

FCC RADIO TEST REPORT

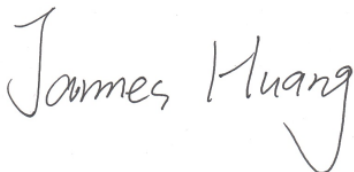
FCC ID : 2AJN7-TP00110AUC
Equipment : Notebook Computer
Brand Name : Lenovo
Model Name : TP00110A
Applicant : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd., Zhongshan Dist.,
Taipei City 104, Taiwan (R.O.C.)
Manufacturer : LC Future Center Limited Taiwan Branch
7F., No. 780, Bei'an Rd.,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

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. 05, 2019 and completed on Apr. 05, 2019. We, Sporton International (Kunshan) 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 NVLAP or any agency of government.

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



Approved by: James Huang / Manager

Sporton International (Kunshan) Inc.

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China**



Table of Contents

History of this test report..... 3

Summary of Test Result..... 4

1 General Description 5

 1.1 Feature of Equipment Under Test..... 5

 1.2 Product Specification of Equipment Under Test 5

 1.3 Modification of EUT 5

 1.4 Testing Site..... 6

 1.5 Applied Standards 6

2 Test Configuration of Equipment Under Test 7

 2.1 Test Mode..... 7

 2.2 Connection Diagram of Test System 7

 2.3 Support Unit used in test configuration and system..... 8

 2.4 Frequency List of Low/Middle/High Channels..... 8

3 Conducted Test Items..... 9

 3.1 Measuring Instruments..... 9

 3.2 Conducted Output Power Measurement and ERP Measurement 10

 3.3 Field Strength of Spurious Radiation Measurement 11

4 List of Measuring Equipment..... 13

5 Uncertainty of Evaluation 14

Appendix A. Test Results of Conducted Test

Appendix B. Test Results of ERP and Radiated Test



History of this test report

Report No.	Version	Description	Issued Date
FG931313C	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 §90.635	Conducted Output Power and Effective Radiated Power	Pass	-
3.3	§2.1053 §90.691	Field Strength of Spurious Radiation	Pass	Under limit 18.81 dB at 2440.000 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: Jason Jia

Report Producer: Echo Wu



1 General Description

1.1 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

Product Specification subjective to this standard	
Tx Frequency	LTE Band 26 : 814.7 ~ 823.3 MHz
Rx Frequency	LTE Band 26 : 859.7 ~ 868.3 MHz
Bandwidth	1.4MHz / 3MHz / 5MHz / 10MHz / 15MHz
Maximum Output Power to Antenna	23.96 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

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0)

Test Site	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone, Jiangsu Province 215335, China		
Test Site No.	Sporton Site No.	FCC designation No.	FCC Test Firm Registration No.
	03CH06-KS	CN5013	630927
Test Engineer	Level Zhao		
Temperature	23~24 °C		
Relative Humidity	63~66 %		

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

1.5 Applied Standards

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

- FCC 47 CFR Part 2, 90
- ANSI / TIA-603-E
- ANSI C63.26-2015
- FCC KDB 971168 D01 Power Meas. License Digital Systems v03r01
- FCC KDB 412172 D01 Determining ERP and EIRP v01r01
- Interim Guidance for Equipment Authorization of Devices with Channel Bandwidths Combined Across Two Contiguous Service Rule Allocations OET/Lab/EACB, June 6, 2013

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

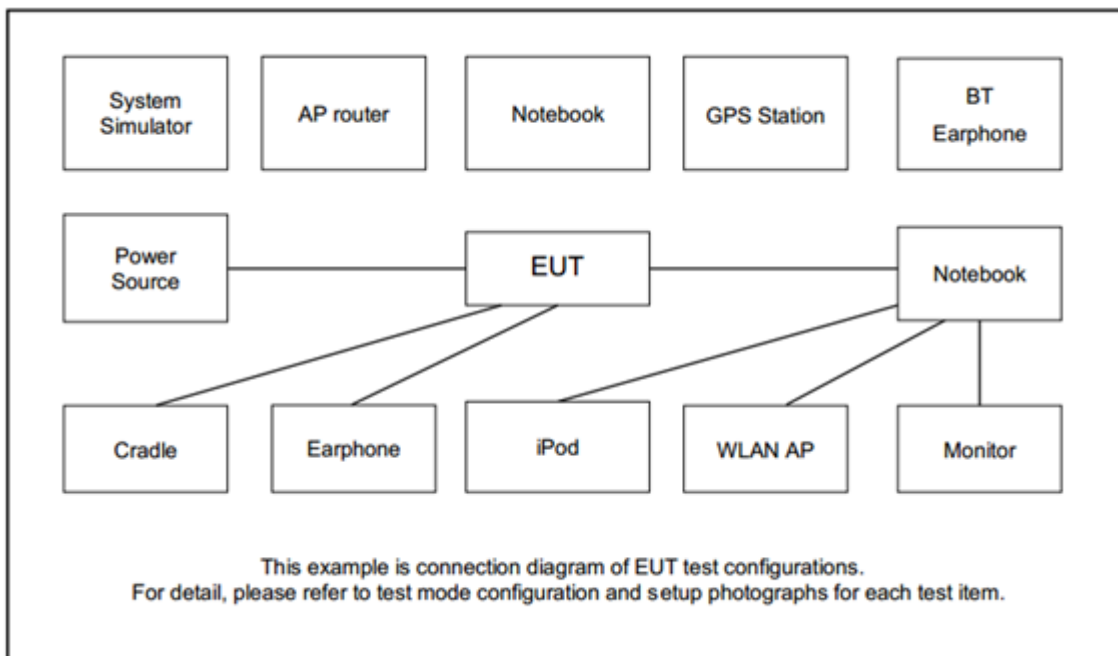
During all testing, EUT is in link mode with base station emulator at maximum power level.

For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z for table mode and notebook mode. The worst cases (Y plane) were recorded in this report.

Frequency range investigated for radiated emission is 30 MHz to 9000 MHz.

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	26	v	v	v	v	v	-	v	v	v	v	v	v	v	v	v
E.R.P.	26					v	-	v	v	v	v			v	v	v
Radiated Spurious Emission	26	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. LTE Band26 transmit frequency for part22 rule is 824MHz-849MHz, for part90 rule is 814MHz-824MHz. ERP over 15MHz bandwidth complies the ERP limit line of part22 rule, therefore ERP of the partial frequency spectrum which falls within part 22 also complies. 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.	System Simulator	Anritsu	8820C	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 26 Channel and Frequency List				
BW [MHz]	Channel/Frequency(MHz)	Lowest	Middle	Highest
15	Channel	26765	-	-
	Frequency	821.5	-	-
10	Channel	-	26740	-
	Frequency	-	819	-
5	Channel	26715	26740	26765
	Frequency	816.5	819	821.5
3	Channel	26705	26740	26775
	Frequency	815.5	819	822.5
1.4	Channel	26697	26740	26783
	Frequency	814.7	819	823.3

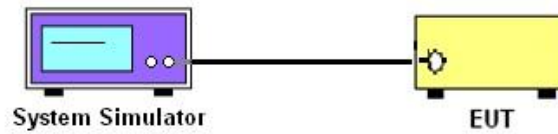
3 Conducted Test Items

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 Measurement

3.2.1 Description of the Conducted Output Power Measurement and ERP Measurement

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

The ERP of mobile transmitters must not exceed 7 Watts for LTE Band 26.

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 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.

3.3 Field Strength of Spurious Radiation Measurement

3.3.1 Description of Field Strength of Spurious Radiated Measurement

The radiated spurious emission was measured by substitution method according to ANSI / TIA-603-E. The power of any emission FCC Part 90.691 on any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth at least $43 + 10 \log (P)$ dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

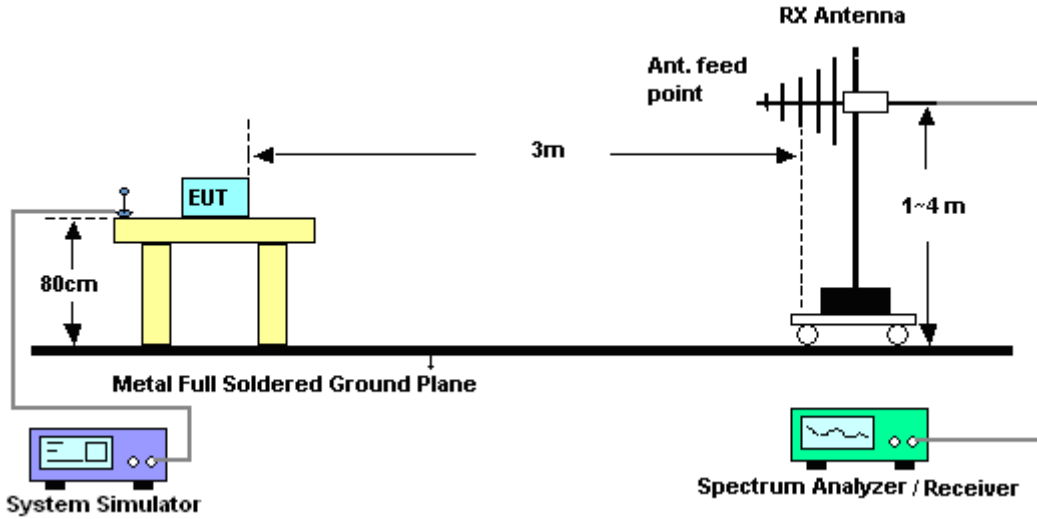
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43+10\log_{10}(P[\text{Watts}])$ dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

3.3.2 Test Procedures

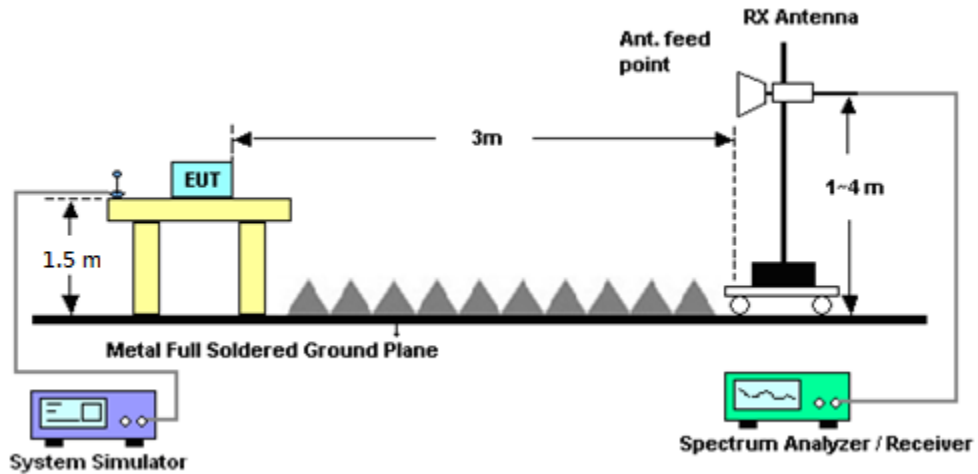
1. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
1. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
2. The table was rotated 360 degrees to determine the position of the highest spurious emission.
3. The height of the receiving antenna is varied between one meter and four meters to search the maximum spurious emission for both horizontal and vertical polarizations.
4. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, Sweep = 500ms, Taking the record of maximum spurious emission.
5. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
6. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.
7. Taking the record of output power at antenna port.
8. Repeat step 7 to step 8 for another polarization.
9. $\text{EIRP (dBm)} = \text{S.G. Power} - \text{Tx Cable Loss} + \text{Tx Antenna Gain}$
10. $\text{ERP (dBm)} = \text{EIRP} - 2.15$
11. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
12. The limit line is derived from $43 + 10\log(P)$ dB below the transmitter power P(Watts)

3.3.3 Test Setup

For radiated test from 30MHz to 1GHz



For radiated test above 1GHz



3.3.4 Test Result of Field Strength of Spurious Radiated

Please refer to Appendix B.



4 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. 05, 2019	Jan. 13, 2020	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY553705 28	10Hz-44GHz	Oct. 10, 2018	Apr. 05, 2019	Oct. 09, 2019	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6112D	35406	30MHz-1GHz	Apr. 19, 2018	Apr. 05, 2019	Apr. 18, 2019	Radiation (03CH06-KS)
Broad-Band Horn Antenna	Schwarzbeck MESS-ELEKT RONIK	BBHA9120D	01648	1GHz~18GHz	Jan. 27, 2019	Apr. 05, 2019	Jan. 26, 2020	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz-1GHz Gain 32dB	Aug. 03, 2018	Apr. 05, 2019	Aug. 02, 2019	Radiation (03CH06-KS)
Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2025788	100MHz-18GHz Gain 55dB	Apr. 17, 2018	Apr. 05, 2019	Apr. 16, 2019	Radiation (03CH06-KS)
Preamplifier	Keysight	83017A	MY532703 19	0.5G-26.5GHz	Oct. 12, 2018	Apr. 05, 2019	Oct. 11, 2019	Radiation (03CH06-KS)
SHF-EHF Horn	Schwarzbeck	BBHA 9170	BBHA1702 49	15-40GHz	Feb. 07, 2019	Apr. 05, 2019	Feb. 06, 2020	Radiation (03CH06-KS)
Amplifier	MITEQ	TTA1840-35- HG	1887435	18~40GHz,45d B Min	Feb. 08, 2019	Apr. 05, 2019	Feb. 07, 2020	Radiation (03CH06-KS)
Radio communication analyzer	Anritsu	MT8820C	KS141204 JCGS01	6201432836	Jan. 14, 2019	Apr. 05, 2019	Jan. 13, 2020	Radiation (03CH06-KS)



5 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.50
---	------

Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.10
---	------

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

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.10
---	------



Appendix A. Test Results of Conducted Test

Conducted Output Power(Average power)

LTE Band 26 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
15	1	0	QPSK	23.95	-	-
15	1	37		23.92	-	-
15	1	74		23.91	-	-
15	36	0		22.91	-	-
15	36	20		22.92	-	-
15	36	39		22.91	-	-
15	75	0		22.89	-	-
15	1	0	16-QAM	22.55	-	-
15	1	37		23.26	-	-
15	1	74		23.26	-	-
15	36	0		21.97	-	-
15	36	20		21.92	-	-
15	36	39		22.01	-	-
15	75	0		21.85	-	-
15	1	0	64-QAM	22.33	-	-
15	1	37		21.83	-	-
15	1	74		21.92	-	-
15	36	0		20.92	-	-
15	36	20		20.90	-	-
15	36	39		20.65	-	-
15	75	0		20.90	-	-
10	1	0	QPSK	-	23.94	-
10	1	25		-	23.93	-
10	1	49		-	23.82	-
10	25	0		-	22.95	-
10	25	12		-	22.84	-
10	25	25		-	22.84	-
10	50	0		-	22.89	-
10	1	0	16-QAM	-	23.06	-
10	1	25		-	22.75	-
10	1	49		-	23.39	-
10	25	0		-	21.86	-
10	25	12		-	21.93	-
10	25	25		-	21.98	-
10	50	0		-	21.91	-
10	1	0	64-QAM	-	22.29	-
10	1	25		-	21.42	-
10	1	49		-	21.93	-
10	25	0		-	20.96	-
10	25	12		-	20.87	-
10	25	25		-	20.87	-
10	50	0		-	20.81	-



LTE Band 26 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
5	1	0	QPSK	23.90	23.92	23.96
5	1	12		23.82	23.94	23.83
5	1	24		23.86	23.84	23.87
5	12	0		22.90	22.95	22.85
5	12	7		22.91	22.85	22.84
5	12	13		22.89	22.84	22.87
5	25	0		22.87	22.90	22.80
5	1	0	16-QAM	22.27	22.99	23.41
5	1	12		23.29	22.74	23.32
5	1	24		23.30	23.33	23.17
5	12	0		22.00	21.77	22.00
5	12	7		21.94	21.93	21.95
5	12	13		21.95	21.88	21.89
5	25	0		21.87	21.85	21.79
5	1	0	64-QAM	22.37	22.28	22.36
5	1	12		21.78	21.35	21.98
5	1	24		21.96	21.85	21.91
5	12	0		20.96	20.96	20.99
5	12	7		20.83	20.82	20.97
5	12	13		20.70	20.86	20.89
5	25	0		20.86	20.78	20.87
3	1	0	QPSK	23.87	23.90	23.90
3	1	8		23.83	23.87	23.82
3	1	14		23.82	23.79	23.90
3	8	0		22.84	22.93	22.85
3	8	4		22.86	22.85	22.86
3	8	7		22.90	22.87	22.85
3	15	0		22.88	22.96	22.84
3	1	0	16-QAM	22.26	22.91	23.39
3	1	8		23.26	22.64	23.22
3	1	14		23.25	23.33	23.13
3	8	0		21.98	21.73	21.96
3	8	4		21.93	21.86	21.87
3	8	7		21.88	21.85	21.80
3	15	0		21.83	21.80	21.75
3	1	0	64-QAM	22.34	22.24	22.31
3	1	8		21.76	21.27	21.97
3	1	14		21.91	21.78	21.89
3	8	0		20.87	20.90	20.99
3	8	4		20.73	20.73	20.95
3	8	7		20.64	20.80	20.81
3	15	0		20.80	20.72	20.79



LTE Band 26 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
1.4	1	0	QPSK	23.89	23.96	23.87
1.4	1	3		23.90	23.86	23.87
1.4	1	5		23.89	23.78	23.83
1.4	3	0		23.79	23.78	23.78
1.4	3	1		23.69	23.85	23.68
1.4	3	3		23.86	23.92	23.76
1.4	6	0		22.79	22.81	22.74
1.4	1	0	16-QAM	22.23	22.81	23.01
1.4	1	3		22.94	22.79	22.97
1.4	1	5		22.91	23.04	23.05
1.4	3	0		22.90	22.65	22.88
1.4	3	1		22.87	22.84	22.86
1.4	3	3		22.85	22.76	22.78
1.4	6	0		21.80	21.79	21.71
1.4	1	0	64-QAM	22.25	22.14	22.30
1.4	1	3		21.71	21.23	21.94
1.4	1	5		21.82	21.76	21.85
1.4	3	0		21.79	21.82	21.90
1.4	3	1		21.70	21.68	21.95
1.4	3	3		21.64	21.73	21.80
1.4	6	0		20.80	20.68	20.75



Appendix B. Test Results of ERP and Radiated Test

ERP

<Reporting Only>

LTE Band 26 / 15MHz (Channel 26765) (GT - LC = 1.39 dB)							
Channel	Mode	RB		Conducted		ERP	
		Size	Offset	Power (dBm)	Power (Watts)	ERP(dBm)	ERP(W)
Lowest	QPSK	1	0	23.95	0.2483	23.19	0.2084
Middle		-	-	-	-	-	-
Highest		-	-	-	-	-	-
Lowest	16QAM	1	37	23.26	0.2118	22.50	0.1778
Middle		-	-	-	-	-	-
Highest		-	-	-	-	-	-
Lowest	64QAM	1	0	22.33	0.1710	21.57	0.1435
Middle		-	-	-	-	-	-
Highest		-	-	-	-	-	-
Limit	ERP < 7W			Result		PASS	



Radiated Spurious Emission

LTE Band 26

LTE Band 26 / 5MHz / QPSK								
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1624	-47.59	-13	-34.59	-52.07	1.21	5.68	H
	2440	-45.87	-13	-32.87	-50.13	1.54	5.80	H
	3256	-50.61	-13	-37.61	-56.76	1.73	7.88	H
								H
								H
								H
	1624	-50.20	-13	-37.20	-54.68	1.21	5.68	V
	2440	-46.68	-13	-33.68	-50.94	1.54	5.80	V
	3256	-55.05	-13	-42.05	-61.20	1.73	7.88	V
								V
								V
								V
Middle	1632	-47.26	-13	-34.26	-51.74	1.21	5.68	H
	2448	-42.59	-13	-29.59	-46.85	1.54	5.80	H
	3264	-50.59	-13	-37.59	-56.74	1.73	7.88	H
								H
								H
								H
	1632	-58.18	-13	-45.18	-62.66	1.21	5.68	V
	2448	-52.83	-13	-39.83	-57.09	1.54	5.80	V
	3264	-58.05	-13	-45.05	-64.20	1.73	7.88	V
								V
								V
								V



Highest	1640	-46.27	-13	-33.27	-50.75	1.21	5.68	H
	2456	-34.83	-13	-21.83	-39.09	1.54	5.80	H
	3280	-49.12	-13	-36.12	-55.27	1.73	7.88	H
								H
								H
								H
	1640	-51.58	-13	-38.58	-56.06	1.21	5.68	V
	2456	-43.20	-13	-30.20	-47.46	1.54	5.80	V
	3280	-52.63	-13	-39.63	-58.78	1.73	7.88	V
								V
								V
								V

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



LTE Band 26 / 10MHz / QPSK								
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Middle	1632	-46.13	-13	-33.13	-50.61	1.21	5.68	H
	2440	-45.01	-13	-32.01	-49.27	1.54	5.80	H
	3256	-51.24	-13	-38.24	-57.39	1.73	7.88	H
								H
								H
								H
								H
	1632	-58.03	-13	-45.03	-62.51	1.21	5.68	V
	2440	-54.50	-13	-41.50	-58.76	1.54	5.80	V
	3256	-57.96	-13	-44.96	-64.11	1.73	7.88	V
								V
								V
								V
								V

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



LTE Band 26 / 15MHz / QPSK								
Channel	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Over Limit (dB)	S.G. Power (dBm)	TX Cable loss (dB)	TX Antenna Gain (dBi)	Polarization (H/V)
Lowest	1632	-45.95	-13	-32.95	-50.43	1.21	5.68	H
	2440	-31.81	-13	-18.81	-36.07	1.54	5.80	H
	3256	-50.50	-13	-37.50	-56.65	1.73	7.88	H
								H
								H
								H
								H
	1632	-50.78	-13	-37.78	-55.26	1.21	5.68	V
	2440	-37.14	-13	-24.14	-41.40	1.54	5.80	V
	3256	-54.00	-13	-41.00	-60.15	1.73	7.88	V
								V
								V
								V
								V

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