

LTE PCI Express M.2 Module

95.1993T01

User Manual

version 0.7

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1. Introduction

Project Name: LTE PCI Express M.2 Module

Foxconn Project Code: 95.1993T01

This documentation describes the hardware, and mechanical requirements specification of LTE PCI Express M.2 Module. It is a confidential document of Foxconn.

1.1 Scope

The function of this module provides a LTE wireless WAN interface to access the internet, and it is fully compliant with LTE specification (3GPP Release 12).

1.2 Function

LTE Standards	3GPP standard
Operating Frequency	Band 25: 1930 to 1995 MHz (DL), 1850 to 1915 MHz (UL) Band 41: (L) 2500 to 2570 MHz (DL/UL) (H) 2620 to 2690MHz (DL/UL)
Number of T/Rx interface:	Band 25: 2Tx /8Rx Band 41L/H: 4Tx /8Rx
Channel Bandwidth:	5, 10, 15, 20 MHz for Band 41 5, 10, 15, 20 MHz for Band 25

Carrier Aggregation

DL carrier aggregation	UL carrier aggregation
B41 (20+20) contiguous	B41 (20+20) contiguous and non-contiguous
B41 (20+20+20) contiguous	B41 (20+15) contiguous and non-contiguous
B25 (5+5) non-contiguous	B41 (15+20) contiguous and non-contiguous
B25 (5+10) non-contiguous	B41 (20+10) contiguous and non-contiguous
	B41 (10+20) contiguous and non-contiguous
	B41 (20+5) contiguous and non-contiguous
	B41 (5+20) contiguous and non-contiguous
	B41 (15+15) contiguous and non-contiguous
	B41 (10+15) contiguous and non-contiguous
	B41 (15+10) contiguous and non-contiguous

(hardware design can support above CA combination, but the final CA combinations plan depends on carrier engagement and software design.)

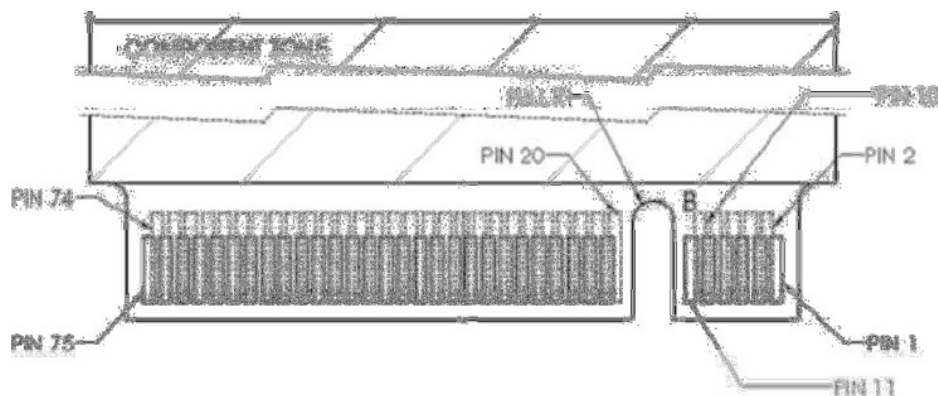
2. Specification

2.1 Physical Interface

RGMII, PCI express M.2 module,
 PCB size: 64.4 mm x 65 mm
 Antenna connector: UFL connector *8
 Dual SIM interface (one for testing)

2.2 Pin Arrangement

Figure 2.1 the sequence of pins on the 75-pin signal interface of M.2 Key.B.



(Input: Carrier board to Module)

(Output: Module to Carrier board)

(Bi-direction: both direction among module and carrier board)

Pin number	pin name	description	direction	Voltage Domain
1	SIM_SEL	Select SIM0 or SIM1 · SIM_SEL Open or HIGH = SIM0 is active · SIM_SEL LOW = SIM1 is active	Input	OD, PU(1.8V)
2	3.6V_AUX	power	input	VCC = 3.6V
3	GND	ground	NA	NA
4	3.6V_AUX	power	input	VCC = 3.6V
5	GND	ground	NA	NA
6	PWR_EN	enable/disable PMIC	Input	PU(VCC=3.6V)
7	USB2.0_DP	USB2.0 D+ signal	Bi-Direction	
8	DCDC_1.8V	power	Output	1.8V
9	USB2.0_DM	USB2.0 D- signal	Bi-Direction	
10	VBUS	USB VBUS	NA	floating
11	GND	ground	NA	NA
12	NA	NA	NA	NA

13	NA	NA	NA	NA
14	NA	NA	NA	NA
15	NA	NA	NA	NA
16	NA	NA	NA	NA
17	NA	NA	NA	NA
18	NA	NA	NA	NA
19	NA	NA	NA	NA
20	SIM1_RST_O	Test SIM reset	Output	SIM1 VCC
21	GND	ground	NA	NA
22	SIM1_CLK_O	Test SIM clock	Output	SIM1 VCC
23	UART0_RXD	UART0 serial receive data	Input	1.8V
24	SIM1_DAT_O	Test SIM data	Bi-Direction	SIM1 VCC
25	UART0_TXD	UART0 serial transmit data	Output	1.8V
26	SIM_VCC1	Test SIM power	output	SIM1 VCC
27	GND	ground	NA	NA
28	GPD2_21	GPIO for future use	NA	1.8V
29	3.6V_AUX	power	input	VCC = 3.6V
30	SIM0_RST	LTE SIM reset	Output	SIM0 VCC
31	3.6V_AUX	power	input	VCC = 3.6V
32	SIM0_CLK	LTE SIM clock	Output	SIM0 VCC
33	GND	ground	NA	NA
34	SIM0_DAT	LTE SIM data	Bi-Direction	SIM0 VCC
35	3.6V_AUX	power	input	VCC = 3.6V
36	SIM_VCC0	SIM power	output	SIM0 VCC
37	3.6V_AUX	power	input	VCC = 3.6V
38	10MS_PULSE	GPIO(1PPS PULSE)	Output	1.8V
39	GND	ground	NA	NA
40	RGMII_RCTL	RGMII Interface	Input	1.8V
41	3.6V_AUX	power	input	VCC = 3.6V
42	RGMII_RCLK	RGMII Interface	Input	1.8V
43	3.6V_AUX	power	input	VCC = 3.6V
44	RGMII_MDIO	RGMII Interface	Input	1.8V
45	GND	ground	NA	NA
46	RGMII_MDC	RGMII Interface	Output	1.8V
47	Default_Fact	factory default	Input	1.8V
48	RGMII_TCLK	RGMII Interface	Output	1.8V
49	GPD2_0	GPIO for future use	NA	1.8V
50	RGMII_TCTL	RGMII Interface	Output	1.8V

51	GND	ground	NA	NA
52	NA	NA	NA	floating
53	GPD2_1	GPIO for future use	NA	1.8V
54	RGMII_RXD3	RGMII Interface	Input	1.8V
55	GPD2_2	GPIO for future use	NA	1.8V
56	RGMII_RXD2	RGMII Interface	Input	1.8V
57	GND	ground	NA	NA
58	RGMII_RXD1	RGMII Interface	Input	1.8V
59	GPD2_3	GPIO for future use	NA	1.8V
60	RGMII_RXD0	RGMII Interface	Input	1.8V
61	GPD2_4	GPIO for future use	NA	1.8V
62	RGMII_TXD3	RGMII Interface	Output	1.8V
63	GPD2_5	GPIO for future use	NA	1.8V
64	RGMII_TXD2	RGMII Interface	Output	1.8V
65	GPD2_6	GPIO for future use	NA	1.8V
66	RGMII_TXD1	RGMII Interface	Output	1.8V
67	RESET#_KEY	Reset signal (Active LOW)	input	PU(1.8V)
68	RGMII_TXD0	RGMII Interface	Output	1.8V
69	GPD2_7	GPIO for future use	NA	1.8V
70	3.6V_AUX	power	input	VCC = 3.6V
71	GND	ground	NA	NA
72	3.6V_AUX	power	input	VCC = 3.6
73	GND	ground	NA	NA
74	3.6V_AUX	power	input	VCC = 3.6V
75	GND	ground	NA	NA

3. Product Requirements

3.1 Hardware Feature

3.1.1 Baseband processor: GDM7243A

GDM7243A is a highly integrated System-on-a-Chip (SOC) designed to support Long Term Evolution (LTE). It includes a LTE baseband, high performance dual Cortex-a7 processor and radio transceivers.

- Dual processor architecture: Application CPU + Modem CPU (LTE)
- RGMII/USIM/UART interface
- Supports NAND Flash Interface

- LTE Features:(Internal: 4Rx-2TX; External: 4Rx-2TX)
 - ✓ 8RX Diversity
 - ✓ TDD/FDD

3.1.2 RF transceiver: GRF7243A

GRF7243A is a fully integrated RF transceiver, all required PLL/VCO/loop filters are integrated. Patented direct-conversion RF architecture with CMOS integration and minimizing external BOM cost.

- Supports all LTE bandwidth with multiple bandwidth channel selection filter 5/10/15/20MHz
- RX saw-less architecture except UHB
- TX single-ended port except UHB

3.1.3 PMIC: G5851

The G5851 provide a complete power supply solution, it contains 4 dc/dc converters and 7 LDOs. All channels DC/DC converters operate at one fixed frequency of 3.0MHz. The G5851 features an I2C compatible interface.

- 2.8V ~ 5.5V Input Voltage Operation.
- Built-In Power ON/OFF Sequence for PMU.
- 7-channel LDOs are Programmable to Voltage Options by I2C.
- SIM Card I/F Level Shifter

3.1.4 MCP

NAND Flash Density: 2-Gbits

- Operating voltage : 1.7V to 1.95V
- Operating Temperature : -25°C ~ +85°C
- Organization :
 - Memory cell array: 2176 x 128K x 8
 - Register: 2176 x 8
 - Page size: 2176 bytes
 - Block size: (128K + 8K) bytes
 - 8bit ECC

Mobile DDR2 SDRAM Density: 2-Gbit

- Operating voltage: 1.7V to 1.95V
- Operating Temperature: -25°C ~ +85°C
- Speed: 533Mbps

3.1.6 USIM

Off-board USIM connector supported. This module provides the dual SIM interface, and it can be selected by SIM_SEL pin (the pin 1 of M.2 connector).

SIM_SEL(internally pull up)	
State	SIM selection
High	SIM0
Low	SIM1

3.1.7 RF CONNECTOR

Figure 3.1 RF connector location and description

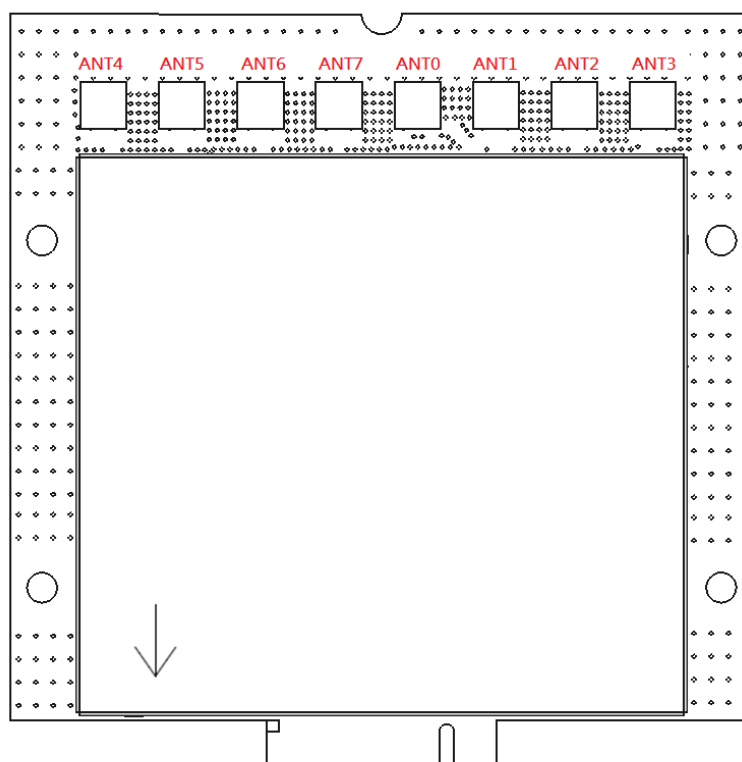
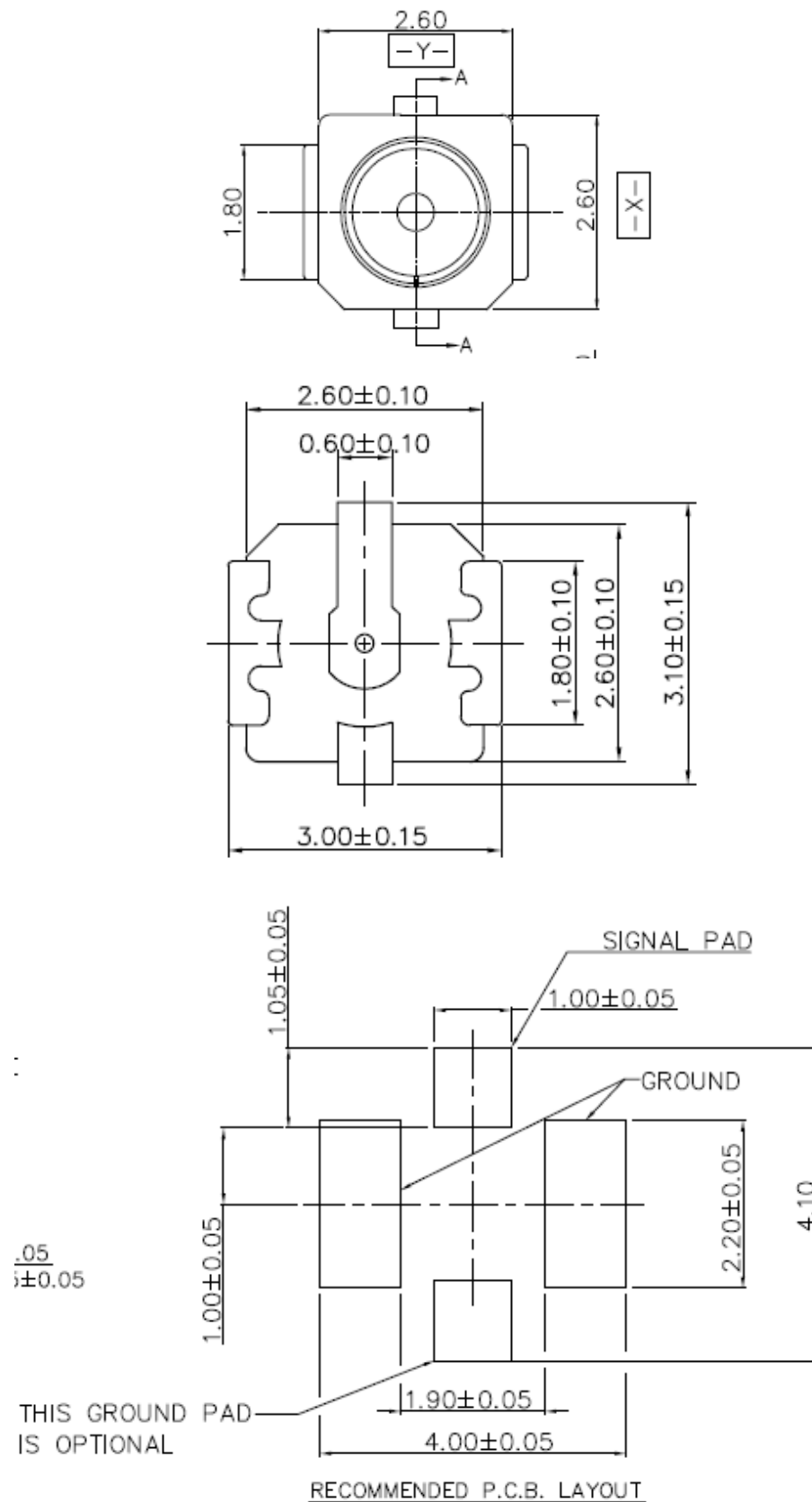
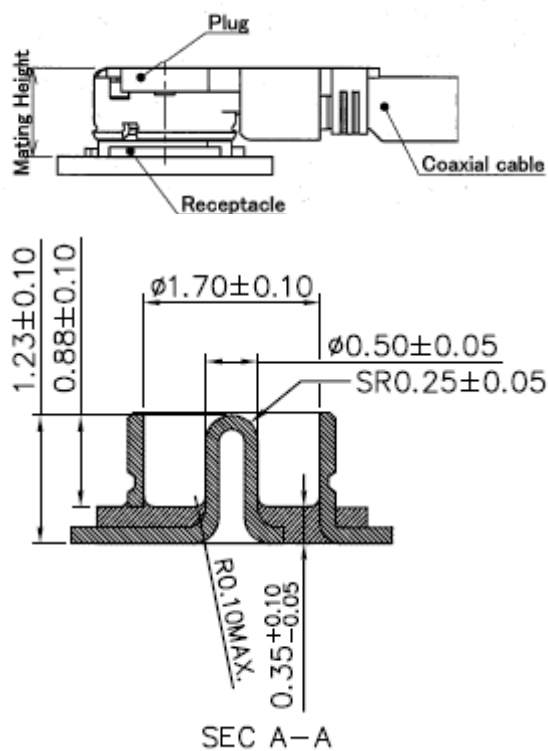


Figure 3.2 RF connector detailed information





ANT	Support Band	TX	RX	Remark
# 0	25,41L, 41H	25,41L,41H	25,41L,41H	TDD/FDD
# 1	25,41L, 41H	NA	25,41L,41H	TDD/FDD
# 2	25,41L, 41H	41L,41H	25,41L,41H	TDD/FDD
# 3	25,41L, 41H	NA	25,41L,41H	TDD/FDD
# 4	25,41L, 41H	41L,41H	25,41L,41H	TDD/FDD
# 5	25,41L, 41H	25	25,41L,41H	TDD/FDD
# 6	25,41L, 41H	41L,41H	25,41L,41H	TDD/FDD
# 7	25,41L, 41H	NA	25,41L,41H	TDD/FDD

And this module supports TX antenna switching as below,
(Each “+” indicates a separate TX path)

Band 41							
Ant0	Ant4	Ant2	Ant6	Ant1	Ant5	Ant3	Ant7
+	+	+	+				
		+	+	+	+		
				+	+	+	+
+	+					+	+
Band 25							
Ant0	Ant4	Ant2	Ant6	Ant1	Ant5	Ant3	Ant7
+	+						
		+	+				
				+	+		
						+	+

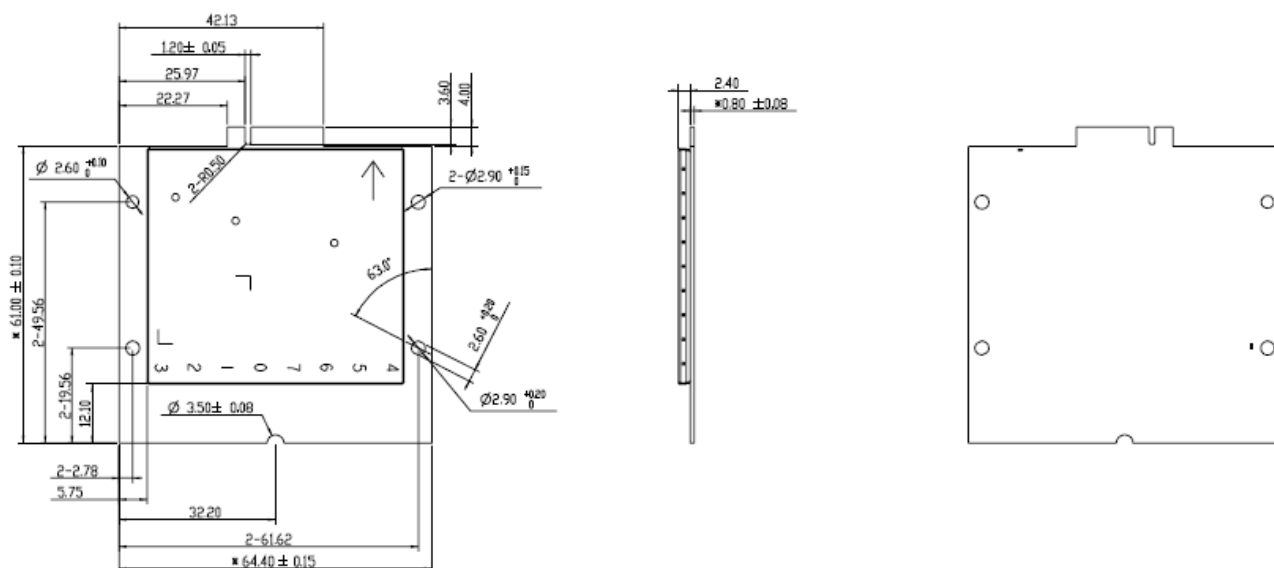
3.2 Mechanical Specifications

3.2.1 Overview

The golden finger of 95.1993T01 is compatible with the NGFF 75 pin card edge-type connector. Refer to NGFF Electromechanical Specification Revision P12 with Input Power and Voltage Tolerance ECN for more details.

3.2.2 Mechanical constraints

Figure 3.3 Shows the mechanical constraints of 95.1993T01



3.3 Electrical Specifications

Parameter	Min	Type	Max	Units
Storage Temperature	-30	+25	+85	°C
Recommend operating temperature (3GPP compliant)	-10	+25	+55	°C
Extendable (with limited performance)	-40		+85	°C
Operating Voltage	3.42	3.6	3.78	V

*Temperature measured on 95.1993T01 module

Table 3.1 Recommended operating conditions

Remark:

1. Extendable operation allows normal mode data transmission for limited time within the extendable temperature range (outside the operating temperature range) the specified electrical characteristics may be degraded.
2. Due to temperature measurement uncertainty, a tolerance on the stated shutdown thresholds may occur. The possible deviation is in the range of +/- 2 °C at the over-temperature and under-temperature limit.

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

4. Operating 95.1993T01 device under conditions beyond its absolute maximum ratings (Table 3-1) may damage the device. Absolute maximum ratings are limiting values to be considered individually when all other parameters are within their specified operating ranges.

Functional operation and specification compliance under any absolute maximum condition, or after exposure to any of these conditions, is not guaranteed or implied. Exposure may affect device reliability

3.3.1 RF performance specifications

RF performance for 95.1993T01:

- DL MCS: up to 256-QAM
- UL MCS: up to 64-QAM
- Uplink MIMO 2x2
- Downlink MIMO 4x4
- Compliance with 3GPP Rel. 12, in particular TS36.101
- Transmission modes: TM1, 2, 3, 4, 5, 6, 7, 8, 9
 - ✓ TM3: 2/3/4 layers MIMO
 - ✓ TM4: 2/3/4 layers MIMO
 - ✓ TM9: 2/3/4 layers MIMO, up to eight CSI-RS

OEM/Integrators Installation Manual

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).

End Product Labeling

When the module is installed in the host device, the FCC 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 FCC ID: MCL951993A”

The FCC ID can be used only when all FCC compliance requirements are met.

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:

Standalone Condition:

- 6.5 dBi in LTE B25
- 11.5 dBi in LTE B41

Assuming collocated with an ordinary WLAN transmitter with 5 dBi antenna gain

- 6.5 dBi in LTE B25
- 10.0 dBi in LTE B41

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.

Federal Communication Commission Interference Statement

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Radiation Exposure Statement

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