LN960
HW User Guide

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APPLICABILITY TABLE

PRODUCTS

- LN960A16

Contents

1. INTRODUCTION

1.1. Scope

The document covers the technical features of and design guideline for Telit LN960 WWAN M.2 Module. It also indicates application interface, hardware, software, reliability and mechanical specification.

1.2. Audience

This document is intended to review by engineering designers, and product managers.

1.3. Contact Information, Support

For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
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Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

2. OVERVIEW

This chapter provides an overview of standard features of Telit LN960 WWAN M.2 Module.

2.1. M.2 Overview

LN960 WWAN M.2 module is the next generation cellular LTE product, providing the connectivity on the world's fastest LTE networks in the extensive coverage of worldwide LTE bands, with unprecedented network performance.

The WWAN M.2 module is in compliance of 3GPP releases 9, 10, 11, and 12, in which the part of LTE advance carrier aggregation (2x, 3x, 4x and 5x in the downlink) and high order modulation (up to 256 QAM) are supported.

2.1.1. General Features

Table 2.1.1-1 LN960 Feature Summary

Feature	Description	Additional Information
Modem Chipset	Qualcomm SDX20	
Carrier Aggregation	2CC, 3CC, 4CC, 5CCs DL CA	
LTE Category	5CA+256QAM (up to Cat16) and Rel13 (FDD+TDD CA)	
Physical	PCI Express M.2 Module	
Mechanical	M2. Card Type 3042 Slot B Pin counts: 75	30mm x 42mm x 2.3mm Max Height=2.38mm (0.08mm PCB tolerance added)
Weight	6 grams	
Operating Voltage	3.135V ~ 4.4V; Single VCC Supply	

Operating Temperature	-40°C to +85 °C	Please refer to details in Chapter 7
SIM	Off-board USIM connector Supported	
RX Diversity	ALL LTE and UMTS Bands Supported	
GNSS	GPS: L1 (1575.42MHz)	
	GLONASS: L1 (1602MHz)	
	Beidou (1561.098MHz)	
	Galileo E1 (1575.42MHz)	
Data Service	LTE CAT 16: DL: 1.0 Gbps/UL 150 Mbps	
	LTE CAT 9: DL: 450 Mbps/UL 50 Mbps	
	LTE Cat 6: DL: 300 Mbps/UL 50 Mbps	
	LTE Cat 4: DL:150 Mbps/UL 50 Mbps	
	DC-HSPA+: 42Mbps DL/5.76Mbps UL HSPA+: 21Mbps DL/5.76Mbps UL	
	WCDMA PS DL 384Kbps /UL 384Kbps	
	WCDMA CS DL 64Kbps /UL 64Kbps	

There are 29 LTE and 8 UMTS bands supported by Telit LN960 WWAN M.2 Module.

Table 2.1.1 -1 Supported LN960 LTE Bands

E-UTRA BAND	Frequency (MHz)	Uplink Frequency UE Receive (MHz)	Downlink Frequency UE Receive (MHz)	Duplex Mode
1	2100	1920-1980	2110-2170	FDD
2	1900	1850-1910	1930-1990	FDD
3	1800	1710-1785	1805-1880	FDD
4	1700	1710-1755	2110-2155	FDD
5	850	824-849	869-894	FDD
7	2600	2500-2570	2620-2690	FDD
8	900	880-915	925-960	FDD
12	700	699-716	729-746	FDD
13	700	777-787	746-756	FDD
17	700	704-716	734-746	FDD
18	850	815-830	860-875	FDD
19	850	830-845	875-890	FDD
20	800	832-862	791 – 821	FDD

21	1500	1477.9-1462.9	1495.9-1510.9	FDD
25	1900	1850-1915	1930-1995	FDD
26	850	814-849	859-894	FDD
28	700	703-748	758-803	FDD
29	700	N/A	717-728	FDD
30	2300	2305-2315	2350-2360	FDD
38	2600	2570-2620		TDD
39	1900	1880-1920		TDD
40	2300	2300-2400		TDD
41	2500	2496-2690		TDD
42	3500	3400-3600		TDD
43	3700	3600-3800		TDD
48	3600	3550-3700		TDD
66	1700	1710-1780	2110-2200	FDD

LTE Air Interface

- LTE Rel13
  (1) DL - 1.0 Gbps / 10-layer / 100 MHz CA
  (2) UL - 150 Mbps / 40 MHz CA
  (3) 256 QAM DL / 64 QAM UL
  (4) 4 × 2 MIMO 5x CA (R13)
  (5) 4 × 4 MIMO Selected CA

(6) FDD + TDD CA

(7) 3.5 GHz and 600 MHz Bands

(8) LAA Band (up to 80 MHz of unlicensed)

(9) Advance LTE IC + NAIC (with CRS only)

WCDMA/HSPA Air Interface

- R99:
  - All modes and data rates for WCDMA FDD
- R5 HSDPA
  - PS data speeds up to 7.2 Mbps on the downlink
- R6 HSUPA
  - E-DCH data rates of up to 5.76 Mbps for 2 ms TTI (UE category 6) uplink
- R7 HSPA+
  - Downlink 64 QAM SISO: up to 21 Mbps
  - Downlink 16 QAM 2X2 MIMO: up to 28 Mbps
- R8 DC-HSPA+
  - Downlink dual carrier with 64 QAM (SISO); up to 42 Mbps

GNSS

- Customizable tracking session
  - Automatic tracking session on startup
  - Concurrent standalone GPS, GLONASS, BeiDou and Galileo
  - gpsOneXTRA with GPS + GLONASS + BeiDou + Galileo support

Table 2.1.1 -2 Supported LN960 UMTS Bands

UTRA BAND	Frequency (MHz)	Uplink Frequency UE Receive (MHz)	Downlink Frequency UE Receive (MHz)	Duplex Mode
1	2100	1920-1980	2110-2170	FDD
2	1900	1850-1910	1930-1990	FDD
4	1700	1710-1755	2110-2155	FDD
5	850	824-849	869-894	FDD
6	800	830-840	875-885	FDD
8	900	880-915	925-960	FDD
9	1700	1750-1785	1845-1880	FDD
19	850	830-845	875-890	FDD

2.1.2. Carrier Aggregation

With the LTE-A carrier aggregation and high order modulation scheme Telit LN960 WWAN M.2 module is designed to run on the world's fastest LTE networks. In the following tables there are 2CC, 3CC, 4CC and 5CC configurations shown in inter-band, and intra-band CA types in single duplex (FDD only) and in hybrid duplex (FDD+TDD) modes.

Table 2.1.2-3 Two Carrier Component Carrier Aggregation Configurations (Downlink)

Region	Carrier	2CC DL CA Combinations
North America	AT&T	CA_12A-30A; CA_12A-66A; CA_14A-30A; CA_14A-66A; CA_29A-30A; CA_29A-66A; CA_2A-12A; CA_2A-14A; CA_2A-29A; CA_2A-2A; CA_2A-30A; CA_2A-46A; CA_2A-5A; CA_2A-66A; CA_4A-12A; CA_4A-29A; CA_4A-30A; CA_4A-4A; CA_4A-5A; CA_5A-30A; CA_5A-66A; CA_5B; CA_66A-66A
	VZW	CA_13A-48A; CA_13A-66A; CA_2A-13A; CA_2A-2A; CA_2A-46A; CA_2A-48A; CA_2A-4A; CA_2A-5A; CA_2A-66A; CA_48A-66A; CA_4A-13A; CA_4A-46A; CA_4A-4A; CA_4A-5A; CA_5A-66A; CA_5B; CA_66A-66A; CA_66B; CA_66C; CA_13A-46A;
	Sprint	CA_25A-25A; CA_25A-26A; CA_41C
Japan	KDDI	CA_1A-19A; CA_1A-26A; CA_1A-28A; CA_1A-41A; CA_1A-5A; CA_1C; CA_26A-41A; CA_38C; CA_39A-41A; CA_39C; CA_3A-19A; CA_3A-26A; CA_3A-28A; CA_3A-5A; CA_3A-7A; CA_3C; CA_40C; CA_41C; CA_5A-7A; CA_7A-28A; CA_7C
	Docomo	

		CA_1A-18A; CA_1A-26A; CA_41C; CA_42C
EU	Various	CA_1A-20A; CA_1A-3A; CA_1A-7A; CA_3A-20A; CA_3A-38A; CA_3A-7A; CA_3C; CA_38C; CA_3A-20A; CA_3A-7A; CA_3C; CA_40C; CA_41C; CA_7A-20A; CA_7C; CA_1A-20A; CA_1A-3A; CA_1A-7A; CA_20A-32A; CA_3A-20A; CA_3A-28A; CA_3A-38A; CA_3A-3A; CA_3A-5A; CA_3A-7A; CA_3C; CA_7A-20A; CA_7A-28A
W	Various	CA_2A-28A; CA_2A-5A; CA_3A-20A; CA_3A-7A; CA_4A-28A; CA_4A-5A; CA_7A-20A; CA_7A-28A; CA_38C; CA_3A-20A; CA_3A-7A; CA_3C; CA_40C; CA_41C; CA_7A-20A; CA_7C
Australia	Telstra, Optus	CA_1A-28A; CA_1A-3A; CA_1A-7A; CA_3A-28A; CA_3A-7A; CA_40C; CA_7A-28A; CA_1A-3A; CA_3A-28A; CA_3A-7A; CA_3A-8A; CA_3C; CA_7A-28A; CA_7C

Table 2.1.2-4 Three Carrier Component Carrier Aggregation Configurations

Region	Carrier	3CC DL CA Combinations
North America	AT&T	CA_12A-30A-66A; CA_12A-66A-66A; CA_14A-66A-66A; CA_2A-12A-30A; CA_2A-12A-66A; CA_2A-14A-30A; CA_2A-29A-30A; CA_2A-2A-12A; CA_2A-2A-66A; CA_2A-30A-66A; CA_2A-46A-66A; CA_2A-4A-12A; CA_2A-4A-5A;

	VZW	CA_2A-5A-30A; CA_2A-5A-66A; CA_2A-66A-66A; CA_13A-48A-48A; CA_13A-48A-66A; CA_13A-48C; CA_13A-66A-66A; CA_13A-66C; CA_2A-13A-66A; CA_2A-2A-13A; CA_2A-2A-4A; CA_2A-2A-5A; CA_2A-2A-66A; CA_2A-46A-46A; CA_2A-46A-66A; CA_2A-46C; CA_2A-48A-48A; CA_2A-48A-66A; CA_2A-48C; CA_2A-4A-13A; CA_2A-4A-4A; CA_2A-4A-5A; CA_2A-5A-66A; CA_2A-66A-66A; CA_48A-48A-66A; CA_48A-66A-66A; CA_48A-66B; CA_48C-66A; CA_4A-46A-46A; CA_4A-46C; CA_4A-4A-13A; CA_5A-46C; CA_5A-66A-66A; CA_5A-66C; CA_2A-13A-46A; CA_2A-46A-66A; CA_66A-13A-46A
Japan	Docomo	CA_19A-42C; CA_1A-3A-19A; CA_1A-42C; CA_3A-42C;
	KDDI	CA_1A-42C
EU	Various	CA_1A-3A-20A; CA_1A-3A-38A; CA_1A-3A-7A
WW	Various	CA_1A-3A-20A; CA_1A-3A-28A; CA_1A-3A-7A; CA_1A-7A-20A; CA_3A-7A-20A; CA_3A-7A-28A; CA_3C-20A; CA_3C-5A; CA_3A-7A-20A; CA_3A-7A-20A; CA_3C-5A
Australia	Telstra	CA_1A-46C; CA_3A-46C; CA_3A-7A-28A; CA_3C-28A; CA_7A-46C; CA_7C-28A;
	Optus	CA_1A-3A-28A; CA_1A-3A-7A; CA_1A-40C; CA_1A-7A-28A; CA_28A-40C; CA_3A-7A-28A;

Table 2.1.2-5 Four Carrier Component Carrier Aggregation Configurations

Region	Carrier	4CC DL CA Combinations
North America	AT&T	CA_12A-30A-66A-66A; CA_2A-12A-30A-66A; CA_2A-12A-66A-66A; CA_2A-29A-30A-66A; CA_2A-2A-12A-30A; CA_2A-2A-12A-66A; CA_2A-2A-29A-30A; CA_2A-2A-5A-30A; CA_2A-2A-5A-66A; CA_2A-2A-66A-66A; CA_2A-46D; CA_2A-4A-12A-30A; CA_2A-4A-4A-12A; CA_2A-4A-5A-30A; CA_2A-5A-30A-66A; CA_2A-5A-66A-66A; CA_2A-5B-30A; CA_2A-5B-66A; CA_4A-46D; CA_4A-4A-12A-30A; CA_5A-30A-66A-66A; CA_5B-30A-66A; CA_5B-66A-66A;
	Verizon	CA_13A-48A-48A-66A; CA_13A-48A-48C; CA_13A-48C-66A; CA_13A-48D; CA_2A-2A-5A-66A; CA_2A-2A-66A-66A; CA_2A-46D; CA_2A-48A-48A-66A; CA_2A-48D; CA_48A-48A-66A-66A; CA_48A-48C-66A; CA_48D-66A; CA_4A-46A-46C; CA_4A-46D; CA_13A-46D; CA_2A-13A-66A-66A; CA_2A-13A-66B; CA_2A-13A-66C; CA_2A-2A-13A-66A; CA_2A-2A-66B; CA_2A-2A-66C; CA_5B-66A-66A; CA_5B-66C;
Japan	Docomo	CA_1A-3A-42C
EU	Various	N/A
WW	Various	CA_1A-3A-7A-20A; CA_1A-3A-7A-28A; CA_3A-5A-7A-7A
Australia	Telstra	CA_1A-3A-7A-28A; CA_1A-3A-7C; CA_1A-46D; CA_28A-

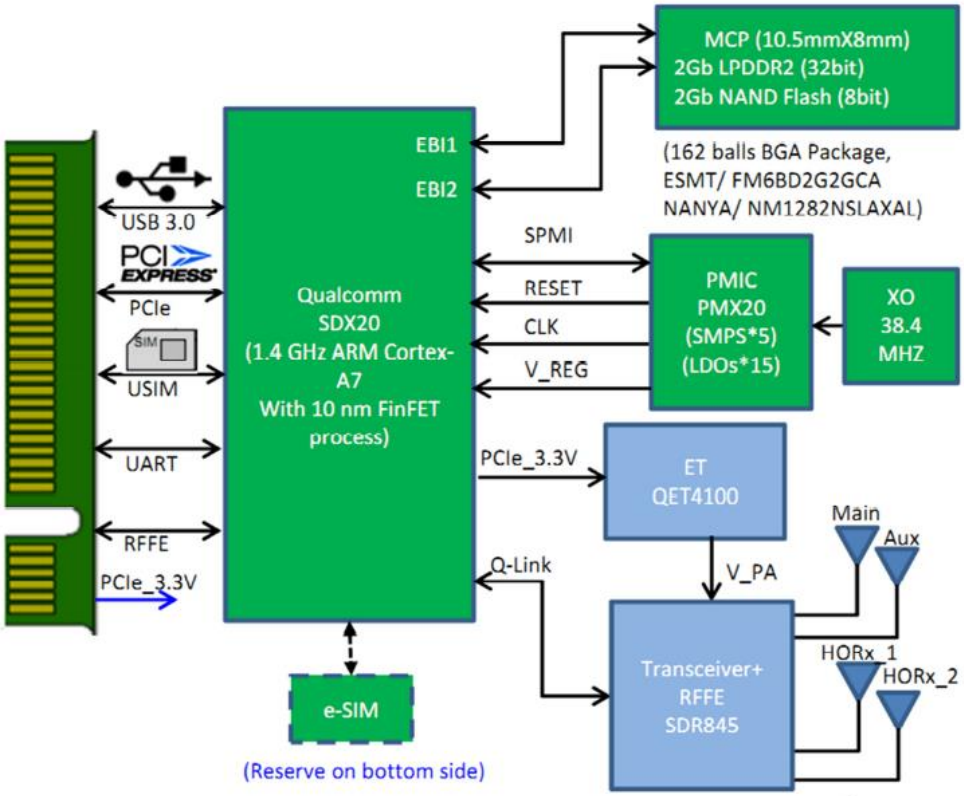
	Optus	46D; CA_3A-46D; CA_7A-46D; CA_1A-3A-7A-28A; CA_3A-40D; CA_40E

Table 2.1.2-6 Five Carrier Component Carrier Aggregation Configurations

Region	Carrier	5CC DL CA Combinations
North America	AT&T	CA_2A-2A-46D; CA_2A-46D-66A; CA_2A-5B-30A-66A; CA_2A-5B-66A-66A;
	Verizon	CA_13A-48A-48C-66A; ; A_13A-48C-48C; CA_13A-48C-66B; CA_13A-48C-66C; CA_13A-48D-66A; CA_13A-48E; CA_2A-48A-48C-66A; CA_2A-48D-66A; CA_2A-48E; CA_48A-48C-66B; CA_48A-48C-66C; CA_48C-48C-66A; CA_48E-66A; CA_2A-2A-5A-66B; CA_2A-2A-5A-66C; CA_2A-5B-66C; CA_2A-5A-46D; CA_2A-13A-46D; CA_2A-46D-66A; CA_13A-46D-66A;
Japan	N/A	N/A
EU	Various	N/A
WW	Various	CA_1A-3A-7A-20A; CA_1A-3A-7A-28A; CA_3A-5A-7A-7A
Australia	Telstra	CA_1A-3A-7C-28A; CA_1A-3C-7C; CA_3C-7C-28A
	Optus	CA_3A-28A-40D; CA_3A-40E

2.2. M.2 WWAN Module – System Block Diagram

Figure 2.2-1 System Block Diagram



2.3. Host Interface Signals

Telit LN960 WWAN M.2 is the PCIe M.2 standard compliant 3042 Slot B module. The main function and basic requirement of 75 pins are introduced in the following table.

Table 2.3-1 Host Interface Summary

Pin	Signal Name	I/O	Description	Supply
1	CONFIG_3	O		
2	Power Supply	I		3.3V
3	GND			
4	Power Supply	I		3.3V
5	GND			
6	FULL_CARD_POWER_OFF#	I		1.8V/3.3V
7	USB_D+	IO		
8	W_DISABLE1#	I		3.3V
9	USB_D-	IO		
10	GPIO_9 LED#	O	Open Drain, Active Low@40mA, indicating LED ON	
11	GND			
12	SLOT KEY			
13	SLOT KEY			
14	SLOT KEY			
15	SLOT KEY			

16	SLOT KEY		
17	SLOT KEY		
18	SLOT KEY		
19	SLOT KEY		
20	GPIO_5 AUDIO_0	IO	1.8V
21	CONFIG_0	O	
22	ANT_TUNER_CONFIG	IO	1.8V
23	GPIO_11 WoWWAN#	O	1.8V
24	GPIO_7 AUDIO_2	IO	1.8V
25	Dynamic Power Reduction	I	3.3V
26	GPIO_10 W_DISABLE2#	I	3.3V
27	GND	Pin	
28	GPIO_8 AUDIO_3	IO	1.8V
29	USB 3.0 TX-	O	
30	UIM_1_Reset	O	
31	USB 3.0 TX+	O	
32	UIM_1_CLK	O	
33	GND	Pin	
34	UIM_1_DATA	IO	
35	USB 3.0 RX-	I	

36	UIM_1_PWR	Pout	
37	USB 3.0 RX+	I	
38		Not Connected	
39	GND	Pin	
40	SIM DETECT (2)	I	
41	PETn0		Reserved, Disabled by Default
42	UIM_2_DATA	IO	
43	PETp0		Reserved, Disabled by Default
44	UIM_2_CLK	O	
45	GND		
46	USIM_2_RESET	O	
47	PERn0		Reserved, Disabled by Default
48	UIM_@_PWR	O	
49	PERp0		Reserved, Disabled by Default
50	PERST#	I	Reserved, Disabled by Default
51	GND		

52	CLKREQ#	IO	Reserved, Disabled by Default	
53	REFCLKN		Reserved, Disabled by Default	
54	PEWAKE#	IO	Reserved, Disabled by Default	
55	REFCLKP		Reserved, Disabled by Default	
56	MIPI_DATA	O		1.8V
57	GND			
58	MIPI_CLK	O		1.8V
59	ANTCTL0	O		1.8V
60	COEX3	IO		1.8V
61	ANTCTL1	O		1.8V
62	COEX_RXD	I		1.8V
63	ANTCTL2	O		1.8V
64	COEX_TXD	O		1.8V
65	ANTCTL3	O		1.8V
66	SIM_DETECT	I		
67	RESET#	I		1.8V
68	ANT_CONFIG	I		1.8V

69	CONFIG_1(GND)		
70	Power Supply	Pin	3.3V
71	GND		
72	Power Supply	Pin	
73	GND		
74	Power Supply	Pin	
75	CONFIG_2(GND)		

3. WWAN M.2 INTERFACE DETAILS

3.1. Platform connection design

3.1.1. Configuration Pins 2.0

The M.2 module provides 4 configuration pins. LN960 is configured as WWAN-USB3.0- 0, refer to PCIe M.2_Rev 1.1.

Item	Module configuration decodes				Module type	Port configuration
Config	Config_0	Config_1	Config_2	Config_3	WWAN-USB3.0	0
Pin No.	21	69	75	1		
State	GND	GND	GND	NC		

3.1.2. Power and Ground

(1) Power Rail Parameters

Parameter	Min	Type	Max	Units
Operating voltage	3.135	3.3	4.4	Vdc

The operating voltage was defined in PCIe M.2_Rev 1.1 standard as 3.135V~4.4V.

(2) 3.135 V is the minimum voltage supplied to LTE M.2 card by the host platform, and VCC must never be under 3.135 V in any case. As our experiment, if we set the VCC=3.0V, the M.2 card will power off possibly when M.2 card working at +23dBm continue mode.

(3) The LTE M.2 module provides 5 power pins and 11 Ground pins. To ensure that the LTE module works normally, all the pins must be connected.

3.1.3. Full_Card_Power_Off

The M.2 LTE module can be controlled to power on/off by the heFull_Card_Power_Of pin.

Item	State	M.2 card state
1	Low	Powers off, It's internally pulled down by 100K ohm resistor
2	High	Powers on, it is 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO.

The recommended connections as below

3.1.4. USB 3.0 interface

The USB controller of LN960 WWAN M.2 Module is compliant with USB3.0 in all modes. When two devices are connected via a USB3.0 interface, one of the devices must act as a host, and the other device must act as a peripheral. The host is responsible for initiating and controlling traffic on the bus.

Figure 3.1.2-1 USB3.0 interface.

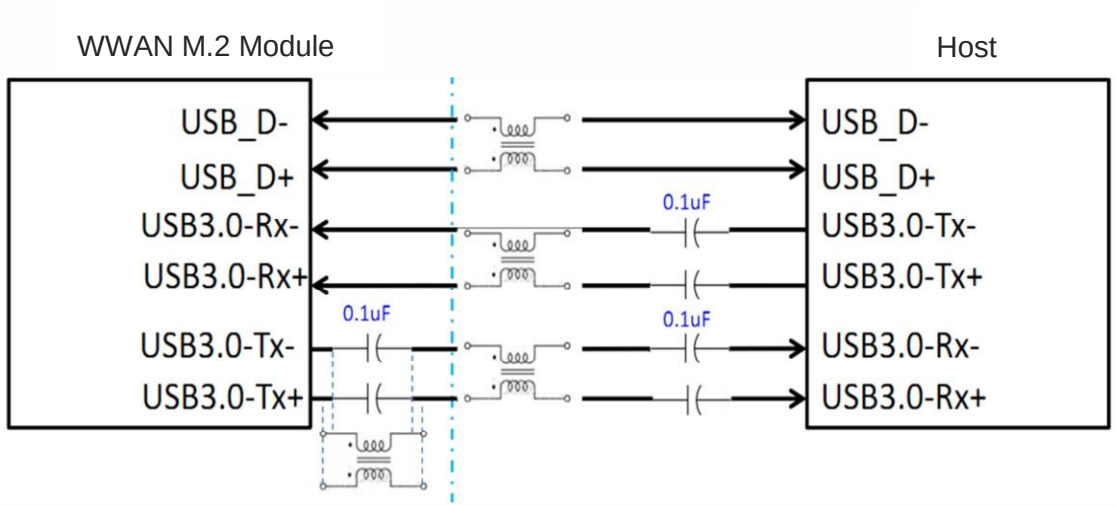
1. Reserve choke on all the USB signals in platform for noise debug.
2. Reserve 0.1uF capacitor on USB3.0 TX/Rx paths.
3. Co-layout USB3 choke and 0.1uF capacitor on module side for noise debug
   Notes: All the above components should be covered by shielding cover.

Table 3.1.2-1 USB 3.0 Interface

Signal Name	Pin	Voltage Level	Description
USB_D+	7	Per USB3.0 Specification	USB Data Plus
USB_D-	9		USB Data Minus
USB3.0-Tx-	29		USB 3.0 Transmit Minus
USB3.0-Tx+	31		USB 3.0 Transmit Plus

USB3.0-Rx-	35		USB 3.0 Receive Minus
USB3.0-Rx+	37		USB 3.0 Receive Plus

When two are connected host is chosen to initiate and to control traffic on the USB bus.



Remark:

USB/PCIe configuration the module supports

Win7: DIAG, RmNet, Modem, NMEA

Win10: MBIM, GNSS

Linux: DIAG, RmNet, Modem, NMEA

3.1.5. W_DISABLE#

This control setting is implementation-specific and represents the collective intention of the host software to manage radio operation. LN960 provides a hardware pin (W_DISABLE#) to disable or enable the radio. Besides, the radio can also be enabled or disabled through software AT commands.

Item	State	Function (WWAN state)
W_DISABLE#1	Low	WWAN Disabled (no RF operation allowed)
	High	WWAN Enabled (RF operation allowed), internally pull up
W_DISABLE#2	Low	GPS Disabled (no RF operation allowed)
	High	GPS Enabled (RF operation allowed), internally pull up

Note: W_Disable# is connected to configurable GPIO pin from PMIC, which can support either 3.3V VIO or 1.8V VIO. The default configuration is 3.3V VIO with interrupt function (low active), 1.8V will not disable RF function.

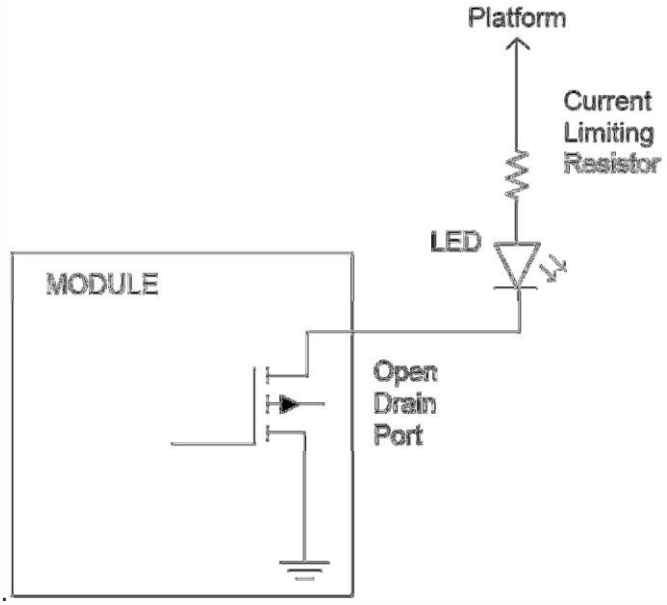
3.1.6. LED Indication

The LED signal is provided to enable wireless communication add-in cards to provide status indications to users via system provided indicators

(1) State of the LED# pin

Item	State	Definition	Interpretation
1	Low	The LED is emitting light.	Radio is capable of transmitting.
2	High	The LED is emitting no light.	Radio is incapable of transmitting.

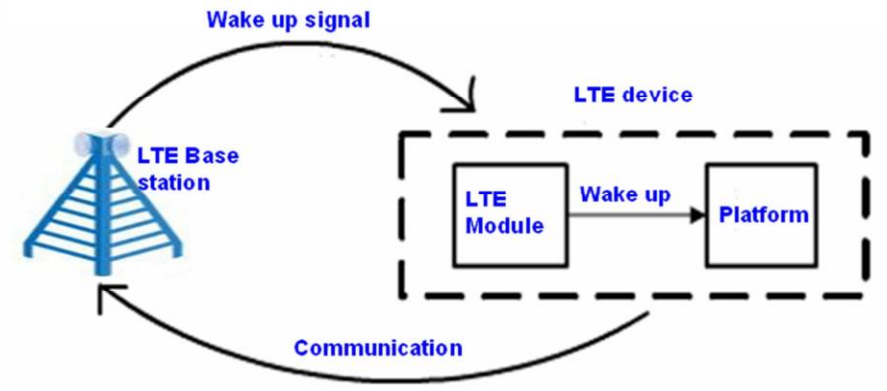
Typical LED Connection in Platform/System



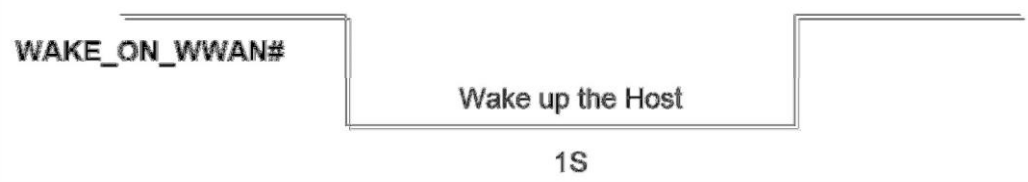
3.1.7. WoWWAN

The WAKE_ON_WWAN# signal is for power saving.

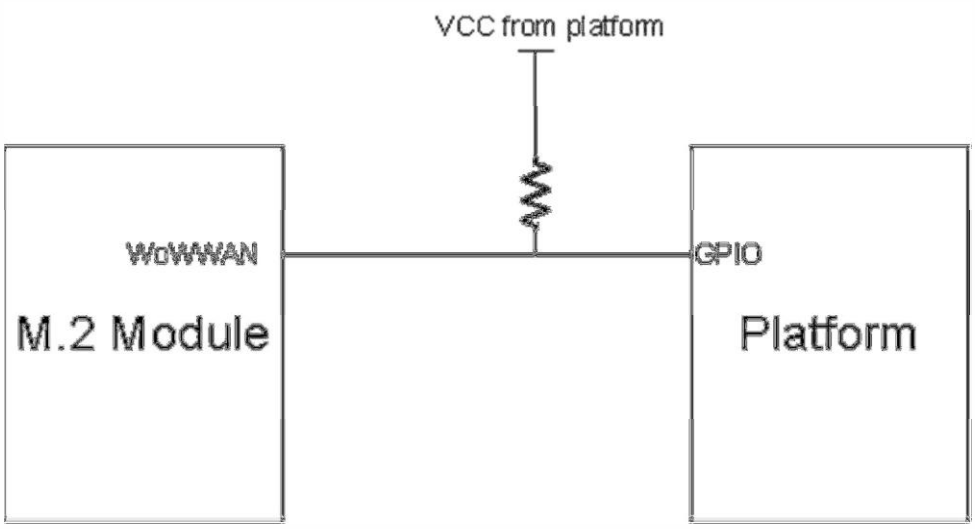
- LTE module always listening at very low power in idle mode
- LTE module will wake up mother board via 'WoWWAN' signal.
- The platform will power on when triggered by the LTE module.



The WAKE_ON_WWAN# signal is used to wake up the host. It is open drain and should be pulled up at the host side. When the WWAN needs to wake up the host, it will output a one second low pulse, shown in Figure 1-4.



Typical Connection in Platform/System



3.1.8. DPR (Dynamic Power Reduction)

The optional DPR signal is used by wireless devices to assist in meeting regulatory SAR (Specific Absorption Rate) requirements for RF exposure. The signal is provided by a host system proximity sensor to the wireless device to provide an input trigger causing a reduction in the radio transmit output power.

The required value of the power reduction will vary between different host systems and is left to the host platform OEM and card vendor to determine, along with the specific implementation details. The assertion and de-assertion of DPR is asynchronous to any system clock. All transients resulting from the proximity sensor need to be de-bounced by system circuitry.

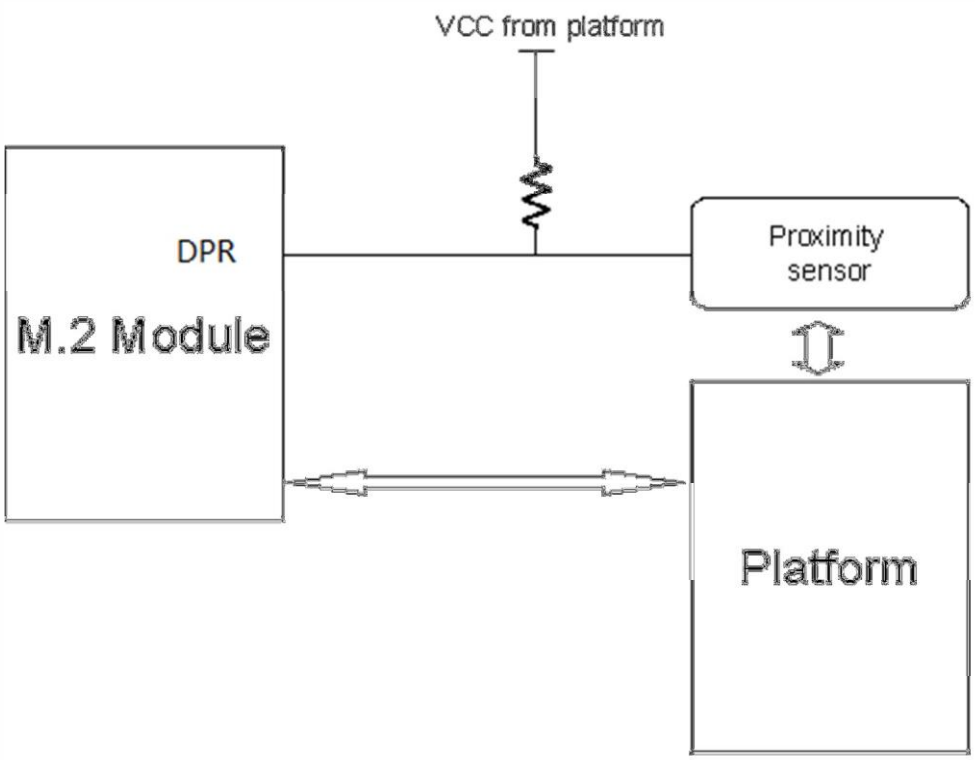
(1) State of the DPR

Item	State	Definition
1	Low	Enable the SAR power back off.
2	High	Disable the SAR power back off, internally pull up

Note: DPR is connected to configurable GPIO pin from PMIC, which can support either 3.3V

VIO or 1.8V VIO. The default configuration is 1.8V VIO with interrupt function (low active)

(2) Typical Connection in Platform/System



(3) DPR table by different Platform requirement

Refer the detail DPR table base on different platform requirement and implement into FW setting

(Waiting customer provide)

Remark:

a. The platform (system) side needs design a proximity sensor connect to platform system side, while the sensor be triggered then pull low the DPR pin to enable SAR power back off mechanism
b. After DPR pin becomes low level, you can set the MAX TX power by AT commands.

3.1.9. USIM

The UIM contains parameters necessary for the WWAN device's operation in a wireless wide area network radio environment. The UIM signals are described in the following paragraphs for M.2 add-in cards that support the off-card UIM interface.

(1) 2 USIM interface

Design 2 USIM interface on M.2 connector; USIM _1 (Pin 30/32/34/36/66) dedicate for external USIM socket; USIM_2 (Pin 40/42/44/46/48) connect to e-SIM chip which two selections between module side with Platform side (Reserve eSIM design on module bottom side)

(2) USIM card socket

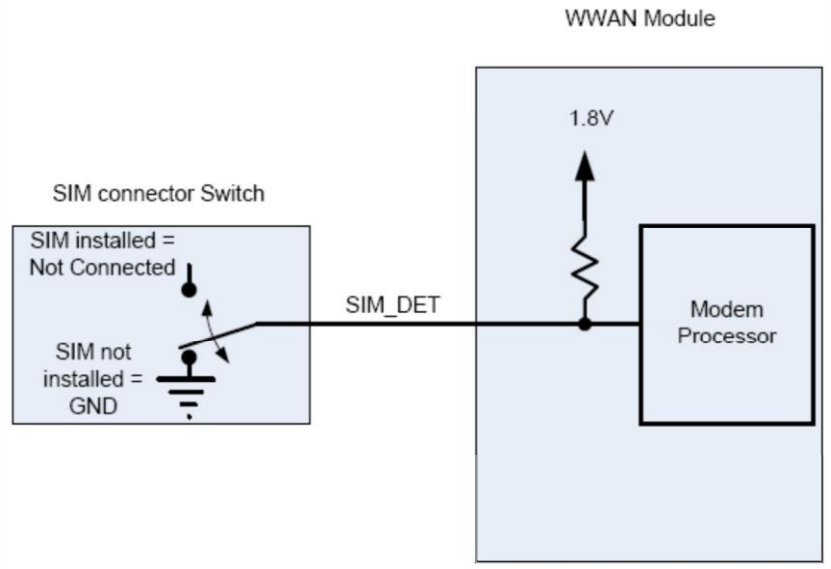
It is recommended to take electrostatic discharge (ESD) protection measures near the USIM card socket. The USIM socket should be placed near the NGFF interface (<100 mm), because a long circuit may impact signal quality.

(3) UIM-PWR

UIM_PWR power supply can supply 1.8 V and 2.85 V power to UIM card and auto detects follow SIM card type (4) SIM Detect

This signal is used to detect the insertion and removal of a SIM device in the SIM socket. With a Normal Short SIM Card connector, PUSH-PUSH type, the detect switch is normally shorted to ground when no SIM card is inserted. When the SIM is inserted, the SIM_DETECT will transition from logic 0 to logic 1 state. The rising edge will indicate insertion of the SIM card. When the SIM is pulled out, the SIM_DETECT will transition from logic1 to logic 0. This falling edge will indicate the pulling out of the SIM card. The M.2 module monitoring this signal will treat the rising/falling edge or the actual logic state as an interrupt, that when triggered, the module will act accordingly.

The UIM_PWR from the PRODUCT shall be turned ON 2 seconds after UIM_DETECT pin is asserted to HIGH. This is to ensure the power is not turned ON earlier before SIM card to be seated well.



3.1.10. Antenna Control

(1). LN960 provides GPIO control signals for external antenna tuner application.

ANTCTRL (0-3) are provided to allow for the implementation of antenna tuning solutions.

The number antenna control lines required will depend on the application and antenna/band requirements. We will provide a tool to fill antenna control table in ODM factory to enable antenna tuner support on specific platforms.

Telit general design for WWAN module with two control signals for reference only.

ANTCTL0	ANTCTL1	Frequency (MHz)	Band support
0	0	880 ~ 960	Band8 (WCDMA) + GSM900 + High Bands
0	1	791 ~ 894	Band5 (WCDMA, LTE) + GSM850 + High Bands
1	0	746 ~787	Band13 (LTE) + High Bands
1	1	704 ~746	Band17 (LTE) + High Bands

(2). LN960 also provides MIPI interface (VIO=1.8V) for external antenna tuner application.

The function is under development for customization. M.2 pin.56 (MIPI_DATA), 58(MIPI_CLK) M.2 pin.20/24 (antenna tuner Power) are provided to allow for the implementation of antenna tuner solutions with variable capacitors. We will provide a tool to fill MIPI registers in ODM factory to enable antenna tuner support on specific platforms.

Pin No.	I/O	Description	Remark
56	I/O	MIPI Data	For external antenna tuner
58	I/O	MIPI Clock	For external antenna tuner
20	Power	VIO=2.7V	For antenna tuner power
24	Power	VIO=1.8V	For antenna tuner power

(3). LN960 support both 4x4 and 2x2 MIMO antennas and by Pin 68 to select the antenna configuration

Item	State	M.2 Antenna Configuration (FW switching follow detect status)
1	Low	4x4 Antenna (Pin 68 pull down to GND), R1<1Kohm or short to GND
2	High	2x2 Antenna (Pin 68 as floating), Remove R1

Note: Pull down resistor (<1K Ohm) between pin68 with Ground on Platform side

3.1.11. Antenna Tuner Mode Switch

LN960 provide two antenna tuner modes configure for Notebook and Tablet scenario through M.2 Pin22 (ANT_TUNER_CONFIG), and get more benefit on antenna performance

Item	Pin 22 State	Tuner Mode	Scenario
1	Low	0	For Notebook
2	High	1	For Tablet

3.1.12. Coexistence

COEX1, COEX2 and COEX3 are provided to allow for the implementation of wireless coexistence solutions between the radio(s) on the M.2 Card and other off-card radio(s). These other radios can be located on another M.2 Card located in the same host platform or as alternate radio implementations (for example, using a PCI Express M.2 CEM or a proprietary form-factor add-in solution).

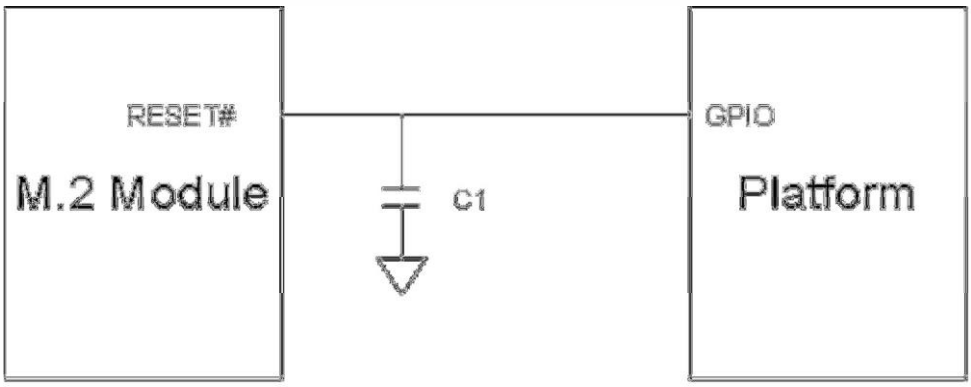
We also dual layout UART Tx/Rx with COEX1 and COEX2 for future extension, please contact with us if need to use these Pins.

Item	Signal name	Description
COEX1	LTE_ACTIVE (COEX_TXD)	TBD
COEX2	LTE_FRAME_SYNC (COEX_RXD)	TBD
COEX3	LTE_WLAN_PRIORITY	TBD

3.1.13. RESET#

Asynchronous RESET# pin, active low. Whenever this pin is active, the modem will immediately be placed in a Power On reset condition. Care should be taken not to activate this pin unless there is a critical failure and all other methods of regaining control and/or communication with the WWAN sub-system have failed.

The Reset# signal is relatively sensitive, it is recommended to install one capacitor (10~100pF) near to the M.2 card pin.



4. HARDWARE FEATURES

LN960 consists of the following key engine components, in addition to the required front-end RF and other discrete components.

Modem engine

■ Soft Baseband: SDX-20

■ RF: SDR845

■ Power: PMX20

Connectivity engine

■ PCIe: PCI express (EP and RC modes)

■ USIM: located off board

■ Antenna: connectors for the off-board antennas

4.1. Mobile Data Modem

The SDX20 chipset supports high-speed data capabilities over a wide range of air interface standards; the supported RF operating bands are defined by the chipset's

RFICs. They are complete system solutions that operate on networks worldwide. The major functions of SDX20 used on LN960.0X are listed below:

❒ Processor:

- Manufactured in 10 nm FinFET process
- System uP (1.4 GHz ARM Cortex-A7 application processor with 256 KB L2 cache and

  1 GHz Qualcomm® Hexagon™ DSP modem processor)

❒ Memory:

- External memory

  EBI1: 2Gb LPDDR2, 32-bit LPDDR2 SDRAM at up to 533MHz

- External memory EBI2: 2Gb NAND flash

❒ Air interface:

- WCDMA (R99, HSDPA, HSUPA, HSPA+, DC-HSPA+)
- LTE (R13 Cat16/18, FDD/TDD)
- GPS/Glonass/Beidou

❒ Advance RX operation:

- Mobile receive diversity (WCDMA, LTE)
- 4x4 MIMO HORxD (LTE) ❒ Connectivity:
- PCI expresses (Supports Endpoint and Root Complex, PCIe Gen 2)
- UART interface
- UIM support (Two dual-voltage (1.8/2.85 V) ports)

4.2. RF transceiver

The SDR845 device is a highly-integrated multimode, multiband RF CMOS transceiver IC that interfaces with the SDX20 device through QLink. The SDR845 is the first integrated single-chip RFIC for LTE downlink carrier aggregation (CA) up to 100 MHz BW supporting 5DL CA (two of the carriers must be contiguous). It also supports LTE uplink carrier aggregation up to 20 MHz + 20 MHz for inter-band and 40 MHz for contiguous intra-band.

4.2.1. Key features of SDR845

Qualcomm Technologies, Inc. (QTI) 28 nm RF CMOS device with an integrated modem subsystem in a PSP package (0.35 mm pitch)

- Integrating RF receive, transmit, and the QLink controller
- First QTI single-chip RF device to support three-carrier
- 4 × 4 MIMO (where two carriers are contiguous)
- First QTI single-chip RF device to have dedicated MIMO inputs
- SDR845 is the first QTI RF transceiver to support 12-layer DL MIMO

4.2.2. Key benefits of SDR845

- First QTI single-chip RF device to support three-carrier 4 × 4 MIMO (where two carriers are contiguous)
- This device is also capable of supporting two-carrier 4 × 4 MIMO and two-carrier 4x HORxD
- First QTI single-chip RF device to have dedicated MIMO inputs SDR845 is the first QTI RF transceiver to support 12-layer DL MIMO
- QTI RF device that supports high-speed digital interface (QLink) between SDR845 and SDX20/SDM845
- QTI RF device supporting external GRFCs that can be used for RF front-end communication and general-purpose functions
- QTI single-chip RF transceiver with integrated LTE-unlicensed (LTE-U)/LAA support
- QTI RF device that supports B42, B43, B46, and B48
- QTI single-chip RF device that supports uplink carrier aggregation (using two Tx chains)
- QTI single-chip RF device that supports the integrated envelope tracking (ET) feature for both Tx chains (ETDAC0 and ETDAC1)
- QTI single-chip RF transceiver that supports up to five downlink (DL) carrier aggregation

- One independent differential low noise amplifier (LNA) port, supporting Tx feedback for all WAN bands (UL)
- Most highly integrated RF transceiver
- Up to 10 receivers running concurrently
- Simplified DC power requirements for this highly integrated RFIC with built-in microprocessor

4.3. Power management IC

LN960 uses the Qualcomm PMX20. The PMX20 device integrates all the wireless product's power management, general housekeeping, and user interface support functions into a single mixed-signal IC. Its versatile design is suitable for any multimode, multiband product. Since the PMX20 includes so many diverse functions, its operation is more easily understood by considering major functional blocks individually. Therefore, the PMD9645 document set is organized by the following device functionality:

- Input power management
- Output power management
- General housekeeping
- User interfaces
- IC interfaces
- Configurable pins—either multipurpose pins (MPPs) or general-purpose inputs/outputs (GPIOs)—that can be configured to function within some of the other categories

4.4. Antenna Design

4.4.1. Antenna specification

LN960 also provides connectivity for off board antennas. The antennas and their connection interface for this device satisfy the requirements specified in the PCI Express M.2 Specification Revision Version 1.1 standard. The antenna elements are typically integrated into the Notebook/Ultrabook /Tablet and connected to LM960 module via flexible RF coaxial cables. LN960 provides four RF connectors (MHF type), one for the primary transmitter/receiver port, one for the diversity receiver and GNSS, the other twos for 4x4

MIMO receiver port

To ensure stable RF performance, customer must assemble adequate antenna according to the antenna specification.

Table 4-1 Main antenna specifications

Parameter	Min.	Typ.	Max.	Units	Notes
Cable loss	/	/	0.5	dB	Maximum loss to antenna
Impedance	/	50	/	Ohm	Antenna load impedance
VSWR	/	/	3:1	/	Maximum allowed VSWR of antenna

Note:

1. Main antenna peak gain limit as 2.5dBi for frequency <1.5GHz and 4dBi for frequency >1.5GHz of module level certification
2. For Japan regional peak gain should be limited as 2.5dBi for frequency <1.5GHz and 3dBi for frequency >1.5GHz
3. For Band 30 peak gain limit as 3dBi (Meet FCC requirement)

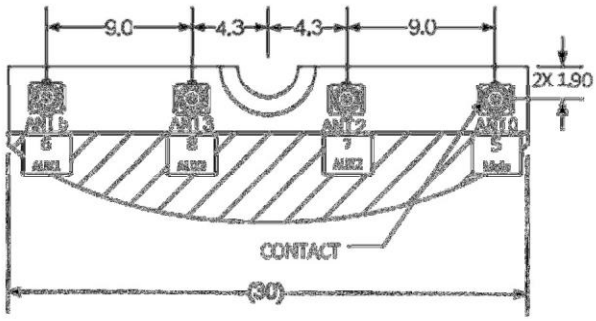
Table 4-2 Aux antenna specifications

Parameter	
Gain	Maximum gain and uniform converge in high angle elevation and zenith. Gain in the azimuth is not desired.
Average 3D gain	>-5dBi
VSWR	Typical value <3:1
Isolation (diversity to Main)	>10dB in all related bands
Polarization	Any

4.4.2. Antenna location and mechanical design.

To ensure customer has a clear knowledge of the two antennas, check below product picture.

Figure 4-1 Antenna connector location and type



Antenna	Interface
0	WWAN Main
1	TBD
2	WWAN MIMO 1
3	WWAN MIMO 2
4	TBD
5	WWAN Aux / GPS

Figure 4-2 RF connectors

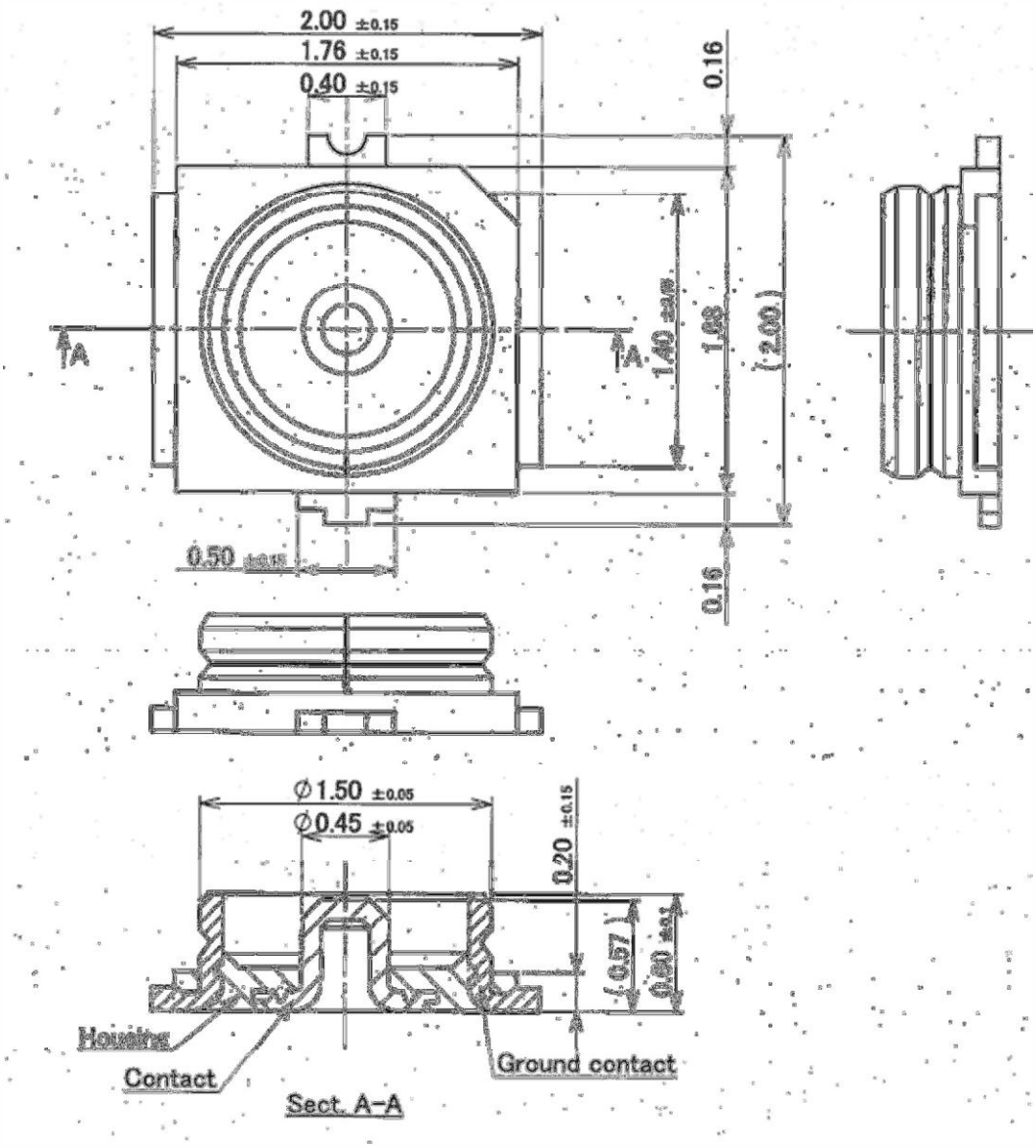
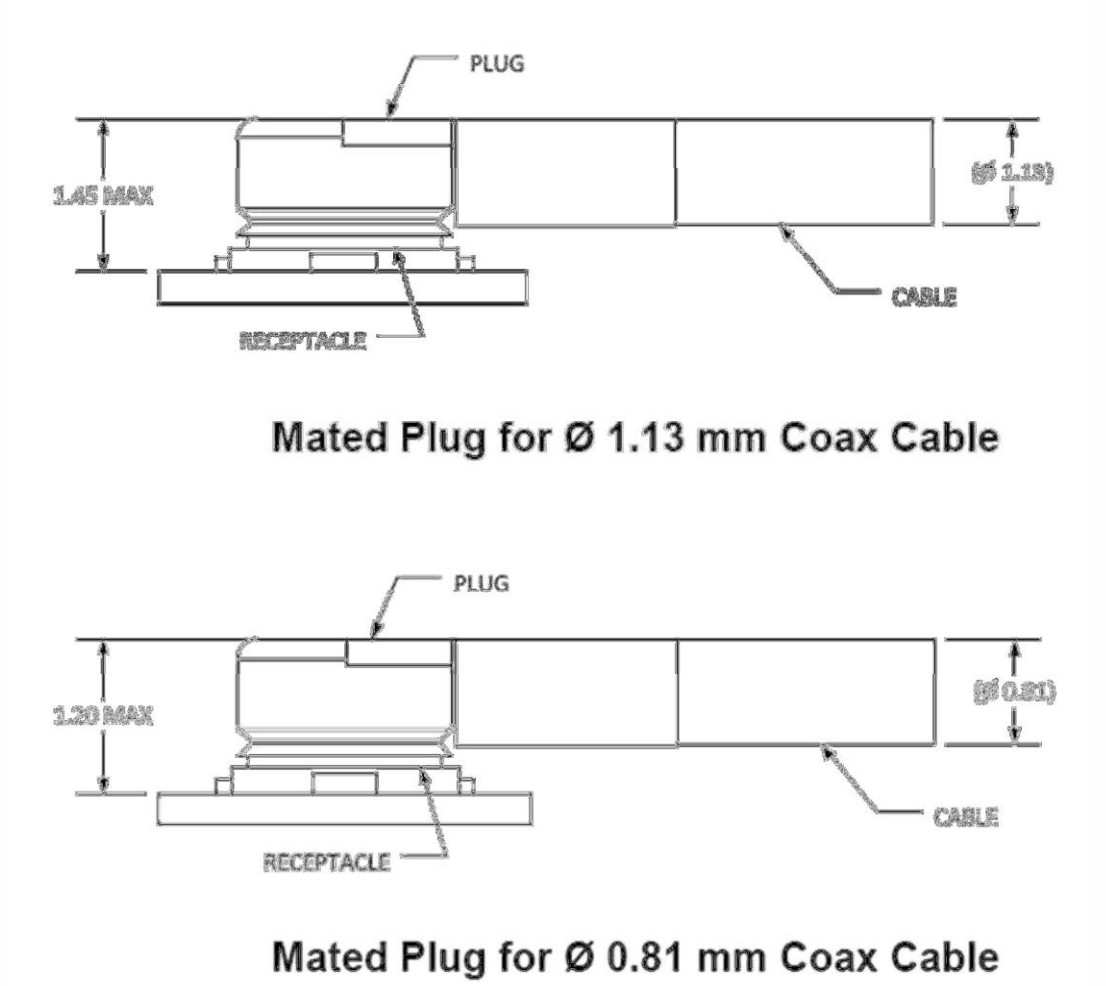


Figure 4-3 RF receptacles



5. MECHANICAL SPECIFICATIONS

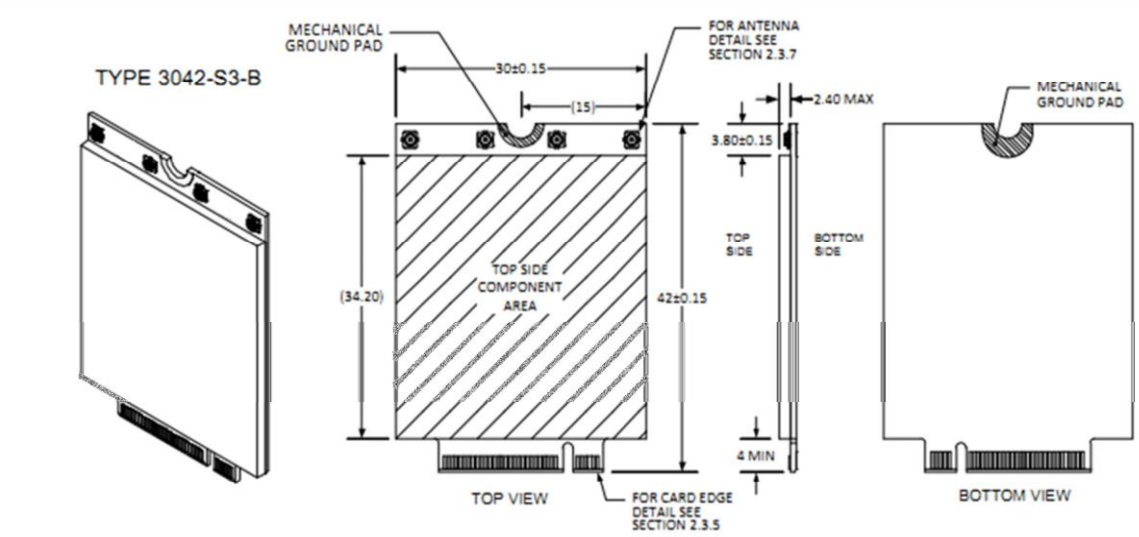
5.1. Overview

LN960 is compatible with the PCI Express M.2 Specification 3042 Key.B type 75-pin card edge-type connector. Refer to Electromechanical Specification Revision 0.7a, Version

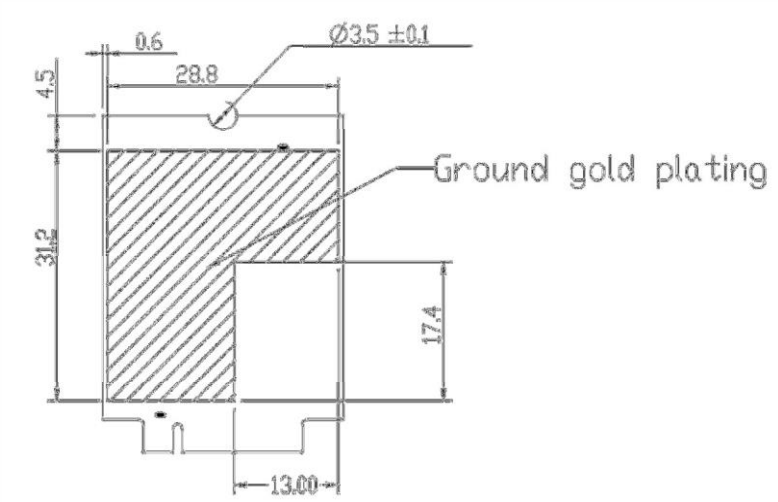
1.0 with Input Power and Voltage Tolerance ECN for more details.

5.2. Mechanical constraints

Figure 5-1 shows the mechanical constraints of LN960(3042-S3-B)



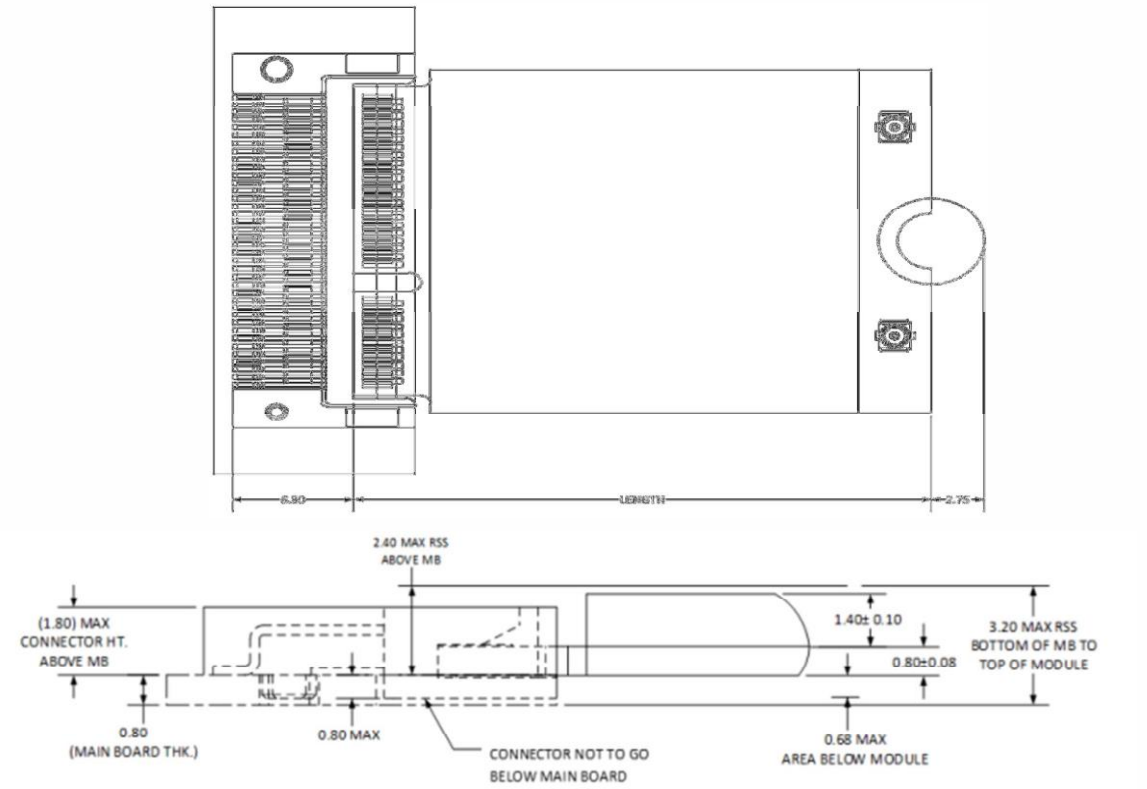
Ground area (with gold plating) on bottom side



5.3. M.2 card assembly

5.3.1. Mid-mount Connection with Single Sided Module

Figure 3-2 shows Stack-up Mid-Line (In-line) Single Sided Module for 1.5 Maximum Component Height, refer to section 2.4.8.3.1 of PCIe M.2_Rev 1.1 standard.

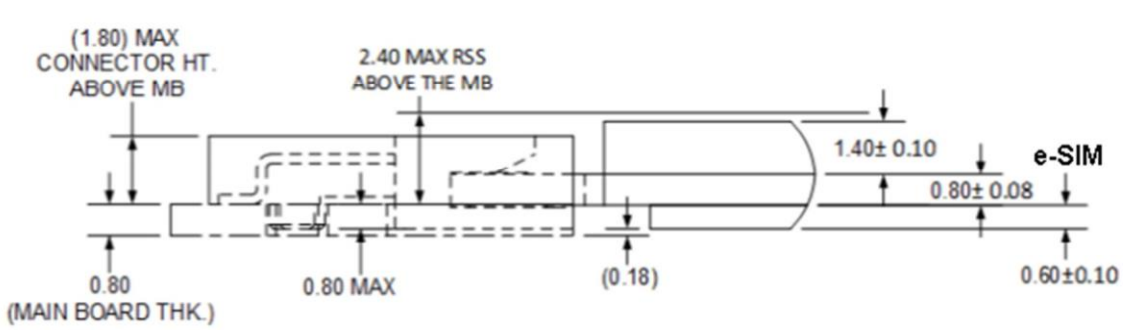


Remark:

a. 2.4mm maximum above mother board
b. Cut area of main board under M.2 module
c. Need to add thermal pad between M.2 modules with mechanical component (like material shielding) for thermal dissipation.

5.3.2. Mid-mount Connection with Double-sided Module (For e-SIM)

Figure 5-3 shows Stack-up Mid Mount Double-sided Module for 1.5 Maximum Top-side Component Height with 0.7 Maximum Bottom-side Component Height (e-SIM mounted); refer to section 2.4.7.3.3 of PCIe M.2_Rev 1.1 standard.

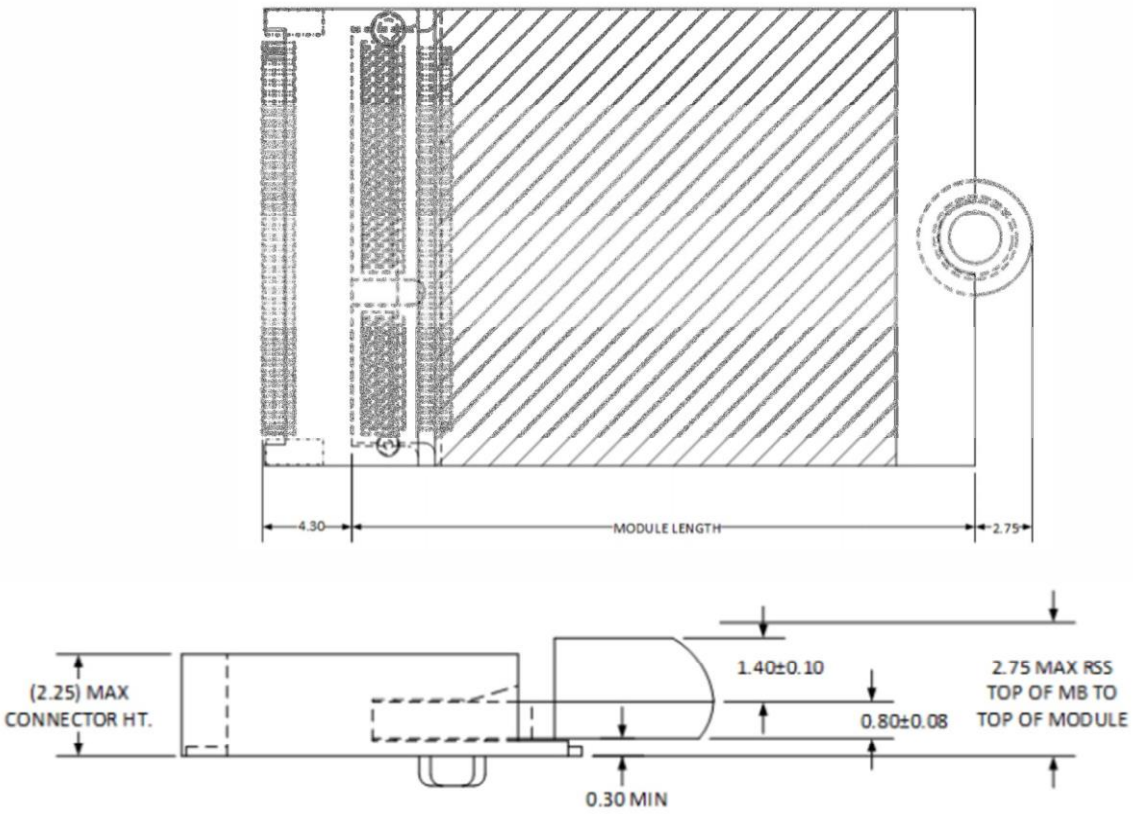


Remark:

a. 2.4mm maximum above mother board
b. Cut area of main board under M.2 module
c. Need to add thermal pad between M.2 module with mechanical component (like material shielding) for thermal dissipation

5.3.3. Top-mount Connection with Single Sided Module

Figure 5-4 shows Top Mount Single-sided Module for 1.5 Maximum Component Height; refer to section 2.4.7.3.1 of PCIe M.2_Rev 1.1 standard.



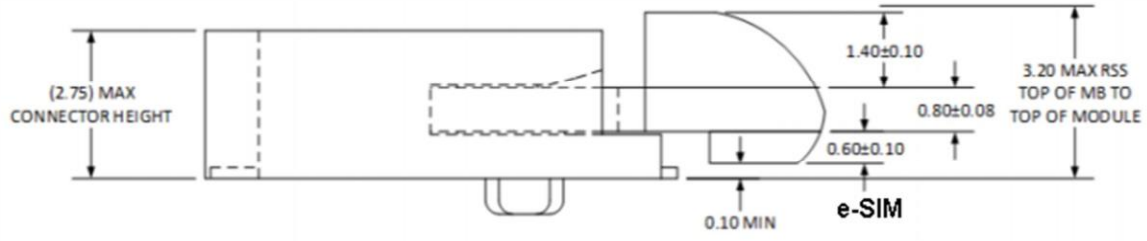
Remark:

a. 2.75mm maximum above mother board
b. Full Keep out area 30x42mm” below module which means platform do not place any components and routings below M.2 module

c. Need to add thermal pad between M.2 modules with mother board for thermal dissipation

5.3.4. Top-mount Connection with Double-sided Module (For e-SIM)

Figure 3-5 shows Stack-up Top Mount Double-sided Module for 1.5 Maximum Top-side Component Height with 0.7 Maximum Bottom-side Component Height (e-SIM mounted); refer to section 2.4.7.3.3 of PCIe M.2_Rev 1.1 standard.

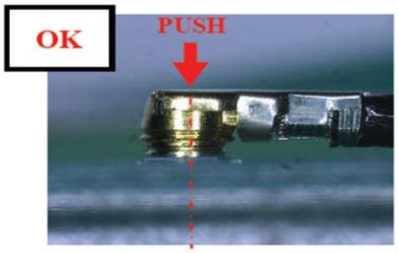


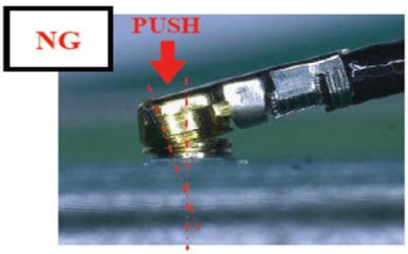
Remark:

a. 3.2mm maximum above mother board
b. Full Keep out area 30x42mm" below module which means platform do not place any components and routings below M.2 module
c. Need to add thermal pad between M.2 modules with mother board for thermal dissipation

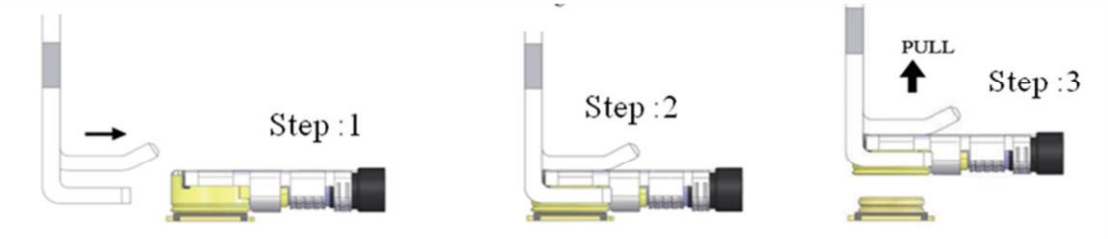
3.4 Connector assembly

a. Mate the connector vertically as much as possible. Adjusting the mating axis of plug and receptacle. Do not slant mate.

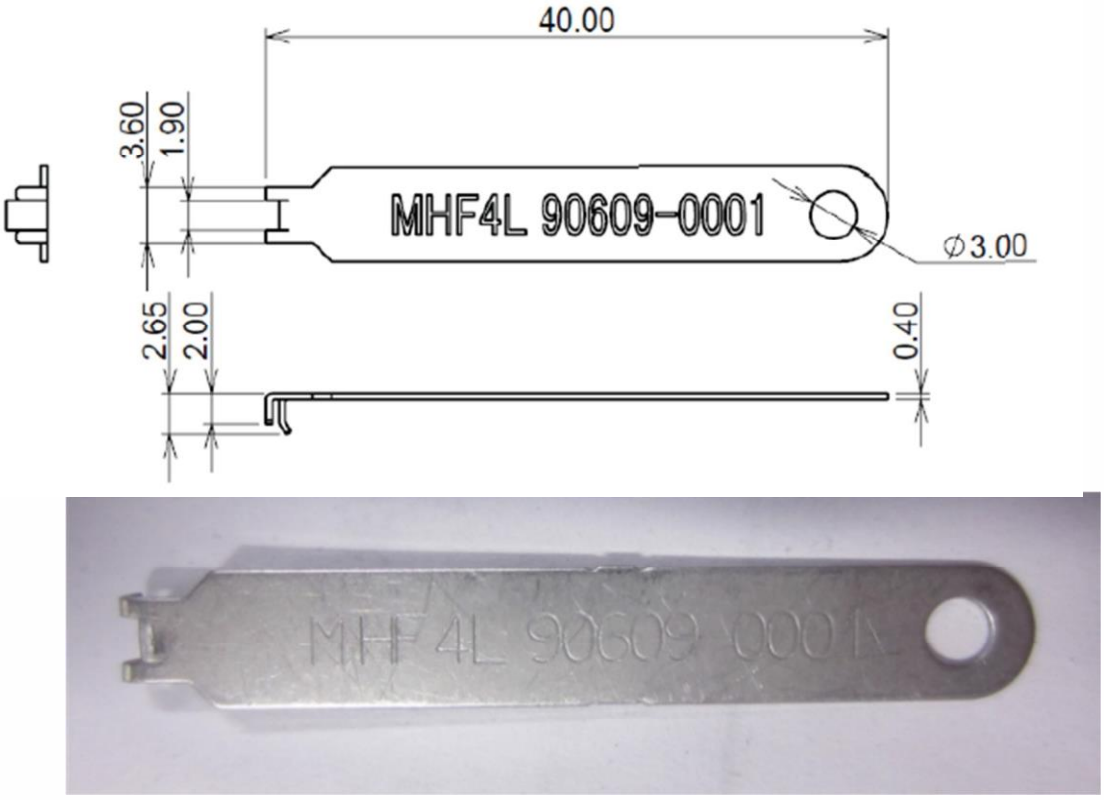




b. Unmating: In case of unmating by pulling tool. Use the pulling tool as the following drawing, and pull plug to vertical direction as directly as possible



c. Pulling tool (Unit: mm)



6. ELECTRICAL SPECIFICATIONS

6.1. Recommended operating conditions

Table 6-1 Recommended operating conditions

Parameter	Min	Type	Max	Units
Storage temperature	-30	+25	+85	°C
Recommend operating temperature (3GPP compliant) (*1)	-30	+25	+70	°C
Extendable (with limited performance) Temperature measure on LN960 module (*2)	-40		+85	
Operating voltage	3.135	3.3	4.4	Vdc

Note: The operating temperature reference point is board temperature on module bottom side (Ground Golding plating area)

(1). Refer application note about thermal mitigation plan

(2). Extendable operation allows normal mode data transmission for limited time until automatic thermal shutdown takes effect. Within the extendable temperature range (outside the operating temperature range) the specified electrical characteristics may be degraded.

(3). Due to temperature measurement uncertainly, a tolerance on the stated shutdown thresholds may occur. The possible deviation is in the range of +/- 2 ℃ at the over-temperature and under-temperature limit.

(4). Need implement thermal solution on Platform (Example add thermal pad to heat dissipated from LTE module to Platform PCB) would get more thermal margin and benefit then extend the operating temperature

Operating LN960 device under conditions beyond its absolute maximum ratings (Table 4-1) may damage the device. Absolute maximum ratings are limiting values to be considered individually when all other parameters are within their specified operating ranges. Functional operation and specification compliance under any absolute maximum condition, or after exposure to any of these conditions, is not guaranteed or implied. Exposure may affect device reliability

6.2. Power consumption

Table 6-2 Radio system power consumption

----TBD

6.3. Thermal dissipation proposal

----TBD

7. RF PERFORMANCE SPECIFICATIONS

Radio performance for LN960 is given in the following sections, including RF receiver, RF transmitter.

7.1. RF maximum TX power specifications

Table 7-1 Conductive Maximum transmits power (LTE BW: 10MHz)

Notes: The below test result is for reference only, we will update the final Spec. base on 1st

10k MP build CPK

Band	3GPP Standard (dBm)	Design Spec.(dBm)		
		Max.	Typ.	Min.
1	23 +/-2	24.5	23.5	22.0
2	23 +/-2	24.5	23.5	22.0
3	23 +/-2	24.5	23.5	22.0
4	23 +/-2	24.5	23.5	22.0
5	23 +/-2	24.5	23.5	22.0
7	23 +/-2	24.5	23.5	22.0
8	23 +/-2	24.5	23.5	22.0
12	23 +/-2	24.5	23.5	22.0
13	23 +/-2	24.5	23.5	22.0
14	23 +/-2	24.5	23.5	22.0
17	23 +/-2	24.5	23.5	22.0
18	23 +/-2	24.5	23.5	22.0
19	23 +/-2	24.5	23.5	22.0
20	23 +/-2	24.5	23.5	22.0
25	23 +/-2	24.5	23.5	22.0
26	23 +/-2	24.5	23.5	22.0
28	23 +/-2	24.5	23.5	22.0
30	23 +/-2	23.0	22.0	21.0
38	23 +/-2	24.5	23.5	22.0
39	23 +/-2	24.5	23.5	22.0
40	23 +/-2	24.5	23.5	22.0
41	23 +/-2	24.5	23.5	22.0
42	23 +/-2	24.5	23.5	22.0
43	23 +/-2	24.5	23.5	22.0

48	23 +/-2	24.5	23.5	22.0
66	23 +/-2	24.5	23.5	22.0
WCDMA	3GPP Standard (dBm)	Design Spec.(dBm)		
		Max.	Typ.	Min.
1	24+1.7/-3.7	24.5	23.5	22.5
2	24+1.7/-3.7	24.5	23.5	22.5
4	24+1.7/-3.7	24.5	23.5	22.5
5(6/19)	24+1.7/-3.7	24.5	23.5	22.5
8	24+1.7/-3.7	24.5	23.5	22.5
9	24+1.7/-3.7	24.5	23.5	22.5

7.2. RF min. Rx sensitivity specifications

Table 7-2 Conductive Minimum Sensitivity (LTE BW: 10MHz)

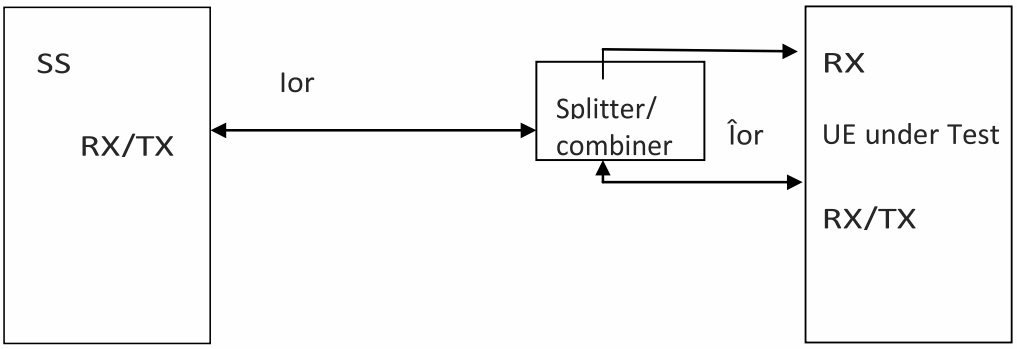
Notes: The below test result is for reference only, we will update the final Spec. after DVT build before April. of 2018

Band	3GPP MIMO Combined (dBm)	Design Spec.(dBm)				
		PRx	DRx	HORx_1	HORx_2	MIMO Combined
1	-95	-98	-98	-97.5	-97.5	TBD
2	-95	-98	-98	-97.5	-97.5	TBD
3	-94	-98	-98	-97.5	-97.5	TBD
4	-97	-98	-98	-97.5	-97.5	TBD
5	-95	-99	-99	NA	NA	-102
7	-95	-97.5	-97.5	-97.5	-97.5	TBD
8	-94	-99	-99	NA	NA	-102
12	-94	-99	-99	NA	NA	-102
13	-94	-99	-99	NA	NA	-102

14	-94	-99	-99	NA	NA	-102
17	-94	-99	-99	NA	NA	-102
18	-97	-99	-99	NA	NA	-102
19	-97	-99	-99	NA	NA	-102
20	-94	-99	-99	NA	NA	-102
25	-93.5	-98	-98	-97.5	-97.5	TBD
26	-94.5	-99	-99	NA	NA	-102
28	-95.5	-99	-99	NA	NA	-102
29	-94	-99	-99	NA	NA	-102
30	-97	-97.5	-97.5	-97.5	-97.5	TBD
32	-97	-99	-99	NA	NA	-102
38	-97	-97.5	-97.5	-97.5	-97.5	TBD
39	-97	-98.5	-98.5	NA	NA	-101
40	-97	-97.5	-97.5	-97.5	-97.5	TBD
41	-96	-97.5	-97.5	-97.5	-97.5	TBD
42	-96	-98	-98	NA	NA	-101
43	-96	-98	-98	NA	NA	-101
48	-96	-98	-98	NA	NA	-101
66	-96.5	-98	-98	NA	NA	-101
46	-93	-98	-98	NA	NA	-101
WCDMA	3GPP MIMO Combined (dBm)	Design Spec.(dBm)				
		PRx	DRx	HORx_1	HORx_1	MIMO Combined
1	-106.7	-109	-109	NA	NA	-112
2	-104.7	-109	-109	NA	NA	-112
4	-106.7	-109	-109	NA	NA	-112
5(6/19)	-104.7	-110	-110	NA	NA	-113
8	-103.7	-110	-110	NA	NA	-113
9	-105.7	-110	-110	NA	NA	-113
GNSS tracking sensitivity	Design target (dBm)	Spec (dBm)				
	-159	-152				

Remark:

a. It has 3dB margin at least refer to 3GPP standard.
b. The typical value of LTE was measured as combine Rx sensitivity which was follow test setup of 3GPP standard (TS36.521 charter 7.2 and charter 7.3.5), the test setup is follow TS36.508 Annex A Figure A.3.
c. Above table is for general application, please inform us if you have any specific requirement.



8. SAFETY RECOMMENDATIONS

8.1. READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- Where it can interfere with other electronic devices in environments such as hospitals, airports, aircrafts, etc.
- Where there is risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product; therefore, care has to be taken to the external components of the module, as well as any project or installation issue, because the risk of disturbing the GSM network or external devices or having impact on the security. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

http://ec.europa.eu/enterprise/sectors/rtte/documents/

The text of the Directive 99/05 regarding telecommunication equipment is available,

while the applicable Directives (Low Voltage and EMC) are available at:

http://ec.europa.eu/enterprise/sectors/electrical/

9. ACRONYMS

NGFF	Next Generation Form Factor

10. DOCUMENT HISTORY

Revision	Date	Changes
1.0	2019-05-30	First issue (Preliminary)

SUPPORT INQUIRIES

Link to **www.telit.com** and contact our technical support team for any questions related to technical issues.

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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.

FCC Caution: 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.

This device is intended only for OEM integrators under the following conditions:

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

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

IMPORTANT NOTE: In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC 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 FCC authorization.

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 FCC ID:RI7LN960A16”. The grantee's FCC ID can be used only when all FCC compliance requirements are met.

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.

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 20cm between the radiator & your body.

Industry Canada statement:

This device complies with ISED’s licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d’ ISED applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un

fonctionnement indésirable.

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

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.
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.

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.

IMPORTANT NOTE:
In the event that these conditions can not be met (for example certain laptop configurations or co-location 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.
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.

Device can be operating in the band 1755-1780 MHz only when under the control of a base station.

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: 5131A-LN960A16”.

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: 5131A-LN960A16 ".

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.

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.