HUAWEI MU739 HSPA+ LGA Module

Hardware Guide

Issue 11

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About This Document

Revision History

Version	Date	Chapter	Descriptions
01	2011-12-21		Creation
02	2012-01-04	6	Updated Figure 6-1
03	2012-02-29	3	Updated USB_VBUS voltage range
		9	Updated Appendix A Circuit of Typical Interface
04	2012-07-17	3.9	Deleted General Purpose I/O Interface in issue 03
		9	Updated Appendix A Circuit of Typical Interface
05	2012-08-23	6	Added the process design
06	2013-05-08	4.5.2	Updated Table 4-3
		4.6.1	Updated Antenna Design Indicators
		4.6.3	Updated GSM/WCDMA Antenna Requirements
		7.2	Updated Table 7-1
		7.3	Deleted Environmental Protection Certification and Test
		7.4	Deleted National Compulsory Certification
		7.5	Deleted GCF and PTCRB
		8.8	Updated WEEE Approval
		8.9	Updated RoHS Approval
		8.11	Updated Care and Maintenance
		8.13	Deleted Specific Absorption Rate (SAR)
		8.13	Updated Regulatory Information
07	2014-07-29	2.2	Updated Table 2-1 Features

Version	Date	Chapter	Descriptions
		2.3	Updated Figure 2-1 Circuit block diagram of the MU739 module
		2.4	Updated Figure 2-2 Application block diagram of the MU739 module
		3	Updated definitions of pins
		4.2	Deleted 4.2 Antenna Installation Guidelines
		4.4	Updated Table 4-2 MU739 conducted Rx sensitivity (Unit: dBm) and Table 4-3 MU739 conducted Tx power (Unit: dBm)
		4.5.4	Deleted 4.5.4 Radio Test Environment
		5.4	Deleted 5.4 Electrical Features of Application Interfaces
		5.4.2	Updated 5.4.2 Power Consumption
		5.5	Updated 5.5 Reliability Features
		5.6	Updated 5.6 EMC and ESD Features
		6.5	Updated 6.5 Packaging
		6.6	Updated 6.6 Label
		9	Updated 9 Appendix A Circuit of Typical Interface
08	2014-08-08	9	Updated 9 Appendix A Circuit of Typical Interface
09	2014-10-28	2.3	Updated Figure 2-1 Circuit block diagram of the MU739 module
		3.4.2	Added the description of power off time
		5.2	Updated the maximum voltage of VBAT in Table 5-1
		5.5	Updated the life test results of the reliability of the MU739 module in Table 5-8
10	2015-02-12	6.4	Updated Figure 6-1 Dimensions of MU739 (Unit: mm)
		6.6	Updated Figure 6-4 MU739 label
		6.7.2	Updated Figure 6-5 PCB pad design (Top View)
		6.7.4	Updated requirements on PCB layout
		6.8	Added thermal design solution
		6.9.2	Updated the stencil design of MU739

Version	Date	Chapter	Descriptions
		6.9.3	Updated reflow profile
11	2015-10-08	3	Updated the description about reserved pins and NC pins
		6.4	Updated dimensions
		6.9.2	Updated the recommended thickness of the stencil

Contents

1 Introduction

This document describes the hardware application interfaces and air interfaces that are provided when the HUAWEI MU739 HSPA+ LGA Module (hereinafter referred to as the MU739 module) is used.

This document helps you to understand the interface specifications, electrical features and related product information of the MU739 module.

2 Overall Description

2.1 About This Chapter

This chapter gives a general description of the MU739 module and provides:

- Function Overview
- Circuit Block Diagram
- Application Block Diagram

2.2 Function Overview

Table 2-1 Features

Feature	Description
Physical Features	• Dimensions (L × W × H): 30 mm × 20 mm × 2.0 mm • Weight: about 3.1 g
Operating Bands	• WCDMA/HSDPA/HSUPA/HSPA+: Band 1, Band 2, Band 4, Band 5, Band 8 • GSM/GPRS/EDGE: 850 MHz/900 MHz/1800 MHz/1900 MHz
Operating Temperature	Normal working temperature: –10°C to +55°C
	Extreme working temperature[1]: –20°C to +70°C
Ambient Temperature for Storage	–40°C to +85°C
Moisture	RH5% to RH95%
Power Voltage	3.3 V to 4.2 V (3.8 V is recommended.)
AT Commands	See the *HUAWEI MU739 HSPA+ LGA Module AT Command Interface Specification*.
Application Interface	USIM card (3.0 V or 1.8 V)

Feature	Description
(114-pin LGA interface)	USIM hot swap function
	Audio: one I2S interface
	USB 2.0 (high speed)
	Power on/off
	Reset
	LED control signals
	Antenna pads x 2
	W_DISABLE_N pin
	BODYSAR_N pin
	Power pins
SMS	New message alert, text message receiving, and text message sending
	Management of text messages: read messages, delete messages, storage status and message list
	Supporting MO and MT. Point-to-point and cell broadcast Supporting formats of TEXT and PDU
Data Services	GSM CS: UL 14.4 kbit/s; DL 14.4 kbit/s
	GPRS: UL 85.6 kbit/s; DL 85.6 kbit/s
	EDGE: DL 236.8 kbit/s; UL 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

[1]: When the MU739 module works from –20°C to –10°C or + 55°C to +70°C, **NOT** all its RF performances comply with the 3GPP RF specifications.

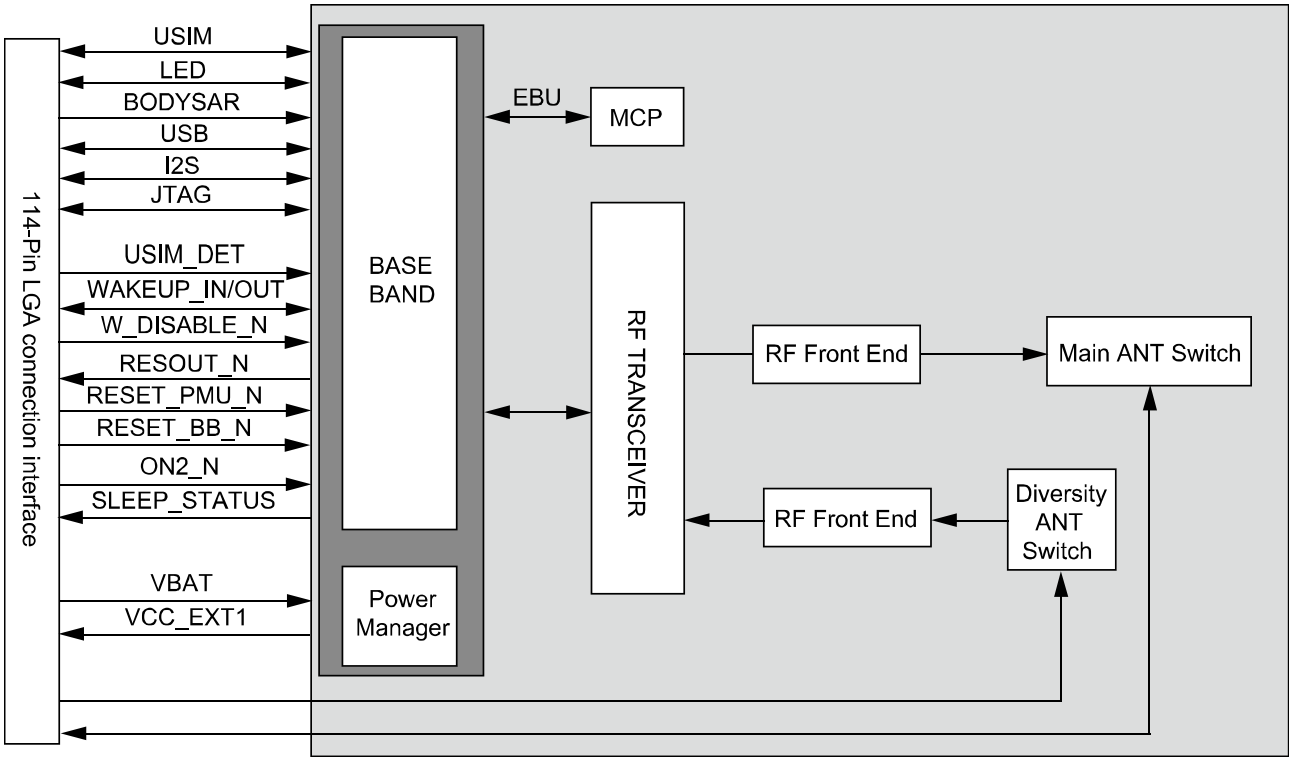
2.3 Circuit Block Diagram

Figure 2-1 shows the circuit block diagram of the MU739 module. The application block diagram and major functional units of the MU739 module contain the following parts:

- Baseband controller
- Power manager
- Multi-chip package (MCP) memory

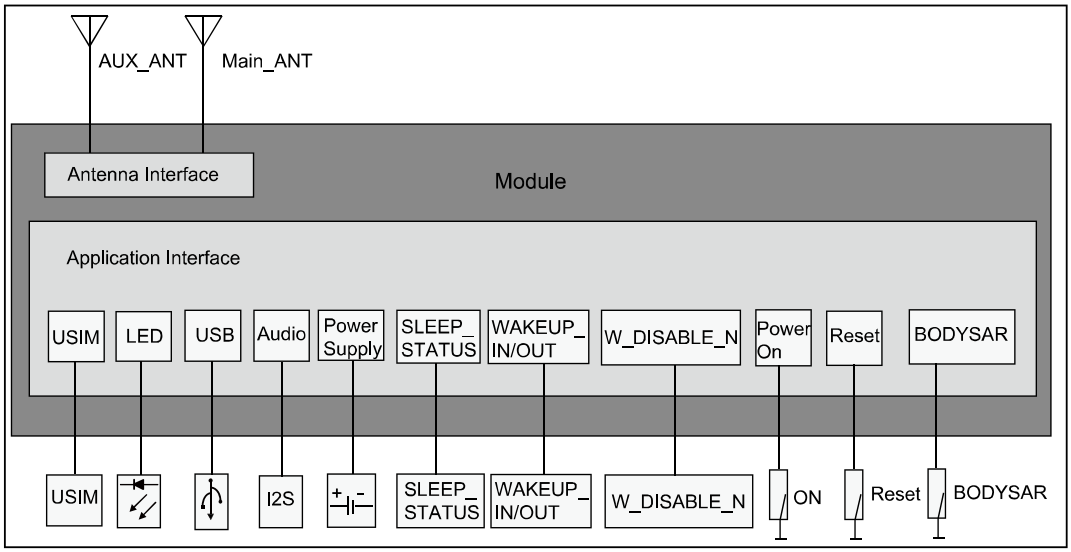
- Radio frequency (RF) transceiver
- RF interface
- RF PA

Figure 2-1 Circuit block diagram of the MU739 module



2.4 Application Block Diagram

Figure 2-2 Application block diagram of the MU739 module



USB Interface	The USB interface supports USB 2.0 high speed standard.
USIM Interface	The USIM interface provides the interface for a USIM card. The USIM card can be inserted into the host side.
Power Supply	DC 3.8 V is recommended.
Audio Interface	The module supports one I2S interface.
RF Pad	RF antenna interface

3 Description of the Application Interfaces

3.1 About This Chapter

This chapter mainly describes the external application interfaces of the MU739 module, including:

- LGA Interface
- Power Interface
- Signal Control Interface
- USB Interface
- USIM Card Interface
- Audio Interface
- JTAG Interface
- RF Antenna Interface
- Reserved Interface
- NC Interface

3.2 LGA Interface

The MU739 module uses a 114-pin LGA as its external interface. For details about the module and dimensions of the LGA, see 6.4 Dimensions.

Figure 3-1 shows the sequence of pins on the 114-pin signal interface of the MU739 module.

Figure 3-1 Bottom view of sequence of LGA interface pins

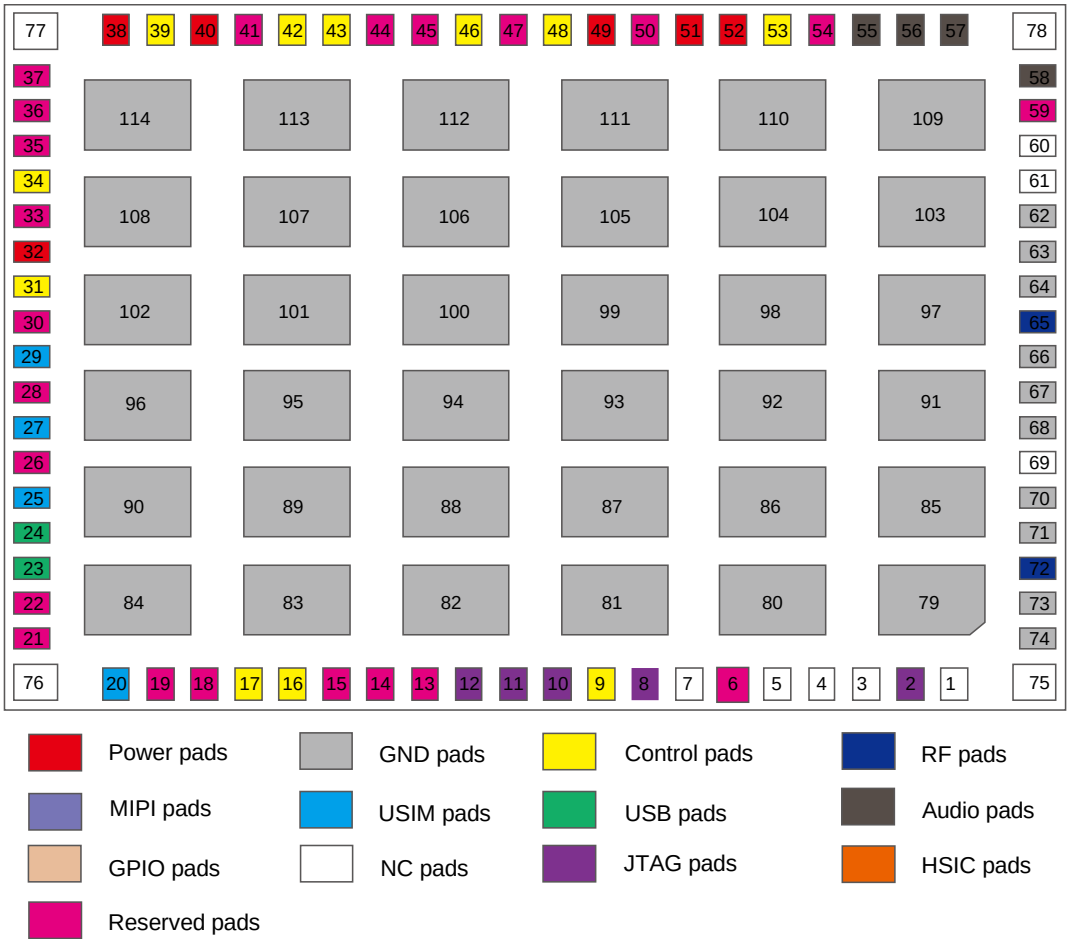


Table 3-1 shows the definitions of pins on the 114-pin signal interface of the MU739 module.

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	NC	-	Not connected	-	-	-	-	-
2	JTAG_TDO	O	JTAG Serial Data Out	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
3	NC	-	Not connected	-	-	-	-	-
4	NC	-	Not connected	-	-	-	-	-
5	NC	-	Not connected	-	-	-	-	-
6	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
7	NC	-	Not connected	-	-	-	-	-
8	JTAG_TRST_N	I	JTAG Reset/Module enable	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
9	RESOUT_N	O	Output to indicate the module's hardware is ready or not. H: Hardware is ready L: Hardware is not ready	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
10	JTAG_TMS	I	JTAG State machine control signal	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
11	JTAG_TDI	I	JTAG Serial Data Input	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
12	JTAG_TCK	I	JTAG clock input	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
13	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
14	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
15	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
16	USIM_DET	I	USIM hot swap detection. Rising edge for insertion; falling edge for removal. H: USIM is present. L: USIM is absent.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
17	SLEEP_STATUS	O	Indicates the sleep status of MU739 H: MU739 is awake. L: MU739 is in sleep.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
18	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
19	Reserved	-	Reserved, please keep this pin open.		-	-	-	-
20	USIM_VCC	PO	Power supply for USIM card	-	1.75	1.8	1.98	USIM_PWR=1.8 V
				-	2.75	2.85	3.3	USIM_PWR=2.85 V
21	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
22	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
23	USB_DP	I/O	High-speed USB D+	-	-	-	-	-
24	USB_DM	I/O	High-speed USB D-	-	-	-	-	-
25	USIM_RST	O	USIM Reset	V_{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x USIM_PWR	
26	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
27	USIM_CLK	O	USIM Clock	V_{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x USIM_PWR	
28	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
29	USIM_DATA	I/O	USIM Data Input/Output	V_{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR=1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x USIM_PWR	
				V_{IH}	0.7 x USIM_PWR	-	3.3	
				V_{IL}	0	-	0.2 x USIM_PWR	
30	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
31	RESET_PMU_N	I	PMU reset, low active	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
32	USB_VBUS	PI	Power supply for USB	-	3.3	-	5.0	-
33	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
34	BODYSAR_N	I	Hardware pin for BODYSAR_N Detection, active low. H: No TX power backoff (default). L: TX power backoff.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
35	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
36	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
37	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
38	VCC_EXT1	PO	1.8 V power output	-	1.7	1.8	1.9	-
39	W_DISABLE_N	I	Flight mode H: The RF will be turned	V_{IH}	1.26	1.8	2.1	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			on (default). L: The RF will be turned off.	V_{IL}	–0.3	-	0.63	-
40	VCC_IN	PI	1.8 V power input	-	1.7	1.8	1.9	-
41	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
42	WAKEUP_IN	I	H: MU739 cannot enter sleep mode. L: Permit MU739 to enter sleep mode (default).	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
43	WAKEUP_OUT	O	Module to wake up the host	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
44	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
45	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
46	LED#	O	Network status indication	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
47	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
48	ON2_N	I	Turn on the module, low active	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
49	VBAT_PMU	PI	Battery supply, power supply for Baseband and Transceiver	-	3.3	3.8	4.2	-
50	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
51	VBAT_PA	PI	Battery supply, power supply for PA	-	3.3	3.8	4.2	-
52	VBAT_PA	PI	Battery supply, power supply for PA	-	3.3	3.8	4.2	-
53	RESET_BB_N	I	Baseband reset, low active	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
54	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
55	I2S_CLK0	O	Serial clock	V_{OH}	1.35	1.8	2.1	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
				V_{OL}	0	-	0.45	-
56	I2S_RX	I	Serial receive data	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
57	I2S_TX	O	Serial transmit data	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
58	I2S_WA0	O	Word alignment select	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
59	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-
60	NC	-	Not connected	-	-	-	-	-
61	NC	-	Not connected	-	-	-	-	-
62	GND	-	Ground	-	-	0	-	-
63	GND	-	Ground	-	-	0	-	-
64	GND	-	Ground	-	-	0	-	-
65	MAIN_ANT	-	Main antenna	-	-	-	-	-
66	GND	-	Ground	-	-	0	-	-
67	GND	-	Ground	-	-	0	-	-
68	GND	-	Ground	-	-	0	-	-
69	NC	-	Not connected	-	-	-	-	-
70	GND	-	Ground	-	-	0	-	-
71	GND	-	Ground	-	-	0	-	-
72	AUX_ANT	-	Diversity antenna	-	-	-	-	-
73	GND	-	Ground	-	-	0	-	-
74	GND	-	Ground	-	-	0	-	-
75	NC	-	Not connected	-	-	-	-	-
76	NC	-	Not connected	-	-	-	-	-
77	NC	-	Not connected	-	-	-	-	-
78	NC	-	Not connected	-	-	-	-	-
79	GND	-	Ground	-	-	0	-	-
80	GND	-	Ground	-	-	0	-	-
81	GND	-	Ground	-	-	0	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
82	GND	-	Ground	-	-	0	-	-
83	GND	-	Ground	-	-	0	-	-
84	GND	-	Ground	-	-	0	-	-
85	GND	-	Ground	-	-	0	-	-
86	GND	-	Ground	-	-	0	-	-
87	GND	-	Ground	-	-	0	-	-
88	GND	-	Ground	-	-	0	-	-
89	GND	-	Ground	-	-	0	-	-
90	GND	-	Ground	-	-	0	-	-
91	GND	-	Ground	-	-	0	-	-
92	GND	-	Ground	-	-	0	-	-
93	GND	-	Ground	-	-	0	-	-
94	GND	-	Ground	-	-	0	-	-
95	GND	-	Ground	-	-	0	-	-
96	GND	-	Ground	-	-	0	-	-
97	GND	-	Ground	-	-	0	-	-
98	GND	-	Ground	-	-	0	-	-
99	GND	-	Ground	-	-	0	-	-
100	GND	-	Ground	-	-	0	-	-
101	GND	-	Ground	-	-	0	-	-
102	GND	-	Ground	-	-	0	-	-
103	GND	-	Ground	-	-	0	-	-
104	GND	-	Ground	-	-	0	-	-
105	GND	-	Ground	-	-	0	-	-
106	GND	-	Ground	-	-	0	-	-
107	GND	-	Ground	-	-	0	-	-
108	GND	-	Ground	-	-	0	-	-
109	GND	-	Ground	-	-	0	-	-
110	GND	-	Ground	-	-	0	-	-
111	GND	-	Ground	-	-	0	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
112	GND	-	Ground	-	-	0	-	-
113	GND	-	Ground	-	-	0	-	-
114	GND	-	Ground	-	-	0	-	-

NOTE

- **I** indicates pins for digital signal input; **O** indicates pins for digital signal output; **PI** indicates power input pins; **PO** indicates power output pins.
- V_{IL} 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.

3.3 Power Interface

3.3.1 Overview

The power supply part of the MU739 module contains:

- VBAT pin for the power supply
- USIM_VCC pin for USIM card power output
- USB_VBUS pin for USB power supply
- VCC_EXT1 pin for 1.8 V power output
- VCC_IN pin for pin 41–46 voltage supply

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
49	VBAT_PMU	PI	Battery supply, power supply for Baseband and Transceiver	-	3.3	3.8	4.2	-
51, 52	VBAT_PA	PI	Battery supply, power supply for PA	-	3.3	3.8	4.2	-
20	USIM_VCC	PO	Power supply for USIM card	-	1.75	1.8	1.98	USIM_PWR=1.8 V
				-	2.75	2.85	3.3	USIM_PWR=2.85 V

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
32	USB_VBUS	PI	Power supply for USB It is connected to VBAT_PMU (default).	-	3.3	-	5.0	-
38	VCC_EXT1	PO	1.8 V power output	-	1.7	1.8	1.9	-
40	VCC_IN	PI	1.8 V power input	-	1.7	1.8	1.9	-
62–64, 66–68, 70, 71, 73, 74, 79–114	GND	-	Ground	-	-	0	-	-

3.3.2 VBAT Interface

When the MU739 module works normally, power is supplied through the VBAT_PMU and VBAT_PA pins and the voltage ranges from 3.3 V to 4.2 V (typical value is 3.8 V). The 114-pin LGA module provides one VBAT_PMU pin, two VBAT_PA pins and forty-six GND pins. To ensure that the MU739 module works normally, all the pins must be connected.

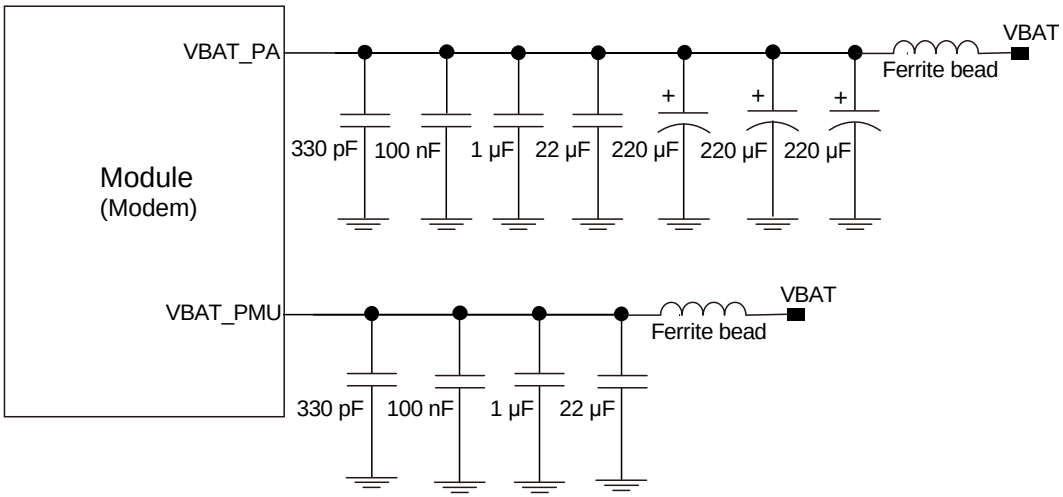
When the MU739 module is used for different applications, special attention should be paid to the design of the power supply. When the MU739 module transmits at the maximum power, the transient peak current may reach 2.75 A. In this case, the VBAT_PA voltage drops. Make sure that the voltage does not decrease below 3.3 V in any case. Otherwise, exceptions such as reset of the MU739 module may occur.

A low-dropout (LDO) regulator or switch-mode power supply with load current larger than 3 A is recommended. At least three 220 µF capacitors should be installed to VBAT_PA pins. And the trace of the power supply should be as short and wide as possible.

It is recommended to employ a ferrite bead in series on VBAT to improve the EMI performance. FBMJ1608HS280NT manufactured by TAIYO YUDEN or MPZ1608S300ATAH0 manufactured by TDK is recommended.

Figure 3-2 shows the recommended power circuit of MU739 module.

Figure 3-2 Recommended power circuit of MU739 module



3.4 Signal Control Interface

3.4.1 Overview

The signal control part of the interface in the MU739 module consists of the following:

- Power on pins (ON2_N)
- RESOUT_N pin
- PMU reset pin (RESET_PMU_N)
- Baseband reset pin (RESET_BB_N)
- Network status LED pin (LED#)
- W_DISABLE_N signal pin
- WAKEUP_IN signal pin
- WAKEUP_OUT signal pin
- SLEEP_STATUS signal pin

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

Table 3-3 Pins on the signal control interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
48	ON2_N	I	Turn on the module, low active	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
9	RESOUT_N	O	Output to indicate the module's hardware is ready or not.	V_{OH}	1.35	1.8	2.1	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
			H: Hardware is ready L: Hardware is not ready	V_{OL}	0	-	0.45	-
31	RESET_PMU_N	I	PMU reset, low active	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
53	RESET_BB_N	I	Baseband reset, low active	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
39	W_DISABLE_N	I	Flight mode H: The RF will be turned on (default). L: The RF will be turned off.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
46	LED#	O	Network status indication	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
42	WAKEUP_IN	I	H: MU739 can't enter sleep mode. L: Permit MU739 to enter sleep mode (default).	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
43	WAKEUP_OUT	O	Module to wake up the host	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
17	SLEEP_STATUS	O	Indicates the sleep status of MU739 H: MU739 is awake. L: MU739 is in sleep.	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
16	USIM_DET	I	USIM hot swap detection. Rising edge for insertion; falling edge for removal. H: USIM is present. L: USIM is absent.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
34	BODYSAR_N	I	Hardware pin for BODYSAR_N Detection, active low. H: No TX power backoff (default). L: TX power backoff.	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-

NOTE
It is recommended to use a resistor of 0 Ω in the AP side to isolate signals transmitted from above pins in Table 3-3 .

3.4.2 Input Signal Control Pins

The MU739 module implements power-on and resets the hardware through the input signal control pins. The power-on and reset control parts of the interface of the MU739 module include ON2_N interface signal and the baseband reset interface signal RESET_BB_N and the PMU reset signal RESET_PMU_N.

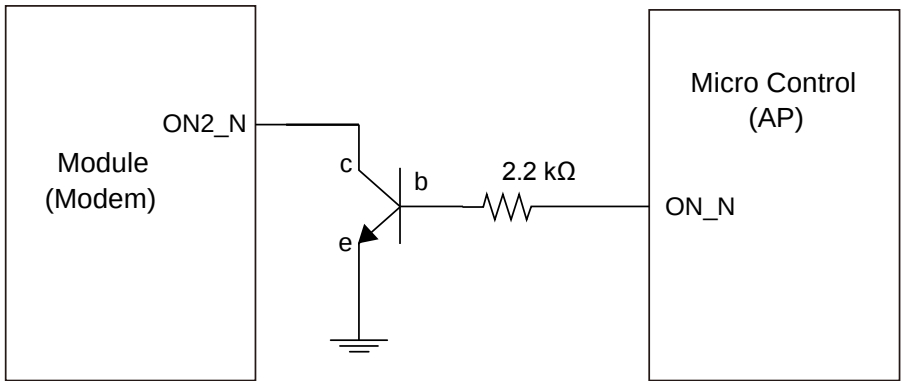
TURN ON

The ON2_N pin is used to implement turning on the module.

The ON2_N pin is low level active.

ON2_N can be controlled by a host processor GPIO (with internal pull-up under reset), when tied to GND, this input can be used to force an automatic booting up when power is applied or after a hard reset is performed.

Figure 3-3 Connections of ON2_N pin



Power On Time

It is recommended to power on module use the ON2_N pin.

After VBAT_PMU has been applied and been stable, the module will wait for an on-event and if the on signal is available, the module will be powered on.

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

ON2_N can power on the module.

Figure 3-4 Power on timing sequence

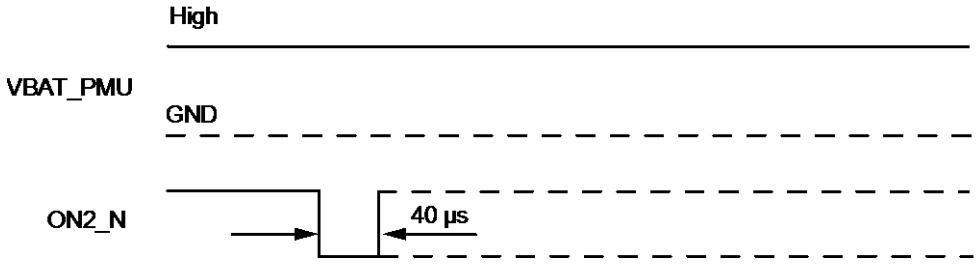
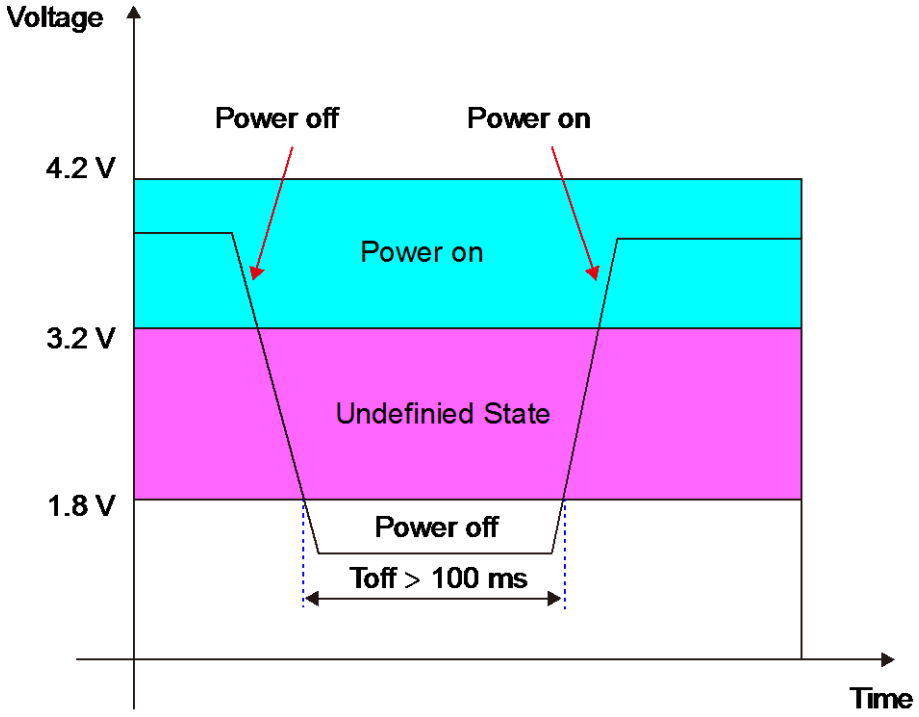


Table 3-4 Power on timing

Parameter	Comments	Time (Min value)	Unit
T_{ON2_N}	ON2_N turn on time	40	μs

Power Off Time

Figure 3-5 Power supply time sequence for power cycling



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

NOTE
MU739 does not support hardware shutting down, and it can only be powered off by cutting off the power supply.

RESET

The RESET_PMU_N pin is used to make a hard reset.

- Active low with internal pull-up (200 kΩ)
- Initiate power down of the modem system (baseband, PMU, RF&clocks)

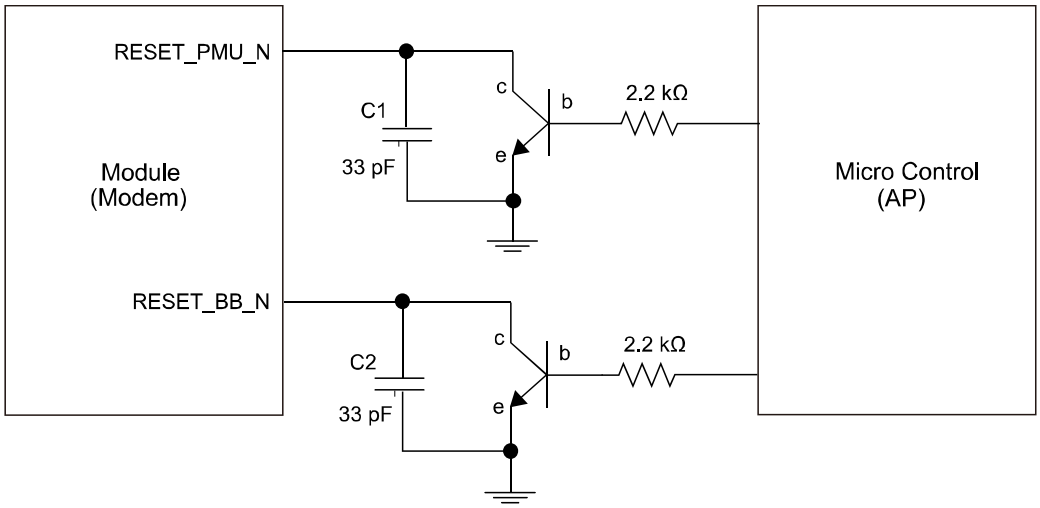
The RESET_BB_N pin is used to make a software reset.

- Active low without pull-up or pull-down
- Resets baseband sub-system.

CAUTION

As the RESET_PMU_N and RESET_BB_N signals are relatively sensitive; it is recommended that you install a 33 pF capacitor near these pins of the interfaces 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, it is recommended to wrap the area adjacent to the signal wire with a ground wire. Otherwise, the module may be reset due to interference.

Figure 3-6 Connections of RESET_BB_N and RESET_PMU_N pins



It is recommended to reset module using the RESET_BB_N.

When a low-level pulse is supplied through the RESET_PMU_N or RESET_BB_N for about 20 ms, the module will be reset.

Figure 3-7 Reset timing

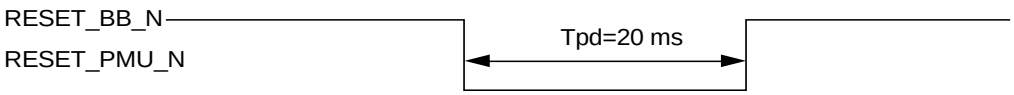


Table 3-5 Reset timing

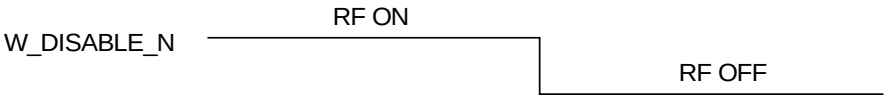
Parameter	Comments	Time (Typical value)	Unit
T_{pd}	Reset time	20	ms

W_DISABLE_N

When W_DISABLE_N is low, the RF will be turned OFF;

When W_DISABLE_N is high, the RF will be turned ON.

Figure 3-8 W_DISABLE_N timing



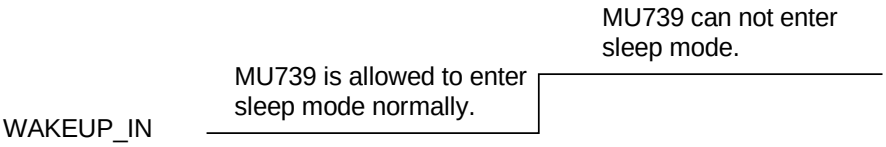
WAKEUP_IN

This is the authorization signal of MU739 entering sleep mode.

If this signal is pulled up to high (1.8 V) level, MU739 cannot enter sleep mode.

If this signal is low or open, MU739 is allowed to enter sleep mode normally.

Figure 3-9 WAKEUP_IN timing



USIM_DET

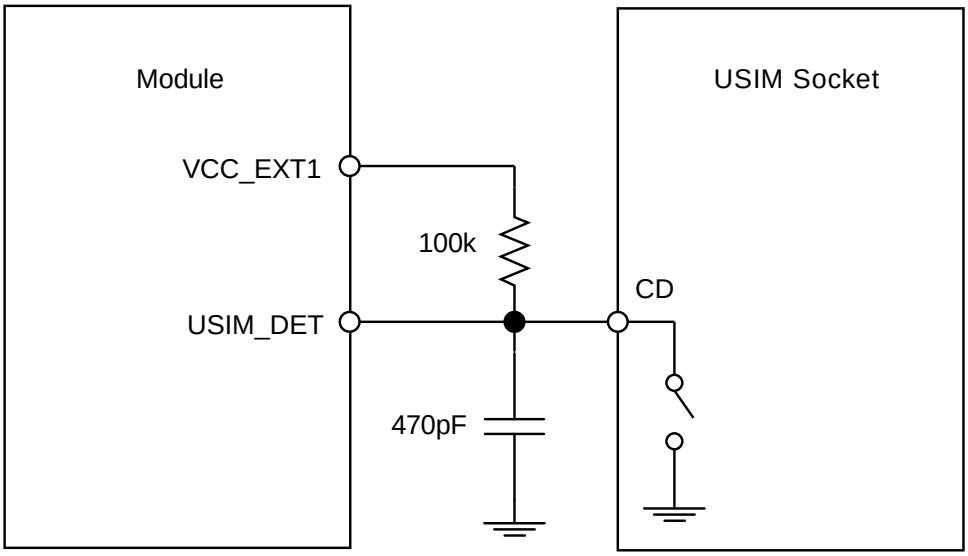
MU739 supports USIM Hot Swap function.

MU739 provides an input pin (USIM_DET) to detect whether the USIM card is present or not. This pin is an edge trigger pin.

Table 3-6 Function of the USIM_DET pin

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

Figure 3-10 Connections of the USIM_DET pin

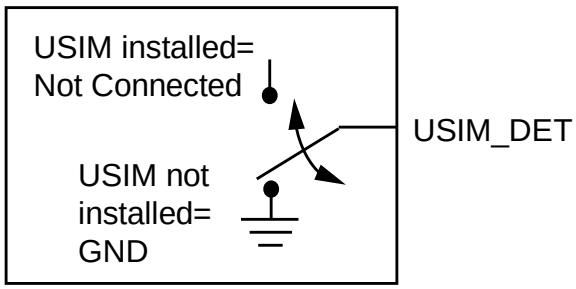


CD is a pin detecting USIM in the USIM socket, in normal, there will be a detect pin in the USIM Socket.

CAUTION

The Normal SHORT USIM connector should be employed. The logic of USIM_DET is shown as below. High represents that USIM is inserted; Low represents that USIM is removed.

USIM Connector Switch



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;

MU739 will detect the rising or falling edge of USIM_DET to react the hot swap.

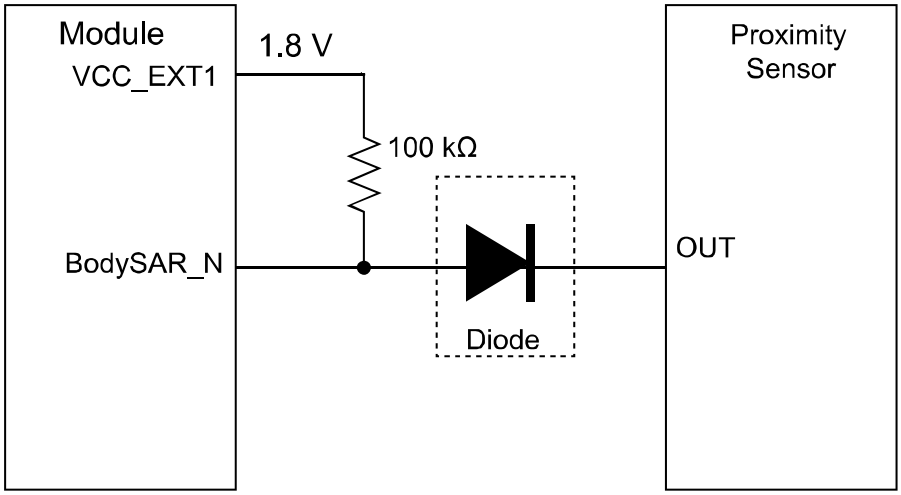
BODYSAR_N

The BODYSAR_N signal is used to monitor the proximity sensor's output and trigger the power backoff actions. It is low active.

There are some essential preconditions:

- MU739 cannot provide any control signal for the proximity sensor; any control or programming required by the P sensor should be handled by the PC side.
- MU739 can only provide one pin (pin 34) as the input, and this pin is the one and only connection between the proximity sensors.
- As for the one pin connection, voltage level translation and back biasing protection issues should be handled by the PC side.

Figure 3-11 Connections of the BodySAR_N pin



If the OUT pin is not open drain, the Diode must be populated to avoid back biasing; if the out OUT is open drain, the Diode should be shorted.

The diode should be a Schottky diode with extremely low forward voltage.

The key parameters of the diode are as below:

I_R<1 μA (at 125°C), V_F<0.4 V (when If=1 mA)

SBR0230T5 (Diodes) or RB520S30T1G (ON) is recommended.

3.4.3 Output Signal Control Pins

The MU739 module provides an LED control pin (LED#).

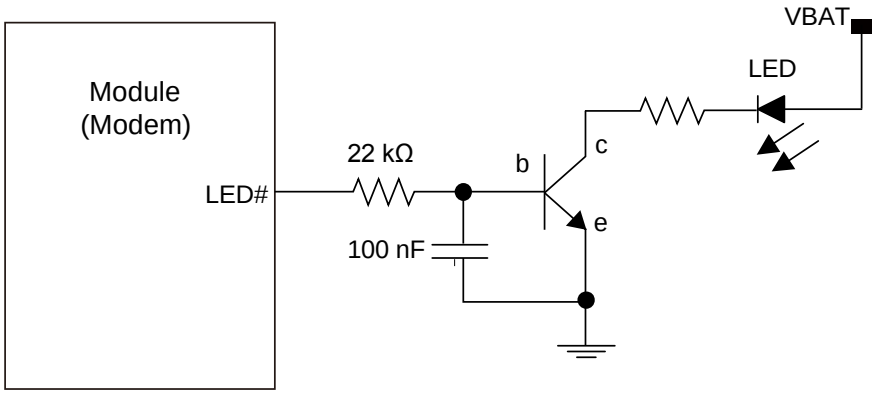
The pulse signal output through this pin controls the status of the LED on the user interface board to display the RF status.

Table 3-7 List of the LED# pin

No.	Operating Status	LED_STATUS
1	RF function is turned on	Output high
2	RF function is turned off	Output low

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

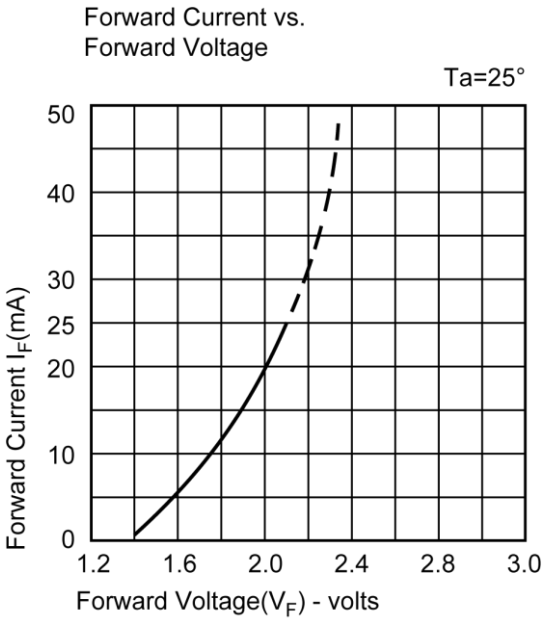
Figure 3-12 Driving circuit



It is recommended to use the triode of DTC144EET1G, LDTC144EET1G or PDTC144EE.115 in Figure 3-12 .

The brightness of the LED depends on the current value, and for most of the indicator lights the current from 2 mA to 5 mA is already enough.

Figure 3-13 LED Typical Electro-Optical Characteristics Curves



SLEEP_STATUS

The SLEEP_STATUS signal is used to indicate the status of MU739. The AP can get to know whether the module is in sleep or not by reading this pin.

When SLEEP_STATUS signal is high, MU739 is in normal work status.

When SLEEP_STATUS signal is low, MU739 is in sleep status.

WAKEUP_OUT

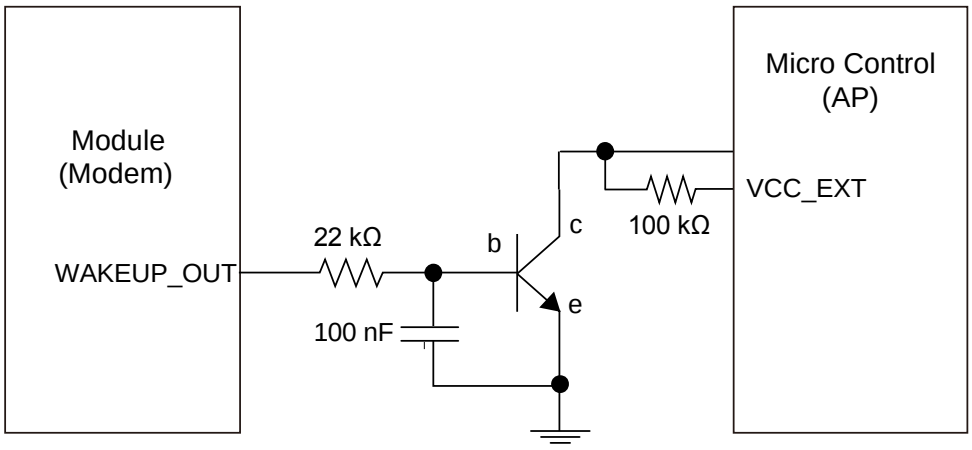
The WAKEUP_OUT signal is used to wake up the AP.

WAKEUP_OUT signal is low by default. When a phone call or an SMS is coming, the MU739 module will output a high pulse which lasts for 1s.

Within the duration of the high pulse, if a new phone call or an SMS is coming, the MU739 module will output the high pulse over again.

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

Figure 3-14 Connections of the WAKEUP_OUT pin



It is recommended to use the triode of DTC144EET1G, LDTC144EET1G or PDTC144EE.115 in Figure 3-14 .

RESOUT_N

RESOUT_N is an output of the module and is used to indicate the hardware of module is ready. Once system powers on, the RESOUT_N signal can be routed to the AP processor to allow the AP to monitor and detect resets of the modem system. During reset, RESOUT_N is an output signal, logic low. RESOUT_N would be monitored by a host processor GPIO (with internal pull-up).

3.5 USB Interface

The MU739 is compliant with USB 2.0 high speed protocol. The USB interface is powered from the USB_VBUS supply. The USB input/output lines are compatible with the USB 2.0 VBAT signal specifications. Figure 3-15 shows the circuit of the USB interface.

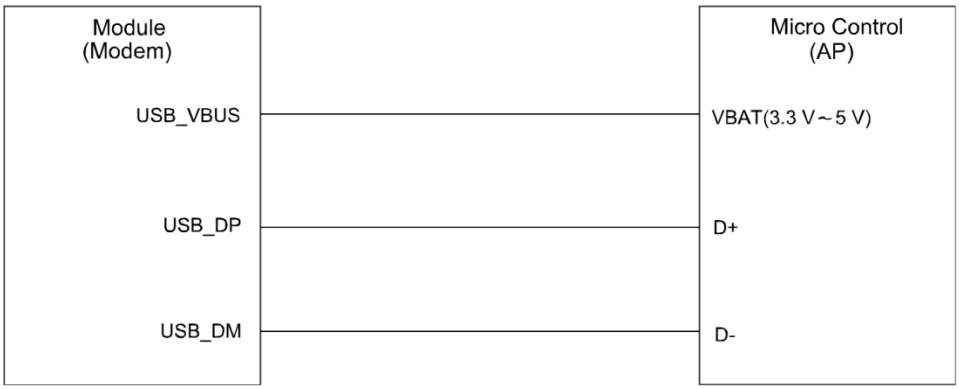
Table 3-8 Definition of the USB interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
23	USB_DP	I/O	High-speed USB D+	-	-	-	-	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
24	USB_DM	I/O	High-speed USB D-	-	-	-	-	-
32	USB_VBUS	PI	Power supply for USB	-	3.3	-	5.0	-

According to USB protocol, for bus timing or electrical characteristics of MU739 USB signal please refer to the chapter 7.3.2 of *Universal Serial Bus Specification 2.0.*

Figure 3-15 Recommended circuit of USB interface



NOTE

- The layout design of this circuit on the AP board should comply with the USB 2.0 high speed protocol, with differential impedance control to 90 Ω.
- It is recommended that set USB_DP and USB_DM pins as test points and then place these test points on the AP for debug.

3.6 USIM Card Interface

3.6.1 Overview

The MU739 module provides a USIM card interface complying with the ISO 7816-3 standard and supports automatic detection of a 3.0 V USIM card or a 1.8 V USIM card. Table 3-9 lists the USIM card interface signals.

Table 3-9 USIM card interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
20	USIM_VCC	PO	Power supply for USIM card	-	1.75	1.8	1.98	USIM_PWR =1.8 V
				-	2.75	2.85	3.3	USIM_PWR =2.85 V

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
25	USIM_RST	O	USIM Reset	V_{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR =1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x USIM_PWR	
27	USIM_CLK	O	USIM Clock	V_{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR =1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x USIM_PWR	
29	USIM_DATA	I/O	USIM Data Input/Output	V_{OH}	0.7 x USIM_PWR	-	3.3	USIM_PWR =1.8 V or 2.85 V
				V_{OL}	0	-	0.2 x USIM_PWR	
				V_{IH}	0.7 x USIM_PWR	-	3.3	
				V_{IL}	0	-	0.2 x USIM_PWR	
16	USIM_DET	I	USIM hot swap detection. Rising edge for insertion; falling edge for removal. H: USIM is present. L: USIM is absent.	V_{IH}	1.26	1.8	2.1	
				V_{IL}	–0.3	-	0.63	

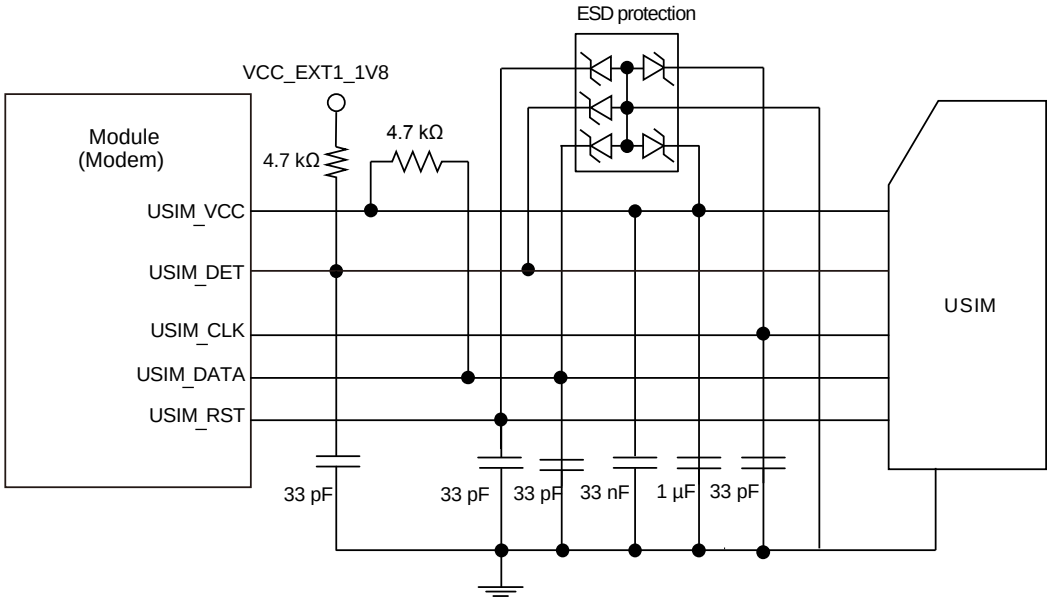
3.6.2 Circuit Recommended for the USIM Card Interface

As the MU739 module is not equipped with a USIM card socket, you need to place a USIM card socket on the user interface board. The USIM card signals are transmitted outwards through the 114-pin LGA interface. Figure 3-16 shows the circuit of the USIM card interface.

NOTE

There is no pull-up resistor on USIM_DATA inside the MU739 module, so an external resistor (4.7 kΩ recommended) must be added between USIM_DATA and USIM_VCC.

Figure 3-16 Circuit of the USIM card interface



CAUTION

- The ESD protection component should choose low capacitance. The capacitance of the component should be **less than 10 pF.**
- To meet the requirements of 3GPP TS 51.010-1 protocols and electromagnetic compatibility (EMC) authentication, the USIM socket should be placed near the 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 MU739 module.
- A 1 uF capacitor and a 33 pF capacitor are placed between the USIM_VCC and Ground pins in parallel. Three 33 pF capacitors are placed between the USIM_DATA and Ground pins, the USIM_RST 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. Transient voltage suppressor diode should be placed as close as possible to the USIM socket, and the Ground pin of the ESD protection component is well connected to the power Ground pin that supplies power to the MU739 module.

3.7 Audio Interface

MU739 provides one I2S interface to support the audio function, and it can be only used in the master mode. If customers need the audio function in their product, please contact with us for more details.

Table 3-10 I2S interface signals

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
55	I2S_CLK0	O	Serial clock	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
56	I2S_RX	I	Serial receive data	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	-
57	I2S_TX	O	Serial transmit data	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-
58	I2S_WA0	O	Word alignment select	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	-

3.8 JTAG Interface

MU739 module provides one JTAG interface (Joint Test Action Group). It is recommended that set the 5 pins related to JTAG interface as test points on the AP for tracing and debugging.

Table 3-11 Signals on the JTAG interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
2	JTAG_TDO	O	JTAG Serial Data Out	V_{OH}	1.35	1.8	2.1	-
				V_{OL}	0	-	0.45	
8	JTAG_TRST_N	I	JTAG Reset/Module enable	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
10	JTAG_TMS	I	JTAG State machine control signal	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
11	JTAG_TDI	I	JTAG Serial Data Input	V_{IH}	1.26	1.8	2.1	-
				V_{IL}	–0.3	-	0.63	
12	JTAG_TCK	I	JTAG clock input	V_{IH}	1.26	1.8	2.1	-

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
				V_{IL}	–0.3	-	0.63	

NOTE
It is suggested to place the above 5 test points on the AP board for debug.

3.9 RF Antenna Interface

MU739 module provides 2 antenna interfaces for connecting the external antennas.

Table 3-12 Signals on RF Antenna interface

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
65	MAIN_ANT	-	Main antenna	-	-	-	-	-
72	AUX_ANT	-	Diversity antenna	-	-	-	-	-

3.10 Reserved Interface

The module provides some reserved pins. All of reserved pins cannot be used by the customer. Please keep these pins open.

Table 3-13 Reserved pins

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
6, 13-15,18,19, 21, 22, 26, 28, 30, 33, 35-37, 41, 44, 45, 47, 50, 54, 59	Reserved	-	Reserved, please keep this pin open.	-	-	-	-	-

3.11 NC Interface

The MU739 module has some NC pins. There are no signal connected to these pins.

Table 3-14 NC pins

Pin No.	Pin Name	Pad Type	Description	Parameter	Min. (V)	Typ. (V)	Max. (V)	Comments
1, 3-5, 7, 60, 61, 69, 75-78	NC	-	Not connected	-	-	-	-	-

4 RF Specifications

4.1 About This Chapter

This chapter describes the RF specifications of the MU739 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 MU739.

Table 4-1 RF bands

Operating Band	Tx	Rx
WCDMA Band 1	1920 MH–1980 MHz	2110 MHz–2170 MHz
WCDMA Band 2	1850 MHz–1910 MHz	1930 MHz–1990 MHz
WCDMA Band 4	1710 MHz–1755 MHz	2110 MHz–2155 MHz
WCDMA Band 5	824 MHz–849 MHz	869 MHz–894 MHz
WCDMA 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

4.3 Conducted RF Measurement

4.3.1 Test Environment

Test instrument	R&S CMU200
Power supply	Keithley 2303, Agilent 66319
RF cable for testing	Rosenberger Precision Microwave Cable

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 MU739.

Table 4-2 MU739 conducted Rx sensitivity (Unit: dBm)

Band	Typical Value	Note
GSM 850	–109.5	BER Class II < 2.44%
GSM 900	–109	BER Class II < 2.44%
GSM 1800	–109	BER Class II < 2.44%
GSM 1900	–108.5	BER Class II < 2.44%
WCDMA Band 1	–110	BER < 0.1%
WCDMA Band 2	–110	BER < 0.1%
WCDMA Band 4	–110	BER < 0.1%
WCDMA Band 5	–110	BER < 0.1%
WCDMA Band 8	–110	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 MU739. The conducted transmit power refers to the maximum power that the module tested at the antenna port can transmit. According to the 3GPP protocol, the required transmit power varies with the power class.

Table 4-3 MU739 conducted Tx power (Unit: dBm)

Band		Typical Value	Note
GSM 850	GMSK (1Tx Slot)	32.5	±1 dB
	8PSK (1Tx Slot)	26.5	±1 dB
GSM 900	GMSK (1Tx Slot)	32.5	±1 dB
	8PSK (1Tx Slot)	26.5	±1 dB
GSM 1800	GMSK (1Tx Slot)	29.5	±1 dB
	8PSK (1Tx Slot)	25.5	±1 dB
GSM 1900	GMSK (1Tx Slot)	29.5	±1 dB
	8PSK (1Tx Slot)	25.5	±1 dB
WCDMA Band 1		23.5	±1 dB
WCDMA Band 2		23.5	±1 dB
WCDMA Band 4		23.5	±1 dB
WCDMA Band 5		23.5	±1 dB
WCDMA Band 8		23.5	±1 dB

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 MU739 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 be as low as possible.

The following antenna efficiency (free space) is recommended for MU739 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 values are recommended for the antenna of MU739:

- 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 the 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 MU739 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 MU739. 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

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.

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 MU739.

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 MU739.
Primary antenna: omnidirectional

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 MU739:
Primary/Diversity/WIFI 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 MU739:

- Gain of the primary antenna ≤ 2.5 dBi
- Gain of the 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 MU739 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 of primary antenna	70 MHz in GSM 850 80 MHz in GSM 900 170 MHz in GSM 1800 140 MHz in GSM 1900 250 MHz in WCDMA Band 1 140 MHz in WCDMA Band 2 445 MHz in WCDMA Band 4 70 MHZ in WCDMA Band 5 80 MHz in WCDMA Band 8

GSM/WCDMA Antenna Requirements	
Bandwidth of diversity antenna	60 MHz in WCDMA Band 1 60 MHz in WCDMA Band 2 45 MHz in WCDMA Band 4 25 MHz in WCDMA Band 5 35 MHz in WCDMA Band 8
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 of the interfaces in the MU739 module, including:

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

5.2 Absolute Ratings

WARNING

Table 5-1 lists the absolute ratings for the MU739 module. Using the MU739 module beyond these conditions may result in permanent damage to the module.

Table 5-1 Absolute maximum ratings for the MU739 module

Symbol	Specification	Minimum Value	Maximum Value	Unit
VBAT	External power voltage	–0.3	4.5	V
V_I	Data pin voltage	–0.3	3.6	V

5.3 Operating and Storage Temperature and Humidity

Table 5-2 lists the operating and storage temperature and humidity for the MU739 module.

Table 5-2 Operating and storage temperature and humidity for the MU739 module

Specification	Minimum Value	Maximum Value	Unit
Normal working temperature	–10	+55	°C
Extreme working temperature[1]	–20	+70	°C
Ambient temperature for storage	–40	+85	°C
Humidity	5	95	%

NOTE
[1]: When the MU739 module works from –20°C to –10°C or +55°C to +70°C, certain RF performances do not comply with the 3GPP RF specifications.

5.4 Power Supply Features

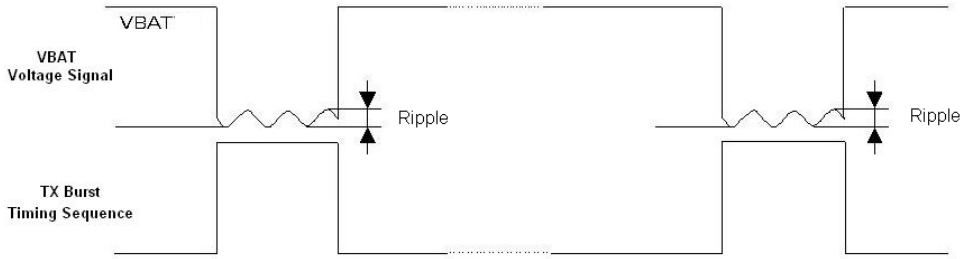
5.4.1 Input Power Supply

Table 5-3 lists the requirements for input power of the MU739 module.

Table 5-3 Requirements for input power for the MU739 module

Parameter	Minimum Value	Typical Value	Maximum Value	Ripple	Unit
VBAT	3.3	3.8	4.2	0.05	V

Figure 5-1 Power Supply During Burst Emission



NOTE
The VBAT Minimum Value must be guaranteed during the burst (with 2.75 A Peak in GSM, GPRS or EGPRS mode).

Table 5-4 Requirements for input current of the MU739 module

Power	Peak (Maximum)	Normal (Maximum)
3.8 V	2750 mA	1100 mA

5.4.2 Power Consumption

The power consumptions of MU739 in different scenarios are respectively listed in Table 5-5 , Table 5-6 and Table 5-7 .

The power consumption listed in this section are tested when the power supply of MU739 module is normal voltage (3.8 V), and all of test values are measured at room temperature.

Table 5-5 Averaged standby DC power consumption of MU739 (WCDMA/HSDPA/GSM)

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
Sleep	HSPA+/ WCDMA	UMTS bands	1.9	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network. USB is in suspend.
	GPRS/E DGE	GSM bands	2.0	Module is powered up. MFRMS=5 (1.175s) Module is registered on the network. USB is in suspend.
	Radio Off	All bands	1.4	Module is powered up. RF is disabled. USB is in suspend.
Idle	HSPA+/ WCDMA	UMTS bands	30	Module is powered up. DRX cycle=8 (2.56s) Module is registered on the network, and no data is transmitted. USB is in active.
	GPRS/E DGE	GSM bands	30	Module is powered up. MFRMS=5 (1.175s)

Description		Bands	Test Value (mA)	Notes/Configuration
			Typical	
				Module is registered on the network, and no data is transmitted. USB is in active.
	Radio Off	All bands	30	Module is powered up. RF is disabled. USB is in active.

Table 5-6 Averaged Data Transmission DC power consumption of MU739 (WCDMA/HSPA+)

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
WCDMA	Band 1 (IMT2100)	175	0 dBm Tx Power
		215	10 dBm Tx Power
		570	23.5 dBm Tx Power
	Band 2 (PCS 1900)	175	0 dBm Tx Power
		220	10 dBm Tx Power
		700	23.5 dBm Tx Power
	Band 4 (AWS)	170	0 dBm Tx Power
		210	10 dBm Tx Power
		600	23.5 dBm Tx Power
	Band 5 (850 MHz)	170	0 dBm Tx Power
		205	10 dBm Tx Power
		560	23.5 dBm Tx Power
	Band 8 (900 MHz)	165	0 dBm Tx Power
		205	10 dBm Tx Power
		600	23.5 dBm Tx Power
HSPA+	Band 1 (IMT2100)	190	0 dBm Tx Power
		230	10 dBm Tx Power
		700	23.5 dBm Tx Power
	Band 2	197	0 dBm Tx Power

Description	Band	Test Value (mA)	Notes/Configuration
		Typical	
	(PCS 1900)	240	10 dBm Tx Power
		720	23.5 dBm Tx Power
	Band 4 (AWS)	195	0 dBm Tx Power
		230	10 dBm Tx Power
		620	23.5 dBm Tx Power
	Band 5 (850 MHz)	191	0 dBm Tx Power
		220	10 dBm Tx Power
		600	23.5 dBm Tx Power
	Band 8 (900 MHz)	190	0 dBm Tx Power
		225	10 dBm Tx Power
		625	23.5 dBm Tx Power

Table 5-7 Averaged DC power consumption of MU739 (GPRS/EDGE)

Description	Test Value (mA)	PCL	Notes/Configuration
	Typical		
GPRS850	230	5	1 Up/1 Down
	395		2 Up/1 Down
	650		4 Up/1 Down
	95	10	1 Up/1 Down
	125		2 Up/1 Down
	165		4 Up/1 Down
GPRS900	225	5	1 Up/1 Down
	390		2 Up/1 Down
	620		4 Up/1 Down
	95	10	1 Up/1 Down
	125		2 Up/1 Down
	165		4 Up/1 Down
GPRS1800	190	0	1 Up/1 Down
	310		2 Up/1 Down

Description	Test Value (mA)	PCL	Notes/Configuration
	Typical		
	410		4 Up/1 Down
	90	10	1 Up/1 Down
	110		2 Up/1 Down
	145		4 Up/1 Down
GPRS1900	180	0	1 Up/1 Down
	295		2 Up/1 Down
	410		4 Up/1 Down
	90	10	1 Up/1 Down
	110		2 Up/1 Down
	145		4 Up/1 Down
EDGE850	175	8	1 Up/1 Down
	285		2 Up/1 Down
	460		4 Up/1 Down
	120	15	1 Up/1 Down
	175		2 Up/1 Down
	270		4 Up/1 Down
EDGE900	175	8	1 Up/1 Down
	280		2 Up/1 Down
	445		4 Up/1 Down
	120	15	1 Up/1 Down
	175		2 Up/1 Down
	265		4 Up/1 Down
EDGE1800	160	2	1 Up/1 Down
	260		2 Up/1 Down
	415		4 Up/1 Down
	110	10	1 Up/1 Down
	155		2 Up/1 Down
	230		4 Up/1 Down
EDGE1900	155	2	1 Up/1 Down
	250		2 Up/1 Down

Description	Test Value (mA)	PCL	Notes/Configuration
	Typical		
	410		4 Up/1 Down
	110	10	1 Up/1 Down
	155		2 Up/1 Down
	230		4 Up/1 Down

NOTE

- All power consumption test configuration can be referenced by GSM Association Official Document TS.09: Battery Life Measurement and Current Consumption Technique.
- Test condition: For Max Tx power, see 4.4.2 Conducted Transmit Power, they are listed in Table 4-3 ; for Max data throughput, see 2.2 Function Overview, they are listed in Table 2-1 Features.

5.5 Reliability Features

Table 5-8 lists the test conditions and results of the reliability of the MU739 module.

Table 5-8 Test conditions and results of the reliability of the MU739 module

Item		Test Condition	Standard	Sample size	Results
Stress	Low-temperature storage	• Temperature: –40ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A119-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High-temperature storage	• Temperature: 85ºC • Operation mode: no power, no package • Test duration: 24 h	JESD22-A103-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	Low-temperature operating	• Temperature: –20ºC • Operation mode: working with service connected • Test duration: 24 h	IEC60068-2-1	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High-temperature operating	• Temperature: 70ºC • Operation mode: working with service connected • Test duration: 24 h	JESD22-A108-C	3 pcs/group	Visual inspection: ok Function test: ok RF specification: ok

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

Item		Test Condition	Standard	Sample size	Results
	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: 70ºC • Operation mode: working with service connected • Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A108-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok
	High temperature & high humidity	• High temperature: 85ºC • Humidity: 85% • Operation mode: powered on and no working • Test duration: 168 h, 336 h, 500 h, 1000 h for inspection point	JESD22-A110-B	50 pcs/group	Visual inspection: ok Function test: ok RF specification: ok Cross section: ok

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

5.6 EMC and ESD Features

The following are the EMC design comments:

- Attention should be paid to static control in the manufacture, assembly, packaging, handling, and storage process to reduce electrostatic damage to HUAWEI module.
- RSE (Radiated Spurious Emission) may exceed the limit defined by EN301489 if the antenna port is protected by TVS (Transient Voltage Suppressor), which is resolved by making some adjustments on RF match circuit.
- TVS should be added on the USB port for ESD protection, and the parasitic capacitance of TVS on D+/D- signal should be less than 2 pF. Common-mode inductor should be added in parallel on D+/D- signal.
- TVS should be added on the USIM interface for ESD protection. The parasitic capacitance of TVS on USIM signal should be less than 10 pF.

- Resistors in parallel and a 10 nF capacitor should be added on RESET_BB_N signal to avoid shaking, and the distance between the capacitor and the related pin should be less than 100 mil.
- PCB routing should be V-type rather than T-type for TVS.
- An integrated ground plane is necessary for EMC design.

The following are the requirements of ESD environment control:

- The electrostatic discharge protected area (EPA) must have an ESD floor whose surface resistance and system resistance are greater than 1×10^4 Ω while less than 1×10^9 Ω.
- The EPA must have a sound ground system without loose ground wires, and the ground resistance must be less than 4 Ω.
- The workbench for handling ESD sensitive components must be equipped with common ground points, the wrist strap jack, and ESD pad. The resistance between the jack and common ground point must be less than 4 Ω. The surface resistance and system resistance of the ESD pad must be less than 1×10^9 Ω.
- The EPA must use the ESD two-circuit wrist strap, and the wrist strap must be connected to the dedicated jack. The crocodile clip must not be connected to the ground.
- The ESD sensitive components, the processing equipment, test equipment, tools, and devices must be connected to the ground properly. The indexes are as follows:
  - Hard ground resistance < 4 Ω
  - 1×10^5 Ω ≤ Soft ground resistance < 1×10^9 Ω
  - 1×10^5 Ω ≤ ICT fixture soft ground resistance < 1×10^{11} Ω
  - The electronic screwdriver and electronic soldering iron can be easily oxidized. Their ground resistance must be less than 20 Ω.
- The parts of the equipment, devices, and tools that touch the ESD sensitive components and moving parts that are close to the ESD sensitive components must be made of ESD materials and have sound ground connection. The parts that are not made of ESD materials must be handled with ESD treatment, such as painting the ESD coating or ionization treatment (check that the friction voltage is less than 100 V).
- Key parts in the production equipment (parts that touch the ESD sensitive components or parts that are within 30 cm away from the ESD sensitive components), including the conveyor belt, conveyor chain, guide wheel, and SMT nozzle, must all be made of ESD materials and be connected to the ground properly (check that the friction voltage is less than 100 V).
- Engineers that touch IC chips, boards, modules, and other ESD sensitive components and assemblies must wear ESD wrist straps, ESD gloves, or ESD finger cots properly. Engineers that sit when handling the components must all wear ESD wrist straps.
- Noticeable ESD warning signs must be attached to the packages and placement areas of ESD sensitive components and assemblies.
- Boards and IC chips must not be stacked randomly or be placed with other ESD components.
- Effective shielding measures must be taken on the ESD sensitive materials that are transported or stored outside the EPA.

NOTE

HUAWEI MU739 Module does not include any protection against overvoltage.

6 Process Design

6.1 About This Chapter

This chapter describes the process design and mechanical specifications:

- Storage Requirement
- Moisture Sensitivity
- Dimensions
- Packaging
- Label
- 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

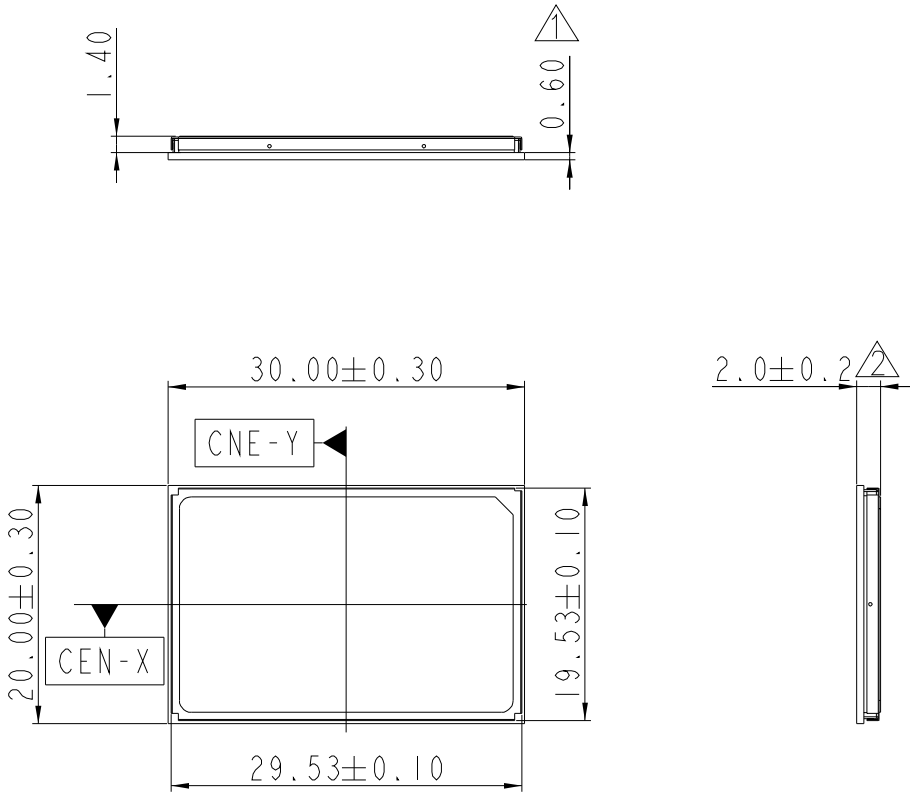
Baking Temperature	Baking Condition	Baking Duration	Remarks
125°C±5°C	Relative humidity ≤ 60%	8 hours	-

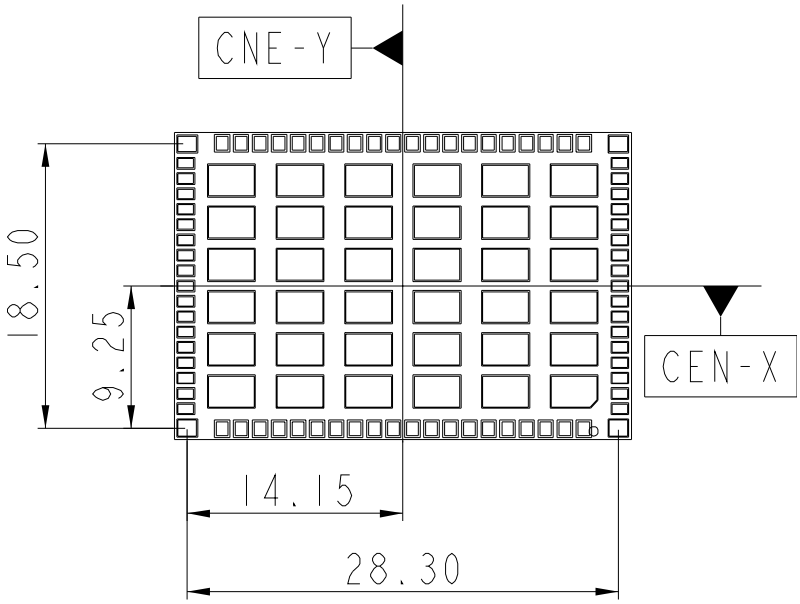
NOTE
Moving, storing, and processing the product must comply with IPC/JEDEC J-STD-033.

6.4 Dimensions

Figure 6-1 shows the dimensions of MU739 in details.

Figure 6-1 Dimensions (Unit: mm)

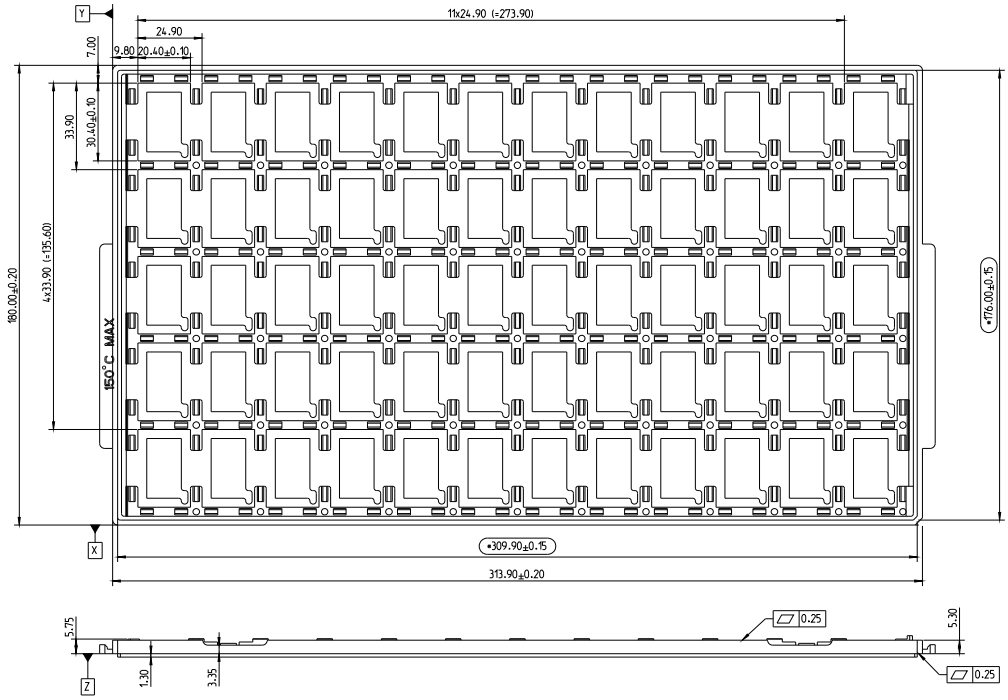




6.5 Packaging

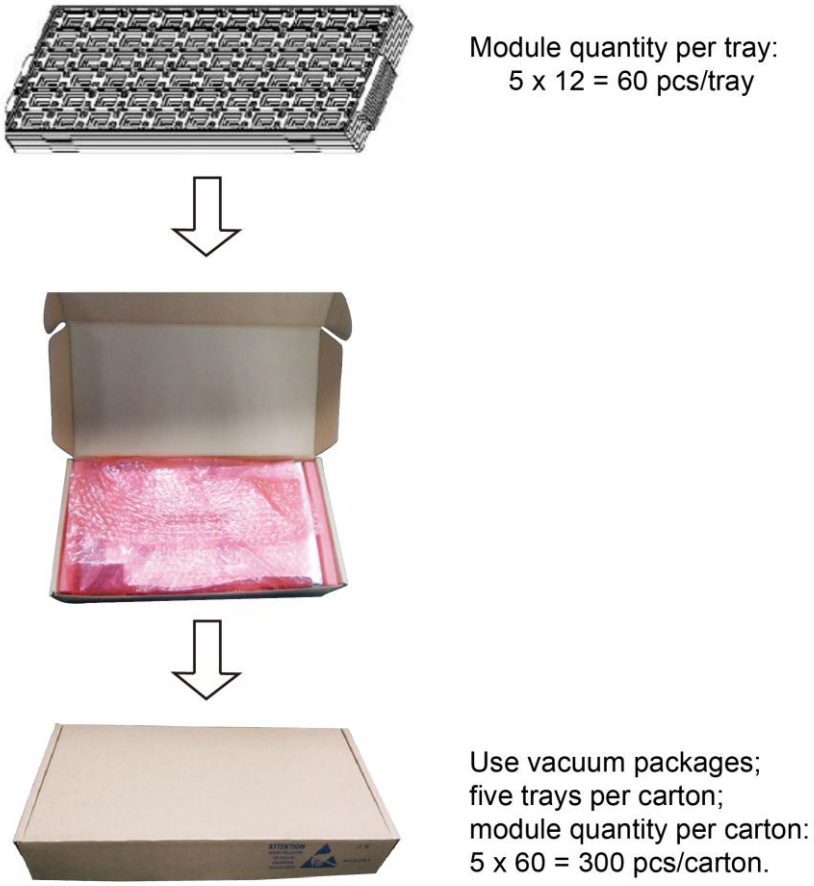
The module uses five layers ESD pallet, anti-vibration foam and vacuum packing into cartons.

Figure 6-2 ESD pallet (Unit: mm)



The following figure shows the packaging.

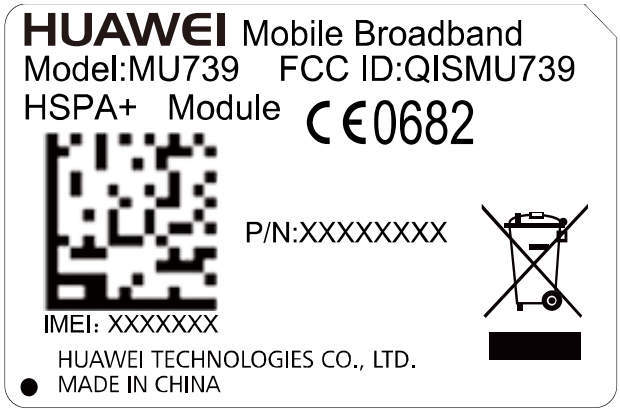
Figure 6-3 Description of the packaging



6.6 Label

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

Figure 6-4 MU739 label



NOTE

The picture mentioned above is only for reference.

6.7 Customer PCB Design

6.7.1 PCB Surface Finish

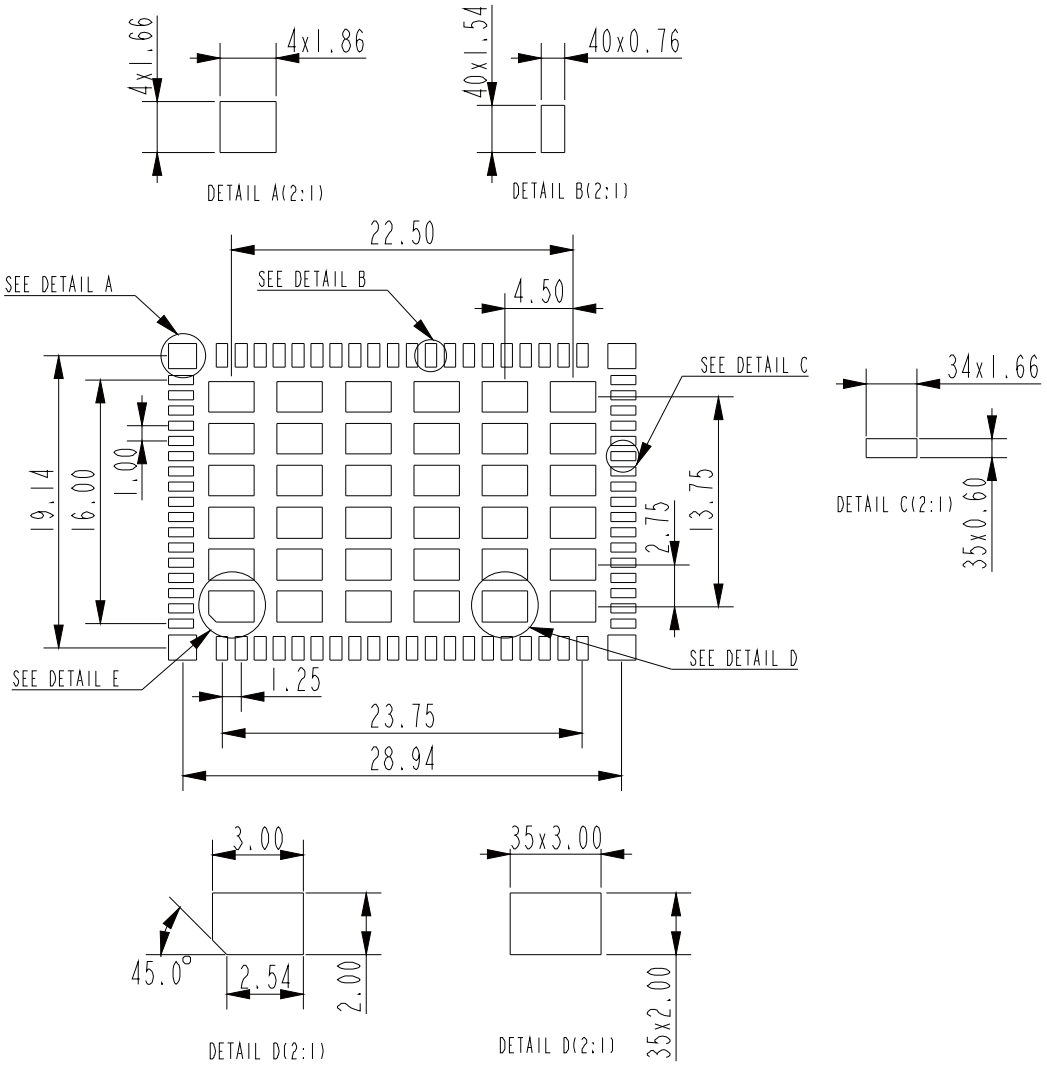
The PCB surface finish recommended is Electroless Nickel, immersion Gold (ENIG). Organic Solderability Preservative (OSP) may also be used, ENIG preferred.

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:

The sizes of the solder pads on customers' PCBs are the same as those of the module package's solder pads. For details, see the following figure.

Figure 6-5 PCB pad design (Top View) (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.

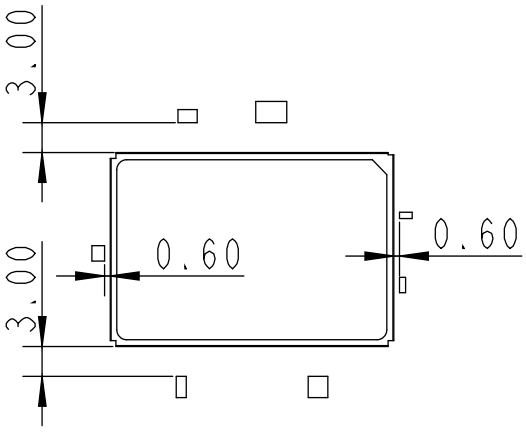
The solder mask must be 100 µm–150 µm larger than the pad, that is, the single side of the solder mask must be 50 µm–75 µm larger than the pad. The specific size depends on the processing capability of the PCB manufacturer.

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 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 LGA 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 6-6 PCB Layout (unit: mm)



6.8 Thermal Design Solution

When the module works in the maximum power condition, the module has high power consumption (for details, see 5.4.2 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 MU739 module, you can refer to 5.3 Operating and Storage Temperature and Humidity.

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 6-7 and Figure 6-8 . 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 6-7 Adding heat sink to the module for optimal heat dissipation

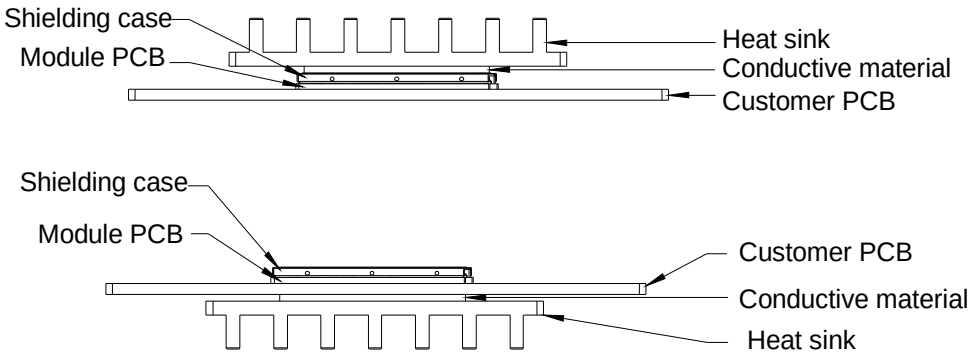
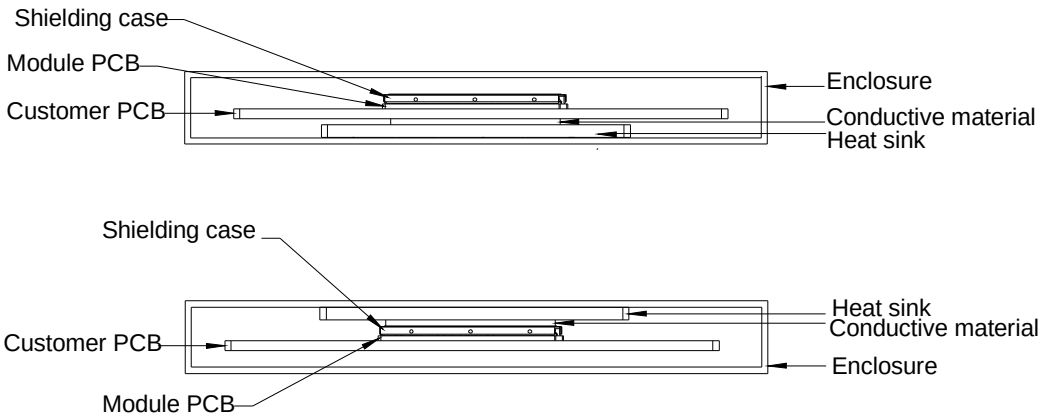


Figure 6-8 Adding enclosure to enhance the heat dissipation of the module



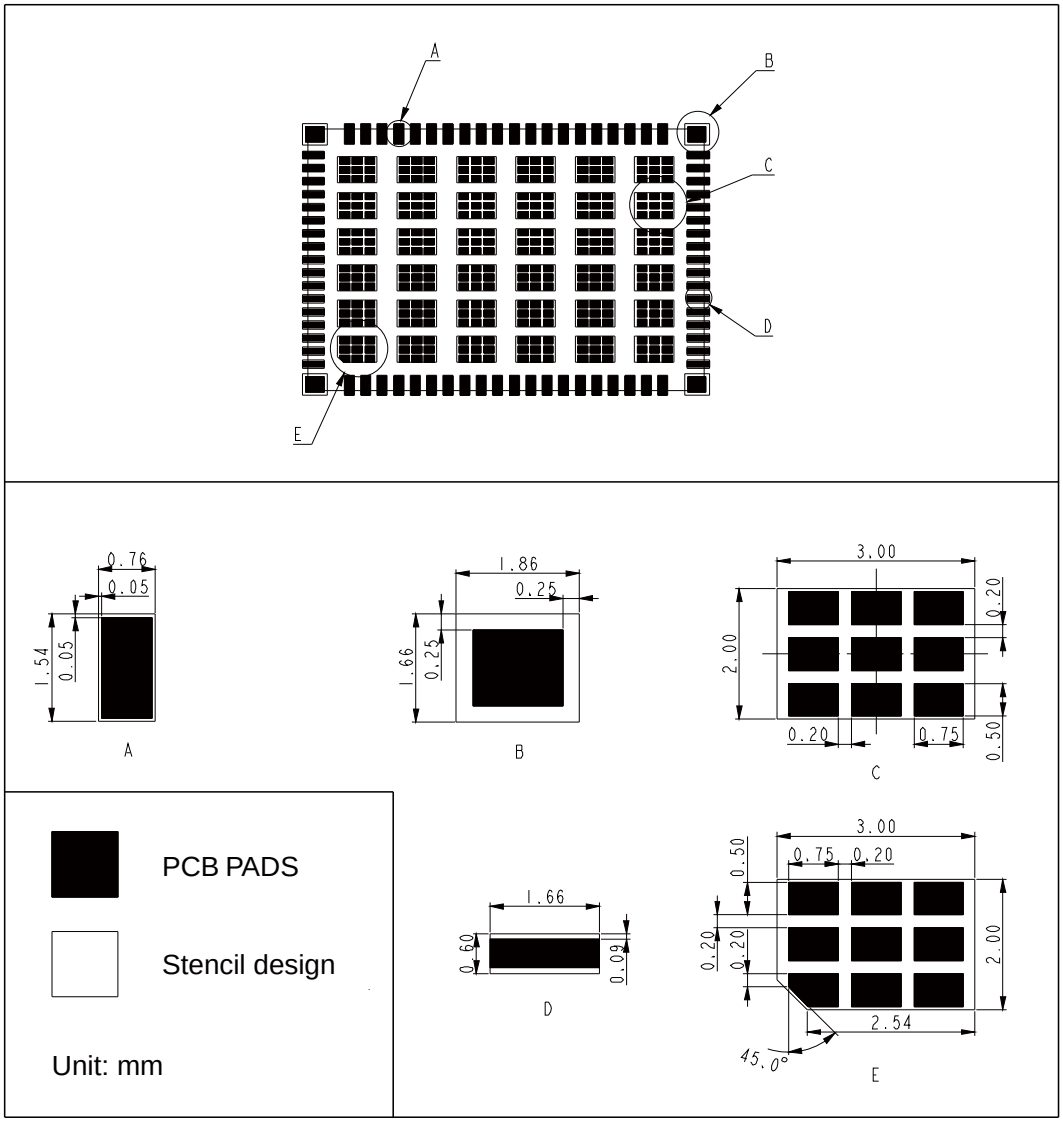
6.9 Assembly Processes

6.9.1 General Description of Assembly Processes

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

6.9.2 Stencil Design

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



NOTE

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

6.9.3 Reflow Profile

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

Figure 6-9 Reflow profile

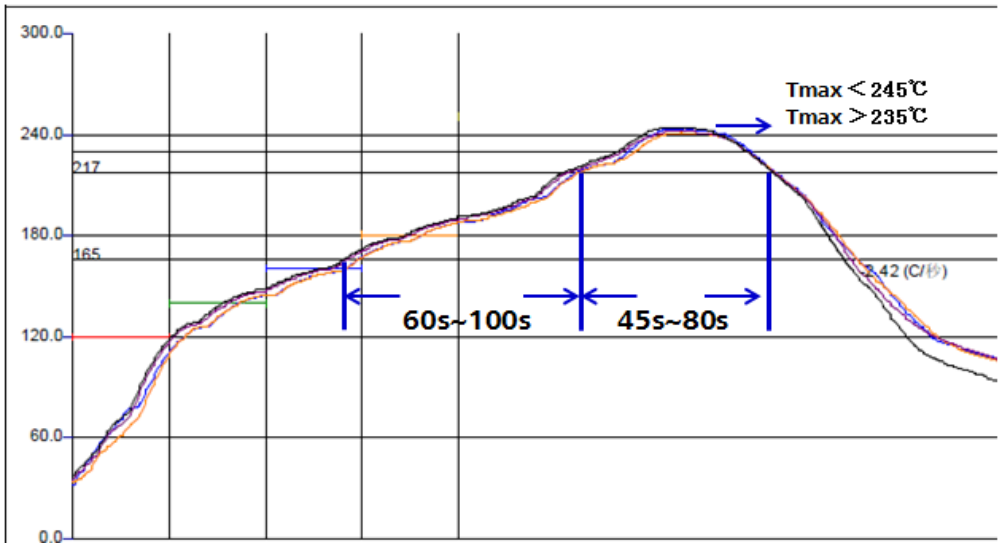
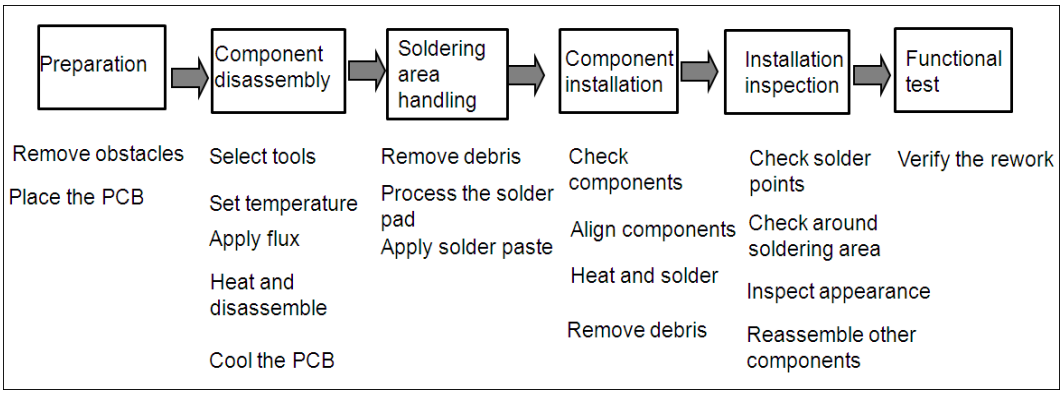


Table 6-2 Reflow parameters

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	

6.10 Specification of Rework

6.10.1 Process of Rework



NOTE

Huawei provides the rework scheme to assemble and remove the module. After the rework, customers can evaluate the reliability based on their own requirement.

6.10.2 Preparations of Rework

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

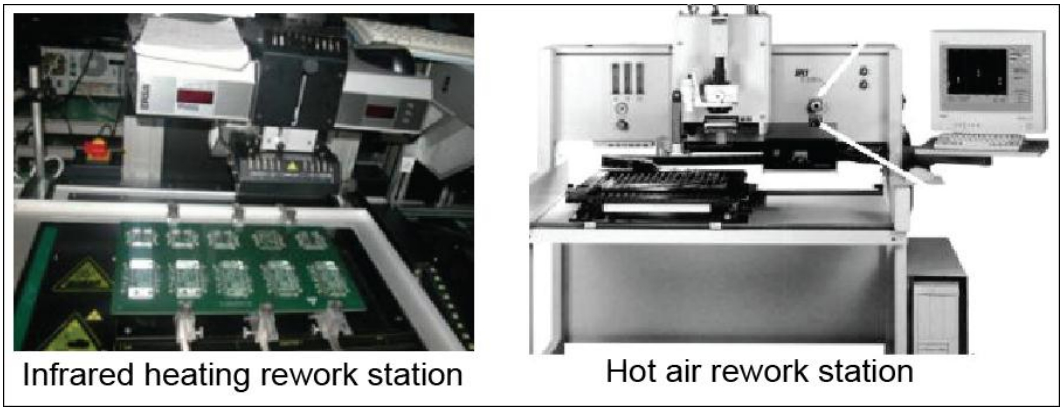
6.10.3 Removing the Module

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 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 the module, 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



6.10.4 Welding Area Treatmtent

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.

6.10.5 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).

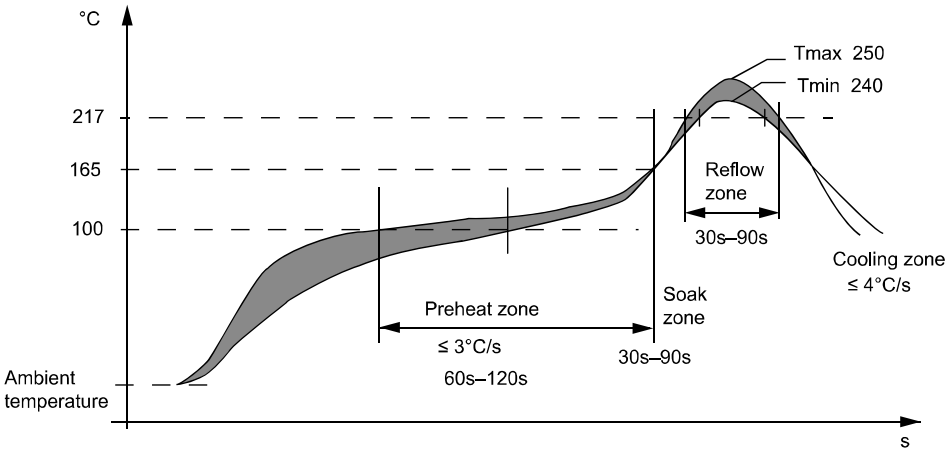
NOTE

- 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.

6.10.6 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 MU739.

7.2 Certifications

NOTE
Table 7-1 shows certifications the MU739 has been implemented. For more demands, please contact us for more details about this information.

Table 7-1 Product Certifications

Certification	Model name
	MU739
CE	√
FCC	√
CCC	√
NCC	-
A-TICK	√
Jate & Telec	-
IC	-
EU RoHS	√
PVC-Free	-
GCF	√
PTCRB	√

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).

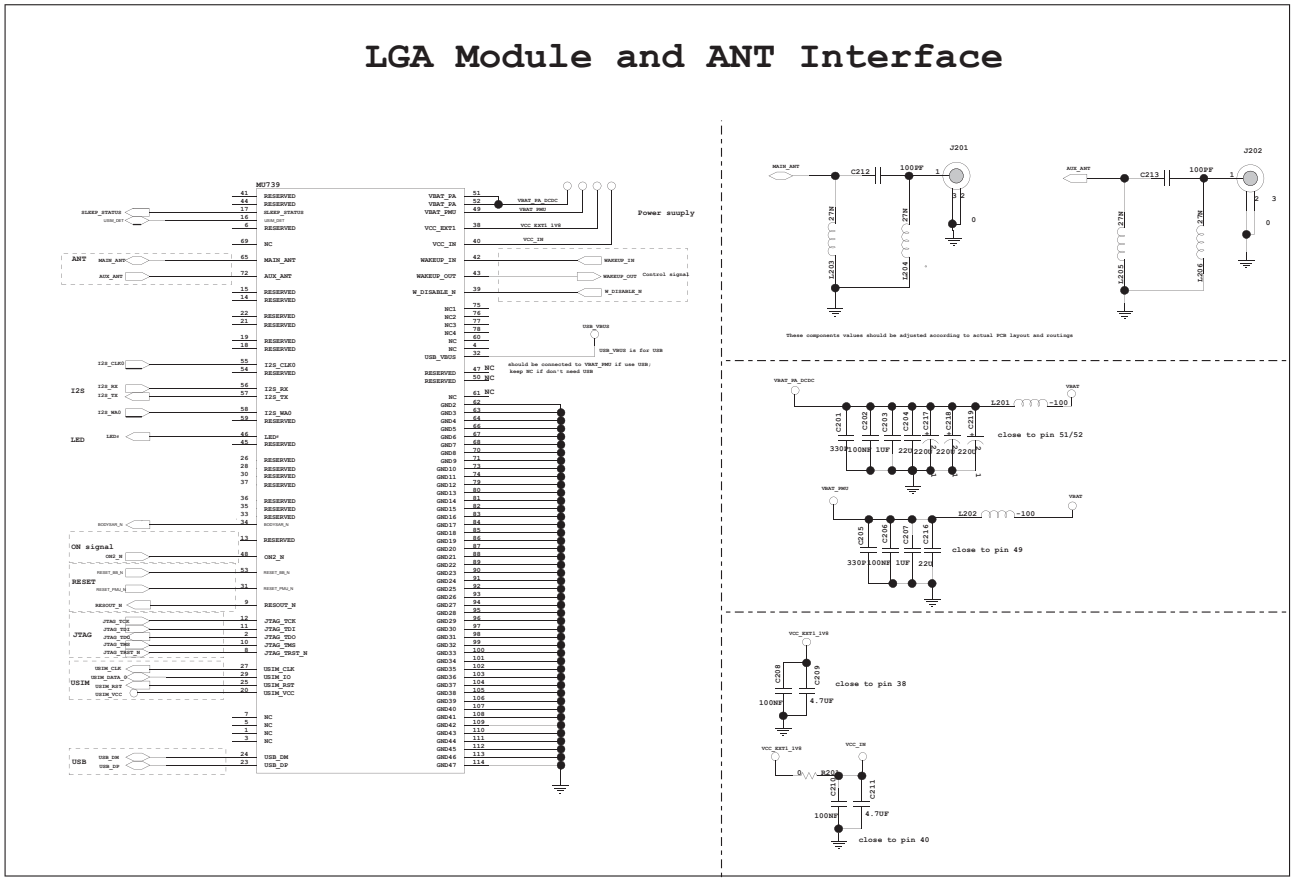
8.13.2 FCC Statement

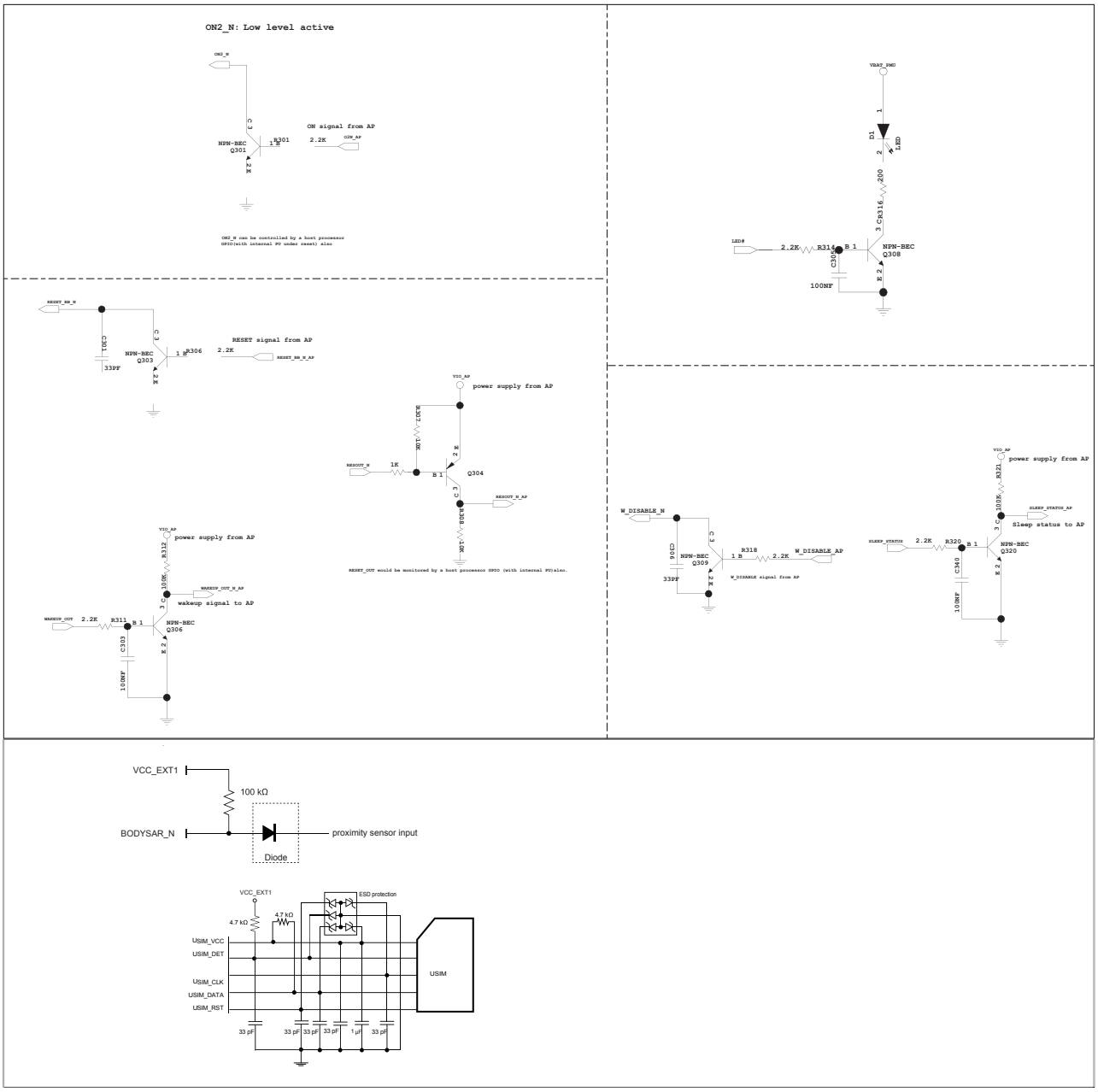
Federal Communications Commission Notice (United States): Before a wireless device model is available for sale to the public, it must be tested and certified to the FCC that it does not exceed the limit established by the government-adopted requirement for safe exposure.

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
CCC	China Compulsory Certification
CE	European Conformity
CS	Coding Scheme
CSD	Circuit Switched Data
DC	Direct Current
DMA	Direct Memory Access
EBU	External Bus Unit
EIA	Electronic Industries Association
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
EU	European Union
FCC	Federal Communications Commission
FDD-TDMA	Frequency Division Duplexing–Time Division Multiple Access
GMSK	Gaussian Minimum Shift Keying
GPIO	General-purpose I/O
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HSDPA	High Speed Downlink Packet Access
HSPA+	Enhanced High Speed Packet Access
HSUPA	High Speed Up-link Packet Access

Acronym or Abbreviation	Expansion
IPC	Inter Processor Communications
ISO	International Standards Organization
I2S	I2C Sound
LCP	Liquid Crystal Polyester
LDO	Low-Dropout
LED	Light-Emitting Diode
LGA	Land Grid Array
MCP	Multi-chip Package
MIPI	Mobile Industry Processor Interface
NTC	Negative Temperature Coefficient
PA	Power Amplifier
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PMU	Power Management Unit
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
RTC	Real-time Clock
TTL	Transistor-transistor Logic
TVS	Transient Voltage Suppressor
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access