



**5G Module,
M3100L**

User Manual

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Introduction

Introduction

This document defines the M3100L module and describes its air interface and hardware interface which are connected with customers' applications.

This document can help customers quickly understand module interface specifications, electrical and mechanical details, as well as other related information of M3100L module. Associated with application note and user guide, customers can use M3100L module to design and set up mobile applications easily.

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Product Concept

General Description

Key Features

Hardware Block Diagram

General Description

M3100L module is a 5G/LTE/WCDMA wireless communication module with receive diversity, which provides data connectivity on 5G (sub-6 GHz), LTE, DC-HSDPA, HSPA+, HSDPA, HSUPA, and WCDMA networks.

Customers can choose a dedicated type based on the region or operator. The following table shows the frequency bands of M3100L module.

Table 1. Frequency Bands of M3100L Module

Mode	Band
5G(Sub-6)-FDD	n20/n28/n66/n71
5G(Sub-6)-TDD	n41/n48/n77/n78
LTE-FDD	B1/B2/B3/B4/B5/B7/B8/B12/B13/B20/B25/B26/B28/B66/B71
LTE-TDD	B38/B39/B40/B41/B48
WCDMA	B1/B2/B4/B5/B8
GNSS ¹⁾	GPS/GLONASS – L1/L5

NOTE

1)GNSS function is optional.

Key Features

The following table describes the detailed features of M3100L module.

Table 2. Key Features of M3100L Module

Feature	Details
Power Supply	Supply voltage : 3.6V ~ 4.35V Typical supply voltage : 3.8V

Transmit Power	Class 3 (24dBm+1/-3dBm) for WCDMA bands Class 3 (23dBm±2.7dBm) for LTE bands Class 2 (26dBm+3/-4dBm) for LTE B41 band Class 3 (23dBm±2.7dBm) for 5GNR bands Class 2 (26dBm+3/-4dBm) for 5GNR n41/n77 band
5GNR Features	Support Rel17 5G NR Support sub6 SA and NSA operation mode Support 256 QAM uplink/downlink in sub6 GHz Support downlink 4x4 MIMO 8 Receiver Diversity on n41 and n77
LTE Features	Support up to CA Cat 19 FDD and TDD Support uplink QPSK , 16-QAM and 64-QAM modulation Support downlink QPSK, 16-QAM, 64-QAM, 256-QAM modulation Support 1.4MHz to 20MHz (5×CA) RF bandwidth Support 4x4 MIMO in DL direction
UMTS Features	Support 3GPP R9 DC-HSDPA, HSPA+, HSDPA, HSUPA and WCDMA Support QPSK, 16-QAM and 64-QAM modulation
GNSS Features	Multiband GNSS : L1+L5 GPS, GLONASS
USB Interface	One eUSB 2.0 and one SS USB 3.1 Gen 2
Qualcomm Universal peripheral engine (QUP)	The QUP module provides up to 9 serial interfaces, also known as serial engines (SE) for SPI, UART, and I2C
PCIe Interface	One PCIe interfaces: 1. Interface 0: one lane PCIe Gen 4 or two lanes PCIe Gen 3
Antenna interfaces	Including antenna(ANT0), antenna(ANT1), MIMO PRx antenna(ANT2), MIMO DRx antenna(ANT3) , antenna (ANT5), antenna(ANT6), antenna(ANT7), antenna(ANT8)
Physical Characteristics	Size : 46.5mm x 60.0mm x 2.65mm Weight : TBD
Temperature Range	Operation temperature range: -30°C ~ +75°C Storage temperature range: -40°C~ +95°C

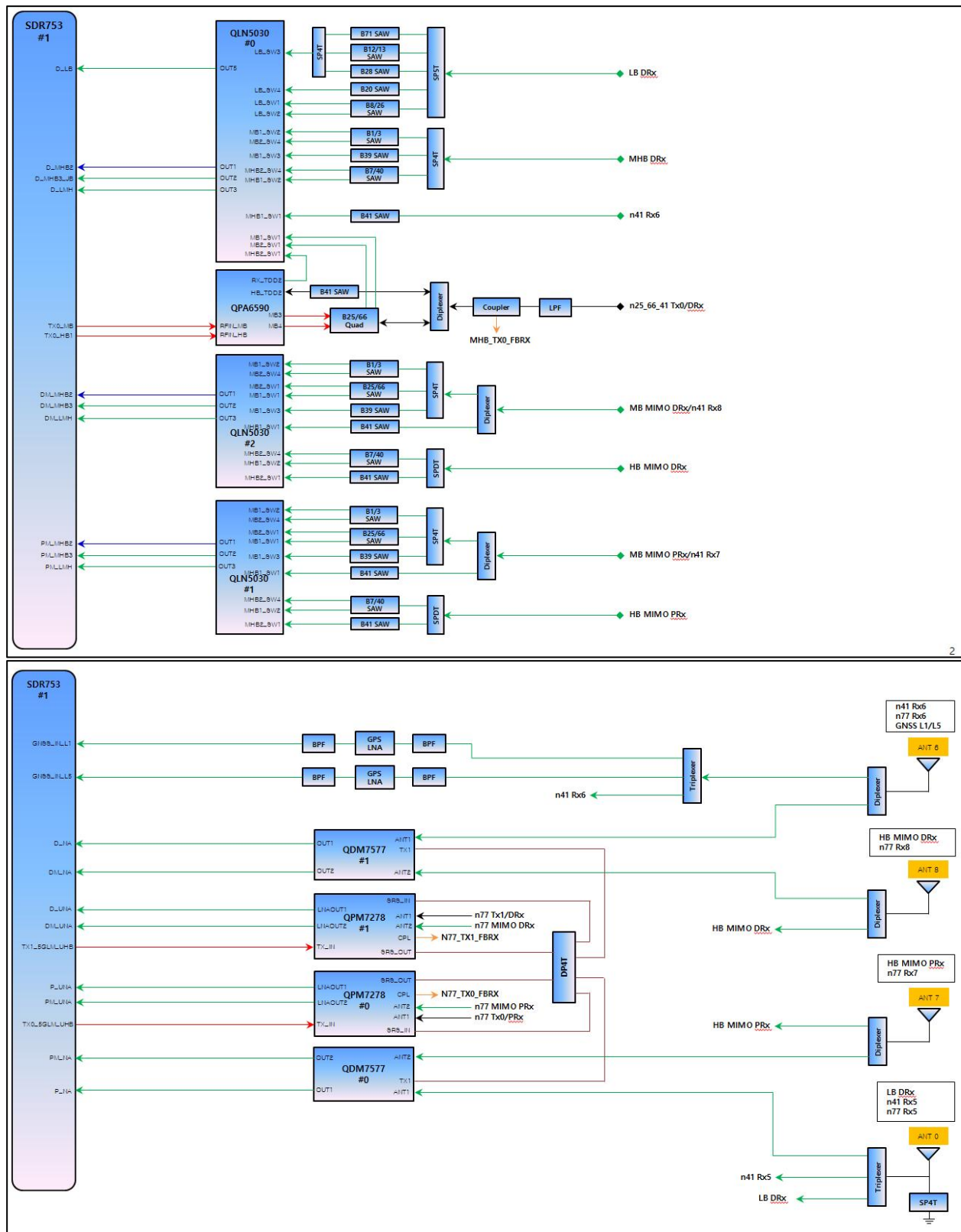


Figure 1. Block Diagram

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Application Interface

- General Description
 - Pin Assignment
 - Pin Description
- Operating Modes
 - Power Supply
 - PCIe Interface

General Description

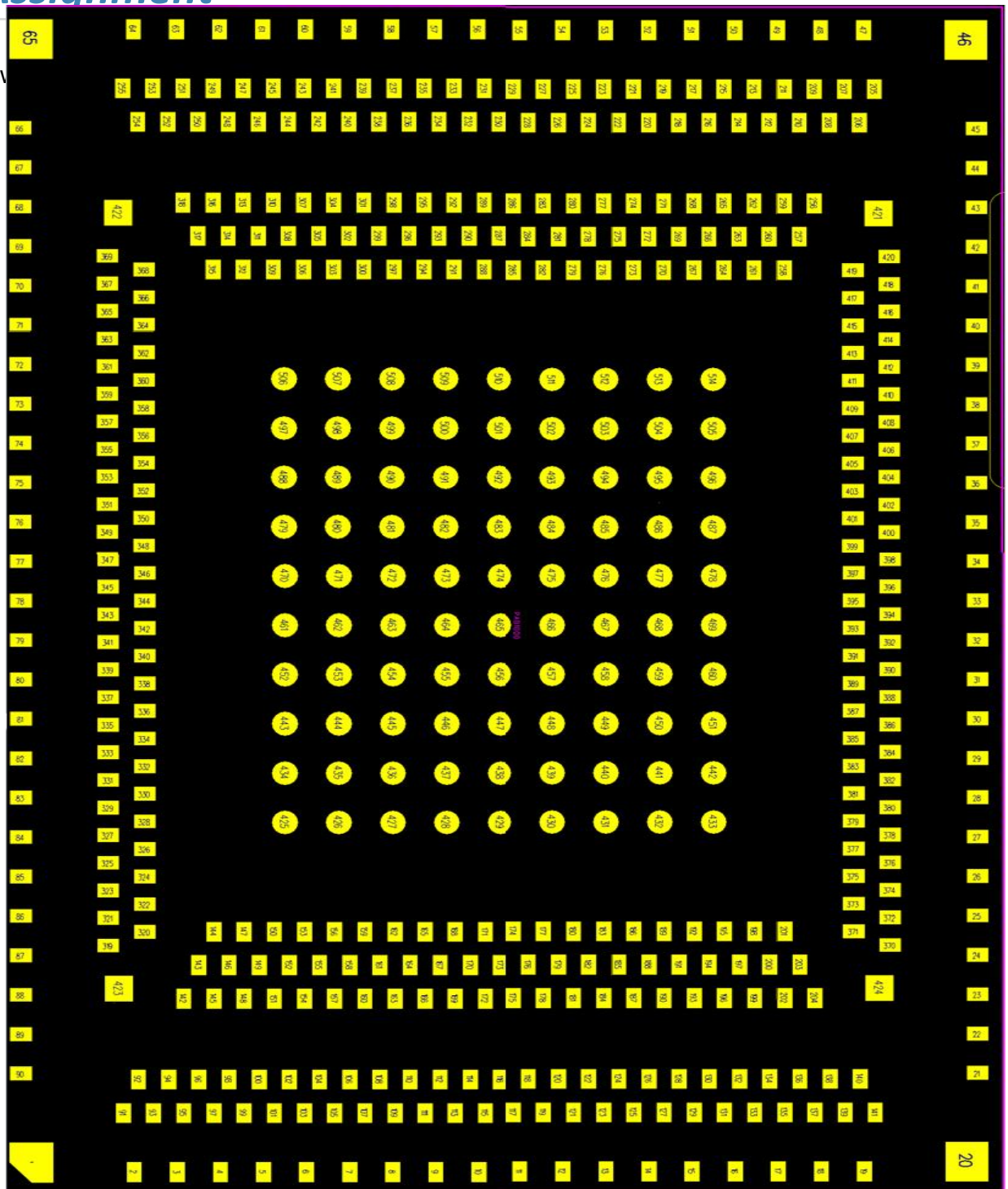
The M3100L module has an LGA-type configuration of pins for connecting to cellular application platforms.

Sub-interfaces included in these pins are described in detail in the following chapters:

- Power supply
- USIM interface
- eUSB 2.0/3.1 interface
- UART interface
- I2C interface
- SPI interface
- PCIe 3.0 interface
- I2S, PCM interface
- Charger IC control interface
- THERM interface
- GPIO's control interface

Pin Assignment

The follow



Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
139~141	VREG_S7_OP9	115	USB_SS_TX_P	148	PCIE0_WAKE_N
16~19	VPH_PWR_3P8	116	USB_SS_TX_M	150	PCIE0_CLK_REQ_N
376, 378	VREG_S4_1P9	118	USB_SS_RX_P	202	PMX_UIM1_RESET
372, 374	VREG_S2_1P2	117	USB_SS_RX_M	198	PMX_UIM1_CLK
377	VREG_1P8_SYS	113	USB_HS_EDP	201	PMX_UIM1_DATA
371	VREG_L1_1P2	114	USB_HS_EDM	186	UIM1_PRESENT
375	VREG_L5_1P8	161	DBG_UART_TX	203	UIM2_LS_EN
133	VREG_L10_3P1	162	DBG_UART_RX	393	SLEEP_CLK
370	VREG_L15_1P2	187	STATUS_LED_ON	394	RFCLK1
379, 410	VREG_L6_1P8	395	SPMI_CLK	399	JTAG_SRST_N
135	VREG_DBB1_3P3	396	SPMI_DATA	403	JTAG_TCK
138	VREG_1P2_SYS	10	I2C_SDA	404	JTAG_TDI
194	VREG_L11_1P8	9	I2C_SCL	401	JTAG_TDO
200	PM7550B_SYS_OK_PON_N	389	KPD_PWR_N	402	JTAG_TMS
147	FORCE_USB_BOOT_P7550B	185	FACTORY_RESIN_N	400	JTAG_TRST_N
188	FAST_BOOT	387	PM_FAULT_N	192	BATT_CHECK
196	PM7550B_PHY_ON	339	BT_SEC_I2S_D1	189	DCDC_CTL
153	PPS_ETH_PHY	340	BT_SEC_I2S_SCK	182	TOUCH_PWR_EN
383	QEP_RESET_N	337	BT_SEC_I2S_D0	179	AQR_MDC
382	QEP_MDC	338	BT_SEC_I2S_WS	320	EBI2_OE_N
384	QEP_MDIO	197	WCN_BT_EN	322	EBI2_CLE_UB_N
381	QEP_INT_N	152	WLAN_EN	324	EBI2_WE_N
110	WLAN_FEM_SELO	193	WCN_AS_EN	326	EBI2_LCD_TE
109	WLAN_FEM_SEL1	156	WLAN_LTE_COXM_TXD	327	EBI2_LCD_CS_N
124	SDX75_SGMII1_TX_M	155	WLAN_LTE_COXM_RXD	328	EBI2_LCD_RESET_N
123	SDX75_SGMII1_TX_P	199	WCN_SW_CTRL	329	LCD_LDO_EN
122	SDX75_SGMII1_RX_M	143	WCN_HOST_SOL	330	LCD_BL_EN
121	SDX75_SGMII1_RX_P	159	WCN_DEV_SOL	331	LCD_VDD_EN
184	QEP_PWR_EN	144	WCN_SW_CTRL_WLAN	348~356	EBI2 data line
183	UIM2_PRESENT	177	PA_MUTING	388	ANT0_SELO
6	UIM2_DATA	180	WCN_LAA_RX	390	ANT0_SEL1
7	UIM2_CLK	98	PCIE0_WCN_REFCLK_P	294	ANT1_SELO
5	UIM2_RESET	97	PCIE0_WCN_REFCLK_M	297	ANT1_SEL1
195	VREG_L13_1P8	100	PCIE0_WCN_RX0_P	21	ANT0_PAD
191	TOUCH_RESET	99	PCIE0_WCN_RX0_M	24	ANT5_PAD
190	BUTTON_LEFT	94	PCIE0_WCN_TX0_P	47	ANT2_PAD
178	BUTTON_MENU	93	PCIE0_WCN_TX0_M	64	ANT1_PAD
181	BUTTON_RIGHT	102	PCIE0_WCN_RX1_P	66	ANT6_PAD
204	AMBIENT_THERM	101	PCIE0_WCN_RX1_M	77	ANT7_PAD
11	SENSOR_I2C_SDA	96	PCIE0_WCN_TX1_P	79	ANT3_PAD
12	SENSOR_I2C_SCL	95	PCIE0_WCN_TX1_M	90	ANT8_PAD
88	TS9_PAD	149	PCIE0_RST_N	235	ANT1_TS9_CON

Pin No.	Pin Name
1,2,4,8,15,20,23,27,29,31,33,35,37,39,41,43,45,46,49,50,52,54,56,58,60,62,65,68,70,72,74,76,78,80,82,84,86,88,90,91,92,103,104,111,112,119,120,125~132,134,136,137,158,160,163~174,176,205~208,225~230,252~261,280~291,312,314~318,332~336,341,342,346,347,358~363,380,391,392,397,398,406~408,414,416~514	GND
3,13,14,26,28,30,32,34,36,38,40,42,44,51,53,55,57,59,61,69,71,73,75,81,83,85,105,106,107,108,142,145,146,151,154,157,175,209~224,231~234,236~251,262~279,292,293,295,296,298~311,313,319,321,323,325,343,344,345,357,364~369,373,385,386,405,409,411,412,413,415	DNI

Pin Description

The following tables show the pin definition and description of M3100L module.

Table 3. I/O Parameters Definition

Type	Description
AI	Analog Input
AO	Analog Output
DI	Digital Input
DO	Digital Output
IO	Bidirectional
OD	Open Drain
PI	Power Input
PO	Power Output

Table 4. Pin Description

Pin No.	Pin Name	I/O	Description
139~141	VREG_S7_0P9	PO	SMPS switch node
16~19	VPH_PWR_3P8	PO	Main power input
376, 378	VREG_S4_1P9	PO	SMPS switch node
372, 374	VREG_S2_1P2	PO	SMPS switch node
377	VREG_1P8_SYS	PO	LDO regulated output
371	VREG_L1_1P2	PO	LDO regulated output
375	VREG_L5_1P8	PO	LDO regulated output
133	VREG_L10_3P1	PO	LDO regulated output
370	VREG_L15_1P2	PO	LDO regulated output
379, 410	VREG_L6_1P8	PO	LDO regulated output
135	VREG_DBB1_3P3	PI	DBB1 input
138	VREG_1P2_SYS	PO	LDO regulated output
194	VREG_L11_1P8	PO	LDO regulated output
200	PM7550B_SYS_OK_PON_N	IO	PM7550B Charger_SYS_OK_N
147	FORCE_USB_BOOT_PM7550B	IO	FORCED_USB_BOOT
188	FAST_BOOT	IO	Configurable I/O
196	PM7550B_PHY_ON	IO	PM7550B PHY ON
153	PPS_ETH_PHY	IO	Configurable I/O
383	QEP_RESET_N	IO	Configurable I/O

382	QEP_MDC	IO	Configurable I/O
384	QEP_MDIO	IO	Configurable I/O
381	QEP_INT_N	IO	Configurable I/O
110	WLAN_FEM_SEL0	IO	Configurable I/O
109	WLAN_FEM_SEL1	IO	Configurable I/O
124	SDX75_SGMII1_TX_M	AO	USXGMII interface 1 serial data Tx - minus
123	SDX75_SGMII1_TX_P	AO	USXGMII interface 1 serial data Tx - plus
122	SDX75_SGMII1_RX_M	AI	USXGMII interface 1 serial data Rx - minus
121	SDX75_SGMII1_RX_P	AI	USXGMII interface 1 serial data Rx - plus
184	QEP_PWR_EN	IO	Configurable I/O
183	UIM2_PRESENT	IO	UIM2 presence detection
6	UIM2_DATA	IO	UIM2 data
7	UIM2_CLK	IO	UIM2 clock
5	UIM2_RESET	IO	UIM2 reset
195	VREG_L13_1P8	PO	LDO regulated output
191	TOUCH_RESET	IO	Configurable I/O
190	BUTTON_LEFT	IO	Configurable I/O
178	BUTTON_MENU	IO	Configurable I/O
181	BUTTON_RIGHT	IO	Configurable I/O
204	AMBIENT_THERM	AI	Analog multiplexer (AMUX) input
11	SENSOR_I2C_SDA	IO	BLSP I2C data
12	SENSOR_I2C_SCL	IO	BLSP I2C clock
115	USB_SS_TX_P	AI, AO	USB super-speed transmit - plus
116	USB_SS_TX_M	AI, AO	USB super-speed transmit - minus
118	USB_SS_RX_P	AI, AO	USB super-speed receive - plus
117	USB_SS_RX_M	AI, AO	USB super-speed receive - minus
113	USB_HS_EDP	AI, AO	EUSB port - plus
114	USB_HS_EDM	AI, AO	EUSB port - minus
161	DBG_UART_TX	IO	BLSP UART transmit data
162	DBG_UART_RX	IO	BLSP UART receive data
187	STATUS_LED_ON	IO	Configurable I/O
395	SPMI_CLK	DI, DO	Slave and PBUS interface for PMICs – clock
396	SPMI_DATA	DI, DO	Slave and PBUS interface for PMICs – data
10	I2C_SDA	IO	BLSP I2C data
9	I2C_SCL	IO	BLSP I2C clock
389	KPD_PWR_N	DI	Module PWR ON key (low active)

185	FACTORY_RESIN_N	DI	Factory reset (low active)
387	PM_FAULT_N	IO	PMIC pault signal
339	BT_SEC_I2S_D1	IO	Secondary I2S data 1 - for BT
340	BT_SEC_I2S_SCK	IO	Secondary I2S clock - for BT
337	BT_SEC_I2S_D0	IO	Secondary I2S data 0 - for BT
338	BT_SEC_I2S_WS	IO	Secondary I2S word select - for BT
197	WCN_BT_EN	IO	Configurable I/O
152	WLAN_EN	IO	Configurable I/O
193	WCN_AS_EN	IO	Configurable I/O
156	WLAN_LTE_COXM_TXD	IO	Configurable I/O
155	WLAN_LTE_COXM_RXD	IO	Configurable I/O
199	WCN_SW_CTRL	IO	Configurable I/O
143	WCN_HOST_SOL	IO	Configurable I/O
159	WCN_DEV_SOL	IO	Configurable I/O
144	WCN_SW_CTRL_WLAN	IO	Configurable I/O
177	PA_MUTING	IO	Configurable I/O
180	WCN_LAA_RX	IO	Configurable I/O
98	PCIE0_WCN_REFCLK_P	AO	PCIe 0 Gen 3 reference clock - plus
97	PCIE0_WCN_REFCLK_M	AO	PCIe 0 Gen 3 reference clock - minus
100	PCIE0_WCN_RX0_P	AI	PCIe 0 Gen 3 receive 0 - plus
99	PCIE0_WCN_RX0_M	AI	PCIe 0 Gen 3 receive 0 - minus
94	PCIE0_WCN_TX0_P	AO	PCIe 0 Gen 3 transmit 0 - plus
93	PCIE0_WCN_TX0_M	AO	PCIe 0 Gen 3 transmit 0 - minus
102	PCIE0_WCN_RX1_P	AI	PCIe 0 Gen 3 receive 1 - plus
101	PCIE0_WCN_RX1_M	AI	PCIe 0 Gen 3 receive 1 - minus
96	PCIE0_WCN_TX1_P	AO	PCIe 0 Gen 3 transmit 1 - plus
95	PCIE0_WCN_TX1_M	AO	PCIe 0 Gen 3 transmit 1 - minus
149	PCIE0_RST_N	IO	PCIe0 reset signal
148	PCIE0_WAKE_N	IO	PCIe0 wake up signal
150	PCIE0_CLK_REQ_N	IO	PCIe0 clock request
202	PMX_UIM1_RESET	IO	UIM1 reset
198	PMX_UIM1_CLK	IO	UIM1 clock
201	PMX_UIM1_DATA	IO	UIM1 data
186	UIM1_PRESENT	IO	UIM1 presence detection
203	UIM2_LS_EN	DI	UIM2_LS_EN
393	SLEEP_CLK	DI	Sleep clock

394	RFCLK1	DI	76.8 MHz RF clock
399	JTAG_SRST_N	DI	JTAG reset for debug
403	JTAG_TCK	DI	JTAG clock input
404	JTAG_TDI	DI	JTAG data input
401	JTAG_TDO	Z	JTAG data output
402	JTAG_TMS	BS	JTAG mode select input
400	JTAG_TRST_N	DI	JTAG reset
192	BATT_CHECK	DI	Configurable I/O
189	DCDC_CTL	DO	Configurable I/O
182	TOUCH_PWR_EN	DO	Configurable I/O
179	AQR_MDC	DO	Configurable I/O
320	EBI2_OE_N	DO	EBI2 LCD control line
322	EBI2_CLE_UB_N	DO	EBI2 LCD control line
324	EBI2_WE_N	DO	EBI2 LCD control line
326	EBI2_LCD_TE	DO	EBI2 LCD control line
327	EBI2_LCD_CS_N	DO	EBI2 LCD control line
328	EBI2_LCD_RESET_N	DO	EBI2 LCD control line
329	LCD_LDO_EN	DO	Configurable I/O
330	LCD_BL_EN	DO	Configurable I/O
331	LCD_VDD_EN	DO	Configurable I/O
348~356	EBI2 data line	DO	EBI2 LCD data line
388	ANT0_SELO	DO	Antenna0 select 0
390	ANT0_SEL1	DO	Antenna0 select 1
294	ANT1_SELO	DO	Antenna1 select 0
297	ANT1_SEL1	DO	Antenna1 select 1
21	ANT0_PAD	AO	Antenna port 0
24	ANT5_PAD	AO	Antenna port 5
47	ANT2_PAD	AO	Antenna port 2
64	ANT1_PAD	AO	Antenna port 1
66	ANT6_PAD	AO	Antenna port 6
77	ANT7_PAD	AO	Antenna port 7
79	ANT3_PAD	AO	Antenna port 3
90	ANT8_PAD	AO	Antenna port 8
235	ANT1_TS9_CON	PI	Antenna TS9 port 1(1.8V)
88	TS9_PAD	AO	Antenna TS9 port

Operating Modes

The table below briefly summarizes the various operating modes referred in the following chapters.

Table 5. Overview of Operating Modes

Mode	Details	
Normal Operation	Idle	Software is active. The module has registered on the network, and it is ready to send and receive data.
	Talk/Data	Network connection is ongoing. In this mode, the power consumption is decided by network setting and data transfer rate.
Airplane Mode	In this mode, RF function will be invalid and Application Processor sleep state.	
Power Down Mode	In this mode, the power management unit shuts down the power supply. Software is not active. The serial interfaces are not accessible.	

- Airplane mode

When the module enters into airplane mode, the RF function does not work, and all AT commands correlative with RF function will be inaccessible. This mode can be set via the following ways.

Software(TBD)

AT+CFUN command provides the choice of the functionality level through setting <fun> into 0, 1 or 4.

AT+CFUN=0: Minimum functionality mode; both (U)SIM and RF functions are disabled.

AT+CFUN=1: Full functionality mode (by default).

AT+CFUN=4: Airplane mode. RF function is disabled.

Power Supply

- Power supply pins

M3100L provides eleven VPH_PWR pins dedicated to connect with the external power supply. The following table shows the details of VBAT pins and ground pins

Table 6 . VPH_PWR and GND Pins

Pin name	Pin No.(CON 1)	Description	Min	Typ	Max	Unit
VPH_PWR	16~19	Power supply for module's main power	3.5	3.8	4.2	V
GND	1,2,4,8,15,20,23,27,29,31,33,35,37,39,41,43,45,46,49,50,52,54,56,58,60,62,65,68,70,72,74,76,78,80,82,84,86,88,90,91,92,103,104,111,112,119,120,125~132,134,136,137,158,160,163~174,176,205~208,225~230,252~261,280~291,312,314~318,332~336,341,342,346,347,358~363,380,391,392,397,398,406~408,414,416~514	Ground	-	0	-	

- Decrease Voltage Drop

The power supply range of the module is from 3.3V to 4.3V. Please make sure the input voltage will never drop below 3.3V. The following figure shows the voltage drop during Tx power in 3G,4G and 5G networks.

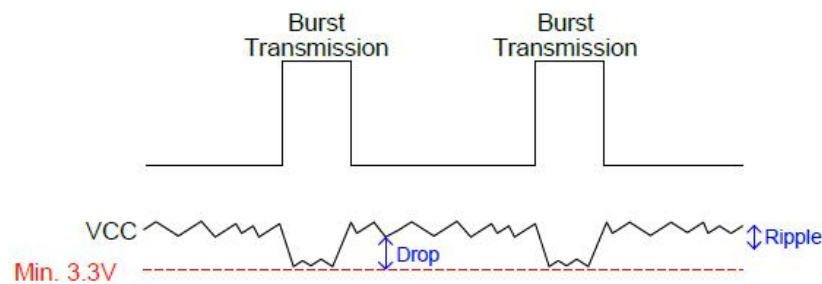


Figure 3. Power Supply Limits during Tx Power

- Reference Design for Power Supply

: TBD

PCIe Interface

M3100L includes one PCIe interface which are compliant with PCI Express Specification Revision 3.0, 4.0. The key features of the PCIe interface are shown below:

- PCI Express Specification Revision 3.0 & 4.0 compliance
- Data rate at 8Gbps per lane
- Can be used to connect to an external Ethernet IC (MAC and PHY) or WLAN IC.

Table 7. Pin Definition of the PCIe Interface

Pin Name	Pin No.	Description	DC Characteristics
PCIE0_WCN_REFCLK_P	98	PCIe 0 Gen 3 reference clock - plus	Compliant with PCIe Gen 3.0 & 4.0 standard specifications. Require differential impedance of 85Ω.
PCIE0_WCN_REFCLK_M	97	PCIe 0 Gen 3 reference clock - minus	
PCIE0_WCN_RX0_P	100	PCIe 0 Gen 3 receive 0 - plus	
PCIE0_WCN_RX0_M	99	PCIe 0 Gen 3 receive 0 - minus	
PCIE0_WCN_TX0_P	94	PCIe 0 Gen 3 transmit 0 - plus	
PCIE0_WCN_TX0_M	93	PCIe 0 Gen 3 transmit 0 - minus	
PCIE0_WCN_RX1_P	102	PCIe 0 Gen 3 receive 1 - plus	
PCIE0_WCN_RX1_M	101	PCIe 0 Gen 3 receive 1 - minus	
PCIE0_WCN_TX1_P	96	PCIe 0 Gen 3 transmit 1 - plus	
PCIE0_WCN_TX1_M	95	PCIe 0 Gen 3 transmit 1 - minus	
PCIE0_RST_N	149	PCIe0 reset signal	
PCIE0_WAKE_N	148	PCIe0 wake up signal	
PCIE0_CLK_REQ_N	150	PCIe0 clock request	

In order to enhance the reliability and availability in applications, please follow the criteria below in the PCIe interface circuit design:

- Keep PCIe data and control signals away from sensitive circuits and signals, such as RF, audio, and 19.2MHz clock signals.
- A capacitance should be added in series on Tx/Rx traces to remove any DC bias.
- Keep the maximum trace length less than 300mm.
- The length difference of Tx or Rx differential pairs should be less than 0.7mm for PCIe routing traces.
- The differential impedance of PCIe data trace should be $85\Omega \pm 10\%$.
- Separate the SS-USB data pairs (Tx, Rx) and PCIe data pairs (Tx, Rx) from each other as far as possible. If SS_USB and PCIe data pairs must cross on adjacent layers, please keep crossings at right angles to minimize unbalanced (asymmetric) coupling.
- PCIe data traces must not be routed under components or crossing other traces.

4

Antenna Interfaces

Antenna Definition
Operating Frequency

Antenna Definition

The M3100L module provide 8 antenna ports for 3G/4G/5G/GNSS. The antenna port impedance is 50Ω.

Definition of antennas interfaces are shown below.

Table 8. Definition of the RF Antenna

Con. Name	Description	Comment
ANT0	LB DRx, n41/n77 Rx5	50Ω impedance
ANT1	LB TRx0, UHB TRx0, MHB Tx1/DRx	50Ω impedance
ANT2	MB/UHB PRx MIMO, n41 Rx7	50Ω impedance
ANT3	MB/UHB DRx MIMO, n41 Rx8	50Ω impedance
ANT5	MHB TRx0, UHB Tx1/DRx	50Ω impedance
ANT6	n41/n77 Rx6, GNSS L1/L5	50Ω impedance
ANT7	HB PRx MIMO, n77 Rx7	50Ω impedance
ANT8	HB DRx MIMO, n77 Rx8	50Ω impedance

Operating Frequency

Table 9. 3G/4G/5G Operating Frequency

Band	Uplink(UL)	Downlink(DL)	Duplex mode
WCDMA B1	1920~1980 MHz	2110~2170 MHz	WCDMA
WCDMA B2	1850~1910 MHz	1930~1990 MHz	WCDMA
WCDMA B4	1710~1755 MHz	2110~2155 MHz	WCDMA
WCDMA B5	824~849 MHz	869~894 MHz	WCDMA
WCDMA B8	880~915 MHz	925~960 MHz	WCDMA
LTE B1	1920~1980 MHz	2110~2170 MHz	FDD
LTE B2	1850~1910 MHz	1930~1990 MHz	FDD
LTE B3	1710~1785 MHz	1805~1880 MHz	FDD
LTE B4	1710~1755 MHz	2110~2155 MHz	FDD
LTE B5	824~849 MHz	869~894 MHz	FDD
LTE B7	2500~2570 MHz	2620~2690 MHz	FDD
LTE B8	880~915 MHz	925~960 MHz	FDD
LTE B12	699~716 MHz	729~746 MHz	FDD
LTE B13	777~787 MHz	746~756 MHz	FDD
LTE B20	832~862 MHz	791~821 MHz	FDD
LTE B25	1850~1915 MHz	1930~1995 MHz	FDD
LTE B26	814~849 MHz	859~984 MHz	FDD
LTE B28	703~748 MHz	758~803 MHz	FDD
LTE B38	2570~2620 MHz	2570~2620 MHz	TDD
LTE B39	1880~1920 MHz	1880~1920 MHz	TDD
LTE B40	2300~2400 MHz	2300~2400 MHz	TDD
LTE B41	2496~2690 MHz	2496~2690 MHz	TDD
LTE B48	3550~3700 MHz	3550~3700 MHz	TDD
LTE B66	1710~1780 MHz	2110~2200 MHz	FDD

LTE B71	663~698 MHz	617~652 MHz	FDD
5GNR n25	1850~1915 MHz	1930~1995 MHz	FDD
5GNR n28	703~748 MHz	758~803 MHz	FDD
5GNR n41	2496~2690 MHz	2496~2690 MHz	TDD
5GNR n48	3550~3700 MHz	3550~3700 MHz	TDD
5GNR n66	1710~1780 MHz	2110~2200 MHz	FDD
5GNR n71	663~698 MHz	617~652 MHz	FDD
5GNR n77	3450~3550 MHz, 3700~3980 MHz	3450~3550 MHz, 3700~3980 MHz	TDD
5GNR n78	3450~3550 MHz	3450~3550 MHz	TDD

Table 10. GNSS Frequency

Type	Frequency
GPS L1	1575.42±1.023MHz
GPS L5	1176.45±10.23MHz
GLONASS	1597.5~1605.8MHz

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Electrical, Reliability and Radio Characteristics

Absolute Maximum Ratings
Operation and Storage Temperatures
RF Output Power
RF Receiving Sensitivity

Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital and analog pins of the module are listed in the following table.

Table 11. Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VPH_PWR	3.3	4.35	V
Peak Current of VPH_PWR	TBD	2.5	A
Voltage at Digital Pins	1.7	1.9	V
Voltage at ADC	TBD	TBD	V

Operation and Storage Temperatures

The operation and storage temperatures are listed in the following table.

Table 12. Operation and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operation Temperature Range	-30	+25	+85	°C
Storage Temperature Range	-50		+150	°C

RF Output Power

The following tables show conducted RF output power of M3100L module.

Table 13. Output Power

Band	Max.	Min
WCDMA Band	23dBm+1/-3dBm	< -49dBm
LTE Band	23dBm±2.7dBm	< -39dBm
LTE B41 band	26dBm+3/-4dBm	< -39dBm
NR Band	23dBm±2.7dBm	< -40dBm
NR n41/n77 band	26dBm+3/-4dBm	< -40dBm

RF Receiving Sensitivity

The RF conducted reception sensitivity of the module fully complies with the 3GPP specification. The following tables show conducted RF receiving sensitivity of M3100L module.

Table 14. M3100L Module Conducted RF Receiving Sensitivity

Band	Primary	Diversity	3GPP Ant) (primary
WCDMA B1	TBD	TBD	-106.7dBm
WCDMA B2	TBD	TBD	-104.7dBm
WCDMA B4	TBD	TBD	-106.7dBm
WCDMA B5	TBD	TBD	-104.7dBm
WCDMA B8	TBD	TBD	-103.7dBm
LTE B1(10MHz)	TBD	TBD	-97.0dBm
LTE B2(10MHz)	TBD	TBD	-95.0dBm
LTE B3(10MHz)	TBD	TBD	-94.0dBm
LTE B4(10MHz)	TBD	TBD	-97.0dBm

LTE B5(10MHz)	TBD	TBD	-95.0dBm
LTE B7(10MHz)	TBD	TBD	-95.0dBm
LTE B8(10MHz)	TBD	TBD	-94.0dBm
LTE B12(5MHz)	TBD	TBD	-97.0dBm
LTE B13(10MHz)	TBD	TBD	-94.0dBm
LTE B20(10MHz)	TBD	TBD	-94.0dBm
LTE B25(5MHz)	TBD	TBD	-96.5dBm
LTE B26(5MHz)	TBD	TBD	-97.5dBm
LTE B28(10MHz)	TBD	TBD	-95.5dBm
LTE B38(10MHz)	TBD	TBD	-97.0dBm
LTE B39(10MHz)	TBD	TBD	-97.0dBm
LTE B40(10MHz)	TBD	TBD	-97.0dBm
LTE B41(20MHz)	TBD	TBD	-92.0dBm
LTE B48(10MHz)	TBD	TBD	-96.0dBm
LTE B66(10MHz)	TBD	TBD	-96.5dBm
LTE B71(10MHz)	TBD	TBD	-94.2dBm

Band	Primary	Diversity	3GPP (2 Antenna)
5GNR n25(10MHz)(SCS:15KHz)	TBD	TBD	-93.3dBm
5GNR n28(10MHz)(SCS:15KHz)	TBD	TBD	-95.5dBm
5GNR n41(100MHz)(SCS:30KHz)	TBD	TBD	-84.7dBm
5GNR n48(10MHz)(SCS:30KHz)	TBD	TBD	-96.1dBm
5GNR n66(10MHz)(SCS:15KHz)	TBD	TBD	-96.3dBm
5GNR n71(10MHz)(SCS:15KHz)	TBD	TBD	-94.0dBm
5GNR n77(20MHz)(SCS:30KHz)	TBD	TBD	-92.4dBm
5GNR n78(20MHz)(SCS:30KHz)	TBD	TBD	-92.9dBm

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Mechanical Dimensions

Mechanical Dimensions of Module
Design Effect Drawings of the Module

Mechanical Dimensions of Module

The following figure shows the mechanical dimensions (in mm) of M3100L module.

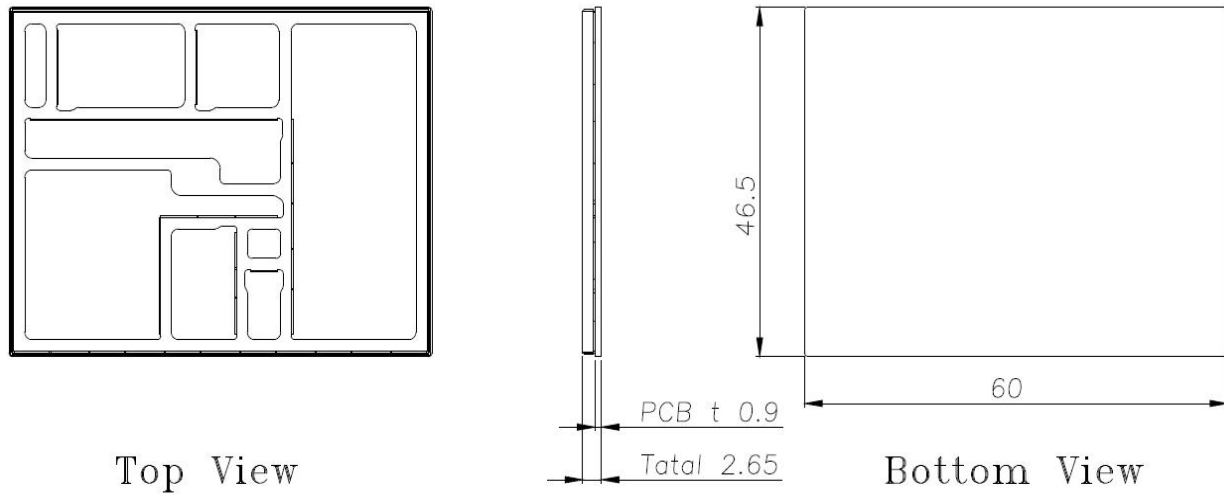
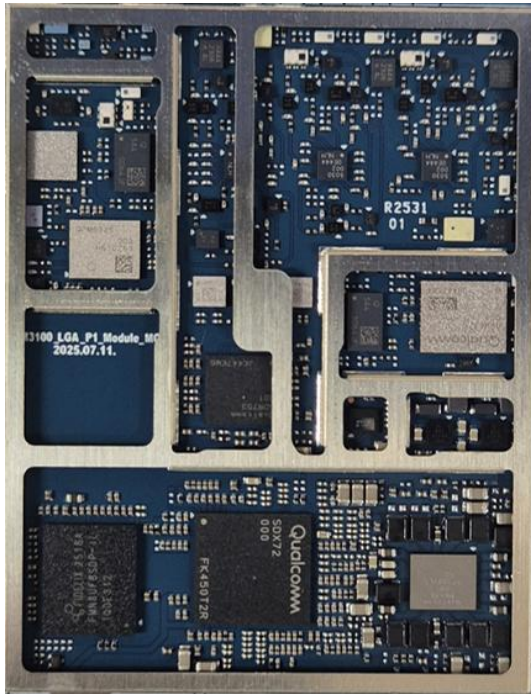


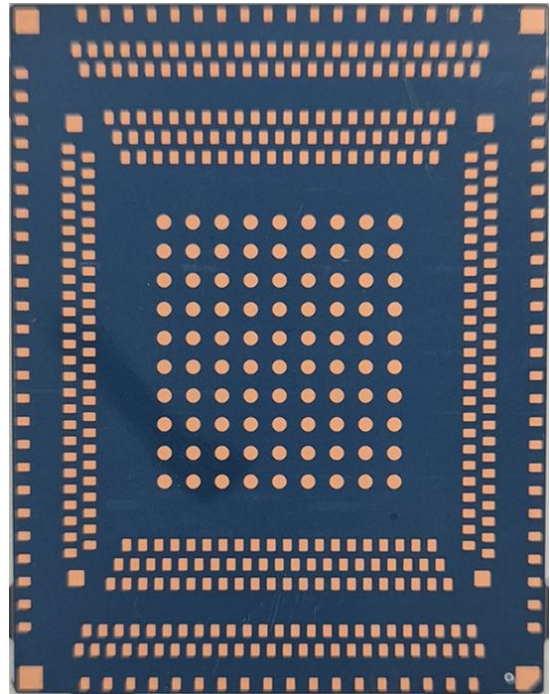
Figure 4. Module Top and Bottom Dimensions

Design Effect Drawings of the Module

The following figure shows the design effect drawings of M3100L module.



Top View



Bottom View

Figure 5. Top & Bottom View of the Module



Regulatory Information

Regulatory Statements

Regulatory Statements

FCC Equipment Authorization ID: XHG-M3100L

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 compliant with the transmitter(s) rule(s).
The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

List of applicable FCC rules

This module has been tested for compliance to FCC Part 15

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

Summarize the specific operational use conditions

The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) or being used in a portable condition will need a separate reassessment through a class II permissive change application or new certification.

RF exposure considerations

This equipment complies with FCC mobile radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.

Antennas

The following antennas have been certified for use with this module; antennas of the same type with equal or lower gain may also be used with this module. The antenna must be installed such that 20 cm can be maintained between the antenna and users.

Antenna Type(PIFA)	WCDMA B2 -1.36dBi; WCDMA B4 -1.91dBi; WCDMA B5 -0.85dBi; LTE B2(25) -1.36dBi; LTE B4(66) -1.91dBi; LTE B5(26) -0.85dBi; LTE B7 -1.34dBi; LTE B12 -0.76dBi; LTE B13 -0.87dBi; LTE B38 -1.34dBi; LTE B40 -0.12dBi; LTE B41 -0.72dBi; LTE B48 -0.18dBi; LTE B71 -1.06dBi; 5G NR n25 -1.36dBi; 5G NR n41 -0.72dBi; 5G NR n48 -0.18dBi; 5G NR n66 -1.91dBi; 5G NR n71 -1.06dBi; 5G NR n77 -0.03dBi; 5G NR n78 -0.03dBi;
Antenna connector	INTENNA

Label and compliance information

The final end product must be labeled in a visible area with the following: "Contains FCC ID: XHG-M3100L". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

Information on test modes and additional testing requirements

This transmitter is tested in a standalone mobile RF exposure condition and any co-located or simultaneous transmission with other transmitter(s) or portable use will require a separate class II permissive change re-evaluation or new certification.

Additional testing, Part 15 Subpart B disclaimer

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B (unintentional radiator) rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable. As long as all 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 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

OEM/Host manufacturer responsibilities

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment

FCC Warning

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.³

Explanation: This module meets the requirements FCC 47 CFR Part2, Part22,Part24,Part24,Part90,Part 96, and Part 96.47.

2.3 Specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.

Explanation: The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) or being used in a portable condition will need a separate reassessment through a class II permissive change application or new certification.

2.4 Limited module procedures

If a modular transmitter is approved as a “limited module,” then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.

A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.

This limited module procedure is also applicable for RF exposure evaluation when it is necessary to demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.

Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects: layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.

- a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s), dielectric constant, and impedance as applicable for each type of antenna);
- b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency, the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
- c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
- d) Appropriate parts by manufacturer and specifications;
- e) Test procedures for design verification; and
- f) Production test procedures for ensuring compliance.

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

Explanation: It is “not applicable” as trace antenna which is not used on the module.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person’s body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use

conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This equipment complies with FCC mobile radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an “omni-directional antenna” is not considered to be a specific “antenna type”)).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: PIFA Antenna

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating “Contains FCC ID” with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The final end product must be labeled in a visible area with the following: “Contains FCC ID: XHG-M3100L”. The grantee’s FCC ID can be used only when all FCC compliance requirements are met.

2.9 Information on test modes and additional testing requirements

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer’s determination that a module as installed in a host complies with FCC requirements.

Explanation: For more information on testing, please contact the manufacturer.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that the modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by

the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Explanation: The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.247) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when it contains digital circuitry.

2.11 Note EMI Considerations

Note that a host manufacturer is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional noncompliant limits due to module placement to host components or properties.

Explanation: For standalone mode, reference the guidance in D04 Module Integration Guide and for simultaneous mode; see D02 Module Q&A Question 12, which permits the host manufacturer to confirm compliance

2.12 How to make changes

Since only Grantees are permitted to make permissive changes, it is recommended that module manufacturers provide contact information and some guidance to host providers in the integration instructions if they expect their module will be used differently than granted.

Explanation: Contact information: win2337@franklitech.co.kr / Tel: 82-70-8228-6445