



FCC RADIO TEST REPORT

FCC ID : PU5-TP00137BLQ
Equipment : Notebook Computer
Brand Name : Lenovo
Model Name : TP00137A, TP00137B
Applicant : Wistron Corporation
21F, No. 88, Sec. 1, Hsin Tai Wu Rd., Hsichih
Dist, New Taipei City 221, Taiwan
Manufacturer : Lenovo PC HK Limited.
23/F, Lincoln House, Taikoo Place, 979 King's
Road, Quarry Bay, Hong Kong, P.R. China
Standard : FCC 47 CFR Part 2, 90(R)

Equipment: Quectel EM05-G tested inside of Lenovo Notebook Computer.

The product was received on Dec. 08, 2021 and testing was performed from Dec. 17, 2021 to Dec. 28, 2021. We, Sporton International Inc. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA-603-E and has been in compliance with the applicable technical standards.

The test results in this partial report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. EMC & Wireless Communications Laboratory



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Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
	§90.542 (a)(7)	Effective Radiated Power	Pass	-
-	-	Peak-to-Average Ratio	-	See Note
-	§2.1049	Occupied Bandwidth	-	See Note
-	§2.1053 §90.543 (e)(2)	Conducted Band Edge Measurement	-	See Note
-	§2.1051 §90.210 (n)	Emission Mask	-	See Note
-	§2.1053 §90.543 (e)(3)	Conducted Spurious Emission	-	See Note
-	§2.1055 §90.539 (e)	Frequency Stability Temperature & Voltage	-	See Note
4.2	§2.1053 §90.543 (e)(3) §90.543 (f)	Radiated Spurious Emission	Pass	Under limit 4.99 dB at 1576.000 MHz

Note: The module (Model: EM05-G) makes no difference after verifying output power, this report reuses test data from the module report.

Declaration of Conformity:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
2. The measurement uncertainty please refer to this report "Uncertainty of Evaluation".
Comments and Explanations:
The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sheng Kuo
Report Producer: Ruby Zou

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00137A, TP00137B
FCC ID	PU5-TP00137BLQ
Sample 1	EUT with AVX Antenna
Sample 2	EUT with AWAN Antenna
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Quectel EM05-G tested inside of Lenovo Notebook Computer.

WWAN Antenna Information				
Main Antenna	Manufacturer	AVX	Peak gain (dBi)	1.72
	Part number	025.901X1.0001	Type	PIFA
	Manufacturer	AWAN	Peak gain (dBi)	-1.74
	Part number	025.901WX.0001	Type	PIFA

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard	
Tx Frequency	LTE Band 14 :790.5 MHz ~ 795.5 MHz
Rx Frequency	LTE Band 14 :760.5 MHz ~ 765.5 MHz
Bandwidth	5MHz / 10MHz
Maximum Output Power to Antenna	24.20 dBm
Type of Modulation	QPSK / 16QAM

1.3 Modification of EUT

No modifications are made to the EUT during all test items.



1.4 Testing Site

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333
Test Site No.	Sporton Site No.
	TH03-HY
Test Engineer	Benjamin Lin
Temperature (°C)	23.5~25
Relative Humidity (%)	49.4~52

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010
Test Site No.	Sporton Site No.
	03CH10-HY (TAF Code: 3786)
Test Engineer	Andy Yang, Karl Hou and Wilson Wu
Temperature (°C)	20~25
Relative Humidity (%)	50~60
Remark	The Radiated Spurious Emission test item subcontracted to Sporton International Inc. Wensan Laboratory

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC Designation No.: TW1190 and TW3786

1.5 Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ◆ ANSI C63.26-2015
- ◆ FCC 47 CFR Part 2, Part 90(R)
- ◆ ANSI / TIA-603-E
- ◆ FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- ◆ FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- ◆ FCC KDB 414788 D01 Radiated Test Site v01r01

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.



2 Test Configuration of Equipment Under Test

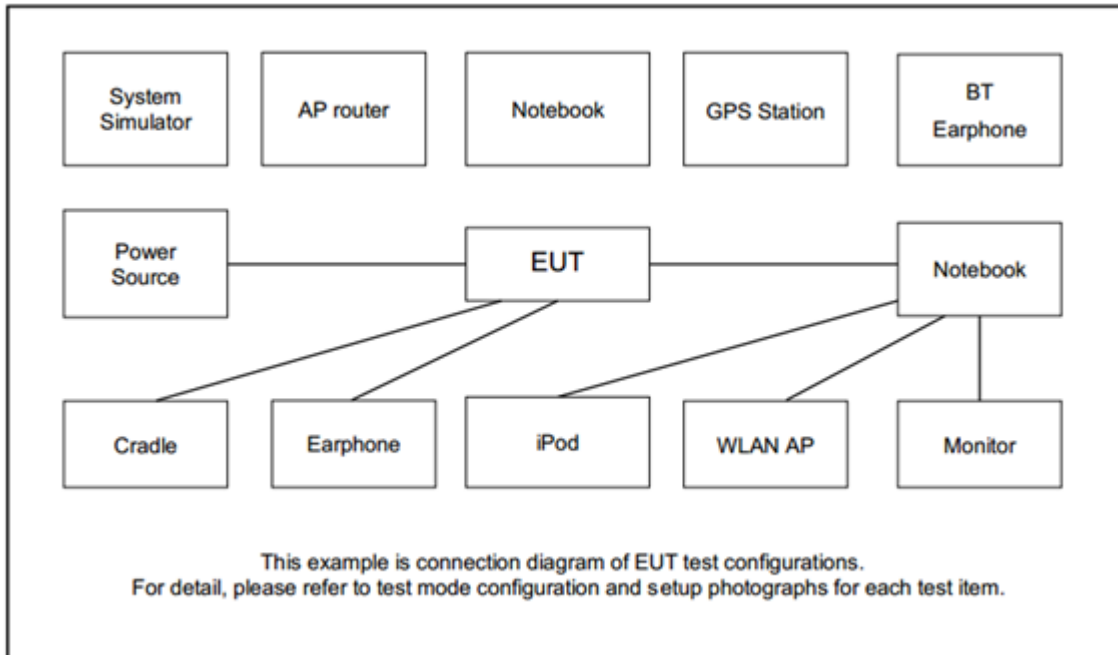
2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03r01 with maximum output power.

For radiated measurement, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in Tablet Type (three orthogonal axis (X: flat, Y: portrait, Z: landscape)) and Notebook Type, adjusting the measurement antenna orientation, following C63.26 exploratory test procedures and find Z Plane with accessory as worst plane.

Conducted Test Cases	Band	Bandwidth (MHz)						Modulation			RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	M	H
Max. Output Power	14	-	-	V	V	-	-	V	V	-	V	V	V	V	V	V
E.R.P	14	-	-	V	V	-	-	V	V	-	Max. Power					
Radiated Spurious Emission	14	-	-	V	V	-	-	V		-	V			V	V	V
Remark	<ol style="list-style-type: none"> The mark "v " means that this configuration is chosen for testing The mark "-" means that this bandwidth is not supported. The device is investigated from 30MHz to 10 times of fundamental signal for radiated spurious emission test under different RB size/offset and modulations in exploratory test. Subsequently, only the worst case emissions are reported. All the radiated test cases were performed with Sample 1. 															

2.2 Connection Diagram of Test System



2.3 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	8821C	N/A	N/A	Unshielded, 1.8 m
2.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A

2.4 Frequency List of Low/Middle/High Channels

LTE Band 14 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
10	Channel	-	23330	-
	Frequency	-	793	-
5	Channel	23305	23330	23355
	Frequency	790.5	793	795.5

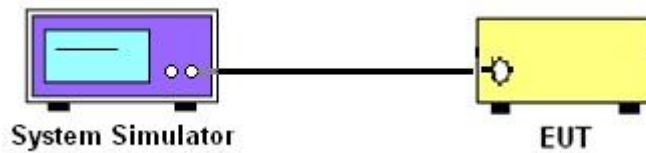
3 Conducted Test Items

3.1 Measuring Instruments

See list of measuring instruments of this test report.

3.1.1 Test Setup

3.1.2 Conducted Output Power



3.1.3 Test Result of Conducted Test

Please refer to Appendix A.



3.2 Conducted Output Power Measurement and ERP

3.2.1 Description of the Conducted Output Power Measurement and ERP Measurement

A base station simulator was used to establish communication with the EUT. Its parameters were set to transmit the maximum power on the EUT. The measured power in the radio frequency on the transmitter output terminals shall be reported.

The ERP of mobile transmitters must not exceed 3 Watts for LTE Band 14.

According to KDB 412172 D01 Power Approach,

$EIRP = P_T + G_T - L_C$, $ERP = EIRP - 2.15$, where

P_T = transmitter output power in dBm

G_T = gain of the transmitting antenna in dBi

L_C = signal attenuation in the connecting cable between the transmitter and antenna in dB

3.2.2 Test Procedures

1. The transmitter output port was connected to base station.
2. Set EUT at maximum power through base station.
3. Select lowest, middle, and highest channels for each band and different modulation.
4. Measure and record the power level from the system simulator.

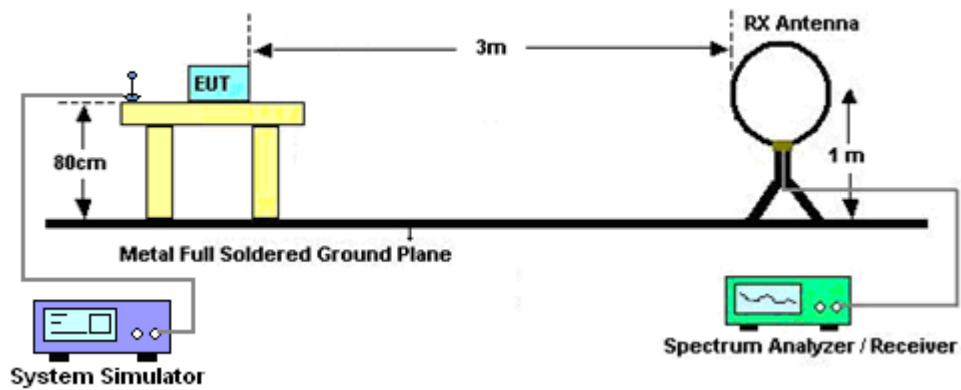
4 Radiated Test Items

4.1 Measuring Instruments

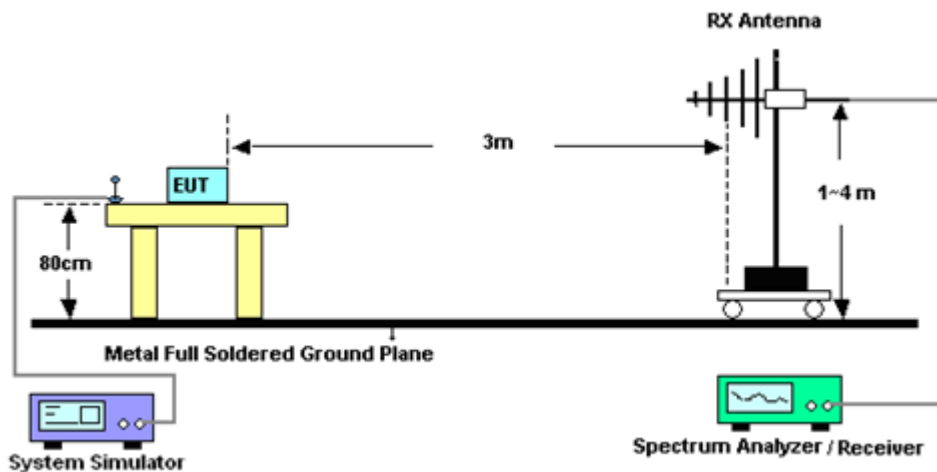
See list of measuring instruments of this test report.

4.1.1 Test Setup

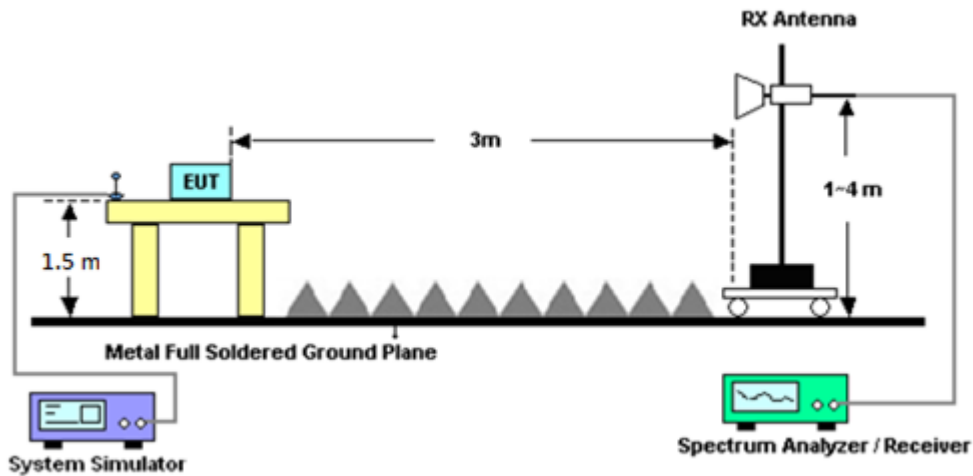
For radiated test below 30MHz



For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



4.1.2 Test Result of Radiated Test

Please refer to Appendix B.

Note:

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.



4.2 Radiated Spurious Emission

4.2.1 Description of Radiated Spurious Emission

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB.

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559–1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

4.2.2 Test Procedures

The testing follows FCC KDB 971168 D01 v03r01 Section 7 and ANSI / TIA-603-E Section 2.2.12.

1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
2. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest spurious emission.
4. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations.
5. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, Sweep = 500ms, Taking the record of maximum spurious emission.
6. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
7. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
8. Taking the record of output power at antenna port.
9. Repeat step 7 to step 8 for another polarization.
10. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
11. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)



5 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Base Station (Measure)	Anritsu	MT8821C	6262025341	N/A	Oct. 05, 2021	Dec. 17, 2021	Oct. 04, 2022	Conducted (TH03-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 07, 2021	Dec. 25, 2021~ Dec. 28, 2021	Sep. 06, 2022	Radiation (03CH16-HY)
Signal Generator	Agilent	MG3694C	163401	0.1Hz~40GHz	Jan. 31, 2021	Dec. 25, 2021~ Dec. 28, 2021	Jan. 30, 2022	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01N -06	41912 & 05	30MHz to 1GHz	Feb. 08, 2021	Dec. 25, 2021~ Dec. 28, 2021	Feb. 07, 2022	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N -06	47020 & 06	30MHz to 1GHz	Oct. 09, 2021	Dec. 25, 2021~ Dec. 28, 2021	Oct. 08, 2022	Radiation (03CH16-HY)
Horn Antenna	SCHWARZB ECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 04, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 03, 2022	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 05, 2021	Dec. 25, 2021~ Dec. 28, 2021	Jul. 04, 2022	Radiation (03CH16-HY)
Amplifier	EMCI	EMC051845SE	980729	1-18GHz	Jul. 09, 2021	Dec. 25, 2021~ Dec. 28, 2021	Jul. 08, 2022	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2021	Dec. 25, 2021~ Dec. 28, 2021	Dec. 08, 2022	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A	MY57290111	3Hz~26.5GHz	Dec. 15, 2021	Dec. 25, 2021~ Dec. 28, 2021	Dec. 14, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4PE	NA	Aug. 28, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4PE	NA	Aug. 28, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-57 57	NA	Aug. 28, 2021	Dec. 25, 2021~ Dec. 28, 2021	Aug. 27, 2022	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Dec. 25, 2021~ Dec. 28, 2021	N/A	Radiation (03CH16-HY)



6 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.86 dB
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.68 dB
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power & ERP)

LTE Band 14 Maximum Average Power [dBm] (GT - LC = 1.72 dB)								
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)
10	1	0	QPSK		24.20		23.77	0.2382
10	1	25			23.81			
10	1	49			24.05			
10	25	0			23.06			
10	25	12			22.88			
10	25	25			22.97			
10	50	0			22.87			
10	1	0	16-QAM		22.66		22.47	0.1766
10	1	25			22.90			
10	1	49			22.83			
10	25	0			21.98			
10	25	12			22.08			
10	25	25			22.07			
10	50	0			22.04			
Limit	ERP < 3W			Result			Pass	

LTE Band 14 Maximum Average Power [dBm] (GT - LC = 1.72 dB)									
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	ERP (dBm)	ERP (W)	
5	1	0	QPSK		24.15	24.13	24.14	23.72	0.2355
5	1	12			23.83	23.78	23.84		
5	1	24			24.08	24.05	24.00		
5	12	0			23.00	23.05	23.04		
5	12	7			22.87	22.88	22.89		
5	12	13			22.97	22.98	22.96		
5	25	0			22.83	22.80	22.89		
5	1	0	16-QAM		22.66	22.61	22.66	22.5	0.1778
5	1	12			22.85	22.93	22.86		
5	1	24			22.80	22.83	22.80		
5	12	0			21.95	21.97	22.01		
5	12	7			22.07	22.07	22.07		
5	12	13			22.04	22.09	22.09		
5	25	0			21.98	22.01	22.01		
Limit	ERP < 3W			Result			Pass		



Appendix B. Test Results of Radiated Test

LTE Band 14

LTE Band 14 / 5MHz / QPSK									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1576	-47.55	-42.15	-5.40	-63.02	-50.61	3.80	9.01	H
	2368	-50.54	-13.00	-37.54	-70.17	-53.65	4.69	9.94	H
	3153	-53.25	-13.00	-40.25	-75.43	-56.99	5.42	11.31	H
									H
									H
	1576	-51.22	-42.15	-9.07	-66.57	-54.28	3.80	9.01	V
	2368	-51.92	-13.00	-38.92	-71.45	-55.03	4.69	9.94	V
	3153	-53.44	-13.00	-40.44	-75.52	-57.18	5.42	11.31	V
									V
									V
Middle	1581	-48.56	-42.15	-6.41	-64.04	-51.65	3.80	9.05	H
	2376	-51.37	-13.00	-38.37	-71.03	-54.53	4.70	10.01	H
	3163	-53.22	-13.00	-40.22	-75.44	-56.99	5.43	11.35	H
									H
									H
	1581	-51.71	-42.15	-9.56	-67.05	-54.80	3.80	9.05	V
	2376	-50.66	-13.00	-37.66	-70.18	-53.82	4.70	10.01	V
	3163	-52.78	-13.00	-39.78	-74.90	-56.55	5.43	11.35	V
									V
									V



Highest	1584	-50.63	-42.15	-8.48	-66.12	-53.74	3.81	9.07	H
	2384	-49.49	-13.00	-36.49	-69.17	-52.71	4.70	10.07	H
	3173	-53.12	-13.00	-40.12	-75.38	-56.92	5.44	11.39	H
									H
									H
	1584	-52.70	-42.15	-10.55	-68.05	-55.81	3.81	9.07	V
	2384	-54.17	-13.00	-41.17	-73.68	-57.39	4.70	10.07	V
	3173	-51.69	-13.00	-38.69	-73.84	-55.49	5.44	11.39	V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.



LTE Band 14 / 10MHz / QPSK									
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Middle	1576	-47.14	-42.15	-4.99	-62.61	-50.20	3.80	9.01	H
	2368	-48.37	-13.00	-35.37	-68.00	-51.48	4.69	9.94	H
	3154	-53.54	-13.00	-40.54	-75.72	-57.28	5.42	11.32	H
									H
									H
	1576	-50.66	-42.15	-8.51	-66.01	-53.72	3.80	9.01	V
	2368	-50.00	-13.00	-37.00	-69.53	-53.11	4.69	9.94	V
	3154	-53.39	-13.00	-40.39	-75.47	-57.13	5.42	11.32	V
									V
									V

Remark: Spurious emissions within 30-1000MHz were found more than 20dB below limit line.