

FCC RADIO TEST REPORT

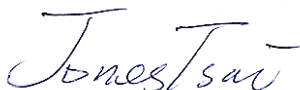
FCC ID : 2AJN7-TP00109A
Equipment : Notebook Computer
Brand Name : Lenovo
Model Name : TP00109A
Applicant : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Manufacturer : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Standard : FCC 47 CFR Part 2, Part 27(D)

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

The product was received on Mar. 13, 2019 and testing was started from Mar. 23, 2019 and completed on Mar. 28, 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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History of this test report

Report No.	Version	Description	Issued Date
FG931312D	01	Initial issue of report	May 03, 2019

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.2	§2.1046	Conducted Output Power and Effective Isotropic Radiated Power	Reporting only	-
4.2	§2.1053 §27.53 (a)(4)	Radiated Spurious Emission	Pass	Under limit 9.97 dB at 4629.000 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: Maggie Chiang

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook Computer
Brand Name	Lenovo
Model Name	TP00109A
FCC ID	2AJN7-TP00109A
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 L860-GL and Intel 9560D2W tested inside of Lenovo Notebook.
3. All test items were performed with Sample 2.

Antenna Information				
WWAN				3G<E (dBi)
Antenna 1	Manufacturer	Amphenol	Peak gain	1.12
	Part number	LXA113-16-000-C	Type	PIFA
Antenna 2	Manufacturer	SPEEDWIRE	Peak gain	1.63
	Part number	F.0G.ZV-0009-001-00	Type	PIFA

1.2 Product Specification of Equipment Under Test

Product Feature	
Tx Frequency	LTE Band 30 : 2307.5 MHz ~2312.5 MHz
Rx Frequency	LTE Band 30 : 2352.5 MHz ~ 2357.5 MHz
Bandwidth	5MHz / 10MHz
Maximum Output Power to Antenna	21.37 dBm
Type of Modulation	QPSK / 16QAM / 64QAM

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.)
Test Site No.	Sporton Site No.
	TH05-HY
Test Engineer	Lemon Su
Temperature	23°C
Relative Humidity	58%

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.)
Test Site No.	Sporton Site No.
	03CH12-HY
Test Engineer	Jack Cheng, Lance Chiang, and Chuan Chu
Temperature	23~24°C
Relative Humidity	63~66%

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 27(D)
- ♦ ANSI / TIA-603-E
- ♦ FCC KDB 971168 Power Meas License Digital Systems D01 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.

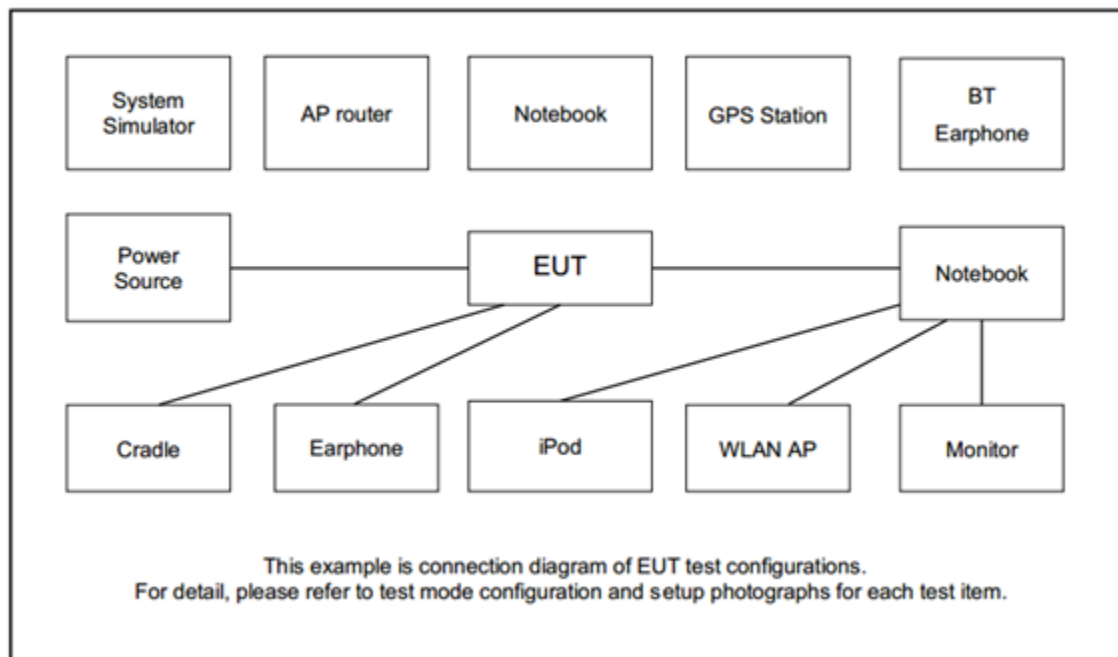
2 Test Configuration of Equipment Under Test

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.

Test Items	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	30	-	-	v	v	-	-	v	v	v	v	v	v	v	v	v
Radiated Spurious Emission	30	Worst Case												v	v	v
Remark	1. The mark “v ” means that this configuration is chosen for testing 2. The mark “-“ means that this bandwidth is not supported. 3. 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. 4. All the radiated test cases were performed with Adapter 3															

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.	System Simulator	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 30 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
10	Channel	-	27710	-
	Frequency	-	2310	-
5	Channel	27685	27710	27735
	Frequency	2307.5	2310	2312.5

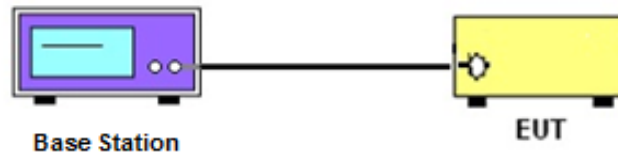
3 Conducted Test Items

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 EIRP Measurement

3.2.1 Description of the Conducted Output Power Measurement and EIRP 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 EIRP of mobile transmitters must not exceed 0.25 Watts for LTE Band 30.

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

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.

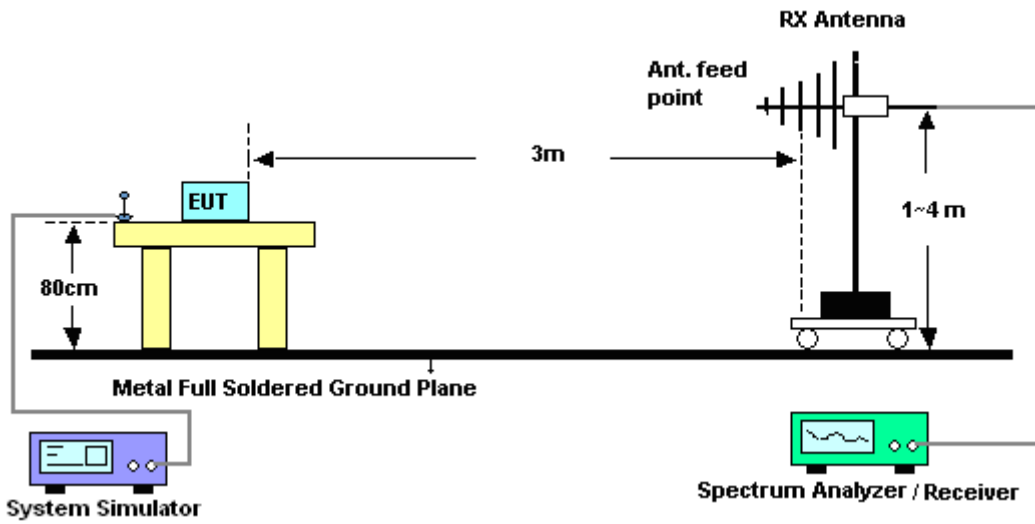
4 Radiated Test Items

4.1 Measuring Instruments

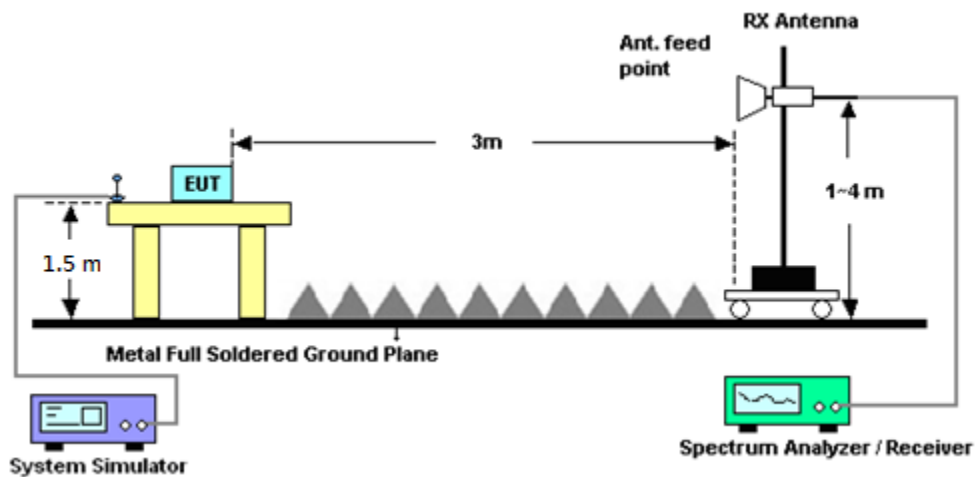
See list of measuring instruments of this test report.

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 Measurement

4.2.1 Description of Radiated Spurious Emission Measurement

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 $70 + 10 \log(P)$ dB. 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 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.
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 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.
8. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.

$$\text{EIRP (dBm)} = \text{S.G. Power} - \text{Tx Cable Loss} + \text{Tx Antenna Gain}$$

$$\text{ERP (dBm)} = \text{EIRP} - 2.15$$

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

The limit line is derived from $70 + 10\log(P)$ dB below the transmitter power P(Watts)

$$= P(W) - [70 + 10\log(P)] \text{ (dB)}$$

$$= [30 + 10\log(P)] \text{ (dBm)} - [70 + 10\log(P)] \text{ (dB)}$$

$$= -40\text{dBm}.$$

5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
LTE Base Station	Anritsu	MT8820C	6201432821	-	Oct. 14, 2018	Mar. 28, 2019	Oct. 13, 2019	Conducted (TH05-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Jan. 07, 2019	Mar. 23, 2019~ Mar. 28, 2019	Jan. 06, 2020	Radiation (03CH12-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800 N1D01N-06	37059&01	30MHz~1GHz	Oct. 13, 2018	Mar. 23, 2019~ Mar. 28, 2019	Oct. 12, 2019	Radiation (03CH12-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1328	1GHz ~ 18GHz	Oct. 19, 2018	Mar. 23, 2019~ Mar. 28, 2019	Oct. 18, 2019	Radiation (03CH12-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz~1GHz	May 21, 2018	Mar. 23, 2019~ Mar. 28, 2019	May 20, 2019	Radiation (03CH12-HY)
Preamplifier	Jet-Power	JPA0118-55-3 03K	17100018000 54002	1GHz~18GHz	Apr. 17, 2018	Mar. 23, 2019~ Mar. 28, 2019	Apr. 16, 2019	Radiation (03CH12-HY)
Preamplifier	EMEC	EM18G40G	060715	18GHz ~ 40GHz	Dec. 06, 2018	Mar. 23, 2019~ Mar. 28, 2019	Dec. 05, 2019	Radiation (03CH12-HY)
EMI Test Receiver	Rohde & Schwarz	ESU26	100390	20Hz~26.5GHz	Dec. 26, 2018	Mar. 23, 2019~ Mar. 28, 2019	Dec. 25, 2019	Radiation (03CH12-HY)
Signal Generator	Rohde & Schwarz	SMF100A	101107	100kHz~40GHz	May 21, 2018	Mar. 23, 2019~ Mar. 28, 2019	May 20, 2019	Radiation (03CH12-HY)
Filter	Wainwright	WLK4-1000-1 530-6000-40S S	SN11	1 GHz Low pass	Sep. 16, 2018	Mar. 23, 2019~ Mar. 28, 2019	Sep. 15, 2019	Radiation (03CH12-HY)
Filter	Wainwright	WHKX12-108 0-1200-1500-6 0SS	SN2	1.2G High Pass	Sep. 16, 2018	Mar. 23, 2019~ Mar. 28, 2019	Sep. 15, 2019	Radiation (03CH12-HY)
Filter	Wainwright	WHKX12-270 0-3000-18000- 60ST	SN3	3GHz High Pass	Jul. 05, 2018	Mar. 23, 2019~ Mar. 28, 2019	Jul. 04, 2019	Radiation (03CH12-HY)
Filter	Woken	WHKX8-5272. 5-6750-18000- 40ST	SN2	6.75G High pass	Sep. 17, 2018	Mar. 23, 2019~ Mar. 28, 2019	Sep.16, 2019	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 126E	0058/126E	30M-18G	Mar. 13, 2019	Mar. 23, 2019~ Mar. 28, 2019	Mar. 12, 2020	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	505134/2	30M~40GHz	Oct. 16, 2018	Mar. 23, 2019~ Mar. 28, 2019	Oct. 15, 2019	Radiation (03CH12-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	800740/2	30M~40GHz	Oct. 16, 2018	Mar. 23, 2019~ Mar. 28, 2019	Oct. 15, 2019	Radiation (03CH12-HY)
Antenna Mast	EMEC	AM-BS-4500- B	N/A	1m~4m	N/A	Mar. 23, 2019~ Mar. 28, 2019	N/A	Radiation (03CH12-HY)
Turn Table	EMEC	TT2000	N/A	0~360 Degree	N/A	Mar. 23, 2019~ Mar. 28, 2019	N/A	Radiation (03CH12-HY)
Software	Audix	E3 6.2009-8-24	RK-000989	N/A	N/A	Mar. 23, 2019~ Mar. 28, 2019	N/A	Radiation (03CH12-HY)

6 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	3.36
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Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	3.70
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Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	3.98
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Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power)

LTE Band 30 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
10	1	0	QPSK	-	21.37	-
10	1	25			21.34	
10	1	49			21.20	
10	25	0			20.41	
10	25	12			20.40	
10	25	25			20.39	
10	50	0			20.44	
10	1	0	16-QAM		20.55	
10	1	25			20.82	
10	1	49			20.77	
10	25	0			19.45	
10	25	12			19.50	
10	25	25			19.44	
10	50	0			19.47	
10	1	0	64-QAM		19.86	
10	1	25			19.65	
10	1	49			19.92	
10	25	0			18.69	
10	25	12			18.55	
10	25	25			18.60	
10	50	0			18.54	
5	1	0	QPSK	21.03	21.12	21.04
5	1	12		21.24	21.27	21.22
5	1	24		21.33	21.35	21.33
5	12	0		20.30	20.38	20.29
5	12	7		20.21	20.30	20.20
5	12	13		20.34	20.35	20.32
5	25	0		20.33	20.39	20.32
5	1	0	16-QAM	20.52	20.54	20.52
5	1	12		20.66	20.72	20.58
5	1	24		20.71	20.75	20.67
5	12	0		19.34	19.44	19.27
5	12	7		19.47	19.50	19.47
5	12	13		19.30	19.40	19.22
5	25	0		19.33	19.41	19.33
5	1	0	64-QAM	19.41	19.46	19.36
5	1	12		19.61	19.65	19.55
5	1	24		19.82	19.90	19.72
5	12	0		18.89	18.94	18.96
5	12	7		18.47	18.51	18.47
5	12	13		18.42	18.50	18.36
5	25	0		18.47	18.52	18.42

**Appendix B. Test Results of EIRP and Radiated Test****EIRP****<Reporting Only>**

LTE Band 30 / 5MHz (Average) (GT - LC = 0.23 dB)							
Channel	Mode	RB		Conducted		EIRP	
		Size	Offset	Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	QPSK	1	24	21.33	0.1358	21.56	0.1432
Middle		1	24	21.35	0.1365	21.58	0.1439
Highest		1	24	21.33	0.1358	21.56	0.1432
Lowest	16QAM	1	24	20.71	0.1178	20.94	0.1242
Middle		1	24	20.75	0.1189	20.98	0.1253
Highest		1	24	20.67	0.1167	20.90	0.1230
Lowest	64QAM	1	24	19.82	0.0959	20.05	0.1012
Middle		1	24	19.90	0.0977	20.13	0.1030
Highest		1	24	19.72	0.0938	19.95	0.0989
Limit	EIRP < 0.25W			Result		PASS	

LTE Band 30 / 10MHz (Average) (GT - LC = 0.23 dB)							
Channel	Mode	RB		Conducted		EIRP	
		Size	Offset	Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	QPSK	-	-	-	-	-	-
Middle		1	0	21.37	0.1371	21.60	0.1445
Highest		-	-	-	-	-	-
Lowest	16QAM	-	-	-	-	-	-
Middle		1	25	20.82	0.1208	21.05	0.1274
Highest		-	-	-	-	-	-
Lowest	64QAM	-	-	-	-	-	-
Middle		1	49	19.92	0.0982	20.15	0.1035
Highest		-	-	-	-	-	-
Limit	EIRP < 0.25W			Result		PASS	

**Radiated Spurious Emission****LTE Band 30**

LTE Band 30 / 5MHz / 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)
Lowest	4619	-51.96	-40	-11.96	-49.38	-63.18	1.46	12.68	H
	6929.25	-59.76	-40	-19.76	-62.78	-70.03	1.73	12.00	H
	9239	-61.23	-40	-21.23	-66.38	-70.83	2.16	11.76	H
									H
	4619	-50.32	-40	-10.32	-46.97	-61.54	1.46	12.68	V
	6929.25	-61.76	-40	-21.76	-64.32	-72.03	1.73	12.00	V
	9239	-59.60	-40	-19.60	-65.79	-69.20	2.16	11.76	V
									V
Middle	4624	-52.69	-40	-12.69	-50.11	-63.91	1.46	12.68	H
	6936	-59.48	-40	-19.48	-62.5	-69.74	1.73	11.99	H
	9249	-61.23	-40	-21.23	-66.36	-70.82	2.16	11.75	H
									H
	4624	-50.99	-40	-10.99	-47.64	-62.21	1.46	12.68	V
	6936	-60.46	-40	-20.46	-63.02	-70.72	1.73	11.99	V
	9249	-60.02	-40	-20.02	-66.19	-69.61	2.16	11.75	V
									V
Highest	4629	-51.04	-40	-11.04	-48.51	-62.25	1.46	12.67	H
	6944	-58.55	-40	-18.55	-61.67	-68.80	1.73	11.98	H
	9259	-61.08	-40	-21.08	-66.2	-70.65	2.17	11.74	H
									H
	4629	-49.97	-40	-9.97	-46.68	-61.18	1.46	12.67	V
	6944	-57.84	-40	-17.84	-60.5	-68.09	1.73	11.98	V
	9259	-60.07	-40	-20.07	-66.26	-69.64	2.17	11.74	V
									V

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



LTE Band 30 / 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)
Middle	4624	-51.09	-40	-11.09	-48.51	-62.31	1.46	12.68	H
	6936	-59.57	-40	-19.57	-62.59	-69.83	1.73	11.99	H
	9249	-60.76	-40	-20.76	-65.89	-70.35	2.16	11.75	H
									H
									H
									H
									H
	4624	-50.27	-40	-10.27	-46.92	-61.49	1.46	12.68	V
	6936	-60.47	-40	-20.47	-63.03	-70.73	1.73	11.99	V
	9249	-60.07	-40	-20.07	-66.24	-69.66	2.16	11.75	V
									V
									V
									V
									V

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