

**COMPLIANCE WORLDWIDE INC.
TEST REPORT 367-18**

**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**

**ISED RSS-220, Issue 1 (March 2009) + Amendment 1 (July 2018)
Devices Using Ultra-Wideband (UWB) Technology**

Issued to

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

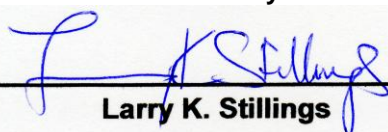
For the

**IsoLynx II UWB Tracking Tag
Model: IL0401**

FCC ID: 2AHCQ-IL0401

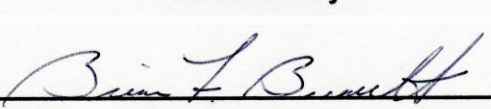
Report Issued on August 19, 2019

Tested By

A blue ink signature of Larry K. Stillings, written over a horizontal line.

Larry K. Stillings

Reviewed By

A blue ink signature of Brian F. Breault, written over a horizontal line.

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. Cables	3
3.3. EUT Hardware	4
3.4. Support Equipment	4
3.5. Test Setup.....	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	8
6.3. UWB Bandwidth.....	9
6.4. Spurious Radiated Emissions	11
6.5. Radiated Emissions in GPS Bands.....	29
6.6. RMS Power in a 1 MHz Bandwidth.....	34
6.7. Peak Emissions in a 50 MHz Bandwidth	37
6.8. Conducted Emissions Test Setup.....	40
6.9. Conducted Emissions Test Results	41
6.10. 99% Emissions Bandwidth.....	43
6.11. Public Exposure to Radio Frequency Energy Levels.....	45
7. Test Site Description	48
8. Test Images	49
8.1. Spurious and Harmonic Emissions - 10 kHz to 1 GHz Front.....	49
8.2. Spurious and Harmonic Emissions - 10 kHz to 30 MHz Rear	50
8.3. Spurious and Harmonic Emissions - 30 MHz to 1 GHz Rear	51
8.4. Spurious and Harmonic Emissions - 1 to 18 GHz Front.....	52
8.5. Spurious and Harmonic Emissions - 1 to 18 GHz Rear.....	53
8.6. Spurious and Harmonic Emissions - 18 to 40 GHz Side	54
8.7. Frequency Stability Setup	55
8.8. Frequency Stability Setup	56
8.9. Conducted Emissions Setup (Front)	57
8.10. Conducted Emissions Setup (Rear).....	58

1. Scope

This test report certifies that the IsoLynx II UWB Tracking Tag, IL0401 as tested, meets the FCC Part 15.250, Subpart C and ISSED 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.

2. Product Details

- 2.1. Manufacturer:** IsoLynx
- 2.2. Model Number:** IL0401
- 2.3. Serial Numbers:** 02050420, 02050447
- 2.4. Description:** The IsoLynx Tracking Tag(IL0401) is a small, battery-powered RFID device that produces ultra-wideband pulses that are used to generate real-time location and movement data. IsoLynx tags are fixed to athletes, equipment, and other objects of interest and transmit UWB "pings" to reference nodes placed around the venue.
- 2.5. Power Source:** DC 3.7 Volts
- 2.6. Hardware Revision:** 2.1.1
- 2.7. Software Revision:** N/A
- 2.8. Modulation Type:** Pulse Modulation, Frequency Hopping
- 2.9. Operating Frequency:** 6.49 GHz Center Frequency Nominal (Channel 5 – 500 MHz BW)
- 2.10. EMC Modifications:** None

3. Product Configuration

3.1 Operational Characteristics & Software

Hardware Setup:

Connect a USB dongle to the laptop. Using a special software application, configure packet size, and PRFs for the EUT. The IL0401 was tested in a total of two modes consisting of 80 byte packets, and 16M and 64M PRFs at a 6.8 Mbps data rate

During the measurement testing, the product was mounted on a polystyrene form to facilitate rotating the product 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 Charge contacts on the rear lower left. Unit is vertical. Interface contacts face antenna at 0°.
- Y Axis Charge contacts on the rear lower right. Unit is vertical. Interface contacts face antenna at 0°.
- Z Axis Interface contacts face up. Charge and interface contacts closest to antenna at 0°.

3.2. Cables

Cable Type	Length	Shield	From	To
None				

3. Product Configuration (cont.)

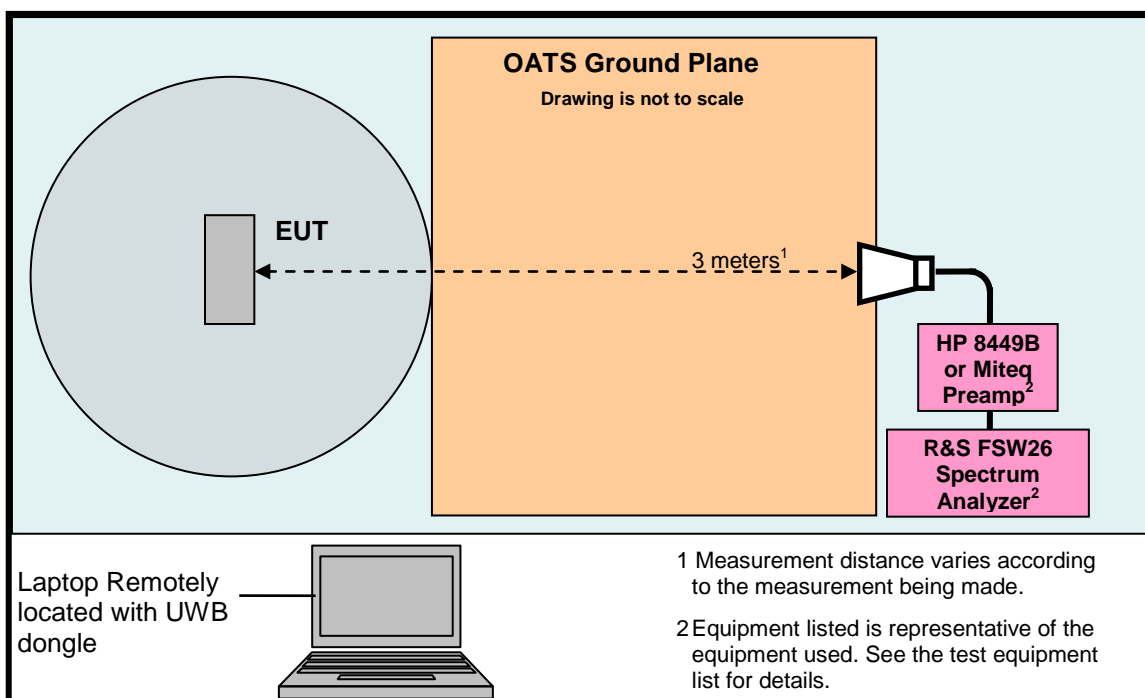
3.3. EUT Hardware

Manufacturer	Model/Part # / Options	Serial Numbers	Input Volts	Freq (Hz)	Description/Function
IsoLynx	IL0401	02050420, 02050447	3.7	DC	UWB Tracking Tag

3.4. Support Equipment

Manufacturer	Model/Part #	Serial Number	Description
Lenovo	ThinkPad T440p	PB-031DX9	Laptop for configuration
Ciholas	DWUWB-SMA	01:00:06C8	Wireless dongle for configuration
Anker	71AN10W		5VDC, 2A charger

3.5. Test Setup Diagram



Test Number: 367-18

Issue Date: 8/19/2019

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	9/10/2020	2 Years
Spectrum Analyzer 9 kHz to 40 GHz	Rohde & Schwarz	FSV40	100899	9/10/2020	2 Years
Spectrum Analyzer 10 Hz to 40 GHz	Rohde & Schwarz	FSVR40	100909	5/3/2020	3 Years
Spectrum Analyzer 3 Hz to 26.5 GHz	Rohde & Schwarz	FSW26	102044	9/13/2020	2 Years
Bilog Antenna 30 to 2000 MHz	Sunol Sciences	JB1	A050913	6/3/2021	2 Years
Loop Antenna 9 kHz to 30 MHz	EMCO	6512	9309-1139	10/26/2019	3 Years
Preamplifier 100 MHz to 7 GHz	Miteq	AFS3-00100200-10-15P-4	988773	4/17/2020	2 Years
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	4/16/2020	2 Years
Preamplifier 2 to 12 GHz	JCA	JCA48-4111B1	7087S	4/17/2020	2 Years
Preamplifier 1 to 26.5 GHz	Hewlett Packard	8449B	3008A01323	9/11/2020	2 Years
Preamplifier 18 to 40 GHz	Miteq	JSD42-21004200-40-5P	649199/649219	11/1/2019	1 Year
Horn Antenna 1 to 18 GHz	ETS-Lindgren	3117	00143292	3/21/2022	3 Years
Horn Antenna 18-40 GHz	Com Power	AH-840	101032	10/9/2020	2 Years
High Pass Filter 8 to 18 GHz	Micro-Tronics	HPM50107	G036	7/20/2020	1 Year
2.4 GHz Band Pass Filter	Micro-Tronics	BRM50702	150	1/23/2020	1 Year
Barometer	Control Company	4195	Cal ID# 236	4/3/2020	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.

4. Measurements Parameters (continued)

4.2. Measurement & Equipment Setup

Test Dates:	5/9/2019, 7/19/2019, 8/16/2019, 8/19/2019
Test Engineers:	Brian Breault, 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 – 10 kHz to 150 kHz 9 kHz – 10 to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth:	300 Hz – 10 kHz to 150 kHz 30 kHz – 10 to 30 MHz 300 kHz - 30 MHz to 1 GHz 3 MHz - Above 1 GHz
Detector Function:	Peak, Quasi-Peak, RMS & CISPR Average

4.3. Measurement Procedure

Test measurements were made in accordance FCC Parts 15.209, 15.250 Subpart C and ISSED RSS-220, Issue 1 & A1.

The test methods used to generate the data is 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	ISED Rule Requirement	Test Report Section	Result	Comment
Antenna Requirement	15.203	RSS-220 5.1 (b)	6.1	Compliant	The antenna is an etched PCB antenna
Operational Requirements	15.250 (a)	RSS-220	6.2	Compliant	
Wideband Bandwidth	15.250 (b)	RSS-220 2 RSS-220 5.1	6.3	Compliant	
Spurious Radiated Emissions	15.250 (d) (1) 15.209	RSS-220 3.4	6.4	Compliant	
Radiated Emissions in GPS Bands	15.250 (d) (2)	RSS-220 5.3.1 (e)	6.5	Compliant	
RMS Power in a 1 MHz Bandwidth	15.250 (d) (1)	RSS-220 5.3.1 (d)	6.6	Compliant	
Peak Emissions in a 50 MHz Bandwidth	15.250 (d) (3)	RSS-220 5.3.1 (g)	6.7	Compliant	
Conducted Emissions	15.207	RSS-GEN	6.8	Compliant	
99% Emission Bandwidth	N/A	RSS-GEN 6.7	6.9	Compliant	
Radio Frequency Exposure	FCC OET Bulletin 65 1.1307 (b) (1)	RSS-102, Issue 5	6.10	Compliant	

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: Three different antennas are utilized by the device under test and use an on board u.fl connector to connect to the antennas.

6.2. Operational Requirements of the Device under Test (15.250 (a), RSS-220)

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	Measured Frequency	-10 dB Band Edges		15.250 Frequency Band		Result
		(MHz)	Lower	Upper	F _{MIN} (MHz)	F _{MAX} (MHz)	
-	OATS		6294.2	6776.7	5925	7250	Compliant
-	Ambient	6540.5	6237.3	6843.7	5925	7250	Compliant
1	-20				5925	7250	Compliant
2	-10				5925	7250	Compliant
3	0	6586.4	6261.2	6911.6	5925	7250	Compliant
4	+10	6586.4	6270.2	6902.6	5925	7250	Compliant
5	+20	6591.4	6283.2	6899.6	5925	7250	Compliant
6	+30	6589.4	6281.2	6897.6	5925	7250	Compliant
7	+40	6574.4	6251.2	6897.6	5925	7250	Compliant
8	+50	6566.9	6279.2	6854.6	5925	7250	Compliant

Note: EUT stops transmitting below -7°C

6. Measurement Data (continued)

6.3. Wideband Bandwidth (15.250 (b), RSS-220 2, 5.1)

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

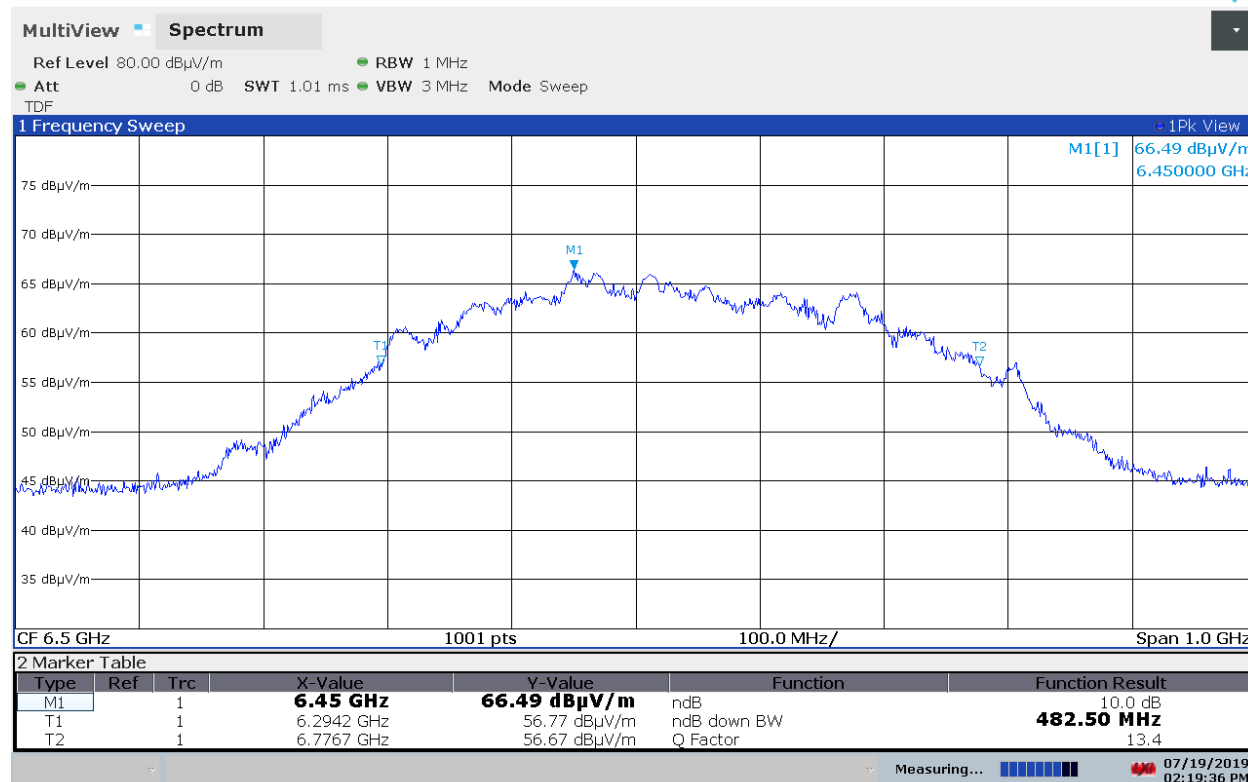
Result: Compliant

6.3.1. Measurement Data – Values in GHz

f_M	The highest emission peak	6.4500
f_L	10 dB below the highest peak	6.2942
f_H	10 dB above the highest peak	6.7767
Bandwidth	Calculated: $(f_H - f_L)$	0.4825

6.3.2. Measurement Plot of 10 dB frequencies (16M PRF)

367-18 IsoLynx Tag 2.1



02:19:36 PM 07/19/2019

6. Measurement Data (continued)

6.3. Wideband Bandwidth (15.250 (b), RSS-220 2, 5.1 continued)

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

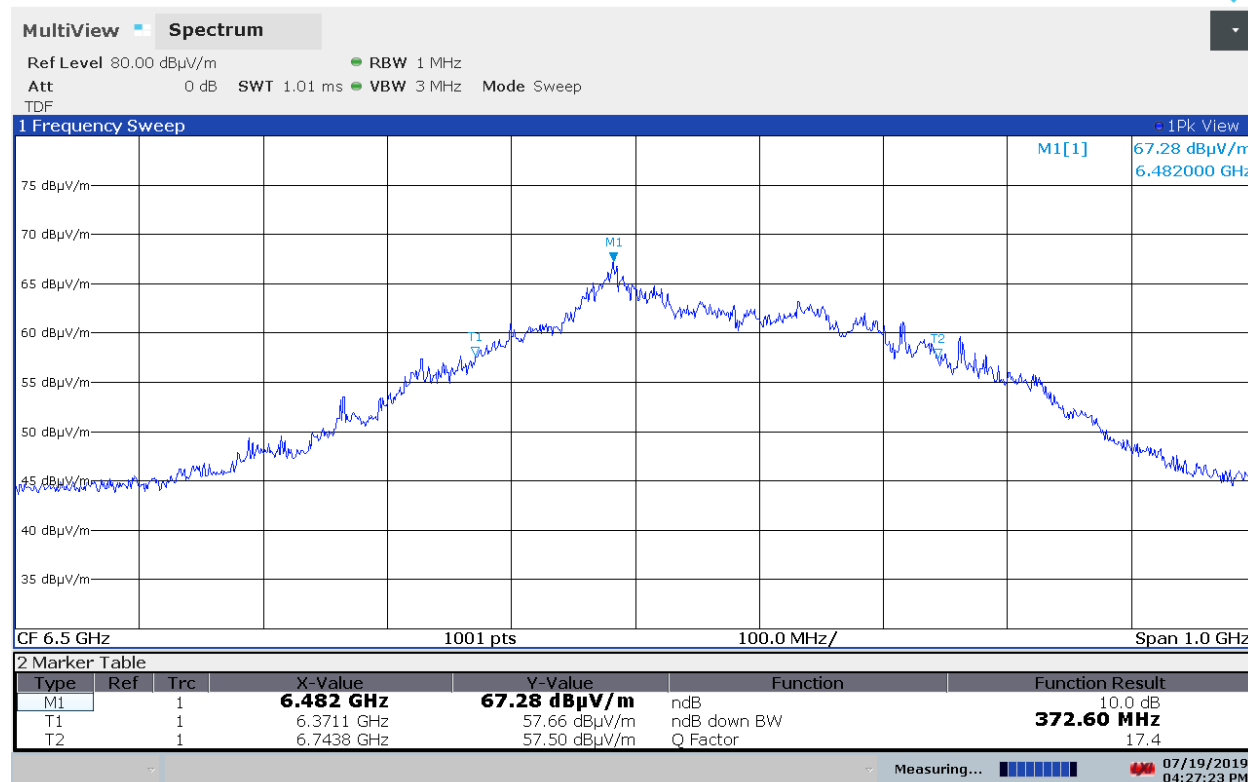
Result: Compliant

6.3.3. Measurement Data – Values in GHz

f_M	The highest emission peak	6.4820
f_L	10 dB below the highest peak	6.3711
f_H	10 dB above the highest peak	6.7438
Bandwidth	Calculated: $(f_H - f_L)$	0.3726

6.3.4. Measurement Plot of 10 dB frequencies (64M PRF)

367-18 IsoLynx Tag 2.1



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6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 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. 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 (RSS-220 5.3.1 (d))

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:

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dBμV/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

6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), 15.209, RSS-220 3.4 continued)

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

Frequency (MHz)	Field Strength (μV/m)	Field Strength (dBμV/m)
0.009 to 0.490	2,400/F	128.5 to 93.8
0.490 to 1.705	24,000/F	73.8 to 63
1.705 - 30	30	69.5
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
960 - 40,000	500	54

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

Frequency Range:	30 kHz to 40 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	200 Hz – 10 kHz to 150 kHz 9 kHz – 150 kHz to 30 MHz 120 kHz - 30 MHz to 1 GHz 1 MHz - Above 1 GHz
EMI Receiver Avg Bandwidth (minimum):	300 Hz – 10 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

Test Number: 367-18

Issue Date: 8/19/2019

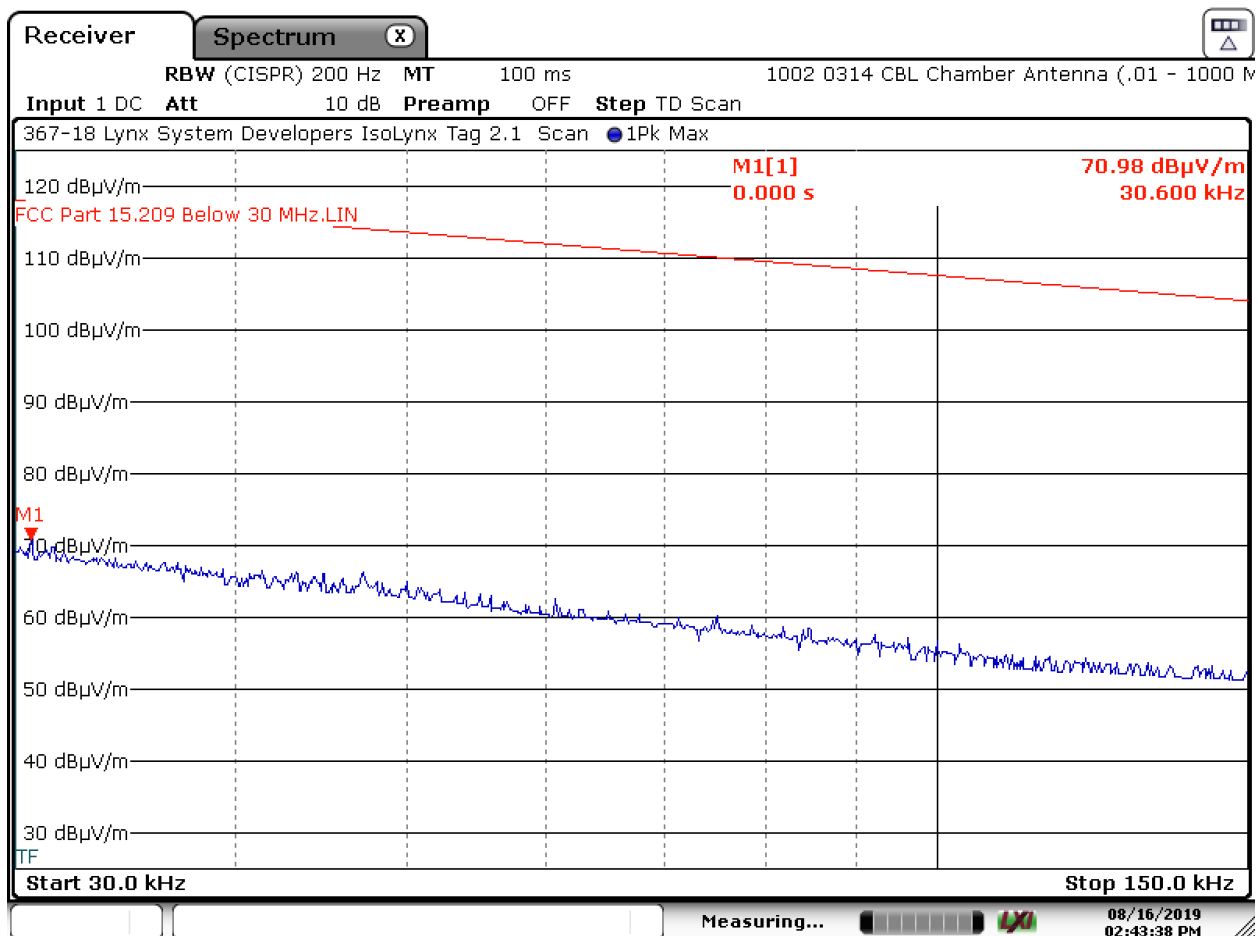
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (16M PRF)



Date: 16.AUG.2019 14:43:38

Test Number: 367-18

Issue Date: 8/19/2019

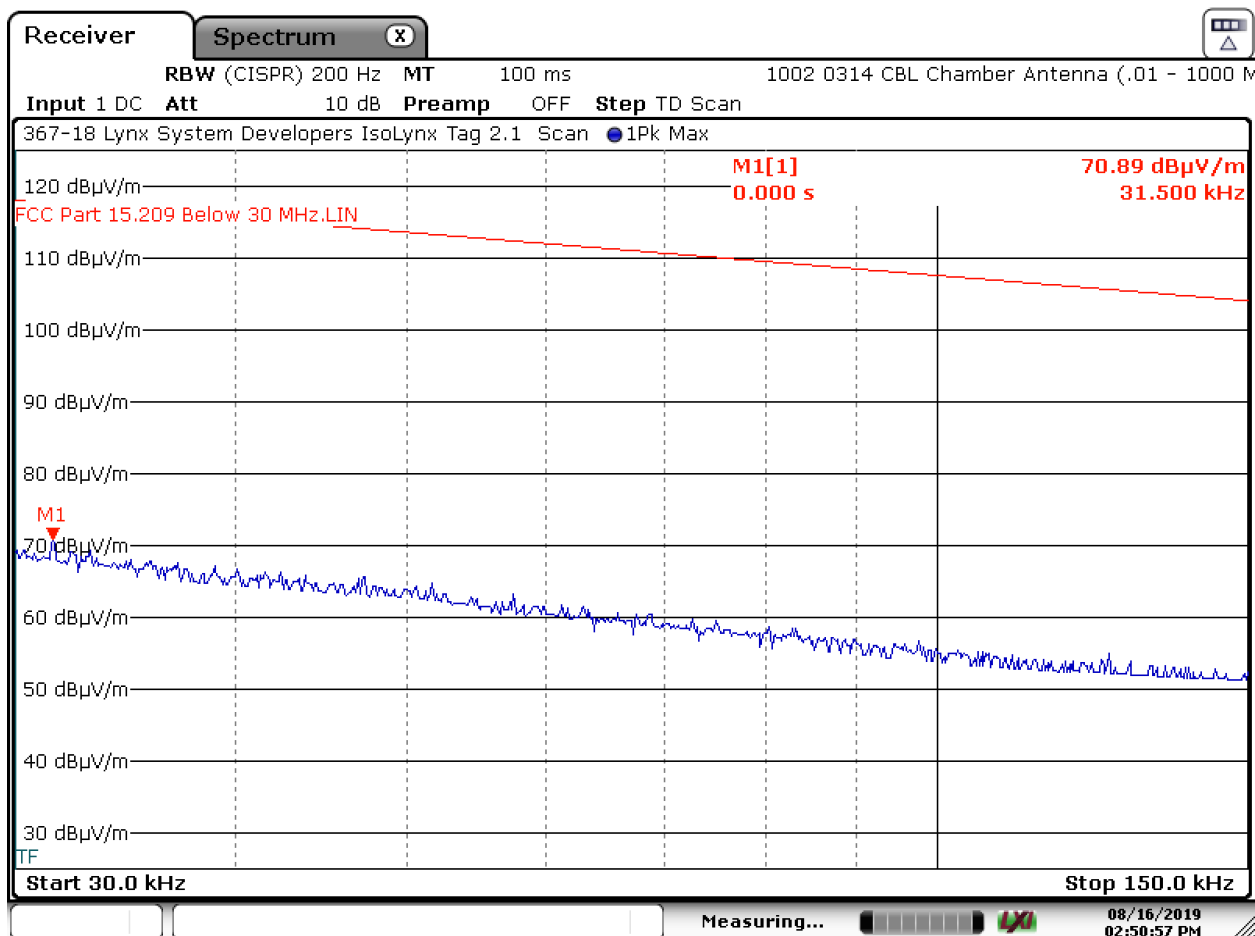
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (16M PRF)



Date: 16.AUG.2019 14:50:56

Test Number: 367-18

Issue Date: 8/19/2019

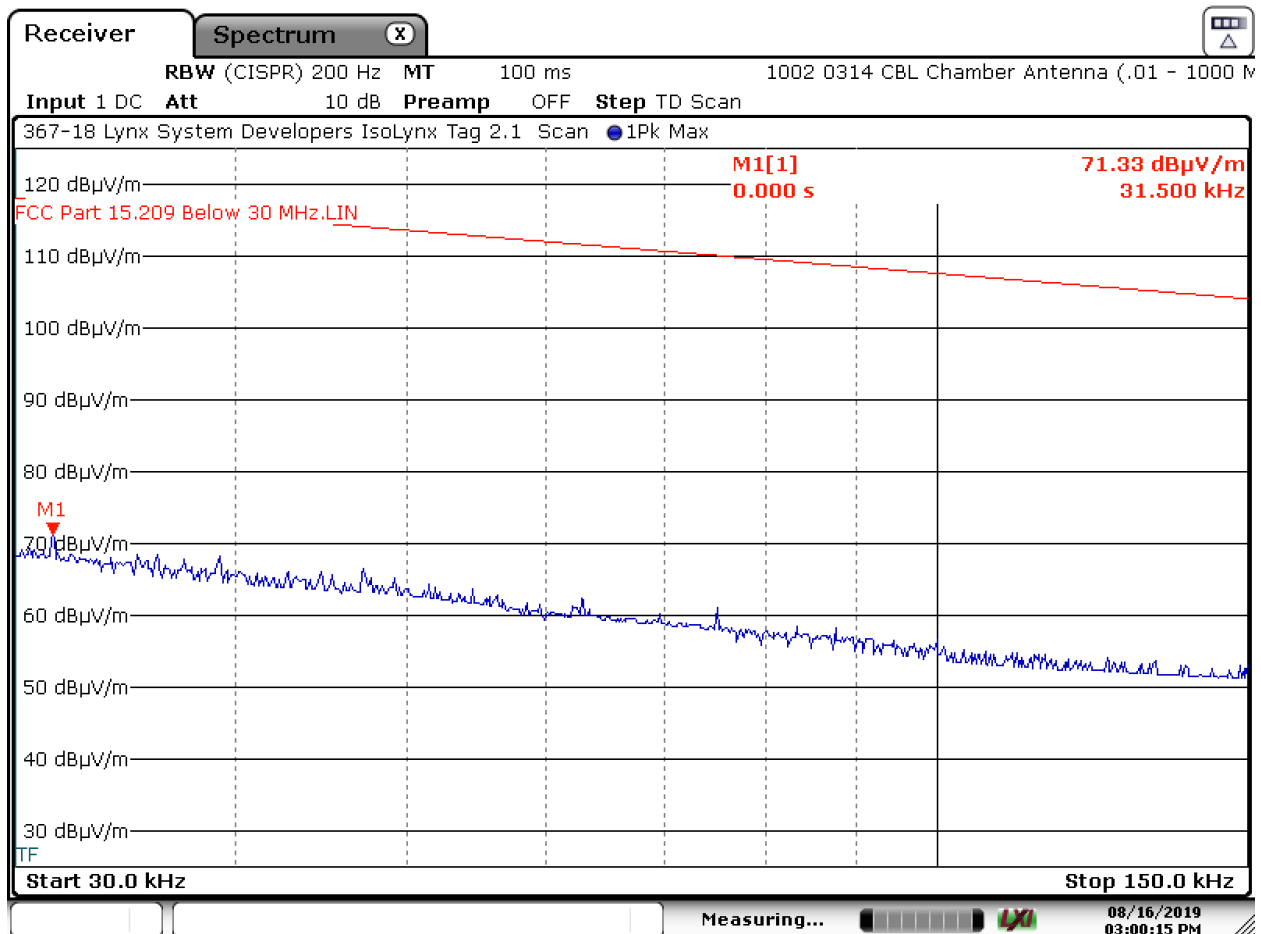
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (16M PRF)



Date: 16.AUG.2019 15:00:13

Test Number: 367-18

Issue Date: 8/19/2019

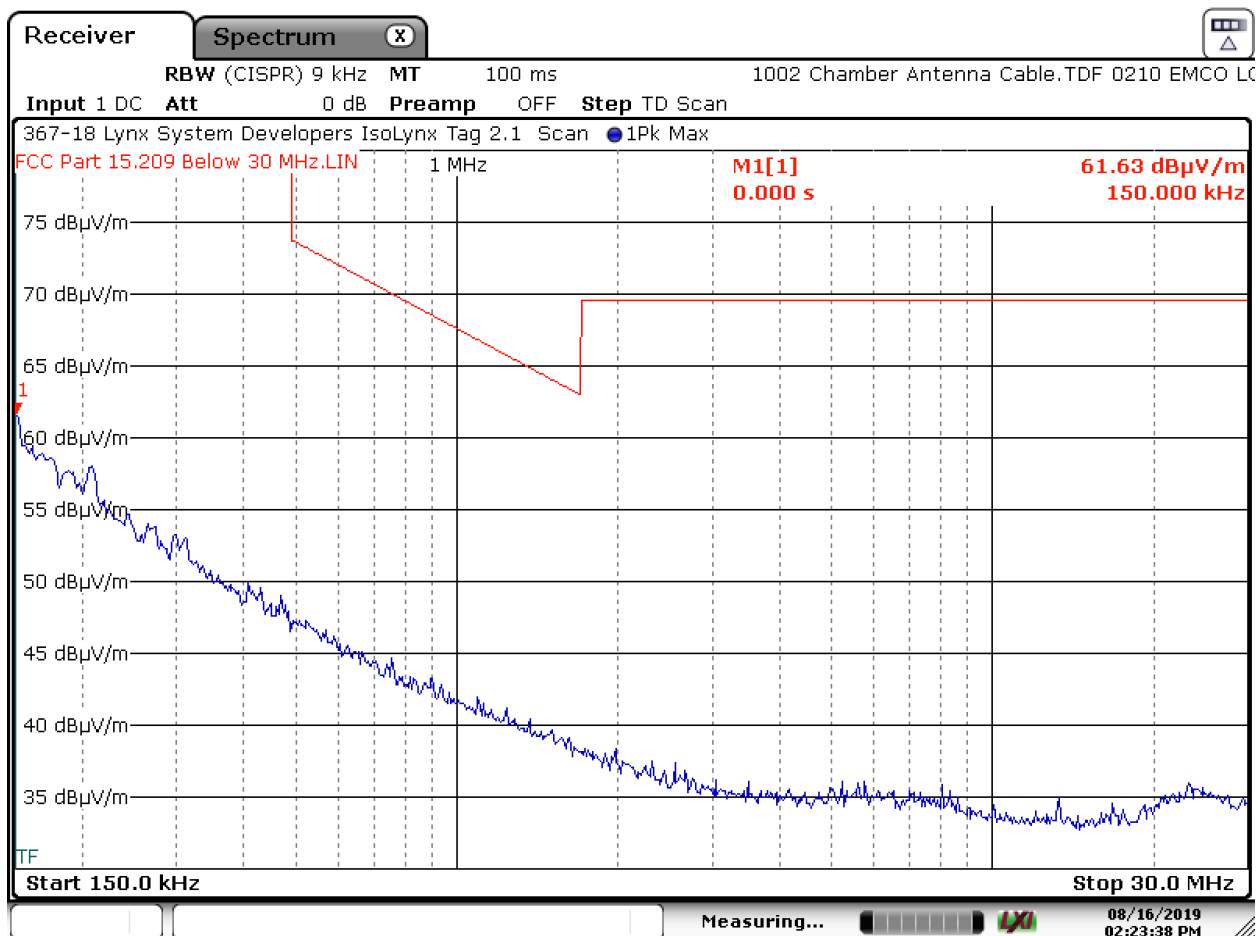
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (16M PRF)



Date: 16.AUG.2019 14:23:36

Test Number: 367-18

Issue Date: 8/19/2019

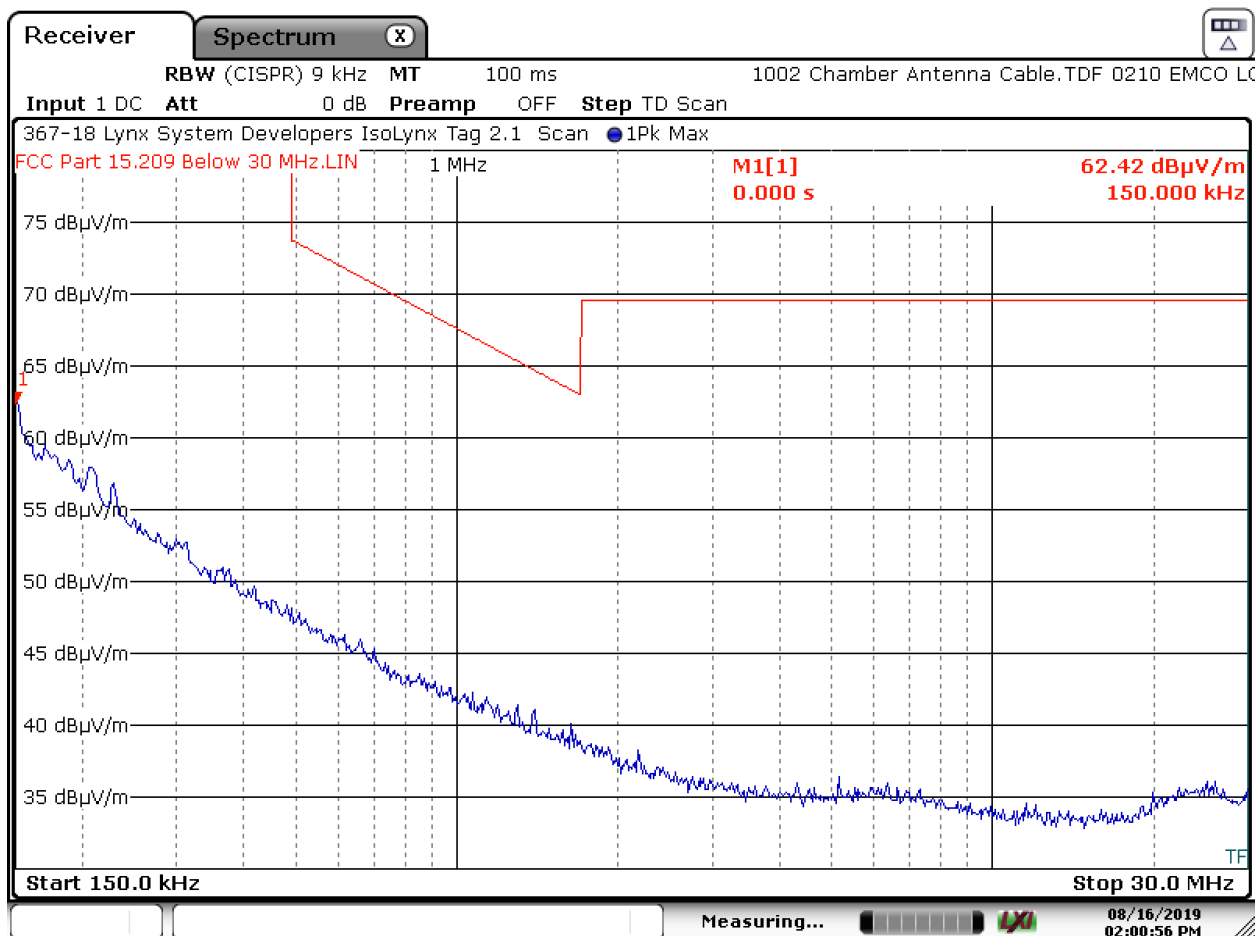
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (64M PRF)



Date: 16.AUG.2019 14:00:54

Test Number: 367-18

Issue Date: 8/19/2019

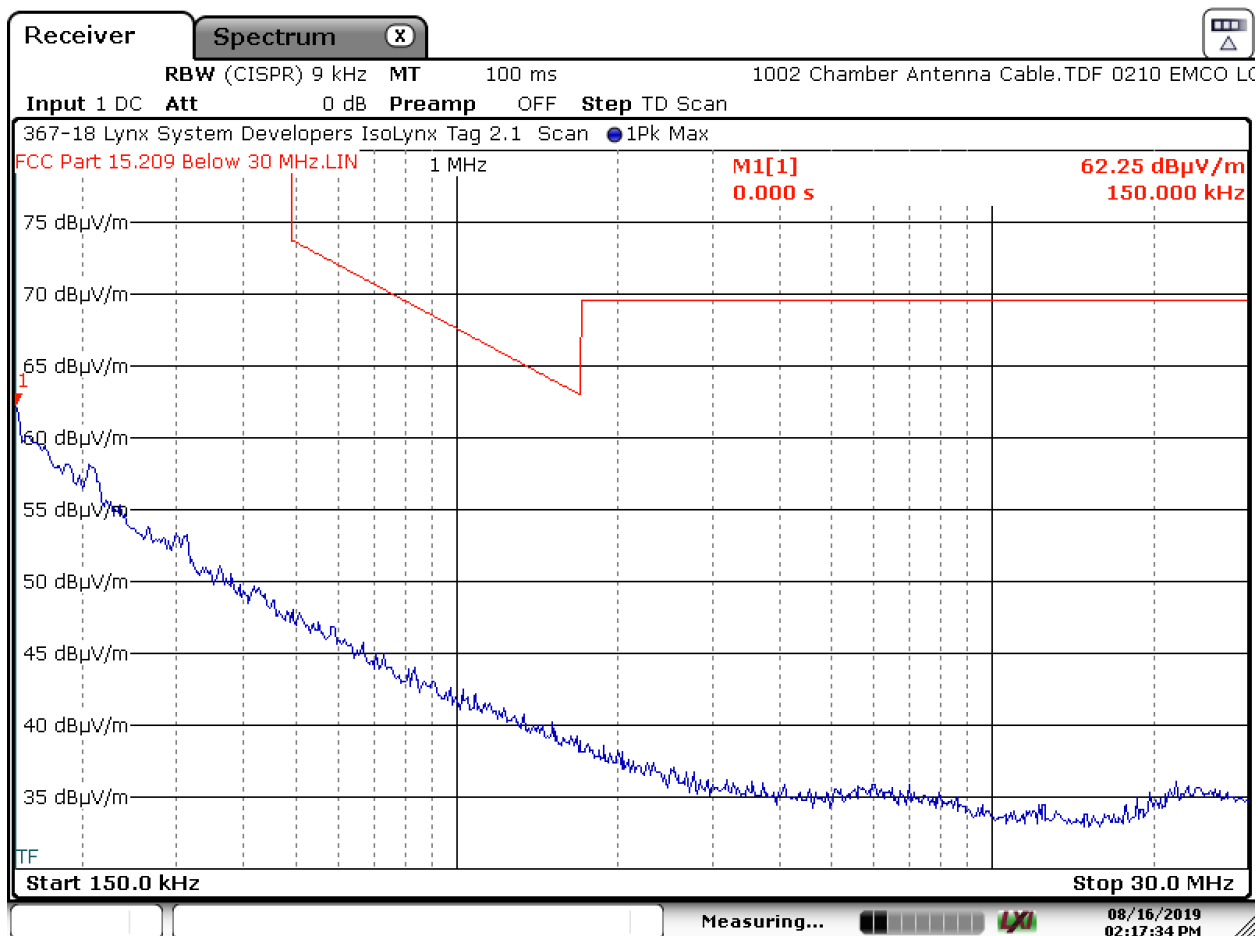
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (16M PRF)



Date: 16.AUG.2019 14:17:32

Test Number: 367-18

Issue Date: 8/19/2019

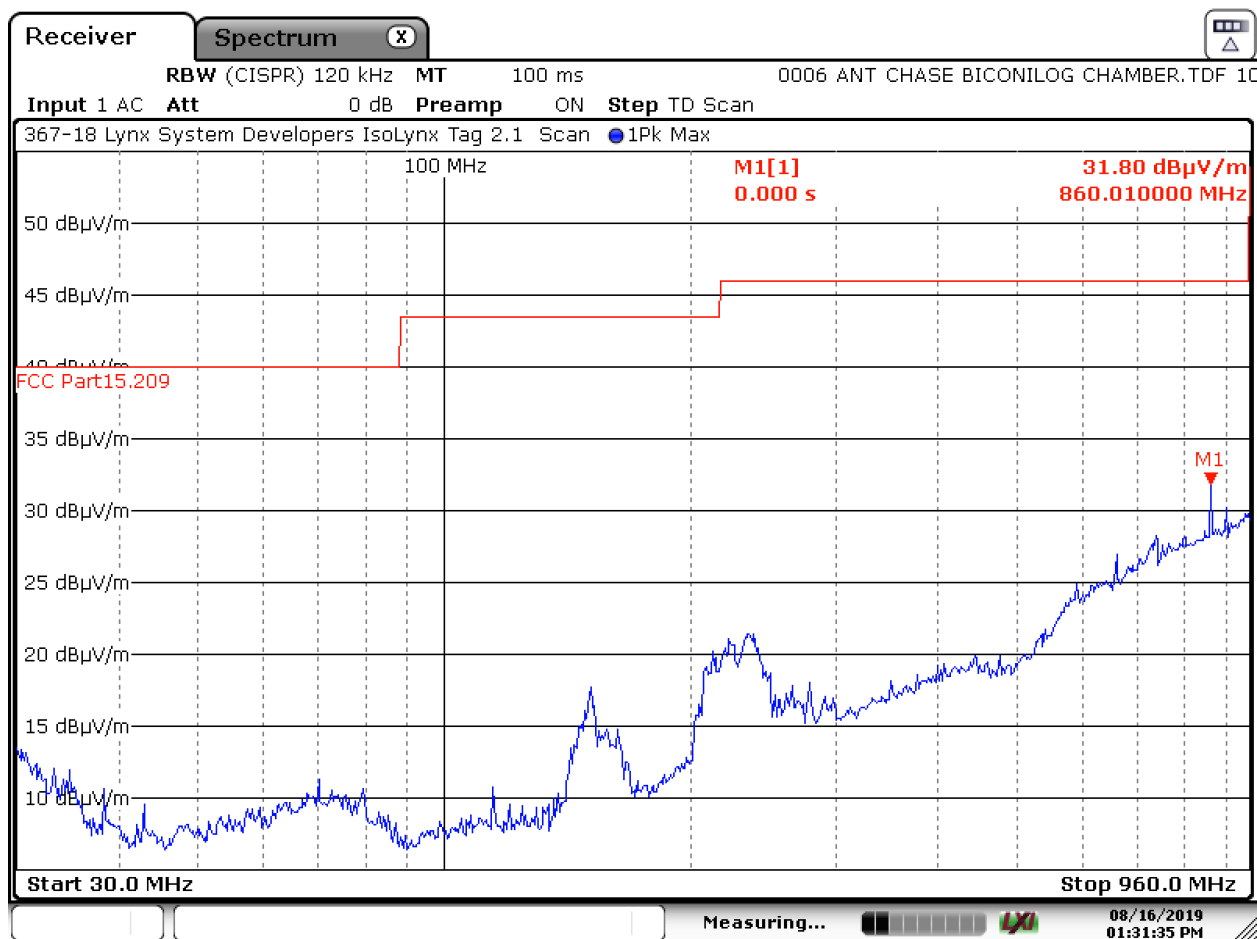
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no emissions within 6 dB of the limits below 960 MHz on our 3 Meter OATS.

6.4.1.7 Horizontal Polarity – 30 to 960 MHz (16M PRF)



Date: 16.AUG.2019 13:31:35

Test Number: 367-18

Issue Date: 8/19/2019

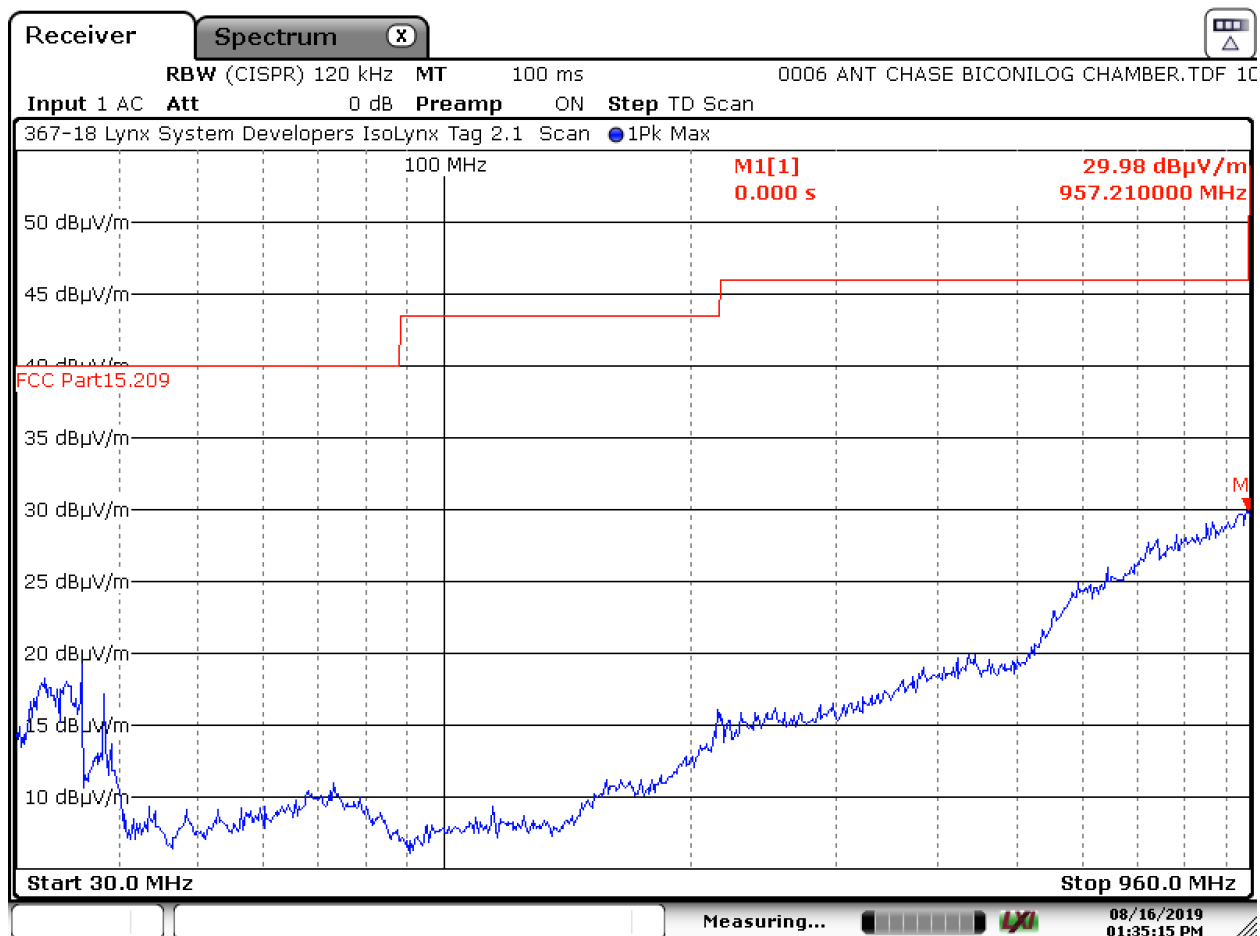
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (16M PRF)



Date: 16.AUG.2019 13:35:14

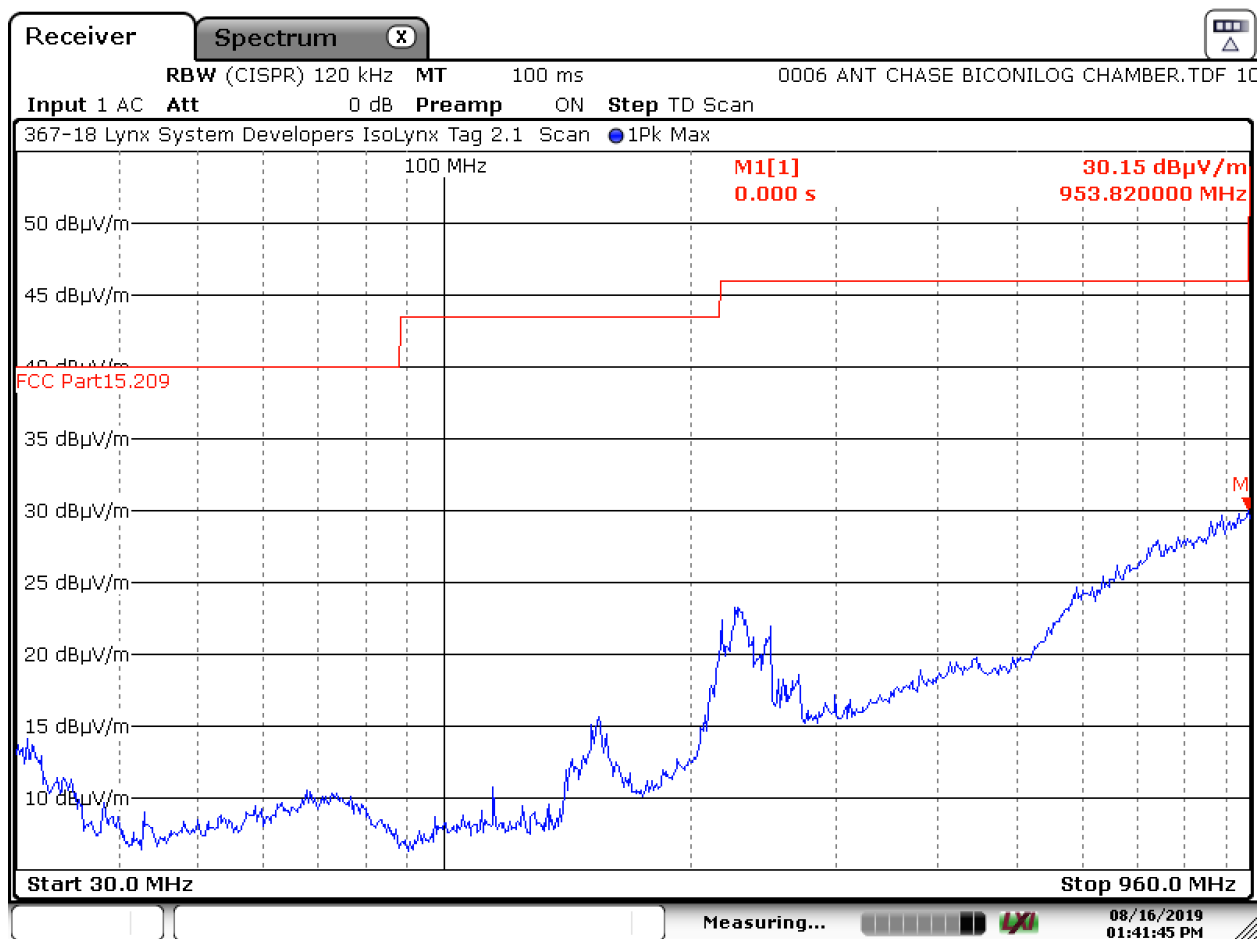
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 kHz to 960 MHz, measured at 3 Meters

The device was prescreened in our 3 Meter Semi-Anechoic Chamber. There were no emissions within 6 dB of the limits below 960 MHz on our 3 Meter OATS.

6.4.1.9 Horizontal Polarity – 30 to 960 MHz (64M PRF)



Date: 16.AUG.2019 13:41:44

Test Number: 367-18

Issue Date: 8/19/2019

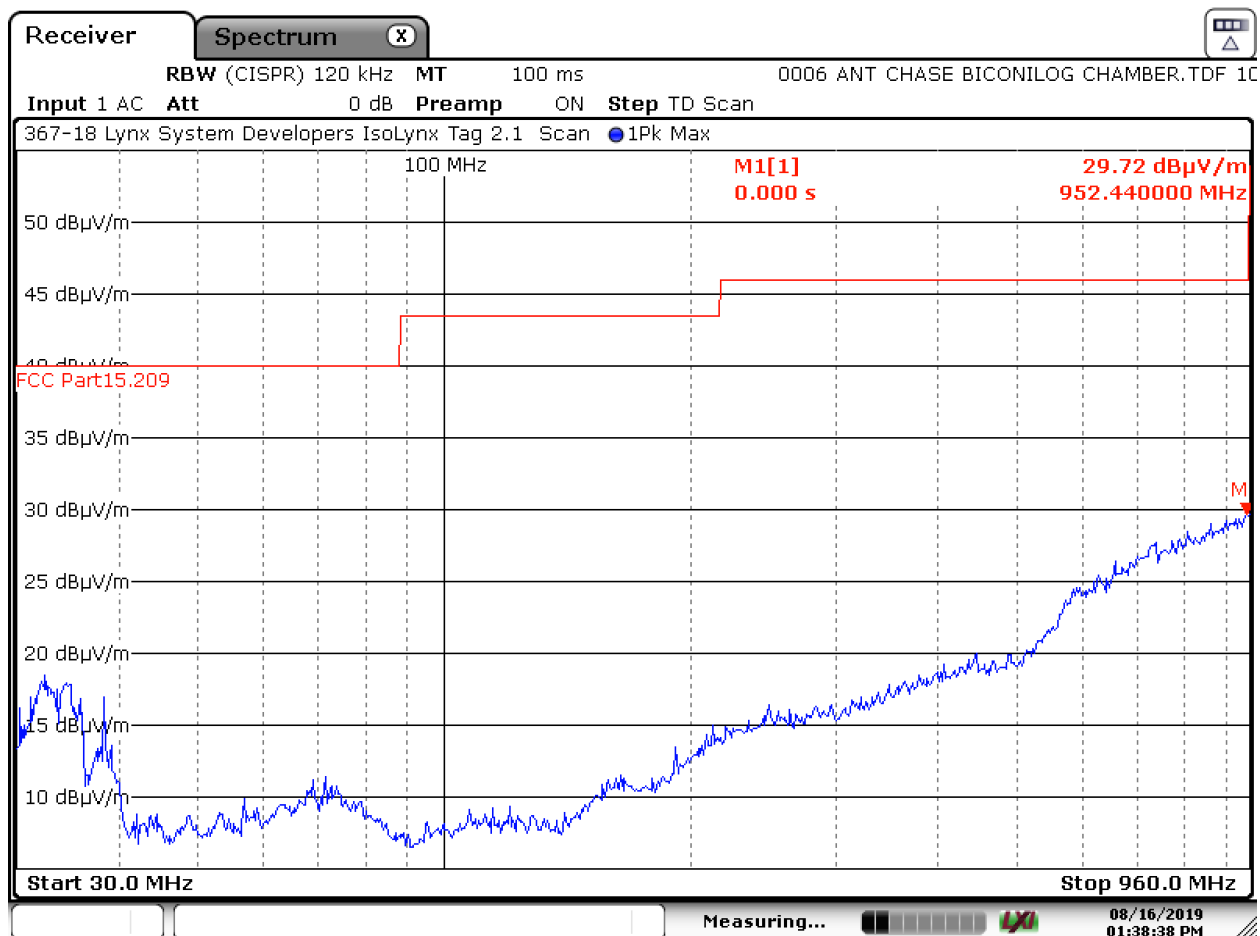
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (5), 15.209, RSS-220 3.4 continued)

6.4.1. 30 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 (64M PRF)



Date: 16.AUG.2019 13:38:37

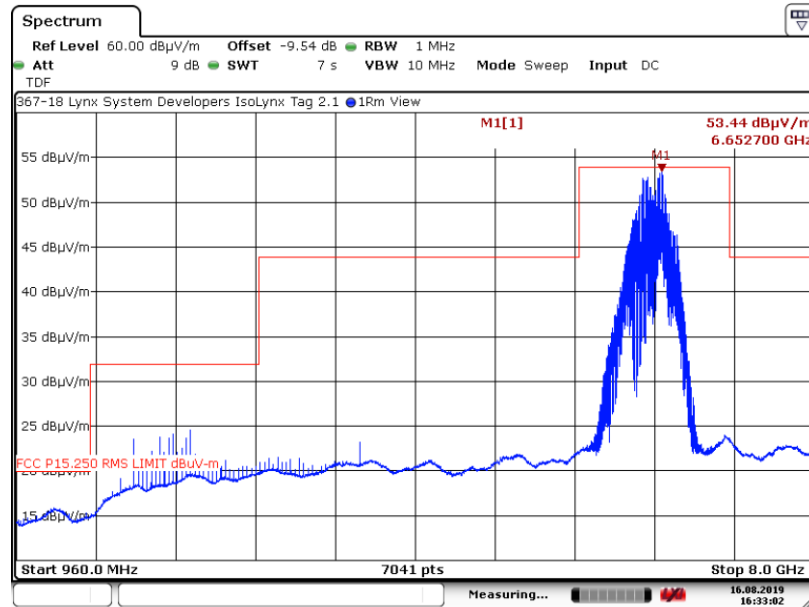
Test Number: 367-18

Issue Date: 8/19/2019

6. Measurement Data (continued)

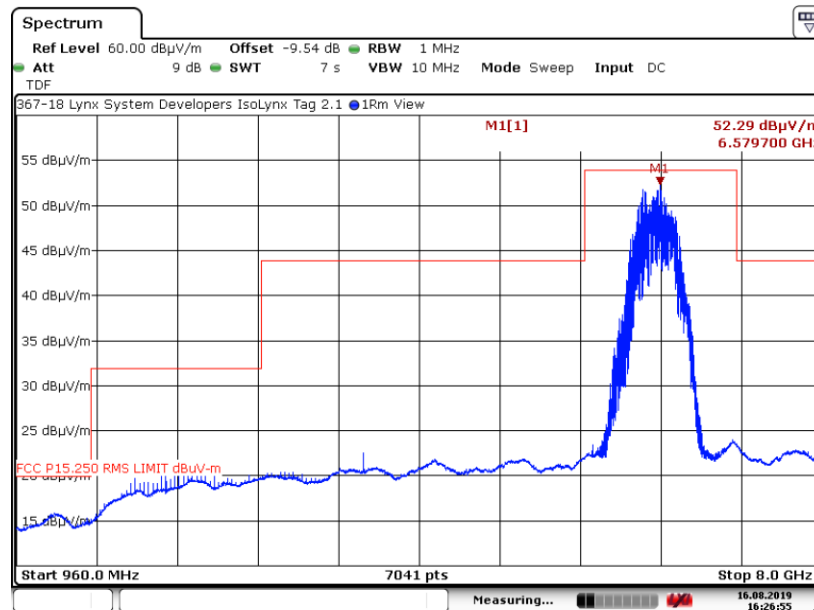
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1(d))

6.4.2. 960 MHz to 8 GHz Horizontal at 1 Meter (16M PRF)



Date: 16.AUG.2019 16:33:02

6.4.3. 960 MHz to 8 GHz Vertical at 1 Meter (16M PRF)

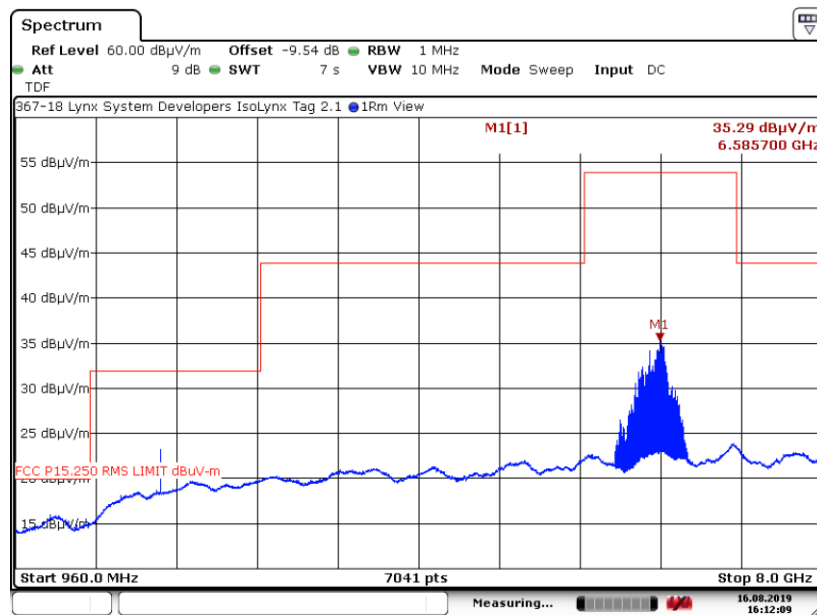


Date: 16.AUG.2019 16:26:55

6. Measurement Data (continued)

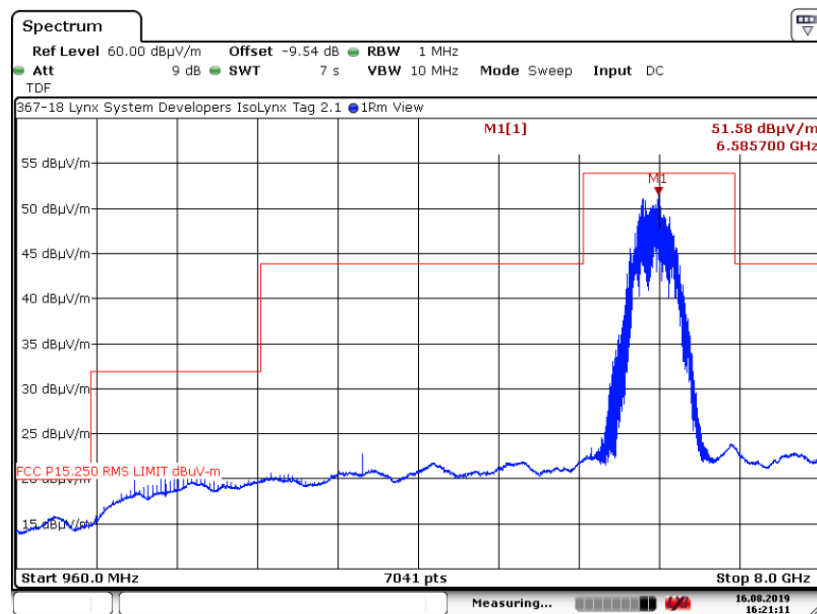
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.4. 960 MHz to 8 GHz Horizontal at 1 Meter (64M PRF)



Date: 16.AUG.2019 16:12:09

6.4.5. 960 MHz to 8 GHz Vertical at 1 Meter (64M PRF)



Date: 16.AUG.2019 16:21:11

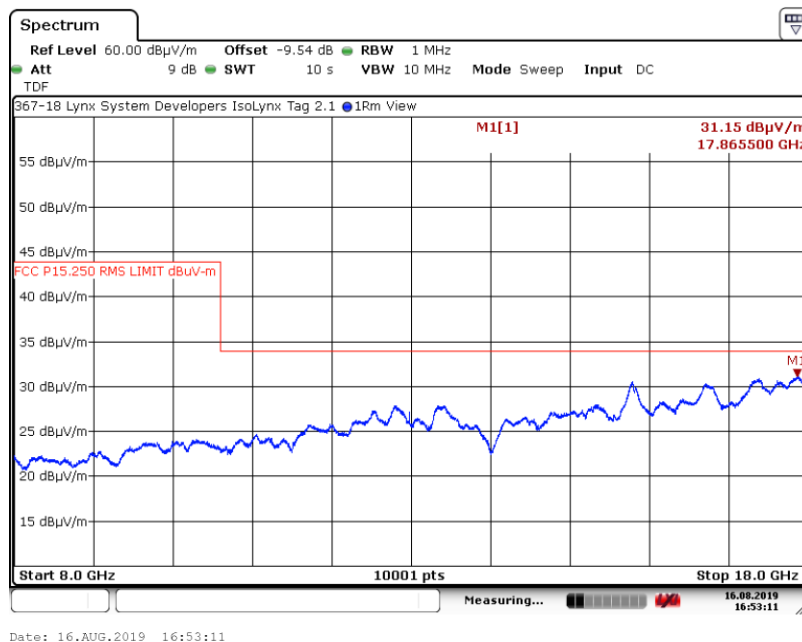
Test Number: 367-18

Issue Date: 8/19/2019

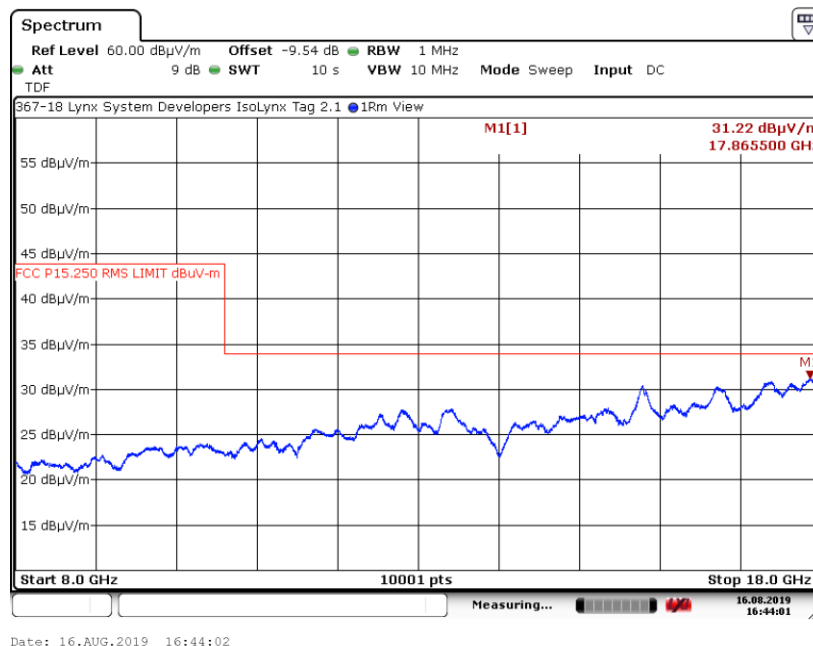
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.13. 8 to 18 GHz Horizontal at 1 Meter (16M PRF)



6.4.14. 8 to 18 GHz Vertical at 1 Meter (16M PRF)



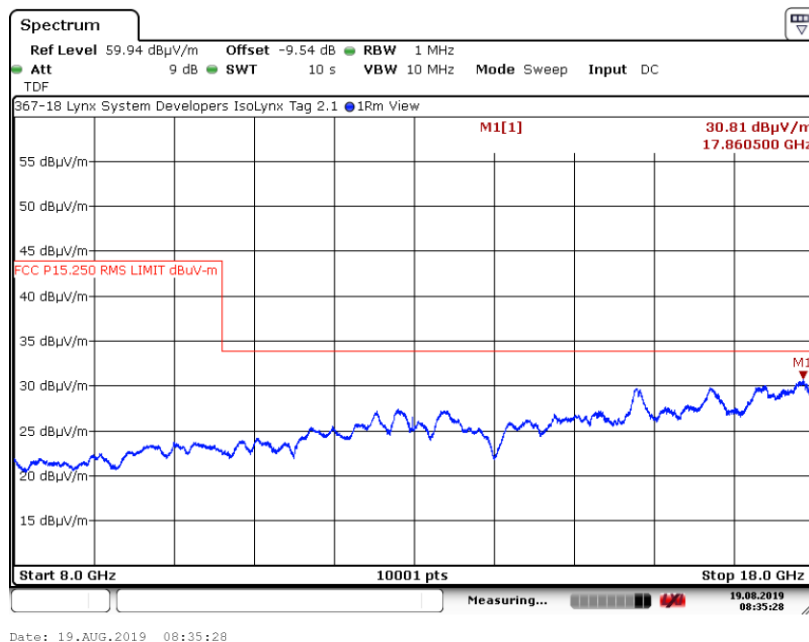
Test Number: 367-18

Issue Date: 8/19/2019

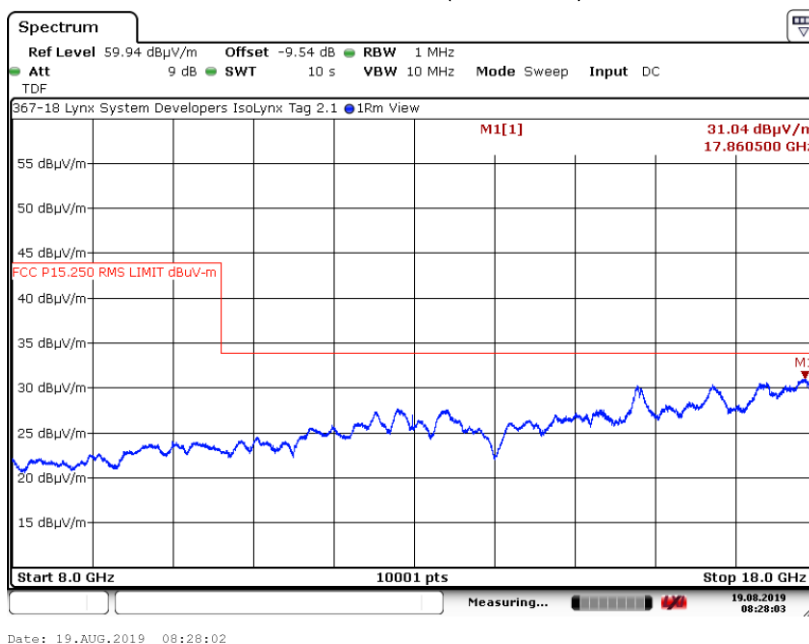
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.15. 8 to 18 GHz Horizontal at 1 Meter (64M PRF)



6.4.16. 8 to 18 GHz Vertical at 1 Meter (64M PRF)



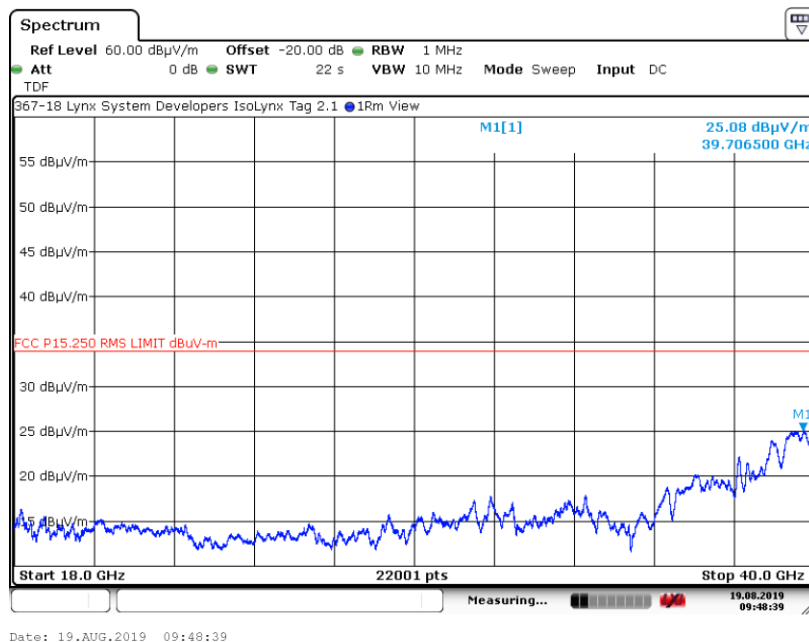
Test Number: 367-18

Issue Date: 8/19/2019

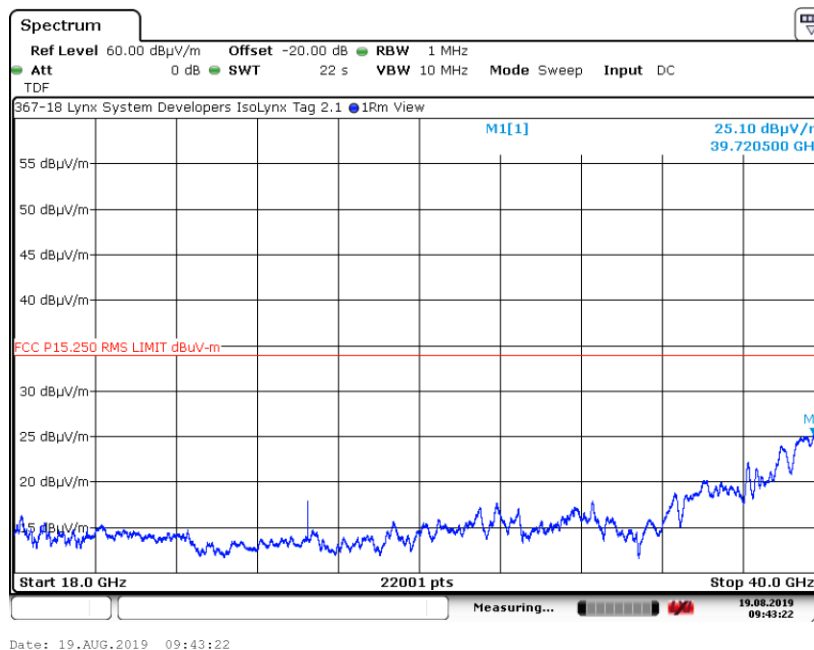
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.25. 18 to 40 GHz Horizontal at 0.3 Meter (16M PRF)



6.4.26. 18 to 40 GHz Vertical at 0.3 Meter (16M PRF)



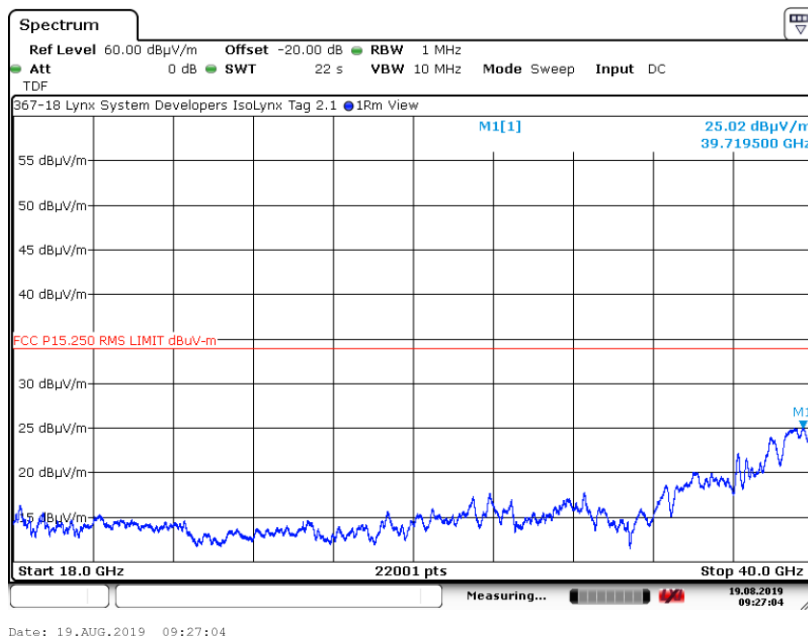
Test Number: 367-18

Issue Date: 8/19/2019

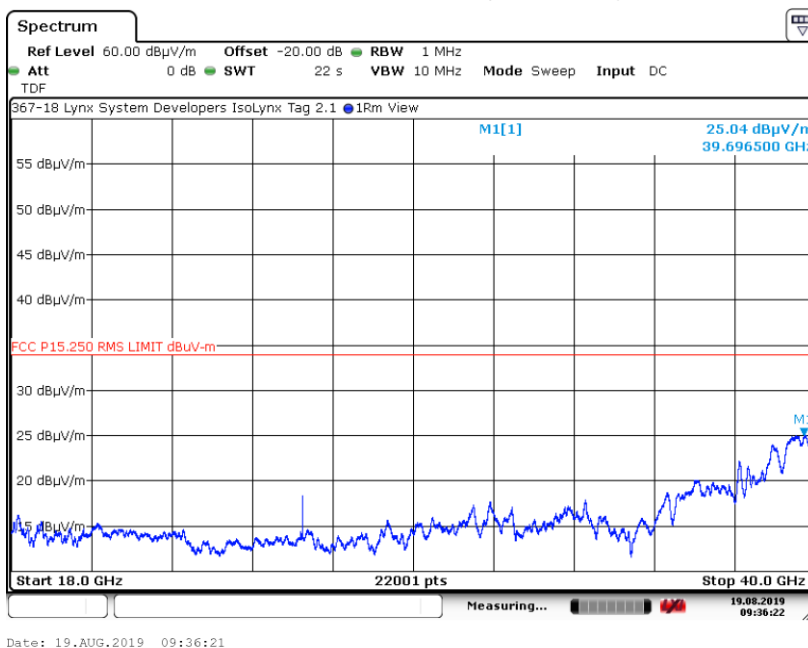
6. Measurement Data (continued)

6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.27. 18 to 40 GHz Horizontal at 0.3 Meter (64M PRF)



6.4.28. 18 to 40 GHz Vertical at 0.3 Meter (64M PRF)



6. Measurement Data (continued)**6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (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 (dBμV/m)
1164 - 1240	-85.3	9.9
1559 - 1610	-85.3	9.9

6.5.1. Measurement & Equipment Setup

EMI Receiver IF Bandwidth: 1 kHz
EMI Receiver Avg Bandwidth: 10 kHz
Detector Function: RMS

6.5.2. Test Procedure

Test measurements were made in accordance with ANSI C63.10:2013, American National Standard for Testing Unlicensed Wireless Devices.

6.5.3. 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. At 3 Meters the -85.3 dBm limit is converted to a field strength limit of 9.9 dBuV/m using a distance correction factor of 95.2.

A distance correction factor of -9.54 dB was entered into the analyzer as an offset since the measurements were made at 1 meter.

Test Number: 367-18

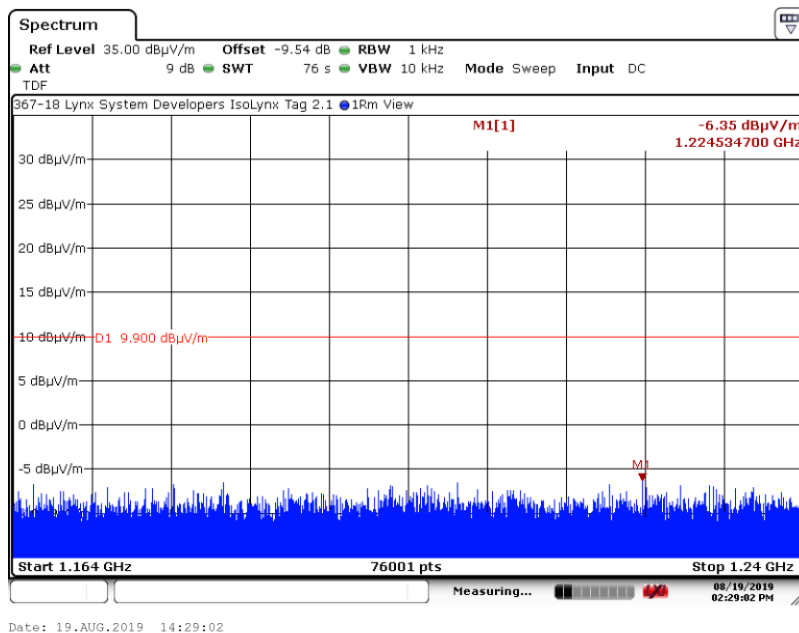
Issue Date: 8/19/2019

6. Measurement Data (continued)

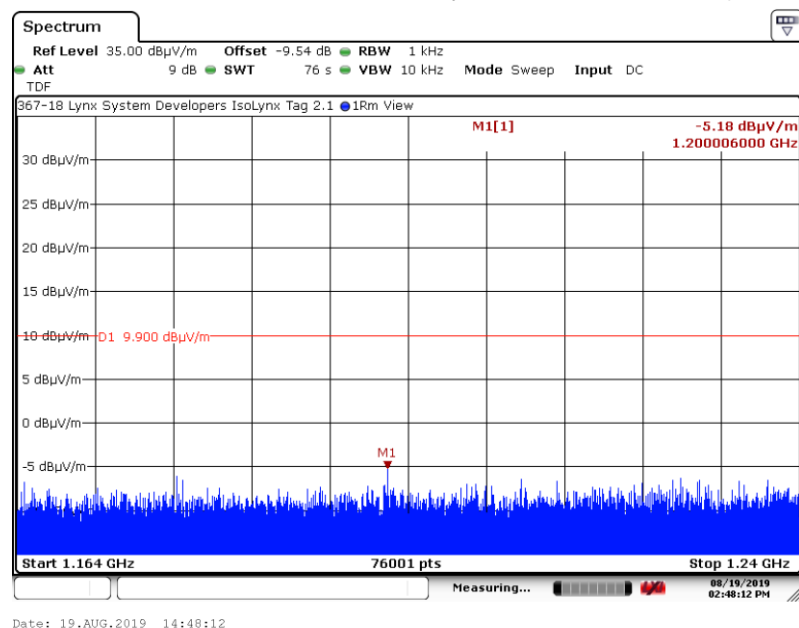
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.2 1164 to 1240 MHz Band

6.5.2.1 Horizontal Measurement Polarity 1164 to 1240 MHz (16M PRF)



6.5.2.2 Vertical Measurement Polarity 1164 to 1240 MHz (16M PRF)



Test Number: 367-18

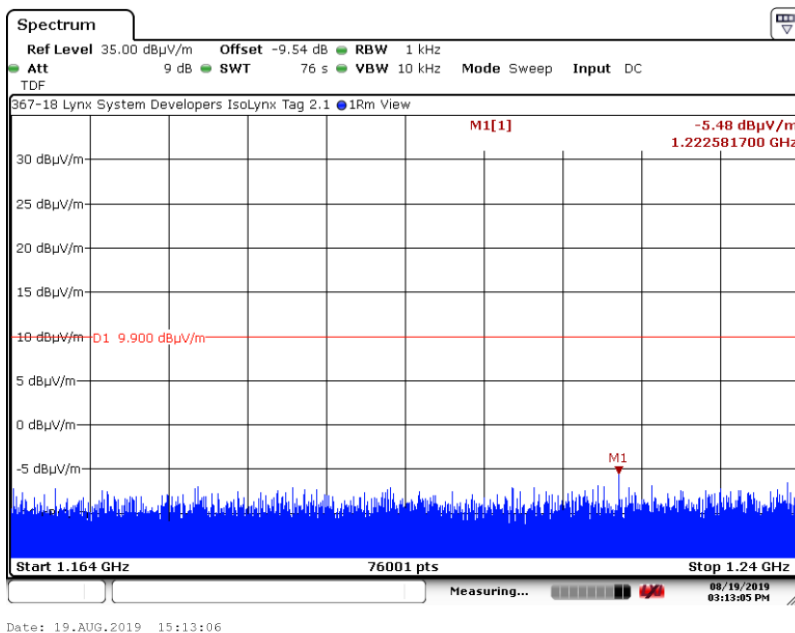
Issue Date: 8/19/2019

6. Measurement Data (continued)

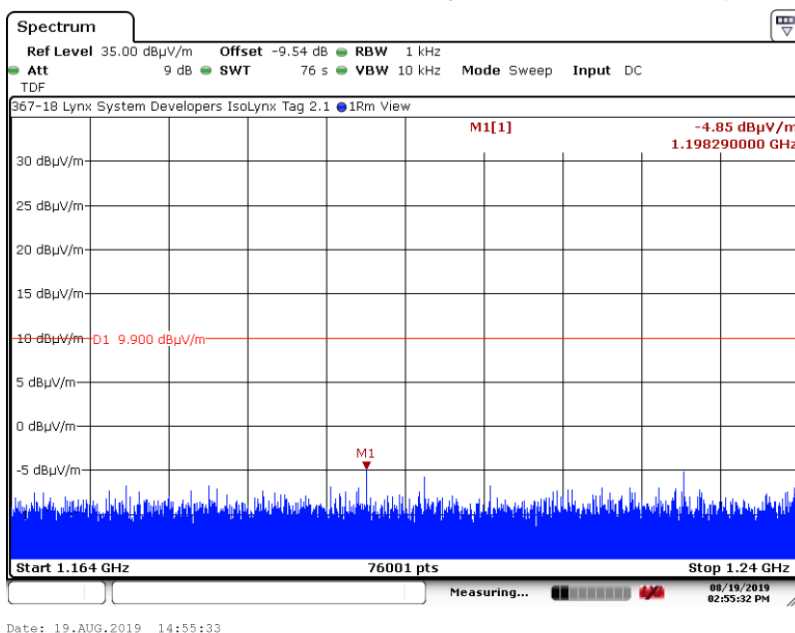
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.2 1164 to 1240 MHz Band

6.5.2.3 Horizontal Measurement Polarity 1164 to 1240 MHz (64M PRF)



6.5.2.4 Vertical Measurement Polarity 1164 to 1240 MHz (64M PRF)



Test Number: 367-18

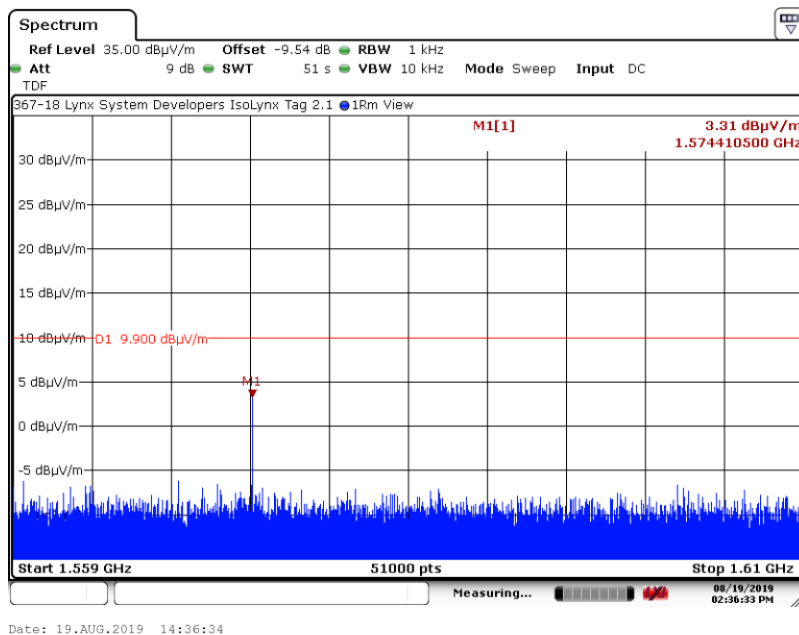
Issue Date: 8/19/2019

6. Measurement Data (continued)

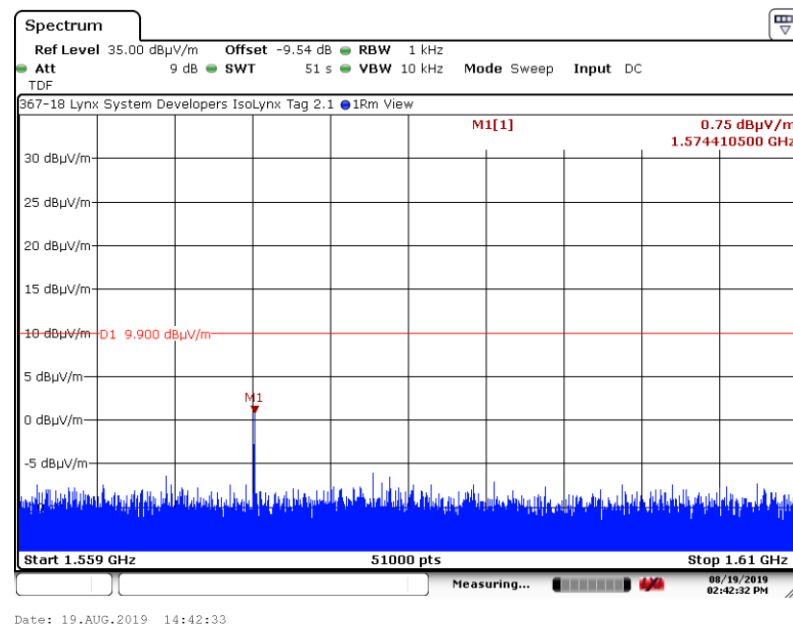
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.3 1559 to 1610 MHz Band

6.5.3.1 Horizontal Measurement Polarity 1559 to 1610 MHz (16M PRF)



6.5.3.2 Vertical Measurement Polarity 1559 to 1610 MHz (16M PRF)

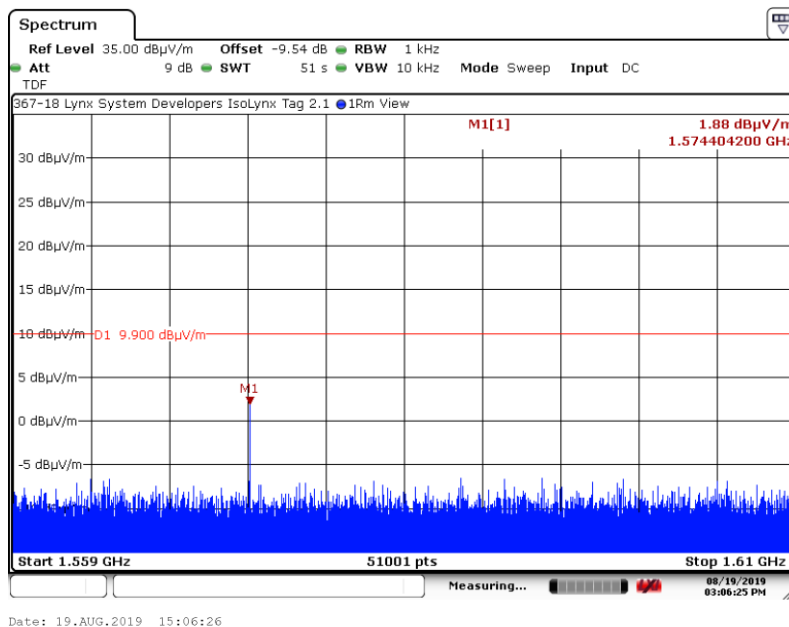


6. Measurement Data (continued)

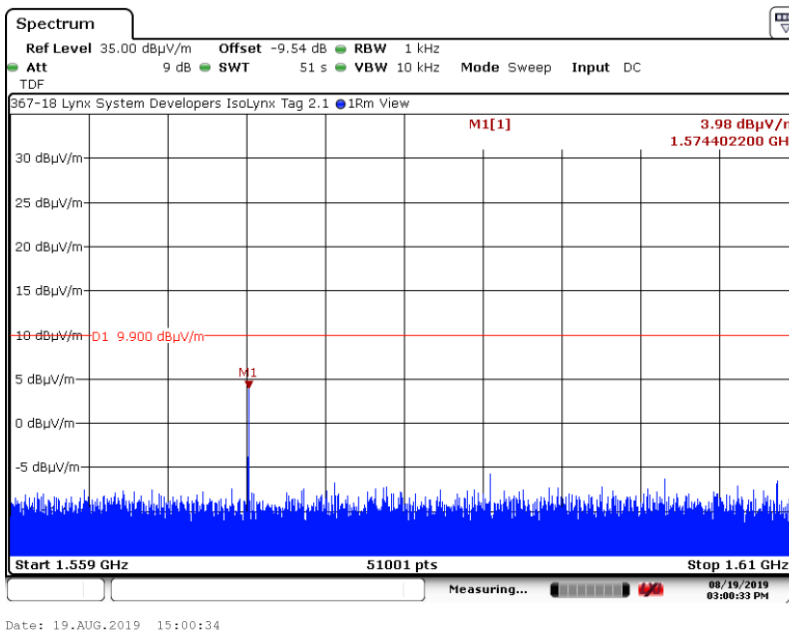
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.3 1559 to 1610 MHz Band

6.5.3.3 Horizontal Measurement Polarity 1559 to 1610 MHz (64M PRF)



6.5.3.4 Vertical Measurement Polarity 1559 to 1610 MHz (64M PRF)



6. Measurement Data (continued)**6.6. RMS Power in a 1 MHz Bandwidth (15.250 (d) (1), RSS-220 5.3.1 (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)
5925 - 7250	-41.3	53.9

Frequency Range:	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

6. Measurement Data (continued)

6.6. RMS Power in a 1 MHz Bandwidth (15.250 (d) (1), RSS-220 5.3.1 (d))

Requirement: The limit for operation in the 5925 to 7250 MHz band is -41.3 dBm EIRP.

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.479	53.77	53.90	-0.13	V	217	141	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, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

$EIRP (dBm) = E_{meas} (dBμV/m) - 95.2$

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.479	-41.43	-41.30	-0.13	V	217	141	Compliant

6.6.1. Plot of RMS Power at 3 Meters (16M PRF)

367-18 IsoLynx Tag 2.1



04:39:07 PM 07/19/2019

6. Measurement Data (continued)

6.6. RMS Power in a 1 MHz Bandwidth (15.250 (d) (1), RSS-220 5.3.1 (d))

Requirement: The limit for operation in the 5925 to 7250 MHz band is -41.3 dBm EIRP.

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.460	53.46	53.90	-0.44	V	217	141	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, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

$EIRP (dBm) = E_{meas} (dBμV/m) - 95.2$

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.460	-41.74	-41.30	-0.44	V	217	141	Compliant

6.6.2. Plot of RMS Power at 3 Meters (64M PRF)

367-18 IsoLynx Tag 2.1



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6. Measurement Data (continued)**6.7. Peak Emissions in a 50 MHz Bandwidth (15.250 (d) (3), 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.

Frequency (MHz)	EIRP (dBm)	EIRP at 3 Meters (dB μ V/m)
5925 - 7250	0	95.2

Frequency Range:	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

6. Measurement Data (continued)

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

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.497	92.35	95.20	-2.85	V	217	141	Compliant

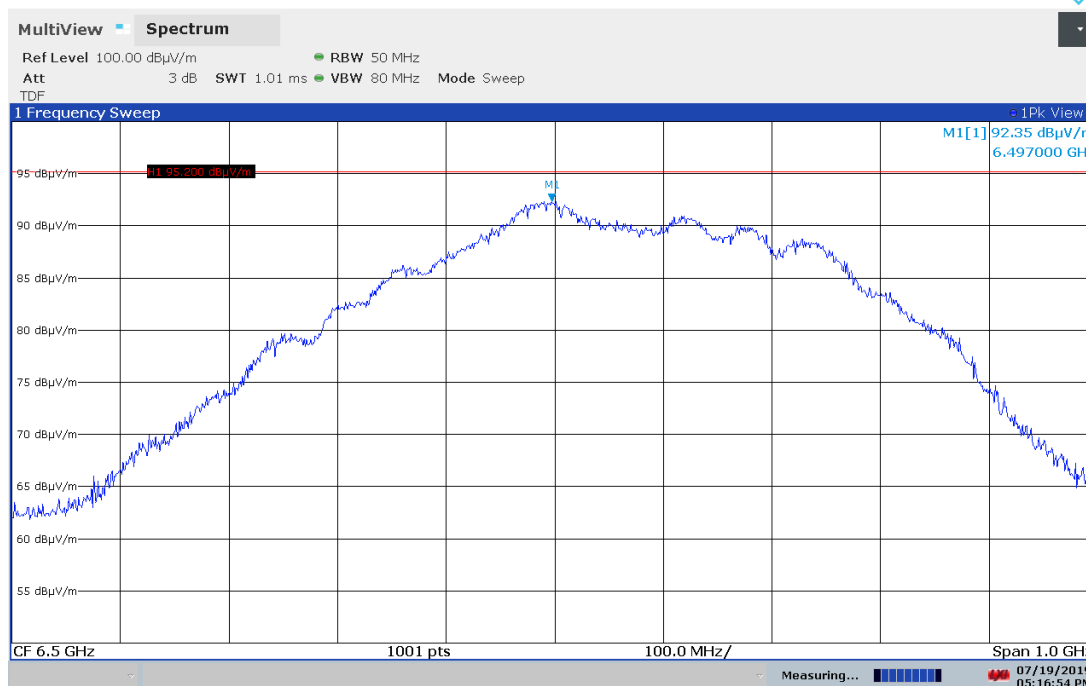
Notes: ¹ Antenna Factor (AF), Cable Factor (CF) and External Preamplifier Gain (PAG) have been entered into the analyzer as transducer factors.

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

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.497	-2.85	0.00	-2.85	V	217	141	Compliant

6.7.1 Plot of Peak Power at 3 Meters (16M PRF)

367-18 IsoLynx Tag 2.1



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6. Measurement Data (continued)

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

Frequency (GHz)	Amplitude ¹	Limit	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	(dBμV/m)	(dBμV/m)	(dB)	H/V	cm	Deg	
6.493	87.53	95.20	-7.67	V	217	141	Compliant

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

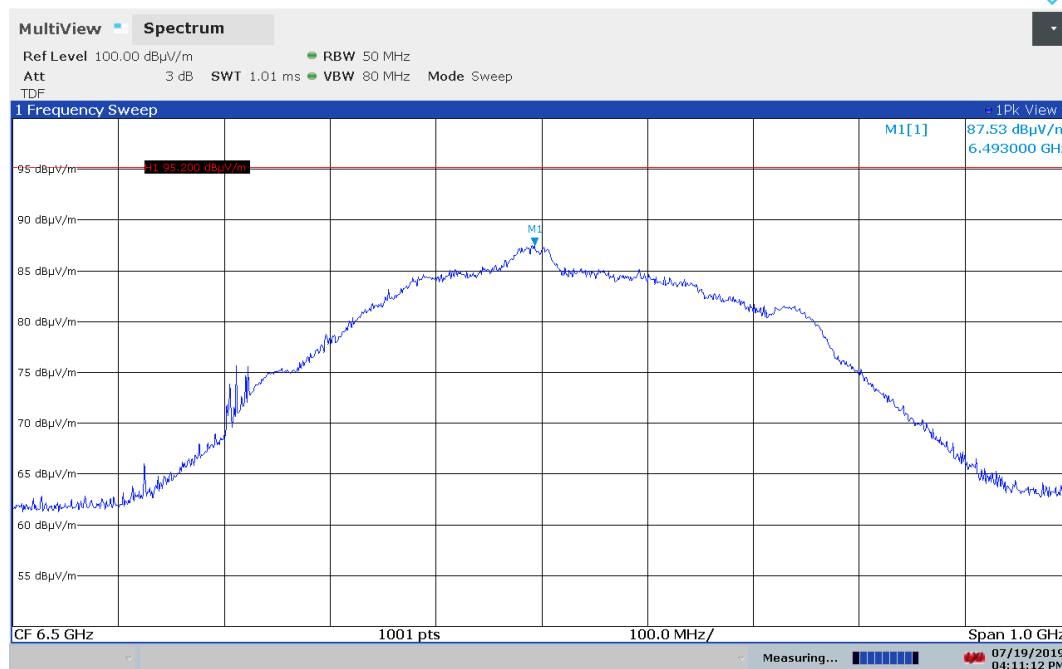
Equation (22) from ANSI C63.10-2013, $EIRP = E_{meas} + 20 \log(d_{meas}) - 104.7$; $d_{meas} = 3$

$EIRP (dBm) = E_{meas} (dBμV/m) - 95.2$

Frequency (GHz)	Amplitude ¹ (dBm)	Limit (dBm)	Margin	Ant Polarity	Ant Height	Turntable Azimuth	Result
	EIRP	EIRP	(dB)	H/V	cm	Deg	
6.493	-7.67	0.00	-7.67	V	217	141	Compliant

6.7.2 Plot of Peak Power at 3 Meters (64M PRF)

367-18 IsoLynx Tag 2.1



04:11:12 PM 07/19/2019

6. Measurement Data (continued)
6.8 Conducted Emissions Test Setup
6.8.1. Regulatory Limit: FCC Part 15.207, 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.

6.8.2 Measurement Equipment and Software Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver 9 kHz to 7 GHz	Rohde & Schwarz	ESR7	101156	9/10/2020
LISN	EMCO	3825/2	9109-1860	9/10/2019
Manufacturer	Software Description		Title/Model #	Rev.
Compliance Worldwide	Test Report Generation Software		Test Report Generator	1.0

6.8.3. Measurement & Equipment Setup

Test Date:	5/9/2019
Test Engineer:	Brian Breault
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

6.8.4. 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: 367-18

Issue Date: 8/19/2019

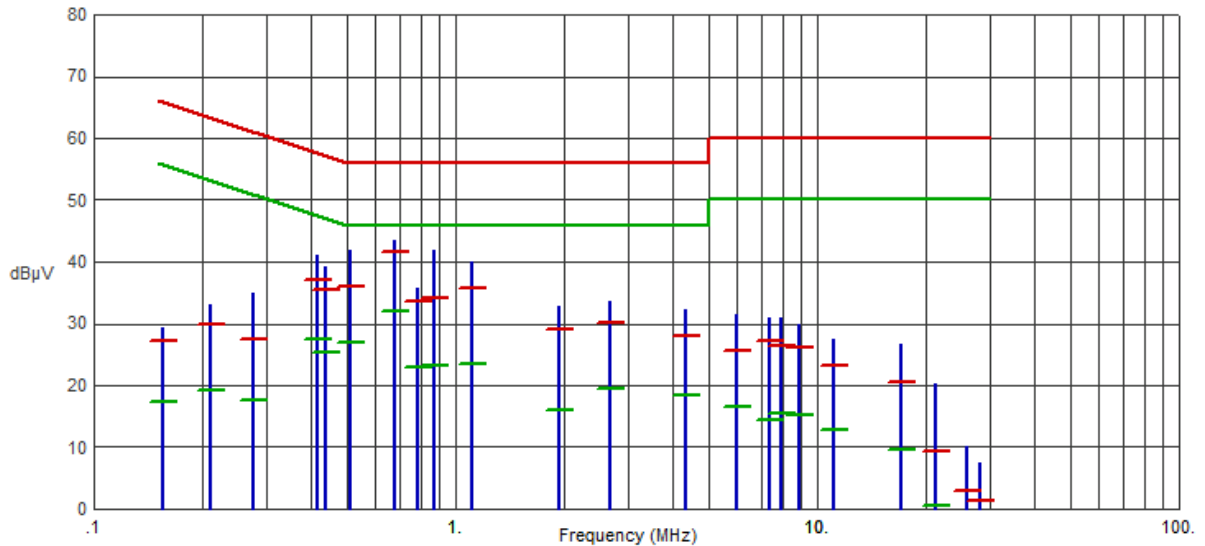
6. Measurement Data (continued)

6.9. Conducted Emissions (FCC 15.207, ISED RSS-GEN 7.2) (continued)

6.9.1. 120 Volts, 60 Hz Phase

Test No.: 213-19, 120 Volts, 60 Hz Phase

FCC Part 15.207



Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
.1556	29.38	27.21	65.70	-38.49	17.28	55.70	-38.42	
.2111	33.03	29.85	63.16	-33.31	19.10	53.16	-34.06	
.2760	34.87	27.39	60.94	-33.55	17.61	50.94	-33.33	
.4144	41.14	37.05	57.56	-20.51	27.42	47.56	-20.14	
.4392	39.16	35.56	57.08	-21.52	25.40	47.08	-21.68	
.5118	41.79	36.01	56.00	-19.99	26.86	46.00	-19.14	
.6820	43.36	41.63	56.00	-14.37	32.01	46.00	-13.99	
.7873	35.86	33.55	56.00	-22.45	22.90	46.00	-23.10	
.8740	41.97	34.20	56.00	-21.80	23.29	46.00	-22.71	
1.1120	39.95	35.83	56.00	-20.17	23.44	46.00	-22.56	
1.9300	32.90	28.99	56.00	-27.01	16.05	46.00	-29.95	
2.6819	33.47	30.22	56.00	-25.78	19.53	46.00	-26.47	
4.3203	32.22	27.97	56.00	-28.03	18.43	46.00	-27.57	
5.9892	31.39	25.63	60.00	-34.37	16.41	50.00	-33.59	
7.3938	30.91	27.27	60.00	-32.73	14.43	50.00	-35.57	
7.9484	30.94	26.47	60.00	-33.53	15.47	50.00	-34.53	
8.8892	29.93	26.01	60.00	-33.99	15.14	50.00	-34.86	
11.1185	27.48	23.10	60.00	-36.90	12.69	50.00	-37.31	
17.1192	26.80	20.44	60.00	-39.56	9.52	50.00	-40.48	
21.3408	20.31	9.37	60.00	-50.63	0.43	50.00	-49.57	
25.8723	10.10	2.81	60.00	-57.19	-4.25	50.00	-54.25	
28.2539	7.39	1.24	60.00	-58.76	-5.55	50.00	-55.55	

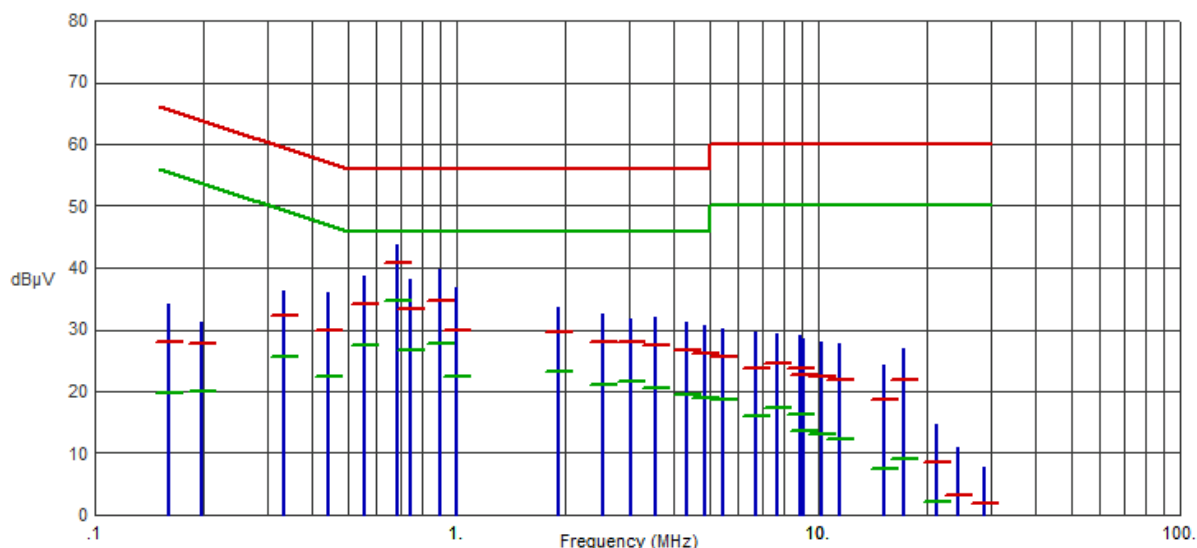
6. Measurement Data (continued)

6.9. Conducted Emissions (FCC 15.207, ISED RSS-GEN 7.2) (continued)

6.9.2. 120 Volts, 60 Hz Neutral

Test No.: 213-19, 120 Volts, 60 Hz Neutral

FCC Part 15.207



Frequency (MHz)	Pk Amp (dBμV)	QP Amp (dBμV)	QP Limit (dBμV)	QP Margin (dB)	Avg Amp (dBμV)	Avg Limit (dBμV)	Avg Margin (dB)	Comments
.1602	34.24	27.88	65.45	-37.57	19.77	55.45	-35.68	
.1981	31.14	27.60	63.69	-36.09	19.93	53.69	-33.76	
.3344	36.17	32.23	59.34	-27.11	25.67	49.34	-23.67	
.4410	35.99	29.74	57.04	-27.30	22.42	47.04	-24.62	
.5557	38.59	34.07	56.00	-21.93	27.47	46.00	-18.53	
.6835	43.68	40.71	56.00	-15.29	34.74	46.00	-11.26	
.7487	38.06	33.32	56.00	-22.68	26.71	46.00	-19.29	
.8961	39.67	34.66	56.00	-21.34	27.74	46.00	-18.26	
1.0021	36.79	29.91	56.00	-26.09	22.35	46.00	-23.65	
1.9193	33.50	29.57	56.00	-26.43	23.15	46.00	-22.85	
2.5319	32.60	27.88	56.00	-28.12	21.00	46.00	-25.00	
3.0441	31.62	28.09	56.00	-27.91	21.54	46.00	-24.46	
3.5551	31.96	27.38	56.00	-28.62	20.66	46.00	-25.34	
4.3152	31.12	26.55	56.00	-29.45	19.46	46.00	-26.54	
4.8481	30.63	26.05	56.00	-29.95	19.05	46.00	-26.95	
5.4728	30.16	25.66	60.00	-34.34	18.54	50.00	-31.46	
6.7094	29.63	23.83	60.00	-36.17	16.04	50.00	-33.96	
7.7358	29.41	24.53	60.00	-35.47	17.43	50.00	-32.57	
8.9351	28.94	23.85	60.00	-36.15	16.23	50.00	-33.77	
9.1076	28.43	22.74	60.00	-37.26	13.69	50.00	-36.31	
10.2536	27.96	22.27	60.00	-37.73	13.19	50.00	-36.81	
11.4296	27.64	21.89	60.00	-38.11	12.32	50.00	-37.68	
15.1605	24.21	18.70	60.00	-41.30	7.46	50.00	-42.54	
17.2081	27.02	21.87	60.00	-38.13	8.94	50.00	-41.06	
21.1710	14.62	8.59	60.00	-51.41	2.16	50.00	-47.84	
24.2480	10.92	3.17	60.00	-56.83	-4.48	50.00	-54.48	
28.7498	7.65	1.81	60.00	-58.19	-4.72	50.00	-54.72	

6. Measurement Data (continued)

6.10. 99% Emission Bandwidth (RSS-GEN 6.7)

Requirement: The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs RSS-Gen, Section 6.7.

Test Note: The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

6.10.1 Plot of 99% Emission Bandwidth (16M PRF)

367-18 IsoLynx Tag 2.1



02:34:00 PM 07/19/2019

Test Number: 367-18

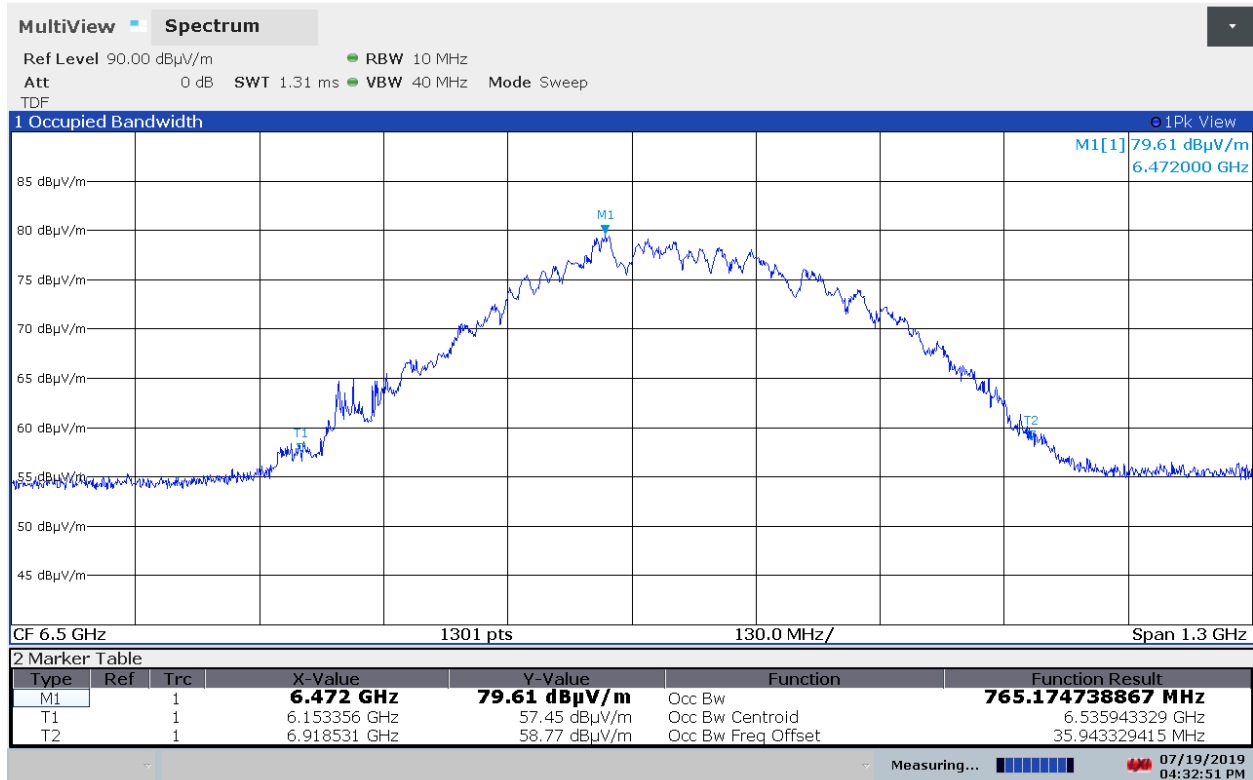
Issue Date: 8/19/2019

6. Measurement Data (continued)

6.10. 99% Emission Bandwidth (RSS-GEN 6.7 continued)

6.10.2 Plot of 99% Emission Bandwidth (64M PRF)

367-18 IsoLynx Tag 2.1



04:32:51 PM 07/19/2019

6. Measurement Data (continued)

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

6.11.1 RF Exposure for devices that operate above 6 GHz

Requirements: 2.1093(b): 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 20 centimeters of the body of the user.

2.1093 (d): Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified 47 CFR 1.1310. Measurements and calculations to demonstrate compliance with MPE Field strength or power density limits for device operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

1.1310, Table 1: Limits for Maximum Permissible Exposure (MPE), Section (B): Limits for General Population/Uncontrolled Exposure for devices that operate between 1500 to 100,000 MHz is 1.0 mW/cm² using a 30 minute averaging time.

Center Frequency (GHz)	MPE Distance (cm)	DUT Peak Output Power (dBm)	DUT Antenna Gain (dBi)	DUT Peak Power (mW)	Power Density		FCC Limit (mW/cm ²)
					(mW/cm ²)	(W/m ²)	
	(1)	(2)	(3)		(4)		(5)
6.497	5	-2.85	0.0	0.519	0.0016514	0.0165139	1
6.493	5	-7.67	0.0	0.171	0.0005443	0.0054431	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. Measured Peak Power at 3 Meters.
3. Antenna Gain included in the measured values of Section 6.7
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.

Note: This is the peak power of the device in a 50 MHz bandwidth, the time averaged power is significantly lower. **20 * LOG (1.3 mS / 12.5 mS) = -19.66 dB**

The BLE Module and UWB radios do not operate simultaneously.

Test Number: 367-18

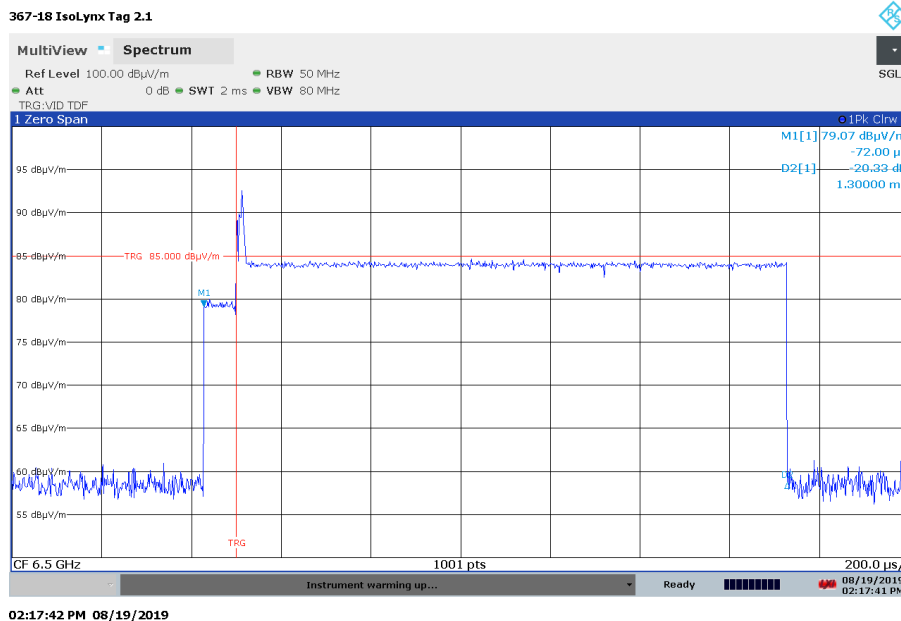
Issue Date: 8/19/2019

6. Measurement Data (continued)

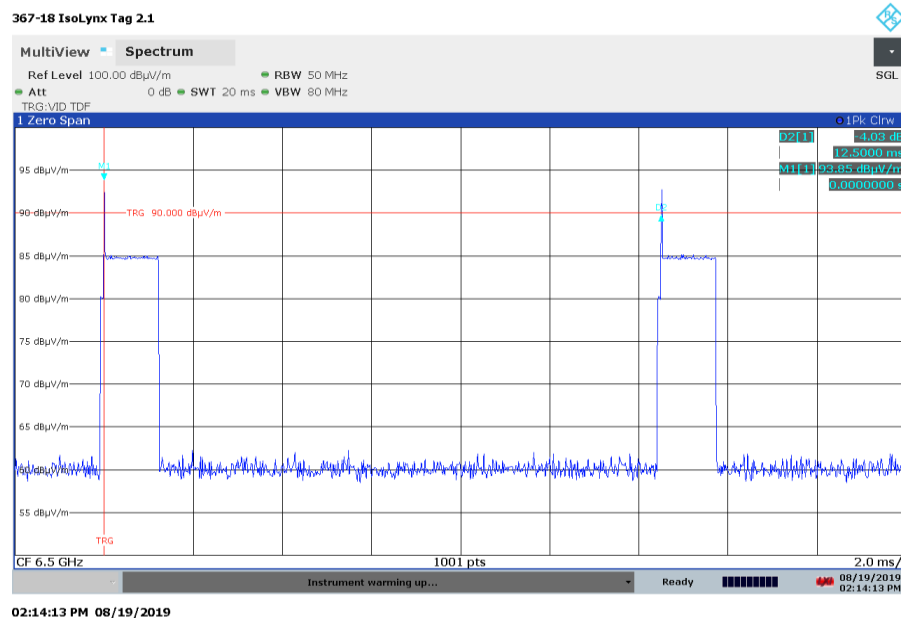
6.11. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))

6.11.1 RF Exposure for devices that operate above 6 GHz (continued)

Worst Case Duty Cycle of the device Burst Length = 1.3 mS



Repetition Time = 12.5 mS



6. Measurement Data (continued)

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

6.11.1 RF Exposure for devices that operate above 6 GHz (continued)

Time averaged power when using the worst case peak power at close distances

Worst Case Peak Output Power of -2.85 dBm or 0.519 mW shows the antenna could be used at a distance of 0.203 cm (2.03 mm) from the body and still be under the FCC Limit of 1 mW/cm²

Frequency (GHz)	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	DUT Output Power milliWatts	Power Density		FCC Limit (mW/cm ²)
					(mW/cm ²)	(W/m ²)	
	(1)	(2)	(3)		(4)		(5)
6.497	0.2032	-2.85	0.0	0.519	0.9998681	9.9986814	1

Further reduction is achieved using the time averaged power of the device that is 19.66 dB lower than the peak power. The time averaged power of -22.51 dBm or 0.006 mW results in a distance of 0.0212 cm (0.212 mm) from the body which provides a calculated exposure below the 1 mW/cm² limit.

Frequency (GHz)	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	DUT Output Power milliWatts	Power Density		FCC Limit (mW/cm ²)
					(mW/cm ²)	(W/m ²)	
	(1)	(2)	(3)		(4)		(5)
6.497	0.0212	-22.51	0.0	0.006	0.9933869	9.9338687	1

A conservative measured distance of the actual end usage of the product results in a distance of at least 0.7 mm from the body when using the clip shown in the manual maintaining the antenna is on the side away from the body. That results in an exposure level significantly below the 1 mW/cm² limit.

Frequency (GHz)	MPE Distance (cm)	DUT Output Power (dBm)	DUT Antenna Gain (dBi)	DUT Output Power milliWatts	Power Density		FCC Limit (mW/cm ²)
					(mW/cm ²)	(W/m ²)	
	(1)	(2)	(3)		(4)		(5)
6.497	0.7	-22.51	0.0	0.006	0.0009112	0.0091116	1

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 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. 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.

8. Test Images

8.1. Spurious and Harmonic Emissions – 30 kHz to 1 GHz Front



8. Test Images

8.2. Spurious and Harmonic Emissions – 30 kHz to 30 MHz Rear



8. Test Images

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



8. Test Images

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



8. Test Images

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



8. Test Images

8.6. Spurious and Harmonic Emissions – 18 to 40 GHz Rear



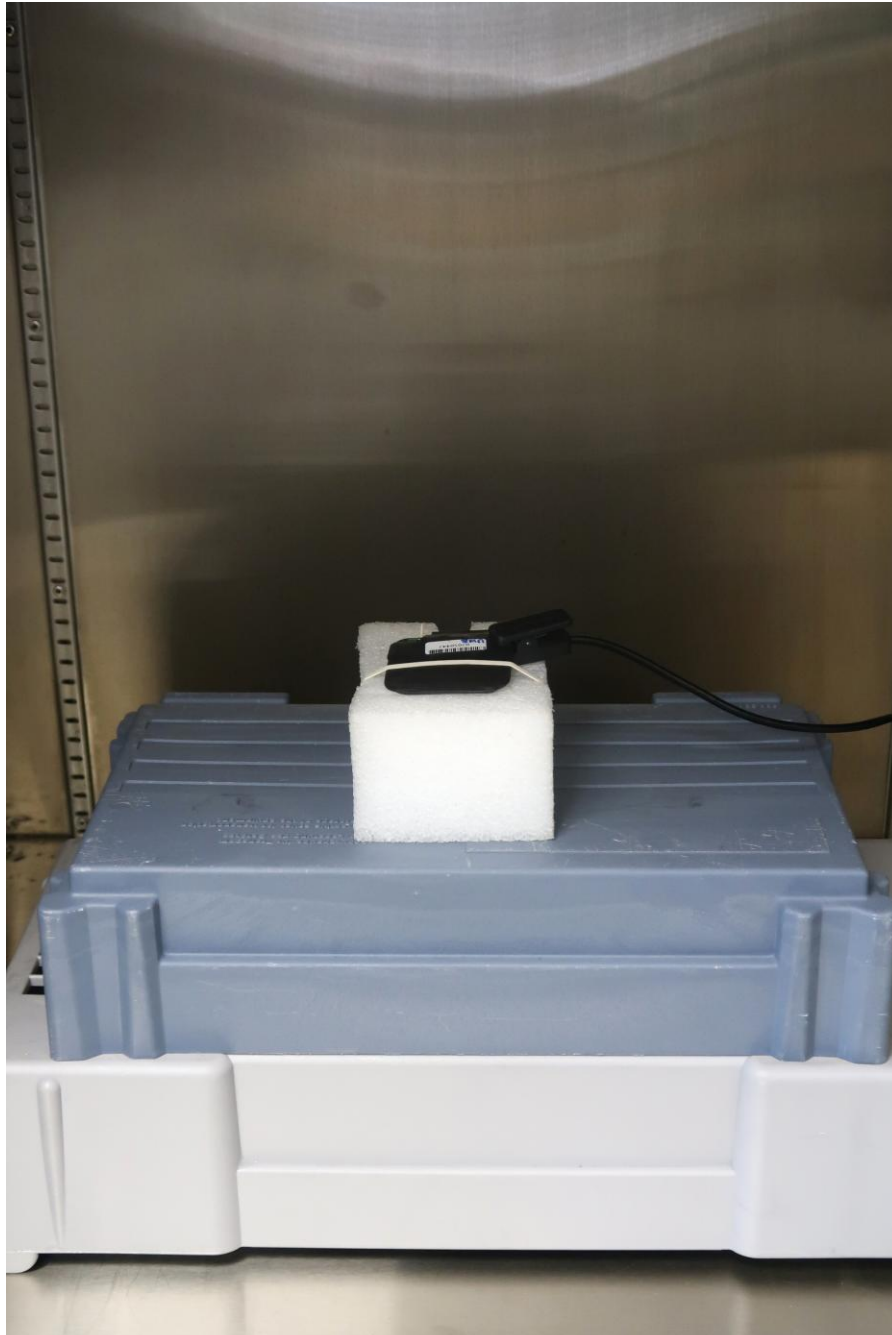
8. Test Images

8.7. Frequency Stability (Setup)



8. Test Images

8.8. Frequency Stability (EUT)



8. Test Setup Photographs

8.9. Power Line Conducted Emissions – Front



8. Test Setup Photographs

8.10. Power Line Conducted Emissions – Rear

