HUAWEI ME909u-521 LTE LGA Module

Hardware Guide

Issue 02

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2013-07-12		Creation
02	2014-01-20	All	Deleted the description related to ME909u-121 and ME909u-721 in issue 01
		3.4.2	Updated Figure 3-4 power on timing sequence
		3.6	Updated Figure 3-14 recommended circuit of USB interface and its notes
		3.11	Updated RF antenna interface
		4.4.1	Added Table 4-3 ME909u-521 module GPS main characteristics
		5.6.2	Updated power consumption
		5.7	Updated reliability features
		5.8	Updated EMC and ESD features
		6.7.3	Added heat dissipation solution
		9	Updated circuit of typical interface

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces provided by HUAWEI ME909u-521 LTE LGA module.

This document helps hardware engineer to understand the interface specifications, electrical features and related product information of the ME909u-521 module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the ME909u-521 module and provides:

- Function Overview
- Circuit Block Diagram
- Application Block Diagram

2.2 Function Overview

Table 2-1 ME909u-521 module features

Feature	Description
Physical Dimensions	Dimensions (L × W × H): 30 mm × 30 mm × 2.35 mm
Weight	about 5 g
Operating Bands	LTE: FDD Band 1, 2, 3, 5, 7, 8, 20, all bands with diversity WCDMA/HSDPA/HSUPA/HSPA+: Band 1, 2, 5, 8, all bands with diversity GSM/GPRS/EDGE: 850/900/1800/1900 MHz GPS/GLONASS: L1
Operating Temperature	Normal operating temperature: –20°C to +70°C Extended operating temperature[1]: –30°C to +75°C
Storage Temperature	–40°C to +85°C
Power Voltage	DC 3.3 V to 4.2 V (typical value is 3.8 V)
AT Commands	See the *HUAWEI ME909u-521 LTE LGA Module AT Command Interface Specification*.

Feature	Description
Application Interface (145-pin LGA interface)	One standard USIM (Class B and Class C) interface
	Audio interface: PCM interface
	USB 2.0 (High Speed)
	4-wire UART[2] x 2 2-wire UART[3] x 1
	GPIO x 5
	Power on/off pin
	Hardware reset pin
	Sleep indicator pin (SLEEP_STATUS)
	Tunable Antenna control (4 GPIOs) (the firmware with this feature is in plan.)
	HSIC interface[4]
	SDIO interface[4]
	SPI interface[4]
	I2C interface[4]
	JTAG
	Antenna interface (Main/AUX/GPS)
	ADC[4] x 2
	Power supply
Antenna interface	WWAN primary antenna pad x 1 WWAN secondary antenna pad x 1 GPS antenna pad x 1
Data Services	GPRS: DL 85.6 kbps/UL 85.6 kbps
	EDGE: DL 236.8 kbps/UL 236.8 kbps
	WCDMA CS: DL 64 kbps/UL 64 kbps
	WCDMA PS: DL 384 kbps/UL 384 kbps
	HSPA+: DL 21.6 Mbps/UL 5.76 Mbps
	DC-HSPA+: DL 43.2 Mbps/UL 5.76 Mbps
	LTE FDD: DL 100 Mbps/UL 50 Mbps @20M BW cat3

NOTE

[1]: When the temperature is beyond the range of –20°C to +70°C, the module may slightly deviate from 3GPP specifications.

[2]: Currently the firmware with this feature is under development. .

[3]: This is only used for debugging.

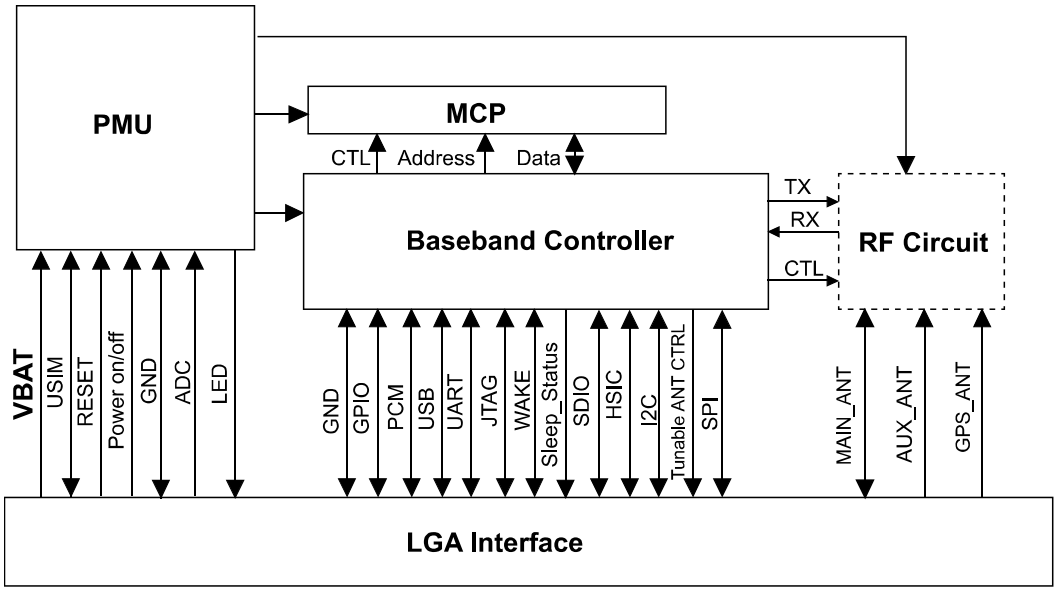
[4]: These interfaces are reserved for intelligent module in future.

2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the ME909u-521 module. The major functional units of the ME909u-521 module contain the following parts:

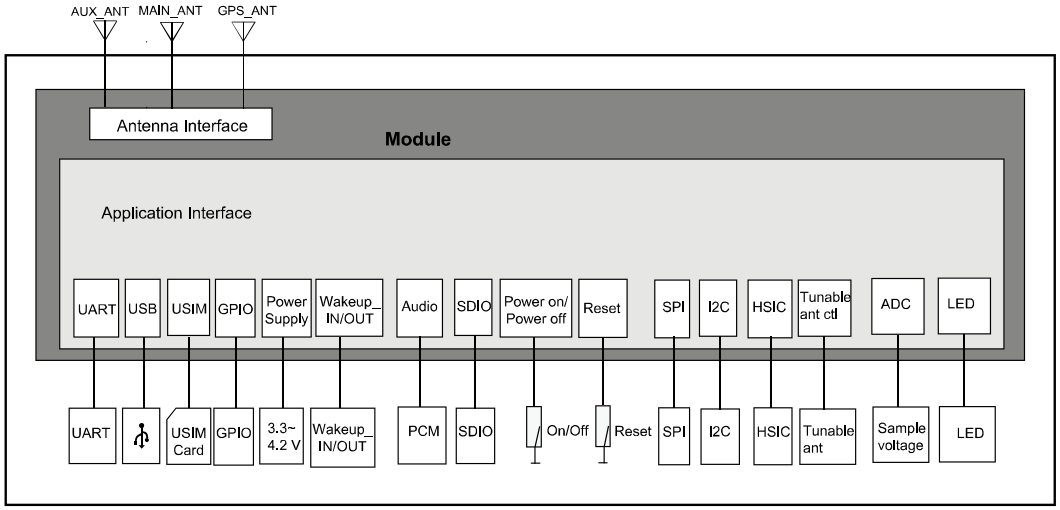
- Power management
- Baseband controller
- Multi-chip package (MCP) memory
- RF Circuit

Figure 2-1 Circuit block diagram of the ME909u-521 module



2.4 Application Block Diagram

Figure 2-2 Application block diagram of the ME909u-521 module



UART Interface:	The module supports 3 UART interfaces. Two are 4-wire UARTs, and the firmware with this feature is under development. One is 2-wire UART, which is 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. The firmware with this feature is under development.
RF Pad:	RF antenna interface.
Tunable ANT CTRL:	Since LTE bands cover wide frequency, tunable ANT CTRL helps customer for tunable antenna design. The firmware with this feature is in plan.
ADC:	Reserved for intelligent module in future.
SPI Interface:	Reserved for intelligent module in future.
SDIO Interface:	Reserved for intelligent module in future.
HSIC Interface:	Reserved for intelligent module in future.
I2C Interface:	Reserved for intelligent module in future.

3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the ME909u-521 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
- Tunable Antenna Control

3.2 LGA Interface

The ME909u-521 module uses a 145-pin LGA as its external interface. For details about the module and dimensions, see "6.4 Dimensions and Interfaces".

Figure 3-1 shows the sequence of pins on the 145-pin signal interface of the ME909u-521 module.

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

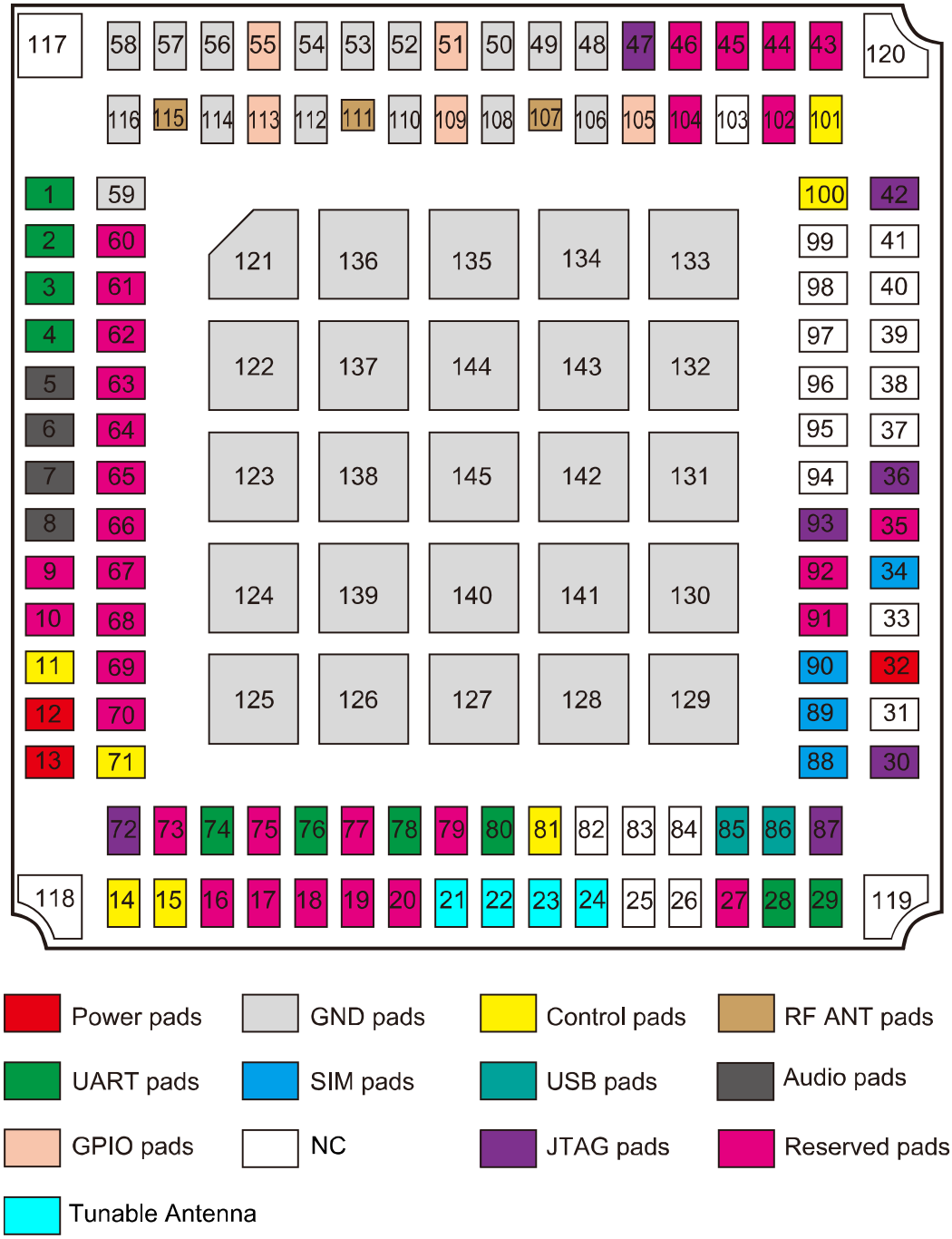


Figure 3-2 shows the appearance of ME909u-521 module. The left one is top view, and the right one is bottom view.

Figure 3-2 Appearance of ME909u-521 module (without label)

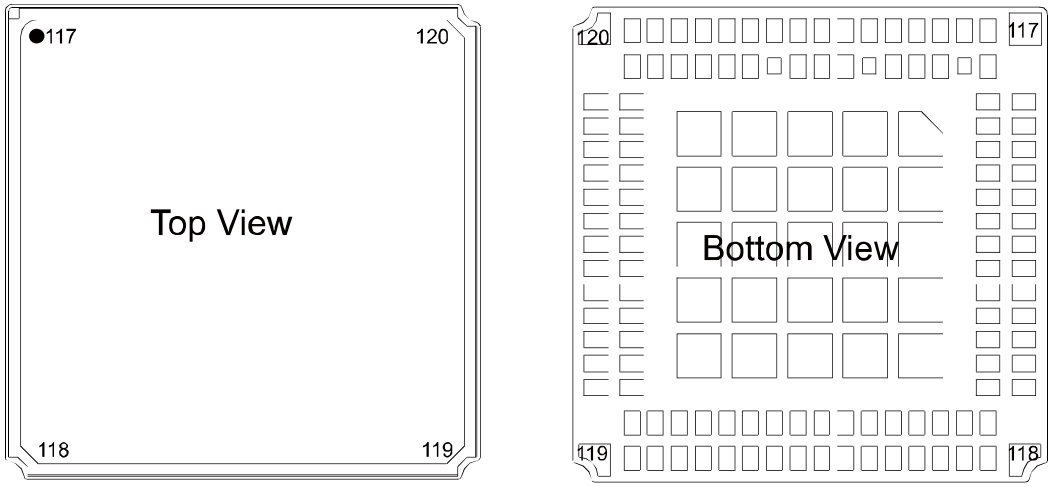


Table 3-1 shows the definitions of pins on the 145-pin signal interface of the ME909u-521 module.

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	–0.3	1.8	2.1
2	UART1_RTS	-	O	UART1 Ready for receive	–0.3	1.8	2.1
3	UART1_CTS	-	I	UART1 Clear to Send	–0.3	1.8	2.1
4	UART1_RX	-	I	UART1 receive data input	–0.3	1.8	2.1
5	PCM_SYNC	-	O	PCM interface sync	–0.3	1.8	2.1
6	PCM_DIN	-	I	PCM interface data in	–0.3	1.8	2.1
7	PCM_DOUT	-	O	PCM interface data out	–0.3	1.8	2.1
8	PCM_CLK	-	O	PCM interface clock	–0.3	1.8	2.1
9	Reserved	-	-	Reserved, must keep this pin open	-	-	-
10	Reserved	-	-	Reserved, must keep this pin open	-	-	-
11	WAKEUP_IN	-	I	Host to set the module into sleep or wake up the module from sleep. This pin must be connected if customer need to use the High-Speed UART in future normally.	–0.3	1.8	2.1

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
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 PMU, used for JTAG	–0.3	1.8	2.1
15	SLEEP_STATUS	-	O	Indicates sleep status of ME909u-521 module	–0.3	1.8	2.1
16	Reserved	-	-	Reserved, must keep this pin open	-	-	-
17	Reserved	-	-	Reserved, must keep this pin open	-	-	-
18	Reserved	-	-	Reserved, must keep this pin open	-	-	-
19	Reserved	-	-	Reserved, must keep this pin open	-	-	-
20	Reserved	-	-	Reserved, must keep this pin open	-	-	-
21	ANT_TUNE0	-	O	Tunable antenna control signal, bit 0	–0.3	1.8	2.1
22	ANT_TUNE1	-	O	Tunable antenna control signal, bit 1	–0.3	1.8	2.1
23	ANT_TUNE2	-	O	Tunable antenna control signal, bit 2	–0.3	1.8	2.1
24	ANT_TUNE3	-	O	Tunable antenna control signal, bit 3	–0.3	1.8	2.1
25	NC	-	-	Not connected, please keep this pin open	-	-	-
26	NC	-	-	Not connected, please keep this pin open	-	-	-
27	Reserved	-	-	Reserved, must keep this pin open	-	-	-
28	UART2_TX	-	O	UART2 transmit output	–0.3	1.8	2.1
29	UART2_RX	-	I	UART2 receive data input	–0.3	1.8	2.1
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	1.75	1.8	1.85

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
33	NC	-	-	Not connected, please keep this pin open	-	-	-
34	SIM_VCC	-	P	Output power supply for USIM card	-	1.8/2.85	-
35	Reserved	-	-	Reserved, must keep this pin open	-	-	-
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, must keep this pin open	-	-	-
44	Reserved	-	-	Reserved, must keep this pin open	-	-	-
45	Reserved	-	-	Reserved, must keep this pin open	-	-	-
46	Reserved	-	-	Reserved, must keep this pin open	-	-	-
47	JTAG_SRST_N	-	I	JTAG reset for debugging	–0.3	1.8	2.1
48	GND	-	G	Ground	-	-	-
49	GND	-	G	Ground	-	-	-
50	GND	-	G	Ground	-	-	-
51	GPIO	-	I/O	General Purpose I/O pins. The function of these pins has not been defined.	–0.3	1.8	2.1
52	GND	-	G	Ground	-	-	-
53	GND	-	G	Ground	-	-	-
54	GND	-	G	Ground	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
55	GPIO	-	I/O	General Purpose I/O pins. The function of these pins has not been defined.	–0.3	1.8	2.1
56	GND	-	G	Ground	-	-	-
57	GND	-	G	Ground	-	-	-
58	GND	-	G	Ground	-	-	-
59	GND	-	G	Ground	-	-	-
60	Reserved	-	-	Reserved, must keep this pin open	-	-	-
61	Reserved	-	-	Reserved, must keep this pin open	-	-	-
62	Reserved	-	-	Reserved, must keep this pin open	-	-	-
63	Reserved	-	-	Reserved, must keep this pin open	-	-	-
64	Reserved	-	-	Reserved, must keep this pin open	-	-	-
65	Reserved	-	-	Reserved, must keep this pin open	-	-	-
66	Reserved	-	-	Reserved, must keep this pin open	-	-	-
67	Reserved	-	-	Reserved, must keep this pin open	-	-	-
68	Reserved	-	-	Reserved, must keep this pin open	-	-	-
69	Reserved	-	-	Reserved, must keep this pin open	-	-	-
70	Reserved	-	-	Reserved, must keep this pin open	-	-	-
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	Reserved	-	-	Reserved, must keep this pin open	-	-	-
74	UART0_RTS	-	O	UART0 Ready for receive	–0.3	1.8	2.1
75	Reserved	-	-	Reserved, must keep this pin open	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
76	UART0_TX	-	O	UART0 transmit output	–0.3	1.8	2.1
77	Reserved	-	-	Reserved, must keep this pin open	-	-	-
78	UART0_RX	-	I	UART0 receive data input	–0.3	1.8	2.1
79	Reserved	-	-	Reserved, must keep this pin open	-	-	-
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 in 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	SIM reset	-	1.8/2.85	-
89	SIM_DATA	-	I/O	SIM data	-	1.8/2.85	-
90	SIM_CLK	-	O	SIM clock	-	1.8/2.85	-
91	Reserved	-	-	Reserved, must keep this pin open	-	-	-
92	Reserved	-	-	Reserved, must keep this pin open	-	-	-
93	JTAG_RTCK	-	O	JTAG return clock	–0.3	1.8	2.1
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	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
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, this pin is pulled up on module	–0.3	1.8	2.1
101	LED_MODE	-	O	Mode indicator Current sink Drive strength: 10 mA The firmware with this feature is under development.	-	-	-
102	Reserved	-	-	Reserved, must keep this pin open	-	-	-
103	NC	-	-	Not connected, please keep this pin open	-	-	-
104	Reserved	-	-	Reserved, must keep this pin open	-	-	-
105	GPIO	-	I/O	General Purpose I/O pins. The function of these pins has not been defined.	–0.3	1.8	2.1
106	GND	-	G	Ground	-	-	-
107	MAIN_ANT	-	I/O	RF primary antenna pad	-	-	-
108	GND	-	G	Ground	-	-	-
109	GPIO	-	I/O	General Purpose I/O pins. The function of these pins has not been defined	–0.3	1.8	2.1
110	GND	-	G	Ground	-	-	-
111	GPS_ANT	-	I	GPS antenna pad	-	-	-
112	GND	-	G	Ground	-	-	-
113	GPIO	-	I/O	General Purpose I/O pins. The function of these pins has not been defined	–0.3	1.8	2.1
114	GND	-	G	Ground	-	-	-
115	AUX_ANT	-	I	RF secondary antenna pad	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
116	GND	-	G	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	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
122	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
123	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
124	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
125	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
126	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
127	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
128	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
129	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
130	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
131	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
132	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
133	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
134	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-

PIN No.	Pin Name		I/O	Description	DC Characteristics (V)		
	Normal	MUX			Min.	Typ.	Max.
135	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
136	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
137	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
138	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
139	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
140	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
141	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
142	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
143	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
144	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-
145	GND	-	G	Thermal Ground Pad, this pad need thermal via	-	-	-

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; **G** indicates ground pins.
- 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 ME909u-521 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	G	Ground	-	-	-
32	VCC_EXT1	P	Pin for external power output	1.75	1.8	1.85
34	SIM_VCC	P	Power supply for USIM card	-	1.8/2.85	-
121–145	GND	G	Thermal Ground Pad	-	-	-

3.3.2 Power Supply VBAT Interface

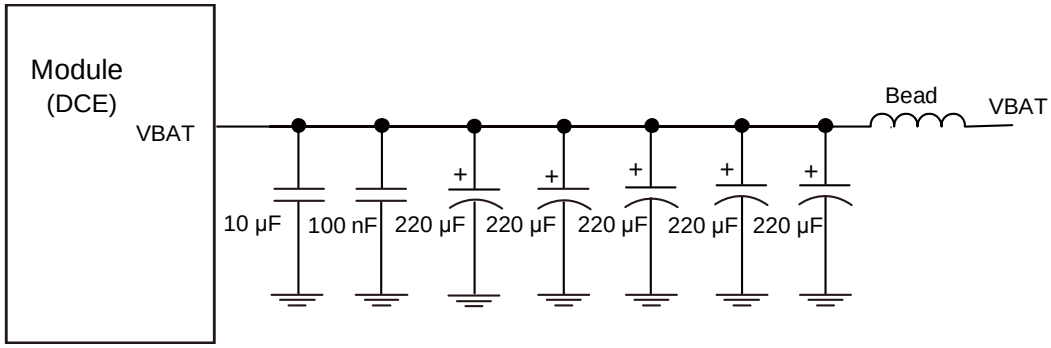
When the ME909u-521 module works normally, power is supplied through the VBAT pins and the voltage ranges from 3.3 V to 4.2 V (typical value: 3.8 V). The 145-pin LGA provides 2 VBAT pins and 41 GND pins for external power input. To ensure that the ME909u-521 module works normally, all the pins must be used efficiently.

When the ME909u-521 module is used for different external applications, pay special attention to the design for the power supply. When the ME909u-521 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 ME909u-521 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 ME909u-521 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 customers 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 3-3 shows the recommended power circuit of ME909u-521 module.

Figure 3-3 Recommended power circuit of ME909u-521 module



When the system power restarts, a discharge circuit is recommended to make sure the power voltage drops below 1.8 V and stays for 100 ms at least. This is very important. If POWER_ON_OFF is asserted when the VBAT is between 1.8 V to 3.2 V, the module may enter an unexpected status.

3.3.3 Output Power Supply Interface

Output power supply interfaces are VCC_EXT1 and SIM_VCC.

Through VCC_EXT1, the ME909u-521 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 ME909u-521 module is in sleep mode, the output power supply interface is in the low power consumption state (< 500 µA). If the ME909u-521 module is in power down mode, the output power supply is in the disabled state.

Through the SIM_VCC power supply interface, the ME909u-521 module can supply 1.8 V or 2.85 V power to USIM card.Please pay attention that the transient current can reach 200 mA.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the ME909u-521 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
- LED control signal (LED_MODE) 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 in module	-	-	-
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 ME909u-521 module H: ME909u-521 is in wakeup state. L: ME909u-521 is in sleep state.	–0.3	1.8	2.1
101	LED_MODE	O	Mode indicator Current sink Drive strength: 10 mA Under development.	-	-	-

NOTE
Please connect the **WAKEUP_IN** pin if you need to use the High-Speed UART normally in future. High-Speed UART can work only while WAKEUP_IN pin is high, or it stops working.

3.4.2 Power-on/off (POWER_ON_OFF) Pin

The ME909u-521 module can be controlled to be powered on/off by the POWER_ON_OFF pin.

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 sequence, please make sure the VBAT is stable.

Figure 3-4 Power on timing sequence

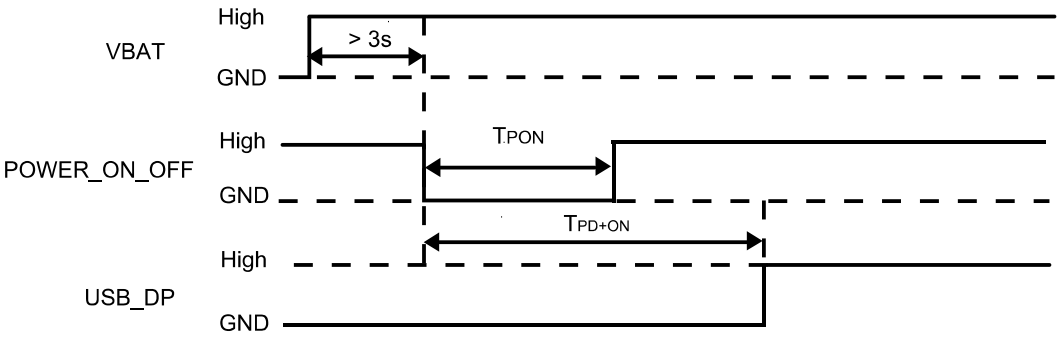


Table 3-4 Power on timing

Parameter	Comments	Time (Nominal values)	Units
T_{PON}	POWER_ON_OFF turn on time.	0.5–1.0	s
T_{PD+ON}	POWER_ON_OFF Valid to USB D+ high	12	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.

Power-Off Time Sequence

Figure 3-5 Power off timing sequence

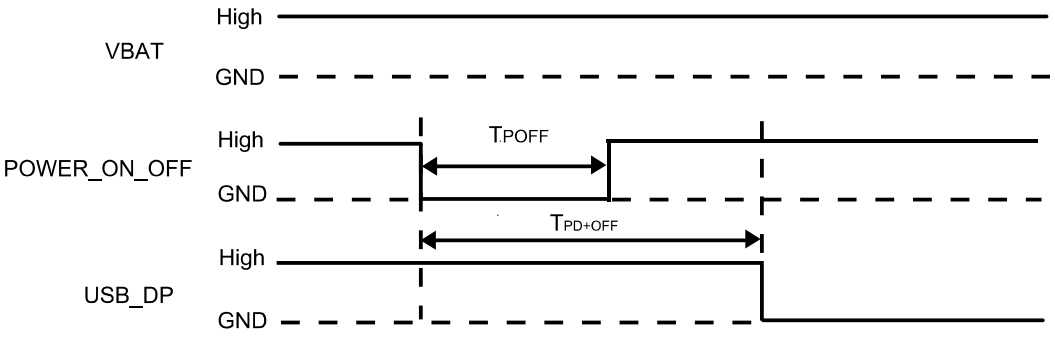


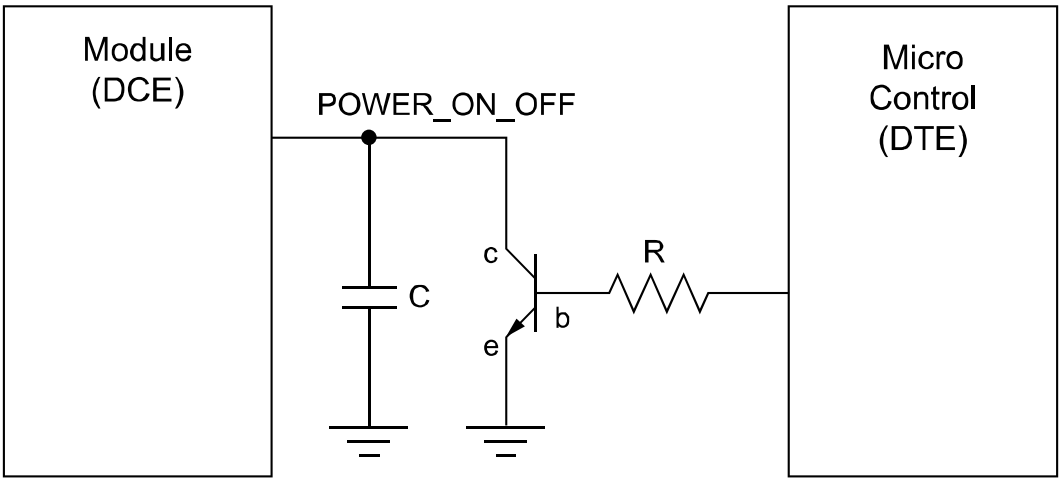
Table 3-5 Power off timing

Parameter	Comments	Time (Nominal values)	Units
T_{POFF}	POWER_ON_OFF turn off time.	3.0–5.0	s
T_{PD+OFF}	POWER_ON_OFF Valid to USB D+ low	T_{POFF}+0.5	s

If POWER_ON_OFF pin is fixed to be a low state, such as connected to GND, ME909u-521 will automatically start up once power is supplied.

Pull-up resistor is never needed for this pin.

Figure 3-6 Connections of the POWER_ON_OFF pin

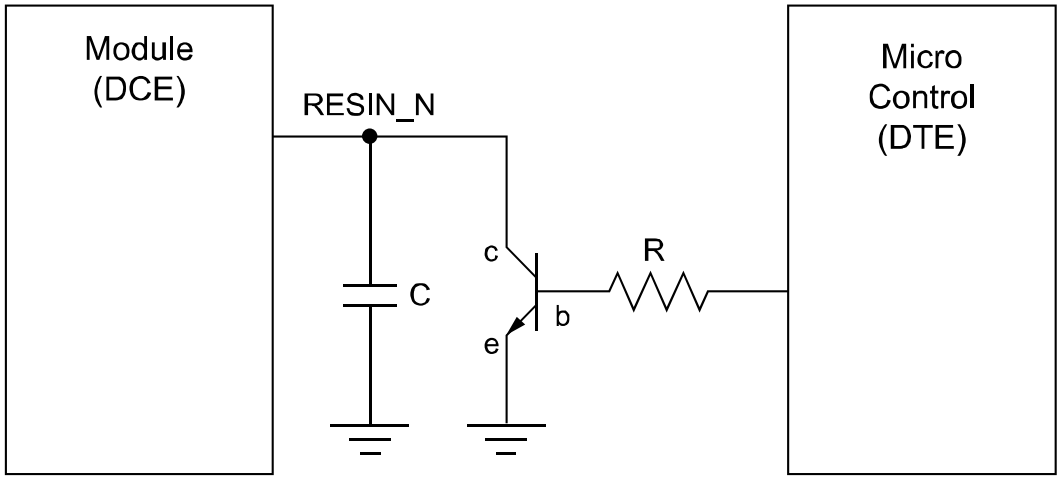


3.4.3 RESIN_N Pins

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.

Pull up resistor is never needed for this pin.

Figure 3-7 Connections of the RESIN_N pin



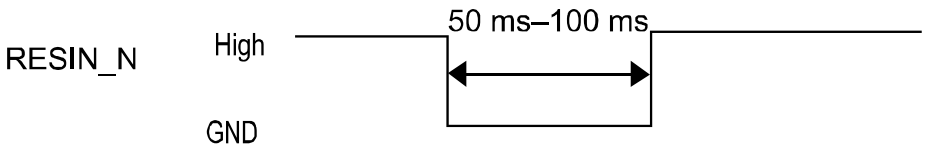
CAUTION

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.

RESIN_N

The ME909u-521 module supports hardware reset function. If the software of the ME909u-521 module stops responding, you can reset the hardware through the RESIN_N signal as shown in Figure 3-8 .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 3-8 Reset pulse timing



NOTE

The RESIN_N pin must not be pulled down for more than 1s. Otherwise, the ME909u-521 module will be powered off.

3.4.4 WAKEUP_IN Signal

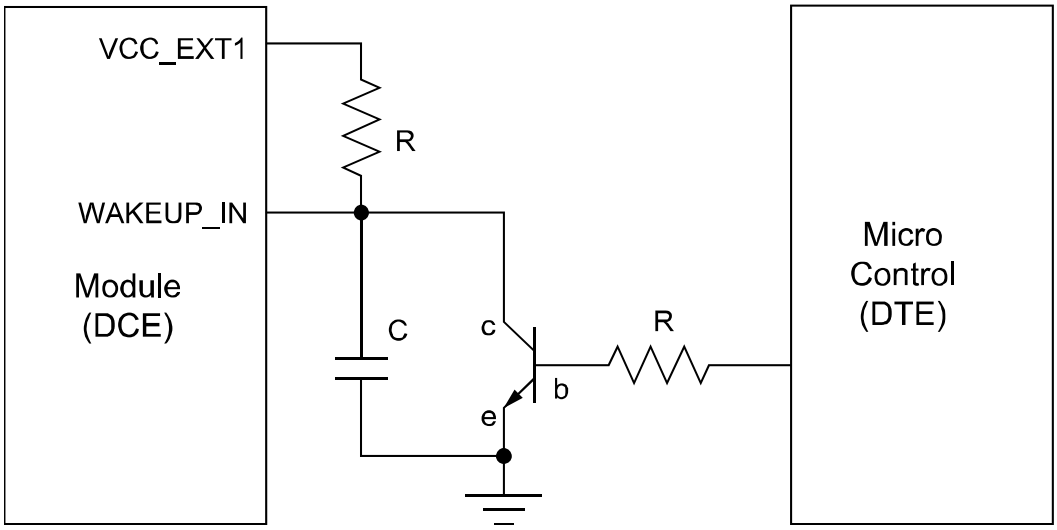
WAKEUP_IN pin is the authorization signal of ME909u-521 module entering sleep mode.

If the signal is pulled up to high level (1.8 V), ME909u-521 module cannot enter sleep mode.

If this pin is not connected, it will keep in low level by default. Yet if you need to use the High-Speed UART in future, you must connect this pin and keep it high while communicating with High-Speed UART.

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

Figure 3-9 Connections of the WAKEUP_IN pin



The pull up resistor should not be greater than 22 kΩ.

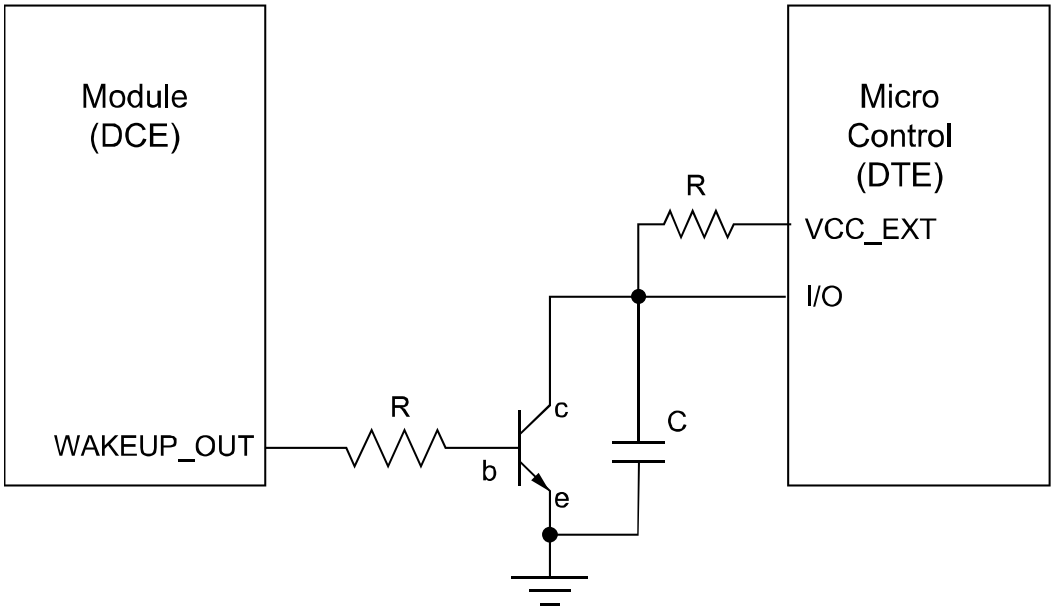
3.4.5 WAKEUP_OUT Signal

The WAKEUP_OUT signal is used to wake up the external devices. Its drive current is no more than 2 mA.

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

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

Figure 3-10 Connections of the WAKEUP_OUT pin



3.4.6 SLEEP_STATUS Signal

SLEEP_STATUS signal is used to indicate the sleep status of ME909u-521 module. The external devices can get to know whether the module is in sleep mode by reading SLEEP_STATUS pin.

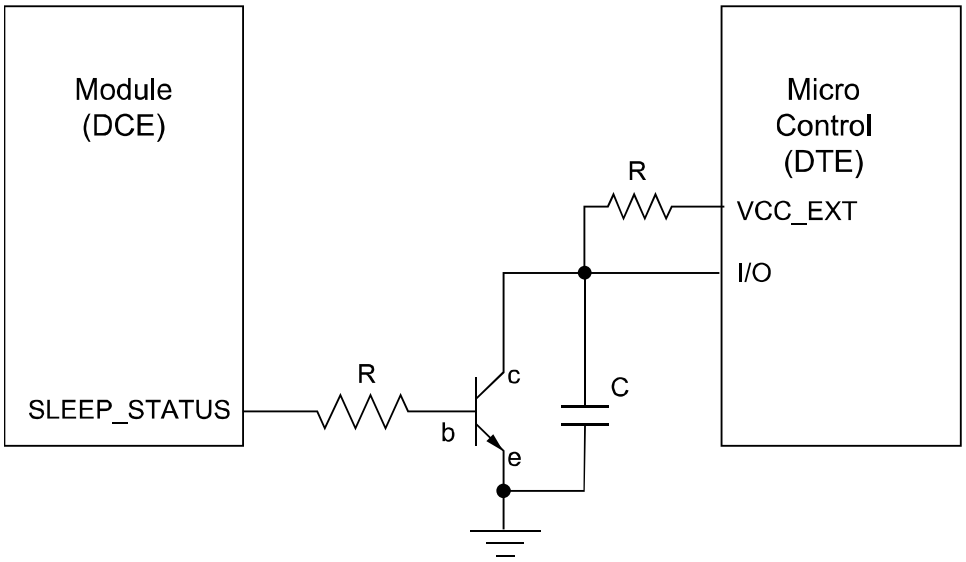
When SLEEP_STATUS pin is in high level, ME909u-521 module is in wakeup state.

When SLEEP_STATUS pin is in low level, ME909u-521 module is in sleep state.

Its drive current is no more than 2 mA.

Figure 3-11 shows recommended circuit of the SLEEP_STATUS pin.

Figure 3-11 Connections of the SLEEP_STATUS pin



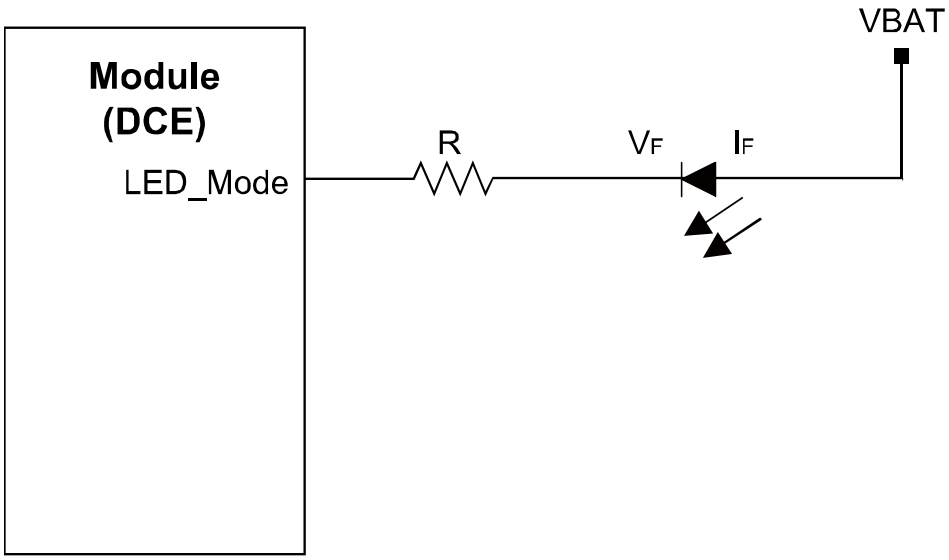
3.4.7 LED# Pin

If you need the LED function, you need reserve circuit and refer to the following figure till the relative firmware is ready.

External Circuits

Figure 3-12 shows the recommended circuits of the LED_MODE pin. According to LED feature, you can adjust the LED brightness by adjusting the resistance of resistor R.

Figure 3-12 Driving circuit



3.5 UART Interface

3.5.1 Overview

The ME909u-521 module is projected to provide two UART interfaces for asynchronous communication channels. They are UART0 (4-wire UART) and UART1 (4-wire UART).

NOTE
Now the firmware with UART feature is still under development.

The UART2 (2-wire UART) is for debugging only. Customer should layout two test points for them in case of system trouble shooting and analysis.

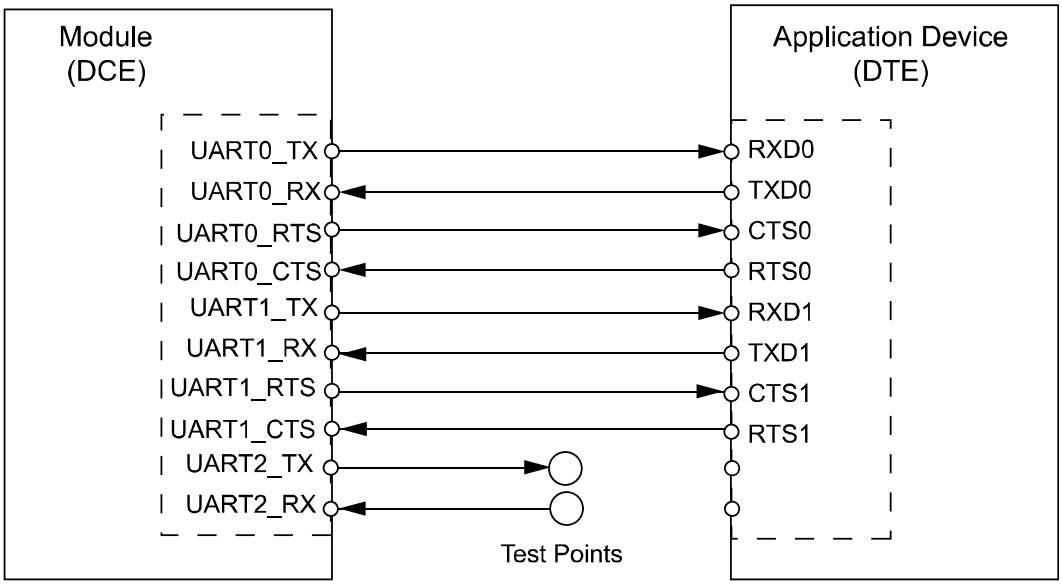
Table 3-6 lists the UART interface signals.

Table 3-6 UART interface signals

Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
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
74	UART0_RTS	O	UART0 Ready for receive	–0.3	1.8	2.1
80	UART0_CTS	I	UART0 Clear to Send	–0.3	1.8	2.1
1	UART1_TX	O	UART1 transmit output	–0.3	1.8	2.1
2	UART1_RTS	O	UART1 Ready for receive	–0.3	1.8	2.1
3	UART1_CTS	I	UART1 Clear to Send	–0.3	1.8	2.1
4	UART1_RX	I	UART1 receive data input	–0.3	1.8	2.1
28	UART2_TX	O	UART2 transmit output	–0.3	1.8	2.1
29	UART2_RX	I	UART2 receive data input	–0.3	1.8	2.1

3.5.2 Circuit Recommended for the UART Interface

Figure 3-13 Connection of the UART interface in the ME909u-521 module (DCE) with the host (DTE)



The RS-232 chip can be used to connect the ME909u-521 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 customer set the pins related to UART interface as test points on the DTE board for debugging.
- The UART0_RX, UART0_TX, UART1_RX, UART1_TX, and UART2_RX, UART2_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, UART1_RX, UART1_TX and UART2_RX, UART2_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 ME909u-521 module.

3.6 USB Interface

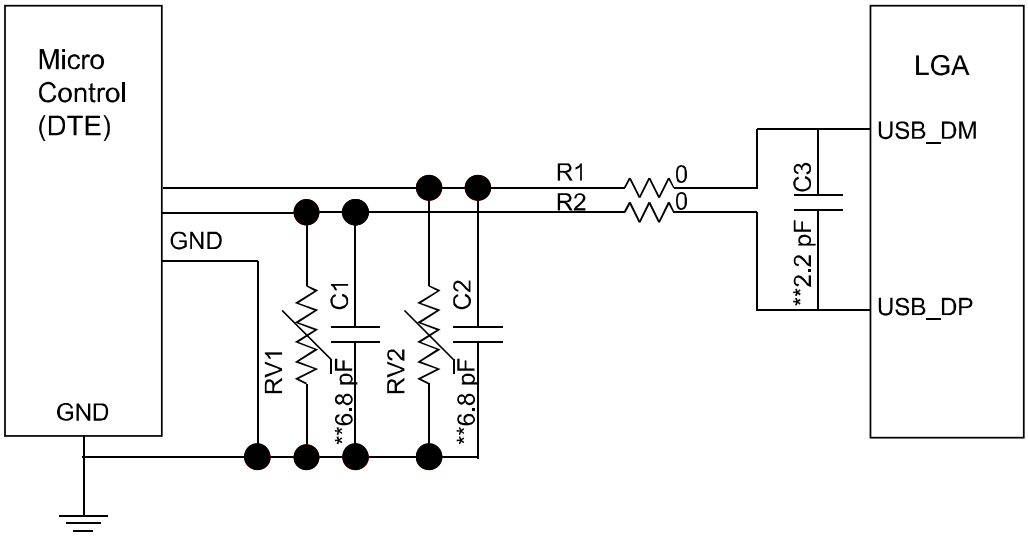
The ME909u-521 module is compliant with USB 2.0 High speed protocol. The USB interface is powered directly from the VBAT supply. The USB signal lines are compatible with the USB 2.0 signal specifications. Figure 3-14 shows the circuit of the USB interface.

Table 3-7 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 ME909u-521 module USB signal, please refer to the chapter 7.3.2 of *Universal Serial Bus Specification 2.0.*

Figure 3-14 Recommended circuit of USB interface



NOTE

- Since the USB interface of ME909u-521 module supports USB 2.0 high speed, the resistance "RV1 and RV2" in the Figure 3-14 must be Voltage Sensitive Resistor with small capacitance (ALVC18S02003 manufactured by AMOTECH or B72590T7900V60 manufactured by EPCOS is recommended).
- 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. But layout stub should not be generated.
- USB_DM and USB_DP are required to control the differential impedance –90 ohm (±10%).
- The length of the gap between USB_DM and USB_DP should not exceed 5 mil.
- The USB differential signal trace must be as short as possible, and laid out away from high-speed clock signals and other periodic signals as far as possible.
- Minimize through-holes and turning angles on the USB signal trace to reduce signal reflection and impedance change.
- Do not route the USB signal trace under the following components: crystal, oscillator, clock circuit, electromagnetic component, and IC that uses or generates clocks.
- Avoid stubs on the USB signal trace because stubs generate reflection and affect the signal quality.
- Route the USB signal trace on a complete reference plane (GND) and avoid crossing inter-board gaps because inter-board gaps cause a large reflow channel area and increase inductance and radiation. In addition, avoid signal traces on different layers.
- The USB signal trace must be far away from core logical components because the high current pulse generated during the state transitions process of core components may impose interference on signals.
- The USB signal trace must be far away from board edges with a minimum distance of 20 × h (h indicates the vertical distance between the trace and the reference layer) to avoid signal radiation.
- C1 and C2 are ready for dealing with filter differential mode interference and C5 is ready for dealing with filter common mode interference. You can choose the value of the C1, C2 and C5 according to the actual PCB which is integrated 30 mm × 30 mm LGA module

3.7 USIM Card Interface

3.7.1 Overview

The ME909u-521 module provides a USIM card interface complying with the ISO 7816-3 standard and supports both Class B and Class C USIM cards.

Table 3-8 USIM card interface signals

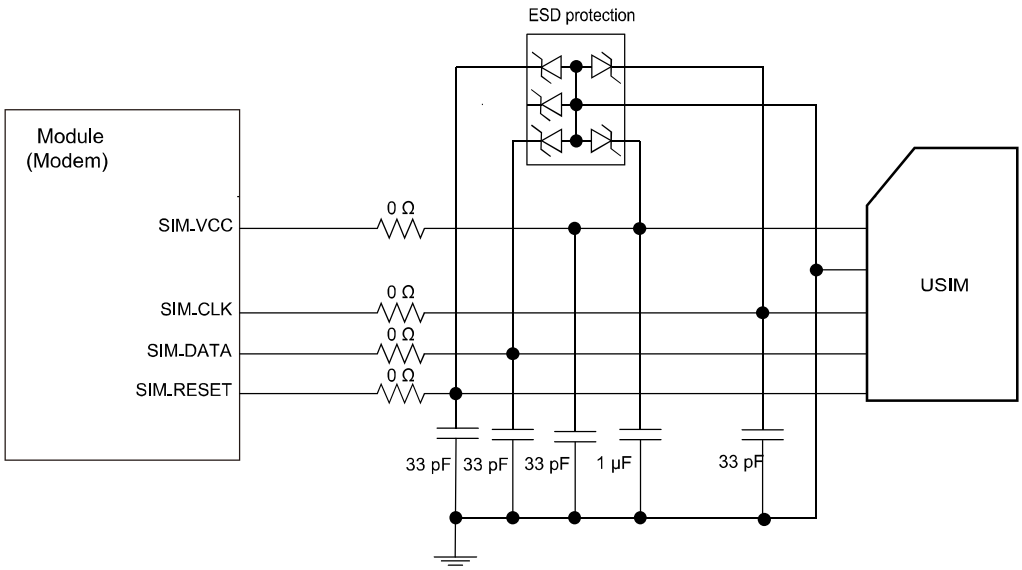
Pin No.	Pin Name	I/O	Description	DC Characteristics (V)		
				Min.	Typ.	Max.
88	SIM_RESET	O	USIM card reset	-	1.8/2.85	-
90	SIM_CLK	O	USIM card clock	-	1.8/2.85	-
89	SIM_DATA	I/O	USIM card data	-	1.8/2.85	-
34	SIM_VCC	P	Power supply for USIM card	-	1.8/2.85	-

3.7.2 Circuit Recommended for the USIM Card Interface

As the ME909u-521 module is not equipped with an USIM socket, you need to place an USIM socket on the user interface board.

Figure 3-15 shows the circuit of the USIM card interface.

Figure 3-15 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 ME909u-521 module.
- A 100 nF capacitor (0402 package is recommended so that greater capacitance such as 1 µF can be employed if necessary) and a 33 pF capacitor are placed between the SIM_VCC and Ground pins in parallel. Three 33 pF capacitors are placed between the SIM_DATA and Ground pins, the SIM_RESET and Ground pins, and the SIM_CLK and Ground pins in parallel to filter interference from RF signals.
- SIM_DATA is already pulled up internally.
- 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 ME909u-521 module.
- The ESD protection component should choose low capacitance. The capacitance of the component should be lower than **10 pF**.

3.8 Audio Interface

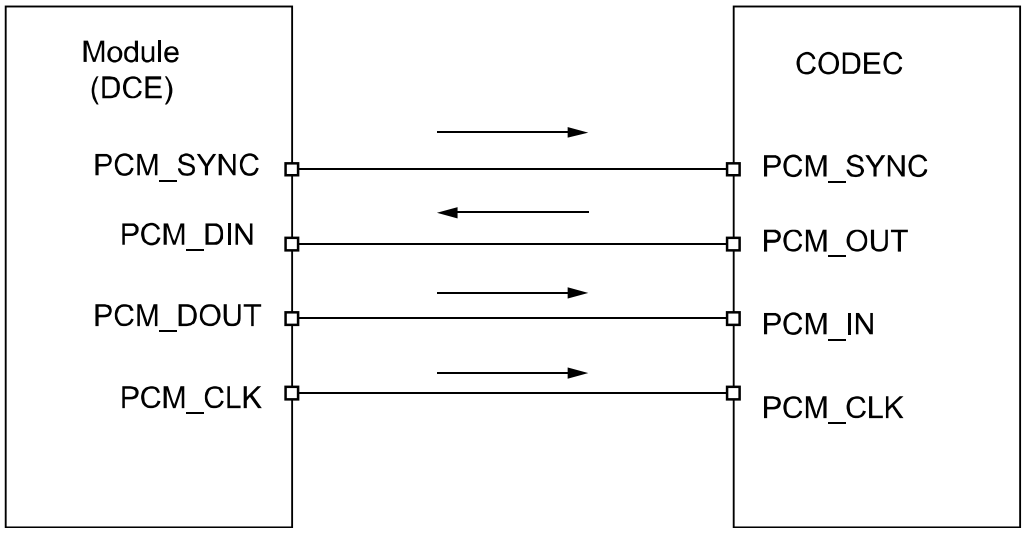
ME909u-521 module provided one PCM digital audio interface. Table 3-9 lists the signals on the digital audio interface.

Table 3-9 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 ME909u-521 module PCM interface enables communication with an external codec to support linear format.

Figure 3-16 Circuit diagram of PCM interface (ME909u-521 module 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 ME909u-521 module 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.
- The signal level of CODEC must match that of the ME909u-521 module.

3.9 General Purpose I/O Interface

The ME909u-521 module provides 5 GPIO pins for customers to use for 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. About the details of GPIO command, see the *HUAWEI ME909u-521 LTE LGA Module AT Command Interface Specification*.

Table 3-10 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 Purpose I/O pins	–0.3	1.8	2.1

3.10 JTAG Interface

The ME909u-521 module provides Joint Test Action Group (JTAG) interface. Table 3-11 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 3-11 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
47	JTAG_SRST_N	I	JTAG reset for debugging	–0.3	1.8	2.1
32	VCC_EXT1	P	Pin for output power supply with 1.8 V	1.75	1.8	1.85

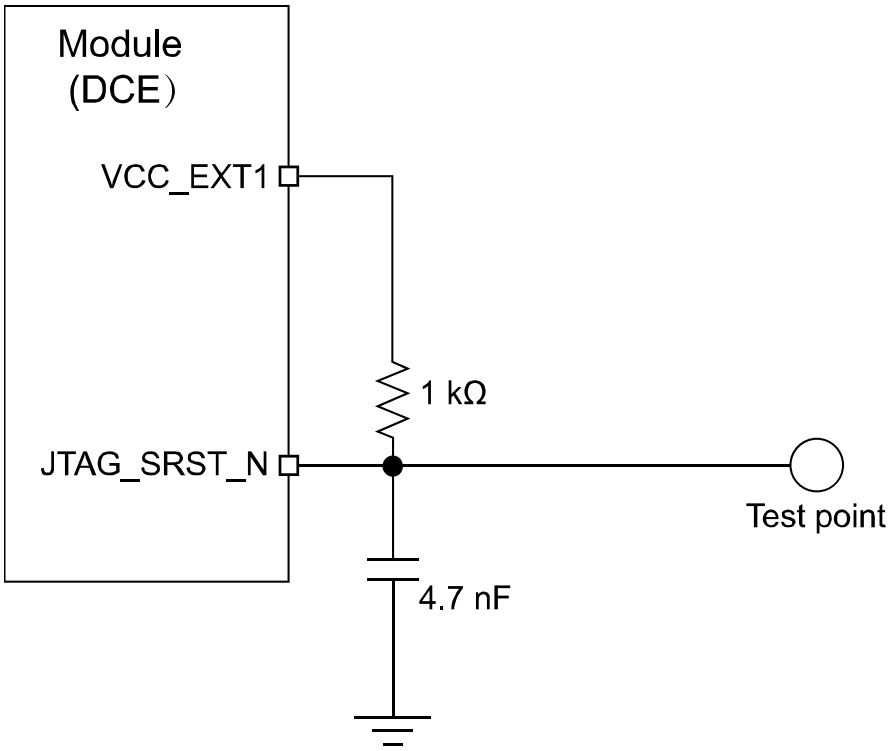
NOTE

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

CAUTION

- JTAG reset pin of ME909u-521 module is different from HUAWEI's other LGA modules, for example: MU509, MC509 and MU609.
- JTAG_SRST_N must be dealt with ESD protection as follow. The 1 kΩ resistor and 4.7 nF capacitor must be placed as close as possible to ME909u-521 module.

Figure 3-17 ESD protection of JTAG_SRST_N



3.11 RF Antenna Interface

The ME909u-521 module provides 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 3-12 Definition of the antenna pads

Pin No.	Pin Name	I/O	Description
107	MAIN_ANT	-	RF primary antenna pad
111	GPS_ANT	-	RF GPS antenna pad
115	AUX_ANT	-	RF secondary antenna pad

Figure 3-18 RF signal trace design about MAIN_ANT for reference (the same for AUX & GPS)

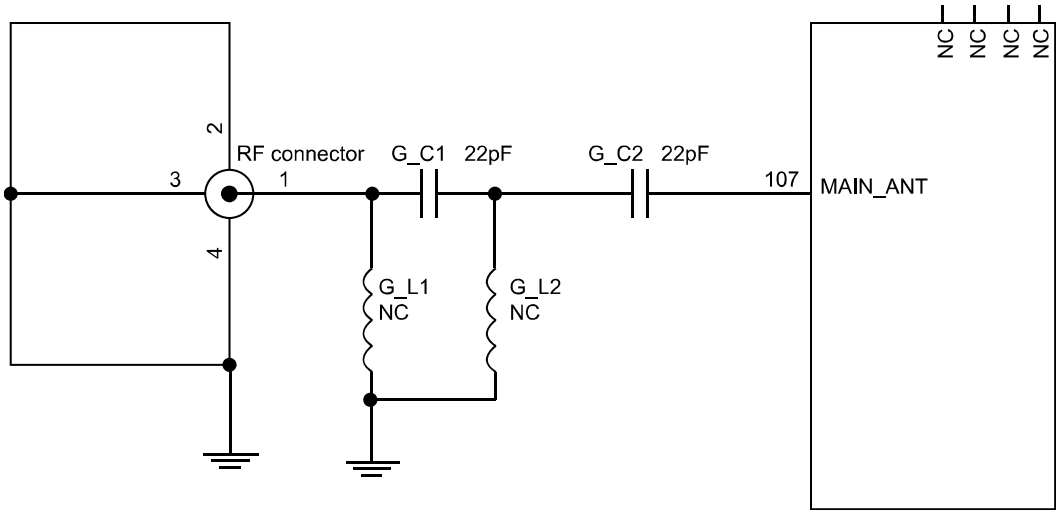
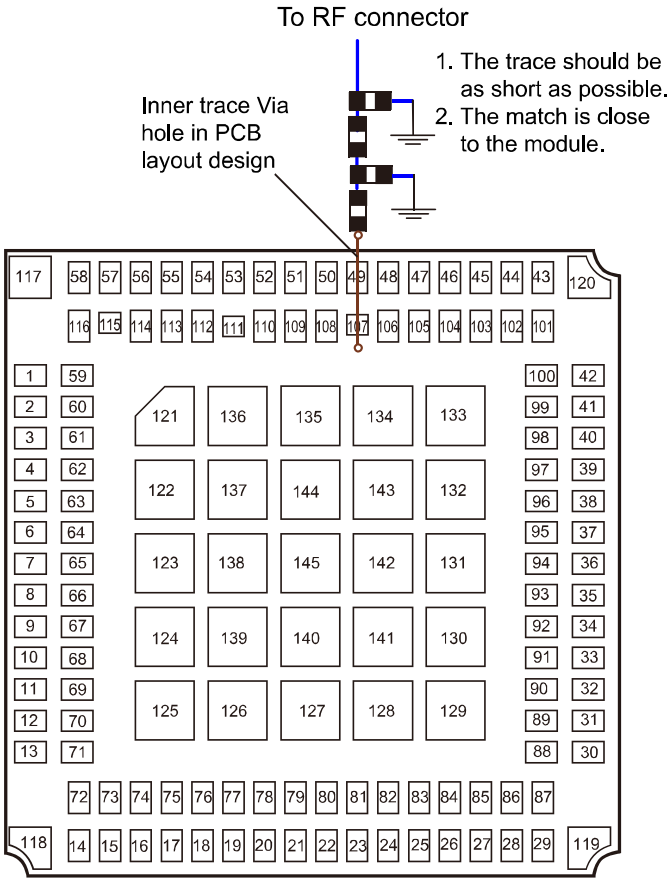


Figure 3-19 RF signal layout design about MAIN_ANT for reference:(the same for AUX & GPS)



For the PCB designed by the user, the impedance of all the RF signal tracks must be 50 Ω. Generally, the impedance depends on the medium factor, track width, and distance from the floor.

In order to reflect the rules of design, the following figures indicate the complete structure of the microstrip and stripline with an impedance of 50 ohm as well as the reference design for stack.

Figure 3-20 Complete structure of the microstrip

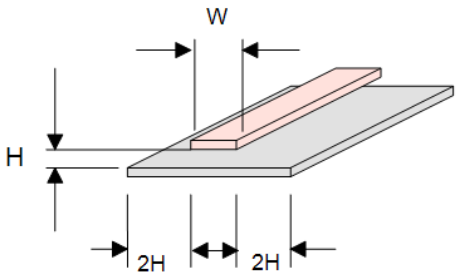


Figure 3-21 Complete structure of the stripline

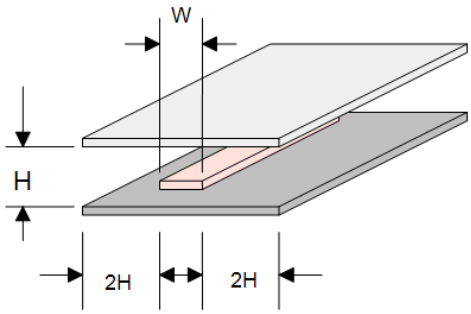
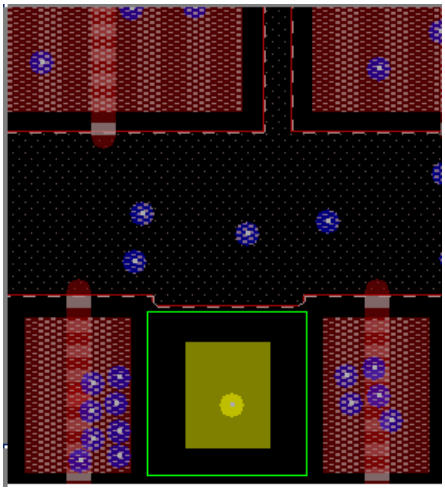
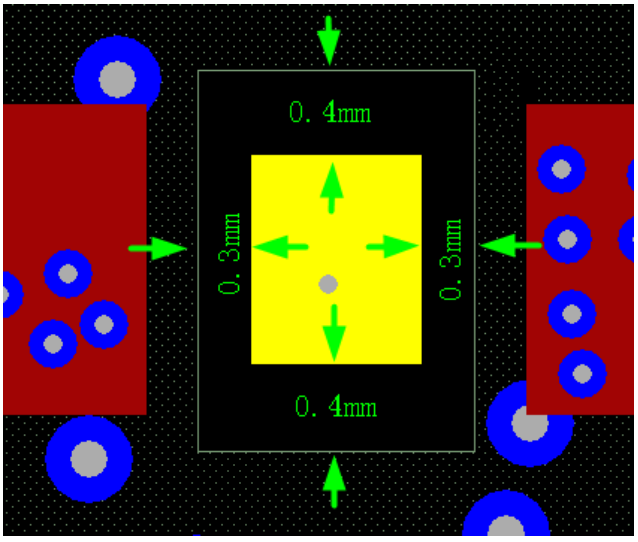


Figure 3-22 Routing for the RF interface



Please use impedance simulation tool to calculate RF MAIN pad impedance. The RF MAIN pad dimension of ME909u-521 is 1.1 mm (L) x 0.9 mm (W). You can get the impedance with lower than 50 Ω calculated by the impedance simulation tool. Since the target impedance is 50 Ω for RF trace, the recommended solution is that to carve out the copper area of the second layer that projected by the RF MAIN pad at top layer. How many layers should be carved out depend on the PCB permittivity, track width, and distance from the floor of your own PCB. Our target is to make the RF MAIN pad impedance as closer to 50 Ω as possible.

Figure 3-23 Reference layout



3.12 Reserved Interface

The ME909u-521 module provides 24 reserved pins. All reserved pins cannot be used by the customer. All of them must be leave unconnected.

Table 3-13 Reserved pin

Pin No.	Pin Name	I/O	Description
9, 10, 16–20, 27, 35, 43–46, 60–69, 92	Reserved	-	Reserved, please keep open

3.13 NC Interface

The ME909u-521 module has 23 NC pins. All NC pins should not be connected. Please keep these pins open.

Table 3-14 NC pins

Pin No.	Pin Name	I/O	Description
25, 26, 31, 33, 37–41, 82–84, 94–99, 103, 117–120	NC	-	Not connected, please keep open.

3.14 Tunable Antenna Control

The module provides 4 tunable antenna control pins.The firmware with this feature is in plan. The mapping of each band to ANT_TUNE outputs is configurable.

Table 3-15 List of tunable antenna control pins

Pin No.	Pin Name	I/O	Description	DC Characteristics(V)		
				Min.	Typ.	Max.
21	ANT_TUNE0	O	Tunable antenna control signal bit 0	–0.3	1.8	2.1
22	ANT_TUNE1	O	Tunable antenna control signal bit 1	–0.3	1.8	2.1
23	ANT_TUNE2	O	Tunable antenna control signal bit 2	–0.3	1.8	2.1
24	ANT_TUNE3	O	Tunable antenna control signal bit 3	–0.3	1.8	2.1

4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the ME909u-521 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 ME909u-521.

Table 4-1 RF bands of ME909u-521

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
LTE Band I	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band II	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band III	1710 MHz–1785 MHz	1805 MHz–1880 MHz

Operating Band	Tx	Rx
LTE Band V	824 MHz–849 MHz	869 MHz–894 MHz
LTE Band VII	2500 MHz–2570 MHz	2620 MHz–2690 MHz
LTE Band VIII	880 MHz–915 MHz	925 MHz–960 MHz
LTE Band XX	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
Power supply	Keithley 2303, Agilent 66319
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 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 ME909u-521 module.

Table 4-2 shows the typical Rx sensitivity values of ME909u-521.

Table 4-2 ME909u-521 conducted Rx sensitivity (Unit: dBm)

Band	Typical Value	Note
GSM 850	–111	BER Class II < 2.44%
GSM 900	–110	BER Class II < 2.44%
DCS 1800	–109.5	BER Class II < 2.44%
PCS 1900	–109.5	BER Class II < 2.44%
WCDMA B1 Main Rx	–110.5	BER < 0.1%
WCDMA B2 Main Rx	–110	BER < 0.1%
WCDMA B5 Main Rx	–111	BER < 0.1%
WCDMA B8 Main Rx	–111	BER < 0.1%
LTE B1 RX	–102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B2 RX	–100.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B3 RX	–101.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B5 RX	–101	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B7 RX	–101	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B8 RX	–100.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE B20 RX	–101.5	Throughput ≥ 95%, 10 MHz Bandwidth

Table 4-3 ME909u-521 module GPS main characteristics

Item	Typical Value
Receive Sensitivity (Cold start)	–147 dBm
Receive Sensitivity (Hot start)	–157 dBm
Receive Sensitivity (Tracking mode)	–157 dBm
TTFF@–130 dBm (Cold start)	38S
TTFF@–130 dBm (Hot start)	2S

NOTE

- The test values are the average of some test samples.
- LTE sensitivity is tested in SIMO (Main+AUX).

4.4.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of ME909u-521 module. 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 ME909u-521.

Table 4-4 ME909u-521 conducted Tx power (unit: dBm)

Band	Typical Value	Note
GSM 850	32.5	±1 dB
GSM 900	32.5	±1 dB
DCS 1800	29.5	±1 dB
PCS 1900	29.5	±1 dB
WCDMA B1	23.5	±1 dB
WCDMA B2	23.5	±1 dB
WCDMA B5	23.5	±1 dB
WCDMA B8	23.5	±1 dB
LTE B1	23	±1 dB
LTE B2	23	±1 dB
LTE B3	23	±1 dB
LTE B5	23	±1 dB
LTE B7	23	±1 dB
LTE B8	23	±1 dB
LTE B20	23	±1 dB

NOTE
Maximum Power Reduction (MPR) of LTE is according to 3GPP TS 36.521-1. And Additional Maximum Power Reduction (A-MPR) of LTE is according to 3GPP TS 36.521-1 6.2.4 section.

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 line from the antenna port of ME909u-521 module to the antenna is also part of the antenna. The line loss increases with the line length and the frequency. It is recommended that the line loss is as low as possible.

The following antenna efficiency (free space) is recommended for ME909u-521 module to ensure high radio performance of the module:

- Efficiency of the primary antenna: ≥ 40% (below 960 MHz); ≥ 50% (over 1420 MHz)
- Efficiency of the secondary 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 line.

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 ME909u-521 module:

- S11 of the primary antenna ≤ –6 dB
- S11 of the secondary antenna ≤ –6 dB
- S11 of the GPS antenna ≤ –10 dB

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 ME909u-521 module to minimize the line length. The secondary antenna needs to be installed perpendicularly to the primary antenna. The secondary antenna can be placed farther away from the ME909u-521 module. Antenna isolation can be measured with a two-port vector network analyzer.

The following S21 values are recommended for the antenna:

- Isolation between the primary and secondary antennas ≤ –12 dB
- Isolation between the primary antenna and the GPS antenna ≤ –15 dB
- 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 primary/secondary antenna of ME909u-521 module. The RHCP(Right-Hand Circular Polarization) is recommended for GPS antenna.

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. We must notice that GPS signal is coming from the satellite in the outer space, it means that the incident waves are over our head.

The following radiation patterns are recommended for the antenna of ME909u-521 module.

- Primary/Secondary antenna: omnidirectional.
- GPS antenna: directional, point to the space.

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 ME909u-521 module.

- Gain of the primary antenna ≤ 2.5 dBi
- Gain of the secondary antenna ≤ 2.5 dBi
- Gain of the GPS antenna ≥ 3 dBi

ECC of the antenna

ECC is short for Envelope Correlation Coefficient. It's the cross-correlation value of the complex patterns of the primary and secondary 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 MIMO performance.

The envelope correlation coefficient depends on the following factors:

- Distance between antennas
- Antenna type
- Antenna direction

For example, the farther distance leads better ECC, a wavelength is usually enough.

The perpendicular polarization and complementary radiation pattern of the antenna can also decrease the value of the ECC.

The following ECC is recommended for ME909u-521 module.

ECC ≤ 0.5 (below 0.96 GHz); ECC ≤ 0.4 (above 1.4 GHz)

NOTE

- The antenna consists of the antenna body and the relevant RF transmission line. Take the RF transmission line 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 Antenna Requirements

The antenna for ME909u-521 module must fulfill the following requirements:

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 of primary antenna	70 MHz in GSM850 80 MHz in GSM900 170 MHz in DCS 140 MHz in PCS 250 MHz in WCDMA /LTE Band 1 140 MHz in WCDMA/LTE Band 2 70 MHz in WCDMA/LTE Band 5 80 MHz in WCDMA/LTE Band 8 170 MHz in LTE Band 3 190 MHz in LTE Band 7 71 MHz in LTE Band 20
Bandwidth of secondary antenna	60 MHz in WCDMA/LTE Band 1 60 MHz in WCDMA/LTE Band 2 25 MHz in WCDMA/LTE Band 5 35 MHz in WCDMA/LTE Band 8 75 MHz in LTE Band 3 70 MHz in LTE Band 7 30 MHz in LTE Band 20
Bandwidth of GPS antenna	35 MHz in GNSS
Gain	≤ 2.5 dBi (≥ 3 dBi for GPS antenna)
Impedance	50 Ω
VSWR absolute max	≤ 3:1(≤ 2:1 for GPS antenna)
VSWR recommended	≤ 2:1(≤ 1.5:1 for GPS antenna)

5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features of ME909u-521 module, including:

- Absolute Ratings
- Operating and Storage Temperatures
- 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 ME909u-521 module. Using the ME909u-521 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings for the ME909u-521 module

Symbol	Specification	Min.	Max.	Unit
VBAT	External power voltage	–0.5	4.4	V
VI	Digital input voltage	–0.5	2.16	V

5.3 Operating and Storage Temperatures

Table 5-2 lists the operating and storage temperatures for the ME909u-521 module.

Table 5-2 Operating and storage temperatures for the ME909u-521 module

Specification	Min.	Max.	Unit
Normal working temperatures[1]	–20	+70	°C
Extended temperatures[2]	–30	+75	°C
Ambient temperature for storage	–40	+85	°C

NOTE

[1]: When the ME909u-521 module works at this temperature, all its RF specifications comply with the 3GPP and 3GPP2 (CDMA) RF specifications.

[2]: The temperatures outside of the range –20°C to +70°C; the module might slightly deviate from the 3GPP and 3GPP2 (CDMA) RF 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	0.65 x V_{DDP_USIM}	3.3	V_{DDP_USIM}=1.8 V or 2.85 V	V
V_{IL}	Low-level input voltage	–0.3	0.25 x V_{DDP_USIM}	V_{DDP_USIM}=1.8 V or 2.85 V	V
V_{OH}	High-level output voltage	V_{DDP_USIM}-0.45	2.85	V_{DDP_USIM}=1.8 V or 2.85 V	V
V_{OL}	Low-level output voltage	0	0.45	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

Parameter	Description	Minimum Value	Maximum Value	Unit
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

NOTE

V_{DD_PX} is power level for digital pad circuits. The value for each digital pad refer to Table 3-1 "Typ. column".

5.6 Power Supply Features

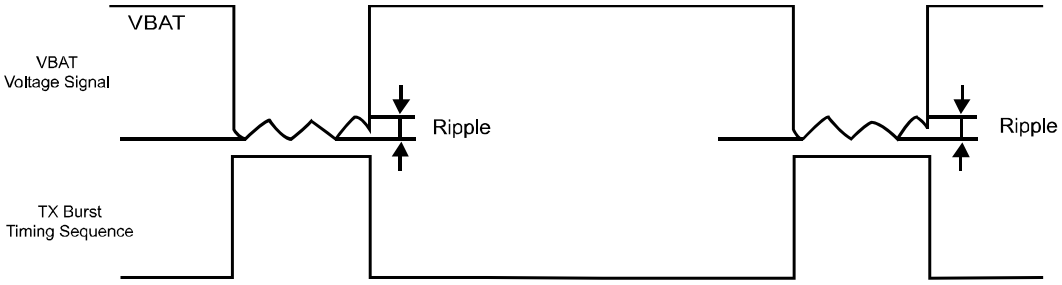
5.6.1 Input Power Supply

Table 5-5 lists the requirements for input power of the ME909u-521 module.

Table 5-5 Requirements for input power for the ME909u-521 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 GSM, GPRS or EGPRS mode).

Table 5-6 Requirements for input current of the ME909u-521 module

Power	Peak (Maximum) Max Avg@100uS	Normal (Maximum) Max Avg@1S
VBAT(3.8V)	2500 mA	1100 mA

5.6.2 Power Consumption

The power consumptions of ME909u-521 in different scenarios are respectively listed in Table 5-7 to Table 5-11 .

The power consumption listed in this section are tested when the power supply of ME909u-521 module is normal voltage (3.8 V), and all of test values are measured at room temperature.

Table 5-7 Averaged power off DC power consumption of ME909u-521

Description	Test Value (μA)	Notes/Configuration
	Typical	
Power off	80	Normal voltage (3.8 V) is ON and POWER_ON_OFF pin is pulled low

Table 5-8 Averaged standby DC power consumption of ME909u-521 (WCDMA/HSDPA/LTE/GSM)

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
Sleep	LTE (sleep)	LTE bands	4.5	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	HSPA+/WCDMA (sleep)	UMTS bands	4.4	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	GPRS/EDGE (sleep)	GSM bands	3.9	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	2.88	Module is powered up. RF is disabled. USB is in suspend.
Idle	LTE (idle)	LTE bands	100	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, and no data is transmitted. USB is in active.
	HSPA+/WCDMA (idle)	UMTS bands	110	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, and no data is transmitted. USB is in active.
	GPRS/EDGE (idle)	GSM bands	94	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network, and no data is transmitted. USB is in active.
	Radio Off (idle)	All bands	92	Module is powered up. RF is disabled. USB is in active.

Table 5-9 Averaged Data Transmission DC power consumption of ME909u-521 (WCDMA/HSDPA/LTE)

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
WCDMA	Band I (IMT2100)	185	0 dBm Tx Power
		250	10 dBm Tx Power
		705	23.5 dBm Tx Power
	Band II (PCS 1900)	185	0 dBm Tx Power
		245	10 dBm Tx Power
		685	23.5 dBm Tx Power

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
	Band V (850 MHz)	160	0 dBm Tx Power
		210	10 dBm Tx Power
		620	23.5 dBm Tx Power
	Band VIII (900 MHz)	155	0 dBm Tx Power
		210	10 dBm Tx Power
		585	23.5 dBm Tx Power
HSDPA	Band I (IMT2100)	250	0 dBm Tx Power
		305	10 dBm Tx Power
		760	23.5 dBm Tx Power
	Band II (PCS 1900)	245	0 dBm Tx Power
		315	10 dBm Tx Power
		700	23.5 dBm Tx Power
	Band V (850 MHz)	220	0 dBm Tx Power
		270	10 dBm Tx Power
		650	23.5 dBm Tx Power
	Band VIII (900 MHz)	215	0 dBm Tx Power
		270	10 dBm Tx Power
		610	23.5 dBm Tx Power
LTE	LTE Band I	270	0 dBm Tx Power
		310	10 dBm Tx Power
		830	23 dBm Tx Power
	LTE Band II	255	0 dBm Tx Power
		310	10 dBm Tx Power
		805	23 dBm Tx Power
	LTE Band III	245	0 dBm Tx Power
		300	10 dBm Tx Power
		787	23 dBm Tx Power
	LTE Band V	230	0 dBm Tx Power
		275	10 dBm Tx Power
		530	23 dBm Tx Power

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
	LTE Band VII	295	0 dBm Tx Power
		344	10 dBm Tx Power
		620	23 dBm Tx Power
	LTE Band VIII	230	0 dBm Tx Power
		260	10 dBm Tx Power
		540	23 dBm Tx Power
	LTE Band XX	265	0 dBm Tx Power
		380	10 dBm Tx Power
		685	23 dBm Tx Power

Table 5-10 Averaged DC power consumption of ME909u-521 (GPRS/EDGE)

Description	Test Value (mA)	PCL	Configuration
	Typical		
GPRS850	370	5	1 Up/1 Down
	520		2 Up/1 Down
	660		4 Up/1 Down
	195	10	1 Up/1 Down
	300		2 Up/1 Down
	460		4 Up/1 Down
GPRS900	365	5	1 Up/1 Down
	560		2 Up/1 Down
	700		4 Up/1 Down
	200	10	1 Up/1 Down
	300		2 Up/1 Down
	480		4 Up/1 Down
GPRS1800	215	0	1 Up/1 Down
	295		2 Up/1 Down
	390		4 Up/1 Down
	115	10	1 Up/1 Down

Description	Test Value (mA)	PCL	Configuration
	Typical		
	145		2 Up/1 Down
	180		4 Up/1 Down
GPRS1900	230	0	1 Up/1 Down
	335		2 Up/1 Down
	430		4 Up/1 Down
	120	10	1 Up/1 Down
	150		2 Up/1 Down
	190		4 Up/1 Down
EDGE850	230	8	1 Up/1 Down
	320		2 Up/1 Down
	425		4 Up/1 Down
	135	15	1 Up/1 Down
	180		2 Up/1 Down
	255		4 Up/1 Down
EDGE900	235	8	1 Up/1 Down
	320		2 Up/1 Down
	445		4 Up/1 Down
	140	15	1 Up/1 Down
	185		2 Up/1 Down
	270		4 Up/1 Down
EDGE1800	175	2	1 Up/1 Down
	235		2 Up/1 Down
	310		4 Up/1 Down
	120	10	1 Up/1 Down
	140		2 Up/1 Down
	175		4 Up/1 Down
EDGE1900	190	2	1 Up/1 Down
	260		2 Up/1 Down
	345		4 Up/1 Down
	120	10	1 Up/1 Down

Description	Test Value (mA)	PCL	Configuration
	Typical		
	150		2 Up/1 Down
	190		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 Powerr, which are listed in Table 4-4 ; for max. data throughput, see 2.2 Function Overview, which are listed in Table 2-1 .

Table 5-11 Averaged GPS operation DC power consumption of ME909u-521

Description	Test Value (mA)	Notes/Configuration
	Typical	
GPS fixing	100	RF is disabled; USB is in active; The Rx power of GPS is –130 dBm.
GPS tracking	100	

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 ME909u-521 module.

Table 5-12 Test conditions and results of the reliability of the ME909u-521 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

Item		Test Condition	Standard	Sample size	Results
	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: –30ºC • 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: 75ºC • 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
	Temperature cycle operating	• High temperature: 75ºC • Low temperature: -30ºC • Operation mode: working with service connected • Test duration: 30 cycles;1 h+1 h/cycle	JESD22-A105-B	3pcs/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
	Thermal shock	• Low temperature: –40º • 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

Item		Test Condition	Standard	Sample size	Results
	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
	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

Item		Test Condition	Standard	Sample size	Results
Life	High temperature operating life	• Temperature: 75ºC • 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-Non operating	• 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/group	Visual inspection: ok Function test: ok RF specification: ok
NOTE Groups ≥ 2					

5.8 EMC and ESD Features

The following are the EMC design comments:

- Attention should be paid to static control in the manufacture, assembly, packaging, handling, 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 adjustment 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 USIM interface for ESD protection. The parasitic capacitance of TVS on USIM signal should be less than 10 pF.
- Resistors in parallel and a 10 nF capacitor should be added on RESIN_N signal 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 ME909u-521 module does not include any protection against overvoltage.

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

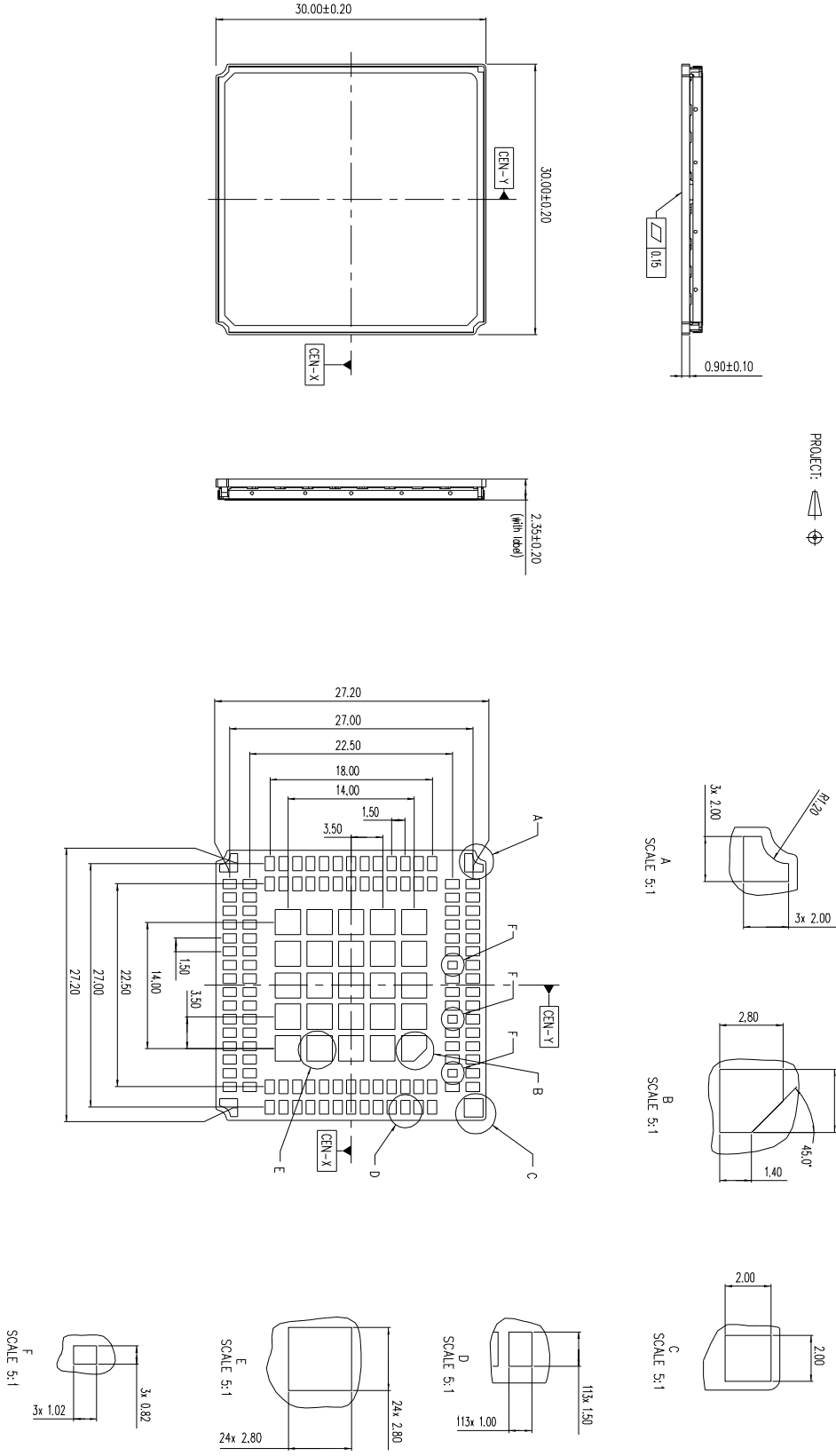
Baking Temperature	Baking Condition	Baking Duration	Remarks
125°C±5°C	Relative humidity ≤ 60%	8 hours	

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.

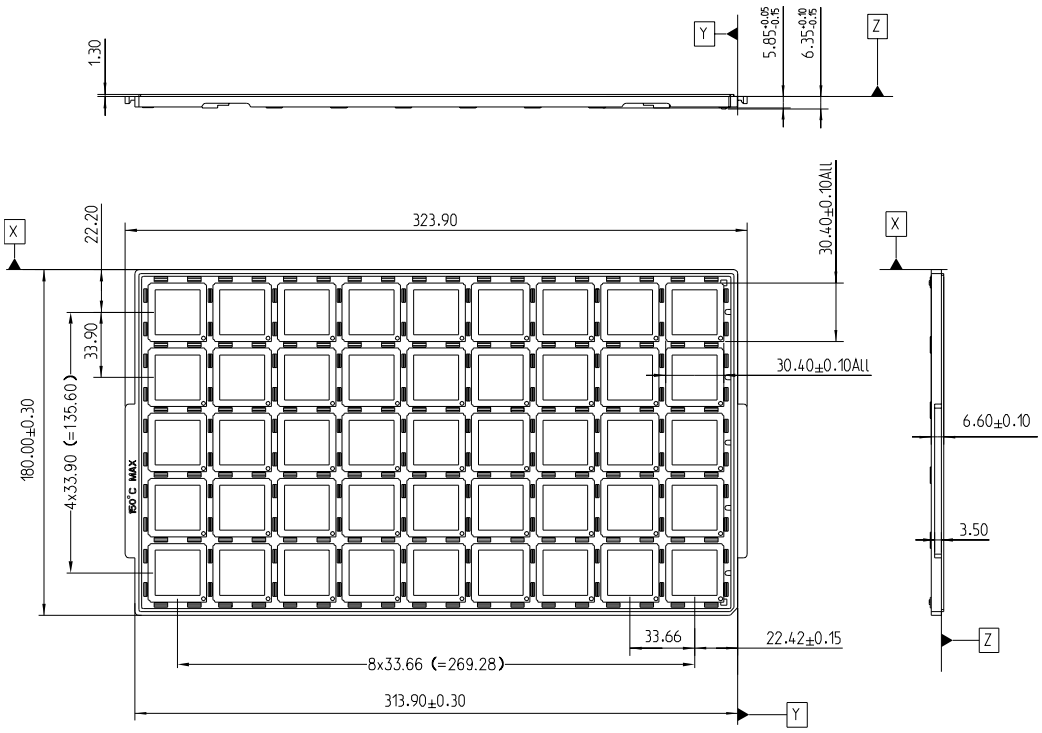
Figure 6-1 Dimensions (unit: mm)



6.5 Packaging

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

Figure 6-2 ESD pallet (unit: mm)

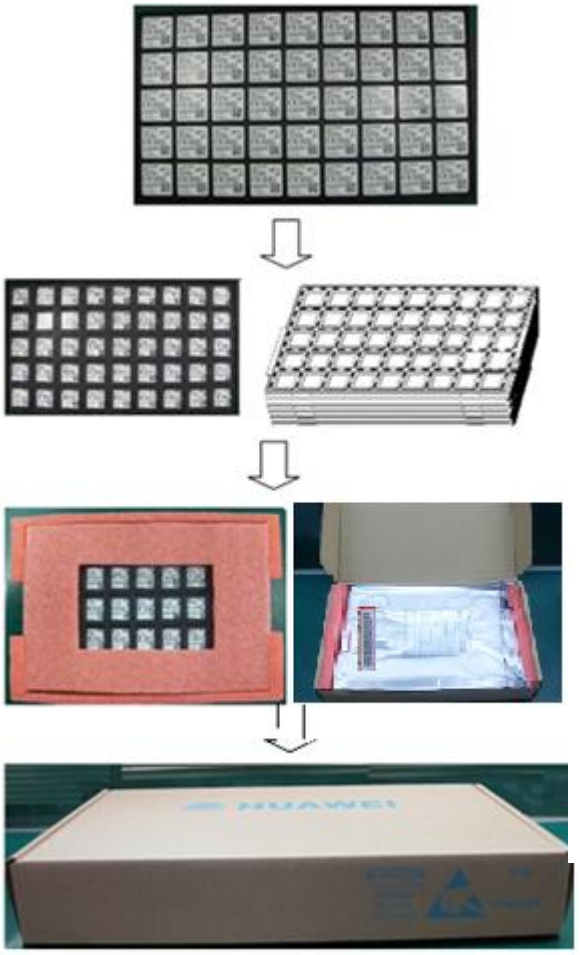


NOTE

- 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.

Figure 6-3 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.

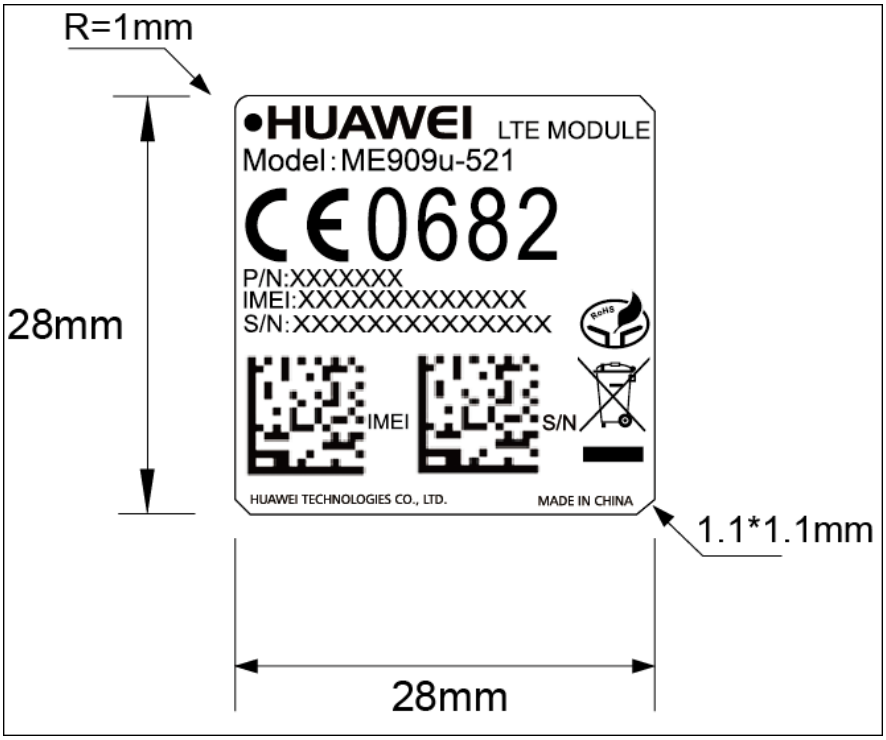
NOTE

- 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 6-4 ME909u-521 label



NOTE

- The picture mentioned above is only for reference.
- The silk-screen should be clear without burrs, and dimensions 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 can only be heated up for 20s–40s under 260°C, or the color of the material of the nameplate may 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 6-5 Footprint design of customer's PCB (unit: mm)

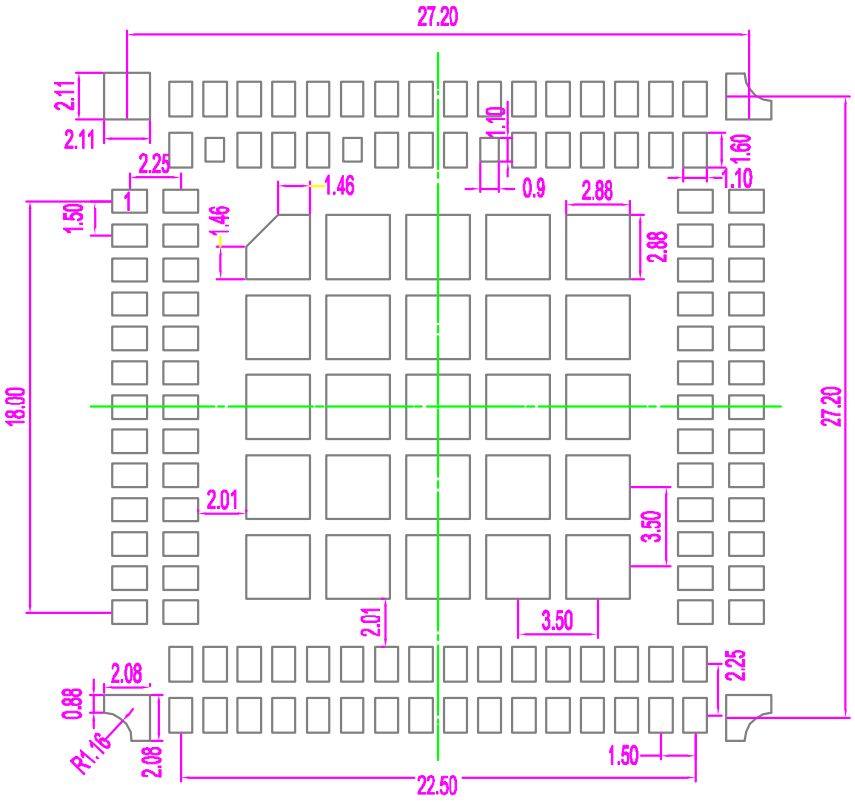
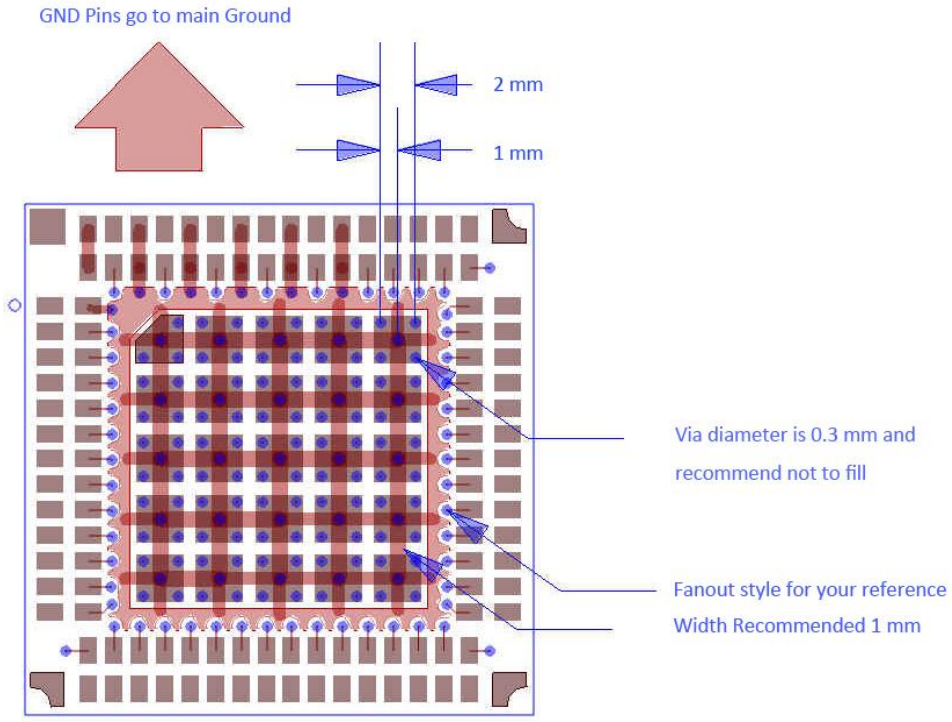


Figure 6-6 Thermal Pads design of customer's PCB (unit: mm)



6.7.3 Heat Dissipation Solution

- The copper size on the PCB must be 70 mm x 70 mm or larger.
- All copper ground layers of the PCB must be connected to each other through via-holes.
- Use anodized heatsink on the shielding case for optimal heat dissipation. The recommended heatsink dimensions are 70 mm x 70 mm x 1.0 mm.
- If a fan is deployed, place the module at the cold air inlet.

Figure 6-7 Adding a heatsink to the module for optimal heat dissipation

6.7.4 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.

6.7.5 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

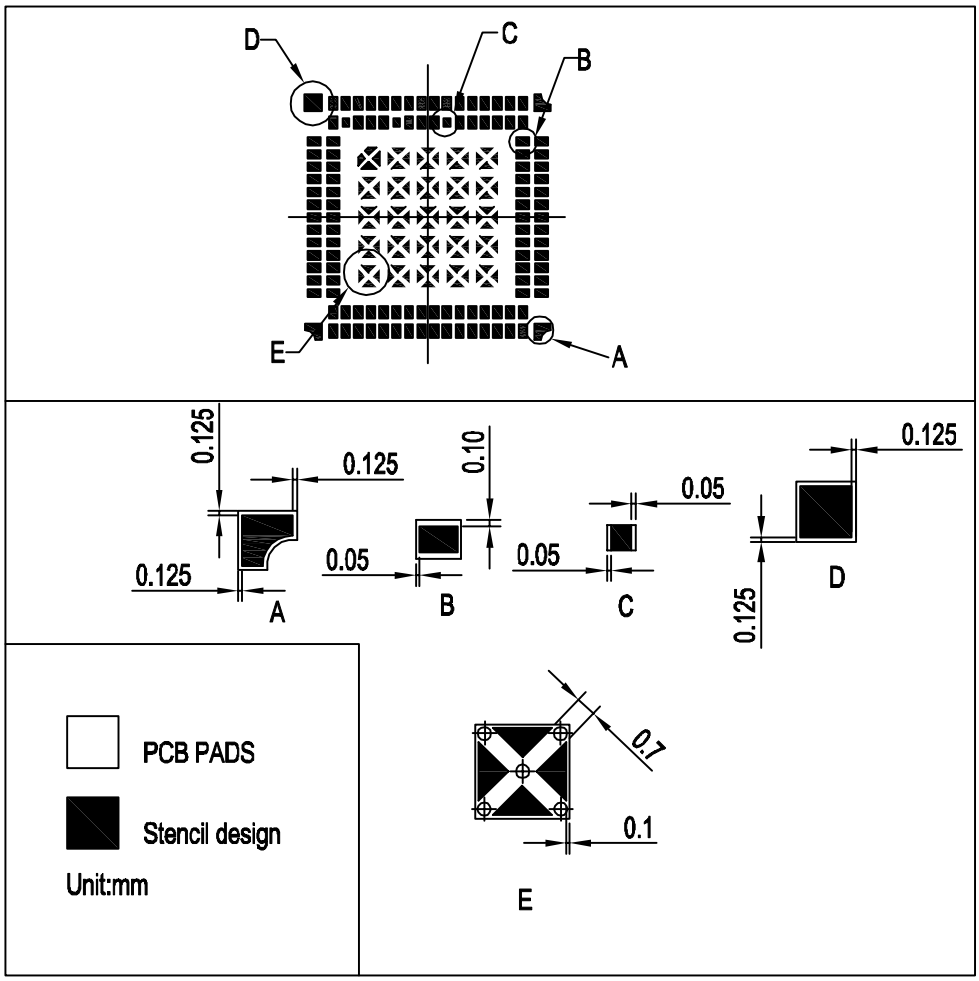
6.8.1 General Description of Assembly Processes

- 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 6-8 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 6-9 Reflow profile

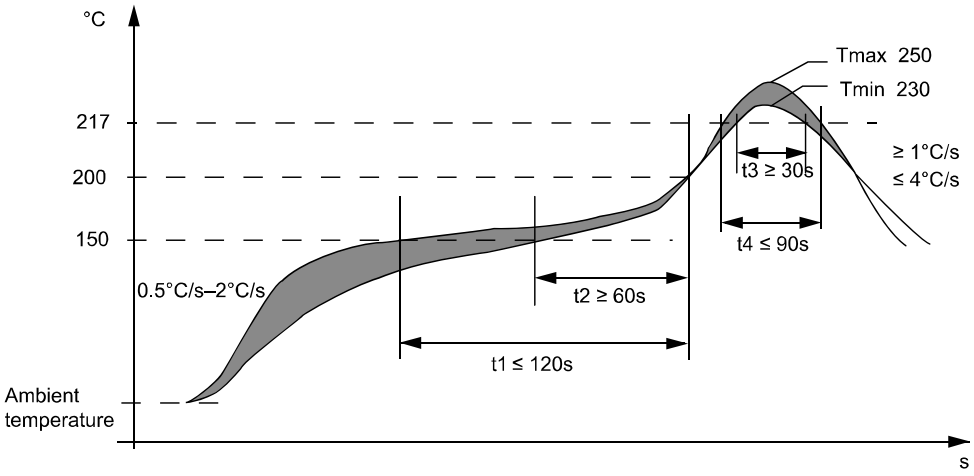
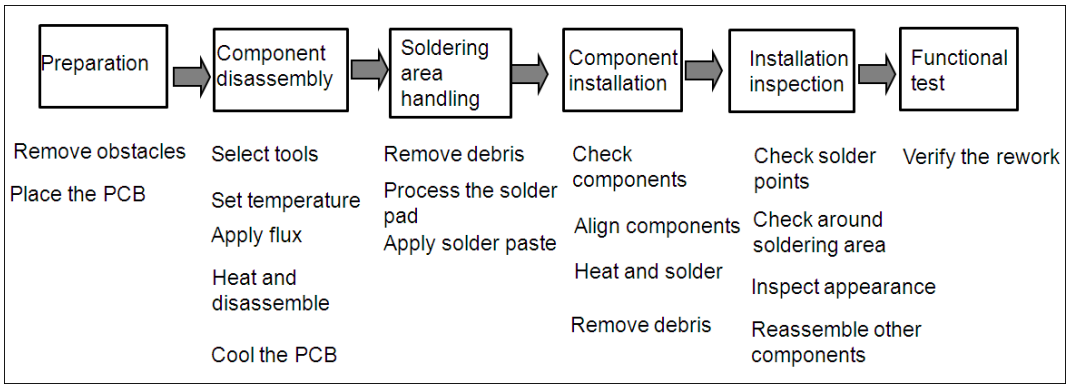


Table 6-2 Reflow parameters

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 .

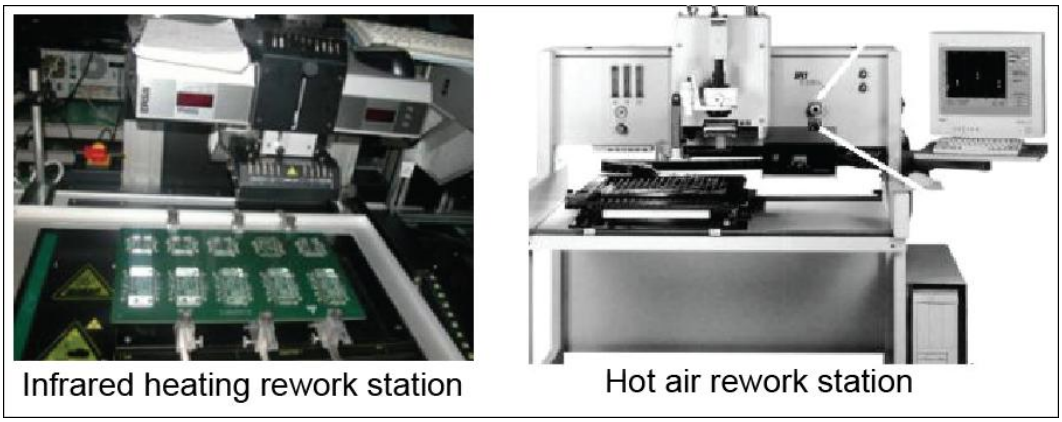
6.9.3 Removing of the Module

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 6-10 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).

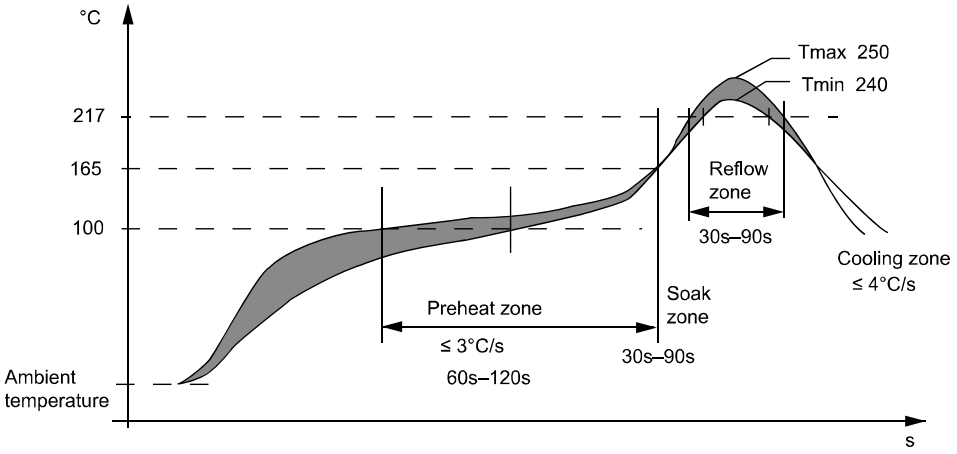
NOTE

- 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 6-11 Temperature graph of rework



7 Certifications

7.1 About This Chapter

This chapter gives a general description of certifications of ME909u-521.

7.2 Certifications

NOTE
Table 7-1 shows certifications the ME909u-521 has been implemented. For more demands, please contact us for more details about this information.

Table 7-1 Product Certifications

Certification	Model name
	ME909u-521
CE	√
GCF	√
RoHS	√
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.

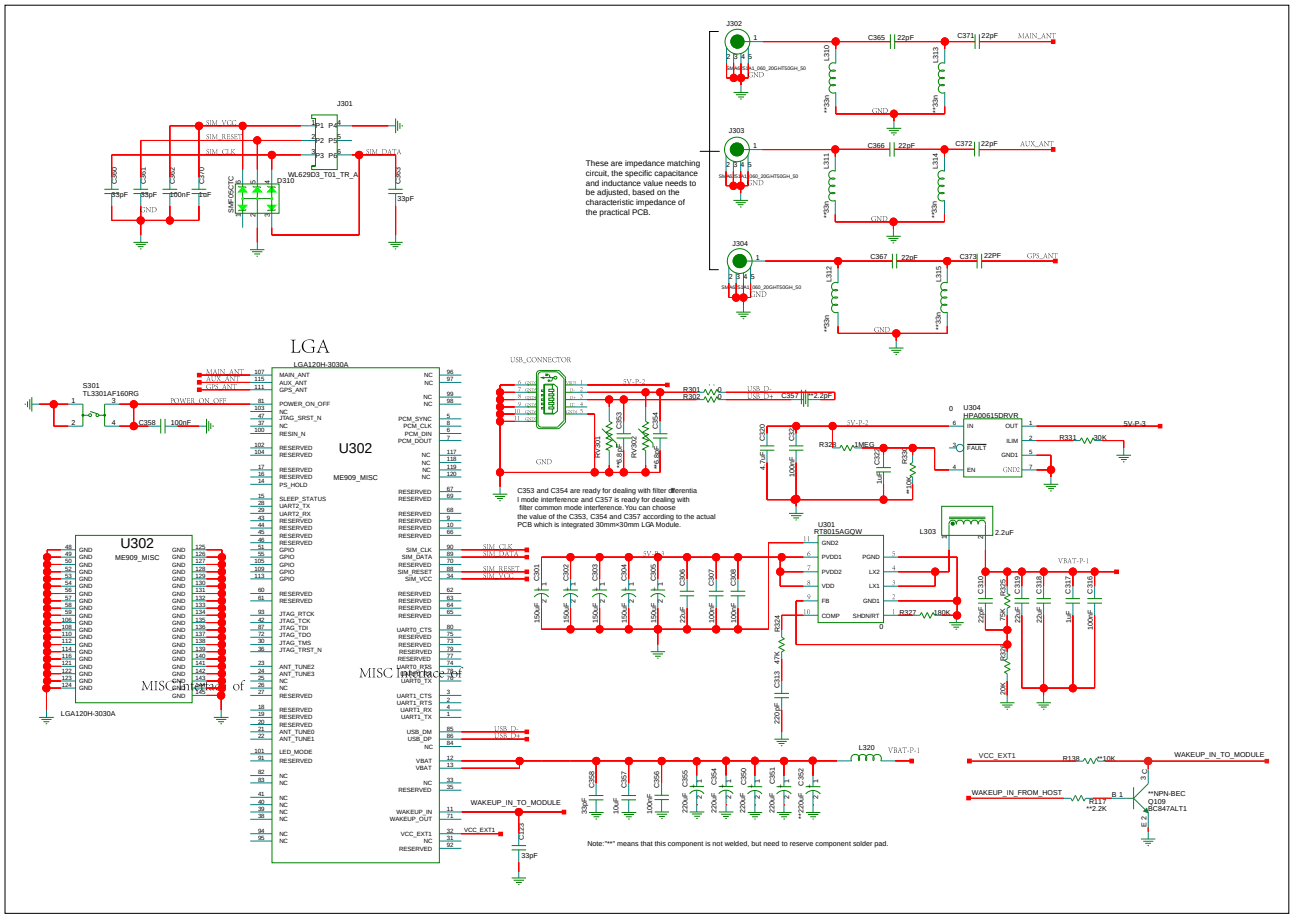
8.13 Regulatory Information

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).

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	Circuit Switched
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
EMC	Electromagnetic Compatibility

Acronym or Abbreviation	Expansion
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
HBM	Human Body Model
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
PID	Product Identity
PMU	Power Management Unit
PS	Packet Switched

Acronym or Abbreviation	Expansion
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
SMS	Short Message Service
TBD	To Be Determined
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
VID	Vendor IDentity
VSWR	Voltage Standing Wave Ratio
WEEE	Waste Electrical and Electronic Equipment
WCDMA	Wideband Code Division Multiple Access
WWAN	Wireless Wide Area Network