



# FCC RF Test Report

APPLICANT : LC Future Center Limited Taiwan Branch  
EQUIPMENT : Notebook  
BRAND NAME : Lenovo  
MODEL NAME : TP00086A  
FCC ID : 2AJN7-TP00086A  
STANDARD : FCC 47 CFR Part 2, 22(H), 24(E), 27(L)  
CLASSIFICATION : PCS Licensed Transmitter (PCB)

This is a partial report which is included the conducted output power, ERP/EIRP, and radiated test items. The product was received on Nov. 08, 2016 and testing was completed on Nov. 25, 2016. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI / TIA / EIA-603-D-2010 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., the test report shall not be reproduced except in full.

Reviewed by: Joseph Lin / Supervisor

Approved by: Jones Tsai / Manager



## SPORTON INTERNATIONAL INC.

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FCC ID : 2AJN7-TP00086A

Page Number : 1 of 15

Report Issued Date : Dec. 27, 2016

Report Version : Rev. 01

Report Template No.: BU5-FG22/24/27 Version 1.2



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## REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FG6N0822A	Rev. 01	Initial issue of report	Dec. 27, 2016

## SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.4	§2.1046	Conducted Output Power	Reporting Only	PASS	-
	§22.913(a)(2)	Effective Radiated Power	< 7 Watts		
	§24.232(c)	Equivalent Isotropic Radiated Power	< 2 Watts		
	§27.50(d)(4)	Equivalent Isotropic Radiated Power	< 1 Watts		
4.4	§2.1053 §22.917(a) §24.238(a) §27.53(h)	Field Strength of Spurious Radiation	$< 43 + 10 \log_{10}(P[\text{Watts}])$	PASS	Under limit 47.49 dB at 3426.000 MHz

# 1 General Description

## 1.1 Applicant

LC Future Center Limited Taiwan Branch

7F., No.780, Bei'an Rd., Zhongshan Dist., Taipei City 104, Taiwan (R.O.C.)

## 1.2 Manufacturer

LC Future Center Limited Taiwan Branch

7F., No.780, Bei'an Rd., Zhongshan Dist., Taipei City 104, Taiwan (R.O.C.)

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Notebook
Brand Name	Lenovo
Model Name	TP00086A
FCC ID	2AJN7-TP00086A
Integrated WWAN Module	Manufacturer: Sierra Wireless Brand Name: AirPrime Model Name: EM7455
Sample 1	EUT with Antenna 1
Sample 2	EUT with Antenna 2
EUT supports Radios application	WCDMA/HSPA/LTE
EUT Stage	Production Unit

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

## 1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
<b>Tx Frequency</b>	<b>WCDMA:</b> Band V: 826.4 MHz ~ 846.6 MHz Band II: 1852.4 MHz ~ 1907.6 MHz Band IV: 1712.4 MHz ~ 1752.6 MHz
<b>Rx Frequency</b>	<b>WCDMA:</b> Band V: 871.4 MHz ~ 891.6 MHz Band II: 1932.4 MHz ~ 1987.6 MHz Band IV: 2112.4 MHz ~ 2152.6 MHz
<b>Maximum Output Power to Antenna</b>	<b>WCDMA:</b> Band V: 22.78 dBm Band II: 22.93 dBm Band IV: 23.09 dBm
<b>Type of Modulation</b>	WCDMA: BPSK (Uplink) HSDPA: 64QMA (Downlink) HSUPA: QPSK (Uplink)

## 1.5 Modification of EUT

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

## 1.6 Maximum ERP/EIRP Power

FCC Rule	System	Type of Modulation	Maximum ERP/EIRP (W)
Part 22	WCDMA Band V RMC 12.2Kbps	BPSK	0.1050
Part 24	WCDMA Band II RMC 12.2Kbps	BPSK	0.3890
Part 27	WCDMA Band IV RMC 12.2Kbps	BPSK	0.4009

## 1.7 Testing Location

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

<b>Test Site</b>	SPORTON INTERNATIONAL INC.	
<b>Test Site Location</b>	No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978	
<b>Test Site No.</b>	<b>Sporton Site No.</b>	
	TH02-HY	03CH07-HY

## 1.8 Applicable Standards

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

- 47 CFR Part 2, 22(H), 24(E), 27(L)
- ANSI / TIA / EIA-603-D-2010
- FCC KDB 971168 D01 Power Meas. License Digital Systems v02r02
- 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 were performed according to KDB 971168 D01 Power Meas. License Digital Systems v02r02 with maximum output power.

Radiated emissions were investigated as following frequency range:

1. 30 MHz to 9000 MHz for WCDMA Band V.
2. 30 MHz to 18000 MHz for WCDMA Band IV.
3. 30 MHz to 19100 MHz for WCDMA Band II.

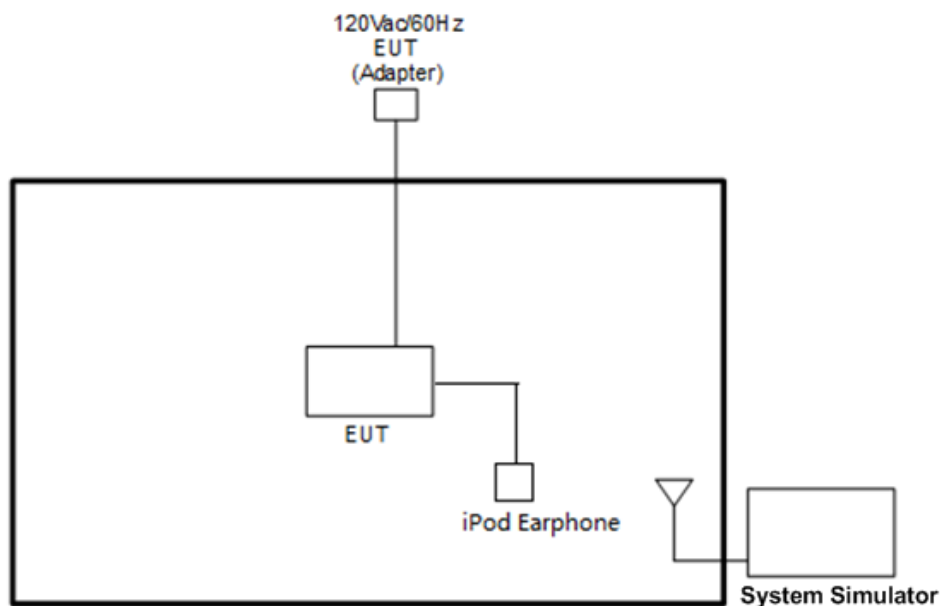
All modes and data rates and positions were investigated.

Test modes are chosen to be reported as the worst case configuration below:

Test Modes	
Band	Radiated TCs
WCDMA Band V	■ RMC 12.2Kbps Link
WCDMA Band II	■ RMC 12.2Kbps Link
WCDMA Band IV	■ RMC 12.2Kbps Link



## 2.2 Connection Diagram of Test System



## 2.3 Support Unit used in test configuration

Item	Equipment	Trade Name	Model No.	FCC ID	Data Cable	Power Cord
1.	System Simulator	R&S	CMU 200	N/A	N/A	Unshielded, 1.8 m
2.	iPod Earphone	Apple	N/A	Verification	Unshielded, 1.0 m	N/A

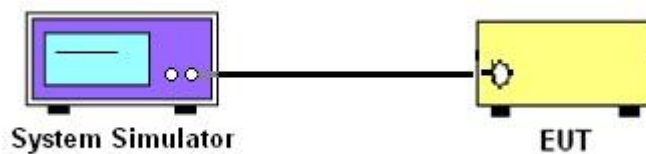
### 3 Conducted Test Result

#### 3.1 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.2 Test Setup

##### 3.2.1 Conducted Output Power



#### 3.3 Test Result of Conducted Test

Please refer to Appendix A.



### **3.4 Conducted Output Power and ERP/EIRP**

#### **3.4.1 Description of the Conducted Output Power and ERP/EIRP**

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 GSM850 and WCDMA Band V.

The EIRP of mobile transmitters must not exceed 2 Watts for GSM1900 and WCDMA Band II.

The EIRP of mobile transmitters must not exceed 1 Watts for WCDMA Band IV.

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

#### **3.4.2 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 the maximum burst average power for GSM and maximum average power for other modulation signal.

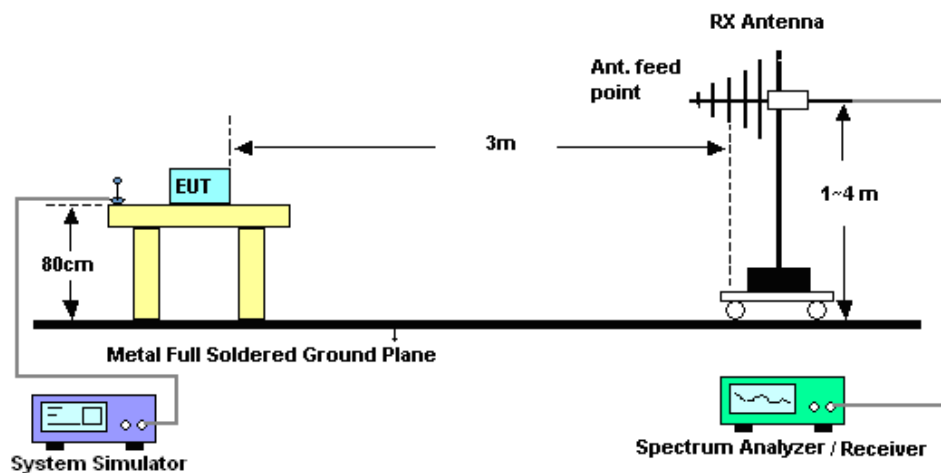
## 4 Radiated Test Items

### 4.1 Measuring Instruments

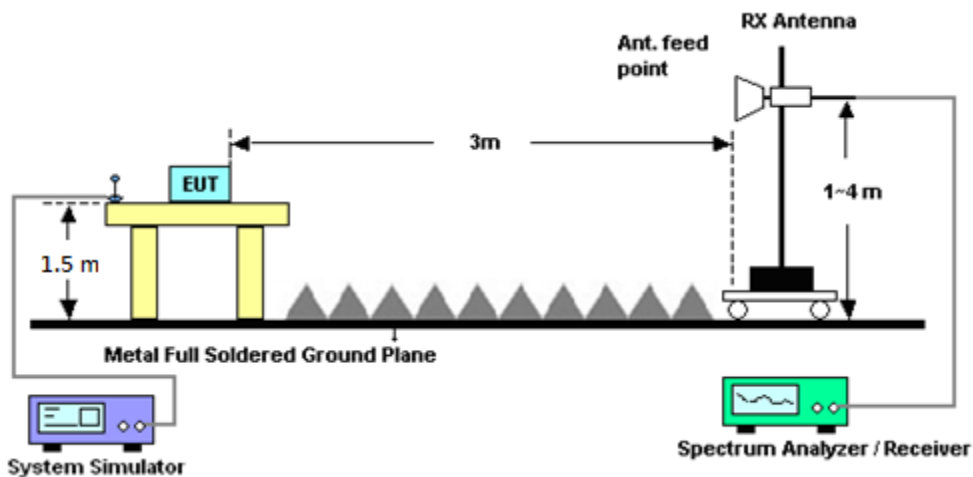
See list of measuring instruments of this test report.

### 4.2 Test Setup

#### 4.2.1 For radiated test from 30MHz to 1GHz



#### 4.2.2 For radiated test above 1GHz



### 4.3 Test Result of Radiated Test

Please refer to Appendix B.

## 4.4 Field Strength of Spurious Radiation Measurement

### 4.4.1 Description of Field Strength of Spurious Radiated Measurement

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

### 4.4.2 Test Procedures

1. The testing follows FCC KDB 971168 D01 v02r02 Section 5.8 and ANSI / TIA-603-D-2010 Section 2.2.12.
2. The EUT was placed on a rotatable wooden table 0.8 meters for frequency below 1GHz and 1.5 meter for frequency above 1GHz above the ground.
3. The EUT was set 3 meters from the receiving antenna, which was mounted on the antenna tower.
4. The table was rotated 360 degrees to determine the position of the highest spurious emission.
5. The height of the receiving antenna is varied between one meter and four meters to search for the maximum spurious emission for both horizontal and vertical polarizations.
6. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking 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.
9. Taking the record of output power at antenna port.
10. Repeat step 7 to step 8 for another polarization.
11.  $EIRP \text{ (dBm)} = S.G. \text{ Power} - Tx \text{ Cable Loss} + Tx \text{ Antenna Gain}$
12.  $ERP \text{ (dBm)} = EIRP - 2.15$
13. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.
14. The limit line is derived from  $43 + 10\log(P)$  dB below the transmitter power P(Watts)  
 $= P(W) - [43 + 10\log(P)] \text{ (dB)}$   
 $= [30 + 10\log(P)] \text{ (dBm)} - [43 + 10\log(P)] \text{ (dB)}$   
 $= -13\text{dBm}.$



## 5 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Base Station(Measu	Rohde & Schwarz	CMW500	116160	MIMO/LTE(FDD TDD with 42 43 )	Mar. 02, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Mar. 01, 2017	Conducted (TH02-HY)
Bilog Antenna	TESEQ	CBL 6111D&00800N1	35419&03	30MHz to 1GHz	Jan. 13, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Jan. 12, 2017	Radiation (03CH07-HY)
Double Ridge Horn Antenna	ESCO	3117	00075962	1GHz ~ 18GHz	Aug. 19, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Aug. 18, 2017	Radiation (03CH07-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20Hz ~ 8.4GHz	Oct. 26, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Oct. 25, 2017	Radiation (03CH07-HY)
Preamplifier	MITEQ	AMF-7D-0010180 0-30-10P	1590075	1GHz ~ 18GHz	Apr. 15, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Apr. 14, 2017	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz-1GHz	Mar. 18, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Mar. 17, 2017	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Feb. 27, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Feb. 26, 2017	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Nov. 17, 2016 ~ Nov. 25, 2016	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Nov. 17, 2016 ~ Nov. 25, 2016	N/A	Radiation (03CH07-HY)
Preamplifier	MITEQ	JS44-18004000-3 3-8P	1840917	18GHz ~ 40GHz	Jun. 14, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Jun. 13, 2017	Radiation (03CH07-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA917025 1	18GHz ~ 40GHz	Oct. 07, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Oct. 06, 2017	Radiation (03CH07-HY)
Horn Antenna	ESCO	3117	00066584	1GHz~18GHz	Sep. 02, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	Sep. 01, 2017	Radiation (03CH07-HY)
Signal Generator	Rohde & Schwarz	SMF100A	101107	100kHz~40GHz	May 19, 2016	Nov. 17, 2016 ~ Nov. 25, 2016	May 18, 2017	Radiation (03CH07-HY)

## 6 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	3.05
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### Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	3.44
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### Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	3.95
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## Appendix A. Test Results of Conducted Test

### Conducted Output Power(Average power)

Conducted Power (*Unit: dBm)						
Band	WCDMA Band V			WCDMA Band II		
Channel	4132	4182	4233	9262	9400	9538
Frequency	826.4	836.4	846.6	1852.4	1880	1907.6
RMC 12.2K	22.77	22.78	22.69	22.90	22.93	22.92
HSDPA Subtest-1	22.00	22.15	22.26	22.14	22.24	22.16
HSDPA Subtest-2	22.01	22.15	22.20	22.10	22.09	22.06
HSDPA Subtest-3	21.53	21.64	21.70	21.61	21.58	21.56
HSDPA Subtest-4	21.52	21.64	21.68	21.60	21.59	21.58
HSUPA Subtest-1	22.06	22.14	22.21	22.10	22.23	22.20
HSUPA Subtest-2	20.40	20.49	20.58	20.75	20.82	20.80
HSUPA Subtest-3	21.01	21.04	21.07	21.06	21.13	21.11
HSUPA Subtest-4	21.31	21.28	21.35	21.61	21.57	21.63
HSUPA Subtest-5	22.03	22.13	22.21	22.08	22.14	22.10

Conducted Power (*Unit: dBm)			
Band	WCDMA Band V		
Channel	1312	1413	1513
Frequency	1712.4	1732.6	1752.6
RMC 12.2K	22.79	22.77	23.09
HSDPA Subtest-1	22.05	22.00	22.30
HSDPA Subtest-2	22.11	22.05	22.27
HSDPA Subtest-3	21.59	21.55	21.76
HSDPA Subtest-4	21.61	22.04	21.70
HSUPA Subtest-1	22.00	22.04	22.21
HSUPA Subtest-2	20.61	20.68	20.85
HSUPA Subtest-3	21.01	21.06	21.23
HSUPA Subtest-4	21.41	21.47	21.64
HSUPA Subtest-5	22.01	22.05	22.29





## Appendix B. Test Results of ERP/EIRP and Radiated Test

### ERP/EIRP

Channel	Mode	Conducted		ERP	
		Power (dBm)	Power (Watts)	ERP(dBm)	ERP(W)
Lowest	WCDMA Band V	22.77	0.1892	20.20	0.1047
Middle	RMC 12.2Kbps	22.78	0.1897	20.21	0.1050
Highest	GT - LC = -0.42 dB	22.69	0.1858	20.12	0.1028
Limit	ERP < 7W	Result		PASS	

Channel	Mode	Conducted		EIRP	
		Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	WCDMA Band II	22.90	0.1950	25.87	0.3864
Middle	RMC 12.2Kbps	22.93	0.1963	25.90	0.3890
Highest	(GT - LC = 2.97 dB)	22.92	0.1959	25.89	0.3882
Limit	EIRP < 2W	Result		PASS	

Channel	Mode	Conducted		EIRP	
		Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	WCDMA Band IV	22.79	0.1901	25.73	0.3741
Middle	RMC 12.2Kbps	22.77	0.1892	25.71	0.3724
Highest	(GT - LC = 2.94 dB)	23.09	0.2037	26.03	0.4009
Limit	EIRP < 1W	Result		PASS	

**Radiated Spurious Emission**

WCDMA Band V(RMC 12.2Kbps)									
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	1656	-70.48	-13	-57.48	-58.2	-72.21	0.98	4.86	H
	2479	-66.86	-13	-53.86	-59.81	-68.76	1.28	5.34	H
	3305	-66.07	-13	-53.07	-64.24	-69.52	1.54	7.14	H
									H
									H
									H
	1656	-70.46	-13	-57.46	-58.63	-72.19	0.98	4.86	V
	2479	-66.54	-13	-53.54	-59.99	-68.44	1.28	5.34	V
	3305	-65.78	-13	-52.78	-61.15	-69.23	1.54	7.14	V
									V
									V
									V
Middle	1672	-70.34	-13	-57.34	-58.24	-72.02	0.99	4.82	H
	2509	-67.03	-13	-54.03	-60.17	-68.99	1.29	5.41	H
	3345	-65.84	-13	-52.84	-61.09	-69.45	1.56	7.32	H
									H
									H
									H
	1672	-70.14	-13	-57.14	-58.48	-71.82	0.99	4.82	V
	2509	-66.78	-13	-53.78	-60.33	-68.74	1.29	5.41	V
	3345	-65.69	-13	-52.69	-61.1	-69.3	1.56	7.32	V
									V
									V
									V
Highest	1696	-70.31	-13	-57.31	-58.23	-71.91	1.00	4.75	H
	2540	-67.28	-13	-54.28	-60.38	-69.26	1.30	5.43	H
	3386	-65.66	-13	-52.66	-61.04	-69.44	1.57	7.50	H
									H
									H
									H
	1696	-69.97	-13	-56.97	-58.48	-71.57	1.00	4.75	V
	2540	-66.69	-13	-53.69	-60.35	-68.67	1.30	5.43	V
	3386	-65.34	-13	-52.34	-60.91	-69.12	1.57	7.50	V
									V
									V
									V

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



WCDMA Band II(RMC 12.2Kbps)									
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	3702	-64.99	-13	-51.99	-60.6	-71.56	1.67	8.24	H
	5557	-62.85	-13	-49.85	-65.3	-69.91	2.66	9.72	H
	7409	-63.56	-13	-50.56	-67.47	-72.72	2.46	11.62	H
									H
									H
									H
	3704	-62.84	-13	-49.84	-58.39	-69.42	1.67	8.24	V
	5557	-62.97	-13	-49.97	-65.36	-70.03	2.66	9.72	V
	7409	-63.46	-13	-50.46	-67.58	-72.62	2.46	11.62	V
									V
									V
									V
Middle	3760	-64.88	-13	-51.88	-60.4	-71.51	1.69	8.31	H
	5640	-63.20	-13	-50.20	-66.04	-70.25	2.71	9.76	H
	7520	-63.93	-13	-50.93	-67.91	-73.32	2.42	11.81	H
									H
									H
									H
	3760	-64.78	-13	-51.78	-60.25	-71.41	1.69	8.31	V
	5640	-63.37	-13	-50.37	-66.16	-70.42	2.71	9.76	V
	7520	-63.66	-13	-50.66	-67.85	-73.05	2.42	11.81	V
									V
									V
									V
Highest	3819	-65.47	-13	-52.47	-60.86	-72.15	1.70	8.38	H
	5726	-62.76	-13	-49.76	-66.01	-69.8	2.76	9.79	H
	7635	-63.66	-13	-50.66	-68.02	-73.16	2.39	11.88	H
									H
									H
									H
	3819	-65.24	-13	-52.24	-60.69	-71.92	1.70	8.38	V
	5726	-62.81	-13	-49.81	-66.08	-69.85	2.76	9.79	V
	7635	-63.33	-13	-50.33	-68	-72.83	2.39	11.88	V
									V
									V
									V

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



WCDMA Band IV(RMC 12.2Kbps)									
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	3426	-60.49	-13	-47.49	-56.12	-66.58	1.58	7.67	H
	5137	-63.58	-13	-50.58	-63.89	-70.86	2.42	9.70	H
	6849	-63.46	-13	-50.46	-67.92	-71.44	2.64	10.62	H
									H
									H
									H
	3426	-60.71	-13	-47.71	-56.28	-66.8	1.58	7.67	V
	5137	-63.78	-13	-50.78	-63.94	-71.06	2.42	9.70	V
	6849	-63.34	-13	-50.34	-67.71	-71.32	2.64	10.62	V
									V
									V
									V
Middle	3468	-62.22	-13	-49.22	-57.93	-68.48	1.59	7.86	H
	5197	-63.61	-13	-50.61	-64.28	-70.86	2.45	9.70	H
	6930	-63.49	-13	-50.49	-67.84	-71.59	2.61	10.72	H
									H
									H
									H
	3468	-61.93	-13	-48.93	-57.64	-68.19	1.59	7.86	V
	5197	-63.48	-13	-50.48	-64.03	-70.73	2.45	9.70	V
	6930	-63.58	-13	-50.58	-67.91	-71.68	2.61	10.72	V
									V
									V
									V
Highest	3504	-62.36	-13	-49.36	-58.3	-68.76	1.61	8.00	H
	5257	-63.67	-13	-50.67	-64.57	-70.88	2.49	9.70	H
	7010	-62.91	-13	-49.91	-67.13	-71.14	2.59	10.82	H
									H
									H
									H
	3504	-63.11	-13	-50.11	-58.85	-69.51	1.61	8.00	V
	5257	-64.03	-13	-51.03	-64.85	-71.24	2.49	9.70	V
	7010	-62.98	-13	-49.98	-67.34	-71.21	2.59	10.82	V
									V
									V
									V

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

## Appendix D. Antenna Information

EM7455				3G & LTE
Antenna 1	Manufacturer	Amphenol	Peak gain	2.97
	P/N	LX-7845-16-000-C	Type	PIFA
Antenna 2	Manufacturer	Speedwire	Peak gain	2.94
	P/N	F.0G.ZV-0006-001-00	Type	PIFA