

FCC DTS RF TEST REPORT



Vista Labs
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| | |
|---------------------------|--|
| Test Report Number..... | HME-19081322-LC-FCC-DTS |
| Applicant..... | HM Electronics Inc |
| Applicant Address..... | 2848 Whiptail Loop, Carlsbad, CA 92010 USA |
| Product Name..... | Base Transceiver |
| Model Number..... | 1408-US |
| Family Product/Model..... | N/A |
| FCC ID..... | BYM1408 |
| Date of EUT received..... | 09/27/2019 |
| Date of Test..... | 09/27/2019 – 12/30/2019 |
| Report Issue Date..... | 05/12/2020 |
| Test Standards..... | 47CFR Part 15.247 |
| Test Result..... | Pass |

Issued By:

Vista Laboratories

1261 Puerta Del Sol, San Clemente, CA 92673 USA

www.vista-compliance.com

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report. This report is not to be reproduced by any means except in full and in any case not without the written approval of Vista Laboratories.

Tested by:

David Zhang/Test Engineer

Approved By:

Yuna Yin/Engineering Reviewer

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| Model Number: | 1408-US |



Laboratory Introduction

Vista Labs is an A2LA accredited 17025 compliant regulatory compliance testing laboratories (Cert. number: 4848-01) strategically located in Orange County, providing services in the electrical and telecommunication industries. Vista labs is also recognized testing facility for Australia (ACMA), Chinese Taipei (BSMI), Chinese Taipei (NCC), Hong Kong (OFCA), Israel (MOC), Korea (RRA), Singapore (IMDA), Vietnam (MIC), etc.

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Presented this 21st day of June 2018.



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For the Accreditation Council
Certificate Number 4848.01
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Presented this 1st day of October 2018.



President and CEO
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Certificate Number 4848.02
Valid to July 31, 2020

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REVISION HISTORY

| Revision | Issue Date | Description | Note |
|----------|------------|------------------|------|
| Original | 05/12/2020 | Original release | N/A |
| | | | |
| | | | |
| | | | |



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1 General Information

1.1 Applicant

| | |
|------------------------------|--|
| Applicant: | HM Electronics Inc |
| Applicant address: | 2848 Whiptail Loop, Carlsbad, CA 92010 USA |
| Manufacturer: | HM Electronics Inc |
| Manufacturer Address: | 2848 Whiptail Loop, Carlsbad, CA 92010 USA |

1.2 Product information

| | |
|----------------------------------|---|
| Product Name | Base Transceiver |
| Model Number | 1408-US |
| Family Model Number | N/A |
| Serial Number | F46YC009 |
| Frequency Band | BLE: 2402-2480MHz 5Ghz-20Mhz: 5180-5240Mhz, 5260-5320Mhz, 5500-5720Mhz, 5745-5825Mhz |
| Type of modulation | BLE: GFSK 5GHz: OFDM |
| Equipment Class/ Category | DTS, UNII |
| Maximum output power | See test result |
| Antenna Information | BLE: Internal chip antenna, 2.5 dBi gain 5GHz: 2 x External omni-directional antenna, 4 dBi gain |
| Clock Frequencies | N/A |
| Port/Connectors | PoE, RJ45, USB-C, fiber optic |
| Input Power | 12VDC, 5A |
| Power Adapter Manu/Model | ATS065T-P120 |
| Power Adapter SN | uA67-1012-C14-2 |
| Hardware version | N/A |
| Software version | N/A |
| Simultaneous Transmission | BLE and 5GHz can transmit simultaneously |
| Additional Info | EUT has two 5GHz antennas, but these two antennas do not transmit simultaneously. |

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1.3 Test standard and method

| | |
|----------------------|---|
| Test standard | 47CFR Part 15.247 |
| Test method | ANSI C63.10: 2013 558074 D01 15.247 Meas Guidance v05r02 |

1.4 Test Purpose and statement

The purpose of this test report is intended to demonstrate the compliance of product listed in section 1.2, received from company listed in section 1.1, to the requirements of standard and method listed in section 1.3. Based on our test results, we conclude that the product tested complies with the requirements of the standards indicated.

2 Test site information

| | |
|-----------------------------|---|
| Lab performing tests | Vista Laboratories |
| Lab Address | 1261 Puerta Del Sol, San Clemente, CA 92673 USA |
| Phone Number | +1 (949) 393-1123 |
| Website | www.Vista-compliance.com |

| Test condition | Test Engineer | Test Environment | Test Date |
|----------------|---------------|-------------------------|-------------------------|
| RF conducted | David Zhang | 23.5°C / 58.2%/996 mbar | 09/27/2019 – 12/30/2019 |
| Radiated | David Zhang | 23.5°C / 58.2%/996 mbar | 09/27/2019 – 12/30/2019 |

3 Modification of EUT

The EUT is an engineering test sample loaded with RF testing firmware specifically designed to support the RF TX/RX measurement in different aspects.

4 Test configuration and operation

4.1 EUT test configuration

EUT is powered by external DC power supply for testing purpose. EUT's RF antenna port is connected to spectrum analyzer through RF test cable for measurement. The test software is used to set EUT to different transmission mode in terms of radio mode (5GHz, BLE), test channel, modulation on/off, etc.

4.2 EUT test mode

| Radio | Channel | Frequency (MHz) |
|-------|---------|-----------------|
| BLE | 0 | 2402 |
| BLE | 20 | 2442 |
| BLE | 39 | 2480 |

4.3 Supporting Equipment

| Index | Description | Model | S/N | Brand | Remark |
|-------|---------------|--------------|------------------|---------------|--------|
| 1 | AC/DC Adapter | ATS065T-P120 | uA67-1012-C14-11 | eUrasia Power | - |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

4.4 EUT setup diagram



4.5 EUT operation

The test software is used to set EUT to different transmission mode in terms of radio mode (5GHz, BLE), test channel, data rate, etc. For Cellular radio, it's controlled by communication tester to change to different mode.

4.6 Test software

| Index | Description | Remark |
|-------|-----------------------|---|
| 1 | Putty.exe 0.63 | Set Wi-Fi radio to different test mode |
| 2 | EMISoft Vasona 6.0049 | EMC/Spurious emission test software used during testing |
| | | |
| | | |

5 EUT and test setup pictures

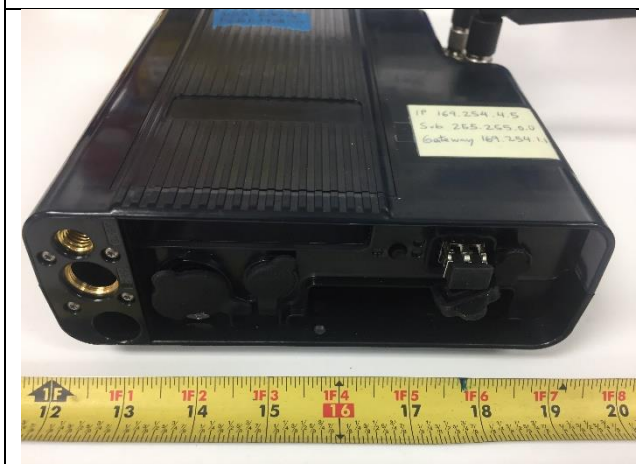
5.1 EUT external pictures



EUT Top View



EUT Bottom View



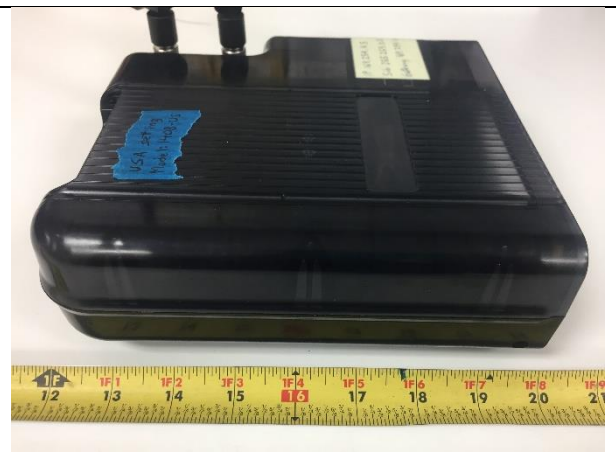
EUT Front View



EUT Rear View

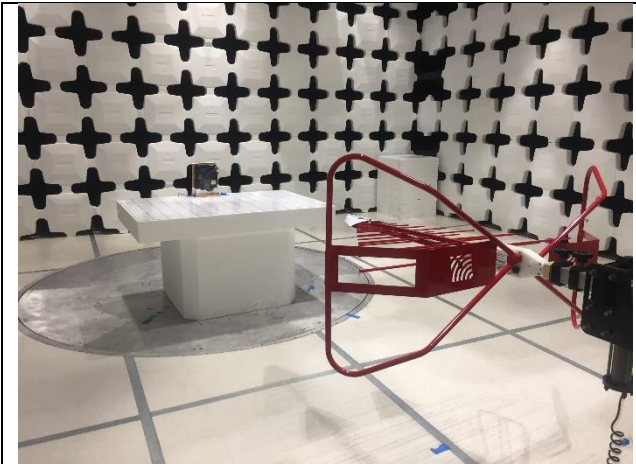


EUT Left View

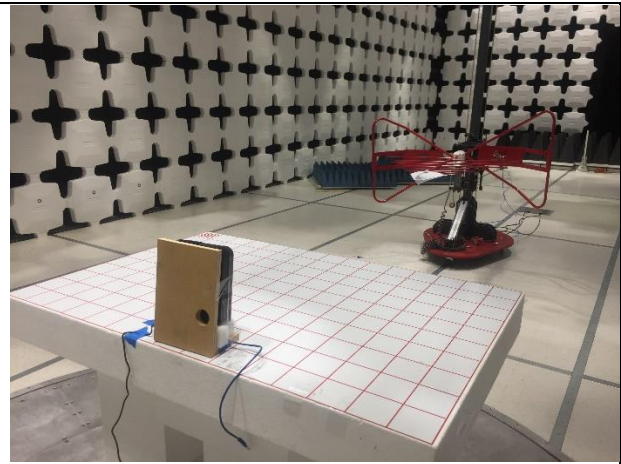


EUT Right View

5.2 EUT test setup



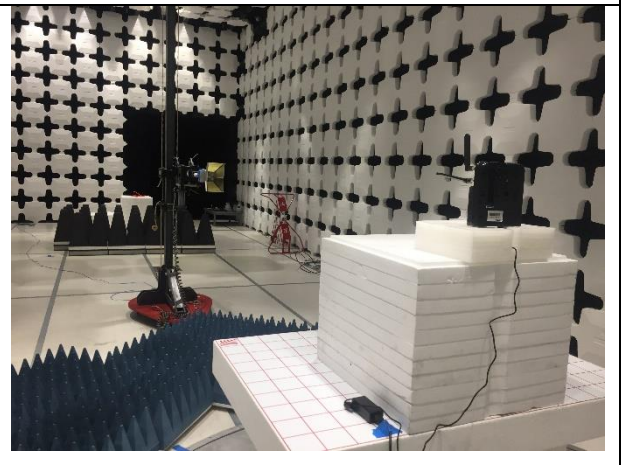
RE Below 1GHz – Front View



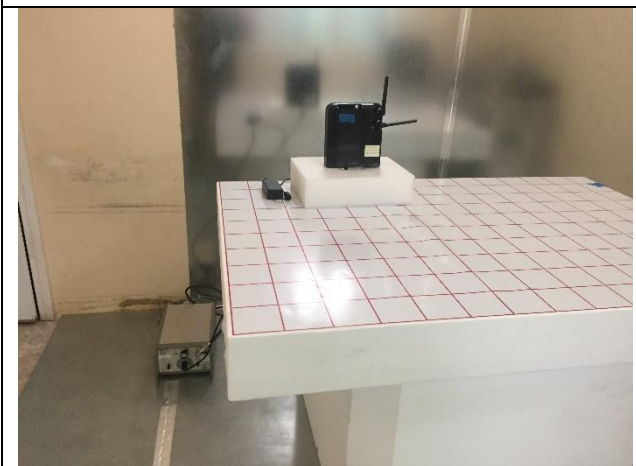
RE Below 1GHz – Rear View



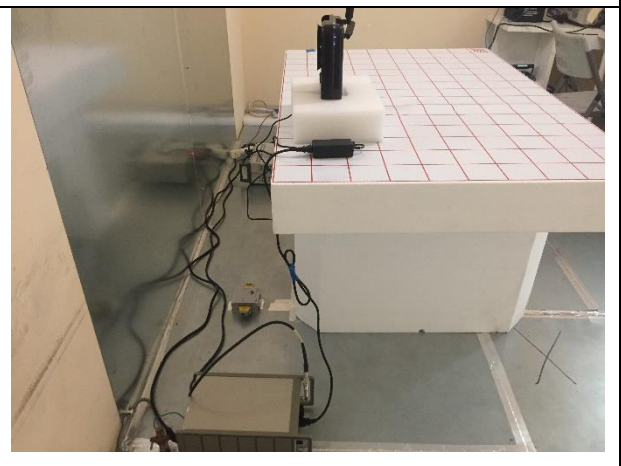
RE Above 1GHz – Front View



RE Above 1GHz – Rear View



AC Line CE – Front View



AC Line CE – Rear View

| | |
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6 Test Summary

| FCC Rules | Test Item | Section | Verdict |
|------------------|---|---------|---------|
| §15.203 | Antenna Requirement | 8.1 | Pass |
| §15.247 (a)(2) | DTS (6 dB) Channel Bandwidth | 8.2 | Pass |
| §15.247(b)(3) | Conducted Maximum Output Power | 8.3 | Pass |
| §15.247(e) | Power Spectral Density | 8.4 | Pass |
| §15.247(d) | Conducted Band-Edge & Unwanted Emissions | 8.5 | Pass |
| §15.205, §15.209 | Radiated Emissions & Unwanted Emissions into Restricted Frequency Bands | 8.6 | Pass |
| §15.207 (a) | AC Power Line Conducted Emissions | 8.7 | Pass |

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7 Uncertainty of Measurement

| Test item | Measurement Uncertainty (dB) |
|--------------------------------|------------------------------|
| RF Output Power (Conducted) | ±1.2 dB |
| Power Spectral Density | ±0.9 dB |
| Unwanted Emission (conducted) | ±2.6 dB |
| Occupied Channel Bandwidth | ±5 % |
| Radiated Emission (9KHz-30MHz) | ±3.5 dB |
| Radiated Emission (30MHz-1GHz) | ±4.6 dB |
| Radiated Emission (1-18GHz) | ±4.9 dB |
| Radiated Emission (18-40GHz) | ±3.5 dB |

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8 Test summary and result

8.1 Antenna Requirement

8.1.1 Requirement

Per § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

8.1.2 Result

Analysis:

EUT has an internal BLE chip antenna. No standard RF connector or coupling is used.

Conclusion:

EUT complies with antenna requirement in § 15.203.

| | |
|-----------------------|-------------------------|
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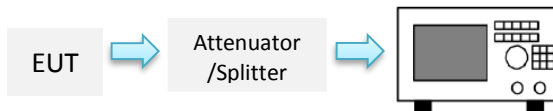
8.2 DTS (6 dB) Bandwidth

8.2.1 Requirement

§ 15.247 (a)(2)

Systems using digital modulation techniques may operate in the 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz bands. The minimum 6 dB bandwidth shall be at least 500 KHz.

8.2.2 Test setup



8.2.3 Test Procedure

According to section 8.2, option 2, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.8 of ANSI C63.10-2013:

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW $\geq 3 \times$ RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Use automatic bandwidth measurement capability on instrument to obtain BW result.

| | |
|-----------------------|-------------------------|
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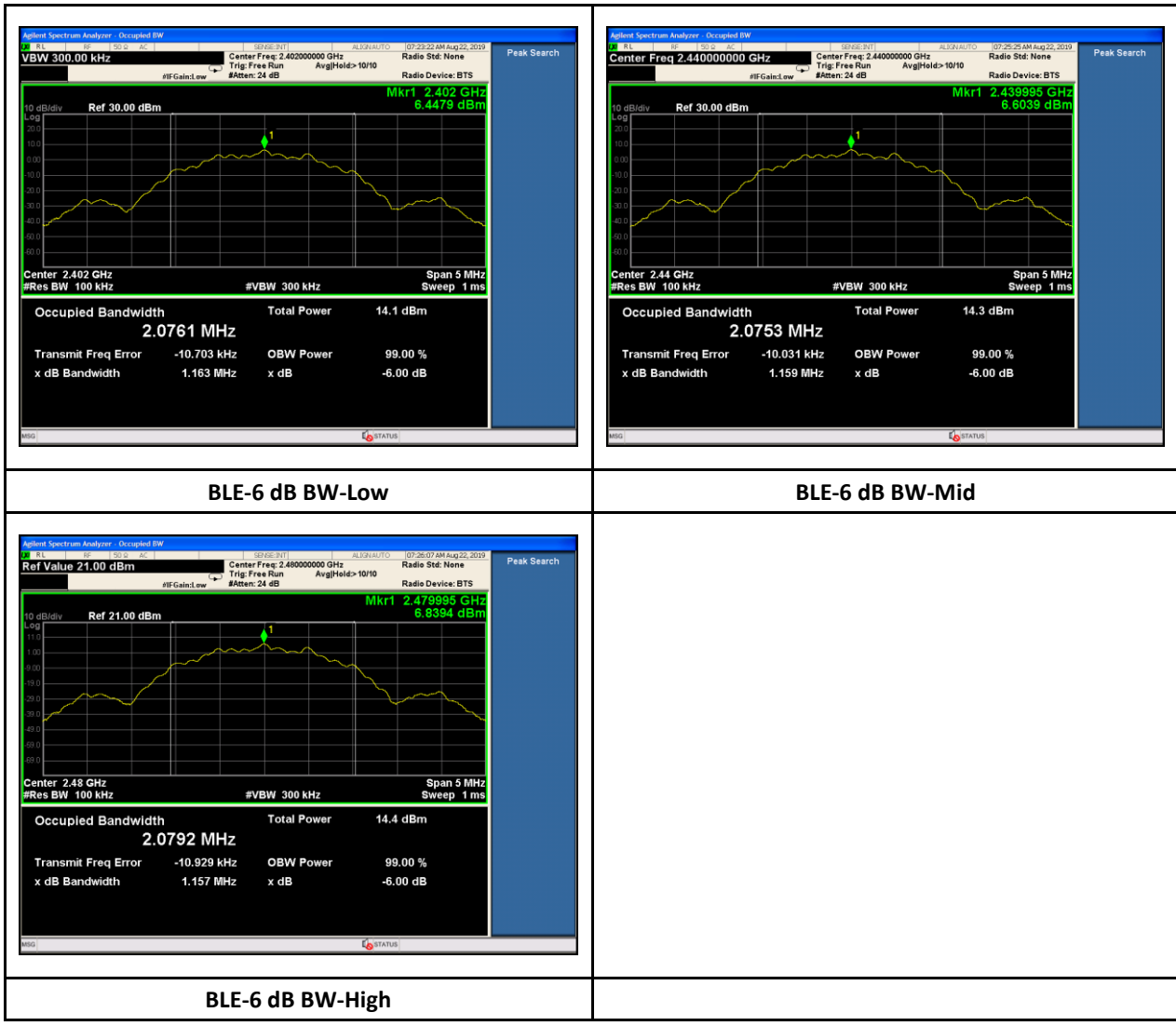
8.2.4 Test Result

| Mode/ Bandwidth | Frequency (MHz) | Data rate | Measured Bandwidth (KHz) | Minimum Bandwidth (KHz) | Result |
|--------------------|-----------------|-----------|--------------------------------|-------------------------------|--------|
| BLE | 2402 | 1Mbps | 1163 | 500 | Pass |
| BLE | 2440 | 1Mbps | 1159 | 500 | Pass |
| BLE | 2480 | 1Mbps | 1157 | 500 | Pass |

| | |
|-----------------------|-------------------------|
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8.2.5 Test Plots



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8.3 Maximum Output Power

8.3.1 Requirement

§ 15.247 (b)(3)

or systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: the maximum output power is 1 Watt.

If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.3.2 Test setup



8.3.3 Test Procedure

For BLE, power measurement is according to subclause 11.9.1.1 of ANSI C63.10-2013:

1. Set the RBW \geq DTS bandwidth
2. Set VBW $\geq 3 \times$ RBW.
2. Set SPAN $\geq 3 \times$ RBW.
3. Sweep time = auto couple.
4. Detector = peak.
5. Trace mode = max hold
6. Allow trace to fully stabilize.
7. Use peak marker function to determine the peak amplitude level.

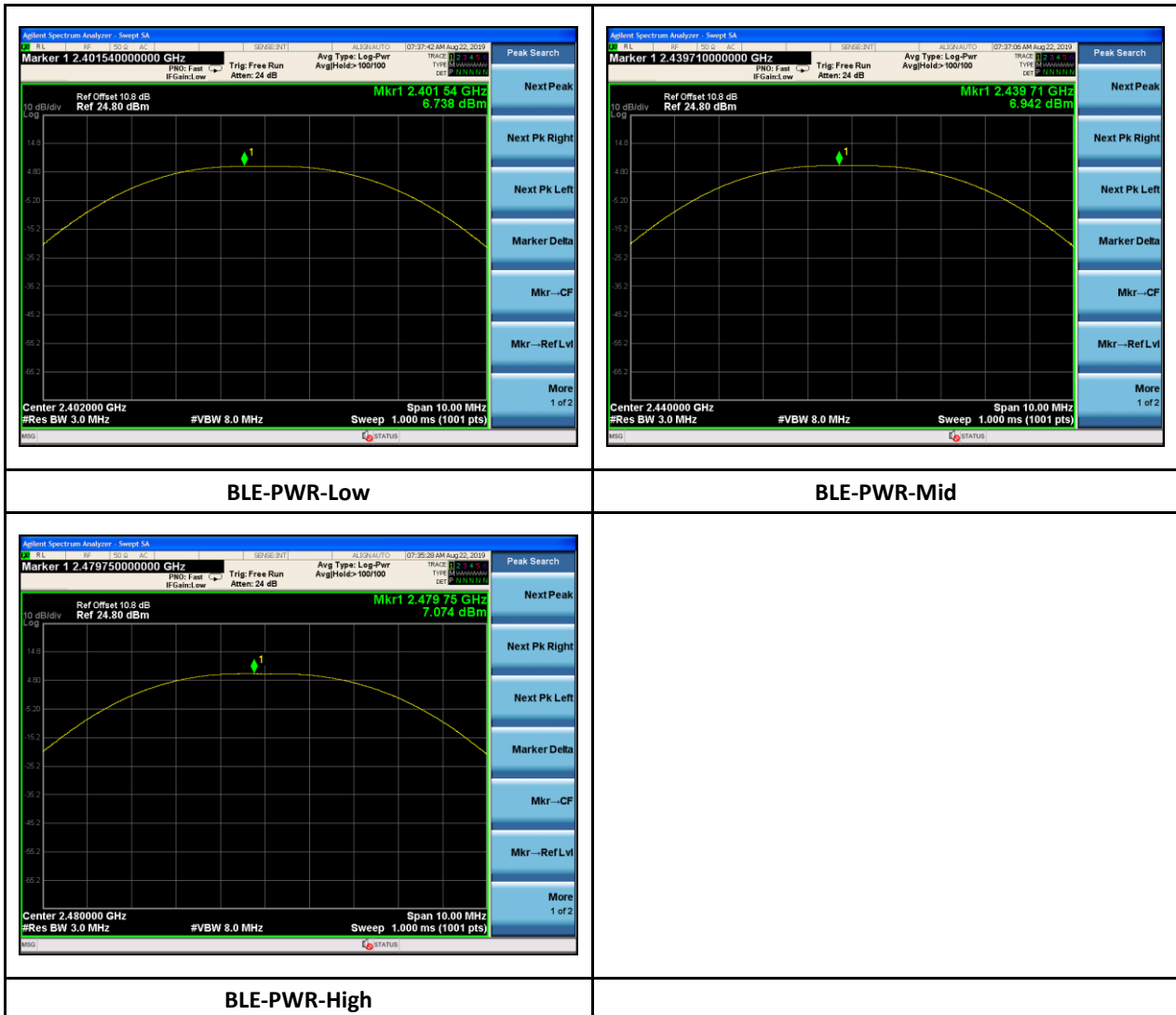
| | |
|-----------------------|-------------------------|
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8.3.4 Test Result

| Mode/ Bandwidth | Frequency (MHz) | Data rate | Measured Output Power (dBm) | Max Output Power (dBm) | Result |
|--------------------|--------------------|-----------|-----------------------------------|---------------------------|--------|
| BLE | 2402 | 1Mbps | 6.738 | 30 | Pass |
| BLE | 2440 | 1Mbps | 6.942 | 30 | Pass |
| BLE | 2480 | 1Mbps | 7.074 | 30 | Pass |

8.3.5 Test Plots



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|-----------------------|-------------------------|
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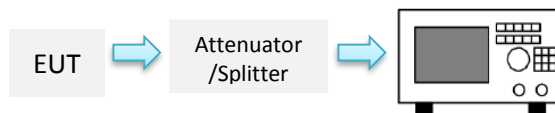
8.4 Power Spectral Density

8.4.1 Requirement

§ 15.247 (e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power is used to determine the power spectral density.

8.4.2 Test setup



8.4.3 Test Procedure

According to section 8.4 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.10.2 PKPSD of ANSI C63.10-2013:

1. Set analyser centre frequency to DTS channel centre frequency.
2. Set the span to 1.5 X DTS bandwidth.
3. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq 3 \times \text{RBW}$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

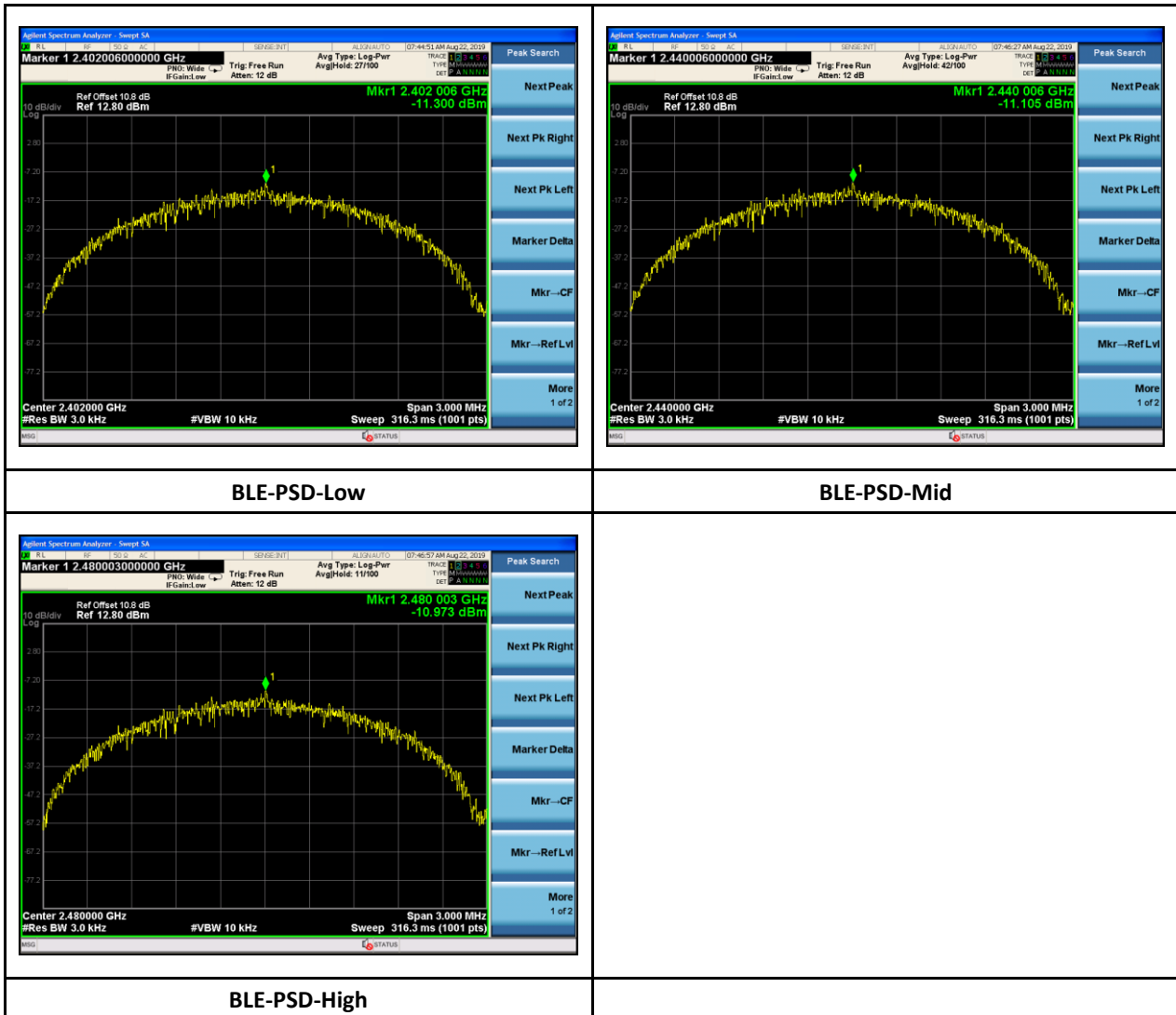
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|-----------------------|-------------------------|
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8.4.4 Test Result

| Mode/ Bandwidth | Frequency (MHz) | Data rate | Measured PSD (dBm/3KHz) | Max PSD (dBm/3KHz) | Result |
|--------------------|--------------------|-----------|----------------------------|-----------------------|--------|
| BLE | 2402 | 1Mbps | -11.300 | 8 | Pass |
| BLE | 2440 | 1Mbps | -11.105 | 8 | Pass |
| BLE | 2480 | 1Mbps | -10.973 | 8 | Pass |

8.4.5 Test Plots



| | |
|-----------------------|-------------------------|
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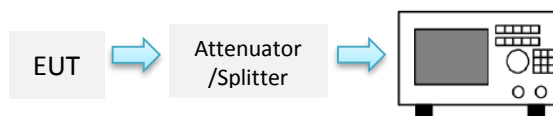
8.5 Conducted Band-Edge & Unwanted Emissions Measurement

8.5.1 Requirement

§ 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

8.5.2 Test setup



8.5.3 Test Procedure

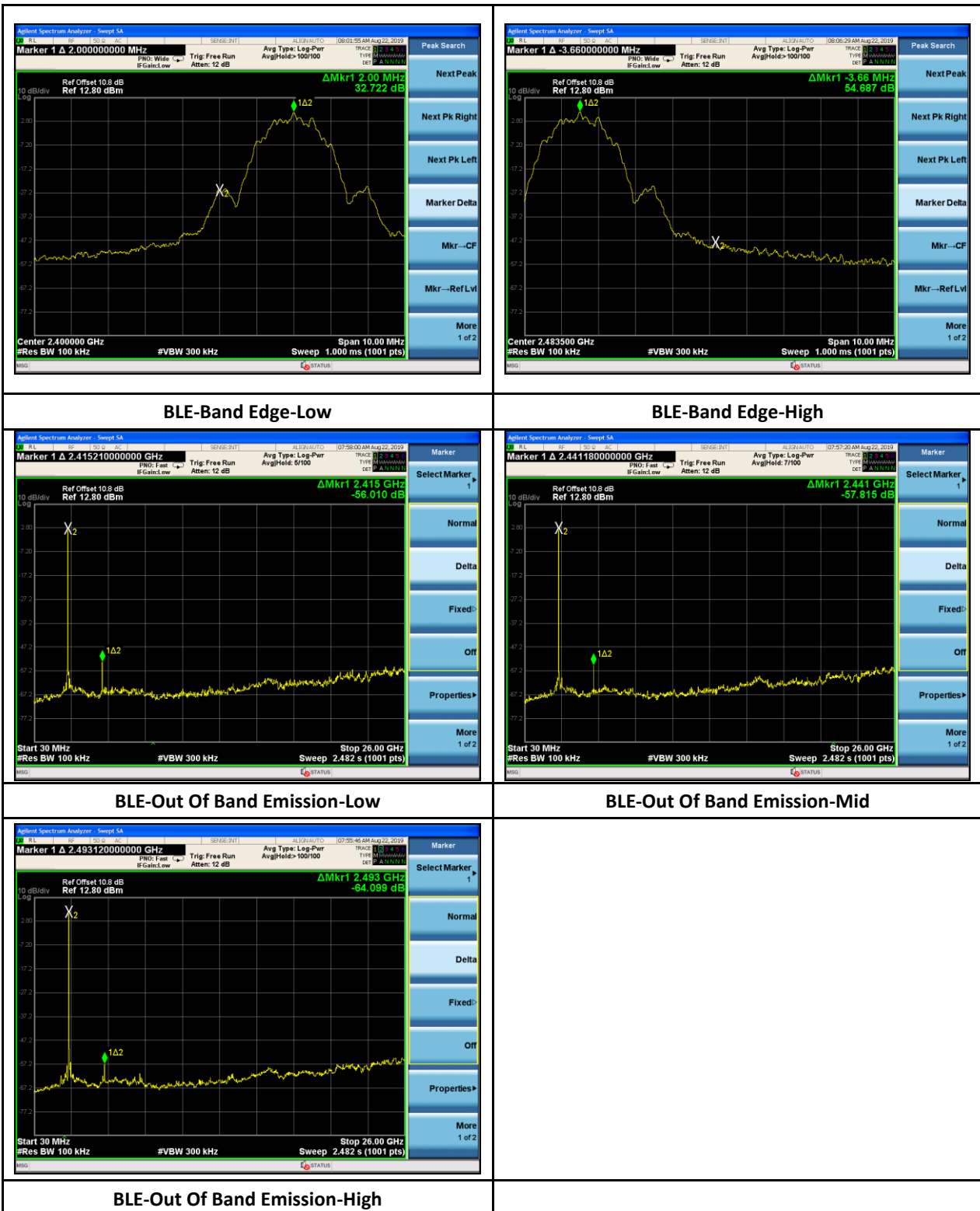
According to section 8.5 Emission level measurement, in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.11.3 in ANSI C63.10-2013:

1. Set the centre frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level.

8.5.4 Test Result

See test plots

8.5.5 Test Plots



8.6 Radiated Band-Edge & Spurious Emissions into Restricted Frequency Bands

8.6.1 Requirement

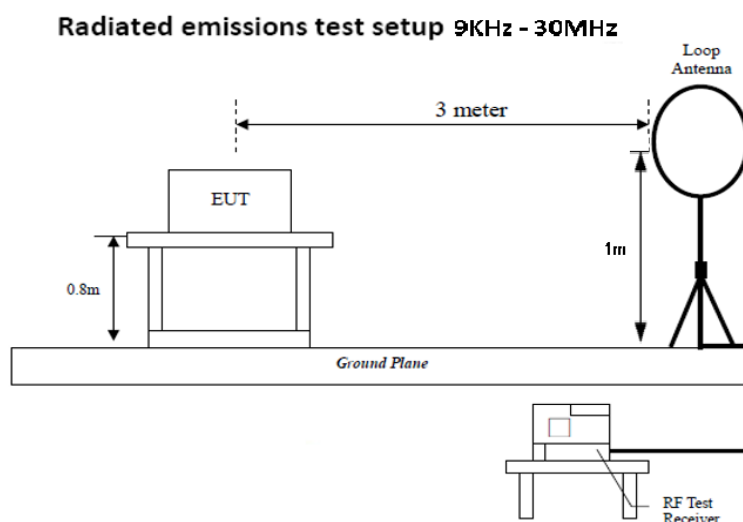
§ 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

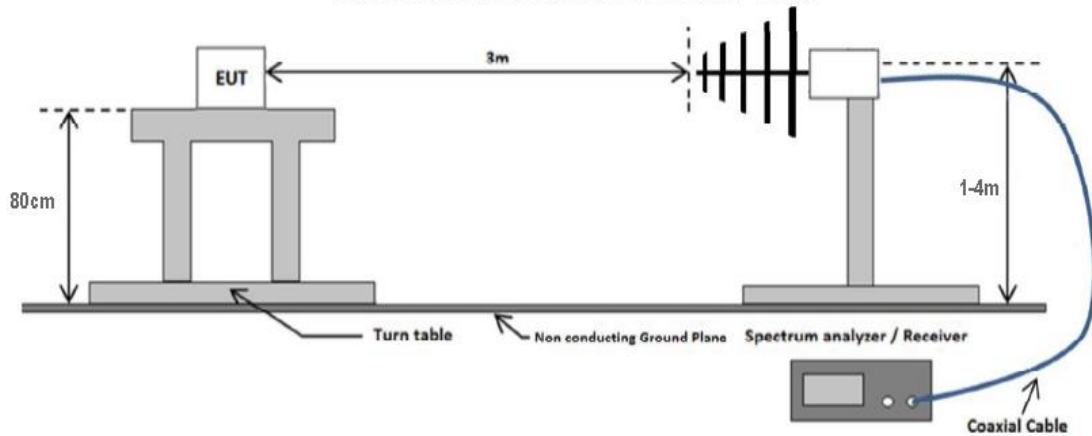
Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

| Frequency range (MHz) | Field Strength ($\mu\text{V}/\text{m}$) |
|-----------------------|---|
| 0.009~0.490 | 2400/F(KHz) |
| 0.490~1.705 | 24000/F(KHz) |
| 1.705~30.0 | 30 |
| 30 – 88 | 100 |
| 88 – 216 | 150 |
| 216 960 | 200 |
| Above 960 | 500 |

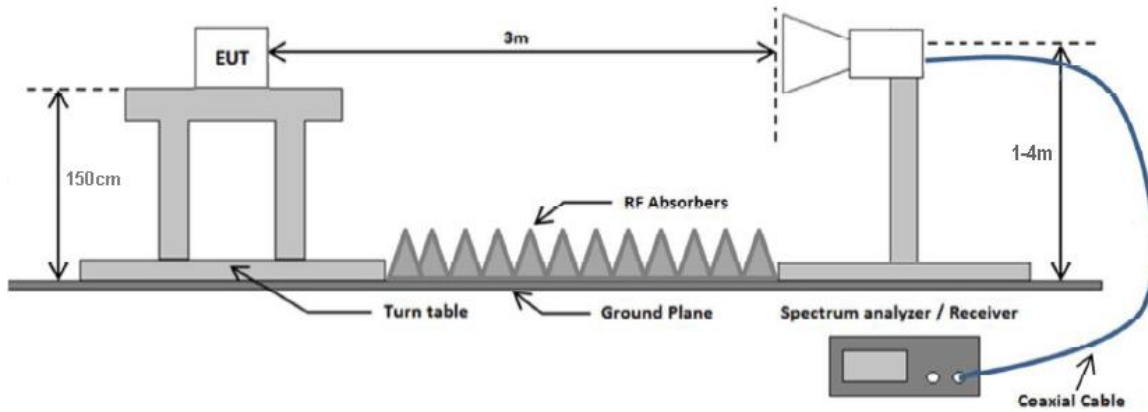
8.6.2 Test setup



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



| | |
|-----------------------|-------------------------|
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8.6.3 Test Procedure

According to section 8.6 in KDB 558074 D01 DTS Meas Guidance v05r02 and subclause 11.12.2.7 Radiated spurious emission measurements in ANSI C62.10-2013 as well as the procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 was followed. Boresight antenna mast was used during the scanning to point to EUT to maximize the emission. The process will be repeated in 3 EUT orientations.

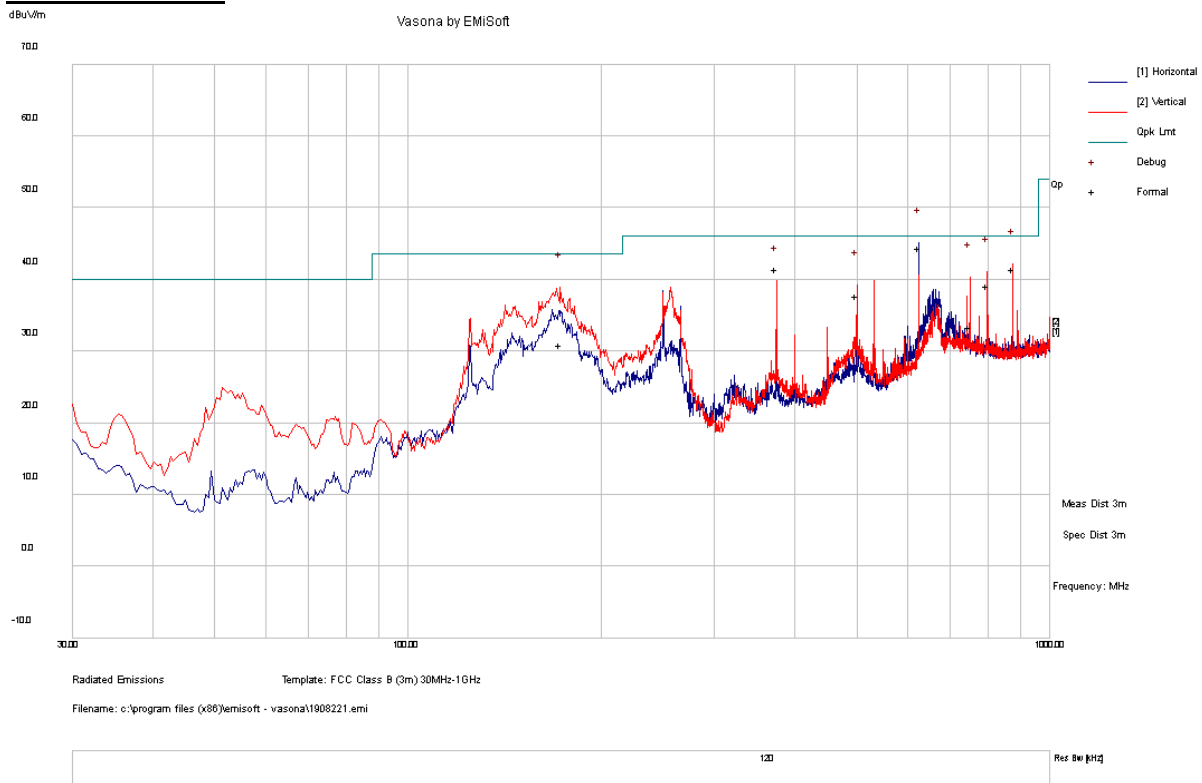
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterization. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarization (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 300 Hz for frequency below 150KHz.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for frequency between 150KHz – 30MHz.
5. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-Peak detection at frequency between 30MHz - 1GHz.
6. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz with Peak detection for Peak and average measurement at frequency above 1GHz.
7. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.

8.6.4 Test Result

RADIATED EMISSIONS < 1 GHZ

| | | | |
|------------------------|------------------|-----------------|-------------------------|
| Test Standard: | 15.209, 15.247 | Mode: | BLE 2402 MHz |
| Frequency Range: | 30 - 1000 MHz | Test Date: | 12/09/2019 - 12/30/2019 |
| Antenna Type/Polarity: | Bi-Log/Hor & Ver | Test Personnel: | David Zhang |
| Remark: | N/A | Test Result: | Pass |

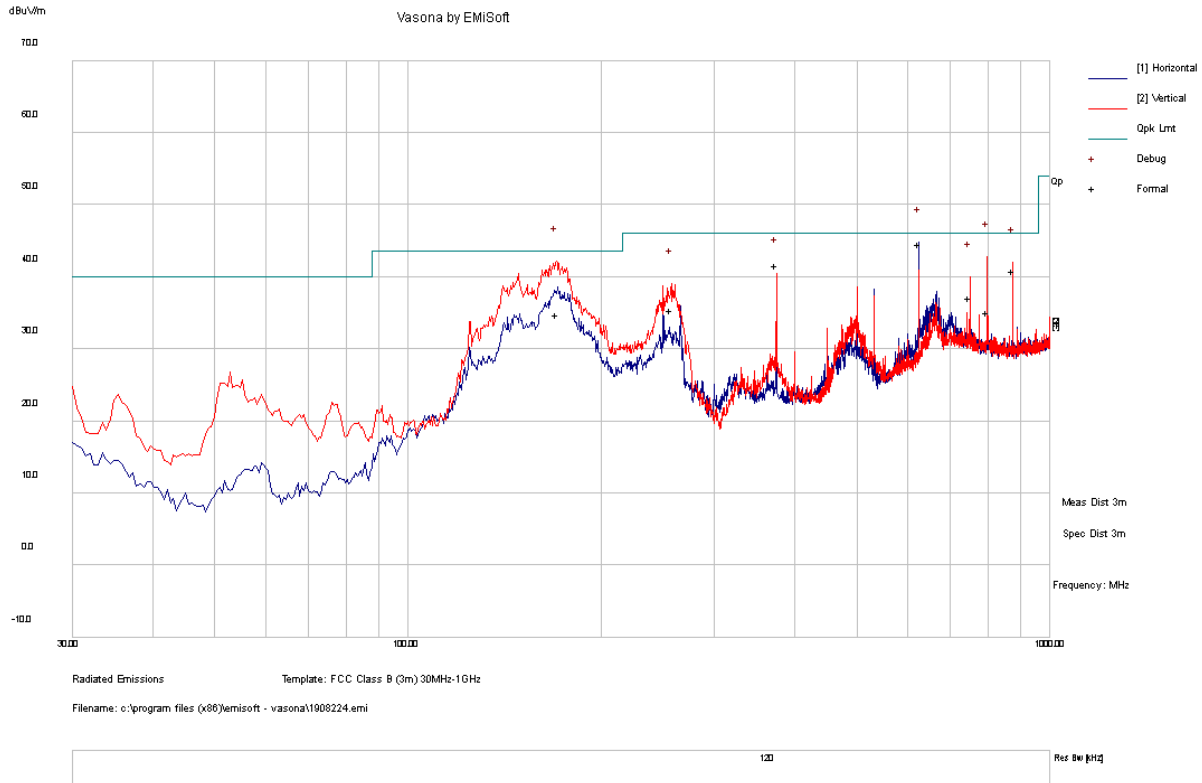
BLE 2402 MHz



| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass/Fail |
|---------------|----------|------------|--------|--------------|------------------|-----|--------|---------|--------------|-----------|-----------|
| 624.96 | 46.24 | 7.20 | -8.99 | 44.46 | Quasi-Peak | H | 112 | 200 | 46.00 | -1.54 | Pass |
| 874.91 | 41.05 | 7.52 | -7.12 | 41.45 | Quasi-Peak | V | 100 | 327 | 46.00 | -4.55 | Pass |
| 172.84 | 48.69 | 4.48 | -22.17 | 31.00 | Quasi-Peak | V | 339 | 133 | 43.50 | -12.50 | Pass |
| 798.00 | 38.63 | 7.25 | -6.76 | 39.11 | Quasi-Peak | V | 100 | 130 | 46.00 | -6.89 | Pass |
| 749.99 | 32.69 | 7.28 | -6.60 | 33.36 | Quasi-Peak | V | 102 | 233 | 46.00 | -12.64 | Pass |
| 374.96 | 50.06 | 6.21 | -14.73 | 41.54 | Quasi-Peak | V | 147 | 1 | 46.00 | -4.46 | Pass |
| 499.94 | 44.45 | 6.08 | -12.72 | 37.81 | Quasi-Peak | V | 100 | 342 | 46.00 | -8.19 | Pass |

| | | | |
|------------------------|------------------|-----------------|-------------------------|
| Test Standard: | 15.209, 15.407 | Mode: | BLE + 5GHz co-located |
| Frequency Range: | 30 - 1000 MHz | Test Date: | 12/09/2019 - 12/30/2019 |
| Antenna Type/Polarity: | Bi-Log/Hor & Ver | Test Personnel: | David Zhang |
| Remark: | N/A | Test Result: | Pass |

BLE + 5GHz co-located

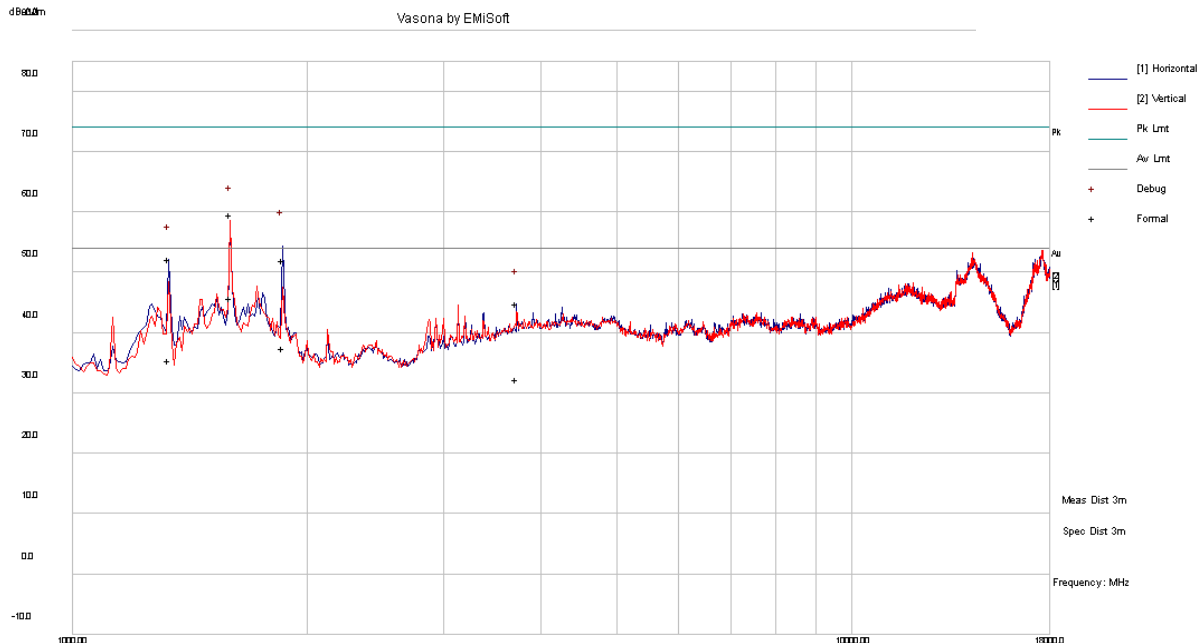


| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass/Fail |
|---------------|----------|------------|--------|--------------|------------------|-----|--------|---------|--------------|-----------|-----------|
| 624.95 | 46.33 | 7.20 | -8.99 | 44.54 | QP | H | 115 | 202 | 46.00 | -1.46 | Pass |
| 170.40 | 52.59 | 4.46 | -22.20 | 34.85 | QP | V | 238 | 0 | 43.50 | -8.65 | Pass |
| 798.00 | 34.59 | 7.25 | -6.76 | 35.08 | QP | V | 322 | 348 | 46.00 | -10.92 | Pass |
| 874.91 | 40.48 | 7.52 | -7.12 | 40.89 | QP | V | 100 | 36 | 46.00 | -5.11 | Pass |
| 374.96 | 50.11 | 6.21 | -14.73 | 41.59 | QP | V | 134 | 356 | 46.00 | -4.41 | Pass |
| 749.98 | 36.40 | 7.28 | -6.60 | 37.07 | QP | V | 112 | 352 | 46.00 | -8.93 | Pass |
| 256.91 | 49.27 | 5.32 | -19.17 | 35.41 | QP | V | 138 | 109 | 46.00 | -10.59 | Pass |

RADIATED EMISSIONS > 1 GHz

| | | | |
|------------------------|------------------|-----------------|-------------------------|
| Test Standard: | 15.209, 15.247 | Mode: | BLE 2402 MHz |
| Frequency Range: | 1 - 18 GHz | Test Date: | 12/09/2019 - 12/30/2019 |
| Antenna Type/Polarity: | Bi-Log/Hor & Ver | Test Personnel: | David Zhang |
| Remark: | N/A | Test Result: | Pass |

BLE 2402 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\1908231.emi

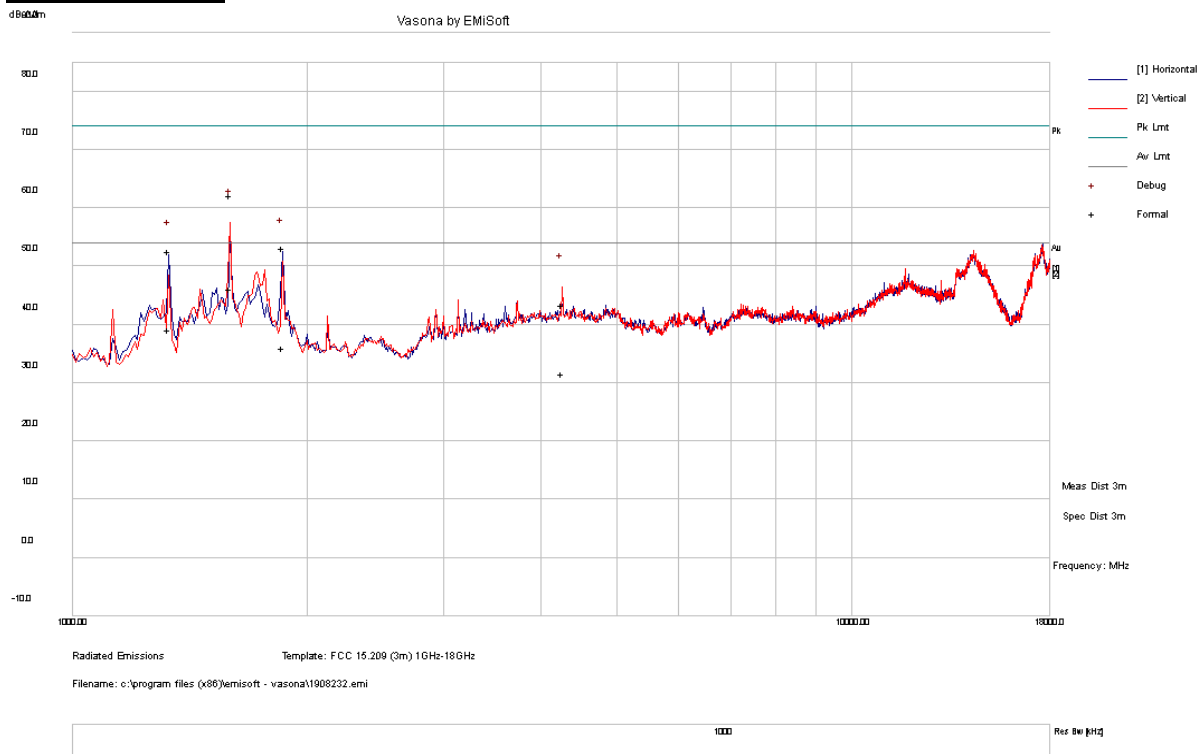
| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass/Fail |
|---------------|----------|------------|-------|--------------|------------------|-----|--------|---------|--------------|-----------|-----------|
| 1596.21 | 52.23 | 10.73 | -3.36 | 59.60 | Peak Max | V | 198 | 355 | 74 | -14.40 | Pass |
| 1862.22 | 42.62 | 10.40 | -0.88 | 52.15 | Peak Max | H | 168 | 57 | 74 | -21.85 | Pass |
| 1330.36 | 45.42 | 10.56 | -3.82 | 52.16 | Peak Max | H | 201 | 283 | 74 | -21.84 | Pass |
| 3721.62 | 25.73 | 12.28 | 6.94 | 44.95 | Peak Max | H | 104 | 346 | 74 | -29.05 | Pass |
| 1596.21 | 38.43 | 10.73 | -3.36 | 45.80 | Average Max | V | 198 | 355 | 54 | -8.20 | Pass |
| 1862.22 | 28.05 | 10.40 | -0.88 | 37.58 | Average Max | H | 168 | 57 | 54 | -16.42 | Pass |
| 1330.36 | 28.81 | 10.56 | -3.82 | 35.56 | Average Max | H | 201 | 283 | 54 | -18.44 | Pass |
| 3721.62 | 13.09 | 12.28 | 6.94 | 32.31 | Average Max | H | 104 | 346 | 54 | -21.69 | Pass |

Report Number: HME-19081322-LC-FCC-DTS
Product: Base Transceiver
Model Number: 1408-US



| | | | |
|------------------------|------------------|-----------------|-------------------------|
| Test Standard: | 15.209, 15.247 | Mode: | BLE 2441 MHz |
| Frequency Range: | 1 - 18 GHz | Test Date: | 12/09/2019 - 12/30/2019 |
| Antenna Type/Polarity: | Bi-Log/Hor & Ver | Test Personnel: | David Zhang |
| Remark: | N/A | Test Result: | Pass |

BLE 2441 MHz



| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass/Fail |
|---------------|----------|------------|-------|--------------|------------------|-----|--------|---------|--------------|-----------|-----------|
| 1595.20 | 54.92 | 10.73 | -3.37 | 62.29 | Peak Max | V | 288 | 360 | 74 | -11.72 | Pass |
| 1861.55 | 43.62 | 10.40 | -0.88 | 53.15 | Peak Max | H | 280 | 318 | 74 | -20.85 | Pass |
| 1330.04 | 45.91 | 10.56 | -3.81 | 52.66 | Peak Max | H | 123 | 50 | 74 | -21.34 | Pass |
| 4252.84 | 21.93 | 13.02 | 8.51 | 43.46 | Peak Max | V | 386 | 351 | 74 | -30.54 | Pass |
| 1595.20 | 38.87 | 10.73 | -3.37 | 46.24 | Average Max | V | 288 | 360 | 54 | -7.77 | Pass |
| 1861.55 | 26.56 | 10.40 | -0.88 | 36.08 | Average Max | H | 280 | 318 | 54 | -17.92 | Pass |
| 1330.04 | 32.46 | 10.56 | -3.81 | 39.21 | Average Max | H | 123 | 50 | 54 | -14.79 | Pass |
| 4252.84 | 10.02 | 13.02 | 8.51 | 31.55 | Average Max | V | 386 | 351 | 54 | -22.45 | Pass |



Electromagnetic Compatibility
 Radio Frequency
 Product Certification
 International Approval

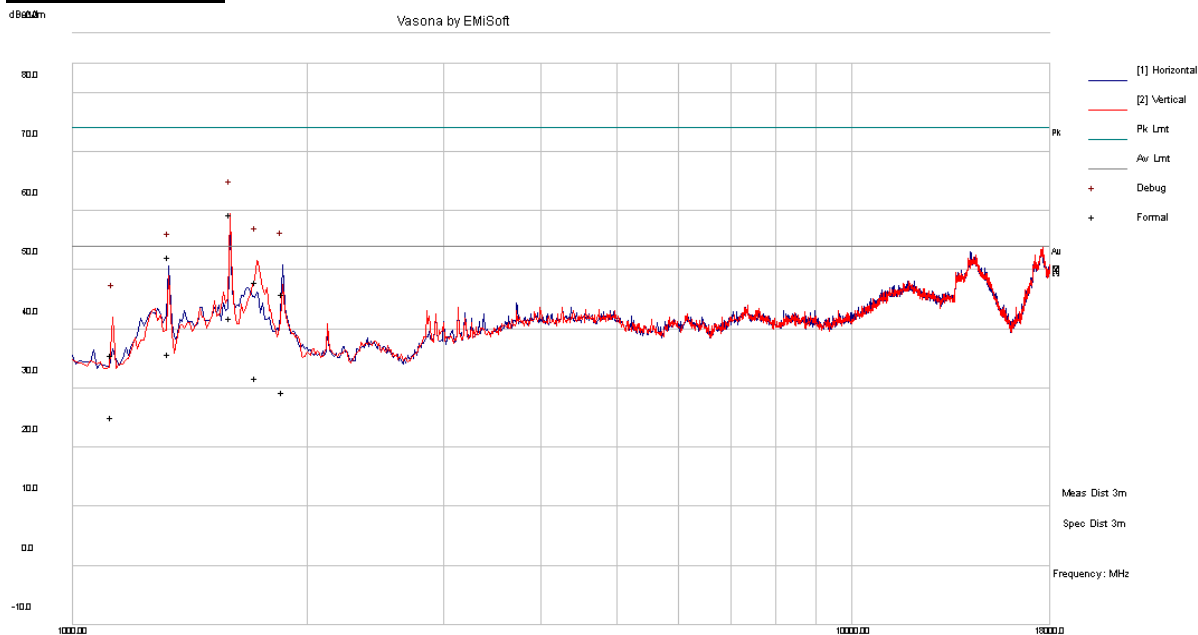
1261 Puerta Del Sol
 San Clemente, CA, 92673
 +1 (949) 393-1123
www.vista-compliance.com

Report Number: HME-19081322-LC-FCC-DTS
Product: Base Transceiver
Model Number: 1408-US



| | | | |
|------------------------|------------------|-----------------|-------------------------|
| Test Standard: | 15.209, 15.247 | Mode: | BLE 2480 MHz |
| Frequency Range: | 1 - 18 GHz | Test Date: | 12/09/2019 - 12/30/2019 |
| Antenna Type/Polarity: | Bi-Log/Hor & Ver | Test Personnel: | David Zhang |
| Remark: | N/A | Test Result: | Pass |

BLE 2480 MHz



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz

Filename: c:\program files (x86)\emisoft - vasona\1908233.emi

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass/Fail |
|---------------|----------|------------|-------|--------------|------------------|-----|--------|---------|--------------|-----------|-----------|
| 1594.89 | 52.13 | 10.73 | -3.37 | 59.50 | Peak Max | V | 335 | 355 | 74 | -14.50 | Pass |
| 1721.61 | 40.31 | 10.57 | -2.82 | 48.06 | Peak Max | V | 236 | 18 | 74 | -25.94 | Pass |
| 1861.84 | 36.41 | 10.40 | -0.88 | 45.94 | Peak Max | H | 268 | 188 | 74 | -28.06 | Pass |
| 1330.09 | 45.55 | 10.56 | -3.81 | 52.30 | Peak Max | H | 121 | 16 | 74 | -21.70 | Pass |
| 1125.50 | 30.08 | 10.14 | -4.63 | 35.59 | Peak Max | V | 288 | 293 | 74 | -38.41 | Pass |
| 1594.89 | 34.60 | 10.73 | -3.37 | 41.96 | Average Max | V | 335 | 355 | 54 | -12.04 | Pass |
| 1721.61 | 23.97 | 10.57 | -2.82 | 31.72 | Average Max | V | 236 | 18 | 54 | -22.29 | Pass |
| 1861.84 | 19.85 | 10.40 | -0.88 | 29.37 | Average Max | H | 268 | 188 | 54 | -24.63 | Pass |
| 1330.09 | 29.14 | 10.56 | -3.81 | 35.89 | Average Max | H | 121 | 16 | 54 | -18.11 | Pass |
| 1125.50 | 19.60 | 10.14 | -4.63 | 25.11 | Average Max | V | 288 | 293 | 54 | -28.89 | Pass |

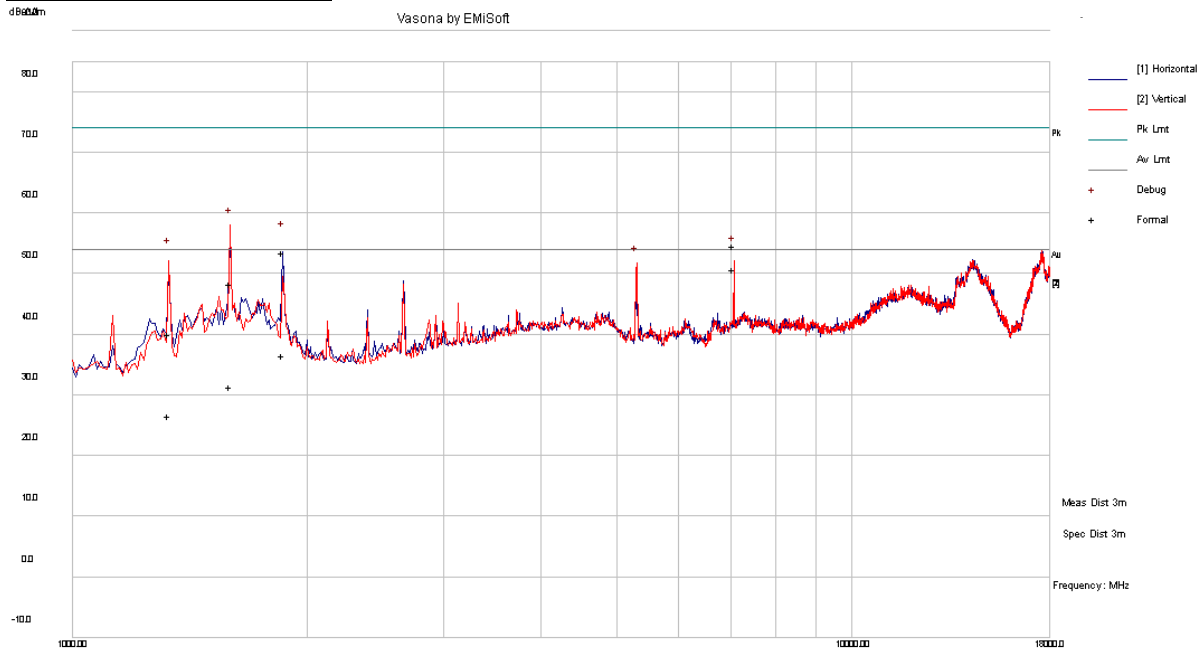


Electromagnetic Compatibility
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 Product Certification
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www.vista-compliance.com

| | | | |
|------------------------|------------------|-----------------|-------------------------|
| Test Standard: | 15.209, 15.407 | Mode: | BLE+5GHz co-located |
| Frequency Range: | 1 - 18 GHz | Test Date: | 12/09/2019 - 12/30/2019 |
| Antenna Type/Polarity: | Bi-Log/Hor & Ver | Test Personnel: | David Zhang |
| Remark: | N/A | Test Result: | Pass |

BLE+5GHz co-located



Radiated Emissions Template: FCC 15.209 (3m) 1GHz-18GHz
 Filename: c:\program files (x86)\emisoft - vasona\1908251.emi

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass/Fail |
|---------------|----------|------------|-------|--------------|------------------|-----|--------|---------|--------------|-----------|-----------|
| 1595.26 | 41.10 | 10.73 | -3.37 | 48.46 | Peak Max | V | 300 | 195 | 74 | -25.54 | Pass |
| 1862.64 | 44.06 | 10.40 | -0.88 | 53.58 | Peak Max | V | 149 | 348 | 74 | -20.42 | Pass |
| 7066.70 | 27.11 | 16.18 | 11.40 | 54.69 | Peak Max | V | 165 | 290 | 74 | -19.31 | Pass |
| 1329.36 | 33.31 | 10.56 | -3.81 | 40.06 | Peak Max | V | 168 | 217 | 74 | -33.95 | Pass |
| 1595.26 | 24.02 | 10.73 | -3.37 | 31.38 | Average Max | V | 300 | 195 | 54 | -22.62 | Pass |
| 1862.64 | 27.07 | 10.40 | -0.88 | 36.60 | Average Max | V | 149 | 348 | 54 | -17.41 | Pass |
| 7066.70 | 23.11 | 16.18 | 11.40 | 50.69 | Average Max | V | 165 | 290 | 54 | -3.31 | Pass |
| 1329.36 | 19.89 | 10.56 | -3.81 | 26.64 | Average Max | V | 168 | 217 | 54 | -27.36 | Pass |

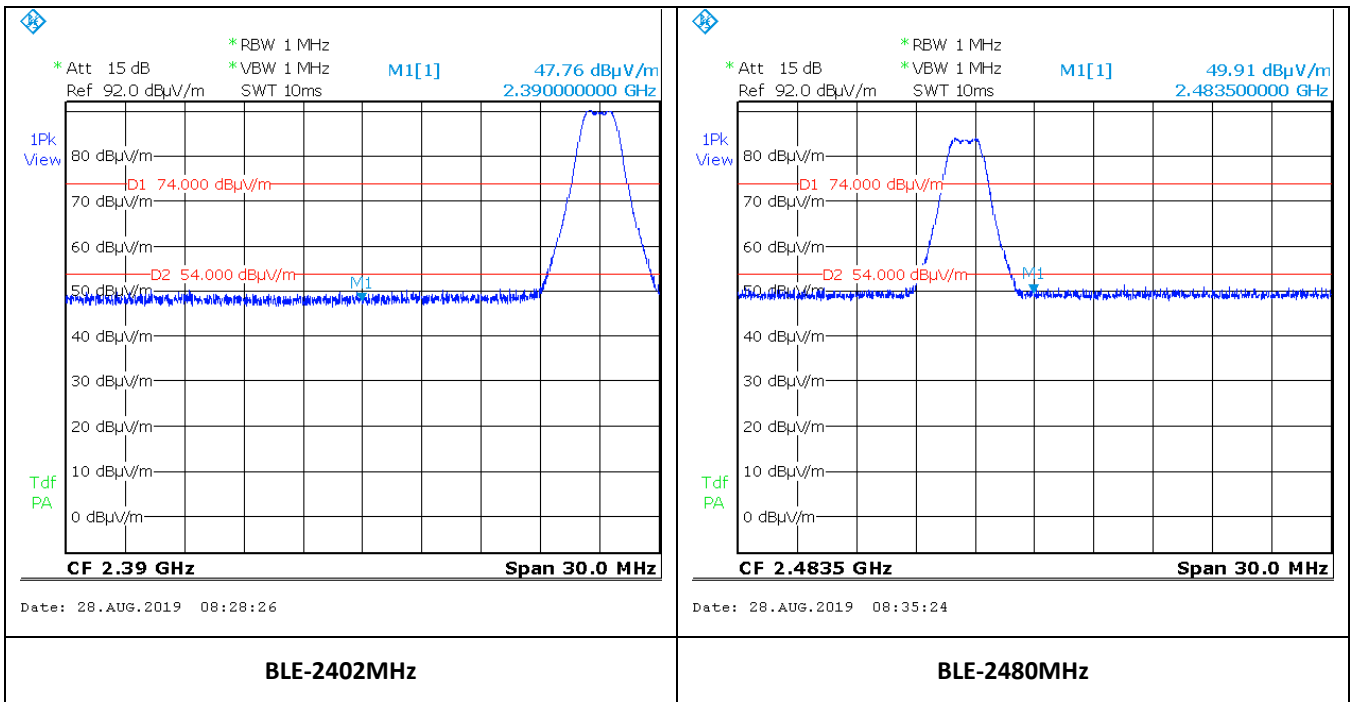
| | |
|-----------------------|-------------------------|
| Report Number: | HME-19081322-LC-FCC-DTS |
| Product: | Base Transceiver |
| Model Number: | 1408-US |



18GHz – 40GHz test result

Note: no substantial emission is found other than the noise floor. Different modes have been verified.

Restricted Band Measurement Result



8.7 Conducted Emissions

8.7.1 Requirement

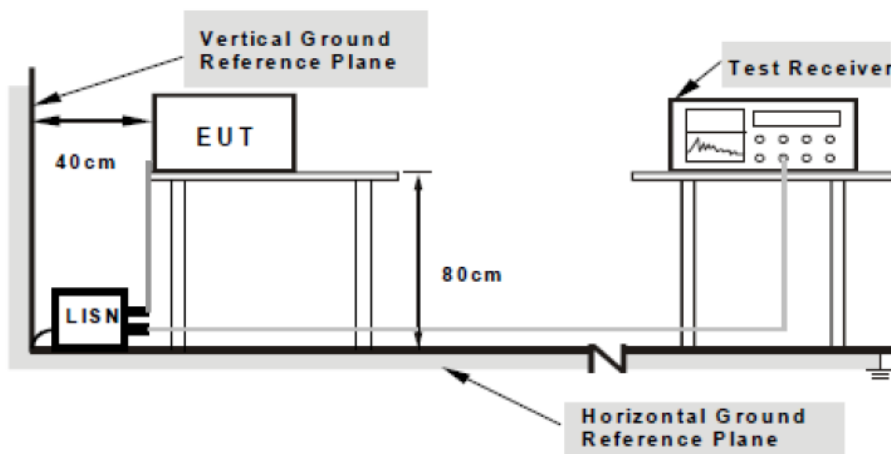
Per § 15.207 (a), an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Limits for Conducted Emissions at the Mains Ports

| Section | Frequency ranges (MHz) | Limit (dBuV) | |
|-----------------|------------------------|--------------|---------|
| | | QP | Average |
| Class B devices | 0.15 – 0.5 | 66 – 56 | 56 – 46 |
| | 0.5 – 5 | 56 | 46 |
| | 5 - 30 | 60 | 50 |

NOTE 1 The lower limit shall apply at the transition frequencies.

8.7.2 Test setup



- Note:**
1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) are 80cm from EUT and at least 80cm from other units and other metal planes support units.

| | |
|-----------------------|-------------------------|
| Report Number: | HME-19081322-LC-FCC-DTS |
| Product: | Base Transceiver |
| Model Number: | 1408-US |



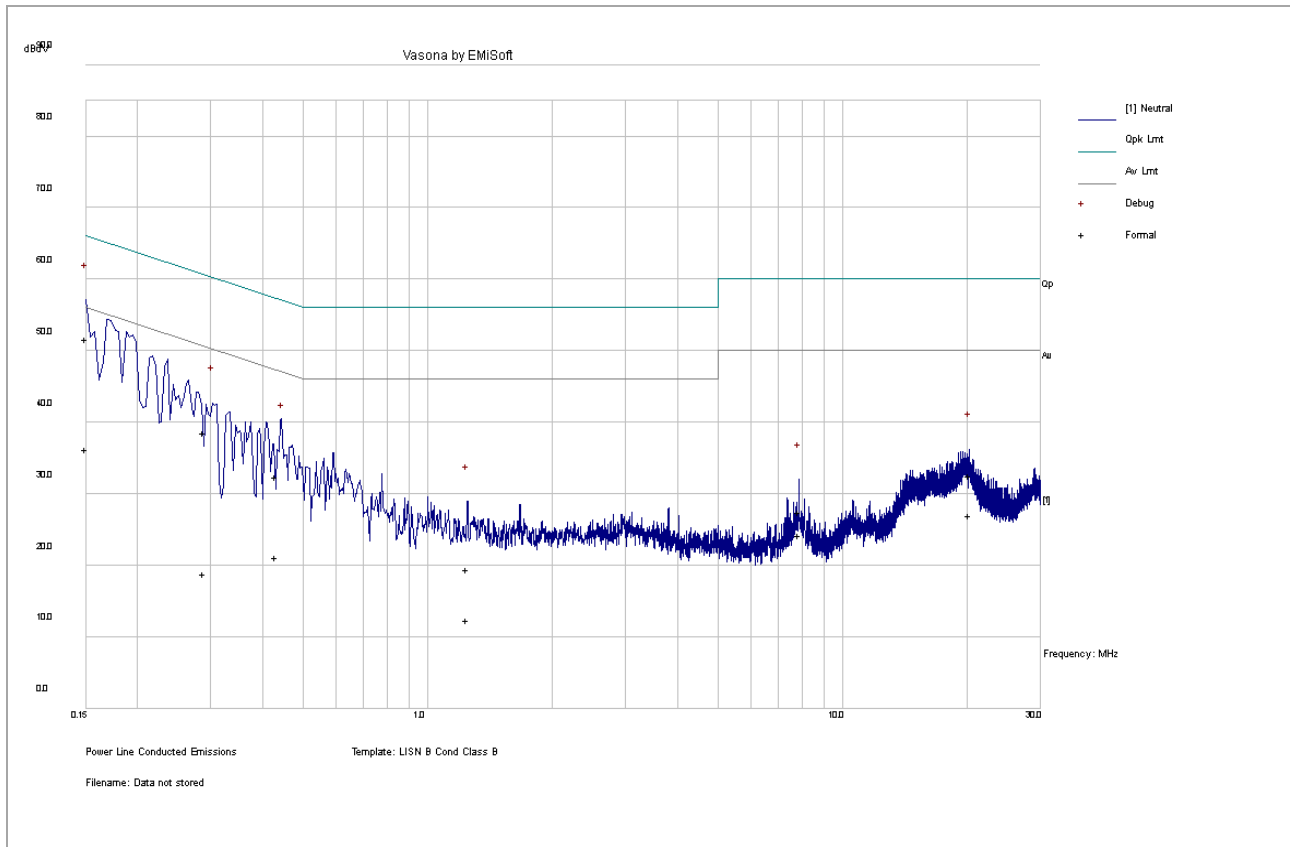
8.7.3 Test Procedure

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m x 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment was powered separately from another main supply.
5. The EUT was switched on and allowed to warm up to its normal operating condition.
6. A scan was made on the NEUTRAL line (for AC mains) or Earth line (for DC power) over the required frequency range using an EMI test receiver.
7. High peaks, relative to the limit line, were then selected.
8. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 10 kHz. For FCC tests, only Quasi-peak measurements were made; while for CISPR/EN tests, both Quasi-peak and Average measurements were made
9. All possible modes of operation were investigated. Only the worst case emissions were measured and reported. All other emissions were relatively insignificant.

8.7.4 Test Result

Neutral Line

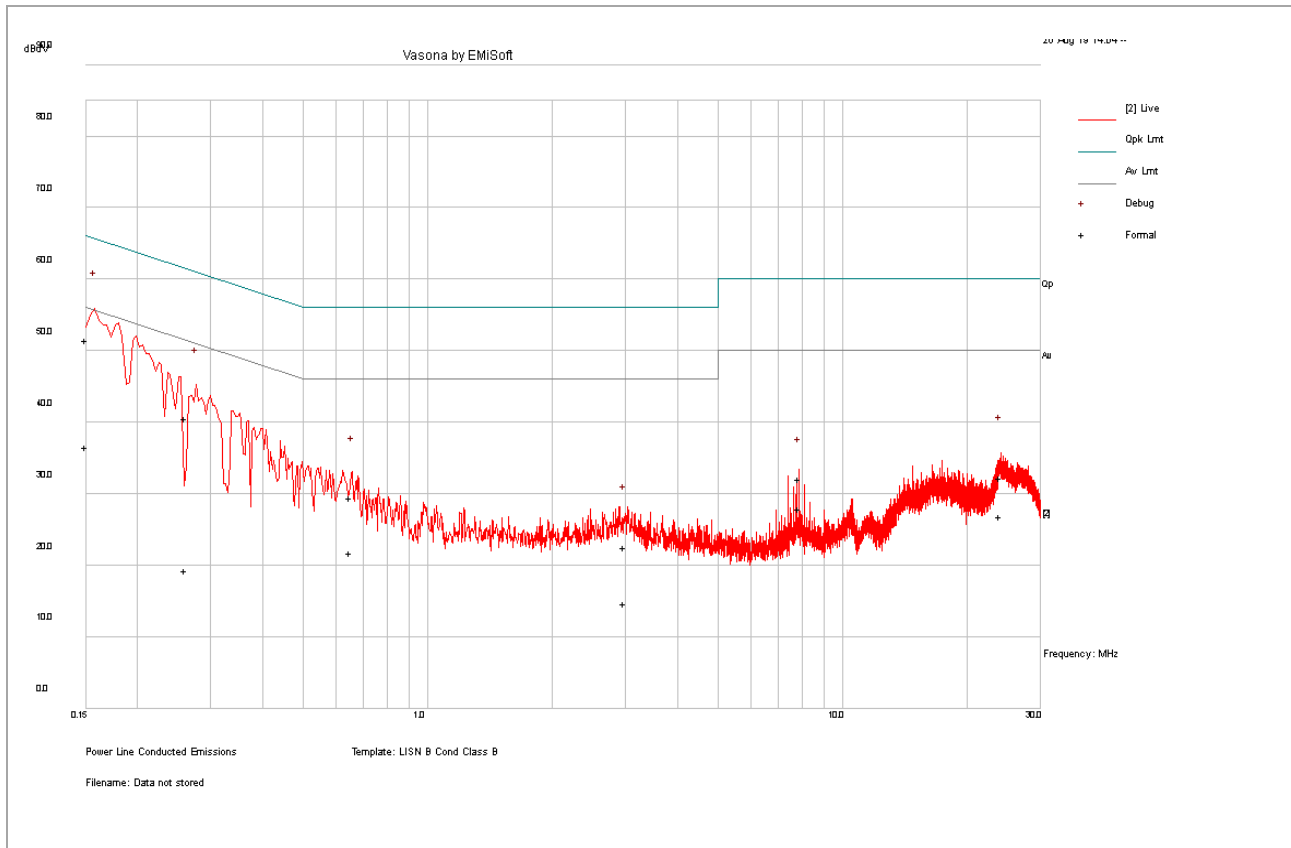
| | | | |
|-------------------------------|---------------------|------------------------|--------------------|
| Test Standard: | 47CFR 15.207 | Mode: | Neutral |
| Frequency Range: | 0.15-30MHz | Test Date: | 11/20/2019 |
| Antenna Type/Polarity: | N/A | Test Personnel: | David Zhang |
| Remark: | 120VAC, 60Hz | Test Result: | Pass |



| Frequency (MHz) | Raw (dBuV) | Cable Loss (dB) | Factors (dB) | Level (dBuV/m) | Meas. Type | Line | Limit (dBuV/m) | Margin (dB) | Pass /Fail |
|-----------------|------------|-----------------|--------------|----------------|------------|---------|----------------|-------------|------------|
| 0.15 | 41.64 | 10.07 | -0.02 | 51.69 | QP | Neutral | 66.00 | -14.31 | Pass |
| 0.29 | 28.42 | 10.09 | 0.00 | 38.51 | QP | Neutral | 60.55 | -22.04 | Pass |
| 0.43 | 21.34 | 10.10 | 0.99 | 32.43 | QP | Neutral | 57.25 | -24.81 | Pass |
| 20.21 | 20.03 | 10.77 | 1.72 | 32.52 | QP | Neutral | 60.00 | -27.48 | Pass |
| 1.25 | 9.15 | 10.18 | 0.18 | 19.51 | QP | Neutral | 56.00 | -36.49 | Pass |
| 7.84 | 16.66 | 10.48 | 0.35 | 27.49 | QP | Neutral | 60.00 | -32.51 | Pass |
| 0.15 | 26.26 | 10.07 | -0.02 | 36.31 | AV | Neutral | 56.00 | -19.69 | Pass |
| 0.29 | 8.74 | 10.09 | 0.00 | 18.83 | AV | Neutral | 50.55 | -31.72 | Pass |
| 0.43 | 10.02 | 10.10 | 0.99 | 21.11 | AV | Neutral | 47.25 | -26.13 | Pass |
| 20.21 | 14.43 | 10.77 | 1.72 | 26.92 | AV | Neutral | 50.00 | -23.08 | Pass |
| 1.25 | 1.98 | 10.18 | 0.18 | 12.34 | AV | Neutral | 46.00 | -33.66 | Pass |
| 7.84 | 13.35 | 10.48 | 0.35 | 24.18 | AV | Neutral | 50.00 | -25.82 | Pass |

Live Line

| | | | |
|-------------------------------|---------------------|------------------------|--------------------|
| Test Standard: | 47CFR 15.207 | Mode: | Line |
| Frequency Range: | 0.15-30MHz | Test Date: | 11/20/2019 |
| Antenna Type/Polarity: | N/A | Test Personnel: | David Zhang |
| Remark: | 120VAC, 60Hz | Test Result: | Pass |



| Frequency (MHz) | Raw (dBuV) | Cable Loss (dB) | Factors (dB) | Level (dBuV/m) | Meas. Type | Line | Limit (dBuV/m) | Margin (dB) | Pass /Fail |
|-----------------|------------|-----------------|--------------|----------------|------------|------|----------------|-------------|------------|
| 0.15 | 41.52 | 10.07 | -0.02 | 51.57 | QP | Live | 66.00 | -14.43 | Pass |
| 0.26 | 30.67 | 10.08 | -0.14 | 40.61 | QP | Live | 61.40 | -20.79 | Pass |
| 0.65 | 19.71 | 10.12 | -0.38 | 29.46 | QP | Live | 56.00 | -26.54 | Pass |
| 24.01 | 19.55 | 10.83 | 1.90 | 32.28 | QP | Live | 60.00 | -27.72 | Pass |
| 7.85 | 21.23 | 10.48 | 0.34 | 32.05 | QP | Live | 60.00 | -27.95 | Pass |
| 2.98 | 12.12 | 10.28 | 0.11 | 22.50 | QP | Live | 56.00 | -33.50 | Pass |
| 0.15 | 26.43 | 10.07 | -0.02 | 36.48 | AV | Live | 56.00 | -19.52 | Pass |
| 0.26 | 9.41 | 10.08 | -0.14 | 19.36 | AV | Live | 51.40 | -32.05 | Pass |
| 0.65 | 11.97 | 10.12 | -0.38 | 21.72 | AV | Live | 46.00 | -24.28 | Pass |
| 24.01 | 14.05 | 10.83 | 1.90 | 26.78 | AV | Live | 50.00 | -23.22 | Pass |
| 7.85 | 17.03 | 10.48 | 0.34 | 27.85 | AV | Live | 50.00 | -22.15 | Pass |
| 2.98 | 4.29 | 10.28 | 0.11 | 14.67 | AV | Live | 46.00 | -31.33 | Pass |

| | |
|-----------------------|-------------------------|
| Report Number: | HME-19081322-LC-FCC-DTS |
| Product: | Base Transceiver |
| Model Number: | 1408-US |



9 Test instrument list

| Equipment | Manufacturer | Model | Serial Number | Cal. Date | Cal. Due |
|----------------------------------|-----------------|--------------------|---------------|------------|------------|
| Semi-Anechoic Chamber | ETS-Lindgren | 10M | VL001 | 5/11/2019 | 5/11/2020 |
| Shielding Control Room | ETS-Lindgren | Series 81 | VL006 | N/A | N/A |
| Spectrum Analyzer | Keysight | N9020A | MY50110074 | 5/4/2019 | 5/4/2020 |
| EMC Test Receiver | R&S | ESL6 | 100230 | 5/7/2019 | 5/7/2020 |
| LISN (9KHz – 30MHz) | EMCO | 3816/2 | 9705-1066 | 5/4/2019 | 5/4/2020 |
| Bi-Log Antenna | ETS-Lindgren | 3142E | 217921 | 11/15/2019 | 11/15/2020 |
| Horn Antenna (1-18GHz) | Electro-Metrics | EM-6961 | 6292 | 5/2/2019 | 5/2/2020 |
| Horn Antenna (18-40GHz) | Com-Power | AH-840 | 101109 | 5/2/2019 | 5/2/2020 |
| Preamplifier | RF Bay, Inc. | LPA-10-20 | 11180621 | 5/10/2019 | 5/10/2020 |
| True RMS Multi-meter | UNI-T | UT181A | C173014829 | 5/10/2019 | 5/10/2020 |
| Temp / Humidity / Pressure Meter | PCE Instruments | PCE-THB 40 | R062028 | 5/9/2019 | 5/9/2020 |
| RF Attenuator | Pasternack | PE7005-3 | VL061 | 5/10/2019 | 5/10/2020 |
| Preamplifier 100KHz - 40GHz | Aeroflex | 33711-392-77150-11 | 064 | 5/10/2019 | 5/10/2020 |
| EM Center Control | ETS-Lindgren | 7006-001 | 160136 | N/A | N/A |
| Turn Table | ETS-Lindgren | 2181-3.03 | VL002 | N/A | N/A |
| Boresight Antenna Tower | ETS-Lindgren | 2171B | VL003 | N/A | N/A |
| Loop Antenna (9k-30MHz) | Com-Power | AL-130 | 121012 | 5/9/2019 | 5/9/2020 |
| RE test cable(below 6GHz) | Vista | RE-6GHz-01 | RE-6GHz-01 | 5/10/2019 | 5/10/2020 |
| RE test cable (1-18GHz) | PhaseTrack | II-240 | RE-18GHz-01 | 5/10/2019 | 5/10/2020 |
| RE test cable (>18GHz) | Sucoflex | 104 | 344903/4 | 5/10/2019 | 5/10/2020 |
| Pulse limiter | Com-Power | LIT-930A | 531727 | 5/15/2019 | 5/15/2020 |
| CE test cable #1 | FIRST RF | FRF-C-1002-001 | CE-6GHz-01 | 5/10/2019 | 5/10/2020 |
| CE test cable#2 | FIRST RF | FRF-C-1002-001 | CE-6GHz-02 | 5/9/2019 | 5/9/2020 |
| Wideband Communication | R&S | CMW500 | 147508 | 5/8/2019 | 5/8/2020 |

