



Report No.: FG1D0314F

: 01

FCC RADIO TEST REPORT

FCC ID : PU5-TP00137BLF 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, 96

Equipment: Fibocom L860-GL-16 tested inside of Lenovo Notebook Computer.

The product was received on Dec. 03, 2021 and testing was performed from Dec. 25, 2021 to Jan. 27, 2022. We, Sporton International Inc. Wensan 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 report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

Lunis Wu

Sporton International Inc. Wensan Laboratory

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History of this test report

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Report No.	Version	Description	Issued Date
FG1D0314F	01	Initial issue of report	Jan. 28, 2022

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Summary of Test Result

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power	Reporting only	-
-	§96.41	Peak-to-Average Ratio	-	See Note
3.3	§96.41	Effective Isotropic Radiated Power	Pass	-
-	§2.1049 §96.41	Occupied Bandwidth	-	See Note
-	§2.1051 §96.41	Conducted Band Edge Measurement	-	See Note
-	§2.1051 §96.41	Conducted Spurious Emission	-	See Note
-	§2.1055	Frequency Stability for Temperature & Voltage	-	See Note
4.4	§2.1051 §96.41	Radiated Spurious Emission	Pass	Under limit 9.47 dB at 28404.000 MHz

Note:

- 1. The module (Model: L860-GL-16) makes no difference after verifying output power, this report reuses test data from the module report.
- Conducted power was verified to be consistent with the original modular approval, so the output power level in the original modular grant is referenced in this report for determining ERP/EIRP of this host product

Declaration of Conformity:

- 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: Lucy Wu

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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-TP00137BLF				
Sample 1	EUT with AVX Antenna				
Sample 2	EUT with AWAN Antenna				
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS				
EUT Stage	Production Unit				

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Remark:

- 1. The above EUT's information was declared by manufacturer.
- 2. Equipment: Fibocom L860-GL-16 tested inside of Lenovo Notebook Computer.

WWAN Antenna Information						
	Manufacturer	AVX	Peak gain (dBi)	0.91		
Main Antenna	Part number	025.901X1.0001	Туре	PIFA		
Walli Antenna	Manufacturer	AWAN	Peak gain (dBi)	0.90		
	Part number	025.901WX.0001	Туре	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	3552.5 MHz ~ 3697.5 MHz				
Rx Frequency	3552.5 MHz ~ 3697.5 MHz				
Bandwidth	5 MHz / 10 MHz / 15 MHz / 20 MHz				
Maximum Output Power to Antenna	20.88 dBm				
Type of Modulation	QPSK / 16QAM / 64QAM				

1.3 Modification of EUT

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

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1.4 Testing Location

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.
Test Site No.	TH03-HY (TAF Code: 1190)
Test Engineer	Benjamin Lin
Temperature (°C)	23.5~25
Relative Humidity (%)	49.4~52
	The Conducted test item subcontracted to Sporton International Inc. EMC
Remark	& Wireless Communications Laboratory

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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.				
Test Site No.	03CH12-HY				
Test Engineer	Jack Cheng, Lance Chiang and Chuan Chu				
Temperature (°C)	21.2~24.2				
Relative Humidity (%)	58.2~68.8				

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
- ANSI / TIA-603-E
- FCC 47 CFR Part 2, 96
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 940660 D01 Part 96 CBRS Eqpt v01
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- FCC KDB 414788 D01 Radiated Test Site v01r01

Remark:

- 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.

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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, and adjusting the measurement antenna orientation, following C63.26 exploratory test procedures and find Notebook Type as worst plane.

		Bandwidth (MHz)				Modulation		RB#		Test Channel						
Test Items	Band	1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	М	Н
Max. Output Power	48	-	1	٧	٧	v	v	v	v	v	٧		v	v	٧	v
E.R.P / E.I.R.P	48	-	-	V	v	v	v	v	v	v			Max.	Power		
Radiated Spurious Emission	48	-	-		٧			v			v			v	٧	>
Remark	 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. 															

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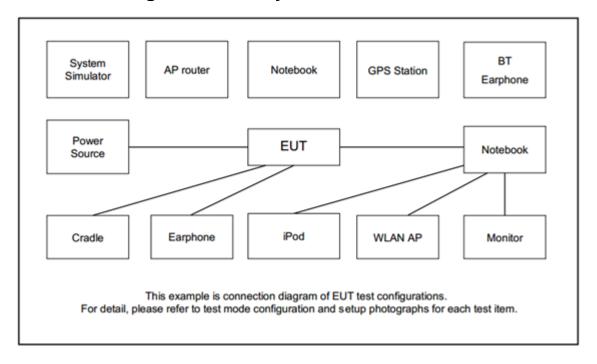
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2.2 Connection Diagram of Test System



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2.3 Support Unit used in test configuration

Iten	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8821C	N/A	N/A	Unshielded, 1.8 m

2.4 Frequency List of Low/Middle/High Channels

LTE Band 48 Channel and Frequency List								
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest				
20	Channel	55340	55990	56640				
20	Frequency	3560.0	3625.0	3690.0				
15	Channel	55315	55990	56665				
15	Frequency	3557.5	3625.0	3692.5				
10	Channel	55290	55990	56690				
10	Frequency	3555.0	3625.0	3695.0				
5	Channel	55265	55990	56715				
5	Frequency	3552.5	3625.0	3697.5				

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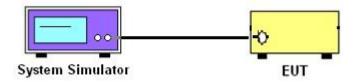
3 Conducted Test Items

3.1 Measuring Instruments

See list of measuring instruments of this test report.

3.1.1 Test Setup

3.1.2 Conducted Output Power



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3.1.3 Test Result of Conducted Test

Please refer to Appendix A.

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3.2 Conducted Output Power

3.2.1 Description of the Conducted Output Power Measurement

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

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3.2.2 Test Procedures

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

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3.3 EIRP

3.3.1 Description of the EIRP Measurement

The EIRP of mobile transmitters must not exceed 23 dBm /10 megahertz.

The testing follows ANSI C63.26-2015 Section 5.2.5.5

According to KDB 412172 D01 Power Approach,

 $EIRP = P_T + G_T - L_C$, 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

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Device	Maximum EIRP	Maximum PSD		
	(dBm/10 MHz)	(dBm/MHz)		
End User Device	23	n/a		

Remark: Total channel power is complied with EIRP limit 23dBm/10MHz.

3.3.1 Test Procedures

The testing follows procedure in Section 5.2 of ANSI C63.26-2015 and KDB 940660 D01 Part 96 CBRS Eqpt v03 Section 3.2(b)(2)

Determine the EIRP by adding the effective antenna gain to the measured average conducted power level.

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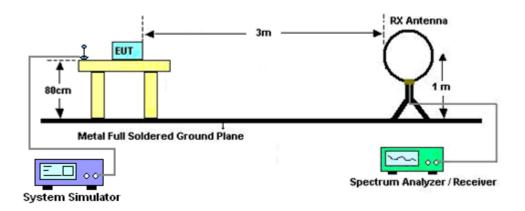
4 Radiated Test Items

4.1 Measuring Instruments

See list of measuring instruments of this test report.

4.2 Test Setup

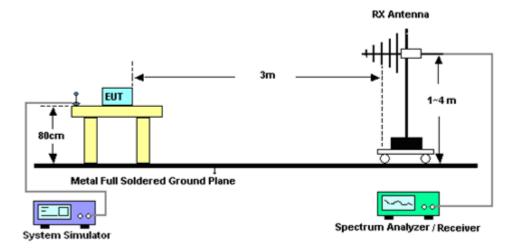
For radiated emissions below 30MHz



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For radiated emissions from 30MHz to 1GHz

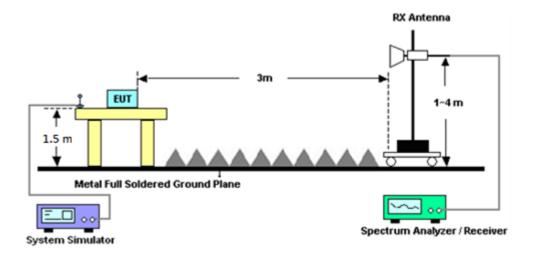
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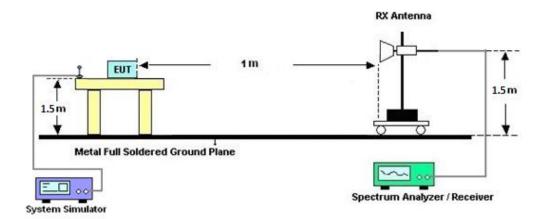
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For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



4.3 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.

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4.4 Radiated Spurious Emission

4.4.1 Description of Radiated Spurious Emission Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E.

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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 -40dBm / MHz.

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

4.4.2 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 height for frequency below 1GHz and 1.5 meter height for frequency above 1GHz respectively above ground.
- 2. The EUT was set 3 meters from the receiving antenna mounted on the antenna tower.
- The table was rotated 360 degrees to determine the position of the highest spurious emission. 3.
- The height of the receiving antenna is varied between 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
- 5. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
- 6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
- 7. A horn antenna was substituted in place of the EUT and was driven by a signal generator. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.

EIRP (dBm) = S.G. Power – Tx Cable Loss + Tx Antenna Gain ERP (dBm) = EIRP - 2.15

8. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

The limit line is -40dBm/MHz

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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. 25, 2021	Oct. 04, 2022	Conducted (TH03-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 07, 2022	Jan. 27, 2022	Jan. 06, 2023	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00800N1D01 N-06	37059 & 01	30MHz~1GHz	Oct. 09, 2021	Jan. 27, 2022	Oct. 08, 2022	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D & N-6-06	35414 & AT-N0602	30MHz~1GHz	Oct. 09, 2021	Jan. 27, 2022	Oct. 08, 2022	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1326	1GHz~18GHz	Oct. 25, 2021	Jan. 27, 2022	Oct. 24, 2022	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBE CK	BBHA 9120 D	9120D-1212	1GHz~18GHz	May 18, 2021	Jan. 27, 2022	May 17, 2022	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA91702 51	18GHz~40GHz	Nov. 30, 2021	Jan. 27, 2022	Nov. 29, 2022	Radiation (03CH12-HY)
SHF-EHF Horn Antenna	SCHWARZBE CK	BBHA 9170	BBHA91705 76	18GHz~40GHz	May 21, 2021	Jan. 27, 2022	May 20, 2022	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103	161075	10MHz~1GHz	Mar. 24, 2021	Jan. 27, 2022	Mar. 23, 2022	Radiation (03CH12-HY)
Preamplifier	Aglient	8449B	3008A02375	1GHz~26.5GHz	May 25, 2021	Jan. 27, 2022	May 24, 2022	Radiation (03CH12-HY)
Preamplifier	Jet-Power	JPA0118-55-3 03K	1710001800 054002	1GHz~18GHz	Jun. 16, 2021	Jan. 27, 2022	Jun. 15, 2022	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060801	18GHz~40GHz	Jun. 22, 2021	Jan. 27, 2022	Jun. 21, 2022	Radiation (03CH12-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200485	10Hz~44GHz	Mar. 05, 2021	Jan. 27, 2022	Mar. 04, 2022	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30MHz~40GHz	Feb. 22, 2021	Jan. 27, 2022	Feb. 21, 2022	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30MHz~40GHz	Feb. 22, 2021	Jan. 27, 2022	Feb. 21, 2022	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4PE	9 kHz~30 MHz	Mar. 11, 2021	Jan. 27, 2022	Mar. 10, 2022	Radiation (03CH12-HY)
Filter	Wainwright	WLKS1200-1 2SS	SN2	1.2GHz Low Pass Filter	Mar. 17, 2021	Jan. 27, 2022	Mar. 16, 2022	Radiation (03CH12-HY)
Filter	Wainwright	WHKX12-108 0-1200-15000 -60SS	SN1	1.2GHz High Pass Filter	Mar. 17, 2021	Jan. 27, 2022	Mar. 16, 2022	Radiation (03CH12-HY)
Filter	Wainwright	WHKX12-270 0-3000-18000 -60ST	SN2	3GHz High Pass Filter	Jul. 12, 2021	Jan. 27, 2022	Jul. 11, 2022	Radiation (03CH12-HY)
Hygrometer	TECPEL	DTM-303B	TP140349	N/A	Sep. 30, 2021	Jan. 27, 2022	Sep. 29, 2022	Radiation (03CH12-HY)
Controller	EMEC	EM1000	N/A	Control Turn table & Ant Mast	N/A	Jan. 27, 2022	N/A	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500- B	N/A	1m~4m	N/A	Jan. 27, 2022	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Jan. 27, 2022	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Jan. 27, 2022	N/A	Radiation (03CH12-HY)

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6 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of	3.10 dB
Confidence of 95% (U = 2Uc(y))	3.10 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))	3.39 dB
Confidence of 95% (0 = 20c(y))	

Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of	4.34 dB
Confidence of 95% (U = 2Uc(y))	4.34 UB

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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power & EIRP)

LTE Band 48 Maximum Average Power [dBm] (GT - LC = 0.91 dB)										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP (W)		
20	1	0		20.65	20.77	20.70				
20	1	99	QPSK	20.60	20.88	20.64	21.79	0.1510		
20	100	0		19.50	19.75	19.60				
20	1	0	16-QAM	19.88	19.96	19.85	20.87	0.1222		
20	1	0	64-QAM	18.60	18.91	18.85	19.82	0.0959		
Limit	EIRP < 23dBm/10MHz			Result			Pa	Pass		

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LTE Band 48 Maximum Average Power [dBm] (GT - LC = 0.91 dB)										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP (W)		
15	1	0	QPSK	20.63	20.75	20.66	21.66	0.1466		
15	1	0	16-QAM	19.76	20.08	19.78	20.99	0.1256		
15	1	0	64-QAM	18.52	18.86	18.82	19.77	0.0948		
Limit	EIRP < 23dBm/10MHz			Result			Pass			

	LTE Band 48 Maximum Average Power [dBm] (GT - LC = 0.91 dB)										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP (W)			
10	1	0	QPSK	20.65	20.80	20.62	21.71	0.1483			
10	1	0	16-QAM	19.60	19.73	19.77	20.68	0.1169			
10	1	0	64-QAM	18.85	19.14	18.85	20.05	0.1012			
Limit	EIRP < 23dBm/10MHz			Result			Pass				

	LTE Band 48 Maximum Average Power [dBm] (GT - LC = 0.91 dB)										
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest	EIRP (dBm)	EIRP (W)			
5	1	0	QPSK	20.53	20.69	20.59	21.60	0.1445			
5	1	0	16-QAM	19.95	19.85	19.82	20.86	0.1219			
5	1	0	64-QAM	19.52	19.21	19.06	20.43	0.1104			
Limit	EIRP < 23dBm/10MHz			Result			Pass				

Appendix B. Test Results of Radiated Test

LTE Band 48

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LTE Band 48 / 10MHz / QPSK												
Channel	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Over Limit (dB)	SPA Reading (dBm)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)			
	7100	-60.53	-40	-20.53	-56.03	-70.50	1.77	11.74	Н			
	10651	-58.84	-40	-18.84	-56.34	-67.27	2.47	10.90	Н			
	14202	-55.16	-40	-15.16	-57.94	-64.01	2.87	11.72	Н			
	21303	-54.22	-40	-14.22	-76.25	-70.94	1.98	18.70	Н			
	24854	-52.39	-40	-12.39	-77.35	-68.39	2.07	18.07	Н			
Lowest	28404	-50.90	-40	-10.90	-76.42	-68.14	2.32	19.56	Н			
Lowest	7100	-59.50	-40	-19.50	-54.61	-69.47	1.77	11.74	V			
	10651	-59.14	-40	-19.14	-56.39	-67.57	2.47	10.90	V			
	14202	-55.39	-40	-15.39	-57.9	-64.24	2.87	11.72	V			
	21303	-54.72	-40	-14.72	-76.61	-71.44	1.98	18.70	V			
	24854	-51.05	-40	-11.05	-77.22	-67.05	2.07	18.07	V			
	28404	-49.47	-40	-9.47	-76.8	-66.71	2.32	19.56	V			
	7241	-60.00	-40	-20.00	-55.6	-69.66	1.85	11.51	Н			
	10861	-57.78	-40	-17.78	-55.65	-66.10	2.58	10.90	Н			
	14482	-55.68	-40	-15.68	-58.37	-63.87	2.85	11.04	Н			
	18102	-54.66	-40	-14.66	-71.9	-70.87	1.76	17.98	Н			
	21723	-54.08	-40	-14.08	-75.73	-70.87	2.00	18.79	Н			
Middle	25344	-50.21	-40	-10.21	-76.86	-66.85	2.14	18.78	Н			
Middle	7241	-59.22	-40	-19.22	-54.57	-68.88	1.85	11.51	V			
	10861	-57.98	-40	-17.98	-55.64	-66.30	2.58	10.90	V			
	14482	-56.09	-40	-16.09	-57.92	-64.28	2.85	11.04	V			
	18102	-54.13	-40	-14.13	-72.3	-70.34	1.76	17.98	V			
	21723	-54.29	-40	-14.29	-75.95	-71.08	2.00	18.79	V			
	25344	-52.01	-40	-12.01	-77.38	-68.65	2.14	18.78	V			

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7381 -58.17 -40 -18.17 -53.55 -67.53 1.93 11.29 Н 11071 -58.61 -40 -18.61 -56.92 -66.98 2.62 10.99 Н 14762 -54.44 -40 -14.44 -58.21 -63.36 2.92 11.84 Н 18452 -55.99 -40 -15.99 -74.51 -72.02 1.88 17.91 Η 22143 -54.24 -40 -76.68 -71.02 2.06 18.84 Н -14.24 25834 -51.38 -40 -77.6 -68.45 2.00 19.07 Н -11.38 Highest ٧ 7381 -58.74 -40 -18.74 -53.95 -68.10 1.93 11.29 ٧ 11071 -58.29 -40 -18.29 -56.43 -66.66 2.62 10.99 14762 -40 -57.86 2.92 ٧ -55.88 -15.88 -64.80 11.84 -71.65 ٧ 18452 -55.62 -40 -15.62 -73.27 1.88 17.91 22143 -53.57 -40 -76.02 -70.35 2.06 18.84 ٧ -13.57 ٧ 25834 -49.52 -40 -9.52 -76.88 -66.59 2.00 19.07

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

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