# CERTIFICATION TEST REPORT

**Report Number. :** 11692709-E5V1

| | | |
|---|---|---|
| **Applicant** | : | QUALCOMM TECHNOLOGIES, INC.<br>5770 MOREHOUSE DRIVE,<br>SAN DIEGO, CA 92121, USA |
| **FCC ID** | : | J9C2NET2LTE |
| **IC** | : | 2723A-2NET2LTE |
| **Model Number** | : | QCL-HUB-2.0-US |
| **EUT Description** | : | WIRELESS DATA HUB |
| **Test Standard(s)** | : | FCC 47 CFR PART 15 SUBPART C<br>INDUSTRY CANADA RSS – 247 ISSUE 2 |

**Date Of Issue:**

September 15, 2017

**Prepared by:**

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NVLAP LAB CODE 200065-0

Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 09/15/17 | Initial Review | -- |

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** QUALCOMM TECHNOLOGIES, INC.
5770 MOREHOUSE DRIVE,
SAN DIEGO, CA 92121 USA

**EUT DESCRIPTION:** WIRELESS DATA HUB

**SERIAL NUMBER:** QUALC001TN10M1RP74, QUALC001TN10M1RN3C

**DATE TESTED:** JULY 28 to AUGUST 07, 2017

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| CFR 47 Part 15 Subpart C | Pass |
| INDUSTRY CANADA RSS-247 Issue 2 | Pass |
| INDUSTRY CANADA RSS-GEN Issue 4 | Pass |

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:

FRANK IBRAHIM
PROGRAM MANAGER
UL VERIFICATION SERVICES INC.

Prepared By:

TOM CHEN
LABORATORY ENGINEER
UL VERIFICATION SERVICES INC.

# 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, RSS-GEN Issue 4, and RSS-247 Issue 2.

# 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 47173 Benicia Street | 47266 Benicia Street |
|---|---|
| ☐ Chamber A(IC: 2324B-1) | ☐ Chamber D(IC: 22541-1) |
| ☒ Chamber B(IC: 2324B-2) | ☐ Chamber E(IC: 22541-2) |
| ☒ Chamber C(IC: 2324B-3) | ☐ Chamber F(IC: 22541-3) |
| | ☐ Chamber G(IC: 22541-4) |
| | ☐ Chamber H(IC: 22541-5) |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/standards/scopes/2000650.htm.

# 4. CALIBRATION AND UNCERTAINTY

## 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

## 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| Parameter | Uncertainty |
|---|---|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz | 3.84 dB |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz | 3.65 dB |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz | 3.15 dB |
| Worst Case Radiated Disturbance, 30 to 1000 MHz | 5.36 dB |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz | 4.32 dB |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.45 dB |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.24 dB |

Uncertainty figures are valid to a confidence level of 95%.

# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

This EUT is a 2net2 device (LTE North American Version AT&T) that has the following radio modules:

- Wistron WWAN module, M14Q2FG.
- Qualcomm Unlicensed Module, QCA WCN 3660.

## 5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

| Frequency Range (MHz) | Mode | Output Power (dBm) | Output Power (mW) |
|---|---|---|---|
| 2402 - 2480 | Basic GFSK | 11.10 | 12.88 |
| 2402 - 2480 | Enhanced 8PSK | 11.00 | 12.59 |

## 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Monopole antenna with a maximum gain of 2.1dBi.

## 5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was adb Ver.1.0.26, QRCT Ver.3.0.84.0

## 5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X/Y/Z, it was determined that X orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in X orientation.

Radiated emission below 1 GHz, above 18 GHz, and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Worst-case data rates were:
GFSK mode: DH5
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

## 5.6. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

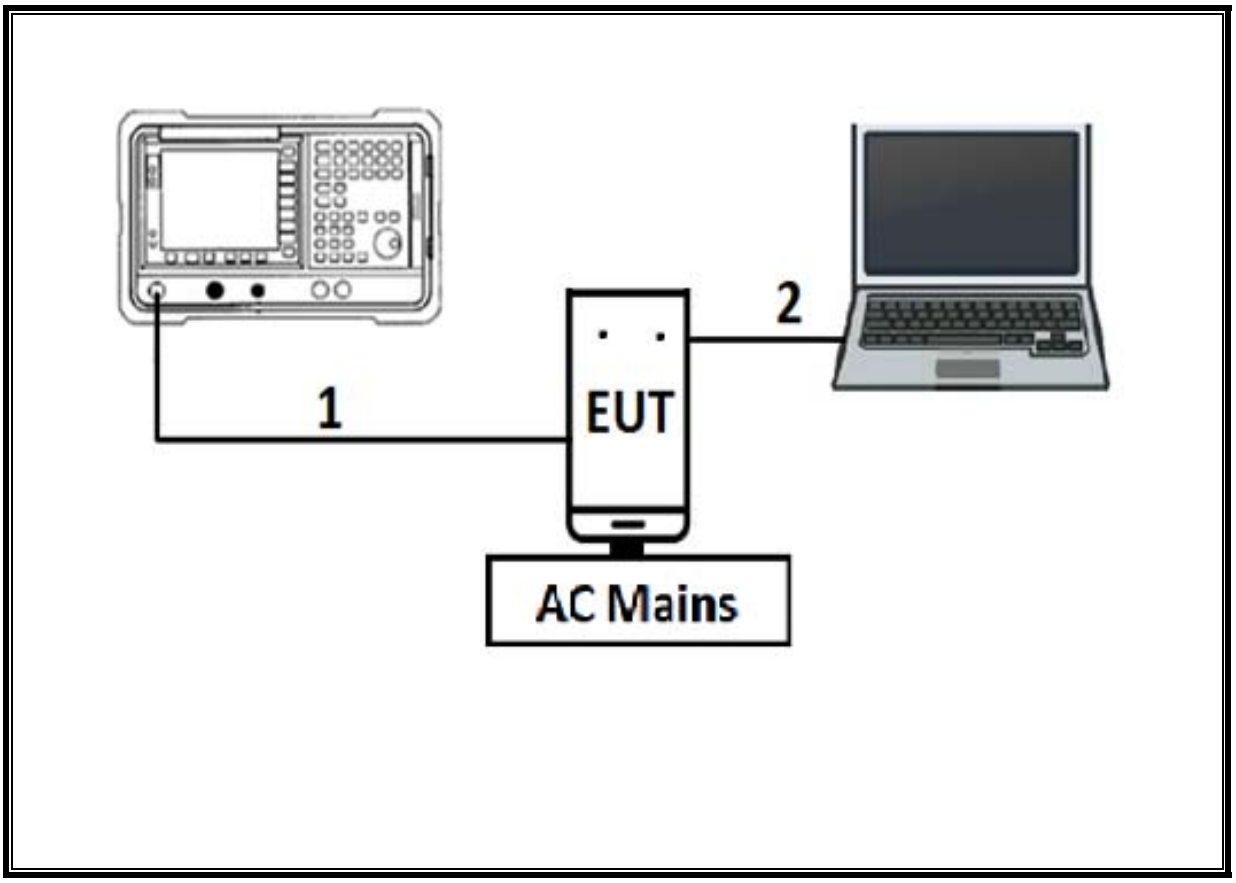
| Support Equipment List | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Serial Number** | **FCC ID** |
| AC Adapter | HP | PPP012D-S | WCNXF0AAR4QOCS | N/A |
| Laptop | HP | EliteBook 6930p | 2CE00821BZ | N/A |

**I/O CABLES (CONDUCTED TEST)**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| **Cable No** | **Port** | **# of identical ports** | **Connector Type** | **Cable Type** | **Cable Length (m)** | **Remarks** |
| 1 | Antenna | 1 | RF | Shielded | 0.2 | To Spectrum Analyzer |
| 2 | USB | 1 | USB | Un-shielded | 1m | Laptop to EUT |

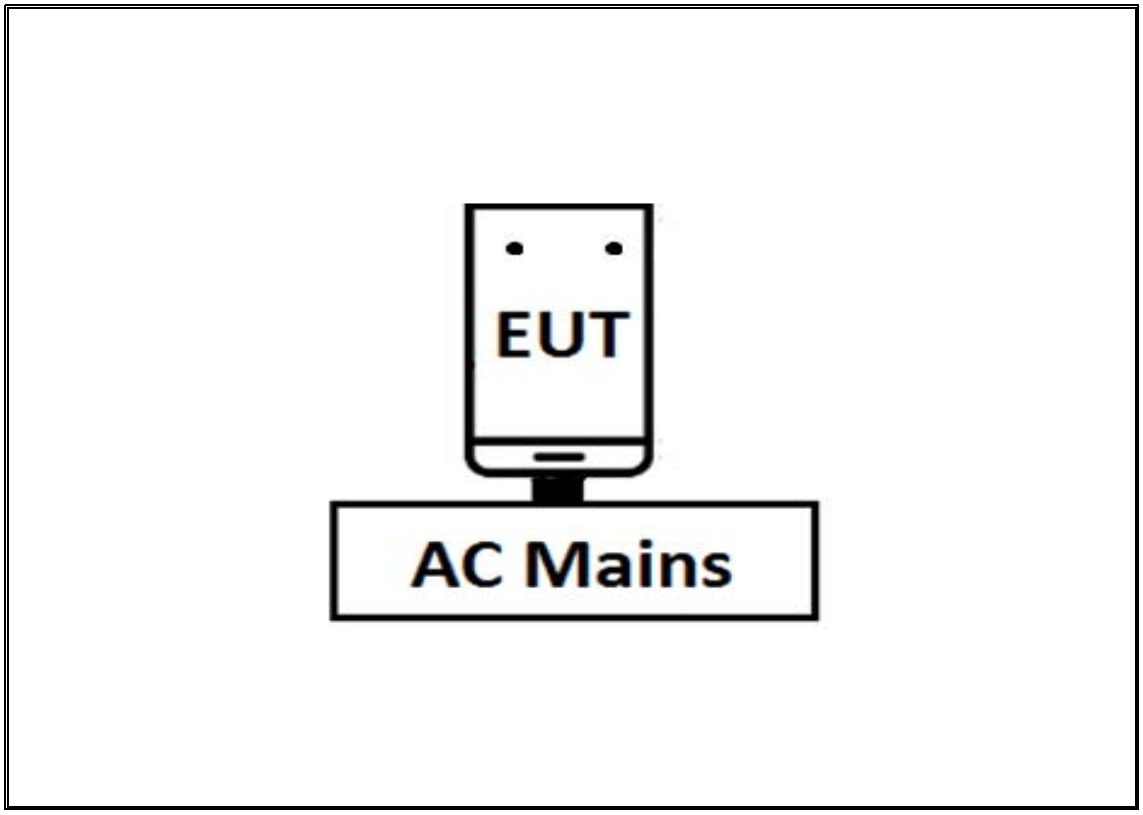
**TEST SETUP- CONDUCTED PORT**

**SETUP DIAGRAM**



**TEST SETUP- RADIATED-ABOVE 1 GHZ and AC LINE CONDUCTED TESTS**

**SETUP DIAGRAM**



# 6. TEST AND MEASUREMENT EQUIPMENT

| TEST EQUIPMENT LIST | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Asset** | **Cal Due** |
| Antenna, Broadband Hybrid, 30MHz to 2000MHz w/4dB Pad | Sunol Sciences Corp. | JB3 | T477 | 06/22/2018 |
| Antenna, Active Loop 9kHz-30MHz | ETS-Lindgren | 6502 | T1683 | 02/17/2018 |
| Antenna, Horn 1-18GHz | ETS-Lindgren | 3117 | T712 | 01/30/2018 |
| Antenna, Horn 18-26.5GHz | ARA | MWH-1826/B | T449 | 06/12/2018 |
| Power Meter, P-series single channel | Agilent (Keysight) Technologies | N1911A | T1264 | 07/08/2018 |
| Power Sensor, P – series, 50MHz to 18GHz, Wideband | Agilent (Keysight) Technologies | N1921A | T413 | 06/20/2018 |
| Amplifier, 1-26.5GHz | MITEQ | AFS42-00101800-25-S-42 | T1165 | 08/01/2017 |
| Amplifier, 1-26.5GHz | Agilent (Keysight) Technologies | 8449B | T404 | 07/05/2018 |
| Amplifier, 10kHz-1GHz | Agilent (Keysight) Technologies | 8447D | T15 | 08/26/2017 |
| Amplifier, 1-8 GHz | MITEQ | AMF-4D-01000800-30-29P | T1170 | 04/28/2018 |
| Spectrum Analyzer, PSA, 3Hz to 26.5GHz | Agilent (Keysight) Technologies | E4440A | T908 | 04/13/2018 |
| Spectrum Analyzer, PXA, 3Hz to 44GHz | Agilent (Keysight) Technologies | N9030A | T907 | 01/23/2018 |
| Spectrum Analyzer, PSA, 3Hz to 26.5GHz | Agilent (Keysight) Technologies | E9030A | T905 | 01/11/2018 |
| LISN | FISCHER | FCC-LISN-50/250-25-2-01 | T1310 | 06/08/2018 |

| Test Software List | | | |
|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Version** |
| Radiated Software | UL | UL EMC | Ver 9.5, Apr 26, 2016 |
| Antenna Port Software | UL | UL RF | Ver 6.8, June 08, 2017 |

# 7. ANTENNA PORT TEST RESULTS

## ON TIME AND DUTY CYCLE

## LIMITS

None; for reporting purposes only.

## PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

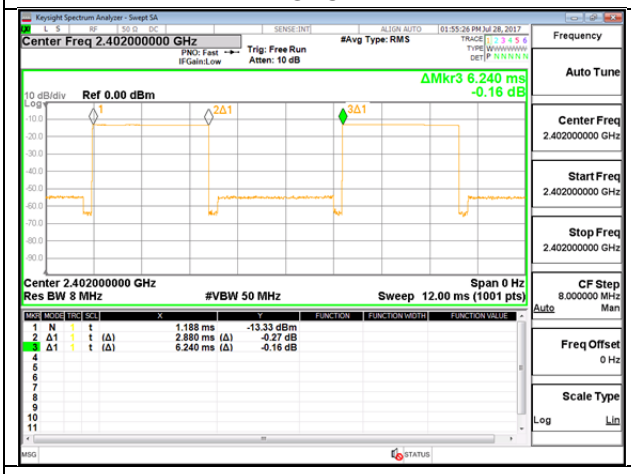
## ON TIME AND DUTY CYCLE RESULTS

ON TIME AND DUTY CYCLE RESULTS

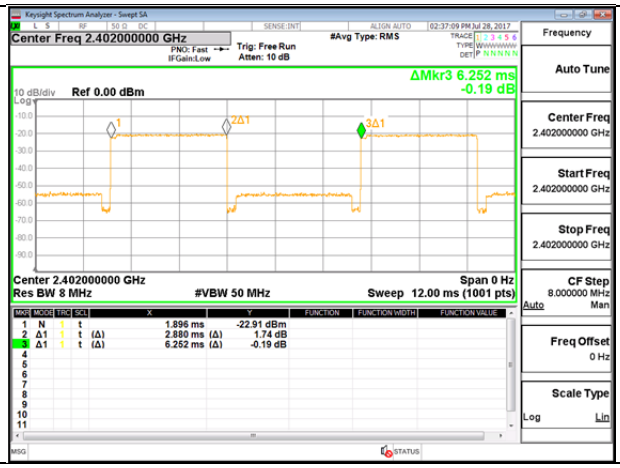
| Mode | ON Time B (msec) | Period (msec) | Duty Cycle x (linear) | Duty Cycle (%) | Duty Cycle Correction Factor (dB) | 1/T Minimum VBW (kHz) |
|---|---|---|---|---|---|---|
| GFSK | 2.880 | 6.240 | 0.462 | 46.15% | 3.36 | 0.347 |
| 8PSK | 2.880 | 6.252 | 0.461 | 46.07% | 3.37 | 0.347 |

DUTY CYCLE PLOTS

GFSK




8PSK




NOTE: HOPPING OFF

# 7.1. BASIC DATA RATE GFSK MODULATION

## 7.1.1. 20 dB BANDWIDTH

**LIMITS**

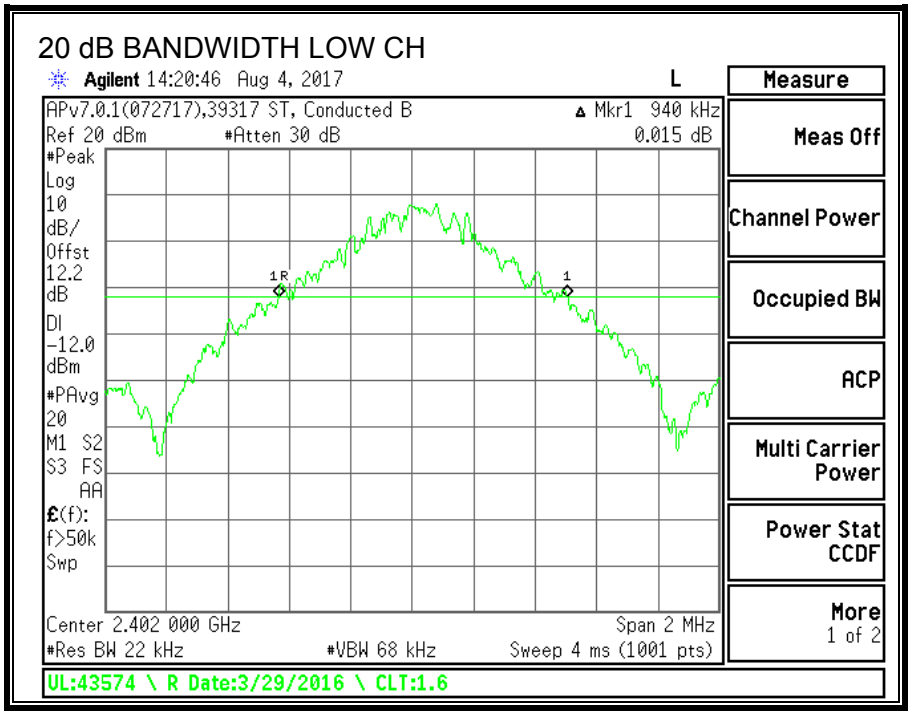
None; for reporting purposes only.

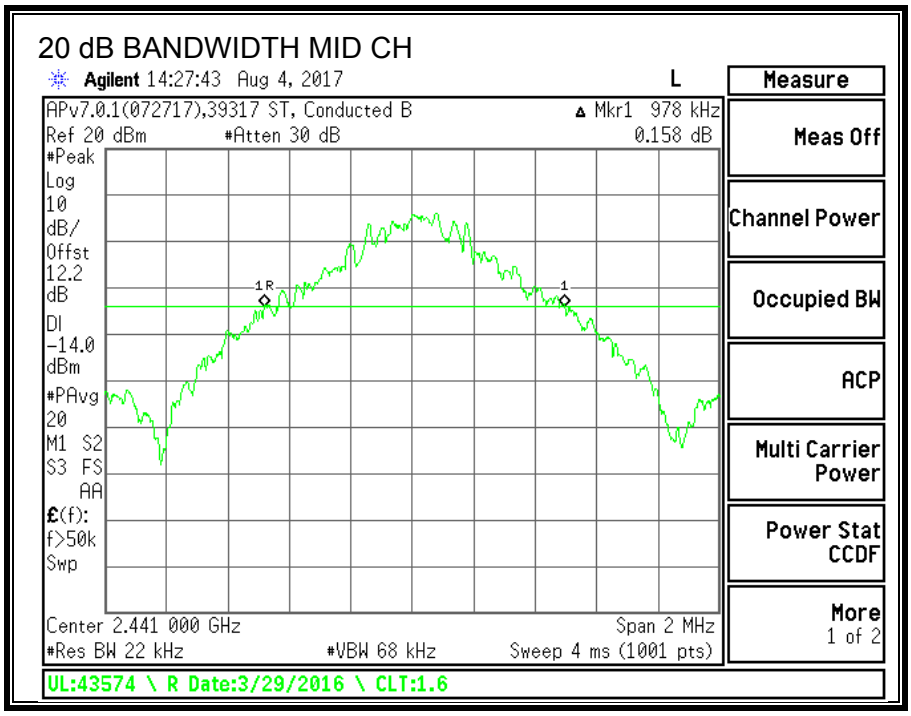
**TEST PROCEDURE**

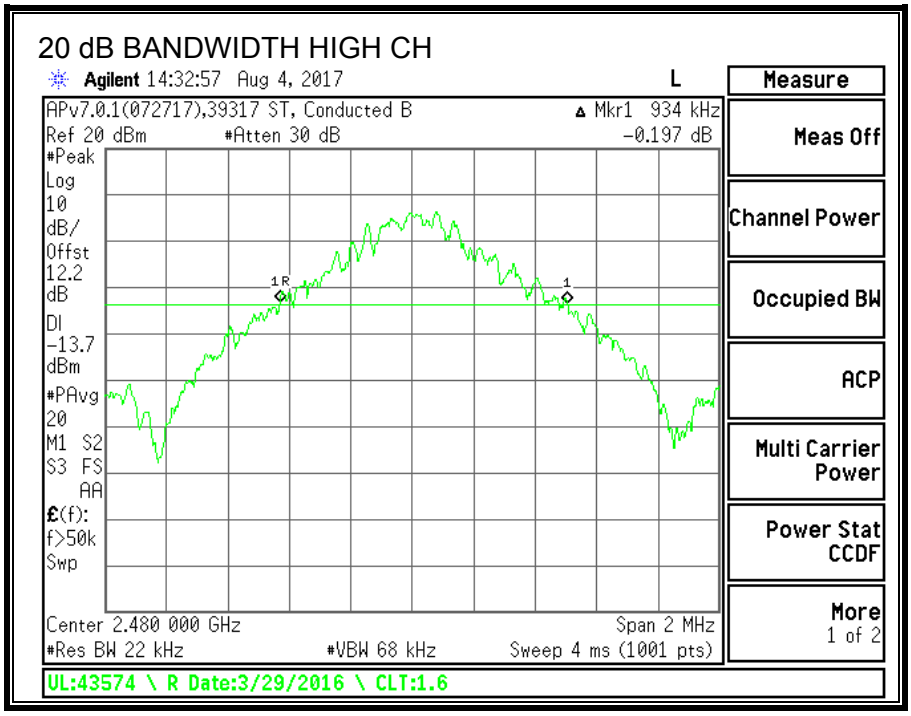
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 20 dB Bandwidth (KHz) |
|---|---|---|
| Low | 2402 | 940 |
| Middle | 2441 | 978 |
| High | 2480 | 934 |





### 7.1.2. 99% BANDWIDTH

**LIMITS**

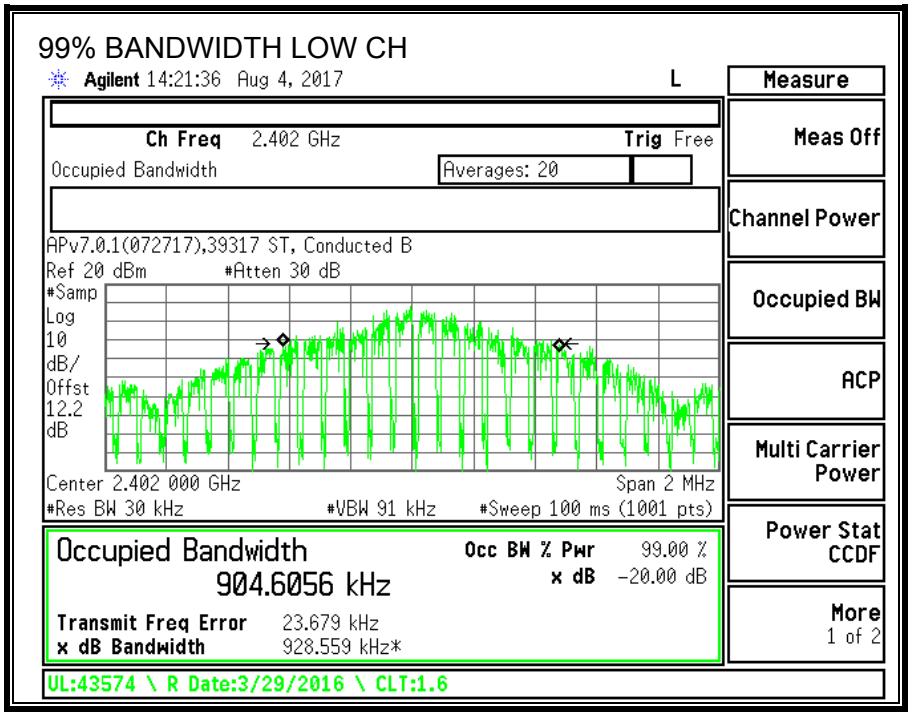
None; for reporting purposes only.

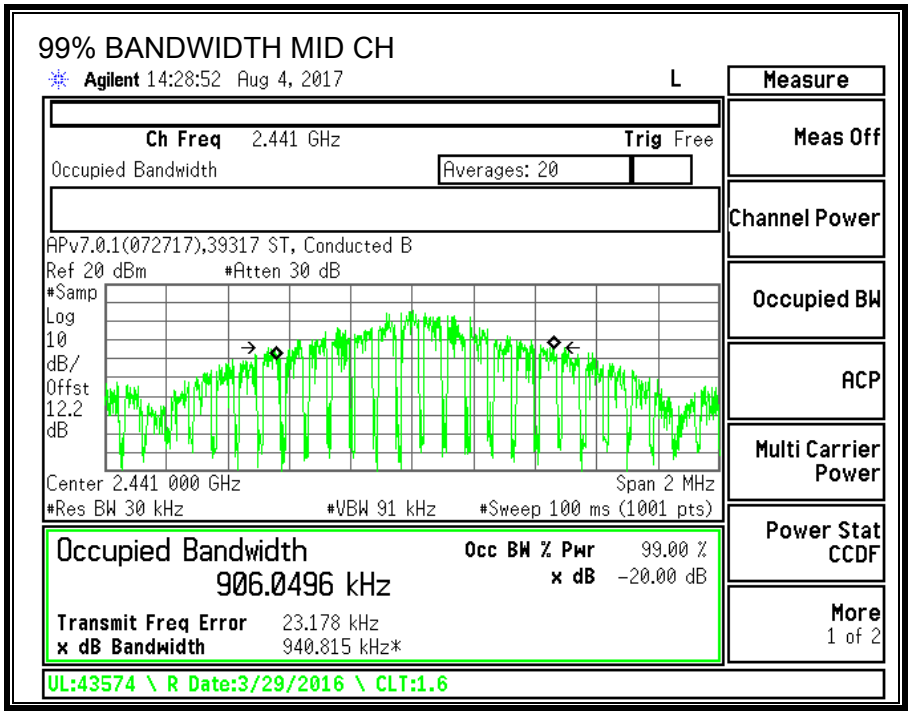
**TEST PROCEDURE**

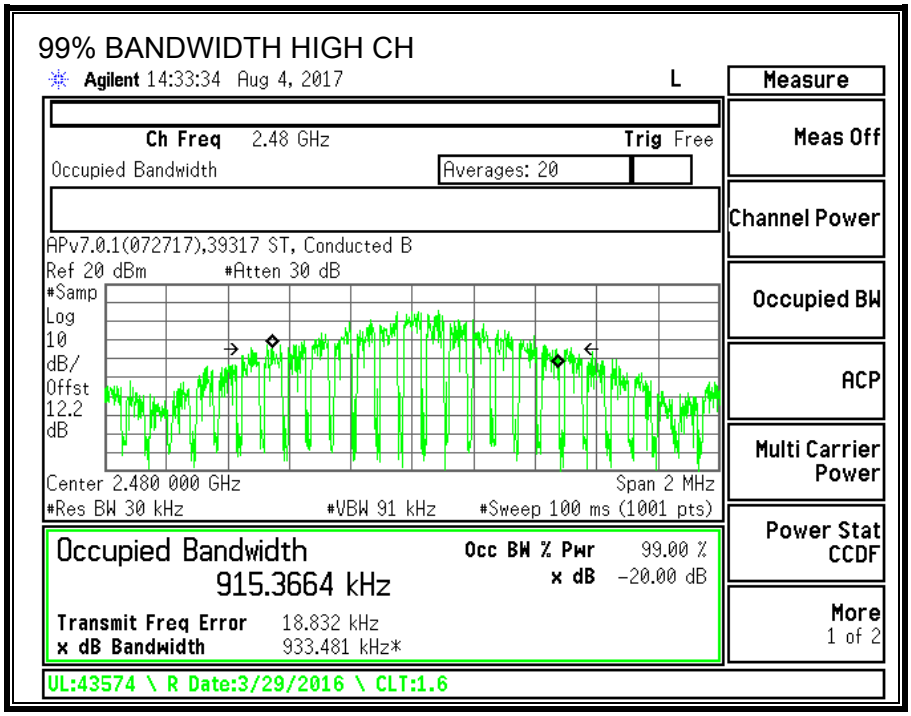
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1 to 3% of the 99% bandwidth and 1% of the Span. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (KHz) |
|---|---|---|
| Low | 2402 | 904.6056 |
| Middle | 2441 | 906.0496 |
| High | 2480 | 915.3664 |





## 7.1.3. HOPPING FREQUENCY SEPARATION

**LIMITS**

FCC §15.247 (a) (1)
IC RSS-247 (5.1) (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

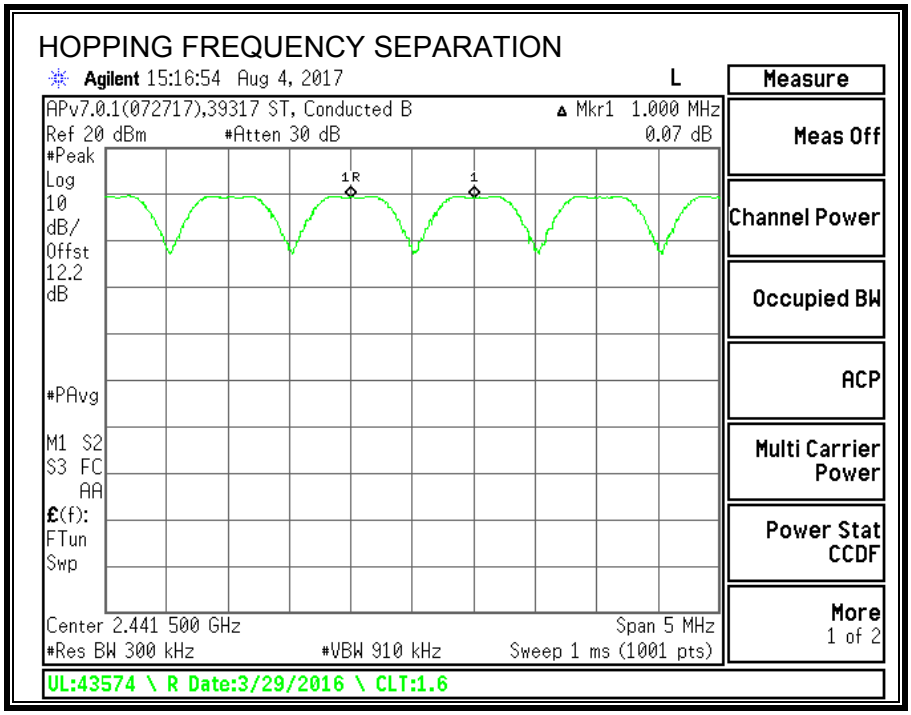
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

**RESULTS**

HOPPING FREQUENCY SEPARATION



## 7.1.4. NUMBER OF HOPPING CHANNELS

**LIMITS**

FCC §15.247 (a) (1) (iii)
IC RSS-247 (5.1) (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

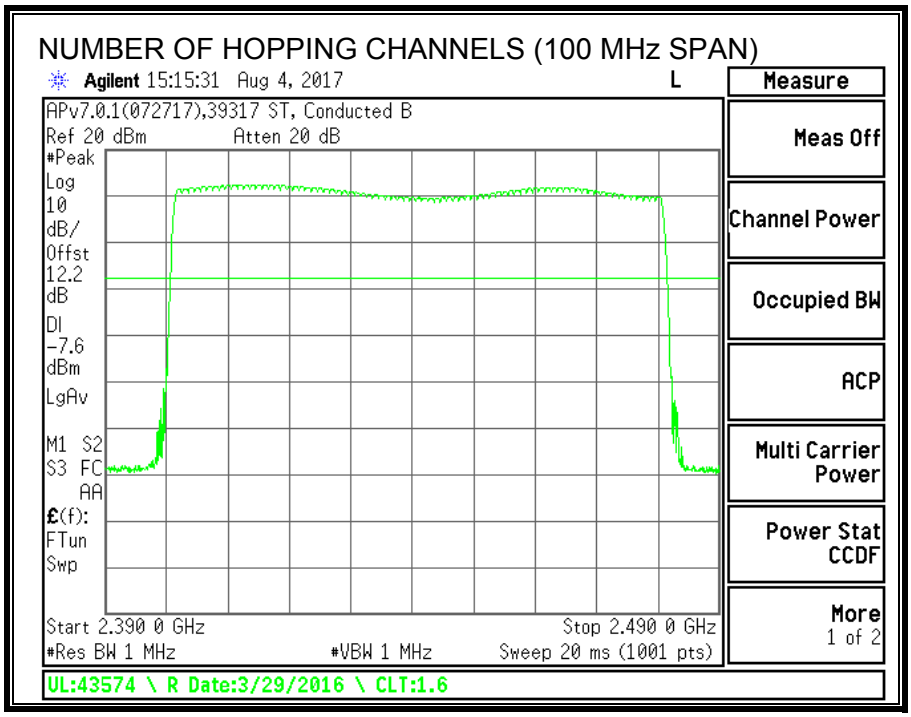
**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

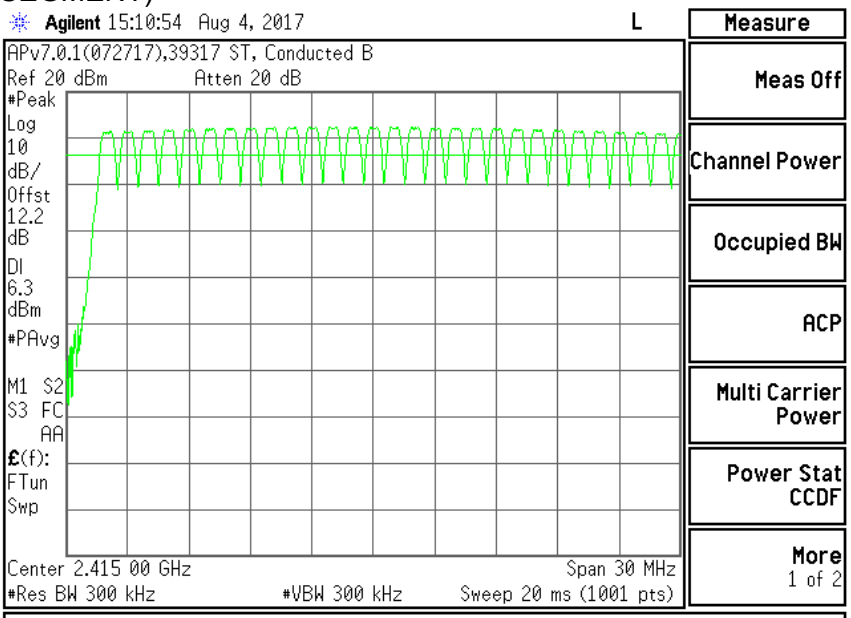
**RESULTS**

Normal Mode: 79 Channels observed.

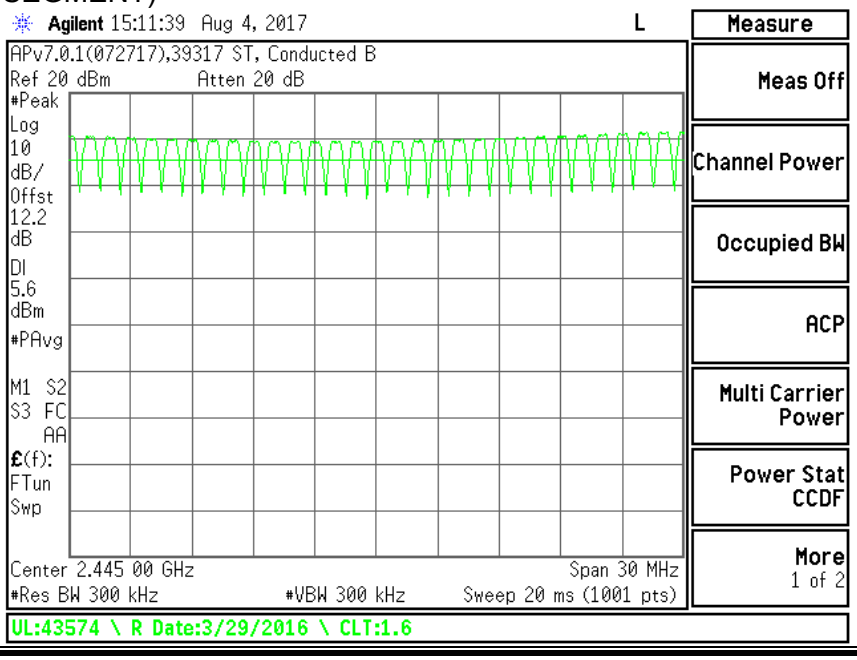
NUMBER OF HOPPING CHANNELS (100 MHz SPAN)



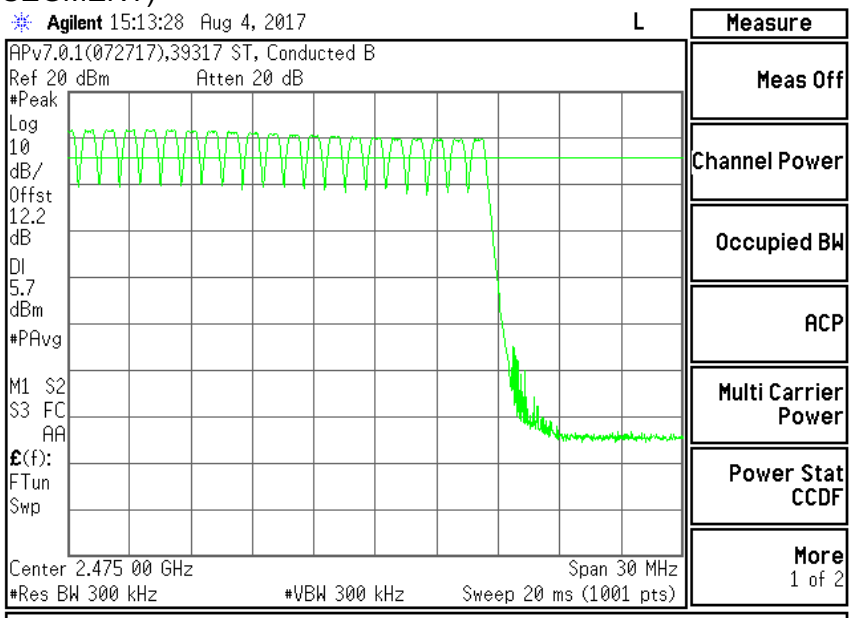
NUMBER OF HOPPING CHANNELS (30 MHz SPAN, FIRST SEGMENT)




NUMBER OF HOPPING CHANNELS (30 MHz SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHz SPAN, THIRD SEGMENT)



## 7.1.5. AVERAGE TIME OF OCCUPANCY

**LIMITS**

FCC §15.247 (a) (1) (iii)
IC RSS-247 (5.1) (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

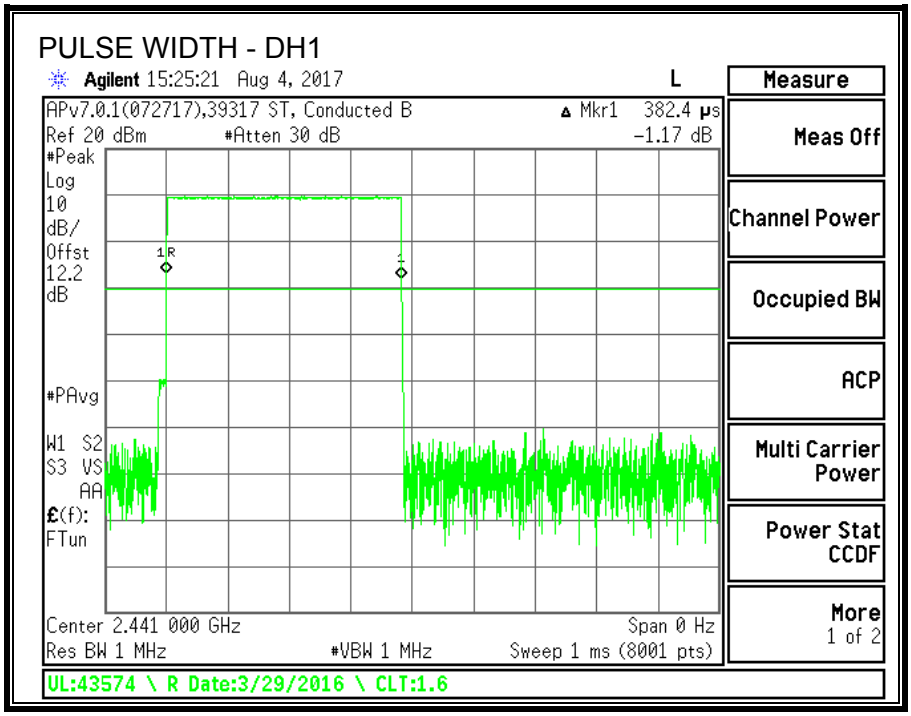
**RESULTS**

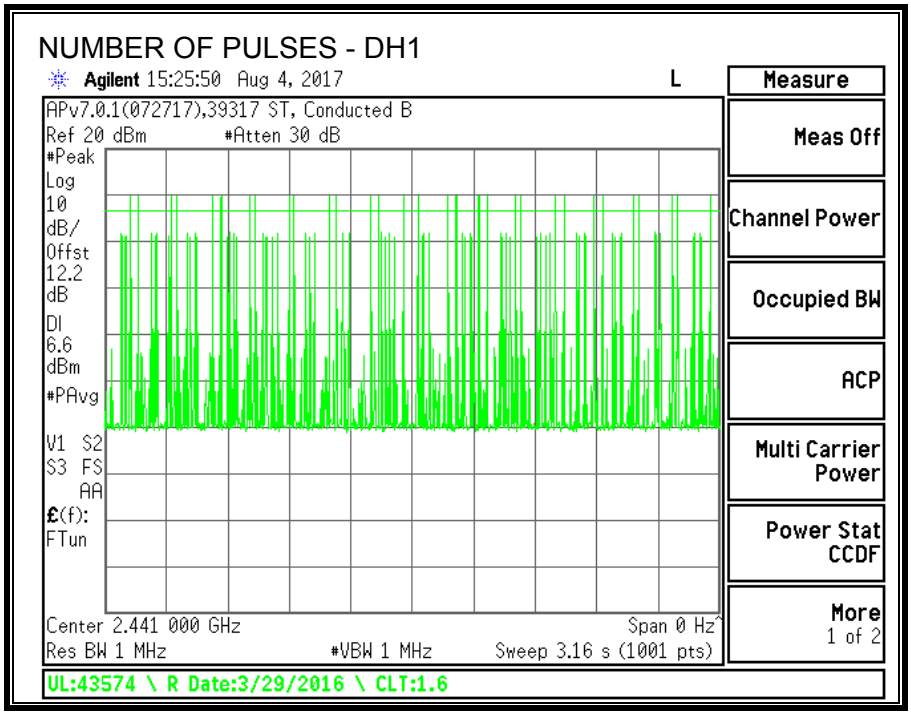
AVERAGE TIME OF OCCUPANCY

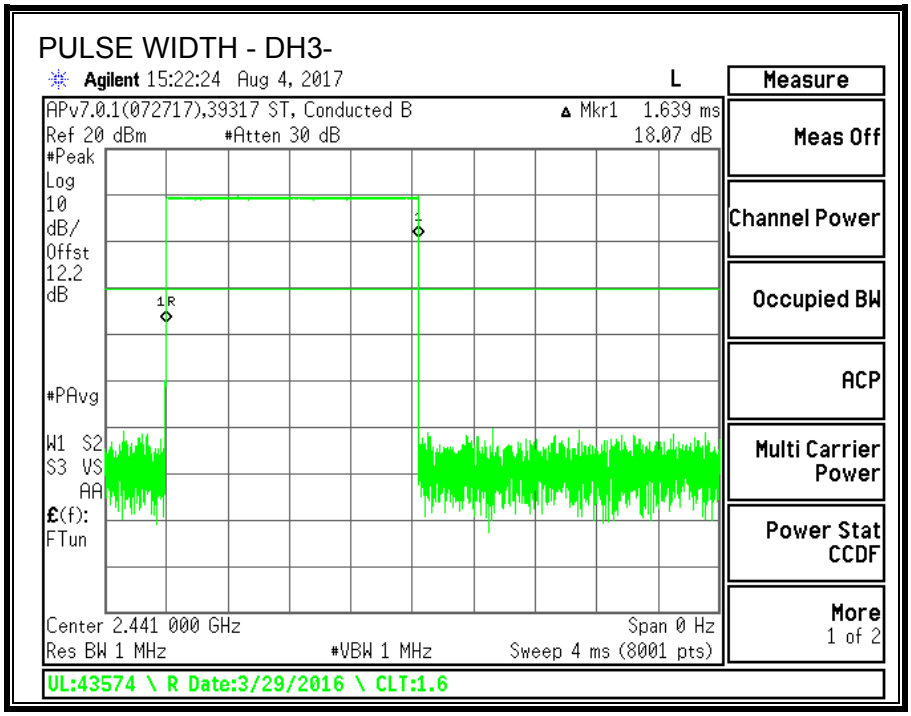
| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| GFSK Normal Mode | | | | | |
| DH1 | 0.3824 | 31 | 0.1185 | 0.4 | -0.2815 |
| DH3 | 1.6390 | 18 | 0.2950 | 0.4 | -0.1050 |
| DH5 | 2.8860 | 11 | 0.3175 | 0.4 | -0.0825 |

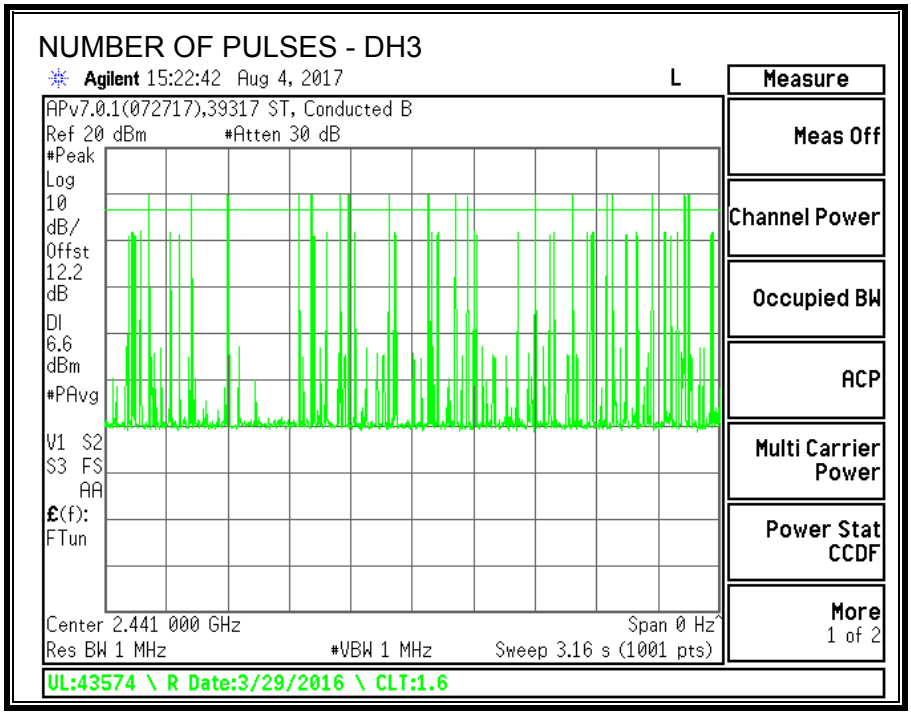
| DH Packet | Pulse Width (sec) | Number of Pulses in 0.8 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| GFSK AFH Mode | | | | | |
| DH1 | 0.3824 | 7.75 | 0.0296 | 0.4 | -0.3704 |
| DH3 | 1.6390 | 4.5 | 0.0738 | 0.4 | -0.3262 |
| DH5 | 2.8860 | 2.75 | 0.0794 | 0.4 | -0.3206 |

NOTE: --

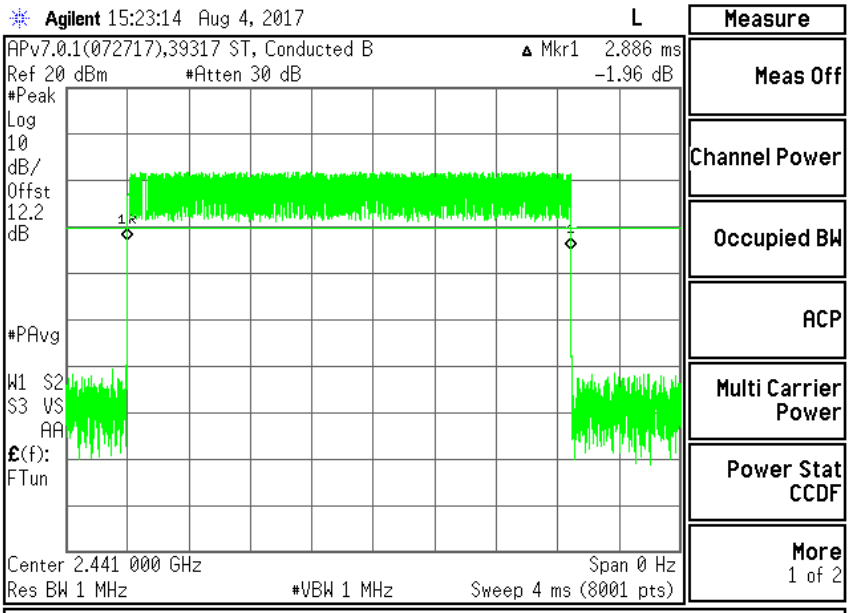


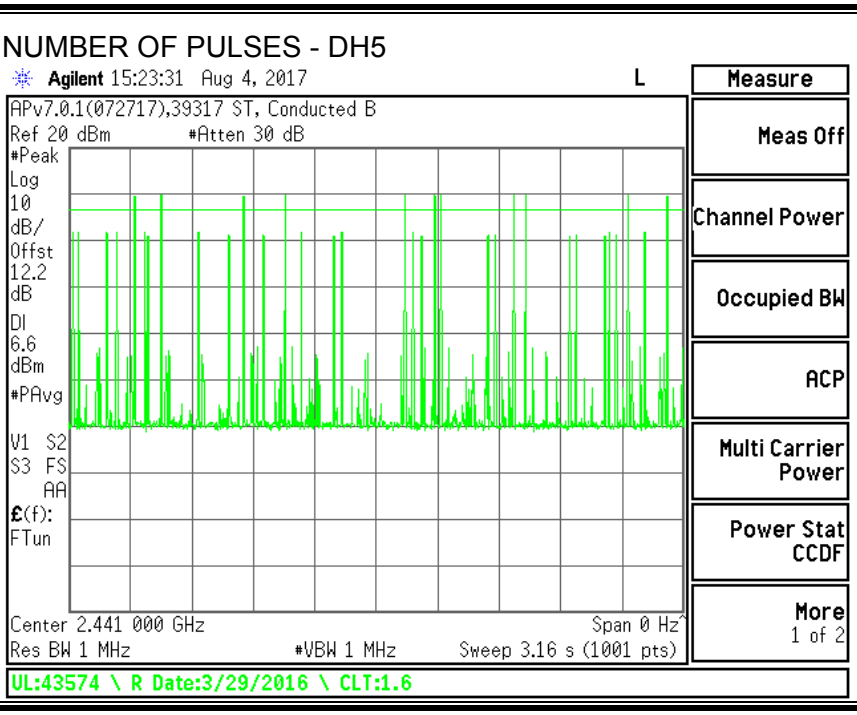


PULSE WIDTH - DH5-




NUMBER OF PULSES - DH5



## 7.1.6. OUTPUT POWER

**LIMITS**

§15.247 (b) (1)
RSS-247 (5.4) (b)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

**TEST PROCEDURE**

The transmitter output is connected to a Bluetooth tester.

**RESULTS**

The cable assembly insertion loss of 11.6 dB (including 10 dB pad and 1.6 dB cable) was entered as an offset in the Bluetooth tester to allow for direct reading of power.

| TEST ENGINEER: | 29435 | Date: | 07/31/2017 |
|---|---|---|---|

| Channel | Frequency (MHz) | Output Power (dBm) |
|---|---|---|
| Low | 2402 | 11.10 |
| Middle | 2441 | 9.80 |
| High | 2480 | 9.70 |

## 7.1.7. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

**LIMITS**

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

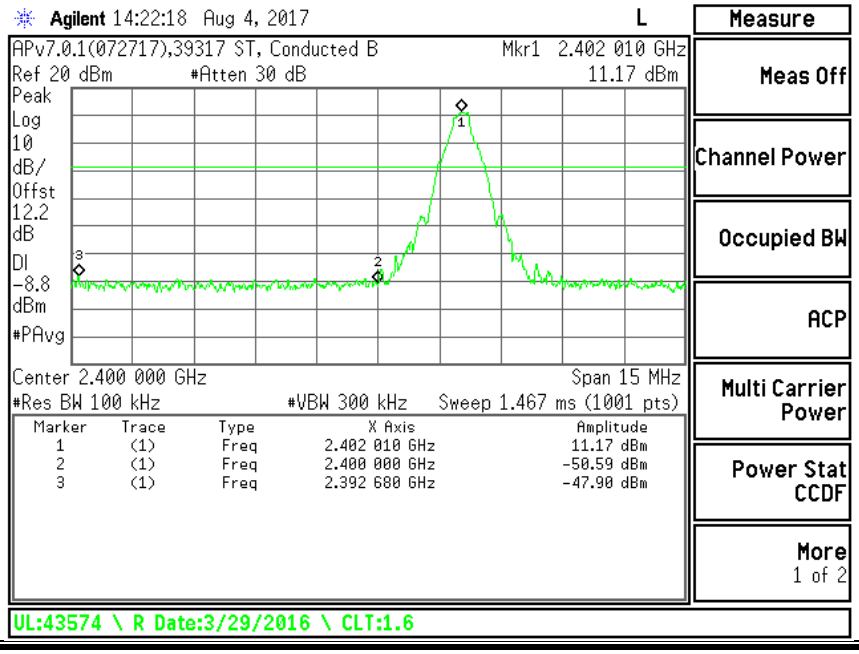
**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

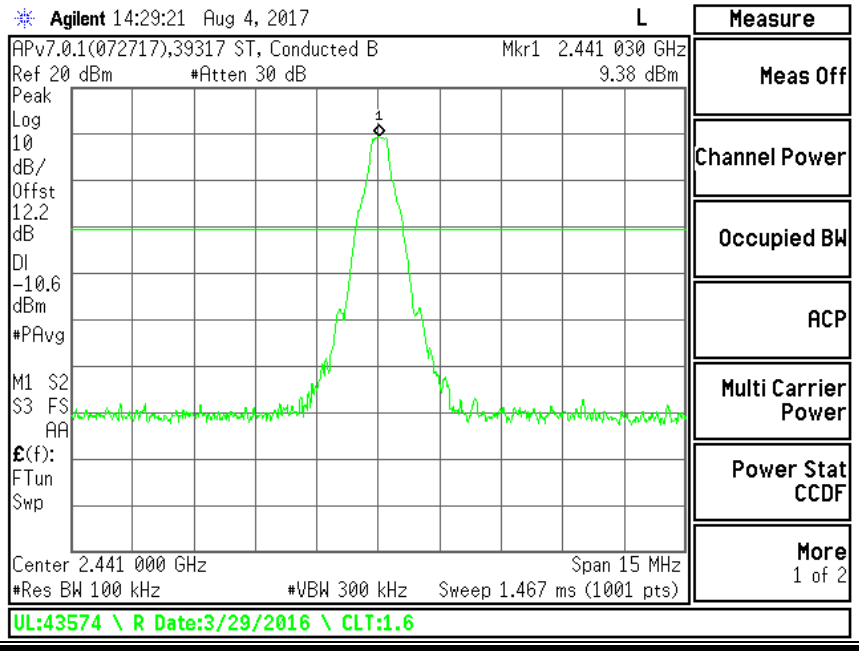
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

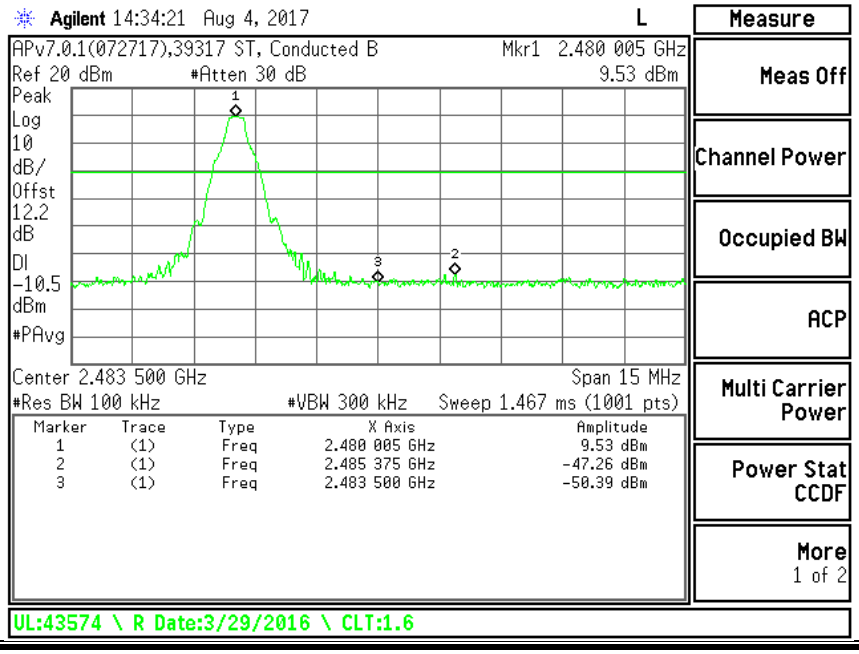
CONDUCTED BANDEDGE LOW CH



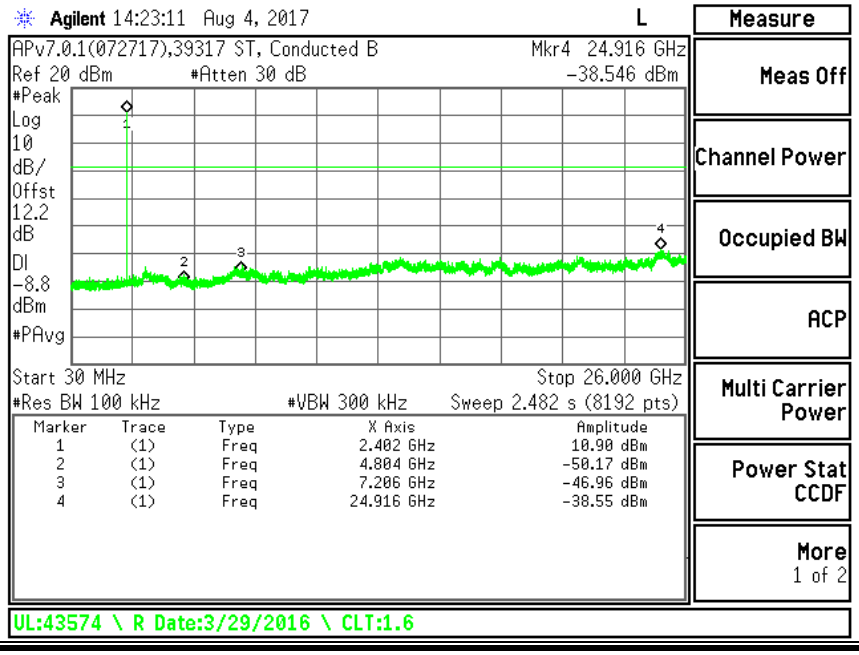

CONDUCTED BANDEDGE MID CH



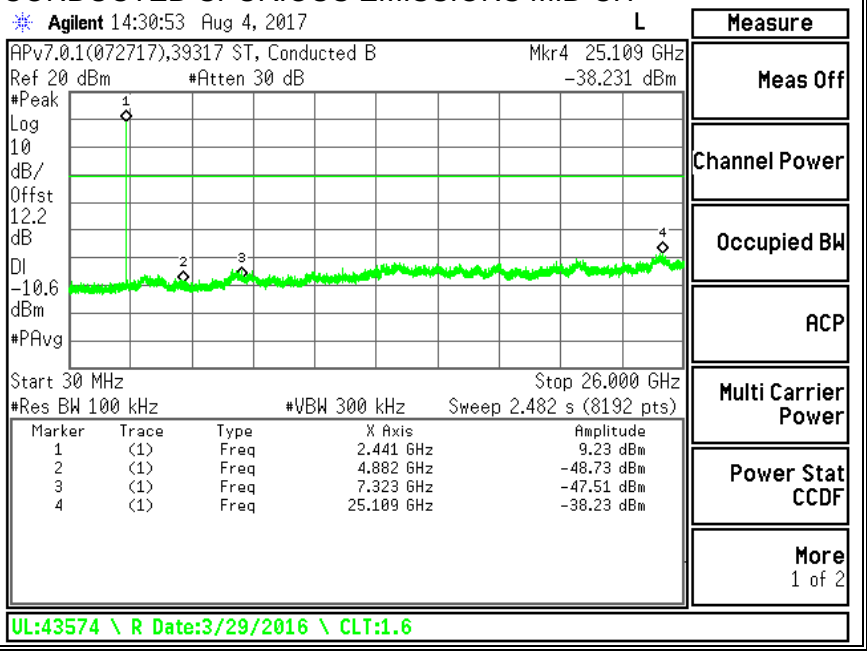
CONDUCTED BANDEDGE HIGH CH



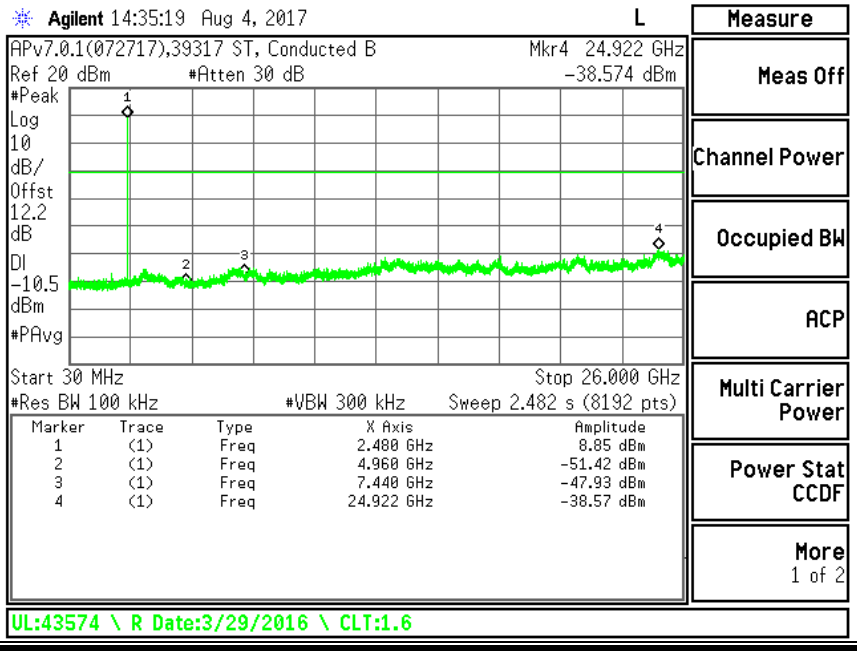

CONDUCTED SPURIOUS EMISSIONS LOW CH



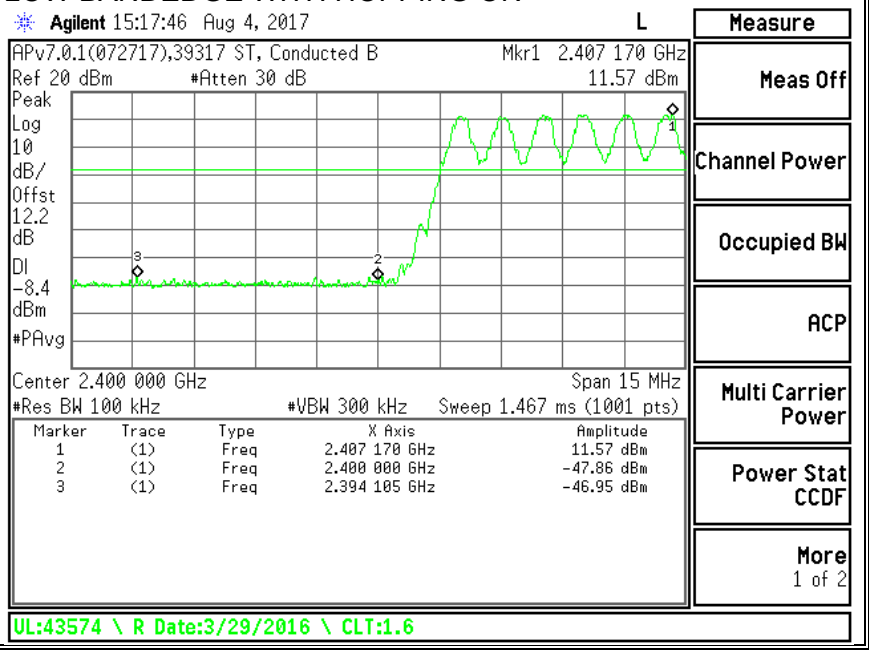
CONDUCTED SPURIOUS EMISSIONS MID CH



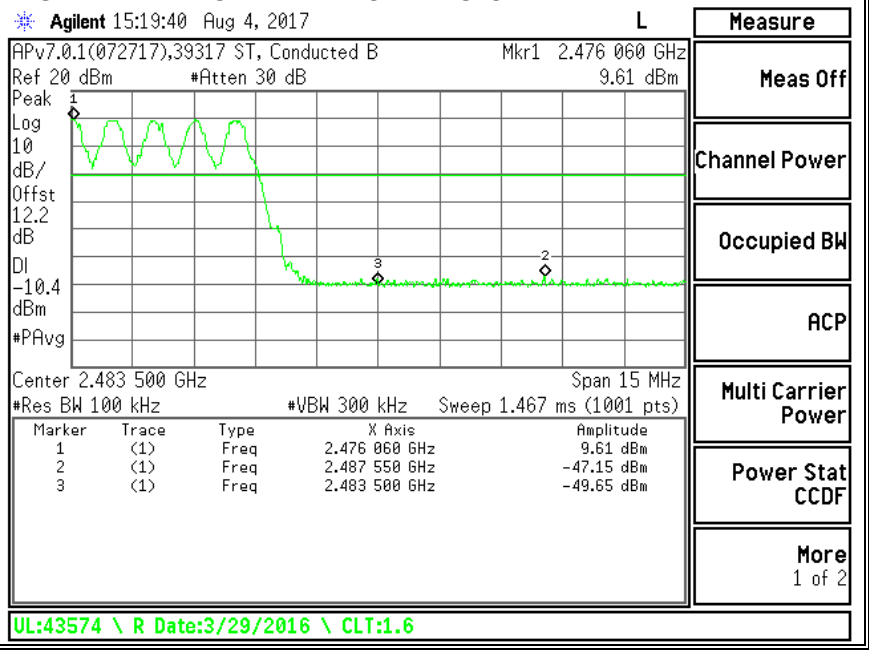

CONDUCTED SPURIOUS EMISSIONS HIGH CH



LOW BANDEDGE WITH HOPPING ON




HIGH BANDEDGE WITH HOPPING ON



# 7.2. ENHANCED DATA RATE 8PSK MODULATION

## 7.2.1. 20 dB BANDWIDTH

**LIMITS**

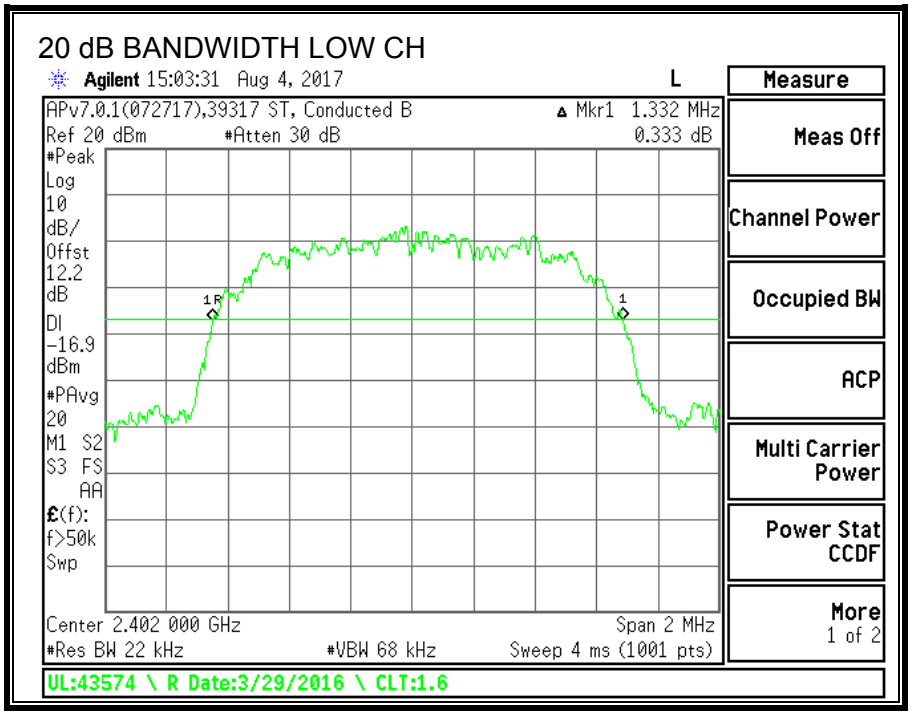
None; for reporting purposes only.

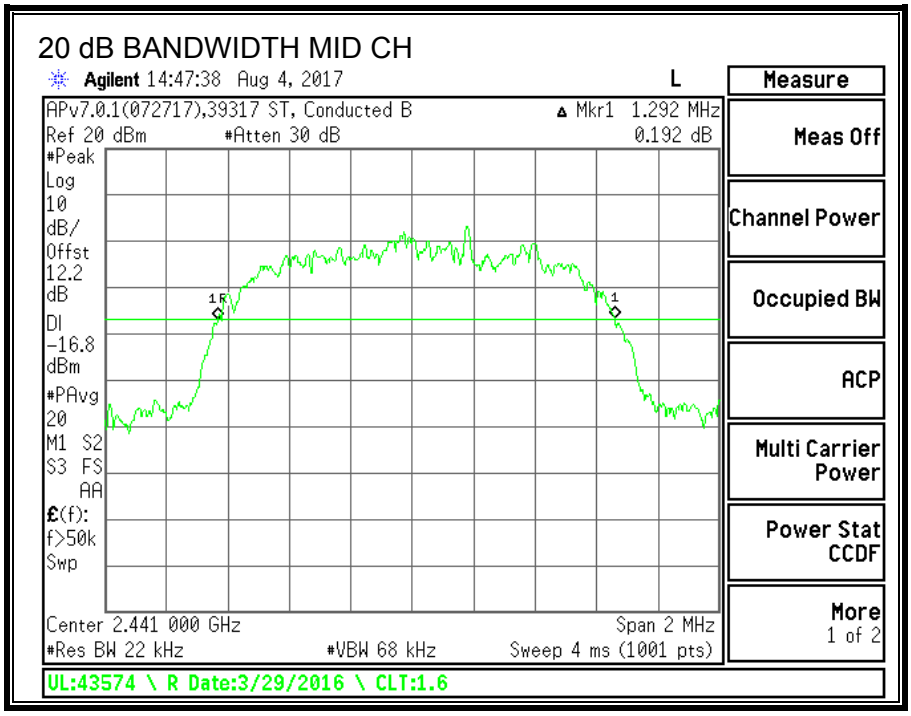
**TEST PROCEDURE**

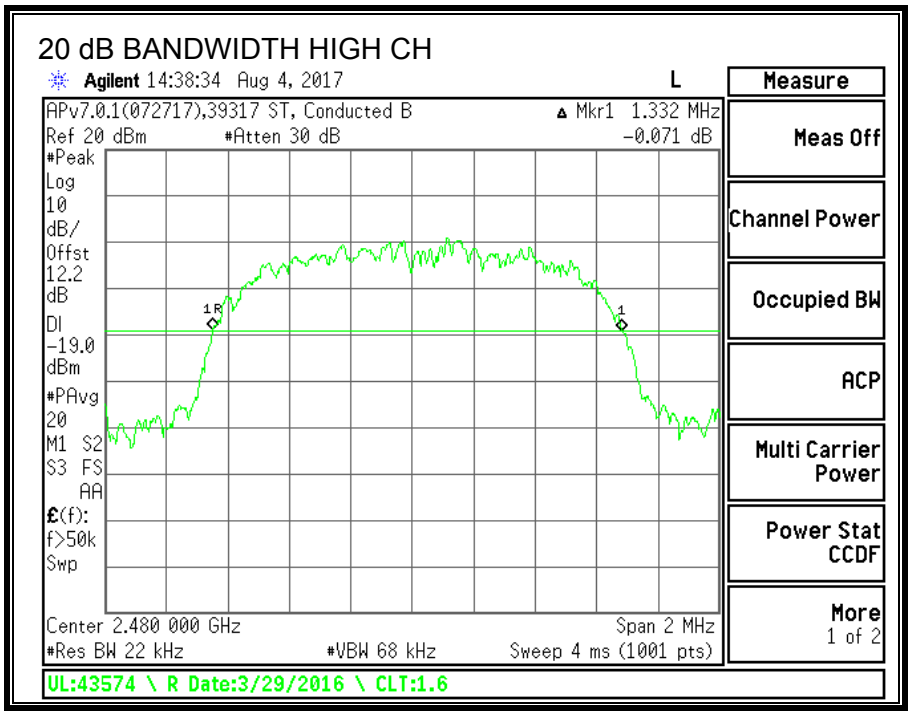
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 20 dB Bandwidth (MHz) |
|---|---|---|
| Low | 2402 | 1.332 |
| Middle | 2441 | 1.292 |
| High | 2480 | 1.332 |





### 7.2.2. 99% BANDWIDTH

**LIMITS**

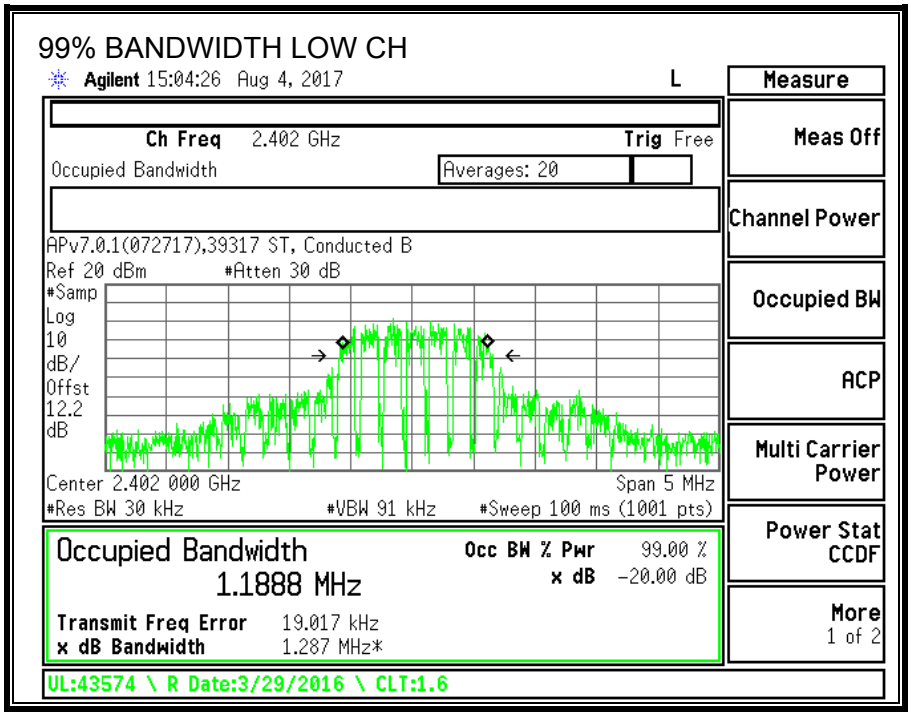
None; for reporting purposes only.

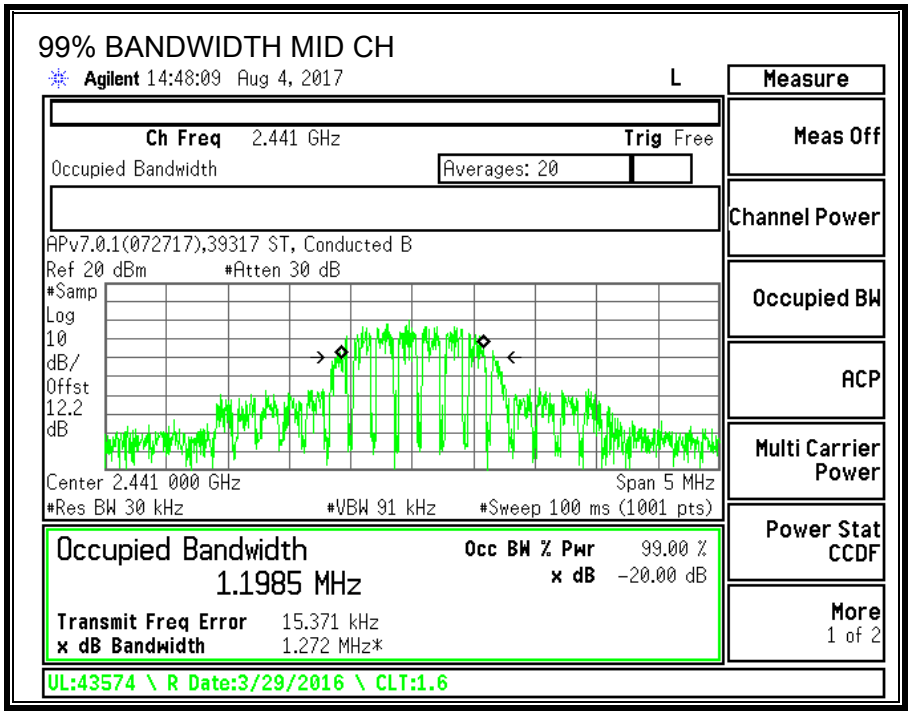
**TEST PROCEDURE**

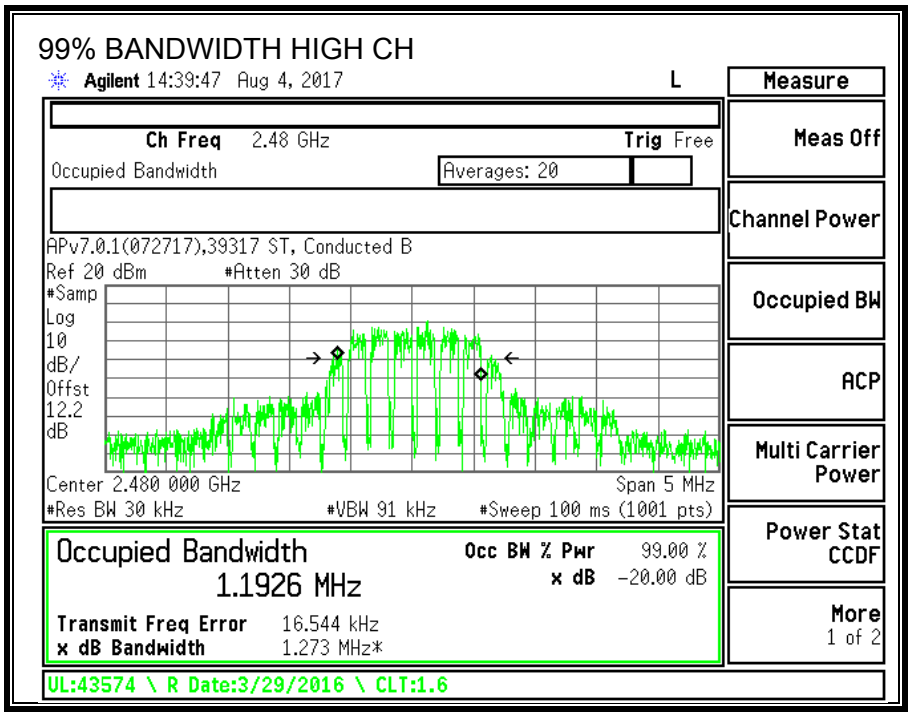
The transmitter output is connected to a spectrum analyzer. The RBW is set to 1 to 3% of the 99% bandwidth and 1% of the Span. The VBW is set to ≥ RBW. The sweep time is coupled.

**RESULTS**

| Channel | Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|---|
| Low | 2402 | 1.1888 |
| Middle | 2441 | 1.1985 |
| High | 2480 | 1.1926 |





## 7.2.3. HOPPING FREQUENCY SEPARATION

**LIMITS**

FCC §15.247 (a) (1)
IC RSS-247 (5.1) (b)

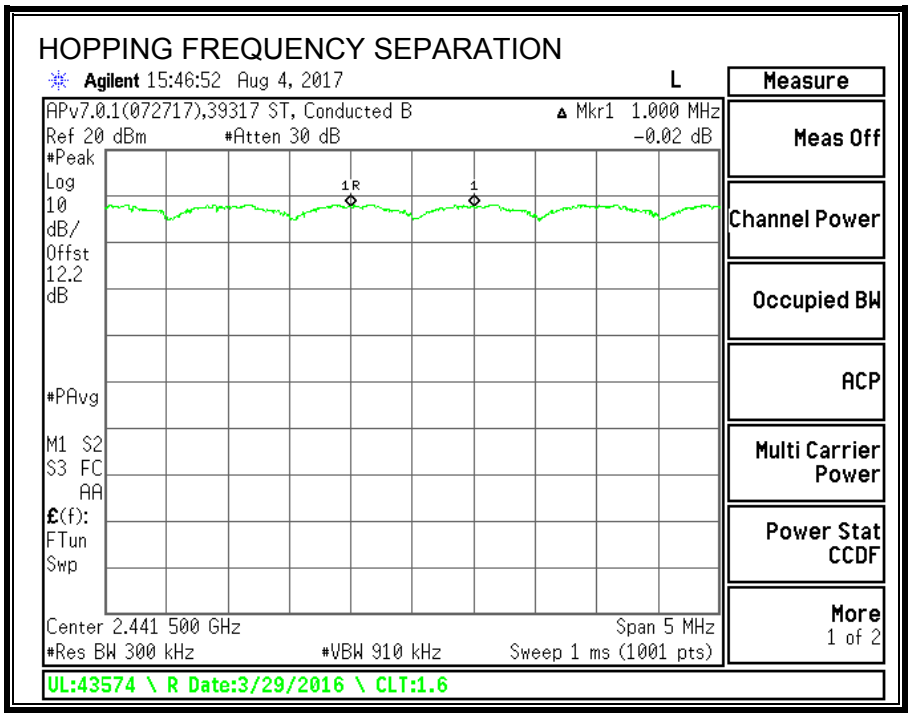
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hoping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The RBW is set to 300 kHz and the VBW is set to 910 kHz. The sweep time is coupled.

**RESULTS**



## 7.2.4. NUMBER OF HOPPING CHANNELS

**LIMITS**

FCC §15.247 (a) (1) (iii)
IC RSS-247 (5.1) (d)

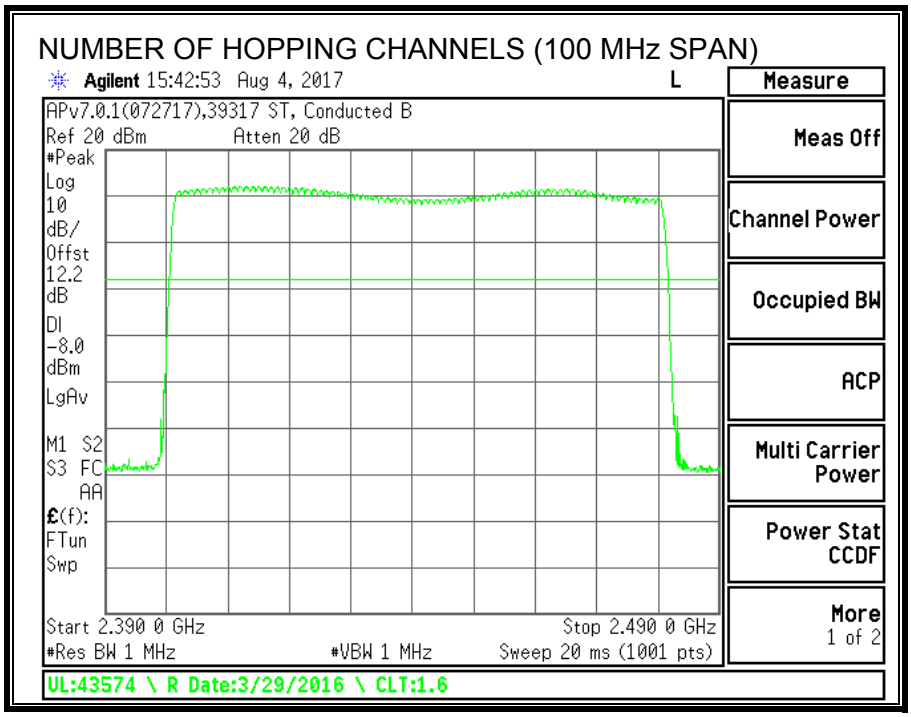
Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

**TEST PROCEDURE**

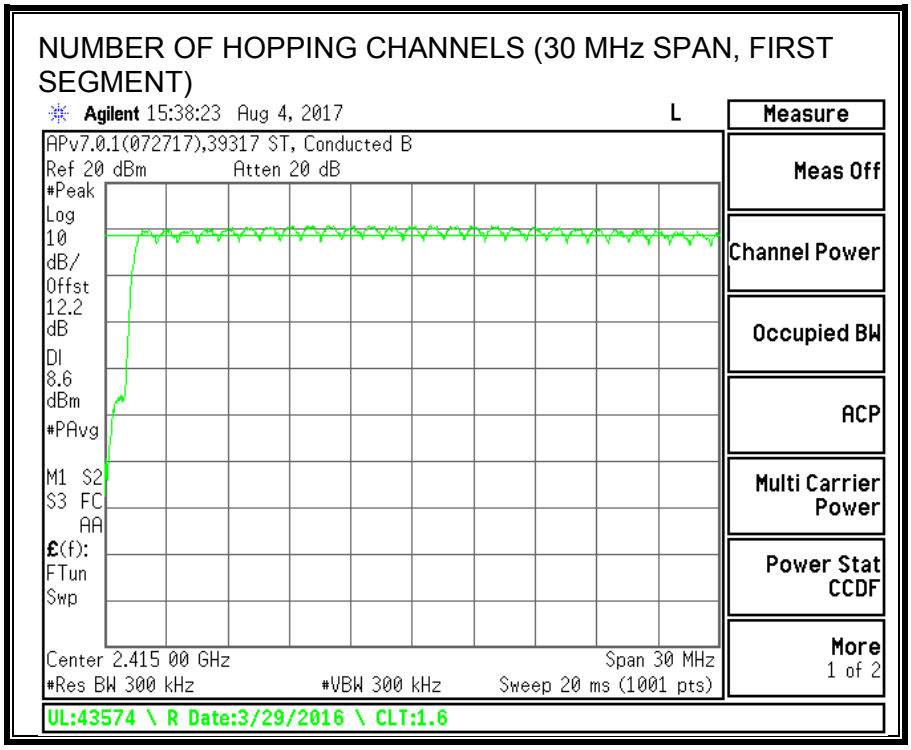
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

**RESULTS**

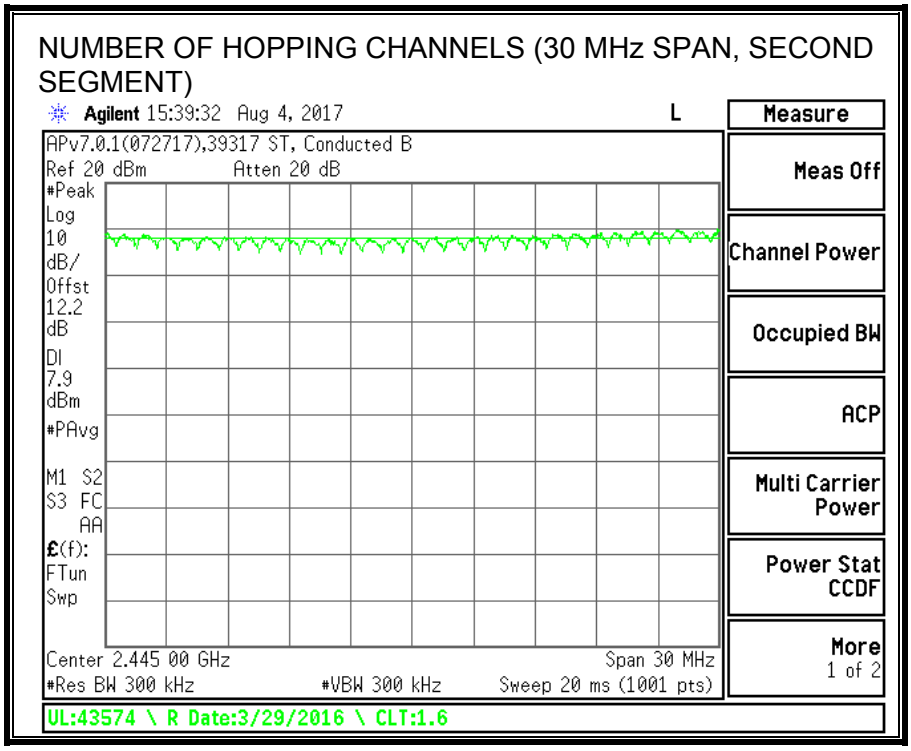
Normal Mode: 79 Channels observed.



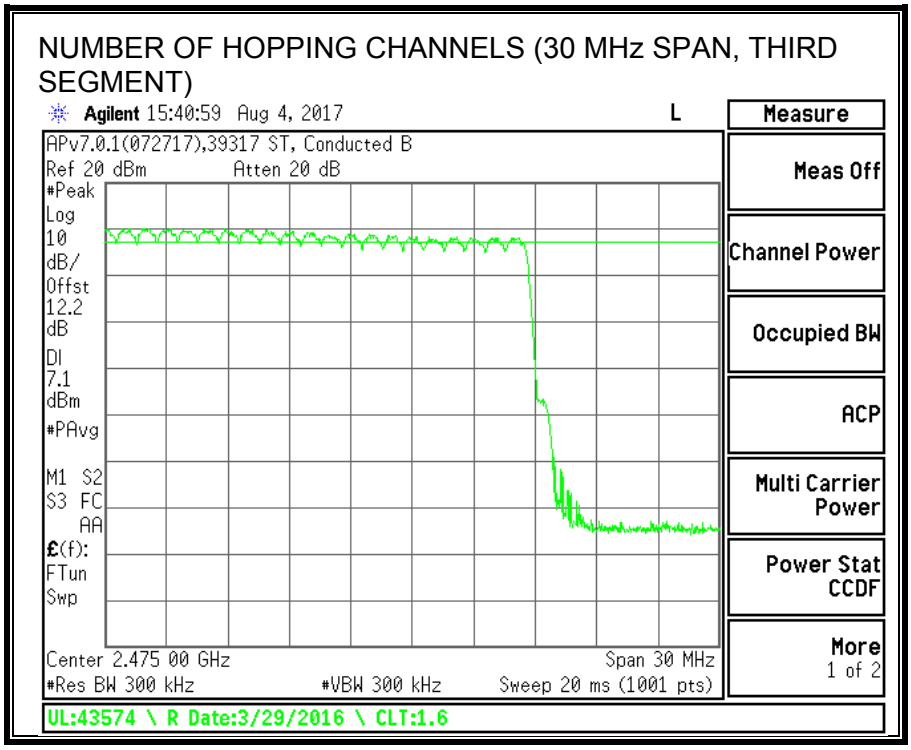
NUMBER OF HOPPING CHANNELS (30 MHz SPAN, FIRST SEGMENT)




NUMBER OF HOPPING CHANNELS (30 MHz SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHz SPAN, THIRD SEGMENT)



## 7.2.5. AVERAGE TIME OF OCCUPANCY

**LIMITS**

FCC §15.247 (a) (1) (iii)
IC RSS-247 (5.1) (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to 10 * (# of pulses in 3.16 s) * pulse width.

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels * 0.4 seconds) is equal to 10 * (# of pulses in 0.8 s) * pulse width.

**RESULTS**

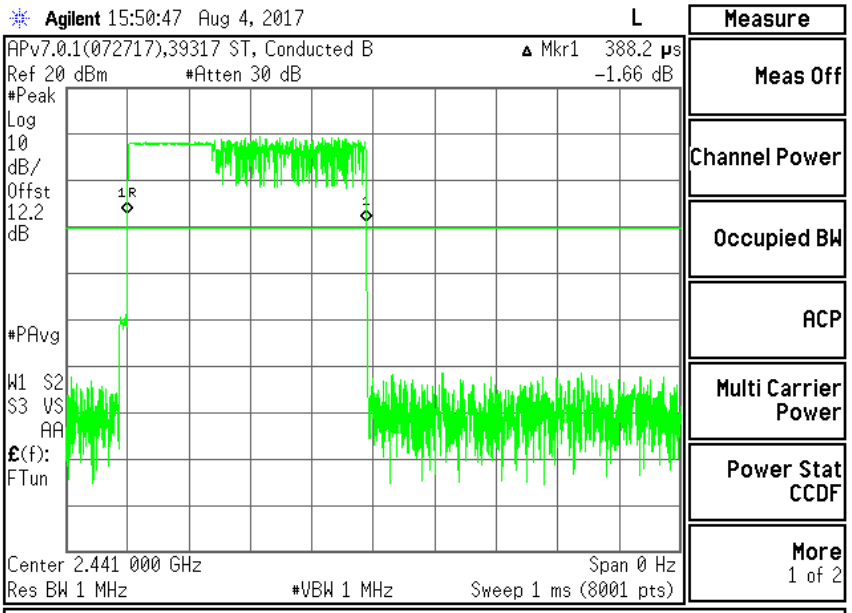
AVERAGE TIME OF OCCUPANCY

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| 8PSK Normal Mode | | | | | |
| 3-DH1 | 0.3882 | 32 | 0.1242 | 0.4 | -0.2758 |
| 3-DH3 | 1.6390 | 20 | 0.3278 | 0.4 | -0.0722 |
| 3-DH5 | 2.8870 | 13 | 0.3753 | 0.4 | -0.0247 |

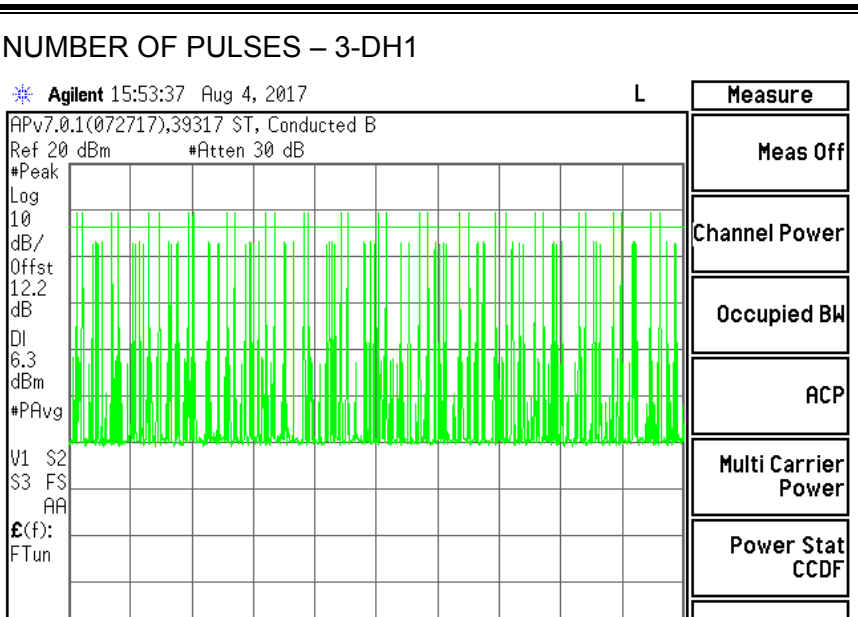
| DH Packet | Pulse Width (sec) | Number of Pulses in 0.8 seconds | Average Time of Occupancy (sec) | Limit (sec) | Margin (sec) |
|---|---|---|---|---|---|
| 8PSK AFH Mode | | | | | |
| 3-DH1 | 0.388 | 8 | 0.03106 | 0.4 | -0.3689 |
| 3-DH3 | 1.639 | 5 | 0.08195 | 0.4 | -0.3181 |
| 3-DH5 | 2.887 | 3.25 | 0.09383 | 0.4 | -0.3062 |

NOTE: --

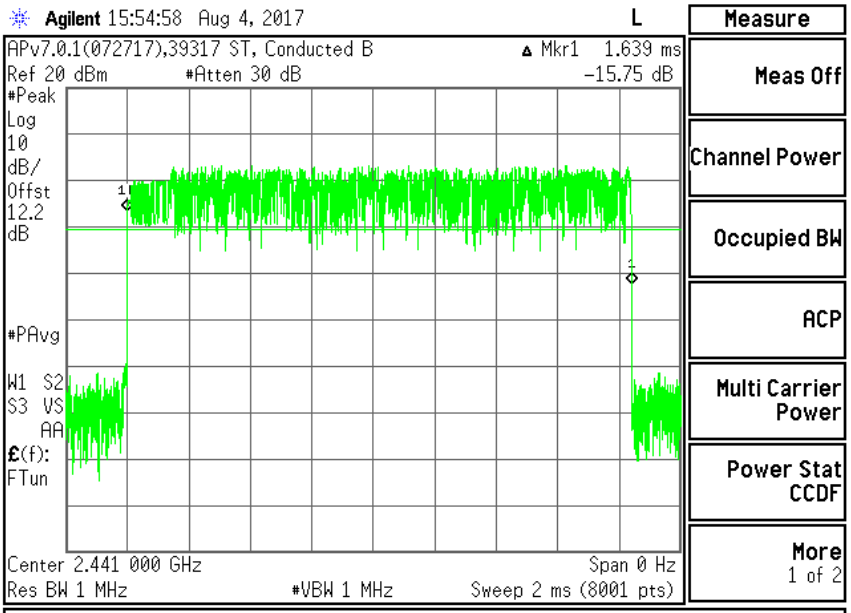
PULSE WIDTH – 3-DH1



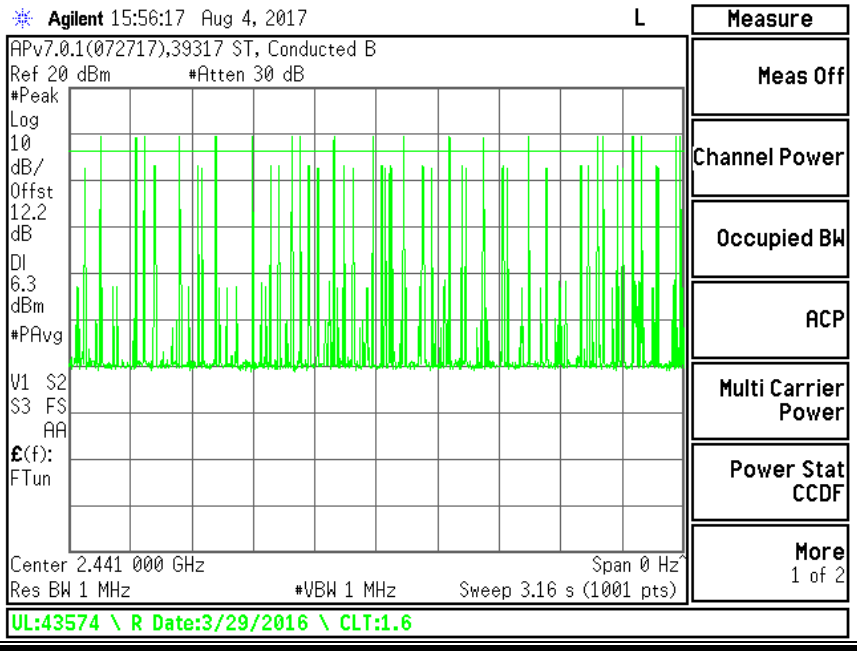

NUMBER OF PULSES – 3-DH1



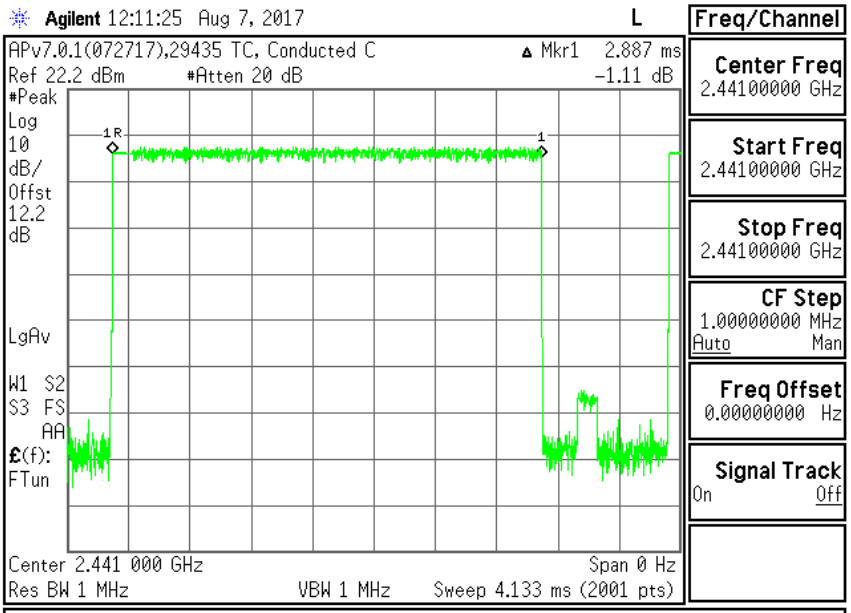
PULSE WIDTH – 3-DH3



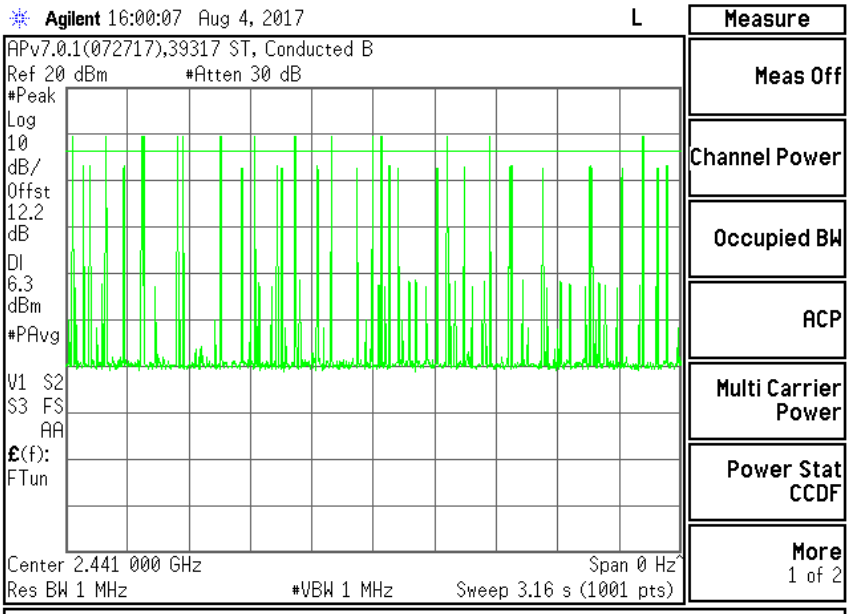

NUMBER OF PULSES – 3-DH3



PULSE WIDTH – 3-DH5




NUMBER OF PULSES – 3-DH5



## 7.2.6. OUTPUT POWER

**LIMITS**

§15.247 (b) (1)
RSS-247 (5.4) (b)

The maximum antenna gain is less than 6 dBi, therefore the limit is 20.97 dBm.

**TEST PROCEDURE**

The transmitter output is connected to a Bluetooth tester.

**RESULTS**

| TEST ENGINEER: | 29435 | Date: | 07/31/2017 |
|---|---|---|---|

| Channel | Frequency (MHz) | Output Power (dBm) |
|---|---|---|
| Low | 2402 | 11.00 |
| Middle | 2441 | 10.10 |
| High | 2480 | 10.20 |

## 7.2.7. CONDUCTED BANDEDGE AND SPURIOUS EMISSIONS

**LIMITS**

FCC §15.247 (d)

IC RSS-247 (5.5)

Limit = -20 dBc

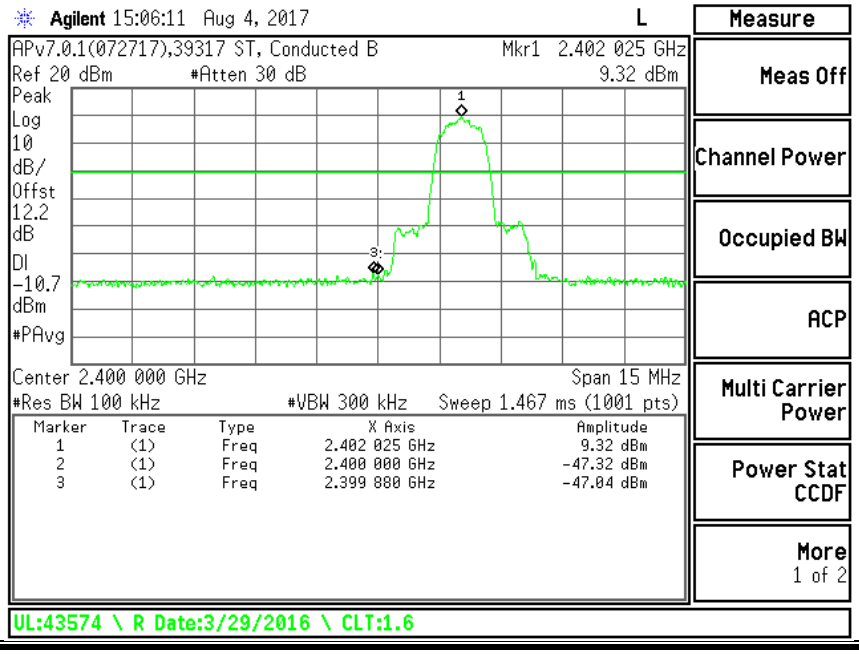
**TEST PROCEDURE**

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

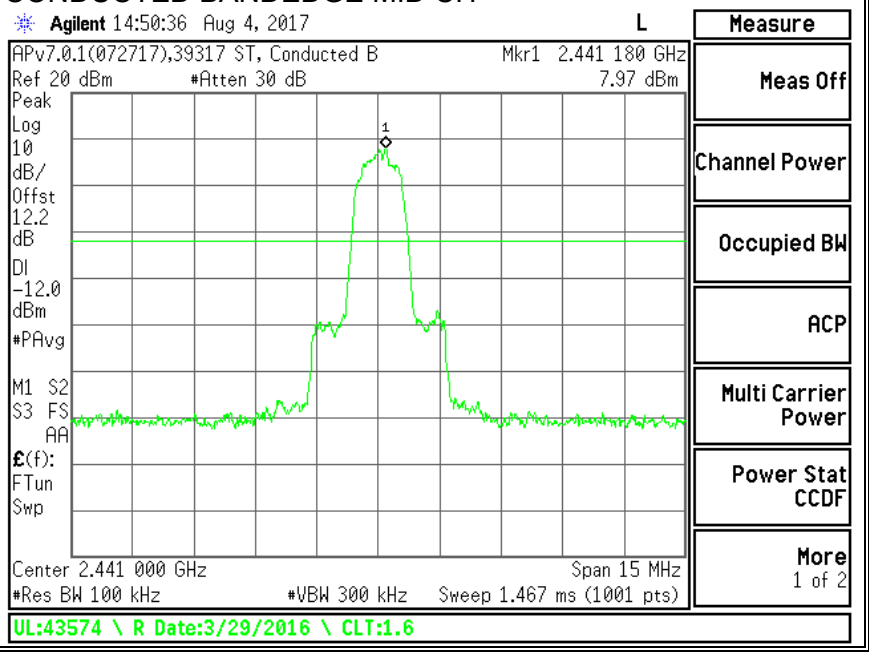
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

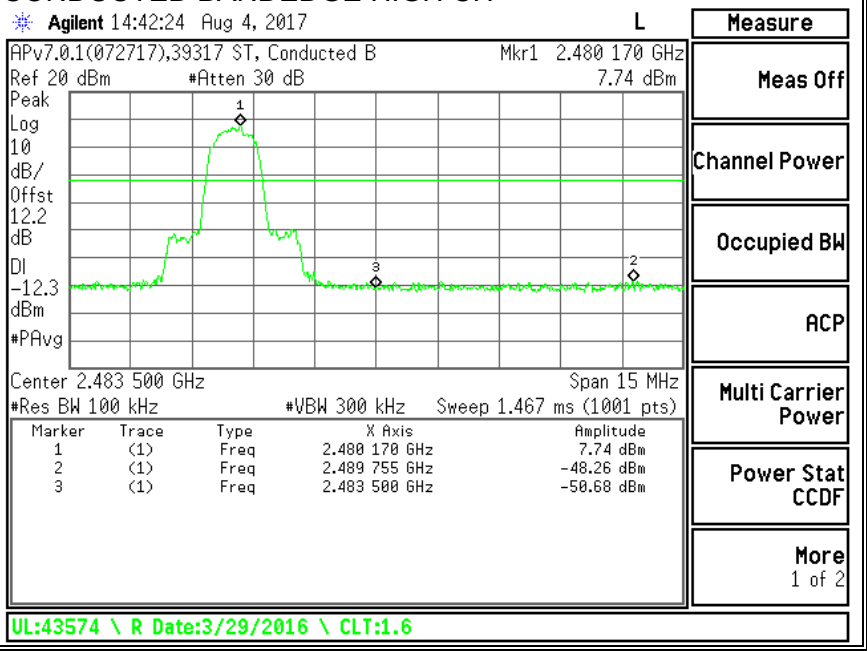
CONDUCTED BANDEDGE LOW CH



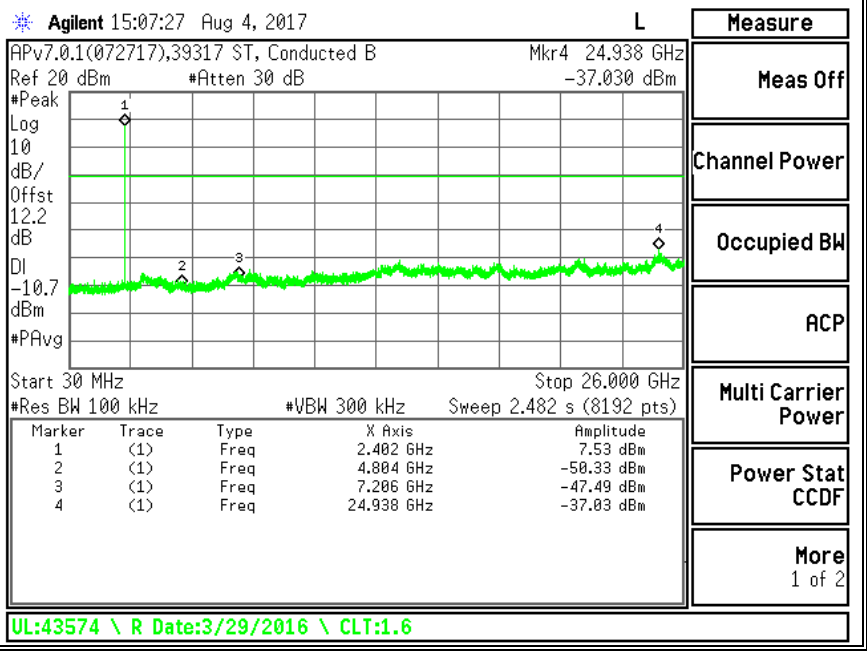

CONDUCTED BANDEDGE MID CH



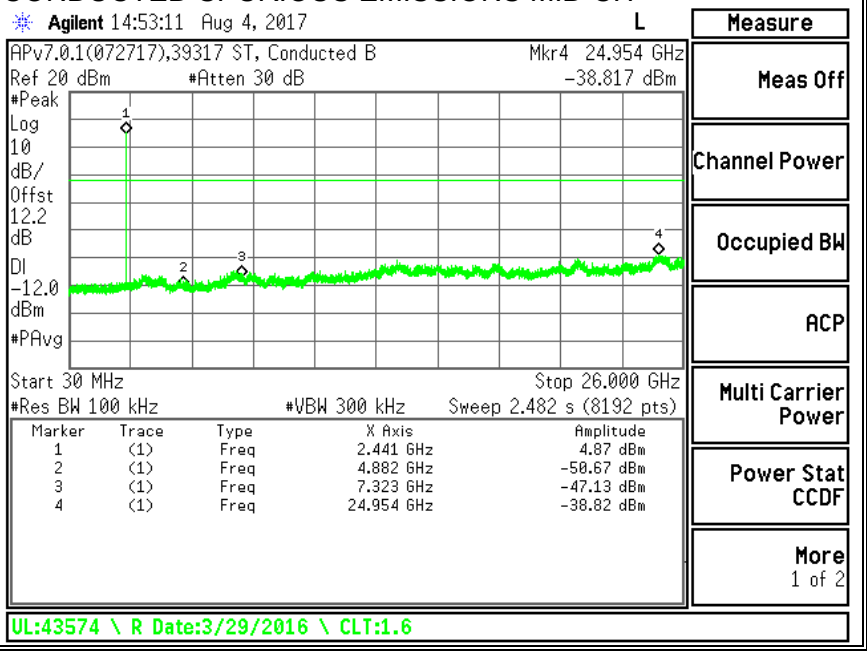
CONDUCTED BANDEDGE HIGH CH



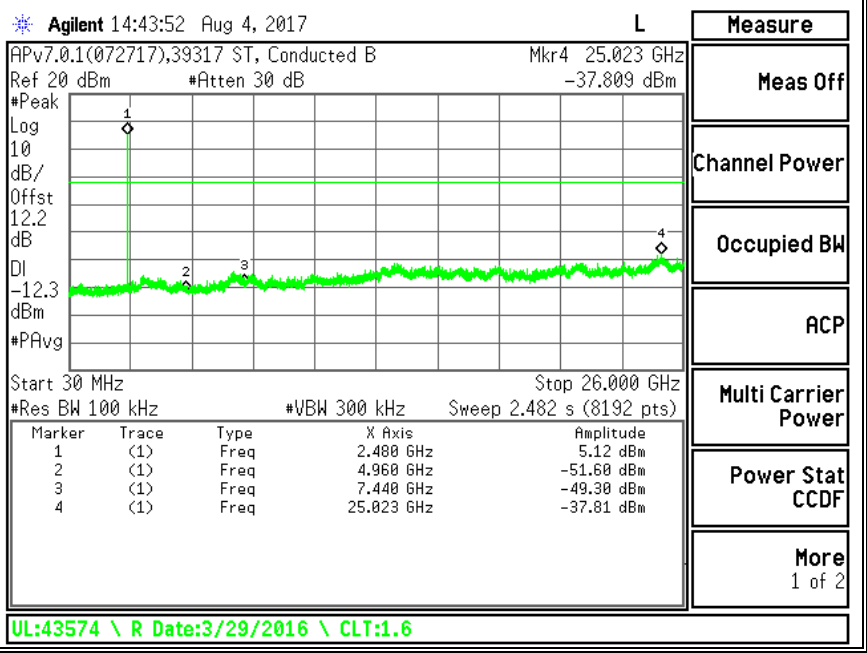

CONDUCTED SPURIOUS EMISSIONS LOW CH



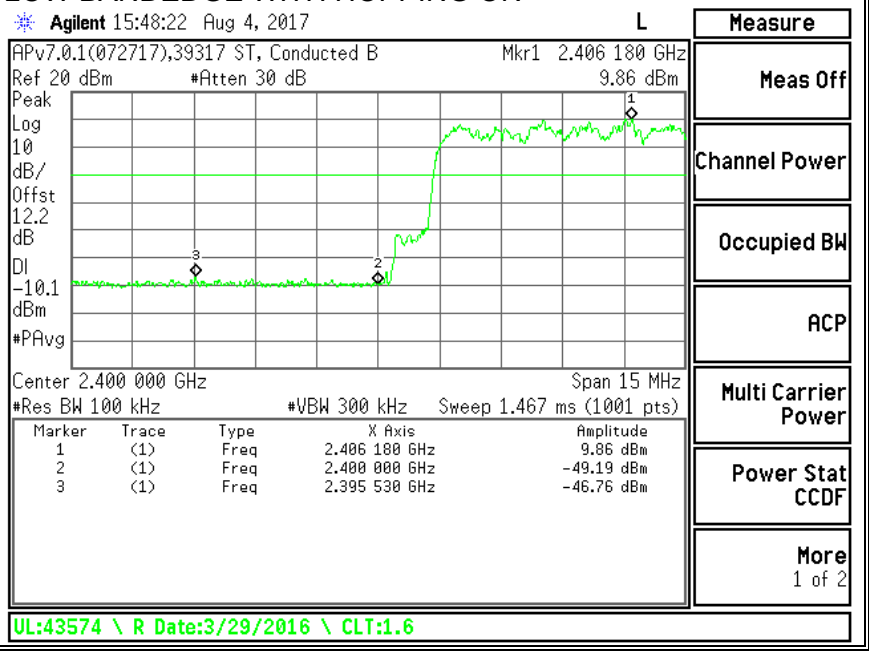
CONDUCTED SPURIOUS EMISSIONS MID CH



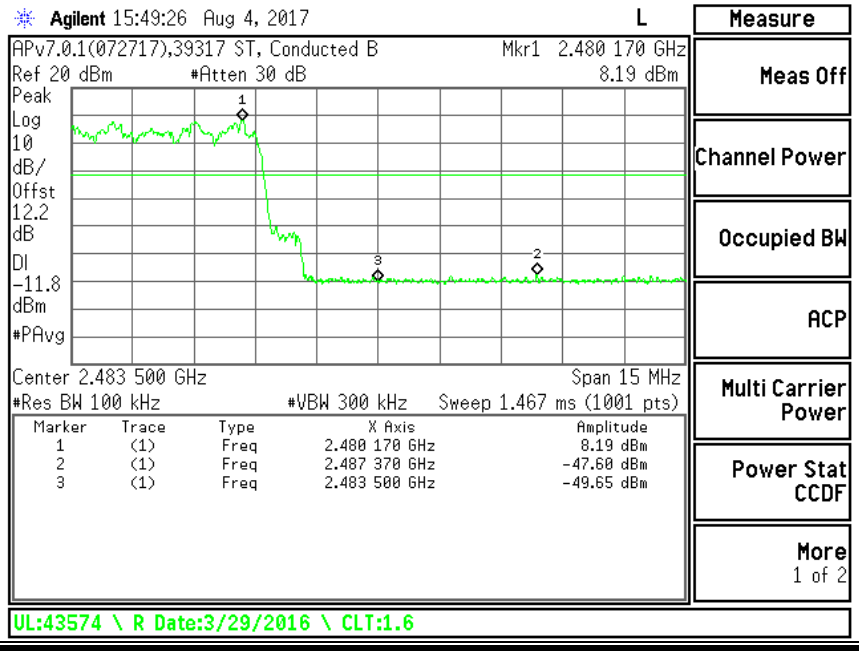

CONDUCTED SPURIOUS EMISSIONS HIGH CH



LOW BANDEDGE WITH HOPPING ON




HIGH BANDEDGE WITH HOPPING ON



# 8. RADIATED TEST RESULTS

## 8.1. LIMITS AND PROCEDURE

**LIMITS**

FCC §15.205 and §15.209
IC RSS-GEN, Section 8.9 and 8.10.

| Frequency Range (MHz) | Field Strength Limit (uV/m) at 3 m | Field Strength Limit (dBuV/m) at 3 m |
|---|---|---|
| 0.009-0.490 | 2400/F(kHz) @ 300 m | - |
| 0.490-1.705 | 24000/F(kHz) @ 30 m | - |
| 1.705 - 30 | 30 @ 30m | - |
| 30 - 88 | 100 | 40 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46 |
| Above 960 | 500 | 54 |

**TEST PROCEDURE**

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1 MHz resolution bandwidth with 1/T (10 Hz) video bandwidth with peak detector for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

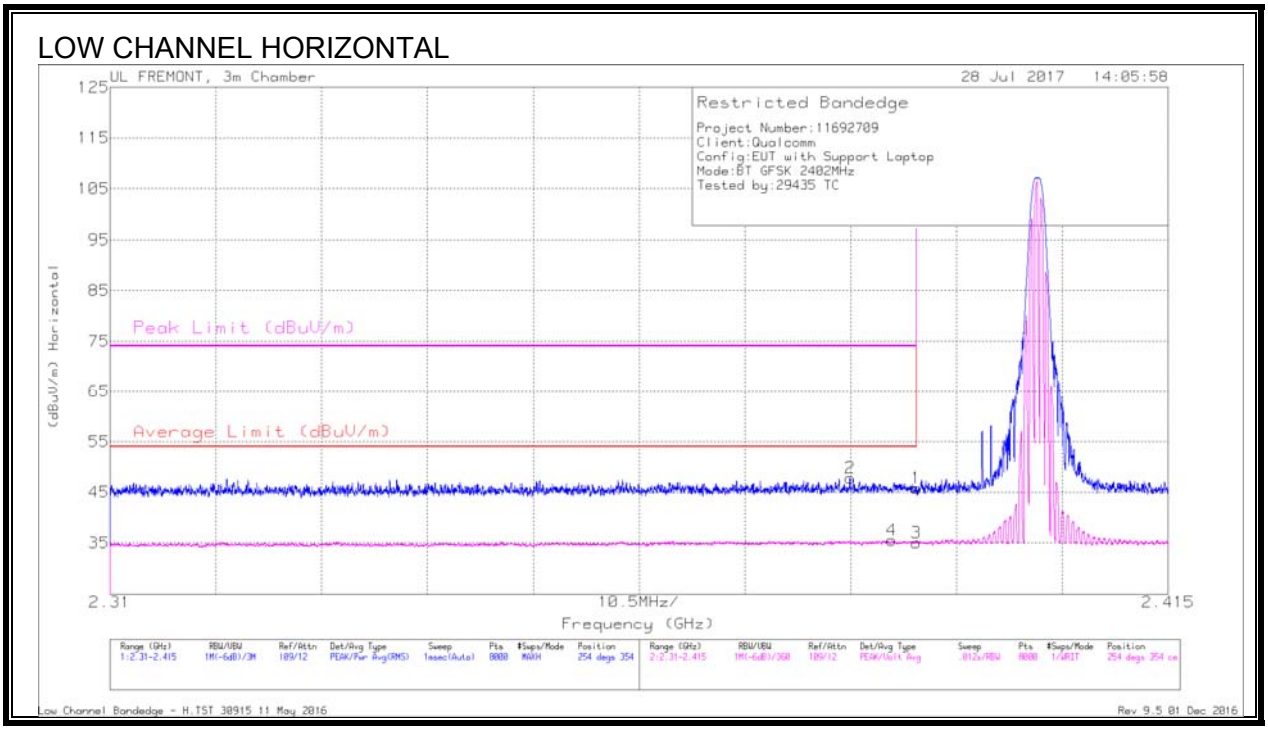
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

**RESULTS**

# 8.2. BASIC DATA RATE GFSK MODULATION

## 8.2.1. RESTRICTED BANDEDGE (LOW CHANNEL)

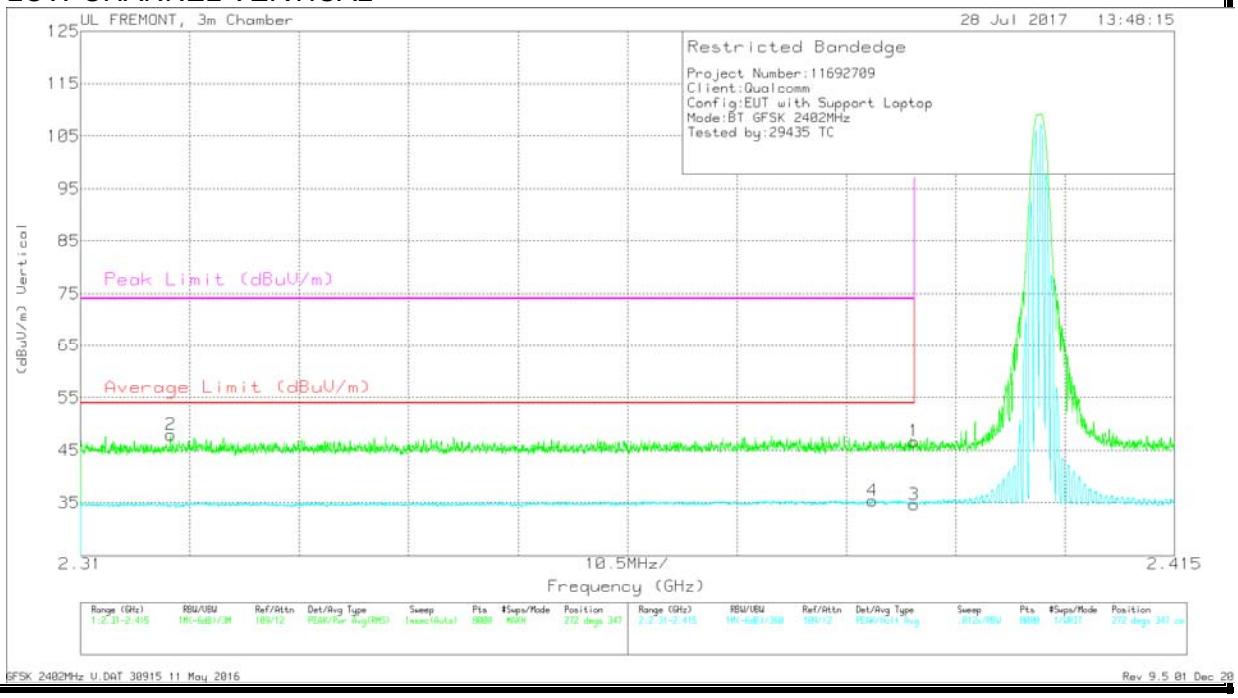
LOW CHANNEL HORIZONTAL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.383 | 38.27 | Pk | 31.9 | -22.4 | 47.77 | - | - | 74 | -26.23 | 254 | 354 | H |
| 4 | 2.388 | 25.96 | VA1T | 31.9 | -22.4 | 35.46 | 54 | -18.54 | - | - | 254 | 354 | H |
| 1 | 2.39 | 36.55 | Pk | 31.9 | -22.6 | 45.85 | - | - | 74 | -28.15 | 254 | 354 | H |
| 3 | 2.39 | 25.7 | VA1T | 31.9 | -22.6 | 35 | 54 | -19 | - | - | 254 | 354 | H |

Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## LOW CHANNEL VERTICAL

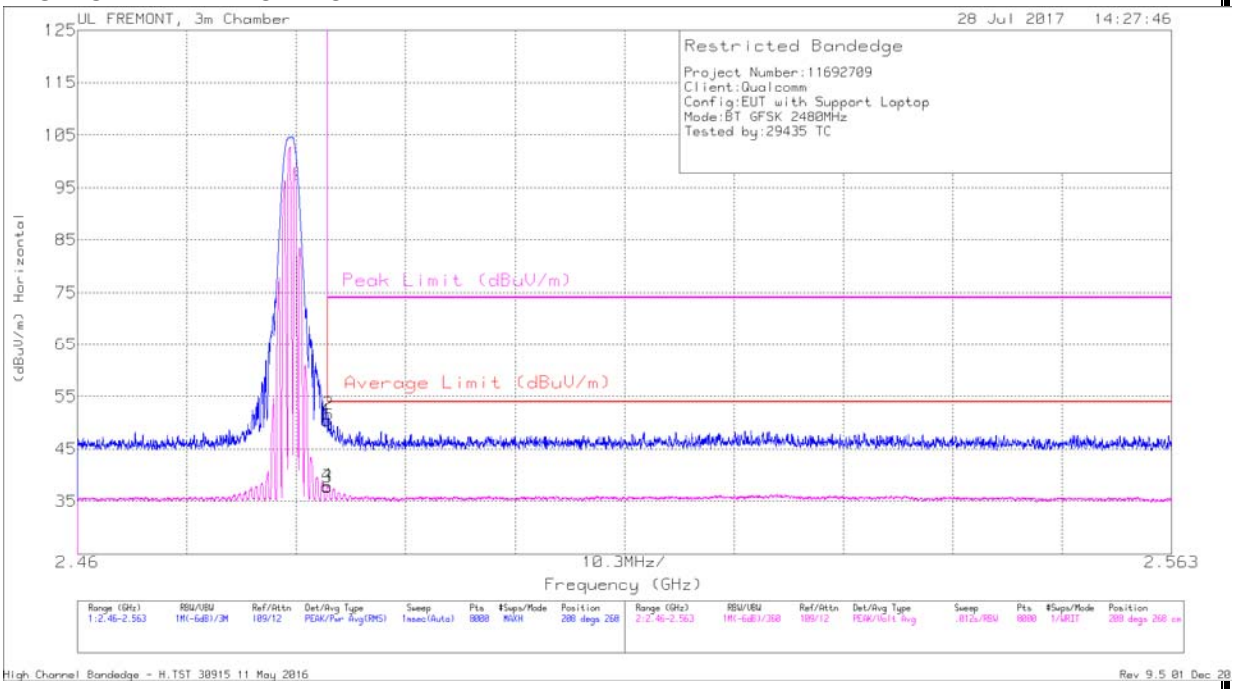



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.319 | 38.77 | Pk | 31.8 | -22.6 | 47.97 | - | - | 74 | -26.03 | 272 | 347 | V |
| 4 | 2.386 | 26.04 | VA1T | 31.9 | -22.5 | 35.44 | 54 | -18.56 | - | - | 272 | 347 | V |
| 1 | 2.39 | 37.42 | Pk | 31.9 | -22.6 | 46.72 | - | - | 74 | -27.28 | 272 | 347 | V |
| 3 | 2.39 | 25.38 | VA1T | 31.9 | -22.6 | 34.68 | 54 | -19.32 | - | - | 272 | 347 | V |

Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 8.2.2. AUTHORIZED BANDEDGE (HIGH CHANNEL)

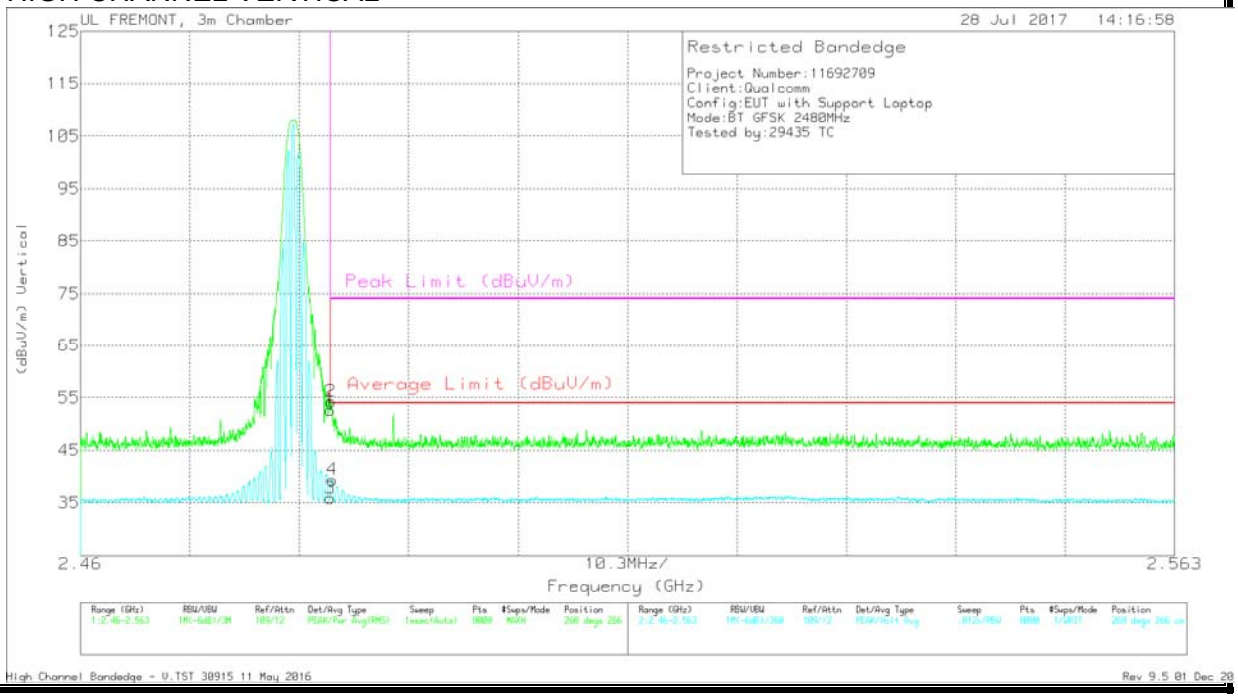
HIGH CHANNEL HORIZONTAL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.484 | 40.69 | Pk | 32.4 | -22.7 | 50.39 | - | - | 74 | -23.61 | 208 | 268 | H |
| 2 | 2.484 | 41.99 | Pk | 32.4 | -22.7 | 51.69 | - | - | 74 | -22.31 | 208 | 268 | H |
| 3 | 2.484 | 28.04 | VA1T | 32.4 | -22.7 | 37.74 | 54 | -16.26 | - | - | 208 | 268 | H |
| 4 | 2.484 | 28.24 | VA1T | 32.4 | -22.7 | 37.94 | 54 | -16.06 | - | - | 208 | 268 | H |

Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## HIGH CHANNEL VERTICAL

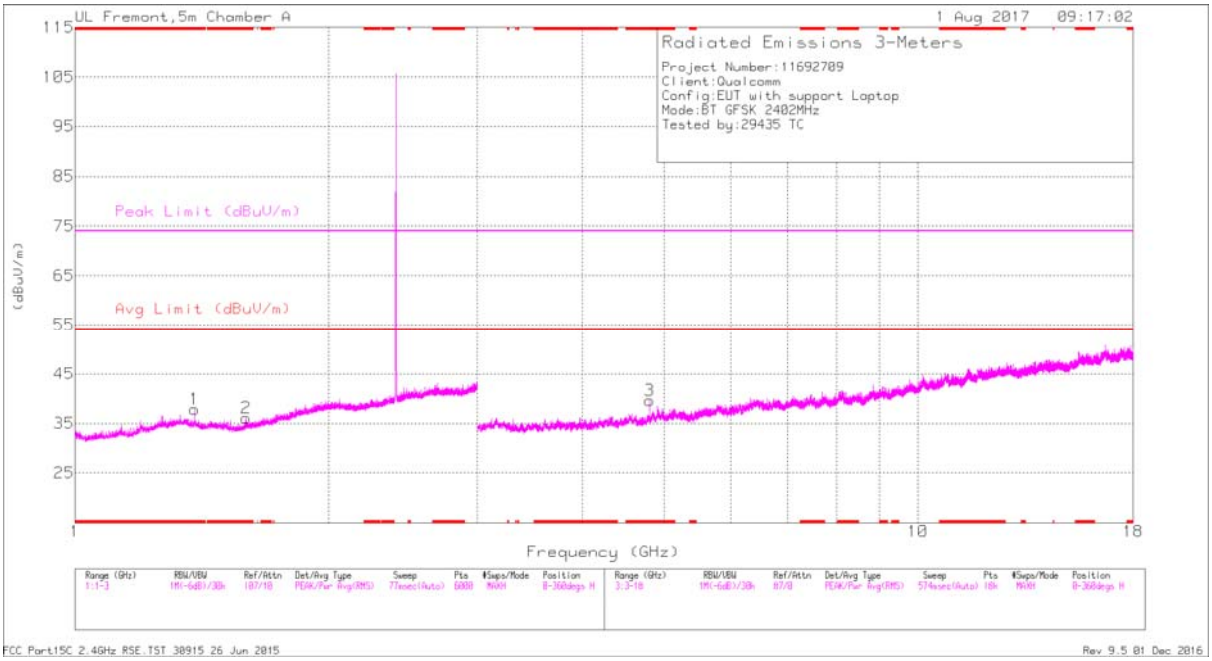



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.484 | 42.97 | Pk | 32.4 | -22.7 | 52.67 | - | - | 74 | -21.33 | 268 | 266 | V |
| 2 | 2.484 | 44.53 | Pk | 32.4 | -22.7 | 54.23 | - | - | 74 | -19.77 | 268 | 266 | V |
| 3 | 2.484 | 26.19 | VA1T | 32.4 | -22.7 | 35.89 | 54 | -18.11 | - | - | 268 | 266 | V |
| 4 | 2.484 | 29.65 | VA1T | 32.4 | -22.7 | 39.35 | 54 | -14.65 | - | - | 268 | 266 | V |

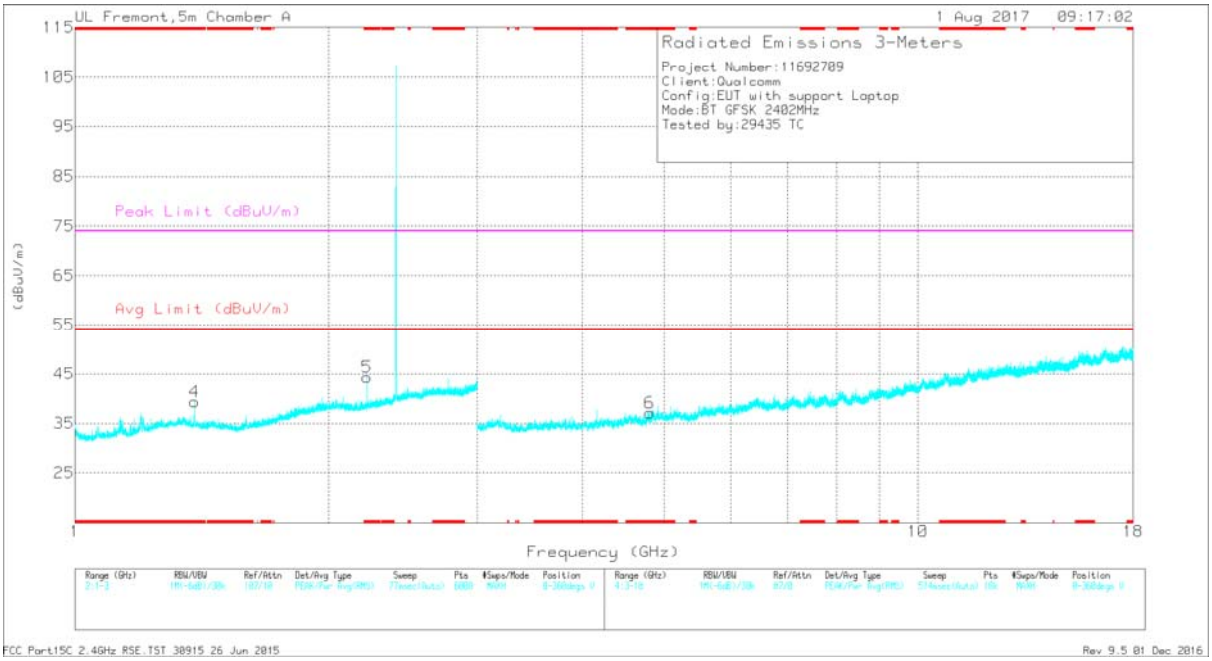
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 8.2.3. HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL




LOW CHANNEL VERTICAL



## Radiated Emissions

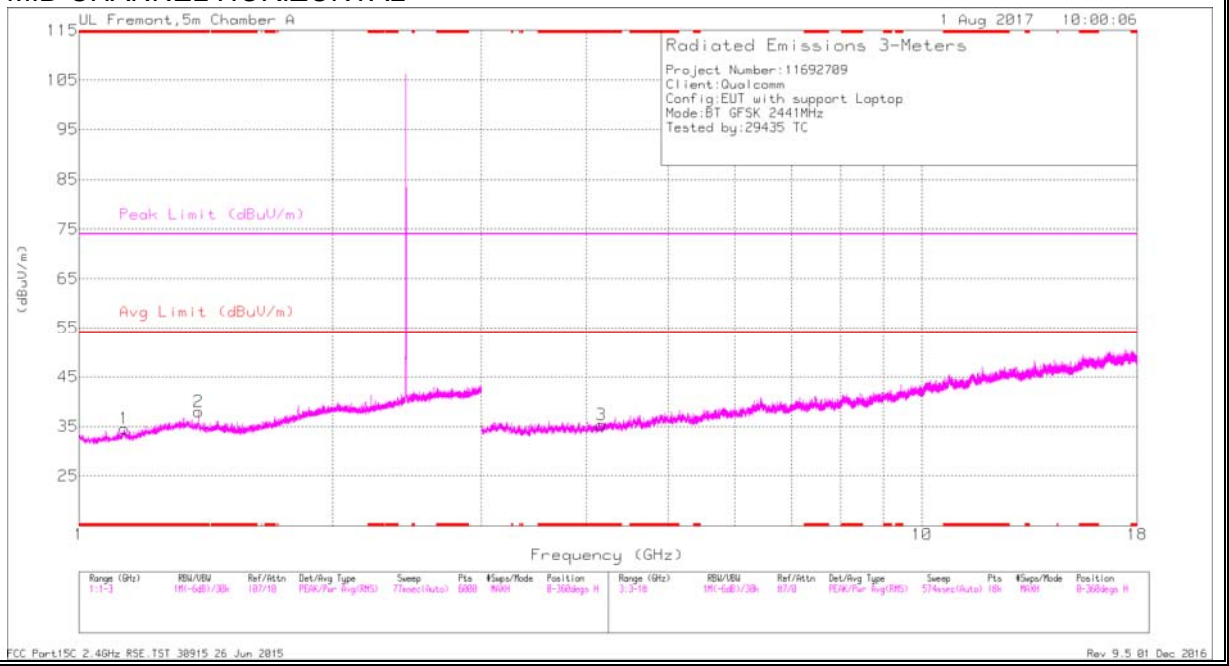
| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.386 | 38.31 | PK2 | 28.9 | -23.4 | 43.81 | - | - | 74 | -30.19 | 353 | 114 | H |
| * 1.386 | 28.46 | VA1T | 28.9 | -23.4 | 33.96 | 54 | -20.04 | - | - | 353 | 114 | H |
| * 1.594 | 41.66 | PK2 | 28.1 | -23.2 | 46.56 | - | - | 74 | -27.44 | 91 | 374 | H |
| * 1.594 | 25.56 | VA1T | 28.1 | -23.2 | 30.46 | 54 | -23.54 | - | - | 91 | 374 | H |
| * 1.386 | 37 | PK2 | 28.9 | -23.4 | 42.5 | - | - | 74 | -31.5 | 102 | 134 | V |
| * 1.386 | 24.33 | VA1T | 28.9 | -23.4 | 29.83 | 54 | -24.17 | - | - | 102 | 134 | V |
| * 2.22 | 39.75 | PK2 | 31.3 | -23.3 | 47.75 | - | - | 74 | -26.25 | 340 | 107 | V |
| * 2.222 | 24.07 | VA1T | 31.3 | -23.4 | 31.97 | 54 | -22.03 | - | - | 340 | 107 | V |
| * 4.802 | 36.34 | PK2 | 34.2 | -27.6 | 42.94 | - | - | 74 | -31.06 | 289 | 161 | H |
| * 4.804 | 23.57 | VA1T | 34.2 | -27.7 | 30.07 | 54 | -23.93 | - | - | 289 | 161 | H |
| * 4.804 | 36.3 | PK2 | 34.2 | -27.7 | 42.8 | - | - | 74 | -31.2 | 358 | 241 | V |
| * 4.804 | 23.77 | VA1T | 34.2 | -27.7 | 30.27 | 54 | -23.73 | - | - | 358 | 241 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

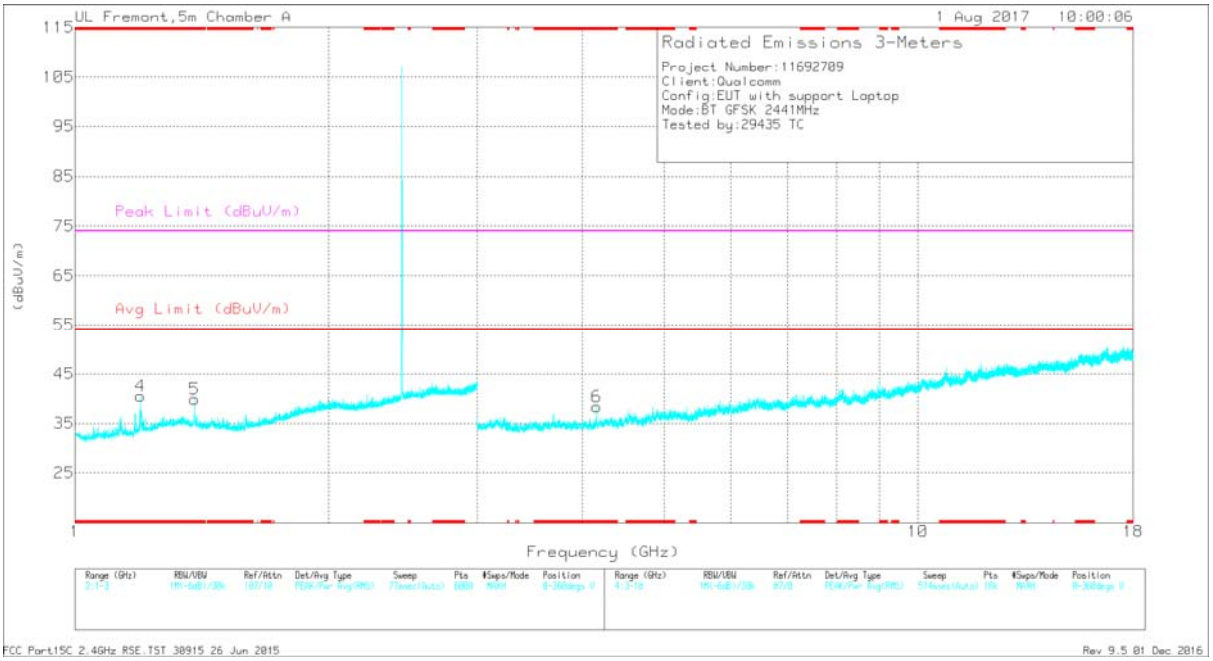
PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

MID CHANNEL HORIZONTAL




MID CHANNEL VERTICAL



## Radiated Emissions

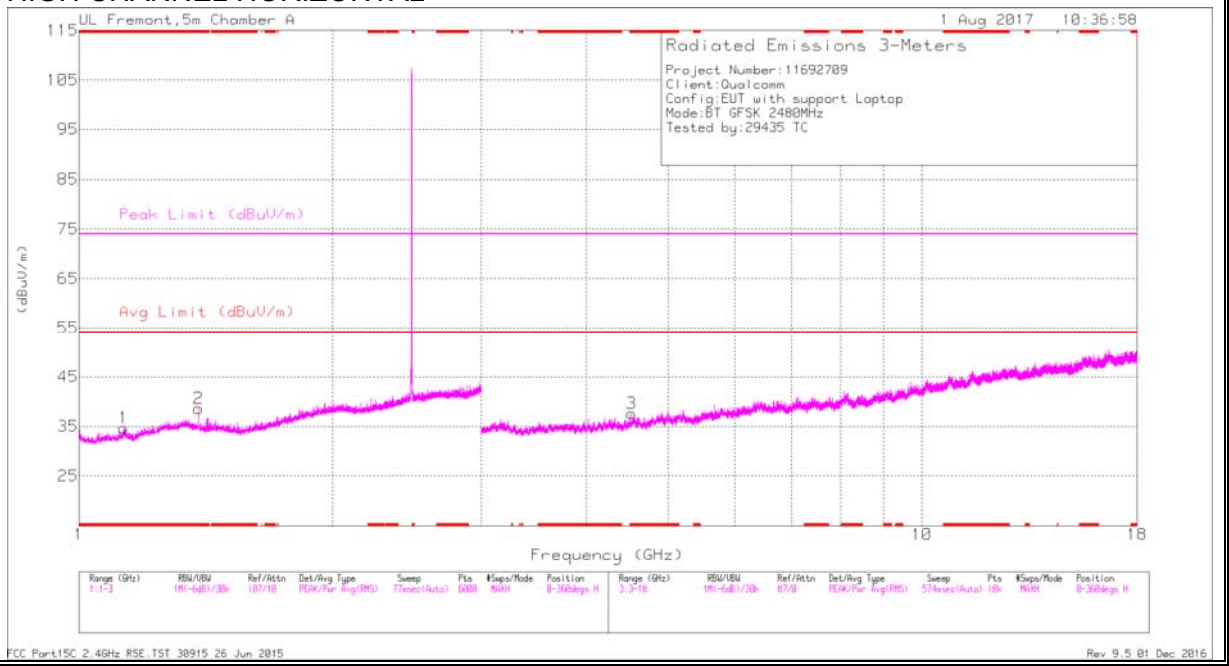
| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.13 | 36.78 | PK2 | 27.7 | -23.7 | 40.78 | - | - | 74 | -33.22 | 350 | 151 | H |
| * 1.134 | 23.84 | VA1T | 27.7 | -23.6 | 27.94 | 54 | -26.06 | - | - | 350 | 151 | H |
| * 1.386 | 37.64 | PK2 | 28.9 | -23.4 | 43.14 | - | - | 74 | -30.86 | 269 | 199 | H |
| * 1.386 | 26.2 | VA1T | 28.9 | -23.4 | 31.7 | 54 | -22.3 | - | - | 269 | 199 | H |
| * 1.195 | 46.08 | PK2 | 28.1 | -23.6 | 50.58 | - | - | 74 | -23.42 | 14 | 257 | V |
| * 1.196 | 24.63 | VA1T | 28.2 | -23.6 | 29.23 | 54 | -24.77 | - | - | 14 | 257 | V |
| * 1.386 | 38.91 | PK2 | 28.9 | -23.4 | 44.41 | - | - | 74 | -29.59 | 360 | 192 | V |
| * 1.386 | 30.12 | VA1T | 28.9 | -23.4 | 35.62 | 54 | -18.38 | - | - | 360 | 192 | V |
| * 4.161 | 36.71 | PK2 | 33.4 | -29 | 41.11 | - | - | 74 | -32.89 | 306 | 186 | H |
| * 4.162 | 24.62 | VA1T | 33.4 | -29 | 29.02 | 54 | -24.98 | - | - | 306 | 186 | H |
| * 4.158 | 40.88 | PK2 | 33.4 | -29 | 45.28 | - | - | 74 | -28.72 | 19 | 213 | V |
| * 4.158 | 29.39 | VA1T | 33.4 | -29 | 33.79 | 54 | -20.21 | - | - | 19 | 213 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

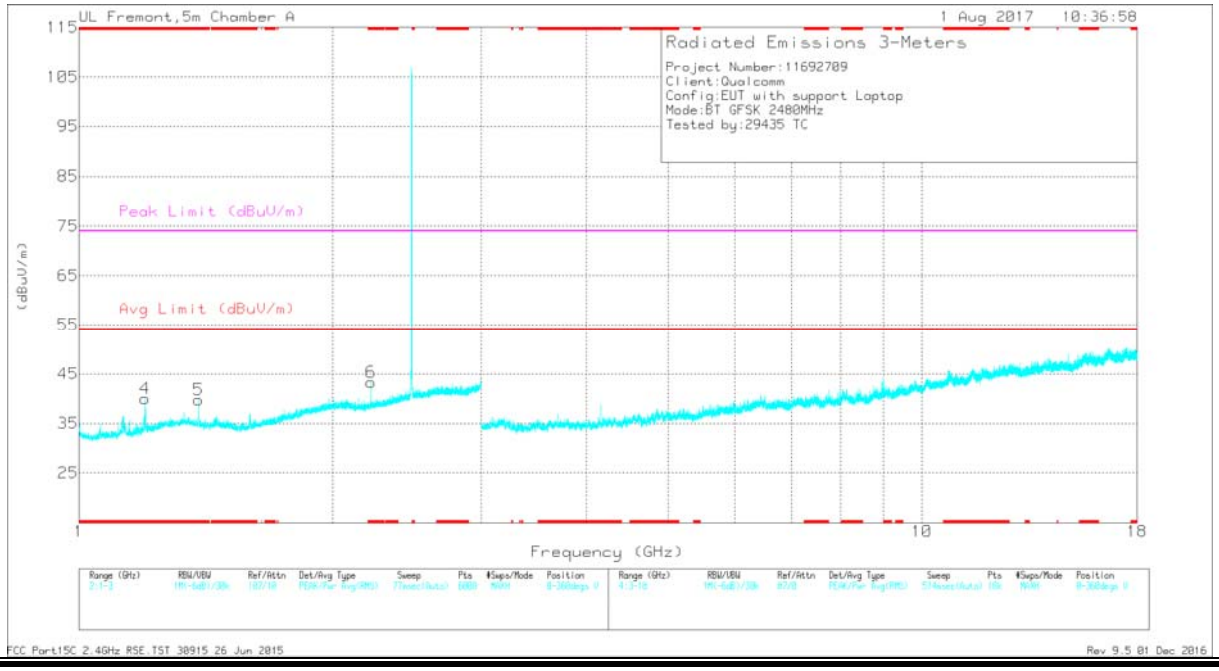
PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HIGH CHANNEL HORIZONTAL




HIGH CHANNEL VERTICAL



## Radiated Emissions

| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.131 | 36.58 | PK2 | 27.7 | -23.7 | 40.58 | - | - | 74 | -33.42 | 335 | 114 | H |
| * 1.131 | 23.48 | VA1T | 27.7 | -23.7 | 27.48 | 54 | -26.52 | - | - | 335 | 114 | H |
| * 1.386 | 38.97 | PK2 | 28.9 | -23.4 | 44.47 | - | - | 74 | -29.53 | 345 | 198 | H |
| * 1.386 | 28.92 | VA1T | 28.9 | -23.4 | 34.42 | 54 | -19.58 | - | - | 345 | 198 | H |
| * 1.199 | 43.65 | PK2 | 28.2 | -23.6 | 48.25 | - | - | 74 | -25.75 | 342 | 206 | V |
| * 1.2 | 25.01 | VA1T | 28.2 | -23.6 | 29.61 | 54 | -24.39 | - | - | 342 | 206 | V |
| * 1.386 | 40.26 | PK2 | 28.9 | -23.4 | 45.76 | - | - | 74 | -28.24 | 356 | 108 | V |
| * 1.386 | 31.94 | VA1T | 28.9 | -23.4 | 37.44 | 54 | -16.56 | - | - | 356 | 108 | V |
| * 2.22 | 40.29 | PK2 | 31.3 | -23.3 | 48.29 | - | - | 74 | -25.71 | 328 | 107 | V |
| * 2.22 | 32.26 | VA1T | 31.3 | -23.3 | 40.26 | 54 | -13.74 | - | - | 328 | 107 | V |
| * 4.524 | 36.23 | PK2 | 33.9 | -28 | 42.13 | - | - | 74 | -31.87 | 130 | 140 | H |
| * 4.526 | 24.19 | VA1T | 33.9 | -28 | 30.09 | 54 | -23.91 | - | - | 130 | 140 | H |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

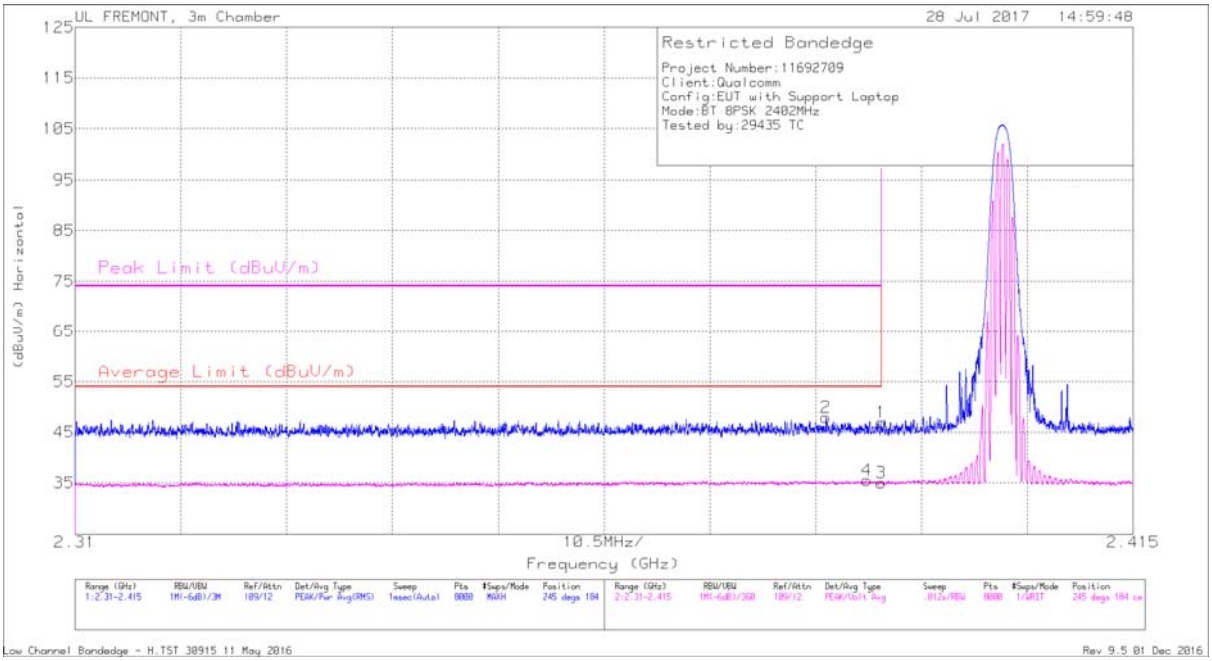
PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

# 8.3. ENHANCED DATA RATE 8PSK MODULATION

## 8.3.1. RESTRICTED BANDEDGE (LOW CHANNEL)

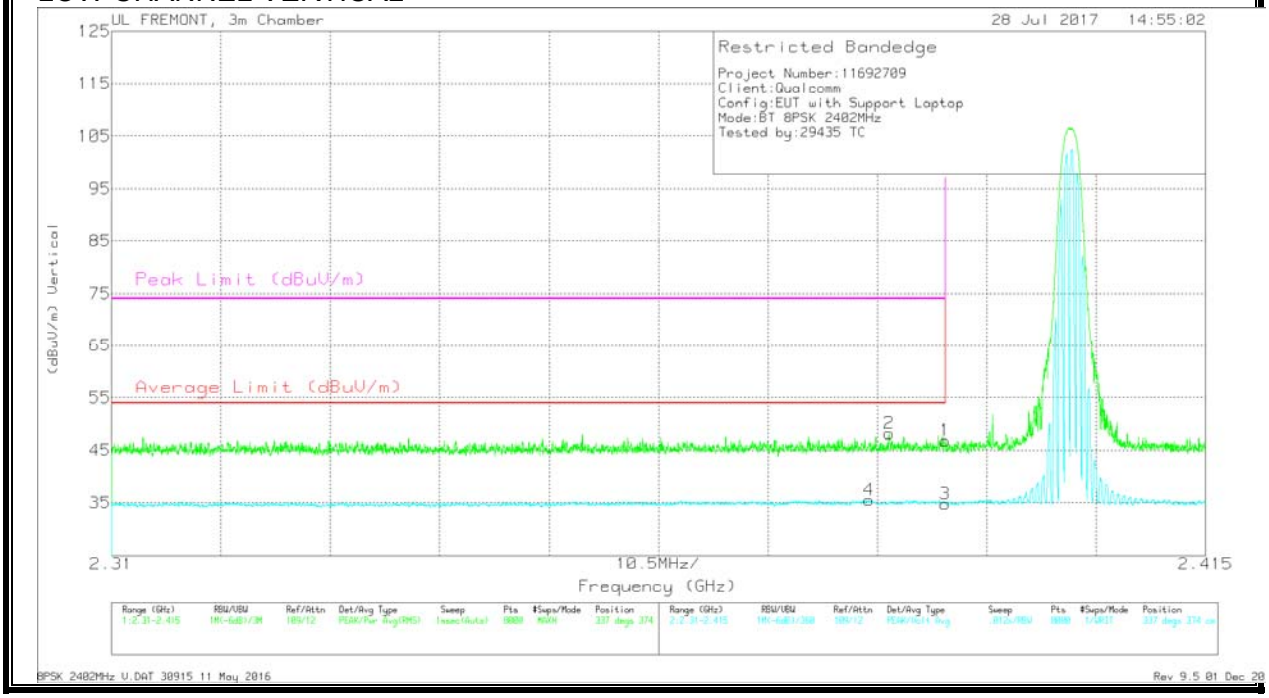
LOW CHANNEL HORIZONTAL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.385 | 38.59 | Pk | 31.9 | -22.6 | 47.89 | - | - | 74 | -26.11 | 245 | 184 | H |
| 4 | 2.389 | 26.08 | VA1T | 31.9 | -22.5 | 35.48 | 54 | -18.52 | - | - | 245 | 184 | H |
| 1 | 2.39 | 37.66 | Pk | 31.9 | -22.6 | 46.96 | - | - | 74 | -27.04 | 245 | 184 | H |
| 3 | 2.39 | 25.75 | VA1T | 31.9 | -22.6 | 35.05 | 54 | -18.95 | - | - | 245 | 184 | H |

Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## LOW CHANNEL VERTICAL

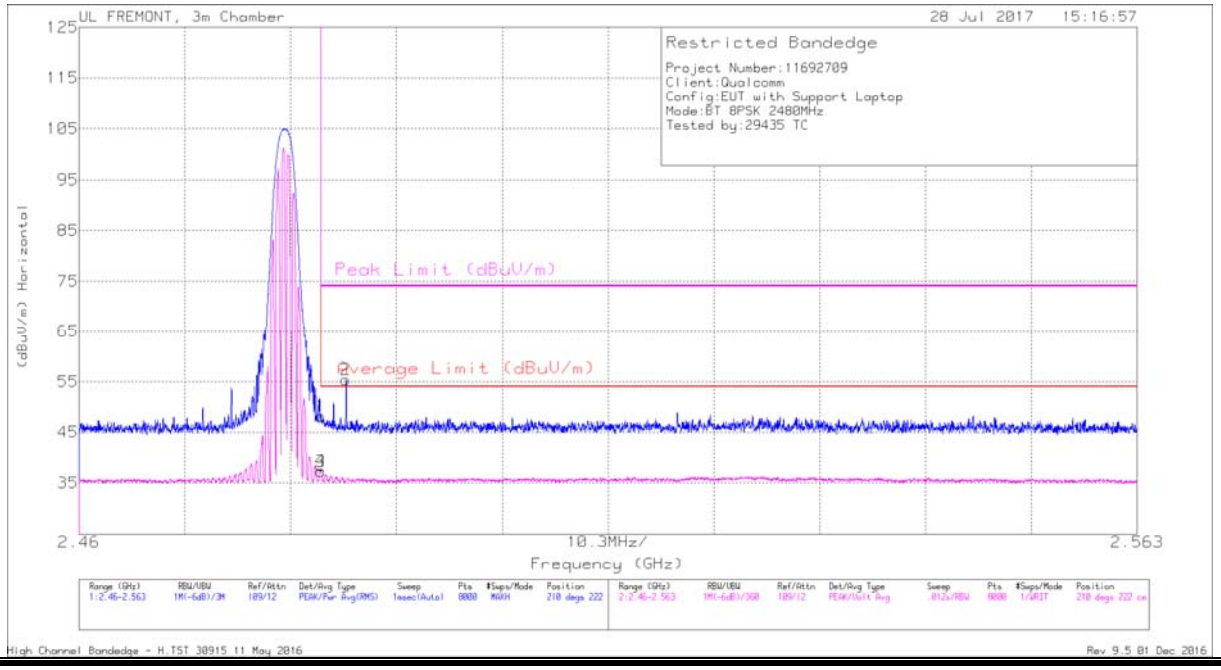



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 2.383 | 25.97 | VA1T | 31.9 | -22.4 | 35.47 | 54 | -18.53 | - | - | 337 | 374 | V |
| 2 | 2.385 | 38.9 | Pk | 31.9 | -22.6 | 48.2 | - | - | 74 | -25.8 | 337 | 374 | V |
| 1 | 2.39 | 37.49 | Pk | 31.9 | -22.6 | 46.79 | - | - | 74 | -27.21 | 337 | 374 | V |
| 3 | 2.39 | 25.51 | VA1T | 31.9 | -22.6 | 34.81 | 54 | -19.19 | - | - | 337 | 374 | V |

Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 8.3.2. AUTHORIZED BANDEDGE (HIGH CHANNEL)

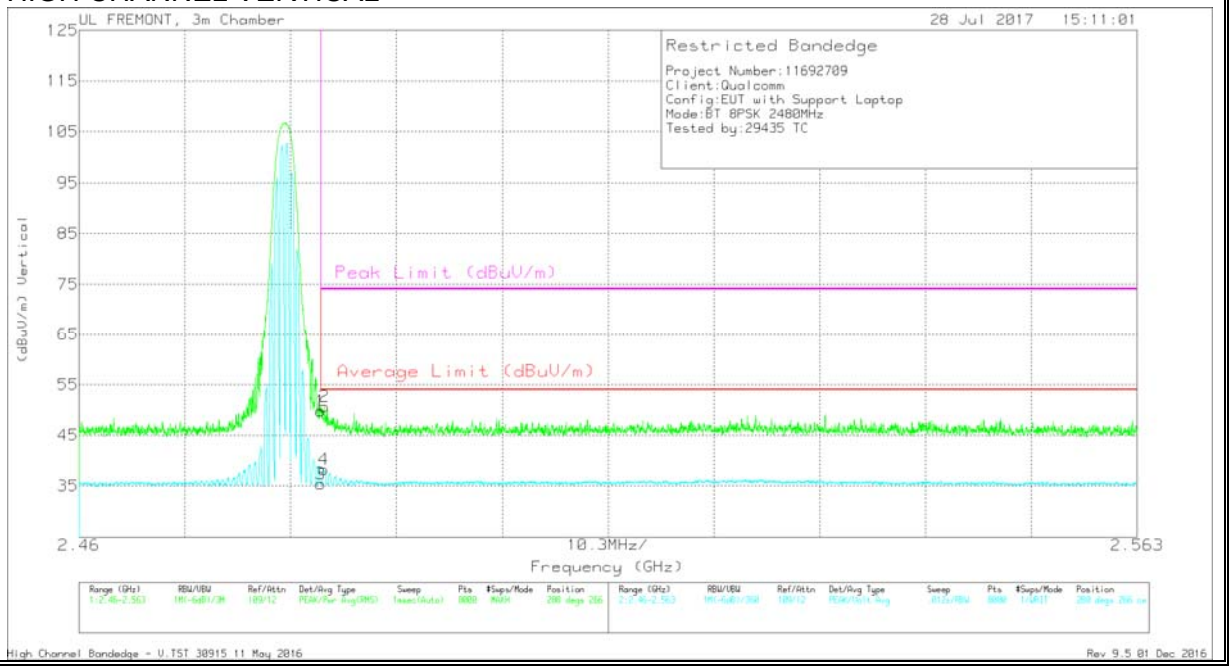
HIGH CHANNEL HORIZONTAL




| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.484 | 38.54 | Pk | 32.4 | -22.7 | 48.24 | - | - | 74 | -25.76 | 210 | 222 | H |
| 3 | 2.484 | 27.6 | VA1T | 32.4 | -22.7 | 37.3 | 54 | -16.7 | - | - | 210 | 222 | H |
| 4 | 2.484 | 27.62 | VA1T | 32.4 | -22.7 | 37.32 | 54 | -16.68 | - | - | 210 | 222 | H |
| 2 | 2.486 | 45.64 | Pk | 32.4 | -22.7 | 55.34 | - | - | 74 | -18.66 | 210 | 222 | H |

Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

HIGH CHANNEL VERTICAL

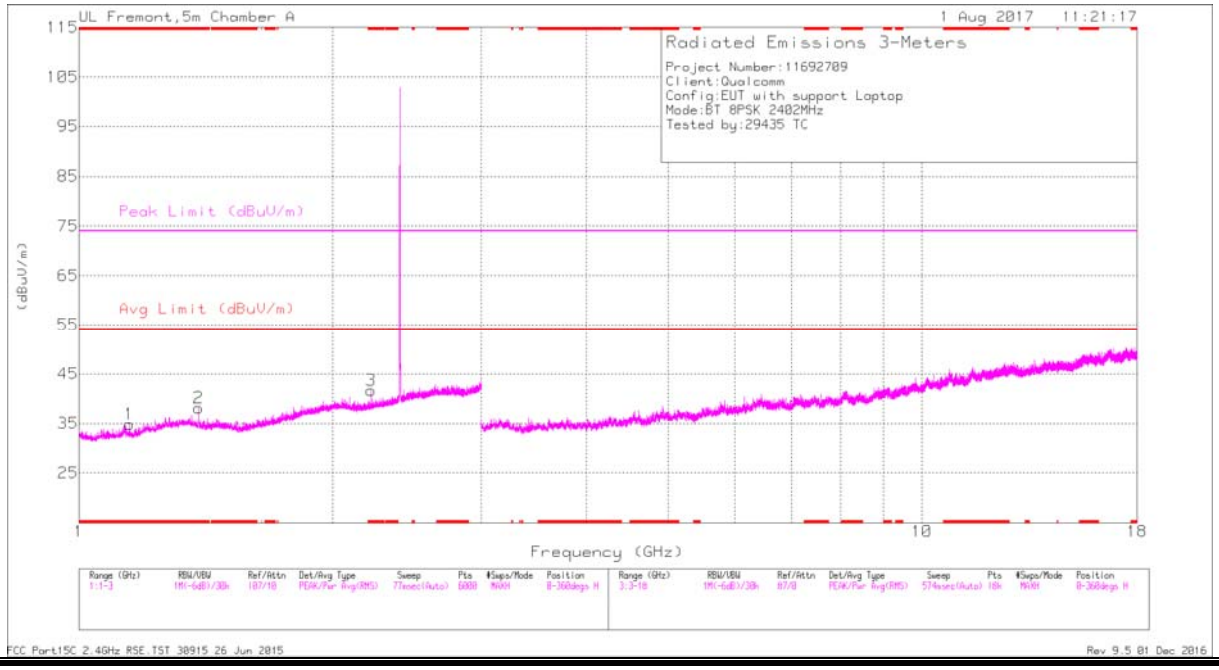



| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | AF T712 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Average Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.484 | 40.05 | Pk | 32.4 | -22.7 | 49.75 | - | - | 74 | -24.25 | 288 | 266 | V |
| 2 | 2.484 | 41 | Pk | 32.4 | -22.7 | 50.7 | - | - | 74 | -23.3 | 288 | 266 | V |
| 3 | 2.484 | 25.72 | VA1T | 32.4 | -22.7 | 35.42 | 54 | -18.58 | - | - | 288 | 266 | V |
| 4 | 2.484 | 28.6 | VA1T | 32.4 | -22.7 | 38.3 | 54 | -15.7 | - | - | 288 | 266 | V |

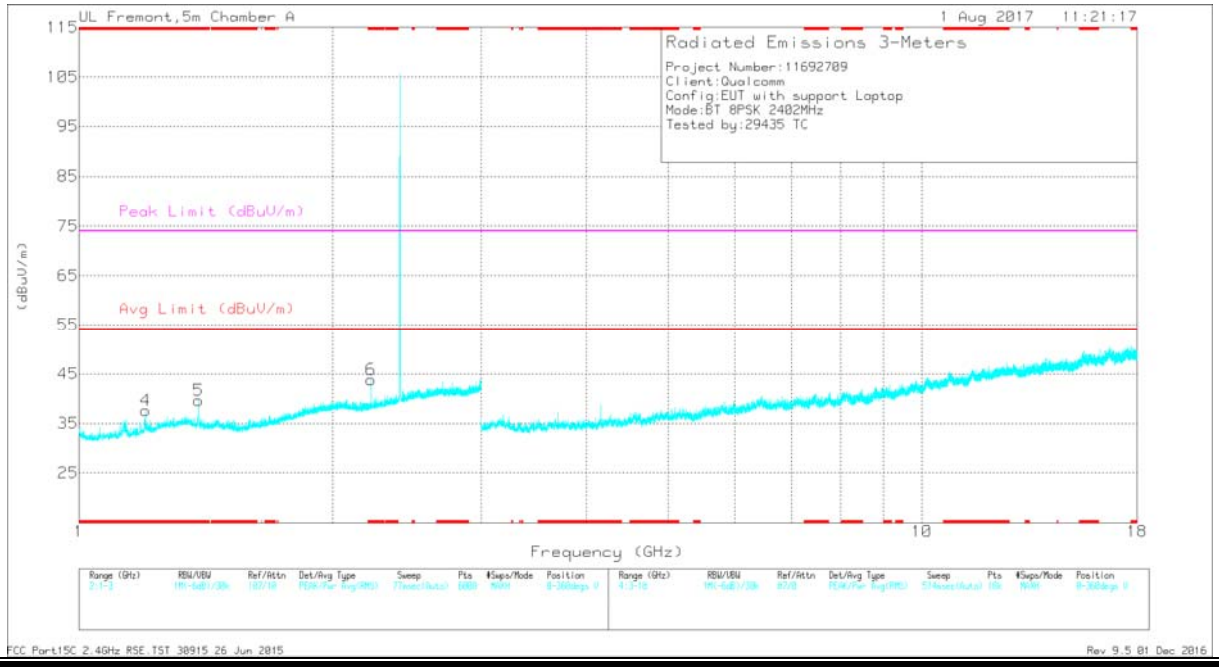
Pk - Peak detector
VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 8.3.3. HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL




LOW CHANNEL VERTICAL



## Radiated Emissions

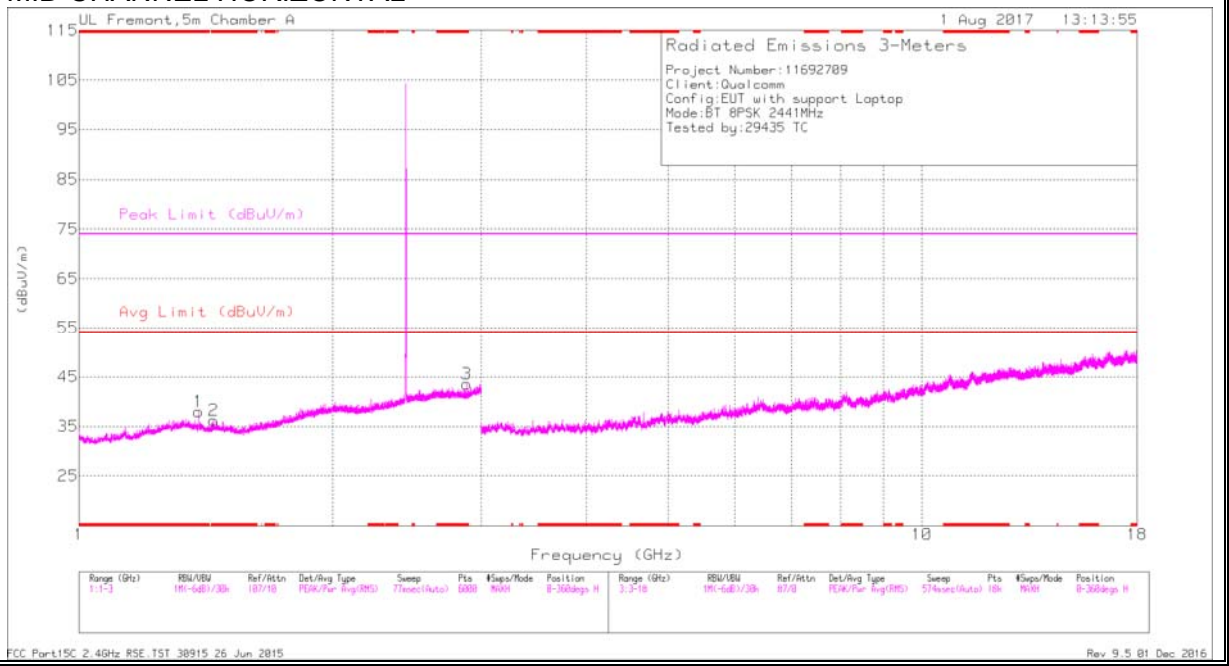
| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.15 | 36.43 | PK2 | 27.6 | -23.6 | 40.43 | - | - | 74 | -33.57 | 286 | 333 | H |
| * 1.15 | 25.51 | VA1T | 27.6 | -23.6 | 29.51 | 54 | -24.49 | - | - | 286 | 333 | H |
| * 1.386 | 38.85 | PK2 | 28.9 | -23.4 | 44.35 | - | - | 74 | -29.65 | 338 | 201 | H |
| * 1.386 | 29.29 | VA1T | 28.9 | -23.4 | 34.79 | 54 | -19.21 | - | - | 338 | 201 | H |
| * 2.22 | 38.61 | PK2 | 31.3 | -23.3 | 46.61 | - | - | 74 | -27.39 | 241 | 240 | H |
| * 2.22 | 28.66 | VA1T | 31.3 | -23.3 | 36.66 | 54 | -17.34 | - | - | 241 | 240 | H |
| * 1.199 | 46.62 | PK2 | 28.2 | -23.6 | 51.22 | - | - | 74 | -22.78 | 3 | 261 | V |
| * 1.2 | 24.53 | VA1T | 28.2 | -23.6 | 29.13 | 54 | -24.87 | - | - | 3 | 261 | V |
| * 1.386 | 40.14 | PK2 | 28.9 | -23.4 | 45.64 | - | - | 74 | -28.36 | 360 | 110 | V |
| * 1.386 | 31.73 | VA1T | 28.9 | -23.4 | 37.23 | 54 | -16.77 | - | - | 360 | 110 | V |
| * 2.22 | 40.99 | PK2 | 31.3 | -23.3 | 48.99 | - | - | 74 | -25.01 | 332 | 105 | V |
| * 2.22 | 34.97 | VA1T | 31.3 | -23.3 | 42.97 | 54 | -11.03 | - | - | 332 | 105 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

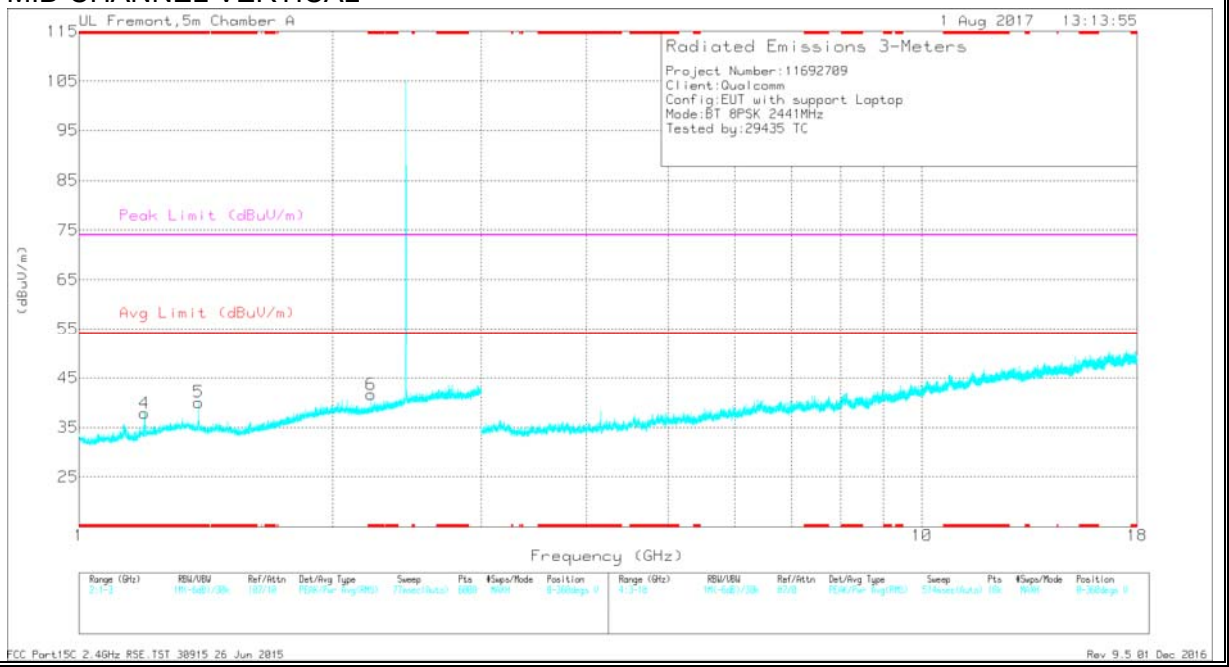
PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

MID CHANNEL HORIZONTAL




MID CHANNEL VERTICAL



## Radiated Emissions

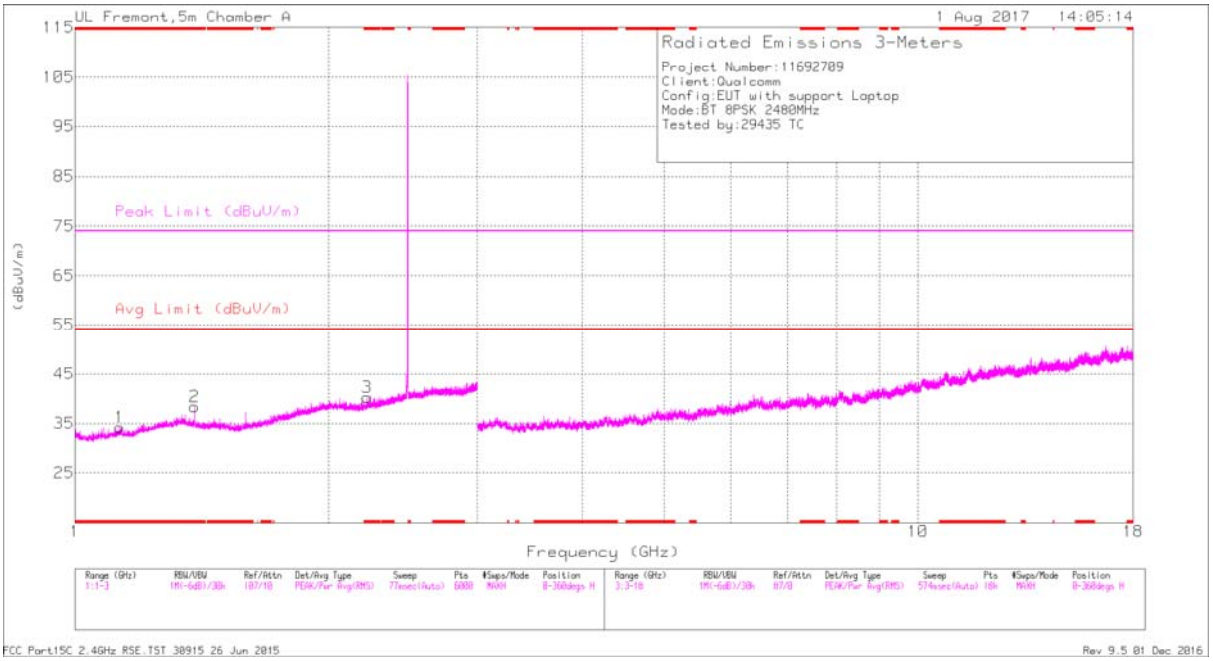
| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.386 | 38.34 | PK2 | 28.9 | -23.4 | 43.84 | - | - | 74 | -30.16 | 343 | 202 | H |
| * 1.386 | 29.62 | VA1T | 28.9 | -23.4 | 35.12 | 54 | -18.88 | - | - | 343 | 202 | H |
| * 1.444 | 36.35 | PK2 | 28.7 | -23.3 | 41.75 | - | - | 74 | -32.25 | 185 | 286 | H |
| * 1.445 | 23.12 | VA1T | 28.7 | -23.3 | 28.52 | 54 | -25.48 | - | - | 185 | 286 | H |
| * 2.883 | 37.38 | PK2 | 32.2 | -21.8 | 47.78 | - | - | 74 | -26.22 | 305 | 252 | H |
| * 2.884 | 24.44 | VA1T | 32.2 | -21.9 | 34.74 | 54 | -19.26 | - | - | 305 | 252 | H |
| * 1.196 | 42.3 | PK2 | 28.2 | -23.6 | 46.9 | - | - | 74 | -27.1 | 175 | 233 | V |
| * 1.196 | 24.23 | VA1T | 28.2 | -23.6 | 28.83 | 54 | -25.17 | - | - | 175 | 233 | V |
| * 1.386 | 39.82 | PK2 | 28.9 | -23.4 | 45.32 | - | - | 74 | -28.68 | 352 | 106 | V |
| * 1.386 | 31.33 | VA1T | 28.9 | -23.4 | 36.83 | 54 | -17.17 | - | - | 352 | 106 | V |
| * 2.22 | 38.86 | PK2 | 31.3 | -23.3 | 46.86 | - | - | 74 | -27.14 | 261 | 205 | V |
| * 2.22 | 24.28 | VA1T | 31.3 | -23.3 | 32.28 | 54 | -21.72 | - | - | 261 | 205 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

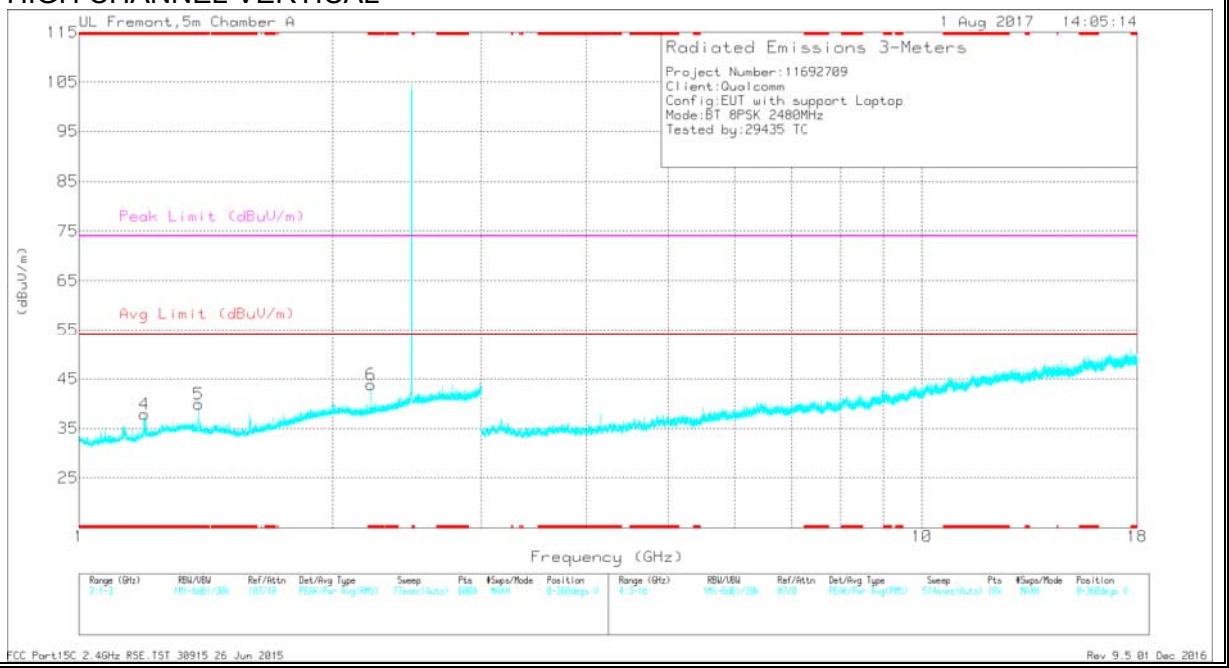
PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## HIGH CHANNEL HORIZONTAL




## HIGH CHANNEL VERTICAL



## Radiated Emissions

| Frequency (GHz) | Meter Reading (dBuV) | Det | AF T862 (dB/m) | Amp/Cbl/Fltr/Pad (dB) | Corrected Reading (dBuV/m) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| * 1.129 | 36.7 | PK2 | 27.7 | -23.7 | 40.7 | - | - | 74 | -33.3 | 354 | 273 | H |
| * 1.129 | 23.46 | VA1T | 27.7 | -23.7 | 27.46 | 54 | -26.54 | - | - | 354 | 273 | H |
| * 1.386 | 38.72 | PK2 | 28.9 | -23.4 | 44.22 | - | - | 74 | -29.78 | 341 | 209 | H |
| * 1.386 | 29.37 | VA1T | 28.9 | -23.4 | 34.87 | 54 | -19.13 | - | - | 341 | 209 | H |
| * 2.22 | 38.29 | PK2 | 31.3 | -23.3 | 46.29 | - | - | 74 | -27.71 | 232 | 109 | H |
| * 2.22 | 29.85 | VA1T | 31.3 | -23.3 | 37.85 | 54 | -16.15 | - | - | 232 | 109 | H |
| * 1.197 | 46.05 | PK2 | 28.2 | -23.6 | 50.65 | - | - | 74 | -23.35 | 15 | 238 | V |
| * 1.196 | 26.33 | VA1T | 28.2 | -23.6 | 30.93 | 54 | -23.07 | - | - | 15 | 238 | V |
| * 1.386 | 39.72 | PK2 | 28.9 | -23.4 | 45.22 | - | - | 74 | -28.78 | 356 | 107 | V |
| * 1.386 | 31.68 | VA1T | 28.9 | -23.4 | 37.18 | 54 | -16.82 | - | - | 356 | 107 | V |
| * 2.22 | 38.53 | PK2 | 31.3 | -23.4 | 46.43 | - | - | 74 | -27.57 | 315 | 215 | V |
| * 2.219 | 24.13 | VA1T | 31.3 | -23.4 | 32.03 | 54 | -21.97 | - | - | 315 | 215 | V |

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

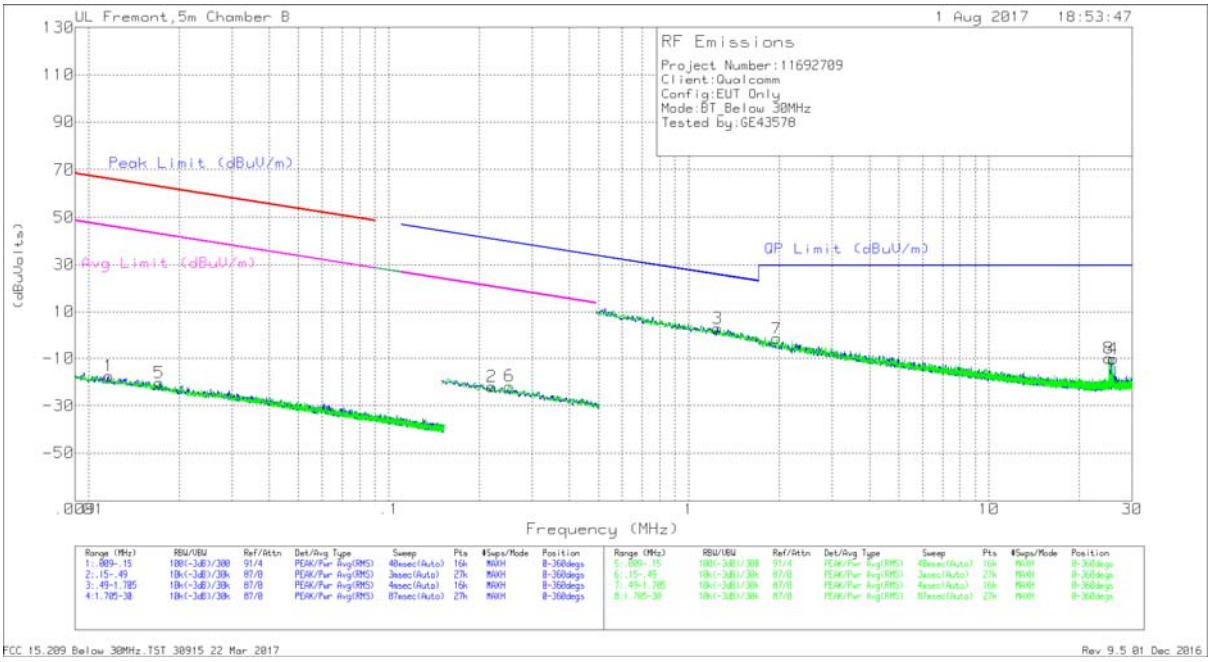
PK2 - KDB558074 Method: Maximum Peak

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

## 8.4. WORST-CASE BELOW 30 MHz

**SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)**

HORIZONTAL AND VERTICAL PLOTS




NOTE: KDB 414788 OATS and Chamber Correlation Justification

- Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Trace Markers

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cbl (dB) | Dist Corr 300m | Corrected Reading (dBuVolts) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | Margin (dB) | Avg Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .01166 | 43.35 | Pk | 17.8 | 1.4 | -80 | -17.45 | 66.25 | -83.7 | 46.25 | -63.7 | - | - | - | - | 0-360 |
| 5 | .01715 | 42.68 | Pk | 15.6 | 1.4 | -80 | -20.32 | 62.9 | -83.22 | 42.9 | -63.22 | - | - | - | - | 0-360 |
| 2 | .22059 | 44.89 | Pk | 11.6 | 1.5 | -80 | -22.01 | - | - | - | - | 40.74 | -62.75 | 20.74 | -42.75 | 0-360 |
| 6 | .25225 | 45.09 | Pk | 11.6 | 1.5 | -80 | -21.81 | - | - | - | - | 39.58 | -61.39 | 19.58 | -41.39 | 0-360 |

Pk - Peak detector

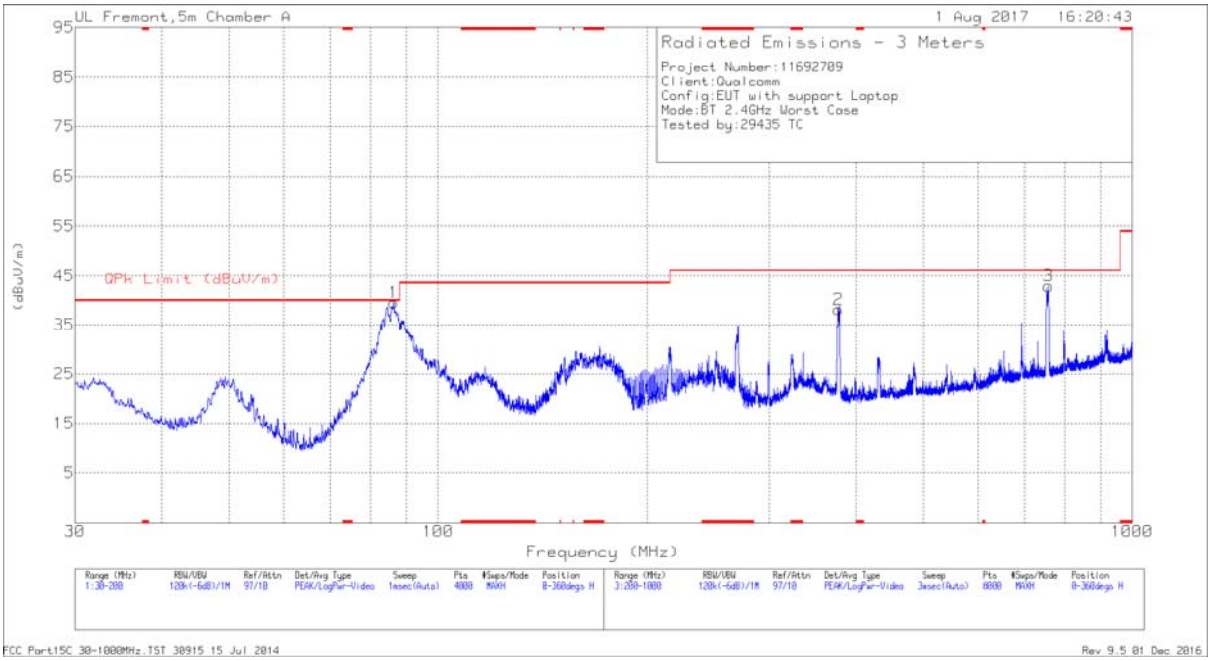
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | Loop Antenna (dB/m) | Cbl (dB) | Dist Corr (dB) 40Log | Corrected Reading (dBuVolts) | QP Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 1.24635 | 29.87 | Pk | 11.6 | 1.5 | -40 | 2.97 | 25.71 | -22.74 | 0-360 |
| 7 | 1.96333 | 25.43 | Pk | 11.7 | 1.5 | -40 | -1.37 | 29.5 | -30.87 | 0-360 |
| 8 | 25.12256 | 19.34 | Pk | 9 | 1.7 | -40 | -9.96 | 29.5 | -39.46 | 0-360 |
| 4 | 25.88865 | 19.08 | Pk | 8.9 | 1.7 | -40 | -10.32 | 29.5 | -39.82 | 0-360 |

Pk - Peak detector

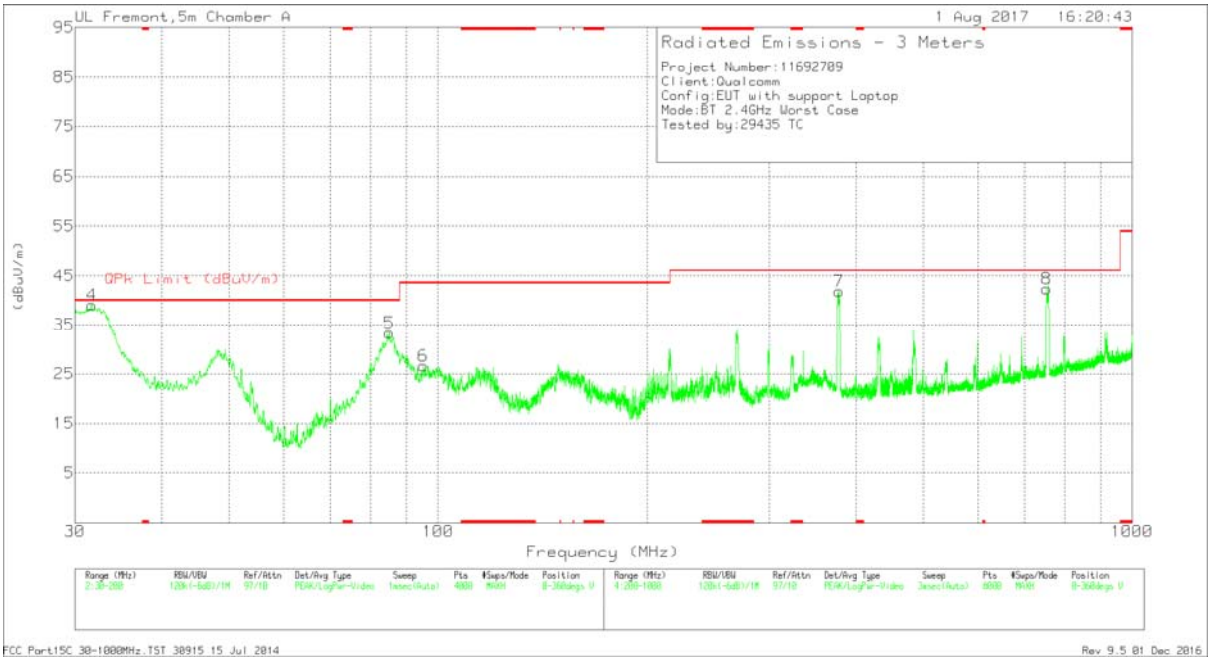
## 8.5. WORST- CASE (30 - 1000 MHz)

**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)**

HORIZONTAL PLOT



VERTICAL PLOT




## DATA

Radiated Emissions

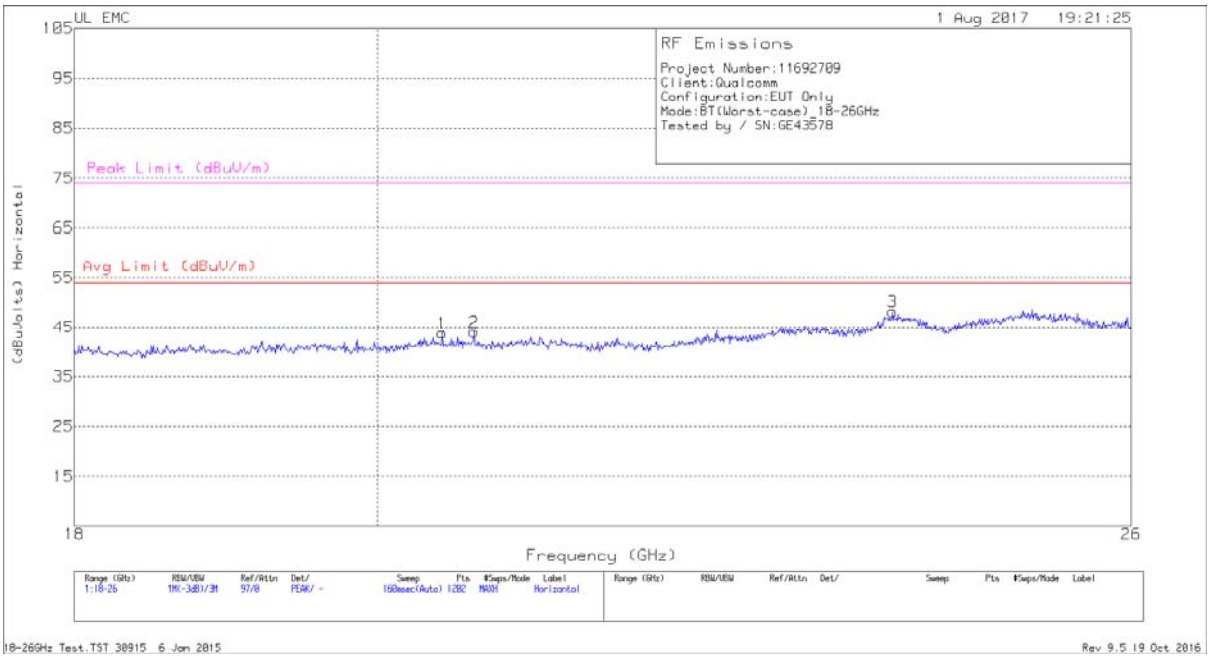
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | AF T130 (dB/m) | Amp/Cbl (dB/m) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 31.5982 | 46.94 | Pk | 23.1 | -31.2 | 38.84 | 40 | -1.16 | 342 | 103 | V |
| | 31.5982 | 42.96 | Qp | 23.1 | -31.2 | 34.86 | 40 | -5.14 | 342 | 103 | V |
| 5 | 85.1368 | 52.62 | Pk | 11.4 | -30.7 | 33.32 | 40 | -6.68 | 0-360 | 100 | V |
| 1 | 86.4018 | 58.37 | Pk | 11.4 | -30.7 | 39.07 | 40 | -.93 | 303 | 200 | H |
| | 86.4018 | 50.44 | Qp | 11.4 | -30.7 | 31.14 | 40 | -8.86 | 303 | 200 | H |
| 6 | 95.2969 | 44.28 | Pk | 12.9 | -30.6 | 26.58 | 43.52 | -16.94 | 0-360 | 100 | V |
| 2 | 377.4231 | 48.25 | Pk | 19 | -29.1 | 38.15 | 46.02 | -7.87 | 0-360 | 200 | H |
| 7 | 378.4938 | 51.17 | Pk | 19 | -29.1 | 41.07 | 46.02 | -4.95 | 338 | 203 | V |
| | 378.4938 | 46.73 | Qp | 19 | -29.1 | 36.63 | 46.02 | -9.39 | 338 | 203 | V |
| 8 | 753.154 | 46.2 | Pk | 24.8 | -28.1 | 42.9 | 46.02 | -3.12 | 0 | 226 | V |
| | 753.154 | 42.65 | Qp | 24.8 | -28.1 | 39.35 | 46.02 | -6.67 | 0 | 226 | V |
| 3 | 756.9479 | 45.37 | Pk | 24.8 | -28 | 42.17 | 46.02 | -3.85 | 31 | 282 | H |
| | 756.9479 | 41.69 | Qp | 24.8 | -28 | 38.49 | 46.02 | -7.53 | 31 | 282 | H |

Pk - Peak detector
Qp - Quasi-Peak detector

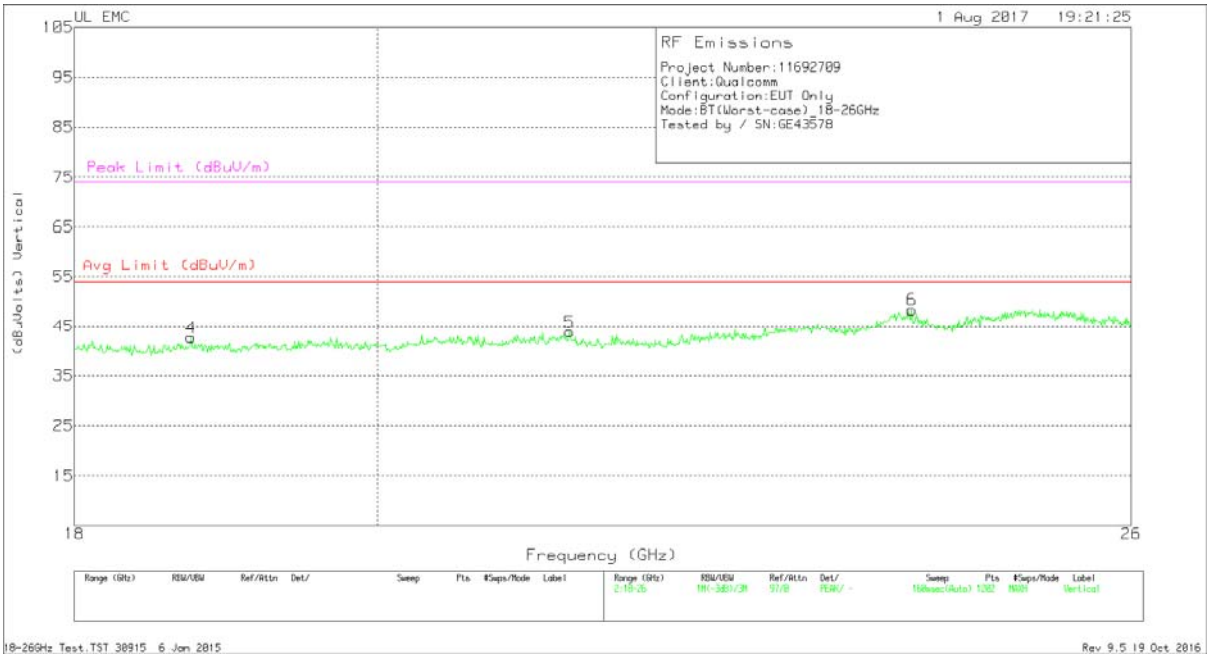
## 8.6. WORST-CASE ABOVE 18 GHz

**SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION)**

HORIZONTAL PLOT




VERTICAL PLOT



**Data**

Trace Markers

| Marker | Frequency (GHz) | Meter Reading (dBuV) | Det | T449 AF (dB/m) | Amp/Cbl (dB) | Dist Corr (dB) | Corrected Reading (dBuVolts) | Avg Limit (dBuV/m) | Margin (dB) | Peak Limit (dBuV/m) | PK Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20.458 | 42.13 | Pk | 33.1 | -21.9 | -9.5 | 43.83 | 54 | -10.17 | 74 | -30.17 |
| 2 | 20.684 | 42.2 | Pk | 33 | -21.7 | -9.5 | 44 | 54 | -10 | 74 | -30 |
| 3 | 23.928 | 43.67 | Pk | 33.9 | -19.9 | -9.5 | 48.17 | 54 | -5.83 | 74 | -25.83 |
| 4 | 18.746 | 41.77 | Pk | 32.3 | -21.9 | -9.5 | 42.67 | 54 | -11.33 | 74 | -31.33 |
| 5 | 21.384 | 41.93 | Pk | 33.1 | -21.7 | -9.5 | 43.83 | 54 | -10.17 | 74 | -30.17 |
| 6 | 24.088 | 44.23 | Pk | 33.9 | -20.3 | -9.5 | 48. 33 | 54 | -5.67 | 74 | -25.67 |

Pk - Peak detector

# 9. AC POWER LINE CONDUCTED EMISSIONS

**LIMITS**

FCC §15.207 (a)
RSS-Gen 8.8

| Frequency of Emission (MHz) | Conducted Limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56 * | 56 to 46 * |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

**TEST PROCEDURE**

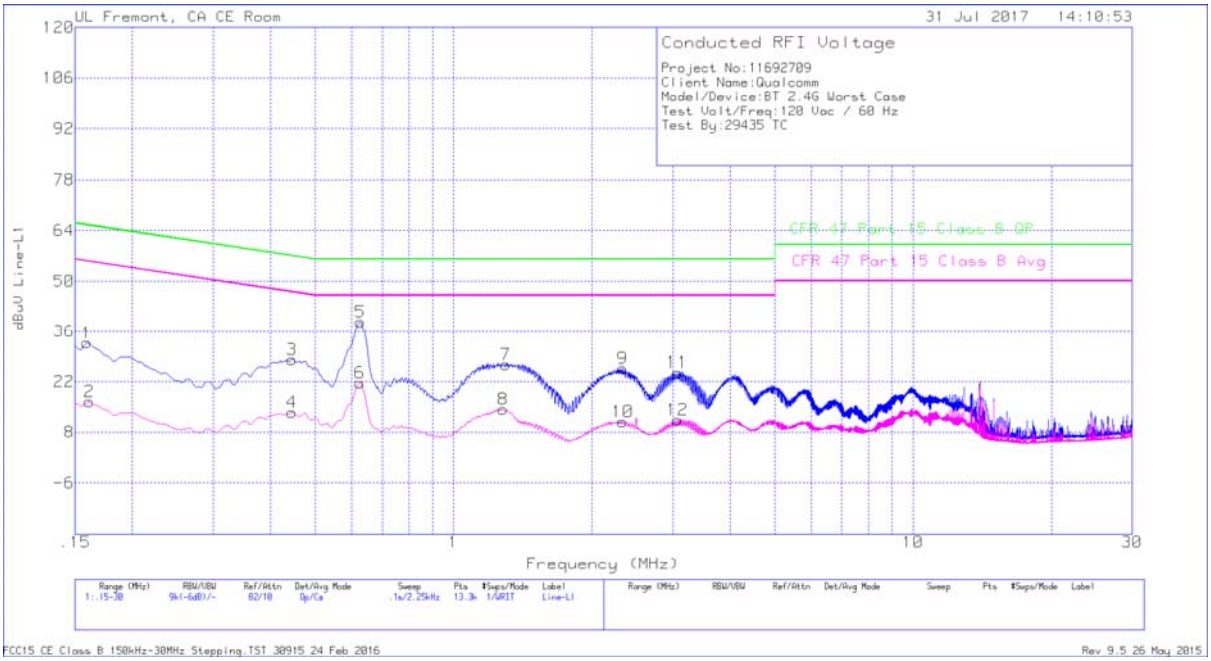
The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

**RESULTS**

**LINE 1 RESULTS**



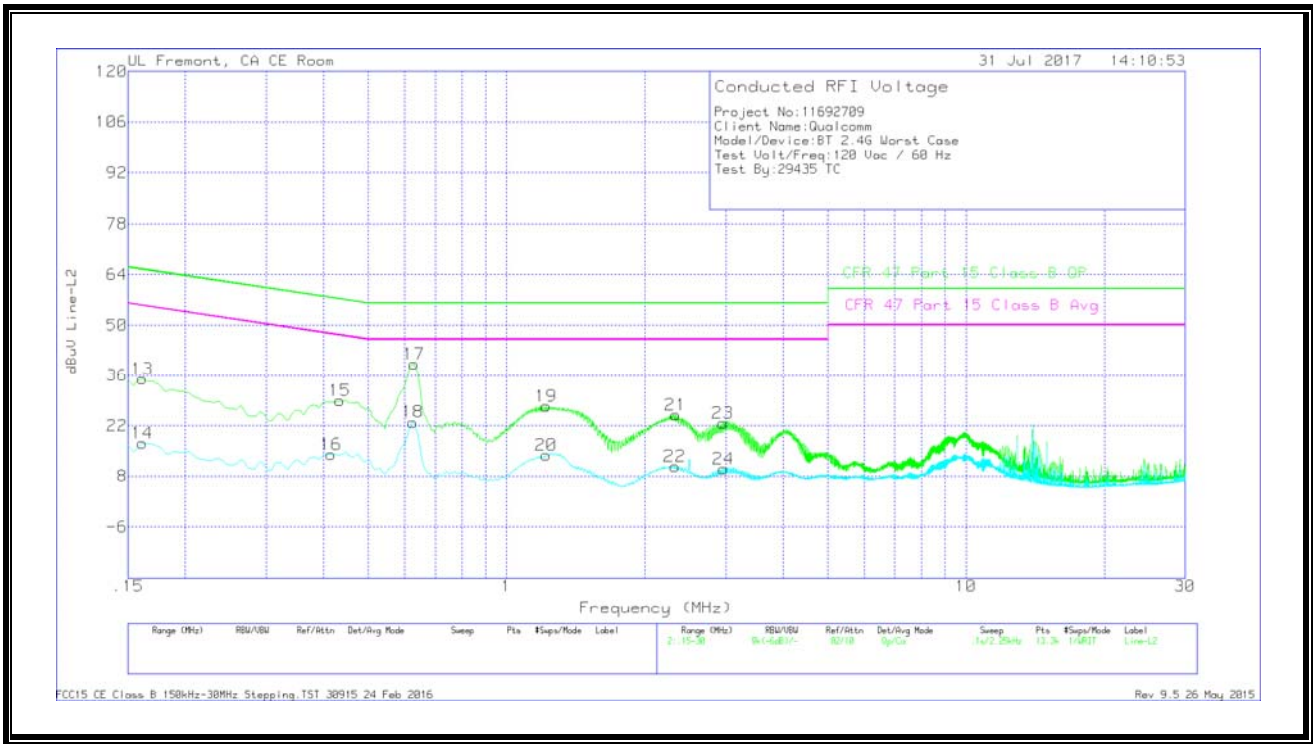

**WORST EMISSIONS**

| Range 1: Line-L1 .15 - 30MHz | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN L1 | LC Cables C1&C3 | Limiter (dB) | Corrected Reading dBuV | CFR 47 Part 15 Class B QP | QP Margin (dB) | CFR 47 Part 15 Class B Avg | Av(CISPR) Margin (dB) |
| 1 | .159 | 22.42 | Qp | .1 | .1 | 10.1 | 32.72 | 65.52 | -32.8 | - | - |
| 2 | .16125 | 6.11 | Ca | .1 | .1 | 10.1 | 16.41 | - | - | 55.4 | -38.99 |
| 3 | .44475 | 17.93 | Qp | 0 | .1 | 10.1 | 28.13 | 56.97 | -28.84 | - | - |
| 4 | .44475 | 3.36 | Ca | 0 | .1 | 10.1 | 13.56 | - | - | 46.97 | -33.41 |
| 5 | .627 | 28.55 | Qp | 0 | .1 | 10.1 | 38.75 | 56 | -17.25 | - | - |
| 6 | .62475 | 11.51 | Ca | 0 | .1 | 10.1 | 21.71 | - | - | 46 | -24.29 |
| 7 | 1.2975 | 16.55 | Qp | 0 | .1 | 10.1 | 26.75 | 56 | -29.25 | - | - |
| 8 | 1.28175 | 4.13 | Ca | 0 | .1 | 10.1 | 14.33 | - | - | 46 | -31.67 |
| 9 | 2.3325 | 15.47 | Qp | 0 | .1 | 10.1 | 25.67 | 56 | -30.33 | - | - |
| 10 | 2.3325 | .74 | Ca | 0 | .1 | 10.1 | 10.94 | - | - | 46 | -35.06 |
| 11 | 3.06938 | 14.33 | Qp | 0 | .1 | 10.1 | 24.53 | 56 | -31.47 | - | - |
| 12 | 3.07163 | 1.16 | Ca | 0 | .1 | 10.1 | 11.36 | - | - | 46 | -34.64 |

Qp - Quasi-Peak detector

Ca - CISPR average detection

**LINE 2 RESULTS**




**WORST EMISSIONS**

| Range 2: Line-L2 .15 - 30MHz | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | LISN L2 | LC Cables C2&C3 | Limiter (dB) | Corrected Reading dBuV | CFR 47 Part 15 Class B QP | QP Margin (dB) | CFR 47 Part 15 Class B Avg | Av(CISPR) Margin (dB) |
| 13 | .16125 | 24.81 | Qp | 0 | .1 | 10.1 | 35.01 | 65.4 | -30.39 | - | - |
| 14 | .16125 | 6.96 | Ca | 0 | .1 | 10.1 | 17.16 | - | - | 55.4 | -38.24 |
| 15 | .4335 | 18.84 | Qp | 0 | .1 | 10.1 | 29.04 | 57.19 | -28.15 | - | - |
| 16 | .4155 | 3.85 | Ca | 0 | .1 | 10.1 | 14.05 | - | - | 47.54 | -33.49 |
| 17 | .62925 | 29.08 | Qp | 0 | .1 | 10.1 | 39.28 | 56 | -16.72 | - | - |
| 18 | .62475 | 12.77 | Ca | 0 | .1 | 10.1 | 22.97 | - | - | 46 | -23.03 |
| 19 | 1.21875 | 17.14 | Qp | 0 | .1 | 10.1 | 27.34 | 56 | -28.66 | - | - |
| 20 | 1.21875 | 3.68 | Ca | 0 | .1 | 10.1 | 13.88 | - | - | 46 | -32.12 |
| 21 | 2.3325 | 14.71 | Qp | 0 | .1 | 10.1 | 24.91 | 56 | -31.09 | - | - |
| 22 | 2.3235 | .47 | Ca | 0 | .1 | 10.1 | 10.67 | - | - | 46 | -35.33 |
| 23 | 2.96025 | 12.5 | Qp | 0 | .1 | 10.1 | 22.7 | 56 | -33.3 | - | - |
| 24 | 2.9625 | -.13 | Ca | 0 | .1 | 10.1 | 10.07 | - | - | 46 | -35.93 |

Qp - Quasi-Peak detector

Ca - CISPR average detection