HUAWEI MU709s-2 HSPA+ LGA Module

Hardware Guide

Issue 0.1

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About This Document

Revision History

Document Version	Date	Chapter	Descriptions
0.1	2014-4-18		This is a draft version, and some chapters are still with "TBD".

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces provided by MU709s-2 module.

This document helps hardware engineer to understand the interface specifications, electrical features and related product information of the MU709s-2 module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MU709s-2 module and provides:

- Function Overview
- Circuit Block Diagram
- Application Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical Dimensions	• Dimensions (L × W × H): 30 mm × 30 mm × 2.27 mm • Weight: about 5 g
Operating Bands	WCDMA/HSDPA/HSUPA/HSPA+: 900 MHz/2100 MHz GSM/GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz
Operating Temperature	Normal operating temperature: –20°C to +70°C Extended operating temperature[1]: –40°C to +85°C
Storage Temperature	–40°C to +85°C
Power Voltage	DC 3.3 V–4.2 V (typical value is 3.8 V)
AT Commands	See the *HUAWEI MU709 Series HSPA+ LGA Module AT Command Interface Specification*.
Application Interface (145-pin LGA interface)	One standard USIM card (Class B and Class C)
	Audio interface: PCM interface
	USB 2.0 (High Speed)

Feature	Description
	8-wire UART (Universal Asynchronous Receiver-Transmitter) x 1, up to 920 kbps 2-wire UART x 1 (this is only used for debugging)
	GPIO (General-purpose I/O) x 5
	LED (Light-Emitting Diode) x 1
	Power on/off interface
	Hardware reset interface
	JTAG (Joint Test Action Group) interface
	Sleep indicator interface (SLEEP_STATUS)
	WAKEUP_IN: Sleep authorization signal
	WAKEUP_OUT: Module to wake up the host
Antenna Interface	WWAN MAIN antenna pad x1, WWAN AUX antenna pad x 1
SMS	New message alert
	Management of SMS: read SMS, write SMS, send SMS, delete SMS and list SMS
	Supports MO and MT: Point-to-point
Data Services	GPRS: UL 85.6 kbps/DL 85.6 kbps
	EDGE: UL 236.8 kbps/DL 236.8 kbps
	WCDMA PS: UL 384 kbps/DL 384 kbps
	HSPA+: UL 5.76 Mbps/DL 21.6 Mbps

NOTE

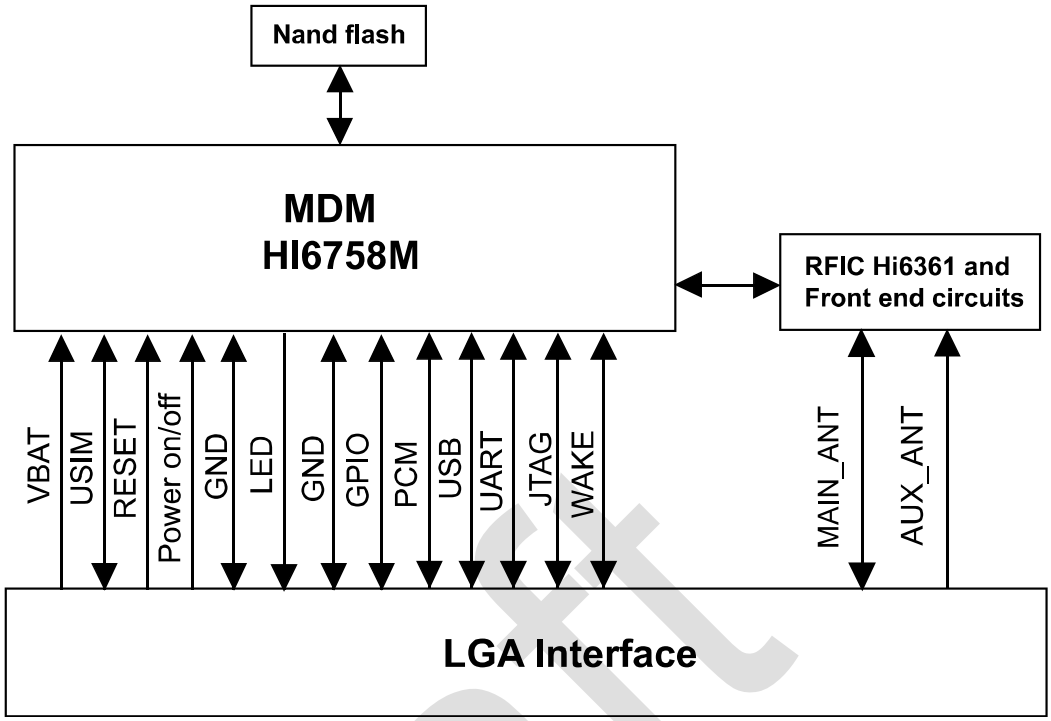
[1]:The temperatures outside of the range –20°C to +70°C; the module might slightly deviate from 3GPP TS 45.005 and 3GPP TS 34.121-1 specifications.

2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the MU709s-2 module. The major functional units of the MU709s-2 module contain the following parts:

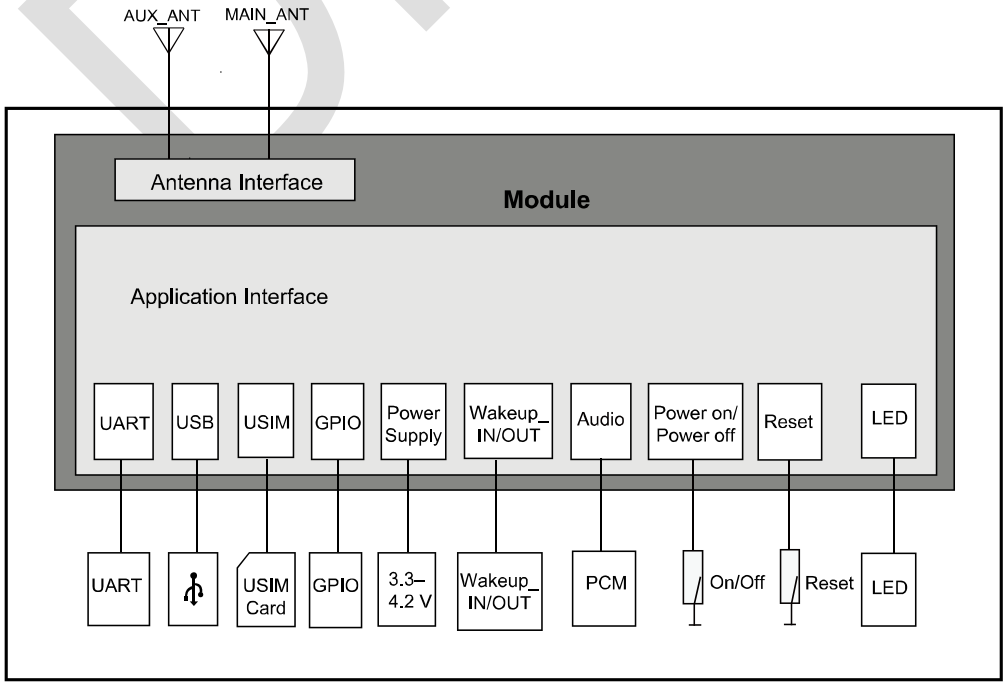
- Power management
- Baseband controller
- Nand flash
- RF Circuit

Figure 2-1 Circuit block diagram of the MU709s-2 module



2.4 Application Block Diagram

Figure 2-2 Application block diagram of the MU709s-2 module



UART Interface:	The module supports 2 UART interfaces. One is 8-wire UART, and the other is 2-wire UART (only for debugging).
USB Interface:	The USB interface supports USB 2.0 high speed standard.
USIM Interface:	The USIM interface provides the interface for a USIM card.
External Power Supply:	DC 3.8 V is recommended.
Audio Interface:	The module supports one PCM interface.
LED:	Indicates the work status.
RF Pad:	RF antenna interface.

3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MU709s-2 module, including:

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

3.2 LGA Interface

The MU709s-2 module uses a 145-pin LGA as its external interface. For details about the module and dimensions, see "6.4 Dimensions and Interfaces ".

Figure 3-1 shows the sequence of pins on the 145-pin signal interface of the MU709s-2 module.

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

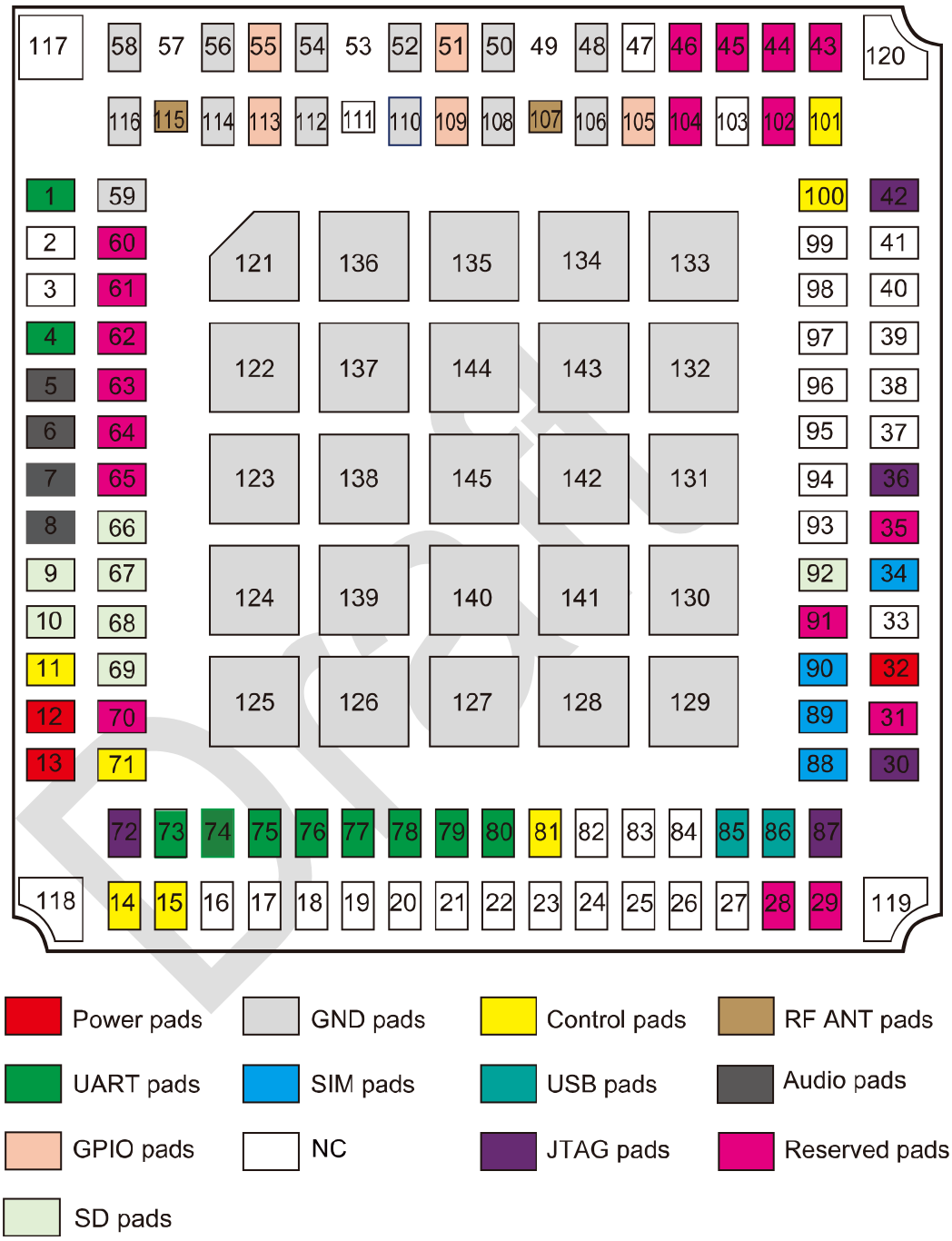


Table 3-1 shows the definitions of pins on the 145-pin signal interface of the MU709s-2 module.

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	UART1_TX	O	UART1 transmit output for debugging.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
2	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
3	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
4	UART1_RX	I	UART1 receive data input for debugging.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
5	PCM_SYNC	O	PCM sync	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
6	PCM_DIN	I	PCM data in	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
7	PCM_DOUT	O	PCM data out	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
8	PCM_CLK	O	PCM clock	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
9	SD_DATA1	I/O	SD Card data signal. Only used for debugging. Please reserve the test point.	V_{OH}	2.25	3.0	3.3	-
				V_{OL}	0	-	0.75	-
				V_{IH}	2.1	3.0	3.3	-
				V_{IL}	–0.3	-	1.05	-
10	SD_DATA2	I/O	SD Card data signal. Only used for debugging. Please reserve the test point.	V_{OH}	2.25	3.0	3.3	-
				V_{OL}	0	-	0.75	-
				V_{IH}	2.1	3.0	3.3	-
				V_{IL}	–0.3	-	1.05	-
11	WAKEUP_IN	I	Sleep	V_{IH}	1.26	1.8	2.1	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			authorization signal. H: Sleep mode is disabled. L: Sleep mode is enabled (default value).	V_{IL}	–0.3	-	0.63	-
12	VBAT	P	Power supply input	-	3.3	3.8	4.2	-
13	VBAT	P	Power supply input	-	3.3	3.8	4.2	-
14	PS_HOLD	I	Power supply hold signal to the module.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
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	2.1	-
				V_{OL}	0	-	0.45	-
16	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
17	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
18	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
19	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
20	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
21	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
22	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
23	NC	-	Not connected, please keep this pin open.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
24	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
25	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
26	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
27	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
28	Reserved	-	Reserved	-	-	-	-	-
29	Reserved	-	Reserved	-	-	-	-	-
30	JTAG_TMS	I	JTAG test mode select.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
31	Reserved	-	Not connected, please keep this pin open.	-	-	-	-	-
32	VCC_EXT1	PO	1.8 V POWER output	-	-	1.8	-	-
33	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
34	SIM_VCC	PO	Power supply for USIM card.	-	-	1.8/2.85	-	-
35	Reserved	-	Reserved	-	-	-	-	-
36	JTAG_TRST_N	I	JTAG reset	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
37	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
38	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
39	NC	-	Not connected, please keep this pin open.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
40	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
41	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
42	JTAG_TCK	I	JTAG clock input	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
43	Reserved	-	Reserved	-	-	-	-	-
44	Reserved	-	Reserved	-	-	-	-	-
45	Reserved	-	Reserved	-	-	-	-	-
46	Reserved	-	Reserved	-	-	-	-	-
47	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
48	GND	-	Ground	-	-	-	-	-
49	NOT USED	-	Do not design PAD	-	-	-	-	-
50	GND	-	Ground	-	-	-	-	-
51	GPIO2	I/O	General I/O pins. The function of these pins has not been defined.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
				V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
52	GND	-	Ground	-	-	-	-	-
53	NOT USED	-	Do not design PAD	-	-	-	-	-
54	GND	-	Ground	-	-	-	-	-
55	GPIO5	I/O	General I/O pins. The function of these pins has not been defined.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
				V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
56	GND	-	Ground	-	-	-	-	-
57	NOT USED	-	Do not design PAD	-	-	-	-	-
58	GND	-	Ground	-	-	-	-	-
59	GND	-	Ground	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
60	Reserved	-	Reserved	-	-	-	-	-
61	Reserved	-	Reserved	-	-	-	-	-
62	Reserved	-	Reserved	-	-	-	-	-
63	Reserved	-	Reserved	-	-	-	-	-
64	Reserved	-	Reserved	-	-	-	-	-
65	Reserved	-	Reserved	-	-	-	-	-
66	SD_DATA3	I/O	SD Card data signal. Only used for debugging. Please reserve the test point.	V_{OH}	2.25	3.0	3.3	-
				V_{OL}	0	-	0.75	-
				V_{IH}	2.1	3.0	3.3	-
				V_{IL}	–0.3	-	1.05	-
67	SD_CLK	O	SD Card CLK signal. Only used for debugging. Please reserve the test point.	V_{OH}	2.25	3.0	3.3	-
				V_{OL}	0	-	0.75	-
68	SD_DATA0	I/O	SD Card data signal. Only used for debugging. Please reserve the test point.	V_{OH}	2.25	3.0	3.3	-
				V_{OL}	0	-	0.75	-
				V_{IH}	2.1	3.0	3.3	-
				V_{IL}	–0.3	-	1.05	-
69	SD_CMD	O	SD Card CMD signal. Only used for debugging. Please reserve the test point.	V_{OH}	2.25	3.0	3.3	-
				V_{OL}	0	-	0.75	-
70	Reserved	-	Reserved	-	-	-	-	-
71	WAKEUP_OUT	O	Module to wake up the host.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
72	JTAG_TDO	O	JTAG test data output	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
73	UART0_DSR	O	UART0 data set ready	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
74	UART0_RTS	O	UART0 ready for receive	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
75	UART0_DCD	O	UART0 data carrier detect	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
76	UART0_TX	O	UART0 transmit output	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
77	UART0_RING	O	UART0 ring indicator	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
78	UART0_RX	I	UART0 receive data input	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
79	UART0_DTR	I	Data terminal ready	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
80	UART0_CTS	I	UART0 clear to send	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
81	POWER_ON_OFF	I	System power-on or power-off	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
82	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
83	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
84	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
85	USB_DM	I/O	USB Data- defined in the USB 2.0 Specification	-	1.35/ 1.8/2 .1	1.35/ 1.8/2 .1	1.35/ 1.8/2 .1	-
86	USB_DP	I/O	USB Data+ defined in the USB 2.0 Specification.	-	-	-	-	-
87	JTAG_TDI	I	JTAG test data input	V_{IH}	2.1	3.0	3.3	-
				V_{IL}	–0.3	-	1.05	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
88	SIM_RESET	O	USIM card reset	V_{OH}	0.7x SIM_VCC	-	3.3	SIM_VCC= 1.8 V or 2.85 V
				V_{OL}	0	-	0.2x SIM_VCC	
89	SIM_DATA	I/O	USIM card data	V_{OH}	0.7x SIM_VCC	-	3.3	SIM_VCC= 1.8 V or 2.85 V
				V_{OL}	0	-	0.2x SIM_VCC	
				V_{IH}	0.65 x SIM_VCC	-	3.3	
				V_{IL}	0	-	0.25 x SIM_VCC	
90	SIM_CLK	O	USIM card clock	V_{OH}	0.7x SIM_VCC	-	3.3	SIM_VCC= 1.8 V or 2.85 V
				V_{OL}	0	-	0.2x SIM_VCC	
91	Reserved	-	Reserved	-	-	-	-	-
92	SD_VCC	PO	SD Card Power Used for debug.	-	-	3.0	-	-
93	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
94	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
95	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
96	NC	-	Not connected, please keep this pin open.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
97	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
98	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
99	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
100	RESIN_N	I	Reset module.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
101	LED_MODE	O	Mode indicator Current sink Drive strength: 10 mA	-	-	-	-	-
102	Reserved	-	Reserved	-	-	-	-	-
103	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
104	Reserved	-	Reserved	-	-	-	-	-
105	GPIO1	I/O	General I/O pins. The function of these pins has not been defined.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
				V_{IH}	1.26	1.8	2.1	
				V_{IL}	–0.3	-	0.63	
106	GND	-	Ground	-	-	-	-	-
107	MAIN_ANT	-	RF main antenna pad	-	-	-	-	-
108	GND	-	Ground	-	-	-	-	-
109	GPIO4	I/O	General I/O pinsThe function of these pins has not been defined.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
				V_{IH}	1.26	1.8	2.1	
				V_{IL}	–0.3	-	0.63	
110	GND	-	Ground	-	-	-	-	-
111	NC	-	Not connected, please keep this pin open.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
112	GND	-	Ground	-	-	-	-	-
113	GPIO3	I/O	General I/O pins. The function of these pins has not been defined.	-	–0.3	1.8	2.1	-
114	GND	-	Ground	-	-	-	-	-
115	AUX_ANT	-	RF AUX antenna pad	-	-	-	-	-
116	GND	-	Ground	-	-	-	-	-
117	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
118	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
119	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
120	NC	-	Not connected, please keep this pin open.	-	-	-	-	-
121	GND	-	Thermal Ground Pad	-	-	-	-	-
122	GND	-	Thermal Ground Pad	-	-	-	-	-
123	GND	-	Thermal Ground Pad	-	-	-	-	-
124	GND	-	Thermal Ground Pad	-	-	-	-	-
125	GND	-	Thermal Ground Pad	-	-	-	-	-
126	GND	-	Thermal Ground Pad	-	-	-	-	-
127	GND	-	Thermal Ground Pad	-	-	-	-	-
128	GND	-	Thermal Ground Pad	-	-	-	-	-
129	GND	-	Thermal Ground Pad	-	-	-	-	-

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

NOTE

- **P** indicates 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.
- The **NC** (Not Connected) pins are floating and there are no signal connected to these pins. Yet some of these pins may be used in MU509, MC509, MU609 and ME909 module, therefore, before you deal with these pins, please refer to the corresponding hardware guide.
- The **Reserved** pins are internally connected to the module. Therefore, these pins should not be used, otherwise they may cause problems. Please contact with us for more details about this information.

3.3 Power Interface

3.3.1 Overview

The power supply part of the MU709s-2 module contains:

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

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

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

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
12, 13	VBAT	P	Pins for power voltage input	-	3.3	3.8	4.2
48, 50, 52, 54, 56, 58, 59, 106, 108, 110, 112, 114, 116	GND	-	GND	-	-	-	-
32	VCC_EXT1	PO	Pin for external power output	-	-	1.8	-
34	SIM_VCC	PO	Power supply for USIM card	-	-	1.8/2.85	-
121–145	GND	-	Thermal Ground Pad	-	-	-	-

3.3.2 Power Supply VBAT Interface

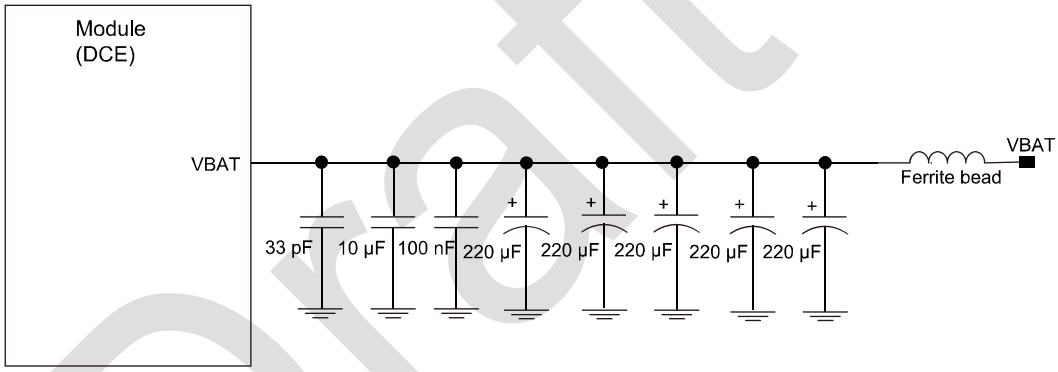
When the MU709s-2 module works normally, power is supplied through the VBAT pins and the voltage ranges from 3.3 V to 4.2 V (typical value: 3.8 V). The 145-pin LGA provides two VBAT pins and GND pins for external power input. To ensure that the MU709s-2 module works normally, all the pins must be used efficiently.

When the MU709s-2 module is used for different external applications, pay special attention to the design for the power supply. When the MU709s-2 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 3.3 V in any case. Otherwise, exceptions such as restart of the MU709s-2 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 MU709s-2 module. In addition, to reduce the impact of channel impedance on voltage drop, you are recommended to try to shorten the power supply circuit of the VBAT interface.

It is recommended that add the EMI ferrite bead (NR3015T4R7M manufactured by TAIYO YUDEN or VLS3015T-4R7MR99 manufactured by TDK is recommended) to directly isolate DTE from DCE in the power circuit. Figure 3-2 shows the recommended power circuit of MU709s-2 module.

Figure 3-2 Recommended power circuit of MU709s-2 module



When the system power restarts, a discharge circuit is recommended to make sure the power voltage drops below 1.8 V for 1s at least.

3.3.3 Output Power Supply Interface

Output power supply interface is VCC_EXT1.

Through the output power supply interface, the MU709s-2 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 MU709s-2 module is in sleep mode, the output power supply interface is in the low power consumption state (< 500 µA). If the MU709s-2 module is in power down mode, the output power supply is in the disabled state.

3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the MU709s-2 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

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 or power-off	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
100	RESIN_N	I	Reset module.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
11	WAKEUP_IN	I	Sleep authorization signal H: Sleep mode is disabled L: Sleep mode is enabled (default value)	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
71	WAKEUP_OUT	O	Module to wake up the host. H: Wake up the host, the module hold 1s high-level-voltage pulse and then output low-level-voltage L: Do not wake up the host (default value)	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
15	SLEEP_STATUS	O	Sleep status indicator H: Module is in wake state L: Module is in sleep state	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
101	LED_MODE	O	Mode indicator Current sink Drive strength: 10 mA	-	-	-	-	-

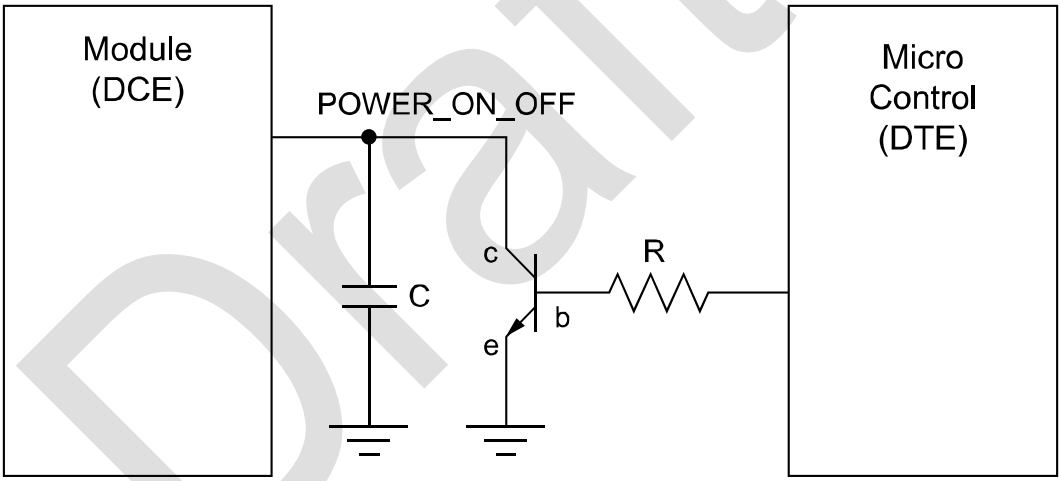
3.4.2 Power-on/off (POWER_ON_OFF) Pin

The MU709s-2 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 MU709s-2 is in power off state.)	MU709s-2 is powered on. **POWER_ON_OFF pin should be pulled down for 1.5s to 2.0s**
2	Low (when MU709s-2 is in power on state.)	MU709s-2 is powered off. **POWER_ON_OFF pin should be pulled down for 3.0s to 5.0s.**

Figure 3-3 Connections of the POWER_ON_OFF pin



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 3-4 Power on timing sequence

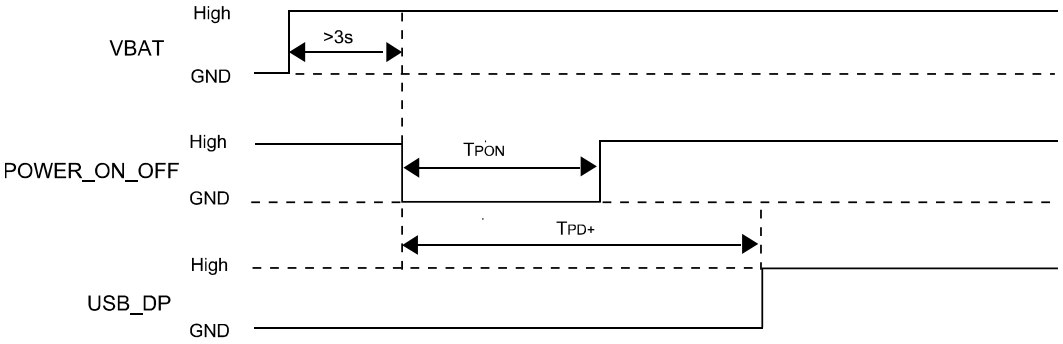


Table 3-5 Power on timing

Parameter	Comments	Time (Nominal values)	Units
T_{PON}	POWER_ON_OFF turn on time.	1.5–2.0	s
T_{PD+}	POWER_ON_OFF Valid to USB D+ high	About 6.0	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 3-5 Power off timing sequence

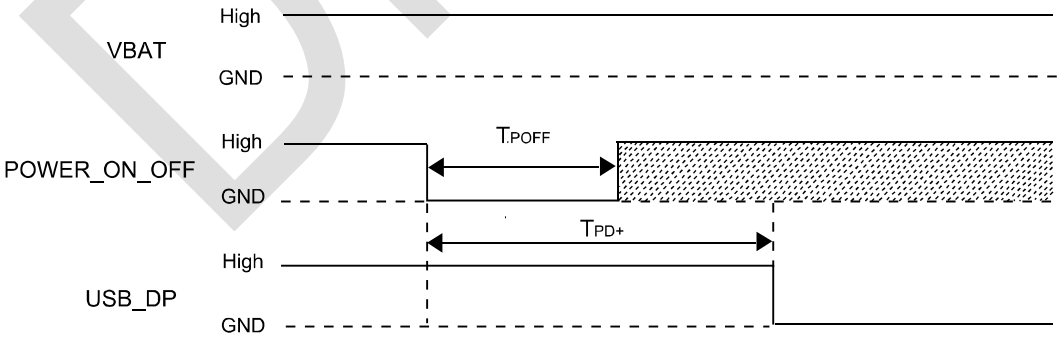


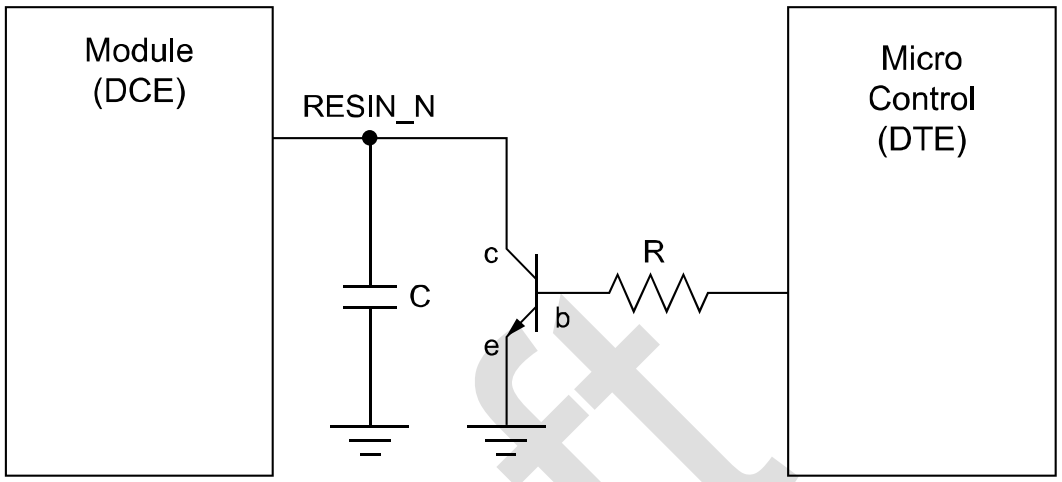
Table 3-6 Power off timing

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

3.4.3 RESIN_N Pin

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 3-6 Connections of the RESIN_N pin

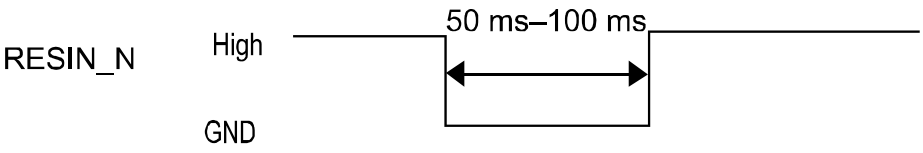


CAUTION

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 MU709s-2 module supports hardware reset function. If the software of the MU709s-2 module stops responding, you can reset the hardware through the RESIN_N signal as shown in Figure 3-7 .When a low-level pulse is supplied through the RESIN_N pin, the hardware will be reset. After the hardware is reset, the software starts powering on the module and reports relevant information according to the actual settings. For example, the AT command automatically reports ^SYSSTART.

Figure 3-7 Reset pulse timing



NOTE

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

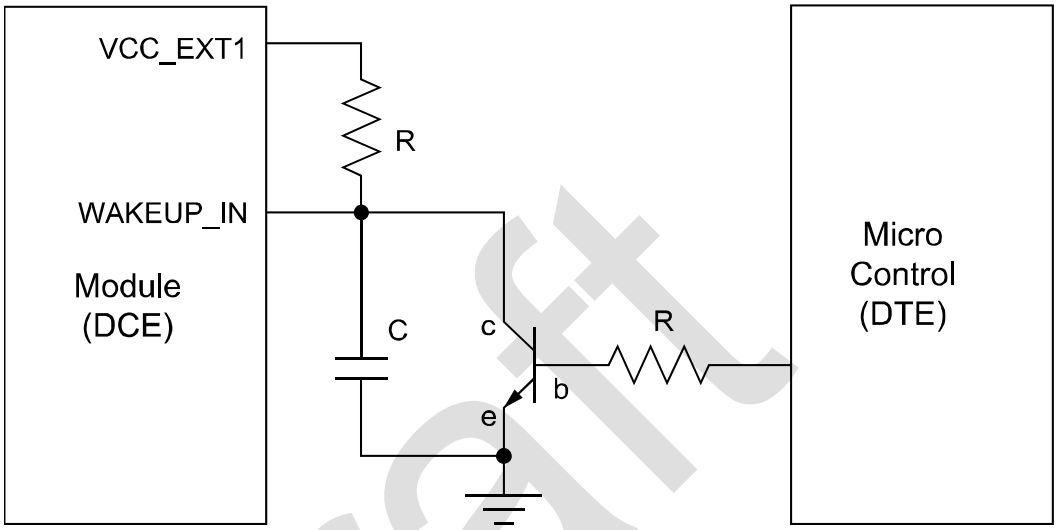
3.4.4 WAKEUP_IN Signal

WAKEUP_IN pin is the authorization signal of MU709s-2 entering sleep mode. It is internally pulled low, so it can be floating if not used.

Table 3-1 shows the definition of the WAKEUP_IN signal.

The module cannot enter sleep mode when this pin is pulled high (1.8 V).

Figure 3-8 Connections of the WAKEUP_IN pin



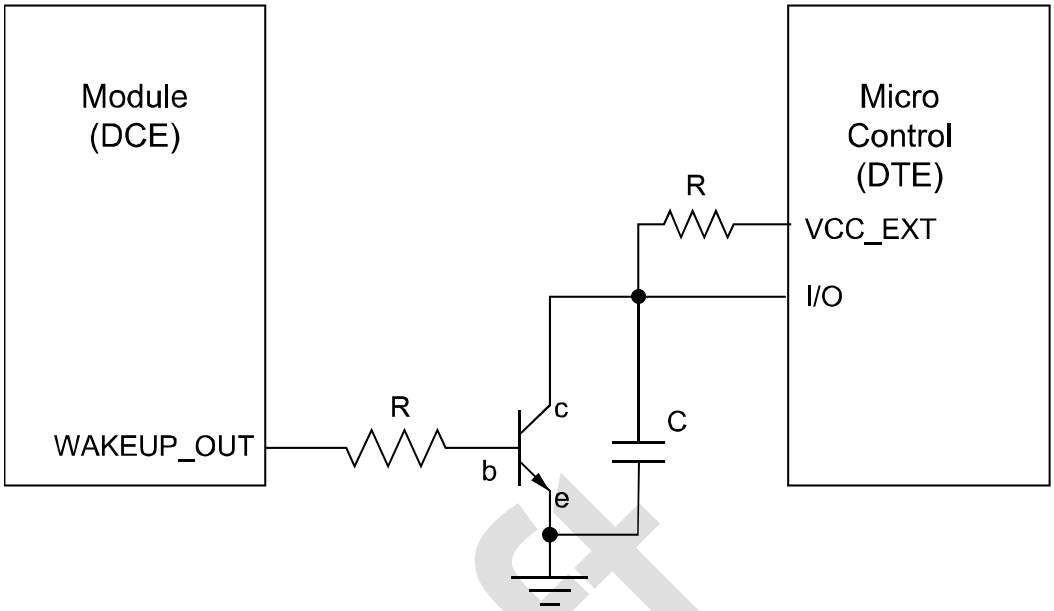
3.4.5 WAKEUP_OUT Signal

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

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

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

Figure 3-9 Connections of the WAKEUP_OUT pin



3.4.6 SLEEP_STATUS Signal

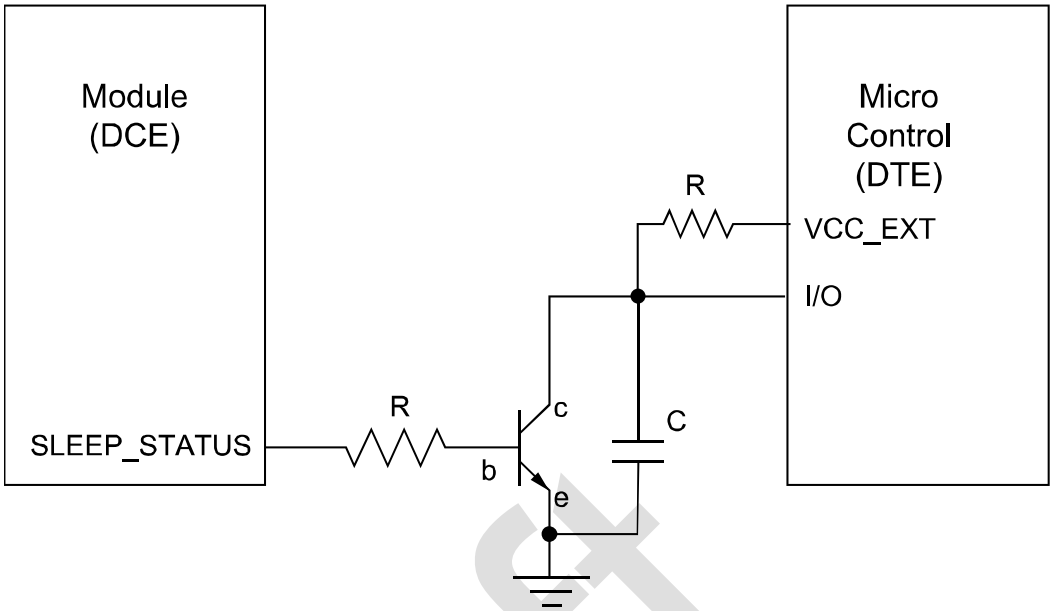
SLEEP_STATUS signal is used to indicate the sleep status of MU709s-2. The external devices can get to know whether the module is in sleep mode by reading SLEEP_STATUS pin.

When SLEEP_STATUS pin is in high level, MU709s-2 is in wakeup state.

When SLEEP_STATUS pin is in low level, MU709s-2 is in sleep state.

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

Figure 3-10 Connections of the SLEEP_STATUS pin



3.4.7 LED_MODE Signal

MU709s-2 provides a LED_MODE signal to indicate the work status.

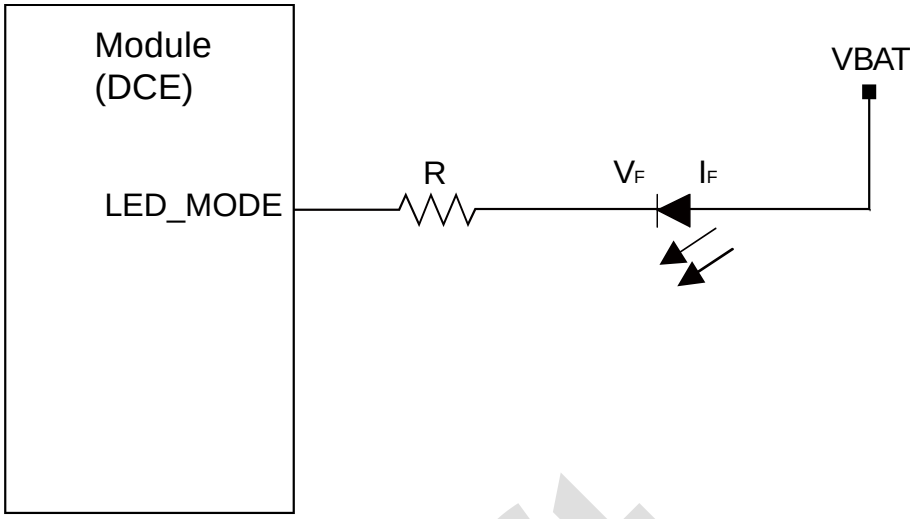
Table 3-7 State of the LED_MODE pin

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

External Circuits

Figure 3-11 shows the recommended circuits of the LED_MODE pin. According to LED feature, you can adjust the LED brightness by adjusting the resistance of resistor R. The mode indicator (LED_MODE) is current sink. Drive strength: 10 mA.

Figure 3-11 Driving circuit



3.5 UART Interface

3.5.1 Overview

The MU709s-2 module provides the UART0 (8-wire UART) interface for one asynchronous communication channel. As the UART0 interface supports signal control through standard modem handshake, AT commands are entered and serial communication is performed through the UART0 interface. The UART1 (2-wire UART) interface is provided for only debugging by MU709s-2 module. The UART has the following features:

- Full-duplex
- 7-bit or 8-bit data
- 1-bit or 2-bit stop bit
- Odd parity check, even parity check, or non-check
- Baud rate clock generated by the system clock
- Direct memory access (DMA) transmission
- Supported baud rate: 9600 bit/s, 19200 bit/s, 38400 bit/s, 57600 bit/s, 115200 bit/s(default), 230400 bit/s, 460800 bit/s and 921600 bit/s
- Baud rate adaptive change is supported.

Table 3-8 lists the UART interface signals.

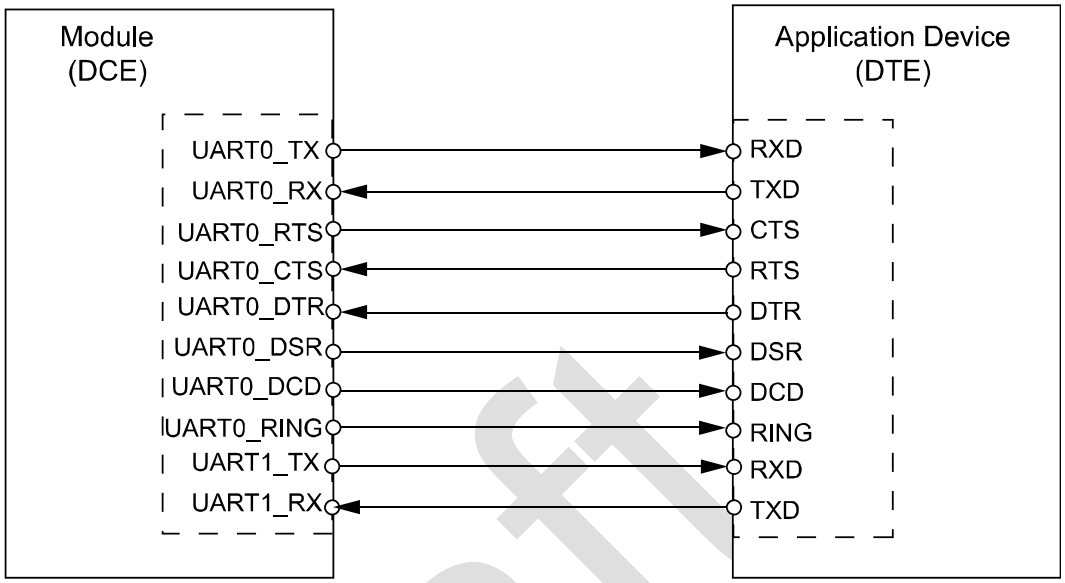
Table 3-8 UART interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
1	UART1_TX	O	UART1 transmit output for debugging.	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
4	UART1_RX	I	UART1 receive data input for debugging	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
76	UART0_TX	O	UART0 transmit output	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
78	UART0_RX	I	UART0 receive data input	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
77	UART0_RING	O	UART0 ring indicator	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
74	UART0_RTS	O	UART0 ready for receive	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
79	UART0_DTR	I	Data terminal ready	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
80	UART0_CTS	I	UART0 clear to send	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
75	UART0_DCD	O	UART0 data carrier detect	V_{OH}	1.35–0.3	1.81.8	2.12.1
				V_{OL}	0	-	0.45
73	UART0_DSR	O	UART0 data set ready	V_{OH}	1.35–0.3	1.81.8	2.12.1
				V_{OL}	0	-	0.45

3.5.2 Circuit Recommended for the UART Interface

Figure 3-12 Connection of the UART interface in the MU709s-2 module (DCE) with the host (DTE)



The RS-232 chip (must support 921600 bit/s) can be used to connect the MU709s-2 module with UART. In this connection, the Complementary Metal Oxide Semiconductor (CMOS) logic level and the Electronic Industries Association (EIA) level are converted mutually.

NOTE

- It is recommended that set the pins related to UART interface as test points on the DTE board for debugging.
- The UART0_RX, UART0_TX, UART1_RX, and UART1_TX must be pulled down. When you want the module is in sleep status, all the UART interface will be in low level. Therefore, UART0_RX, UART0_TX and UART1_RX, UART1_TX must be pulled down in order to confirm they are in low logic when the module is in sleep status.
- The level of RS-232 Transceivers must match that of the MU709s-2 module.

3.6 USB Interface

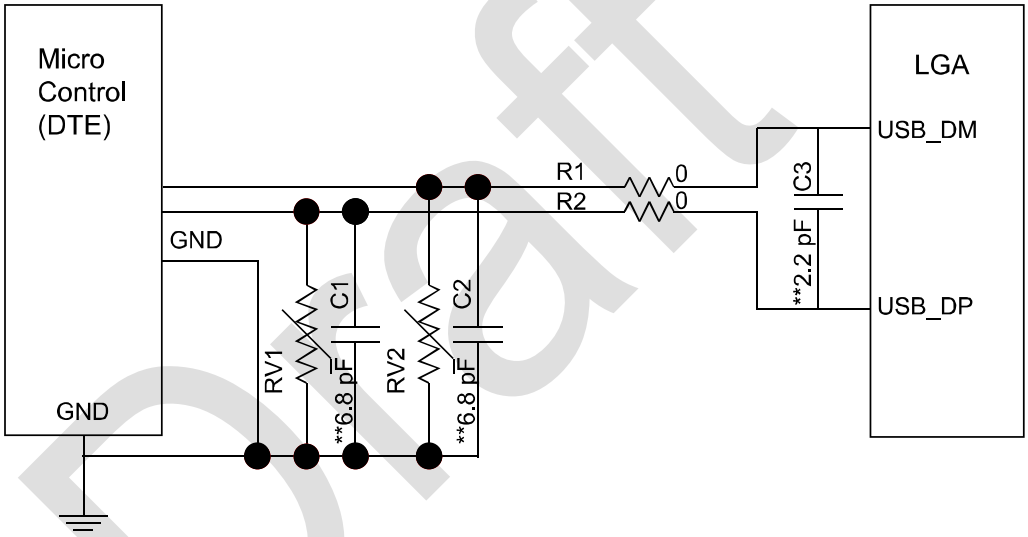
The MU709s-2 is compliant with USB 2.0 High speed protocol. The USB interface is powered directly from the VBAT supply. The USB signal lines are compatible with the USB 2.0 signal specifications. Figure 3-13 shows the circuit of the USB interface.

Table 3-9 Definition of the USB interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
85	USB_DM	I/O	USB Data- defined in the USB 2.0 Specification	-	1.35/1.8/2.1	1.35/1.8/2.1	1.35/1.8/2.1
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 MU709s-2 USB signal, please refer to the chapter 7.3.2 of *Universal Serial Bus Specification 2.0.*

Figure 3-13 Recommended circuit of USB interface



NOTE

- USB_DM and USB_DP are required to control the differential impedance –90 ohm (±10%).
- The length of the gap between USB_DM and USB_DP should not exceed 5 mil.
- The USB differential signal trace must be as short as possible, and laid out away from high-speed clock signals and other periodic signals as far as possible.
- Minimize through-holes and turning angles on the USB signal trace to reduce signal reflection and impedance change.
- Do not route the USB signal trace under the following components: crystal, oscillator, clock circuit, electromagnetic component, and IC that uses or generates clocks.
- Avoid stubs on the USB signal trace because stubs generate reflection and affect the signal quality.
- Route the USB signal trace on a complete reference plane (GND) and avoid crossing inter-board gaps because inter-board gaps cause a large reflow channel area and increase inductance and radiation. In addition, avoid signal traces on different layers.
- The USB signal trace must be far away from core logical components because the high current pulse generated during the state transitions process of core components may impose interference on signals.
- The USB signal trace must be far away from board edges with a minimum distance of 20 × h (h indicates the vertical distance between the trace and the reference layer) to avoid signal radiation.
- C1 and C2 are ready for dealing with filter differential mode interference and 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 MU709s-2 module provides a USIM card interface complying with the ISO 7816-3 standard and supports both Class B and Class C USIM cards.

Table 3-10 USIM card interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ. (V)	Max.(V)	Comments
88	SIM_RESET	O	USIM card reset	V_{OH}	0.7x SIM_VCC	-	3.3	SIM_VCC= 1.8V or 2.85V
				V_{OL}	0	-	0.2x SIM_VCC	
89	SIM_DATA	I/O	USIM card data	V_{OH}	0.7x SIM_VCC	-	3.3	SIM_VCC= 1.8V or 2.85V
				V_{OL}	0	-	0.2x SIM_VCC	-

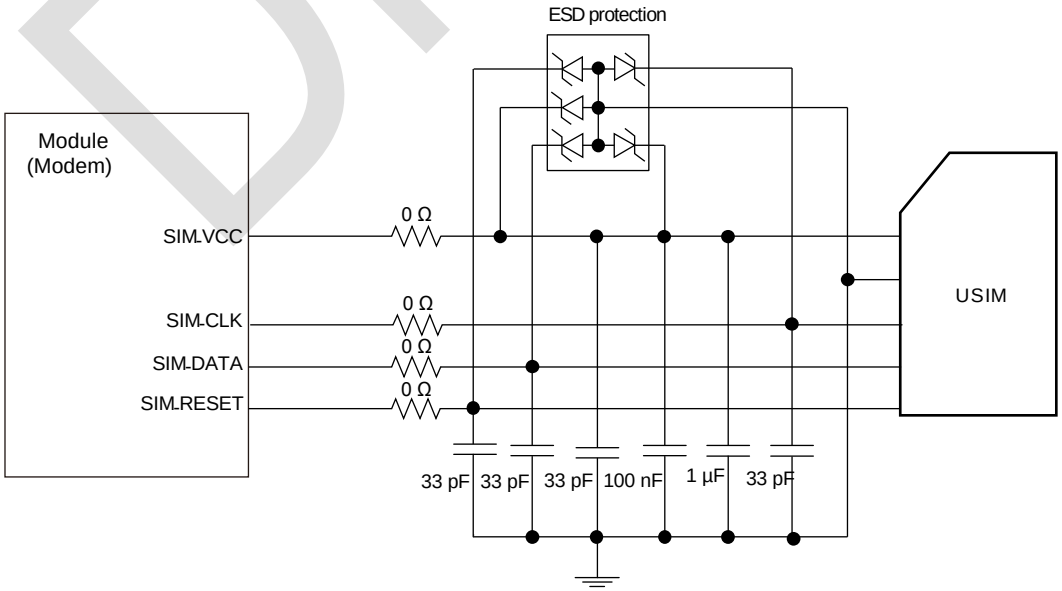
Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ. (V)	Max.(V)	Comments
				V_{IH}	0.65x SIM_VCC	-	3.3	-
				V_{IL}	0	-	0.25x SIM_VCC	-
90	SIM_CLK	O	USIM card clock	V_{OH}	0.7x SIM_VCC	-	3.3	SIM_VCC= 1.8V or 2.85V
				V_{OL}	0	-	0.2x SIM_VCC	-
34	SIM_VCC	PO	Power supply for USIM card	-	-	1.8/2.85	-	-

3.7.2 Circuit Recommended for the USIM Card Interface

As the MU709s-2 module is not equipped with an USIM socket, you need to place an USIM socket on the user interface board.

Figure 3-14 shows the circuit of the USIM card interface.

Figure 3-14 Circuit of the USIM card interface



CAUTION

- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the USIM socket should be placed near the LGA interface (it is recommended that the PCB circuit connects the LGA interface and the USIM socket does not exceed 100 mm), because a long circuit may lead to wave distortion, thus affecting signal quality.
- It is recommended that you wrap the area adjacent to the SIM_CLK and SIM_DATA signal wires with ground. The Ground pin of the USIM socket and the Ground pin of the USIM card must be well connected to the power Ground pin supplying power to the MU709s-2 module.
- A 100 nF capacitor and 1 μF capacitor are placed between the SIM_VCC and GND pins in a parallel manner (If SIM_VCC circuit is too long, that the larger capacitance such as 4.7 μF can be employed if necessary). Three 33 pF capacitors are placed between the SIM_DATA and Ground pins, the SIM_RESET and Ground pins, and the SIM_CLK and Ground pins in parallel to filter interference from RF signals.
- It is recommended to take electrostatic discharge (ESD) protection measures near the USIM card socket. The TVS diode with Vrwm of 5 V and junction capacitance less than 10 pF must be placed as close as possible to the USIM socket, and the Ground pin of the ESD protection component is well connected to the power Ground pin that supplies power to the MU709s-2 module.

3.8 Audio Interface

MU709s-2 provided one PCM digital audio interface. Table 3-11 lists the signals on the digital audio interface.

Table 3-11 Signals on the digital audio interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
5	PCM_SYNC	O	PCM sync	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
6	PCM_DIN	I	PCM data in	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
7	PCM_DOUT	O	PCM data out	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
8	PCM_CLK	O	PCM clock	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45

The MU709s-2 PCM interface enables communication with an external codec to support linear format.

Figure 3-15 Circuit diagram of the interface of the PCM (MU709s-2 is used as PCM master)

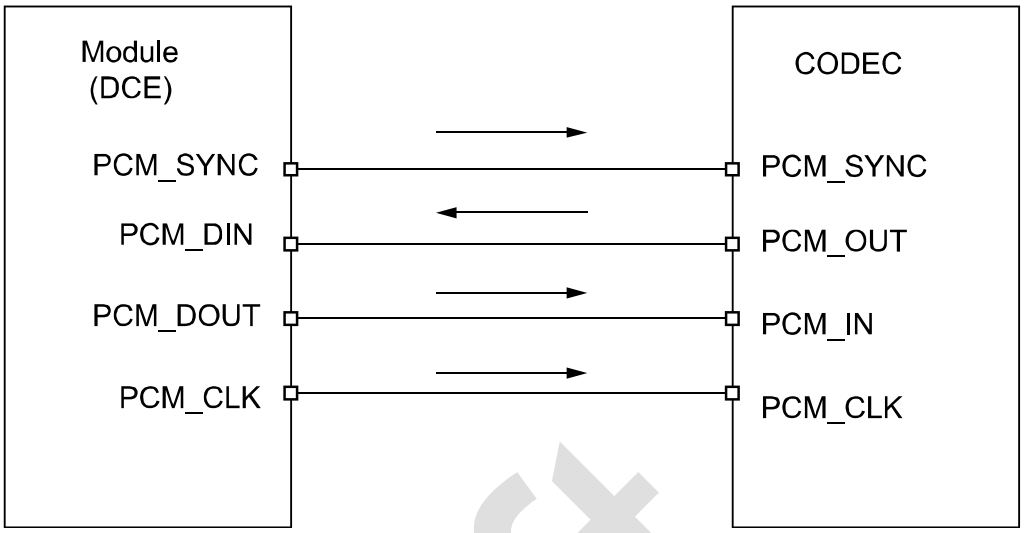
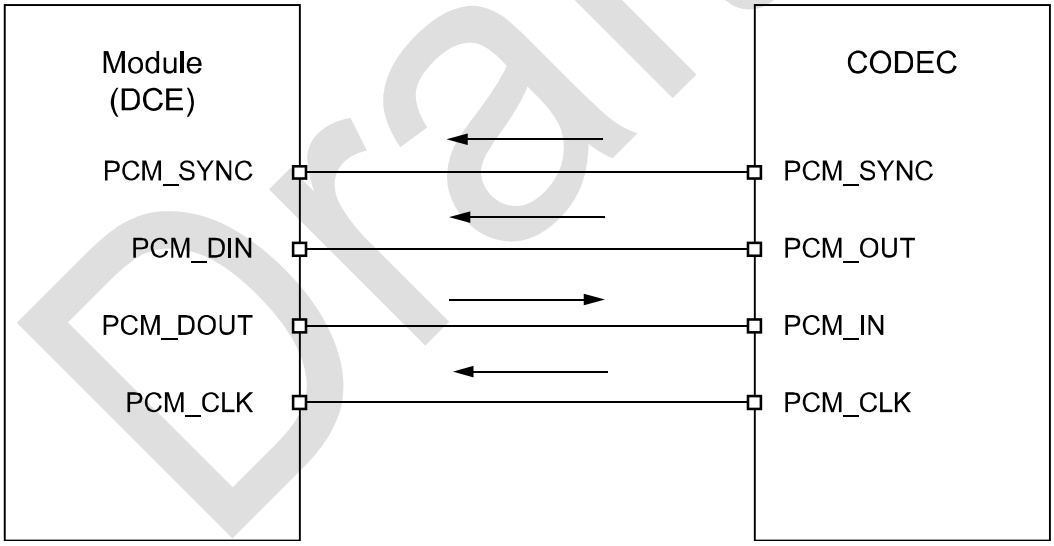


Figure 3-16 Circuit diagram of the interface of the PCM (MU709s-2 is used as PCM slave)



NOTE

- PCM_SYNC: Output when PCM is in master mode; Input when PCM is in slave mode.
- PCM_CLK: Output when PCM is in master mode; Input when PCM is in slave mode.
- MU709s-2 supports both master and 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 General Purpose I/O Interface

The MU709s-2 module provides 5 GPIO pins for customers to use controlling signals which are worked at 1.8 V CMOS logic levels. Customers can use AT command to control the state of logic levels of 5 GPIO output signal. See the *HUAWEI MU709 Series HSPA+ LGA Module AT Command Interface Specification*.

Table 3-12 Signals on the GPIO interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
51, 55, 105, 109, 113	GPIO	I/O	General I/O pins. The function of these pins has not been defined.	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
				V_{IH}	1.26	1.8	2.1
				V_{IL}	-0.3	-	0.63

3.10 JTAG Interface

The MU709s-2 module provides Joint Test Action Group (JTAG) interface. Table 3-13 shows the signals on the JTAG interface. It is recommended that route out the 7 pins as test points on the DTE for tracing and debugging.

Table 3-13 Signals on the JTAG interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
30	JTAG_TMS	I	JTAG test mode select	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
36	JTAG_TRST_N	I	JTAG reset	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
42	JTAG_TCK	I	JTAG clock input	V_{IH}	1.26	1.8	2.1
				V_{IL}	–0.3	-	0.63
72	JTAG_TDO	O	JTAG test data output	V_{OH}	1.35	1.8	2.1
				V_{OL}	0	-	0.45
87	JTAG_TDI	I	JTAG test data input	V_{IH}	2.1	3.0	3.3
				V_{IL}	–0.3	-	1.05
100	RESIN_N	I	Reset module.	V_{IH}	2.1	3.0	3.3
				V_{IL}	–0.3	-	1.05

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

3.11 RF Antenna Interface

The MU709s-2 module provided two antenna pads (MAIN_ANT, AUX_ANT) for connecting the external antennas.

Table 3-14 Definition of the antenna pads

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
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 3-17 RF signal trace design about MAIN_ANT for reference (the same for AUX)

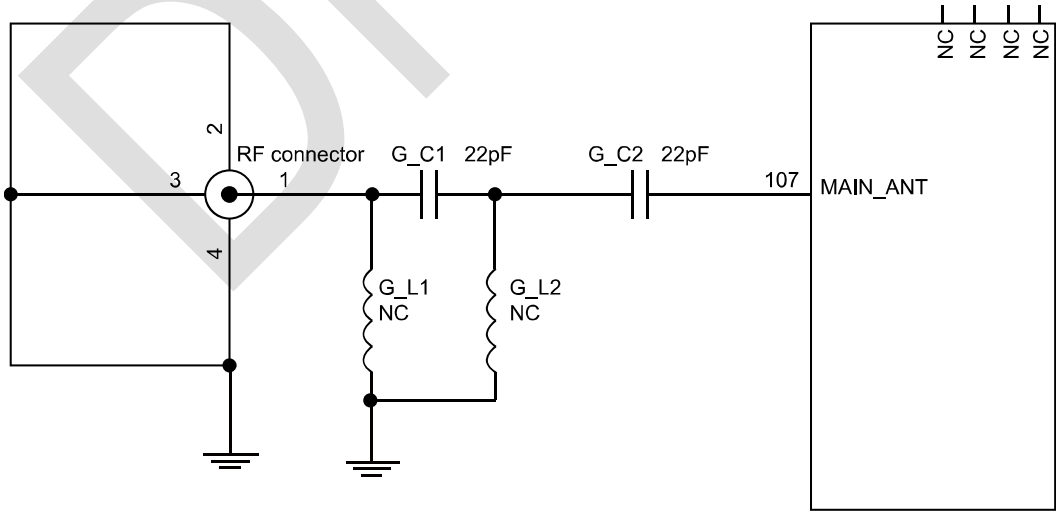
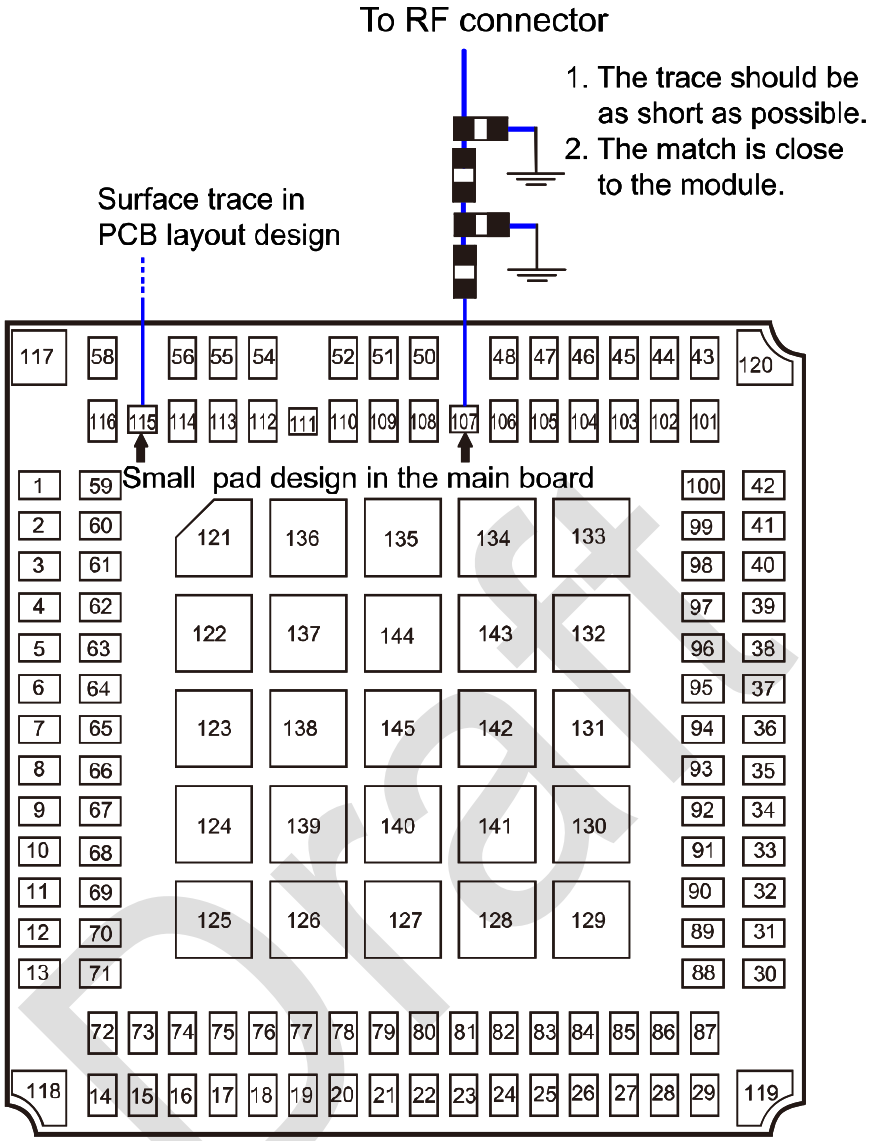


Figure 3-18 RF signal layout design about MAIN_ANT for reference (the same for AUX)



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 3-19 Complete structure of the microstrip

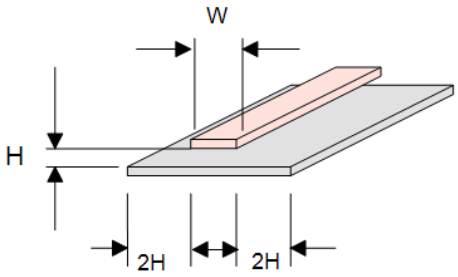


Figure 3-20 Complete structure of the stripline

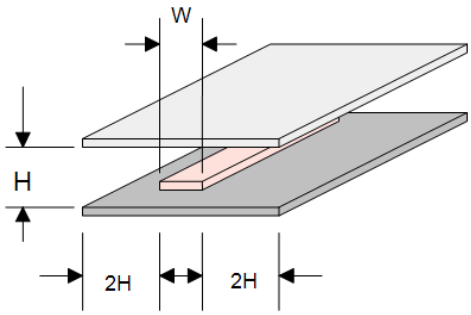


Figure 3-21 Pad for the RF interface

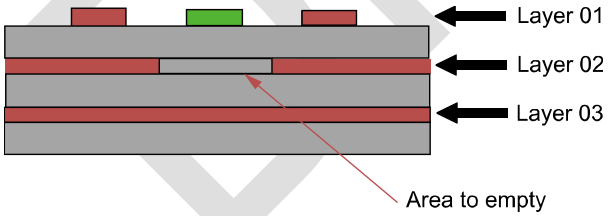
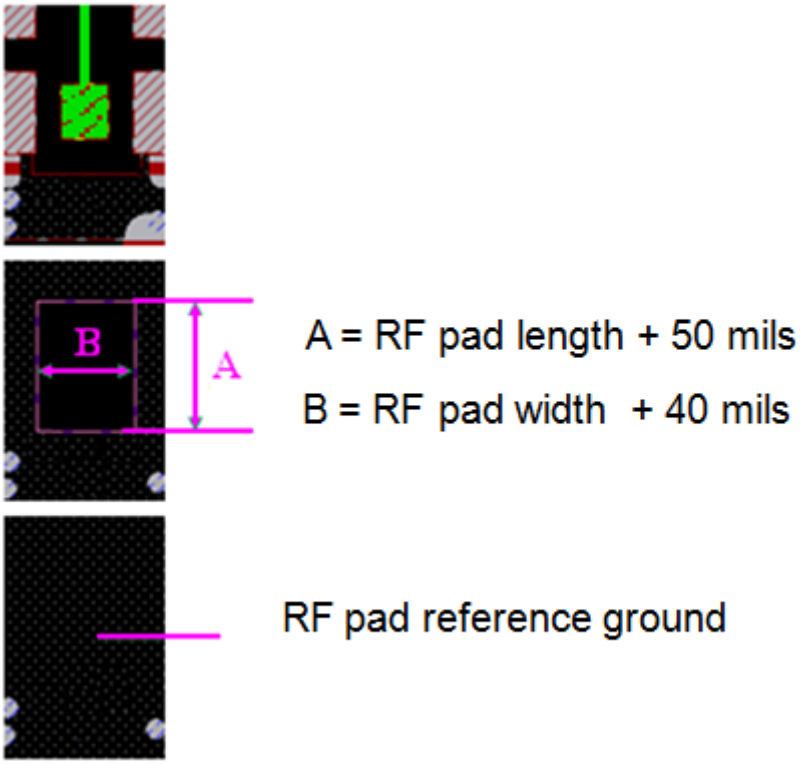


Figure 3-22 RF Pad design for MU709s-2



Please use impedance simulation tool to calculate RF MAIN pad impedance. The RF MAIN pad dimension of MU709s-2 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.

3.12 Reserved Interface

The MU709s-2 module provides 18 reserved pins. All reserved pins cannot be used by the customer.

Table 3-15 Reserved pin

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
28, 29, 31,35, 43–46, 60–65, 70, 91, 102, 104	Reserved	-	Reserved	-	-	-	-

3.13 NC Interface

The MU709s-2 module has 37 NC pins. All NC pins should not be connected. Please keep these pins open.

Table 3-16 NC pin

Pin No.	Pin Name	Pad Type	Description	Parameter	Min.(V)	Typ.(V)	Max.(V)
2, 3, 16–27, 33, 37–41, 47, 82–84, 93–99, 103, 111, 117–120	NC	-	Not connected, please keep open	-	-	-	-

4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the MU709s-2 module, including:

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

4.2 Operating Frequencies

Table 4-1 shows the RF bands supported by MU709s-2.

Table 4-1 RF bands

Operating Band	Tx	Rx
UMTS Band I	1920 MHz–1980 MHz	2110 MHz–2170 MHz
UMTS Band VIII	880 MHz–915 MHz	925 MHz–960 MHz
GSM 850	824 MHz–849 MHz	869 MHz–894 MHz
GSM 900	880 MHz–915 MHz	925 MHz–960 MHz
GSM 1800 (DCS)	1710 MHz–1785 MHz	1805 MHz–1880 MHz
GSM 1900 (PCS)	1850 MHz–1910 MHz	1930 MHz–1990 MHz

4.3 Conducted RF Measurement

4.3.1 Test Environment

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

NOTE

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

4.3.2 Test Standards

Huawei modules meet 3GPP TS51.010-1 and 3GPP TS34.121-1 test standards. Each module passes strict tests at the factory and thus the quality of the modules is guaranteed.

4.4 Conducted Rx Sensitivity and Tx Power

4.4.1 Conducted Receive Sensitivity

The conducted receive sensitivity is a key parameter that indicates the receiver performance of MU709s-2.

The 3GPP Protocol Claim column in Table 4-2 lists the required minimum values, and the Test Value column lists the tested values of MU709s-2.

Table 4-2 MU709s-2 conducted Rx sensitivity (Unit: dBm)

Band	Typical Value	Note
GSM 850	–110 dBm	BER Class II < 2.44%
GSM 900	–110 dBm	BER Class II < 2.44%
DCS 1800	–109.5 dBm	BER Class II < 2.44%
PCS 1900	–109 dBm	BER Class II < 2.44%
WCDMA B1 Main RX	–111 dBm	BER < 0.1%
WCDMA B8 Main RX	–112.5 dBm	BER < 0.1%

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

4.4.2 Conducted Transmit Power

The conducted transmit power is another indicator that measures the performance of MU709s-2. 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 4-3 lists the required ranges of the conducted transmit power of MU709s-2. The tested values listed in the Test Value column must range from the minimum power to the maximum power.

Table 4-3 MU709s-2 conducted Tx power (unit: dBm)

Item		3GPP Protocol Claim (dBm)	MU709s-2 Test Value (dBm)		
			Min.	Typ.	Max.
GSM 850	GMSK(1Tx Slot)	31 to 35	31	32.5	34
	8PSK(1Tx Slot)	24 to 30	25	27	29
GSM 900	GMSK(1Tx Slot)	31 to 35	31	32.5	34
	8PSK(1Tx Slot)	24 to 30	25	27	29
GSM 1800	GMSK(1Tx Slot)	28 to 32	28	29.5	31
	8PSK(1Tx Slot)	23 to 29	24	26	28
GSM 1900	GMSK(1Tx Slot)	28 to 32	28	29.5	31
	8PSK(1Tx Slot)	23 to 29	24	26	28
WCDMA Band I		21 to 25	22	23.5	24.5
WCDMA Band VIII		21 to 25	22	23.5	24.5

4.5 Antenna Design Requirements

4.5.1 Antenna Design Indicators

Antenna Efficiency

Antenna efficiency is the ratio of the input power to the radiated or received power of an antenna. The radiated power of an antenna is always lower than the input power due to the following antenna losses: return loss, material loss, and coupling loss. The efficiency of an antenna relates to its electrical dimensions. To be specific, the antenna efficiency increases with the electrical dimensions. In addition, the transmission cable from the antenna port of MU709s-2 to the antenna is also part of

the antenna. The cable loss increases with the cable length and the frequency. It is recommended that the cable loss is as low as possible, for example, MXHP32HP1000 made by Murata or equivalent.

The following antenna efficiency (free space) is recommended for MU709s-2 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 cable.

S11 or VSWR

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

The following S11 value is recommended for the antenna of MU709s-2:

- **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 MU709s-2 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 MU709s-2. 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 MU709s-2.

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 MU709s-2.
Primary/diversity antenna: omnidirectional

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

Envelope Correlation Coefficient

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

- Distance between antennas
- Antenna type
- Antenna direction

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

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

Gain and Directivity

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

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

The following antenna gain is recommended for MU709s-2. **Gain of the primary/diversity antenna ≤ 2.5 dBi**

NOTE

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

4.5.2 Interference

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

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

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

4.5.3 GSM/WCDMA Antenna Requirements

The antenna for MU709s-2 must fulfill the following requirements:

GSM/WCDMA Antenna Requirements	
Frequency range	Depending on frequency band(s) provided by the network operator, the customer must use the most suitable antenna for that/those band(s)
Bandwidth	70 MHz in GSM 850 80 MHz in GSM 900 170 MHz in DCS 140 MHz in PCS 80 MHz in WCDMA 900 (35 MHz for diversity antenna) 250 MHz in WCDMA 2100 (60 MHz for diversity antenna)
Gain	≤ 2.5 dBi
Impedance	50 Ω
VSWR absolute max	≤ 3:1
VSWR recommended	≤ 2:1

5 Electrical and Reliability Features

5.1 About This Chapter

This chapter describes the electrical and reliability features in the MU709s-2 module, including:

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

5.2 Absolute Ratings

WARNING

Table 5-1 lists the absolute ratings for the MU709s-2 module. Using the MU709s-2 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute ratings for the MU709s-2 module

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

5.3 Operating and Storage Temperatures and Humidity

Table 5-2 lists the operating and storage temperatures and humidity for the MU709s-2 module.

Table 5-2 operating and storage temperatures and humidity for the MU709s-2 module

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

NOTE

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

5.4 Electrical Features of USIM

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

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

5.5 Electrical Features of Application Interfaces

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

Table 5-4 Electrical features of application interfaces

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

5.6 Power Supply Features

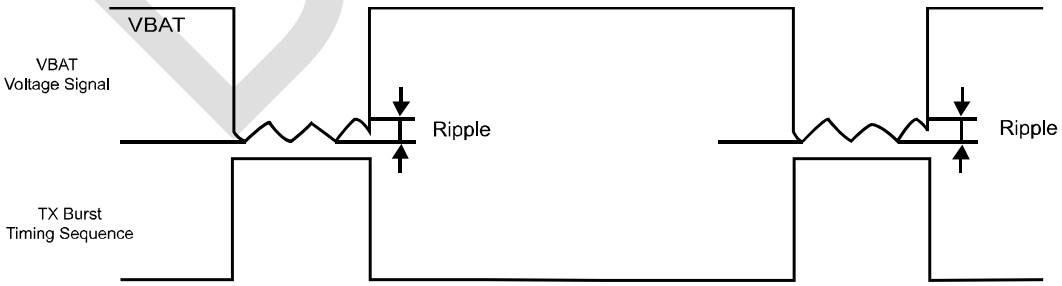
5.6.1 Input Power Supply

Table 5-5 lists the requirements for input power of the MU709s-2 module.

Table 5-5 Requirements for input power for the MU709s-2 module

Parameter	Min.	Typ.	Max.	Ripple	Unit
VBAT	3.3	3.8	4.2	0.1	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 5-6 Requirements for input current of the MU709s-2 module

Power	Peak (Maximum)	Normal (Maximum)
VBAT	2750 mA	1100 mA

5.6.2 Power Consumption

The power consumption of MU709s-2 in different scenarios are respectively listed in Table 5-7 to Table 5-10 .

The power consumption listed in this section is tested when the power supply of MU709s-2 module is normal voltage (3.8 V) and all of Test values are measured at room temperature.

Table 5-7 Averaged power off DC power consumption of MU709s-2

Description	Test Value (μA)	Notes/Configuration
	Typical	
Power off	40	Normal voltage (3.8 V) is ON while power on event is not triggered.

Table 5-8 Averaged standby DC power consumption of MU709s-2

Description		Bands	Test Value（mA）	Notes/Configuration
			Typical	
Sleep	HSPA/WCDMA	UMTS bands	3.60	Module is powered up DRX cycle=7(1.28s) Module is registered on the network. USB is in suspend.
	GPRS/EDGE	GSM bands	2.65	Module is powered up MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
Idle	HSPA/WCDMA	UMTS bands	50	Module is powered up DRX cycle=7(1.28s) Module is registered on the network, no data is transmitted USB is in active.

Description		Bands	Test Value（mA）	Notes/Configuration
			Typical	
	GPRS/EDGE	GSM bands	50	Module is powered up MFRMS =5 (1.175s) Module is registered on the network. no data is transmitted USB is in active.

Table 5-9 Averaged Data Transmission DC power consumption of MU709s-2 (HSPA/WCDMA)

Description	Band	Test Value	Units	Power (dBm)
WCDMA	Band I (IMT2100)	210	mA	0 dBm Tx Power
		270		10 dBm Tx Power
		590		23.5 dBm Tx Power
	Band VIII (900 MHz)	220	mA	0 dBm Tx Power
		280		10 dBm Tx Power
		610		23.5dBm Tx Power
HSPA	Band I (IMT2100)	230	mA	0 dBm Tx Power
		300		10 dBm Tx Power
		610		23.5 dBm Tx Power
	Band VIII (900 MHz)	230	mA	0 dBm Tx Power
		300		10 dBm Tx Power
		620		23.5 dBm Tx Power

Table 5-10 Averaged DC power consumption of MU709s-2 (GPRS/EDGE)

Description	Test Value	Units	PCL	Configuration
GPRS 850	270	mA	3	1 Up/1 Down
	400			2 Up/1 Down
	550			4 Up/1 Down
	170	mA	10	1 Up/1 Down
	200			2 Up/1 Down

Description	Test Value	Units	PCL	Configuration
	300			4 Up/1 Down
GPRS 900	260	mA	3	1 Up/1 Down
	370			2 Up/1 Down
	520			4 Up/1 Down
	160	mA	10	1 Up/1 Down
	200			2 Up/1 Down
	280			4 Up/1 Down
GPRS 1800	220	mA	3	1 Up/1 Down
	300			2 Up/1 Down
	400			4 Up/1 Down
	150	mA	10	1 Up/1 Down
	180			2 Up/1 Down
	240			4 Up/1 Down
GPRS 1900	210	mA	3	1 Up/1 Down
	310			2 Up/1 Down
	400			4 Up/1 Down
	150	mA	10	1 Up/1 Down
	180			2 Up/1 Down
	250			4 Up/1 Down
EDGE 850	220	mA	5	1 Up/1 Down
	300			2 Up/1 Down
	420			4 Up/1 Down
	200	mA	10	1 Up/1 Down
	260			2 Up/1 Down
	400			4 Up/1 Down
EDGE 900	220	mA	5	1 Up/1 Down
	290			2 Up/1 Down
	420			4 Up/1 Down
	200	mA	10	1 Up/1 Down
	260			2 Up/1 Down
	400			4 Up/1 Down

Description	Test Value	Units	PCL	Configuration
EDGE 1800	200	mA	5	1 Up/1 Down
	260			2 Up/1 Down
	360			4 Up/1 Down
	180	mA	10	1 Up/1 Down
	230			2 Up/1 Down
	340			4 Up/1 Down
EDGE 1900	200	mA	5	1 Up/1 Down
	250			2 Up/1 Down
	360			4 Up/1 Down
	180	mA	10	1 Up/1 Down
	240			2 Up/1 Down
	340			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.
- Test condition: For Max. Tx. power, see 4.4.2 Conducted Transmit Power, which are listed in Table 4-3 , for Max. data throughput, see 2.2 Function Overview, which are listed in Table 2-1 .

5.7 Reliability Features

Table 5-11 lists the test conditions and results of the reliability of the MU709s-2 module.

Table 5-11 Test conditions and results of the reliability of the MU709s-2 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	TBD
	High-temperature storage	• Temperature: 85ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A103-C	3 pcs/group	TBD

Item		Test Condition	Standard	Sample size	Results
	Low-temperature operating	• Temperature: –40ºC • Operation mode: working with service connected • Test duration: 24 h	IEC60068-2-1	3 pcs/group	TBD
	High-temperature operating	• Temperature: 85ºC • Operation mode: working with service connected • Test duration: 24 h	JESD22-A108-C	3 pcs/group	TBD
	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	TBD
	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	TBD
	Thermal shock	• Low temperature: –40ºC • High temperature: 85ºC • Temperature change interval: < 20s • Operation mode: no power • Test duration: 100 cycles; 15 min+15 min/cycle	JESD22-A106-B	3 pcs/group	TBD
	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	TBD

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. • Operation mode: working with service connected	JESD22-B103-B	3 pcs/group	TBD
	Shock test	• Half-sine wave shock • Peak acceleration: 30 Grms • Shock duration: 11 ms • Operation mode: working with service connected • Test duration: 6 axial directions. 3 shocks for each axial direction. • Operation mode: working with service connected	JESD-B104-C	3 pcs/group	TBD
	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	TBD
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	TBD
	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	TBD

Item		Test Condition	Standard	Sample size	Results
	Temperature cycle-Non operating	• High temperature: 85ºC • Low temperature: –40ºC • Temperature change slope: 6ºC/min • Operation mode: no power • Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A104-C	50 pcs/group	TBD
ESD	HBM (Human Body Model)	• 1 kV (Class 1 B) • Operation mode: no power	JESD22-A114-D	3 pcs/group	TBD
	ESD with DVK (or embedded in the host)	• Contact Voltage: ±2 kV, ±4 kV • Air Voltage: ±2 kV, ±4 kV, ±8 kV • Operation mode: working with service connected	IEC61000-4-2	2 pcs/group	TBD
NOTE Groups ≥ 2					

5.8 EMC and ESD Features

The following are the EMC design comments:

- Attention should be paid to static control in the manufacture, assembly, packaging, handling 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 SIM 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.
- PCB routing should be V-type rather than T-type for TVS.
- An integrated ground plane is necessary for EMC design.

The following are the requirements of ESD environment control:

- The electrostatic discharge protected area (EPA) must have an ESD floor whose surface resistance and system resistance are greater than 1 x 10^4 Ω while less than 1 x 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 x 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 x 10^5 Ω ≤ Soft ground resistance < 1 x 10^9 Ω
  - 1 x 10^5 Ω ≤ ICT fixture soft ground resistance < 1 x 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 ME709s-2 module does not include any protection against overvoltage..

6 Mechanical Specifications

6.1 About This Chapter

This chapter describes the process design and mechanical specifications:

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

6.2 Storage Requirement

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

6.3 Moisture Sensitivity

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

Table 6-1 Baking parameters

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

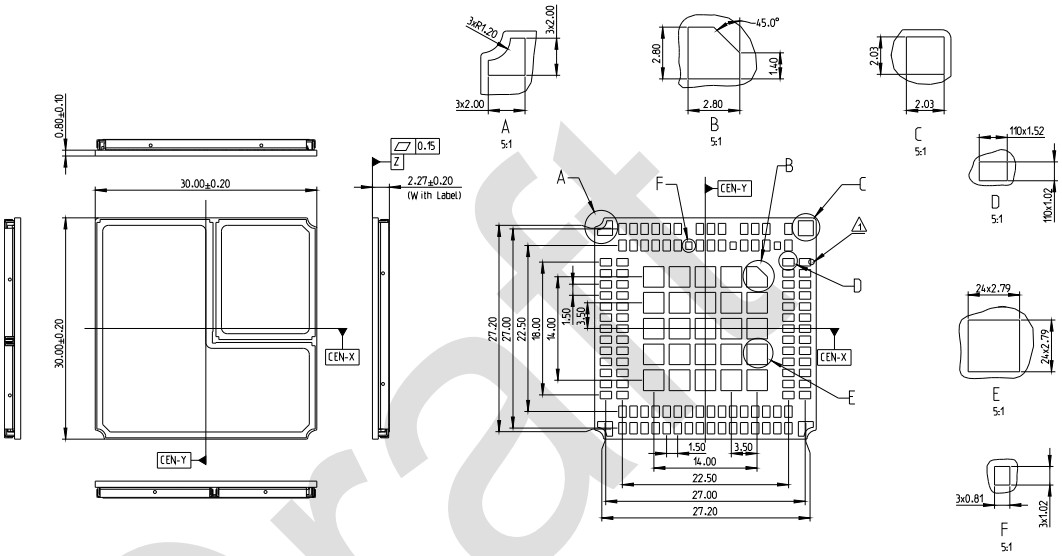
NOTE

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

6.4 Dimensions and Interfaces

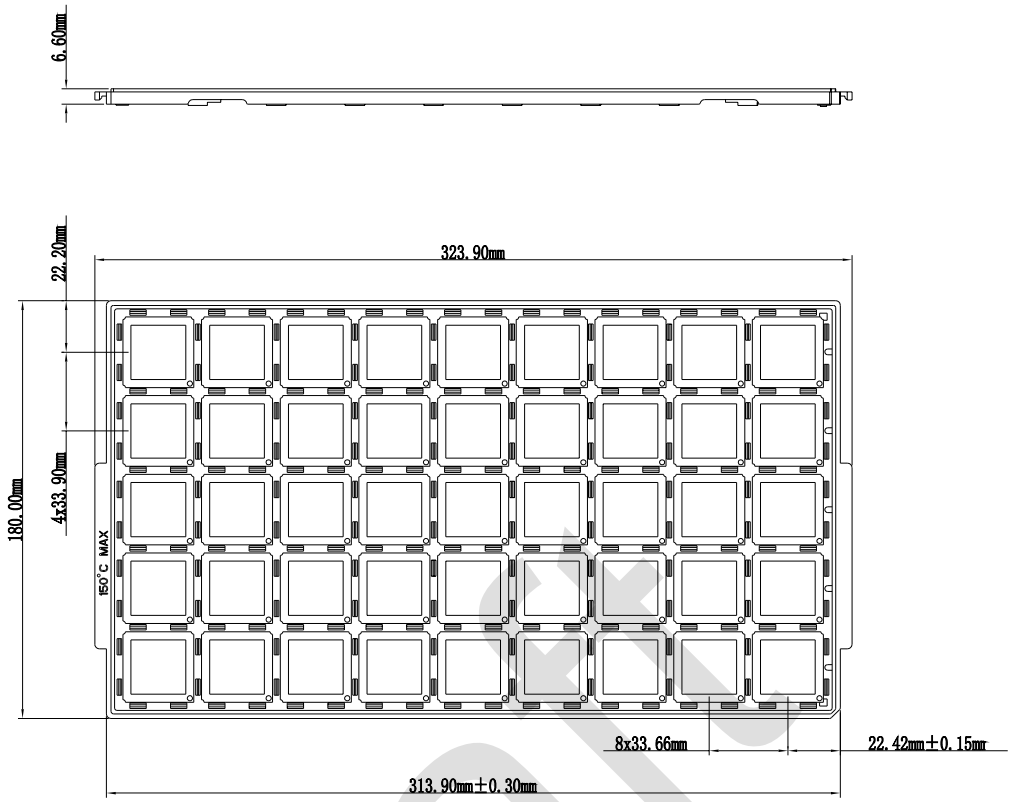
Figure 6-1 shows the dimensions in details.

Figure 6-1 Dimensions (unit: mm)

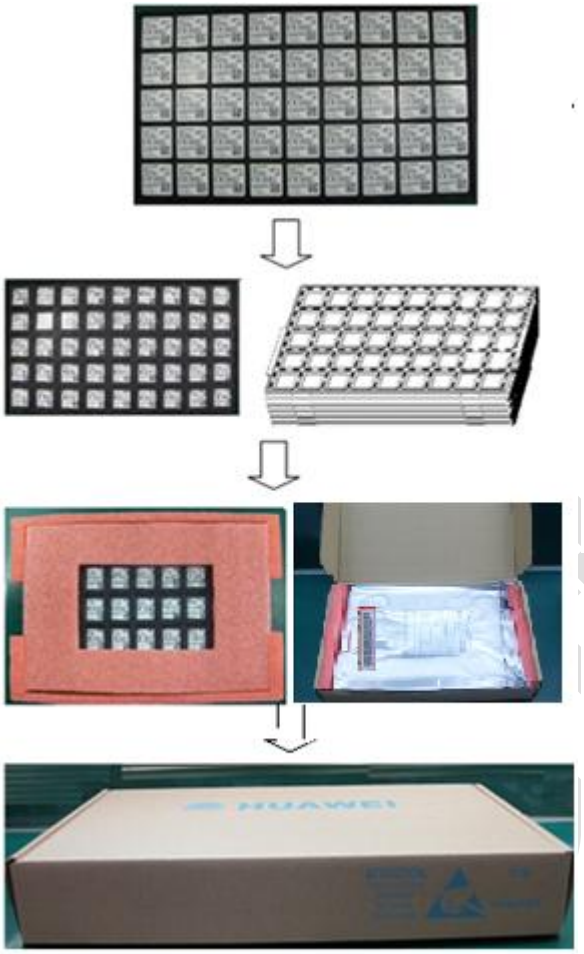


6.5 Packaging

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


6.60mm
22.20mm
323.90mm
180.00mm
4x33.90mm
150°C MAX
8x33.66mm
22.42mm±0.15mm
313.90mm±0.30mm

The following figure shows the packaging.



Orient LGA modules in the specified direction.

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

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

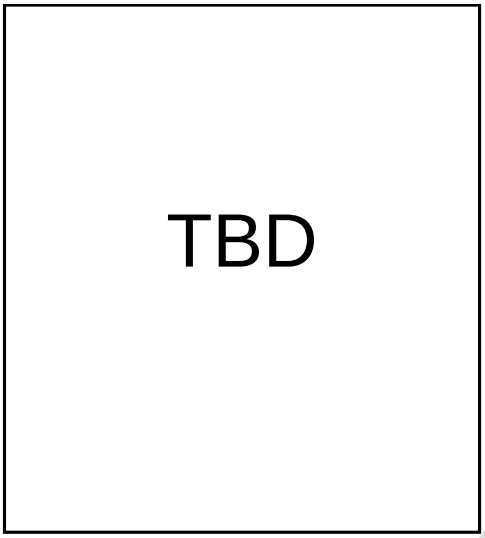
Total quantity per package: 5 x 45 = 225 pcs/vacuum package.

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

6.6 Label

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

Figure 6-2 MU709s-2 label (has not been frozen)



NOTE

The picture mentioned above is only for reference.

6.7 Customer PCB Design

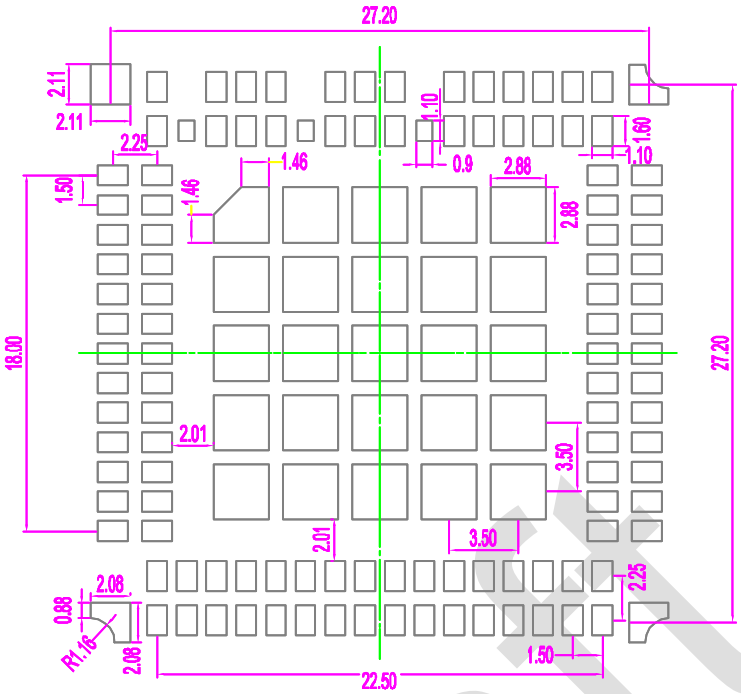
6.7.1 PCB Surface Finish

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

6.7.2 PCB Pad Design

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

Figure 6-3 MU709s-2 Footprint design (unit: mm)



6.7.3 Solder Mask

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

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

6.7.4 Requirements on PCB Layout

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

6.8 Assembly Processes

6.8.1 General Description of Assembly Processes

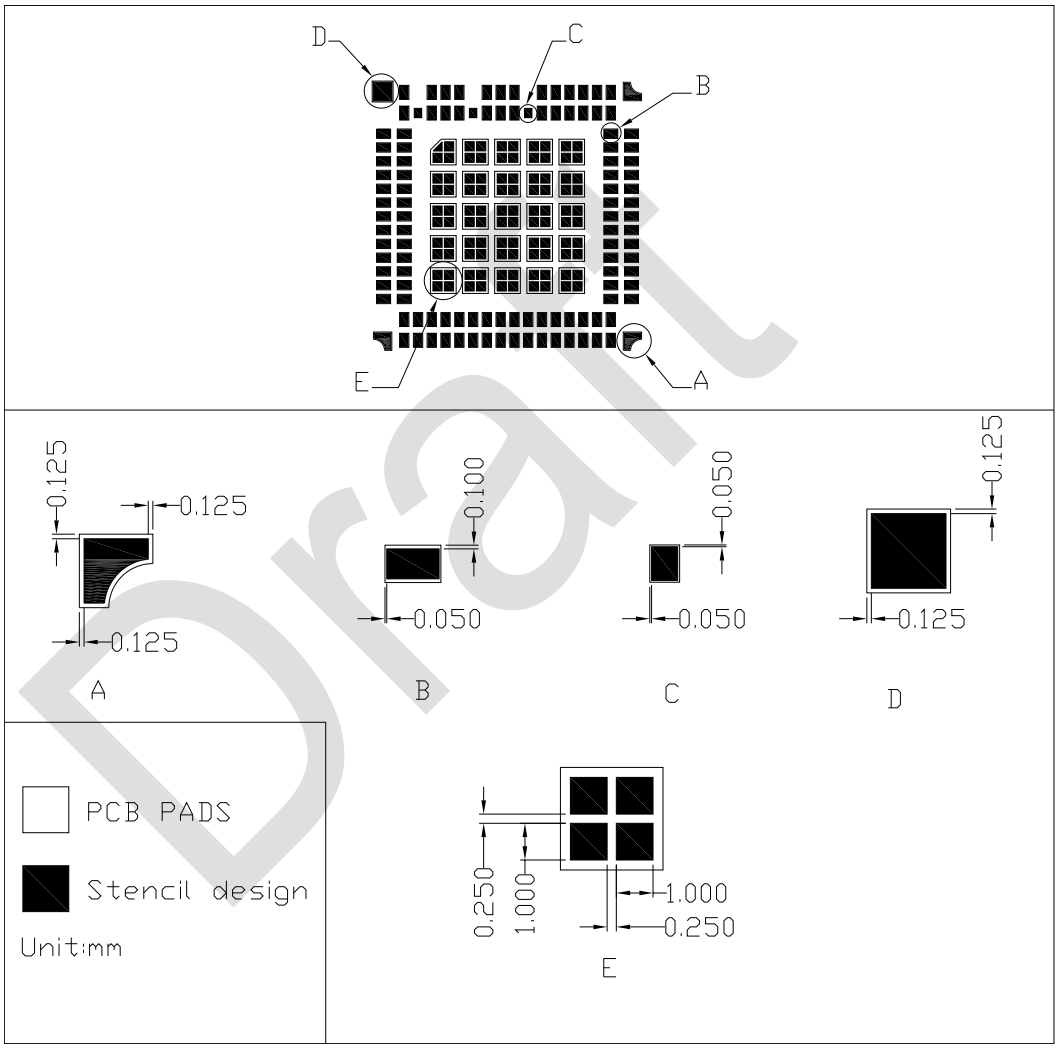
- Tray modules are required at SMT lines, because LGA modules are placed on ESD pallets.

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

6.8.2 Stencil Design

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

Figure 6-4 Recommended stencil design of LGA module (unit: mm)



NOTE

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

6.8.3 Reflow Profile

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

Figure 6-5 Reflow profile

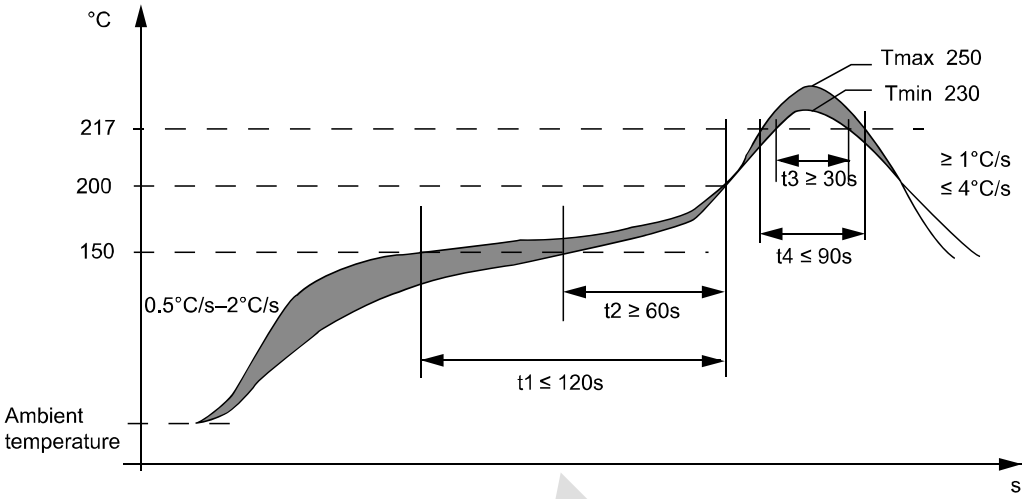
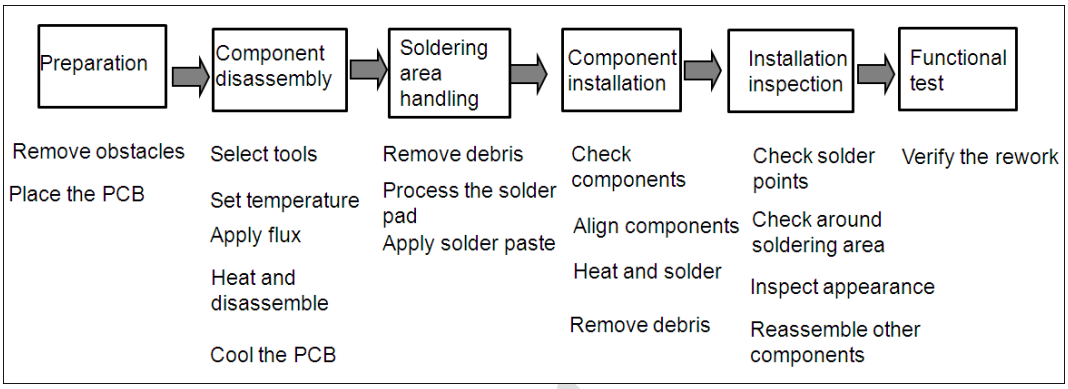


Table 6-2 Reflow parameters

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

6.9 Specification of Rework

6.9.1 Process of Rework



6.9.2 Preparations of Rework

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

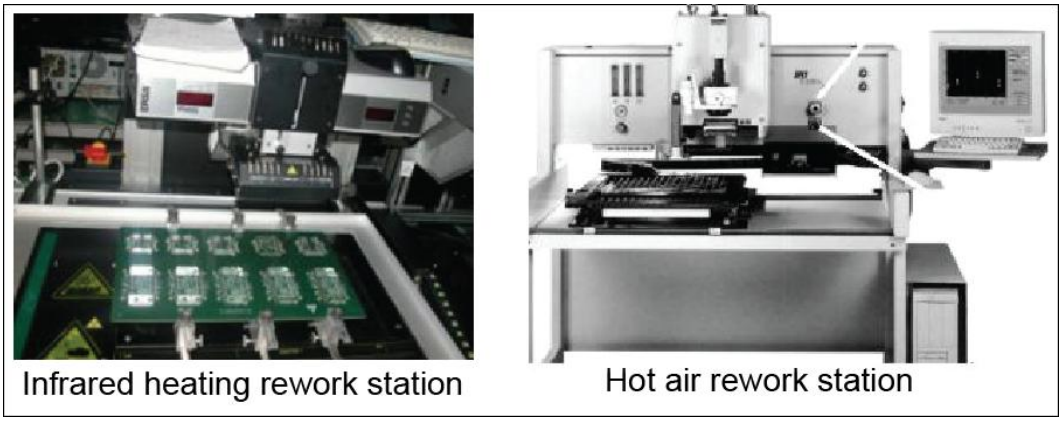
6.9.3 Removing of the Module

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

NOTE

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

Figure 6-6 Equipment used for rework



6.9.4 Welding Area Treatment

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

Step 2 Clean the pad and remove the flux residuals.

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

NOTE

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

6.9.5 Module Installation

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

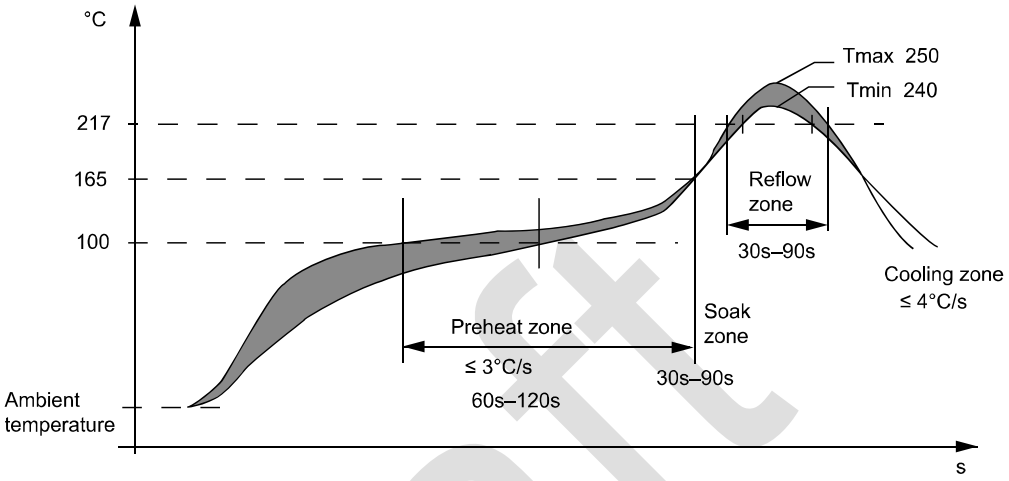
NOTE

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

6.9.6 Specifications of Rework

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

Figure 6-7 Temperature graph of rework



7 Certifications

7.1 About This Chapter

This chapter gives a general description of certifications of MU709s-2.

7.2 Certifications

NOTE

The certification of MU709s-2 is testing now. Table 7-1 shows certifications the MU709s-2 will be implemented. For more demands, please contact us for more details about this information.

Table 7-1 Product Certifications

Certification	Model name
	MU709s-2
CE	√
FCC	-
CCC	√
RoHS	√
GCF	√
PTCRB	-
WEEE	√

8 Safety Information

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

8.1 Interference

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

8.2 Medical Device

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

8.3 Area with Inflammables and Explosives

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

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

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

8.4 Traffic Security

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

8.5 Airline Security

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

8.6 Safety of Children

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

8.7 Environment Protection

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

8.8 WEEE Approval

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

8.9 RoHS Approval

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

8.10 Laws and Regulations Observance

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

8.11 Care and Maintenance

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

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

8.12 Emergency Call

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

8.13 Regulatory Information

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

8.13.1 CE Approval (European Union)

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

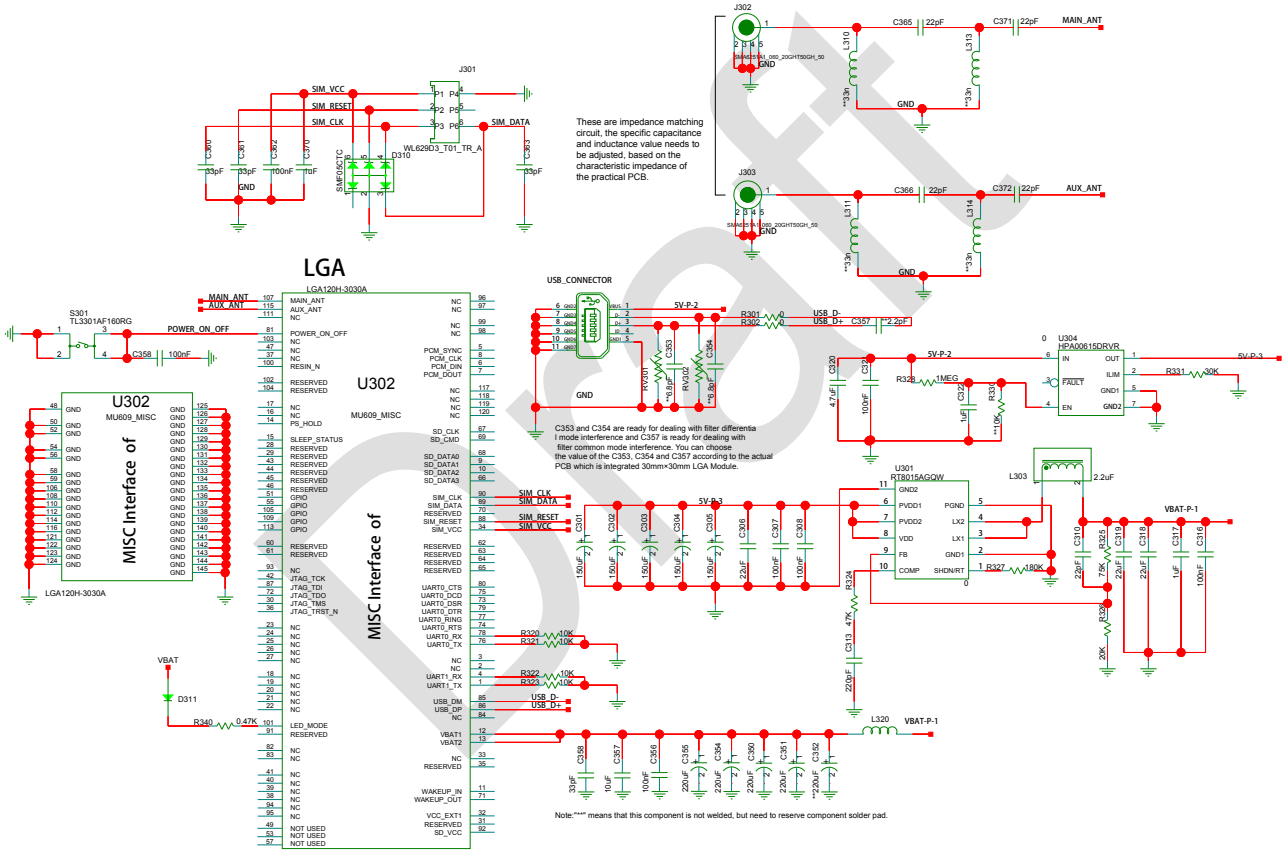
8.13.2 FCC Statement

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

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

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

9 Appendix A Circuit of Typical Interface



10 Appendix B Acronyms and Abbreviations

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

Acronym or Abbreviation	Expansion
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FCC	Federal Communications Commission
GMSK	Gaussian Minimum Shift Keying
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HBM	Human Body Model
HSDPA	High-Speed Downlink Packet Access
HSPA	Enhanced High Speed Packet Access
HSUPA	High Speed Up-link Packet Access
ISO	International Standards Organization
JTAG	Joint Test Action Group
LCP	Liquid Crystal Polyester
LDO	Low-Dropout
LED	Light-Emitting Diode
LGA	Land Grid Array
MCP	Multi-chip Package
MDM	Mobile Data Modem
MO	Mobile Originated
MT	Mobile Terminated
NC	Not Connected
NTC	Negative Temperature Coefficient
NSMD	Non-solder Mask Defined
PA	Power Amplifier
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PDU	Protocol Data Unit

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