



FCC RADIO TEST REPORT

FCC ID : 2AJN7-TP00110AUC
Equipment : Notebook Computer
Brand Name : Lenovo
Model Name : TP00110A
Applicant : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Manufacturer : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Standard : FCC 47 CFR Part 2, 90(R)

Equipment: Fibocom L860-GL and Intel 9560D2W tested inside of Lenovo Notebook Computer.

The product was received on Mar. 13, 2019 and testing was started from Apr. 08, 2019 and completed on Apr. 11, 2019. 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 report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

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.

Approved by: Jones Tsai

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



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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	-
4.2	§2.1053 §90.543 (e)(3) §90.543 (f)	Radiated Spurious Emission	Pass	Under limit 0.73 dB at 1576.000 MHz

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Wii Chang

Report Producer: Natasha Hsieh

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00110A
FCC ID	2AJN7-TP00110AUC
Sample 1	EUT with Amphenol Antenna
Sample 2	EUT with SPEEDWIRE Antenna
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 Bluetooth BR/EDR/LE
EUT Stage	Production Unit

Remark:

1. The above EUT's information was declared by manufacturer.
2. Equipment: Fibocom L850-GL and Intel 9560D2W tested inside of Lenovo Notebook Computer.
3. All test items were performed with Sample 1.

Antenna Information				
WWAN				3G<E (dBi)
Antenna 1	Manufacturer	Amphenol	Peak gain	2.30
	Part number	LX9865-16-000-C	Type	PIFA
Antenna 2	Manufacturer	SPEEDWIRE	Peak gain	2.07
	Part number	F.0G.ZV-0008-001 -00	Type	PIFA

1.2 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx Frequency	LTE Band 14 :790.5 MHz ~ 795.5 MHz
Rx Frequency	LTE Band 14 :760.5 MHz ~ 765.5 MHz
Bandwidth	LTE Band 14 : 5MHz / 10MHz
Maximum Output Power to Antenna	LTE Band 14 : 22.91 dBm
Type of Modulation	QPSK / 16QAM / 64 QAM

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.
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. TH05-HY
Test Engineer	Aaron Shen
Temperature	20~25°C
Relative Humidity	50~53%

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

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	Sporton Site No. 03CH15-HY
Test Engineer	Watt Tseng
Temperature	23~24 °C
Relative Humidity	55~56 %

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

FCC Designation No.: TW1190 and TW0007

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
- ♦ 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

Remark: All test items were verified and recorded according to the standards and without any deviation during the test.

2 Test Configuration of Equipment Under Test

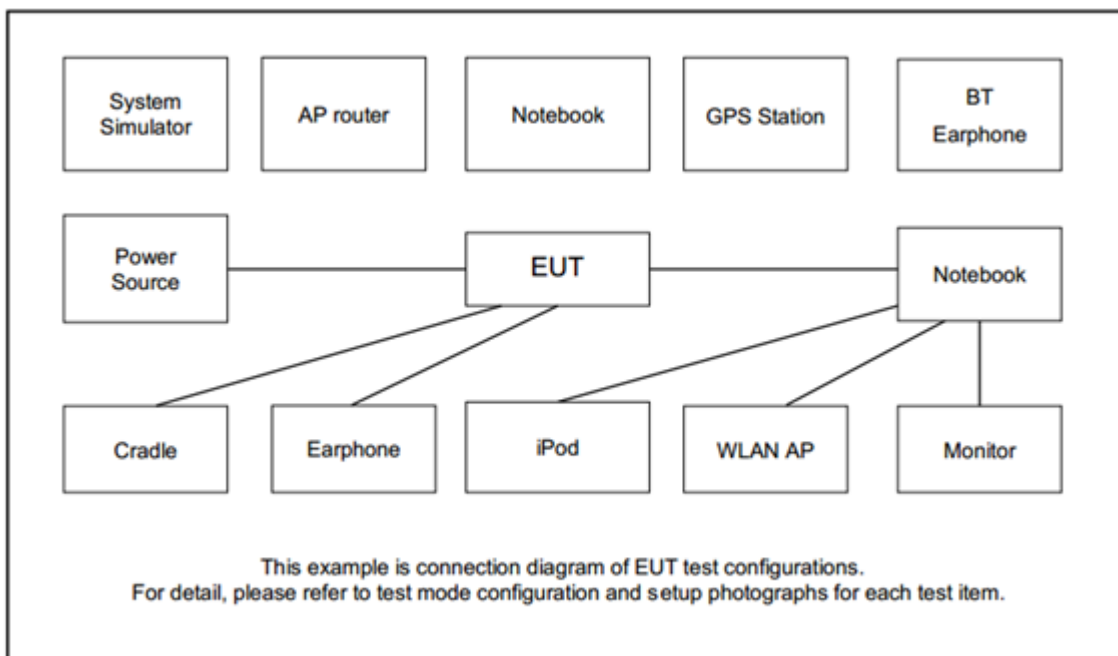
2.1 Test Mode

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, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.

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	v
E.R.P	14	-	-	v	v	-	-	v	v	v	v			v	v	v
Radiated Spurious Emission	14	Worst Case											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 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 Adapter 1. 															

2.2 Connection Diagram of Test System





2.3 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model No.	FCC ID	Data Cable	Power Cord
1.	LTE Base Station	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	Earphone	zyia	N/A	N/A	Unshielded, 1.2 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

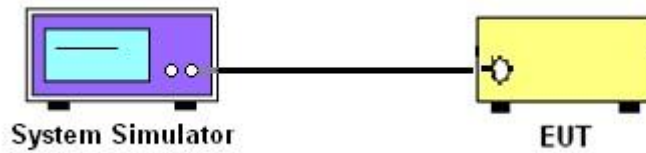
3 Conducted Test Items

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.

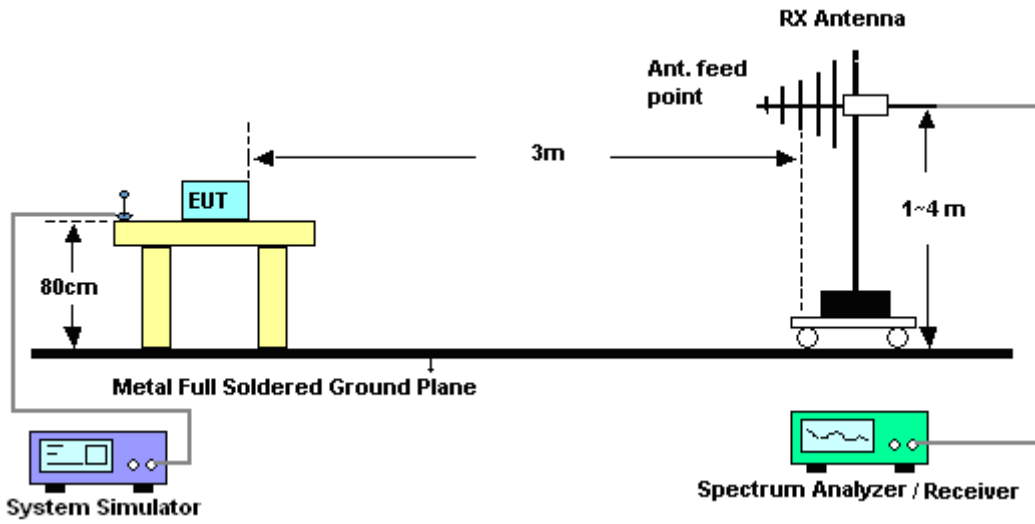
4 Radiated Test Items

4.1 Measuring Instruments

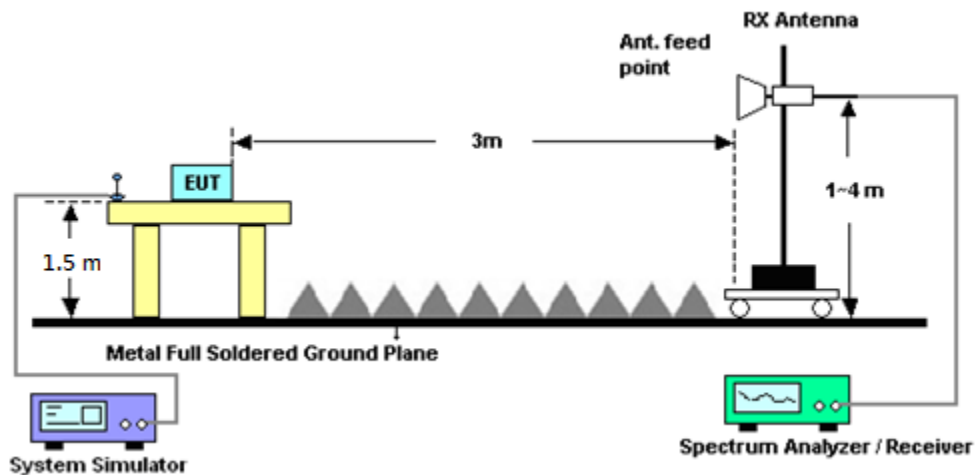
See list of measuring instruments of this test report.

4.1.1 Test Setup

For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



4.1.2 Test Result of Radiated Test

Please refer to Appendix B.



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 5.8 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	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
LTE Base Station	Anritsu	MT8820C	KS141204 JCGS01	6201432836	Jan. 14, 2019	Apr. 11, 2019	Jan. 12, 2020	Conducted (TH05-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 06, 2018	Apr. 08, 2019	Dec. 05, 2019	Radiation (03CH15-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jan. 07, 2019	Apr. 08, 2019	Jan. 06, 2020	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170 576	18GHz ~ 40GHz	May 08, 2018	Apr. 08, 2019	May 07, 2019	Radiation (03CH15-HY)
Amplifier	SONOMA	310N	363440	9kHz~1GHz	Dec. 28, 2018	Apr. 08, 2019	Dec. 27, 2019	Radiation (03CH15-HY)
Bilog Antenna	TESEQ	CBL6111D&0 0800N1D01N- 06	41912&05	30MHz to 1GHz	Feb. 12, 2019	Apr. 08, 2019	Feb. 11, 2020	Radiation (03CH15-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-162 0	1G~18GHz	Oct. 17, 2018	Apr. 08, 2019	Oct. 16, 2019	Radiation (03CH15-HY)
Preamplifier	Keysight	83017A	MY532701 95	1GHz~26.5GHz	Aug. 23, 2018	Apr. 08, 2019	Aug. 22, 2019	Radiation (03CH15-HY)
Spectrum Analyzer	Agilent	E4446A	MY501801 36	3Hz~44GHz	Apr. 25, 2018	Apr. 08, 2019	Apr. 24, 2019	Radiation (03CH15-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Apr. 08, 2019	N/A	Radiation (03CH15-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Apr. 08, 2019	N/A	Radiation (03CH15-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Apr. 08, 2019	N/A	Radiation (03CH15-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170 251	18GHz- 40GHz	Nov. 20, 2018	Apr. 08, 2019	Nov. 19, 2019	Radiation (03CH15-HY)
Signal Generator	Rohde & Schwarz	SMF100A	101107	100kHz~40GHz	May 22, 2018	Apr. 08, 2019	May 21, 2019	Radiation (03CH15-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-152 2	1G~18GHz	Sep. 07, 2018	Apr. 08, 2019	Sep. 06, 2019	Radiation (03CH15-HY)
Software	Audix	E3 6.2009-8-24	RK-00045 1	N/A	N/A	Apr. 08, 2019	N/A	Radiation (03CH15-HY)



6 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.37
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	3.67
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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	4.03
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power)

LTE Band 14 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
10	1	0	QPSK		22.91	
10	1	25			22.78	
10	1	49			22.87	
10	25	0			21.86	
10	25	12			21.79	
10	25	25			21.81	
10	50	0			21.83	
10	1	0	16-QAM	-	22.35	-
10	1	25			22.01	
10	1	49			22.10	
10	25	0			21.04	
10	25	12			20.90	
10	25	25			20.96	
10	50	0			20.83	
10	1	0	64-QAM		21.35	
10	1	25			21.38	
10	1	49			21.32	
10	25	0			20.16	
10	25	12			20.17	
10	25	25			20.38	
10	50	0			20.18	
5	1	0	QPSK	22.79	22.80	22.66
5	1	12		22.83	22.79	22.84
5	1	24		22.80	22.77	22.87
5	12	0		21.88	21.84	21.68
5	12	7		21.92	21.75	21.66
5	12	13		21.83	21.90	21.92
5	25	0		22.06	21.75	21.76
5	1	0	16-QAM	21.93	22.37	22.02
5	1	12		22.20	21.93	22.34
5	1	24		22.07	22.35	22.38
5	12	0		20.83	21.05	20.97
5	12	7		20.91	20.99	20.91
5	12	13		20.83	21.04	21.00
5	25	0		20.86	20.89	20.94
5	1	0	64-QAM	21.34	21.34	21.36
5	1	12		21.30	21.38	21.30
5	1	24		21.24	21.39	21.34
5	12	0		20.08	20.31	20.25
5	12	7		20.03	20.29	20.27
5	12	13		20.32	20.09	20.13
5	25	0		20.07	20.13	20.27



Appendix B. Test Results of ERP and Radiated Test

ERP

LTE Band 14 / 5MHz (Average) (GT - LC = 0.67 dB)							
Channel	Mode	RB		Conducted		ERP	
		Size	Offset	Power (dBm)	Power (Watts)	ERP(dBm)	ERP(W)
Lowest	QPSK	1	24	22.80	0.1905	21.32	0.1355
Middle		1	24	22.77	0.1892	21.29	0.1346
Highest		1	24	22.87	0.1936	21.39	0.1377
Lowest	16QAM	1	24	22.07	0.1611	20.59	0.1146
Middle		1	24	22.35	0.1718	20.87	0.1222
Highest		1	24	22.38	0.1730	20.90	0.1230
Lowest	64QAM	1	24	21.24	0.1330	19.76	0.0946
Middle		1	24	21.39	0.1377	19.91	0.0979
Highest		1	24	21.34	0.1361	19.86	0.0968
Limit	ERP < 3W			Result		PASS	

LTE Band 14 / 10MHz (Average) (GT - LC = 0.67 dB)							
Channel	Mode	RB		Conducted		ERP	
		Size	Offset	Power (dBm)	Power (Watts)	ERP(dBm)	ERP(W)
Lowest	QPSK	-	-	-	-	-	-
Middle		1	0	22.91	0.1954	21.43	0.1390
Highest		-	-	-	-	-	-
Lowest	16QAM	-	-	-	-	-	-
Middle		1	0	22.35	0.1718	20.87	0.1222
Highest		-	-	-	-	-	-
Lowest	64QAM	-	-	-	-	-	-
Middle		1	25	21.38	0.1374	19.90	0.0977
Highest		-	-	-	-	-	-
Limit	ERP < 3W			Result		PASS	



Radiated Spurious Emission

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	1584	-43.63	-42.15	-1.48	-54.60	-49.26	0.66	8.44	H
	2376	-34.94	-13	-21.94	-51.06	-42.48	0.94	10.63	H
	3168	-53.77	-13	-40.77	-72.10	-62.02	1.17	11.57	H
	3960	-53.83	-13	-40.83	-74.40	-62.69	1.65	12.67	H
									H
									H
	1584	-44.68	-42.15	-2.53	-55.44	-50.31	0.66	8.44	V
	2376	-34.17	-13	-21.17	-50.43	-41.71	0.94	10.63	V
	3168	-48.36	-13	-35.36	-66.74	-56.61	1.17	11.57	V
	3960	-51.96	-13	-38.96	-72.68	-60.82	1.65	12.67	V
									V
									V
Middle	1592	-44.34	-42.15	-2.19	-55.23	-50.00	0.66	8.47	H
	2384	-36.83	-13	-23.83	-52.89	-44.38	0.94	10.64	H
	3184	-52.87	-13	-39.87	-71.25	-61.15	1.17	11.60	H
									H
									H
									H
	1592	-44.30	-42.15	-2.15	-55.00	-49.96	0.66	8.47	V
	2384	-36.26	-13	-23.26	-52.47	-43.81	0.94	10.64	V
	3184	-47.83	-13	-34.83	-66.30	-56.11	1.17	11.60	V
									V
									V
									V



Highest	1592	-45.65	-42.15	-3.50	-56.54	-51.31	0.66	8.47	H
	2392	-36.90	-13	-23.90	-52.92	-44.46	0.94	10.65	H
	3192	-52.78	-13	-39.78	-71.18	-61.08	1.18	11.62	H
									H
									H
									H
									H
	1592	-45.19	-42.15	-3.04	-55.89	-50.85	0.66	8.47	V
	2392	-35.22	-13	-22.22	-51.39	-42.78	0.94	10.65	V
	3192	-47.70	-13	-34.70	-66.22	-56.00	1.18	11.62	V
									V
									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	-43.31	-42.15	-1.16	-54.34	-48.91	0.65	8.40	H
	2368	-37.08	-13	-24.08	-53.25	-44.61	0.93	10.62	H
	3152	-51.95	-13	-38.95	-70.24	-60.17	1.17	11.53	H
	3944	-53.10	-13	-40.10	-73.64	-61.96	1.64	12.66	H
									H
									H
									H
	1576	-42.88	-42.15	-0.73	-53.68	-48.48	0.65	8.40	V
	2368	-36.09	-13	-23.09	-52.39	-43.62	0.93	10.62	V
	3152	-46.07	-13	-33.07	-64.36	-54.29	1.17	11.53	V
	3944	-50.08	-13	-37.08	-70.74	-58.94	1.64	12.66	V
									V
									V
									V

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