**F2 Labs**
**16740 Peters Road**
**Middlefield, Ohio 44062**
**United States of America**
**www.f2labs.com**

# CERTIFICATION TEST REPORT

| | |
|---|---|
| **Manufacturer:** | **Sound Quest, LLC**<br>**806 Beaver Street**<br>**Bristol, Pennsylvania 19007 USA** |
| **Applicant:** | **Hearing Lab Technology, LLC**<br>**14301 FAA Boulevard, Suite 105**<br>**Forth Worth, Texas 76155 USA** |
| **Product Name:** | **Custom ITC-I/Custom ITC-A** |
| **Product Description:** | Custom Hearing Aid with Bluetooth Connectivity |
| **Operating Voltage/Freq. of EUT During Testing:** | Battery-Operated (1.5VDC) |
| **Model(s):** | **ITC-U***<br>**Denotes actual model tested as representative of product family that includes Custom ITC-I (also known as U - made for i-Phone) and Custom ITC-A (also known as Android).* |
| **FCC ID:** | **2AC2W-SQCUSITC** |
| **Testing Commenced:** | 2022-03-09 |
| **Testing Ended:** | 2022-03-10 |
| **Summary of Test Results:** | **In Compliance**<br>The EUT complies with the EMC requirements when manufactured identically as the unit tested in this report, including any required modifications and/or manufacturer's statement. Any changes to the design or build of this unit subsequent to this testing may deem it non-compliant. |

- **FCC Part 15 Subpart C, Section 15.249**
- **FCC Part 15 Subpart C, Section 15.215(c) – Additional provisions to the general radiated emission limitations**
- **FCC Part 15 Subpart A, Section 15.31(e) – Measurement Standards**

**Evaluation Conducted by:**

Julius Chiller, EMC/Wireless Engineer

**Report Reviewed by:**

Ken Littell, Vice President of EMC

F2 Labs
26501 Ridge Road
Damascus, MD 20872
Ph 301.253.4500

F2 Labs
16740 Peters Road
Middlefield, OH 44062
Ph 440.632.5541

F2 Labs
8583 Zionsville Road
Indianapolis, IN 46268
Ph 317.610.0611

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# 1 ADMINISTRATIVE INFORMATION

## 1.1 Measurement Location:

F2 Labs in Middlefield, Ohio. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.

## 1.2 Measurement Procedure:

All measurements were performed according to the 2013 version of ANSI C63.10 and recommended FCC procedure of measurement under Section 15.249. A list of the measurement equipment can be found in Section 6.

## 1.3 Uncertainty Budget:

The uncertainty in EMC measurements arises from several factors which affect the results, some associated with environmental conditions in the measurement room, the test equipment being used, and the measurement techniques adopted.

The measurement uncertainty budgets detailed below are calculated from the test and calibration data and are expressed with a 95% confidence factor using a coverage factor of k=2. The Uncertainty for a laboratory is referred to as *U*lab. For Radiated and Conducted Emissions, the Expanded Uncertainty is compared to the *U*cispr values to determine if a specific margin is required to deem compliance.

*U*lab

| Measurement Range | Combined Uncertainly | Expanded Uncertainty |
|---|---|---|
| Radiated Emissions <1 GHz @ 3m | 2.54 | 5.07dB |
| Radiated Emissions <1 GHz @ 10m | 2.55 | 5.09dB |
| Radiated Emissions 1 GHz to 2.7 GHz | 1.81 | 3.62dB |
| Radiated Emissions 2.7 GHz to 18 GHz | 1.55 | 3.10dB |
| AC Power Line Conducted Emissions, 150kHz to 30 MHz | 1.38 | 2.76dB |
| AC Power Line Conducted Emissions, 9kHz to 150kHz | 1.66 | 3.32dB |

*U*cispr

| Measurement Range | Expanded Uncertainty |
|---|---|
| Radiated Emissions <1 GHz @ 3m | 5.2dB |
| Radiated Emissions <1 GHz @ 10m | 5.2dB |
| Radiated Emissions 1 GHz to 2.7 GHz | Under Consideration |
| Radiated Emissions 2.7 GHz to 18 GHz | Under Consideration |
| AC Power Line Conducted Emissions, 150kHz to 30 MHz | 3.6dB |
| AC Power Line Conducted Emissions, 9kHz to 150kHz | 4.0dB |

If *U*lab is less than or equal to *U*cispr, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If *U*lab is greater than *U*cispr in table 1, then:
- compliance is deemed to occur if no measured disturbance, increased by (*U*lab – *U*cispr), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance, increased by (*U*lab – *U*cispr), exceeds the disturbance limit.

Note: Only measurements listed in the tables above that relate to tests included in this Test Report are applicable.

## 1.4 Document History:

| Document Number | Description | Issue Date | Approved By |
|---|---|---|---|
| F2P27157A-06E | First Issue | 2022-04-11 | K. Littell |

## 2 SUMMARY OF TEST RESULTS

| Test Name | Standard(s) | Results |
|---|---|---|
| 99% Occupied Bandwidth | CFR 47 Part 15.215(c) | Complies |
| -20dB Occupied Bandwidth | CFR 47 Part 15.215(c) | Complies |
| Field Strength of Emissions | CFR 47 Part 15.249(a)(d) | Complies |
| Conducted Emissions | CFR 47 Part 15.207(a) | Not Applicable |
| Voltage Variation | CFR 47 Part 15.31(e) | Complies* |

**Requirements of 15.31 were met by using new batteries.*

| Modifications Made to the Equipment |
|---|
| None |

## 3 TABLE OF MEASURED RESULTS

| Test | Low Channel 2402 MHz | Mid Channel 2440 MHz | High Channel 2480 MHz |
|---|---|---|---|
| Average Field Strength of Fundamental | 2.4 mV/m<br>67.6 dBµV/m | 2.25 mV/m<br>67.0 dBµV/m | 1.86 mV/m<br>65.4 dBµV/m |
| Average Limit for Fundamental | 50 millivolts/meter<br>93.97 dBµV/m | 50 millivolts/meter<br>93.97 dBµV/m | 50 millivolts/meter<br>93.97 dBµV/m |
| -20dB Occupied Bandwidth (MHz) | 1.114 | 1.153 | 1.169 |
| 99% Occupied Bandwidth (MHz) | 1.049 | 1.065 | 1.057 |

The 99% / -20dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

# 4 ENGINEERING STATEMENT

This report has been prepared on behalf of Hearing Lab Technology, LLC to provide documentation for the testing described herein. This equipment has been tested and found to comply with part 15.249 of the FCC Rules using ANSI C63.10 2013 standard. The test results found in this test report relate only to the items tested.

# 5 EUT INFORMATION AND DATA

## 5.1 Equipment Under Test:

Product: **U56 Series Hearing Aid**
Model: **ITC-U***
**Denotes actual model tested as representative of product family that includes Custom ITC-I (also known as U - made for i-Phone) and Custom ITC-A (also known as Android).*
Serial No.: 22912346
FCC ID: **2AC2W-SQCUSITC**

## 5.2 Trade Name:

SoundQuest LLC

## 5.3 Power Supply:

Battery-operated (1.5VDC)

## 5.4 Applicable Rules:

CFR 47, Part 15.249

## 5.5 Antenna:

Integral, -12dB max/-16dB Avg Gain

## 5.6 Accessories:

None

## 5.7 Test Item Condition:

The equipment to be tested was received in good condition.

## 5.8 Testing Algorithm:

Bluetooth radio in hearing aid was tested on the low (2402 MHz), mid (2440 MHz) and high (2480 MHz) channels.

## 6 LIST OF MEASUREMENT INSTRUMENTATION

| Equipment Type | Asset Number | Manufacturer | Model | Serial Number | Calibration Due Date |
|---|---|---|---|---|---|
| Shielded Chamber | CL166-E | Albatross Projects | B83117-DF435-T261 | US140023 | 2022-06-09 |
| Temp./Hum. Recorder | CL234 | Extech | 44581 | 03 | 2022-04-01 |
| Receiver | CL151 | Rohde & Schwarz | ESU40 | 100319 | 2023-03-31 |
| Horn Antenna | CL098 | Emco | 3115 | 9809-5580 | 2023-01-26 |
| Horn Antenna 18-26.5 GHz | CL114 | A.H. Systems, Inc. | SAS-572 | 237 | 2023-07-30 |
| Pre-Amplifier | CL153 | Keysight Tech. | 83006A | MY39500791 | 2022-04-01 |
| Pre-amplifier | CL285 | Com-Power | PAM-0207 | 322 | 2023-03-30 |
| Active 18” Loop Antenna | CL163-Loop | A.H. Systems, Inc. | EHA-52B | 100 | 2022-09-14 |
| Antenna, JB3 Combination | CL175 | Sunol Sciences | JB3 | A030315 | 2022-09-14 |
| Software: | EMC 32, Version 5.20.2 | | Software Verified: 2022-03-07 to 2022-03-08 | | |
| Software | Tile Version 3.4.B.3 | | Software Verified: 2022-03-07 to 2022-03-08 | | |
| Low Loss Cable Set | -- | Pasternack | PE3C0666-252 / PE3C066-50CM | None Spec. | 2023-10-12 |

# 7 OCCUPIED BANDWIDTH

## 7.1 Requirements:

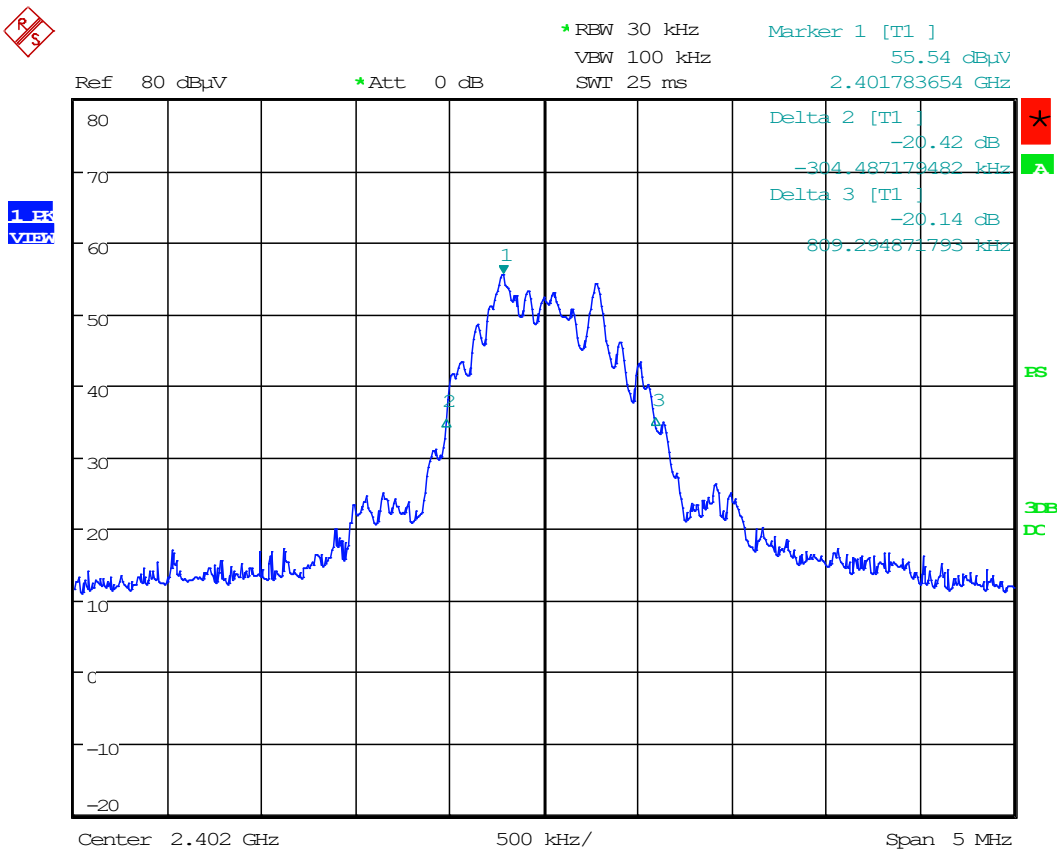
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the -20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

Bandwidth measurements were made at the low (2.402 GHz), mid (2.440 GHz) and upper (2.480 GHz) frequencies. The bandwidth was measured using the analyzer's marker function.

## 7.2 Occupied Bandwidth Test Data

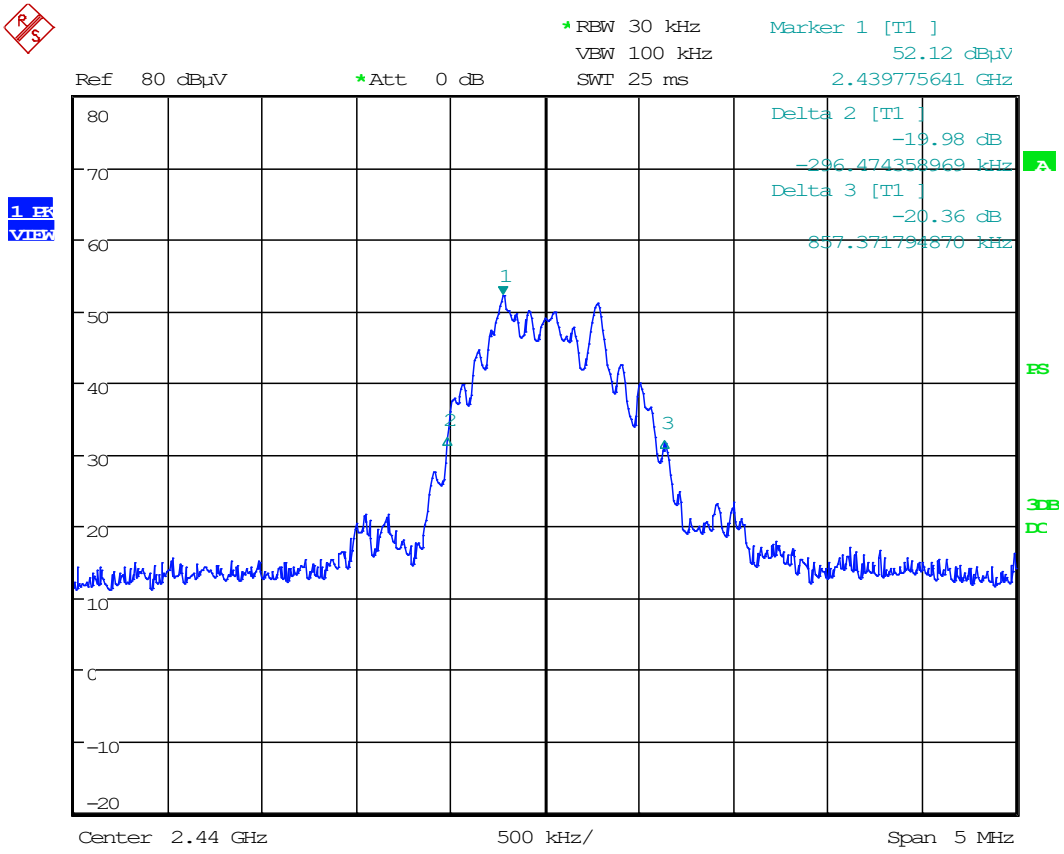
| Test Date(s): | 2022-03-09 | Test Engineer(s): | J. Chiller |
|---|---|---|---|
| Standards: | CFR 47 Part 15.215(c) | Air Temperature: | 20.4ºC |
| | | Relative Humidity: | 29% |

### -20dB, Low Channel



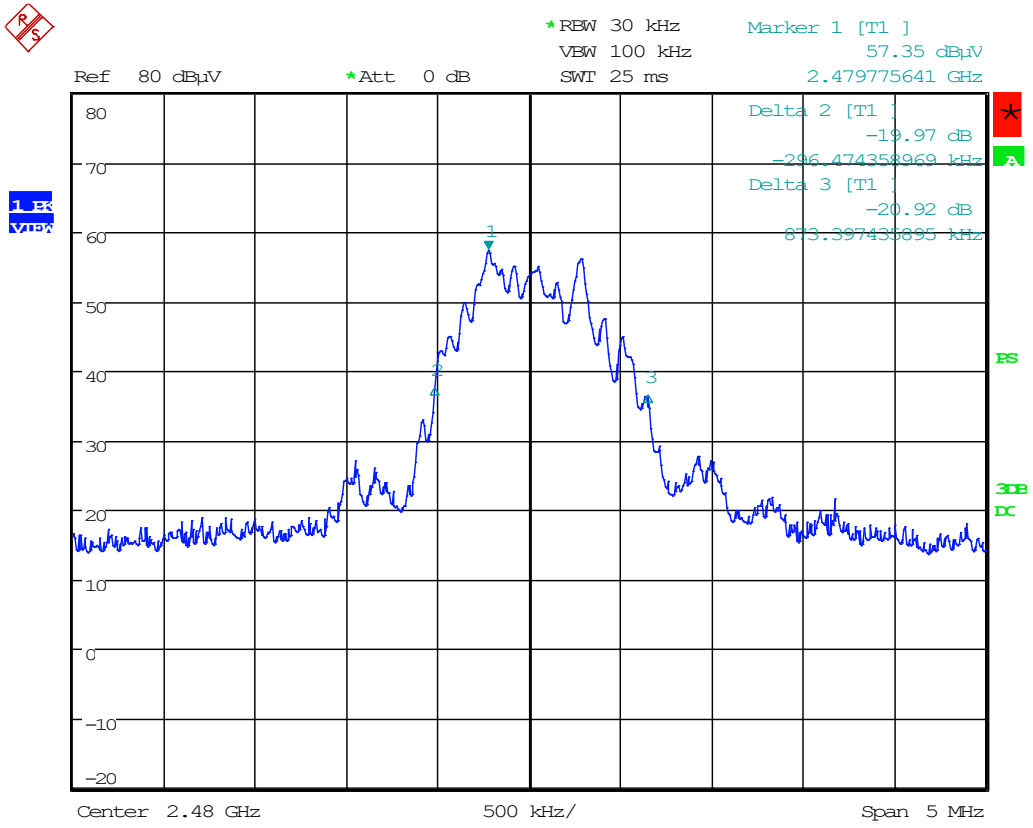

Date: 9.MAR.2022 15:11:27

## -20dB, Mid Channel



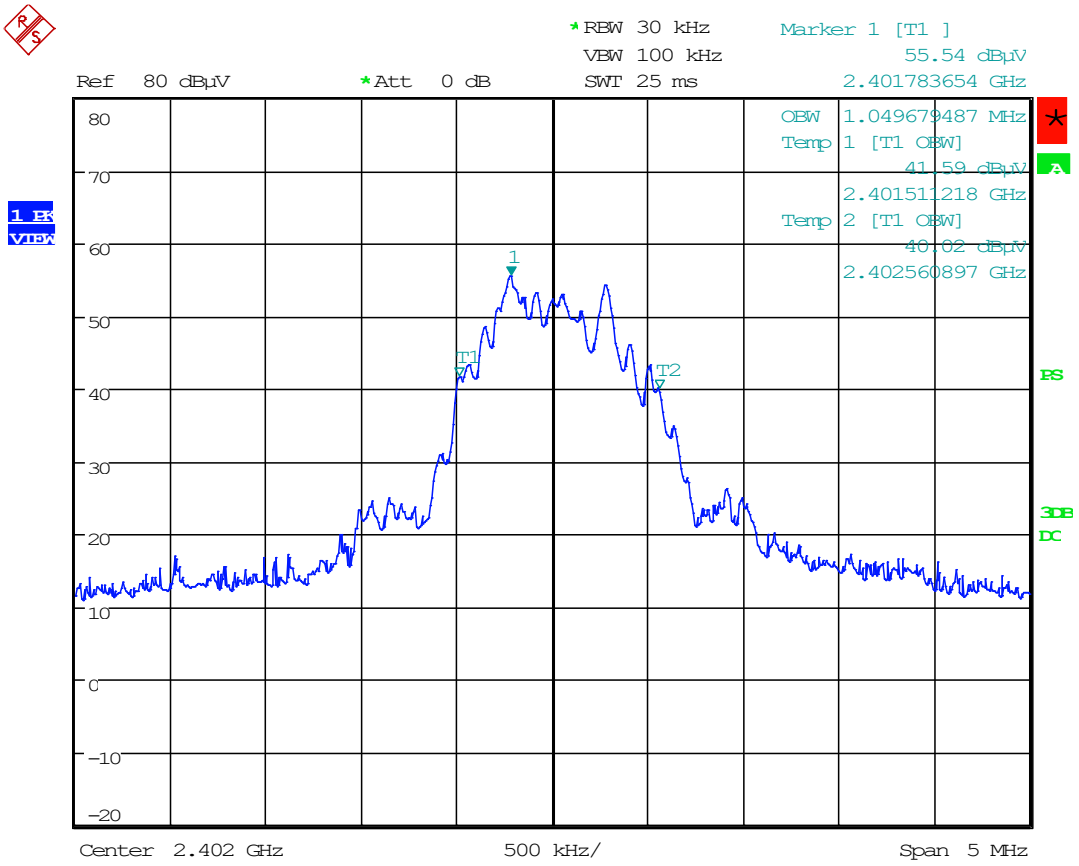

Date: 9.MAR.2022 15:17:32

## -20dB, High Channel



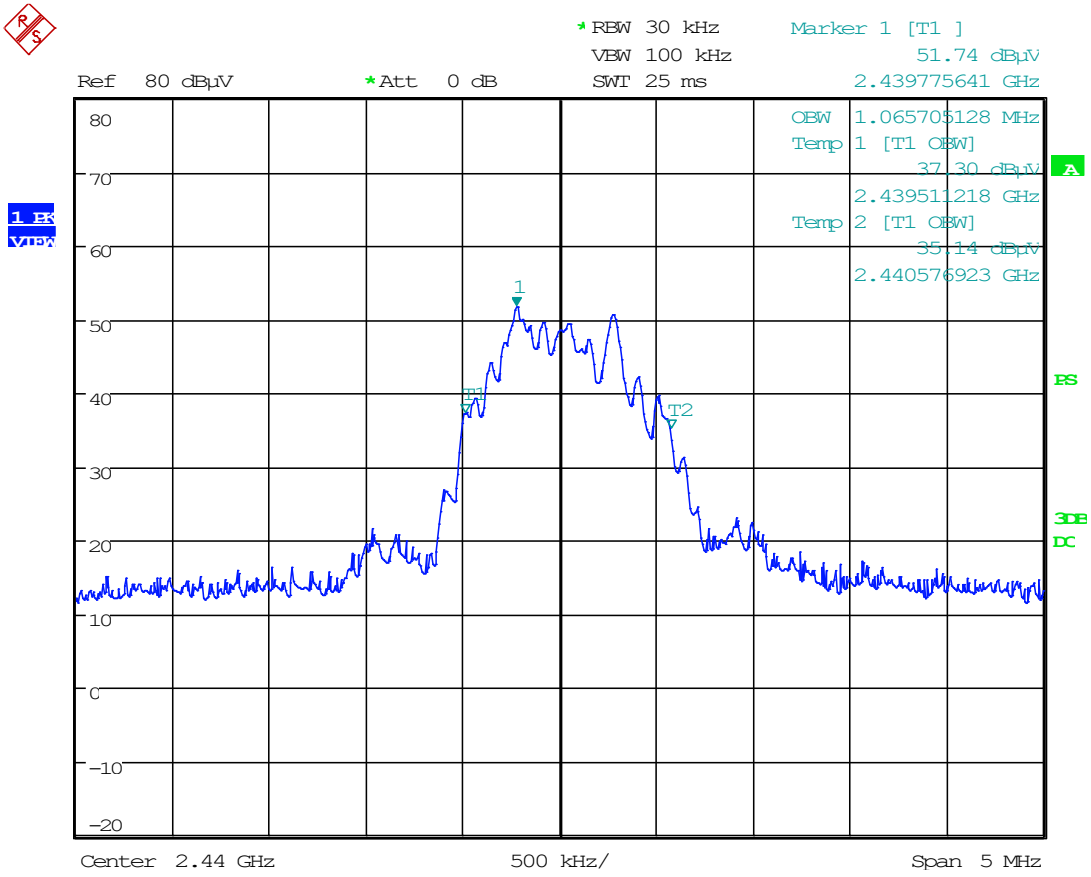

Date: 9.MAR.2022 15:20:35

## 99%, Low Channel

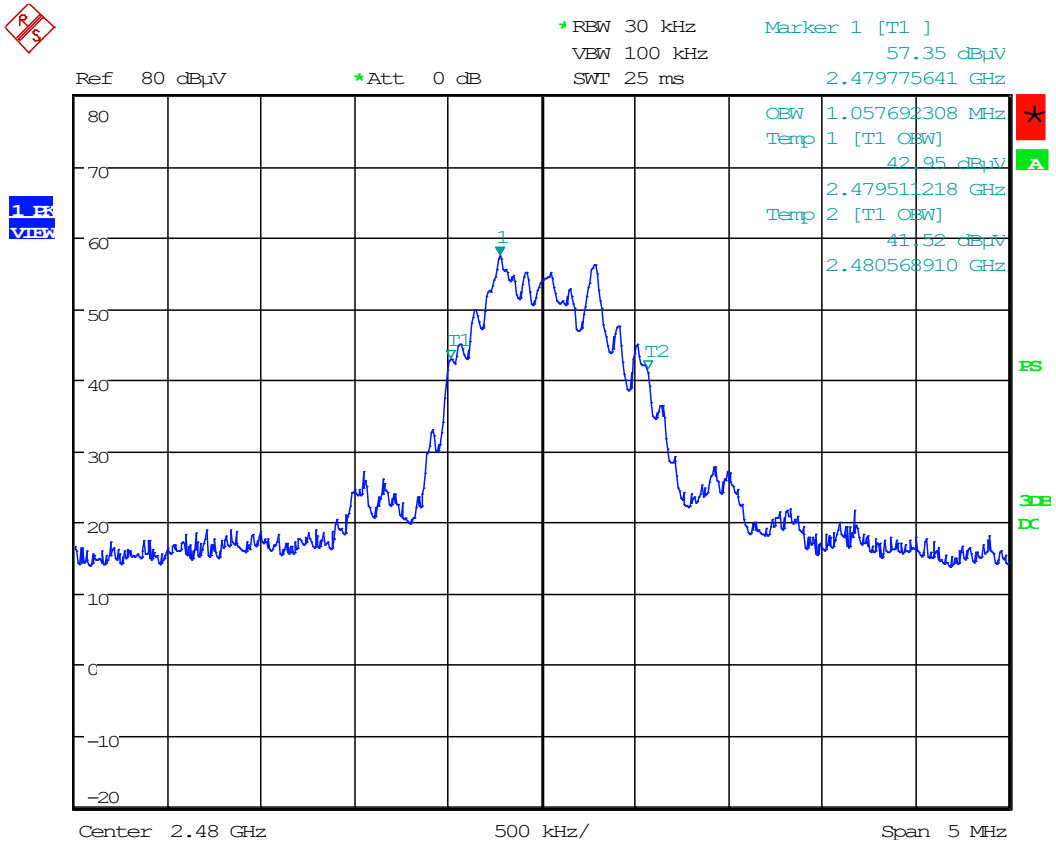



Date: 9.MAR.2022 15:10:46

## 99%, Mid Channel



## 99%, High Channel



## 8 FIELD STRENGTH OF EMISSIONS FROM INTENTIONAL RADIATORS

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|---|---|---|
| 902-928 MHz | 50 | 500 |
| 2400-2483.5 MHz | 50 | 500 |
| 5725-5875 MHz | 50 | 500 |
| 24.0-24.25 GHz | 250 | 2500 |

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

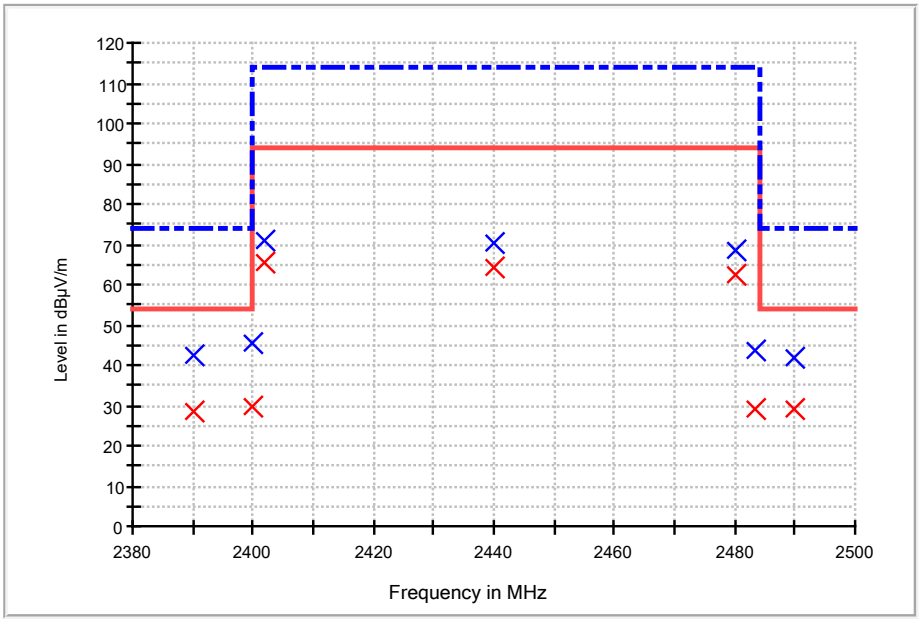
NOTE: During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions.

## 8.1 Test Data - Field Strength – Band Edges

| | | | |
|---|---|---|---|
| **Test Date(s):** | 2022-03-09 | **Test Engineer(s):** | J. Chiller |
| **Standards:** | CFR 47 Part 15.249(a) | **Air Temperature:** | 20.6ºC |
| | | **Relative Humidity:** | 29% |

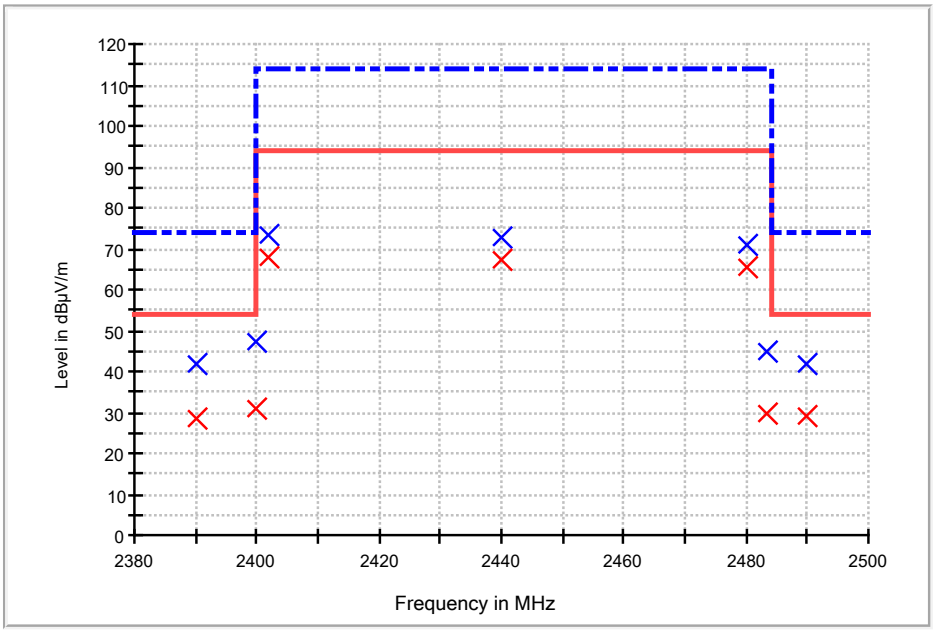
### Band Edges - Vertical

| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin - AVG (dB) | Limit - AVG (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2390.000000 | 42.1 | 28.7 | 1000.000 | 100.0 | V | 149.0 | 5.9 | 25.3 | 54.0 |
| 2400.000000 | 45.7 | 29.9 | 1000.000 | 100.0 | V | 149.0 | 5.8 | 24.1 | 54.0 |
| 2402.000000 | 71.2 | 65.6 | 1000.000 | 100.0 | V | 149.0 | 5.8 | 28.4 | 94.0 |
| 2440.000000 | 70.1 | 64.5 | 1000.000 | 100.0 | V | 149.0 | 5.7 | 29.5 | 94.0 |
| 2480.000000 | 68.2 | 62.6 | 1000.000 | 100.0 | V | 149.0 | 5.7 | 31.4 | 94.0 |
| 2483.500000 | 43.5 | 29.2 | 1000.000 | 100.0 | V | 149.0 | 5.8 | 24.8 | 54.0 |
| 2490.000000 | 41.9 | 28.8 | 1000.000 | 100.0 | V | 149.0 | 5.8 | 25.2 | 54.0 |

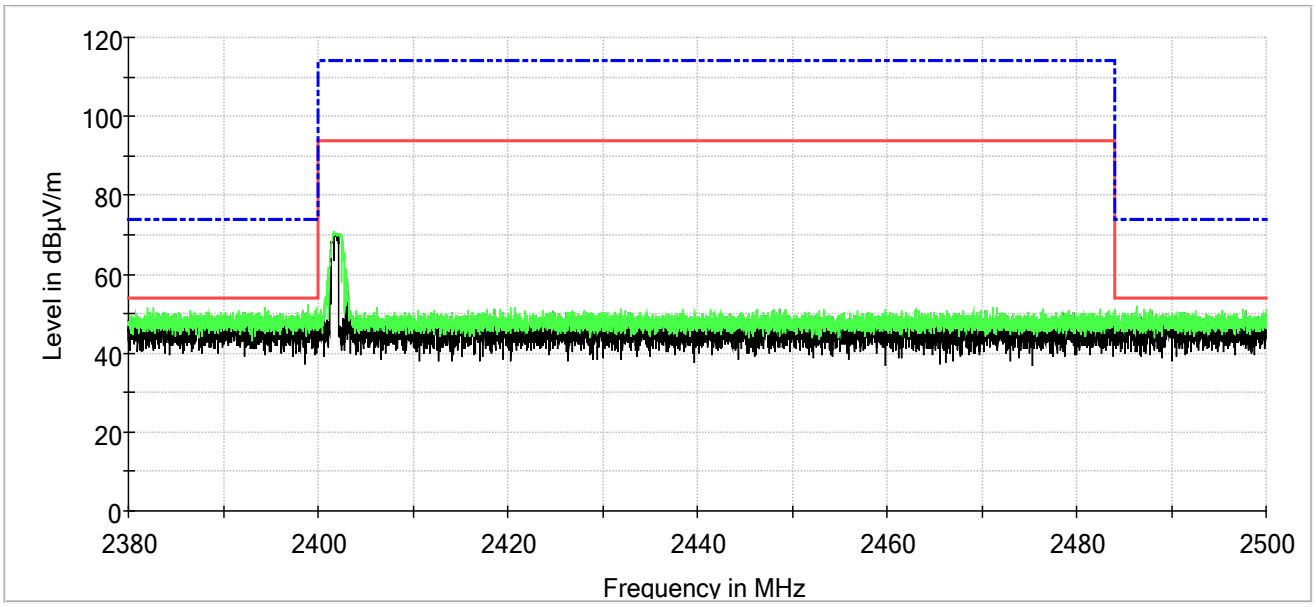


## Band Edges - Horizontal

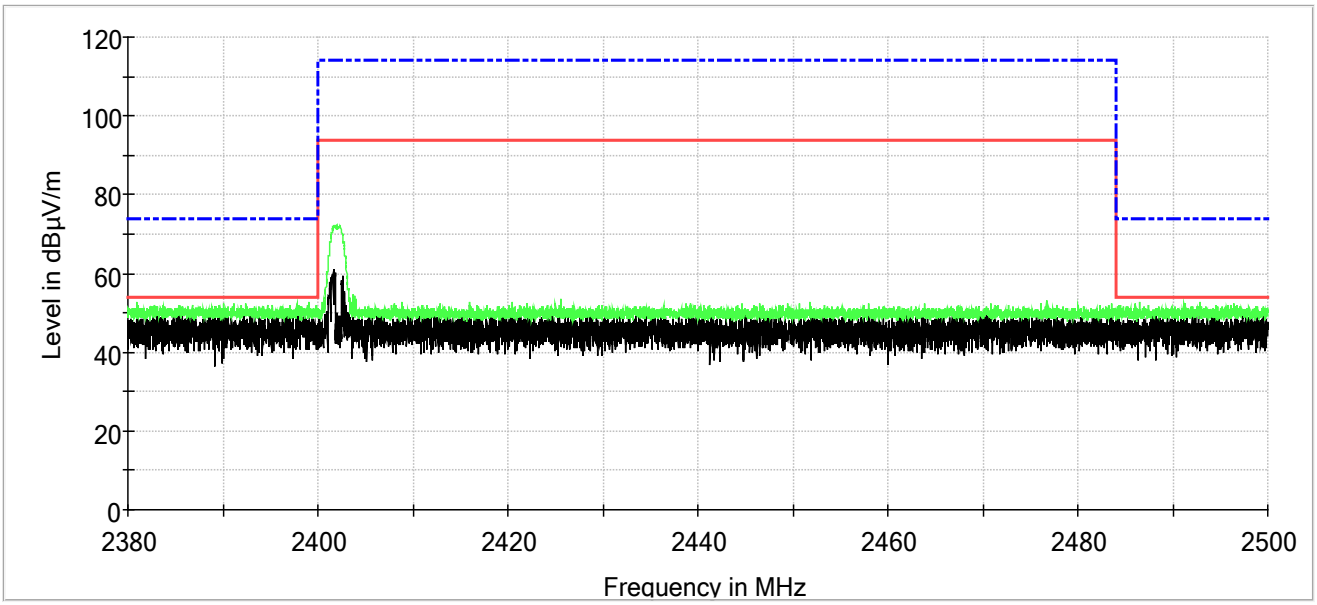
| Frequency (MHz) | MaxPeak (dBµV/m) | Average (dBµV/m) | Bandwidth (kHz) | Height (cm) | Polarization | Azimuth (deg) | Corr. (dB) | Margin - AVG (dB) | Limit - AVG (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 2390.000000 | 42.0 | 28.7 | 1000.000 | 100.0 | H | 157.0 | 5.9 | 25.3 | 54.0 |
| 2400.000000 | 47.3 | 30.7 | 1000.000 | 100.0 | H | 157.0 | 5.8 | 23.3 | 54.0 |
| 2402.000000 | 73.2 | 67.6 | 1000.000 | 100.0 | H | 157.0 | 5.8 | 26.4 | 94.0 |
| 2440.000000 | 72.5 | 67.0 | 1000.000 | 100.0 | H | 155.0 | 5.7 | 27.0 | 94.0 |
| 2480.000000 | 71.0 | 65.4 | 1000.000 | 100.0 | H | 159.0 | 5.7 | 28.6 | 94.0 |
| 2483.500000 | 45.0 | 29.5 | 1000.000 | 100.0 | H | 159.0 | 5.8 | 24.5 | 54.0 |
| 2490.000000 | 41.7 | 28.8 | 1000.000 | 100.0 | H | 159.0 | 5.8 | 25.2 | 54.0 |



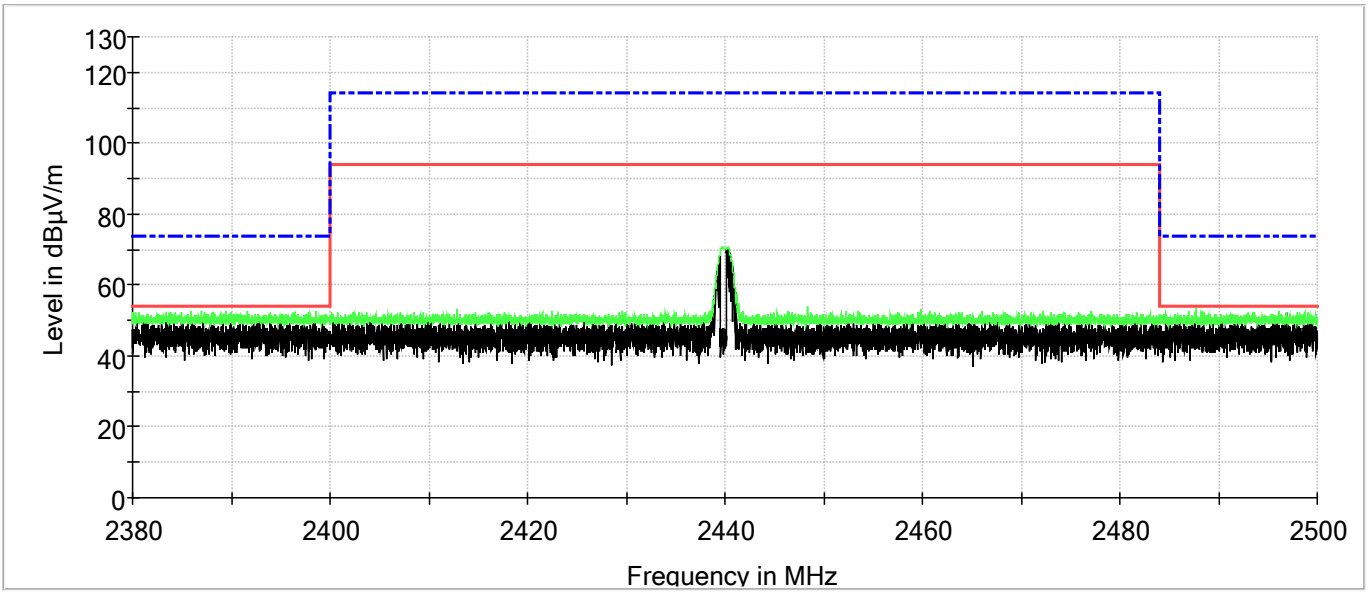
## Low Band Edge, Vertical



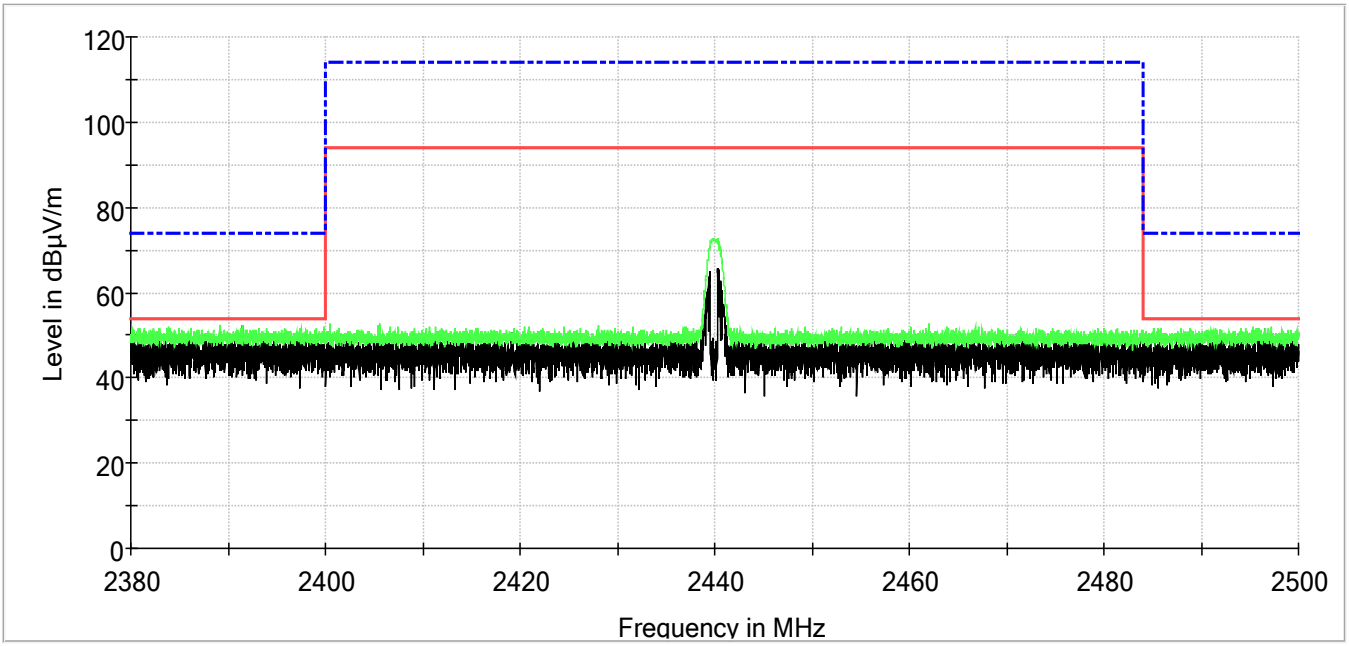

## Low Band Edge, Horizontal



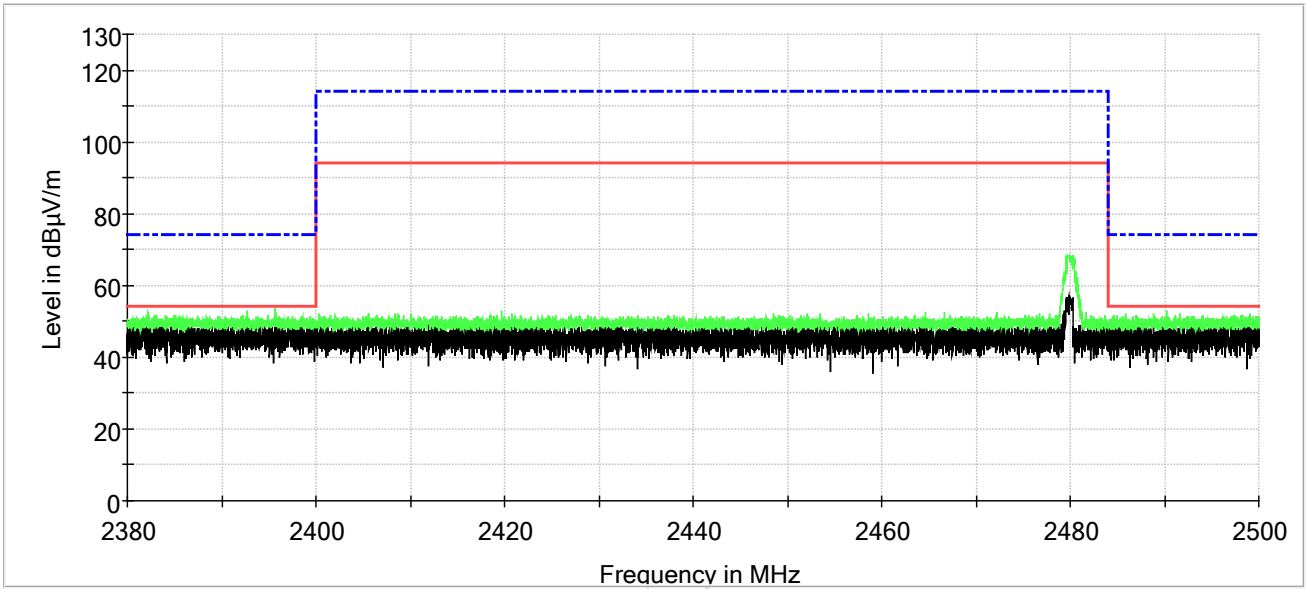
## Mid Band Edge, Vertical



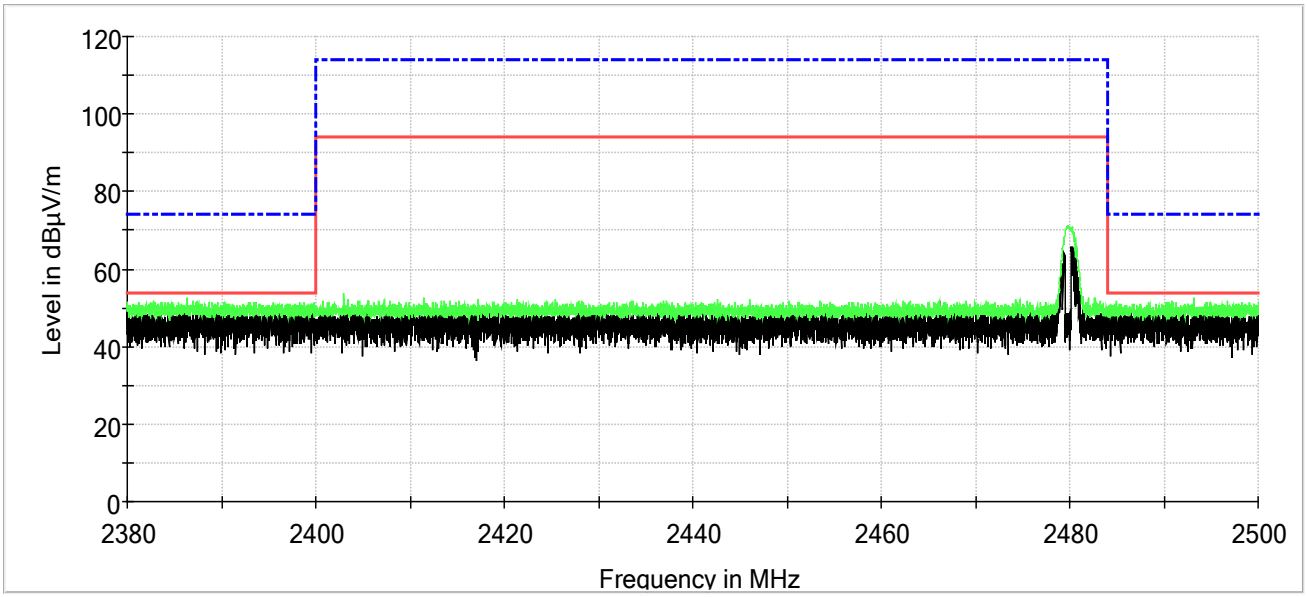

## Mid Band Edge, Horizontal



## High Band Edge, Vertical




## High Band Edge, Horizontal



## 8.2 Test Data – Spurious Emissions

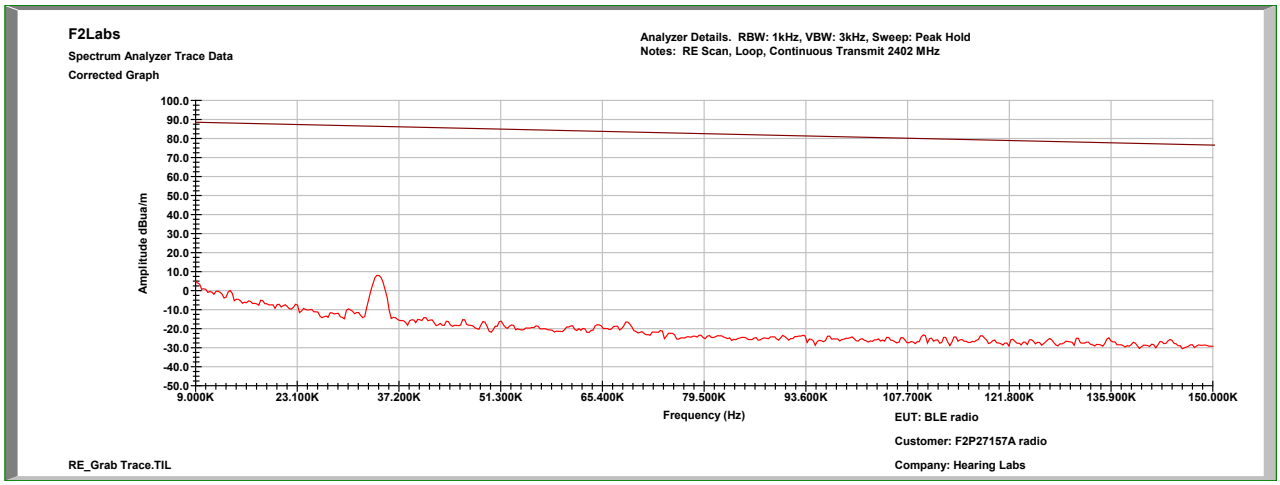
Notes: Plots are peak, max hold pre-scan data included only to determine what frequencies to investigate and measure. During the pre-scan evaluation, the EUT was rotated in all possible directions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. At some frequencies, no emissions from the EUT were measurable over the ambient noise floor. The readings did not change with EUT on and EUT off.

At least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies did not change with the EUT on or off. At those frequencies, the test distance was shortened to 1 meter and still no emissions from the EUT were visible or over the ambient or limit. Frequencies were scanned from 9kHz to 26 GHz and the highest emissions are listed below.

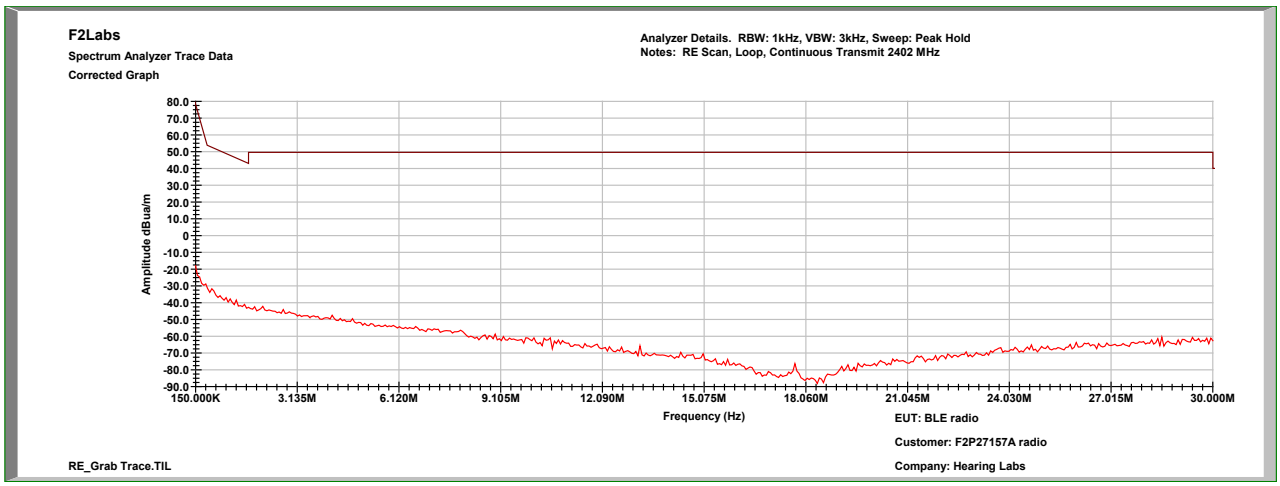
In the following plots, the black line indicates ambient noise and the red line indicates the measurement with the EUT on. Emissions to be found by the EUT were measured and listed in tables below.

| Test Date(s): | 2022-03-09 to 2022-03-10 | Test Engineer(s): | J. Chiller |
|---|---|---|---|
| Standards: | CFR 47 Part 15.249(d) | Air Temperature: | 20.6ºC |
| | | Relative Humidity: | 29% |

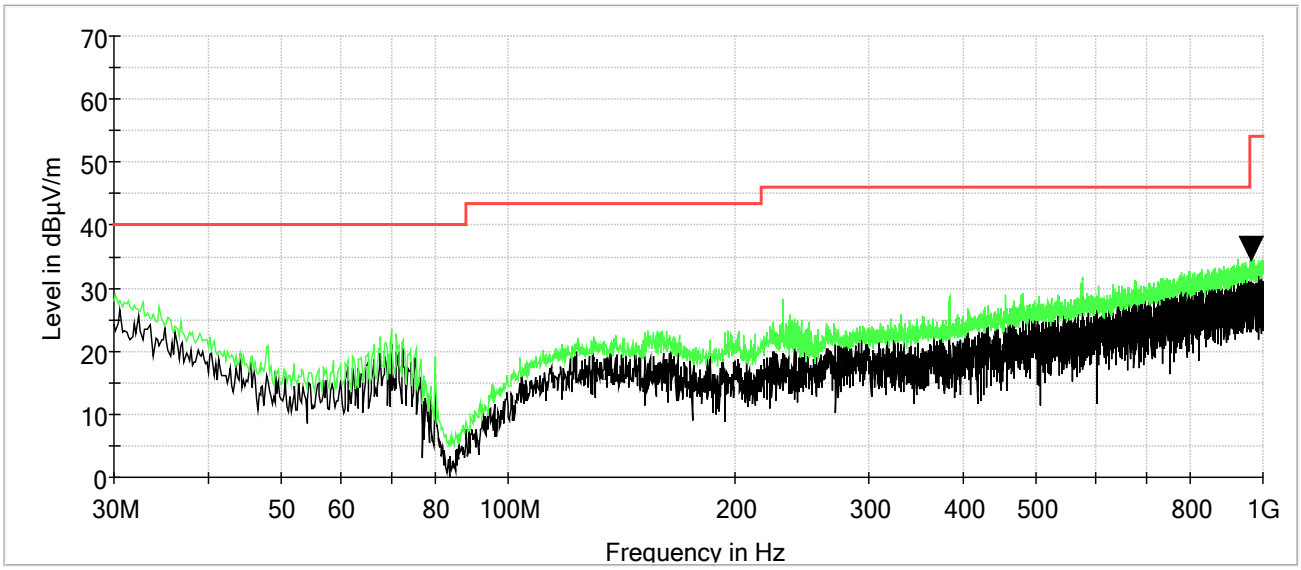
## 0.009 MHz to 0.15 MHz



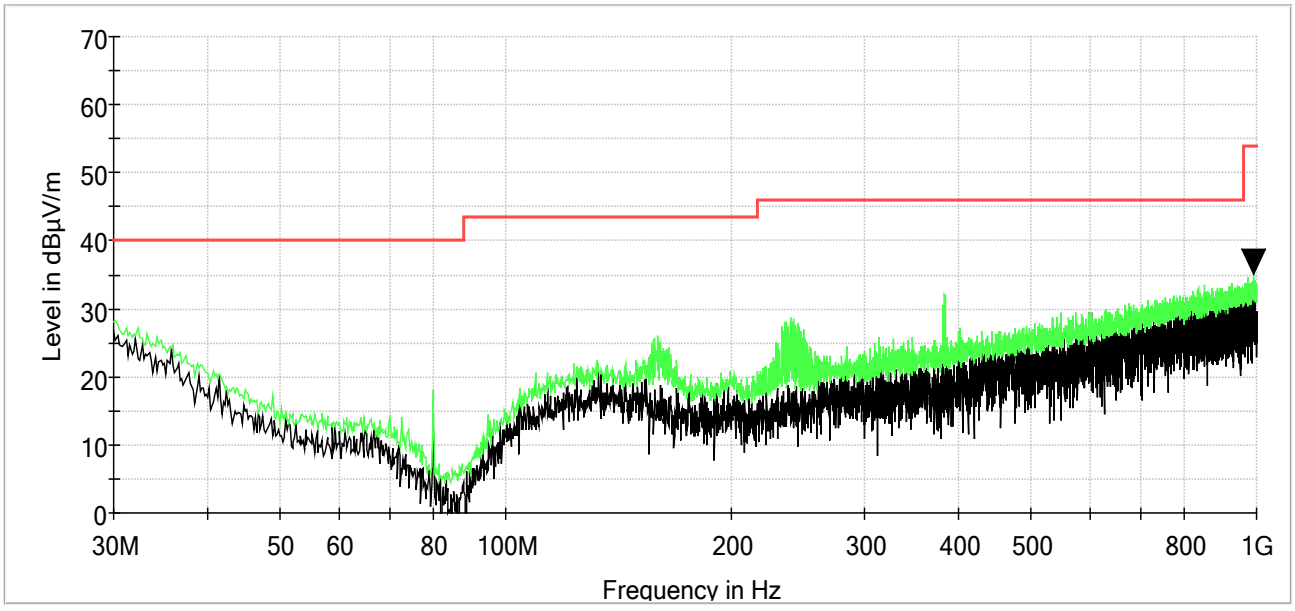

## 0.15 MHz to 30 MHz



## 30 MHz to 1000 MHz, Vertical



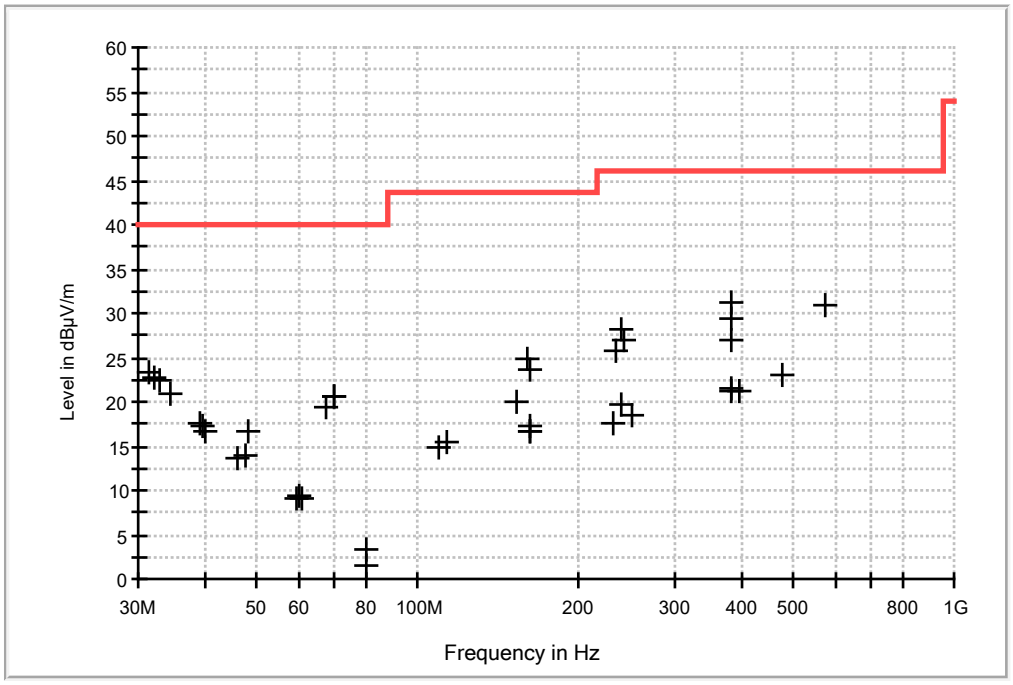

## 30 MHz to 1000 MHz, Horizontal



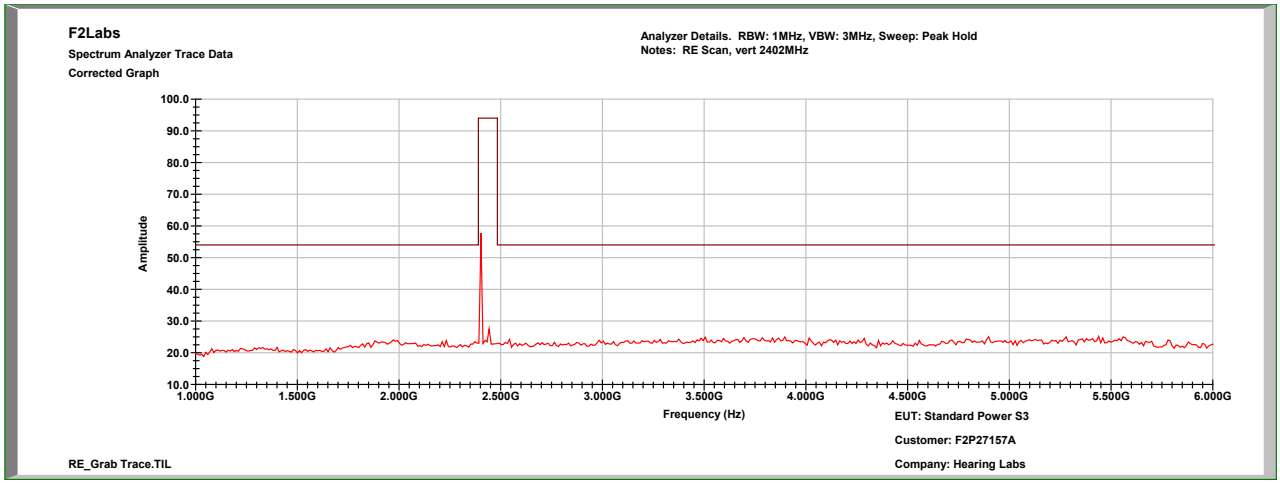
## Measurements, 30 MHz to 1000 MHz (Includes data from all channels)

| Frequency (MHz) | Antenna Polarization | Antenna Height (cm) | Azimuth (degrees) | Reading (dBµV) | Correction Factors (dB) | Emission (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 31.360000 | V | 100.00 | 141.00 | 25.6 | -2.2 | 23.40 | 40.0 | -16.6 |
| 32.120000 | H | 100.00 | 0.00 | 25.6 | -2.7 | 22.90 | 40.0 | -17.1 |
| 32.720000 | V | 100.00 | 142.00 | 25.6 | -3.2 | 22.40 | 40.0 | -17.6 |
| 34.480000 | V | 100.00 | 142.00 | 25.5 | -4.5 | 21.00 | 40.0 | -19.0 |
| 39.000000 | H | 100.00 | 0.00 | 25.4 | -7.9 | 17.50 | 40.0 | -22.5 |
| 39.520000 | H | 100.00 | 0.00 | 25.6 | -8.3 | 17.30 | 40.0 | -22.7 |
| 40.080000 | H | 100.00 | 0.00 | 25.6 | -8.8 | 16.80 | 40.0 | -23.2 |
| 45.720000 | V | 100.00 | 142.00 | 26.0 | -12.5 | 13.50 | 40.0 | -26.5 |
| 47.840000 | V | 100.00 | 142.00 | 27.4 | -13.5 | 13.90 | 40.0 | -26.1 |
| 48.040000 | V | 100.00 | 142.00 | 30.4 | -13.6 | 16.80 | 40.0 | -23.2 |
| 59.520000 | H | 100.00 | 0.00 | 24.2 | -15.0 | 9.20 | 40.0 | -30.8 |
| 60.080000 | H | 100.00 | 0.00 | 24.2 | -15.0 | 9.20 | 40.0 | -30.8 |
| 60.840000 | H | 100.00 | 0.00 | 24.1 | -14.9 | 9.20 | 40.0 | -30.8 |
| 67.640000 | V | 100.00 | 142.00 | 34.0 | -14.6 | 19.40 | 40.0 | -20.6 |
| 69.960000 | V | 100.00 | 142.00 | 34.9 | -14.4 | 20.50 | 40.0 | -19.5 |
| 69.960000 | V | 100.00 | 142.00 | 34.9 | -14.4 | 20.50 | 40.0 | -19.5 |
| 79.840000 | H | 100.00 | 4.00 | 16.3 | -14.7 | 1.60 | 40.0 | -38.4 |
| 79.920000 | H | 100.00 | 144.00 | 18.2 | -14.8 | 3.40 | 40.0 | -36.6 |
| 108.760000 | V | 100.00 | 142.00 | 24.6 | -9.7 | 14.90 | 43.5 | -28.6 |
| 113.600000 | V | 100.00 | 142.00 | 24.5 | -9.0 | 15.50 | 43.5 | -28.0 |
| 153.000000 | V | 100.00 | 142.00 | 29.5 | -9.4 | 20.10 | 43.5 | -23.4 |
| 159.400000 | H | 100.00 | 208.00 | 34.3 | -9.5 | 24.80 | 43.5 | -18.7 |
| 160.760000 | H | 100.00 | 245.00 | 33.3 | -9.5 | 23.80 | 43.5 | -19.7 |
| 160.840000 | H | 100.00 | 259.00 | 26.3 | -9.5 | 16.80 | 43.5 | -26.7 |
| 161.920000 | V | 100.00 | 142.00 | 26.7 | -9.5 | 17.20 | 43.5 | -26.3 |
| 162.120000 | V | 100.00 | 142.00 | 26.2 | -9.5 | 16.70 | 43.5 | -26.8 |
| 231.000000 | V | 100.00 | 142.00 | 27.5 | -10.0 | 17.50 | 46.0 | -28.5 |
| 232.720000 | H | 100.00 | 113.00 | 35.7 | -9.9 | 25.80 | 46.0 | -20.2 |
| 239.120000 | V | 100.00 | 142.00 | 29.3 | -9.5 | 19.80 | 46.0 | -26.2 |
| 239.120000 | H | 100.00 | 138.00 | 37.6 | -9.5 | 28.10 | 46.0 | -17.9 |
| 243.000000 | H | 100.00 | 88.00 | 36.5 | -9.5 | 27.00 | 46.0 | -19.0 |
| 249.400000 | V | 100.00 | 142.00 | 27.9 | -9.5 | 18.40 | 46.0 | -27.6 |
| 384.040000 | H | 100.00 | 262.00 | 34.4 | -5.1 | 29.30 | 46.0 | -16.7 |
| 384.040000 | H | 100.00 | 182.00 | 32.0 | -5.1 | 26.90 | 46.0 | -19.1 |
| 384.040000 | H | 100.00 | 316.00 | 36.4 | -5.1 | 31.30 | 46.0 | -14.7 |
| 384.240000 | V | 100.00 | 142.00 | 26.6 | -5.1 | 21.50 | 46.0 | -24.5 |
| 384.240000 | V | 100.00 | 142.00 | 26.4 | -5.1 | 21.30 | 46.0 | -24.7 |
| 395.680000 | V | 100.00 | 142.00 | 25.8 | -4.7 | 21.10 | 46.0 | -24.9 |
| 479.120000 | V | 100.00 | 142.00 | 25.4 | -2.3 | 23.10 | 46.0 | -22.9 |
| 576.320000 | V | 100.00 | 142.00 | 31.3 | -0.5 | 30.80 | 46.0 | -15.2 |

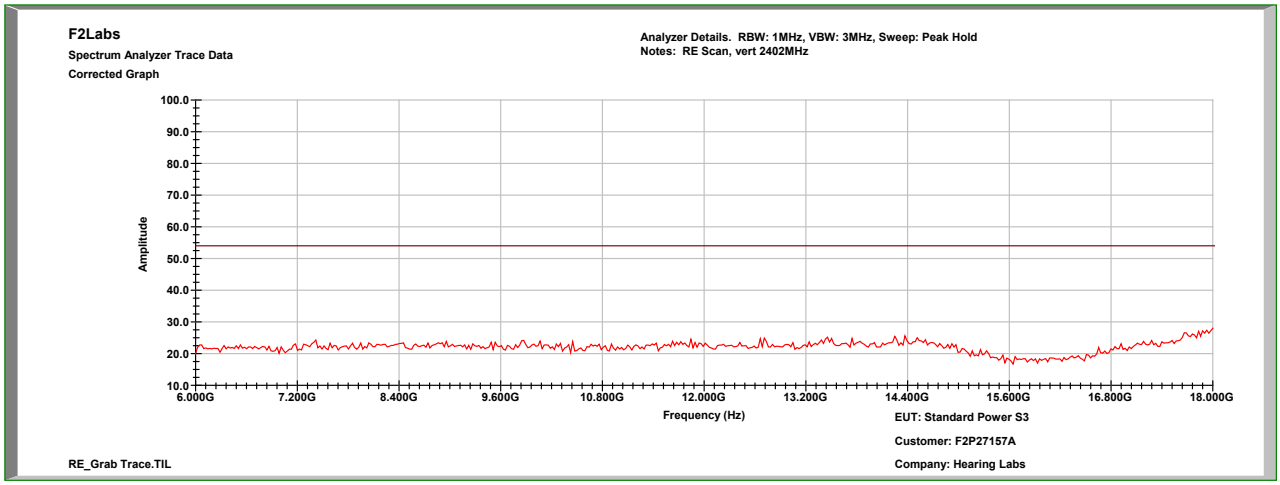
## Measurements - 30 MHz to 1000 MHz



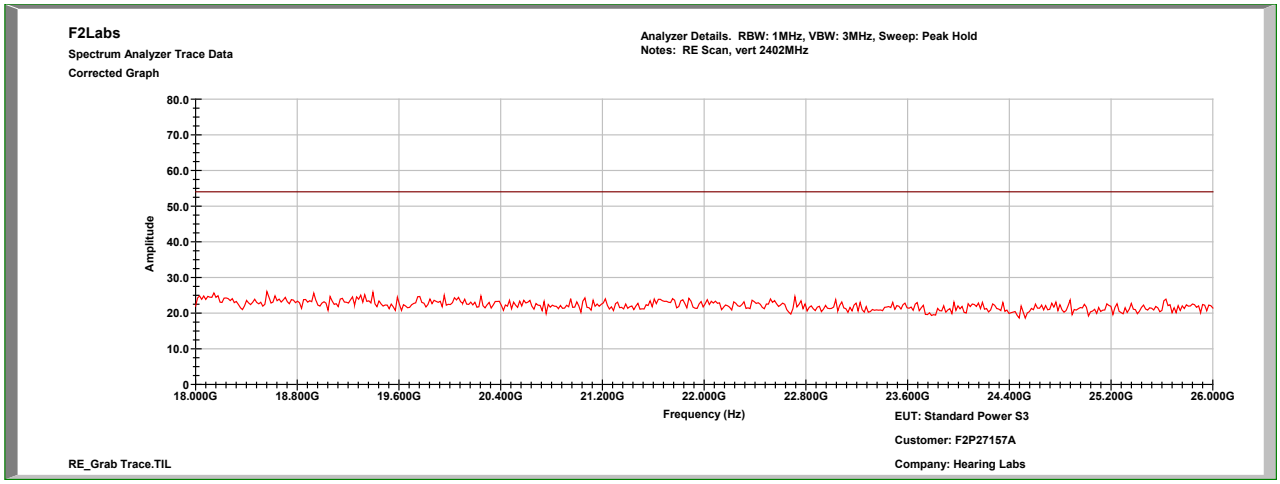
## Low Channel: 1 GHz to 6 GHz, Vertical



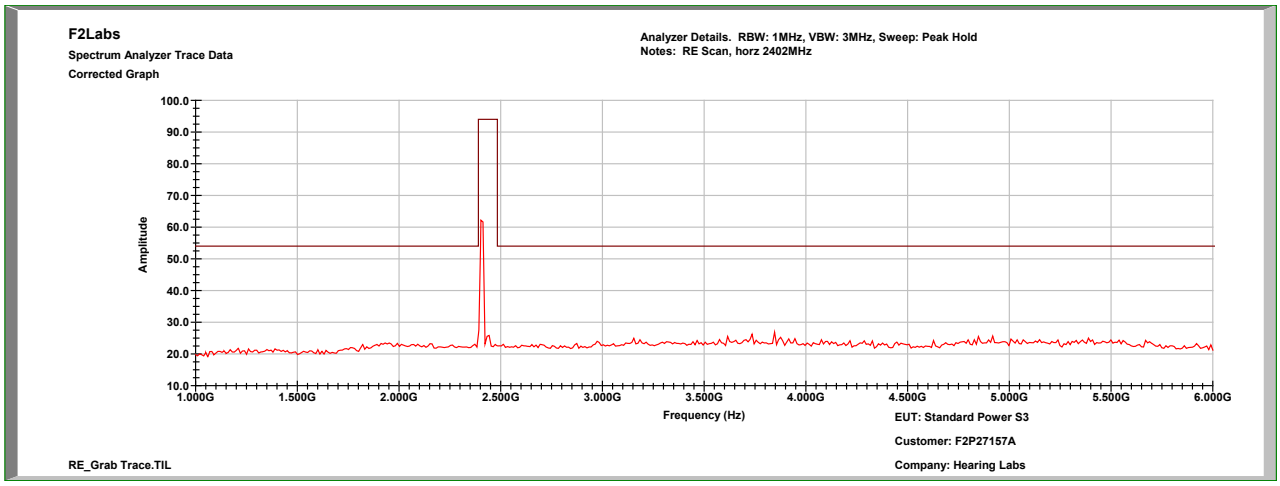

## Low Channel: 6 GHz to 18 GHz, Vertical



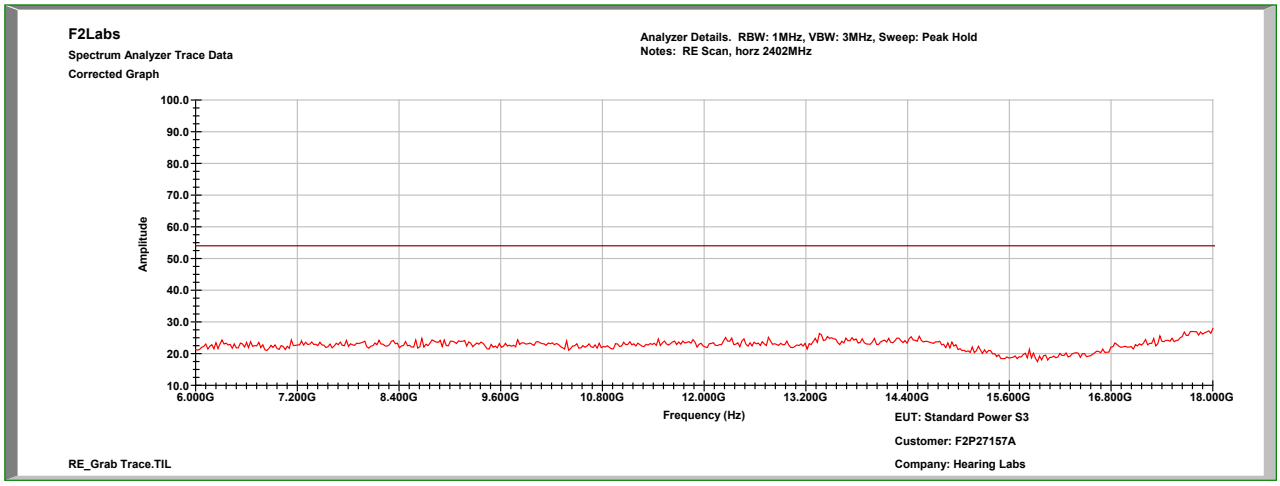
## Low Channel: 18 GHz to 26 GHz, Vertical



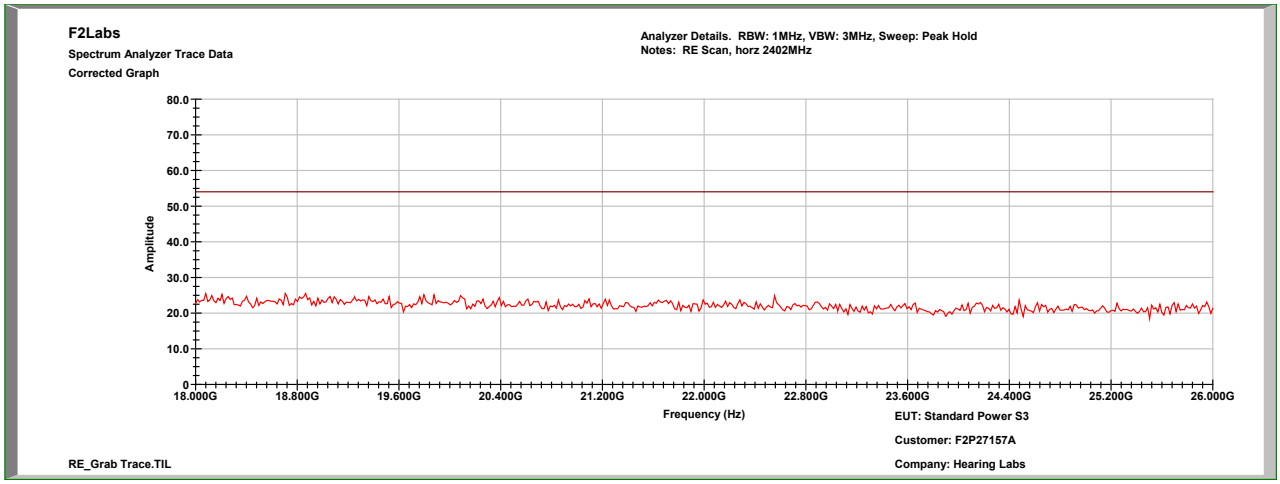
## Low Channel: Low Channel: 1 GHz to 6 GHz, Horizontal



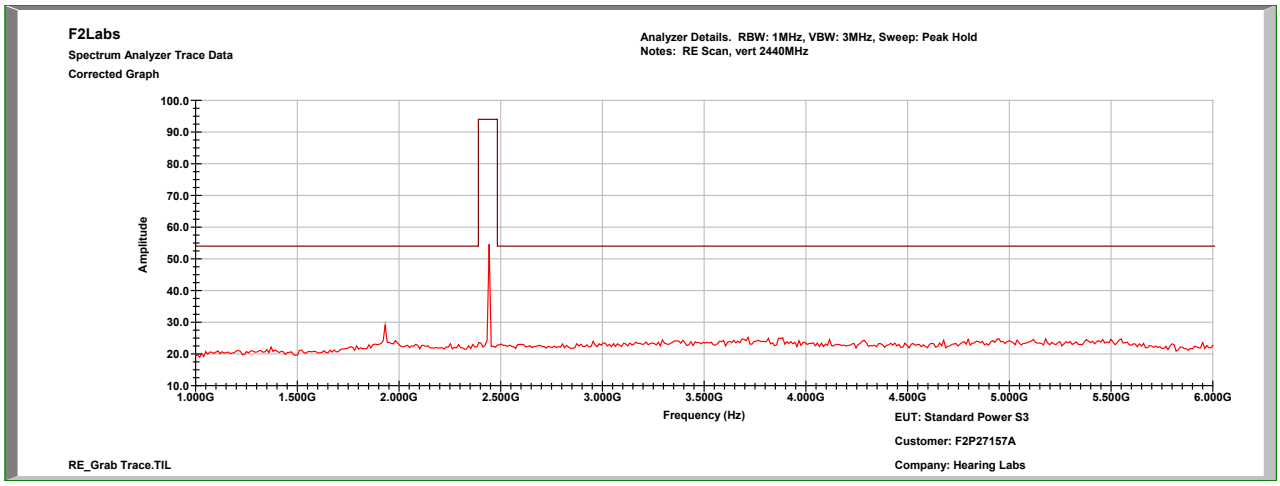

## Low Channel: 6 GHz to 18 GHz, Horizontal



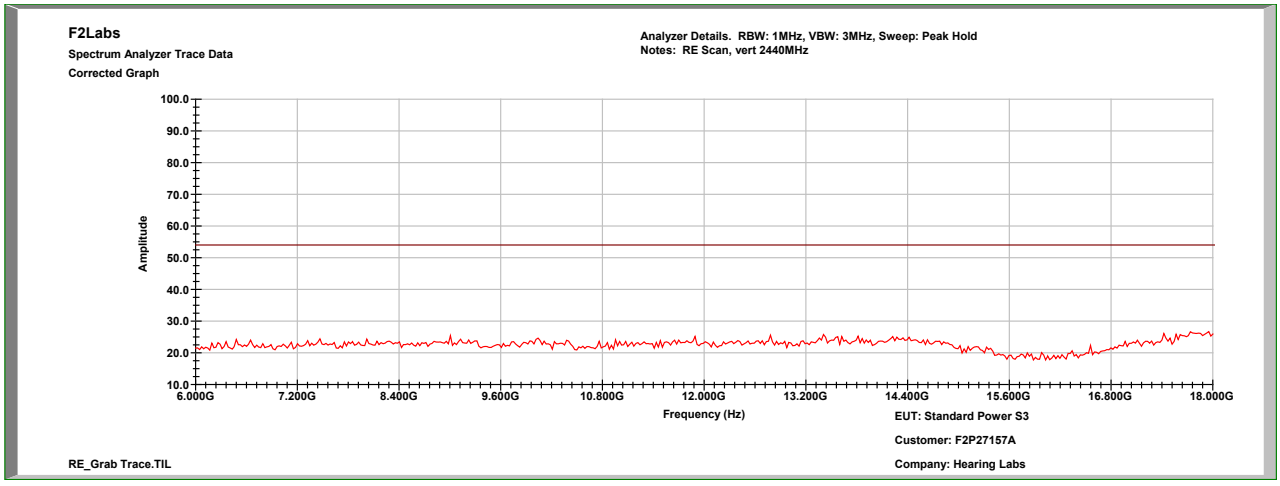
## Low Channel: 18 GHz to 26 GHz, Horizontal



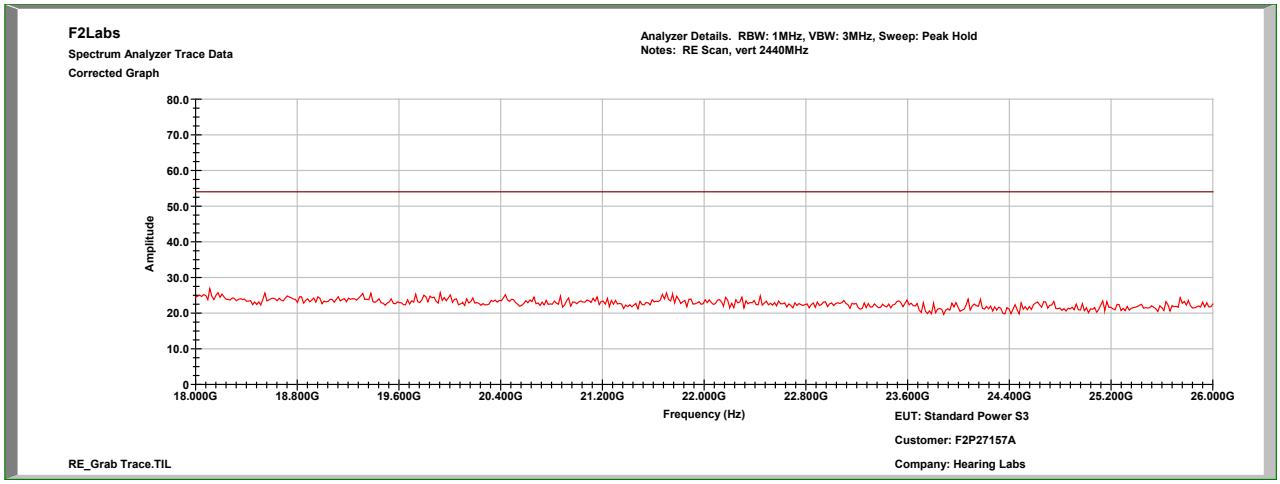
## Mid Channel: 1 GHz to 6 GHz, Vertical



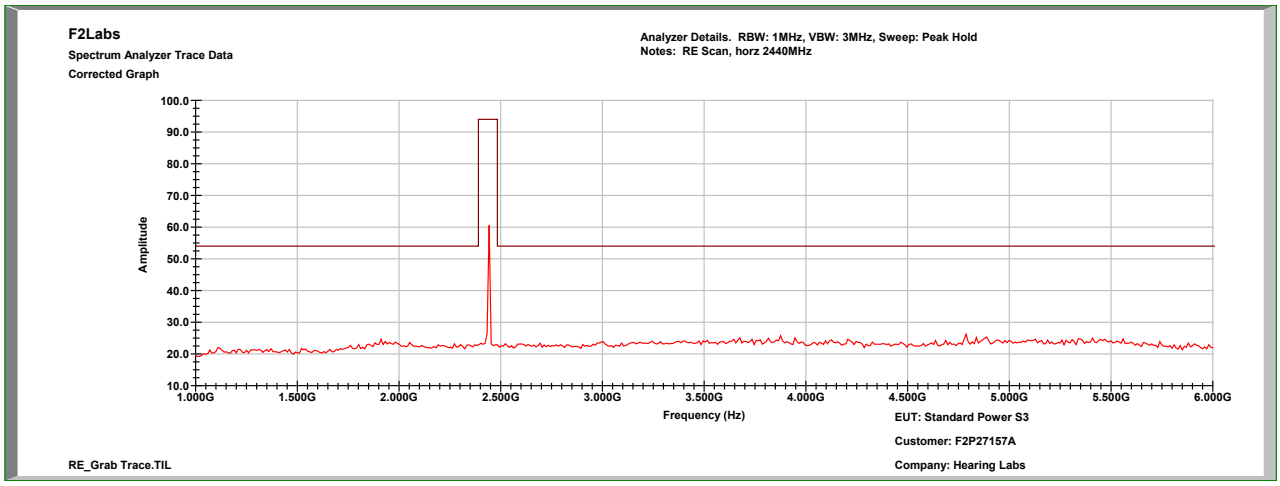

## Mid Channel: 6 GHz to 18 GHz, Vertical



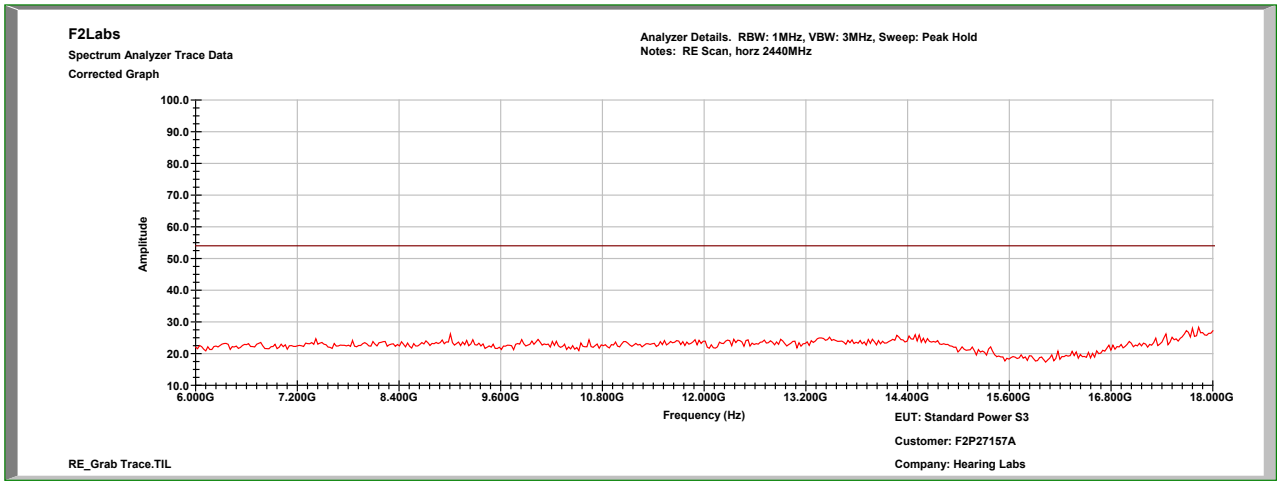
## Mid Channel: 18 GHz to 26 GHz, Vertical



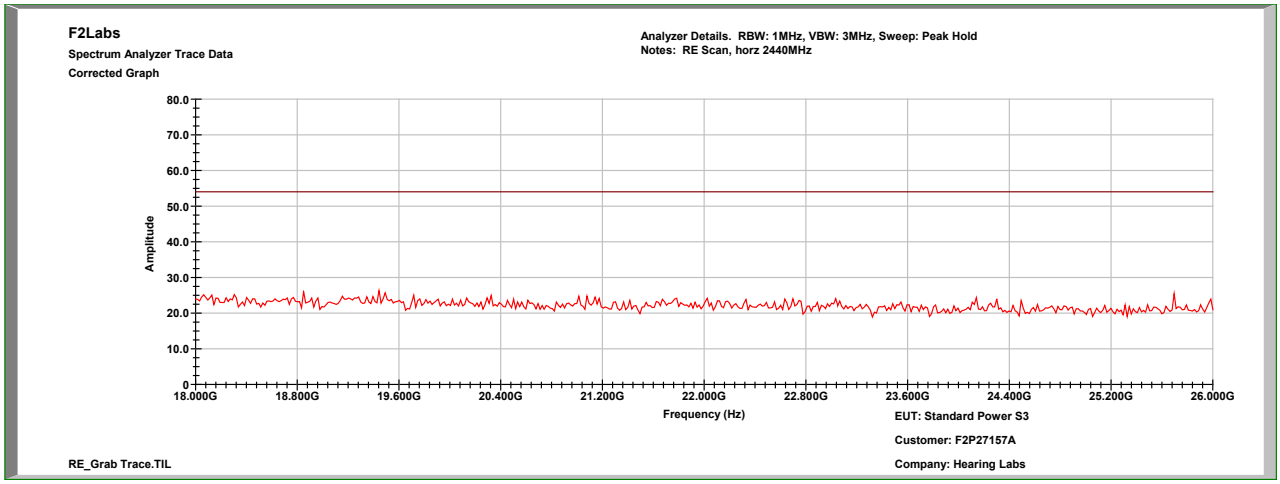
## Mid Channel: Mid Channel: 1 GHz to 6 GHz, Horizontal



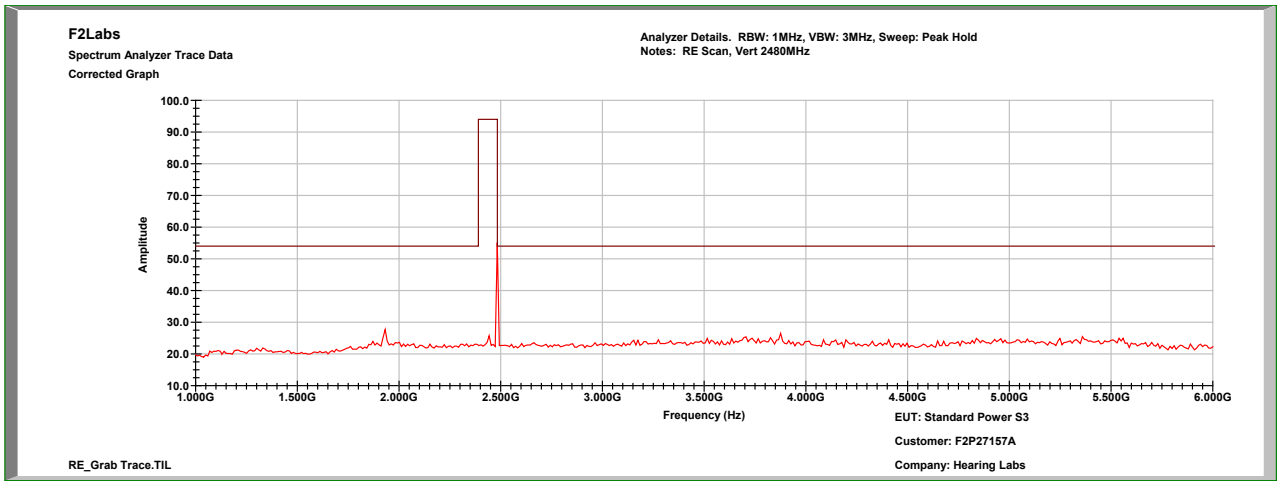

## Mid Channel: 6 GHz to 18 GHz, Horizontal



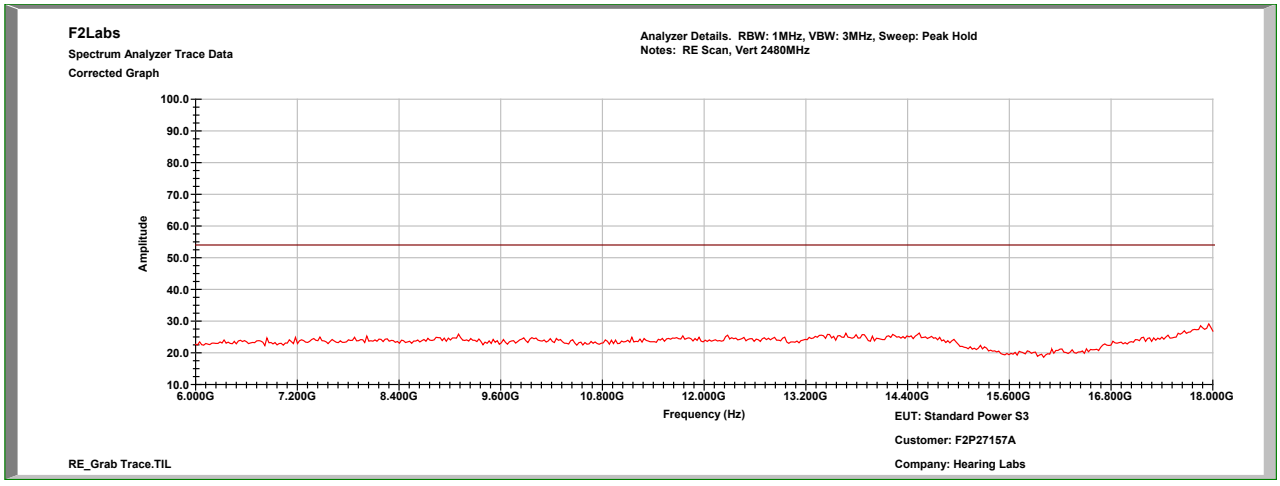
## Mid Channel: 18 GHz to 26 GHz, Horizontal



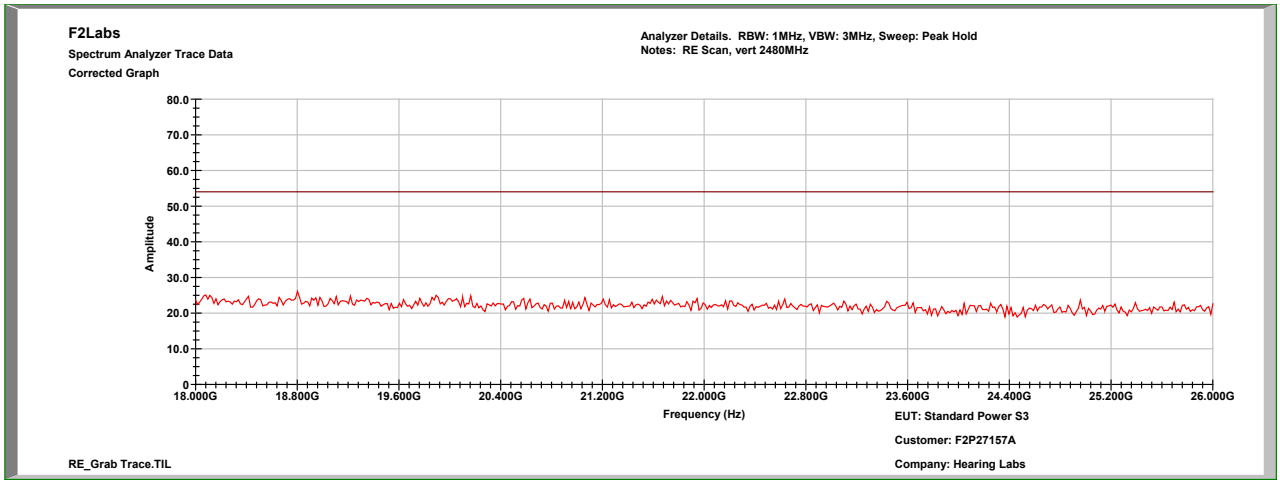
## High Channel: 1 GHz to 6 GHz, Vertical



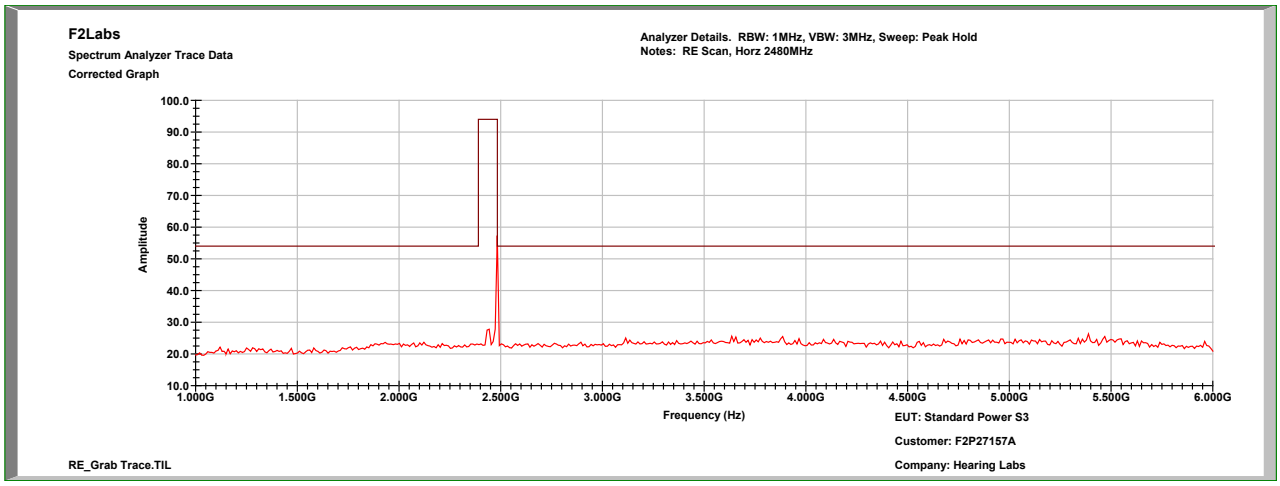

## High Channel: 6 GHz to 18 GHz, Vertical



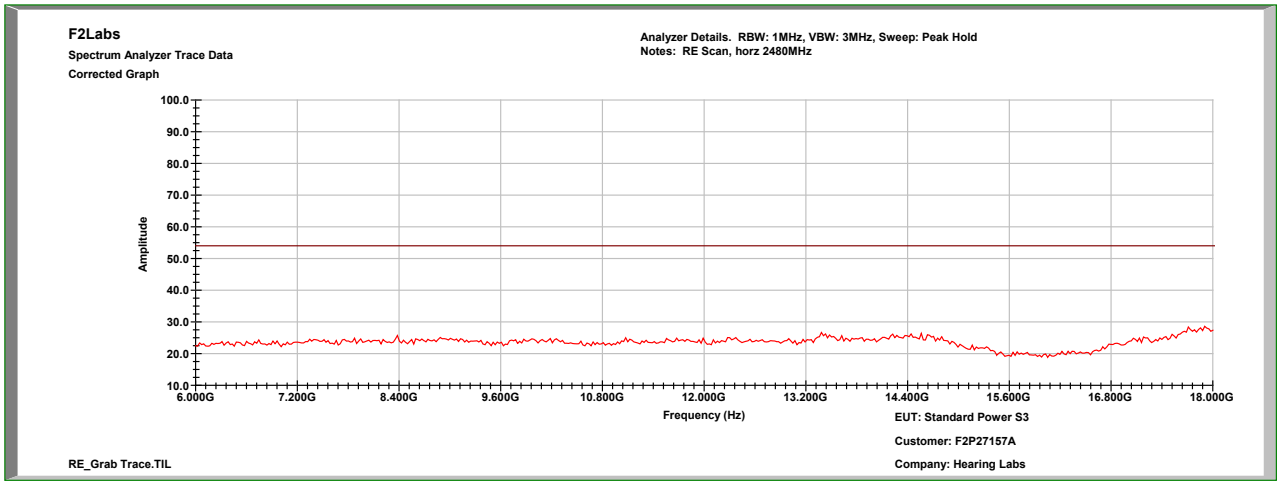
## High Channel: 18 GHz to 26 GHz, Vertical



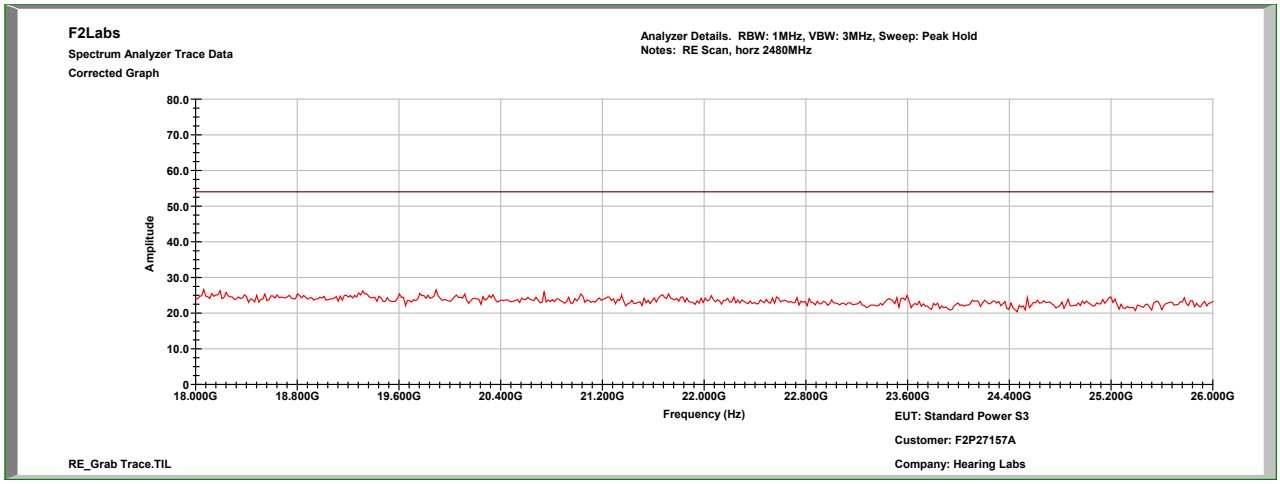
## High Channel: Low Channel: 1 GHz to 6 GHz, Horizontal




## High Channel: 6 GHz to 18 GHz, Horizontal



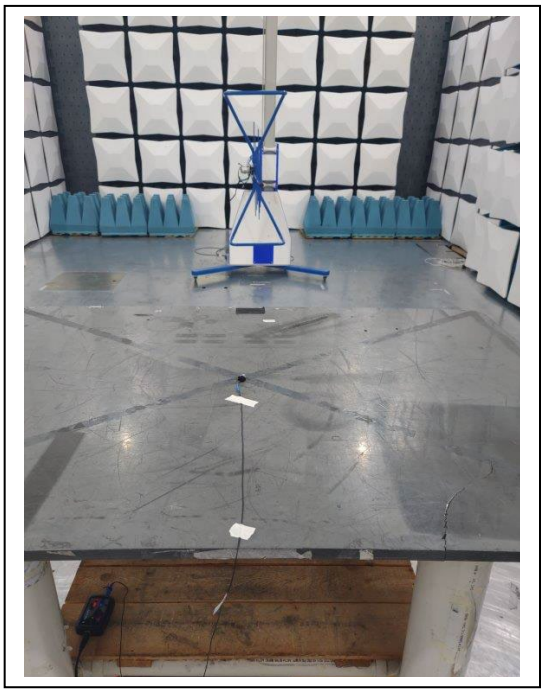
## HIgh Channel: 18 GHz to 26 GHz, Horizontal



## 9 TEST SETUP PHOTOGRAPHS

**Radiated Emissions: 0.009 MHz to 0.15 MHz**

**Radiated Emissions: 30 MHz to 1000 MHz**



## Radiated Emissions: 1 GHz to 26 GHz,
## Band Edge, Field Strength of Emissions, Occupied Bandwidth