RADIO TEST REPORT

For

MODEL NO. 1619
FCC ID: C3K1619

Test Report No. R-TR53-FCCBT-1
Issue Date: 09/23/2014

FCC CFR47 Part 15 Subpart C

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	09/23/2014	All	All	First Version	Jennifer Liu

Microsoft

Table of Contents

Test Report Attestation

Microsoft Corporation
Model: 1619
FCC ID: C3K1619

Applicable Standards

Specification	Test Result
FCC CFR47 Rule Parts 15.209, 15.247	Complies

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. All indications of Pass/Fail in this report are opinions expressed by the Microsoft EMC Laboratory based on interpretations and/or observations of test result on the tested sample only.

This report shall not be used to claim product certification, approval, or endorsement by A2LA or any agency of any Government.
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Written By: Jennifer Liu
Radio Compliance 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

3.3 Test Equipment

The site and related equipment are constructed in conformance with the requirements of ANSI C63.4, CISPR 16-1-1 and other equivalent applicable standards.
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.
Expanded uncertainty calculations are available upon request.

Test item	Value (dB)
Conducted disturbance at mains port	3.30
Radiated disturbance (<1 GHz)	6.10
Radiated disturbance (>1 GHz)	4.80

5 Product Description

Company Name:	Microsoft Corporation
Address:	One Microsoft Way
City, State, Zip:	Redmond, WA 98052-6399
Customer Contact:	Brad Sybouts
Functional Description of the EUT:	Mobile Wireless Device
Model:	1619
FCC ID:	C3K1619
Radio Description:	BT LE (2402- 2480 MHz)
Modulation:	GFSK, π/4DQPSK, 8DPSK
EUT Classification:	FHSS
FCC Rule Part:	Part 15.247
Test Procedure:	DA 00-705
Equipment Design State:	EV5
Equipment Condition:	Good
Test Sample Serial Numbers:	1407095240006931149 (Large Size -Conducted); X894650000677143249 (Small Size- Radiated); 1407075140011221149 (Medium Size- Radiated); 1407095240009131149 (Large Size- Radiated)

5.1 Test Configurations

Test Software Details:

BT Compliance Tool, Version 1.0.17 for controlling and operating BT/BTLE radio functionality

The EUT comes in Small, Medium and Large sizes. Radiated testing was performed on all three sizes. The radio circuitry is the same on all three configurations and hence conducted testing was only performed on the Large size sample and deemed representative for all sizes.

Modes of Operation and Channel Details:
BT (FHSS): Channels 0-78 (2402 – 2480MHz)
Powered on a continuous Rx and Tx mode as required.

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 are permanently attached and there are no provisions for connection to an external antenna.

Antenna Gains at 2.4 GHz:

Small size EUT= -3.9dBi,
Medium size EUT= -3.5dBi, and
Large size EUT= -4.6dBi

5.4 Equipment Modifications

No modifications were made during testing.

6 Test Results Summary

Test Description	FCC Rule Part	Limit	Test Result (Pass/Fail)
20dB Bandwidth	15.247 (a)(1)(iii)	< 1MHz if less than 15 channels.	Pass
Output Power	15.247 (b)(1)	< 1 Watt if ≥ 75 non-overlapping channels used	Pass
Channel Spacing	15.247 (a)(1)	2/3 of 20dB BW for systems with output power <125mW	Pass
Number of Hopping Frequencies	15.247 (a)(1)(iii)	> 15 channels	Pass
Dwell Time	15.247 (a)(1)(iii)	< 0.4 sec in 31.6 sec period	Pass
Band Edge	15.247 (d)	< 20dBc	Pass
Radiated Spurious Emissions/ Restricted Band Emissions	15.205, 15.209	15.209 limits	Pass
AC Powerline Conducted Emissions	15.207	15.207 limits	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.

Manufacturer	Description	Model #	Asset #	Calibration Due
Agilent	Spectrum Analyzer	N9030A	RF-011	6/6/2015
ETS-Lindgren	Antenna	DRH-118	RF-137	7/10/2015
ETS-Lindgren	Antenna	3160-09	RF-037	N/A*
ETS-Lindgren	Antenna	6512	RF-202	12/13/2014
Micro-Tronix	Notch Filter	BRM50702-02	RF-055	N/A*
Rohde & Schwarz	Pre-Amp	TS-PR18	RF-041	N/A*
Rohde & Schwarz	Pre-Amp	TS-PR26	RF-042	N/A*
Rohde & Schwarz	EMI Test Receiver	ESU40	RF-012	5/2/2015
Rohde & Schwarz	Switch Control Unit	OSP130	RF-018	N/A*
Rohde & Schwarz	Switch Control Unit	OSP150	RF-019	N/A*
Rosenburger	RF Cable	L72-449-915	EMC-326	N/A*
Rohde & Schwarz	Software	EMC-32 V9.0.10	N/A	N/A

*Note: List of equipment that fall under the category of cables, pre-amplifiers or switching panels with Calibration due date of “n/a” have regular in house verification. The calibrations of the measuring instruments, including any accessories that may affect such calibration, are checked frequently to ensure their accuracy.

8 Test Site Description

8.1 Radiated Emissions Test Site

Radiated measurements are performed in a 3m semi-anechoic chamber manufactured by TDK which fully meets NSA requirements for the frequency range of 30MHz to 1000MHz and SVSWR for 1-18GHz.

A Sunol antenna mast and turntable are used for changing Antenna height and azimuth. For all measurements, the Antenna height is varied from 1 meter to 4 meters and the turn table rotated 360 degrees to determine the highest emissions. A non-conducting 1m x 1.5m x 80cm table is installed on the turntable to support the EUT.

The EUT and its support equipment were exercised and cabling manipulated to maximize each emission.

For radiated emissions above 1GHz, linearly polarized horn antennas are used. RF absorbers cover the ground plane such that the site validation criterion called out in CISPR 16-1-4 is met. For radiated measurements below 1GHz, Linearly polarized broadband antennas are used. The RF absorbers are removed to reveal the ground plane.

8.2 Conducted Emissions Test Site

Conducted Emissions are performed in a shielded room manufactured by TDK.

The EUT and its support equipment are set on a non-conducting 1m x 1.5m x 80cm table installed 0.4m from the Vertical Ground Plane with the LISN bonded to the ground plane.

8.3 Antenna port conducted measurements

All antenna port conducted measurements are performed on a bench-top setup consisting of a Spectrum Analyzer, Communication tester (where applicable), Power Meter (as necessary), Splitters/Combiners (as necessary), Attenuators and pre-characterized RF cables.

The correction factors between the EUT and the Spectrum Analyzer is added internally in the Analyzer settings. The plots displayed accounts for these correction factors.

8.4 Test Setup Diagrams

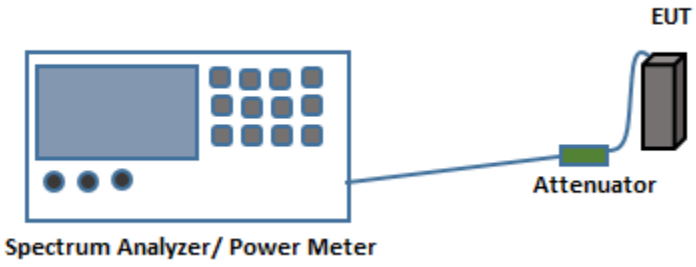


Fig.1. Test Setup for Antenna port conducted measurements

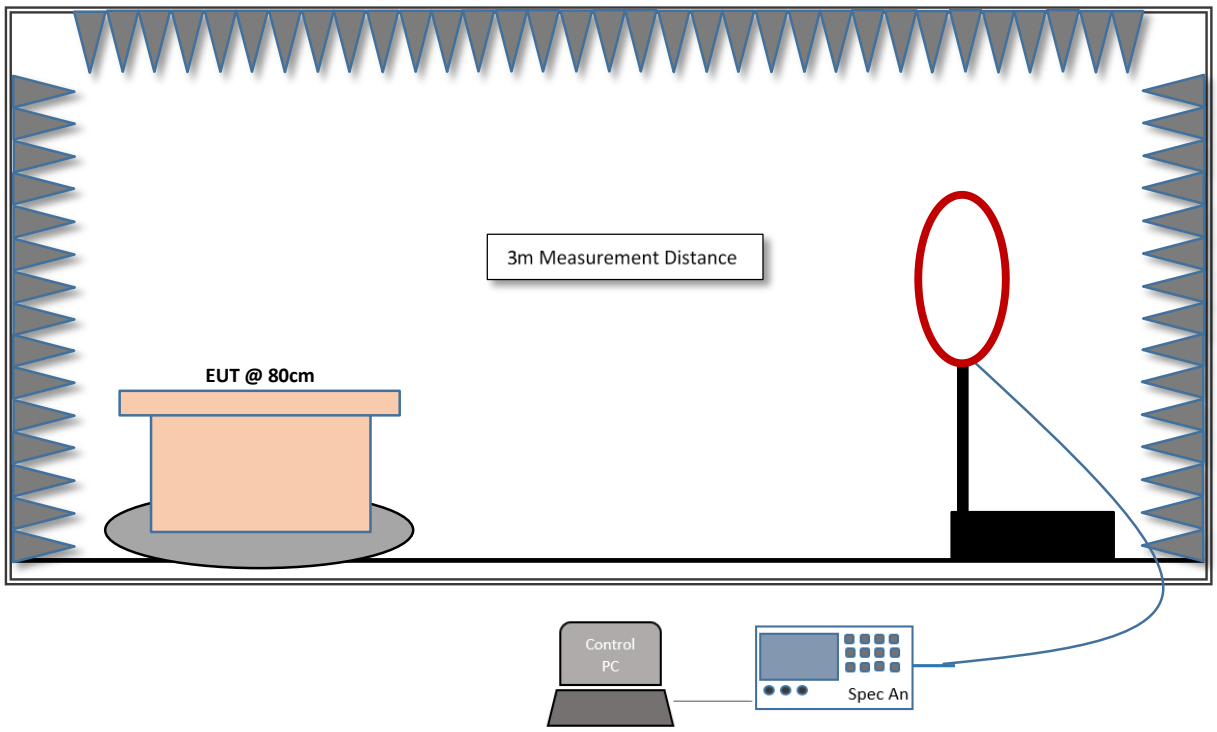


Fig.2. Test Setup for Radiated measurements <30 MHz

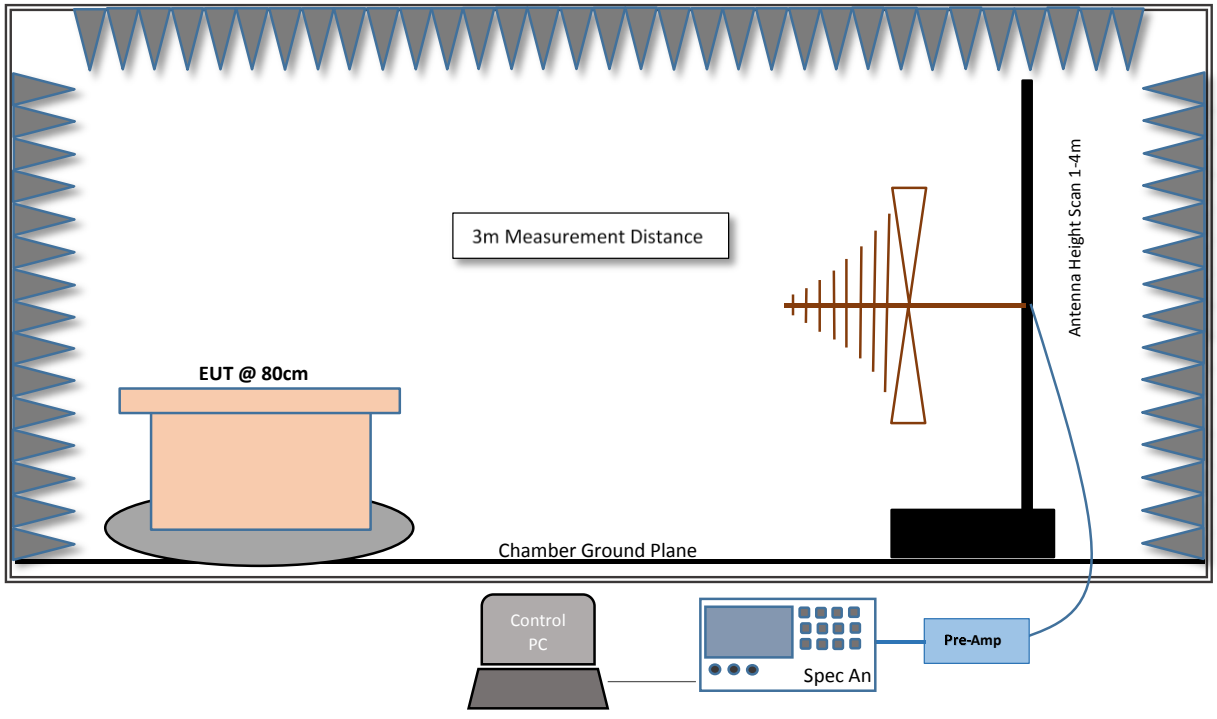


Fig.3. Test Setup for Radiated measurements in 30MHz- 1GHz Range

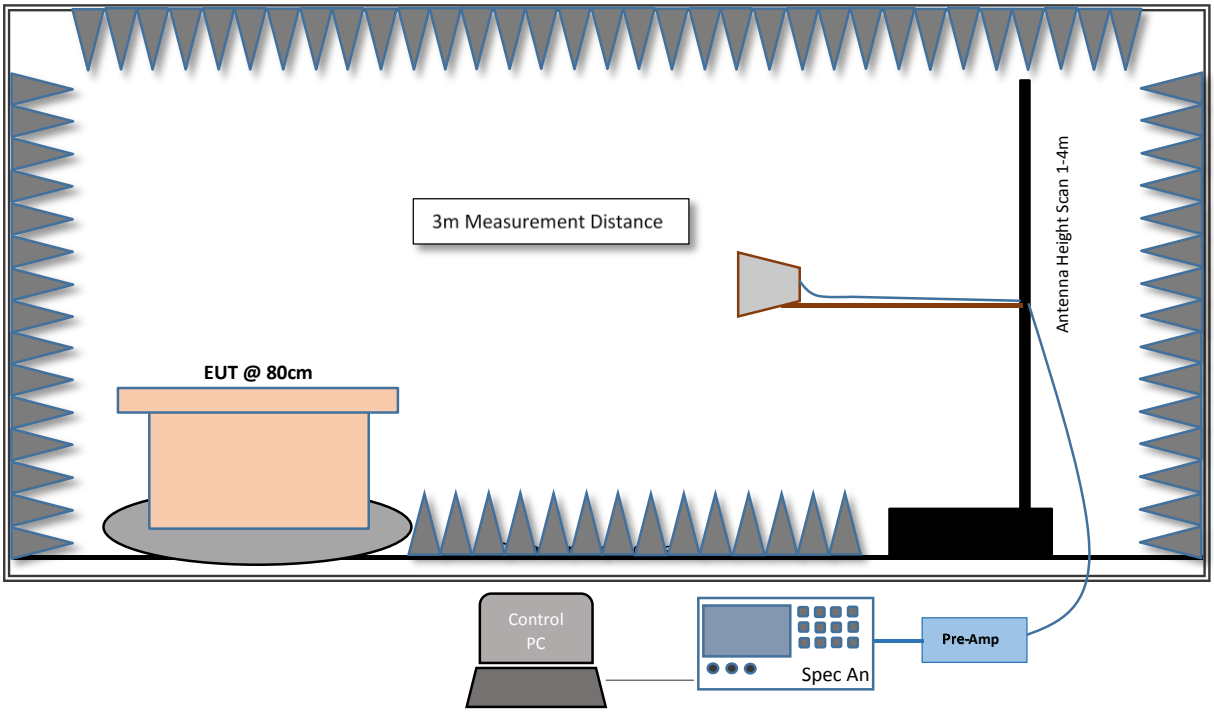


Fig.4. Test Setup for Radiated measurements in 1GHz- 18GHz Range

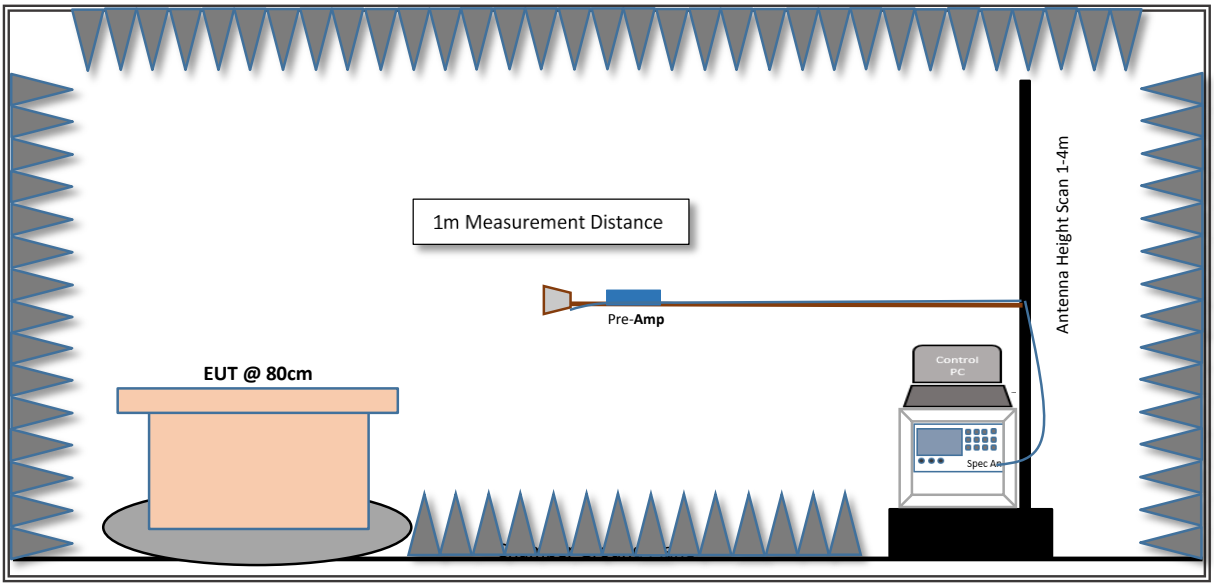


Fig.5. Test Setup for Radiated measurements >18GHz

9 Test Results- Conducted

9.1 20dB Bandwidth

9.1.1 Test Requirement:

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

9.1.2 Test Method:

Measurements are performed according to the procedure defined in DA 00-705 'Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems'

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:

The Limit is 1MHz unless there are more than 15 non-overlapping channels.

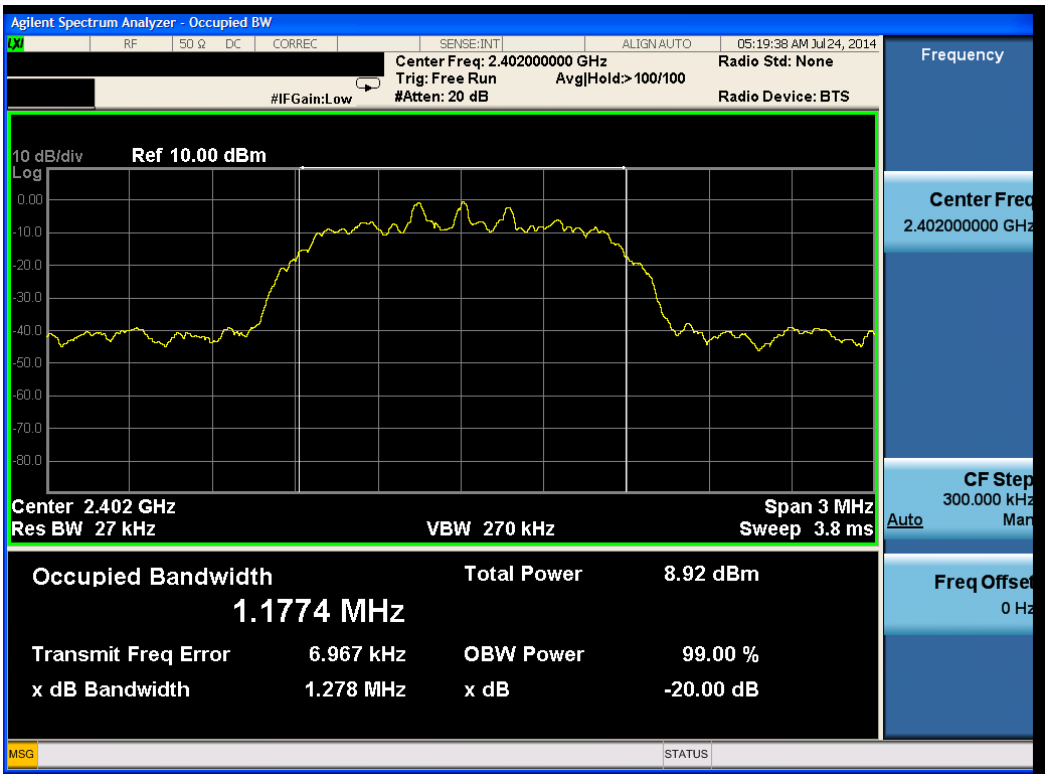
9.1.4 Test Results:

Frequency (MHz)	Data Rate (Mbps)	Channel No.	20dB Bandwidth (kHz)
2402	1.0	0	940.4
2441	1.0	39	941
2480	1.0	78	941.4
2402	2.0	0	1278
2441	2.0	39	1278
2480	2.0	78	1281
2402	3.0	0	1292
2441	3.0	39	1299
2480	3.0	78	1298

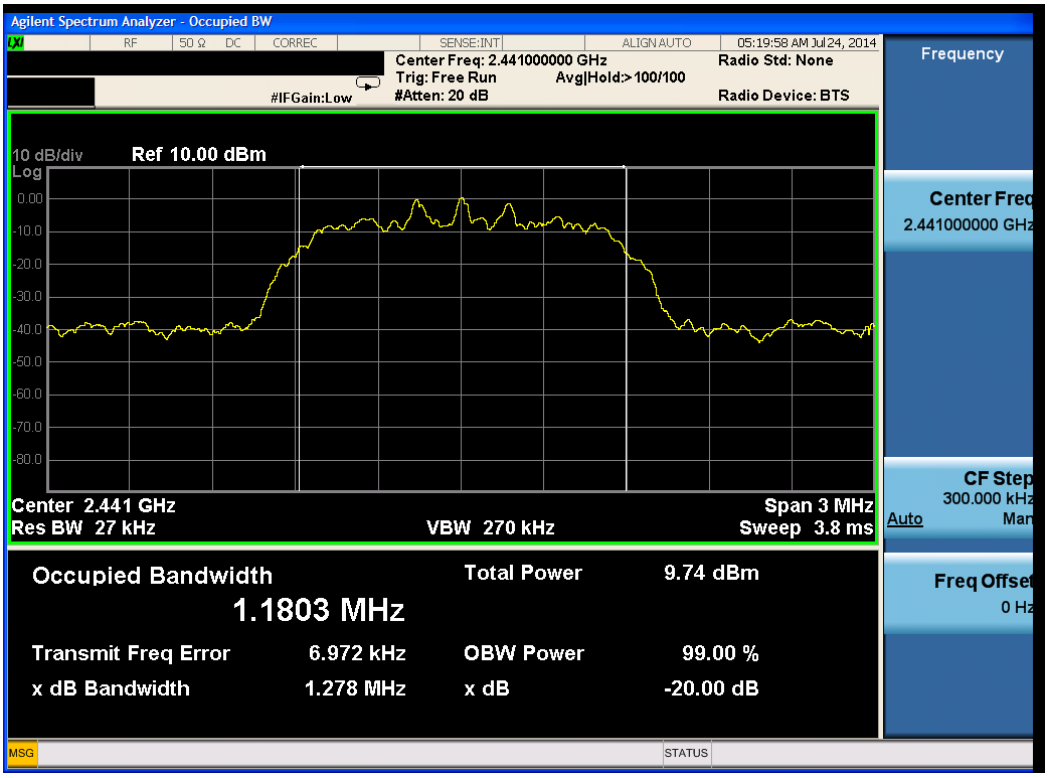
Plot 9-1. 20dB Bandwidth (Ch. 0, 1Mbps)

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

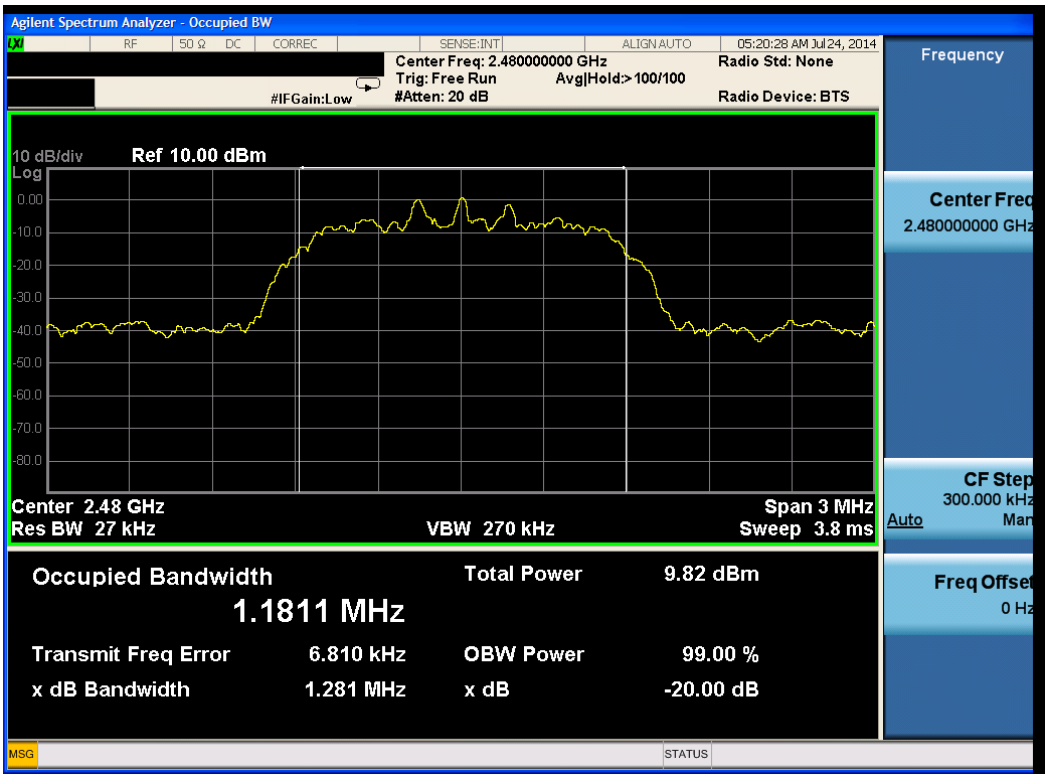
Plot 9-3. 20dB Bandwidth (Ch. 78, 1Mbps)



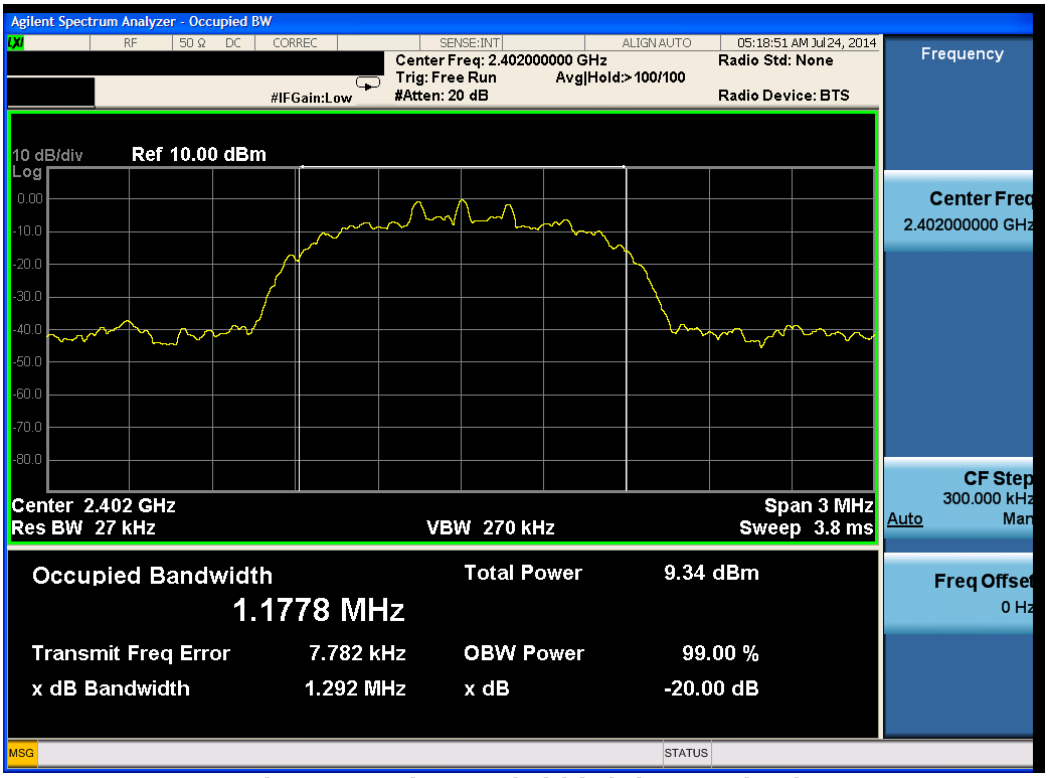
Plot 9-4. 20dB Bandwidth (Ch. 0, 2Mbps)



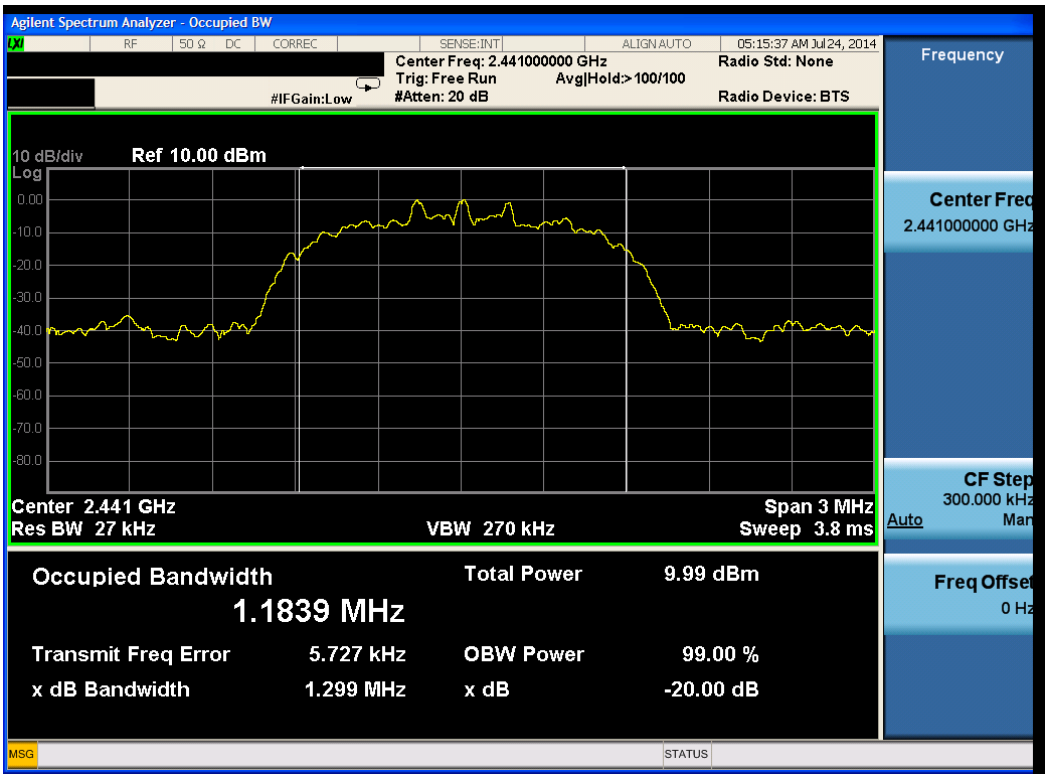
Plot 9-5. 20dB Bandwidth (Ch. 39, 2Mbps)



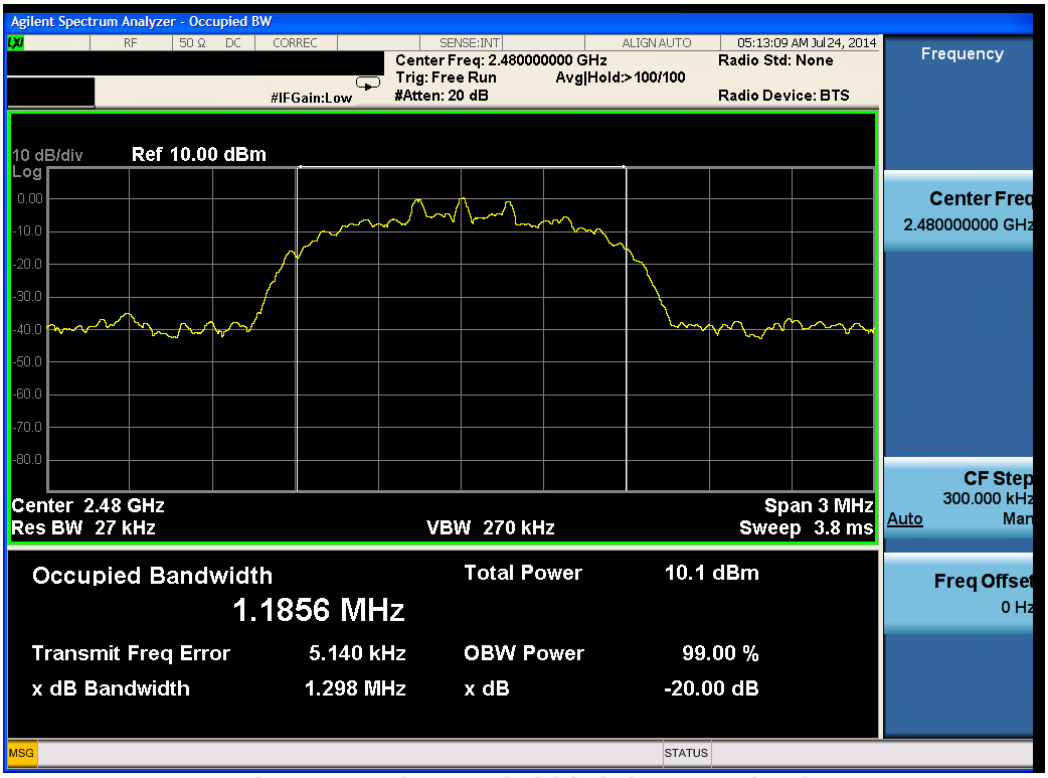
Plot 9-6. 20dB Bandwidth (Ch. 78, 2Mbps)



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



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



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

9.2 Output Power

9.2.1 Test Requirement:

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

9.2.2 Test Method:

Spectrum analyzer settings:

For Peak Powers:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ 3 x RBW
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.

For Average Powers:

Average power measurements are made using the analyzer's "burst power" function with RBW = 3MHz.

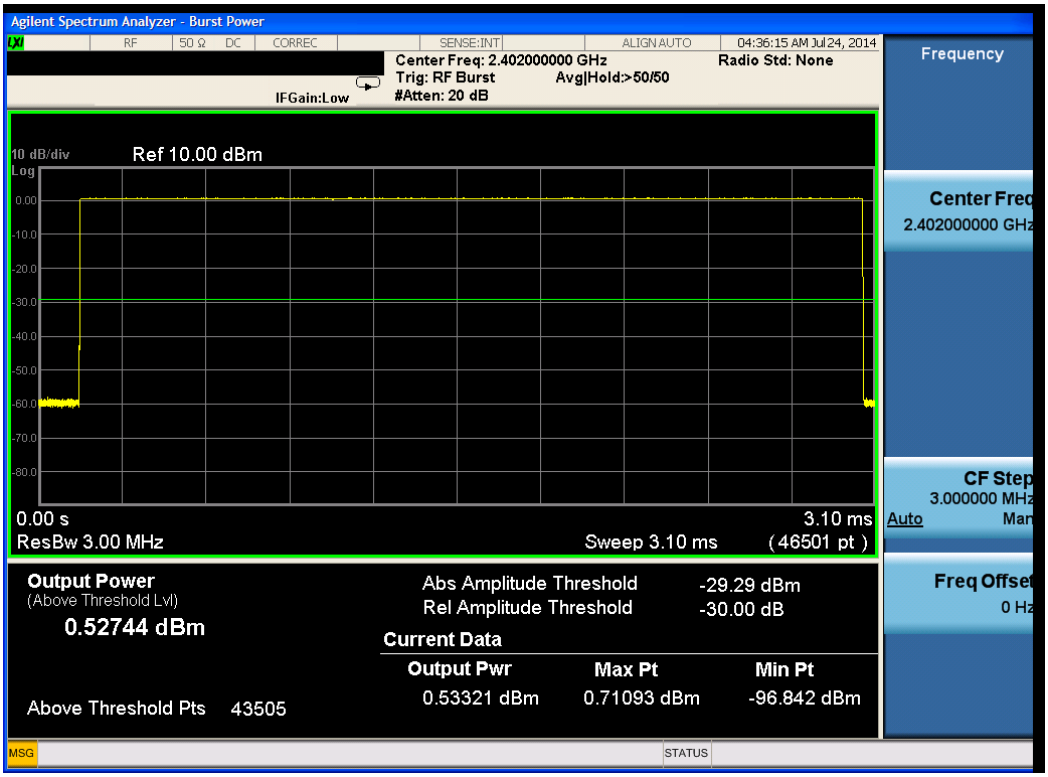
The burst power function measures the maximum average power over the on-time of a single burst. All data rates and packet types are measured and highest powers are found with DH5 packet type.

9.2.3 Limits:

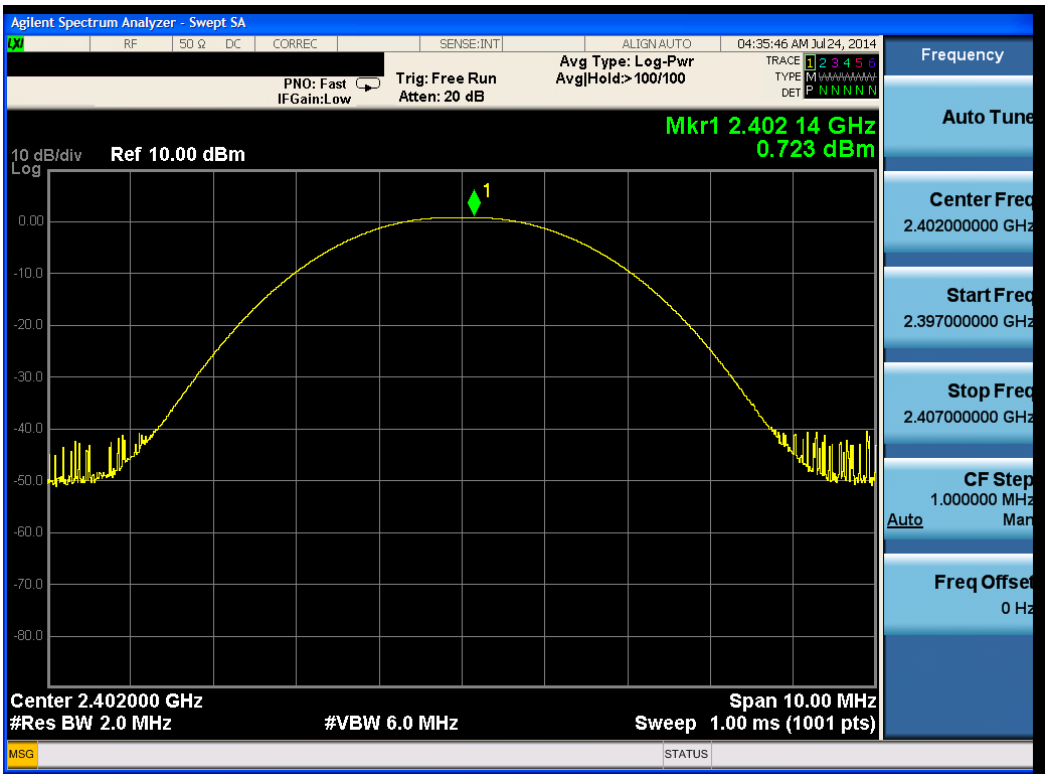
1 Watt if ≥ 75 non-overlapping channels.

9.2.4 Test Results:

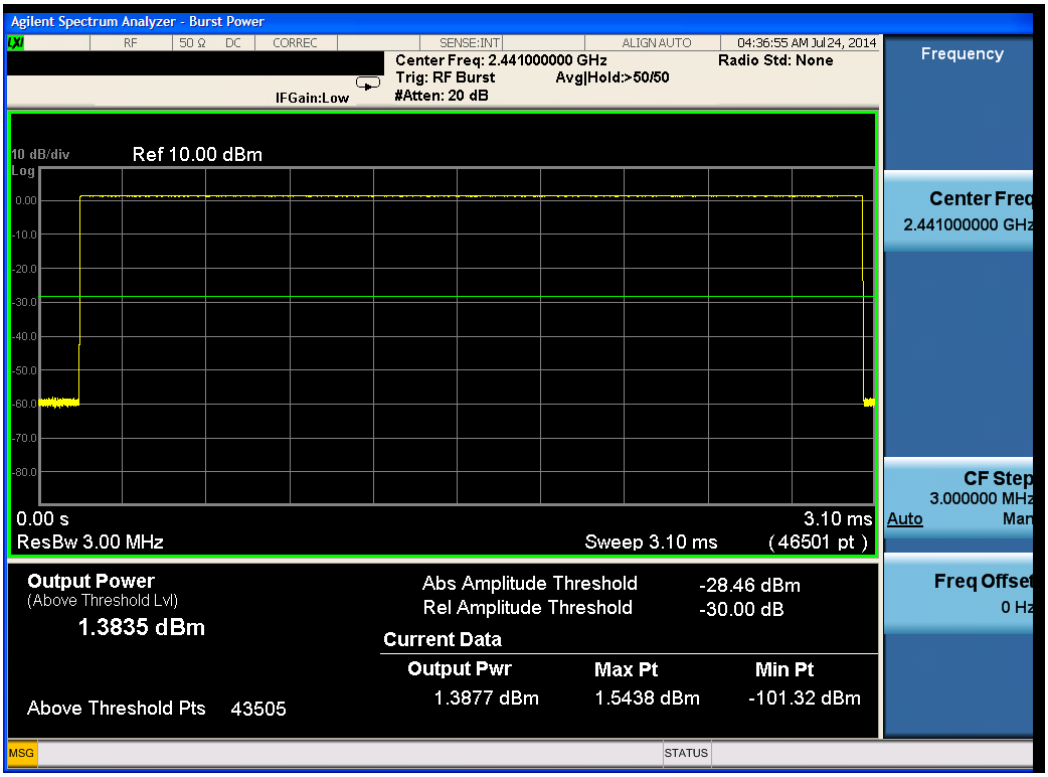
Frequency (MHz)	Mode	Channel No.	Peak Power (dBm)	Peak Power (W)	Average Power (dBm)	Average Power (W)
2402	DH5	0	0.723	0.0012	0.52744	0.0011
2441	DH5	39	1.542	0.0014	1.3835	0.0014
2480	DH5	78	1.575	0.0014	1.4212	0.0014
2402	2-DH5	0	2.872	0.0019	0.54563	0.0011
2441	2-DH5	39	3.57	0.0023	1.3488	0.0014
2480	2-DH5	78	3.597	0.0023	1.426	0.0014
2402	3-DH5	0	3.257	0.0021	0.54315	0.0011
2441	3-DH5	39	3.944	0.0025	1.3498	0.0014
2480	3-DH5	78	3.964	0.0025	1.4864	0.0014



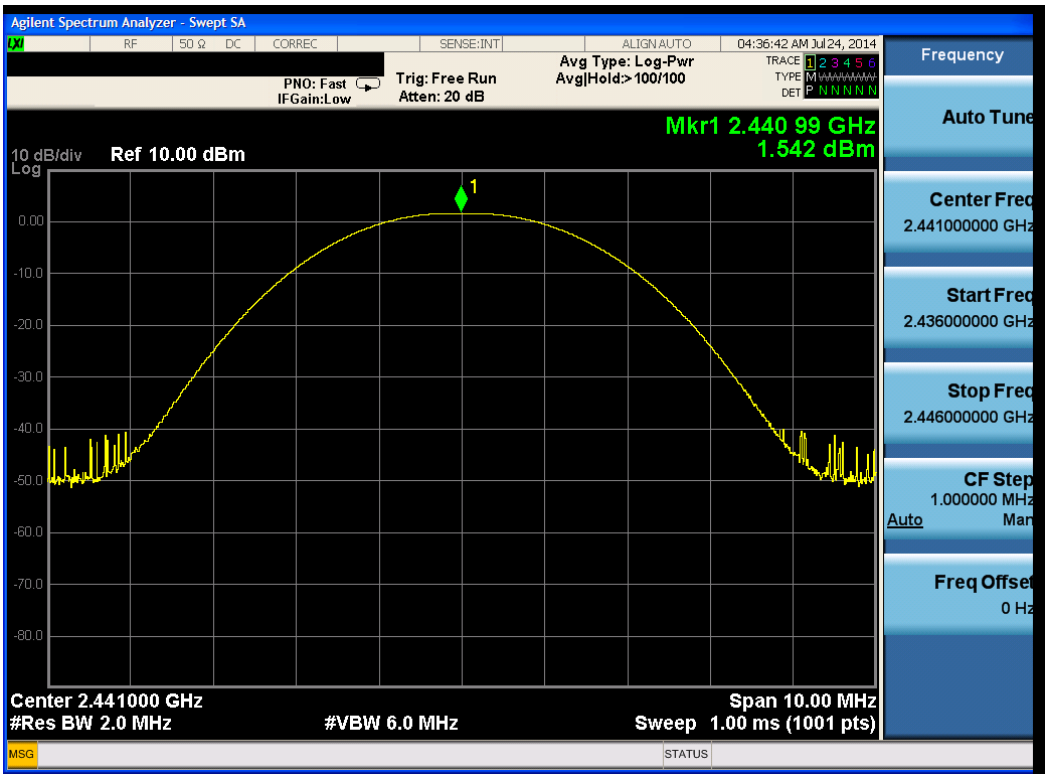
Plot 9-10. Average Power (Ch. 0, 1Mbps)



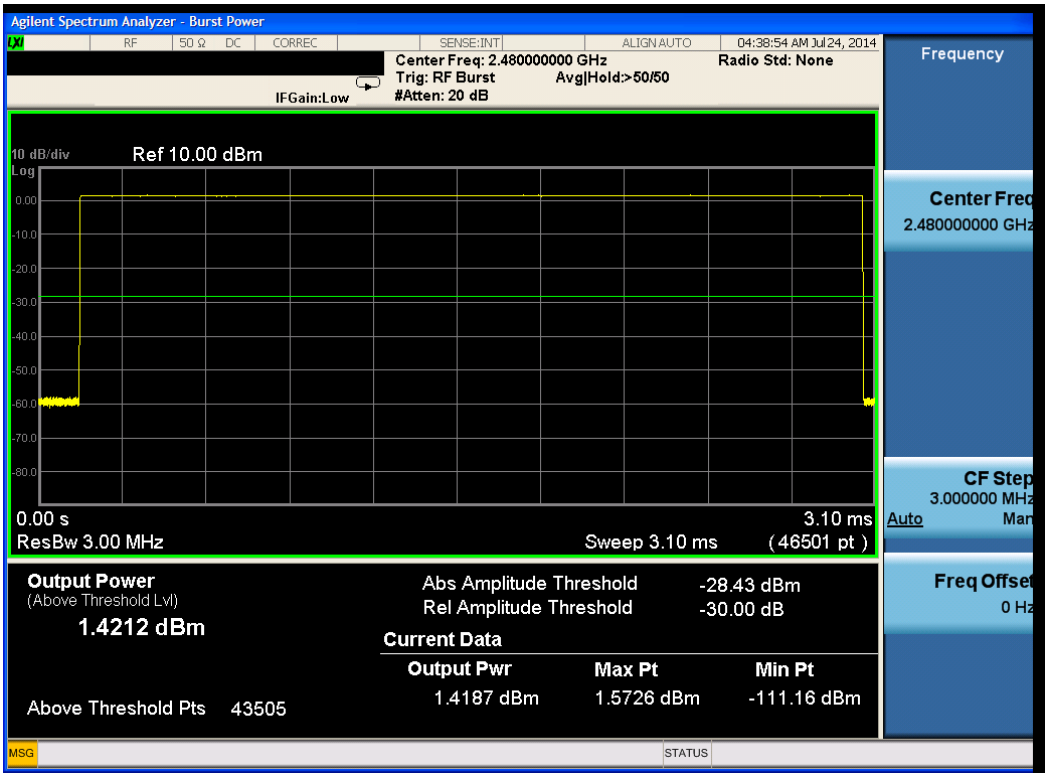
Plot 9-11. Peak Power (Ch. 0, 1Mbps)



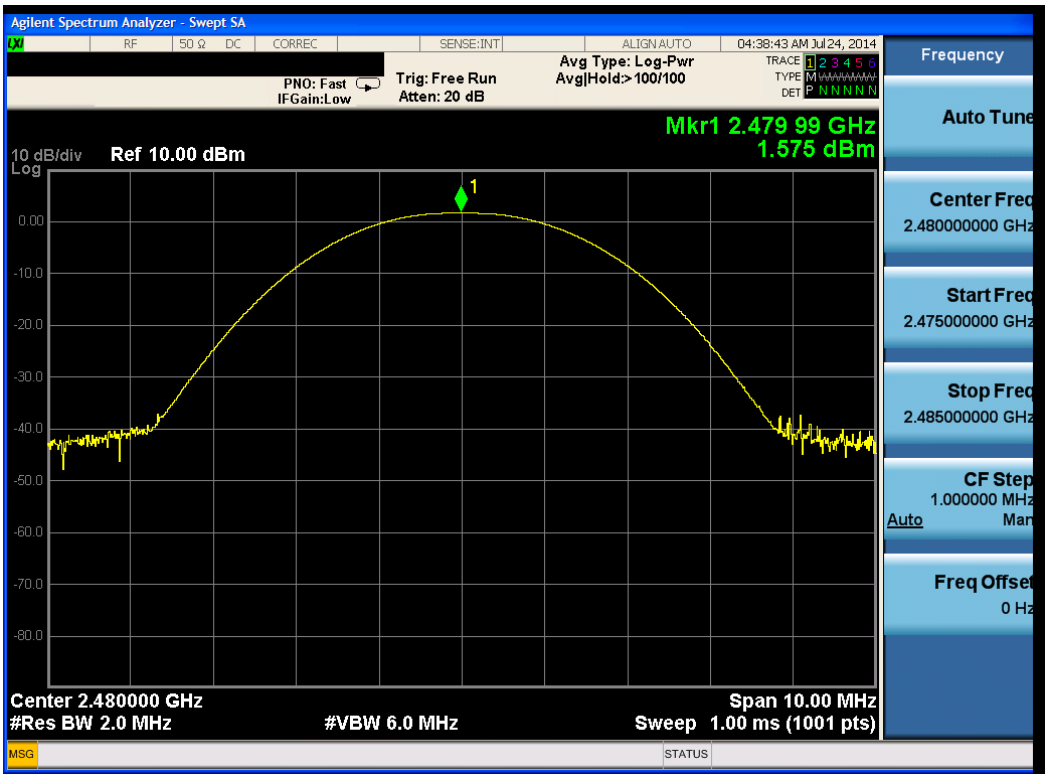
Plot 9-12. Average Power (Ch. 39, 1Mbps)



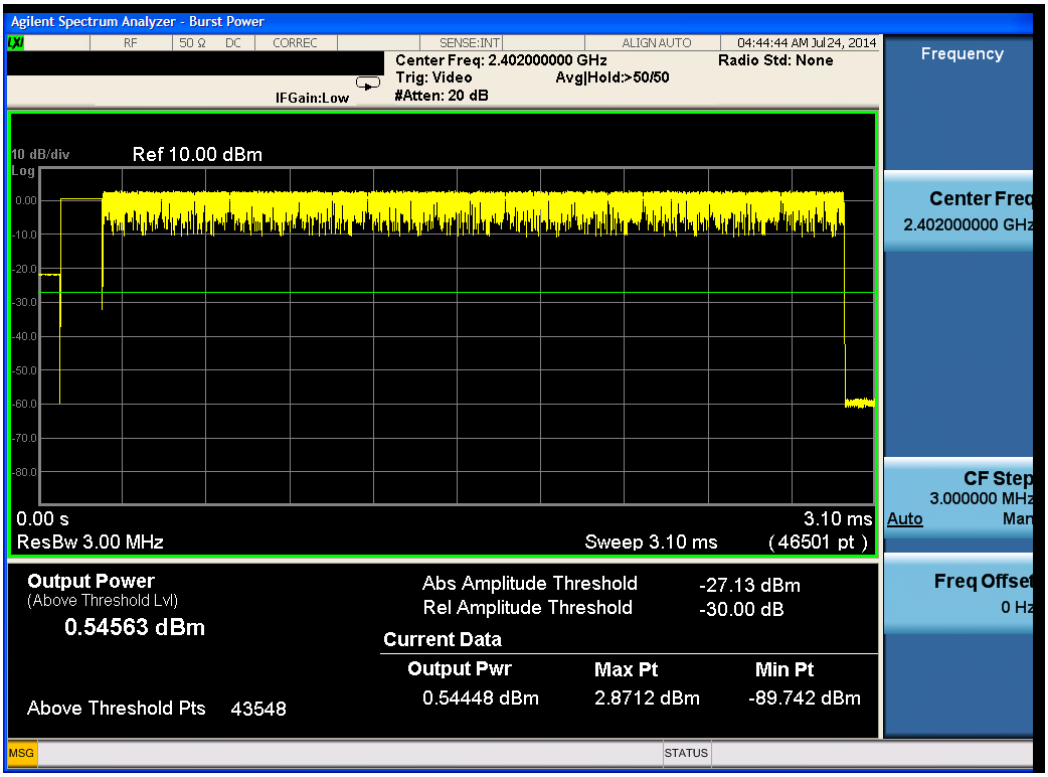
Plot 9-13. Peak Power (Ch. 39, 1Mbps)



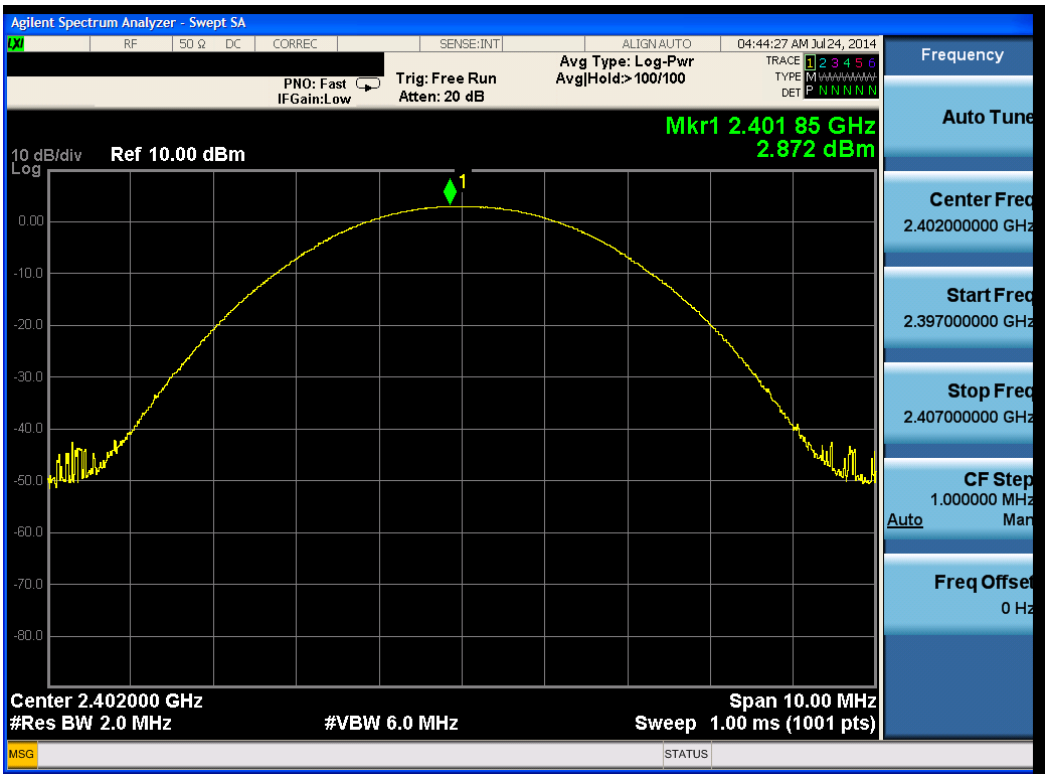
Plot 9-14. Average Power (Ch. 78, 1Mbps)



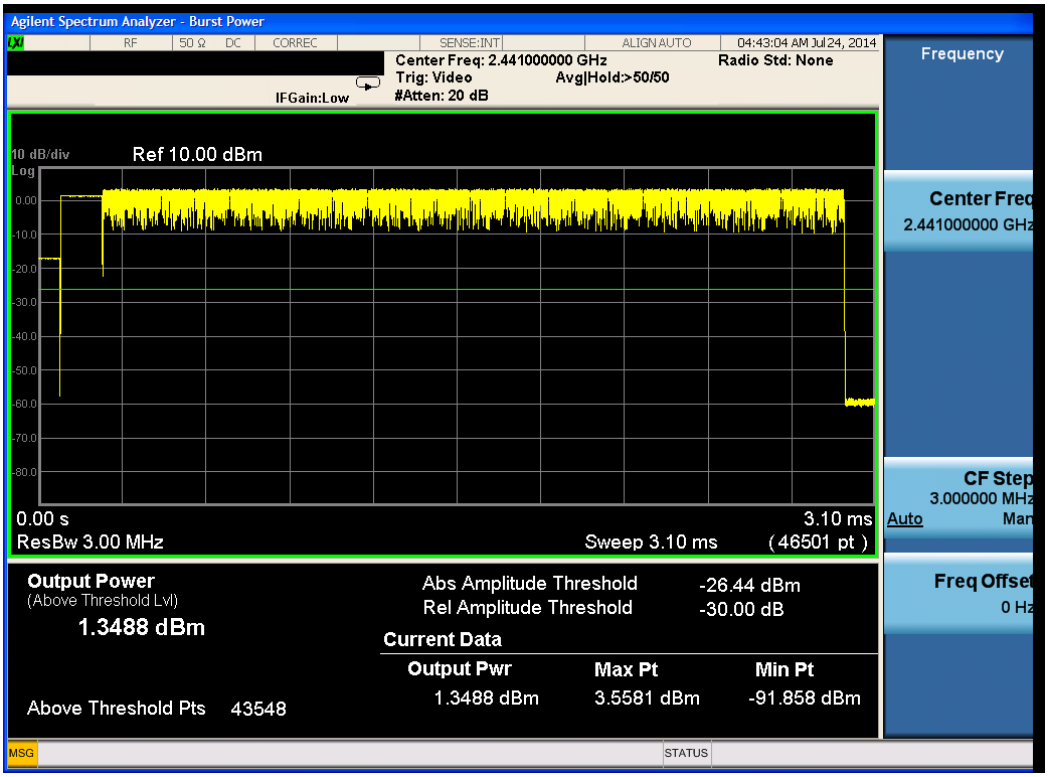
Plot 9-15. Peak Power (Ch. 78, 1Mbps)



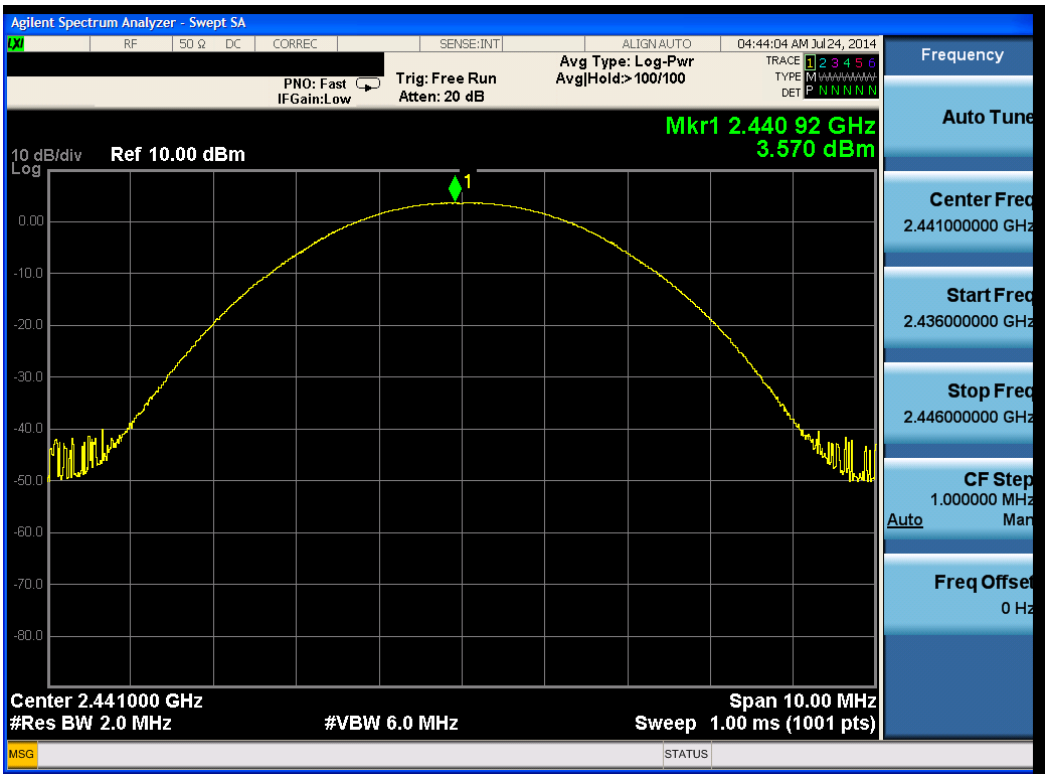
Plot 9-16. Average Power (Ch. 0, 2Mbps)



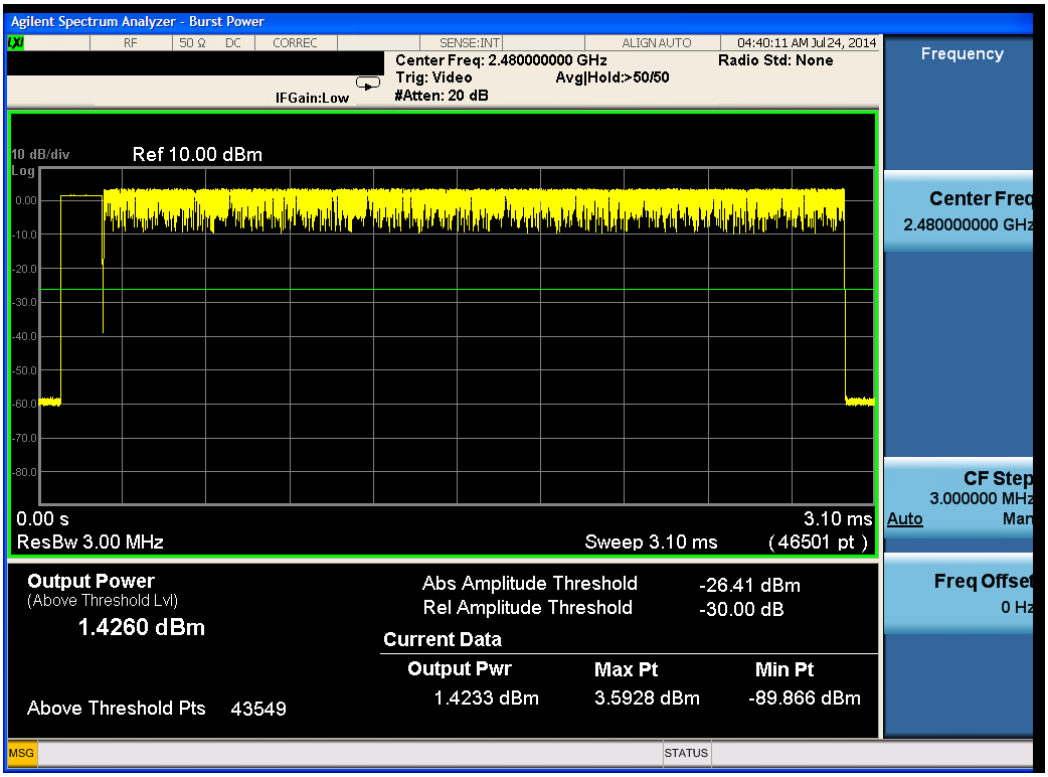
Plot 9-17. Peak Power (Ch. 0, 2Mbps)



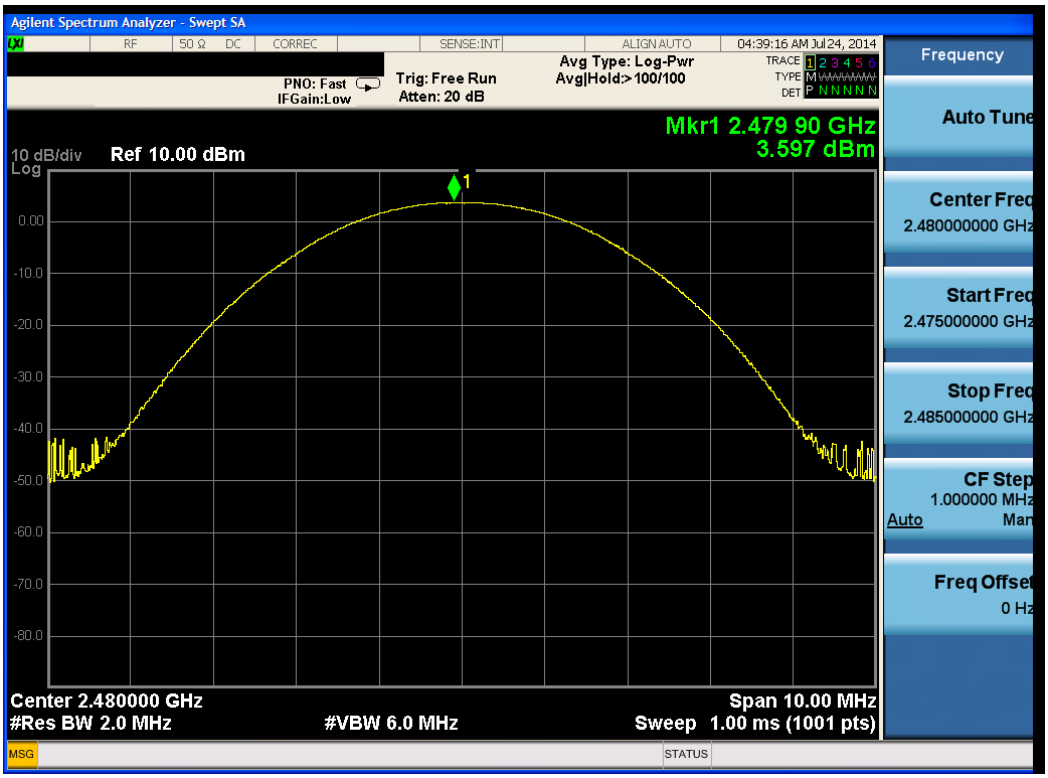
Plot 9-18. Average Power (Ch. 39, 2Mbps)



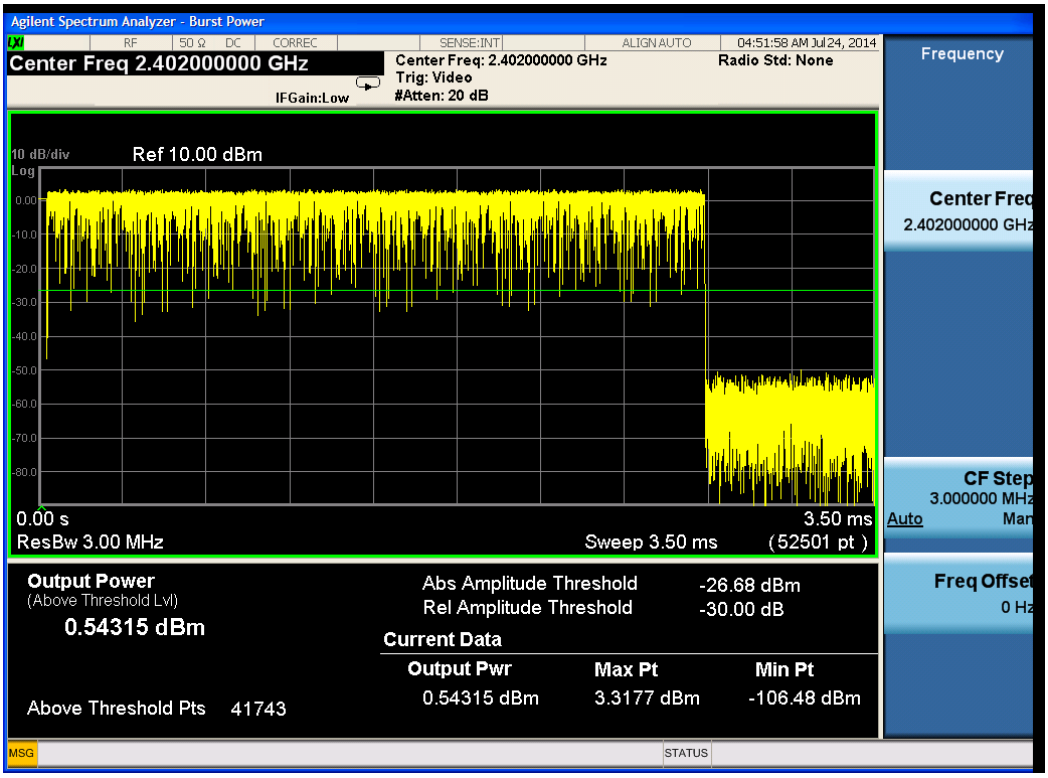
Plot 9-19. Peak Power (Ch. 39, 2Mbps)



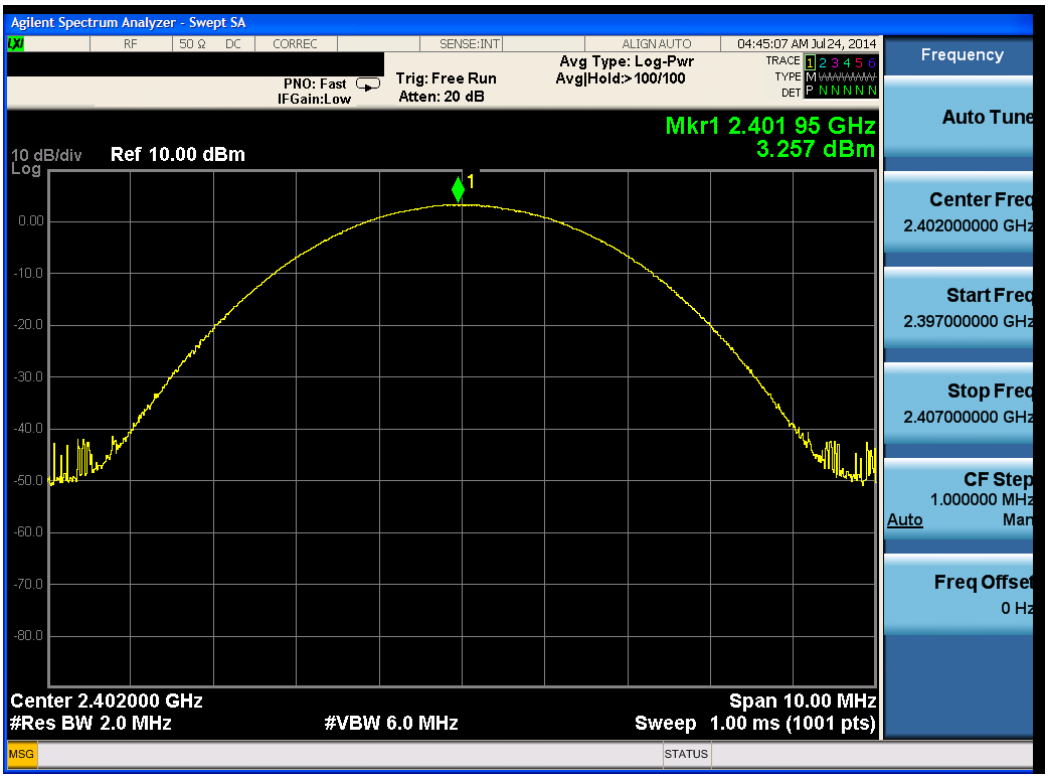
Plot 9-20. Average Power (Ch. 78, 2Mbps)



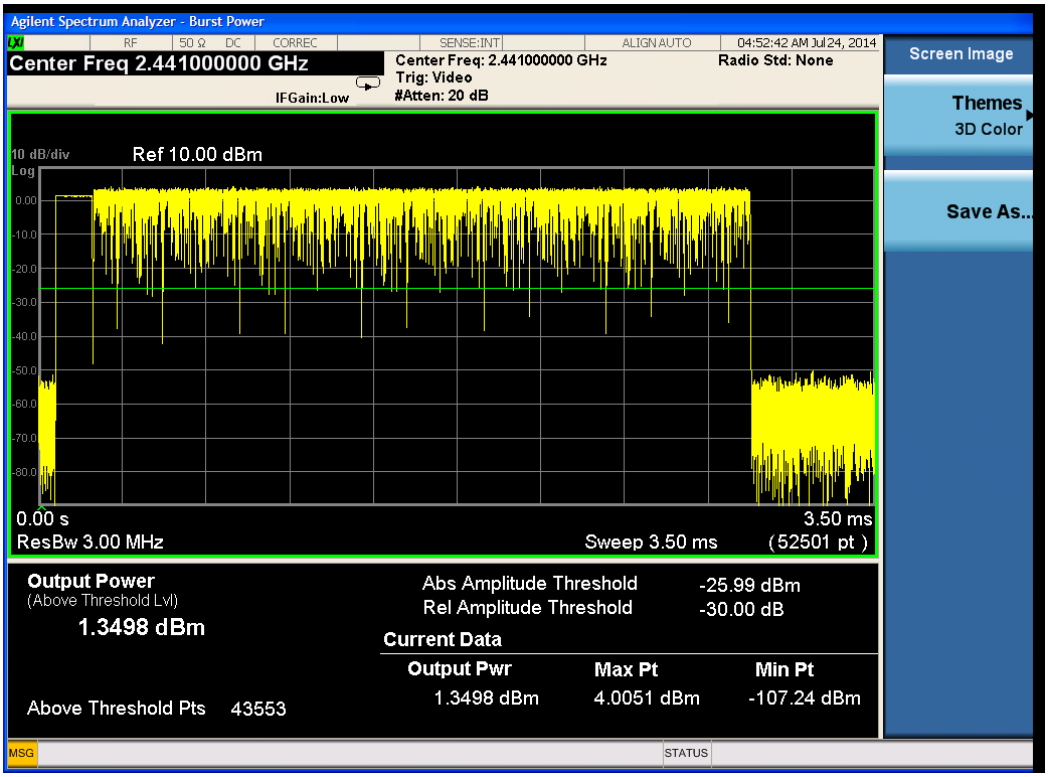
Plot 9-21. Peak Power (Ch. 78, 2Mbps)



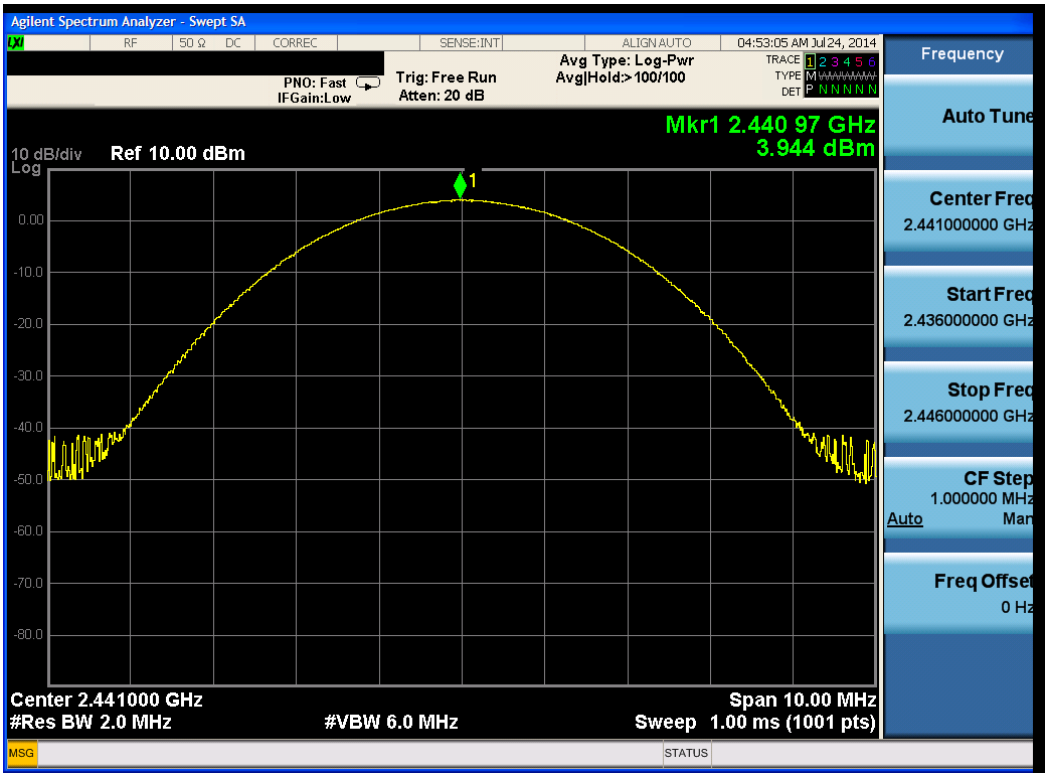
Plot 9-22. Average Power (Ch. 0, 3Mbps)



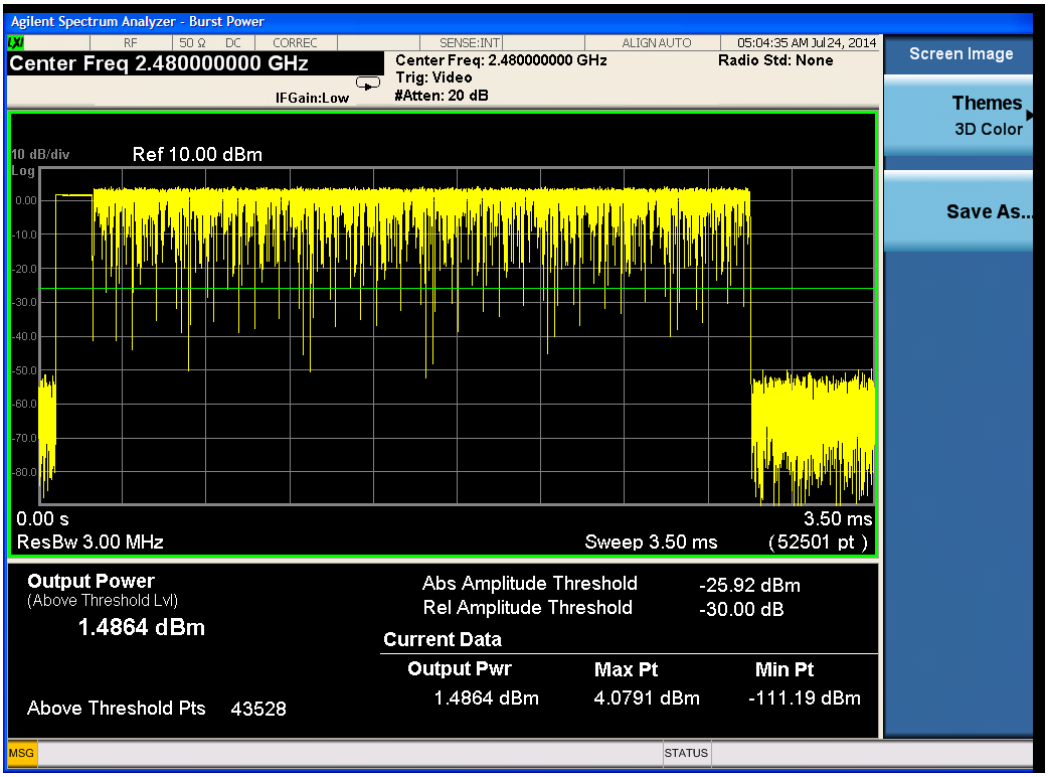
Plot 9-23. Peak Power (Ch. 0, 3Mbps)



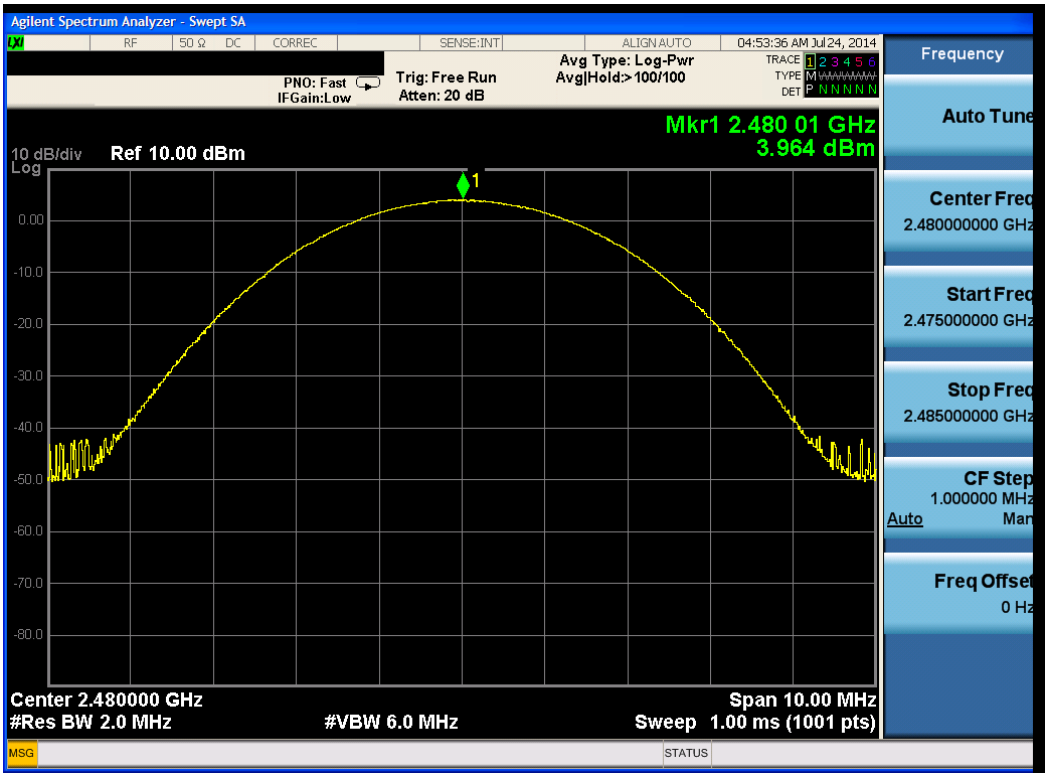
Plot 9-24. Average Power (Ch. 39, 3Mbps)



Plot 9-25. Peak Power (Ch. 39, 3Mbps)



Plot 9-26. Average Power (Ch. 78, 3Mbps)



Plot 9-27. Peak Power (Ch. 78, 3Mbps)

9.3 Channel Spacing

9.3.1 Test Requirement:

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

9.3.2 Test Method:

The EUT was in pseudorandom hopping mode with the separation of two peaks measured using the delta marker.

Spectrum analyzer settings:

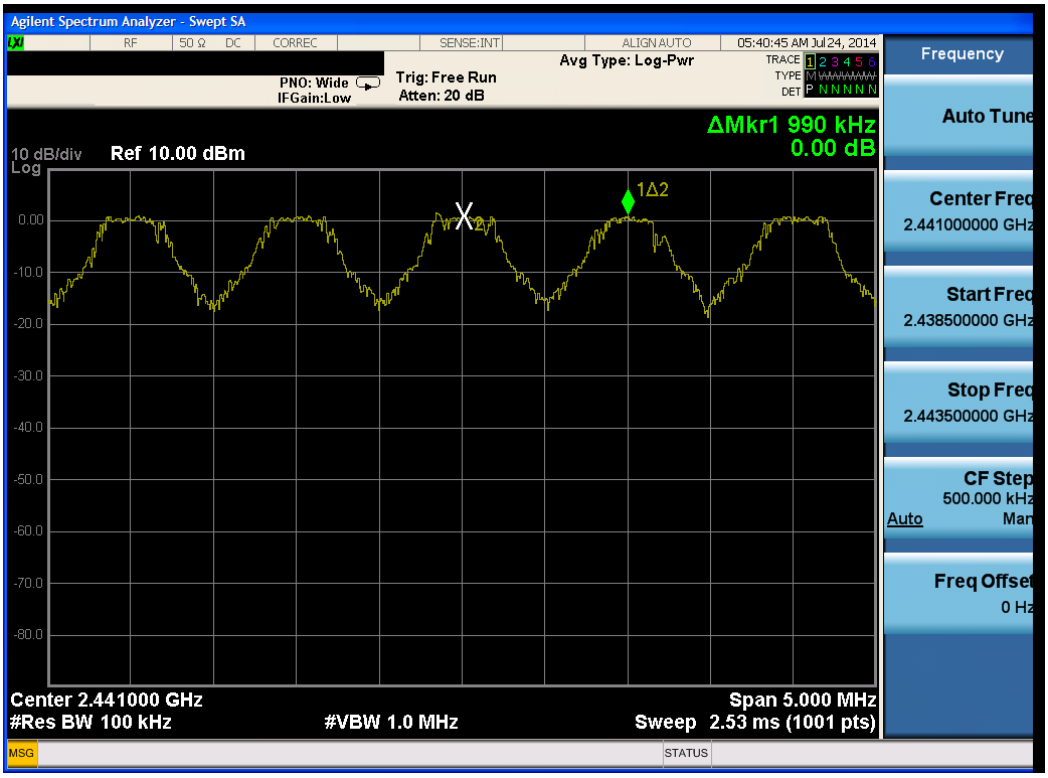
Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) > 1% of the span
Video (or Average) Bandwidth (VBW) ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold
The trace was allowed to stabilize. The marker-delta function was used to determine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

Frequency (MHz)	Data Rate (Mbps)	Channel No.	Min. Channel Separation (kHz)
2402	1.0	0	627
2441	1.0	39	627
2480	1.0	78	628
2402	2.0	0	852
2441	2.0	39	852
2480	2.0	78	854
2402	3.0	0	861
2441	3.0	39	866
2480	3.0	78	865



Plot 9-28 Channel Separation

9.4 Number of Hopping Frequencies

9.4.1 Test Requirement:

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

9.4.2 Test Method:

The EUT had its hopping function enabled.

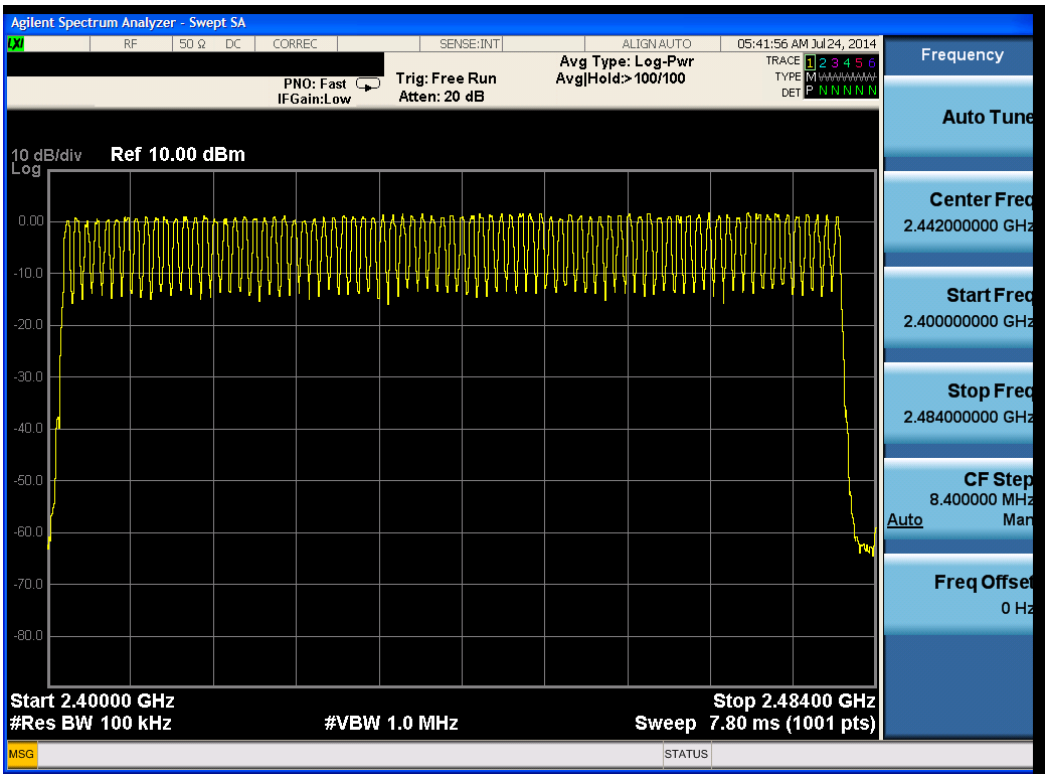
Spectrum analyzer settings:

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 hopping channels.

9.4.4 Test Results:



Plot 9-29. Number of Hopping Channels

9.5 Dwell Time

9.5.1 Test Requirement:

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

9.5.2 Test Method:

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

9.5.3 Limits:

0.4s

9.5.4 Test Results:

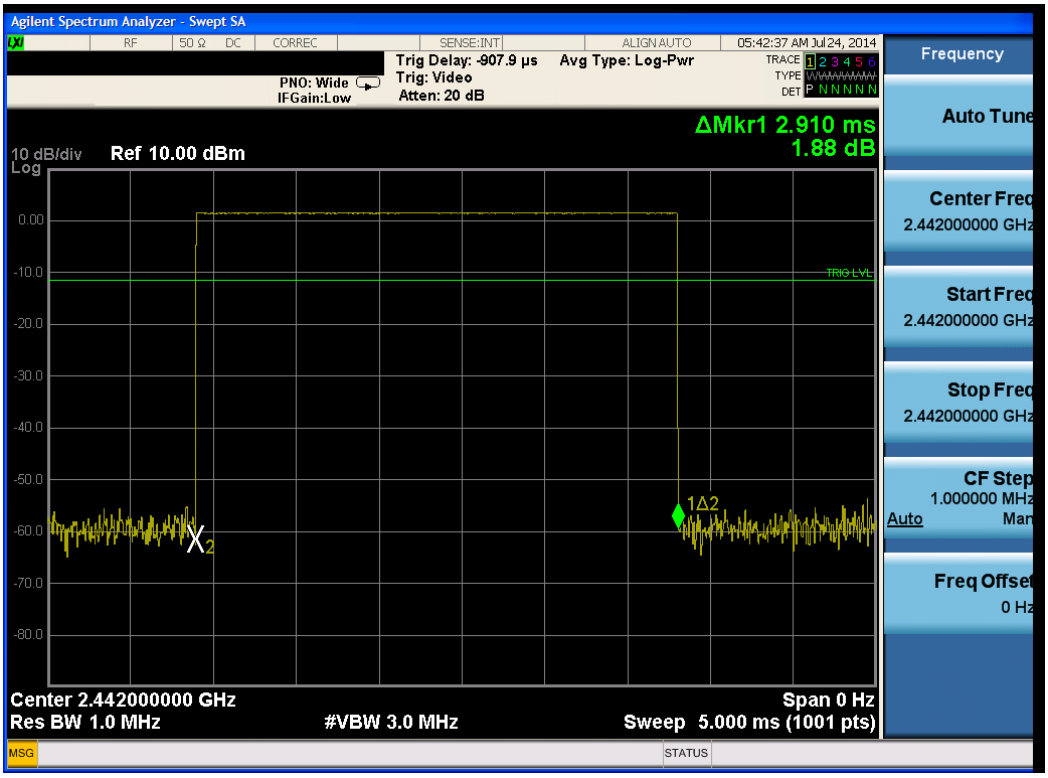
Standard Bluetooth 1x/EDR has a channel hopping rate of 1600 hops/s.

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.

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 * 2.91ms = 310.41ms.



Plot 9-30. Dwell Time

9.6 Band Edge

9.6.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

9.6.2 Test Method:

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.

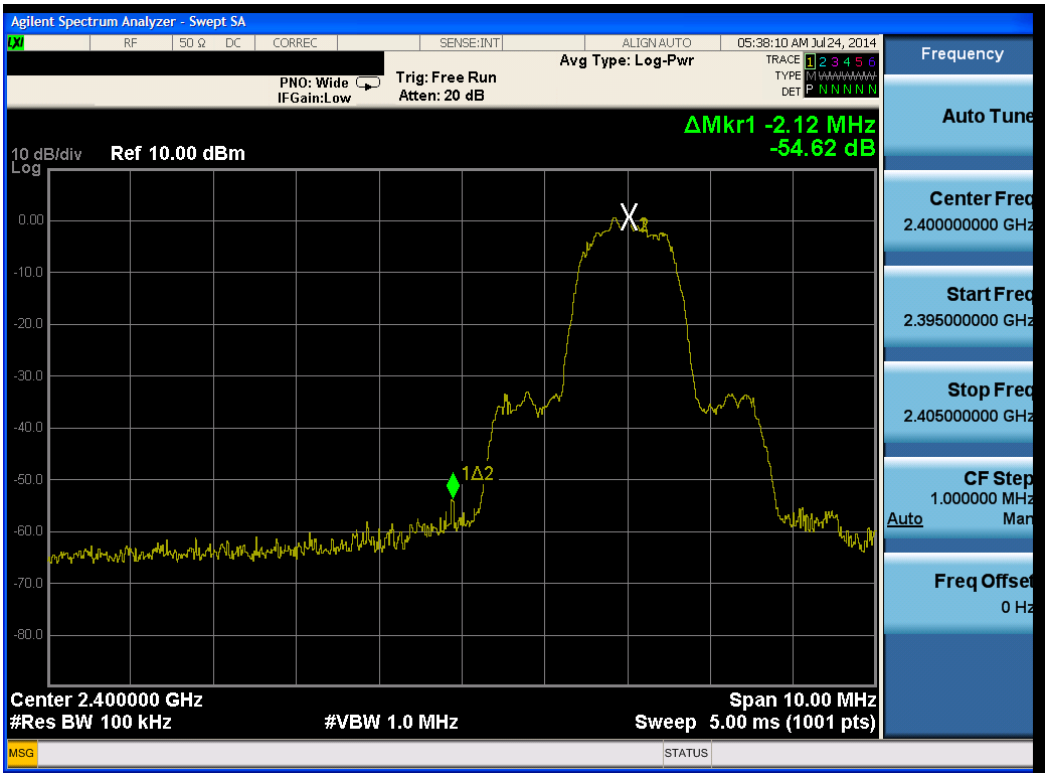
With the same instrument settings, the hopping function of the EUT was enabled and the trace was allowed to stabilize. The same procedure listed above was used to determine if any spurious emissions caused by the hopping function complied with the specified limit.

9.6.3 Limits:

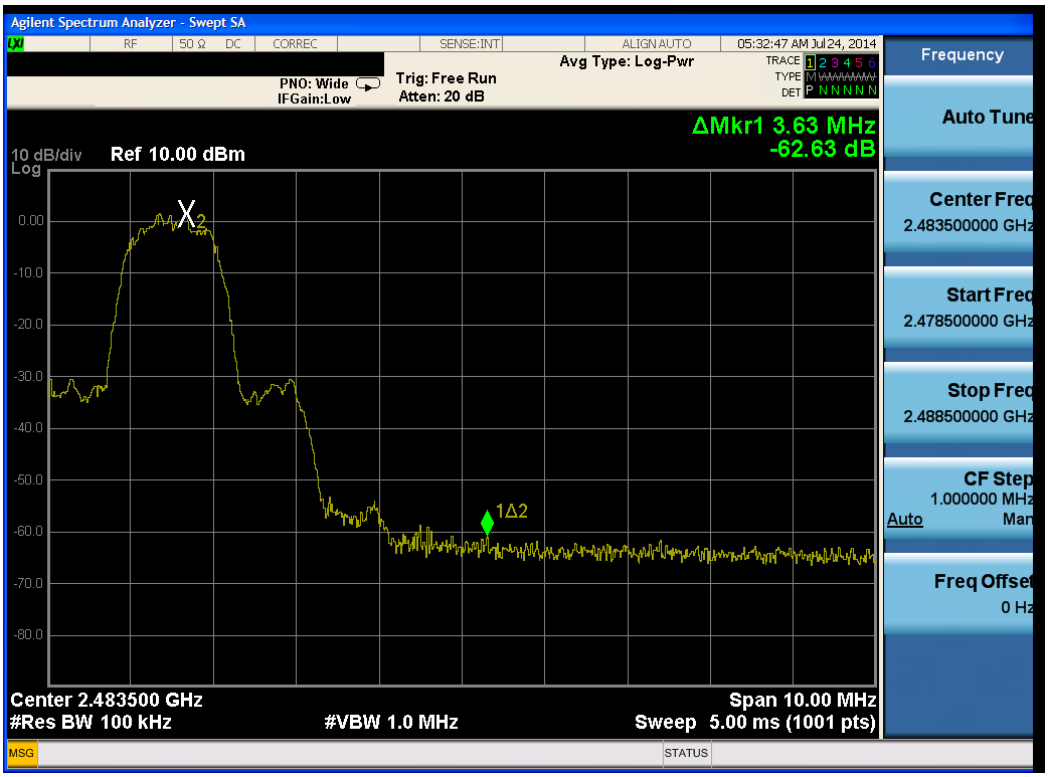
The maximum level is 20dBc with measurements taken with the EUT in pseudorandom hopping mode and with hopping mode disabled.

9.6.4 Test Results:

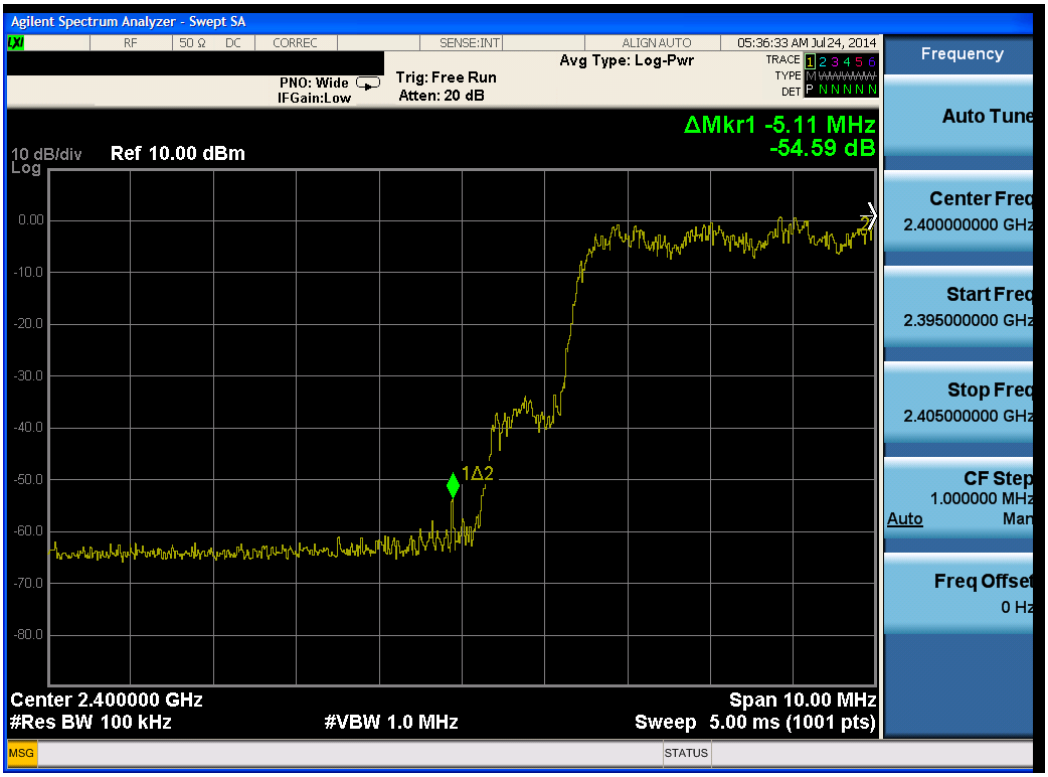
Band edge measurements were taken at the highest emission outside of the authorized band. All data rates and modulations were tested and worst case emissions were found with 1Mbps and DH5 mode.



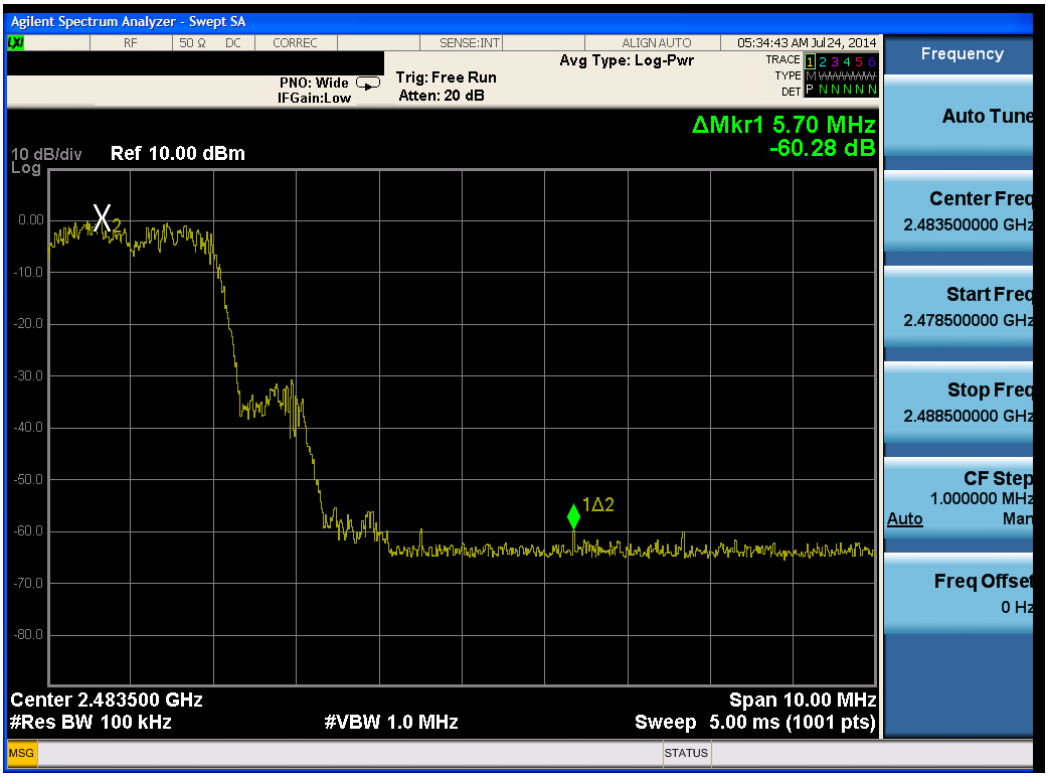
Plot 9-31. Low Bandedge (Hopping disabled)



Plot 9-32 High Bandedge (Hopping disabled)



Plot 9-33. Low Bandedge (Hopping enabled)



Plot 9-34. High Bandedge (Hopping enabled)

9.7 Conducted Spurious Emissions

9.7.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

9.7.2 Test Method:

Spectrum analyzer settings:

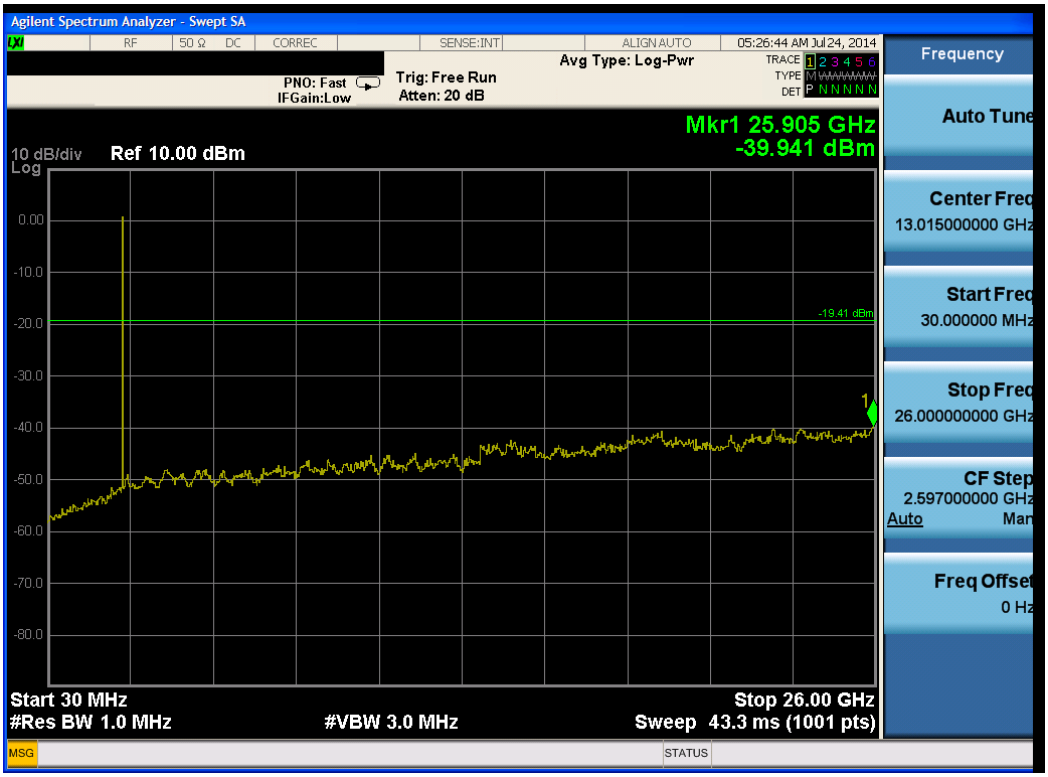
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz
VBW ≥ 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold
The trace was allowed to stabilize. 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:

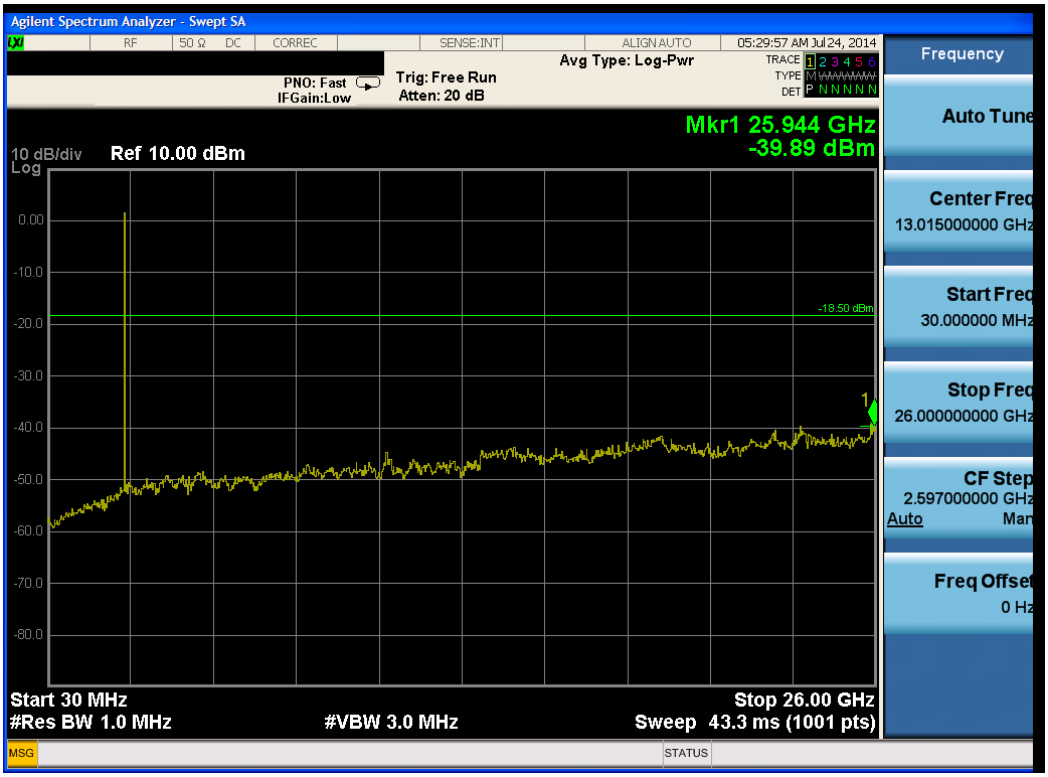
The maximum level is 20dBc.

9.7.4 Test Results:

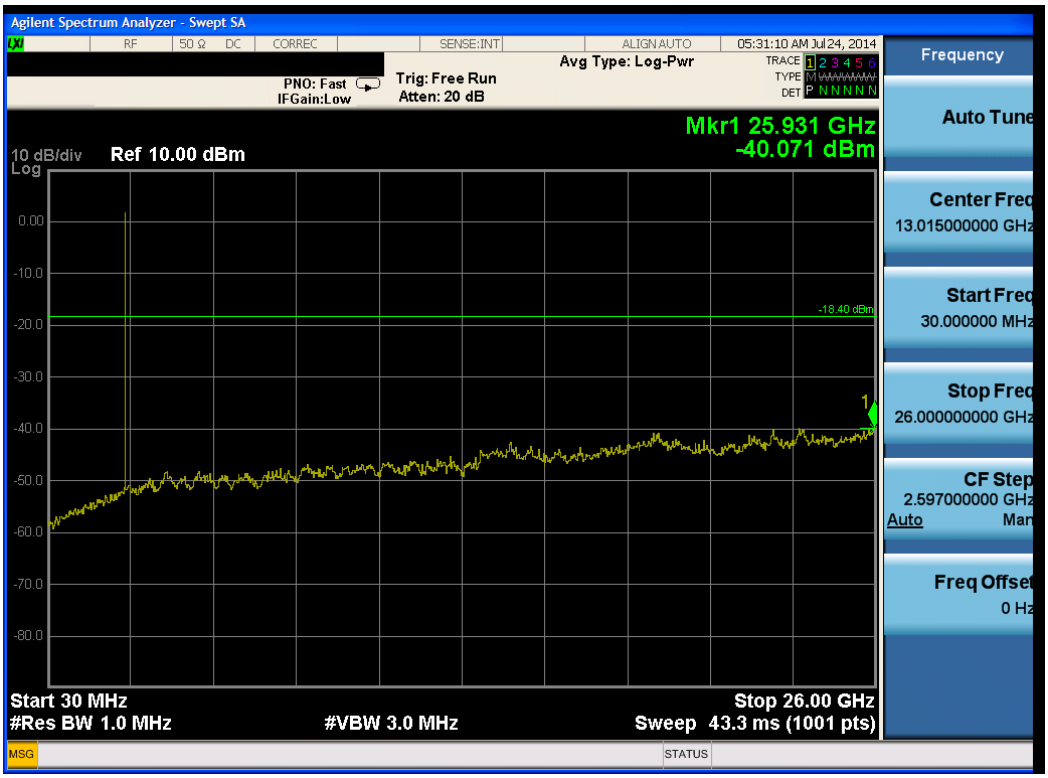
All data rates and modulations were tested and the worst case emissions were found at 1Mbps and DH5 modulation.



Plot 9-35. Conducted Spurious Emissions (Ch. 0)



Plot 9-36. Conducted Spurious Emissions (Ch. 39)



Plot 9-37. Conducted Spurious Emissions (Ch. 78)

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

9.8.1 Test Requirement:

FCC CFR 47 Rule Part 15.247 (d)

9.8.2 Test Method:

This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT.

Spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f > 1 GHz, 100 kHz for f < 1 GHz
VBW > 3 x RBW
Sweep = auto
Detector function = peak
Trace = max hold

Guidelines in ANSI C63.4-2009 were followed with respect to maximizing the emission by rotating the EUT, and each emission was measured while the EUT was situated in three orthogonal planes adjusting the measurement antenna height and polarization, etc. The EUT is tested in the low, middle and high channels and in three orthogonal axes, antenna mast height and polarities and the worst case configurations are represented below. 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.

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. Additionally, emissions found in the restricted bands as listed in 15.205 are tested for compliance per limits 15.209.

Quasi-peak measurements are made for emissions below 1GHz.

Average and peak measurements are made for emissions above 1GHz. For average measurements, RBW = 1MHz, and VBW = 1/t where t is pulse width in seconds and for peak measurements, RBW = 1MHz, and VBW = 3MHz.

All radiated measurements were performed in 3Mbps mode since the EUT operates at its highest power in this mode.

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) 74 (Peak)

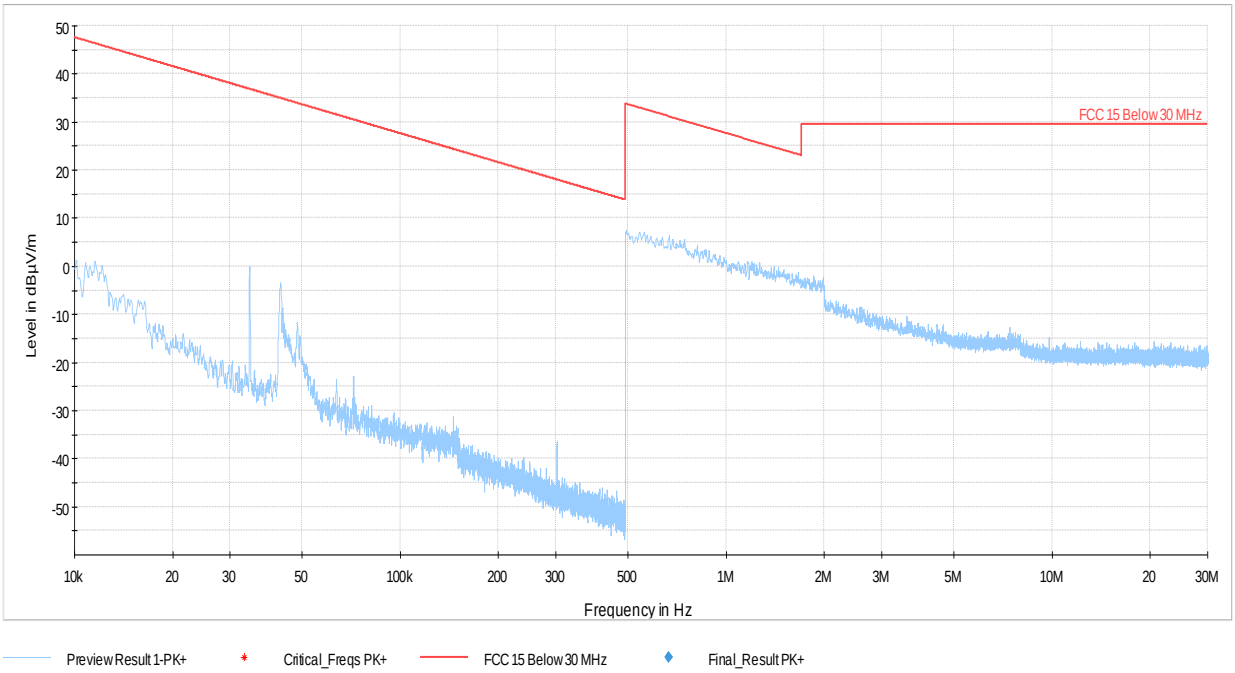
9.8.4 Test Result:

Pass.

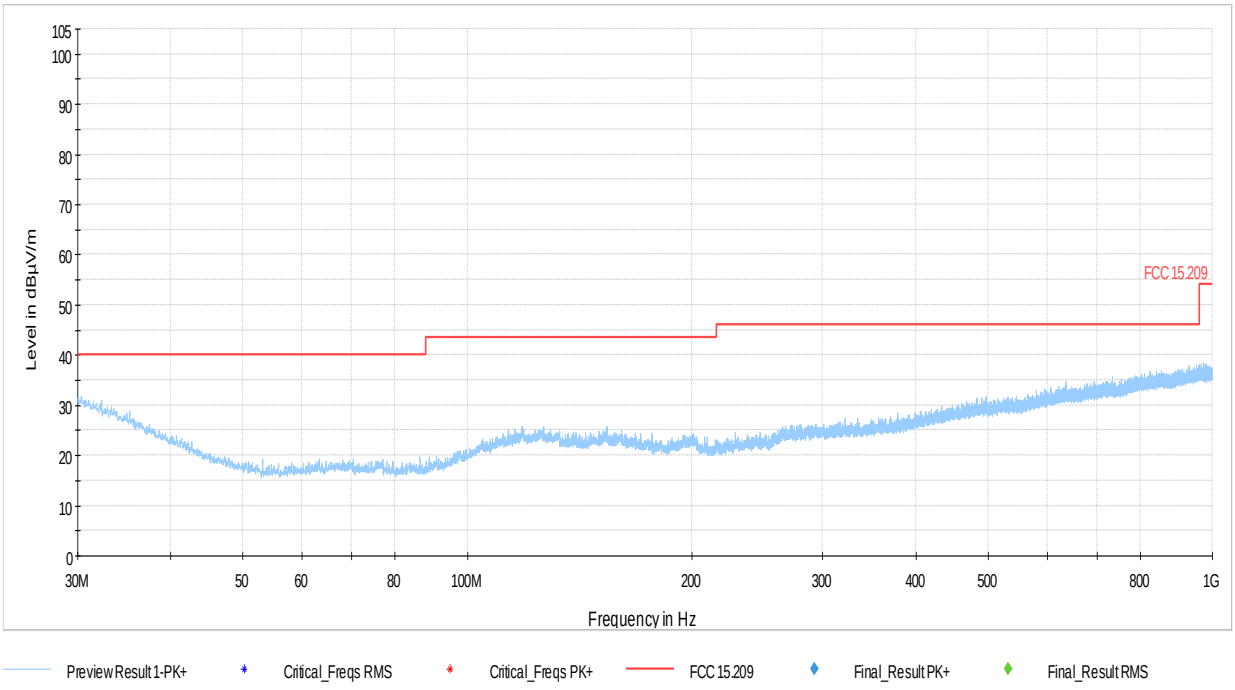
9.8.5 Test Data:

9.8.5.1 Small size sample

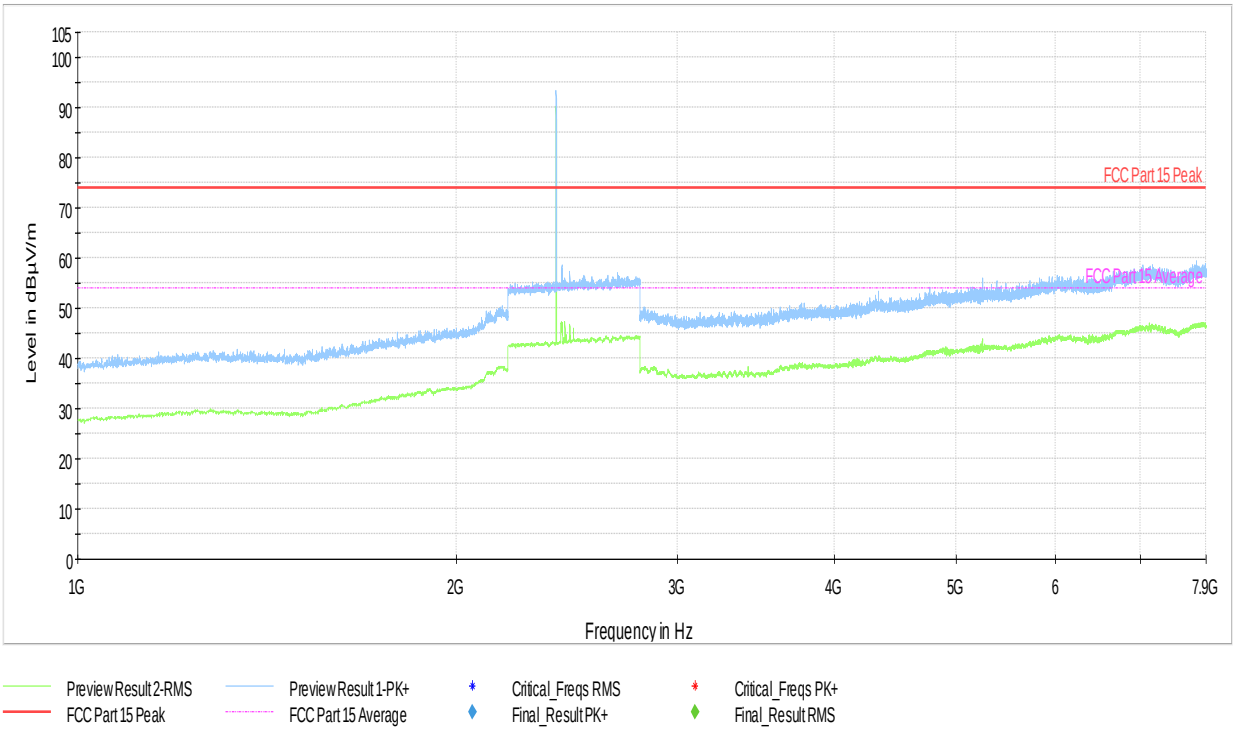
Worst case configuration and results shown below.
No significant emissions to report above noise floor and <6dB from limit.



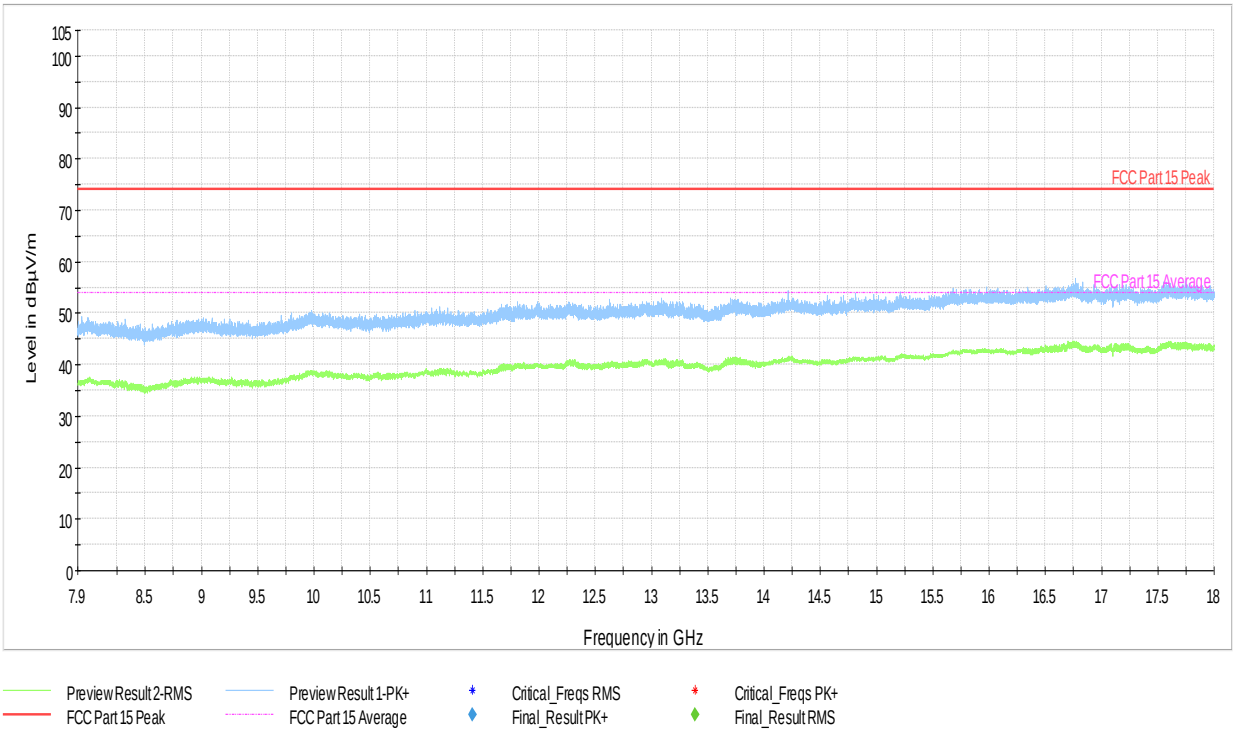
Plot 9-38. Radiated Spurious Emissions (Ch. 39) (X axis) (10 kHz – 30 MHz)



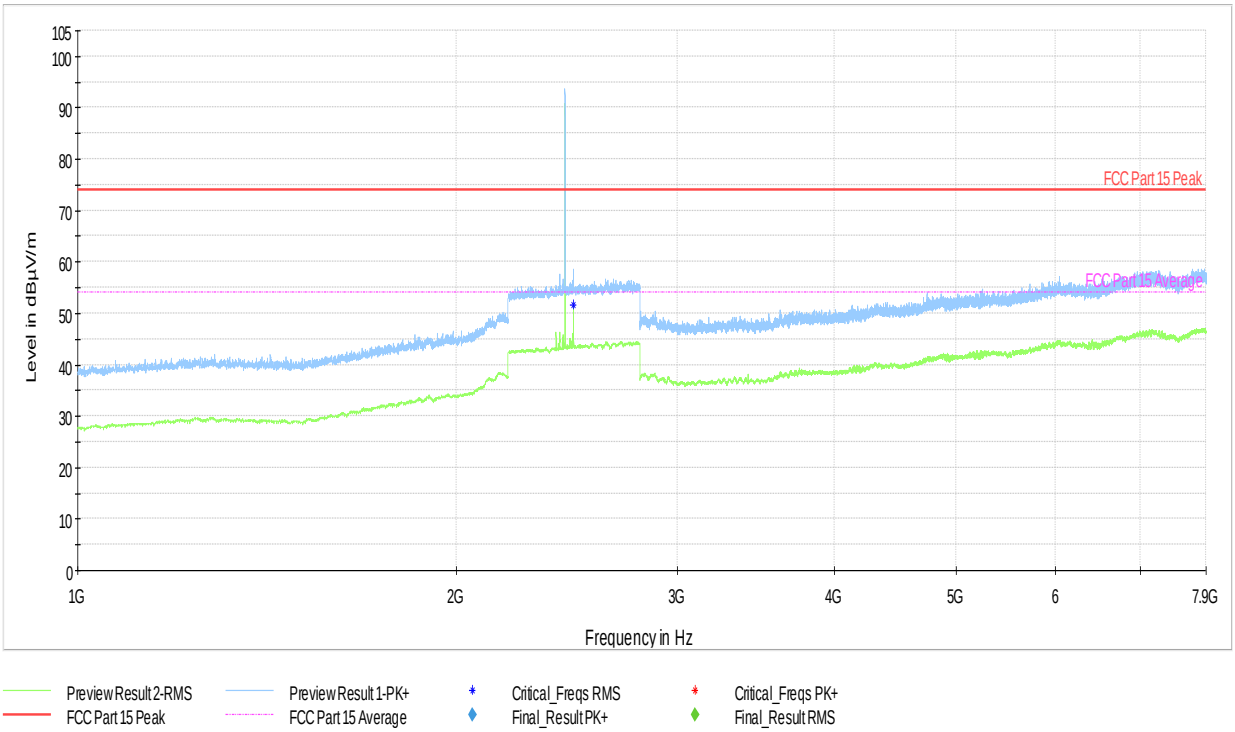
Plot 9-39. Radiated Spurious Emissions (Ch. 39) (30MHz - 1GHz)



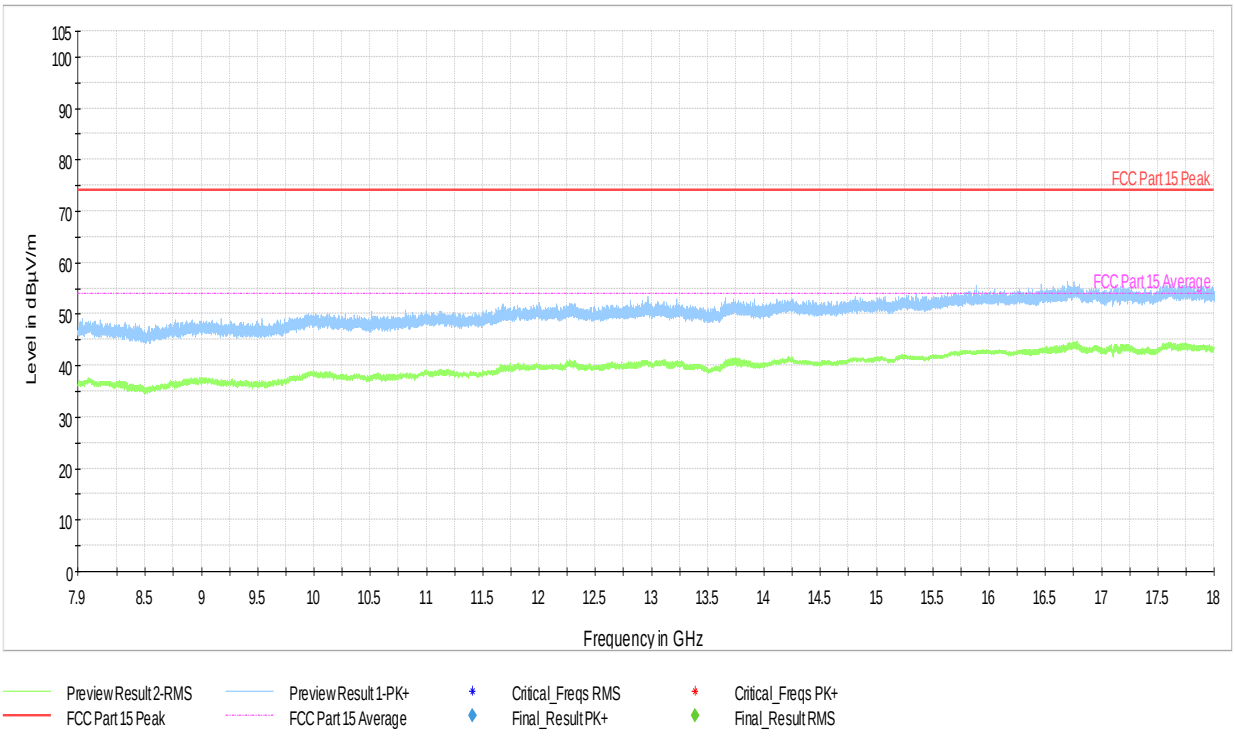
Plot 9-40. **Radiated Spurious Emissions (Ch. 0) (1-7.9GHz)**



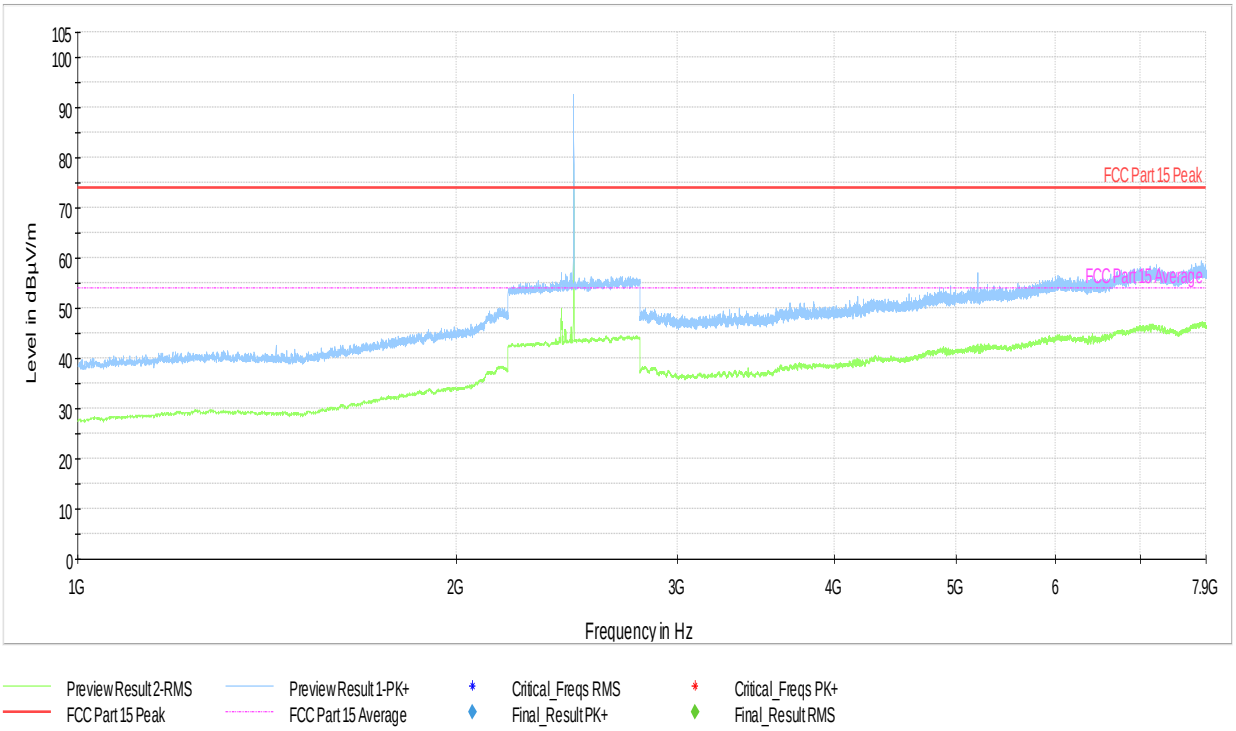
Plot 9-41. Radiated Spurious Emissions (Ch. 0) (7.9 – 18GHz)



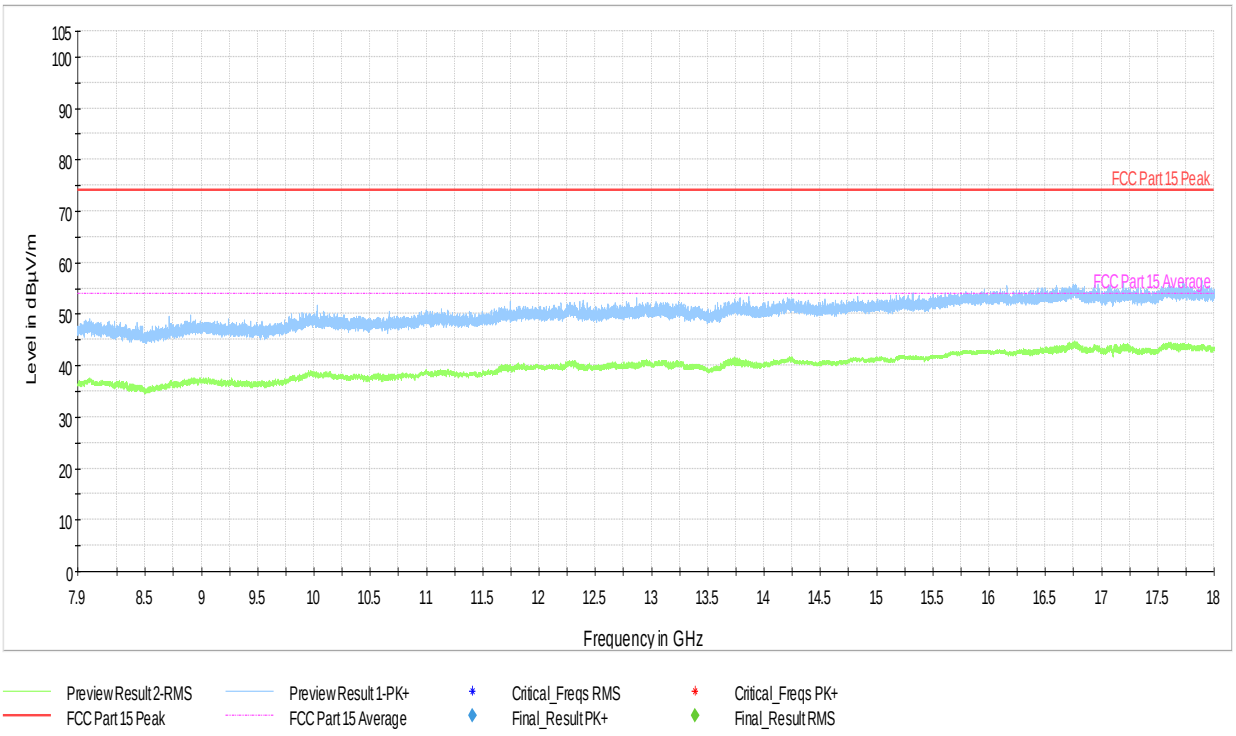
Plot 9-42. Radiated Spurious Emissions (Ch. 39) (1 – 7.9GHz)



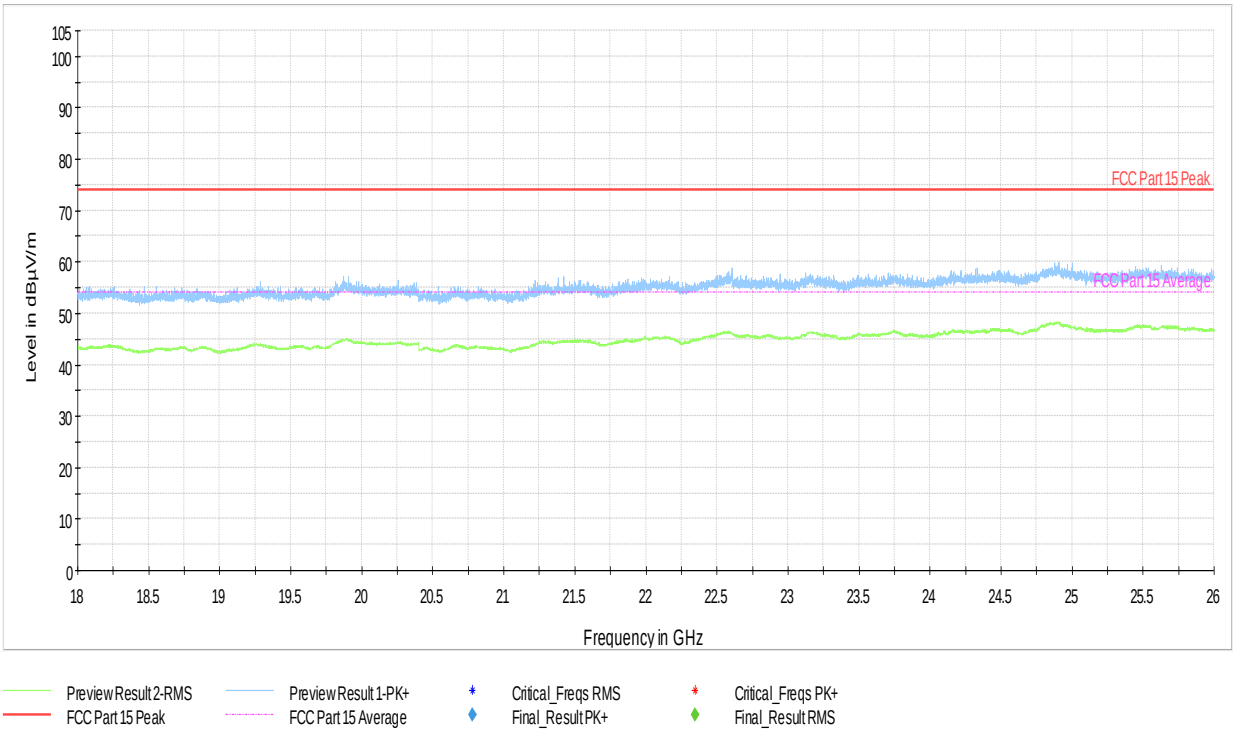
Plot 9-43. Radiated Spurious Emissions (Ch. 39) (7.9 – 18GHz)



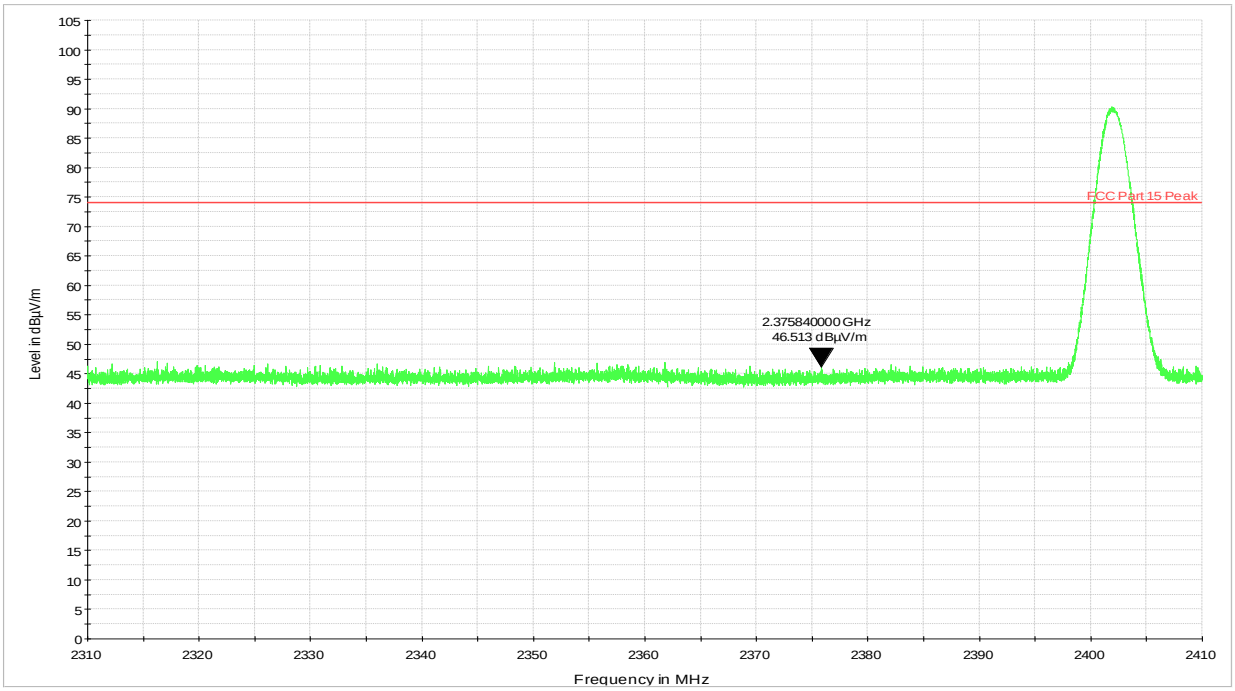
Plot 9-44. Radiated Spurious Emissions (Ch. 78) (1 – 7.9GHz)



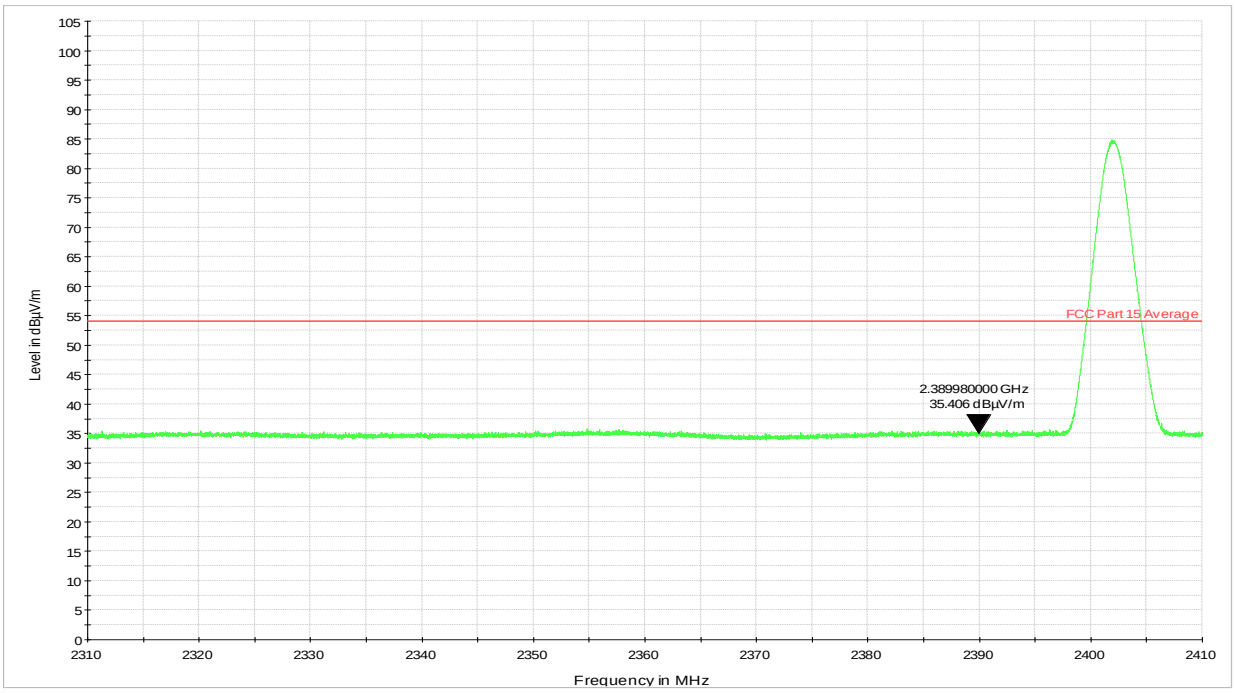
Plot 9-45. Radiated Spurious Emissions (Ch. 78) (7.9 – 18GHz)



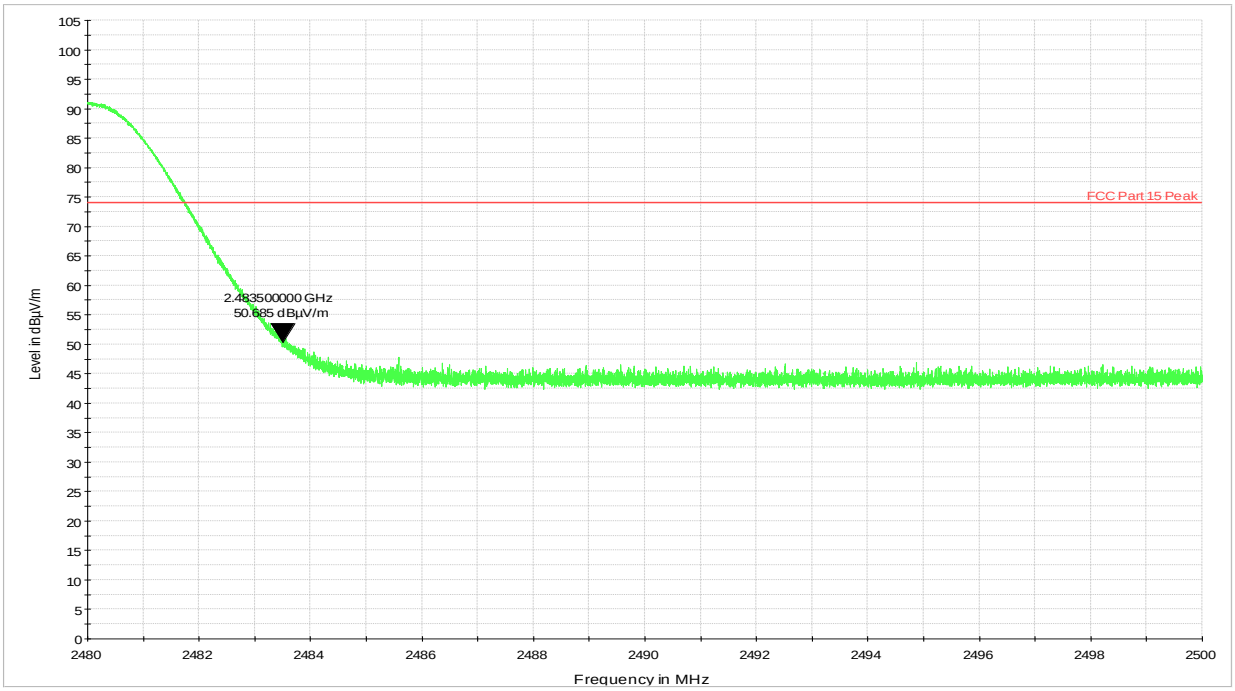
Plot 9-46. Radiated Spurious Emissions (Ch. 39) (18 - 26GHz)



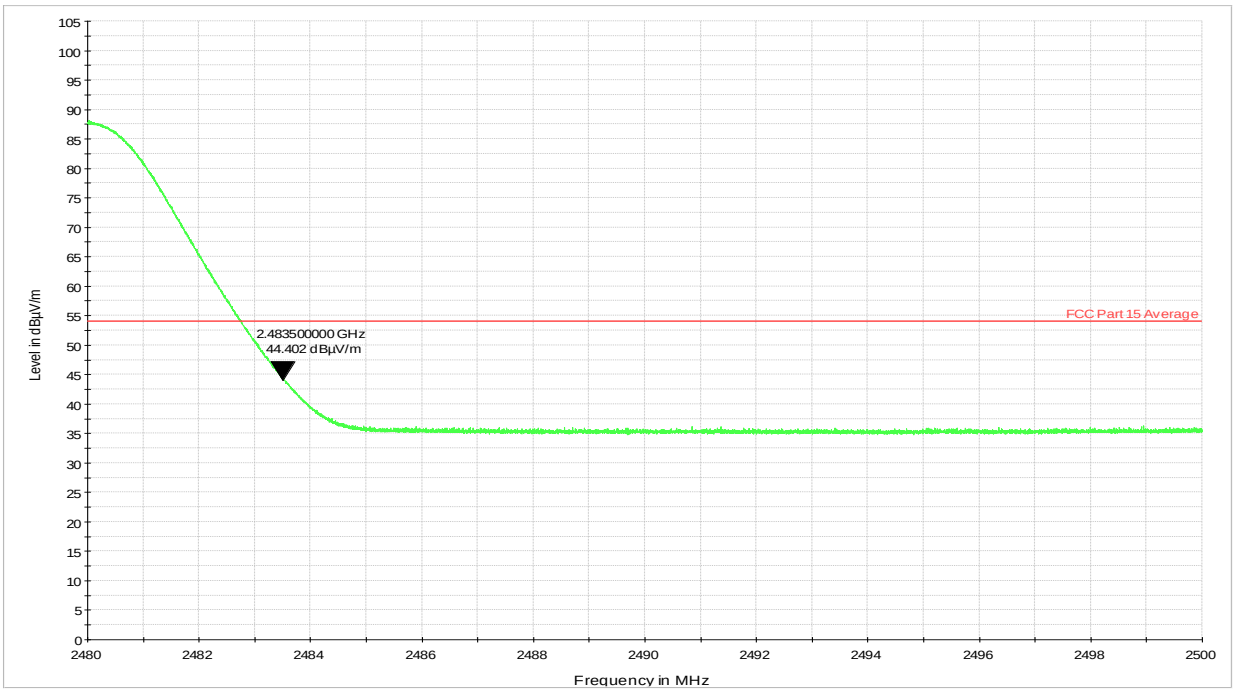
Plot 9 47. Restricted Band Edge – Ch. 0 (2310-2390MHz) – Peak



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



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

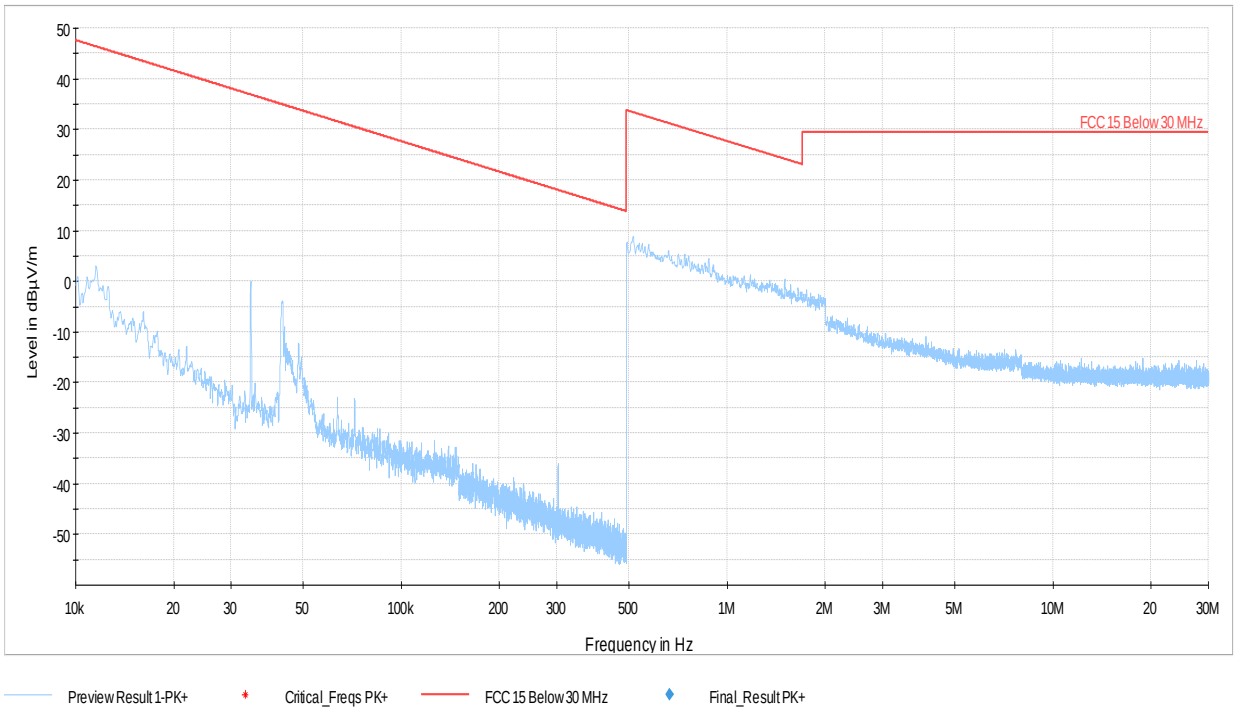


Plot 9-50. Restricted Band Edge – Ch. 78 (2483.5-2500MHz) - Average

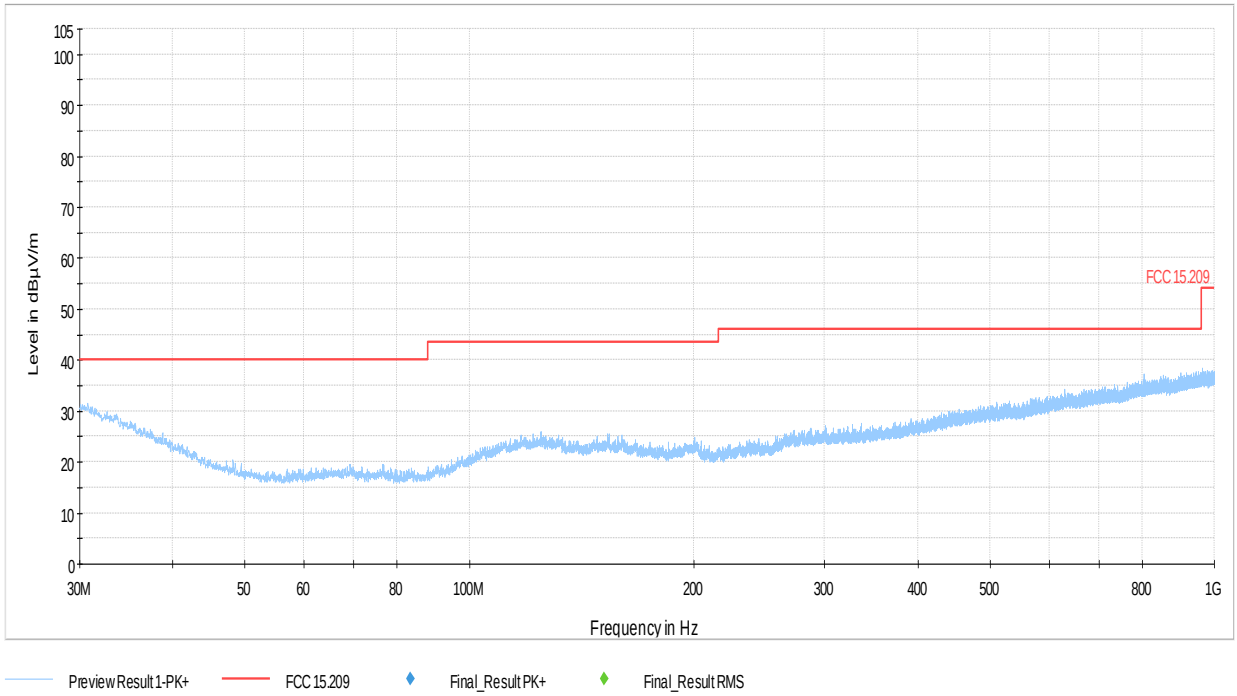
9.8.5.2 Medium size sample

Worst case results shown below.

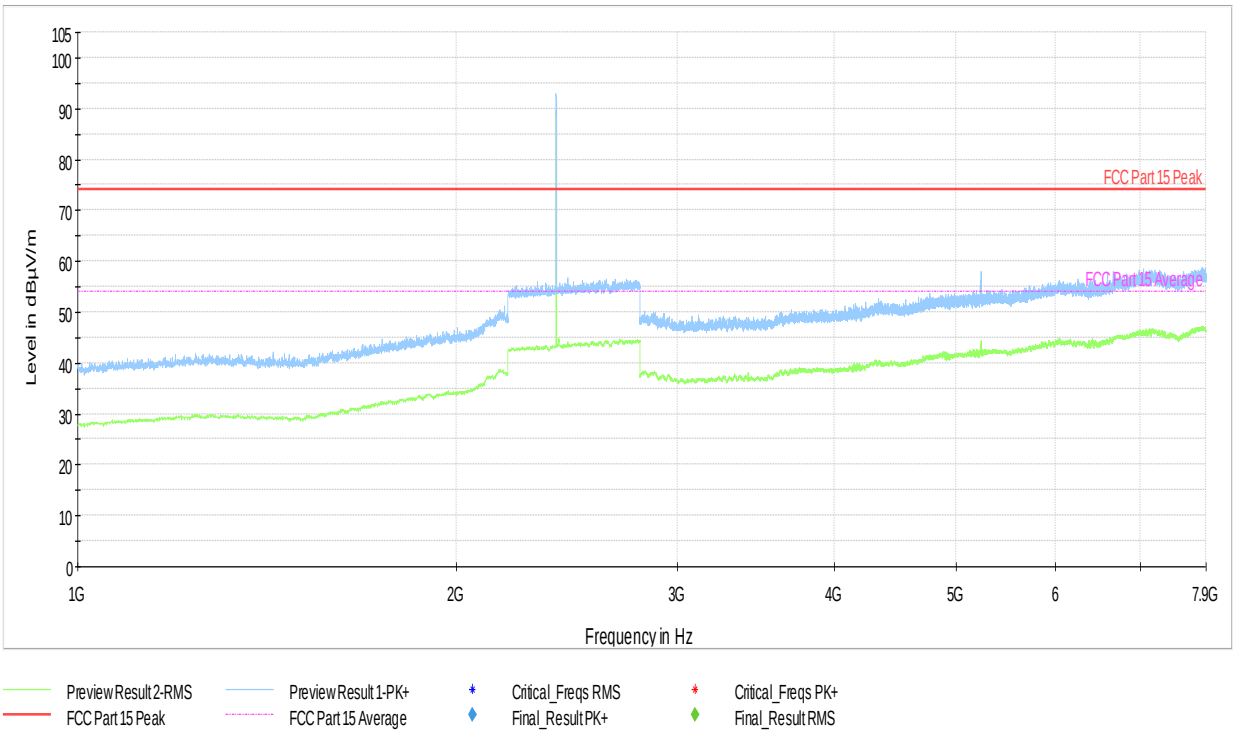
No significant emissions to report above noise floor and <6dB from limit.



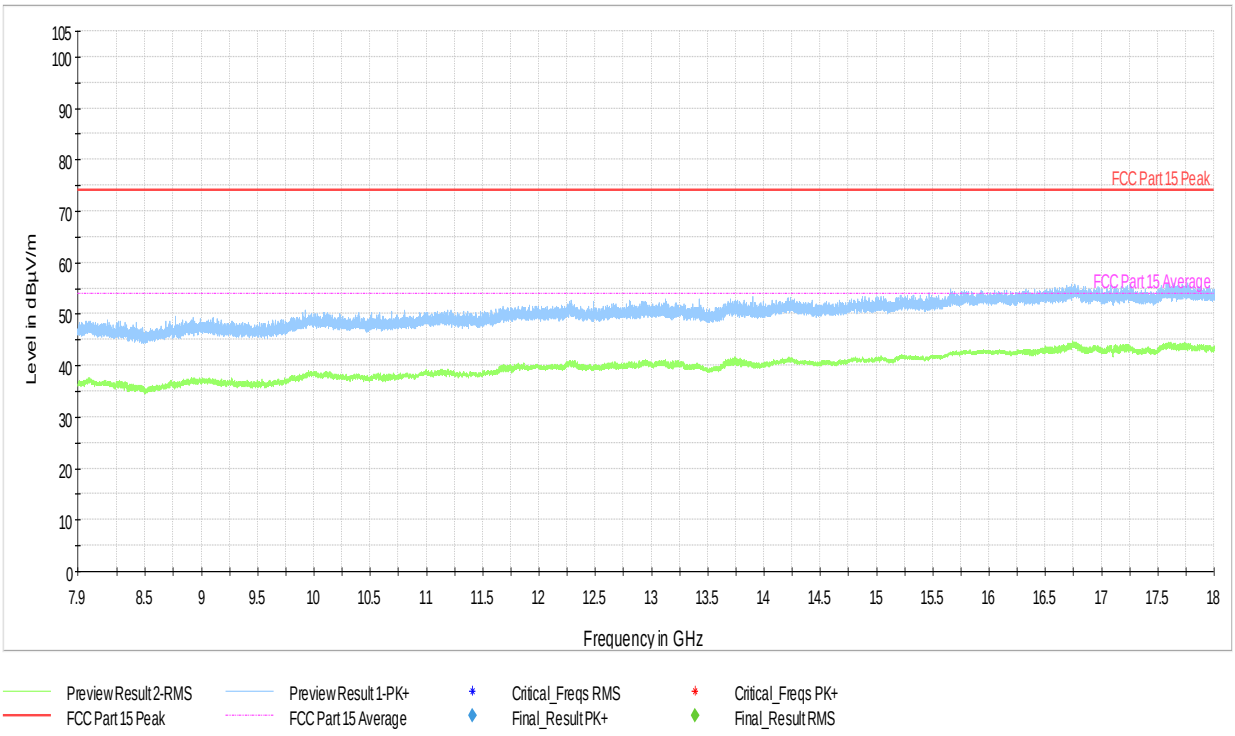
Plot 9-51. Radiated Spurious Emissions (Ch. 39) (X axis) (10 kHz – 30 MHz)



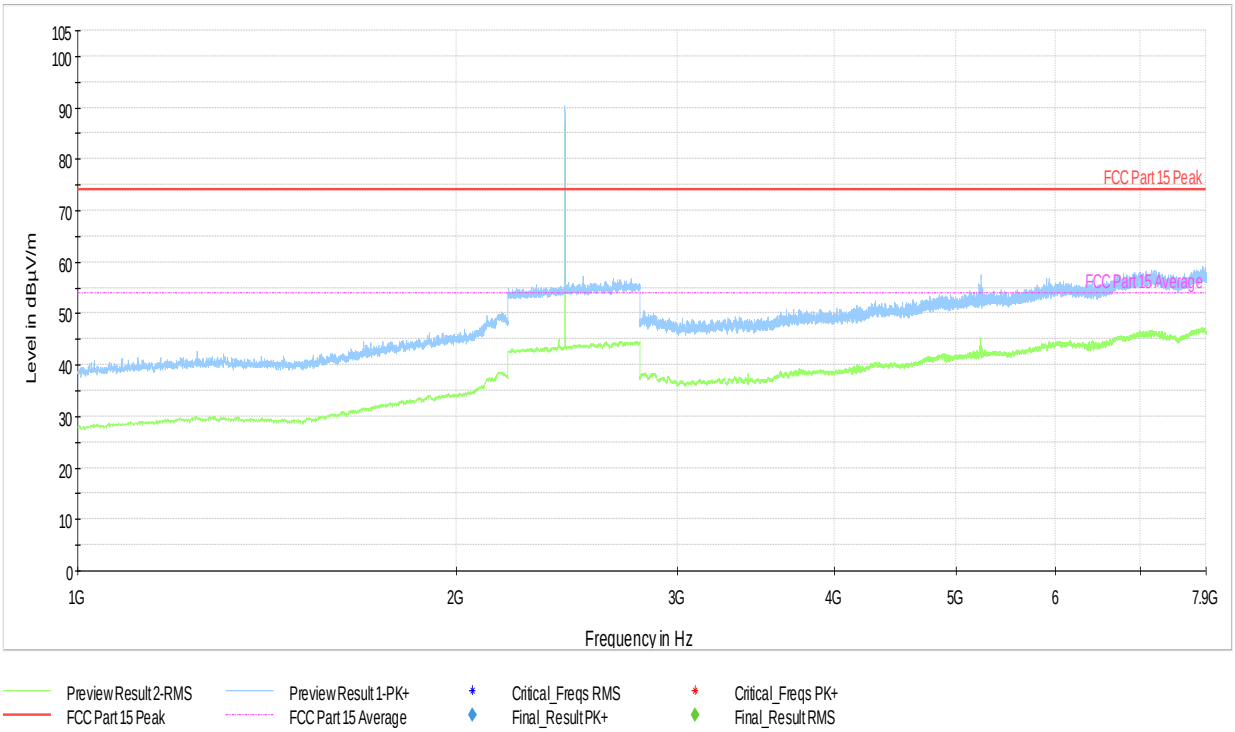
Plot 9-52. Radiated Spurious Emissions (Ch. 39) (30MHz – 1GHz)



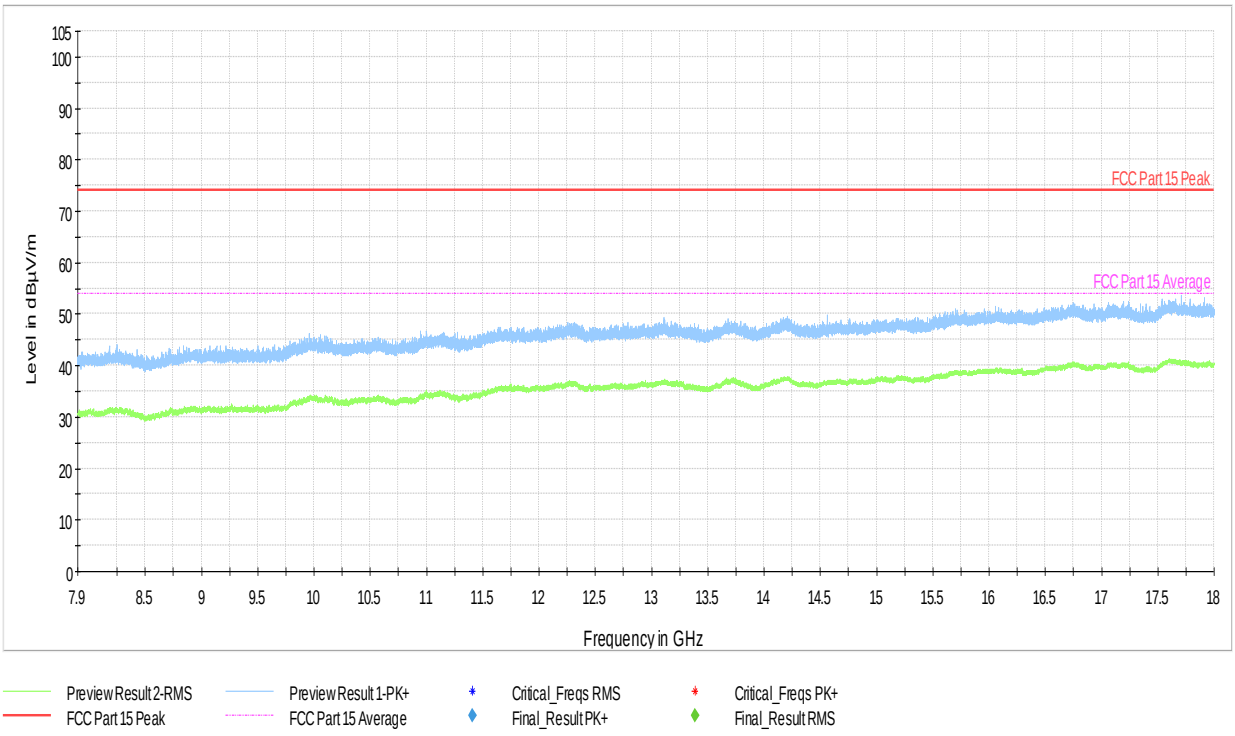
Plot 9-53. Radiated Spurious Emissions (Ch. 0) (1 – 7.9GHz)



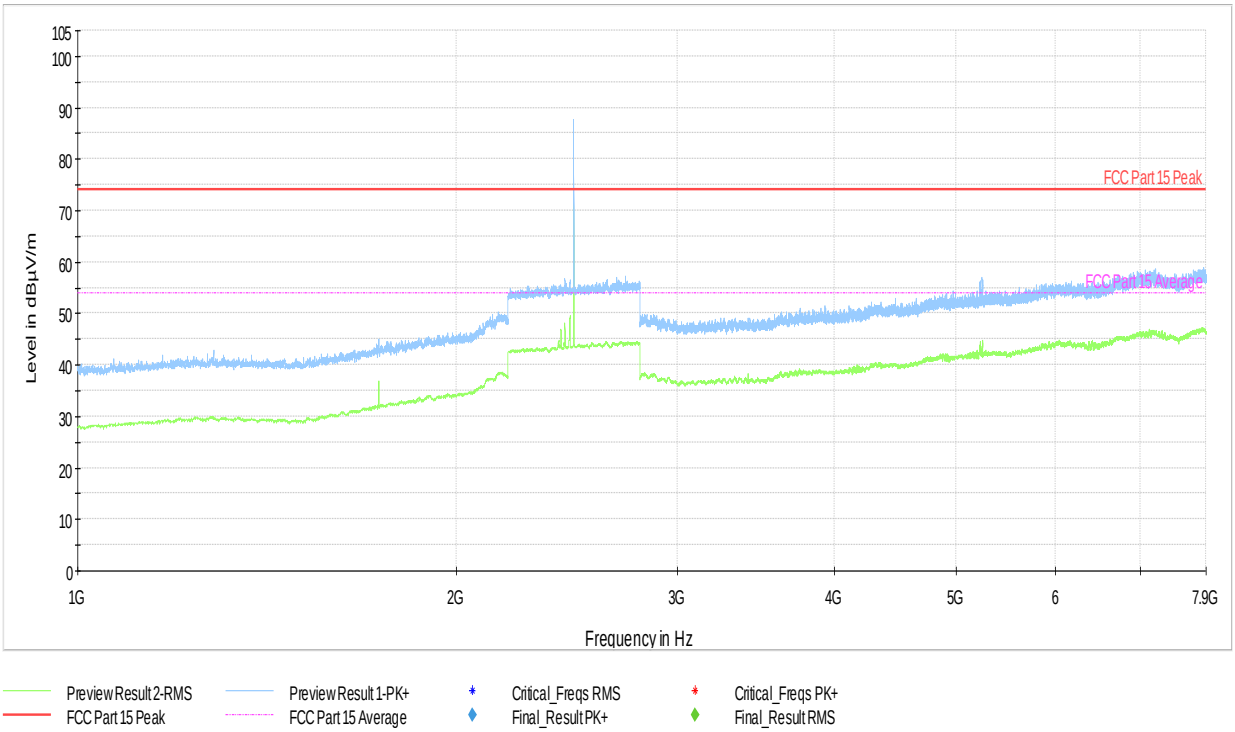
Plot 9-54. Radiated Spurious Emissions (Ch. 0) (7.9 – 18GHz)



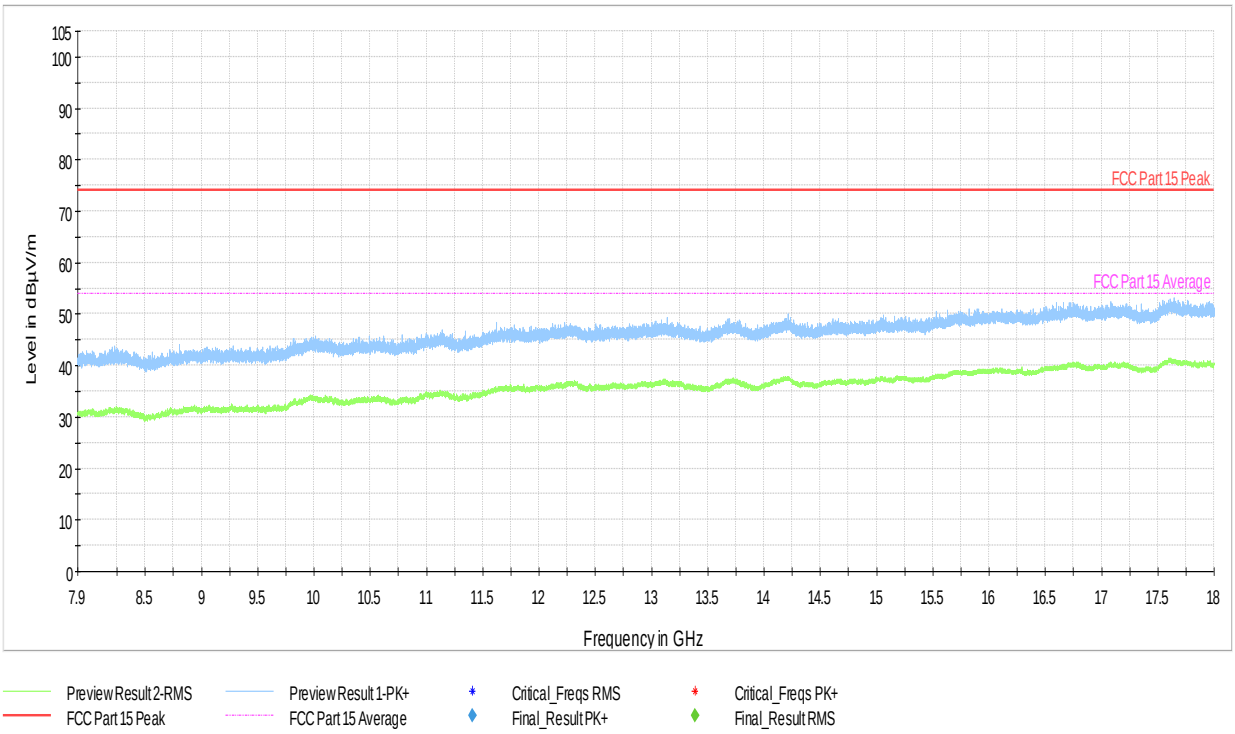
Plot 9-55. Radiated Spurious Emissions (Ch. 39) (1 – 7.9GHz)



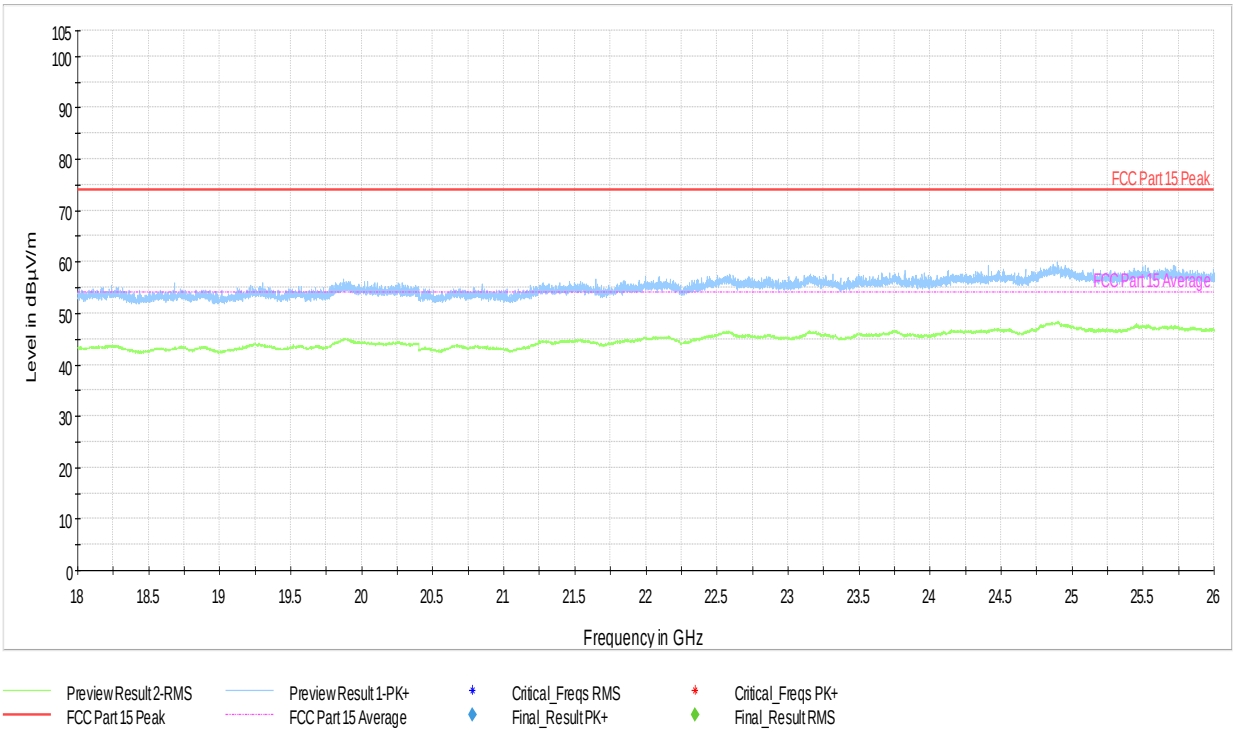
Plot 9-56. Radiated Spurious Emissions (Ch. 39) (7.9 – 18GHz)



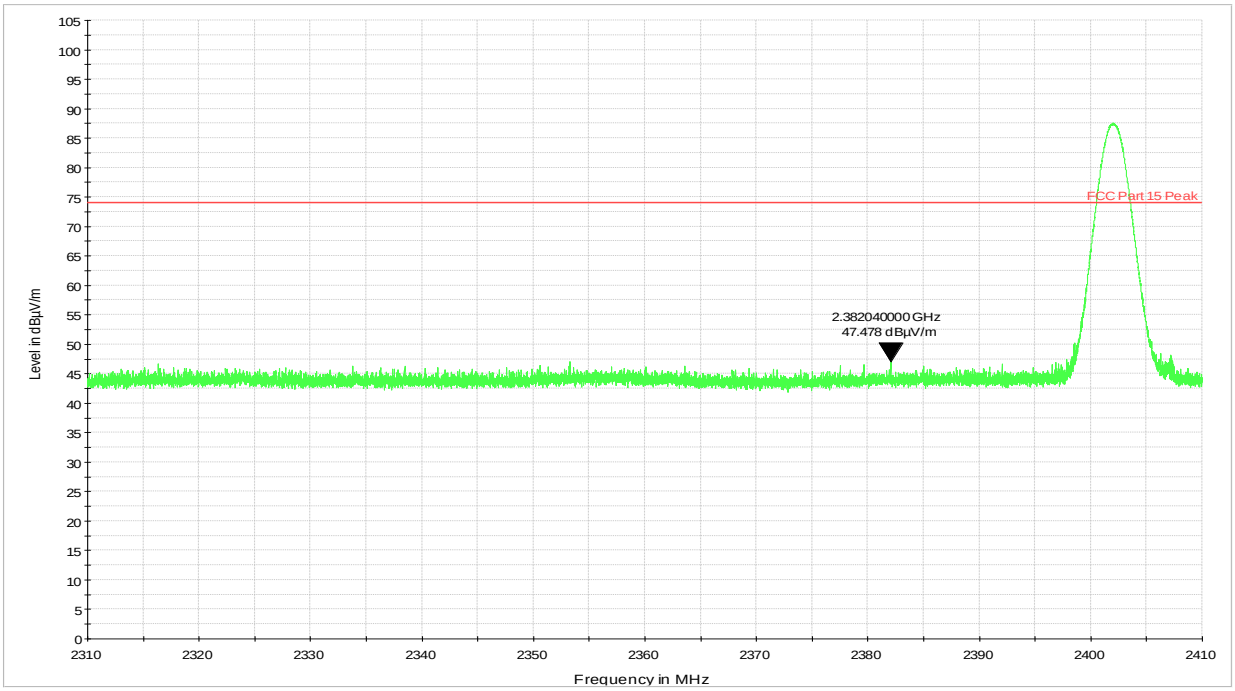
Plot 9-57. Radiated Spurious Emissions (Ch. 78) (1 – 7.9GHz)



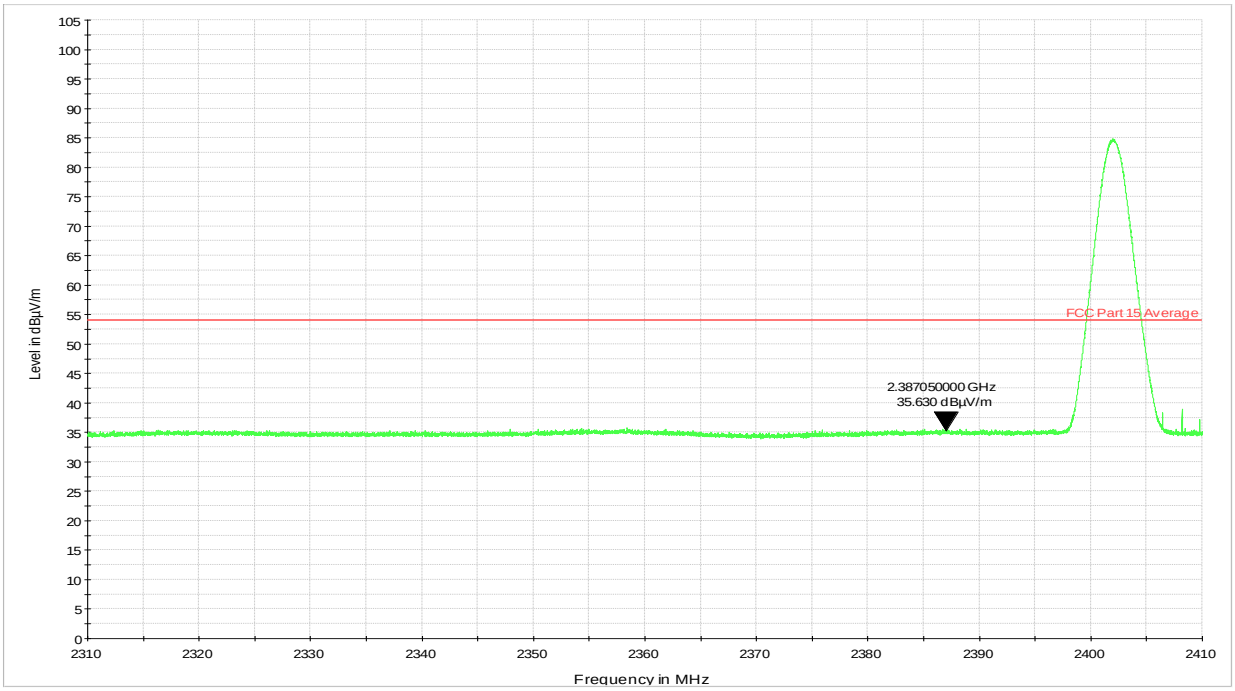
Plot 9-58. Radiated Spurious Emissions (Ch. 78) (7.9 – 18GHz)



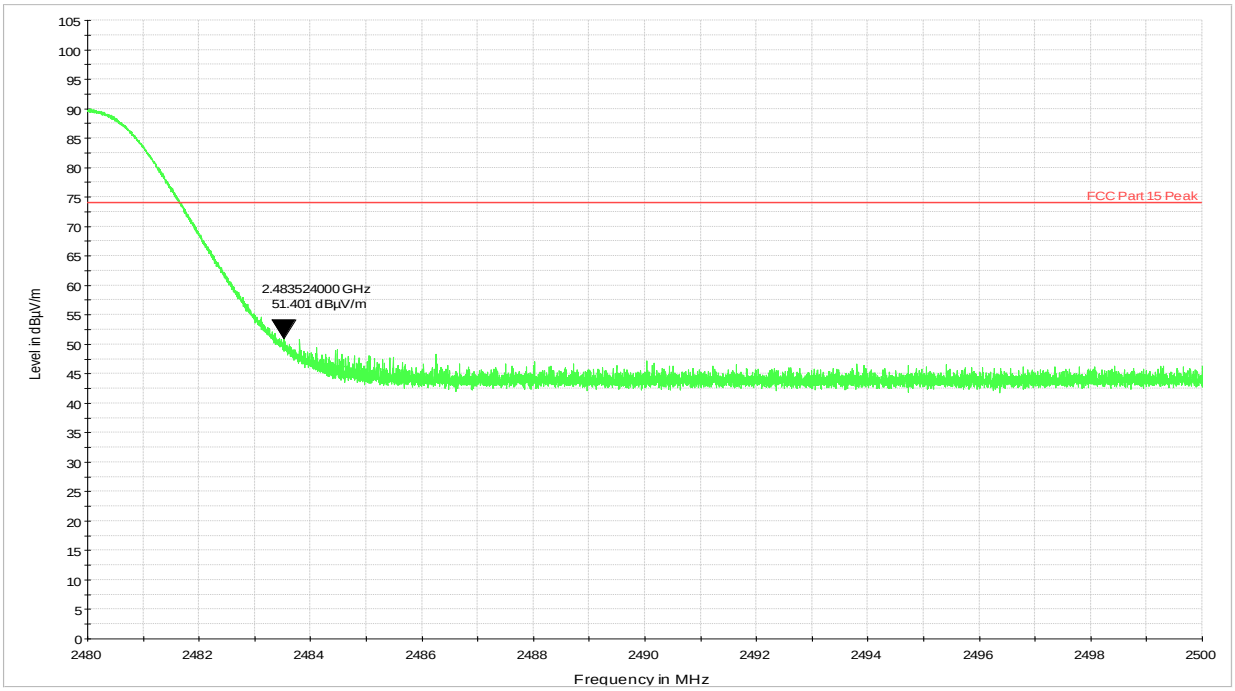
Plot 9-59. Radiated Spurious Emissions (Ch. 39) (18 - 26GHz)



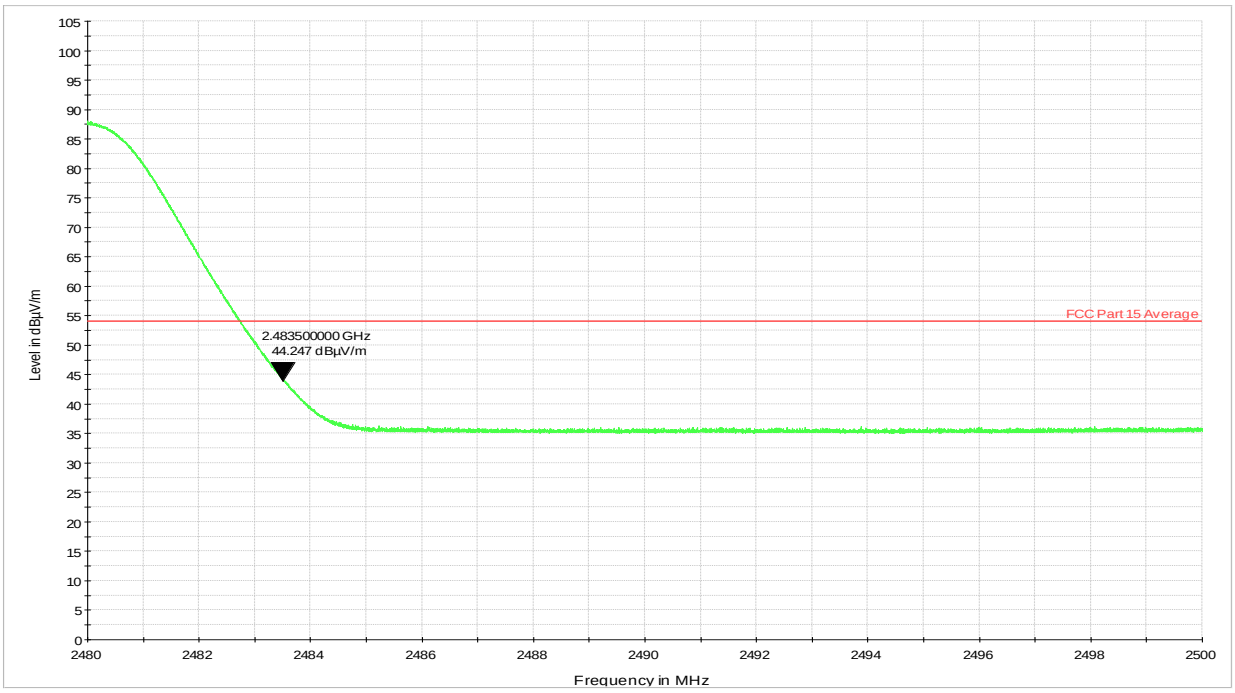
Plot 9-60. Restricted Band Edge – Ch. 0 (2310-2390MHz) – Peak



Plot 9-61. Restricted Band Edge – Ch. 0 (2310-2390MHz) – Average



Plot 9-62. Restricted Band Edge – Ch. 78 (2483.5-2500MHz) – Peak

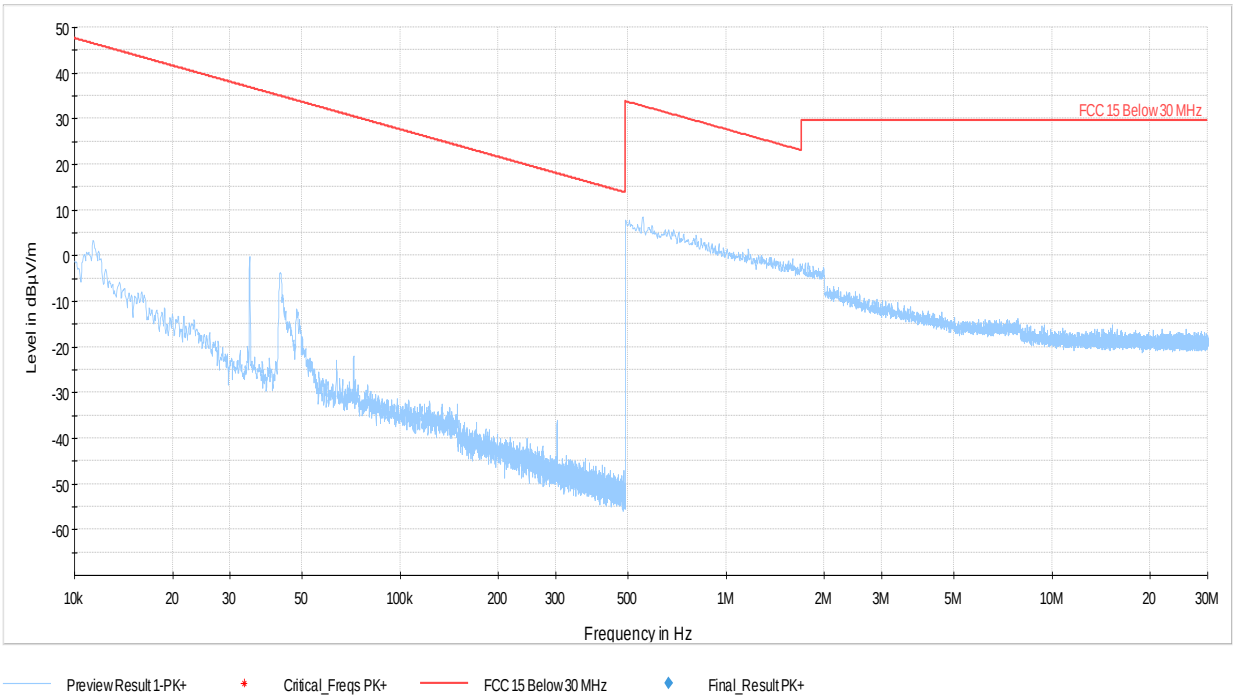


Plot 9-63. Restricted Band Edge – Ch. 78 (2483.5-2500MHz) – Average

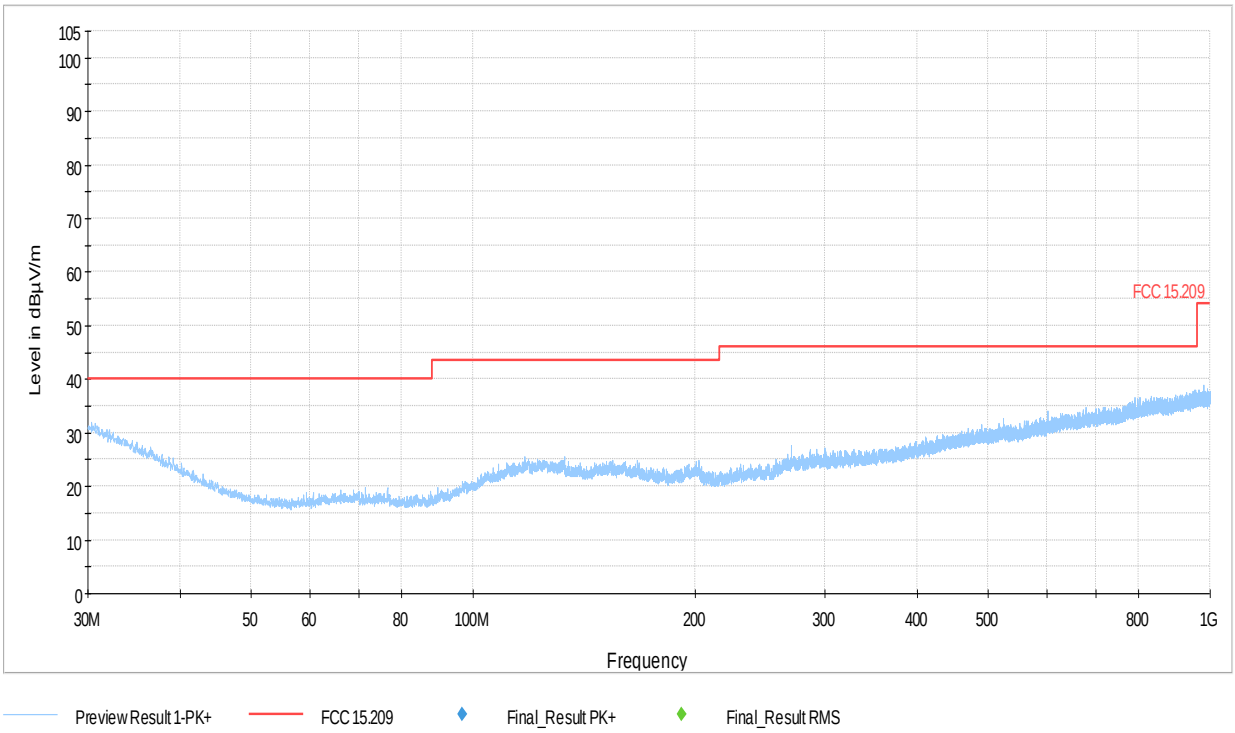
9.8.5.3 Large size sample

Worst case results shown below.

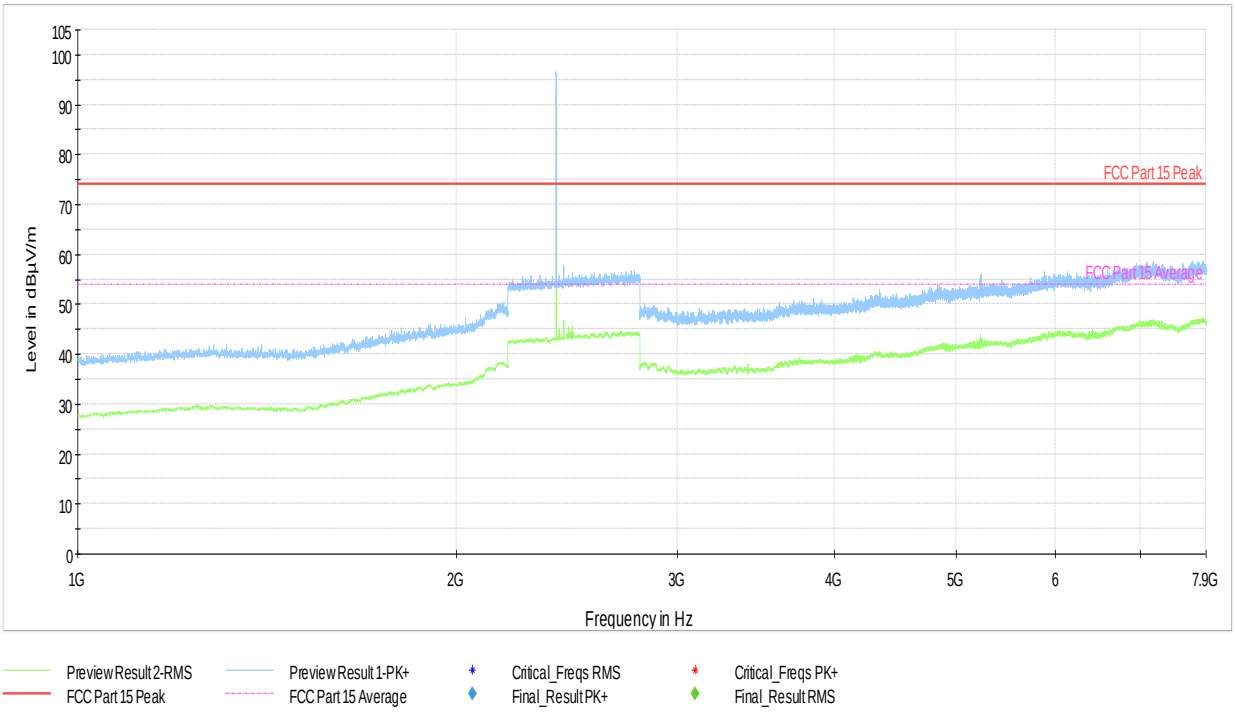
No significant emissions to report above noise floor and <6dB from limit.



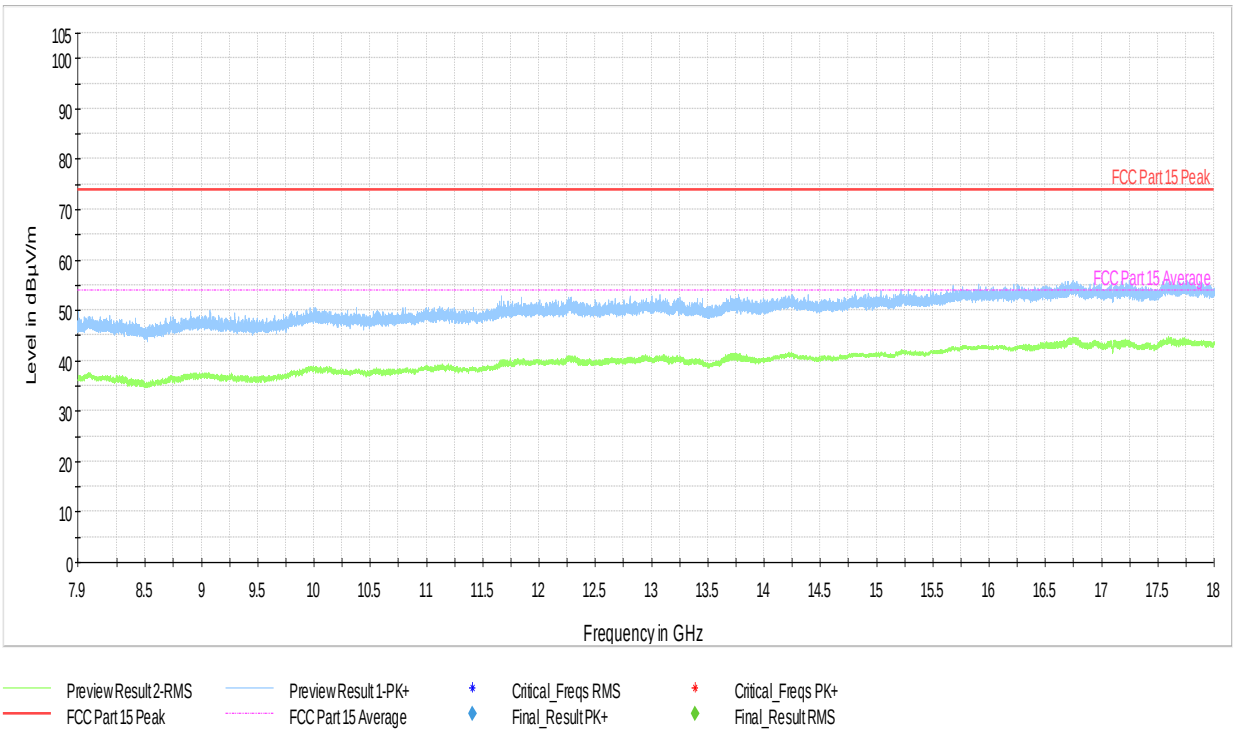
Plot 9-64. Radiated Spurious Emissions (Ch. 39) (X axis) (10 kHz – 30 MHz)



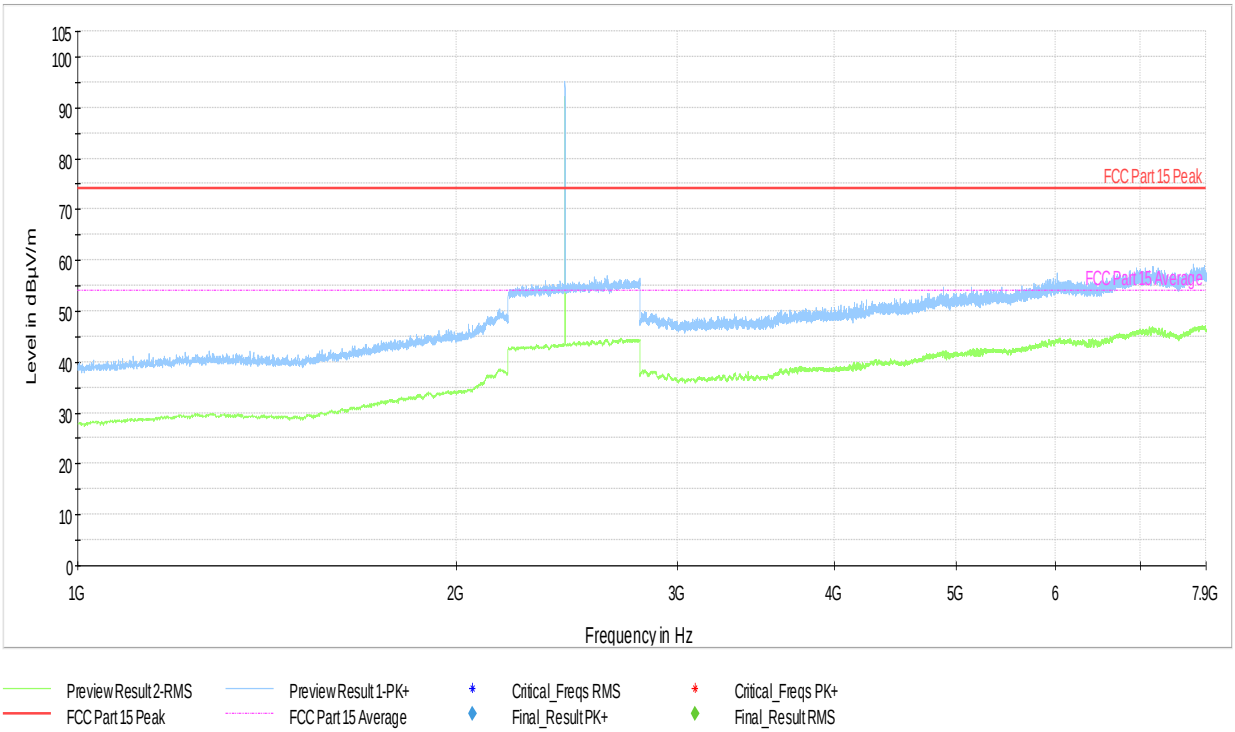
Plot 9-65. Radiated Spurious Emissions - Ch. 39, Large (30MHz – 1GHz)



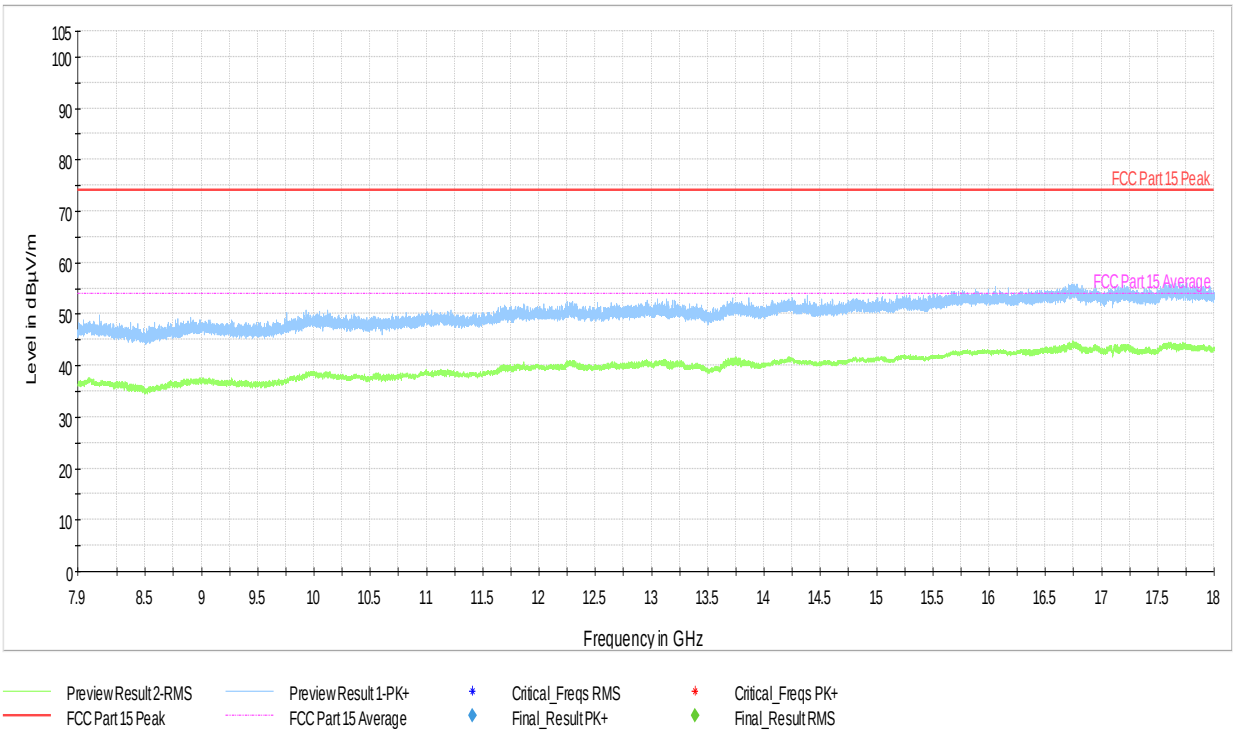
Plot 9-66. Radiated Spurious Emissions (Ch. 0) (1 – 7.9GHz)



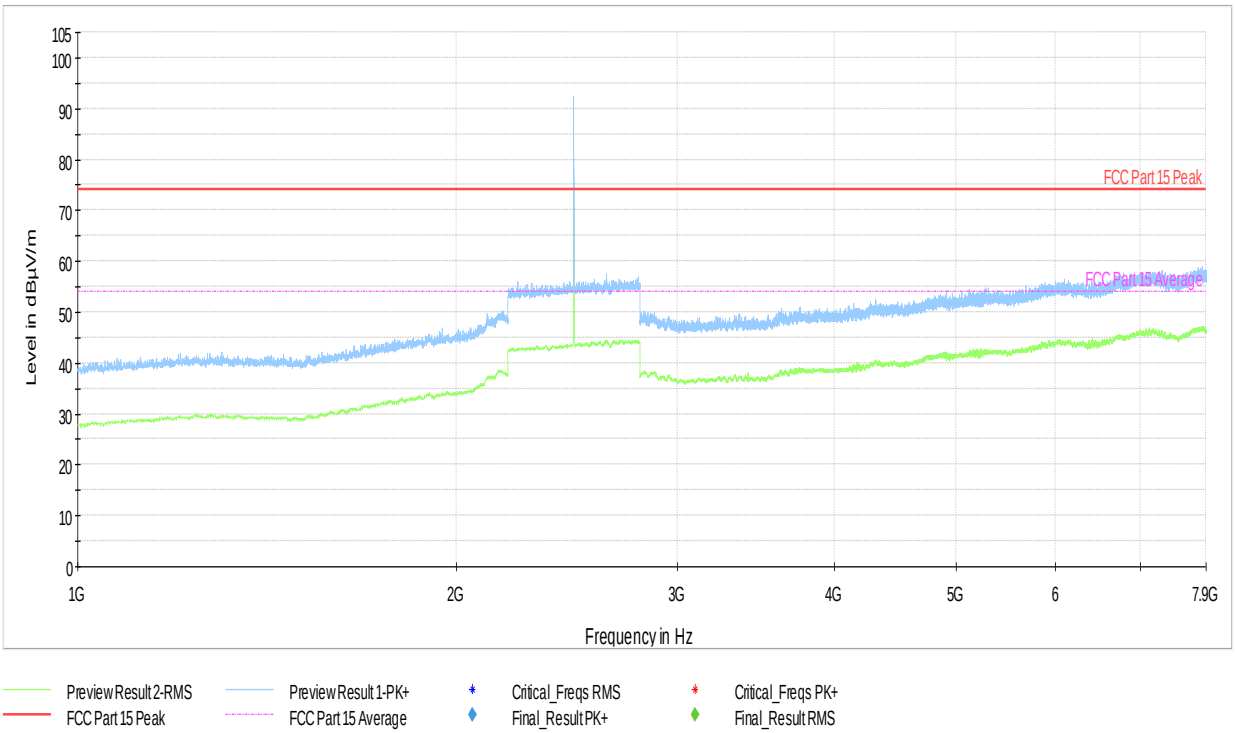
Plot 9-67. Radiated Spurious Emissions (Ch. 0) (7.9 – 18GHz)



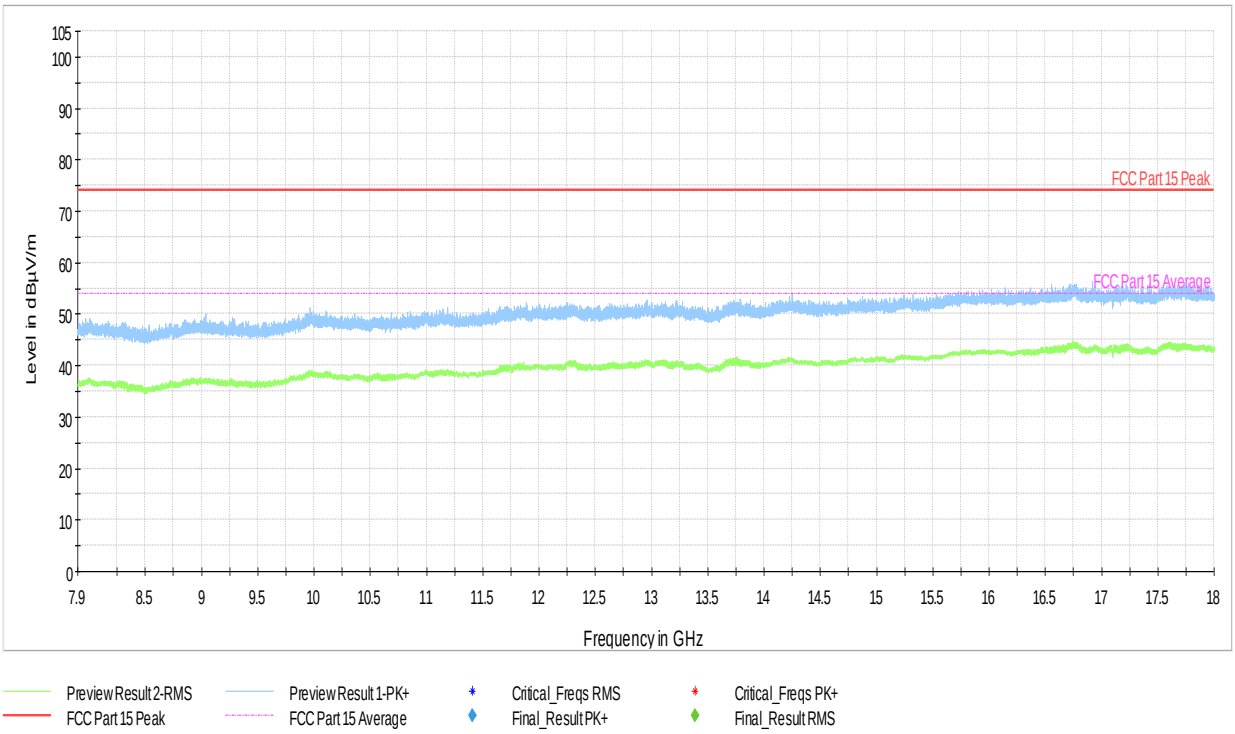
Plot 9-68. Radiated Spurious Emissions (Ch. 39) (1 – 7.9GHz)



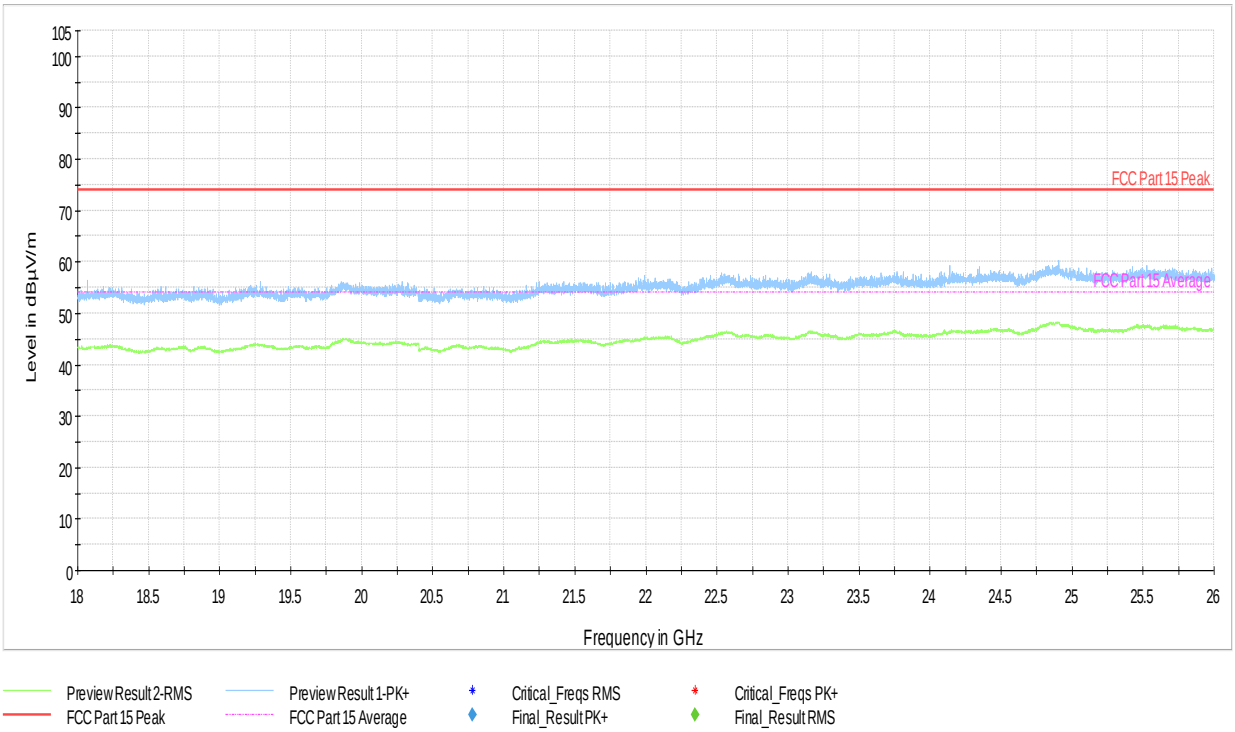
Plot 9-69. Radiated Spurious Emissions (Ch. 39) (7.9 – 18GHz)



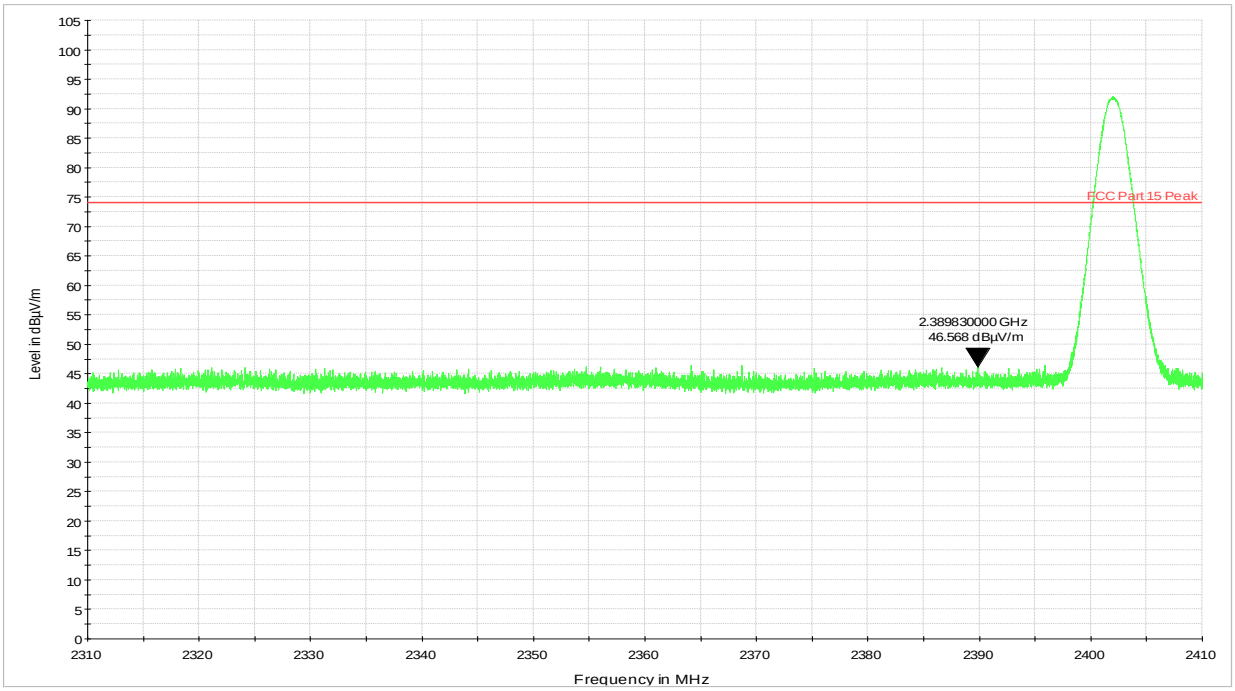
Plot 9-70. Radiated Spurious Emissions (Ch. 78) (1 – 7.9GHz)



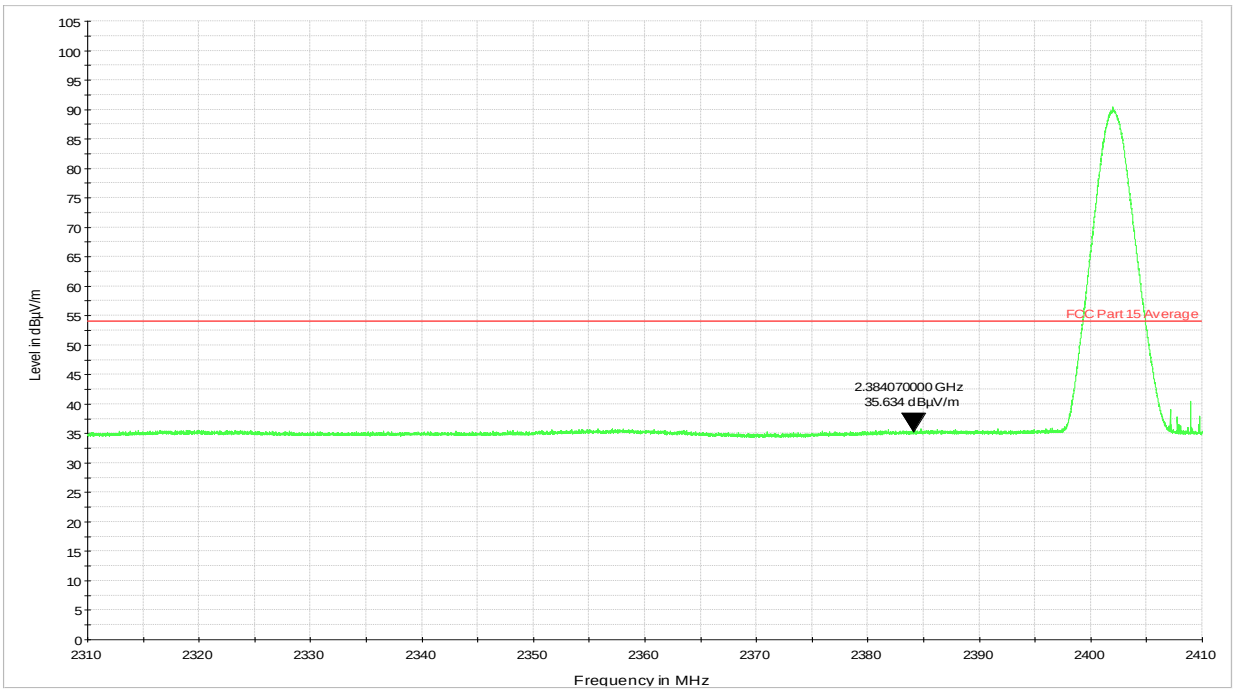
Plot 9-71. Radiated Spurious Emissions (Ch. 78) (7.9 – 18GHz)



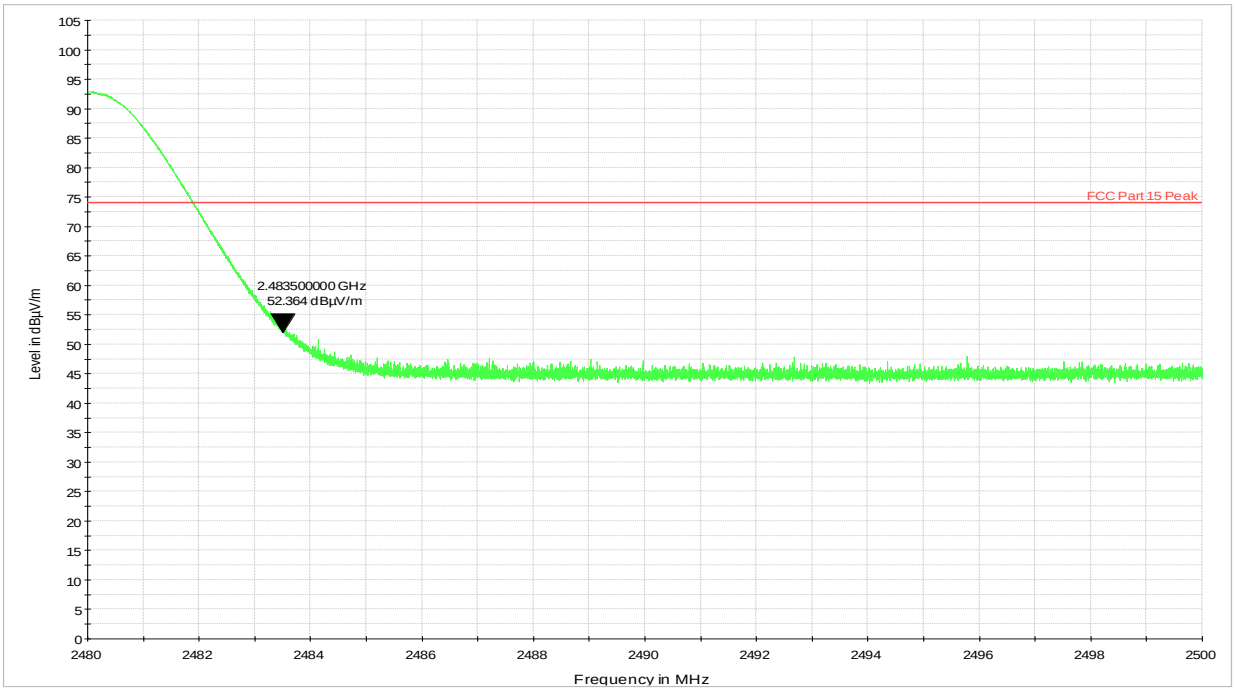
Plot 9-72. Radiated Spurious Emissions (Ch. 39) (18 – 26GHz)



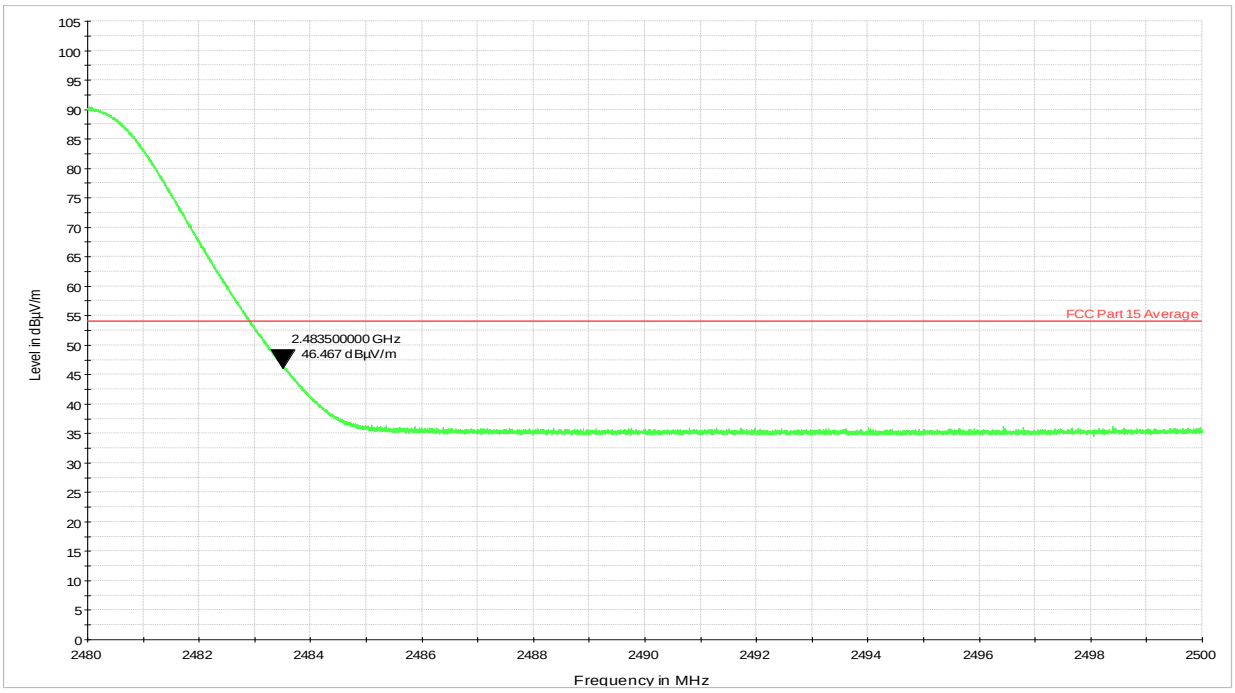
Plot 9-73. Restricted Band Edge – Ch. 0 (2310-2390MHz) – Peak



Plot 9-74. Restricted Band Edge – Ch. 0 (2310-2390MHz) – Average



Plot 9-75. Restricted Band Edge – Ch. 78 (2483.5-2500MHz) – Peak



Plot 9-76. Restricted Band Edge – Ch. 78 (2483.5-2500MHz) - Average

9.9 AC LINE CONDUCTED EMISSIONS

9.9.1 Test Requirement:

FCC CFR 47 Rule Part 15.207

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.

Sample Calculation:

Conducted Emissions: Adjusted Level = Measured Level + LISN Factor + Cable Factor + External Attenuation

Eg. Emissions at 5 MHz= 27.9+10.03+0.12= 38.05 dBµV

9.9.3 Limits:

FCC CFR 47 Rule Part 15.207

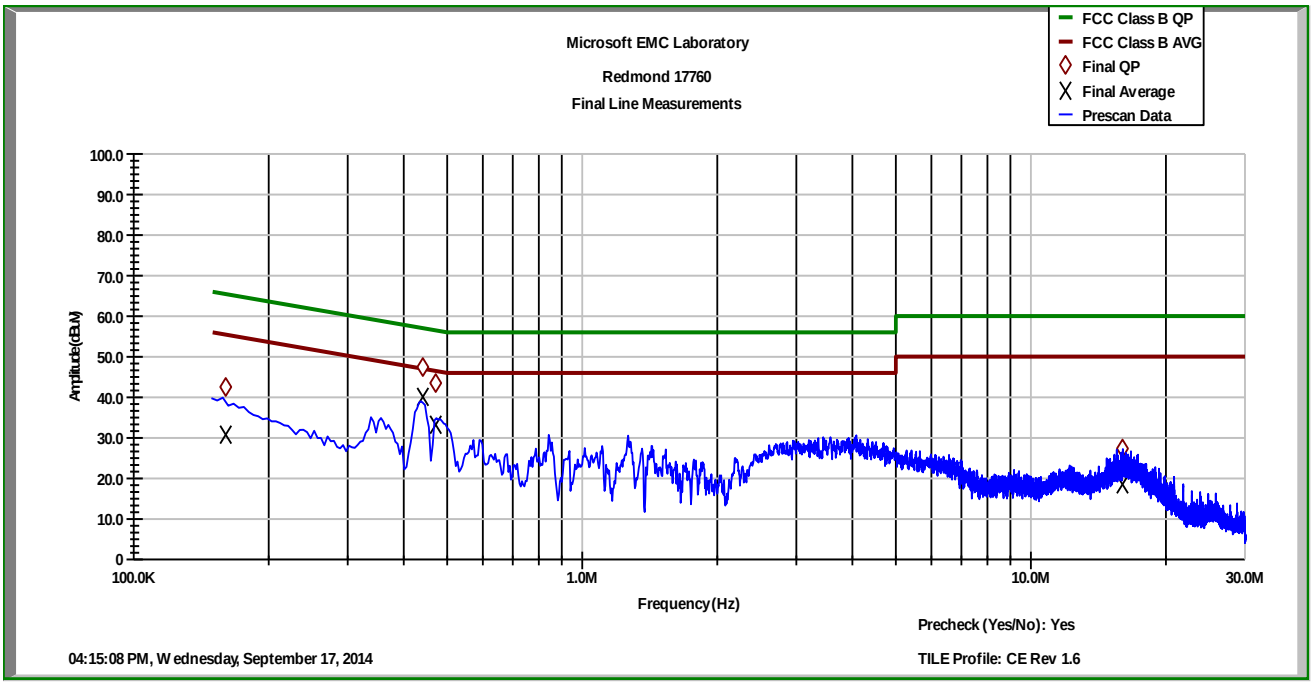
Frequency of emissions (MHz)	Quasi Peak (dBµV)	Average (dBµV)
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

9.9.4 Test Equipment

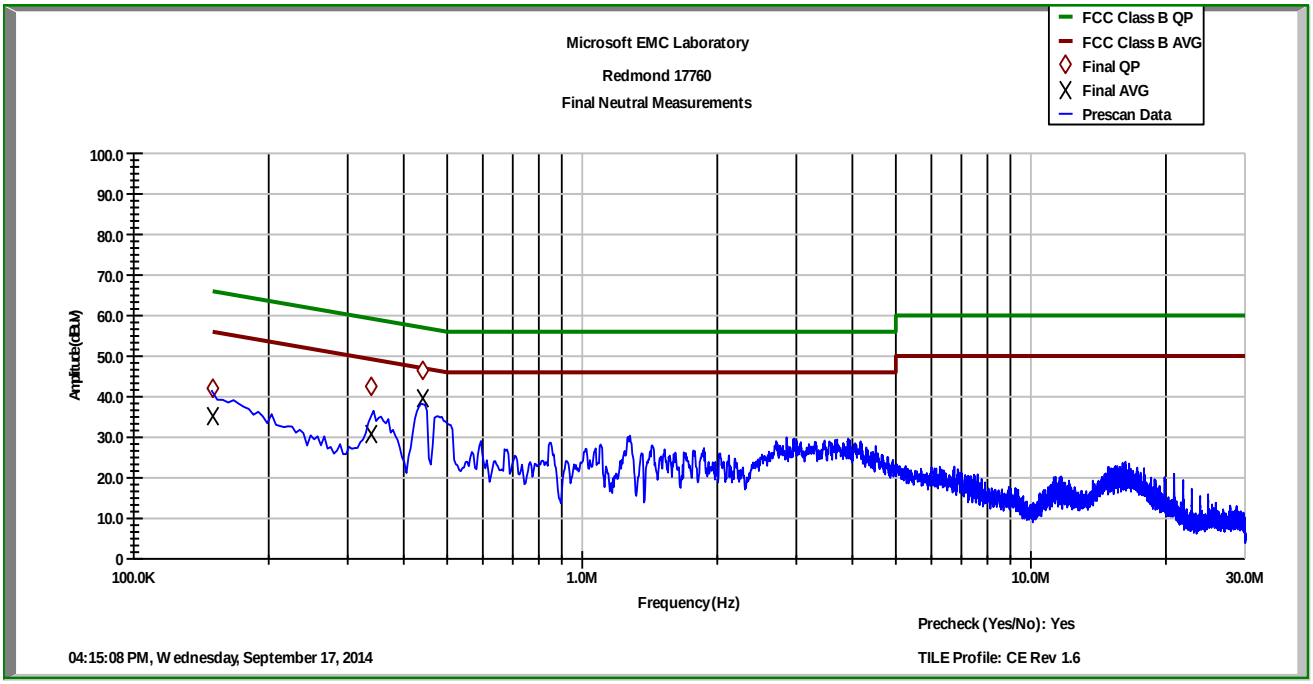
Description	Manufacturer	Model	ID	Last Cal	Cal Interval
EMI Receiver	Rohde-Schwarz	ESR3	EMC-669	10/14/13	12 mo.
LISN	TESEQ	NNB 51	EMC-676	10/28/13	12 mo.
Cable	Microcoax	N/A	EMC-367	No cal	0 mo.
TILE SW	ETS	N/A	N/A	N/A	N/A

9.9.5 Test Results:

9.9.5.1 Small size sample



Plot 9-77. Peak Line Measurements

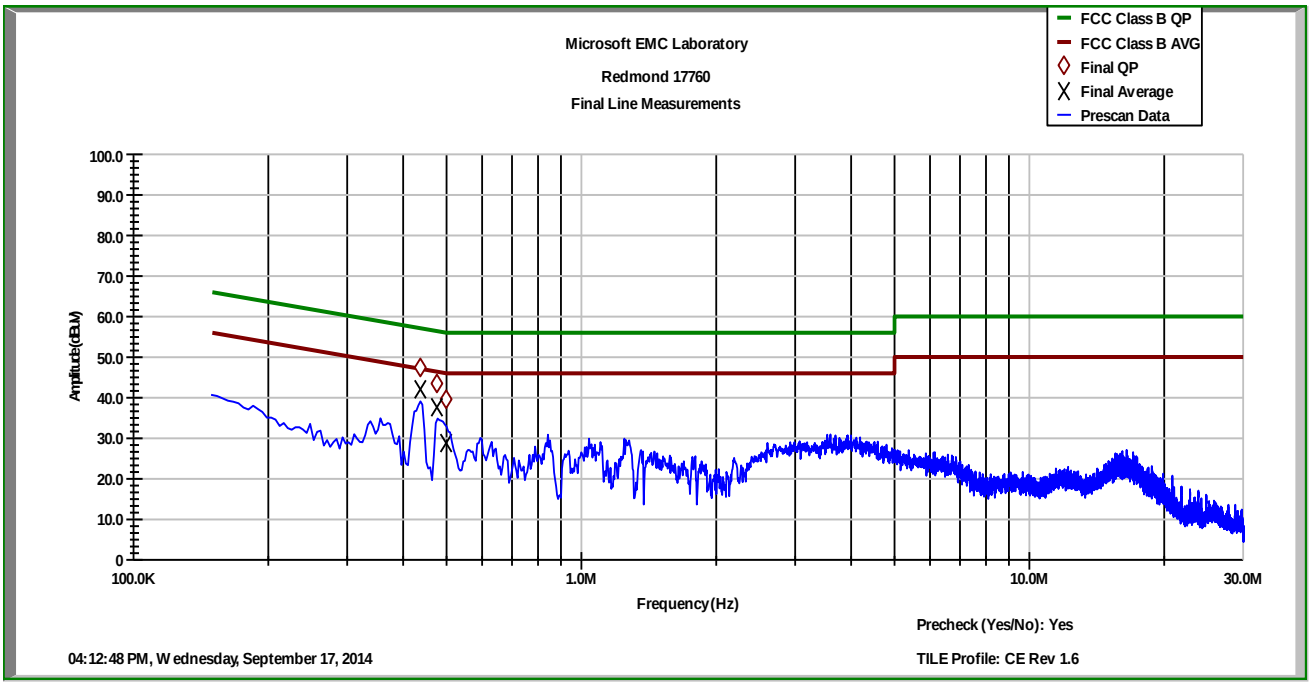


Plot 9-78. Peak Neutral Measurements

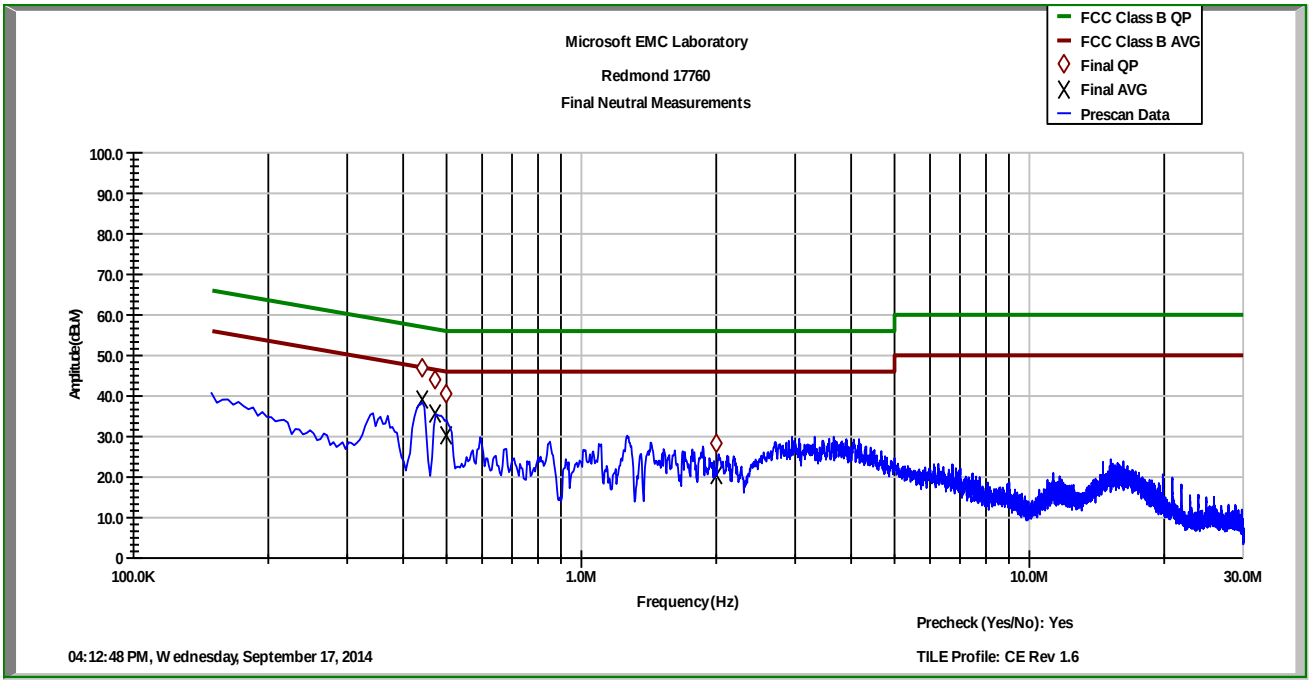
Freq (MHz)	PK Amplitude (dBµV)	QP Amplitude (dBµV)	AVG Amplitude (dBµV)	Cable Loss (dB)	LISN Factors	External Attenuation (dB)	PK Net Reading (dBµV)	QP Net Reading (dBµV)	AVG Net Reading (dBµV)	Class B QP Limit (dBµV)	Class B AVG Limit (dBµV)	Line Tested (L or N)	PK Margin compared to AVG Limit (dB)	QP Margin (dB)	AVG Margin (dB)
0.16	39	32.32	20.82	0.08	9.97	-	49.05	42.37	30.87	66	56	L	-5.79	-23.35	-24.85
0.44	38.73	37.53	30.2	0.11	10.02	-	48.86	47.66	40.33	58	48	L	1.06	-10.06	-7.39
0.47	34.46	33.18	23.2	0.11	10.02	-	44.6	43.31	33.33	57	47	L	-1.56	-13.54	-13.52
16.03	22.82	17.27	8.46	0.18	10.1	-	33.09	27.54	18.73	60	50	L	-12.49	-32.46	-31.27
0.15	41.06	32.14	25.36	0.07	9.97	-	51.1	42.19	35.41	66	56	N	-4.9	-23.81	-20.59
0.34	35.71	32.57	20.5	0.1	9.99	-	45.8	42.67	30.6	61	51	N	-3.92	-17.91	-19.98
0.44	38.16	36.42	29.6	0.11	10.01	-	48.28	46.54	39.72	58	48	N	0.42	-11.17	-7.99

Table: Final QP and Average Measurement Data

9.9.5.2 Medium size sample



Plot 9-79. Peak Line Measurements

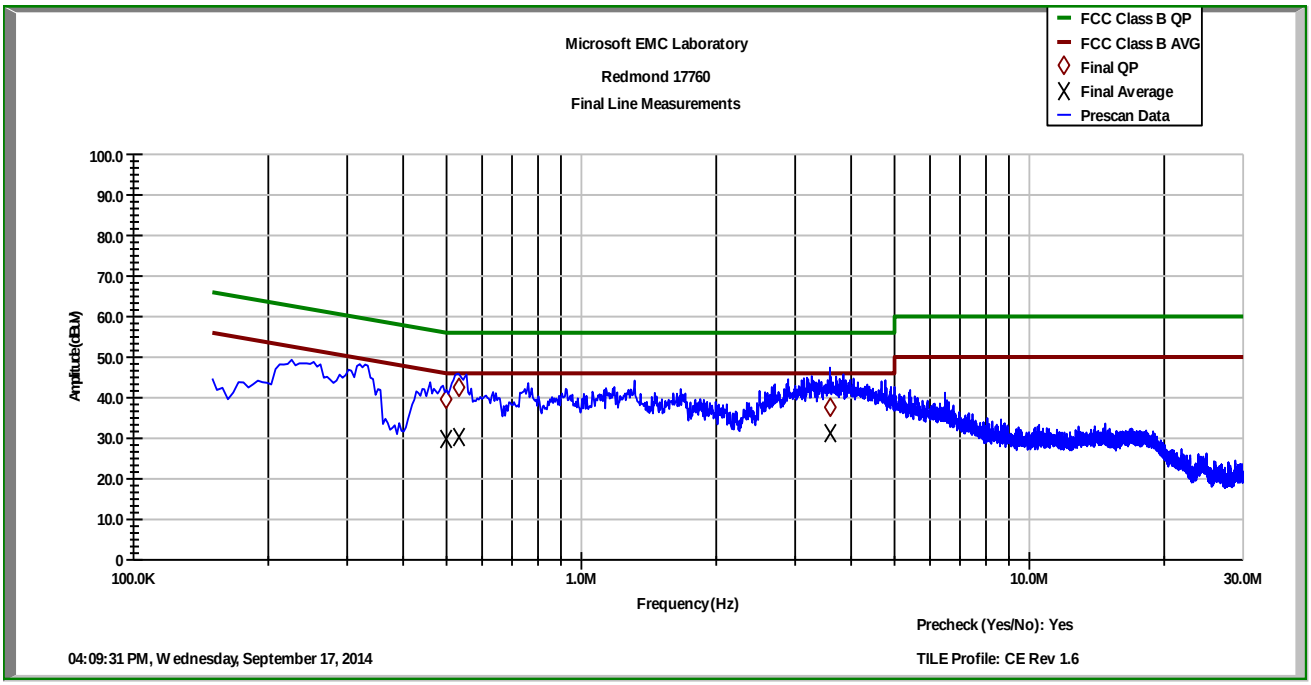


Plot 9-80. Peak Neutral Measurements

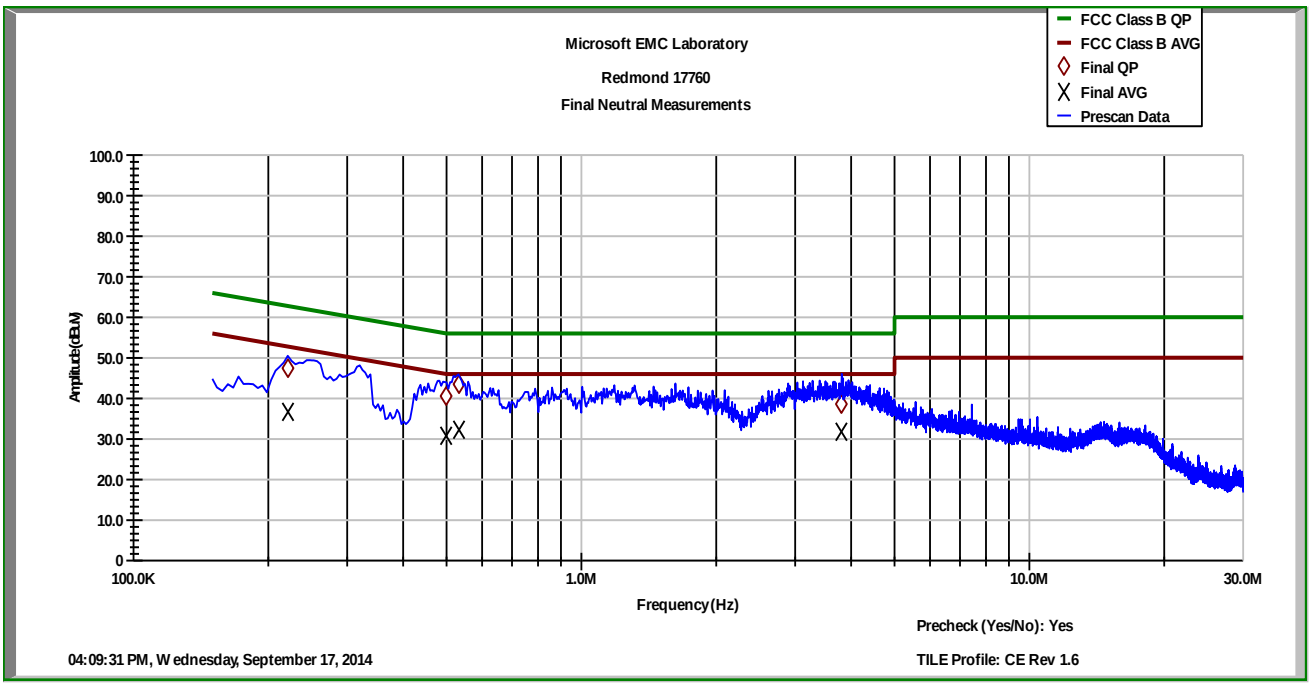
Freq (MHz)	PK Amplitude (dBµV)	QP Amplitude (dBµV)	AVG Amplitude (dBµV)	Cable Loss (dB)	LISN Factors	External Attenuation (dB)	PK Net Reading (dBµV)	QP Net Reading (dBµV)	AVG Net Reading (dBµV)	Class B QP Limit (dBµV)	Class B AVG Limit (dBµV)	Line Tested (L or N)	PK Margin compared to AVG Limit (dB)	QP Margin (dB)	AVG Margin (dB)
0.44	39.08	37.32	31.97	0.11	10.0	-	49.2	47.5	42.1	58	48	L	1.41	-10.35	-5.7
0.48	34.82	33.39	27.4	0.11	10.0	-	45.0	43.5	37.53	57	47	L	-1.69	-13.12	-9.11
0.5	32.83	29.28	18.7	0.1	10.0	-	43.0	39.4	28.83	56	46	L	-1.29	-16.59	-17.17
0.44	38.37	36.78	29.05	0.11	10.01	-	48.49	46.9	39.17	58	48	N	0.82	-10.77	-8.5
0.47	35.44	33.8	25.41	0.11	10.02	-	45.57	43.92	35.53	57	47	N	-1.2	-12.85	-11.24
0.5	34.06	30.32	20.28	0.1	10.02	-	44.19	40.44	30.4	56	46	N	-0.75	-15.56	-15.6
2	21.32	18.11	10.32	0.11	10	-	31.43	28.22	20.43	56	46	N	-6.86	-27.78	-25.57

Table: Final QP and Average Measurement Data

9.9.5.3 Large size sample



Plot 9-81. Peak Line Measurements



Plot 9-82. Peak Neutral Measurements

Freq (MHz)	PK Amplitude (dBµV)	QP Amplitude (dBµV)	AVG Amplitude (dBµV)	Cable Loss (dB)	LISN Factors	External Attenuation (dB)	PK Net Reading (dBµV)	QP Net Reading (dBµV)	AVG Net Reading (dBµV)	Class B QP Limit (dBµV)	Class B AVG Limit (dBµV)	Line Tested (L or N)	PK Margin compared to AVG Limit (dB)	QP Margin (dB)	AVG Margin (dB)
0.53	35.77	33.2	22.22	0.1	10.02	-	45.9	43.32	32.34	56	46	N	-0.1	-12.68	-13.66
0.53	35.78	32.54	20.32	0.1	10.03	-	45.91	42.67	30.45	56	46	L	-0.09	-13.33	-15.55
0.5	33.82	30.42	20.85	0.1	10.02	-	43.94	40.54	30.97	56	46	N	0.36	-15.46	-15.03
0.5	31.77	29.65	19.54	0.1	10.03	-	41.9	39.78	29.67	56	46	L	0.26	-16.22	-16.33
0.22	40.39	37.35	26.7	0.1	9.97	-	50.46	47.42	36.77	64	54	N	-3.51	-16.55	-17.2
3.81	35.89	28.57	21.72	0.12	10.01	-	46.03	38.71	31.86	56	46	N	0.03	-17.29	-14.14
3.59	37.27	27.35	21.27	0.11	10.02	-	47.4	37.47	31.39	56	46	L	1.4	-18.53	-14.61

Table: Final QP and Average Measurement Data

Microsoft

End of Test Report