

# FCC Radio Test Report

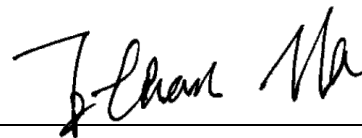
## FCC ID: 2ATKG-RAD78235

This report concerns: Original Grant

**Project No.** : 1906C019  
**Equipment** : Sutro Hub + Charger  
**Test Model** : SHC-1  
**Series Model** : N/A  
**Applicant** : Sutro Connect Inc.  
**Address** : 181 2nd St. San Francisco, CA 94105, US

**Date of Receipt** : Jun. 11, 2019  
**Date of Test** : Jun. 11, 2019 ~ Jul. 18, 2019  
**Issued Date** : Aug. 29, 2019  
**Tested by** : BTL Inc.

**Technical Engineer** :



(Ethan Ma)

**Authorized Signatory** :



(Steven Lu)

# **B T L I N C .**

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Certificate #5123.02

## Declaration

**BTL** represents to the client that testing is done in accordance with standard procedures as applicable and that test instruments used has been calibrated with standards traceable to international standard(s) and/or national standard(s).

**BTL's** reports apply only to the specific samples tested under conditions. It is manufacture's responsibility to ensure that additional production units of this model are manufactured with the identical electrical and mechanical components. **BTL** shall have no liability for any declarations, inferences or generalizations drawn by the client or others from **BTL** issued reports.

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**BTL's** laboratory quality assurance procedures are in compliance with the **ISO/IEC 17025** requirements, and accredited by the conformity assessment authorities listed in this test report.

**BTL** is not responsible for the sampling stage, so the results only apply to the sample as received.

The information, data and test plan are provided by manufacturer which may affect the validity of results, so it is manufacturer's responsibility to ensure that the apparatus meets the essential requirements of applied standards and in all the possible configurations as representative of its intended use.

## Limitation

For the use of the authority's logo is limited unless the Test Standard(s)/Scope(s)/Item(s) mentioned in this test report is (are) included in the conformity assessment authorities acceptance respective.

Please note that the measurement uncertainty is provided for informational purpose only and are not use in determining the Pass/Fail results.

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**REPORT ISSUED HISTORY**

| Report Version | Description                   | Issued Date   |
|----------------|-------------------------------|---------------|
| R00            | Original Issue.               | Aug. 02, 2019 |
| R01            | Modified the comments of TCB. | Aug. 29, 2019 |

## 1. GENERAL SUMMARY

Equipment : Sutro Hub + Charger  
Brand Name : N/A  
Test Model : SHC-1  
Series Model : N/A  
Applicant : Sutro Connect Inc.  
Manufacturer : Sutro Connect Inc.  
Address : 181 2nd St. San Francisco, CA 94105, US  
Date of Test : Jun. 11, 2019 ~ Jul. 18, 2019  
Test Sample : Engineering Sample No.: DG19060630  
Standard(s) : 47 CFR FCC Part 27 Subpart L  
47 CFR FCC Part 27 Subpart H  
47 CFR FCC Part 2  
ANSI / TIA / EIA-603-E-2016  
KDB 971168 D01 Power Meas License Digital Systems v03r01

The above equipment has been tested and found compliance with the requirement of the relative standards by BTL Inc.

The test data, data evaluation, and equipment configuration contained in our test report (Ref No. BTL-FCCP-2-1906C019) were obtained utilizing the test procedures, test instruments, test sites that has been accredited by the Authority of A2LA according to the ISO/IEC 17025 quality assessment standard and technical standard(s).

**Test results included in this report are only for the eMTC Band 4, 12 parts.**

## 2. SUMMARY OF TEST RESULTS

Test procedures according to the technical standard(s):

| FCC Part 27 Subpart L,H & Part 2                 |                                                                   |         |           |
|--------------------------------------------------|-------------------------------------------------------------------|---------|-----------|
| Standard(s) Section                              | Test Item                                                         | Verdict | Tested By |
| 2.1046<br>27.50(d)(4)<br>27.50(c)(10)            | Effective Radiated Power &<br>Equivalent Isotropic Radiated Power | PASS    | Paul Li   |
| 2.1049                                           | Occupied Bandwidth                                                | PASS    | Paul Li   |
| 2.1051<br>27.53(c)(2)(4)<br>27.53(g)<br>27.53(h) | Conducted Spurious Emissions                                      | PASS    | Paul Li   |
| 2.1051<br>27.53(c)(2)(4)<br>27.53(g)<br>27.53(h) | Radiated Spurious Emissions                                       | PASS    | Paul Li   |
| 2.1051<br>27.53(c)(2)(4)<br>27.53(g)<br>27.53(h) | Band Edge Measurements                                            | PASS    | Paul Li   |
| -                                                | Peak To Average Ratio                                             | PASS    | Paul Li   |
| 2.1055<br>27.54                                  | Frequency Stability                                               | PASS    | Paul Li   |

NOTE:

(1)" N/A" denotes test is not applicable to this device.

## 2.1 TEST FACILITY

The test facilities used to collect the test data in this report is at the location of No.3, Jinshagang 1st Road, Shixia, Dalang Town, Dongguan, Guangdong, China.

BTL's test firm number for FCC: 357015

BTL's designation number for FCC: CN1240

## 2.2 MEASUREMENT UNCERTAINTY

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2))

The BTL measurement uncertainty as below table:

### A. Radiated Measurement:

| Test Site       | Method | Measurement Frequency Range | Ant.<br>H / V | U,(dB) |
|-----------------|--------|-----------------------------|---------------|--------|
| DG-CB03<br>(3m) | CISPR  | 9KHz ~ 30MHz                | V             | 3.79   |
|                 |        | 9KHz ~ 30MHz                | H             | 3.57   |
|                 |        | 30MHz ~ 200MHz              | V             | 4.88   |
|                 |        | 30MHz ~ 200MHz              | H             | 4.14   |
|                 |        | 200MHz ~ 1,000MHz           | V             | 4.62   |
|                 |        | 200MHz ~ 1,000MHz           | H             | 4.80   |

| Test Site       | Method | Measurement Frequency Range | U,(dB) |
|-----------------|--------|-----------------------------|--------|
| DG-CB03<br>(3m) | CISPR  | 1GHz ~ 6GHz                 | 4.58   |
|                 |        | 6GHz ~ 18GHz                | 5.18   |

| Test Site       | Method | Measurement Frequency Range | U,(dB) |
|-----------------|--------|-----------------------------|--------|
| DG-CB03<br>(1m) | CISPR  | 18 ~ 26.5 GHz               | 3.80   |
|                 |        | 26.5 ~ 40 GHz               | 4.30   |

Note: Unless specifically mentioned, the uncertainty of measurement has not been taken into account to declare the compliance or non-compliance to the specification.

### 3. GENERAL INFORMATION

#### 3.1 GENERAL DESCRIPTION OF EUT

|                     |                                                                                                                                      |                 |                   |       |     |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------------|-------------------|-------|-----|
| Equipment           | Sutro Hub + Charger                                                                                                                  |                 |                   |       |     |
| Brand Name          | N/A                                                                                                                                  |                 |                   |       |     |
| Test Model          | SHC-1                                                                                                                                |                 |                   |       |     |
| Series Model        | N/A                                                                                                                                  |                 |                   |       |     |
| Model Difference(s) | N/A                                                                                                                                  |                 |                   |       |     |
| Antenna Type        | Internal Antenna                                                                                                                     |                 |                   |       |     |
| Antenna Gain        | eMTC Band 4                                                                                                                          | 3.18 dBi        |                   |       |     |
|                     | eMTC Band 12                                                                                                                         | 3.09 dBi        |                   |       |     |
| Hardware Version    | 1.3A                                                                                                                                 |                 |                   |       |     |
| Software Version    | 1.0.0                                                                                                                                |                 |                   |       |     |
| IMEI No.            | Radiated                                                                                                                             | 356726101144095 |                   |       |     |
|                     | Conducted                                                                                                                            | 356726101144095 |                   |       |     |
| Power Source        | DC voltage supplied from AC/DC adapter.<br>Model: NT-120300D1                                                                        |                 |                   |       |     |
| Power Rating        | I/P: 100-240V ~50/60Hz 1.0A Max    O/P: 12V  3A |                 |                   |       |     |
| eMTC Category       | CAT-M1                                                                                                                               |                 |                   |       |     |
| Modulation Type     | QPSK, 16QAM                                                                                                                          |                 |                   |       |     |
| Operation Frequency | eMTC Band 4 (Channel Bandwidth: 1.4MHz)                                                                                              |                 | 1710MHz ~ 1755MHz |       |     |
|                     | eMTC Band 12 (Channel Bandwidth: 1.4MHz)                                                                                             |                 | 699MHz ~ 716MHz   |       |     |
| Max. EIRP Power     | eMTC Band 4 (Channel Bandwidth: 1.4MHz)                                                                                              |                 | QPSK              | 25.47 | dBm |
|                     |                                                                                                                                      |                 | 16QAM             | 24.92 | dBm |
| Max. ERP Power      | eMTC Band 12 (Channel Bandwidth: 1.4MHz)                                                                                             |                 | QPSK              | 23.97 | dBm |
|                     |                                                                                                                                      |                 | 16QAM             | 23.80 | dBm |

Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.

### 3.2 DESCRIPTION OF TEST MODES AND TEST CONDITION

The EUT system operated these modes were found to be the worst case during the pre-scanning test sa following:

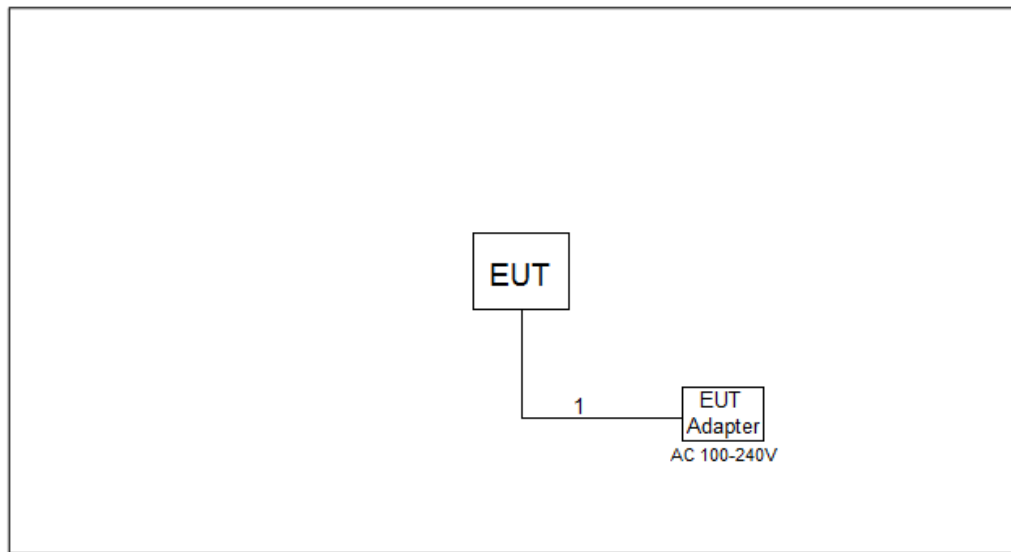
| Test item                           | Modes     | Modulation |       | Test Channel |   |   |
|-------------------------------------|-----------|------------|-------|--------------|---|---|
|                                     |           | QPSK       | 16QAM | L            | M | H |
| Equivalent Isotropic Radiated Power | CAT-M1 B4 | ✓          | ✓     | ✓            | ✓ | ✓ |
| Conducted Output Power              | CAT-M1 B4 | ✓          | ✓     | ✓            | ✓ | ✓ |
| Occupied Bandwidth                  | CAT-M1 B4 | ✓          | ✓     |              | ✓ |   |
| Conducted Spurious Emissions        | CAT-M1 B4 | ✓          |       |              | ✓ |   |
| Radiated Spurious Emissions         | CAT-M1 B4 | ✓          |       |              | ✓ |   |
| Band Edge Measurements              | CAT-M1 B4 | ✓          |       | ✓            |   | ✓ |
| Peak To Average Ratio               | CAT-M1 B4 | ✓          | ✓     | ✓            | ✓ | ✓ |
| Frequency Stability                 | CAT-M1 B4 | ✓          |       |              | ✓ |   |

| Test item                    | Modes      | Modulation |       | Test Channel |   |   |
|------------------------------|------------|------------|-------|--------------|---|---|
|                              |            | QPSK       | 16QAM | L            | M | H |
| Effective Radiated Power     | CAT-M1 B12 | ✓          | ✓     | ✓            | ✓ | ✓ |
| Conducted Output Power       | CAT-M1 B12 | ✓          | ✓     | ✓            | ✓ | ✓ |
| Occupied Bandwidth           | CAT-M1 B12 | ✓          | ✓     |              | ✓ |   |
| Conducted Spurious Emissions | CAT-M1 B12 | ✓          |       |              |   | ✓ |
| Radiated Spurious Emissions  | CAT-M1 B12 | ✓          |       |              |   | ✓ |
| Band Edge Measurements       | CAT-M1 B12 | ✓          |       | ✓            |   | ✓ |
| Peak To Average Ratio        | CAT-M1 B12 | ✓          | ✓     | ✓            | ✓ | ✓ |
| Frequency Stability          | CAT-M1 B12 | ✓          |       |              | ✓ |   |

#### EUT TEST CONDITIONS:

| Test Item                                                      | Environmental Conditions | Test Voltage       |
|----------------------------------------------------------------|--------------------------|--------------------|
| Equivalent Isotropic Radiated Power / Effective Radiated Power | 23.2°C, 51.3%RH          | DC 12V             |
| Conducted Output Power                                         | 23.2°C, 51.3%RH          | DC 12V             |
| Occupied Bandwidth                                             | 23.2°C, 51.3%RH          | DC 12V             |
| Conducted Spurious Emissions                                   | 23.2°C, 51.3%RH          | DC 12V             |
| Radiated Spurious Emissions                                    | 24°C, 68%RH              | AC 120V/60Hz       |
| Band Edge                                                      | 23.2°C, 51.3%RH          | DC 12V             |
| Peak to Average Ratio                                          | 23.2°C, 51.3%RH          | DC 12V             |
| Frequency Stability                                            | Normal and Extreme       | Normal and Extreme |

### 3.3 BLOCK DIGRAM SHOWING THECONFIGURATIONOFSYSTEMTESTED



### 3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| Item | Equipment | Brand | Model No. | Series No. |
|------|-----------|-------|-----------|------------|
| -    | -         | -     | -         | -          |

| Item | Cable Type | Shielded Type | Ferrite Core | Length |
|------|------------|---------------|--------------|--------|
| 1    | DC Cable   | NO            | NO           | 1.5m   |

## 4. TEST RESULT

### 4.1 OUTPUT POWER MEASUREMENT

#### 4.1.1 LIMIT

Mobile / Portable station are limited to 1 watts / 1 watts e.i.r.p. (eMTC Band 4)

Mobile / Portable station are limited to 30 watts / 3 watts e.r.p. (eMTC Band 12)

#### 4.1.2 TEST PROCEDURE

The testing follows FCC KDB 971168 v03r01 Section 5.0.

##### EIRP/ERP:

$EIRP = \text{Conducted Power} + \text{Antenna gain}$

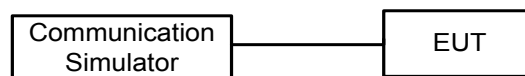
$ERP \text{ power} = EIRP \text{ power} - 2.15 \text{ dBi}$

##### Conducted Power:

The EUT was set up for the maximum power with CAT-M1 link data modulation and link up with simulator. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

#### 4.1.3 TESTSETUP LAYOUT

Conducted Power Measurement



#### 4.1.4 TEST DEVIATION

No deviation

#### 4.1.5 TEST RESULTS

Please refer to the Appendix A.

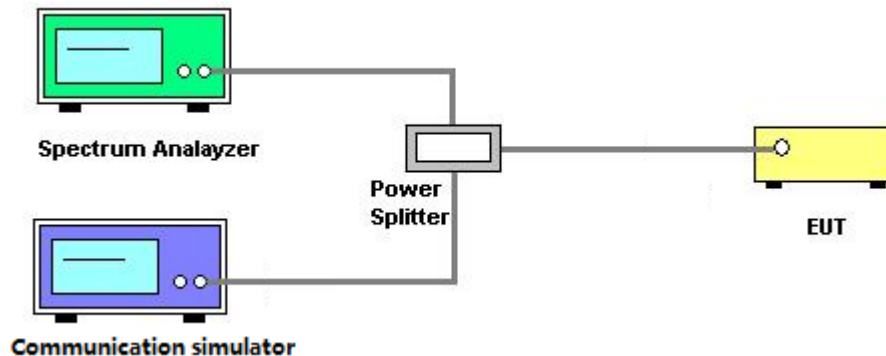
## 4.2 OCCUPIED BANDWIDTH MEASUREMENT

### 4.2.1 TEST PROCEDURE

The testing follows FCC KDB 971168 v03r01 Section 4.0.

1. The EUT makes a call to the communication simulator. All measurements were done at low, middle and high operational frequency range. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth and 26dB bandwidth.
2. The EUT was connected to spectrum analyzer and system simulator via a power divider.
3.  $RBW = (1\% \sim 5\%) \cdot EBW$   
 $VBW \geq 3 \cdot RBW$
4. Set spectrum analyzer with RMS detector.

### 4.2.2 TEST SETUP LAYOUT



### 4.2.3 TEST DEVIATION

No deviation

### 4.2.4 TEST RESULTS

Please refer to the Appendix B.

### 4.3 CONDUCTED EMISSIONS MEASUREMENT

#### 4.3.1 LIMIT

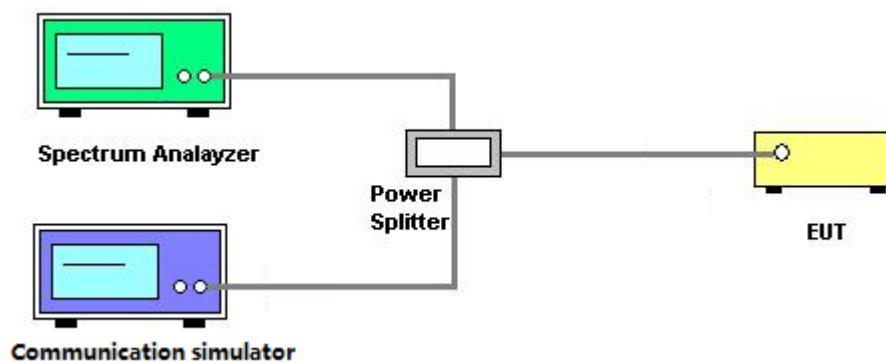
The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB. The emission limit equal to -13dBm.

#### 4.3.2 TEST PROCEDURES

The testing follows FCC KDB 971168 v03r01 Section 6.0.

1. The EUT was connected to spectrum analyzer and system simulator via a power divider.
2. The band edges of low, middle and high channels for the highest RF powers were measured.  
Set RBW $\geq$ 1% EBW in the 1MHz band immediately outside and adjacent to the band edge.
3. Set spectrum analyzer with RMS detector.
4. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

#### 4.3.3 TESTSETUP LAYOUT



#### 4.3.4 TESTDEVIATION

No deviation

#### 4.3.5 TEST RESULTS

Please refer to the Appendix C.

## 4.4 RADIATED EMISSIONS MEASUREMENT

### 4.4.1 LIMIT

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB. The emission limit equal to -13dBm.

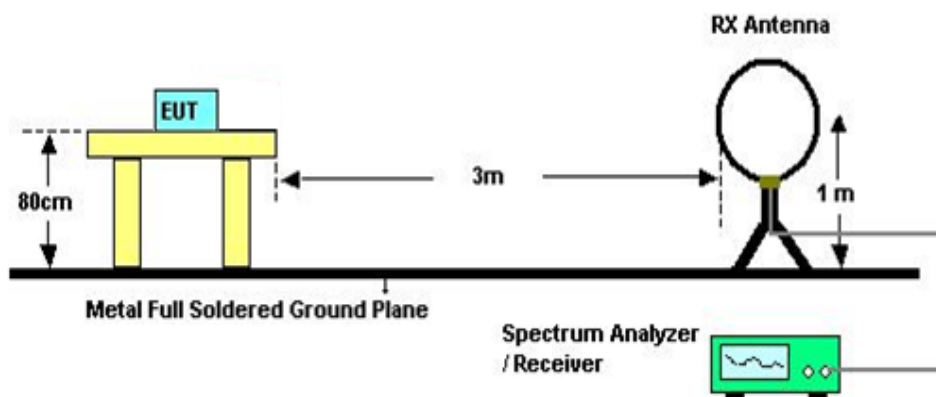
### 4.4.2 TEST PROCEDURES

The testing follows FCC KDB 971168 v03r01 Section 5.8.

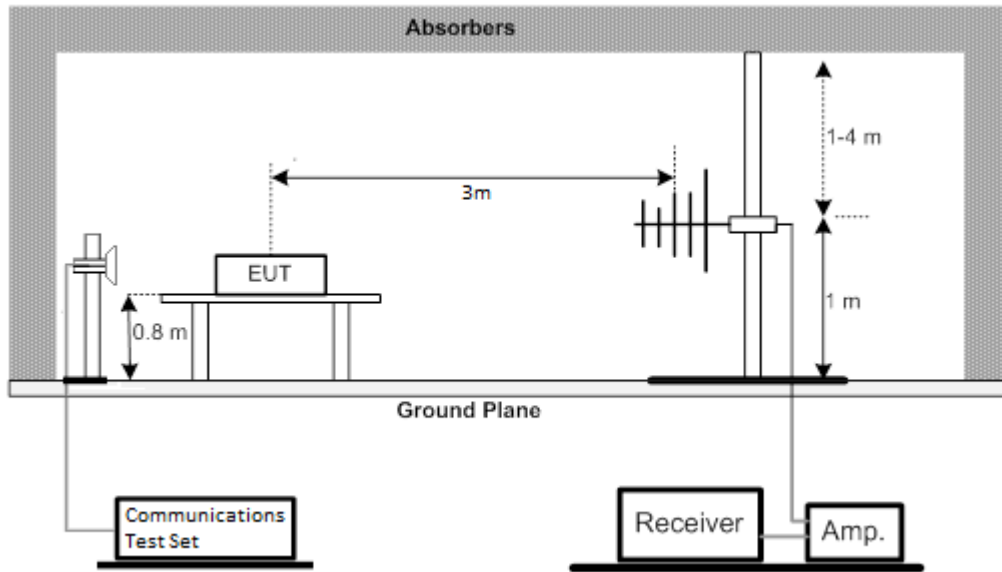
1. In the semi-anechoic chamber, EUT placed on the 0.8m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1m to 4m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
2. 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
3. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution horn.
4. 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.P.R power - 2.15dBi.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

### 4.4.3 TESTSETUP LAYOUT

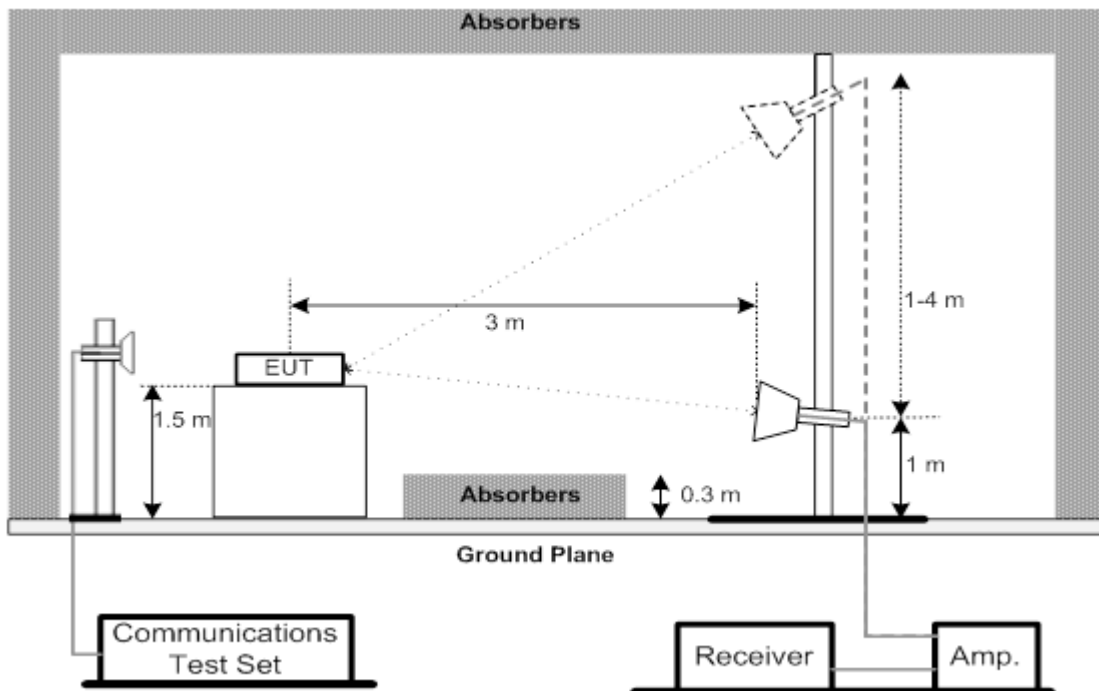
Below 30MHz

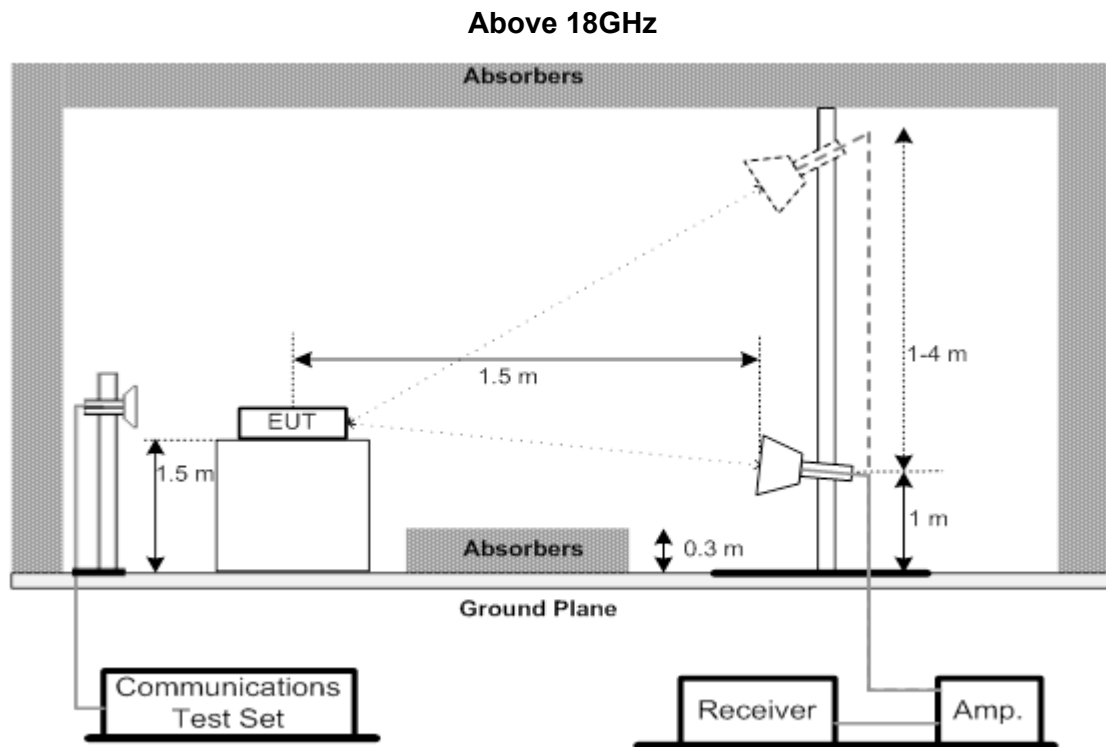


### 30MHz to 1GHz



### 1GHz to 18GHz





#### 4.4.4 TEST DEVIATION

No deviation

#### 4.4.5 TEST RESULTS

Please refer to the Appendix D.

## 4.5 BAND EDGE MEASUREMENT

### 4.5.1 LIMIT

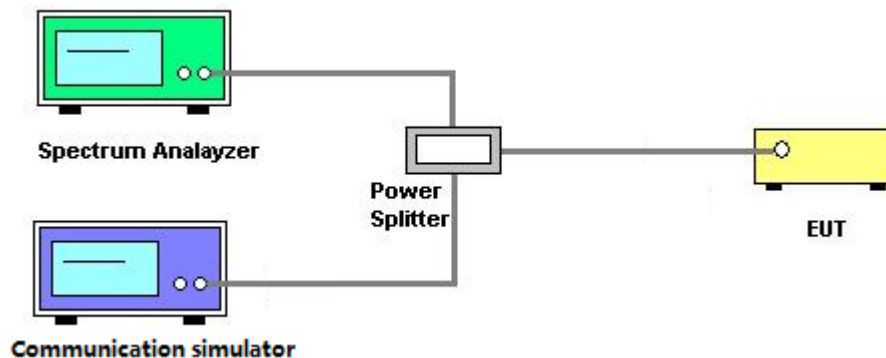
The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least  $43 + 10 \log (P)$  dB. Compliance with this provision is based on the use of measurement instrumentation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

### 4.5.2 TEST PROCEDURES

The testing follows FCC KDB 971168 v03r01 Section 6.0.

1. All measurements were done at low and high operational frequency range.
2.  $RBW = 99\%OBW * (1\% \sim 5\%)$   
 $VBW \geq 3 * RBW$
3. Set spectrum analyzer with RMS detector.
4. Record the max trace plot into the test report.

### 4.5.3 TESTSETUP LAYOUT



### 4.5.4 TESTDEVIATION

No deviation

### 4.5.5 TEST RESULTS

Please refer to the Appendix E.

## 4.6 PEAK TO AVERAGE RATIO MEASUREMENT

### 4.6.1 LIMIT

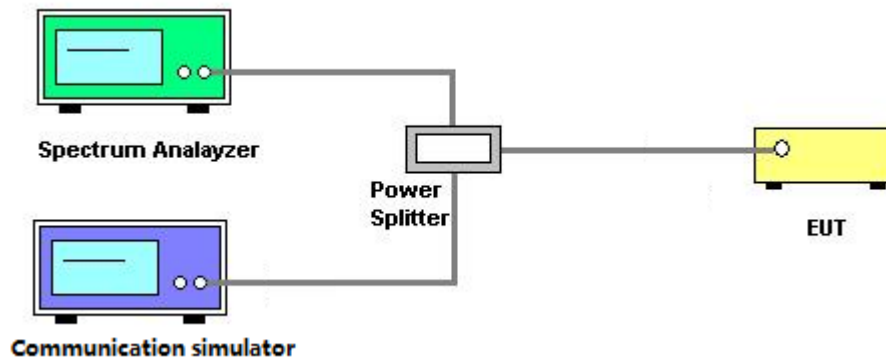
In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB.

### 4.6.2 TEST PROCEDURES

The testing follows FCC KDB 971168 v03r01 Section 5.7.

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%.

### 4.6.3 TESTSETUP LAYOUT



### 4.6.4 TESTDEVIATION

No deviation

### 4.6.5 TEST RESULTS

Please refer to the Appendix F.

## 4.7 FREQUENCY STABILITY MEASUREMENT

### 4.7.1 LIMIT

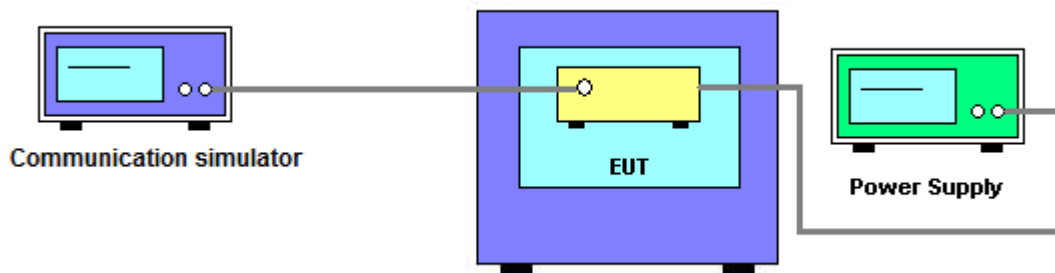
$\pm 1.5$  ppm is for base and fixed station.  $\pm 2.5$  ppm is for mobile station.

### 4.7.2 TEST PROCEDURES

The testing follows FCC KDB 971168 v03r01 Section 9.0.

1. 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.
2. 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.
3. 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.
4. The frequency error was recorded frequency error from the communication simulator.

### 4.7.3 TESTSETUP LAYOUT



### 4.7.4 TESTDEVIATION

No deviation

### 4.7.5 TEST RESULTS

Please refer to the Appendix G.

## 5. LIST OF MEASUREMENT EQUIPMENTS

| Radiated Emission Measurement |                                     |                             |                                         |               |                  |
|-------------------------------|-------------------------------------|-----------------------------|-----------------------------------------|---------------|------------------|
| Item                          | Kind of Equipment                   | Manufacturer                | Type No.                                | Serial No.    | Calibrated until |
| 1                             | Antenna                             | Schwarzbeck                 | VULB9160                                | 9160-3232     | Mar. 09, 2020    |
| 2                             | Amplifier                           | Agilent                     | 8449B                                   | 3008A02274    | Mar. 10, 2020    |
| 3                             | Amplifier                           | HP                          | 8447D                                   | 2944A09673    | Aug. 11, 2019    |
| 4                             | HighPass Filter                     | Wairwright Instruments Gmbh | WHK 1.5/15G-10ST                        | 11            | Mar. 10, 2020    |
| 5                             | Band Reject Filter                  | Wairwright Instruments Gmbh | WRCG<br>1710/1785-1690/180<br>5-60/12SS | 38            | Mar. 10, 2020    |
| 6                             | Band Reject Filter                  | Wairwright Instruments Gmbh | WRCG<br>824/849-810/863-60/<br>9SS      | 7             | Mar. 10, 2020    |
| 7                             | Band Reject Filter                  | Wairwright Instruments Gmbh | WRCG<br>880/915-860/935-60/<br>9SS      | 14            | Mar. 10, 2020    |
| 8                             | Band Reject Filter                  | Wairwright Instruments Gmbh | WRCG<br>1850/1910-1830/193<br>0-60/10SS | 17            | Mar. 10, 2020    |
| 9                             | HighPass Filter                     | Wairwright Instruments Gmbh | WHK3.1/18G-10SS                         | 24            | Mar. 10, 2020    |
| 10                            | Microwave Preamplifier With Adaptor | EMC INSTRUMENT              | EMC2654045                              | 980039 & HA01 | Mar. 10, 2020    |
| 11                            | Receiver                            | Agilent                     | N9038A                                  | MY52130039    | Aug. 11, 2019    |
| 12                            | wideband radio communication tester | R&S                         | CMW500                                  | 152372        | Mar. 10, 2020    |
| 13                            | High pass filter                    | KANGMAIWEI                  | ZHPF-M3-12.75G-38<br>69                 | B2015073763   | Feb. 12, 2020    |
| 14                            | High pass filter                    | KANGMAIWEI                  | ZHPF-M1000-4000-1                       | B2015073762   | Feb. 12, 2020    |
| 15                            | High pass filter                    | KANGMAIWEI                  | ZHPF-M6-186-1727                        | B2015073764   | Feb. 12, 2020    |
| 16                            | Cable                               | emci                        | LMR-400(30MHz-1G<br>Hz)(8m+5m)          | N/A           | May 24, 2020     |
| 17                            | Cable                               | mitron                      | B10-01-01-12M                           | 18072744      | Jul. 30, 2019    |
| 18                            | Controller                          | ETS-Lindgren                | 2090                                    | N/A           | N/A              |
| 19                            | Measurement Software                | Farad                       | EZ-EMC<br>Ver.NB-03A1-01                | N/A           | N/A              |
| 20                            | Loop Antenna                        | EM                          | EM-6876-1                               | 230           | Jan. 15, 2020    |
| 21                            | Double Ridged Guide Antenna         | ETS                         | 3115                                    | 75789         | Mar. 09, 2020    |
| 22                            | Broad-Band Horn Antenna             | Schwarzbeck                 | BBHA 9170                               | 9170319       | Jun. 23, 2020    |

| Conducted Measurement |                                     |               |              |             |                  |
|-----------------------|-------------------------------------|---------------|--------------|-------------|------------------|
| Item                  | Kind of Equipment                   | Manufacturer  | Type No.     | Serial No.  | Calibrated until |
| 1                     | EXA Spectrum Analyzer               | Agilent       | N9010A       | MY50520044  | Mar. 10, 2020    |
| 2                     | POWER SPLITTER                      | Mini-Circuits | ZFRSC-123-S+ | 331000910-1 | Mar. 10, 2020    |
| 3                     | wideband radio communication tester | R&S           | CMW500       | 152372      | Mar. 10, 2020    |
| 4                     | Spectrum Analyzer                   | R&S           | FSP40        | 100185      | Aug. 11, 2019    |

| Frequency Stability Measurement |                                     |               |              |             |                  |
|---------------------------------|-------------------------------------|---------------|--------------|-------------|------------------|
| Item                            | Kind of Equipment                   | Manufacturer  | Type No.     | Serial No.  | Calibrated until |
| 1                               | Multi-output DC Power Supply        | GW Instek     | GPC-3030DN   | EK880675    | Sep. 26, 2020    |
| 2                               | POWER SPLITTER                      | Mini-Circuits | ZFRSC-123-S+ | 331000910-1 | Mar. 10, 2020    |
| 3                               | wideband radio communication tester | R&S           | CMW500       | 152372      | Mar. 10, 2020    |
| 4                               | Const Temp,& Humidity Chamber       | Bell          | BTH-50C      | 20170306001 | Mar. 10, 2020    |

Remark: "N/A" denotes no model name, serial no. or calibration specified.  
All calibration period of equipment list is one year.

## APPENDIX A - OUTPUT POWER

|            |                    |
|------------|--------------------|
| Test Mode: | eMTC Band 4 - QPSK |
|------------|--------------------|

| Bandwidth | Channel | Frequency (MHz) | Max. Conducted Power (dBm) | Max. EIRP Power (dBm) |
|-----------|---------|-----------------|----------------------------|-----------------------|
| 1.4M      | 19957   | 1710.7          | 22.29                      | 25.47                 |
|           | 20175   | 1732.5          | 21.81                      | 24.99                 |
|           | 20393   | 1754.3          | 22.03                      | 25.21                 |

|            |                     |
|------------|---------------------|
| Test Mode: | eMTC Band 4 - 16QAM |
|------------|---------------------|

| Bandwidth | Channel | Frequency (MHz) | Max. Conducted Power (dBm) | Max. EIRP Power (dBm) |
|-----------|---------|-----------------|----------------------------|-----------------------|
| 1.4M      | 19957   | 1710.7          | 21.74                      | 24.92                 |
|           | 20175   | 1732.5          | 21.41                      | 24.59                 |
|           | 20393   | 1754.3          | 21.55                      | 24.73                 |

|            |                     |
|------------|---------------------|
| Test Mode: | eMTC Band 12 - QPSK |
|------------|---------------------|

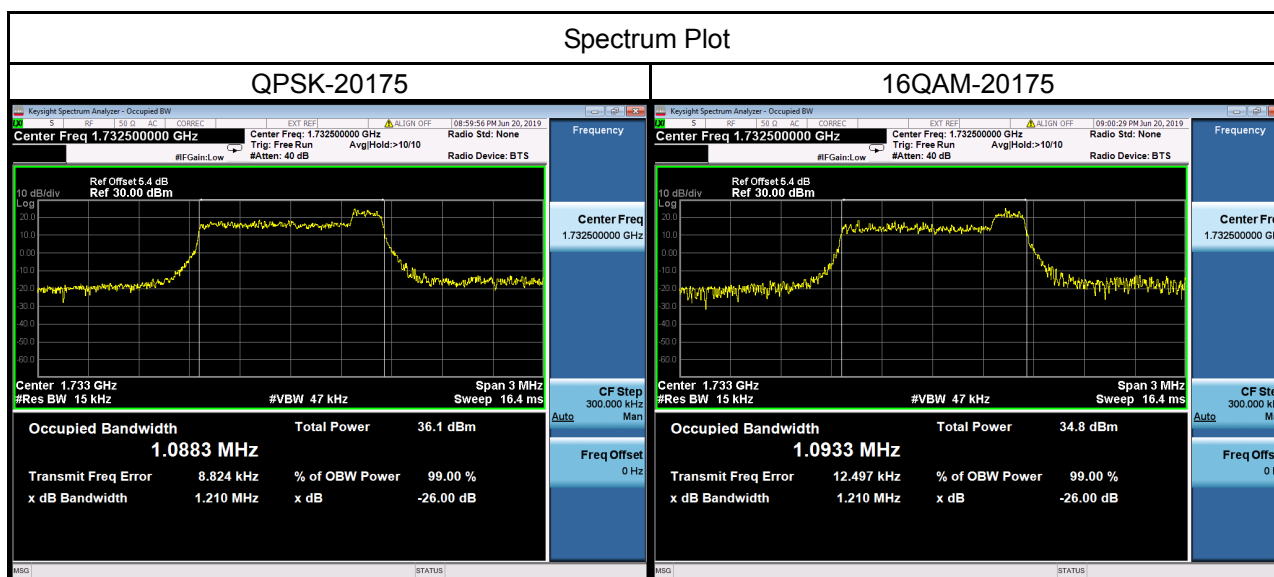
| Bandwidth | Channel | Frequency (MHz) | Max. Conducted Power (dBm) | Max. ERP Power (dBm) |
|-----------|---------|-----------------|----------------------------|----------------------|
| 1.4M      | 23017   | 699.7           | 23.03                      | 23.97                |
|           | 23095   | 707.5           | 22.72                      | 23.66                |
|           | 23173   | 715.3           | 22.78                      | 23.72                |

|            |                     |
|------------|---------------------|
| Test Mode: | eMTC Band 12 -16QAM |
|------------|---------------------|

| Bandwidth | Channel | Frequency (MHz) | Max. Conducted Power (dBm) | Max. ERP Power (dBm) |
|-----------|---------|-----------------|----------------------------|----------------------|
| 1.4M      | 23017   | 699.7           | 22.86                      | 23.80                |
|           | 23095   | 707.5           | 22.65                      | 23.59                |
|           | 23173   | 715.3           | 22.68                      | 23.62                |

## APPENDIX B - OCCUPIED BANDWIDTH

| eMTC Band 4_1.4M |                 |                              |         |                 |                              |
|------------------|-----------------|------------------------------|---------|-----------------|------------------------------|
| QPSK             |                 |                              | 16QAM   |                 |                              |
| Channel          | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) |
| 20175            | 1732.5          | 1.0883                       | 20175   | 1732.5          | 1.0933                       |
| Channel          | Frequency (MHz) | 26dB Bandwidth (MHz)         | Channel | Frequency (MHz) | 26dB Bandwidth (MHz)         |
| 20175            | 1732.5          | 1.210                        | 20175   | 1732.5          | 1.210                        |



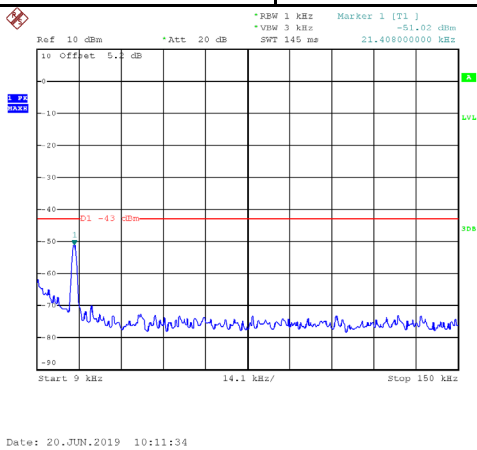
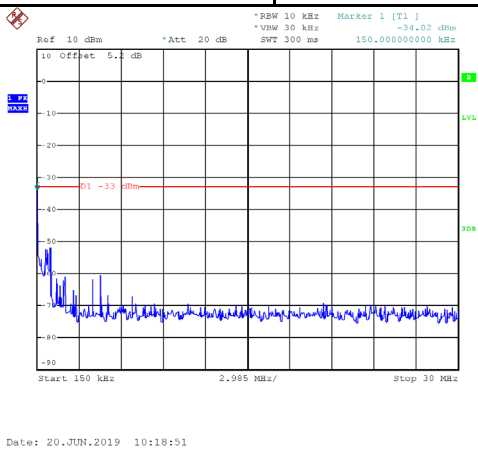
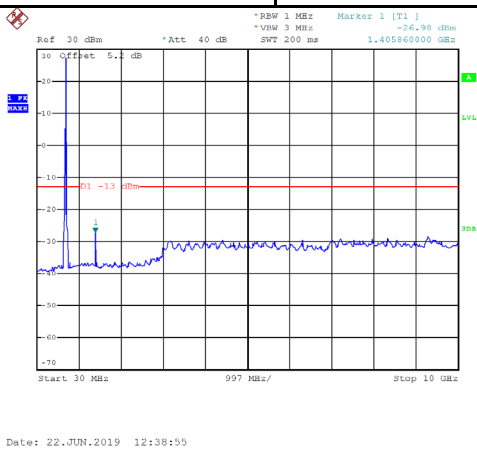
| eMTC Band 12_1.4M |                 |                              |         |                 |                              |
|-------------------|-----------------|------------------------------|---------|-----------------|------------------------------|
| QPSK              |                 |                              | 16QAM   |                 |                              |
| Channel           | Frequency (MHz) | 99% Occupied Bandwidth (MHz) | Channel | Frequency (MHz) | 99% Occupied Bandwidth (MHz) |
| 23095             | 707.5           | 1.0881                       | 23095   | 707.5           | 1.0881                       |
| Channel           | Frequency (MHz) | 26dB Bandwidth (MHz)         | Channel | Frequency (MHz) | 26dB Bandwidth (MHz)         |
| 23095             | 707.5           | 1.206                        | 23095   | 707.5           | 1.205                        |



## APPENDIX C - CONDUCTED EMISSIONS

| eMTC Band 4_1.4M |                |         |                |
|------------------|----------------|---------|----------------|
| Channel          | Frequency(MHz) | Channel | Frequency(MHz) |
| 20175            | 1732.5         | 20175   | 1732.5         |
|                  |                |         |                |
| Channel          | Frequency(MHz) | -       | -              |
| 20175            | 1732.5         | -       | -              |
|                  |                | -       |                |

Note: The spike is no limit.

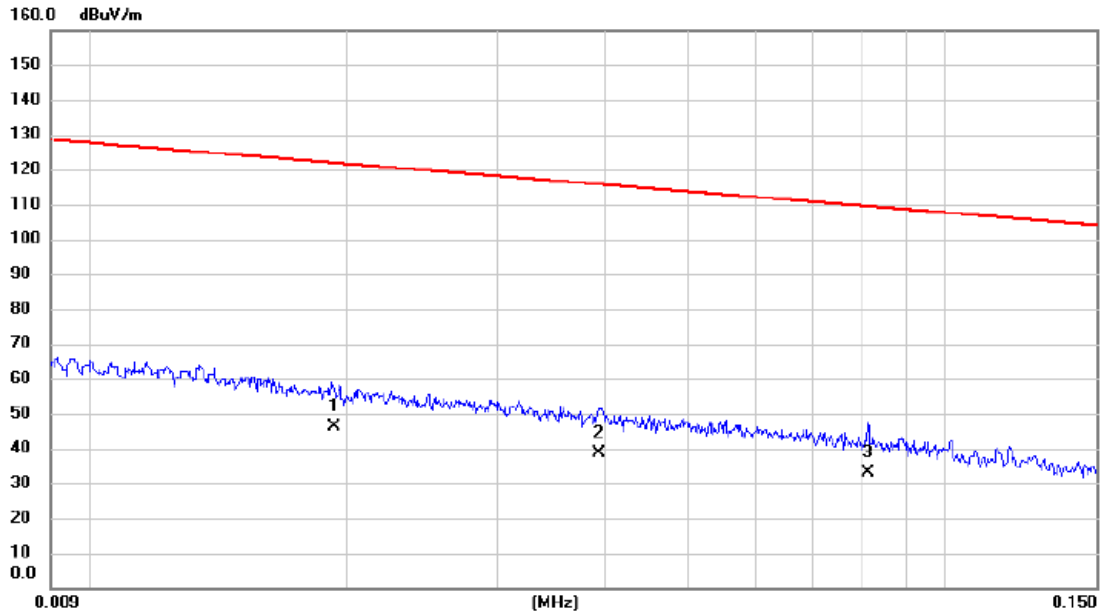
| eMTC Band 12_1.4M                                                                  |                |                                                                                    |                |
|------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------|----------------|
| Channel                                                                            | Frequency(MHz) | Channel                                                                            | Frequency(MHz) |
| 23173                                                                              | 715.3          | 23173                                                                              | 715.3          |
|   |                |  |                |
| Channel                                                                            | Frequency(MHz) | -                                                                                  | -              |
| 23173                                                                              | 715.3          | -                                                                                  | -              |
|  |                | -                                                                                  |                |

Note: The spike is no limit.

## APPENDIX D - RADIATED EMISSION

Test Mode: TX Mode

Ant 0°

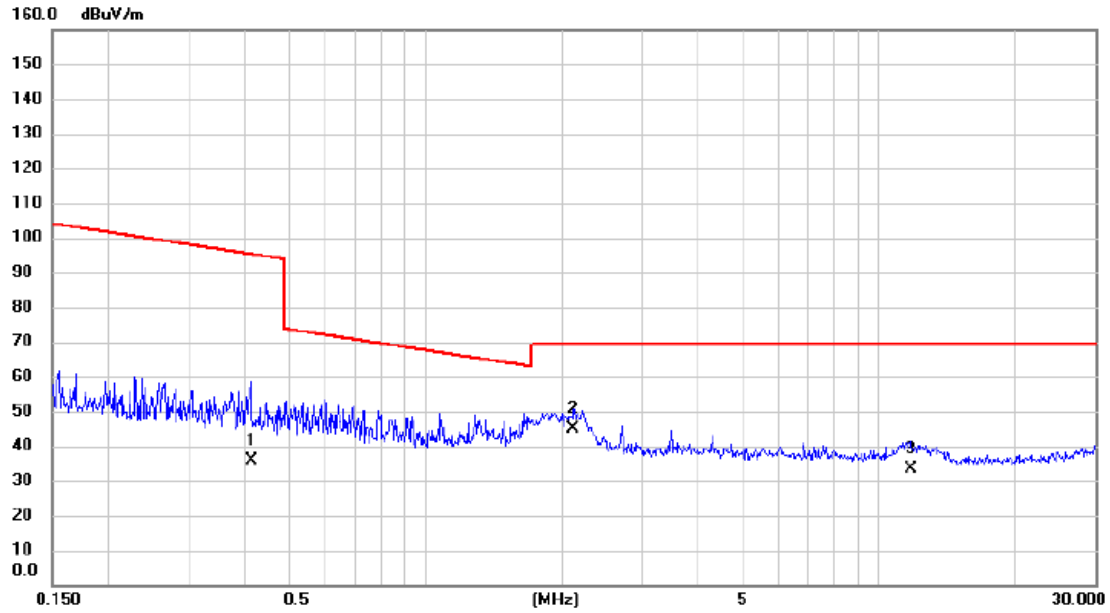


| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measure-ment | Limit  | Margin |          |         |
|-----|-----|--------|---------------|----------------|--------------|--------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV/m       | dBuV/m | dB     | Detector | Comment |
| 1   | *   | 0.0193 | 32.10         | 14.03          | 46.13        | 121.89 | -75.76 | AVG      |         |
| 2   |     | 0.0394 | 24.80         | 13.89          | 38.69        | 115.69 | -77.00 | AVG      |         |
| 3   |     | 0.0812 | 19.30         | 13.54          | 32.84        | 109.41 | -76.57 | AVG      |         |

Note: \* is maximum data.

Test Mode: TX Mode

Ant 0°

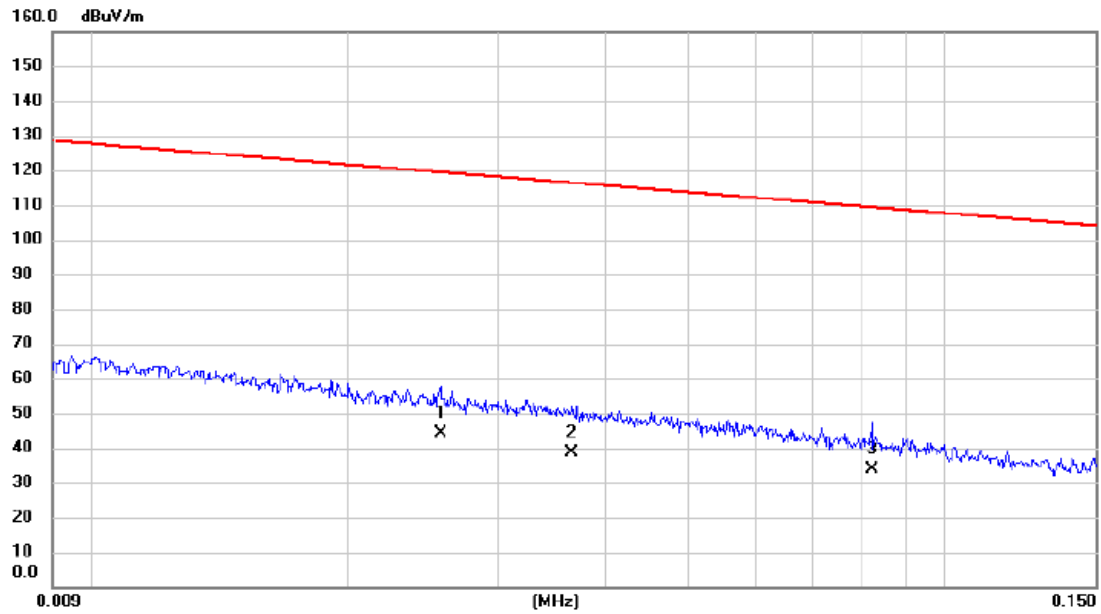


| No. | Mk. | Freq.   | Reading Level | Correct Factor | Measurement | Limit  | Margin |          |         |
|-----|-----|---------|---------------|----------------|-------------|--------|--------|----------|---------|
|     |     | MHz     | dBuV          | dB             | dBuV/m      | dBuV/m | dB     | Detector | Comment |
| 1   |     | 0.4127  | 22.40         | 13.27          | 35.67       | 95.29  | -59.62 | AVG      |         |
| 2   | *   | 2.1213  | 33.10         | 11.75          | 44.85       | 69.54  | -24.69 | QP       |         |
| 3   |     | 11.7446 | 21.90         | 11.62          | 33.52       | 69.54  | -36.02 | QP       |         |

Note: \* is maximum data.

Test Mode: TX Mode

Ant 90°

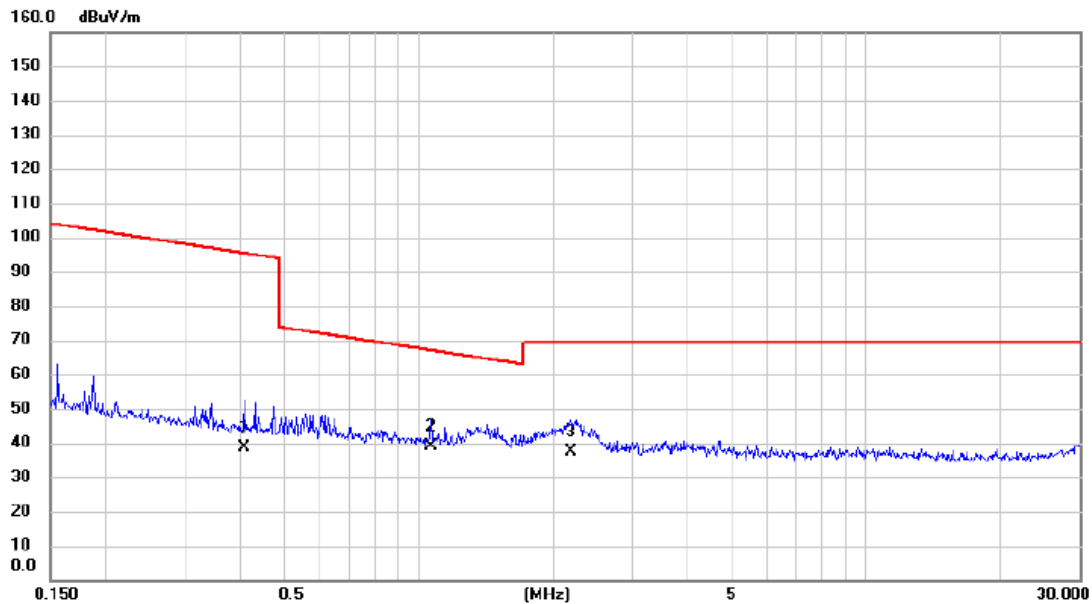


| No. | Mk. | Freq.  | Reading Level | Correct Factor | Measurement | Limit  | Margin |          |         |
|-----|-----|--------|---------------|----------------|-------------|--------|--------|----------|---------|
|     |     | MHz    | dBuV          | dB             | dBuV/m      | dBuV/m | dB     | Detector | Comment |
| 1   | *   | 0.0257 | 30.20         | 13.84          | 44.04       | 119.41 | -75.37 | AVG      |         |
| 2   |     | 0.0366 | 24.80         | 13.89          | 38.69       | 116.34 | -77.65 | AVG      |         |
| 3   |     | 0.0822 | 20.10         | 13.54          | 33.64       | 109.31 | -75.67 | AVG      |         |

Note: \* is maximum data.

Test Mode: TX Mode

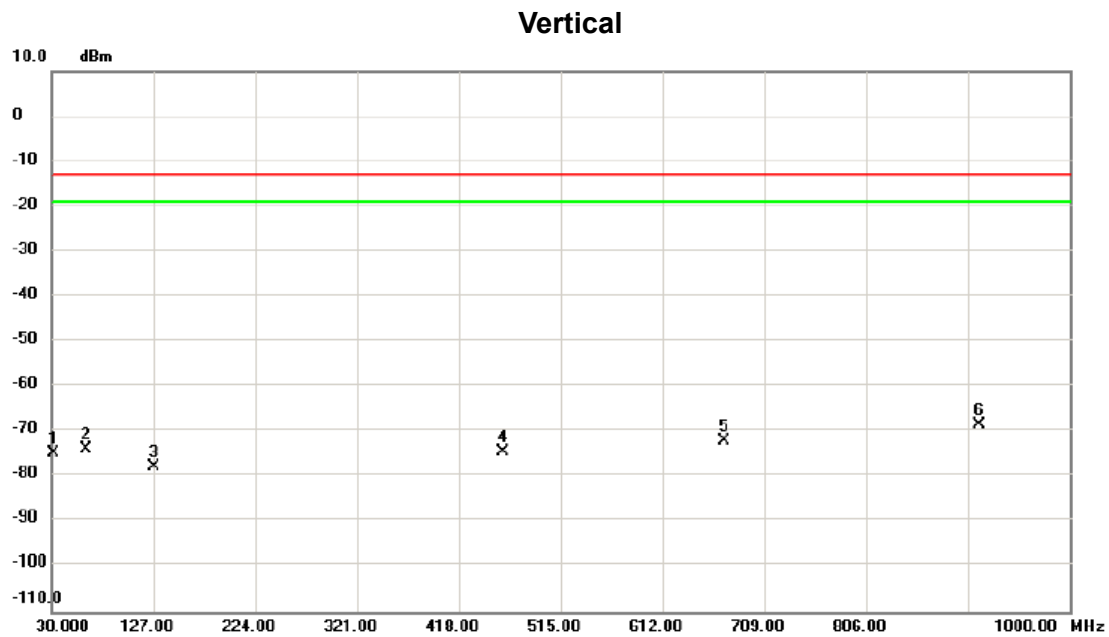
Ant 90°



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dB | Detector | Comment |
|-----|-----|--------------|--------------------------|-------------------------|----------------------------|-----------------|--------------|----------|---------|
| 1   |     | 0.4083       | 25.30                    | 13.28                   | 38.58                      | 95.38           | -56.80       | AVG      |         |
| 2   | *   | 1.0653       | 26.70                    | 12.45                   | 39.15                      | 67.05           | -27.90       | QP       |         |
| 3   |     | 2.1898       | 25.80                    | 11.71                   | 37.51                      | 69.54           | -32.03       | QP       |         |

Note: \* is maximum data.

Test Mode: eMTC Band 4\_TX CH20175\_1.4M

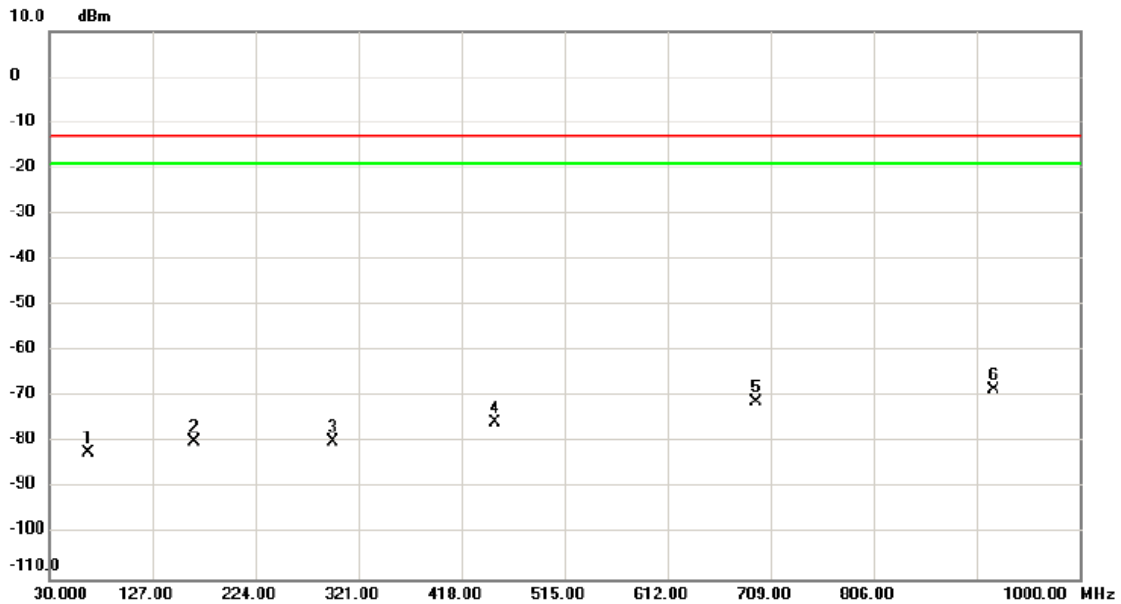


| No. | Mk. | Freq.   | Reading Level | Correct Factor | Measure-ment | Limit  | Margin |          |         |
|-----|-----|---------|---------------|----------------|--------------|--------|--------|----------|---------|
|     |     | MHz     | dBm           | dB             | dBm          | dBm    | dB     | Detector | Comment |
| 1   |     | 31.455  | -59.87        | -14.84         | -74.71       | -13.00 | -61.71 | peak     |         |
| 2   |     | 62.495  | -58.80        | -15.00         | -73.80       | -13.00 | -60.80 | peak     |         |
| 3   |     | 127.485 | -64.64        | -13.04         | -77.68       | -13.00 | -64.68 | peak     |         |
| 4   |     | 460.195 | -66.55        | -8.00          | -74.55       | -13.00 | -61.55 | peak     |         |
| 5   |     | 671.170 | -67.79        | -4.40          | -72.19       | -13.00 | -59.19 | peak     |         |
| 6   | *   | 914.155 | -66.89        | -1.60          | -68.49       | -13.00 | -55.49 | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 4\_TX CH20175\_1.4M

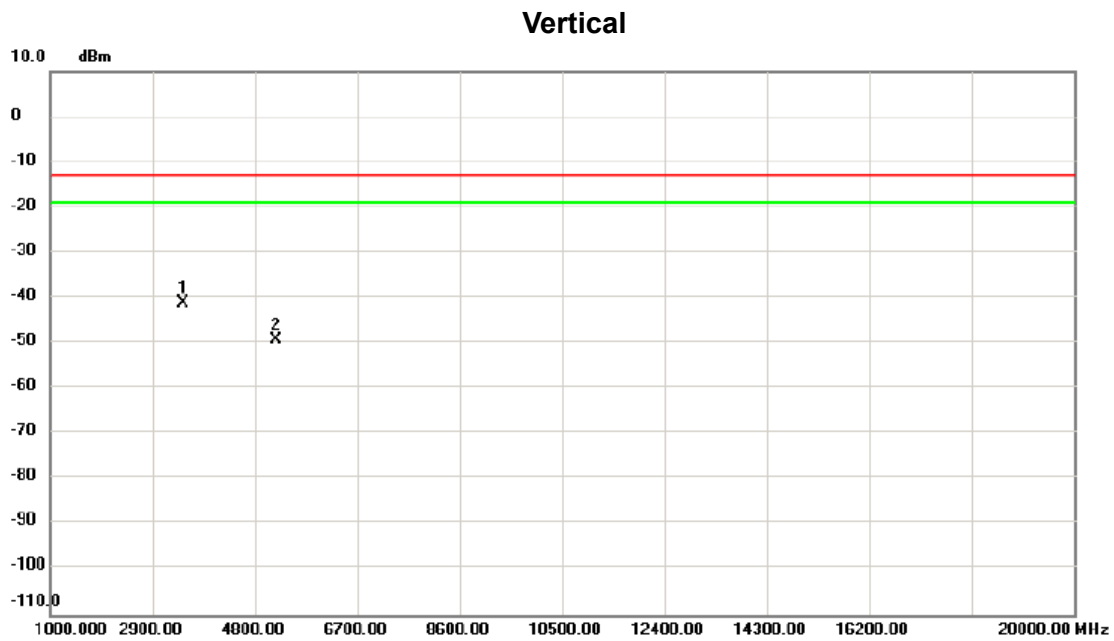
### Horizontal



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBm | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBm | Limit<br>dBm | Margin<br>dB | Detector | Comment |
|-----|-----|--------------|-------------------------|-------------------------|-------------------------|--------------|--------------|----------|---------|
| 1   |     | 66.375       | -66.73                  | -15.46                  | -82.19                  | -13.00       | -69.19       | peak     |         |
| 2   |     | 166.770      | -67.79                  | -11.97                  | -79.76                  | -13.00       | -66.76       | peak     |         |
| 3   |     | 296.750      | -68.15                  | -11.63                  | -79.78                  | -13.00       | -66.78       | peak     |         |
| 4   |     | 449.040      | -67.45                  | -8.11                   | -75.56                  | -13.00       | -62.56       | peak     |         |
| 5   |     | 695.905      | -67.15                  | -4.07                   | -71.22                  | -13.00       | -58.22       | peak     |         |
| 6   | *   | 918.520      | -66.83                  | -1.50                   | -68.33                  | -13.00       | -55.33       | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 4\_TX CH20175\_1.4M

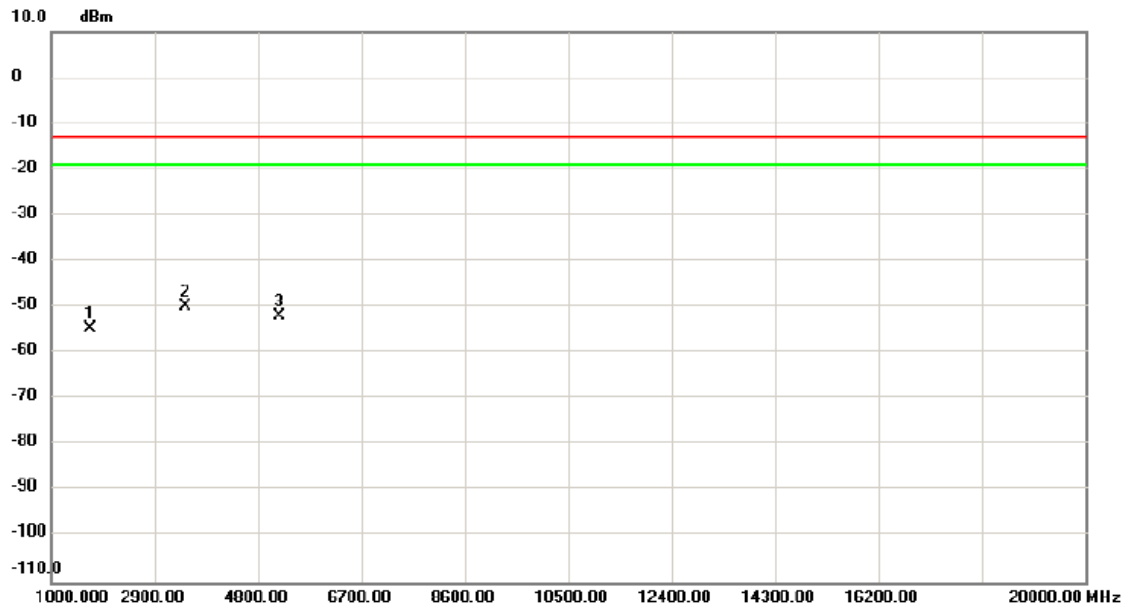


| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBm | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBm | Limit<br>dBm | Margin<br>dB | Detector | Comment |
|-----|-----|--------------|-------------------------|-------------------------|-------------------------|--------------|--------------|----------|---------|
| 1   | *   | 3460.500     | -42.12                  | 0.94                    | -41.18                  | -13.00       | -28.18       | peak     |         |
| 2   |     | 5199.000     | -53.62                  | 4.43                    | -49.19                  | -13.00       | -36.19       | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 4\_TX CH20175\_1.4M

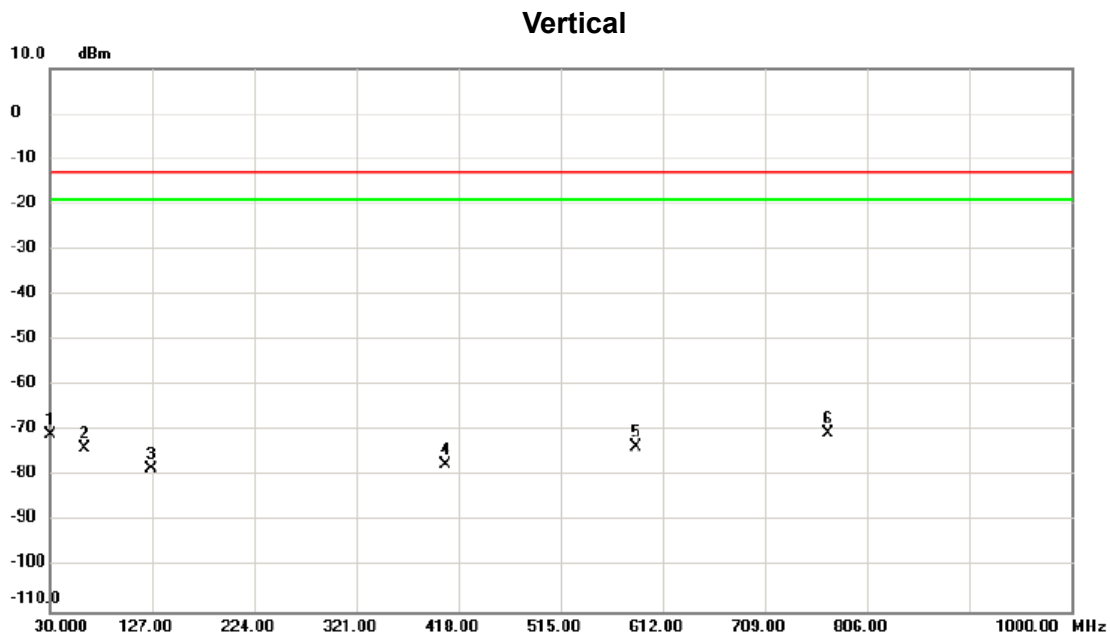
### Horizontal



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBm | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBm | Limit<br>dBm | Margin<br>dB | Detector | Comment |
|-----|-----|--------------|-------------------------|-------------------------|-------------------------|--------------|--------------|----------|---------|
| 1   |     | 1731.500     | -49.95                  | -4.70                   | -54.65                  | -13.00       | -41.65       | peak     |         |
| 2   | *   | 3460.500     | -50.70                  | 0.94                    | -49.76                  | -13.00       | -36.76       | peak     |         |
| 3   |     | 5199.000     | -56.44                  | 4.43                    | -52.01                  | -13.00       | -39.01       | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 12\_TX CH23173\_1.4M

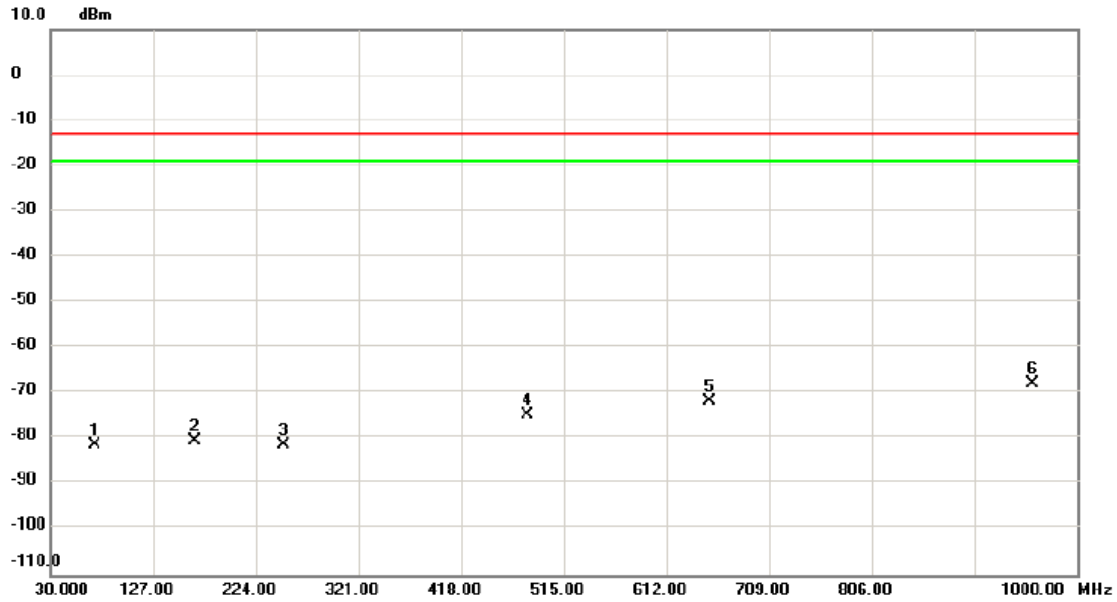


| No. | Mk. | Freq.   | Reading Level | Correct Factor | Measurement | Limit  | Margin |          |         |
|-----|-----|---------|---------------|----------------|-------------|--------|--------|----------|---------|
|     |     | MHz     | dBm           | dB             | dBm         | dBm    | dB     | Detector | Comment |
| 1   |     | 30.000  | -55.80        | -15.01         | -70.81      | -13.00 | -57.81 | peak     |         |
| 2   |     | 62.980  | -58.80        | -15.03         | -73.83      | -13.00 | -60.83 | peak     |         |
| 3   |     | 126.030 | -65.22        | -13.04         | -78.26      | -13.00 | -65.26 | peak     |         |
| 4   |     | 405.875 | -68.15        | -9.30          | -77.45      | -13.00 | -64.45 | peak     |         |
| 5   |     | 587.265 | -67.41        | -6.11          | -73.52      | -13.00 | -60.52 | peak     |         |
| 6   | *   | 769.625 | -67.04        | -3.39          | -70.43      | -13.00 | -57.43 | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 12\_TX CH23173\_1.4M

### Horizontal

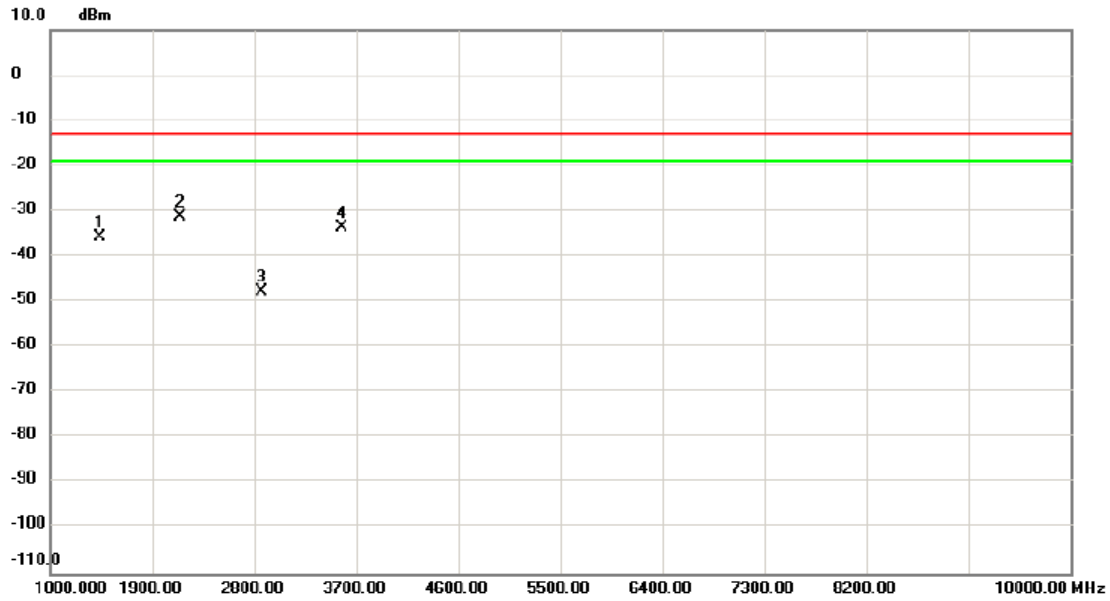


| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBm | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBm | Limit<br>dBm | Margin<br>dB | Detector | Comment |
|-----|-----|--------------|-------------------------|-------------------------|-------------------------|--------------|--------------|----------|---------|
| 1   |     | 72.195       | -64.60                  | -16.63                  | -81.23                  | -13.00       | -68.23       | peak     |         |
| 2   |     | 165.800      | -68.54                  | -11.82                  | -80.36                  | -13.00       | -67.36       | peak     |         |
| 3   |     | 250.190      | -67.51                  | -13.70                  | -81.21                  | -13.00       | -68.21       | peak     |         |
| 4   |     | 480.080      | -66.88                  | -7.84                   | -74.72                  | -13.00       | -61.72       | peak     |         |
| 5   |     | 653.225      | -67.17                  | -4.64                   | -71.81                  | -13.00       | -58.81       | peak     |         |
| 6   | *   | 957.805      | -67.30                  | -0.64                   | -67.94                  | -13.00       | -54.94       | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 12\_TX CH23173\_1.4M

Vertical

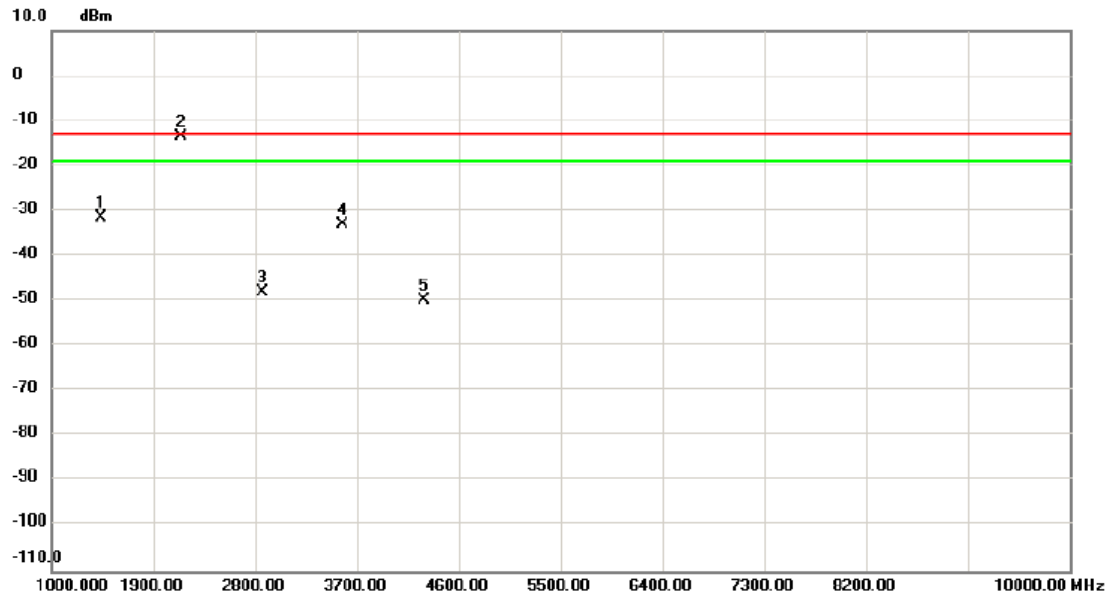


| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBm | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBm | Limit<br>dBm | Margin<br>dB | Detector | Comment |
|-----|-----|--------------|-------------------------|-------------------------|-------------------------|--------------|--------------|----------|---------|
| 1   |     | 1432.000     | -29.29                  | -6.47                   | -35.76                  | -13.00       | -22.76       | peak     |         |
| 2   | *   | 2147.500     | -28.07                  | -3.18                   | -31.25                  | -13.00       | -18.25       | peak     |         |
| 3   |     | 2863.000     | -45.96                  | -1.67                   | -47.63                  | -13.00       | -34.63       | peak     |         |
| 4   |     | 3578.500     | -34.97                  | 1.28                    | -33.69                  | -13.00       | -20.69       | peak     |         |

Note: \* is maximum data.

Test Mode: eMTC Band 12\_TX CH23173\_1.4M

### Horizontal



| No. | Mk. | Freq.    | Reading Level | Correct Factor | Measurement | Limit  | Margin |          |         |
|-----|-----|----------|---------------|----------------|-------------|--------|--------|----------|---------|
|     |     | MHz      | dBm           | dB             | dBm         | dBm    | dB     | Detector | Comment |
| 1   |     | 1432.000 | -25.15        | -6.47          | -31.62      | -13.00 | -18.62 | peak     |         |
| 2   | *   | 2147.260 | -10.39        | -3.18          | -13.57      | -13.00 | -0.57  | peak     |         |
| 3   |     | 2863.000 | -46.30        | -1.67          | -47.97      | -13.00 | -34.97 | peak     |         |
| 4   |     | 3578.500 | -34.30        | 1.28           | -33.02      | -13.00 | -20.02 | peak     |         |
| 5   |     | 4294.000 | -52.12        | 2.39           | -49.73      | -13.00 | -36.73 | peak     |         |

Note: \* is maximum data.

## APPENDIX E - BAND EDGE

eMTC Band 4\_1.4M - QPSK

1RB0

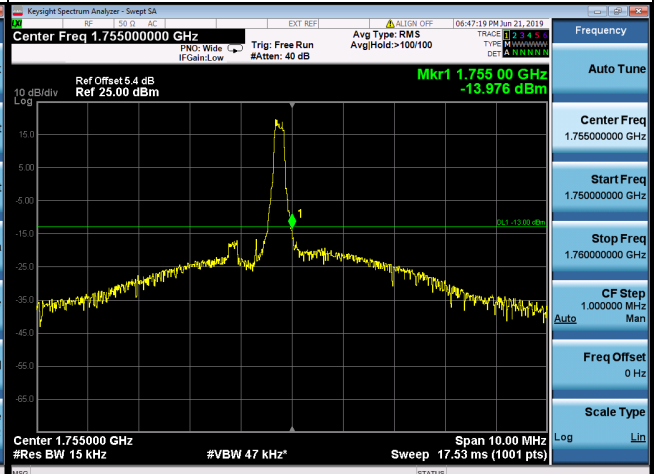
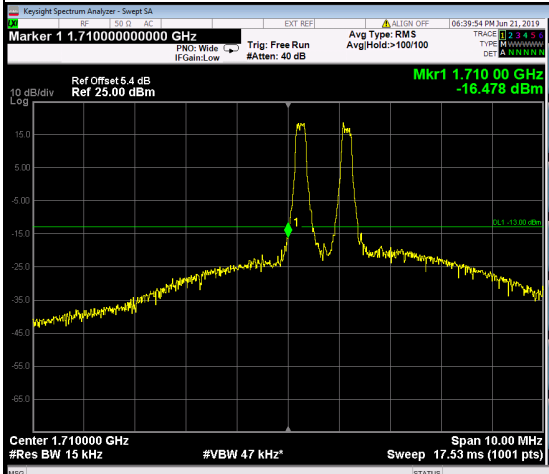
1RB5

Channel

19975

Channel

20393



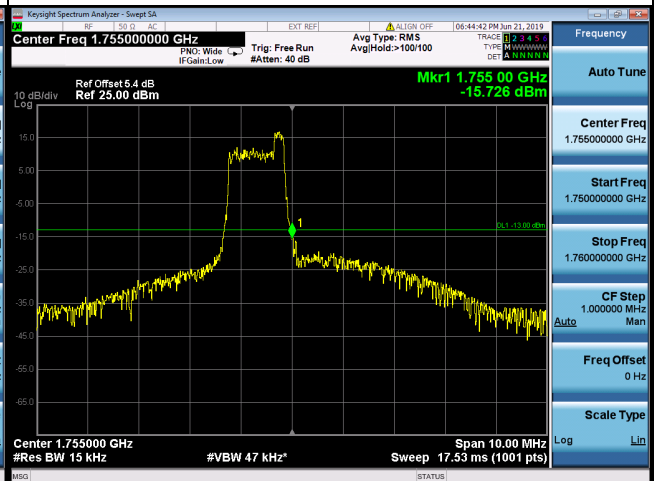
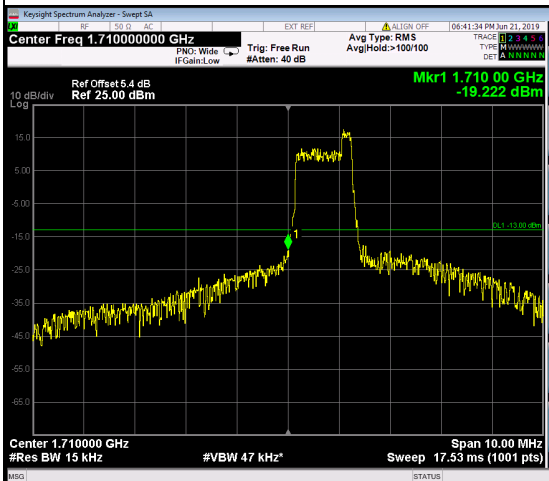
Full RB

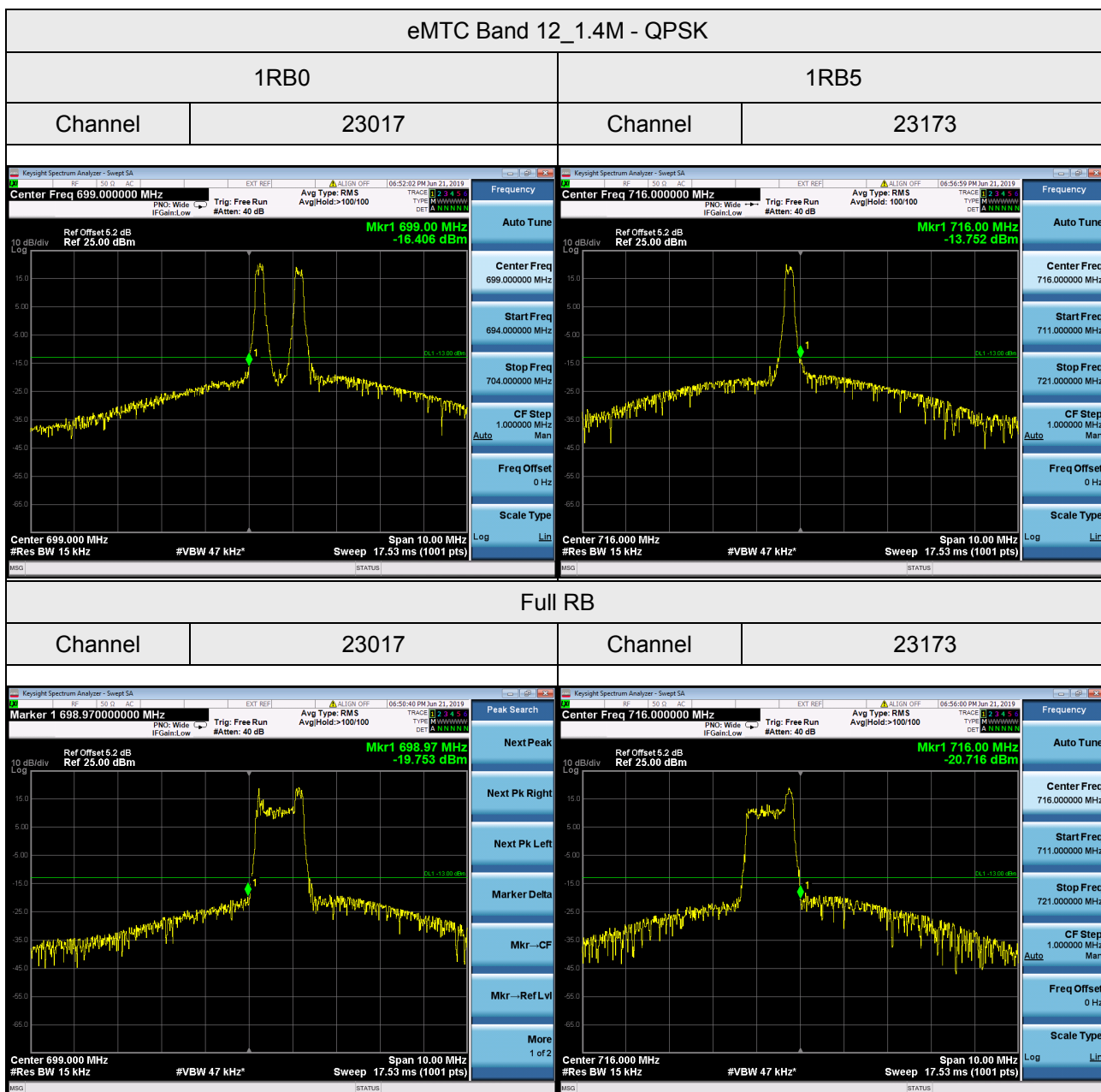
Channel

19975

Channel

20393

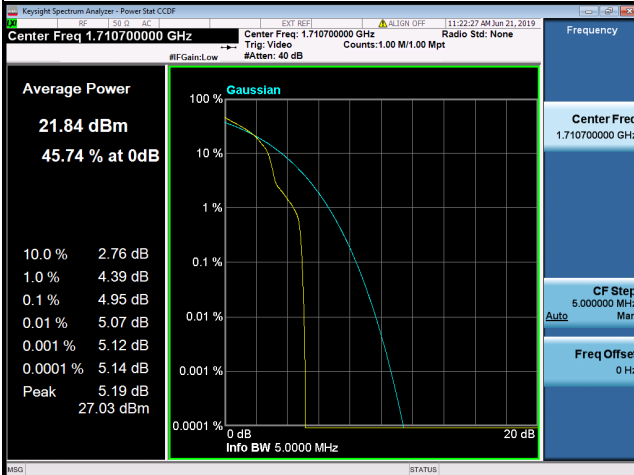




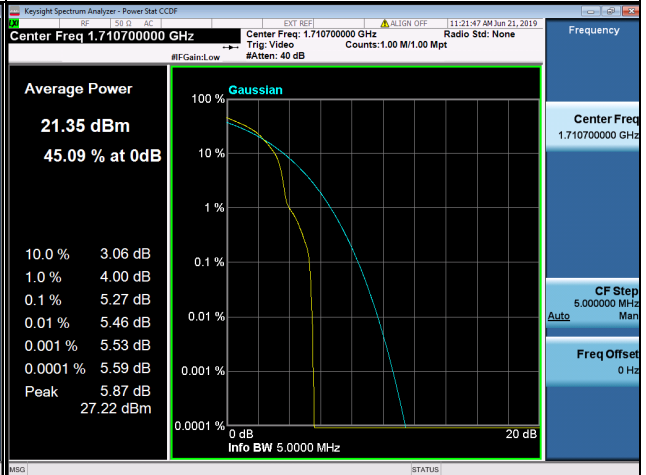
## APPENDIX F - PEAK TO AVERAGE RATIO

# eMTC Band 4 Spectrum Plot\_1.4M

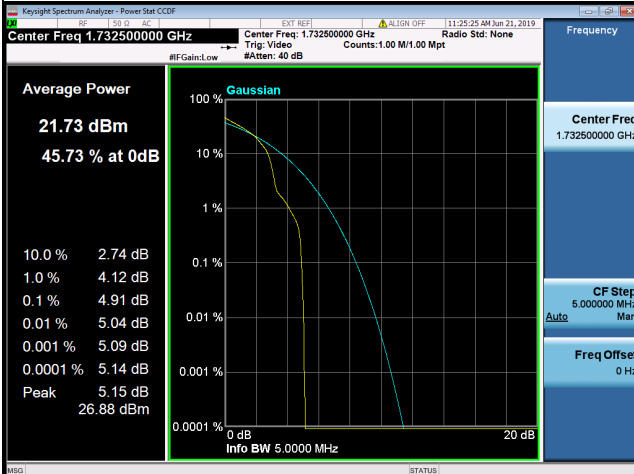
## QPSK-19957



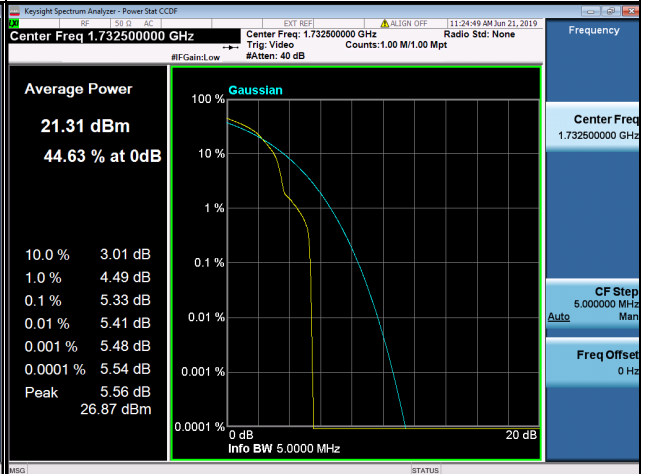
## 16QAM-19957



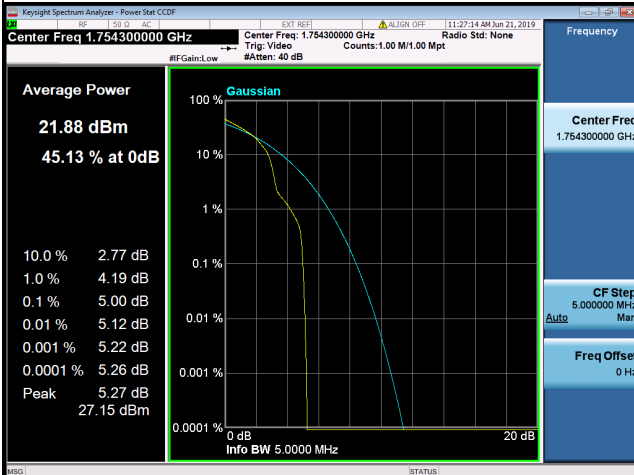
## QPSK-20175



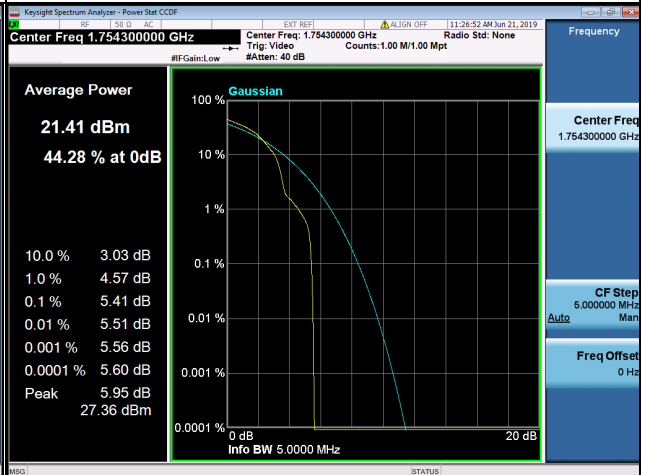
## 16QAM-20175



## QPSK-20393



## 16QAM-20393



# eMTC Band 12 Spectrum Plot\_1.4M



## APPENDIX G - FREQUENCY STABILITY

|            |                          |
|------------|--------------------------|
| Test Mode: | eMTC Band 4_CH20175_1.4M |
|------------|--------------------------|

### Temperature vs. Frequency Stability

| Temperature(°C)      | Frequency Error (Hz) | Frequency Error (ppm) | Limit(ppm) |
|----------------------|----------------------|-----------------------|------------|
| -30                  | 3.14                 | 0.00181241            | ±2.5       |
| -20                  | -3.54                | -0.00204329           |            |
| -10                  | -4.69                | -0.002707071          |            |
| 0                    | 5.14                 | 0.002966811           |            |
| 10                   | -6.21                | -0.003584416          |            |
| 20                   | -4.15                | -0.002395382          |            |
| 30                   | 5.48                 | 0.003163059           |            |
| 40                   | 3.82                 | 0.002204906           |            |
| 50                   | -6.28                | -0.00362482           |            |
| Max. Deviation (ppm) | -6.28                | -0.00362482           |            |

### Voltage vs. Frequency Stability

| Voltage(Volts)       | Frequency Error (Hz) | Frequency Error (ppm) | Limit(ppm) |
|----------------------|----------------------|-----------------------|------------|
| 10.8                 | -7.81                | -0.004507937          | ±2.5       |
| 12.0                 | -3.65                | -0.002106782          |            |
| 13.2                 | -4.21                | -0.002430014          |            |
| Max. Deviation (ppm) | -7.81                | -0.004507937          |            |

|            |                           |
|------------|---------------------------|
| Test Mode: | eMTC Band 12_CH23095_1.4M |
|------------|---------------------------|

### Temperature vs. Frequency Stability

| Temperature(°C)      | Frequency Error (Hz) | Frequency Error (ppm) | Limit(ppm) |
|----------------------|----------------------|-----------------------|------------|
| -30                  | -6.32                | 0.008932862           | ±2.5       |
| -20                  | -4.14                | 0.00585159            |            |
| -10                  | 7.48                 | 0.010572438           |            |
| 0                    | 4.21                 | 0.00595053            |            |
| 10                   | 8.21                 | 0.01160424            |            |
| 20                   | -5.54                | 0.007830389           |            |
| 30                   | 6.28                 | 0.008876325           |            |
| 40                   | -3.14                | 0.004438163           |            |
| 50                   | -2.95                | 0.004169611           |            |
| Max. Deviation (ppm) | 8.21                 | 0.01160424            |            |

### Voltage vs. Frequency Stability

| Voltage(Volts)       | Frequency Error (Hz) | Frequency Error (ppm) | Limit(ppm) |
|----------------------|----------------------|-----------------------|------------|
| 10.8                 | 3.58                 | 0.005060071           | ±2.5       |
| 12.0                 | -8.49                | 0.012                 |            |
| 13.2                 | 3.18                 | 0.0044947             |            |
| Max. Deviation (ppm) | -8.49                | 0.012                 |            |

**End of Test Report**