

COMPLIANCE WORLDWIDE INC. TEST REPORT 406-17R1

In Accordance with the Requirements of
Federal Communications Commission 47 CFR Part 15.519, Subpart F
Technical Requirements for Handheld UWB Systems

IC RSS-220, Issue 1 (March 2009)
Devices Using Ultra-Wideband (UWB) Technology

Issued to

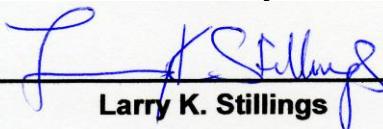
**Redpoint Positioning Corporation
100 N Washington Street, 5th Floor
Boston, MA 02114
(617) 207 4096**

**For the
RTLS Module
Model MOD-V7**

**FCC ID: 2ADX4-MODV7
IC: 12677A-MODV7**

**Report Issued on December 20, 2017
Revision R1 Issued on March 16, 2018**

Tested By



Larry K. Stillings

Reviewed By



Brian F. Breault

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Table of Contents

1. Scope.....	3
2. Product Details	3
2.1. Manufacturer	3
2.2. Model Number.....	3
2.3. Serial Number	3
2.4. Description	3
2.5. Power Source.....	3
2.6. Hardware Revision.....	3
2.7. Software Revision	3
2.8. Modulation Type.....	3
2.9. Operating Frequency	3
2.10. EMC Modifications	3
3. Product Configuration.....	3
3.1. Operational Characteristics & Software	3
3.2. EUT Hardware	3
3.3. EUT Cables/Transducers.....	3
3.4. Support Equipment	3
3.5. Test Setup	4
3.6. EUT Orientation Diagram.....	4
4. Measurements Parameters	5
4.1. Measurement Equipment Used to Perform Test	5
4.2. Measurement & Equipment Setup	6
4.3. Measurement Procedure	6
4.4. Measurement Uncertainty	6
5. Measurement Summary	7
6. Measurement Data	8
6.1. Antenna Requirement	8
6.2. Operational Requirements	9
6.3. UWB Bandwidth.....	11
6.4. Radiated Emissions below 960 MHz	14
6.5. Radiated Emissions above 960 MHz	29
6.6. Radiated Emissions in the GPS Bands.....	44
6.7. RMS Emissions of UWB Transmission.....	47
6.8. Peak Emissions in a 50 MHz Bandwidth	52
6.9. Conducted Emissions Test Setup.....	57
6.10. Conducted Emissions Results	58
6.11. Public Exposure to Radio Frequency Energy Levels.....	60
7. Test Site Description	64
8. Test Images	65
8.1. Spurious and Harmonic Emissions - 30 kHz to 1 GHz Front.....	65
8.2. Spurious and Harmonic Emissions - 30 kHz to 30 MHz Rear	66
8.3. Spurious and Harmonic Emissions - 30 MHz to 1 GHz Rear	67
8.4. Spurious and Harmonic Emissions - Above 1 GHz Front.....	68
8.5. Spurious and Harmonic Emissions - 1 to 18 GHz Rear.....	69
8.6. Spurious and Harmonic Emissions - 18 to 40 GHz Side	70
8.7. Conducted Emissions Front.....	71
8.8. Conducted Emissions Rear	72

Test Number: 406-17R1
Issue Date: 3/16/2018

1. Scope

This test report certifies that the Redpoint Positioning RTLS Module as tested, meets the FCC Part 15, Subpart F and IC RSS-220 requirements. The scope of this test report is limited to the test sample provided by the client, only in as much as that sample represents other production units. If any significant changes are made to the unit, the changes shall be evaluated and a retest may be required. Revision R1 updates section 6.2 with additional plots of operation.

2. Product Details

2.1. Manufacturer:	Redpoint Positioning Corporation
2.2. Model Numbers:	MOD-V7
2.3. Serial Numbers:	Pre-production
2.4. Description:	The Redpoint RTLS Modulæ is a full-function real-time location system (or RTLS) subsystem in a compact factor.
2.5. Power Source:	DC 2.8 to 3.6 Volts
2.6. Hardware Revision:	Rev B
2.7. Software Revision:	N/A
2.8. Modulation Type:	Pulse Modulation, Frequency Hopping
2.9. Operating Frequencies:	3.494 GHz (Channel 1), 3.994 GHz (Channel 2), 4.493 GHz (Channel 3), 6.490 GHz (Channel 5) Center Frequencies Nominal (500 MHz BW)
2.10. EMC Modifications:	None

3. Product Configuration

3.1 Operational Characteristics & Software

Hardware Setup:

Using the embedded custom firmware, the channel may be configured for a continuous transmission.

3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
Redpoint	MOD-V7	Pre-production	3.3	DC	V7 Module

3.3. EUT Cables/Transducers

Cable Type	Length	Shield	From	To
USB	6M	Yes	EUT	Laptop for Configuration

3.4. Support Equipment

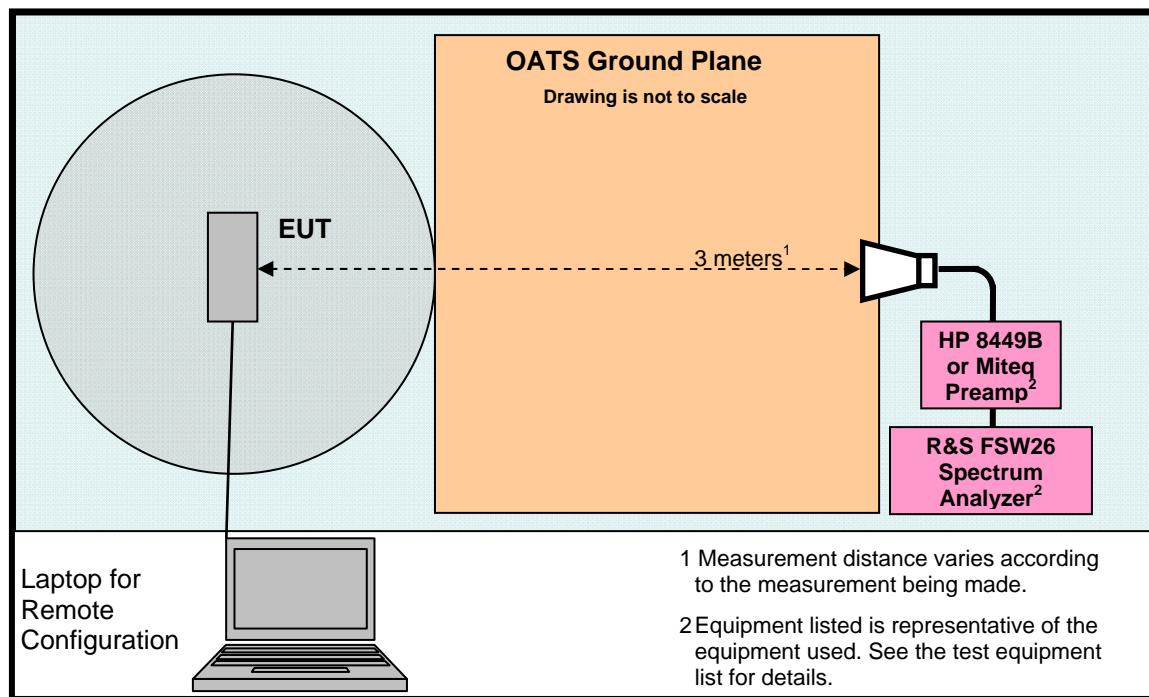
Manufacturer	Model/Part # / Options	Serial Number	Input Voltage	Freq (Hz)	Description/Function
Dell	Inspirion E1505	5573349937	120	60	Laptop for Configuration

Test Number: 406-17R1

Issue Date: 3/16/2018

3. Product Configuration (cont.)

3.5. Test Setup Diagram



3.6. EUT Orientation Diagram

In addition, the measurements were performed with the device in three orthogonal positions in accordance with ANSI C63.10-2013, sections 5.10.1, 6.4.6 and Annex H. The three orthogonal axes were defined as follows:

X-Axis

X Axis Horizontal on edge
Y Axis Upright on edge
Z Axis Flat on table

Y-Axis

Front of unit is facing the antenna at 0°
Edge of unit is facing the antenna at 0°
Front of the unit is facing the antenna at 0°

Z-Axis

Test Number: 406-17R1

Issue Date: 3/16/2018

4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Interval
EMI Receiver 9 kHz to 7 GHz	Rohde & Schwarz	ESR7	101156	7/23/2018	3 Years
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSV40	100899	7/23/2018	3 Years
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	7/23/2018	3 Years
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102057	12/7/2018	2 Years
Bilog Antenna 30 to 2000 MHz	Sunol Sciences	JB1	A050913	6/3/2019	3 Years
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	10/26/2018	2 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	6/2/2018	2 Year
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	6/1/2018	1 Year
Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	7/22/2018	3 Years
Preamplifier 18 to 40 GHz	Avantek	AWT-40039	FM22038832	6/2/2018	1 Year
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	2/22/2019	3 Years
Horn Antenna 18-40 GHz	Com Power	AH-840	101032	2/24/2018	2 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	5/15/2018	1 Year
Barometer	Control Company	4195	Cal ID# 236	10/8/2018	2 Years

¹ ESR7 Firmware revision: V3.36, SP2 Date installed: 11/02/2017 Previous V3.36, installed 05/16/2017.

² FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016 Previous V2.30 SP1, installed 10/22/2014.

³ FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016 Previous V2.23, installed 10/20/2014.

⁴ FSW26 Firmware revision: V2.80, Date installed: 10/28/2017 Previous V2.61, installed 04/04/2017.

Test Number: 406-17R1**Issue Date: 3/16/2018****4. Measurements Parameters (continued)****4.2. Measurement & Equipment Setup**

Test Dates:	11/10/2017, 11/17/2017, 11/18/2017, 11/29/2017, 12/20/2017, 3/16/2018
Test Engineers:	Larry Stillings
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	10 kHz to 40 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 30 kHz to 150 kHz 9 kHz – 150 kHz to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz 300 Hz – 30 kHz to 150 kHz 30 kHz – 150 kHz to 30 MHz 300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak & Average

4.3. Measurement Procedure

Test measurements were made in accordance FCC Parts 15.209, 15.519 Subpart F and IC RSS-220 requirements.

The test methods used to generate the data in this test report is in accordance with ANSI C63.10:2013, American National Standard for Testing Unlicensed Wireless Devices.

4.4. Measurement Uncertainty

The following uncertainties are expressed for an expansion/coverage factor of K=2.

RF Frequency (out of band)	$\pm 1 \times 10^{-8}$
Radiated Emission of Transmitter to 100 GHz	± 4.55 dB
Radiated Emission of Receiver	± 4.55 dB
Temperature	$\pm 0.91^\circ$ C
Humidity	$\pm 5\%$

Test Number: 406-17R1

Issue Date: 3/16/2018

5. Measurements Summary

Test Requirement	FCC Rule Requirement	IC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-220 5.1 (b)	6.1	Compliant	The antenna is a pcb surface mount type
Operational Requirements	15.519 (a) (1)	RSS-220	6.2	Compliant	
UWB Bandwidth	15.503 (a) (d) 15.519 (b)	RSS-220 2 RSS-220 5.1	6.3	Compliant	
Radiated Emissions below 960 MHz	15.209	RSS-220 3.4	6.4	Compliant	
Radiated Emissions above 960 MHz	15.519 (c) 15.521 (d)	RSS-220 3.4	6.5	Compliant	
Radiated Emissions in GPS Bands	15.519 (d)	RSS-220 5.3.1 (e)	6.6	Compliant	
RMS Emissions of UWB Transmission in a 1 MHz Bandwidth	15.519 (c) 15.521 (d)	RSS-220 5.3.1 (d)	6.7	Compliant	
Peak Emissions in a 50 MHz Bandwidth	15.519 (e) 15.521 (g)	RSS-220 5.3.1 (g)	6.8	Compliant	
Conducted Emissions	15.207	RSS-GEN	6.9 6.10	Compliant	Via Laptop
Radio Frequency Exposure	FCC OET Bulletin 65	RSS-GEN RSS-102	6.11	Compliant	

Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data

6.1. Antenna Requirement (15.203, RSS-220 5.1 (b))

Requirement: 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

Result: The antenna utilized by the device under test is a pcb surface mount type.

6. Measurement Data (continued)

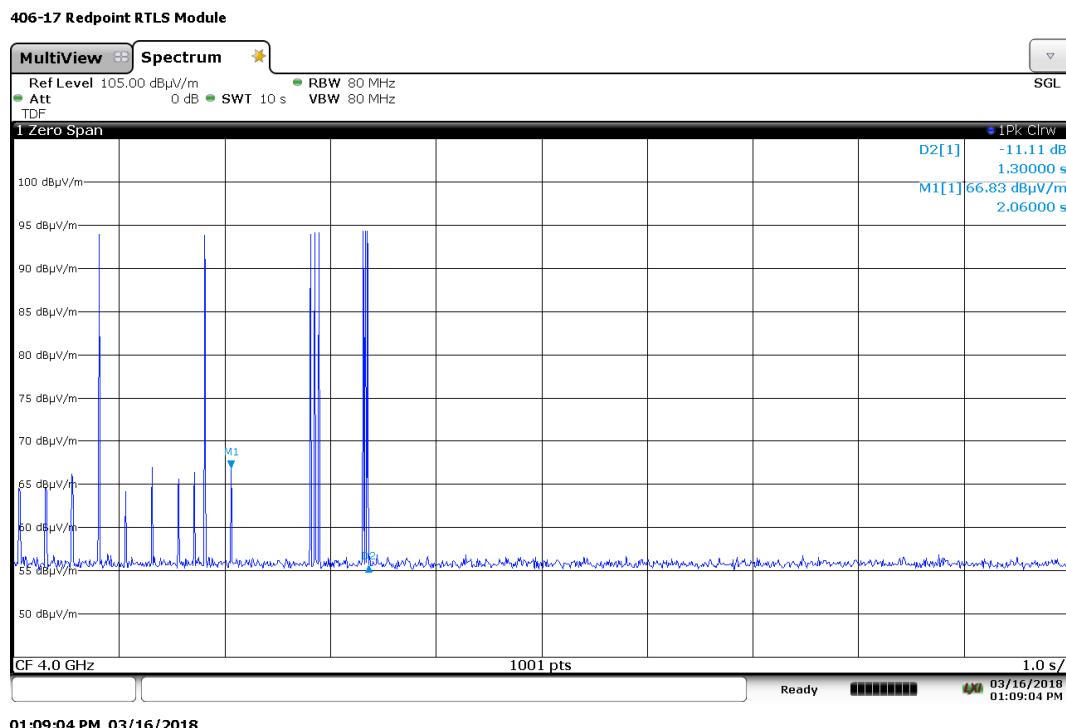
6.2. Operational Requirements of the Device under Test (15.519 (a) (1))

Requirement: UWB device operating under the provisions of this section must be hand held, i.e., they are relatively small device that are primarily hand held while being operated and do not employ a fixed infrastructure. UWB devices operating under the provisions of this section may operate indoors or outdoors.

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

Result: Compliant

6.2.1 Plot of 10 Second Shutoff



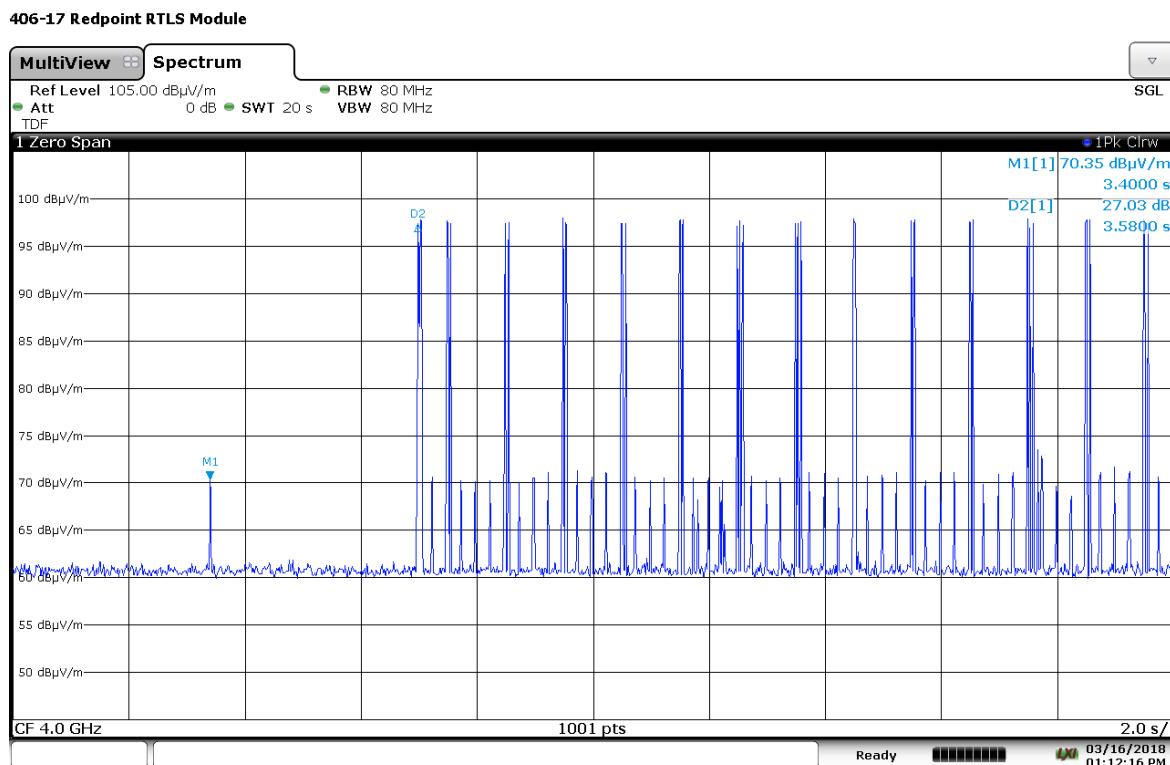
Note: Marker 1 is when the anchor (support equipment) stops transmitting, Marker D2 shows the EUT shutting off after 1.3 Seconds.

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.2. Operational Requirements of the Device under Test (15.519 (a) (1))

6.2.2 Plot of Re-established communications



01:12:17 PM 03/16/2018

Note: Marker 1 is with anchor (support equipment) turned back on to establish communications, Marker D2 shows EUT re-establishing communication after 3.58 Seconds.

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

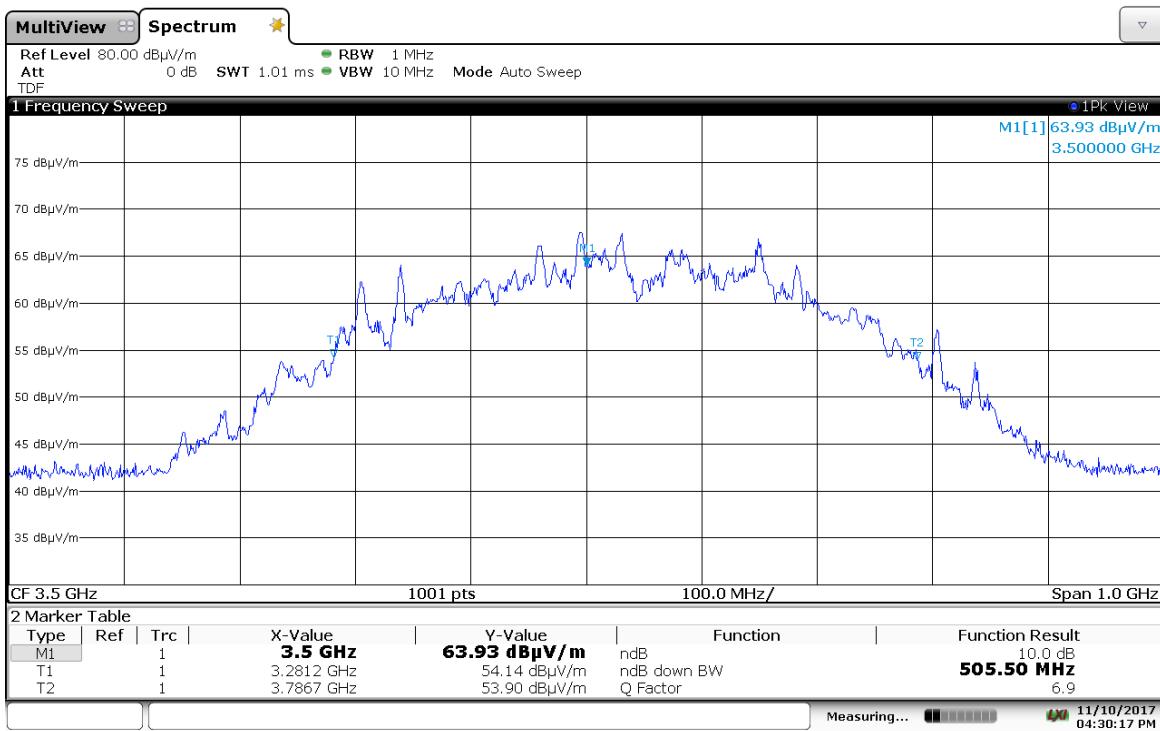
6.3. UWB Bandwidth (15.503 (a) (d), 15.519 (b), RSS-220 5.1)

Requirement: The UWB bandwidth of a device operating under the provisions of this section shall be contained between 3,100 MHz and 10,600 MHz and at any point in time, and has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

6.3.1. Measurement Data – Values in GHz

		CH1	CH2	CH3	CH5
f_M	The highest emission peak	3.500	3.993	4.498	6.493
f_L	10 dB below the highest peak	3.2812	3.7073	4.2572	6.2203
f_H	10 dB above the highest peak	3.7867	4.3067	4.8057	6.7577
f_C	Calculated: $(f_H + f_L) / 2$	3.5340	4.0070	4.5315	6.4890
Bandwidth	Calculated: $(f_H - f_L)$	0.5055	0.5994	0.5485	0.5375
Fractional BW	Calculated: $2 * (f_H - f_L) / (f_H + f_L)$	0.1430	0.1496	0.1210	0.0828

6.3.2. Measurement Plot of 10 dB frequencies (Channel 1)



04:30:18 PM 11/10/2017

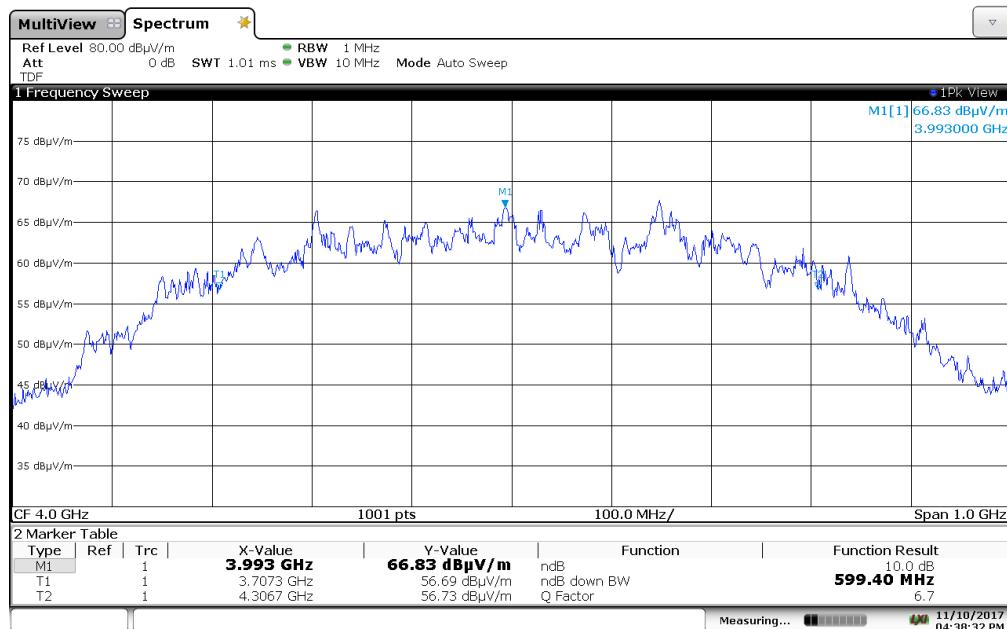
Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

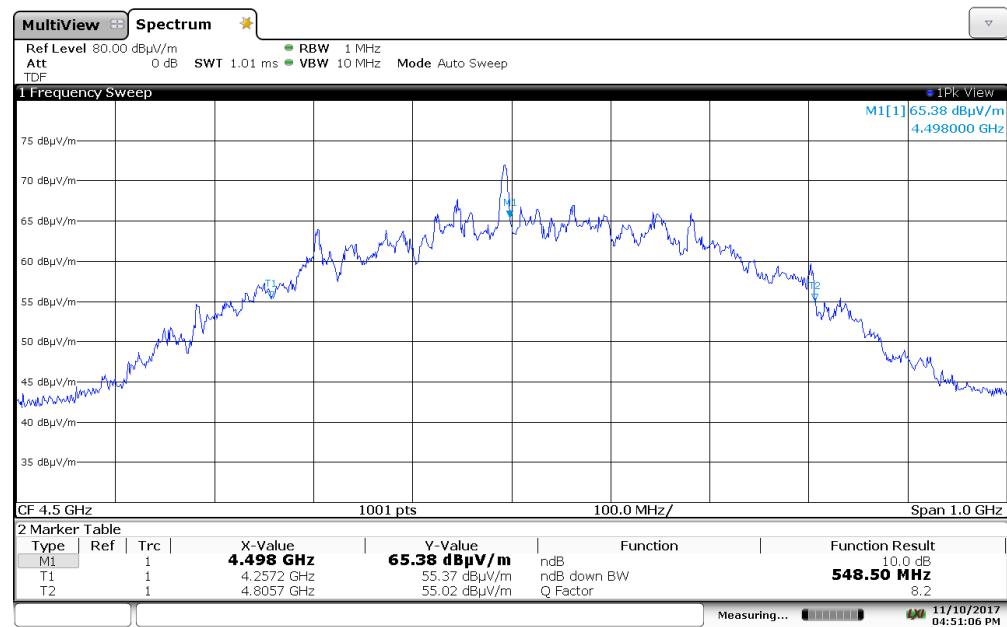
6.3. UWB Bandwidth (15.503 (a) (d), 15.519 (b), RSS-220 5.1)

6.3.3. Measurement Plot of 10 dB frequencies (Channel 2)



04:38:33 PM 11/10/2017

6.3.4. Measurement Plot of 10 dB frequencies (Channel 3)



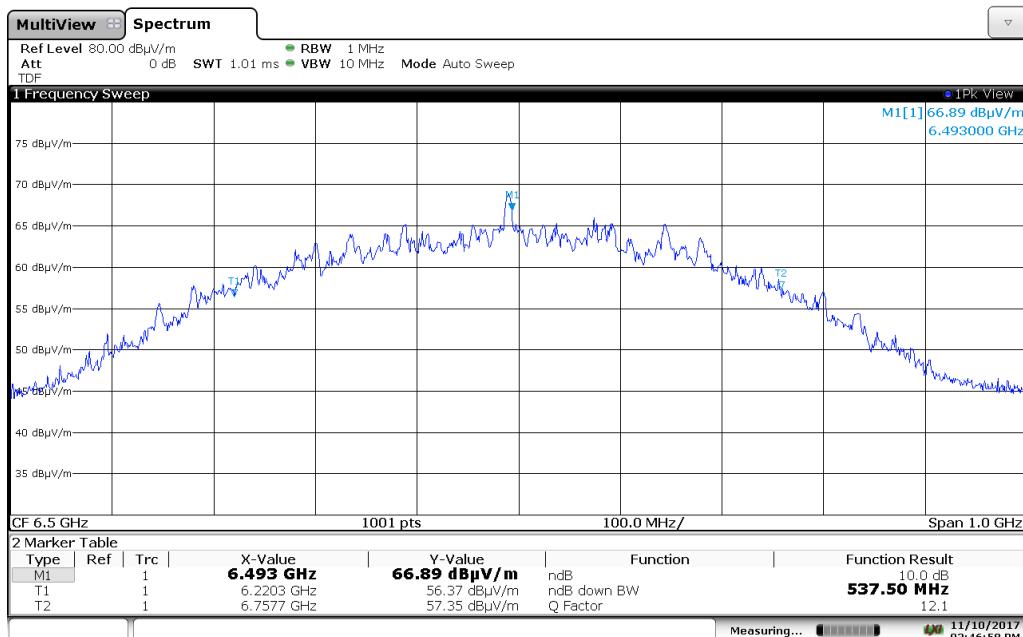
04:51:06 PM 11/10/2017

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.3. UWB Bandwidth (15.503 (a) (d), 15.519 (b), RSS-220 5.1)

6.3.5. Measurement Plot of 10 dB frequencies (Channel 5)



Test Number: 406-17R1**Issue Date: 3/16/2018****6. Measurement Data (continued)****6.4. Spurious Radiated Emissions below 960 MHz (15.519 (c), 15.209, RSS-220 3.4)**

Requirement: The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in Section 15.209.

Radiated Emissions Field Strength Limits at 3 Meters (Section 15.209, RSS-220)

Frequency (MHz)	Field Strength (μ V/m)	Field Strength (dB μ V/m)
0.009 to 0.490	2,400/F (F in kHz)	128.5 to 93.8
0.490 to 1.705	24,000/F (F in kHz)	73.8 to 63
1.705 - 30	30	69.5
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46

Test Notes: Refer to Section 4.1 for the test equipment used.

Frequency Range:	30 kHz to 960 MHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 30 kHz to 150 kHz 9 kHz – 150 kHz to 30 MHz 120 kHz - 30 MHz to 960 MHz
EMI Receiver Avg Bandwidth (minimum):	300 Hz – 30 kHz to 150 kHz 30 kHz – 150 kHz to 30 MHz 300 kHz - 30 MHz to 960 MHz
Detector Function:	Peak, Quasi-Peak & Average

Test Number: 406-17R1
Issue Date: 3/16/2018

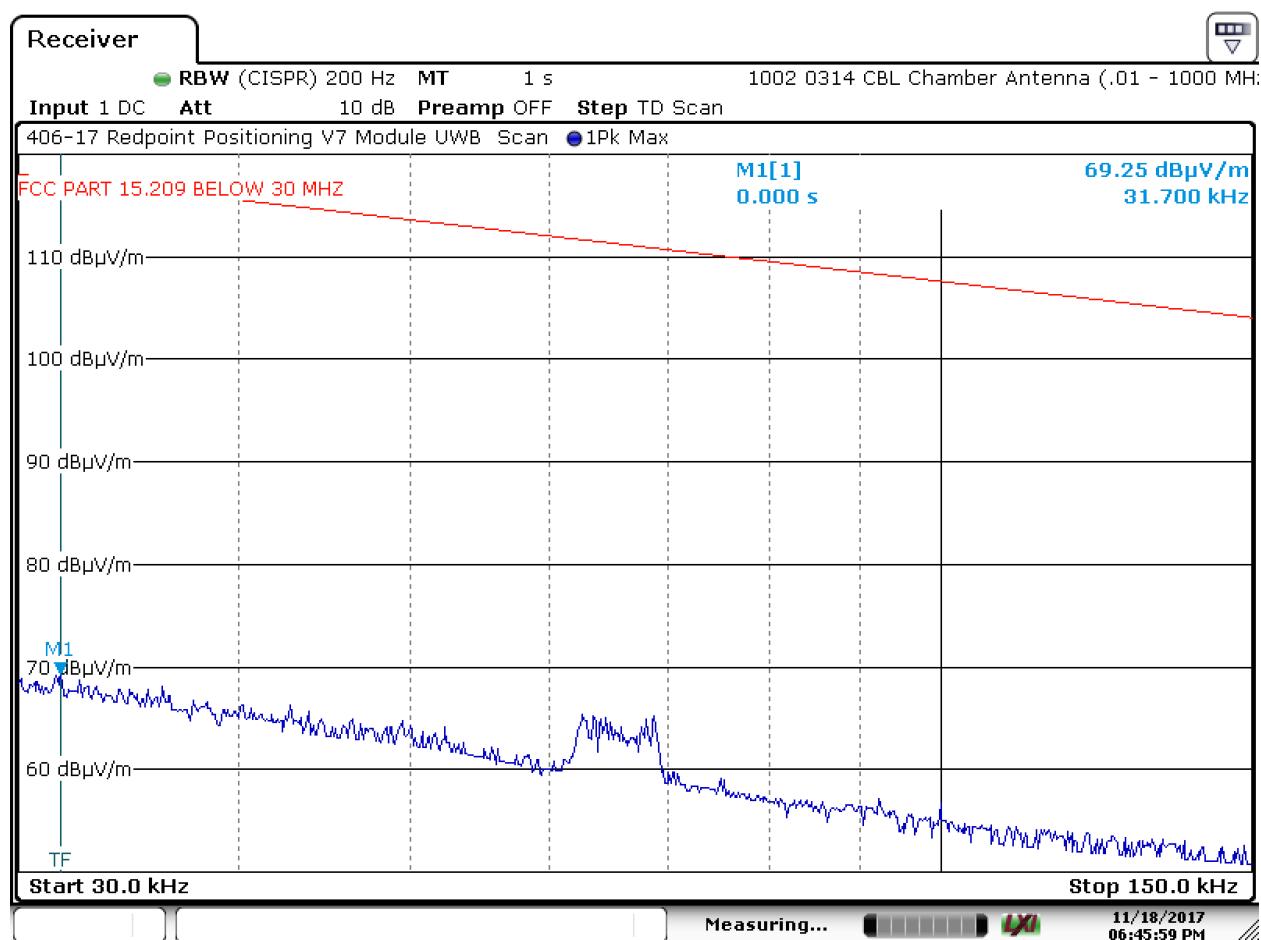
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.1 Parallel Measurement Antenna – 30 to 150 kHz – Channel 1



Date: 18.NOV.2017 18:45:58

Note: All other channels were noise floor

Test Number: 406-17R1

Issue Date: 3/16/2018

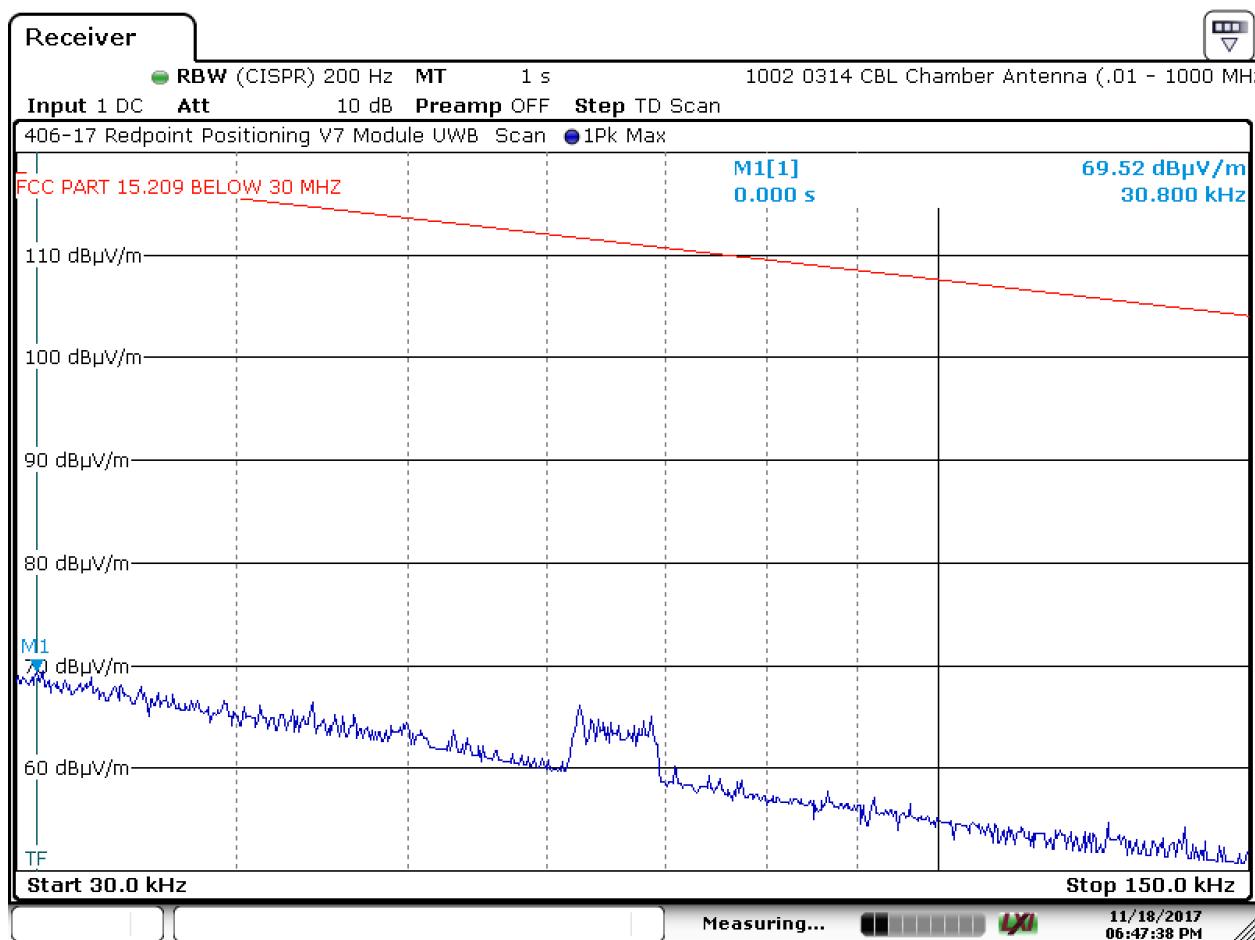
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.2 Perpendicular Measurement Antenna – 30 to 150 kHz – Channel 1



Date: 18.NOV.2017 18:47:36

Note: All other channels were noise floor

Test Number: 406-17R1

Issue Date: 3/16/2018

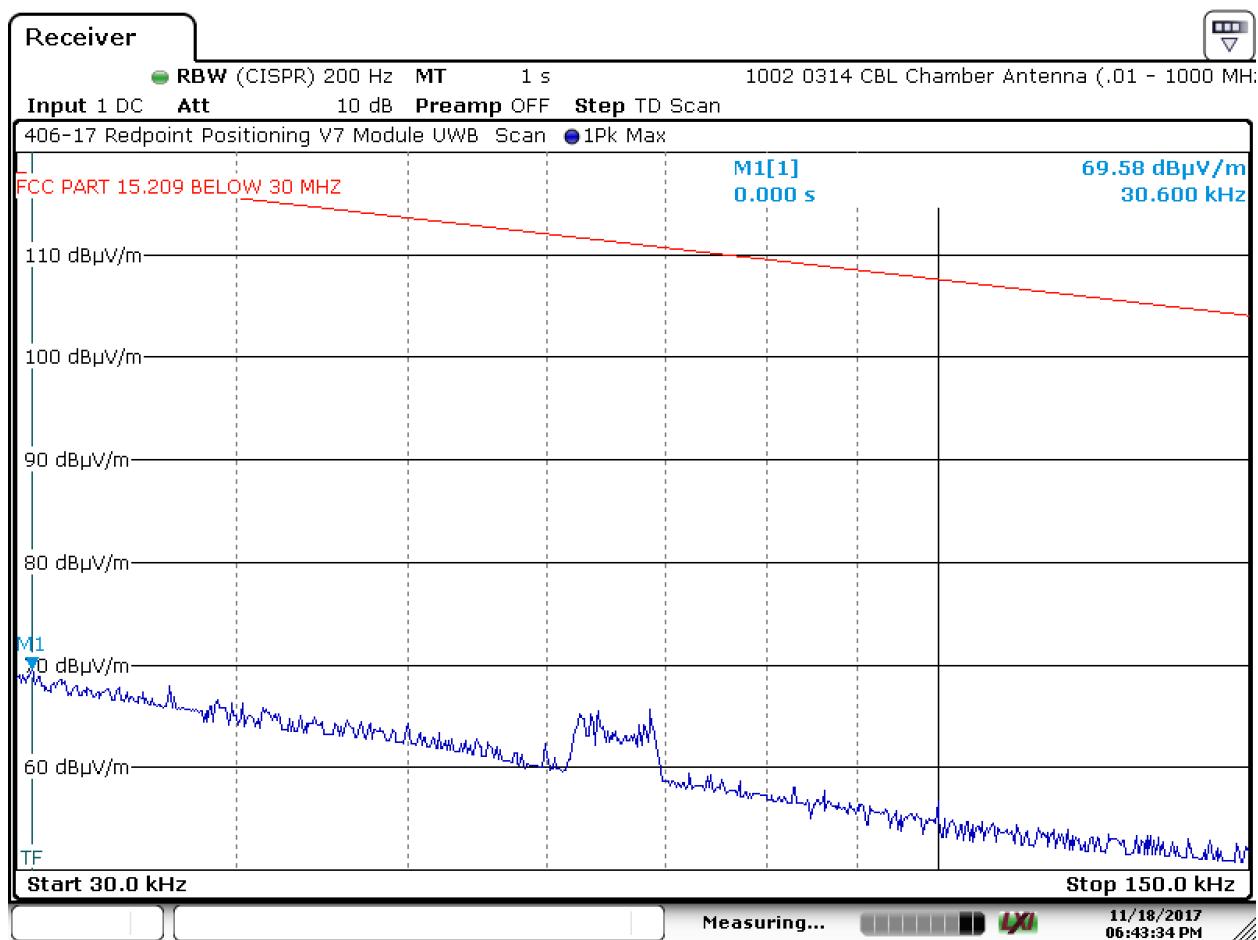
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.3 Ground Parallel Measurement Antenna – 30 to 150 kHz – Channel 1



Date: 18.NOV.2017 18:43:33

Note: All other channels were noise floor

Test Number: 406-17R1
Issue Date: 3/16/2018

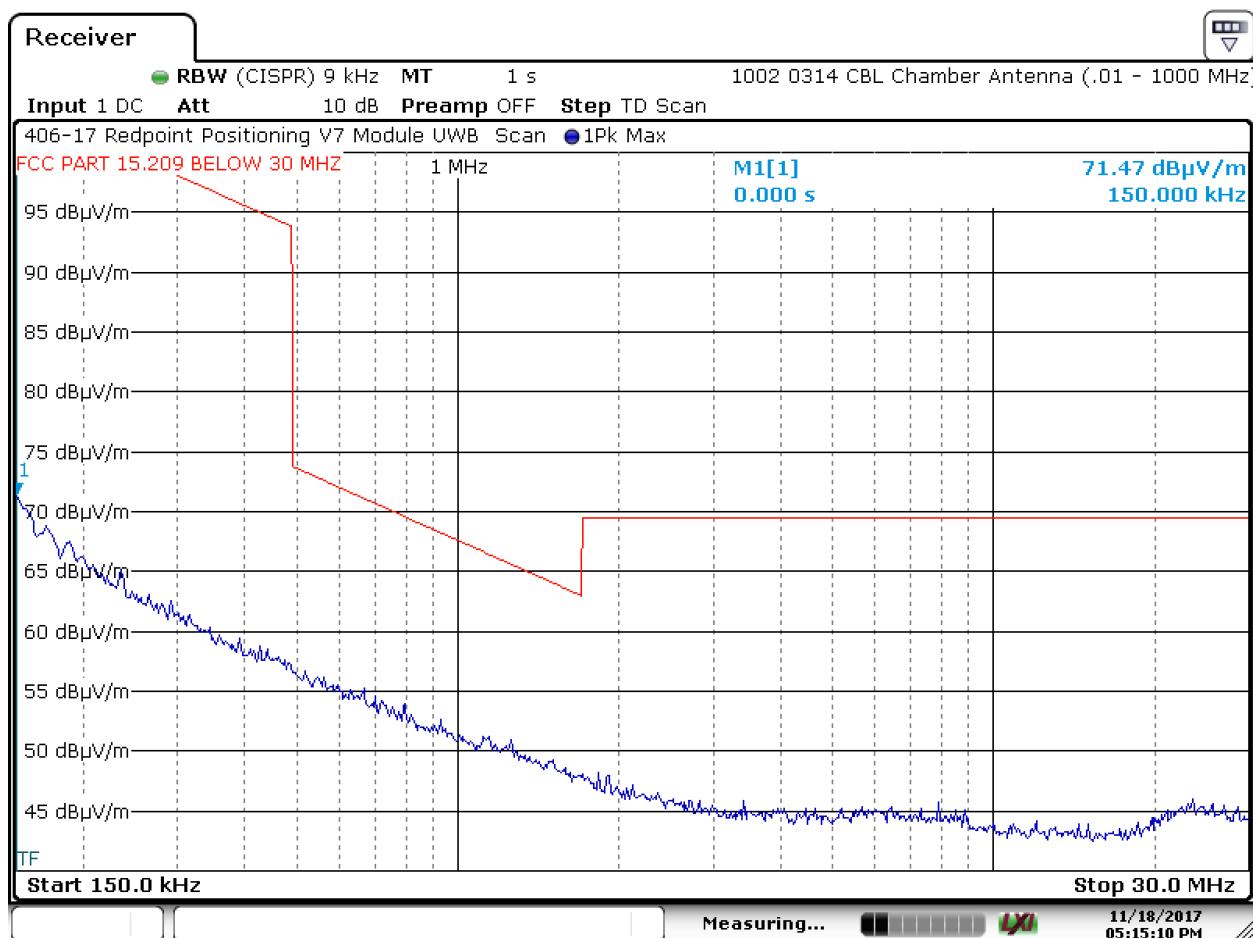
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.4 Parallel Measurement Antenna – 150 kHz to 30 MHz – Channel 1



Date: 18.NOV.2017 17:15:09

Note: All other channels were noise floor

Test Number: 406-17R1
Issue Date: 3/16/2018

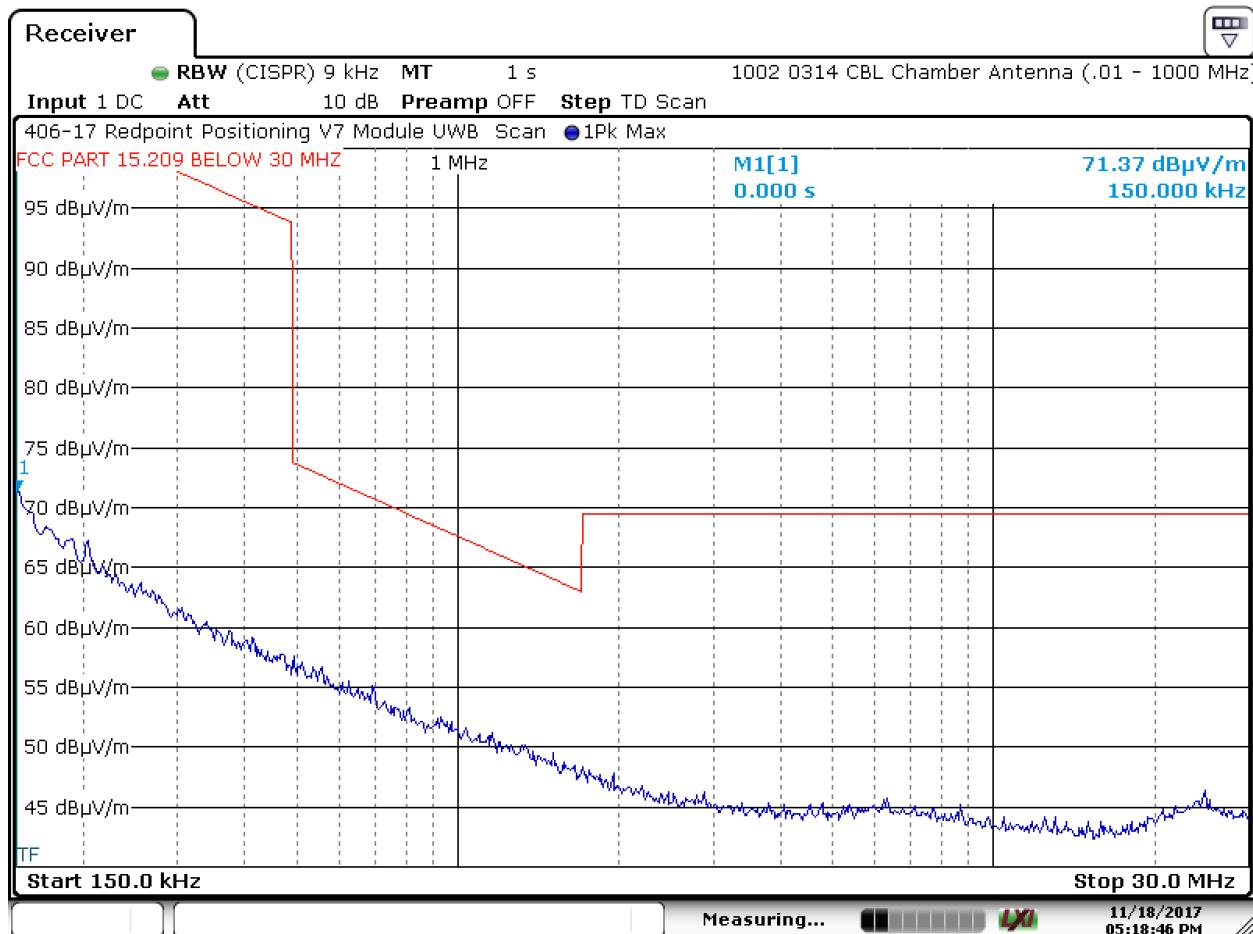
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.5 Perpendicular Measurement Antenna – 150 kHz to 30 MHz – Channel 1



Date: 18.NOV.2017 17:18:45

Note: All other channels were noise floor

Test Number: 406-17R1
Issue Date: 3/16/2018

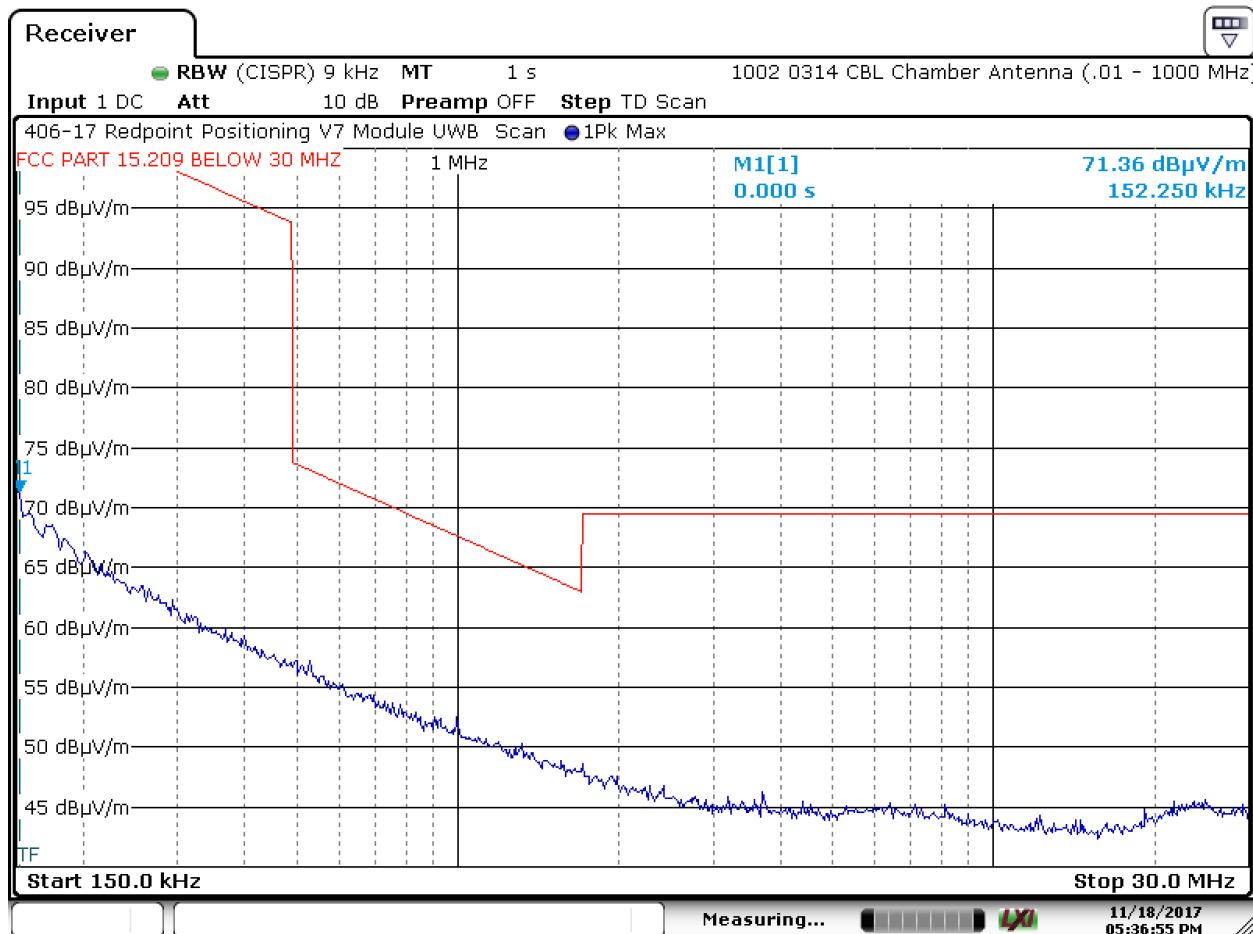
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.6 Ground Parallel Measurement Antenna – 150 kHz to 30 MHz – Channel 1



Date: 18.NOV.2017 17:36:54

Note: All other channels were noise floor

Test Number: 406-17R1
Issue Date: 3/16/2018

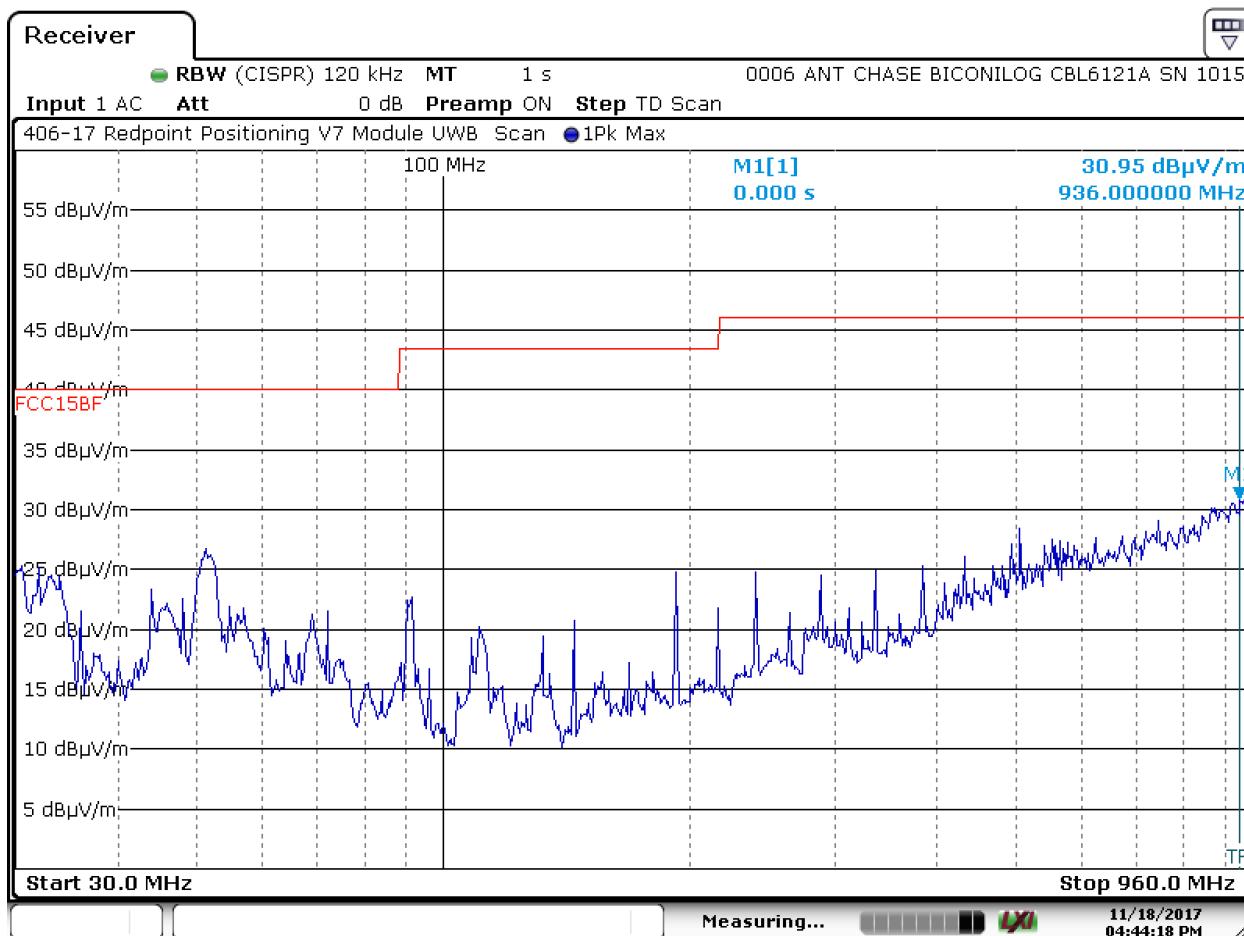
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.7 Horizontal Polarity – 30 to 960 MHz – Channel 1



Date: 18.NOV.2017 16:44:17

Test Number: 406-17R1
Issue Date: 3/16/2018

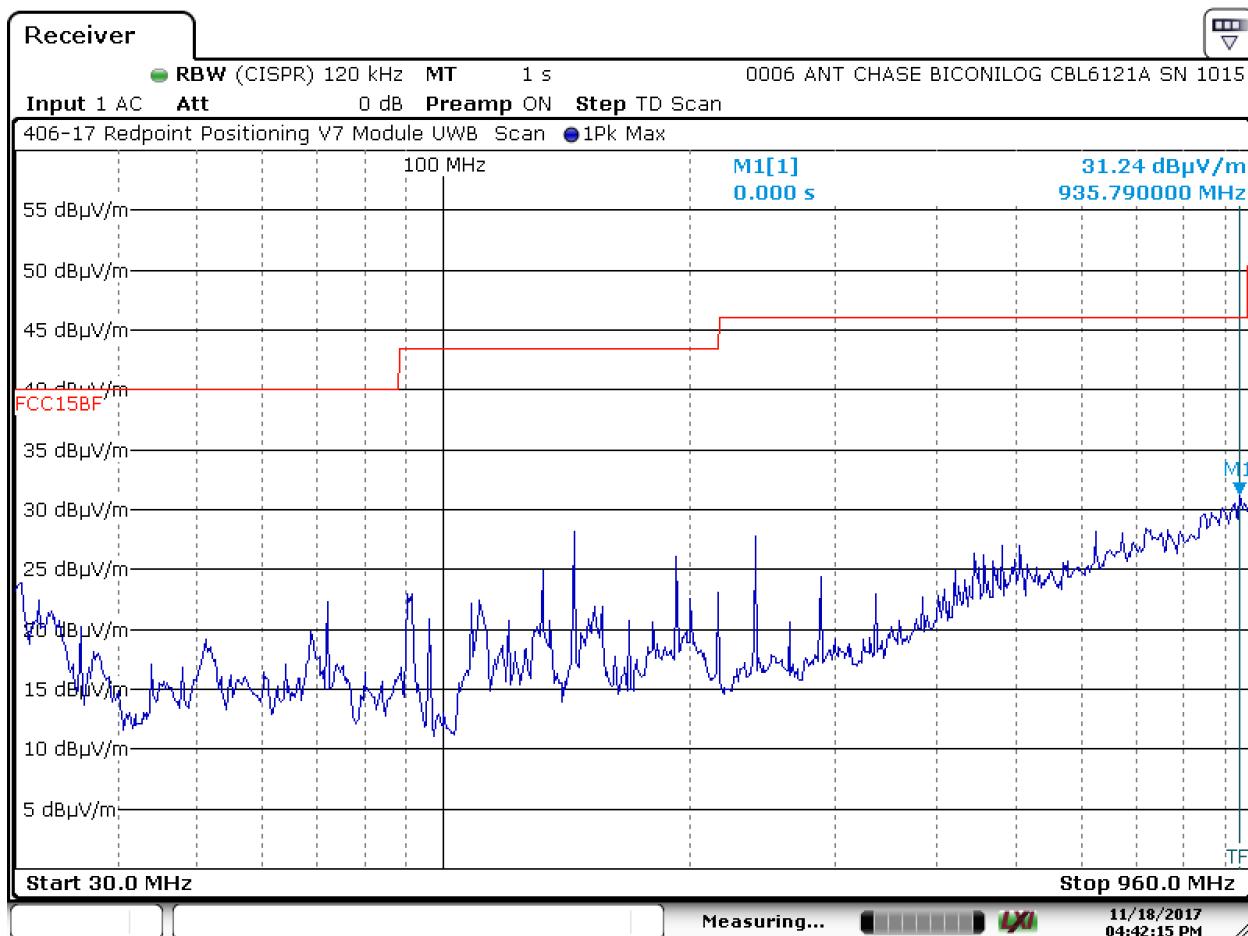
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.8 Vertical Polarity – 30 to 960 MHz – Channel 1



Date: 18.NOV.2017 16:42:14

Measuring...

 11/18/2017
04:42:15 PM

Test Number: 406-17R1
Issue Date: 3/16/2018

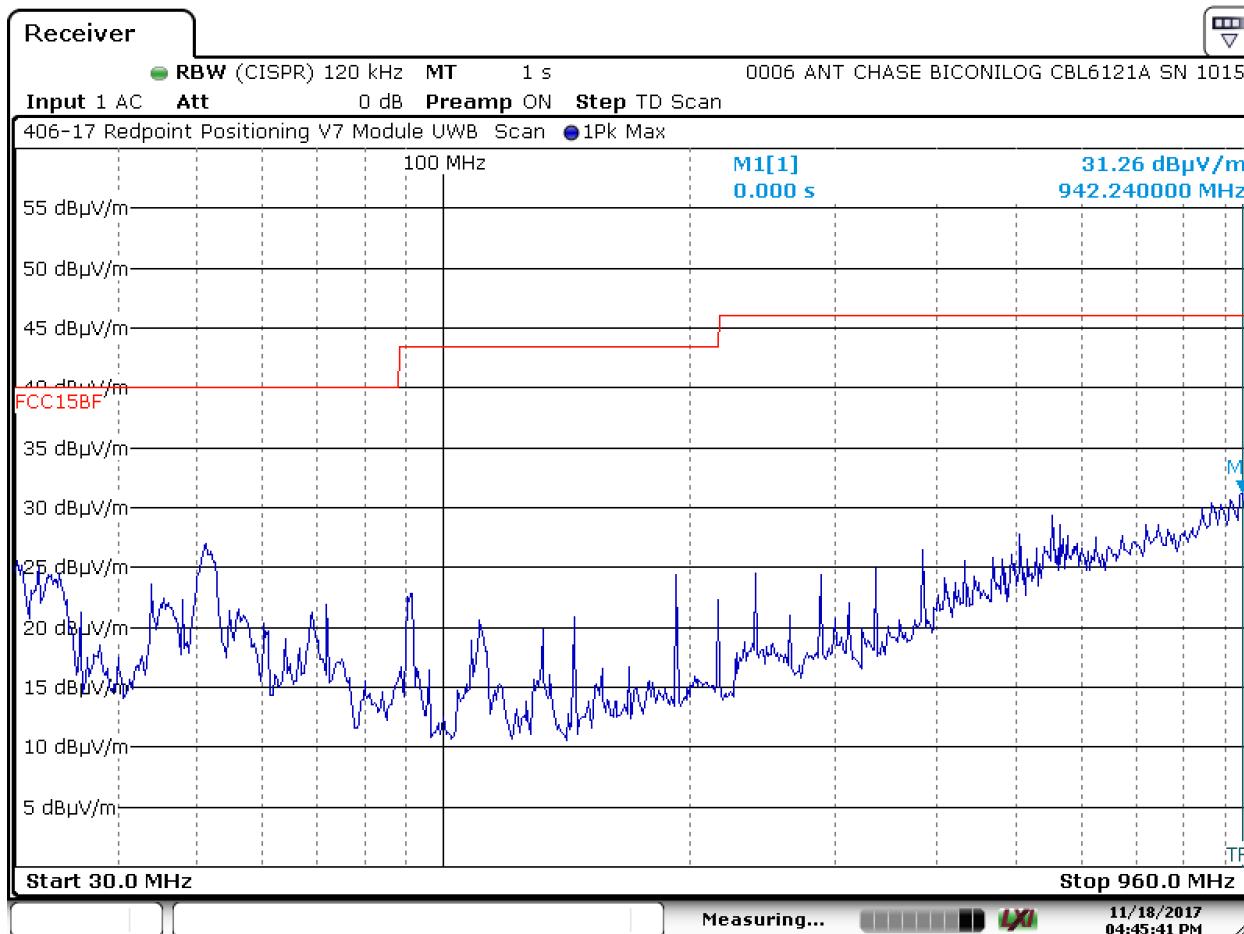
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.9 Horizontal Polarity – 30 to 960 MHz – Channel 2



Date: 18.NOV.2017 16:45:40

Test Number: 406-17R1
Issue Date: 3/16/2018

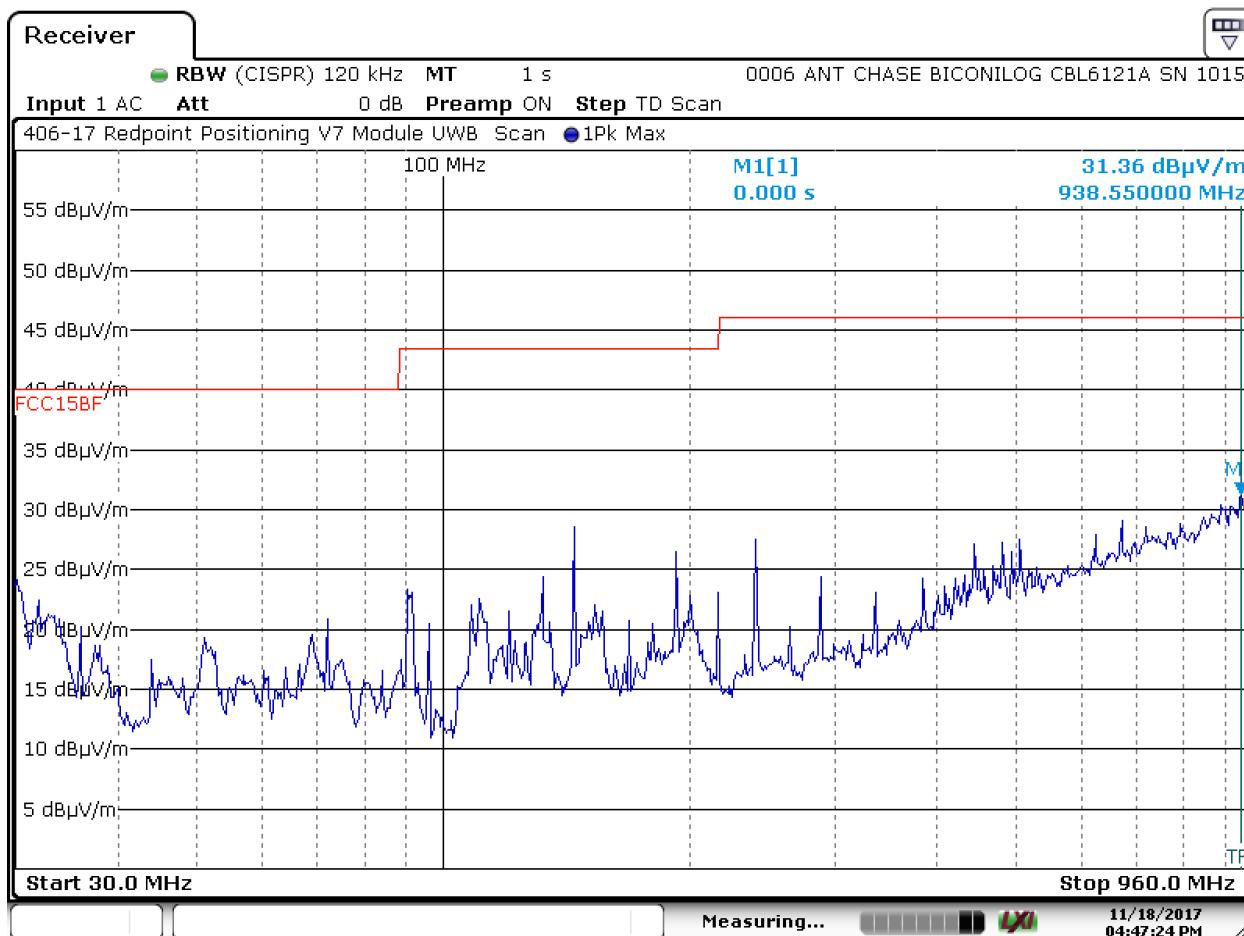
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.10 Vertical Polarity – 30 to 960 MHz – Channel 2



Date: 18.NOV.2017 16:47:23

Test Number: 406-17R1
Issue Date: 3/16/2018

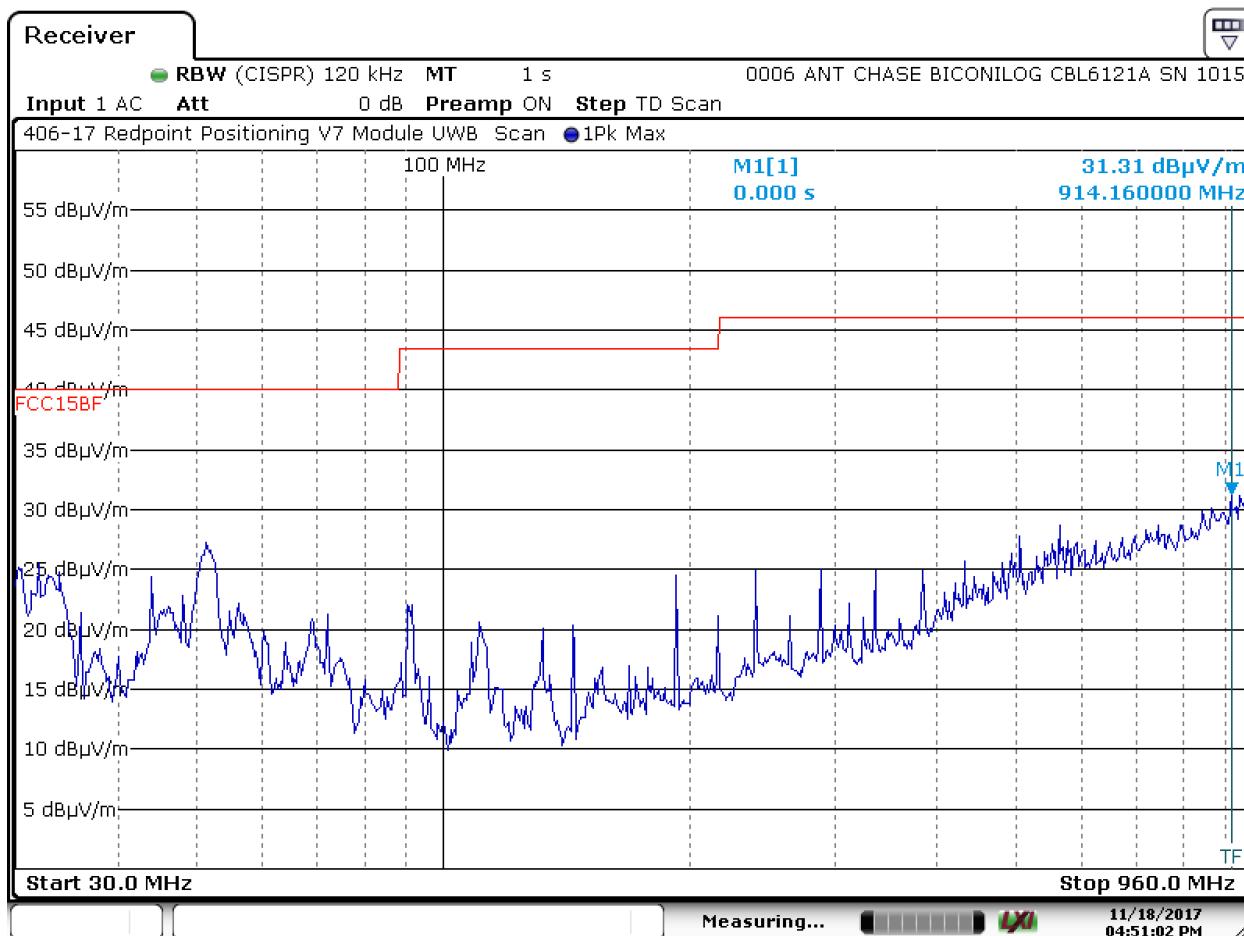
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.11 Horizontal Polarity – 30 to 960 MHz – Channel 3



Date: 18.NOV.2017 16:51:01

Test Number: 406-17R1
Issue Date: 3/16/2018

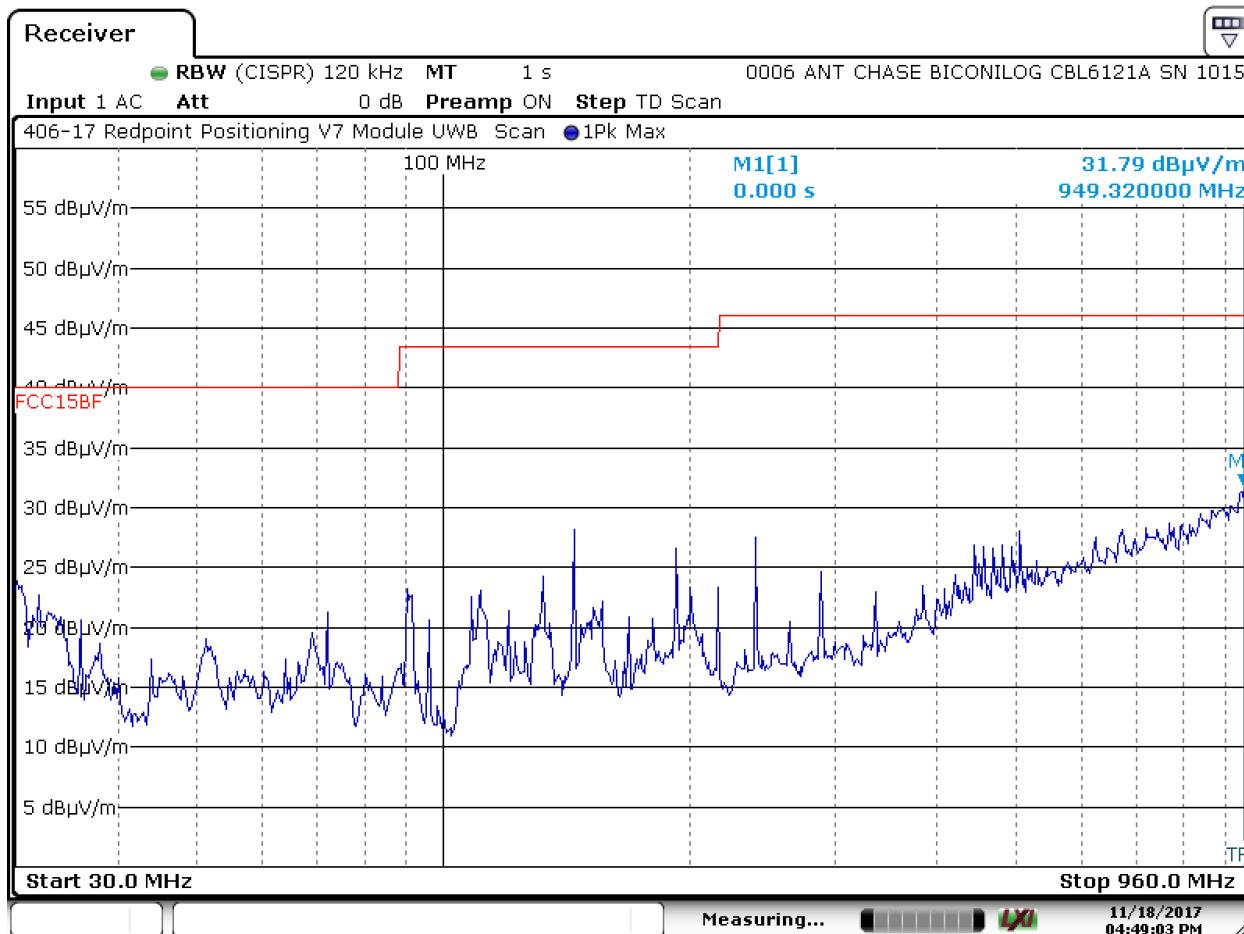
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.12 Vertical Polarity – 30 to 960 MHz – Channel 3



Date: 18.NOV.2017 16:49:02

Test Number: 406-17R1
Issue Date: 3/16/2018

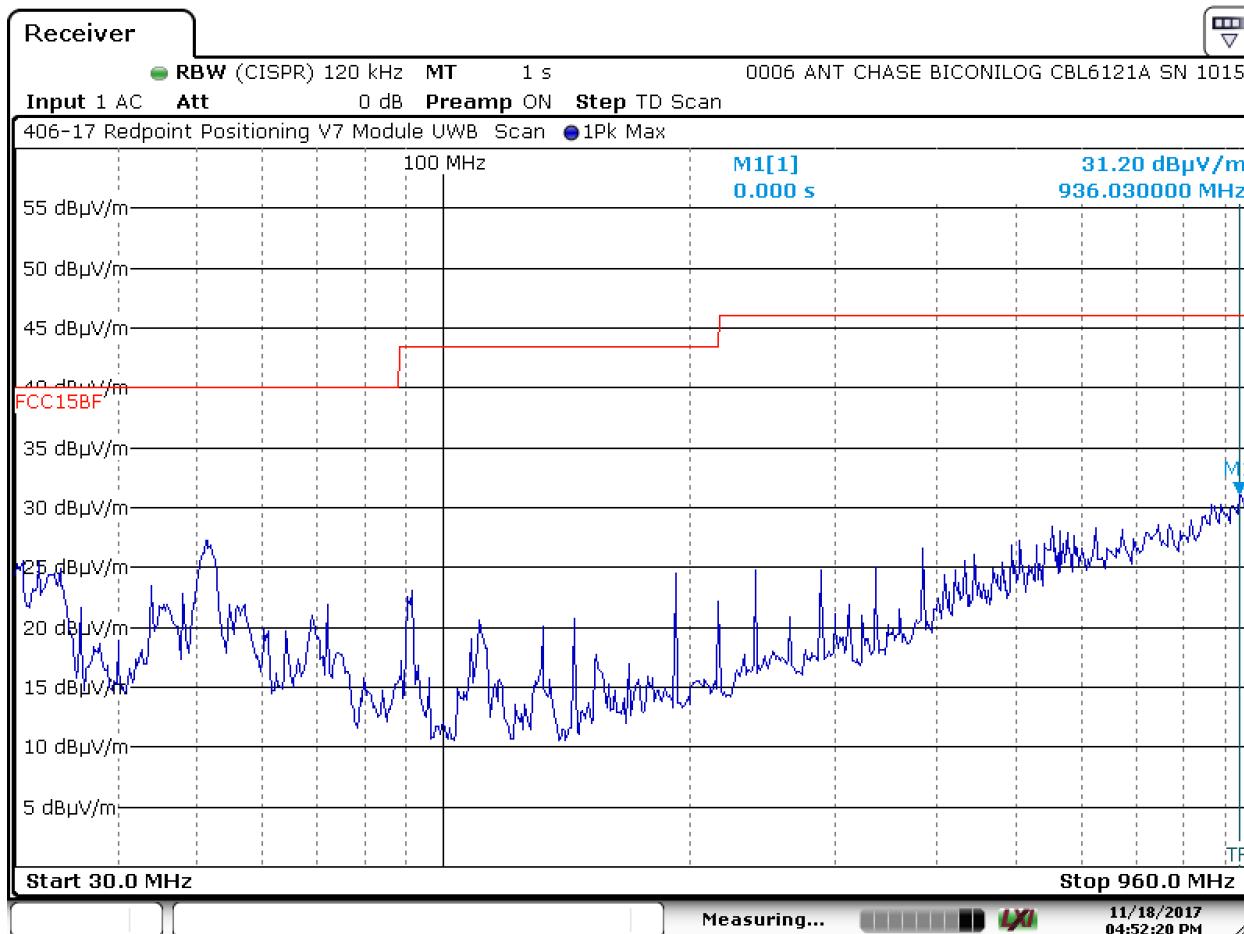
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.13 Horizontal Polarity – 30 to 960 MHz – Channel 5



Date: 18.NOV.2017 16:52:19

Test Number: 406-17R1
Issue Date: 3/16/2018

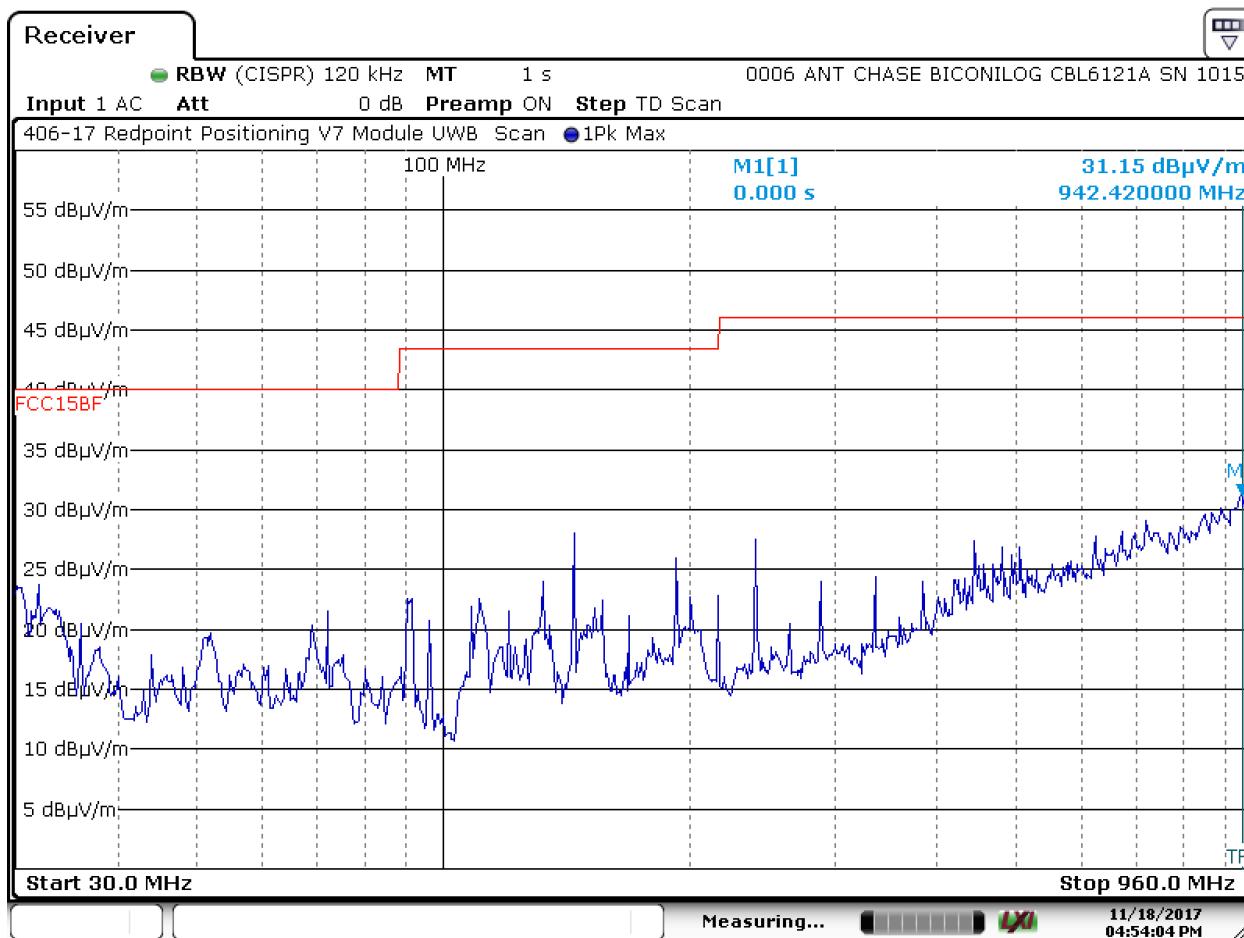
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.209, RSS-220 3.4 continued)

6.4.1. 10 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no measurable emissions below 960 MHz on our 3 Meter OATS.

6.4.1.14 Vertical Polarity – 30 to 960 MHz – Channel 5



Date: 18.NOV.2017 16:54:03

Test Number: 406-17R1**Issue Date: 3/16/2018****6. Measurement Data (continued)****6.5. Spurious Radiated Emissions above 960 MHz (15.519 (c), 15.521 (d))**

Requirement: The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time.

The EIRP in terms of dBm, can be converted to a field strength, in dB μ V/m at 3 Meters by adding 95.2.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
960 - 1610	-75.3	19.9
1610 - 1990	-63.3	31.9
1990 - 3100	-61.3	33.9
3100 - 10600	-41.3	53.9
Above 10600	-61.3	33.9

Frequency Range:

960 MHz to 40 GHz

Measurement Distance:

1 Meter and 0.3 Meter

EMI Receiver IF Bandwidth:

1 MHz

EMI Receiver Avg Bandwidth

10 MHz

Detector Function:

RMS 1 mS Average as defined in 15.521(d)

Notes: Measurements made from 960 MHz to 18 GHz were made in a semi-anechoic chamber at 1 Meter using a -9.54 dB distance offset was programmed into the spectrum analyzer.

Measurements made from 8 to 18 GHz were done with the aid of a High Pass Filter before the low noise amplifier.

Measurements made from 18 to 40 GHz were done at 0.3 meters and a -20.00 dB distance offset was programmed into the spectrum analyzer.

Channels 2 & 3 worst case was Z-Axis, Channels 1 & 5, Y-Axis.

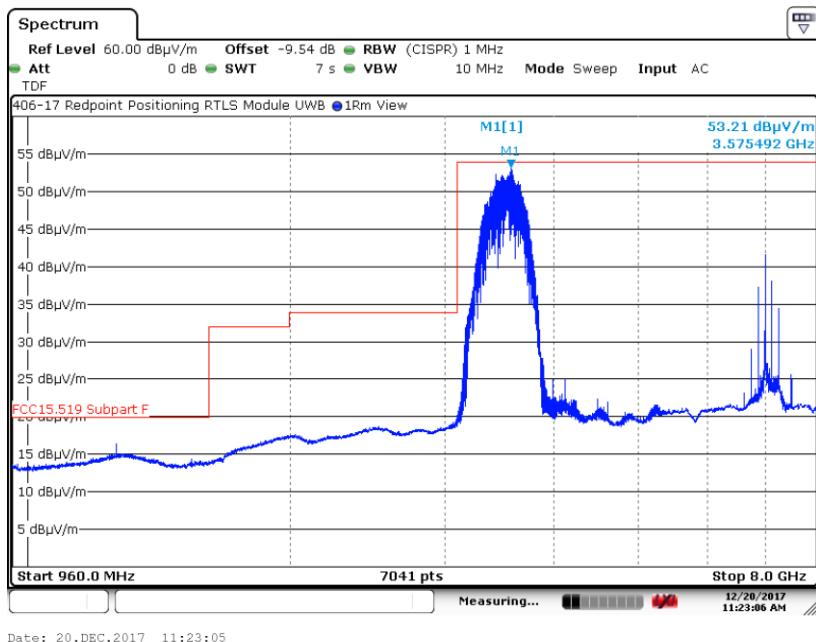
Test Number: 406-17R1

Issue Date: 3/16/2018

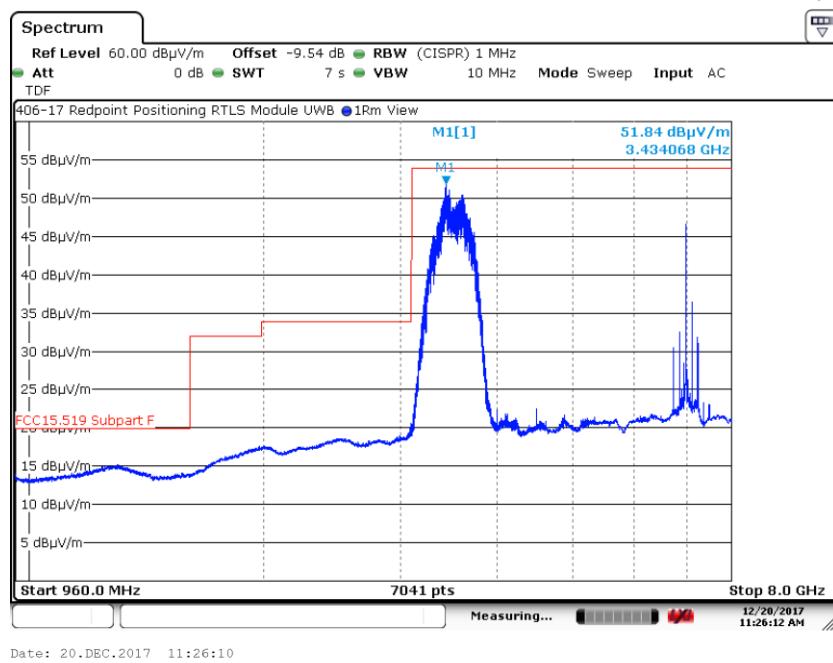
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.1. 960 MHz to 8 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH1



6.5.2. 960 MHz to 8 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH1



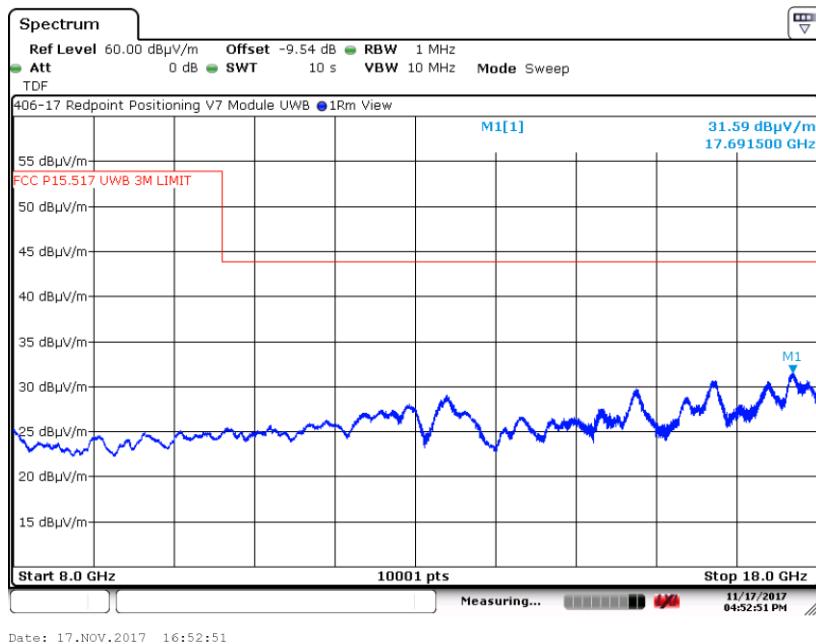
Test Number: 406-17R1

Issue Date: 3/16/2018

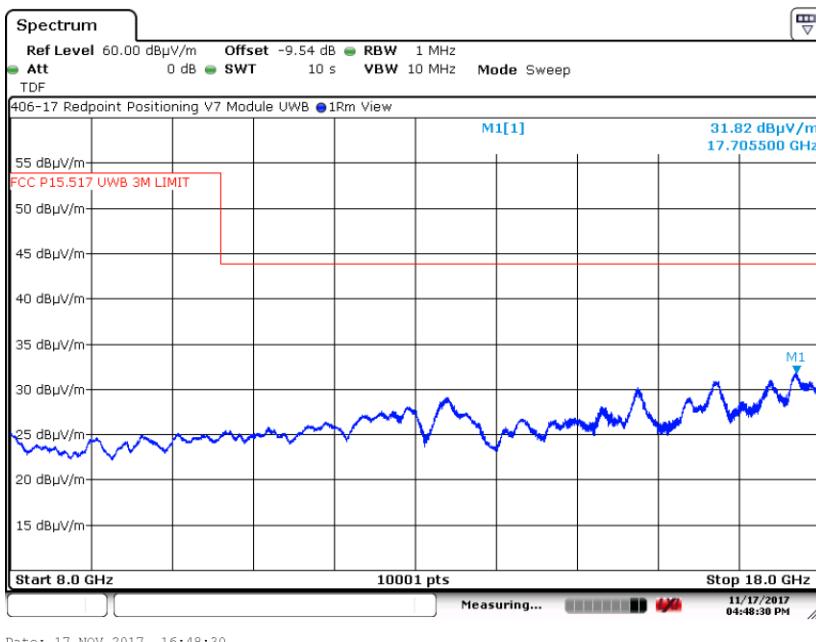
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.3. 8 to 18 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH1



6.5.4. 8 to 18 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH1



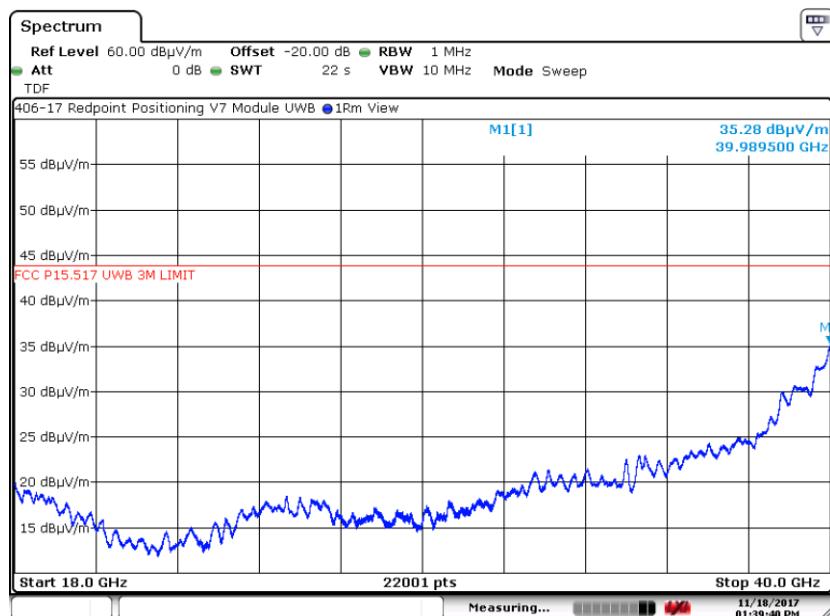
Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

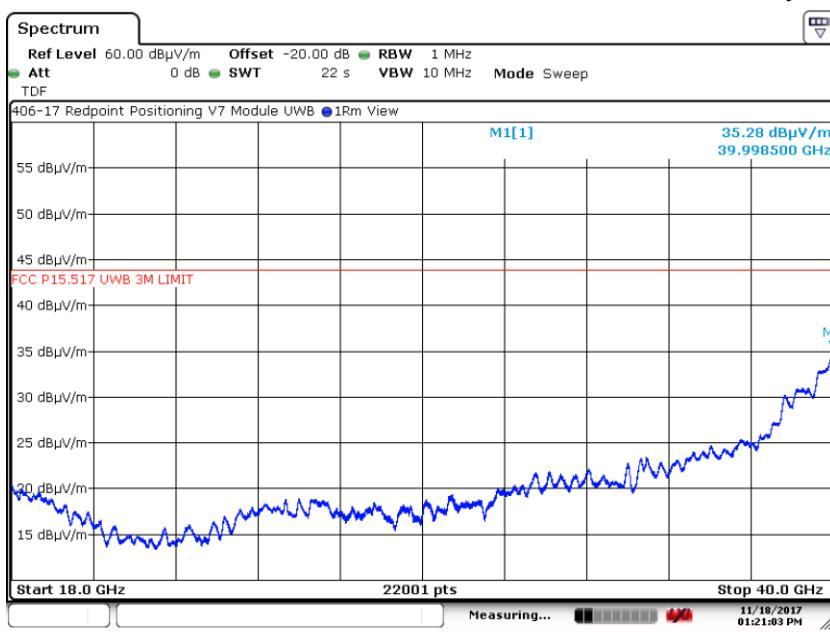
6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.5. 18 to 40 GHz Horizontal at 0.3 Meter, -20.00 dB offset in analyzer CH1



Date: 18.NOV.2017 13:39:41

6.5.6. 18 to 40 GHz Vertical at 0.3 Meter, -20.00 dB offset in analyzer CH1



Date: 18.NOV.2017 13:21:03

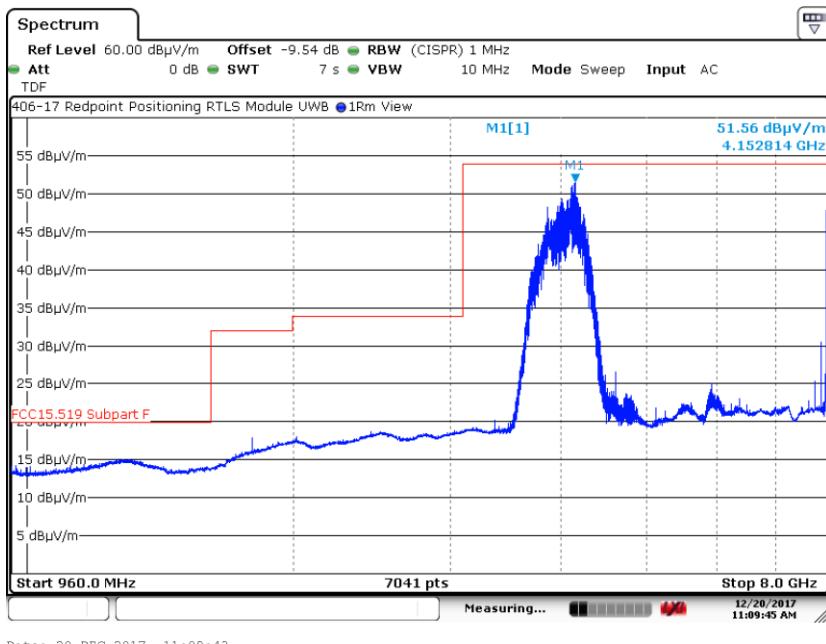
Test Number: 406-17R1

Issue Date: 3/16/2018

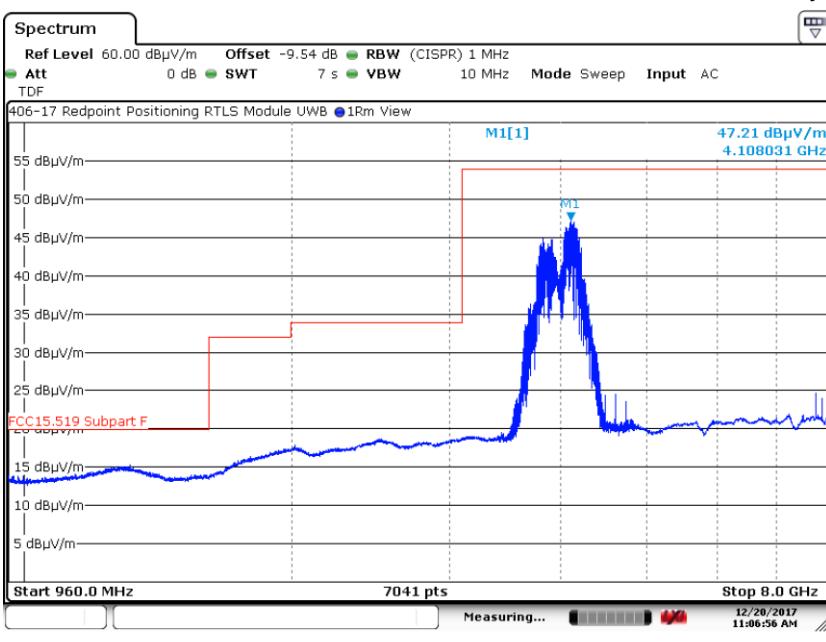
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.7. 960 MHz to 8 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH2



6.5.8. 960 MHz to 8 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH2



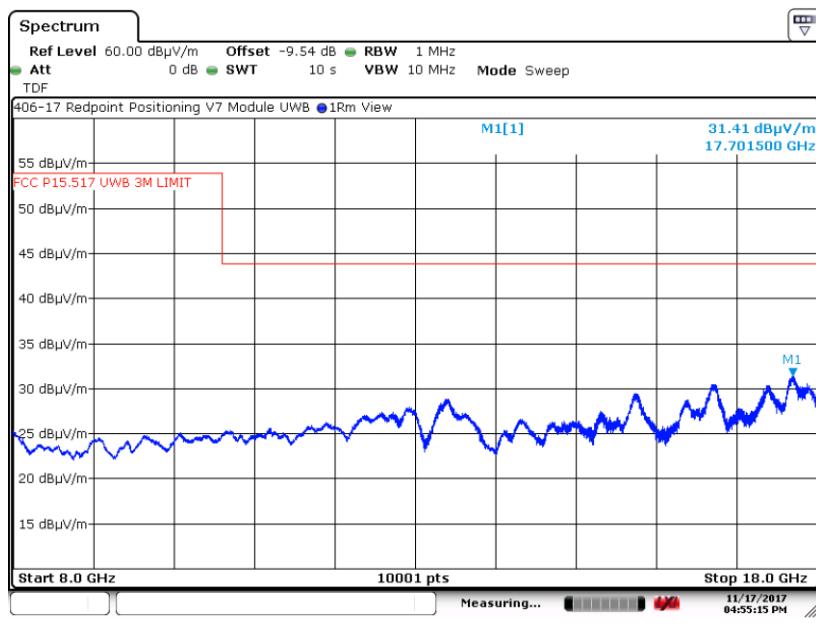
Test Number: 406-17R1

Issue Date: 3/16/2018

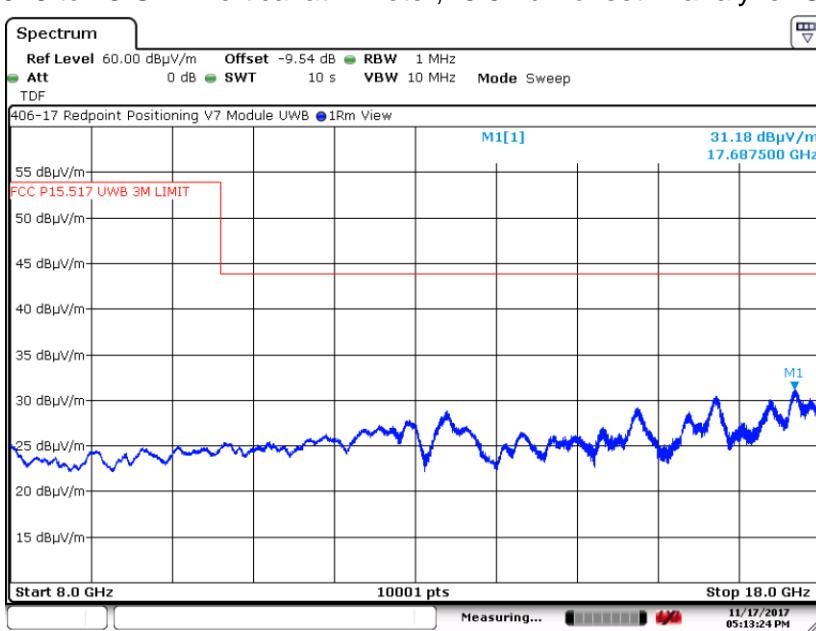
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.9. 8 to 18 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH2



6.5.10. 8 to 18 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH2



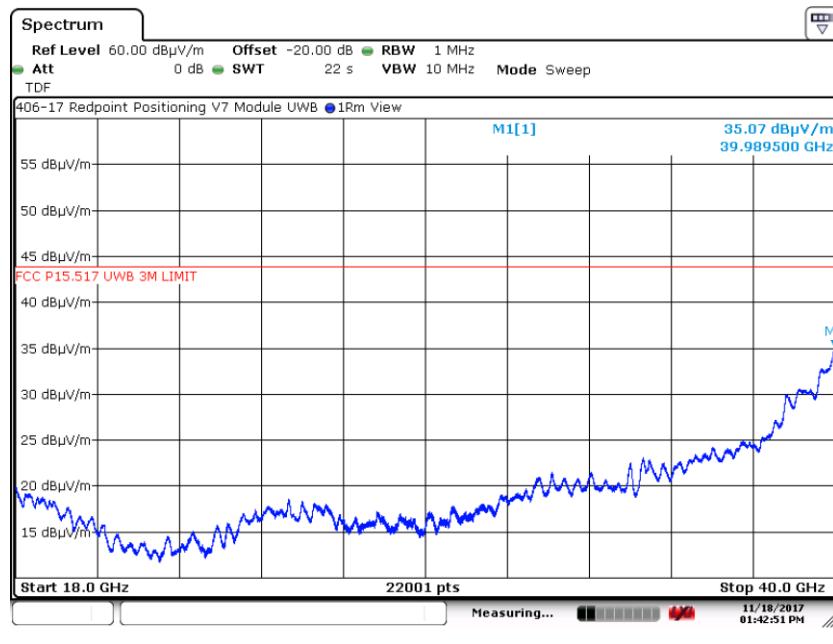
Test Number: 406-17R1

Issue Date: 3/16/2018

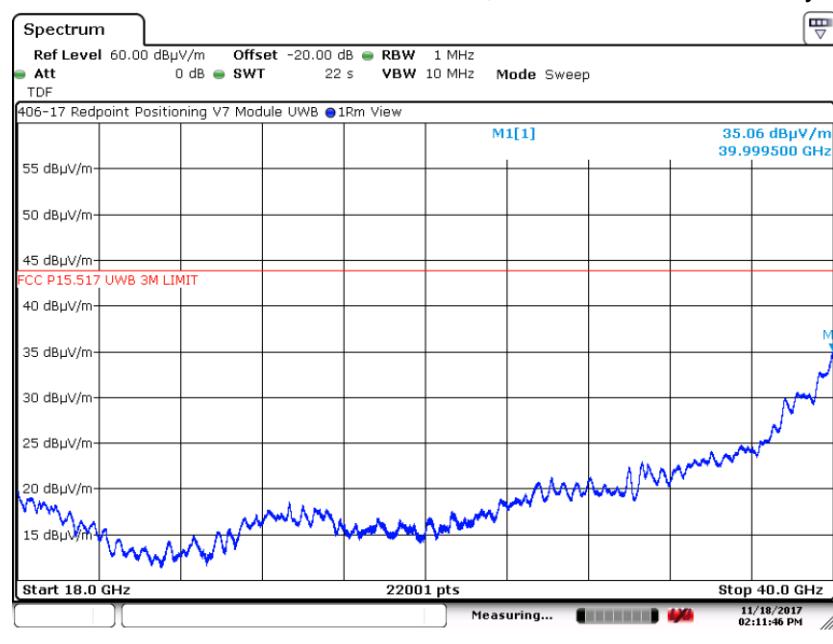
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.11. 18 to 40 GHz Horizontal at 0.3 Meter, -20.00 dB offset in analyzer CH2



6.5.12. 18 to 40 GHz Vertical at 0.3 Meter, -20.00 dB offset in analyzer CH2



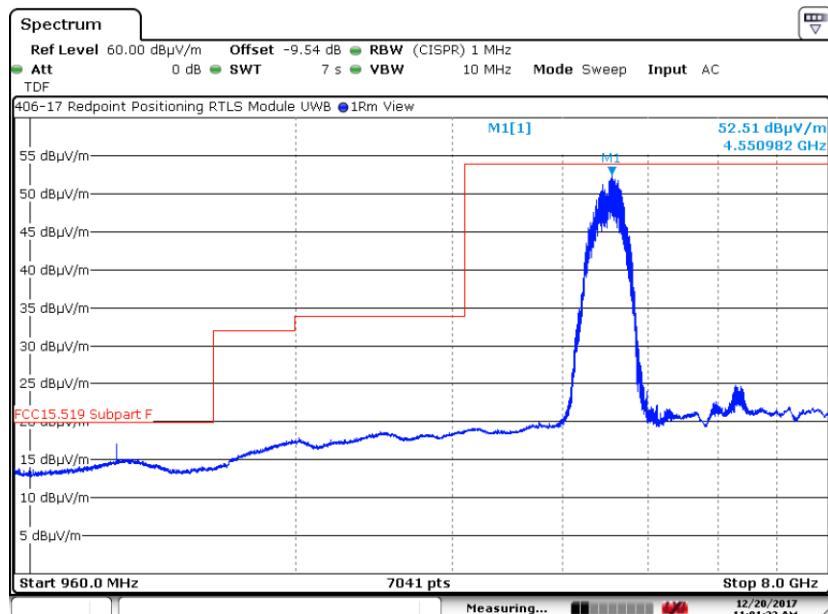
Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

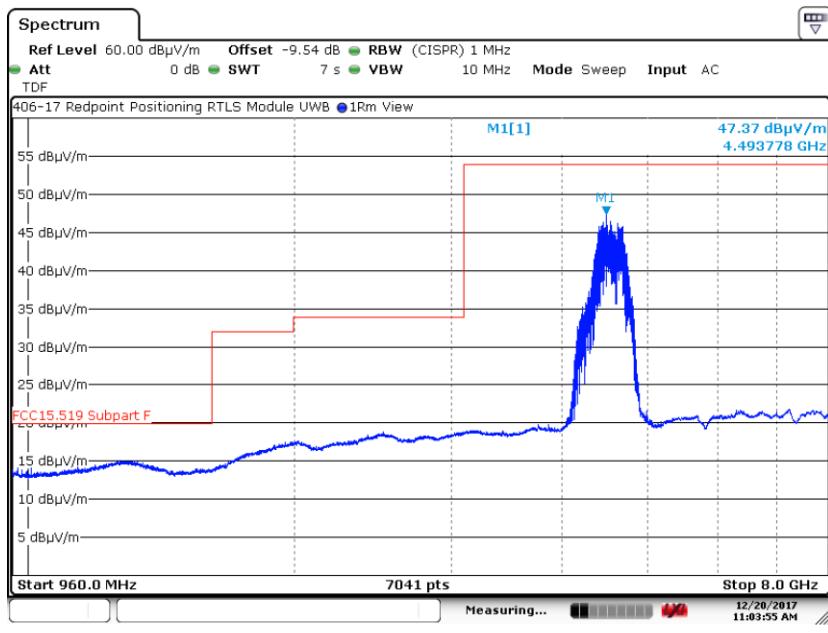
6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.13. 960 MHz to 8 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH3



Date: 20.DEC.2017 11:01:21

6.5.14. 960 MHz to 8 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH3



Date: 20.DEC.2017 11:03:53

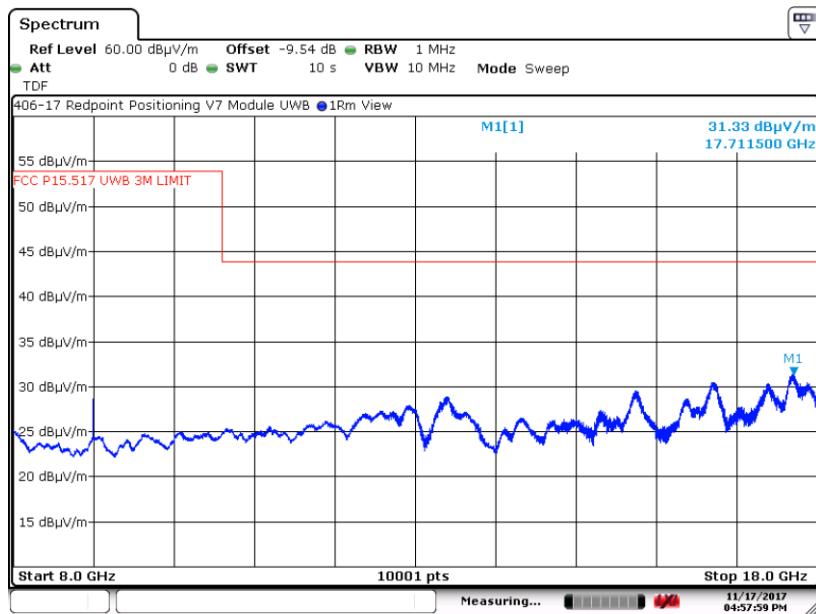
Test Number: 406-17R1

Issue Date: 3/16/2018

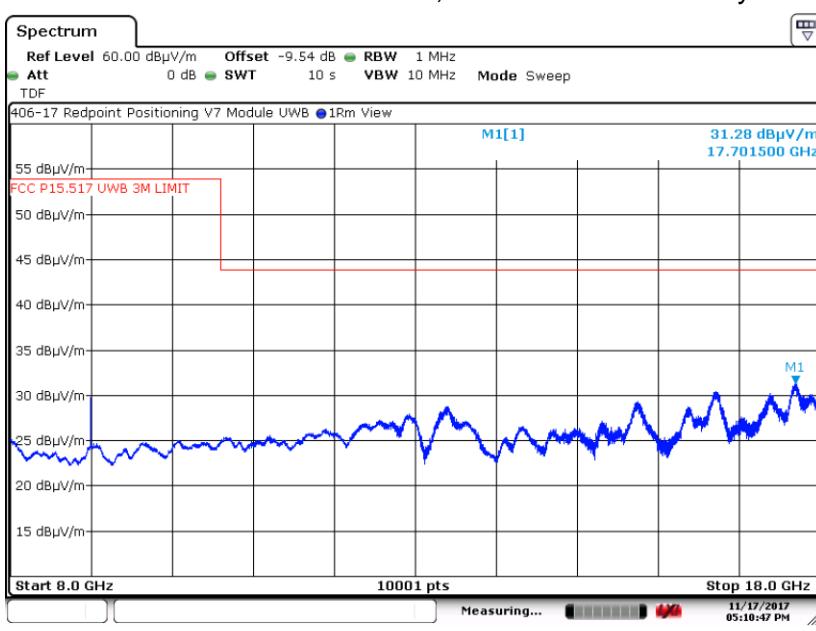
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.15. 8 to 18 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH3



6.5.16. 8 to 18 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH3



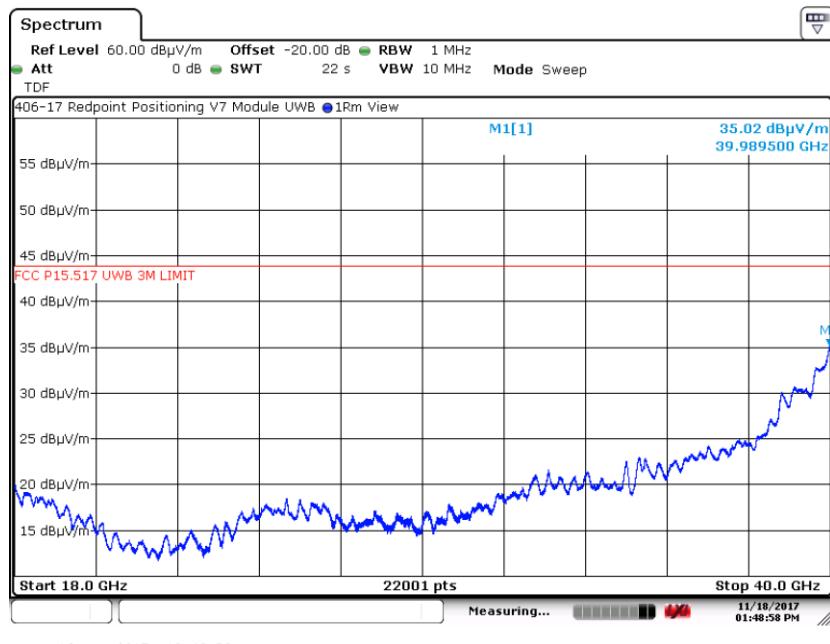
Test Number: 406-17R1

Issue Date: 3/16/2018

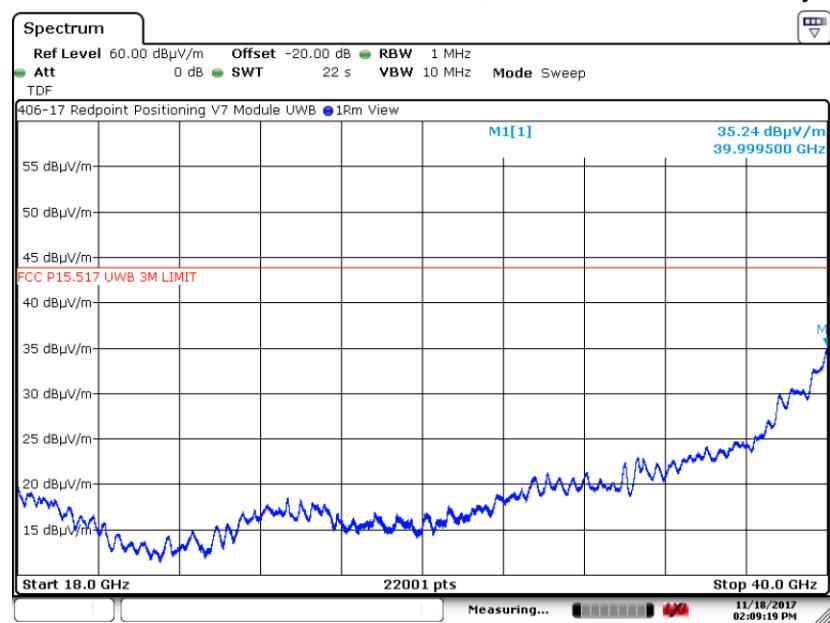
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.17. 18 to 40 GHz Horizontal at 0.3 Meter, -20.00 dB offset in analyzer CH3



6.5.18. 18 to 40 GHz Vertical at 0.3 Meter, -20.00 dB offset in analyzer CH3



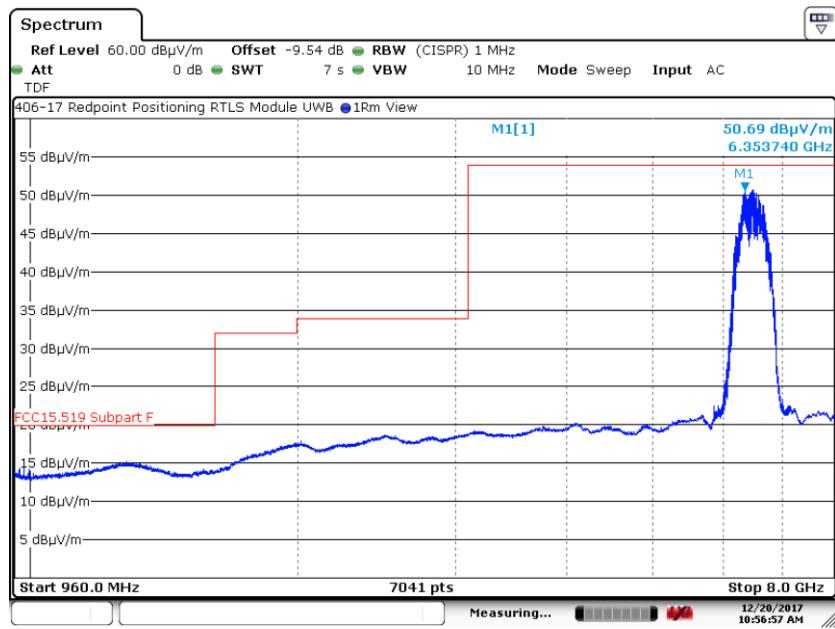
Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

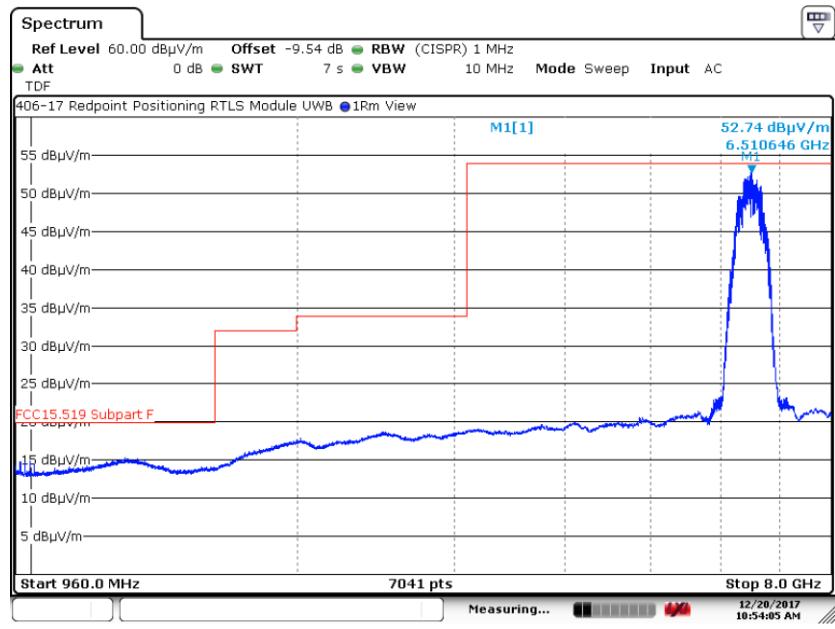
6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.19. 960 MHz to 8 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH5



Date: 20.DEC.2017 10:56:56

6.5.20. 960 MHz to 8 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH5



Date: 20.DEC.2017 10:54:04

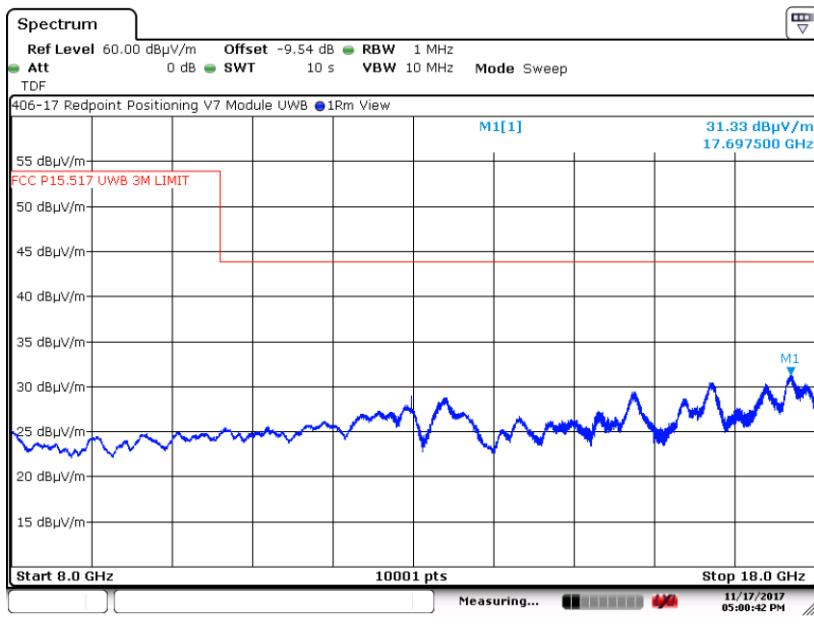
Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

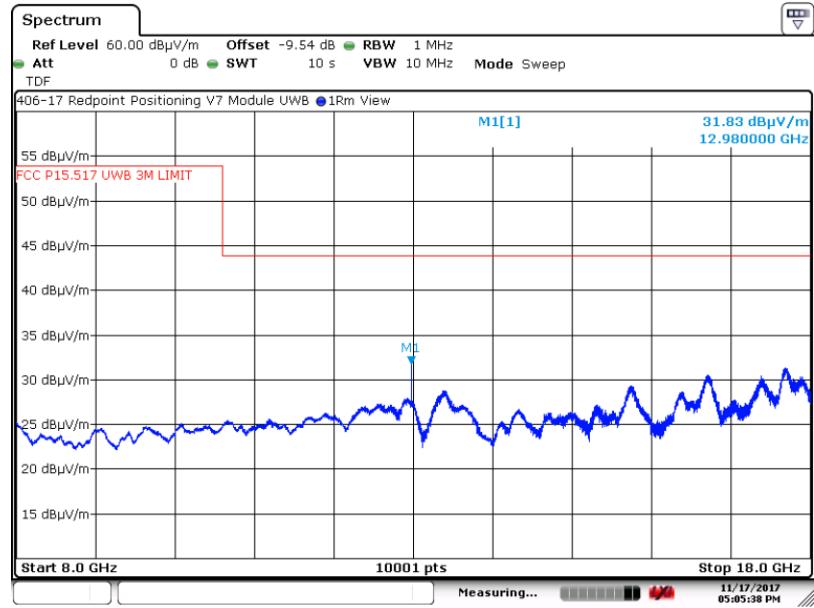
6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.21. 8 to 18 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH5



Date: 17.NOV.2017 17:00:42

6.5.22. 8 to 18 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH5



Date: 17.NOV.2017 17:05:38

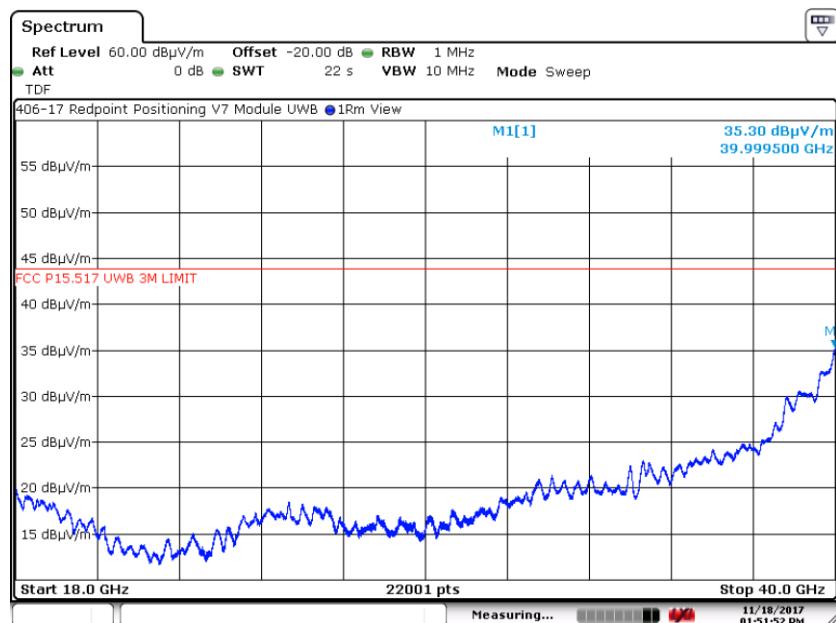
Test Number: 406-17R1

Issue Date: 3/16/2018

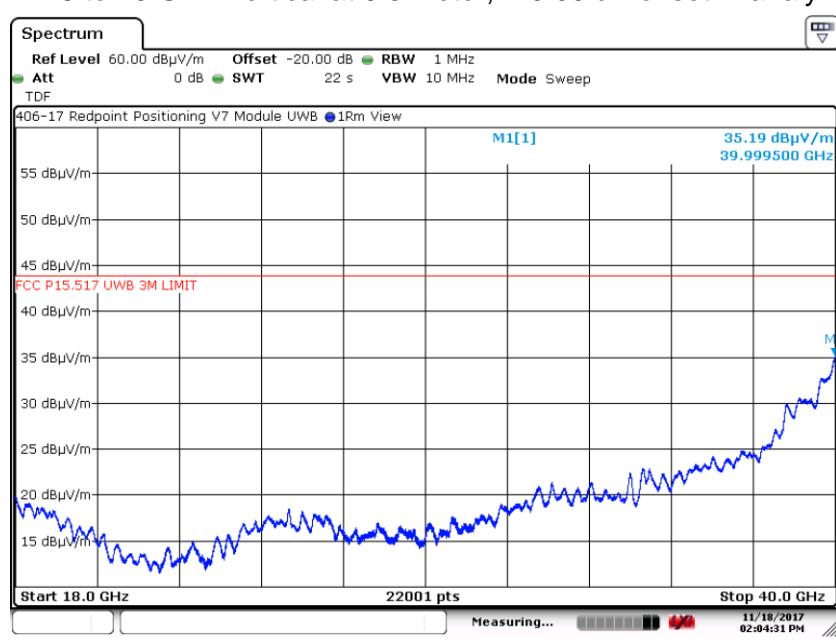
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (15.519 (c) continued)

6.5.23. 18 to 40 GHz Horizontal at 0.3 Meter, -20.00 dB offset in analyzer CH5



6.5.24. 18 to 40 GHz Vertical at 0.3 Meter, -20.00 dB offset in analyzer CH3



Test Number: 406-17R1**Issue Date: 3/16/2018****6. Measurement Data (continued)****6.5. Spurious Radiated Emissions (RSS-220 5.3.1 (d) continued)**

Requirement: The radiated emissions at or below 960 MHz from a device shall not exceed the limits in Section 3.4. The radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time.

The EIRP in terms of dBm, can be converted to a field strength, in dB μ V/m at 3 Meters by adding 95.2.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
960 - 1610	-75.3	19.9
1610 – 4750	-70.0	25.2
4750 – 10,600	-41.3	53.9
Above 10,600	-61.3	33.9

Frequency Range: 960 MHz to 8 GHz
Measurement Distance: 1 Meter
EMI Receiver IF Bandwidth: 1 MHz
EMI Receiver Avg Bandwidth: 10 MHz
Detector Function: RMS 1 mS Average as defined in Annex Section 4(b)

Notes: Measurements made from 960 MHz to 8 GHz were made in a semi-anechoic chamber at 1 Meter using a -9.54 dB distance offset was programmed into the spectrum analyzer. Worst case orientation was the Y-Axis.

Measurement data above 8 GHz for Channel 5 is provided in plots 6.5.21 to 6.5.24 on the previous pages.

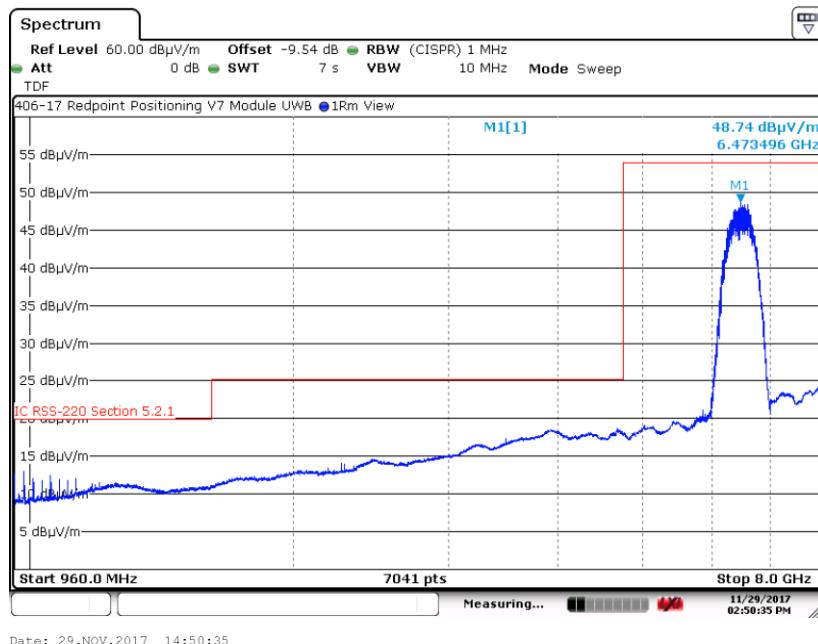
Test Number: 406-17R1

Issue Date: 3/16/2018

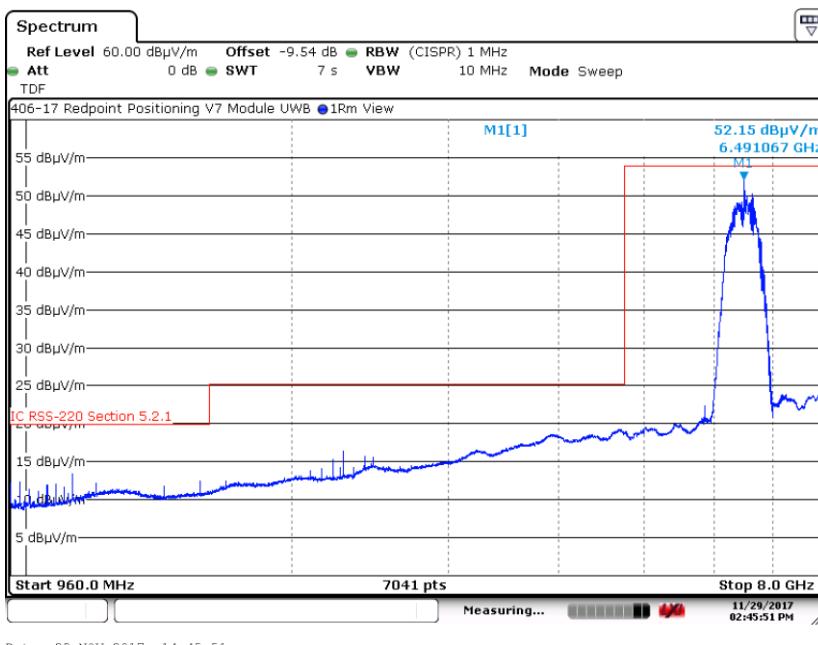
6. Measurement Data (continued)

6.5. Spurious Radiated Emissions (RSS-220 5.3.1 (d)) continued

6.5.25. 960 MHz to 8 GHz Horizontal at 1 Meter, -9.54 dB offset in analyzer CH5



6.5.26. 960 MHz to 8 GHz Vertical at 1 Meter, -9.54 dB offset in analyzer CH5



Test Number: 406-17R1**Issue Date: 3/16/2018****6. Measurement Data (continued)****6.6. Spurious Radiated Emissions in GPS Bands (15.519 (d), RSS 5.2.1 (e))**

Requirement: In addition to the radiated emission limits specified in the table in paragraph (d) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
1164 - 1240	-85.3	9.9
1559 - 1610	-85.3	9.9

6.6.1. Measurement & Equipment Setup

EMI Receiver IF Bandwidth: 1 kHz
EMI Receiver Avg Bandwidth: 10 kHz
Detector Functions: RMS Average

6.6.2. 1164 to 1240 MHz & 1559 to 1610 MHz

There were no broadband emissions related to the UWB transmitter. Measured signals were narrowband and related to the microprocessor / clocks and do not fall under the requirements of this section. Measurements were made at 1.5 Meters with a -9.54 dB distance correction factor. The -85.3 dBm limit was converted to a field strength limit of 9.9 dB μ V/m using a factor of 95.2.

Note: Worst case data of all channels and axis.

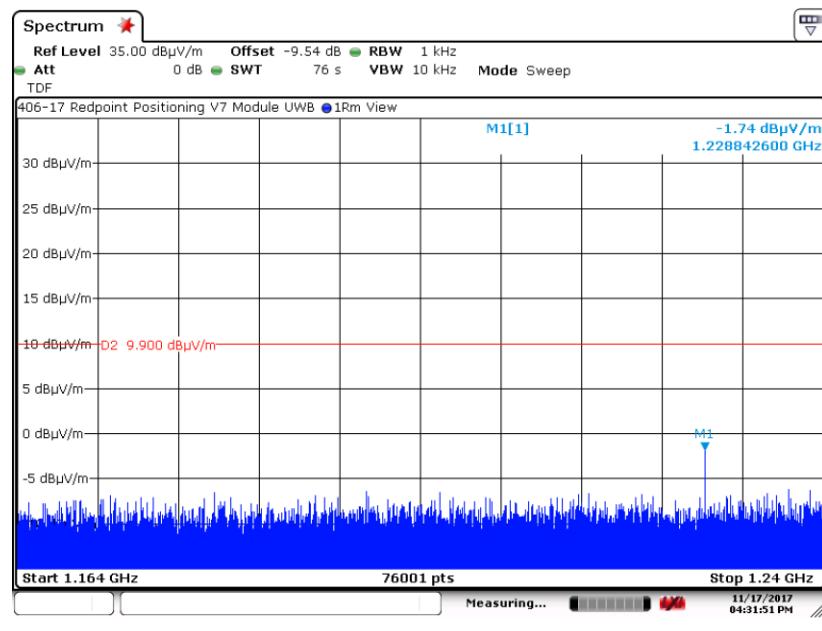
Test Number: 406-17R1

Issue Date: 3/16/2018

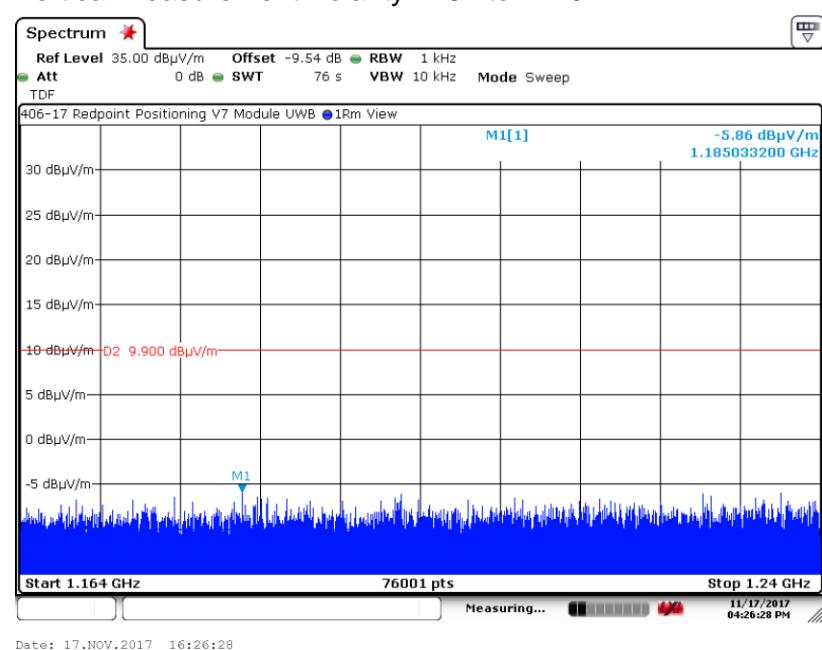
6. Measurement Data (continued)

6.6. Spurious Radiated Emissions in GPS Bands (15.519 (d) continued)

6.6.3.1 Horizontal Measurement Polarity 1164 to 1240 MHz



6.6.3.2 Vertical Measurement Polarity 1164 to 1240 MHz



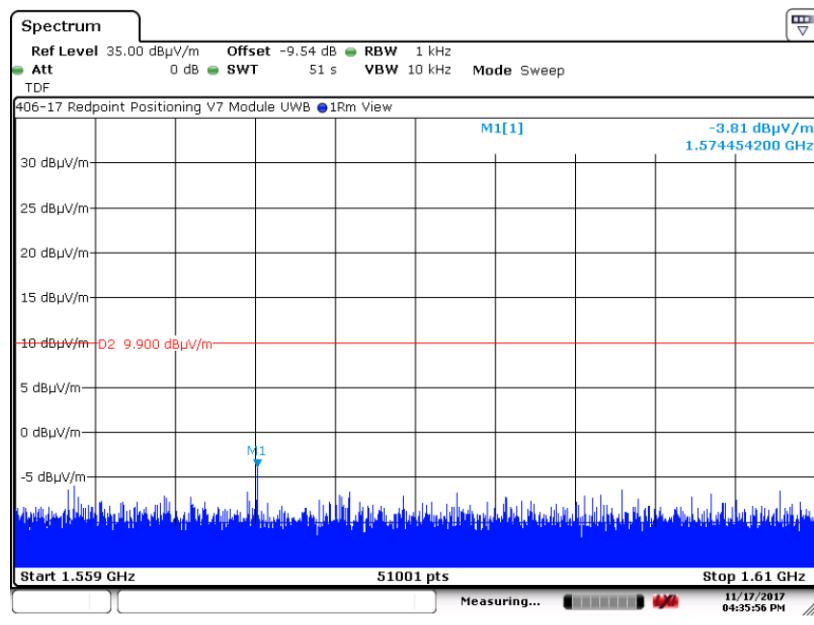
Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

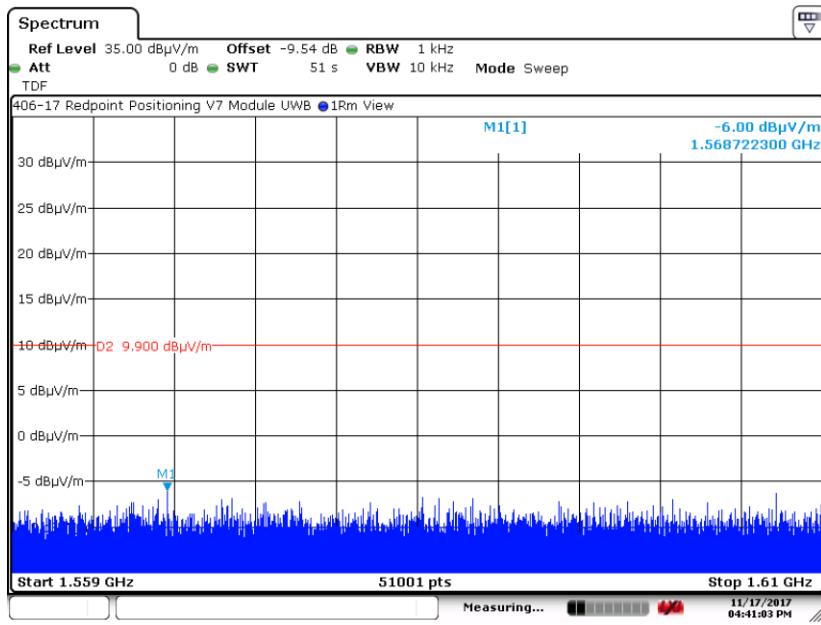
6.6. Spurious Radiated Emissions in GPS Bands (15.519 (d) continued)

6.6.3.3 Horizontal Measurement Polarity 1559 to 1610 MHz



Date: 17.NOV.2017 16:35:57

6.6.3.4 Vertical Measurement Polarity 1559 to 1610 MHz



Date: 17.NOV.2017 16:41:04

Test Number: 406-17R1**Issue Date: 3/16/2018****6. Measurement Data (continued)****6.7. Radiated Emissions of UWB Transmission (15.519 (c), 15.521 (d), RSS-220 5.3.1)**

Requirement: The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

The RMS average measurement is based on the use of a spectrum analyzer with a resolution bandwidth of 1 MHz, an RMS detector, and a 1 millisecond or less averaging time.

The EIRP in terms of dBm, can be converted to a field strength, in dB μ V/m at 3 Meters by adding 95.2.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
3100 - 10600	-41.3	53.9

Frequency Range: 3 to 4 GHz, 3.5 to 4.5 GHz, 4 to 5 GHz,
6 to 7 GHz

Measurement Distance: 3 Meters

EMI Receiver IF Bandwidth: 1 MHz

EMI Receiver Avg Bandwidth 10 MHz

Detector Function: RMS 1 mS Average as defined in 15.521(d)

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.7. Spurious Radiated Emissions (15.519 (c), 15.521(d), RSS-220 5.3.1 (d))

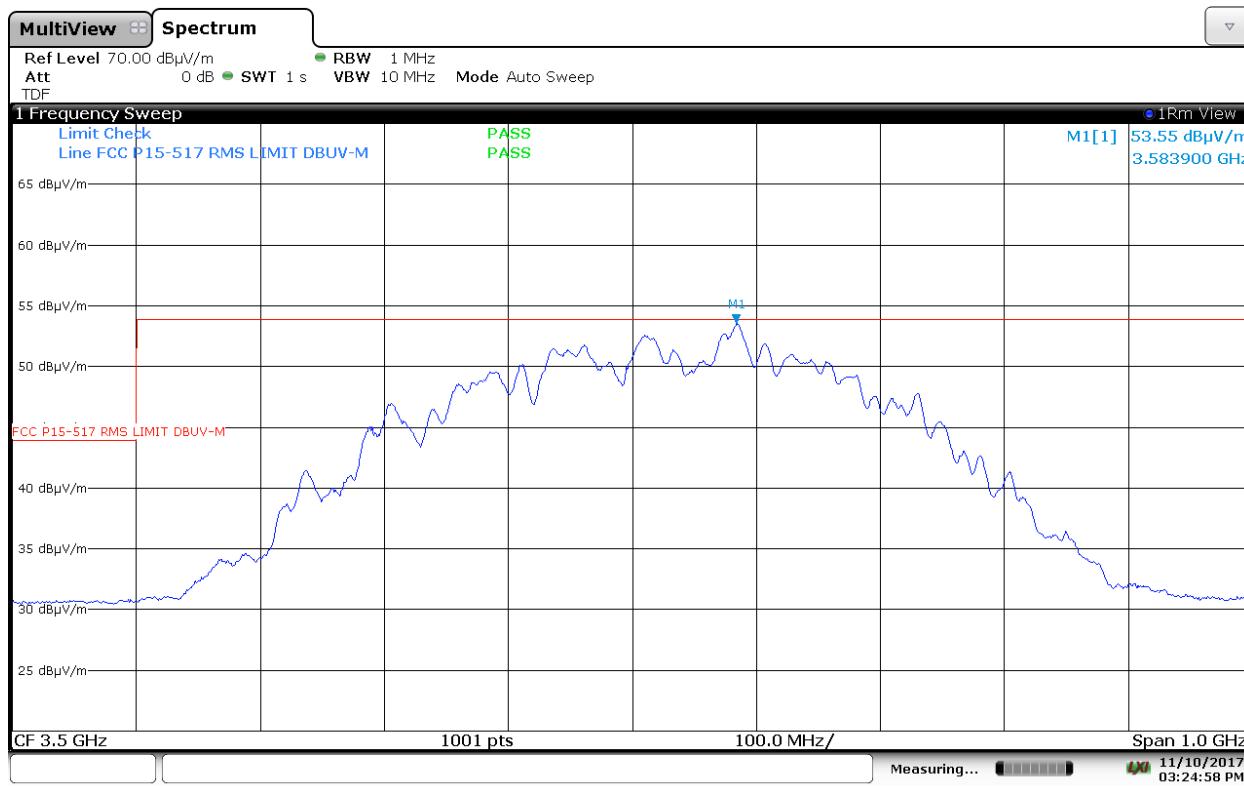
6.7.1. Plot of RMS Power at 3 Meters (Channel 1)

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
3.5839	53.55	53.90	-0.35	H	146	311	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$
 $EIRP (\text{dBm}) = E_{meas} (\text{dB}\mu\text{V/m}) - 95.2$

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
3.5839	-41.65	-41.30	-0.35	H	146	311	Compliant



Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.7. Spurious Radiated Emissions (15.519 (c), 15.521(d), RSS-220 5.3.1(d)) continued

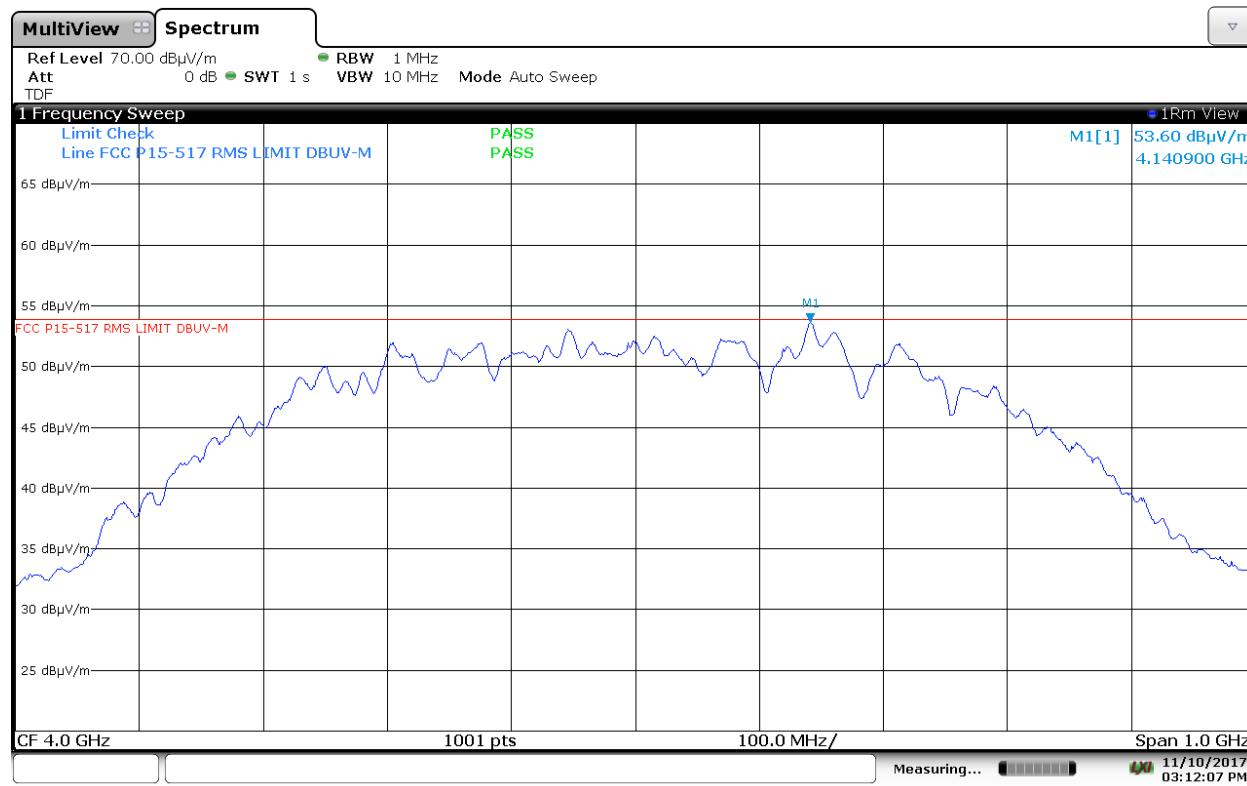
6.7.2. Plot of RMS Power at 3 Meters (Channel 2)

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
4.1409	53.60	53.90	-0.30	H	146	300	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$
 $EIRP (\text{dBm}) = E_{meas} (\text{dB}\mu\text{V/m}) - 95.2$

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
4.1409	-41.60	-41.30	-0.30	H	146	300	Compliant


03:12:07 PM 11/10/2017

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.7. Spurious Radiated Emissions (15.519 (c), 15.521(d), RSS-220 5.3.1(d)) continued

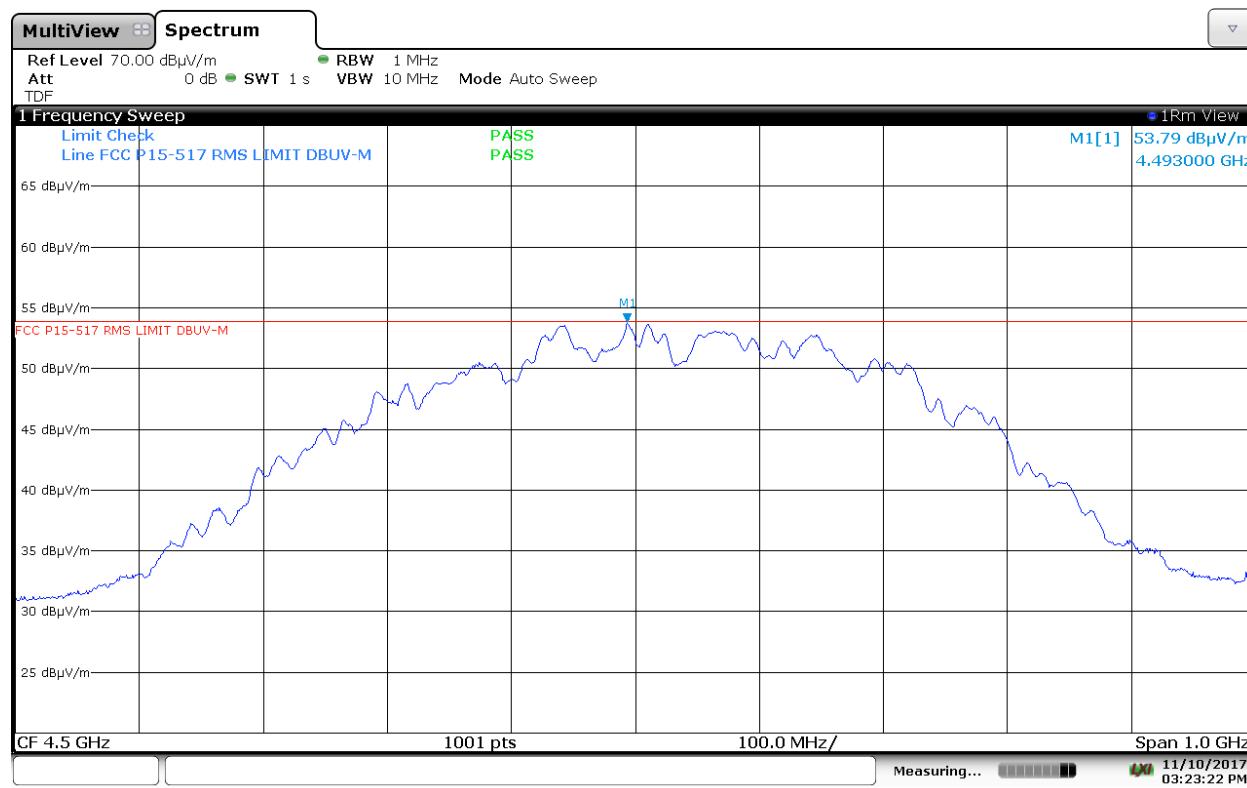
6.7.3. Plot of RMS Power at 3 Meters (Channel 3)

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
4.493	53.79	53.90	-0.11	H	154	308	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$
 $EIRP (\text{dBm}) = E_{meas} (\text{dB}\mu\text{V/m}) - 95.2$

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
4.493	-41.41	-41.30	-0.11	H	154	308	Compliant


03:23:22 PM 11/10/2017
Measuring...
**11/10/2017
03:23:22 PM**

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.7. Spurious Radiated Emissions (15.519 (c), 15.521(d), RSS-220 5.3.1(d)) continued

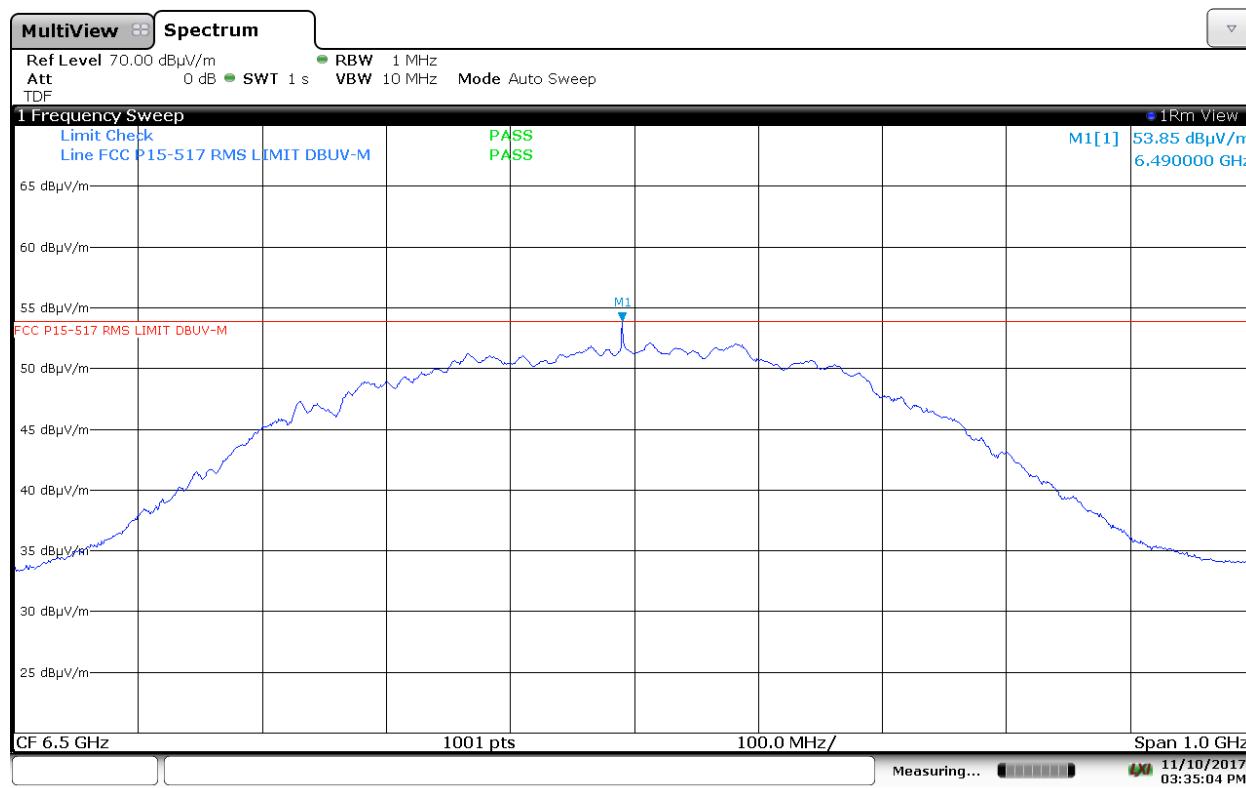
6.7.4. Plot of RMS Power at 3 Meters (Channel 5)

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
6.4900	53.85	53.90	-0.05	H	120	56	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, EIRP = $E_{\text{meas}} + 20 \log (d_{\text{meas}}) - 104.7$; $d_{\text{meas}} = 3$
 $EIRP (\text{dBm}) = E_{\text{meas}} (\text{dB}\mu\text{V/m}) - 95.2$

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
6.4900	-41.35	-41.30	-0.05	H	120	56	Compliant


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Test Number: 406-17R1**Issue Date: 3/16/2018****6. Measurement Data (continued)****6.8. Peak Emissions in a 50 MHz Bandwidth (15.519 (e), 15.521 (g), RSS-220 5.3.1(g))**

Requirement: There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, f_M . That limit is 0 dBm EIRP.

The EIRP in terms of dBm, can be converted to a field strength, in dB μ V/m at 3 Meters by adding 95.2. As used in this subpart, EIRP refers to the highest signal strength measured in any direction and at any frequency from the UWB device.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
3100 - 10600	0	95.2

Frequency Range: 3 to 4 GHz, 3.5 to 4.5 GHz, 4 to 5 GHz,
6 to 7 GHz

Measurement Distance: 3 Meters

EMI Receiver IF Bandwidth: 50 MHz

EMI Receiver Avg Bandwidth: 80 MHz

Detector Function: Peak, Max Held

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.8. Peak Emissions in a 50 MHz Bandwidth (15.519 (e), 15.521 (g) continued)

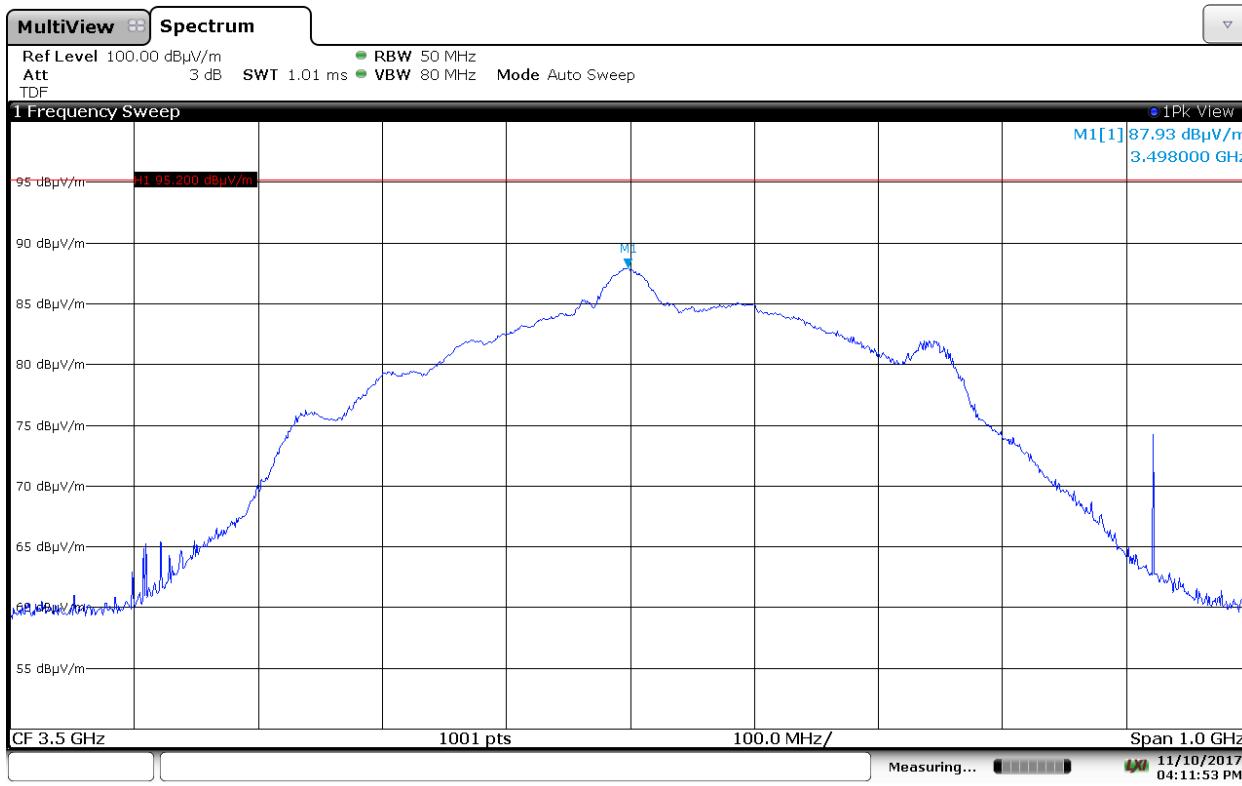
6.8.1 Plot of Peak Power at 3 Meters (Channel 1)

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
3.498	87.93	95.20	-7.27	H	146	311	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, EIRP = $E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$
 $EIRP$ (dBm) = E_{meas} (dB μ V/m) - 95.2

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
3.498	-7.27	0.00	-7.27	H	146	311	Compliant


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Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.8. Peak Emissions in a 50 MHz Bandwidth (15.519 (e), 15.521 (g) continued)

6.8.2 Plot of Peak Power at 3 Meters (Channel 2)

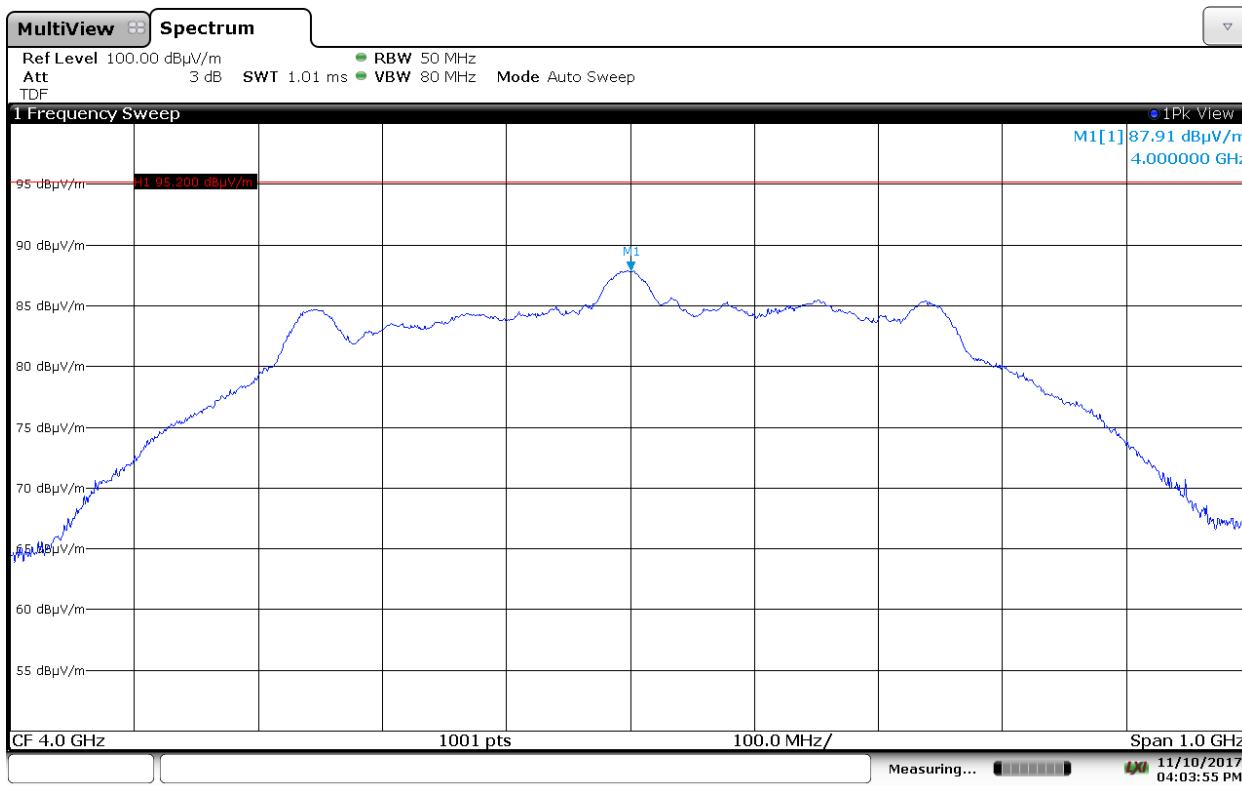
Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
4.000	87.91	95.20	-7.29	H	146	300	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, EIRP = E_{meas} + 20 log (d_{meas}) - 104.7; d_{meas} = 3

$$\text{EIRP (dBm)} = \text{E}_{\text{meas}} \text{ (dB}\mu\text{V/m)} - 95.2$$

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
4.000	-7.29	0.00	-7.29	H	146	300	Compliant


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**11/10/2017
04:03:55 PM**

Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.8. Peak Emissions in a 50 MHz Bandwidth (15.519 (e), 15.521 (g) continued)

6.8.3 Plot of Peak Power at 3 Meters (Channel 3)

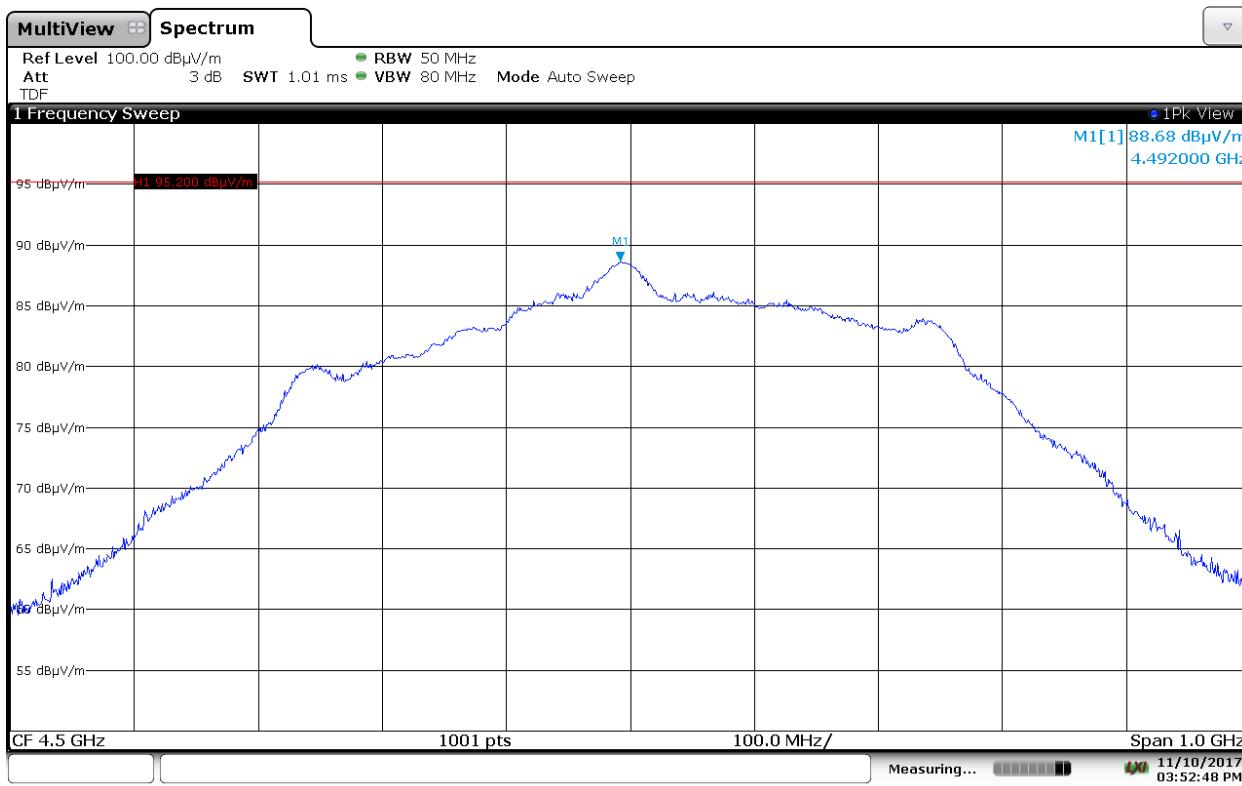
Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
4.492	88.68	95.20	-6.52	H	154	308	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, EIRP = E_{meas} + 20 log (d_{meas}) - 104.7; d_{meas} = 3

$$\text{EIRP (dBm)} = \text{E}_{\text{meas}} \text{ (dB}\mu\text{V/m)} - 95.2$$

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
4.492	-6.52	0.00	-6.52	H	154	308	Compliant



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Test Number: 406-17R1
Issue Date: 3/16/2018

6. Measurement Data (continued)

6.8. Peak Emissions in a 50 MHz Bandwidth (15.519 (e), 15.521 (g) continued)

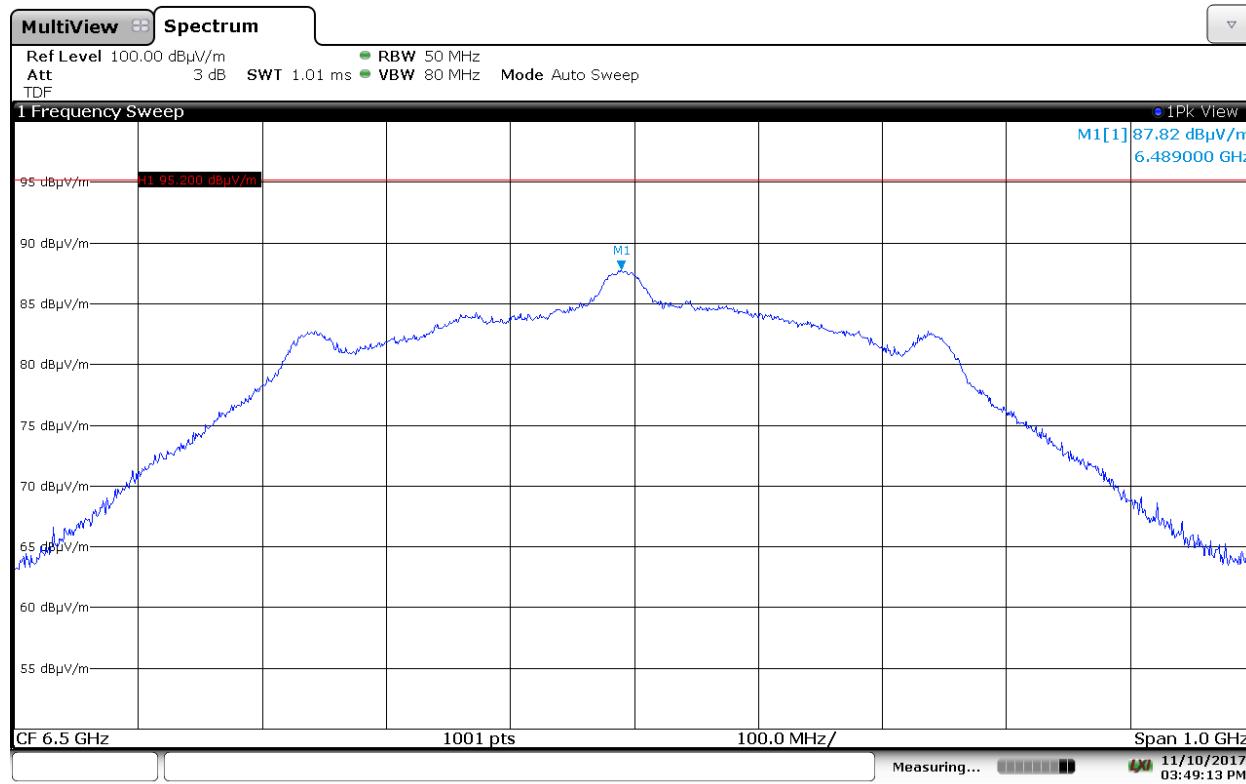
6.8.4 Plot of Peak Power at 3 Meters (Channel 5)

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dB μ V/m)	(dB μ V/m)	(dB)	H/V	cm	Deg	
6.489	87.82	95.20	-7.38	H	120	56	Compliant

Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

Equation (22) from ANSI C63.10-2013, EIRP = $E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$
 $EIRP$ (dBm) = E_{meas} (dB μ V/m) - 95.2

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBm)	(dBm)	(dB)	H/V	cm	Deg	
6.489	-7.38	0.00	-7.38	H	120	56	Compliant



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Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

6.9 Conducted Emissions Test Setup

6.9.1. Regulatory Limit: FCC Part 15, Class B, IC RSS-GEN

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-Peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5.0	56	46
5.0 to 30.0	60	50

* Decreases with the logarithm of the frequency.

6.9.2 Measurement Equipment and Software Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver	Hewlett Packard	8546A	3330A00115	12/4/2018
RF Filter Section	Hewlett Packard	85460A	3325A00121	12/4/2018
LISN	EMCO	3825/2	9109-1860	11/17/2018
Manufacturer	Software Description	Title/Model #		Rev.
Compliance Worldwide	Test Report Generation Software	Test Report Generator		1.0

6.9.3. Measurement & Equipment Setup

Test Date:	11/20/2017
Test Engineer:	Mark R. McSweeney
Site Temperature (°C):	22.8
Relative Humidity (%RH):	48.3
Frequency Range:	0.15 MHz to 30 MHz
EMI Receiver IF Bandwidth:	9 kHz
EMI Receiver Avg Bandwidth:	30 kHz
Detector Functions:	Peak, Quasi-Peak. & Average

6.9.4. Test Procedure

Test measurements were made in accordance with ANSI C63.4-2014, Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz.

Test Number: 406-17R1
Issue Date: 3/16/2018

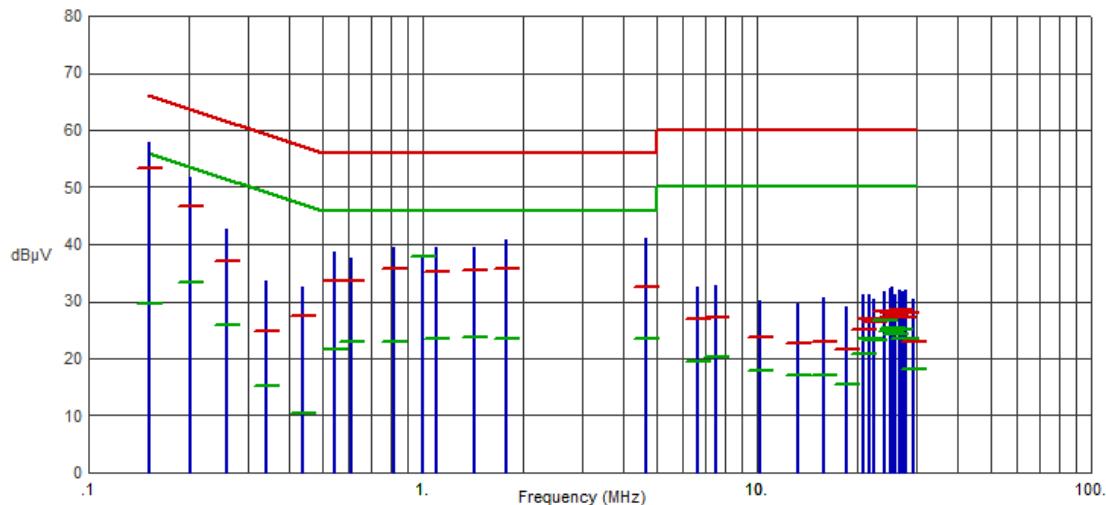
6. Measurement Data (continued)

6.10 Conducted Emissions Test Results

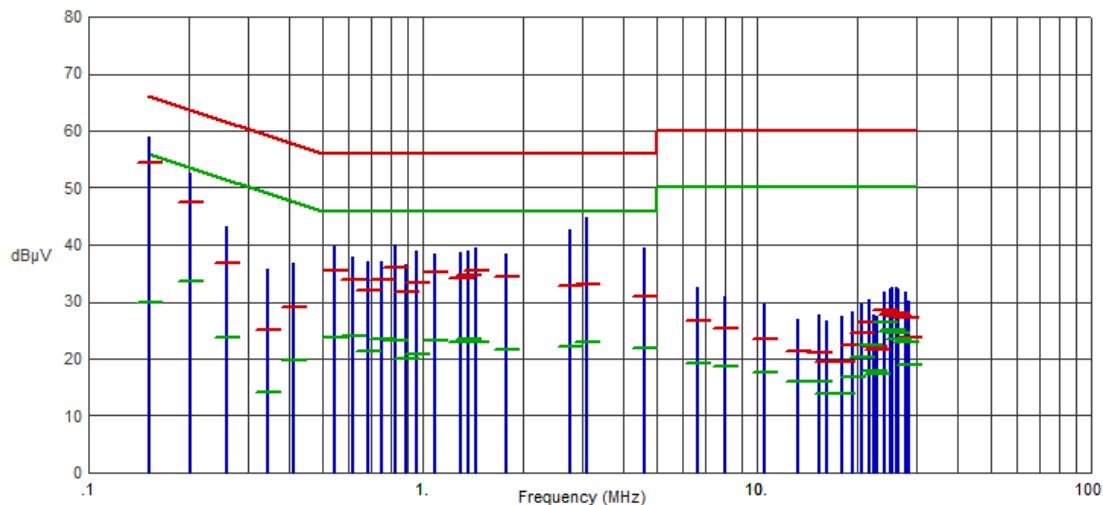
6.10.1. 120 Volts, 60 Hz Phase

Test No.: 406-17, 120 Volts, 60 Hz Phase

FCC Part 15.207



Frequency (MHz)	Pk Amp (dB μ V)	QP Amp (dB μ V)	QP Limit (dB μ V)	QP Margin (dB)	Avg Amp (dB μ V)	Avg Limit (dB μ V)	Avg Margin (dB)	Comments
.1523	57.92	53.37	65.87	-12.50	29.47	55.87	-26.40	
.2018	51.76	46.76	63.54	-16.78	33.25	53.54	-20.29	
.2580	42.77	37.13	61.50	-24.37	25.95	51.50	-25.55	
.3390	33.63	24.88	59.23	-34.35	15.22	49.23	-34.01	
.4380	32.52	27.54	57.10	-29.56	10.46	47.10	-36.64	
.5438	38.72	33.69	56.00	-22.31	21.51	46.00	-24.49	
.6135	37.47	33.61	56.00	-22.39	23.00	46.00	-23.00	
.8205	39.44	35.73	56.00	-20.27	22.93	46.00	-23.07	
1.0000	38.21	37.89	56.00	-18.11	37.86	46.00	-8.14	
1.0950	39.44	35.12	56.00	-20.88	23.53	46.00	-22.47	
1.4325	39.47	35.57	56.00	-20.43	23.86	46.00	-22.14	
1.7790	40.68	35.65	56.00	-20.35	23.35	46.00	-22.65	
4.6433	41.12	32.40	56.00	-23.60	23.34	46.00	-22.66	
6.6165	32.45	26.94	60.00	-33.06	19.53	50.00	-30.47	
7.5345	32.79	27.15	60.00	-32.85	20.38	50.00	-29.62	
10.2120	30.12	23.86	60.00	-36.14	17.89	50.00	-32.11	
13.2113	29.70	22.65	60.00	-37.35	17.12	50.00	-32.88	
15.8370	30.60	23.01	60.00	-36.99	17.08	50.00	-32.92	
18.5550	29.00	21.55	60.00	-38.45	15.55	50.00	-34.45	
20.7690	31.26	25.10	60.00	-34.90	20.90	50.00	-29.10	
21.7793	31.23	26.90	60.00	-33.10	23.48	50.00	-26.52	
22.2855	30.48	26.45	60.00	-33.55	23.26	50.00	-26.74	
24.1013	31.76	28.37	60.00	-31.63	26.69	50.00	-23.31	
24.9990	32.27	27.14	60.00	-32.86	24.74	50.00	-25.26	
25.5143	32.61	27.96	60.00	-32.04	25.27	50.00	-24.73	
26.0160	31.24	27.54	60.00	-32.46	24.24	50.00	-25.76	
26.6235	32.03	28.53	60.00	-31.47	24.95	50.00	-25.05	
27.2288	31.71	27.26	60.00	-32.74	23.36	50.00	-26.64	
27.8340	31.87	27.91	60.00	-32.09	23.59	50.00	-26.41	
29.2358	30.52	22.98	60.00	-37.02	18.05	50.00	-31.95	

Test Number: 406-17R1
Issue Date: 3/16/2018
6. Measurement Data (continued)
6.10. Conducted Emissions Test Results (continued)
6.10.2. 120 Volts, 60 Hz Neutral
Test No.: 406-17, 120 Volts, 60 Hz Neutral
FCC Part 15.207


Frequency (MHz)	Pk Amp (dB μ V)	QP Amp (dB μ V)	QP Limit (dB μ V)	QP Margin (dB)	Avg Amp (dB μ V)	Avg Limit (dB μ V)	Avg Margin (dB)	Comments
.1523	58.86	54.31	65.87	-11.56	29.86	55.87	-26.01	
.2018	52.41	47.57	63.54	-15.97	33.68	53.54	-19.86	
.2580	43.11	36.73	61.50	-24.77	23.81	51.50	-27.69	
.3435	35.71	25.20	59.12	-33.92	14.05	49.12	-35.07	
.4088	36.79	29.19	57.67	-28.48	19.64	47.67	-28.03	
.5460	39.75	35.51	56.00	-20.49	23.86	46.00	-22.14	
.6180	37.82	33.90	56.00	-22.10	23.93	46.00	-22.07	
.6878	37.06	31.89	56.00	-24.11	21.43	46.00	-24.57	
.7530	37.11	33.78	56.00	-22.22	23.38	46.00	-22.62	
.8250	40.06	36.05	56.00	-19.95	23.15	46.00	-22.85	
.8903	36.48	31.76	56.00	-24.24	20.04	46.00	-25.96	
.9578	38.81	33.35	56.00	-22.65	20.91	46.00	-25.09	
1.0928	38.48	35.19	56.00	-20.81	23.32	46.00	-22.68	
1.3020	38.64	34.06	56.00	-21.94	22.82	46.00	-23.18	
1.3628	38.87	34.59	56.00	-21.41	23.37	46.00	-22.63	
1.4460	39.50	35.34	56.00	-20.66	22.97	46.00	-23.03	
1.7790	38.46	34.36	56.00	-21.64	21.62	46.00	-24.38	
2.7645	42.77	32.68	56.00	-23.32	22.22	46.00	-23.78	
3.1065	44.72	33.18	56.00	-22.82	22.91	46.00	-23.09	
4.6275	39.47	31.01	56.00	-24.99	21.95	46.00	-24.05	
6.6233	32.46	26.74	60.00	-33.26	19.07	50.00	-30.93	
8.0138	30.80	25.39	60.00	-34.61	18.62	50.00	-31.38	
10.5338	29.47	23.40	60.00	-36.60	17.51	50.00	-32.49	
13.2428	26.88	21.46	60.00	-38.54	15.92	50.00	-34.08	
15.4298	27.61	21.04	60.00	-38.96	15.87	50.00	-34.13	
16.1048	26.63	19.48	60.00	-40.52	13.89	50.00	-36.11	
17.9903	27.43	19.39	60.00	-40.61	13.98	50.00	-36.02	
24.1013	31.68	28.48	60.00	-31.52	26.46	50.00	-23.54	
25.5143	32.49	28.01	60.00	-31.99	25.20	50.00	-24.80	
28.4370	30.09	23.65	60.00	-36.35	18.99	50.00	-31.01	

Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

6.11. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))

6.11.1. SAR Test Exclusion Calculation

Requirement: Portable devices as defined in § 2.1093 of this chapter operating under Part 15 are subject to radio frequency radiation exposure requirements as specified in §§ 1.1307(b) and 2.1093 of this chapter.

For a 1-g SAR, the test exclusion result must be ≤ 3.0 .

Test Notes: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by the following formula:

$$\text{SAR Test Exclusion} = \frac{P_{\text{MAX}}}{d_{\text{MIN}}} \times \sqrt{f_{(\text{GHz})}} \quad (1)$$

P_{MAX} mW Maximum power of channel, including tune-up tolerance

d_{MIN} mm Minimum test separation distance, mm (≤ 50 mm)

$f_{(\text{GHz})}$ GHz $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz (>100 MHz and <6 GHz)

(1) FCC OET 447498 - Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

Result: The device under test meets the exclusion requirement detailed in FCC OET 447498.

Channel:		1	2	3	
Input:	P_{MAX}	0.1863	0.1854	0.2214	mW
	d_{MIN}	5.00	5.00	5.00	mm
	$f_{(\text{GHz})}$	3.498	4.000	4.492	GHz
Test Exclusion:		0.070	0.074	0.094	
Limit Exemption:		3.000	3.000	3.000	

¹ Taken from the peak data in Section 6.5 of this test report (converted to mW).

The device does not exceed the test limit exemption and therefore a routine SAR Evaluation is not required

Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

6.11. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1), RSS-GEN, Issue 4 Section 3.2, RSS 102)

6.11.2. RSS-102 Issue 5 Requirements

Requirement: SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. Portable devices are subject to radio frequency radiation exposure requirements.

Test Notes: The limit was taken from Table 1 of RSS-102 Issue 5.

6.11.3 RF Exposure for devices that operate above 6 GHz

Center Frequency (GHz)	MPE Distance (cm)	DUT Output Power (dBm EIRP)	DUT Antenna Gain (dBi)	Power Density		FCC Limit	IC Limit
				(mW/cm ²)	(W/m ²)		
(1)	(2)	(3)	(4)	(5)	(6)		
6.489	5	-9.98	2.6	0.0005819	0.0058190	10	1

$$PD = \frac{OP + AG}{(4 \times \pi \times d^2)}$$

1. Reference CFR 2.1093(b): For purposes of this section, a portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is/are within 5 centimeters of the body of the user.
2. Section 6.7 of this test report.
3. Data supplied by the client.
4. Power density is calculated from field strength measurement and antenna gain.
5. Reference CFR 1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure.
6. Reference IC RSS-102 Section 4 Table 4 RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

6.11. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))

6.11.4. SAR Test Exclusion Calculation

Requirement: Portable devices as defined in § 2.1093 of this chapter operating under Part 15 are subject to radio frequency radiation exposure requirements as specified in §§ 1.1307(b) and 2.1093 of this chapter.

For a 1-g SAR, the test exclusion result must be ≤ 3.0 .

Test Notes: The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by the following formula:

$$\text{SAR Test Exclusion} = \frac{P_{\text{MAX}}}{d_{\text{MIN}}} \times \sqrt{f_{(\text{GHz})}} \quad (1)$$

P_{MAX} mW Maximum power of channel, including tune-up tolerance

d_{MIN} mm Minimum test separation distance, mm (≤ 50 mm)

$f_{(\text{GHz})}$ GHz $f_{(\text{GHz})}$ is the RF channel transmit frequency in GHz (>100 MHz and <6 GHz)

(1) FCC OET 447498 - Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

Result: The device under test meets the exclusion requirement detailed in FCC OET 447498.

Bluetooth Low Energy

Channel:	37	17	39	
Input ¹ :	P_{MAX}	4.864	3.811	3.899 mW
	d_{MIN}^2	5.00	5.00	5.00 mm
	$f_{(\text{GHz})}$	2.402	2.440	2.480 GHz
Test Exclusion:	1.51	1.19	1.23	
Limit Exemption:	3.0	3.0	3.0	

The device does not exceed the test limit exemption and therefore a routine SAR Evaluation is not required

Worst Case UWB and BLE Radios Combined

UWB Test Exclusion:	0.094	Channel 3
BLE Test Exclusion:	1.510	Channel 37
TOTAL:	1.604	
Limit Exemption:	3.0	

Test Number: 406-17R1

Issue Date: 3/16/2018

6. Measurement Data (continued)

6.11. Public Exposure to Radio Frequency Energy Levels (RSS-GEN, RSS-102)

Public Exposure to Radio Frequency Energy Levels 1.1307 (b)(1), RSS-GEN, Issue 4 Section 3.2, RSS 102

Requirement: SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1. Portable devices are subject to radio frequency radiation exposure requirements.

Test Notes: The limit was taken from Table 1 of RSS-102 Issue 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5.

Results: Compliant

UWB Radio

Frequency	Separation Distance	Maximum Power	RSS-102 Limit	Result
MHz	mm	mW	mW	
3498	≤5	0.186	5.01	Compliant
4000	≤5	0.185	4.46	Compliant
4492	≤5	0.221	3.92	Compliant

Bluetooth Radio

Frequency	Separation Distance	Maximum Power	RSS-102 Limit	Result
MHz	mm	mW	mW	
2402	≤5	4.86	10.65	Compliant
2440	≤5	3.81	10.14	Compliant
2480	≤5	3.90	9.86	Compliant



Test Number: 406-17R1



Issue Date: 3/16/2018

7. Test Site Description

Compliance Worldwide is located at 357 Main Street in Sandown, New Hampshire. The test sites at Compliance Worldwide are used for conducted and radiated emissions testing in accordance with the Federal Communications Commission (FCC) and Industry Canada standards. Through our American Association for Laboratory Accreditation (A2LA) ISO Guide 17025:2005 Accreditation our test sites are designated with the FCC (designation number **US1091**), Industry Canada (file number **IC 3023A-1**) and VCCI (Member number 3168) under registration number A-0274.

Compliance Worldwide is also designated as a Phase 1 CAB under APEC-MRA (US0132) for Australia/New Zealand AS/NZS CISPR 22, Chinese-Taipei (Taiwan) BSMI CNS 13438 and Korea (RRA) KN 11, KN 13, KN 14-1, KN 22, KN 32, KN 61000-6-3, KN 61000-6-4.

The radiated emissions test site is a 3 and 10 meter enclosed open area test site (OATS). Personnel, support equipment and test equipment are located in the basement beneath the OATS ground plane.

The conducted emissions site is part of a 16' x 20' x 12' ferrite tile chamber and uses one of the walls for the vertical ground plane required by EN 55022. A second conducted emissions site is also located in the basement of the OATS site with a 2.3 x 2.5 meter ground plane and a 2.4 x 2.4 meter vertical wall.

Both sites are designed to test products or systems 1.5 meters W x 1.5 meters L x 2.0 meters H, floor standing or table top.