



Test Report No.: RFA210305W001-3



# FCC TEST REPORT (PART 27)


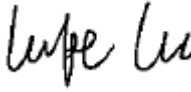
|            |   |
|------------|---|
| Applicant: | ThingsMatrix Inc.   |
| Address:   | 9442 North Capital of Texas Hwy, Plaza One, Suite 500, Austin, TX 78759 |

|                           |   |
|---------------------------|---|
| Manufacturer or Supplier: | ThingsMatrix Inc.   |
| Address:                  | 9442 North Capital of Texas Hwy, Plaza One, Suite 500, Austin, TX 78759 |
| Product:                  | IoT Wireless Device   |
| Brand Name:               | ThingsMatrix  |
| Model Name:               | TMX08-EX  |
| FCC ID:                   | 2ATV9TMX08-EX   |
| Date of tests:            | Mar. 17, 2021 ~ Mar. 25, 2021   |

The tests have been carried out according to the requirements of the following standard:

- FCC Part 27, Subpart C, L     ANSI/TIA/EIA-603- D
- FCC Part 2                       ANSI/TIA/EIA-603-E     ANSI C63.26-2015

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

|  |   |
|--|---|
| Prepared by Simon Wang<br>Supervisor / Mobile Department   | Approved by Luke Lu<br>Manager / Mobile Department  |
| <br>Date: Mar.28, 2021  | <br>Date: Mar.28, 2021 |
| <small>This report is governed by, and incorporates by reference, CPS Conditions of Service as posted at the date of issuance of this report at <a href="http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions">http://www.bureauveritas.com/home/about-us/our-business/cps/about-us/terms-conditions</a> and is intended for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. Measurement uncertainty is only provided upon request for accredited tests. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence or if you require measurement uncertainty; provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents.</small> |   |



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## RELEASE CONTROL RECORD

| ISSUE NO.       | REASON FOR CHANGE  | DATE ISSUED   |
|-----------------|--|---------------|
| RF190701W004-3  | Original release   | Jul. 24, 2019 |
| RFA210305W001-3 | Base on the original release changes the non-RF components include DC-DC power chip model , add RS232 debug external interface and digital temperature sensor , an NTC thermistor, use lidar sensor instead of ultrasonic sensor ,update the worst case LTE band 13 radiated spurious and verify all band conducted power , other refer to the original release report | Mar. 25, 2021 |

## 1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

| APPLIED STANDARD: FCC Part 27 & Part 2 |                              |        |  |
|--|------------------------------|--------|--|
| STANDARD SECTION                       | TEST TYPE AND LIMIT          | RESULT | REMARK   |
| 2.1046<br>27.50(d)(4)                  | Maximum Peak Output Power    | PASS   | See Note   |
| 2.1055<br>27.54                        | Frequency Stability          | N/A    | See Note   |
| 2.1049<br>27.53(h)                     | Occupied Bandwidth           | N/A    | See Note   |
| 27.50(d)(5)                            | Peak to average ratio        | N/A    | See Note   |
| 27.53(h)                               | Band Edge Measurements       | N/A    | See Note   |
| 2.1051<br>27.53(h)                     | Conducted Spurious Emissions | N/A    | See Note   |
| 2.1053<br>27.53(h)                     | Radiated Spurious Emissions  | PASS   | Meet the requirement of limit.<br>Minimum passing margin is<br>-5.60dB at 1572.00MHz |

**Note: :**

1. These items please refer to the LTE module report RXA1706-0199RF01R1 which The FCC ID is XMR201707BG96, and the LTE module has been certified by TA Technology(shanghai)Co.,Ltd on 09/12/2017.
2. Per the product equivalent declaration provided by the manufacturer, the change not affect any RF parameters, Verify the original report (FCC ID: 2ATV9TMX08; Report No.: RF190701W004-3) conducted Power and worst mode of radiated spurious emission.

### 1.1 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

| MEASUREMENT                | UNCERTAINTY |
|----------------------------|-------------|
| Maximum Peak Output Power  | ±1dB        |
| Frequency Stability        | ±39.27Hz    |
| Radiated emissions         | ±4.48dB     |
| Conducted emissions        | ±2 dB       |
| Occupied Channel Bandwidth | ±21.7KHz    |
| Band Edge Measurements     | ±4.48dB     |
| Peak to average ratio      | ±0.76dB     |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.



## 1.2 TEST SITE AND INSTRUMENTS

| Equipment                             | Manufacturer | Model No.                           | Serial No.                      | Last Cal.   | Next Cal.   |
|---------------------------------------|--------------|-------------------------------------|---------------------------------|-------------|-------------|
| MXE EMI Receiver                      | KEYSIGHT     | N9038A-544                          | MY54450026                      | May. 19,20  | May. 18,23  |
| EXA Signal Analyzer                   | KEYSIGHT     | N9010A-526                          | MY54510322                      | Mar. 27,20  | Mar. 26,21  |
| Bilog Antenna 1                       | ETS-LINDGREN | 3143B                               | 00161964                        | Mar. 27,20  | Mar. 26,21  |
| Bilog Antenna 2                       | ETS-LINDGREN | 3143B                               | 00161965                        | Feb. 24,21  | Feb. 25,22  |
| Horn Antenna 1                        | ETS-LINDGREN | 3117                                | 00168728                        | Nov. 24, 20 | Nov. 23, 21 |
| Horn Antenna 2                        | ETS-LINDGREN | 3117                                | 00168692                        | Nov. 23, 20 | Nov. 22, 21 |
| Horn Antenna (18GHz-40GHz)            | N/A          | QWH-SL-18-40<br>-K-SG/QMS-00<br>361 | 15433                           | Mar. 27,20  | Mar. 26,21  |
| Radio Communication Analyzer          | ANRITSU      | MT8820C                             | 6201465426                      | Feb. 24,21  | Feb. 23,22  |
| Signal Pre-Amplifier                  | EMSI         | EMC 9135                            | 980249                          | Jun. 02,20  | Jun. 01,21  |
| Signal Pre-Amplifier                  | EMSI         | EMC 012645B                         | 980257                          | Jun. 02,20  | Jun. 01,21  |
| Signal Pre-Amplifier                  | EMSI         | EMC 184045B                         | 980259                          | Jun. 02,20  | Jun. 01,21  |
| 3m Semi-anechoic Chamber              | ETS-LINDGREN | 9m*6m*6m                            | Euroshieldpn-<br>CT0001143-1216 | Feb. 24,21  | Feb. 23,22  |
| Test Software                         | E3           | V 9.160323                          | N/A                             | Feb. 24,21  | Feb. 23,22  |
| Test Software                         | ADT          | ADT_Radiated<br>_V7.6.15.9.2        | N/A                             | Feb. 24,21  | Feb. 23,22  |
| 10dB Attenuator                       | JFW/USA      | 50HF-010-SM<br>A                    | 1505                            | Feb. 24,21  | Feb. 23,22  |
| Power Meter                           | Anritsu      | ML2495A                             | 1506002                         | Aug. 25,20  | Aug. 24,21  |
| Power Sensor                          | Anritsu      | MA2411B                             | 1339352                         | NA          | NA          |
| Humid & Temp Programmable Tester      | Juyi         | ITH-120-45-CP<br>-AR                | IAA1504-001                     | Jun. 23,20  | Jun. 21,21  |
| MXG Analog Microvave Signal Generator | KEYSIGHT     | N5183A                              | MY50143024                      | Nov. 21, 20 | Nov. 20, 21 |

- NOTE:**
1. The calibration interval of the above test instruments is 12 months or 24 months and the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.
  2. The test was performed in 3m Semi-anechoic Chamber and RF Oven Room.
  3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.
  4. The FCC Site Registration No. is 525120; The Designation No. is CN1171.

## 2 GENERAL INFORMATION

### 2.1 GENERAL DESCRIPTION OF EUT

|  |   |   |       |
|--|---|---|-------|
| <b>PRODUCT</b>                                   | IoT Wireless Device   |   |       |
| <b>MODEL NAME</b>                                | TMX08-EX  |   |       |
| <b>POWER SUPPLY</b>                              | 12Vdc (adapter or host equipment)<br>3.7Vdc (Li-ion, battery) |   |       |
| <b>MODULATION TECHNOLOGY</b>                     | <b>LTE CAT-M1</b>   | QPSK, 16QAM                                     |       |
| <b>FREQUENCY RANGE</b>                           | <b>LTE Band 4<br/>Channel Bandwidth: 1.4MHz</b>               | 1710.7MHz ~ 1754.3MHz                           |       |
|  | <b>LTE Band 4<br/>Channel Bandwidth: 3MHz</b>                 | 1711.5MHz ~ 1753.5MHz                           |       |
|  | <b>LTE Band 4<br/>Channel Bandwidth: 5MHz</b>                 | 1712.5MHz ~ 1752.5MHz                           |       |
|  | <b>LTE Band 4<br/>Channel Bandwidth: 10MHz</b>                | 1715.0MHz ~ 1750.0MHz                           |       |
|  | <b>LTE Band 4<br/>Channel Bandwidth: 15MHz</b>                | 1717.5MHz ~ 1747.5MHz                           |       |
|  | <b>LTE Band 4<br/>Channel Bandwidth: 20MHz</b>                | 1720.0MHz ~ 1745.0MHz                           |       |
|  | <b>LTE Band 12<br/>Channel Bandwidth: 1.4MHz</b>              | 699.7MHz ~ 715.3MHz                             |       |
|  | <b>LTE Band 12<br/>Channel Bandwidth: 3MHz</b>                | 700.5MHz ~ 714.5MHz                             |       |
|  | <b>LTE Band 12<br/>Channel Bandwidth: 5MHz</b>                | 701.5MHz ~ 713.5MHz                             |       |
|  | <b>LTE Band 12<br/>Channel Bandwidth: 10MHz</b>               | 704.0MHz ~ 711.0MHz                             |       |
|  | <b>LTE Band 13<br/>Channel Bandwidth: 5MHz</b>                | 779.5MHz ~ 784.5MHz                             |       |
|  | <b>LTE Band 13<br/>Channel Bandwidth: 10MHz</b>               | 782.0MHz  |       |
|  | <b>MAX. ERP/EIRP POWER</b>                                    | <b>LTE Band 4<br/>Channel Bandwidth: 1.4MHz</b> | 105mW |
|  |   | <b>LTE Band 4<br/>Channel Bandwidth: 3MHz</b>   | 104mW |
| <b>LTE Band 4<br/>Channel Bandwidth: 5MHz</b>    |   | 105mW   |       |
| <b>LTE Band 4<br/>Channel Bandwidth: 10MHz</b>   |   | 107mW   |       |
| <b>LTE Band 4<br/>Channel Bandwidth: 15MHz</b>   |   | 105mW   |       |
| <b>LTE Band 4<br/>Channel Bandwidth: 20MHz</b>   |   | 94mW  |       |
| <b>LTE Band 12<br/>Channel Bandwidth: 1.4MHz</b> |   | 131mW   |       |



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|                         |   |       |
|-------------------------|---|-------|
|                         | <b>LTE Band 12<br/>Channel Bandwidth: 3MHz</b>  | 137mW |
|                         | <b>LTE Band 12<br/>Channel Bandwidth: 5MHz</b>  | 137mW |
|                         | <b>LTE Band 12<br/>Channel Bandwidth: 10MHz</b>   | 123mW |
|                         | <b>LTE Band 13<br/>Channel Bandwidth: 5MHz</b>  | 81mW  |
|                         | <b>LTE Band 13<br/>Channel Bandwidth: 10MHz</b>   | 69mW  |
| <b>ANTENNA TYPE</b>     | External antenna  |       |
| <b>ANTENNA GAIN</b>     | 2dBi for LTE CAT-M1 Band 4<br>0dBi for LTE CAT-M1 Band 12<br>-2dBi for LTE CAT-M1 Band 13 |       |
| <b>HW VERSION</b>       | V2.0  |       |
| <b>SW VERSION</b>       | TMX08-EXV02   |       |
| <b>ACCESSORY DEVICE</b> | Refer to user's manual  |       |
| <b>DATA CABLE</b>       | N/A   |       |

**NOTE:**

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

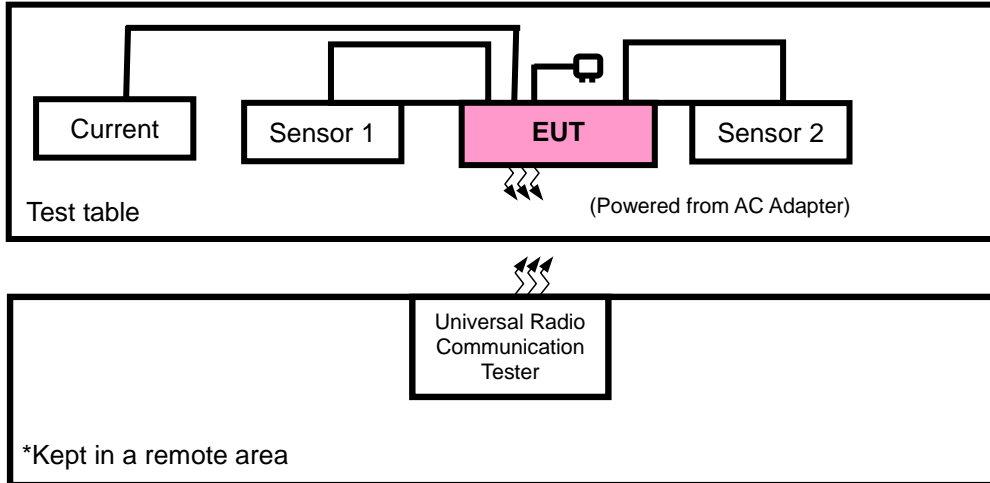
**List of Accessories:**

| <b>ACCESSORIES</b>   | <b>MODEL</b>                  | <b>SPECIFICATION</b>           |
|----------------------|-------------------------------|--------------------------------|
| Power supply adapter | TDX-1201000                   | I/P:100~240VAC<br>O/P:12VDC/1A |
| Battery              | Li-ion Polymer Battery        | DC 3.7V, 3000mAh,<br>11.1Wh    |
| Sensor 1             | Ultrasonic&Temperature sensor | -                              |
| Sensor 2             | Lidar sensor                  | -                              |
| Current draw sensor  | Current draw sensor           | -                              |
| Cellular Antenna     | Cellular Antenna              | -                              |
| GPS Antenna          | GPS Antenna                   | -                              |



## 2.2 CONFIGURATION OF SYSTEM UNDER TEST

### FOR RADIATION EMISSION TEST



## 2.3 DESCRIPTION OF TEST MODES

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis and antenna ports. The worst case radiated emission configuration selected for the final test are marked bold as listed below:

| EUT CONFIGURE MODE | DESCRIPTION                 |
|--------------------|-----------------------------|
| -                  | EUT + Adapter with LTE link |

### LTE BAND 4

| TEST ITEM         | AVAILABLE CHANNEL | TESTED CHANNEL      | CHANNEL BANDWIDTH | MODULATION  | MODE               |
|-------------------|-------------------|---------------------|-------------------|-------------|--------------------|
| EIRP              | 19957 to 20393    | 19957, 20175, 20393 | 1.4MHz            | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 19965 to 20385    | 19965, 20175, 20385 | 3MHz              | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 19975 to 20375    | 19975, 20175, 20375 | 5MHz              | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 20000 to 20350    | 20000, 20175, 20350 | 10MHz             | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 20025 to 20325    | 20025, 20175, 20325 | 15MHz             | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 20050 to 20300    | 20050, 20175, 20300 | 20MHz             | QPSK, 16QAM | 1 RB / 0 RB Offset |
| RADIATED EMISSION | 19957 to 20393    | 20175               | 1.4MHz            | QPSK        | 1 RB / 0 RB Offset |
|                   | 19965 to 20385    | 19965, 20175, 20385 | 3MHz              | QPSK        | 1 RB / 0 RB Offset |
|                   | 19975 to 20375    | 20175               | 5MHz              | QPSK        | 1 RB / 0 RB Offset |
|                   | 20000 to 20350    | 20175               | 10MHz             | QPSK        | 1 RB / 0 RB Offset |
|                   | 20025 to 20325    | 20175               | 15MHz             | QPSK        | 1 RB / 0 RB Offset |
|                   | 20050 to 20300    | 20175               | 20MHz             | QPSK        | 1 RB / 0 RB Offset |

**Note:** This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.

### LTE BAND 12

| TEST ITEM         | AVAILABLE CHANNEL | TESTED CHANNEL      | CHANNEL BANDWIDTH | MODULATION  | MODE               |
|-------------------|-------------------|---------------------|-------------------|-------------|--------------------|
| ERP               | 23017 to 23173    | 23017, 23095, 23173 | 1.4MHz            | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 23025 to 23165    | 23025, 23095, 23165 | 3MHz              | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 23035 to 23155    | 23035, 23095, 23155 | 5MHz              | QPSK, 16QAM | 1 RB / 0 RB Offset |
|                   | 23060 to 23130    | 23060, 23095, 23130 | 10MHz             | QPSK, 16QAM | 1 RB / 0 RB Offset |
| RADIATED EMISSION | 23017 to 23173    | 23095               | 1.4MHz            | QPSK        | 1 RB / 0 RB Offset |
|                   | 23025 to 23165    | 23025, 23095, 23165 | 3MHz              | QPSK        | 1 RB / 0 RB Offset |
|                   | 23035 to 23155    | 23095               | 5MHz              | QPSK        | 1 RB / 0 RB Offset |
|                   | 23060 to 23130    | 23095               | 10MHz             | QPSK        | 1 RB / 0 RB Offset |

**Note:** This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.



**LTE BAND 13**

| TEST ITEM         | AVAILABLE CHANNEL | TESTED CHANNEL      | CHANNEL BANDWIDTH | MODULATION  | MODE                      |
|-------------------|-------------------|---------------------|-------------------|-------------|---------------------------|
| ERP               | 23205 to 23255    | 23205, 23230, 23255 | 5MHz              | QPSK, 16QAM | 1 RB / 0 RB Offset        |
|                   | 23230             | 23230               | 10MHz             | QPSK, 16QAM | 1 RB / 0 RB Offset        |
| RADIATED EMISSION | 23205 to 23255    | 23205, 23230, 23255 | 5MHz              | QPSK        | 1 RB / 0 RB Offset        |
|                   | <b>23230</b>      | <b>23230</b>        | <b>10MHz</b>      | <b>QPSK</b> | <b>1 RB / 0 RB Offset</b> |

**Note:** This device was tested under all bandwidths, RB configurations and modulations. The worst case was found in QPSK modulation.

**TEST CONDITION:**

| TEST ITEM         | ENVIRONMENTAL CONDITIONS | INPUT POWER        | TESTED BY |
|-------------------|--------------------------|--------------------|-----------|
| RADIATED EMISSION | 23deg. C, 70%RH          | 12Vdc from adapter | Jace H    |



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## 2.4 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**FCC 47 CFR Part 2**

**FCC 47 CFR Part 27**

**KDB 971168 D01 Power Meas License Digital Systems v03r01**

**ANSI/TIA/EIA-603-D**

**ANSI/TIA/EIA-603-E**

**ANSI C63.26-2015**

**NOTE:** All test items have been performed and recorded as per the above standards.



### 3 TEST TYPES AND RESULTS

#### 3.1 OUTPUT POWER MEASUREMENT

##### 3.1.1 LIMITS OF OUTPUT POWER MEASUREMENT

Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are limited to 1 watt EIRP.

Portable stations (hand-held devices) operating in the 699-716 MHz and 777-7887 bands are limited to 3 watts ERP.

##### 3.1.2 TEST PROCEDURES

###### EIRP / ERP MEASUREMENT:

Per KDB 971168 D01 Power Meas License Digital Systems v03r01 or subclause 5.2.5.5 of ANSI C63.26-2015, the relevant equation for determining the ERP or EIRP from the conducted RF output power measured using the guidance provided above is:

$$\text{ERP or EIRP} = P_{\text{Meas}} + G_{\text{T}} - L_{\text{C}}$$

Where:

ERP or EIRP = effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as  $P_{\text{Meas}}$ , typically dBW or dBm);

$P_{\text{Meas}}$  = measured transmitter output power or PSD, in dBm or dBW;

$G_{\text{T}}$  = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);

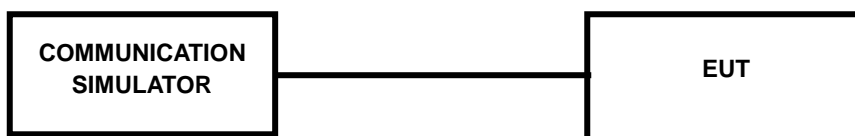
$L_{\text{C}}$  = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

###### CONDUCTED POWER MEASUREMENT:

- a. The EUT was set up for the maximum power with LTE link data modulation and link up with simulator.
- b. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

### 3.1.3 TEST SETUP

#### CONDUCTED POWER MEASUREMENT:



For the actual test configuration, please refer to the attached file (Test Setup Photo).

### 3.1.4 TEST RESULTS

#### AVERAGE CONDUCTED OUTPUT POWER (dBm)

Base on verify the Conducted Power is the same with module test report (RXA1706-0399RF03R1) by lab, the test results please refer the module Report No.: RXA1706-0199RF03R1, and the pre-scan data as below.

#### LTE BAND 4

| LTE Band 4 |            |         |           |                         |                         |                         |     |
|------------|------------|---------|-----------|-------------------------|-------------------------|-------------------------|-----|
| BW         | Modulation | RB Size | RB Offset | Low CH<br>19957         | Mid CH<br>18900         | High CH<br>19193        | MPR |
|            |            |         |           | Frequency<br>1710.7 MHz | Frequency<br>1732.5 MHz | Frequency<br>1754.3 MHz |     |
| 1.4        | QPSK       | 1       | 0         | 22.50                   | 22.48                   | 22.57                   | 0   |
|            |            | 1       | 3         | 22.42                   | 22.33                   | 22.47                   | 0   |
|            |            | 1       | 5         | 22.82                   | 22.74                   | 22.90                   | 0   |
|            |            | 3       | 0         | 22.83                   | 22.76                   | 22.80                   | 0   |
|            |            | 3       | 2         | 22.60                   | 22.37                   | 22.75                   | 0   |
|            |            | 3       | 3         | 22.37                   | 22.17                   | 22.53                   | 0   |
|            |            | 6       | 0         | 22.28                   | 22.04                   | 22.44                   | 0   |
|            | 16QAM      | 1       | 0         | 22.66                   | 22.47                   | 22.81                   | 0   |
|            |            | 1       | 3         | 22.67                   | 22.56                   | 22.86                   | 0   |
|            |            | 1       | 5         | 22.55                   | 22.41                   | 22.72                   | 0   |
|            |            | 3       | 0         | 22.50                   | 22.48                   | 22.57                   | 0   |
|            |            | 3       | 2         | 22.42                   | 22.33                   | 22.47                   | 0   |
|            |            | 3       | 3         | 22.82                   | 22.74                   | 22.90                   | 0   |
|            |            | 6       | 0         | 22.83                   | 22.76                   | 22.80                   | 0   |



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**LTE BAND 12**

| LTE Band 12 |            |         |           |                        |                        |                        |     |
|-------------|------------|---------|-----------|------------------------|------------------------|------------------------|-----|
| BW          | Modulation | RB Size | RB Offset | Low CH<br>23017        | Mid CH<br>23095        | High CH<br>23173       | MPR |
|             |            |         |           | Frequency<br>699.7 MHz | Frequency<br>707.5 MHz | Frequency<br>715.3 MHz |     |
| 1.4         | QPSK       | 1       | 0         | 23.03                  | 23.21                  | 23.05                  | 0   |
|             |            | 1       | 3         | 23.05                  | 23.16                  | 23.05                  | 0   |
|             |            | 1       | 5         | 23.15                  | 23.27                  | 23.18                  | 0   |
|             |            | 3       | 0         | 23.13                  | 23.26                  | 23.05                  | 0   |
|             |            | 3       | 2         | 23.09                  | 23.18                  | 23.07                  | 0   |
|             |            | 3       | 3         | 23.04                  | 23.16                  | 23.03                  | 0   |
|             | 16QAM      | 6       | 0         | 23.04                  | 23.12                  | 23.03                  | 0   |
|             |            | 1       | 0         | 23.15                  | 23.28                  | 23.13                  | 0   |
|             |            | 1       | 3         | 23.04                  | 23.25                  | 23.06                  | 0   |
|             |            | 1       | 5         | 23.02                  | 23.20                  | 23.02                  | 0   |
|             |            | 3       | 0         | 23.03                  | 23.21                  | 23.05                  | 0   |
|             |            | 3       | 2         | 23.05                  | 23.16                  | 23.05                  | 0   |
|             |            | 3       | 3         | 23.15                  | 23.27                  | 23.18                  | 0   |
|             |            | 6       | 0         | 23.13                  | 23.26                  | 23.05                  | 0   |

**LTE BAND 13**

| LTE Band 13 |            |         |           |                        |                      |                        |     |
|-------------|------------|---------|-----------|------------------------|----------------------|------------------------|-----|
| BW          | Modulation | RB Size | RB Offset | Low CH<br>23205        | Mid CH<br>23230      | High CH<br>23255       | MPR |
|             |            |         |           | Frequency<br>779.5 MHz | Frequency<br>782 MHz | Frequency<br>784.5 MHz |     |
| 5           | QPSK       | 1       | 0         | 23.50                  | 23.48                | 23.50                  | 0   |
|             |            | 1       | 3         | 23.51                  | 23.45                | 23.51                  | 0   |
|             |            | 1       | 5         | 23.54                  | 23.53                | 23.53                  | 0   |
|             |            | 3       | 0         | 23.45                  | 23.52                | 23.48                  | 0   |
|             |            | 3       | 2         | 23.43                  | 23.47                | 23.44                  | 0   |
|             |            | 3       | 3         | 23.45                  | 23.47                | 23.50                  | 0   |
|             | 16QAM      | 6       | 0         | 23.41                  | 23.47                | 23.44                  | 0   |
|             |            | 1       | 0         | 23.48                  | 23.50                | 23.48                  | 0   |
|             |            | 1       | 3         | 23.45                  | 23.49                | 23.45                  | 0   |
|             |            | 1       | 5         | 23.39                  | 23.38                | 23.40                  | 0   |
|             |            | 3       | 0         | 23.50                  | 23.48                | 23.50                  | 0   |
|             |            | 3       | 2         | 23.51                  | 23.45                | 23.51                  | 0   |
|             |            | 3       | 3         | 23.54                  | 23.53                | 23.53                  | 0   |
|             |            | 6       | 0         | 23.45                  | 23.52                | 23.48                  | 0   |

## 3.2 FREQUENCY STABILITY MEASUREMENT

### 3.2.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

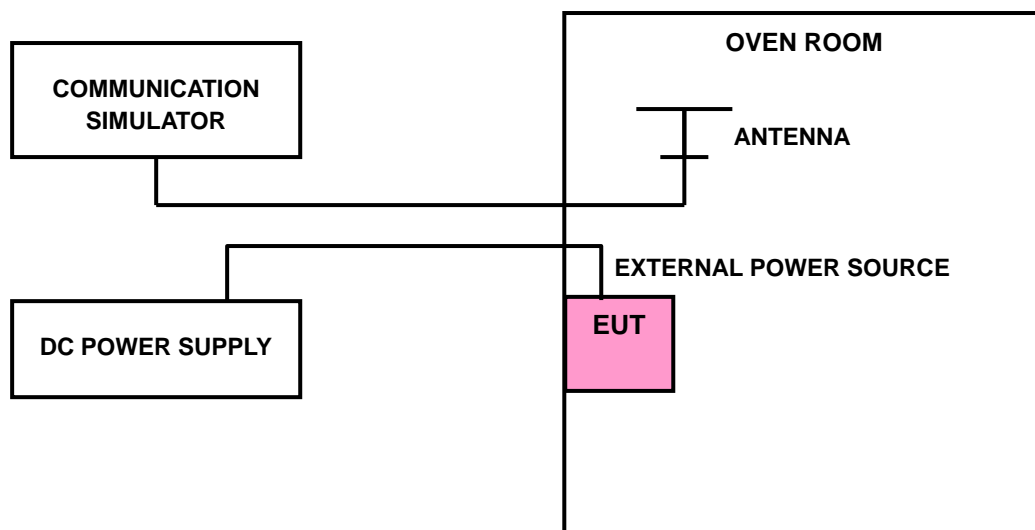
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

### 3.2.2 TEST PROCEDURE

- Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.
- EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.
- The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the  $\pm 0.5^{\circ}\text{C}$  during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

**NOTE:** The frequency error was recorded frequency error from the communication simulator.

### 3.2.3 TEST SETUP







Test Report No.: RFA210305W001-3

### 3.2.4 TEST RESULTS

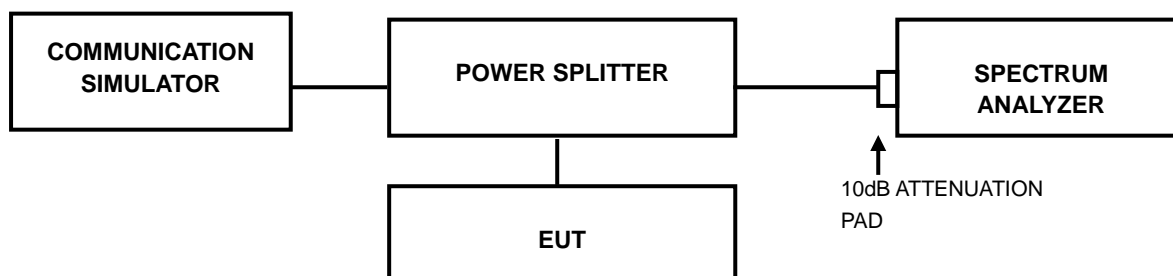
The test results was recorded in Report No.: RXA1706-0199RF03R1.

### 3.3 OCCUPIED BANDWIDTH MEASUREMENT

#### 3.3.1 LIMITS OF OCCUPIED BANDWIDTH MEASUREMENT

The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

#### 3.3.2 TEST SETUP



#### 3.3.3 TEST PROCEDURES

- The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

#### 3.3.4 TEST RESULTS

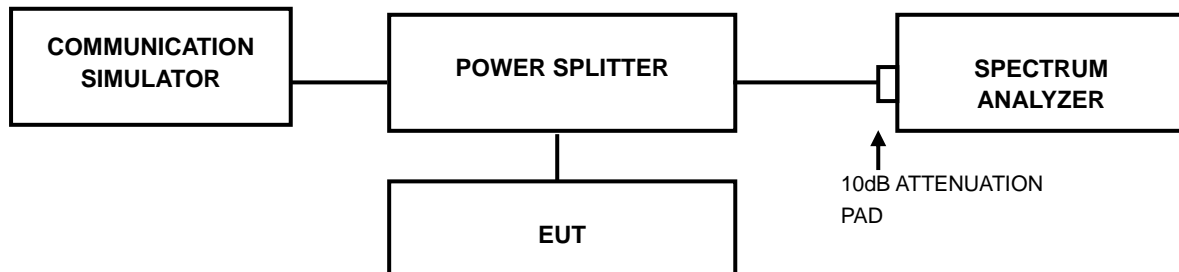
The test results was recorded in Report No.: RXA1706-0199RF03R1.

### 3.4 PEAK TO AVERAGE RATIO

#### 3.4.1 LIMITS OF PEAK TO AVERAGE RATIO MEASUREMENT

In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB

#### 3.4.2 TEST SETUP



#### 3.4.3 TEST PROCEDURES

1. Set resolution/measurement bandwidth  $\geq$  signal's occupied bandwidth;
2. Set the number of counts to a value that stabilizes the measured CCDF curve;
3. Record the maximum PAPR level associated with a probability of 0.1%.

#### 3.4.4 TEST RESULTS

The test results was recorded in Report No.: RXA1706-0199RF03R1.

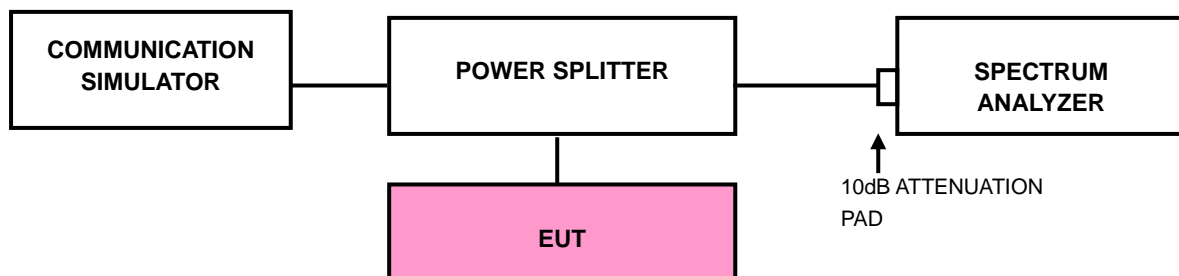
### 3.5 BAND EDGE MEASUREMENT

#### 3.5.1 LIMITS OF BAND EDGE MEASUREMENT

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log (P)$  dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater.

However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

#### 3.5.2 TEST SETUP





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### 3.5.3 TEST PROCEDURES

- a. The EUT was set up for the maximum peak power with LTE link data modulation. The power was measured with R&S Spectrum Analyzer. All measurements were done at 2 channels (low and high operational frequency range.).
- b. The band edge measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- c. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 20kHz and VBW of the spectrum is 100 kHz. (LTE bandwidth 1.4MHz)
- d. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 30kHz and VBW of the spectrum is 100kHz. (LTE bandwidth 3MHz)
- e. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 50kHz and VBW of the spectrum is 200kHz. (LTE bandwidth 5MHz)
- f. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 100kHz and VBW of the spectrum is 300kHz. (LTE bandwidth 10MHz)
- g. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 200kHz and VBW of the spectrum is 1MHz. (LTE bandwidth 15MHz)
- h. The center frequency of spectrum is the band edge frequency and span is 1~5 MHz. RBW of the spectrum is 200kHz and VBW of the spectrum is 1MHz. (LTE bandwidth 20MHz)
- i. Record the max trace plot into the test report.

### 3.5.4 TEST RESULTS

The test results was recorded in Report No.: RXA1706-0199RF03R1.

### 3.6 CONDUCTED SPURIOUS EMISSIONS

#### 3.6.1 LIMITS OF CONDUCTED SPURIOUS EMISSIONS MEASUREMENT

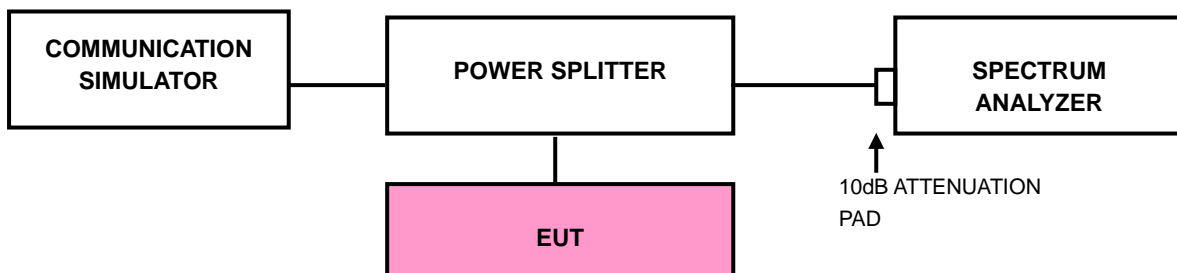
The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log_{10}(P)$  dB. The limit of emission equal to  $-13\text{dBm}$

On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than  $65 + 10 \log(P)$  dB in a 6.25 kHz band segment, for mobile and portable stations.

#### 3.6.2 TEST PROCEDURE

- a. The EUT makes a phone call to the communication simulator. All measurements were done at middle operational frequency range.
- b. Measuring frequency range is from 30 MHz to 19.1GHz for WCDMA Band 4 & LTE Band 4, and 30 MHz to 9GHz for LTE Band 13. 10dB attenuation pad is connected with spectrum. RBW=1MHz and VBW=3MHz are used for conducted emission measurement.

#### 3.6.3 TEST SETUP



#### 3.6.4 TEST RESULTS

The test results was recorded in Report No.: RXA1706-0199RF03R1.



### 3.7 RADIATED EMISSION MEASUREMENT

#### 3.7.1 LIMITS OF RADIATED EMISSION MEASUREMENT

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log_{10}(P)$  dB. The limit of emission equal to  $-13\text{dBm}$

#### 3.7.2 TEST PROCEDURES

- a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- b. The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value" of step a. Record the power level of S.G
- c.  $\text{EIRP} = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn.}$
- d. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole,  $\text{E.R.P power} = \text{E.I.P.R power} - 2.15\text{dBi.}$

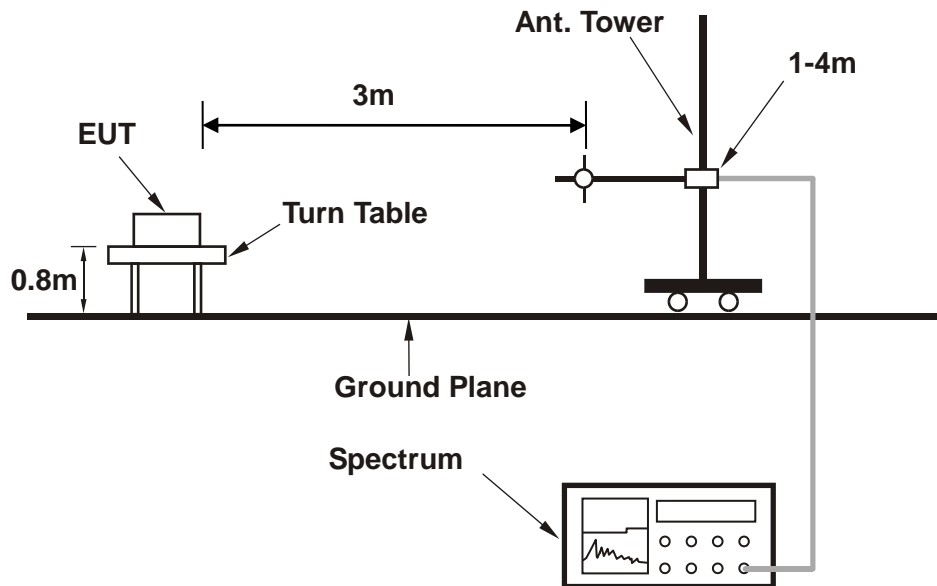
**NOTE:** The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

#### 3.7.3 DEVIATION FROM TEST STANDARD

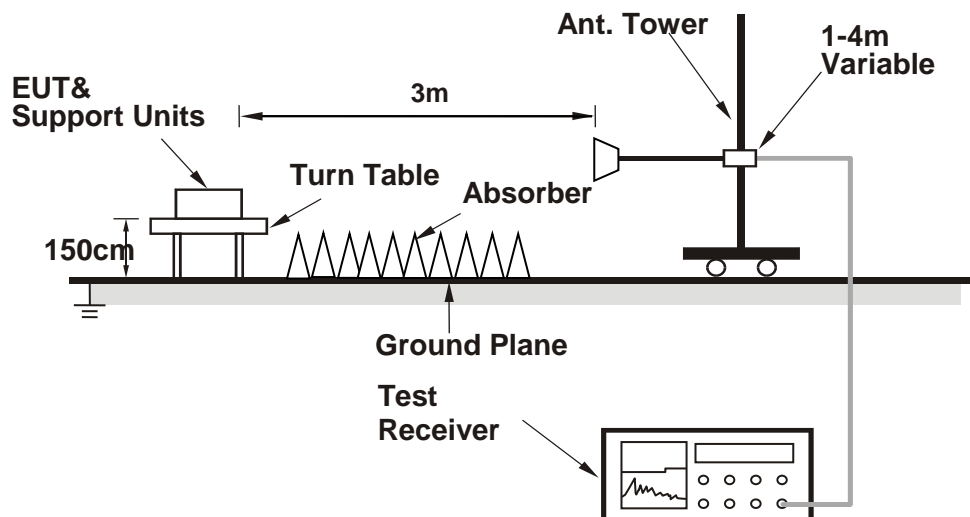
No deviation

### 3.7.4 TEST SETUP

#### < Frequency Range 30MHz~1GHz >



#### < Frequency Range above 1GHz >



For the actual test configuration, please refer to the attached file (Test Setup Photo).





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### 3.7.5 TEST RESULTS

#### BELOW 1GHz WORST-CASE DATA

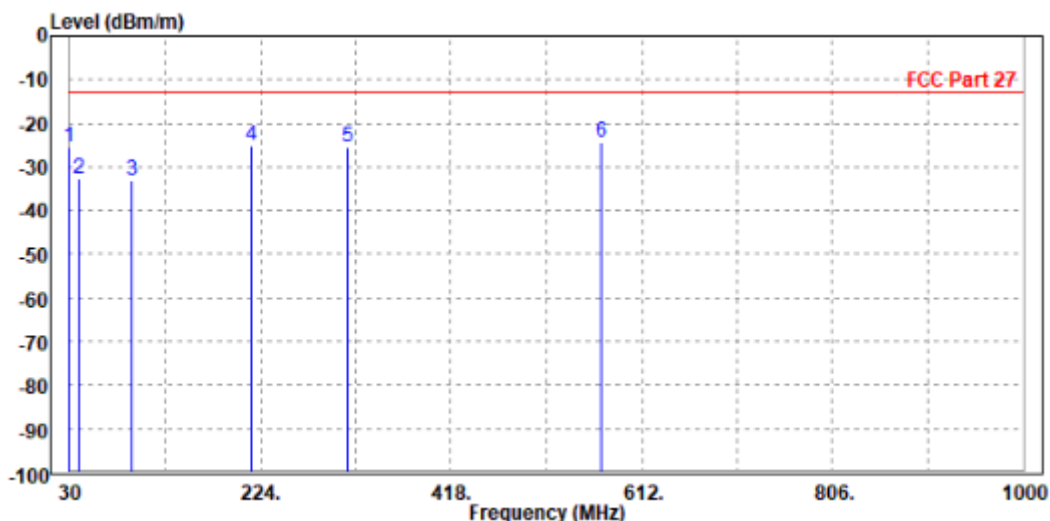
30 MHz – 1GHz data:

LTE BAND 13

CHANNEL BANDWIDTH: 10M / QPSK

|  |                  |                        |                     |
|--|------------------|------------------------|---------------------|
| <b>MODE</b>  | TX channel 23230 | <b>FREQUENCY RANGE</b> | Below 1000MHz       |
| <b>ENVIRONMENTAL CONDITIONS</b>                                | 23deg. C, 70%RH  | <b>INPUT POWER</b>     | DC 12V from adapter |
| <b>TESTED BY</b>   | Jace             |                        |                     |
| <b>ANTENNA POLARITY &amp; TEST DISTANCE: HORIZONTAL AT 3 M</b> |                  |                        |                     |

|      | Freq    | Level  | Read Level | Limit Line | Over Limit | Factor | Remark | Pol/Phase  |
|------|---------|--------|------------|------------|------------|--------|--------|------------|
|      | MHz     | dBm/m  | dBm        | dBm/m      | dB         | dB/m   |        |            |
| 1    | 30.000  | -25.38 | -46.28     | -13.00     | -12.38     | 20.90  | Peak   | Horizontal |
| 2    | 39.700  | -32.86 | -46.75     | -13.00     | -19.86     | 13.89  | Peak   | Horizontal |
| 3    | 93.050  | -32.97 | -41.51     | -13.00     | -19.97     | 8.54   | Peak   | Horizontal |
| 4    | 214.300 | -25.00 | -36.00     | -13.00     | -12.00     | 11.00  | Peak   | Horizontal |
| 5    | 312.270 | -25.51 | -39.50     | -13.00     | -12.51     | 13.99  | Peak   | Horizontal |
| 6 PP | 571.260 | -24.39 | -44.09     | -13.00     | -11.39     | 19.70  | Peak   | Horizontal |

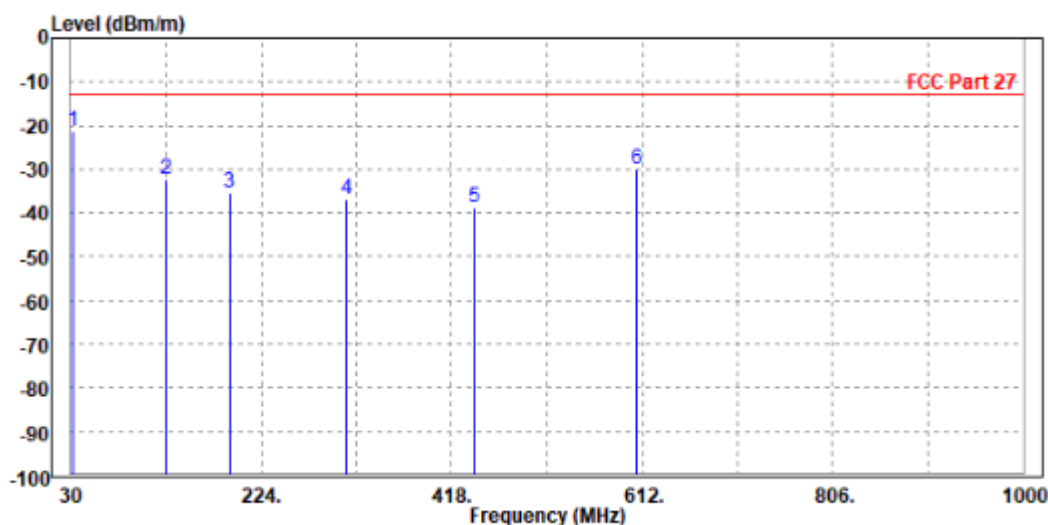




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|  |                  |                        |                     |
|--|------------------|------------------------|---------------------|
| <b>MODE</b>  | TX channel 23230 | <b>FREQUENCY RANGE</b> | Below 1000MHz       |
| <b>ENVIRONMENTAL CONDITIONS</b>                              | 23deg. C, 70%RH  | <b>INPUT POWER</b>     | DC 12V from adapter |
| <b>TESTED BY</b>   | Jace Hu          |                        |                     |
| <b>ANTENNA POLARITY &amp; TEST DISTANCE: VERTICAL AT 3 M</b> |                  |                        |                     |

|      | Freq    | Level  | Read Level | Limit Line | Over Limit | Factor | Remark | Pol/Phase |
|------|---------|--------|------------|------------|------------|--------|--------|-----------|
|      | MHz     | dBm/m  | dBm        | dBm/m      | dB         | dB/m   |        |           |
| 1 PP | 31.940  | -21.12 | -41.05     | -13.00     | -8.12      | 19.93  | Peak   | Vertical  |
| 2    | 127.000 | -32.30 | -39.62     | -13.00     | -19.30     | 7.32   | Peak   | Vertical  |
| 3    | 191.990 | -35.38 | -45.34     | -13.00     | -22.38     | 9.96   | Peak   | Vertical  |
| 4    | 311.300 | -36.79 | -50.75     | -13.00     | -23.79     | 13.96  | Peak   | Vertical  |
| 5    | 440.310 | -38.63 | -56.40     | -13.00     | -25.63     | 17.77  | Peak   | Vertical  |
| 6    | 606.180 | -30.01 | -50.09     | -13.00     | -17.01     | 20.08  | Peak   | Vertical  |





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**ABOVE 1GHz**

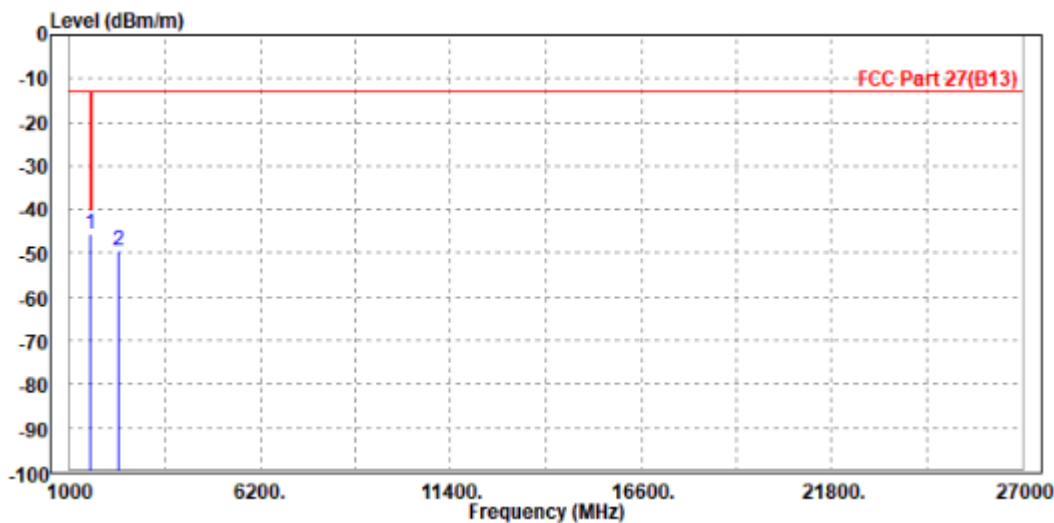
**Note:** For higher frequency, the emission is too low to be detected.

**LTE BAND 13**

**CHANNEL BANDWIDTH: 10MHz / QPSK**

|  |                  |                        |                     |
|--|------------------|------------------------|---------------------|
| <b>MODE</b>  | TX channel 23230 | <b>FREQUENCY RANGE</b> | Above 1000MHz       |
| <b>ENVIRONMENTAL CONDITIONS</b>                                | 23deg. C, 70%RH  | <b>INPUT POWER</b>     | DC 12V from adapter |
| <b>TESTED BY</b>   | Jace Hu          |                        |                     |
| <b>ANTENNA POLARITY &amp; TEST DISTANCE: HORIZONTAL AT 3 M</b> |                  |                        |                     |

|   | Freq        | Level  | Read Level | Limit Line | Over Limit | Factor | Remark | Pol/Phase  |
|---|-------------|--------|------------|------------|------------|--------|--------|------------|
|   | MHz         | dBm/m  | dBm        | dBm/m      | dB         | dB/m   |        |            |
| 1 | PP 1572.000 | -45.60 | -47.92     | -40.00     | -5.60      | 2.32   | Peak   | Horizontal |
| 2 | 2346.000    | -49.52 | -57.42     | -13.00     | -36.52     | 7.90   | Peak   | Horizontal |

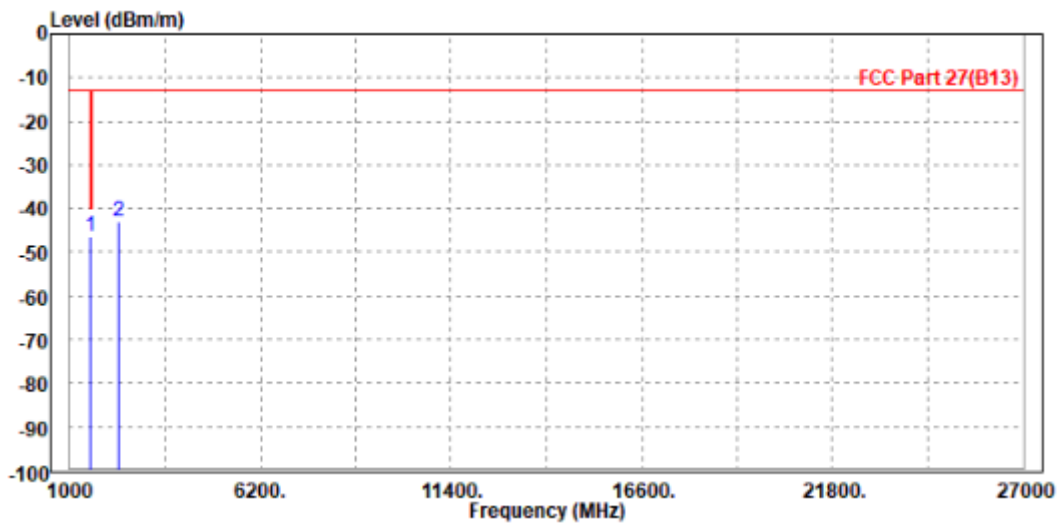




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|  |                  |                        |                     |
|--|------------------|------------------------|---------------------|
| <b>MODE</b>  | TX channel 23230 | <b>FREQUENCY RANGE</b> | Above 1000MHz       |
| <b>ENVIRONMENTAL CONDITIONS</b>                              | 23deg. C, 70%RH  | <b>INPUT POWER</b>     | DC 12V from adapter |
| <b>TESTED BY</b>   | Jace Hu          |                        |                     |
| <b>ANTENNA POLARITY &amp; TEST DISTANCE: VERTICAL AT 3 M</b> |                  |                        |                     |

|   |    | Freq     | Level  | Read Level | Limit Line | Over Limit | Factor | Remark | Pol/Phase |
|---|----|----------|--------|------------|------------|------------|--------|--------|-----------|
|   |    | MHz      | dBm/m  | dBm        | dBm/m      | dB         | dB/m   |        |           |
| 1 | PP | 1572.000 | -46.52 | -49.22     | -40.00     | -6.52      | 2.70   | Peak   | Vertical  |
| 2 |    | 2346.000 | -42.99 | -49.90     | -13.00     | -29.99     | 6.91   | Peak   | Vertical  |





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## 4 INFORMATION ON THE TESTING LABORATORIES

We, BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO. LTD., were founded in 2015 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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**Email:** [customerservice.dg@cn.bureauveritas.com](mailto:customerservice.dg@cn.bureauveritas.com)

**Web Site:** [www.adt.com.tw](http://www.adt.com.tw)

The address and road map of all our labs can be found in our web site also.



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## 5 APPENDIX A – MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No modifications were made to the EUT by the lab during the test.

---END---