LN940 WWAN M.2
HW User Guide

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1. INTRODUCTION

1.1. Scope

The document covers the technical features of and design guideline for Telit LN940 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
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Telit appreciates feedback from the users of our information.

2. OVERVIEW

This chapter provides an overview of standard features of Telit LN940 WWAN M.2 Module.

2.1. M.2 Overview

LN940 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 and 3x in the downlink) and high order modulation (up to 256 QAM) are supported.

2.1.1. General Features

Table 2.1.1-1 LN940 Feature Summary

Feature	Description	Additional Information
Modem Chipset	Qualcomm MDM9240	
Carrier Aggregation	2CC & 3CC DL CA	Up to inter-band 3CC DL CA
LTE Category	Cat9 and Cat11 up to @60Mhz	
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
USIM	Off-board USIM connector Supported	

RX Diversity	ALL LTE and UMTS Bands Supported
GNSS	GPS: L1 (1575.42MHz)
	GLONASS: L1 (1602MHz)
	Beidou (1561.098MHz)
Data Service	LTE CAT 11: 600Mbps DL/50Mbps UL
	LTE CAT 9: 450Mbps DL/50 Mbps UL
	DC-HSPA+: 42Mbps DL/5.76Mbps UL HSPA+: 21Mbps DL/5.76Mbps UL
	WCDMA PS 384Kbps DL/384Kbps UL
	WCDMA CS 64Kbps DL/64Kbps UL

There are 22 LTE and 7 UMTS bands supported by Telit LN940 WWAN M.2 Module.

Table 2.1.1 -2 Supported LN940 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
66	1700	1710-1780	2110-2200	FDD

Table 2.1.1 -2 Supported LN940 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
19	850	830-845	875-890	FDD

2.1.2. Carrier Aggregation

With the LTE-A carrier aggregation and high order modulation scheme Telit LN940 WWAN M.2 module is designed to run on the world's fastest LTE networks. In the following tables there are seventy 2CC and sixty-four 3CC configurations shown in inter-band,and intra-band CA types in single duplex (FDD only) nd in hybrid duplex (FDD+TDD) modes.

Table 2.1.2-1 Two Carrier Component Carrier Aggregation Configurations (Downlink)

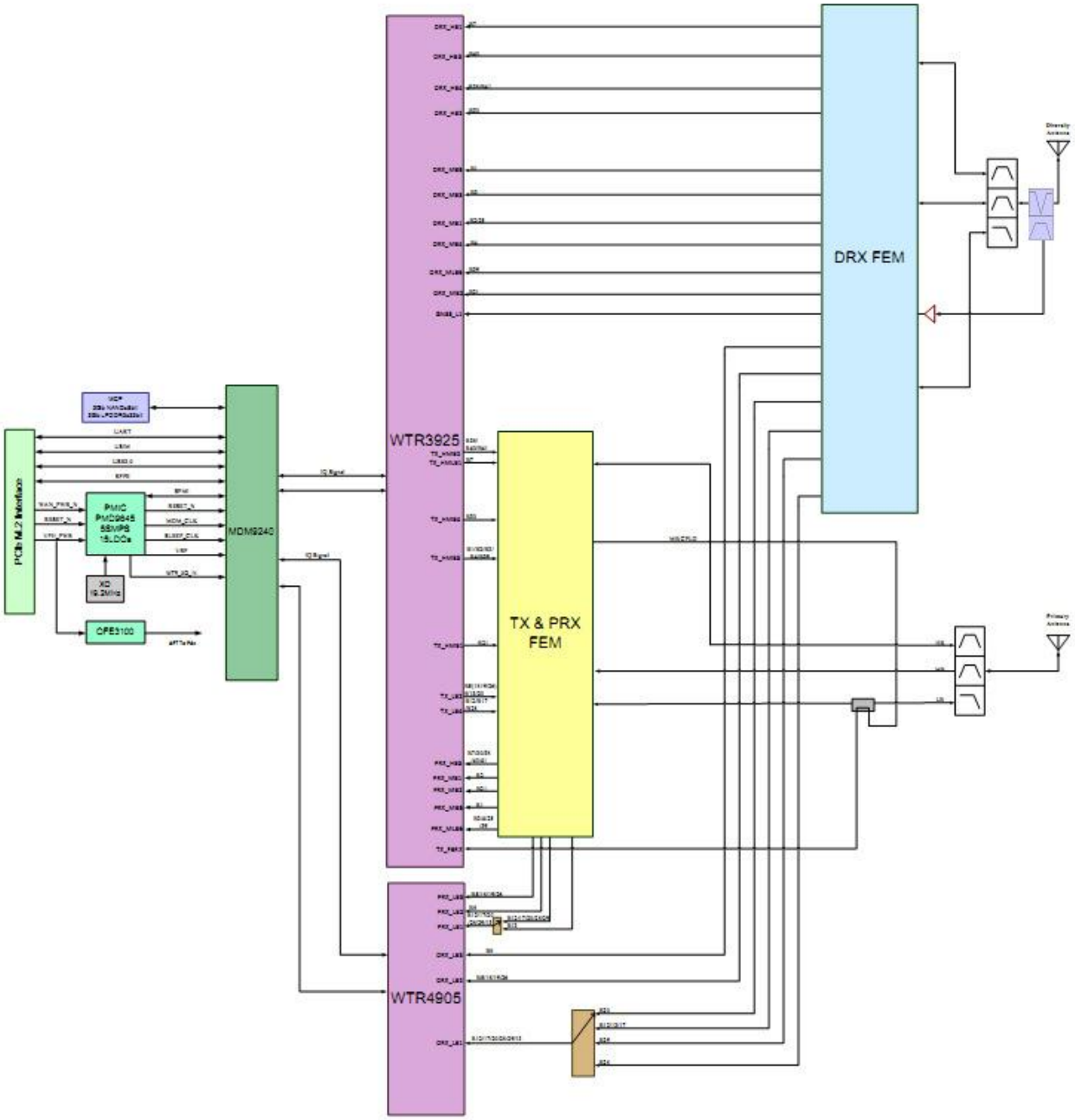
Region	Carrier	2CC DL CA Combinations
North America	AT&T, VZW, Sprint, TMO	B2+ B2, B2+ B4, B2 + B5, B2+ B12, B2 + B13, B2 +B17, B2 + B29, B2 + B30, B4+ B4, B4 + B5, B4 + B7, B4+B12, B4 + B13, B4 + B17,B4+ B29, B4 + B30, B5+B30, B12 + B12, B12 + B30, B25 + B25, B25 + B26, B25+B41, B26 + B41, B29+B30, B41+B41, B2+B66, B5+B66, B12+B66, B13+B66, B66+B66, B29+B66, B30+B66
Korea	SKT, KT, LGU+	B1+B5, B1+B3, B1+B7, B3+B5, B3+B8, B5+ B7, B3+B7, B7+B7
Japan	KDDI, Docomo, Softbank	B1+B3, B1+B8, B1+B18, B1+B19, B1+B26, B3+B19, B19+B21, B3+B41, B41+B41
EU	Various	B1+B20, B3+B3, B3+B7, B3+ B20, B3+ B38, B7+B7, B7+B8, B7+B20, B38+B38
China	CMCC, CTCC, CUCC	B1+B3, B1+B26, B3+B26, B3+B40, B39+B39, B39+B41, B40+B40, B41+B41
Australia/SEA/LA	Telstra, Optus	B1+B3, B1+ B7, B1 + B28, B3+ B8, B3 + B28, B5 + B7, B5+ B40, B7 + B8, B7 +B28

Table 2.1.2-1 Three Carrier Component Carrier Aggregation Configurations

Region	Carrier	3CC DL CA Combinations
North America	AT&T, VZW, Sprint, TMO	B2+ B2+ B2, B2 + B2 + B12, B2 +B2+B13, B2+B4+B4, B2+B4+B5, B2+B4 +B12, B2+B4+B13, B2+ B4 + B29, B2+ B5+B30, B2+B12+B12, B2+B12+ B30, B2+B29+B30, B4+B4+B5, B4+B4+B7, B4+B4+B12, B4+B4 +B13, B4+ B5 + B30, B4+B12+B12, B4+B12+B30, B4+B29+ B30, B25+B26+B41, B25+B41+B41, B26+B41+B41, B41+B41+B41, B13+B66+B2, B12+B66+B66, B13+B66+B66, B5+B66+B2, B5+B66+B66, B66+B66+B2, B66+B66+B66
Korea	SKT, KT, LGU+	B1+B3+B5, B1+B7+B7, B1+B3+B8, B1+B5+B7, B3+B5+B7,B1+B7+B28, B3+B7+B8, B3+B7+B7, B5+B7+B7
Japan	KDDI, Docomo, Softbank	B1+B3+B19, B1+B3+B28, B1+B41+B41, B41+B41+B41
EU	Various	B1+B3+B20, B1+B7+B20, B3+B3+ B7, B3+B3+B20, B3+B7+B20, B3+B7+B7, B3+B20+B38,B3+B38+B38
China	CMCC, CTCC, CUCC	B1+B3+B3, B1+B3+B26, B1+B3+B41, B3+B40+B40, B39+B39+B41, B39+B41+B41, B40+B40+B40, B41+B41+B41
Australia/SEA/LA	Telstra, Optus	B3+B3+B5, B3+B3+B8, B3+B7+B7, B3+B7+B28, B7+B7+B28, B3+B40+B40, B28+B40+B40, B40+B40+B40

2.2. M.2 WWAN Module – System Block Diagram

Figure 2.2-1 System Block Diagram



2.3. Host Interface Signals

Telit LN940 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	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	GPIO_6 AUDIO_1	IO	1.8V
23	GPIO_3 WoWWAN#	O	1.8V
24	GPIO_7 AUDIO_2	IO	1.8V
25	Dynamic Power Reduction	I	3.3V
26	W_DISABLE2#	I	3.3V
27	GND	Pin	
28	GPIO_8 AUDIO_3	IO	1.8V
29	USB 3.0 TX-	O	
30	UIM_Reset	O	
31	USB 3.0 TX+	O	
32	UIM_CLK	O	
33	GND	Pin	
34	UIM_DATA	IO	
35	USB 3.0 RX-	I	
36	UIM_PWR	Pout	
37	USB 3.0 RX+	I	

38	Not Connected		
39	GND	Pin	
40	GNSS_SCL	I/O	Reserved
41	PETn0		Reserved, Disabled by Default
42	GPIO_1 GNSS_SDA		Reserved
43	PETp0		Reserved, Disabled by Default
44	GPIO_2 GNSS_IRQ		Reserved
45	GND		
46	GPIO_3 SYSCLK		Reserved
47	PERn0		Reserved, Disabled by Default
48	GPIO_4 TX_BLANKING		
49	PERp0		Reserved, Disabled by Default
50	PERST#		Reserved, Disabled by Default
51	GND		
52	CLKREQ#		Reserved, Disabled by Default
53	REFCLKN		Reserved, Disabled by Default
54	PEWAKE#		Reserved, Disabled by Default

55	REFCLKP	Reserved, Disabled by Default	
56	MIPI_CLK		
57	GND		
58	MIPI_DATA		
59	ANTCTL0	O	
60	COEX3	IO	
61	ANTCTL1	O	
62	COEX_RXD	I	
63	ANTCTL2	O	
64	COEX_TXD	O	
65	ANTCTL3	O	
66	SIM_DETECT	I	
67	RESET#	I	
68		Not Connected	
69	CONFIG_1		
70	Power Supply	Pin	3.3V
71	GND		
72	Power Supply	Pin	
73	GND		
74	Power Supply	Pin	

75	CONFIG_2

3. WWAN M.2 INTERFACE DETAILS

3.1. Interprocessor Communications (IPC)

The LN940 WWAN M.2 Module provides two interfaces on the M.2 host interfaces that support Interprocessor Communications (IPC).

3.1.1. USB 2.0 High-Speed

The USB controller is compliant to USB2.0 specification and with the Link Power Management (LPM). LPM introduces the sleep state (L1) which significantly reduces the transitional latencies between the defined power states.

Table 3.1.1-1 USB 2.0 Interface

Signal Name	Pin	Voltage Level	Description
USB_D+	7	Per USB2.0 Specification	USB Data Pus
USB_D-	9		USB Data Minus

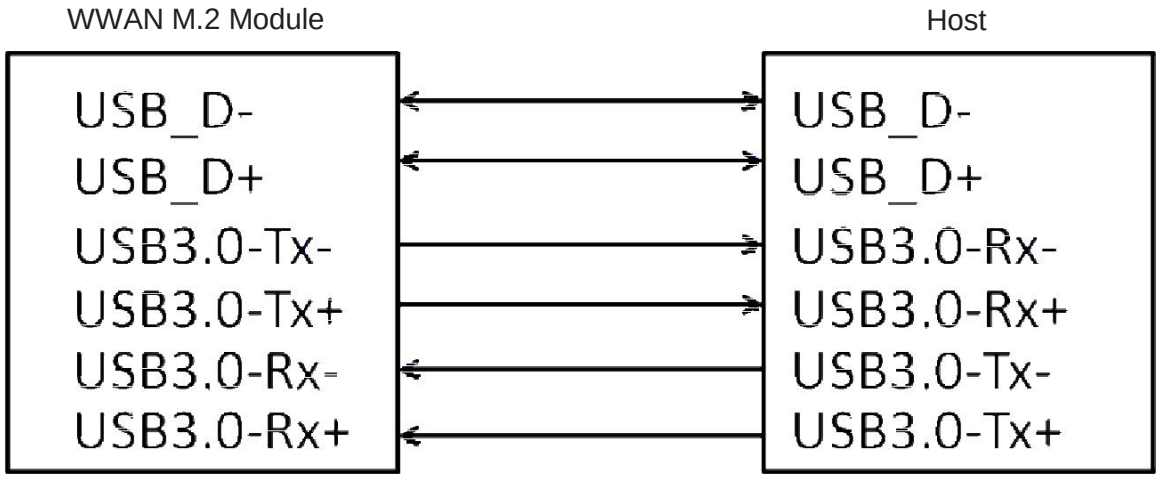
3.1.2. USB 3.0 Super-Speed

The USB controller of LN940 WWAN M.2 Module is also compliant with USB3.0 specification. It enables better transfer speed with improved bus use, duplex mode, than USB2.0.

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.



3.2. USIM Interface

The USIM interface is fully compliant to the ISO/IEC 7816-3 specification

The USIM contains parameters necessary for the operation of WWAN radio environment.

Table 3.2-1 USB 3.0 USIM Interface

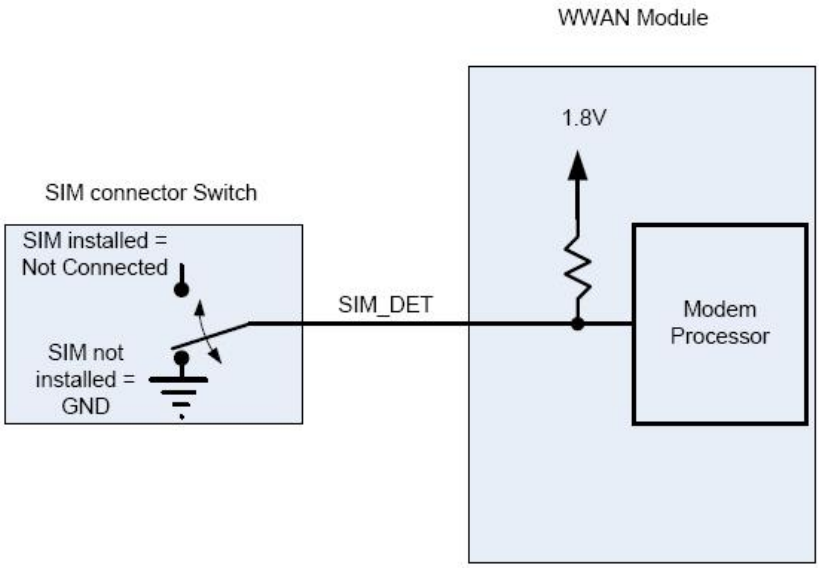
Signal Name	Pin	Voltage Level	Description
UIM_RESET	30	1.8V	UIM Reset signal
UIM_CLK	32	1.8V	UIM Clock signal
UIM_DATA	34	1.8V/2.85V	UIM Data signal
UIM_PWR	36	1.8V/2.85V	Power source for UIM
SIM_DETECT	66	1.8V	This is an indication to the modem to detect the SIM insertion/removal. It is usually connected to the SIM reader SW pin and is card type dependent

3.2.1. SIM Design Recommendations

(1) It's recommended to take Electrostatic Discharge (ESD) protection measures near the USIM card socket.
(2) The USIM socket shall be placed near the NGFF interface. The length of the traces shall not exceed 100mm.
(3) The SIM_DECECT signal is used to detect the insertion of and removal of SIM card from SIM socket.
With a Normal Short SIM Card Connector, PUSH-PUSH type, the detect switch is normally shorted to the ground when no SIM card is inserted.
    a. When SIM card in inserted the SIM_DETECT shall transition from Logic 0 state to Logic 1 state. The rising edge shall indicate the insertion of SIM card.
    b. When SIM card is removed from the socket the SIM_DETECT shall transition from Logic 1 state and Logic 0 state. The falling edge shall indicate the removal of SIM card.
    c. This signal shall treat the rising or falling edge or actual logic state as an interrupt. Once triggered the LN940 WWAN M.2 module shall act accordingly.

(4) The UIM_PWR shall be turn ON 2 seconds after the SIM_DETECT pin is asserted to High. This mechanism is to ensure the power is not turned ON before the SIM card is not seated well.

Figure 3.2.1 USIM Design Recommendation



3.3. System Control Interface

The system control interface is used to control the power-up and reset of the WWAN M.2 Module. There are additional control signals to disable the radio, drive the LED as status indicator, an output to wake up the host and an input trigger for body SAR

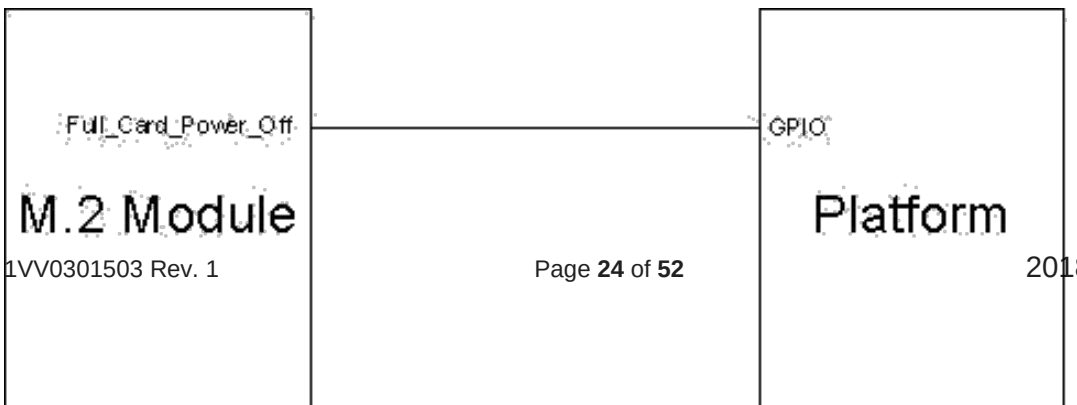
3.3.1. Power On & Reset

The host platform has two signals to power on/off and reset the WWAN M.2 module

Table 3.3-1 Power On & Reset Interface

Signal Name	Pin	Voltage Level	Description
FULL_CARD_POWER_OFF	6	3.3 V or 1.8V	This is an “Active Low” pin. When the state is **“Low”** the M.2 module powers off, internally pulled down by 100K ohm resister. When the state is “High” the M.2 module powers on and it should be 3.3 V tolerant. Also, 1.8V is supported as well.
RESET#	67	1.8V	Asynchronous RESET# pin is an “Active Low” pin. Whenever this active the M.2 module will immediately be taken and placed in the Power On reset condition. M.2 Module is NOT recommended to activate this pin unless there is a critical failure or all other approaches of regaining control and/or communication with M.2 Module have failed. It is recommended to install **one capacitor (10-100pF)** close to the M.2 module pin.

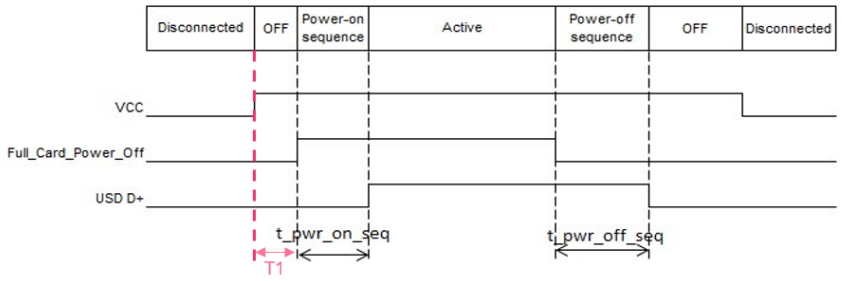
The design to the host is recommended as below,



3.3.1.1. Power On

Typical Power on timing parameters:

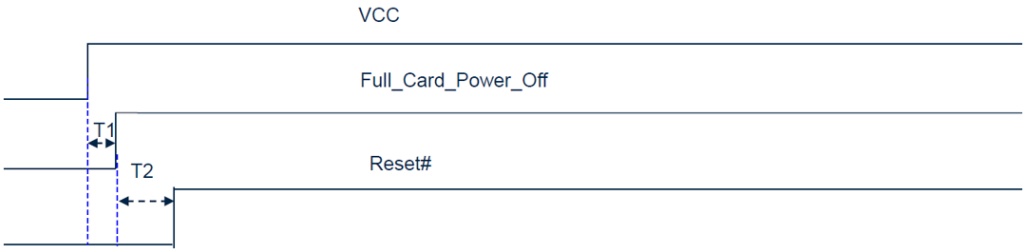
Parameter	Description	Time	Specification
t_pwr_on_seq	Power valid to USB D+ Double enumeration	589ms	<1s
t_pwr_on_seq	Power valid to USB D+ Single enumeration	7.772s	<10s



T1>0ms, as short as possible

PIN6 and Reset# when Power ON Timing:

Parameter	Description	Time
T1	Power valid to Full_Card_Power_Off	T1>0ms, as short as possible
T2	Full_Card_Power_off valid to Reset#	T2>0ms, as short as possible

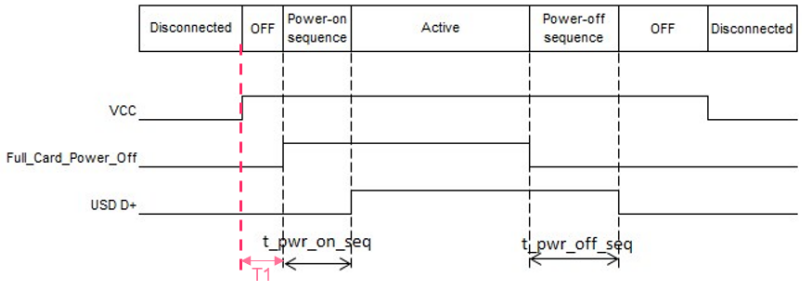


3.3.1.2. Power OFF

Typical Power off timing parameters:

Parameter	Description	Time	Specification
t_pwr_off_seq	Power valid to USB D+	7.146s	<20s

The time is measured at 7.146 seconds in which no USB data is detected between module and host. In addition It may take up to another 10 seconds to complete the graceful module shutdown. In other words it takes first 7 ~10 seconds to clear up all the USB data and then takes the 2nd 10 seconds to complete the graceful shutdown process. 20 seconds in total to complete entire power-off sequence.



T1>0ms, as short as possible

3.3.1.3. Power RESET

The host can assert FULL_CARD_POWER_OFF (PIN6) low for more than 500ms, follow by pulling it HIGH to reset modem. This should be final resort because this is a force shutdown follow by recovery procedure.

Pulling FULL_CARD_POWER_OFF back to HIGH is powering back M.2 module and the timing will follow the power up sequence documented in previous section.

Notice: AT command “AT+reset” is to totally reboot the module, so it needs more time to boot the module, it will be suggested to use 90 seconds.

(At least, boot up from power-on needs 25 seconds + 15 seconds for 1st camp on the network, but if in “no service area”, it needs more time to search and register network)

3.3.2. Host Radio Disable Operation

Two additional control signals are used to disable the radio on the module. The signal W_DISABLE#1 is allowed to disable the WWAN of and the signal W_DISABLE#2 is allowed to disable the GPS of LN940 M.2 Module in order to meet public safety regulations or when otherwise desired implementation of this signal is required for systems and all add-in card that implement frequency capabilities.

Table 3.3.2 Host Radio Disable Interface

Signal Name	Pin	Voltage Level	Description

W_DISABLE#1	8	3.3V	This is an “Active Low” pin to disable the **WWAN** radio of LN940 M.2 Module. When the state is **“Low”** the M.2 module radio can be disabled and made incapable of transmitting. When the state is **"High"** the radio transmitter is to be made capable of transmitting, internally pulled up. The radio can also be toggled by software (AT commands).
W_DISABLE#2	26	3.3V	This is an “Active Low” pin to disable the **GPS** radio of LN940 M.2 Module. When the state is **“Low”** the M.2 module radio can be disabled and made incapable of transmitting. When the state is **"High"** the radio transmitter is to be made capable of transmitting, internally pulled up. The radio can also be toggled by software (AT commands).

3.3.3. LED Interface – Status Indicator

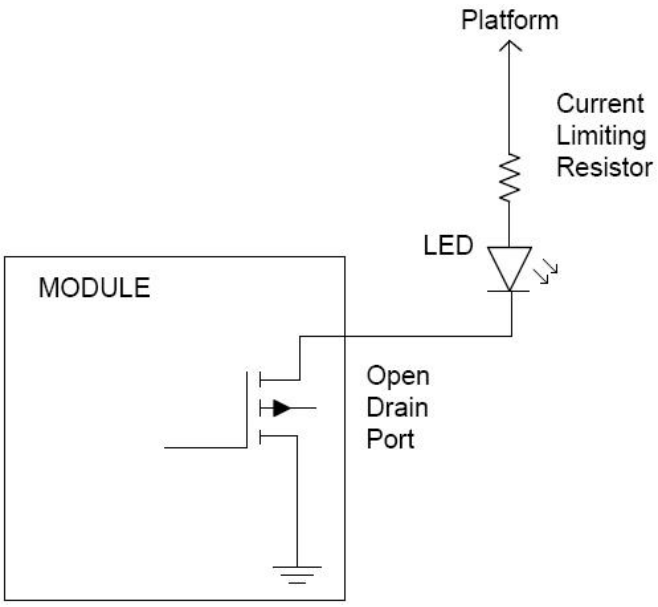
The LED signal is provided to enable add-in card to provide the RF status indications to users via system-provided indicators.

Table 3.3.3 Status LED Interface

Signal Name	Pin	Voltage Level	Description

LED#1 (OD)	10	3.3V	This is an “Active Low” output signal intended to drive system-mounted LED indicators. When the state is **“Low”** the LED is lit to indicate radio capable of transmitting. When the state is **“High”** the LED is NOT lit to indicate radio incapable of transmitting.

Figure 3.3.3 LED-to-host Design recommendation



3.3.4. Wake on WWAN Signal

An output signal is available to wake the host platform, WAKE_WWAN#. This is an active, open drain output, requiring a pull-up resister on the host side.

Table 3.3.4 Wake on WWAN Interface

Signal Name	Pin	Voltage Level	Description

Wake_WWAN#(OD)	10	1.8V	This is an “Active Low”, “Open Drain” output signal, used to wake the host

When the LN940 M.2 WWAN module is about to wake host an one second low pulse

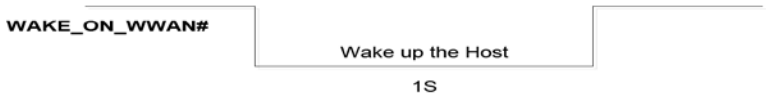
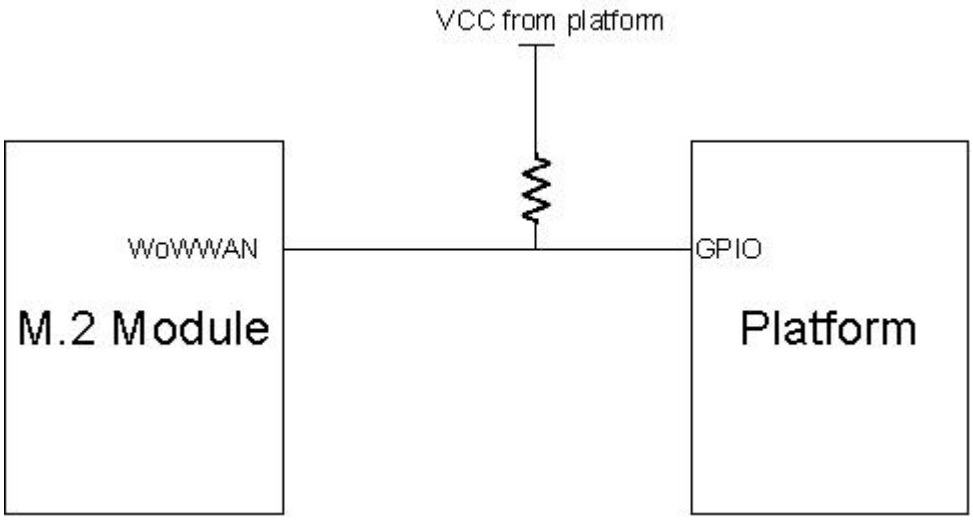


Table 3.3.4 host side design recommendation



3.3.5. Dynamic Power Reduction

With the SAR (Specific Absorption Rate) regulatory requirement met for the design of Tablets and Ultrabooks in which the antenna is in the base of the unit the DPR# is available to trigger the reduction of radio transmit power.

The signal to DPR# is provided to trigger by the proximity sensor of the host.

The required value of the transmit power reduction may vary by different host designs. The assertion and deassertion of DPR is asynchronous to any system clock. All transients resulting from the proximity sensor is required to de-bounce by system circuitry.

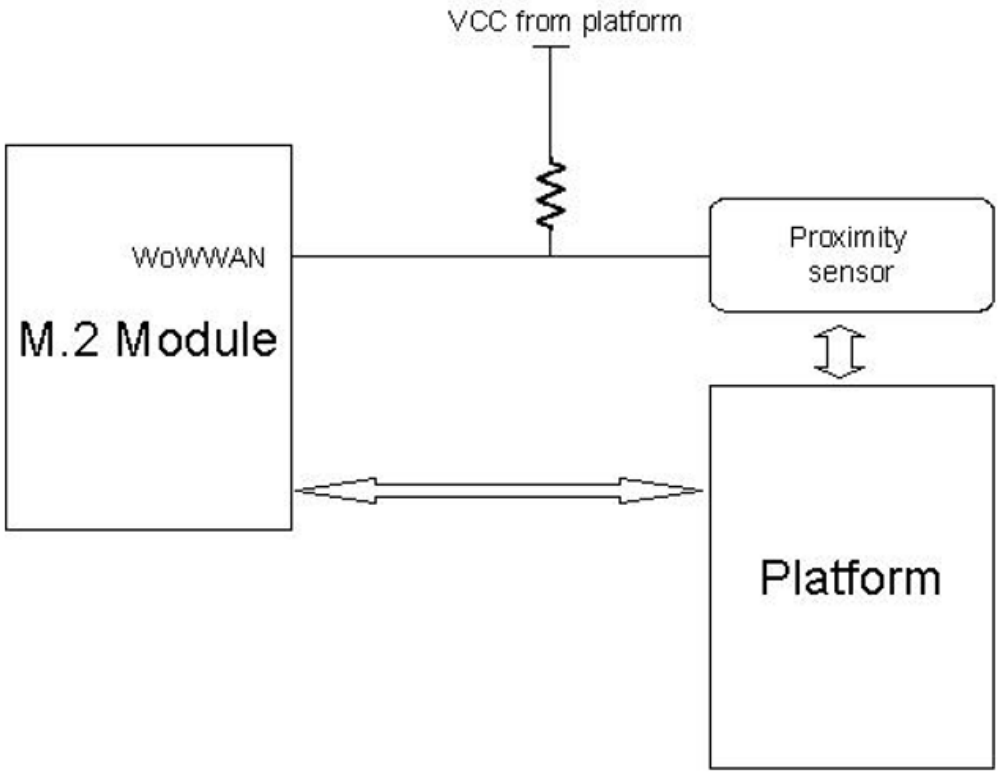
In conjunction with the DPR signal a full power control tool is available to the host to adjust the RF transmit power level of LN940 WWAN M.2 Module.

The DPR pin has 10Kohm pull-up resister on the LN940 WWAN M.2 Module.

Table 3.3.5 DPR interface

Signal Name	Pin	Voltage Level	Description
DPR#	25	3.3V	This is an **"Active Low",** input signal. When the state is **"Low"** the SAR power back off is enabled. When the state is **"High"** the SAR power back off is disabled, internally pulled up.

Figure 3.3.5 DPR on host design recommendation



3.4. Tunable Antenna Interface

In the notebook platforms since the WWAN antennas are usually located on the top of the lid there is a long RF mini-coax cable that can be up to 60cm long between the antennas and the WWAN M.2 module. It's preferred to use switches/tunable components directly on the antenna for antenna band switching or tuning for efficiency improvement.

Four GPIO pins are available on the host interface that can be connected to an external antenna switch, to load the antenna with different impedances, and to configure the different frequency responses for the main antenna

Table 3.4-1 Tunable Antenna GPIO interface

Signal Name	Pin	Voltage Level	Description
ANTCTL0	59	1.8V	Antenna Control 0
ANTCTL1	61	1.8V	Antenna Control 1
ANTCTL2	63	1.8V	Antenna Control 2
ANTCTL3	65	1.8V	Antenna Control 3

Alternatively two MIPI signals are also available to configure the external antenna tuner.

Table 3.4-1 Tunable Antenna MIPI Interface

Signal Name	Pin	Voltage Level	Description
MIPI_CLK	56	1.8V	MIPI Clock
MIPI_DATA	58	1.8V	MIPI Data

The SW tool is available configure the table of antenna tuner parameters.

3.5. In-Device Coexistence Interface

As more and more radios are added to notebook and tablet the source of RF interference increases significantly as multiple radios will have overlapping transmissions and receptions. This problem will increase further as overlapping bands continue to be rolled out. WLAN, BT, WWAN will all use overlapping bands, ranging from 2300Mhz to 2600Mhz.

In-Device Coexistence is a feature which improves the user experience and maximizes throughput and QoS of connectivity systems (WLAN, BT and GNSS) when these radios are simultaneously running with the WWAN M.2 LTE modem.

These three COEX interfaces are provided to implement In-device wireless coexistence solution.

Table 3.5 In device coexistence Interface

Signal Name	Pin	Voltage Level	Description
COEX3	60	1.8V	LTE_ACTIVE (COEX_TXD)
COEX2	62	1.8V	LTE_FRAME_SYNC (COEX_RXD)
COEX1	64	1.8V	LTE_ACTIVE (COEX_TXD)

3.6. Power Supply Interface

The WWAN M.2 Module requires the host to provide the 3.3V power source.

The 3.3V power and ground pins are listed in Table

Table 3.6 Power supply Interface

Power Pins	Description
2, 4, 70,72, 74	3.3V
3, 5, 11, 27, 33, 39, 45, 51, 57, 71, 73	Ground

3.7. Configuration Pins

There are 4 Configuration pins on the WWAN M.2 Module to assist the host identifying the presence of an Add-In card in the socket.

All configuration pins can be read and decoded by the host platform to recognize the indicated module configuration and host interface supported.

Table 3.7 configuration Interface

Item	Module Configuration Decode				Module Type	Port Configuration
Signal Name	CONFIG_0	CONFIG_1	CONFIG_2	CONFIG_3	WWAN-USB3.0	0
Pin	21	69	75	1		
State	GND	GND	GND	GND		

3.8. Antenna Interface

The M.2 module has two antenna connectors to support a Tx/PRx antenna and a secondary antenna that will be multiplexed between the diversity receiver and GNSS receiver.

The antenna signals are not available at the host interface but have their own connectors.

4. OPERTAING ENVIRONMENT

Table 6 Recommended Operating Conditions

Parameter	Min.	Typical	Max.
Storage Temperature	-30°C	25°C	85°C
Recommended Operating Temperature (3GPP Compliant)	-10°C	25°C	55°C
Restricted Operating Temperature (*1) (Operational, non-3GPP Compliant)	-20°C	25°C	70°C
Extendable (with Limited Performance)(*2)	-40°C	N/A	85°C
Operating Voltage	**3.135 V**	**3.3V**	**4.4V**

(*1) Restricted Operation allows normal mode data transmission for limited time until automatic thermal shutdown takes effect. Within the restricted temperature range (outside the operating temperature range) the specified electrical characteristics may be increased or decreased

(*2) A tolerance on the sated shutdown threshold may occur. The deviation is in the range of +/-2°C at the limits of over temperature and under temperature.

It may damage the M.2 Module when it is being operated under the condition beyond its absolute maximum ratings (Table 7-1). 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.

5. POWER DELIVERY REQUIREMENTS

5.1. Electrical Parameters (3.3 V Power Supply)

M.2 Module utilizes a single regulated power rail of 3.3V provided by the host platform.

Parameter	Min.	Typical	Max.	Units
Operating Voltage	3.135*	3.3	4.4	Vcc

(*) The minimum voltage supplied to M.2 module by the host platform has to be 3.135 V. With voltage supplied below 3.135 V the M.2 module may shut off abnormally and the RF performance cannot be guaranteed.

5.2. Power Consumption

USE Scenario	Targeted Value (Typical)	Targeted Value (Max)
WCDMA in Suspend mode	<5mA	
WCDMA (Tx=24dBm)	<800mA	<1500mA
LTE in Suspend mode	<5mA	
LTE (16QAM) Tx=23 dBm	<900mA	<1200mA
LTE CA Mode, Tx=23dBm	<1100mA	<2200mA
GPS/GNSS Tracking	<150mA	<300mA
Connected Standby	<3mA	
Radio Off	<3mA	

6. OTHER REQUIREMENTS

6.1. Conducted Transmit Power

Table 8-4 Maximum Conducted Transmit Power

(ACLR > 5dB margin @room temperature)

Condition	Operating Bands	Tx 3GPP Standard	Tx Manufacturing Requirement
E-UTRA Class 3	1,2,3(9),4,5,(18/19/26),7/8/ 12(17)/13/20/21/25/28/29/30/ 38/39/40/41	23dBm +/- 2dB	23dBm +/- 1dB
W-CDMA Class 3	1,2,4,5,8	24dBm +1.7/-3.7dB	23.5dBm +/-1dB

6.2. Receiver Sensitivity

Table 8-5 Minimum Conducted Receiver Sensitivity (10Mhz LTE BW)

LTE Band	PRx (dBm)	DRx (dBm)	MIMO Combined (dBm)	3GPP, MIMO Combined (dBm)
1	-97.5	-97	-100	-95
2	-98	-97	-100	-95
3	-98.5	-97	-100	-94
4	-97	-97	-100	-97
5	-99	-100	-102	-95
7	-98.5	-97	-100	-95
8	-99.5	-99.5	-102.5	-94
12	-99	-99	-102	-94
13	-99	-98.5	-101.5	-94
17	-99	-99	-102	-94

18	-99	-99	-102	-97
19	-99	-99	-102	-97
20	-99	-98.5	-101.5	-94
21	-98	-98	-101	-97
25	-98	-97	-100	-93.5
26	-99	-99	-102	-94.5
28	-98.5	-99	-101	-95.5
29	-98	-98	-101	-94
30	-97	-96.5	-100	-97
38	-97.5	-97	-100	-97
39	-98	-98	-100	-97
40	-97	-97	-100	-97
41	-97.5	-96	-99	-96
66	-97	-97	-100	-96.5

Table 8-5-2 Minimum Conducted Receiver Sensitivity (WCDMA)

WCDMA Band	PRx (dBm)	DRx (dBm)	MIMO Combined (dBm)	3GPP, MIMO Combined (dBm)
1	-109	-109	-112	-106.7
2	-109	-109	-112	-104.7
4	-109	-109	-112	-106.7
5(6/19)	-110	-110	-113	-104.7
8	-110	-110	-113	-103.7

6.3. Antenna Recommendations

The antenna elements are typically intergraded into the notebook and tablet with connection to LN940 WWAN M.2 module by flexible RF coaxial cables.

Type of two RF antenna receptacles of LN940 WWAN M.2 module is MHF – MAIN port is for primary transmitter and receiver and AUX port is for diversity receiver and GNSS.

To assure the RF performance the following antenna guidance shall be followed by platform designers.

Table 8.6-1 Main Antenna Design Guideline

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

Table 8.6-2 Aux Antenna Design Guideline

Parameter	Description
Gain	Maximum gain and uniform coverage in high angle elevation and zenith. Gain in the azimuth is not desired
Average 3D Gain	It has to be greater than 5dBi
VSWR	Typical Value has to be less than 3:1
Isolation (Diversity/AUX to MAIN)	It has to be greater than 10dB in all related bands
Polarization	Any

6.4. GNSS Sensitivity

Table 8-7 Minimum Conducted Receiver Sensitivity (GNSS)

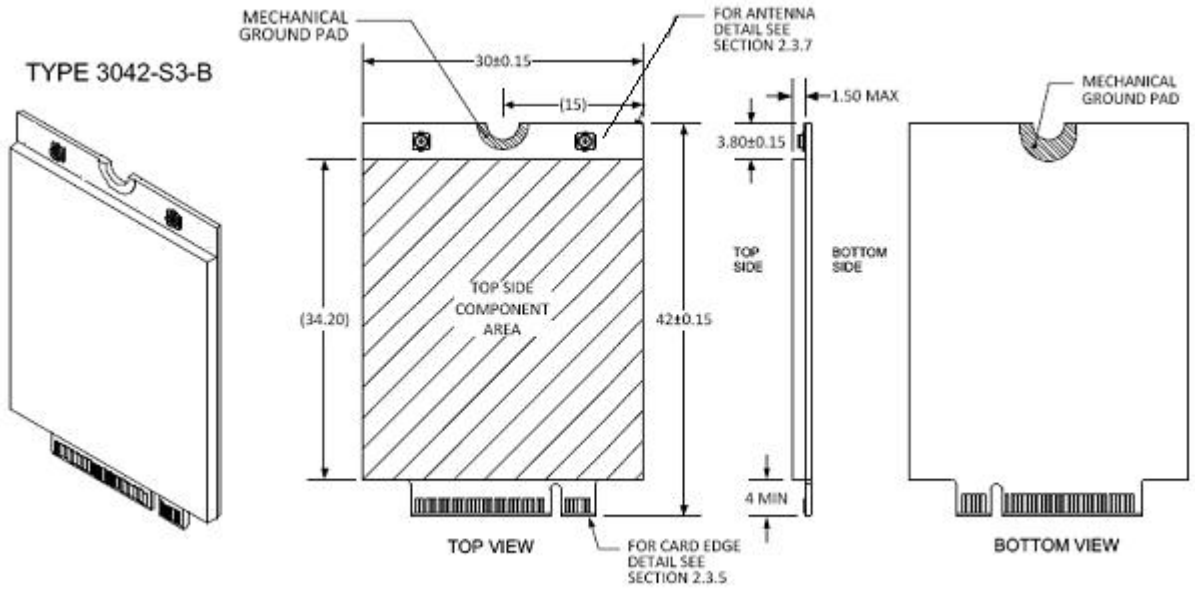
GNSS	Design Requirement (dBm)
Tracking Sensitivity	-152

7. WWAN CARD TYPE 3042

7.1. Mechanical Dimension

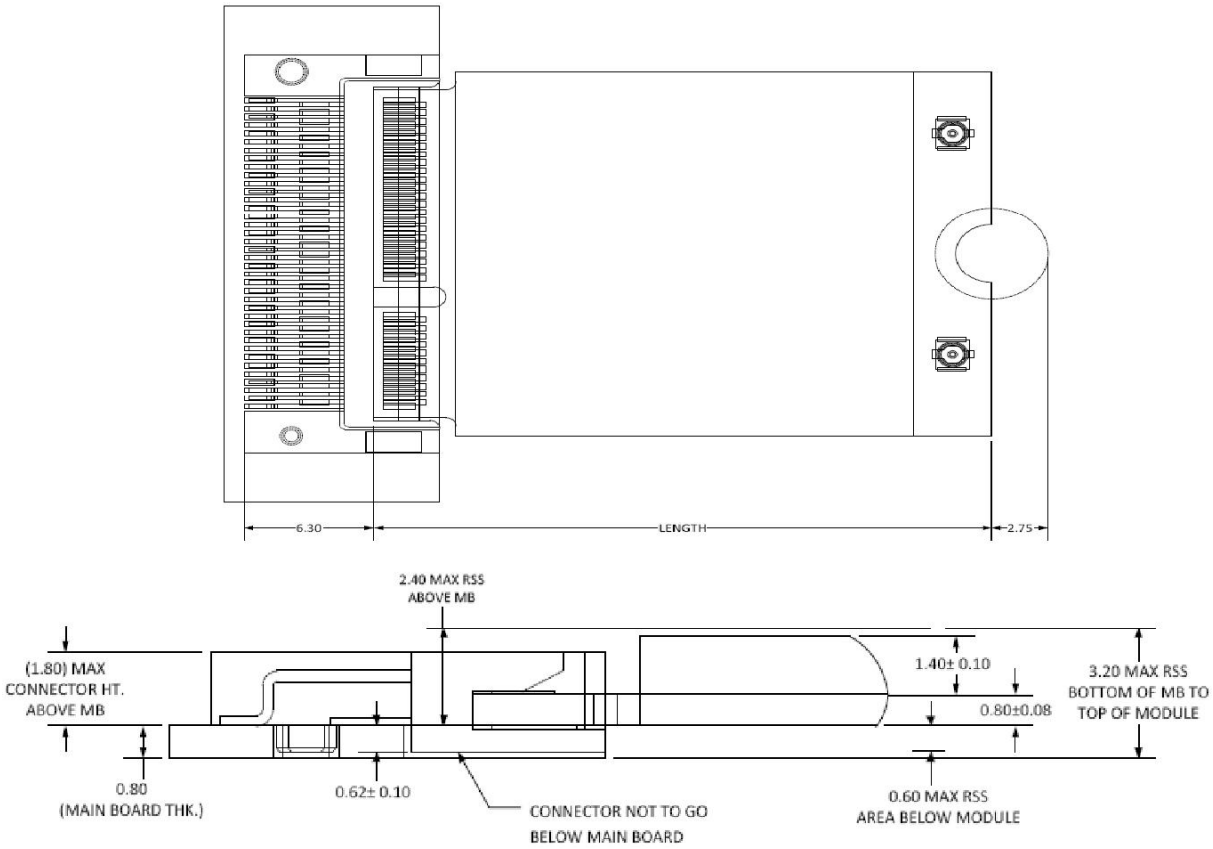
LN940 WWAN M.2 module is compatible with the PCI Express M.2 specification.

Figure Mechanical Dimension



7.2. LN940 WWAN M.2 Module Assembly

Figure Stackup Mid-Line (In-Line) Single Sided Module

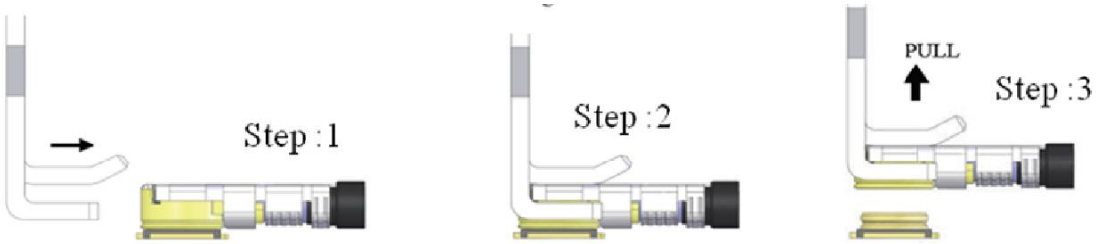


(1) 2.4mm maximum above motherboard
(2) Cut area of main board under M.2 module
(3) Need to ad thermal pad between M.2 Module and mechanical component for thermal dissipation

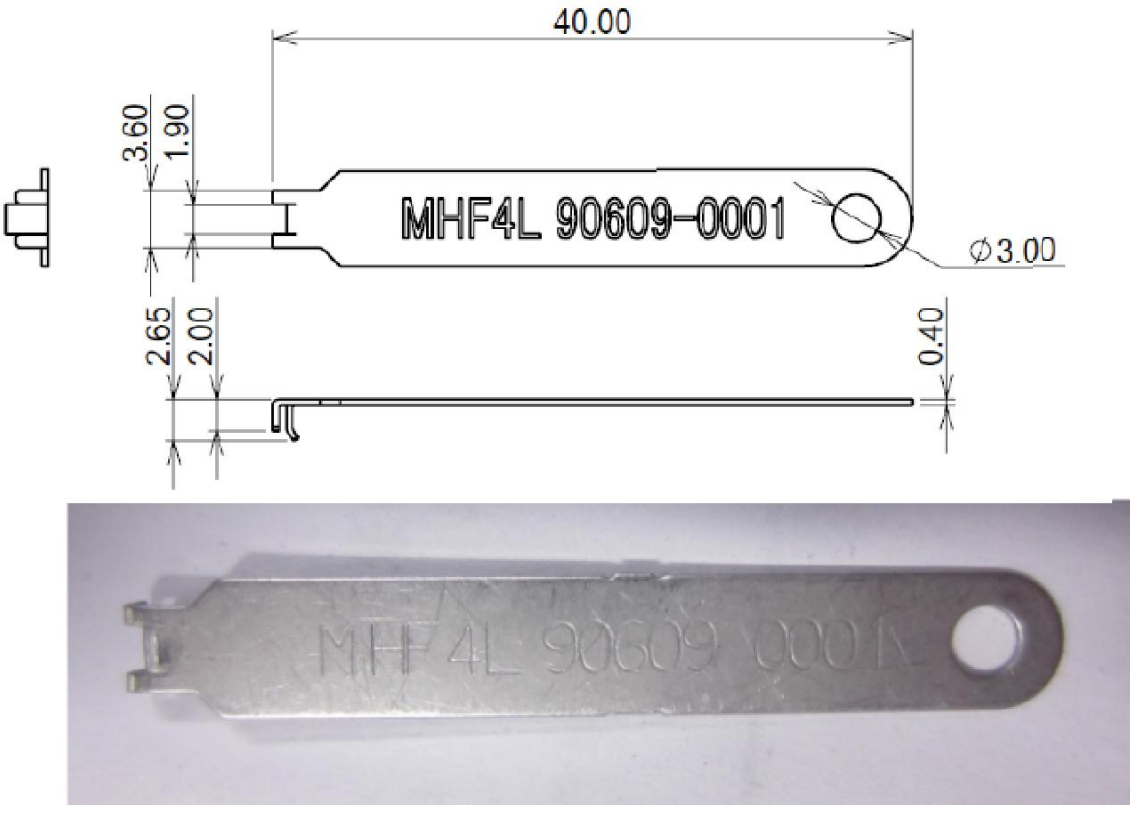
7.3. Antenna Connector Assembly

(1) Mating the connector vertically as much as possible. Adjusting the mating axis of plug and receptable. Do NOT slant mate.

(2) Unmating: In case of unmating by pulling gadget (see below). Pulling plug in vertical direction.



(3) Pulling Gadget is shown below (Unit: mm)



7.4. Antenna Connector Locations

Figure Antenna Connector Location

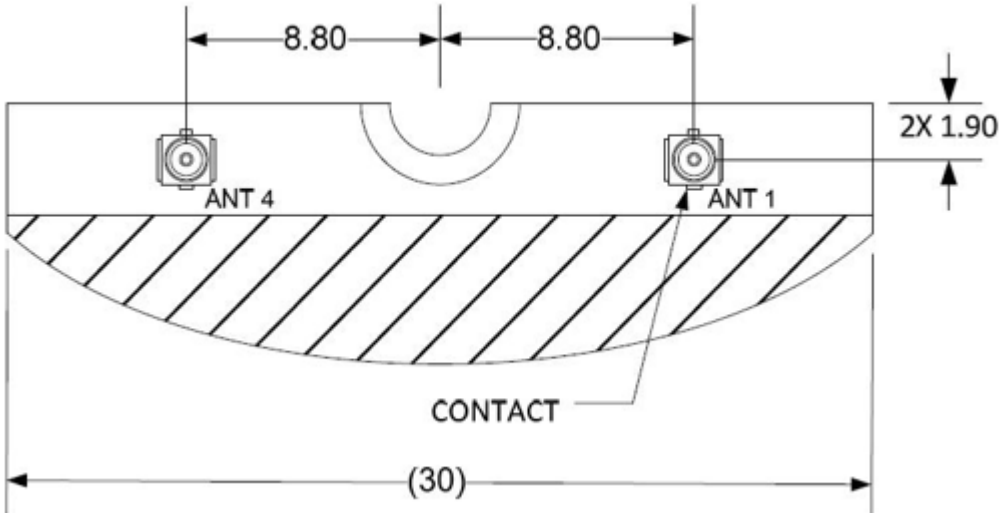


Table Antenna Connector Assignment

Antenna	Interface
0	N/A
1	WWAN Main TX/RX
2	N/A
3	N/A
4	WWAN AUX RX/GNSS
5	N/A

Figure. RF Connector Specification

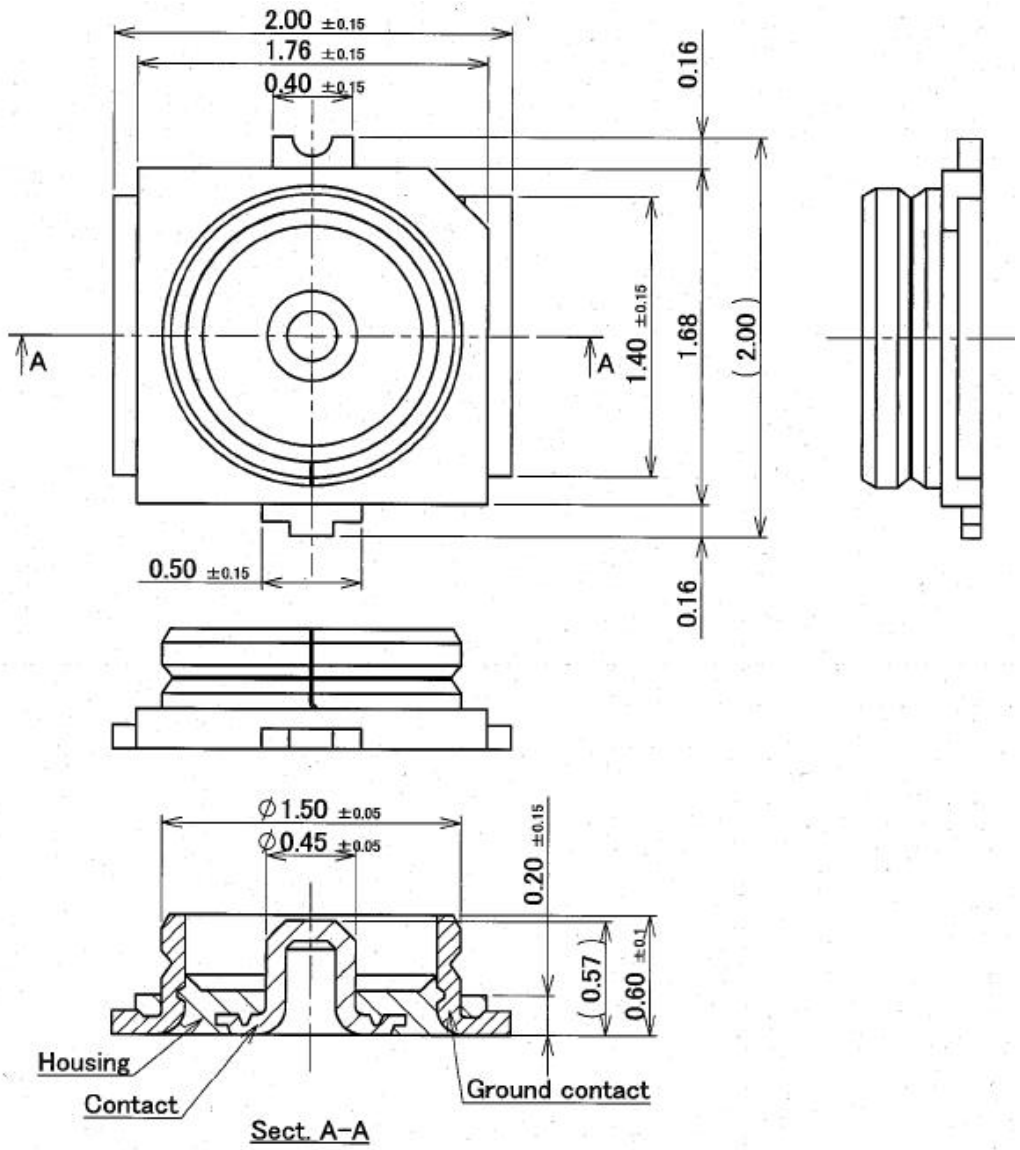
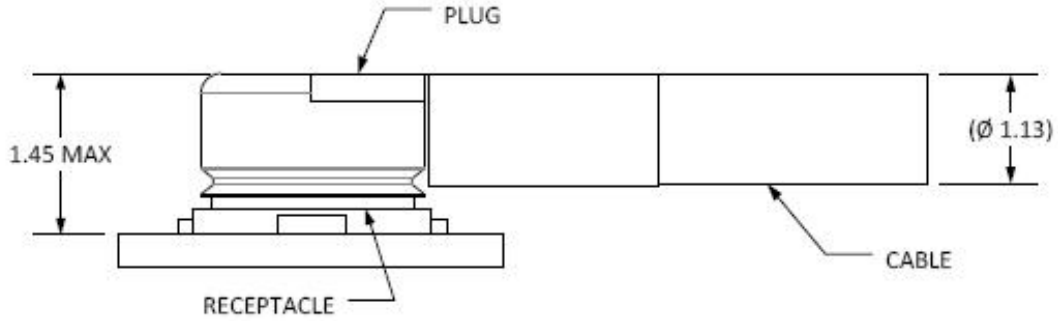


Figure RF Receptacles Specification



Mated Plug for Ø 1.13 mm Coax Cable

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
0.1	2017-01-13	First issue (Preliminary)
1	2017-06-26	RF sensitivity updated, CA configurations updated
1.1	2017-10-25	CA configurations updated, power consumption data updated
1.2	2018-02-12	Add the power-on/ power-off/ reset/ AT+reset restrictions to chapter 3.3.1

SUPPORT INQUIRIES

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

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