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47 C.F.R. Part 15 FCC Rules, Subpart C
&
Industry Canada RSS-GEN & RSS-210 Test Results
for the

WiAutoLink 15 kV and WiAutoLink 27 kV Sectionalizer with 2.4 GHz ISM Band IEEE 802.15.4 Compliant Radio

Equipment:	WiAutoLink 15 kV
Client:	ABB, Inc. PPMV
Address:	655 Century Point Lake Mary - Florida - 32746

Test Report Number: FCCIR-ABB-12-05-13A
Date: December 20, 2013
Total Number of Pages: 71

NVLAP LAP Code: 200125-0
Industry Canada Site Number 7868A-1

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1 IDENTIFICATION SUMMARY

1.1 Test Report

Test Report Number: FCCIR-ABB-12-05-13A
Test Report Date: December 20, 2013

Report written and approved by:

Date	Name	Signature
December 20, 2013	Peter J. Walsh, NCE	Pete J. Walsh

1.2 Testing Laboratory

Walshire Labs, LLC
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1.3 Limits and Reservations

The test results in this report apply only to the particular Device Under Test (DUT) and component Implementations Under Test (IUTs) declared in this test report. The results and associated conclusions apply only to the DUT while operating in the configuration and modes described herein. The test data contained herein is intended to be used by a TCB for the purpose of achieving FCC Part 15 and Industry Canada RSS-210, Issue 8 certification of the DUT.

This test report has been revised to make minor editorial changes in response to the TCB review.

The test report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

1.4 Client Information

Name:	ABB, Inc. PPMV
Street:	655 Century Point
City:	Lake Mary
State:	FL
Zip Code	32746
Country:	USA
Phone:	407 732 2746
Contact Person:	Gary Haynes
Phone:	407 732 2746
Email:	gary.haynes@us.abb.com

1.5 Dates

Date of commission:	November 19, 2013
Date of receipt of DUT:	December 17, 2013
Date of test completion:	December 18, 2013

1.6 Device Under Test (DUT)

Name:	Model WiAutoLink 15 kV Sectionalizer
Version:	15 kV with 2.4 GHz Band IEEE 802.15.4 Compliant Radio
Serial Number:	1YSA13AWS100021
Antenna Type:	Inverted F PCB trace antenna
Nominal Gain:	4.83 dBi
Modulation Type:	O-QPSK
Emission Designator:	3M025G1D
Symbols:	16-ary Orthogonal

2 GENERAL INFORMATION

2.1 Product Description

The EUT is an IEEE 802.15.4 compliant transceiver that operates in the 2400 to 2483.5 MHz band in accordance with 47 C.F.R. § 15.247 and Industry Canada's RSS-210 Specification. Key features are:

- 100mW nominal output power
- Integrated PCB F antenna
- Powerful Texas Instruments 256k MSP430 with 802.15.4 MAC or ZigBee Stack
- LSR serial interface based on 802.15.4 MAC
- Low power operation

2.2 Interface Cable Details

There were no interface cables used in the system during testing. To enable the test modes, a USB cable was used to interface the unit with a PC.

2.3 Peripheral Devices

The following test support devices were used in the test set-up. Additionally a PC was used to invoke test modes. However, the PC was disconnected prior to making any measurements.

Qty	Description	Manufacturer/Model	Serial Number
1	High Current Test Set	Phenix Technologies / HC-2	11-6544

2.4 Test Methodology

A radiated emission testing was performed according to ANSI C63.4-2003, the procedure referenced by Part 15, FCC Rules. Radiated emissions tests were performed at an antenna to EUT distance of 3 meters except for tests in the 18 GHz to 25 GHz band which were performed at 1m. The measurement of digital transmission systems operating under Section 15.247 was performed in accordance with KDB Publication Number 558074 D01 DTS Measurement Guidance v03r01 issued by the FCC's OET. Industry Canada's RSS-210 Issue 8 Specification was also used to support the test.

2.5 Test Facility

The 3-meter semi-anechoic test chamber and measurement facility used to collect the radiated and conducted data is located at 8545 126th Avenue N., Largo FL 33773. This site is NVLAP Accredited (200125-0). The site has also been registered with Industry Canada, 2146A-1.

2.6 Deviations

No deviations were exercised during the course of the testing.

3 SYSTEM TEST CONFIGURATION

3.1 Justification

For radiated emissions measurements, the DUT was mounted on its host equipment a current sensing and current interrupting device for medium voltage overhead power lines. The 15 kV model was chosen for test because based upon exploratory tests it exhibited a slightly higher radiated signal than the 27 kV model though both are electrically identical. The DUT was powered by passing an ac current carrying wire through its body with the current supplied by a high current test set. Since the orientation was known to be vertical and fixed it was positioned in that manner on a non-conductive table. To set the required test modes the DUT was temporarily connected to a PC via a USB cable. The PC ran a utility program to enable either the receive test mode or the continuous transmit test modes and also configure the DUT's channel.

As the radio was powered by low voltage and not directly from the ac mains, the conducted emissions test on the ac power port was not applicable.

RF conducted measurements were performed on a second test sample that had the RF path routed to a connector instead of the onboard antenna. This allowed for conducted measurements to be performed using a very short cable characterized for its loss over frequency.

Unless noted otherwise, the test modes used for radiated emissions were the continuous modulated transmit test mode and the receive test mode. The measured duty cycle of the continuous transmit test mode was 56.1%. Therefore this test mode could be used as it represented a higher than worse case duty cycle than would occur in normal operation.

For 802.15.4 devices, the worst case duty cycle would be a full data frame or 133 bytes where the transmitter does not get an acknowledgement and retries 3 more times. In this example, the on time for one frame is 32 μs/byte * 133 bytes = 4.26 ms. Four frames are transmitted for a total on time of 17 ms and a duty cycle of 17% for 100 ms.

The power settings were as shown in Table 3.1-1 below.

Table 3.1-1 – Power Setting by Channel Number

Channel Number	Center Frequency (MHz)	Power Setting
11	***2405***	***0xF9***
12	**2410**	**0xF9**
13	**2415**	**0xF9**
14	**2420**	**0xF9**
15	**2425**	**0xF9**
16	**2430**	**0xF9**
17	**2435**	**0xF9**
18	**2440**	**0xF9**
19	***2445***	***0xF9***
20	**2450**	**0xF9**
21	**2455**	**0xF9**
22	**2460**	**0xF9**
23	**2465**	**0xF9**
24	**2470**	**0xF9**
25	***2475***	***0xF9***
26	**2480**	***Channel not used.***

Tests were performed on the italicized channels in the table above.

3.2 Special Accessories

None were used during the tests.

3.3 Equipment Modifications

No modifications were needed to achieve compliance.

Signature:	*(signature)*	Date:	December 18, 2013
Typed/Printed Name:	Peter J. Walsh		
Position:	Regulatory Lab Manager		

If modifications were needed to achieve compliance, the client shall acknowledge these by signing below.

Applicant's Signature:	______________________	Date:	______________________
Typed/Printed Name:	______________________		
Position:	______________________		

4 CONDUCTED EMISSIONS DATA

References: 47 C.F.R. § 15.207 (a) RSS-GEN § 7.2.4

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

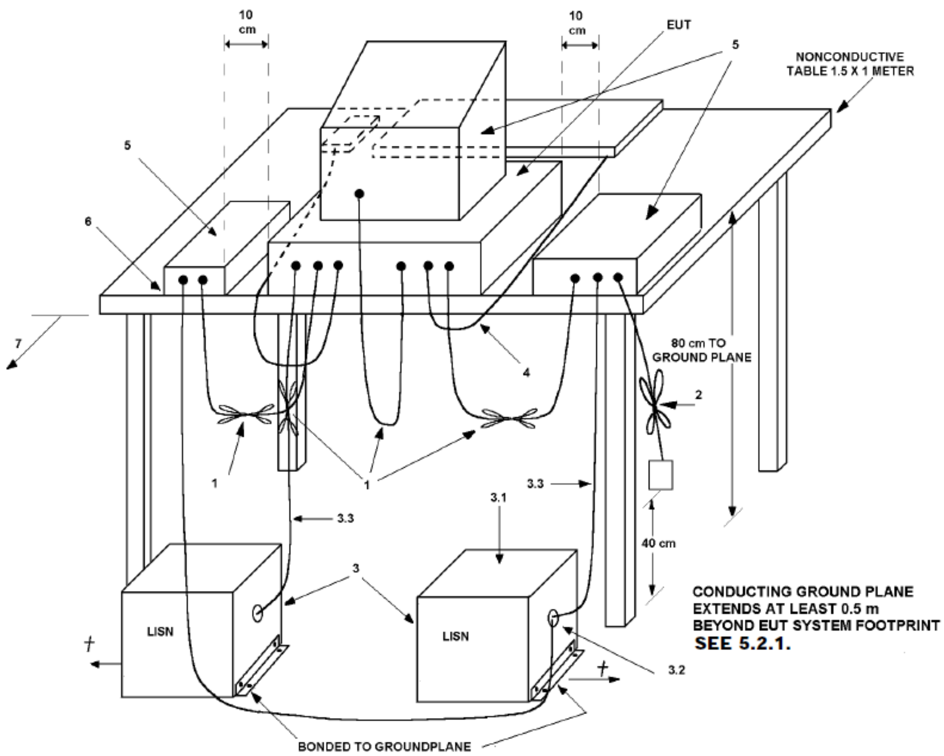
Table 4-1

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

* Decreases with the logarithm of the frequency.

4.1 Test Procedure

The test is performed in accordance with ANSI C63.4-2003 § 7. The test setup is consistent with ANSI C63.4-2003 Figure 10a as shown below. The test is performed in a semi-anechoic chamber. As such, the optional vertical conducting plane is not used.



LEGEND:

1) Interconnecting cables that hang closer than 40 cm to the groundplane shall be folded back and forth in the center forming a bundle 30 to 40 cm long (see 6.1.4 and 11.2.4).
2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.1.4).
3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference groundplane (see 5.2.3 and 7.2.1).
   3.1) All other equipment powered from additional LISN(s).
   3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3) LISN at least 80 cm from nearest part of EUT chassis.
4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use (See 6.2.1.3 and 11.2.4).
5) Non-EUT components of EUT system being tested (see also Figure 13).
6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.1.1 and 6.2.1.2).
7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the groundplane (see 5.2.2 for options).

Figure 10a—Test arrangement for conducted emissions

Conducted emissions measurements are first made using a peak detector and average detector simultaneously. The receiver then performs the final measurements using a quasi-peak detector for comparison with the quasi-peak limit and an average detector for comparison with the average limit.

4.2 Measured Data

Compliance Verdict: None

As the DUT was not ac powered, the conducted emissions test was not applicable. The DUT is powered by low voltage DC provided by the host device. The host device's power scavenging circuitry does not directly connect to the ac mains. The host device is powered by medium voltage overhead power lines.[1]

4.3 Conducted Emissions Test Instrumentation

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
EMI Receiver	Rohde & Schwarz ESCS 30	825788/002	12/14/2015
LISN	Rohde & Schwarz ESH3-Z5	840730/005	09/04/2014

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

4.4 Conducted Emissions Photographs

No photos were taken as the test was not performed.

[1] The referenced standard ANSI C63.4-2003 does not prescribe measurements for equipment with a rated input voltage greater than 600 V.

5 RADIATED EMISSIONS DATA

References: 47 C.F.R. § 15.209
RSS-210 § 2.2

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Table 5-1

Frequency of Emission (MHz)	Field Strength (3 m) (microvolts/meter)	Field Strength (3 m) (dBµV/m)
0.009 – 0.490	2400/F (kHz) @ 300 m	300
0.490 – 1.705	24000/F (kHz) @ 30 m	30
1.705 – 30.0	30 @ 30 m	30
30 - 88	100**	40.0
88 - 216	150**	43.5
216 - 960	200**	46.0
Above 960	500	54.0

*** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

References: 47 C.F.R. § 15.205
RSS-210 § 2.2

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

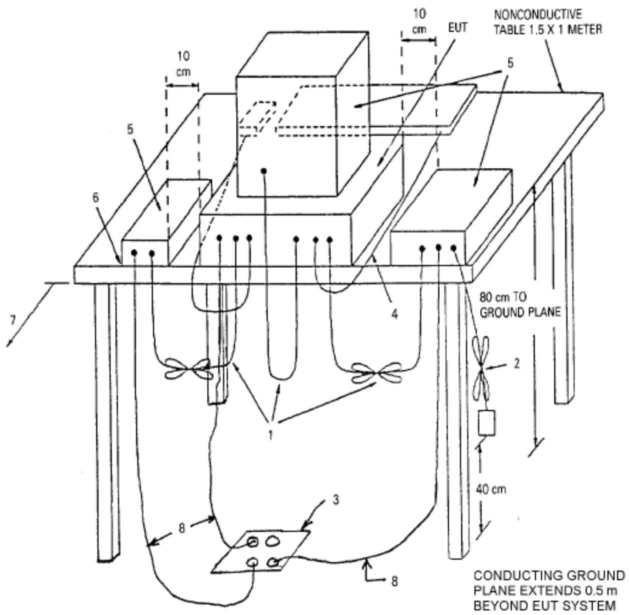
Table 5-2

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

5.1 Test Procedure

The test is performed in accordance with ANSI C63.4-2003 § 8. The test setup is consistent with ANSI C63.4-2003 Figure 11a below. The test is performed in a semi-anechoic chamber.



LEGEND:

1) Interconnecting cables that hang closer than 40 cm to the groundplane shall be folded back and forth in the center, forming a bundle 30 to 40 cm long (see 6.1.4 and 11.2.4).
2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance. The total length shall not exceed 1 m (see 6.1.4).
3) If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the groundplane with the receptacle flush with the groundplane (see 6.1.4).
4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use (see 6.2.1.3 and 11.2.4).
5) Non-EUT components of EUT system being tested (see also Figure 13).
6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.1.1 and 6.2.1.2).
7) No vertical conducting plane used (see 5.2.2).
8) Power cords drape to the floor and are routed over to receptacle (see 6.1.4).

Figure 11a—Test arrangement for radiated emissions tabletop equipment

The following data lists the significant emission frequencies, amplitude levels (including cable correction and antenna factors), plus the limit. The frequency range investigated was 30 MHz to 25 GHz. The highest frequency to which the DUT must be measured is 24.835 GHz as this is ten times the highest operating frequency of the DUT.

5.2 Test Data

Compliance Verdict: PASS

Figures 5.2-1 and 5.2-2 show composite preview scan graphs of the radiated emissions levels from 30 to 1000 MHz measured with a peak detector in both vertical (red trace) and horizontal (blue trace) antenna polarities at turntable angles between 0 and 360 degrees and antenna heights of 100 cm, 250 cm and 400 cm. In the 30 to 1000 MHz frequency range, the final measurement detector was quasi-peak; the measurement bandwidth was 120 kHz. The channel was set to the midband channel 19 as this had the highest output power.

Figure 5.2-1 shows the results with the unit operating in the receive test mode. Figure 5.2-2 shows the results with the unit operating in the continuous transmit test mode. There were no emissions within 20 dB of the limit in the 30 – 1000 MHz band.

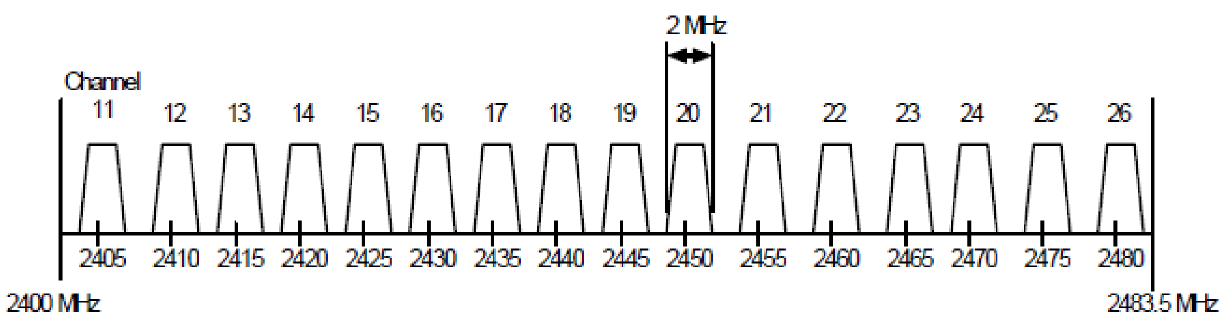
For measurements taken above 1 GHz, the final measurement detectors were peak and average. The measurement bandwidth was 1 MHz.

Figure 5.2-3 shows the peak detector radiated emissions from 1000 MHz to 10 GHz with the unit in the receive test mode in fulfillment of the RSS-GEN § 4.10 Receiver Spurious requirement.

Figures 5.2-4 through 5.2-17 show the radiated emissions test results above 1 GHz. These plots include measurements at all turntable angles and an antenna heights set to maximize emissions. These measurements were made with the DUT transmitting on the channel as noted by the plots. Radiated emissions measurements were made over a frequency range which included the 2400 MHz to 2483.5 MHz operating band as well as frequencies above and below this band to ensure compliance with the restricted band limits for operation on Channels 11, 19 and 25.

Though not shown as graphical plots in this test report radiated emissions were measured over the 10 GHz to 25 GHz band. These measurements showed that there were no emissions close to the respective peak and average detector limits.

Figure E.1 from the IEEE 802.15.4 standard below shows the DUT's channel plan with the exception that channel 26 is not used.



c) IEEE 802.15.4 channel selection (2400 MHz PHY)

Figure E.1—IEEE 802.15.4 (2400 MHz PHY) and IEEE 802.11b channel selection

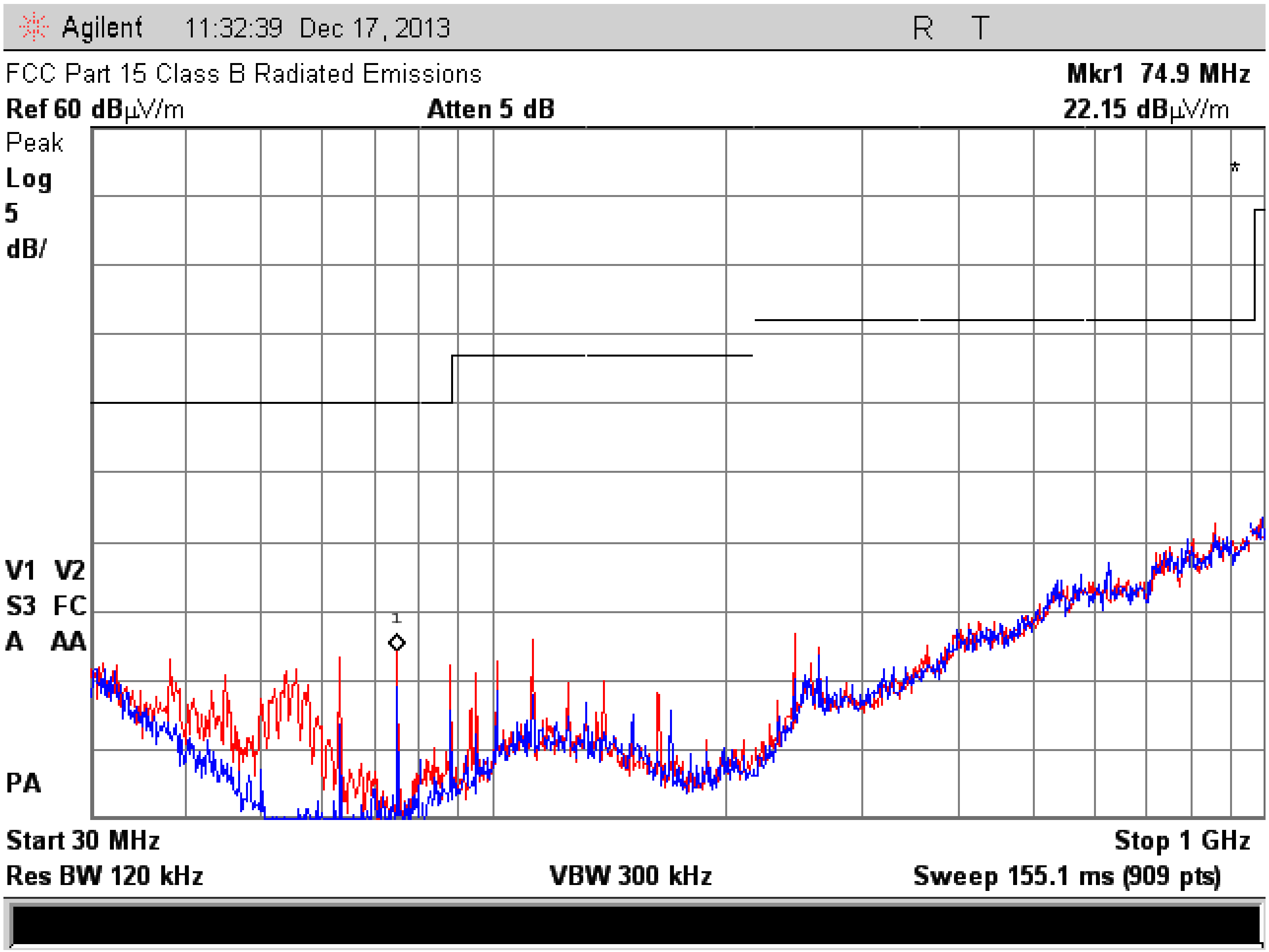


Figure 5.2-1 – Radiated Emissions Peak Detector Plot for the 30 – 1000 MHz Band in Receive Mode

Notes:

The above is a peak detector plot with the red trace showing vertical polarity and the blue trace showing horizontal polarity. The measurement was made in accordance with RSS GEN § 4.10. There were no emissions from the EUT that were within 20 dB of the limit as measured with an EMI receiver with the quasipeak detector. This was the case for all received channels.

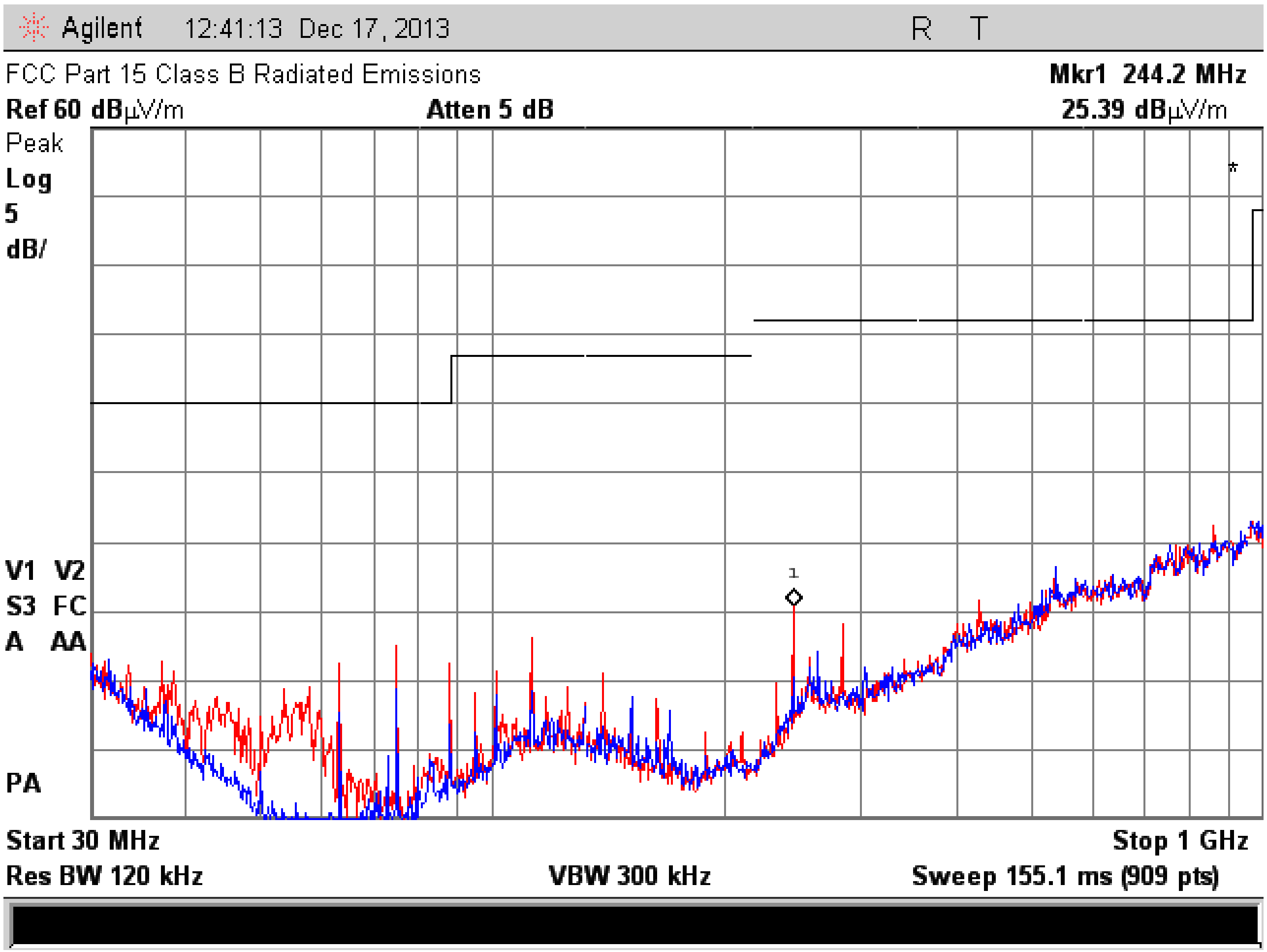


Figure 5.2-2 – Radiated Emissions Plot for the 30 – 1000 MHz Band in Transmit Mode Channel 19

Notes:

The above is a peak detector plot with the red trace showing vertical polarity and the blue trace showing horizontal polarity. The purpose of this scan was measure any spurious emissions in this band. There were no emissions from the EUT that were within 20 dB of the limit as measured with an EMI receiver with the quasipeak detector. Exploratory measurements were also made on channels 11 and 25 resulting in similar levels all well below the limit.

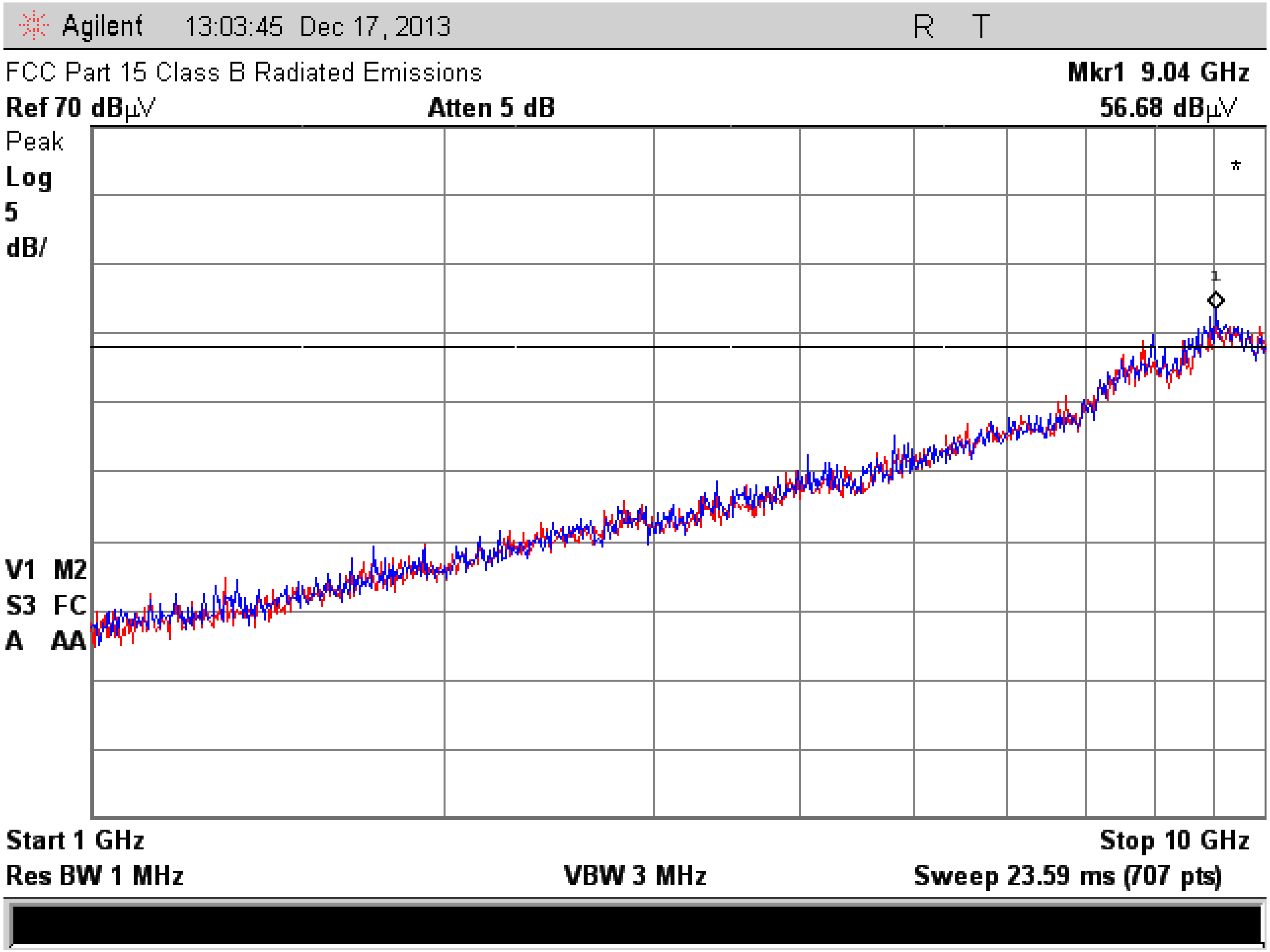


Figure 5.2-3 – Radiated Emissions Peak Detector Plot for the 1 GHz – 10 GHz Band in Receive Mode

Notes:

The above is a peak detector plot with the red trace showing vertical polarity and the blue trace showing horizontal polarity. The measurement was made in accordance with RSS GEN § 4.10. There were no significant emissions from 10 GHz to 25 GHz.

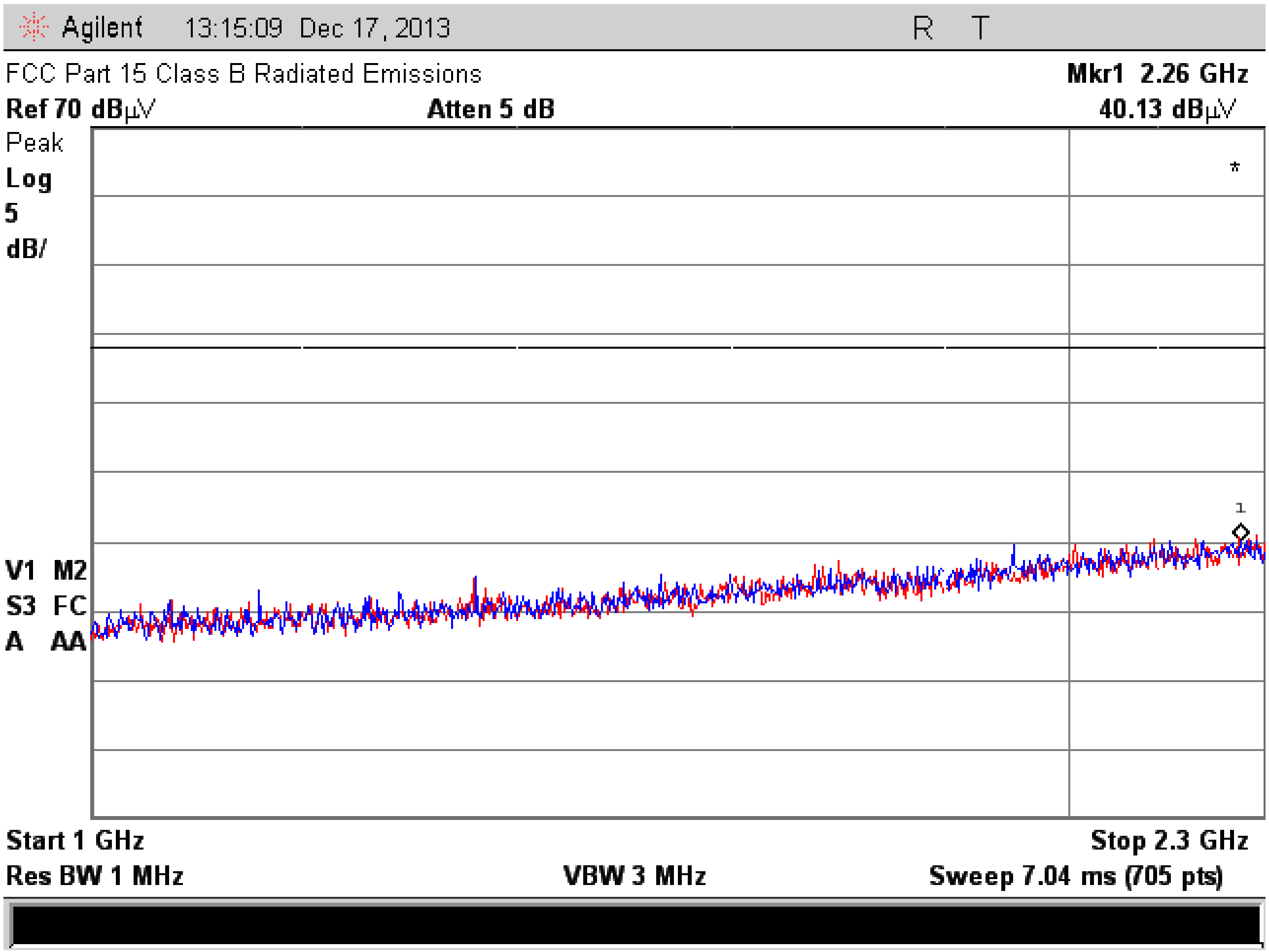


Figure 5.2-4 – Radiated Emissions 1 to 2.3 GHz for Channel 19 w/ Peak Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. There were no emissions from the EUT that were within 20 dB of the limit. The results were effectively the same for Channels 11 and 25.

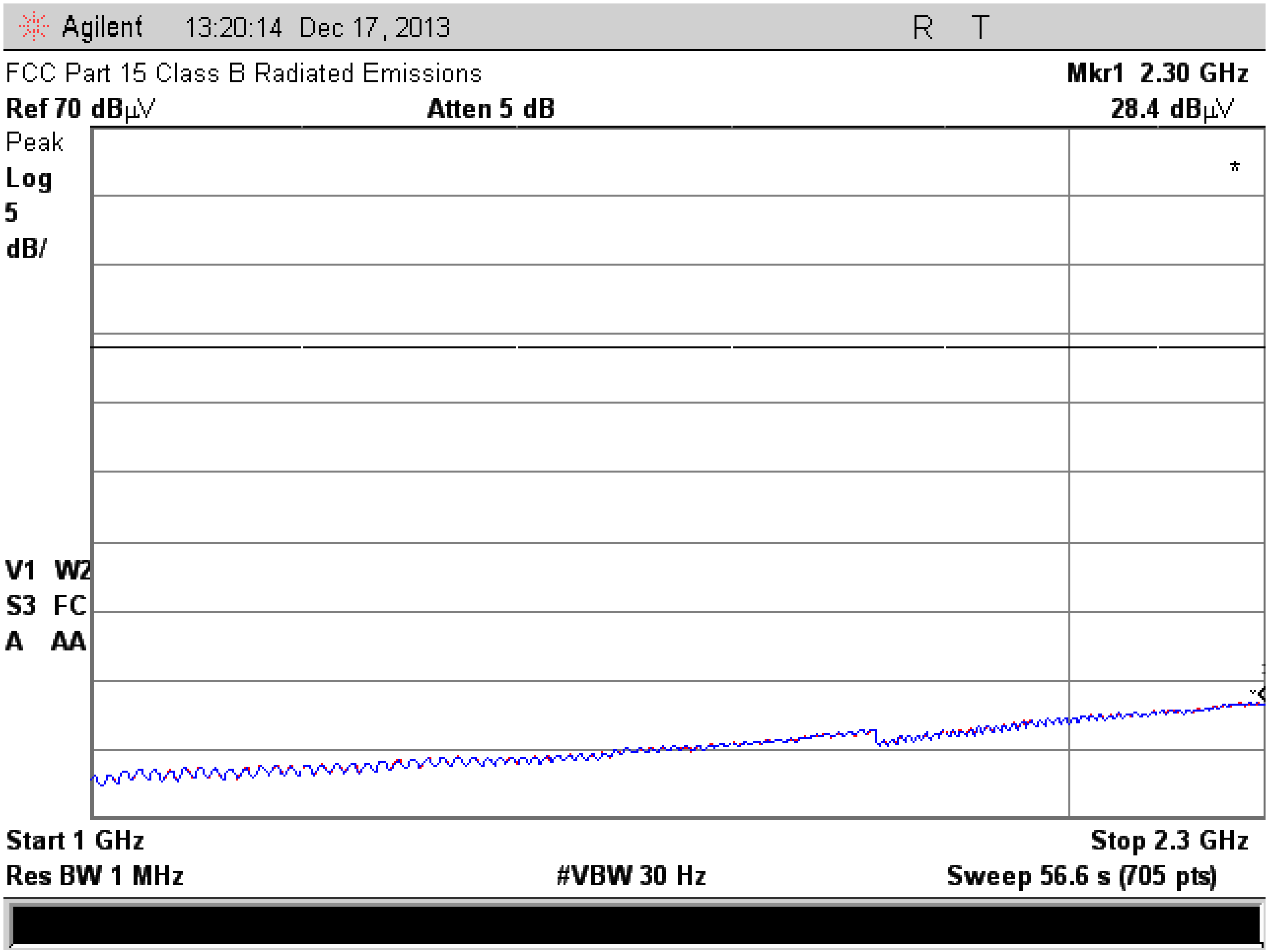


Figure 5.2-5 – Radiated Emissions 1 to 2.3 GHz for Channel 19 w/ Average Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The DUT was set to transmit in its continuous transmission test mode. There were no emissions from the EUT that were within 20 dB of the limit. The results were effectively the same for Channels 11 and 25.

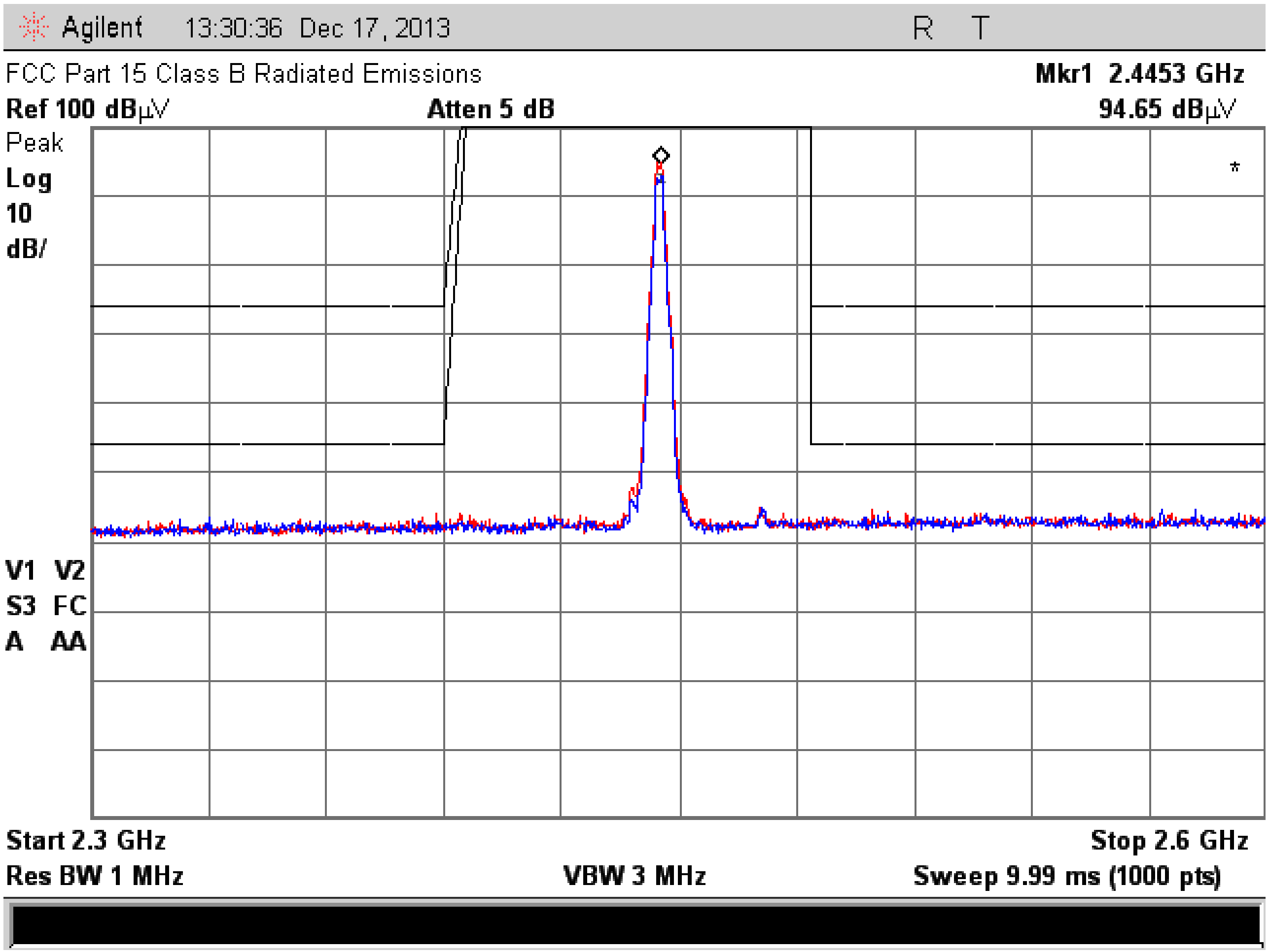


Figure 5.2-6 – Band Edge Radiated Emissions Channel 19 w/ Peak Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity.

The maximum field strength of the fundamental was observed at a height of 110 cm in vertical polarity and turntable angle of 40 degrees. The peak detector level was 94.7 dBµV/m. There were no significant emissions at the band edges with this channel.

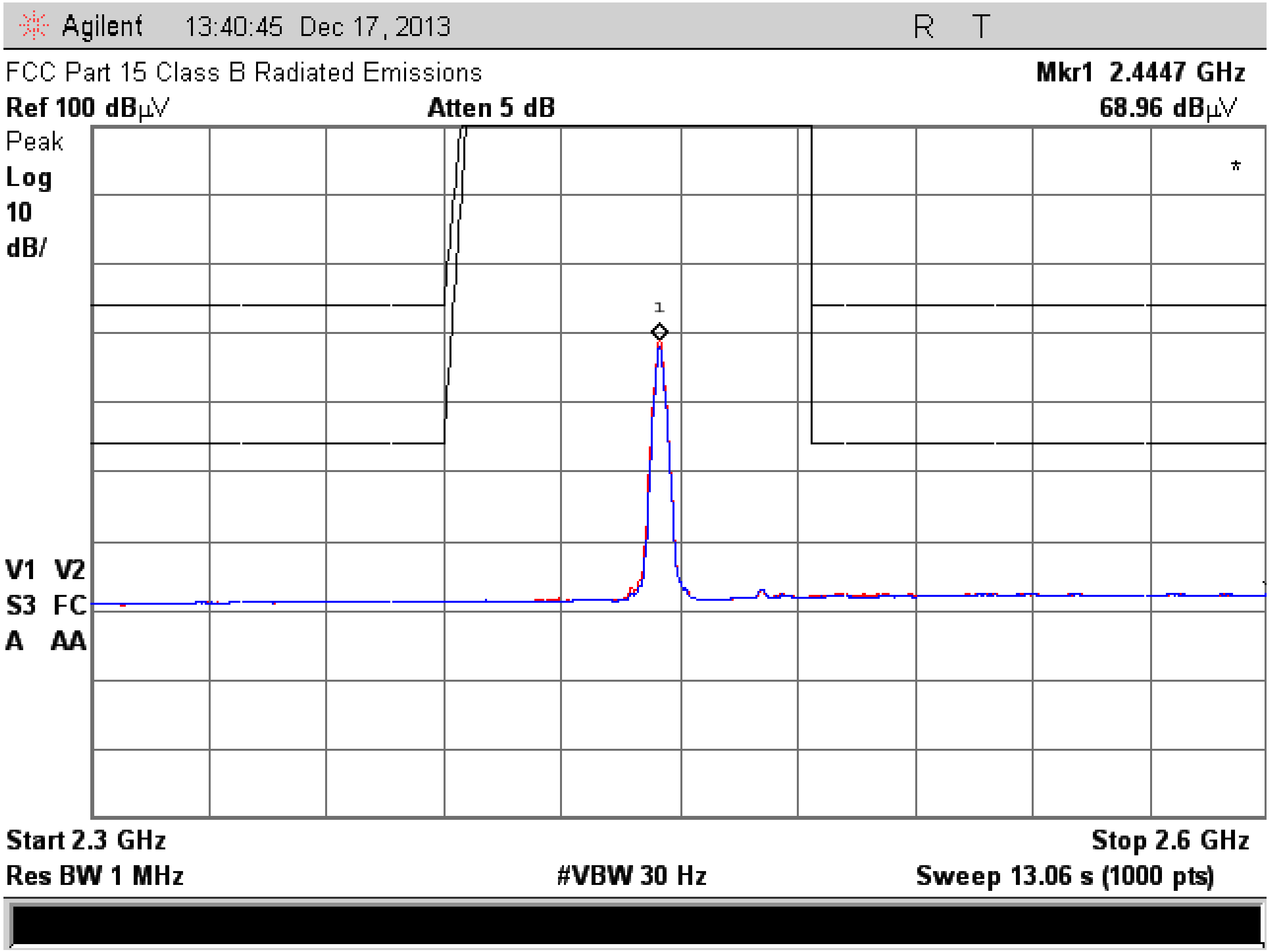


Figure 5.2-7 – Band Edge Radiated Emissions Channel 19 w/ Average Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity.

The maximum field strength of the fundamental was observed at a height of 110 cm in vertical polarity and turntable angle of 40 degrees. The average detector level was 68.96 dBµV/m. There were no significant emissions at the band edges with this channel.

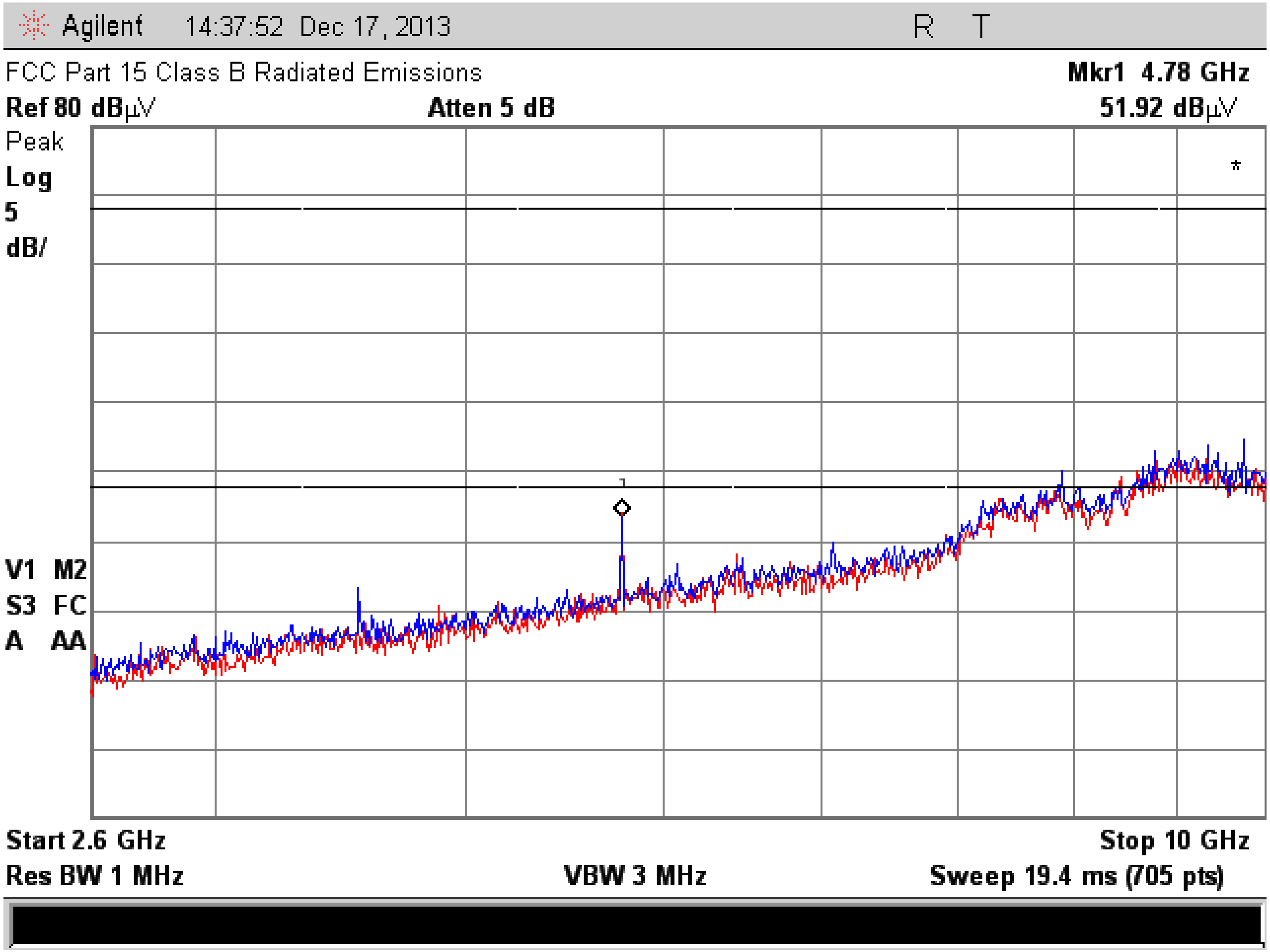


Figure 5.2-8 – Radiated Emissions 2.6 to 10 GHz for Channel 19 w/ Peak Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The emission at the marker frequency was the second harmonic. It was well below the limit. This occurred in vertical polarity at a height of 110 cm and turn table angle of 240 degrees.

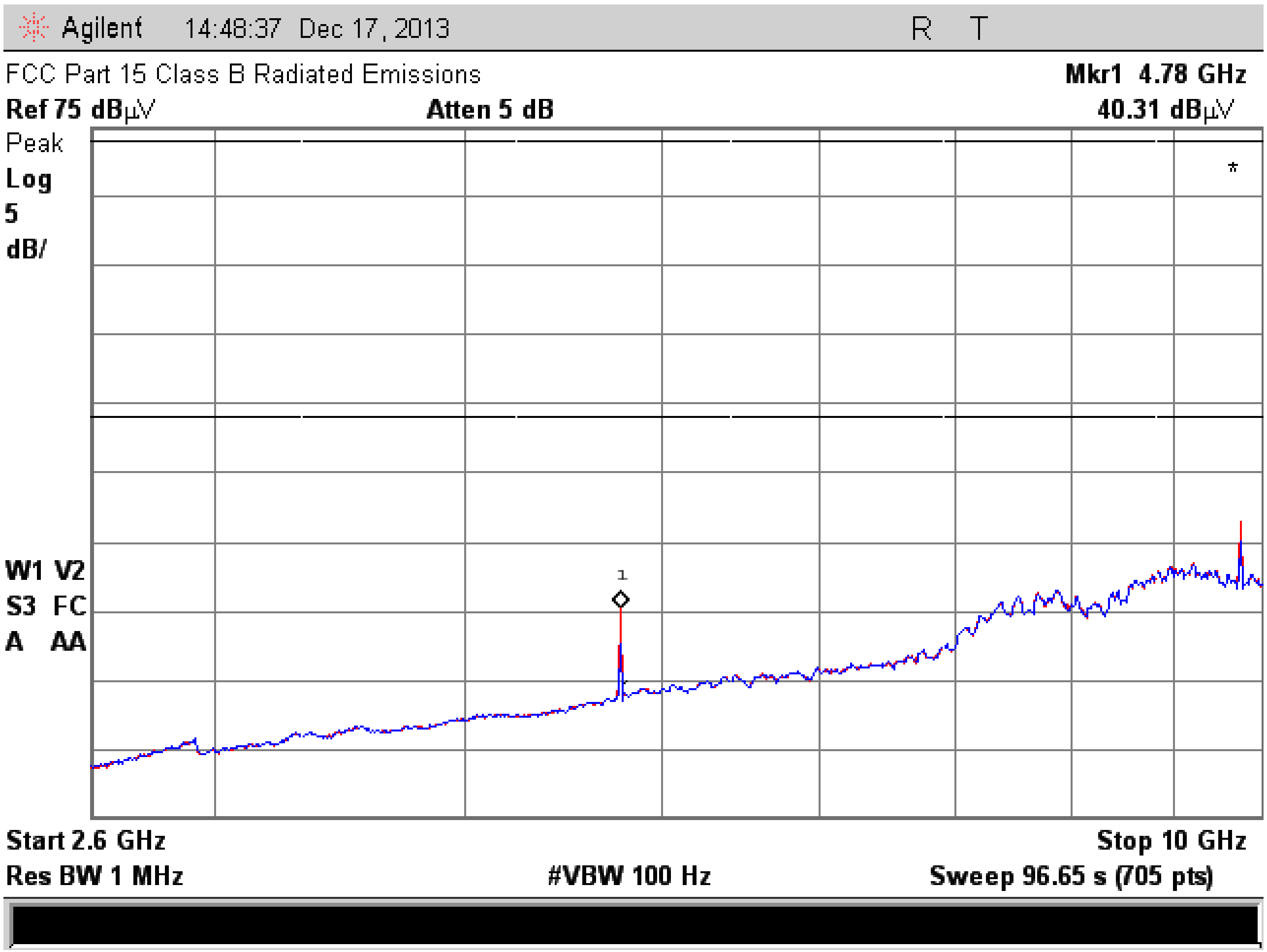


Figure 5.2-9 – Radiated Emissions 2.6 to 10 GHz for Channel 19 w/ Average Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The emission at the marker frequency was the second harmonic. It was well below the limit. This occurred in vertical polarity at a height of 110 cm and turn table angle of 240 degrees.

Though not shown there were no detectable emissions above 10 GHz.

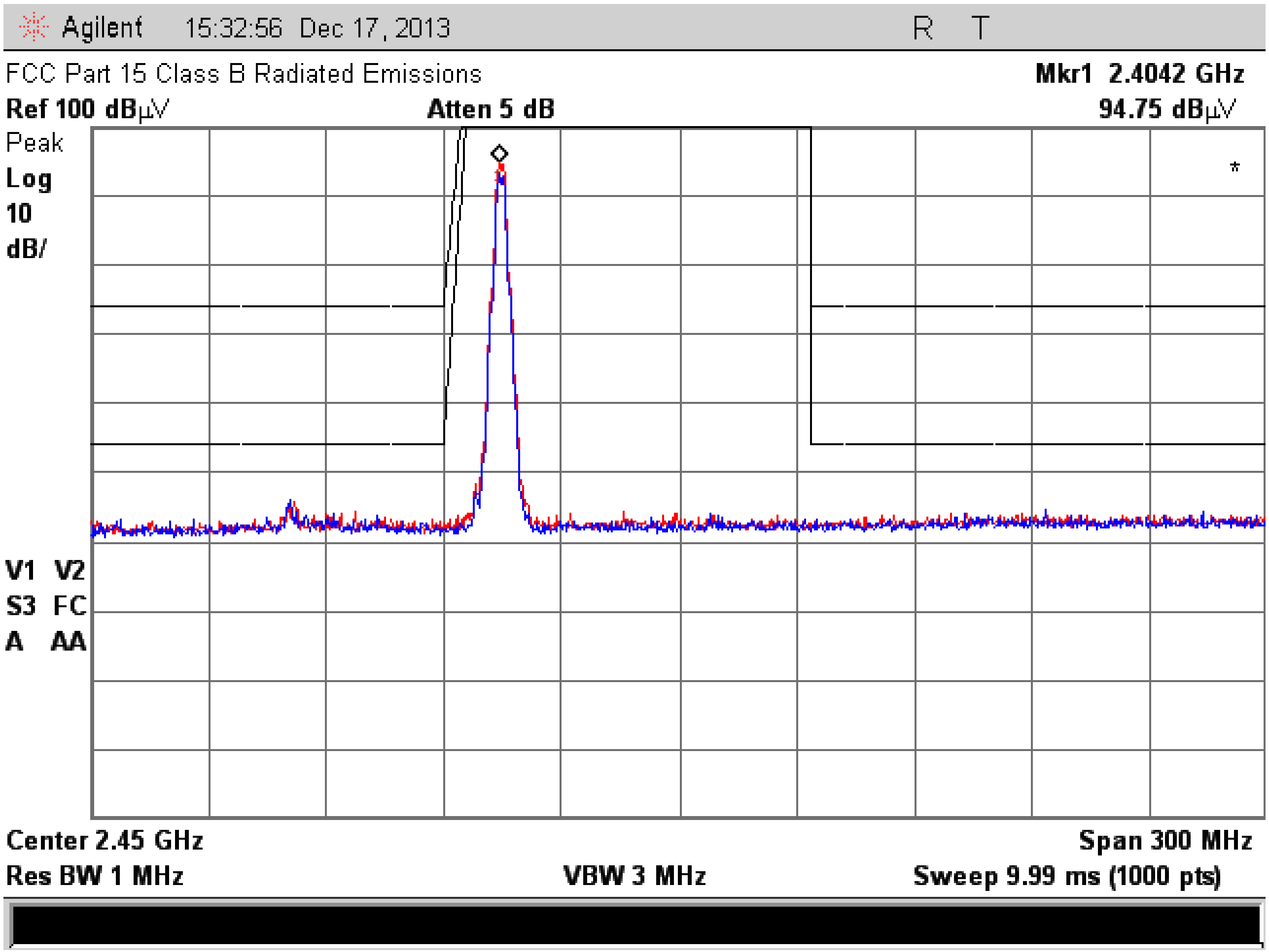


Figure 5.2-10 – Band Edge Radiated Emissions Channel 11 w/ Peak Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity.

The maximum field strength of the fundamental was observed at a height of 110 cm in vertical polarity and turntable angle of 260 degrees. The peak detector level was 94.8 dBµV/m. There were no significant emissions at the band edges with this channel.

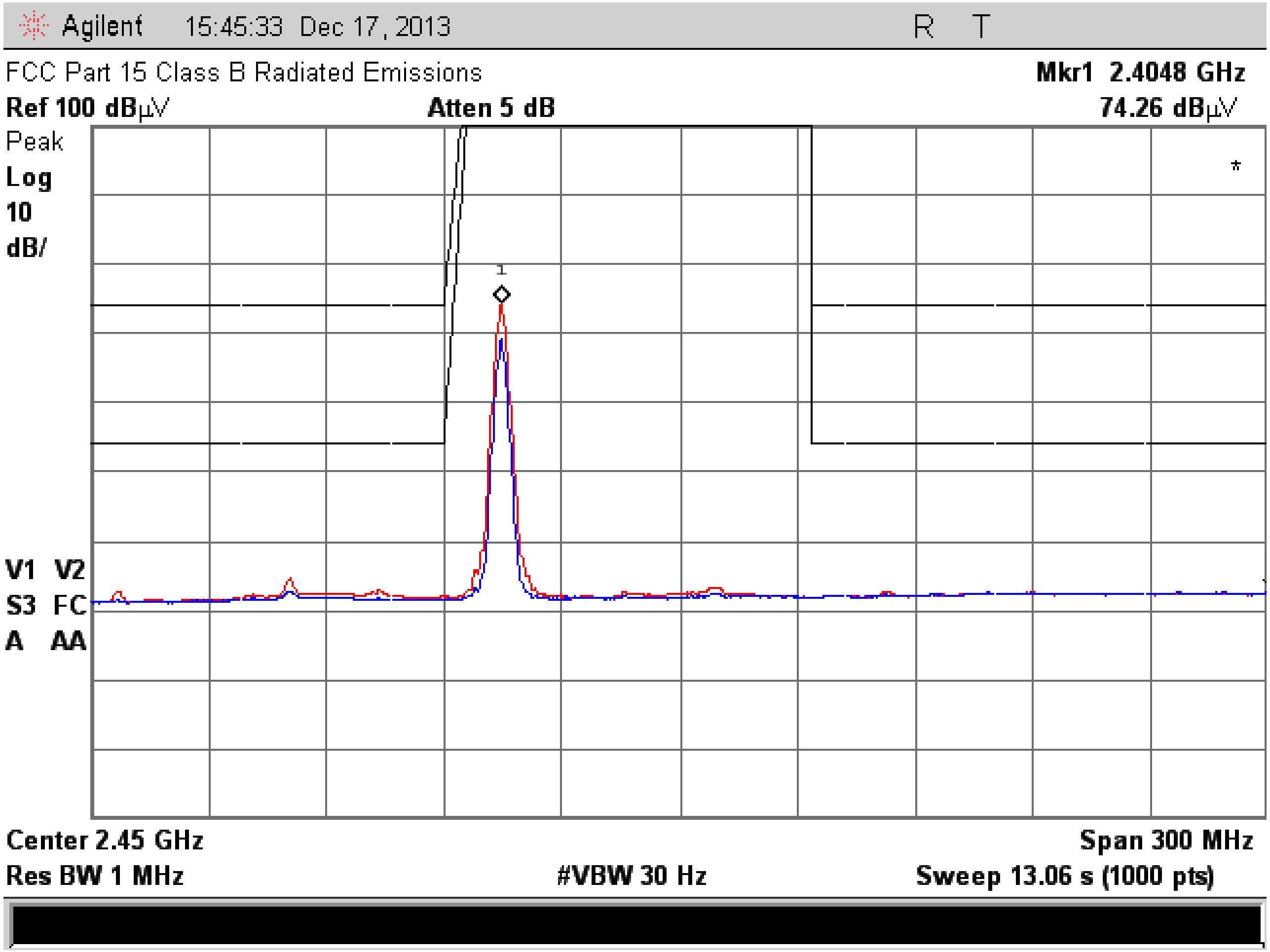


Figure 5.2-11 – Band Edge Radiated Emissions Channel 11 w/ Average Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The average detector level was 74.3 dBµV/m.

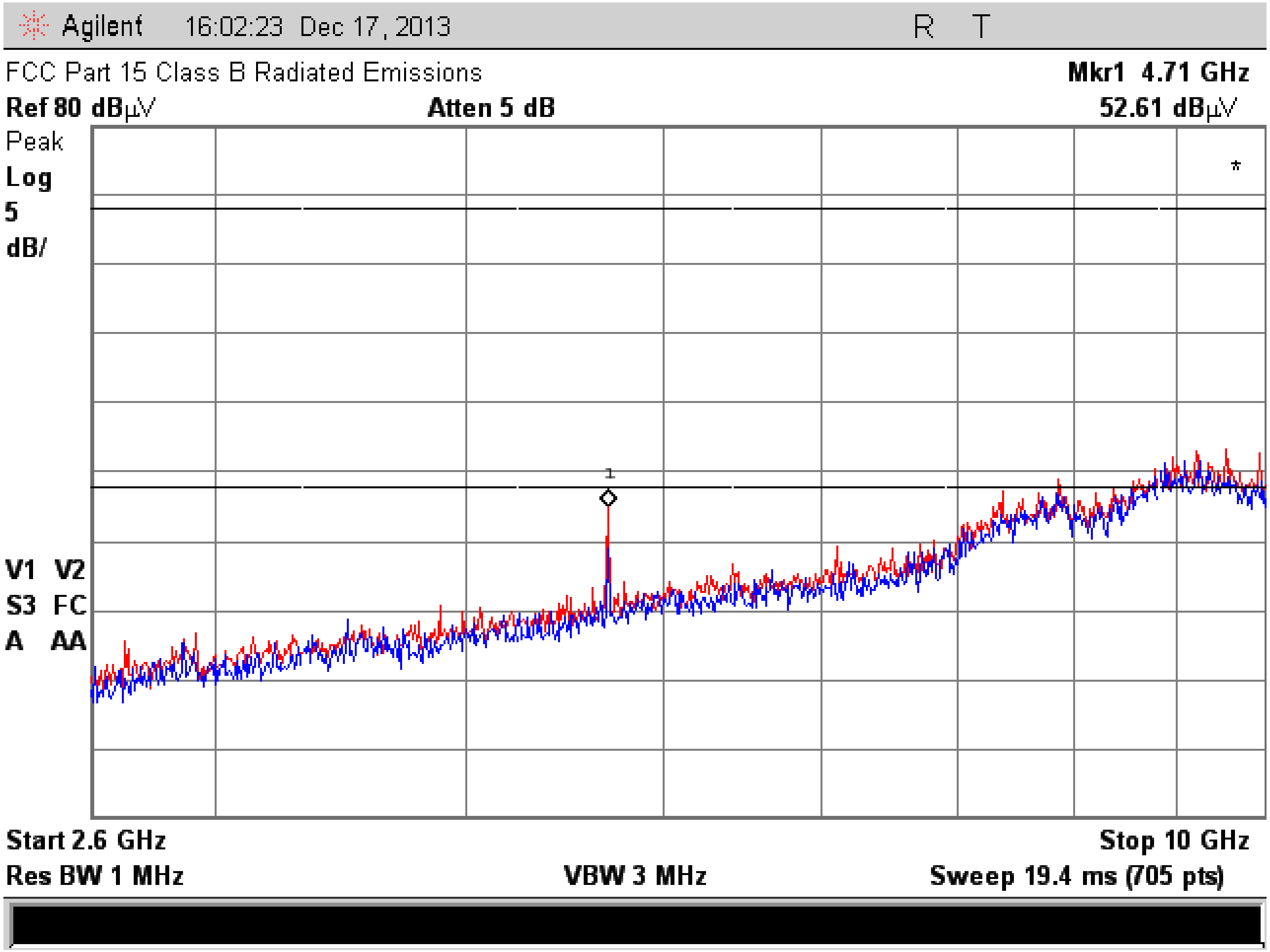


Figure 5.2-12 – Radiated Emissions 2.6 to 10 GHz for Channel 11 w/ Peak Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The emission at the marker frequency was the second harmonic. It was well below the limit. This occurred in vertical polarity at a height of 110 cm and turn table angle of 208 degrees.

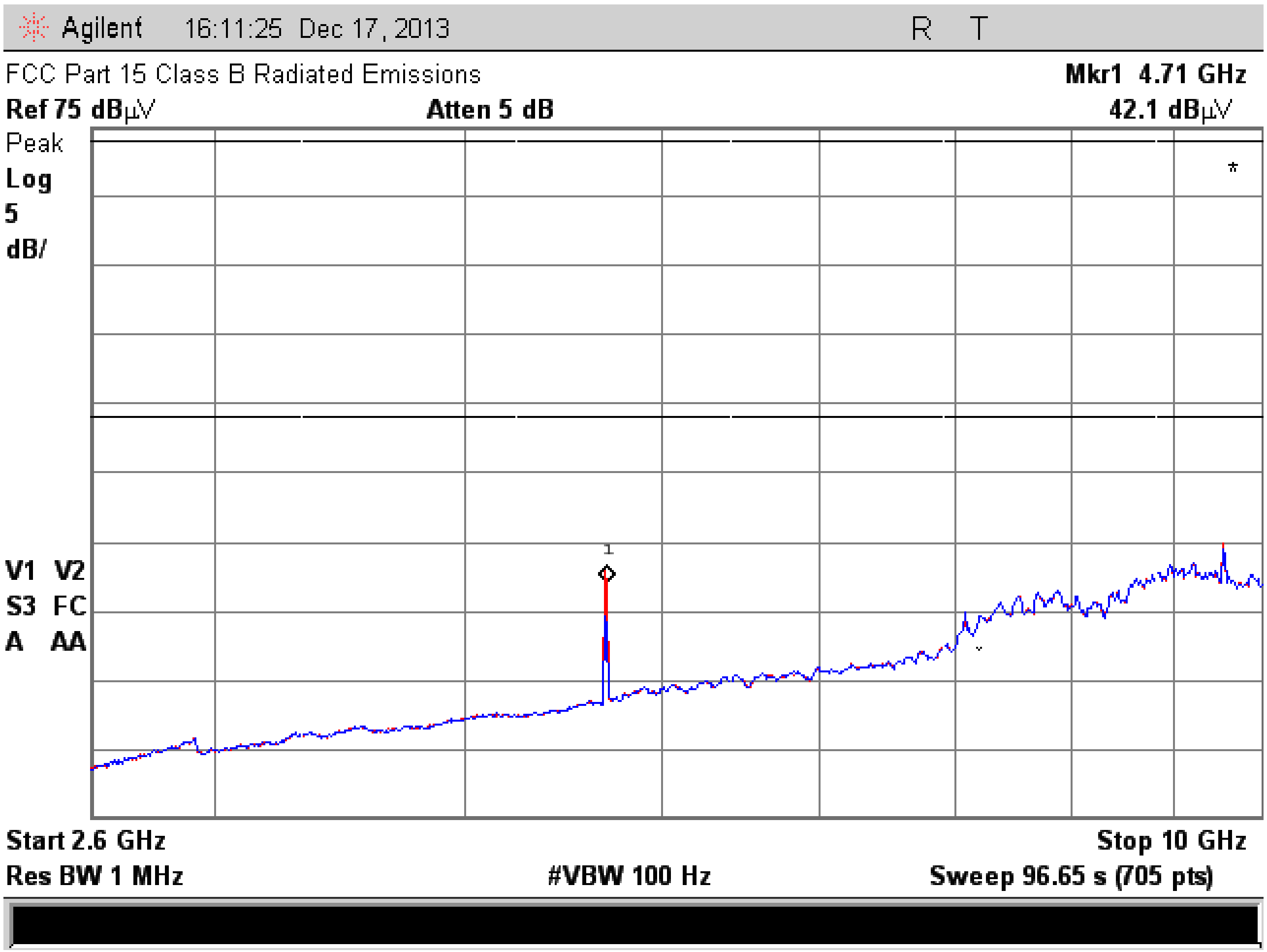


Figure 5.2-13 – Radiated Emissions 2.6 to 10 GHz for Channel 11 w/ Average Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The emission at the marker frequency was the second harmonic. It was well below the limit. This occurred in vertical polarity at a height of 100 cm and turn table angle of 208 degrees.

Though not shown there were no detectable emissions above 10 GHz.

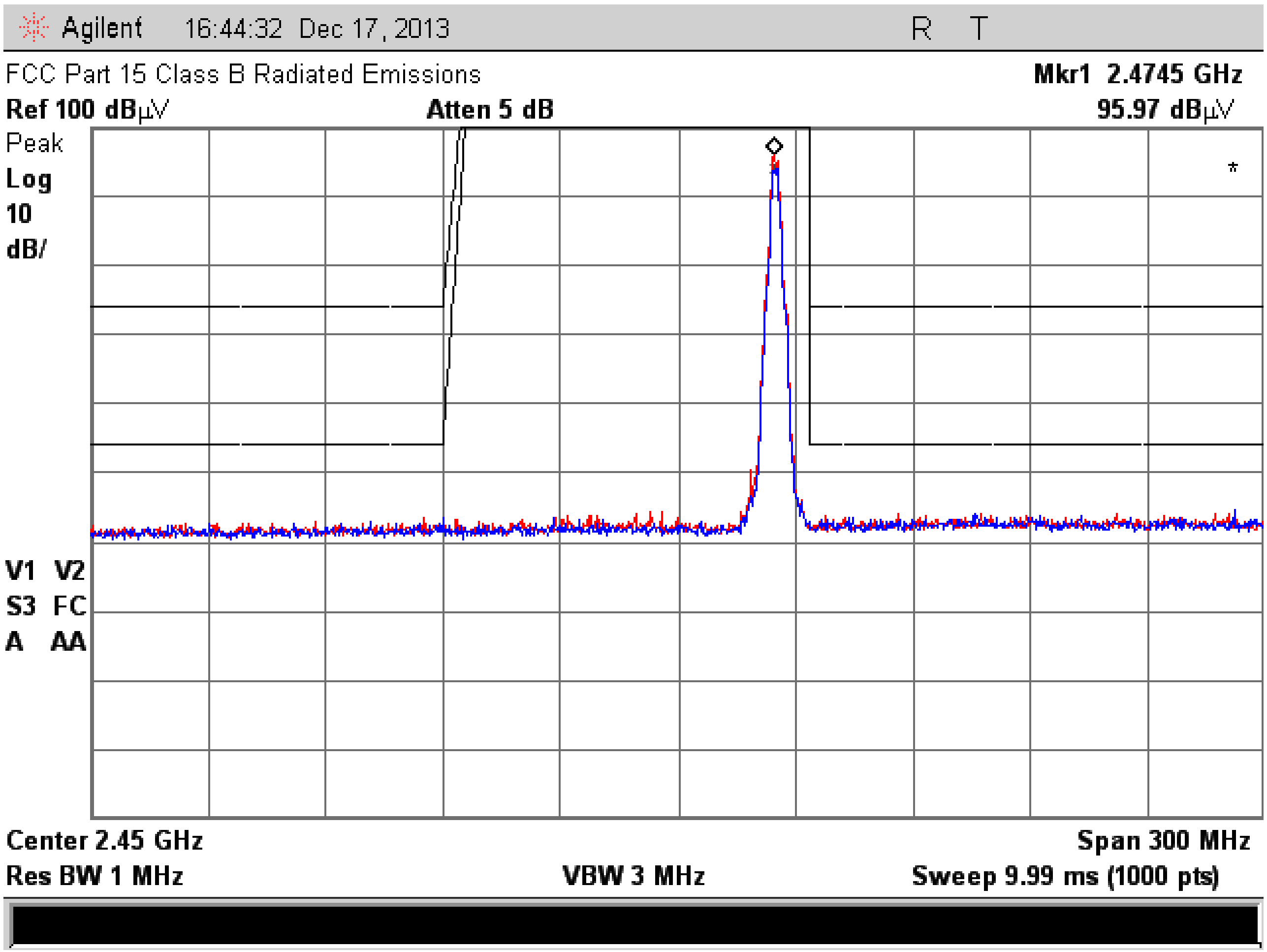


Figure 5.2-14 – Band Edge Radiated Emissions Channel 25 w/ Peak Detector

The red trace was with vertical polarity. The blue trace was with horizontal polarity.

The maximum field strength of the fundamental was observed at a height of 110 cm in vertical polarity and turntable angle of 77 degrees. The peak detector level was 96.0 dBµV/m. There were no significant emissions at the band edges with this channel.

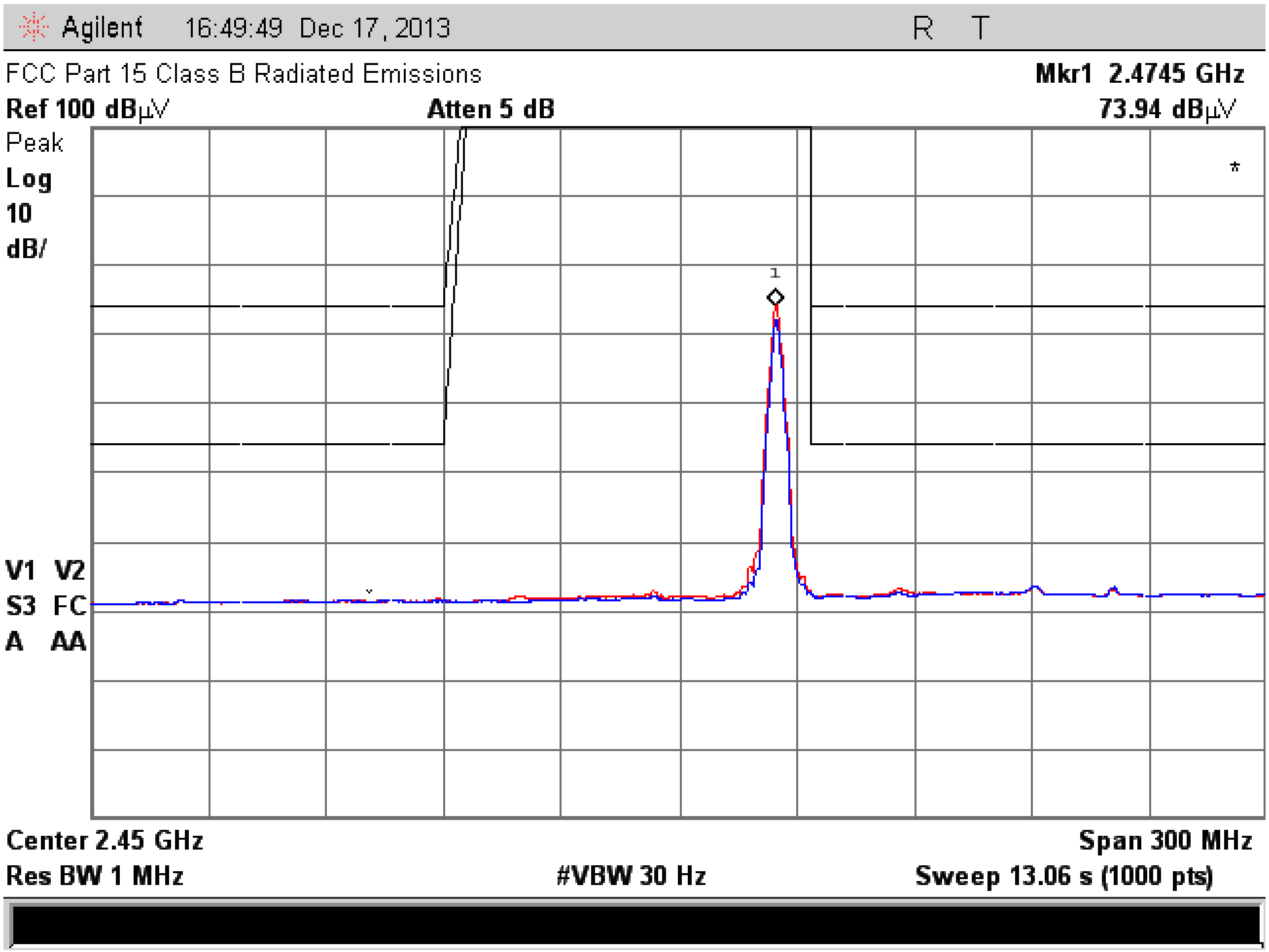


Figure 5.2-15 – Band Edge Radiated Emissions Channel 25 w/ Average Detector

The red trace was with vertical polarity. The blue trace was with horizontal polarity.

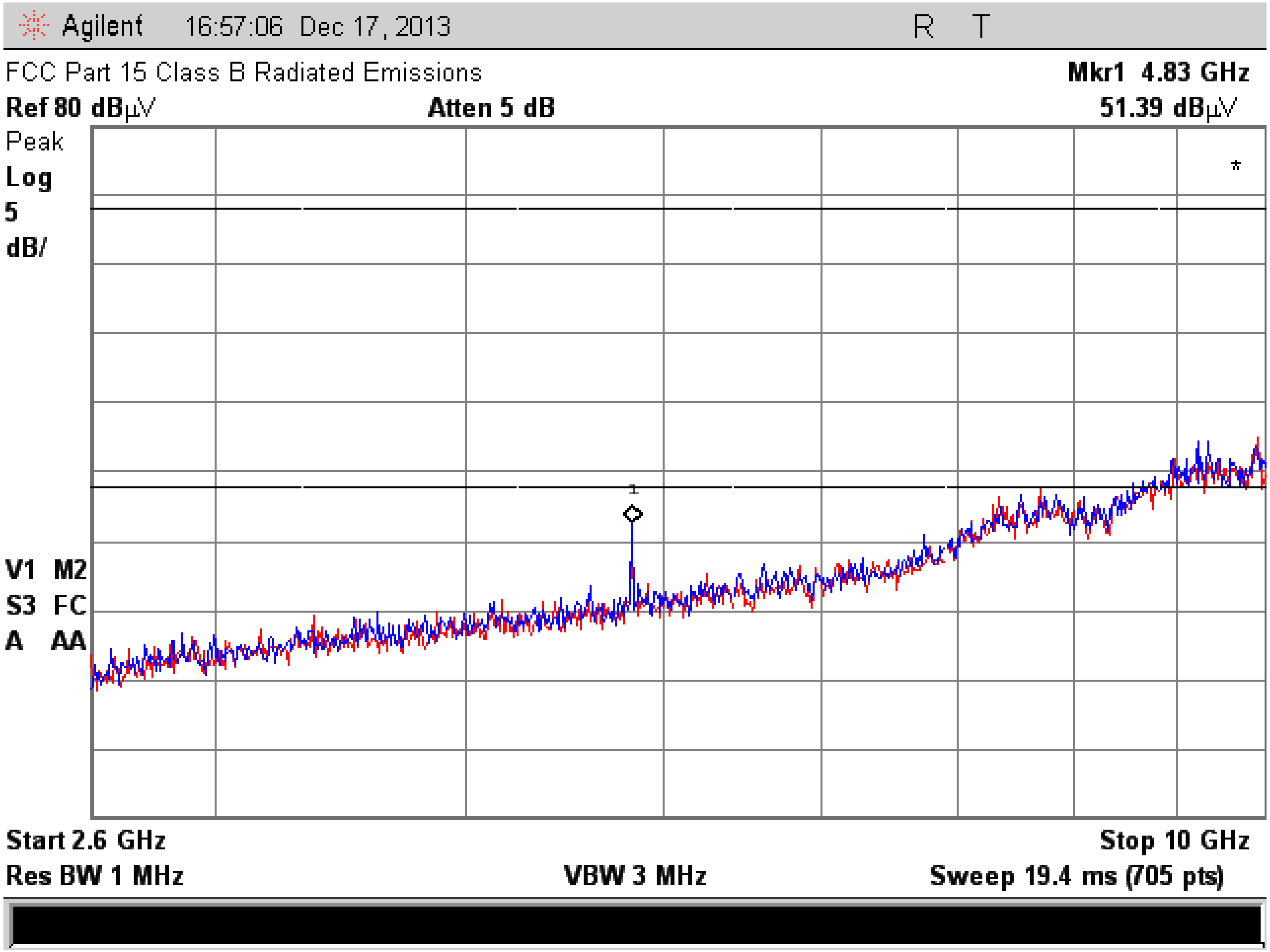


Figure 5.2-16 – Radiated Emissions 2.6 to 10 GHz for Channel 25 w/ Peak Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The emission at the marker frequency was the second harmonic. It was well below the limit. This occurred in horizontal polarity at a height of 100 cm and turn table angle of 212 degrees.

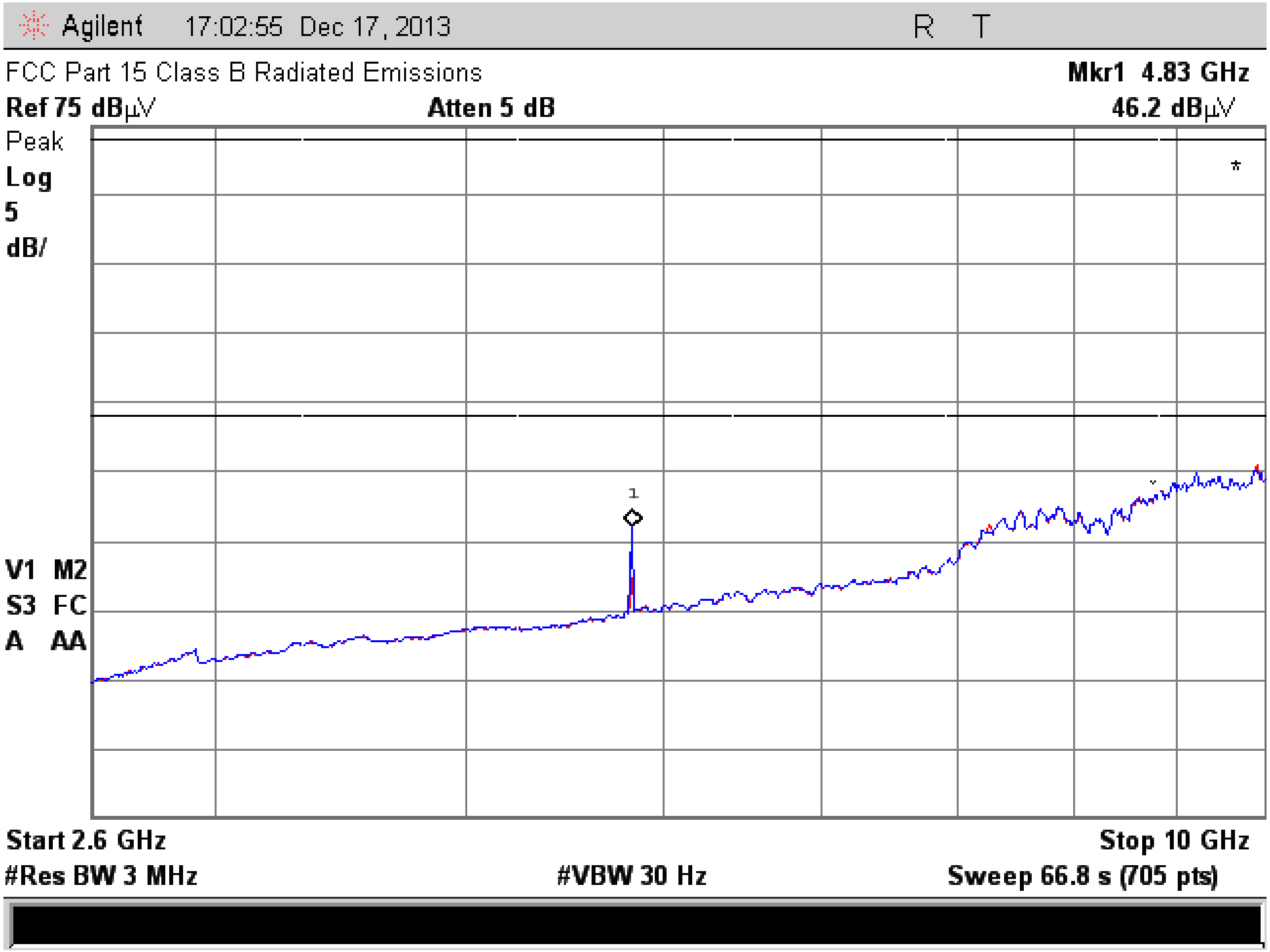


Figure 5.2-17 – Radiated Emissions 2.6 to 10 GHz for Channel 25 w/ Average Detector

Notes:

The red trace was with vertical polarity. The blue trace was with horizontal polarity. The emission at the marker frequency was the second harmonic. It was well below the limit. This occurred in horizontal polarity at a height of 100 cm and turn table angle of 212 degrees.

Though not shown there were no detectable emissions above 10 GHz.

Table 5.2-1 – Radiated Emissions Peak Levels 1 – 25 GHz

Frequency (MHz)	Peak (dBµV/m)	Antenna height (cm)	Polarity	Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Notes
2.405	94.8	110	Vertical	260	None	N/A	Channel 11
2.445	94.7	110	Vertical	40	None	N/A	Channel 19
2.475	96.0	110	Vertical	77	None	N/A	Channel 25
4.810	52.6	110	Vertical	208	74	21.4	Channel 11 second harmonic
4.890	51.9	110	Vertical	240	74	22.1	Channel 19 second harmonic
4.950	51.4	100	Horizontal	212	74	22.6	Channel 25 second harmonic
9.620	57.9	110	Vertical	22	None	N/A	Channel 11 fourth harmonic
9.780	52.9	110	Vertical	196	None	N/A	Channel 19 fourth harmonic
9.900	62.8	110	Vertical	195	None	N/A	Channel 25 forth harmonic

Table 5.2-2 – Radiated Emissions Average Levels 1 – 25 GHz

Frequency (MHz)	Average (dBµV/m)	Antenna height (cm)	Polarity	Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Notes
2.405	74.3	110	Vertical	260	None	N/A	Channel 11
2.445	69.0	110	Vertical	40	None	N/A	Channel 19
2.475	73.4	110	Vertical	77	None	N/A	Channel 25
4.810	42.1	110	Vertical	208	54	11.9	Channel 11 second harmonic
4.890	40.3	110	Vertical	240	54	13.7	Channel 19 second harmonic
4.950	46.2	100	Horizontal	212	54	7.8	Channel 25 second harmonic
9.620	42.5	110	Vertical	22	None	N/A	Channel 11 fourth harmonic
9.780	47.5	110	Vertical	196	None	N/A	Channel 19 forth harmonic
9.900	51.2	110	Vertical	195	None	N/A	Channel 25 forth harmonic

* CF is the antenna correction factor and cable loss

Minimum Margin: **7.8 dBµV/m**

Measurement Uncertainty: +4.8 dB, -5.2 dB

Test Personnel:

Date	Name	Signature
December 17, 2013	Peter J. Walsh, NCE	Peter J. Walsh

5.3 Test Instrumentation Used, Radiated Measurement

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
EMI Receiver	Rohde & Schwarz ESCS 30	825788/002	12/4/2015
Spectrum Analyzer	Agilent E7405A	MY42000055	3/29/2015
Preamplifier	Com-Power PA-122	181925	5/31/2015
Antenna	Chase EMCCBL6112B	2579	1/20/2014
Antenna	EMCO Horn Model 3115	9002-3393	3/7/2015
Antenna	Com-Power AL-130	121033	4/17/2014
Antenna	Schwarzbeck Mess - Electronik	SBA 9119	12/14/2014

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

5.4 Field Strength Calculation

The field strength is calculated by adding the antenna correction factor and cable loss and subtracting the amplifier gain (if any) from the measured reading.

The Rohde & Schwarz Model ESCS30 receiver and Agilent E7405A spectrum analyzer have the capability of automatically performing the field strength calculations. The amplitude level displayed on the receiver or analyzer represents the total measured field strength. This level is directly compared to the appropriate FCC limit to determine the actual margin of the DUT.

5.5 Radiated Emissions Photographs

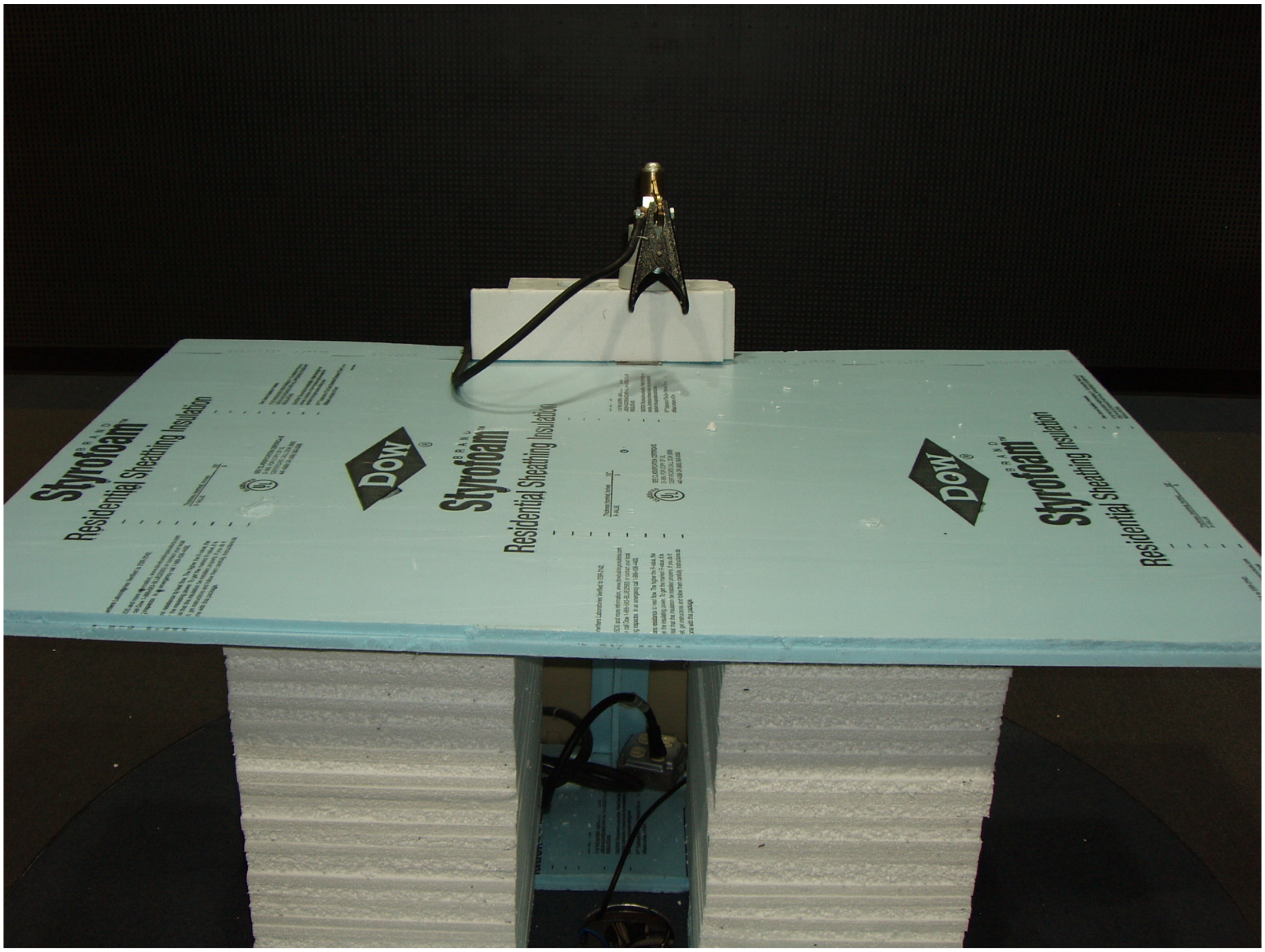


Photo 5.5-1 - Front View of the Radiated Emissions Test Set-up

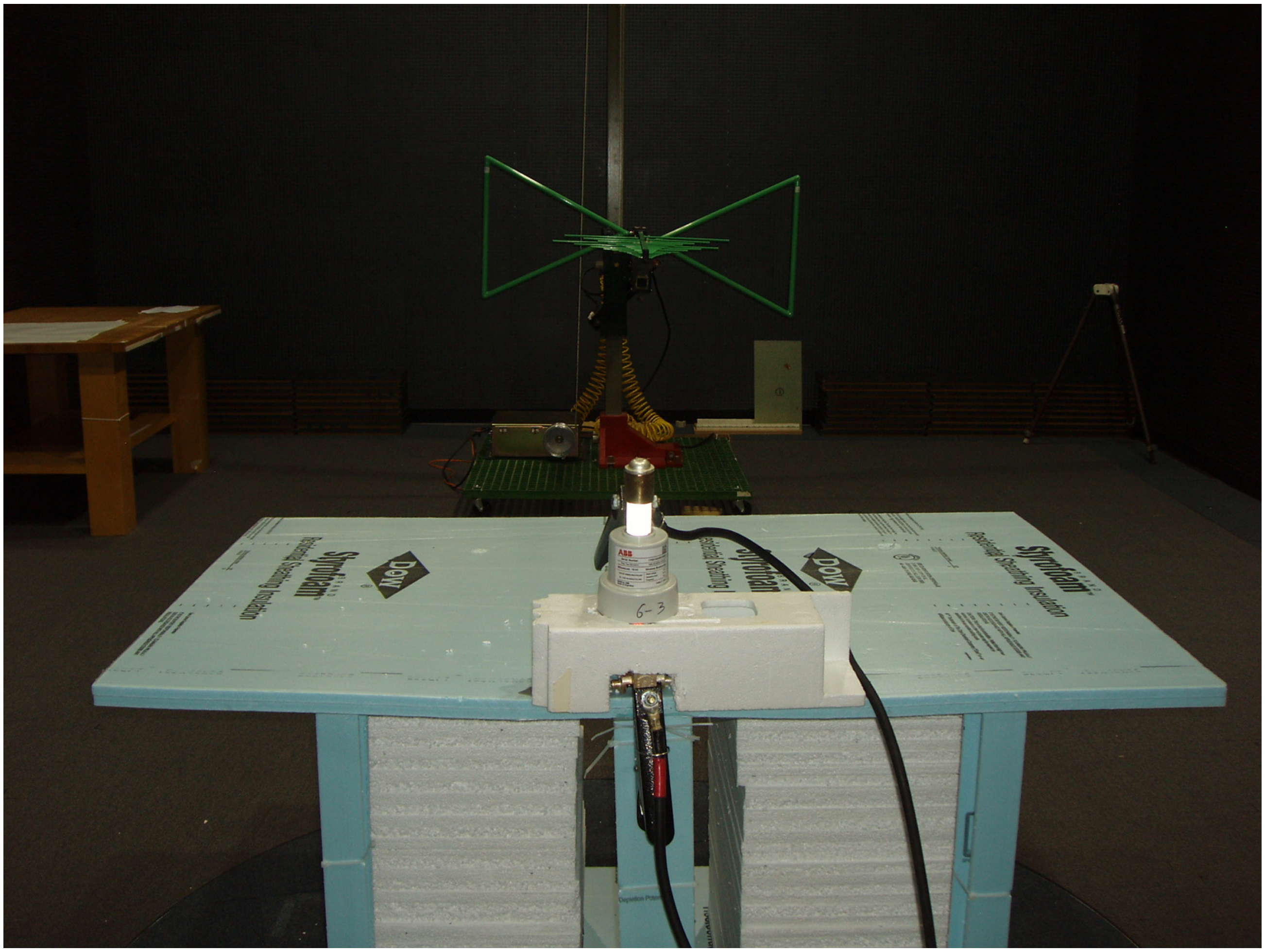


Photo 5.5-2 - Rear View of the Radiated Emissions Test Set-up 30 MHz to 1000 MHz

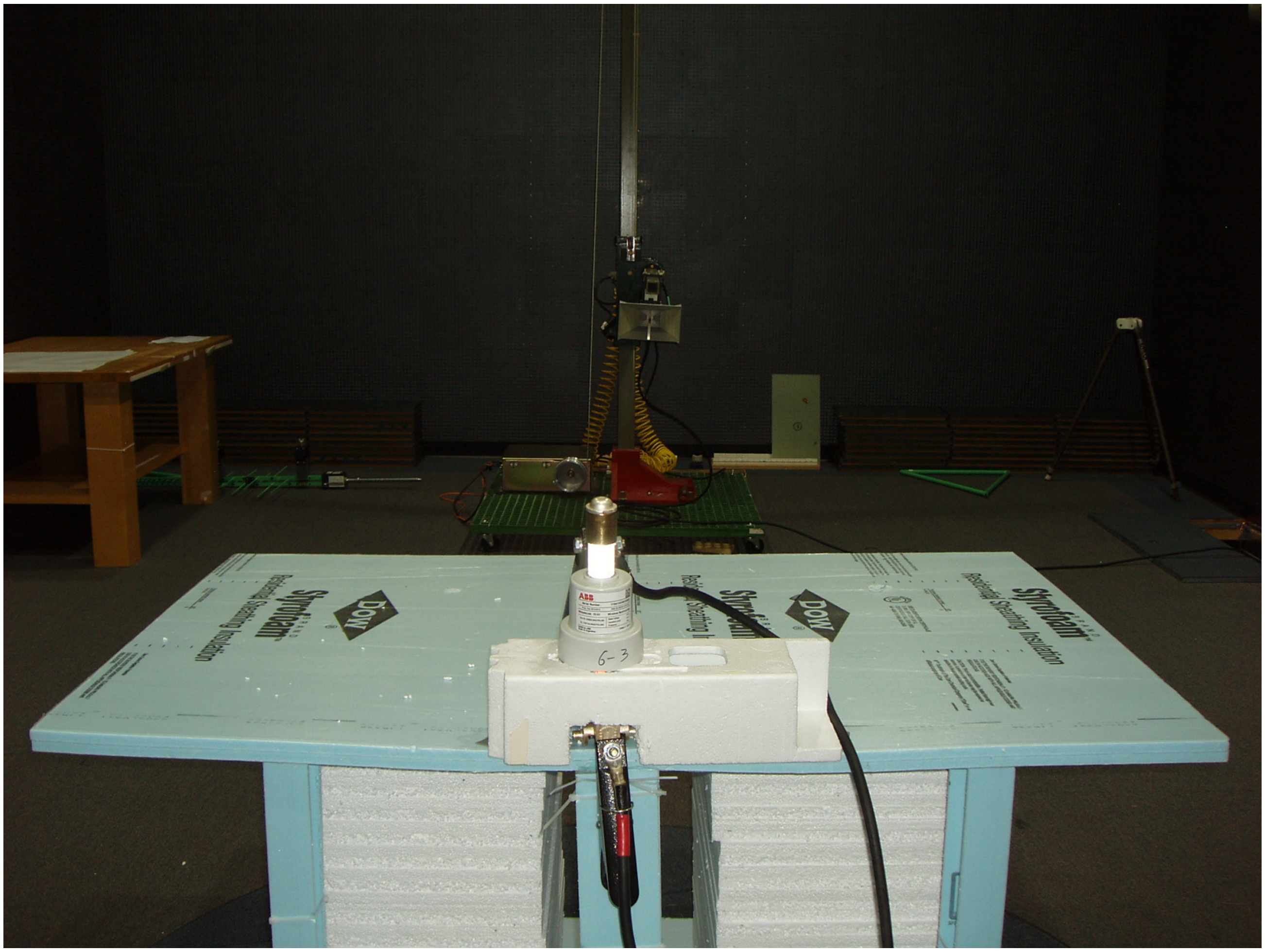


Photo 5.5-3 - Rear View of the Radiated Emissions Test Set-up above 1000 MHz

6 ANTENNA REQUIREMENT

References: 47 C.F.R. § 15.203
RSS-GEN § 7.1.4

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

6.1 Test Procedure

Inspect the DUT.

6.2 Test Data

Compliance Verdict: PASS

This requirement is met because an internal PCB trace inverted F antenna is be used.

6.3 Antenna Photograph

Photo 6.3-1 below shows the DUT's antenna.

Photo 6.3-1

7 BANDWIDTH DATA

References: 47 C.F.R. § 15.247 (a) (2)
RSS-210 § A8.2 (a)

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

7.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 100 kHz and its span set to encompass the full bandwidth of the emission. The DUT is conditioned to transmit at its maximum duty cycle.

7.2 Test Data

Compliance Verdict: PASS

Figures 7.2-1 through 7.2-3 show the 6 dB bandwidth of the DUT operating on Channels 11, 19, and 25 respectively. The IEEE 802.15.4 standard assures that the 6 dB bandwidth will be much greater than the required 500 kHz.

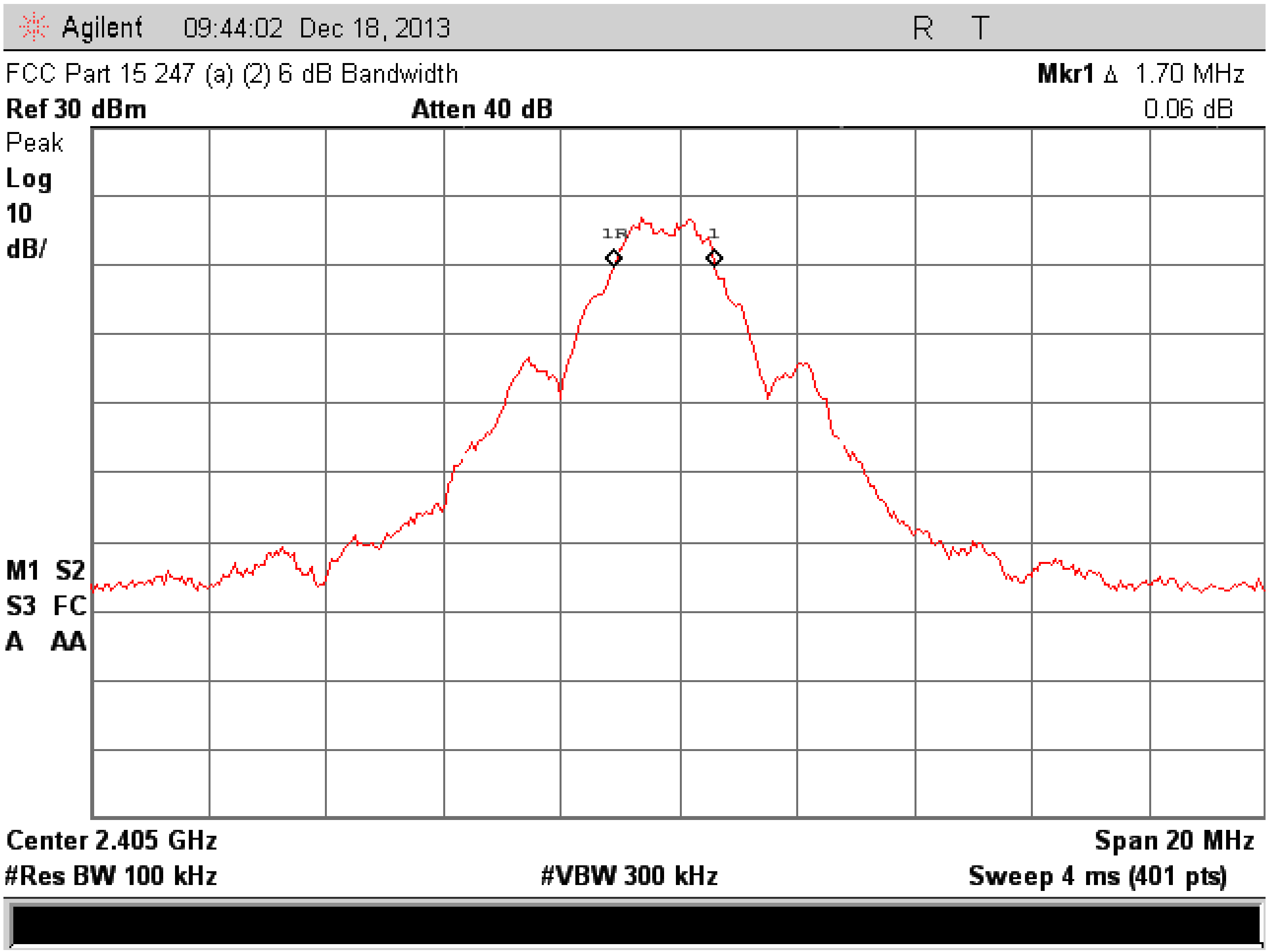


Figure 7.2-1 – Channel 11 Bandwidth

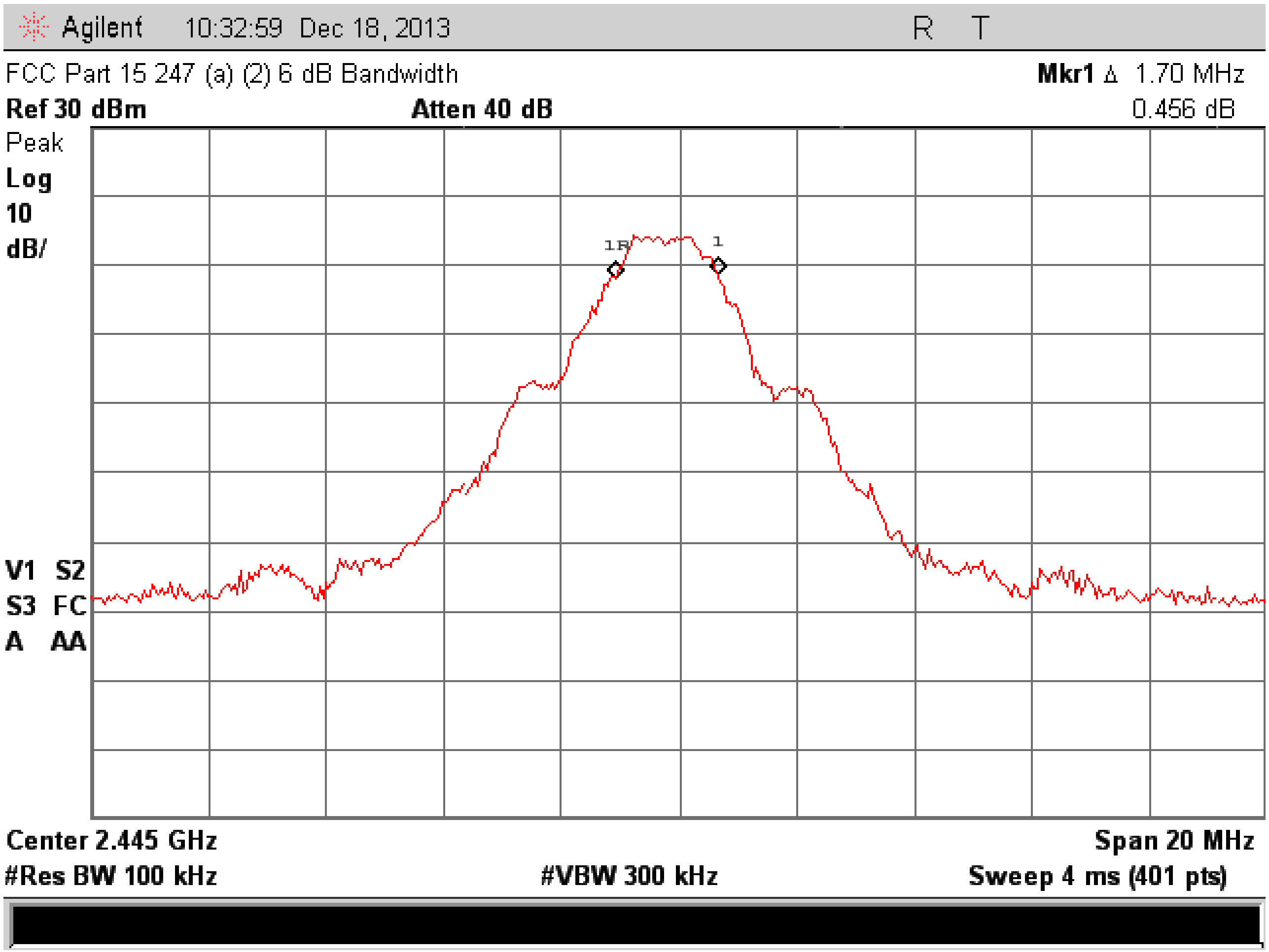


Figure 7.2-2 – Channel 19 Bandwidth

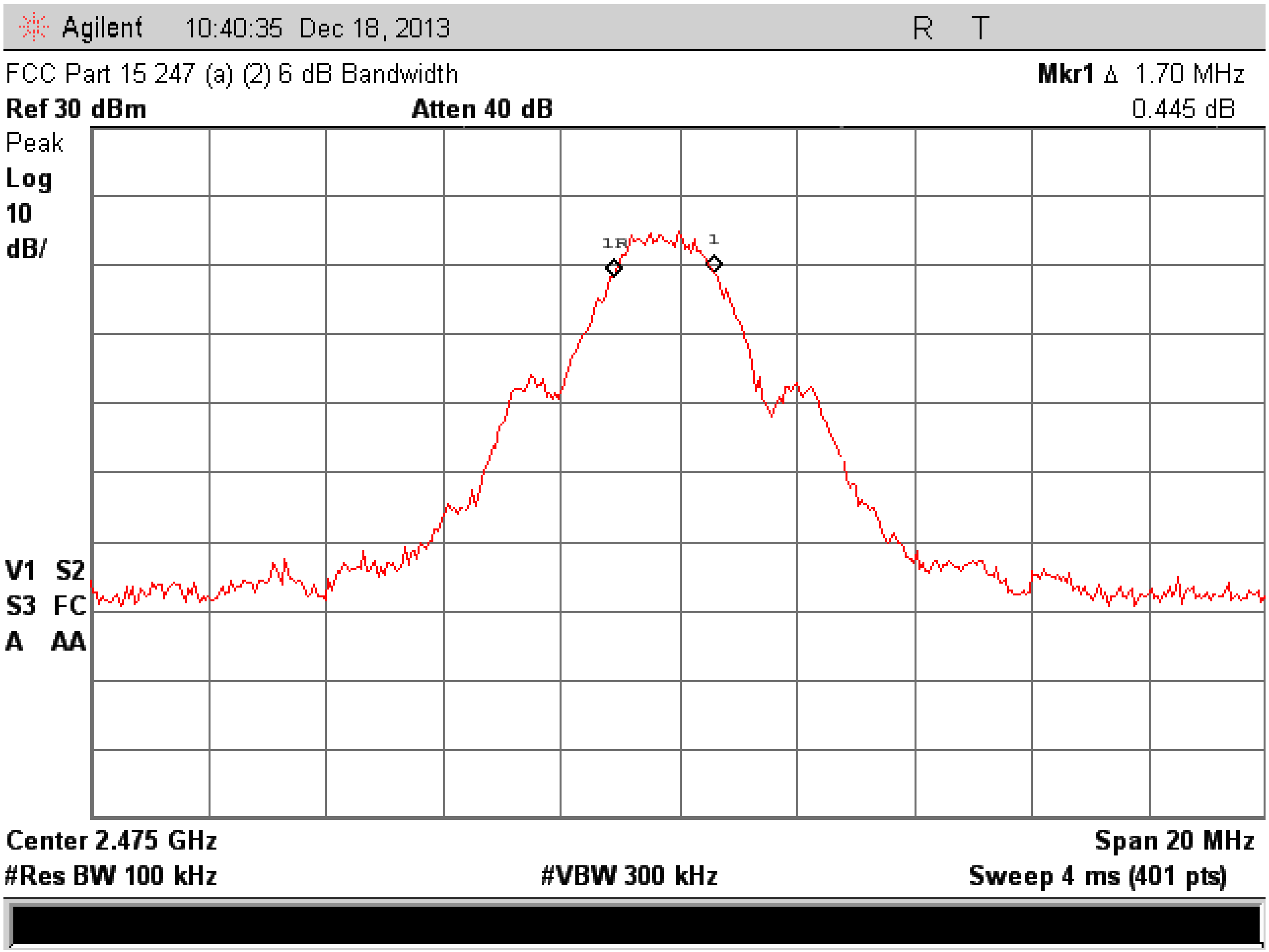


Figure 7.2-3 – Channel 25 Bandwidth

7.3 Test Instrumentation Used, Bandwidth Measurement

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
Spectrum Analyzer	Agilent E7405A	MY42000055	3/29/2015

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

7.4 Photograph of the Setup for Conducted Measurements

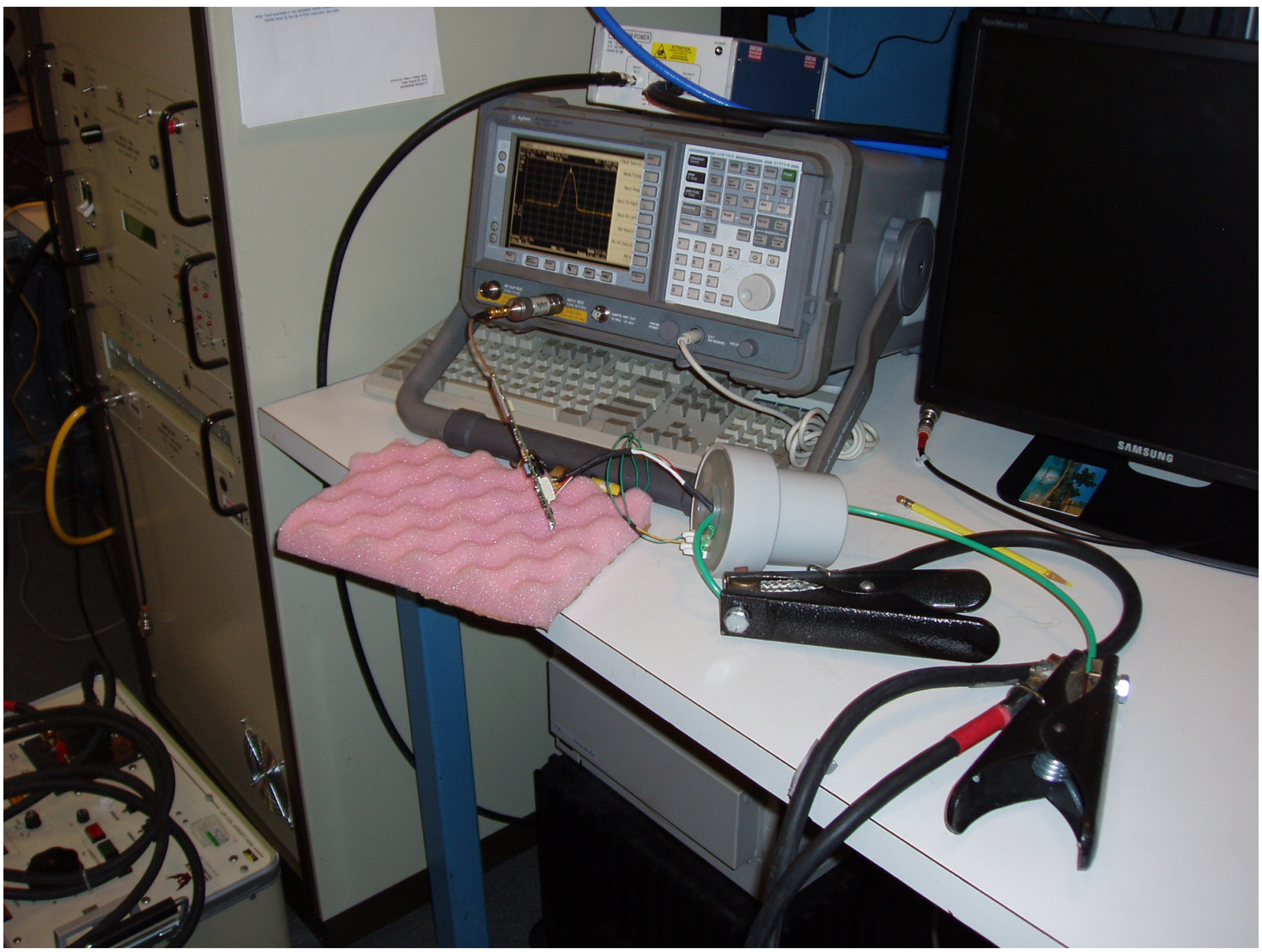


Photo 7.4-1 – Conducted Measurement Test -Setup

8 PEAK POWER DATA

References: 47 C.F.R. § 15.247 (b)
RSS-210 § A8.4 (4)

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

References: 47 C.F.R. § 15.247 (c)
RSS-GEN § 7.1.4

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i)Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log(number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beam forming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

8.1 Test Procedure

The measurement is made using a direct connection between the DUT’s antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 3 MHz, video bandwidth set to 3 MHz and its span set to encompass the full bandwidth of the emission, approximately 5 times the 20 dB bandwidth of the channel. The DUT is conditioned to transmit continuously by selecting the modulated transmission test mode. The trace should be set to max hold. A marker is placed using the spectrum analyzer’s peak search function.

8.2 Test Data

Compliance Verdict: PASS

First the total power limit must be determined. The system employed a single antenna with a gain declared by the manufacturer to be 4.83 dBi. Because the gain did not exceed 6.0 dBi by more than 3 dBi, it was not necessary to further reduce the DUT’s output power. The 1 watt peak limit was applicable.

Table 8.2-1 below shows the measured power at the DUT's antenna terminal.

Table 8.2-1 – Measured Power on Channels 11, 19, and 25

Antenna Power (dBm)	Total Power (watts)	Total Power (dBm)	Power Setting	Channel
19.83	0.096	19.83	0xF9	11
19.38	0.087	19.38	0xF9	19
19.12	0.082	19.12	0xF9	25

Figures 8.2-1 through 8.2-3 show the in-band spectral characteristics and the peak power measured by the spectrum analyzer.

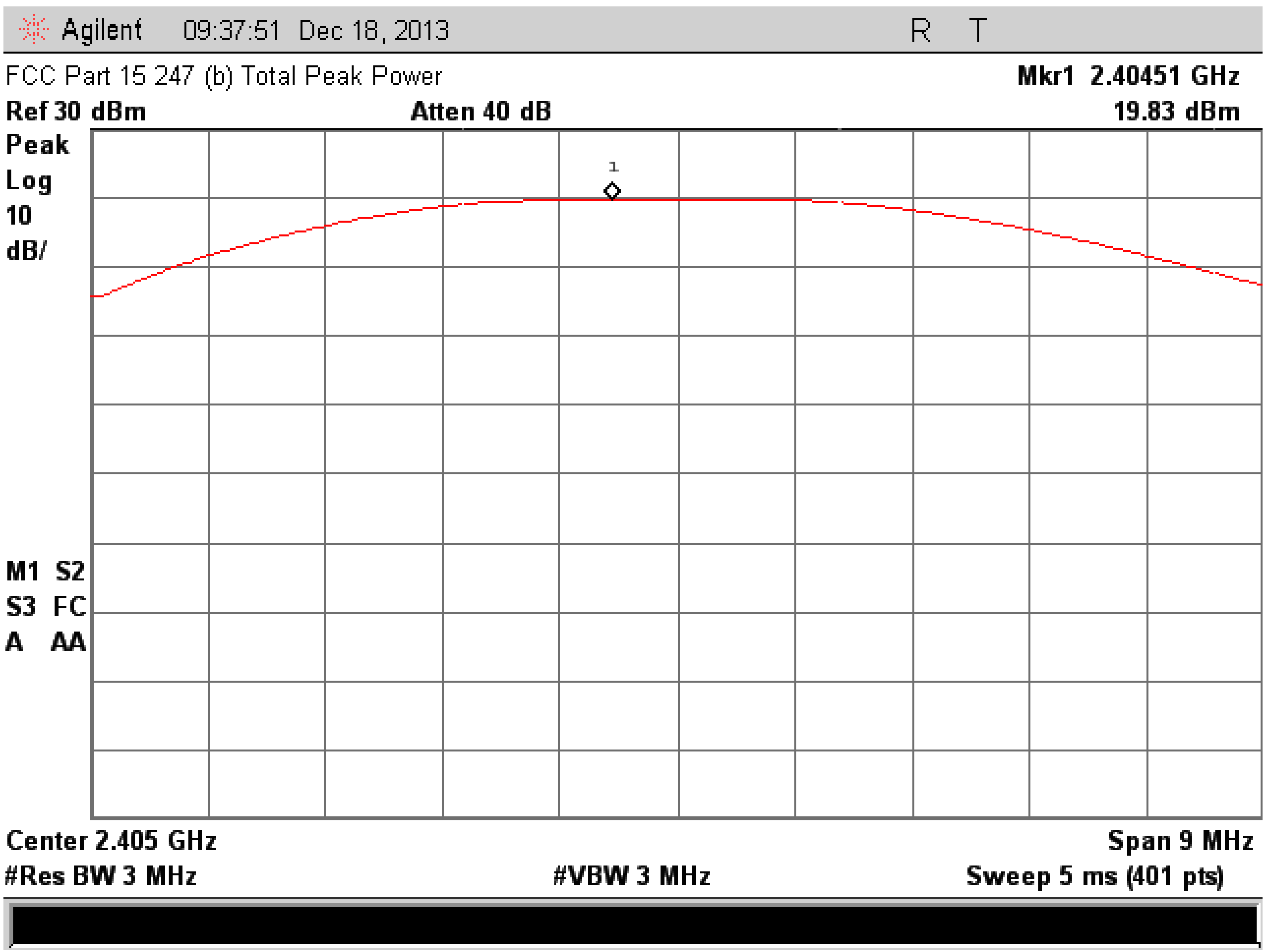


Figure 8.2-1 – Channel 11 Signal Power

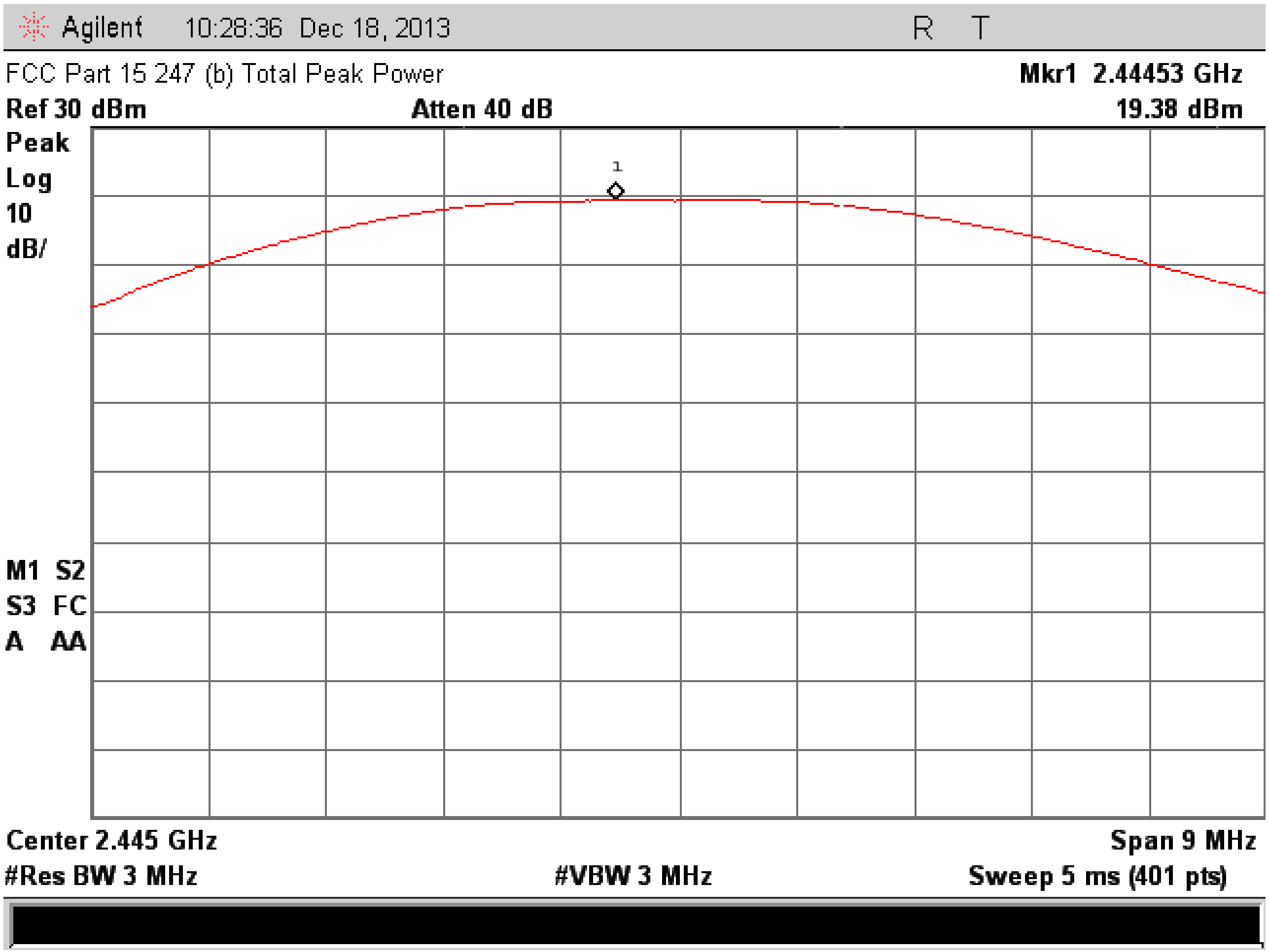


Figure 8.2-2 – Channel 19 Signal Power

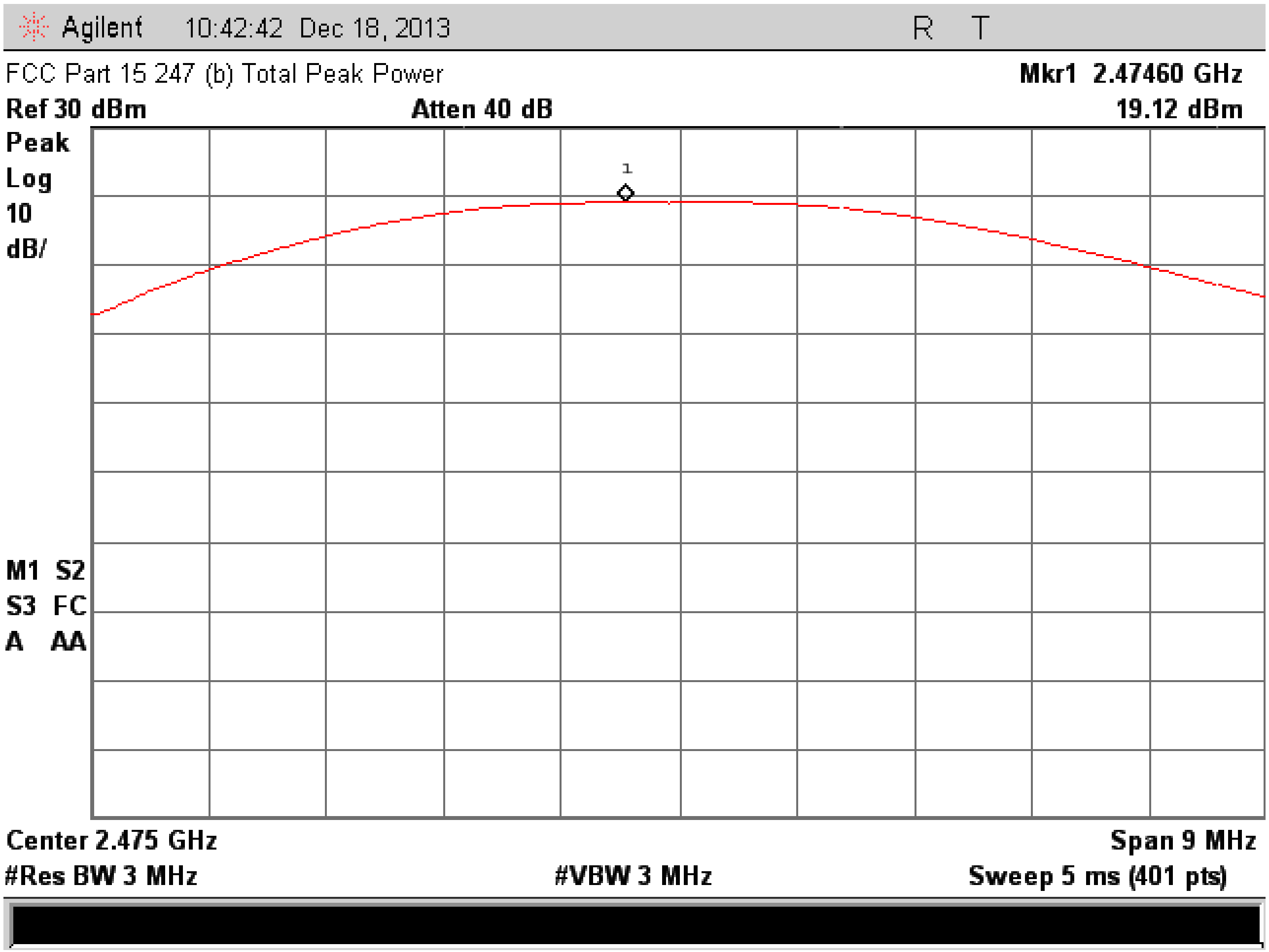


Figure 8.2-3 – Channel 25 Signal Power

8.3 Test Instrumentation Used, Peak Power Measurement

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
Spectrum Analyzer	Agilent E7405A	MY42000055	3/29/2015

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

9 OUT OF BAND POWER DATA

References: 47 C.F.R. § 15.247 (d)
RSS-210 § A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

9.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 100 kHz and its span set to encompass the full bandwidth of the emission. The DUT is conditioned to transmit at its maximum duty cycle. The maximum peak power level of the emission is measured first. Next, a limit line is programmed at a level 20 dB below the measured maximum peak power level outside the operating band. Spurious emissions are measured relative to that limit.

Radiated emissions in the restricted bands are measured using the test method referenced in Section 5.1.

9.2 Test Data

Compliance Verdict: PASS

Figure 9.2-1 shows the out of band conducted data relative to the peak conducted level. This measurement was made with the DUT set in the continuous modulated mode. The display line was set 20 dB lower than the peak level of the desired power. There were no spurious emissions close to the limit. Though not shown, the conducted levels in the 30 MHz to 1000 MHz band were well below the limit.

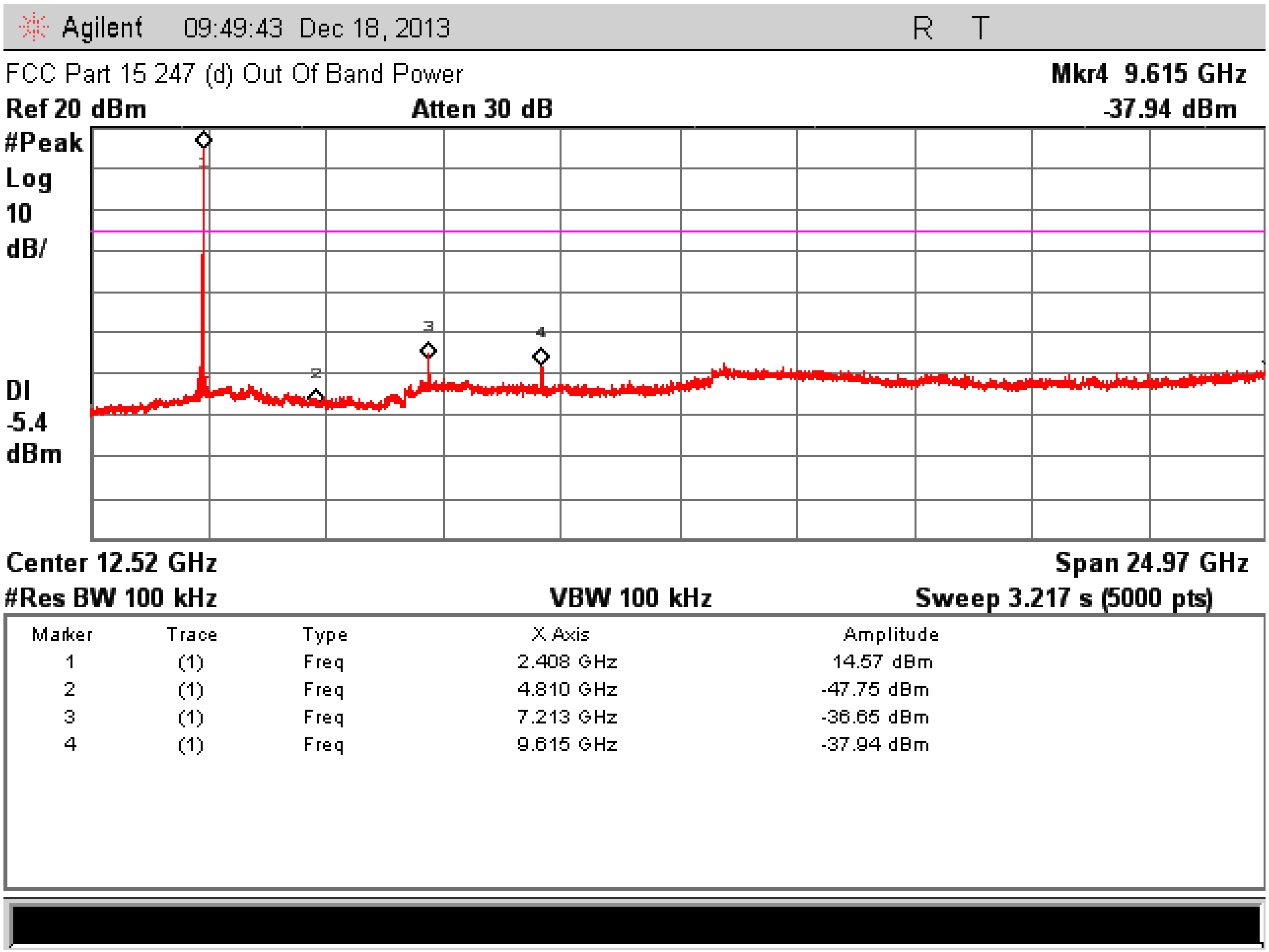


Figure 9.2-1 – Out of Band Conducted Data for Channel 11

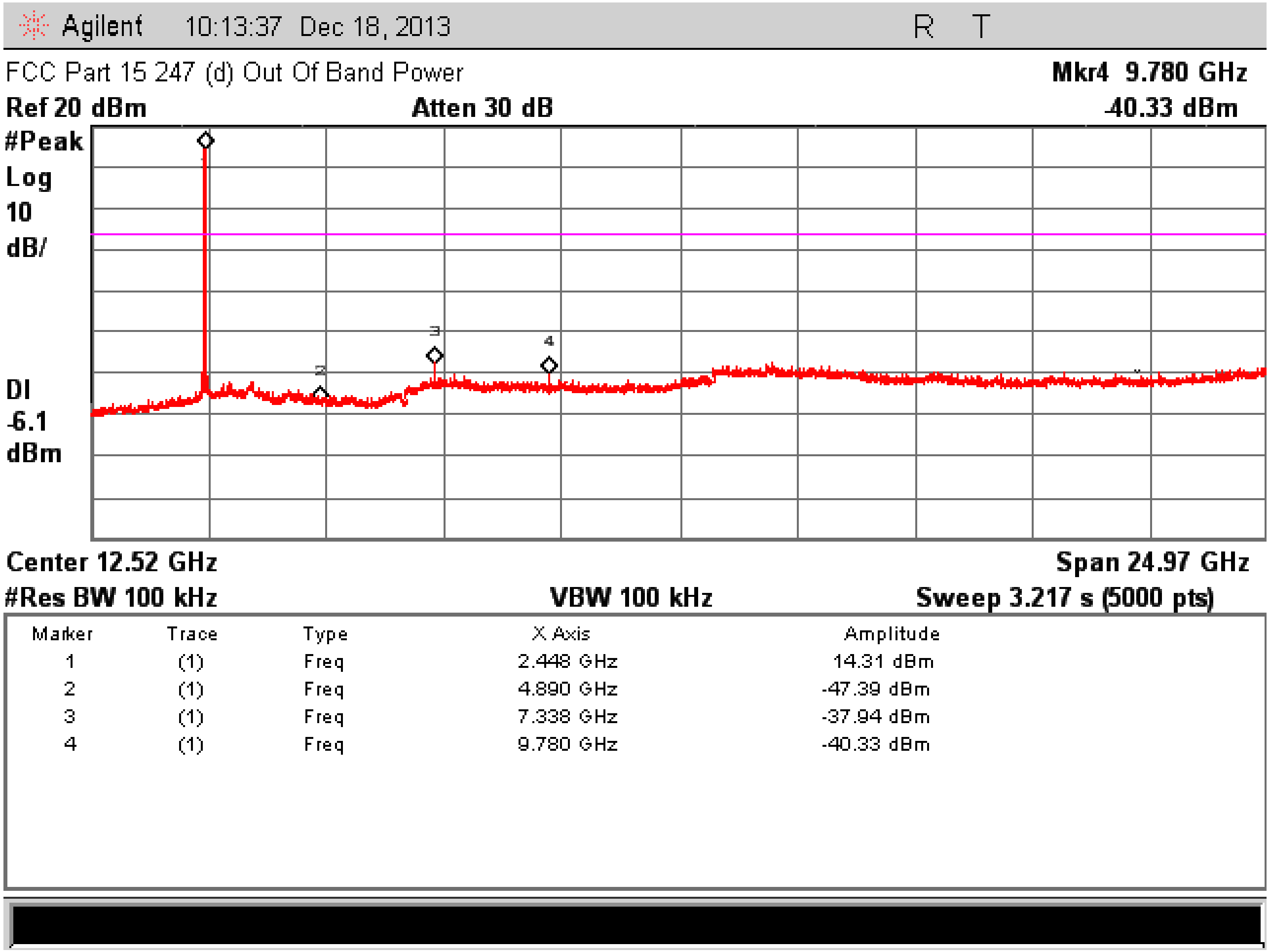


Figure 9.2-2 – Out of Band Conducted Data for Channel 19

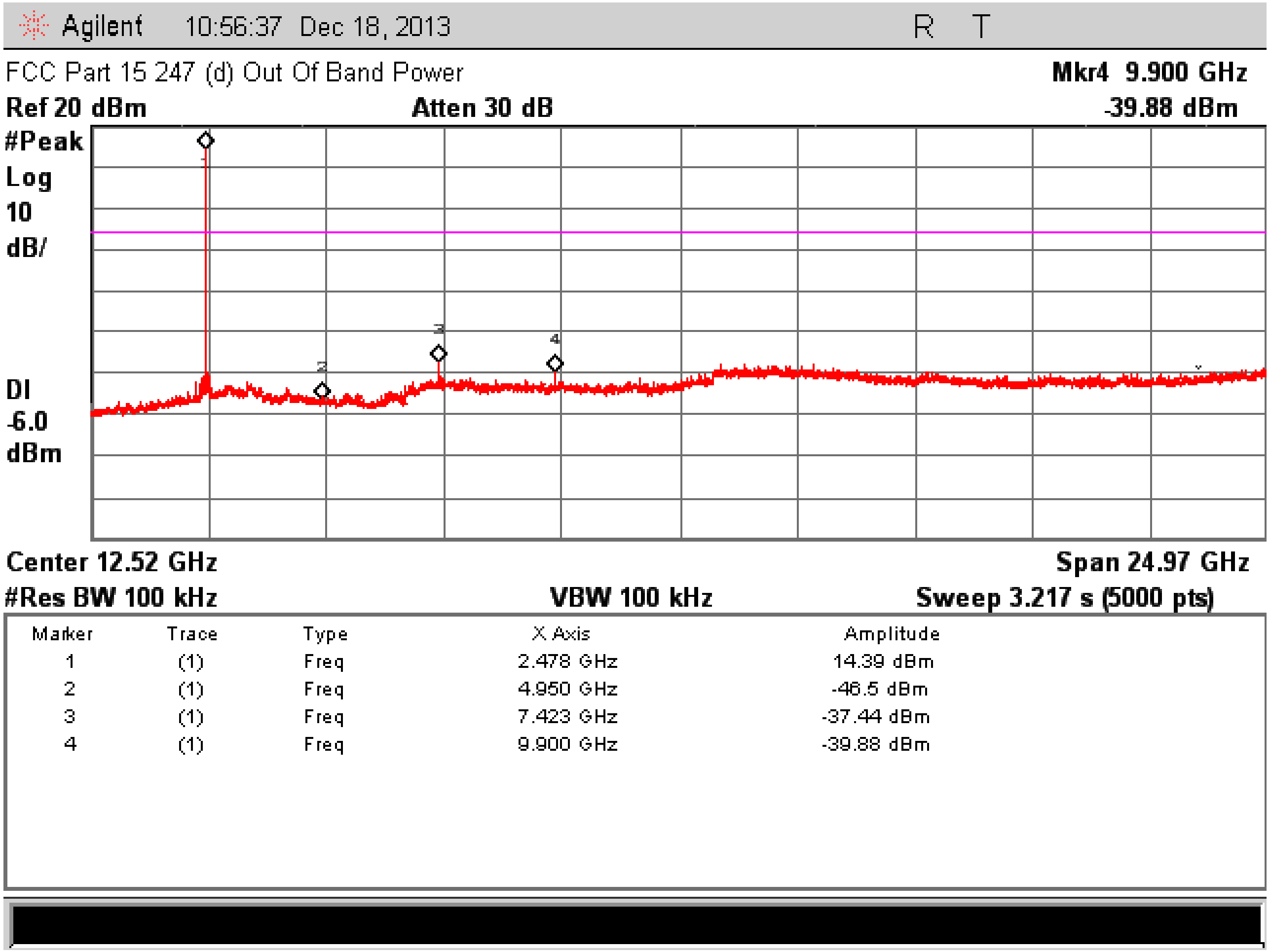


Figure 9.2-3 – Out of Band Conducted Data for Channel 25

9.3 Test Instrumentation Used, Out of band Power Measurement

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
Spectrum Analyzer	Agilent E7405A	MY42000055	3/29/2015

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

10 POWER SPECTRAL DENSITY DATA

References: 47 C.F.R. § 15.247 (e)
RSS-210 § A8.2 (b)

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

10.1 Test Procedure

The measurement is made using a direct connection between the DUT's antenna connection and the spectrum analyzer. The spectrum analyzer's resolution bandwidth (RBW) is set to 3 kHz and its span set to encompass the full bandwidth of the emission. The DUT was conditioned to transmit continuously by selecting the modulated transmission test mode. The maximum peak power level of the emission was then measured.

10.2 Test Data

Compliance Verdict: PASS

Figures 10.2-1 through 10.2-3 show the conducted power in a 3 kHz bandwidth (PSD) of the DUT on Channels 11, 19, and 25 respectively.

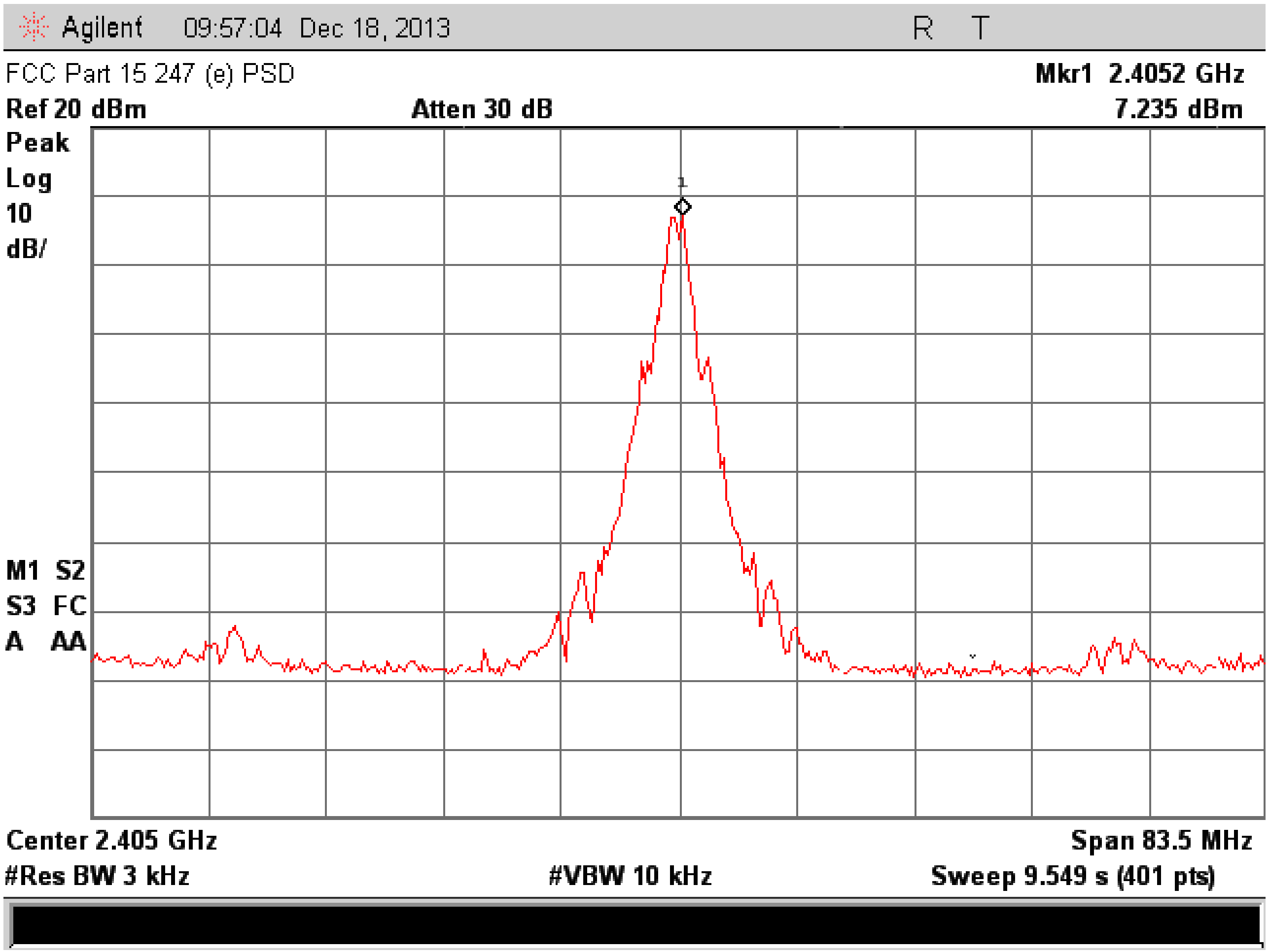


Figure 10.2-1 – Channel 11 PSD

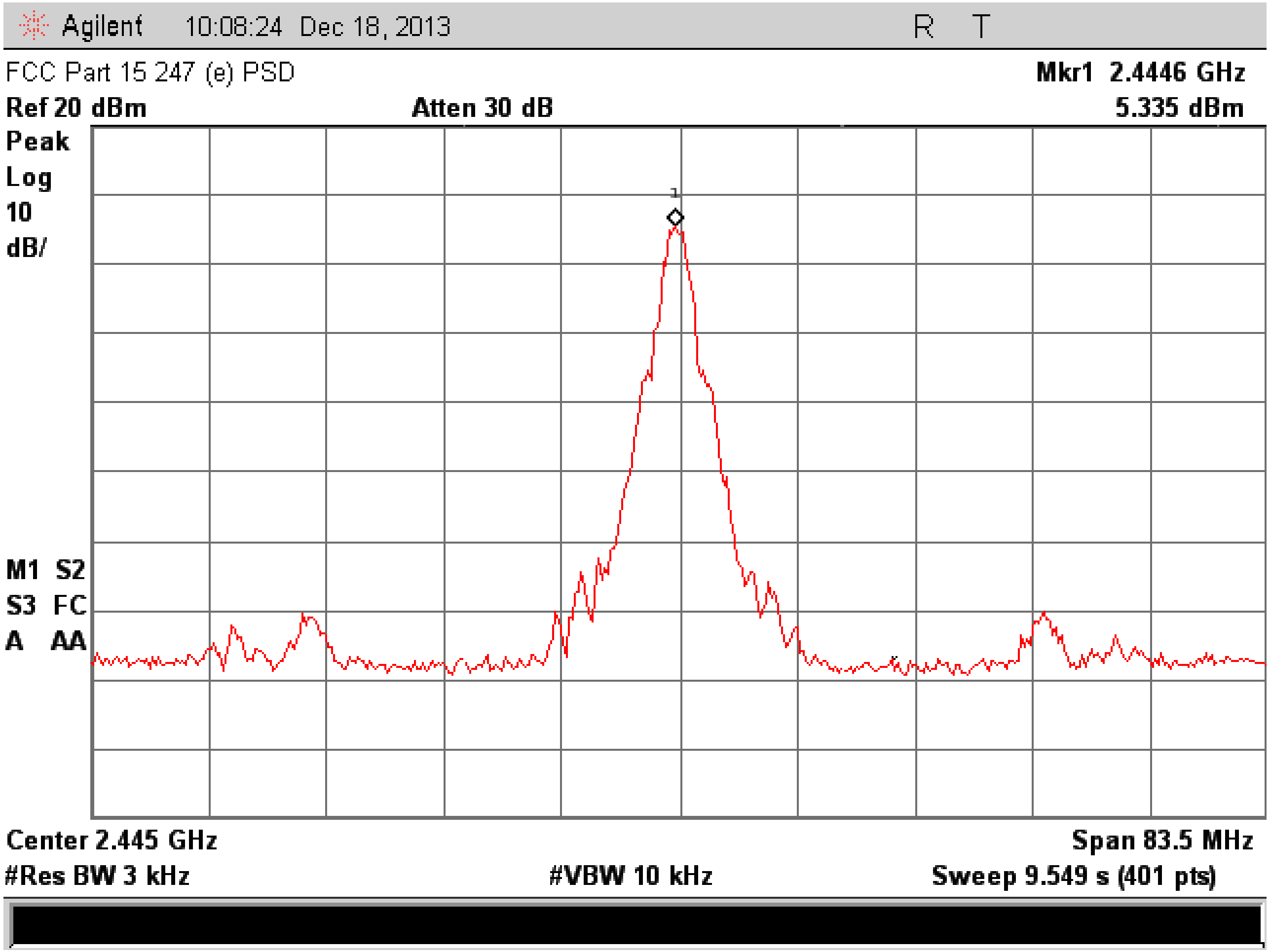


Figure 10.2-2 – Channel 19 PSD

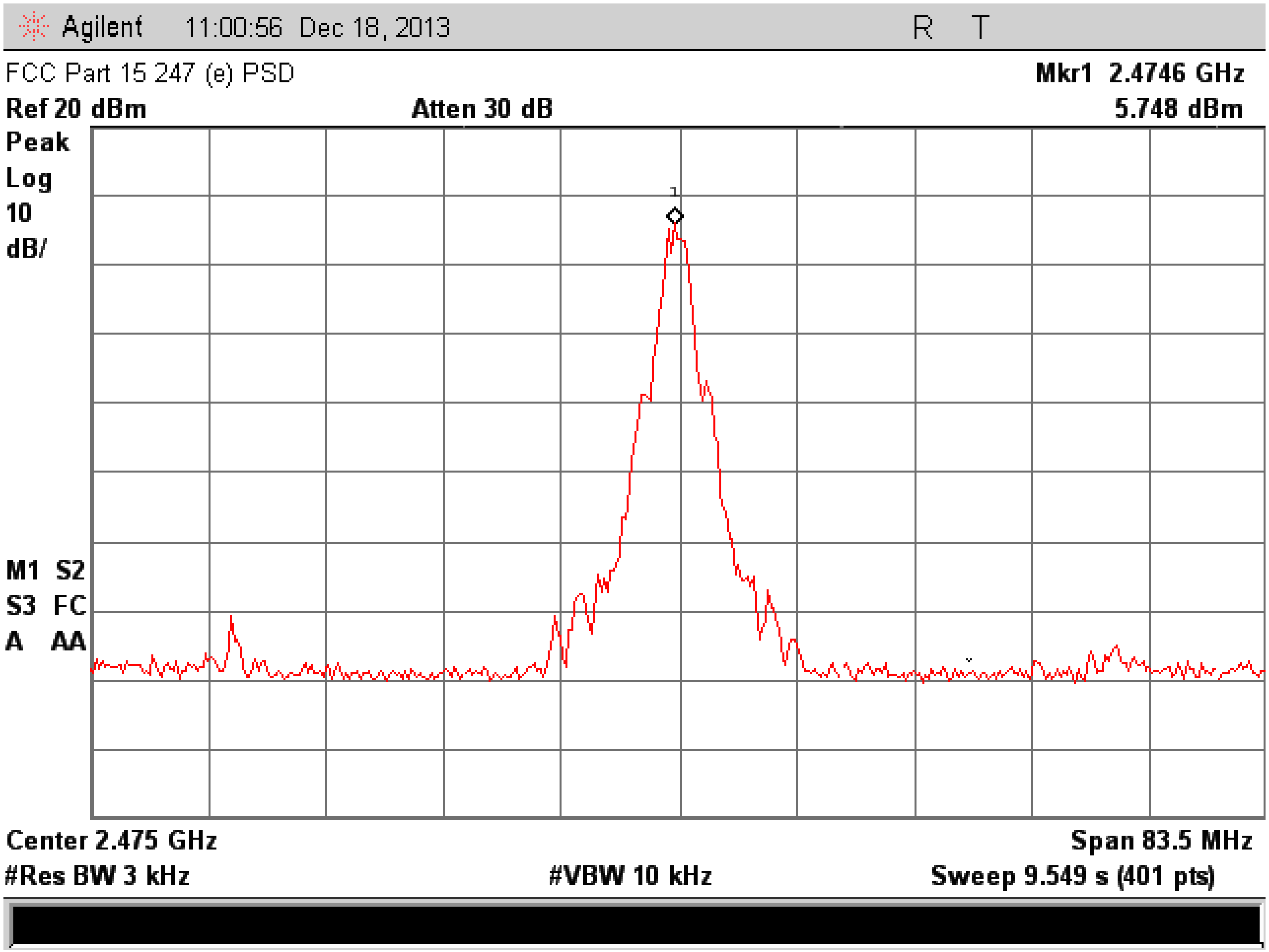


Figure 10.2-3 – Channel 25 PSD

10.3 Test Instrumentation Used, PSD Measurement

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
Spectrum Analyzer	Agilent E7405A	MY42000055	3/29/2015

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

11 DUTY CYCLE

References: 47 C.F.R. § 15.35 (c)
RSS-GEN § 4.5

Unless otherwise specified, e.g. §15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

11.1 Test Procedure

The measurement is made as a field strength measurement except that the spectrum analyzer's frequency span is set to 0 Hz to facilitate a time domain measurement. The sweep time is set to 100 msec or lower to measure the on time. The DUT is conditioned to transmit at its maximum duty cycle as made possible by the continuous transmission test mode. The duty cycle is then calculated by summing the on times and dividing by 100 msec.

11.2 Test Data

Compliance Verdict: None

The duty cycle of the continuous transmission test mode was calculated as an informative test. A duty cycle correction factor was not applied to any measured results.

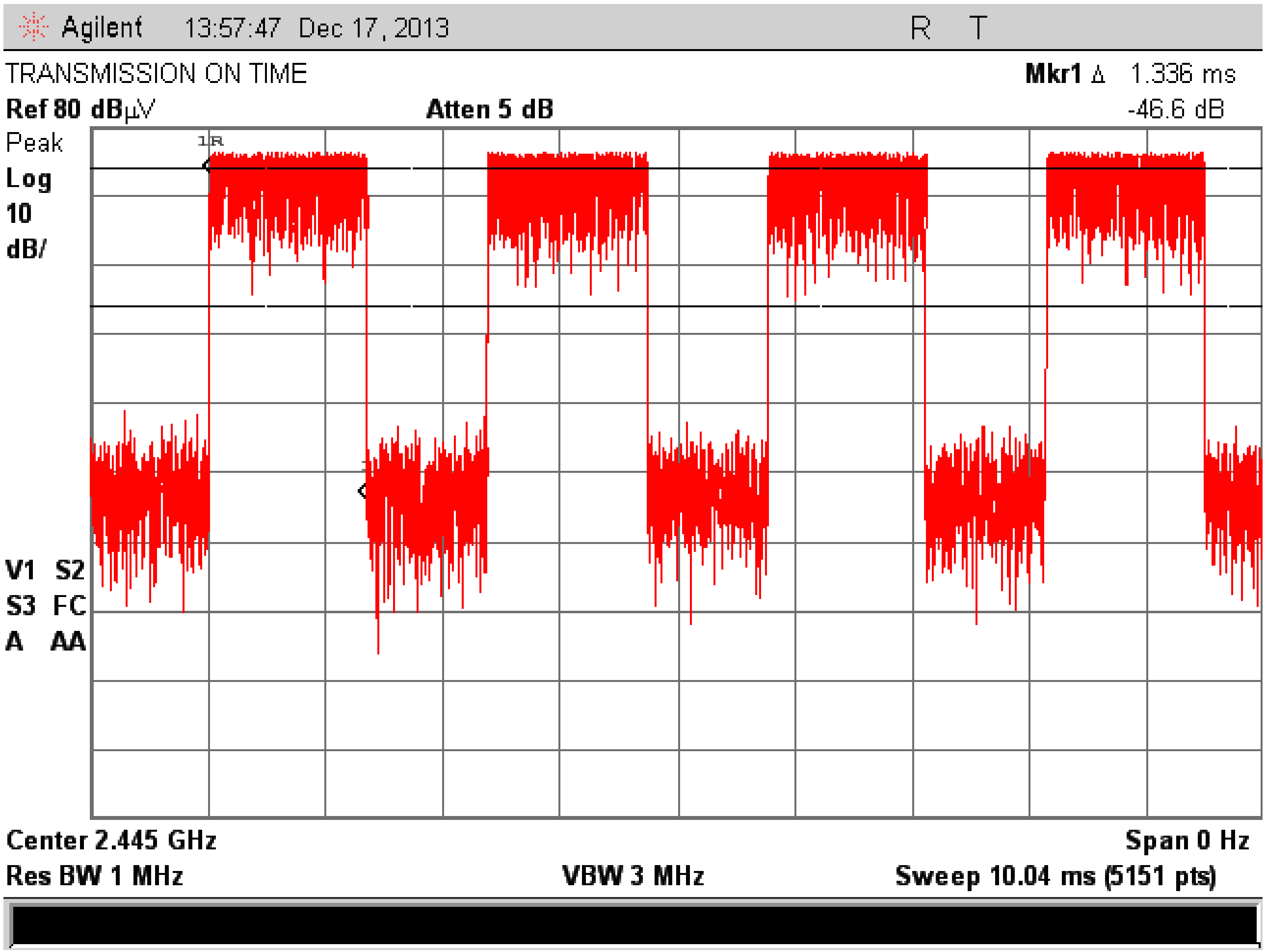


Figure 11.2-1 – Transmission On Time

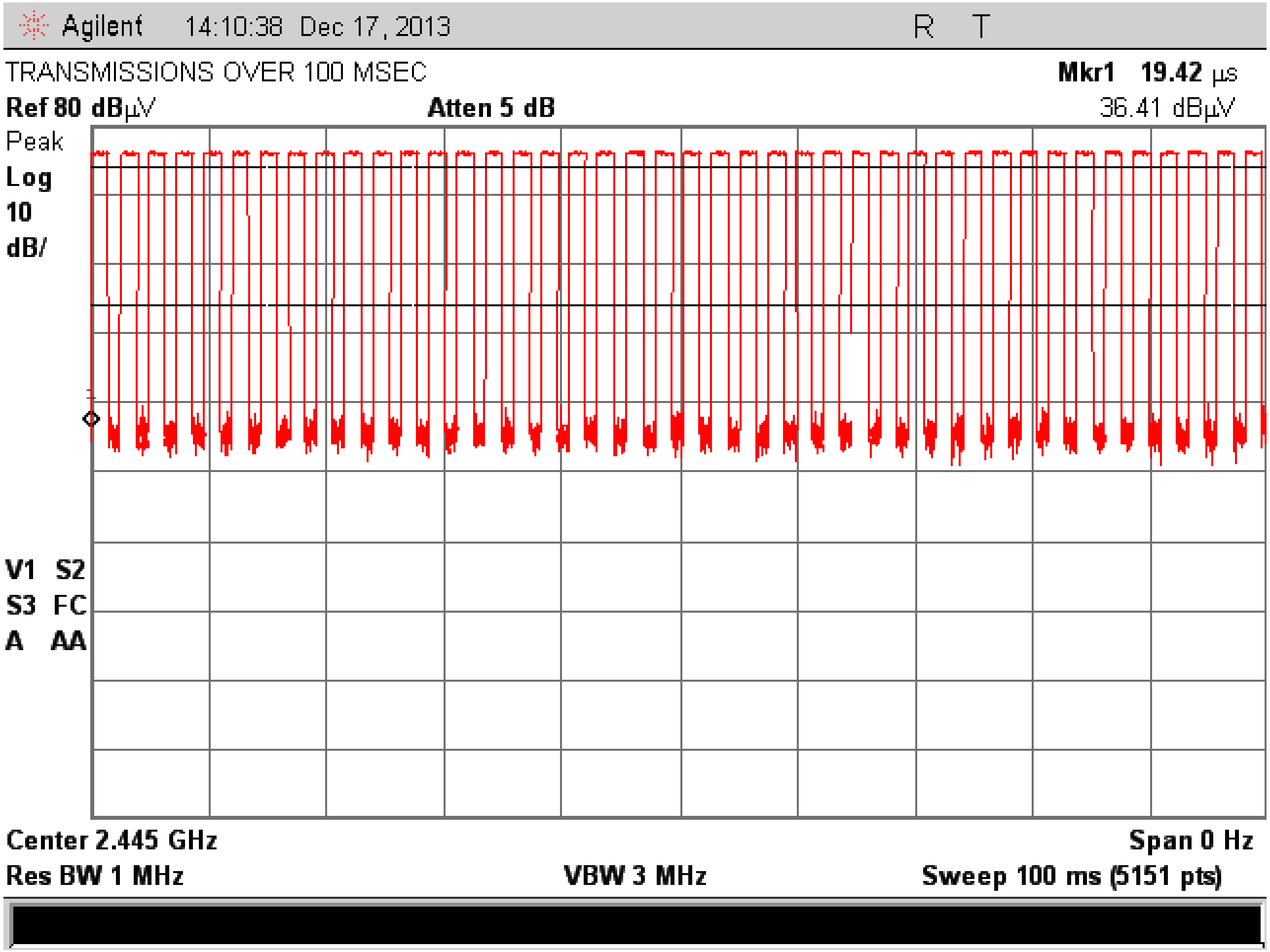


Figure 11.2-2 – Transmissions over a 100 msec Window

Cumulative On Time = 42 X 1.336 msec = 56.112 msec

Duty Cycle = 56.11 / 100.00 = 56.1 %

For 802.15.4 devices, the worst case duty cycle would be a full data frame or 133 bytes where the transmitter does not get an acknowledgement and retries 3 more times. In this example, the on time for one frame is 32 µs/byte * 133 bytes = 4.26 ms. Four frames are transmitted for a total on time of 17 ms and a duty cycle of 17% for 100 ms.

The measured duty cycle of the DUT in the continuous transmission test mode was 56.1%. Therefore this test mode could be used as it represented a higher than worse case duty cycle than would occur in normal operation.

11.3 Test Instrumentation Used, Radiated Emissions Measurement

Type	Manufacturer/ Model No.	Serial Number	Calibration Due Date
EMI Receiver	Rohde & Schwarz ESCS 30	825788/002	12/4/2015
Spectrum Analyzer	Agilent E7405A	MY42000055	3/29/2015
Preamplifier	Com-Power PA-122	181925	5/31/2015
Notch Filter	Micro-tronics BRM50702-01	023	3/22/2014
Antenna	Chase EMCCBL6112B	2579	1/20/2014
Antenna	EMCO Horn Model 3115	9002-3393	3/7/2015
Antenna	Com-Power AL-130	121033	4/17/2014
Antenna	Schwarzbeck Mess - Electronik	SBA 9119	12/14/2014

Calibration and Traceability: All measuring and test equipment are calibrated and are traceable to the National Institute for Standards and Technology (NIST) and Methods. The interval is 24 months.

12 LABELING AND USER'S GUIDE REQUIREMENTS

12.1 FCC Label Statement

The FCC compliance label shall include the following information:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

The FCC id number will be: FCC ID: 2ABDQ WIAUTOLINK

The Industry Canada id number will be: IC: 11571A-WIAUTOLINK

Figure 12.1-1 below shows a drawing of the label. Because of the small size of the label, the manufacturer has placed the required notice in the user manual.

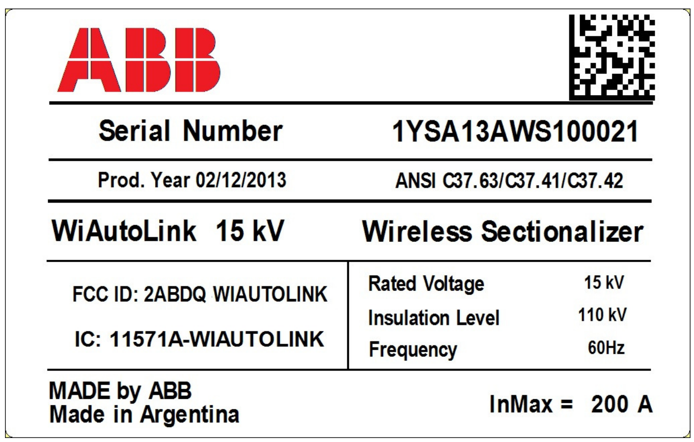


Figure 12.1-1 - Sample Label for the Model WiAutoLink 15 kV

Figure 12.1-2 - Sample Label for the Model WiAutoLink 27 kV

12.2 Instruction Manual Statements

The instruction manual must contain the following statements:

- Changes or modifications not expressly approved by the responsible party could void the user's authority to operate the equipment.
- This device has been designed to operate with the on-board inverted F antenna. No other antennas may be used.
- To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication. Operating the device with the supplied antenna will ensure that this requirement is met.
- Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
- A separation distance of 20 cm should be observed to maintain compliance with the FCC's RF exposure guidelines set out in OET Bulletin 65.

13 MPE CONSIDERATIONS

References: 47 C.F.R. § 1.1310

Radiofrequency radiation exposure limits.

The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation."

Table 13-1

Table 1—Limits for Maximum Permissible Exposure (MPE) **Frequency range (MHz)**	**Electric field strength (V/m)**	**Magnetic field strength (A/m)**	**Power density (mW/cm2)**	**Averaging time (minutes)**
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100.000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100.000			1.0	30
f = frequency in MHz				
* = Plane-wave equivalent power density				

2.5.2 Exemption from Routine Evaluation Limits – RF Exposure Evaluation
RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, except when the device operates as follows:

below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W;

at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Prediction of MPE Limit for a Specified Distance

Reference: OET Bulletin 65, Edition 97-01

The power density formula is as follows:

$$S = \frac{PG}{4\pi R^2}$$

where: S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

Table 13-2 – MPE Calculation for OET Bulletin 65 Compliance

Maximum peak output power at antenna terminal:	19.83	(dBm)
Maximum peak output power at antenna terminal:	96.16	(mW)
Antenna Gain (typical):	4.83	(dBi)
Maximum Antenna Gain:	3.04	(numeric)
Prediction Distance:	20.00	(cm)
Prediction Frequency:	2405.00	(MHz)
MPE Limit for Uncontrolled Exposure at Prediction Frequency:	1.00	(mW/cm^2)
Power Density at the Prediction Frequency:	0.0582	(mW/cm^2)
Maximum Allowable Antenna Gain:	17.18	(dBi)
Margin of Compliance at 20 cm:	12.35	(dB)

Table 13-3 – MPE Calculation for RSS-102 Compliance

Maximum peak output power at antenna terminal:	19.83	(dBm)
Maximum peak output power at antenna terminal:	96.16	(mW)
Antenna Gain (typical):	4.83	(dBi)
Maximum Antenna Gain:	3.04	(numeric)
Prediction Distance:	20.00	(cm)
Prediction Frequency:	2405.00	(MHz)
MPE Limit for Uncontrolled Exposure at Prediction Frequency:	1.00	(mW/cm^2)
Power Density at the Prediction Frequency:	0.0582	(mW/cm^2)
Maximum Allowable Antenna Gain:	17.18	(dBi)
Margin of Compliance at 20 cm:	12.35	(dB)

The device meets the condition for an Industry Canada exemption from the routine evaluation limits because the output power is less than the 200 mW limit for general public use.

ANNEX A NVLAP CERTIFICATE of ACCREDITATION

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200125-0

Walshire Labs, LLC
Largo, FL

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2013-04-01 through 2014-03-31
Effective dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Institute of Standards and Technology

NVLAP-01C (REV. 2009-01-28)

ANNEX B DISCLOSURE STATEMENT

Walshire Labs, LLC represents to the client that testing was done in accordance with standard procedures as applicable and that reported test results are accurate within generally accepted commercial ranges of accuracy. Walshire Labs Inc. test reports only apply to the specific sample(s) tested. This report is the property of the client. This report shall not be reproduced except in full without the expressed written approval of Walshire Labs, LLC.

TERMS and CONDITIONS

ARTICLE 1 *- Services, Walshire Labs will:*

1.1 Act for Client in a professional manner, using the degree of care and skill ordinarily exercised by and consistent with the standards of the profession.

1.2 Provide only those services that lie within the technical and professional area of expertise and capability of the Lab.

1.3 Perform all technical services in accordance with accepted laboratory test principles and practices.

1.4 Use test equipment which has been calibrated within a period not exceeding the manufacturer's recommendation and which is traceable to the NIST.

1.6 Consider all reports to be the confidential property of the client, and distribute reports only to those persons designated by the client.

ARTICLE 2 *- Client's Responsibilities, The Client will:*

2.1 Provide all information necessary for proper performance of technical services.

2.2 Designate a person who is authorized to transmit instructions, receive information and test data reports, interpret and define Client's policies, and make decisions regarding technical services, as may be required at Clients expense.

2.3 Deliver without cost, representative samples of product for technical evaluation, together with any relevant data.

2.4 Furnish such labor and equipment necessary to handle sample product and to facilitate the technical evaluation.

2.5 The Client shall provide prior to the start of evaluation testing a signed Purchase Order for the amount agreed to by both parties.

ARTICLE 3 *- General Requirements.*

3.1 The only warranty made by Walshire Labs, in connection with services performed thereunder is that it will use that degree of care and skill as stated in Article 1.1 and 1.3 above. No other warranty, expressed or implied, is made or intended for services provided thereunder.

3.2 Walshire Labs shall supply technical services and prepare reports based solely on product samples submitted. The Client understands that application of the data to other devices is highly speculative and should be applied with extreme caution.

3.3 Walshire Labs agrees to exercise ordinary care in receiving, preserving, and shipping any test sample to be tested, but assumes no responsibility for damages, either direct or consequential, which arise or are alleged to arise from loss, damage or destruction of the sample due to the act of examination, modification or testing, or technical analysis, or circumstances beyond our control.

3.4 The Client recognizes that generally accepted error variances apply and agrees to consider such error variances in its use of test data.

3.5 It is agreed between Walshire Labs and Client that no distribution of any test reports, etc. shall be made to any third party without the prior written consent of both parties.

3.6 Test Reports may not be used by the Client to claim product endorsement by NVLAP or any agency of the U.S. Government.

ARTICLE 4 *- Payment.*

4.1 The Client agrees to pay for services and expenses as covered in the Purchase Order or modified by Article 2.2. Walshire Labs will present an invoice at the completion of work and will be paid within 15 days of receipt by Client.