

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



Larry K. Stillings

Reviewed By



Brian F. Breault

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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 ISED 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 | | | | |

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3. Product Configuration (cont.)

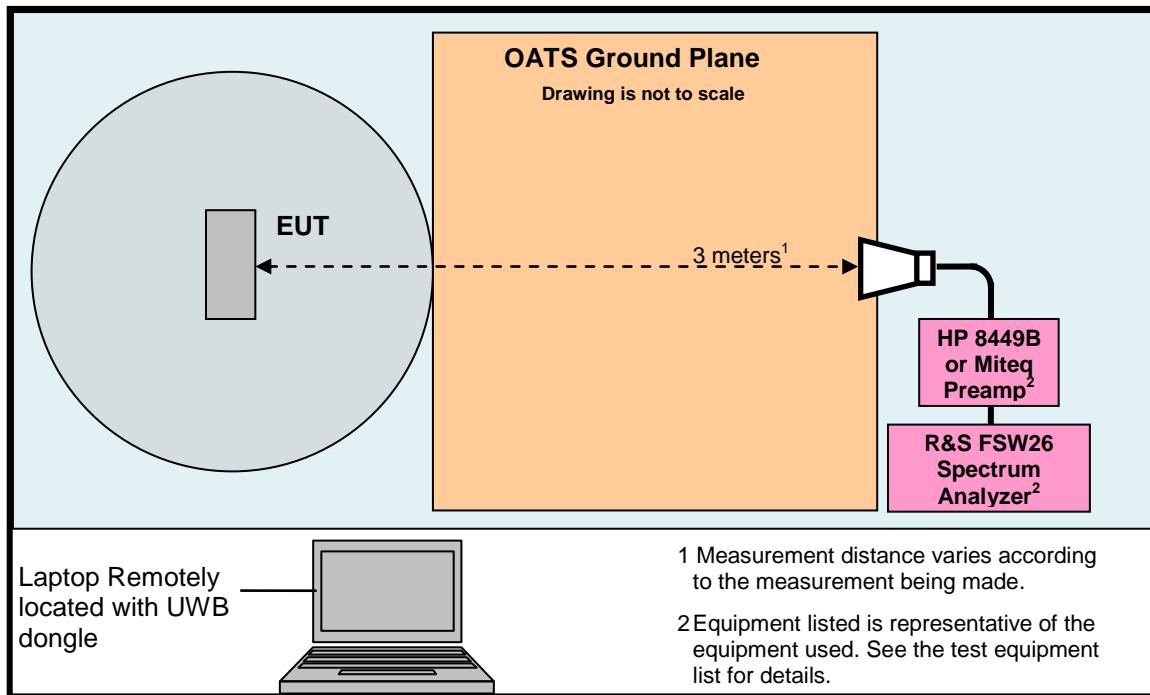
3.3. EUT Hardware

| 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



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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.

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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 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 |
| 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 ISED RSS-220, Issue 1 & A1.

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 | $\pm 5\%$ |

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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 | |

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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 (MHz) | -10 dB Band Edges | | 15.250 Frequency Band | | Result |
|--------|------------|--------------------------------|----------------------|--------|---------------------------|---------------------------|-----------|
| | | | 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

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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

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6. Measurement Data (continued)

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

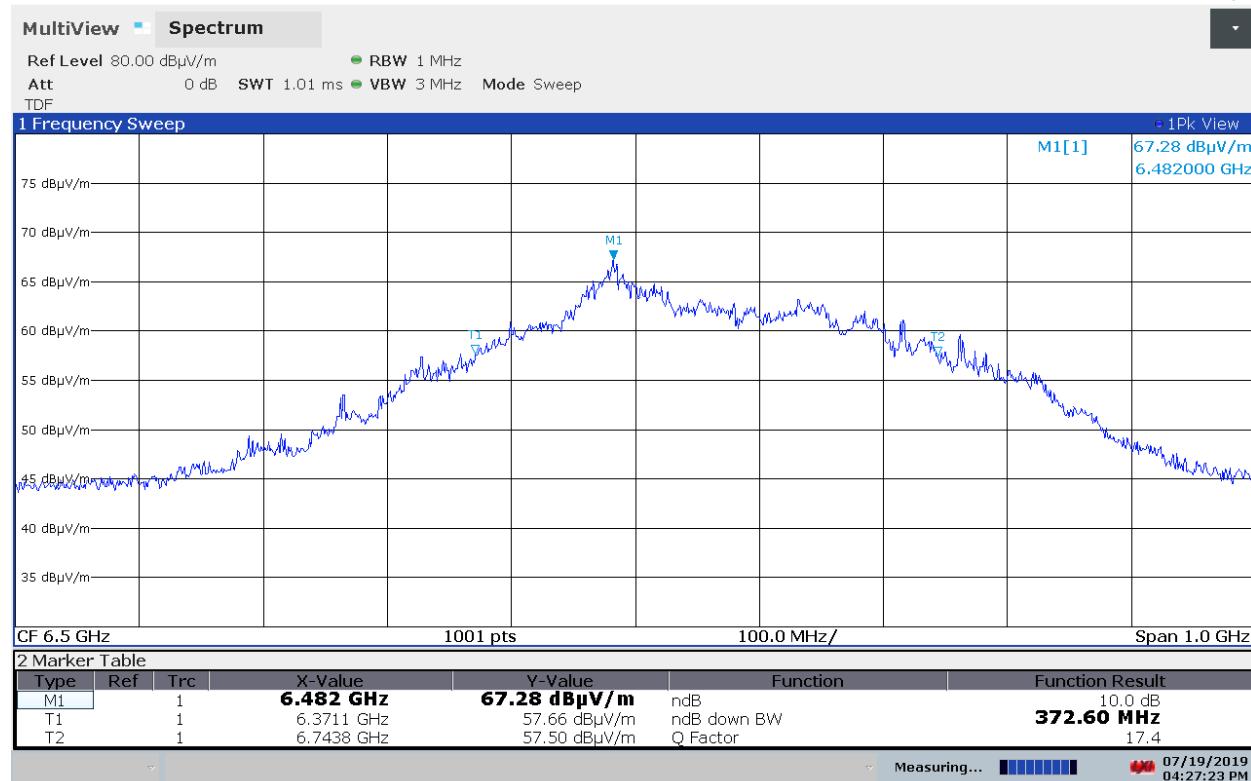
Requirement: The -10 dB bandwidth of the fundamental emission shall be at least 50 MHz.

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

04:27:23 PM 07/19/2019

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Issue Date: 8/19/2019

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 (dB μ V/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 (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 |

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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 (μ V/m) | Field Strength (dB μ V/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 |

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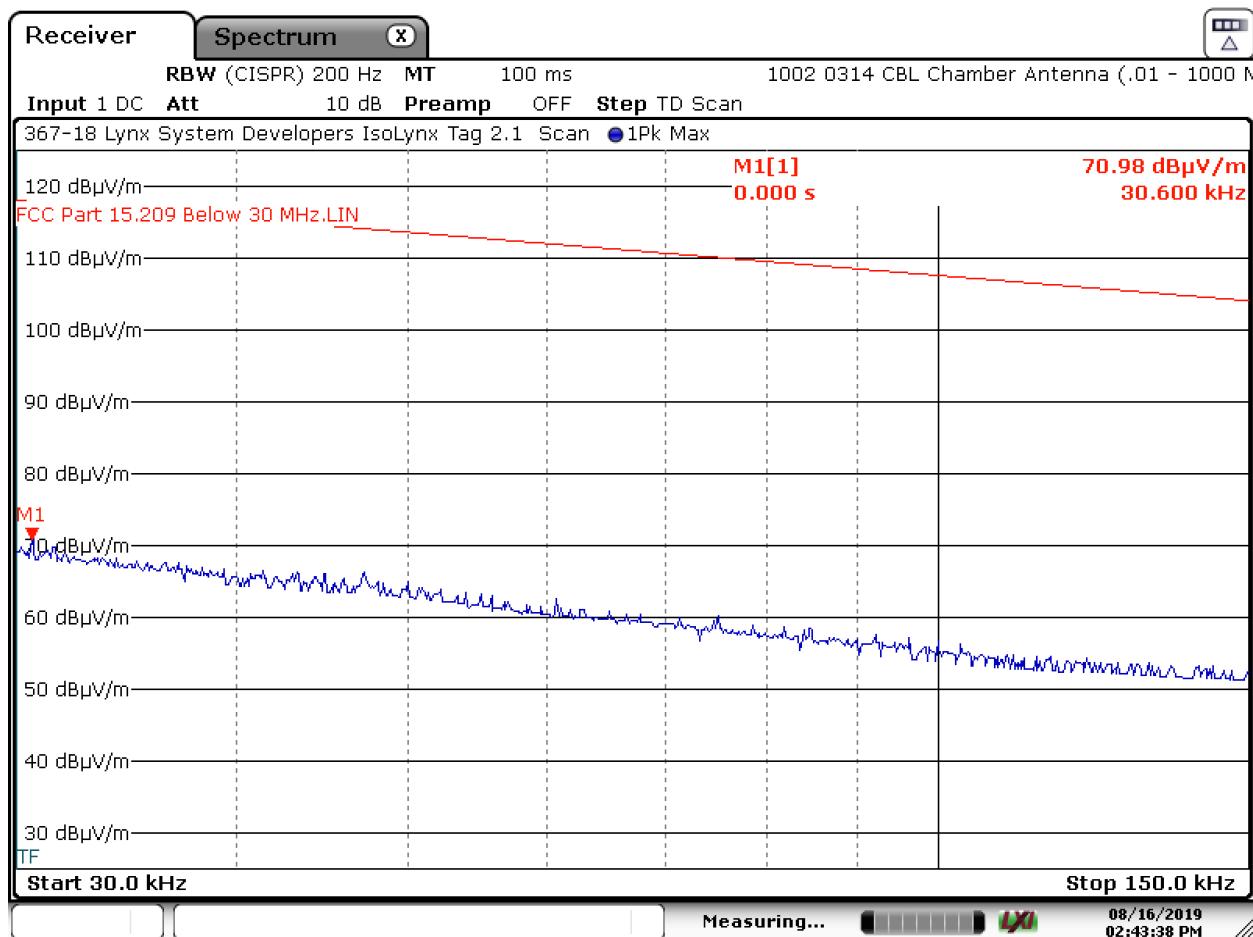
6. Measurement Data (continued)

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

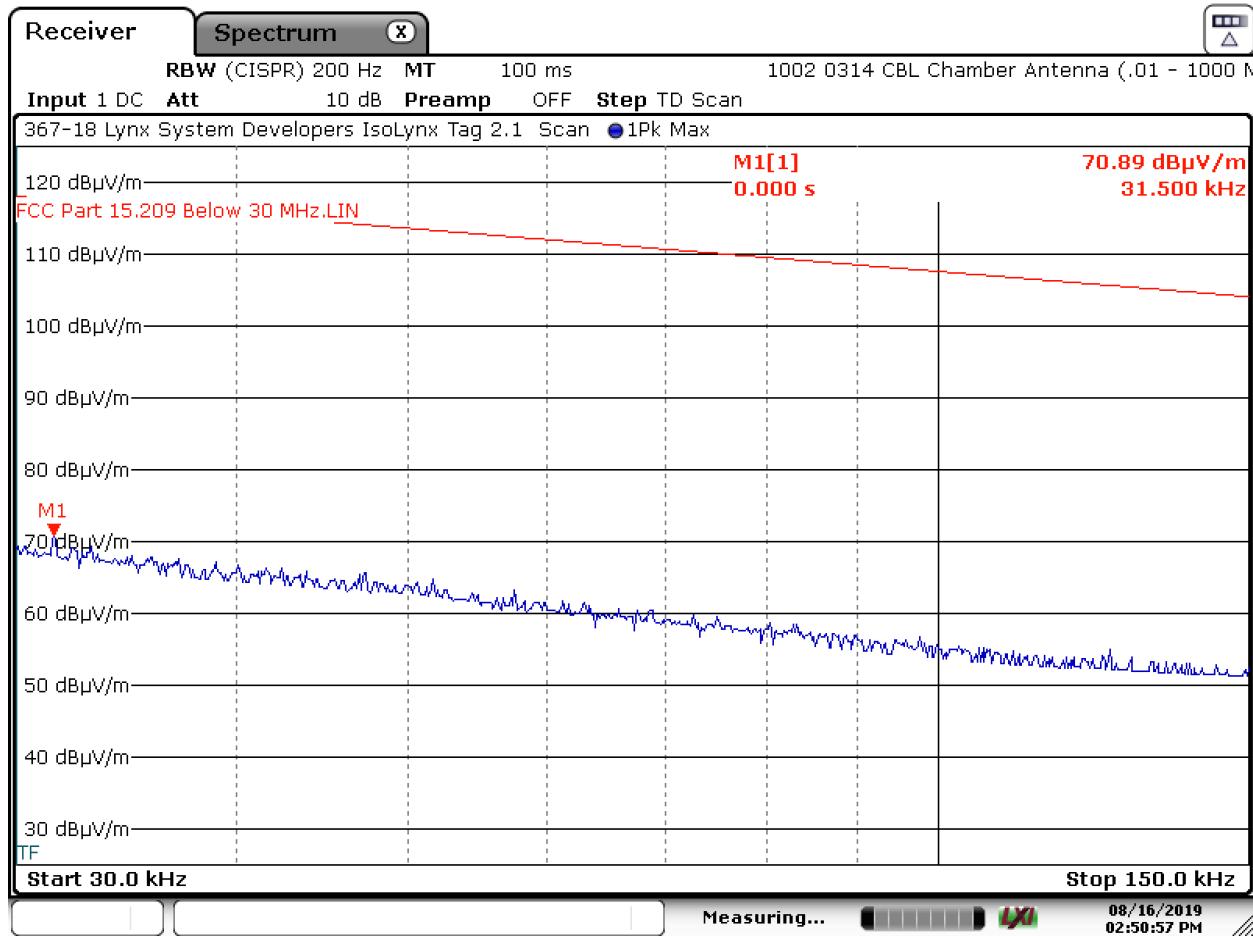
6. Measurement Data (continued)

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

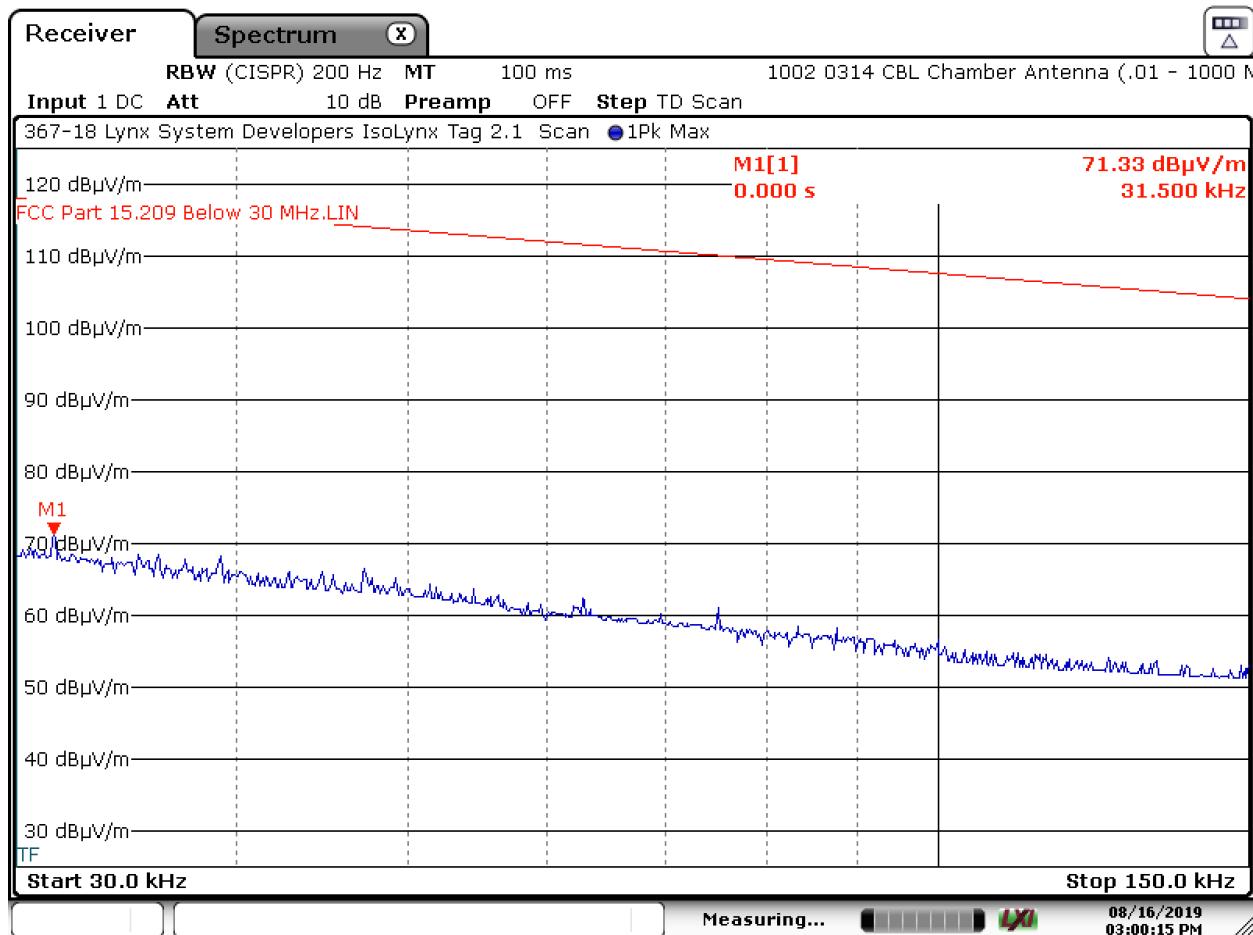
6. Measurement Data (continued)

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

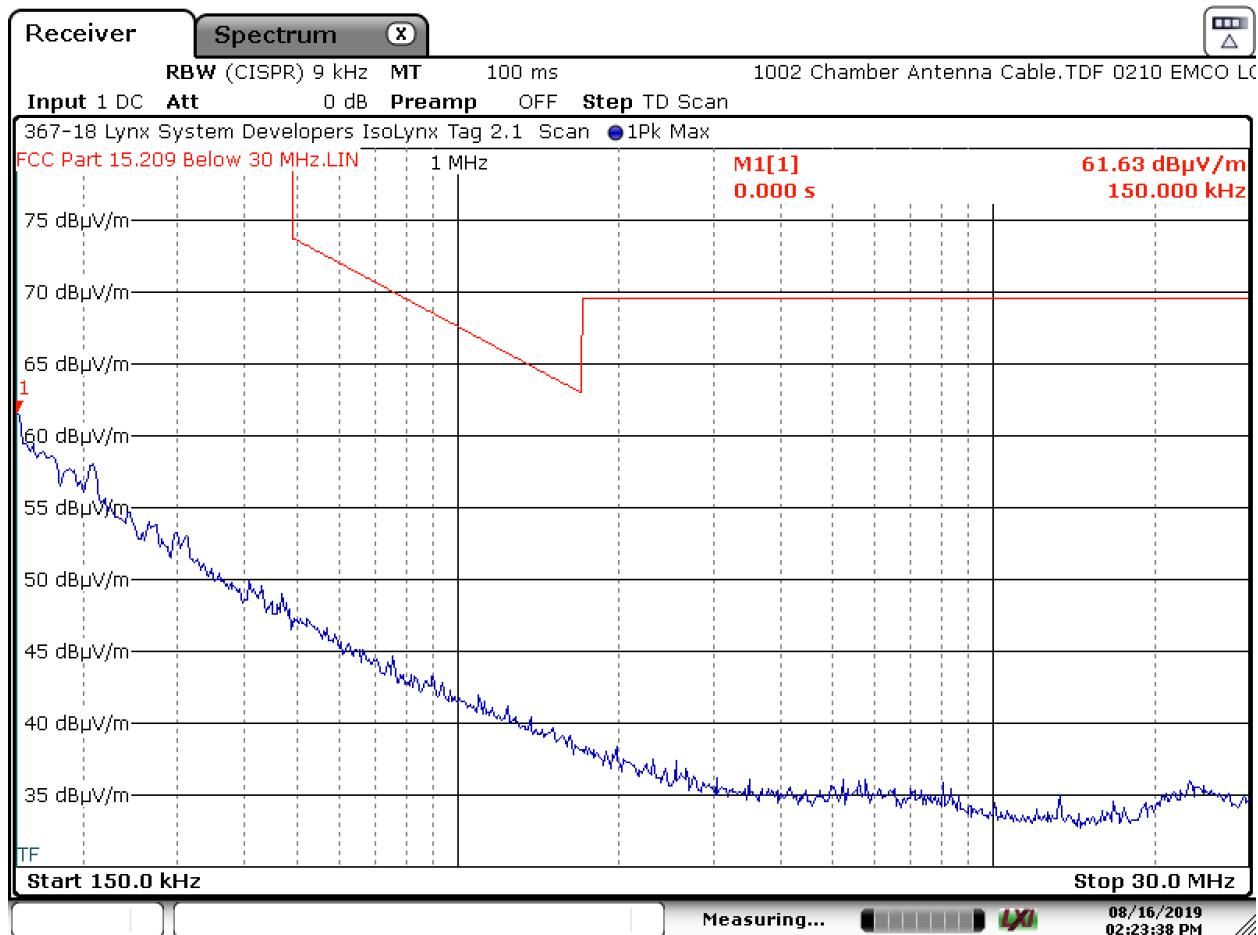
6. Measurement Data (continued)

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

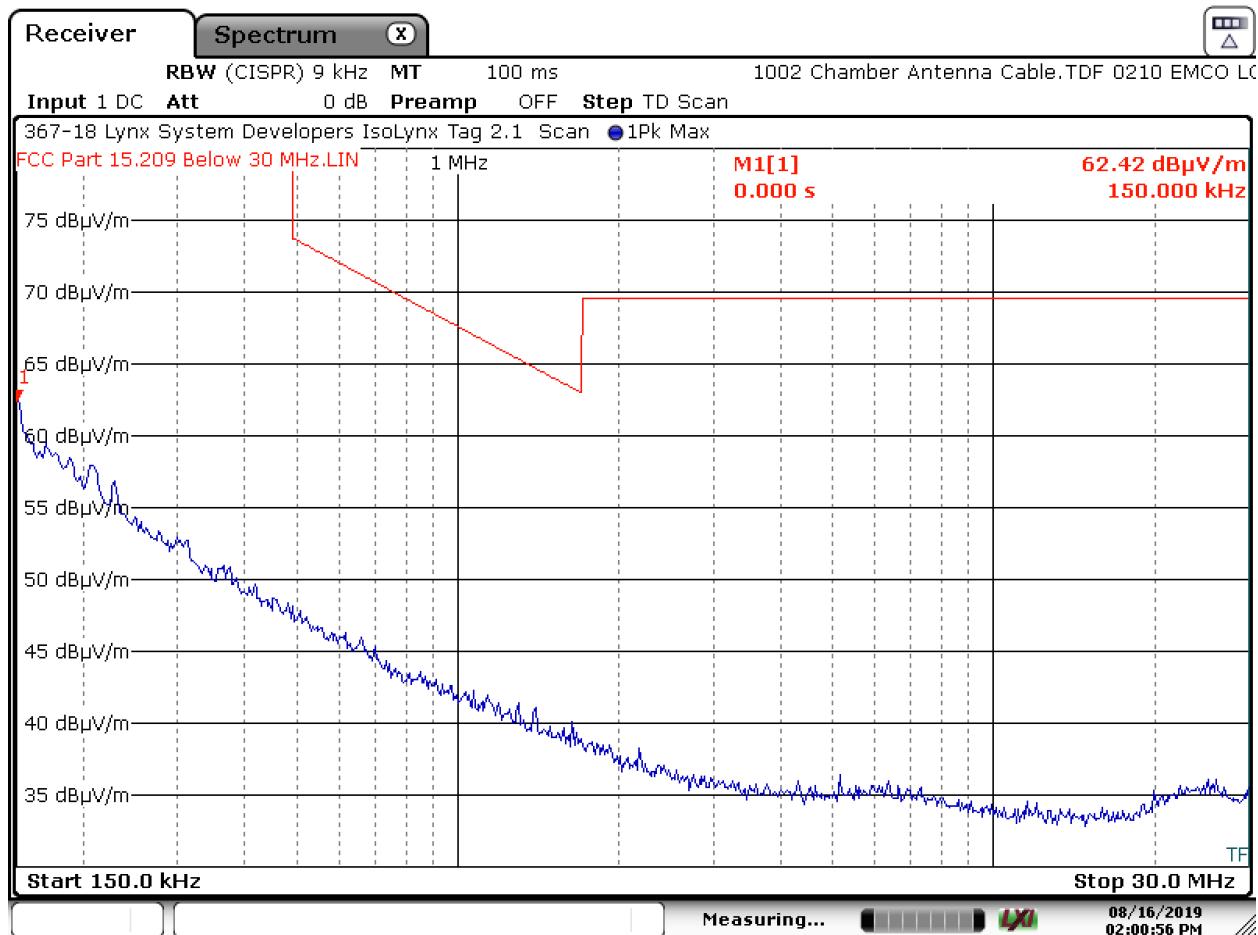
6. Measurement Data (continued)

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

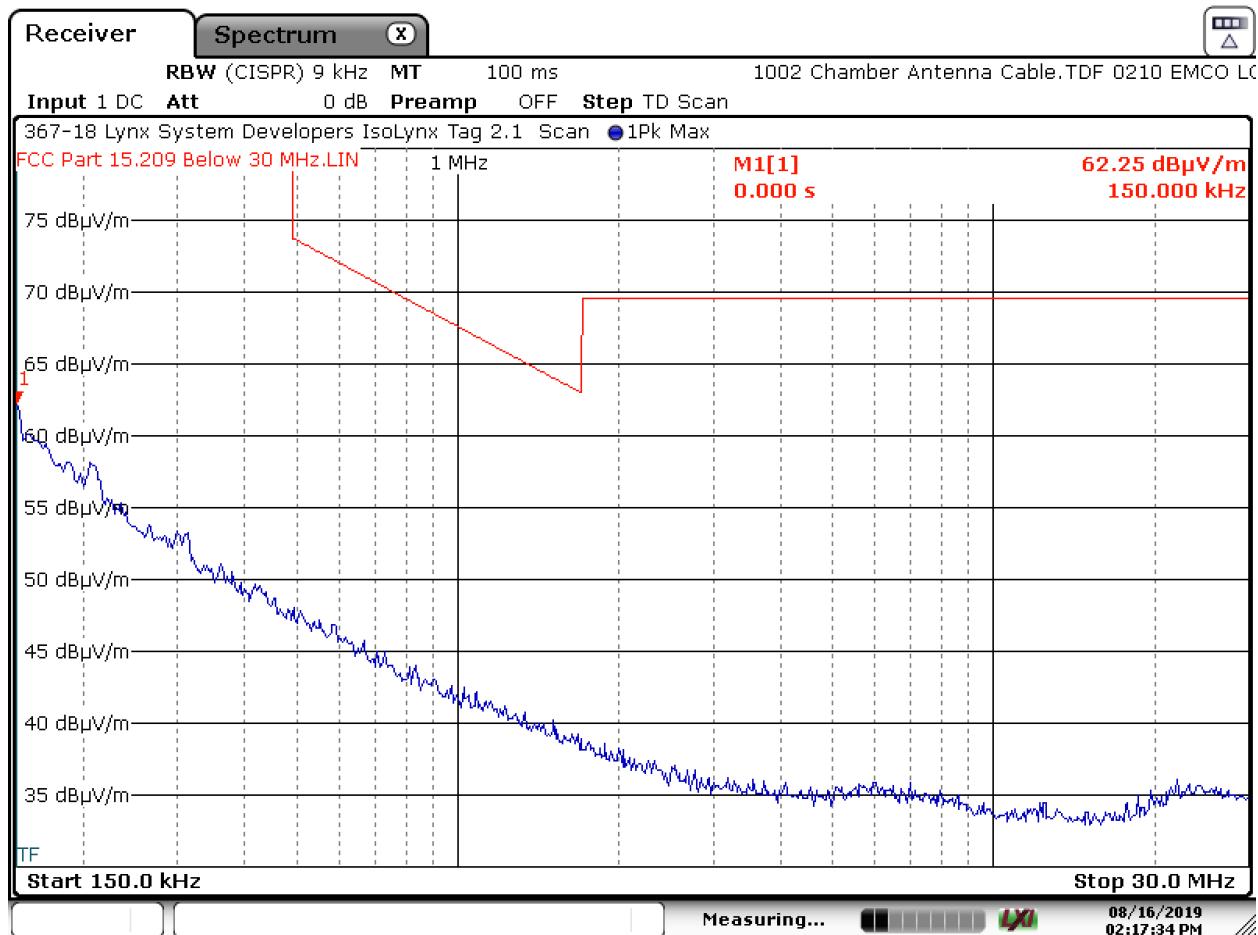
6. Measurement Data (continued)

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

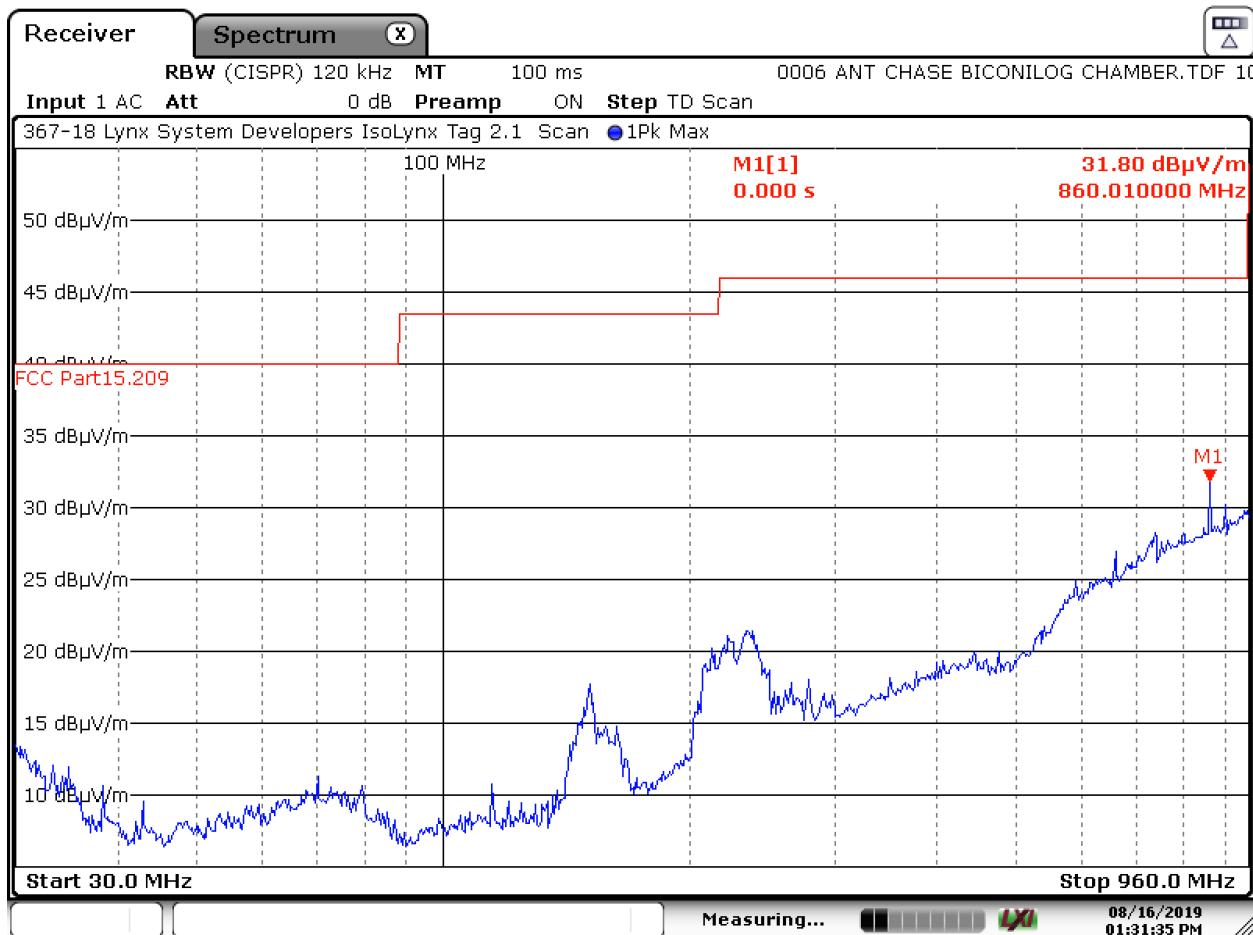
6. Measurement Data (continued)

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

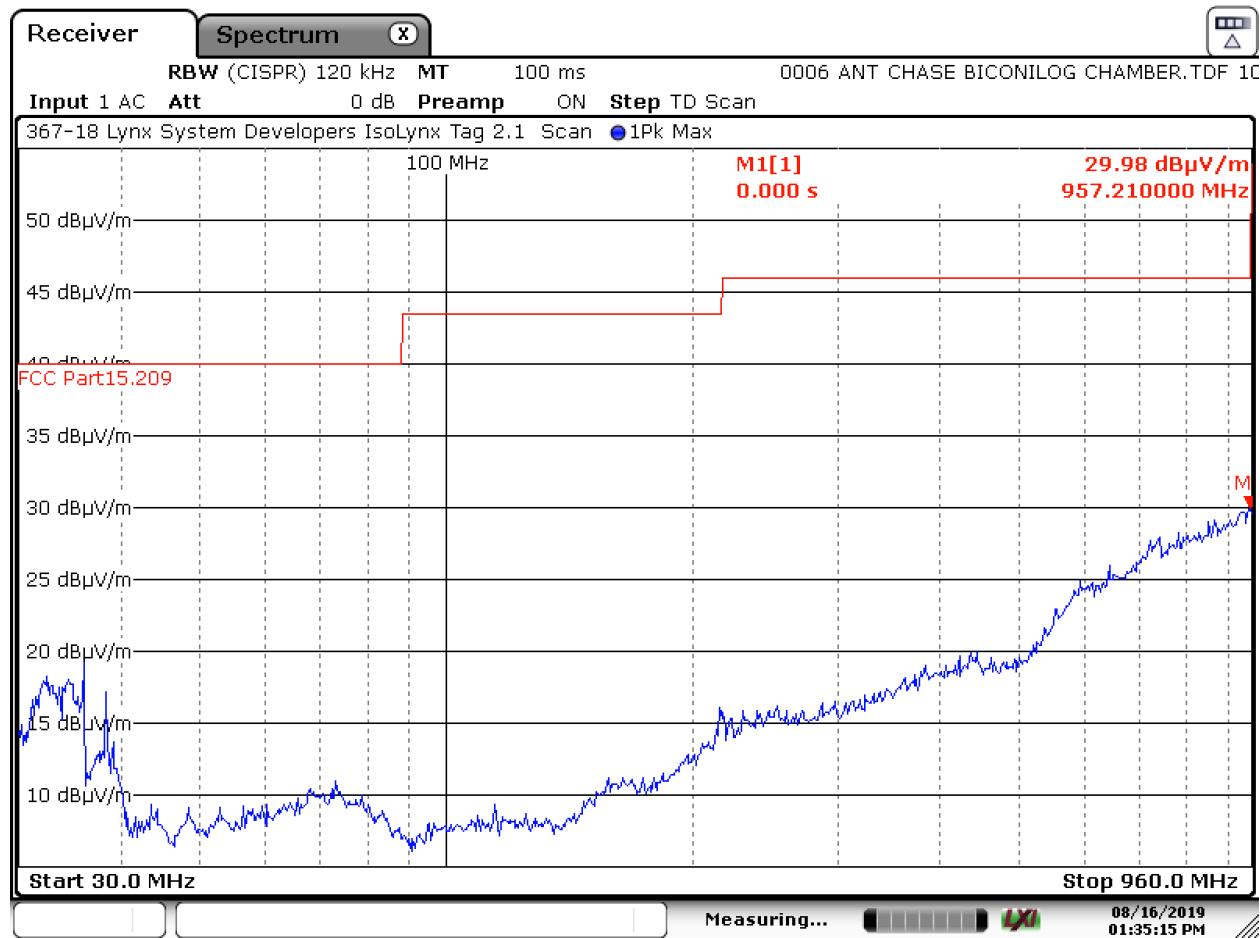
6. Measurement Data (continued)

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

Test Number: 367-18
Issue Date: 8/19/2019

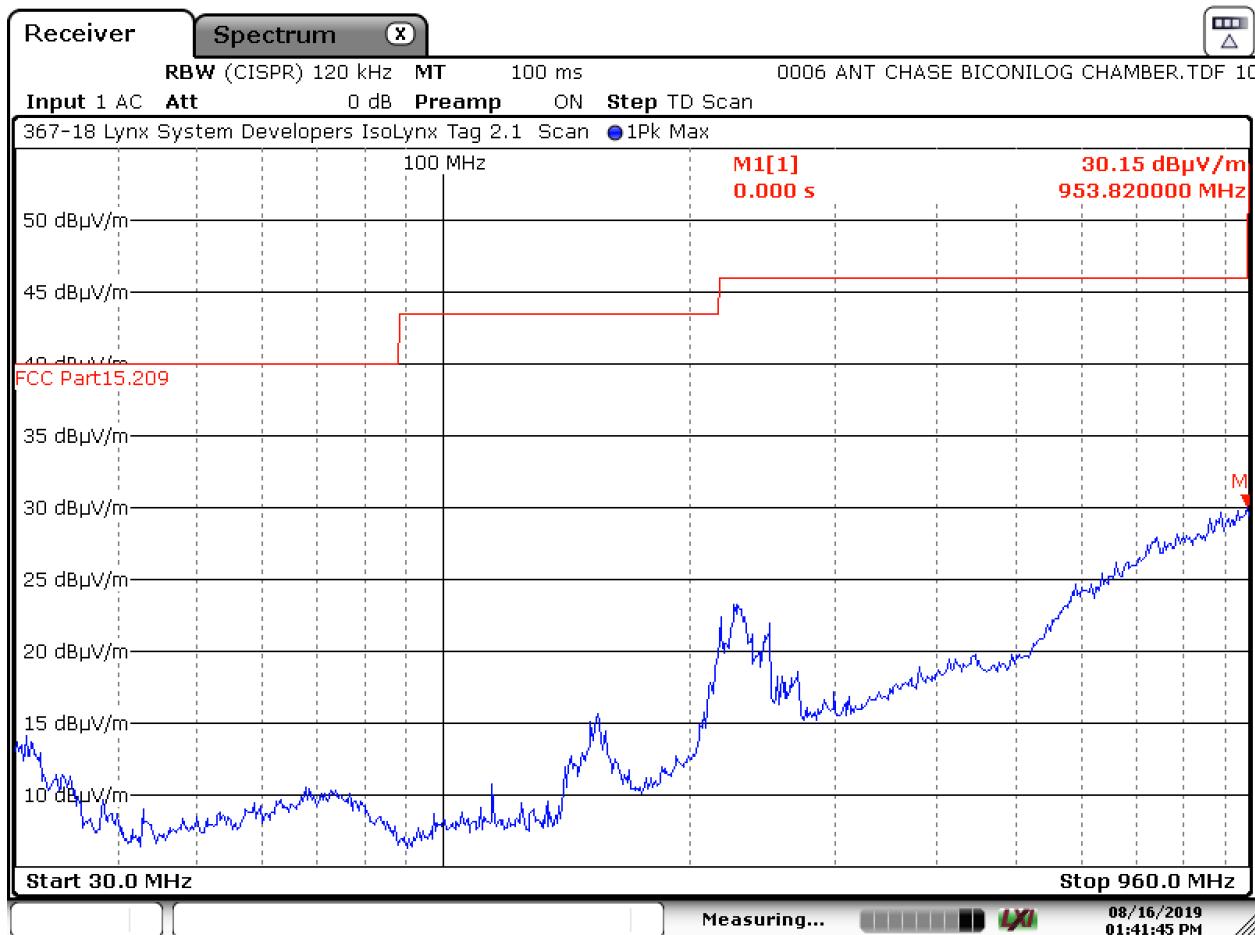
6. Measurement Data (continued)

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.

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



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

Test Number: 367-18
Issue Date: 8/19/2019

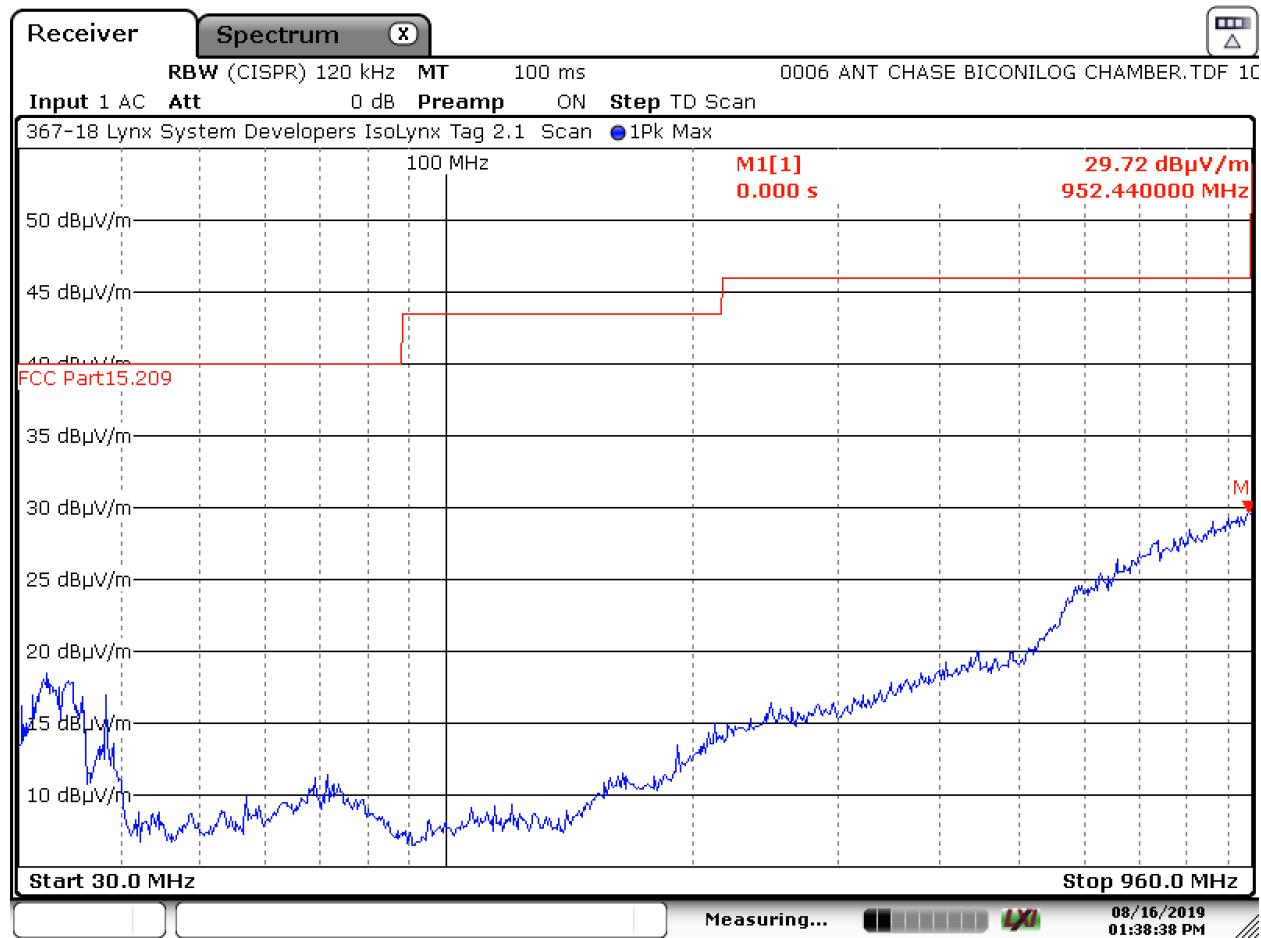
6. Measurement Data (continued)

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

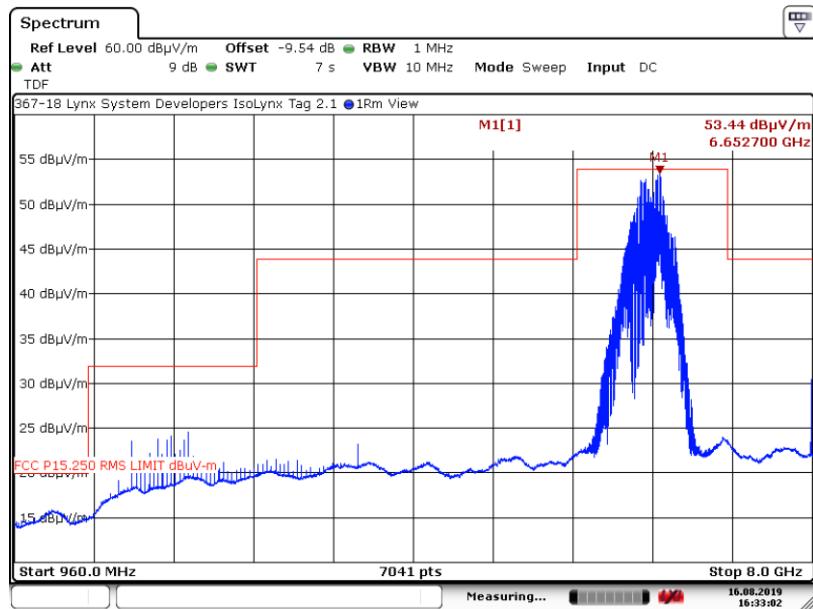
Test Number: 367-18

Issue Date: 8/19/2019

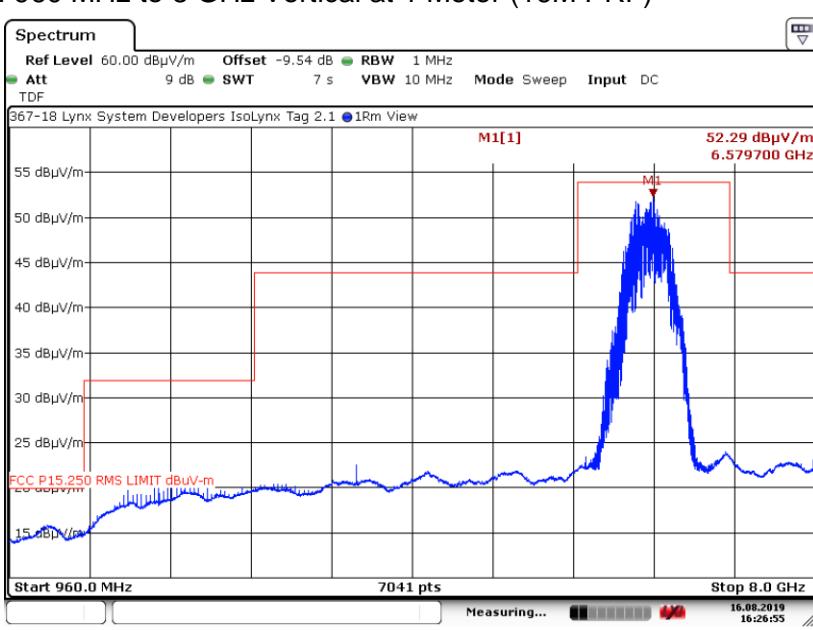
6. Measurement Data (continued)

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)



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



Test Number: 367-18

Issue Date: 8/19/2019

6. Measurement Data (continued)

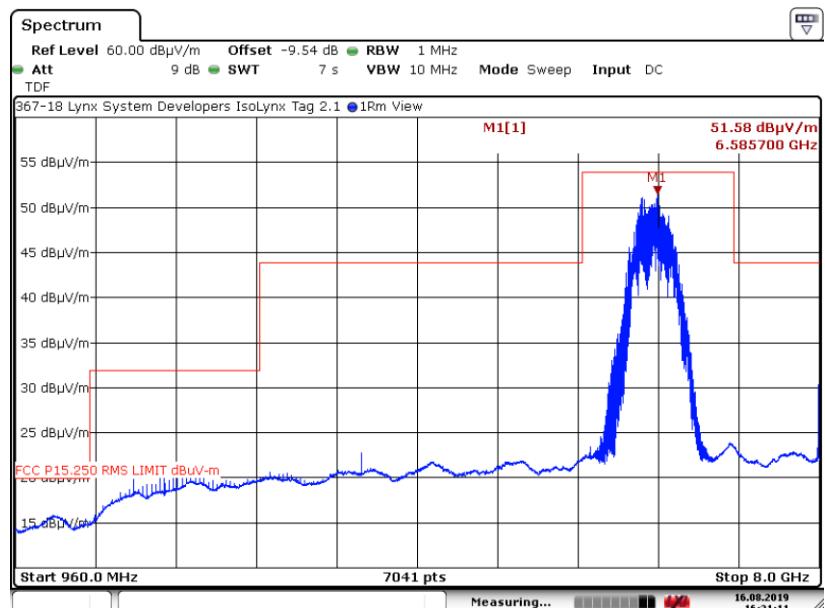
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

6.4.4. 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

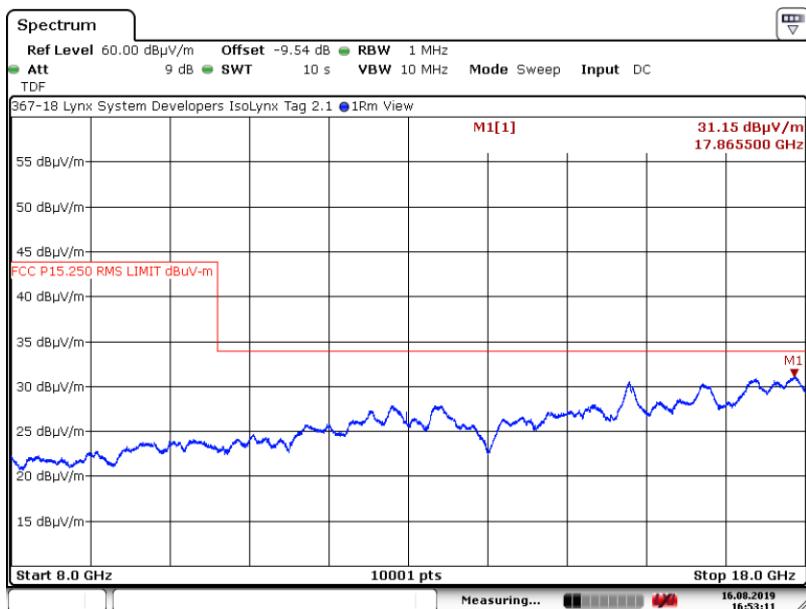
Test Number: 367-18

Issue Date: 8/19/2019

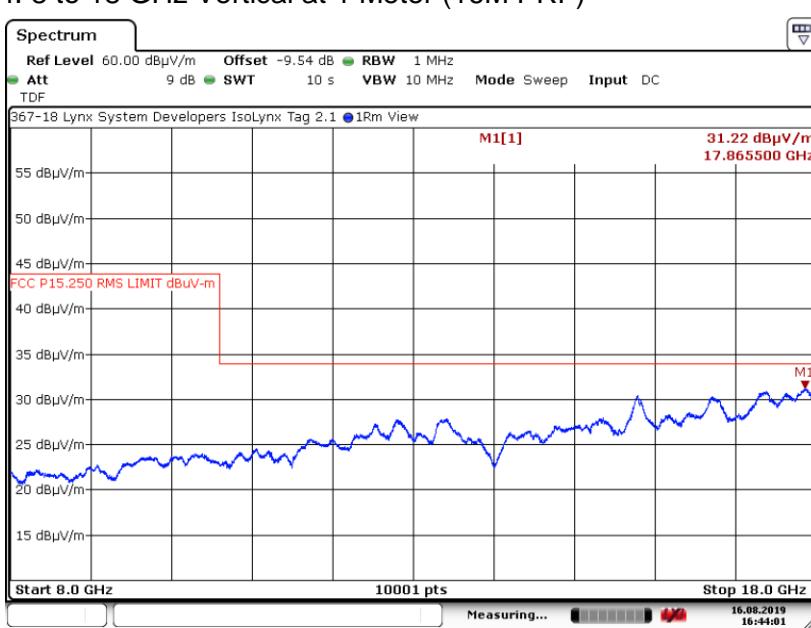
6. Measurement Data (continued)

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)



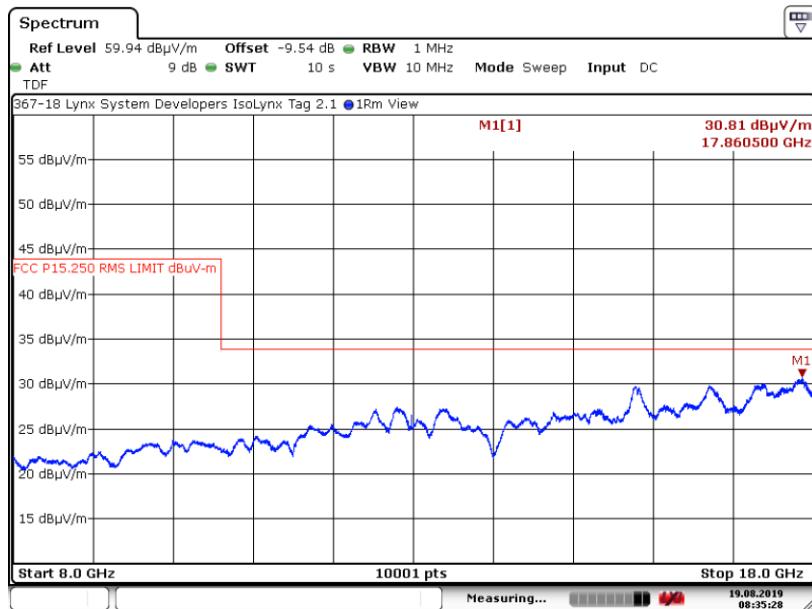
Test Number: 367-18

Issue Date: 8/19/2019

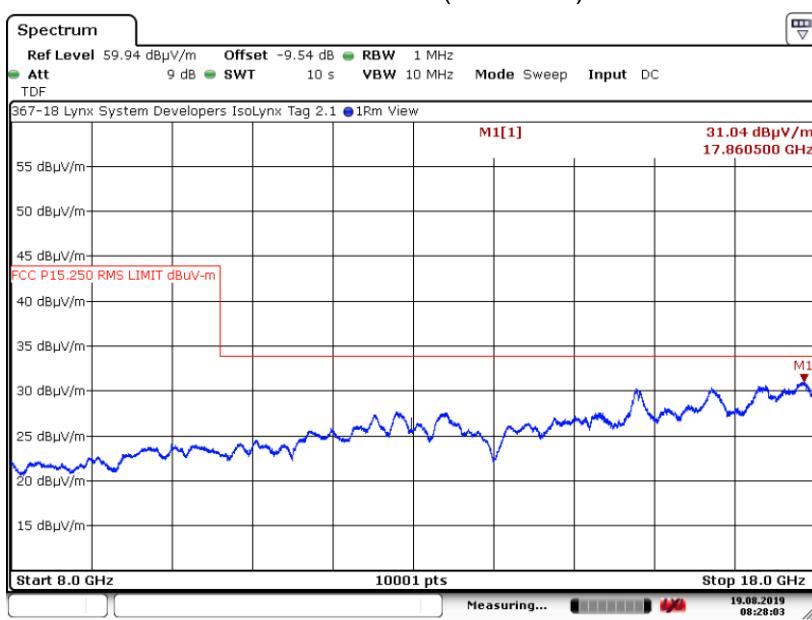
6. Measurement Data (continued)

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)



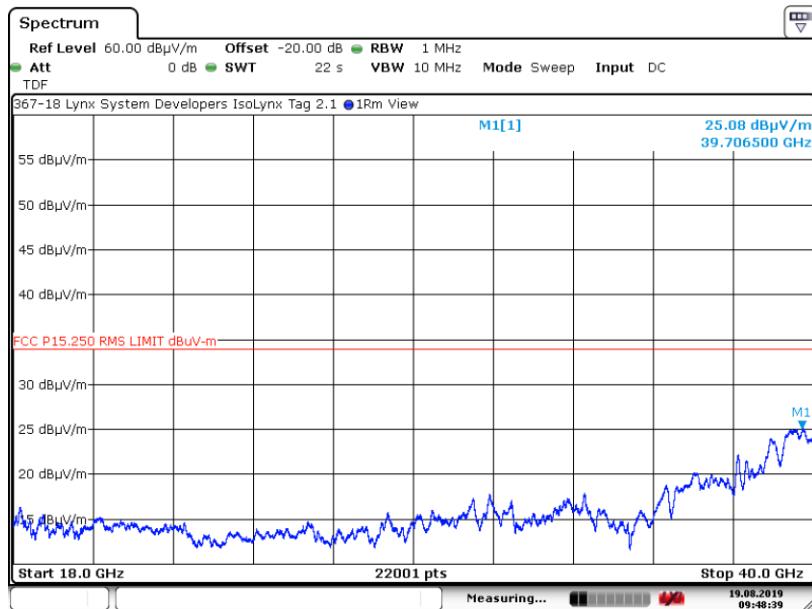
Test Number: 367-18

Issue Date: 8/19/2019

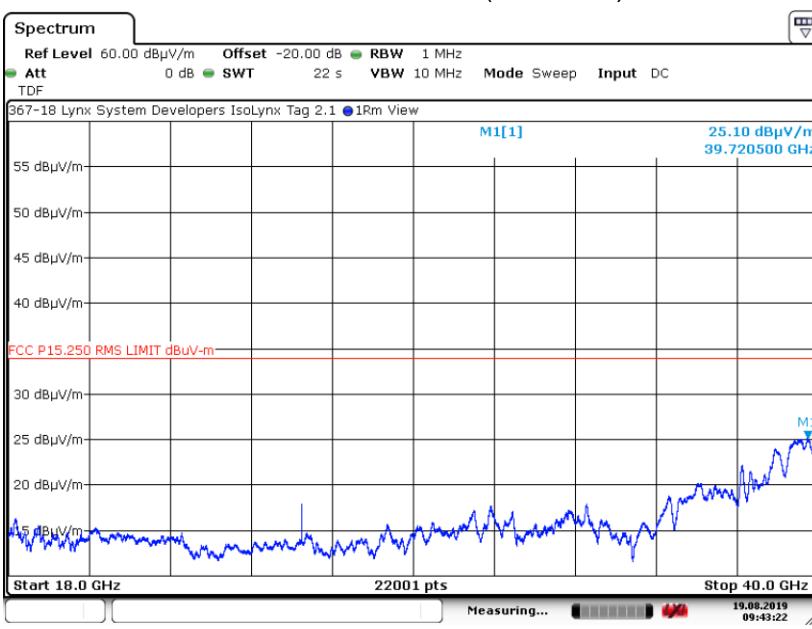
6. Measurement Data (continued)

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)

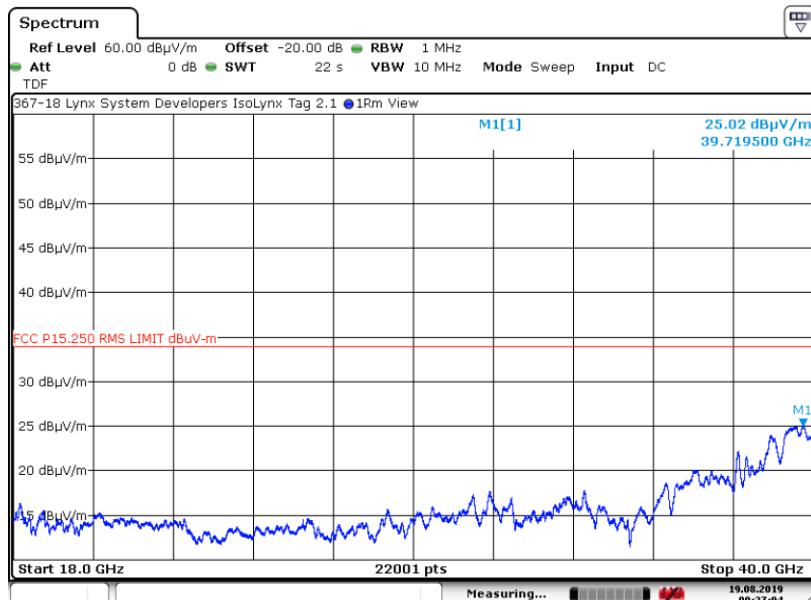


Test Number: 367-18
Issue Date: 8/19/2019

6. Measurement Data (continued)

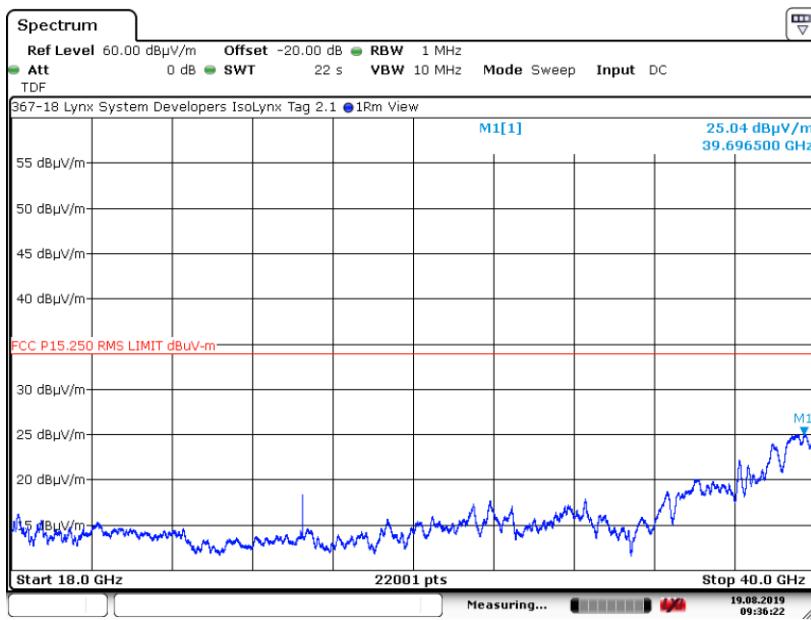
6.4. Spurious Radiated Emissions (15.250 (d) (1), RSS-220 5.3.1 (d) continued)

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



Date: 19.AUG.2019 09:27:04

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



Date: 19.AUG.2019 09:36:21

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))

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 |

6.5.1. 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 dB μ V/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

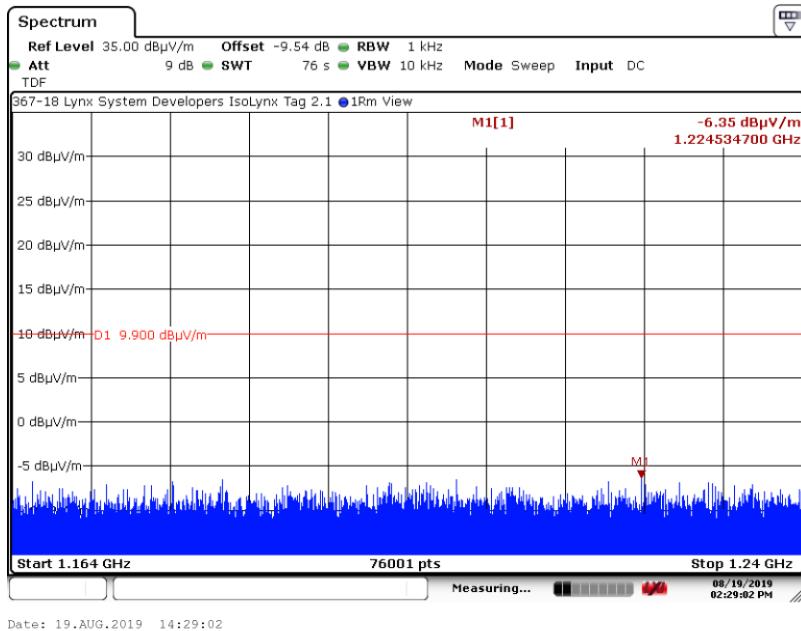
Issue Date: 8/19/2019

6. Measurement Data (continued)

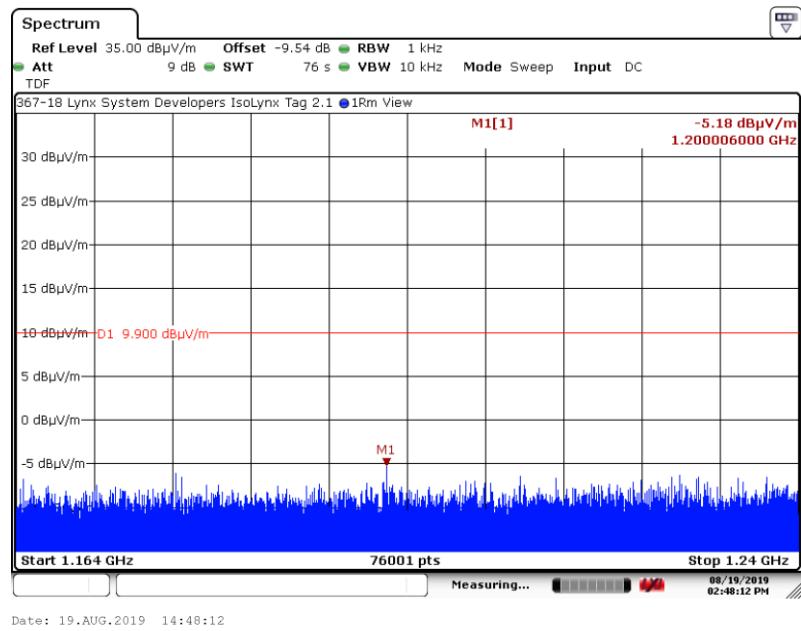
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

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

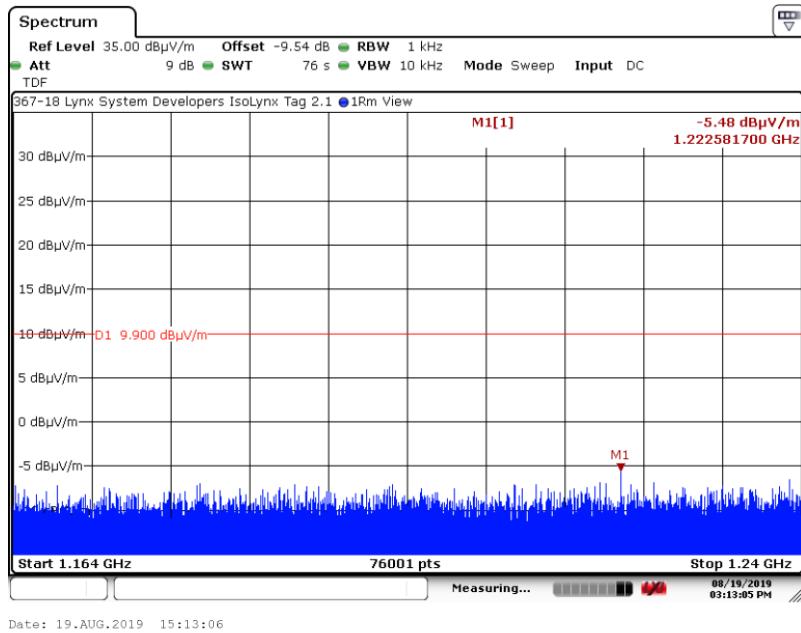
Issue Date: 8/19/2019

6. Measurement Data (continued)

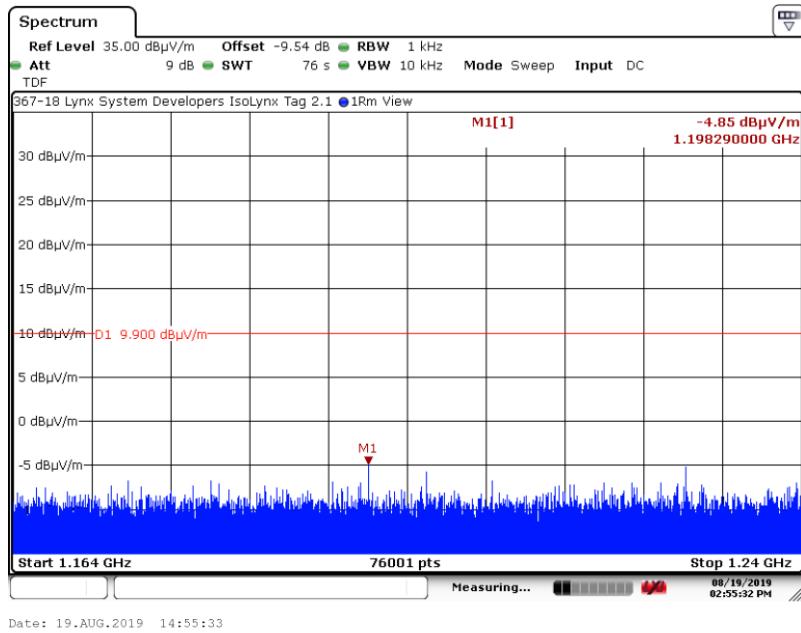
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

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

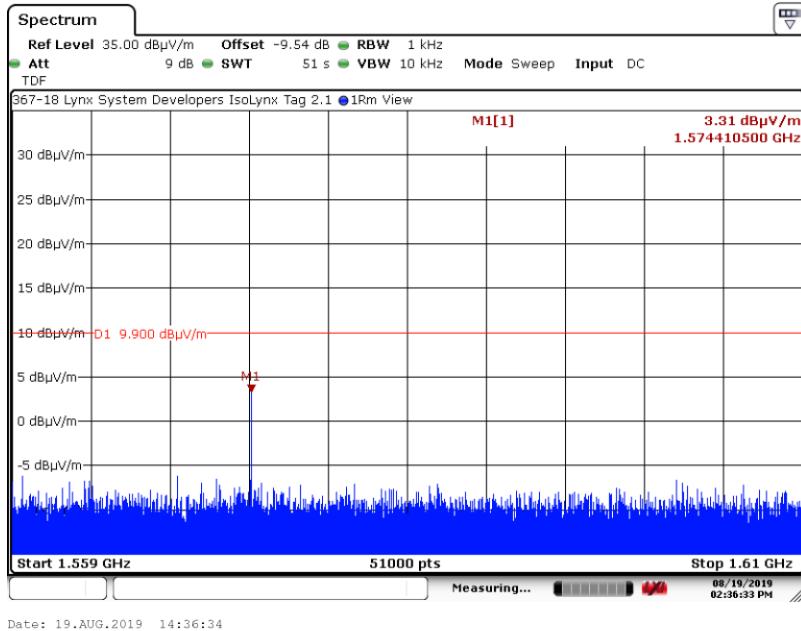
Issue Date: 8/19/2019

6. Measurement Data (continued)

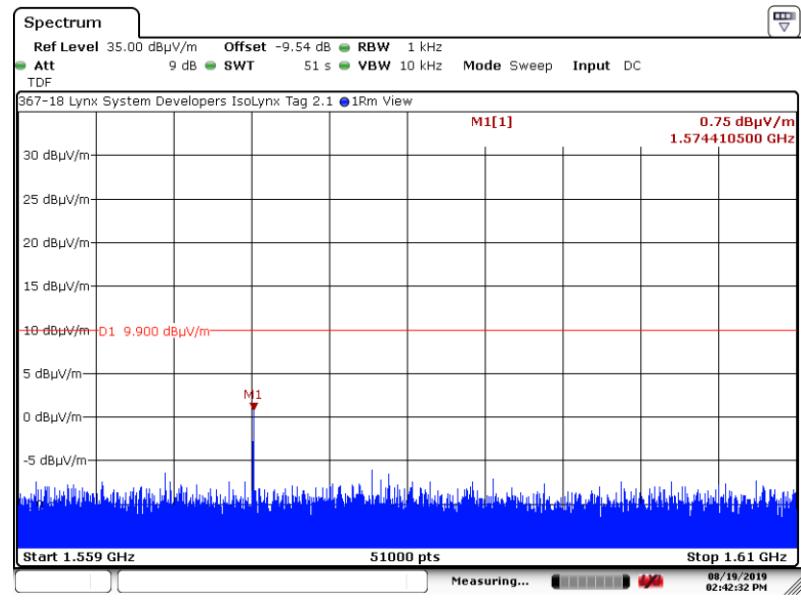
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

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)



Test Number: 367-18

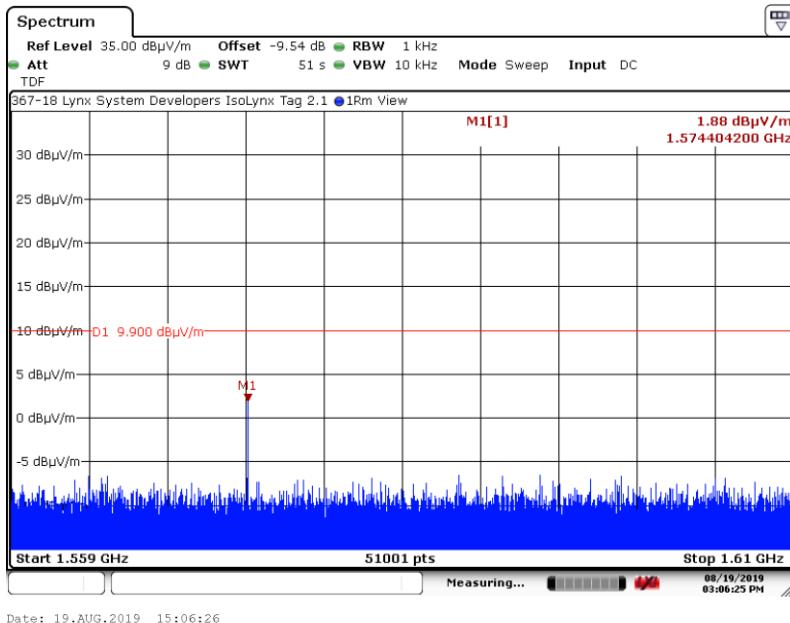
Issue Date: 8/19/2019

6. Measurement Data (continued)

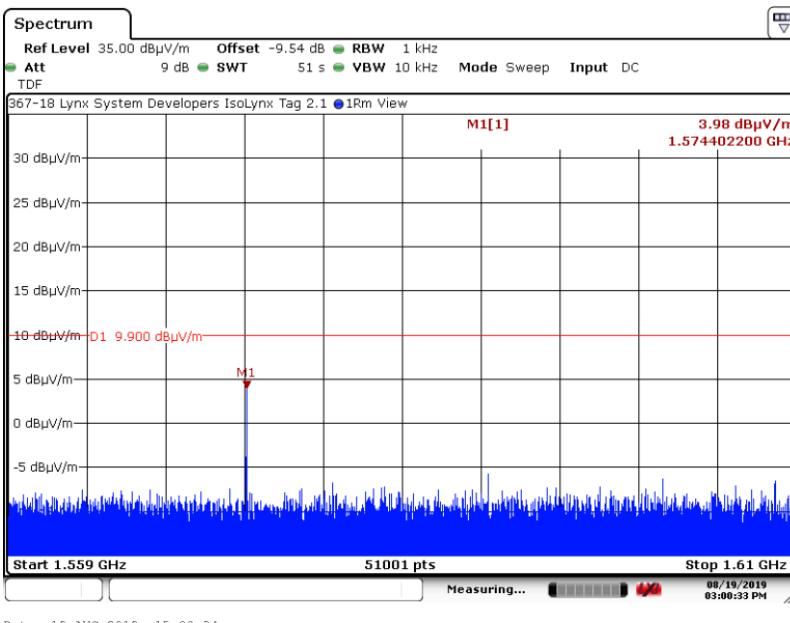
6.5. Spurious Radiated Emissions in GPS Bands (15.250 (d) (2), RSS-220 5.3.1 (e))

6.5.3 1559 to 1610 MHz Band

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



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



Test Number: 367-18**Issue Date: 8/19/2019****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 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

Test Number: 367-18
Issue Date: 8/19/2019

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 |
|-----------------|------------------------|----------------|--------|--------------|------------|-------------------|-----------|
| | (dB μ V/m) | (dB μ V/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 = $E_{\text{meas}} + 20 \log (d_{\text{meas}}) - 104.7$; $d_{\text{meas}} = 3$
 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 | |
| 6.479 | -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

Test Number: 367-18
Issue Date: 8/19/2019

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 |
|-----------------|------------------------|----------------|--------|--------------|------------|-------------------|-----------|
| | (dB μ V/m) | (dB μ V/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 = $E_{\text{meas}} + 20 \log (d_{\text{meas}}) - 104.7$; $d_{\text{meas}} = 3$
 $EIRP (\text{dBm}) = E_{\text{meas}} (\text{dB}\mu\text{V/m}) - 95.2$

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

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



04:04:36 PM 07/19/2019

Test Number: 367-18**Issue Date: 8/19/2019****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

Test Number: 367-18
Issue Date: 8/19/2019

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 |
|-----------------|------------------------|----------------|--------|--------------|------------|-------------------|-----------|
| | (dB μ V/m) | (dB μ V/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, $EIRP = E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$

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

| 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)



Test Number: 367-18
Issue Date: 8/19/2019

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.

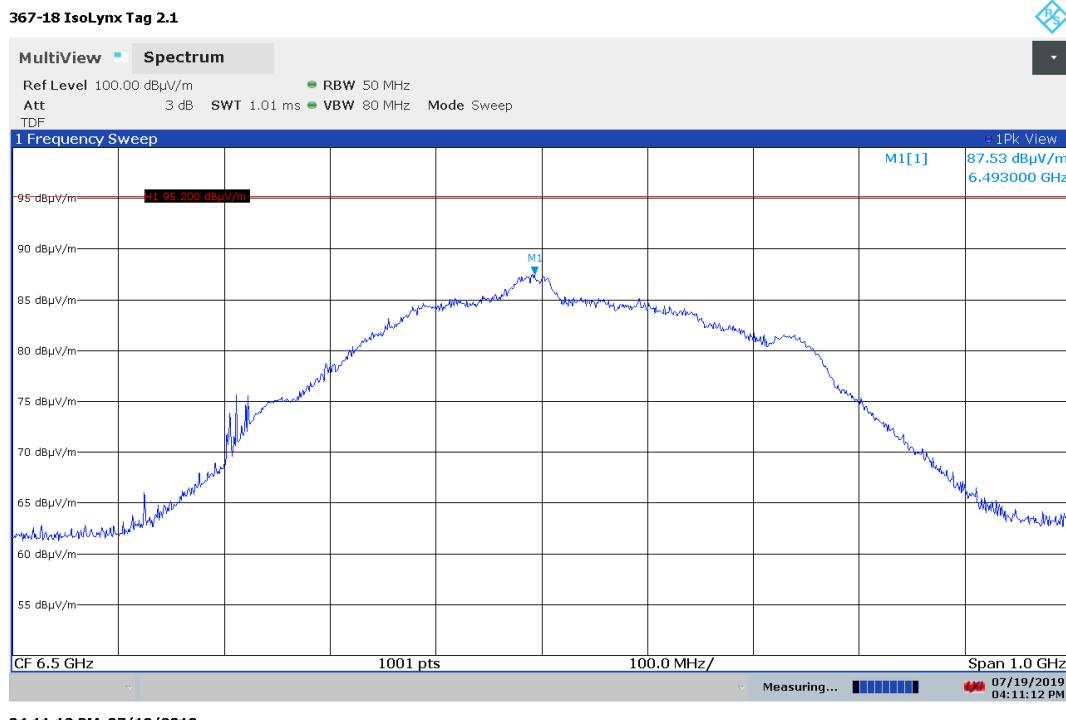
| Frequency (GHz) | Amplitude ¹ | Limit | Margin | Ant Polarity | Ant Height | Turntable Azimuth | Result |
|-----------------|------------------------|----------------|--------|--------------|------------|-------------------|-----------|
| | (dB μ V/m) | (dB μ V/m) | (dB) | H/V | cm | Deg | |
| 6.493 | 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, $EIRP = E_{meas} + 20 \log (d_{meas}) - 104.7$; $d_{meas} = 3$
 $EIRP (\text{dBm}) = E_{meas} (\text{dB}\mu\text{V/m}) - 95.2$

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

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



Test Number: 367-18
Issue Date: 8/19/2019

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

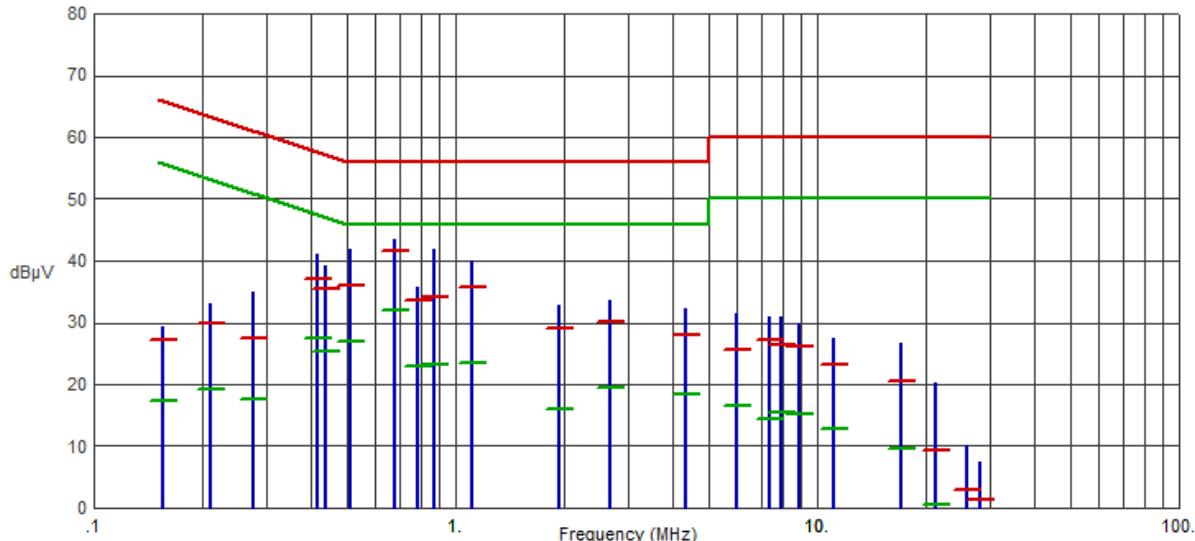
Test measurements were made in accordance with ANSI C63.4-2014, Standard Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronics Equipment in the Range of 9 kHz to 40 GHz.

Test Number: 367-18
Issue Date: 8/19/2019

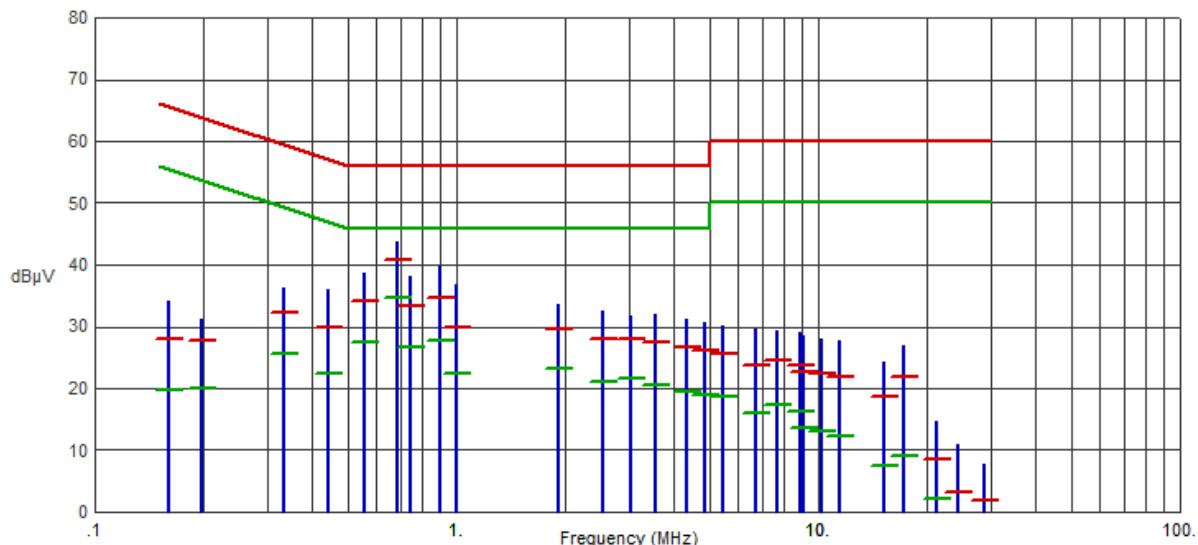
6. Measurement Data (continued)

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 | |

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)
6.9.2. 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 | |

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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)

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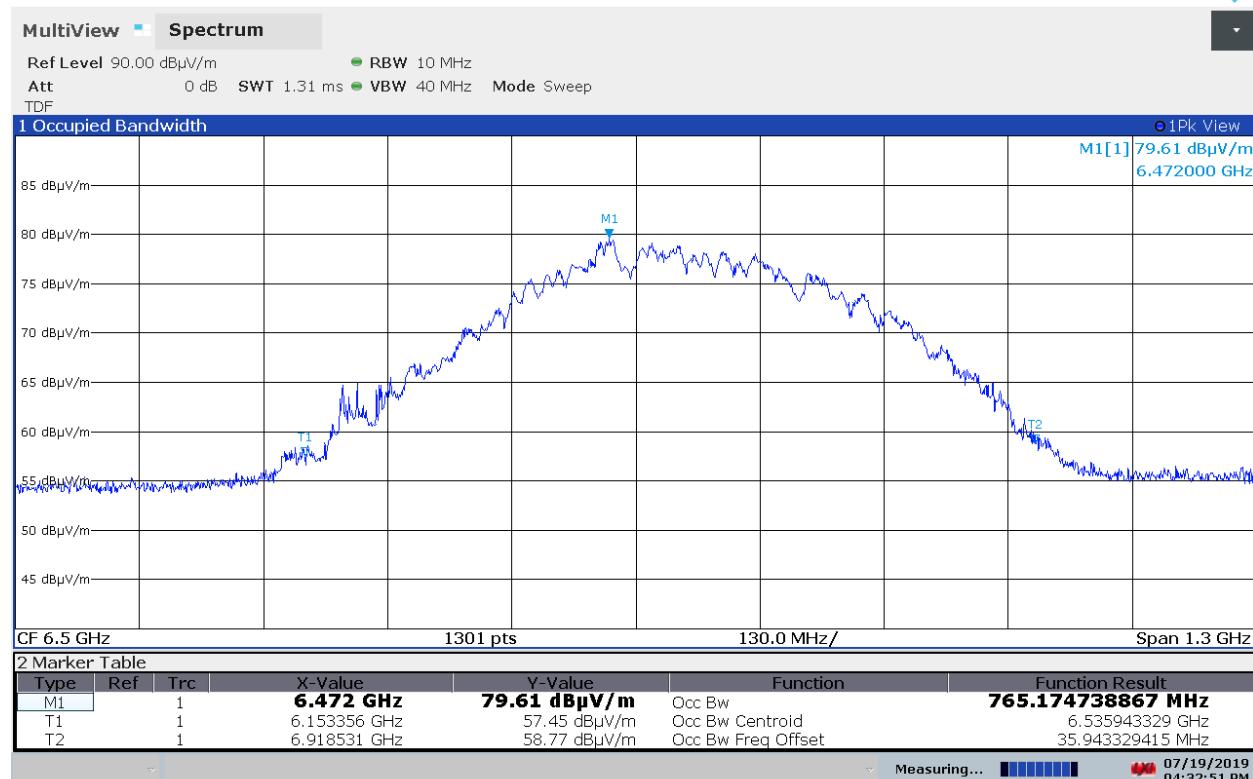

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6. Measurement Data (continued)

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

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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. $20 * \text{LOG} (1.3 \text{ mS} / 12.5 \text{ mS}) = -19.66 \text{ dB}$

The BLE Module and UWB radios do not operate simultaneously.

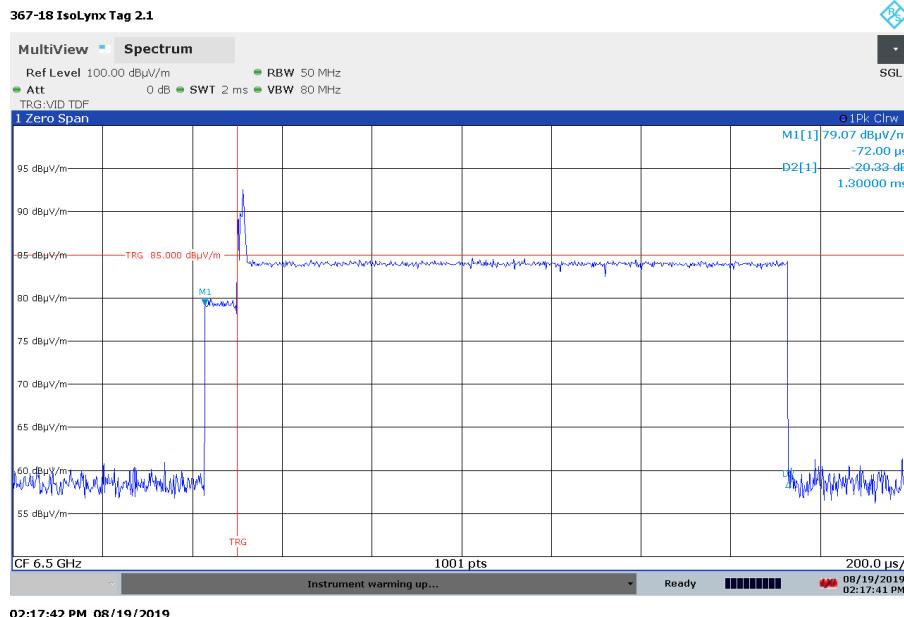
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6. Measurement Data (continued)

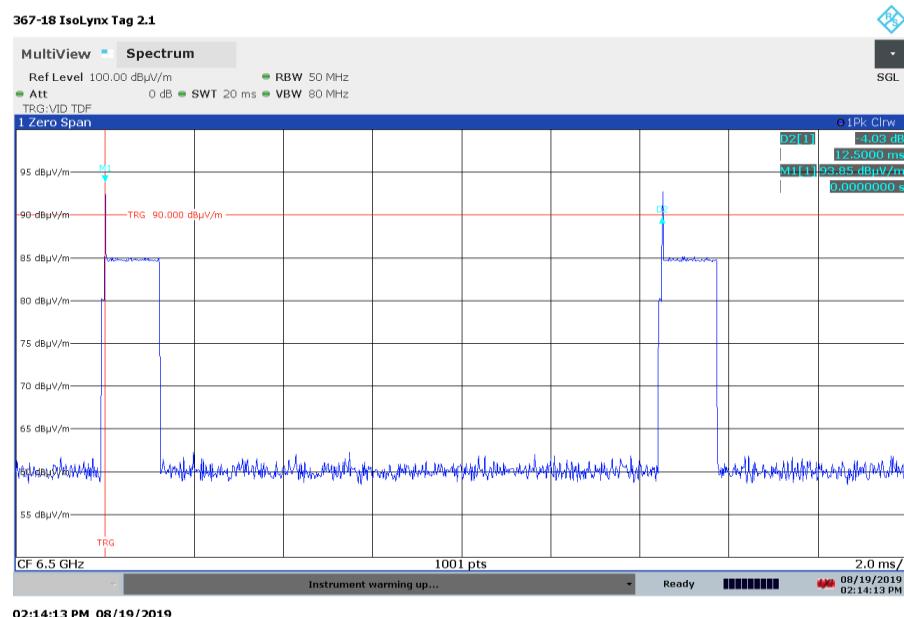
6.11. Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1))

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



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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 |

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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.

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8. Test Images

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



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8. Test Images

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



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8. Test Images

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



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8. Test Images

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



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8. Test Images

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



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8. Test Images

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



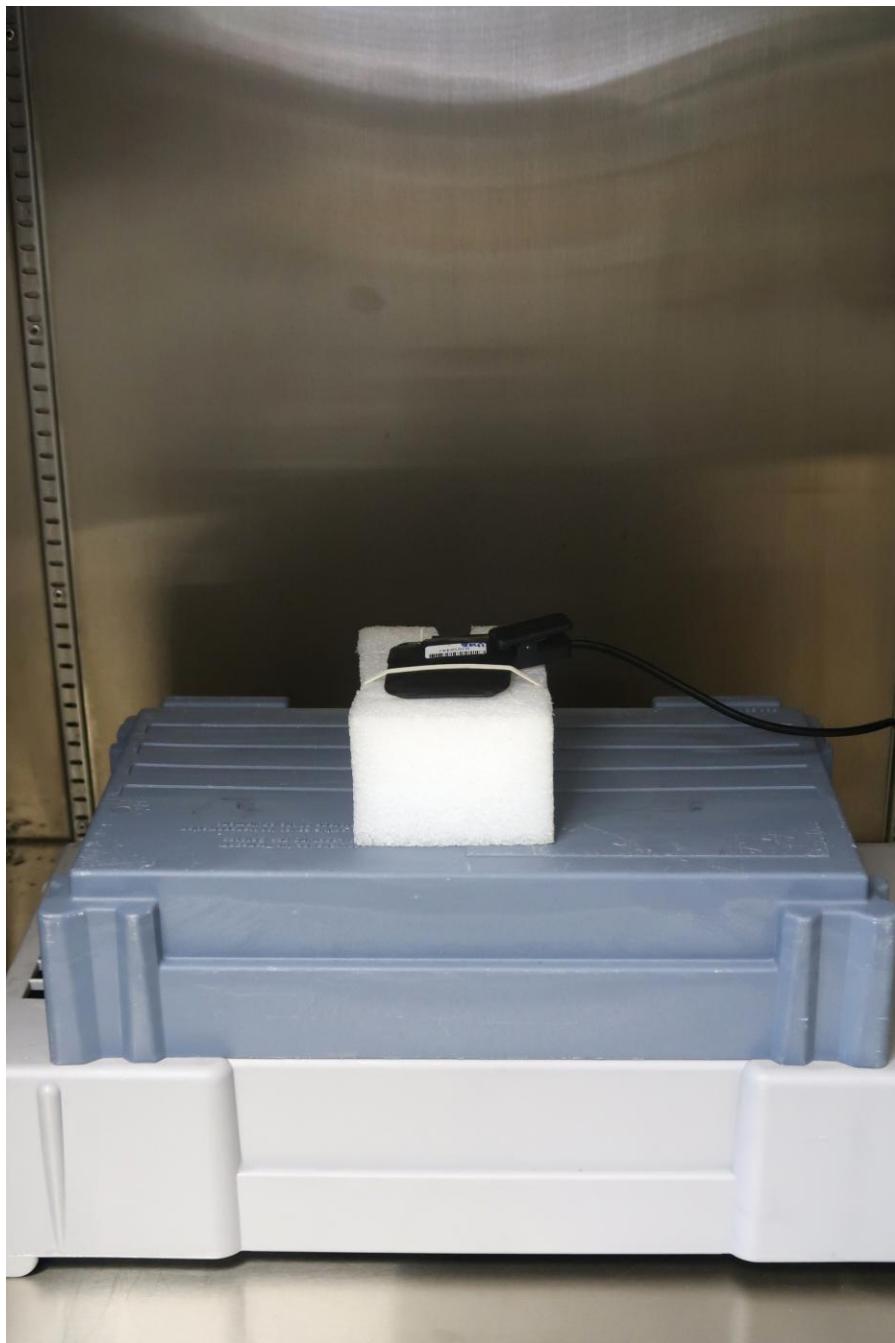
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8. Test Images

8.7. Frequency Stability (Setup)



8. Test Images**8.8. Frequency Stability (EUT)**

8. Test Setup Photographs**8.9. Power Line Conducted Emissions – Front**

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8. Test Setup Photographs

8.10. Power Line Conducted Emissions – Rear

