5G RML-N2x Module User Manual

Update date : Oct 15, 2024

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Notice

The document is subject to update from time to time owing to the product version upgrade or other

reasons. Unless otherwise specified, the document only serves as the user guide. All the statements,

information and suggestions contained in the document do not constitute any explicit or implicit guarantee.

Revision History

Version	Date	Name	Major Changes
AA	July 01, 2024	HW V01	First release
AB	Oct 15, 2024	HW V02	● Update Ch.2.1 ● Update Antenna port mapping

Applicability Table

No.	Product model	Description
1	ZLN1	5G RML-N2x: (V01 module) **All relevant LGA HW spec、figures and design guidelines in this document are common specification for All 5G LGA model.**

Noted: Sample testing Scope and intended audience

When module version is Engineering samples (ES) and used in the early stages of development. The means these devices undergo limited testing and sometimes have significant feature limitations. They are suitable to assist with printed circuit board development, to conduct board-level electrical evaluation tests, and to explore manufacturing considerations.

Engineering samples should not be used for product-level & reliability qualification, power consumption optimize, and we also do not provide RMA analysis services on this version samples.

Content

1. Foreword

1.1 Introduction

This document describes the hardware of the COMPAL® 5G LGA Module product. It helps you quickly retrieve interface specifications, electrical and mechanical details, and information on the requirements to be considered for integrating further components. **All relevant LGA HW spec、figures and design guidelines in this document are common specification for All 5G LGA mode.**

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 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, we assume 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 handsfree 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.

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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 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.

Safety of Children

Do not allow children to use the wireless device without guidance. Small and sharp components of the wireless device may cause danger to children or cause suffocation if children swallow the components.

Environment Protection

Observe the local regulations regarding the disposal of your packaging materials, used wireless device and accessories, and promote their recycling.

WEEE Approval

The wireless device is in compliance with the essential requirements and other relevant provisions of the Waste Electrical and Electronic Equipment Directive 2012/19/EU (WEEE Directive).

RoHS Approval

The wireless device is in compliance with the restriction of the use of certain hazardous substances in electrical and electronic equipment Directive 2011/65/EU (RoHS Directive).

2. Overview

2.1 Introduction

RML-N2x is a highly integrated 5G NR wireless communication module that adopts standard PCIe interface and backward supports with LTE system. It is applicable to most broadband communication networks of the mobile operator across the world. **All relevant LGA HW spec、figures and design guidelines in this document are common specification for All 5G LGA mode**.

2.2 Specification

Table 2-1 LGA module features

Specification		
Platform	MTK MT6990 Quad-core Arm® Cortex-A55 MPCore™ 2.0GHz boost 2.2GHz	
Memory	Support LPDDR4 2GB, eMMC Flash 32GB (Optional)	
Operating Band **(Full SKU)**	5G • n29, n66, n70, n71	
	Simultaneous GPS: L1/L5, GLONASS(GLO), Galileo(GAL) and BeiDou(BDS)	
Network option	SA	Option 2
	NSA	Option 3x/3a
Downlink	LTE	N/A
	5G sub-6	4CC; Max aggregated BW 300MHz; MIMO 4x4
Uplink	LTE	N/A
	5G sub-6	2CC SISO / 1CC MIMO 2x2
HPUE (Class 2)	n66, n70, n71	
UL 2x2 MIMO	n66, n70, n71	
DL 4x4 MIMO	All bands	
TAS	Support	
Carrier aggregation	UL_CA/DL_CA/EN-DC	
Power Supply	DC 3.4V～4.4V(Typical value is 4.2V)	
Temperature	Operating temperature[1]:-30°C ～+75°C	

Physical characteristics	Extended temperature[2] : -40°C ～+85°C
	Storage temperature: -40°C ～+85°C
	Dimension:45x45mm, Thickness=2.65mm(typ.)
	Weight: 14g ±0.3g

Interface	
Antenna Port	4G/Sub-6G Antenna x 4 and GPS Antenna x 1
	Support 4x4 MIMO
Function Interface	DSSA (Dual SIM, Single Active) SIM1 & SIM2, The SIM2 can be applied for ESIM (without SIM2 hotswap)
	I2S for Audio x 1
	USB 2.0 HS or USB 3.2 Gen2 SS
	UART0 2-wire UART for Debug UART2 4-wire UART for Bluetooth command
	GPIO (General-Purpose I/O) x 11pin Reserve Column Key x 2pin, Row Key x 3pin, it also can be used for GPIO Purpose Reserve RF BPI Interface x 11, it also can be used for GPIO Purpose (only Pin242 need to pull low for detected as a client version, CUST Board) Reserve OTG ID detection pin x 1 and Enable Pin x 1
	Power on/off switch key pin Support Cable Power On Reserve FULL_CARD_POWER_OFF pin for module power enable/disable pin
	Hardware reset pin
	SPI interface x 1
	SDIO 3.0 interface
	DSI x1 (4lane) and DBI-C x1 (DBI IF only support type C) for LCM interface (It needs to check if SW can support the driver or not)
	LED SINK control pin x3 (Support up to 12 mA) and PWM control pin x1 for LCM backlight
	I2C Interface x2
	Tunable antenna(3xMIPI)

	PCIe Gen3 2-lane x2 (For MTK Wifi 802.11ax solution: MT7915) PCIe Gen3 1-lane x 1 (Reserve)
	USXGMII x2 (Support 1Gbit and 2.5Gbit Ethernet interface, additional components are required on the circuit), **RML-N2x default support SGMII/HSGMII only.**
	Others Interface: (The trigger and read control de-pend on SW) AUXADC (PM6685) 15bit x 2pin AUXADC (PM6361) 12bit x 3pin
	Power supply: (Reserve) a.Dual Voltage Support LV 1.8V/HV 3V IF for SIM Card Power.
Software	
Driver	Linux kernel [3]
Protocol Stack	IPV4/IPV6
AT commands	3GPP TS 27.007 and 27.005
Firmware update	FOTA
Others feature	Support 5G NR NSA and SA
	Multiple carrier aggregation
	AGNSS
Management tool	WebUI for user (Monitor data usage, manage device & network settings), and Debug screen for engineer

🔺 NOTE:

[1] To meet this operating temperature range, you need to ensure effective thermal dissipation, for example, by adding passive or active heatsinks, heat pipes, vapor chambers, etc. Within this range, the module can meet 3GPP.

[2] To meet this extended temperature range, you need to ensure effective thermal dissipation, for example, by adding passive or active heatsinks, heat pipes, vapor chambers, etc.

When the LGA module works at this temperature, the module remains the ability to establish and maintain functions such as Voice, SMS, emergency call, etc.

Radio spectrum and radio network are not influenced, while one or more specifications, such as Pout, may undergo a reduction in value, exceeding the specified tolerances of 3GPP.

[3] SW driver plan to support Android platform.

2.3 Operating Band

The 5G LGA Module operating bands of the antennas are as follows Table 4-1:

Table 4-2 Full SKU operating

Band name	Tx (MHz)	Rx (MHz)	LTE	5G NR
FLO	*N/A*	716 - 728		n29
B66	1710 - 1780	2110 - 2200		n66
B70	1695 - 1710	1995 - 2020		n70
B71	663 - 698	617 - 652		n71

2.4 Transmitting Power

The transmitting power for each band of the LGA module as shown in the following table:

Table 4-3 Full SKU NR-FR1 FDD

Mode	Band	Typical Value (dBm)	Tolerance
NR-FR1	n66	23	±2
	n66 MIMO	26	±2
	n70	23	±2
	n70 MIMO	26	±2
	n71	23	±2
	n71 MIMO	26	±2

⚠ NOTE

If device is operated in EN-DC mode, total TX power would be "LTE + NR $\cong 23 \pm 2$" due to power sharing algorithm.

2.5 Receiver Sensitivity

The receiver sensitivity for each band of the 5G LGA Module as shown in the following table:

Table 4-4 Full SKU NR band

Mode	Band	Single Port				Combined Port	
		PRx (Typ.)	DRx (Typ.)	PRx MIMO (Typ.)	DRx MIMO (Typ.)	4-RX	3GPP spec
NR(10MHZ,15K)	n29	TBD	TBD	TBD	TBD	TBD	-96.5
NR(20MHZ,15K)	n66	TBD	TBD	TBD	TBD	TBD	-96
NR(20MHZ,15K)	n70	TBD	TBD	TBD	TBD	TBD	-96.5
NR(20MHZ,15K)	n71	TBD	TBD	TBD	TBD	TBD	-88.7

⚠ NOTE

The above values are measured in one antenna situation.

2.6 RF Antenna Interface

The LGA module provides Nine antenna pads (ANT0~ANT8) for connecting the external antennas. (default is NC)

The RF pad difference is the most important difference between LGA modules; please refer to 45 mm x 45 mm LGA Module Hardware Migration Guide.

Route the antenna pad as close as possible to antenna connector. In addition, the impedance of RF signal traces must be 50 Ω.
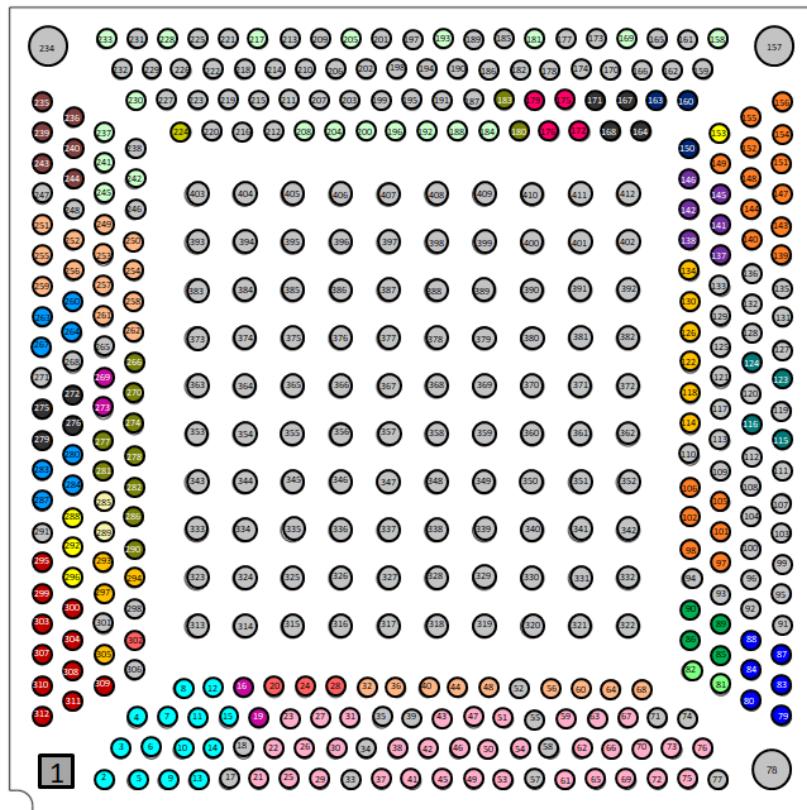

Figure 3-1 Antenna port location

Pin	ANT No.
169	ANT_0
193	ANT_1
205	ANT_2
217	ANT_3
233	ANT_4
181	N/C
228	N/C
158	N/C
203	N/C

Figure 3-2 Definition of the antenna pinout location

Table 3-5 Definition of the antenna port mapping

	Frequency	Ant_0	Ant_1	Ant_2	Ant_3	Ant_4
LB	600–960MHz	Tx0[1]/PRx2	DRx2	Tx1/PRX	DRx	
MHB	1710–2690MHz	Tx0/PRX	DRx	Tx1[1]/DRX2	PRx2	
n41	2496-2690	Tx0[1]/PRX2	DRx2	Tx1/DRX	PRx	
n77	3300–5000MHz	Tx0[1]/DRX	DRX2	Tx1/PRx	PRx2	
GPS L1	1575–1610MHz					Rx
GPS L5	1176MHz					Rx

Note.1:

For UL 2x2 MIMO , MB+MB/LB+LB ENDC/LTE UL CA/NR ULCA

For the PCB designed by the user, the impedance of all the RF signal tracks must be 50 Ω. Generally, the impedance depends on the medium factor, track width, and distance from the floor.

In order to reflect the rules of design, the following figures indicate the complete structure of the microstrip and stripline with an impedance of 50 ohm as well as the reference design for stack.
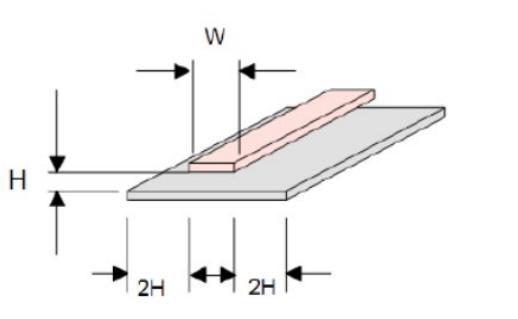
Figure 3-3 Complete structure of the microstrip
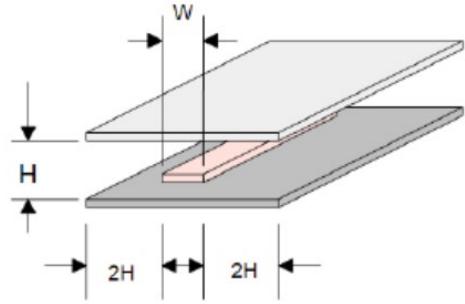
Figure 3-4 Complete structure of the stripline

Please use impedance simulation tool to calculate RF MAIN pad impedance. The RF MAIN pad dimension of LGA module is Φ 0.8mm. You can get the impedance with lower than 50 Ω calculated by the impedance simulation tool. Since the target impedance is 50 Ω for RF trace, the recommended solution is that to carve out the copper area of the second layer that projected by the RF MAIN pad at top layer. How many layers should be carved out depend on the PCB permittivity, track width, and distance from the floor of your own PCB. Our target is to make the RF MAIN pad impedance as closer to 50 Ω as possible.

Table 3-6

Rated Condition		Environment Condition
Frequency Range	DC to 6GHz	Temperature Range
Characteristic Impedance	50Ω	–40°C to +85°C

ANT4
Width: 12mil
Length: 439mil

ANT3
Width: 12mil
Length: 458mil

ANT2
Width: 12mil
Length: 478mil

ANT1
Width: 12mil
Length: 475mil

PCB thickness: 1.7mm
Trace copper foil: 1oz
Antenna Connector :
20449-001E-03 I-PEX

ANT0
Width: 12mil
Length: 499mil

ANT4_CARKIT ANT3_CARKIT ANT2_CARKIT ANT1_CARKIT ANT0_CARKIT
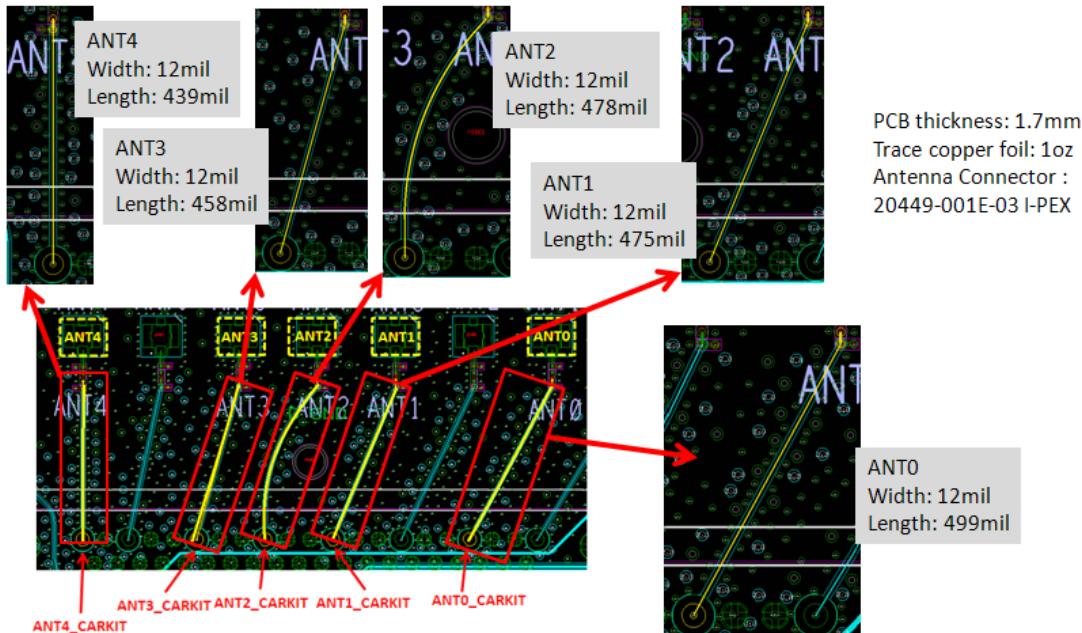
Trace design

The trace from module transmitter to antenna connector on the EVB must be maintained identical as the above specification with i-pex connector. Only trace designs approved by the module original grantee or through permissive change can be used by an host manufacturer. Any changes are deemed as antenna type change and should be reviewed to ensure compliance with the FCC regulation rules.

Verification must be conducted and the results shall not exceed below ranges to ensure identical antenna design is applied to subsequent integration and end product production.

Test procedures of Verification

1. Set Transmission in the supported modulation mode, band and Channel.
2. Verify RF tuned-up power through conducted measurement with appropriate cable loss. The KDB guidance 971168 D01 can be followed to obtain the measurement results.
3. Verify the RF output power results obtained if it's accordance with the datasheet and test reports.

3. Application Interface

3.1 LGA Interface

The RML-N2x uses a 412-pin LGA as its external interface. For details about the module and dimensions, see 5.4 Dimensions and Interfaces

3.2 Pin Map

	Function	
●	POWER (VPH_PWR x 6, Others Power x 5)	11
●	PMIC_Charger Pin (4)	4
●	Key (10)	10
○	LED & BL (4)	1+3
●	USB 2.0 (2)	2
●	USB 3.1 (4)	4
●	SIM 1/2 (8)	8
●	SDIO (6)	6
●	LCM_EBI2 (9 bit) (18)	18
●	I2S (ACO) (6)	6
●	Debug UART (4)	4
●	SPI (4)	4
●	I2C (4)	4
●	AUXIN (3)	3
●	GPIO (11)	11
○	AUXADC (2)	2
●	SGMII (14)	14
●	PICE Gen3x2 (35)	35
●	ANT Tunable IC (6)	6
●	WIFI_BT (22)	22
●	GPS	1
○	Antenna (20)	20
●	NC	8
○	GND	Center 100 RF 52 BB & Others 55
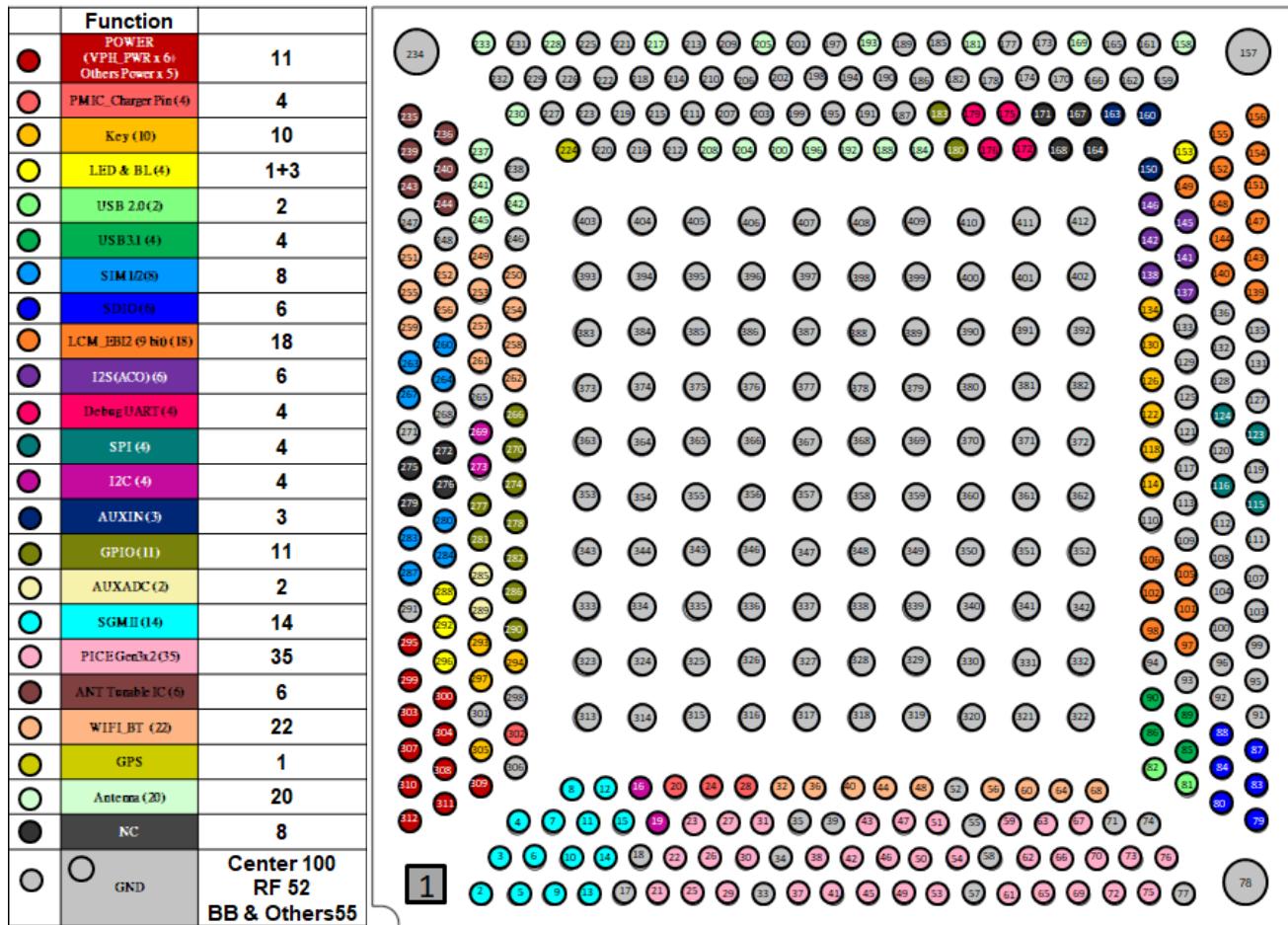
Figure 3-1 PAD Sequence of LGA module (Perspective View from TOP Side)

3.2.1 Pin Definition

The pin definition is as follows Table 3-1:

Table 3-1 pin definition

Pin NO.	Pin Name	I/O	Pin Description	Type(V)
2	USXGMII_1_RXN	AI	USXGMII IF RX Lane1_N	
3	USXGMII_1_RXP	AI	USXGMII IF RX Lane1_P	
4	GBE1_INT	DIO	Ethernet control pin	1.8V
5	USXGMII_1_TXP	AO	USXGMII IF TX Lane1_P	
6	USXGMII_1_TXN	AO	USXGMII IF TX Lane1_N	

7	GBE1_RST	DIO	Ethernet control pin	1.8V
8	GBE0_RST	DIO	Ethernet control pin	1.8V
9	USXGMII_0_RXN	AI	USXGMII IF RX Lane0_N	
10	USXGMII_0_RXP	AI	USXGMII IF RX Lane0_P	
11	MDIO	DIO	Ethernet control pin management data clock	1.8V
12	GBE0_INT	DIO	Ethernet control pin	1.8V
13	USXGMII_0_TXN	AO	USXGMII IF TX Lane0_N	
14	USXGMII_0_TXP	AO	USXGMII IF TX Lane0_P	
15	MDC	DIO	Ethernet control pin management data clock	1.8V
16	SCL4	DIO	I2C IF Reserve for Codec IC	1.8V
19	SDA4	DIO	I2C IF Reserve for Codec IC	1.8V
20	IDDIG	DI	For USB ID, for OTG2.0	1.8V
21	PCIE_D_CLKP	AIO	PCIE IF Clock (1lane)	
22	PCIE_D_CLKN	AIO	PCIE IF Clock (1lane)	
23	PCIE3_PERSTN	DIO	For PCIE Control Pin	1.8V
24	USB_VBUSVALID	DI	Detect pin for check VBUS insert or not(1.8V IO)	1.8V
25	PCIE_D_LN0_TXN	AO	PCIE TX Lane0_N (1lane)	
26	PCIE_D_LN0_TXP	AO	PCIE TX Lane0_P (1lane)	
27	PCIE3_CLKREQN	DIO	For PCIE Control Pin	1.8V
28	USB_DRVBUS	DO	OTG Enable Pin for charging IC	1.8V
29	PCIE_D_LN0_RXP	AI	PCIE RX Lane0_P (1lane)	
30	PCIE_D_LN0_RXN	AI	PCIE RX Lane0_N (1lane)	
31	PCIE3_PEWAKEN	DIO	For PCIE Control Pin	1.8V
32	PCM0_DO	AIO	I2S or PCM reserve for WIFI/BT connectivity MT7915/MT7975	1.8V
36	PCM0_DI	AIO	I2S or PCM reserve for WIFI/BT connectivity MT7915/MT7975	1.8V
37	PCIE_B_LN1_TXN	AO	For PCIE TX Lane1_N Reserve for WIFI/BT connectivity MT7915/MT7975.	
38	PCIE_B_LN1_TXP	AO	For PCIE TX Lane1_P Reserve for WIFI/BT connectivity MT7915/MT7975.	
40	PCM0_SYNC	AIO	I2S or PCM reserve for WIFI/BT connectivity MT7915/MT7975	1.8V
41	PCIE_B_LN1_RXN	AI	For PCIE RX Lane1_N Reserve for WIFI/BT connectivity MT7915/MT7975.	

42	PCIE_B_LN1_RXP	AI	For PCIE RX Lane1_P Reserve for WIFI/BT connectivity MT7915/MT7975.	
43	PCIE1_CLKREQN	DIO	For PCIE Control Pin, Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
44	WLAN_ACT_1	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
45	PCIE_B_CLKN	AIO	For PCIE Clock IF Reserve for WIFI/BT connectivity MT7915/MT7975.	
46	PCIE_B_CLKP	AIO	For PCIE Clock IF Reserve for WIFI/BT connectivity MT7915/MT7975.	
47	PCIE1_PERSTN	DIO	For PCIE Control Pin, Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
48	PCM0_CLK	AIO	I2S or PCM reserve for WIFI/BT connectivity MT7915/MT7975	1.8V
49	PCIE_B_LN0_TXN	AO	For PCIE TX Lane0_N Reserve for WIFI/BT connectivity MT7915/MT7975.	
50	PCIE_B_LN0_TXP	AO	For PCIE TX Lane0_P Reserve for WIFI/BT connectivity MT7915/MT7975.	
51	PCIE1_PEWAKEN	DIO	For PCIE Control Pin, Reserve for WIFI/BT connectivity MT7915/MT7975.	
53	PCIE_B_LN0_RXP	AI	For PCIE RX Lane0_P Reserve for WIFI/BT connectivity MT7915/MT7975.	
54	PCIE_B_LN0_RXN	AI	For PCIE RX Lane0_N Reserve for WIFI/BT connectivity MT7915/MT7975.	
56	BT_PRI_RXD_1	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
59	PCIE0_PEWAKEN	DIO	For PCIE Control Pin, Reserve for WIFI/BT connectivity MT7915/MT7975.	
60	PTA_RX_1	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
61	PCIE_A_LN0_RXP	AI	For PCIE IF RX Lane0_P, Reserve for WIFI/BT connectivity MT7915/MT7975.	
62	PCIE_A_LN0_RXN	AI	For PCIE IF RX Lane0_N, Reserve for WIFI/BT connectivity MT7915/MT7975.	
63	PCIE0_PERSTN	DIO	For PCIE Control Pin, Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
64	PTA_TX_1	DIO	Connsys Co-Ex Interface (1.8V)	1.8V

65	PCIE_A_LN0_TXP	AO	For PCIE IF TX Lane0_P, Reserve for WIFI/BT connectivity MT7915/MT7975.	
66	PCIE_A_LN0_TXN	AO	For PCIE IF TX Lane0_N, Reserve for WIFI/BT connectivity MT7915/MT7975.	
67	PCIE0_CLKREQN	DIO	For PCIE Control Pin, Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
68	BT_ACT_TXD_1	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
69	PCIE_A_LN1_RXP	AI	For PCIE IF RX Lane1_P, Reserve for WIFI/BT connectivity MT7915/MT7975.	
70	PCIE_A_LN1_RXN	AI	For PCIE IF RX Lane1_N, Reserve for WIFI/BT connectivity MT7915/MT7975.	
72	PCIE_A_LN1_TXP	AO	For PCIE IF TX Lane1_P, Reserve for WIFI/BT connectivity MT7915/MT7975.	
73	PCIE_A_LN1_TXN	AO	For PCIE IF TX Lane1_N, Reserve for WIFI/BT connectivity MT7915/MT7975.	
75	PCIE_A_CLKN	AIO	For PCIE IF Clock Reserve for WIFI/BT connectivity MT7915/MT7975.	
76	PCIE_A_CLKP	AIO	For PCIE IF Clock Reserve for WIFI/BT connectivity MT7915/MT7975.	
79	MSDC1_CLK	B	SDC clock	1.8
80	MSDC1_DAT0	DIO	SDC data bit 0	1.8
81	USB_DM	AIO	For USB2.0 HS data minus	
82	USB_DP	AIO	For USB2.0 HS data plus	
83	MSDC1_DAT1	DIO	SDC data bit 1	1.8
84	MSDC1_DAT3	DIO	SDC data bit 3	1.8
85	SSUSB_TXP	AIO	For USB SS Tx plus	
86	SSUSB_TXN	AIO	For USB SS Tx minus	
87	MSDC1_DAT2	DIO	SDC data bit 2	1.8
88	MSDC1_CMD	DO	SDC command	1.8
89	SSUSB_RXP	AIO	For USB SS Rx plus	
90	SSUSB_RXN	AIO	For USB SS Rx minus	
97	LPCE0B	AIO	DBI-C Interface for LCM	1.8
98	LPA0	AIO	DBI-C Interface for LCM	1.8
101	LSDI	AIO	DBI-C Interface for LCM	1.8
102	LPRDB	AIO	DBI-C Interface for LCM	1.8
105	LPWRB	AIO	DBI-C Interface for LCM	1.8
106	LPRSTB	AIO	DBI-C Interface for LCM	1.8
114	KPROW2	DIO	Row Key 2	1.8V
115	SPI0_MI	DIO	SPI0 master in, slave out	1.8V
116	SPI0_CLK	DIO	SPI0 Clock	1.8V

118	KPCOL2	DIO	Column Key 2	1.8V
122	KPCOL1	DIO	Column Key 1	1.8V
123	SPI0_CSB	DIO	SPI0 chips select	1.8V
124	SPI0_MO	DIO	SPI0 master out, slave in	1.8V
126	KPROW1	DIO	Row Key 1	1.8V
130	KPROW0	DIO	Row Key 0	1.8V
134	KPCOL0	DIO	Column Key 0 (Use for Force DL, low to trigger)	1.8V
137	I2S0_LRCK	DIO	Primary audio interface, MI2S word select	1.8V
138	I2S0_BCK	DIO	Primary audio interface, MI2S clock	1.8V
139	DSI0_D0N	AIO	MIPI DSI Interface for LCM	
140	DSI0_D0P	AIO	MIPI DSI Interface for LCM	
141	I2S0_MCK	DIO	Audio master clock	1.8V
142	I2S0_DI	DIO	I2S reserve for Audio codec	1.8V
143	DSI0_D3P	AIO	MIPI DSI Interface for LCM	
144	DSI0_D3N	AIO	MIPI DSI Interface for LCM	
145	I2S0_DO	DIO	I2S reserve for Audio codec	1.8V
146	I2S4_MCK	DIO	Audio master clock	1.8V
147	DSI0_D1N	AIO	MIPI DSI Interface for LCM	
148	DSI0_D1P	AIO	MIPI DSI Interface for LCM	
149	LCM_RST	AIO	GPIO Reserve for LCD Reset	1.8V
150	AUXIN1	AIO	PMIC Side AUX Channel Reserve for ADC 12bit	0~1.98V
151	DSI0_CKP	AIO	MIPI DSI Interface for LCM	
152	DSI0_CKN	AIO	MIPI DSI Interface for LCM	
153	DISP_PWM	DIO	Display PWM Output	1.8V
154	DSI0_D2P	AIO	MIPI DSI Interface for LCM	
155	DSI_TE	AIO	GPIO Reserve for LCD tearing effect	1.8V
156	DSI0_D2N	AIO	MIPI DSI Interface for LCM	
158	NC_ANT		NC	
160	AUXIN3	AIO	PMIC Side AUX Channel Reserve for ADC 12bit	0~1.98V
163	AUXIN5	AIO	PMIC Side AUX Channel Reserve for ADC 12bit	0~1.98V
169	ANT0_CARKIT		ANT0	
172	AP_UTXD0	DO	UART0 transmit data – (used for debug)	1.8V
175	AP_URXD0	DI	UART0 receive data (used for debug)	1.8V
176	AP_URTS0	DO	UART0 RTS Require To Send	1.8V
179	AP_UCTS0	DI	UART0 CTS Clear To Send	1.8V
180	EINT10	DIO	GPIO Reserve for EN Pin	1.8V
181	NC_ANT		NC	
183	EINT7	DIO	GPIO Reserve	1.8V
184	BPI_D_BUS17_ANT0		RF BPI IF	1.8V
188	BPI_D_BUS18_ANT1		RF BPI IF	1.8V
192	BPI_D_BUS19_ANT2		RF BPI IF	1.8V
193	ANT1_CARKIT		ANT1	
196	BPI_D_BUS20_ANT3		RF BPI IF	1.8V

200	BPI_D_BUS16_OLAT5		RF BPI IF	1.8V
204	BPI_D_BUS21_ANT4		RF BPI IF	1.8V
205	ANT2_CARKIT		ANT2	
208	BPI_D_BUS12_OLAT1		RF BPI IF	1.8V
217	ANT3_CARKIT		ANT3	
224	GPS_PPS	DO	Connsys GPS Interface (1.8V)	1.8V
228	NC_ANT		NC	
230	NC_ANT		NC	
233	ANT4_CARKIT		ANT4	
235	MIPI2_D_SCLK	DIO	RF MIPI Need to Reserve jumper to GND for C-load tuning	1.8V
236	MIPI2_D_SDATA	DIO	RF MIPI Need to Reserve jumper to GND for C-load tuning	1.8V
237	BPI_D_BUS15_OLAT4		RF BPI IF	1.8V
239	MIPI1_D_SCLK	DIO	RF MIPI Need to Reserve jumper to GND for C-load tuning	1.8V
240	MIPI1_D_SDATA	DIO	RF MIPI Need to Reserve jumper to GND for C-load tuning	1.8V
241	BPI_D_BUS13_OLAT2		RF BPI IF	1.8V
242	BPI_D_BUS14_OLAT3		RF BPI IF, Reserve pull-low for CUST Board detection	1.8V
243	MIPI0_D_SCLK	DIO	RF MIPI Need to Reserve jumper to GND for C-load tuning	1.8V
244	MIPI0_D_SDATA	DIO	RF MIPI Need to Reserve jumper to GND for C-load tuning	1.8V
245	BPI_D_BUS11_OLAT0		RF BPI IF	1.8V
249	AP_UTXD2	DO	UART2 transmit data – (used for debug), Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
250	EINT4 (MT6685_INT)	DO	Unused, please keep floating or NM. Just reserve for WIFI/BT connectivity MT7915/MT7975. (32KHz Clock output)	1.8V
251	WLAN_ACT	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
252	PTA_RX	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
253	AP_UCTS2	DI	UART2 CTS Clear ToSend Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
254	EINT16	DIO	GPIO Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
255	PTA_TX	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
256	BT_PRI_RXD	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
257	AP_URXD2	DI	UART2 receive data (used for debug), Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
258	EINT15	DIO	GPIO Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
259	BT_ACT_TXD	DIO	Connsys Co-Ex Interface (1.8V)	1.8V
260	INT_SIM2	DI	For SIM2 interrupt for detect pin (Does not support SIM2 hotswap)	1.8V

261	AP_URTS2	DO	UART2 RTS Require ToSend Reserve for WIFI/BT connectivity MT7915/MT7975 UART	1.8V
262	EINT17	DIO	GPIO Reserve for WIFI/BT connectivity MT7915/MT7975.	1.8V
263	SIM2_SIO	DIO	For USIM2 Data	1.8V/3V
264	SIM2_SRST	DIO	For USIM2 reset	1.8V/3V
266	NC(EVT) EINT111(DVT)	DIO	NC for EVT DVT for GPIO Reserve	NC/ 1.8V
267	SIM2_SCLK	DIO	For USIM2 clock	1.8V/3V
269	SCL3	DIO	I2C IF Reserve for CC detect or Gauge IC	1.8V
270	EINT6	DIO	GPIO Reserve	1.8V
273	SDA3	DIO	I2C IF Reserve for CC detect or Gauge IC	1.8V
274	NC(EVT) EINT110(DVT)	DIO	NC for EVT DVT for GPIO Reserve	NC/ 1.8V
277	NC (EVT) EINT109(DVT)	DIO	NC for EVT DVT for GPIO Reserve	NC/ 1.8V
278	EINT5	DIO	GPIO Reserve	1.8V
280	SIM1_SRST	DIO	For USIM reset	1.8V/3V
281	EINT9	DIO	GPIO Reserve for EN Pin	1.8V
282	EINT8	DIO	GPIO Reserve	1.8V
283	INT_SIM1	DIO	For SIM1 interrupt for detect pin (Active High)	1.8V
284	SIM1_SIO	DIO	For USIM Data	1.8V/3V
285	AUXADC_VIN7	AIO	PMIC Side AUX ADC Channel Reserve for thermal detection monitor (15bit)	0~1.98
286	EINT0	DIO	GPIO Reserve for Enter Meta Mode (Module internal used, low trigger to Meta Mode)	1.8V
287	SIM1_SCLK	DIO	For USIM clock	1.8V/3V
288	MT6361_ISINK3	AIO	Current SINK control pin for LED	0~ VPH
289	AUXADC_VIN6	AIO	PMIC Side AUX ADC Channel Reserve for thermal detection monitor (15bit)	0~1.98
290	EINT11	DIO	GPIO Reserve for EN Pin	1.8V
292	MT6361_ISINK1	AIO	Current SINK control pin for LED	0~ VPH
293	PWRKEY	DI	PWRKEY button (power on/off control) active low	1.8V
294	FULL_CARD_POWER_OFF#	DI	PMIC Enable Control (Active High), >1.45V, <3.3V Must need Connect to GND, if unused	1.8V/3.3V Or GND
295	DVDD28_MSDC1	PI	If need support T-Card function, need connect to external 1.8V If unused, need contact to VIO18_PMU(PIN 309)	VIO18
296	MT6361_ISINK2	AIO	Current SINK control pin for LED	0~ VPH
297	SYSRSTB	DO	System reset input from PMIC output (should be just used for monitor)	1.8V

299	VMC_PMU	PO	Reserve for MSDC1 SD Card function Power.(level shift)	1.8/2.95V
300	SIM2_VCC	PO	VSIM2 Output voltage	1.8/3V
302	VDET	PI	Voltage for power input detect. When VDET get high, it also can turn-on system, such as Cable Power on feature.	VBUS
303	SIM1_VCC	PO	VSIM1 Output voltage	1.8/3V
304	VSYS	PI	For LGA Module power (4A/4.2V)	3.4~4.4V
305	RESET#	DI	Reset Control for PMIC (when H to L，will generate SYSRSTB to reset AP)	1.8V
307	VSYS	PI	For LGA Module power　(4A/4.2V)	3.4~4.4V
308	VSYS	PI	For LGA Module power　(4A/4.2V)	3.4~4.4V
309	VIO18_1_PMU	PO	1.8V Output, this is just reserve for Pin295, if no need SD Card function. Please do not connect to other Power Supply Source purpose.	1.8V
310	VSYS	PI	For LGA Module power　(4A/4.2V)	3.4~4.4V
311	VSYS	PI	For LGA Module power　(4A/4.2V)	3.4~4.4V
312	VSYS	PI	For LGA Module power　(4A/4.2V)	3.4~4.4V
1,78, 157,234,313~412	PAD GND		PAD GND	GND
17,18,33~35,39,52,55,57,58,71,74,77,91~96，99，100，103，104，107~113,117,119~121,125,127~129,131~133,135,136,159,161,162,165,166,170,173,174,177,178,182,185~187,189~191,194,195,197~199,201~203,206，207，209~216,218,219,220~223，225~227,229,231,232,238,246~248,265,268,271,291,298,301,306	GND		GND	GND
164,167,168,171,272,275,276,279	NC		Not Connection	NC

AI :　　Analog input

AO :　　Analog output

B :　　Bidirectional digital with CMOS input

PD:　　Pull-Down

PU:　　Pull-Up

T:　　　Tristate

OD: Open Drain

PP: Push-Pull

PI: Power Input

PO: Power Output

Z: High-impedance (Hi-Z) output

⚠ NOTE

The unused pins can be left floating.

- **P** indicates power pins; **I** indicate pins for digital signal input; **O** indicates pins for digital signal output; **PO** indicates power output pins; **PI** indicates power input pins.

- **VIL** indicates Low-level Input voltage; **VIH** indicates High-level Input voltage; **VOL** indicates Low-level Output voltage; **VOH** indicates High-level Output voltage.

- The **NC** pins are not connected, therefore, before you deal with these pins; please refer to the corresponding hardware guide.

The **Reserved** pins are internally connected to the module. Therefore, these pins should not be used, otherwise they may cause problems. Please contact with us for more details about this information.

4. FCC Notice

Model: RML-N2x

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: GKRRMLN2X"

Industry Canada Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference.
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L'appareil ne doit pas produire de brouillage;
(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

CAN ICES-3(B)/ NMB-3(B)

Radiation Exposure Statement

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

Cet équipement est conforme aux limites d'exposition aux rayonnements FCC/IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

OEM integrators must identify all possible combinations of simultaneous transmission configuration for all transmitters and antennas installed in the host platform. When there are multiple transmitting devices installed in a host platform, an RF exposure evaluation for the simultaneous transmission condition must be performed.

End Product Labeling

When the module is installed in the host device, the IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text:

"Contains IC: 2533B-RMLN2X"

1. Antenna Gain

Bands	Freq.	Monopole
	Uplink(MHz)	Gain(dBi)
n71	663~698	2.0
n66	1710~1780	2.0
n29	716 - 728	2.0
n70	1695 - 1710	2.0