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CERTIFICATION TEST REPORT

Manufacturer: Intervet Inc.
dba Merck Animal Health
2 Giralda Farms
Madison, New Jersey 07940 USA

Applicant: Same as Above

Product Name: Whisper® On-Arrival Veterinary Device

Product Description: Sound collection equipment containing six sound sensors that captures lung and heart sound of cattle and transmits to a tablet computer.

Operating Voltage/Frequency: **Handle Radio:** Battery-Operated (2 AAA cells)
Sensor Radio: Battery-Operated (3.7VDC Lithium)

Model: 2020WOA1

FCC ID: 2AUHW-2020WOA1

Testing Commenced: Sept. 17, 2019

Testing Ended: Sept. 17, 2019

Summary of Test Results: **In Compliance**

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.



Standards:

- ❖ 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
- ❖ FCC15.207 - Conducted Limits
- ❖ FCC Part 15 Subpart A, Section 15.31(e) – Measurement Standards

Evaluation Conducted by:

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Report Reviewed by:

Ken Littell, Director of EMC & Wireless Operations

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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 of DXT operating 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 are 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 Uncertainty	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
F2P22013A-01E	First Issue	Sept. 27, 2019	K. Littell

**2 SUMMARY OF TEST RESULTS**

Test Name	Standard(s)	Results
-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)	Complies
Variation of the Input Power	CFR 47 Part 15.231(e)	Complies*

***Notes:**

Product was operated using batteries.

Requirements of 15.31 were met by using new batteries in the 2425 MHz radio and fully charged batteries for the 3.7VDC lithium battery used for the Sensor with BLE radio. The BLE is disabled during charging and cannot be turned on or transmit.

Modifications Made to the Equipment
None



3 TABLE OF MEASURED RESULTS

2.4 BLE Band

Test	Low Channel 2402 MHz	Mid Channel 2440 MHz	High Channel 2480 MHz
Field Strength of Fundamental	67.8 dB μ V/m	66.6 dB μ V/m	69.1 dB μ V/m
Limit for Fundamental	50 millivolts/meter (93.97 dB μ V/m)	50 millivolts/meter (93.97 dB μ V/m)	50 millivolts/meter (93.97 dB μ V/m)
-20dB Occupied Bandwidth (MHz)	1.954	1.811	1.9114

Long-Range Handle Radio

Test	2425 MHz
Field Strength of Fundamental	20.8 dB μ V/m
Limit for Fundamental	50 millivolts/meter (93.97 dB μ V/m)
-20dB Occupied Bandwidth (MHz)	0.406

The -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 Merck Animal Health 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: **Whisper® On-Arrival Veterinary Device**

Model: **2020WOA1**

Serial Nos.: 103, 104, 106

FCC ID: **2AUHW-2020WOA1**

5.2 Trade Name:

Merck Animal Health

5.3 Power Supply:

Battery-Operated

5.4 Applicable Rules:

CFR 47, Part 15.249

5.5 Equipment Category:

DXT

5.6 Antenna:

Integral Antenna

5.7 Accessories:

AC Adapter – CUI Inc. model SW16-S-N

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUTs were set for continuous transmission of a modulated signal on Low, Mid and High channels of the 2.4 GHz BLE band. All 2425 second radio data is from the single channel radio located in the handle and transmitting at same time as BLE.

**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	Oct. 31, 2019
Temp/Hum. Recorder	CL261	Extech	445814	04	Mar. 6, 2020
18" Loop	CL163-Loop	AH Systems, Inc.	EHA-52B	100	July 24, 2020
Receiver	CL151	Rohde & Schwarz	ESU40	100319	Oct. 25, 2019
Pre-Amplifier	CL250	Com-Power	PAM-118A	18040011	Oct. 26, 2019
Pre-Amplifier	CL153	Hewlett Packard	8447E	MY39500791	Aug. 5, 2020
Antenna, Horn	CL098	Emco	3115	9809-5580	Jan. 31, 2021
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	Oct. 14, 2020
LISN	CL181	Com-Power	LI-125A	191226	Sept. 6, 2020
LISN	CL182	Com-Power	LI-125A	191225	Sept. 6, 2020
Software:	Tile Version 3.4.B.3		Software Verified: Sept. 17, 2019		
Software:	EMC 32, Version 5.20.2		Software Verified: Sept. 17, 2019		



7 FCC PART 15.215(e), 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.

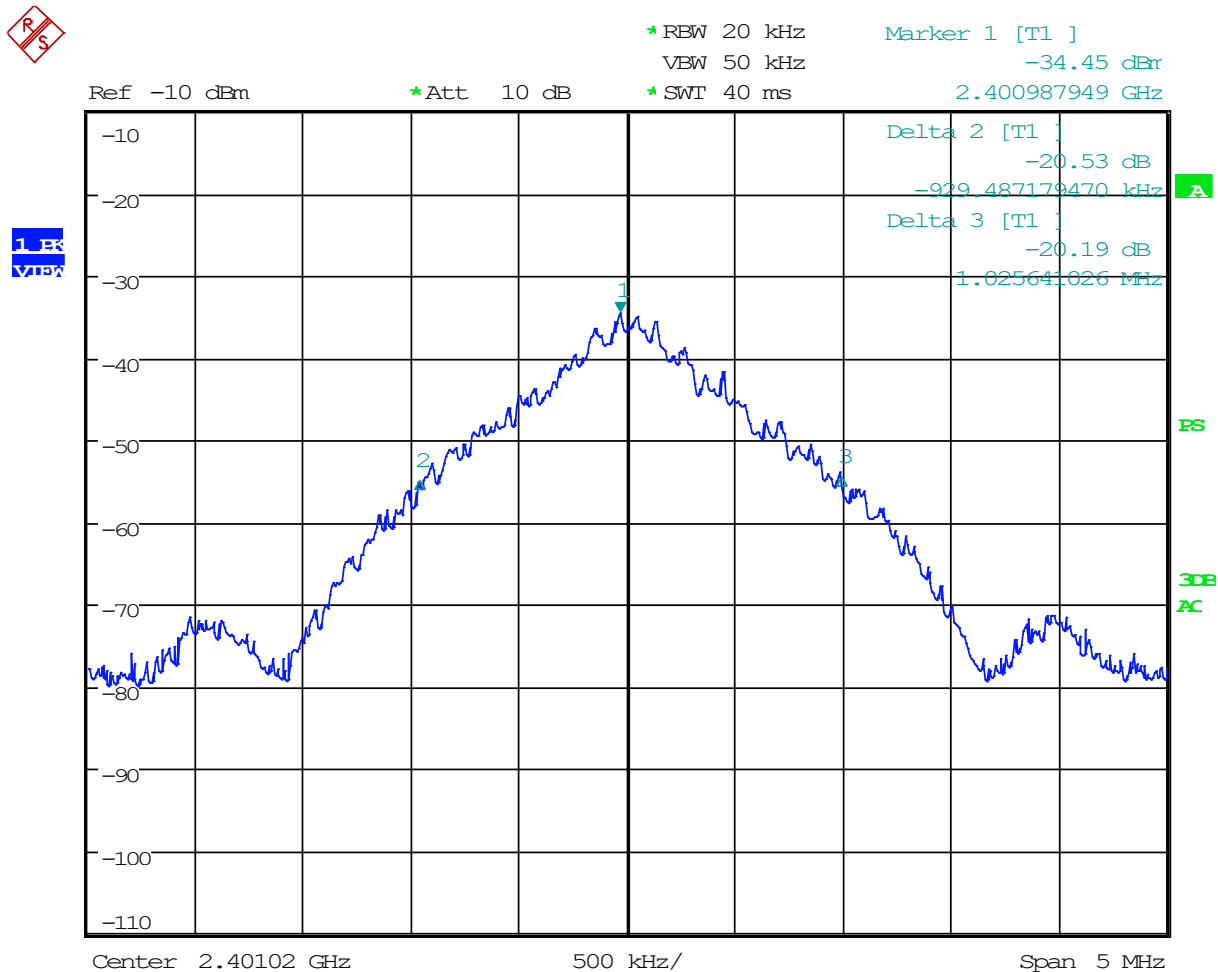
Bandwidth measurements were made at the low (2.402 GHz), mid (2.440 GHz) and upper (2.480 GHz) frequencies. The control radio (handle) is a single frequency radio at 2.425 GHz. The bandwidth was measured using the marker delta function.



7.2 Occupied Bandwidth Test Data

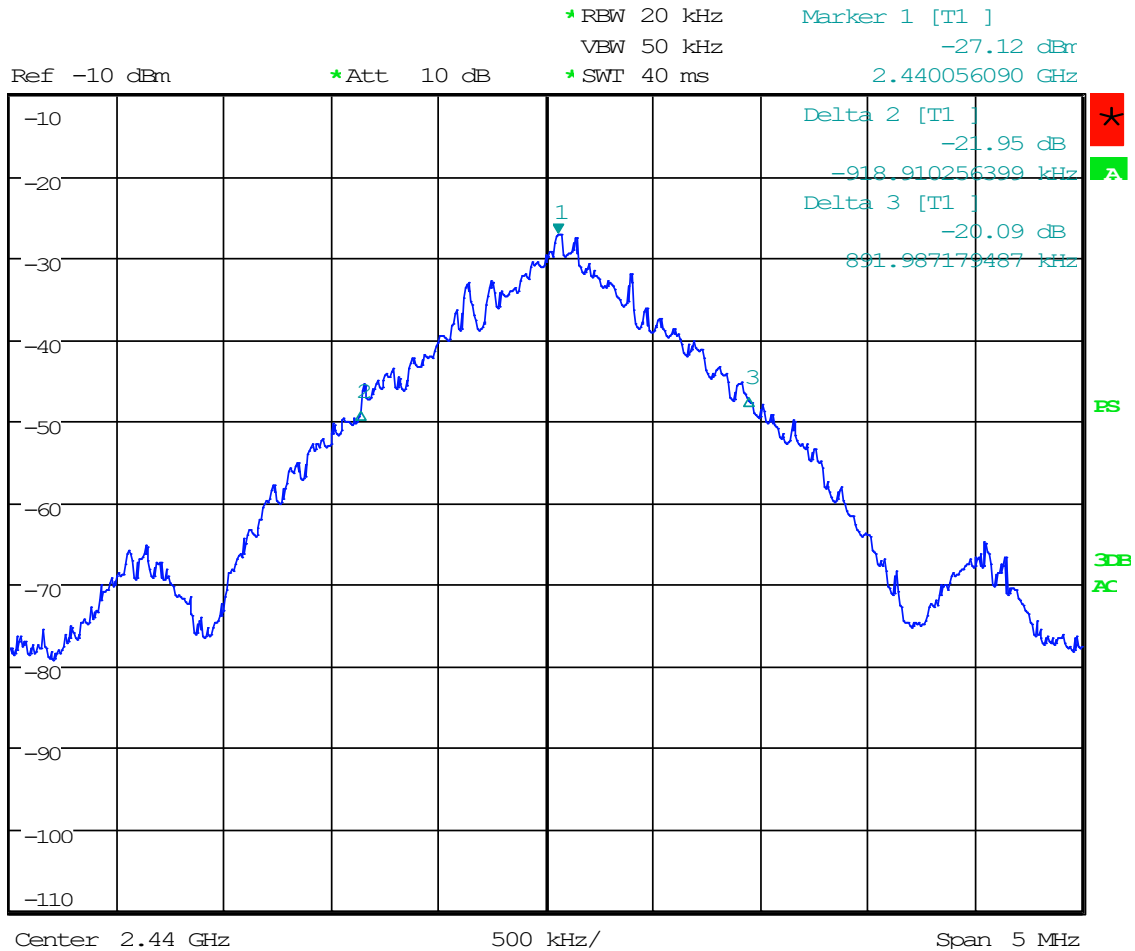
Test Date(s):	Sept. 17, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.215(c)	Air Temperature:	20.6°C
		Relative Humidity:	58%

BLE: -20dB OBW, Low Channel





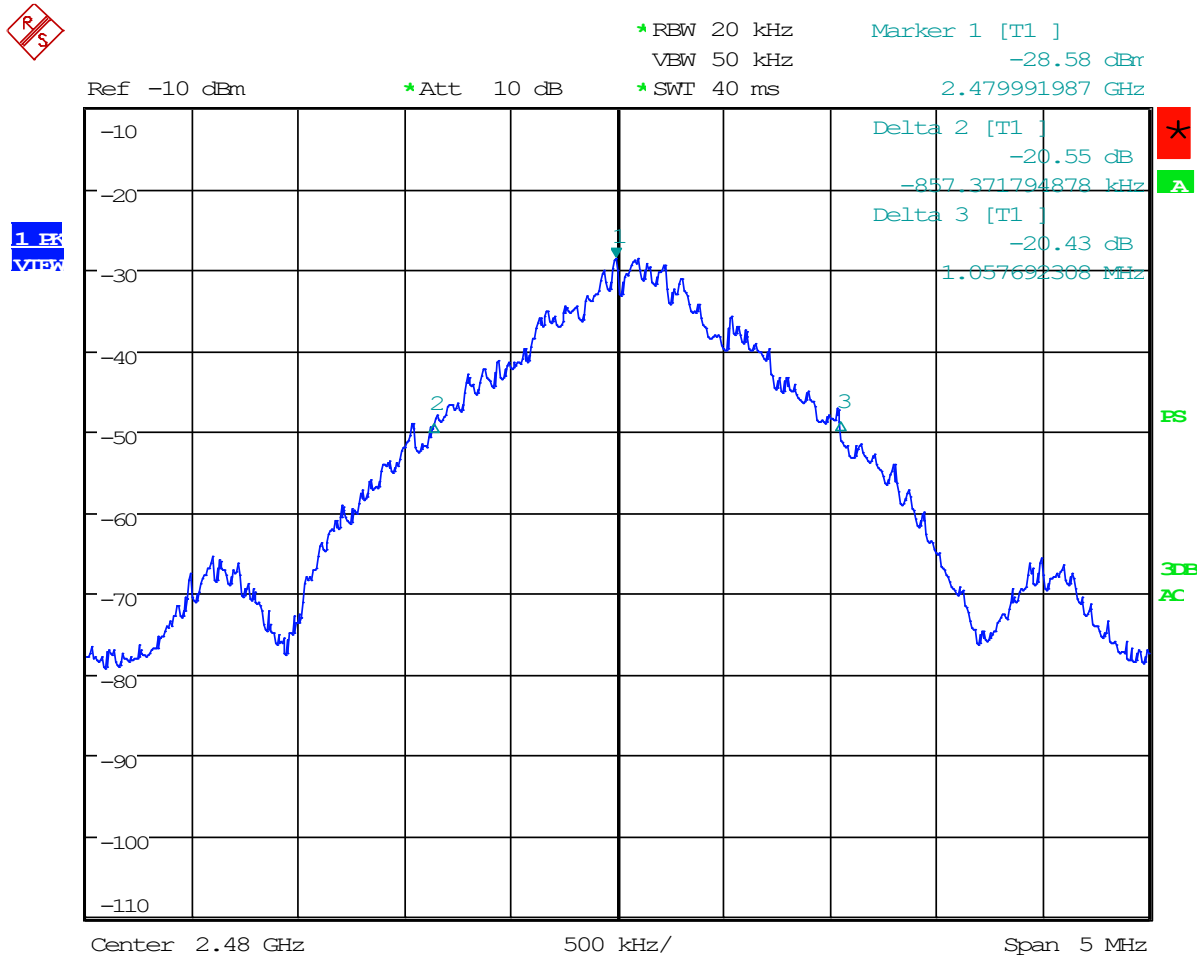
BLE: -20dB OBW, Mid Channel



Date: 17.SEP.2019 12:39:16



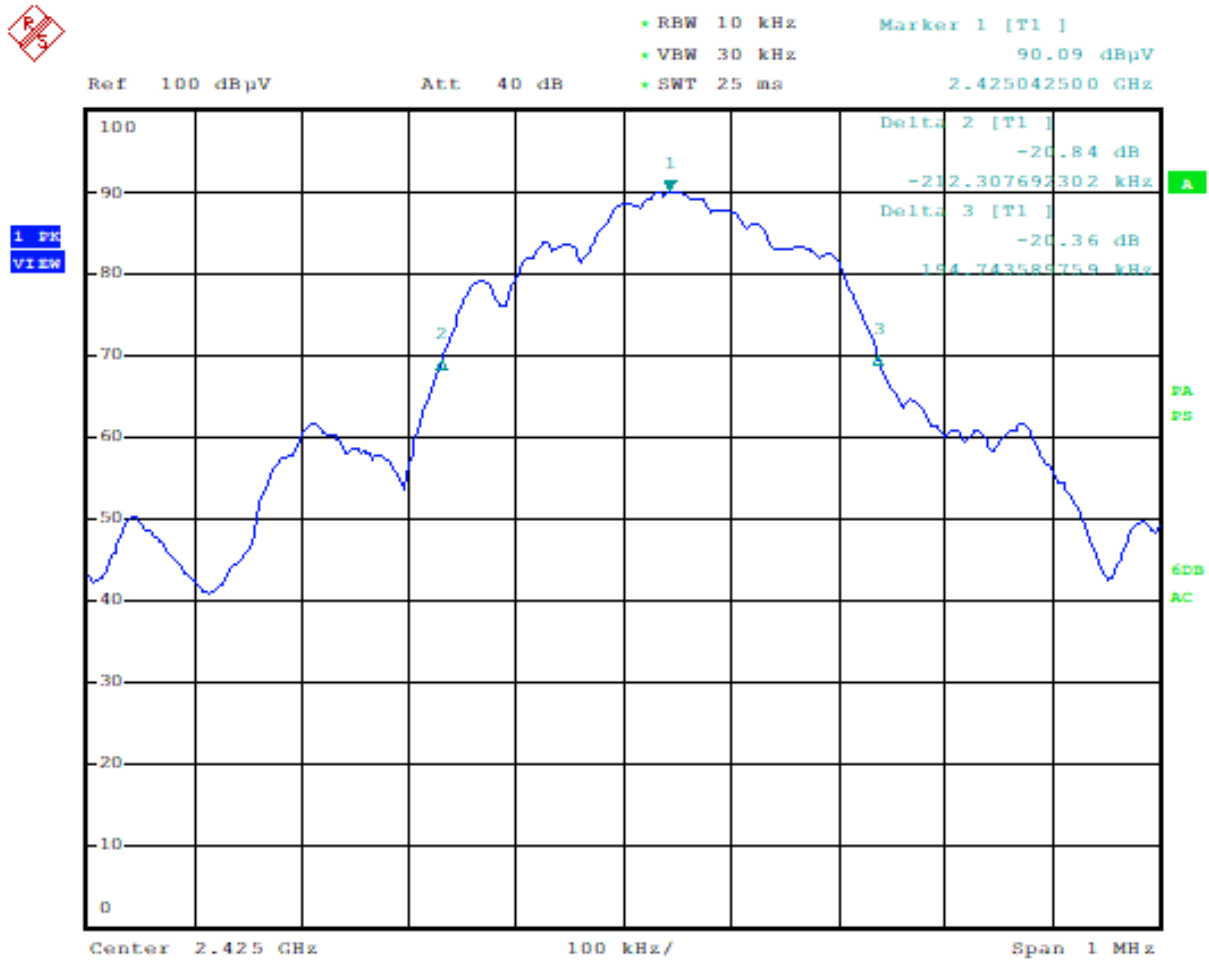
BLE: -20dB OBW, High Channel



Date: 17.SEP.2019 12:42:10



2425 MHz Radio: -20dB OBW



Date: 23.SEP.2019 13:42:33

**8 FCC PART 15.249(a)(d) – 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 three orthogonal positions 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.

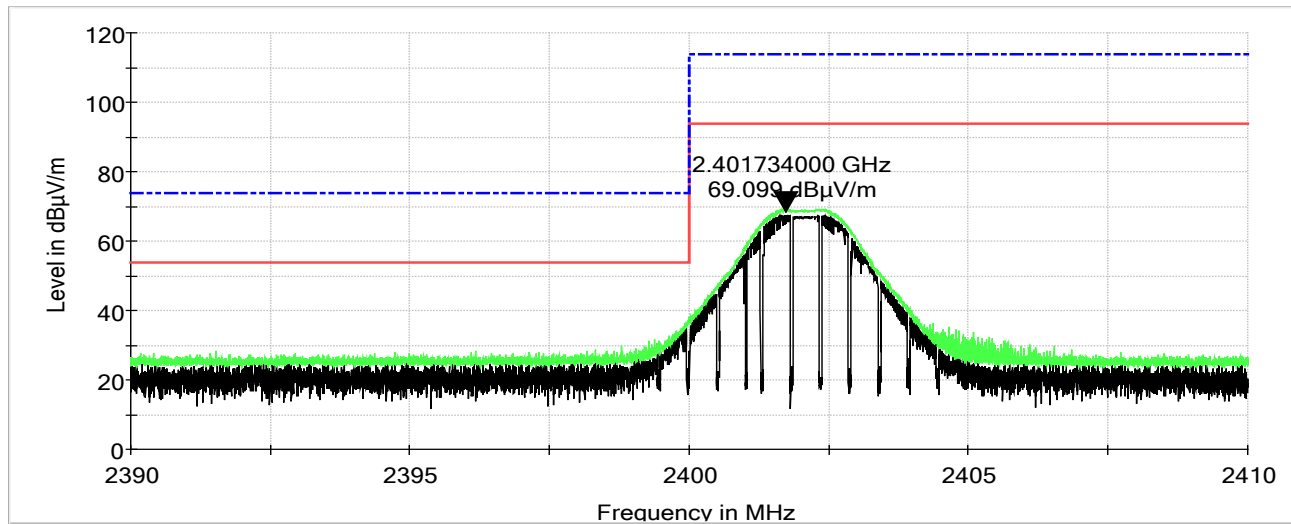
In the following plots, the black trace indicates the active scan and the green indicates the the MaxPk with the EUT on. Emissions to be found by the EUT were measured and listed in tables that follow.



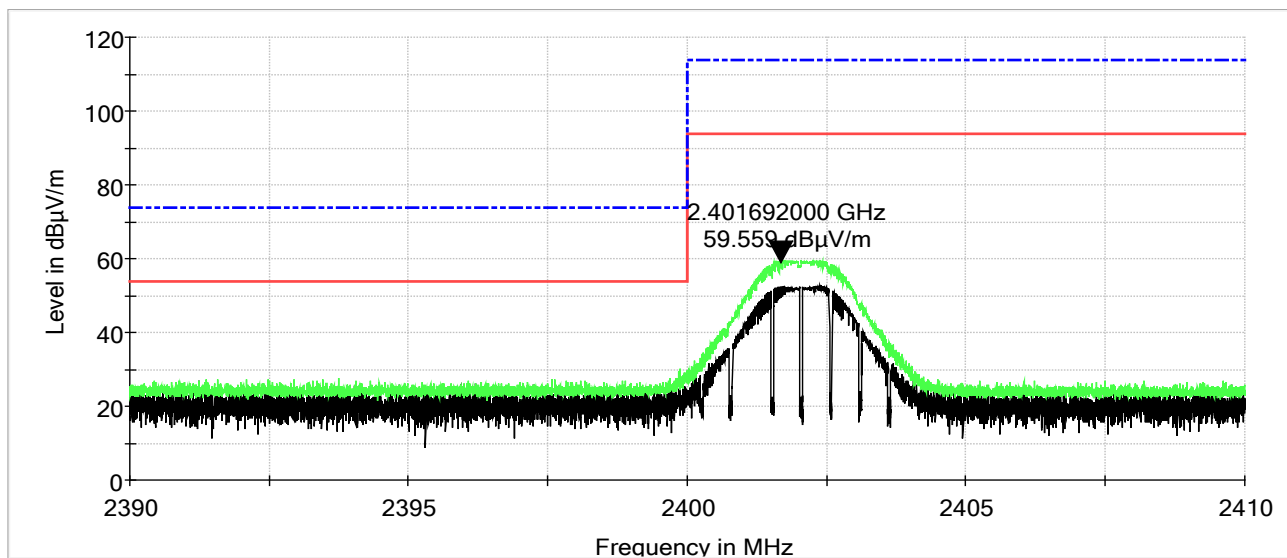
8.1 Test Data – Band Edge and Field Strength of Emissions

Test Date(s):	Sept. 17, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(a)	Air Temperature:	21.0°C
		Relative Humidity:	57%

Band Edge: Low Channel, Vertical

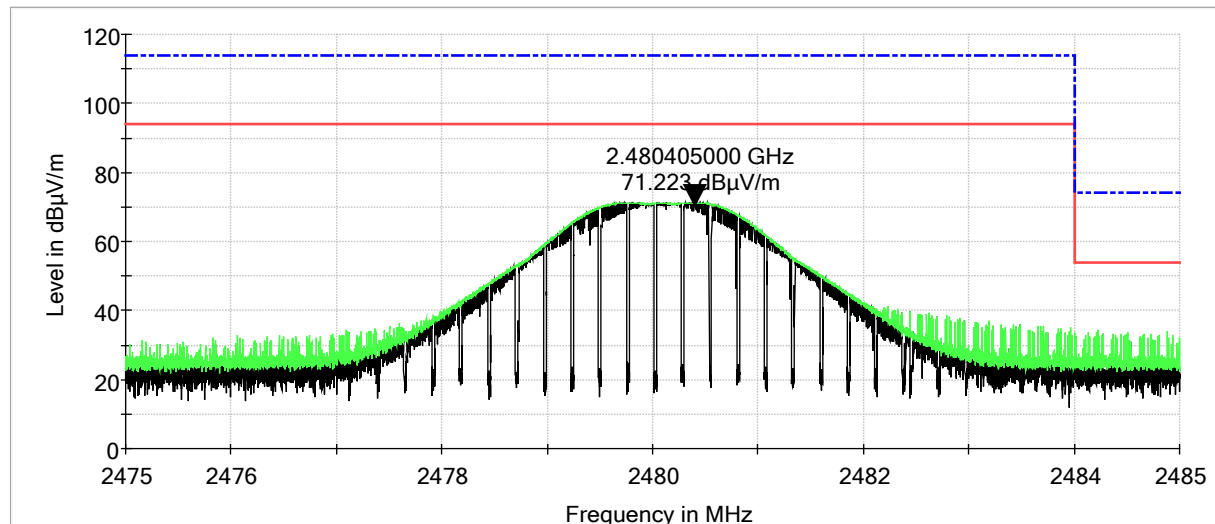


Band Edge: Low Channel, Horizontal

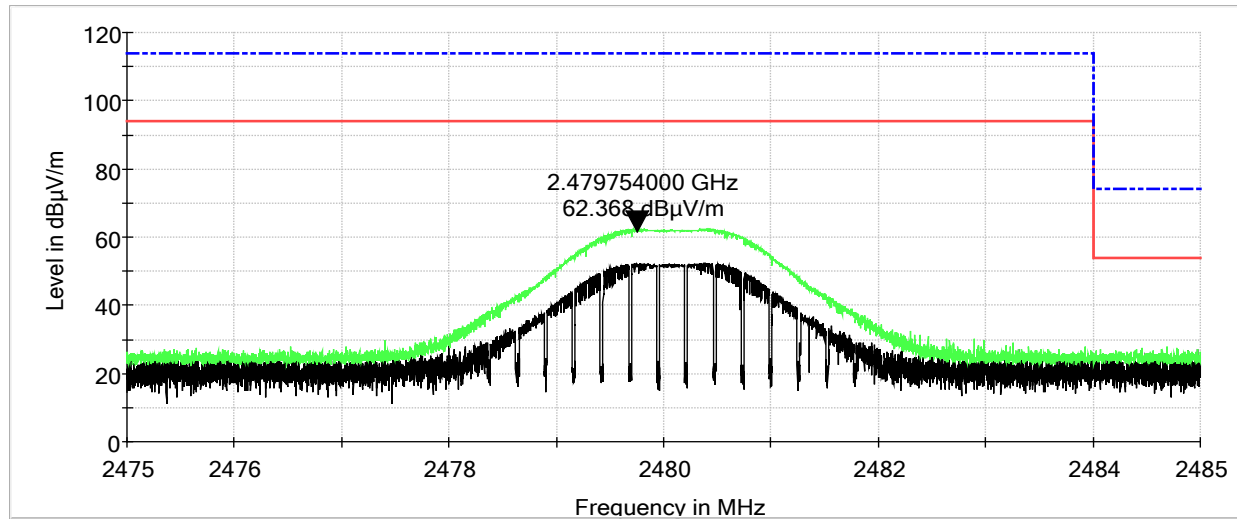




Band Edge: High Channel, Vertical



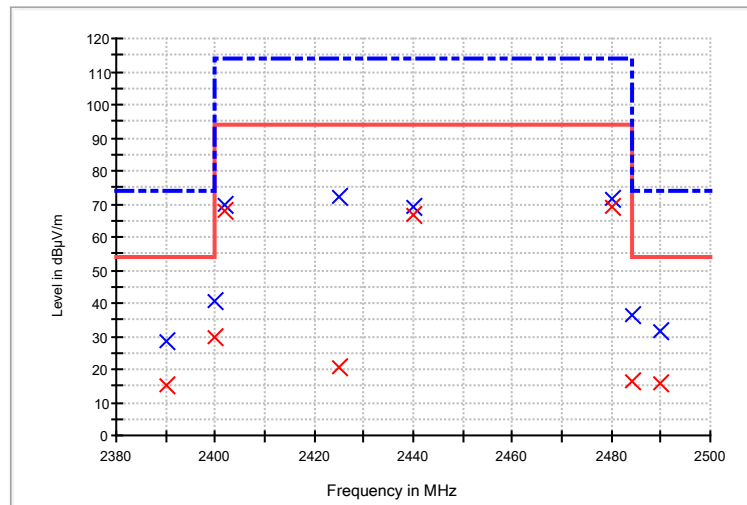
Band Edge: High Channel, Horizontal





Measurements

Frequency (MHz)	Polarity	Corr. (dB)	MaxPeak (dB μ V/m)	MaxPeak (dB μ V/m) Limit	MaxPeak Margin	Average (dB μ V/m)	Average (dB μ V/m) Limit	Average Margin	Bandwidth (kHz)	Antenna Height (cm)	Azimuth (deg)
2390.000000	V	-19.10	28.2	74	-45.8	15	54	-39.0	1000.000	150.000	304.000
2400.000000	V	-19.40	40.4	114	-73.6	29.5	94	-64.5	1000.000	150.000	304.000
2402.000000	V	-19.40	70	114	-44.0	67.8	94	-26.2	1000.000	150.000	304.000
2425.000000	H	-19.20	72	114	-42.0	20.8	94	-73.2	1000.000	150.000	217.000
2440.000000	V	-19.10	68.9	114	-45.1	66.6	94	-27.4	1000.000	150.000	340.000
2480.000000	V	-19.10	71.4	114	-42.6	69.1	94	-24.9	1000.000	150.000	340.000
2484.000000	V	-19.00	36.3	74	-37.7	16.5	54	-37.5	1000.000	150.000	340.000
2490.000000	V	-19.00	31.7	74	-42.3	15.6	54	-38.4	1000.000	150.000	340.000





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 orthogonal positions 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. Frequencies were scanned from 9kHz to 26 GHz and the highest emissions are listed below.

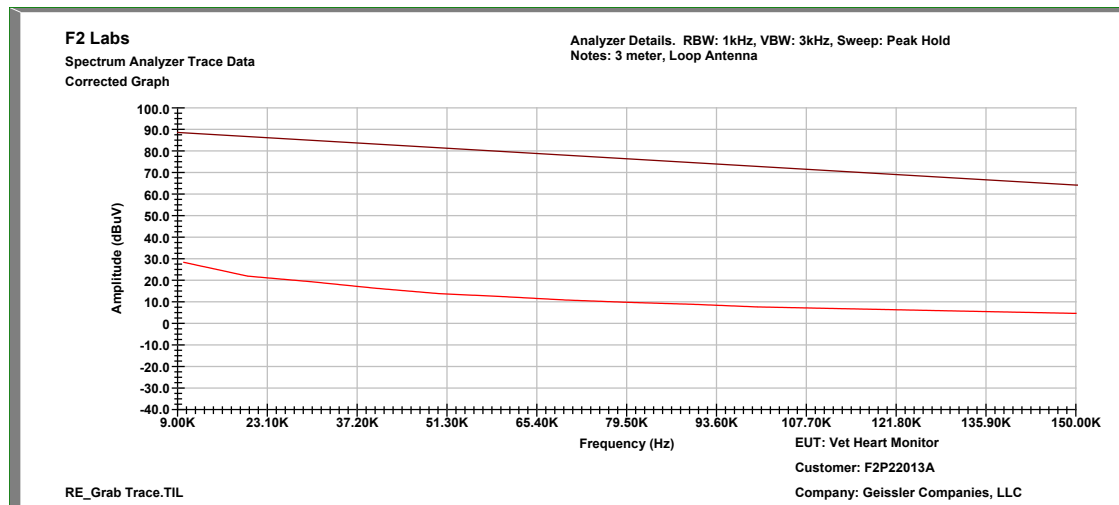
In the following plots, the black trace indicates the active scan and the green indicates the the MaxPk with the EUT on. Emissions to be found by the EUT were measured and listed in tables that follow.



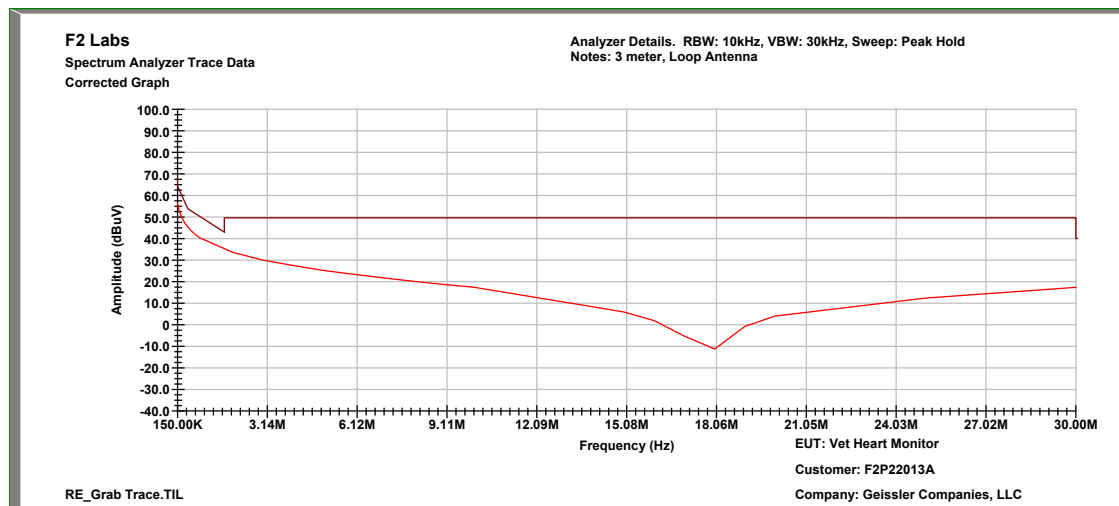
Test Date(s):	Sept. 17, 2019	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.249(d) / Part 15.209	Air Temperature:	21.9°C
		Relative Humidity:	56%

Note: All spurious emissions test data applies to both radios.

Characterization Scan, 0.009 MHz to 0.15 MHz



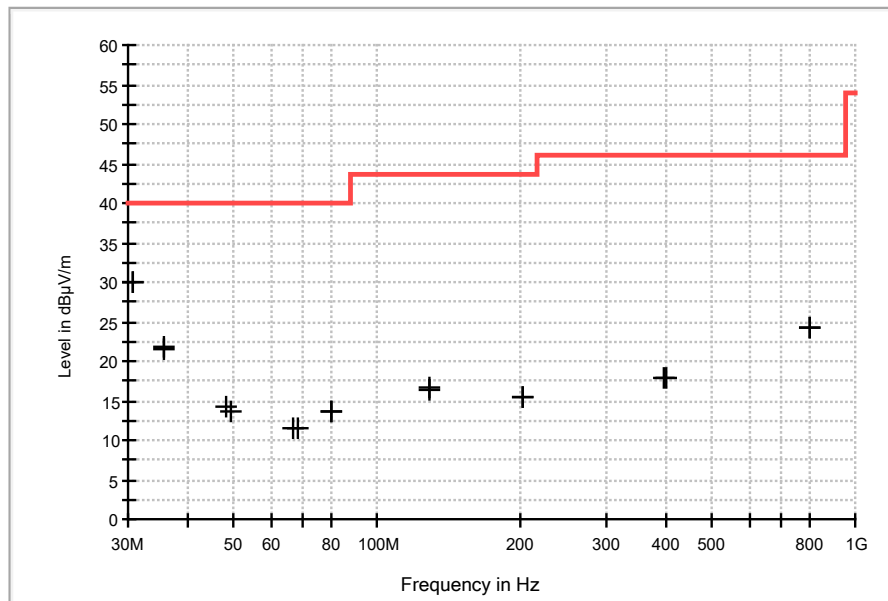
Characterization Scan, 0.15 MHz to 30 MHz





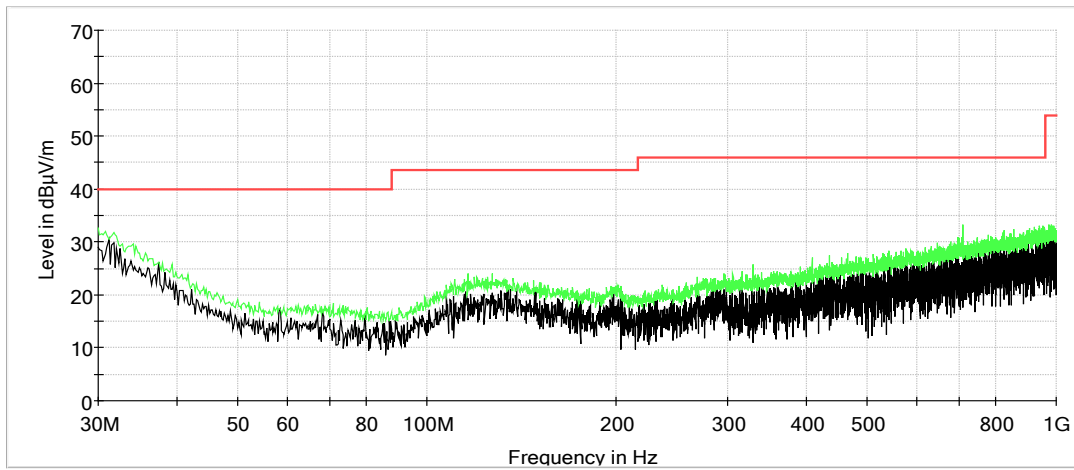
The following data reflects emissions from High, Mid and Low channels, as well as the 2425 MHz single channel transmitter. There were no emissions from the EUT other than the fundamental.

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (deg)	Reading (dBμV)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
30.760000	H	100.00	0.00	24.0	6.1	30.1	40.0	-9.9
30.760000	V	100.00	0.00	24.0	6.1	30.1	40.0	-9.9
35.600000	H	100.00	0.00	19.1	2.6	21.7	40.0	-18.3
35.600000	V	100.00	0.00	19.0	2.6	21.6	40.0	-18.4
48.280000	V	100.00	0.00	20.0	-5.9	14.1	40.0	-25.9
49.040000	H	100.00	0.00	19.8	-6.2	13.6	40.0	-26.4
66.560000	V	100.00	0.00	18.7	-7.2	11.5	40.0	-28.5
68.040000	H	100.00	0.00	18.5	-7.1	11.4	40.0	-28.6
80.000000	V	100.00	0.00	21.4	-7.7	13.7	40.0	-26.3
80.000000	H	100.00	0.00	21.4	-7.7	13.7	40.0	-26.3
128.120000	H	100.00	0.00	18.1	-1.6	16.5	43.5	-27.0
128.480000	V	100.00	0.00	18.0	-1.6	16.4	43.5	-27.1
200.480000	V	100.00	0.00	18.1	-2.5	15.6	43.5	-27.9
200.880000	H	100.00	0.00	18.0	-2.4	15.6	43.5	-27.9
399.360000	H	100.00	0.00	17.5	0.5	18.0	46.0	-28.0
400.080000	V	100.00	0.00	17.4	0.5	17.9	46.0	-28.1
801.880000	V	100.00	0.00	18.1	6.2	24.3	46.0	-21.7
802.640000	H	100.00	0.00	18.2	6.2	24.4	46.0	-21.6

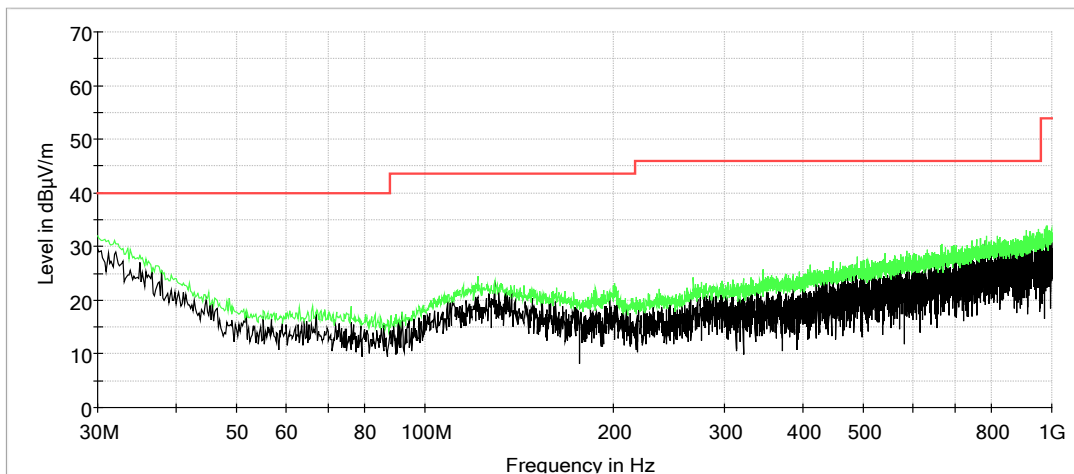




Low Channel: Characterization Scan, 30 MHz to 1000 MHz, Vertical

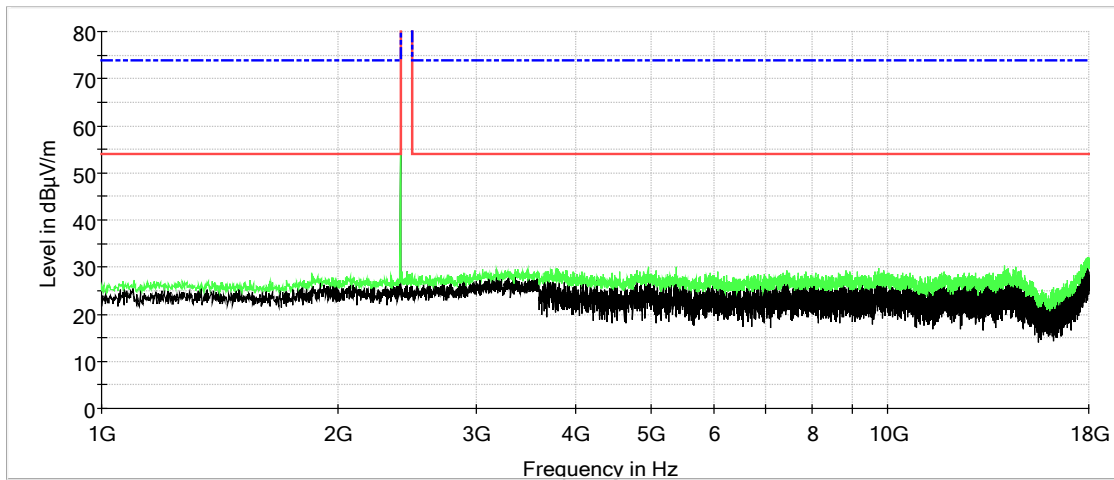


Low Channel: Characterization Scan, 30 MHz to 1000 MHz, Horizontal

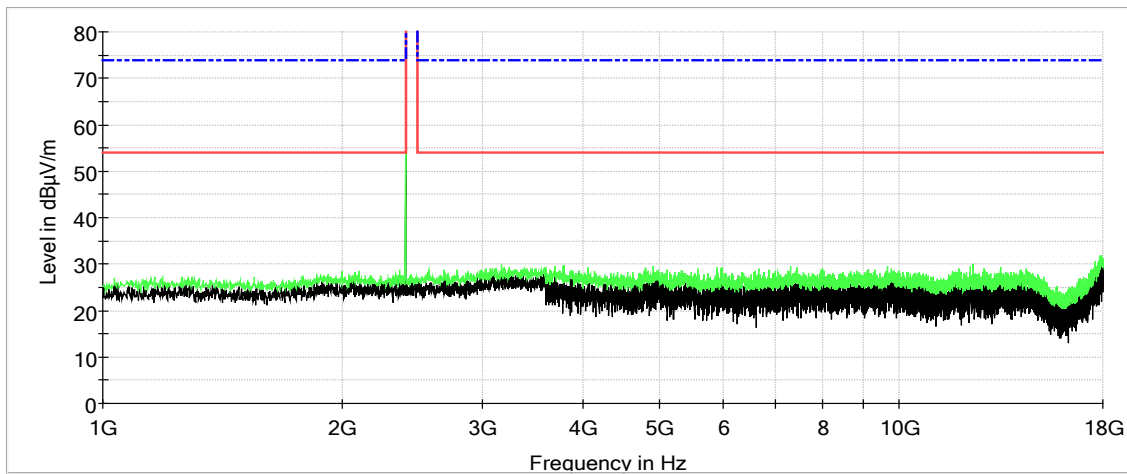




Low Channel: Characterization Scan, 1 GHz to 18 GHz, Vertical

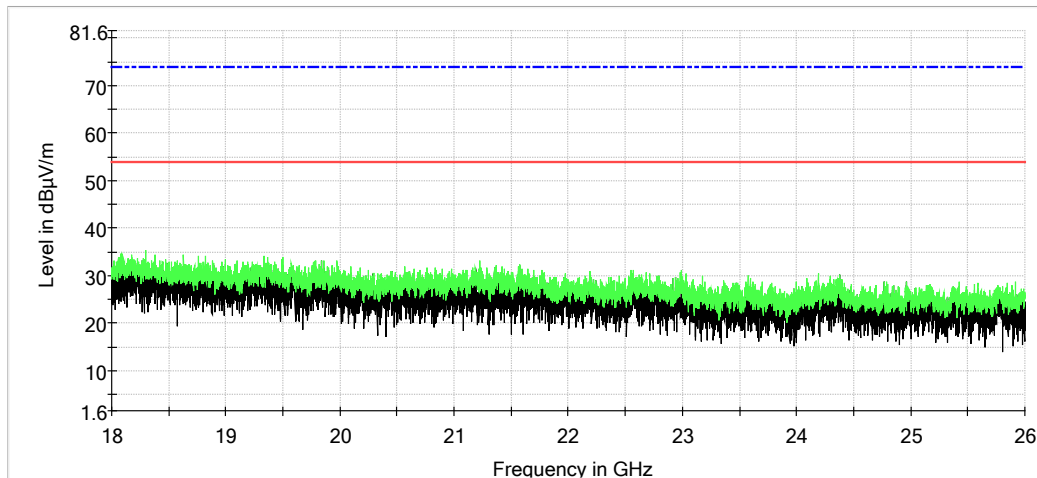


Low Channel: Characterization Scan, 1 GHz to 18 GHz, Horizontal

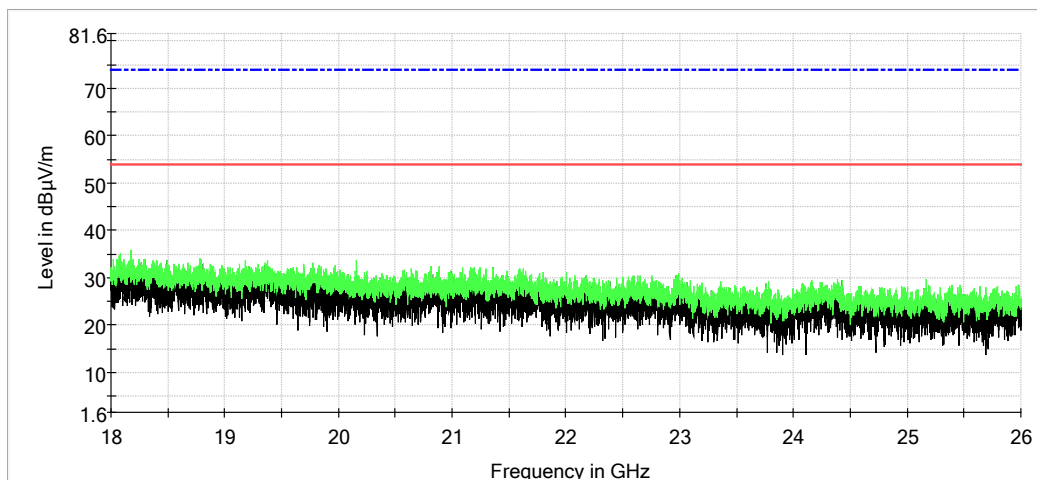




Low Channel: Characterization Scan, 18 GHz to 26 GHz, Vertical

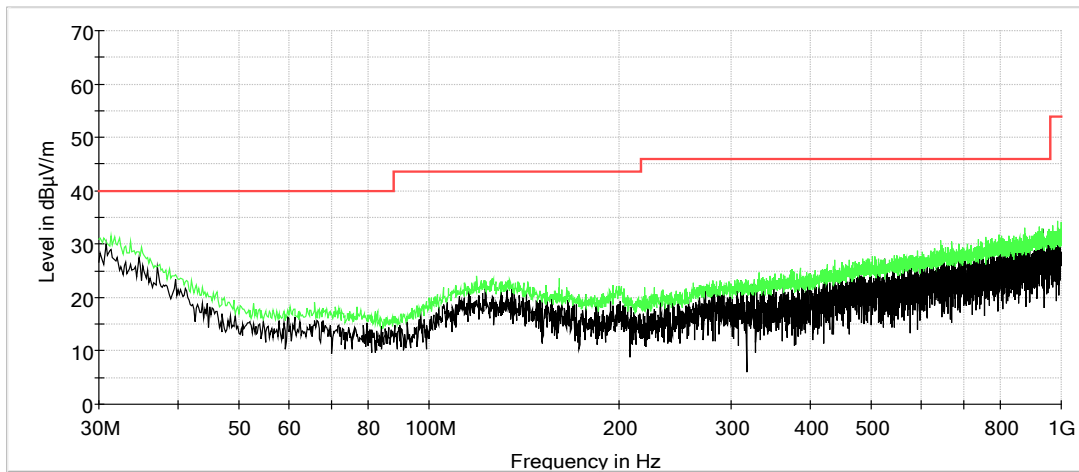


Low Channel: Characterization Scan, 18 GHz to 26 GHz, Horizontal

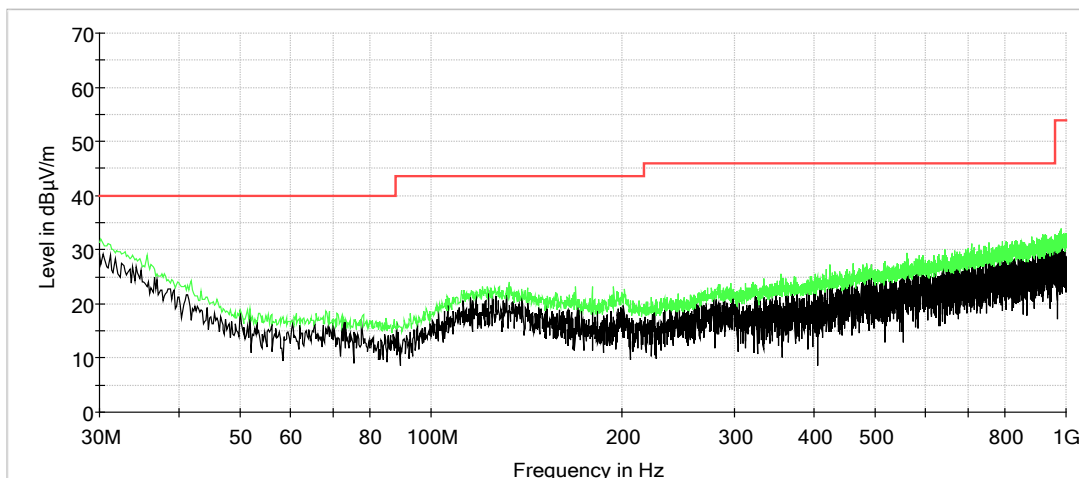




Mid Channel: Characterization Scan, 30 MHz to 1000 MHz, Vertical

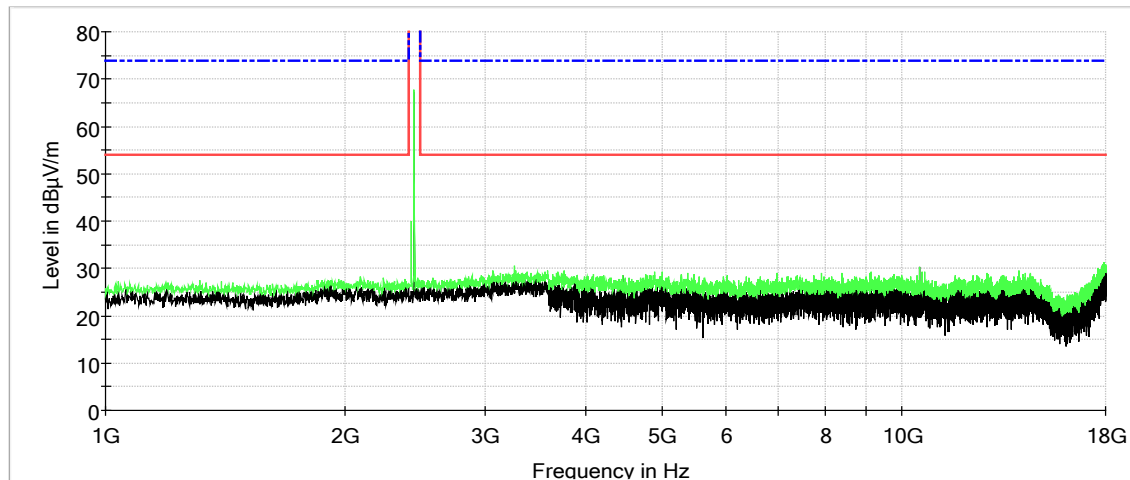


Mid Channel: Characterization Scan, 30 MHz to 1000 MHz, Horizontal

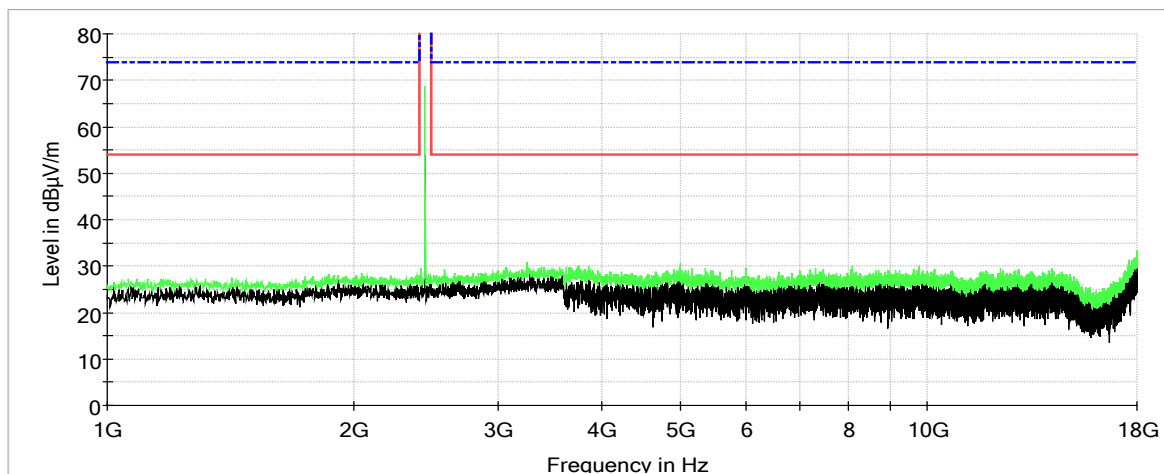




Mid Channel: Characterization Scan, 1 GHz to 18 GHz, Vertical

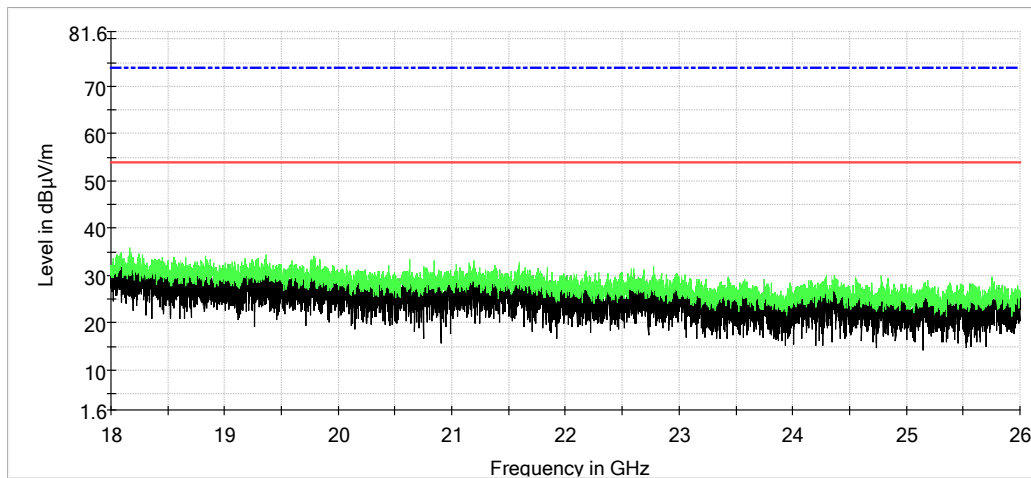


Mid Channel: Characterization Scan, 1 GHz to 18 GHz, Horizontal

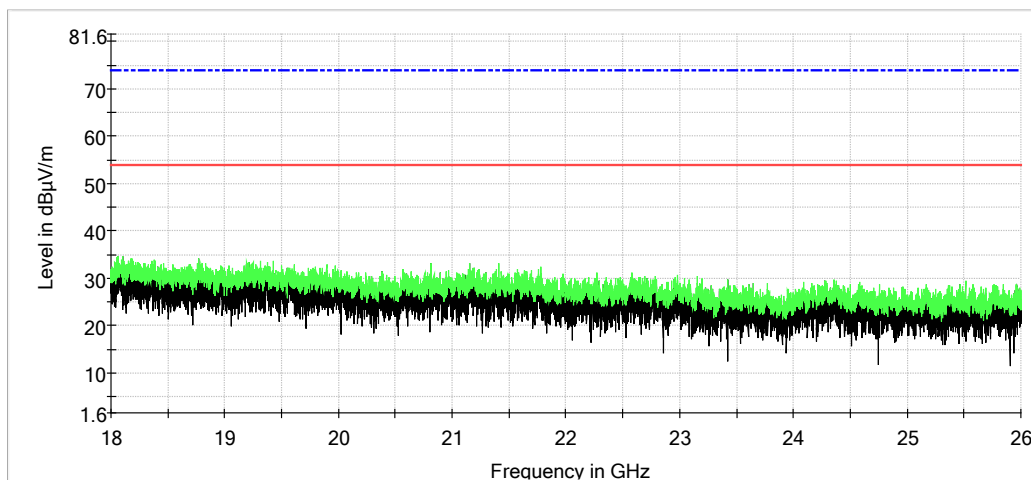




Mid Channel: Characterization Scan, 18 GHz to 26 GHz, Vertical

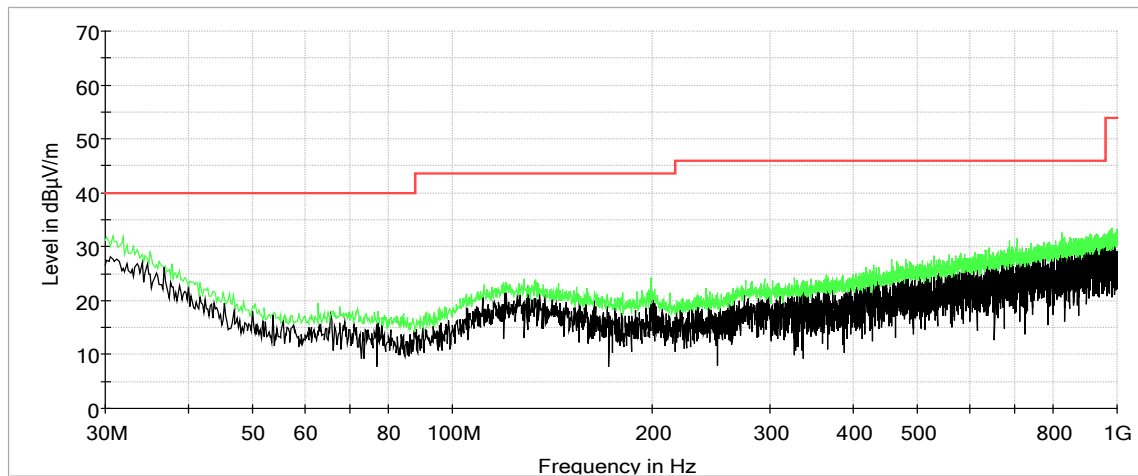


Mid Channel: Characterization Scan, 18 GHz to 26 GHz, Horizontal

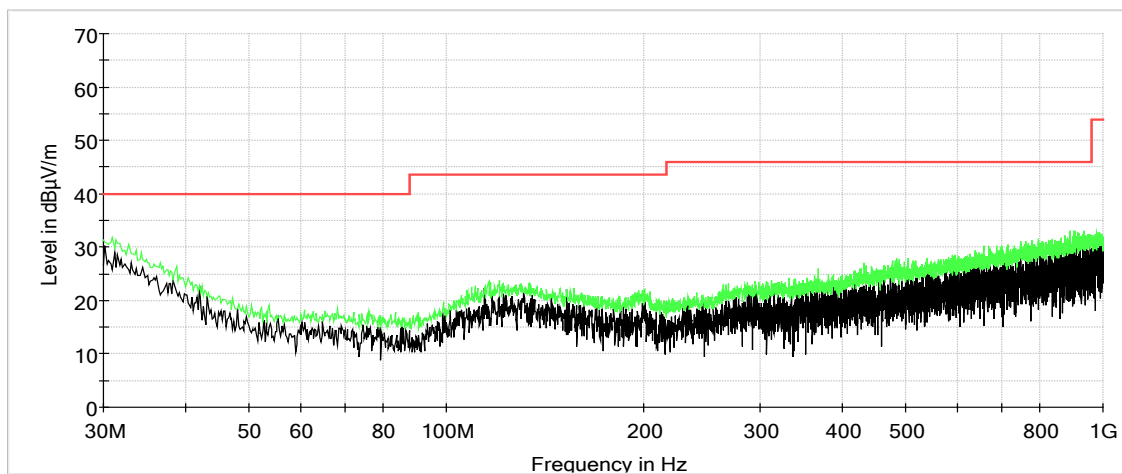




High Channel: Characterization Scan, 30 MHz to 1000 MHz, Vertical

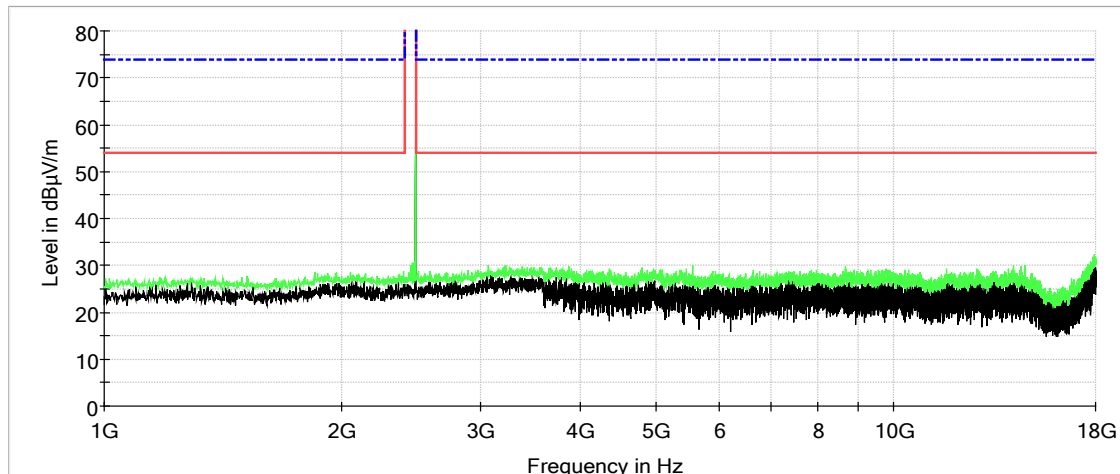


High Channel: Characterization Scan, 30 MHz to 1000 MHz, Horizontal

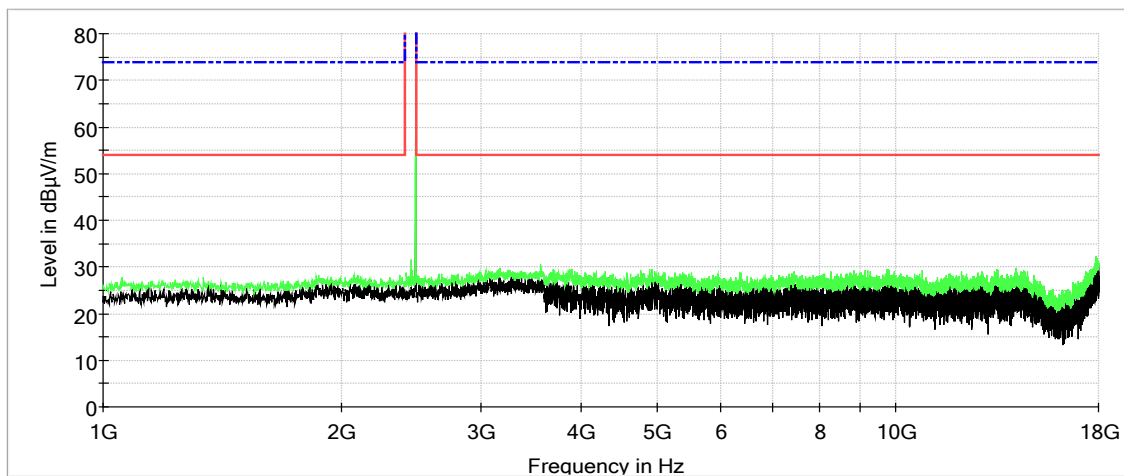




High Channel: Characterization Scan, 1 GHz to 18 GHz, Vertical

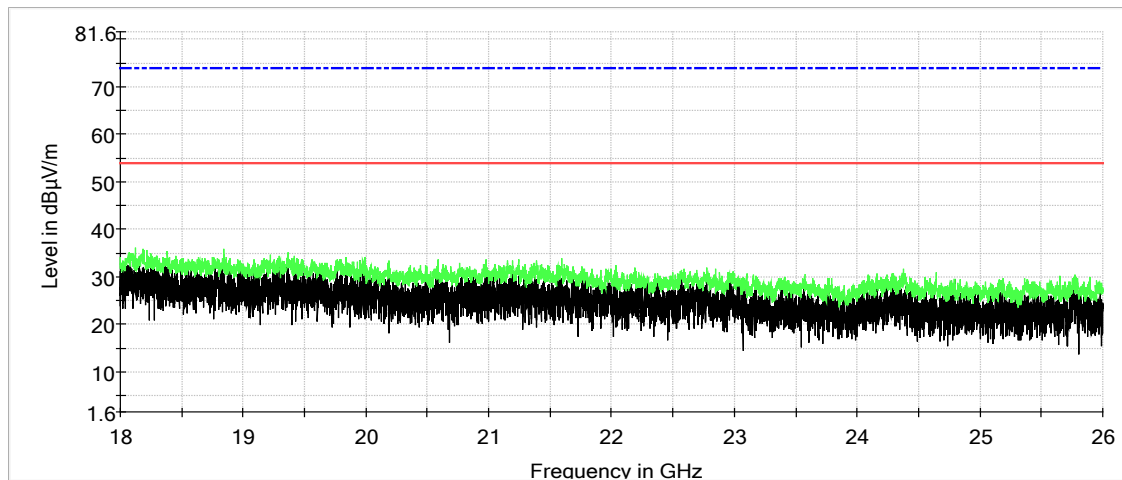


High Channel: Characterization Scan, 1 GHz to 18 GHz, Horizontal

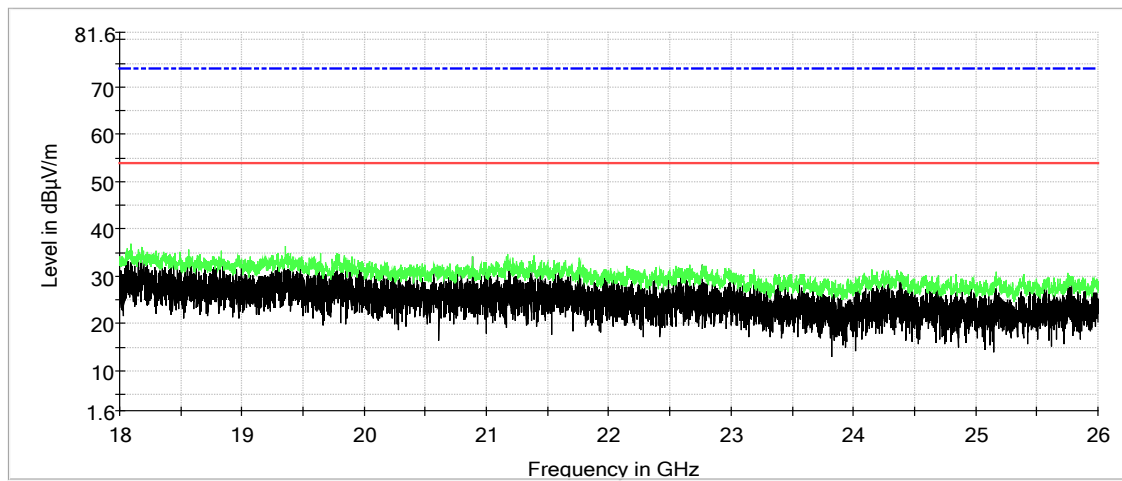




High Channel: Characterization Scan, 18 GHz to 26 GHz, Vertical



High Channel: Characterization Scan, 18 GHz to 26 GHz, Horizontal





9 CONDUCTED EMISSIONS

9.1 Requirements

In accordance with FCC CFR 47 Part 15.207(a), "Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

9.2 Procedure

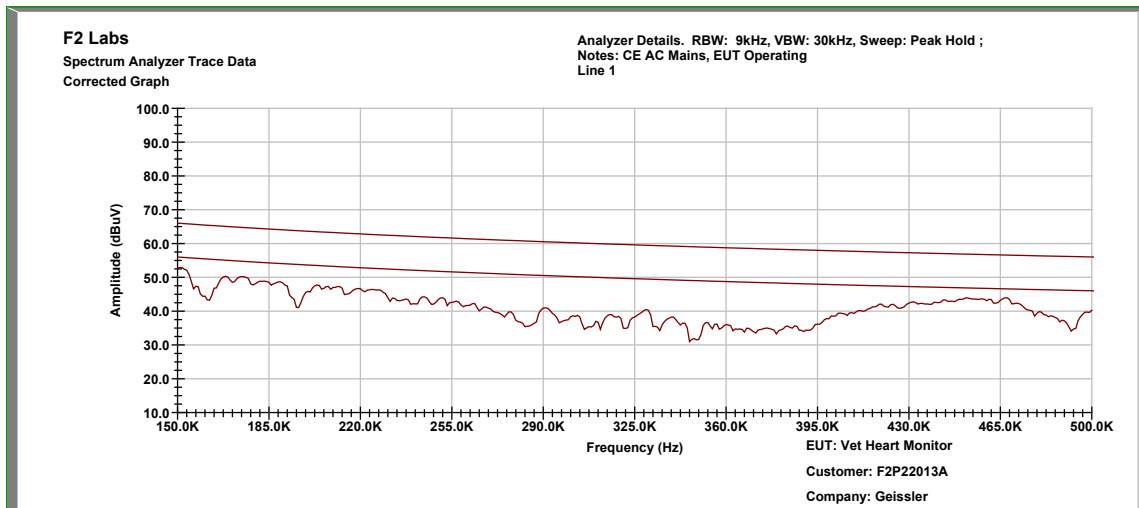
The EUT was placed on a 1.0 x 1.5 meter non-conductive table, 0.8 meter above a horizontal ground plane and 0.4 meter from a vertical ground plane. Power was provided to the EUT through a LISN bonded to a 3 x 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver via a transient limiter, and emissions in the range 150 kHz to 30 MHz were measured. The measurements were recorded using the quasi-peak and average detectors as directed by the standard, and the resolution bandwidth during testing was 9 kHz. The raw measurements were corrected to allow for attenuation from the LISN, transient limiter and cables.



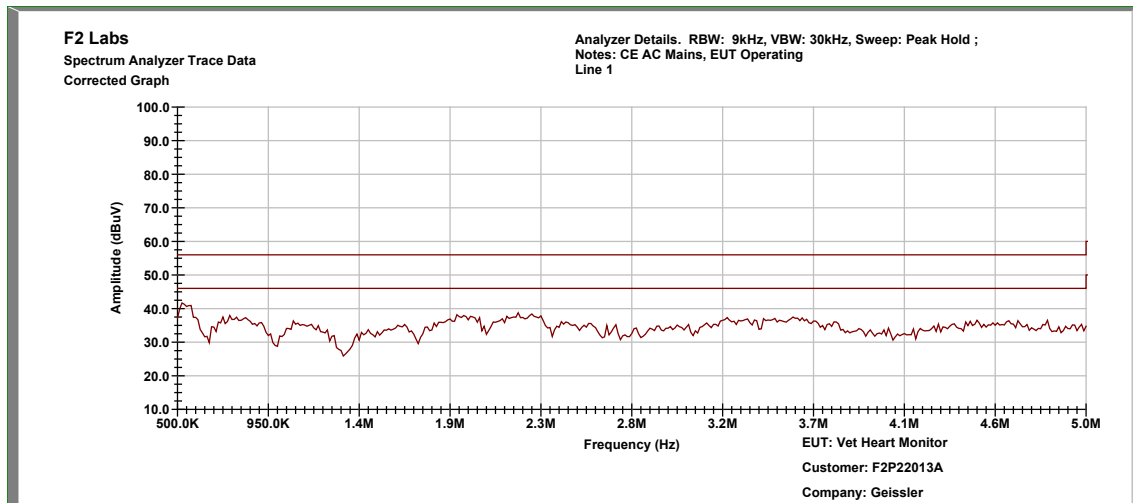
9.3 Conducted Emissions Test Data

Test Date(s):	Sept. 17, 2019	Test Engineer:	J. Chiller
Rule:	15.207	Air Temperature:	22.1° C
Test Results:	Complies	Relative Humidity:	37%

Conducted Test – Live: 0.15 MHz to 0.5 MHz

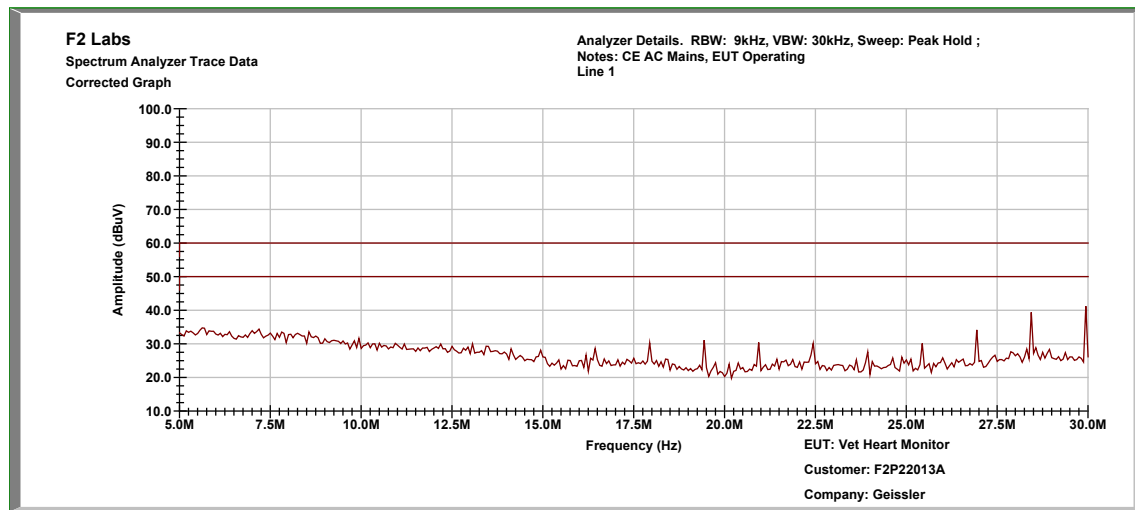


Conducted Test – Live: 0.5 MHz to 5.0 MHz





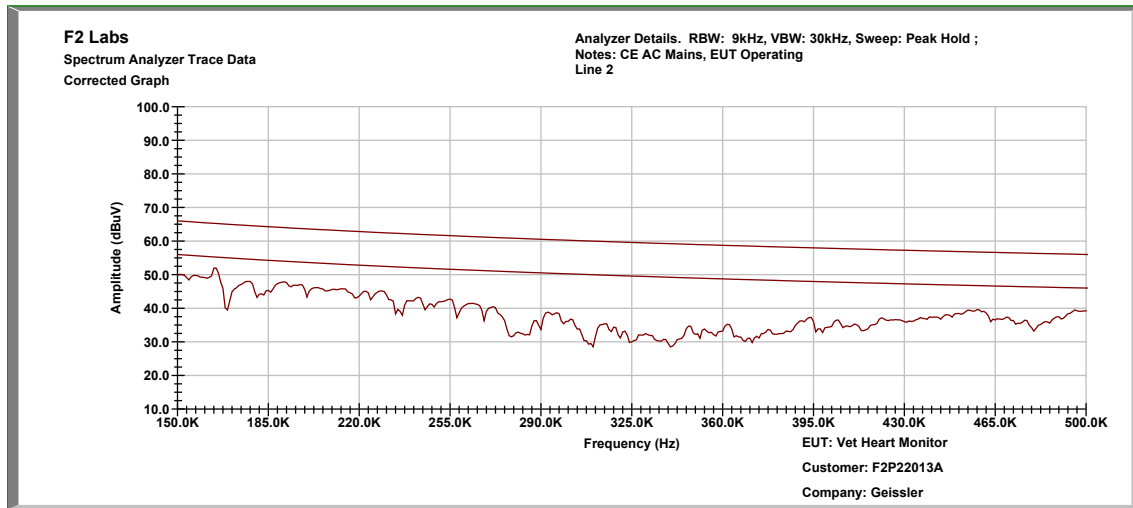
Conducted Test – Live: 5.0 MHz to 30.0 MHz



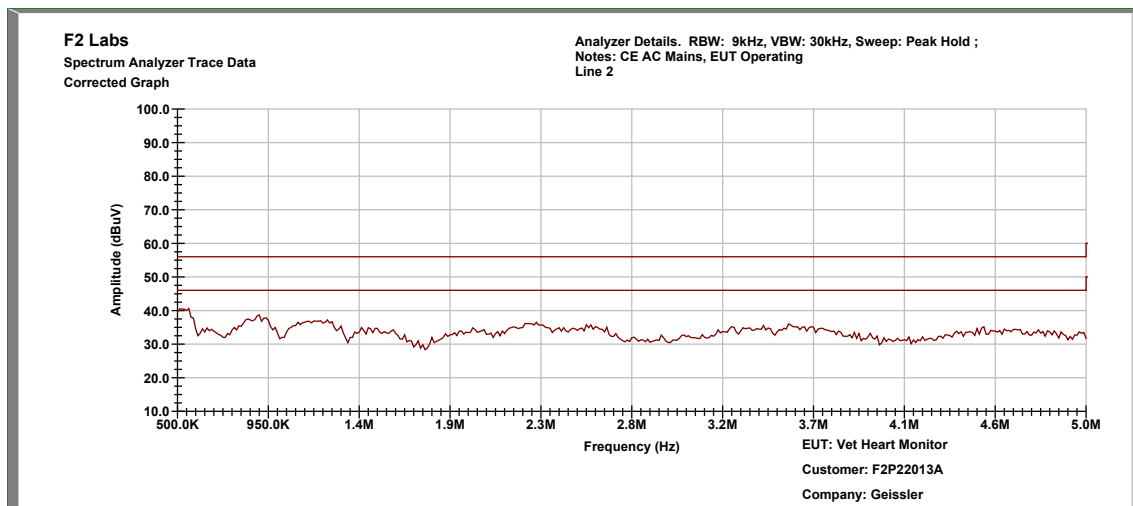
Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBμV)	Adjustment (dB)	Results (dBμV)	Limit (dBμV)	Margin (dB)
1	Live	0.164	Quasi-Peak	33.27	11.433	44.70	65.259	-20.6
			Average	20.00	11.433	31.43	55.259	-23.8
2	Live	0.171	Quasi-Peak	37.28	11.364	48.64	64.913	-16.3
			Average	24.35	11.364	35.71	54.913	-19.2
3	Live	0.188	Quasi-Peak	35.34	11.193	46.53	64.103	-17.6
			Average	22.83	11.193	34.02	54.103	-20.1
4	Live	0.200	Quasi-Peak	30.69	11.080	41.77	63.611	-21.8
			Average	19.55	11.080	30.63	53.611	-23.0
5	Live	0.436	Quasi-Peak	35.38	10.563	45.94	57.136	-11.2
			Average	24.47	10.563	35.03	47.136	-12.1
6	Live	0.465	Quasi-Peak	28.96	10.557	39.52	56.603	-17.1
			Average	20.35	10.557	30.91	46.603	-15.7

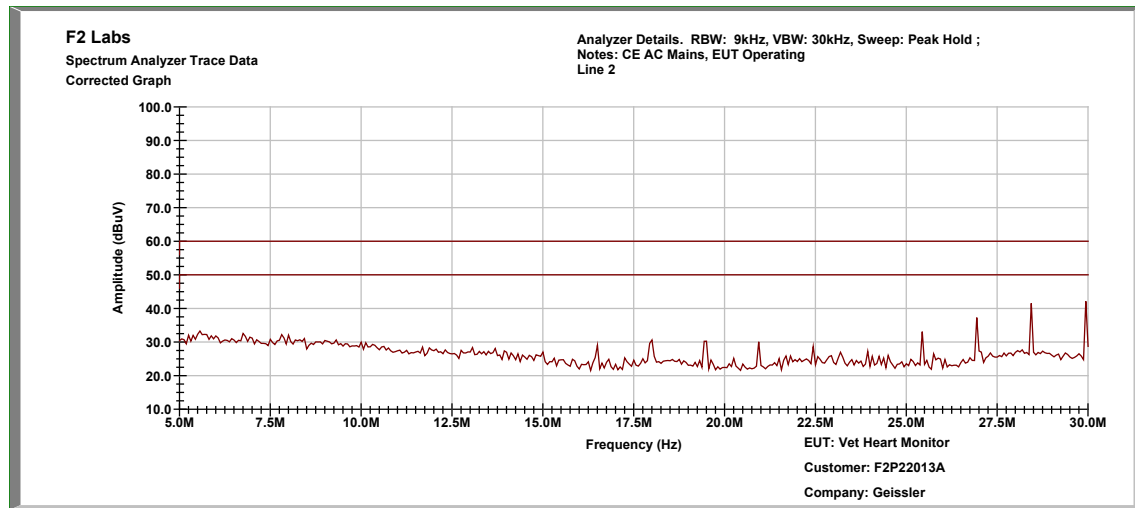


Conducted Test – Neutral: 0.15 MHz to 0.5 MHz



Conducted Test – Neutral: 0.5 MHz to 5.0 MHz

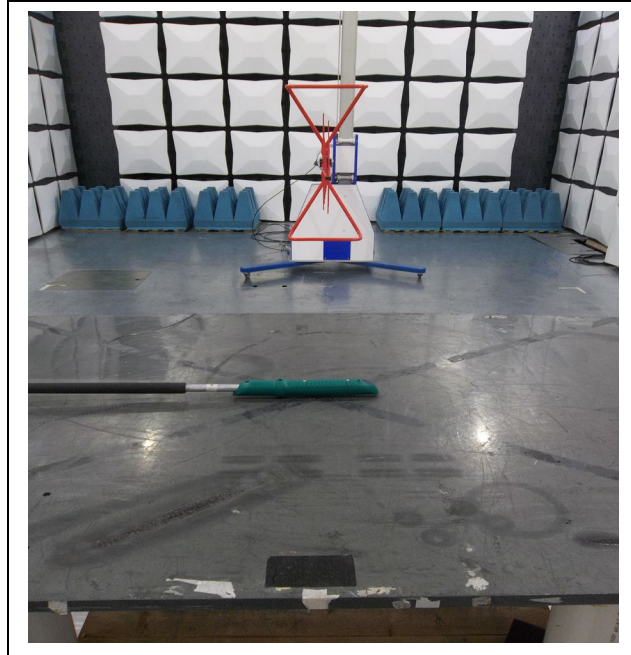


**Conducted Test – Neutral: 5.0 MHz to 30.0 MHz**

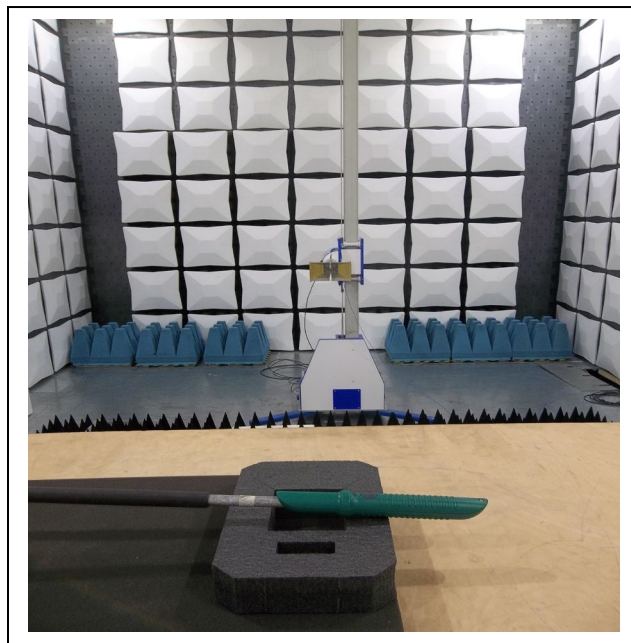
Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dB μ V)	Adjustment (dB)	Results (dB μ V)	Limit (dB μ V)	Margin (dB)
1	Neutral	0.163	Quasi-Peak	34.42	11.501	45.92	65.304	-19.4
			Average	20.89	11.501	32.39	55.304	-22.9
2	Neutral	0.226	Quasi-Peak	32.84	10.864	43.70	62.591	-18.9
			Average	22.55	10.864	33.41	52.591	-19.2
3	Neutral	0.218	Quasi-Peak	33.50	10.938	44.44	62.886	-18.4
			Average	22.51	10.938	33.45	52.886	-19.4
4	Neutral	0.395	Quasi-Peak	31.83	10.572	42.40	57.958	-15.6
			Average	24.01	10.572	34.58	47.958	-13.4
5	Neutral	0.423	Quasi-Peak	34.06	10.563	44.62	57.372	-12.7
			Average	28.42	10.563	38.98	47.372	-8.4
6	Neutral	0.485	Quasi-Peak	35.12	10.545	45.67	56.253	-10.6
			Average	29.43	10.545	39.98	46.253	-6.3

10 PHOTOGRAPHS

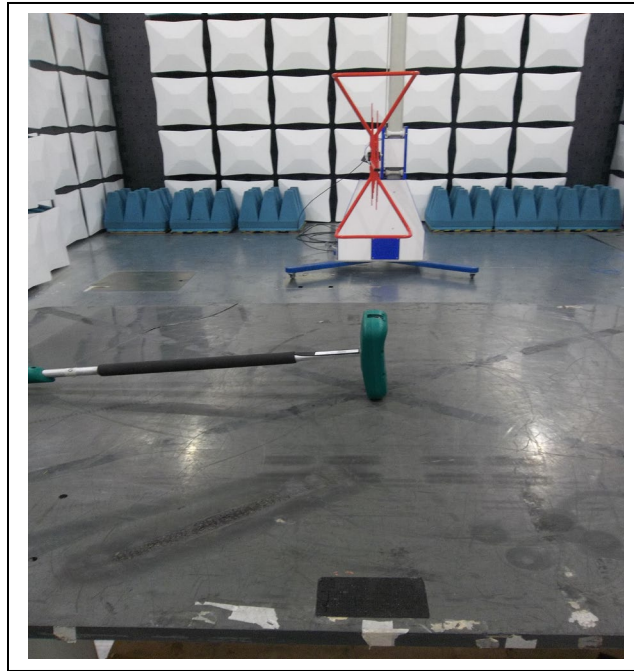
2425 MHz Radio: Less Than 1 GHZ



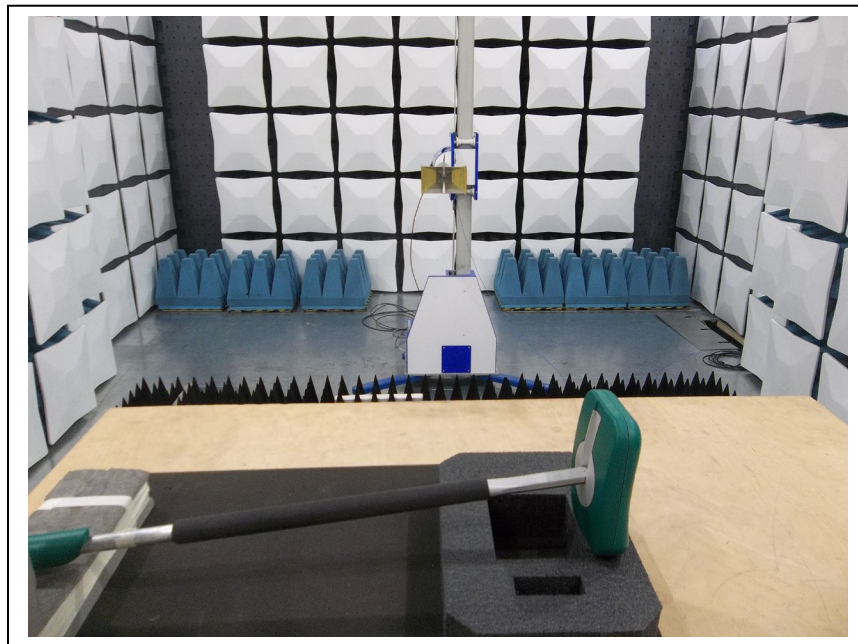
2425 MHz Radio: Greater Than 1 GHz, Field Strength of Emissions, Occupied Bandwidth



BLE: Less Than 1 GHz



**BLE: Greater Than 1 GHz,
Field Strength of Emissions, Occupied Bandwidth**





Conducted Emissions

