# RADIO TEST REPORT

For

MODEL NO. 1703
FCC ID: C3K1703
IC ID: 3048A-1703

Test Report No. R-TR190-FCCIC-BT-2
Issue Date: 09/24/2015

FCC CFR47 Part 15 Subpart C
Industry Canada RSS-247 Issue 1

*Prepared by*
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ACCREDITED
TESTING CERT #3472.01

# 1 Record of Revisions

| Revision | Date | Section | Page(s) | Summary of Changes | Author/Revised By: |
|---|---|---|---|---|---|
| 1.0 | 09/15/2015 | All | All | First Version | Daniel Salinas |
| 2.0 | 09/24/2015 | 9.4, 9.5 | 31, 33-34 | Add AFH mode results | Daniel Salinas |
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Microsoft

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# Test Report Attestation

**Microsoft Corporation**
**Model:** 1703
**FCC ID:** C3K1703
**IC ID:** 3048A-1703

**Applicable Standards**

| Specification | Test Result |
|---|---|
| FCC CFR47 Rule Parts 15.209, 15.247 | Pass |
| Industry Canada RSS-247 Issue 1 | Pass |

Microsoft EMC Laboratory attests that the product model identified in this report has been tested to and meets the requirements identified in the above standards. The test results in this report solely pertains to the specific sample tested, under the conditions and operating modes as provided by the customer.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government. Reproduction, duplication or publication of extracts from this test report is prohibited and requires prior written approval of Microsoft EMC Laboratory.

This report replaces test report R-TR190-FCCIC-BT-1 issued by Microsoft on 09/15/2015.

Written By: Daniel Salinas
Radio Test Engineer

Reviewed/ Issued By: Sajay Jose
EMC/RF Compliance Lab Manager

# 2 Deviations from Standards

None.

# 3 Facilities and Accreditations

## 3.1 Test Facility

All test facilities used to collect the test data are located at
Microsoft EMC Laboratory,
17760 NE 67th Ct,
Redmond WA, 98052, USA

## 3.2 Accreditations

The lab is established and follows procedures as outlined in IEC/ISO 17025 and A2LA accreditation requirements.
A2LA Accredited Testing Certificate Number: 3472.01
FCC Registration Number: US1141
IC Site Registration Numbers: 3048A-1, 3048A-2, 3048A-3, 3048A-4

## 3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4 2014, CISPR 16-1-1 and other equivalent applicable standards. Test site requirements for measurements above 1 GHz are in accordance with ANSI C63.4 2009. ANSI C63.10 2013 and the appropriate KDB test methods were followed.
The calibrations of the measuring instruments, including any accessories that may affect such calibration, are checked frequently to assure their accuracy. Adjustments are made and correction factors applied in accordance with instructions contained in the user manual for the measuring equipment.

# 4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the product, as specified in CISPR 16-4-2. This represents an expanded uncertainty expressed at 95% confidence level using a coverage factor k=2. These levels are for reference only and not included to determine product compliance.
Expanded uncertainty calculations are available upon request.

| Test item | Value (dB) |
|---|---|
| Radiated disturbance (30 MHz to 1 GHz) | 6.01 |
| Radiated disturbance (1 GHz to 18 GHz) | 4.80 |
| Conducted Disturbance at Mains Port | 3.30 |

# 5 Product Description

| | |
|---|---|
| Company Name: | Microsoft Corporation |
| Address: | One Microsoft Way |
| City, State, Zip: | Redmond, WA 98052-6399 |
| Customer Contact: | Sahithi Kandula |
| Functional Description of the EUT: | Handheld computing device with 802.11 2x2 a/b/g/n/ac WLAN, Bluetooth Radios |
| Model: | 1703 |
| FCC ID: | C3K1703 |
| IC ID: | 3048A-1703 |
| Radio Description: | BT (2402- 2480 MHz) |
| Modulation(s): | GFSK, π/4DQPSK, 8DPSK |
| Antenna Type and Gain: | Internal<br>4 dBi |
| EUT Classification: | FHSS |
| Equipment Design State: | EV3B |
| Equipment Condition: | Good |
| Test Sample Details: | SN(s): 000187552375, 000133752157 - Conducted<br>SN(s): 000132152157, 000181452357 - Radiated |

## 5.1 Test Configurations

Test software “WiFi Tool” (V2.7.4 & V2.7.3) provided by the customer and “Lab Tool” (V2.0.0.77) from the module vendor was used to program the EUT to transmit continuously. The device can operate in GFSK, π/4DQPSK and 8DPSK modulations and all modes were tested and included in this report. Channel numbers 0, 39 and 78 were used as Low, Mid and High Channels respectively.

## 5.2 Environmental Conditions

Ambient air temperature of the test site was within the range of 10 ºC to 40 ºC (50 ºF to 104 ºF) unless the EUT specified testing over a different temperature range. Humidity levels were in the range of 10% to 90% relative humidity. Testing conditions were within tolerance and any deviations required from the EUT are reported.

## 5.3 Antenna Requirements

The antennas were permanently attached and there were no provisions for connection to an external antenna.

## 5.4 Equipment Modifications

No modifications were made during testing.

## 5.5 Dates of Testing

Testing was performed on July 1st -29th, and August 21st, 2015.

# 6 Test Results Summary

| Test Description | FCC Rule Part<br>IC Rule Part | Limit | Test Result (Pass/Fail) |
|---|---|---|---|
| 20dB Bandwidth | 15.247 (a)(1)(iii)<br>RSS-247 [5.1] | For reporting purposes only. | Pass |
| Output Power | 15.247 (b)(3)<br>RSS-247 [5.4] | < 1 Watt | Pass |
| Channel Spacing | 15.247 (a)(1)<br>RSS-247 [5.1] | 2/3 of 20dB BW or 25 kHz | Pass |
| Number of Hopping Frequencies | 15.247 (a)(1)(iii)<br>RSS-247 [5.1] | > 15 channels | Pass |
| Dwell Time | 15.247 (a)(1)(iii)<br>RSS-247 [5.1] | < 0.4 sec in 31.6 sec period | Pass |
| Conducted Band Edge/Spurious Emissions | 15.247 (d)<br>RSS-247 [5.5] | Atleast 20dBc | Pass |
| Radiated Spurious Emissions/ Restricted Band Emissions | 15.205, 15.209<br>RSS-247 [5.5]<br>RSS-Gen [8.9] | FCC CFR 47 15.209 limits<br>RSS-Gen [8.9] | Pass |
| AC Powerline Conducted Emissions | 15.207<br>RSS-Gen [8.8] | FCC CFR 47 15.207 limits<br>RSS-Gen [8.8] | Pass |

# 7 Test Equipment List

The site and related equipment are in conformance with the requirements of ANSI C63.4, CISPR 16-1-1, and other equivalent applicable standards.

| Equipment used for Radiated and Conducted Measurements | | | | |
|---|---|---|---|---|
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Calibration Due** |
| Rohde & Schwarz | EMI Test Receiver | ESU40 | RF-192 | 4/14/2016 |
| Rohde & Schwarz | EMI Test Receiver | ESU40 | RF-012 | 4/12/2016 |
| Agilent | Spectrum Analyzer | N9030A | EMC-607 | 6/16/2016 |
| Rohde & Schwarz | Signal Analyzer | FSV40 | RF-195 | 4/10/2016 |
| Rohde & Schwarz | Signal Analyzer | FSV40 | RF-245 | 4/10/2016 |
| Sunol Sciences | Antenna - Broadband | JB6 | EMC-008 | 3/4/2016 |
| ETS-Lindgren | Antenna | 3117 | RF-139 | 4/9/2016 |
| ETS-Lindgren | Antenna | 3117 | RF-138 | 5/13/2016 |
| ETS-Lindgren | Antenna - Standard Gain | 3160-09 | RF-179 | 4/30/2016 |
| ETS-Lindgren | Antenna - Standard Gain | 3160-10 | RF-038 | 4/30/2016 |
| Rohde & Schwarz | Custom Filter Bank+PreAmp | SFUNIT RX | RF-323 | 3/21/2016 |
| Rohde & Schwarz | Custom Filter Bank | SFUNIT RX | RF-324 | 3/21/2016 |
| Rohde & Schwarz | Pre-Amp | TS-PR26 | RF-042 | 1/6/2016 |
| Rohde & Schwarz | Pre-Amp | TS-PR40 | RF-200 | 1/6/2016 |
| Rohde & Schwarz | Switch and Control Unit | OSP130 | RF-249 | 1/9/2016 |
| Rohde & Schwarz | Switch and Control Unit | OSP150 | RF-250 | 1/9/2016 |
| Rohde & Schwarz | Switch and Control Unit | OSP130 | RF-018 | 12/18/2015 |
| Rohde & Schwarz | Switch and Control Unit | OSP150 | RF-019 | 12/18/2015 |

| | | | | |
|---|---|---|---|---|
| Maturo | Antenna Tower Controller | NCD | RF-002 | N/A |
| Maturo | Device Positioner | TD1.5 | RF-003 | N/A |
| Maturo | System Controller | NCD-120 | RF-327 | N/A |
| Sunol Sciences | System Controller | SC110V | RF-001 | N/A |
| Madge Tech | THP Monitor | PRH Temp 2000 | EMC-681 | 11/5/2015 |
| Madge Tech | THP Monitor | PRH Temp 2000 | EMC-171 | N/A |
| Fluke | Multimeter | 87V | EMC-193 | 4/9/2016 |
| Rohde & Schwarz | Software | EMC-32 V9.15 | N/A | N/A |
| Huber Suhner | RF Cable | 102A | RF-272 | 1/6/2016 |
| Huber Suhner | RF Cable | Sucoflex 102A | RF-269 | 3/21/2016 |

| **Equipment used for Line Conducted Emissions Measurement** | | | | |
|---|---|---|---|---|
| **Manufacturer** | **Description** | **Model #** | **Asset #** | **Calibration Due** |
| Rohde & Schwarz | EMI Test Receiver | ESR 3 | EMC-669 | 11/3/2015 |
| Teseq | LISN | NNB 51 | EMC-187 | 10/11/2015 |
| Teseq | LISN | NNB 51 | EMC-642 | 10/11/2015 |
| Micro-Coax | RF Cable | UFA210A-1-1800-50U50U | EMC-367 | 8/6/2016 |
| Madge Tech | THP Monitor | PRHTemp2000 | EMC-837 | 6/23/2016 |
| ETS | TILE SW | Ver 7.0 | N/A | N/A |

# 8 Test Site Description

## 8.1 Radiated Emissions Test Site

Radiated measurements are performed in a 3m semi-anechoic chamber, which meets NSA requirements for the frequency range of 30MHz to 1000MHz. For measurements above 1 GHz, absorbers with a 2.4m X 2.4m configuration are laid out on the ground plane between the Receiving antenna and the EUT in accordance with the requirements of ANSI C63.4:2009.

### 8.1.1 Radiated Measurements in 30M- 1000 MHz

The EUT is positioned on a Turntable at a height of 80cm using a non-conducting table. A Linearly polarized broadband antenna is positioned at 3m from the EUT periphery. The turntable is rotated 360 degrees and the antenna height varied from 1m to 4m to determine the highest emissions. This is repeated for both Horizontal and Vertical Polarizations of the Measurement Antenna. The EUT is also rotated about its three orthogonal orientations to investigate emissions.

### 8.1.2 Radiated Measurements above 1GHz

The EUT is positioned on a Turntable at a height of 150cm using a device positioner. A Linearly polarized antenna is positioned at 3m from the EUT periphery. Guidelines in ANSI C63.10 2013 were followed with respect to maximizing the emissions. The turntable is rotated 360 degrees, the antenna height maintained at 150cm and the device positioner rotated about it's horizontal axis to determine the highest emissions. This is repeated for both Horizontal and Vertical Polarizations of the Measurement Antenna. Measurements above 18GHz were performed at a distance of 1m.

## 8.2 Antenna port conducted measurements

All antenna port conducted measurements were performed on a bench-top setup consisting of a spectrum analyzer, power meter (as necessary), splitters/combiners (as necessary), attenuators, and pre-characterized RF cables.

The correction factors between the EUT and the spectrum analyzer was added internally in the analyzer settings. The plots displayed accounts for these correction factors.

## 8.3 Test Setup Diagrams

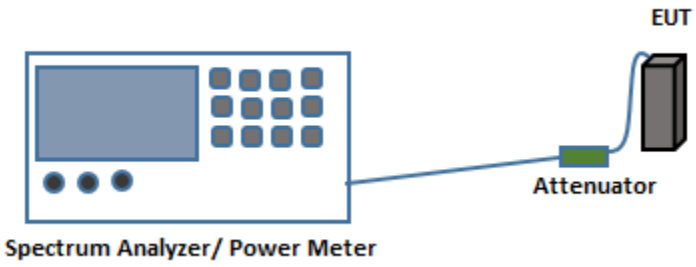



**Fig.1. Test Setup for Antenna port conducted measurements**

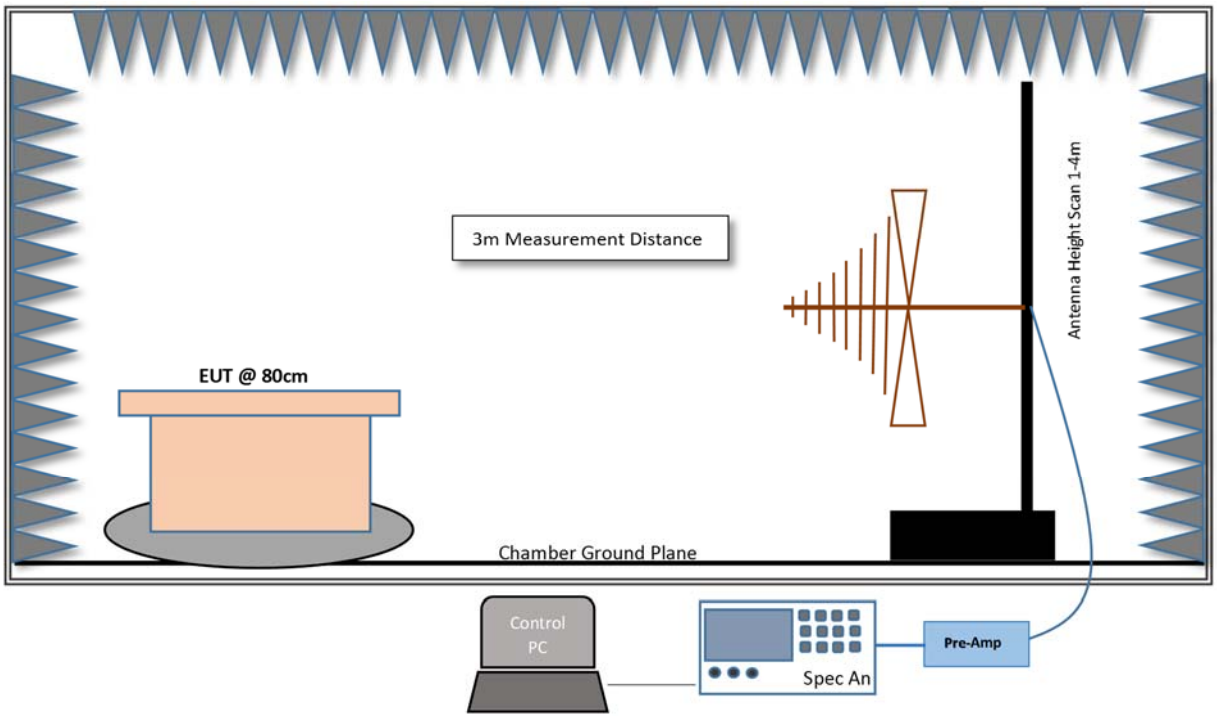



**Fig.2. Test Setup for Radiated measurements in 30MHz- 1GHz Range**

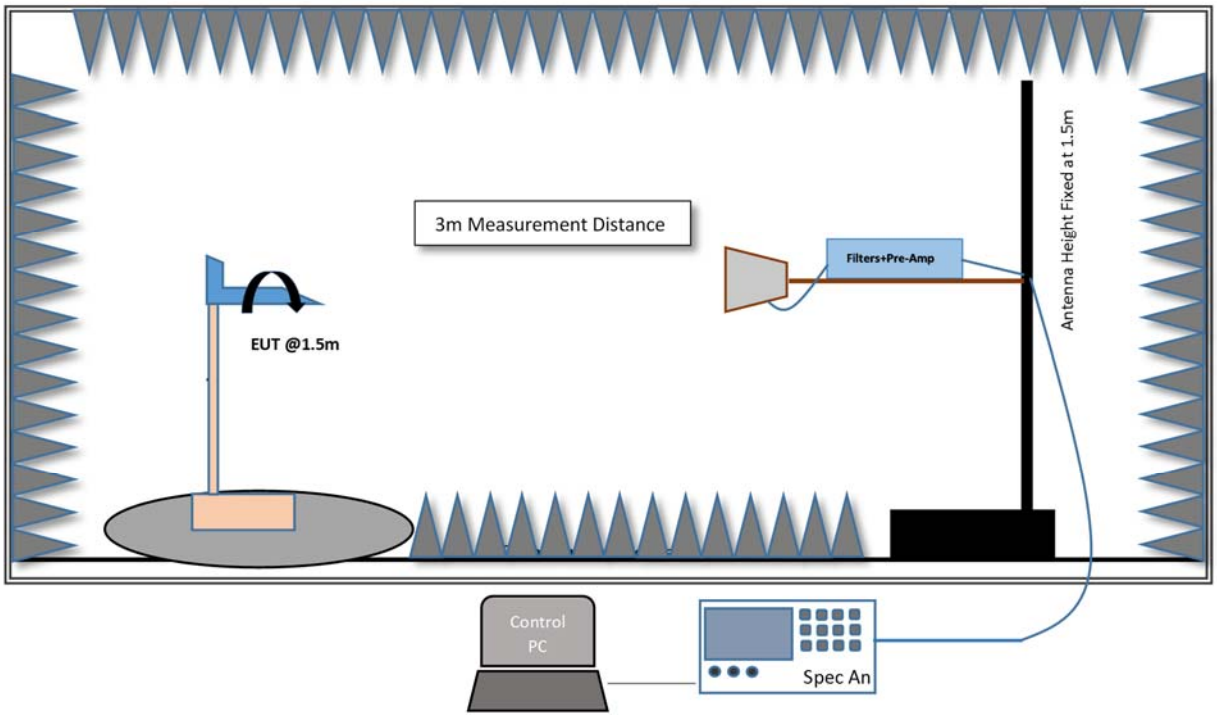



**Fig.3. Test Setup for Radiated measurements in 1GHz- 18GHz Range**

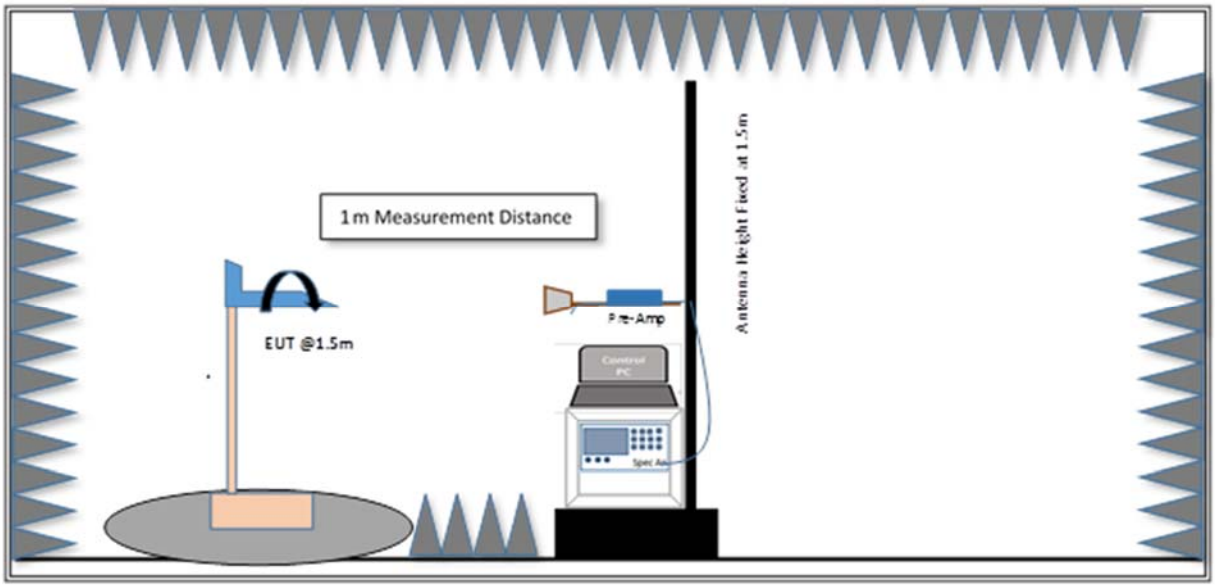



**Fig.4. Test Setup for Radiated measurements >18GHz**

# 9 Test Results- Conducted

## 9.1 20dB Bandwidth

### 9.1.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(1)(iii)

RSS-247 [5.1]

### 9.1.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10.

**Spectrum analyzer settings:**
The Occupied Bandwidth function on the spectrum analyzer was used to measure 20dB BW with the settings below:
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 1% of the 20 dB bandwidth
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

### 9.1.3 Limits:

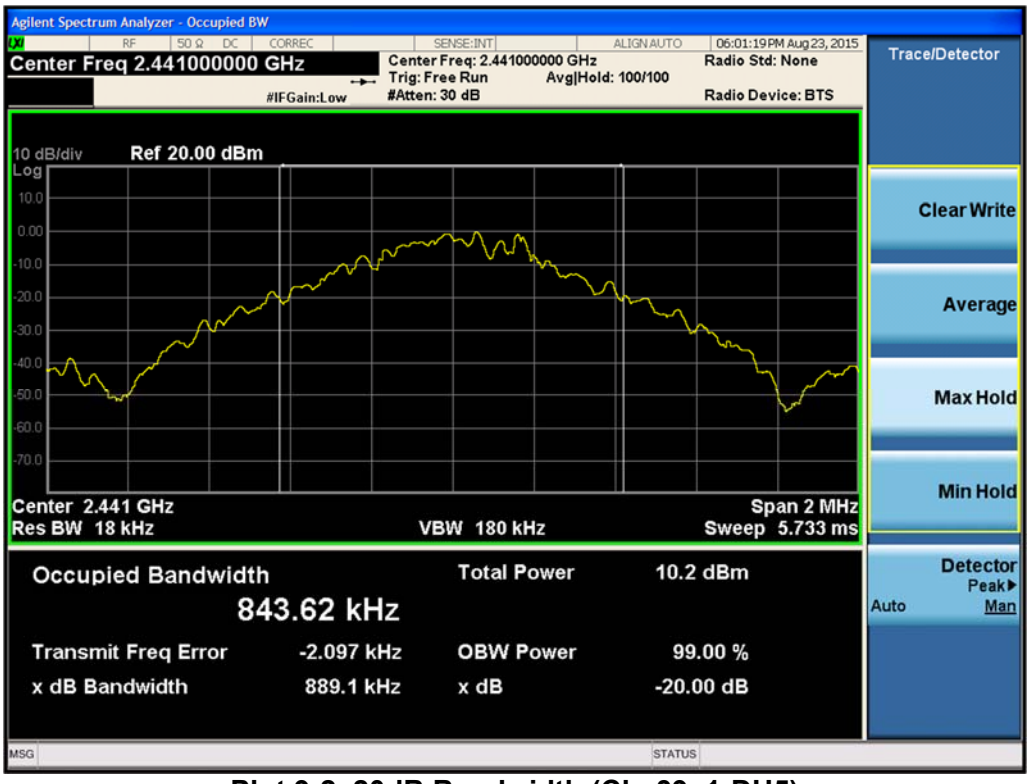
N/A

### 9.1.4 Test Results:

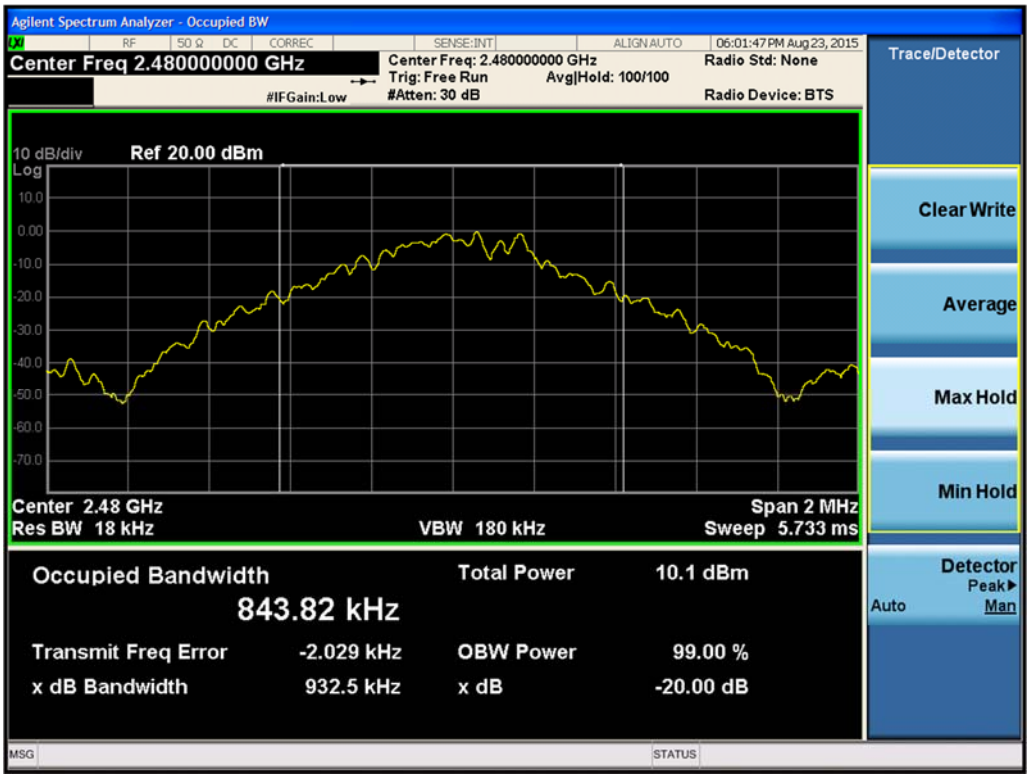
| Frequency (MHz) | Mode | Data Rate (Mbps) | Channel No. | 20 dB Bandwidth (kHz) |
|---|---|---|---|---|
| 2402 | 1-DH5 | 1 | 0 | 890.4 |
| 2441 | 1-DH5 | 1 | 39 | 889.1 |
| 2480 | 1-DH5 | 1 | 78 | 932.5 |
| 2402 | 2-DH5 | 2 | 0 | 1335 |
| 2441 | 2-DH5 | 2 | 39 | 1319 |
| 2480 | 2-DH5 | 2 | 78 | 1316 |
| 2402 | 3-DH5 | 3 | 0 | 1321 |
| 2441 | 3-DH5 | 3 | 39 | 1296 |
| 2480 | 3-DH5 | 3 | 78 | 1299 |

### 9.1.5 Test Data:

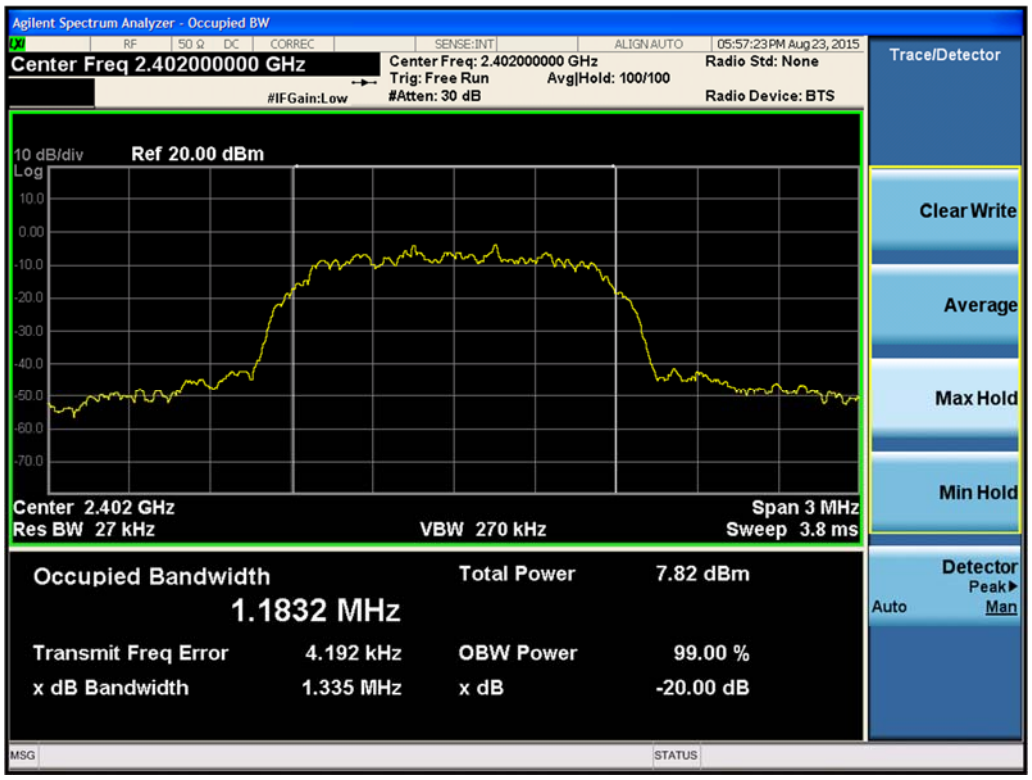

**Plot 9-1. 20dB Bandwidth (Ch. 0, 1-DH5)**



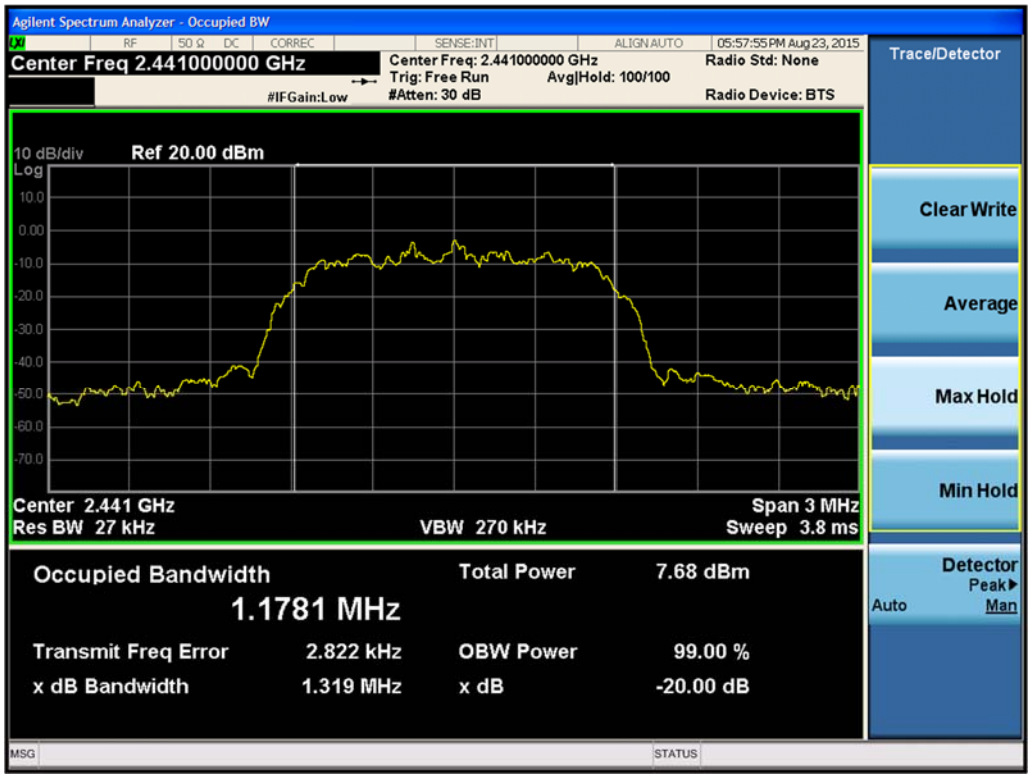

**Plot 9-2. 20dB Bandwidth (Ch. 39, 1-DH5)**



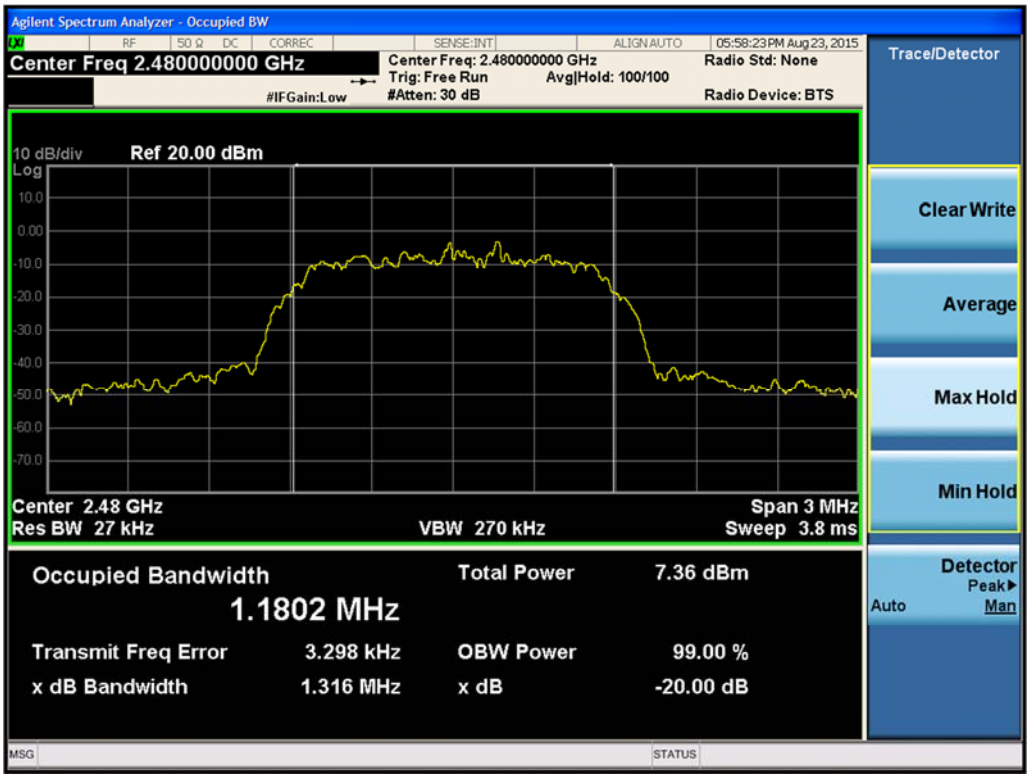

**Plot 9-3. 20dB Bandwidth (Ch. 78, 1-DH5)**



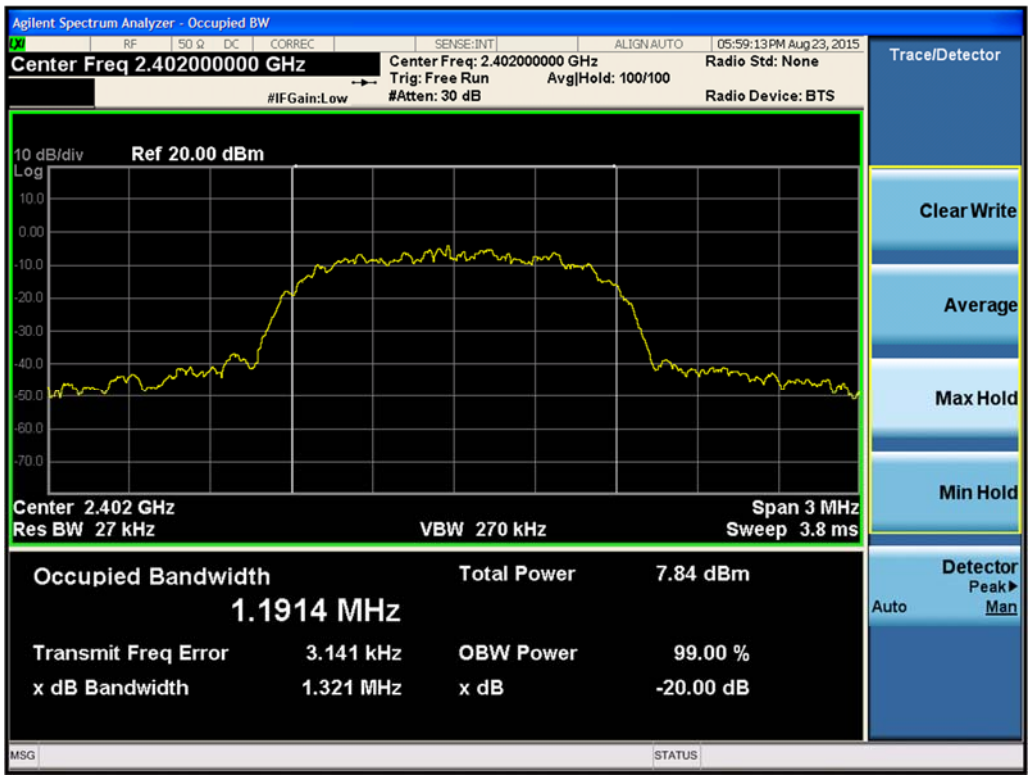

**Plot 9-4. 20dB Bandwidth (Ch. 0, 2-DH5)**



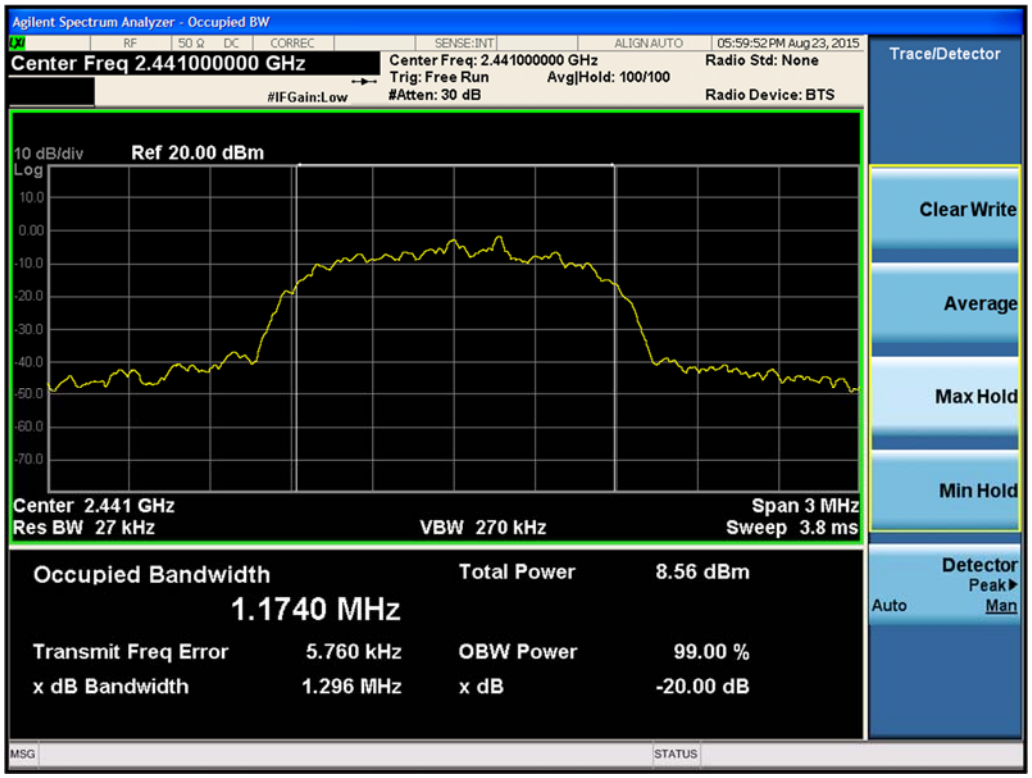

**Plot 9-5. 20dB Bandwidth (Ch. 39, 2-DH5)**



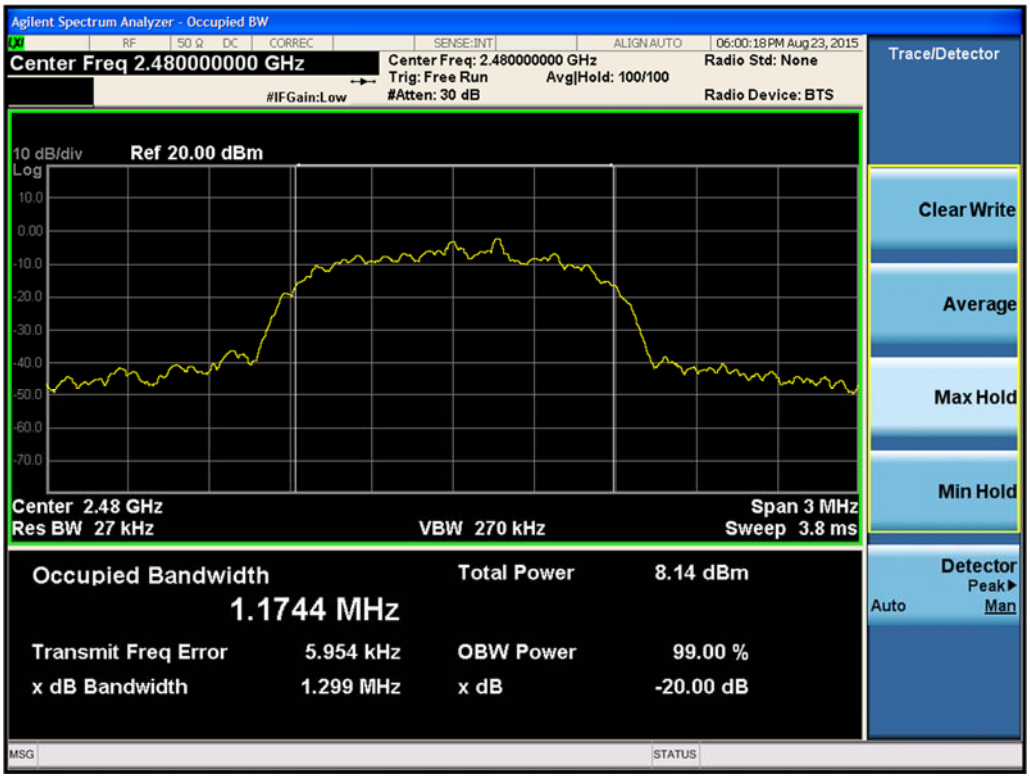

**Plot 9-6. 20dB Bandwidth (Ch. 78, 2-DH5)**




**Plot 9-7. 20dB Bandwidth (Ch. 0, 3-DH5)**




**Plot 9-8. 20dB Bandwidth (Ch. 39, 3-DH5)**




**Plot 9-9. 20dB Bandwidth (Ch. 78, 3-DH5)**

## 9.2 Output Power

### 9.2.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (b)(1)

RSS-247 [5.4]

### 9.2.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10.

**Spectrum analyzer settings:**
**Peak Power Measurements:**
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured= 3MHz
VBW ≥ 3 x RBW= 50 MHz
Sweep = auto
Detector function = peak
Trace = max hold
The trace was allowed to stabilize. A Marker was set to the peak of the emission. The indicated level is the peak output power.

### 9.2.3 Limits:

15.247: 1 Watt if ≥ 75 non-overlapping channels.

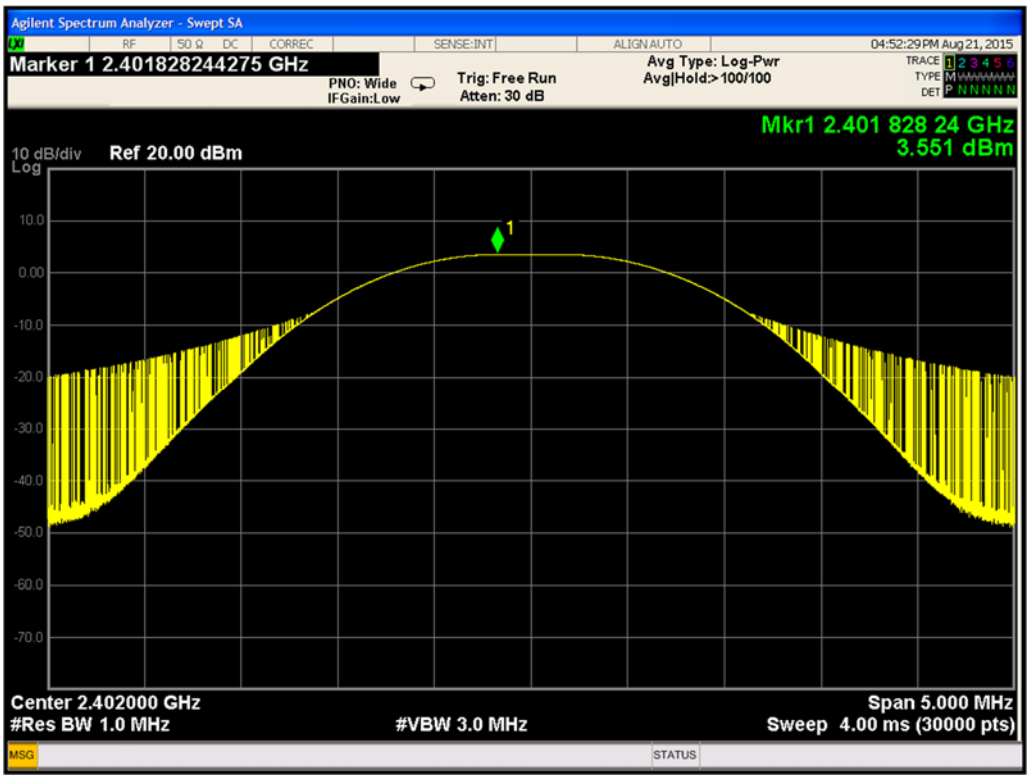
RSS-247: 1 W (30dBm) conducted and 4 W (36dBm) EIRP.

### 9.2.4 Test Results:

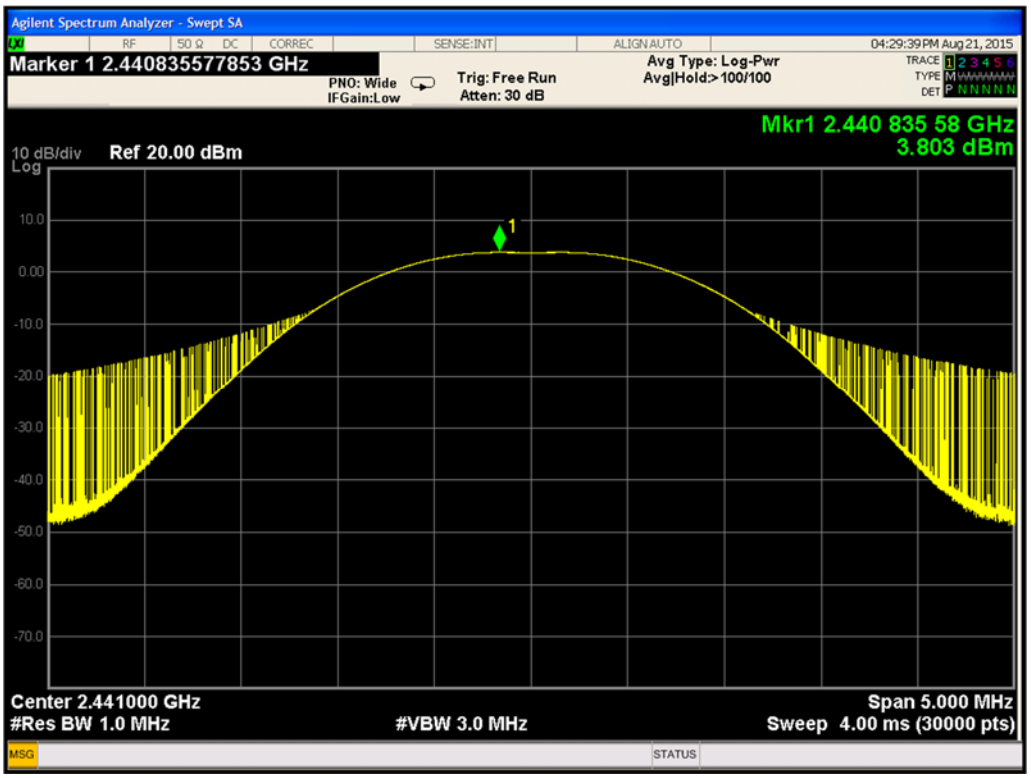
Pass

| Frequency (MHz) | Mode | Data Rate (Mbps) | Channel No. | Peak Power (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Conducted Peak Power (W) |
|---|---|---|---|---|---|---|---|
| 2402 | 1-DH5 | 1 | 0 | 3.55 | 4.0 | 7.55 | 0.002 |
| 2441 | 1-DH5 | 1 | 39 | 3.80 | 4.0 | 7.80 | 0.002 |
| 2480 | 1-DH5 | 1 | 78 | 3.62 | 4.0 | 7.62 | 0.002 |
| 2402 | 2-DH5 | 2 | 0 | 2.79 | 4.0 | 6.79 | 0.002 |
| 2441 | 2-DH5 | 2 | 39 | 3.72 | 4.0 | 7.72 | 0.002 |
| 2480 | 2-DH5 | 2 | 78 | 3.40 | 4.0 | 7.40 | 0.002 |
| 2402 | 3-DH5 | 3 | 0 | 3.07 | 4.0 | 7.07 | 0.002 |
| 2441 | 3-DH5 | 3 | 39 | 3.59 | 4.0 | 7.59 | 0.002 |
| 2480 | 3-DH5 | 3 | 78 | 3.25 | 4.0 | 7.25 | 0.002 |

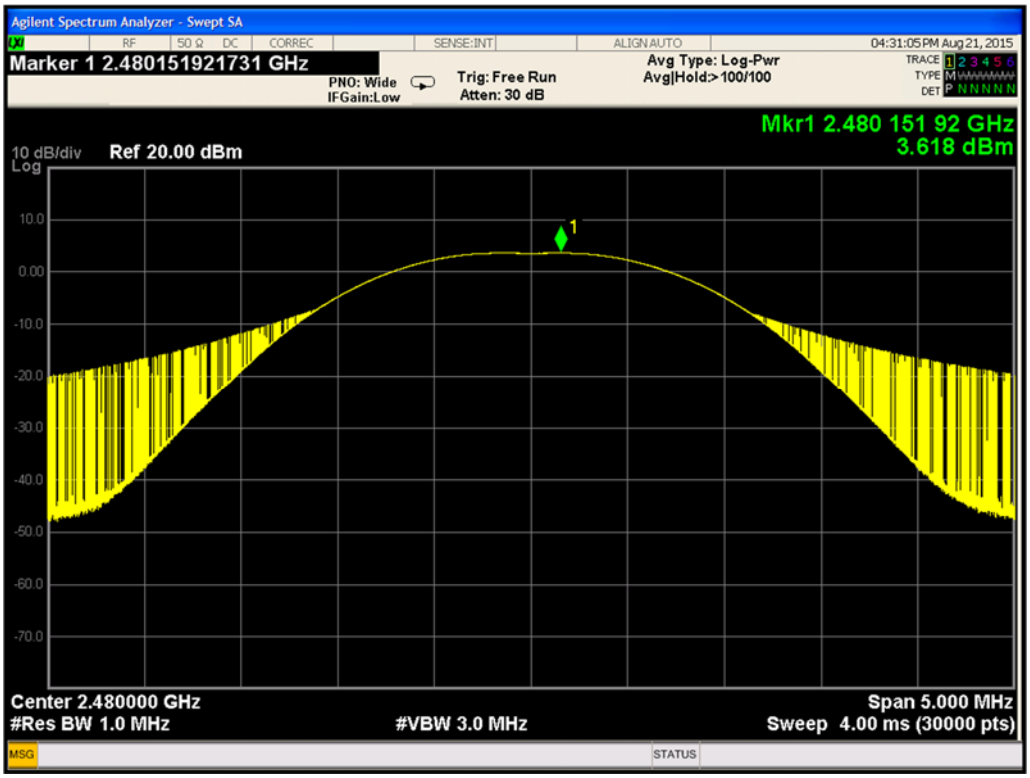
### 9.2.5 Test Data:



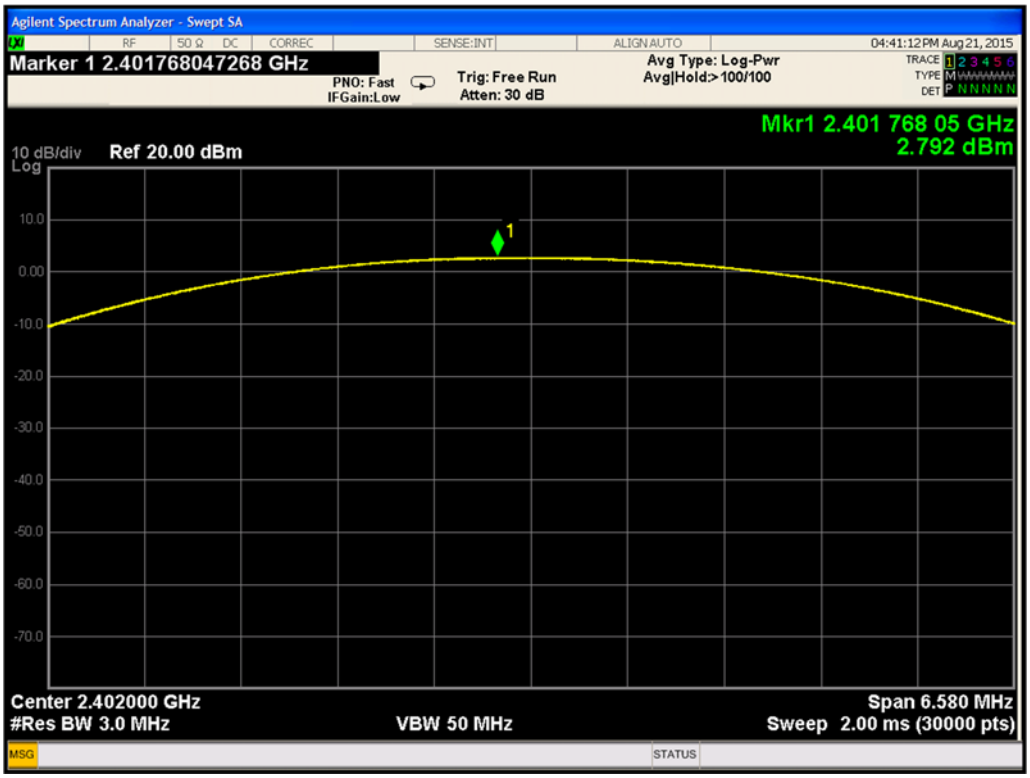

**Plot 9-10. Peak Power (Ch. 0, 1-DH5)**



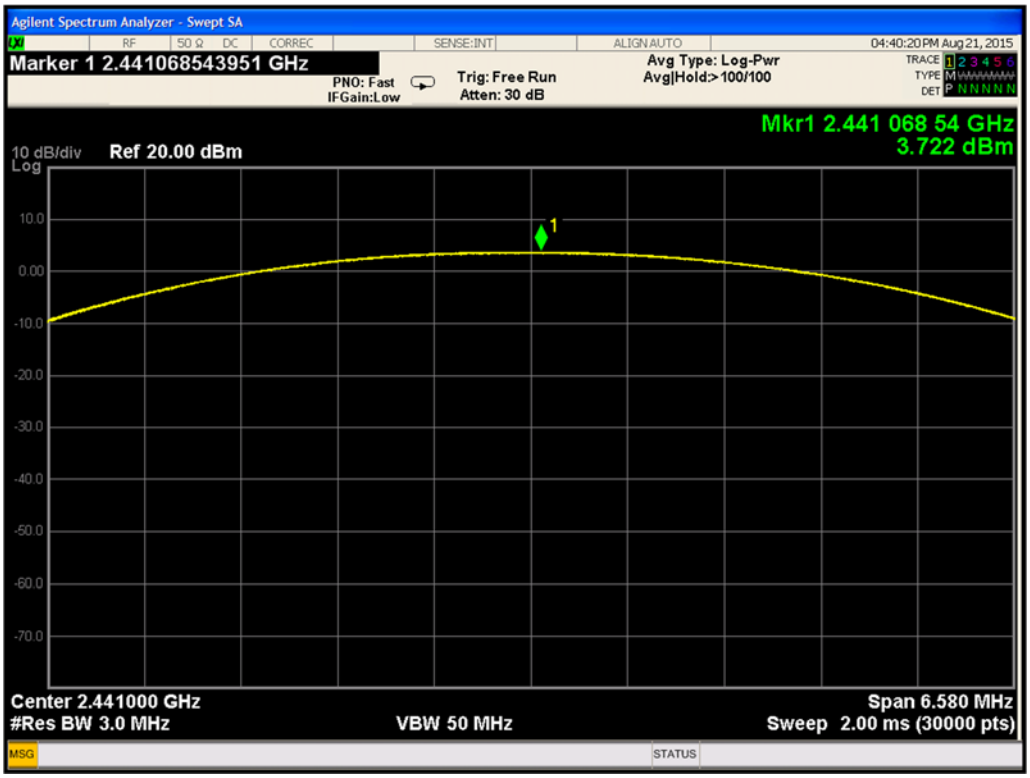

**Plot 9-11. Peak Power (Ch. 39, 1-DH5)**



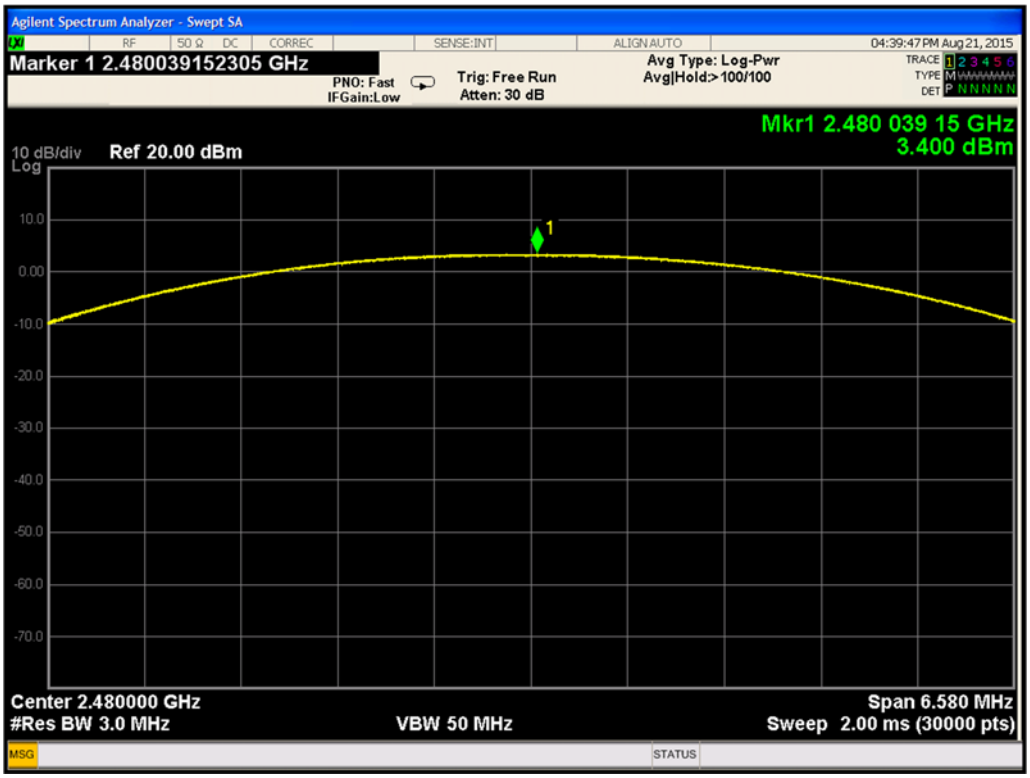

**Plot 9-12. Peak Power (Ch. 78, 1-DH5)**



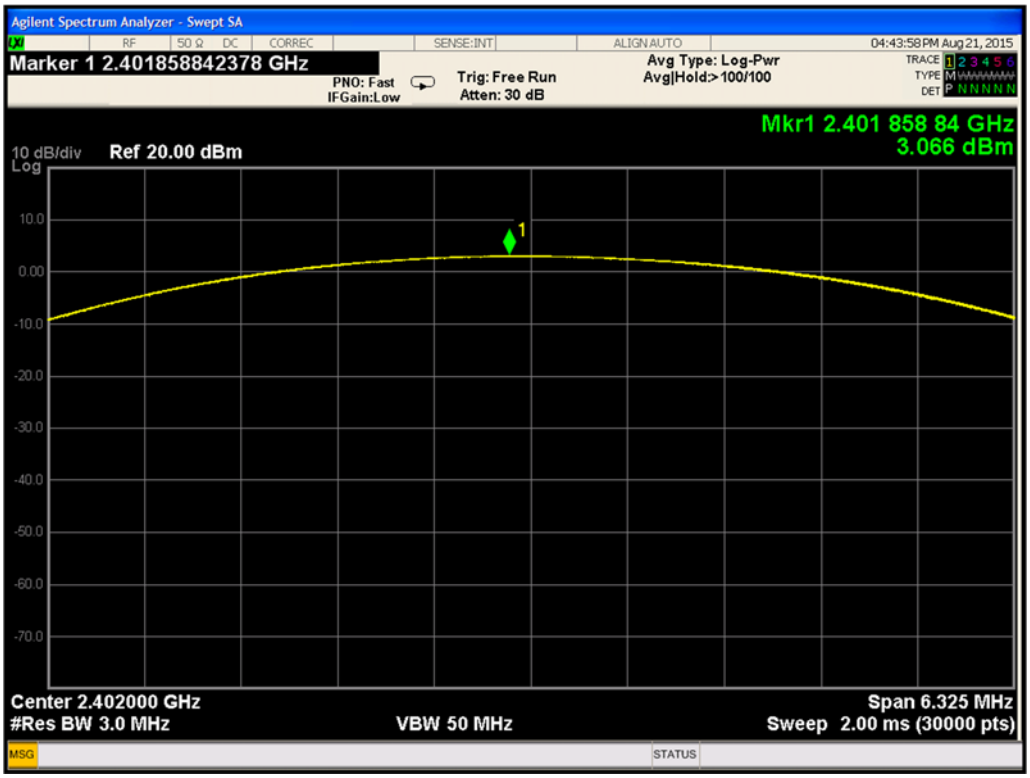

**Plot 9-13. Peak Power (Ch. 0, 2-DH5)**



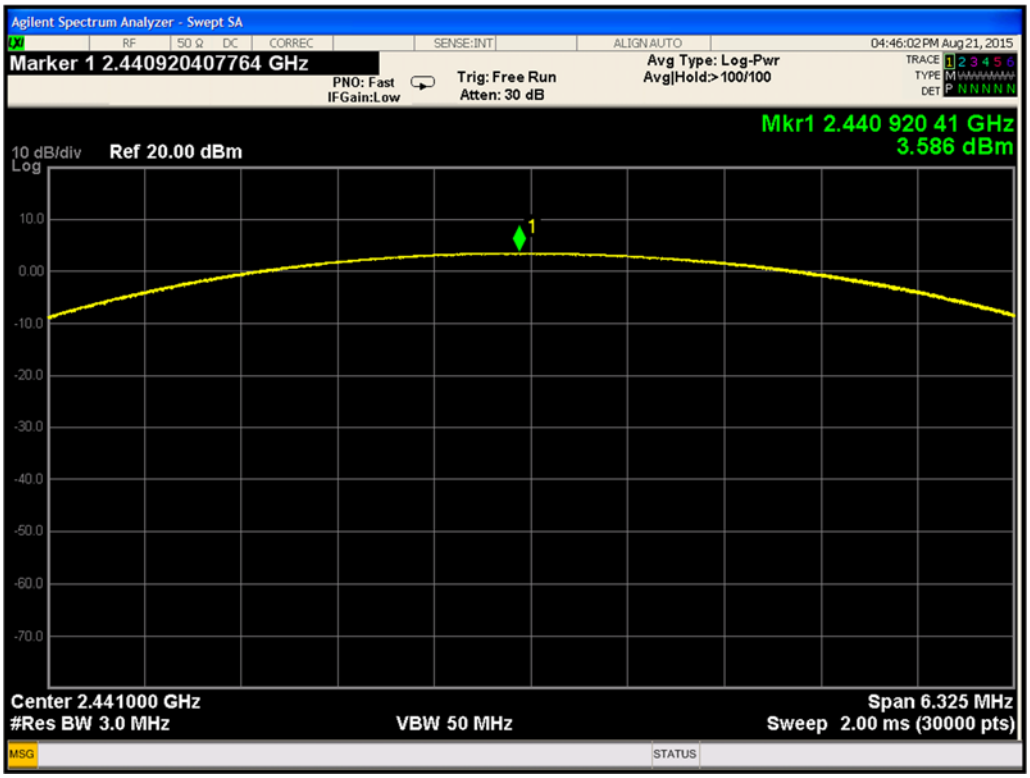

**Plot 9-14. Peak Power (Ch. 39, 2-DH5)**



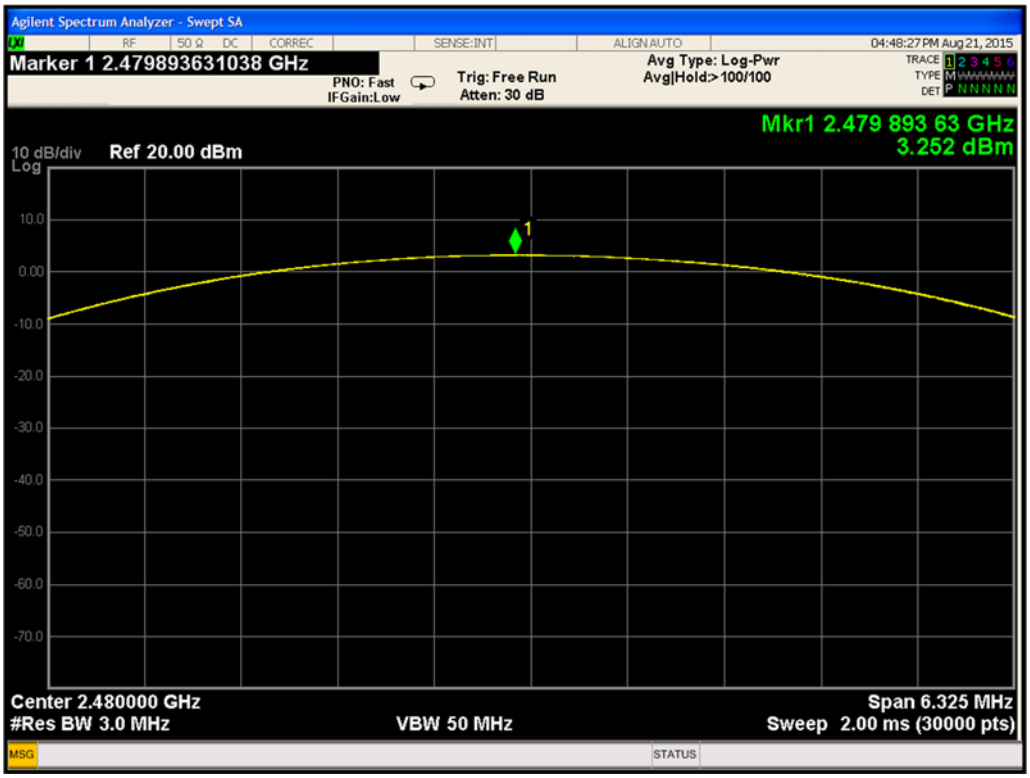

**Plot 9-15. Peak Power (Ch. 78, 2-DH5)**




**Plot 9-16. Peak Power (Ch. 0, 3-DH5)**




**Plot 9-17. Peak Power (Ch. 39, 3-DH5)**




**Plot 9-18. Peak Power (Ch. 78, 3-DH5)**

## 9.3 Channel Spacing

### 9.3.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(1)

RSS-247 [5.1]

### 9.3.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10. The EUT was in pseudorandom hopping mode with the separation of two peaks measured using the delta marker.

**Spectrum analyzer settings:**

Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) > 1% of the span
Video (or Average) Bandwidth (VBW) ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold
The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

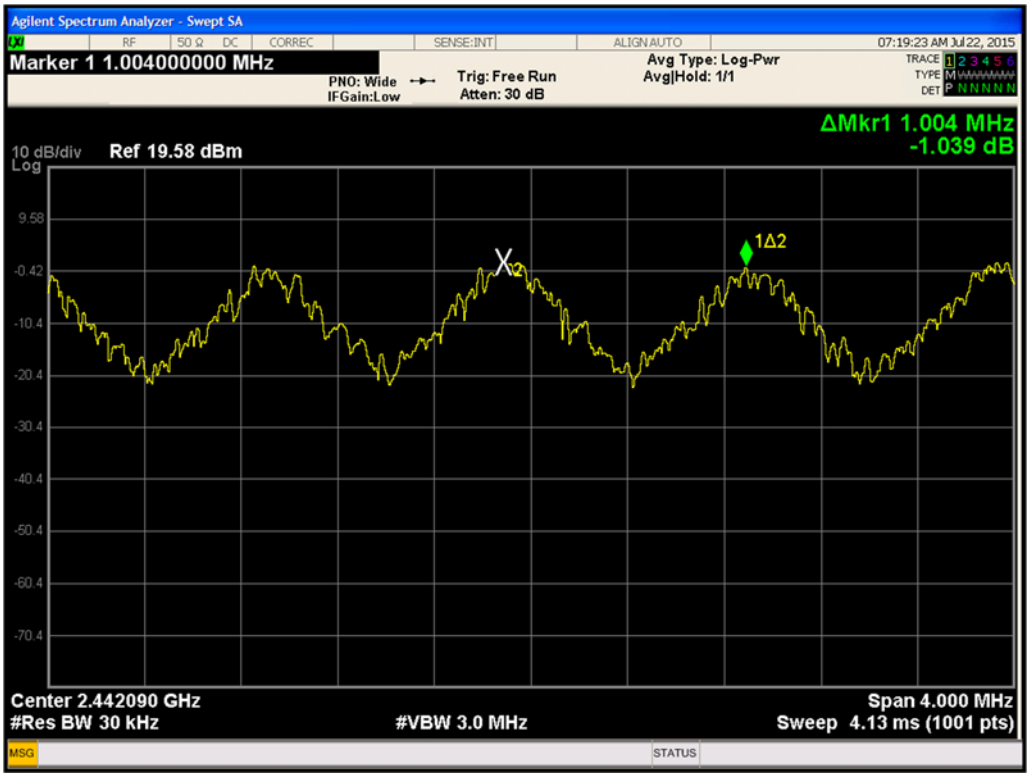
### 9.3.3 Limits:

The channel carrier frequencies must be separated by 25kHz or the 20dB BW of the hopping channel whichever is greater. If the output power is less than 125mW, then the channel separation can be 2/3 of the 20dB bandwidth or 25kHz whichever is greater.

### 9.3.4 Test Results:

Pass.
Minimum channel separation= 1 MHz

### 9.3.5 Test Data:




**Plot 9-19 Channel Separation**

## 9.4 Number of Hopping Frequencies

### 9.4.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(1)(iii)

RSS-247 [5.1]

### 9.4.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10. The EUT had its hopping function enabled.

**Spectrum analyzer settings:**

Span = the frequency band of operation
RBW ≥ 1% of the span
VBW ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold
The trace was allowed to stabilize and the number of channels was counted.

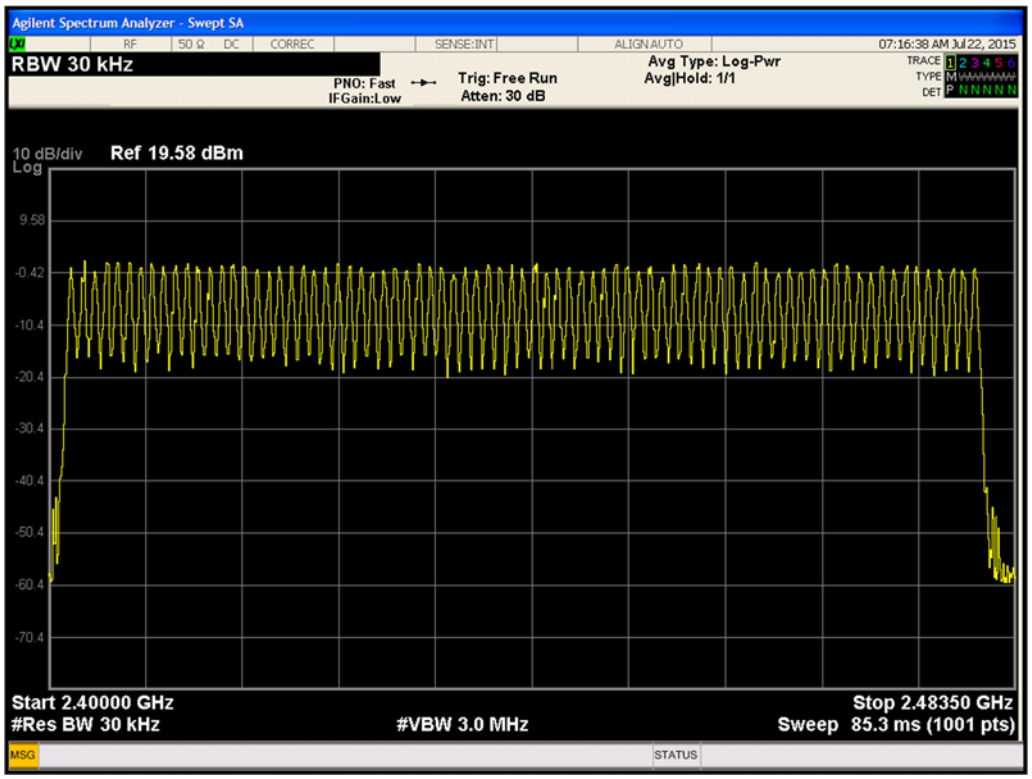
### 9.4.3 Limits:

The minimum number of hopping channels required is 15.

### 9.4.4 Test Results

Pass. The EUT utilizes 79 hopping channels in BDR and EDR modes. In AFH mode, the EUT utilizes a minimum of 20 hopping channels.

### 9.4.5 Test Data:




**Plot 9-20. Number of Hopping Channels**

## 9.5 Dwell Time

### 9.5.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (a)(1)(iii)

RSS-247 [5.1]

### 9.5.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10. The EUT had its hopping function enabled.

**Spectrum analyzer settings:**
Span = zero span, centered on a hopping channel
RBW = 1 MHz
VBW ≥ 3 x RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

Dwell Time is measured with analyzer set to zero span at the middle channel and the trigger set to capture a burst. DH5 mode exhibited the longest burst time. The dwell time limit in 1x/EDR mode is number of hopping channels * 400ms. For Bluetooth, 79 channels *400ms = 31.6 s. In AFH mode, 20 channels * 400ms = 8 s.

### 9.5.3 Limits:

400 ms

### 9.5.4 Test Results:

Pass.

Standard Bluetooth 1x/EDR has a channel hopping rate of 1600 hops/s.

1x/EDR mode uses 5 transmit and 1 receive slots for a total of 6 slots.

Bluetooth is hopping at a rate of 1600/6 = 266.67 hops/s/slot. Then, 266.67 hops/s/79 channels = 3.38 hops/s for one channel.

The dwell time limit is number of hopping channels * 400ms. For Bluetooth, 79 channels *400ms = 31.6 s.

So the number of hops over a 31.6 s period is 3.38 hops/s * 31.6 s = 106.67 hops.

Worst case dwell time for one channel = 106.67 hops * Dwell Time = 106.67 hops * 2.893ms = 308.916 ms.

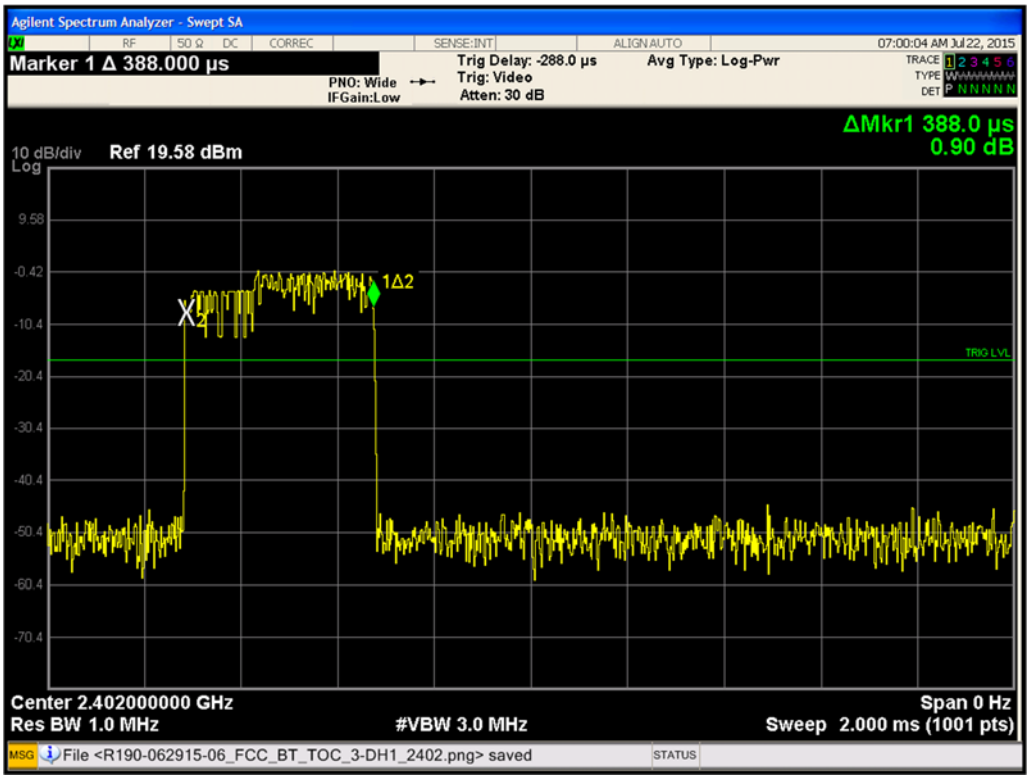
In AFH mode, the EUT utilizes a minimum of 20 channels. In this mode, the hopping rate is reduced to 800 hops/s with 6 time slots.

The hopping rate is calculated as 800/6 = 133.33 hops/s/slot. Since there are a minimum of 20 channels, 133.33 hops/s/slot/20 channels = 6.67 hops/s on a single channel.

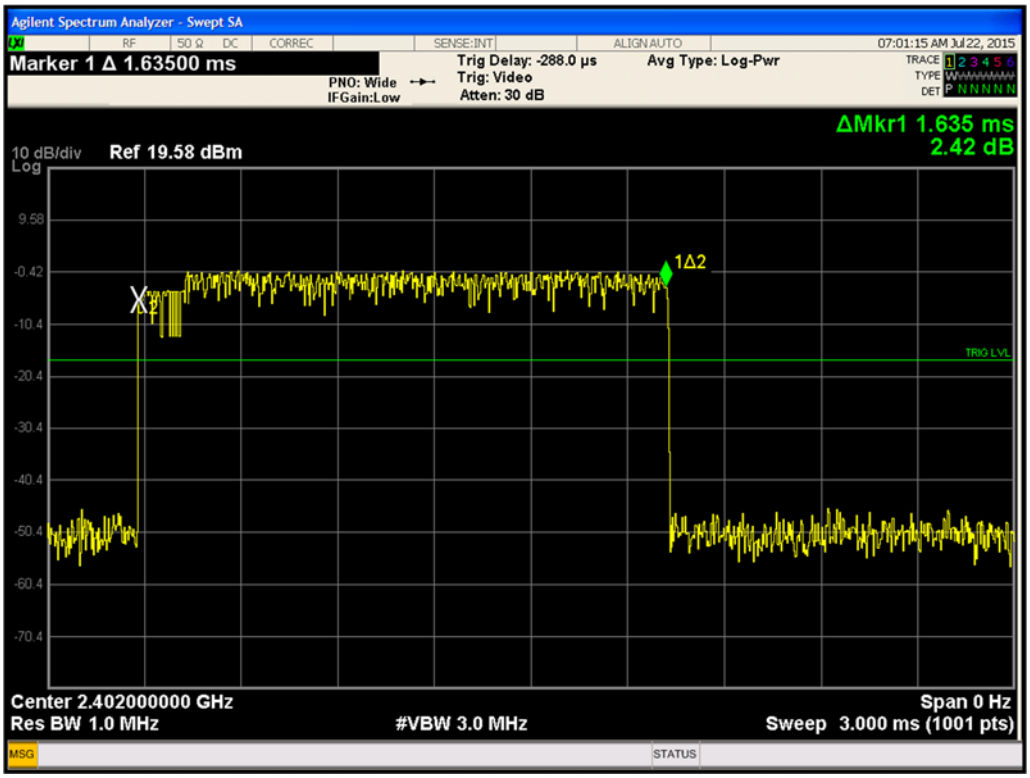
The number of hops over an 8 s period is 6.67 hops/s * 8 s = 53.36 hops.

The worst case dwell time for one channel = 53.36 hops * Dwell Time = 53.6 hops * 2.893ms = 155.06ms.

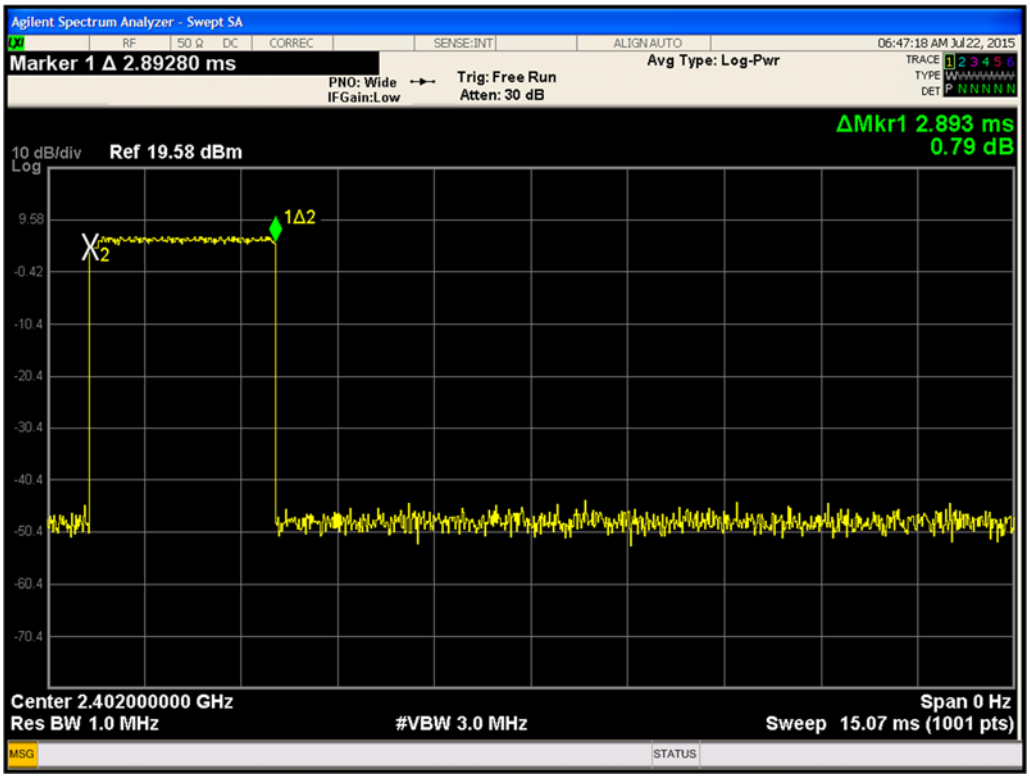
### 9.5.5 Test Data:




**Plot 9-21. Dwell Time – DH1**




**Plot 9-22. Dwell Time – DH3**




**Plot 9-23 Dwell Time - DH5**

## 9.6 Band Edge

### 9.6.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

RSS-247 [5.5]

### 9.6.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10.

**Spectrum analyzer settings:**

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation
RBW ≥ 1% of the span
VBW ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = Max hold
The trace was allowed to stabilize. The market was set on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. The delta marker function was set and the marker-to-peak function moved to the peak of the in-band emission.

With the same instrument settings, the hopping function of the EUT was enabled and the trace was allowed to stabilize. The same procedure listed above was used to determine if any spurious emissions caused by the hopping function complied with the specified limit.

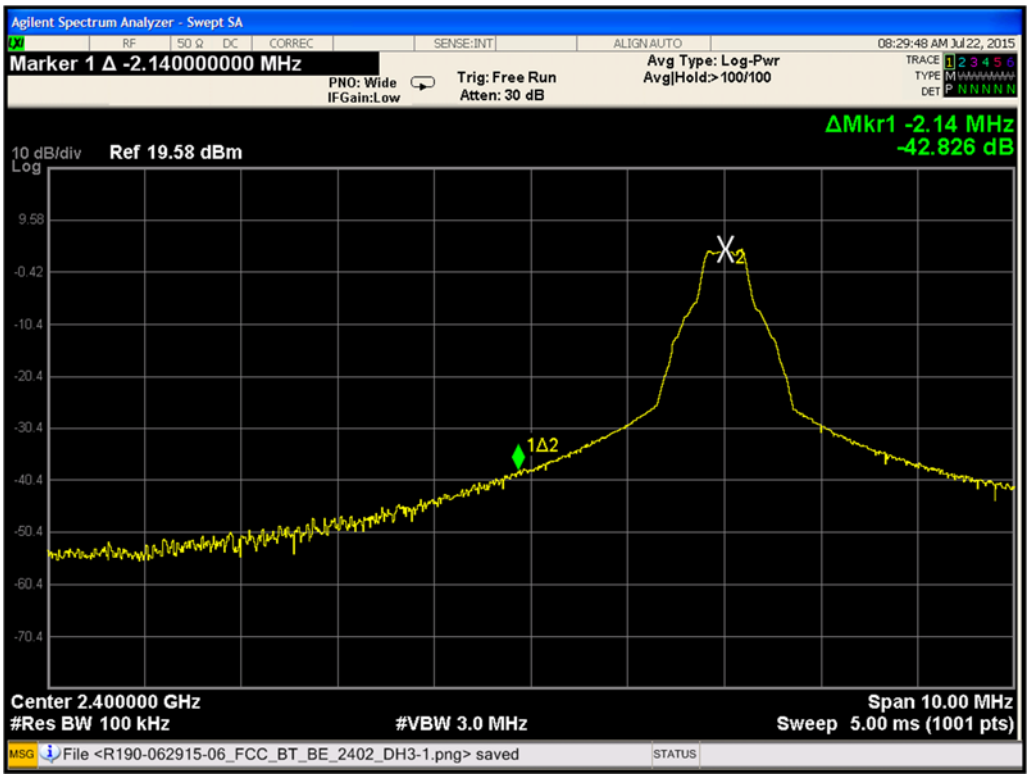
### 9.6.3 Limits:

The maximum level is 20dBc with measurements taken with the EUT in pseudorandom hopping mode and with hopping mode disabled.

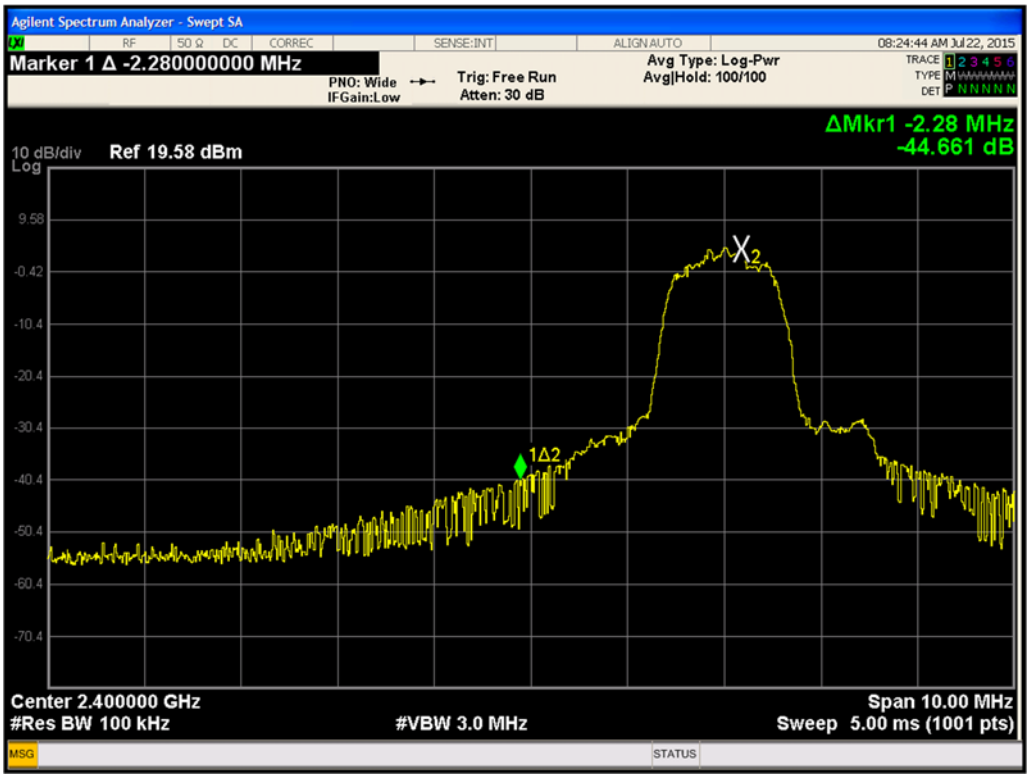
### 9.6.4 Test Results:

Pass.

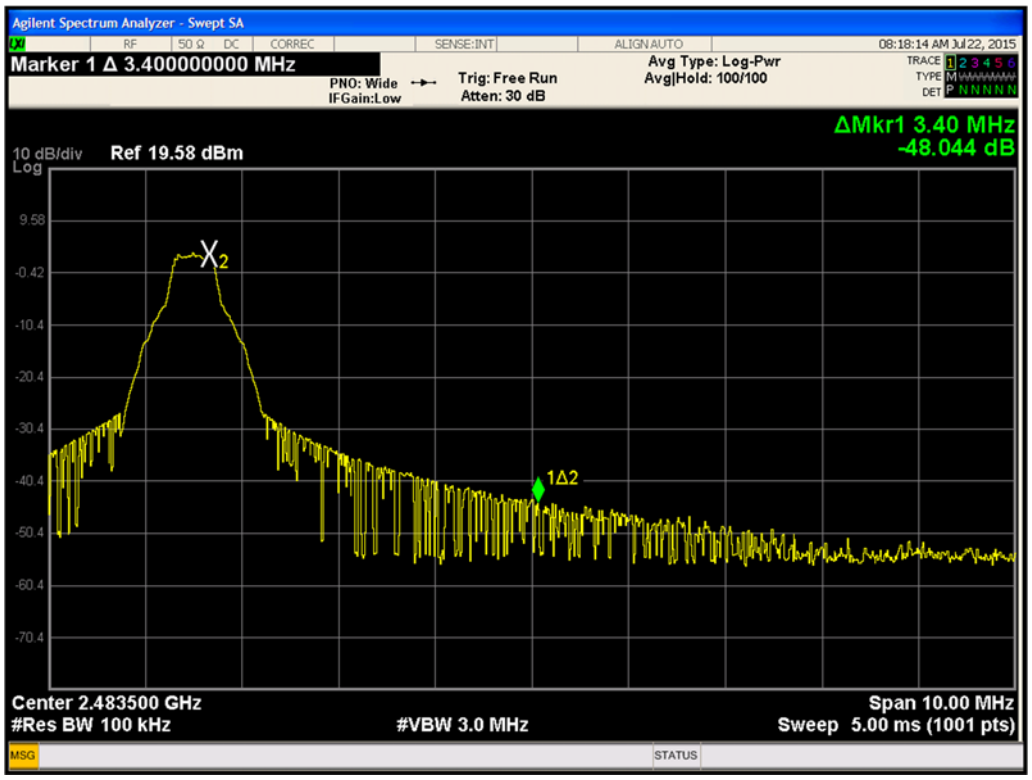
### 9.6.5 Test Data:



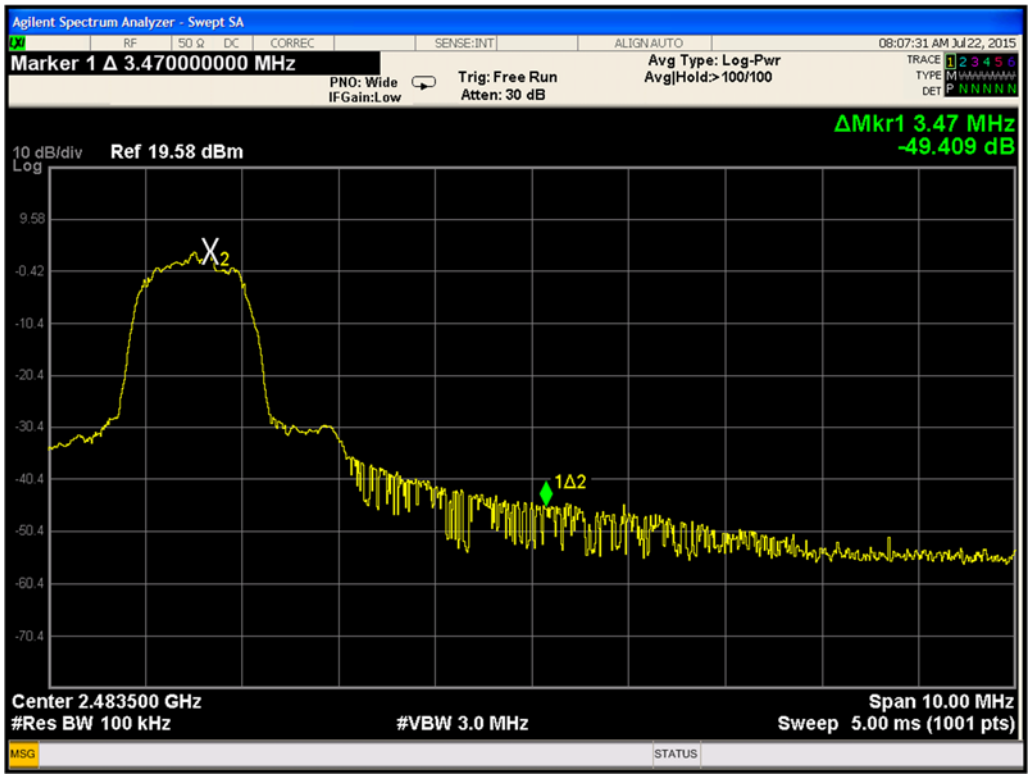

**Plot 9-24. Low Channel Band edge: 1-DH5 Mode (Hopping disabled)**



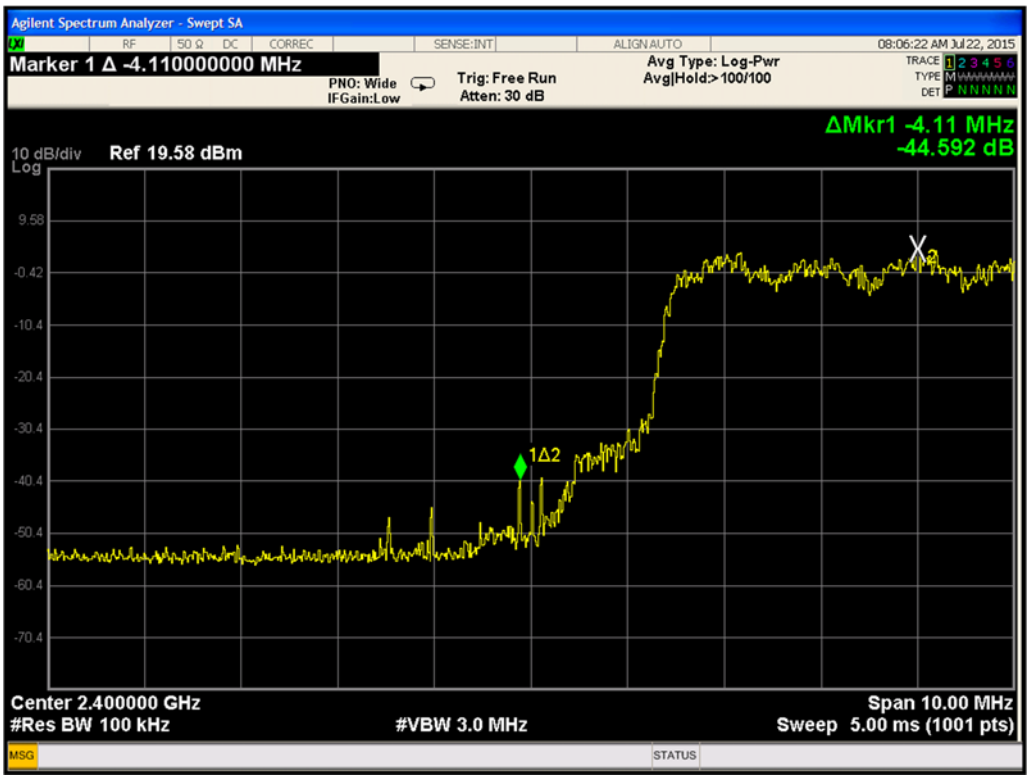

**Plot 9-25. Low Channel Band edge: 3-DH5 Mode (Hopping disabled)**



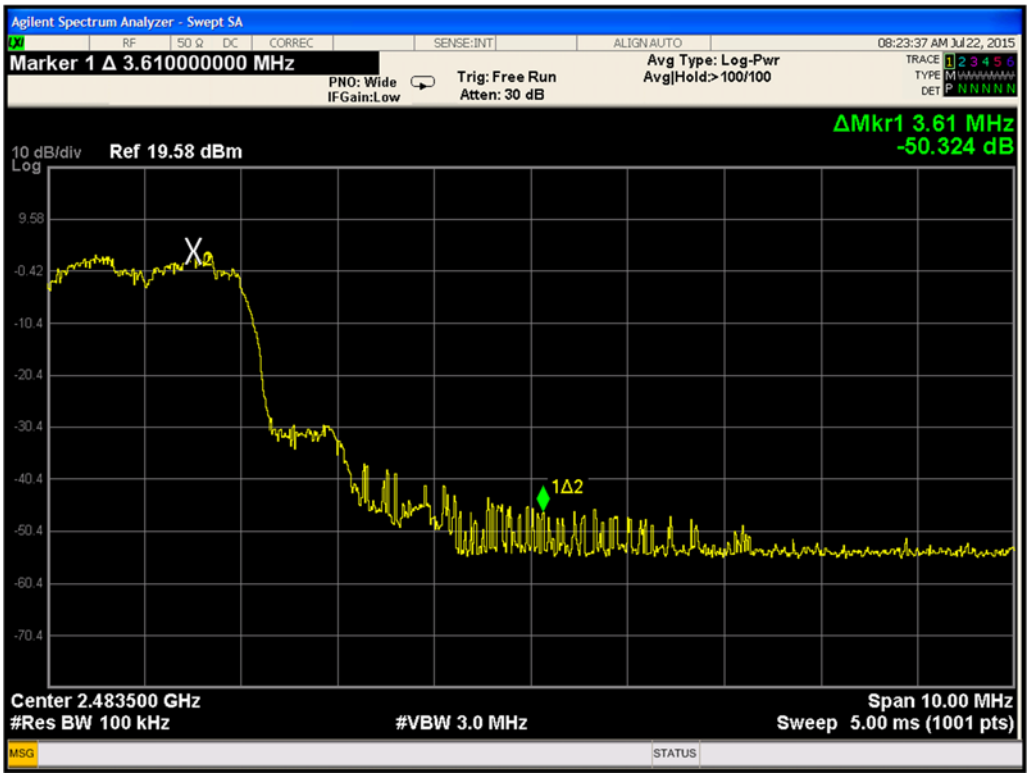

**Plot 9-26. High Channel Band edge: 1-DH5 Mode (Hopping disabled)**




**Plot 9-17 High Channel Band edge: 3-DH5 Mode (Hopping disabled)**




**Plot 9-28. Low Channel Band edge (Hopping enabled)**




**Plot 9-29. High Channel Band edge (Hopping enabled)**

## 9.7 Conducted Spurious Emissions

### 9.7.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

RSS-247 [5.5]

### 9.7.2 Test Method:

Measurements were performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems' and ANSI C63.10.

**Spectrum analyzer settings:**
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz
VBW ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold
The trace was allowed to stabilize. The marker was set on the peak of any spurious emission recorded. The level displayed had to comply with the limit specified.

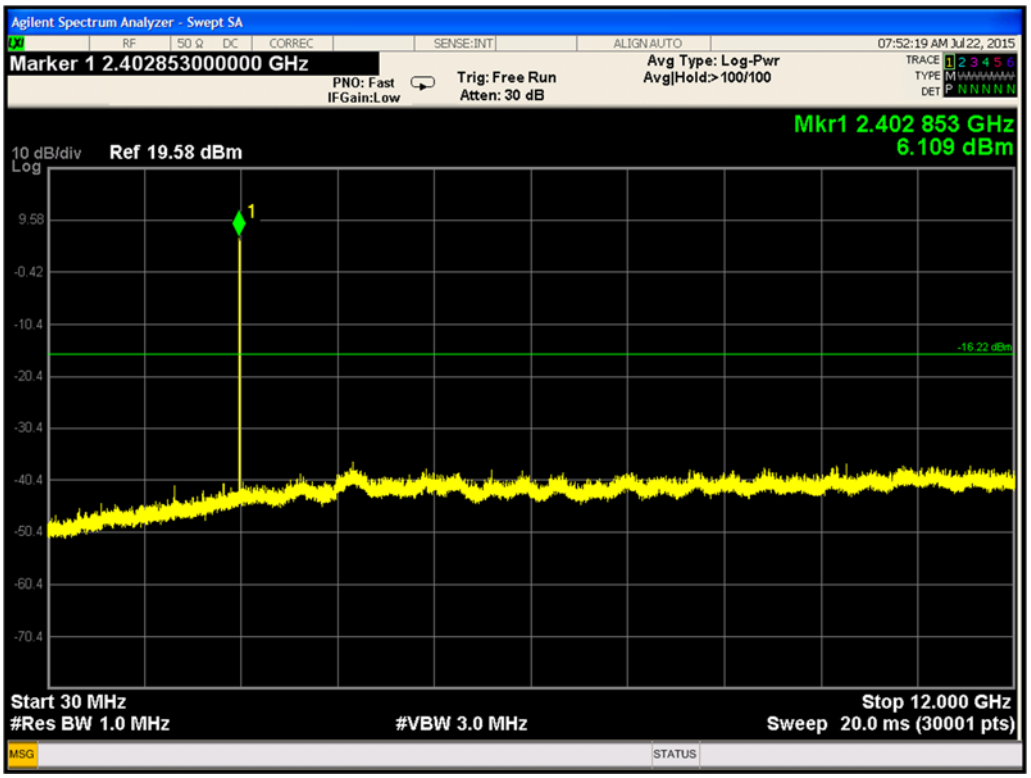
### 9.7.3 Limits:

The maximum spurious emission shall be atleast 20dBc.

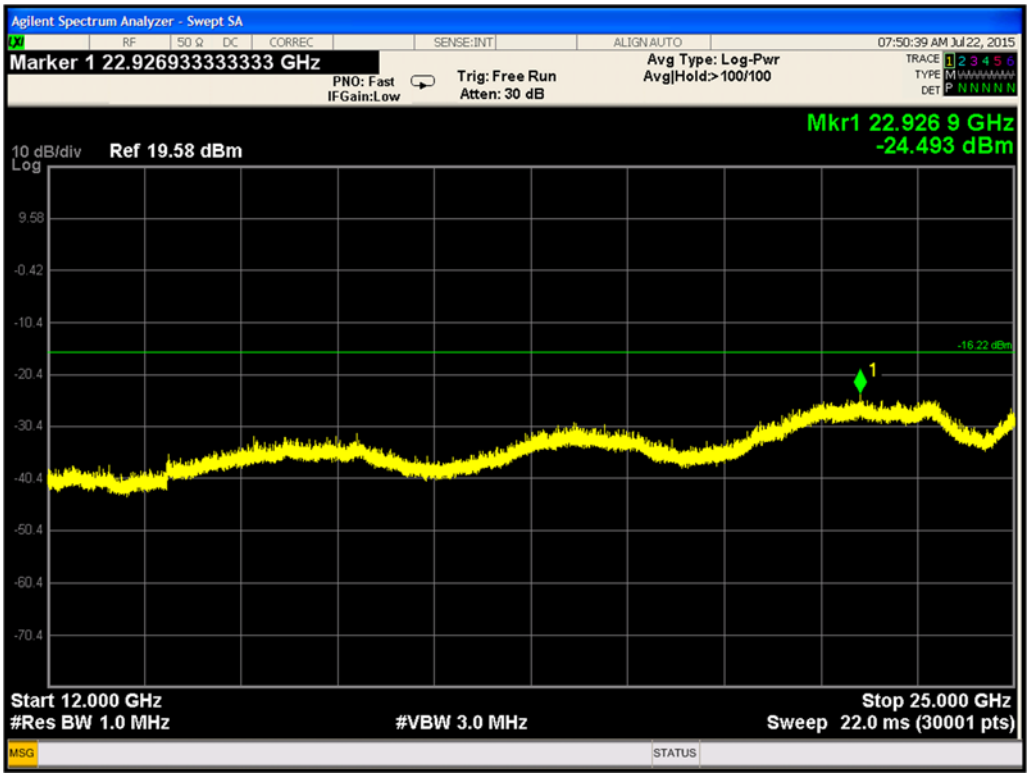
### 9.7.4 Test Results:

Pass

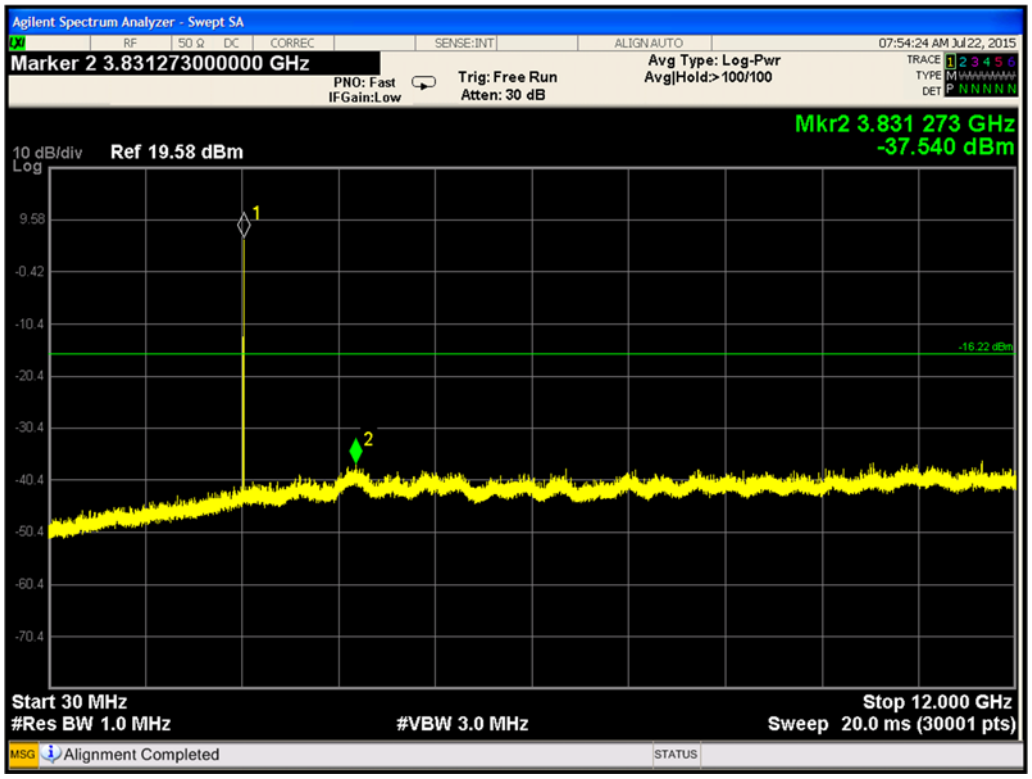
### 9.7.5 Test Data:



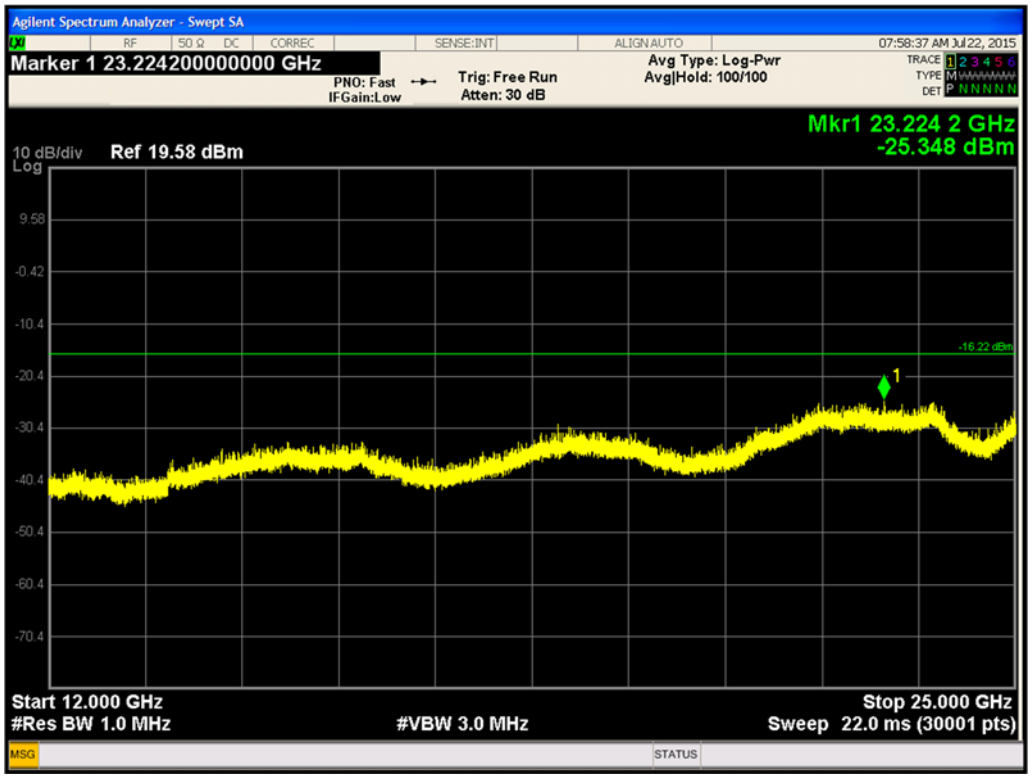

**Plot 9-30. Conducted Spurious Emissions 30-12000 MHz: 1-DH5 Mode (Ch. 0)**



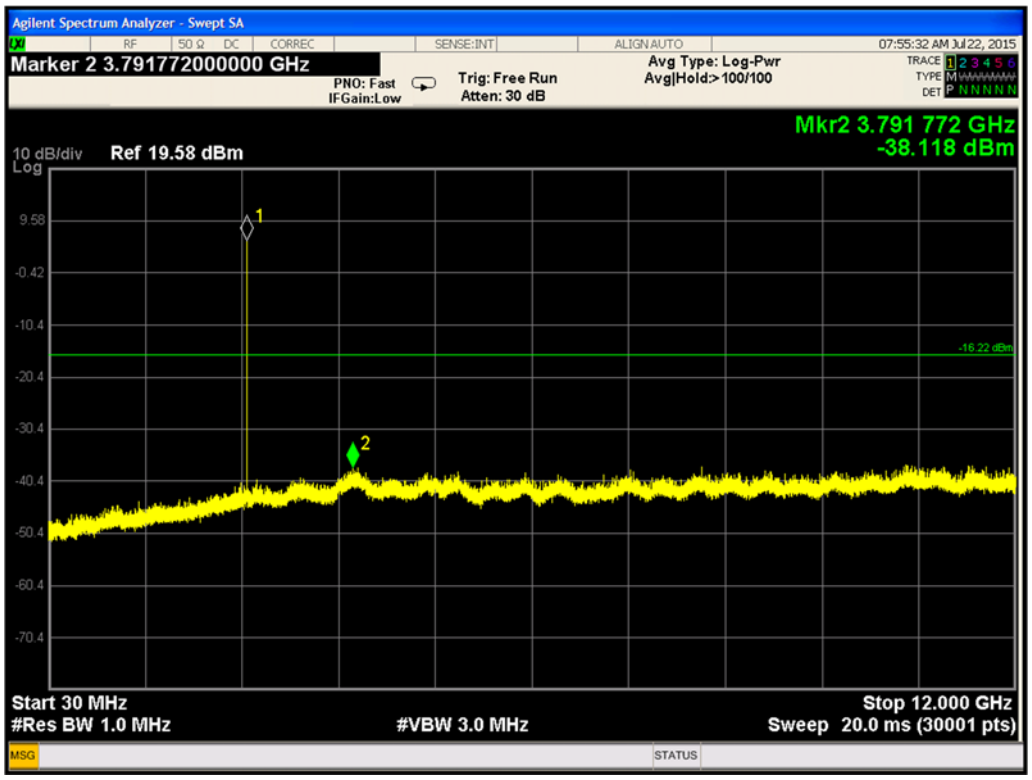

**Plot 9-31. Conducted Spurious Emissions 12-25 GHz: 1-DH5 Mode (Ch. 0)**



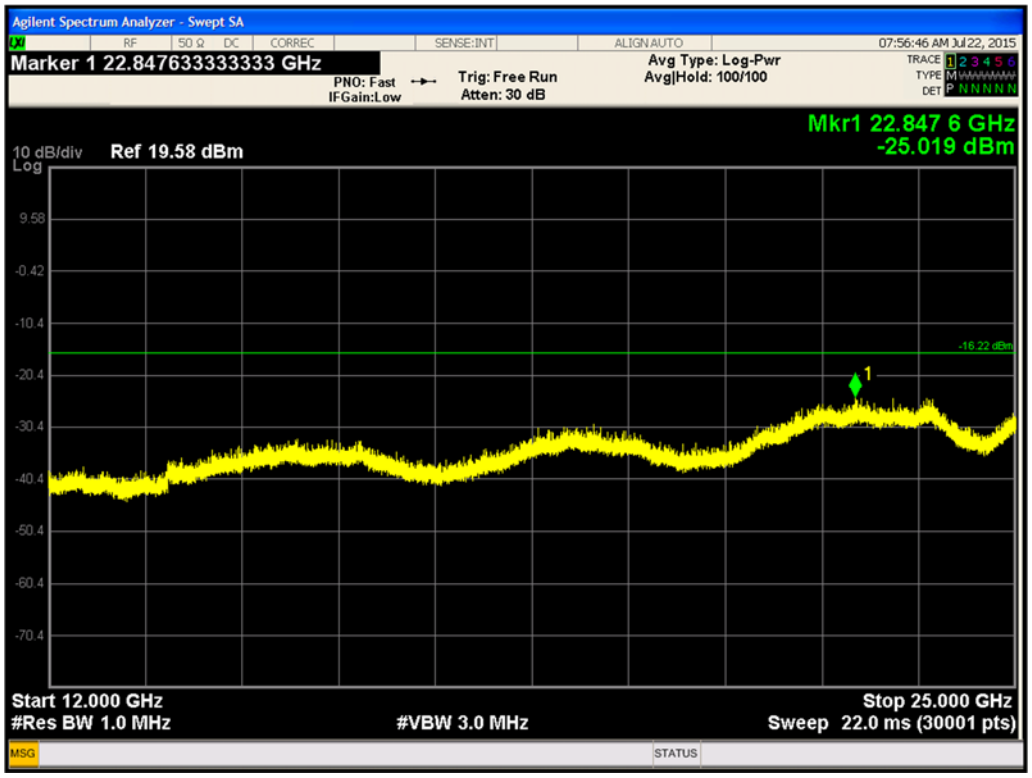

**Plot 9-32. Conducted Spurious Emissions 30-12000 MHz: 1-DH5 Mode (Ch. 39)**



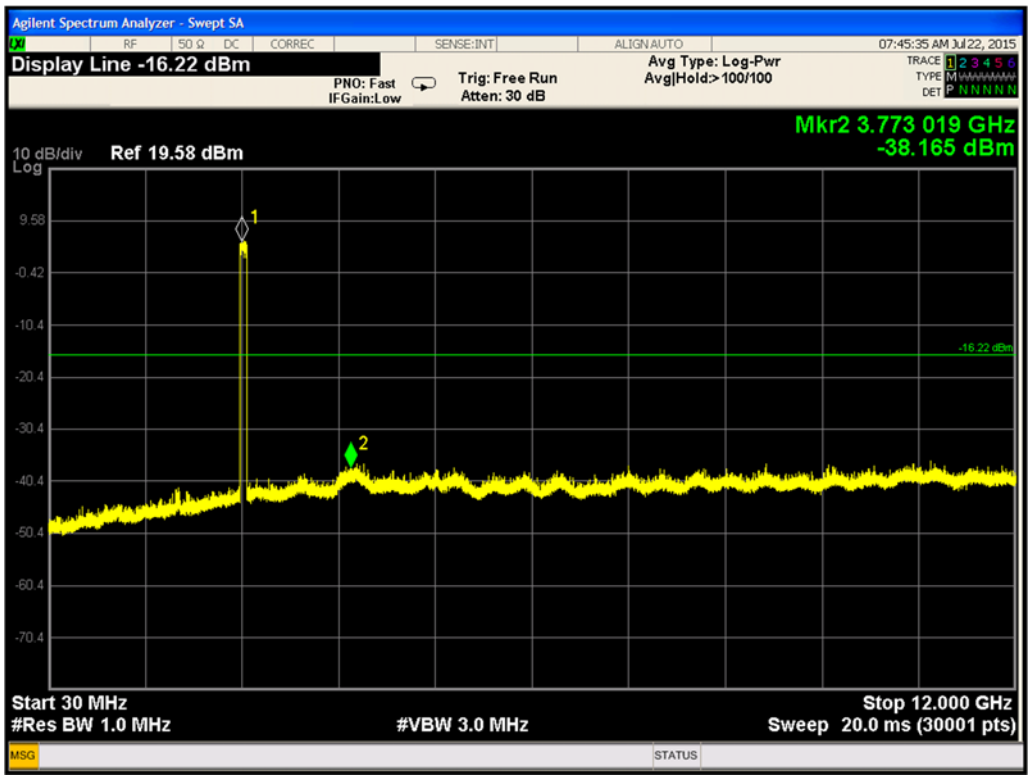

**Plot 9-33. Conducted Spurious Emissions 12-25 GHz: 1-DH5 Mode (Ch. 39)**



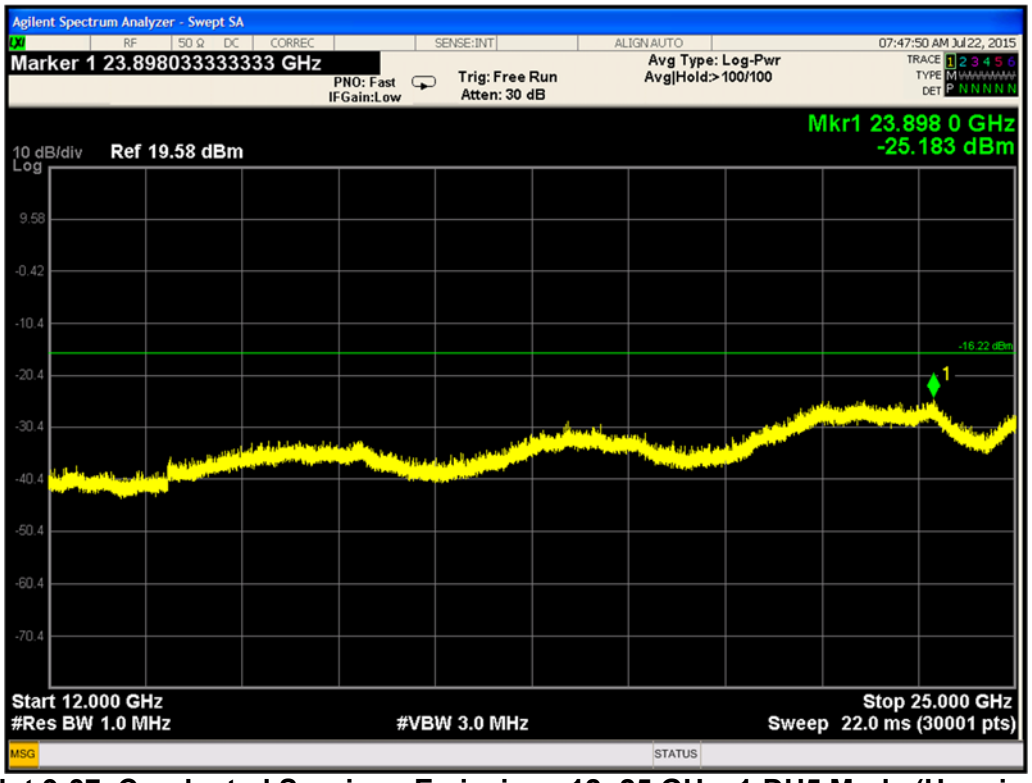

**Plot 9-34. Conducted Spurious Emissions 30-12000 MHz: 1-DH5 Mode (Ch. 78)**




**Plot 9-35. Conducted Spurious Emissions 12-25 GHz: 1-DH5 Mode (Ch. 78)**




**Plot 9-36. Conducted Spurious Emissions 30-12000 MHz: 1-DH5 Mode (Hopping)**




**Plot 9-37. Conducted Spurious Emissions 12- 25 GHz: 1-DH5 Mode (Hopping)**

## 9.8 Radiated Out-of-Band Emissions/Restricted Band Edge Emissions

### 9.8.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

RSS-247 [5.5], RSS-Gen [8.9]

### 9.8.2 Test Method:

Radiated spurious measurements are made from 30MHz to the 10th harmonic of the fundamental frequency of the transmitter. The limit for radiated spurious emissions is per 15.209 and RSS-247 [5.5]. Additionally, emissions found in the restricted bands as listed in 15.205 were tested for compliance per limits in 15.209 and RSS-Gen.

The EUT was tested near the low, middle and high channels of operation in each sub band. Guidelines in ANSI C63.10 2013 were followed with respect to maximizing the emissions. Emissions below 1 GHz were maximized by continuously scanning the unit in three orthogonal orientations. Measurements above 1 GHz were maximized by rotating the EUT about its vertical and horizontal axis. The horizontal axis was varied in 30 degree increments up to 150 degrees in accordance with ANSI C 63.10 2013. Both Horizontal and vertical polarizations were investigated. Worst case maximized data is shown in this test report. The EUT's maximum emissions for measurements below 1GHz were observed to be with the unit placed flat on the table.

A pre-amp and a high pass filter were required for this test, in order to provide the measuring system with sufficient sensitivity. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength.

Since the device operates at its highest power in 1-DH5 mode, all radiated spurious emissions were performed in this mode.

**Radiated Spurious Emissions**

**Spectrum Analyzer Settings:**

***30 MHz- 1 GHz:***

RBW= 120 kHz
VBW ≥ 3 X RBW
Trace Mode: Peak Detector (Max Hold). Final measurements performed using QP Detector.
Span= 30 MHz- 1 GHz
Sweep time= Auto

***Above 1 GHz:***

RBW= 1 MHz
VBW= 3 MHz
Trace Mode: Peak Detector (Max Hold) and RMS Average Detector (Max Hold)
Span= 1- 18 GHz and 18- 26.5 GHz.
Sweep time= Auto

**Restricted Band-Edge Emissions**

**Spectrum Analyzer Settings:**

RBW= 1 MHz
VBW= 3 MHz
Trace Mode: Peak Detector (Max Hold) and RMS Average Detector (Max Hold)
Span= 2310 – 2500 MHz
Sweep Points = 801
Sweep Time = Peak: Auto; Average: 100 s

**Sample Calculation:**

Field Strength Level: Amplitude (Analyzer level) + AFCL (Antenna Factor and Cable losses) – Amplifier Gain = 50 dBuV + 33 dB – 25 dB = 78dBuV/m

### 9.8.3 Limits:

| Frequency (MHz) | Field Strength (µV/m) | Measurement Distance (meters) | Corrected Field Strength for 3m measurement distance (dBµV/m) |
|---|---|---|---|
| 0.009-0.490 | 2400/F (kHz) | 300 | 48.5- 13.8 |
| 0.490-1.705 | 24000/F (kHz) | 30 | 33.8- 23.0 |
| 1.705-30 | 30 | 30 | 29.5 |
| 30-88 | 100 | 3 | 40 |
| 88-216 | 150 | 3 | 43.5 |
| 216-960 | 200 | 3 | 46 |
| 960-1000 | 500 | 3 | 54 |
| Above 1000 | 500 | 3 | 54 (Average)<br>74 (Peak) |

### 9.8.4 Test Result:

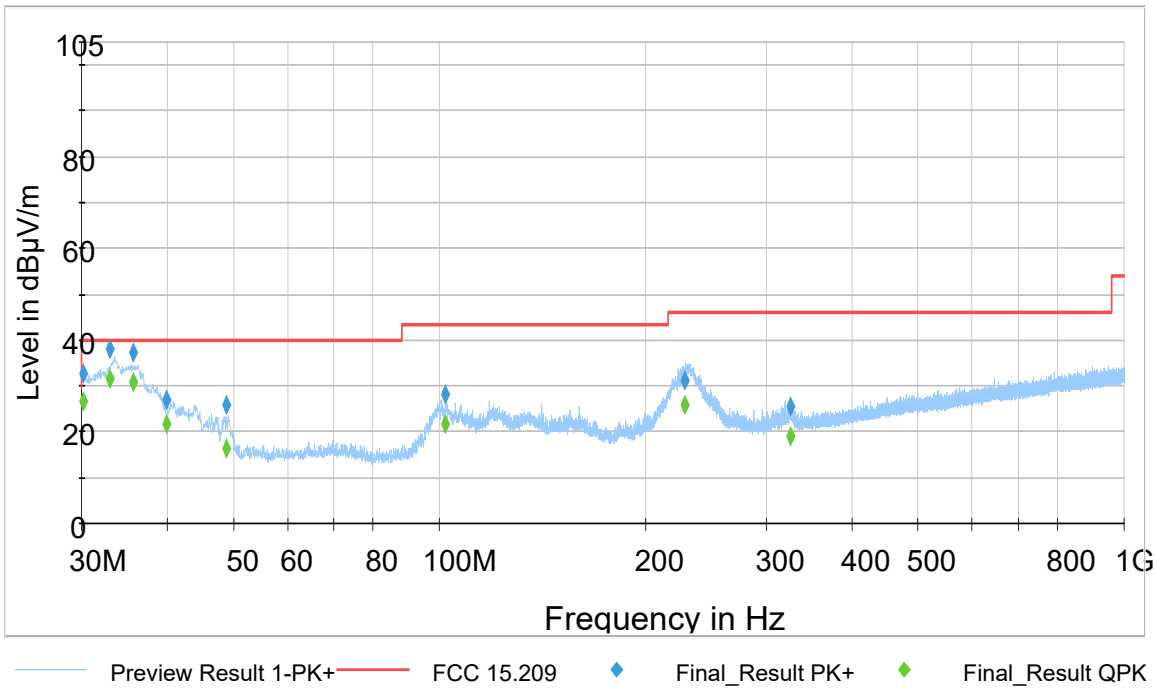
Pass.

### 9.8.5 Test Data:

#### *9.8.5.1 Emissions in 30 MHz- 1 GHz range*

Worst case emissions in mid channel of operation shown here.

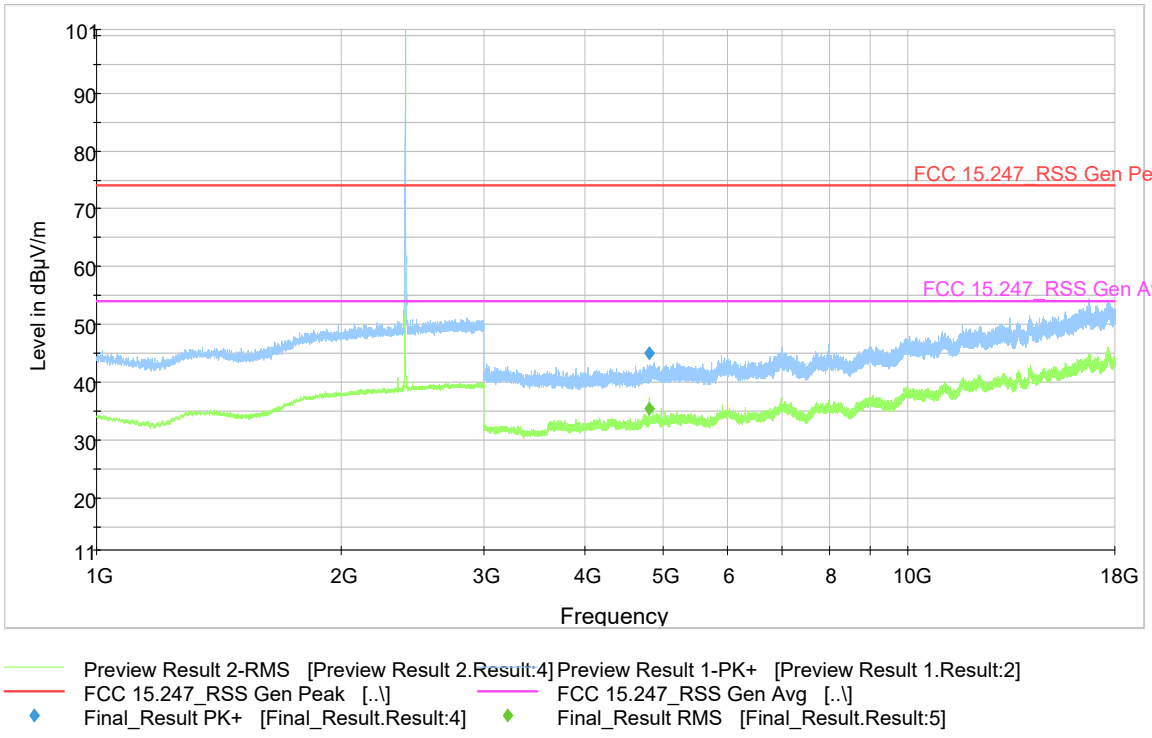
| Frequency (MHz) | Raw Quasi-Peak Field Strength (dBµV/m) | Correction Factor (dB) | Corrected Quasi-Peak Field Strength (dBµV/m) | QP Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 30.20 | 5.64 | 21.1 | 26.74 | 40 | -13.26 |
| 33.02 | 12.46 | 19.3 | 31.76 | 40 | -8.24 |
| 35.71 | 13.34 | 17.6 | 30.94 | 40 | -9.06 |
| 39.96 | 6.73 | 14.9 | 21.63 | 40 | -18.37 |
| 48.80 | 6.44 | 9.8 | 16.24 | 40 | -23.76 |
| 101.86 | 9.92 | 11.6 | 21.52 | 43.52 | -22 |
| 228.37 | 13.63 | 12.3 | 25.93 | 46.02 | -20.09 |
| 325.20 | 3.39 | 15.5 | 18.89 | 46.02 | -27.13 |



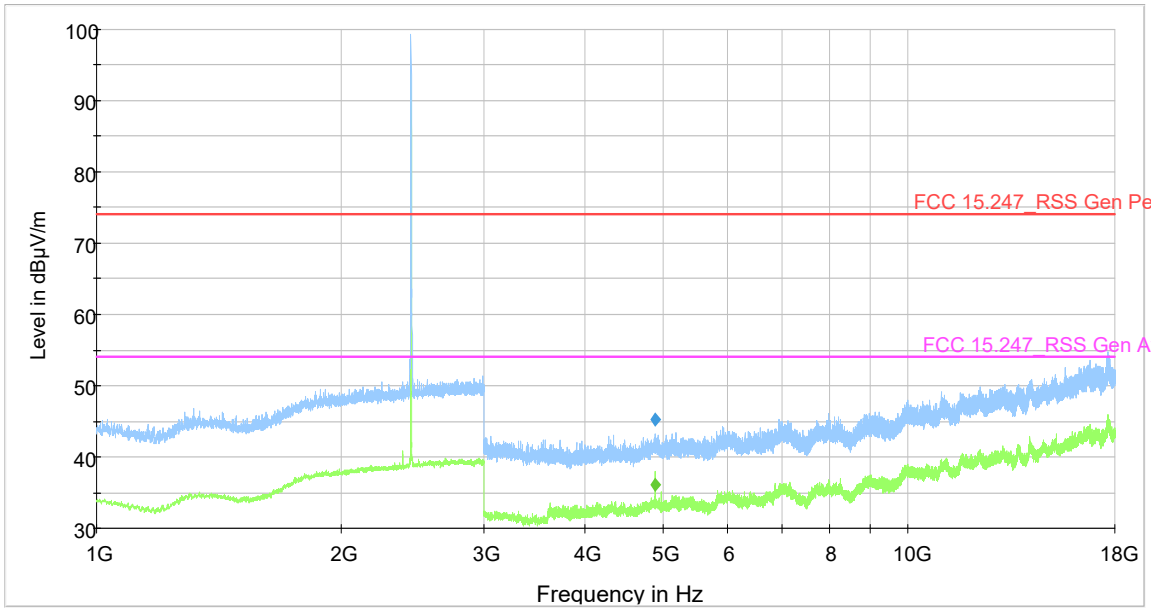

**Plot 9-38. Radiated Spurious Emissions (Ch. 39) (30MHz - 1GHz)**

### 9.8.5.2 Emissions in 1-18 GHz range

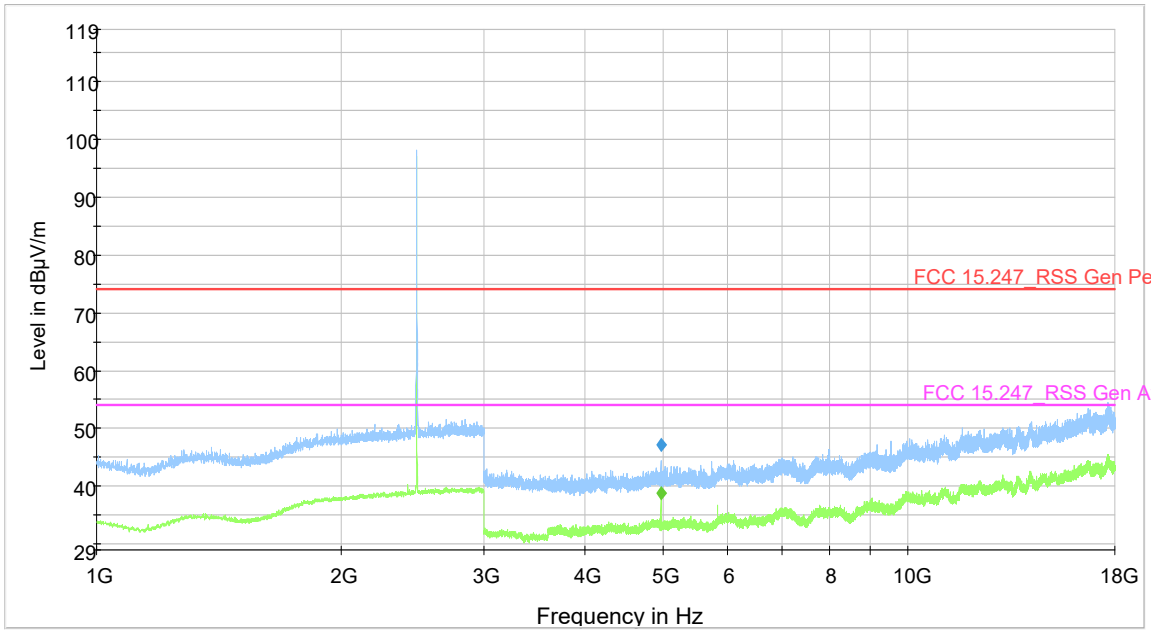
| RSE - 18GHz Average Data | | | | | | |
|---|---|---|---|---|---|---|
| **Carrier Frequency (MHz)** | **Frequency (MHz)** | **Raw Avg. Amplitude (dBµV)** | **Correction Factor (dB)** | **Corrected Avg. Field Strength (dBµV/m)** | **Average Limit (dBµV/m)** | **Margin (dB)** |
| 2402 | 4804.1 | 27.27 | 8.1 | 35.37 | 54 | -18.63 |
| 2441 | 4882.2 | 28.19 | 7.9 | 36.09 | 54 | -17.91 |
| 2480 | 4959.8 | 30.88 | 8.0 | 38.88 | 54 | -15.12 |
| **RSE - 18GHz Peak Data** | | | | | | |
| **Carrier Frequency (MHz)** | **Frequency (MHz)** | **Raw Peak Amplitude (dBµV)** | **Correction Factor (dB)** | **Corrected Peak Field Strength (dBµV/m)** | **Peak Limit (dBµV/m)** | **Margin (dB)** |
| 2402 | 4804.6 | 36.95 | 8.1 | 45.05 | 74 | -28.95 |
| 2441 | 4881.8 | 37.31 | 7.9 | 45.21 | 74 | -28.79 |
| 2480 | 4959.7 | 39.18 | 8.0 | 47.18 | 74 | -26.82 |




**Plot 9-39. Radiated Spurious Emissions (Ch. 0) (1-18 GHz)**



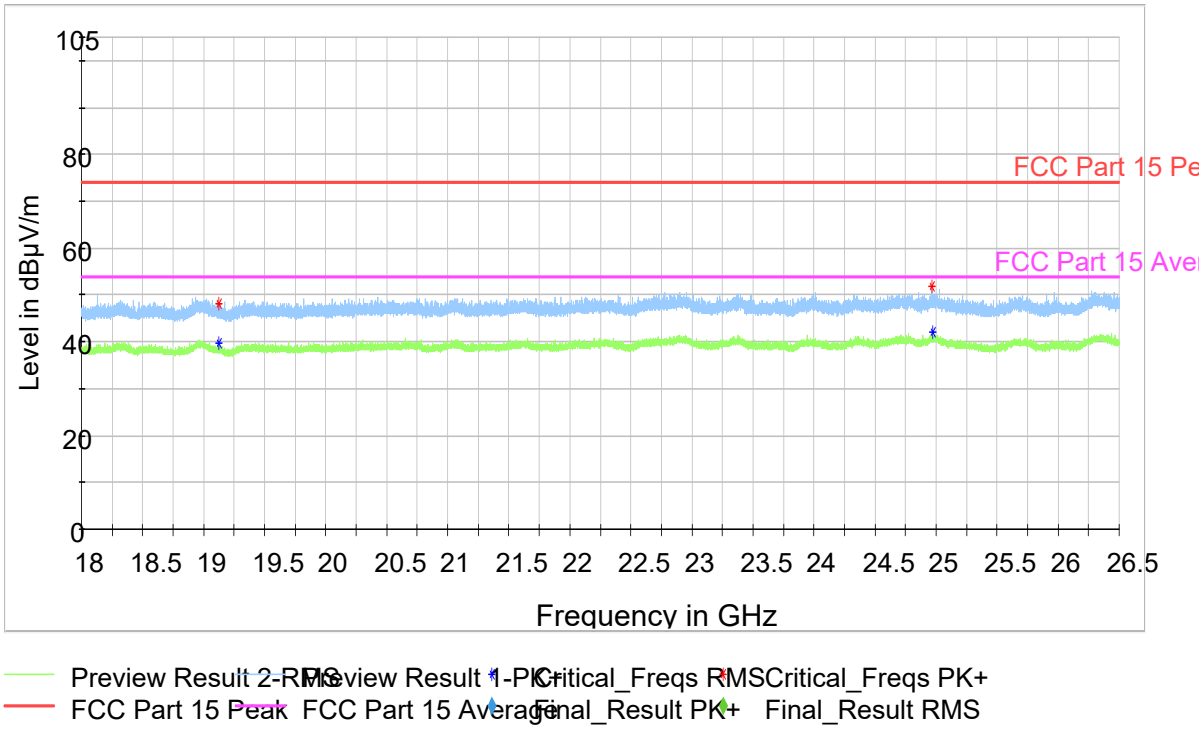

**Plot 9-40. Radiated Spurious Emissions (Ch. 39) (1-18 GHz)**




**Plot 9-41. Radiated Spurious Emissions (Ch. 78) (1-18 GHz)**

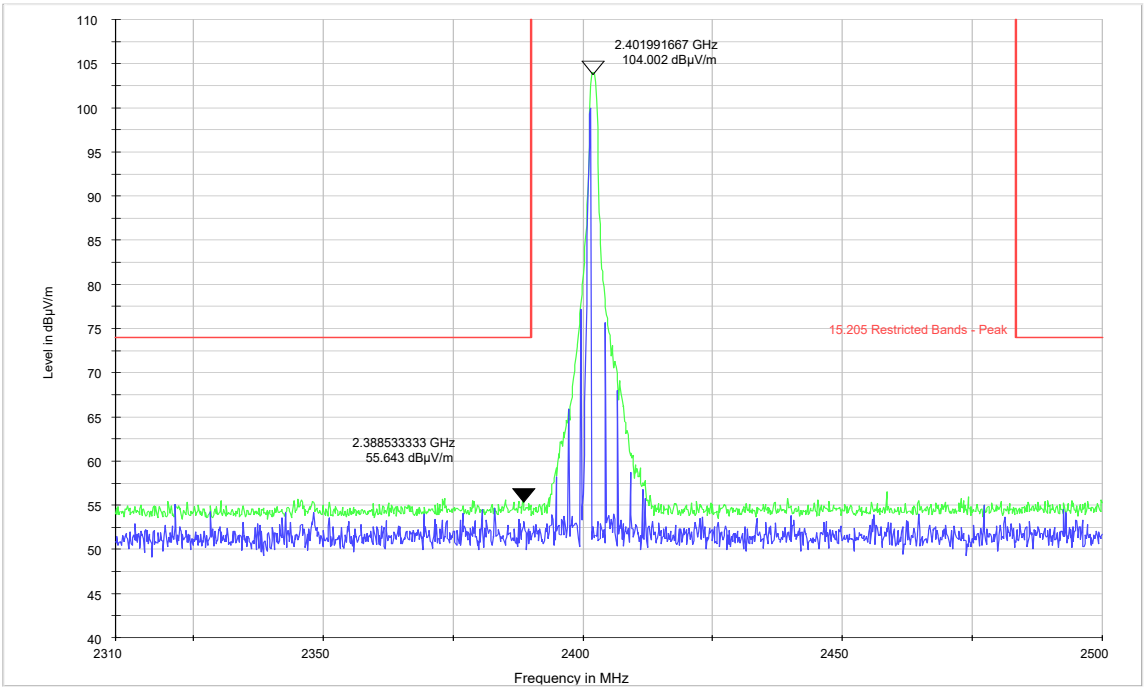
### 9.8.5.3 Emissions in 18-26.5 GHz range

No significant emissions to report above noise floor.

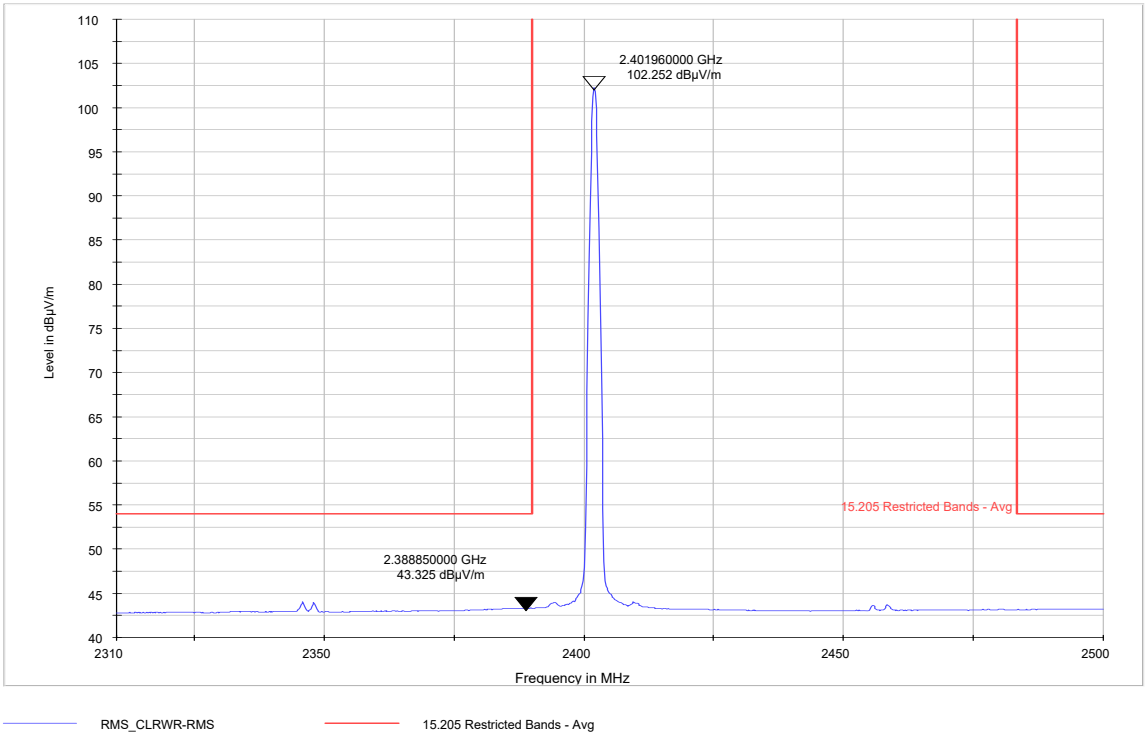



**Plot 9-42. Radiated Spurious Emissions (Ch. 0) (18 - 26GHz)**

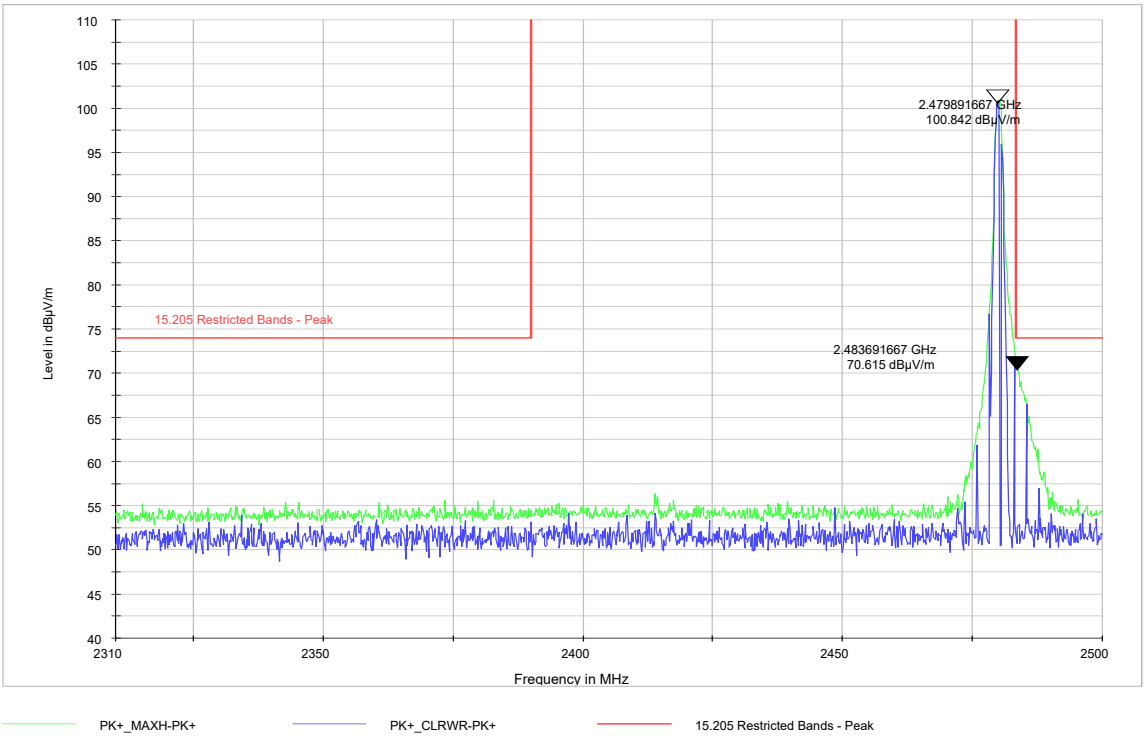
### 9.8.5.4 Radiated restricted Band-edge emissions



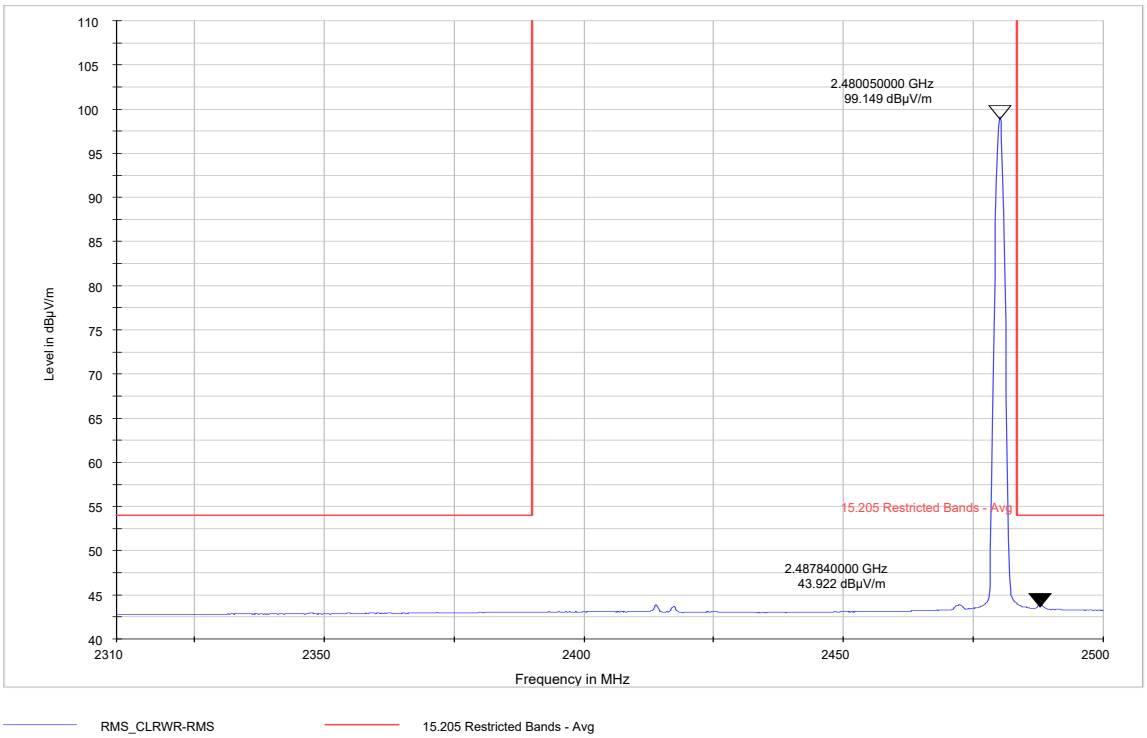

**Plot 9-43. Restricted Band Edge 1-DH5 Mode– Ch. 0 (2310-2390MHz) – Peak**



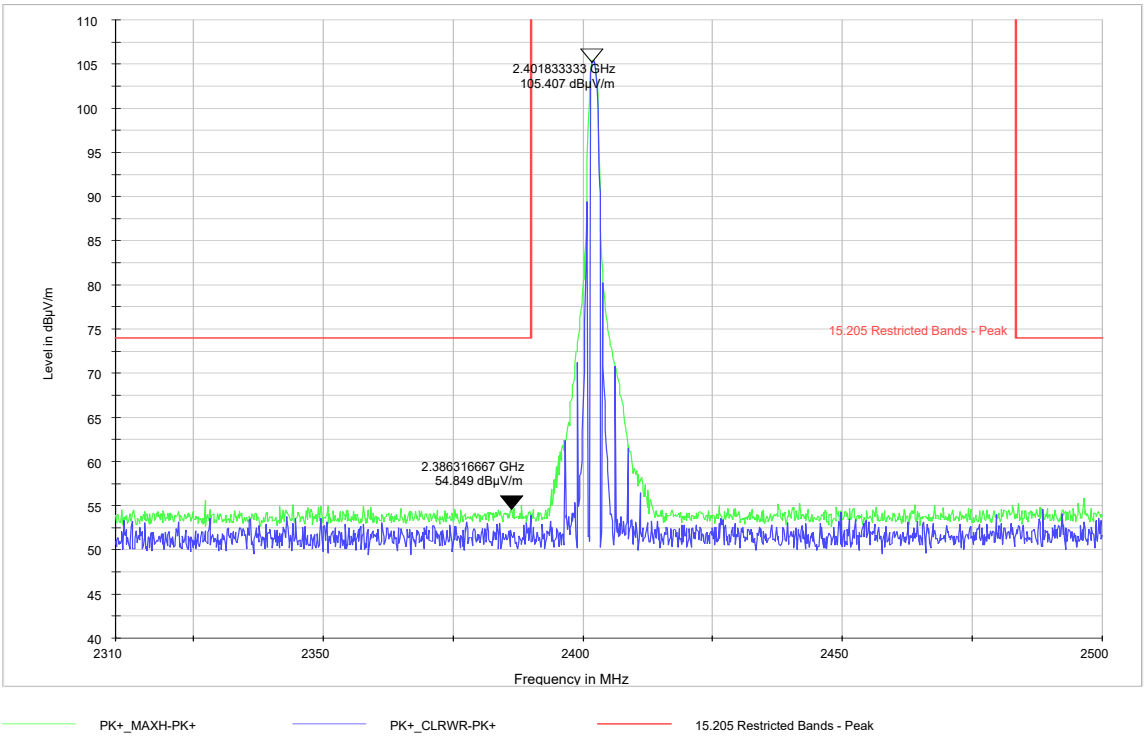

**Plot 9-44. Restricted Band Edge 1-DH5 Mode– Ch. 0 (2310-2390MHz) – Average**



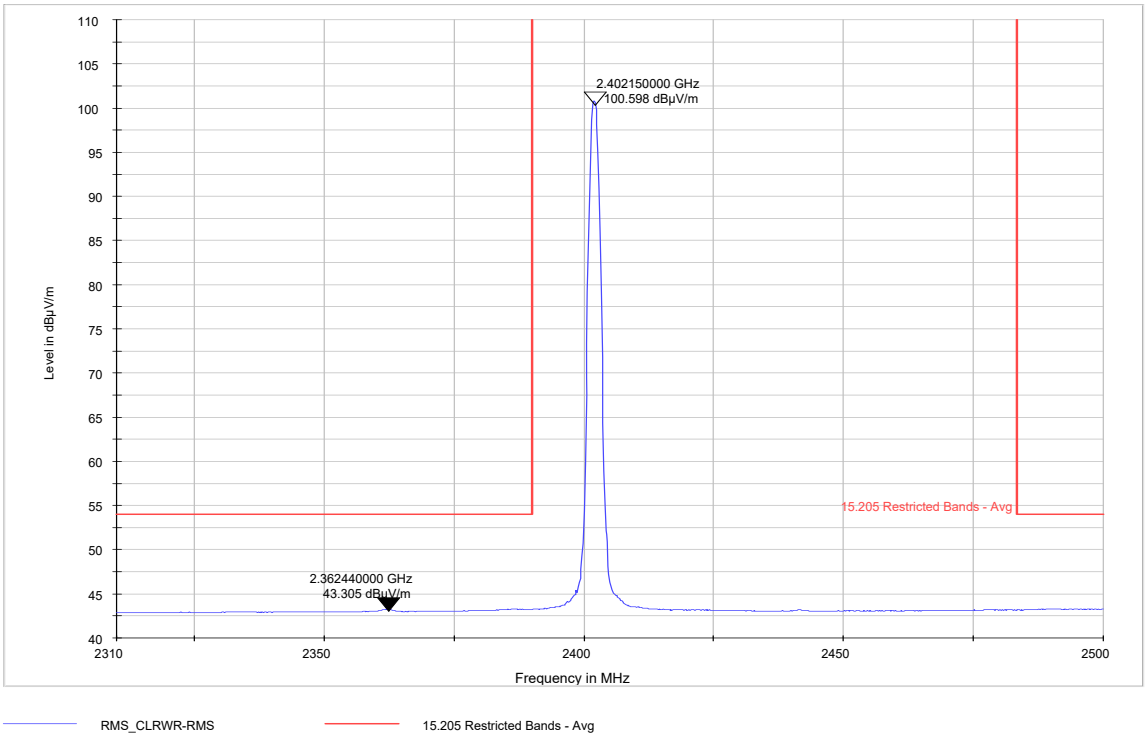

**Plot 9-45. Restricted Band Edge 1-DH5 Mode– Ch. 78 (2483.5-2500MHz) – Peak**




**Plot 9-46. Restricted Band Edge 1-DH5 Mode– Ch. 78 (2483.5-2500MHz) – Average**

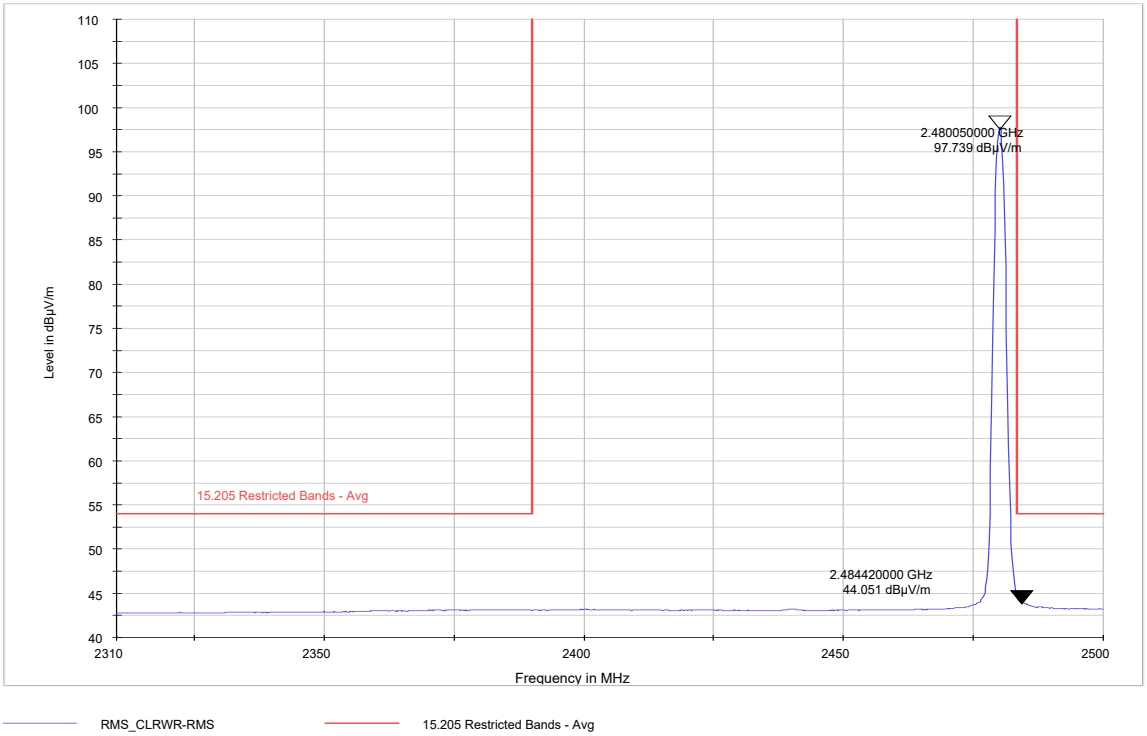



**Plot 9-47. Restricted Band Edge 2-DH5 Mode– Ch. 0 (2310-2390MHz) – Peak**

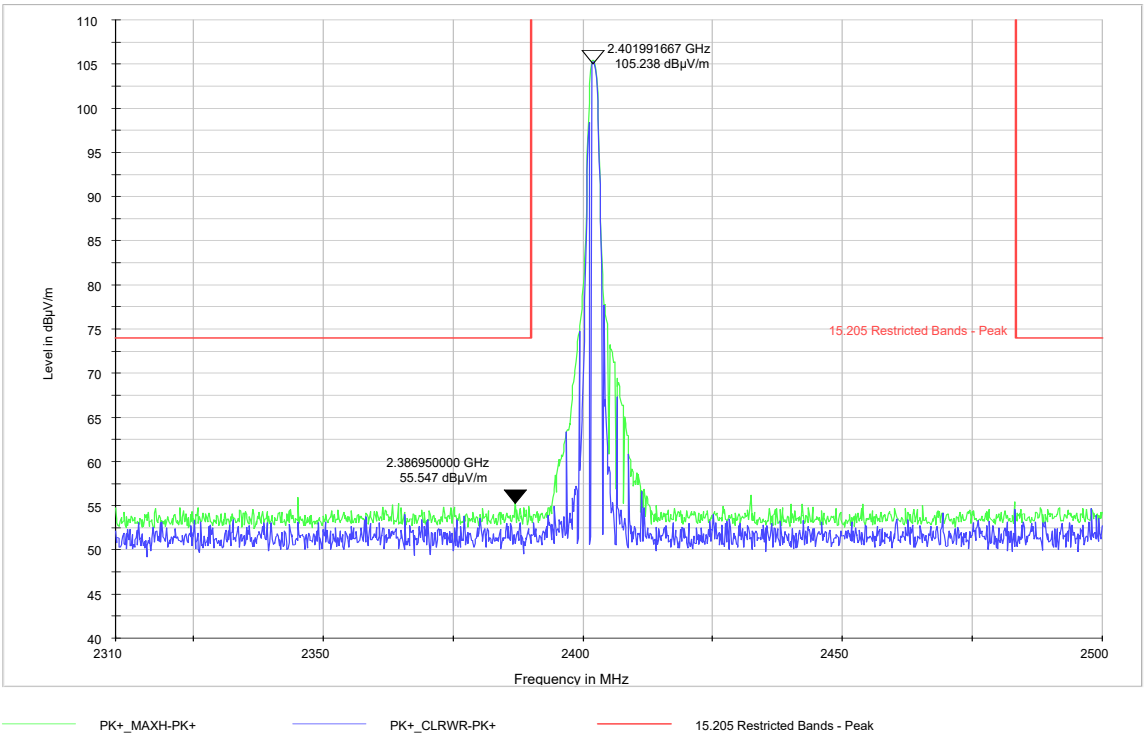



**Plot 9-48. Restricted Band Edge 2-DH5 Mode– Ch. 0 (2310-2390MHz) - Average**

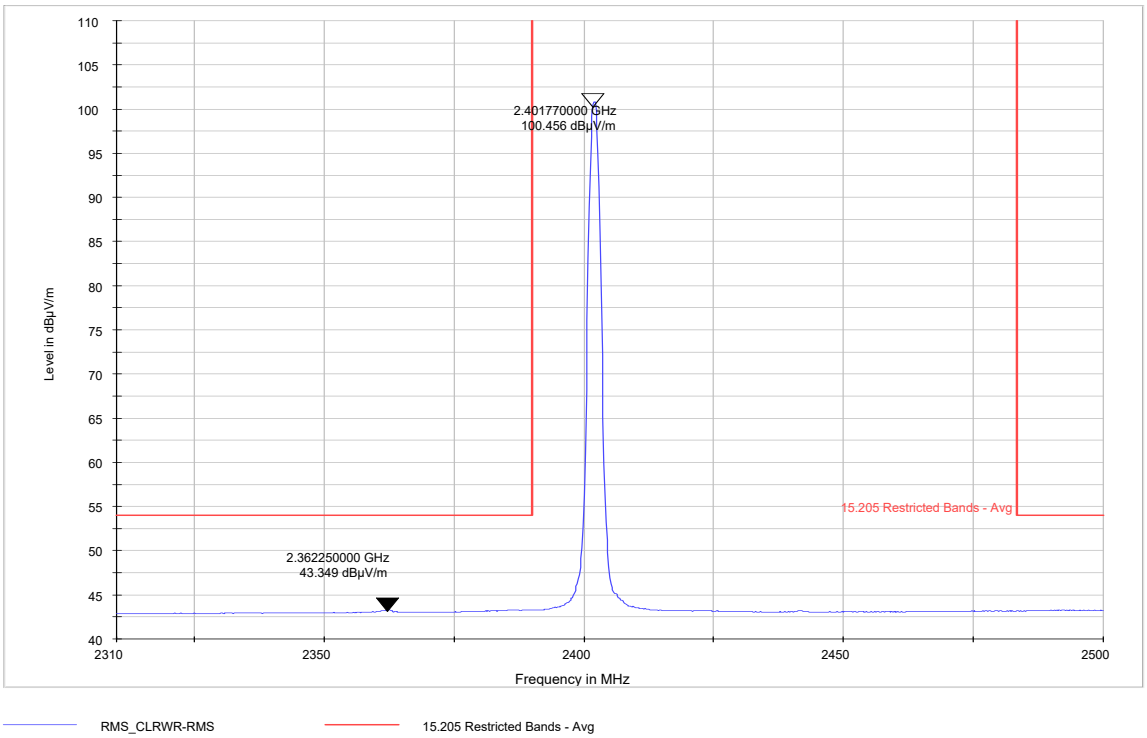

**Plot 9-49. Restricted Band Edge 2-DH5 Mode– Ch. 78 (2483.5-2500MHz) – Peak**



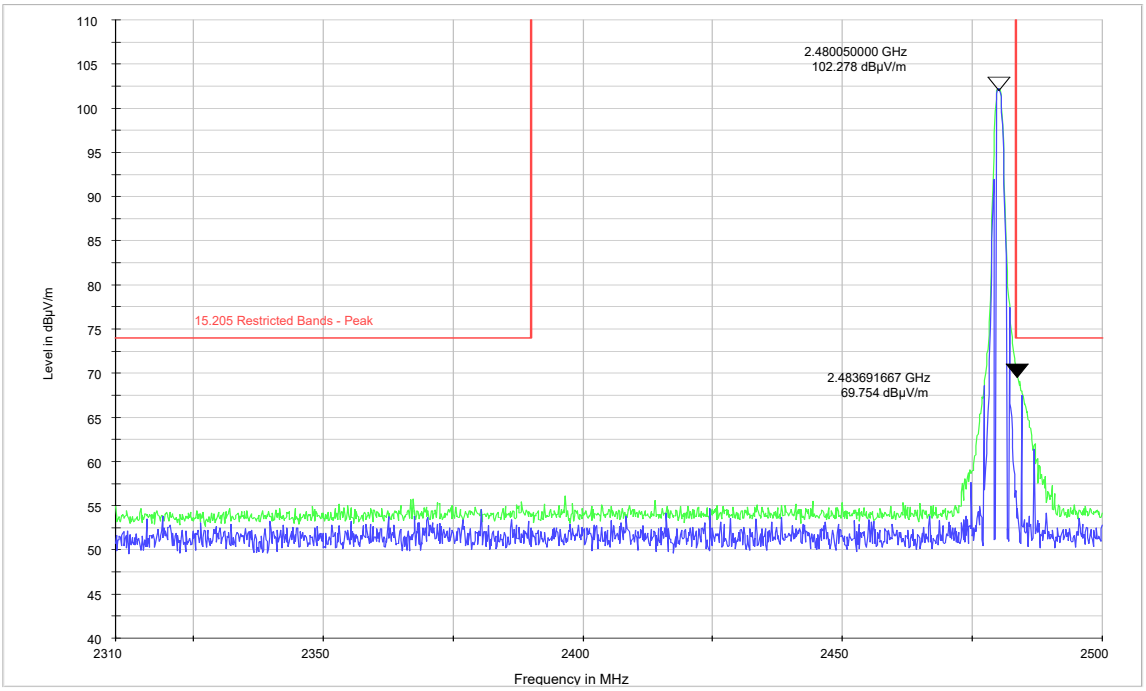

**Plot 9-50. Restricted Band Edge 2-DH5 Mode– Ch. 78 (2483.5-2500MHz) – Average**



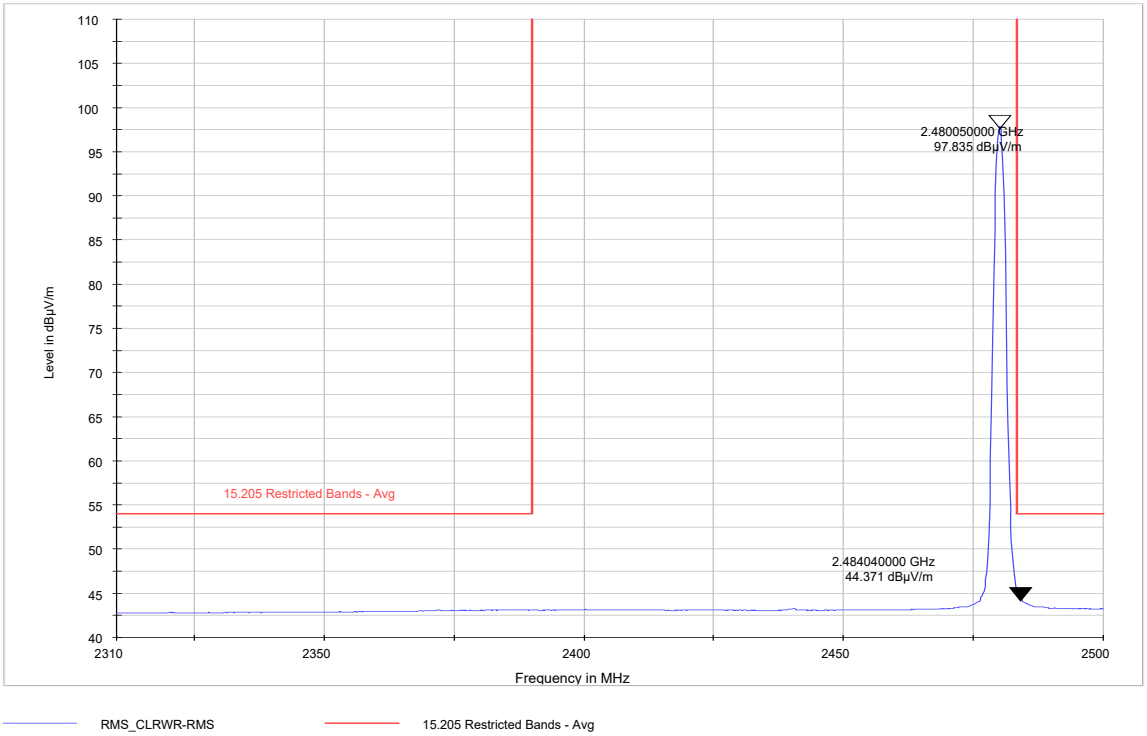

**Plot 9-51. Restricted Band Edge 3-DH5 Mode– Ch. 0 (2310-2390MHz) – Peak**




**Plot 9-52. Restricted Band Edge 3-DH5 Mode– Ch. 0 (2310-2390MHz) - Average**




**Plot 9-53. Restricted Band Edge 3-DH5 Mode– Ch. 78 (2483.5-2500MHz) – Peak**




**Plot 9-54. Restricted Band Edge 3-DH5 Mode– Ch. 78 (2483.5-2500MHz) - Average**

## 9.9 AC Line Conducted Emissions

### 9.9.1 Test Requirements

FCC CFR 47 Rule Part 15.207 (a)

Industry Canada RSS Gen [8.8]

### 9.9.2 Test Method

Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with the power cords that are used under normal operating conditions. These measurements are made using a LISN (Line Impedance Stabilization Network). AC powered peripherals are attached to a second LISN with the 50 ohm measuring port terminated by a 50 ohm resistive load.

**EMI Receiver Settings:**
***150 kHz – 30 MHz:***
RBW= 9 kHz
VBW ≥ 3 X RBW
Trace Mode: Peak Detector (Max Hold).
Final measurements performed using Quasi-Peak and Average Detectors.
Span= 150 kHz – 30 MHz
Sweep time= Auto

### 9.9.3 Limit

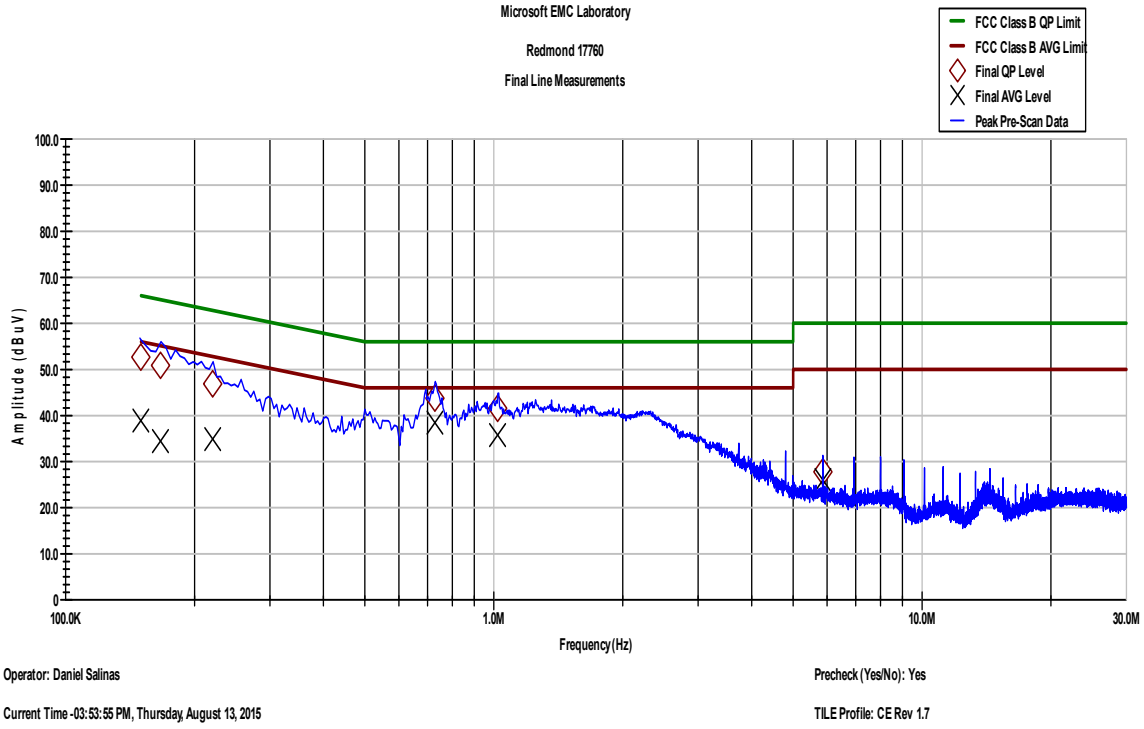
| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

### 9.9.4 Test Result:

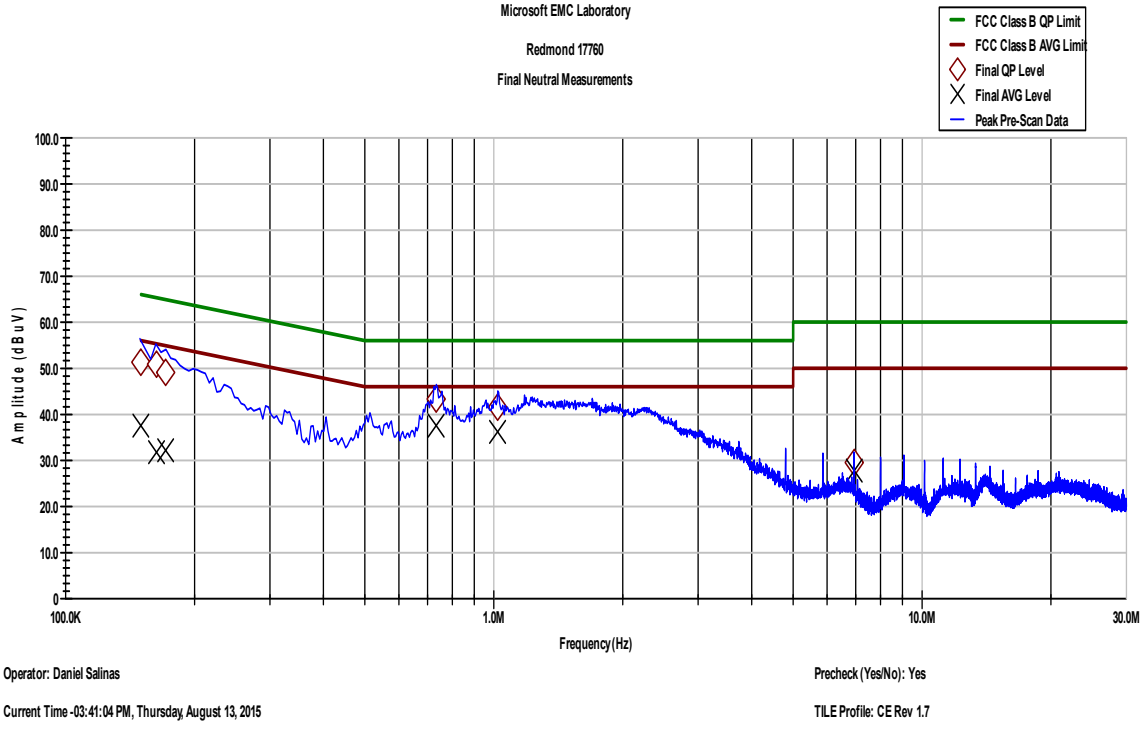
Pass

### 9.9.5 Test Data:

| Frequency (MHz) | QP Net Reading (dBµV) | AVG Net Reading (dBµV) | Quasi-Peak Limit (dBµV) | Average Limit (dBµV) | Line Tested (L or N) | Quasi-Peak Margin (dB) | Average Margin (dB) |
|---|---|---|---|---|---|---|---|
| 0.15 | 52.83 | 38.96 | 66 | 56 | L | -13.17 | -17.04 |
| 0.17 | 51 | 34.41 | 65.51 | 55.51 | L | -14.51 | -21.1 |
| 0.22 | 47.07 | 34.72 | 63.97 | 53.97 | L | -16.9 | -19.25 |
| 0.73 | 43.95 | 38.34 | 56 | 46 | L | -12.05 | -7.66 |
| 1.02 | 41.43 | 35.76 | 56 | 46 | L | -14.57 | -10.24 |
| 5.87 | 27.79 | 25.79 | 60 | 50 | L | -32.21 | -24.21 |
| 0.15 | 51.33 | 37.69 | 66 | 56 | N | -14.67 | -18.31 |
| 0.16 | 51.03 | 31.8 | 65.64 | 55.64 | N | -14.61 | -23.84 |
| 0.17 | 49.03 | 32.18 | 65.39 | 55.39 | N | -16.35 | -23.2 |
| 0.73 | 43.5 | 37.59 | 56 | 46 | N | -12.5 | -8.41 |
| 1.02 | 41.54 | 35.99 | 56 | 46 | N | -14.46 | -10.01 |
| 6.93 | 29.7 | 27.6 | 60 | 50 | N | -30.3 | -22.4 |




**Plot 9-55. AC Line Conducted Emissions- Line (150 kHz- 30 MHz)**




**Plot 9-56. AC Line Conducted Emissions- Neutral (150 kHz- 30 MHz)**

Microsoft

# End of Report