LCUK54-WRD Hardware Design

LTE-A Series

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Revision History

Version	Date	Description
-	2024-04-01	Creation of the document
1.0.0	2024-04-01	Preliminary

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1 Introduction

The hardware design defines the air and hardware interfaces of LCUK54-WRD which connect to your applications.

This document can help you quickly understand the interface specifications, electrical and mechanical details as well as other related information of the module. Besides, reference designs will be offered to exemplify diverse applications of the modules. With this hardware design coupled with application notes and user guides, you can use the modules to design and set up mobile applications easily.

1.1. Reference Standards

The module complies with the following standards:

- *PCI Express M.2 Specification Revision 4.0, Version 1.1*
- *Universal Serial Bus Specification, Revision 4.0*
- *ISO/IEC 7816-3*
- *MIPI Alliance Specification for RF Front-End Control Interface Version 2.0*
- *3GPP TS 27.007 and 3GPP TS 27.005*
- *3GPP TS 34.121-1 and 3GPP TS 36.521-1*

1.2. Special Marks

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Table 1: Special Marks

Mark	Definition
*	Unless otherwise specified, an asterisk (*) after a function, feature, interface, pin name, command, argument, and so on indicates that it is under development and currently not supported; and the asterisk (*) after a model indicates that the model sample is currently unavailable.
[…]	Brackets ([…]) used after a pin enclosing a range of numbers indicate all pins of the same type. For example, SDIO_DATA[0:3] refers to all four SDIO pins: SDIO_DATA0, SDIO_DATA1, SDIO_DATA2, and SDIO_DATA3.

2 Product Overview

2.1. Frequency Bands and Functions

LCUK54-WRD is an LTE-A/UMTS/HSPA+ wireless communication module with diversity receiver. They provide data connectivity on LTE-FDD, LTE-TDD, DC-HSDPA, HSPA+, HSDPA, HSUPA and WCDMA networks. It is a standard WWAN M.2 Key-B module. For more details, see *PCI Express M.2 Specification Revision 4.0, Version 1.1*.

It supports embedded operating systems such as Windows, Linux and Android, and also provides GNSS [1] to meet specific application demands.

The following table shows the frequency bands and GNSS functions of the module. For details about CA combinations, see ***document [1]***.

Table 2: Frequency Bands and GNSS Function

Mode	Frequency Band
LTE-FDD (with Rx-diversity)	B1/B2/B3/B4/B5/B7/B8/B12/B13/B14/B17/B18/B19/B20/B25/B26 /B28/B29 [2]/B30/B32 [2]/B66/B71
LTE-TDD (with Rx-diversity)	B34/B38/B39/B40(CE)/B41
WCDMA (with Rx-diversity)	B1/B2/B3/B4/B5/B6/B8/B19

2.2. Key Features

Table 3: Key Features

Feature	Details
Function Interface	PCI Express M.2 Interface
Power Supply	● Supply voltage: 3.135–4.4 V ● Typical supply voltage: 3.7 V

[1] GNSS function is optional.

[2] LTE-FDD B29/B32 support Rx only and is only for secondary component carrier.

(U)SIM Interface	● Compliant with *ISO/IEC 7816-3*, ETSI and IMT-2000 ● Supports (U)SIM card: 1.8/3.0 V ● Supports Dual SIM Single Standby (one eSIM and one USIM interface)
eSIM	Supports eSIM function
USB Interface	● Compliant with USB 2.0 specifications, with maximum transmission rates up to 480 Mbps ● Used for AT command communication, data transmission, firmware upgrade, software debugging, GNSS NMEA sentence output ● Supports USB serial drivers: — Windows 10/11 — Linux 2.6–6.x — Android 4.x–13.x
Rx-diversity	LTE/WCDMA
Antenna Interfaces	● Main antenna connector and Rx-diversity/GNSS antenna connector ● 50 Ω impedance
Transmitting Power	● WCDMA: Class 3 (23 dBm ±2 dB) ● LTE B7/B38/B40(CE)/B41: Class 3 (23 dBm ±1 dB) ● LTE B30: Class 3 (22 dBm ±1 dB) ● LTE other bands: Class 3 (23.5 dBm ±1 dB)
LTE Features	● Supports 3GPP Rel-12 LTE-FDD and LTE-TDD ● Supports CA category: up to DL CA Cat 6 ● Supports modulations: — UL: QPSK and 16QAM modulations — DL: QPSK, 16QAM and 64QAM modulations ● Supports 1.4/3/5/10/15/20 MHz RF bandwidths ● Max. transmission data rates: — LTE-FDD: 300 Mbps (DL)/50 Mbps (UL) — LTE-TDD: 226 Mbps (DL)/28 Mbps (UL)
UMTS Features	● Supports 3GPP Rel-9 DC-HSDPA, HSPA+, HSDPA, HSUPA and WCDMA ● Supports modulations: — DL: BPSK, QPSK, 16QAM and 64QAM — UL: BPSK, QPSK ● Max. transmission data rates: — DC-HSDPA: Max. 42 Mbps (DL) — HSUPA: Max. 5.76 Mbps (UL) — WCDMA: Max. 384 kbps (DL)/384 kbps (UL)
GNSS Features [3]	● Supports GPS, GLONASS, BDS, Galileo and QZSS ● Data update rate: 1 Hz by default
AT Commands	● Compliant with *3GPP TS 27.007* and *3GPP TS 27.005* ● Enhanced AT commands

[3] GNSS function is optional.

Internet Protocol Features	● QMI/MBIM/NITZ/HTTP/HTTPS ● Supports PAP and CHAP for PPP connections
Firmware Upgrade	Via USB 2.0 or DFOTA
SMS	● Point-to-point MO and MT ● Text and PDU modes ● SMS cell broadcast ● SMS storage: ME by default
Physical Characteristics	● M.2 Key-B ● Size: 30.0 mm × 42.0 mm × 2.3 mm ● Weight: approx. 6.2 g
Temperature Ranges	● Operating temperature range [4]: -25 to +75 °C ● Extended temperature range [5]: -40 to +85 °C ● Storage temperature range: -40 to +90 °C
RoHS	All hardware components are fully compliant with EU RoHS directive

2.3. Functional Diagram

The following figure shows a functional diagram of LCUK54-WRD.

- Power management
- Baseband
- LPDDR2 SDRAM + NAND flash
- Radio frequency
- M.2 Key-B interface

[4] To meet the normal operating temperature range requirements, it is necessary to ensure effective thermal dissipation, e.g., by adding passive or active heatsinks, heat pipes, vapor chambers. Within the temperature range of -10 °C to +55 °C, the mentioned RF performance margins higher than 3GPP specifications can be guaranteed. When temperature goes beyond temperature range of -10 °C to 55 °C, a few RF performances of module may be slightly off 3GPP specifications.

[5] To meet the extended operating temperature range requirements, it is necessary to ensure effective thermal dissipation, e.g., by adding passive or active heatsinks, heat pipes, vapor chambers. Within this range, the module remains the ability to establish and maintain functions such as SMS, without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as Pout, may undergo a reduction in value, exceeding the specified tolerances of 3GPP. When the temperature returns to the normal operating temperature level, the module will meet 3GPP specifications again.

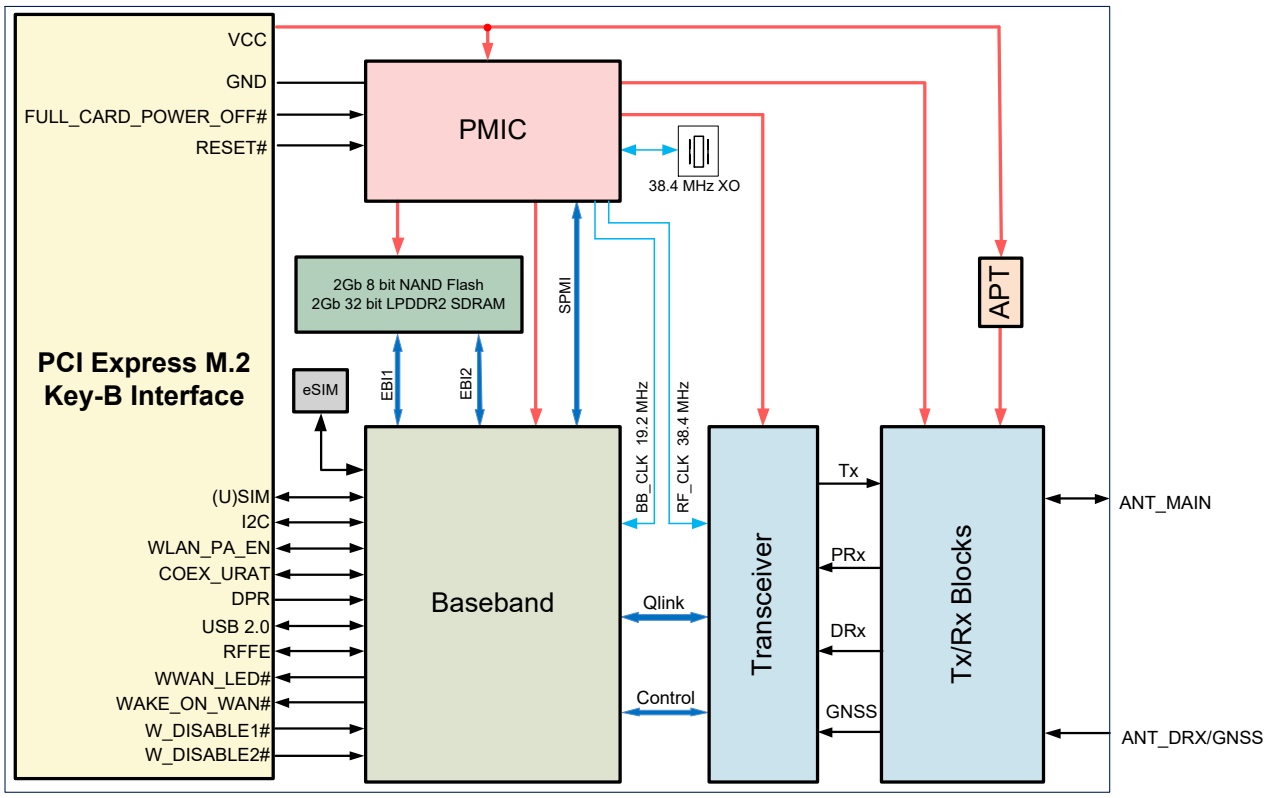
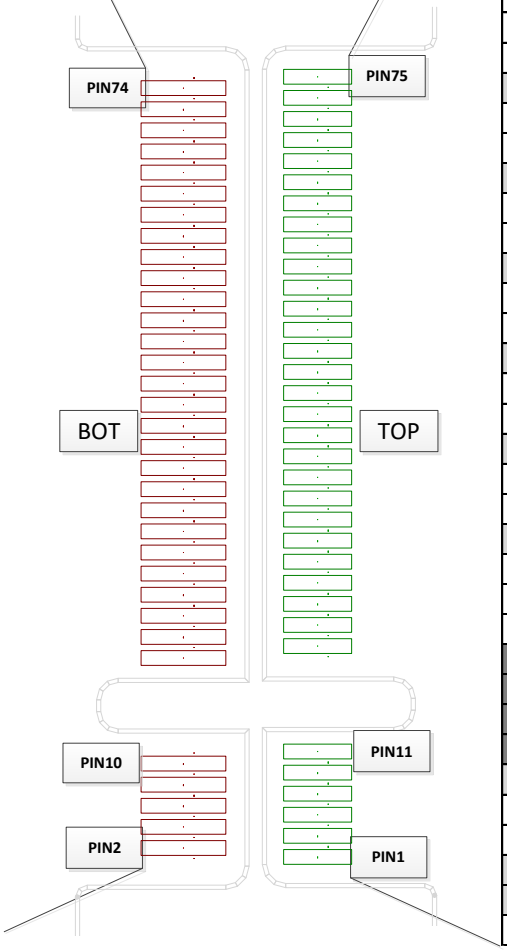


Figure 1: Functional Diagram

2.4. Pin Assignment

The following figure shows the pin assignment of the module.

No.	Pin Name
74	VCC
72	VCC
70	VCC
68	NC
66	USIM_DET
64	COEX_TXD
62	COEX_RXD
60	WLAN_PA_EN
58	RFFE_DATA
56	RFFE_CLK
54	RESERVED
52	RESERVED
50	RESERVED
48	NC
46	NC
44	I2C_IRQ
42	I2C_SDA
40	I2C_SCL
38	NC
36	USIM_VDD
34	USIM_DATA
32	USIM_CLK
30	USIM_RST
28	RESERVED
26	W_DISABLE2#
24	RESERVED
22	RESERVED
20	RESERVED
	Notch
	Notch
	Notch
	Notch
10	WWAN_LED#
8	W_DISABLE1#
6	FULL_CARD_POWER_OFF#
4	VCC
2	VCC



Pin Name	No.
CONFIG_2	75
VIO_CFG	73
GND	71
CONFIG_1	69
RESET#	67
ANTCTL3	65
ANTCTL2	63
ANTCTL1	61
ANTCTL0	59
GND	57
RESERVED	55
RESERVED	53
GND	51
RESERVED	49
RESERVED	47
GND	45
RESERVED	43
RESERVED	41
GND	39
RESERVED	37
RESERVED	35
GND	33
RESERVED	31
RESERVED	29
GND	27
DPR	25
WAKE_ON_WAN#	23
CONFIG_0	21
Notch	
Notch	
Notch	
Notch	
GND	11
USB_DM	9
USB_DP	7
GND	5
GND	3
CONFIG_3	1

Figure 2: Pin Assignment

NOTE

Before the module turns on, ensure the pins DPR and USIM_DET are not pulled high to avoid current sink damaging the module. For more details, contact NetPrisma Technical Support.

2.5. Pin Definitions

Table 4: Parameter Definition

Parameter	Description
AI	Analog Input
AO	Analog Output
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
OD	Open Drain
PI	Power Input
PO	Power Output
PU	Pull Up

DC characteristics include power domain and rated current.

Table 5: Pin Description

Pin No.	Pin Name	I/O	Description	DC Characteristics	Comment
1	CONFIG_3	DO	Connected to GND internally		
2	VCC	PI	Power supply for the module	Vmin = 3.135 V Vnom = 3.7 V Vmax = 4.4 V	
3	GND		Ground		
4	VCC	PI	Power supply for the module	Refer to Pin 2	
5	GND		Ground		
6	FULL_CARD_ POWER_OFF#	DI, PD	Turn on/off the module High level: turn on Low level: turn off	V_{IH}max = 4.4 V V_{IH}min = 1.19 V V_{IL}max = 0.2 V	Internally pulled down with a 100 kΩ resistor.
7	USB_DP	AIO	USB differential data (+)		Require differential impedance of 90 Ω. A test point

					must be reserved.
8	W_DISABLE1#	DI	Airplane mode control Active LOW	1.8/3.3 V	Internally pulled up to 1.8 V with a 100 kΩ resistor.
9	USB_DM	AIO	USB differential data (-)		Require differential impedance of 90 Ω. A test point must be reserved.
10	WWAN_LED#	OD	RF status indication LED Active LOW	VCC	
11	GND		Ground		
12	Notch		Notch		
13	Notch		Notch		
14	Notch		Notch		
15	Notch		Notch		
16	Notch		Notch		
17	Notch		Notch		
18	Notch		Notch		
19	Notch		Notch		
20	RESERVED		Reserved		
21	CONFIG_0	DO	Not connected internally		
22	RESERVED		Reserved		
23	WAKE_ON_WAN#	OD	Wake up the host Active LOW	1.8/3.3 V	Externally pull up to 1.8 V or 3.3 V.
24	RESERVED		Reserved		
25	DPR	DI, PU	Dynamic power reduction	1.8 V	Internally pulled up to 1.8 V.

			Active LOW		
26	W_DISABLE2#*	DI	GNSS control Active LOW	1.8/3.3 V	Internally pulled up to 1.8 V with a 100 kΩ resistor.
27	GND		Ground		
28	RESERVED		Reserved		
29	RESERVED		Reserved		
30	USIM_RST	DO	(U)SIM card reset	USIM_VDD	
31	RESERVED		Reserved		
32	USIM_CLK	DO	(U)SIM card clock	USIM_VDD	
33	GND		Ground		
34	USIM_DATA	DIO	(U)SIM card data	USIM_VDD	Internally pulled up to 1.8 V with a 10 kΩ resistor.
35	RESERVED		Reserved		
36	USIM_VDD	PO	(U)SIM card power supply	High-Voltage: Vmin = 3.05 V Vnom = 2.85 V Vmax = 2.7 V Low-Voltage: Vmin = 1.95 V Vnom = 1.8 V Vmax = 1.65 V	
37	RESERVED		Reserved		
38	NC		Not connected		
39	GND		Ground		
40	I2C_SCL	OD	I2C serial clock	1.8 V	Internally pulled up to 1.8 V.
41	RESERVED		Reserved		
42	I2C_SDA	OD	I2C serial data	1.8 V	Internally pulled up to 1.8 V.

43	RESERVED		Reserved	
44	I2C_IRQ	DI	I2C interrupt signal	1.8 V
45	GND		Ground	
46	NC		Not connected	
47	RESERVED		Reserved	
48	NC		Not connected	
49	RESERVED		Reserved	
50	RESERVED		Reserved	
51	GND		Ground	
52	RESERVED		Reserved	
53	RESERVED		Reserved	
54	RESERVED		Reserved	
55	RESERVED		Reserved	
56	RFFE_CLK* [6]	DO	Used for external MIPI IC control	1.8 V
57	GND		Ground	
58	RFFE_DATA* [6]	DIO	Used for external MIPI IC control	1.8 V
59	ANTCTL0*	DO	Antenna GPIO control	1.8 V
60	WLAN_PA_EN*	DI	Self-protection of LNA control	1.8 V
61	ANTCTL1*	DO	Antenna GPIO control	1.8 V
62	COEX_RXD*	DI	LTE/WLAN coexistence receive	1.8 V
63	ANTCTL2*	DO	Antenna GPIO control	1.8 V
64	COEX_TXD*	DO	LTE/WLAN coexistence transmit	1.8 V
65	ANTCTL3*	DO	Antenna GPIO control	1.8 V

[6] If RFFE_CLK and RFFE_DATA are required, contact NetPrisma Technical Support for more details.

66	USIM_DET	DI	(U)SIM card hot-plug detect	1.8 V	
67	RESET#	DI	Reset the module Active LOW	1.8 V	Internally pulled up to 1.8 V with a 100 kΩ resistor. A test point is recommended to be reserved if unused.
68	NC		Not connected		
69	CONFIG_1	DO	Connected to GND internally		
70	VCC	PI	Power supply for the module	Refer to Pin 2	
71	GND		Ground		
72	VCC	PI	Power supply for the module	Refer to Pin 2	
73	VIO_CFG		Configuration of PCIe sideband signals [7]	Power domain NC: support 1.8/3.3 V; GND: support 3.3 V	The default state is NC (Not connected).
74	VCC	PI	Power supply for the module	Refer to Pin 2	
75	CONFIG_2	DO	Not connected internally		

NOTE

Keep all RESERVED and NC and unused pins unconnected. All GND pins should be connected to ground.

[7] PCIe sideband signals include PERST#, CLKREQ# and PEWAKE#.

3 Operating Characteristics

3.1. Operating Modes

The table below summarizes different operating modes of the module.

Table 6: Overview of Operating Modes

Mode	Details	
Full Functionality Mode	Idle	Software is active. The module has registered on the network, and it is ready to send and receive data.
	Data	Network is connected. In this mode, the power consumption is decided by network setting and data transmission rate.
Minimum Functionality Mode	**AT+CFUN=0** sets the module to a minimum functionality mode without removing the power supply. In this mode, both RF function and (U)SIM card are invalid.	
Airplane Mode	**AT+CFUN=4** or driving W_DISABLE1# pin low will set the module to airplane mode. In this mode, the RF function is invalid.	
Sleep Mode	The module keeps receiving paging messages, SMS, TCP/UDP data from the network with its power consumption reduced to the minimal level.	
Power Down Mode	In this mode, the power management unit shuts down the power supply. Software is inactive, while all interfaces are inaccessible and the operating voltage (connected to VCC) remains applied.	

NOTE

For more details about the AT command, see ***document [2]***.

3.2. Sleep Mode

In sleep mode, DRX (Discontinuous Reception) of the module is able to reduce the power consumption to an ultra-low level, and DRX cycle index values are broadcasted by the wireless network. The figure below shows the relationship between the DRX run time and the power consumption in sleep mode. The longer the DRX cycle is, the lower the power consumption will be.

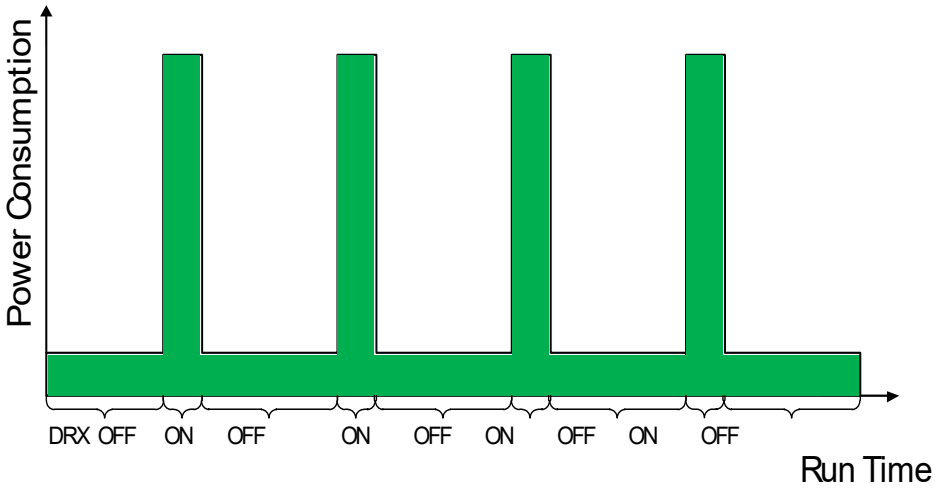


Figure 3: DRX Run Time and Power Consumption in Sleep Mode

NOTE

DRX cycle values are transmitted over the wireless network.

The following part of this chapter describes the power saving procedure and sleep mode of the module.

If the host supports USB Suspend/Resume and remote wakeup function, the following two conditions must be met simultaneously to bring the module into sleep mode.

- Execute **AT+QSCLK=1**.
- The host's USB bus, which is connected to the module's USB interface, enters suspend state.

The following figure shows the connection between the module and the host.

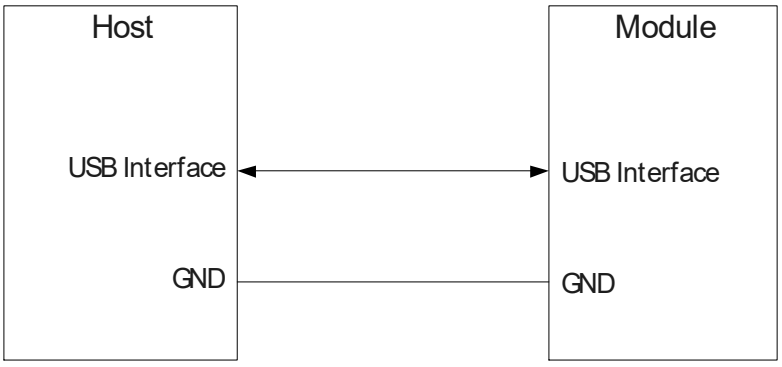


Figure 4: Sleep Mode Application with USB Remote Wakeup Function

The module will wake up when the host sends data to the module through USB interface.

3.3. Airplane Mode

Execute **AT+CFUN=4** or driving W_DISABLE1# pin low will set the module to airplane mode. For more details, see ***Chapter 4.3.1***.

3.4. Communication Interface with Host

The module supports communication with the host through USB interface. USB 2.0 should be reserved for firmware upgrade. See the USB mode features as below:

USB Mode:

- Supports all USB 2.0 features.
- Supports MBIM/QMI/AT.

3.5. Power Supply

3.5.1. Power Supply Pins

Table 7: Definition of VCC and GND Pins

Pin No.	Pin Name	I/O	Description	Comment
2, 4, 70, 72, 74	VCC	PI	Power supply for the module	Vmin = 3.135 V Vnom = 3.7 V Vmax = 4.4 V
3, 5, 11, 27, 33, 39, 45, 51, 57, 71	GND		Ground	

3.5.2. Reference Design for Power Supply

The performance of the module largely depends on the power supply design. The continuous current of the power supply should be 2 A at least and the peak current should be 3 A at least.

The following figure shows a reference design for +5 V input power supply based on a DC-DC converter. The typical output of the power supply is about 3.7 V.

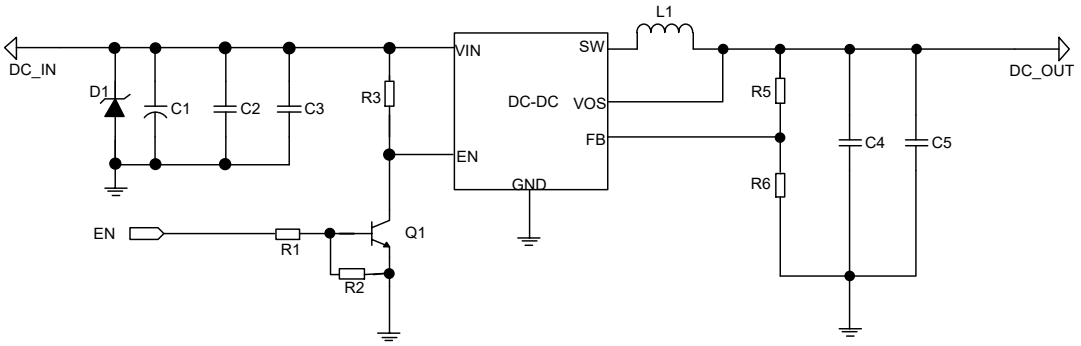


Figure 5: Reference Circuit for Power Supply

NOTE

To avoid corrupting the data in the internal flash, do not cut off the power supply before the module is completely turned off by pulling down FULL_CARD_POWER_OFF# pin for more than 1 s, and do not cut off power supply directly when the module is working.

3.5.3. Voltage Stability Requirements

The power supply of the module ranges from 3.135 V to 4.4 V. Please ensure that the input voltage never drops below 3.135 V, otherwise the module will be powered off automatically. The following figure shows the maximum voltage drop during burst transmission in 3G/4G networks.

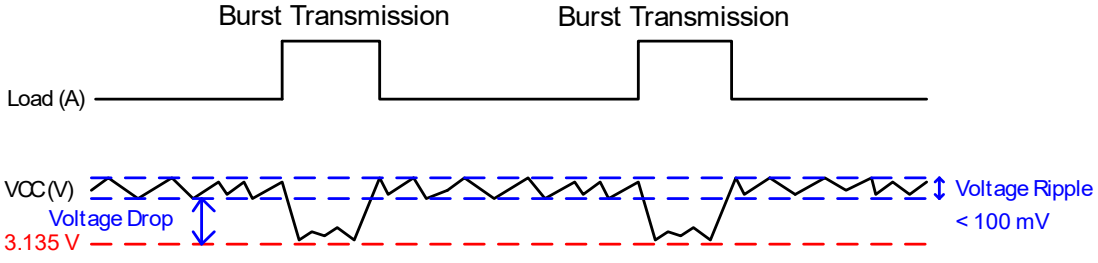


Figure 6: Power Supply Limits During Burst Transmission

To decrease the voltage drop, two bypass capacitors of about 220 µF with low ESR (ESR = 0.7 Ω) should be used, and two multi-layer ceramic chip capacitor (MLCC) arrays also should be used due to their ultra-low ESR. It is recommended to use eight ceramic capacitors (1 µF, 100 nF, 33 pF, 10 pF) to compose the MLCC arrays, and to place these capacitors close to VCC pins. The width of VCC trace should be not less than 2.5 mm. In principle, the longer the VCC trace is, the wider it should be.

In addition, to guarantee the stability of the power supply, it is recommended to use a TVS component with a reverse TVS voltage of 5.1 V and a dissipation power higher than 0.5 W. The following figure shows a reference circuit of the VCC.

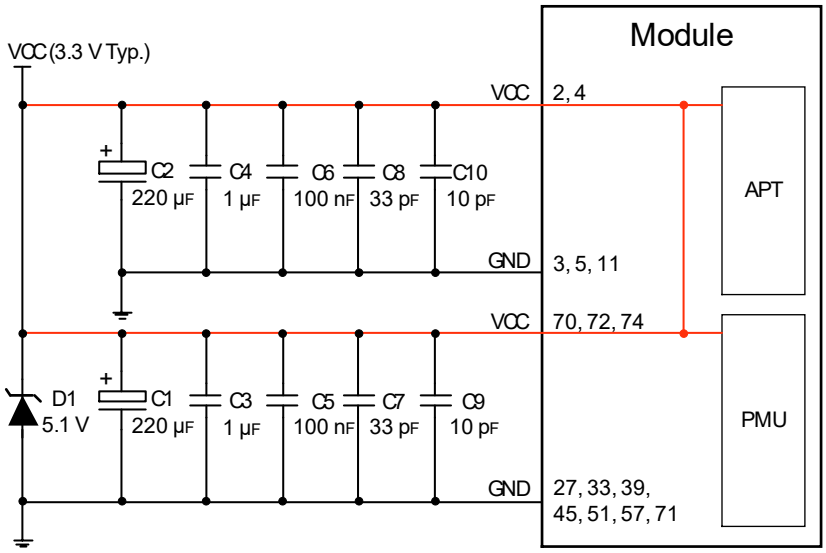


Figure 7: Reference Circuit for VCC Pins

3.5.4. Power Supply Voltage Monitoring

You can use **AT+CBC** to monitor the voltage value of VCC. For more details, see ***document [2]***.

3.6. Turn On

FULL_CARD_POWER_OFF# serves to turn on/off the module. This input signal is 3.3 V tolerant and can be driven by either 1.8 V or 3.3 V GPIO. Also, it has been internally pulled down with a 100 kΩ resistor.

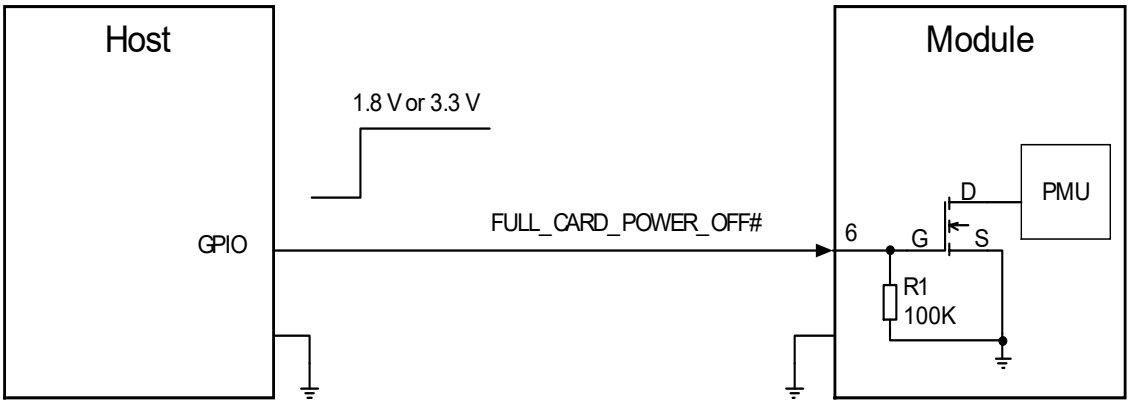
When FULL_CARD_POWER_OFF# is driven high (≥ 1.19 V), the module will be turned on.

Table 8: Pin Definition of FULL_CARD_POWER_OFF#

Pin No.	Pin Name	I/O	Description	Comment
6	FULL_CARD_ POWER_OFF#	DI, PD	Turn on/off the module High level: turn on	Internally pulled down with a 100 kΩ resistor.

Low level: turn off

It is recommended to use a host GPIO to control FULL_CARD_POWER_OFF#. A simple reference circuit is illustrated in the following figure.



NOTE: The voltage of pin 6 should be not less than 1.19 V when it is at high level.

Figure 8: Turn On the Module Using a Host GPIO

The turn-on timing is illustrated in the following figure.

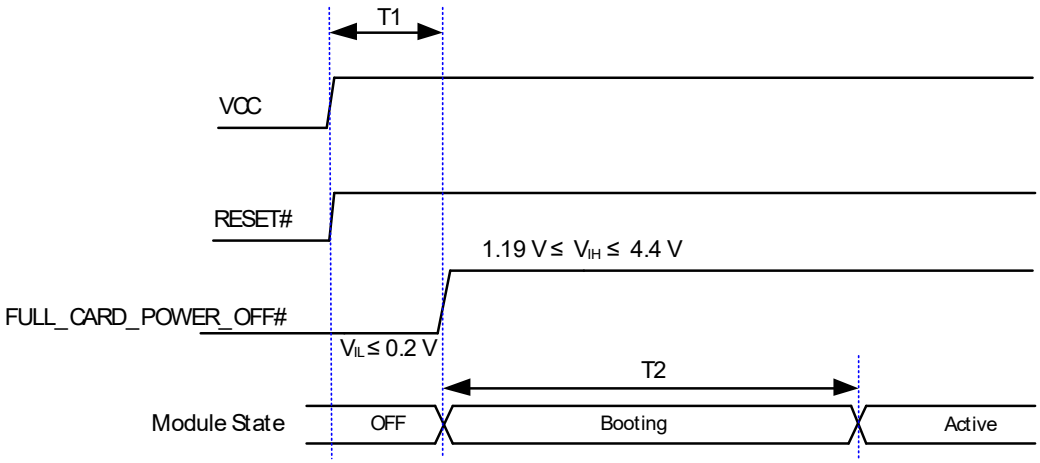


Figure 9: Turn-On Timing

Table 9: Turn-On Timing of the Module

Symbol	Min.	Typ.	Max.	Comment

T1	100 ms	-	-	The turn-on timing of the module (T1 is from RESET# high to FULL_CARD_POWER_OFF# high).
T2	-	13.7 s	-	The system booting timing of the module.

NOTE

1. RESET# is automatically pulled up as soon as the module is turned on. RESET# is not allowed to be pulled down by host during the power-up process.
2. When the FULL_CARD_POWER_OFF# signal is low, please avoid any leakage current entering the module's DPR pin from the host.

3.7. Turn Off

If the module is turned off with a host GPIO, when VCC is supplied with power, driving FULL_CARD_POWER_OFF# low (≤ 0.2 V) will turn off the module normally. The turn-off timing is illustrated in the following figure.

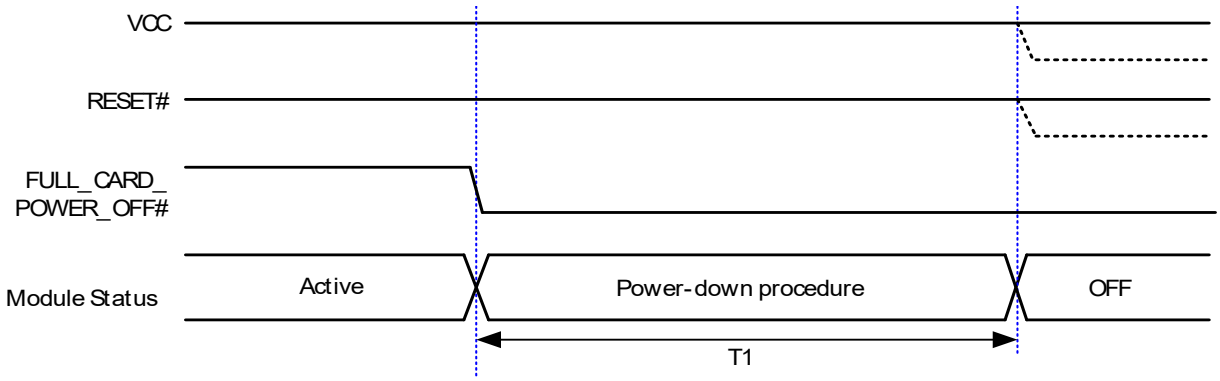


Figure 10: Turn-Off Timing

Table 10: Turn-Off Timing of the Module

Symbol	Min.	Typ.	Max.	Comment
T1	1 s	-	-	The turn-off timing of the module.

3.8. Reset

The RESET# pin serves to reset the module. Triggering the RESET# signal will lead to loss of all data

from the modem and removal of system drivers. It will also lead to disconnection of the modem from the network.

Table 11: Pin Definition of RESET#

Pin No.	Pin Name	I/O	Description	Comment
67	RESET#	DI, PU	Reset the module Active LOW	Internally pulled up to 1.8 V with a 100 kΩ resistor. A test point is recommended to be reserved if unused.

The module can be reset by pulling down the RESET# pin for at least 200 ms.

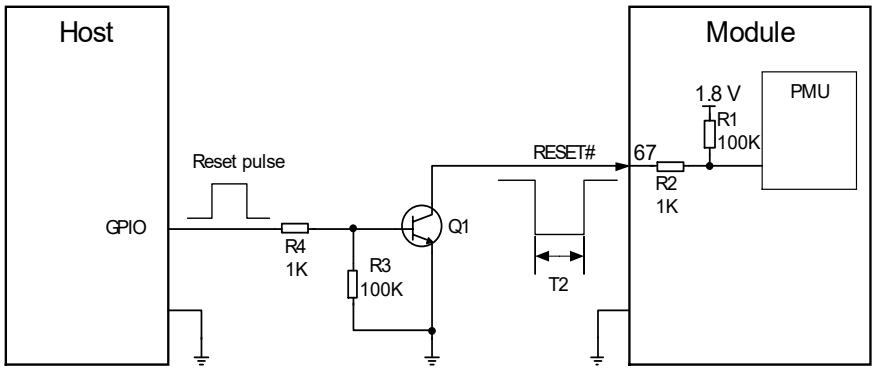


Figure 11: Reference Circuit for RESET# with Open Collector Driving Circuit

The reset timing is illustrated in the following figure.

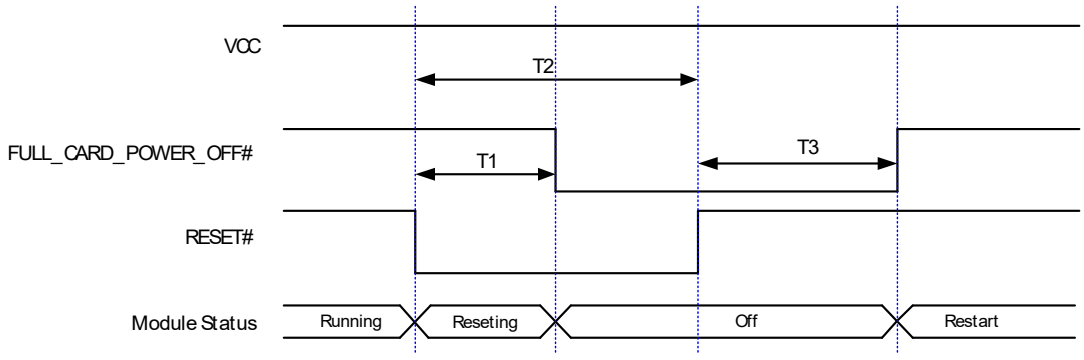


Figure 12: Reset Timing

Table 12: Reset Timing of the Module

Symbol	Min.	Typ.	Max.	Comment

T1	0 ms	100 ms	-	It is recommended to pull down RESET# for about 100 ms before driving FULL_CARD_POWER_OFF# low.
T2	200 ms	-	-	Driving RESET# low for at least 200 ms can reset the module.
T3	-	50 ms	-	Set up by the host, 50 ms by default.

NOTE

When the FULL_CARD_POWER_OFF# signal is low, please avoid any leakage current entering the module's DPR pin from the host.

4 Application Interfaces

The physical connections and signal levels of the module comply with the PCI Express M.2 specification. This chapter mainly describes the definition and application of the following interfaces/pins of the module:

- (U)SIM interfaces
- USB interface
- Control and indication interfaces
- Antenna Tuner Control Interface*
- Configuration pins

4.1. (U)SIM Interfaces

The (U)SIM interfaces circuitry meet ETSI and IMT-2000 requirements and *ISO/IEC 7816-3*. Both Class B (3.0 V) and Class C (1.8 V) (U)SIM cards are supported, and dual SIM single standby function is supported. The module supports eSIM inside the module.

4.1.1. Pin definition of (U)SIM

Table 13: Pin Definition of (U)SIM Interfaces

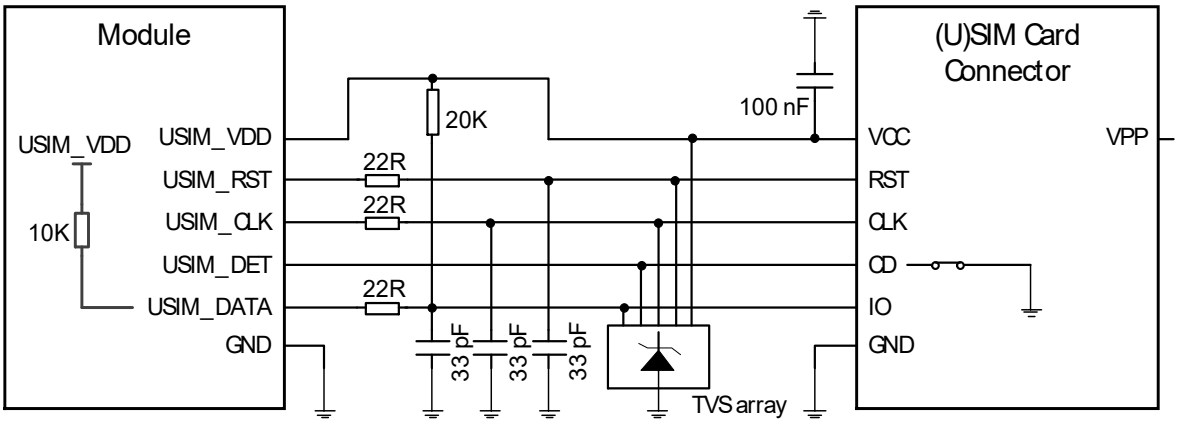
Pin No.	Pin Name	I/O	Description	Comment
36	USIM_VDD	PO	(U)SIM card power supply	
34	USIM_DATA	DIO	(U)SIM card data	Internally pulled up to 1.8 V with a 10 kΩ resistor.
32	USIM_CLK	DO	(U)SIM card clock	
30	USIM_RST	DO	(U)SIM card reset	
66	USIM_DET	DI	(U)SIM card hot-plug detect	

4.1.2. Normally Closed (U)SIM Card Connector

With a normally closed (U)SIM card connector, USIM_DET pin is normally shorted to ground when there is no (U)SIM card inserted. (U)SIM card detection by high level is applicable to this type of connector. Once (U)SIM hot-plug is enabled by executing AT+QSIMDET=1,1, insertion of a (U)SIM card will drive USIM_DET from low to high level, and the removal of it will drive USIM_DET from high to low level.

- When the (U)SIM card is absent, CD is shorted to ground and USIM_DET is at low level.
- When the (U)SIM card is present, CD is open from ground and USIM_DET is at high level.

The following figure shows a reference design of (U)SIM interface with a normally closed (U)SIM card connector.



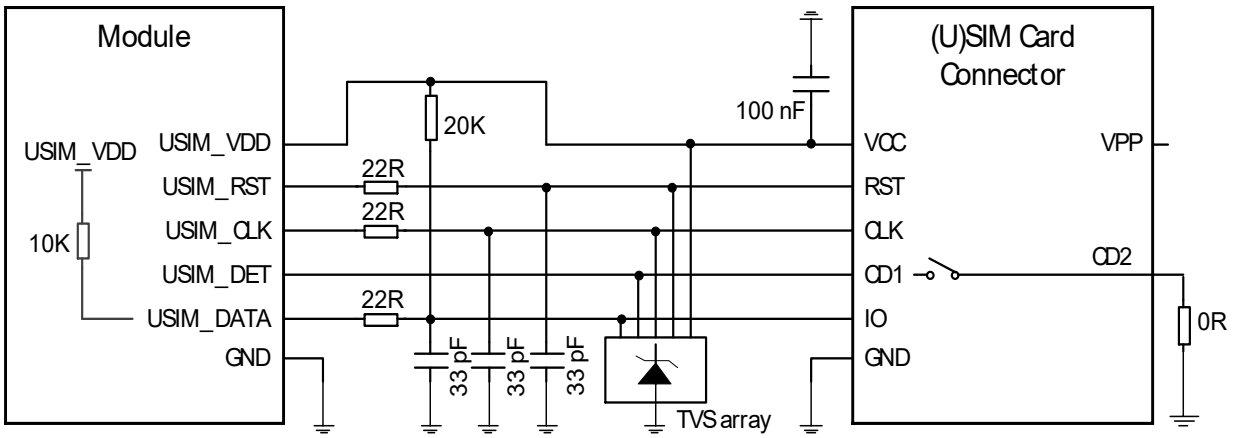
NOTE: All these resistors, capacitors and TVS array should be close to (U)SIM card connector in PCB layout. The external pull-up resistor of USIM_DATA is optional.

Figure 13: Reference Circuit for Normally Closed (U)SIM Card Connector

4.1.3. Normally Open (U)SIM Card Connector

With a normally open (U)SIM card connector, CD1 and CD2 of the connector are disconnected when there is no (U)SIM card inserted. (U)SIM card detection by low level is applicable to this type of connector. Once (U)SIM hot-plug is enabled by executing **AT+QSIMDET=1,0**, a (U)SIM card insertion will drive USIM_DET from high to low level, and the removal of it will drive USIM_DET from low to high level.

When the (U)SIM card is absent, CD1 is open from CD2 and USIM_DET is at high level.
When the (U)SIM card is present, CD1 is pull down to ground and USIM_DET is at low level.
The following figure shows a reference design for (U)SIM interface with a normally open (U)SIM card connector.



NOTE: All these resistors, capacitors and TVS array should be close to (U)SIM card connector in PCB layout. The external pull-up resistor of USIM_DATA is optional.

Figure 14: Reference Circuit of Normally Open (U)SIM Card Connector

NOTE

1. If the (U)SIM card detection function is not needed, please keep USIM_DET unconnected.
2. If the (U)SIM card detection function is required, note that a pull-up resistor should not be added to the USIM_DET signal.

4.1.4. (U)SIM Design Notices

To enhance the reliability and availability of the (U)SIM card in applications, please follow the criteria below in (U)SIM circuit design.

- Place the (U)SIM card connector as close to the module as possible. Keep the trace length less than 200 mm.
- Keep (U)SIM card signals away from RF and VCC traces.
- Ensure the ground between the module and the (U)SIM card connector is short and wide. Keep the trace width of ground and USIM_VDD not less than 0.2 mm to maintain the same electric potential. Keep the trace width of USIM_DATA, USIM_CLK, USIM_RST and USIM_DET not less than 0.1 mm.
- To avoid cross-talk between USIM_DATA and USIM_CLK, keep them away from each other and shield them with surrounded ground.
- To offer better ESD protection, add a TVS array of which the parasitic capacitance should be not higher than 20 pF. Add 22 Ω resistors in series between the module and the (U)SIM card connector to suppress EMI such as spurious transmission. The 33 pF capacitors are used to filter out RF interference. Additionally, keep the (U)SIM peripheral circuit close to the (U)SIM card connector.
- For USIM_DATA, a 20 kΩ pull-up resistor is optional to be added near the (U)SIM card connector.
- The (U)SIM card connector should be placed near the M.2 socket, because a long trace may lead to waveform distortion, which affects the signal quality.

4.2. USB Interface

The module provides one integrated Universal Serial Bus (USB) interface which complies with USB 2.0 specifications and supports high-speed (480 Mbps) and full-speed (12 Mbps) modes on USB 2.0. The USB interface is used for AT command communication, data transmission, firmware upgrade, software debugging, GNSS NMEA sentence output.

Table 14: Pin Definition of USB Interface

Pin No.	Pin Name	I/O	Description	Comment
7	USB_DP	AIO	USB differential data (+)	Require differential impedance of 90 Ω. Test points must be reserved.
9	USB_DM	AIO	USB differential data (-)	

For more details about the USB 2.0 specifications, please visit http://www.usb.org/home.

The following figure presents a reference circuit for the USB interface.

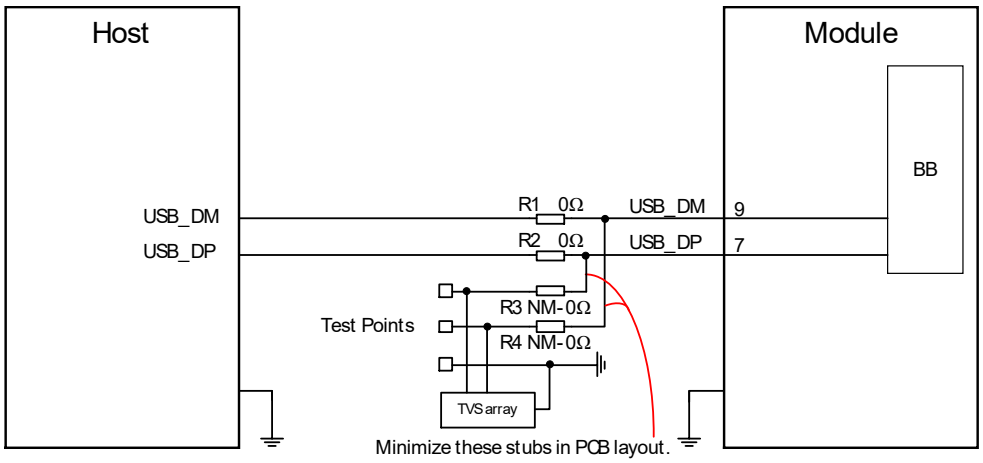


Figure 15: Reference Circuit for USB Interface

To ensure the signal integrity of USB 2.0 data traces, R1, R2, R3 and R4 must be placed close to the module, and the stubs must be minimized in PCB layout.
Please follow the principles below when designing the USB interface to meet 2.0 specifications:

- Route the USB signal traces as differential pairs with ground surrounded. The impedance of differential trace of USB 2.0 is 90 Ω.
- For USB 2.0, the trace length should be less than 120 mm, and the differential data pair matching should be less than 2 mm.

- Do not route signal traces under crystals, oscillators, magnetic devices, PCIe, other high-speed and RF signal traces. Route the USB differential traces in inner-layer of the PCB, and surround the traces with ground on that layer and with ground planes above and below.
- Junction capacitance of the ESD protection components might cause influences on USB data traces, so you should pay attention to the selection of the components. Typically, the stray capacitance should be less than 2.0 pF for USB 2.0.
- Keep the ESD protection components as close to the USB connector as possible.
- If possible, reserve 0 Ω resistor on USB_DP and USB_DM traces respectively.

4.3. Control and Indication Interfaces

Table 15: Pin Definition of Control and Indication Interfaces

Pin No.	Pin Name	I/O	Description	Comment
8	W_DISABLE1#	DI	Airplane mode control Active LOW	Internally pulled up to 1.8 V with a 100 kΩ resistor.
10	WWAN_LED#	OD	RF status indication LED Active LOW	
23	WAKE_ON_WAN#	OD	Wake up the host Active LOW	
25	DPR	DI, PU	Dynamic power reduction Active LOW	High level by default.
26	W_DISABLE2#*	DI	GNSS control Active LOW	Internally pulled up to 1.8 V with a 100 kΩ resistor.
60	WLAN_PA_EN*	DI	Self-protection of LNA control	

4.3.1. W_DISABLE1#

The module provides a W_DISABLE1# pin to disable or enable airplane mode through hardware operation. W_DISABLE1# is pulled up by default. Driving it low will configure the module into airplane mode. In airplane mode, the RF function will be disabled.

The RF function can also be enabled or disabled through AT commands. The following table shows the AT command and corresponding RF function status of the module.

Table 16: RF Function Status

W_DISABLE1#	Logic	AT Command	RF Function Status	Operating Mode

Level			
High	**AT+CFUN=1**	Enable	Full functionality mode
	AT+CFUN=0	Disable	Minimum functionality mode
	AT+CFUN=4	Disable	Airplane mode
Low	**AT+CFUN=0** **AT+CFUN=1** **AT+CFUN=4**	Disable	Airplane mode

4.3.2. W_DISABLE2#

The module provides a W_DISABLE2# pin to disable or enable the GNSS function. The W_DISABLE2# pin is pulled up by default. Driving it low will disable the GNSS function.

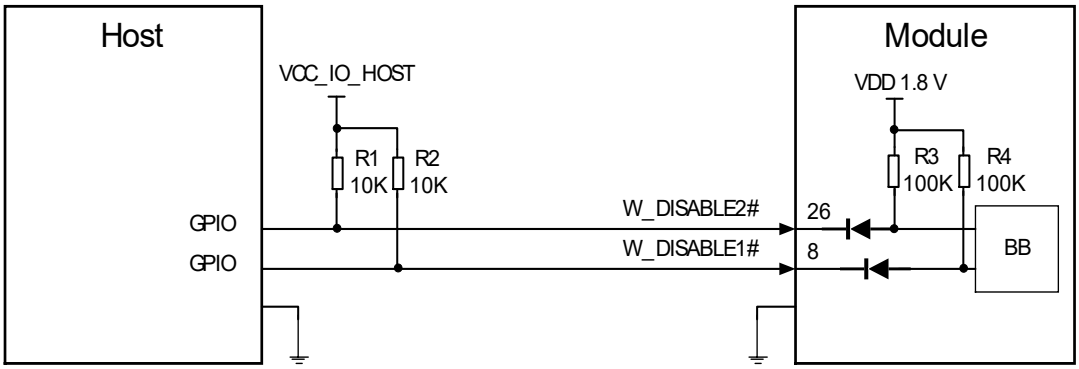
The GNSS function can also be controlled through AT commands. The combination of W_DISABLE2# pin and AT commands controls the GNSS function.

Table 17: GNSS Function Status

W_DISABLE2# Logic Level	AT Command	GNSS Function Status
High	**AT+QGPS=1**	Enable
	AT+QGPSEND	Disable
Low	**AT+QGPS=1**	Disable
	AT+QGPSEND	

For details about AT commands mentioned above, see ***document [3]***.

A simple voltage-level translator based on diodes is used on W_DISABLE1# pin and W_DISABLE2# pin which are pulled up to a 1.8 V voltage in the module. The control signals (GPIO) of the host device could be at 1.8 V or 3.3 V voltage level. W_DISABLE1# and W_DISABLE2# are active low signals. A reference circuit of the two pins is shown below.



NOTE: The voltage level of VCC_IO_HOST could be 1.8 V or 3.3 V typically.

Figure 16: Reference Circuit of W_DISABLE1# and W_DISABLE2#

4.3.3. WWAN_LED#

The WWAN_LED# signal is used to indicate RF status of the module, and its sink current is up to 10 mA.

To reduce power consumption of the LED, a current-limited resistor must be placed in series with the LED, as illustrated in the figure below. The LED is ON when the WWAN_LED# signal is at low level.

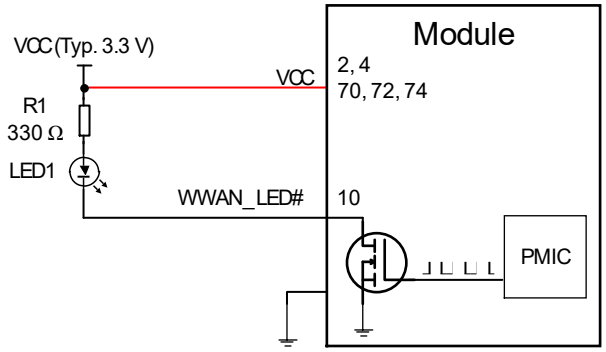


Figure 17: WWAN_LED# Reference Circuit

Table 18: Network Status Indications of WWAN_LED#

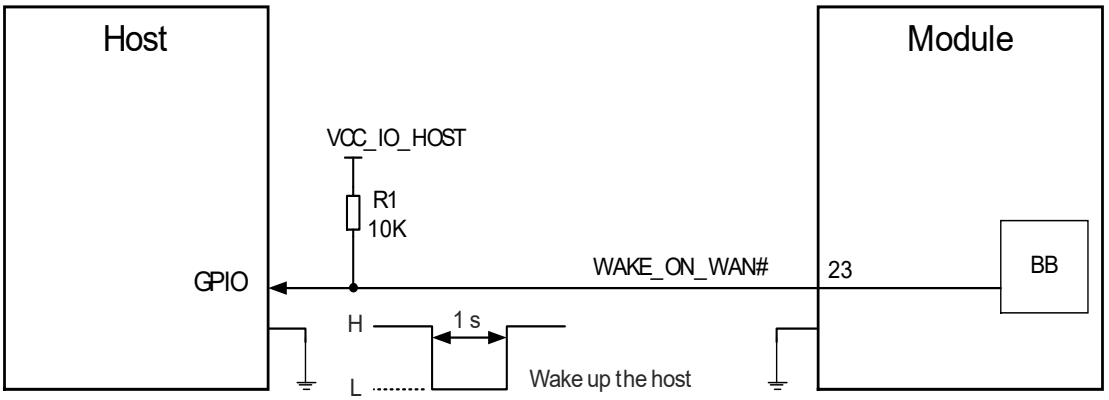
WWAN_LED# Logic Level	Description
Low (LED On)	RF function is turned on
High (LED off)	RF function is turned off if any of the following occurs: ● The (U)SIM card is not powered. ● W_DISABLE1# is at low level (airplane mode enabled). ● **AT+CFUN=4** and **AT+CFUN=0** (RF function disabled).

4.3.4. WAKE_ON_WAN#

The WAKE_ON_WAN# is an open drain pin, which requires a pull-up resistor on the host. When a URC returns, a one-second low level pulse signal will be outputted to wake up the host.

Table 19: State of the WAKE_ON_WAN#

WAKE_ON_WAN# State	Module Operation Status
Outputs a one-second pulse signal at low level	SMS/Data is incoming (to wake up the host)
Always at high level	Idle/Sleep



NOTE: The voltage level on VCC_IO_HOST depends on the host side due to the open drain in pin 23.

Figure 18: Reference Circuit of WAKE_ON_WAN#

4.3.5. DPR

The module provides a DPR (Dynamic Power Reduction) pin for body SAR (Specific Absorption Rate) detection. The signal is sent from a host system proximity sensor to the module to provide an input trigger, which will reduce the output power in burst transmission.

Table 20: Pin definition of DPR

Pin No.	Pin Name	I/O	Description	Comment
25	DPR	DI	Dynamic power reduction Active low	High level by default.

Table 21: Function of the DPR Signal

Logic Level	Function
High/Floating	No backoff of max transmitting power occurred
Low	Backoff of max transmitting power occurred according to configuration in SAR efs file

Figure 19: DPR Signal Reference Circuit Design

NOTE

See ***document [4]*** for more details about **AT+QCFG="SAR_DSI"**.

4.3.6. WLAN_PA_EN

- In LTE mode, WLAN_PA_EN is set to 0 (low level) by default.
- When WLAN_PA_EN is set to 1 (high level), the LNA will be in self-protection mode.

Table 22: Pin definition of WLAN_PA_EN

Pin No.	Pin Name	I/O	Description
60	WLAN_PA_EN	DI	Self-protection of LNA control

4.4. Antenna Tuner Control Interface*

ANTCTL[0:3] and RFFE interfaces are used for antenna tuner control and should be routed to an appropriate antenna control circuit.

4.4.1. Antenna Tuner Control Interface through GPIOs

Table 23: Pin Definition of Antenna Tuner Control Interface through GPIOs

Pin No.	Pin Name	I/O	Description
59	ANTCTL0	DO	Antenna GPIO control
61	ANTCTL1	DO	
63	ANTCTL2	DO	
65	ANTCTL3	DO	

4.4.2. Antenna Tuner Control Interface through RFFE

Table 24: Pin Definition of Antenna Tuner Control Interface through RFFE

Pin No.	Pin Name	I/O	Description
56	RFFE_CLK	DO	Used for external MIPI IC control
58	RFFE_DATA	DIO	Used for external MIPI IC control

NOTE

If RFFE_CLK and RFFE_DATA are required, contact NetPrisma Technical Support for more details.

4.5. Cellular/WLAN COEX Interface*

The module provides the cellular/WLAN COEX interface. The following table shows the pin definition of this interface.

Table 25: Pin Definition of Cellular/WLAN COEX Interface

Pin No.	Pin Name	I/O	Description
62	COEX_RXD	DI	LTE/WLAN coexistence receive
64	COEX_TXD	DO	LTE/WLAN coexistence transmit

NOTE

Please note that COEX_RXD and COEX_TXD cannot be used as general UART.

4.6. Configuration Pins

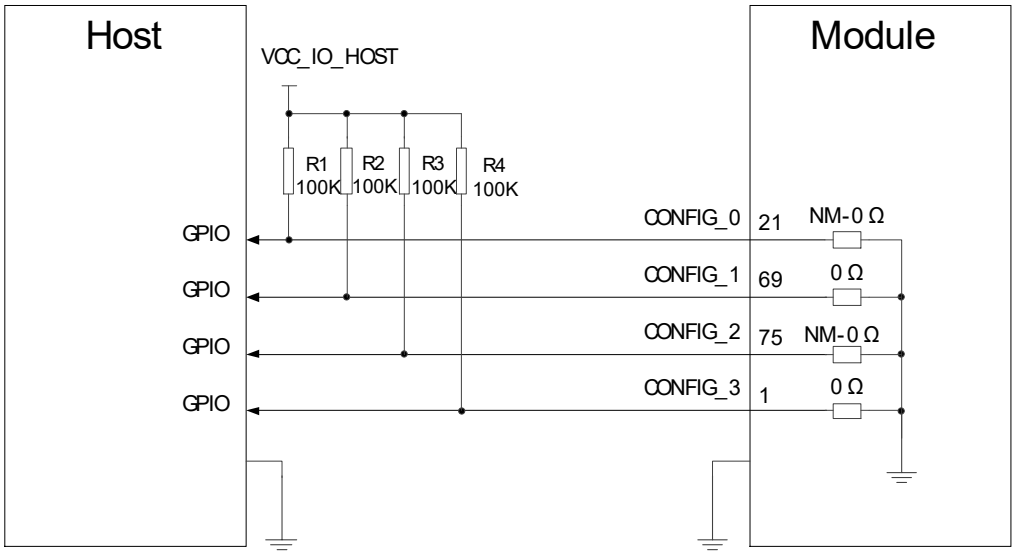
Table 26: List of Configuration Pins

Config_0 (Pin 21)	Config_1 (Pin 69)	Config_2 (Pin 75)	Config_3 (Pin 1)	Module Type and Main Host Interface	Port Configuration
NC	GND	NC	GND	WWAN - SSIC	2

Table 27: Pin Definition of Configuration Pins

Pin No.	Pin Name	I/O	Description
21	CONFIG_0	DO	Not connected internally
69	CONFIG_1	DO	Connected to GND internally
75	CONFIG_2	DO	Not connected internally
1	CONFIG_3	DO	Connected to GND internally

The following figure shows a reference circuit for these four pins.



NOTE: The voltage level VCC_IO_HOST depends on the host side, and could be a 1.8 V or 3.3 V voltage level.

Figure 20: Recommended Circuit of Configuration Pins

5 RF Specifications

Appropriate antenna type and design should be used with matched antenna parameters according to specific application. It is required to perform a comprehensive functional test for the RF design before mass production of terminal products. The entire content of this chapter is provided for illustration only. Analysis, evaluation and determination are still necessary when designing target products.

5.1. Cellular Network

5.1.1. Antenna Interfaces & Frequency Bands

The module provides a main antenna connector and a Rx-diversity/GNSS antenna connector, which are used to resist the fall of signals caused by high-speed movement and multipath effect. The impedance of antenna ports is 50 Ω.

Table 28: Antenna Connector Definition

Antenna Connector	I/O	Description	Comment
ANT_MAIN	AIO	Main antenna interface: ● LTE: TRX ● WCDMA: TRX	50 Ω impedance
ANT_DRX/GNSS	AI	RX-Diversity/GNSS antenna interface: ● LTE: DRX ● WCDMA: DRX ● GNSS: L1	

Table 29: Frequency Bands

3GPP Band	Transmit	Receive	Unit
WCDMA B1	1920–1980	2110–2170	MHz
WCDMA B2	1850–1910	1930–1990	MHz
WCDMA B3	1710–1785	1805–1880	MHz
WCDMA B4	1710–1755	2110–2155	MHz
WCDMA B5	824–849	869–894	MHz

WCDMA B6	830–840	875–885	MHz
WCDMA B8	880–915	925–960	MHz
WCDAM B19	830–845	875–890	MHz
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B2	1850–1910	1930–1990	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B4	1710–1755	2110–2155	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B7	2500–2570	2620–2690	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-FDD B12	699–716	729–746	MHz
LTE-FDD B13	777–787	746–756	MHz
LTE-FDD B14	788–798	758–768	MHz
LTE-FDD B17	704–716	734–746	MHz
LTE-FDD B18	815–830	860–875	MHz
LTE-FDD B19	830–845	875–890	MHz
LTE-FDD B20	832–862	791–821	MHz
LTE-FDD B25	1850–1915	1930–1995	MHz
LTE-FDD B26	814–849	859–894	MHz
LTE-FDD B28	703–748	758–803	MHz
LTE-FDD B29 [8]	-	717–728	MHz
LTE-FDD B30	2305–2315	2350–2360	MHz
LTE-FDD B32 [8]	-	1452–1496	MHz
LTE-FDD B66	1710–1780	2110–2200	MHz

[8] LTE-FDD B29/B32 supports Rx only and is only for secondary component carrier.

LTE-FDD B71	663–698	617–652	MHZ
LTE-TDD B34	2010-2025	2010–2025	MHZ
LTE-TDD B38	2570–2620	2570–2620	MHz
LTE-TDD B39	1880–1920	1880–1920	MHz
LTE-TDD B40(CE)	2300–2400	2300–2400	MHz
LTE-TDD B41	2496–2690	2496–2690	MHz

5.1.2. Tx Power

Table 30: Conducted RF Output Power

Frequency Band	Modulation	Max.	Min.	Comment
WCDMA B1	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B2	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B3	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B4	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B5	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B6	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B8	BPSK	23 dBm ±2 dB	< -50 dBm	-
WCDMA B19	BPSK	23 dBm ±2 dB	< -50 dBm	-
LTE-FDD B1	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B2	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B3	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B4	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B5	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B7	QPSK	23 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B8	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B12	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B13	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB

LTE-FDD B14	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B17	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B18	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B19	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B20	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B25	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B26	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B28	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B30	QPSK	22 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B66	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-FDD B71	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-TDD B34	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-TDD B38	QPSK	23 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-TDD B39	QPSK	23.5 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-TDD B40(CE)	QPSK	23 dBm ±1 dB	< -40 dBm	10 MHz, 1RB
LTE-TDD B41	QPSK	23 dBm ±1 dB	< -40 dBm	10 MHz, 1RB

5.1.3. Rx Sensitivity

Table 31: Rx Sensitivity

Frequency Band	SIMO [9] (dBm)	3GPP (SIMO) (dBm)	Comment [10]
WCDMA B1	-111.5	-106.7	
WCDMA B2	-111	-104.7	
WCDMA B3	-111	-103.7	
WCDMA B4	-111	-106.7	
WCDMA B5	-113	-104.7	
WCDMA B6	-113	-106.7	
WCDMA B8	-113.5	-103.7	

[9] SIMO is a smart antenna technology that uses a single antenna at the transmitter side and multiple antennas at the receiver side, which can improve Rx performance.
[10] The RB configuration follows 3GPP specification.

WCDMA B19	-113	-106.7	
LTE-FDD B1	-100	-96.3	10 MHz
LTE-FDD B2	-100	-94.3	10 MHz
LTE-FDD B3	-100	-93.3	10 MHz
LTE-FDD B4	-99	-96.3	10 MHz
LTE-FDD B5	-101	-94.3	10 MHz
LTE-FDD B7	-98.5	-94.3	10 MHz
LTE-FDD B8	-101	-93.3	10 MHz
LTE-FDD B12	-101	-93.3	10 MHz
LTE-FDD B13	-101	-93.3	10 MHz
LTE-FDD B14	-101	-93.3	10 MHz
LTE-FDD B17	-101	-93.3	10 MHz
LTE-FDD B18	-101	-96.3	10 MHz
LTE-FDD B19	-101	-96.3	10 MHz
LTE-FDD B20	-100.5	-93.3	10 MHz
LTE-FDD B25	-99.5	-92.8	10 MHz
LTE-FDD B26	-100.5	-93.8	10 MHz
LTE-FDD B28	-100.5	-94.8	10 MHz
LTE-FDD B29 [11]	-101	-93.3	10 MHz
LTE-FDD B30	-98	-95.3	10 MHz
LTE-FDD B32 [11]	-99.5	-96.3	10 MHz
LTE-FDD B66	-99	-95.8	10 MHz
LTE-FDD B71	-100.5	-94.3	10 MHz
LTE-TDD B34	-100	-96.3	10 MHz
LTE-TDD B38	-99.5	-96.3	10 MHz
LTE-TDD B39	-99.5	-96.3	10 MHz
LTE-TDD B40(CE)	-98.5	-96.3	10 MHz
LTE-TDD B41	-98.5	-94.3	10 MHz

[11] The test results are based on CA_2A-29A, and CA_20A-32A. LTE-FDD B29/B32 supports Rx only and is only for secondary component carrier.

5.2. GNSS [12]

5.2.1. Antenna Interface & Frequency Bands

The module includes a fully integrated global navigation satellite system solution.

The module supports standard NMEA 0183 protocol, and outputs NMEA sentences at 1 Hz data update rate via USB interface by default.

By default, the module GNSS engine is switched off. It is to be switched on via AT command. For more details, see ***document [3]***.

Table 32: GNSS Frequency

Type	Frequency	Unit
GPS/Galileo	1575.42 ±1.023	MHz
GLONASS	1601.65 ±4.15	MHz
BDS	1561.098 ±2.046	MHz
QZSS	1575.42 ±1.023	MHz

5.2.2. GNSS Performance

Table 33: GNSS Performance

Parameter	Description	Condition	Typ.	Unit
Sensitivity	Acquisition	Autonomous	-146	dBm
	Reacquisition	Autonomous	-158	dBm
	Tracking	Autonomous	-157	dBm
TTFF	Cold start @ open sky	Autonomous	32	s
		XTRA start	12	s
	Warm start @ open sky	Autonomous	27.5	s
		XTRA start	3	s
	Hot start @ open sky	Autonomous	2	s
		XTRA start	2	s

[12] GNSS function is optional.

Accuracy	CEP-50	Autonomous @ open sky	2	m

NOTE

1. Tracking sensitivity: the minimum GNSS signal power at which the module can maintain lock (keep positioning for at least 3 minutes continuously).
2. Reacquisition sensitivity: the minimum GNSS signal power required for the module to maintain lock within 3 minutes after loss of lock.
3. Acquisition sensitivity: the minimum GNSS signal power at which the module can fix position successfully within 3 minutes after executing cold start command.

5.3. Antenna Design Requirements

Table 34: Antenna Requirements

Type	Requirements
Main Antenna (WCDMA/LTE Tx/Rx)	● VSWR: ≤ 2 ● Efficiency: > 30 % ● Max Input Power: 50 W ● Input Impedance: 50 Ω
Diversity/GNSS Antenna (WCDMA/LTE/GNSS Rx)	● Cable Insertion Loss: — **< 1 dB:** LB (<1 GHz) — **< 1.5 dB:** MB (1–2.3 GHz) — **< 2 dB:** LB (> 2.3 GHz)

NOTE

It is recommended to use a passive GNSS antenna when LTE B13 or B14 is supported, as the use of active antenna may generate harmonics which will affect the GNSS performance.

5.4. Antenna Connectors

5.4.1. Antenna Connector Location

The antenna connector locations are shown below.

Figure 21: Antenna Connectors on LCUK54-WRD

5.4.2. Antenna Connector Specifications

The module is mounted with standard 2 mm × 2 mm receptacle antenna connectors for convenient antenna connection. The antenna connector's PN is IPEX 20449-001E, and the connector dimensions are illustrated as below:

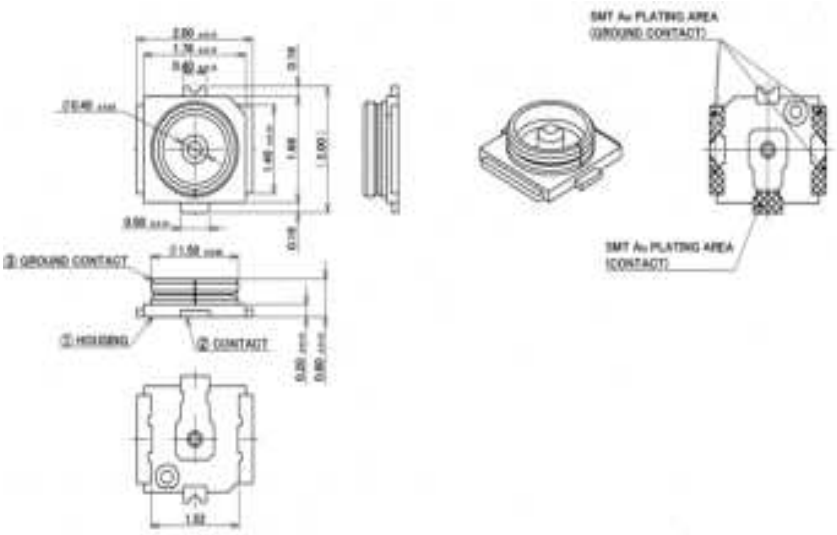


Figure 22: Dimensions of the Receptacle (Unit: mm)

Table 35: Major Specifications of the RF Connectors

Item	Specification
Nominal Frequency Range	DC to 6 GHz
Nominal Impedance	50 Ω
Temperature Rating	-40 to +85 °C
Voltage Standing Wave Ratio (VSWR)	Meet the requirements of: Max. 1.3 (DC–3 GHz) Max. 1.45 (3–6 GHz)

5.4.3. Antenna Connector Installation

The receptacle RF connector used in conjunction with the modules will accept two types of mated plugs that will meet a maximum height of 1.2 mm using a Ø 0.81 mm coaxial cable or a maximum height of 1.45 mm utilizing a Ø 1.13 mm coaxial cable.

The following figure shows the dimensions of mated plugs using Ø 0.81 mm/Ø 1.13 mm coaxial cables:

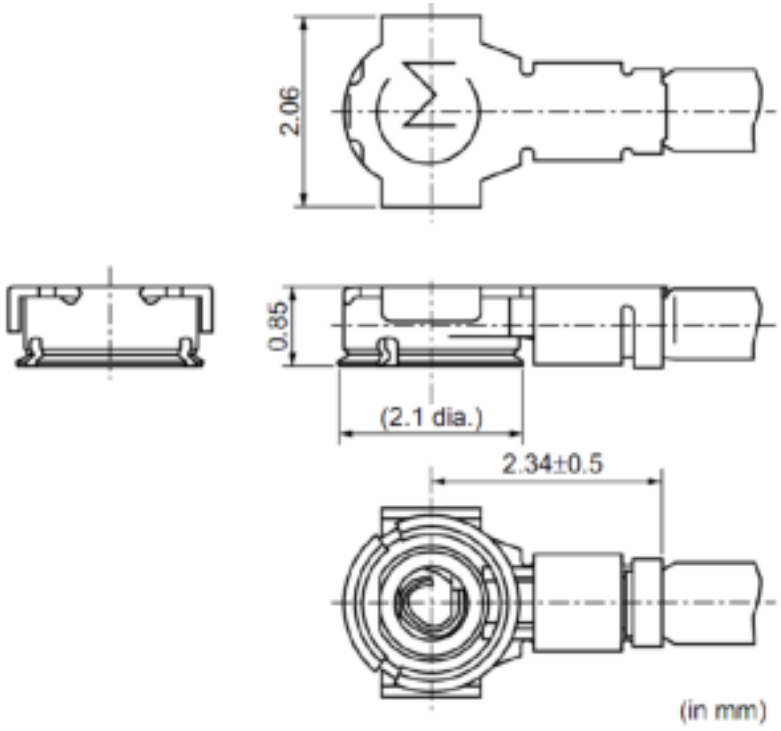


Figure 23: Dimensions of Mated Plugs (Ø0.81/Ø1.13 mm Coaxial Cables)

The following figure illustrates the connection between the receptacle RF connector on the module and the mated plugs using a Ø 0.81 mm coaxial cable.

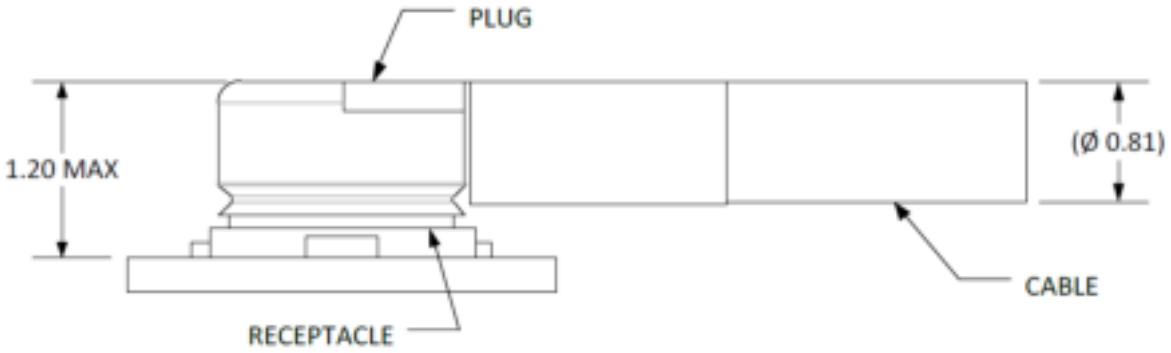


Figure 24: Space Factor of Mated Connectors (Ø0.81 mm Coaxial Cables) (Unit: mm)

The following figure illustrates the connection between the receptacle RF connector on the module and the mated plugs using a Ø 1.13 mm coaxial cable.

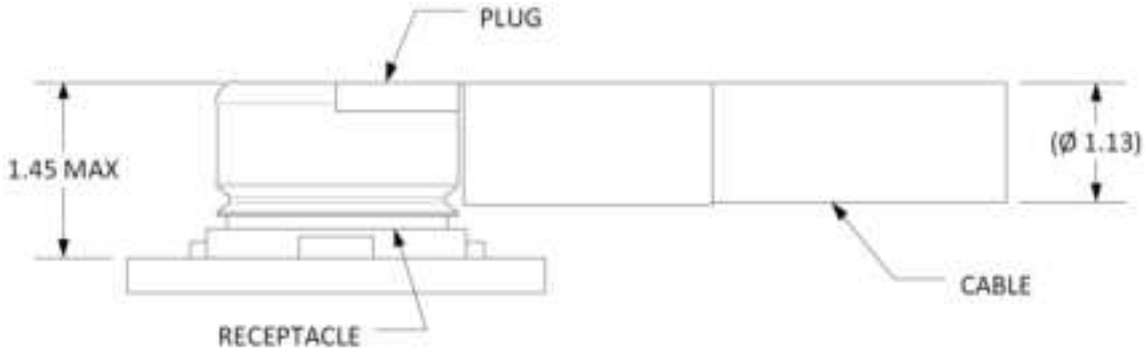


Figure 25: Space Factor of Mated Connectors (Ø 1.13 mm Coaxial Cables) (Unit: mm)

5.4.4. Recommended RF Connector Installation

5.4.4.1. Assemble Coaxial Plug Manually

The illustration for plugging in a coaxial cable plug is shown below, $\theta = 90°$ is acceptable, while $\theta \neq 90°$ is not.

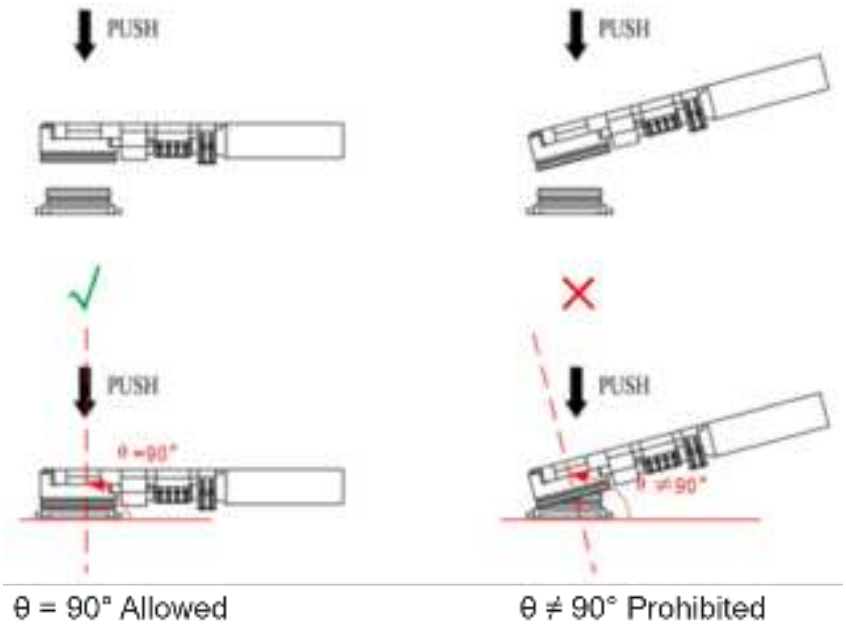


Figure 27: Plug in a Coaxial Cable Plug

The illustration of pulling out the coaxial cable plug is shown below, θ = 90° is acceptable, while θ ≠ 90° is not.

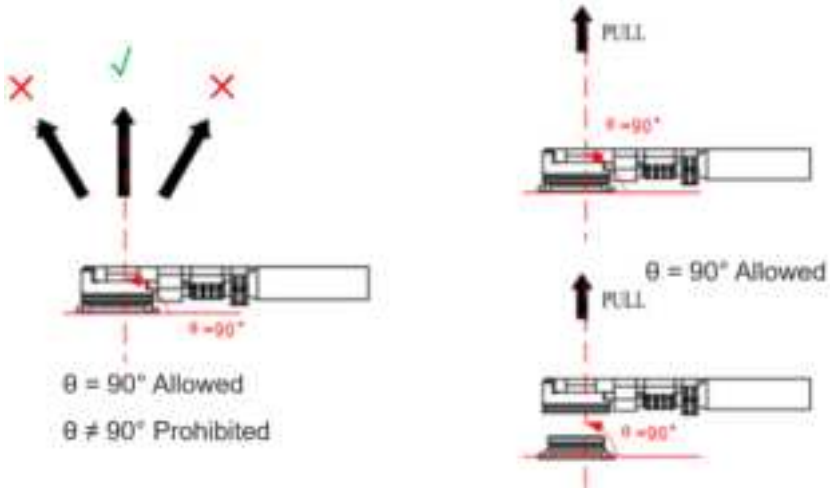


Figure 26: Pull out a Coaxial Cable Plug

5.4.4.2. Assemble Coaxial Plug with jig

The pictures of installing the coaxial cable plug with a jig is shown below, θ = 90° is acceptable, while θ ≠ 90° is not.

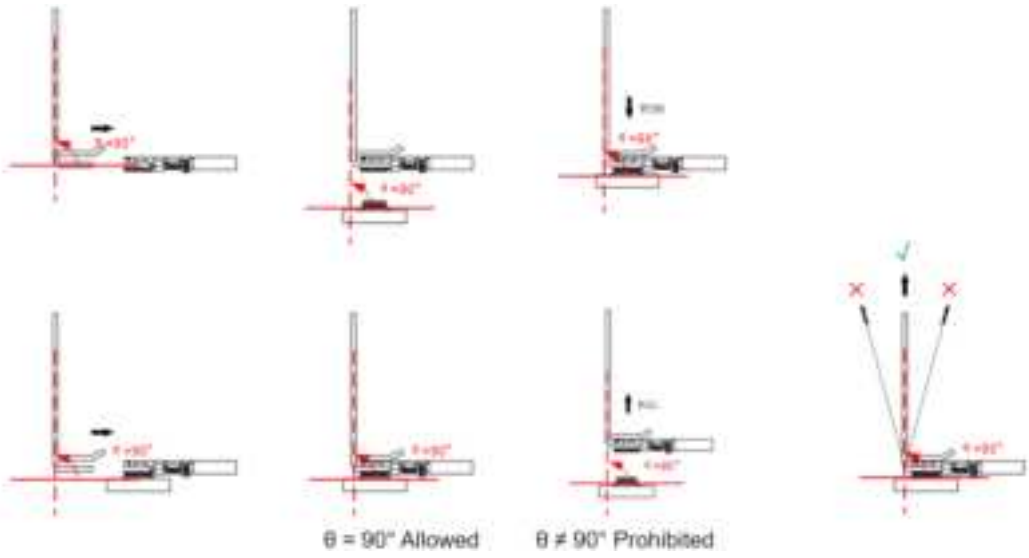


Figure 29: Install the Coaxial Cable Plug with Jig

5.4.5. Recommended Manufacturers of RF Connector and Cable

RF connectors and cables by I-PEX are recommended. For more details, visit https://www.i-pex.com.

6 Electrical Characteristics and Reliability

6.1. Absolute Maximum Ratings

Absolute maximum ratings for power supply of the module are listed in the following table.

Table 36: Absolute Maximum Ratings

Parameter	Min.	Typ.	Max.	Unit
VCC	-0.3	3.7	4.7	V

6.2. Power Supply Ratings

The typical input voltage of the module is 3.7 V.

Table 37: Power Supply Requirements

Parameter	Description	Condition	Min.	Typ.	Max.	Unit
VCC	Power supply for the module	The actual input voltages must be kept between the minimum and maximum values.	3.135	3.7	4.4	V
Voltage Ripple	-		-	30	100	mV

6.3. Power Consumption

Table 38: Averaged Power Consumption

Description	Condition	Typ.	Unit
OFF State	Power off	70	μA
Sleep State	**AT+CFUN=0** (USB 2.0 suspend)	1.68	mA
	AT+CFUN=4 (USB 2.0 suspend)	1.75	mA
	WCDMA PF = 64 (USB 2.0 suspend)	3.05	mA
	LTE-FDD PF = 64 (USB 2.0 suspend)	3.28	mA
	LTE-TDD PF = 64 (USB 2.0 suspend)	3.55	mA
Idle State	WCDMA PF = 64	20.25	mA
	WCDMA PF = 256	19.48	mA
	LTE-FDD PF = 64	20.58	mA
	LTE-FDD PF = 256	19.61	mA
	LTE-TDD PF = 64	20.90	mA
	LTE-TDD PF = 256	19.67	mA
WCDMA Data Transmission (GNSS Off)	WCDMA B1 HSDPA CH10700 @ 22.34 dBm	718	mA
	WCDMA B1 HSUPA CH10700 @ 21.83 dBm	650	mA
	WCDMA B2 HSDPA CH9800 @ 22.37 dBm	675	mA
	WCDMA B2 HSUPA CH9800 @ 21.74 dBm	633	mA
	WCDMA B3 HSDPA CH1338 @ 22.39 dBm	722	mA
	WCDMA B3 HSUPA CH1338 @ 20.44 dBm	596	mA
	WCDMA B4 HSDPA CH1638 @ 22.45 dBm	756	mA
	WCDMA B4 HSUPA CH1638 @ 20.32 dBm	627	mA
	WCDMA B5 HSDPA CH4407 @ 22.39 dBm	649	mA
	WCDMA B5 HSUPA CH4407 @ 21.51 dBm	590	mA
	WCDMA B6 HSDPA CH4400 @ 22.51 dBm	632	mA
	WCDMA B6 HSUPA CH4400 @ 21.79 dBm	593	mA

	WCDMA B8 HSDPA CH3012 @ 22.51 dBm	665	mA
	WCDMA B8 HSUPA CH3012 @ 21.12 dBm	592	mA
	WCDMA B19 HSDPA CH738 @ 22.52 dBm	632	mA
	WCDMA B19 HSUPA CH738 @ 21.79 dBm	593	mA
LTE Data Transmission (GNSS Off)	LTE-FDD B1 CH300 @ 23.93 dBm	828	mA
	LTE-FDD B2 CH900 @ 23.8 dBm	829	mA
	LTE-FDD B3 CH1575 @ 23.64 dBm	812	mA
	LTE-FDD B4 CH2175 @ 23.63 dBm	880	mA
	LTE-FDD B5 CH2525 @ 23.75 dBm	762	mA
	LTE-FDD B7 CH3100 @ 23.26 dBm	1070	mA
	LTE-FDD B8 CH3625 @ 23.65 dBm	796	mA
	LTE-FDD B12 CH5095 @ 23.63 dBm	752	mA
	LTE-FDD B13 CH5230 @ 23.62 dBm	686	mA
	LTE-FDD B14 CH5330 @ 23.78 dBm	668	mA
	LTE-FDD B17 CH5790 @ 23.57 dBm	745	mA
	LTE-FDD B18 CH5925 @ 23.59 dBm	774	mA
	LTE-FDD B19 CH6075 @ 23.59 dBm	763	mA
	LTE-FDD B20 CH6300 @ 23.6 dBm	703	mA
	LTE-FDD B25 CH8365 @ 23.91 dBm	840	mA
	LTE-FDD B26 CH8865@ 23.64 dBm	784	mA
	LTE-FDD B28 CH9360 @ 23.47 dBm	720	mA
	LTE-FDD B30 CH9820 @ 22.47 dBm	1100	mA
	LTE-FDD B66 CH66886 @ 23.56 dBm	875	mA
	LTE-FDD B71 CH68786 @ 23.56 dBm	768	mA
	LTE-TDD B34 CH36275@ 23.73 dBm	410	mA

	LTE-TDD B38 CH38000 @ 23.29 dBm	500	mA
	LTE-TDD B39 CH38450 @ 23.76 dBm	411	mA
	LTE-TDD B40(CE) CH39150 @ 23.12 dBm	540	mA
	LTE-TDD B41 CH40740 @ 23.35 dBm	462	mA
WCDMA	WCDMA B1 CH10700 @ 23.47 dBm	773	mA
	WCDMA B2 CH9800 @ 23.43 dBm	729	mA
	WCDMA B3 CH1338 @ 23.46 dBm	778	mA
	WCDMA B4 CH1638 @ 23.47 dBm	819	mA
	WCDMA B5 CH4407 @ 23.47 dBm	699	mA
	WCDMA B6 CH4400 @ 23.52 dBm	684	mA
	WCDMA B8 CH3012 @ 23.49 dBm	717	mA
	WCDMA B19 CH738 @ 23.52 dBm	683	mA

NOTE

1. Power consumption test is carried out under 3.7 V, 25 °C with 5G-M2 EVB, and with thermal dissipation measures.
2. For more details about power consumption, please contact NetPrisma Technical Support to obtain the power consumption test report of the module.

6.4. Digital I/O Characteristics

Table 39: (U)SIM High/Low-voltage I/O Requirements

Parameter	Description	Min.	Max.	Unit

V_{IH}	High-level input voltage	0.7 × USIM_VDD	USIM_VDD + 0.3	V
V_{IL}	Low-level input voltage	-0.3	0.2 × USIM_VDD	V
V_{OH}	High-level output voltage	0.8 × USIM_VDD	USIM_VDD	V
V_{OL}	Low-level output voltage	0	0.4	V

Table 40: 1.8 V Digital I/O Requirements

Parameter	Description	Min.	Max.	Unit
V_{IH}	High-level input voltage	1.65	2.1	V
V_{IL}	Low-level input voltage	-0.3	0.54	V
V_{OH}	High-level output voltage	1.3	1.8	V
V_{OL}	Low-level output voltage	0	0.4	V

Table 41: 3.3 V Digital I/O Requirements

Parameter	Description	Min.	Max.	Unit
3.3 V	Power domain	3.135	3.464	V
V_{IH}	High-level input voltage	2.0	3.6	V
V_{IL}	Low-level input voltage	-0.5	0.8	V

6.5. ESD Protection

Static electricity occurs naturally and it may damage the module. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly and testing of the module; add ESD protection components to the ESD sensitive interfaces and points in the product design.

Table 42: Electrostatic Discharge Characteristics (Temperature: 25–30 ºC, Humidity: 40 ±5 %)

Tested Interface	Contact Discharge	Air Discharge	Unit
VCC, GND	±5	±10	kV
Antenna Interfaces	±4	±8	kV
Other Interfaces	±0.5	±1	kV

6.6. Operating and Storage Temperatures

Table 43: Operating and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operating Temperature Range [13]	-25	+25	+75	ºC
Extended Temperature Range [14]	-40	-	+85	ºC
Storage temperature Range	-40	-	+90	ºC

[13] To meet the normal operating temperature range requirements, it is necessary to ensure effective thermal dissipation, e.g., by adding passive or active heatsinks, heat pipes, vapor chambers. Within the temperature range of -10 °C to +55 °C, the mentioned RF performance margins higher than 3GPP specifications can be guaranteed. When temperature goes beyond temperature range of -10 °C to 55 °C, a few RF performances of module may be slightly off 3GPP specifications.

[14] To meet the extended operating temperature range requirements, it is necessary to ensure effective thermal dissipation, e.g., by adding passive or active heat sinks, heat pipes, vapor chambers. Within this range, the module remains the ability to establish and maintain functions such as SMS, without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as Pout, may undergo a reduction in value, exceeding the specified tolerances of 3GPP. When the temperature returns to the normal operating temperature level, the module will meet 3GPP specifications again.

6.7. Thermal Dissipation

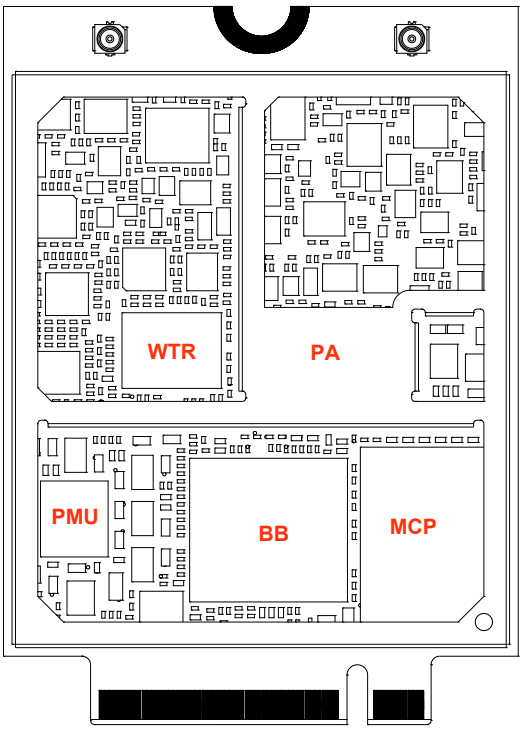


Figure 27: Distribution of Heat Source Chips Inside the Module

The module offers the best performance when all internal IC chips are working within their operating temperatures. When the IC chip reaches or exceeds the maximum junction temperature, the module may still work but the performance and function (such as RF output power, data rate, etc.) will be affected to a certain extent. Therefore, the thermal design should be maximally optimized to ensure all internal IC chips always work within the recommended operating temperature range.

The following principles for thermal consideration are provided for reference:

- Keep the module away from heat sources on your PCB, especially high-power components such as processor, power amplifier, and power supply.
- Maintain the integrity of the PCB copper layer and drill as many thermal vias as possible.
- Expose the copper in the PCB area where module is mounted.
- Apply a soft thermal pad with appropriate thickness and high thermal conductivity between the module and the PCB to conduct heat.
- Follow the principles below when the heatsink is necessary:
  - Do not place large size components in the area where the module is mounted on your PCB to reserve enough place for heatsink installation.
  - Attach the heatsink to the shielding cover of the module; In general, the base plate area of the heatsink should be larger than the module area to cover the module completely;
  - Choose the heatsink with adequate fins to dissipate heat;

- Choose a TIM (Thermal Interface Material) with high thermal conductivity, good softness and good wettability and place it between the heatsink and the module;
- Fasten the heatsink with four screws to ensure that it is in close contact with the module to prevent the heatsink from falling off during the drop, vibration test, or transportation.

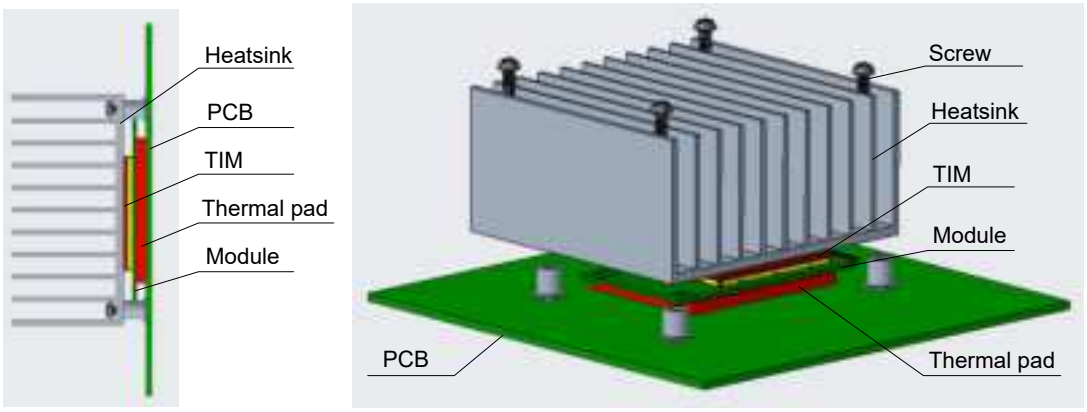


Figure 28: Placement and Fixing of the Heatsink

Table 44: Maximum Operating Temperature for Main Chips (Unit: °C)

BASEBAND	MCP	PMU	WTR	MMPA	APT
85	85	85	85	100	85

6.8. Notification

Please follow the principles below in the module application.

6.8.1. Coating

If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.

6.8.2. Cleaning

Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.

6.8.3. Installing

It is recommended to fix the module firmly when the module is inserted into a socket.

Fix the module firmly to avoid poor contact caused by shaking. It is recommended to install the module on the socket with a screw as shown below.

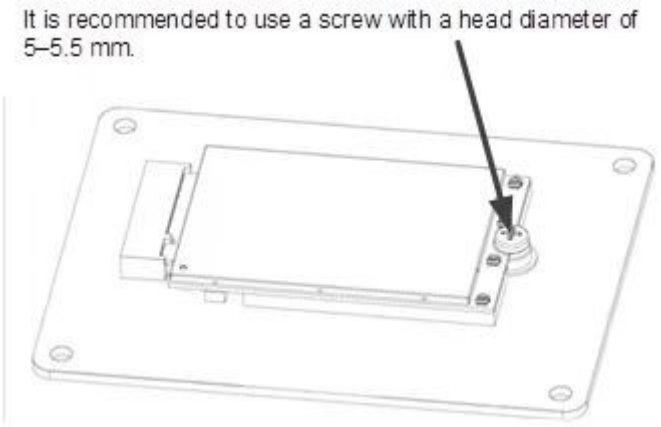


Figure 29: Installation Schematic

7 Mechanical Information and Packaging

This chapter mainly describes mechanical dimensions and packaging specifications of the module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.15 mm unless otherwise specified.

7.1. Mechanical Dimensions

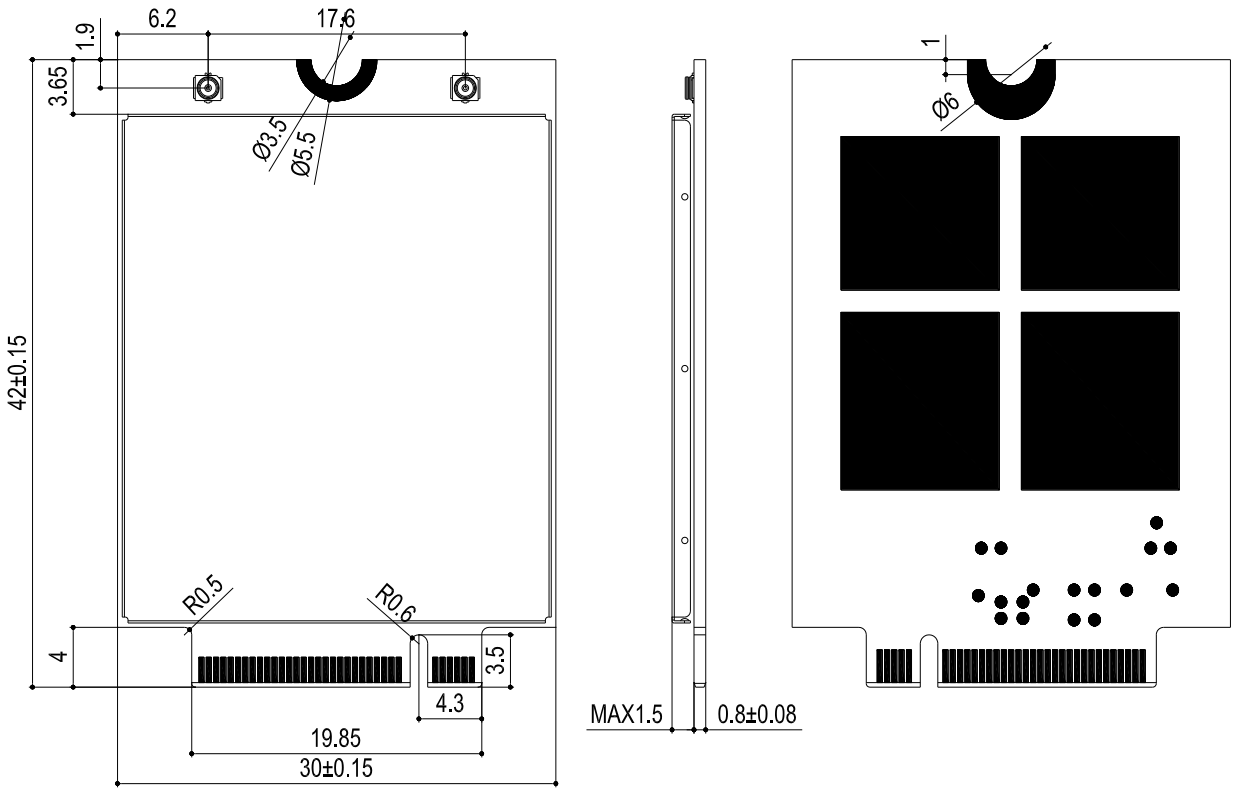


Figure 30: Mechanical Dimensions

7.2. Top and Bottom Views

Figure 31: Top and Bottom Views of the Module

NOTE

Images above are for illustration purpose only and may differ from the actual modules. For authentic appearance and label, please refer to the module received from NetPrisma.

7.3. M.2 Connector

The module adopts a standard PCI Express M.2 connector which compiles with the directives and standards listed in PCI Express M.2 Specification.

7.4. Storage Conditions

The storage requirements are shown below.

1. Recommended Storage Condition: the temperature should be 23 ±5 °C and the relative humidity should be 35–60 %.

2. Shelf life: 12 months in Recommended Storage Condition.

NOTE

Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

7.5. Packaging Specifications

This chapter describes only the key parameters and process of packaging. All figures below are for reference only. The appearance and structure of the packaging materials are subject to the actual delivery.

The modules adopt blister tray packaging and details are as follow:

7.5.1. Blister Tray

Dimension details are as follow:

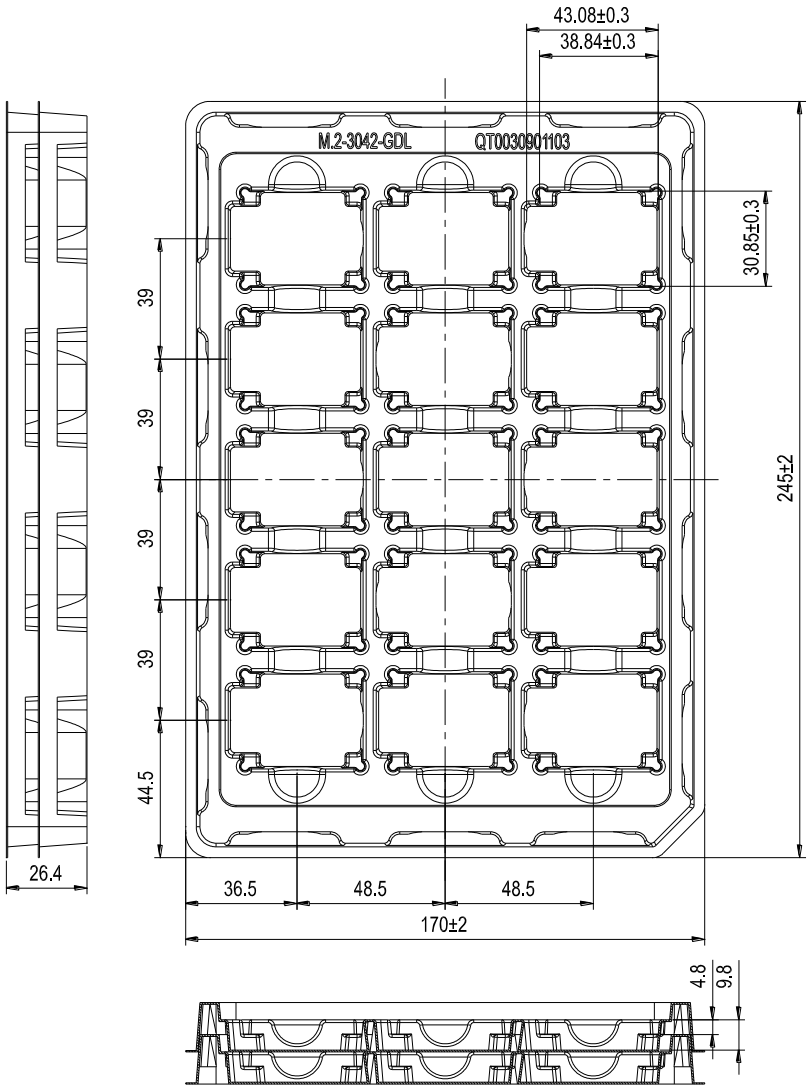
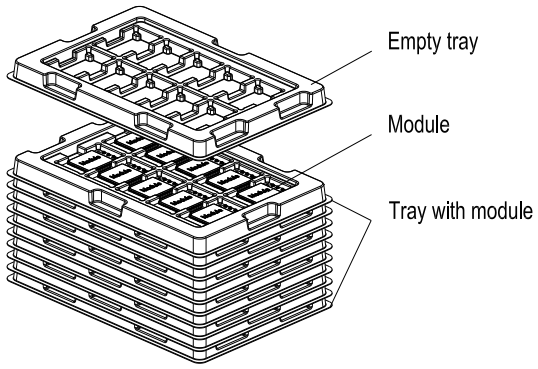
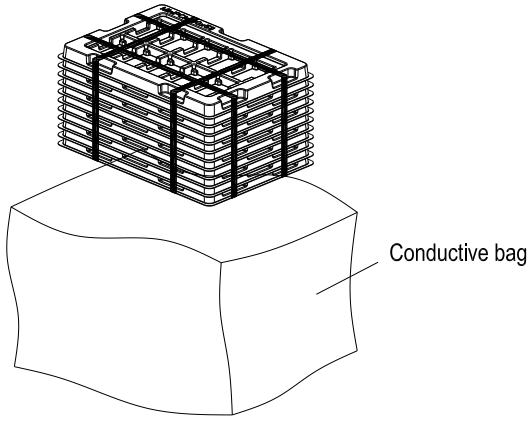


Figure 32: Blister Tray Dimension Drawing

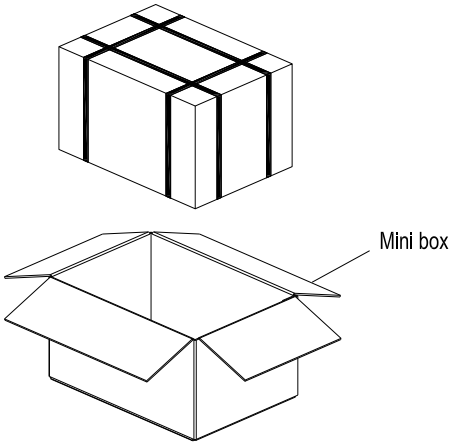
7.5.2. Packaging Process



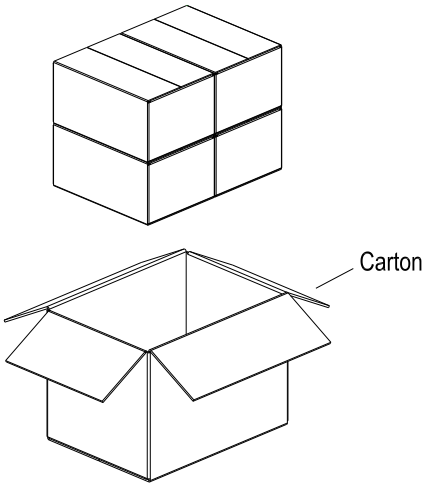
Each blister tray packs 10 modules. Stack 10 blister trays with modules together, and put 1 empty blister tray on the top.



Packing 11 blister trays together and then put blister trays into a conductive bag, seal and pack the conductive bag.



Put seal-packed blister trays into a mini box. One mini box can pack 100 modules.



Put 4 mini boxes into 1 carton and then seal it. One carton can pack 400 modules.

Figure 33: Packaging Process

8 Appendix References

Table 45: Related Documents

Document Name
[1] NetPrisma_LCUK54-WRD_CA_Feature
[2] NetPrisma_LCUK54-WRD_AT_Commands_Manual
[3] NetPrisma_LCUK54-WRD_GNSS_Application_Note
[4] NetPrisma_LCUK54-WRD_RF_Application_Note

Table 46: Terms and Abbreviations

Abbreviation	Description
APT	Average Power Tracking
AT	ATtention
BB	Baseband
BDS	BeiDou Navigation Satellite System
BIOS	Basic Input/Output System
bps	Bit(s) per second
BPSK	Binary Phase Shift Keying
CBRS	Citizen Broadband Radio Service
CPE	Customer-Premise Equipment
COEX	Coexistence
DC-HSDPA	Dual-carrier High Speed Downlink Package Access
DFOTA	Delta Firmware Upgrade Over-The-Air
DL	Downlink

DPR	Dynamic Power Reduction
DRX	Discontinuous Reception
DRx	Diversity Receive
EBI	External Bus Interface
EIRP	Equipment Isotropic Radiated Power
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance
FDD	Frequency Division Duplex
GLONASS	Global Navigation Satellite System (Russia)
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HSDPA	High Speed Downlink Packet Access
HSPA	High Speed Packet Access
HSUPA	High Speed Uplink Packet Access
IC	Integrated Circuit
kbps	Kilobits per second
LAA	License Assisted Access
LDO	Low-dropout Regulator
LED	Light Emitting Diode
LPDDR2	Low Power Double Data Rate 2
LSB	Least Significant Bit
LTE	Long Term Evolution
MBIM	Mobile Broadband Interface Model
Mbps	Megabits per second

MCP	Multiple Chip Package
ME	Mobile Equipment
MFBI	Multi-Frequency Band Indicator
MIPI	Mobile Industry Processor Interface
MIMO	Multiple-Input Multiple-Output
MLCC	Multi-layer Ceramic Capacitor
MMPA	Multimode Multiband Power Amplifier
MO	Mobile Originated
MSB	Most Significant Bit
MT	Mobile Terminated
NAND	NON-AND
NC	Not Connected
NPN	Negative-Positive-Negative
OS	Operating System
PA	Power Amplifier
PAP	Password Authentication Protocol
PC	Personal Computer
PCB	Printed Circuit Board
PCIe	Peripheral Component Interconnect Express
PDU	Protocol Data Unit
PME	Power Management Event
PMIC	Power Management IC
PMU	Power Management Unit
POS	Point of Sale
PPP	Point-to-Point Protocol

PRx	Primary Receive
QMI	Qualcomm MSM (Mobile Station Modems) Interface
QPSK	Quadrature Phase Shift Keying
QZSS	Quasi-Zenith Satellite System
RB	Resource Block
RF	Radio Frequency
RFFE	RF Front-End
RH	Relative Humility
Rx	Receive
SAR	Specific Absorption Rate
SDRAM	Synchronous Dynamic Random-Access Memory
SMS	Short Message Service
SPMI	System Power Management Interface
TCP	Transmission Control Protocol
TDD	Time Division Duplex
TRx	Transmit & Receive
Tx	Transmit
UART	Universal Asynchronous Receiver/Transmitter
UDP	User Datagram Protocol
UL	Uplink
URC	Unsolicited Result Code
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module
VFB	Voltage Feedback
VIH	High-level Input Voltage

VIL	Low-level Input Voltage
VOH	High-level Output Voltage
VOL	Low-level Output Voltage
WCDMA	Wideband Code Division Multiple Access
WTR	Wafer-scale RF transceiver
XO	Crystal Oscillator

9.1 FCC

9.1.1. Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations.
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).
The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

9.1.2. Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to XXXX that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

9.1.3. End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: 2BEY3LCUK54WRDA” “Contains IC: 32052-LCUK54WRDA “
The FCC ID/IC ID can be used only when all FCC/IC compliance requirements are met.

9.1.4. Antenna Installation

(1)The antenna must be installed such that 20 cm is maintained between the antenna and users,

(2)The transmitter module may not be co-located with any other transmitter or antenna.
(3)Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

Band	MAX Gain (dBi)
WCDMA B2	8.00
WCDMA B4	5.00
WCDMA B5	9.42
LTE B2	8.50
LTE B4	5.50
LTE B5	9.91
LTE B7	9.00
LTE B12	9.20
LTE B13	9.66
LTE B14	9.73
LTE B17	9.24
LTE B25	8.50
LTE B26(814-824)	9.86
LTE B26(824-849)	9.91
LTE B30	0.98
LTE B38	9.00
LTE B41	9.00
LTE B66	5.50
LTE B71	8.98

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

9.1.5. Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

9.1.6. Federal Communication Commission Interference Statement

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.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can

be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

9.1.7. List of applicable FCC rules

This module has been tested and found to comply with part 22, part 24, part 27 and part 90 requirements for Modular Approval.

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

9.1.8. This device is intended only for OEM integrators under the following conditions:(For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

9.1.9. Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

9.2. IC

9.2.1. Industry Canada Statement

This device complies with Industry Canada’s licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference; and

(2) This device must accept any interference, including interference that may cause undesired operation of the device

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts

de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

9.2.2. Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

9.2.3. Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

9.2.4. This device is intended only for OEM integrators under the following conditions: (For module device use)

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

9.2.5. Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

1)L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2)Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

9.2.6. IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

9.2.7. NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada

9.2.8. End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains IC: 32052-LCUK54WRDA”.

9.2.9.Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 32052-LCUK54WRDA".

9.2.10.Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module.
The end user manual shall include all required regulatory information/warning as show in this manual.

9.2.11.Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

9.2.12 Antenna Requirements

The following antennae were approved with the prototype:
This radio transmitter [32052-LCUK54WRDA] has been approved by innovation, Science and development Economic Canada to operate with the types of antennas listed below, with the maximum allowable gain indicated. The types of antennas not included in this list that have a gain of any type lis ted are strictly prohibited for use with this device.

Les antennes suivantes ont été approuvées avec le prototype:
Cet émetteur radio [32052-LCUK54WRDA] a été approuvé par innovation, Science et développement économique Canada pour fonctionner avec les types d’antennes énumérés ci-dessous, avec le gain maximal autorisé indiqué. Les types d’antennes non inclus dans cette liste qui ont un gain tout type lis ted sont strictement interdits pour une utilisation avec cet appareil.

Band	Description	MAX Gain (dBi)
WCDMA B2		3.87
WCDMA B4		3.91
WCDMA B5		3.32
LTE B2		3.87
LTE B4		3.91
LTE B5		3.32
LTE B7		3.16

LTE B12	PIFA Antenna	3.19
LTE B13		3.28
LTE B14		3.25
LTE B17		3.19
LTE B25		3.87
LTE B26(824-849)		3.32
LTE B30		0.98
LTE B38		3.07
LTE B41		3.16
LTE B66		3.91
LTE B71		3.07