



Report No.: FG2D0922D

# FCC RADIO TEST REPORT

FCC ID : PU5-TP00132C

**Equipment**: Notebook Computer

Brand Name : Lenovo Model Name : TP00132C

**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, China

Standard : FCC 47 CFR Part 2, 90(R)

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

The product was received on Dec. 09, 2022 and testing was performed from Jan. 20, 2023 to Mar. 03, 2023. 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 partial report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

Louis Wu

Sporton International Inc. Wensan Laboratory

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E-mail : Alex@sporton.com.tw Report Version : 01

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# History of this test report

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FG2D0922D	01	Initial issue of report	Apr. 07, 2023

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### **Summary of Test Result**

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Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
0.0	§2.1046	Conducted Output Power	Reporting only	-
3.2	§90.542 (a)(7)	Effective Radiated Power	Pass	-
-	-	Peak-to-Average Ratio	-	See Note
-	§2.1049	Occupied Bandwidth	-	See Note
-	§2.1053 §90.543 (e)(2)	Conducted Band Edge Measurement	-	See Note
-	§2.1051 §90.210 (n)	Emission Mask	-	See Note
-	§2.1053 §90.543 (e)(3)	Conducted Spurious Emission	-	See Note
-	§2.1055 §90.539 (e)	Frequency Stability Temperature & Voltage	-	See Note
4.2	§2.1053 §90.543 (e)(3) §90.543 (f)	Radiated Spurious Emission	Pass	3.56 dB under the limit at 1586.000 MHz

#### Note:

- For host device, Effective Radiated Power and Radiated Spurious Emission are verified and complies with limit in this test report.
- For host device, the Conducted Output Power is no difference after compared to module (Model: L860-GL-16).

#### **Conformity Assessment Condition:**

- The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the
  regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who
  shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken
  into account.
- 2. Please refer to the section "Uncertainty of Evaluation" for measurement uncertainty.

#### Disclaimer:

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sheng Kuo Report Producer: Cindy Liu

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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	TP00132C
FCC ID	PU5-TP00132C
Sample 1	EUT with AVX/ Ethertronics Antenna
Sample 2	EUT with LUXSHARE-ICT Antenna
Integrated WLAN Module	Brand Name: Intel Model Name: AX211D2W FCC ID: PD9AX211D2
Integrated NFC Module	Brand Name: Foxconn Model Name: T77H747
EUT supports Radios application	WCDMA/HSPA/LTE/GNSS/NFC WLAN 11a/b/g/n HT20/HT40 WLAN 11ac VHT20/VHT40/VHT80/VHT160 WLAN 11ax HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
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/ Ethertronics	Peak gain (dBi)	LTE Band 14: 1.12				
Main Antenna	Part number	SA31F29287AA	Туре	PIFA				
wain Antenna	Manufacturer	LUXSHARE-ICT	Peak gain (dBi)	LTE Band 14: -0.70				
	Part number	SA31F29290AA	Туре	PIFA				

**Remark:** The above EUT's information was declared by manufacturer. Please refer to Disclaimer in report summary.

### 1.2 Product Specification of Equipment Under Test

Product Specification is subject to this standard						
Tx Frequency	LTE Band 14 :790.5 MHz ~ 795.5 MHz					
Rx Frequency	LTE Band 14 :760.5 MHz ~ 765.5 MHz					
Bandwidth	5MHz / 10MHz					
Maximum Output Power to Antenna	23.64 dBm					
Type of Modulation	QPSK / 16QAM / 64QAM					

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### 1.3 Modification of EUT

No modifications made to the EUT during the testing.

### 1.4 Testing Site

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory					
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333					
Took Cita No	Sporton Site No.					
Test Site No.	TH03-HY (TAF Code: 1190)					
Test Engineer	Mike Yeh					
Temperature (°C)	22.8~23.4					
Relative Humidity (%)	52~55					
Remark	The Conducted test item subcontracted to Sporton International Inc. EMC & 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.			
rest Site No.	03CH16-HY			
Test Engineer	Andy Yang, Karl Hou and Steven Wu			
Temperature (°C)	20~25			
Relative Humidity (%)	50~65			

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 declared by the manufacturer, the EUT must comply with the requirements of the following standards:

- + ANSI C63.26-2015
- FCC 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
- FCC KDB 414788 D01 Radiated Test Site v01r01

#### Remark:

- 1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
- 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

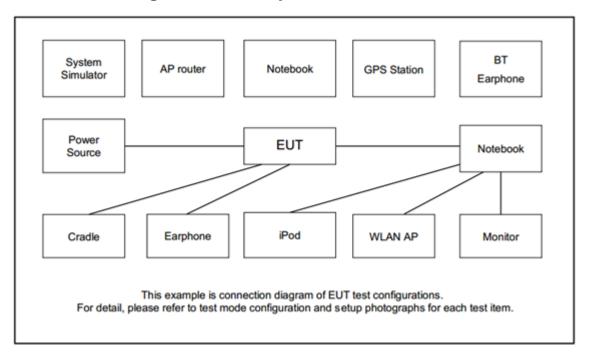
#### 2.1 Test Mode

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.

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Conducted	D	Bandwidth (MHz)		Modulation		RB#			Test Channel							
Test Cases	Band	1.4	3	5	10	15	20	QPSK	16QAM	64QAM	1	Half	Full	L	М	Н
Max. Output Power	14	-	-	>	٧	-	-	٧	٧		>	٧	v	v	>	٧
E.R.P	14	-	-	v	v	-	-	v	٧			ı	Max.	Powe	r	
Radiated																
Spurious	14	-	-	v	v	-	-	V			v			v	٧	v
Emission																
Remark	<ol> <li>The mark "v" means that this configuration is chosen for testing</li> <li>The mark "-" means that this bandwidth is not supported.</li> <li>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.</li> <li>All the radiated test cases were performed with Adapter 1 and Sample 1.</li> <li>For modulation of QPSK/16QAM, the maximum power of QPSK/16QAM is higher than other modulation(64QAM), therefore, according to engineering evaluation, we choose higher power (QPSK/16QAM) to perform all tests and show in the report.</li> </ol>															

### 2.2 Connection Diagram of Test System



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# 2.3 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model No.	FCC ID	Data Cable	Power Cord
1.	Earphone	Lenove	TS300-01MS21-8S	N/A	Shielded, 1.2m	N/A
2.	System Simulator	Anritsu	MT8821C	N/A	N/A	Unshielded, 1.8 m

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# 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	-					
10	Frequency	-	793	-					
E	Channel	23305	23330	23355					
5	Frequency	790.5	793	795.5					

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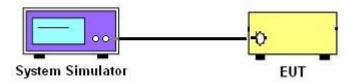
### 3 Conducted Test Items

### 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 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.

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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<sub>T</sub> = gain of the transmitting antenna in dBi

Lc = 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.

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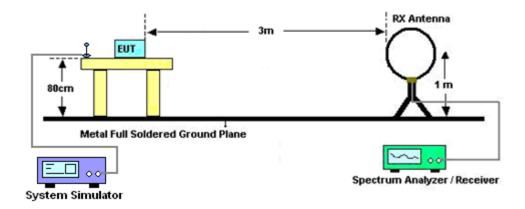
### 4 Radiated Test Items

### 4.1 Measuring Instruments

See list of measuring instruments of this test report.

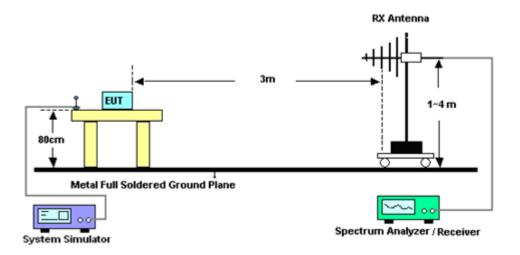
### 4.1.1 Test Setup

#### For radiated test below 30MHz



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



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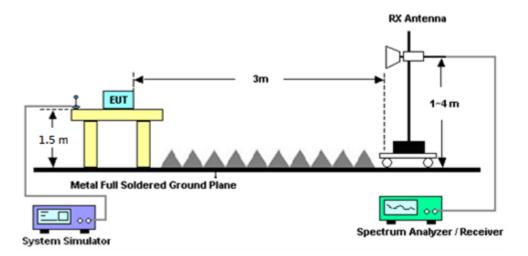
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#### For radiated test above 1GHz



#### 4.1.2 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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### 4.2 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.

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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 7 and ANSI / TIA-603-E Section 2.2.12.

- 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 + 10log(P)dB below the transmitter power P(Watts)

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#### **List of Measuring Equipment** 5

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration	Test Date	Due Date	Remark
mstrument	Diana Name	Wodel No.	Serial No.	Citaracteristics	Date	lest Date	Due Date	Kemark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Jan. 20, 2023~ Mar. 03, 2023	Sep. 19, 2023	Radiation (03CH16-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz~44GHz	Oct. 07, 2022	Jan. 20, 2023~ Mar. 03, 2023	Oct. 06, 2023	Radiation (03CH16-HY)
Signal	Agilent	MG3694C	163401	0.1Hz~40GHz	Feb. 13, 2022	Jan. 20, 2023~ Feb. 08, 2023	Feb. 12, 2023	Radiation (03CH16-HY)
Generator Signal	Agilent	MG3694C	163401	0.1Hz~40GHz	Feb. 08, 2023	Feb. 09, 2023~	Feb. 07, 2024	Radiation
Generator  Bilog Antenna	TESEQ	CBL 6111D &	40103 & 07	30MHz to 1GHz	Apr. 24, 2022	Mar. 03, 2023 Jan. 20, 2023~	Apr. 23, 2023	(03CH16-HY) Radiation
		00800N1D01N-06 CBL 6111D &				Mar. 03, 2023 Jan. 20, 2023~	•	(03CH16-HY) Radiation
Bilog Antenna	TESEQ SCHWARZB	00802N1D01N-06	47020 & 06	30MHz to 1GHz	Oct. 08, 2022	Mar. 03, 2023 Jan. 20, 2023~	Oct. 07, 2023	(03CH16-HY) Radiation
Horn Antenna	ECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 09, 2022	Mar. 03, 2023	Aug. 08, 2023	(03CH16-HY)
Horn Antenna	SCHWARZB ECK	BBHA 9120 D	9120D-1522	1G~18GHz	Mar. 10, 2022	Jan. 20, 2023~ Mar. 03, 2023	Mar. 09, 2023	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 04, 2022	Jan. 20, 2023~ Mar. 03, 2023	Jul. 03, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM1G18G	060812	1-18GHz	Dec. 26, 2022	Jan. 20, 2023~ Mar. 03, 2023	Dec. 25, 2023	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2022	Jan. 20, 2023~ Mar. 03, 2023	Dec. 08, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	Jan. 20, 2023~ Mar. 03, 2023	Dec. 14, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	805935/4	N/A	Aug. 09, 2022	Jan. 20, 2023~ Mar. 03, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	802434/4	N/A	Aug. 09, 2022	Jan. 20, 2023~ Mar. 03, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-5 757	N/A	Aug. 09, 2022	Jan. 20, 2023~ Mar. 03, 2023	Aug. 08, 2023	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jan. 20, 2023~ Mar. 03, 2023	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Jan. 20, 2023~ Mar. 03, 2023	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jan. 20, 2023~ Mar. 03, 2023	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jan. 20, 2023~ Mar. 03, 2023	N/A	Radiation (03CH16-HY)
Radio Communication Analyzer	Anritsu	MT8821C	6262025353	LTE FDD/TDD LTE-2CC DLCA/ULCA	Oct. 13, 2022	Jan. 21, 2023~ Jan. 22, 2023	Oct. 12, 2023	Conducted (TH03-HY)
Coupler	Warison	20dB 25W SMA Directional Coupler	#B	1-18GHz	Jan. 06, 2023	Jan. 21, 2023~ Jan. 22, 2023	Jan. 05, 2024	Conducted (TH03-HY)

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# 6 Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of	2.98 dB
Confidence of 95% (U = 2Uc(y))	2.90 db

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

Measuring Uncertainty for a Level of	2 E4 AB
Confidence of 95% (U = 2Uc(y))	3.54 dB

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# **Appendix A. Test Results of Conducted Test**

# Conducted Output Power(Average power & ERP)

LTE Band 14 Maximum Average Power [dBm] (GT - LC = 1.12 dB)									
BW [MHz]	RB Size	ze RB Offset Mod Lowest Middle Highest ERP (dBm) ERP							
10	1	0	QPSK		23.35		22.32	0.1706	
10	1	0	16-QAM	-	22.67	-	21.64	0.1459	
Limit	ERP < 3W			Result			Pass		

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LTE Band 14 Maximum Average Power [dBm] (GT - LC = 1.12 dB)										
BW [MHz]	RB Size RB Offset Mod Lowest Middle Highest ERP (dBm) ERP (W									
5	1	0	QPSK	23.64	23.35	23.64	22.61	0.1824		
5	1	0	16-QAM	22.83	22.55	22.90	21.87	0.1538		
Limit	nit ERP < 3W			Result			Pass			

# **Appendix B. Test Results of Radiated Test**

# LTE Band 14

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	LTE Band 14 / 5Hz / QPSK										
Channel	Frequency ( MHz )	ERP (dBm)	Limit ( dBm )	Margin ( dB )	SPA Reading (dBm)	S.G. Power ( dBm )	TX Cable loss ( dB )	TX Antenna Gain (dBi)	Polarization (H/V)		
	1576	-47.28	-42.15	-5.13	-61.29	-50.34	3.80	9.01	Н		
	2365	-52.54	-13.00	-39.54	-70.71	-55.63	4.68	9.92	Н		
	3153	-54.55	-13.00	-41.55	-75.46	-58.29	5.42	11.31	Н		
									Н		
									Н		
									Н		
Lowest									Н		
	1576	-51.39	-42.15	-9.24	-65.28	-54.45	3.80	9.01	V		
	2365	-48.64	-13.00	-35.64	-66.72	-51.73	4.68	9.92	V		
	3153	-54.92	-13.00	-41.92	-75.73	-58.66	5.42	11.31	V		
									V		
									V		
									V		
	1581	-46.58	-42.15	-4.43	-60.59	-49.67	3.80	9.05	Н		
	2372	-53.31	-13.00	-40.31	-71.50	-56.44	4.69	9.98	Н		
	3163	-54.42	-13.00	-41.42	-75.37	-58.19	5.43	11.35	Н		
									Н		
									Н		
									Н		
Middle									Н		
	1581	-51.68	-42.15	-9.53	-65.55	-54.77	3.80	9.05	V		
	2372	-50.39	-13.00	-37.39	-68.46	-53.52	4.69	9.98	V		
	3163	-54.55	-13.00	-41.55	-75.40	-58.32	5.43	11.35	V		
									V		
									V		
									V		

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	1586	-45.71	-42.15	-3.56	-59.71	-48.84	3.81	9.09	Н
	2380	-53.34	-13.00	-40.34	-71.55	-56.53	4.70	10.04	Η
	3173	-54.54	-13.00	-41.54	-75.53	-58.34	5.44	11.39	Н
									Н
									Н
									Н
Lligh oot									Н
Highest	1586	-50.79	-42.15	-8.64	-64.64	-53.92	3.81	9.09	V
	2380	-49.73	-13.00	-36.73	-67.78	-52.92	4.70	10.04	V
	3173	-54.67	-13.00	-41.67	-75.55	-58.47	5.44	11.39	V
									V
									V
									V
									V

Report No.: FG2D0922D

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

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			L	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)					
	1577	-47.48	-42.15	-5.33	-61.49	-50.55	3.80	9.02	Н					
	2365	-50.78	-13.00	-37.78	-68.95	-53.87	4.68	9.92	Н					
	3154	-54.61	-13.00	-41.61	-75.52	-58.35	5.42	11.32	Н					
									Н					
									Н					
									Н					
Middle									Н					
Middle	1577	-51.79	-42.15	-9.64	-65.68	-54.86	3.80	9.02	V					
	2365	-47.56	-13.00	-34.56	-65.64	-50.65	4.68	9.92	V					
	3154	-54.60	-13.00	-41.60	-75.41	-58.34	5.42	11.32	V					
									V					
									V					
									V					
									V					

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