

FCC Test Report

(PART 27)

Report No.: RF161117C09-3

FCC ID: XHG-R872

Test Model: R872

Received Date: Nov. 17, 2016

Test Date: Jan. 06, 2017 ~ Jan. 18, 2017

Issued Date: Jan. 24, 2017

Applicant: Franklin Technology Inc.

Address: 906 JEI Platz, 186, Gasan digital 1-ro, Geumcheon-gu, Seoul, Korea, (08502)

Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan (R.O.C.)

Test Location: No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)



This report is 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. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, 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. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agency.

Table of Contents

| | |
|---|-----------|
| Release Control Record | 3 |
| 1 Certificate of Conformity | 4 |
| 2 Summary of Test Results..... | 5 |
| 2.1 Measurement Uncertainty..... | 5 |
| 2.2 Test Site and Instruments | 6 |
| 3 General Information | 8 |
| 3.1 General Description of EUT | 8 |
| 3.2 Configuration of System under Test..... | 9 |
| 3.2.1 Description of Support Units..... | 9 |
| 3.3 Test Mode Applicability and Tested Channel Detail | 10 |
| 3.4 EUT Operating Conditions | 11 |
| 3.5 General Description of Applied Standards..... | 11 |
| 4 Test Types and Results | 12 |
| 4.1 Output Power Measurement..... | 12 |
| 4.1.1 Limits of Output Power Measurement..... | 12 |
| 4.1.2 Test Procedures..... | 12 |
| 4.1.3 Test Setup..... | 13 |
| 4.1.4 Test Results | 14 |
| 4.2 Frequency Stability Measurement | 16 |
| 4.2.1 Limits of Frequency Stability Measurement..... | 16 |
| 4.2.2 Test Procedure | 16 |
| 4.2.3 Test Setup..... | 16 |
| 4.2.4 Test Results | 17 |
| 4.3 Occupied Bandwidth Measurement..... | 19 |
| 4.3.1 Limits of Occupied Bandwidth Measurement | 19 |
| 4.3.2 Test Procedure | 19 |
| 4.3.3 Test Setup..... | 19 |
| 4.3.4 Test Result | 20 |
| 4.4 Band Edge Measurement..... | 21 |
| 4.4.1 Limits of Band Edge Measurement | 21 |
| 4.4.2 Test Setup..... | 21 |
| 4.4.3 Test Procedures..... | 21 |
| 4.4.4 Test Results | 22 |
| 4.5 Peak to Average Ratio | 26 |
| 4.5.1 Limits of Peak to Average Ratio Measurement | 26 |
| 4.5.2 Test Setup..... | 26 |
| 4.5.3 Test Procedures..... | 26 |
| 4.5.4 Test Results | 27 |
| 4.6 Conducted Spurious Emissions..... | 28 |
| 4.6.1 Limits of Conducted Spurious Emissions Measurement..... | 28 |
| 4.6.2 Test Setup..... | 28 |
| 4.6.3 Test Procedure | 28 |
| 4.6.4 Test Results | 29 |
| 4.7 Radiated Emission Measurement..... | 30 |
| 4.7.1 Limits of Radiated Emission Measurement | 30 |
| 4.7.2 Test Procedure | 30 |
| 4.7.3 Deviation from Test Standard | 30 |
| 4.7.4 Test Setup..... | 30 |
| 4.7.5 Test Results | 31 |
| 5 Pictures of Test Arrangements..... | 35 |
| Appendix – Information on the Testing Laboratories | 36 |

Release Control Record

| Issue No. | Description | Date Issued |
|---------------|------------------|---------------|
| RF161117C09-3 | Original Release | Jan. 24, 2017 |

1 Certificate of Conformity

Product: Mobile Hotspot

Brand: Franklin

Test Model: R872

Sample Status: Production Unit

Applicant: Franklin Technology Inc.

Test Date: Jan. 06, 2017 ~ Jan. 18, 2017

Standards: FCC Part 27, Subpart C, L

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by :

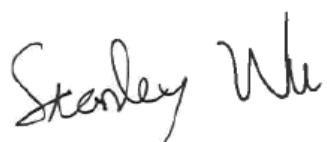


, **Date:**

Jan. 24, 2017

Rona Chen / Specialist

Approved by :



, **Date:**

Jan. 24, 2017

Stanley Wu / Assistant Manager

2 Summary of Test Results

| Applied Standard: FCC Part 27 & Part 2 (LTE 13) | | | |
|---|------------------------------|--------|--|
| FCC Clause | Test Item | Result | Remarks |
| 2.1046 27.50(b)(10) | Maximum Peak Output Power | Pass | Meet the requirement of limit. |
| 2.1055 27.54 | Frequency Stability | Pass | Meet the requirement of limit. |
| 2.1049 27.53(g) | Occupied Bandwidth | Pass | Meet the requirement of limit. |
| 27.50(d)(5) | Peak to Average Ratio | Pass | Meet the requirement of limit. |
| 27.53(g) | Band Edge Measurements | Pass | Meet the requirement of limit. |
| 2.1051 27.53(g) | Conducted Spurious Emissions | Pass | Meet the requirement of limit. |
| 2.1053 27.53(g)(f) | Radiated Spurious Emissions | Pass | Meet the requirement of limit. Minimum passing margin is -7.35 dB at 1564.00 MHz. |

2.1 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 | Frequency | Expended Uncertainty (k=2) (±) |
|------------------------------------|--------------------|--------------------------------|
| Conducted Emissions at mains ports | 150 kHz ~ 30 MHz | 2.44 dB |
| Radiated Emissions up to 1 GHz | 30 MHz ~ 200 MHz | 2.93 dB |
| | 200 MHz ~ 1000 MHz | 2.95 dB |
| Radiated Emissions above 1 GHz | 1 GHz ~ 18 GHz | 2.26 dB |
| | 18 GHz ~ 40 GHz | 1.94 dB |

2.2 Test Site and Instruments

| Description & Manufacturer | Model No. | Serial No. | Date of Calibration | Due Date of Calibration |
|--|----------------|---------------------|---------------------|-------------------------|
| Test Receiver Agilent | N9038A | MY51210203 | Jan. 21, 2016 | Jan. 20, 2017 |
| Spectrum Analyzer Agilent | N9010A | MY52220314 | Dec. 16, 2016 | Dec. 15, 2017 |
| Spectrum Analyzer ROHDE & SCHWARZ | FSU43 | 101261 | Dec. 13, 2016 | Dec. 12, 2017 |
| BILOG Antenna SCHWARZBECK | VULB9168 | 9168-472 | Dec. 26, 2016 | Dec. 27, 2017 |
| HORN Antenna SCHWARZBECK | BBHA 9120 D | 9120D-969 | Dec. 12, 2016 | Dec. 13, 2017 |
| Double Ridge Guide Horn Antenna EMC | 3115 | 5619 | Dec. 26, 2016 | Dec. 27, 2017 |
| BILOG Antenna SCHWARZBECK | VULB 9168 | 9168-153 | Dec. 12, 2016 | Dec. 13, 2017 |
| Fixed Attenuator Mini-Circuits | BW-N10W5+ | NA | Jul. 08, 2016 | Jul. 07, 2017 |
| MXG Vector signal generator Agilent | N5182B | MY53050430 | Oct. 19, 2016 | Oct. 18, 2017 |
| Preamplifier EMCI | EMC 012645 | 980115 | Oct. 21, 2016 | Oct. 20, 2017 |
| Preamplifier EMCI | EMC 184045 | 980116 | Oct. 21, 2016 | Oct. 20, 2017 |
| Preamplifier EMCI | EMC 330H | 980112 | Oct. 21, 2016 | Oct. 20, 2017 |
| Power Meter Anritsu | ML2495A | 1232002 | Sep. 08, 2016 | Sep. 07, 2017 |
| Power Sensor Anritsu | MA2411B | 1207325 | Sep. 08, 2016 | Sep. 07, 2017 |
| RF signal cable HUBER+SUHNNER | SUCOFLEX 104 | 309219/4 2950114 | Oct. 21, 2016 | Oct. 20, 2017 |
| RF signal cable HUBER+SUHNNER | SUCOFLEX 104 | 250130/4 | Oct. 21, 2016 | Oct. 20, 2017 |
| RF Coaxial Cable Worken | 8D-FB | Cable-Ch10-01 | Oct. 21, 2016 | Oct. 20, 2017 |
| Software BV ADT | E3 6.120103 | NA | NA | NA |
| Antenna Tower MF | MFA-440H | NA | NA | NA |
| Turn Table MF | MFT-201SS | NA | NA | NA |
| Antenna Tower & Turn Table Controller MF | MF-7802 | NA | NA | NA |
| Fixed Attenuator Mini-Circuits | BW-N10W5+ | NA | Jul. 08, 2016 | Jul. 07, 2017 |
| Radio Communication Analyzer | MT8820C | 6201300640 | Aug. 10, 2015 | Aug. 09, 2017 |
| Communications Tester-Wireless | 8960 Series 10 | MY53201073 | Jul. 03, 2015 | Jul. 02, 2017 |

Note:

1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The FCC Site Registration No. is 690701.
5. The IC Site Registration No. is IC7450F-10.

3 General Information

3.1 General Description of EUT

| | | |
|----------------------------|---|-------------------|
| Product | Mobile Hotspot | |
| Brand | Franklin | |
| Test Model | R872 | |
| Status of EUT | Production Unit | |
| Power Supply Rating | 5.0 Vdc (adapter or host equipment) 3.8 Vdc (Li-ion battery) | |
| Modulation Type | LTE | QPSK, 16QAM |
| Frequency Range | LTE Band 13 (Channel Bandwidth: 5 MHz) | 779.5 ~ 784.5 MHz |
| | LTE Band 13 (Channel Bandwidth: 10 MHz) | 782.0 MHz |
| Emission Designator | LTE Band 13 (Channel Bandwidth: 5 MHz) | 4M49W7D |
| | LTE Band 13 (Channel Bandwidth: 10 MHz) | 8M96W7D |
| Max. ERP Power | LTE Band 13 (Channel Bandwidth: 5 MHz) | 76.91mW |
| | LTE Band 13 (Channel Bandwidth: 10 MHz) | 77.98mW |
| Antenna Type | Fixed Internal Antenna | |
| Accessory Device | Refer to Note as below | |
| Data Cable Supplied | Refer to Note as below | |

Note:

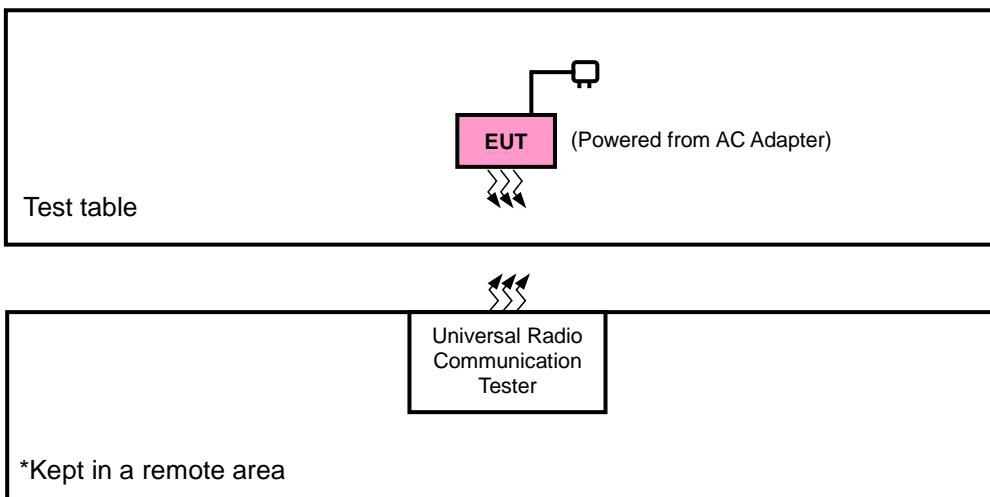
1. The EUT contains following accessory devices.

| Product | Brand | Model | Description |
|---------|-------------------|------------|---|
| Adapter | Franklin Wireless | FWCR900TVL | I/P: 100-240 Vac, 0.3 A O/P: 5 Vdc, 1 A 1.5 m cable non-shielded cable w/o core |
| Battery | Franklin Wireless | R871 | 3.8 Vdc, 2450 mAh |

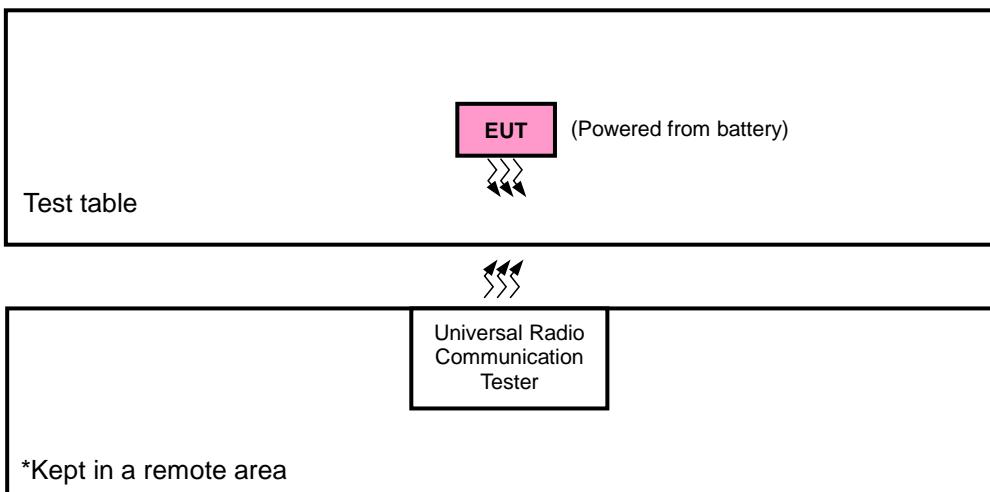
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Configuration of System under Test

<Radiated Emission Test>



<E.R.P. / E.I.R.P. Test>



3.2.1 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.3 Test Mode Applicability and Tested Channel Detail

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 was found when positioned as the table below. Following channel(s) was (were) selected for the final test as listed below:

| Band | ERP / EIRP | Radiated Emission |
|-------------|------------|-------------------|
| LTE Band 13 | Y-plane | X-axis |

LTE Band 13

| EUT Configure Mode | Test Item | Available Channel | Tested Channel | Channel Bandwidth | Modulation | Mode |
|--------------------|-----------------------|-------------------|---------------------|-------------------|-------------|---------------------|
| - | ERP | 23205 to 23255 | 23205, 23230, 23255 | 5 MHz | QPSK | 1 RB / 12 RB Offset |
| | | 23230 | 23230 | | 16QAM | 1 RB / 24 RB Offset |
| | Frequency Stability | 23205 to 23255 | 23205, 23255 | 10 MHz | QPSK | 1 RB / 49 RB Offset |
| | | 23230 | 23230 | | 16QAM | 1 RB / 24 RB Offset |
| - | Occupied Bandwidth | 23205 to 23255 | 23205, 23230, 23255 | 5 MHz | QPSK, 16QAM | 25 RB / 0 RB Offset |
| | | 23230 | 23230 | 10 MHz | QPSK, 16QAM | 50 RB / 0 RB Offset |
| - | Peak to Average Ratio | 23205 to 23255 | 23205, 23230, 23255 | 5 MHz | QPSK, 16QAM | 1 RB / 12 RB Offset |
| | | 23230 | 23230 | 10 MHz | QPSK, 16QAM | 1 RB / 49 RB Offset |
| - | Band Edge | 23205 to 23255 | 23205 | 5 MHz | QPSK | 1 RB / 0 RB Offset |
| | | | 23255 | 5 MHz | QPSK | 25 RB / 0 RB Offset |
| | | 23230 | 23230 | 10 MHz | QPSK | 1 RB / 24 RB Offset |
| | | | 23230 | 10 MHz | QPSK | 50 RB / 0 RB Offset |
| | Conducted Emission | 23205 to 23255 | 23205, 23230, 23255 | 5 MHz | QPSK | 1 RB / 12 RB Offset |
| | | 23230 | 23230 | 10 MHz | QPSK | 1 RB / 49 RB Offset |
| | Radiated Emission | 23230 | 23230 | 10 MHz | QPSK | 1 RB / 0 RB Offset |
| | | | | | | 50 RB / 0 RB Offset |

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 |
|-----------------------|--------------------------|----------------|-------------|
| ERP / EIRP | 25 deg. C, 65 % RH | 3.8 Vdc | Getaz Yang |
| Frequency Stability | 25 deg. C, 65 % RH | 3.8 Vdc | Carlos Chen |
| Occupied Bandwidth | 25 deg. C, 65 % RH | 3.8 Vdc | Carlos Chen |
| Band Edge | 25 deg. C, 65 % RH | 3.8 Vdc | Carlos Chen |
| Peak to Average Ratio | 25 deg. C, 65 % RH | 3.8 Vdc | Carlos Chen |
| Conducted Emission | 25 deg. C, 65 % RH | 3.8 Vdc | Carlos Chen |
| Radiated Emission | 25 deg. C, 65 % RH | 120 Vac, 60 Hz | Getaz Yang |

3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

3.5 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 v02r02

ANSI/TIA/EIA-603-D 2010

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

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 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 776-787 MHz band are limited to 3 watts ERP

4.1.2 Test Procedures

EIRP / ERP Measurement:

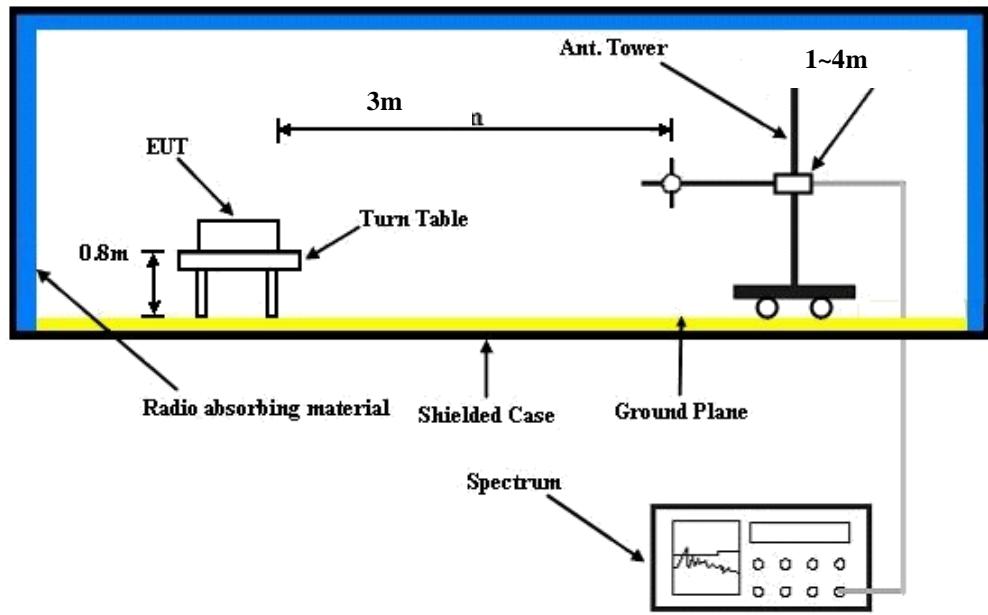
- a. All measurements were done at low, middle and high operational frequency range. RBW and VBW is 5 MHz for WCDMA and 10 MHz for LTE mode.
- b. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
- c. 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 b. Record the power level of S.G.
- d. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn. E.R.P power can be calculated from E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.P.R power - 2.15 dBi.

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.

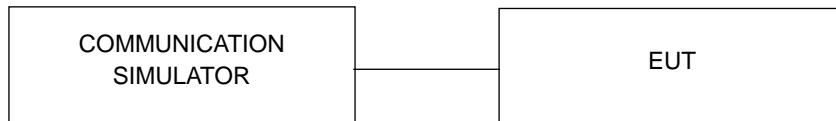
4.1.3 Test Setup

EIRP / ERP Measurement:



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

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

| Band / BW | RB Size | RB Offset | QPSK | | | 3GPP MPR (dB) | 16QAM | | | 3GPP MPR (dB) |
|-----------|---------|-----------|--------------|--------------|---------------|---------------|--------------|--------------|---------------|---------------|
| | | | Low Ch 23205 | Mid Ch 23230 | High Ch 23255 | | Low Ch 23205 | Mid Ch 23230 | High Ch 23255 | |
| | | | 779.5 MHz | 782.0 MHz | 784.5 MHz | | 779.5 MHz | 782.0 MHz | 784.5 MHz | |
| 13 / 5M | 1 | 0 | 22.60 | 22.37 | 22.68 | 0 | 21.20 | 21.22 | 21.21 | 1 |
| | 1 | 12 | 22.96 | 22.69 | 22.98 | 0 | 21.31 | 21.30 | 21.37 | 1 |
| | 1 | 24 | 22.89 | 22.61 | 22.77 | 0 | 21.28 | 21.27 | 21.46 | 1 |
| | 12 | 0 | 21.54 | 21.44 | 21.45 | 1 | 20.55 | 20.56 | 20.41 | 2 |
| | 12 | 6 | 21.62 | 21.59 | 21.62 | 1 | 20.48 | 20.59 | 20.65 | 2 |
| | 12 | 13 | 21.60 | 21.38 | 21.59 | 1 | 20.49 | 20.50 | 20.55 | 2 |
| | 25 | 0 | 21.53 | 21.50 | 21.53 | 1 | 20.58 | 20.60 | 20.65 | 2 |

| Band / BW | RB Size | RB Offset | QPSK | | 3GPP MPR (dB) | 16QAM | | 3GPP MPR (dB) | |
|-----------|---------|-----------|--------------|-----------|---------------|--------------|--------------|---------------|--|
| | | | Mid Ch 23230 | | | Mid Ch 23230 | Mid Ch 23230 | | |
| | | | 782.0 MHz | 782.0 MHz | | 782.0 MHz | 782.0 MHz | | |
| 13 / 10M | 1 | 0 | 22.44 | | 0 | 21.08 | | 1 | |
| | 1 | 24 | 22.48 | | 0 | 21.26 | | 1 | |
| | 1 | 49 | 22.52 | | 0 | 21.2 | | 1 | |
| | 25 | 0 | 21.46 | | 1 | 20.39 | | 2 | |
| | 25 | 12 | 21.41 | | 1 | 20.54 | | 2 | |
| | 25 | 25 | 21.52 | | 1 | 20.63 | | 2 | |
| | 50 | 0 | 21.39 | | 1 | 20.55 | | 2 | |

ERP Power (dBm)

| LTE Band 13 | | | | | | | |
|----------------------------------|---------|-----------------|-----------|------------------------|-----------|----------|--------------------|
| Channel Bandwidth: 5 MHz / QPSK | | | | | | | |
| Plane | Channel | Frequency (MHz) | LVL (dBm) | Correction Factor (dB) | ERP (dBm) | ERP (mW) | Polarization (H/V) |
| Y | 23205 | 779.5 | -11.36 | 32.24 | 18.73 | 74.64 | H |
| | 23230 | 782.0 | -11.16 | 32.17 | 18.86 | 76.91 | |
| | 23255 | 784.5 | -11.18 | 32.11 | 18.78 | 75.51 | |
| | 23205 | 779.5 | -17.25 | 32.43 | 13.03 | 20.09 | V |
| | 23230 | 782.0 | -17.18 | 32.42 | 13.09 | 20.37 | |
| | 23255 | 784.5 | -17.25 | 32.46 | 13.06 | 20.23 | |
| Channel Bandwidth: 5 MHz / 16QAM | | | | | | | |
| Y | 23205 | 779.5 | -11.99 | 32.24 | 18.10 | 64.57 | H |
| | 23230 | 782.0 | -11.89 | 32.17 | 18.13 | 65.01 | |
| | 23255 | 784.5 | -11.88 | 32.11 | 18.08 | 64.27 | |
| | 23205 | 779.5 | -18.49 | 32.43 | 11.79 | 15.10 | V |
| | 23230 | 782.0 | -18.43 | 32.42 | 11.84 | 15.28 | |
| | 23255 | 784.5 | -18.55 | 32.46 | 11.76 | 15.00 | |

LTE Band 13

| LTE Band 13 | | | | | | | |
|-----------------------------------|---------|-----------------|-----------|------------------------|-----------|----------|--------------------|
| Channel Bandwidth: 10 MHz / QPSK | | | | | | | |
| Plane | Channel | Frequency (MHz) | LVL (dBm) | Correction Factor (dB) | ERP (dBm) | ERP (mW) | Polarization (H/V) |
| Y | 23230 | 782.0 | -11.10 | 32.17 | 18.92 | 77.98 | H |
| | 23230 | 782.0 | -17.14 | 32.42 | 13.13 | 20.56 | V |
| Channel Bandwidth: 10 MHz / 16QAM | | | | | | | |
| Y | 23230 | 782.0 | -11.79 | 32.17 | 18.23 | 66.53 | H |
| | 23230 | 782.0 | -18.29 | 32.42 | 11.98 | 15.78 | V |

4.2 Frequency Stability Measurement

4.2.1 Limits of Frequency Stability Measurement

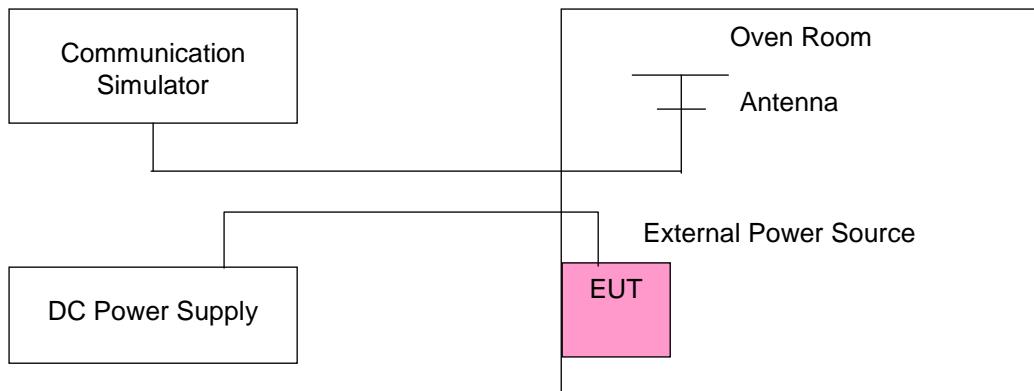
The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

4.2.2 Test Procedure

- a. 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.
- b. 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.
- c. 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.

4.2.3 Test Setup



4.2.4 Test Results

Frequency Error vs. Voltage

| Voltage (Volts) | LTE Band 13 | | | | Limit (ppm) | |
|--------------------|--------------------------|-----------------------|-----------------|-----------------------|-------------|--|
| | Channel Bandwidth: 5 MHz | | | | | |
| | Low Channel | | High Channel | | | |
| | Frequency (MHz) | Frequency Error (ppm) | Frequency (MHz) | Frequency Error (ppm) | | |
| 3.8 | 779.500001 | 0.001 | 784.500001 | 0.002 | 2.5 | |
| 3.5 | 779.500002 | 0.002 | 784.500002 | 0.002 | 2.5 | |
| 4.35 | 779.500001 | 0.002 | 784.500002 | 0.002 | 2.5 | |

Note: The applicant defined the normal working voltage of the battery is from 3.5 Vdc to 4.35 Vdc.

Frequency Error vs. Temperature

| Temp. (°C) | LTE Band 13 | | | | Limit (ppm) | |
|------------|--------------------------|-----------------------|-----------------|-----------------------|-------------|--|
| | Channel Bandwidth: 5 MHz | | | | | |
| | Low Channel | | High Channel | | | |
| | Frequency (MHz) | Frequency Error (ppm) | Frequency (MHz) | Frequency Error (ppm) | | |
| -30 | 779.500002 | 0.003 | 784.500003 | 0.003 | 2.5 | |
| -20 | 779.500002 | 0.002 | 784.500002 | 0.002 | 2.5 | |
| -10 | 779.500003 | 0.004 | 784.500003 | 0.004 | 2.5 | |
| 0 | 779.500004 | 0.004 | 784.500003 | 0.004 | 2.5 | |
| 10 | 779.500002 | 0.002 | 784.500003 | 0.003 | 2.5 | |
| 20 | 779.499999 | -0.002 | 784.499999 | -0.002 | 2.5 | |
| 30 | 779.499998 | -0.003 | 784.499999 | -0.002 | 2.5 | |
| 40 | 779.499997 | -0.004 | 784.499998 | -0.003 | 2.5 | |
| 50 | 779.499998 | -0.002 | 784.499997 | -0.004 | 2.5 | |
| 55 | 779.499997 | -0.004 | 784.499997 | -0.004 | 2.5 | |

Note:

1. The applicant declared that the normal operating temperature of the EUT is from -30°C to 55°C.
2. The EUT would shut down automatically as below -30°C.

Frequency Error vs. Voltage

| Voltage (Volts) | LTE Band 13 | | Limit (ppm) | |
|--------------------|---------------------------|-----------------------|-------------|--|
| | Channel Bandwidth: 10 MHz | | | |
| | Frequency (MHz) | Frequency Error (ppm) | | |
| 3.8 | 782.000002 | 0.003 | 2.5 | |
| 3.5 | 782.000003 | 0.004 | 2.5 | |
| 4.35 | 782.000004 | 0.005 | 2.5 | |

Note: The applicant defined the normal working voltage of the battery is from 3.5 Vdc to 4.35 Vdc.

Frequency Error vs. Temperature

| Temp. (°C) | LTE Band 13 | | Limit (ppm) | |
|------------|---------------------------|-----------------------|-------------|--|
| | Channel Bandwidth: 10 MHz | | | |
| | Frequency (MHz) | Frequency Error (ppm) | | |
| -30 | 782.000003 | 0.004 | 2.5 | |
| -20 | 782.000001 | 0.001 | 2.5 | |
| -10 | 782.000004 | 0.005 | 2.5 | |
| 0 | 782.000002 | 0.003 | 2.5 | |
| 10 | 782.000002 | 0.003 | 2.5 | |
| 20 | 781.999999 | -0.001 | 2.5 | |
| 30 | 781.999998 | -0.003 | 2.5 | |
| 40 | 781.999998 | -0.003 | 2.5 | |
| 50 | 781.999999 | -0.002 | 2.5 | |
| 55 | 781.999998 | -0.003 | 2.5 | |

Note:

1. The applicant declared that the normal operating temperature of the EUT is from -30°C to 55°C.
2. The EUT would shut down automatically as below -30°C.

4.3 Occupied Bandwidth Measurement

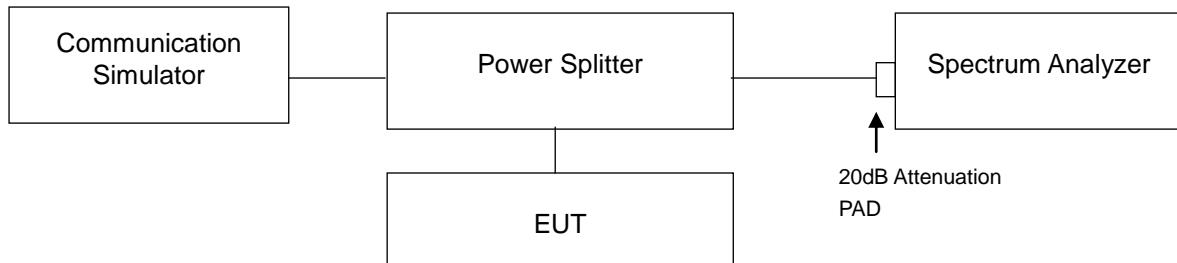
4.3.1 Limits of Occupied Bandwidth Measurement

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.

4.3.2 Test Procedure

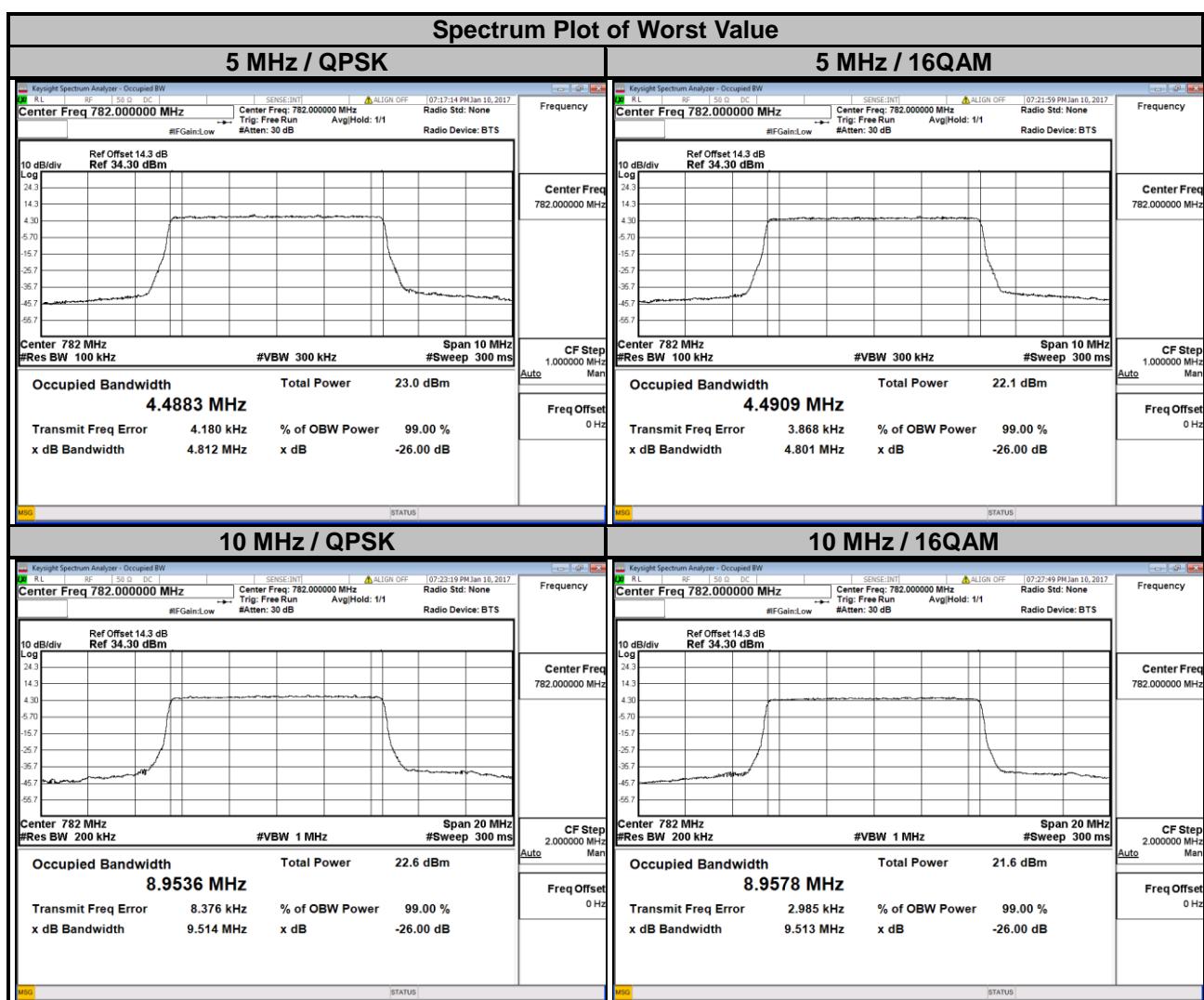
- a. The conducted occupied bandwidth used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- b. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

4.3.3 Test Setup



4.3.4 Test Result

| LTE Band 13 | | | | | | | |
|--------------------------|-----------------|-------------------------------|--------|---------------------------|-----------------|-------------------------------|--------|
| Channel Bandwidth: 5 MHz | | | | Channel Bandwidth: 10 MHz | | | |
| Channel | Frequency (MHz) | 99 % Occupied Bandwidth (MHz) | | Channel | Frequency (MHz) | 99 % Occupied Bandwidth (MHz) | |
| | | QPSK | 16QAM | | | QPSK | 16QAM |
| 23205 | 779.5 | 4.4881 | 4.4900 | 23230 | 782.0 | 8.9536 | 8.9578 |
| 23230 | 782.0 | 4.4883 | 4.4909 | | | | |
| 23255 | 784.5 | 4.4848 | 4.4891 | | | | |



4.4 Band Edge Measurement

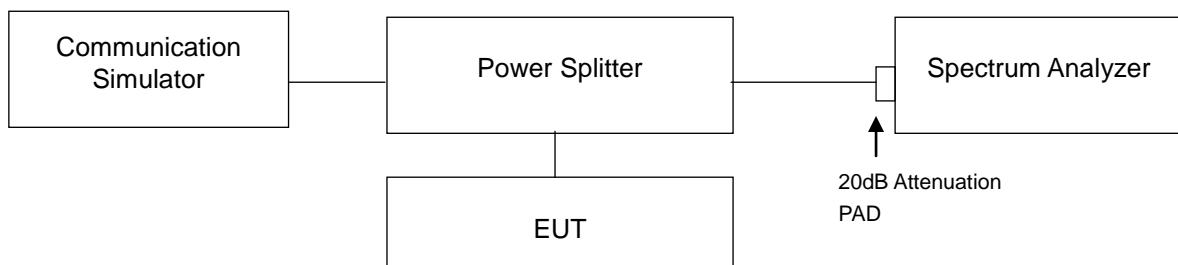
4.4.1 Limits of Band Edge Measurement

For operations in the 776-787 MHz band, 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.

For operations in the 1710–1755 MHz bands, 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.

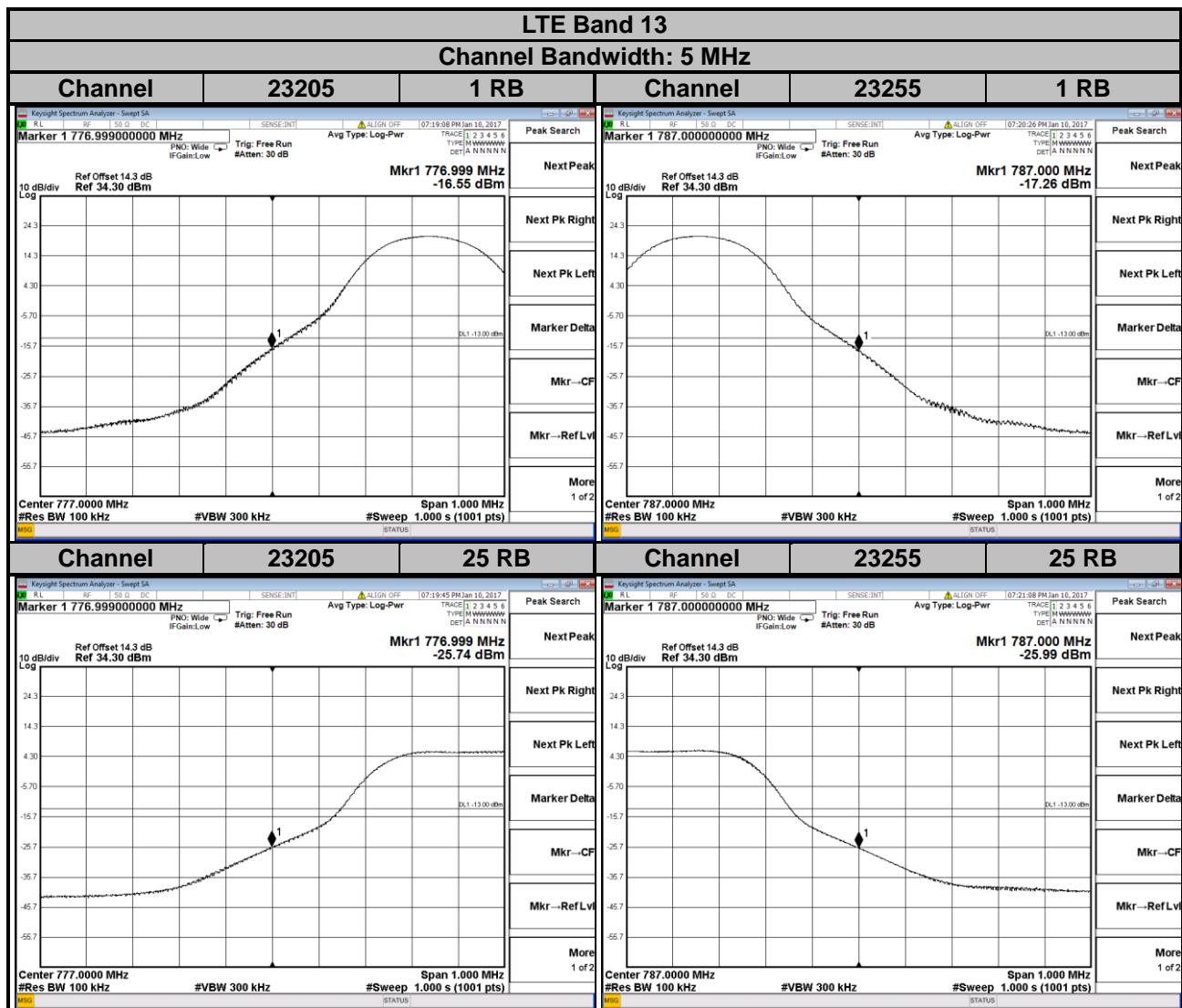
4.4.2 Test Setup



4.4.3 Test Procedures

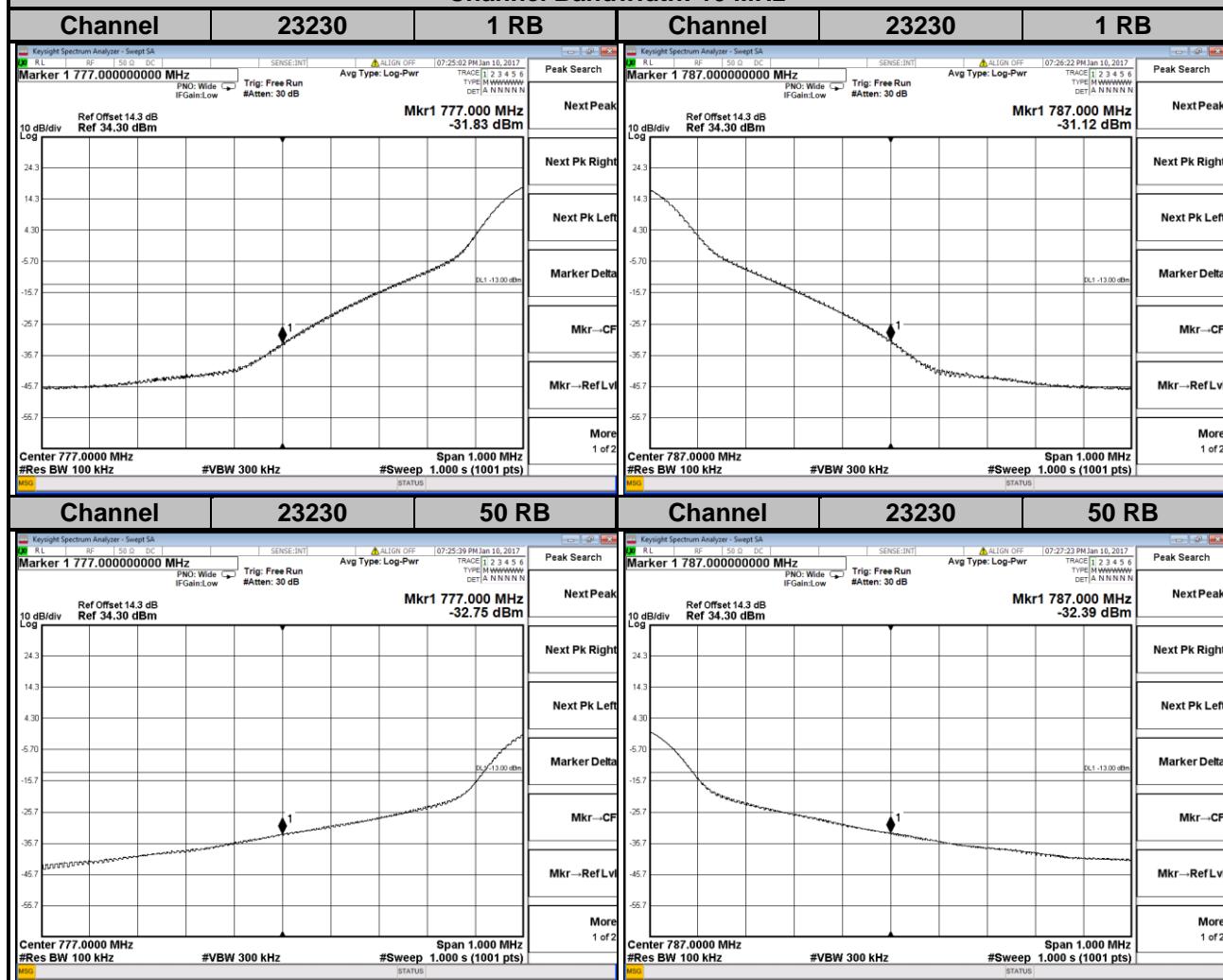
- All measurements were done at low and high operational frequency range.
- The center frequency of spectrum is the band edge frequency and span is 1 MHz. RB of the spectrum is 100 kHz and VB of the spectrum is 300 kHz (LTE Bandwidth 5 MHz/10 MHz).
- Record the max trace plot into the test report.

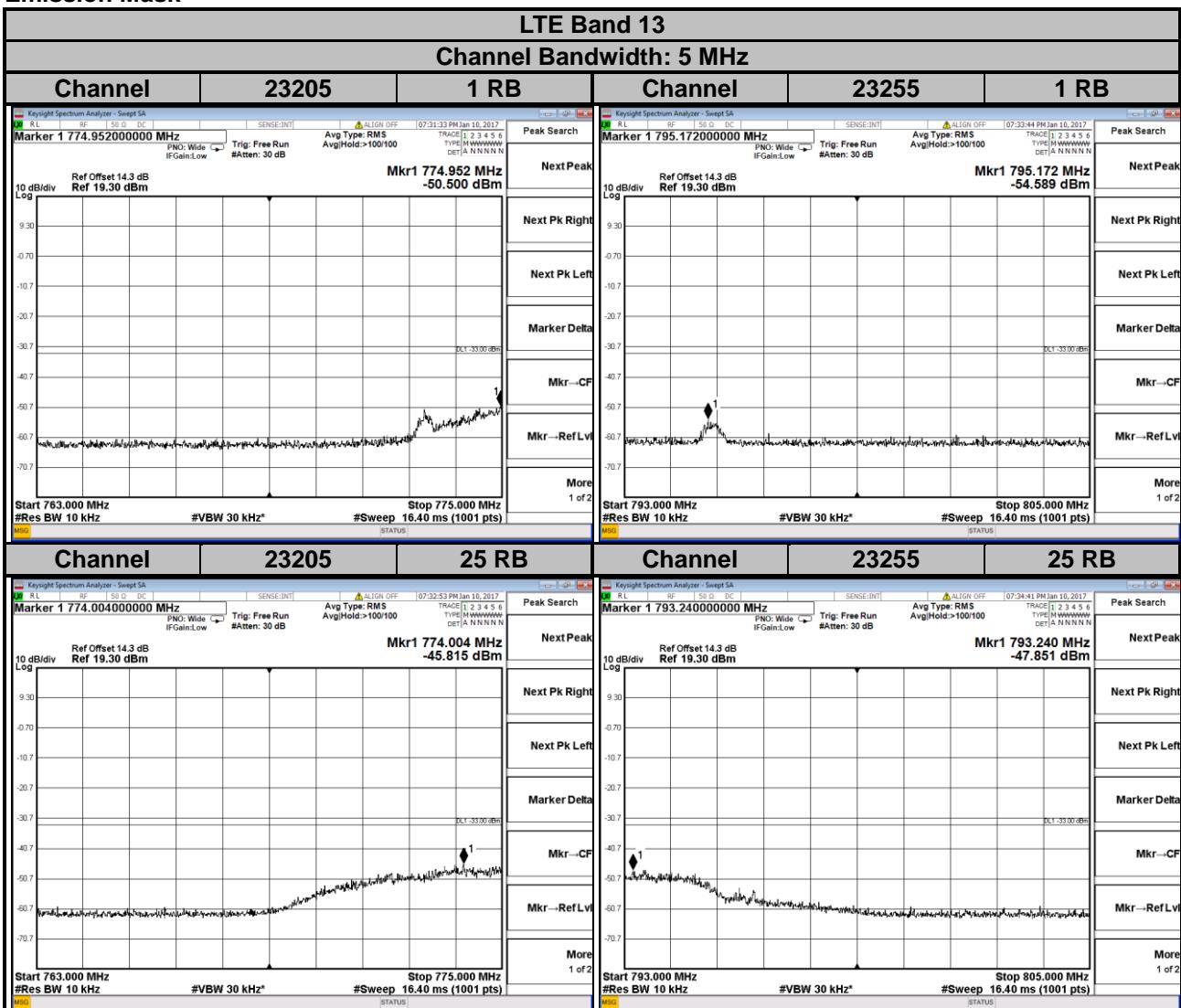
4.4.4 Test Results



LTE Band 13

Channel Bandwidth: 10 MHz

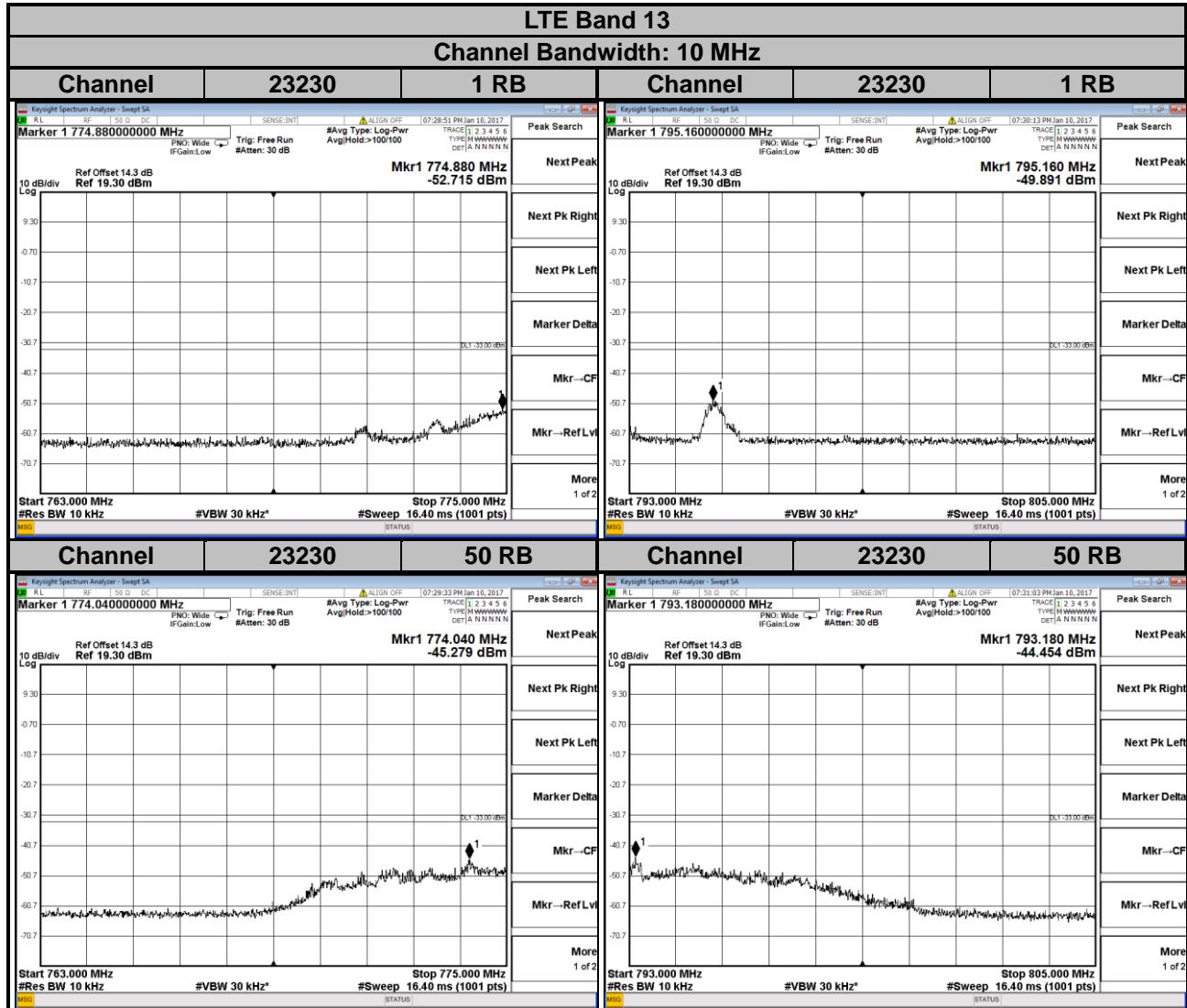


Emission Mask


For the 763 - 775 MHz and 793 - 805 MHz band ,the FCC limit is $65+10\log(P[\text{watt}])$ in a 6.25 kHz bandwidth . Since it was not possible to set the resolution bandwidth to 6.25 kHz with the available equipment , a bandwidth of 10 kHz was used instead to show compliance. By using a 10 kHz bandwidth on the spectrum analyzer.

$$10\log(10\text{kHz}/6.25\text{kHz}) = 2.04 \text{ dB}$$

$$\text{Limit line} = -35 \text{ dBm} + 2.04 \text{ dB} = -32.96 \text{ dBm}$$



For the 763 - 775 MHz and 793 - 805 MHz band ,the FCC limit is $65+10\log(P[\text{watt}])$ in a 6.25 kHz bandwidth . Since it was not possible to set the resolution bandwidth to 6.25 kHz with the available equipment , a bandwidth of 10 kHz was used instead to show compliance. By using a 10 kHz bandwidth on the spectrum analyzer.

$$10\log(10\text{kHz}/6.25\text{kHz}) = 2.04 \text{ dB}$$

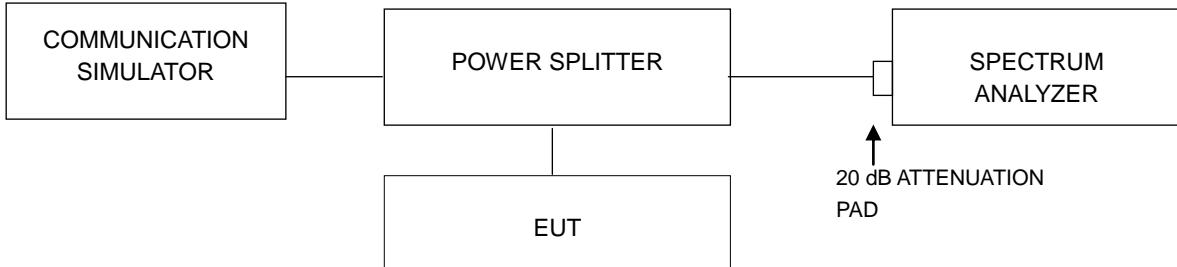
$$\text{Limit line} = -35 \text{ dBm} + 2.04 \text{ dB} = -32.96 \text{ dBm}$$

4.5 Peak to Average Ratio

4.5.1 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.

4.5.2 Test Setup

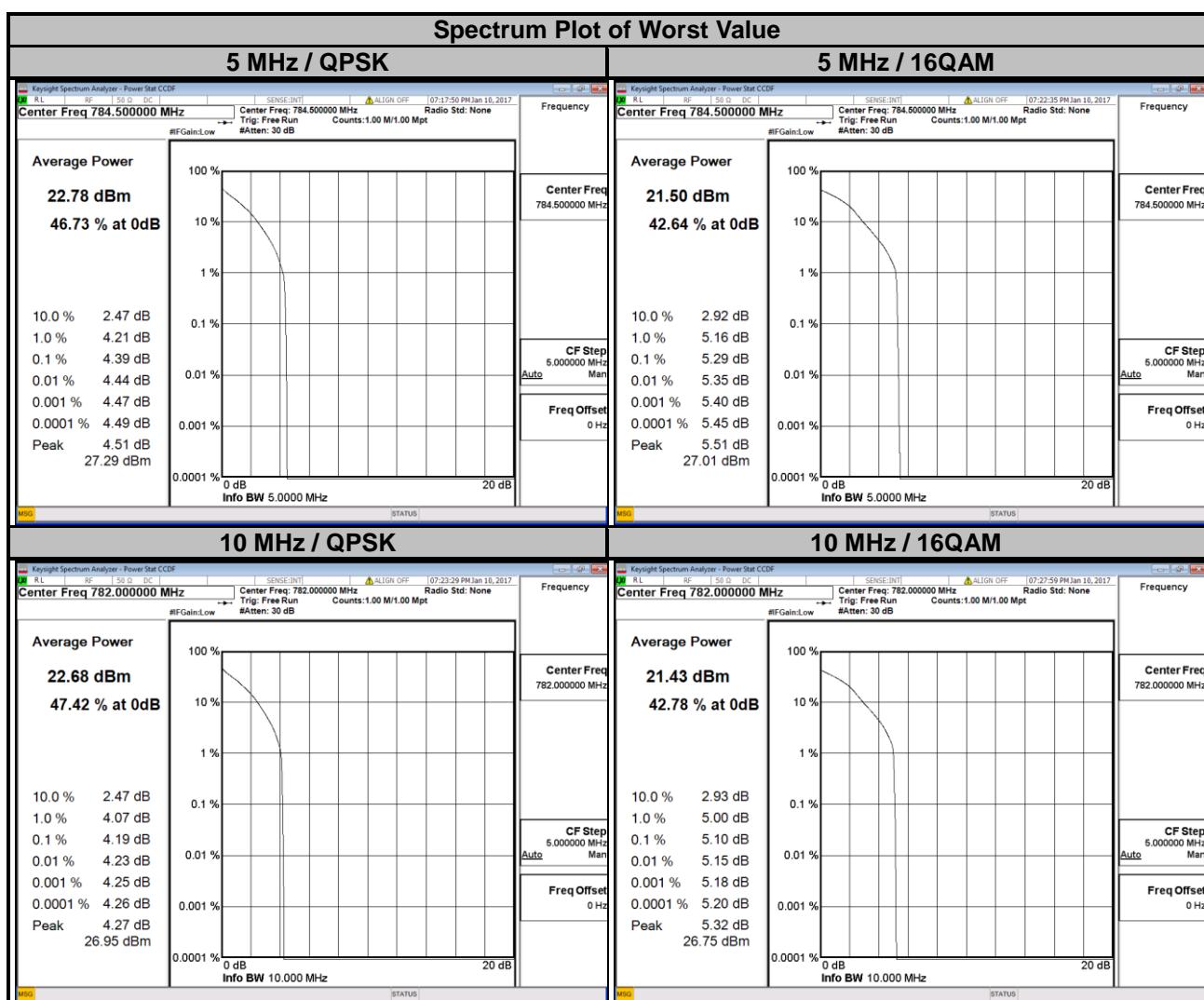


4.5.3 Test Procedures

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 %.

4.5.4 Test Results

| LTE Band 13 | | | | | | | |
|--------------------------|-----------------|----------------------------|-------|---------------------------|-----------------|----------------------------|-------|
| Channel Bandwidth: 5 MHz | | | | Channel Bandwidth: 10 MHz | | | |
| Channel | Frequency (MHz) | Peak to Average Ratio (dB) | | Channel | Frequency (MHz) | Peak to Average Ratio (dB) | |
| | | QPSK | 16QAM | | | QPSK | 16QAM |
| 23205 | 779.5 | 4.18 | 5.08 | 23230 | 782.0 | 4.19 | 5.10 |
| 23230 | 782.0 | 4.37 | 5.26 | | | | |
| 23255 | 784.5 | 4.39 | 5.29 | | | | |

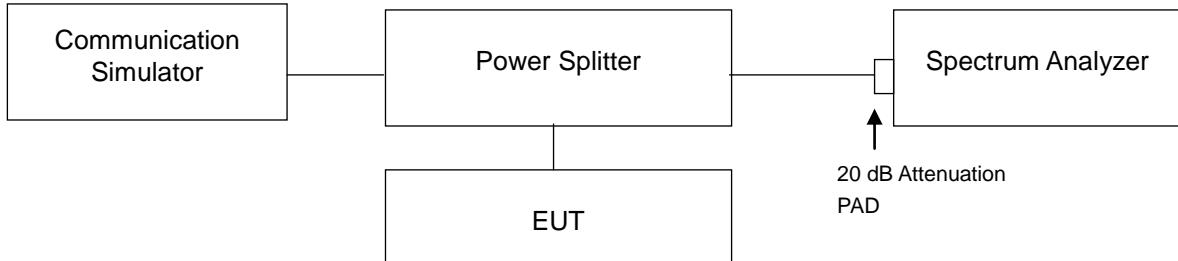


4.6 Conducted Spurious Emissions

4.6.1 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 is equal to -13 dBm.

4.6.2 Test Setup

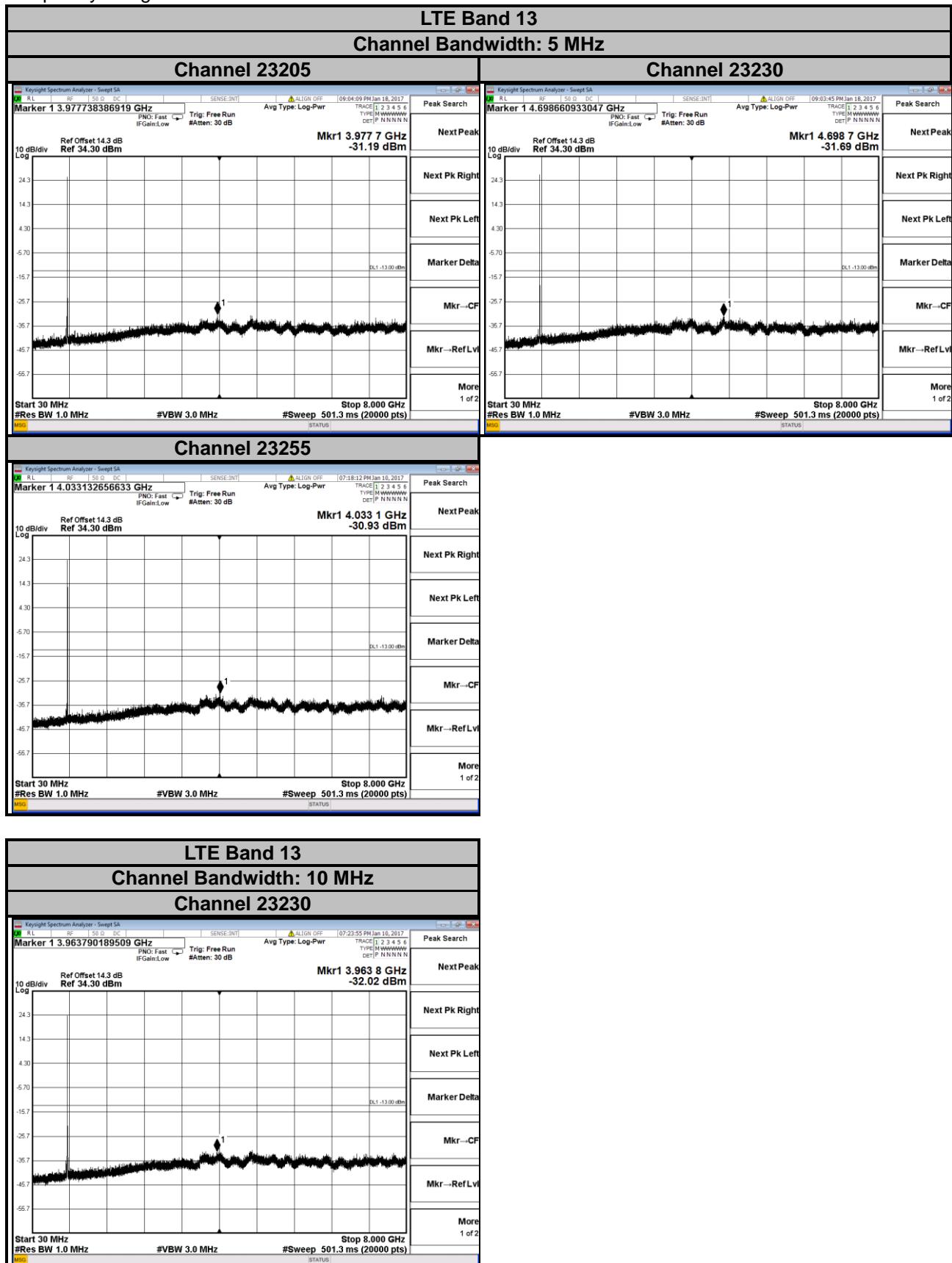


4.6.3 Test Procedure

- The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
- Measuring frequency range is from 30 MHz to 8 GHz. 10 dB attenuation pad is connected with spectrum. RBW=1 MHz and VBW=3 MHz are used for conducted emission measurement.

4.6.4 Test Results

Frequency Range: 30 MHz ~ 8 GHz



4.7 Radiated Emission Measurement

4.7.1 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 is equal to -13 dBm.

4.7.2 Test Procedure

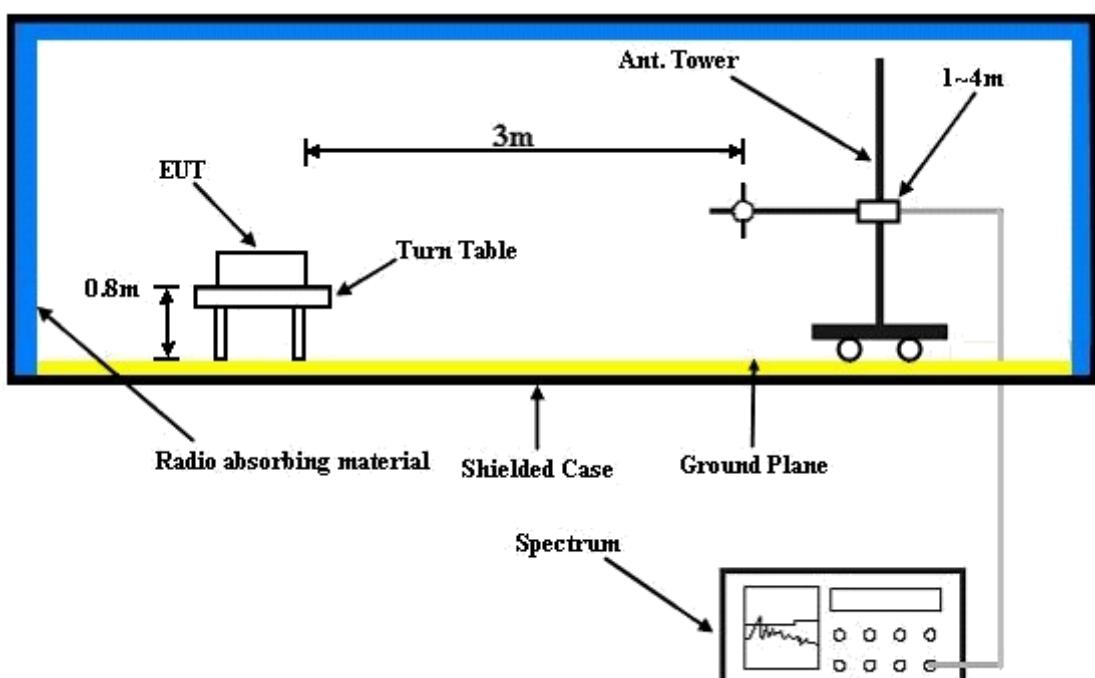
- Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- 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.
- EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.
- E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, E.R.P power = E.I.R.P power - 2.15 dBi.

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

4.7.3 Deviation from Test Standard

No deviation.

4.7.4 Test Setup



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

4.7.5 Test Results

LTE Band 13

Channel Bandwidth: 10 MHz / QPSK

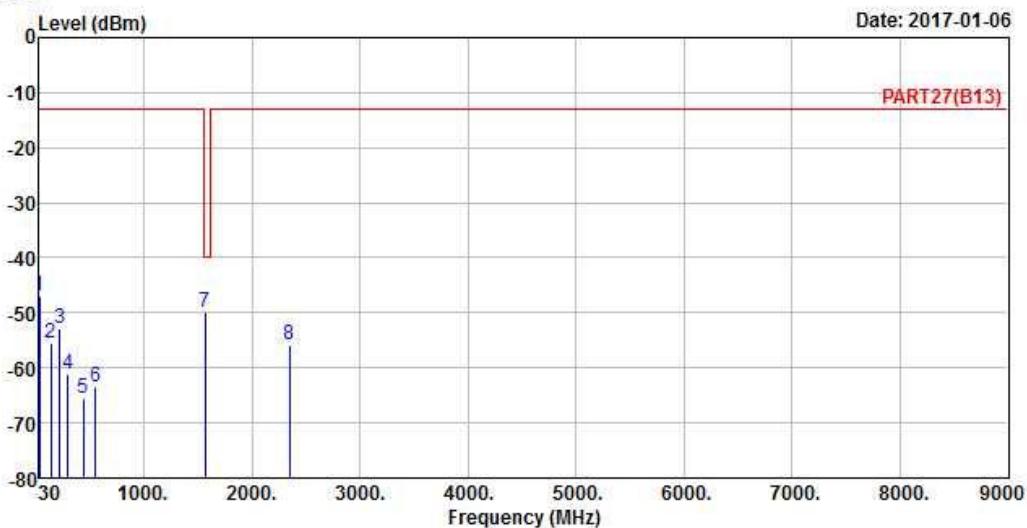
1RB, 0RB Offset



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 5



Site : 966 Chamber 5

Condition: PART27(B13) HORIZONTAL

Remak : LTE Band 13 QPSK_10M Link

Tested by: Getaz Yang

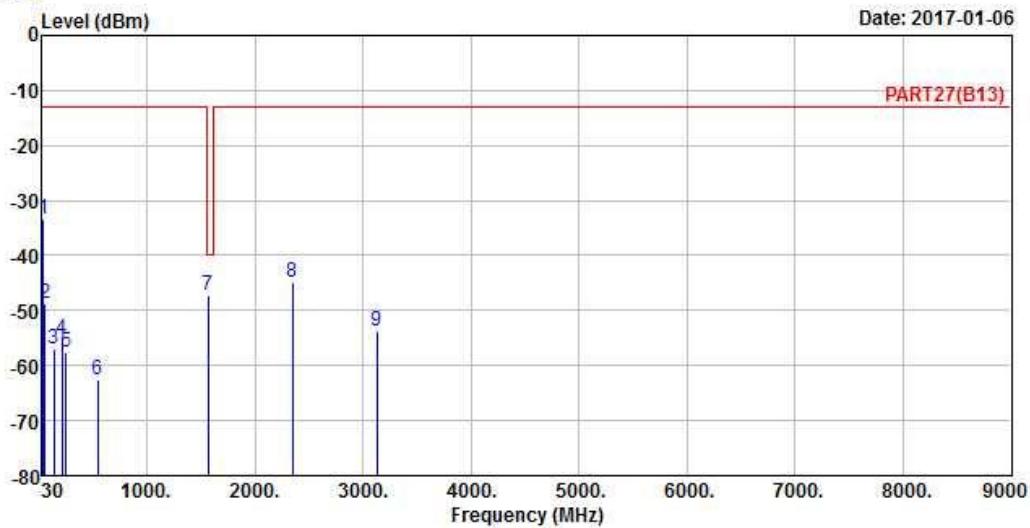
| Freq | Read | Limit | Over | Remark | | |
|------|---------|--------|--------|--------|--------|-------------|
| | Level | Level | Line | | | |
| MHz | dBm | dBm | dBm | dB | | |
| 1 | 32.91 | -46.85 | -45.76 | -13.00 | -33.85 | -1.09 Peak |
| 2 | 135.73 | -55.57 | -46.90 | -13.00 | -42.57 | -8.67 Peak |
| 3 | 218.18 | -52.71 | -45.43 | -13.00 | -39.71 | -7.28 Peak |
| 4 | 293.84 | -61.16 | -54.27 | -13.00 | -48.16 | -6.89 Peak |
| 5 | 435.46 | -65.56 | -59.90 | -13.00 | -52.56 | -5.66 Peak |
| 6 | 551.86 | -63.48 | -60.71 | -13.00 | -50.48 | -2.77 Peak |
| 7 pp | 1564.00 | -49.99 | -34.97 | -40.00 | -9.99 | -15.02 Peak |
| 8 | 2346.00 | -55.91 | -45.47 | -13.00 | -42.91 | -10.44 Peak |



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 6



Site : 966 Chamber 5

Condition: PART27(B13) VERTICAL

Remak : LTE Band 13 QPSK_10M Link

Tested by: Getaz Yang

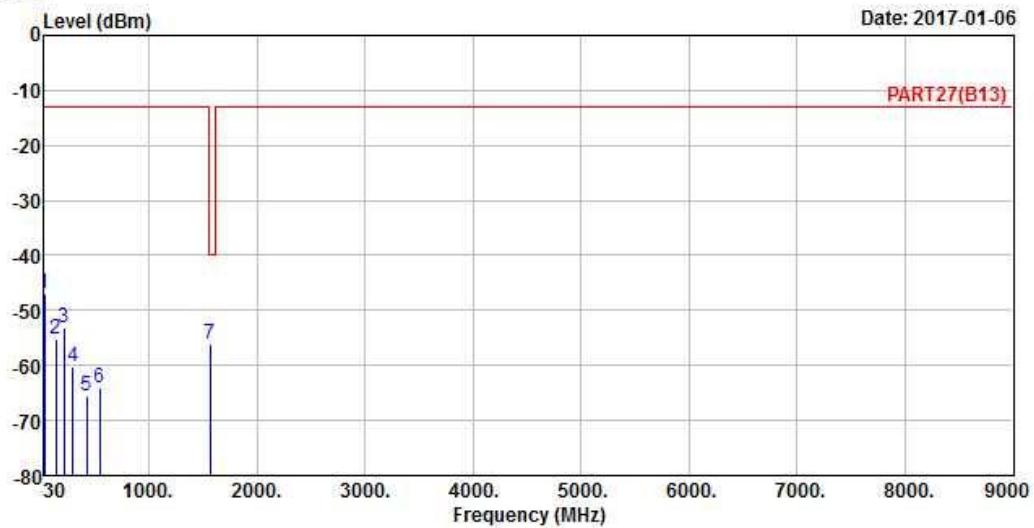
| Freq | Level | Read | Limit | Over | Factor | Remark |
|------|---------|--------|--------|--------|--------|-------------|
| | | MHz | dBm | dBm | | |
| 1 | 39.70 | -33.40 | -34.04 | -13.00 | -20.40 | 0.64 Peak |
| 2 | 58.13 | -48.78 | -41.65 | -13.00 | -35.78 | -7.13 Peak |
| 3 | 136.70 | -56.84 | -48.18 | -13.00 | -43.84 | -8.66 Peak |
| 4 | 216.24 | -55.24 | -47.88 | -13.00 | -42.24 | -7.36 Peak |
| 5 | 248.25 | -57.50 | -51.43 | -13.00 | -44.50 | -6.07 Peak |
| 6 | 545.07 | -62.56 | -59.54 | -13.00 | -49.56 | -3.02 Peak |
| 7 pp | 1564.00 | -47.35 | -32.33 | -40.00 | -7.35 | -15.02 Peak |
| 8 | 2346.00 | -44.78 | -34.34 | -13.00 | -31.78 | -10.44 Peak |
| 9 | 3128.00 | -53.67 | -44.64 | -13.00 | -40.67 | -9.03 Peak |

50RB, 0RB Offset


Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 5



Site : 966 Chamber 5

Condition: PART27(B13) HORIZONTAL

Remak : LTE Band 13 QPSK_10M Link

Tested by: Getaz Yang

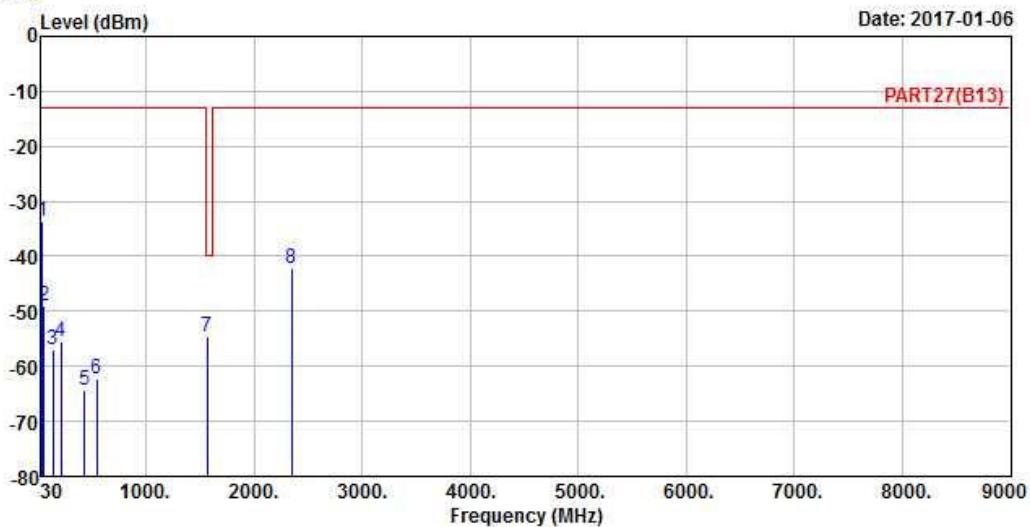
| Freq | Level | Read | Limit | Over | Factor | Remark |
|------|---------|--------|--------|--------|--------|-------------|
| | | MHz | dBm | dBm | Line | Limit |
| 1 | 32.91 | -46.95 | -45.86 | -13.00 | -33.95 | -1.09 Peak |
| 2 | 136.70 | -55.35 | -46.69 | -13.00 | -42.35 | -8.66 Peak |
| 3 | 214.30 | -53.23 | -45.79 | -13.00 | -40.23 | -7.44 Peak |
| 4 | 293.84 | -60.11 | -53.22 | -13.00 | -47.11 | -6.89 Peak |
| 5 | 421.88 | -65.41 | -59.64 | -13.00 | -52.41 | -5.77 Peak |
| 6 | 546.04 | -63.97 | -60.98 | -13.00 | -50.97 | -2.99 Peak |
| 7 pp | 1564.00 | -56.16 | -41.14 | -40.00 | -16.16 | -15.02 Peak |



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 6



Site : 966 Chamber 5

Condition: PART27(B13) VERTICAL

Remak : LTE Band 13 QPSK_10M Link

Tested by: Getaz Yang

| Freq | MHz | Read | Limit | Over | Factor | Remark |
|------|---------|--------|--------|--------|--------|-------------|
| | | Level | Level | Line | | |
| 1 | 39.70 | -33.65 | -34.29 | -13.00 | -20.65 | 0.64 Peak |
| 2 | 58.13 | -49.15 | -42.02 | -13.00 | -36.15 | -7.13 Peak |
| 3 | 136.70 | -56.84 | -48.18 | -13.00 | -43.84 | -8.66 Peak |
| 4 | 214.30 | -55.48 | -48.04 | -13.00 | -42.48 | -7.44 Peak |
| 5 | 430.61 | -64.48 | -58.78 | -13.00 | -51.48 | -5.70 Peak |
| 6 | 545.07 | -62.25 | -59.23 | -13.00 | -49.25 | -3.02 Peak |
| 7 pp | 1564.00 | -54.52 | -39.50 | -40.00 | -14.52 | -15.02 Peak |
| 8 | 2346.00 | -42.32 | -31.88 | -13.00 | -29.32 | -10.44 Peak |

5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

Appendix – Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 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:

Linko EMC/RF Lab

Tel: 886-2-26052180
Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565
Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety

Tel: 886-3-3183232
Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

--- END ---