

# 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)

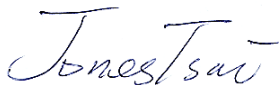
Equipment: Fibocom L850-GL tested inside of Lenovo Notebook.

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



## **SPORTON INTERNATIONAL INC.**

**No. 52, Hwa Ya 1<sup>st</sup> Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C.**



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### 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<br>§27.53 (a)(4) | Radiated Spurious Emission | $< 70 + 10 \log_{10}(P[\text{Watts}])$ | PASS   | Under limit<br>6.69 dB at<br>11530.000<br>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<br>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.

|                           |  |
|---------------------------|--|
| <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,<br>Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. |
| <b>Test Site No.</b>      | <b>Sporton Site No.</b>  |
|                           | TH05-HY  |

|                           |  |
|---------------------------|--|
| <b>Test Site</b>          | SPORTON INTERNATIONAL INC.   |
| <b>Test Site Location</b> | No.58, Aly. 75, Ln. 564, Wenhua 3rd Rd. Guishan Dist,<br>Taoyuan City, Taiwan (R.O.C.) |
| <b>Test Site No.</b>      | <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

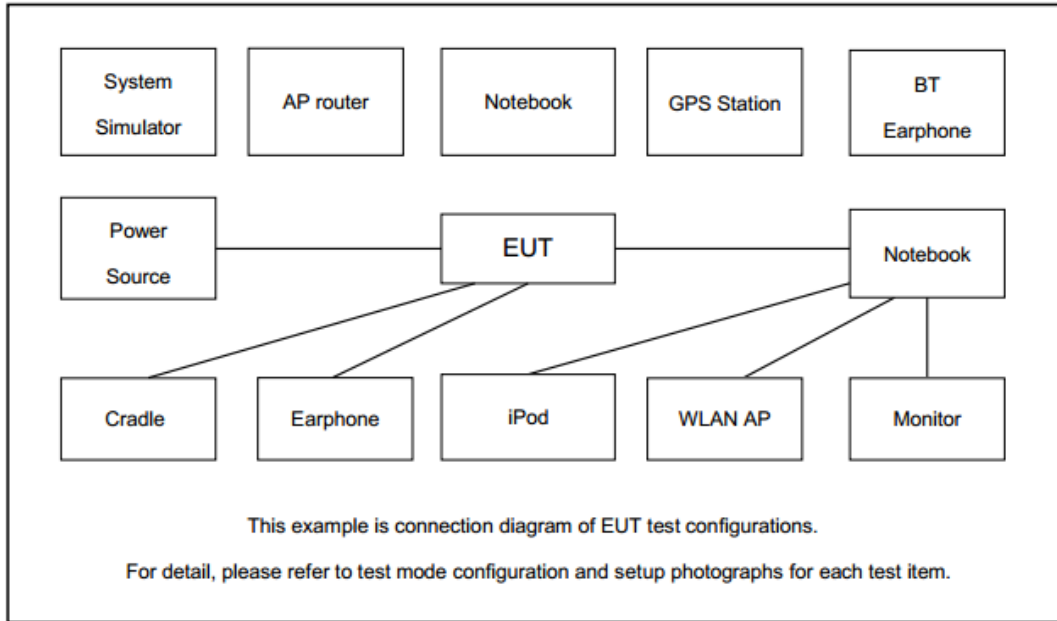
### 2.1 Test Mode

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<br>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<br>Power             | 30  | -               | - | v | v  | -  | -  | v          | v     | v    | v    | v    | v            | v | v |
| Radiated<br>Spurious<br>Emission | 30  | Worse Case      |   |   |    |    |    |            |       |      |      | v    | v            | v |   |
| Note                             | <ol style="list-style-type: none"> <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> </ol> |                 |   |   |    |    |    |            |       |      |      |      |              |   |   |

## 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  |



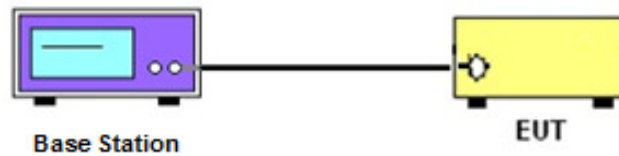
### 3 Conducted Test Items

#### 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.

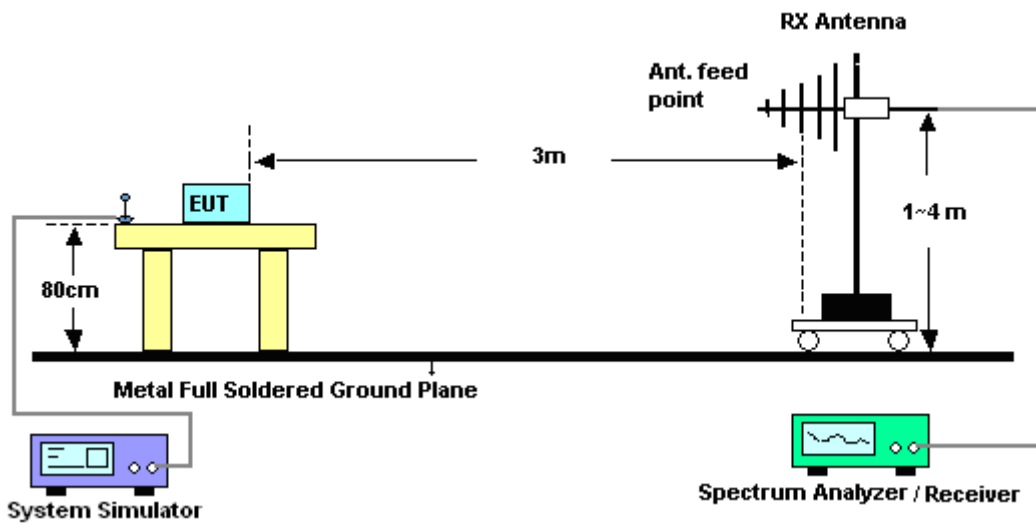
## 4 Radiated Test Items

### 4.1 Measuring Instruments

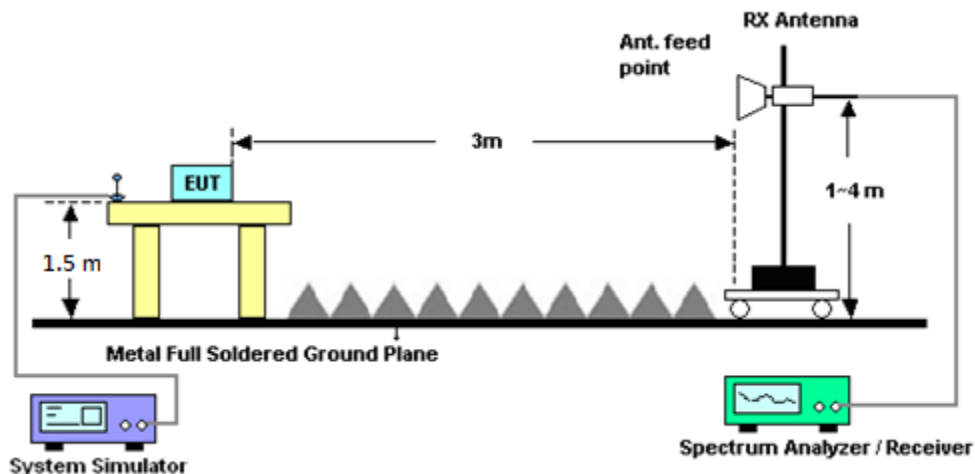
See list of measuring instruments of this test report.

### 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)

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

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

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

## 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-N0602 | 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      | WHKX12-1080-1200-1500-60SS | 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-4500-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(MXE)                | 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                  | BBHA9170576    | 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                  | BBHA9170584    | 18GHz- 40GHz                   | Nov. 27, 2017    | Jan. 10, 2018~Jan. 18, 2018  | Nov. 26, 2018 | Radiation (03CH11-HY) |
| Preamplifier         | MITEQ           | AMF-7D-00101800-30-1       | 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 |
|---|------|

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

|   |      |
|---|------|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 3.67 |
|---|------|

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

|   |      |
|---|------|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 4.03 |
|---|------|



## 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   |        | <b>22.67</b> |         |
| 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.