN-SSIC 0.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
69	CONFIG_1	O	**Connected to Ground internally.** ME936 is configured as WWAN-SSIC 0.	-	-	0	-	-
75	CONFIG_2	O	**Connected to Ground internally.** ME936 is configured as WWAN-SSIC 0.	-	-	0	-	-

In the M.2 specification, the 4 pins are defined as Table 3-13 .

Table 3-13 List of config pins

Config_0 (Pin 21)	Config_1 (Pin 69)	Config_2 (Pin 75)	Config_3 (Pin 1)	Module type and Main host interface	Port Configuration
Ground	Ground	Ground	Ground	SSD-SATA	N/A
Ground	NC	Ground	Ground	SSD-PCIe	N/A
NC	**Ground**	**Ground**	**Ground**	**WWAN-SSIC**	**0**
NC	NC	NC	NC	No Module present	N/A

The GPIO0–7 pins have configurable assignments. There are 4 possible functional pin out configurations. These 4 configurations are called Port Config0~3. In each Port Configuration, each GPIO is defined as a specific functional pin. The GPIO pin assignment can see in Table 3-14 . ME936 supports Config0. But the audio function is not implemented in ME936.

Table 3-14 GPIO Pin Function Assignment per Port Configuration

GPIO Pin	Port Config0 (GNSS+Audio ver1)
GPIO_0 (Pin 40)	GNSS_SCL
GPIO_1 (Pin 42)	GNSS_SDA
GPIO_2 (Pin 44)	GNSS_I2C_IRQ
GPIO_3 (Pin 46)	SYSCLK
GPIO_4 (Pin 48)	TX_Blanking
GPIO_5 (Pin 20)	Audio_0 (not supported)
GPIO_6 (Pin 22)	Audio_1 (not supported)
GPIO_7 (Pin 24)	Audio_2 (not supported)

3.9 NC Pins

The module has some NC pins. All of NC pins are not connected in the module.

Table 3-15 List of NC pins

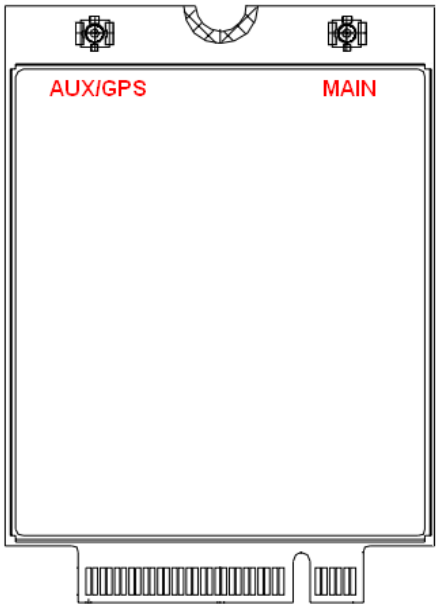
Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
28, 29, 31, 35, 37, 38, 41, 43, 47, 49, 50, 52, 53, 54, 55, 56, 58, 68	NC	-	Not connected	-	-	-	-	-

3.10 RF Antenna Interface

3.10.1 RF Connector Location

ME936 provides 2 antenna connectors for connecting the external antennas.

Figure 3-27 RF antenna connectors



3.10.2 Coaxial RF Connector Guidelines

- The antenna interface must be used with coaxial cables with characteristic impedance of 50 Ω.

- The ME936 module supports the buckled RF connector antenna connection methods: buckled RF connector MM4829-2702RA4 by MURATA or other equivalent connectors.

Figure 3-28 shows the RF connector dimensions.

Figure 3-28 RF connector dimensions

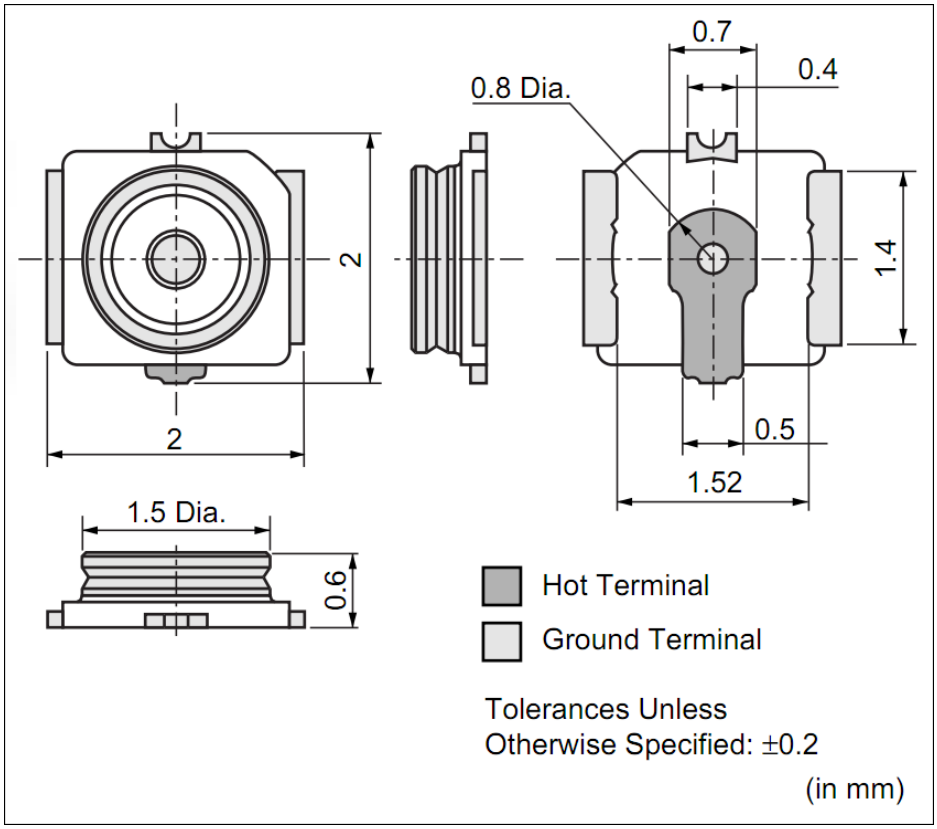


Table 3-16 The major specifications of the RF connector

Rated Condition		Environmental Condition
Frequency range	DC to 6 GHz	Temperature range: –40°C to +85°C
Characteristic impedance	50 Ω	

There are two kinds of coaxial cables mating the RF connector in the ME936.

Figure 3-29 shows the specifications of 0.81 mm coaxial cable mating the recommended RF connector.

Figure 3-29 Specifications of 0.81 mm coaxial cable mating with the RF connector

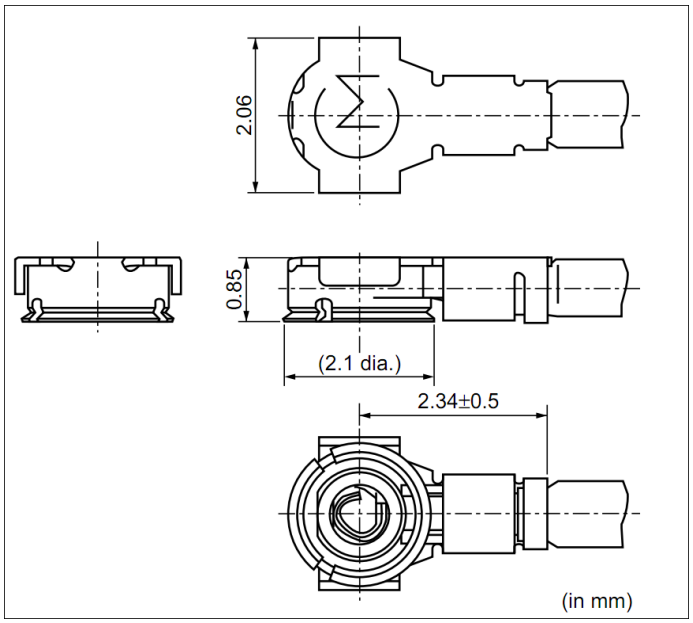


Figure 3-30 shows the connection between the RF connector and the 0.81 mm cable.

Figure 3-30 Connection between the RF connector and the 0.81 mm cable

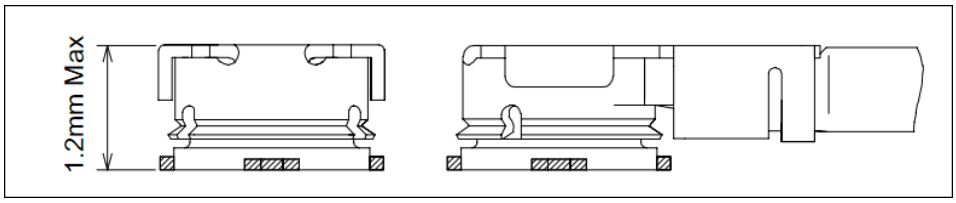


Figure 3-31 shows the specifications of 1.13 mm coaxial cable mating the recommended RF connector.

Figure 3-31 Specifications of 1.13 mm coaxial cable mating with the RF connector

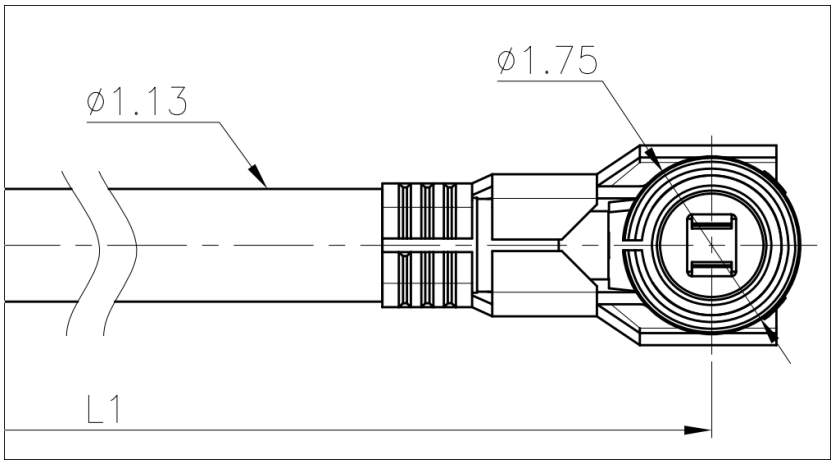
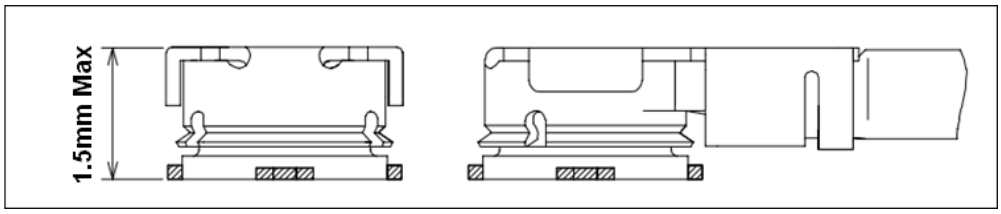


Figure 3-32 shows the connection between the RF connector and the 1.13 mm cable.

Figure 3-32 Connection between the RF connector and the 1.13 mm cable



4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the ME936 module, including:

- Operating Frequencies
- Conducted RF Measurement
- Conducted Rx Sensitivity and Tx Power

4.2 Operating Frequencies

Table 4-1 shows the RF bands supported by ME936.

Table 4-1 RF bands

Operating Band	Tx	Rx
UMTS Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
UMTS Band 4 (AWS)	1710 MHz–1755 MHz	2110 MHz–2155 MHz
UMTS Band 5	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band 8	880 MHz–915 MHz	925 MHz–960 MHz
GSM 850	824 MHz–849 MHz	869 MHz–894 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800 (DCS)	1710 MHz–1785 MHz	1805 MHz–1880 MHz
GSM 1900 (PCS)	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band 3	1710 MHz–1785 MHz	1805 MHz–1880 MHz

Operating Band	Tx	Rx
LTE Band 4	1710 MHz–1755 MHz	2110 MHz–2155 MHz
LTE Band 5	824 MHz–849 MHz	869 MHz–894 MHz
LTE Band 7	2500 MHz–2570 MHz	2620 MHz–2690 MHz
LTE Band 8	880 MHz–915 MHz	925 MHz–960 MHz
LTE Band 13	777 MHz–787 MHz	746 MHz–756 MHz
LTE Band 17	704 MHz–716 MHz	734 MHz–746 MHz
LTE Band 20	832 MHz–862 MHz	791 MHz–821 MHz
GPS L1	-	1574.42 MHz–1576.42 MHz
GLONASS L1	-	1597.55 MHz–1605.89 MHz

4.3 Conducted RF Measurement

4.3.1 Test Environment

Test instrument	R&S CMU200, R&S CMW500, Agilent E5515C, GSS6700
Power supply	Keithley 2303, Agilent 66319
RF cable for testing	Rosenberger Precision Microwave Cable
Murata coaxial cable	MXHP32HP1000

NOTE

- The compensation for different frequency bands relates to the cable and the test environment.
- The instrument compensation needs to be set according to the actual cable conditions.

4.3.2 Test Standards

Huawei modules meet 3GPP TS 51.010-1, 3GPP TS 34.121-1 and 3GPP TS 36.521-1, test standards. Each module passes strict tests at the factory and thus the quality of the modules is guaranteed.

4.4 Conducted Rx Sensitivity and Tx Power

4.4.1 Conducted Receive Sensitivity

The conducted receive sensitivity is a key parameter that indicates the receiver performance of ME936.

The **3GPP Protocol Claim** column in Table 4-2 lists the required minimum values, and the **Test Value** column lists the tested values of ME936.

Table 4-2 ME936 conducted Rx sensitivity

Band	Typical Value	Note
GSM 850	–109.5	BER Class II < 2.44%
GSM 900	–109.5	BER Class II < 2.44%
DCS 1800	–110	BER Class II < 2.44%
PCS 1900	–109	BER Class II < 2.44%
WCDMA B1 Main Rx	–110.5	BER < 0.1%
WCDMA B2 Main Rx	–110	BER < 0.1%
WCDMA B4 Main Rx	–110.5	BER < 0.1%
WCDMA B5 Main Rx	–110.5	BER < 0.1%
WCDMA B8 Main Rx	–111	BER < 0.1%
LTE B1 RX	–101	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B2 RX	–101.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B3 RX	–101	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B4 RX	–101	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B5 RX	–101	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B7 RX	–99.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B8 RX	–102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B13 RX	–100	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B17 RX	–102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B20 RX	–101.5	Throughput ≥ 95%, 10 MHz Bandwidth

NOTE

1. Sensitivity of WCDMA and GSM are tested in the main port.
2. LTE sensitivity is tested in SIMO (Main + AUX), BW=10 MHz.

Table 4-3 ME936 GPS specifications

TTFF	Cold start	37s/–130 dBm
	Warm start	37s/–130 dBm
	Hot Start	1s/–130 dBm (GPS signal powers off 1s)
Sensitivity	Cold start	–144 dBm
	Tracking	–159 dBm

NOTE

1. The test values are the average of some test samples.
2. If GPS and LTE Band 13 of ME936 are enabled at the same time, the GPS performance may be affected and the module may not be positioned in the weak signals.

4.4.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of ME936. The conducted transmit power refers to the maximum power that the module tested at the antenna port can transmit. According to the 3GPP protocol, the required transmit power varies with the power class.

Table 4-4 lists the required ranges of the conducted transmit power of ME936. The tested values listed in the Test Value column must range from the minimum power to the maximum power.

Table 4-4 ME936 conducted Tx power

Item		**3GPP Protocol Claim (dBm)**	**ME936 Test Value (dBm)**		
			Min.	**Typ.**	**Max.**
GSM850	GMSK (1Tx Slot)	31 to 35	31.5	32.5	33.5
	8PSK (1Tx Slot)	24 to 30	25	26	27
GSM900	GMSK (1Tx Slot)	31 to 35	31.5	32.5	33.5
	8PSK (1Tx Slot)	24 to 30	25	26	27
GSM1800	GMSK (1Tx Slot)	28 to 32	28.5	29.5	30.5
	8PSK (1Tx Slot)	23 to 29	24	25	26
GSM1900	GMSK (1Tx Slot)	28 to 32	28.5	29.5	30.5
	8PSK (1Tx Slot)	23 to 29	24	25	26
UMTS Band 1		21 to 25	22.5	23.5	24.5
UMTS Band 2		21 to 25	22.5	23.5	24.5
UMTS Band 4		21 to 25	22.5	23.5	24.5

Item	3GPP Protocol Claim (dBm)	ME936 Test Value (dBm)		
		Min.	Typ.	Max.
UMTS Band 5	21 to 25	22.5	23.5	24.5
UMTS Band 8	21 to 25	22.5	23.5	24.5
LTE Band 1	21 to 25	22	23	24
LTE Band 2	21 to 25	22	23	24
LTE Band 3	21 to 25	22	23	24
LTE Band 4	21 to 25	22	23	24
LTE Band 5	21 to 25	22	23	24
LTE Band 7	21 to 25	22	23	24
LTE Band 8	21 to 25	22	23	24
LTE Band 13	21 to 25	22	23	24
LTE Band 17	21 to 25	22	23	24
LTE Band 20	21 to 25	22	23	24

NOTE
Maximum Power Reduction (MPR and AMPR) of LTE is according to 3GPP TS 36.521-1 as below.

Modulation	RB Allocation	MPR (dB)
QPSK	>1 RB, ≤ Partial RB	0
QPSK	> Partial RB	≤ 1
16QAM	≥ 1 RB, ≤ Partial RB	≤ 1
16QAM	> Partial RB	≤ 2

4.5 Antenna Design Requirements

4.5.1 Antenna Design Indicators

Antenna Efficiency

Antenna efficiency is the ratio of the input power to the radiated or received power of an antenna. The radiated power of an antenna is always lower than the input power due to the following antenna losses: return loss, material loss, and coupling loss. The

efficiency of an antenna relates to its electrical dimensions. To be specific, the antenna efficiency increases with the electrical dimensions. In addition, the transmission cable from the antenna port of ME936 to the antenna is also part of the antenna. The cable loss increases with the cable length and the frequency. It is recommended that the cable loss is as low as possible, for example, MXHP32HP1000 made by Murata or equivalent.

The following antenna efficiency (free space) is recommended for ME936 to ensure high radio performance of the module:

- Efficiency of the primary antenna: ≥ 40% (working frequency below 960 MHz); ≥ 50% (working frequency above 1420 MHz)
- Efficiency of the secondary antenna: ≥ half of the efficiency of the primary antenna in receiving band (≥ 50% @ 1574.42 MHz–1605.89 MHz)

In addition, the efficiency should be tested with the transmission cable.

S11(VSWR) and S21

S11 indicates the degree to which the input impedance of an antenna matches the reference impedance (50 Ω). S11 shows the resonance feature and impedance bandwidth of an antenna. Voltage standing wave ratio (VSWR) is another expression of S11. S11 relates to the antenna efficiency. S11 can be measured with a vector analyzer.

The following S11 values are recommended for the antenna of ME936:

- S11 of the primary antenna ≤ –6 dB
- S11 of the secondary antenna ≤ –6 dB (≤ –10 dB @ 1574.42 MHz–1605.89 MHz)

In addition, S11 is less important than the efficiency, and S11 has not strong correlation to wireless performance.

S21 indicates the isolation between two antennas.

Isolation

For a wireless device with multiple antennas, the power of different antennas is coupled with each other. Antenna isolation is used to measure the power coupling. The power radiated by an antenna might be received by an adjacent antenna, which decreases the antenna radiation efficiency and affects the running of other devices. To avoid this problem, evaluate the antenna isolation as sufficiently as possible at the early stage of antenna design.

Antenna isolation depends on the following factors:

- Distance between antennas
- Antenna type
- Antenna direction

The primary antenna must be placed as near as possible to the ME936 to minimize the cable length. The secondary antenna needs to be installed perpendicularly to the primary antenna. The secondary antenna can be placed farther away from the ME936. Antenna isolation can be measured with a two-port vector network analyzer.

The following S21 values are recommended for the antenna on laptops:

- Isolation between the primary and secondary antennas ≤ –12 dB(≤ –15 dB @ 1574.42 MHz–1605.89 MHz)
- Isolation between the primary (secondary) antenna and the Wi-Fi antenna ≤ –15 dB

Polarization

The polarization of an antenna is the orientation of the electric field vector that rotates with time in the direction of maximum radiation.

The linear polarization is recommended for the antenna of ME936.

Radiation Pattern

The radiation pattern of an antenna reflects the radiation features of the antenna in the remote field region. The radiation pattern of an antenna commonly describes the power or field strength of the radiated electromagnetic waves in various directions from the antenna. The power or field strength varies with the angular coordinates (θ and φ), but is independent of the radial coordinates.

The radiation pattern of half wave dipole antennas is omnidirectional in the horizontal plane, and the incident waves of base stations are often in the horizontal plane. For this reason, the receiving performance is optimal.

The following radiation patterns are recommended for the antenna of ME936.
Primaryantenna: omnidirectional.

Secondary antenna: omnidirectional (Upper Hem Partial Radiated Power ≥ 40% @ 1574.42 MHz–1605.89 MHz)

In addition, the secondary antenna’s pattern should be complementary with the primary antenna’s pattern.

Gain and Directivity

The radiation pattern of an antenna represents the field strength of the radiated electromagnetic waves in all directions, but not the power density that the antenna radiates in the specific direction. The directivity of an antenna, however, measures the power density that the antenna radiates.

Gain, as another important parameter of antennas, correlates closely to the directivity. The gain of an antenna takes both the directivity and the efficiency of the antenna into account. The appropriate antenna gain prolongs the service life of relevant batteries.

The following antenna gain is recommended for ME936.

- Gain of the master antenna ≤ 2.5 dBi
- Gain of the secondary antenna ≤ 2.5 dBi

ECC of the antenna

ECC is short for Envelope Correlation Coefficient. It is the cross-correlation value of the complex patterns of the master and diversity antenna. It indicates how similar the magnitude and the phase patterns of the two antennas are. If two antennas have no similarity, the ECC should be zero. Actually, the less ECC, the better diversity performance.

The following ECC is recommended for ME936.

- ECC ≤ 0.5 (working frequency below 0.96 GHz)
- ECC ≤ 0.3 (working frequency above 1.4 GHz)

NOTE

- The antenna consists of the antenna body and the relevant RF transmission cable. Take the RF transmission cable into account when measuring any of the preceding antenna indicators.
- Huawei cooperates with various famous antenna suppliers who are able to make suggestions on antenna design, for example, Amphenol, Skycross, etc.

4.5.2 Interference

Besides the antenna performance, the interference on the user board also affects the radio performance (especially the TIS) of the module. To guarantee high performance of the module, the interference sources on the user board must be properly controlled.

On the user board, there are various interference sources, such as the LCD, CPU, audio circuits, and power supply. All the interference sources emit interference signals that affect the normal operation of the module. For example, the module sensitivity can be decreased due to interference signals. Therefore, during the design, need to consider how to reduce the effects of interference sources on the module. You can take the following measures: Use an LCD with optimized performance; shield the LCD interference signals; shield the signal cable of the board; or design filter circuits.

Huawei is able to make technical suggestions on radio performance improvement of the module.

4.5.3 Antenna Requirements

The antenna for ME936 must fulfill the following requirements:

Table 4-5 Antenna requirements of ME936

Antenna Requirements	
Frequency range	Depending on frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)

Antenna Requirements	
Bandwidth of primary antenna	70 MHz in GSM850 80 MHz in GSM900 170 MHz in DCS 140 MHz in PCS 250 MHz in UMTS 2100/LTE Band 1 140 MHz in UMTS 1900/LTE Band 2 170 MHz in LTE Band 3 445 MHz in UMTS 1700 (AWS)/LTE Band 4 70 MHz in UMTS 850/LTE Band 5 80 MHz in UMTS 800/LTE Band 8 190 MHz in LTE Band 7 41 MHz in LTE Band 13 42 MHz in LTE Band 17 71 MHz in LTE Band 20
Bandwidth of secondary antenna	60 MHz in UMTS 2100/LTE Band 1 60 MHz in UMTS 1900/LTE Band 2 75 MHz in LTE Band 3 45MHz in UMTS 1700(AWS)/LTE Band 4 25 MHz in UMTS 850/LTE Band 5 35 MHz in UMTS 800/LTE Band 8 70 MHz in LTE Band 7 10MHz in LTE Band 13 12MHz in LTE Band 17 30 MHz in LTE Band 20 35 MHz in GNSS
Gain	≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max.	≤ 3:1 (≤ 2:1 @ 1574.42 MHz–1605.89 MHz)
VSWR recommended	≤ 2:1 (≤ 1.5:1 @ 1574.42 MHz–1605.89 MHz)

5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the ME936 module, including:

- Absolute Ratings
- Operating and Storage Temperatures and Humidity
- Power Supply Features
- Reliability Features
- EMC and ESD Features

5.2 Absolute Ratings

WARNING

Table 5-1 lists the absolute ratings for the ME936 module. Using the ME936 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings for the ME936 module

Symbol	Specification	Min.	Max.	Unit
3.3V	External power voltage	–0.3	4.4	V

5.3 Operating and Storage Temperatures and Humidity

Table 5-2 lists the operating and storage temperatures and humidity for the ME936 module.

Table 5-2 Operating and storage temperatures and humidity for the ME936 module

Specification	Min.	Max.	Unit
Normal working temperatures[1]	–10	+55	°C
Extended temperatures[2]	–20	+70	°C
Ambient temperature for storage	–40	+85	°C

NOTE

[1]: When the ME936 module works at this temperature, all its RF indexes comply with the 3GPP TS 45.005 specifications.

[2]: When the ME936 module works at this temperature, **NOT** all its RF indexes comply with the 3GPP TS 45.005 specifications.

5.4 Power Supply Features

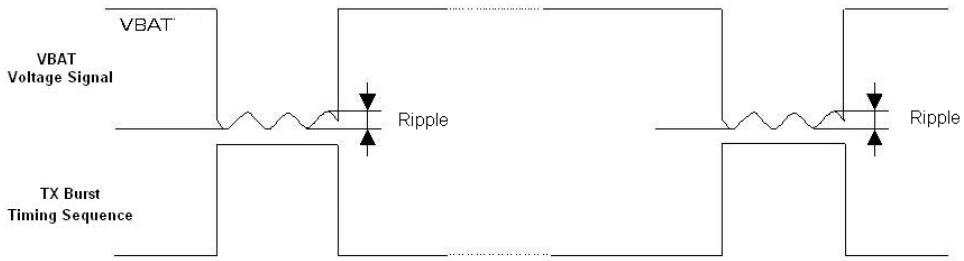
5.4.1 Input Power Supply

Table 5-3 lists the requirements for input power of the ME936 module.

Table 5-3 Requirements for input power for the ME936 module

Parameter	Min.	Typ.	Max.	Ripple	Unit
3.3V	3.135	3.3	4.4	0.05	V

Figure 5-1 Power Supply During Burst Emission



NOTE

The minimum value of the power supply must be guaranteed during the burst (with 2.5 A Peak in GPRS or EGPRS mode).

Table 5-4 Requirements for input current of the ME936 module

Power	Peak (Maximum) Max Avg@100uS	Normal (Maximum) Max Avg@1S
3.3V	2500 mA	1100 mA

5.4.2 Power Consumption

The power consumption of ME936 in different scenarios are respectively listed in Table 5-5 to Table 5-9 .

The power consumption listed in this section are tested when the power supply of ME936 module is normal voltage (3.3 V), and all of test values are measured at room temperature.

Table 5-5 Averaged power off DC power consumption of ME936

Description	Test Value (uA)	Notes/Configuration
	Typical	
Power off	150	Normal voltage (3.3 V) is ON and Power_On_Off pin is pulled low

Table 5-6 Averaged standby DC power consumption of ME936 (WCDMA/HSDPA/LTE/GSM)

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
Sleep	LTE (sleep)	LTE bands	2.4	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	HSPA+/WCDMA (sleep)	UMTS bands	2.2	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	GPRS/EDGE (sleep)	GSM bands	2.3	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
	Radio Off (sleep)	All bands	1.7	Module is powered up. RF is disabled. USB is in suspend.
Idle	LTE (idle)	LTE bands	53	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, no data is transmitted. USB is in active.
	HSPA+/WCDMA (idle)	UMTS bands	51	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, no data is transmitted. USB is in active.
	GPRS/EDGE (idle)	GSM bands	52	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network, no data is transmitted. USB is in active.
	Radio Off (idle)	All bands	51	Module is powered up. RF is disabled. USB is in active.

Table 5-7 Averaged Data Transmission DC power consumption of ME936 (WCDMA/HSDPA/LTE)

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
WCDMA	Band I (IMT 2100)	180	0 dBm Tx Power
		227	10 dBm Tx Power
		827	23.5 dBm Tx Power
	Band II (PCS 1900)	182	0 dBm Tx Power
		234	10 dBm Tx Power
		940	23.5 dBm Tx Power

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
	Band IV (1700 MHz)	180	0 dBm Tx Power
		217	10 dBm Tx Power
		707	23.5 dBm Tx Power
	Band V (850 MHz)	172	0 dBm Tx Power
		210	10 dBm Tx Power
		765	23.5 dBm Tx Power
	Band VIII (900 MHz)	176	0 dBm Tx Power
		215	10 dBm Tx Power
		735	23.5 dBm Tx Power
HSDPA	Band I (IMT2100)	210	0 dBm Tx Power
		262	10 dBm Tx Power
		855	23.5 dBm Tx Power
	Band II (PCS 1900)	210	0 dBm Tx Power
		265	10 dBm Tx Power
		970	23.5 dBm Tx Power
	Band IV (1700 MHz)	210	0 dBm Tx Power
		258	10 dBm Tx Power
		810	23.5 dBm Tx Power
	Band V (850 MHz)	200	0 dBm Tx Power
		240	10 dBm Tx Power
		795	23.5 dBm Tx Power
	Band VIII (900 MHz)	200	0 dBm Tx Power
		245	10 dBm Tx Power
		755	23.5 dBm Tx Power
LTE	Band I	393	0 dBm Tx Power
		446	10 dBm Tx Power
		861	23 dBm Tx Power
	Band II	390	0 dBm Tx Power

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
		455	10 dBm Tx Power
		955	23 dBm Tx Power
	Band III	390	0 dBm Tx Power
		467	10 dBm Tx Power
		867	23 dBm Tx Power
	Band IV	390	0 dBm Tx Power
		445	10 dBm Tx Power
		910	23 dBm Tx Power
	Band V	330	0 dBm Tx Power
		370	10 dBm Tx Power
		785	23 dBm Tx Power
	Band VII	400	0 dBm Tx Power
		480	10 dBm Tx Power
		1040	23 dBm Tx Power
	Band VIII	410	0 dBm Tx Power
		445	10 dBm Tx Power
		990	23 dBm Tx Power
	Band XIII	332	0 dBm Tx Power
		370	10 dBm Tx Power
		800	23 dBm Tx Power
	Band XVII	335	0 dBm Tx Power
		370	10 dBm Tx Power
		745	23 dBm Tx Power
	Band XX	3	0 dBm Tx Power
		415	10 dBm Tx Power
		757	23 dBm Tx Power

Table 5-8 DC power consumption of ME936 (GPRS/EDGE)

Description	Test Value (mA)	PCL	Configuration
	Typical		
GPRS850	285	5	1 Up/1 Down
	390		2 Up/1 Down
	540		4 Up/1 Down
	150	10	1 Up/1 Down
	246		2 Up/1 Down
	365		4 Up/1 Down
GPRS900	290	5	1 Up/1 Down
	395		2 Up/1 Down
	540		4 Up/1 Down
	147	10	1 Up/1 Down
	225		2 Up/1 Down
	365		4 Up/1 Down
GPRS1800	205	0	1 Up/1 Down
	283		2 Up/1 Down
	355		4 Up/1 Down
	108	10	1 Up/1 Down
	136		2 Up/1 Down
	180		4 Up/1 Down
GPRS1900	213	0	1 Up/1 Down
	298		2 Up/1 Down
	380		4 Up/1 Down
	112	10	1 Up/1 Down
	145		2 Up/1 Down
	190		4 Up/1 Down
EDGE850	277	8	1 Up/1 Down
	350		2 Up/1 Down
	425		4 Up/1 Down
	125	15	1 Up/1 Down
	165		2 Up/1 Down

Description	Test Value (mA)	PCL	Configuration
	Typical		
	235		4 Up/1 Down
EDGE900	276	8	1 Up/1 Down
	375		2 Up/1 Down
	475		4 Up/1 Down
	130	15	1 Up/1 Down
	180		2 Up/1 Down
	255		4 Up/1 Down
EDGE1800	225	2	1 Up/1 Down
	305		2 Up/1 Down
	405		4 Up/1 Down
	130	10	1 Up/1 Down
	165		2 Up/1 Down
	225		4 Up/1 Down
EDGE1900	230	2	1 Up/1 Down
	320		2 Up/1 Down
	425		4 Up/1 Down
	135	10	1 Up/1 Down
	170		2 Up/1 Down
	230		4 Up/1 Down

NOTE

All power consumption test configuration can be referenced by GSM Association Official Document TS.09: Battery Life Measurement and Current Consumption Technique.

- LTE test condition: 10/20 MHz bandwidth, QPSK, 1 RB when testing max Tx power and full RB when testing 0 dBm or 10 dBm;
- Test condition: For Max Tx power, see 4.4.2 Conducted Transmit Power, they are listed in Table 4-4 ; for Max data throughput, see 2.2 Function Overview, they are listed in Table 2-1 .

Table 5-9 Averaged GPS operation DC power consumption of ME936

Description	Test Value (mA)	Notes/Configuration
	Typical	
GPS fixing	95	RF is disabled. USB is in active. The Rx power of GPS is –130 dBm.
GPS tracking	95	

5.5 Reliability Features

Table 5-10 lists the test conditions and results of the reliability of the ME936 module.

Table 5-10 Test conditions and results of the reliability of the ME936 module

Item		Test Condition	Standard	Sample size	Results
Stress	Low-temperature storage	• Temperature: –40ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A119-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High-temperature storage	• Temperature: 85ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A103-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Low-temperature operating	• Temperature: –20ºC • Operation mode: working with service connected • Test duration: 24 h	IEC60068-2-1	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High-temperature operating	• Temperature: 70ºC • Operation mode: working with service connected • Test duration: 24 h	JESD22-A108-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Damp heat cycling	• High temperature: 55ºC • Low temperature: 25ºC • Humidity: 95%±3% • Operation mode: working with service connected • Test duration: 6 cycles; 12 h+12 h/cycle	JESD22-A101-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok

Item		Test Condition	Standard	Sample size	Results
	Thermal shock	• Low temperature: –40ºC • High temperature: 85ºC • Temperature change interval: < 20s • Operation mode: no power • Test duration: 100 cycles; 15 min+15 min/cycle	JESD22-A106-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Salty fog test	• Temperature: 35°C • Density of the NaCl solution: 5%±1% • Operation mode: no power, no package • Test duration: Spraying interval: 8 h Exposing period after removing the salty fog environment: 16 h	JESD22-A107-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Sine vibration	• Frequency range: 5 Hz to 200 Hz • Acceleration: 1 Grms • Frequency scan rate: 0.5 oct/min • Operation mode: working with service connected • Test duration: 3 axial directions. 2 h for each axial direction. • Operation mode: working with service connected	JESD22-B103-B	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Shock test	• Half-sine wave shock • Peak acceleration: 30 Grms • Shock duration: 11 ms • Operation mode: working with service connected • Test duration: 6 axial directions. 3 shocks for each axial direction. • Operation mode: working with service connected	JESD-B104-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok

Item		Test Condition	Standard	Sample size	Results
	Drop test	• 0.8 m in height. Drop the module on the marble terrace with one surface facing downwards, six surfaces should be tested. • Operation mode: no power, no package	IEC60068-2-32	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
Life	High temperature operating life	• Temperature: 70ºC • Operation mode: working with service connected • Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A108-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High temperature & high humidity	• High temperature: 85ºC • Humidity: 85% • Operation mode: powered on and no working • Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A110-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok Cross section: ok
	Temperature cycle	• High temperature: 85ºC • Low temperature: –40ºC • Temperature change slope: 6ºC/min • Operation mode: no power • Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A104-C	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok Cross section: ok
ESD	HBM (Human Body Model)	• 1 kV (Class 1 B) • Operation mode: no power	JESD22-A114-D	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	ESD with DVK (or embedded in the host)	• Contact Voltage: ±2 kV, ±4 kV • Air Voltage : ±2 kV, ±4 kV, ±8 kV • Operation mode: working with service connected	IEC61000-4-2	2 pcs	Visual inspection: ok Function test: ok RF specification: ok

NOTE
Groups ≥ 2

5.6 EMC and ESD Features

The following are the EMC design comments:

- Attention should be paid to static control in the manufacture, assembly, packaging, handling, and storage process to reduce electrostatic damage to HUAWEI module.
- RSE (Radiated Spurious Emission) may exceed the limit defined by EN301489 if the antenna port is protected by TVS (Transient Voltage Suppressor), which is resolved by making some adjustments on RF match circuit.
- TVS should be added on the USB port for ESD protection, and the parasitic capacitance of TVS on D+/D- signal should be less than 2 pF. Common-mode inductor should be added in parallel on D+/D- signal.
- TVS should be added on the SIM interface for ESD protection. The parasitic capacitance of TVS on SIM signal should be less than 10 pF.
- Resistors in parallel and a 10 nF capacitor should be added on RESET# and Power_On_Off signal to avoid shaking, and the distance between the capacitor and the related pin should be less than 100 mil.
- PCB routing should be V-type rather than T-type for TVS.
- An integrated ground plane is necessary for EMC design.

The following are the requirements of ESD environment control:

- The electrostatic discharge protected area (EPA) must have an ESD floor whose surface resistance and system resistance are greater than 1×10^4 Ω while less than 1×10^9 Ω.
- The EPA must have a sound ground system without loose ground wires, and the ground resistance must be less than 4 Ω.
- The workbench for handling ESD sensitive components must be equipped with common ground points, the wrist strap jack, and ESD pad. The resistance between the jack and common ground point must be less than 4 Ω. The surface resistance and system resistance of the ESD pad must be less than 1×10^9 Ω.
- The EPA must use the ESD two-circuit wrist strap, and the wrist strap must be connected to the dedicated jack. The crocodile clip must not be connected to the ground.
- The ESD sensitive components, the processing equipment, test equipment, tools, and devices must be connected to the ground properly. The indexes are as follows:
  - Hard ground resistance < 4 Ω
  - 1×10^5 Ω ≤ Soft ground resistance < 1×10^9 Ω
  - 1×10^5 Ω ≤ ICT fixture soft ground resistance < 1×10^{11} Ω
  - The electronic screwdriver and electronic soldering iron can be easily oxidized. Their ground resistance must be less than 20 Ω.
- The parts of the equipment, devices, and tools that touch the ESD sensitive components and moving parts that are close to the ESD sensitive components must be made of ESD materials and have sound ground connection. The parts that are not made of ESD materials must be handled with ESD treatment, such as painting the ESD coating or ionization treatment (check that the friction voltage is less than 100 V).

- Key parts in the production equipment (parts that touch the ESD sensitive components or parts that are within 30 cm away from the ESD sensitive components), including the conveyor belt, conveyor chain, guide wheel, and SMT nozzle, must all be made of ESD materials and be connected to the ground properly (check that the friction voltage is less than 100 V).
- Engineers that touch IC chips, boards, modules, and other ESD sensitive components and assemblies must wear ESD wrist straps, ESD gloves, or ESD finger cots properly. Engineers that sit when handling the components must all wear ESD wrist straps.
- Noticeable ESD warning signs must be attached to the packages and placement areas of ESD sensitive components and assemblies.
- Boards and IC chips must not be stacked randomly or be placed with other ESD components.
- Effective shielding measures must be taken on the ESD sensitive materials that are transported or stored outside the EPA.

NOTE
The HUAWEI ME936 module does not include any protection against overvoltage.

6 Mechanical Specifications

6.1 About This Chapter

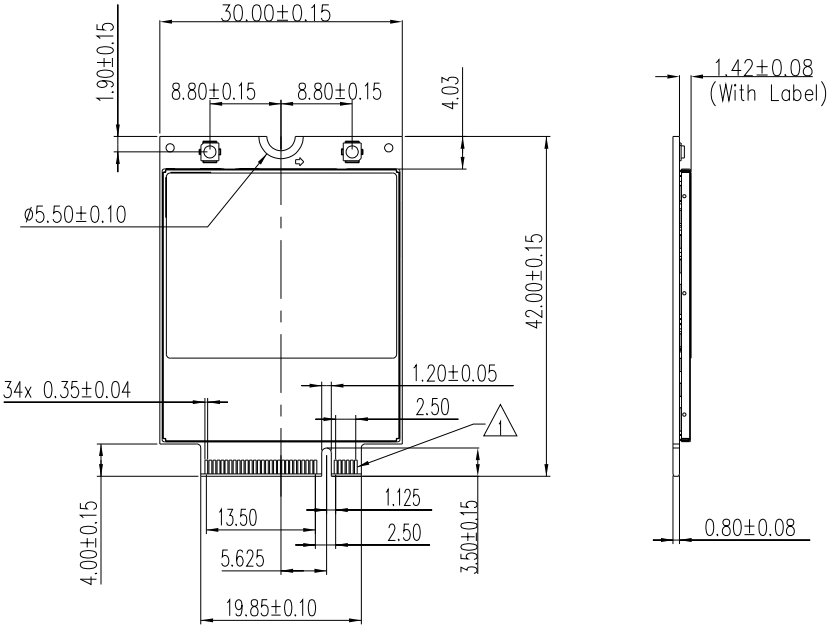
This chapter describes the following aspects of the ME936 module:

- Dimensions of ME936
- Label
- Packing System

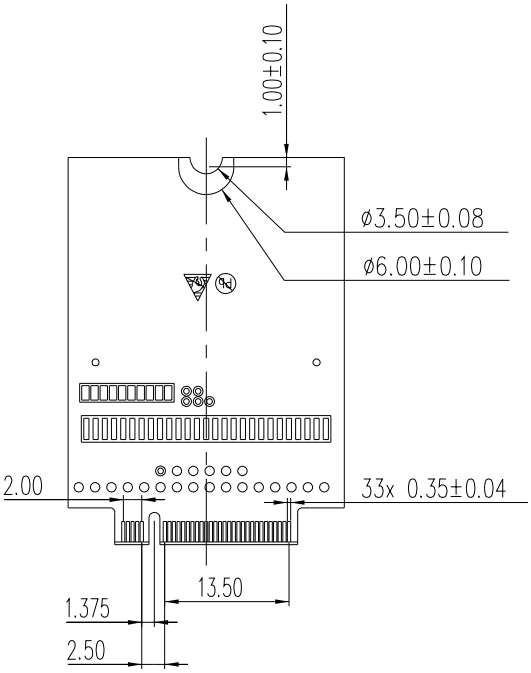
6.2 Dimensions of ME936

Figure 6-1 shows the dimensions of ME936 in details.

Figure 6-1 Dimensions of ME936 (unit: mm)



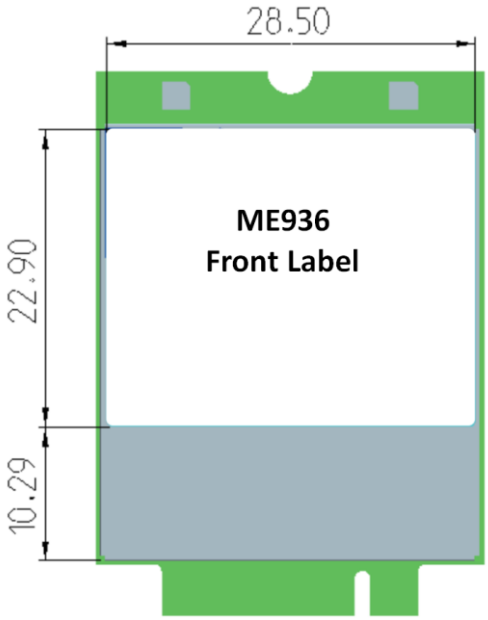
Top View



Bottom View

6.3 Label

Figure 6-2 Dimensions of front label (unit: mm)



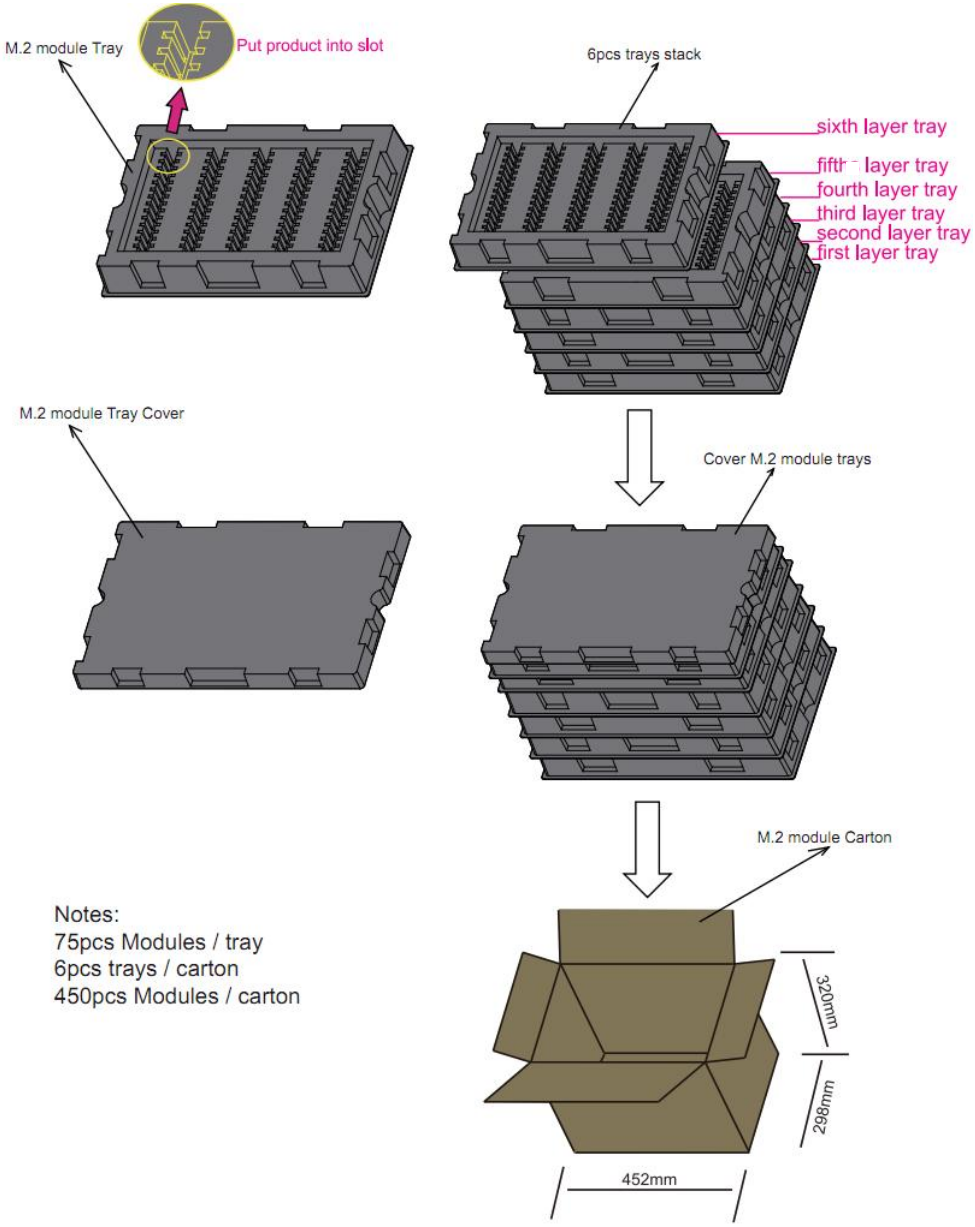
6.4 Packing System

HUAWEI M.2 module uses five layers ESD pallet, anti-vibration foam and vacuum packing into cartons. The package of HUAWEI modules complies with ISTA-2A.

ME936 package includes the blister tray, the blister tray cover, and the carton (with bottom and top clapboard).

The blister tray of the ME936 module package is shown as in the following figure. There are 75 pcs modules for every tray, 6 pcs trays in one carton, and 450 pcs modules for every carton. And the blister tray cover covers the top tray.

Figure 6-3 Packet system



7 Installation

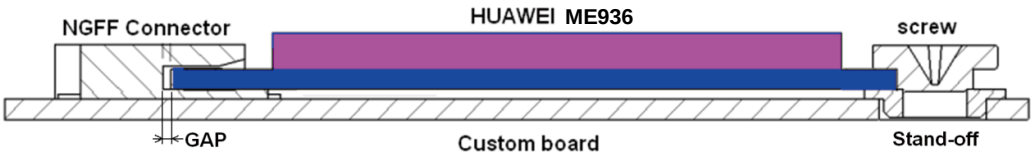
7.1 About This Chapter

This chapter describes the assembly of ME936, including:

- Connect ME936 to Board
- Antenna Plug

7.2 Connect ME936 to Board

Figure 7-1 Install ME936



It refers to M.2 specification.

The module will need a mechanical retention at the end of the board. The module specifies a 5.5 mm Dia. keep out zone at the end for attaching a screw.

The module Stand-off and mounting screw also serve as part of the module Electrical Ground path. The Stand-off should be connected directly to the ground plane on the platform. So that when the module is mounted and the mounting screw is screwed on to hold the module in place, this will make the electrical ground connection from the module to the platform ground plane.

CAUTION

The module could not be installed or removed when the host is powered on. Otherwise, it may result in permanent damage to the module.

7.3 Thermal Management

Because ME936 is very small, the dissipating heat is very important to it.

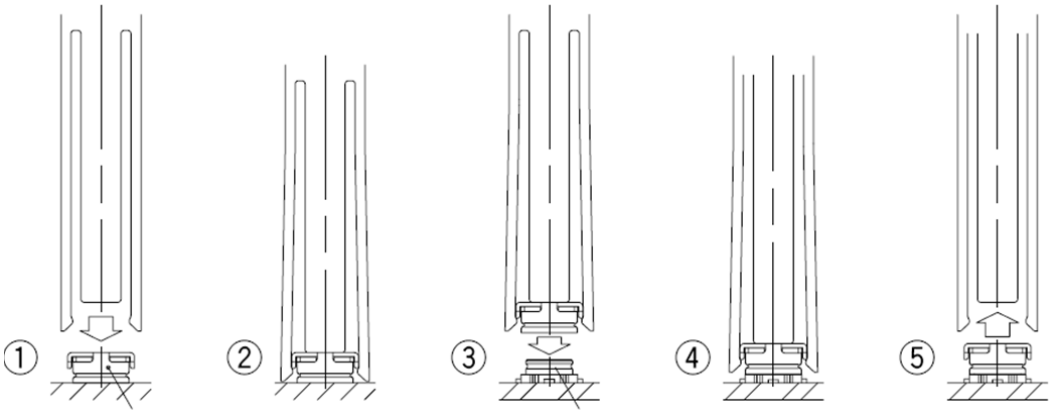
It has to take several means to ensure ME936 to meet the specification.

The methods are described as follow:

- The mounting screw is to hold the module in place, and connect the heat source to the platform ground plane of the custom board.
- About the custom board, it can afford larger and much more area of grounding layers to enhance cooling of the PCB and ensure that the heat spreads evenly in the PCB.
- The stand-off provides a thermal ground path. The design requirements for thermal are a material with a minimum conductivity of 50 watts per meter Kelvin and surface area of 22 Sq mm.
- The customer can add a heat sink on the model top surface, and this method can bring out much heat source of the module.

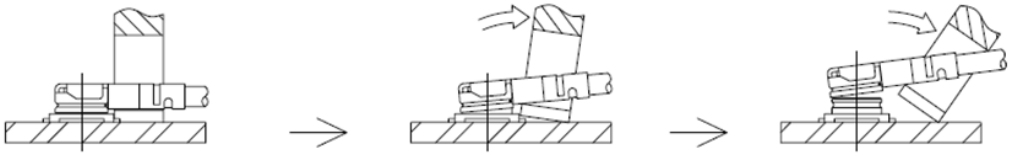
7.4 Antenna Plug

Figure 7-2 Mating the plug



1. Align the mating tool or the mating end of the tool over the plug end of the cable assembly.
2. Firmly place the tool over the plug until it is secured in the tool.
3. Place the plug cable assembly (held in the tool) over the corresponding receptacle.
4. Assure that the plug and receptacle are aligned press-down perpendicular to the mounting surface until both connectors are fully mated.
5. Remove the mating tool by pulling it up carefully.

Figure 7-3 Unmating the plug

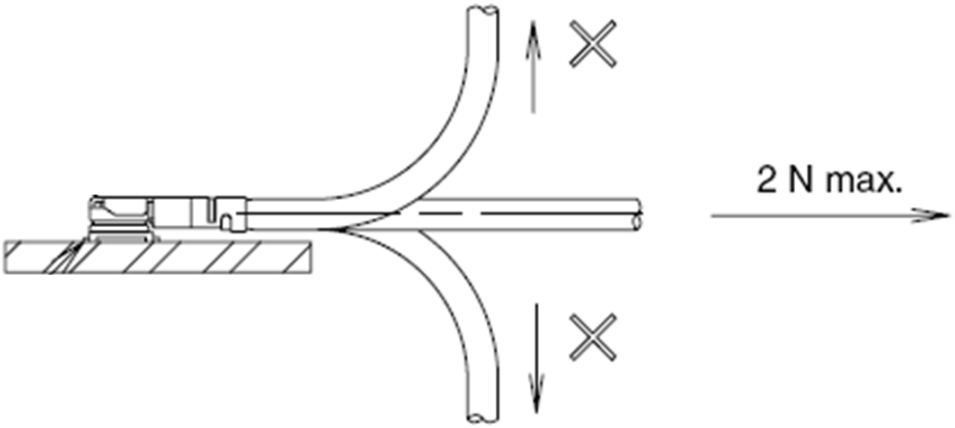


NOTE

- The extraction tool is recommended.
- Any attempt of unmating by pulling on the cable may result in damage and influence the mechanical/electrical performance.

It is not recommended to apply any pull forces after the bending of the cable, as described in Figure 7-4 .

Figure 7-4 Do not apply any pull forces after the bending of the cable



8 Certifications

8.1 About This Chapter

This chapter gives a general description of certifications of ME936.

8.2 Certifications

NOTE
Table 8-1 shows certifications the ME936 has been implemented. For more demands, please contact us for more details about this information.

Table 8-1 Product Certifications

Certification	Model name
	ME936
CE	√
FCC	√
NCC	√
A-TICK	√
IC	√
EU RoHS	√
PVC-Free	√
GCF	√
PTCRB	√
Halogen-free	√

9 Safety Information

Read the safety information carefully to ensure the correct and safe use of your wireless device. Applicable safety information must be observed.

9.1 Interference

Power off your wireless device if using the device is prohibited. Do not use the wireless device when it causes danger or interference with electric devices.

9.2 Medical Device

- Power off your wireless device and follow the rules and regulations set forth by the hospitals and health care facilities.
- Some wireless devices may affect the performance of the hearing aids. For any such problems, consult your service provider.
- Pacemaker manufacturers recommend that a minimum distance of 15 cm be maintained between the wireless device and a pacemaker to prevent potential interference with the pacemaker. If you are using an electronic medical device, consult the doctor or device manufacturer to confirm whether the radio wave affects the operation of this device.

9.3 Area with Inflammables and Explosives

To prevent explosions and fires in areas that are stored with inflammable and explosive devices, power off your wireless device and observe the rules. Areas stored with inflammables and explosives include but are not limited to the following:

- Gas station
- Fuel depot (such as the bunk below the deck of a ship)
- Container/Vehicle for storing or transporting fuels or chemical products
- Area where the air contains chemical substances and particles (such as granule, dust, or metal powder)
- Area indicated with the "Explosives" sign

- Area indicated with the "Power off bi-direction wireless equipment" sign
- Area where you are generally suggested to stop the engine of a vehicle

9.4 Traffic Security

- Observe local laws and regulations while using the wireless device. To prevent accidents, do not use your wireless device while driving.
- RF signals may affect electronic systems of motor vehicles. For more information, consult the vehicle manufacturer.
- In a motor vehicle, do not place the wireless device over the air bag or in the air bag deployment area. Otherwise, the wireless device may hurt you owing to the strong force when the air bag inflates.

9.5 Airline Security

Observe the rules and regulations of airline companies. When boarding or approaching a plane, power off your wireless device. Otherwise, the radio signal of the wireless device may interfere with the plane control signals.

9.6 Safety of Children

Do not allow children to use the wireless device without guidance. Small and sharp components of the wireless device may cause danger to children or cause suffocation if children swallow the components.

9.7 Environment Protection

Observe the local regulations regarding the disposal of your packaging materials, used wireless device and accessories, and promote their recycling.

9.8 WEEE Approval

The wireless device is in compliance with the essential requirements and other relevant provisions of the Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE Directive).

9.9 RoHS Approval

The wireless device is in compliance with the restriction of the use of certain hazardous substances in electrical and electronic equipment Directive 2011/65/EU (RoHS Directive).

9.10 Laws and Regulations Observance

Observe laws and regulations when using your wireless device. Respect the privacy and legal rights of the others.

9.11 Care and Maintenance

It is normal that your wireless device gets hot when you use or charge it. Before you clean or maintain the wireless device, stop all applications and power off the wireless device.

- Use your wireless device and accessories with care and in clean environment. Keep the wireless device from a fire or a lit cigarette.
- Protect your wireless device and accessories from water and vapour and keep them dry.
- Do not drop, throw or bend your wireless device.
- Clean your wireless device with a piece of damp and soft antistatic cloth. Do not use any chemical agents (such as alcohol and benzene), chemical detergent, or powder to clean it.
- Do not leave your wireless device and accessories in a place with a considerably low or high temperature.
- Use only accessories of the wireless device approved by the manufacture. Contact the authorized service center for any abnormity of the wireless device or accessories.
- Do not dismantle the wireless device or accessories. Otherwise, the wireless device and accessories are not covered by the warranty.
- The device should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

9.12 Emergency Call

This wireless device functions through receiving and transmitting radio signals. Therefore, the connection cannot be guaranteed in all conditions. In an emergency, you should not rely solely on the wireless device for essential communications.

9.13 Regulatory Information

The following approvals and notices apply in specific regions as noted.

9.13.1 CE Approval (European Union)

The wireless device is approved to be used in the member states of the EU. The wireless device is in compliance with the essential requirements and other relevant provisions of the Radio and Telecommunications Terminal Equipment Directive 1999/5/EC (R&TTE Directive).

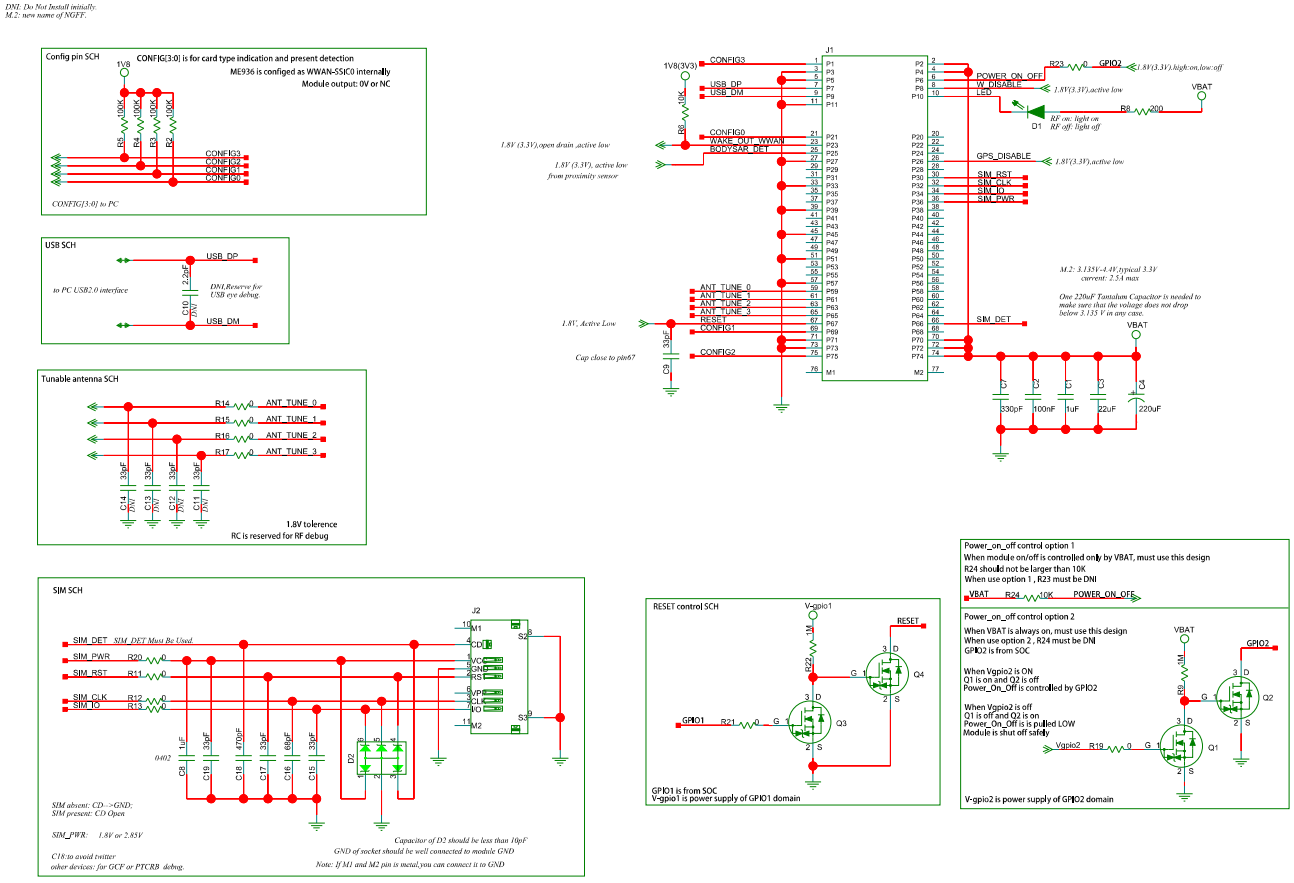
9.13.2 FCC Statement

Federal Communications Commission Notice (United States): Before a wireless device model is available for sale to the public, it must be tested and certified to the FCC that it does not exceed the limit established by the government-adopted requirement for safe exposure.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications made to this equipment not expressly approved by HUAWEI may void the FCC authorization to operate this equipment.

10 Appendix A Circuit of Typical Interface



11 Appendix B Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
AP	Application Process
CCC	China Compulsory Certification
CE	European Conformity
CS	Coding Scheme
CSD	Circuit Switched Data
DC	Direct Current
DMA	Direct Memory Access
EBU	External Bus Unit
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FCC	Federal Communications Commission
GMSK	Gaussian Minimum Shift Keying
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSIC	High Speed Inter-Chip Interface
HSDPA	High-Speed Downlink Packet Access
LTE	Long Term Evolution

Acronym or Abbreviation	Expansion
HSUPA	High Speed Up-link Packet Access
ISO	International Standards Organization
LCP	Liquid Crystal Polyester
LDO	Low-Dropout
LED	Light-Emitting Diode
M.2	New Name for NGFF
MCP	Multi-chip Package
NGFF	Next Generation Form Factor
NTC	Negative Temperature Coefficient
PA	Power Amplifier
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PMU	Power Management Unit
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
TVS	Transient Voltage Suppressor
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access