



RML-N1t LGA Module User Manual



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1. Foreword

1.1 Introduction

This document describes the hardware of the COMPAL® 5G RML-N1t LGA Module products. It helps you quickly retrieve interface specifications, electrical and mechanical details, and information on the requirements to be considered for integrating further components.

1.2 Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating with 5G RML-N1t LGA module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, Compal assumes no liability for customers' failure to comply with these precautions.



Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a hands free kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.



Switch off the cellular terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If the device offers an Airplane Mode, then it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on boarding the aircraft.



Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.



Cellular terminals or mobiles operating over radio signals and cellular network cannot be guaranteed to connect in all possible conditions (for example, with unpaid bills or with an invalid (U) SIM card). When emergent help is needed in such conditions, please remember using emergency call. In order to make or receive a call, the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength.



The cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.



In locations with potentially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potentially explosive atmospheres include fueling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders, etc.



2. Overview

2.1 Introduction

The RML-N1t devices are WWAN LGA module in size 45x45mm. The LGA module and device software combination deliver multiband, multimode WWAN connectivity in a single hardware configuration. RML-N1t supports NR FR1 (sub6) n25/ n41/ n48/ n66/ n71/n77, LTE Band 2/ 4/ 5/ 12/ 25/ 41/ 48/ 66/ 71. The RML-N1t devices also have an internal GPS receiver that can operate standalone or in simultaneous operation with its WWAN radios.

The RML-N1t device uses Mediatek chipset components. It implements the 5G NR standard for sub-6 GHz bands. The MT6195 device is a highly-integrated multimode, multiband RF CMOS transceiver IC that interfaces with the MT6890 device through IQ interface, it is the integrated single-chip RFIC that supports 5G NR sub-6 together with 4G LTE.

RML-N1t and supported features for the NR FR1, Duplex mode: FDD (Frequency Division Duplex) and TDD ((Time Division Duplex)). MIMO (Multi-input Multi-output) capability: up to 4x4 DL MIMO; CA (Carrier Aggregation) capability: DLCA: inter-band, intra-band contiguous and intra-band non-contiguous DLCA; ULCA: inter-band. Modulation: UL: 256QAM; DL: 256QAM. Waveform: UL: CP-OFDM and DFT-S-OFDM; DL: CP-OFDM.

As for LTE, RML-N1t supports both FDD and TDD mode, MIMO capability: up to 4x4 DL MIMO, and 2x2 UL MIMO. CA capability: DLCA: inter-band, intra-band contiguous and intra-band non-contiguous DLCA; ULCA: inter-band and intra-band contiguous ULCA. Modulation: UL: 256QAM; DL: 256QAM



2.2 Trace Design

EA3_6 EA1_5

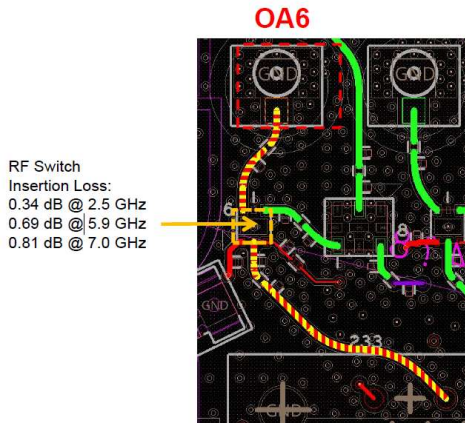


ANT6_CARKIT
ANT5_CARKIT

ANT4_CARKIT
ANT3_CARKIT

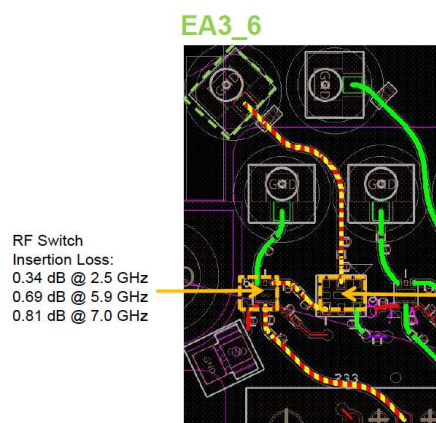
ANT2_CARKIT
ANT1_CARKIT

ANT0_CARKIT



RF Switch
Insertion Loss:
0.34 dB @ 2.5 GHz
0.69 dB @ 5.9 GHz
0.81 dB @ 7.0 GHz

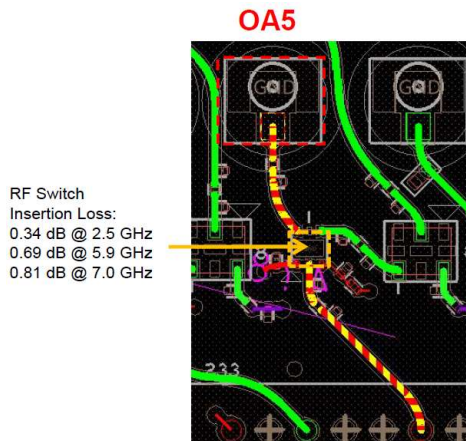
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Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4



RF Switch
Insertion Loss:
0.34 dB @ 2.5 GHz
0.69 dB @ 5.9 GHz
0.81 dB @ 7.0 GHz

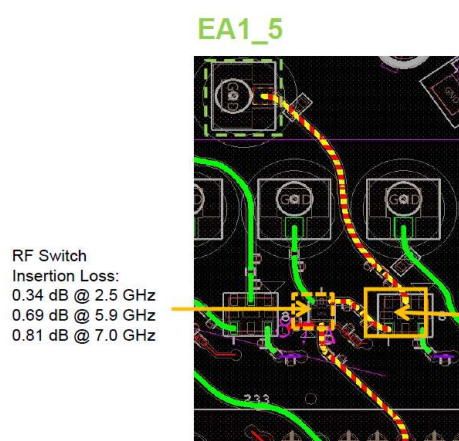
Diplexer
Insertion Loss:
0.40 dB max. @ 698 ~ 960 MHz
0.45 dB max. @ 1427 ~ 1511 MHz
0.45 dB max. @ 1710 ~ 2170 MHz
0.65 dB max. @ 2300 ~ 2496 MHz
0.85 dB max. @ 2496 ~ 2690 MHz
0.85 dB max. @ 3400 ~ 3600 MHz
0.75 dB max. @ 3600 ~ 3800 MHz
0.65 dB max. @ 5150 ~ 5850 MHz

Trace Length: 1114.91mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4



RF Switch
Insertion Loss:
0.34 dB @ 2.5 GHz
0.69 dB @ 5.9 GHz
0.81 dB @ 7.0 GHz

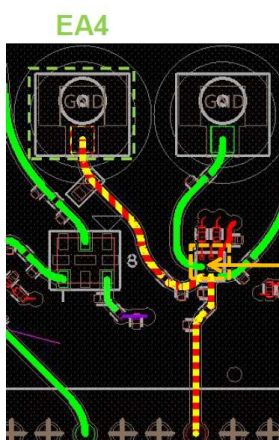
Trace Length: 495.74mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4



RF Switch
Insertion Loss:
0.34 dB @ 2.5 GHz
0.69 dB @ 5.9 GHz
0.81 dB @ 7.0 GHz

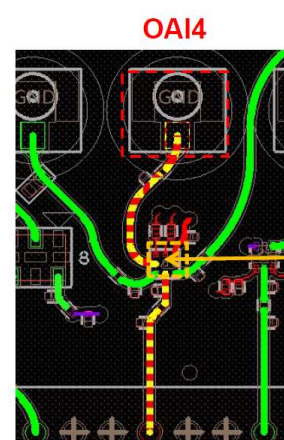
Diplexer
Insertion Loss:
0.40 dB max. @ 698 ~ 960 MHz
0.45 dB max. @ 1427 ~ 1511 MHz
0.45 dB max. @ 1710 ~ 2170 MHz
0.65 dB max. @ 2300 ~ 2496 MHz
0.85 dB max. @ 2496 ~ 2690 MHz
0.85 dB max. @ 3400 ~ 3600 MHz
0.75 dB max. @ 3600 ~ 3800 MHz
0.65 dB max. @ 5150 ~ 5850 MHz

Trace Length: 1048.39mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4



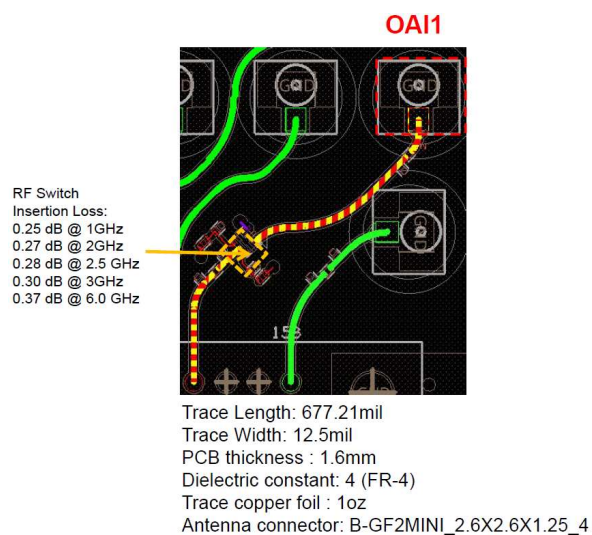
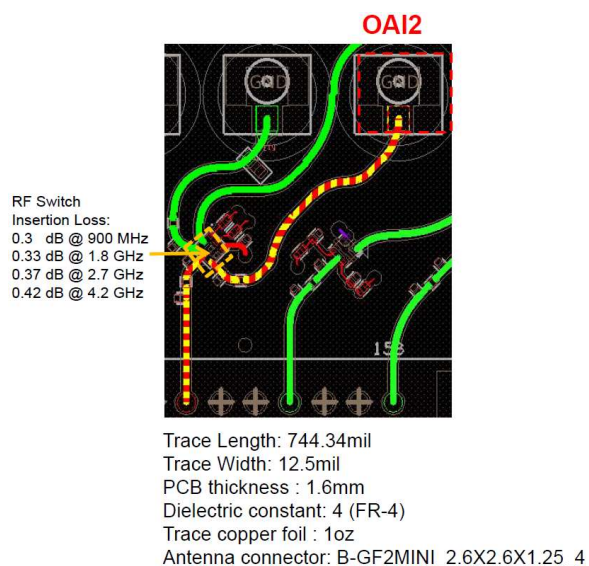
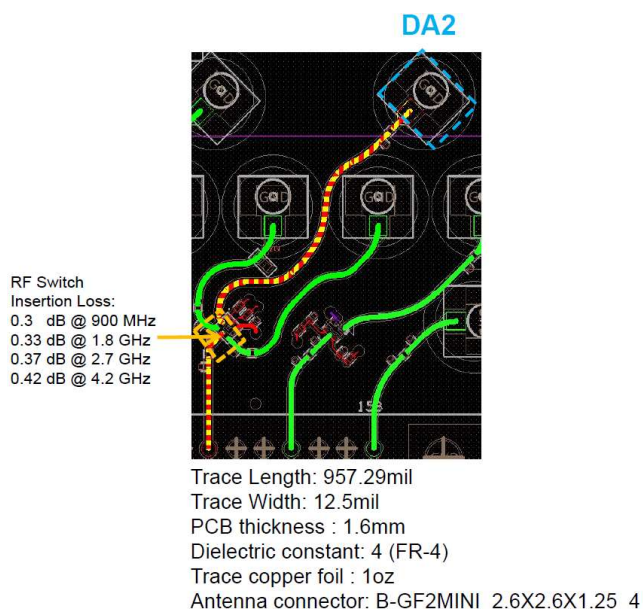
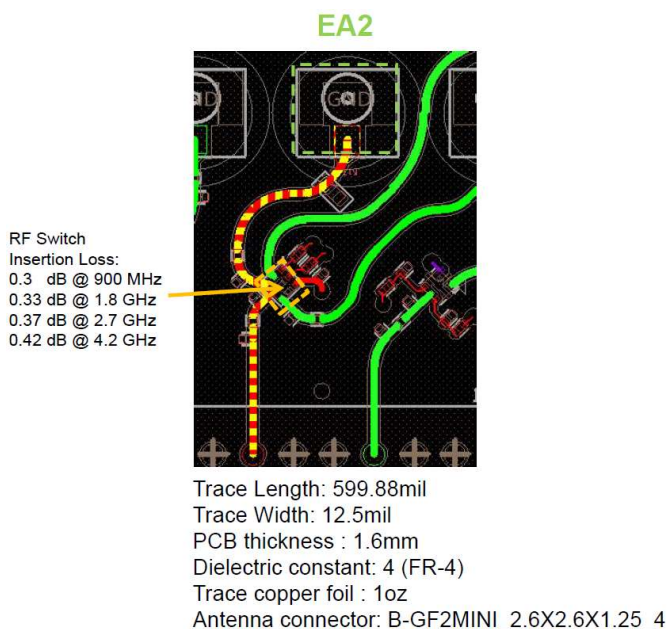
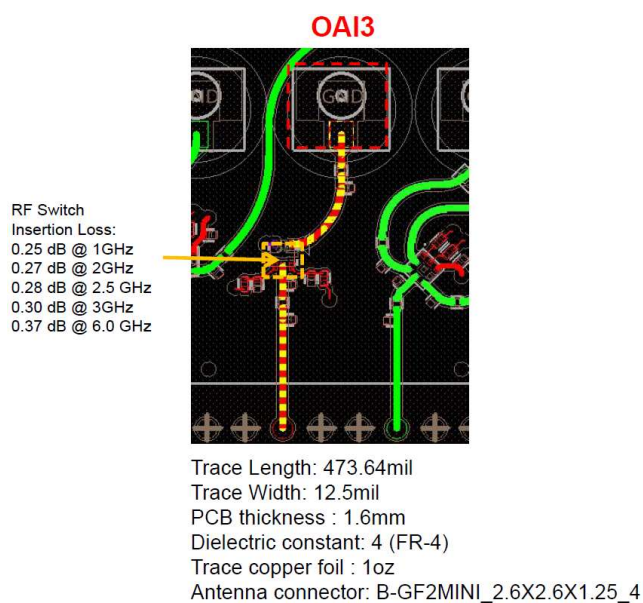
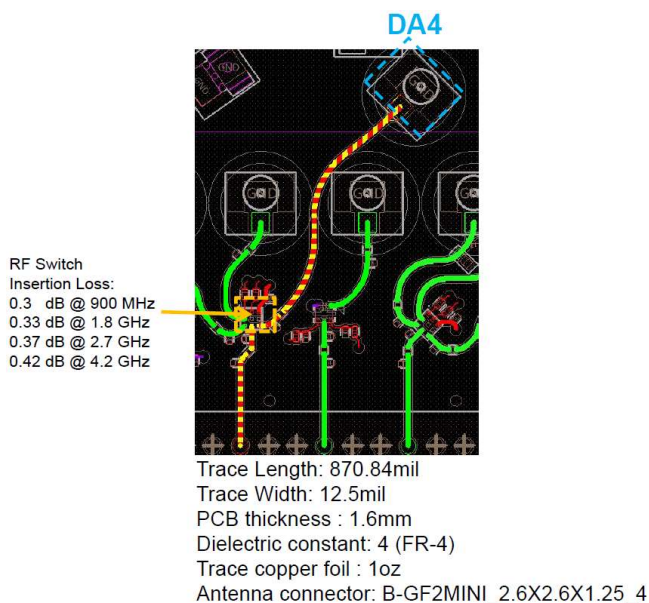
RF Switch
Insertion Loss:
0.3 dB @ 900 MHz
0.33 dB @ 1.8 GHz
0.37 dB @ 2.7 GHz
0.42 dB @ 4.2 GHz

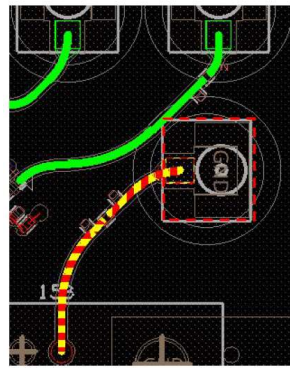
Trace Length: 605.85mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4



RF Switch
Insertion Loss:
0.3 dB @ 900 MHz
0.33 dB @ 1.8 GHz
0.37 dB @ 2.7 GHz
0.42 dB @ 4.2 GHz

Trace Length: 516.13mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4





OAI0

Trace Length: 360.36mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4

EA1-5



Trace Length: 857.28mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4

Trace Length: 870.51mil
Trace Width: 7.1mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4

RF Switch
Insertion Loss:
0.25 dB @ 1GHz
0.27 dB @ 2GHz
0.28 dB @ 2.5 GHz
0.30 dB @ 3GHz
0.37 dB @ 6.0 GHz

Diplexer
Insertion Loss:
0.40 dB max. @ 698 ~ 960 MHz
0.45 dB max. @ 1427 ~ 1511 MHz
0.45 dB max. @ 1710 ~ 2170 MHz
0.65 dB max. @ 2300 ~ 2496 MHz
0.85 dB max. @ 2496 ~ 2690 MHz
0.85 dB max. @ 3400 ~ 3600 MHz
0.75 dB max. @ 3600 ~ 3800 MHz
0.65 dB max. @ 5150 ~ 5850 MHz

EA3-6



Trace Length: 845.81mil
Trace Width: 12.5mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4

Trace Length: 673.33mil
Trace Width: 7.1mil
PCB thickness : 1.6mm
Dielectric constant: 4 (FR-4)
Trace copper foil : 1oz
Antenna connector: B-GF2MINI_2.6X2.6X1.25_4

Diplexer
Insertion Loss:
0.40 dB max. @ 698 ~ 960 MHz
0.45 dB max. @ 1427 ~ 1511 MHz
0.45 dB max. @ 1710 ~ 2170 MHz
0.65 dB max. @ 2300 ~ 2496 MHz
0.85 dB max. @ 2496 ~ 2690 MHz
0.85 dB max. @ 3400 ~ 3600 MHz
0.75 dB max. @ 3600 ~ 3800 MHz
0.65 dB max. @ 5150 ~ 5850 MHz

RF Switch
Insertion Loss:
0.25 dB @ 1GHz
0.27 dB @ 2GHz
0.28 dB @ 2.5 GHz
0.30 dB @ 3GHz
0.37 dB @ 6.0 GHz



Transmitting Power

The transmitting power for each band of the RML-N1t Module as shown in the following table:

Table 2-1 LTE FDD/TDD

Mode	Band	Typical Value (dBm)	Note
LTE FDD/TDD	Band 2 (OAI2/DA2/EA2)	23	±2
	Band 4 (OAI2/DA2/OAI4/DA4)	23	±2
	Band 4 (EA2/EA4)	22.5	±2
	Band 5 (OAI0)	23	±2
	Band 12 (OAI0)	23	±2
	Band25 (OAI2/DA2/EA2)	23	±2
	Band 41 (OAI2/DA2/EA2)	24	+1/-2
	Band 48 (OA5)	19.5	+1/-2
	Band 48 (EA1_5)	18	+1/-2
	Band 66 (OAI2/DA2/OAI4/DA4)	23	±2
	Band 66 (EA2/EA4)	22.5	±2
	Band 71 (OAI0)	23	±2

Table 2-2 NR-FR1 FDD

Mode	Band	Typical Value (dBm)	Note
NR-FR1 FDD	n25 (OAI2/DA2/EA2/OAI4/DA4/EA4)	23	±2
	n66 (OIA2/DA2/OAI4/DA4)	23	±2
	n66 (EA2/EA4)	22.5	±2
	n71 (OAI0)	23	±2

Table 2-3 NR-FR1 TDD

Mode	Band	Typical Value (dBm)	Note
NR-FR1 TDD	n41 (OAI1/EA1_5/OAI2/DA2/EA2/OAI3/ EA3_6/OAI4/DA4/EA4)	24.2	±2
	n48 (OA5/EA1_5)	18	+1/-2
	n77 (OA5/OAI2/DA2/OA6/OAI4/DA4)	25.8	±2
	n77 (EA1_5/EA2/EA3_6/EA4)	24	±2



2.3 Antennas (Maximum allowable gain)

Table 2-4 Maximum allowable gain

Modulation	Frequency (MHz)	Max. Allowable Antenna Gain (dBi)
LTE Band 2 (OAI2/DA2/EA2)	1850 ~ 1910	8.00
LTE Band 4 (OAI2/DA2/OAI4/DA4)	1710 ~ 1755	5.00
LTE Band 4 (EA2/EA4)	1710 ~ 1755	5.50
LTE Band 5 (OAI0)	824 ~ 849	6.00
LTE Band 12 (OAI0)	699 ~ 716	5.50
LTE Band 25 (OAI2/DA2/EA2)	1850 ~ 1915	8.00
NR n25 (OAI2/DA2/EA2/OAI4/DA4/EA4)	1850 ~ 1915	8.00
LTE Band 41(OAI2/DA2/EA2)	2496 ~ 2690	6.80
NR n41 (OAI1/EA1_5/OAI2/DA2/EA2/OAI3/ EA3_6/OAI4/DA4/EA4)	2496 ~ 2690	6.80
LTE Band 48 (OA5)	3550 ~ 3700	2.50
LTE Band 48 (EA1_5)	3550 ~ 3700	4.00
NR n48 (OA5/EA1_5)	3550 ~ 3700	4.00
LTE Band 66 / NR n66 (OAI2/DA2/OAI4/DA4)	1710 ~ 1780	5.00
LTE Band 66 / NR n66 (EA2/EA4)	1710 ~ 1780	5.50
LTE Band 71 / NR n71 (OAI0)	663 ~ 698	5.00
NR n77 (OA5/OAI2/DA2/OA6/OAI4/DA4)	3300 ~ 3550 3700 ~ 3980	2.20
NR n77 (EA1_5/EA2/EA3_6/EA4)	3300 ~ 3550 3700 ~ 3980	4.00



Table 2-5: Antenna port mapping table---For US band LGA module

Frequency				EA1_5		EA3_6			
				EA2 DA2		EA4 DA4			
		OAI0	OAI1	OAI2	OAI3	OAI4	OA5	OA6	GA7
LB	600-900 MHz	Tx/PRx	DRx		PRx2	DRx2			
MB	1710-2200 MHz		DRx	Tx/PRx	PRx2	Tx ¹ /PRx			
HB	2300-2700 MHz		DRx	Tx/PRx	PRx2	Tx/PRx			
n41	2496-2690 MHz		DRx ⁴	Tx ³ /PRx	PRx2 ⁴	Tx/PRx			
n77	3300-3980 MHz			DRx2 ⁴		PRx2 ⁴	Tx/PRx	Tx ² /DRx	
GPS L1	1575-1610 MHz								Rx
GPS L5	1176 MHz								Rx

Note 1: MB(B4/B66)CA / MB(n25/n66)ENDC

Note 2: n77 UL 2x2 MIMO/ LB + n77 CA

Note 3: n41 UL MIMO

Note 4: n41/n77 support SRS(TX) mode



3. FCC Notice

Model: RML-N1t

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).

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) To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile exposure condition must not exceed:

In the event that these conditions cannot 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 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 authorization.



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.

Module Warning statements

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
- (2) This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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 or more 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.

RF Exposure

This device has been tested and meets applicable limits for Radio Frequency (RF) exposure. The antenna(s) used for this transmitter should be installed and operated with minimum distance 20 cm between the radiator & your body.

Label requirements

Any device incorporating this module must include an external, visible, permanent marking or label which states:

“Contains FCC ID: GKRRMLN1T”