RHEIN TECH LABORATORIES, INC.

Engineering Solutions & Electromagnetic Compatibility Services

# FCC Certification Report

## Electric Infrastructure Security Council
## 10 G Street, NE; Ste. 600
## Washington, DC 20002 (USA)
## Contact: Scott Blevins

## Model: BNET-V
## Base Station Radio
## FCC ID: 2AVVL0BSXR1BNETV001

**June 23, 2020**

| Standards Referenced for this Report | |
|---|---|
| Part 2: 2019 | Frequency Allocations and Radio Treaty Matters; General Rules and Regulations |
| Part 90: 2019 | Private Land Mobile Radio Services |
| ANSI C63.26: 2015 | American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services |

| FCC Rule Parts | Frequency Range (MHz) | Rated Conducted Output Power (W) | Frequency Tolerance (ppm) | Transmit Mode | Emission Designator |
|---|---|---|---|---|---|
| 90 | 450-470 | 20 | 0.1 | Analog FM | 11K0F3E |

**Report Prepared By: Daniel Baltzell**

**Document Number: 2020019**



*These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by ANAB. Refer to certificate and scope of accreditation AT-1445.*

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## 1 Test Result Summary

| Test | FCC Reference | Result |
|---|---|---|
| RF Power Output | 2.1046(a), 90.205 | Complies |
| Spurious Emissions at Antenna Terminals | 2.1051, 90.210 | Complies |
| Field strength of spurious radiation | 2.1053(a), 90.210 | Complies |
| Occupied Bandwidth/Emission Masks | 2.1049(c)(1), 90.210 | Complies |
| Frequency Stability vs. Temperature and Voltage | 2.1055, 90.213 | Complies |
| Modulation Characteristics | 2.1047(a)(b) | Complies |
| Transient Frequency Response (421-512 MHz) | 90.214 | Complies |

## 2 General Information

The following Certification Report is prepared on behalf of Electric Infrastructure Security Council (EIS Council) in accordance with the Federal Communications Commission rules and regulations. The Equipment Under Test (EUT) was the BNET-V Base Station radio; FCC ID: 2AVVL0BSXR1BNETV001.

The radio is subject to FCC SDoC. SDoC testing was performed and the data is contained in a separate SDoC report.

All measurements contained in this application were conducted in accordance with the applicable sections of FCC Rules and Regulations CFR 47 Parts 2, and 90. Calibration checks are performed regularly on the instruments, and all accessories including high pass filter, coaxial attenuator, preamplifier and cables.

### 2.1 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the parking lot of Rhein Tech Laboratories, Inc. 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report submitted to, and approved by, the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

### 2.2 Related Submittal(s)/Grant(s)

This is a new certification application for FCC.

### 2.3 Grant Notes

Power is 20 W. The grant listed power is rated power and actual measured power is shown in the test report.

### 2.4 Tested System Details

The test sample was received on May 7, 2020. Listed below are the identifiers and descriptions of all equipment, cables, and internal devices used with the EUT for this test, as applicable. The device was programmed for multiple modes of operation and modulation types.

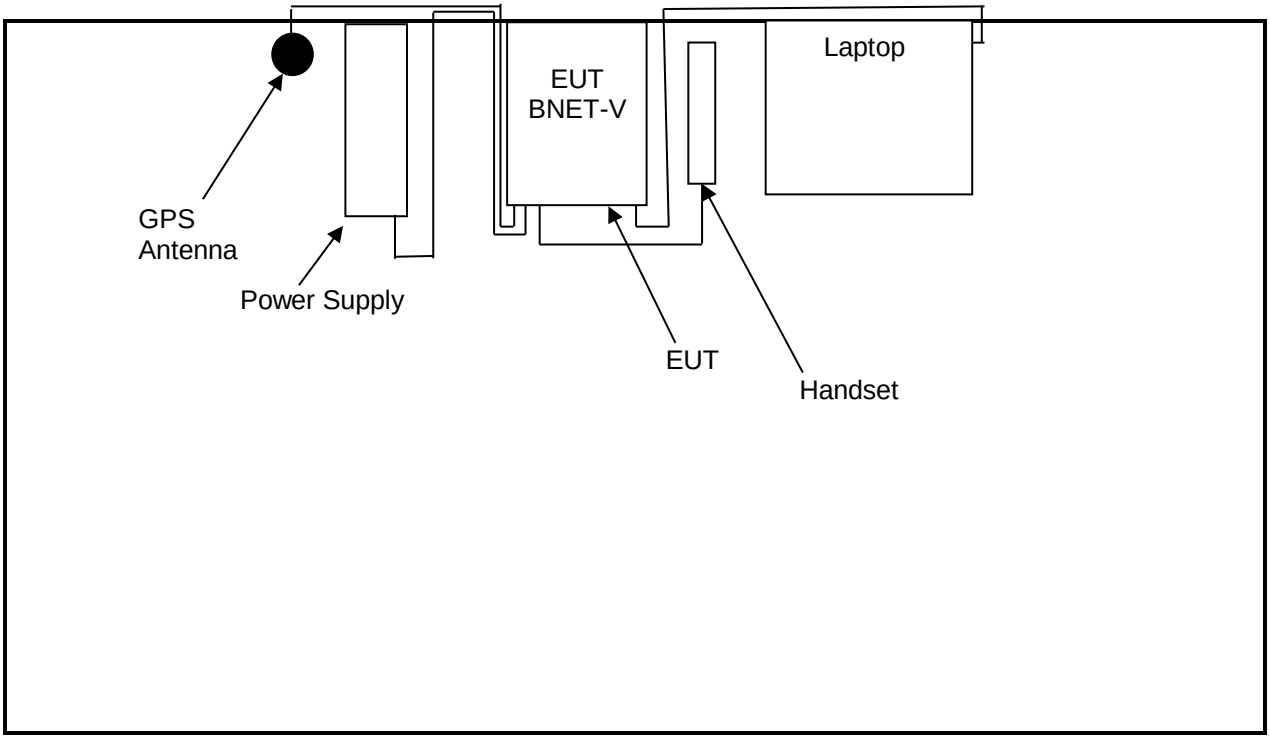
**Table 2-1: Equipment Under Test (EUT)**

| Part | Manufacturer | Model | Serial Number | FCC ID | Cable | RTL Bar Code |
|---|---|---|---|---|---|---|
| Base Station | ElS Council | Black Sky BNET-V | B40-0046 | 2AVVL0BSXR1 BNETV001 | 4m shielded antenna | 23586 |
| Handset | Sonetronics Inc. | H-189/6R | 2 | N/A | 0.6m coiled | 23587 |
| GPS Antenna | Antcom Corp | 4G15A-XT-4 | 579707 | N/A | 4m shielded | 23584 |

**Table 2-2: Auxiliary Equipment**

| Part | Manufacturer | Model | Serial Number | FCC ID | Cable | RTL Bar Code |
|---|---|---|---|---|---|---|
| Power Supply | TDK-Lambda | UP36-12 | LOC-717A37 400C0 | N/A | 1.85m shielded AC/ 3.5m unshielded DC | 23585 |
| Laptop | Hewlett Packard | Elitebook 850 | 1032 | N/A | 2m Ethernet | 23583 |
| AC Adapter | Hewlett Packard | PPP009C | CT:WECJP0BG C90JBJ0B | N/A | 1.8m unshielded AC/ 1.7m unshielded DC | 23588 |

**Figure 2-1: Configuration of Tested System**



## 3 FCC Parts 2.1046(a), 90.205: Transmitter Power; Part 2.1033(C)(8) Voltages and Currents through the Final Amplifying Stage

24 VDC and 1.2 Amps

### 3.1 Test Procedure

ANSI C63.26 §5.2

The EUT was connected to a coaxial attenuator having a 50 Ω load impedance.

**Manufacturer's Rated Power:** 20.0 W

### 3.2 Test Data

Ambient Temperature: +24.2°C Relative Humidity: 33% Barometric Pressure: 99.7 kPa

**Table 3-1: RF Conducted Output Power – Measured**

| Frequency (MHz) | High Power (dBm) | High Power (W) |
|---|---|---|
| 450.0125 | 42.7 | 18.6 |
| 460.0000 | 43.3 | 21.4 |
| 469.9875 | 43.0 | 20.0 |

**Results**: The EUT is compliant.

Measurement uncertainties shown for these tests are expanded Gaussian uncertainties expressed at 95% confidence level using a coverage factor k = 2. Measurement uncertainty = ±0.5 dB.

**Table 3-2: Test Equipment Used for Testing RF Power Output - Conducted**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901581 | Rohde & Schwarz | FSU | Spectrum Analyzer | 1166.1660.50 | 04/26/2021 |
| 901724 | API Weinschel, Inc. | 48-40-34 | 40 dB 100W Attenuator | CJ8921 | 09/09/2020 |

**Test Personnel:**

| Daniel Baltzell | | May 8, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

## 4 FCC Parts 2.1051, 90.210: Conducted Spurious Emissions

### 4.1 Test Procedure

ANSI C63.26 §5.7

The transmitter is terminated with a 50 Ω load and interfaced with a spectrum analyzer.

Device with digital modulation: Modulated to its maximum extent.

### 4.2 Test Data

Ambient Temperature: +24.1°C Relative Humidity: 31% Barometric Pressure: 101.3 kPa

Frequency range of measurement per Part 2.1057: 9 kHz to 10 x Fc

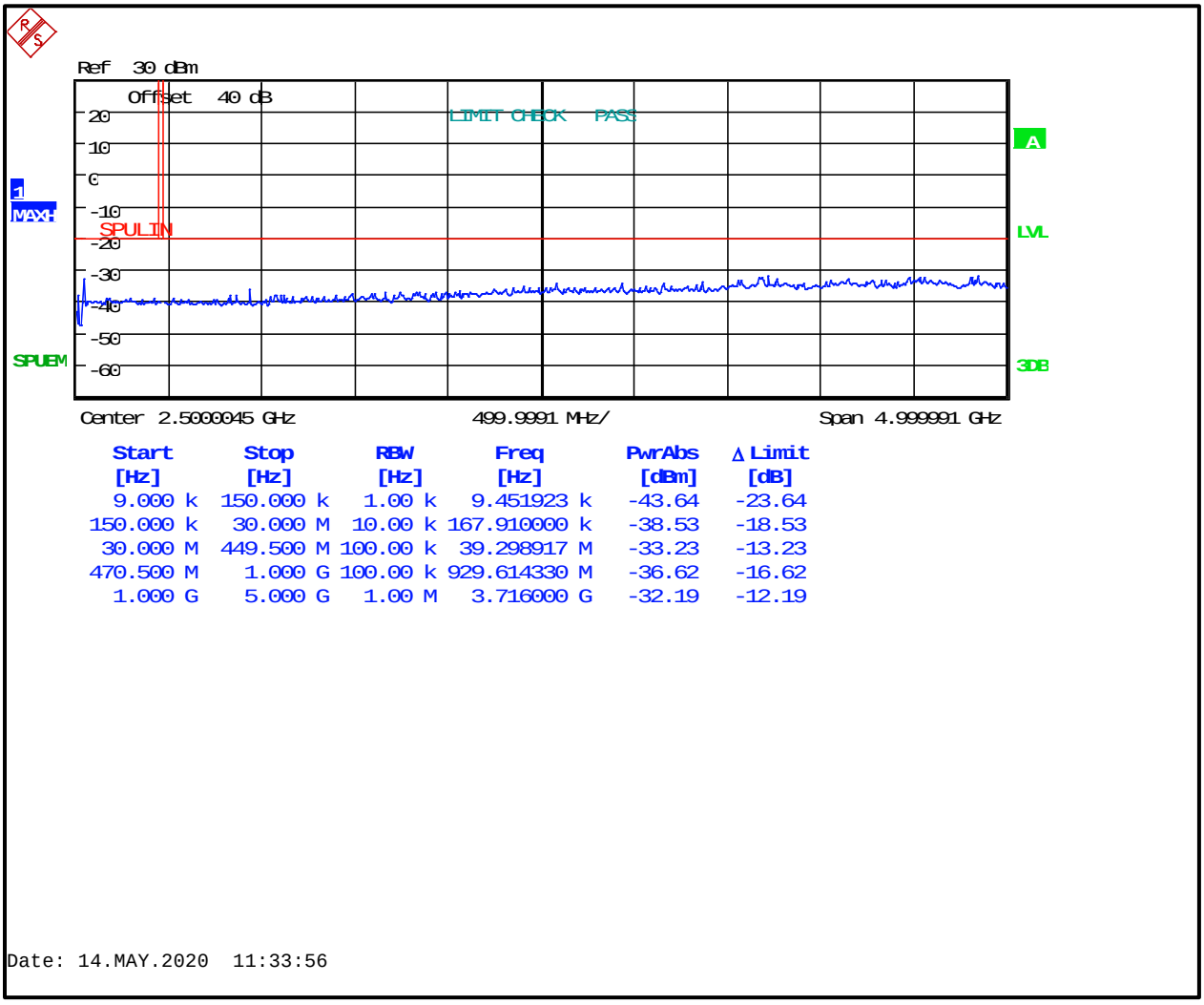
Limits: (50+10 LOG P(W)) for narrowband

The following channels (in MHz) were investigated:

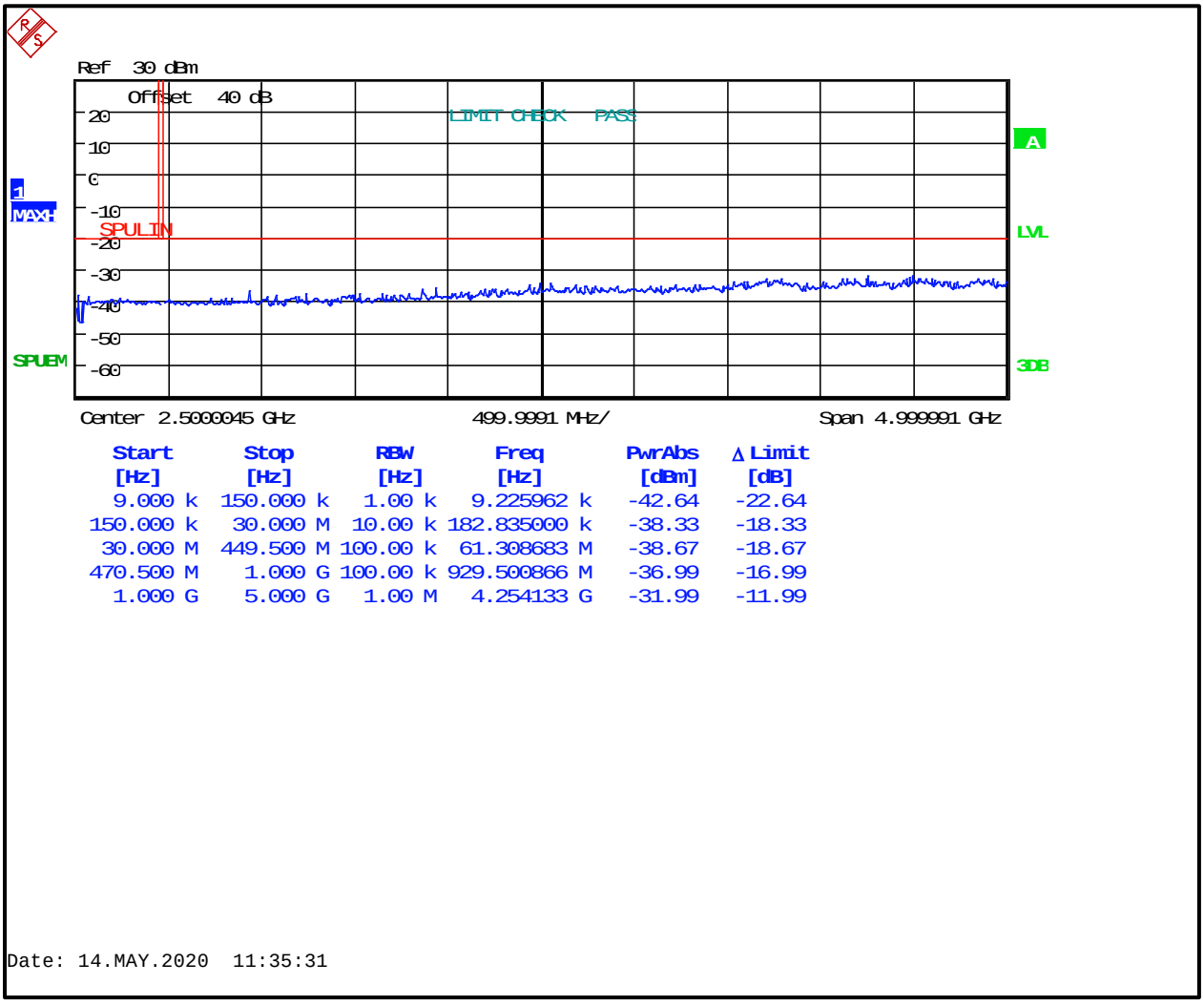
| UHF Test Frequencies |
|---|
| 450.0125 |
| 460.0000 |
| 469.9875 |

Both high and low power settings were checked; high power was found to be worst case, and is presented. All modes were investigated and analog mode is presented as representative data.

**Plot 4-1: Spurious Emissions at Antenna Terminals – 450.0125 MHz**



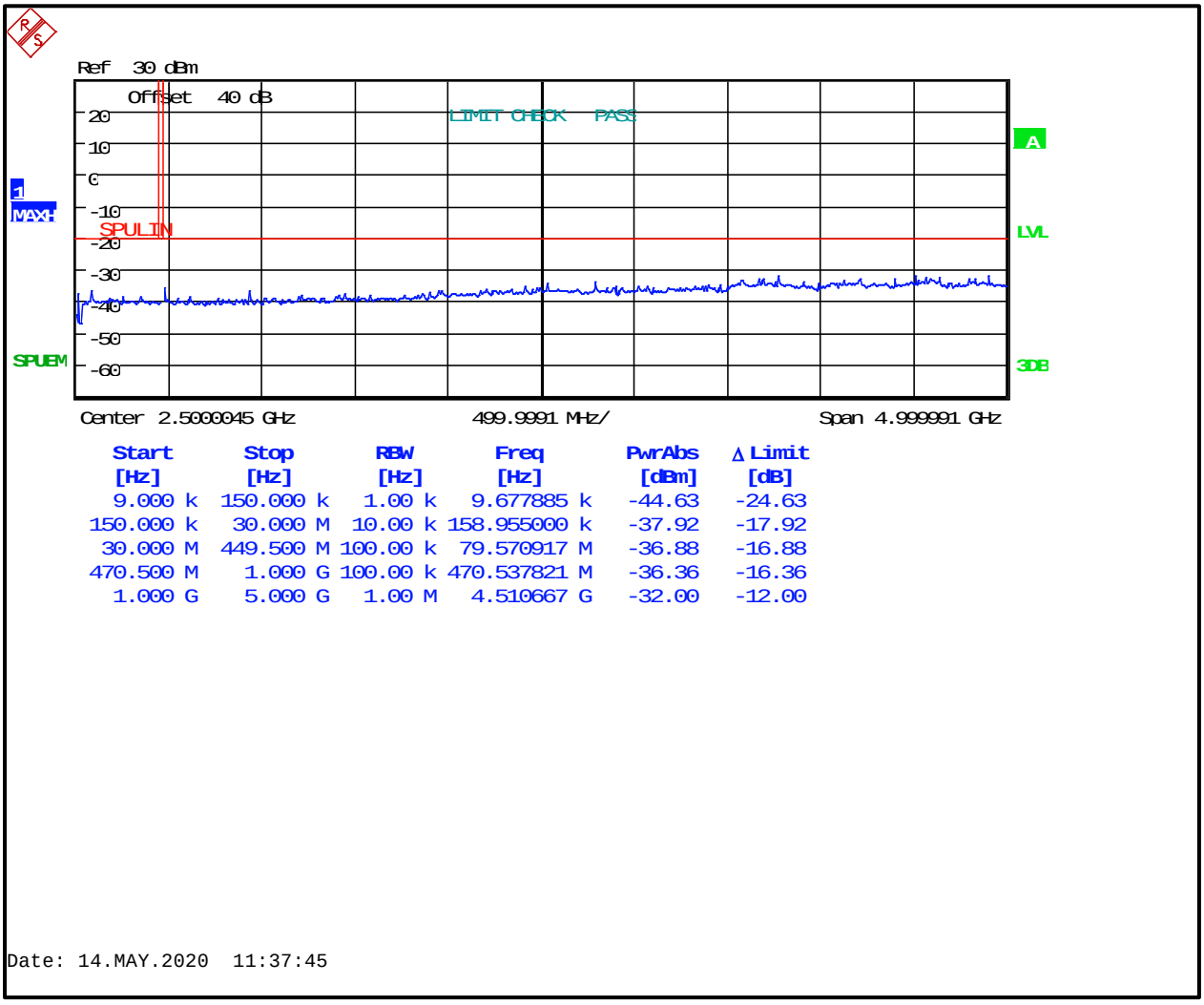
**Plot 4-2: Spurious Emissions at Antenna Terminals – 460.0000 MHz**




| Start [Hz] | Stop [Hz] | RBW [Hz] | Freq [Hz] | PwrAbs [dBm] | Δ Limit [dB] |
|---|---|---|---|---|---|
| 9.000 k | 150.000 k | 1.00 k | 9.225962 k | -42.64 | -22.64 |
| 150.000 k | 30.000 M | 10.00 k | 182.835000 k | -38.33 | -18.33 |
| 30.000 M | 449.500 M | 100.00 k | 61.308683 M | -38.67 | -18.67 |
| 470.500 M | 1.000 G | 100.00 k | 929.500866 M | -36.99 | -16.99 |
| 1.000 G | 5.000 G | 1.00 M | 4.254133 G | -31.99 | -11.99 |

Date: 14.MAY.2020 11:35:31

**Plot 4-3: Spurious Emissions at Antenna Terminals – 469.9875 MHz**




**Results**: The EUT is compliant.

Measurement uncertainties shown for these tests are expanded uncertainties expressed at the 95% confidence level using a coverage factor K=2. Measurement uncertainty: ±0.5 dB

**Table 4-1: Test Equipment Used for Testing Spurious Emissions**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901581 | Rohde & Schwarz | FSU | Spectrum Analyzer | 1166.1660.50 | 04/26/2021 |
| 900819 | Narda Microline | 766-10 | 10 dB Attenuator; 20 W | 06242 | 09/13/2020 |
| 901133 | Par Electronics | 400-512 (25W) | UHF Notch Filter | N/A | 09/09/2020 |

**Test Personnel:**

| Daniel Baltzell | | May 14, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

# 5 FCC Parts 2.1053(a), 90.210: Radiated Emissions

## 5.1 Test Procedure

ANSI C63.26 §5.5

The spurious emissions levels were measured, and the device under test was replaced by a substitution antenna connected to a signal generator. This signal generator level was then corrected by subtracting the cable loss from the substitution antenna to the signal generator, and the gain of the antenna (dBi) was added to achieve the EIRP level, then converted from the corrected signal generator level (dBm) to dBc, and compared to the limit.

## 5.2 Test Data

Ambient Temperature: +17.8°C Relative Humidity: 27% Barometric Pressure: 101.6 kPa

**Table 5-1: Field Strength of Spurious Radiation – 450.0125 MHz**

Conducted Power 42.7 dBm; 18.6 W; Limit=50+10LogP=62.7 dBc

| Frequency (MHz) | Spectrum Analyzer Level (dBuV) | Signal Generator Level (dBm) | Cable Loss to Transmit Antenna (dB) | Substitution Antenna Gain (dBi) | Corrected Signal Generator Level (dBc) | Margin (dB) |
|---|---|---|---|---|---|---|
| 900.025 | 3.5 | -70.8 | 0.3 | 20.4 | 93.5 | -30.8 |
| 1350.038 | 7.6 | -67.5 | 0.4 | 4.8 | 105.7 | -43.0 |
| 1800.050 | 8.6 | -65.7 | 0.4 | 7.3 | 101.5 | -38.8 |
| 2250.063 | 8.7 | -65.4 | 0.5 | 7.7 | 101.0 | -38.3 |
| 2700.075 | 8.3 | -65.6 | 0.6 | 7.6 | 101.4 | -38.7 |
| 3150.088 | 8.4 | -65.3 | 0.7 | 7.2 | 101.5 | -38.8 |
| 3600.100 | 4.8 | -68.8 | 0.8 | 7.5 | 104.7 | -42.0 |
| 4050.113 | 2.9 | -68.0 | 0.8 | 7.8 | 103.7 | -41.0 |
| 4500.125 | 2.9 | -68.4 | 0.9 | 9.1 | 102.9 | -40.2 |

**Table 5-2: Field Strength of Spurious Radiation – 460.0000 MHz**

Conducted Power 43.3 dBm; 21.4 W; Limit=50+10LogP=63.3 dBc

| Frequency (MHz) | Spectrum Analyzer Level (dBuV) | Signal Generator Level (dBm) | Cable Loss to Transmit Antenna (dB) | Substitution Antenna Gain (dBi) | Corrected Signal Generator Level (dBc) | Margin (dB) |
|---|---|---|---|---|---|---|
| 920.000 | 2.3 | -73.1 | 0.3 | 20.3 | 96.5 | -33.2 |
| 1380.000 | 8.8 | -65.3 | 0.4 | 4.7 | 104.3 | -41.0 |
| 1840.000 | 7.4 | -66.9 | 0.4 | 6.8 | 103.8 | -40.5 |
| 2300.000 | 8.8 | -65.3 | 0.5 | 7.7 | 101.5 | -38.2 |
| 2760.000 | 8.0 | -65.9 | 0.6 | 7.8 | 102.0 | -38.7 |
| 3220.000 | 8.4 | -65.3 | 0.7 | 7.2 | 102.1 | -38.8 |
| 3680.000 | 2.3 | -71.2 | 0.8 | 7.5 | 107.8 | -44.5 |
| 4140.000 | 2.4 | -68.6 | 0.8 | 8.1 | 104.6 | -41.3 |
| 4600.000 | 3.1 | -68.3 | 0.9 | 9.0 | 103.5 | -40.2 |

**Table 5-3: Field Strength of Spurious Radiation – 469.9875 MHz**

Conducted Power 43 dBm; 20 W; Limit=50+10LogP=63 dBc

| Frequency (MHz) | Spectrum Analyzer Level (dBuV) | Signal Generator Level (dBm) | Cable Loss to Transmit Antenna (dB) | Substitution Antenna Gain (dBi) | Corrected Signal Generator Level (dBc) | Margin (dB) |
|---|---|---|---|---|---|---|
| 939.975 | 5.0 | -69.8 | 0.3 | 20.7 | 92.4 | -29.4 |
| 1409.963 | 6.8 | -67.8 | 0.4 | 4.7 | 106.5 | -43.5 |
| 1879.950 | 7.7 | -66.6 | 0.5 | 6.4 | 103.6 | -40.6 |
| 2349.938 | 14.0 | -60.1 | 0.5 | 7.5 | 96.1 | -33.1 |
| 2819.925 | 8.0 | -65.9 | 0.6 | 7.9 | 101.6 | -38.6 |
| 3289.913 | 8.8 | -64.9 | 0.7 | 7.3 | 101.3 | -38.3 |
| 3759.900 | 2.5 | -71.0 | 0.8 | 7.2 | 107.5 | -44.5 |
| 4229.888 | 2.9 | -68.5 | 0.9 | 8.5 | 103.8 | -40.8 |
| 4699.875 | 2.8 | -68.7 | 0.9 | 9.0 | 103.6 | -40.6 |

**Results**: The EUT is compliant.

Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2.

Radiated Emissions: ±4.6 dB

**Table 5-4: Test Equipment Used for Testing Field Strength of Spurious Radiation**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900878 | Rhein Tech Laboratories | AM3-1197-0005 | 3 meter antenna mast, polarizing | OATS1 | N/A |
| 901592 | Insulated Wire Inc. | KPS-1503-3600-KPR | SMK RF Cables 20' | NA | 01/29/2021 |
| 901242 | Rhein Tech Laboratories | WRT-000-0003 | Wood rotating table | N/A | N/A |
| 901669 | ETS-Lindgren | 3142E | Biconilog Antenna (30 MHz – 6000 MHz) | 00166065 | 04/24/2022 |
| 901581 | Rohde & Schwarz | FSU | Spectrum Analyzer | 1166.1660.50 | 04/26/2021 |
| 901582 | Rohde & Schwarz | 1167.0000.02 | Signal Generator | 101903 | 04/24/2021 |

**Test Personnel:**

| Daniel Baltzell | | May 13, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

## 6 FCC Parts 2.1049(c)(1), 90.210: Bandwidths/Masks

Occupied Bandwidth - Compliance with the Emission Masks

### 6.1 Test Procedure

ANSI C63.26 §5.4

Notes: FCC 90.210 specifies mask D

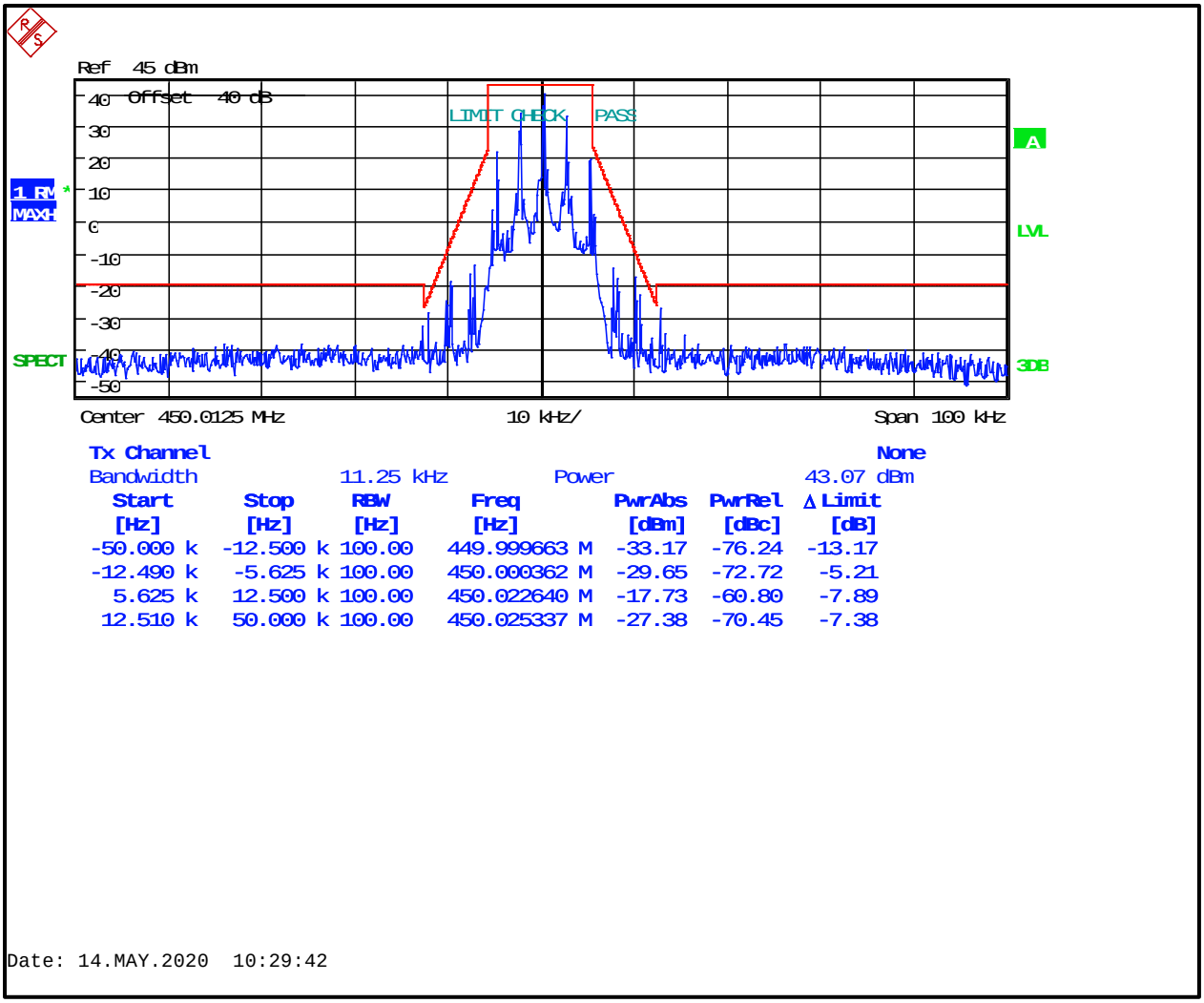
| Applicable Emission Masks | | |
|---|---|---|
| **Frequency Band (MHz)** | **Mask for Equipment With Audio Low Pass Filter** | **Mask for Equipment Without Audio Low Pass Filter** |
| Below 25 [1] | A or B | A or C |
| 25–50 | B | C |
| 72–76 | B | C |
| 150–174 [2] | B, D, or E | C, D, or E |
| 150 Paging-only | B | C |
| 220–222 | F | F |
| 421–512 [2] | B, D, or E | C, D, or E |
| 450 Paging-only | B | G |
| 806–809/851–854 | B | H |
| 809–824/854–869 [3] | B | G |
| 896–901/935–940 | I | J |
| 902–928 | K | K |
| 929–930 | B | G |
| 4940–4990 MHz | L or M | L or M |
| 5850–5925 [4] | | |
| All other bands | B | C |

[1] Equipment using single sideband J3E emission must meet the requirements of Emission Mask A. Equipment using other emissions must meet the requirements of Emission Mask B or C, as applicable.
[2] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
[3] Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691.
[4] DSRCS Roadside Unit equipment in the 5850–5925 MHz band is governed under subpart M of this part.

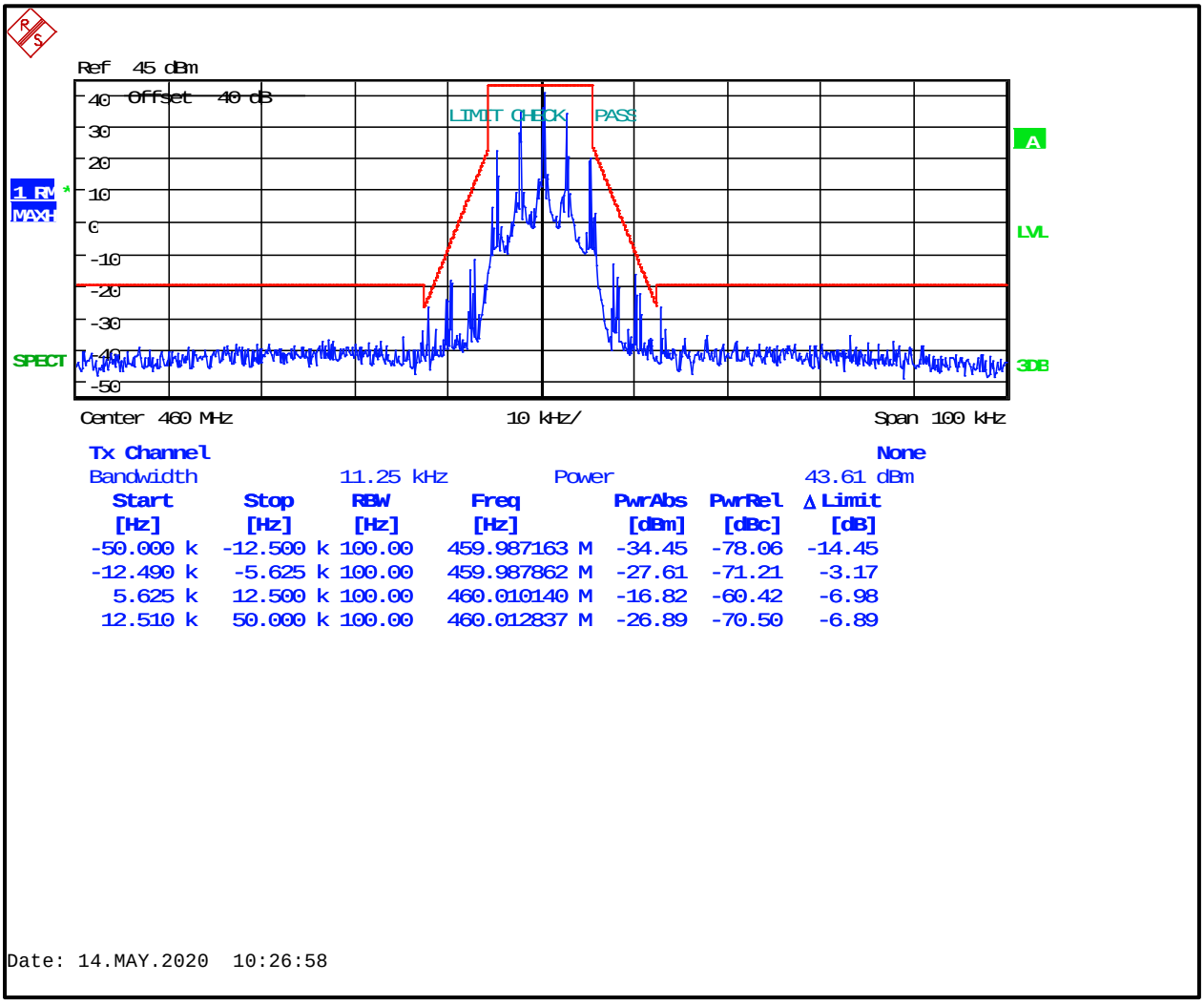
## 6.2 Test Data

Ambient Temperature: +24.1°C Relative Humidity: 31% Barometric Pressure: 101.3 kPa

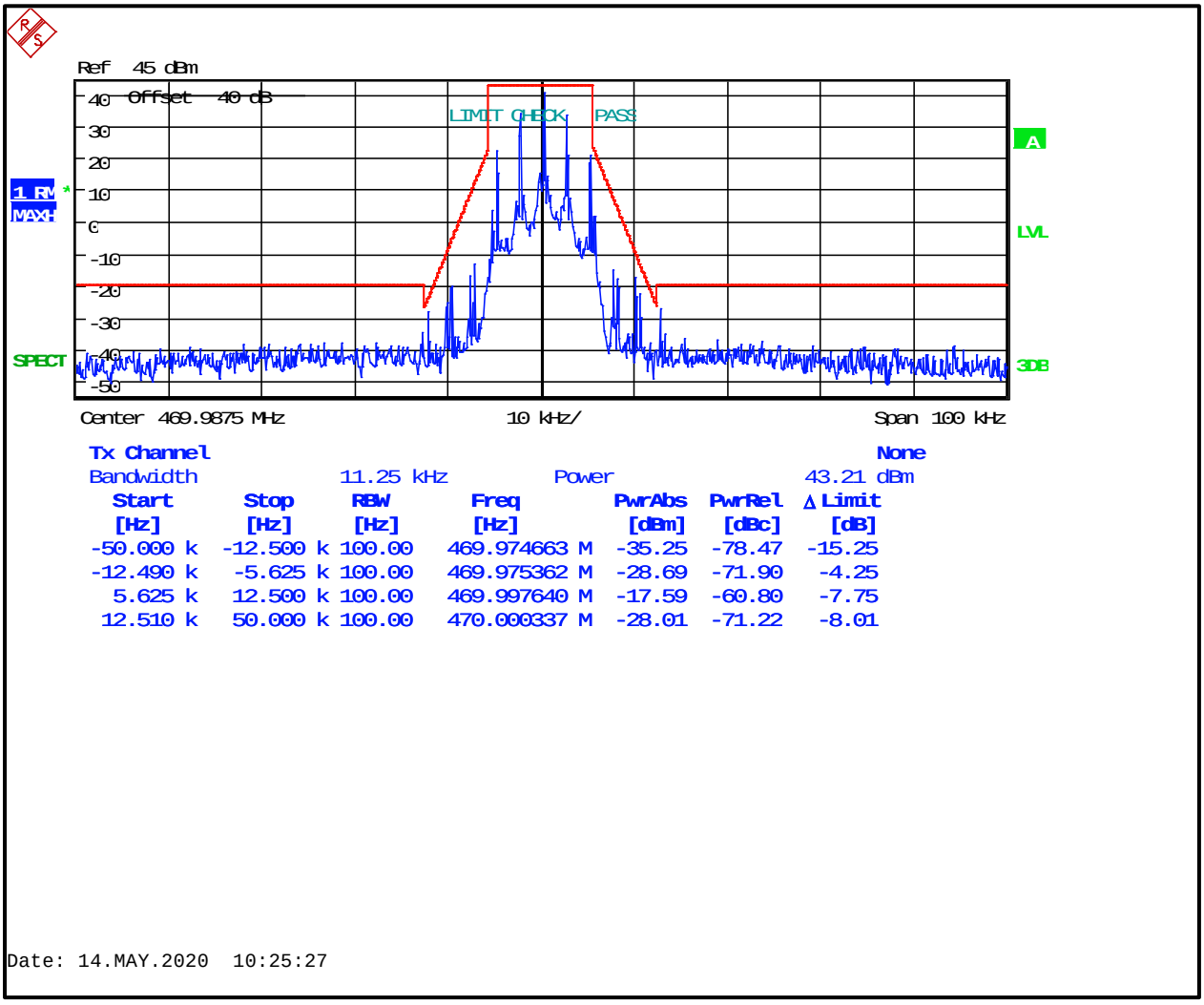
**Plot 6-1: Occupied Bandwidth – 450.0125 MHz; Narrowband Analog; Mask D**



**Plot 6-2: Occupied Bandwidth – 460.0000 MHz; Narrowband Analog; Mask D**



**Plot 6-3: Occupied Bandwidth – 469.9875 MHz; Narrowband Analog; Mask D**




**Results**: The EUT is compliant.

Measurement uncertainty: Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2. Measurement uncertainty= ±2 dB.

**Table 6-1: Test Equipment Used for Testing Occupied Bandwidth**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901581 | Rohde & Schwarz | FSU | Spectrum Analyzer | 1166.1660.50 | 04/26/2021 |
| 901724 | API Weinschel, Inc. | 48-40-34 | 40 dB 100W Attenuator | CJ8921 | 09/09/2020 |
| 901057 | Hewlett Packard | 3336B | Synthesizer/ Level Generator | 2514A02585 | 01/31/2021 |

**Test Personnel:**

| Daniel Baltzell | | May 14, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

# 7 FCC Parts 2.1055, 90.213: Frequency Stability

## 7.1 Test Procedure

ANSI C63.26 §5.6

The carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The EUT was evaluated over the temperature range -30°C to +50°C.

The temperature was initially set to -30°C and a 1-hour period was observed for stabilization of the EUT. The frequency stability was measured within one minute after application of primary power to the transmitter. The temperature was raised at intervals of 10 degrees centigrade through the range. A ½-hour period was observed to stabilize the EUT at each measurement step and the frequency stability was measured within one minute after application of primary power to the transmitter. Additionally, the power supply voltage of the EUT was varied +/-15% nominal input voltage.

90.213: Base stations – 1.5 ppm.

### 7.2 Test Data

Ambient Temperature: +24.1°C Relative Humidity: 31% Barometric Pressure: 101.3 kPa

#### 7.2.1 Temperature Frequency Stability

**Table 7-1: Temperature Frequency Stability – 450.0125 MHz**

| Temperature (°C) | Measured Frequency (Hz) | ppm |
|---|---|---|
| -30 | 450.012500 | 0.00 |
| -20 | 450.012500 | 0.00 |
| -10 | 450.012500 | 0.00 |
| 0 | 450.012500 | 0.00 |
| 10 | 450.012500 | 0.00 |
| 20 (reference) | 450.012500 | 0.00 |
| 30 | 450.012500 | 0.00 |
| 40 | 450.012500 | 0.00 |
| 50 | 450.012500 | 0.00 |

**Table 7-2: Temperature Frequency Stability – 460.0000 MHz**

| Temperature (°C) | Measured Frequency (Hz) | ppm |
|---|---|---|
| -30 | 459.999996 | -0.01 |
| -20 | 460.000000 | 0.00 |
| -10 | 460.000000 | 0.00 |
| 0 | 460.000000 | 0.00 |
| 10 | 460.000000 | 0.00 |
| 20 (reference) | 460.000000 | 0.00 |
| 30 | 460.000000 | 0.00 |
| 40 | 460.000000 | 0.00 |
| 50 | 460.000000 | 0.00 |

**Table 7-3: Temperature Frequency Stability – 469.9875 MHz**

| Temperature (°C) | Measured Frequency (Hz) | ppm |
|---|---|---|
| -30 | 469.987500 | 0.00 |
| -20 | 469.987500 | 0.00 |
| -10 | 469.987500 | 0.00 |
| 0 | 469.987500 | 0.00 |
| 10 | 469.987500 | 0.00 |
| 20 (reference) | 469.987500 | 0.00 |
| 30 | 469.987500 | 0.00 |
| 40 | 469.987500 | 0.00 |
| 50 | 469.987500 | 0.00 |

### 7.2.2 Frequency Stability/Voltage Variation

**Table 7-4: Frequency Stability/Voltage Variation – 450.0125 MHz**

| Voltage (VDC) | Measured Frequency (MHz) | ppm |
|---|---|---|
| 20.4 | 450.012500 | 0.00 |
| 24.(reference) | 450.012500 | 0.00 |
| 27.6 | 450.012500 | 0.00 |

**Table 7-5: Frequency Stability/Voltage Variation – 460.0000 MHz**

| Voltage (VDC) | Measured Frequency (MHz) | ppm |
|---|---|---|
| 20.4 | 459.999996 | -0.01 |
| 24.(reference) | 460.000000 | 0.00 |
| 27.6 | 459.999996 | -0.01 |

**Table 7-6: Frequency Stability/Voltage Variation – 469.9875 MHz**

| Voltage (VDC) | Measured Frequency (MHz) | ppm |
|---|---|---|
| 20.4 | 469.987500 | 0.00 |
| 24.(reference) | 469.987500 | 0.00 |
| 27.6 | 469.987500 | 0.00 |

**Results**: The EUT is compliant.

Measurement uncertainties shown for these tests are expanded Gaussian uncertainties expressed at 95% confidence level using a coverage factor k = 2. Measurement uncertainty = ±12 Hz.

**Table 7-7: Test Equipment Used for Testing Frequency Stability**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 900946 | Tenney Engineering, Inc. | TH65 | Temperature Chamber with Humidity | 11380 | 04/07/2022 |
| 901672 | Rohde & Schwarz | FSEM30 | Spectrum Analyzer | FSEM30 | 04/25/2022 |
| 901724 | API Weinschel, Inc. | 48-40-34 | 40 dB 100W Attenuator | CJ8921 | 09/09/2020 |
| 901350 | Meterman | 33XR | Multimeter | 040402802 | 09/20/2021 |

**Test Personnel:**

| Daniel Baltzell | | May 14, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

## 8 FCC Part 90.214: Transient Frequency Response

### 8.1 Test Procedure

ANSI C63.26 §6.5.2.2

**§90.214 Transient frequency behavior:** Transmitters designed to operate in the 150-174 MHz and 421-512 MH frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

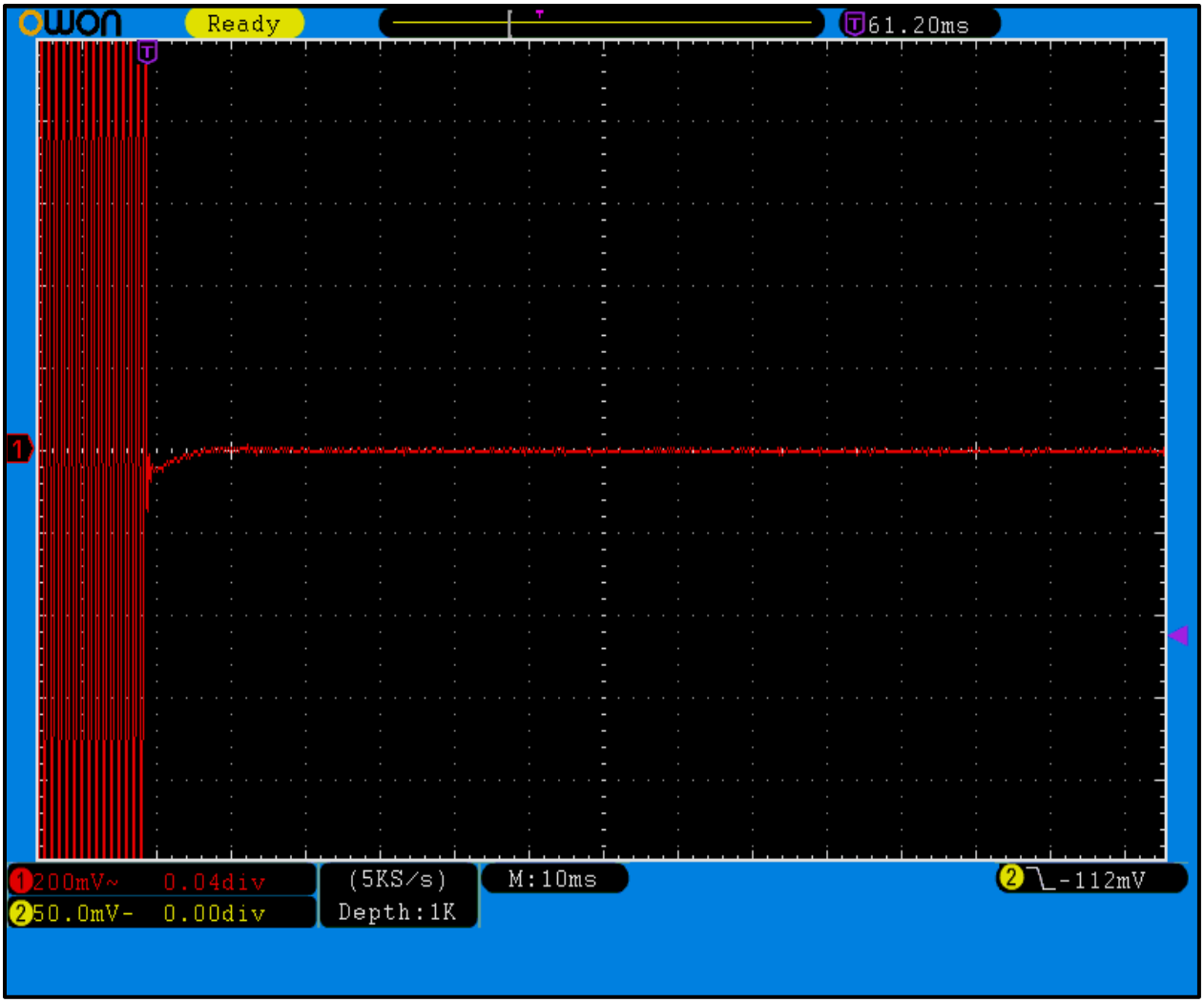
| Time intervals [1] [2] | Maximum frequency difference[3] | All equipment | |
|---|---|---|---|
| | | 150 to 174 MHz | 421 to 512 MHz |
| **Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels** | | | |
| $t_1$[4]…….. | ±25.0 kHz | 5.0 ms | 10.0ms |
| $t_2$…….. | ±12.5 kHz | 20.0 ms | 25.0ms |
| $t_3$[4]…….. | ±25.0 kHz | 5.0 ms | 10.0ms |
| **Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels** | | | |
| $t_1$[4]…….. | ±12.5 kHz | 5.0 ms | 10.0ms |
| $t_2$…….. | ±6.25 kHz | 20.0 ms | 25.0ms |
| $t_3$[4]…….. | ±12.5 kHz | 5.0 ms | 10.0ms |
| **Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels** | | | |
| $t_1$[4]…….. | ±6.25 kHz | 5.0 ms | 10.0ms |
| $t_2$…….. | ±3.125 kHz | 20.0 ms | 25.0ms |
| $t_3$[4]…….. | ±6.25 kHz | 5.0 ms | 10.0ms |

$1_{on}$ is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
$t_1$ is the time period immediately following $t_{on.}$
$t_2$ is the time period immediately following $t_{1.}$
$t_3$ is the time period from the instant when the transmitter is turned off until $t_{off.}$
$t_{off}$ is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of $t_2$ to the beginning of $t_{3,}$ the frequency difference must not exceed the limits specified in §90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

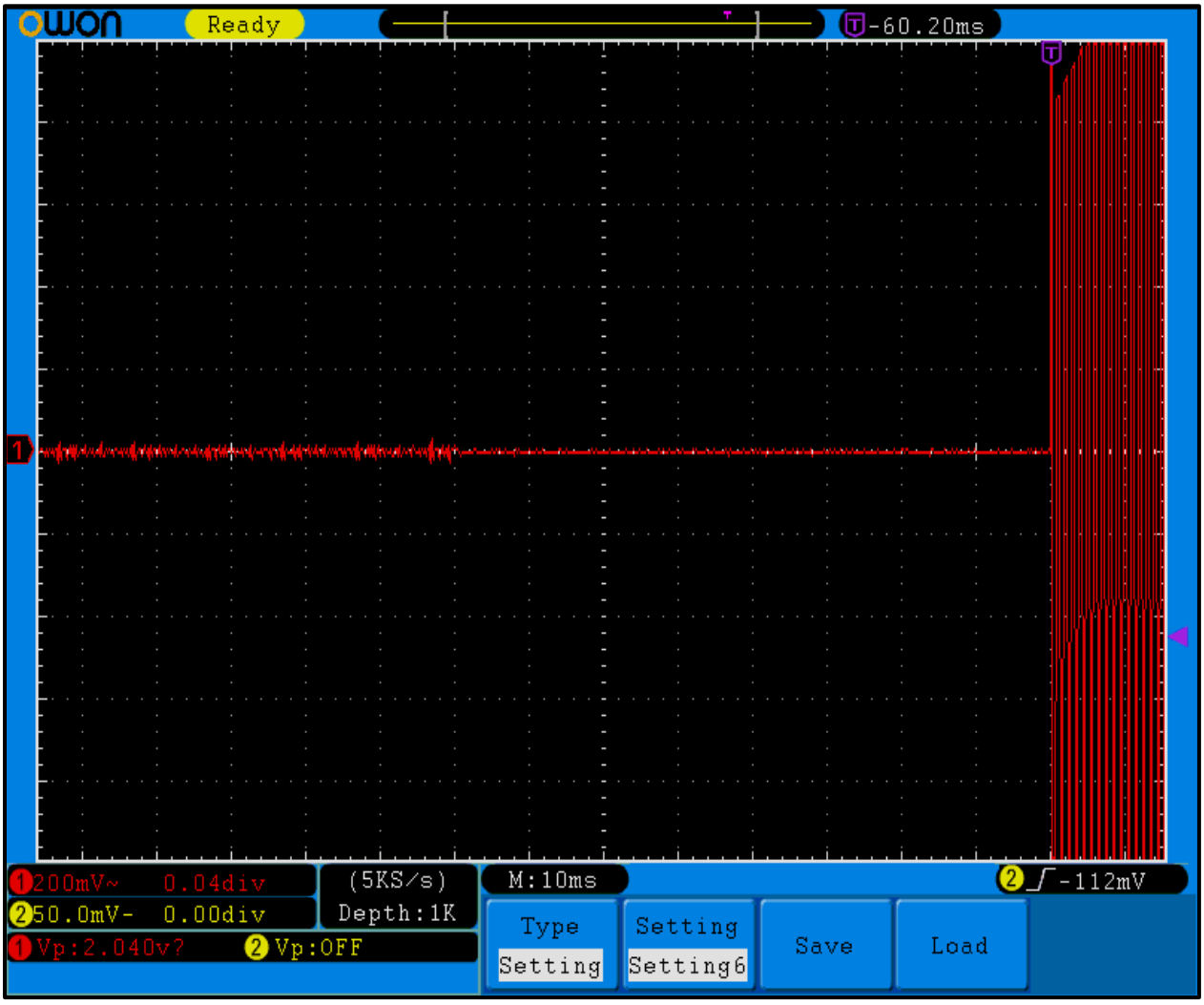
## 8.2 Test Data

Ambient Temperature: +24.1°C Relative Humidity: 32% Barometric Pressure: 100.6 kPa

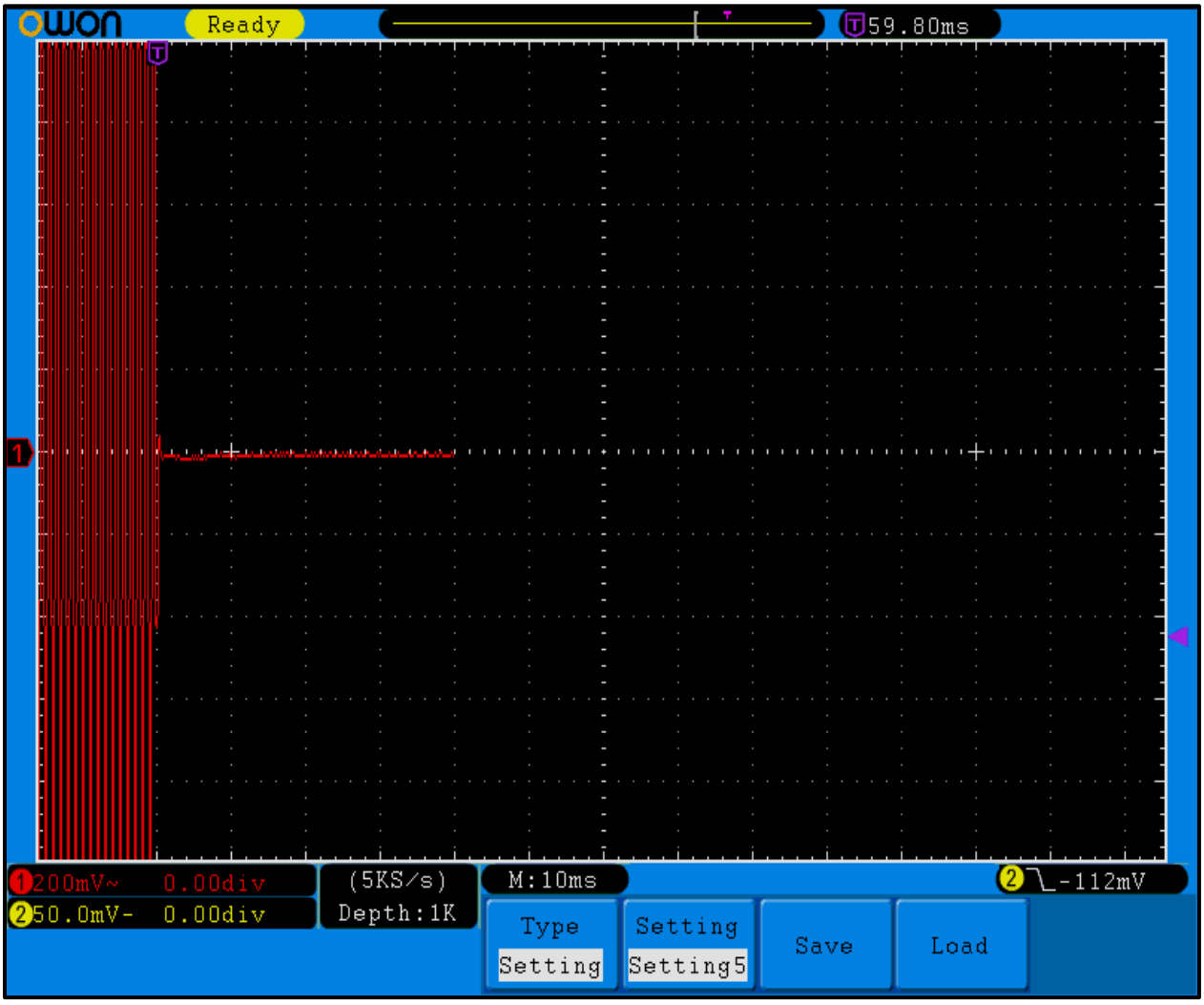
**Plot 8-1: Transient Frequency Behavior – NB; Carrier On Time; 450.0125 MHz**



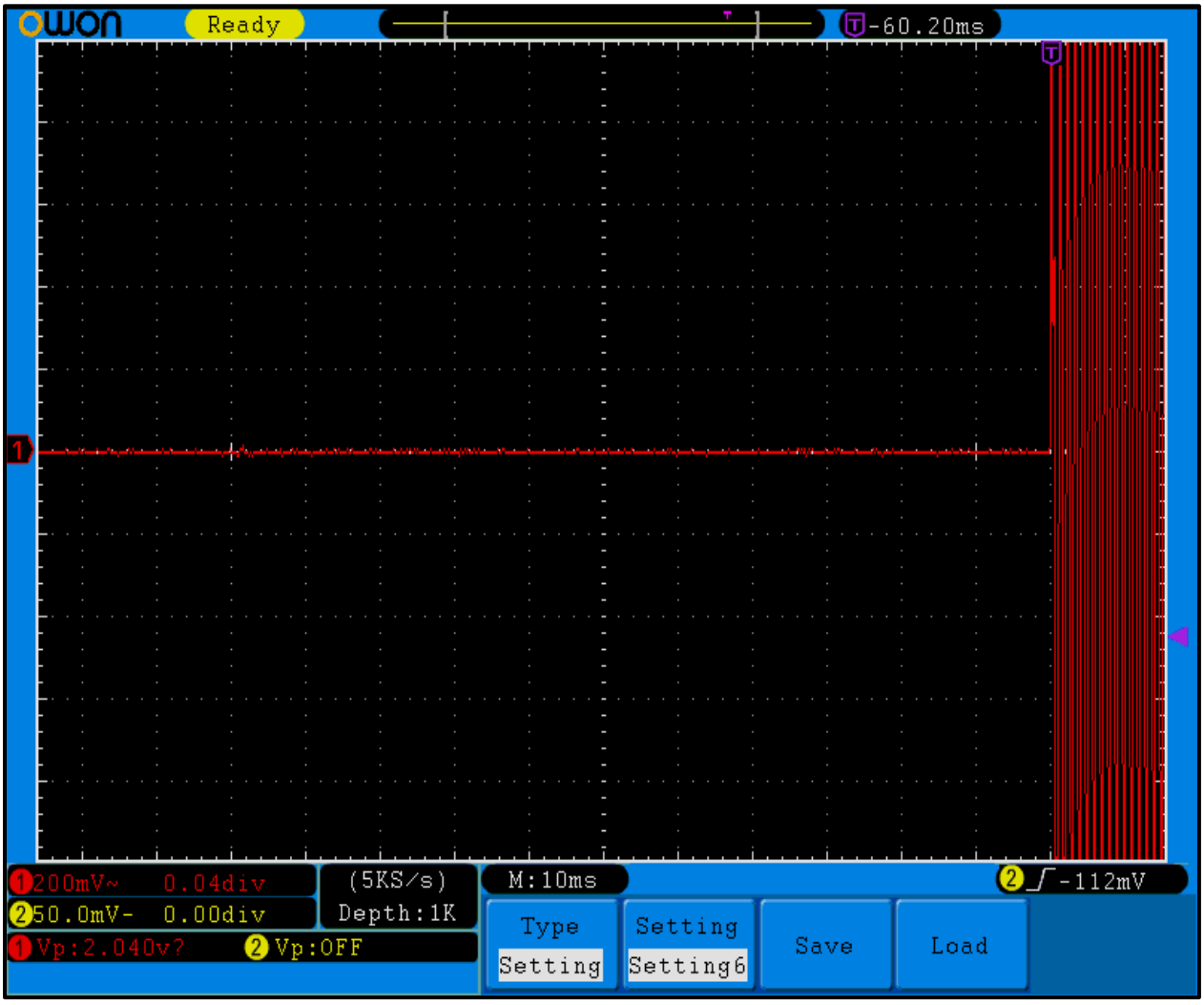
**Plot 8-2: Transient Frequency Behavior – NB; Carrier Off Time; 450.0125 MHz**



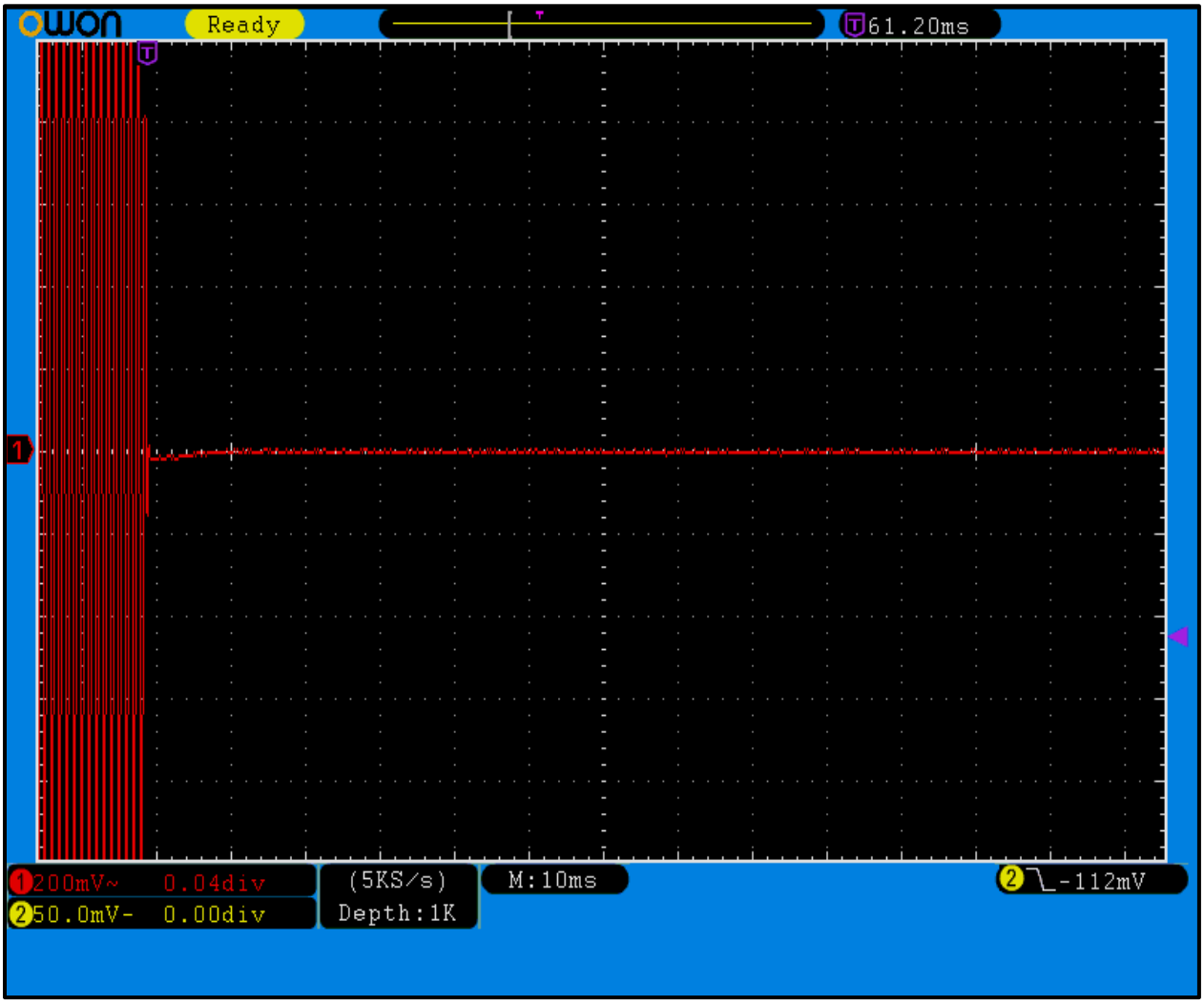
**Plot 8-3: Transient Frequency Behavior – NB; Carrier On Time; 460.0000 MHz**



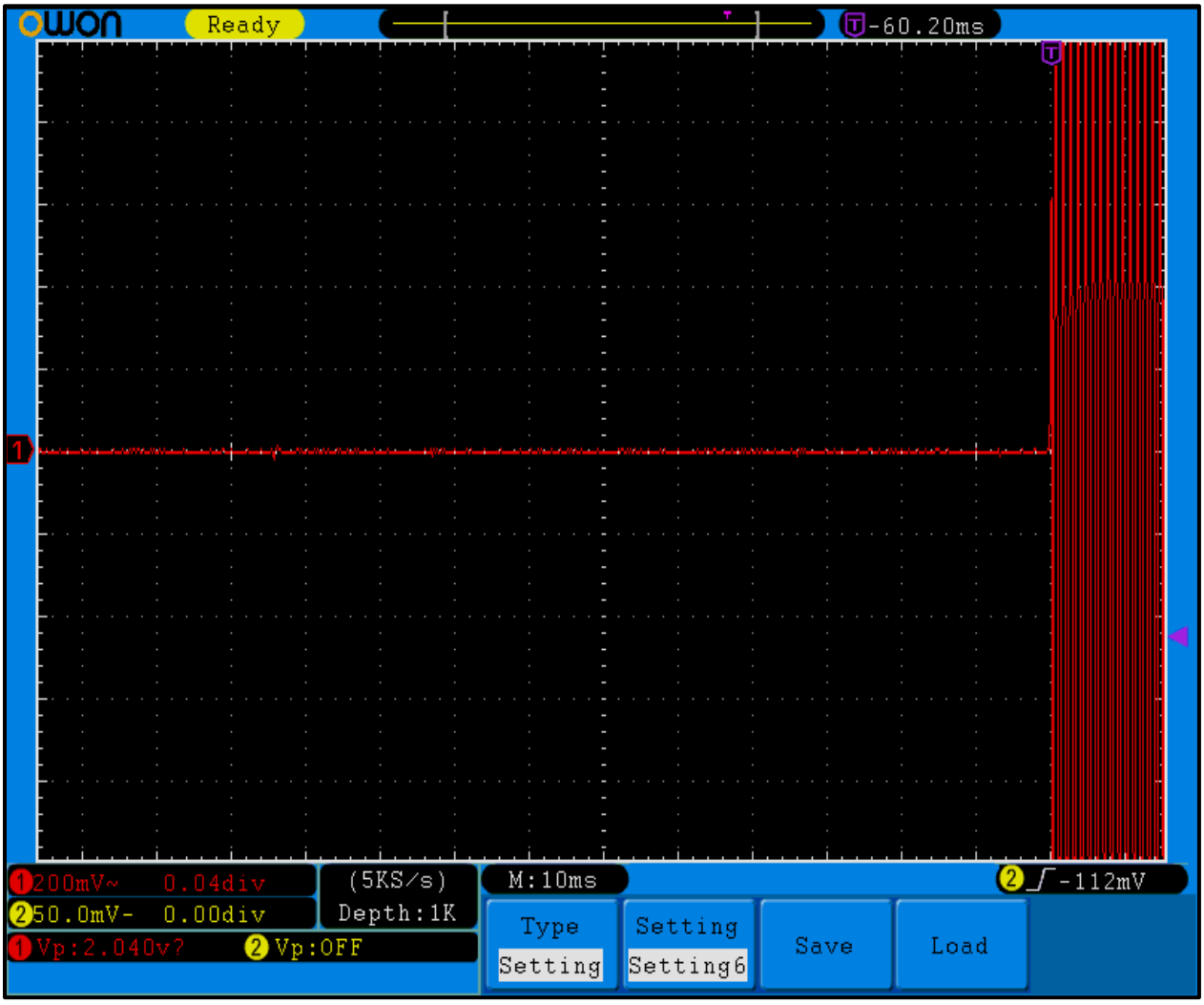
**Plot 8-4: Transient Frequency Behavior – NB; Carrier Off Time; 460.0000 MHz**



**Plot 8-5: Transient Frequency Behavior – NB; Carrier On Time; 469.9875 MHz**



**Plot 8-6: Transient Frequency Behavior – NB; Carrier Off Time; 469.9875 MHz**




**Results**: The EUT is compliant.

Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor k = 2. Measurement uncertainty = ±100 Hz

**Table 8-1: Test Equipment Used for Testing Transient Frequency Behavior**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901610 | OWON | SDS7102V | Oscilloscope | SDS71021312068 | 04/02/2021 |
| 900917 | Hewlett Packard | 8648C | Synthesized. Signal Generator (9 kHz - 3200 MHz) | 3537A01741 | 02/01/2021 |
| 900948 | Weinschel | 47-10-43 | Attenuator DC-18GHz, 10 dB, 50W | BH1487 | 09/13/2020 |
| 901346 | Pasternack | 1795 | Power Divider (10 MHz - 1 GHz) | 4067 | N/A |
| 900352 | Werlatone | Directional Coupler | Coupler | C1795/4989 | 09/09/2020 |
| 901263 | Agilent Technologies | .01-12 GHz | SMA Detector | 2936A05505 | N/A |
| 901118 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2406A00178 | 02/01/2021 |
| 901724 | Aeroflex | 48-40-34 | 40 dB Attenuator | CJ8921 | 09/09/2020 |
| 901477 | Micro-Coax | UFA210A-0-0360-300300 | RF cable 0.04 - 18 GHz | 212349-002 | 01/2920/21 |
| 901235 | IW Microwave Products | KPS-1503-360-KPS | High Frequency RF Cables | 36" | 10/29/2020 |
| 901727 | Insulated Wire Inc. | KPS-1503-360-KPR | SMK RF Cables 36” | NA | 08/20/2020 |

**Test Personnel:**

| Daniel Baltzell | | May 15, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

# 9 FCC Part 2.1047(a)(b): Modulation Characteristics

## 9.1 Test Procedures

### 9.1.1 Audio Frequency Response

ANSI C63-26 §5.3.3

The audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

The input audio level at 1000 Hz was set to produce 20% of the rated system deviation. This point is shown as the 0 dB reference level, noted DEVref. The audio signal generator was varied from 100 Hz to 5 kHz with the input level held constant. The deviation in kHz was recorded using a modulation analyzer as DEVfreq. The response in dB relative to 1 kHz was calculated as follows:

Audio Frequency Response = 20 LOG (DEVfreq/DEVref)

### 9.1.2 Audio Low Pass Filter Response

No Low Pass Filter present

The Audio Low Pass Filter Response is the frequency response of the post limiter low pass filter circuit above 3000 Hz.

### 9.1.3 Modulation Limiting

ANSI C63-26 §5.3.2

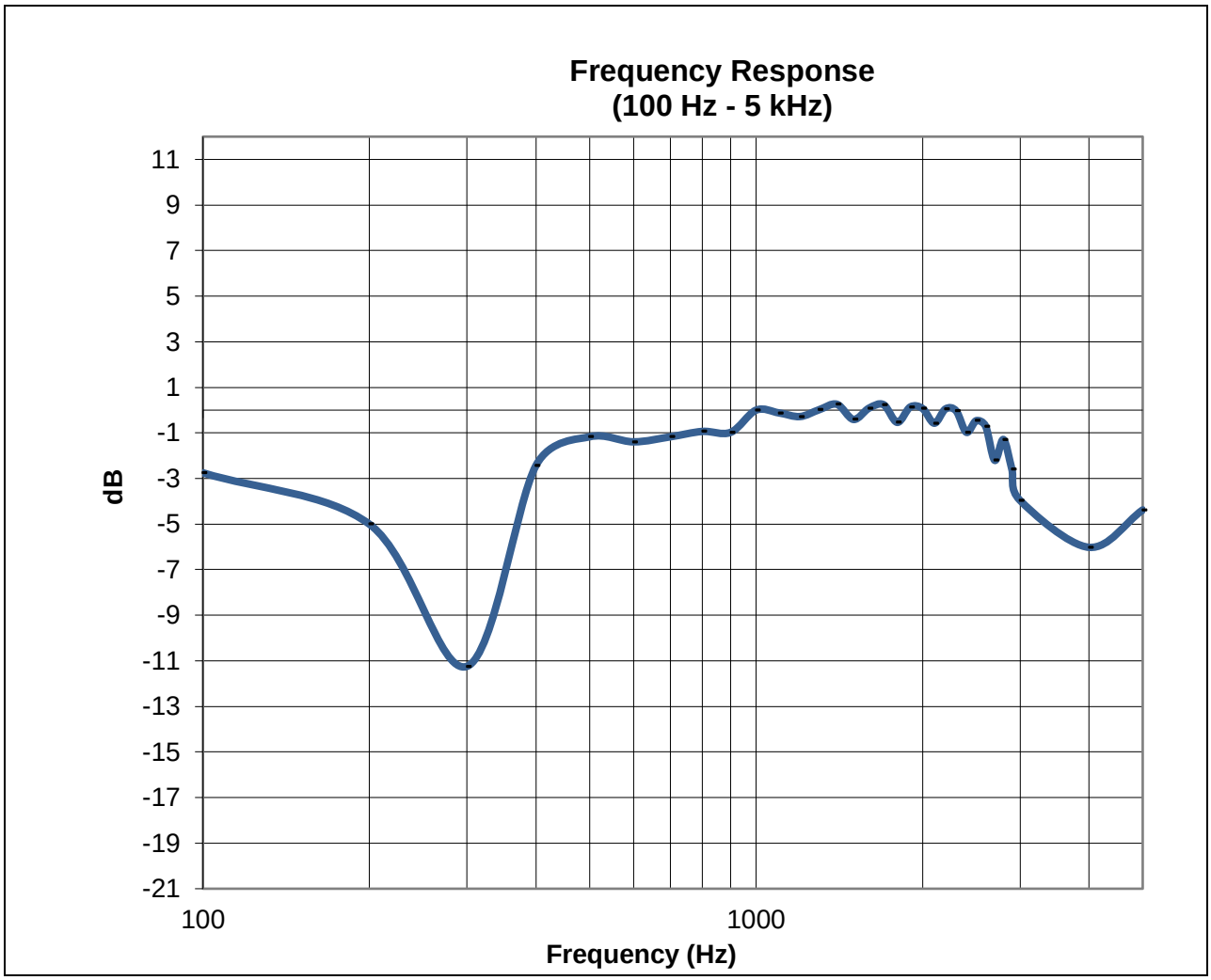
The transmitter was adjusted for full rated system deviation. The audio input level was adjusted for 60% of rated system deviation at 1000 Hz. Using this level (0 dB) as a reference, the audio input level was varied from the reference +/-20 dB for modulation frequencies of 300 Hz, 1,000 Hz, and 2,500 Hz. The system deviation obtained as a function of the input level was recorded. Both positive and negative peak deviations were recorded.

### 9.2 Test Data

Ambient Temperature: +24.2°C Relative Humidity: 23% Barometric Pressure: 101.6 kPa

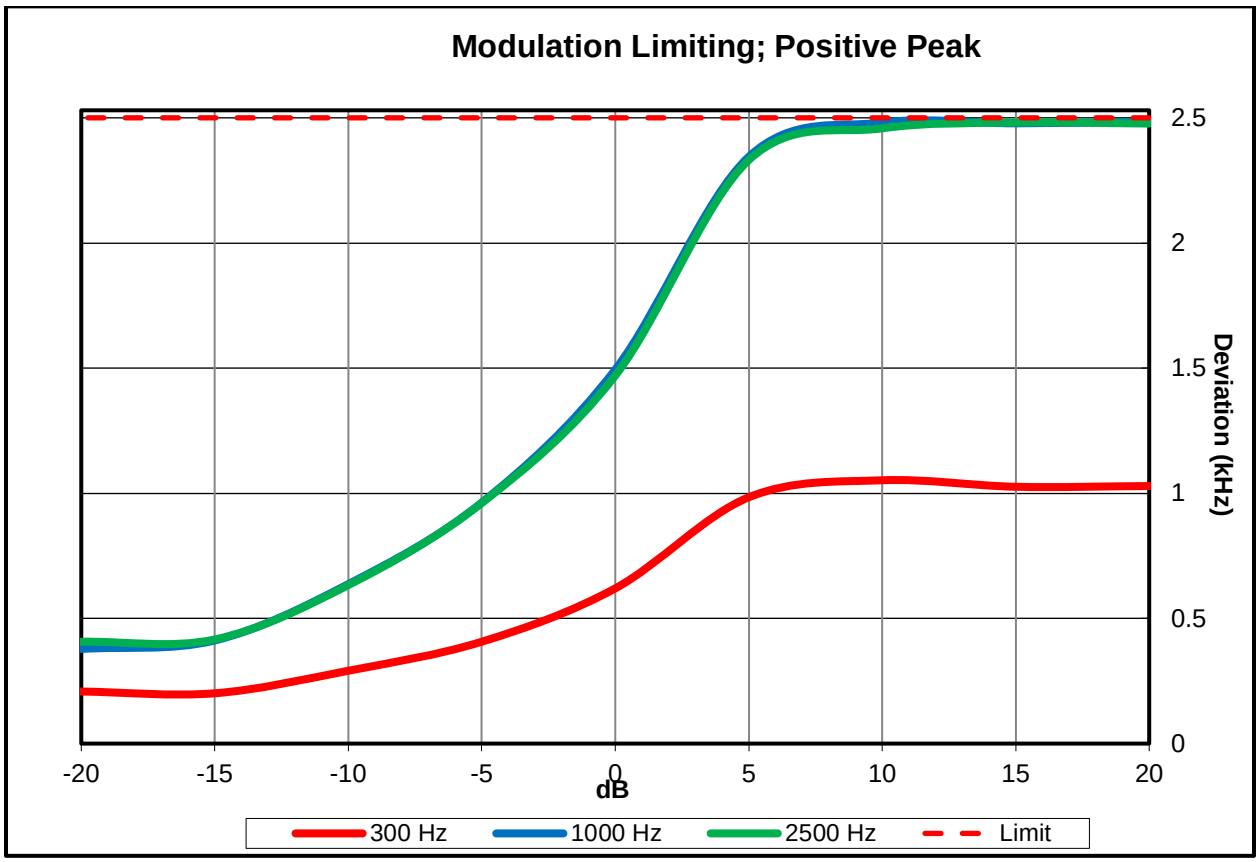
#### 9.2.1 Frequency Response of Audio Modulating Circuit

**Plot 9-1: Modulation Characteristics – Frequency Response – 460.0000 MHz**



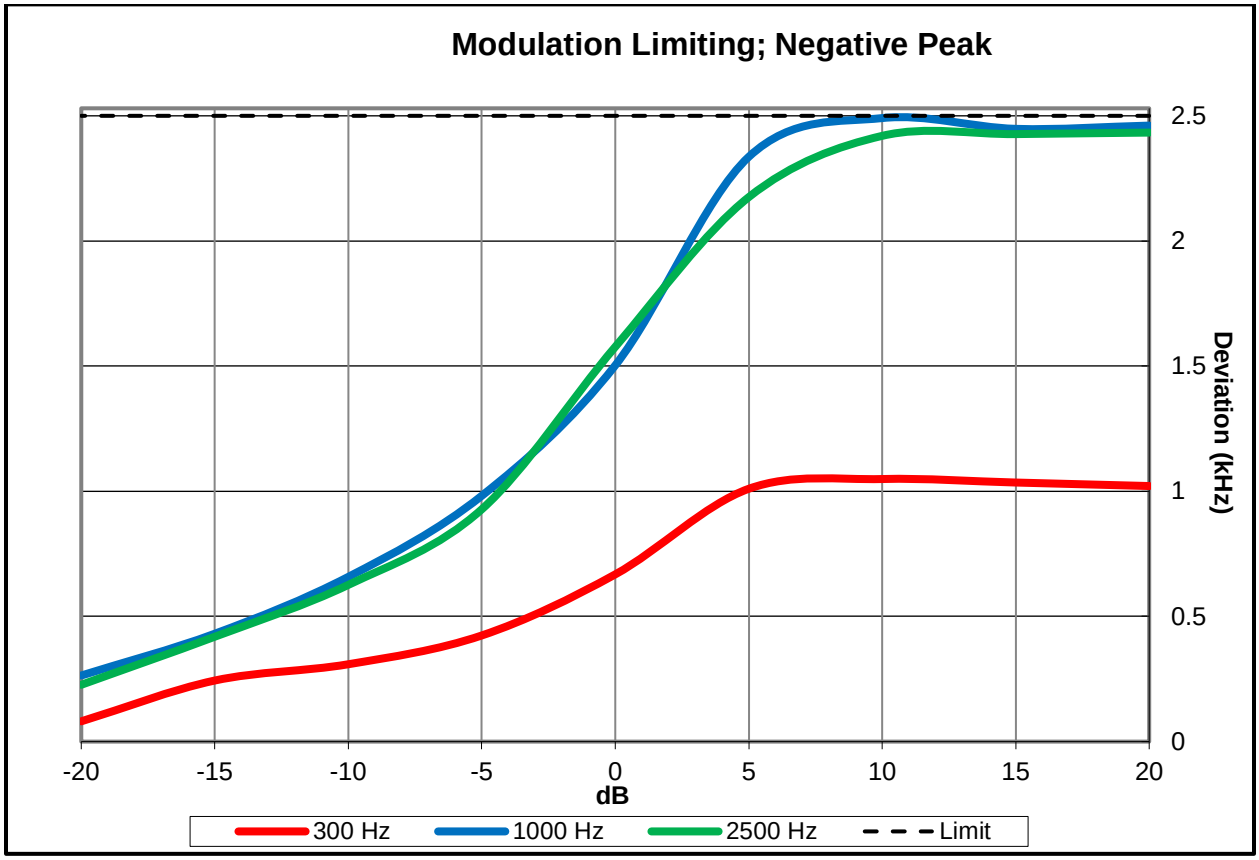
### 9.2.2 Modulation Limiting

**Plot 9-2: Modulation Characteristics – Modulation Limiting – 460.0000 MHz; Positive Peak**




| Normalized Injection Amplitude (dB) | Injection Frequency (Hz) Positive Peak | | |
|---|---|---|---|
| | 300 | 1000 | 2500 |
| 20 | 1.029 | 2.484 | 2.477 |
| 15 | 1.026 | 2.478 | 2.481 |
| 10 | 1.052 | 2.481 | 2.458 |
| 5 | 0.984 | 2.344 | 2.331 |
| 0 | 0.62 | 1.494 | 1.47 |
| -5 | 0.407 | 0.963 | 0.961 |
| -10 | 0.291 | 0.637 | 0.633 |
| -15 | 0.201 | 0.412 | 0.416 |
| -20 | 0.208 | 0.378 | 0.407 |

**Plot 9-3: Modulation Characteristics – Modulation Limiting – 460.0000 MHz; NB, Negative Peak**




| Normalized Injection Amplitude (dB) | Injection Frequency (Hz) Negative Peak | | |
|---|---|---|---|
| | 300 | 1000 | 2500 |
| 20 | 1.021 | 2.461 | 2.433 |
| 15 | 1.035 | 2.448 | 2.427 |
| 10 | 1.049 | 2.491 | 2.42 |
| 5 | 1.01 | 2.336 | 2.175 |
| 0 | 0.668 | 1.503 | 1.577 |
| -5 | 0.424 | 0.982 | 0.928 |
| -10 | 0.309 | 0.658 | 0.626 |
| -15 | 0.244 | 0.431 | 0.419 |
| -20 | 0.081 | 0.264 | 0.227 |

**Results**: The EUT is compliant.

Measurement uncertainty: ±1.4%. This measurement uncertainty is an expanded uncertainty for 95% confidence level received with a coverage factor k=2.

**Table 9-1: Test Equipment Used for Testing Modulation Requirements**

| RTL Asset # | Manufacturer | Model | Part Type | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| 901057 | Hewlett Packard | 3336B | Synthesizer/ Level Generator | 2514A02585 | 01/31/2021 |
| 901118 | Hewlett Packard | 8901A Opt. 002-003 | Modulation Analyzer | 2406A00178 | 02/01/2021 |
| 901537 | Aeroflex | 48-40-34 | 40 dB Attenuator | CB6628 | 09/09/2020 |

**Test Personnel:**

| Daniel Baltzell | | May 13, 2020 |
|---|---|---|
| EMC Test Engineer | Signature | Date of Test |

## 10 FCC Part 2.202: Necessary Bandwidth and Emission Bandwidth

Voice – 12.5 kHz channel separation FM
Calculation:
Max modulation (M) in kHz: 3.0
Max deviation (D) in kHz: 2.5
Constant factor (K): 1 (default)
Bn = 2xM+2xDK = 11.0 kHz
Emission designator: 11K0F3E

## 11 Conclusion

The data in this measurement report shows that the Electric Infrastructure Security Council Model BNET-V Base Station radio, FCC ID: 2AVVL0BSXR1BNETV001, complies with the applicable requirements of Parts 90 and 2 of the FCC Rules.