# TEST REPORT

## Report Number. : R14956064-E7

| | | |
|---|---|---|
| **Applicant** | : | WHOOP, Inc.<br>1 Kenmore Square Ste 601<br>Boston, Massachusetts 02215, United States |
| **Model** | : | WS50 |
| **FCC ID** | : | 2AJ2X-WS50 |
| **IC** | : | 22056-WS50 |
| **EUT Description** | : | Sensor Device |
| **Test Standard(s)** | : | FCC 47 CFR PART 15 SUBPART C: 2024<br>ISED RSS-210 ISSUE 11: 2024<br>ISED RSS-GEN ISSUE 5 + A1 + A2: 2021 |

**Date Of Issue:**
2025-02-24

**Prepared by:**
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CERT #0751.06

# Revision History

| Rev. | Issue Date | Revisions | Revised By |
|---|---|---|---|
| V1 | 2024-07-17 | Initial Issue | Charles Moody |
| V2 | 2025-02-10 | Added Summary of Test Results Section 2 to Report | Charles Moody |
| V3 | 2025-02-14 | Revised Table in Section 6.2 | Charles Moody |
| V4 | 2025-02-24 | Updated ISED RSS 210 Issue | Charles Moody |


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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** WHOOP, Inc.
1 Kenmore Square St 601
Boston, Massachusetts 02215, United States

**EUT DESCRIPTION:** Sensor Device

**MODEL:** WS50

**SERIAL NUMBER:** 5AMD002134, 5AMD001836

**SAMPLE RECEIPT DATE:** 2024-06-17

**DATE TESTED:** 2024-06-19 TO 2024-06-21

| APPLICABLE STANDARDS | |
|---|---|
| **STANDARD** | **TEST RESULTS** |
| FCC PART 15 SUBPART C : 2024 | Complies |
| ISED RSS-210 Issue 11: 2024 | Complies |
| ISED RSS-GEN Issue 5 + A1 +A2: 2021 | Complies |

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
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# 2. SUMMARY OF TEST RESULTS

| FCC Clause | ISED Clause | Requirement | Result | Comment |
|---|---|---|---|---|
| 15.209, 15.205, 15.225 | RSS-216 5.3.3 | Radiated Emissions | Compliant | None |
| 15.215 | RSS-GEN 6.7 | Emissions Bandwidth | For Reporting Purposes only. | None. |
| 15.207 | RSS-216 5.3.2 | AC Mains Conducted Emissions | NOT Performed | Eut is battery powered and charged only through WPT |
| 15.225(e) | N/A | Frequency Tolerance | Compliant. | None |

Note 1: AC Mains scans were performed while the EUT was charging a load, as well as operating as intended while terminated into a dummy load.

# 3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2020, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 5 + A1 + A2, and RSS-210 Issue 11.

# 4. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Certificate Number 0751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

| | Address | ISED CABID | ISED Company Number | FCC Registration |
|---|---|---|---|---|
| ☐ | Building:<br>12 Laboratory Dr<br>RTP, NC 27709, U.S.A | US0067 | 2180C | 825374 |
| ☒ | Building:<br>2800 Perimeter Park Dr. Suite B<br>Morrisville, NC 27560, U.S.A | | 27265 | |


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# 5. DECISION RULES AND MEASUREMENT UNCERTAINTY

## 5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

## 5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

## 5.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER | UNCERTAINTY |
|---|---|
| Radio Frequency (Spectrum Analyzer) | 141.2 Hz |
| Occupied Channel Bandwidth | 1.22% |
| All emissions, radiated | 6.01 dB |
| Conducted Emissions (0.150-30MHz) - LISN | 3.40 dB |
| Temperature | 0.57°C |
| Humidity | 3.39% |
| DC Supply voltages | 1.70% |
| Time | 3.39% |

Uncertainty figures are valid to a confidence level of 95%.

## 5.4. SAMPLE CALCULATION

**RADIATED EMISSIONS**
Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

**MAINS CONDUCTED EMISSIONS**
Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV


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# 6. EQUIPMENT UNDER TEST

## 6.1. DESCRIPTION OF EUT

The EUT is a wearable sensor device that contains a BLE and NFC radio. This report covers the full emissions testing of the NFC radio.

## 6.2. MAXIMUM ELECTRIC FIELD STRENGTH

The transmitter has maximum peak radiated electric and magnetic field strength as follows:

| Fundamental Frequency (MHz) | Mode | E field (30m distance) FCC (dBuV/m) |
|---|---|---|
| 13.56 | Worst Case Tag Configuration | 1.86 |

## 6.3. SOFTWARE AND FIRMWARE

The test utility software used during testing was 50.19.0.130000256.

## 6.4. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated under three orthogonal orientations X, Y and Z. The Y orientation was determined to be the worst-case orientation.

The EUT only operates as Type A with a data rate of 106 kbps.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788

99% BW, 20dB BW, and frequency stability were performed in the worst-case tag configuration.

To remain compliant with Tx Spurious Emissions limit from 30-1000MHz, the power of the NFC radio had to be reduced to 80%.


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## 6.5. DESCRIPTION OF TEST SETUP

**SUPPORT EQUIPMENT**

| Support Equipment List | | | | |
|---|---|---|---|---|
| **Description** | **Manufacturer** | **Model** | **Serial Number** | **FCC ID** |
| Laptop | Dell | Latitude 7320 | FPC60F3 | - |
| Laptop | Dell | P112F | N/A | N/A |

**I/O CABLES**

| I/O Cable List | | | | | | |
|---|---|---|---|---|---|---|
| **Cable No.** | **Port** | **# of Identical Ports** | **Connector Type** | **Cable Type** | **Cable Length (m)** | **Remarks** |
| None | | | | | | |

**SETUP DIAGRAM**

Please refer to R14956064-EP2 for setup diagrams


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# 7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville – Chamber 4)

| Equip. ID | Description | Manufacturer/Brand | Model Number | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| | **0.009-30MHz** | | | | |
| 135144 | Active Loop Antenna | ETS-Lindgren | 6502 | 2024-01-24 | 2025-01-24 |
| | **30-1000 MHz** | | | | |
| 90628 | Hybrid Broadband Antenna | Sunol Sciences Corp. | JB3 | 2024-01-02 | 2026-01-02 |
| | **Gain-Loss Chains** | | | | |
| 207638 | Gain-loss string: 0.009-30MHz | Various | Various | 2024-05-22 | 2025-05-22 |
| 207639 | Gain-loss string: 25-1000MHz | Various | Various | 2024-05-22 | 2025-05-22 |
| | **Receiver & Software** | | | | |
| 197955 | Spectrum Analyzer | Rohde & Schwarz | ESW44 | 2024-04-16 | 2025-04-16 |
| SOFTEMI | EMI Software | UL | Version 9.5 (18 Oct 2021) | | |
| | **Additional Equipment used** | | | | |
| 241204 | Environmental Meter | Fisher Scientific | 15-077-963 | 2023-09-05 | 2025-09-05 |

Test Equipment Used - Wireless Conducted Measurement Equipment

| Equipment ID | Description | Manufacturer | Model Number | Last Cal. | Next Cal. |
|---|---|---|---|---|---|
| | **Common Equipment** | | | | |
| | **Conducted Room 2** | | | | |
| 90416 | Spectrum Analyzer | Keysight Technologies | N9030A | 2023-06-09 | 2024-06-30 |
| 76023 | Temp/Humid Chamber | Cincinnati Sub-Zero | ZPH-8-3.5-SCT/AC | 2024-01-12 | 2025-01-12 |
| 238710 | Environmental Meter | Fisher Scientific | 15-077-963 | 2023-06-27 | 2024-06-27 |
| 76021 | DC Regulated Power Supply | CircuitSpecialists.Com | CSI3005X5 | NA | NA |
| SOFTEMI | Antenna Port Software | UL | Version 2022.8.16 | NA | NA |
| | **Additional Equipment used** | | | | |
| - | Near Field Probe Kit | EMC Test Systems | 7405 | - | - |


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# 8. OCCUPIED BANDWIDTH AND 20dB BANDWIDTH

**LIMITS**

None; for reporting purposes only.

RSS-Gen Issue 5+A1+A2: 2021 Section 6.7

20dB Bandwidth: §15.215 (c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

**TEST PROCEDURE**

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1-5% of the OBW. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

**RESULTS**


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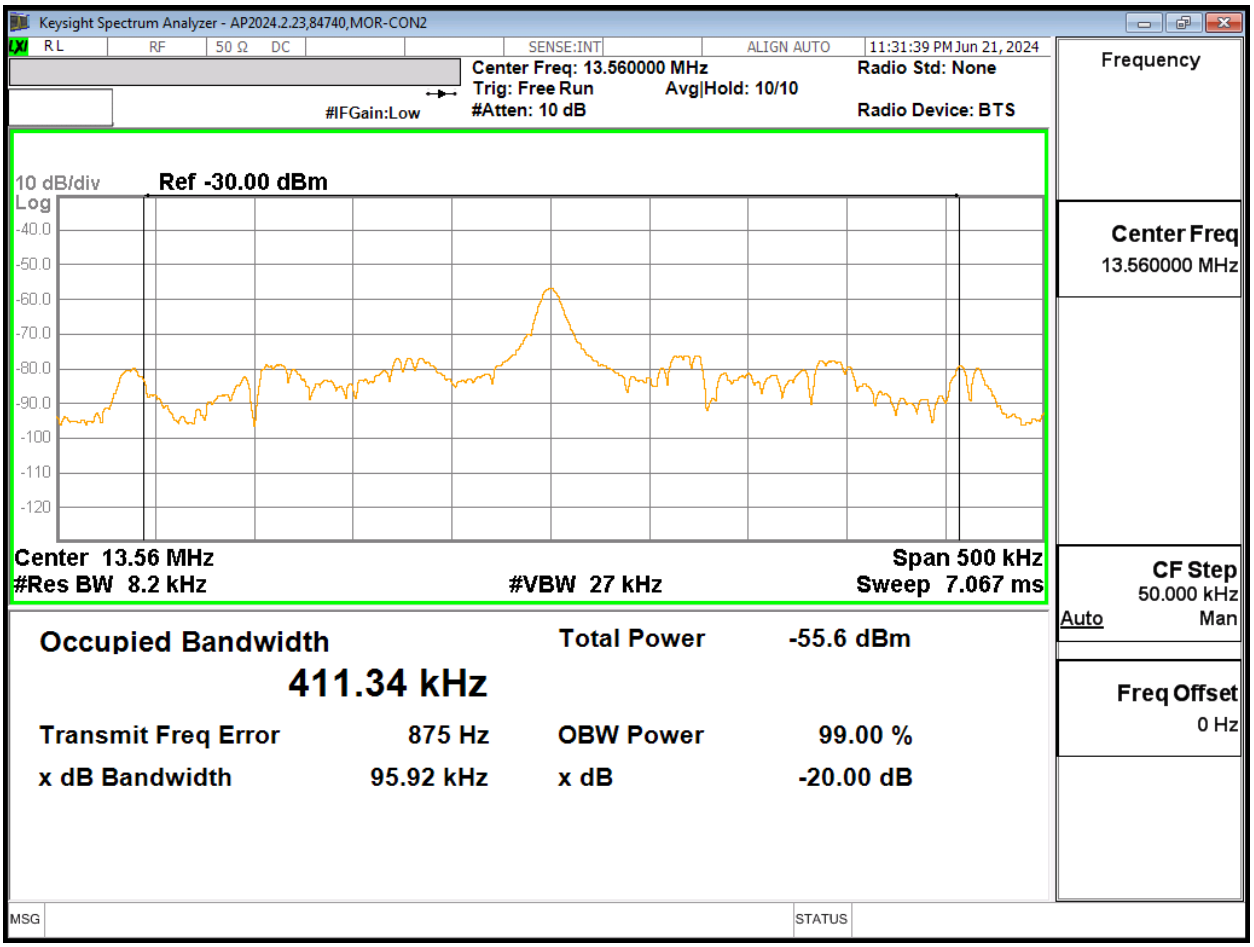
**99% and 20dB BW**

| Frequency (MHz) | 99% Bandwidth (KHz) | 20dB Bandwidth (KHz) |
|---|---|---|
| 13.56 | 411.34 | 95.92 |





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# 9. RADIATED EMISSION TEST RESULTS

## 9.1. LIMITS AND PROCEDURE

**LIMIT**

§15.225
IC RSS-210, Annex B.6
IC RSS-GEN, Section 8.9 (Transmitter)

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/ meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110– 14.010 MHz and shall not exceed the general radiated emission limits in § 15.209 as follows:
§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Limits for radiated disturbance of an intentional radiator | | |
|---|---|---|
| Frequency range (MHz) | Limits (µV/m) | Measurement Distance (m) |
| 0.009 – 0.490 | 2400 / F (kHz) | 300 |
| 0.490 – 1.705 | 24000 / F (kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |
| 30 – 88 | 100** | 3 |
| 88 - 216 | 150** | 3 |
| 216 – 960 | 200** | 3 |
| Above 960 | 500 | 3 |

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.
§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

Formula for converting the filed strength from uV/m to dBuV/m is:
Limit (dBuV/m) = 20 log limit (uV/m)

In addition:

§15.209 (d) The emission limits shown the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.


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§15.209 (d) The provisions in §§ 15.225, measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

**TEST PROCEDURE**

ANSI C63.10, 2020

The EUT is an intentional radiator that incorporates a digital device, the highest fundamental frequency generated or used in the device is 13.56 MHz; therefore, the frequency range was investigated from 0.15 MHz to the $10^{th}$ harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater.

**RESULTS**


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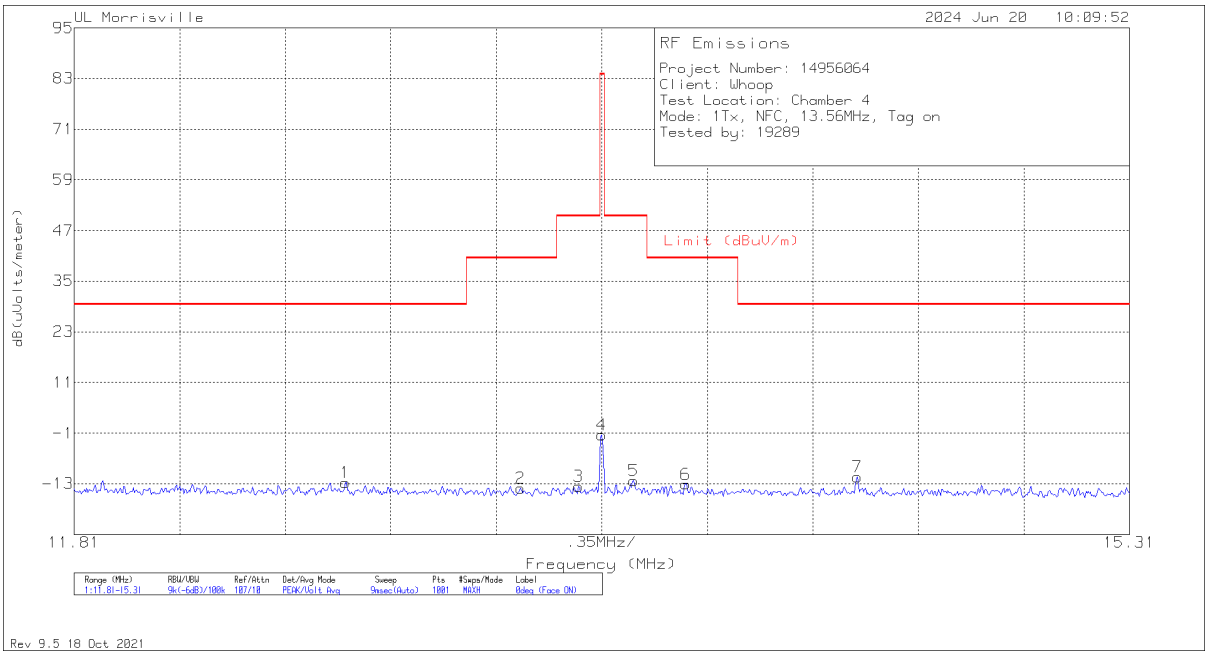
## 9.2. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.009 – 30MHz)

### 9.2.1. FUNDAMENTAL RESULTS

#### 9.2.1.1. TAG ON




**0 DEGREES**

### DATA – 0 Degrees

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.7095 | 15.99 | Pk | 10.8 | .5 | -40 | -12.71 | 29.5 | -42.21 | 358 | 0 degs |
| 2 | 13.2905 | 14.81 | Pk | 10.7 | .5 | -40 | -13.99 | 40.5 | -54.49 | 358 | 0 degs |
| 3 | 13.483 | 15.25 | Pk | 10.7 | .5 | -40 | -13.55 | 50.5 | -64.05 | 358 | 0 degs |
| 4 | 13.56 | 27.39 | Pk | 10.7 | .5 | -40 | -1.41 | 84 | -85.41 | 358 | 0 degs |
| 5 | 13.665 | 16.58 | Pk | 10.7 | .5 | -40 | -12.22 | 50.5 | -62.72 | 358 | 0 degs |
| 6 | 13.83825 | 15.71 | Pk | 10.7 | .5 | -40 | -13.09 | 40.5 | -53.59 | 358 | 0 degs |
| 7 | 14.407 | 17.47 | Pk | 10.7 | .5 | -40 | -11.33 | 29.5 | -40.83 | 358 | 0 degs |

Pk - Peak detector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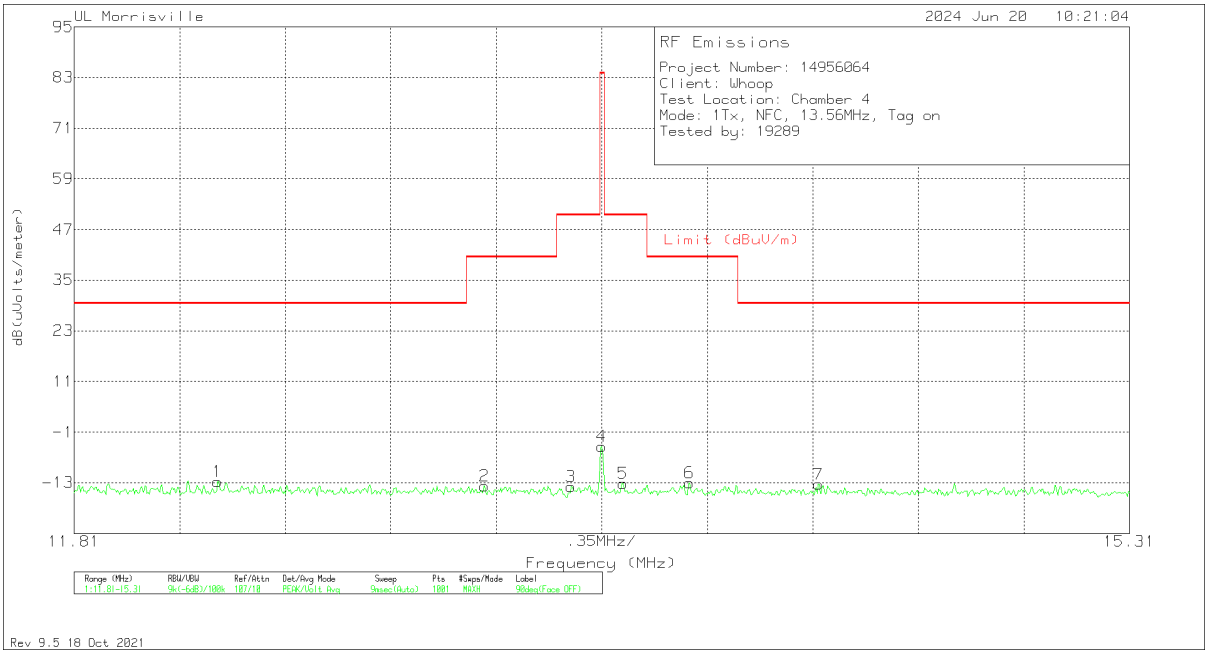


**90 DEGREES**

## DATA – 90 Degrees

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.286 | 16.04 | Pk | 10.8 | .5 | -40 | -12.66 | 29.5 | -42.16 | 301 | 90 degs |
| 2 | 13.1715 | 15 | Pk | 10.7 | .5 | -40 | -13.8 | 40.5 | -54.3 | 301 | 90 degs |
| 3 | 13.4585 | 14.93 | Pk | 10.7 | .5 | -40 | -13.87 | 50.5 | -64.37 | 301 | 90 degs |
| 4 | 13.56 | 24.45 | Pk | 10.7 | .5 | -40 | -4.35 | 84 | -88.35 | 301 | 90 degs |
| 5 | 13.63 | 15.59 | Pk | 10.7 | .5 | -40 | -13.21 | 50.5 | -63.71 | 301 | 90 degs |
| 6 | 13.8505 | 15.8 | Pk | 10.7 | .5 | -40 | -13 | 40.5 | -53.5 | 301 | 90 degs |
| 7 | 14.27925 | 15.43 | Pk | 10.7 | .5 | -40 | -13.37 | 29.5 | -42.87 | 301 | 90 degs |

Pk - Peak detector



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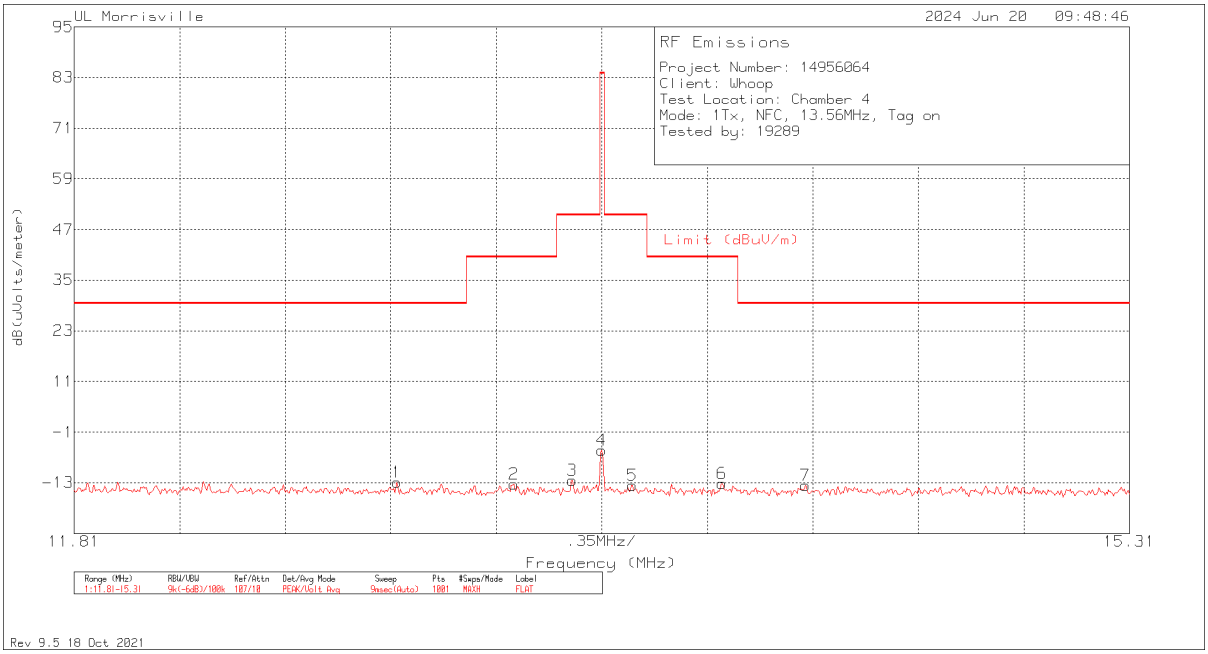


**FLAT**

## DATA – FLAT

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.881 | 15.79 | Pk | 10.8 | .5 | -40 | -12.91 | 29.5 | -42.41 | 20 | Flat |
| 2 | 13.2695 | 15.5 | Pk | 10.7 | .5 | -40 | -13.3 | 40.5 | -53.8 | 20 | Flat |
| 3 | 13.462 | 16.35 | Pk | 10.7 | .5 | -40 | -12.45 | 50.5 | -62.95 | 20 | Flat |
| 4 | 13.56 | 23.48 | Pk | 10.7 | .5 | -40 | -5.32 | 84 | -89.32 | 20 | Flat |
| 5 | 13.6615 | 15.22 | Pk | 10.7 | .5 | -40 | -13.58 | 50.5 | -64.08 | 20 | Flat |
| 6 | 13.959 | 15.7 | Pk | 10.7 | .5 | -40 | -13.1 | 40.5 | -53.6 | 20 | Flat |
| 7 | 14.2355 | 15.16 | Pk | 10.7 | .5 | -40 | -13.64 | 29.5 | -43.14 | 20 | Flat |

Pk - Peak detector



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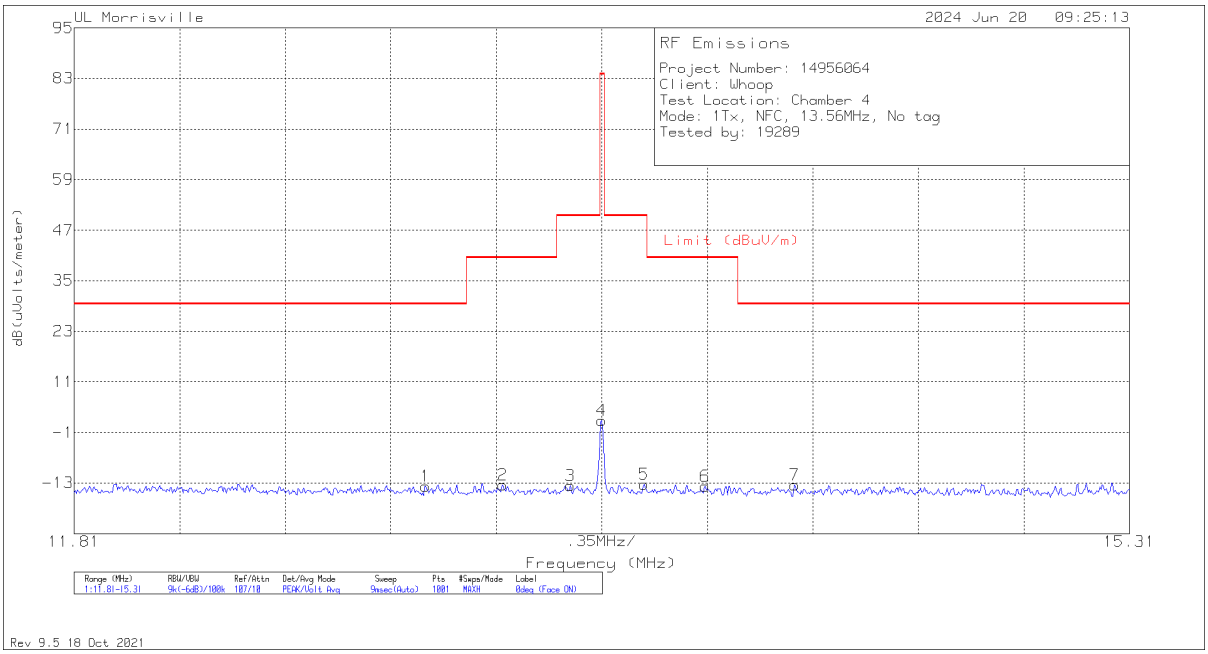
### 9.2.1.2. TAG OFF




**0 DEGREES**

## DATA – 0 Degrees

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.9755 | 15.03 | Pk | 10.7 | .5 | -40 | -13.77 | 29.5 | -43.27 | 334 | 0 degs |
| 2 | 13.231 | 15.3 | Pk | 10.7 | .5 | -40 | -13.5 | 40.5 | -54 | 334 | 0 degs |
| 3 | 13.455 | 15.17 | Pk | 10.7 | .5 | -40 | -13.63 | 50.5 | -64.13 | 334 | 0 degs |
| 4 | 13.56 | 30.66 | Pk | 10.7 | .5 | -40 | 1.86 | 84 | -82.14 | 334 | 0 degs |
| 5 | 13.7 | 15.52 | Pk | 10.7 | .5 | -40 | -13.28 | 50.5 | -63.78 | 334 | 0 degs |
| 6 | 13.903 | 15.07 | Pk | 10.7 | .5 | -40 | -13.73 | 40.5 | -54.23 | 334 | 0 degs |
| 7 | 14.2005 | 15.36 | Pk | 10.7 | .5 | -40 | -13.44 | 29.5 | -42.94 | 334 | 0 degs |

Pk - Peak detector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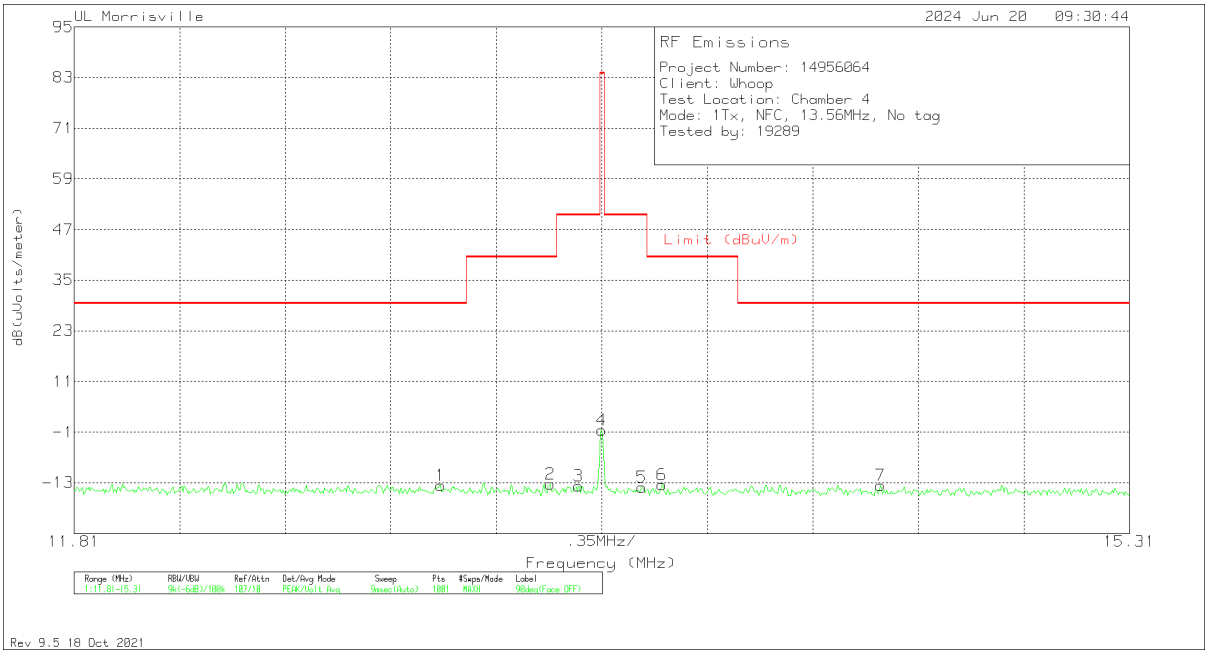


**90 DEGREES**

## DATA – 90 Degrees

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13.0245 | 15.2 | Pk | 10.7 | .5 | -40 | -13.6 | 29.5 | -43.1 | 242 | 90 degs |
| 2 | 13.3885 | 15.47 | Pk | 10.7 | .5 | -40 | -13.33 | 40.5 | -53.83 | 242 | 90 degs |
| 3 | 13.483 | 15.05 | Pk | 10.7 | .5 | -40 | -13.75 | 50.5 | -64.25 | 242 | 90 degs |
| 4 | 13.56 | 28.27 | Pk | 10.7 | .5 | -40 | -.53 | 84 | -84.53 | 242 | 90 degs |
| 5 | 13.693 | 14.69 | Pk | 10.7 | .5 | -40 | -14.11 | 50.5 | -64.61 | 242 | 90 degs |
| 6 | 13.7595 | 15.29 | Pk | 10.7 | .5 | -40 | -13.51 | 40.5 | -54.01 | 242 | 90 degs |
| 7 | 14.484 | 15.18 | Pk | 10.7 | .5 | -40 | -13.62 | 29.5 | -43.12 | 242 | 90 degs |

Pk - Peak detector


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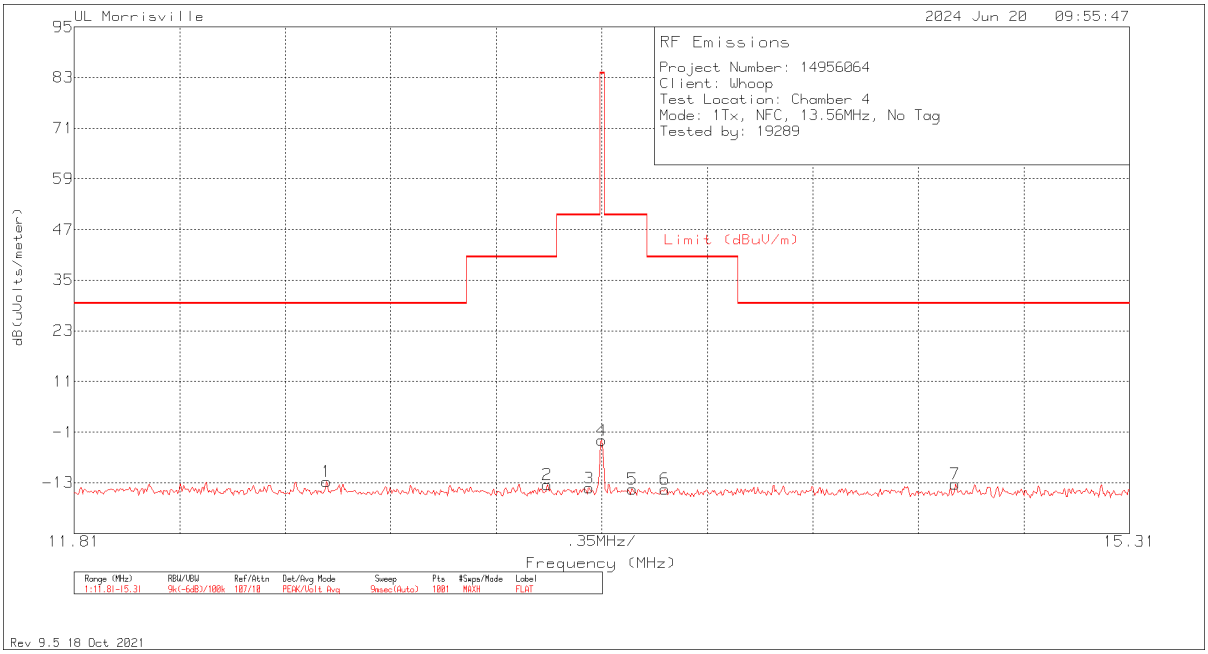


**FLAT**

## DATA – FLAT

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12.6465 | 16.04 | Pk | 10.8 | .5 | -40 | -12.66 | 29.5 | -42.16 | 349 | Flat |
| 2 | 13.378 | 15.39 | Pk | 10.7 | .5 | -40 | -13.41 | 40.5 | -53.91 | 349 | Flat |
| 3 | 13.518 | 14.53 | Pk | 10.7 | .5 | -40 | -14.27 | 50.5 | -64.77 | 349 | Flat |
| 4 | 13.56 | 25.82 | Pk | 10.7 | .5 | -40 | -2.98 | 84 | -86.98 | 349 | Flat |
| 5 | 13.6615 | 14.33 | Pk | 10.7 | .5 | -40 | -14.47 | 50.5 | -64.97 | 349 | Flat |
| 6 | 13.77 | 14.31 | Pk | 10.7 | .5 | -40 | -14.49 | 40.5 | -54.99 | 349 | Flat |
| 7 | 14.7325 | 15.49 | Pk | 10.7 | .5 | -40 | -13.31 | 29.5 | -42.81 | 349 | Flat |

Pk - Peak detector



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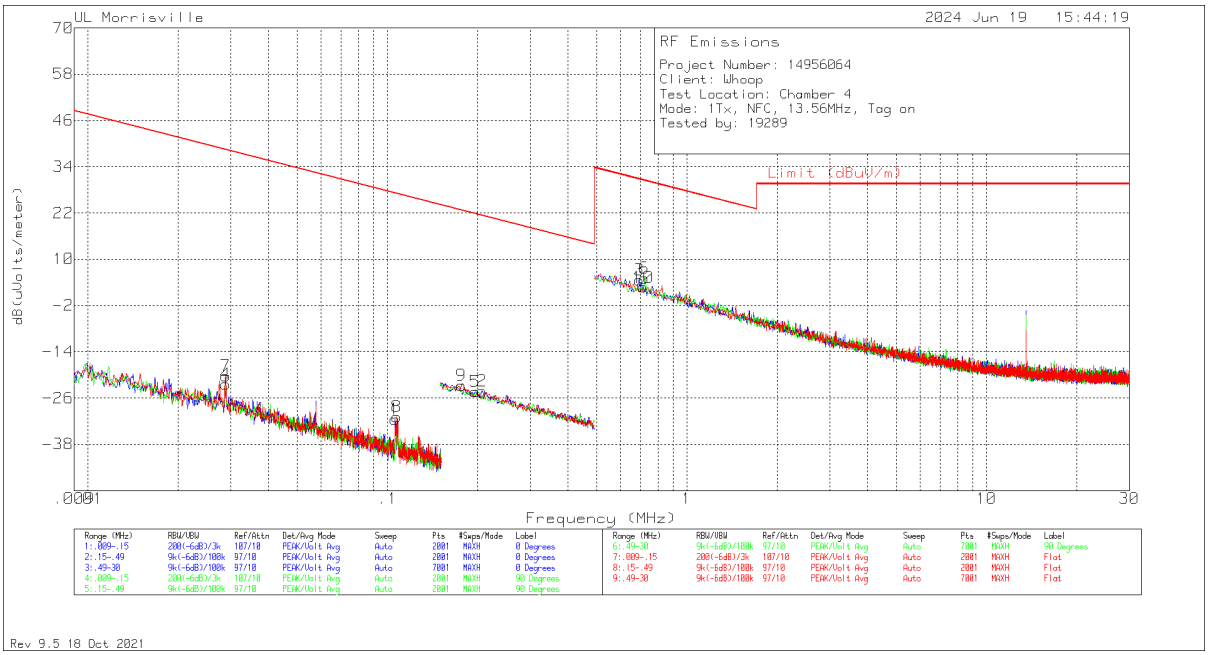
### 9.2.2. SPURIOUS EMISSIONS RESULTS

#### 9.2.2.1. TAG ON

Note: All measurements were made at a test distance of 3 m. The measured data was extrapolated from the test distance (3m) to the specification distance (300 m from 9-490 kHz and 30 m from 490 kHz – 30 MHz) to clearly show the relative levels of fundamental and spurious emissions and demonstrate compliance with the requirement that the level of any spurious emissions be below the level of the intentionally transmitted signal. The extrapolation factor for the limits were 40*Log (test distance / specification distance).




**E-FIELD**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | QP/AV Limit (dBuV/m) | PK Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | .02881 | 43.94 | Pk | 13.6 | .1 | -80 | -22.36 | 38.41 | 58.41 | -60.77 | 0-360 | 90 degs |
| 7 | .02881 | 45.98 | Pk | 13.6 | .1 | -80 | -20.32 | 38.41 | 58.41 | -58.73 | 0-360 | Flat |
| 1 | .10606 | 37.24 | Pk | 11.1 | .1 | -80 | -31.56 | 27.09 | - | -58.65 | 0-360 | 0 degs |
| 8 | .10741 | 37.98 | Pk | 11.1 | .1 | -80 | -30.82 | 26.98 | - | -57.8 | 0-360 | Flat |
| 9 | .17652 | 46.04 | Pk | 11.1 | .1 | -80 | -22.76 | 22.67 | 42.67 | -45.43 | 0-360 | Flat |
| 5 | .19624 | 44.4 | Pk | 11.1 | .1 | -80 | -24.4 | 21.75 | 41.75 | -46.15 | 0-360 | 90 degs |
| 2 | .2067 | 44.56 | Pk | 11.1 | .1 | -80 | -24.24 | 21.3 | 41.3 | -45.54 | 0-360 | 0 degs |
| 3 | .69237 | 33.16 | Pk | 11.2 | .2 | -40 | 4.56 | 30.8 | - | -26.24 | 0-360 | 0 degs |
| 10 | .71345 | 31.34 | Pk | 11.2 | .2 | -40 | 2.74 | 30.54 | - | -27.8 | 0-360 | Flat |
| 6 | .72188 | 33.69 | Pk | 11.2 | .2 | -40 | 5.09 | 30.43 | - | -25.34 | 0-360 | 90 degs |

Pk - Peak detector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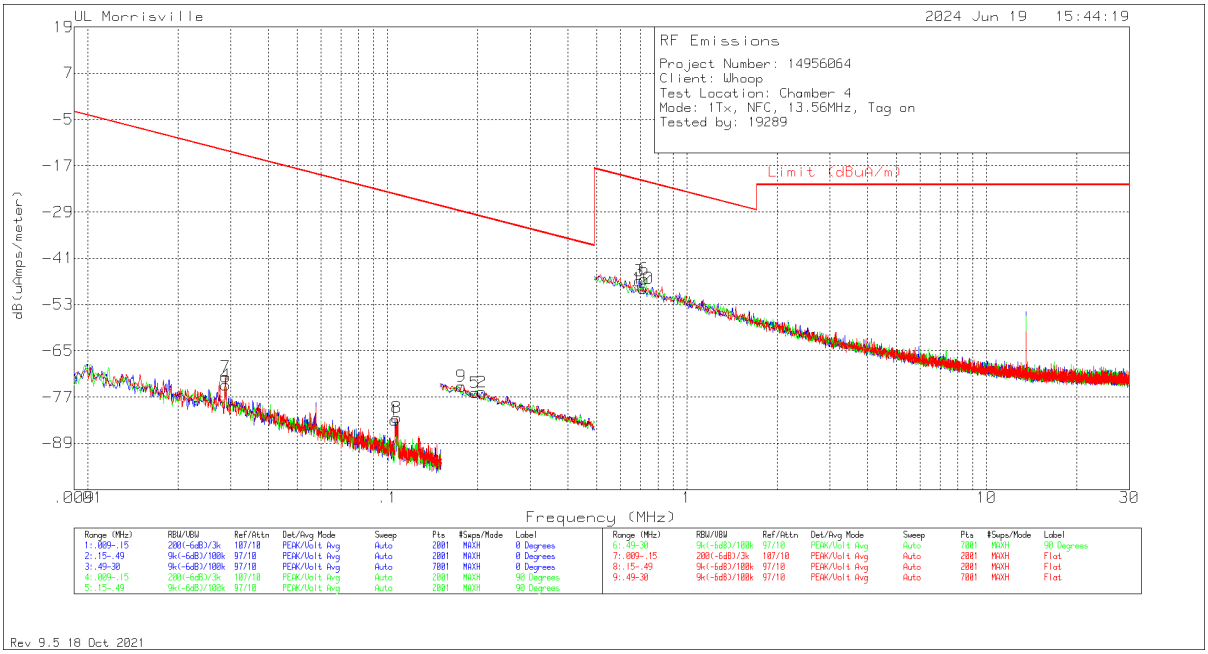


**H-FIELD**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uAmps/meter) | QP/AV Limit (dBuA/m) | PK Limit (dBuA/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | .02881 | 43.94 | Pk | -37.9 | .1 | -80 | -73.86 | -13.09 | 6.91 | -60.77 | 0-360 | 90 degs |
| 7 | .02881 | 45.98 | Pk | -37.9 | .1 | -80 | -71.82 | -13.09 | 6.91 | -58.73 | 0-360 | Flat |
| 1 | .10606 | 37.24 | Pk | -40.4 | .1 | -80 | -83.06 | -24.41 | - | -58.65 | 0-360 | 0 degs |
| 8 | .10741 | 37.98 | Pk | -40.4 | .1 | -80 | -82.32 | -24.52 | - | -57.8 | 0-360 | Flat |
| 9 | .17652 | 46.04 | Pk | -40.4 | .1 | -80 | -74.26 | -28.83 | -8.83 | -45.43 | 0-360 | Flat |
| 5 | .19624 | 44.4 | Pk | -40.4 | .1 | -80 | -75.9 | -29.75 | -9.75 | -46.15 | 0-360 | 90 degs |
| 2 | .2067 | 44.56 | Pk | -40.4 | .1 | -80 | -75.74 | -30.2 | -10.2 | -45.54 | 0-360 | 0 degs |
| 3 | .69237 | 33.16 | Pk | -40.3 | .2 | -40 | -46.94 | -20.7 | - | -26.24 | 0-360 | 0 degs |
| 10 | .71345 | 31.34 | Pk | -40.3 | .2 | -40 | -48.76 | -20.96 | - | -27.8 | 0-360 | Flat |
| 6 | .72188 | 33.69 | Pk | -40.3 | .2 | -40 | -46.41 | -21.07 | - | -25.34 | 0-360 | 90 degs |

Pk - Peak detector



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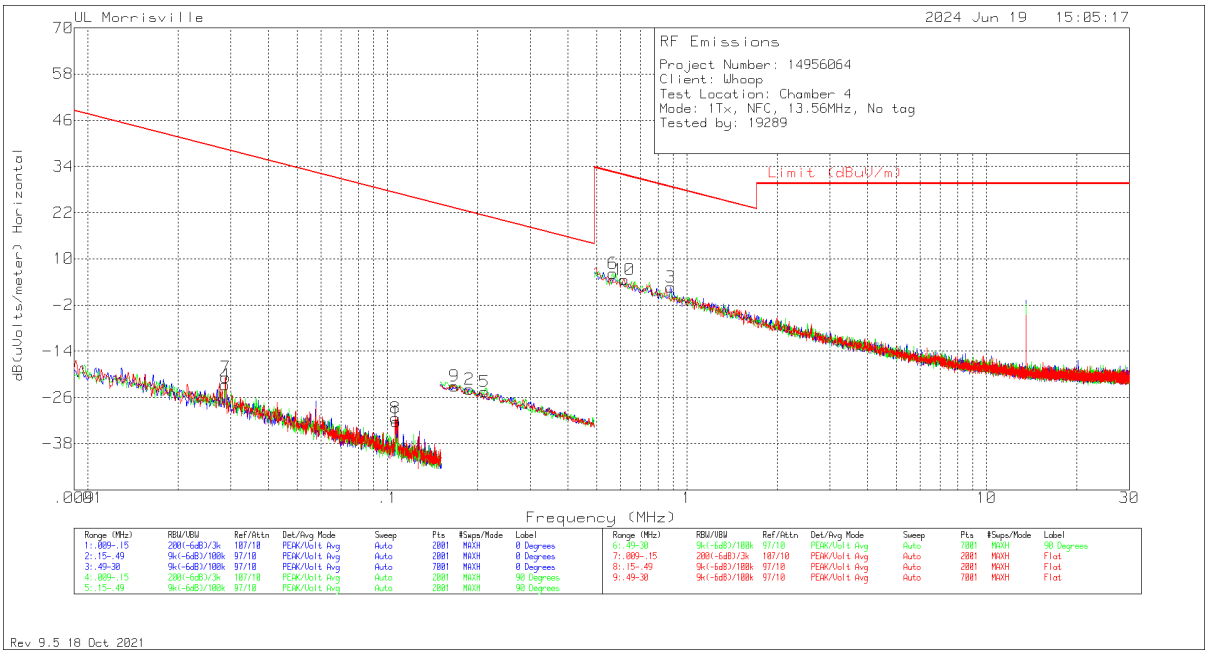
### 9.2.2.2. TAG OFF




**E-FIELD**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uVolts/meter) | QP/AV Limit (dBuV/m) | PK Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | .02874 | 43.64 | Pk | 13.6 | .1 | -80 | -22.66 | 38.44 | 58.44 | -61.1 | 0-360 | 90 degs |
| 7 | .02881 | 45.53 | Pk | 13.6 | .1 | -80 | -20.77 | 38.41 | 58.41 | -59.18 | 0-360 | Flat |
| 8 | .10663 | 37.41 | Pk | 11.1 | .1 | -80 | -31.39 | 27.05 | - | -58.44 | 0-360 | Flat |
| 1 | .10698 | 36.55 | Pk | 11.1 | .1 | -80 | -32.25 | 27.02 | - | -59.27 | 0-360 | 0 degs |
| 9 | .16768 | 45.74 | Pk | 11.1 | .1 | -80 | -23.06 | 23.11 | 43.11 | -46.17 | 0-360 | Flat |
| 2 | .18749 | 44.96 | Pk | 11.1 | .1 | -80 | -23.84 | 22.14 | 42.14 | -45.98 | 0-360 | 0 degs |
| 5 | .21069 | 44.35 | Pk | 11.1 | .1 | -80 | -24.45 | 21.13 | 41.13 | -45.58 | 0-360 | 90 degs |
| 6 | .56589 | 35.09 | Pk | 11.1 | .1 | -40 | 6.29 | 32.55 | - | -26.26 | 0-360 | 90 degs |
| 10 | .61648 | 33.34 | Pk | 11.2 | .1 | -40 | 4.64 | 31.81 | - | -27.17 | 0-360 | Flat |
| 3 | .88209 | 31.36 | Pk | 11.1 | .2 | -40 | 2.66 | 28.69 | - | -26.03 | 0-360 | 0 degs |

Pk - Peak detector



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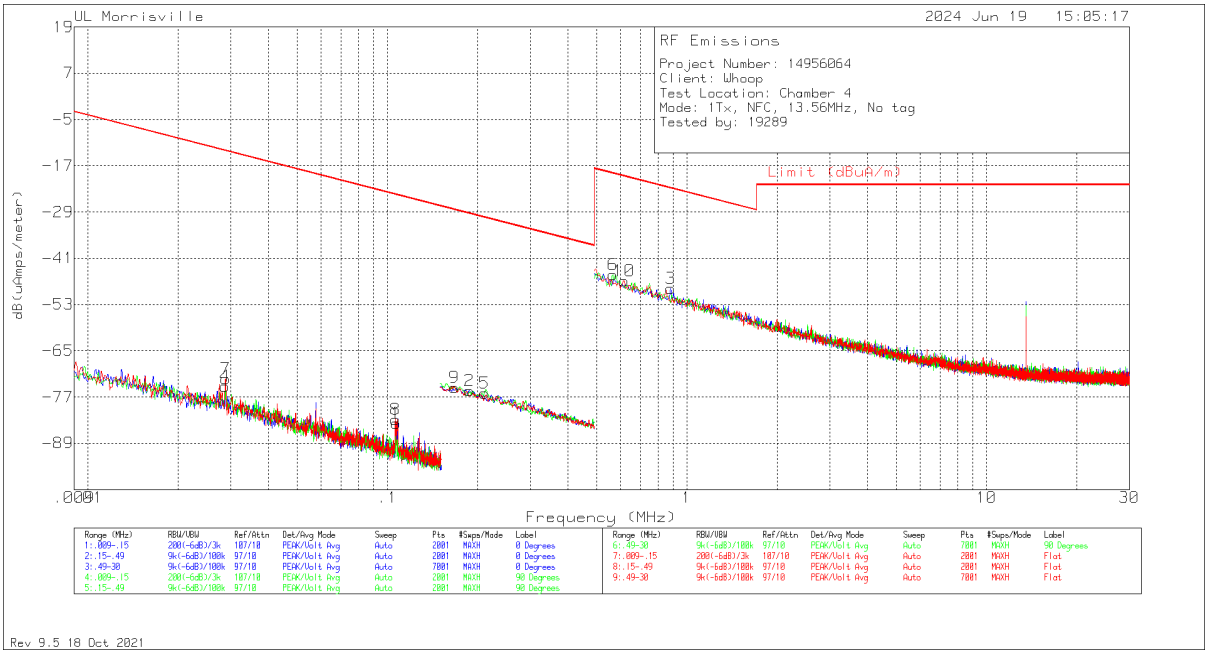


**H-FIELD**

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 135144 (dBuV/m) | Gain/Loss (dB) | Dist. Corr. Factor (dB) | Corrected Reading dB(uAmps/meter) | QP/AV Limit (dBuA/m) | PK Limit (dBuA/m) | Margin (dB) | Azimuth (Degs) | Loop Angle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | .02874 | 43.64 | Pk | -37.9 | .1 | -80 | -74.16 | -13.06 | 6.94 | -61.1 | 0-360 | 90 degs |
| 7 | .02881 | 45.53 | Pk | -37.9 | .1 | -80 | -72.27 | -13.09 | 6.91 | -59.18 | 0-360 | Flat |
| 8 | .10663 | 37.41 | Pk | -40.4 | .1 | -80 | -82.89 | -24.45 | - | -58.44 | 0-360 | Flat |
| 1 | .10698 | 36.55 | Pk | -40.4 | .1 | -80 | -83.75 | -24.48 | - | -59.27 | 0-360 | 0 degs |
| 9 | .16768 | 45.74 | Pk | -40.4 | .1 | -80 | -74.56 | -28.39 | -8.39 | -46.17 | 0-360 | Flat |
| 2 | .18749 | 44.96 | Pk | -40.4 | .1 | -80 | -75.34 | -29.36 | -9.36 | -45.98 | 0-360 | 0 degs |
| 5 | .21069 | 44.35 | Pk | -40.4 | .1 | -80 | -75.95 | -30.37 | - | -45.58 | 0-360 | 90 degs |
| 6 | .56589 | 35.09 | Pk | -40.4 | .1 | -40 | -45.21 | -18.95 | - | -26.26 | 0-360 | 90 degs |
| 10 | .61648 | 33.34 | Pk | -40.3 | .1 | -40 | -46.86 | -19.69 | - | -27.17 | 0-360 | Flat |
| 3 | .88209 | 31.36 | Pk | -40.4 | .2 | -40 | -48.84 | -22.81 | - | -26.03 | 0-360 | 0 degs |

Pk - Peak detector



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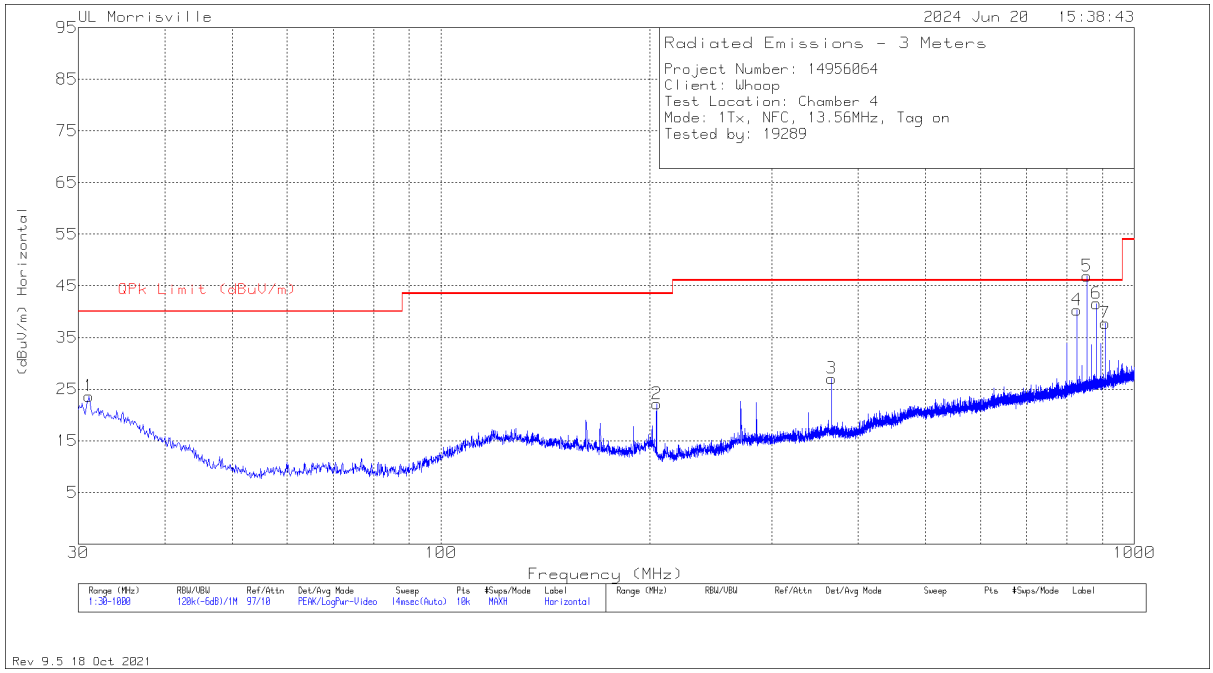
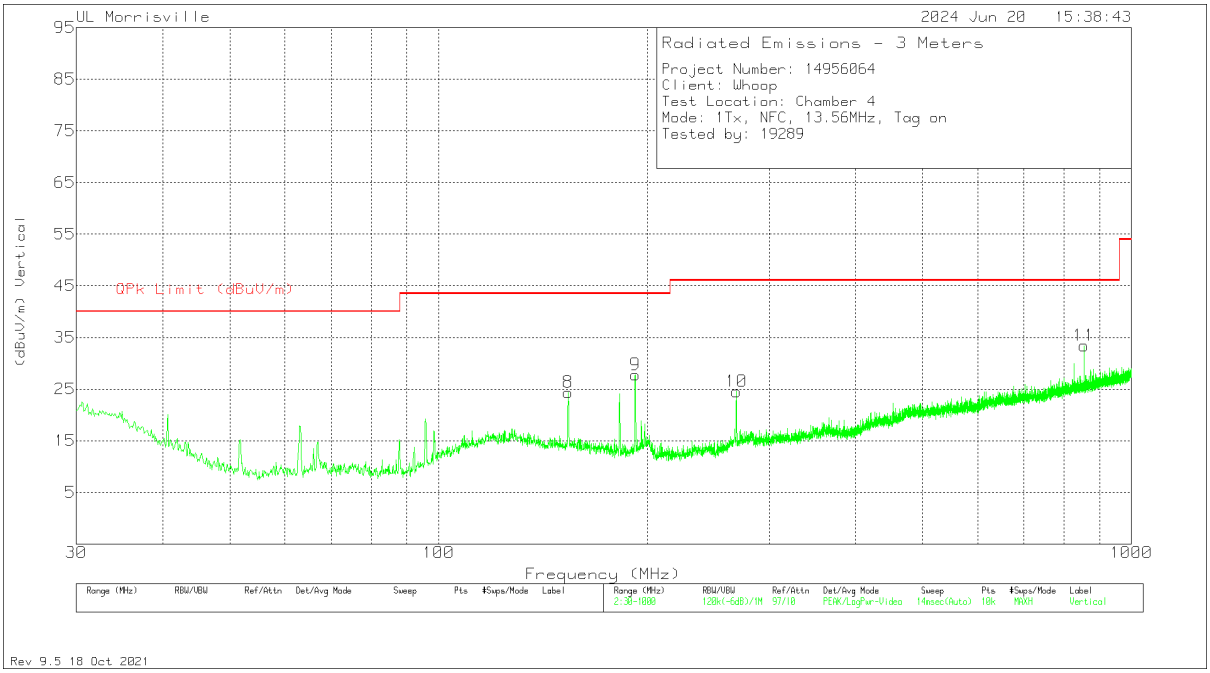
## 9.3. TX SPURIOUS EMISSION 30 TO 1000 MHz

### 9.3.1. Tag On




**HORIZONTAL**




**VERTICAL**



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## RADIATED EMISSIONS

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 90628 (dB/m) | Gain/Loss (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 31.067 | 29.66 | Pk | 26.1 | -32.1 | 23.66 | 40 | -16.34 | 0-360 | 200 | H |
| 8 | 153.869 | 36.88 | Pk | 18.6 | -31.1 | 24.38 | 43.52 | -19.14 | 0-360 | 100 | V |
| 9 | 192.281 | 40.97 | Pk | 17.6 | -30.8 | 27.77 | 43.52 | -15.75 | 0-360 | 100 | V |
| 2 | 204.794 | 35.96 | Pk | 17 | -30.8 | 22.16 | 43.52 | -21.36 | 0-360 | 200 | H |
| 10 | 269.202 | 35.64 | Pk | 19.3 | -30.4 | 24.54 | 46.02 | -21.48 | 0-360 | 100 | V |
| 3 | 366.105 | 36.08 | Pk | 21 | -30 | 27.08 | 46.02 | -18.94 | 0-360 | 100 | H |
| 4 | 827.15179 | 37.35 | Qp | 27.7 | -28 | 37.05 | 46.02 | -8.97 | 34 | 105 | H |
| 5 | 854.271 | 44.66 | Qp | 27.8 | -27.8 | 44.66 | 46.02 | -1.36 | 97 | 102 | H |
| 11 | 854.306 | 33.42 | Pk | 27.8 | -27.8 | 33.42 | 46.02 | -12.6 | 0-360 | 100 | V |
| 6 | 881.39263 | 38.23 | Qp | 28 | -27.6 | 38.63 | 46.02 | -7.39 | 89 | 168 | H |
| 7 | 908.529 | 36.6 | Pk | 28.3 | -27.1 | 37.8 | 46.02 | -8.22 | 0-360 | 100 | H |

Pk - Peak detector
Qp - Quasi-Peak detector


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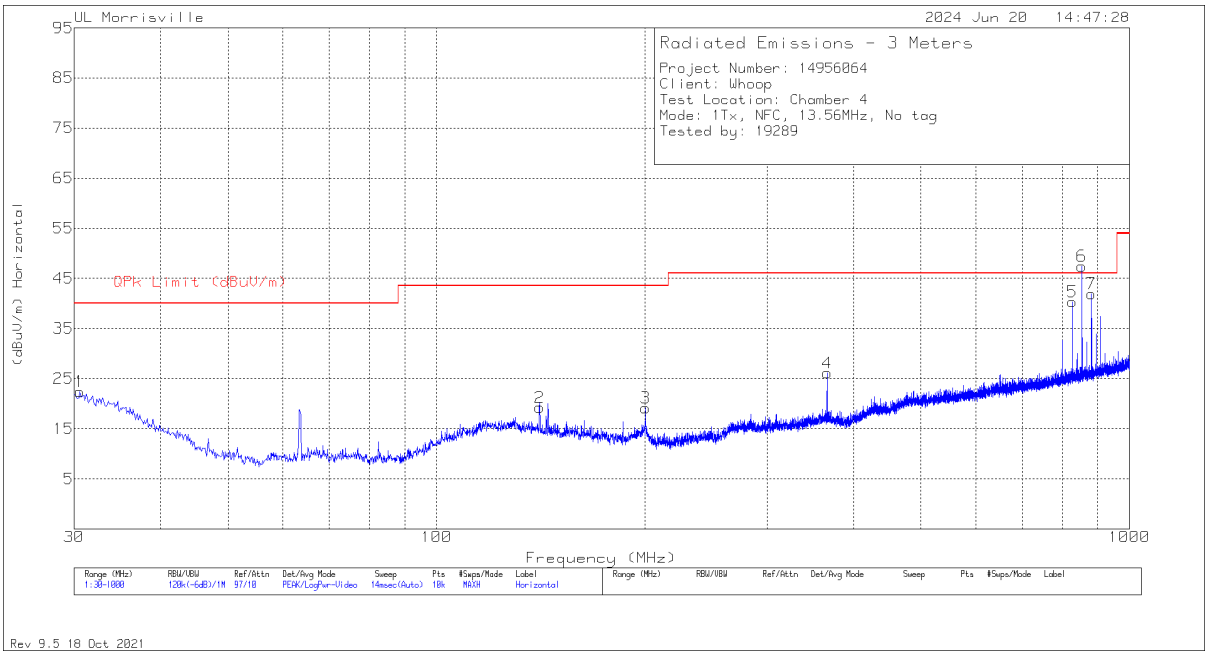
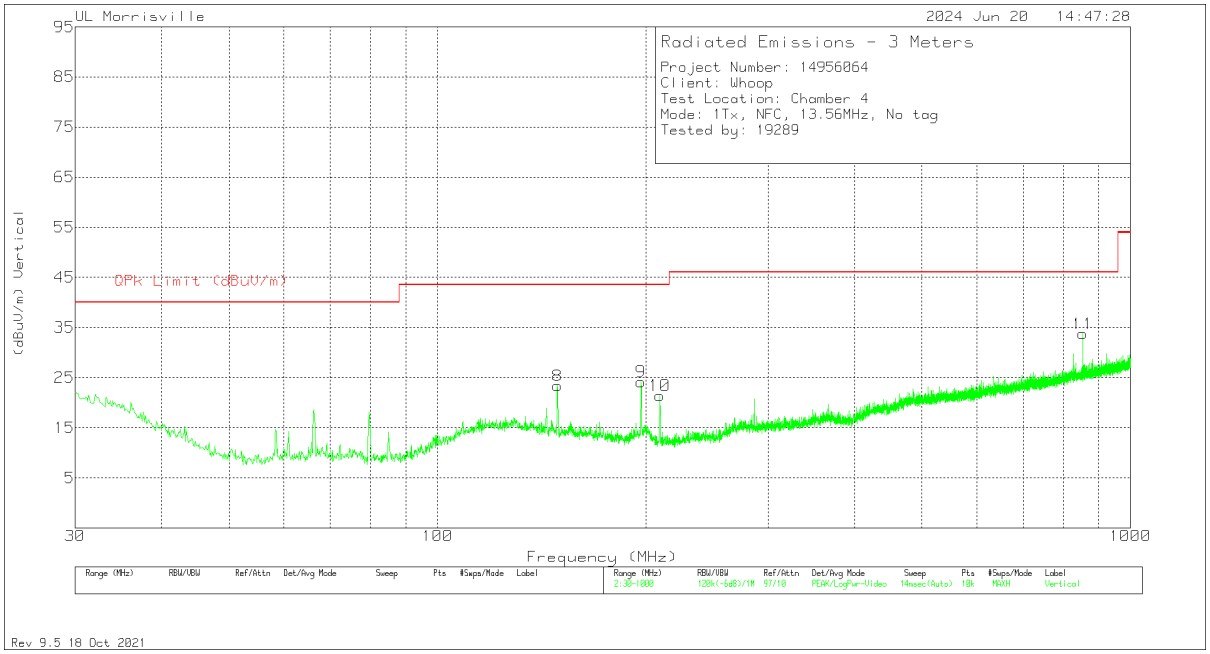
### 9.3.2. Tag Off




**HORIZONTAL**




**VERTICAL**



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## RADIATED EMISSIONS

| Marker | Frequency (MHz) | Meter Reading (dBuV) | Det | 90628 (dB/m) | Gain/Loss (dB) | Corrected Reading (dBuV/m) | QPk Limit (dBuV/m) | Margin (dB) | Azimuth (Degs) | Height (cm) | Polarity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 30.582 | 28.01 | Pk | 26.5 | -32.1 | 22.41 | 40 | -17.59 | 0-360 | 100 | H |
| 2 | 140.968 | 31.22 | Pk | 19.1 | -31.1 | 19.22 | 43.52 | -24.3 | 0-360 | 100 | H |
| 8 | 148.922 | 35.65 | Pk | 18.7 | -31 | 23.35 | 43.52 | -20.17 | 0-360 | 100 | V |
| 9 | 196.743 | 36.59 | Pk | 18.4 | -30.8 | 24.19 | 43.52 | -19.33 | 0-360 | 100 | V |
| 3 | 200.332 | 31.13 | Pk | 18.8 | -30.8 | 19.13 | 43.52 | -24.39 | 0-360 | 100 | H |
| 10 | 209.353 | 35.51 | Pk | 16.5 | -30.6 | 21.41 | 43.52 | -22.11 | 0-360 | 100 | V |
| 4 | 366.105 | 35.1 | Pk | 21 | -30 | 26.1 | 46.02 | -19.92 | 0-360 | 100 | H |
| 5 | 827.15223 | 35.82 | Qp | 27.7 | -28 | 35.52 | 46.02 | -10.5 | 218 | 189 | H |
| 6 | 854.27514 | 44.3 | Qp | 27.8 | -27.8 | 44.3 | 46.02 | -1.72 | 244 | 106 | H |
| 11 | 854.306 | 33.74 | Pk | 27.8 | -27.8 | 33.74 | 46.02 | -12.28 | 0-360 | 100 | V |
| 7 | 881.39111 | 37.1 | Qp | 28 | -27.6 | 37.5 | 46.02 | -8.52 | 297 | 164 | H |

Pk - Peak detector
Qp - Quasi-Peak detector


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# 10. FREQUENCY STABILITY

**LIMIT**

§15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency, over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

IC RSS-210, Annex B.6
Carrier frequency stability shall be maintained to ±0.01% (±100 ppm).

**TEST PROCEDURE**

ANSI C63.10-2020 Clause 6.8

**RESULTS**

No non-compliance noted.


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## 10.1. Battery

| Reference Frequency: EUT Channel 13.56 MHz @ 20ºC<br>Limit: ± 100 ppm = 1.356 kHz | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Power Supply | Envir. Temp | Frequency Deviation Measureed with Time Elapse | | | | | | | | |
| (Vdc) | (ºC) | Startup (MHz) | Delta (ppm) | @ 2 mins (MHz) | Delta (ppm) | @ 5 mins (MHz) | Delta (ppm) | @ 10 mins (MHz) | Delta (ppm) | Limit (ppm) |
| 4.50 | 50 | 13.5597726 | 3.048 | 13.5597649 | 3.612 | 13.5597643 | 3.656 | 13.5597643 | 3.657 | ± 100 |
| 4.50 | 40 | 13.5597866 | 2.014 | 13.5597776 | 2.680 | 13.5597759 | 2.802 | 13.5597754 | 2.843 | ± 100 |
| 4.50 | 30 | 13.5598012 | 0.935 | 13.5597947 | 1.417 | 13.5597955 | 1.357 | 13.5597969 | 1.256 | ± 100 |
| 4.50 | ***20*** | ***13.5598139*** | ***0.000*** | ***13.5598086*** | ***0.392*** | ***13.5598082*** | ***0.419*** | ***13.5598079*** | ***0.442*** | ***± 100*** |
| 4.50 | 10 | 13.5598532 | -2.895 | 13.5598495 | -2.623 | 13.5598529 | -2.875 | 13.5598567 | -3.154 | ± 100 |
| 4.50 | 0 | 13.5598753 | -4.525 | 13.5598744 | -4.463 | 13.5598763 | -4.604 | 13.5598781 | -4.735 | ± 100 |
| 4.50 | -10 | 13.5598830 | -5.093 | 13.5598833 | -5.114 | 13.5598830 | -5.092 | 13.5598825 | -5.055 | ± 100 |
| 4.50 | -20 | 13.5598812 | -4.960 | 13.5598831 | -5.101 | 13.5598783 | -4.748 | 13.5598665 | -3.880 | ± 100 |
| 3.00 | 20 | 13.5598468 | -2.427 | 13.5598523 | -2.828 | 13.5598424 | -2.104 | 13.5598410 | -1.999 | ± 100 |

Tested by: 84740
Test date: 2024-06-21


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# 11. SETUP PHOTOS

Please refer to R14956064-EP2 for setup photos

## END OF TEST REPORT


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