

# FCC RF Test Report

APPLICANT : LC Future Center Limited Taiwan Branch  
EQUIPMENT : Notebook  
BRAND NAME : Lenovo  
MODEL NAME : TP00086B  
FCC ID : 2AJN7-TP00086B  
STANDARD : FCC 47 CFR Part 2, 27  
CLASSIFICATION : PCS Licensed Transmitter (PCB)

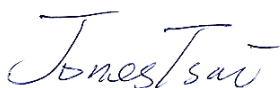
Equipment: Fibocom L850-GL tested inside of Lenovo Notebook.

This is a partial report. The product was received on Dec. 21, 2017 and completely tested on Jan. 18, 2018. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI / TIA-603-E and shown 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



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FCC ID : 2AJN7-TP00086B

Page Number : 1 of 14

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## REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FG7O2534-06D	Rev. 01	Initial issue of report	Jan. 24, 2018

**SUMMARY OF TEST RESULT**

Report Section	FCC Rule	Description	Limit	Result	Remark
3.4	§2.1046	Conducted Output Power	Reporting Only	PASS	-
4.4	§2.1053 §27.53 (a)(4)	Radiated Spurious Emission	$< 70 + 10 \log_{10}(P[\text{Watts}])$	PASS	Under limit 6.69 dB at 11530.000 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 & Specification	
<b>Product Name</b>	Notebook
<b>Brand Name</b>	Lenovo
<b>Model Name</b>	TP00086B
<b>FCC ID</b>	2AJN7-TP00086B
<b>Sample 1</b>	EUT with Antenna 1
<b>Sample 2</b>	EUT with Antenna 2
<b>Integrated WWAN Module</b>	Brand Name: Fibocom Model Name: L850-GL

**Remark:**

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. All test items were performed with Sample 1.
3. Equipment: Fibocom L850-GL tested inside of Lenovo Notebook.

L850-GL				3G & LTE
<b>Antenna 1</b>	<b>Manufacturer</b>	Amphenol	<b>Peak gain</b>	2.99
	<b>P/N</b>	LX-8905-16-000-C	<b>Type</b>	PIFA
<b>Antenna 2</b>	<b>Manufacturer</b>	Speedwire	<b>Peak gain</b>	2.72
	<b>P/N</b>	F.0G.ZV-0006-006-00	<b>Type</b>	PIFA

## 1.4 Modification of EUT

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

## 1.5 Testing Site

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1190 and TW0007 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1 <sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.
Test Site No.	<b>Sporton Site No.</b>
	TH05-HY

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.	<b>Sporton Site No.</b>
	03CH11-HY

## 1.6 Applied Standards

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

- ♦ 47 CFR Part 2, Part 27(D)
- ♦ ANSI / TIA -603-E
- ♦ FCC KDB 971168 Power Meas License Digital Systems D01 v03
- ♦ 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

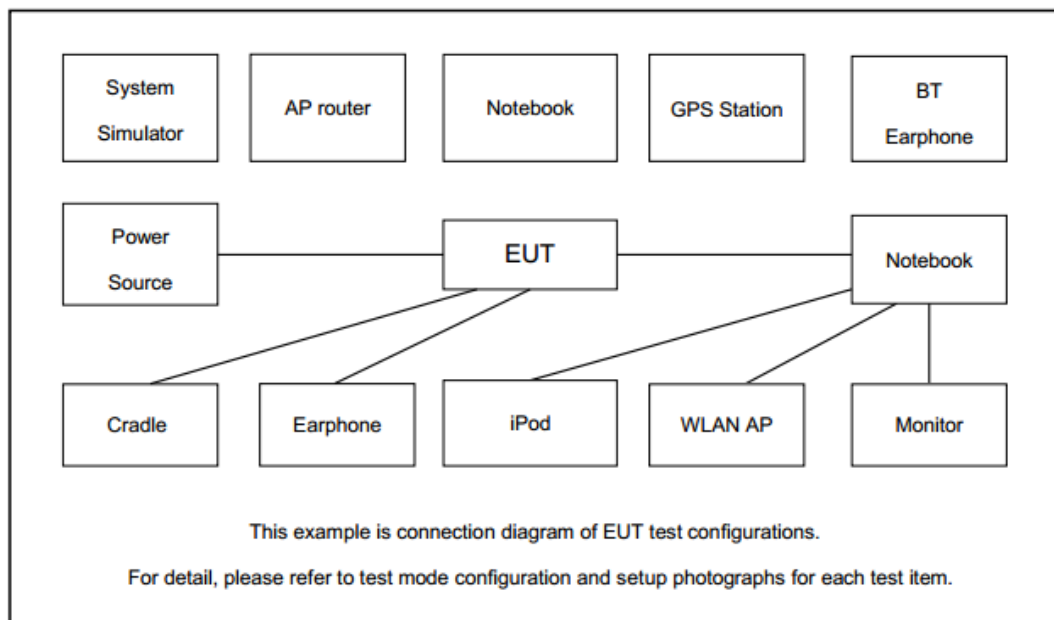
### 2.1 Test Mode

Antenna port conducted and radiated test items listed below are performed according to KDB 971168 D01 Power Meas. License Digital Systems v03 with maximum output power.

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes to find the maximum emission.

Conducted Test Cases	Band	Bandwidth (MHz)						Modulation		RB #			Test Channel		
		1.4	3	5	10	15	20	QPSK	16QAM	1	Half	Full	L	M	H
Max. Output Power	30	-	-	V	V	-	-	V	V	V	V	V	V	V	V
Radiated Spurious Emission	30	Worse Case											V	V	V
Note	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.														

## 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	8821C	N/A	N/A	N/A
2.	iPod Earphone	Apple	N/A	Verification	N/A	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



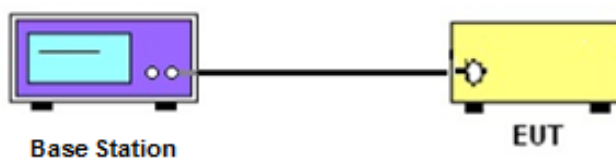
### 3 Conducted Test Items

#### 3.1 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.2 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 Measurement**

### **3.4.1 Description of the Conducted Output Power 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.

### **3.4.2 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.

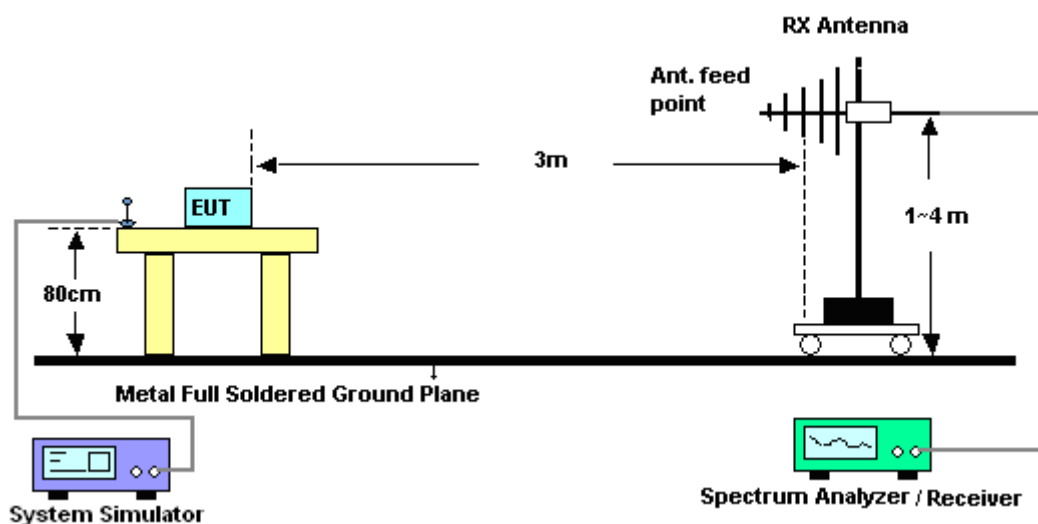
## 4 Radiated Test Items

### 4.1 Measuring Instruments

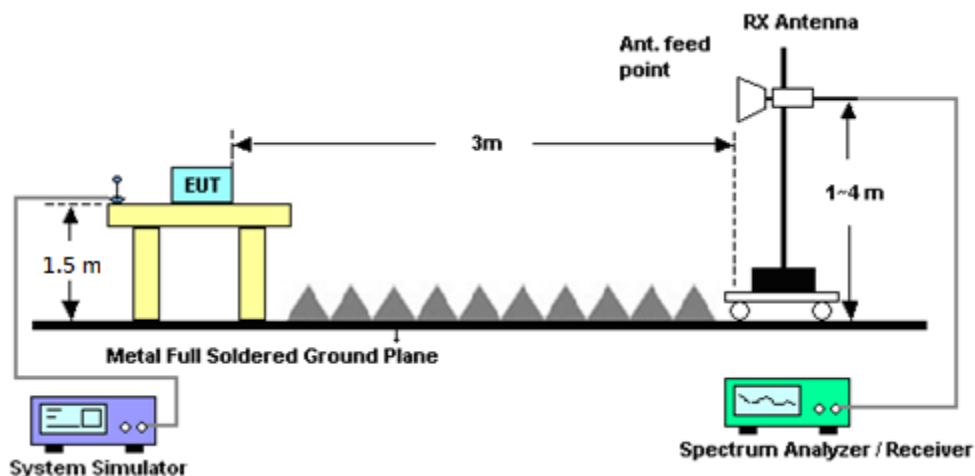
See list of measuring instruments of this test report.

### 4.2 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 Radiated Spurious Emission Measurement

### 4.4.1 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  $70 + 10 \log (P)$  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 v03 Section 5.8 and ANSI / TIA-603-E Section 2.2.12.
2. 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.
3. The EUT was set 3 meters from the receiving antenna 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 1m to 4m to search the maximum spurious emission for both horizontal and vertical polarizations.
6. During the measurement, the system simulator parameters were set to force the EUT transmitting at maximum output power.
7. Make the measurement with the spectrum analyzer's RBW = 1MHz, VBW = 3MHz, taking the record of maximum spurious emission.
8. A horn antenna was substituted in place of the EUT and was driven by a signal generator.
9. Tune the output power of signal generator to the same emission level with EUT maximum spurious emission.

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

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

10. 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	GSM/GPRS /WCDMA/LTE	Oct. 13, 2017	Jan. 02, 2018	Oct. 12, 2018	Conducted (TH05-HY)
Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz,VS WR : 2.5:1 max	Jul. 18, 2017	Jan. 10, 2018~ Jan. 18, 2018	Jul. 17, 2018	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Nov. 10, 2016	Jan. 10, 2018~ Jan. 18, 2018.	Nov. 09, 2018	Radiation (03CH11-HY)
Bilog Antenna	TESEQ	CBL 6111D&N-6-06	35414&AT-N0 602	30MHz~1GHz	Oct. 14, 2017	Jan. 10, 2018~ Jan. 18, 2018	Oct. 13, 2018	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBEC K	BBHA 9120 D	9120D-1326	1GHz ~ 18GHz	Oct. 16, 2017	Jan. 10, 2018~ Jan. 18, 2018	Oct. 15, 2018	Radiation (03CH11-HY)
Horn Antenna	SCHWARZBEC K	BBHA 9120 D	9120D-1522	1GHz ~ 18GHz	Mar. 17, 2017	Jan. 10, 2018~ Jan. 18, 2018	Mar. 16, 2018	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Nov. 23, 2017	Jan. 10, 2018~ Jan. 18, 2018	Nov. 22, 2019	Radiation (03CH11-HY)
Preamplifier	Keysight	83017A	MY53270080	1GHz~26.5GHz	Nov. 10, 2016	Jan. 10, 2018~ Jan. 18, 2018	Nov. 09, 2018	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY54200486	10Hz ~ 44GHz	Oct. 19, 2017	Jan. 10, 2018~ Jan. 18, 2018	Oct. 18, 2018	Radiation (03CH11-HY)
Filter	Wainwright	WHKX12-10 80-1200-150 0-60SS	SN2	1.2G High Pass	Sep. 18, 2017	Jan. 10, 2018~ Jan. 18, 2018	Sep. 17, 2018	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-450 0-B	N/A	1~4m	N/A	Jan. 10, 2018~ Jan. 18, 2018	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Jan. 10, 2018~ Jan. 18, 2018	N/A	Radiation (03CH11-HY)
EMI Test Receiver	Keysight	N9038A(MX E)	MY57290111	3Hz~26.5GHz	Nov. 02, 2017	Jan. 10, 2018~ Jan. 18, 2018	Nov. 01, 2018	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBEC K	BBHA 9170	BBHA917057 6	18GHz- 40GHz	Apr. 27, 2017	Jan. 10, 2018~ Jan. 18, 2018	Apr. 26, 2018	Radiation (03CH11-HY)
SHF-EHF Horn Antenna	SCHWARZBEC K	BBHA 9170	BBHA917058 4	18GHz- 40GHz	Nov. 27, 2017	Jan. 10, 2018~ Jan. 18, 2018	Nov. 26, 2018	Radiation (03CH11-HY)
Preamplifier	MITEQ	AMF-7D-00 101800-30-1	1590074	1GHz~18GHz	May 22, 2017	Jan. 10, 2018~ Jan. 18, 2018	May 21, 2018	Radiation (03CH11-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 30 Maximum Average Power [dBm]						
BW [MHz]	RB Size	RB Offset	Mod	Lowest	Middle	Highest
10	1	0	QPSK	-	22.67	-
10	1	25			22.61	
10	1	49			22.55	
10	25	0			21.80	
10	25	12			21.75	
10	25	25			21.70	
10	50	0			21.93	
10	1	0	16-QAM	-	21.98	-
10	1	25			22.02	
10	1	49			21.83	
10	25	0			20.78	
10	25	12			20.82	
10	25	25			20.80	
10	50	0			20.95	
5	1	0	QPSK	22.59	22.62	22.62
5	1	12		22.61	22.58	22.60
5	1	24		22.58	22.58	22.58
5	12	0		21.76	21.76	21.81
5	12	7		21.73	21.80	21.73
5	12	13		21.78	21.84	21.76
5	25	0		21.77	21.83	21.73
5	1	0	16-QAM	21.98	22.02	22.03
5	1	12		21.93	22.06	21.88
5	1	24		21.95	21.97	21.86
5	12	0		20.80	20.79	20.81
5	12	7		20.76	20.81	20.70
5	12	13		20.78	20.81	20.76
5	25	0		20.75	20.84	20.76



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

### EIRP

LTE Band 30 / 5MHz (Average) (GT - LC = 0.95 dB)							
Channel	Mode	RB		Conducted		EIRP	
		Size	Offset	Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	QPSK	1	0	22.59	0.1816	23.54	0.2259
Middle		1	0	22.62	0.1828	23.57	0.2275
Highest		1	0	22.62	0.1828	23.57	0.2275
Lowest	16QAM	1	12	21.93	0.1560	22.88	0.1941
Middle		1	12	22.06	0.1607	23.01	0.2000
Highest		1	12	21.88	0.1542	22.83	0.1919
Limit	EIRP < 2W			Result		PASS	

LTE Band 30 / 10MHz (Average) (GT - LC = 0.95 dB)							
Channel	Mode	RB		Conducted		EIRP	
		Size	Offset	Power (dBm)	Power (Watts)	EIRP(dBm)	EIRP(W)
Lowest	QPSK	-	-	-	-	-	-
Middle		1	0	22.67	0.1849	23.62	0.2301
Highest		-	-	-	-	-	-
Lowest	16QAM	-	-	-	-	-	-
Middle		1	25	22.02	0.1592	22.97	0.1982
Highest		-	-	-	-	-	-
Limit	EIRP < 2W			Result		PASS	



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

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	4614	-50.52	-40	-10.52	-44.52	-61.9	0.82	12.20	H
	6918	-59.50	-40	-19.50	-59.82	-70	0.98	11.48	H
	9220	-55.29	-40	-15.29	-61.5	-65.9	1.37	11.98	H
	11530	-50.19	-40	-10.19	-58.65	-60.6	1.52	11.92	H
									H
									H
									H
	4614	-50.92	-40	-10.92	-45.9	-62.3	0.82	12.20	V
	6918	-53.00	-40	-13.00	-54	-63.5	0.98	11.48	V
	9220	-54.29	-40	-14.29	-60.74	-64.9	1.37	11.98	V
	11530	-46.69	-40	-6.69	-55.57	-57.1	1.52	11.92	V
									V
									V
									V

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