

COMPLIANCE WORLDWIDE INC. TEST REPORT 200-16R1

In Accordance with the Requirements of
Federal Communications Commission 47 CFR Part 15.250, Subpart C
Wideband Systems within the band 5925 to 7250 MHz

Issued to

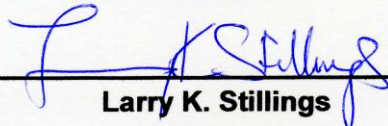
IsoLynx, LLC.
179 Ward Hill Avenue
Haverhill, MA 01835
978-556-9780

For the
IsoLynx II UWB Tracking Tag
Model Number: IL0301


FCC ID: 2AHCQ-IL0301

Report Issued on April 13, 2016
Revision R1 Issued on April 20, 2016

Tested By


Larry K. Stillings

Reviewed By


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1. Scope

This test report certifies that the IsoLynx II UWB Tracking Tag, Model IL0301 as tested, meets the FCC Part 15.250, Subpart C 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 includes the Frequency Stability data in section 6.2 and corrects the rule part reference in section 6.5, also updated test equipment list with DMM & Thermal Chamber information.

2. Product Details

2.1. Manufacturer:	IsoLynx
2.2. Model Number:	IL0301
2.3. Serial Number:	SN 346
2.4. Description:	Wireless Tracking and Real Time Location System
2.5. Power Source:	3.7 VDC 300 mAh Rechargeable Battery
2.6. Hardware Revision:	N/A
2.7. Software Revision:	N/A
2.8. Modulation Type:	Pulse Modulation, Frequency Hopping
2.9. Operating Frequency:	6489.6 GHz Center Frequency Nominal (Channel 5 – 500 MHz BW)
2.10. EMC Modifications:	None

3. Product Configuration

3.1 Operational Characteristics & Software

Hardware Setup:

Remove the IsoLynx IL0301 from the battery charger.

The Unit's LED should start blinking and start transmitting normally with the provided special firmware.

During the measurement testing, the product was mounted on a polystyrene form to facilitate rotating the In-Line Control Module through three orthogonal axes as required by ANSI C63.10-2013, section 5.10.1, for a hand held or body worn device. The three axes were defined as follows:

X-Axis	Vertical with the arrow of on the tag facing to the left. The top of tag was facing the antenna at 0° turntable azimuth.
Y-Axis	Vertical with arrow on the tag facing up. The top of the tag was facing the antenna at 0° turntable azimuth.
Z-Axis	Flat on the table. The arrow on the tag was facing the antenna at 0° turntable azimuth.

3. Product Configuration (cont.)

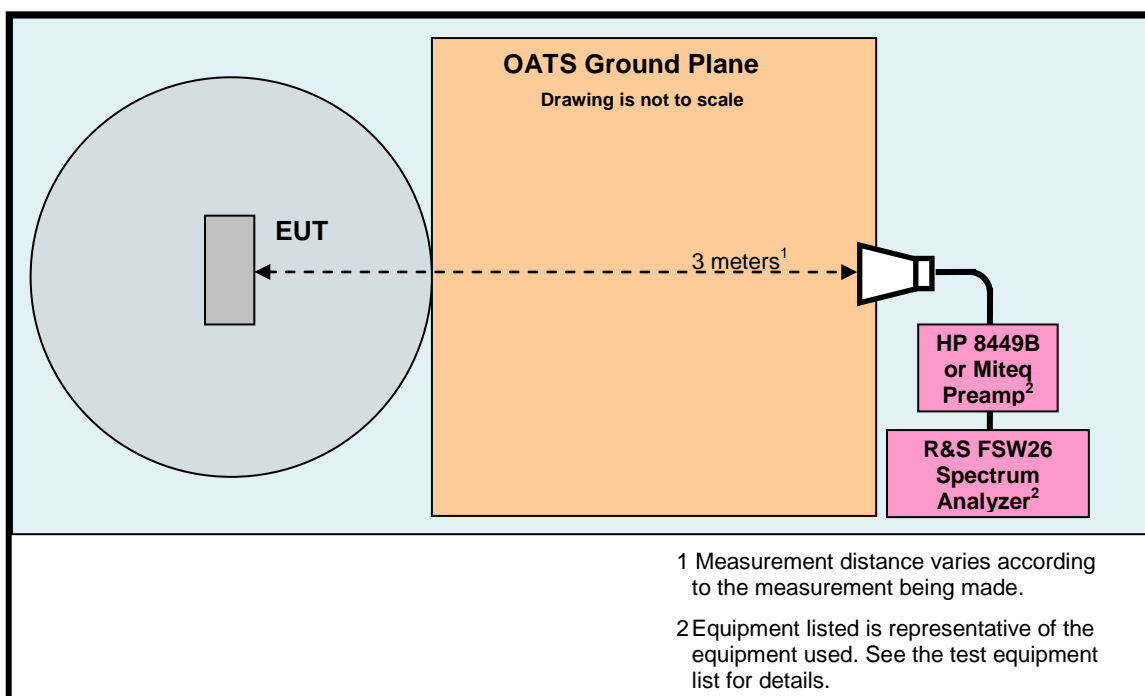
3.2. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Number	Input Volts	Freq (Hz)	Description/Function
IsoLynx	IL0301	Pre production	3.7	DC	UWB Tracking Tag

3.3. Support Equipment

Manufacturer	Model/Part #	Serial Number
None		

3.4. Test Setup Diagram



Note: A Samsung USB Charger was used for the conducted emissions configuration.

4. Measurements Parameters

4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Cal Interval
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	7/23/2017	2 yr
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSV40	100899	7/23/2017	2 yr
EMI Receiver 9 kHz to 7 GHz	Rohde & Schwarz	ESR7	101156	7/23/2017	2 yr
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102044	6/1/2016	1 yr
Bilog Antenna 30 to 2000 MHz	Sunol Sciences	JB1	A050913	5/15/2016	3 yr
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	9/23/2016	2 yr
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	4/3/2016	1 yr
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	10/15/2016	1 yr
Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	7/22/2017	2 yr
Preamplifier 18 to 40 GHz	Avantek	AWT-40039	FM22038832	11/25/2016	1 yr
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	2/22/2019	3 yr
Horn Antenna 700 MHz to 18 GHz	Electro-Metrics	RGA 50/60	2813	7/15/2016	2 yr
Horn Antenna 18-40 GHz	Com Power	AH-840	03075	9/24/2016	2 yr
Barometer	Control Company	4195	Cal ID# 236	10/8/2017	2 yr
Digital Multi-meter with Thermocouple	Fluke	187	80350579	10/6/2016	1 yr
Temperature Chamber	Associated Research	E-0029	N/A	N/A	---

¹ ESR7 Firmware revision: V2.26,

² FSV40 Firmware revision: V2.30 SP1

³ FSVR40 Firmware revision: V2.23,

Date installed: 8/15/2014

Date installed: 10/22/2014

Date installed: 10/20/2014

Previous V2.17, installed 6/11/2014.

Previous V2.30, installed 7/23/2014.

Previous V1.63 SP1, installed 8/28/2013.

4. Measurements Parameters (continued)

4.2. Measurement & Equipment Setup

Test Dates:	3/14/2016, 4/5/2016, 4/6/2016
Test Engineers:	Brian Breault, Larry Stillings
Normal Site Temperature (15 - 35°C):	21.6
Relative Humidity (20 -75%RH):	35
Frequency Range:	10 MHz to 40 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	9 kHz – 10 to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth:	30 kHz – 10 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, 15.250 Subpart C.

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	$\pm 5\%$

5. Measurements Summary

Test Requirement	FCC Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	6.1	Compliant	The antenna is housed within a sealed enclosure with the intentional radiator.
Operational Requirements	15.250 (a)	6.2	Compliant	
Wideband Bandwidth	15.250 (b)	6.3	Compliant	
Spurious Radiated Emissions	15.250 (d) (1) 15.209	6.4	Compliant	
Radiated Emissions in GPS Bands	15.250 (d) (2) 15.209			
Peak Emissions in a 50 MHz Bandwidth	15.250 (d) (3)	6.5	Compliant	
Conducted Emissions	15.207	6.6 6.7	N/A	Samsung USB Charger
Radio Frequency Exposure	FCC OET Bulletin 65	6.8	Compliant	

6. Measurement Data

6.1. Antenna Requirement (15.203)

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 an internal, non user replaceable unit.

6.2. Operational Requirements of the Device under Test (15.250 (a))

Requirement: The -10 dB bandwidth of a device operating under the provisions of this section must be contained within the 5925 to 7250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

Result: Compliant

6.2.1 Frequency Stability over Temperature

Marker	Temp °C	Meas Freq.	-10 dB Band Edges		15.250 Frequency Band		Result
		(MHz)	Lower	Upper	F _{MIN} (MHz)	F _{MAX} (MHz)	
-	OATS	6286.2	6138.4	6824.7	5925	7250	Compliant
-	Ambient	6286.2	6116.5	6981.1	5925	7250	Compliant
1	-20	6286.2	6116.5	7017.1	5925	7250	Compliant
2	-10	6286.2	6118.0	7021.6	5925	7250	Compliant
3	0	6286.2	6124.0	7017.1	5925	7250	Compliant
4	+10	6286.2	6208.0	6866.9	5925	7250	Compliant
5	+20	6286.2	6209.1	6864.7	5925	7250	Compliant
6	+30	6286.2	6206.1	6867.4	5925	7250	Compliant
7	+40	6286.2	6209.1	6865.2	5925	7250	Compliant
8	+50	6286.2	6205.3	6862.6	5925	7250	Compliant

6. Measurement Data (continued)

6.3. Wideband Bandwidth (15.250 (b))

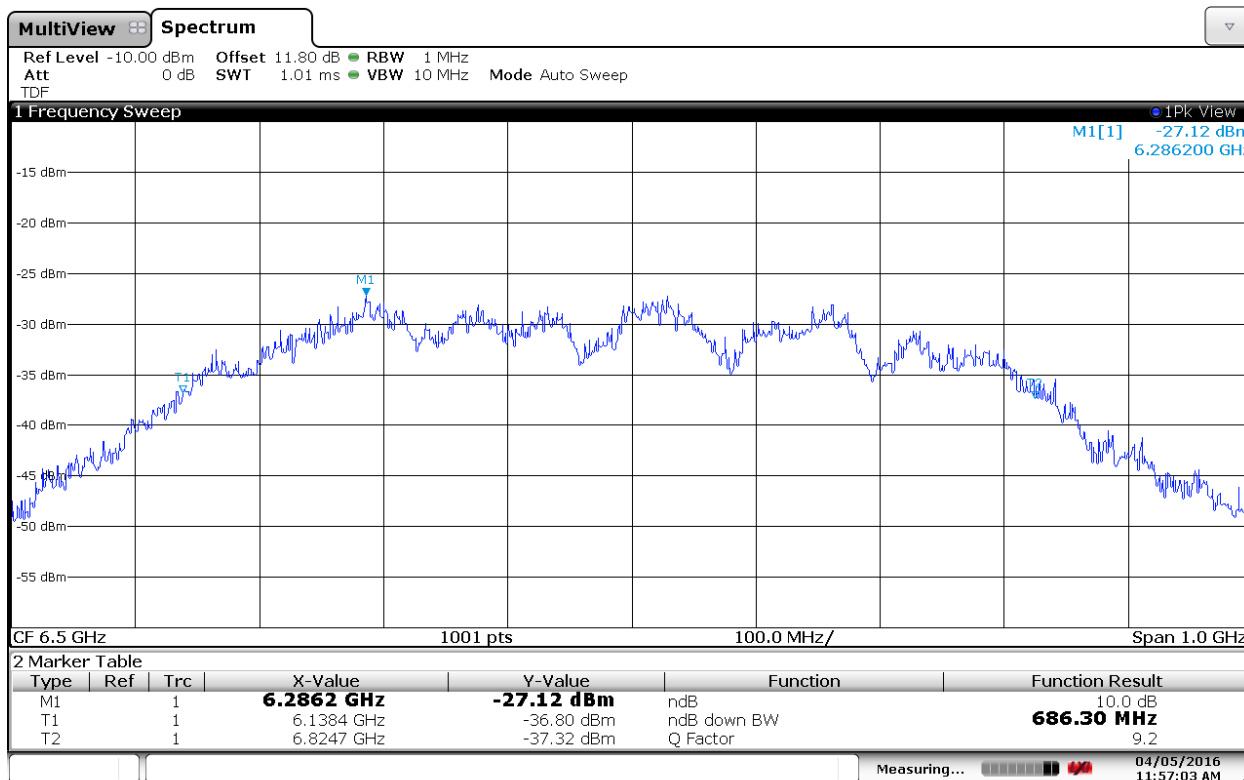
Requirement: The -10 dB bandwidth of the fundamental emission shall be at least 50 MHz.

Result: Compliant

6.3.1. Measurement Data – Values in GHz

f_M	The highest emission peak	6.2862
f_L	10 dB below the highest peak	6.1384
f_H	10 dB above the highest peak	6.8247
Bandwidth	Calculated: ($f_H - f_L$)	0.6863

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



Date: 5.APR.2016 11:57:02

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209)

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. 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:

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/m)
960 - 1610	-75.3	19.9
1610 - 1990	-63.3	31.9
1990 - 3100	-61.3	33.9
3100 – 5925	-51.3	43.9
5925 – 7250	-41.3	53.9
7250 – 10,600	-51.3	43.9
Above 10,600	-61.3	33.9

Spurious Radiated Emissions in GPS Bands (15.250 (d) (2))

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 (dBμV/m)
1164 - 1240	-85.3	9.9
1559 - 1610	-85.3	9.9

Radiated Emissions Field Strength Limits at 3 Meters (Section 15.250 (d),15.209)

Frequency (MHz)	Field Strength (dBμV/m)
0.009 to 0.490	128.5 to 93.8
0.490 to 1.705	73.8 to 63
1.705 - 30	69.5
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 40,000	54

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

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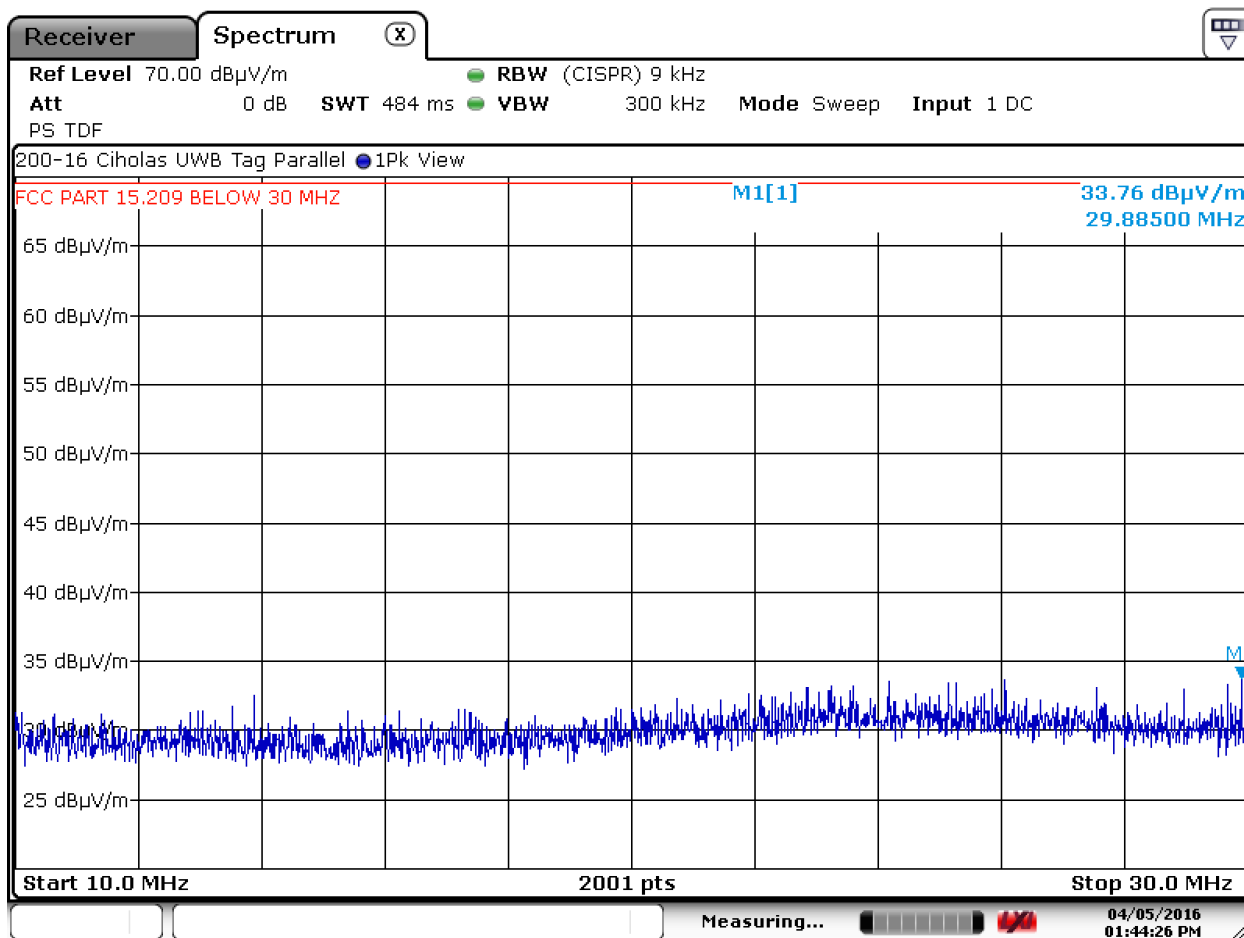
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209)

6.4.1. 10 MHz 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 – 10 to 30 MHz



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Test Number: 200-16R1

Issue Date: 4/20/2016

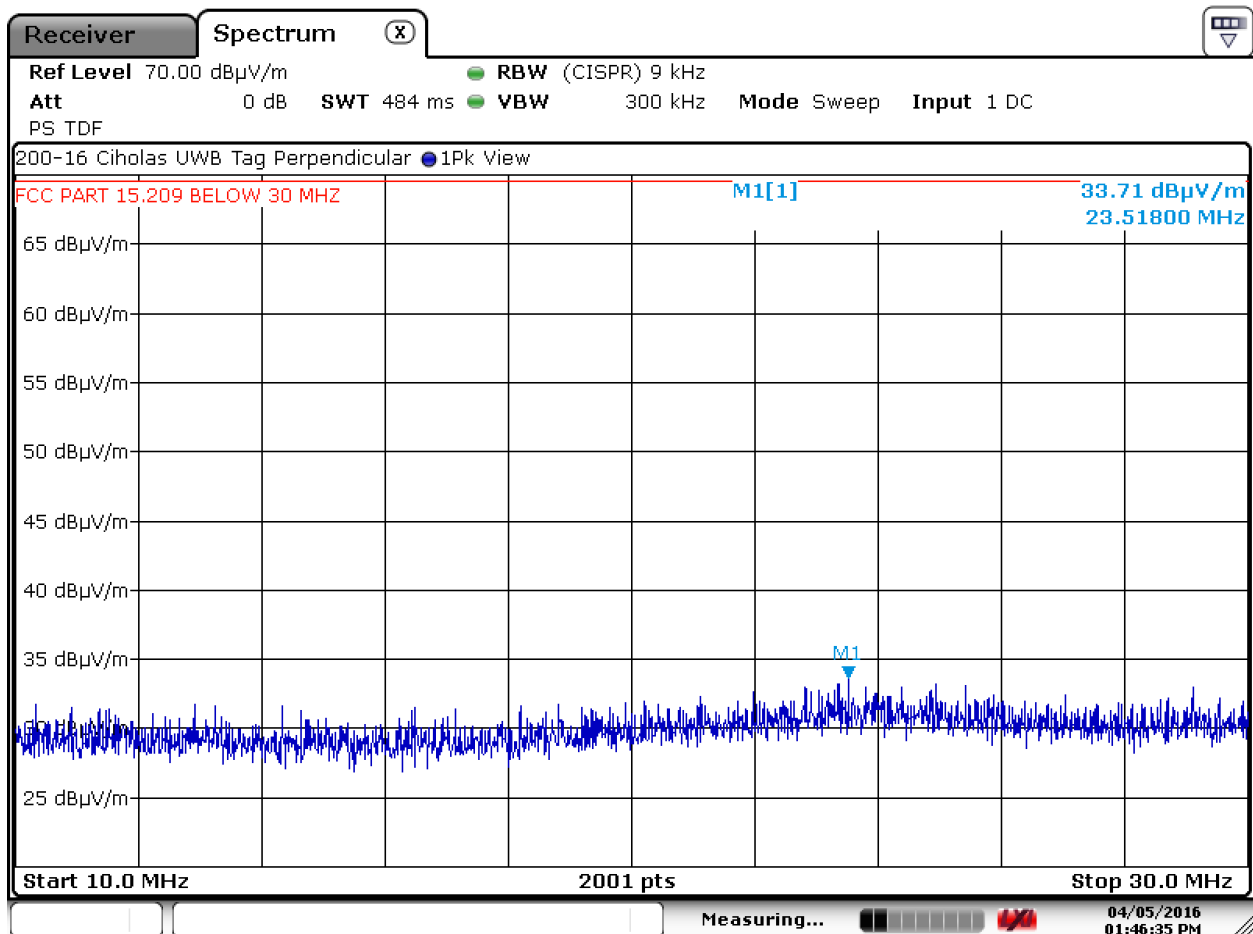
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209)

6.4.1. 10 MHz 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 – 10 to 30 MHz



Date: 5.APR.2016 13:46:34

Test Number: 200-16R1

Issue Date: 4/20/2016

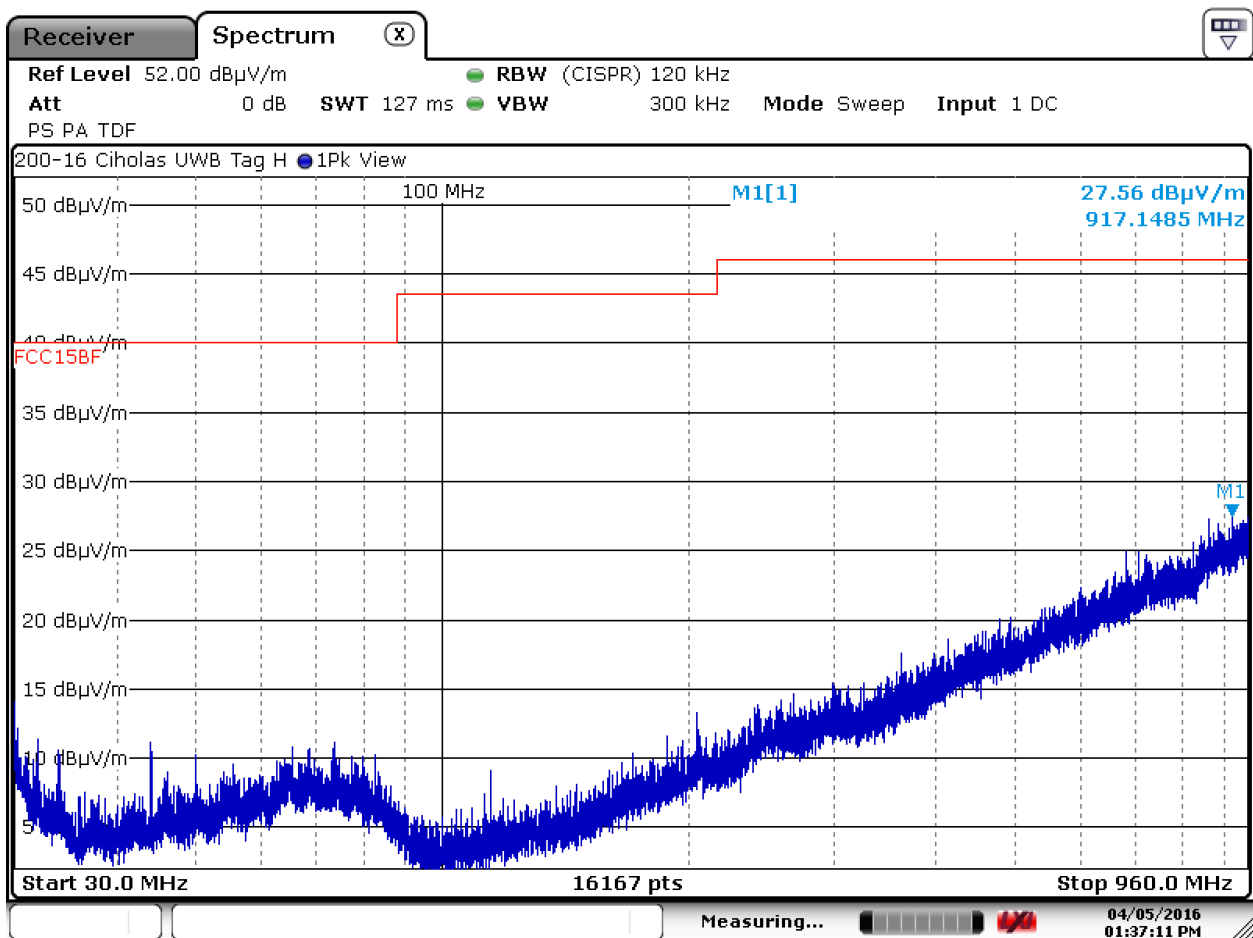
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209)

6.4.1. 10 MHz 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 Horizontal Polarity – 30 to 960 MHz



Date: 5.APR.2016 13:37:11

Test Number: 200-16R1

Issue Date: 4/20/2016

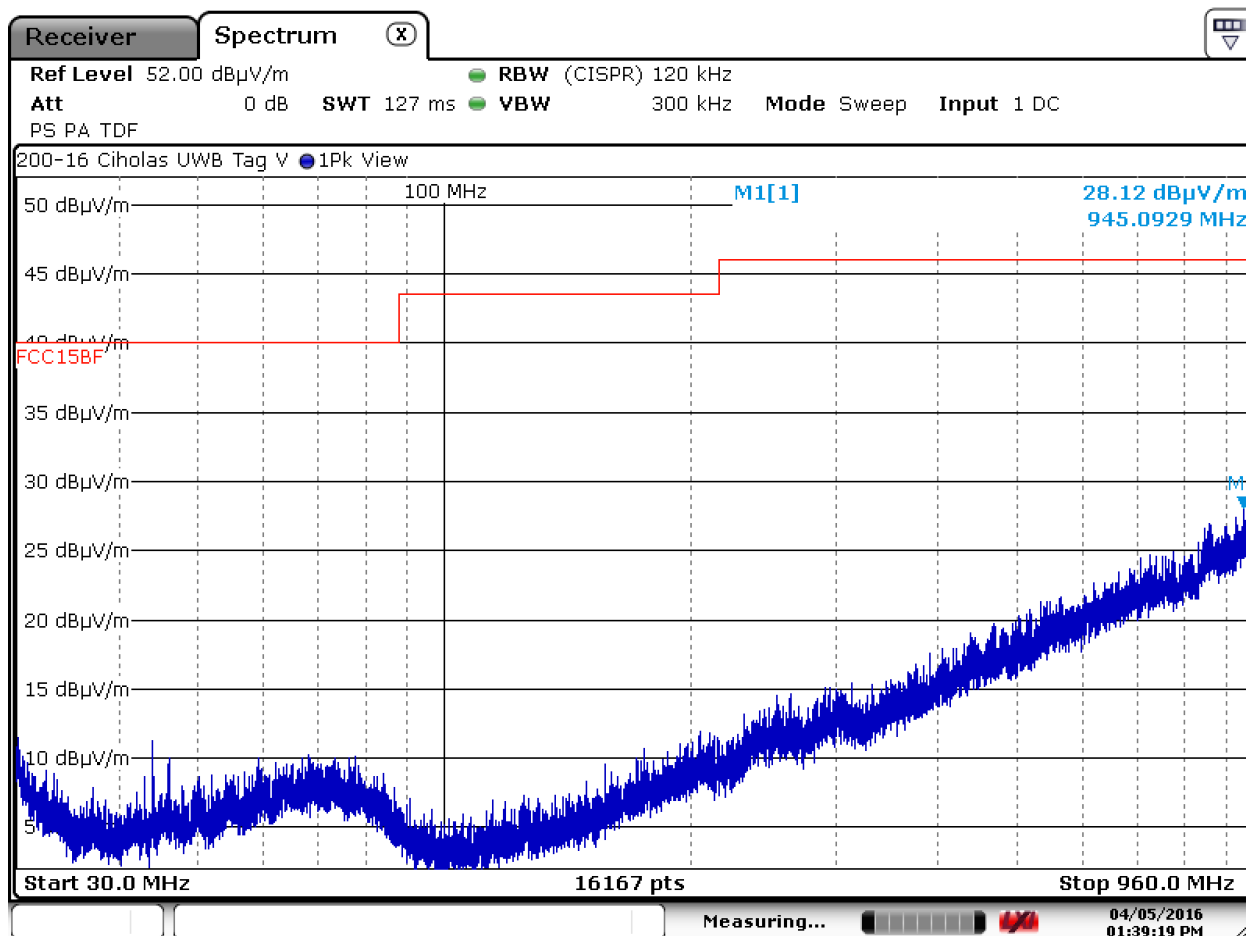
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209)

6.4.1. 10 MHz 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 Vertical Polarity – 30 to 960 MHz



Date: 5.APR.2016 13:39:18

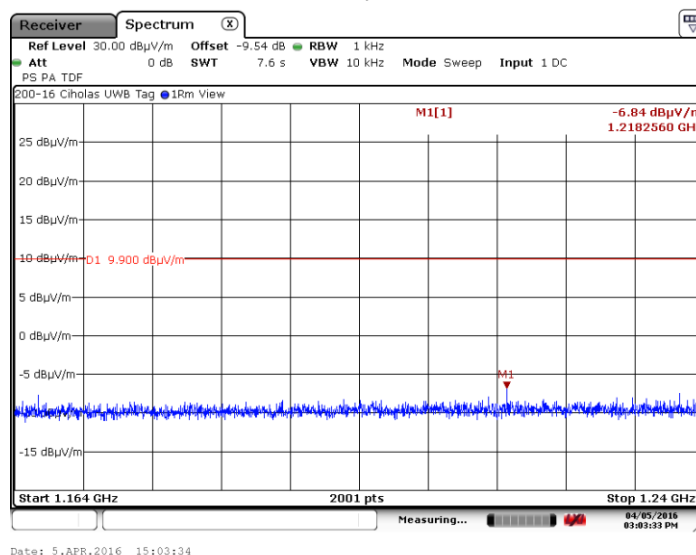
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), 15.209)

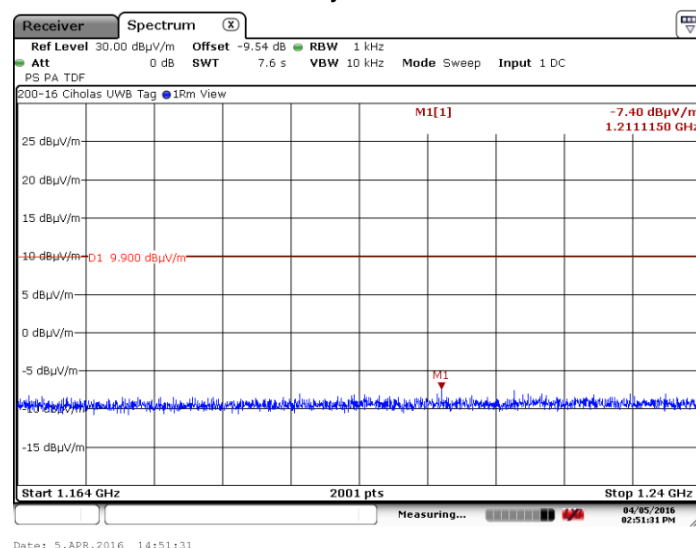
6.4.2 1164 to 1240 MHz & 1559 to 1610 MHz

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 Meters using a 9.54 dB distance offset and the -85.3 dBm limit was converted to a field strength limit of 9.9 dBuV/m.

6.4.2.1 Horizontal Measurement Polarity 1164 to 1240 MHz



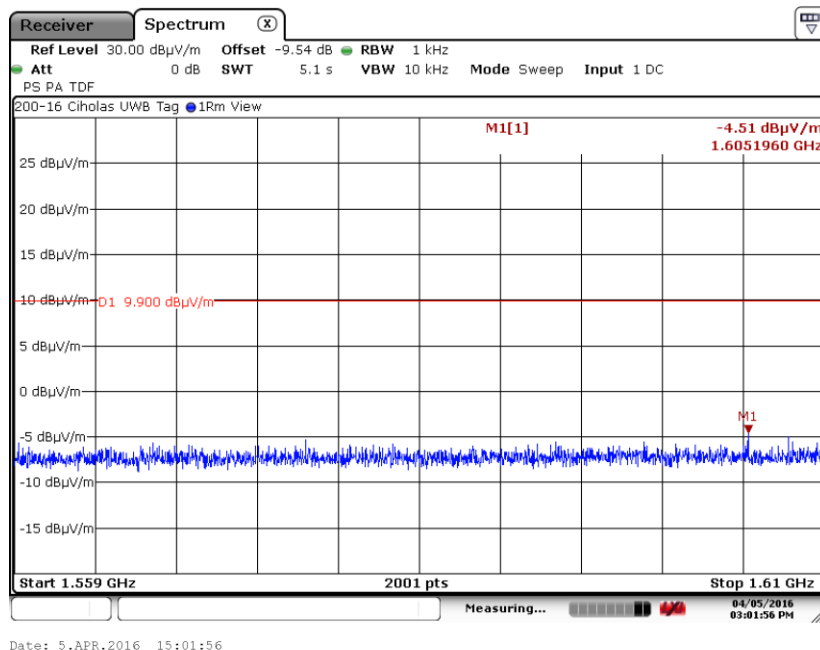
6.4.2.2 Vertical Measurement Polarity 1164 to 1240 MHz



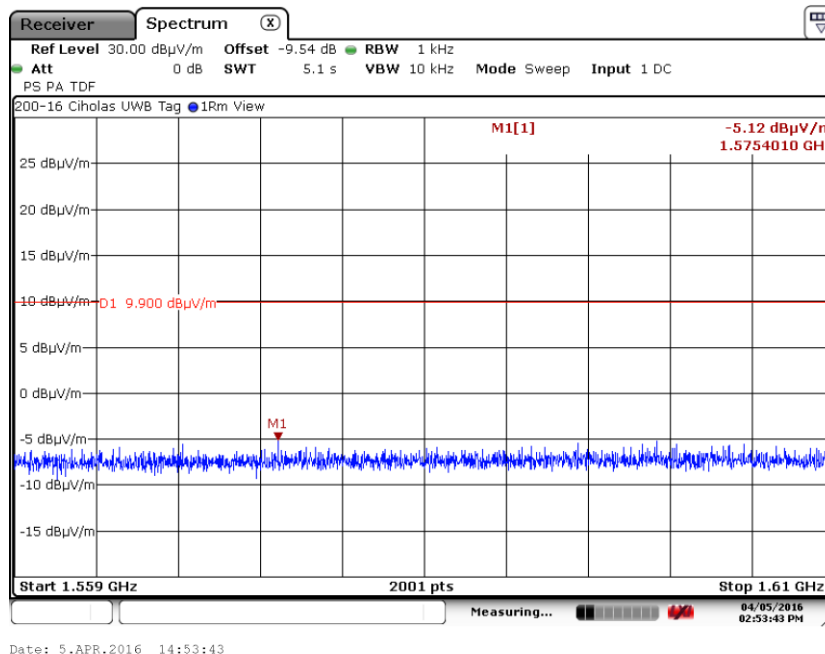
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), 15.209)

6.4.2.3 Horizontal Measurement Polarity 1559 to 1610 MHz



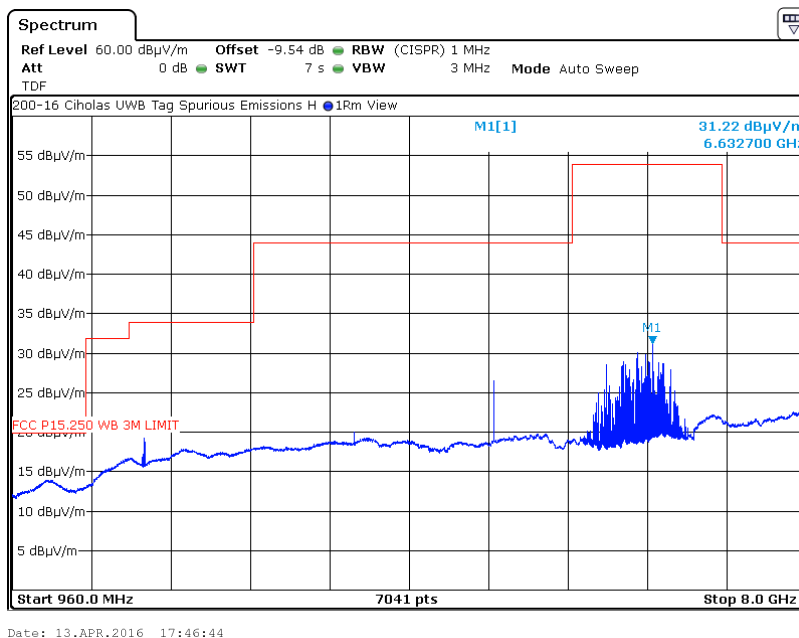
6.4.2.4 Vertical Measurement Polarity 1559 to 1610 MHz



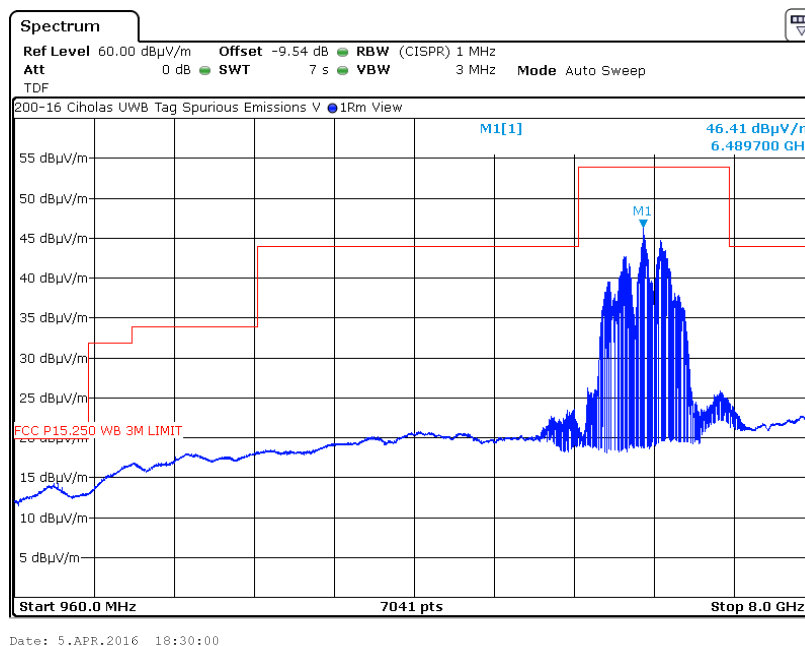
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209)

6.4.3. 960 MHz to 8 GHz Horizontal at 1 Meter



6.4.4. 960 MHz to 8 GHz Vertical at 1 Meter



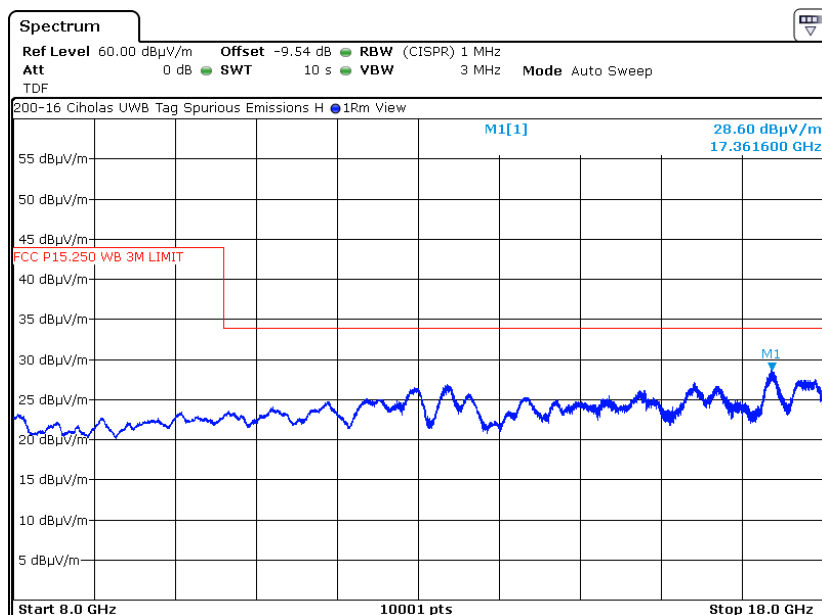
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6. Measurement Data (continued)

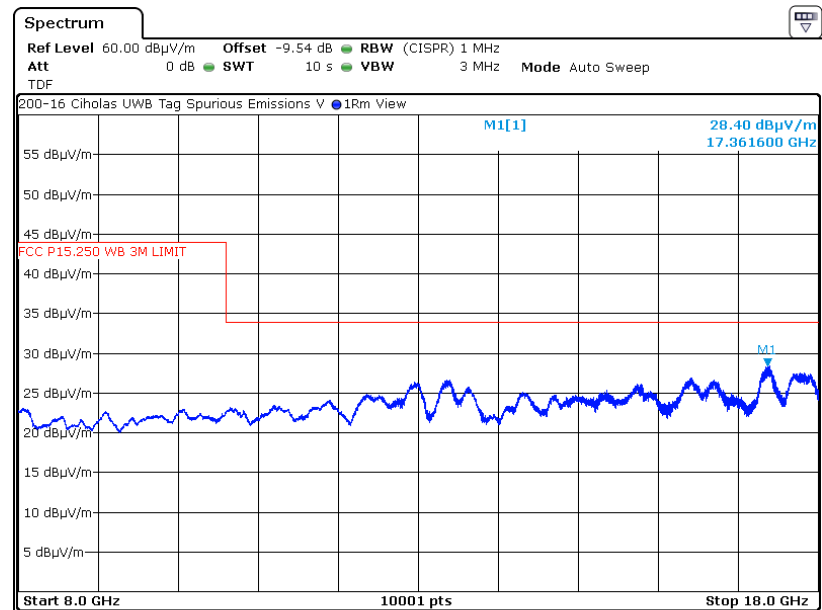
6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209)

6.4.5. 8 to 18 GHz Horizontal at 1 Meter



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6.4.6. 8 to 18 GHz Vertical at 1 Meter



Date: 5.APR.2016 19:00:32

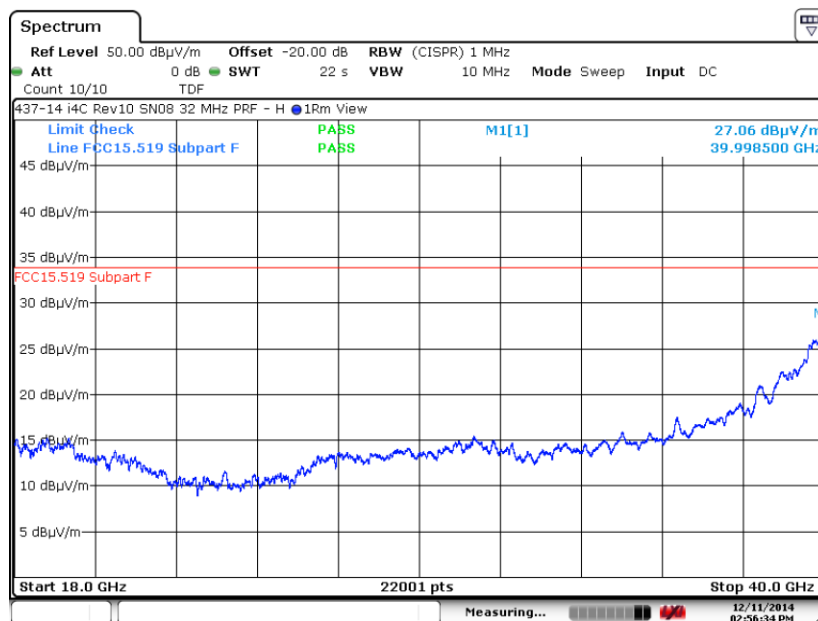
Test Number: 200-16R1

Issue Date: 4/20/2016

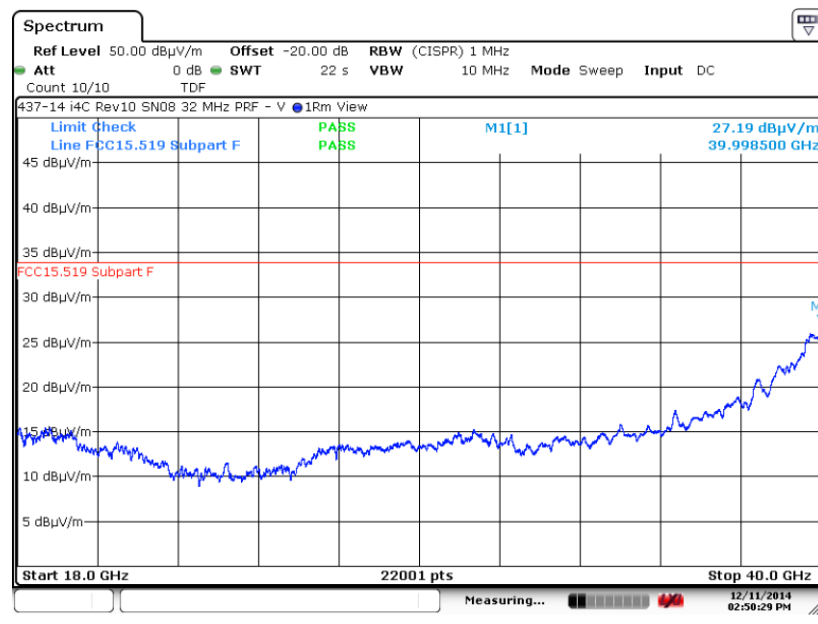
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209)

6.4.7. 18 to 40 GHz Horizontal at 0.3 Meter



6.4.8. 18 to 40 GHz Vertical at 0.3 Meter



Test Number: 200-16R1

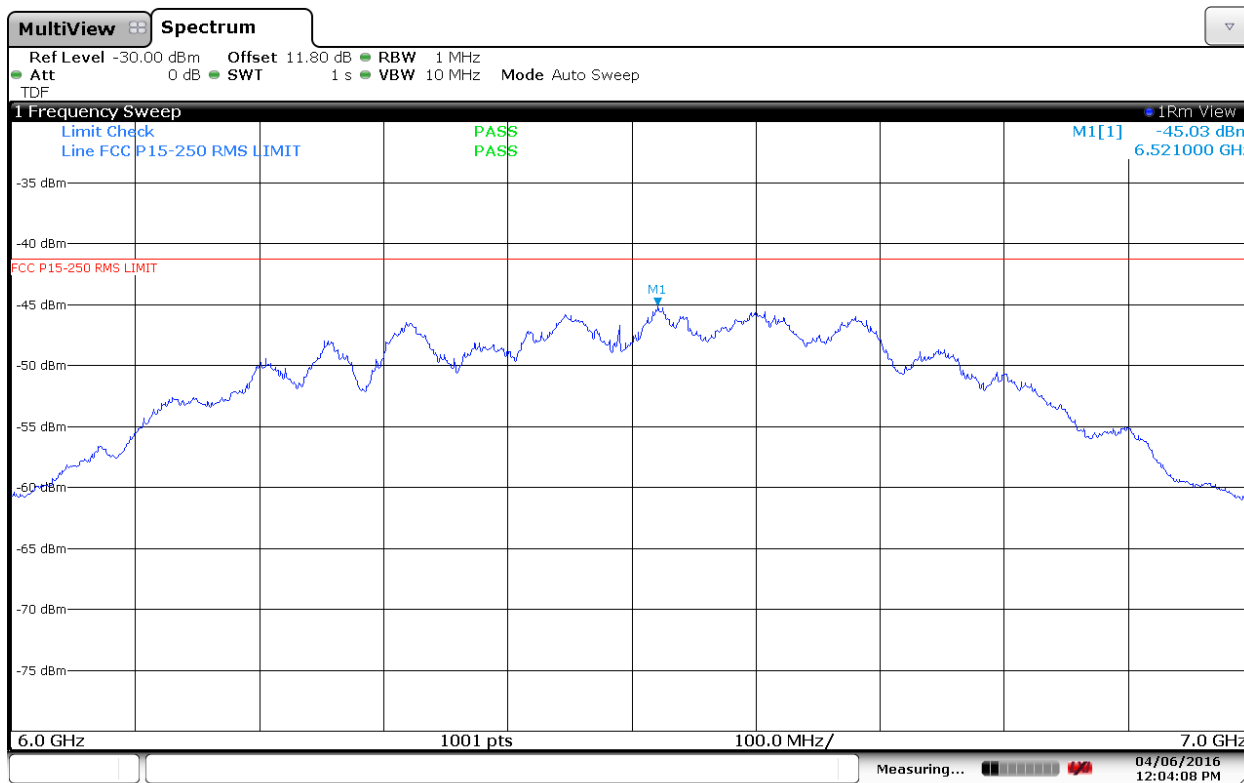
Issue Date: 4/20/2016

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209)

6.4.9. Plot of RMS Power at 3 Meters (Channel 5) Worse case

Highest emission GHz:	6.521
Measured value adjusted for 3 Meter distance in dBm RMS	-45.03
Limit in a 1 MHz RBW RMS	-41.30
Margin dB:	3.73



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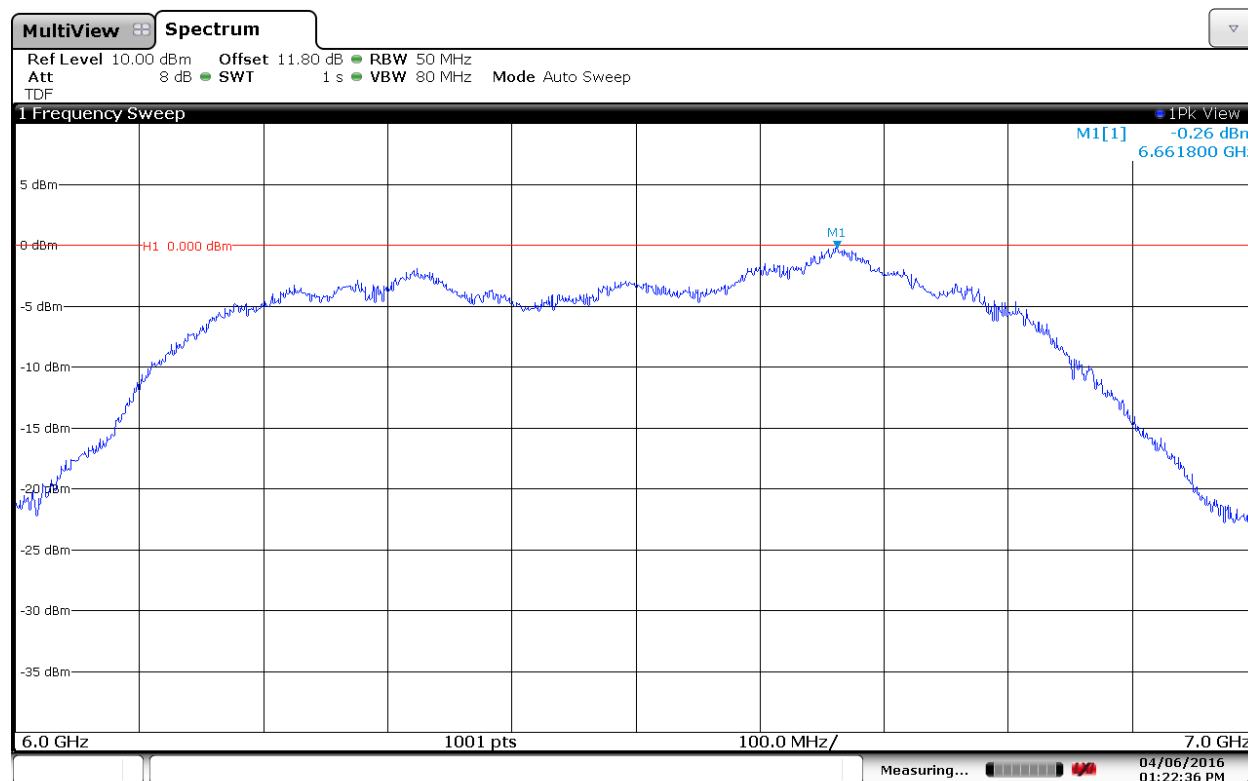
6. Measurement Data (continued)

6.5. Peak Emissions in a 50 MHz Bandwidth (15.250 (d) (3))

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. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521.

Highest emission peak (f_M) GHz:	6.6618
Measured value adjusted for 3 Meter distance in dBm EIRP	-0.26
Margin dB:	0.26

6.5.1 Plot of Peak Power at 3 Meters (Channel 5) Worse case



Date: 6.APR.2016 13:22:36

6. Measurement Data (continued)

6.6 Conducted Emissions Test Setup

6.6.1. Regulatory Limit: FCC Part 15.207

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.

6.6.2 Measurement Equipment and Software Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver	Hewlett Packard	8546A	3330A00115	6/2/2016
RF Filter Section	Hewlett Packard	85460A	3325A00121	6/2/2016
LISN	EMCO	3825/2	9109-1860	7/21/2016
Manufacturer	Software Description		Title/Model #	Rev.
Compliance Worldwide	Test Report Generation Software		Test Report Generator	1.0

6.6.3. Measurement & Equipment Setup

Test Date: 3/14/2016
 Test Engineer: Cody Merry
 Site Temperature (°C): 22
 Relative Humidity (%RH): 35
 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

6.6.4. 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.

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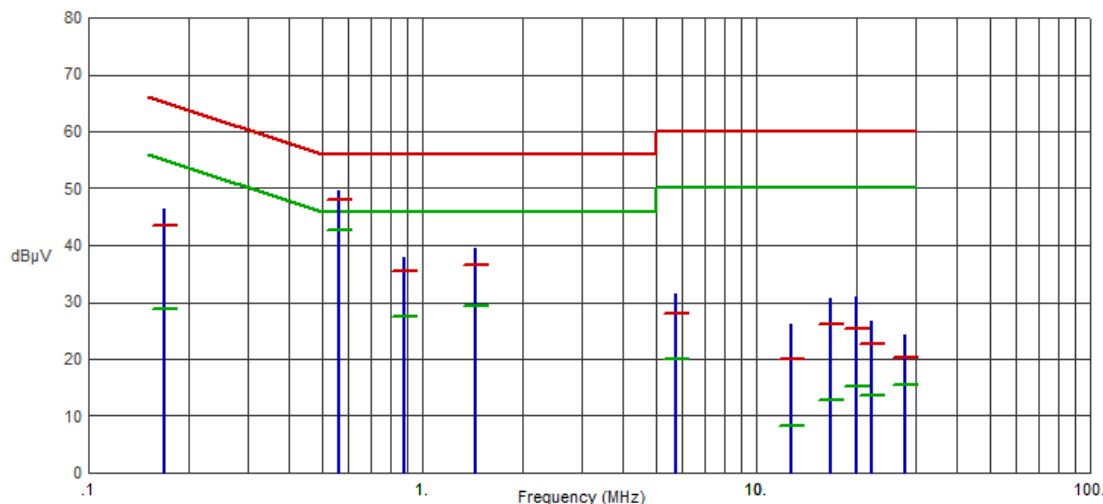
6. Measurement Data (continued)

6.7 Conducted Emissions Test Results

6.7.1 120 Volts, 60 Hz Phase

Test No.: 351-15, 120 Volts, 60 Hz Phase

FCC, Class B



Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
.1694	46.41	43.58	64.99	-21.41	28.86	54.99	-26.13	
.5615	49.73	48.05	56.00	-7.95	42.73	46.00	-3.27	
.8843	37.98	35.34	56.00	-20.66	27.56	46.00	-18.44	
1.4413	39.44	36.59	56.00	-19.41	29.29	46.00	-16.71	
5.7626	31.51	28.03	60.00	-31.97	20.07	50.00	-29.93	
12.7404	26.08	19.93	60.00	-40.07	8.37	50.00	-41.63	
16.7865	30.57	26.07	60.00	-33.93	12.70	50.00	-37.30	
19.9254	30.86	25.40	60.00	-34.60	15.19	50.00	-34.81	
22.1439	26.73	22.60	60.00	-37.40	13.62	50.00	-36.38	
28.0019	24.17	20.21	60.00	-39.79	15.55	50.00	-34.45	

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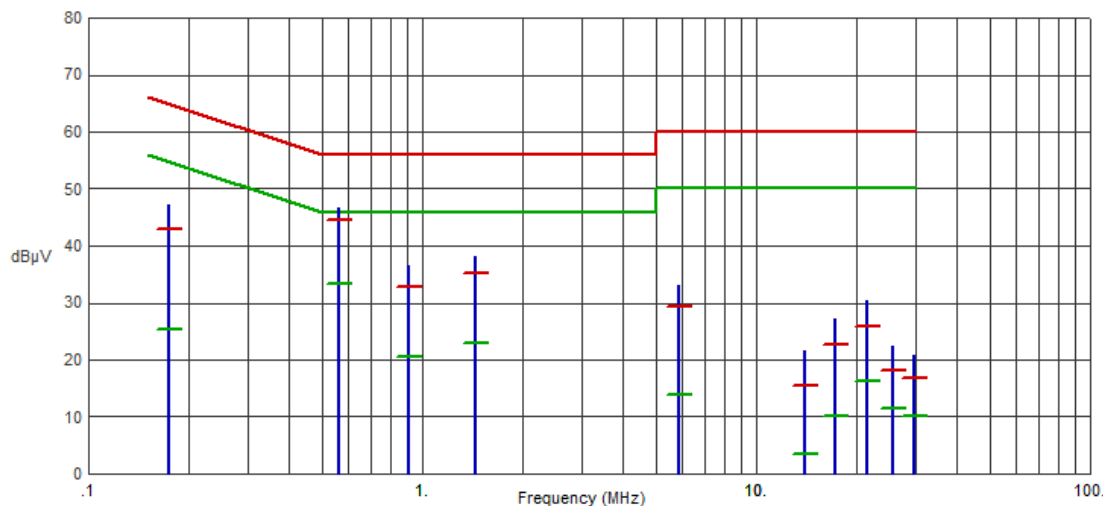
6. Measurement Data (continued)

6.7. Conducted Emissions Test Results (continued)

6.7.2. 120 Volts, 60 Hz Neutral

Test No.: 351-15, 120 Volts, 60 Hz Neutral

FCC, Class B



Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
.1734	47.15	42.88	64.80	-21.92	25.36	54.80	-29.44	
.5632	46.78	44.45	56.00	-11.55	33.45	46.00	-12.55	
.9127	36.47	32.80	56.00	-23.20	20.62	46.00	-25.38	
1.4467	38.26	35.28	56.00	-20.72	22.90	46.00	-23.10	
5.8334	33.15	29.32	60.00	-30.68	13.97	50.00	-36.03	
13.9388	21.72	15.45	60.00	-44.55	3.34	50.00	-46.66	
17.2123	27.28	22.54	60.00	-37.46	10.02	50.00	-39.98	
21.4575	30.33	25.78	60.00	-34.22	16.32	50.00	-33.68	
25.6804	22.50	18.19	60.00	-41.81	11.52	50.00	-38.48	
29.5472	20.68	16.80	60.00	-43.20	10.06	50.00	-39.94	

6. Measurement Data (continued)

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

6.8.1. 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 5			
Input:	P_{MAX}	0.9357	mW
	d_{MIN}	5.00	mm
	$f_{(\text{GHz})}$	6.662	GHz
Test Exclusion:		0.48	
Limit Exemption:		3.00	

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

7. Test Images

7.1. Spurious and Harmonic Emissions – 10 MHz to 1 GHz Front



7. Test Images

7.2. Spurious and Harmonic Emissions – 10 MHz to 30 MHz Rear



7. Test Images

7.3. Spurious and Harmonic Emissions – 30 MHz to 1 GHz Rear



7. Test Images

7.4. Spurious and Harmonic Emissions – 1 to 18 GHz Front



Test Number: 200-16R1

Issue Date: 4/20/2016

7. Test Images

7.5. Spurious and Harmonic Emissions – 1 to 18 GHz Rear



Test Number: 200-16R1

Issue Date: 4/20/2016

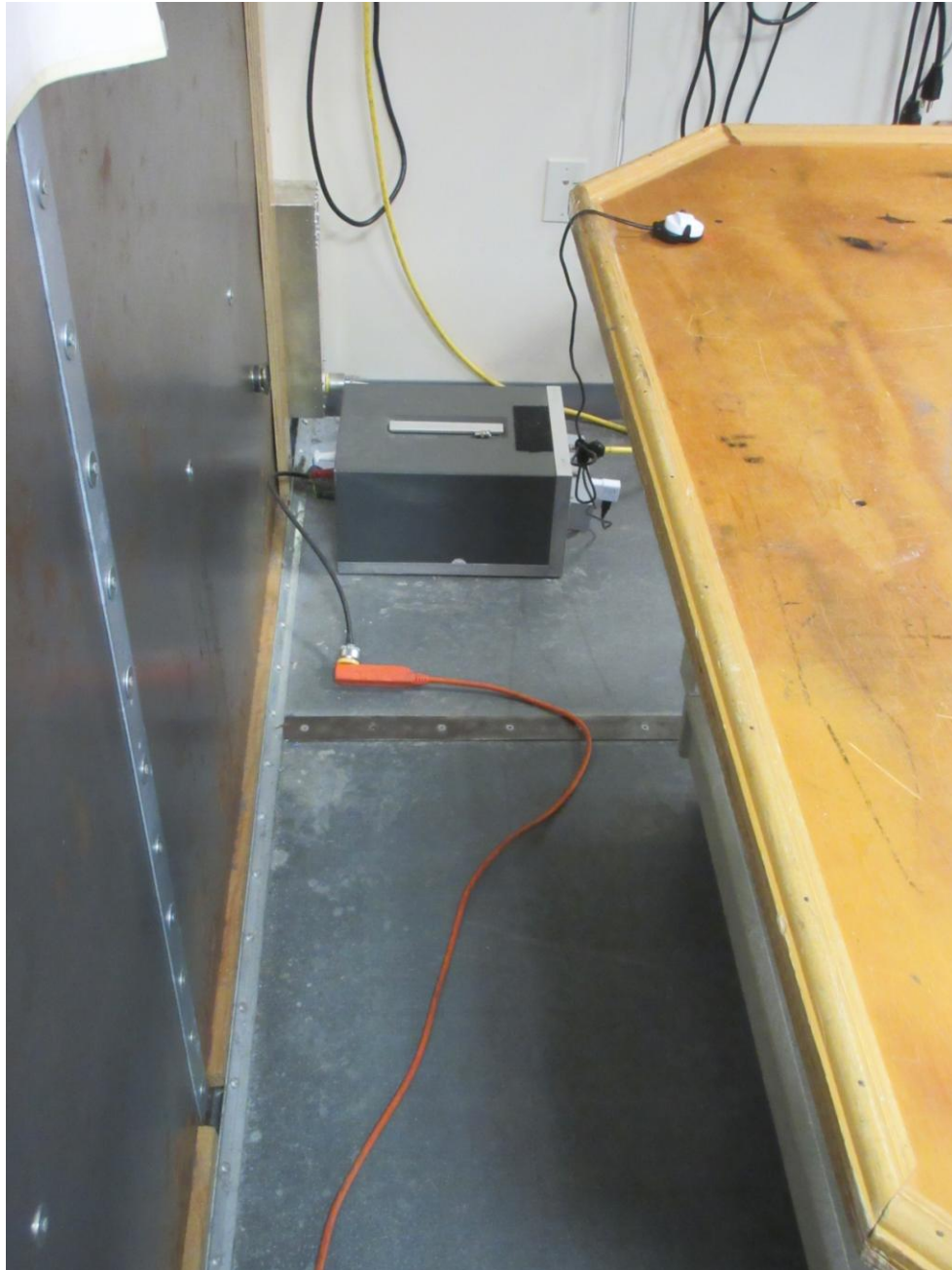
7. Test Images

7.6. Conducted Emissions (Front)



7. Test Images

7.7. Conducted Emissions (Rear)



7. Test Images

7.8. Frequency Stability (Setup)



8. 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 Federal Communications Commission (FCC) and Industry Canada standards. A description of the test sites is on file with the FCC (registration number **96392**) and Industry Canada (file number **IC 3023A-1**).

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.

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