

## COMPLIANCE WORLDWIDE INC. TEST REPORT 315-23R2

In Accordance with the Requirements of

**Federal Communications Commission 47 CFR Part 15, Subpart F  
Technical Requirements for Ground Penetrating Radar Systems**

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

Issued to

**SPH Engineering SIA  
Dzirnavu iela 62-9  
Riga, LV-1050 Latvia**

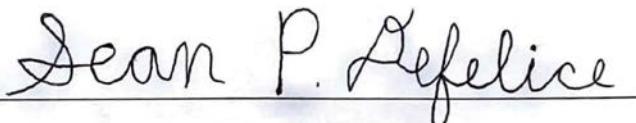
For the

**Ground Penetrating Radar  
Model: Zond Aero 500 NG**

**FCC ID: 2AUQQ-AERO500NG  
IC: 25515-AERO500NG**

**Report Issued on January 31, 2024  
Revision R1 Issued on April 30, 2024  
Revision R2 Issued on May 6, 2024**

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## 1. Scope

This test report certifies that the SPH Engineering Zond Aero 500 NG, as tested, meets the FCC Part 15, Subpart F 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. Measurement Uncertainty will not be applied to any of the measurement / testing results in this test report to determine pass/fail criteria per the Decision Rule as defined in ISO/IEC Guide 17025-2017 Clause 3.7. Revision R1 corrects the upper measurement range to the 10<sup>th</sup> harmonic of the highest 10 dB bandwidth point and adds Section 6.2.1 additional operational requirements. Revision R2 adds an additional page to section 6.6 to specifically call out the requirements of RSS-220 6.2.1g and in the Annex regarding peak measurements.

## 2. Product Details

<b>2.1. Manufacturer:</b>	SPH Engineering SIA.
<b>2.2. Model Number:</b>	Zond Aero 500 NG
<b>2.3. Serial Number:</b>	Pre-production
<b>2.4. Description:</b>	The Zond Aero 500 NG is a 500 MHz GPR antenna used for analyzing various below surface environments.
<b>2.5. Power Source:</b>	11.1 VDC Battery Powered, rechargeable using the supplied Mascot Charger.
<b>2.6. Hardware Revision:</b>	Rev B
<b>2.7. Software Revision:</b>	N/A
<b>2.8. Modulation Type:</b>	Pulse
<b>2.9. Operating Frequency:</b>	500 MHz, nominal
<b>2.10. EMC Modifications:</b>	None

## 3. Product Configuration

### 3.1 Operational Characteristics & Software

1. Turn on the notebook and start up the Prism 2 software.
2. Turn on the GPR antenna and allow the unit to boot up.
3. Configure the GPR antenna to perform a scan

### 3.2. EUT Hardware

Manufacturer	Model	Serial Number	Description/Function
SPH Engineering	Zond Aero 500 NG	Pre production	Ground Penetrating Radar

### 3.3. EUT Cables/Transducers

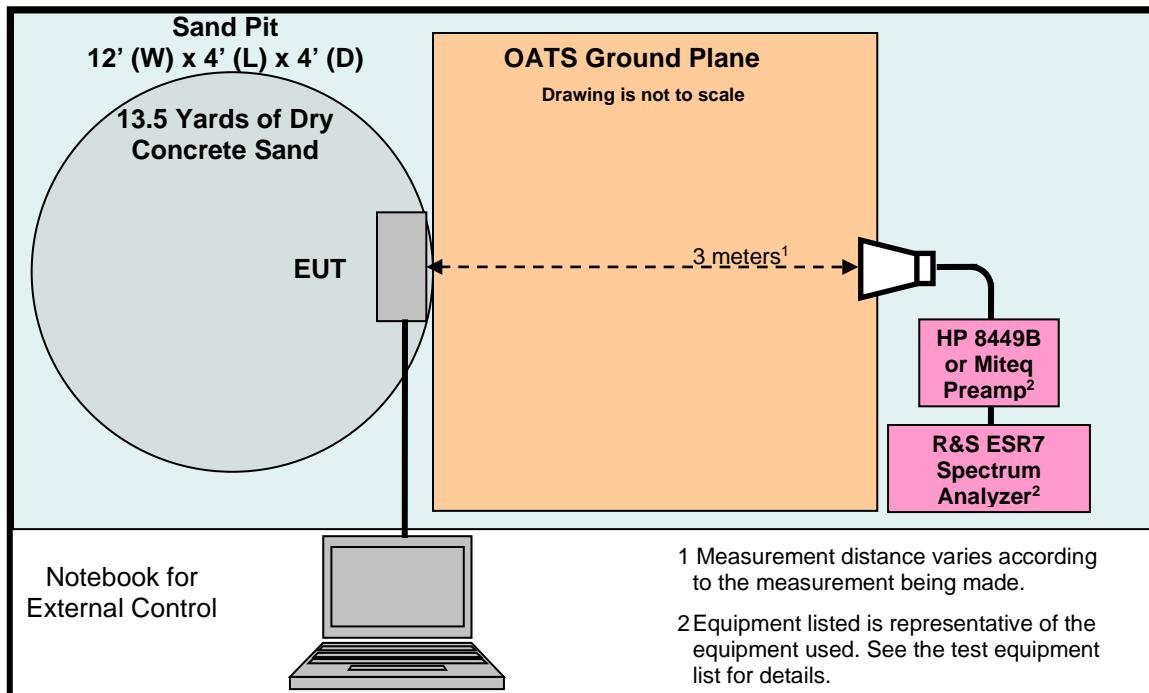
Manufacturer	Model/Part #	Length (m)	Shield Y/N	Description/Function
Any	Ethernet Cable	6	N	Cable from control notebook to GPR Antenna
Any	Power Cable	2M	N	Power Cable for Charger (conducted only)

### 3. Product Configuration (continued)

#### 3.4. Support Equipment

Device	Manufacturer	Model	Serial No.	Comment
Laptop	Lenovo	P50	PC0MHJ8Y	For setting up EUT

#### 3.5. Test Setup Diagram



#### 4. Measurements Parameters

##### 4.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due	Cal Interval
EMI Test Receiver, 9kHz to 7GHz <sup>1</sup>	Rohde & Schwarz	ESR7	101156	10/26/2024	3 years
EMI Test Receiver, 10 Hz to 7GHz <sup>1</sup>	Rohde & Schwarz	ESR7	101770	7/23/2024	3 years
Spectrum Analyzer 20 Hz to 40 GHz <sup>2</sup>	Rohde & Schwarz	FSV40	100899	8/12/2024	4 years
Spectrum Analyzer 9 kHz to 40 GHz <sup>3</sup>	Rohde & Schwarz	FSVR40	100909	9/18/2024	4 years
Preamp 100 MHz – 7 GHz	Miteq	AFS3-01000200-10-15P-4	988773	9/28/2024	1 year
Preamplifier 100 MHz to 18 GHz	Miteq	AMF-7D-00101800-30-10P	1953081	9/27/2024	1 year
Bilog Antenna 30 to 2000 MHz	Com-Power	AC-220	25509	12/13/2024	4 years
Horn Antenna 960 MHz to 18 GHz	ETS-Lindgren	3117	00227631	4/21/2025	3 years
Horn Antenna 960 MHz to 18 GHz	ETS-Lindgren	3117	00143292	5/11/2025	3 years
Barometric Pressure / Humidity / Temperature Data Logger	Extech Instruments	SD700	Q590483	10/14/2024	3 years

<sup>1</sup> ESR7 Firmware revision: V3.48 SP3, Date installed: 09/30/2020

Previous V3.48 SP2, installed 07/23/2020.

<sup>2</sup> FSV40 Firmware revision: V2.30 SP4, Date installed: 05/04/2016

Previous V2.30 SP1, installed 10/22/2014.

<sup>3</sup> FSVR40 Firmware revision: V2.23 SP1, Date installed: 08/19/2016

Previous V2.23, installed 10/22/2014.

##### 4.2. Measurement & Equipment Setup

Test Date:	10/9/2023, 10/12/2023, 11/13/2023, 11/14/2023, 1/12/2024, 4/29/2024
Test Engineer:	Sean Defelice
Normal Site Temperature (15 - 35°C):	24
Relative Humidity (20 - 75%RH):	35
Frequency Range:	30 MHz to 10 GHz
Measurement Distance:	3 Meters
EMI Receiver IF Bandwidth:	120 kHz - 30 MHz to 960 MHz 1 MHz - Above 960 MHz
EMI Receiver Avg Bandwidth:	≥ 3 * RBW or IF(BW)
Detector Function:	Peak, Quasi-Peak, EMI Average and RMS Average

#### 4. Measurements Parameters (continued)

##### 4.3. Measurement Procedures

Test measurements were made in accordance FCC Part 15.509, 15.521, ISED RSS-220 Issue I, RSS-Gen, Issue 5, ANSI C63.10:2013 Clause 10 and KDB Publication 393764 D01 UWB FAG v01, dated July 31, 2015.

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

In accordance with ANSI C63.10:2013, Section 10.2.2, the device under test was placed on a bed of dry sand and rotated through 16 azimuth angles (per Clause 5.4) to determine which produced the highest emission relative to the limit. The azimuth that produced the highest emission relative to the limit was used for all radiated emission measurements.

##### 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 10 GHz	$\pm 4.55$ dB
Radiated Emission of Receiver	$\pm 4.55$ 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-GEN 6.8	6.1	Compliant	The antenna is housed within a sealed enclosure with the intentional radiator.
Operational Requirements	15.509 (b)	RSS-220 Section 1 Section 6.2.1 (b)	6.2	Compliant	
Additional Operational Requirements	N/A	RSS-220 6.2.1(b)	6.2.1	Compliant	The notebook computer software controls the on and off functions of the UWB signal
UWB Bandwidth	15.503 (a) 15.509 (a)	RSS-220 Section 6.2.1 (a)	6.3	Compliant	
Spurious Radiated Emissions	15.509 (d) 15.209	RSS-220 Section 3.4 Section 6.2.1 (d)	6.4	Compliant	
Radiated Emissions in GPS Bands	15.509 (e) 15.209	RSS-220 Section 6.2.1 (e)	6.5	Compliant	
Peak Emissions in a 50 MHz Bandwidth	15.509 (f)	RSS-220 Section 6.2.1 (f)	6.6	Compliant	
Conducted Emissions	15.207	RSS-GEN 8.8	6.7 6.8	Compliant	
99% Occupied Bandwidth	N/A	RSS-GEN 6.7	6.9	Compliant	

## 6. Measurement Data

### 6.1. Antenna Requirement (FCC Part 15.203, ISED RSS GEN 6.8)

Requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply.

Result: The antenna utilized by the device under test is an internal, non-user replaceable unit.

### 6.2. Operational Requirements of the Device under Test (15.509 (b) RSS-220 6.2)

Requirement: Operation under the provisions of this section is limited to GPRs and wall imaging systems operated for the purposes with law enforcement, fire fighting, emergency rescue, scientific research, commercial mining, or construction.

Result: The manufacturer states that the device under test complies with the requirements outlined in section FCC Part 15.509 (b) and RSS-220 Section 6.2.

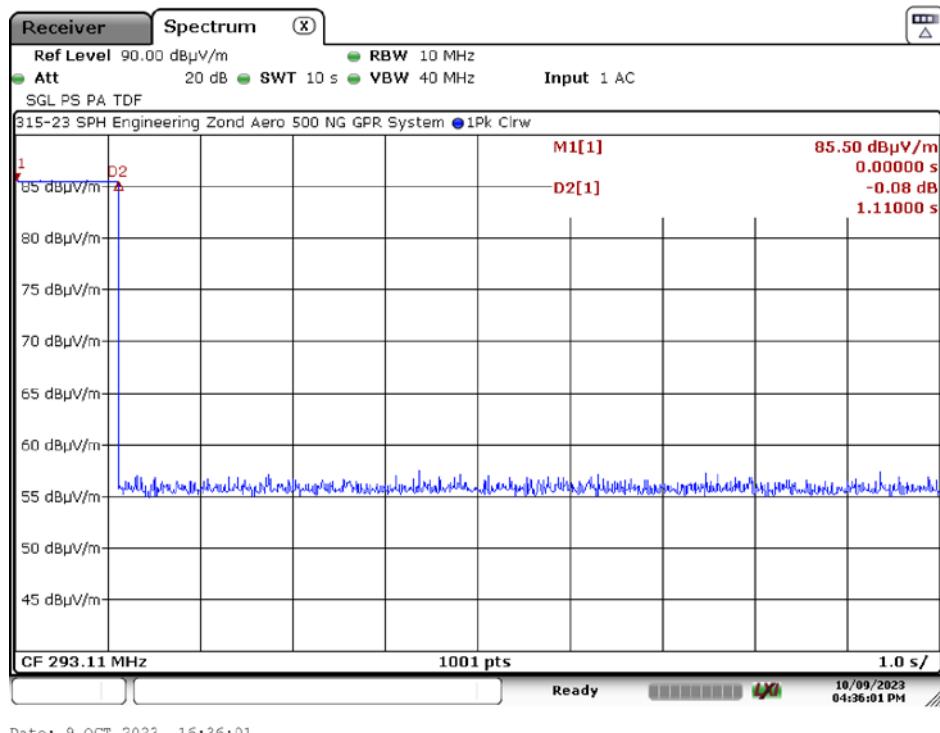
## 6. Measurement Data (continued)

### 6.2.1 Additional Operational Requirements RSS-220 6.2.1 (b)

**Requirement:** A device operating under the provisions of this section shall contain a mechanism that deactivates the equipment when normal use is interrupted. For manually operated hand-held devices, this mechanism shall contain a manual switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of remotely/computer-controlled equipment with a switch located on the radar imaging device, it is permissible to operate the device by a remote-control unit provided that deactivation takes place within 10 seconds of the remote switch being released by the operator.

**Result:** Compliant. The software used with the GPR device immediately stops the UWB transmission when the stop button is selected. The device also contains a manual power on-off switch which immediately disables the unit from transmitting.

#### 6.2.1.1 Plot of Ceased Transmission



**Note:** Technician pressed "STOP" via the software and the unit responded with ceasing transmission within a 1/2 second.

## 6. Measurement Data (continued)

### 6.3. UWB Bandwidth (15.503 (a), 15.509 (a), RSS-220 Section 6.2.1 (a))

Requirement: The UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated  $f_H$  and the lower boundary is designated  $f_L$ . The frequency at which the highest radiated emission occurs is designated  $f_M$ . The center frequency  $f_C$ , equals  $(f_H + f_L) / 2$ . The fractional bandwidth equals  $2 * (f_H - f_L) / (f_H + f_L)$ .

Result: Compliant.

Requirement: The UWB bandwidth of an imaging system operating under the provisions of this section must be below 10.6 GHz.

Result: Compliant.

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**Issue Date: 5/6/2024**

## 6. Measurement Data (continued)

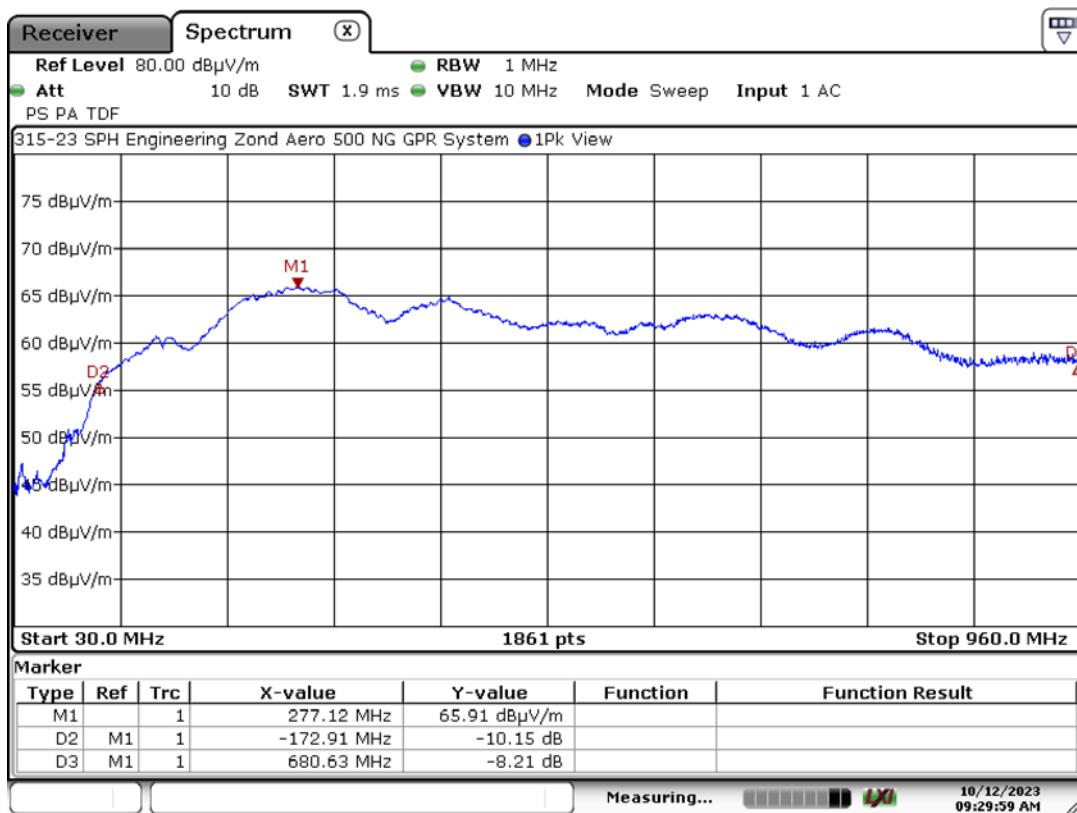
### 6.3. UWB Bandwidth (15.503 (a), 15.509 (a), RSS-220 Section 6.2.1 (a) continued)

#### 6.3.1. Measurement Data (Values in GHz)

$f_M$	The highest emission peak	0.27712
$f_L$	10 dB below the highest peak	0.10421
$f_H$	10 dB above the highest peak	0.95775
$f_C$	Calculated: $(f_H + f_L)/2$	0.53098
Bandwidth	Calculated: $(f_H - f_L)$	0.85354
Fractional BW	Calculated: $2*(f_H - f_L)/(f_H + f_L)$	<b>1.60748</b>

**Note:** The Fraction Bandwidth is greater than 0.2 and therefore the minimum UWB Bandwidth of 500 MHz requirement does not need to be met.

#### 6.3.2. Measurement Plot of 10 BW in Anechoic Chamber = 853.54 MHz



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**6. Measurement Data (continued)**
**6.4. Spurious Radiated Emissions (15.509 (d), 15.209. RSS-220 Section 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. Limits are converted from EIRP (dBm) to field strength at 3 meters using a conversion factor of 95.2.

Frequency (MHz)	EIRP (dBm)	Field Strength (dB $\mu$ V/m)
960 - 1610	-65.3	29.9
1610 - 1990	-53.3	41.9
1990 - 3100	-51.3	43.9
3100 - 10600	-41.3	53.9
Above 10600	-51.3	43.9

**Radiated Emissions Field Strength Limits at 3 Meters (Section 15.209, RSS-220 3.4)**

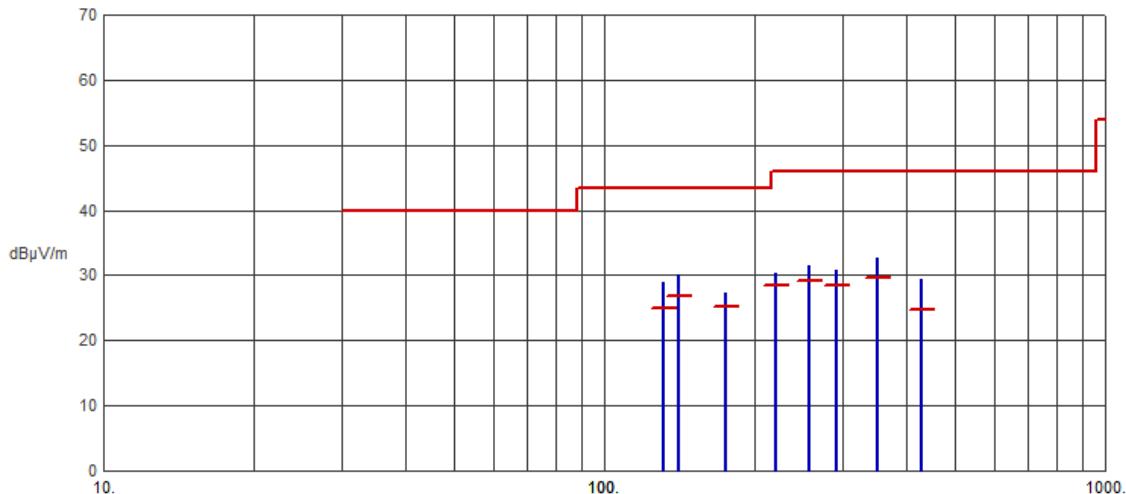
Frequency (MHz)	Field Strength ( $\mu$ V/m)	Field Strength (dB $\mu$ V/m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0

Test Notes: Refer to Section 4.1 for the test equipment used and Section 4.2 for the test equipment setups.

Sample Calculation: Final Result (dB $\mu$ V/m) = Measurement Value (dB $\mu$ V) + Antenna Factor (dB/m) + Cable Loss (dB) – Pre-amplifier Gain (dB) Internal or External.

**Note:** All correction factors are loaded into the measurement instrument prior to testing to determine the final result.

**Test Number: 315-23R2**
**Issue Date: 5/6/2024**
**6. Measurement Data (continued)**
**6.4. Spurious Radiated Emissions (15.209, RSS-220 Section 3.4 continued)**
**6.4.1. 30 MHz to 960 MHz, Horizontal Polarity**

 Test No.: 315-23, Radiated Emissions - Horizontal Polarity FCC, Class B


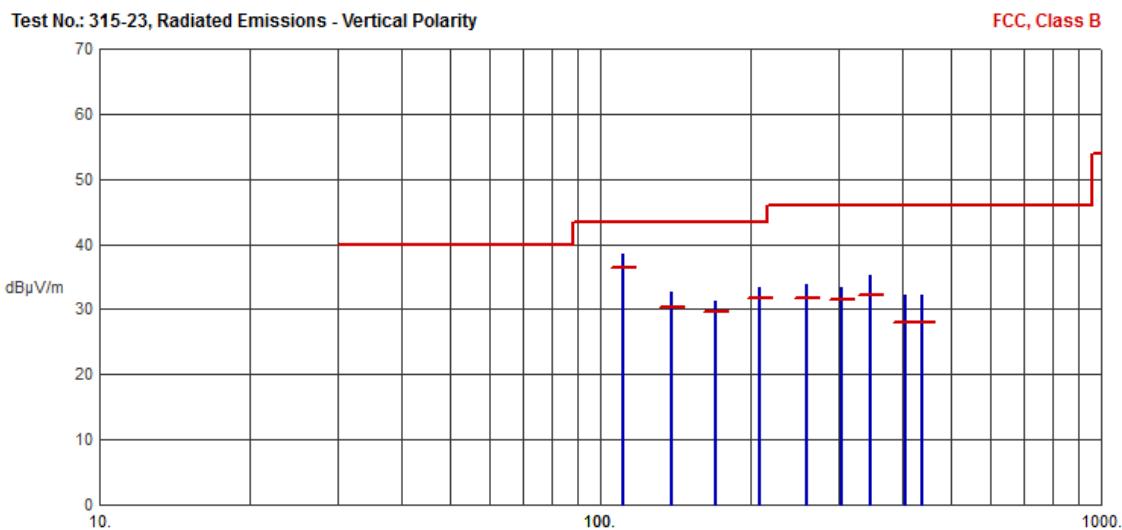
Frequency (MHz)	Pk Amp (dB $\mu$ V/m)	QP Amp (dB $\mu$ V/m)	QP Limit (dB $\mu$ V/m)	Margin (dB)	Ant Ht (cm)	Table (Deg)	Comments
130.9700	28.89	24.98	43.50	-18.52	N/A	N/A	
141.1700	30.21	26.94	43.50	-16.56	N/A	N/A	
175.2200	27.33	25.16	43.50	-18.34	N/A	N/A	
219.8000	30.31	28.48	46.00	-17.52	N/A	N/A	
257.2700	31.52	29.17	46.00	-16.83	N/A	N/A	
290.3900	30.78	28.54	46.00	-17.46	N/A	N/A	
350.1500	32.65	29.63	46.00	-16.37	N/A	N/A	
430.0400	29.33	24.69	46.00	-21.31	N/A	N/A	

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## 6. Measurement Data (continued)

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

#### 6.4.2. 30 MHz to 960 MHz, Vertical Polarity



Frequency (MHz)	Pk Amp (dB $\mu$ V/m)	QP Amp (dB $\mu$ V/m)	QP Limit (dB $\mu$ V/m)	Margin (dB)	Ant Ht (cm)	Table (Deg)	Comments
110.8377	38.54	36.46	43.50	-7.04	N/A	N/A	
138.3808	32.77	30.45	43.50	-13.05	N/A	N/A	
170.2634	31.24	29.70	43.50	-13.80	N/A	N/A	
208.0402	33.40	31.67	43.50	-11.83	N/A	N/A	
259.1300	33.85	31.65	46.00	-14.35	N/A	N/A	
304.0100	33.45	31.53	46.00	-14.47	N/A	N/A	
346.4300	35.30	32.27	46.00	-13.73	N/A	N/A	
406.4900	32.09	28.10	46.00	-17.90	N/A	N/A	
438.3800	32.16	28.02	46.00	-17.98	N/A	N/A	

**6. Measurement Data (continued)**
**6.4. Spurious Radiated Emissions (15.509 (d), RSS-220 Section 6.2.1 (d))**
**6.4.5. 960 MHz to 10 GHz**
**6.4.5.1 RMS Power 960 to 10 GHz Horizontal Polarity**

Frequency (MHz)	RMS Amp (dB $\mu$ V/m)	RMS Limit (dB $\mu$ V/m)	Margin (dB)	Ant Ht (cm)	Oreintation (Deg)	Comments
1011.4	25.81	29.90	-4.09	287	315	
1081.4	25.40	29.90	-4.50	107	315	
1169.3	26.18	29.90	-3.72	150	315	
1217.2	26.31	29.90	-3.59	145	315	
1489.9	23.35	29.90	-6.55	103	315	
1589.8	23.55	29.90	-6.35	211	315	

**Notes:** Using: 1 MHz RBW / 10 MHz VBW and 1mS/MHz RMS Average Detector. There were no measurable signals above 1.6 GHz.

**6. Measurement Data (continued)**
**6.4. Spurious Radiated Emissions (15.509 (d), RSS-220 Section 6.2.1 (d))**
**6.4.5. 960 MHz to 10 GHz**
**6.4.5.2 Plot of RMS Power 960 to 10 GHz Vertical Polarity**

Frequency (MHz)	RMS Amp (dB $\mu$ V/m)	RMS Limit (dB $\mu$ V/m)	Margin (dB)	Ant Ht (cm)	Orientation (Deg)	Comments
1045.4	28.15	29.90	-1.75	117	225	
1118.3	29.12	29.90	-0.78	106	225	
1179.3	28.32	29.90	-1.58	110	225	
1241.2	27.44	29.90	-2.46	101	225	
1443.0	25.16	29.90	-4.74	100	225	
1555.9	25.06	29.90	-4.84	102	225	

**Notes:** Using: 1 MHz RBW / 10 MHz VBW and 1mS/MHz RMS Average Detector. There were no measurable signals above 1.6 GHz.

## 6. Measurement Data (continued)

### 6.5. Spurious Radiated Emissions in GPS Bands (15.509 (e), RSS-220 6.2.1 (e))

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

Frequency (MHz)	EIRP (dBm)	Field Strength (dB $\mu$ V/m) at 3 Meters
1164 - 1240	-75.3	19.9
1559 - 1610	-75.3	19.9

#### 6.5.1. Measurement & Equipment Setup

EMI Receiver IF Bandwidth: 1 kHz

EMI Receiver Avg Bandwidth: 10 kHz

Detector Function: RMS Average, 1mS/point

#### 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. The -75.3 dBm limit was converted to a field strength limit of 19.9 dB $\mu$ V/m using a distance correction factor of 95.2 at 3 meters.

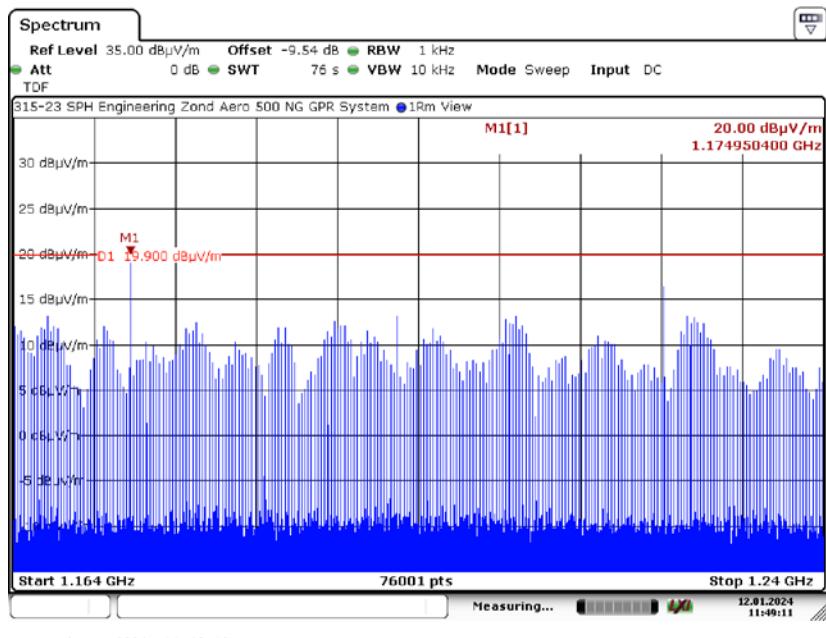
**Note:** There are several narrowband signals in the 1164 to 1240 MHz band related to digital circuitry within the device as shown with the device transmitting the UWB signal and then with the UWB transmission off that are not subjected to the 15.509 limit and only need to comply with the 15.209 limits.

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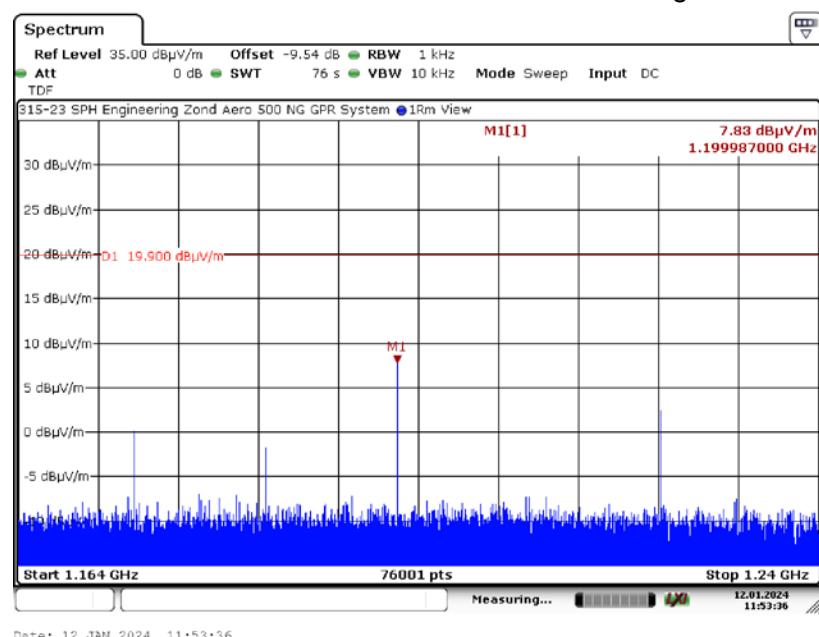
## 6. Measurement Data (continued)

### 6.5.4 Spurious Radiated Emissions in GPS Bands (15.509 (e) continued)

#### 6.5.4.1 1164 to 1240 MHz – Horizontal - Transmitting



#### 6.5.4.2 1164 to 1240 MHz – Horizontal – Not Transmitting

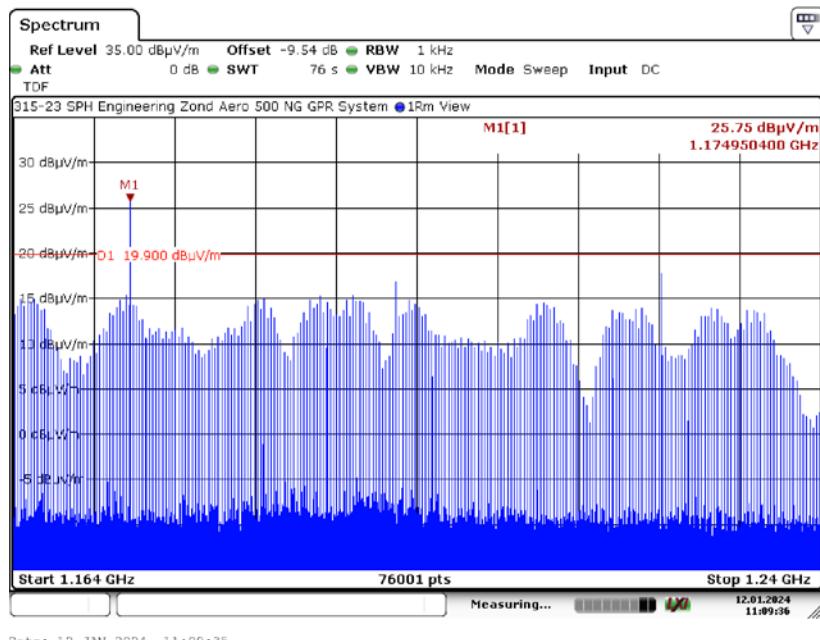


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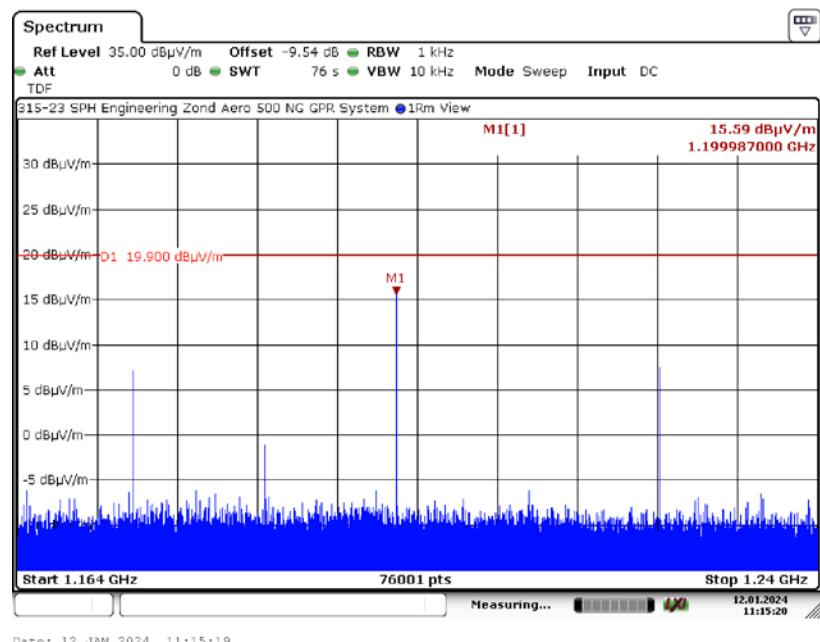
## 6. Measurement Data (continued)

### 6.5.4 Spurious Radiated Emissions in GPS Bands (15.509 (e) continued)

#### 6.5.4.3 1164 to 1240 MHz – Vertical - Transmitting



#### 6.5.4.4 1164 to 1240 MHz – Vertical – Not Transmitting

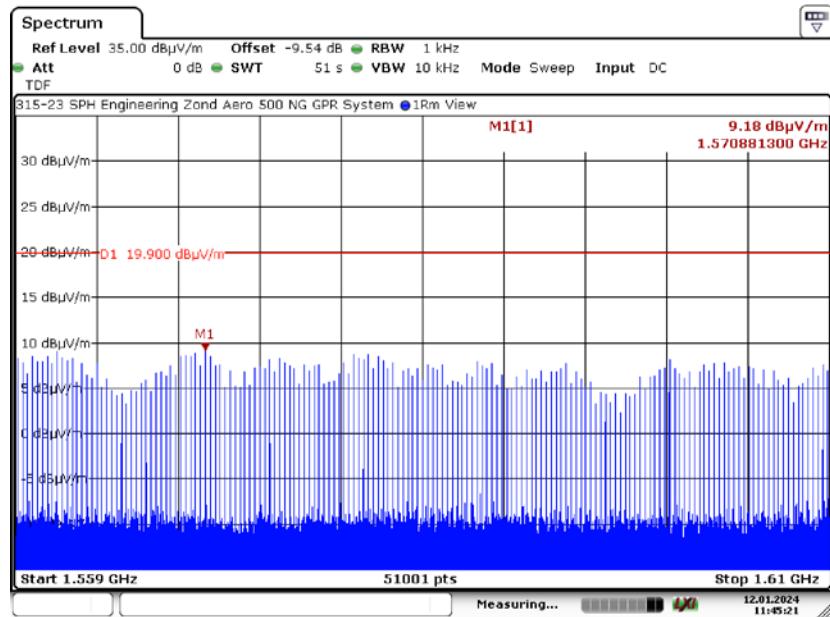


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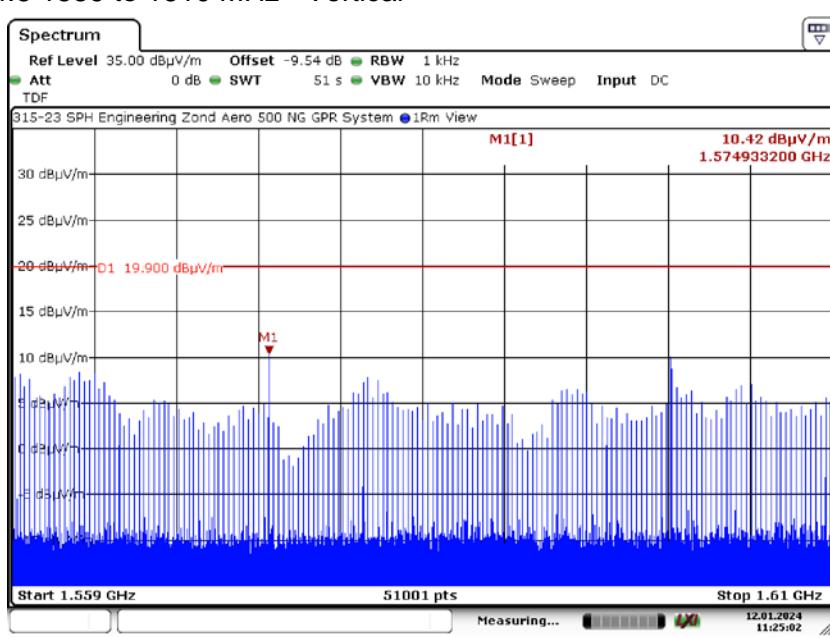
## 6. Measurement Data (continued)

### 6.5.4 Spurious Radiated Emissions in GPS Bands (15.509 (e) continued)

#### 6.5.4.5 1559 to 1610 MHz - Horizontal



#### 6.5.4.6 1559 to 1610 MHz - Vertical



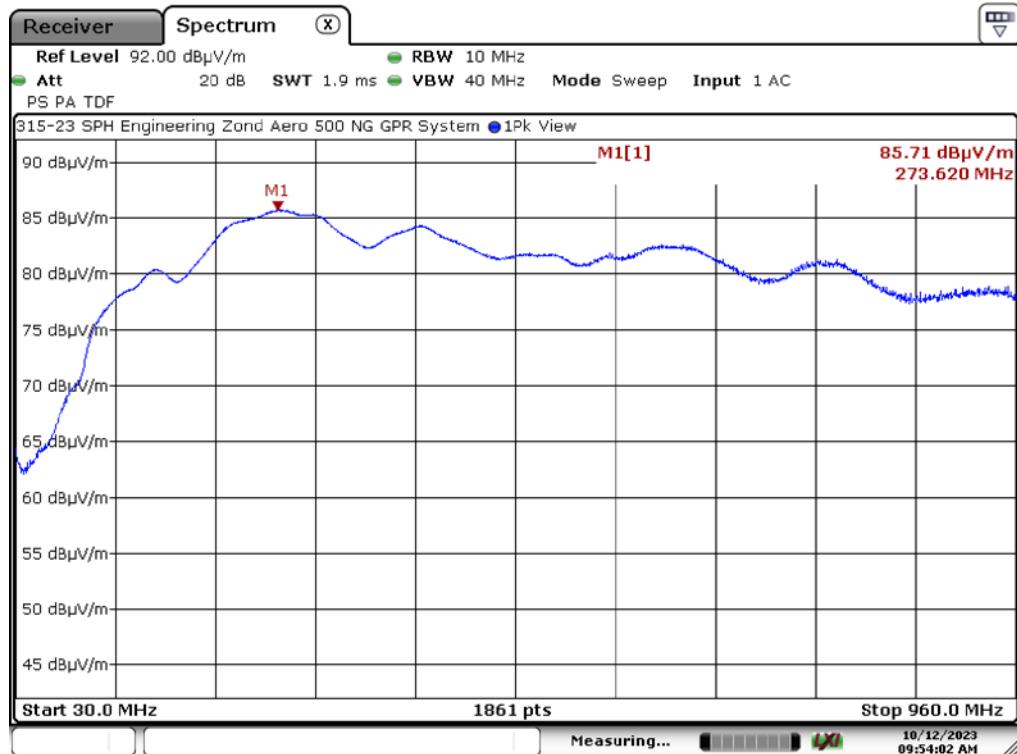
## 6. Measurement Data (continued)

### 6.6. Peak Emissions in a 50 MHz Bandwidth (15.509 (f))

**Requirement:** For UWB devices where the frequency at which the highest radiated emissions occurs,  $f_M$ , is above 960 MHz, there is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency  $f_M$ . That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in Section 15.521. The 0 dBm limit was converted to -13.98 dBm limit when using a 10 MHz RBW. The limit was then converted to a 3 meter field strength limit of 81.22 dB $\mu$ V/m by using a conversion factor of 95.2.

**Result:** Compliant, the highest radiated emission occurs below 960 MHz and is not subject to the 0 dBm EIRP limit.

#### 6.6.1 Plot of Peak Power below 960 MHz



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## 6. Measurement Data (continued)

### 6.6. Peak Emissions in a 50 MHz Bandwidth (RSS-220 Section 6.2.1 (g))

Requirement: The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined below.

Peak measurements shall be made in addition to average measurements. Transmissions shall not exceed 0 dBm e.i.r.p. in any 50 MHz bandwidth when the average limit is -41.3 dBm/MHz.

This is the equivalent peak limit as calculated by combining the 6 dB peak-to-average conversion with a resolution bandwidth (RBW) scaling factor of  $20 \log(1 \text{ MHz}/50 \text{ MHz})$ . Only the 50 MHz bandwidth, centred on the frequency  $f_M$  where the highest power occurs, needs to be measured to satisfy the peak requirements for all frequencies. A different resolution bandwidth and a correspondingly different peak limit may also be used, in which case the RBW may be set anywhere between 1 MHz and 50 MHz. The peak e.i.r.p. limit is then calculated as  $20 \log(\text{RBW}/50) \text{ dBm}$  where the RBW is in MHz. This may be converted to a peak field strength level at 3 metres using  $E(\text{dB}\mu\text{V}/\text{m}) = P(\text{e.i.r.p.}(\text{dBm})) + 95.2$ .

The peak measurement was made using a 10 MHz RBW. The correction factor is -13.98 dBm. The limit was converted to a 3 meter field strength limit of 81.22 dB $\mu$ V/m by using a conversion factor of 95.2.

Result: Compliant, the highest radiated emission occurs below 960 MHz where there is no average limit and is not subject to the 0 dBm EIRP limit. See plot 6.6.1 on the previous page.

## 6. Measurement Data (continued)

### 6.7. Conducted Emissions, Regulatory Limit: FCC Part 15.209, RSS-GEN 8.8

Frequency Range (MHz)	Limits (dB $\mu$ 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.

#### 6.7.1. Measurement Equipment Used to Perform Test

Device	Manufacturer	Model No.	Serial No.	Cal Due
EMI Receiver	Rohde & Schwarz	ESR7	101156	10/26/2024
LISN	EMCO	3825/2	9109-1860	1/4/2025

#### 6.7.2. Measurement & Equipment Setup

Test Date:	10/9/2023
Test Engineer:	Sean Defilice
Site Temperature (°C):	24
Relative Humidity (%RH):	35
Frequency Range:	0.15 MHz to 30 MHz
EMI Receiver IF Bandwidth:	9 kHz
EMI Receiver Avg Bandwidth:	≥ 3 * RBW or IF(BW)
Detector Functions:	Peak, Quasi-Peak. & Average

#### 6.7.3. Test Procedure

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

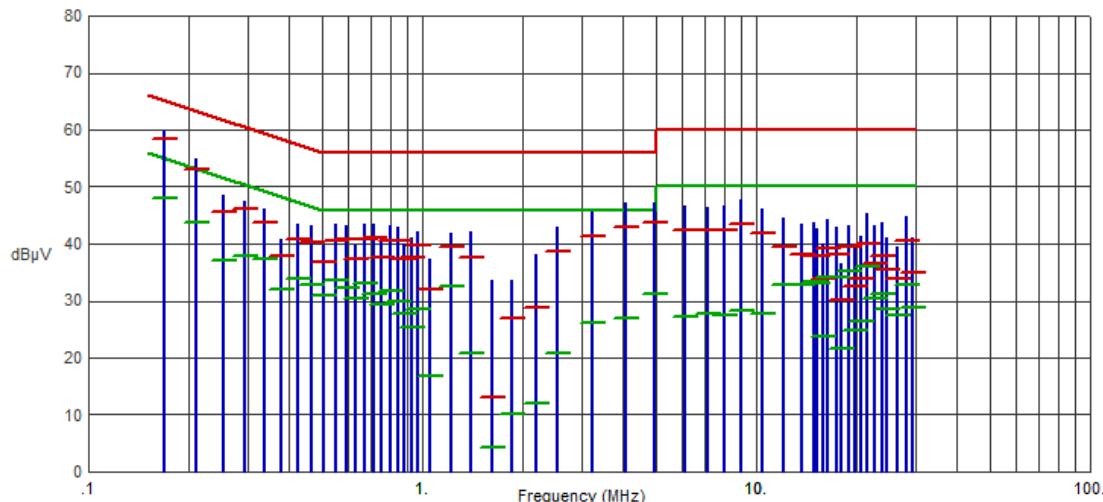
Sample Calculation: Final Result (dB $\mu$ V) = Measurement Value (dB $\mu$ V) + LISN Factor (dB) + Cable Loss (dB).

**Note:** All correction factors are loaded into the measurement instrument prior to testing to determine the final result

**6. Measurement Data (continued)**
**6.8. Conducted Emissions Test Results**
**6.8.1. 120 Volts, 60 Hz Phase**

Test No.: 315-23, 120 Volts, 60 Hz Phase

FCC, Class B



Frequency (MHz)	Pk Amp (dB $\mu$ V)	QP Amp (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Margin (dB)	Avg Amp (dB $\mu$ V)	Avg Limit (dB $\mu$ V)	Avg Margin (dB)	Comments
.1680	59.77	58.39	65.06	-6.67	48.09	55.06	-6.97	
.2108	55.03	53.15	63.17	-10.02	43.82	53.17	-9.35	
.2535	48.42	45.72	61.64	-15.92	37.18	51.64	-14.46	
.2940	47.42	46.01	60.41	-14.40	37.89	50.41	-12.52	
.3368	46.22	43.84	59.28	-15.44	37.40	49.28	-11.88	
.3795	40.92	37.75	58.29	-20.54	32.11	48.29	-16.18	
.4223	43.58	40.82	57.40	-16.58	33.81	47.40	-13.59	
.4650	43.27	40.37	56.60	-16.23	32.85	46.60	-13.75	
.5055	39.66	36.77	56.00	-19.23	30.84	46.00	-15.16	
.5483	43.34	40.57	56.00	-15.43	33.52	46.00	-12.48	
.5910	43.33	40.75	56.00	-15.25	32.28	46.00	-13.72	
.6315	39.64	37.33	56.00	-18.67	30.29	46.00	-15.71	
.6743	43.44	40.84	56.00	-15.16	32.96	46.00	-13.04	
.7170	43.56	40.95	56.00	-15.05	31.28	46.00	-14.72	
.7575	40.33	37.66	56.00	-18.34	29.29	46.00	-16.71	
.8003	43.29	40.57	56.00	-15.43	31.80	46.00	-14.20	
.8430	42.96	40.53	56.00	-15.47	29.91	46.00	-16.09	
.8835	39.93	37.40	56.00	-18.60	27.66	46.00	-18.34	
.9285	41.03	37.58	56.00	-18.42	25.30	46.00	-20.70	
.9689	42.18	39.67	56.00	-16.33	28.44	46.00	-17.56	
1.0568	37.45	32.04	56.00	-23.96	16.86	46.00	-29.14	
1.2143	41.98	39.55	56.00	-16.45	32.60	46.00	-13.40	
1.3920	42.06	37.72	56.00	-18.28	20.89	46.00	-25.11	
1.6103	33.57	13.11	56.00	-42.89	4.21	46.00	-41.79	
1.8578	33.68	26.81	56.00	-29.19	10.15	46.00	-35.85	
2.1953	38.23	28.74	56.00	-27.26	11.88	46.00	-34.12	
2.5373	42.87	38.74	56.00	-17.26	20.93	46.00	-25.07	
3.2190	45.60	41.33	56.00	-14.67	26.09	46.00	-19.91	
4.0493	47.19	42.93	56.00	-13.07	26.97	46.00	-19.03	

**Test Number: 315-23R2**
**Issue Date: 5/6/2024**
**6. Measurement Data (continued)**
**6.8. Conducted Emissions Test Results (continued)**
**6.8.1. 120 Volts, 60 Hz Phase (continued)**

Frequency (MHz)	Pk Amp (dB $\mu$ V)	QP Amp (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Margin (dB)	Avg Amp (dB $\mu$ V)	Avg Limit (dB $\mu$ V)	Avg Margin (dB)	Comments
4.9605	47.20	43.61	56.00	-12.39	31.12	46.00	-14.88	
6.1148	46.66	42.31	60.00	-17.69	27.25	50.00	-22.75	
7.1228	46.47	42.27	60.00	-17.73	27.61	50.00	-22.39	
8.0498	46.74	42.41	60.00	-17.59	27.50	50.00	-22.50	
8.9723	47.84	43.47	60.00	-16.53	28.30	50.00	-21.70	
10.4730	46.11	41.75	60.00	-18.25	27.68	50.00	-22.32	
12.0750	44.61	39.53	60.00	-20.47	32.67	50.00	-17.33	
13.6208	43.56	38.26	60.00	-21.74	32.68	50.00	-17.32	
14.8605	43.68	37.94	60.00	-22.06	33.38	50.00	-16.62	
15.1688	42.79	37.86	60.00	-22.14	33.01	50.00	-16.99	
15.9203	39.93	33.89	60.00	-26.11	23.70	50.00	-26.30	
16.4085	44.28	39.18	60.00	-20.82	34.11	50.00	-15.89	
17.3378	43.03	38.04	60.00	-21.96	34.18	50.00	-15.82	
18.0128	36.42	30.15	60.00	-29.85	21.47	50.00	-28.53	
18.8858	43.31	39.35	60.00	-20.65	35.28	50.00	-14.72	
19.6913	39.17	32.43	60.00	-27.57	24.71	50.00	-25.29	
20.5305	41.36	33.77	60.00	-26.23	26.46	50.00	-23.54	
21.3630	45.41	39.95	60.00	-20.05	35.88	50.00	-14.12	
22.6230	43.19	36.66	60.00	-23.34	30.27	50.00	-19.73	
23.8268	43.73	37.80	60.00	-22.20	31.20	50.00	-18.80	
24.7178	41.15	35.34	60.00	-24.66	28.51	50.00	-21.49	
26.3918	39.42	33.91	60.00	-26.09	27.42	50.00	-22.58	
28.0568	44.79	40.46	60.00	-19.54	32.81	50.00	-17.19	
29.3280	41.16	34.85	60.00	-25.15	28.73	50.00	-21.27	

**Test Number: 315-23R2**
**Issue Date: 5/6/2024**

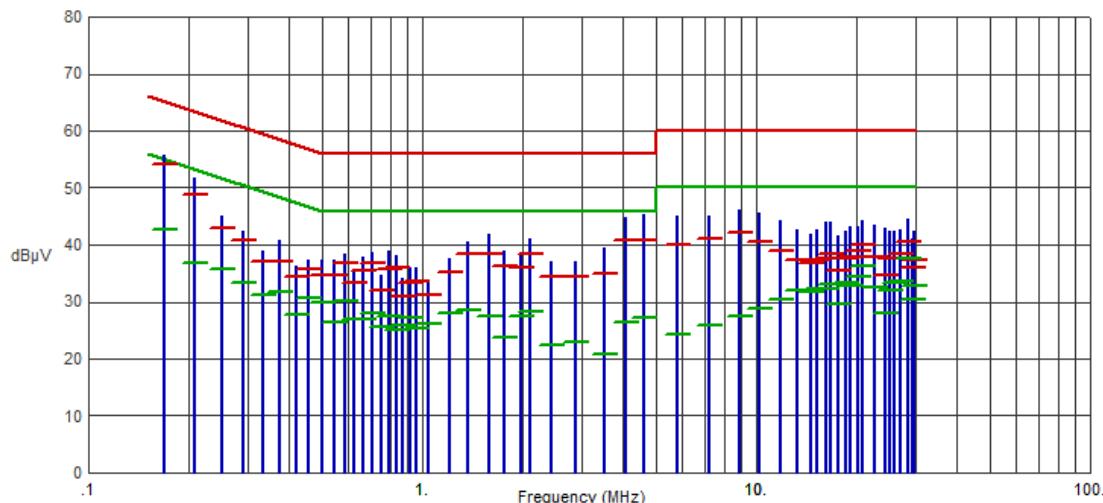
## 6. Measurement Data (continued)

### 6.8. Conducted Emissions Test Results (continued)

#### 6.8.2. 120 Volts, 60 Hz Neutral

Test No.: 315-23, 120 Volts, 60 Hz Neutral

FCC, Class B



Frequency (MHz)	Pk Amp (dB $\mu$ V)	QP Amp (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Margin (dB)	Avg Amp (dB $\mu$ V)	Avg Limit (dB $\mu$ V)	Avg Margin (dB)	Comments
.1680	55.68	54.07	65.06	-10.99	42.76	55.06	-12.30	
.2085	51.73	48.73	63.26	-14.53	36.73	53.26	-16.53	
.2513	45.14	42.83	61.71	-18.88	35.63	51.71	-16.08	
.2918	42.51	40.73	60.47	-19.74	33.25	50.47	-17.22	
.3345	39.01	37.11	59.34	-22.23	31.09	49.34	-18.25	
.3750	40.84	37.07	58.39	-21.32	31.71	48.39	-16.68	
.4178	36.34	34.47	57.49	-23.02	27.82	47.49	-19.67	
.4583	37.39	35.81	56.72	-20.91	30.76	46.72	-15.96	
.5010	37.23	34.59	56.00	-21.41	29.74	46.00	-16.26	
.5438	37.31	34.73	56.00	-21.27	26.52	46.00	-19.48	
.5843	38.52	36.68	56.00	-19.32	30.19	46.00	-15.81	
.6270	35.76	33.21	56.00	-22.79	27.01	46.00	-18.99	
.6675	37.92	35.45	56.00	-20.55	27.05	46.00	-18.95	
.7103	38.73	36.89	56.00	-19.11	27.98	46.00	-18.02	
.7508	34.62	32.07	56.00	-23.93	25.55	46.00	-20.45	
.7913	39.05	35.65	56.00	-20.35	27.48	46.00	-18.52	
.8363	38.06	35.94	56.00	-20.06	25.01	46.00	-20.99	
.8768	34.03	30.90	56.00	-25.10	25.75	46.00	-20.25	
.9173	35.88	33.33	56.00	-22.67	27.18	46.00	-18.82	
.9600	36.07	33.53	56.00	-22.47	25.38	46.00	-20.62	
1.0455	33.42	31.17	56.00	-24.83	26.09	46.00	-19.91	
1.2120	37.67	35.33	56.00	-20.67	27.89	46.00	-18.11	
1.3740	40.45	38.34	56.00	-17.66	28.48	46.00	-17.52	
1.5878	41.94	38.50	56.00	-17.50	27.46	46.00	-18.54	
1.7565	38.95	36.17	56.00	-19.83	23.79	46.00	-22.21	
1.9658	38.72	35.91	56.00	-20.09	27.57	46.00	-18.43	
2.0940	41.16	38.34	56.00	-17.66	28.28	46.00	-17.72	
2.4270	37.13	34.31	56.00	-21.69	22.37	46.00	-23.63	
2.8815	37.12	34.35	56.00	-21.65	22.81	46.00	-23.19	

**Test Number: 315-23R2**
**Issue Date: 5/6/2024**
**6. Measurement Data (continued)**
**6.8. Conducted Emissions Test Results (continued)**
**6.8.2. 120 Volts, 60 Hz Neutral (Continued)**

Frequency (MHz)	Pk Amp (dB $\mu$ V)	QP Amp (dB $\mu$ V)	QP Limit (dB $\mu$ V)	QP Margin (dB)	Avg Amp (dB $\mu$ V)	Avg Limit (dB $\mu$ V)	Avg Margin (dB)	Comments
3.5250	39.51	34.83	56.00	-21.17	20.87	46.00	-25.13	
4.0763	44.89	40.75	56.00	-15.25	26.37	46.00	-19.63	
4.6163	45.26	40.75	56.00	-15.25	27.16	46.00	-18.84	
5.7908	44.94	40.07	60.00	-19.93	24.38	50.00	-25.62	
7.2105	45.11	41.09	60.00	-18.91	25.86	50.00	-24.14	
8.9340	46.18	42.07	60.00	-17.93	27.54	50.00	-22.46	
10.2188	45.52	40.46	60.00	-19.54	28.92	50.00	-21.08	
11.7668	44.35	38.88	60.00	-21.12	30.51	50.00	-19.49	
13.3125	42.61	37.40	60.00	-22.60	32.03	50.00	-17.97	
14.5523	41.93	36.70	60.00	-23.30	31.73	50.00	-18.27	
15.1710	42.58	37.26	60.00	-22.74	32.25	50.00	-17.75	
16.1003	43.99	37.65	60.00	-22.35	32.37	50.00	-17.63	
16.7168	44.11	38.49	60.00	-21.51	33.02	50.00	-16.98	
17.5515	41.57	35.44	60.00	-24.56	29.73	50.00	-20.27	
18.5753	42.53	37.73	60.00	-22.27	33.40	50.00	-16.60	
19.2233	43.12	37.83	60.00	-22.17	32.73	50.00	-17.27	
20.1233	43.28	38.87	60.00	-21.13	34.42	50.00	-15.58	
20.8928	44.31	40.10	60.00	-19.90	36.26	50.00	-13.74	
22.5668	43.41	37.81	60.00	-22.19	32.59	50.00	-17.41	
24.2408	42.85	34.71	60.00	-25.29	27.87	50.00	-22.13	
25.0733	42.34	37.49	60.00	-22.51	31.88	50.00	-18.12	
25.9080	42.44	37.68	60.00	-22.32	33.21	50.00	-16.79	
27.1613	42.54	38.35	60.00	-21.65	33.53	50.00	-16.47	
28.4123	44.61	40.54	60.00	-19.46	37.69	50.00	-12.31	
29.2538	41.11	36.00	60.00	-24.00	30.46	50.00	-19.54	
29.7195	42.33	37.20	60.00	-22.80	32.82	50.00	-17.18	

## 6. Measurement Data (continued)

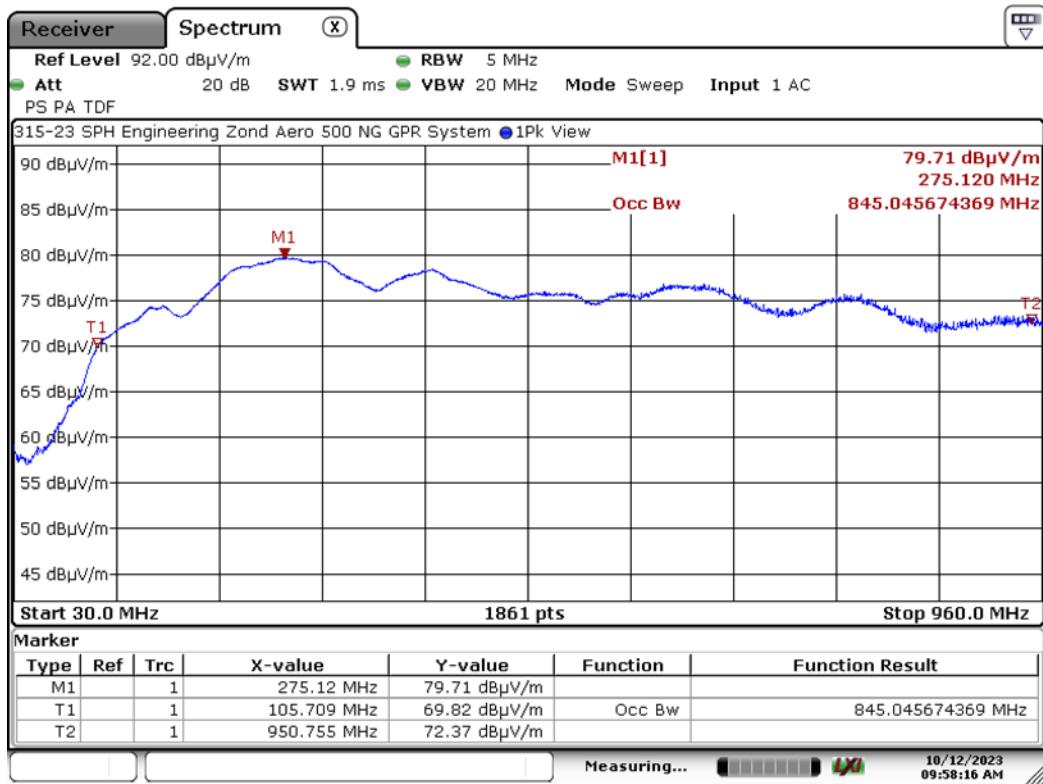
### 6.9. 99% Emission Bandwidth (RSS-GEN 6.7)

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.

#### 6.9.1 Plot of 99% Emission Bandwidth





Test Number: 315-23R2



Issue Date: 5/6/2024

## 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.

The radiated emissions test site for measurements above 1GHz is a 3 Meter open area test site (OATS) with a 3.6 by 3.6 meter anechoic absorber floor patch to achieve a quasi-free space measurement environment per ANSI C63.4/C63.10 and CISPR 16-1-4 standards.

The 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.

Off the rear of the 10 Meter Enclosed Open Area Test Site a Sandpit has been added to accommodate the testing of Ground Penetrating Radar (GPR) products. The sand pit measures 12' (L) x 4' (W) x 4' (D) and is filled with 13.5 yards of dry concrete sand.

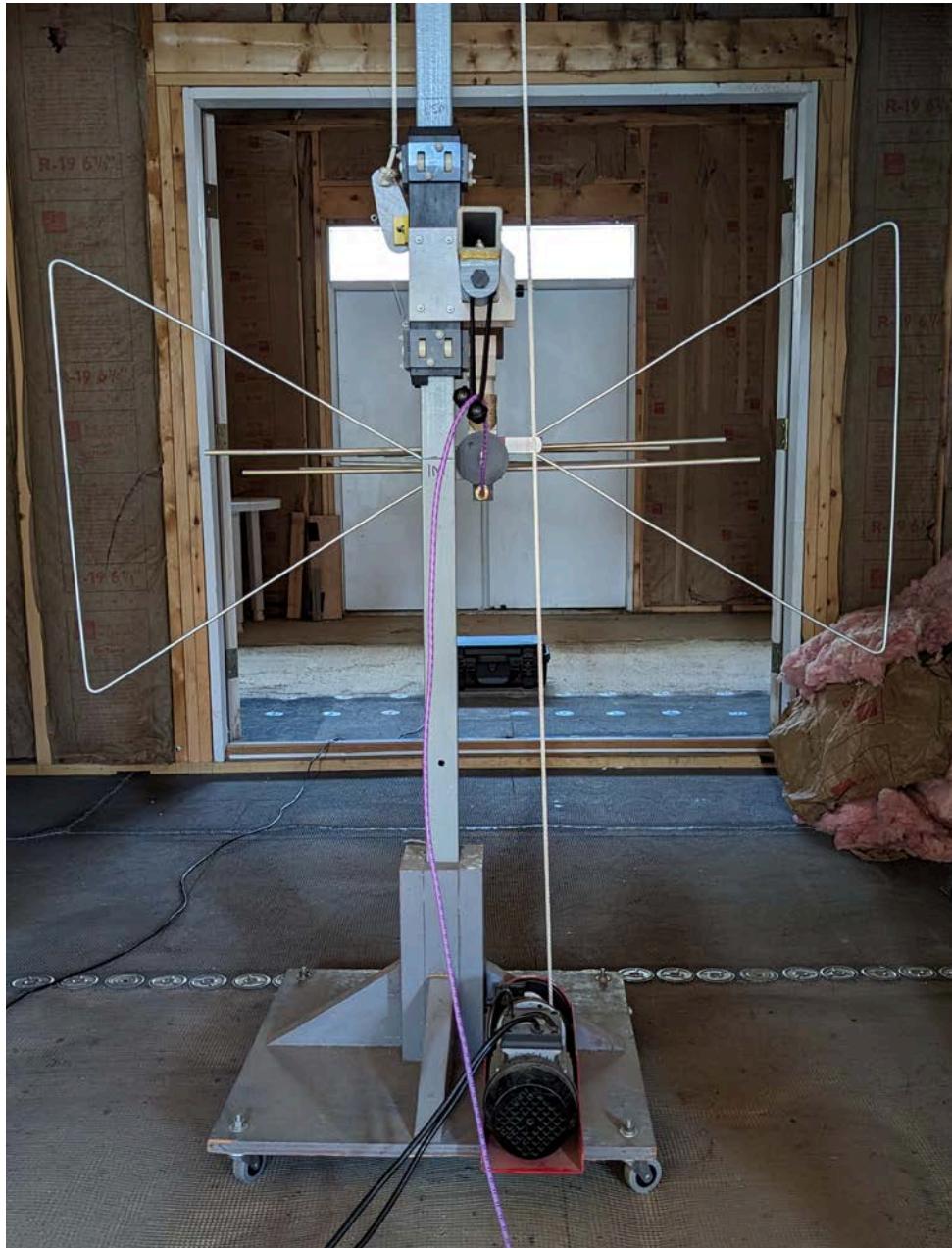
## 8. Test Images

### 8.1. Spurious Emissions – 30 MHz – 960 MHz Front



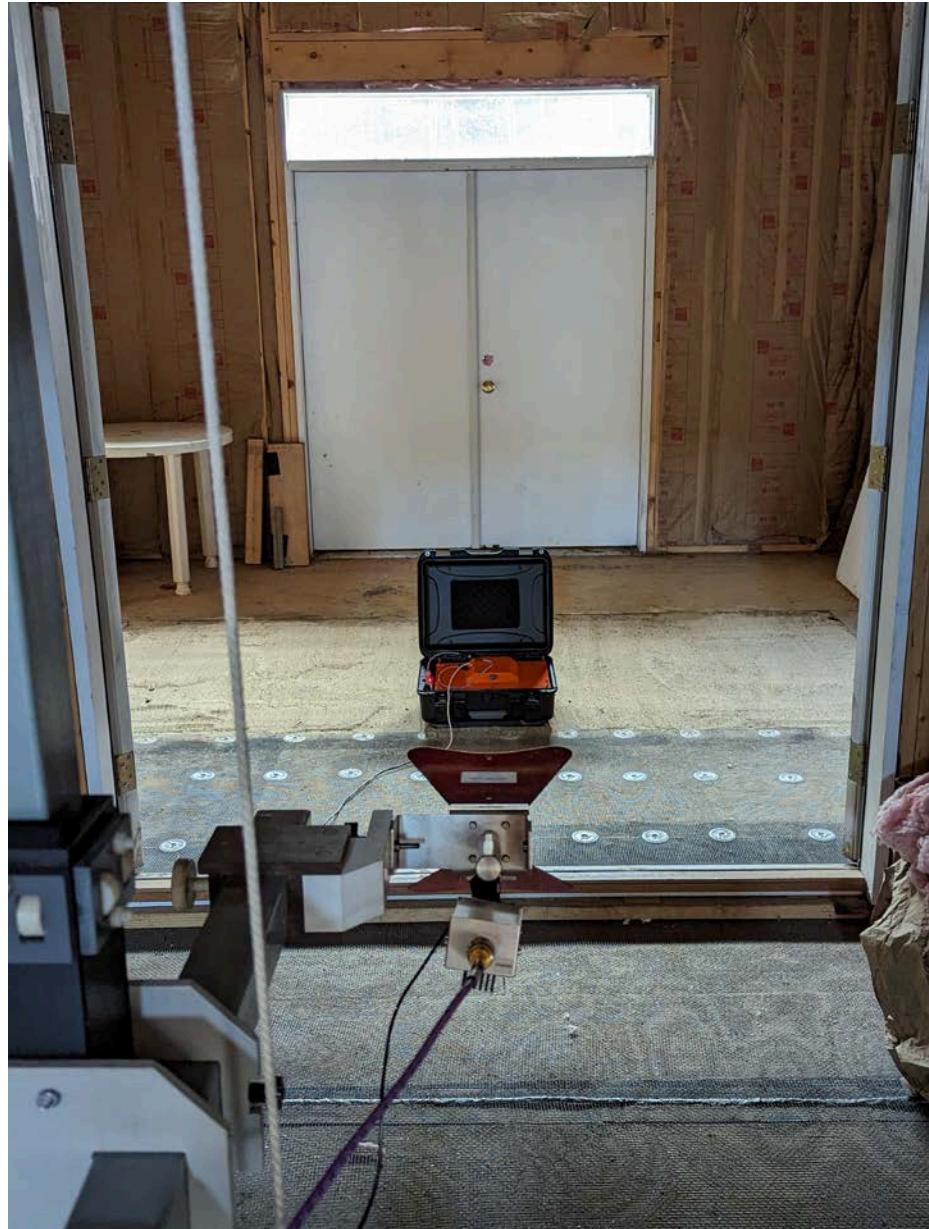
**8. Test Images**

**8.2. Spurious Emissions – 30 MHz – 960 MHz Rear**



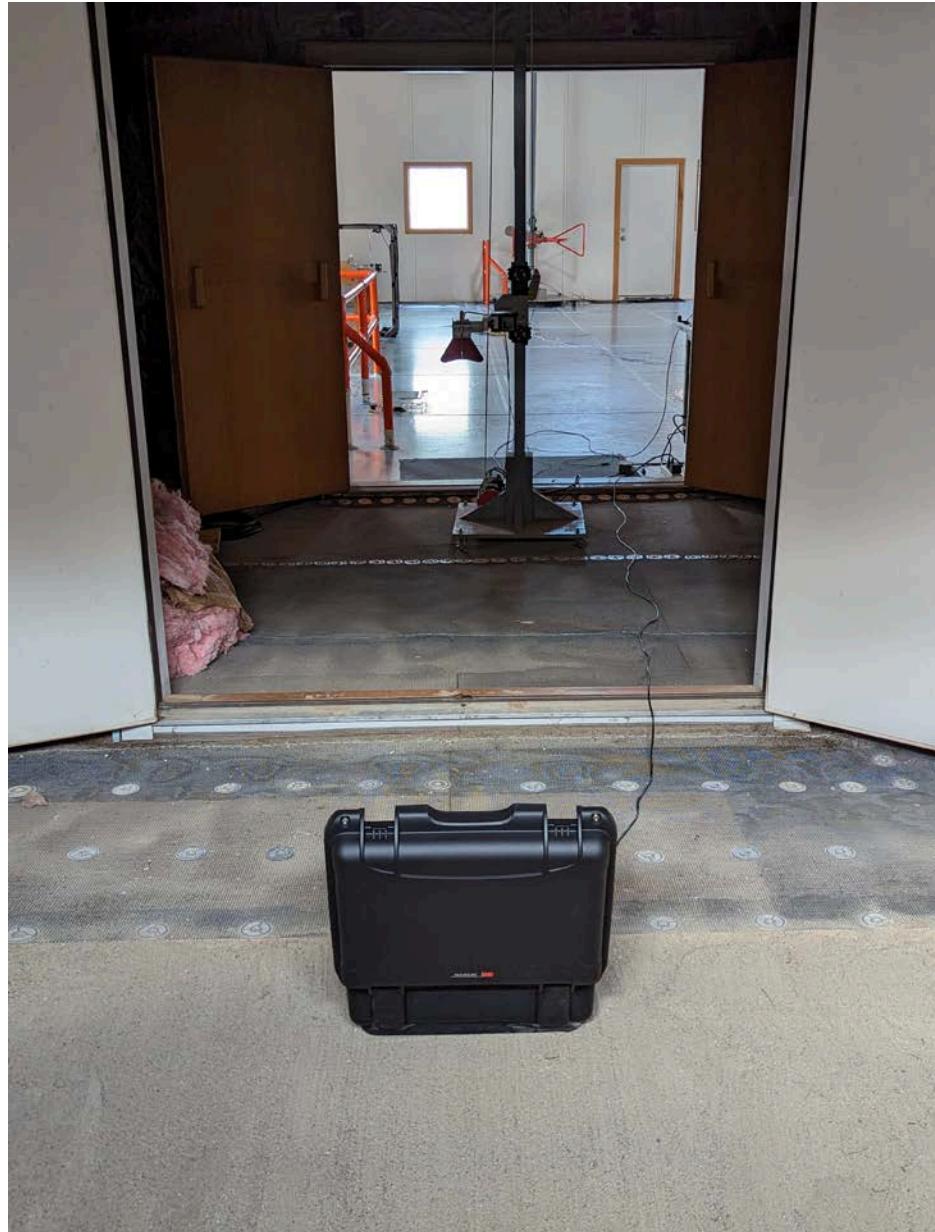
**8. Test Images**

**8.3. Spurious Emissions – 960 MHz – 10 GHz Front**



**8. Test Images**

**8.4. Spurious Emissions – 960 MHz – 10 GHz Rear**



**8. Test Images (continued)**

**8.5. Conducted Emissions, Front View**



8. Test Images (continued)

8.6. Conducted Emissions, Rear View

