IMG2 User Guide V1.0

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Contact Information

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Revision History

Rev. #	Author	Summary of Changes	Date
1.0	WNC	First release.	2018/09/20

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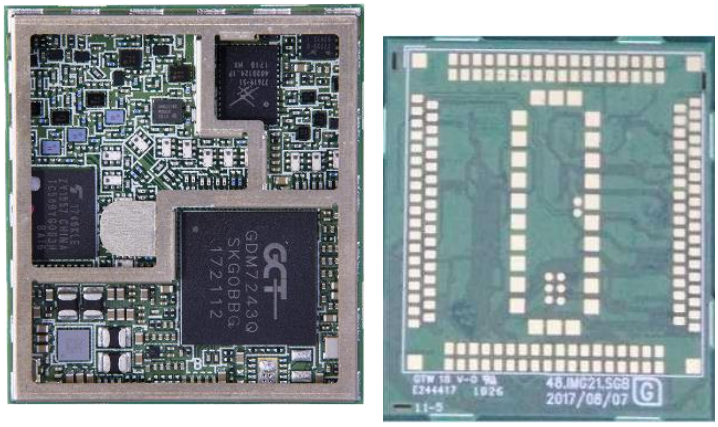
Contents

1. Introduction

This document gives an instruction on how to use IMG2 module and HDK.

1.1. LTE IMG2 Overview

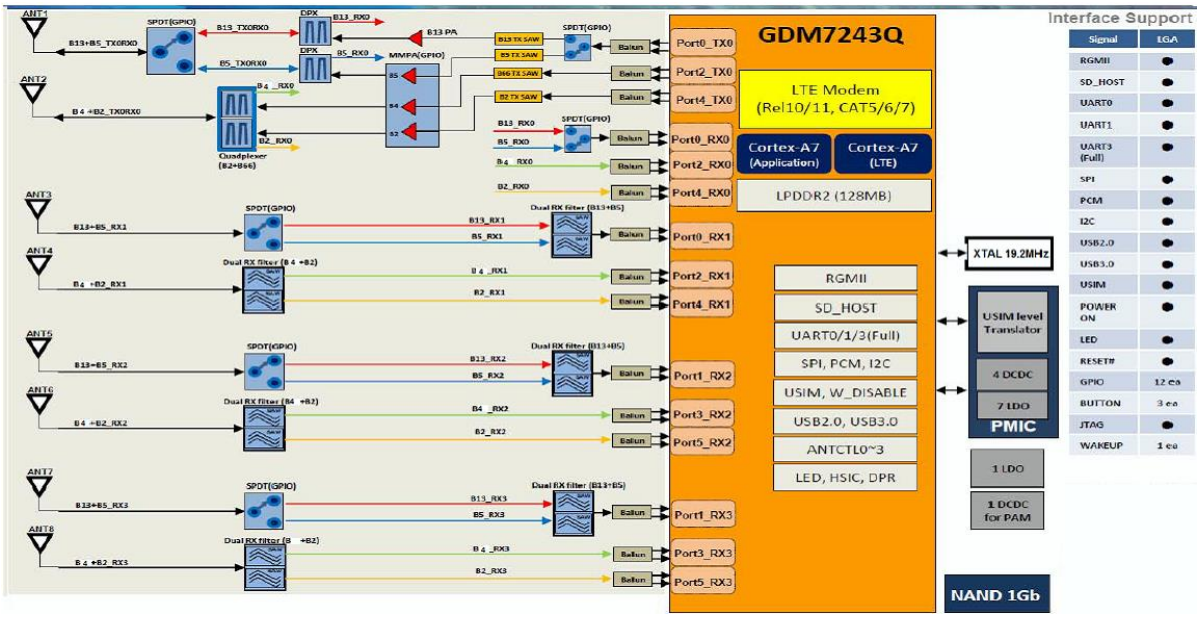


Form Factor: LGA

Dimension: 32x36x4.3(mm)

DC Voltage: 3.3~4.3V

Block Diagram



Note:

1. Only using ANT1~ANT4, all of other antenna ports should be terminated by 50ohm load for module application, and which output performancs are guaranteed accordingly.

2. This module not certified for embedded antenna or hanheld devices

Features:

Platform: GCT GDM7243Q

Support FDD Band 2/4/5/13

compliant with LTE specification (3GPP Release 10)

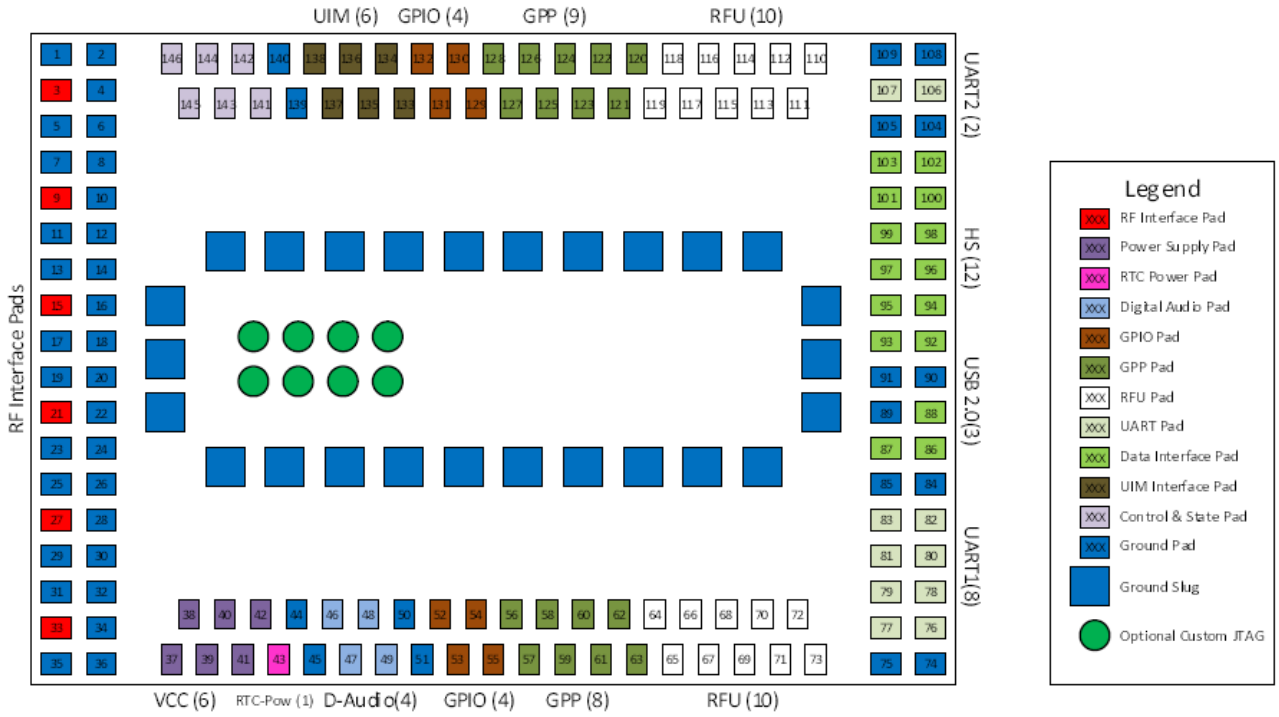
Support 1T2R Cat. 6 with downlink carrier aggression

- Uplink: 50Mbps
- Downlink: 300Mbps
- Supports downlink inter and intra 2-Carrier Aggregation (Class C), 2+2, 5+5, 4+4 2+4, 2+5, 2+13, 4+5, 4+13, 5+13,
- Support all LTE Bandwidth per 3GPP standard (1.4/3/5/10/15/20MHz)

- **Frequency Bands**

LTE	UL (MHz)	DL (MHz)	TX Power
Band 2	1850~1910	1930~1990	23 +/-2.7dBm
Band 4	1710~1755	2110~2155	23 +/-2.7dBm
Band 5	824~849	869~894	23 +/-2.7dBm
Band 13	777~787	746~756	23 +/-2.7dBm

a) LGA PCB footprint



b) LGA Pin Assignments

Pin #	ETSI Pin assign in ETSI Spec LGA			IMG2 LGA			IMG2 Description
	Signal	Dir	Level	Signal	Dir	Level	
1	GND						
2	GND						
3	RF_GNSS			NC			Antenna for a GNSS receiver
4	GND						
5	GND						
6	GND						
7	LB_RF1						
8	GND						
9	GND						
10	GND						
11	LB_RF2						
12	GND						
13	GND						
14	GND						
15	LB_RF3						
16	GND						
17	GND						
18	GND						
19	LB_RF4						
20	GND						
21	GND						
22	GND						
23	HB_RF1						
24	GND						
25	GND						
26	GND						

27	HB_RF2						
28	GND						
29	GND						
30	GND						
31	HB_RF3						
32	GND						
33	GND						
34	GND						
35	HB_RF4						
36	GND						
37	VCC1						Power (Typ=3.8V, Min=3.4V, Max=4.2V)
38	VCC2						Power (Typ=3.8V, Min=3.4V, Max=4.2V)
39	VCC3						Power (Typ=3.8V, Min=3.4V, Max=4.2V)
40	VCC4						Power (Typ=3.8V, Min=3.4V, Max=4.2V)
41	VCC5						Power (Typ=3.8V, Min=3.4V, Max=4.2V)
42	VCC6						Power (Typ=3.8V, Min=3.4V, Max=4.2V)
43	RTC_POWER			NC			Typ=3.0V, Min=2.0V, Max=3.25V
44	GND						
45	GND						
46	PCM_SYNC/I2S_WS			PCM_SYNC	O	1.8V	
47	PCM_DIN/I2S_DIN			PCM_IN	I	1.8V	

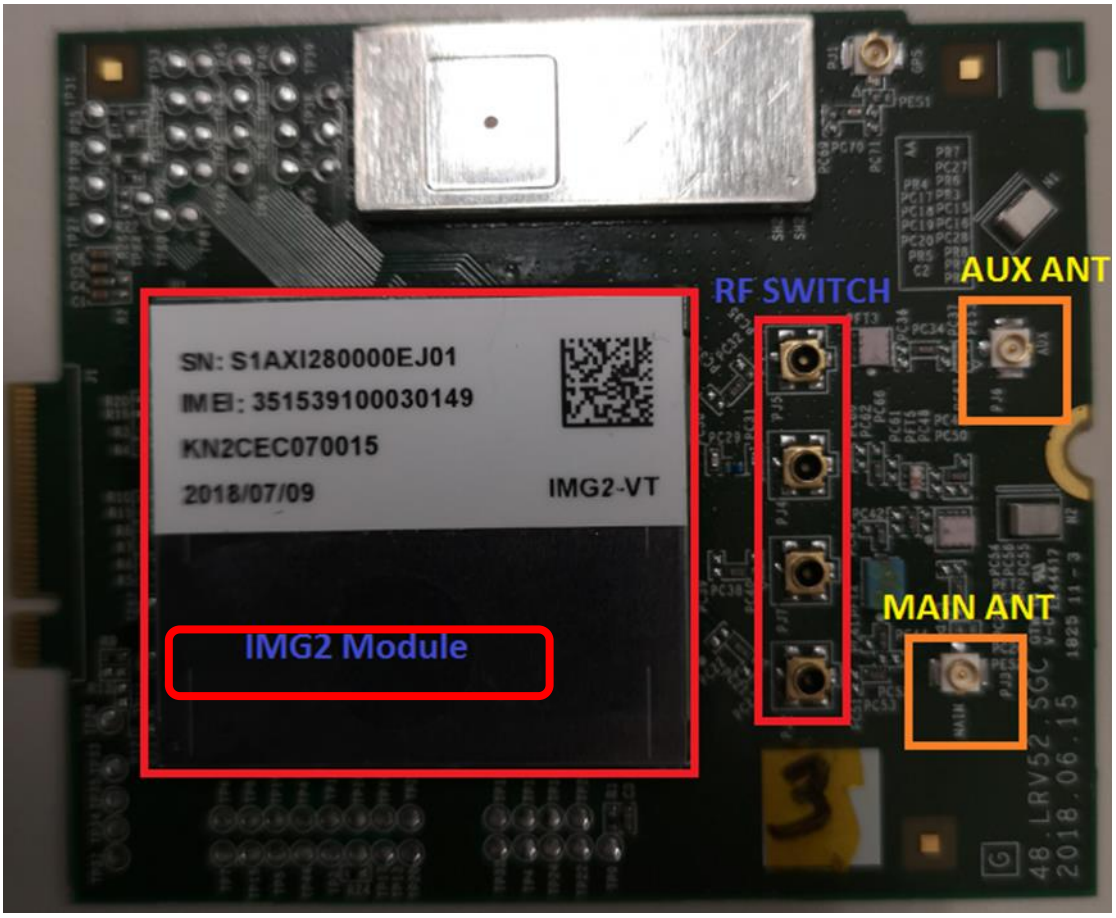
48	PCM_DOUT/I2S_DOUT			PCM_OUT	O	1.8V	
49	PCM_CLK/I2S_CLK			PCM_MCLK	O	1.8V	
50	GND						
51	GND						
52	GPIO01		VREF	UART0_TXD	O	1.8V	
53	GPIO02		VREF	UART0_RXD	I	1.8V	
54	GPIO03		VREF	W_DISABLE#1	I	3.3V	
55	GPIO04		VREF	W_DISABLE#2	I	1.8V	
56	GPP01			I2C_CLK	O	1.8V	
57	GPP02			I2C_SDA	B	1.8V	
58	GPP03						
59	GPP04			RGMII_MDC		3.3V	RGMII Signals
60	GPP05			RGMII_MDIO			
61	GPP06			RGMII_TCLK			
62	GPP07			RGMII_TCTL			
63	GPP08			RGMII_TXD0			
64	RFU			RGMII_TXD1			
65	RFU			RGMII_TXD2			
66	RFU			RGMII_TXD3			
67	RFU			RGMII_RXD0			
68	RFU			RGMII_RXD1			
69	RFU			RGMII_RXD2			
70	RFU			RGMII_RXD3			
71	RFU			RGMII_RCLK			
72	RFU			RGMII_RCTL			
73	RFU			PHY2MAC_125Mhz			
74	GND						
75	GND						
76	UART1_DTR		VREF	UART2_RXD		VREF(1.8V)	
77	UART1_RING		VREF	UART2_TXD		VREF(1.8V)	
78	UART1_DCD		VREF	COEX3		VREF(1.8V)	
79	UART1_DSR		VREF			VREF(1.8V)	
80	UART1_CTS		VREF	UART3_CTS		VREF(1.8V)	
81	UART1_RTS		VREF	UART3_RTS		VREF(1.8V)	
82	UART1_RX		VREF	UART3_RXD		VREF(1.8V)	

83	UART1_TX		VREF	UART3_TXD		VREF(1.8V)	
84	GND						
85	GND						
86	USB_DP			USB2.0_DP	B		
87	VBUS/GPIO87				I		
88	UAB_DM			USB2.0_DM	B		
89	GND						
90	GND						
91	GND						
92	USB3_SSTXn			USB3.0-SSTX-	B		
93	PCIe_CLKREQ/MPHY_SB1			NC			
94	USB3_SSTXp			USB3.0-SSTX+	B		
95	PCI#_WAKE			NC			
96	USB3_SSRXn			USB3.0-SSRX-	B		
97	PCIe_RST			NC			
98	USB3_SSRXp			USB3.0-SSRX+	B		
99	USB_STROBE			NC			
100	USB_DATA			NC			
101	MPHY_TX2_DP			NC			
102	PCIe_REFCLKn/MPHY_RX2_DN			NC			
103	PCIe_REFCLKp/MPHY_RX2_DP			NC			
104	GND						
105	GND						
106	UART2_RX		VREF	UART1_RXD		VREF(1.8V)	
107	UART2_TX		VREF	UART1_TXD		VREF(1.8V)	
108	GND						
109	GND						
110	RFU			SPI_CS2#	O	1.8V	
111	RFU			SPI_SCLK	O	1.8V	
112	RFU			SPI_MOSI	O	1.8V	
113	RFU			SPI_MISO	I	1.8V	
114	RFU			SLIC_RST#	O	1.8V	
115	RFU			SLIC_INT#	I	1.8V	
116	RFU			GPS_SYNC	O		

117	RFU			GPS_ENABLE	O		
118	RFU			CLKOUT_GPS	O		
119	RFU			ETH_EN			
120	GPP09			SDH0_CLK	O	1.8V	
121	GPP10			SCH0_CMD	O	1.8V	
122	GPP11			SDH0_DAT0	B	1.8V	
123	GPP12			SDH0_DAT1	B	1.8V	
124	GPP13			SDH0_DAT2	B	1.8V	
125	GPP14			SDH0_DAT3	B	1.8V	
126	GPP15			SDH0_CD#	B	1.8V	
127	GPP16			DPR	I	1.8V	
128	GPP17			SDH0(WIFI)_RST#			
129	GPIO05		VREF	ANTCTL0	O	1.8V	
130	GPIO06		VREF	ANTCTL1	O	1.8V	
131	GPIO07		VREF	ANTCTL2	O	1.8V	
132	GPIO08		VREF	ANTCTL3	O	1.8V	
133	UIM_VCC	O	1.8/3.0V	SIM_VCC	O	1.8/3.0V	
134	UIM_DAT	B	1.8/3.0V	SIM_DAT	B	1.8/3.0V	
135	UIM_CLK	O	1.8/3.0V	SIM_CLK	O	1.8/3.0V	
136	UIM_RESET	O	1.8/3.0V	SIM_RST	O	1.8/3.0V	
137	UIM_DETECT	I	1.8/3.0V	NC	I	1.8/3.0V	
138	UIM_SPU	TBD		NC	TBD		
139	GND						
140	GND						
141	WWAN_STATE	O	VREF	NC	O	1.8V/3.3V	
142	POWER_ON	I	VREF	ENABLE_MODULE	I	VREF(1.8V)	
143	WAKEUP_OUT/GPIO143	O	VREF	WAKEUP#_HOST	O	VREF(1.8V)	
144	WAKEUP_IN/GPIO144	I	VREF	WAKEUP#_LTE	I	VREF(1.8V)	
145	RESET	I	VREF	RESET#_1.8V	I	VREF(1.8V)	
146	VREF	O		1.8V	O	DCDC_1.8V	

1.2. LTE IMG2 Design Reference

LTE Module IMG2 on EVK M.2 PCBA with RF Switch connectors (ANT1~ANT4).



EVK PCB Structure

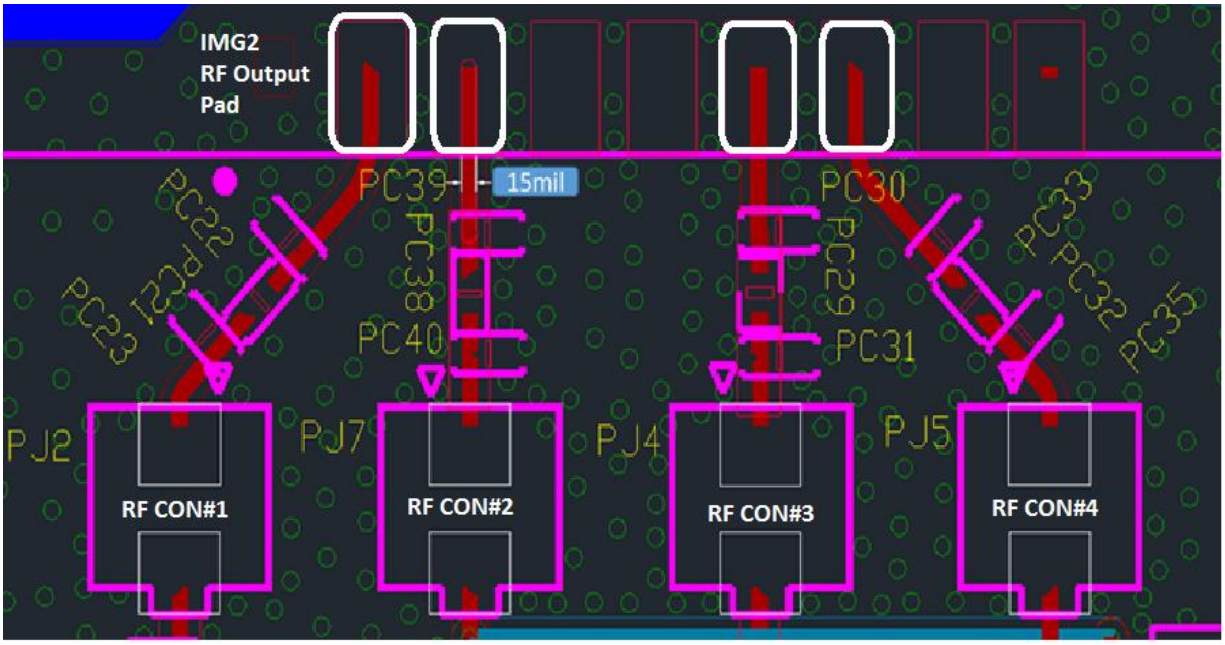
類型 Type	鑽孔構造 Drill Structure	層別 Layer	假設的殘銅率(%) Assumptive copper area (%)	材料型號 Material Type	ER (@2GHZ)	Thickness after Process	
GT P/N:	18012203-03					(mil)	(mm)
		Top Solder Mask			3.8	1.00	0.025
Metal		L1		Base Cu + Plating		1.40	0.036

Dielectric		Prepreg		2116*2	4	9.37	0.238
Metal		L2	75.0%	1OZ		1.15	0.029
Dielectric		Core		0.005"	4.2	5.00	0.127
Metal		L3	75.0%	1OZ		1.15	0.029
Dielectric		Prepreg		2116*2	4	9.37	0.238
Metal		L4		Base Cu + Plating		1.40	0.036
		Bottom Solder Mask			3.8	1.00	0.025
	Board thickness : 0.8mm+/-10%(Including Plating+S/M)				Total :	30.84	0.783

RF Trace Impedance Table

NO.	控制層 Layer	阻值要求 Impedance Requirement (ohms)	Tolerance	阻抗類型 Impedance Type	參考層 Ref. Layer	線寬 Trace Width (mil)	線距 Trace Spacing (mil)	Line to gnd space (mil)	计算值 Calculated Values (ohms)
1	L1	50	+/-10%	Coplanar Single	L2	15	-	10	49.8
2	L4	50	+/-10%	Coplanar Single	L3	15	-	10	49.8

Layout guidelines for RF trace outputs



All PJ2/PJ7/PJ4/PJ5 connectors are RF switch connectors and the part description as below.
“INTERNAL CONNECTOR,MICRO RF SWSMT,180DEG.,JACK,RF SWITCH,(FOXCONN),KMC1001-F007-7F”.
The main purpose of these RF switches is to verify the conductive TRX RF performances or for debugging.

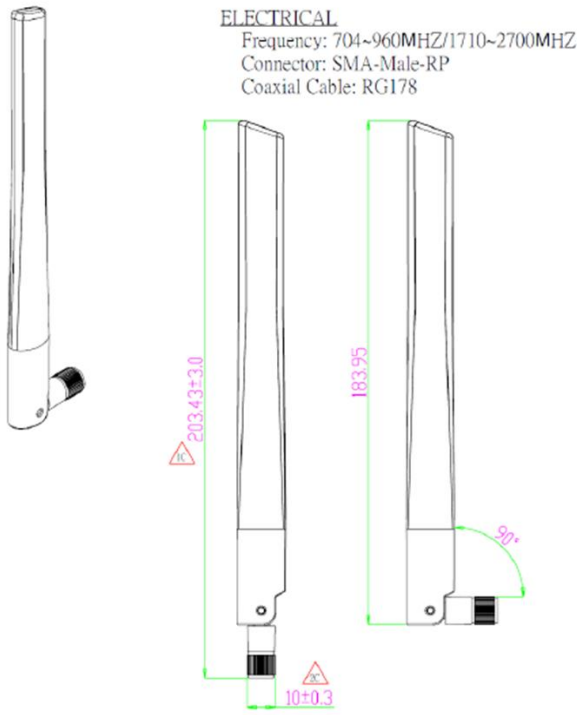
Some key performances should be verified:

i) TX Power Level
ii) Spectrum Emmission Mask
iii) RX Sensitivity
iv) EVM
v) Frequency Error
vi) VSWR

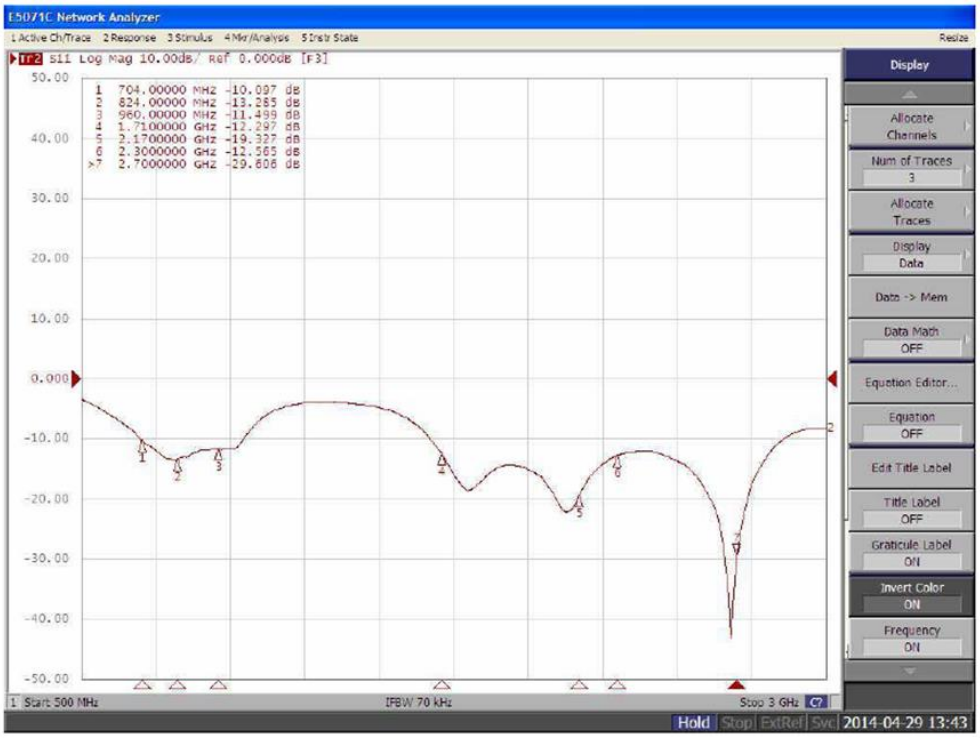
1.3. LTE IMG2 Antenna Design

The antenna should be 50ohm characteristic impedance with Return Loss less than -10dB at all desired frequency bands.The following external antenna as an example for OEM verifications because this special dipole antenna being certified with IMG2 LTE module.
Manufactured by MAGLAYERS
Model Name: WDA-2010-4G0R2-A1

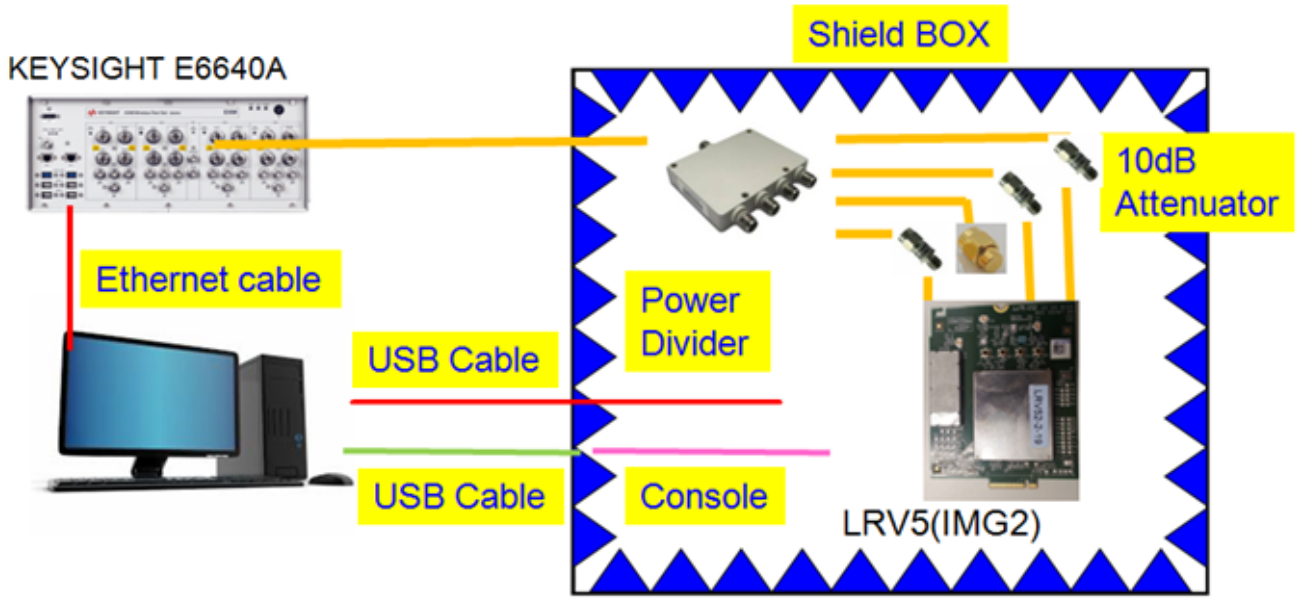
Outlines of external antenna



Return loss <= -10dB



1.4. LTE IMG2 Test Procedure for Design Verification



Equipment List

Item	Quantity	Specification
KS E6640A	1	
Shielding box	1	
PC	1	
DC Power Supply	1	PPT-3615
USB Cable	2	
Ethernet Cable	1	
Test fixture	1	

LTE Test Plan

Test Item			Report			
Transmit Performance	1.1	UE Maximum Output Power	Band 2	Band 4	Band 5	Band 13
	1.2	Maximum Power Reduction (MPR)				
	1.3	Minimum Output Power				
	1.4	Frequency Error				
	1.5	Error Vector Magnitude (EVM)				
	1.6	Carrier leakage				
	1.7	Spectrum Emission Mask PASS				
	1.8	Adjacent Channel Leakage power Ratio				
Receiver Performance	2.1	Reference sensitivity level	Receiver Performance			
	2.2	Maximum input level				
PHY Rate Test	3.1	Conductive Max. DL PHY Rate Test	PHY Rate Test			
	3.2	Conductive Max. UL PHY Rate Test				

LTE Test Spec.

3GPP TS-36521 test case	LTE TX Characteristics	Spec	
		Upper	Lower
6.2.2-QPSK-1RB#0	UE Maximum Output Power	25.7	20.3
6.2.2-QPSK-PRB#0	UE Maximum Output Power	25.7	20.3
6.2.3-QPSK-PRB#0	Maximum Power Reduction (MPR)	25.7	20.3
6.2.3-QPSK-PRB#Max	Maximum Power Reduction (MPR)	25.7	20.3
6.2.3-QPSK-PRB#Max	Maximum Power Reduction (MPR)	25.7	20.3
6.2.3-QPSK-FRB	Maximum Power Reduction (MPR)	25.7	19.3
6.2.3-16QAM-PRB#0	Maximum Power Reduction (MPR)	25.7	19.3
6.2.3-16QAM-PRB#Max	Maximum Power Reduction (MPR)	25.7	19.3
6.2.3-16QAM-FRB	Maximum Power Reduction (MPR)	25.7	18.3
6.3.2-QPSK-FRB	Minimum Output Power	-39	None
6.5.1-QPSK-FRB	Frequency Error	0.1	-0.1
6.5.2.1-QPSK-PRB#0	PUSCH EVM@Max Pwr	17.5	None
6.5.2.1-QPSK-PRB#0	PUSCH Refer Signal EVM@Max Pwr	17.5	None
6.5.2.1-QPSK-PRB#Max	PUSCH EVM@Max Pwr	17.5	None
6.5.2.1-QPSK-PRB#Max	PUSCH Refer Signal EVM@Max Pwr	17.5	None
6.5.2.1-QPSK-FRB	PUSCH EVM@Max Pwr	17.5	None
6.5.2.1-QPSK-FRB	PUSCH Refer Signal EVM@Max Pwr	17.5	None
6.5.2.1-16QAM-PRB#0	PUSCH EVM@Max Pwr	12.5	None
6.5.2.1-16QAM-PRB#0	PUSCH Refer Signal EVM@Max Pwr	12.5	None
6.5.2.1-16QAM-PRB#Max	PUSCH EVM@Max Pwr	12.5	None
6.5.2.1-16QAM-PRB#Max	PUSCH Refer Signal EVM@Max Pwr	12.5	None
6.5.2.1-16QAM-FRB	PUSCH EVM@Max Pwr	12.5	None
6.5.2.1-16QAM-FRB	PUSCH Refer Signal EVM@Max Pwr	12.5	None
6.5.2.1-QPSK-PRB#0	PUSCH EVM@-36.8dBm	17.5	None
6.5.2.1-QPSK-PRB#0	PUSCH Refer Signal EVM@-36.8dBm	17.5	None
6.5.2.1-QPSK-PRB#Max	PUSCH EVM@-36.8dBm	17.5	None
6.5.2.1-QPSK-PRB#Max	PUSCH Refer Signal EVM@-36.8dBm	17.5	None
6.5.2.1-QPSK-FRB	PUSCH EVM@-36.8dBm	17.5	None
6.5.2.1-QPSK-FRB	PUSCH Refer Signal EVM@-36.8dBm	17.5	None
6.5.2.1-16QAM-PRB#0	PUSCH EVM@-36.8dBm	12.5	None
6.5.2.1-16QAM-PRB#0	PUSCH Refer Signal EVM@-36.8dBm	12.5	None
6.5.2.1-16QAM-PRB#Max	PUSCH EVM@-36.8dBm	12.5	None
6.5.2.1-16QAM-PRB#Max	PUSCH Refer Signal EVM@-36.8dBm	12.5	None
6.5.2.1-16QAM-FRB	PUSCH EVM@-36.8dBm	12.5	None
6.5.2.1-16QAM-FRB	PUSCH Refer Signal EVM@-36.8dBm	12.5	None
6.5.2.1-	PRACH EVM@Test Point1	17.5	None
6.5.2.1-	PRACH EVM@Test Point2	17.5	None
6.5.2.2-QPSK-PRB#0	Carrier leakage@3.2dBm	-24.2	None
6.5.2.2-QPSK-PRB#Max	Carrier leakage@3.2dBm	-24.2	None
6.5.2.2-QPSK-PRB#0	Carrier leakage@-26.8dBm	-19.2	None
6.5.2.2-QPSK-PRB#Max	Carrier leakage@-26.8dBm	-19.2	None
6.5.2.2-QPSK-PRB#0	Carrier leakage@-36.8dBm	-9.2	None
6.5.2.2-QPSK-PRB#Max	Carrier leakage@-36.8dBm	-9.2	None

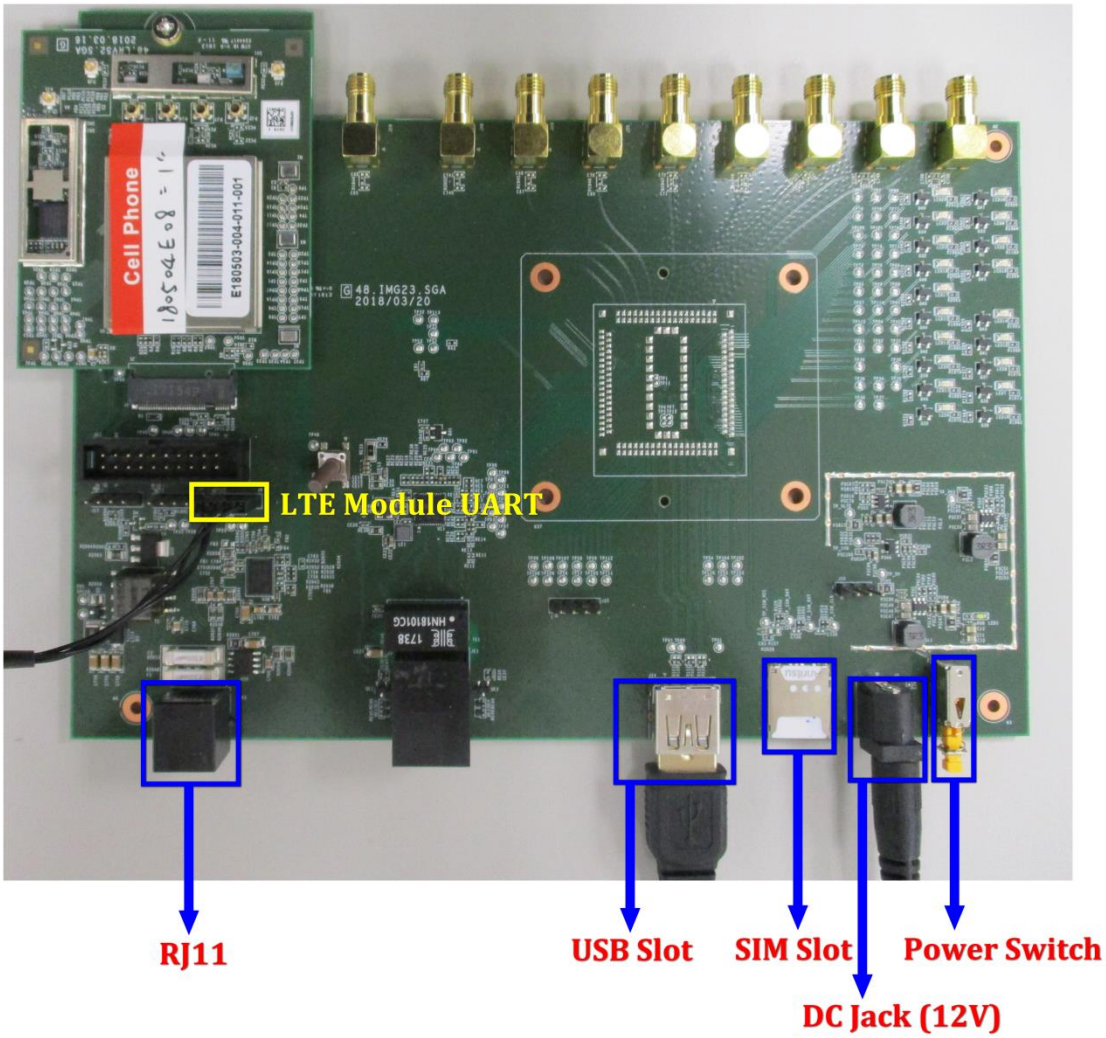
6.6.2.1-QPSK-PRB#0	Spectrum Emission Mask	None	None
6.6.2.1-QPSK-PRB#0	-Lower Mark Margin@-0.01MHz	-16.5	None
6.6.2.1-QPSK-PRB#0	-Lower Mark Margin@-1.50MHz	-8.5	None
6.6.2.1-QPSK-PRB#0	-Lower Mark Margin@-8.50MHz	-11.5	None
6.6.2.1-QPSK-PRB#0	-Lower Mark Margin@-10.50MHz	-23.5	None
6.6.2.1-QPSK-PRB#0	-Upper Mark Margin@0.49MHz	-16.5	None
6.6.2.1-QPSK-PRB#0	-Upper Mark Margin@1.50MHz	-8.5	None
6.6.2.1-QPSK-PRB#0	-Upper Mark Margin@7.50MHz	-11.5	None
6.6.2.1-QPSK-PRB#0	-Upper Mark Margin@10.50MHz	-23.5	None
6.6.2.1-QPSK-PRB#Max	Spectrum Emission Mask	None	None
6.6.2.1-QPSK-PRB#Max	-Lower Mark Margin@-0.16MHz	-16.5	None
6.6.2.1-QPSK-PRB#Max	-Lower Mark Margin@-1.50MHz	-8.5	None
6.6.2.1-QPSK-PRB#Max	-Lower Mark Margin@-8.50MHz	-11.5	None
6.6.2.1-QPSK-PRB#Max	-Lower Mark Margin@-12.50MHz	-23.5	None
6.6.2.1-QPSK-PRB#Max	-Upper Mark Margin@0.01MHz	-16.5	None
6.6.2.1-QPSK-PRB#Max	-Upper Mark Margin@1.50MHz	-8.5	None
6.6.2.1-QPSK-PRB#Max	-Upper Mark Margin@5.50MHz	-11.5	None
6.6.2.1-QPSK-PRB#Max	-Upper Mark Margin@11.50MHz	-23.5	None
6.6.2.1-QPSK-FRB	Spectrum Emission Mask	None	None
6.6.2.1-QPSK-FRB	-Lower Mark Margin@-0.01MHz	-16.5	None
6.6.2.1-QPSK-FRB	-Lower Mark Margin@-1.50MHz	-8.5	None
6.6.2.1-QPSK-FRB	-Lower Mark Margin@-5.50MHz	-11.5	None
6.6.2.1-QPSK-FRB	-Lower Mark Margin@-10.50MHz	-23.5	None
6.6.2.1-QPSK-FRB	-Upper Mark Margin@0.01MHz	-16.5	None
6.6.2.1-QPSK-FRB	-Upper Mark Margin@1.50MHz	-8.5	None
6.6.2.1-QPSK-FRB	-Upper Mark Margin@5.50MHz	-11.5	None
6.6.2.1-QPSK-FRB	-Upper Mark Margin@10.50MHz	-23.5	None
6.6.2.1-16QAM-PRB#0	Spectrum Emission Mask	None	None
6.6.2.1-16QAM-PRB#0	-Lower Mark Margin@-0.07MHz	-16.5	None
6.6.2.1-16QAM-PRB#0	-Lower Mark Margin@-1.50MHz	-8.5	None
6.6.2.1-16QAM-PRB#0	-Lower Mark Margin@-8.50MHz	-11.5	None
6.6.2.1-16QAM-PRB#0	-Lower Mark Margin@-10.50MHz	-23.5	None
6.6.2.1-16QAM-PRB#0	-Upper Mark Margin@0.58MHz	-16.5	None
6.6.2.1-16QAM-PRB#0	-Upper Mark Margin@1.50MHz	-8.5	None
6.6.2.1-16QAM-PRB#0	-Upper Mark Margin@7.50MHz	-11.5	None
6.6.2.1-16QAM-PRB#0	-Upper Mark Margin@10.50MHz	-23.5	None
6.6.2.1-16QAM-PRB#Max	Spectrum Emission Mask	None	None
6.6.2.1-16QAM-PRB#Max	-Lower Mark Margin@-0.61MHz	-16.5	None
6.6.2.1-16QAM-PRB#Max	-Lower Mark Margin@-1.50MHz	-8.5	None
6.6.2.1-16QAM-PRB#Max	-Lower Mark Margin@-8.50MHz	-11.5	None
6.6.2.1-16QAM-PRB#Max	-Lower Mark Margin@-10.50MHz	-23.5	None
6.6.2.1-16QAM-PRB#Max	-Upper Mark Margin@0.01MHz	-16.5	None
6.6.2.1-16QAM-PRB#Max	-Upper Mark Margin@1.50MHz	-8.5	None
6.6.2.1-16QAM-PRB#Max	-Upper Mark Margin@5.50MHz	-11.5	None
6.6.2.1-16QAM-PRB#Max	-Upper Mark Margin@10.50MHz	-23.5	None
6.6.2.1-16QAM-FRB	Spectrum Emission Mask	None	None
6.6.2.1-16QAM-FRB	-Lower Mark Margin@-0.01MHz	-16.5	None
6.6.2.1-16QAM-FRB	-Lower Mark Margin@-1.50MHz	-8.5	None
6.6.2.1-16QAM-FRB	-Lower Mark Margin@-5.50MHz	-11.5	None

6.6.2.1-16QAM-FRB	-Lower Mark Margin@-10.50MHz	-23.5	None
6.6.2.1-16QAM-FRB	-Upper Mark Margin@0.01MHz	-16.5	None
6.6.2.1-16QAM-FRB	-Upper Mark Margin@1.50MHz	-8.5	None
6.6.2.1-16QAM-FRB	-Upper Mark Margin@5.50MHz	-11.5	None
6.6.2.1-16QAM-FRB	-Upper Mark Margin@10.50MHz	-23.5	None
6.6.2.3-QPSK-PRB#0	Adjacent Channel Power	None	None
6.6.2.3-QPSK-PRB#0	-EUTRA @-10MHZ	-29.2	None
6.6.2.3-QPSK-PRB#0	-EUTRA @ 10MHZ	-29.2	None
6.6.2.3-QPSK-PRB#0	-UTRA @-12.5MHZ	-35.2	None
6.6.2.3-QPSK-PRB#0	-UTRA @-7.5MHZ	-32.2	None
6.6.2.3-QPSK-PRB#0	-UTRA @ 7.5MHZ	-32.2	None
6.6.2.3-QPSK-PRB#0	-UTRA @ 12.5MHZ	-35.2	None
6.6.2.3-QPSK-PRB#Max	Adjacent Channel Power	None	None
6.6.2.3-QPSK-PRB#Max	-EUTRA @-10MHZ	-29.2	None
6.6.2.3-QPSK-PRB#Max	-EUTRA @ 10MHZ	-29.2	None
6.6.2.3-QPSK-PRB#Max	-UTRA @-12.5MHZ	-35.2	None
6.6.2.3-QPSK-PRB#Max	-UTRA @-7.5MHZ	-32.2	None
6.6.2.3-QPSK-PRB#Max	-UTRA @ 7.5MHZ	-32.2	None
6.6.2.3-QPSK-PRB#Max	-UTRA @ 12.5MHZ	-35.2	None
6.6.2.3-QPSK-FRB	Adjacent Channel Power	None	None
6.6.2.3-QPSK-FRB	-EUTRA @-10MHZ	-29.2	None
6.6.2.3-QPSK-FRB	-EUTRA @ 10MHZ	-29.2	None
6.6.2.3-QPSK-FRB	-UTRA @-12.5MHZ	-35.2	None
6.6.2.3-QPSK-FRB	-UTRA @-7.5MHZ	-32.2	None
6.6.2.3-QPSK-FRB	-UTRA @ 7.5MHZ	-32.2	None
6.6.2.3-QPSK-FRB	-UTRA @ 12.5MHZ	-35.2	None
6.6.2.3-16QAM-PRB#0	Adjacent Channel Power	None	None
6.6.2.3-16QAM-PRB#0	-EUTRA @-10MHZ	-29.2	None
6.6.2.3-16QAM-PRB#0	-EUTRA @ 10MHZ	-29.2	None
6.6.2.3-16QAM-PRB#0	-UTRA @-12.5MHZ	-35.2	None
6.6.2.3-16QAM-PRB#0	-UTRA @-7.5MHZ	-32.2	None
6.6.2.3-16QAM-PRB#0	-UTRA @ 7.5MHZ	-32.2	None
6.6.2.3-16QAM-PRB#0	-UTRA @ 12.5MHZ	-35.2	None
6.6.2.3-16QAM-PRB#Max	Adjacent Channel Power	None	None
6.6.2.3-16QAM-PRB#Max	-EUTRA @-10MHZ	-29.2	None
6.6.2.3-16QAM-PRB#Max	-EUTRA @ 10MHZ	-29.2	None
6.6.2.3-16QAM-PRB#Max	-UTRA @-12.5MHZ	-35.2	None
6.6.2.3-16QAM-PRB#Max	-UTRA @-7.5MHZ	-32.2	None
6.6.2.3-16QAM-PRB#Max	-UTRA @ 7.5MHZ	-32.2	None
6.6.2.3-16QAM-PRB#Max	-UTRA @ 12.5MHZ	-35.2	None
6.6.2.3-16QAM-FRB	Adjacent Channel Power	None	None
6.6.2.3-16QAM-FRB	-EUTRA @-10MHZ	-29.2	None
6.6.2.3-16QAM-FRB	-EUTRA @ 10MHZ	-29.2	None
6.6.2.3-16QAM-FRB	-UTRA @-12.5MHZ	-35.2	None
6.6.2.3-16QAM-FRB	-UTRA @-7.5MHZ	-32.2	None
6.6.2.3-16QAM-FRB	-UTRA @ 7.5MHZ	-32.2	None
6.6.2.3-16QAM-FRB	-UTRA @ 12.5MHZ	-35.2	None

3GPP TS-36521 test case	LTE RX Characteristics	Band	Channel (Frequency)	Antenna Port	Spec (3GPP TS 36.521-1)	
					Upper	Lower
7.3	Reference sensitivity level	2	18650 (1935 MHz)	Combine	None	-95
			18900 (1960 MHz)	Combine		-95
			19150 (1985 MHz)	Combine		-95
		4	20000 (2115 MHz)	Combine	None	-97
			20175 (2132.5 MHz)	Combine		-97
			20350 (2150 MHz)	Combine		-97
		5	20450 (874 MHz)	Combine	None	-95
			20525 (881.5 MHz)	Combine		-95
			20600 (889 MHz)	Combine		-95
		13	18650 (1935 MHz)	Combine	None	-94
7.3	Maximum input level	2	18650 (1935 MHz)	Main	-25	None
				AUX		
			18900 (1960 MHz)	Main		
				AUX		
			19150 (1985 MHz)	Main		
				AUX		
		4	20000 (2115 MHz)	Main	-25	None
				AUX		
			20175 (2132.5 MHz)	Main		
				AUX		
			20350 (2150 MHz)	Main		
				AUX		
		5	20450 (874 MHz)	Main	-25	None
				AUX		
			20525 (881.5 MHz)	Main		
				AUX		
			20600 (889 MHz)	Main		
				AUX		
		13	18650 (1935 MHz)	Main	-25	None
				AUX		

1.5. HDK Overview

1.5.1. Overview



1.5.2. LTE Module Installation

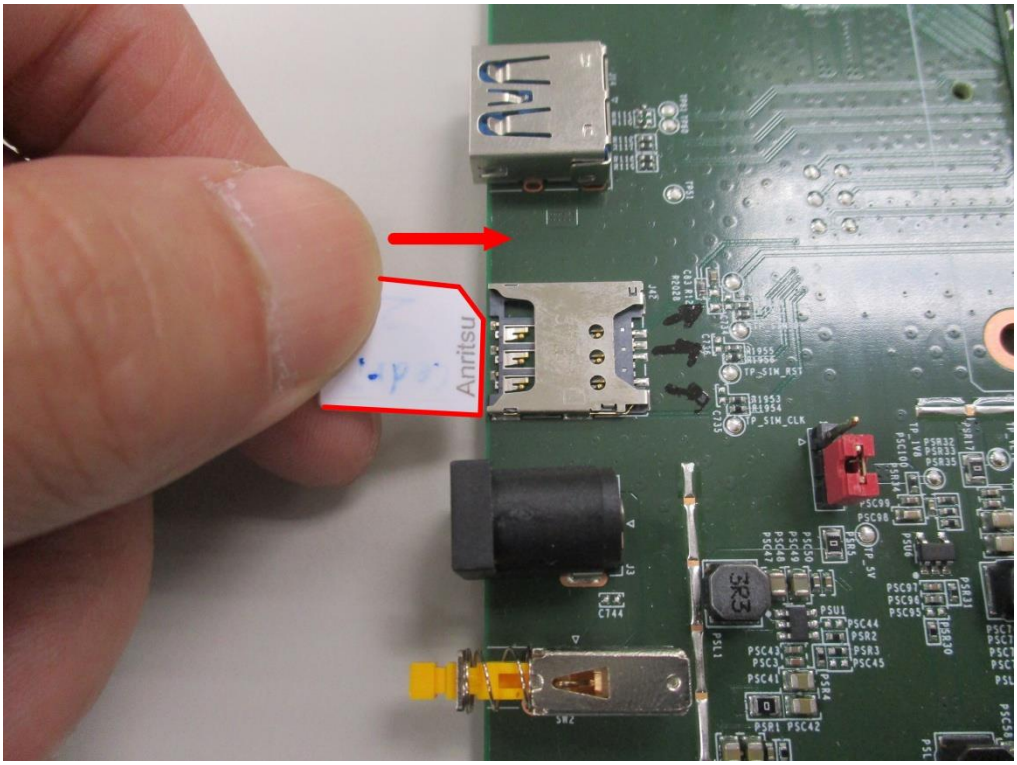
Three steps to accomplish module installation:

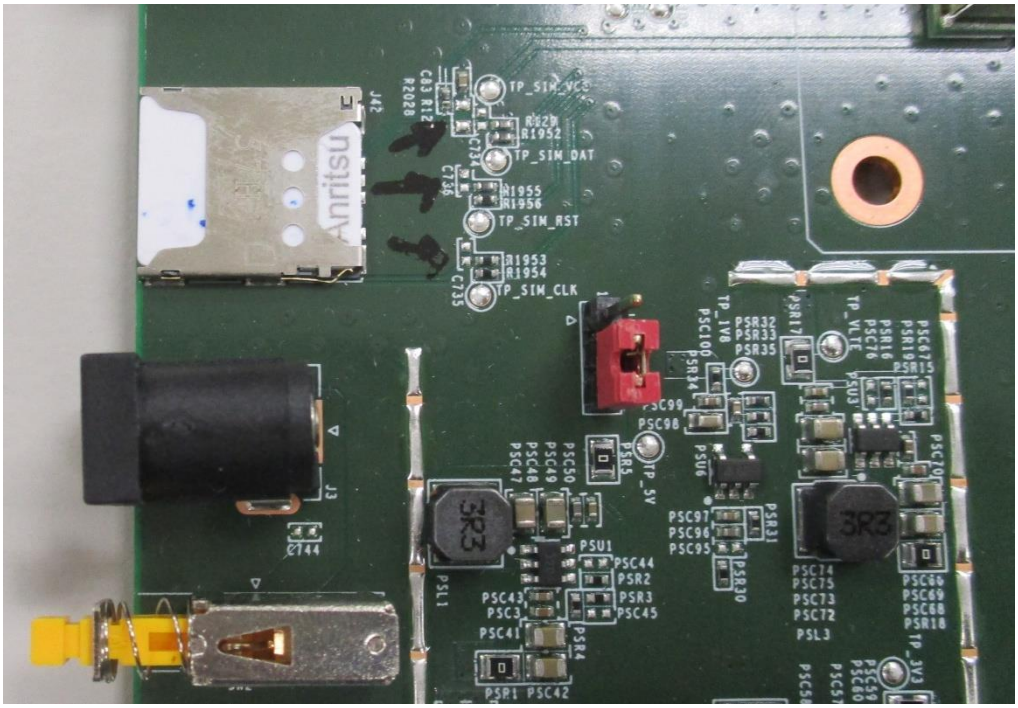
Step1. Insert module with about 15° angle to NGFF connector.

Step2. Press down the module.

Step3. Fasten with a screw.

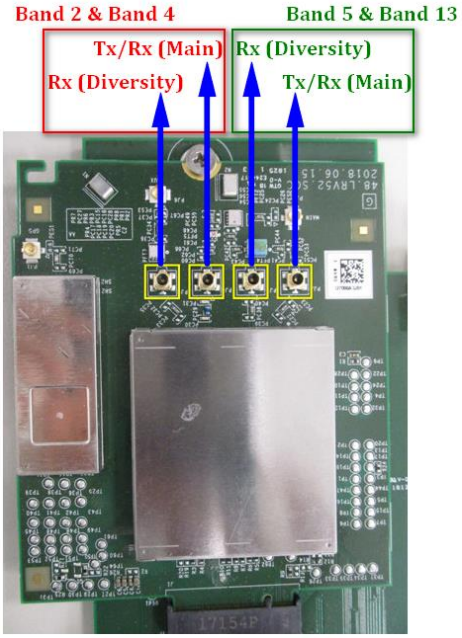
1.5.3. SIM Installation





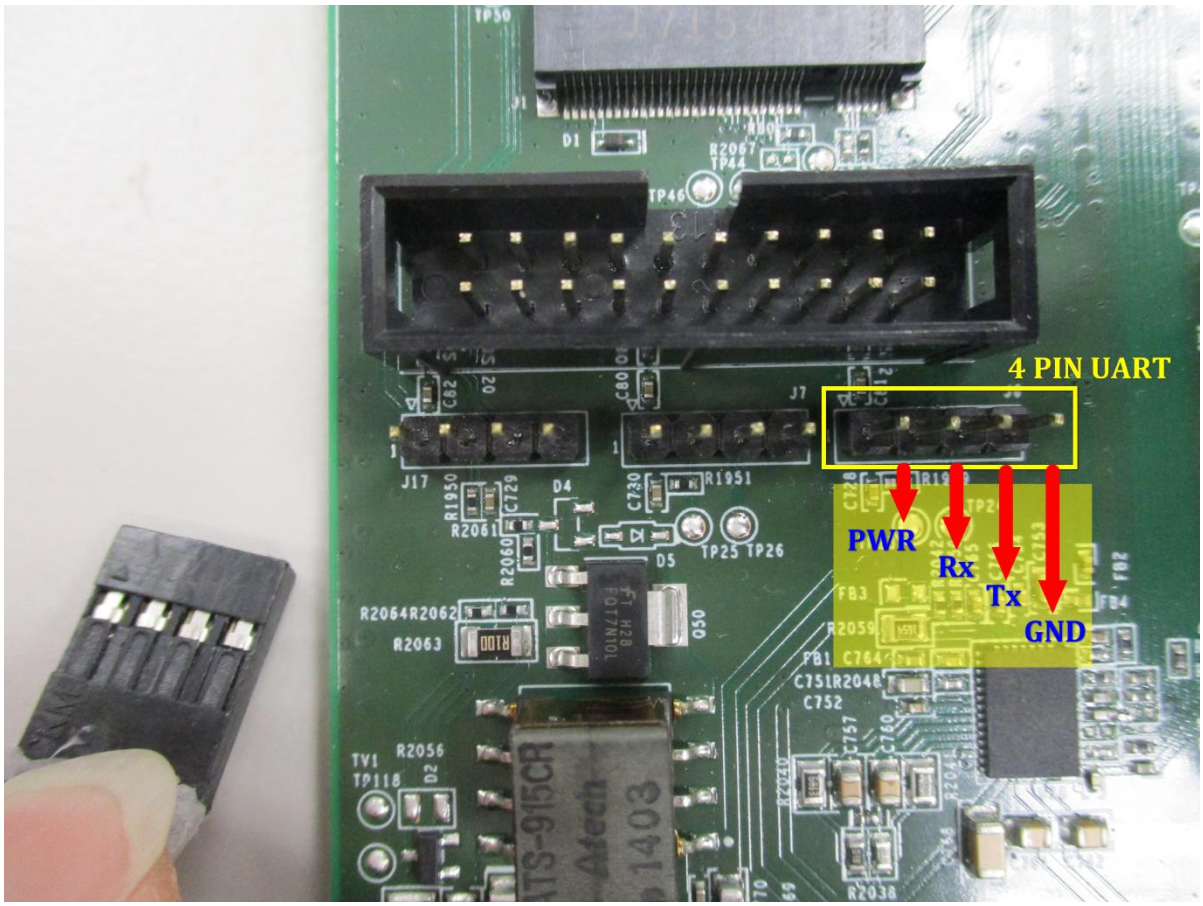
1.5.4. LTE RF Connector

LTE RF connection is RF cable type dependency. That said, only Murata cable can be used while doing conductive test.



1.5.5. UART Access (Option)

4 PIN UART provides LTE module UART access. Generally it is used for debugging and an RS232-to-USB adaptor is required. Baud rate is 921600.



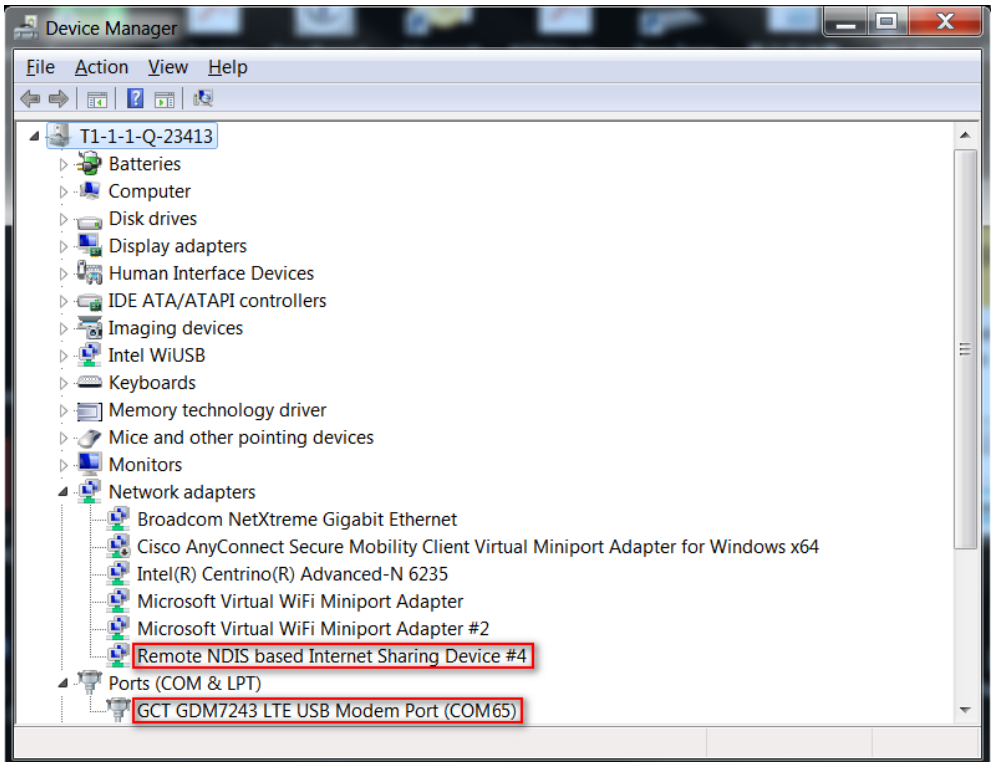
1.5.6. Driver Installation

The communication between DUT and PC is Ethernet-over-USB. Please install driver (i.e., dpinst.exe) on a PC first.

Two interfaces are derived when connecting USB connector to PC.

- USB RNDIS : network interface
- Modem Com port : AT command interface which supports baud rate: 921600 at most

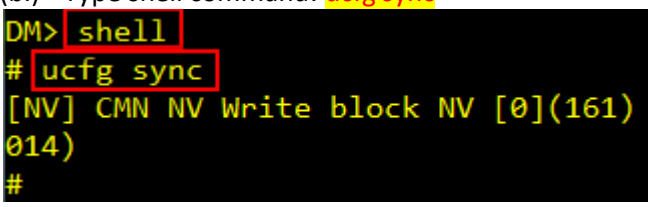
In device manager, you will see an RNDIS interface and a Modem COM port after DUT boots up completely. PC will obtain an IP address of 192.168.0.X assigned by DUT via DHCP.



2. Prerequisite Configuration

2.1. Factory Reset

This section provides a way to execute “Factory Reset”. SDM parameter values will be persistent throughout “Factory Reset”. “Factory Reset” is applied to Motive testing, 7Layers OTADM testing and Field testing. It is used during the testing while “Factory Reset ” is needed.

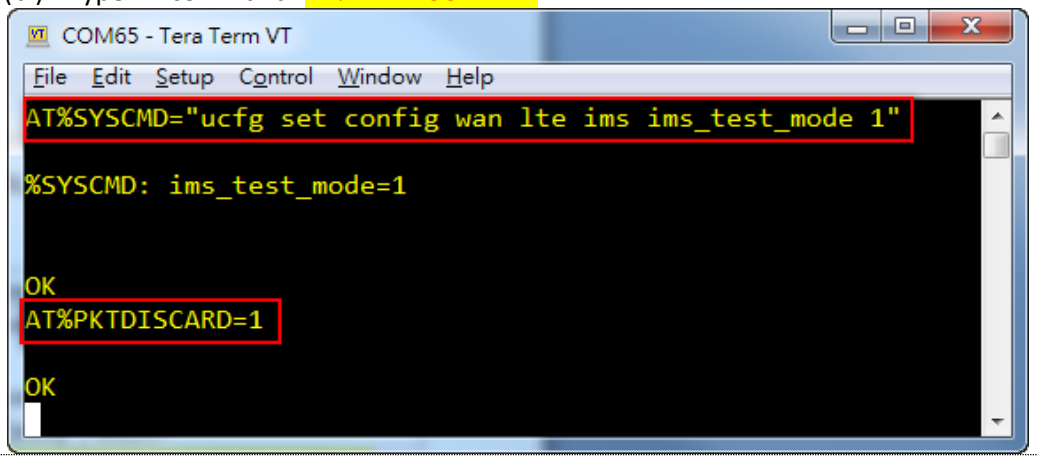
Step 1	Power on DUT and then wait a while (i.e., around 20 sec).
Step 2	Make sure a Modem COM port is observed in device manager. (Please refer to section 1.1.6) This Modem COM port (i.e., AT command interface) can simply connected through generic UART console program such as “TeraTerm”, “putty”, etc,…
Step 3	(a.) Type shell (b.) Type shell command: ucfg sync 
Step 4	※Then a DUT reboot is required to apply the setting.

2.2. RF conformance Setup

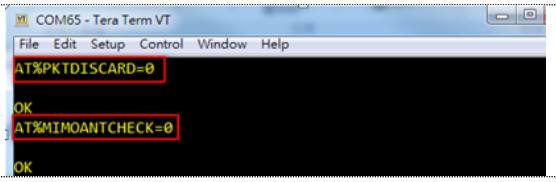
- This section is applied to RF conformance test such as GCF

—	TS 36.521-1:	Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing
—	TS 36.521-3:	Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 3: Radio Resource Management (RRM) conformance testing

- Prior to test please have “Factory Reset” for DUT as described in section 2.1. Besides, RF conformance test just uses the internet PDN. And, UL data should be blocked. The instruction is shown as following;

Step 1	Power on DUT and then wait a while (i.e., around 20 sec).
Step 2	Make sure a Modem COM port is observed in device manager. (Please refer to section 1.1.6) This Modem COM port (i.e., AT command interface) can simply connected through generic UART console program such as “TeraTerm”, “putty”, etc,…
Step 3	(a.) Type AT command: AT%SYSCMD="ucfg set config wan lte ims ims_test_mode 1" (b.) Type AT command: AT%PKTDISCARD=1 
Step 4	※Then a DUT reboot is required to apply the setting.

- In order to avoid DUT incorrect operation caused by manually changing it for test purpose. While DUT is reused for another test plan please change it back as following,

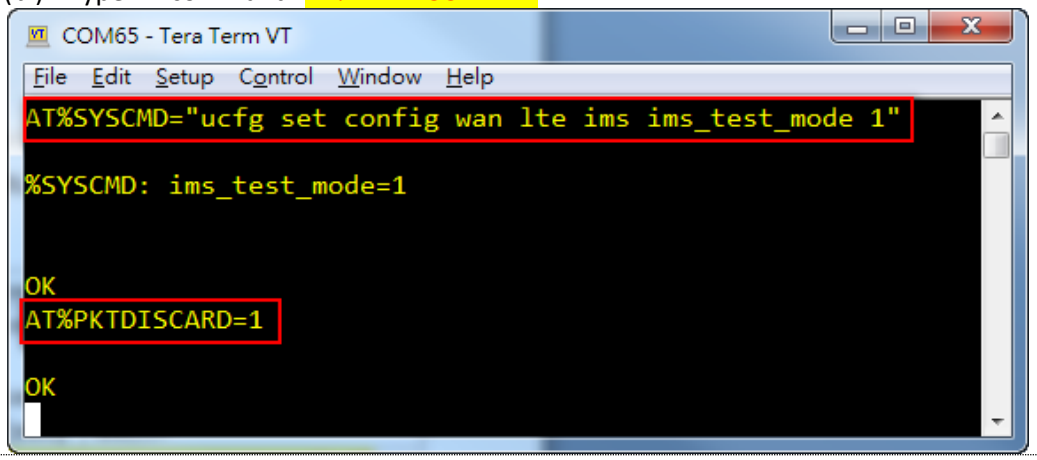
(a.) Type AT command: AT%PKTDISCARD=0 (b.) Type AT command: AT%MIMOANTCHECK=0	

2.3. Protocol conformance Setup

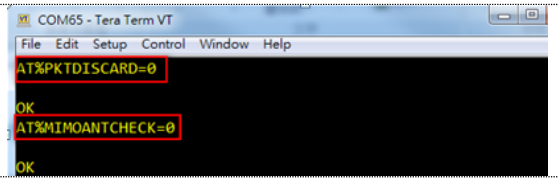
- This section is applied to Protocol conformance test such as GCF

—	TS 36.523-1:	Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Packet Core (EPC); User Equipment (UE) conformance specification; Part 1: Protocol conformance specification

- Prior to test please have “Factory Reset” for DUT as described in section 2.1. Besides, Protocol conformance test just uses the internet PDN. And, UL data should be blocked. The instruction is shown as following;

Step 1	Power on DUT and then wait a while (i.e., around 20 sec).
Step 2	Make sure a Modem COM port is observed in device manager. (Please refer to section 1.1.6) This Modem COM port (i.e., AT command interface) can simply connected through generic UART console program such as “TeraTerm”, “putty”, etc,…
Step 3	(a.) Type AT command: AT%SYSCMD="ucfg set config wan lte ims ims_test_mode 1" (b.) Type AT command: AT%PKTDISCARD=1 
Step 4	※Then a DUT reboot is required to apply the setting.

- In order to avoid DUT incorrect operation caused by manually changing it for test purpose. While DUT is reused for another test plan please change it back as following,

(c.) Type AT command: AT%PKTDISCARD=0 (d.) Type AT command: AT%MIMOANTCHECK=0	

2.4. UICC Test Setup

- This section is applied to UICC test such as GCF

— TS 31.121:	UICC-terminal interface; Universal Subscriber Identity Module (USIM) application test specification
— TS 31.124:	Mobile Equipment (ME) conformance test specification; Universal Subscriber Identity Module Application Toolkit (USAT) conformance test specification
— TS 102.230:	Smart Cards; UICC-Terminal interface; Physical, electrical and logical test specification

- Please refer to G7243_USAT_Test_Guide_v2.5.pdf

2.5. LTE IMS VoIP

This section provides commands for configuration change requirement.
Commands are marked in red. Please input command in # prompt.
Please not that if you apply "Factory Reset" in section 2.1, it will set all VoIP parameters to device's default values.

1). IMS RTP RTCP Inactivity Timer

Command	ucfg set config wan lte ims volte rtp_rtcp_inactivity_timer_ims <value>
Description	This parameter indicates the maximum length of time a call can remain active without any media (RTP or RTCP) traffic within a group. Each time an RTP or RTCP packet occurs within a call, this timeout resets. The value is an integer measured in Seconds.
Example	Note: set rtcp_inactivity_timer to 300s
	ucfg set config wan lte ims volte rtp_rtcp_inactivity_timer_ims 300

Get current setting from device	*ucfg get config wan lte ims volte rtp_rtcp_inactivity_timer_ims*

2). IMS Session Timer

Command	ucfg set config wan lte ims volte session_timer_ims <value>
Description	The Session-Expires header value can be configured through the SESSION-EXP tag. Session-Expires conveys the duration of the session. SIP entities MUST be prepared to handle Session-Expires header field values of any duration greater than 90 Seconds. Small session intervals can be destructive to the network. They cause excessive messaging traffic that affects both user agents and proxy servers. More information about Session Expires and Min-Session Expire can be found in RFC 4028. The value is an integer measured in Seconds.
Example	Note: set session_timer_ims to 90 seconds
	ucfg set config wan lte ims volte session_timer_ims 90

Get current setting from device	*ucfg get config wan lte ims volte session_timer_ims*

3). IMS Min Se Timer

Command	ucfg set config wan lte ims volte min_se_ims <value>
Description	The minimum value for session-expires value The Min-SE header field indicates the minimum value for the session interval, in units of seconds. The value of this element is inserted in MIN-SE header in INVITE request. The value must be greater than 90 seconds. More information about Session Expires and Min-Session Expire can be found in RFC 4028. The value is an integer measured in Seconds.
Example	Note: set min_se_ims to 90 seconds
	ucfg set config wan lte ims volte min_se_ims 90

Get current setting from device	*ucfg get config wan lte ims volte min_se_ims*

4). Enable/Disable SCR_AMRWB

Command	ucfg set config wan lte ims volte scr_amrwb <value>
Example	Note: enable SCR_AMRWB
	ucfg set config wan lte ims volte scr_amrwb 1
	Note: disable SCR_AMRWB
	ucfg set config wan lte ims volte scr_amrwb 0

Get current setting from device	*ucfg get config wan lte ims volte scr_amrwb*

5). Enable/Disable AMR_WB

Command	ucfg set config wan lte ims volte scr_amrwb <value>
Example	Note: enable AMR_WB
	ucfg set config wan lte ims volte amrwb 1
	Note: disable AMR_WB
	ucfg set config wan lte ims volte amrwb 0

Get current setting from device	*ucfg get config wan lte ims volte amrwb*

6). Set AMR_WB Mode

Command	ucfg set config wan lte ims volte amrwbmodset <value>
Example	Note: set amrwbmodeset parameter 8
	ucfg set config wan lte ims volte amrwbmodset 8
	Note: set amrwbmodeset parameter to "0,1,2"
	ucfg set config wan lte ims volte amrwbmodset 0,1,2
	Note: set amrwbmodeset parameter to "0,2,5,7"
	ucfg set config wan lte ims volte amrwbmodset 0,2,5,7

Get current setting from device	*ucfg get config wan lte ims volte amrwbmodset*

7). Set TTY Mode

Command	ucfg set config wan lte ims volte tty_mode <value>
Example	Note: set TTY mode to TTY FULL
	ucfg set config wan lte ims volte tty_mode 3
	Note: set TTY mode to TTY HCO
	ucfg set config wan lte ims volte tty_mode 1
	Note: set TTY mode to TTY VCO
	ucfg set config wan lte ims volte tty_mode 2
	Note: set TTY mode to TTY OFF
	ucfg set config wan lte ims volte tty_mode 0

Get current setting from device	*ucfg get config wan lte ims volte tty_mode*

3. AT Command Control

Tester can enter 3GPP AT Command through “GCT GDM7243 LTE USB Monitor Port” interface (i.e., section 1.1.6) and it can simply connected through generic UART console program such as “TeraTerm”, “putty”, etc,…

Some proprietary AT commands and VzW AT commands support for testing purpose as followings;

Antenna Selection				
This command will persist through power cycle				
(A.) Set command				
Usage	AT%MIMOANTCHECK=0	AT%MIMOANTCHECK=1	AT%MIMOANTCHECK=2	AT%MIMOANTCHECK?
Description	Enable Main & Div.	Enable Div. only	Enable Main only	Query current enabled antenna port +MIMOANTCHECK : 0
(B.) Read command returns the current setting of <+MIMOANTCHECK :>				
Usage	AT%MIMOANTCHECK?			
Response	+MIMOANTCHECK : 0 → both Main & Div are enabled +MIMOANTCHECK : 1 → only Div is enabled +MIMOANTCHECK : 2 → only Main is enabled			

Read RSRP	
Usage	AT+VZWRSRP?
Response	+VZWRSRP: <cellID>1,<EARFCN>1,<RSRP>1,<cellID>2,<EARFCN>2,<RSRP>2,…,<cellID>n, <EARFCN>n,<RSRP>n
	+CME ERROR: <err>

Read RSRQ	
Usage	AT+VZWRSRQ?
Response	+VZWRSRQ: <cellID>1,<EARFCN>1,<RSRQ>1,<cellID>2,<EARFCN>2,<RSRQ>2,…,<cellID>n,<EARFCN>n,<RSRQ>n
	+CME ERROR: <err>

Edit APN Table						
This command will persist through power cycle						
(A.) Set command						
Usage	AT+VZWAPNE=<wapn>,<apncl>,<apnni>,<apntype>,<apnb>,<apned>					
Description	<wapn> index digit	<apncl>: class digit	<apnni>: name string	<apntype>: type string	<apnb>: bearer string	<apned> string
	1, 2 or 3	1, 2 or 3		IPv4 IPv6 IPv4v6	LTE	Enabled Disabled
Note	(i) <wapn> and <apncl> should be the same (ii) Since it is LTE only device, <apnb> should be given as LTE					
Example	Edit 3rd APN. Give APN name as empty; APN type as IPV4; APN bearer as LTE and 3rd APN is enabled					
	AT+VZWAPNE=3,3,,IPv4,LTE,Enabled					
(B.) Read command returns the current setting of <+VZWAPNE :>						
Usage	AT+VZWAPNE?					
Response	1,IMS,IPv4v6,LTE,Enabled,0, 2,VZWADMIN,IPv4v6,LTE,Enabled,0, 3,VZWINTERNET,IPv4v6,LTE,Enabled,0, 4,VZWAPP,IPv4v6,LTE,Enabled,0,					

Enable/Disable packet discard		
This command will persist through power cycle		
(A.) Set command		
Usage	AT%PKTDISCARD=1	AT%PKTDISCARD=0
Description	Discard the UL packet	Back to normal operation
(B.) Read command returns the current setting of <+MIMOANTCHECK :>		
Usage	AT%PKTDISCARD?	
Response	+PKTDISCARD : OFF → back to normal operation +PKTDISCARD : ON → discard the UL packet	

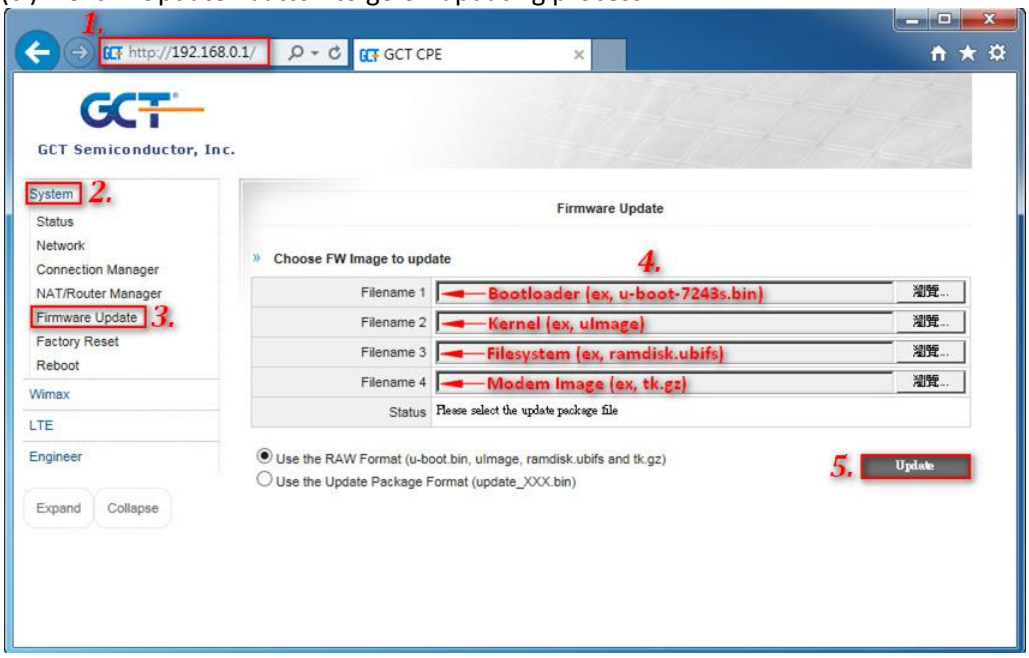
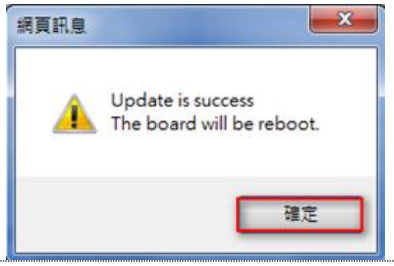
Enable/Disable packet discard		
This command will **NOT** persist through power cycle		
Usage	AT%GSWTESTW=3,1	AT%GSWTESTW=3,0
Description	Discard the UL packet	Back to normal operation

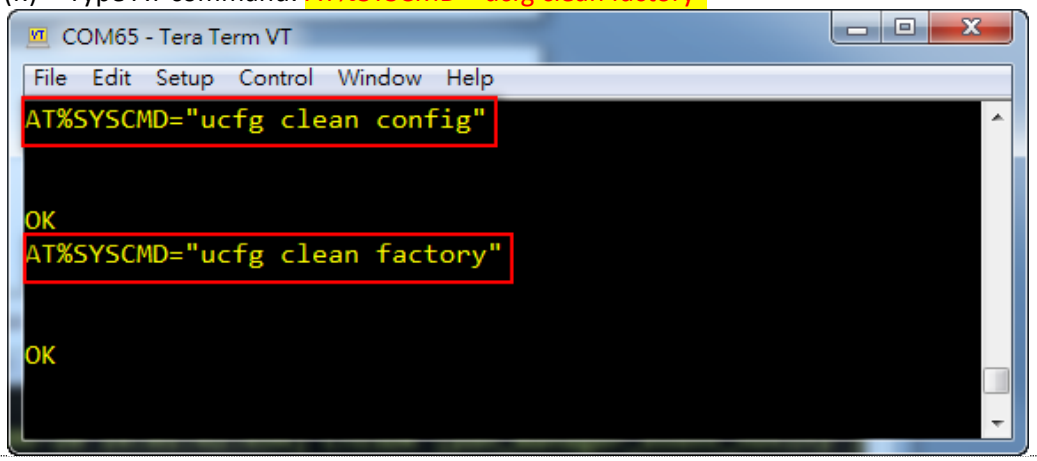
Clear RPLMN list	
Usage	AT%VZWMRUC

Clear FPLMN list	
Usage	AT+CRSM=214,28539,0,0,0,"FFFFFFFFFFFFFFFFFFFFFFFF"

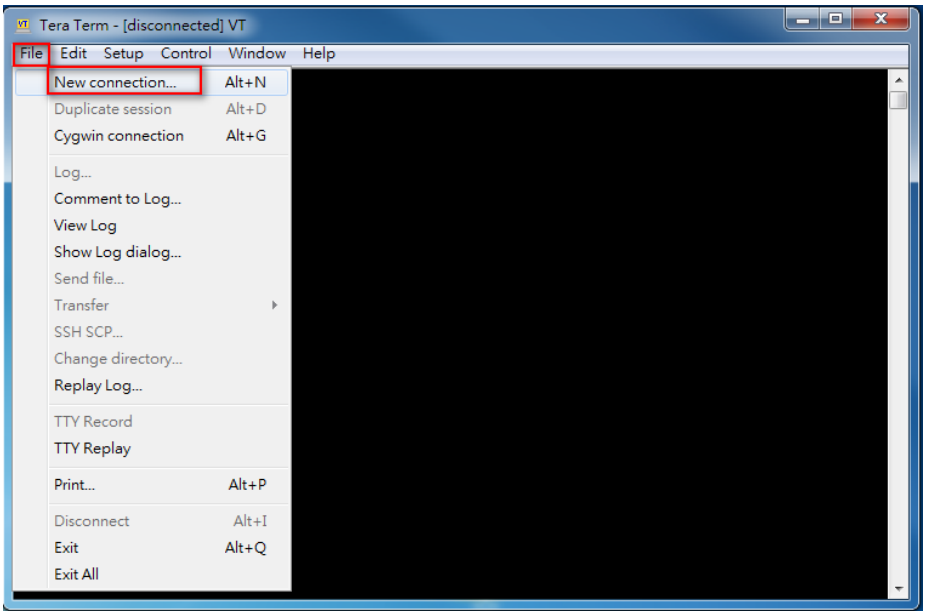
4. F/W Update

4.1. F/W Update via WebUI

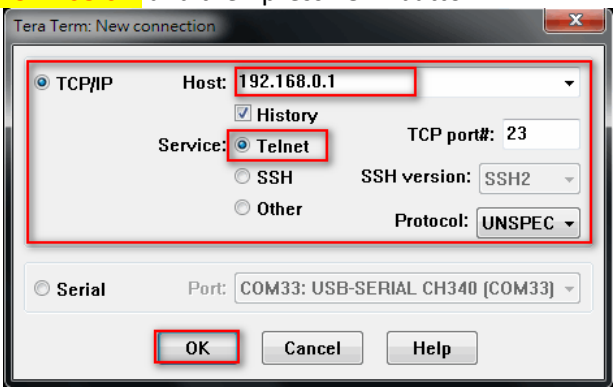
Step 1	Power on DUT and then wait a while (i.e., around 20 sec)
Step 2	Make sure it can ping to DUT (i.e., 192.168.0.1) from PC (e.g., 192.168.0.X)
Step 3	(a.) Navigate WebUI (i.e., http://192.168.0.1) (b.) Select Filename1=Bootloader, Filename2=Kernel, Filename3=Filesystem, Filename4=Modem Image to be downloaded. (It should be selected at least one file among four to go on updating process). Generally we will provide Kernel and Filesystem image. (c.) Click “Update” button to go on updating process  (d.) Click “OK” button to be continue while a prompt box displays 

Step 4	Make sure a Modem COM port is observed in device manager. (Please refer to section 1.1.6) This Modem COM port (i.e., AT command interface) can simply connected through generic UART console program such as “TeraTerm”, “putty”, etc,…
Step 5	(e.) Type AT command: AT%SYSCMD="ucfg clean config" (f.) Type AT command: AT%SYSCMD="ucfg clean factory" 
Step 6	※Then a DUT reboot is required to apply the setting.

Step 4 (a.) File => New connection…

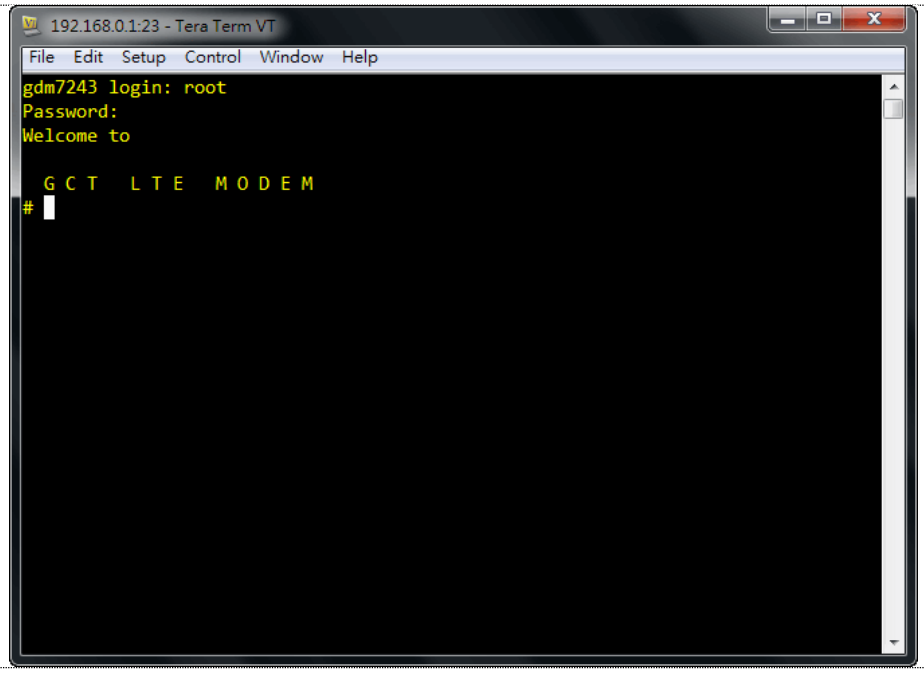


(b.) Click “TCP/IP” radio button; select “Telnet” radio button; give an IP address of 192.168.0.1 and then press “OK” button.



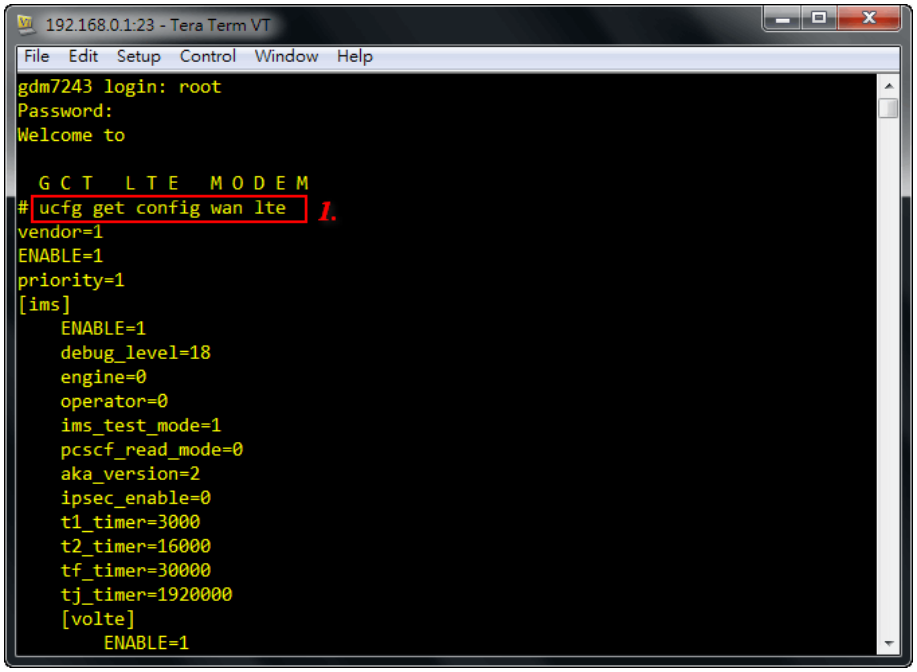
(c.) Click “TCP/IP” radio button; select “Telnet” radio button; give an IP address of 192.168.0.1 and then press “OK” button.

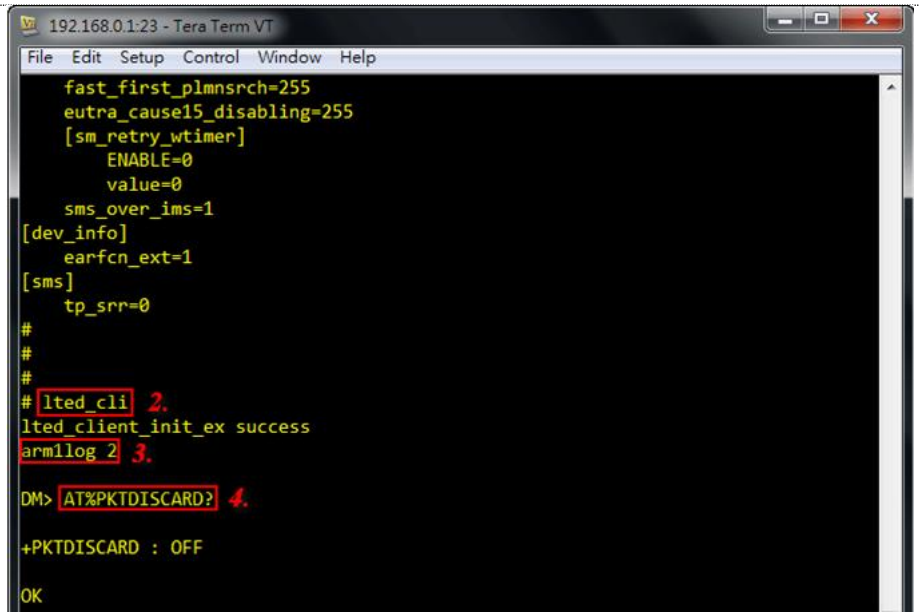
(a.) DUT Username: root; Password: gct



Step 5 Type commands sequentially below:

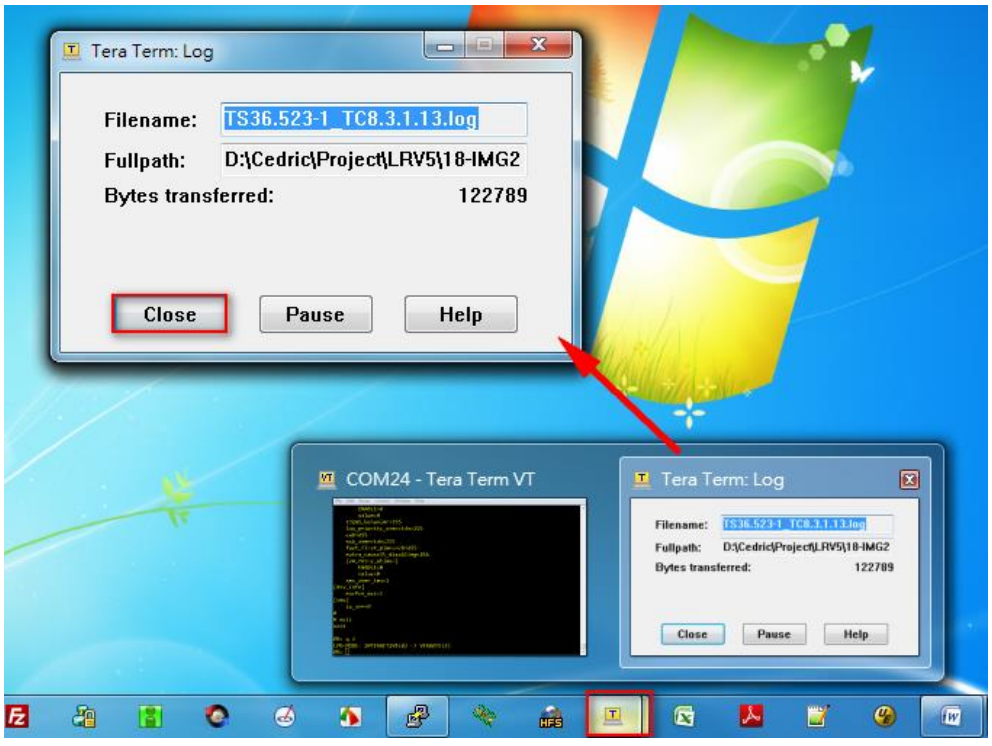
1. ucfg get config wan lte
2. lted_cli
3. arm1log 2
4. AT%PKTDISCARD?





Step 6 Run test case

Step 7 Press “Close” button after test case stop.



4.2. Debug Level

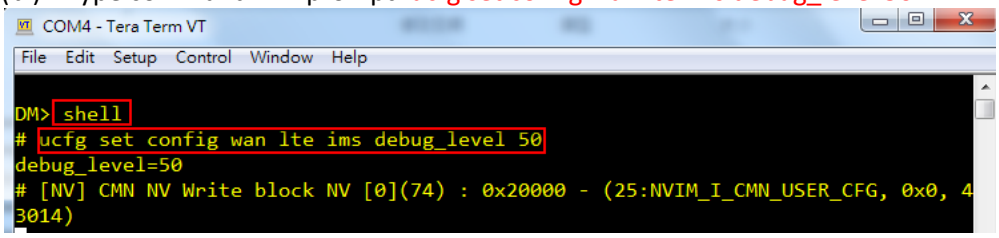
An introduction to enable default debug level is described in Section 5.2. Furthermore, this subsection illustrates on how to enable a specific debug level.

4.2.1. IMS

4.2.1.1. Configuration to Enable IMS Debug Level

After applying configuration, it will store in device's NV. However, it is different from default debug level. That said, it will be invalid after you restore device to factory default. Step 5 gives a way to quickly check and confirm whether the device is already enabled this specific debug level or not.

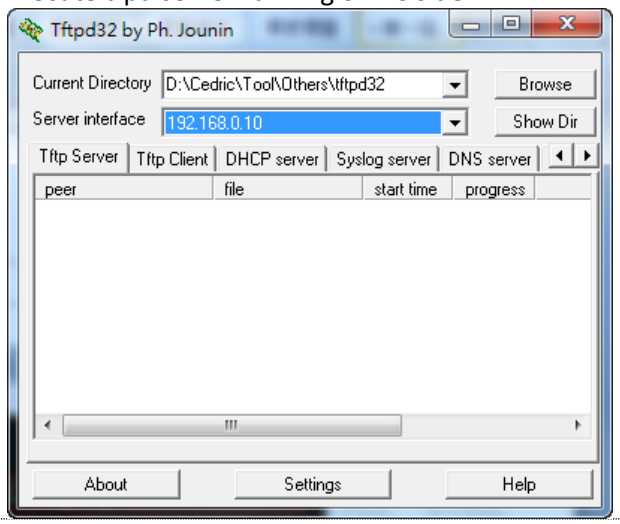
Note: commands are mark in red

Step 1	Power on DUT and then wait a while (i.e., around 20 sec).
Step 2	Please have UART access. (Hint: section 1.1.5) COM port can simply connect through generic UART console program such as "TeraTerm".
Step 3	(a.) Type command in DM> prompt: shell (b.) Type command in # prompt: ucfg set config wan lte ims debug_level 50 
Step 4	※Then a DUT reboot is required to apply above setting.
Step 5	Please check and confirm if previous setting is applied. (a.) Type command in DM> prompt: shell (b.) Type command in # prompt: ucfg get config wan lte ims debug_level 

4.2.2. Get Log File from Device

- Please have DUT set up properly based on section 1.1.6.

Step 1 Execute tfpd server running on PC side.



Step 2 (a.) Type command in DM> prompt: shell

(b.) Type command in # prompt to get /var/log/EcrioSACALC.log from device to PC.