HUAWEI ME909s Series LTE LGA Module

Hardware Guide

Issue 04

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
01	2015-08-14		Initial release
02	2016-02-20	2.4	Deleted Application Block Diagram
		2.2	Updated Table 2-1 Features
		3.2	Updated LGA Interface
		3.5	Updated UART Interface
		3.9	Updated GPIO Interface
		4.2	Updated the NOTE of Operating Frequencies
		4.5.3	Updated Antenna Requirements
		5.6	Updated EMC and ESD Features
		6.5	Updated Packaging
03	2016-09-06	2	Updated Table 2-1 Features
		3.2	Updated Figure 3-1 Sequence of LGA interface (Top view)
		3.4.8	Updated Figure 3-15 Connections of the USIM_DET pin
		3.7	Updated Figure 3-19 Circuit of the USIM card interface
		5.4.2	Updated Table 5-6 Averaged standby DC power consumption of ME909s-821 LGA module
		6.6.2	Updated Figure 6-4 LGA module Footprint design (Unit: mm)
		6.8.2	Updated Figure 6-8 Recommended stencil design of LGA module (Unit: mm)

Document Version	Date	Chapter	Descriptions
		6.9.3	Updated Figure 6-10 Equipment used for rework
04	2016-12-21	3.2	Updated Table 3-1 Definitions of pins on the LGA interface
		5.5	Updated Table 5-12 Test conditions and results of the reliability of the ME909s LGA module

Scope

ME909s-821

ME909s-120

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces provided by HUAWEI ME909s Series (ME909s-821 and ME909s-120) LTE LGA Module (hereinafter referred to as the ME909s LGA module).

This document helps hardware engineer to understand the interface specifications, electrical features and related product information of the ME909s LGA module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the ME909s LGA module and provides:

- Function Overview
- Circuit Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical Dimensions	**ME909s-821** • Dimensions (L × W × H): 30 mm × 30 mm × 2.57 mm • Weight: about 5 g **ME909s-120** • Dimensions (L × W × H): 30 mm × 30 mm × 2.52 mm • Weight: about 5 g
Operating Bands	**ME909s-821** • FDD LTE: Band 1, Band 3, Band 8, all bands with diversity • TDD LTE: Band 38, Band 39, Band 40, Band 41, all bands with diversity • DC-HSPA+/HSPA+/HSPA/WCDMA: Band 1, Band 5, Band 8, Band 9, all bands with diversity • TD-SCDMA: Band 34, Band 39 • GSM/GPRS/EDGE: 1800 MHz/900 MHz

Feature	Description
	ME909s-120 • FDD LTE: Band 1, Band 2, Band 3, Band 4, Band 5, Band 7, Band 8, Band 20, all bands with diversity • WCDMA/HSDPA/HSUPA/HSPA+: Band 1, Band 2, Band 5, Band 8, all bands with diversity • GSM/GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz
Operating Temperature	Normal operating temperature: –30°C to +75°C Extended operating temperature[1]: –40°C to +85°C
Storage Temperature	–40°C to +85°C
Humidity	RH5% to RH95%
Power Voltage	DC 3.2 V to 4.2 V (typical value is 3.8 V)
AT Commands	See the *HUAWEI ME909s Series LTE Module AT Command Interface Specification*.
Application Interface (145-pin LGA interface)	One standard USIM (Class B and Class C) interface
	Audio interface: PCM interface
	USB 2.0 (High Speed)
	UART interface: • 8-wire UART0 x 1 • 2-wire UART2 x 1 (This is only used for debugging)
	GPIO
	ADC x 2
	LED x 1
	Power on/off interface
	Hardware reset interface
	JTAG interface
	SLEEP_STATUS
	WAKEUP_IN
	WAKEUP_OUT
	USIM_DET
Antenna Interface	• WWAN MAIN antenna pad x 1 • WWAN AUX antenna pad x 1
SMS	New message alert

Feature	Description
	Management of SMS: read SMS, write SMS, send SMS, delete SMS and list SMS
	Supports MO and MT: Point-to-point
Data Services	**ME909s-821** GPRS: UL 85.6 kbit/s; DL 85.6 kbit/s EDGE: UL 236.8 kbit/s; DL 236.8 kbit/s WCDMA CS: UL 64 kbit/s; DL 64 kbit/s WCDMA PS: UL 384 kbit/s; DL 384 kbit/s HSPA+: UL 5.76 Mbit/s; DL 21.6 Mbit/s DC-HSPA+: UL 5.76 Mbit/s; DL 42 Mbit/s TD-HSPA: UL 2.2 Mbit/s; DL 2.8 Mbit/s TD-SCDMA PS: UL 384 kbit/s; DL 2.8 Mbit/s LTE FDD: UL 50 Mbit/s; DL 150 Mbit/s @20M BW cat4 LTE TDD: UL 10 Mbit/s; DL 112 Mbit/s @20M BW cat4 (Uplink-downlink configuration 2, 1:3) **ME909s-120** GPRS: UL 85.6 kbit/s; DL 85.6 kbit/s EDGE: UL 236.8 kbit/s; DL 236.8 kbit/s WCDMA CS: UL 64 kbit/s; DL 64 kbit/s WCDMA PS: UL 384 kbit/s; DL 384 kbit/s HSPA+: UL 5.76 Mbit/s; DL 21.6 Mbit/s DC-HSPA+: UL 5.76 Mbit/s; DL 42 Mbit/s LTE FDD: UL 50 Mbit/s; DL 150 Mbit/s @20M BW cat4
Operating Systems	Android 2.x/3.x/4.x Linux (Kernel 2.6.29 or later) Windows 7/8/8.1/10 Windows CE 5.0/6.0/7.0

NOTE
[1]: When the ME909s LGA module works in the range from –40°C to –30°C or +75°C to +85°C, **NOT** all their RF performances comply with 3GPP specifications.

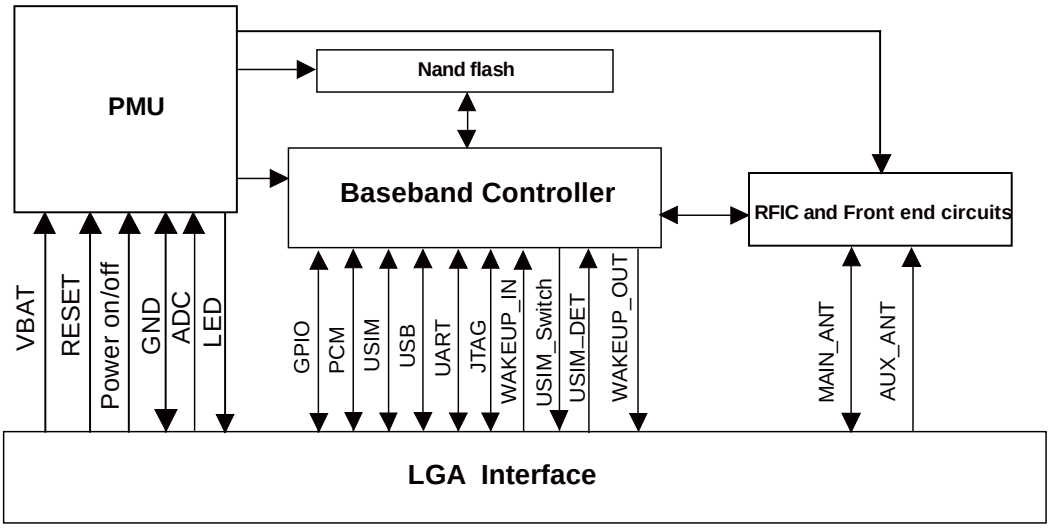
2.3 Circuit Block Diagram

The ME909s LGA module is developed based on Huawei's Balong Hi6921M platform. Figure 2-1 shows the circuit block diagram of the module. The major functional units of the module contain the following parts:

- Power Management
- Baseband Controller

- Nand Flash
- RF Circuit

Figure 2-1 Circuit block diagram of the ME909s LGA module



3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the ME909s LGA module, including:

- LGA Interface
- Power Interface
- Signal Control Interface
- UART Interface
- USB Interface
- USIM Card Interface
- Audio Interface
- GPIO Interface
- ADC Interface
- JTAG Interface
- RF Antenna Interface
- Reserved Interface
- NC Interface
- Test Points Design

3.2 LGA Interface

The ME909s LGA module uses the 145-pin LGA as their external interface. For details about the module and dimensions, see 6.4 Dimensions .

Figure 3-1 shows the sequence of pins on the 145-pin signal interface of the ME909s LGA module.

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

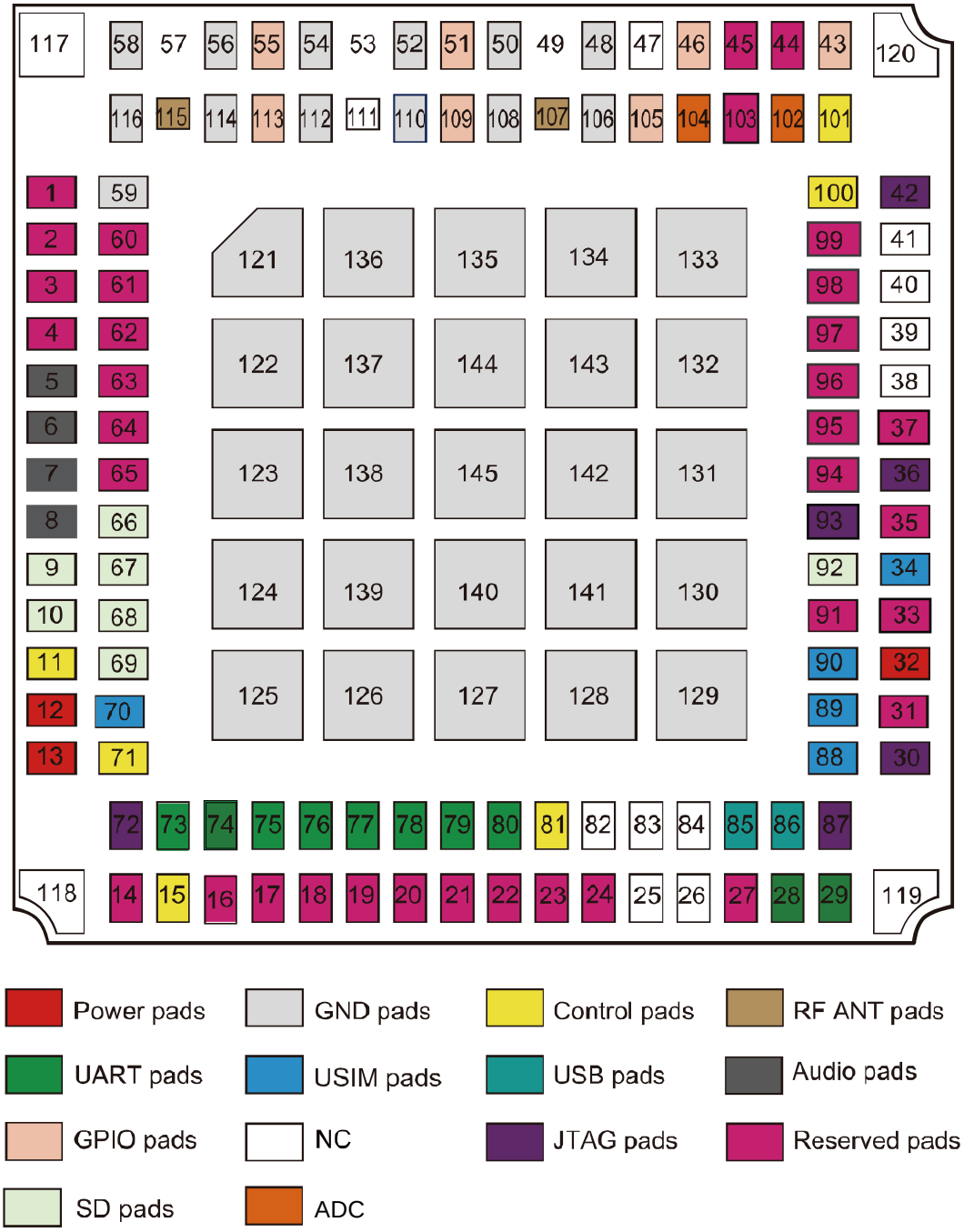


Figure 3-2 Appearance of the module (Without Label)

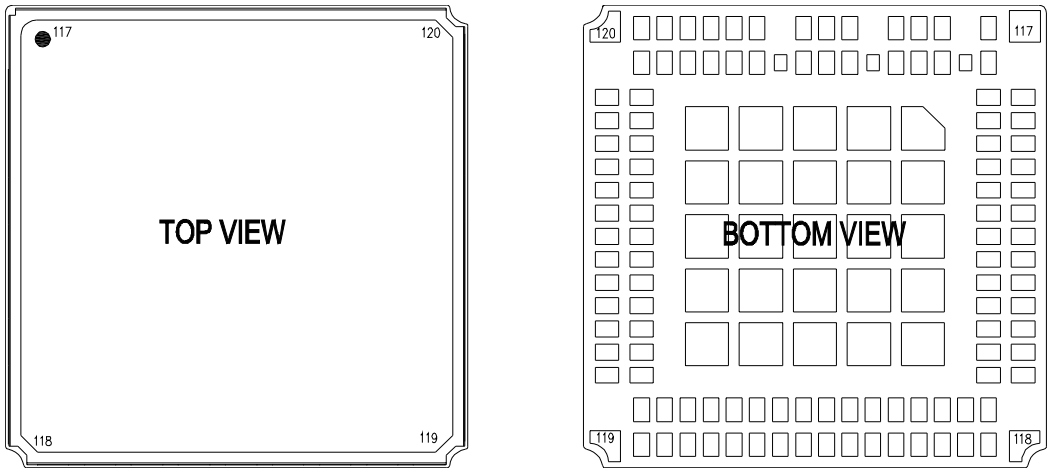


Table 3-1 shows the definitions of pins on the 145-pin signal interface of the ME909s LGA module.

Table 3-1 Definitions of pins on the LGA interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
1	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
2	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
3	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
4	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
5	PCM_SYNC[1]	O	PCM sync	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
6	PCM_DIN	I	PCM data in	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
7	PCM_DOUT	O	PCM data out	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
8	PCM_CLK[1]	O	PCM clock	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
9	SD_DATA1	I/O	SD Card data signal.	V_{OH}	2.25	3.0	3.15	Only used for debugging. Please
				V_{OL}	0	3.0	0.375	
				V_{IH}	1.875	3.0	3.15	

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
				V_{IL}	–0.3	3.0	0.7215	reserve this pin as the test point.
10	SD_DATA2	I/O	SD Card data signal.	V_{OH}	2.25	3.0	3.15	
				V_{OL}	0	3.0	0.375	
				V_{IH}	1.875	3.0	3.15	
				V_{IL}	–0.3	3.0	0.7215	
11	WAKEUP_IN	I	Sleep authorization signal. H: Sleep mode is disabled. L: Sleep mode is enabled (default value).	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
12	VBAT	PI	Power supply input for RF. The rising time of VBAT must be greater than 100 µs	-	3.2	3.8	4.2	-
13	VBAT	PI	Power supply input The rising time of VBAT must be greater than 100 µs	-	3.2	3.8	4.2	-
14	Reserved	I	Reserved, please keep this pin open.	-	-	-	-	-
15	SLEEP_STATUS	O	Sleep status indicator. H: Module is in wakeup state. L: Module is in sleep state.	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
16	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
17	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
18	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
19	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
20	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
21	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
22	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
23	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
24	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
25	NC	-	Not connected	-	-	-	-	-
26	NC	-	Not connected	-	-	-	-	-
27	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
28	UART2_TX	O	UART2 transmit output	V_{OH}	1.35	1.8	1.98	Only used for debugging. Please reserve this pin as the test point.
				V_{OL}	0	-	0.45	
29	UART2_RX	I	UART2 receive data input	V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
30	JTAG_TMS	I	JTAG test mode select.	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
31	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
32	VCC_EXT1	PO	1.8 V Power output	-	1.62	1.8	1.98	-
33	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
34	USIM_VCC	PO	Power supply for USIM card.	-	1.75	1.8	1.98	USIM_VCC= 1.8 V
					2.75	3.0	3.3	USIM_VCC= 3.0 V
35	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
36	JTAG_TRST_N	I	JTAG reset	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
37	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
38	NC	-	Not connected	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
39	NC	-	Not connected	-	-	-	-	-
40	NC	-	Not connected	-	-	-	-	-
41	NC	-	Not connected	-	-	-	-	-
42	JTAG_TCK	I	JTAG clock input	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
43	GPIO1	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	The function of these pins has not been defined.
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
44	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
45	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
46	GPIO2	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	The function of these pins has not been defined.
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
47	NC	-	Not connected	-	-	-	-	-
48	GND	-	Ground	-	-	-	-	-
49	NOT USED	-	Do not design PAD	-	-	-	-	-
50	GND	-	Ground	-	-	-	-	-
51	GPIO3	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	The function of these pins has not been defined.
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
52	GND	-	Ground	-	-	-	-	-
53	NOT USED	-	Do not design PAD	-	-	-	-	-
54	GND	-	Ground	-	-	-	-	-
55	GPIO4/USIM_ Switch	I/O	General Purpose I/O pins (Default) or USIM	V_{OH}	1.35	1.8	1.98	The function of this pin can be used

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			Switch control signal.	V_{OL}	0	-	0.45	as GPIO or USIM Switch, while the USIM Switch should be enabled by AT command.
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
56	GND	-	Ground	-	-	-	-	-
57	NOT USED	-	Do not design PAD	-	-	-	-	-
58	GND	-	Ground	-	-	-	-	-
59	GND	-	Ground	-	-	-	-	-
60	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
61	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
62	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
63	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
64	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
65	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
66	SD_DATA3	I/O	SD Card data signal.	V_{OH}	2.25	3.0	3.15	Only used for debugging. Please reserve this pin as the test point.
				V_{OL}	0	3.0	0.375	
				V_{IH}	1.875	3.0	3.15	
				V_{IL}	–0.3	3.0	0.7215	
67	SD_CLK	O	SD Card CLK signal.	V_{OH}	2.25	3.00	3.15	
				V_{OL}	0	-	0.375	
68	SD_DATA0	I/O	SD Card data signal.	V_{OH}	2.25	3.0	3.15	
				V_{OL}	0	3.0	0.375	
				V_{IH}	1.875	3.0	3.15	

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
				V_{IL}	–0.3	3.0	0.7215	
69	SD_CMD	O	SD Card cmd signal.	V_{OH}	2.25	3.00	3.15	
				V_{OL}	0	-	0.375	
70	USIM_DET	I	USIM hot swap detection pin. When it is High, USIM is present. When it is Low, USIM is absent.	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up. Keep USIM_DET floating, if it is not used.
				V_{IL}	0	-	0.18	
71	WAKEUP_OUT	O	Module to wake up the host.	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
72	JTAG_TDO	O	JTAG test data output	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
73	UART0_DSR	O	UART0 data set Ready	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
74	UART0_RTS	O	UART0 request to send	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
75	UART0_DCD	O	UART0 Data Carrier Detect	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
76	UART0_TX	O	UART0 transmit output	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
77	UART0_RING	O	UART0 Ring Indicator	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
78	UART0_RX	I	UART0 receive data input	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
79	UART0_DTR	I	UART0 Data Terminal Ready	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
80	UART0_CTS	I	UART0 Clear to Send	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
81	POWER_ON_OFF	I	System power-on or power-off	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up.
				V_{IL}	0	-	0.18	

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
82	NC	-	Not connected	-	-	-	-	-
83	NC	-	Not connected	-	-	-	-	-
84	NC	-	Not connected	-	-	-	-	-
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	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	
88	USIM_RESET	O	USIM card reset	V_{OH}	0.7x USIM_VCC	-	3.3	USIM_VCC= 1.8 V or 3.0 V
				V_{OL}	0	-	0.2x USIM_VCC	
89	USIM_DATA	I/O	USIM card data	V_{OH}	0.7 x USIM_VCC	-	3.3	USIM_VCC= 1.8 V or 3.0 V
				V_{OL}	0	-	0.2 x USIM_VCC	
				V_{IH}	0.65x USIM_VCC	-	3.30	
				V_{IL}	0	-	0.25x USIM_VCC	
90	USIM_CLK	O	USIM card clock	V_{OH}	0.7 x USIM_VCC	-	3.3	USIM_VCC= 1.8 V or 3.0 V
				V_{OL}	0	-	0.2 x USIM_VCC	
91	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
92	SD_VCC	PO	SD Card power signal.	-	2.85	3.00	3.15	-
93	JTAG_RTCK	O	JTAG return clock, Pin	V_{OH}	1.35	1.8	2.1	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			for trace connection, it is a reserved test point for customers.	V_{OL}	0	-	0.45	
94	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
95	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
96	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
97	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
98	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
99	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
100	RESIN_N	I	Reset module.	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up.
				V_{IL}	0	-	0.18	
101	LED_MODE	O	Mode indicator current sink Drive strength: 10 mA	-	-	-	-	
102	ADC_1	AI	Conversion interface for analog signals to digital signals	-	0	-	2.5	-
103	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
104	ADC_2	AI	Conversion interface for analog signals to digital signals	-	0	-	2.5	-
105	GPIO5	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	The function of these pins has not been defined.
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
106	GND	-	Ground	-	-	-	-	-
107	MAIN_ANT	-	RF main antenna pad	-	-	-	-	-
108	GND	-	Ground	-	-	-	-	-
109	GPIO6	I/O	General Purpose I/O	V_{OH}	1.35	1.8	1.98	The function

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			pins.	V_{OL}	0	-	0.45	of these pins has not been defined.
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
110	GND	-	Ground	-	-	-	-	-
111	NC	-	Not connected	-	-	-	-	-
112	GND	-	Ground	-	-	-	-	-
113	GPIO7	I/O	General Purpose I/O pins	V_{OH}	1.35	1.8	1.98	The function of these pins has not been defined.
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
114	GND	-	Ground	-	-	-	-	-
115	AUX_ANT	-	RF AUX antenna pad	-	-	-	-	-
116	GND	-	Ground	-	-	-	-	-
117	NC	-	Not connected	-	-	-	-	-
118	NC	-	Not connected	-	-	-	-	-
119	NC	-	Not connected	-	-	-	-	-
120	NC	-	Not connected	-	-	-	-	-
121	GND	-	Thermal Ground Pad	-	-	-	-	-
122	GND	-	Thermal Ground Pad	-	-	-	-	-
123	GND	-	Thermal Ground Pad	-	-	-	-	-
124	GND	-	Thermal Ground Pad	-	-	-	-	-
125	GND	-	Thermal Ground Pad	-	-	-	-	-
126	GND	-	Thermal Ground Pad	-	-	-	-	-
127	GND	-	Thermal Ground Pad	-	-	-	-	-
128	GND	-	Thermal Ground Pad	-	-	-	-	-
129	GND	-	Thermal Ground Pad	-	-	-	-	-
130	GND	-	Thermal Ground Pad	-	-	-	-	-
131	GND	-	Thermal Ground Pad	-	-	-	-	-
132	GND	-	Thermal Ground Pad	-	-	-	-	-
133	GND	-	Thermal Ground Pad	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
134	GND	-	Thermal Ground Pad	-	-	-	-	-
135	GND	-	Thermal Ground Pad	-	-	-	-	-
136	GND	-	Thermal Ground Pad	-	-	-	-	-
137	GND	-	Thermal Ground Pad	-	-	-	-	-
138	GND	-	Thermal Ground Pad	-	-	-	-	-
139	GND	-	Thermal Ground Pad	-	-	-	-	-
140	GND	-	Thermal Ground Pad	-	-	-	-	-
141	GND	-	Thermal Ground Pad	-	-	-	-	-
142	GND	-	Thermal Ground Pad	-	-	-	-	-
143	GND	-	Thermal Ground Pad	-	-	-	-	-
144	GND	-	Thermal Ground Pad	-	-	-	-	-
145	GND	-	Thermal Ground Pad	-	-	-	-	-

NOTE

- **P** indicates power pins; **PI** indicates input power pins; **PO** indicates output power pins; **I** indicates pins for digital signal input; **O** indicates pins for digital signal output; **AI** indicates pins for analog signal input.
- V_{IL} indicates Low-level Input voltage; V_{IH} indicates High-level Input voltage; V_{OL} indicates Low-level Output voltage; V_{OH} indicates High-level Output voltage.
- The **NC** (Not Connected) pins are floating and there are no signal connected to these pins.
- 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.
- [1]: PCM_SYNC and PCM_CLK: Output, when ME909s LGA module is used as PCM master.

3.3 Power Interface

3.3.1 Overview

The power supply part of the ME909s LGA module contains:

- VBAT pins for the power supply
- VCC_EXT1 pin for external power output with 1.8 V
- USIM_VCC pin for USIM card power output
- SD_VCC pin for SD card power output

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

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

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
12 and 13	VBAT	PI	Power supply input for RF. The rising time of VBAT must be greater than 100 µs	-	3.2	3.8	4.2	-
32	VCC_EXT1	PO	1.8 V Power output	-	1.62	1.8	1.98	-
34	USIM_VCC	PO	Power supply for USIM card	-	1.75	1.8	1.98	USIM_VCC= 1.8 V
					2.75	3.0	3.3	USIM_VCC= 3.0 V
92	SD_VCC	PO	SD Card Power.	-	2.85	3.00	3.15	-
48, 50, 52, 54, 56, 58, 59, 106, 108, 110, 112, 114 and 116	GND	-	GND	-	-	-	-	-
121–145	GND	-	Thermal Ground Pad	-	-	-	-	-

3.3.2 Power Supply VBAT Interface

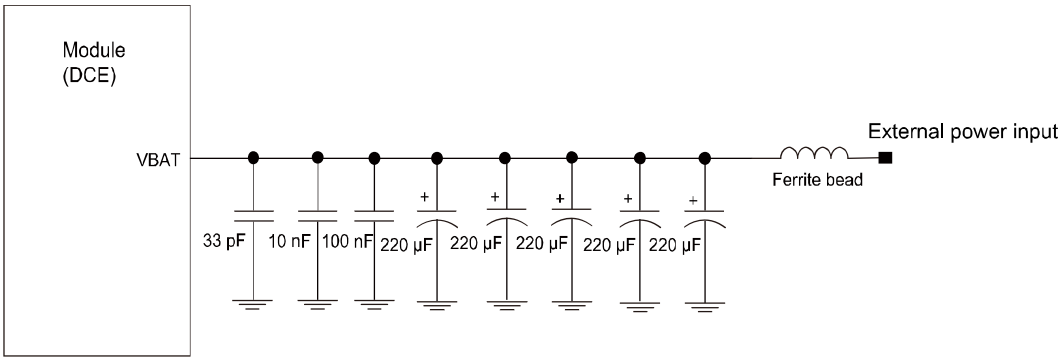
When the ME909s LGA module works normally, power is supplied through the VBAT pins and the voltage ranges from 3.2 V to 4.2 V (typical value: 3.8 V). The 145-pin LGA provides two VBAT pins and GND pins for external power input. To ensure that the ME909s LGA module works normally, all the pins must be used efficiently.

When the ME909s LGA module is used for different external applications, pay special attention to the design for the power supply. When the ME909s LGA module works at 2G mode and transmits signals at the maximum power, the transient current may reach the transient peak value of about 2.75 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 3.2 V in any case. Otherwise, exceptions such as restart of the ME909s LGA module may occur.

A low-dropout (LDO) regulator or switch power with current output of more than 3 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 ME909s LGA 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.

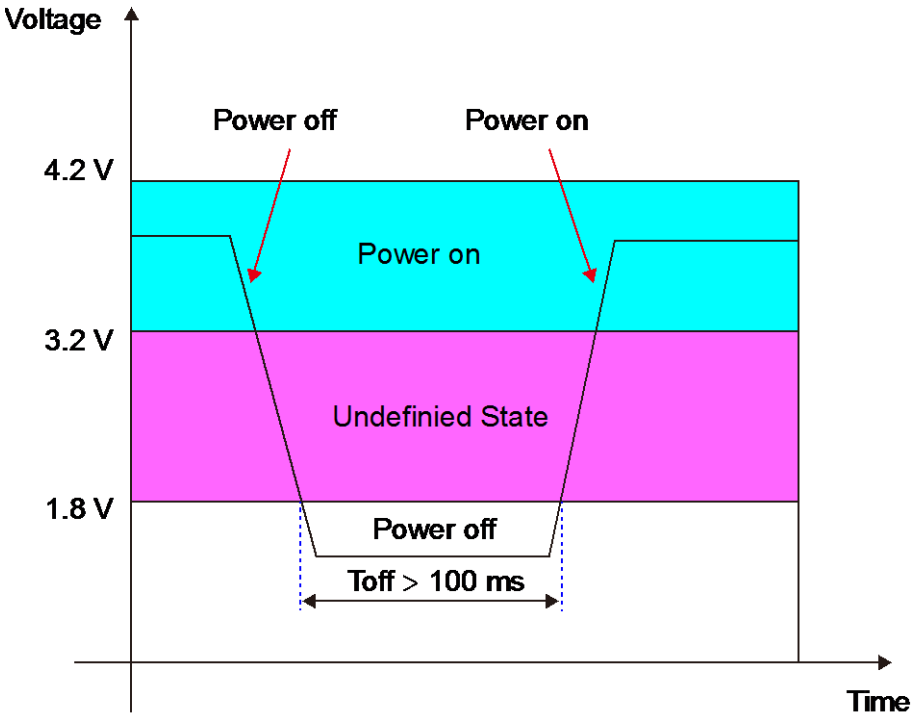
It is recommended that customers add the EMI ferrite bead (FBMJ1608HS280NT manufactured by TAIYO YUDEN or MPZ1608S300ATAH0 manufactured by TDK is recommended) to directly isolate DTE from DCE in the power circuit. Figure 3-3 shows the recommended power circuit of ME909s LGA module.

Figure 3-3 Recommended power circuit of ME909s LGA 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. If POWER_ON_OFF is asserted when the VBAT ranges from 1.8 V to 3.2 V, the module may enter an unexpected status.

Figure 3-4 Power supply time sequence for power cycling



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

NOTE
The rising time of VBAT should be 100 µs at least.

3.3.3 Output Power Supply Interface

Output power supply interfaces are VCC_EXT, USIM_VCC and SD_VCC.

Through the VCC_EXT, the 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 module is in power down mode, the output power supply is in the disabled state.

Through the USIM_VCC, the module can supply 1.8 V or 3.0 V power to the USIM card.

The SD_VCC is SD card power that only used for debugging. Please reserve the test point.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface on the ME909s LGA 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 signal (LED_MODE) pin
- USIM_DET signal (USIM_DET) 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	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
81	POWER_ON_OFF	I	System power-on and power-off	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up.
				V_{IL}	0	-	0.18	
100	RESIN_N	I	Reset module.	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up。
				V_{IL}	0	-	0.18	
11	WAKEUP_IN[1]	I	Sleep authorization signal H: Sleep mode is disabled L: Sleep mode is enabled (default value)	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
71	WAKEUP_OUT[2]	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)	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	
15	SLEEP_STATUS[3]	O	Sleep status indicator H: Module is in wake state L: Module is in sleep state	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
101	LED_MODE	O	Mode indicator current sink Drive strength: 10 mA	-	-	-	-	-
70	USIM_DET	I	USIM hot swap detection pin. When it is High, USIM is present. When it is Low, USIM is absent.	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up. Keep USIM_DET floating, if it is not used.
				V_{IL}	0	-	0.18	

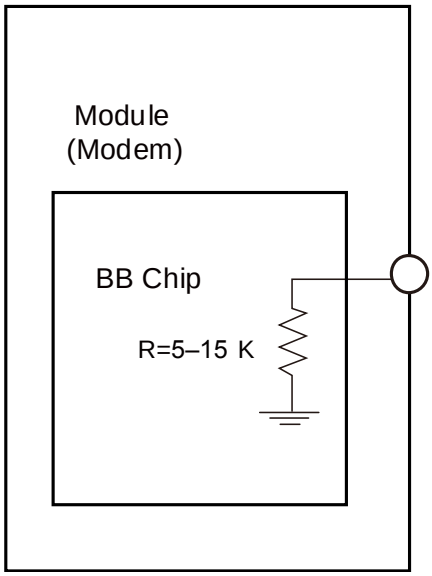
NOTE

- [1]: The WAKEUP_IN pin can be used to wake up the module.
- [2]: WAKEUP_OUT: When the module is not in sleep mode, this pin's drive current is 4 mA.

  When the module is in sleep mode, this pin's output level is low and drive current smaller than 0.1 mA. The resistance is maintained at 5 kΩ–15 kΩ, as shown in Figure 3-5 . The output level may be changed if there is a stronger pull-up. It is recommended that customers take Figure 3-12 for reference to design their circuit.
- [3]: SLEEP_STATUS: When the module is not in sleep mode, this pin's drive current is 4 mA.

  When the module is in sleep mode, this pin's output level is low and drive current smaller than 0.1 mA. The resistance is maintained at 5 kΩ–15 kΩ, as shown in Figure 3-5 . The output level may be changed if there is a stronger pull-up. It is recommended that customers take Figure 3-13 for reference to design their circuit.

Figure 3-5 Maintaining the resistance in sleep mode



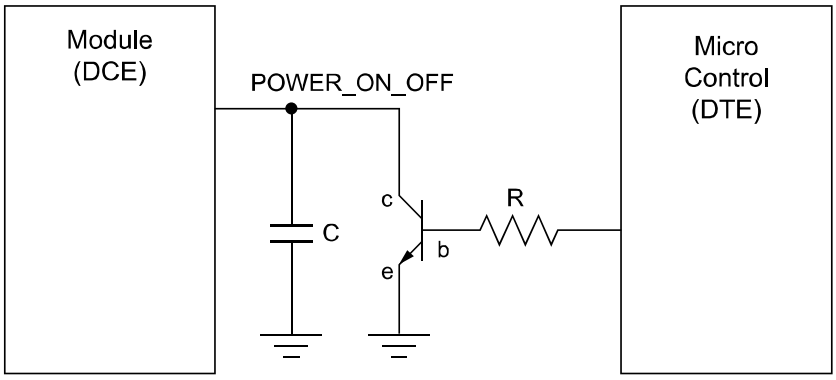
3.4.2 Power-on/off Pin

The ME909s LGA module can be controlled to power on/off by the POWER_ON_OFF pin.

Table 3-4 Two states of POWER_ON_OFF

Item	Pin state	Description
1	Low (when ME909s LGA module is in power off state.)	ME909s LGA module is powered on. POWER_ON_OFF pin should be pulled down for 1.0s at least.
2	Low (when ME909s LGA module is in power on state.)	ME909s LGA module is powered off. POWER_ON_OFF pin should be pulled down for 4.0s at least.

Figure 3-6 Connections of 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, please make sure the VBAT is stable.

Figure 3-7 Power on timing sequence

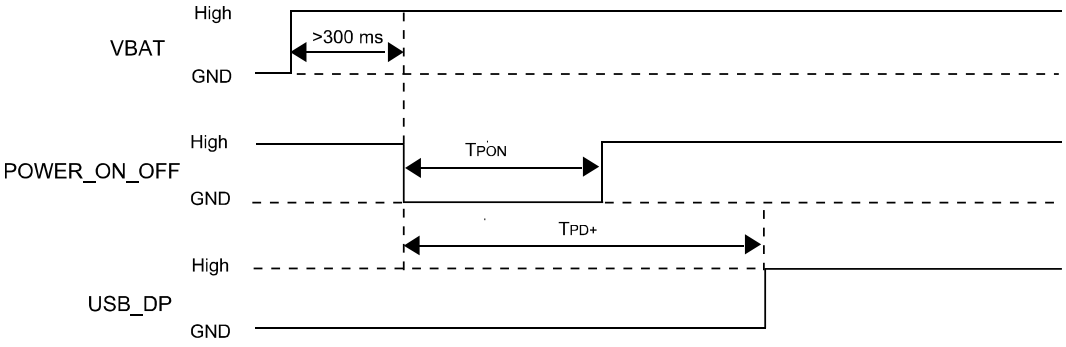


Table 3-5 Power on timing

Parameter	Comments	Time (Nominal values)	Units
T_{PON}	POWER_ON_OFF turn on time.	> 1.0	s
T_{PD+}	POWER_ON_OFF valid to USB D+ high	About 7.0	s

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

Power-Off Time Sequence

Figure 3-8 Power off timing sequence

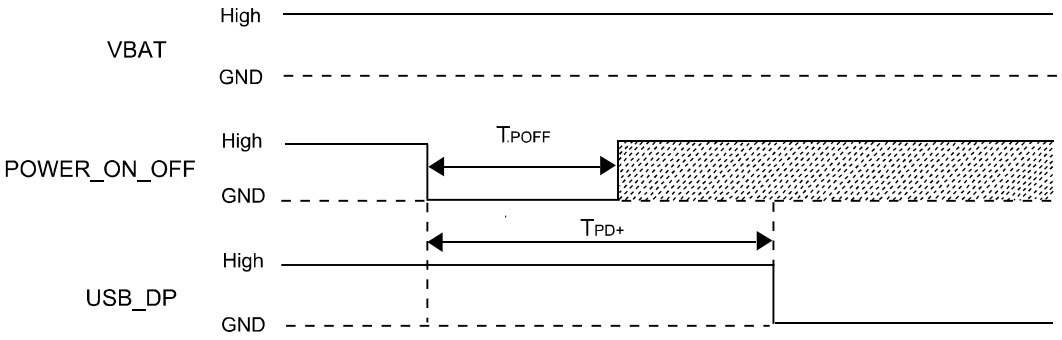


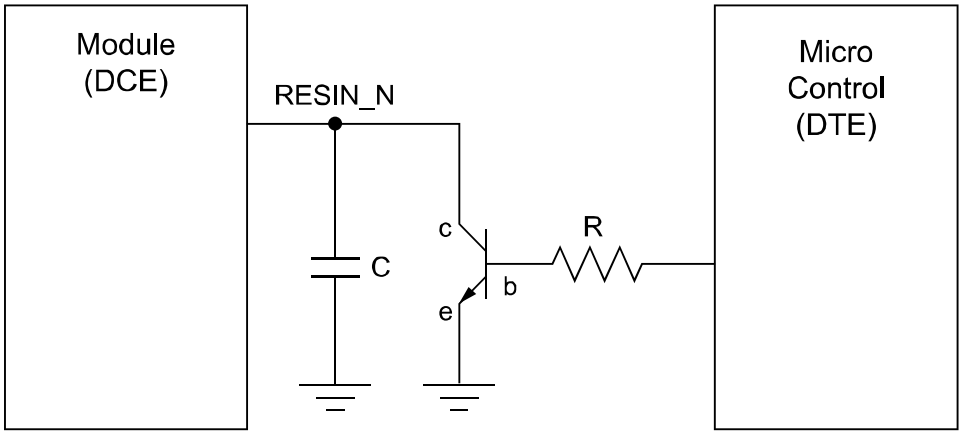
Table 3-6 Power off timing

Parameter	Comments	Time (Nominal values)	Units
T_{POFF}	POWER_ON_OFF turn off time.	> 4.0	s
T_{PD+}	POWER_ON_OFF valid to USB D+ low	> 4.0	s

3.4.3 RESIN_N

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

Figure 3-9 Connections of the RESIN_N pin

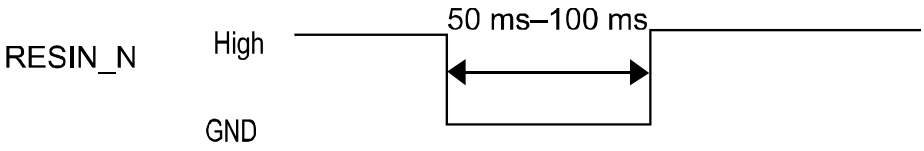


CAUTION

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.

The ME909s LGA module supports hardware reset function. If the software of the ME909s LGA module stops responding, you can reset the hardware through the RESIN_N signal as shown in Figure 3-10 .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 3-10 Reset pulse timing



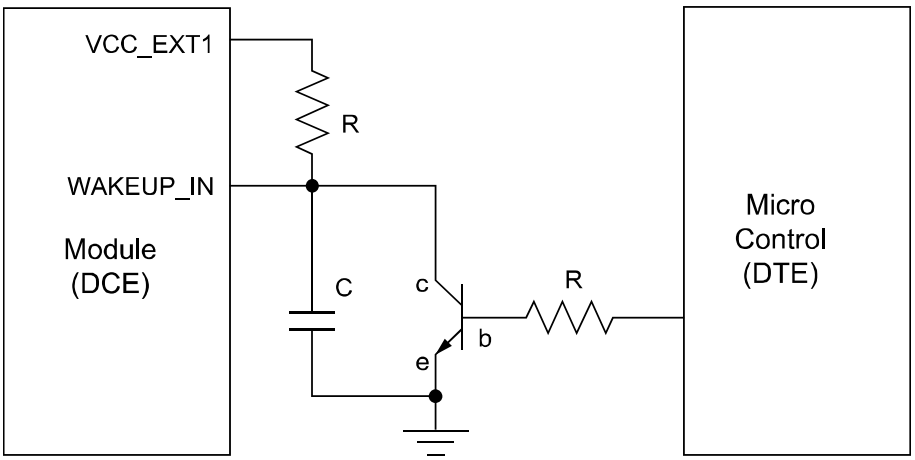
3.4.4 WAKEUP_IN Signal

WAKEUP_IN pin is the authorization signal of ME909s LGA module entering sleep mode. If this pin is not connected, it will keep in low level by default.

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

The module cannot enter sleep mode when this pin is pulled up (1.8 V), and the module should be waked up when the pin is pulled up.

Figure 3-11 Connections of the WAKEUP_IN pin

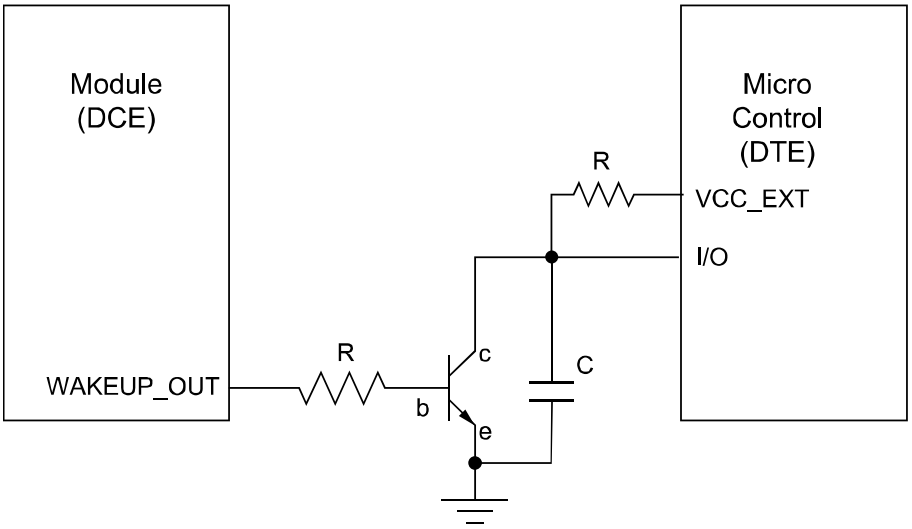


3.4.5 WAKEUP_OUT Signal

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

- When WAKEUP_OUT pin is in high level, the module can wake up the host.
- When WAKEUP_OUT pin is in low level, the module cannot wake up the host. (default)

Figure 3-12 Connections of the WAKEUP_OUT pin

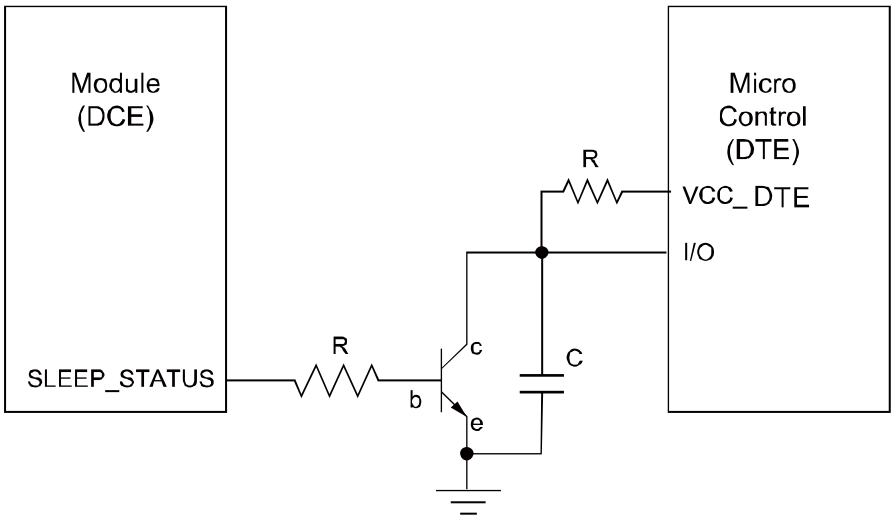


3.4.6 SLEEP_STATUS Signal

The SLEEP_STATUS pin is used to indicate the sleep status of the module.

- When SLEEP_STATUS pin is in high level, the module is in wakeup state.
- When SLEEP_STATUS pin is in low level, the module is in sleep state.

Figure 3-13 Connections of the SLEEP_STATUS pin



3.4.7 LED_MODE Signal

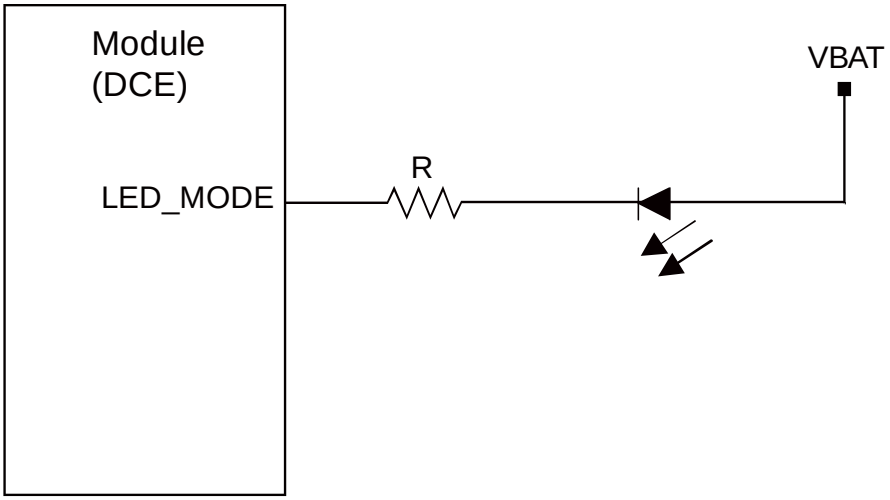
ME909s LGA module provides an LED_MODE signal to indicate the work status.

Table 3-7 State of the LED_MODE pin

No.	Operating Status	LED_MODE
1	No service/Restricted service	Outputs: low (0.1s)-high (0.1s)-low (0.1s)-high (1.7s) 2s cycle
2	Register to the network	Outputs: low (0.1s)-high (1.9s) 2s cycle
3	Dial-up successfully	Outputs: low

Figure 3-14 shows the recommended circuits of LED_MODE. The brightness of LED can be adjusted by adjusting the resistance of the resistor.

Figure 3-14 Driving circuit



3.4.8 USIM_DET Pin

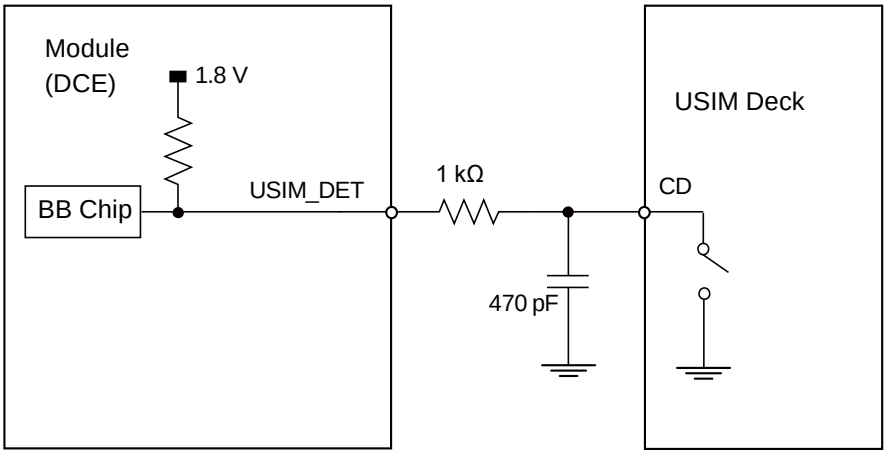
ME909s LGA module supports USIM hot swap function.

ME909s LGA module provides an input pin (USIM_DET) to detect whether the USIM card is present or not. This pin is a level trigger pin, and it is internally pulled up. If the module does not support USIM card hot swap, keep USIM_DET floating.

Table 3-8 Function of the USIM_DET pin

No.	USIM_DET	Function
1	High level	USIM card insertion. If the USIM card is present, USIM_DET should be High.
2	Low level	USIM card removal. If the USIM card is absent, USIM_DET should be Low.

Figure 3-15 Connections of the USIM_DET pin

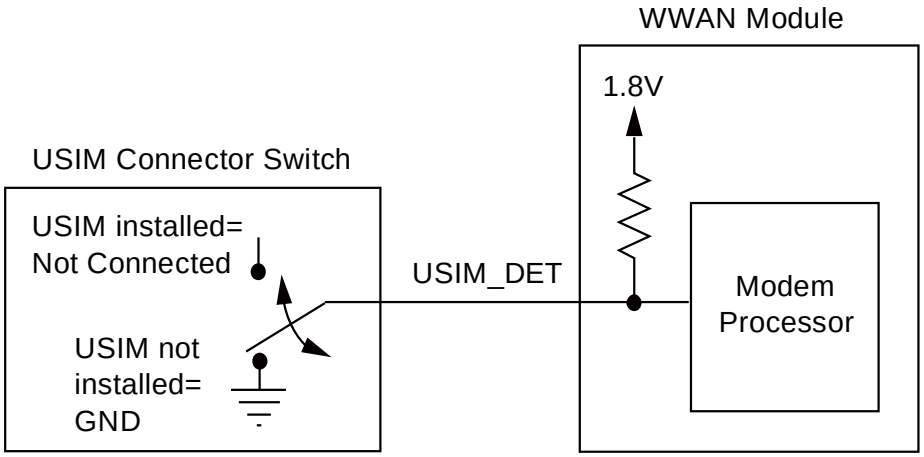


CD is a pin detecting of USIM in the USIM socket, in normal, there will be a detect pin in the USIM socket.

CAUTION

- It is recommended not to add a diode on the USIM_DET pin outside the module.
- The normal SHORT USIM connector should be employed. The logic of USIM_DET is shown as Figure 3-16 . High represents that USIM is inserted; Low represents that USIM is removed.
- When USIM is inserted (hot), USIM_DET will change from Low to High;
- When USIM is removed (hot), USIM_DET will change from High to Low;
- The module will detect the level of USIM_DET to support the hot swap.

Figure 3-16 Logic of USIM_DET



3.5 UART Interface

3.5.1 Overview

The ME909s LGA module provides the UART0 (8-wire UART) interface for one asynchronous communication channel. As the UART0 interface supports signal control through standard modem handshake, AT commands are entered and serial communication is performed through the UART0 interface. The UART2 (2-wire UART) interface is provided for only debugging by the ME909s LGA module. The UART have the following features:

- Full-duplex
- 7-bit or 8-bit data
- 1-bit or 2-bit stop bit
- Odd parity check, even parity check, or non-check
- Baud rate clock generated by the system clock
- Direct memory access (DMA) transmission
- UART0 supports baud rate: 300 bit/s, 600 bit/s, 1200 bit/s, 2400 bit/s ,4800 bit/s, 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s (default), 230400 bit/s, 1000000 bit/s, 3000000 bit/s
- Baud rate auto adaptive change is supported. AP (Access Point) must choose one default Baud rate to communicate with module in the beginning.

The 2-wire UART is for debugging only. Customers should layout two test points for them, which are required for system troubleshooting and analysis.

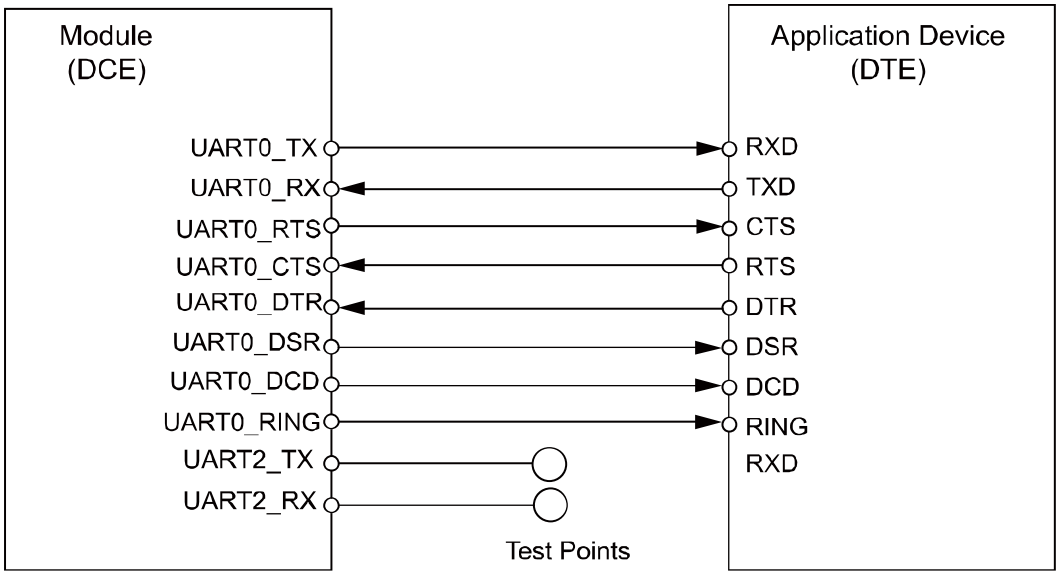
Table 3-9 UART interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
76	UART0_TX	O	UART0 transmit output	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
78	UART0_RX	I	UART0 receive data input	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
77	UART0_RING	O	UART0 ring indicator	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
74	UART0_RTS	O	UART0 request to send	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
79	UART0_DTR	I	UART0 data terminal ready	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
80	UART0_CTS	I	UART0 clear to send	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
75	UART0_DCD	O	UART0 data carrier	V_{OH}	1.35	1.8	1.98	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			detect	V_{OL}	0	-	0.45	-
73	UART0_DSR	O	UART0 data set ready	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
28	UART2_TX	O	UART2 transmit output	V_{OH}	1.35	1.8	1.98	Only used for debugging. Please reserve this pin as the test point.
				V_{OL}	0	-	0.45	
29	UART2_RX	I	UART2 receive data input	V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	

3.5.2 Circuit Recommended for the UART Interface

Figure 3-17 Connection of the UART interface in the ME909s LGA module (DCE) with the host (DTE)



The RS-232 chip (must support 921600 bit/s) can be used to connect the module with UART. In this connection, the CMOS (Complementary Metal Oxide Semiconductor) logic level and the EIA (Electronic Industries Association) level are converted mutually.

NOTE

- The UART cannot wake up the module from the sleep status, and you can pull up the WAKEUP_IN signal for 1s instead.
- It is recommended to set the pins related to UART2 interface as test points on the DTE board for debugging. The level of RS-232 transceivers must match that of the ME909s LGA module.

3.6 USB Interface

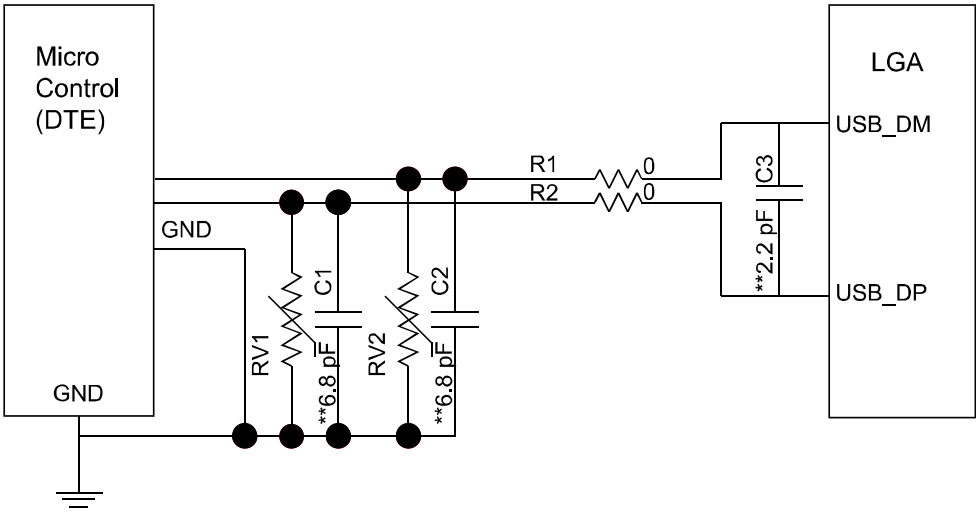
The ME909s LGA module is compliant with USB 2.0 High speed protocol. The USB interface is powered directly from the VBAT supply. The USB signal lines are compatible with the USB 2.0 signal specifications. Figure 3-18 shows the circuit of the USB interface.

Table 3-10 Definition of the USB interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
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	-	-	-	-	-

According to USB protocol, for bus timing or electrical characteristics of ME909s LGA USB signal, please refer to the chapter 7.3.2 of *Universal Serial Bus Specification 2.0.*

Figure 3-18 Recommended circuit of USB interface



NOTE

- USB_DM and USB_DP are required to control the differential impedance 90 Ω (±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 C3 is ready for dealing with filter common mode interference. You can choose the value of the C1, C2 and C3 according to the actual PCB which is integrated 30 mm × 30 mm LGA module

3.7 USIM Card Interface

3.7.1 Overview

The ME909s LGA module provides a USIM card interface complying with the ISO 7816-3 standard and supports both Class B and Class C USIM cards.

Table 3-11 USIM card interface signals

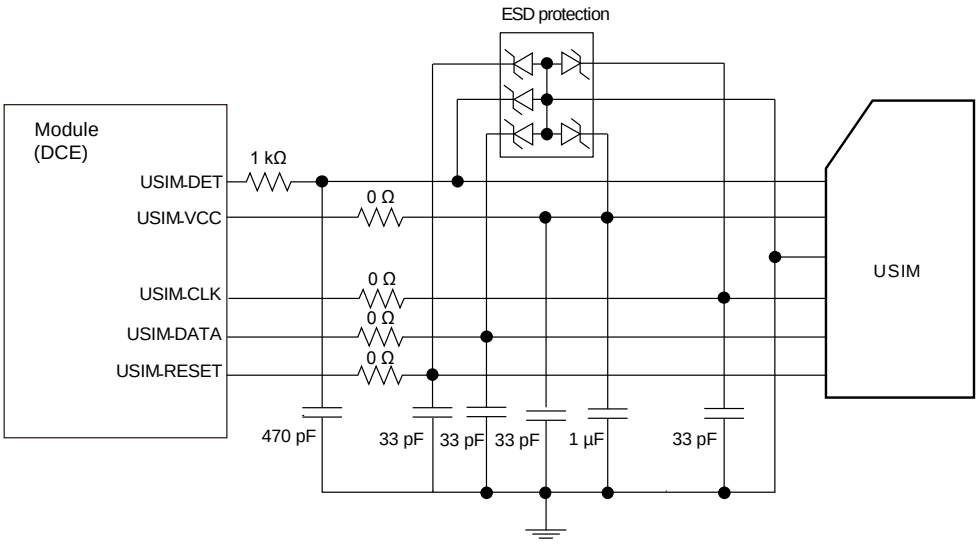
Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
88	USIM_RESET	O	USIM card reset	V_{OH}	0.7 x USIM_VCC	-	3.3	USIM_VCC= 1.8 V or 3.0 V
				V_{OL}	0	-	0.2 x USIM_VCC	
89	USIM_DATA	I/O	USIM card data	V_{OH}	0.7 x USIM_VCC	-	3.3	USIM_VCC= 1.8 V or 3.0 V
				V_{OL}	0	-	0.2 x USIM_VCC	
				V_{IH}	0.65 x USIM_VCC	-	3.30	

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)	Comments
				V_{IL}	0	-	0.25 x USIM_VCC	
90	USIM_CLK	O	USIM card clock	V_{OH}	0.7 x USIM_VCC	-	3.3	USIM_VCC= 1.8 V or 3.0 V
				V_{OL}	0	-	0.2 x USIM_VCC	
34	USIM_VCC	PO	Power supply for USIM card	-	1.75	1.8	1.98	USIM_VCC= 1.8 V
					2.75	3.0	3.3	USIM_VCC= 3.0 V
70	USIM_DET	I	USIM hot swap detection pin. When it is High, USIM is present. When it is Low, USIM is absent.	V_{IH}	1.62	1.8	1.98	The signal is internally pulled up. Keep USIM_DET floating, if it is not used.
				V_{IL}	0	-	0.18	

3.7.2 Circuit Recommended for the USIM Card Interface

As the ME909s LGA module is not equipped with a USIM socket, you need to place a USIM socket on the user interface board. Figure 3-19 shows the circuit of the USIM card interface.

Figure 3-19 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 USIM_CLK and USIM_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 ME909s LGA module.
- A 100 nF capacitor and 1 µF capacitor are placed between the USIM_VCC and GND pins in a parallel manner (If USIM_VCC circuit is too long, that the larger capacitance such as 4.7 µF can be employed if necessary). Three 33 pF capacitors are placed between the USIM_DATA and Ground pins, the USIM_RESET and Ground pins, and the USIM_CLK and Ground pins in parallel to filter interference from RF signals.
- It is recommended to take electrostatic discharge (ESD) protection measures near the USIM card socket. The TVS diode with Vrwm of 5 V and junction capacitance less than 10 pF must be placed as close as possible to the USIM socket, and the Ground pin of the ESD protection component is well connected to the power Ground pin that supplies power to the ME909s LGA module.
- It is recommended to place a 1 kΩ resistor in series on the USIM_DET interface for ESD protection if USIM_DET is used.

3.8 Audio Interface

ME909s LGA module provides one PCM digital audio interface. Table 3-12 lists the signals on the digital audio interface.

Table 3-12 Signals on the digital audio interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
5	PCM_SYNC	O	PCM sync	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
6	PCM_DIN	I	PCM data in	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
7	PCM_DOUT	O	PCM data out	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
8	PCM_CLK	O	PCM clock	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-

The ME909s LGA PCM interface enables communication with an external codec to support linear format.

Figure 3-20 Circuit diagram of the interface of the PCM (ME909s LGA module is used as PCM master)

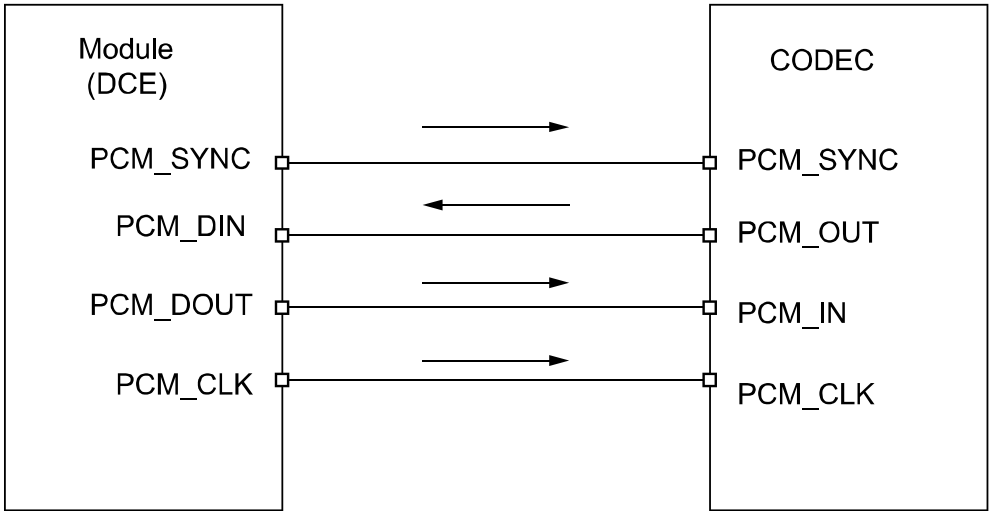
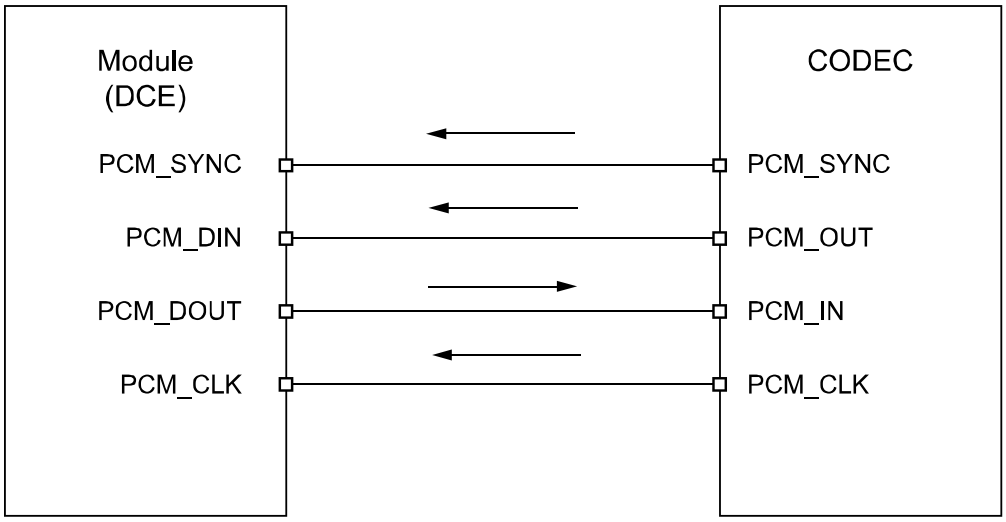


Figure 3-21 Circuit diagram of the interface of the PCM (ME909s LGA module is used as PCM slave)



NOTE

- The signal level of CODEC must match that of the module.
- ME909s LGA module supports both master and slave mode.
- PCM_CLK: Output when PCM is in master mode; Input when PCM is in slave mode.
- PCM_SYNC: Output when PCM is in master mode; Input when PCM is in slave mode.
- It is recommended that a TVS be used on the related interface, to prevent electrostatic discharge and protect integrated circuit (IC) components.

3.9 GPIO Interface

The ME909s LGA module provides GPIO pins for customers to use as 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 GPIO output signal. See the *HUAWEI ME909s Series LTE Module AT Command Interface Specification*.

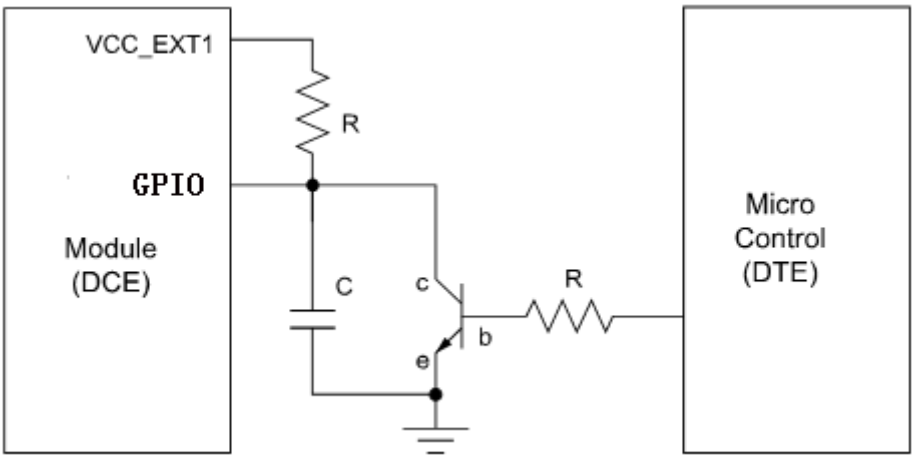
Table 3-13 Signals on the GPIO interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
55	GPIO5/USIM Switch	I/O	General Purpose I/O pins (Default) or USIM Switch control signal.	V_{OH}	1.35	1.8	1.98	The function of this pin can be defined as GPIO or USIM Switch, while the USIM Switch should be enabled by AT command.
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
113	GPIO3	I/O	General Purpose I/O	V_{OH}	1.35	1.8	1.98	The function of

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			pins (Default)	V_{OL}	0	-	0.45	these pins has not been defined.
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
51	GPIO2	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
105	GPIO1	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
109	GPIO4	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
43	GPIO1	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	
46	GPIO2	I/O	General Purpose I/O pins.	V_{OH}	1.35	1.8	1.98	
				V_{OL}	0	-	0.45	
				V_{IH}	1.17	1.8	1.98	
				V_{IL}	–0.3	-	0.63	

When the GPIO interface is used for input, the module will not respond in sleep mode (it will resume response after being waken up from sleep mode by the WAKEUP_IN pin) and the module is configured to pull-down inside. In sleep mode, the pull-down resistance is 5 kΩ–15 kΩ. For the peripheral circuits, see Figure 3-22 .

Figure 3-22 Reference peripheral circuits when the GPIO interface is used for input



When the GPIO interface is used for output and the module is not in sleep mode, the drive current is 4 mA. When the module is in sleep mode, the drive current is smaller than 0.1 mA. The resistance is maintained at 5 kΩ–15 kΩ, as shown in Figure 3-23 . The output level may be changed if there is a stronger pull-up or pull-down. For the peripheral circuits, see Figure 3-24 .

Figure 3-23 Maintaining the resistance in sleep mode

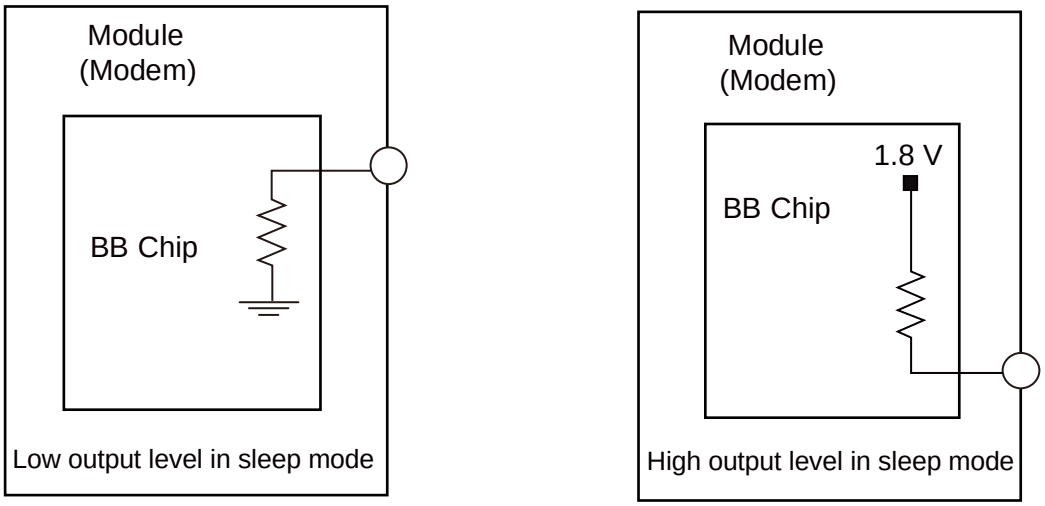
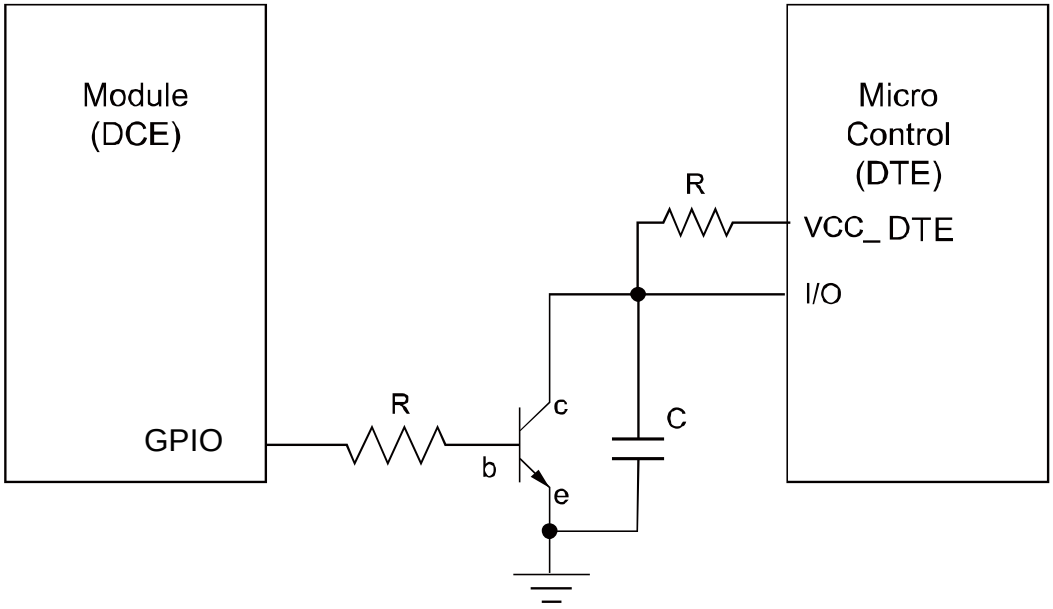


Figure 3-24 Reference peripheral circuits when the GPIO interface is used for output



3.10 ADC Interface

The ME909s LGA module provides two ADC interfaces. Customers can query their voltage through AT^ADCREADEX command. For details, you can see *HUAWEI ME909s Series LTE Module AT Command Interface Specification*.

Table 3-14 Signals on the ADC interface

PIN No.	Pin Name	Pad Type	Description	Min. (V)	Typ. (V)	Max. (V)	Comments
102	ADC_1	AI	Conversion interface for analog signals to digital signals	0	-	2.5	-
104	ADC_2	AI	Conversion interface for analog signals to digital signals	0	-	2.5	-

3.11 JTAG Interface

The ME909s LGA module provides Joint Test Action Group (JTAG) interface. Table 3-15 shows the signals on the JTAG interface. It is recommended that route out the 6 pins as test points on the DTE for tracing and debugging.

Table 3-15 Signals on the JTAG interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
30	JTAG_TMS	I	JTAG test mode select	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
36	JTAG_TRST_N	I	JTAG reset	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
42	JTAG_TCK	I	JTAG clock input	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
72	JTAG_TDO	O	JTAG test data output	V_{OH}	1.35	1.8	1.98	-
				V_{OL}	0	-	0.45	-
87	JTAG_TDI	I	JTAG test data input	V_{IH}	1.17	1.8	1.98	-
				V_{IL}	–0.3	-	0.63	-
93	JTAG_RTCK	O	JTAG return clock, Pin for trace connection, it is a reserved test point for customers.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-

3.12 RF Antenna Interface

The ME909s LGA module provides two antenna pads (MAIN_ANT and AUX_ANT) for connecting the external antennas.

Table 3-16 Definition of the antenna pads

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
107	MAIN_ANT	-	RF MAIN antenna pad	-	-	-	-	-
115	AUX_ANT	-	RF AUX antenna pad	-	-	-	-	-

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

Figure 3-25 RF signal trace design about MAIN_ANT for reference (the same for AUX_ANT)

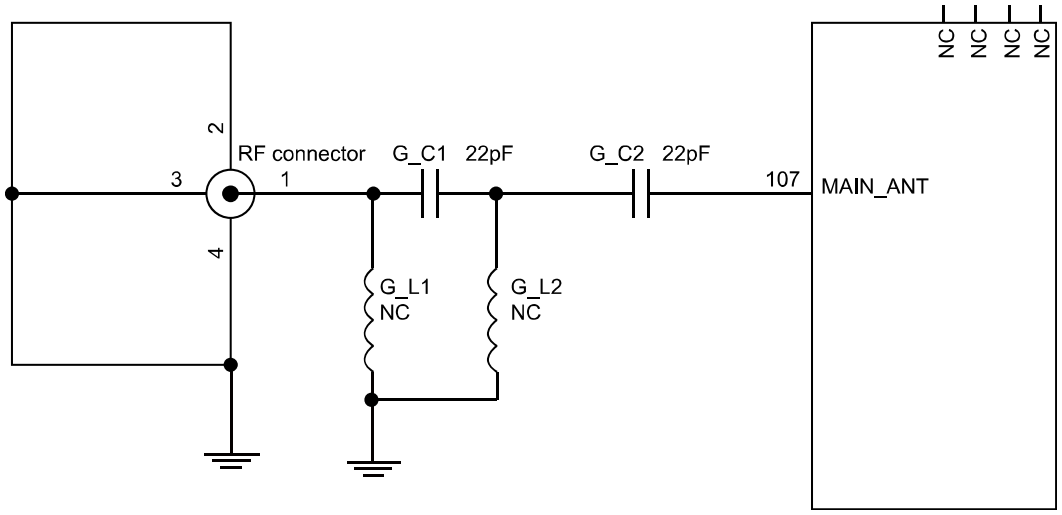
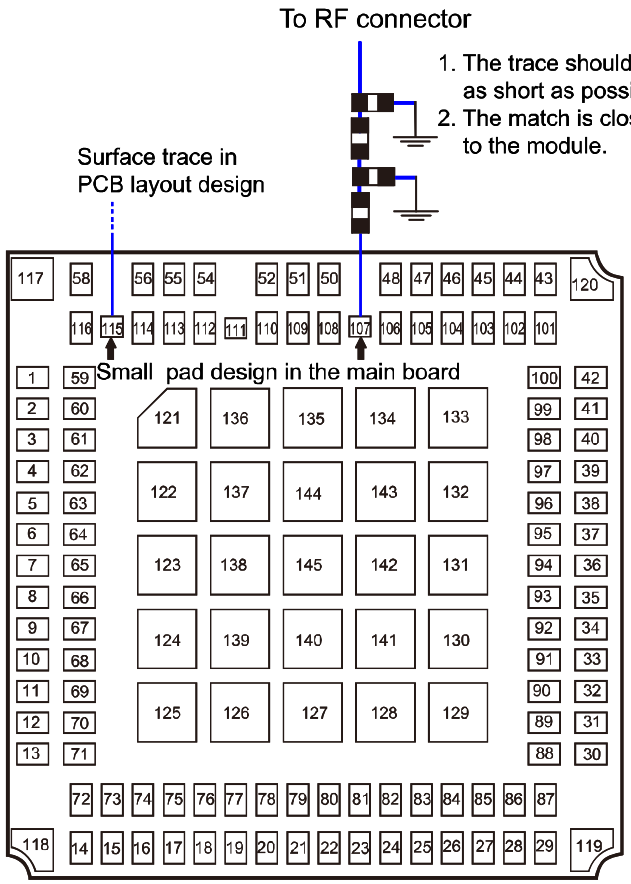


Figure 3-26 RF signal layout design about MAIN_ANT for reference (the same for AUX_ANT)



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 Ω as well as the reference design for stack.

Figure 3-27 Complete structure of the microstrip

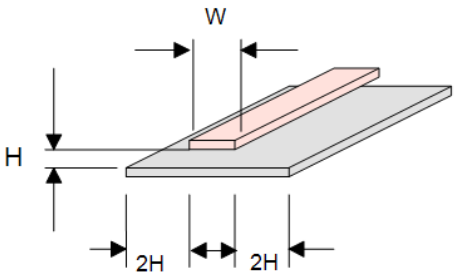


Figure 3-28 Complete structure of the stripline

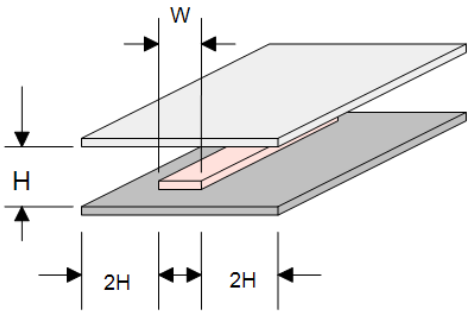


Figure 3-29 Pad for the RF interface

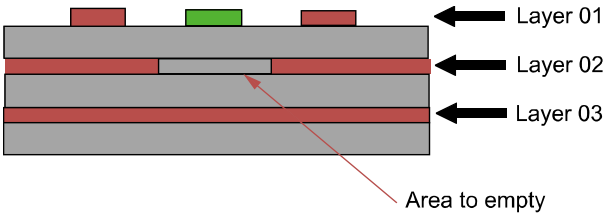
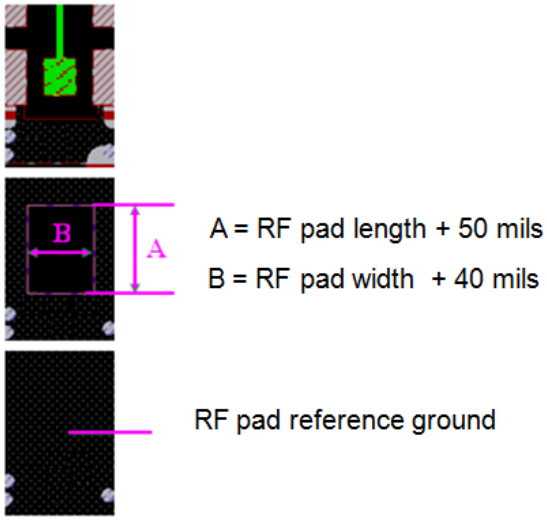


Figure 3-30 RF Pad design for ME909s LGA



Please use impedance simulation tool to calculate RF MAIN pad impedance. The RF MAIN pad dimension of the module 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.

3.13 Reserved Interface

The ME909s LGA module provides some reserved pins. All reserved pins cannot be used by the customer.

Table 3-17 Reserved pin

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
1-4,14, 16-24, 27, 31, 33, 35, 37, 44, 45, 60–65, 91, 94–99 and 103	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-

3.14 NC Interface

The ME909s LGA module provides some NC pins. All NC pins should not be connected. Please keep these pins open.

Table 3-18 NC pin

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
25, 26, 38–41, 47, 82–84, 111, 117–120	NC	-	Not connected	-	-	-	-	-

3.15 Test Points Design

In the process of debugging when the module is embedded into the integrated equipment, test points play an important role. Some problems related to the module can be quickly resolved when test points are properly designed.

1. **The test points below must be designed in the customer board**:
   - JTAG test points: It is the most common method of debugging.
   - USB test points: USB is the most important communication channel between module and AP (host). Not only test points should be placed, but also a 0 ohm series resistor should be placed on USB_D+/USB_D- signal. The resistor can be welded off when necessary, then the USB of module is cut off from AP and can be connected to PC to do some analyses.
   - POWER_ON_OFF, RESIN_N: They are some of the most important signals, test points should be placed.
   - UART2: UART2 is used for printing the log information.
   - SD signals: SD signals are used for debugging.
   - VBAT: Not only test points should be placed, but also a series magnetic bead should be placed on VBAT signal. The magnetic bead can be welded off when necessary, then the power of module is cut off from customer board and can be connected to external power to do analyses about problems related to power interference.
   - VCC_EXT1: to judge whether the module is powered on or not, just test the VCC_EXT1.
2. **The test points below should be placed according to the requirement in the customer board:** ADC, SLEEP_STATUS, GPIO, PCM, SIM, UART2, WAKEUP_IN and WAKEUP_OUT, except the two cases below:
   - The corresponding signal is not used.
   - The corresponding signal is used, but there is already someplace else can be tested, such as SIM socket pin.

4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the ME909s LGA module, including:

- Operating Frequencies
- Conducted RF Measurement
- Conducted Rx Sensitivity and Tx Power
- Antenna Design Requirements
- Suggestions about LTE and 2.4 GHz Wi-Fi Co-existence

4.2 Operating Frequencies

Table 4-1 and Table 4-2 show the RF bands supported by ME909s LGA module.

Table 4-1 RF bands of the ME909s-821 LGA module

Operating Band	Tx	Rx
UMTS Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band 5	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band 8	880 MHz–915 MHz	925 MHz–960 MHz
UMTS Band 9	1749.9 MHz–1784.9 MHz	1844.9 MHz–1879.9 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band 3	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 8	880 MHz–915 MHz	925 MHz–960 MHz
LTE Band 38	2570 MHz–2620 MHz	2570 MHz–2620 MHz
LTE Band 39	1880 MHz–1920 MHz	1880 MHz–1920 MHz

Operating Band	Tx	Rx
LTE Band 40[1]	2300 MHz–2400 MHz	2300 MHz–2400 MHz
LTE Band 41[2]	2496 MHz–2690 MHz	2496 MHz–2690 MHz
TD-SCDMA Band 34	2010 MHz–2025 MHz	2010 MHz–2025 MHz
TD-SCDMA Band 39	1880 MHz–1920 MHz	1880 MHz–1920 MHz

NOTE

- [1]: The module may not meet the RF performance requirements at frequency 2390–2400 MHz in the LTE B40 band.
- [2]: The module may not meet the RF performance requirements at frequency 2496–2555 MHz or 2655–2690 MHz in the LTE B41 band.

Table 4-2 RF bands of the ME909s-120 LGA module

Operating Band	Tx	Rx
UMTS Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
UMTS Band 5	824 MHz–849 MHz	869 MHz–894 MHz
UMTS Band 8	880 MHz–915 MHz	925 MHz–960 MHz
GSM 850	824 MHz–849 MHz	869 MHz–894 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800	1710 MHz–1785 MHz	1805 MHz–1880 MHz
GSM 1900	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band 1	1920 MHz–1980 MHz	2110 MHz–2170 MHz
LTE Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
LTE Band 3	1710 MHz–1785 MHz	1805 MHz–1880 MHz
LTE Band 4	1710 MHz–1755 MHz	2110 MHz–2155 MHz
LTE Band 5	824 MHz–849 MHz	869 MHz–894 MHz
LTE Band 7	2500 MHz–2570 MHz	2620 MHz–2690 MHz
LTE Band 8	880 MHz–915 MHz	925 MHz–960 MHz
LTE Band 20	832 MHz–862 MHz	791 MHz–821 MHz

4.3 Conducted RF Measurement

4.3.1 Test Environment

Test instrument	R&S CMU200, R&S CMW500, Agilent E5515C, Starpoint SP6010
Power supply	KEITHLEY 2306; Aglient66319D
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 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 ME909s LGA module.

Table 4-3 and Table 4-4 list the typical tested values of the ME909s LGA module.

Table 4-3 ME909s-821 LGA module conducted Rx sensitivity

Band	Test Value (Unit: dBm)	Note
GSM 900	–109	BER Class II < 2.44%
GSM 1800	–107	BER Class II < 2.44%
UMTS Band 1	–110.5	BER < 0.1%
UMTS Band 5	–110.5	BER < 0.1%
UMTS Band 8	–110.5	BER < 0.1%
UMTS Band 9	–110.5	BER < 0.1%
LTE Band 1	–103	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 3	–102.5	FDD QPSK throughput > 95%, 10 MHz Bandwidth

Band	Test Value (Unit: dBm)	Note
LTE Band 8	–102.5	FDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 38	–101.5	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 39	–102	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 40	–101	TDD QPSK throughput > 95%, 10 MHz Bandwidth
LTE Band 41	–101	TDD QPSK throughput > 95%, 10 MHz Bandwidth
TD-SCMDA Band 34	–112	BER < 0.1%
TD-SCMDA Band 39	–112.5	BER < 0.1%

Table 4-4 ME909s-120 LGA module conducted Rx sensitivity

Band	Test Value (Unit: dBm)	Note
GSM 850	–109	BER Class II < 2.44%
GSM 900	–109	BER Class II < 2.44%
GSM 1800	–108.5	BER Class II < 2.44%
GSM 1900	–109	BER Class II < 2.44%
UMTS Band 1	–111.5	BER < 0.1%
UMTS Band 2	–111.5	BER < 0.1%
UMTS Band 5	–111.5	BER < 0.1%
UMTS Band 8	–111.5	BER < 0.1%
LTE Band 1	–102.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 2	–102.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 3	–102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 4	–102	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 5	–102.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 7	–102.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 8	–102.5	Throughput ≥ 95%, 10 MHz Bandwidth
LTE Band 20	–102.5	Throughput ≥ 95%, 10 MHz Bandwidth

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 ME909s LGA 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 4-5 and Table 4-6 list the required ranges of the conducted transmit power of ME909s LGA module.

Table 4-5 ME909s-821 LGA module conducted Tx power

Band		Typical Value (Unit: dBm)	Note (Unit: dB)
GSM 900	GMSK (1Tx Slot)	32.5	±1.5
	8PSK (1Tx Slot)	27	±1.5
GSM 1800	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	26	±1.5
UMTS Band 1		23.5	±1
UMTS Band 5		23.5	±1
UMTS Band 8		23.5	±1
UMTS Band 9		23.5	±1
TD-SCDMA Band 34		23.5	±1
TD-SCDMA Band 39		23.5	±1
TDD LTE Band 38		23	±1.5
TDD LTE Band 39		23	±1.5
TDD LTE Band 40		23	±1.5
TDD LTE Band 41		23	±1.5
FDD LTE Band 1		23	±1.5
FDD LTE Band 3		23	±1.5
FDD LTE Band 8		23	±1.5

Table 4-6 ME909s-120 LGA module conducted Tx power

Band		Typical Value (Unit: dBm)	Note (Unit: dB)
GSM 850	GMSK (1Tx Slot)	32.5	±1.5

Band		Typical Value (Unit: dBm)	Note (Unit: dB)
	8PSK (1Tx Slot)	27	±1.5
GSM 900	GMSK (1Tx Slot)	32.5	±1.5
	8PSK (1Tx Slot)	27	±1.5
GSM 1800	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	26	±1.5
GSM 1900	GMSK (1Tx Slot)	29.5	±1.5
	8PSK (1Tx Slot)	26	±1.5
UMTS Band 1		23.5	±1
UMTS Band 2		23.5	±1
UMTS Band 5		23.5	±1
UMTS Band 8		23.5	±1
LTE Band 1		23	±1.5
LTE Band 2		23	±1.5
LTE Band 3		23	±1.5
LTE Band 4		23	±1.5
LTE Band 5		23	±1.5
LTE Band 7		23	±1.5
LTE Band 8		23	±1.5
LTE Band 20		23	±1.5

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

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 ME909s LGA 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 ME909s LGA to ensure high radio performance of the module:

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

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

S11 (VSWR）

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

The following S11 value is recommended for the antenna of ME909s LGA module:

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

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

Isolation

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

Antenna isolation depends on the following factors:

- Distance between antennas
- Antenna type
- Antenna direction

The primary antenna must be placed as near as possible to the ME909s LGA to minimize the cable length. The diversity antenna needs to be installed perpendicularly to the primary antenna. The diversity antenna can be placed farther away from the ME909s LGA. Antenna isolation can be measured with a two-port vector network analyzer.

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

- **Isolation between the primary and diversity antennas: ≤ –12 dB**
- **Isolation between the primary (diversity) antenna and the Wi-Fi antenna: ≤ –15 dB**

Polarization

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

The linear polarization is recommended for the antenna of ME909s LGA.

Radiation Pattern

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

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

The following radiation patterns are recommended for the antenna of ME909s LGA.
Primary/diversity antenna: omnidirectional

In addition, the diversity 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 ME909s LGA.

Gain of the primary/diversity antenna ≤ 2.5 dBi

ECC of the Antenna

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

The following ECC is recommended for ME909s LGA module.

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

NOTE

- The antenna consists of the antenna body and the relevant RF transmission 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 line 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 ME909s LGA module must fulfill the following requirements:

Table 4-7 ME909s LGA module antenna requirements

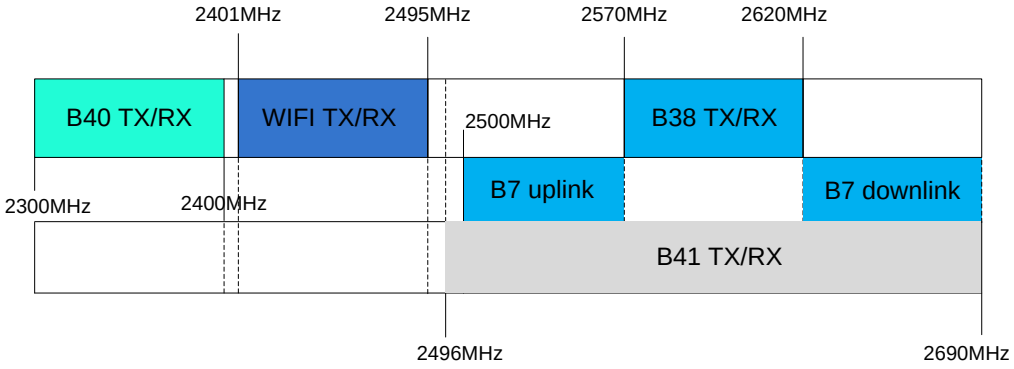
Antenna Requirements	
Frequency range	Depending on frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)
Bandwidth of primary antenna	**ME909s-821** 250 MHz in UMTS Band 1; LTE Band 1 170 MHz in GSM 1800; LTE Band 3 70 MHz in UMTS Band 5; 80 MHz in GSM 900; UMTS Band 8; LTE Band 8 130 MHz in UMTS Band 9 50 MHz in LTE Band 38 40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41 15 MHz in TD-SCDMA Band 34 40 MHz in TD-SCDMA Band 39 **ME909s-120** 250 MHz in UMTS Band 1; LTE Band 1 140 MHz in GSM 1900; UMTS Band 2; LTE Band 2 170 MHz in GSM 1800; LTE Band 3

Antenna Requirements	
	445 MHz in LTE Band 4 70 MHz in GSM 850; UMTS Band 5; LTE Band 5 190MHz in LTE Band 7 80 MHz in GSM 900; UMTS Band 8; LTE Band 8 71 MHz in LTE Band 20
Bandwidth of secondary antenna	**ME909s-821** 60 MHz in UMTS Band 1; LTE Band 1 75 MHz in LTE Band 3 25 MHz in UMTS Band 5 35 MHz in UMTS Band 8; LTE Band 8 30 MHz in UMTS Band 9 50 MHz in LTE Band 38 40 MHz in LTE Band 39 100 MHz in LTE Band 40 194 MHz in LTE Band 41 **ME909s-120** 60 MHz in UMTS Band 1; LTE Band 1 60 MHz in UMTS Band 2; LTE Band 2 75 MHz in LTE Band 3 45 MHz in LTE Band 4 25 MHz in UMTS Band 5; LTE Band 5 70 MHz in LTE Band 7 35 MHz in UMTS Band 8; LTE Band 8 30 MHz in LTE Band 20
Gain	≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max	≤ 3:1
VSWR recommended	≤ 2:1

4.6 Suggestions about LTE and 2.4 GHz Wi-Fi Co-existence

4.6.1 Theory Analysis

The band gap between LTE Band 38/40/41 and Wi-Fi (2.4 G) is very narrow just as shown as below.



The two systems interfere with each other because of nonlinear characteristic of LTE Band 38/40/41 and Wi-Fi transmitter. The main impacts are as follows:

1. LTE Band transmitter spurious in Wi-Fi Band impacts on the sensitivity of Wi-Fi receiver.
2. LTE Band output power can block Wi-Fi receiver.
3. Wi-Fi transmitter spurious in LTE Band impacts on the sensitivity of LTE Bands.
4. Wi-Fi output power can block LTE Band receiver.

According to the theoretical analysis, in order to achieve the co-existence between Wi-Fi and LTE, the rejection between Wi-Fi and LTE Band 41 or Band 40 needs to be over 60 dB. (The analysis is based on the Wi-Fi chip Broadcom BCM432XX, the co-existence design depends on the customer's Wi-Fi chipset specification.)

NOTE
In fact, the current devices cannot meet this requirement, so we need to increase the isolation between antennas and disable some channels.

4.6.2 Suggestions about the Interference

These risks have been taken into consideration in the design of the ME909s LGA module. The system design also should be paid attention:

1. It is recommended that the system should be added Wi-Fi SAW filter to guarantee good attenuation in the LTE transmit Band (including Band 38, Band 40, Band 41), otherwise, LTE Band output power will block Wi-Fi receiver.
2. The good isolation between LTE antenna and Wi-Fi antenna is more than 25 dB.
3. Two ways above can help to make the isolation to be 60 dB. If they are still not enough, some channels may need to be disabled.

5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features in the ME909s LGA module, including:

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

5.2 Absolute Ratings

WARNING

Table 5-1 lists the absolute ratings for the ME909s LGA module. Using the ME909s LGA module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings

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

5.3 Operating and Storage Temperatures

Table 5-2 lists the operating and storage temperatures for the ME909s LGA module.

Table 5-2 Operating and storage temperatures

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

NOTE
[1]: When the ME909s LGA module works in the range from –40°C to –30°C or +75°C to +85°C, **NOT** all their RF performances comply with 3GPP specifications.

5.4 Power Supply Features

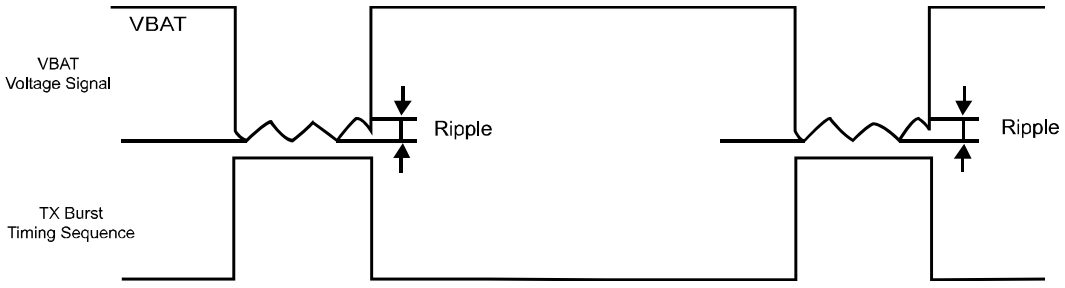
5.4.1 Input Power Supply

Table 5-3 lists the requirements for input power of the ME909s LGA module.

Table 5-3 Requirements for input power

Parameter	Min.	Typ.	Max.	Ripple	Unit
VBAT	3.2	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 2.75 A Peak in GPRS or GSM mode).

Table 5-4 Requirements for input current

Power	Peak (GSM 1 slot)	Normal (WCDMA)	Normal (LTE 23 dbm)
VBAT	2750 mA	1100 mA	1100 mA

5.4.2 Power Consumption

The power consumptions of ME909s LGA module in different scenarios are respectively listed in Table 5-5 to Table 5-11 .

The power consumption listed in this section is tested when the power supply of ME909s LGA module is 3.8 V, and all of test values are measured at room temperature.

Table 5-5 Averaged power off DC power consumption

Description	Test Value (Unit: μA)	Notes/Configuration
	Typical	
Power off	65	Normal voltage (3.8 V) is ON while power on event is not triggered.

Table 5-6 Averaged standby DC power consumption of ME909s-821 LGA module

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Sleep	LTE	LTE bands	1.9	Module is powered up. Paging cycle=256 (2.56s) Module is registered on the network. USB is in suspend
	TD-SCDMA	TD-SCDMA bands	2.5	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend
	HSPA+/WCDMA	UMTS bands	1.7	Module is powered up DRX cycle=8 (1.28s) Module is registered on the network. USB is in suspend
	GPRS/EDGE	GSM bands	2.1	Module is powered up MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Idle	LTE	LTE bands	48	Module is powered up. Paging cycle=256 (2.56s) Module is registered on the network, no data is transmitted. USB is in active.
	TD-SCDMA	TD-SCDMA bands	50	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in active
	HSPA+/WCDMA	UMTS bands	55	Module is powered up DRX cycle=8 (1.28s) Module is registered on the network, no data is transmitted USB is in active.
	GPRS/EDGE	GSM bands	55	Module is powered up MFRMS=5 (1.175s) Module is registered on the network, no data is transmitted USB is in active.

Table 5-7 Averaged standby DC power consumption of ME909s-120 LGA module

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
Sleep	LTE	LTE bands	1.85	Module is powered up. Paging cycle=256 (2.56s) Module is registered on the network. USB is in suspend.
	HSPA/WCDMA	UMTS bands	1.5	Module is powered up DRX cycle=8 (1.28s) Module is registered on the network. USB is in suspend.

Description		Bands	Test Value (Unit: mA)	Notes/Configuration
			Typical	
	GPRS/EDGE	GSM bands	1.87	Module is powered up MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
Idle	LTE	LTE bands	48	Module is powered up. Paging cycle=256 (2.56s) Module is registered on the network, no data is transmitted. USB is in active.
	HSPA/WCDMA	UMTS bands	47	Module is powered up DRX cycle=8 (1.28s) Module is registered on the network, no data is transmitted USB is in active.
	GPRS/EDGE	GSM bands	48	Module is powered up MFRMS=5 (1.175s) Module is registered on the network. no data is transmitted USB is in active.

Table 5-8 Averaged Data Transmission DC power consumption of ME909s-821 LGA module (LTE/HSPA/WCDMA/TD-SCDMA)

Description	Band	Test Value (Unit: mA)	Notes/Configuration
		Typical	
WCDMA	Band 1 (IMT 2100)	188	0 dBm Tx Power
		216	10 dBm Tx Power
		603	23.5 dBm Tx Power
	Band 5 (850MHz)	181	0 dBm Tx Power
		199	10 dBm Tx Power
		501	23.5 dBm Tx Power
	Band 8	188	0 dBm Tx Power

Description	Band	Test Value (Unit: mA)	Notes/Configuration
		Typical	
	(900 MHz)	207	10 dBm Tx Power
		504	23.5 dBm Tx Power
	Band 9 (J1700)	212	0 dBm Tx Power
		289	10 dBm Tx Power
		719	23.5 dBm Tx Power
HSPA	Band 1 (IMT 2100)	179	0 dBm Tx Power
		213	10 dBm Tx Power
		578	23.5 dBm Tx Power
	Band 5 (850MHz)	172	0 dBm Tx Power
		189	10 dBm Tx Power
		439	23.5 dBm Tx Power
	Band 8 (900 MHz)	177	0 dBm Tx Power
		201	10 dBm Tx Power
		489	23.5 dBm Tx Power
	Band 9 (J1700)	221	0 dBm Tx Power
		300	10 dBm Tx Power
		743	23.5 dBm Tx Power
TDD LTE	Band 38	195	0 dBm Tx Power
		242	10 dBm Tx Power
		400	23 dBm Tx Power
	Band 39	182	0 dBm Tx Power
		213	10 dBm Tx Power
		273	23 dBm Tx Power
	Band 40	195	0 dBm Tx Power
		242	10 dBm Tx Power
		438	23 dBm Tx Power
	Band 41	195	0 dBm Tx Power
		246	10 dBm Tx Power
		405	23 dBm Tx Power
FDD LTE	Band 1	263	0 dBm Tx Power

Description	Band	Test Value (Unit: mA)	Notes/Configuration
		Typical	
		315	10 dBm Tx Power
		623	23 dBm Tx Power
	Band 3	268	0 dBm Tx Power
		338	10 dBm Tx Power
		807	23 dBm Tx Power
	Band 8	264	0 dBm Tx Power
		298	10 dBm Tx Power
		520	23 dBm Tx Power
TD-SCDMA	Band 34	84	0 dBm Tx Power
		87	10 dBm Tx Power
		132	23 dBm Tx Power
	Band 39	95	0 dBm Tx Power
		101	10 dBm Tx Power
		133	23 dBm Tx Power

Table 5-9 Averaged Data Transmission DC power consumption of ME909s-120 LGA module (WCDMA/HSDPA/LTE)

Description	Band	Test Value (Unit: mA)	Notes/Configuration
		Typical	
WCDMA	Band 1 (IMT 2100)	190	0 dBm Tx Power
		225	10 dBm Tx Power
		690	23.5 dBm Tx Power
	Band 2 (PCS 1900)	187	0 dBm Tx Power
		220	10 dBm Tx Power
		670	23.5 dBm Tx Power
	Band 5 (850 MHz)	180	0 dBm Tx Power
		215	10 dBm Tx Power
		555	23.5 dBm Tx Power
	Band 8	185	0 dBm Tx Power

Description	Band	Test Value (Unit: mA)	Notes/Configuration
		Typical	
	(900 MHz)	220	10 dBm Tx Power
		635	23.5 dBm Tx Power
HSDPA	Band 1 (IMT2100)	205	0 dBm Tx Power
		243	10 dBm Tx Power
		631	23.5 dBm Tx Power
	Band 2 (PCS 1900)	202	0 dBm Tx Power
		238	10 dBm Tx Power
		580	23.5 dBm Tx Power
	Band 5 (850 MHz)	200	0 dBm Tx Power
		235	10 dBm Tx Power
		535	23.5 dBm Tx Power
	Band 8 (900 MHz)	205	0 dBm Tx Power
		247	10 dBm Tx Power
		575	23.5 dBm Tx Power
LTE	Band 1	270	0 dBm Tx Power
		330	10 dBm Tx Power
		725	23 dBm Tx Power
	Band 2	275	0 dBm Tx Power
		330	10 dBm Tx Power
		715	23 dBm Tx Power
	Band 3	273	0 dBm Tx Power
		340	10 dBm Tx Power
		735	23 dBm Tx Power
	Band 4	276	0 dBm Tx Power
		340	10 dBm Tx Power
		705	23 dBm Tx Power
	Band 5	280	0 dBm Tx Power
		642	10 dBm Tx Power

Description	Band	Test Value (Unit: mA)	Notes/Configuration
		Typical	
		725	23 dBm Tx Power
	Band 7	280	0 dBm Tx Power
		340	10 dBm Tx Power
		725	23 dBm Tx Power
	Band 8	278	0 dBm Tx Power
		330	10 dBm Tx Power
		645	23 dBm Tx Power
	Band 20	280	0 dBm Tx Power
		330	10 dBm Tx Power
		665	23 dBm Tx Power

Table 5-10 Averaged DC power consumption of ME909s-821 LGA module (GPRS/EDGE)

Description	Test Value	Units	PCL	Configuration
GPRS 900	314	mA	5	1 Up/1 Down
	468			2 Up/1 Down
	627			4 Up/1 Down
	169	mA	10	1 Up/1 Down
	257			2 Up/1 Down
	430			4 Up/1 Down
GPRS 1800	190	mA	0	1 Up/1 Down
	275			2 Up/1 Down
	363			4 Up/1 Down
	107	mA	10	1 Up/1 Down
	133			2 Up/1 Down
	190			4 Up/1 Down
EDGE 900	213	mA	8	1 Up/1 Down
	292			2 Up/1 Down

Description	Test Value	Units	PCL	Configuration
	390			4 Up/1 Down
	121	mA	15	1 Up/1 Down
	157			2 Up/1 Down
	238			4 Up/1 Down
EDGE 1800	161	mA	2	1 Up/1 Down
	225			2 Up/1 Down
	295			4 Up/1 Down
	108	mA	10	1 Up/1 Down
	136			2 Up/1 Down
	194			4 Up/1 Down

Table 5-11 Averaged DC power consumption of ME909s-120 LGA module (GPRS/EDGE)

Description	Test Value	Units	PCL	Configuration
GPRS 850	307	mA	5	1 Up/1 Down
	455			2 Up/1 Down
	625			4 Up/1 Down
	172	mA	10	1 Up/1 Down
	258			2 Up/1 Down
	435			4 Up/1 Down
GPRS 900	315	mA	5	1 Up/1 Down
	445			2 Up/1 Down
	615			4 Up/1 Down
	175	mA	10	1 Up/1 Down
	257			2 Up/1 Down
	430			4 Up/1 Down
GPRS 1800	210	mA	0	1 Up/1 Down
	285			2 Up/1 Down
	380			4 Up/1 Down
	112	mA	10	1 Up/1 Down

Description	Test Value	Units	PCL	Configuration
	145			2 Up/1 Down
	195			4 Up/1 Down
GPRS 1900	230	mA	0	1 Up/1 Down
	323			2 Up/1 Down
	440			4 Up/1 Down
	115	mA	10	1 Up/1 Down
	145			2 Up/1 Down
	205			4 Up/1 Down
EDGE 850	210	mA	8	1 Up/1 Down
	295			2 Up/1 Down
	387			4 Up/1 Down
	125	mA	15	1 Up/1 Down
	165			2 Up/1 Down
	245			4 Up/1 Down
EDGE 900	205	mA	8	1 Up/1 Down
	287			2 Up/1 Down
	382			4 Up/1 Down
	125	mA	15	1 Up/1 Down
	165			2 Up/1 Down
	245			4 Up/1 Down
EDGE 1800	170	mA	2	1 Up/1 Down
	230			2 Up/1 Down
	310			4 Up/1 Down
	108	mA	10	1 Up/1 Down
	135			2 Up/1 Down
	195			4 Up/1 Down
EDGE 1900	187	mA	2	1 Up/1 Down
	248			2 Up/1 Down
	335			4 Up/1 Down
	114	mA	10	1 Up/1 Down
	145			2 Up/1 Down

Description	Test Value	Units	PCL	Configuration
	205			4 Up/1 Down

NOTE

- All power consumption test configuration can be referenced by GSM Association Official Document *TS.09: Battery Life Measurement and Current Consumption Technique*.
- LTE test condition: 10/20 MHz bandwidth, QPSK, 1 RB when testing max. Tx power and full RB when testing 0 dBm or 10 dBm.
- Test condition: For Max. Tx. power, see 4.4.2 Conducted Transmit Power, which are listed in Table 4-5 and Table 4-6 , for Max. data throughput, see 2.2 Function Overview, which are listed in Table 2-1 .

5.5 Reliability Features

Table 5-12 lists the test conditions and results of the reliability of the ME909s LGA module.

Table 5-12 Test conditions and results of the reliability of the ME909s LGA module

Item		Test Condition	Standard	Sample size	Results
Stress	Low-temperature storage	• Temperature: –40ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A119-C	3 pcs/group	Visual inspection: OK Function test: OK RF specification: OK
	High-temperature storage	• Temperature: 85ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A103-C	3 pcs/group	Visual inspection: OK Function test: OK RF specification: OK
	Low-temperature operating	• Temperature: –40ºC • 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: 85ºC • 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

Item		Test Condition	Standard	Sample size	Results
	Temperature cycle operating	• High temperature: 85ºC • Low temperature: –40ºC • 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: –40ºC • High temperature: 85ºC • Temperature change interval: < 30s • Operation mode: no power • Test duration: 100 cycles; 15 min+15 min/cycle	JESD22-A106-B	3 pcs/group	Visual inspection: OK Function test: OK RF specification: OK
	Salty fog test	• Temperature: 35°C • Density of the NaCl solution: 5%±1% • Operation mode: no power, no package • Test duration: Spraying interval: 8 h Exposing period after removing the salty fog environment: 16 h	JESD22-A107-B	3 pcs/group	Visual inspection: OK Function test: OK RF specification: OK

Item		Test Condition	Standard	Sample size	Results
	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.	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.	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
Life	High temperature operating life	• Temperature: 85ºC • 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

Item		Test Condition	Standard	Sample size	Results
	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
	Temperature cycle-Non operating	• High temperature: 85ºC • Low temperature: –40ºC • Temperature change slope: 6ºC/min • Operation mode: no power • Test duration: 168 cycle, 336 cycle, 500 cycle, 668cycle for inspection point	JESD22-A104-C	50 pcs/group	Visual inspection: OK Function test: OK RF specification: OK
ESD	HBM (Human Body Model)	• 1 kV (Class 1 B) • Operation mode: no power	JESD22-A114-D	3 pcs/group	Visual inspection: OK Function test: OK RF specification: OK
	ESD with DVK (or embedded in the host)	• Contact Voltage: ±2 kV, ±4 kV • Air Voltage: ±2 kV, ±4 kV, ±8 kV • Operation mode: working with service connected	IEC61000-4-2	2 pcs	Visual inspection: OK Function test: OK RF specification: OK
NOTE Groups ≥ 2					

5.6 EMC and ESD Features

The following are the EMC design comments:

- Attention should be paid to static control in the manufacture, assembly, packaging, handling and storage process to reduce electrostatic damage to HUAWEI module.

- RSE (Radiated Spurious Emission) may exceed the limit defined by EN301489 if the antenna port is protected by TVS (Transient Voltage Suppressor), which is resolved by making some 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 10nF capacitance should be added on RESIN_N and POWER_ON_OFF signal to avoid shaking, and the distance between the capacitor and the related pins should be less than 100 mil.
- A TVS should be added to the module power supply. It is recommended that the TVS's Clamping Voltage (V_{CL}) be smaller than 12 V and Peak Pulse Power (P_{PP}) at least 100 W.
- PCB routing should be V-type rather than T-type for TVS (Transient Voltage Suppressor).
- 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

HUAWEI ME909s LGA 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
- Packaging
- Customer PCB Design
- Thermal Design Solution
- 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

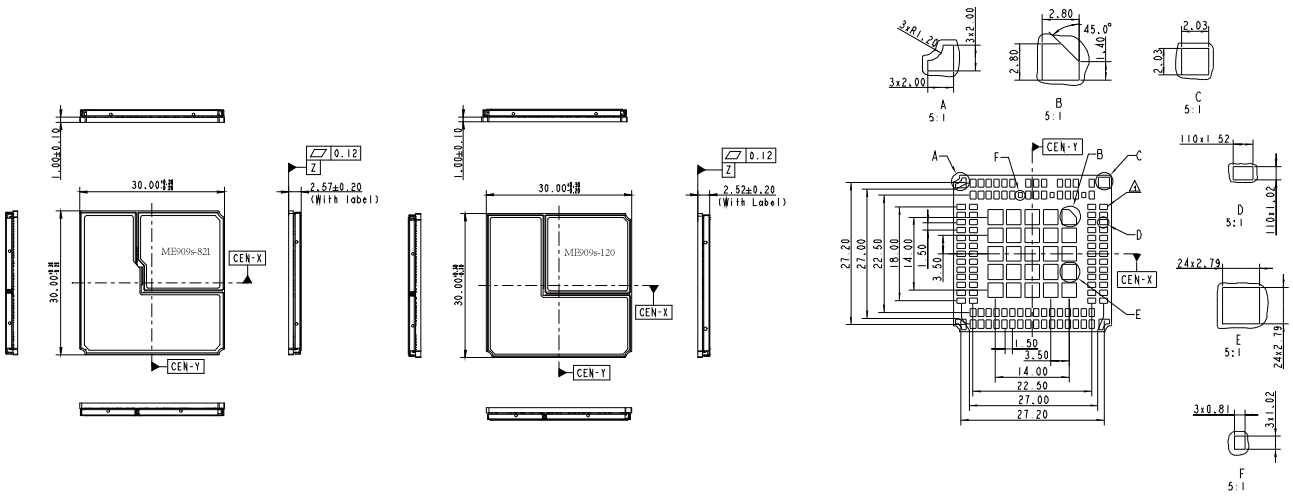
Baking Temperature	Baking Condition	Baking Duration	Remarks
125°C±5°C	Relative humidity ≤ 60%	8 hours	-

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

6.4 Dimensions

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. The tray specification complies with Jedec_Tray_DGuide4-10D.

Figure 6-2 ESD pallet (Unit: mm)

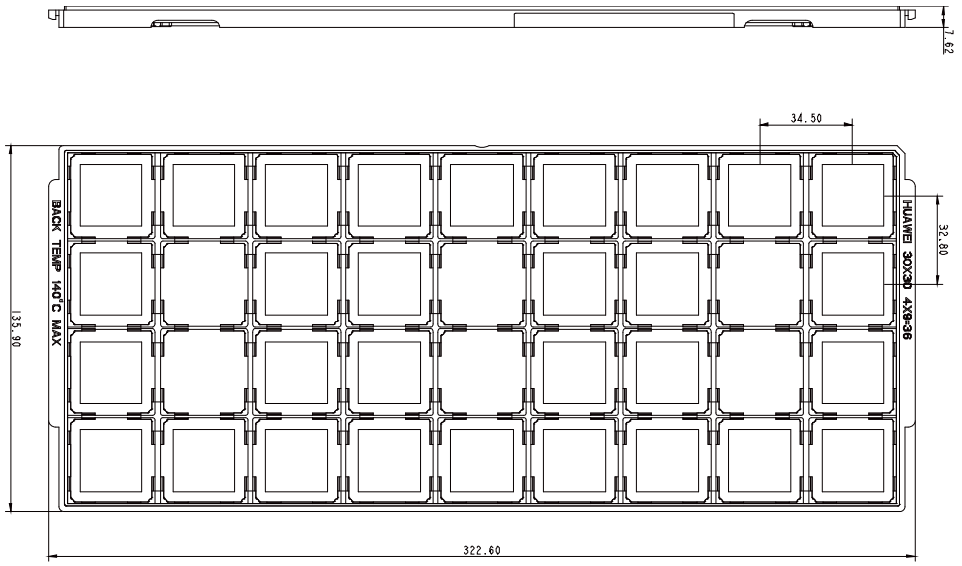
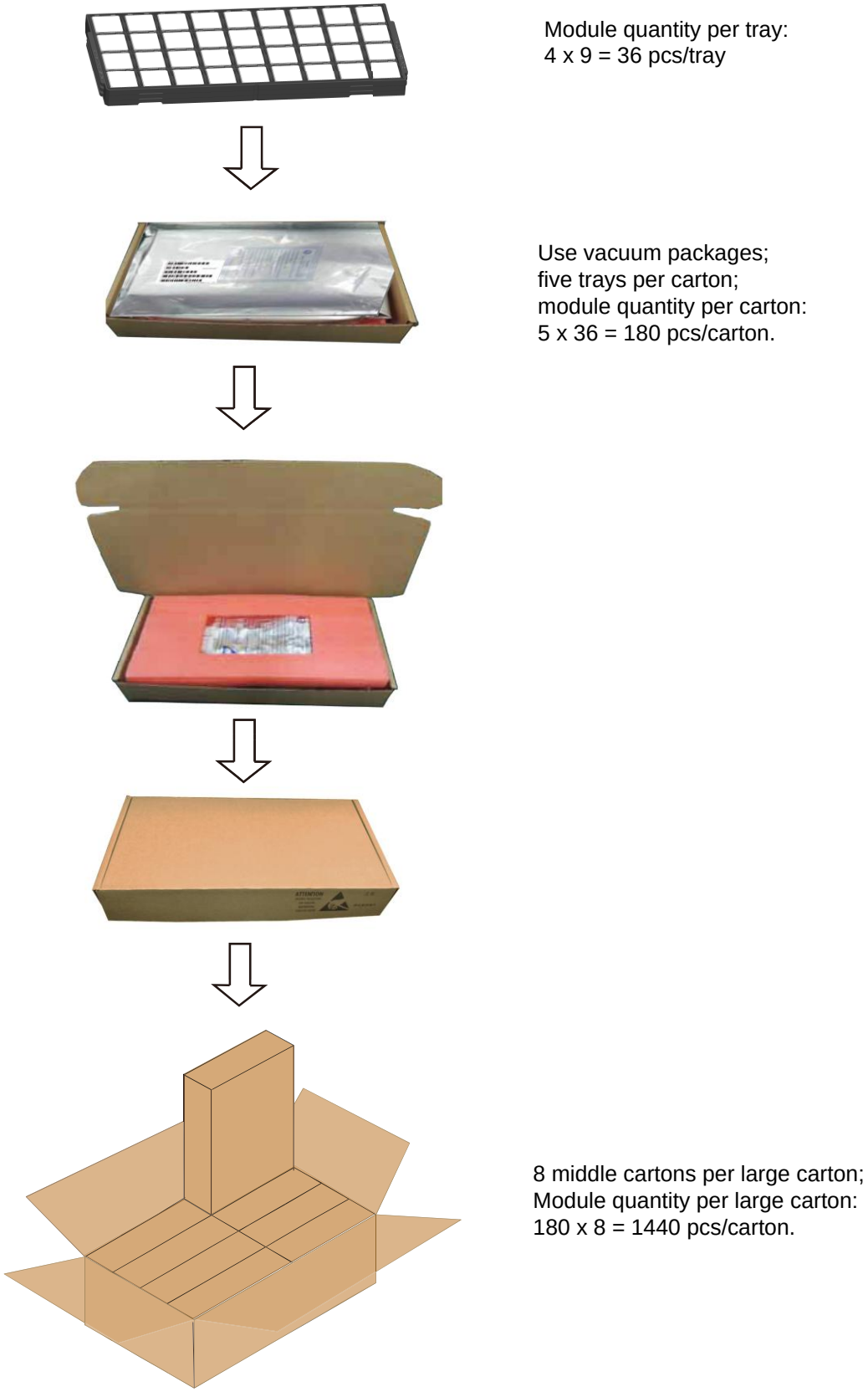


Figure 6-3 The packaging



6.6 Customer PCB Design

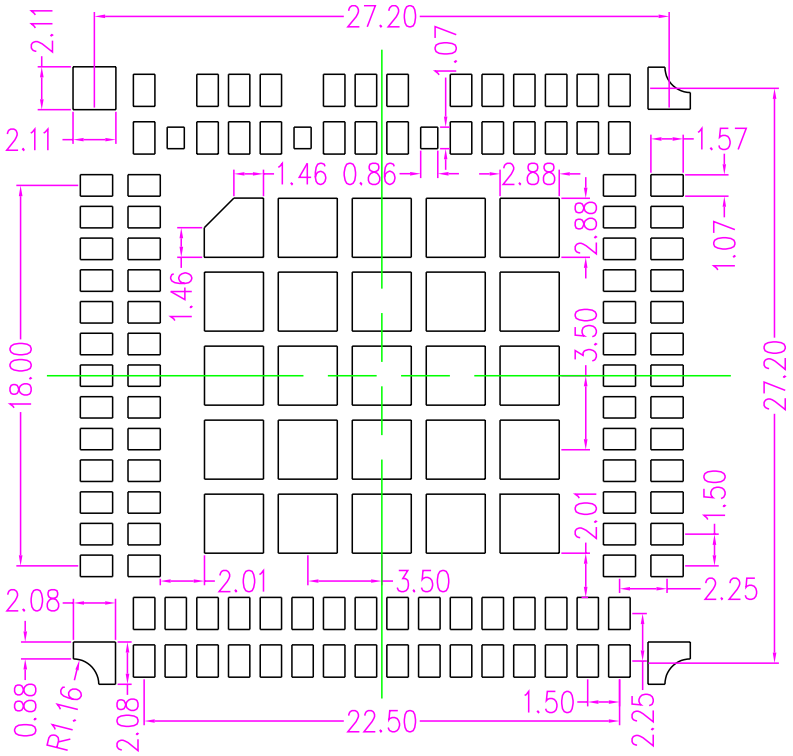
6.6.1 PCB Surface Finish

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

6.6.2 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 6-4 ME909s LGA module Footprint design (Unit: mm)



6.6.3 Solder Mask

NSMD is recommended. In addition, the solder mask of the NSMD (Non-solder Mask Defined) pad design is larger than the pad so the reliability of the solder joint can be improved.

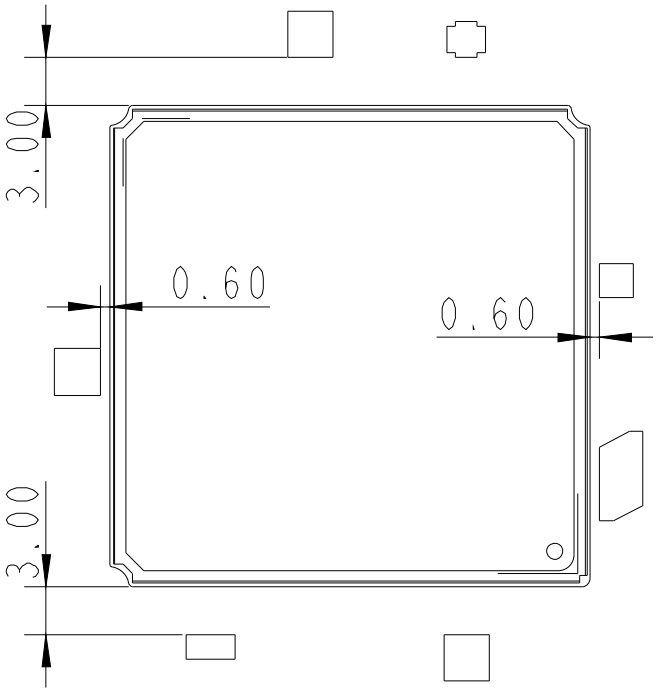
The solder mask must be 100 µm–150 µm larger than the pad, that is, the single side of the solder mask must be 50 µm–75 µm larger than the pad. The specific size depends on the processing capability of the PCB manufacturer.

6.6.4 Requirements on PCB Layout

- To reduce deformation, a thickness of at least 1.0 mm is recommended.

- Other devices must be located more than 3 mm (5 mm recommended) away from the two parallel sides of the LGA module (rework requirement), and other sides with 0.6 mm. The minimum distance between the LGA module and the PCB edge is 0.3 mm.
- When the PCB layout is double sided, the module must 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.

Figure 6-5 PCB Layout (Unit: mm)



6.7 Thermal Design Solution

When the module works in the maximum power condition, the module has high power consumption (for details, see Power Consumption). To improve the module reliability and stability, focus on the thermal design of the device to speed up heat dissipation. For thermal characteristics of the ME909s LGA module, you can refer to Operating and Storage Temperatures.

Take the following heat dissipation measures:

- The copper size on the PCB should be 70 mm x 70 mm or larger.
- All copper ground layers of the PCB must be connected to each other through via-holes.
- Increase the quantity of the PCB ground planes.
- The ground planes should be as continuous as possible.
- If a fan is deployed, place the module at the cold air inlet.
- Use heat sink, thermal conductive material and product enclosure to enhance the heat dissipation of the module.

- Use anodized heat sink on the shielding case or the customer PCB on bottom side for optimal heat dissipation. The recommended heat sink dimensions are 70 mm x 70 mm x1 mm or larger.
- The material of the heat sink should adopt the higher thermal conductivity metallic materials, e.g. Al or Cu.
- The recommended thermal conductivity of the thermal conductive material is 1.0 W/m-k or higher (recommended manufacturers: Laird or Bergquist).
- Conductive material should obey the following rule: after the heat sink is fastened to the shielding case, the compression amount of the thermal conductive material accounts for 15% to 30% of the thermal conductive material size.
- Conductive material should be as thin as possible.
- The recommended material of the enclosure is metallic materials, especially you can add pin fin on the enclosure surface.
- If the heat sink is installed above the shielding case, you should attach the thermal conductive material between the shielding case and the heat sink; if the heat sink is installed below the bottom side of the customer PCB, you should attach the thermal conductive material between the customer PCB and the heat sink, as shown in Figure 6-6 and Figure 6-7 . Preferably, we recommend the heat sink be installed below the bottom side of the customer PCB.
- Use more pin fins to enlarge heat dissipation area.

Figure 6-6 Adding heat sink to the module for optimal heat dissipation

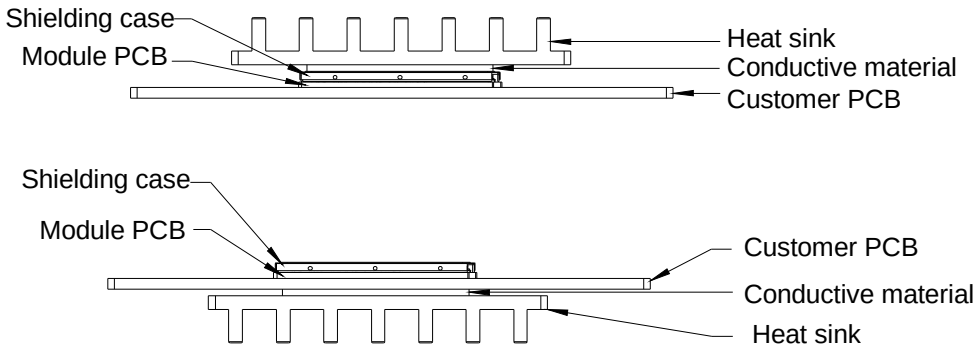
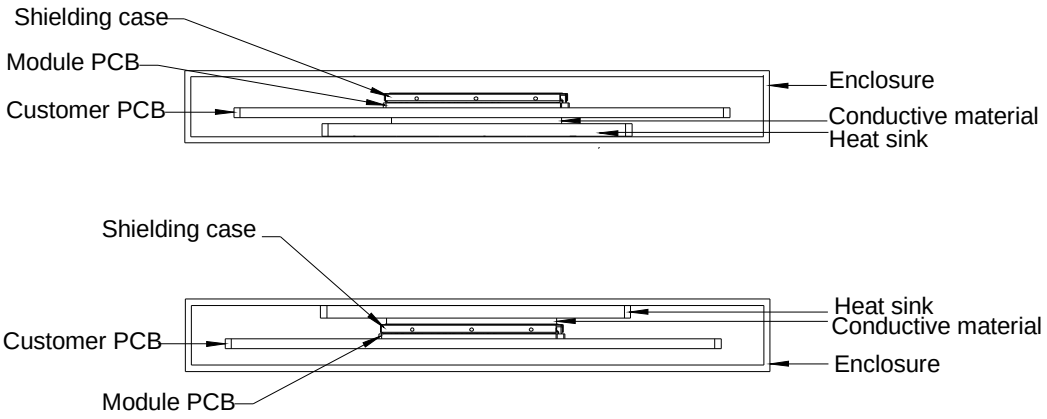


Figure 6-7 Adding enclosure to enhance the heat dissipation of the module



6.8 Assembly Processes

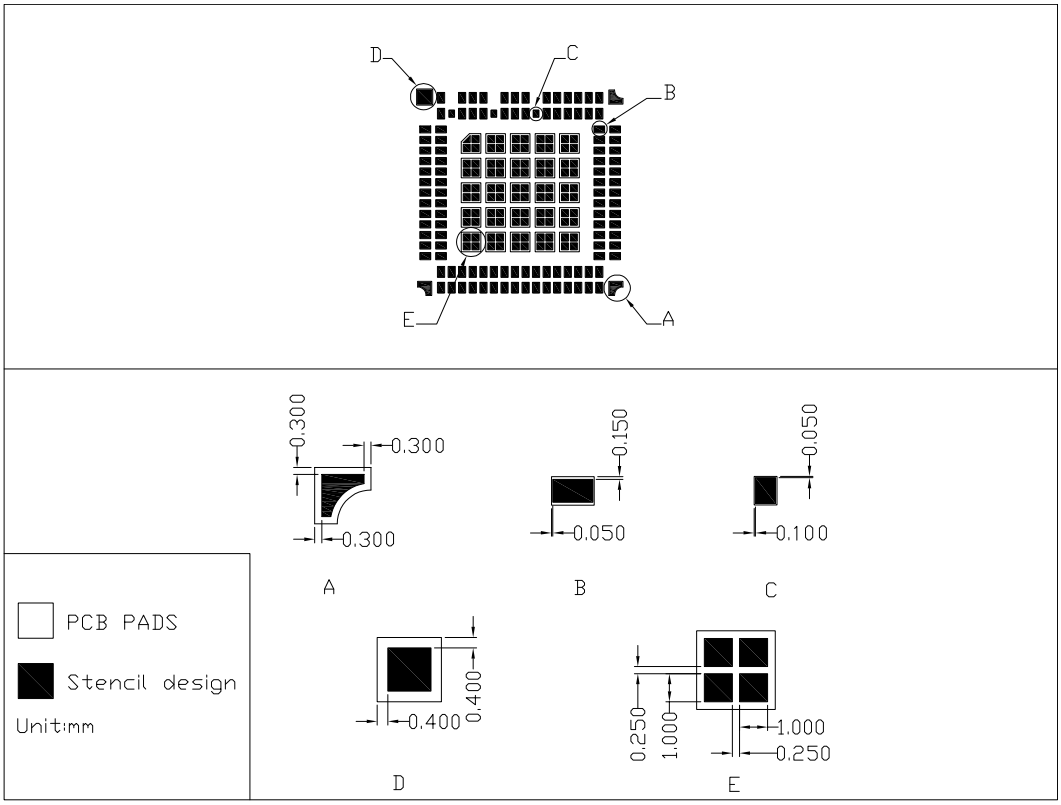
6.8.1 General Description of Assembly Processes

- 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

The LGA module must be reflowed on the top side of the customer's development board. For the soldering temperature of the LGA module, see the following figure.

Figure 6-9 Reflow profile

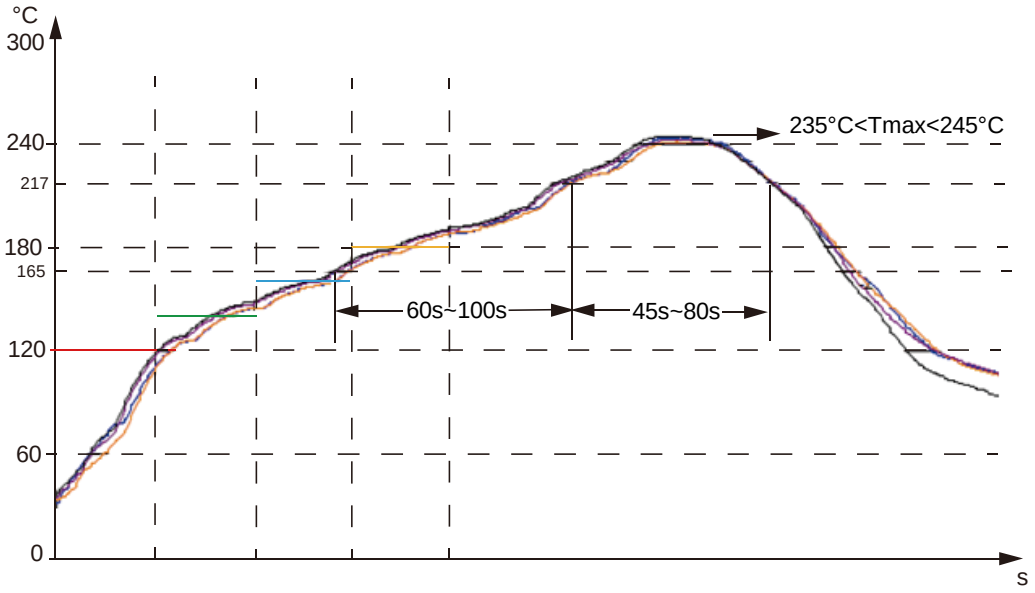
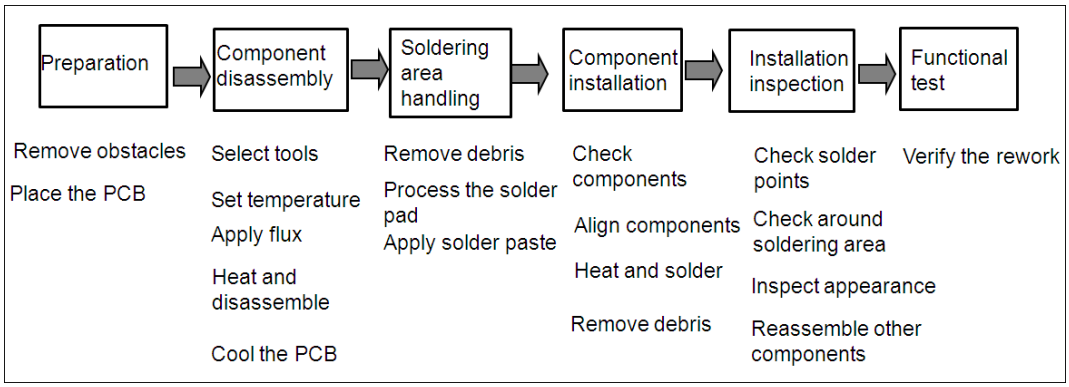


Table 6-2 Reflow parameters

Temperature Zone	Time	Key Parameter
Preheat zone (40°C–165°C)	-	Heating rate: 0.5°C/s–2°C/s
Soak zone (165°C–217°C)	(t1–t2): 60s–100s	-
Reflow zone (> 217°C)	(t3–t4): 45s–80s	Peak reflow temperature: 235°C–245°C
Cooling zone	Cooling rate: 2°C/s ≤ Slope ≤ 5°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 .

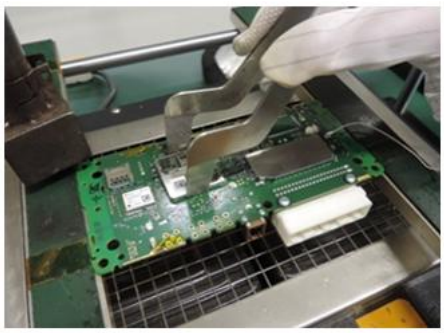
6.9.3 Removing of the Module

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.
- You must not reuse the module after disassembly from PCB during rework.
- It is proposed that a special clamp is used to remove the module.

Figure 6-10 Equipment used for rework



Remove the module by a special clamp

Hot air rework station

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

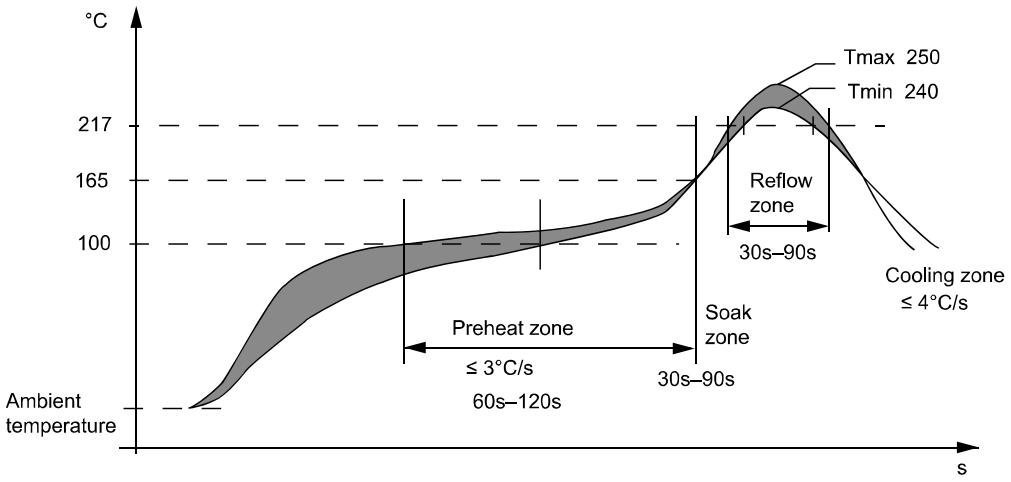
Install the module precisely on the motherboard and ensure the right installation direction of the module and the reliability of the electrical connection with the PCB. It is recommended that the module be preheated in order to ensure that the temperature of all parts to be soldered is uniform during 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 Inter-metallic 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 the ME909s LGA module.

7.2 Certifications

NOTE
Figure 7-1 shows certifications the ME909s LGA module have been implemented. For more demands, please contact us for more details about this information.

Figure 7-1 Product Certifications of ME909s LGA module

Certification	Model name	
	ME909s -821	ME909s -120
CE	-	√
RoHS	√	√
CCC	√	-
GCF	-	√
WEEE	√	√

8 Safety Information

8.1 About This Chapter

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

- Interference
- Medical Device
- Area with Inflammables and Explosives
- Traffic Security
- Airline Security
- Safety of Children
- Environment Protection
- WEEE Approval
- RoHS Approval
- Laws and Regulations Observance
- Care and Maintenance
- Emergency Call
- Regulatory Information

8.2 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.

8.3 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.

8.4 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

8.5 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.

8.6 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.

8.7 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.

8.8 Environment Protection

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

8.9 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).

8.10 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).

8.11 Laws and Regulations Observance

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

8.12 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.

8.13 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.

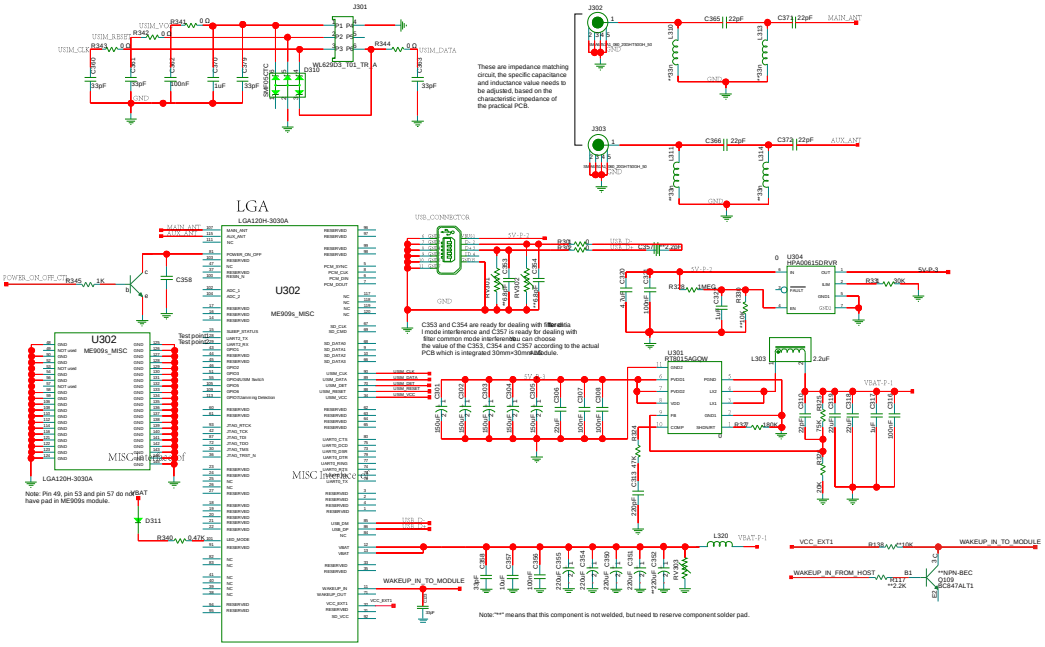
8.14 Regulatory Information

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

8.14.1 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
AP	Access Point
AUX	Auxiliary
BER	Bit Error Rate
BIOS	Basic Input Output System
CCC	China Compulsory Certification
CE	European Conformity
CMOS	Complementary Metal Oxide Semiconductor
CSD	Circuit Switched Data
DC	Direct Current
DCE	Data Communication Equipment
DL	Down Link
DMA	Direct Memory Access
DTE	Data Terminal Equipment
EDGE	Enhanced Data Rate for GSM Evolution
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union

Acronym or Abbreviation	Expansion
FCC	Federal Communications Commission
GMSK	Gaussian Minimum Shift Keying
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HBM	Human Body Model
HSDPA	High-Speed Downlink Packet Access
HSPA	Enhanced High Speed Packet Access
HSUPA	High Speed Up-link Packet Access
IMC	Inter-metallic Compound
ISO	International Standards Organization
JTAG	Joint Test Action Group
LED	Light-Emitting Diode
LGA	Land Grid Array
MO	Mobile Originated
MT	Mobile Terminated
NC	Not Connected
NSMD	Non-solder Mask Defined
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PMU	Power Management Unit
PID	Product Identity
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
SMS	Short Message Service
TIS	Total Isotropic Sensitivity
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver-Transmitter
UL	Up Link

Acronym or Abbreviation	Expansion
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VIP	Vendor Identity
VSWR	Voltage Standing Wave Ratio
WEEE	Waste Electrical and Electronic Equipment
WCDMA	Wideband Code Division Multiple Access
WWAN	Wireless Wide Area Network
LTE	Long Term Evolution