HUAWEI MU609 HSPA LGA Module

Hardware Guide

Issue 01

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2013-04-10		Creation

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces provided by MU609 module.

This document helps hardware engineer to understand the interface specifications, electrical features and related product information of the MU609 module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MU609 module and provides:

- Function Overview
- Circuit Block Diagram
- Application Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical dimensions	• Dimensions (L × W × H): 30 mm × 30 mm ×2.27 mm • Weight: about 5 g
Operating Bands	WCDMA/HSDPA/HSUPA/HSPA: 850 MHz/900 MHz/1900 MHz/2100 MHz GSM/GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz GPS L1: 1575.42 MHz
Operating Temperature	Normal operating temperature: –20°C to +70°C Extended operating temperature[1]: –40°C to +85°C
Storage Temperature	–40°C to +85°C
Moisture	RH5% to RH95%
Power Voltage	DC 3.3 V–4.2 V (typical value is 3.8 V)
AT Commands	See the *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

Feature	Description
Application Interface (145-pin LGA interface)	One standard USIM (Universal Subscriber Identity Module) card (Class B and Class C)
	Audio interface: PCM interface
	USB 2.0 (High Speed)
	One 8-wire UART (Universal Asynchronous Receiver-Transmitter) and one 2-wire UART (this is only used for debugging)
	GPIOx5
	Power on/off interface
	Hardware reset interface
	Sleep indicator interface (SLEEP_STATUS)
Antenna interface	WWAN MAIN antenna pad x1, WWAN AUX antenna pad x1, GPS antenna pad x1
SMS	New message alert
	Management of SMS: read SMS, write SMS, send SMS, delete SMS and list SMS.
	Supports MO and MT: Point-to-point
Data Services	GPRS: UL 85.6 kbps/DL 85.6 kbps
	EDGE: UL 236.8 kbps/DL 236.8 kbps
	WCDMA PS: UL 384 kbps/DL 384 kbps
	HSPA: UL 5.76 Mbps/DL 14.4 Mbps

NOTE

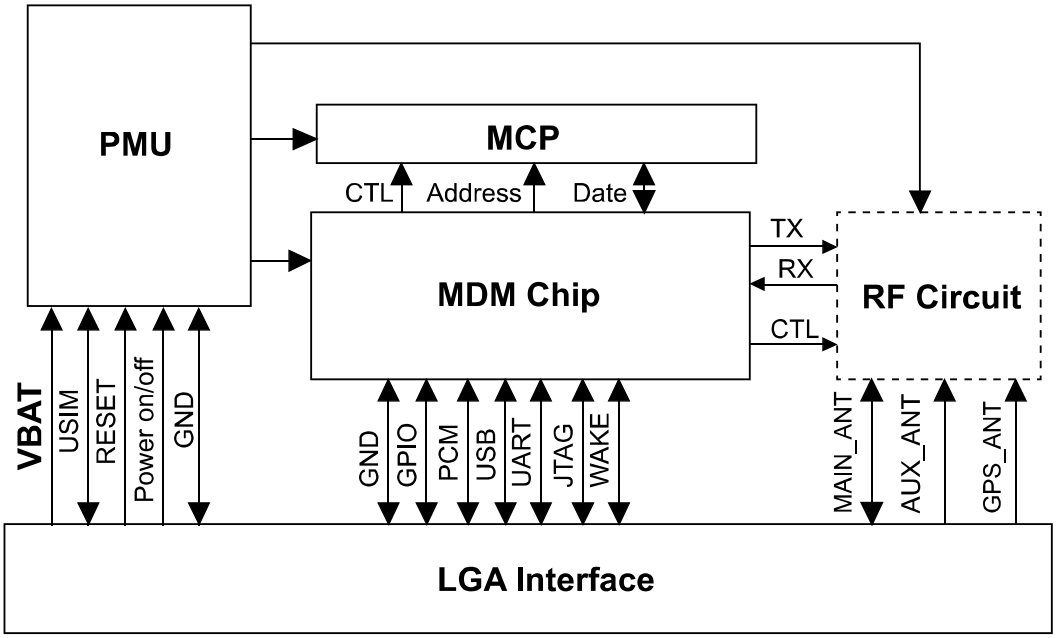
[1]:The temperatures outside of the range –20°C to +70°C; the module might slightly deviate from 3GPP TS 45.005 and 3GPP TS 34.121-1 specifications.

2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the MU609 module. The major functional units of the MU609 module contain the following parts:

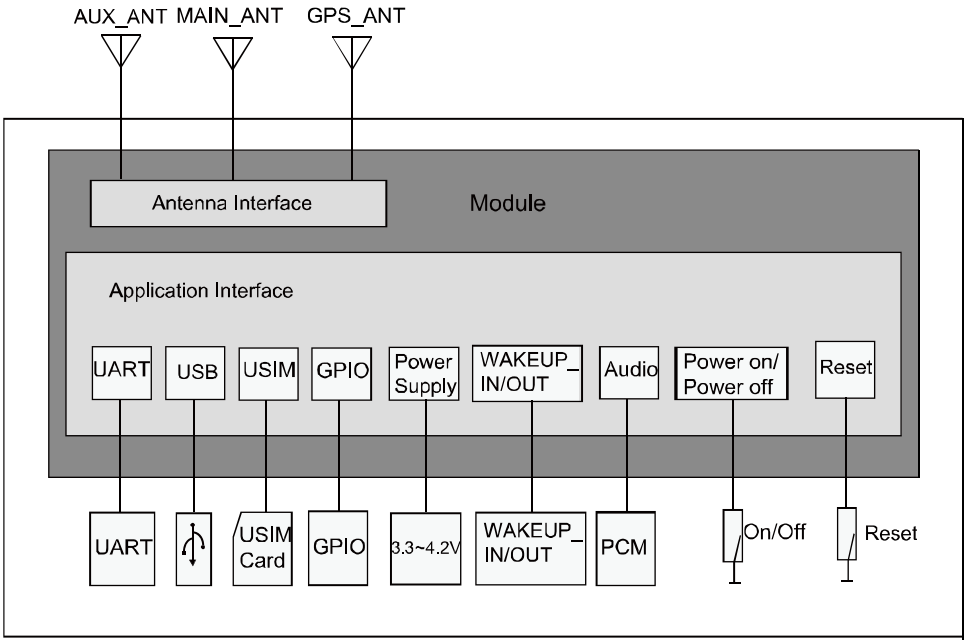
- Power management
- Baseband controller
- Multi-chip package (MCP) memory
- RF Circuit

Figure 2-1 Circuit block diagram of the MU609 module



2.4 Application Block Diagram

Figure 2-2 Application block diagram of the MU609 module



UART Interface: The module supports 2 UART interfaces. One is 8-wire UART, and the other is 2-wire UART (only for debugging).

USB Interface:	The USB interface supports USB 2.0 high speed standard.
USIM Interface:	The USIM interface provides the interface for a USIM card.
External Power Supply:	DC 3.8 V is recommended.
Audio Interface:	The module supports one PCM interface.
RF Pad:	RF antenna interface.

3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MU609 module, including:

- LGA Interface
- Power Interface
- Signal Control Interface
- UART Interface
- USB Interface
- USIM Card Interface
- Audio Interface
- General Purpose I/O Interface
- JTAG Interface
- RF Antenna Interface
- Reserved Interface
- NC Interface

3.2 LGA Interface

The MU609 module uses a 145-pin LGA as its external interface. For details about the module and dimensions, see "Dimensions and interfaces".

Figure 3-1 shows the sequence of pins on the 145-pin signal interface of the MU609 module.

Figure 3-1 Sequence of LGA interface (**Top view**)

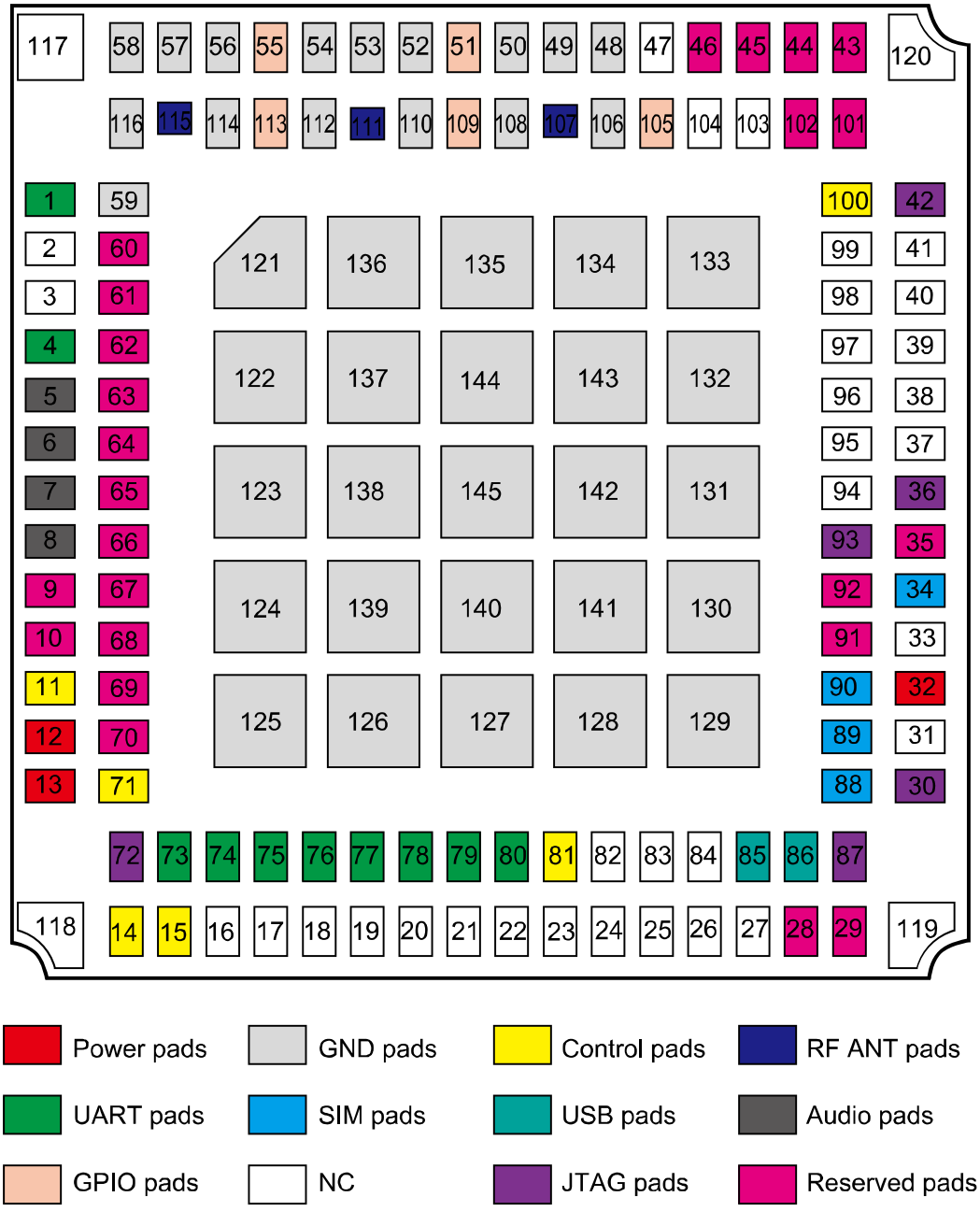


Table 3-1 shows the definitions of pins on the 145-pin signal interface of the MU609 module.

Table 3-1 Definitions of pins on the LGA interface

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
1	UART1_TX	-	O	UART1 transmit output for debugging	–0.3	1.8	2.1
2	NC	-	-	Not connected, please keep this pin open	-	-	-
3	NC	-	-	Not connected, please keep this pin open	-	-	-
4	UART1_RX	-	I	UART1 receive data input for debugging	–0.3	1.8	2.1
5	PCM_SYNC	-	O	PCM interface sync	–0.3	1.8	2.1
6	PCM_DIN	-	I	PCM I/F data in	–0.3	1.8	2.1
7	PCM_DOUT	-	O	PCM I/F data out	–0.3	1.8	2.1
8	PCM_CLK	-	O	PCM interface clock	–0.3	1.8	2.1
9	Reserved	-	-	Reserved	-	-	-
10	Reserved	-	-	Reserved	-	-	-
11	WAKEUP_IN	-	I	Host to set the module into sleep or wake up the module from sleep.	–0.3	1.8	2.1
12	VBAT	-	P	Power supply input	3.3	3.8	4.2
13	VBAT	-	P	Power supply input	3.3	3.8	4.2
14	PS_HOLD	-	I	Power supply hold signal to the module	–0.3	1.8	2.1
15	SLEEP_STATUS	-	O	Sleep status of MU609	–0.3	1.8	2.1
16	NC	-	-	Not connected, please keep this pin open	-	-	-
17	NC	-	-	Not connected, please keep open	-	-	-
18	NC	-	-	Not connected, please keep this pin open	-	-	-
19	NC	-	-	Not connected, please keep this pin open	-	-	-
20	NC	-	-	Not connected, please keep this pin open	-	-	-
21	NC	-	-	Not connected, please keep this pin open	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
22	NC	-	-	Not connected, please keep this pin open	-	-	-
23	NC	-	-	Not connected, please keep this pin open	-	-	-
24	NC	-	-	Not connected, please keep this pin open	-	-	-
25	NC	-	-	Not connected, please keep this pin open	-	-	-
26	NC	-	-	Not connected, please keep this pin open	-	-	-
27	NC	-	-	Not connected, please keep this pin open	-	-	-
28	Reserved	-	-	Reserved	-	-	-
29	Reserved	-	-	Reserved	-	-	-
30	JTAG_TMS	-	I	JTAG test mode select	–0.3	1.8	2.1
31	NC	-	-	Not connected, please keep this pin open	-	-	-
32	VCC_EXT1	-	P	1.8 V POWER output	-	1.8	-
33	NC	-	-	Not connected, please keep this pin open	-	-	-
34	SIM_VCC	-	P	Power supply for USIM card	-	1.8/2.85	-
35	Reserved	-	-	Reserved	-	-	-
36	JTAG_TRST_N	-	I	JTAG reset	–0.3	1.8	2.1
37	NC	-	-	Not connected, please keep this pin open	-	-	-
38	NC	-	-	Not connected, please keep this pin open	-	-	-
39	NC	-	-	Not connected, please keep this pin open	-	-	-
40	NC	-	-	Not connected, please keep this pin open	-	-	-
41	NC	-	-	Not connected, please keep this pin open	-	-	-
42	JTAG_TCK	-	I	JTAG clock input	–0.3	1.8	2.1
43	Reserved	-	-	Reserved	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
44	Reserved	-	-	Reserved	-	-	-
45	Reserved	-	-	Reserved	-	-	-
46	Reserved	-	-	Reserved	-	-	-
47	NC	-	-	Not connected, please keep this pin open	-	-	-
48	GND	-	-	Ground	-	-	-
49	GND	-	-	Ground	-	-	-
50	GND	-	-	Ground	-	-	-
51	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	–0.3	1.8	2.1
52	GND	-	-	Ground	-	-	-
53	GND	-	-	Ground	-	-	-
54	GND	-	-	Ground	-	-	-
55	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	–0.3	1.8	2.1
56	GND	-	-	Ground	-	-	-
57	GND	-	-	Ground	-	-	-
58	GND	-	-	Ground	-	-	-
59	GND	-	-	Ground	-	-	-
60	Reserved	-	-	Reserved	-	-	-
61	Reserved	-	-	Reserved	-	-	-
62	Reserved	-	-	Reserved	-	-	-
63	Reserved	-	-	Reserved	-	-	-
64	Reserved	-	-	Reserved	-	-	-
65	Reserved	-	-	Reserved	-	-	-
66	Reserved	-	-	Reserved	-	-	-
67	Reserved	-	-	Reserved	-	-	-
68	Reserved	-	-	Reserved	-	-	-
69	Reserved	-	-	Reserved	-	-	-
70	Reserved	-	-	Reserved	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
71	WAKEUP_OUT	-	O	Module to wake up the host	–0.3	1.8	2.1
72	JTAG_TDO	-	O	JTAG test data output	–0.3	1.8	2.1
73	UART0_DSR	-	O	UART0 data set ready	–0.3	1.8	2.1
74	UART0_RTS	-	O	UART0 ready for receive	–0.3	1.8	2.1
75	UART0_DCD	-	O	UART0 data carrier detect	–0.3	1.8	2.1
76	UART0_TX	-	O	UART0 transmit output	–0.3	1.8	2.1
77	UART0_RING	-	O	UART0 ring indicator	–0.3	1.8	2.1
78	UART0_RX	-	I	UART0 receive data input	–0.3	1.8	2.1
79	UART0_DTR	-	I	Data terminal ready	–0.3	1.8	2.1
80	UART0_CTS	-	I	UART0 clear to send	–0.3	1.8	2.1
81	POWER_ON_OFF	-	I	System power-on or power-off	-	Pulled up on module	-
82	NC	-	-	Not connected, please keep this pin open	-	-	-
83	NC	-	-	Not connected, please keep this pin open	-	-	-
84	NC	-	-	Not connected, please keep this pin open	-	-	-
85	USB_DM	-	I/O	USB Data- defined in the USB 2.0 Specification	-	-	-
86	USB_DP	-	I/O	USB Data+ defined in the USB 2.0 Specification	-	-	-
87	JTAG_TDI	-	I	JTAG test data input	–0.3	1.8	2.1
88	SIM_RESET	-	O	USIM card reset	-	1.8/2.85	-
89	SIM_DATA	-	I/O	USIM card data	-	1.8/2.85	-
90	SIM_CLK	-	O	USIM card clock	-	1.8/2.85	-
91	Reserved	-	-	Reserved	-	-	-
92	Reserved	-	-	Reserved	-	-	-
93	JTAG_RTCK	-	O	JTAG return clock	–0.3	1.8	2.1

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
94	NC	-	-	Not connected, please keep this pin open	-	-	-
95	NC	-	-	Not connected, please keep this pin open	-	-	-
96	NC	-	-	Not connected, please keep this pin open	-	-	-
97	NC	-	-	Not connected, please keep this pin open	-	-	-
98	NC	-	-	Not connected, please keep this pin open	-	-	-
99	NC	-	-	Not connected, please keep this pin open	-	-	-
100	RESIN_N	-	I	Reset module.	–0.3	1.8	2.1
101	Reserved	-	-	Reserved	-	-	-
102	Reserved	-	-	Reserved	-	-	-
103	NC	-	-	Not connected, please keep this pin open	-	-	-
104	NC	-	-	Not connected, please keep this pin open	-	-	-
105	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined.	–0.3	1.8	2.1
106	GND	-	-	Ground	-	-	-
107	MAIN_ANT	-	-	RF main antenna pad	-	-	-
108	GND	-	-	Ground	-	-	-
109	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	–0.3	1.8	2.1
110	GND	-	-	Ground	-	-	-
111	GPS_ANT	-	-	GPS antenna pad	-	-	-
112	GND	-	-	Ground	-	-	-
113	GPIO	-	I/O	General I/O pins. The function of these pins has not been defined	–0.3	1.8	2.1
114	GND	-	-	Ground	-	-	-
115	AUX_ANT	-	-	RF AUX antenna pad	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
116	GND	-	-	Ground	-	-	-
117	NC	-	-	Not connected, please keep this pin open	-	-	-
118	NC	-	-	Not connected, please keep this pin open	-	-	-
119	NC	-	-	Not connected, please keep this pin open	-	-	-
120	NC	-	-	Not connected, please keep this pin open	-	-	-
121	GND	-	-	Thermal Ground Pad	-	-	-
122	GND	-	-	Thermal Ground Pad	-	-	-
123	GND	-	-	Thermal Ground Pad	-	-	-
124	GND	-	-	Thermal Ground Pad	-	-	-
125	GND	-	-	Thermal Ground Pad	-	-	-
126	GND	-	-	Thermal Ground Pad	-	-	-
127	GND	-	-	Thermal Ground Pad	-	-	-
128	GND	-	-	Thermal Ground Pad	-	-	-
129	GND	-	-	Thermal Ground Pad	-	-	-
130	GND	-	-	Thermal Ground Pad	-	-	-
131	GND	-	-	Thermal Ground Pad	-	-	-
132	GND	-	-	Thermal Ground Pad	-	-	-
133	GND	-	-	Thermal Ground Pad	-	-	-
134	GND	-	-	Thermal Ground Pad	-	-	-
135	GND	-	-	Thermal Ground Pad	-	-	-
136	GND	-	-	Thermal Ground Pad	-	-	-
137	GND	-	-	Thermal Ground Pad	-	-	-
138	GND	-	-	Thermal Ground Pad	-	-	-
139	GND	-	-	Thermal Ground Pad	-	-	-
140	GND	-	-	Thermal Ground Pad	-	-	-
141	GND	-	-	Thermal Ground Pad	-	-	-
142	GND	-	-	Thermal Ground Pad	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
143	GND	-	-	Thermal Ground Pad	-	-	-
144	GND	-	-	Thermal Ground Pad	-	-	-
145	GND	-	-	Thermal Ground Pad	-	-	-

NOTE

- **P** indicates power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output. **AI** indicates pins for analog signal input.
- The **NC** (Not Connected) pins are floating and there are no signal connected to these pins. Yet some of these pins may be used in MU509, MC509 and ME909 module, 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 MU609 module contains:

- VBAT pins for the power supply
- VCC_EXT1 pin for external power output with 1.8 V
- SIM_VCC 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.	Signal Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
12, 13	VBAT	P	Pins for power voltage input	3.3	3.8	4.2
48–50, 52–54, 56–59, 106, 108, 110, 112, 114, 116	GND	-	GND	-	-	-
32	VCC_EXT1	P	Pin for external power output	-	1.8	-
34	SIM_VCC	P	Power supply for USIM card	-	1.8/2.85	-

Pin No.	Signal Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
121–145	GND	-	Thermal Ground Pad	-	-	-

3.3.2 Power Supply VBAT Interface

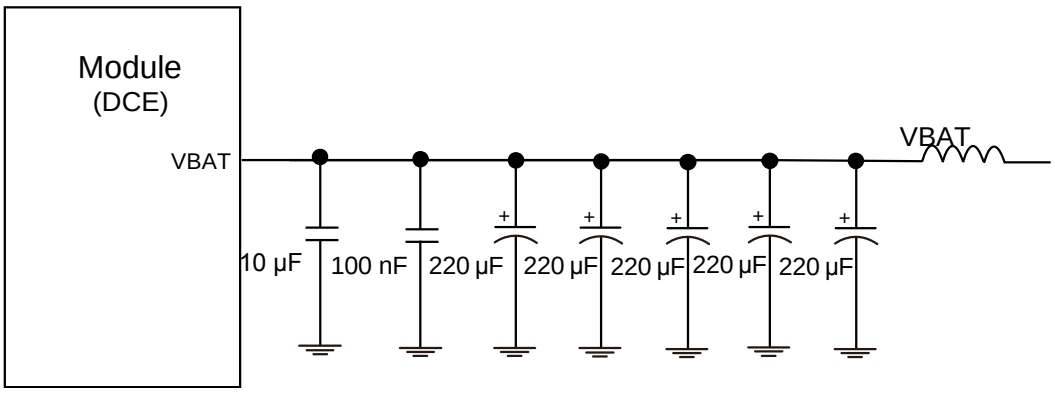
When the MU609 module works normally, power is supplied through the VBAT pins and the voltage ranges from 3.3 V to 4.2 V (typical value: 3.8 V). The 145-pin LGA provides two VBAT pins and GND pins for external power input. To ensure that the MU609 module works normally, all the pins must be used efficiently.

When the MU609 module is used for different external applications, pay special attention to the design for the power supply. When the MU609 module works at 2G mode and transmits signals at the maximum power, the transient current may reach the transient peak value of about 2.5 A due to the differences in actual network environments. In this case, the VBAT voltage drops. If you want wireless good performance, please make sure that the voltage does not decrease below 3.3 V in any case. Otherwise, exceptions such as restart of the MU609 module may occur.

A low-dropout (LDO) regulator or switch power with current output of more than 2.5 A is recommended for external power supply. Furthermore, five 220 µF or above energy storage capacitors are connected in parallel at the power interface of the MU609 module. In addition, to reduce the impact of channel impedance on voltage drop, you are recommended to try to shorten the power supply circuit of the VBAT interface.

It is recommended that add the EMI ferrite bead (NR3015T4R7M manufactured by TAIYO YUDEN or VLS3015T-4R7MR99 manufactured by TDK is recommended) to directly isolate DTE from DCE in the power circuit. Figure 3-2 shows the recommended power circuit of MU609 module.

Figure 3-2 Recommended power circuit of MU609 module



When the system power restarts, a discharge circuit is recommended to make sure the power voltage drops below 1.9 V for 1s at least.

3.3.3 Output Power Supply Interface

Output power supply interface is VCC_EXT1.

Through the output power supply interface, the MU609 module can supply 1.8 V power externally with an output current of 10 mA (typical value) for external level conversion or other applications.

If the MU609 module is in sleep mode, the output power supply interface is in the low power consumption state (< 500 μA). If the MU609 module is in power down mode, the output power supply is in the disabled state.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the MU609 module consists of the following:

- Power-on/off (POWER_ON_OFF) pin
- System reset (RESIN_N) pin
- WAKEUP_IN Signal (WAKEUP_IN) pin
- WAKEUP_OUT Signal (WAKEUP_OUT) pin
- SLEEP_STATUS Signal (SLEEP_STATUS) pin

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

Table 3-3 Definitions of the pins on the signal control interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
81	POWER_ON_OFF	I	Pin for controlling power-on and power-off		Pulled up on chip	
100	RESIN_N	I	Pin for resetting the system	–0.3	1.8	2.1
11	WAKEUP_IN	I	H: Sleep mode is disabled L: Sleep mode is enabled (default value)	–0.3	1.8	2.1
71	WAKEUP_OUT	O	Module to wake up the host. H: Wake up the host, the module hold 1s high-level-voltage pulse and then output low-level-voltage. L: Do not wake up the host (default value).	–0.3	1.8	2.1
15	SLEEP_STATUS	O	Indicates sleep status of MU609 H: MU609 is in wakeup state. L: MU609 is in sleep state.	–0.3	1.8	2.1

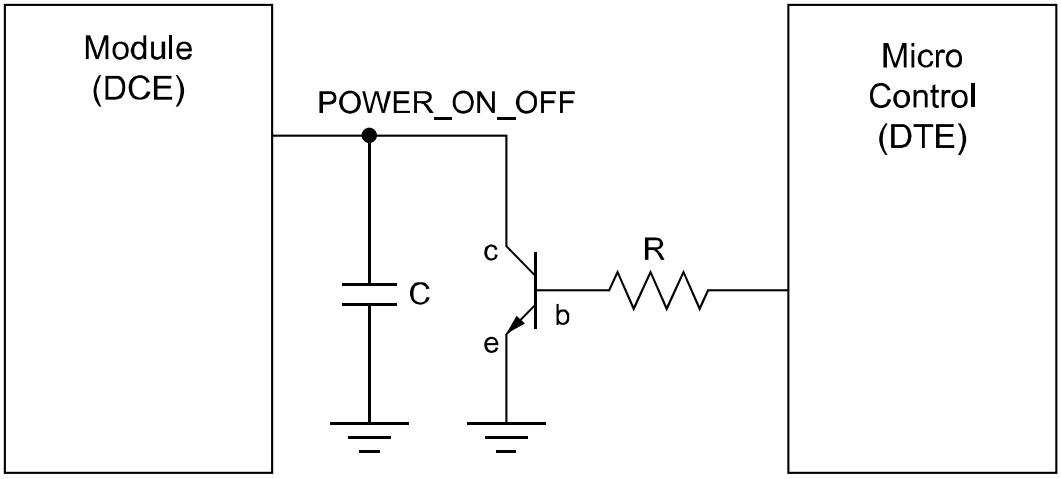
3.4.2 Power-on/off (POWER_ON_OFF) Pin

The MU609 module can be controlled to power on/off by the Power_On_Off pin.

Table 3-4 Two states of Power_On_Off

Item.	Pin state	Description
1	Low (when MU609 are in power off state.)	MU609 is powered on. **POWER_ON_OFF pin should be pulled down for 0.5s to 1.0s.**
2	Low (when MU609 are in power on state.)	MU609 is powered off. **POWER_ON_OFF pin should be pulled down for 3.0s to 5.0s.**

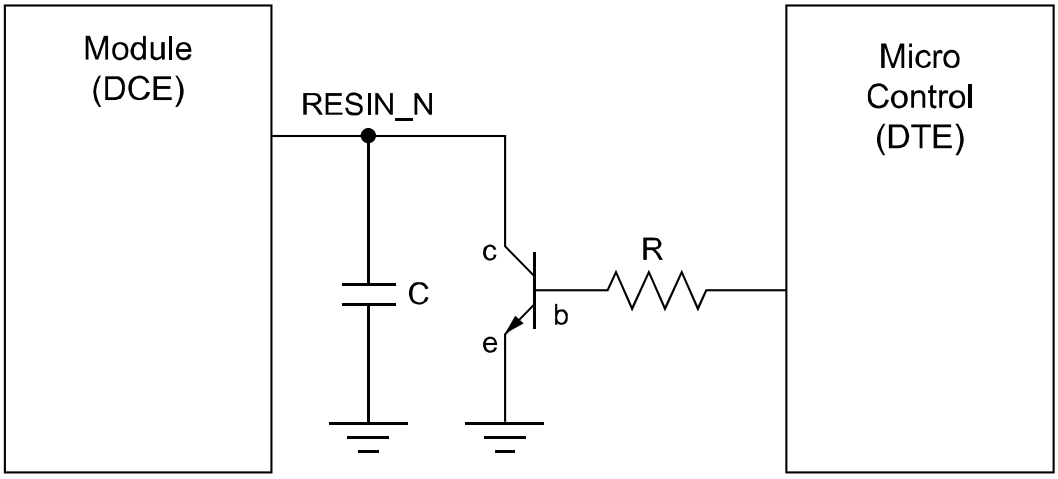
Figure 3-3 Connections of the POWER_ON_OFF pin



3.4.3 RESIN_N Pins

The RESIN_N pin is used to reset the module's system. When the software stops responding, the RESIN_N pin can be pulled down to reset the hardware.

Figure 3-4 Connections of the RESIN_N pin



CAUTION

As the RESIN_N and POWER_ON_OFF signals are relatively sensitive, it is recommended that you install a 10 nF–0.1 µF capacitor near the RESIN_N and POWER_ON_OFF pins of the interface for filtering. In addition, when you design a circuit on the PCB of the interface board, it is recommended that the circuit length not exceed 20 mm and that the circuit be kept at a distance of 2.54 mm (100 mil) at least from the PCB edge. Furthermore, you need to wrap the area adjacent to the signal wire with a ground wire. Otherwise, the module may be reset due to interference.

Power-On Time Sequence

After VBAT has been applied and is stable, the POWER_ON_OFF signal is pulled down, and then the module will boot up.

During power on timing, please make sure the VBAT is stable.

Figure 3-5 Power on timing sequence

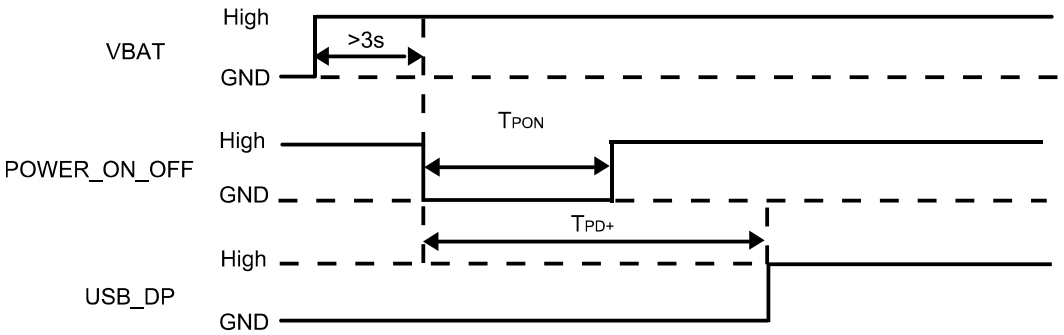


Table 3-5 Power on timing

Parameter	Comments	Time (Nominal values)	Units
T_{PON}	POWER_ON_OFF turn on time.	0.5–1.0	s
T_{PD+}	POWER_ON_OFF Valid to USB D+ high	3.0–5.0	s

If the DTE needs to detect the PID/VID of module during the BIOS phase, the detection time should exceed the T_{PD+} time.

Figure 3-6 Power off timing

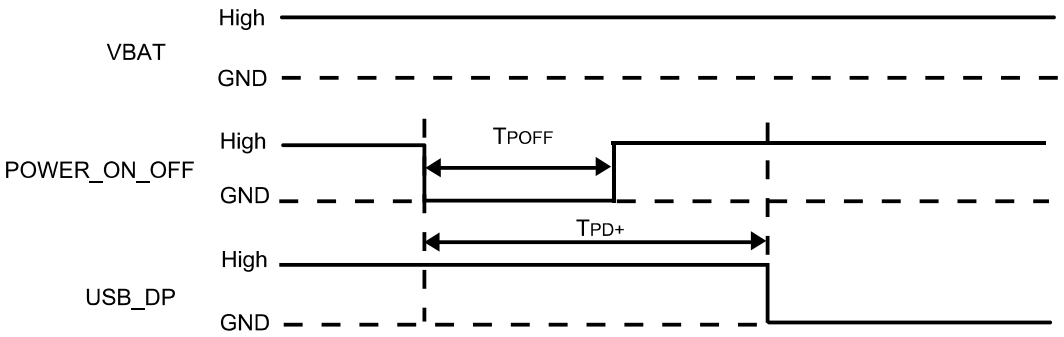


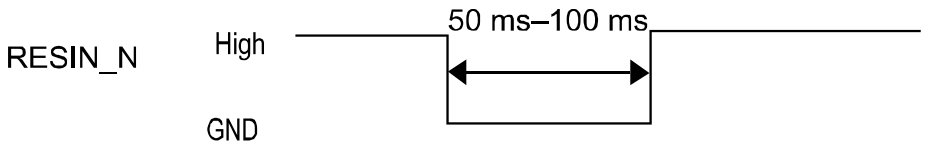
Table 3-6 Power off timing

Parameter	Comments	Time (Nominal values)	Units
T_{POFF}	POWER_ON_OFF turn off time.	3.0	s
T_{PD+}	POWER_ON_OFF Valid to USB D+ low	3.0–5.0	s

RESIN_N

The MU609 module supports hardware reset function. If the software of the MU609 module stops responding, you can reset the hardware through the RESIN_N signal as shown in Figure 3-7 .When a low-level pulse is supplied through the RESIN_N pin, the hardware will be reset. After the hardware is reset, the software starts powering on the module and reports relevant information according to the actual settings. For example, the AT command automatically reports ^SYSSTART.

Figure 3-7 Reset pulse timing



NOTE

The RESIN_N pin must not be pull down for more than 1s.

3.4.4 WAKEUP_IN Signal

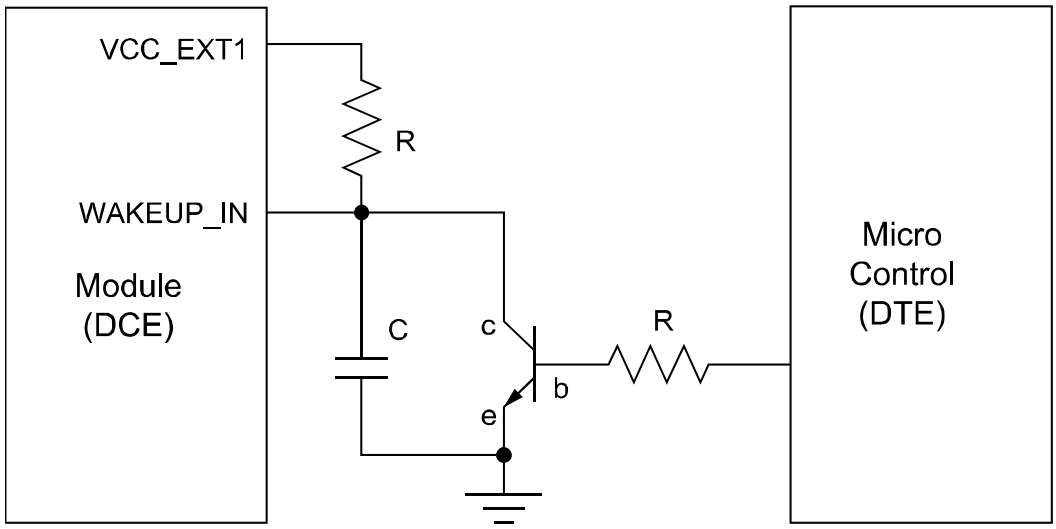
WAKEUP_IN pin is the authorization signal of MU609 entering sleep mode.

If the signal is pulled up to high level (1.8 V), MU609 cannot enter sleep mode.

If this pin is floating, it will keep in low level by default.

Table 3-3 shows the definition of the WAKEUP_IN signal.

Figure 3-8 Connections of the WAKEUP_IN pin



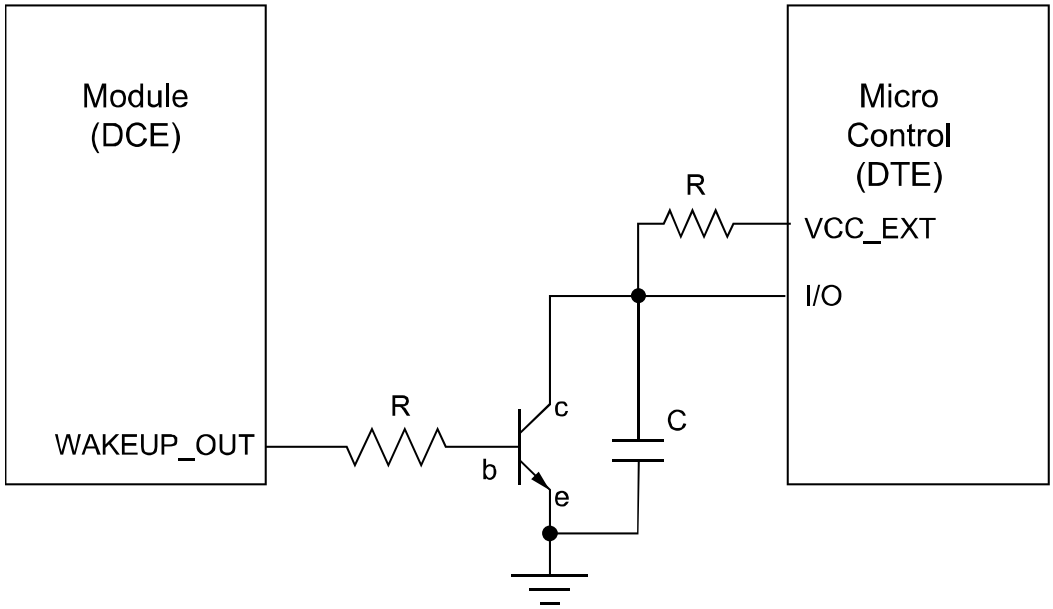
3.4.5 WAKEUP_OUT Signal

The WAKEUP_OUT signal is used to wake up the external devices.

Table 3-3 shows the definition of the WAKEUP_OUT signal.

Figure 3-9 shows recommended circuit of the WAKEUP_OUT pin.

Figure 3-9 Connections of the WAKEUP_OUT pin



3.4.6 SLEEP_STATUS Signal

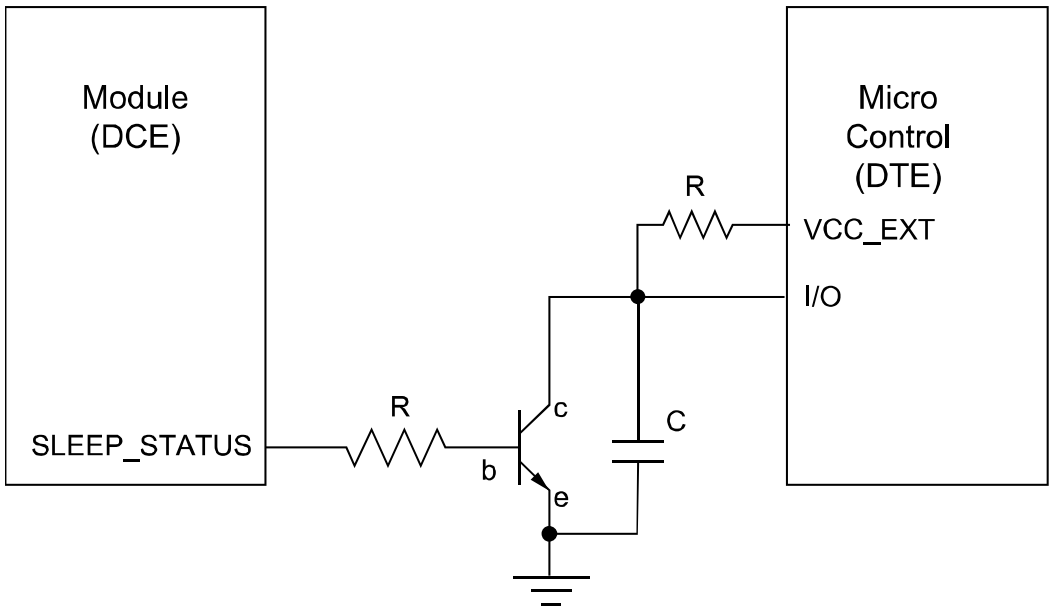
SLEEP_STATUS signal is used to indicate the sleep status of MU609. The external devices can get to know whether the module is in sleep mode by reading SLEEP_STATUS pin.

When SLEEP_STATUS pin is in high level, MU609 is in wakeup state.

When SLEEP_STATUS pin is in low level, MU609 is in sleep state.

Figure 3-10 shows recommended circuit of the SLEEP_STATUS pin.

Figure 3-10 Connections of the SLEEP_STATUS pin



3.5 UART Interface

3.5.1 Overview

The MU609 module provides the UART0 (8-wire UART) interface for one asynchronous communication channel. As the UART0 interface supports signal control through standard modem handshake, AT commands are entered and serial communication is performed through the UART0 interface. The UART1 (2-wire UART) interface is provided by MU609 module. AT commands are entered through the UART1 interface for debugging. The UART has the following features:

- Full-duplex
- 7-bit or 8-bit data
- 1-bit or 2-bit stop bit
- Odd parity check, even parity check, or non-check
- Baud rate clock generated by the system clock
- Direct memory access (DMA) transmission
- Baud rate ranging from 600 bit/s to 230400 bit/s (115200 bit/s by default)
  Baud rate adaptive changes are not supported.

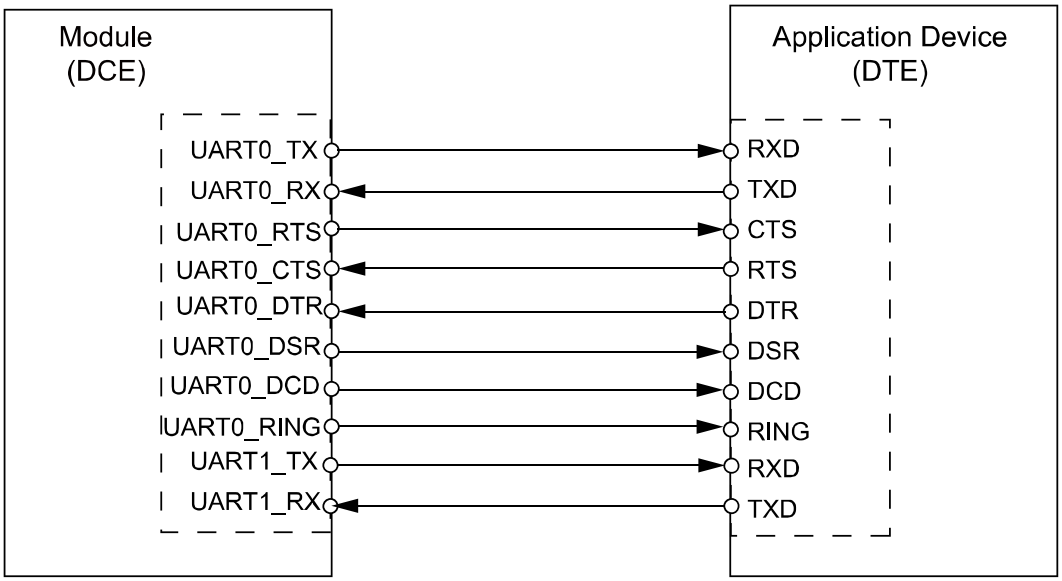
Table 3-7 lists the UART interface signals.

Table 3-7 UART interface signals

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
1	UART1_TX	O	UART1 transmit output only for debugging.	–0.3	1.8	2.1
4	UART1_RX	I	UART1 receive data input for debugging.	–0.3	1.8	2.1
76	UART0_TX	O	UART0 transmit output	–0.3	1.8	2.1
78	UART0_RX	I	UART0 receive data input	–0.3	1.8	2.1
77	UART0_RING	O	UART0 Ring Indicator	–0.3	1.8	2.1
74	UART0_RTS	O	UART0 Ready for receive	–0.3	1.8	2.1
79	UART0_DTR	I	Data Terminal Ready	–0.3	1.8	2.1
80	UART0_CTS	I	UART0 Clear to Send	–0.3	1.8	2.1
75	UART0_DCD	O	UART0 Data Carrier Detect	–0.3	1.8	2.1
73	UART0_DSR	O	UART0 Data Set Ready	–0.3	1.8	2.1

3.5.2 Circuit Recommended for the UART Interface

Figure 3-11 Connection of the UART interface in the MU609 module (DCE) with the host (DTE)



The RS-232 chip can be used to connect the MU609 module with UART. In this connection, the Complementary Metal Oxide Semiconductor(CMOS) logic level and the Electronic Industries Association (EIA) level are converted mutually. For example, it is recommended that you use the MAX218 chip (The MAX218's max baud is 120000 bit/s) with a 2-wire serial port.

NOTE

- It is recommended that set the pins related to UART interface as test points on the DTE board for debugging.
- The UART0_RX, UART0_TX and UART1_RX, UART1_TX must be pulled down. When you want the module is in sleep status, all the UART interface will be in low level. Therefore, UART0_RX, UART0_TX and UART1_RX, UART1_TX must be pulled down in order to confirm they are in low logic when the module is in sleep status.
- The level of RS-232 Transceivers must match that of the MU609 module.

3.6 USB Interface

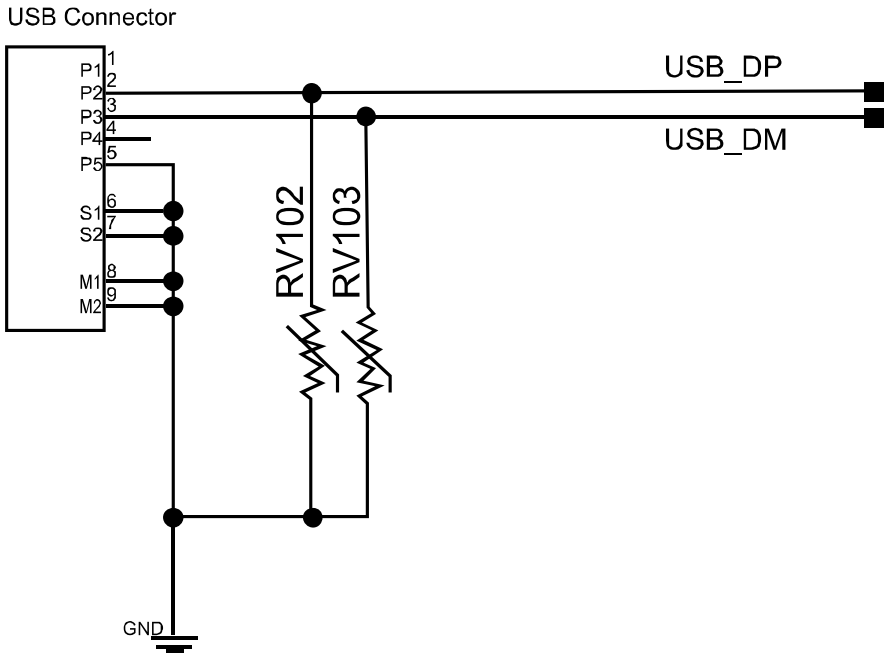
The MU609 is compliant with USB 2.0 High speed protocol. The USB interface is powered directly from the VBAT supply. The USB signal lines are compatible with the USB 2.0 signal specifications. Figure 3-12 shows the circuit of the USB interface.

Table 3-8 Definition of the USB interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
85	USB_DM	I/O	USB data signal D-	-	-	-
86	USB_DP	I/O	USB data signal D+	-	-	-

According to USB protocol, for bus timing or electrical characteristics of MU609 USB signal, please refer to the chapter 7.3.2 of *Universal Serial Bus Specification 2.0.*

Figure 3-12 Recommended circuit of USB interface



NOTE

- Since the USB interface of MU609 module supports USB 2.0 high speed, the resistance "RV102 and RV103" in the Figure 3-12 must be Voltage Sensitive Resistor with small capacitance (ALVC18S02003 manufactured by AMOTECH or B72590T7900V60 manufactured by EPCOS is recommended.). In addition, The layout design of this circuit on the DTE board should comply with the USB 2.0 high speed protocol, with differential lining and impedance control to 90 Ω
- It is recommended that set USB_DM and USB_DP pins as test points and then place these test points on the DTE for debugging.

3.7 USIM Card Interface

3.7.1 Overview

The MU609 module provides a USIM card interface complying with the ISO 7816-3 standard and supports both Class B and Class C USIM cards.

Table 3-9 USIM card interface signals

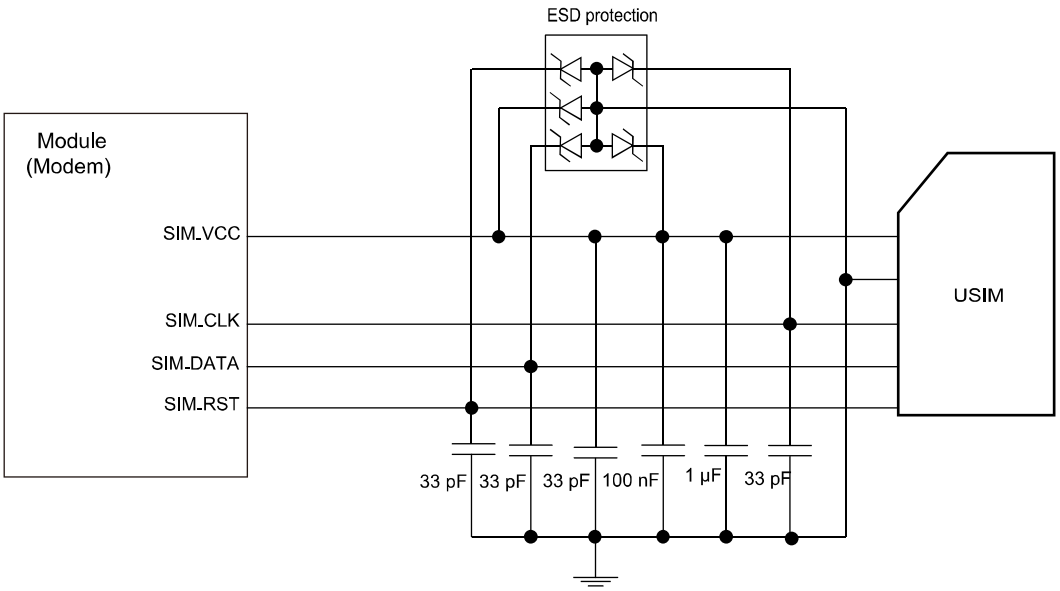
Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
88	SIM_RESET	O	USIM card reset	-	1.8/2.85	-
90	SIM_CLK	O	USIM card clock	-	1.8/2.85	-
89	SIM_DATA	I/O	USIM card data	-	1.8/2.85	-
34	SIM_VCC	P	Power supply for USIM card	-	1.8/2.85	-

3.7.2 Circuit Recommended for the USIM Card Interface

As the MU609 module is not equipped with an USIM socket, you need to place an USIM socket on the user interface board.

Figure 3-13 shows the circuit of the USIM card interface.

Figure 3-13 Circuit of the USIM card interface



CAUTION

- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the USIM socket should be placed near the LGA interface (it is recommended that the PCB circuit connects the LGA 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 MU609 module.
- A 100 nF capacitor and1 µF capacitor are placed between the SIM_VCC and GND pins in a parallel manner (If SIM_VCC circuit is too long, that the larger capacitance such as 4.7 µF can be employed if necessary). Three 33 pF capacitors are placed between the SIM_DATA and Ground pins, the SIM_RST and Ground pins, and 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. The TVS diode with Vrwm of 5 V and junction capacitance less than 10 pF must 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 MU609 module.

3.8 Audio Interface

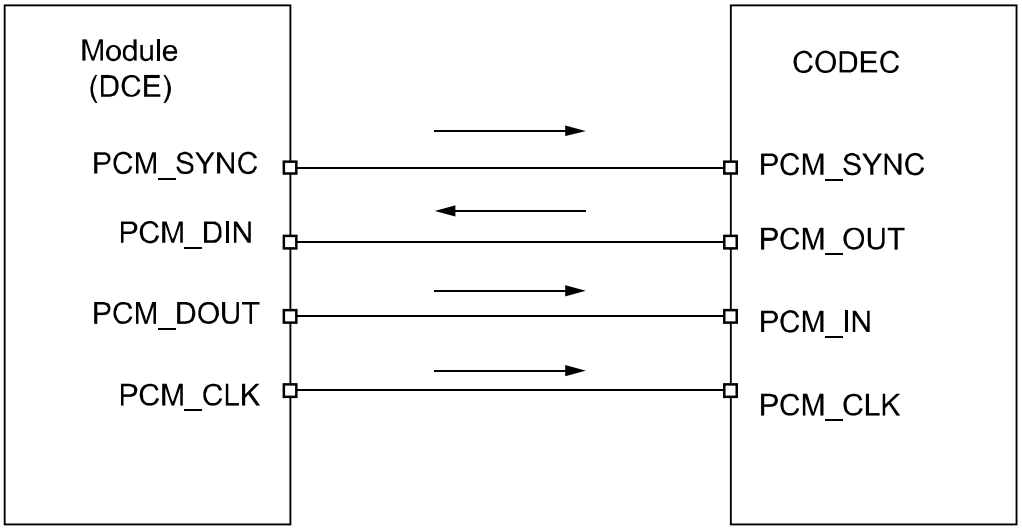
MU609 provided one PCM digital audio interface. Table 3-10 lists the signals on the digital audio interface.

Table 3-10 Signals on the digital audio interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
8	PCM_CLK	O	PCM clock	–0.3	1.8	2.1
6	PCM_DIN	I	PCM data input	–0.3	1.8	2.1
5	PCM_SYNC	O	PCM interface sync	–0.3	1.8	2.1
7	PCM_DOUT	O	PCM data output	–0.3	1.8	2.1

The MU609 PCM interface enables communication with an external codec to support linear format.

Figure 3-14 Circuit diagram of the interface of the PCM (MU609 is used as PCM master)



NOTE

- PCM_SYNC: Output when PCM is in master mode;
- PCM_CLK: Output when PCM is in master mode;
- The PCM function of MU609 is only supported in master mode.
- It is recommended that a TVS be used on the related interface, to prevent electrostatic discharge and protect integrated circuit (IC) components.

3.9 General Purpose I/O Interface

The MU609 module provides 5 GPIO pins for customers to use controlling signals which are worked at 1.8 V CMOS logic levels. Customers can use AT command to control the state of logic levels of 5 GPIO output signal. See the *HUAWEI MU609 HSPA LGA Module AT Command Interface Specification*.

Table 3-11 Signals on the GPIO interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
51, 55, 105, 109, 113	GPIO	I/O	General I/O pins	–0.3	1.8	2.1

3.10 JTAG Interface

The MU609 module provides Joint Test Action Group (JTAG) interface. Table 3-12 shows the signals on the JTAG interface. It is recommended that route out the 9 pins as test points on the DTE for tracing and debugging.

Table 3-12 Signals on the JTAG interface

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
30	JTAG_TMS	I	JTAG test mode selection	–0.3	1.8	2.1
36	JTAG_TRST_N	I	JTAG test reset	–0.3	1.8	2.1
42	JTAG_TCK	I	JTAG test clock	–0.3	1.8	2.1
72	JTAG_TDO	O	JTAG test data output	–0.3	1.8	2.1
87	JTAG_TDI	I	JTAG test serial data input	–0.3	1.8	2.1
93	JTAG_RTCK	O	JTAG test clock return signal	–0.3	1.8	2.1
14	PS_HOLD	I	Power supply hold signal to PMU	–0.3	1.8	2.1
100	RESIN_N	I	Reset module.	–0.3	1.8	2.1
32	VCC_EXT1	P	Pin for output power supply with 1.8 V	-	1.8	-

NOTE
It is recommended that route out the JTAG pins on the DTE board as the test point for debugging.

3.11 RF Antenna Interface

The MU609 module provided three antenna pads (MAIN_ANT, GPS_ANT and AUX_ANT) for connecting the external antennas.

Route the antenna pad as close as possible to antenna connector. In addition, the impedance of RF signal traces must be 50 Ω.

Table 3-13 Definition of the antenna pads

Pin No.	Pin Name	I/O	Description
107	MAIN_ANT	-	RF MAIN pad
111	GPS_ANT	-	RF GPS pad
115	AUX_ANT	-	RF AUX pad

3.12 Reserved Interface

The MU609 module provides 24 reserved pins. All reserved pins cannot be used by the customer.

Table 3-14 Reserved pin

Pin No.	Pin Name	I/O	Description
9, 10, 28, 29, 35, 43–46, 60–70, 91,92,101-102	Reserved	-	Reserved

3.13 NC Interface

The MU609 module has 37 NC pins. All NC pins should not be connected. Please keep these pins open.

Pin No.	Pin Name	I/O	Description
2, 3, 16–27, 31, 33, 37–41, 47, 82–84, 94–99, 103, 104, 117–120	NC	-	Not connected, please keep open.

4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the MU609 module, including:

- Operating Frequencies
- Conducted RF Measurement
- Conducted Rx Sensitivity and Tx Power
- Antenna Design Requirements

4.2 Operating Frequencies

Table 4-1 shows the RF bands supported by MU609.

Table 4-1 RF bands

Operating Band	Tx	Rx
UMTS Band I	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band II	1850 MHz–1910 MHz	1930 MHz–1990 MHz
UMTS Band V	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band VIII	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
GPS	-	1574.42 MHz–1576.42 MHz

4.3 Conducted RF Measurement

4.3.1 Test Environment

Test instrument	R&S CMU200
Power supply	KEITHLEY 2306
RF cable for testing	L08-C014-350 of DRAKA COMTEQ or Rosenberger Cable length: 29 cm

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 TS51.010-1 and 3GPP TS34.121-1 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 MU609.

The 3GPP Protocol Claim column in Table 4-2 lists the required minimum values, and the Test Value column lists the tested values of MU609.

Table 4-2 MU609 conducted Rx sensitivity (Unit: dBm)

Item		3GPP Protocol Claim (dBm)	MU609 Test Value (dBm)		
			Min.	Typ.	Max.
GSM850	GMSK (CS1, BLER<10%)	< –102	-	-	–108
	8PSK (MCS5, BLER<10%)	< –98	-	-	–101
GSM900	GMSK (CS1, BLER<10%)	< –102	-	-	–108
	8PSK (MCS5, BLER<10%)	< –98	-	-	–101

Item		3GPP Protocol Claim (dBm)	MU609 Test Value (dBm)		
			Min.	Typ.	Max.
GSM1800	GMSK (CS1, BLER<10%)	< –102	-	-	–107
	8PSK (MCS5, BLER<10%)	< –98	-	-	–101
GSM1900	GMSK (CS1, BLER<10%)	< –102	-	-	–107
	8PSK (MCS5, BLER<10%)	< –98	-	-	–101
Band I (BER<0.1%)		< –106.7	-	-	–108
Band II (BER<0.1%)		< –104.7	-	-	–108
Band VIII (BER<0.1%)		< –103.7	-	-	–108
Band V (BER<0.1%)		< –104.7	-	-	–108

Table 4-3 MU609 GPS main characteristics

Item	Type Value
Receive Sensitivity(Cold start)	–144 dBm
Receive Sensitivity(Hot start)	–155 dBm
Receive Sensitivity(Tracking mode)	–155 dBm
TTFF@-130dBm(Cold start)	35s
TTFF@-130dBm(Hot start)	1s

NOTE
The test values are the average of some test samples.

4.4.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of MU609. The conducted transmit power refers to the maximum power that the module tested at the antenna pad 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 MU609. The tested values listed in the Test Value column must range from the minimum power to the maximum power.

Table 4-4 MU609 conducted Tx power (unit: dBm)

Item		3GPP Protocol Claim (dBm)	MU609 Test Value (dBm)		
			Min.	Typ.	Max.
GSM850	GMSK(1Tx Slot)	31 to 35	31	32.5	34
	8PSK(1Tx Slot)	24 to 30	25	27	29
GSM900	GMSK(1Tx Slot)	31 to 35	31	32.5	34
	8PSK(1Tx Slot)	24 to 30	25	27	29
GSM1800	GMSK(1Tx Slot)	28 to 32	28	29.5	31
	8PSK(1Tx Slot)	23 to 29	24	26	28
GSM1900	GMSK(1Tx Slot)	28 to 32	28	29.5	31
	8PSK(1Tx Slot)	23 to 29	24	26	28
Band I		21 to 25	22	23.5	24.5
Band II		21 to 25	22	23.5	24.5
Band VIII		21 to 25	22	23.5	24.5
Band V		21 to 25	22	23.5	24.5

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 MU609 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 MU609 to ensure high radio performance of the module:

- **Efficiency of the primary antenna: ≥ 40% (below 960 MHz); ≥ 50% (over 1710 MHz)**
- **Efficiency of the diversity antenna: ≥ half of the efficiency of the primary antenna in receiving band**
- **Efficiency of the GPS antenna: ≥ 50%**

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

S11 or VSWR

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 value is recommended for the antenna of MU609:

- **S11 of the primary antenna: ≤ –6 dB**
- **S11 of the diversity antenna: ≤ –6 dB**
- **S11 of the GPS antenna: ≤ –10 dB**

In addition, S11 is less important than the efficiency, and S11 has weak correlation to wireless performance.

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 MU609 to minimize the cable length. The diversity antenna needs to be installed perpendicularly to the primary antenna. The diversity antenna can be placed farther away from the MU609. Antenna isolation can be measured with a two-port vector network analyzer.

The following antenna isolation is recommended for the antennas on laptops:

- **Isolation between the primary and diversity antennas: ≤ –12 dB**
- **Isolation between the primary (diversity) antenna and the GPS antenna: ≤ –15 dB**
- **Isolation between the primary (diversity) 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 MU609.

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 MU609.
Primary/diversity/GPS antenna: omnidirectional

In addition, the diversity antenna's pattern should be complementary with the primary's.

Envelope Correlation Coefficient

The envelope correlation coefficient indicates the correlation between different antennas in a multi-antenna system (primary antenna, diversity antenna, and MIMO antenna). The correlation coefficient shows the similarity of radiation patterns, that is, amplitude and phase, of the antennas. The ideal correlation coefficient of a diversity antenna system or a MIMO antenna system is 0. A small value of the envelope correlation coefficient between the primary antenna and the diversity antenna indicates a high diversity gain. The envelope correlation coefficient depends on the following factors:

- Distance between antennas
- Antenna type
- Antenna direction

The antenna correlation coefficient differs from the antenna isolation. Sufficient antenna isolation does not represent a satisfactory correlation coefficient. For this reason, the two indicators need to be evaluated separately.

For the antennas on laptops, the recommended envelope correlation coefficient between the primary antenna and the diversity antenna is smaller than 0.5.

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 MU609. **Gain of the primary/diversity antenna ≤ 2.5 dBi**

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, you 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 GSM/WCDMA/GPS Antenna Requirements

The antenna for MU609 must fulfill the following requirements:

GSM/WCDMA/GPS 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)
Bandwidth	70 MHz in GSM850 80 MHz in GSM900 170 MHz in DCS 140 MHz in PCS 70 MHZ in WCDMA850 (25MHz for diversity antenna) 80 MHz in WCDMA900 (35MHz for diversity antenna) 140 MHz in WCDMA1900 (60MHz for diversity antenna) 250 MHz in WCDMA2100 (60MHz for diversity antenna) 2 MHz in GPS
Gain	Gain ≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max	≤ 3:1 (≤ 2:1 for GPS antenna)
VSWR recommended	≤ 2:1 (≤ 1.5:1 for GPS antenna)

4.5.4 Radio Test Environment

The antenna efficiency, antenna gain, radiation pattern, TRP, and TIS can be tested in a microwave testing chamber.

Huawei has a complete set of OTA test environments (SATIMO microwave testing chambers and ETS microwave testing chambers). The testing chambers are certified by professional organizations and are applicable to testing at frequencies ranging from 380MHz to 6GHz. The test items are described as follows:

Passive Tests

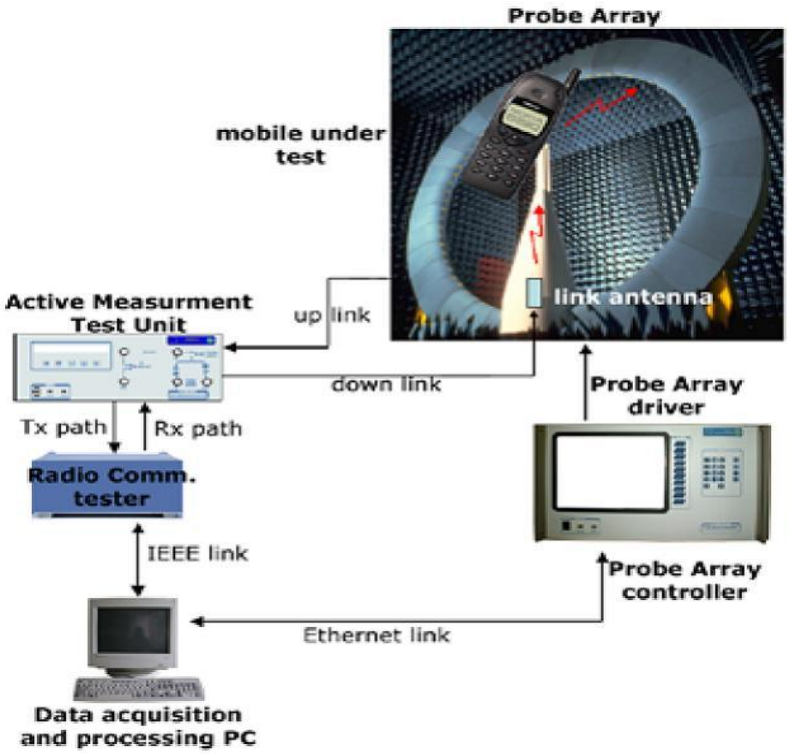
- Antenna efficiency
- Gain
- Pattern shape
- Envelope correlation coefficient

Active Tests

- **TRP:** GSM, WCDMA systems
- **TIS:** GSM, WCDMA systems

Figure 4-1 shows the SATIMO microwave testing chamber.

Figure 4-1 SATIMO microwave testing chamber



5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of the interfaces in the MU609 module, including:

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

5.2 Absolute Ratings

WARNING

Table 5-1 lists the absolute ratings for the MU609 module. Using the MU609 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings for the MU609 module

Symbol	Specification	Min.	Max.	Unit
VBAT	External power voltage	–0.3	4.5	V
VI	Digital input voltage	–0.3	2.3	V

5.3 Operating and Storage Temperatures and Humidity

Table 5-2 lists the operating and storage temperatures and humidity for the MU609 module.

Table 5-2 operating and storage temperatures and humidity for the MU609 module

Specification	Min.	Max.	Unit
Normal working temperatures	–20	+70	°C
Extended temperatures[1]	–40	–20	°C
Extended temperatures[1]	+70	+85	°C
Ambient temperature for storage	–40	+85	°C
Moisture	5	95	%

NOTE

[1]: The temperatures outside of the range –20°C to +70°C; the module might slightly deviate from 3GPP TS 45.005 and 3GPP TS 34.121-1 specifications.

5.4 Electrical Features of USIM

Table 5-3 Electrical features of Digital Pins in the I/O supply domain of the USIM Interface

Parameter	Description	Min.	Max.	Notes	Unit
V_{IH}	High-level input voltage	0.7 x V_{DDP_USIM}	3.05	V_{DDP_USIM}=1.8 V or 2.85 V	V
V_{IL}	Low-level input voltage	0	0.2 x V_{DDP_USIM}	V_{DDP_USIM}=1.8 V or 2.85 V	V
V_{OH}	High-level input voltage	0.7 x V_{DDP_USIM}	3.05	V_{DDP_USIM}=1.8 V or 2.85 V	V
V_{OL}	Low-level input voltage	0	0.2 x V_{DDP_USIM}	V_{DDP_USIM}=1.8 V or 2.85 V	V

5.5 Electrical Features of Application Interfaces

Table 5-4 lists electrical features (typical values).

Table 5-4 Electrical features of application interfaces

Parameter	Description	Minimum Value	Maximum Value	Unit
V_{IH}	Logic high-level input voltage	0.65 x V_{DD_PX}	V_{DD_PX} + 0.3	V
V_{IL}	Logic low-level input voltage	–0.3	0.35 x V_{DD_PX}	V
V_{OH}	Logic high-level output voltage	V_{DD_PX}–0.45	V_{DD_PX}	V
V_{OL}	Logic low-level output voltage	0	0.45	V

5.6 Power Supply Features

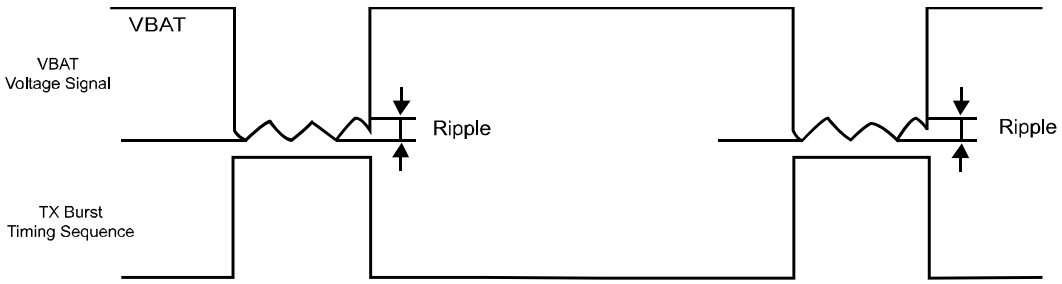
5.6.1 Input Power Supply

Table 5-5 lists the requirements for input power of the MU609 module.

Table 5-5 Requirements for input power for the MU609 module

Parameter	Min.	Typ.	Max.	Ripple	Unit
VBAT	3.3	3.8	4.2	0.05	V

Figure 5-1 Power Supply During Burst Emission



NOTE

The VBAT Minimum value must be guaranteed during the burst (with 2. 5 A Peak in GPRS or GSM mode).

Table 5-6 Requirements for input current of the MU609 module

Power	Peak (Maximum)	Normal (Maximum)
VBAT	2500 mA	1100 mA

5.6.2 Power Consumption

The power consumptions of MU609 in different scenarios are respectively listed in Table 5-7 , Table 5-8 , Table 5-9 , Table 5-10 and Table 5-11 .

The power consumption listed in this section is tested when the power supply of MU609 module is 3.8 V. Typical values are measured at room temperature, and minimum and maximum values are measured over the entire operating temperature range.

Table 5-7 Averaged Power off DC power consumption

Description	Test Value	Units	Notes/Configuration
Power off	8	μA	VBAT is ON and the module does not work.

Table 5-8 Averaged standby DC power consumption

Description	Bands	Test Value	Units	Notes/Configuration
HSPA/WCDMA (Standby)	UMTS bands	1.7	mA	DRX cycle=8 (2.56s) Module is registered on and not connected to the 3G network. USB is in suspend mode.
HSPA/WCDMA (Standby)	UMTS bands	2.2	mA	DRX cycle=6 (0.64s) Module is registered on and not connected to the 3G network. USB is in suspend mode.
GPRS/EDGE (Standby)	GSM bands	2.1	mA	MFRMS=5 (1.175s) Module is registered on and not connected to the 2G network. USB is in suspend mode.
GPRS/EDGE (Standby)	GSM bands	2.8	mA	MFRMS=2 (0.47s) Module is registered on and not connected to the 2G network. USB is in suspend mode.

Description	Bands	Test Value	Units	Notes/Configuration
HSPA/WCDMA (Connect Standby)	UMTS bands	25	mA	DRX cycle=8 (2.56s) Module is registered on the 3G network, and PDP is activated, No data transmission. USB is in suspend mode.
HSPA/WCDMA (Connect Standby)	UMTS bands	25	mA	DRX cycle=6 (0.64s) Module is registered on the 3G network, and PDP is activated, No data transmission. USB is in suspend mode.
GPRS/EDGE (Connect Standby)	GSM bands	25	mA	MFRMS=5 (1.175s) Module is registered on the 2G network, and PDP is activated, No data transmission. USB is in suspend mode.
GPRS/EDGE (Connect Standby)	GSM bands	25	mA	MFRMS=2 (0.47s) Module is registered on the 2G network, and PDP is activated, No data transmission. USB is in suspend mode.

Table 5-9 DC power consumption (HSPA/WCDMA)

Description	Band	Test Value	Units	Power (dBm)
WCDMA	Band I (IMT2100)	290	mA	1 dBm Tx Power
		350		10 dBm Tx Power
		680		24 dBm Tx Power
	Band II (PCS 1900)	300	mA	1 dBm Tx Power
		360		10 dBm Tx Power
		705		24 dBm Tx Power
	Band V (850 MHz)	260	mA	1 dBm Tx Power
		300		10 dBm Tx Power
		600		24 dBm Tx Power

Description	Band	Test Value	Units	Power (dBm)
	Band VIII (900 MHz)	300	mA	1 dBm Tx Power
		320		10 dBm Tx Power
		640		24 dBm Tx Power
HSDPA	Band I (IMT2100)	380	mA	1 dBm Tx Power
		430		10 dBm Tx Power
		720		24 dBm Tx Power
	Band II (PCS 1900)	375	mA	1 dBm Tx Power
		430		10 dBm Tx Power
		745		24 dBm Tx Power
	Band V (850 MHz)	330	mA	1 dBm Tx Power
		380		10 dBm Tx Power
		620		24 dBm Tx Power
	Band VIII (900 MHz)	350	mA	1 dBm Tx Power
		390		10 dBm Tx Power
		660		24 dBm Tx Power
HSUPA	Band I (IMT2100)	390	mA	1 dBm Tx Power
		450		10 dBm Tx Power
		730		24 dBm Tx Power
	Band II (PCS 1900)	380	mA	1 dBm Tx Power
		440		10 dBm Tx Power
		755		24 dBm Tx Power
	Band V (850 MHz)	350	mA	1 dBm Tx Power
		390		10 dBm Tx Power
		630		24 dBm Tx Power
	Band VIII (900 MHz)	360	mA	1 dBm Tx Power
		410		10 dBm Tx Power
		680		24 dBm Tx Power

Table 5-10 DC power consumption (GPRS/EDGE)

Description	Test Value	Units	PCL	Configuration
GPRS850	300	mA	5	1 Up/1 Down
	460			2 Up/1 Down
	630			4 Up/1 Down
	180	mA	10	1 Up/1 Down
	280			2 Up/1 Down
	460			4 Up/1 Down
GPRS900	280	mA	5	1 Up/1 Down
	430			2 Up/1 Down
	590			4 Up/1 Down
	170	mA	10	1 Up/1 Down
	270			2 Up/1 Down
	440			4 Up/1 Down
GPRS1800	230	mA	0	1 Up/1 Down
	350			2 Up/1 Down
	490			4 Up/1 Down
	120	mA	10	1 Up/1 Down
	170			2 Up/1 Down
	230			4 Up/1 Down
GPRS1900	240	mA	0	1 Up/1 Down
	360			2 Up/1 Down
	520			4 Up/1 Down
	110	mA	10	1 Up/1 Down
	160			2 Up/1 Down
	220			4 Up/1 Down
EDGE850	290	mA	8	1 Up/1 Down
	430			2 Up/1 Down
	610			4 Up/1 Down
	170	mA	15	1 Up/1 Down
	270			2 Up/1 Down
	450			4 Up/1 Down

Description	Test Value	Units	PCL	Configuration
EDGE900	270	mA	8	1 Up/1 Down
	430			2 Up/1 Down
	580			4 Up/1 Down
	160	mA	15	1 Up/1 Down
	260			2 Up/1 Down
	440			4 Up/1 Down
EDGE1800	220	mA	2	1 Up/1 Down
	340			2 Up/1 Down
	480			4 Up/1 Down
	120	mA	10	1 Up/1 Down
	160			2 Up/1 Down
	230			4 Up/1 Down
EDGE1900	230	mA	2	1 Up/1 Down
	350			2 Up/1 Down
	510			4 Up/1 Down
	110	mA	10	1 Up/1 Down
	150			2 Up/1 Down
	210			4 Up/1 Down

Table 5-11 DC power consumption (GPS)

Description	Max Test Value	Units	Configuration
GPS location request	120	mA	

NOTE
The above values are the average of some test samples.

5.7 Reliability Features

Table 5-12 lists the test conditions and results of the reliability of the MU609 module.

Table 5-12 Test conditions and results of the reliability of the MU609 module

Item	Test Condition	Standard
Low-temperature storage	Temperature: –40ºC±2ºC Test duration: 24 h	IEC60068
High-temperature storage	Temperature: 85ºC±2ºC Test duration: 24 h	IEC60068
Low-temperature working	Temperature: –30ºC±2ºC Test duration: 24 h	IEC60068
High-temperature working	Temperature: 75ºC±2ºC Test duration: 24 h	IEC60068
Damp heat cycling	High temperature: 55ºC±2ºC Low temperature: 25ºC±2ºC Humidity: 95% Repetition times: 4 Test duration: 12 h+12 h	IEC60068
Temperature shock	Low temperature: –40ºC±2ºC High temperature: 85ºC±2ºC Temperature change interval: < 30s Test duration: 15 min Repetition times: 100	IEC60068
Salty fog test	Temperature: 35°C Density of the NaCl solution: 5%±1% Spraying interval: 8 h Duration of exposing the module to the temperature of 35°C: 16 h	IEC60068
Sine vibration	Frequency range: 5 Hz to 200 Hz Acceleration: 10 m/s^2 Frequency scan rate: 1 oct/min Test period: 3 axial directions. Five circles for each axial direction.	IEC60068
Shock test	Half-sine wave shock Peak acceleration: 300 m/s^2 Shock duration: 11 ms Test period: 6 axial directions. One shock for each axial direction.	IEC60068

Item	Test Condition	Standard
Clash test	Half-sine wave Peak acceleration: 180 m/s^2 Pulse duration: 6 ms Repetition time: 6 directions. 1000 times for each direction.	IEC60068
Drop test	First case: 0.3 m in height. Drop the MU609 module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested. Second case: 0.8 m in height. Drop the MU609 module on the marble terrace with one surface facing downwards twice. Six surfaces should be tested.	IEC60068

5.8 EMC and ESD Features

EMC tests have to be performed on the application as soon as possible to detect any potential problems.

Special attention should be paid to the following:

- Possible harmful emissions radiated by the application to the RF receiver in the receiver band.
- ESD protection is mandatory on all signals which are externally accessible
- Typically, ESD protection is mandatory for the following:
  - USIM
  - UART
  - USB
- Length of the USIM interface lines (preferably <10 cm).
- EMC protection on audio input/output (filters against 900MHz emissions).
- Biasing of the microphone inputs.
- Ground plane: HUAWEI Wireless recommends a common ground plane for analog/digital/RF grounds.
- A metallic or plastic case with conductive paint is recommended, except for the area around the antenna.

NOTE

The HUAWEI MU609 Module does not include any protection against over voltage.

6 Mechanical Specifications

6.1 About This Chapter

This chapter describes the process design and mechanical specifications:

- Storage Requirement
- Moisture Sensitivity
- Dimensions and interfaces
- Packaging
- Label
- Customer PCB Design
- Assembly Processes
- Specification of Rework

6.2 Storage Requirement

The module must be stored and sealed properly in vacuum package under a temperature below 40°C and the relative humidity less than 90% in order to ensure the weldability within 12 months.

6.3 Moisture Sensitivity

- The moisture sensitivity is level 3.
- After unpacking, the module must be assembled within 168 hours under the environmental conditions that the temperature is lower than 30°C and the relative humidity is less than 60%. If the preceding conditions cannot be met, the module needs to be baked according to the parameters specified in Table 6-1 .

Table 6-1 Baking parameters

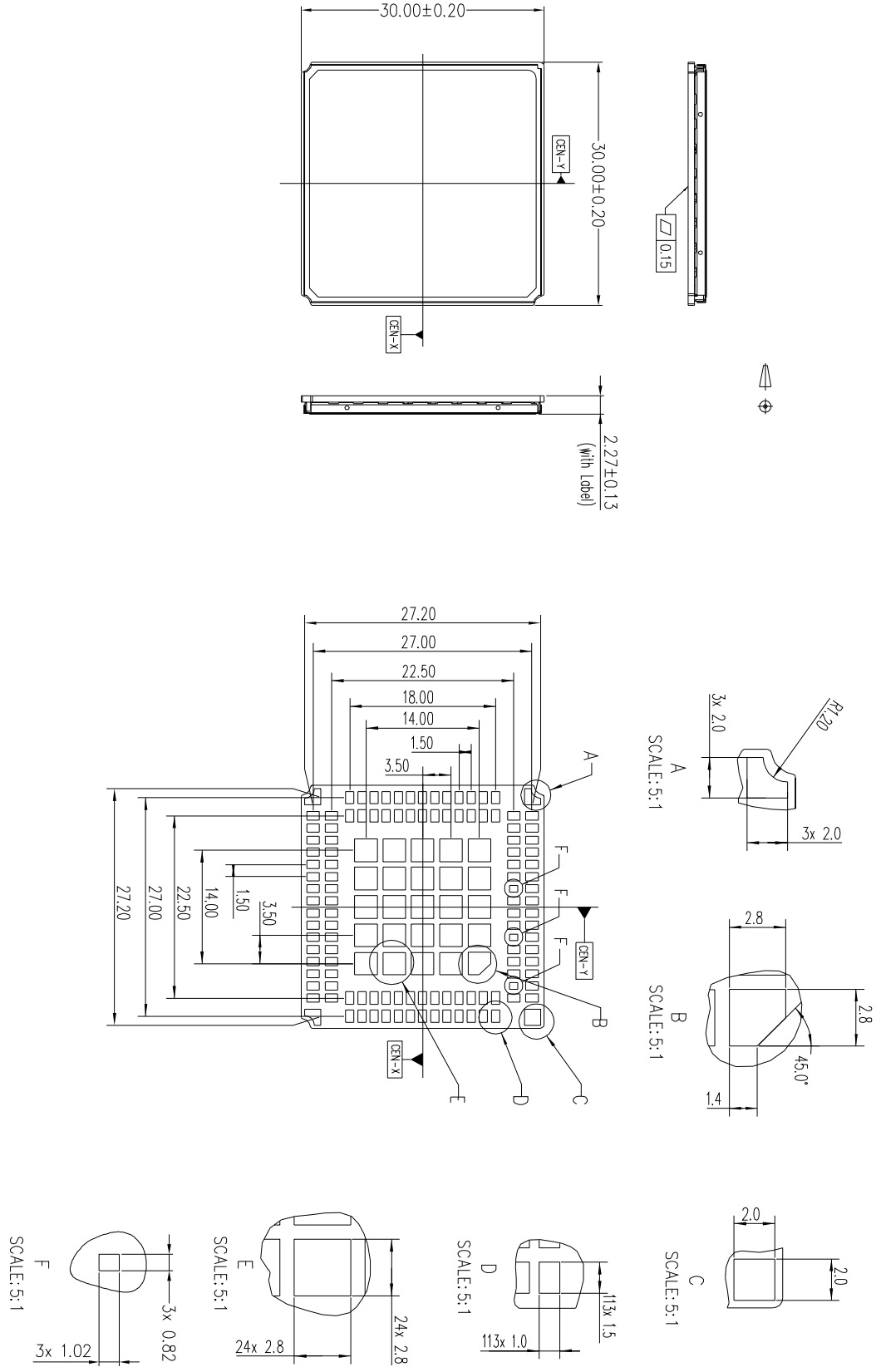
Baking Temperature	Baking Condition	Baking Duration	Remarks
125°C±5°C	Relative humidity ≤ 60%	8 hours	

NOTE
Moving, storing, and processing the product must comply with IPC/JEDEC J-STD-033.

6.4 Dimensions and interfaces

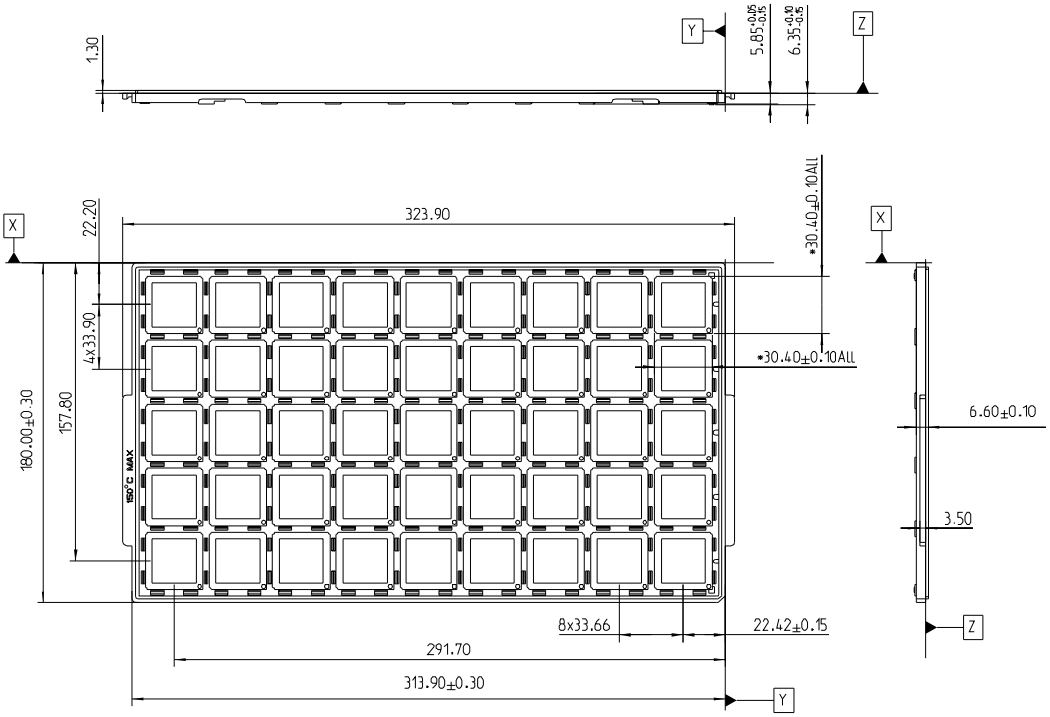
Figure 6-1 shows the dimensions in details.

Figure 6-1 Dimensions (unit: mm)



6.5 Packaging

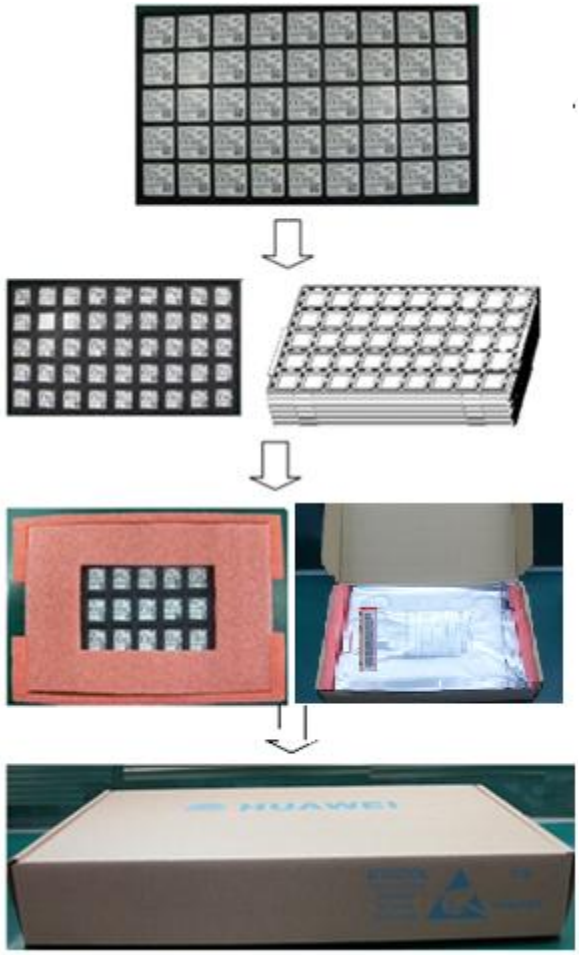
HUAWEI LGA module uses five layers ESD pallet, anti-vibration foam and vacuum packing into cartons.



NOTE

- All materials used must meet eco-friendly requirements.
- According to the requirements and test methods specified in EIA 541, the surface resistance must range from 10,000 Ω to 1000,000 Ω.
- Packaging materials must be resistant to temperature higher than or equal to 150°C.
- Triboelectricity must be lower than 100 V.

The following figure shows the packaging.



Orient LGA modules in the specified direction.

Module quantity per tray: 5 x 9 = 45 pcs/tray

6 trays in each vacuum package. Do not place any modules on the tray at the top of each package.

Total quantity per package: 5 x 45 = 225pcs/vacuum package.

Use vacuum packages; one package per carton; module quantity per carton: 5 x 45 = 225pcs/carton.

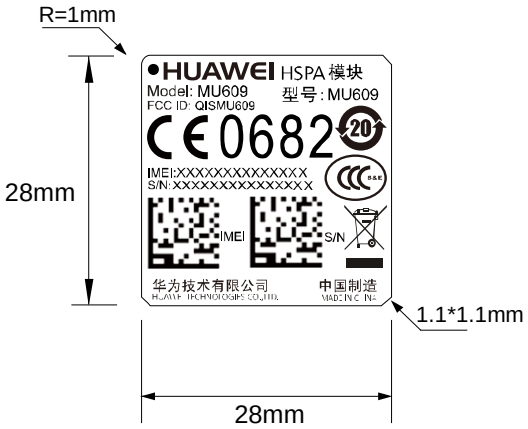
NOTE

- A secondary SMT assembly will be conducted on the LGA modules. To keep LGA modules dry and ensure a quality secondary SMT assembly, use vacuum packing for the LGA modules in accordance with the packing standards for Moisture Sensitivity Level (MSL) 3 components.
- Include desiccant and humidity indicators in the packages. Attach the packages with labels indicating that the LGA modules contained in the packages are MSL 3 components.
- Packages must be made of ESD materials. Packages or containers must be attached with ESD labels.

6.6 Label

The label is made from deformation-resistant, fade-resistant, and high-temperature-resistant material and is able to endure the high temperature of 260°C.

Figure 6-2 MU609 label



NOTE

- The picture mentioned above is only for reference.
- The silk-screen should be clear, without burrs, and dimension should be accurate.
- The material and surface finishing and coatings which used have to make satisfied with the EU WEEE and RoHS directives.
- The label must be heated up for 20s–40s and able to endure the high temperature of 260°C. And the color of the material of the nameplate cannot change.

6.7 Customer PCB Design

6.7.1 PCB Surface Finish

The PCB surface finish recommended is Electroless Nickel, immersion Gold (ENIG). Organic Solderability Preservative (OSP) may also be used, ENIG preferred.

6.7.2 PCB Pad Design

To achieve assembly yields and solder joints of high reliability, it is recommended that the PCB pad size be designed as follows:

Figure 6-3 MU609 Footprint design (unit: mm)

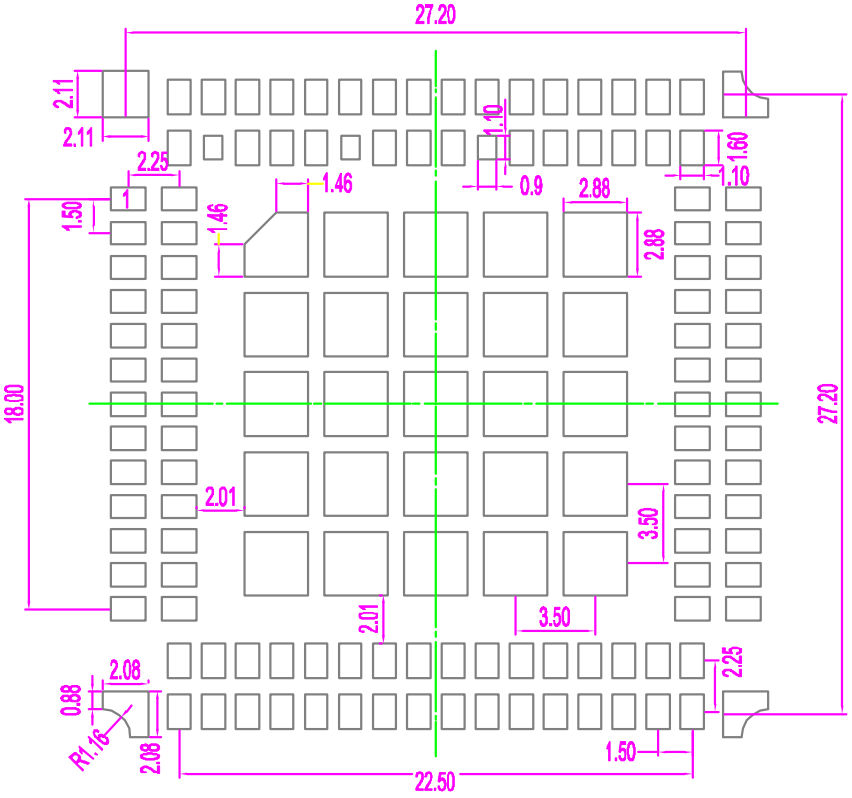
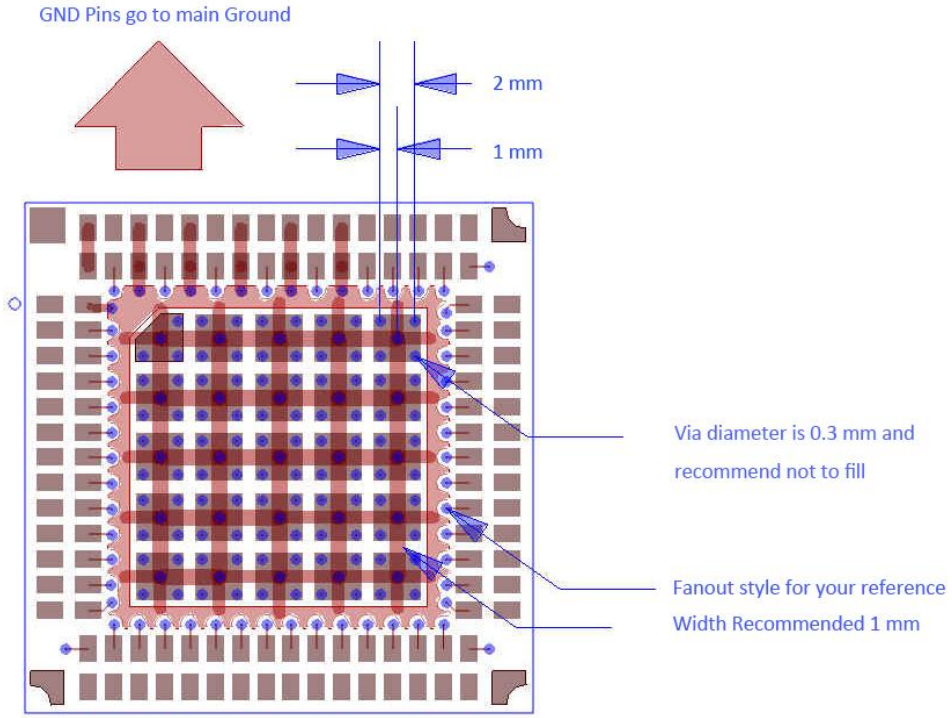


Figure 6-4 Thermal Pads design (unit: mm)



6.7.3 Solder Mask

NSMD is recommended. In addition, the solder mask of the NSMD pad design is larger than the pad so the reliability of the solder joint can be improved.

The solder mask must be 100 µm–150 µm larger than the pad, that is, the single side of the solder mask must be 50 µm–75 µm larger than the pad. The specific size depends on the processing capability of the PCB manufacturer.

6.7.4 Requirements on PCB Layout

- To reduce deformation, a thickness of at least 1.0 mm is recommended.
- Other devices must be located more than 3 mm (5 mm recommended) away from the LGA module. The minimum distance between the LGA module and the PCB edge is 0.5 mm.
- When the PCB layout is double sided, it is recommended that the LGA module be placed on the second side for assembly; so as to avoid module dropped from PCB or component (located in module) re-melding defects caused by uneven weight.

6.8 Assembly Processes

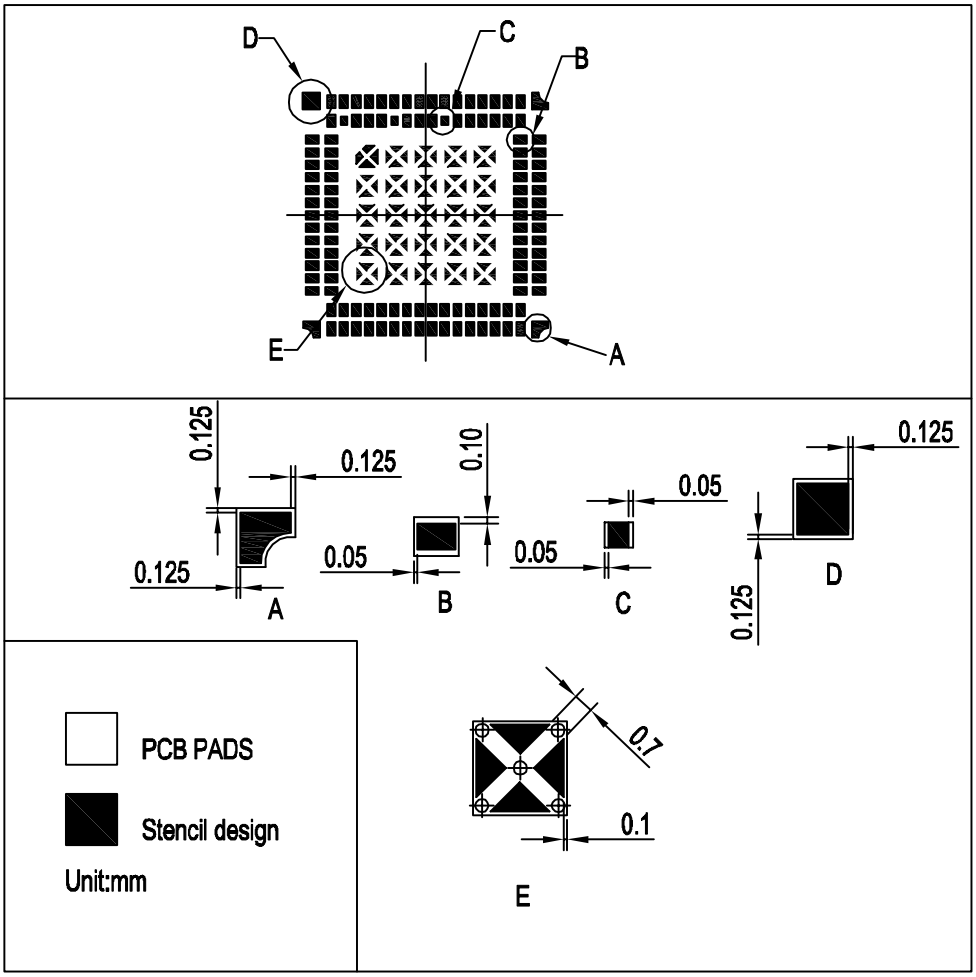
6.8.1 General Description of Assembly Processes

- Tray modules are required at SMT lines, because LGA modules are placed on ESD pallets.
- Reflow ovens with at least seven temperature zones are recommended.
- Use reflow ovens or rework stations for soldering, because LGA modules have large solder pads and cannot be soldered manually.

6.8.2 Stencil Design

It is recommended that the stencil for the LGA module be 0.15 mm in thickness. For the stencil design. see the following figure:

Figure 6-5 Recommended stencil design of LGA module (unit: mm)



NOTE

The stencil design has been qualified for HUAWEI motherboard assembly, customers can adjust the parameters by their motherboard design and process situation to assure LGA soldering quality and no defect.

6.8.3 Reflow Profile

For the soldering temperature of the LGA module, see the following figure.

Figure 6-6 Reflow profile

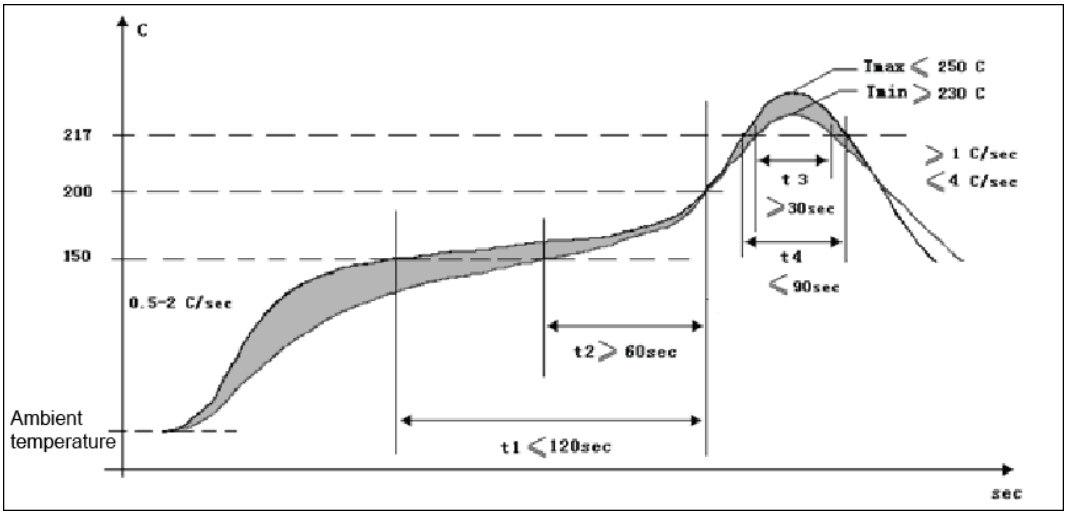
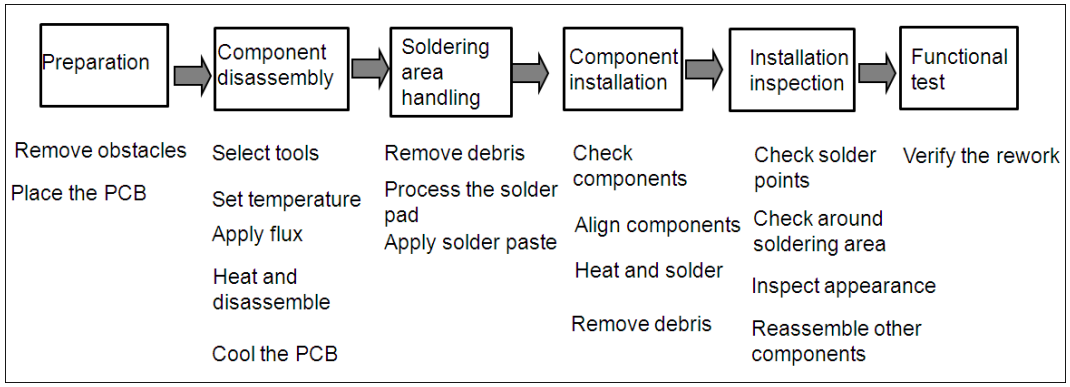


Table 6-2 Reflow parameters

Temperature Zone	Time	Key Parameter
Preheat zone (40°C–150°C)	60s–120s	Heating rate: 0.5°C/s–2°C/s
Soak zone (150°C–200°C)	(t1–t2): 60s–120s	Heating rate: < 1.0°C/s
Reflow zone (> 217°C)	(t3–t4): 30s–90s	Peak reflow temperature: 230°C–250°C
Cooling zone	Cooling rate: 1°C/s ≤ Slope ≤ 4°C/s	

6.9 Specification of Rework

6.9.1 Process of Rework



6.9.2 Preparations of Rework

- Remove barrier or devices that can't stand high temperature before rework.
- If the device to be reworked is beyond the storage period, bake the device according to Table 6-1 .

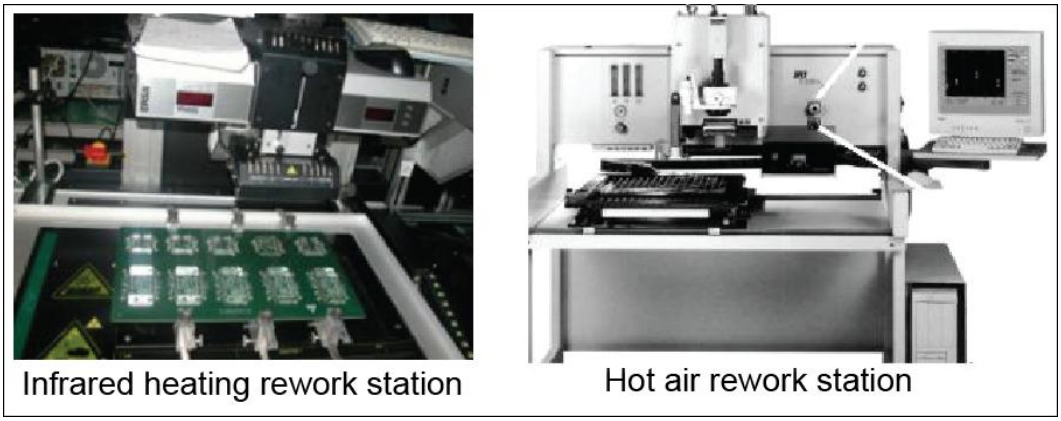
6.9.3 Removing of the Module

The solder is molten and reflowed through heating during the module removing process. The heating rate must be quick but controllable in order to melt all the solder joints simultaneously. Pay attention to protect the module, PCB, neighboring devices, and their solder joints against heating or mechanical damages.

NOTE

- The LGA module has many solder pads and the pads are large. Therefore, common soldering irons and heat guns cannot be used in the rework. Rework must be done using either infrared heating rework stations or hot air rework stations. Infrared heating rework stations are preferred, because they can heat components without touching them. In addition, infrared heating rework stations produce less solder debris and less impact on modules, while hot air rework stations may cause shift of other components not to be reworked.
- It is proposed that a special clamp is used to remove the module.

Figure 6-7 Equipment used for rework



6.9.4 Welding Area Treatment

Step 1 Remove the old solder by using a soldering iron and solder braid that can wet the solder.

Step 2 Clean the pad and remove the flux residuals.

Step 3 Solder pre-filling: Before the module is installed on a board, apply some solder paste to the pad of the module by using the rework fixture and stencil or apply some solder paste to the pad on the PCB by using a rework stencil.

NOTE

It is recommended that a fixture and a mini-stencil be made to apply the solder paste in the rework.

6.9.5 Module Installation

Install the module precisely on the module and ensure the right installation direction of the module and the reliability of the electrical connection with the PCB. It is recommended that the module be preheated in order to ensure that the temperature of all parts to be soldered is uniform during the reflow process. The solder quickly reflows upon heating so the parts are soldered reliably. The solder joints undergo proper reflow duration at a preset temperature to form a favorable Intermetallic Compound (IMC).

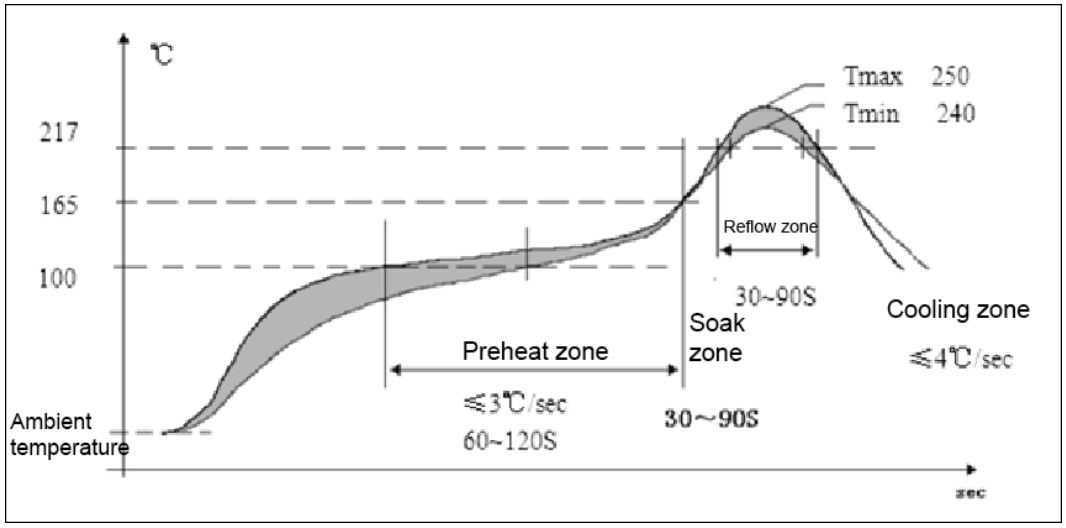
NOTE

- It is recommended that a special clamp be used to pick the module when the module is installed on the pad after applied with some solder.
- A special rework device must be used for the rework.

6.9.6 Specifications of Rework

Temperature parameter of rework: for either the removing or welding of the module, the heating rate during the rework must be equal to or smaller than 3°C/s, and the peak temperature between 240°C–250°C. The following parameters are recommended during the rework.

Figure 6-8 Temperature graph of rework



7 Certifications

7.1 About This Chapter

This chapter gives a general description of certifications of MU609.

7.2 Certifications

NOTE

The certification of MU609 is testing now. Table 7-1 shows certifications the MU609 will be implemented. For more demands, please contact us for more details about this information.

Table 7-1 Product Certifications

Certification	Model name
	MU609
CE	√
FCC	√
CCC	√
RoHS	√
GCF	√
PTCRB	√
WEEE	√

8 Safety Information

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

8.1 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.

8.2 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.

8.3 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

8.4 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.

8.5 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.

8.6 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.

8.7 Environment Protection

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

8.8 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).

8.9 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).

8.10 Laws and Regulations Observance

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

8.11 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.

8.12 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.

8.13 Regulatory Information

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

8.13.1 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).

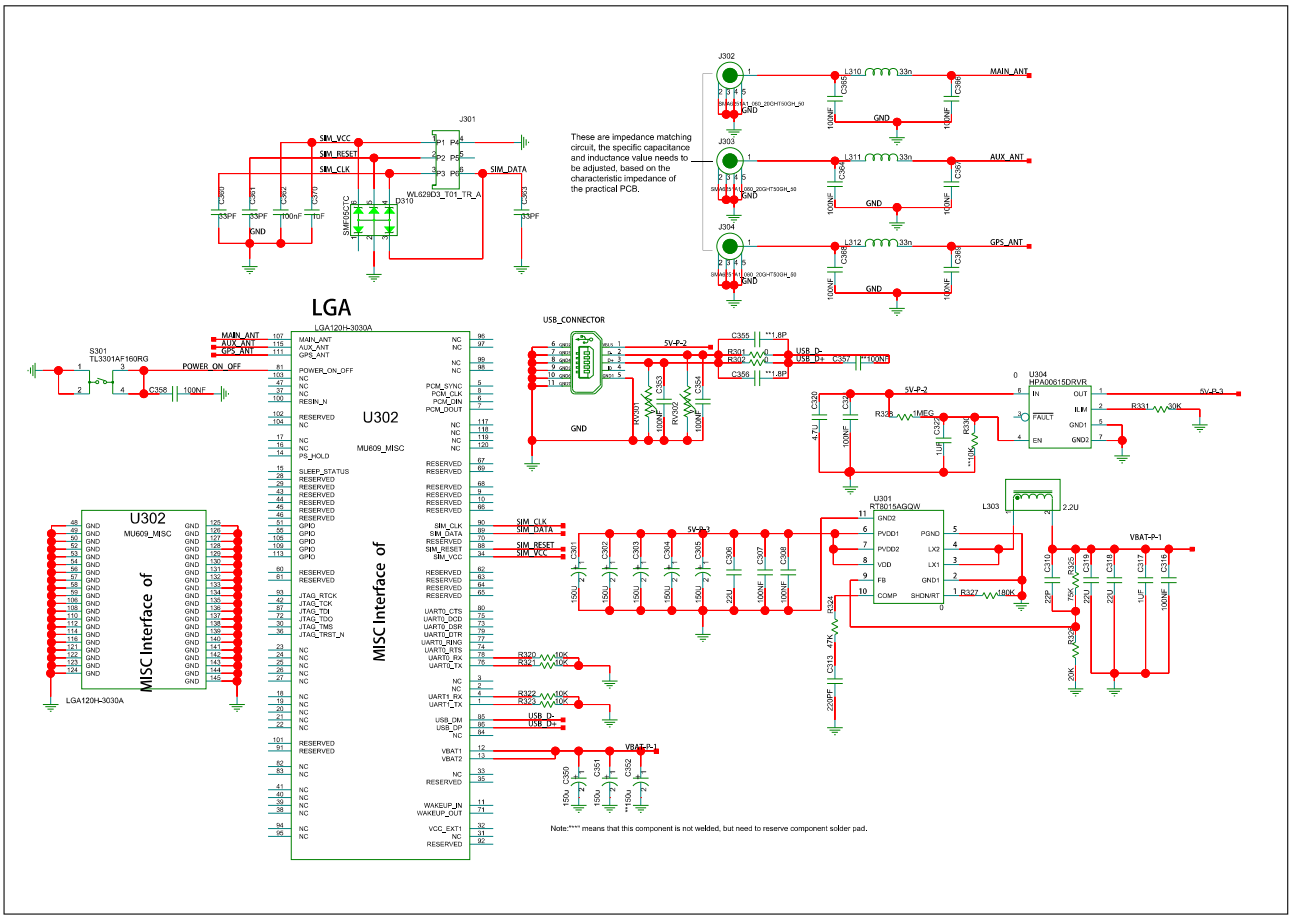
8.13.2 FCC Statement

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.

9 Appendix A Circuit of Typical Interface



10 Appendix B Acronyms and Abbreviations

Acronym or Abbreviation	Expansion
3GPP	Third Generation Partnership Project
8PSK	8 Phase Shift Keying
AUX	Auxiliary
BER	Bit Error Rate
BLER	Block Error Rate
BIOS	Basic Input Output System
CCC	China Compulsory Certification
CE	European Conformity
CMOS	Complementary Metal Oxide Semiconductor
CTL	Control
CS	Coding Scheme
CSD	Circuit Switched Data
DC	Direct Current
DCE	Data Communication Equipment
DL	Down Link
DMA	Direct Memory Access
DTE	Data Terminal Equipment
EBU	External Bus Unit
EDGE	Enhanced Data Rate for GSM Evolation
EIA	Electronic Industries Association

Acronym or Abbreviation	Expansion
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
GPS	Global Positioning System
GSM	Global System for Mobile Communication
HSDPA	High-Speed Downlink Packet Access
HSPA	Enhanced High Speed Packet Access
HSUPA	High Speed Up-link Packet Access
ISO	International Standards Organization
JTAG	Joint Test Action Group
LCP	Liquid Crystal Polyester
LDO	Low-Dropout
LED	Light-Emitting Diode
LGA	Land Grid Array
MCP	Multi-chip Package
MDM	Mobile Data Modem
MO	Mobile Originated
MT	Mobile Terminated
NC	Not Connected
NTC	Negative Temperature Coefficient
NSMD	Non-solder Mask Defined
PA	Power Amplifier
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PID	Product IDentity
PMU	Power Management Unit

Acronym or Abbreviation	Expansion
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
SMS	Short Message Service
TIS	Total Isotropic Senstivity
TRP	Total Radiated Power
TTFF	Time to First Fix
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver-Transmitter
UL	Up Link
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VIP	Vendor IDentity
VSWR	Voltage Standing Wave Ratio
WEEE	Waste Electrical and Electronic Equipment
WCDMA	Wideband Code Division Multiple Access
WWAN	Wireless Wide Area Network
RFU	For future use
AP	Application process