PERFECT WIRELESS EXPERIENCE

FIBOCOM MC116-NA Hardware Guide

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Applicability Type

No.	Product Model	Description
1	MC116-NA	MCP is 1+1, and supports MAIN_ANT, DIV_ANT, GNSS_ANT

Copyright

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Change History

Version	Author	Reviewer	Approver	Update Date	Description
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Contents

Contents **5**
1 Introduction **8**
1.1 Document Introduction 8
1.2 Safety Precautions 8
2 Product Overview **10**
2.1 Product Introduction 10
2.2 Product Specification 10
2.3 Functional Diagram 11
2.4 Evaluation Board 12
3 Pin Description **13**
3.1 Pin Assignment 13
3.2 Pin Function 14
4 Electrical Characteristics **21**
4.1 Power 21
4.2 Power Supply 21
4.3 1.8V Output 22
4.4 Power Consumption 23
5 Functional Interfaces **25**
5.1 Control Interfaces 25
5.1.1 Power On/Off *25*
5.1.1.1 Power On 25
5.1.1.2 Power Off 27
5.1.2 RESET *27*
5.2 Network Status Indicator Interface 29
5.2.1 Interface Status Description *29*
5.3 (U)SIM Card Interface 30
5.3.1 (U)SIM Pin Definition *30*
5.3.2 (U)SIM Interface Circuit *31*
5.3.2.1 (U)SIM Card Connector with Card Detection Signal 31
5.3.2.2 (U)SIM Card Connector Without Detection Signal 32
5.3.3 (U)SIM Hot Plug *32*
5.3.4 (U)SIM Design Requirements *33*

5.4 USB Interface 34
5.4.1 USB Pin Definition 34
5.5 UART Interface 35
5.5.1 UART Interface Definition 35
5.5.2 UART Port Application 35
5.6 ADC Interface 36
5.7 PCM Interface 37
5.7.1 Support Model 37
5.7.2 PCM Interface Definition 37
5.7.3 PCM Interface Description 37
5.7.4 PCM Signal Description 38
6 Low Power Consumption 40
6.1 Airplane Mode 40
6.2 Sleep Mode 40
6.2.1 USB Application (USB Suspend Is Not Supported, VBUS Is Supported) 40
6.2.2 USB Application (USB Suspend Is Not Supported, VBUS Is Not Supported) 41
6.2.3 USB Application (USB Suspend Is Supported) 41
6.2.4 UART Application (WAKEUP_IN Pin Level Control) 41
6.2.5 UART Application (DTR Pin Level Control) 42
6.2.6 ATS24 Command 42
7 RF Interface 44
7.1 Operating Bands 44
7.2 Output Power 44
7.3 Receive Sensitivity 45
7.4 GNSS Receiver 45
7.4.1 GNSS Specification 45
7.4.2 GNSS Observes Protocol 46
7.5 Antenna Design 46
7.5.1 Antenna Index 46
7.5.2 Antenna Reference Design 47
8 Reliability 50
8.1 Limiting Voltage Range 50
8.1.1 Absolute Voltage Range 50
8.1.2 Operating Voltage Range 50

8.2 Environment Temperature Range 50
8.3 Environmental Reliability Requirements 51
8.4 ESD Characteristics 51
9 Structure Specification 53
9.1 Product Appearance 53
9.2 Structure Dimension 53
9.3 PCB Soldering Pad and Stencil Design 53
9.4 SMT 53
9.5 Carrier and Storage 53
10 Approval 54
11 Appendixes 55
11.1 Terms and Acronyms 55
11.2 Related Documents 57
11.3 Reference Standards 57
11.4 Contact 58
12 Warnning 58

1 Introduction

1.1 Document Introduction

This document describes the electrical characteristics, RF performance, structure size, application environment, etc. of MC116-NA module. With the assistance of the document and other instructions, the developers can quickly understand the hardware functions of the MC116-NA module and develop products.

1.2 Safety Precautions

By following the safety guidelines below, you can protect the personal safety and help protect the product and work environment from potential damage. Product manufacturers need to communicate the following safety instructions to end users. In case of failure to comply with these safety rules, Fibocom Wireless will not be responsible for the consequences caused by the user's misuse.

Road safety first! When you drive, do not use the handheld devices even if it has a hand-free feature. Please stop and call!

Please turn off the mobile device before boarding. The wireless feature of the mobile device is not allowed on the aircraft to prevent interference with the aircraft communication system. Ignoring this note may result in flight safety issue or even breaking the law.

When in a hospital or health care facility, please be aware of restrictions on the use of mobile devices. Radio frequency interference may cause medical equipment to malfunction, so it may be necessary to turn off the mobile device.

The mobile device does not guarantee that an effective connection can be made under any circumstances, for example, when there is no prepayment for the mobile device or the (U)SIM is invalid. When you encounter the above situation in an emergency, remember to use an emergency call, while keeping your device turned on and in areas where signal is strong.

Your mobile device receives and transmits RF signals when it is powered on. Radio interference occurs when it is near televisions, radios, computers, or other electronic devices.

Keep the mobile device away from flammable gases. Turn off the mobile device when near gas stations, oil depots, chemical plants or explosive workplaces. There is a safety hazard in operating electronic equipment in any potentially explosive environment.

2 Product Overview

2.1 Product Introduction

The MC116-NA wireless module is a wideband wireless terminal product applicable to various network formats and multi-bands including FDD-LTE

2.2 Product Specification

Table 2-1 Product specification

Specification		
Operating frequency	MC116-NA	LTE FDD: Band 2,4,5,12,13,17,66
Data transmission	LTE FDD Rel.9	10Mbps DL/5Mbps UL (Cat 1);
Power	3.3V～4.3V (3.8V Typical)	
Temperature	Normal: -30°C～+75°C	
	Extended: -40°C～+85°C	
	Storage: -40°C～+85°C	
Power consumption	Base current: < 1.5mA (TBD)	
	Sleep mode: ≤ 3mA (TBD)	
	Idle mode: < 20mA (USB sleep); < 30mA (USB wakeup) (TBD)	
Physical characteristics	Package: LCC+LGA 144 Pin	
	Size: 32.0 mm×29.0± mm×2.4 mm	
	Weight: About 5.5g	
Interface		
Antenna	Antenna: Main×1, GNSS×1, DIV×1	
Functional Interface	(U)SIM 3.0V/1.8V	
	USB 2.0	
	Status Indicator	
	UART x 2, PCM, I2C, SGMII, SPI, SDIO, GPIOs	
	ADC×2	
Software		
Protocol Stack	Embedded TCP/IP and UDP/IP protocol stack	

AT Command	3GPP TS 27.007 and 27.005, and proprietary FIBOCOM AT
Firmware update	USB (UART does not support DOWNLOAD)
Voice service	VoLTE, HR, FR, EFR, AMR, DTMF, Caller ID, Call Transfer, Call Hold, Call Waiting and Multi-Talk, etc.
SMS	point-to-point MO, MT; cell broadcast; support Text and PDU modes
MMS service	Need AP to realize MMS protocol

Note:

When the temperature is beyond the normal operating temperature range (-30°C to +75°C), the RF performance of the module may slightly exceeds the 3GPP specification.

2.3 Functional Diagram

Figure 2-1 shows the main hardware features of the MC116-NA module, including baseband and RF features.

Baseband includes:

- LTE_FDD controller
- PMIC
- MCP
- UART, USB, (U)SIM, PCM, I2C, SPI, SGMII, SDIO, ADC, GPIO

RF includes:

- RF Transceiver
- RF PA
- RF filter
- Antenna

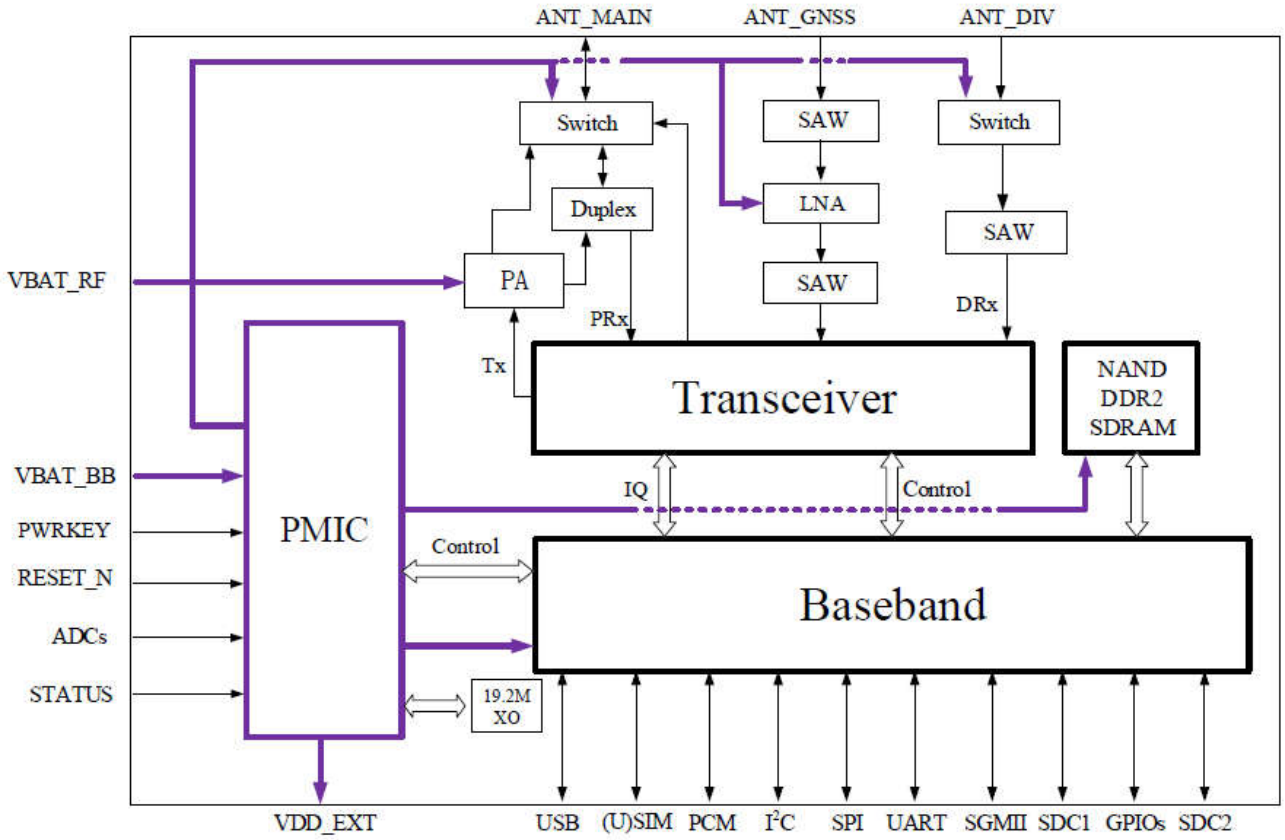


Figure 2-1 Functional diagram

2.4 Evaluation Board

Fibocom provides EVK-GT8230-NL and ADP-MC116-NA evaluation boards to convenient module's debug and use.

3 Pin Description

3.1 Pin Assignment

The MC116-NA series module is available in 144 pins. The number of the LCC pins is 80 and that of the LGA pins is 64. The top view of the pin assignment is shown as the following figure:

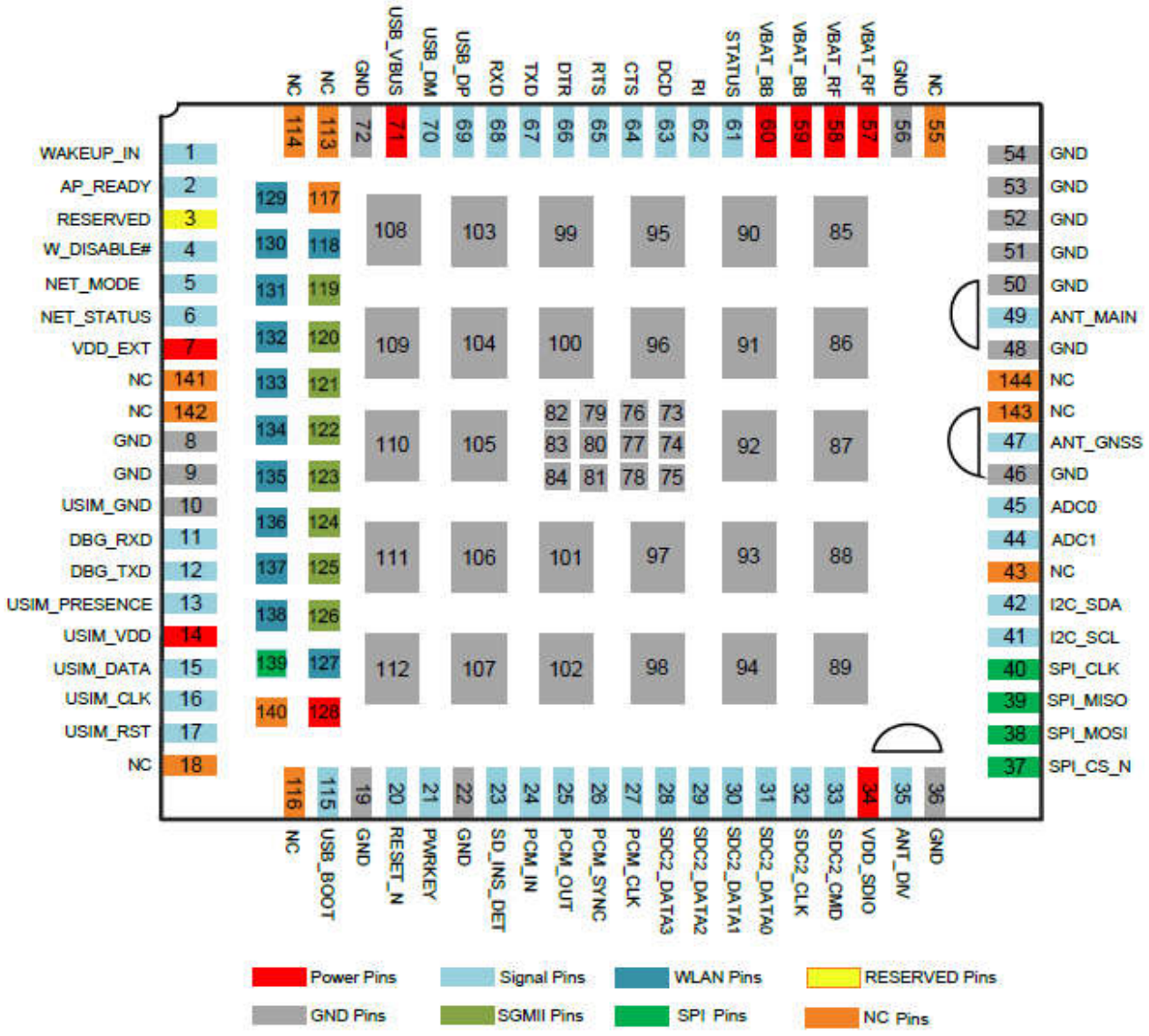


Figure 3-1 Pin assignment (top view diagram)

Note:

"73 ~ 112" is the thermal pin, and the module is grounded internally. It is recommended that the heat sink pad is reserved for PCB packaging and welded.

3.2 Pin Function

Table 3-1 I/O description parameters

Symbol	Description
IO	Input/Output
DI	Digital input
DO	Digital output
PI	Power input
PO	Power output
AI	Analog input
AO	Analog output
OD	Open drain
OC	Open collector

The pin function description of MC116-NA series module is shown as table 3-2:

Table 3-2 Pin description

Pin Num	Pin Name	I/O	Level	Description
1	WAKEUP_IN	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	External device wake-up module, low active by default, with software programmable option.
2	AP_READY	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Reserved
3	RESERVED	-	-	Reserved
4	W_DISABLE#	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Module flight mode control. Pulled up by default. Pull down this pin, the module enters airplane mode
5	NET_MODE	O	V_{OL}max=0.45V V_{OH}min=1.35V	Module network state indicate (by default)
6	NET_STATUS	O	V_{OL}max=0.45V	Module network state indicator

Pin Num	Pin Name	I/O	Level	Description
			V_{OH}min=1.35V	
7	VDD_EXT	PO	1.8V	Module digital level, 1.8V output, 80mA
8	GND	G	-	Ground
9	GND	G	-	Ground
10	GND	G	-	Ground
11	DBG_RXD	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Debug serial port receive data
12	DBG_TXD	O	V_{OL}max=0.45V V_{OH}min=1.35V	Debug serial port transmit data
13	USIM_PRESENCE	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	(U)SIM card hot plug detection
14	USIM_VDD	PO	For 1.8V (U)SIM: Vmax=1.9V Vmin=1.7V For 3.0V (U)SIM: Vmax=3.05V Vmin=2.7V $I_O$max=50mA	(U)SIM power, identify 1.8V or 3V (U)SIM card automatically
15	USIM_DATA	IO	For 1.8V (U)SIM: V_{IL}max=0.6V V_{IH}min=1.2V V_{OL}max=0.45V V_{OH}min=1.35V For 3.0V (U)SIM: V_{IL}max=1.0V V_{IH}min=1.95V V_{OL}max=0.45V V_{OH}min=2.55V	(U)SIM data signal
16	USIM_CLK	O	For 1.8V (U)SIM: V_{OL}max=0.45V V_{OH}min=1.35V For 3.0V (U)SIM: V_{OL}max=0.45V	(U)SIM clock signal

Pin Num	Pin Name	I/O	Level	Description
			V_{OH}min=2.55V	
17	USIM_RST	O	For 1.8V (U)SIM: V_{OL}max=0.45V V_{OH}min=1.35V For 3.0V (U)SIM: V_{OL}max=0.45V V_{OH}min=2.55V	(U)SIM reset signal
18	NC	-	-	NC
19	GND	G	-	Ground
20	RESET_N	I	V_{IH}max=2.1V V_{IH}min=1.3V V_{IL}max=0.5V	Module reset signal, active low, no need pull up externally
21	PWRKEY	I	V_{IH}max=2.1V V_{IH}min=1.3V V_{IL}max=0.5V	Module power on/off signal, active low, no need pull up externally. Because the internal diode drops. The voltage of the pin is 0.8V after powering the module.
22	GND	G	-	Ground
23	SD_INS_DET	I	-	Reserved
24	PCM_IN	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	PCM input signal
25	PCM_OUT	O	V_{OL}max=0.45V V_{OH}min=1.35V	PCM output signal
26	PCM_SYNC	IO	V_{OL}max=0.45V V_{OH}min=1.35V V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	PCM synchronization signal
27	PCM_CLK	IO	V_{OL}max=0.45V V_{OH}min=1.35V V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	PCM clock signal
28	SDC2_DATA3	IO	-	Reserved

Pin Num	Pin Name	I/O	Level	Description
29	SDC2_DATA2	IO	-	Reserved
30	SDC2_DATA1	IO	-	Reserved
31	SDC2_DATA0	IO	-	Reserved
32	SDC2_CLK	O	-	Reserved
33	SDC2_CMD	IO	-	Reserved
34	VREG_L13_2P85	PO	-	Reserved
35	ANT_DIV	I	-	Diversity antenna
36	GND	-	-	Ground
37	SPI_CS_N	O	-	Reserved
38	SPI_MOSI	O	-	Reserved
39	SPI_MISO	I	-	Reserved
40	SPI_CLK	O	-	Reserved
41	I2C_SCL	OD	-	I2C interface clock signal
42	I2C_SDA	OD	-	I2C interface data signal
43	NC	-	-	NC
44	ADC1	I	-	Analog to digital converter interface1
45	ADC0	I	-	Analog to digital converter interface 0
46	GND	G	-	Ground
47	ANT_GNSS	I	-	GNSS antenna
48	GND	-	-	Ground
49	ANT_MAIN	IO	-	Main antenna
50	GND	G	-	Ground
51	GND	G	-	Ground
52	GND	G	-	Ground
53	GND	G	-	Ground
54	GND	G	-	Ground
55	NC	-	-	NC
56	GND	G	-	Ground
57	VBAT_RF	PI	Vmax=4.3V Vmin=3.3V Vtyp=3.8V	RF power input (3.3V~4.3V)
58	VBAT_RF	PI	Vmax=4.3V Vmin=3.3V Vtyp =3.8V	RF power input (3.3V~4.3V)
59	VBAT_BB	PI	Vmax=4.3V Vmin=3.3V	Baseband power input（3.3V~4.3V）

Pin Num	Pin Name	I/O	Level	Description
			Vtyp =3.8V	
60	VBAT_BB	PI	Vmax=4.3V Vmin=3.3V Vtyp =3.8V	Baseband Power Input (3.3V~4.3V)
61	STATUS	O	V_{OH}min=1.35V V_{OL}max=0.45V	Module network state indicate
62	RI	O	V_{OL}max=0.45V V_{OH}min=1.35V	Module output ring indicator
63	DCD	O	V_{OL}max=0.45V V_{OH}min=1.35V	Module output data carrier detection
64	CTS	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Clear to send
65	RTS	O	V_{OL}max=0.45V V_{OH}min=1.35V	Request to send
66	DTR	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Data ready. The control of the sleep mode
67	TXD	O	V_{OL}max=0.45V V_{OH}min=1.35V	Transmit data
68	RXD	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Receive data
69	USB_DP	IO	Conform to USB2.0 standard specification	USB differential data bus (+)
70	USB_DM	IO	Conform to USB2.0 standard specification	USB differential data bus (-)
71	USB_VBUS	PI	Vmax=5.25V Vmin=3.8V Vnorm=5.0V	USB plug detection
72	GND	G	-	Ground
73~112	GND	G	-	GND

Pin Num	Pin Name	I/O	Level	Description
113	NC	-	-	NC
114	NC	-	-	NC
115	USB_BOOT	I	V_{IL}min=-0.3V V_{IL}max=0.6V V_{IH}min=1.2V V_{IH}max=2.0V	Emergency download, active high, recommended to reserve test point
116	NC	-	-	NC
117	NC	-	-	NC
118	WLAN_SLP_CLK	O	-	Reserved
119	EPHY_RST_N	O	-	Reserved
120	EPHY_INT_N	I	-	Reserved
121	SGMII_MDATA	IO	-	Reserved
122	SGMII_MCLK	O	-	Reserved
123	SGMII_TX_M	O	-	Reserved
124	SGMII_TX_P	O	-	Reserved
125	SGMII_RX_P	I	-	Reserved
126	SGMII_RX_M	I	-	Reserved
127	PM_ENABLE	O	-	Reserved
128	VREG_L5_UIM2	PO	-	Reserved
129	SDC1_DATA3	IO	-	Reserved
130	SDC1_DATA2	IO	-	Reserved
131	SDC1_DATA1	IO	-	Reserved
132	SDC1_DATA0	IO	-	Reserved
133	SDC1_CLK	O		Reserved
134	SDC1_CMD	O	-	Reserved
135	WAKE_WLAN	I		Reserved
136	WLAN_EN	O	-	Reserved
137	COEX_UART_RXD	I	-	Reserved
138	COEX_UART_TXD	O	-	Reserved
139	BT_EN	O	-	Reserved
140	NC	-	-	NC
141	NC	-	-	NC
142	NC	-	-	NC
143	NC	-	-	NC
144	NC	-	-	NC

Note:

Keep the unused pins floating. The reserved pins are in development

4 Electrical Characteristics

4.1 Power

Table 4-1 shows the power interface of MC116-NA series module.

Table 4-1 Power interface

Pin Name	I/O	Pin	Description
VBAT_RF	PI	57, 58	Module power supply, 3.3V~4.3V, typical value 3.8V
VBAT_BB	PI	59, 60	Module power supply, 3.3V~4.3V, typical value 3.8V
VDD_EXT	PO	7	Module digital voltage output, 1.8V, 80mA
GND	G	8, 9, 10, 19, 22, 36, 46, 48, 50-54, 56, 72~112	All GND pins must be grounded

Note:

In the rest of the document, VBAT includes VBAT_BB and VBAT_RF.

4.2 Power Supply

The MC116-NA series module needs to be powered by the VBAT pin. The recommend power design is shown in Figure 4-1:

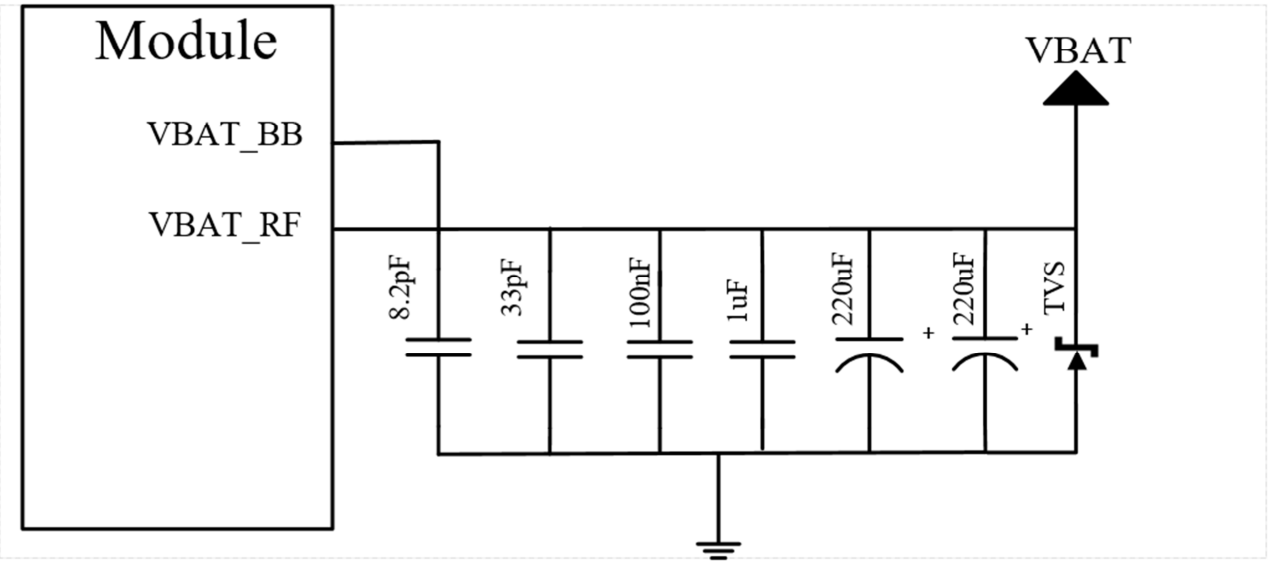


Figure 4-1 Recommend power design

Table 4-2 shows the filter capacitors design of power supply:

Table 4-2 Filter capacitors design of power supply

Recommended Capacitor	Application	Description
220uF×2	Regulating capacitor	Reduce power fluctuations during module operation, requiring low ESR capacitor LDO or DCDC power requires not less than 440uF capacitor Battery power can be properly reduced to 100uF ~ 220uF capacitor
1uF, 100nF	Digital signal noise	Filter clock and digital signal interference
33pF	700, 850/900MHz bands	Filter low band RF interference
8.2pF	1700/1800/1900, 2100/2300, 2500/2600MHz bands	Filter middle/high band RF interference

The power stability can ensure the normal operation of MC116-NA module. The power supply ripple limit for the module is no more than 300mV (the circuit ESR < 100mΩ) requires special attention when design circuit. The power voltage needs to be at least 3.3V. Otherwise, the module may power off or restart. The power limit is shown in Figure 4-2:

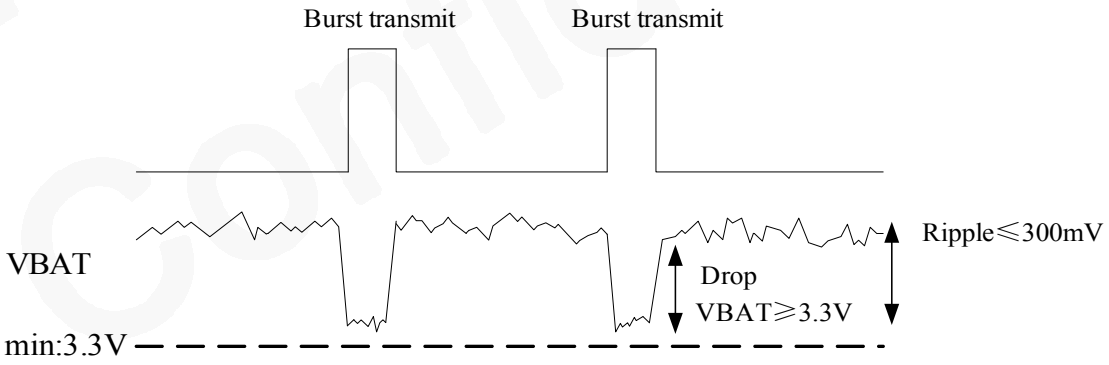


Figure 4-2 Power limit

4.3 1.8V Output

The MC116-NA series module outputs a 1.8V voltage through the VDD_EXT for the use of the internal digital circuit of module. The voltage is the logic level of the module and can be used to indicate module Power on/off, or for external low current (< 80mA) circuits. Leave the signal floating if no use. The logic

level of VDD_EXT is defined as follows:

Table 4-3 VDD_EXT logic level

Parameter	Minimum	Typical	Maximum	Unit
VDD_EXT	1.71	1.8	1.89	V

4.4 Power Consumption

The power consumption of MC116-NA series module measured at 3.8V power supply is shown as the following table:

Table 4-4 Power consumption

Parameter	Mode	Condition	Average Current Typ. (mA)
I_{off}	Power off	Power supply, module power off	0.018
I_{Idle}	LTE FDD	Paging cycle #32 frames (USB sleep)	≤20 (TBD)
		Paging cycle #32 frames (USB wake up)	≤30 (TBD)
		Paging cycle #256 frames (USB sleep)	≤20 (TBD)
		Paging cycle #256 frames (USB wake up)	≤30 (TBD)
	Radio Off	AT+CFUN=0(USB sleep)	≤15 (TBD)
		AT+CFUN=0 (USB wake up)	≤25 (TBD)
I_{sleep}	FDD-LTE	Paging cycle #64 frames (USB sleep)	≤3 (TBD)
		Paging cycle #128 frames (USB sleep)	≤3 (TBD)
		Paging cycle #256 frames (USB sleep)	≤3 (TBD)
$I_{LTE-RMS}$	LTE FDD	LTE FDD Data transfer Band 2 @+23dBm	≤680 (TBD)
		LTE FDD Data transfer Band 4 @+23dBm	≤750 (TBD)
		LTE FDD Data transfer Band 5 @+23dBm	≤640 (TBD)
		LTE FDD Data transfer Band 12 @+23dBm	≤640 (TBD)
		LTE FDD Data transfer Band 13 @+23dBm	≤680 (TBD)
		LTE FDD Data transfer Band 17 @+23dBm	≤680 (TBD)

Parameter	Mode	Condition	Average Current Typ. (mA)
		LTE FDD Data transfer Band 66 @+23dBm	≤750 (TBD)

Note:

I_{Idle}(USB sleep) condition current test needs AT command：`at+gtusbsleepen=2,0`

I_{Idle}(USB wake up) condition current test needs to make sure that USB port is normal.

5 Functional Interfaces

5.1 Control Interfaces

Control interfaces used for module power on/off and reset operations. The pin definitions are as follows:

Table 5-1 Control signal

Pin Name	I/O	Pin No.	Description
RESET_N	I	20	When the module is in operating mode, pull down RESET_N for 700ms~1s, and then release it, the module is reset
PWRKEY	I	21	When the module is in power off mode, pull down PWRKEY for 100ms~2s, and release it, the module will power on; When the module is in operating mode, pull down PWRKEY for 3s~8s, and then release it, the module will power off

5.1.1 Power On/Off

5.1.1.1 Power On

When MC116-NA series module is in power off mode, pull down PWRKEY pin for 100ms~2s, the module will power on. It is recommended to use OC/OD drive circuit to control PWRKEY pin. The OC drive reference circuit is shown as follows:

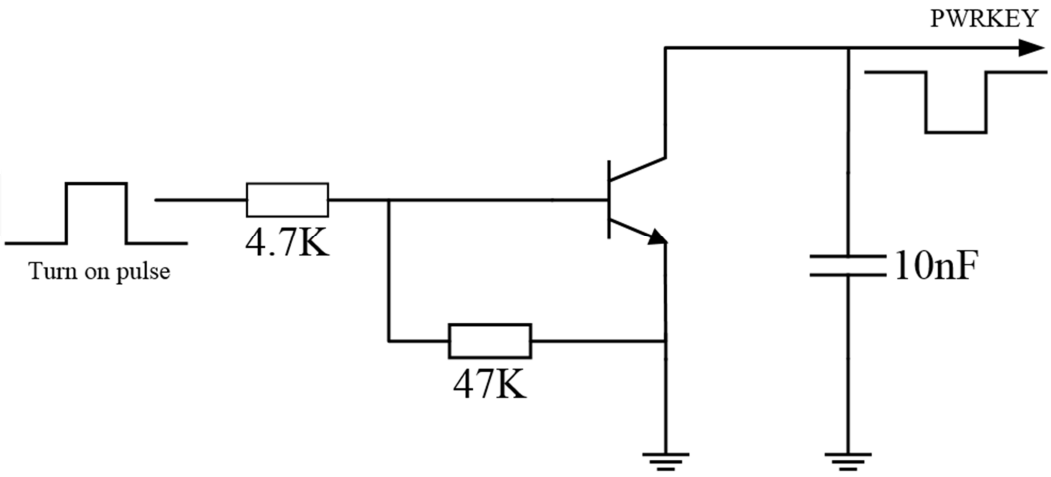


Figure 5-1 OC drive power on reference circuit

The other way to control PWRKEY pin is use a button switch, a TVS should located near the button (ESD9X5VL-2/TR is recommended) for ESD protection. The button switch power on reference circuit is shown as follows:

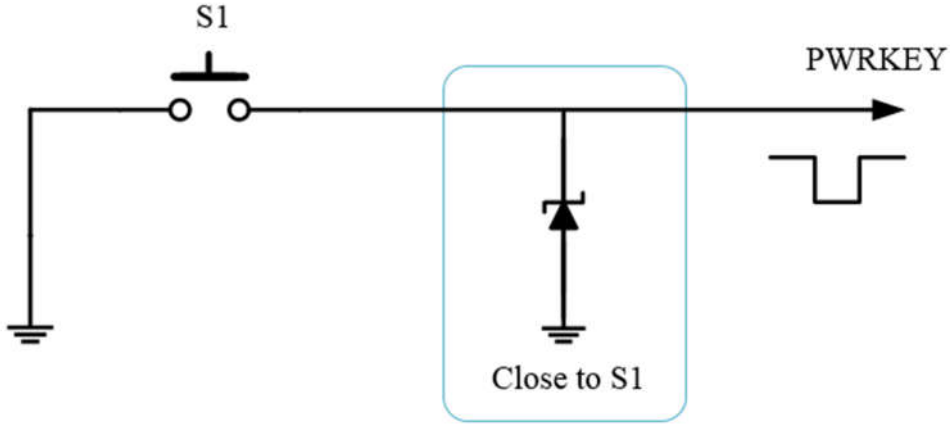


Figure 5-2 Button switch power on reference circuit

Figure 5-3 shows power on timing.

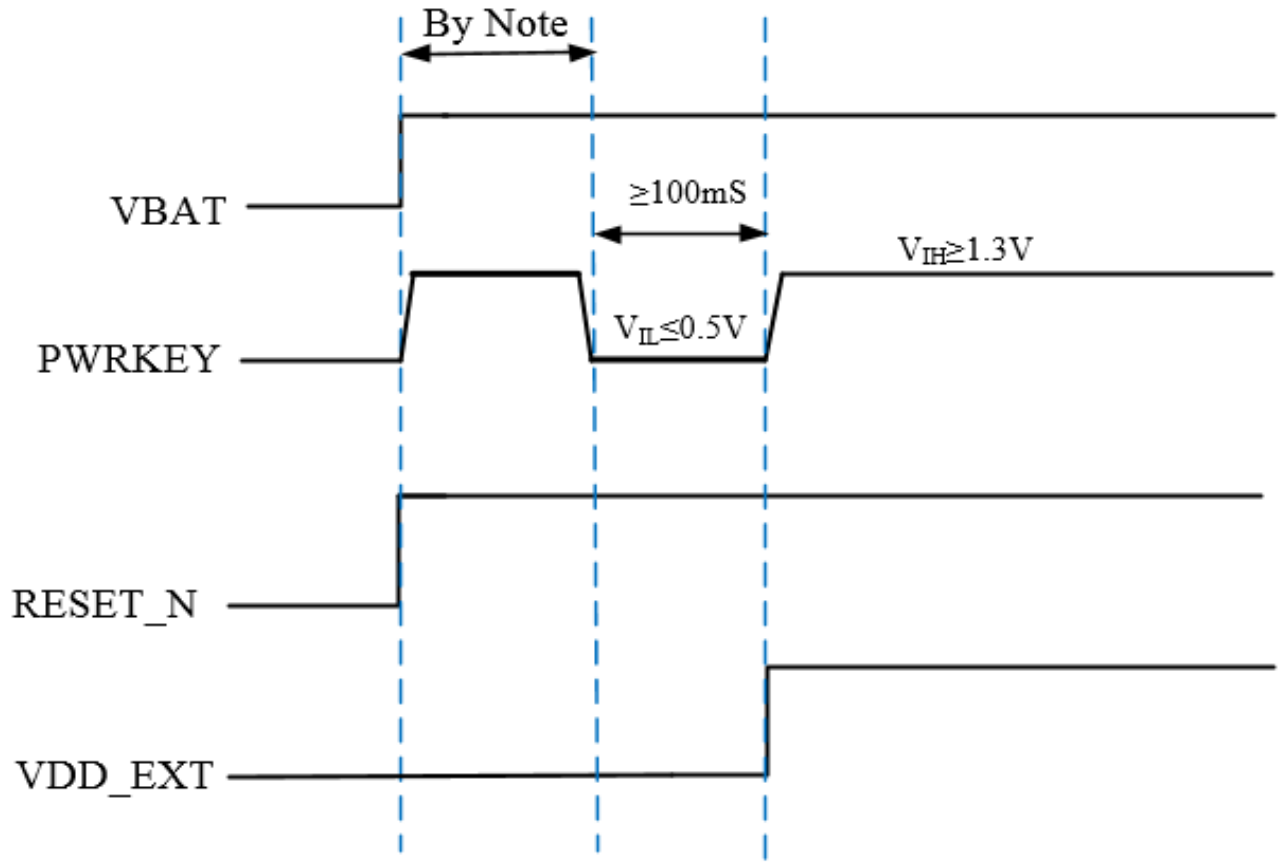


Figure 5-3 Power on timing

Note:

Before pulling down PWRKEY pin, the voltage of VBAT must be stable, recommended time interval between VBAT enable and pull down PWRKEY pin at least 30ms.

5.1.1.2 Power Off

The module supports three power off methods as described in table 5-2.

Table 5-2 Power off

Mode	Methods	Applicable Scenario
Low-voltage power off	When VBAT voltage is low or powered down, the module will power off	The module does not power off through normal process, i.e. does not logout from the base station
Hardware power off	Pull down PWRKEY for 3s~8s	Hardware normal power off
AT power off	AT+CPWROFF	Software normal power off

Note:

1. When the module is in operating mode, please do not cut off module power supply to avoid damage internal flash. It is recommended to power off the module by PWRKEY pin or AT commands, then cut off power supply.

2. When powering off by AT commands, please don't pull down PWRKEY pin, otherwise, the module will power on again automatically.

The power off timing is shown as follows:

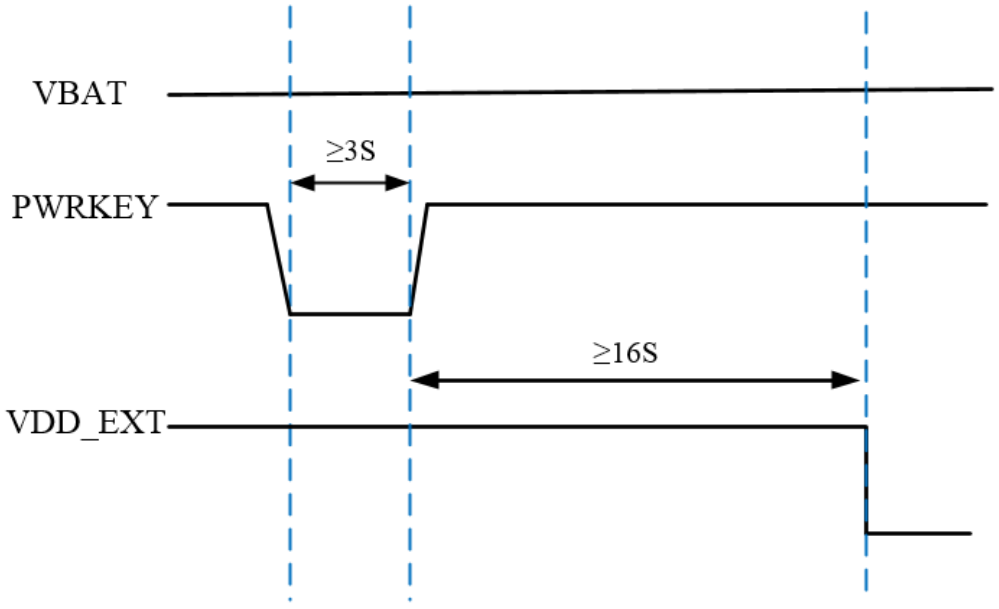


Figure 5-4 Power off timing

5.1.2 RESET

The module supports two modes to reset: hardware reset and software reset.

Table 5-3 Reset

Reset Mode	Reset Method
Hardware reset	Pull down RESET_N pin for 700ms~1s, then release it
Software reset	Send AT commands AT+RESET

Clients can control RESET_N pin by two modes: OC/OD drive circuits and button switch, corresponding reference circuits are shown in Figure 5-5 and Figure 5-6:

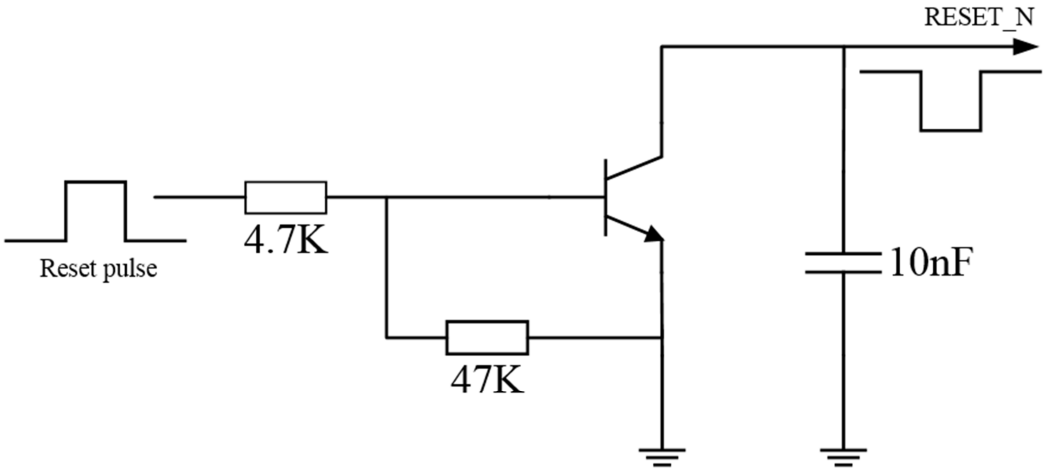


Figure 5-5 OC driven reset reference circuits

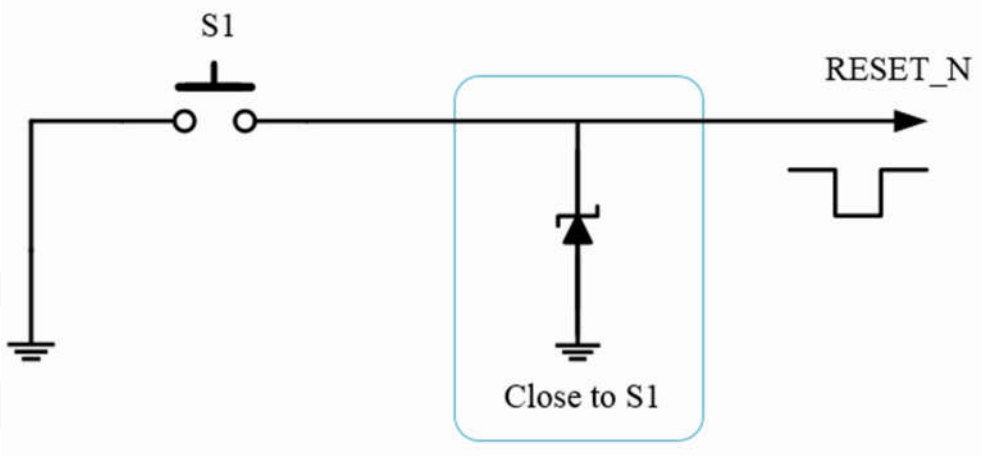


Figure 5-6 Button reset reference circuits

The reset timing is shown as follows:

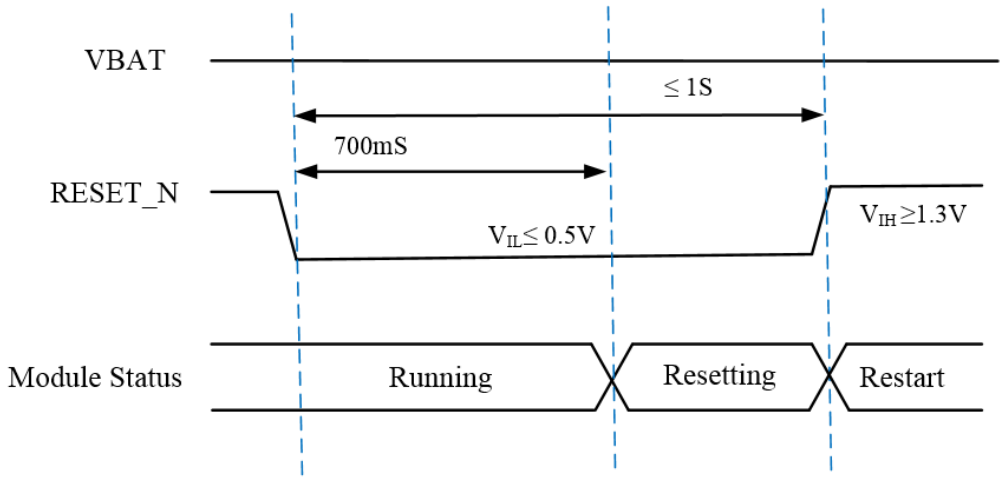


Figure 5-7 Reset timing

5.2 Network Status Indicator Interface

MC116-NA series module provides three network status indicator pins. Pin 5 is network status indicator by default, AT commands AT+LEDCFG can switch to pin 6 or pin 61, table 5-4 is the pin definition.

Table 5-4 Network status indicators

PIN Name	I/O	PIN Num.	Description
NET_MODE	O	5	Network status indicator (by default)
NET_STATUS	O	6	Network status indicator
STATUS	O	61	Network status indicator

5.2.1 Interface Status Description

Network status indication pins are used to drive indicate light and describe module's network status. The work status of the MC116-NA series module network indicator light is described as the following table:

Table 5-5 Work status of network indicator light

Mode	Module Network Indicator Pin Status	Indicator Light Flash/Off Status	Description
1	600ms High/600ms Low	Flash 600ms on/600ms off	No SIM card Request SIM PIN Registering network (T < 15S) Register network failed
2	3000ms High/75ms Low	Slow flash 3000ms on/75ms off	Standby

Mode	Module Network Indicator Pin Status	Indicator Light Flash/Off Status	Description
3	75ms High/75ms Low	Speed flash 75ms on/75ms off	Data link established
4	Low	Off	Voice call
5	High	on	Sleep

The reference design circuit of the MC116-NA series module network indicator light is shown as follows:

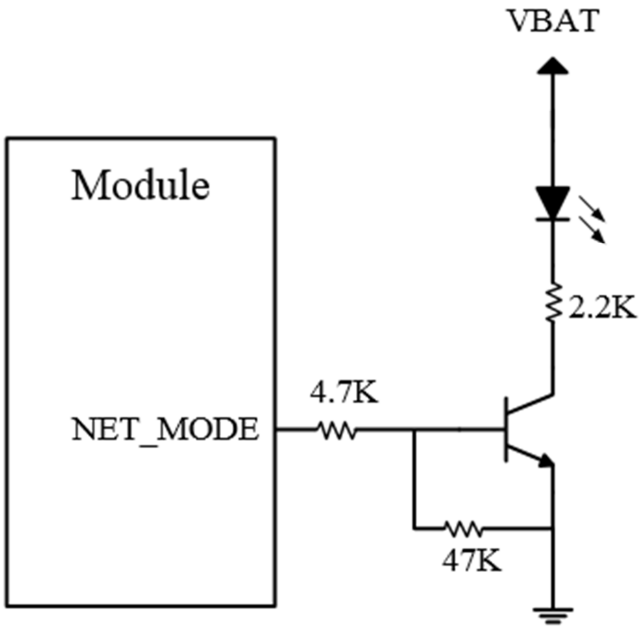


Figure 5-8 Network indicator light reference circuit

5.3 (U)SIM Card Interface

MC116-NA series module has built-in (U)SIM card interface, and supports 1.8V and 3.0V (U)SIM cards.

5.3.1 (U)SIM Pin Definition

(U)SIM pin definition is shown in the following table:

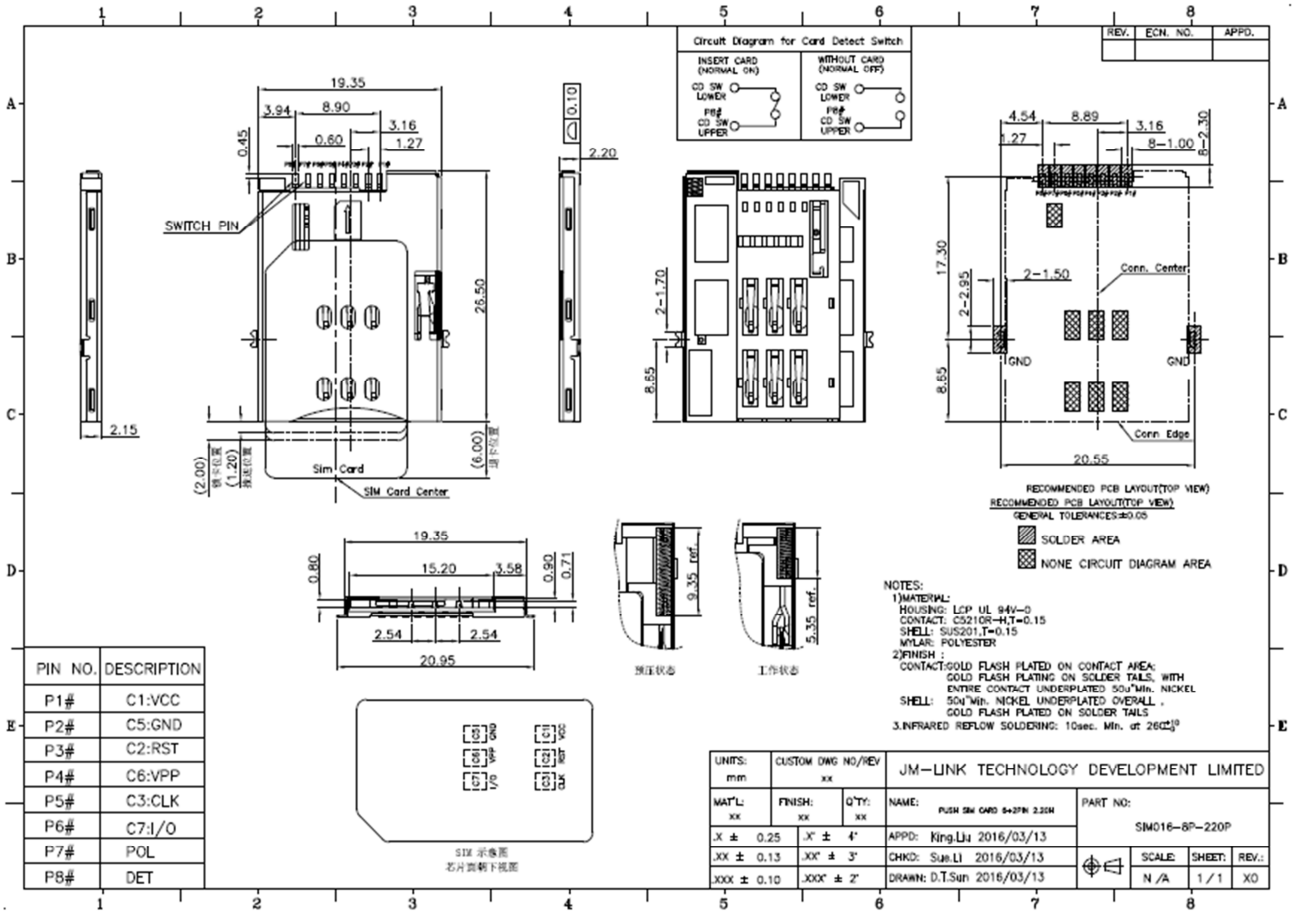
Table 5-6 (U)SIM card pin

Pin Name	I/O	Pin No.	Description
USIM_PRESENCE	I	13	Detect (U)SIM card for hot-plug
USIM_VDD	PO	14	(U)SIM Power
USIM_DATA	IO	15	(U)SIM DATA
USIM_CLK	O	16	Clock Signal
USIM_RESET	O	17	Reset Signal

5.3.2 (U)SIM Interface Circuit

5.3.2.1 (U)SIM Card Connector with Card Detection Signal

(U)SIM circuit design requires (U)SIM card connector. It is recommended to choose card connector with card detect signal that supports card hot-plug function (SIM016-8P-220P is recommended by Fibocom).



PIN NO.	DESCRIPTION
P1#	C1:VCC
P2#	C5:GND
P3#	C2:RST
P4#	C6:VPP
P5#	C3:CLK
P6#	C7:I/O
P7#	POL
P8#	DET

Figure 5-9 (U)SIM card connector (SIM016-8P-220P)

SIM016-8P-220P card connector, DET and POL are short connected when the card is inserted; DET and POL are disconnected when there is no card. The following is the reference design circuit, (U)SIM card insert, USIM_PRESENCE pin is high level; (U)SIM card pull out, USIM_PRESENCE pin is low level.

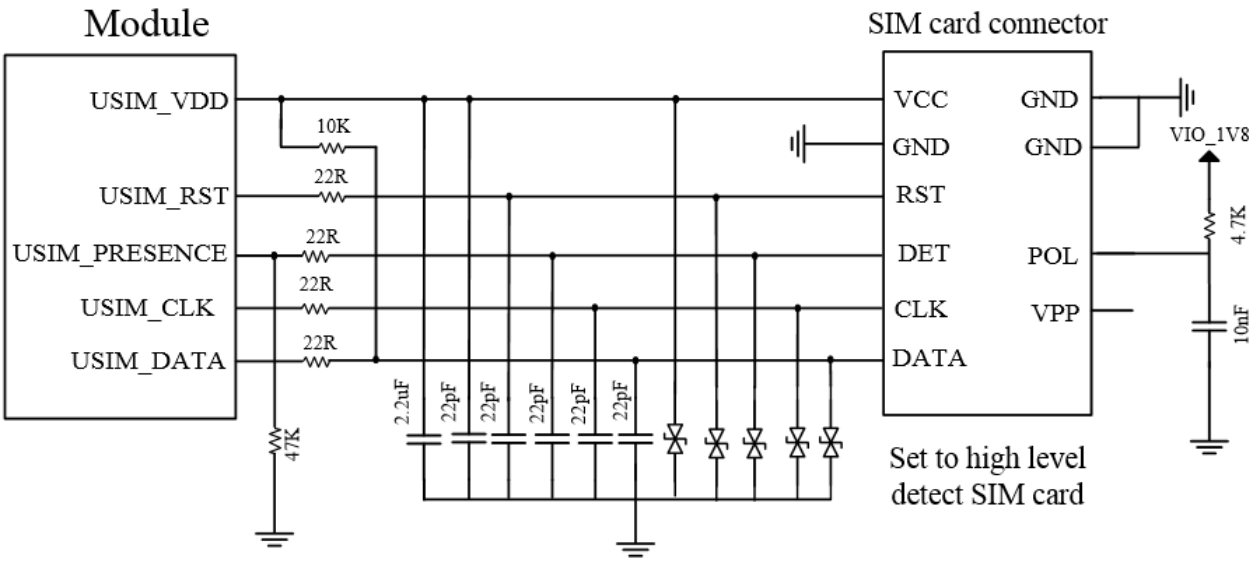


Figure 5-10 (U)SIM card connector with detection signal reference circuit

5.3.2.2 (U)SIM Card Connector Without Detection Signal

If use (U)SIM card connector without detection signal USIM_ PRESENCE pin must keep floating.

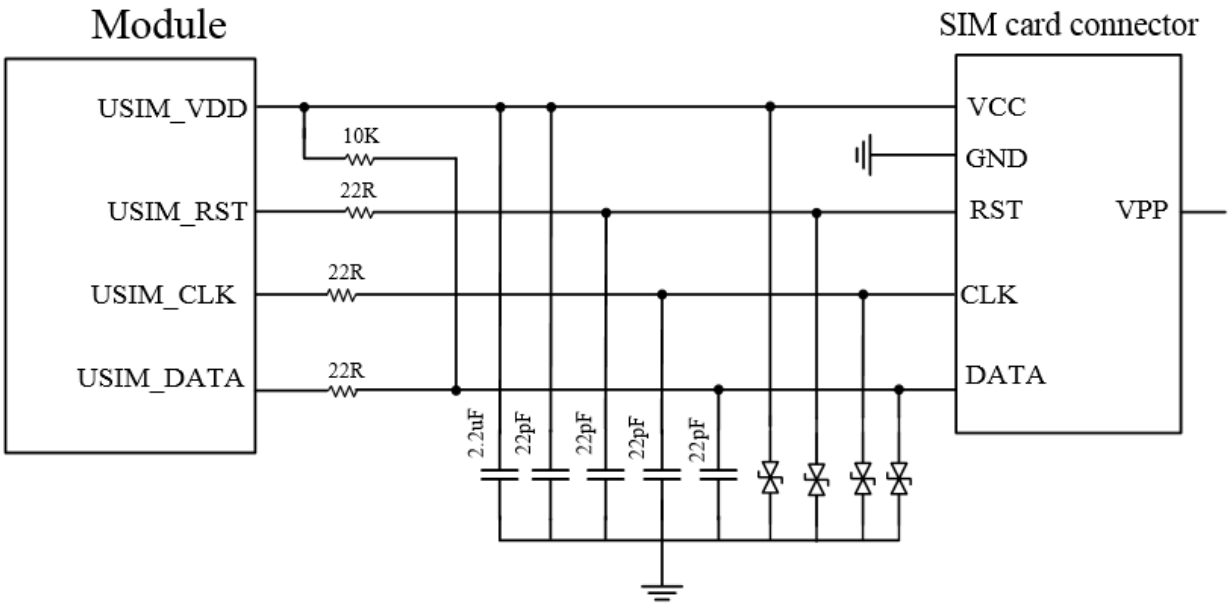


Figure 5-11 (U)SIM card connector without detection signal reference circuit

5.3.3 (U)SIM Hot Plug

MC116-NA series module supports (U)SIM hot plug function. It determines the insertion and removal of (U)SIM card by detecting the USIM_ PRESENCE pin state.

The card hot plug function can be configured by the “AT+MSMPD” commands, and the AT commands are shown in the following table:

Table 5-7 (U)SIM card hot plug function configured

AT Command	(U)SIM Card Hot Plug Detection	Function Description
AT+MSMPD=1	Enabled	(U)SIM card hot plug detection is enabled by default. The module determines the insertion and removal of (U)SIM card by detect the USIM_ PRESENCE pin state
AT+MSMPD=0	Disabled	(U)SIM card hot plug detection function is disabled The module read the (U)SIM card when module power on, and does not detect the USIM_PRESENCE state

After enabling the hot plug detection function of the (U)SIM card, if USIM_PRESENCE is in high level, the module will detect the (U)SIM card insertion and execute card initialization program. After reading the (U)SIM card information, the module will register network. When the USIM_PRESENCE is in low level, the module detects (U)SIM card is removed, and it will not read the (U)SIM card.

Note:

The USIM_PRESENCE pin active high by default, and can be switched to active low by AT command.

Table 5-8 USIM_PRESENCE effective level switched

AT Command	Function Description
AT+GTSET=" SIMPHASE",1	Default, high level detect
AT+GTSET=" SIMPHASE",0	Low level detect

5.3.4 (U)SIM Design Requirements

(U)SIM card circuit design shall meet EMC standards and ESD requirements, and at the same time, shall improve anti-interference ability to ensure that the (U)SIM card can work stably. The design needs to strictly observe the following rules:

- (U)SIM card connector is placed as close to the module as possible, away from the RF antenna, DCDC power, clock signal lines and other strong interference sources;
- Adopt the (U)SIM card connector with metal shield shell to improve anti-interference ability;

- The length of cable from the module to the (U)SIM card connector shall not exceed 100mm. Longer cable reduces signal quality.
- USIM_CLK and USIM_DATA signals are ground isolated to avoid mutual interference. If it is difficult to do so, (U)SIM signal needs to be ground protected as a set;
- The filter capacitor and ESD device of (U)SIM card signal cable should place close to the (U)SIM card connector.
- Please select equivalent capacitor is 22pF~33pF for ESD device.
- USIM_DATA should pull up to USIM_VDD with a 10K resistor.

5.4 USB Interface

5.4.1 USB Pin Definition

Table 5-9 USB pin definition

Pin Name	I/O	Pin No.	Description
USB_DP	IO	69	USB differential data bus D+
USB_DM	IO	70	USB differential data bus D-
USB_VBUS	PI	71	USB Plug detect

For more information about the USB 2.0 specification, please refer to http://www.usb.org/home

Note:

Since the module supports USB 2.0 High-Speed, TVS tube equivalent capacitance on the USB_DM/DP differential signal cable is required to be less than 1pF, and a 0.5pF capacitance TVS is recommended.

Connect a 0-Ω resistor to USB_DM / DP differential line to help analyze problems.

USB_DM and USB_DP are high-speed differential signal cables, can achieve the maximum transmission rate of 480Mbits/s, and must follow the rules below in PCB Layout:

• USB_DM and USB_DP signal cable's control differential impedance is 90Ω.

• USB_DM and USB_DP signal cables shall be parallel and equal in length, and avoid the right-angle route.

• USB_DM and USB_DP signal cables are routed on the signal layer closest to the ground layer, and the cables shall be grounded.

5.5 UART Interface

5.5.1 UART Interface Definition

MC116-NA series module has two serial ports: the main serial port and debug serial port. The main serial ports support 4800bps, 9600bps, 19200bps, 38400bps, 57600bps, 115200bps, 230400bps baud rates. The default baud rate is 115200bps, used for data transmission and AT command transmission.

Debug serial port supports 115200bps baud rate for FIBOCOM internal debug. Table 5-10 and table 5-11 are the pin definition of main serial port and debug serial port.

Table 5-10 Main serial port

Pin Name	I/O	Pin Num	Description
RI	O	62	Ring indicator
DCD	O	63	Data carrier detection
CTS	I	64	Clear to send
RTS	O	65	Request to send
DTR	I	66	Data ready, sleep mode control
TXD	O	67	Module Transmit data
RXD	I	68	Module Receive data

Table 5-11 Debug serial port

Pin Name	I/O	Pin Num	Description
DBG_RXD	I	11	Module Receive data
DBG_TXD	O	12	Module Transmit data

5.5.2 UART Port Application

The serial port level of MC116-NA series module is 1.8V, if the level of the client host system is 3.3V or other, level translator needed between the module and the host. The reference design circuit of level translator is shown as follows:

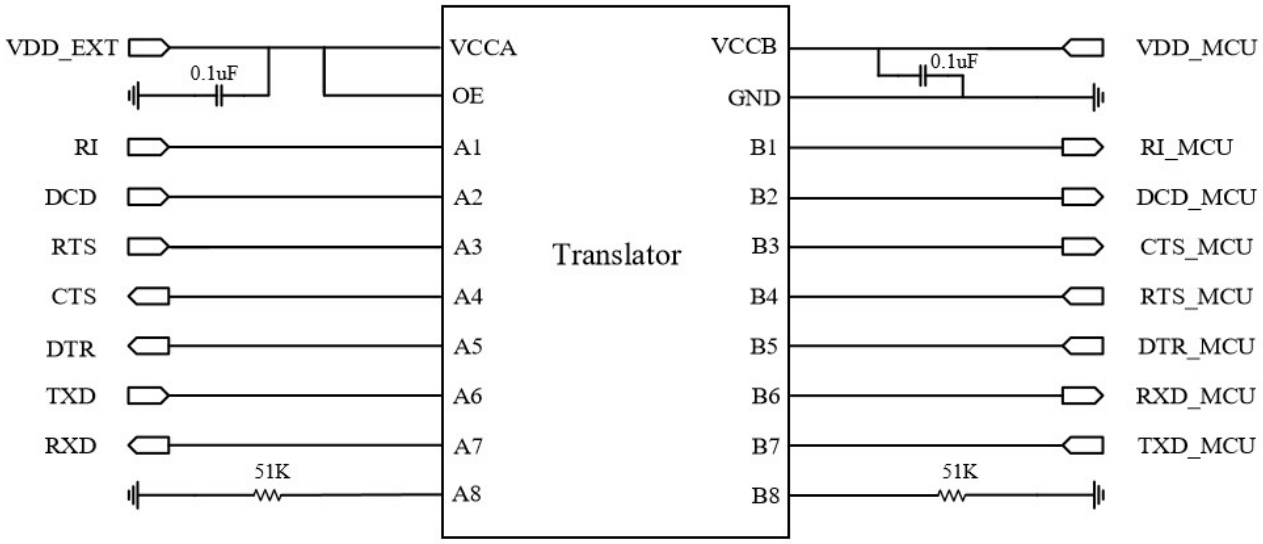


Figure 5-12 UART level translate reference 1

The other level translator circuit is shown as Figure 5-13, The rest input and output circuit design of dotted line please refer to solid line part, but pay attention to signal connection direction.

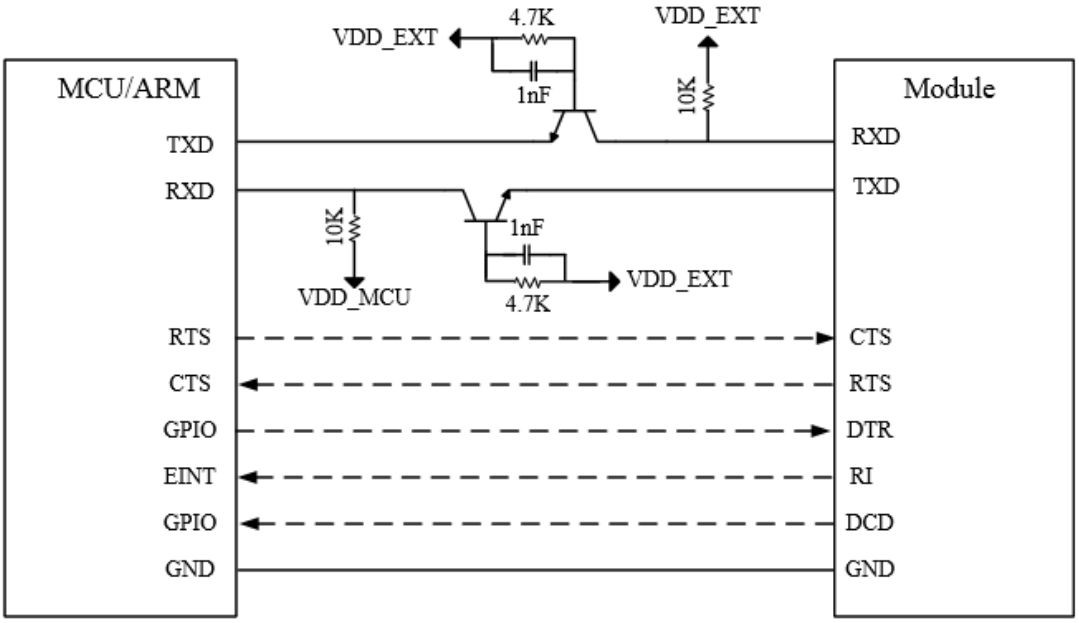


Figure 5-13 UART level translate reference 2

Note:

Level translate circuits is not suitable for applications of baud rates above 460Kbps.

5.6 ADC Interface

MC116-NA series module supports two channels ADC interface. Use AT+TADC command can read the value of ADC interface. The voltage range of ADC interface is 0.3V~VBAT_BB.

Table 5-12 ADC pin definition

PIN Name	I/O	Pin No.	Description
ADC0	I	45	Analog to digital converter interface 0
ADC1	I	44	Analog to digital converter interface 1

5.7 PCM Interface

MC116-NA series module provides a PCM interface for communication with digital audio devices such as an external CODEC.

5.7.1 Support Model

Table 5-13 Support model of PCM

Product Model	Description
MC116-NA	Support

5.7.2 PCM Interface Definition

Table 5-14 PCM pin definition

Pin Name	I/O	Pin No.	Description
PCM_IN	I	24	PCM data input
PCM_OUT	O	25	PCM data output
PCM_SYNC	IO	26	PCM data synchronous signal
PCM_CLK	IO	27	PCM clock

5.7.3 PCM Interface Description

Table 5-15 PCM interface description

Pin Name	Frequency.	Duty Cycle	Coded Format	Operating Mode	Description
PCM_CLK	2.048MHz	50%	16bit Liner mono	Module serves as master	PCM CLK
PCM_OUT	-	-			PCM Output
PCM_IN	-	-			PCM Input
PCM_SYNC	8KHz	Short pulse			PCM Synchronous Signal (Falling edge sampling)

MC116-NA series module adopts the above configuration by default, any adjustment please contact

Fibocom Wireless technical support.

5.7.4 PCM Signal Description

The PCM signal of MC116-NA series module adopts domestic mainstream Europe E1 standard. PCM_CLK frequency is 2.048MHz clock in 16bit linear format encoding. PCM_SYNC is a 8kHz burst (488nS).

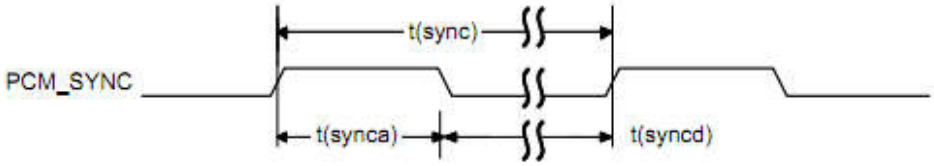


Figure 5-14 PCM_SYNC Timing

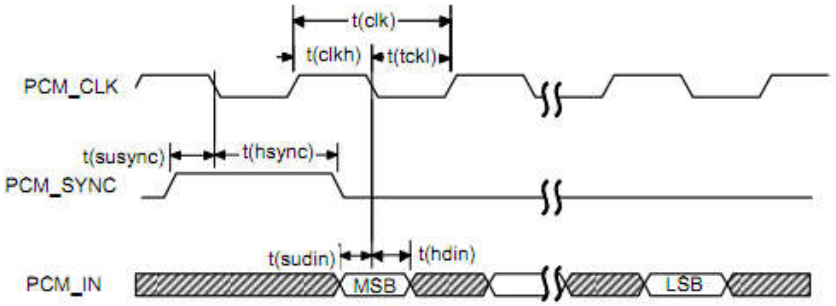


Figure 5-15 PCM_CODEC to MC116-NA timing

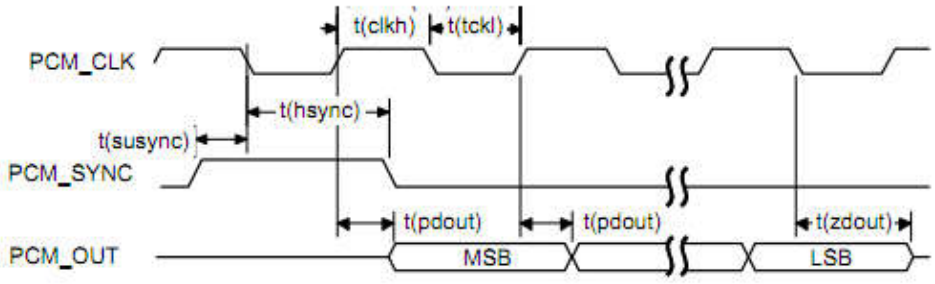


Figure 5-16 MC116-NA to PCM_CODEC timing

Table 5-16 Codec timing parameters

Parameter		Min	Typ	Max	Unit
t(sync)	PCM_SYNC cycle time	–	125	–	μs
t(synca)	PCM_SYNC asserted time	–	488	–	ns
t(syncd)	PCM_SYNC deasserted time	–	124.5	–	μs

Parameter		Min	Typ	Max	Unit
t(clk)	PCM_CLK cycle time	–	488	–	ns
t(clkh)	PCM_CLK high time	–	244	–	ns
t(clkl)	PCM_CLK low time	–	244	–	ns
t(susync)	PCM_SYNC offset time to PCM_CLK falling	–	122	–	ns
t(sudin)	PCM_DIN setup time to PCM_CLK falling	60	–	–	ns
t(hdin)	PCM_DIN hold time after PCM_CLK falling	10	–	–	ns
t(pdout)	Delay from PCM_CLK rising to PCM_DOUT valid	–	–	60	ns
t(zdout)	Delay from PCM_CLK falling to PCM_DOUT high impedance	–	160	–	ns

6 Low Power Consumption

6.1 Airplane Mode

W_DISABLE# Pin Description:

Table 6-1 W_DISABLE# pin description

Pin name	I/O	Pin Num.	Description
W_DISABLE#	I	4	Module airplane mode control

MC116-NA series module supports two ways to enter airplane mode:

Table 6-2 Module enters airplane mode ways

1	Hardware I/O interface button control	First send “AT+WDISABLEEN=1” to enable W_DISABLE# pin function. Pull high or float W_DISABLE# pin (pull high by default), module enter normal mode, pull it down, module enter airplane mode.
2	AT command control	AT+CFUN=4--module enter airplane mode AT+CFUN=1--module enter normal mode

6.2 Sleep Mode

6.2.1 USB Application (USB Suspend Is Not Supported, VBUS Is Supported)

If the host nonsupport USB suspend function, the module can enter sleep mode by disconnect USB_VBUS from the external control circuit:

Sleep:

Send AT+GTUSBDETECTEN=1 to enable USB plug detect function.

AT+GTLPMMODE=1,X command to set the WAKEUP_IN pin’s level of control module enter sleep mode.

Reset module, command effective.

(X=0, WAKEUP_IN pin is high level, module enter sleep mode;

X=1, WAKEUP_IN pin is low level, module enter sleep mode)

AT+CSCLK=1 command to enable sleep function.

AT+GTUSBSLEEPEN=1,0 command to set USB sleep mode.

Draw out the USB cable or disable the USB HUB controller, module enter sleep mode.

Wakeup:

Plug in USB cable or enable the USB HUB controller can wake up the module.

6.2.2 USB Application (USB Suspend Is Not Supported, VBUS Is Not Supported)

If the host nonsupport USB suspend and nonsupport VBUS function, the module can enter sleep mode by disconnect USB_VBUS from the external control circuit:

Sleep:

Send AT+GTLPMMODE=1,X command to set the WAKEUP_IN pin's level of control module enter sleep mode. Reset module, command effective.

(X=0, WAKEUP_IN pin is high level, module enter sleep mode;

X=1, WAKEUP_IN pin is low level, module enter sleep mode)

AT+CSCLK=1 command to enable sleep function.

AT+GTUSBSLEEPEN=1,1 command to set USB sleep mode

Draw out the USB cable or disable the USB HUB controller, module enter sleep mode.

Wakeup:

Plug in USB cable or enable the USB HUB controller can wake up the module.

6.2.3 USB Application (USB Suspend Is Supported)

If the host support USB Suspend/Resume. Setting USB sleep in Linux system.

Sleep:

Send AT+GTLPMMODE=1,X command to set the WAKEUP_IN pin's level of control module enter sleep mode. Reset module, command effective.

(X=0, WAKEUP_IN pin is high level, module enter sleep mode;

X=1, WAKEUP_IN pin is low level, module enter sleep mode)

AT+CSCLK=1 command to enable sleep function.

AT+GTUSBSLEEPEN=0,0 command to set USB sleep mode

In Linux system, set the level and control of USB device as auto to suspend the devices of module.

Standing the module and host about 2 seconds, the module can enter suspend mode automatically.

Wakeup:

Any operation of USB can wake up the module from sleep mode.

6.2.4 UART Application (WAKEUP_IN Pin Level Control)

When host and module connected through UART, use the following steps to make the module enter

Sleep:

Sent AT+GTLPMMODE=1,X command to set et the WAKEUP_IN pin's level of control module enter sleep mode. Reset module, command effective.

(X=0, WAKEUP_IN pin is high level, module enter sleep mode;

X=1, WAKEUP_IN pin is low level, module enter sleep mode)

AT+GTUSBSLEEPEN=2,X command to disable USB function (X can be 0 or 1)

AT+CSCLK=1 command to enable sleep function.

Wakeup:

The level of WAKEUP_IN pin contrary with that when the module enters sleep mode, module allow be waked up. (X=0, WAKEUP_IN pin is low level, wake up module;

X=1, WAKEUP_IN pin is high level, wake up module)

6.2.5 UART Application (DTR Pin Level Control)

When host and module connected through UART, use the following steps can make the module enter

Sleep:

Send AT+GTLPMMODE=2,X command to set the DTR set pin's level of control module enter sleep mode. Reset module, command effective.

(X=0, DTR pin is high level, module enter sleep mode;

X=1, DTR pin is low level, module enter sleep mode)

AT+GTUSBSLEEPEN=2,X command to disable USB function (X can be 0 or 1)

AT+CSCLK = 1 command to enable sleep function.

Wake up:

The level of DTR pin contrary with that when the module enters sleep mode, module allow be wake up. (X=0, DTR pin is low level, wake up module; X=1, DTR pin is high level, wake up module)

6.2.6 ATS24 Command

ATS24 command can also make module enter sleep mode.

Sleep:

Send AT+GTLPMMODE=0 Reset module, command effective.

ATS24=X command to into sleep after X seconds. (X is nonzero integer)

AT+GTUSBSLEEPEN=2,X command to disable USB function (X can be 0 or 1)

Wake up:

Send the AT command fast by UART serial port can wake up the module. If don't send AT commands between X seconds, module will try to enter sleep mode.

Note:

Since the level of UART sleep power is different, power consumption of use ATS24 command to enter sleep mode is higher than that use Pin control to enter sleep mode.

When ATS24 command enter sleep mode countdown, it isn't entering sleep mode once overtime strictly, but try to enter sleep mode. If system don't support after overtime, it will

timekeeping automatically.

If you want to use the RI signal to represent the state of the module, please refer to the AT+GTWAKE command in FIBOCOM AT Commands User Manual_Sleep.

For more sleep command description, please refer to *FIBOCOM AT Commands_Sleep*.

7 RF Interface

MC116-NA series module has ANT_MAIN, ANT_DIV and ANT_ GNSS three antenna interfaces, its pin definition is shown as table 7-1:

Table 7-1 RF interface

Pin Name	I/O	Pin No.	Description
ANT_DIV	I	35	Diversity antenna
ANT_GNSS	I	47	GPS antenna
ANT_MAIN	IO	49	Main antenna

7.1 Operating Bands

Table 7-2 Operating bands

Operating Band	Description	Mode	Tx (MHz)	Rx (MHz)
Band 2	PCS 1900MHz	LTE FDD	1850- 1910	1930 - 1990
Band 4	AWS-1 1700	LTE FDD	1710 - 1755	2110 - 2155
Band 5	CLR 850MHz	LTE FDD	824 - 849	869 - 894
Band 12	Lower SMH blocks A/B/C 700	LTE FDD	699-716	729-746
Band 13	Lower SMH blocks A/B/C 700	LTE FDD	777-787	746-756
Band 17	Lower SMH (Blocks B–C)	LTE FDD	704-716	734-746
Band 66	Extended AWS-1 (Blocks A – I)	LTE FDD	1710-1780	2110 - 2200

7.2 Output Power

The output power of MC116-NA series module is shown as follows:

Table 7-3 Output power

Mode	Band	Tx Power (dBm)	Note
LTE FDD	Band 2	23±2	10MHz Bandwidth, 1 RB
	Band 4	23±2	10MHz Bandwidth, 1 RB
	Band 5	23±2	10MHz Bandwidth, 1 RB
	Band 12	23±2	10MHz Bandwidth, 1 RB
	Band 13	23±2	10MHz Bandwidth, 1 RB

Mode	Band	Tx Power (dBm)	Note
	Band 17	23±2	10MHz Bandwidth, 1 RB
	Band 66	23±2	10MHz Bandwidth, 1 RB

7.3 Receive Sensitivity

Table 7-4 Receive sensitivity

Mode	Band	Rx Sensitivity (dBm) PRX Typ.	Rx Sensitivity (dBm) DRX Typ.	Note
LTE FDD	Band 2	-97.8	-98.5	10MHz Band width
	Band 4	-97.8	-98	10MHz Band width
	Band 5	-99	-99.5	10MHz Band width
	Band 12	-98	-98.5	10MHz Band width
	Band 13	-97	-98	10MHz Band width
	Band 17	-98	-98	10MHz Band width
	Band 66	-97.8	-98	10MHz Band width

7.4 GNSS Receiver

7.4.1 GNSS Specification

MC116-NA series module supports GNSS function and adopts Qualcomm Gen8 technology, its specification is shown as follows:

Table 7-5 GNSS specification

Description		Condition	Typ.
Current consumption （AT+CFUN=0）		GNSS fixing	68mA（TBD）
		GNSS tracking	68mA（TBD）
		Standby	33mA（TBD）
TTFF	GNSS	Cold start	45s
		Warm start	40s
		Hot Start	4s
Sensitivity	fixing		-146dbm（TBD）
	tracking		-158dbm（TBD）

Description		Condition	Typ.
	CN0	GNSS Signal@-130dBm	39dB-HZ（TBD）
Positional Accuracy	CEP	GNSS Signal @-130dBm	<3m

7.4.2 GNSS Observes Protocol

MC116-NA series module adopts NMEA-0183 protocol.

7.5 Antenna Design

7.5.1 Antenna Index

1) Antenna efficiency

Antenna efficiency is the ratio of antenna input power to radiated power. Due to the antenna return loss, material loss, and coupling loss, the radiated power is always lower than the input power. Recommend> 40% (-4dB).

2) S11 or VSWR

S11 shows that the matching degree of the antenna's 50Ω impedance, to a certain extent, affects the antenna efficiency. VSWR test methods can be used to measure this parameter. Recommend S11 <-10dB.

3) Polarization

Polarization is the rotation direction of the electric field in the maximum radiation direction of the antenna. It is recommended to use linear polarization.

4) Radiation pattern

Radiation pattern refers to the antenna's electromagnetic field strength in the far field in all directions. Half-wave dipole antenna is the most suitable terminal antenna. For built-in antenna, PIFA antennas or IFA antennas are recommended:

Antenna area: 6mm high*10mm wide*100mm long.

Antenna radiation direction: Omni_directional (all direction).

5) Gain and directivity

Antenna directivity refers to the electromagnetic field strength of electromagnetic wave in all directions. Gain is a collection of antenna benefits and antenna directivity.

Recommended antenna gain ≤ 2.5dBi.

6) Interference

In addition to the antenna performance, other interferences on the PCB also affect the performance of the module. In order to ensure the high performance of the module, interference must be controlled.

Suggestions: For example, LCD, CPU, FPC cable, audio circuit, power supply should be away from the antenna as far as possible, and make the appropriate isolation and shielding, or filtering on the path.

7) Antenna index requirements

Table 7-6 Main antenna requirements

MC116-NA Series Module Main Antenna Requirement	
Frequency range	It must use the most suitable antenna to adapt to the relevant frequency band
Bandwidth (LTE)	LTE band 2 (1900): 140 MHz LTE Band 4 (2100): 440 MHz LTE Band 5 (850): 70 MHz LTE Band 12 (700): 50 MHz LTE Band 13 (750): 41 MHz LTE Band 17 (700): 50 MHz LTE Band 66 (2100): 490 MHz
Impedance	50Ω
Input power	> 23dBm average power LTE
Standing wave ratio recommended	≤ 2:1

7.5.2 Antenna Reference Design

Antenna is a sensitive device, susceptible to the external environment. For example, the size of the module, the location of the antenna, the space it occupies, and the surrounding ground all may affect antenna performance. In addition, the RF cable connect with antenna, and the location of the fixed antenna also may affect its performance. MC116-NA series module's three antenna all led by welding plate. recommended clients use the U.FL-R-SMT-1 antenna connector and corresponding match adapter cable. Figure 7-1 is reference design of main antenna and diversity antenna.

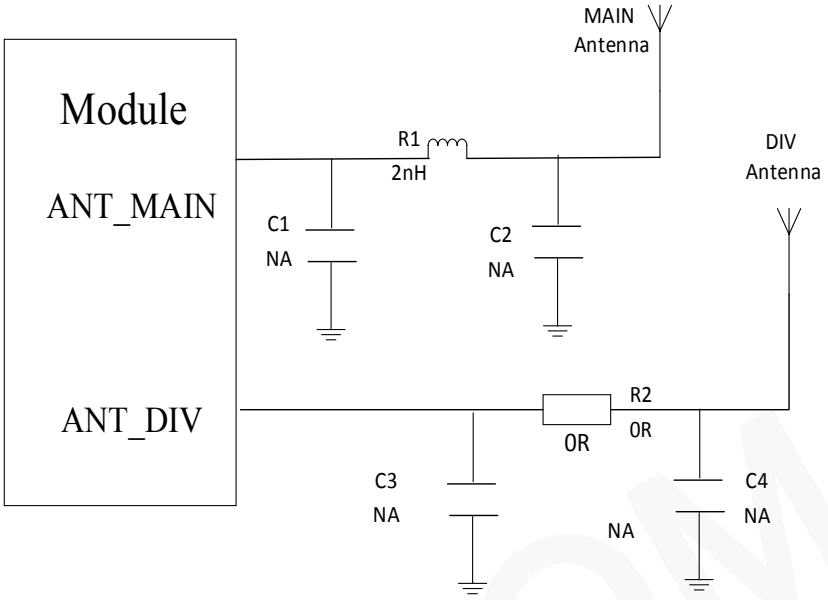


Figure 7-1 Main and diversity antenna reference circuit

Figure 7-2 is reference design of GNSS antenna.

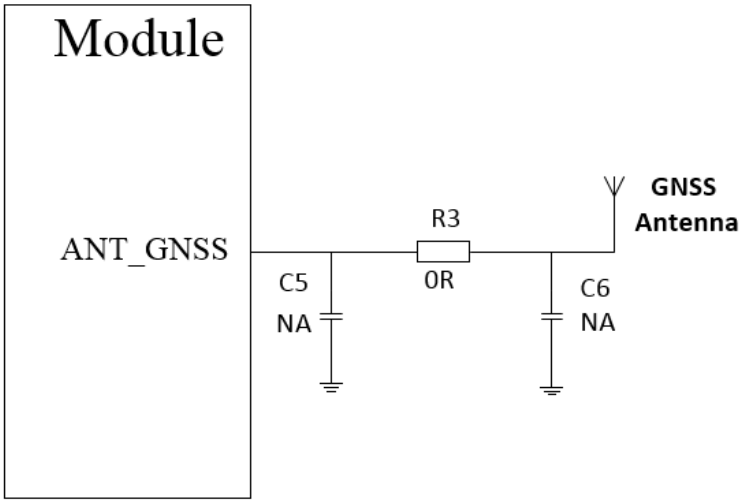


Figure 7-2 GNSS antenna reference circuit

Note :

- All matches must be placed close to antenna to make sure the characteristic impedance of transmission cable is 50Ω.
- Since the antenna loss should be less than 0.3dB, keep PCB cable as short as possible.
- Keep the PCB LAYOUT straight, and reduce holes on the route to another layer; also avoid right-angle and acute-angle wiring.
- PCB cable should have a good reference ground to avoid other signal cable near the antenna.
- Recommend a complete ground level, and use this complete ground level as a reference ground.

- Ground around antenna must be keep connect with main ground.
- For more design information please refer to *FIBOCOM RF Antenna Application Design Instruction*.

8 Reliability

8.1 Limiting Voltage Range

The limiting voltage range is maximum voltage range that power supply and digital or analog input/output interfaces can withstand.

8.1.1 Absolute Voltage Range

The absolute voltage range of MC116-NA series module is shown as table 8-1.

Table 8-1 Absolute voltage range

Parameter	Description	Min	Typ	Max	Unit
VBAT	Power supply	-0.3	3.8	4.7	V
GPIO	Digital IO supply voltage	-0.3	1.8	2.0	V

8.1.2 Operating Voltage Range

V_L：logic low level; V_H: logic high level.

Parameter	V_L		V_H		Unit
	Min	Max	Min	Max	
Digital input	-0.3	0.6	1.2	2.0	V
Digital output	-	0.45	1.35	-	V

Table 8-2 Operating Voltage Range

Parameter	I/O	Min	Typ	Max	Unit
VBAT	PI	3.3	3.8	4.3	V
USIM_VDD	PO	1.7/2.75	1.8/2.85	1.9/2.95	V

8.2 Environment Temperature Range

The recommended operating temperature range of MC116-NA series module.is -30℃~+75℃. When module operating at limited temperature range, some RF indexes may exceed standard, so module application terminal should consider temperature control measurement. The module application terminal is recommended storage in certain temperature conditions. Modules out of the temperature range may not operate or may be damaged.

Table 8-3 Environment temperature range

Temperature	Min	Typ.	Max	Unit
Operating temperature	-30	25	75	℃
Limited operating temperature	-40		85	℃
Storage temperature	-40		85	℃

8.3 Environmental Reliability Requirements

Table 8-4 Environmental reliability requirement

Test Item	Test Condition
Low temperature storage test	Temperature -40℃±3℃, 24 hours in shutdown state
High temperature storage test	Temperature +85℃±3℃, 24 hours in shutdown state
Temperature shock test	In shutdown state, 0.5 hour at -40℃ and +85℃ environment respectively, the temperature conversion time <3min, for 24 cycles
High temperature and humidity test	Temperature +85℃±3℃, humidity 90 ~ 95% RH, 24 hours in shutdown state
Low temperature operating test	Temperature -30℃±3℃, 24 hours in operating state
High temperature operating test	Temperature +75℃±3℃, 24 hours in operating state
Vibration test	Conduct vibration test according to the requirements shown in the table below: Frequency: Random vibration ASD (Acceleration Spectral Density) 5~20Hz: $0.96m^2/s^3$ 20~500Hz: $0.96m^2/s^3$(20Hz), other -3dB/octave
Connector life test	30 times of insertion/removal for RF antenna interface cable

8.4 ESD Characteristics

MC116-NA series module design has considered ESD issue and provided ESD protect measurements, but take ESD issue taken by module carrier and secondary development into consideration, developers should care ESD protection of module application terminal. In addition to considering anti-static treatment of packaging, please refer to recommended circuit of interface design in the document.

ESD allowable discharge range of MC116-NA series module show as table 8-5:

Table 8-5 ESD allowable discharge range

Interface	Air Discharge	Contact Discharge

Interface	Air Discharge	Contact Discharge
Antenna port	±8KV	±4KV
Other port	±1KV	±0.5KV

9 Structure Specification

9.1 Product Appearance

The product appearance of MC116-NA series module is shown in Figure 9-1:

TBD

Figure 9-1 Product appearance

9.2 Structure Dimension

The structure dimension of MC116-NA series module is shown as Figure 9-2:

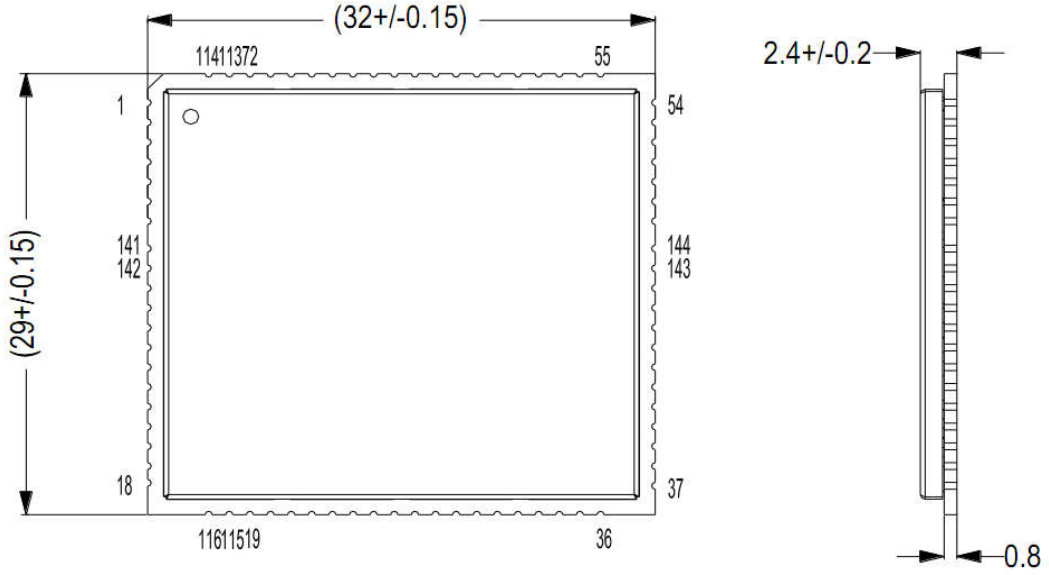


Figure 9-2 Structure dimension (unit: mm)

9.3 PCB Soldering Pad and Stencil Design

PCB soldering pad and stencil design please refer to *FIBOCOM MC116 SMT Design Guide*.

9.4 SMT

SMT production process parameters and related requirements please refer to *FIBOCOM MC116 SMT Design Guide*.

9.5 Carrier and Storage

Carrier and storage please refer to *FIBOCOM MC116 SMT Design Guide*.

10 Approval

MC116-NA series module approval show as table 10-1:

Table 10-1 Approval

Certification Scheme	MC116-NA
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD

For more information, please refer to Fibocom net.

11 Appendixes

11.1 Terms and Acronyms

Term	Definition
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
DRX	Discontinuous Reception
EGSM	Extended GSM900 Band
FDD	Frequency Division Duplexing
GMSK	Gaussian Minimum Shift Keying
GSM	Global System for Mobile Communications
HSDPA	High Speed Down Link Packet Access
IMEI	International Mobile Equipment Identity
Imax	Maximum Load Current
LED	Light Emitting Diode
LSB	Least Significant Bit
LTE	Long Term Evolution
CA	Carrier Aggregation
DLCA	Downlink Carrier Aggregation
SCell	Secondary Cell for CA
ME	Mobile Equipment
MS	Mobile Station
MT	Mobile Terminated

Term	Definition
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PSK	Phase Shift Keying
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RHCP	Right Hand Circularly Polarized RMS
RMS	Root Mean Square
RTC	Real Time Clock
Rx	Receive
SMS	Short Message Service
TDMA	Time Division Multiple Access
TE	Terminal Equipment
TX	Transmitting Direction
TDD	Time Division Duplexing
UART	Universal Asynchronous Receiver & Transmitter
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
(U)SIM	(Universal) Subscriber Identity Module
USSD	Unstructured Supplementary Service Data
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value

Term	Definition
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value
VSWR	Voltage Standing Wave Ratio
WCDMA	Wideband Code Division Multiple Access

Table 11-1 Terms and Acronyms

11.2 Related Documents

- FIBOCOM EVK-GT8230-NL User Guide
- FIBOCOM ADP-MC116-NA User Guide
- FIBOCOM MC116 SMT Design Guide
- FIBOCOM Application Design Guide_RF Antenna
- FIBOCOM MC116 AT Commands

11.3 Reference Standards

The design of the product complies with the following standards:

- 3GPP TS 51.010-1 V10.5.0: Mobile Station (MS) conformance specification; Part 1: Conformance specification
- 3GPP TS 34.121-1 V10.8.0: User Equipment (UE) conformance specification; Radio transmission and reception (FDD); Part 1: Conformance specification
- 3GPP TS 34.122 V10.1.0: Technical Specification Group Radio Access Network; Radio