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CERTIFICATION TEST REPORT

Manufacturer: **Rolls Corporation**
5968 South 350 West
Salt Lake City, Utah 84107 USA

Applicant: **Same as Above**

Product Name: **Rolls HR70 FM Broadcast Transmitter**

Product Description: Low power FM broadcast transmitter for 200 ft or less radius use. With RCA and XLR inputs, recording outputs and ducking feature.

Operating Voltage/Frequency: **12VDC**

Model: **HR70**

FCC ID: **K48HR70**

Testing Commenced: 2021-03-18

Testing Ended: 2021-05-12

Summary of Test Results: **In Compliance, with Modifications**

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 15.239 – Operation in the band 88-108 MHz**
- ❖ **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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TABLE OF CONTENTS

Section	Title	Page
1	ADMINISTRATIVE INFORMATION	4
2	SUMMARY OF TEST RESULTS/MODIFICATIONS	7
3	TABLE OF MEASURED RESULTS	8
4	ENGINEERING STATEMENT	9
5	EUT INFORMATION AND DATA	10
6	LIST OF MEASUREMENT INSTRUMENTATION	11
7	OCCUPIED BANDWIDTH	12
8	FIELD STRENGTH OF EMISSIONS	19
9	VOLTAGE VARIATIONS	28
10	CONDUCTED EMISSIONS	31
11	PHOTOGRAPHS - TEST SETUPS	36



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 devices operating under Section 15.239. 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 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.



Order Nos. F2P24290, F2P24290-C1A

Applicant: Rolls Corporation
Model: HR70

1.4 Document History:

Document Number	Description	Issue Date	Approved By
F2P24290-C1A-01E	First Issue	2021-05-12	K. Littell



2 SUMMARY OF TEST RESULTS

Test Name	Standard(s)	Results
-20dB Occupied Bandwidth	CFR 47 Part 15.215(a)	Complies
Field Strength of Emissions	CFR 47 Part 15.239(b)	Complies*
Variation of the Input Power	CFR 47 Part 15.31(e)	Complies
Conducted Emissions	CFR 47 Part 15.207(a)	Complies

**Complies with modifications noted below.*

Note: Product was operated using an AC to DC power supply, so Voltage Variation testing in 15.31(3)(e) was performed at the nominal voltage, and then the 85% and 115% of that voltage was tested also. The field strength at the Low, Mid, and High channels was measured to verify how much the power and frequency were affected by the variation of the input power. No shift in frequency or power was measured at either of the varied voltages on any of the channels.

Modifications Made to the Equipment
The following modifications were made to meet Occupied Bandwidth requirements: • Changed resistor values in limiter by placing 3.3K ohm across the existing 2.2K ohm. The following modifications were made to meet Field Strength requirements: • Placed Fair-Rite clamp core #0431164281 on DC and Audio input lines. • Adjusted antenna length to 9.65" (24cm). • Placed 10ohm resistor across the existing 10ohm resistor in the output attenuator on PCB.



3 TABLE OF MEASURED RESULTS

Test		Low Channel 88.3 MHz	Mid Channel 98.1 MHz	High Channel 107.7 MHz
Average Field Strength of Fundamental*		35.1 dB μ V/m	42.3 dB μ V/m	45.8 dB μ V/m
Average Limit for Fundamental		48 dB μ V/m (250 μ V/m)	48 dB μ V/m (250 μ V/m)	48 dB μ V/m (250 μ V/m)
Peak Field Strength of Fundamental		38.1 dB μ V/m	45.4 dB μ V/m	47.4 dB μ V/m
Peak Limit for Fundamental		68 dB μ V/m	68 dB μ V/m	68 dB μ V/m
-20dB Occupied Bandwidth		0.177 MHz	0.177 MHz	0.180 MHz
99% Occupied Bandwidth (MHz)		0.164 MHz	0.163 MHz	0.171 MHz
Voltage Variations	-15%	13.20 dBuV	--	26.30 dBuV
	+15%	13.10 dBuV	--	26.10 dBuV

NOTE: Field Strength measured with the EUT antenna length at 9.56" (24.5cm).

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 Rolls Corporation to provide documentation for the testing described herein. This equipment has been tested and found to comply with part 15.239 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: Rolls HR70 FM Broadcast Transmitter

Model: HR70

Serial No.: 2019727

Firmware: V 2.0

Hardware: V 2.0

FCC ID: **K48HR70**

5.2 Trade Name:

Rolls Corporation

5.3 Power Supply:

AC Adapter YJS015E-1500500U

5.4 Applicable Rules:

CFR 47, Part 15.239, subpart C

5.5 Equipment Category:

FM Transmitter

5.6 Antenna:

Wire Antenna, 0dBi Gain

5.7 Accessories: None

5.8 Test Item Condition:

The equipment to be tested was received in good condition.

5.9 Testing Algorithm:

EUT was tested at 88.3, 98.1 and 107.7 MHz in the FM Broadcast band. EUT was set with FM modulation at 12.5 kHz audio tone. Antenna length was adjusted until the field strength was compliant.

**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	2022-03-09
Temp/Hum. Recorder	CL263	Extech	445814	06	2022-03-19
Receiver	CL151	Rohde & Schwarz	ESU40	100319	2021-10-06
Low Loss Cable Set	--	Pasternack	PE3C0666-252 / PE3C066-50CM	None Spec.	2023-10-12
Pre-Amplifier	CL153	Keysight Tech.	83006A	MY39500791	2022-02-12
Pre-Amplifier	CL285	Com-Power	PAM-0207	322	2021-11-04
Active 18" Loop Antenna	CL163-Loop	A.H. Systems, Inc.	EHA-52B	100	2021-10-15
Antenna, JB3 Combination	CL175	Sunol Sciences	JB3	A030315	2021-11-05
Horn Antenna	CL098	Emco	3115	9809-5580	2022-01-08
Software:	Tile Version 3.4.B.3		Software Verified: 2021-03-18 to 2021-03-19		
Software:	EMC 32, Version 8.53.0		Software Verified: 2021-03-18 to 2021-03-19		
Spectrum Analyzer	0141	Hewlett Packard	8591E	3520A04145	2021-02-17
Transient Limiter	0202	Hewlett Packard	11947A	3107A00729	2020-11-30
Software:	Tile Version 3.4.B.3.		Software Verified: 2020-11-09		
LISN	CL181	Com-Power	LI-125A	191226	2020-11-30
LISN	CL182	Com-Power	LI-125A	191225	2020-11-30



7 FCC PART 15.215(e), OCCUPIED BANDWIDTH

7.1 Requirements:

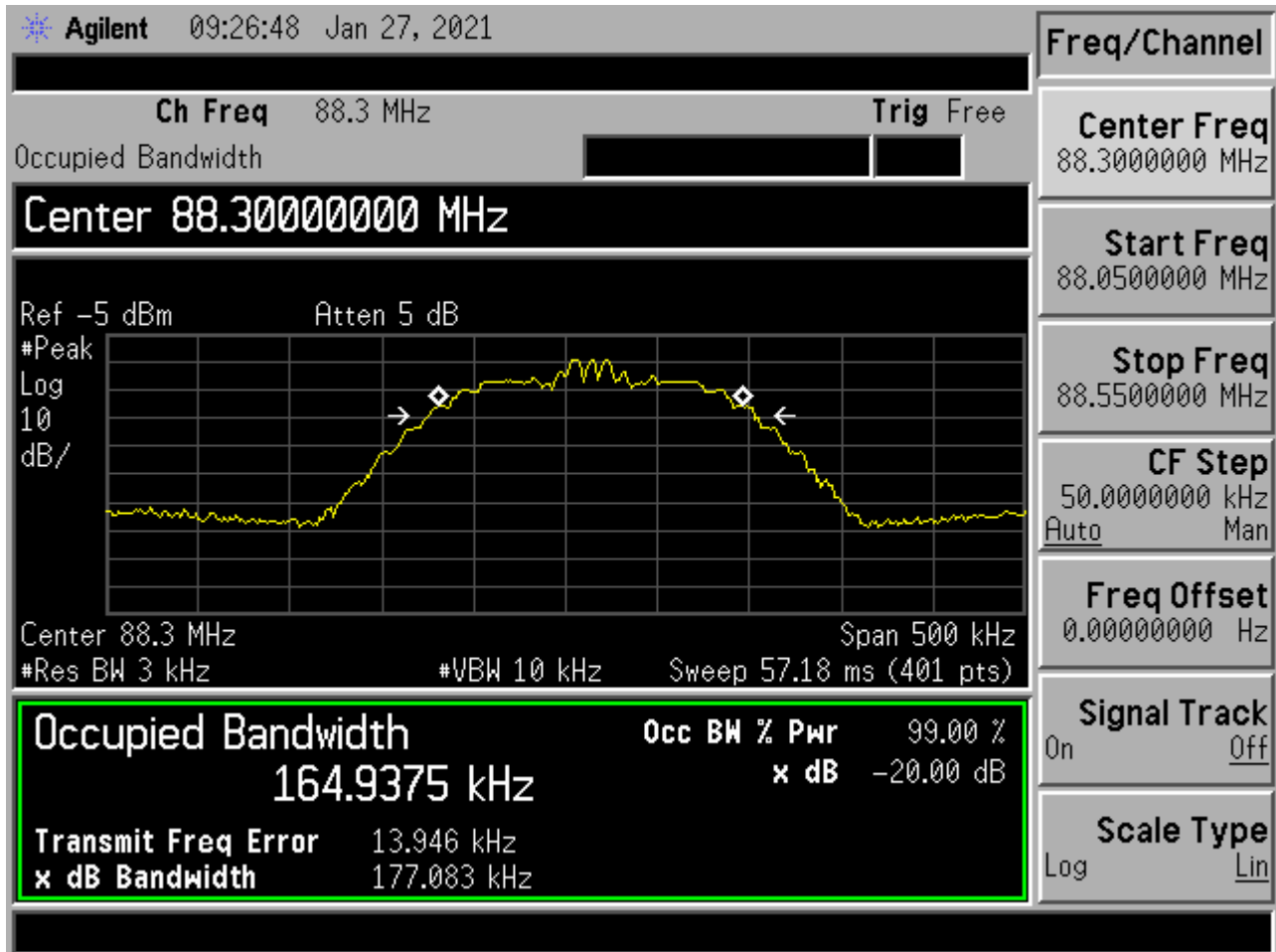
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the -20dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific 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.

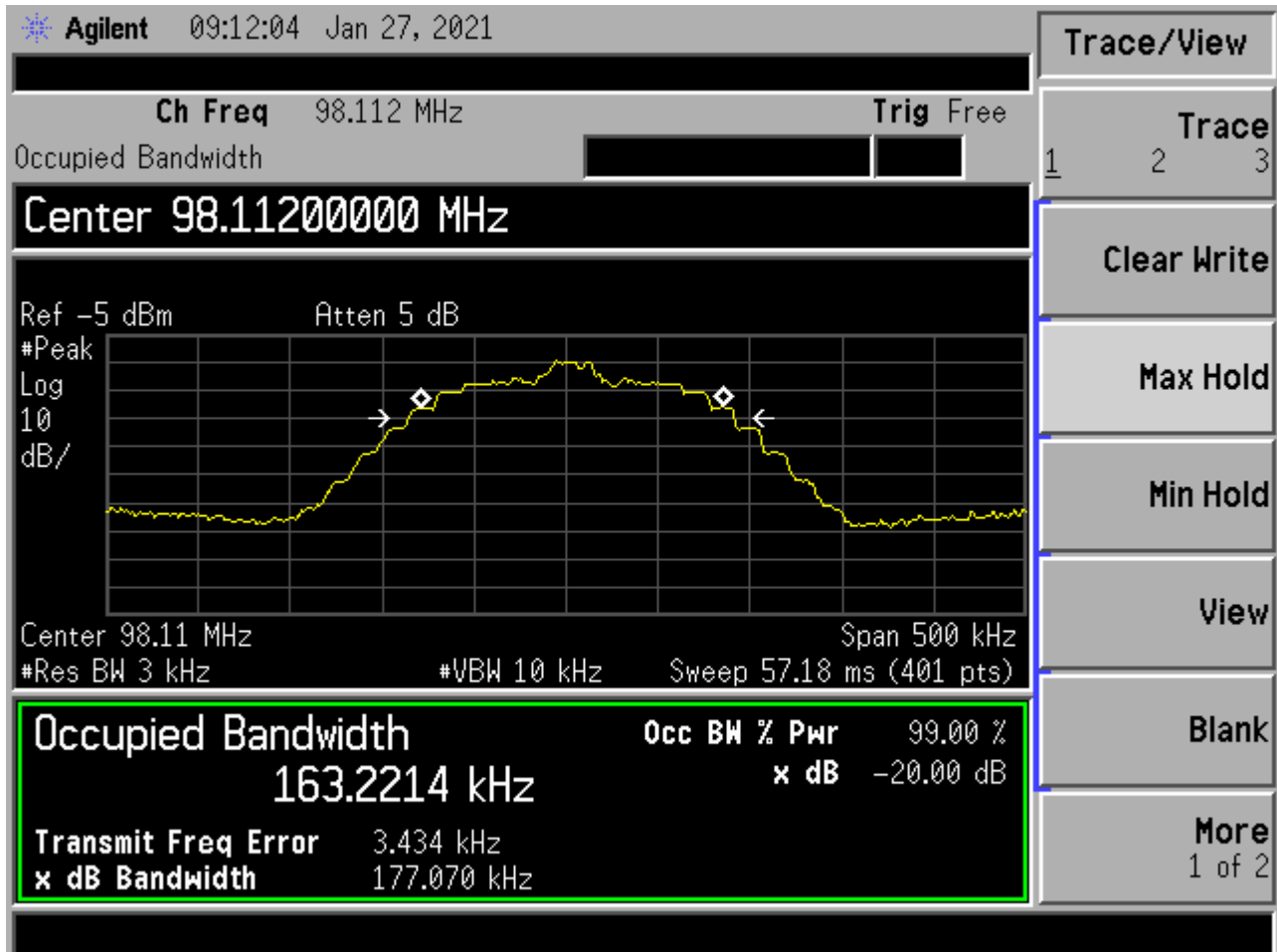
Bandwidth measurements were made at the low (88.3 MHz), mid (98.1 MHz) and upper (107.7 MHz) frequencies. The bandwidth was measured using the analyzer's marker function.

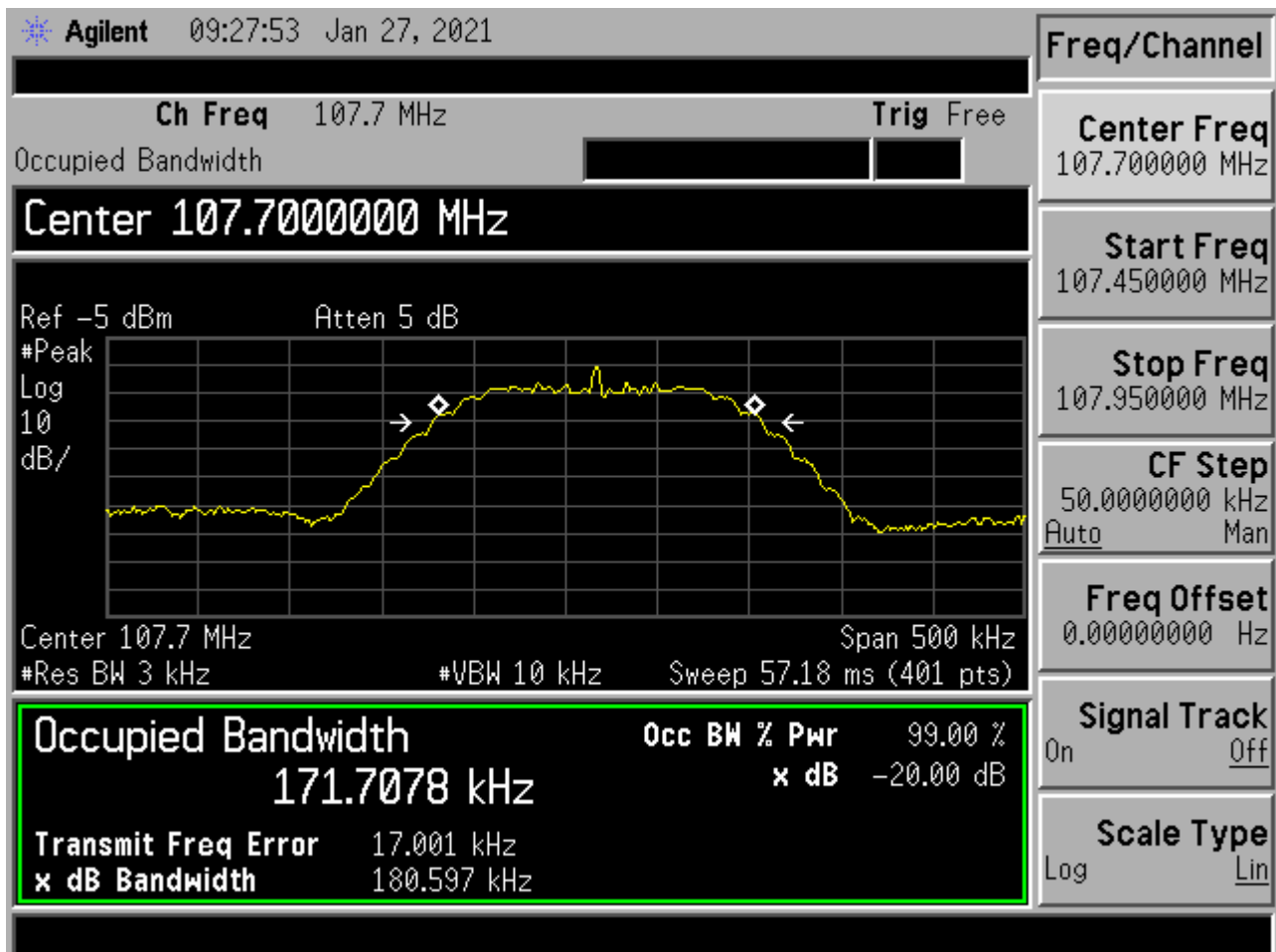
7.2 Occupied Bandwidth Test Data

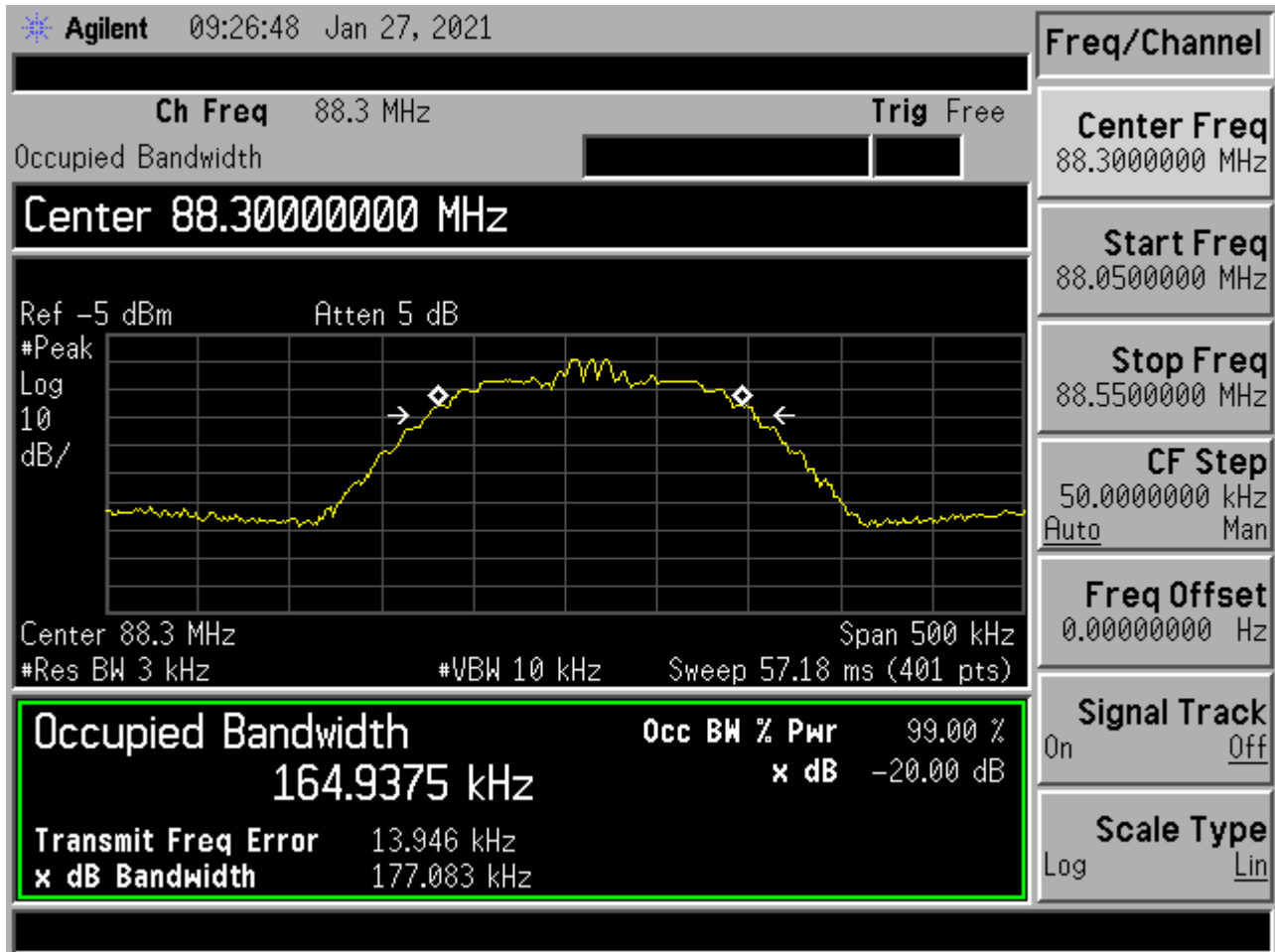
Test Date(s):	2021-01-27	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.215(c)	Air Temperature:	22.1°C
		Relative Humidity:	38%

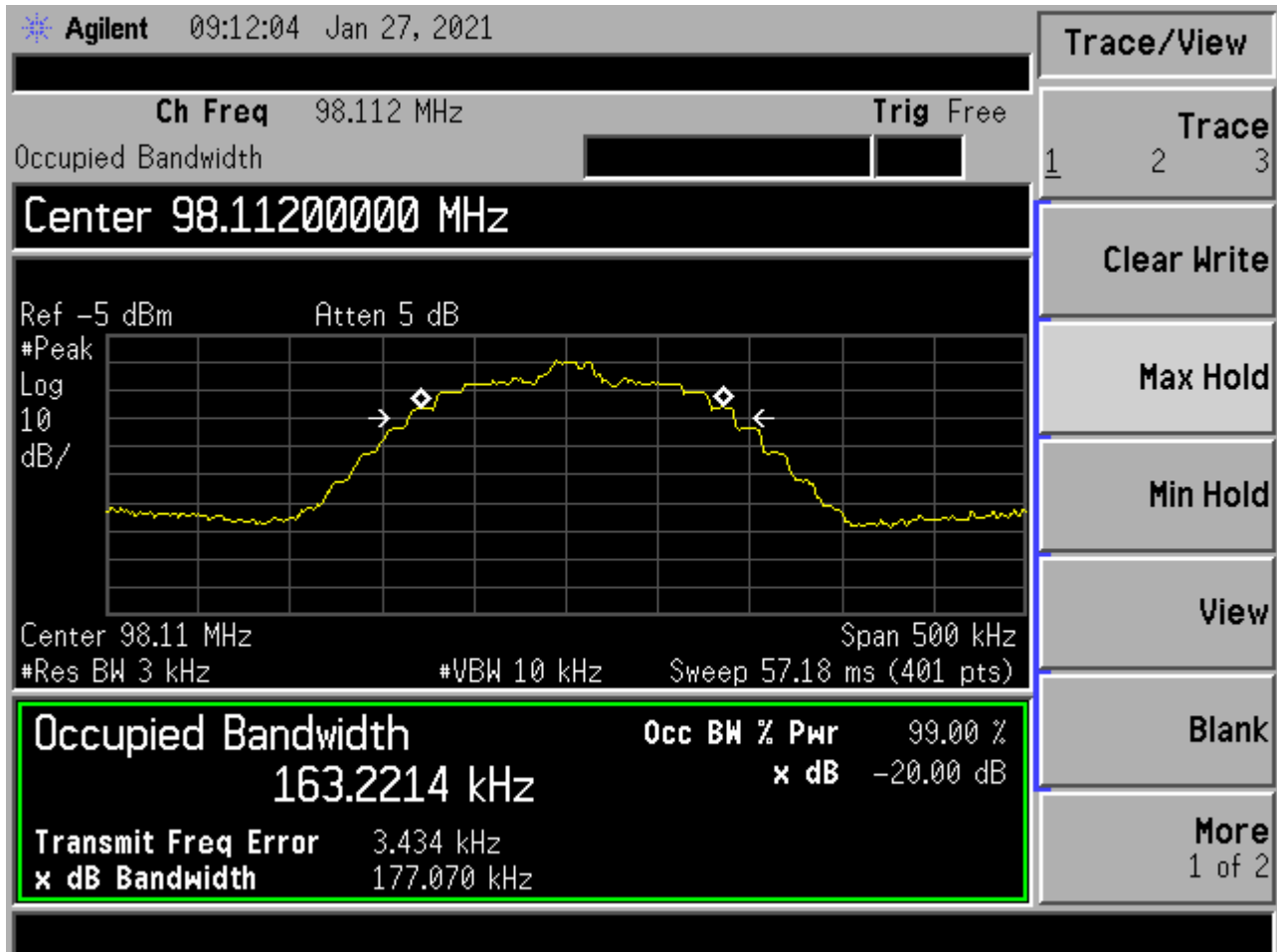
-20dB, Low Channel

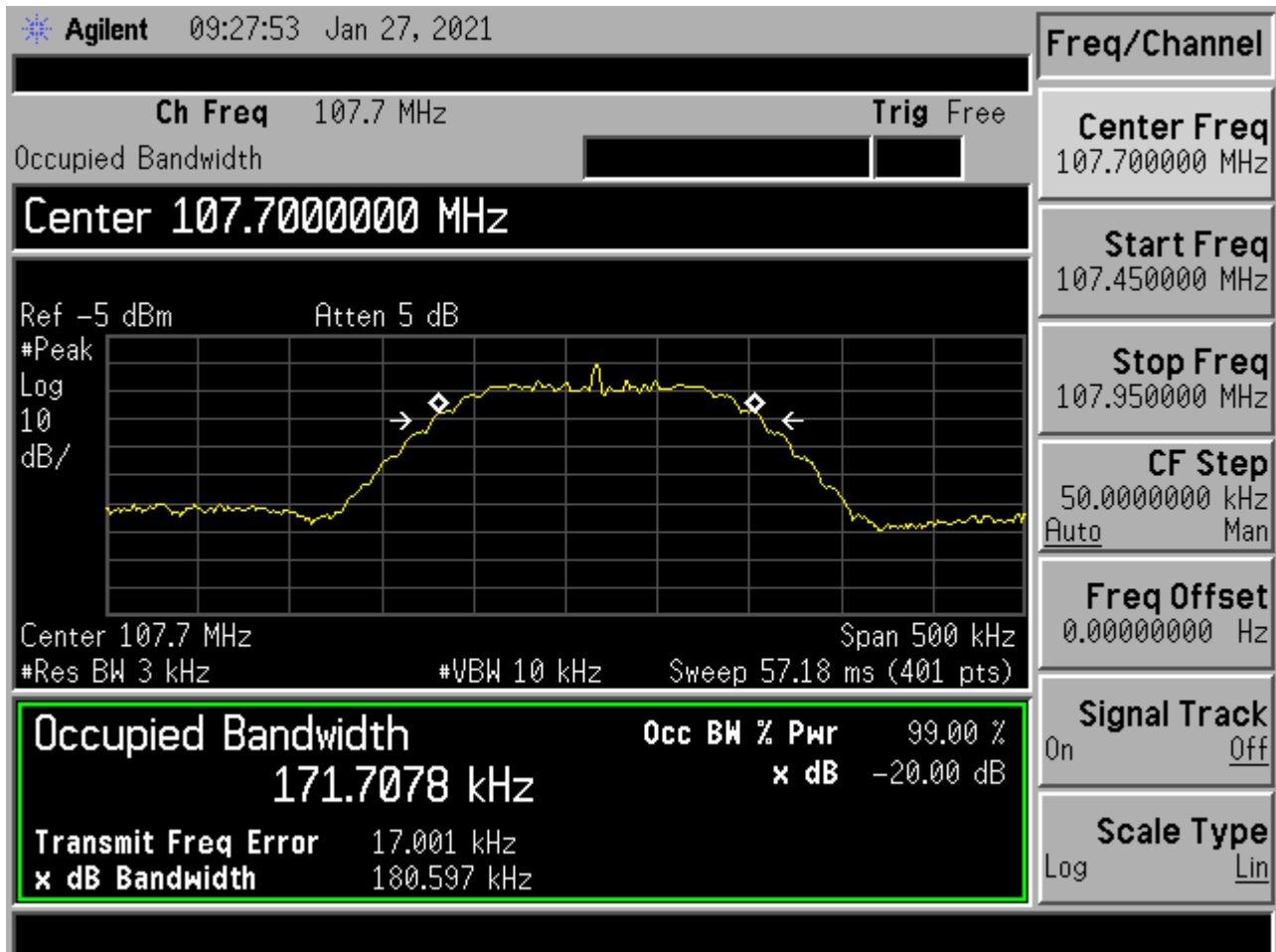


**-20dB, Mid Channel**

**-20dB, High Channel**

**-20dB/99%, Low Channel**

**-20dB/99%, Mid Channel**

**-20dB/99%, High Channel**



8 15.239 Operation in the band 88-108 MHz

(b) The field strength of any emissions within the permitted 200 kHz band shall not exceed 250 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

(c) The field strength of any emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed the general radiated emission limits in §15.209.

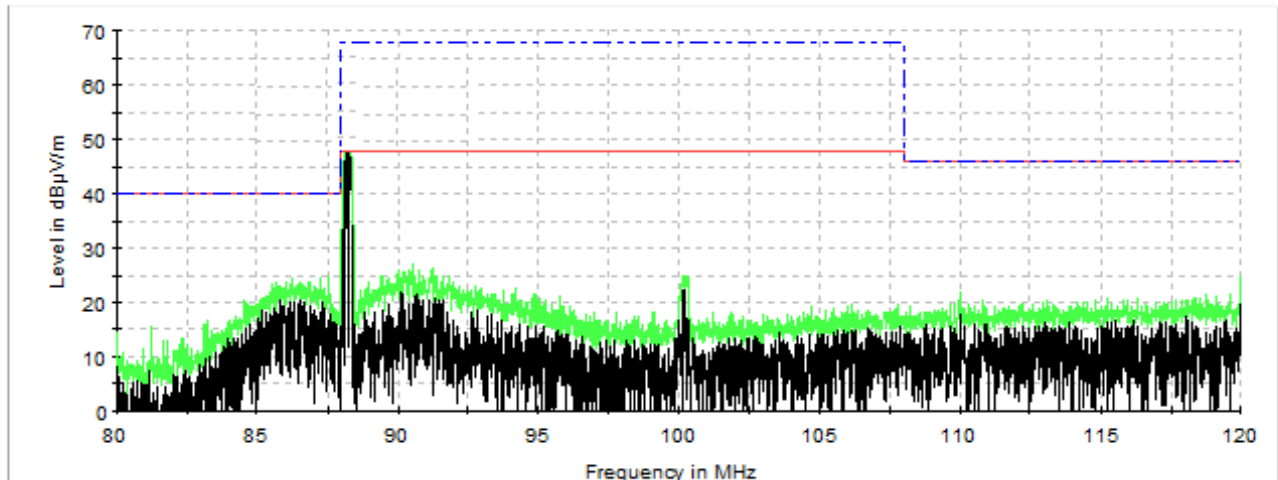
NOTE: During the scan evaluation, the EUT was rotated in all orthogonal positions to find the maximum emissions. The orthogonal position that showed the highest emissions was used. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions.



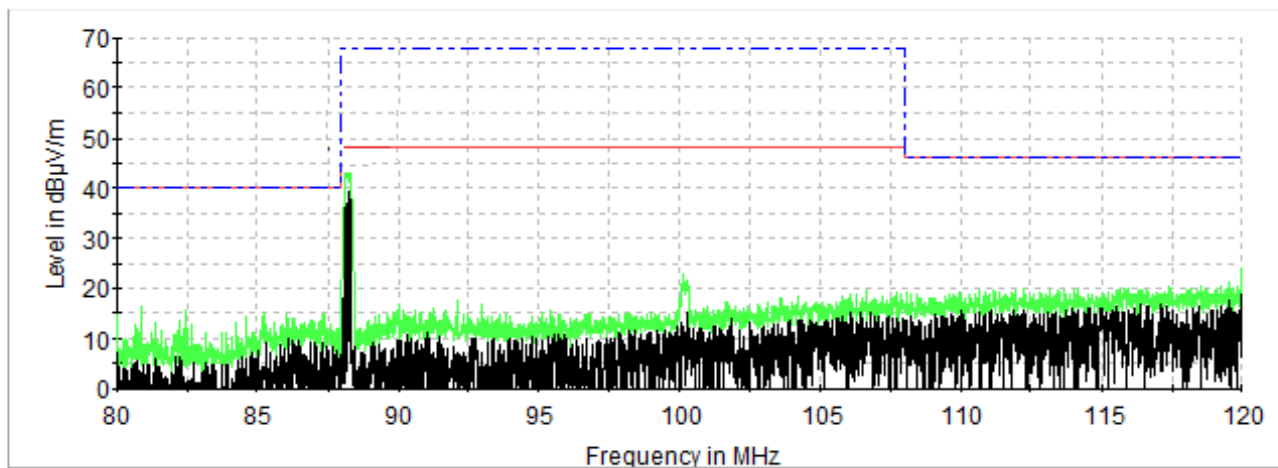
8.1 Test Data - Field Strength of Emissions from Intentional Radiators

Test Date(s):	2021-03-18	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.239(a)	Air Temperature:	24.2°C
		Relative Humidity:	37%

Low Channel, Band Edges: Vertical

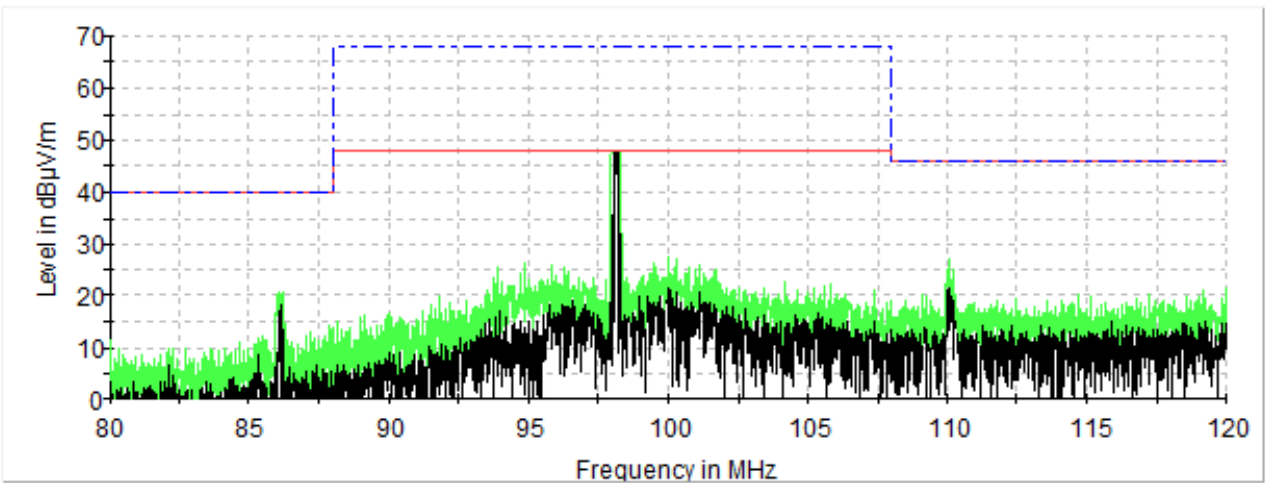


Low Channel, Band Edges: Horizontal

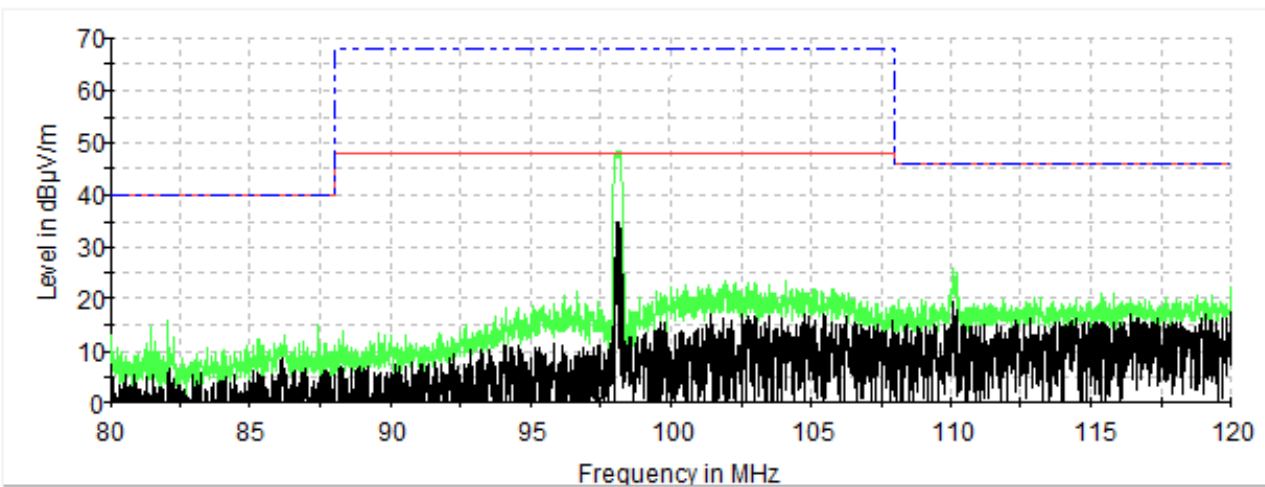




Mid Channel, Band Edges: Vertical

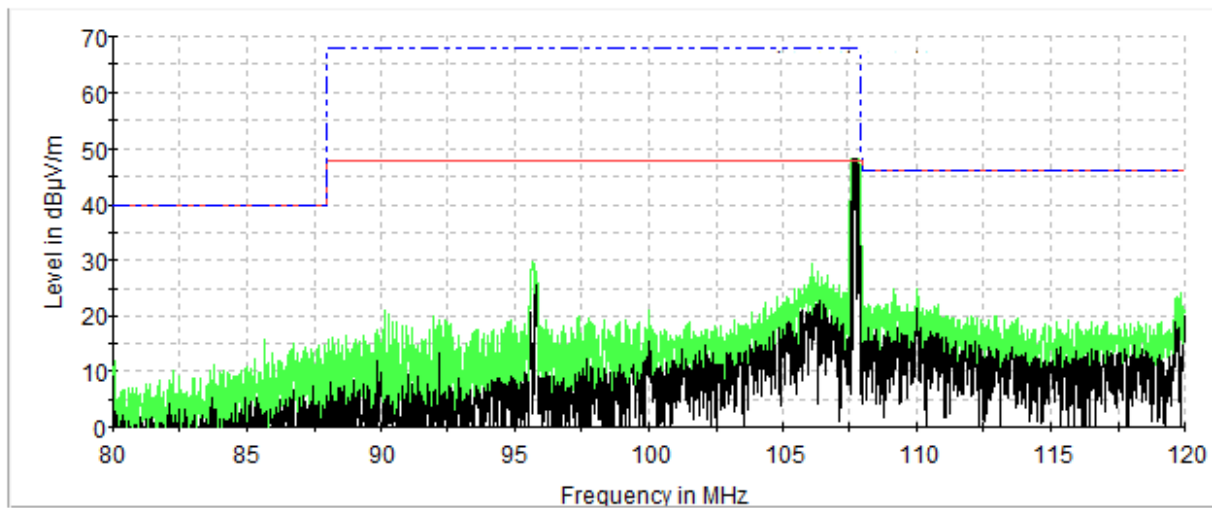


Mid Channel, Band Edges: Horizontal

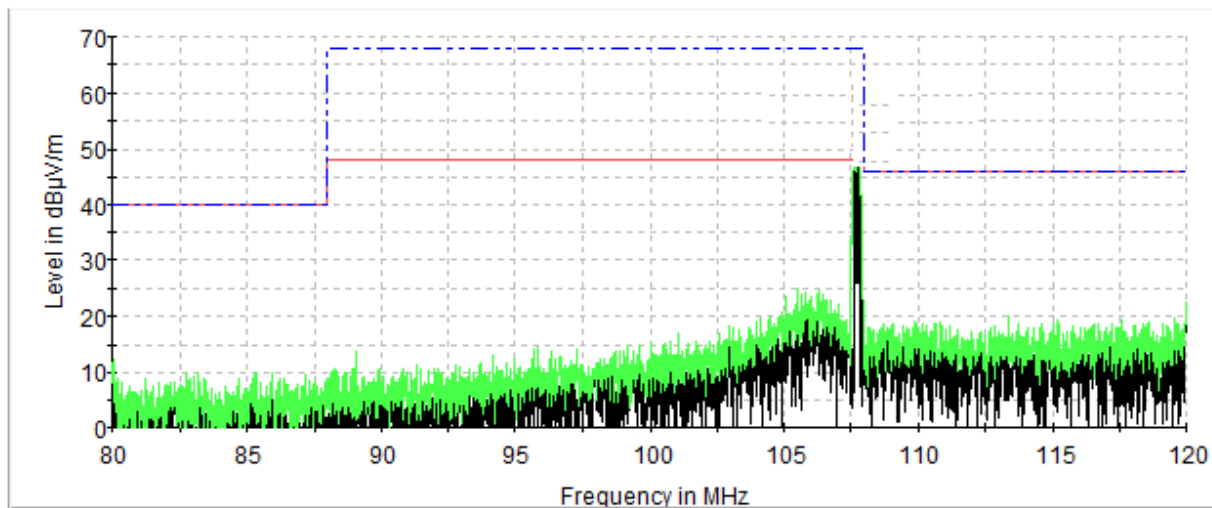




High Channel, Band Edges: Vertical



High Channel, Band Edges: Horizontal





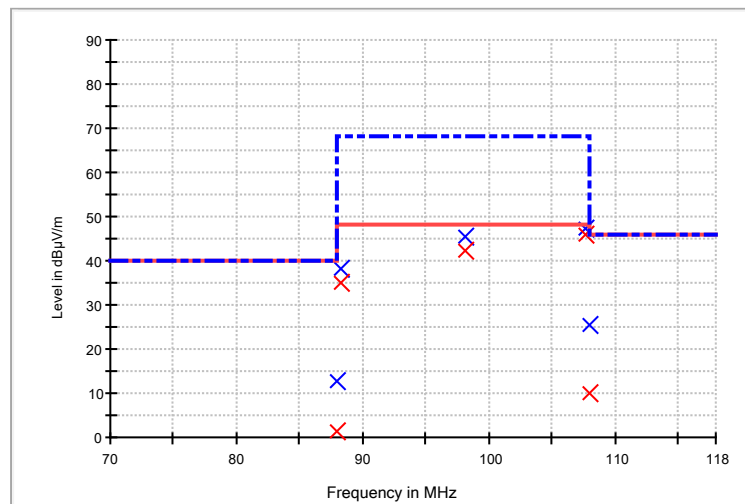
Band Edge and Field Strength of the Fundamentals

MaxPeak

Frequency (MHz)	Antenna Polarization	Bandwidth (kHz)	Antenna Height (cm)	Azimuth (deg)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
88.00	V	120.00	100.00	0.00	27.9	-15.0	12.90	40.0	-27.1
88.30	V	120.00	100.00	1.00	53.1	-15.0	38.10	40.0	-1.9
98.10	V	120.00	100.00	0.00	58.1	-12.7	45.40	48.0	-2.6
107.70	V	120.00	100.00	0.00	57.3	-9.9	47.40	48.0	-0.6
108.00	V	120.00	100.00	0.00	35.4	-9.8	25.60	46.0	-20.4

AVG

Frequency (MHz)	Antenna Polarization	Bandwidth (kHz)	Antenna Height (cm)	Azimuth (deg)	Reading (dBμV)	Cable Loss & Antenna Factor (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
88.00	V	120.00	100.00	0.00	16.5	-15.0	1.50	48.0	-46.5
88.30	V	120.00	100.00	1.00	50.1	-15.0	35.10	48.0	-12.9
98.10	V	120.00	100.00	0.00	55.0	-12.7	42.30	48.0	-5.7
107.70	V	120.00	100.00	0.00	55.7	-9.9	45.80	48.0	-2.2
108.00	V	120.00	100.00	0.00	19.8	-9.8	10.00	46.0	-36.0





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.

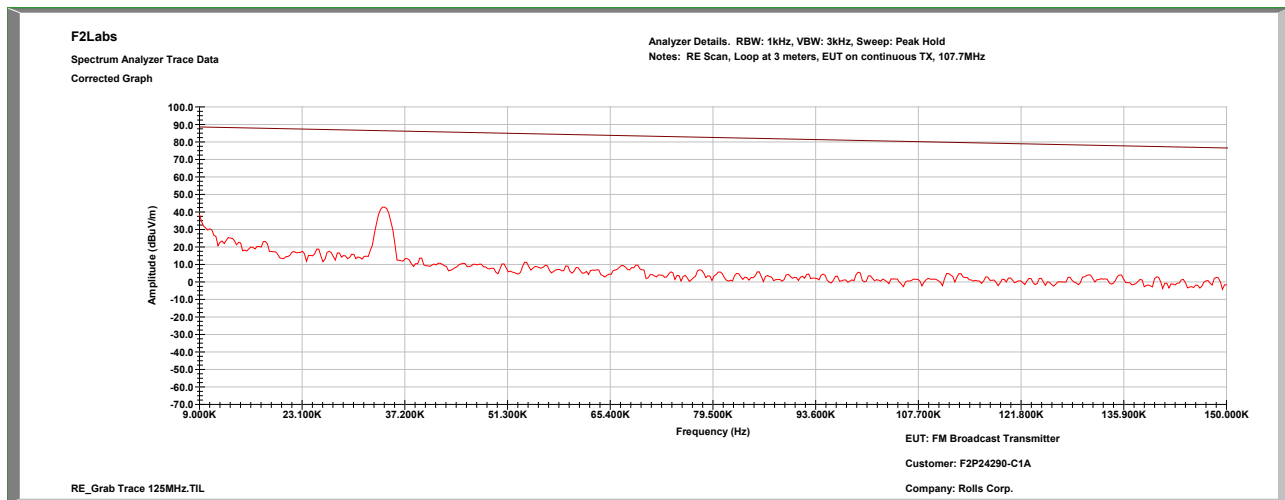
At least 6 of the highest frequencies were measured per ANSI 63.4 in a 3-meter anechoic chamber. Frequencies below 1 GHz were measured using a quasi-peak detector. The antenna was raised between 1 and 4 meters and the EUT turntable was rotated 360 degrees to maximize the emissions. Some of the frequencies 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 3 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.

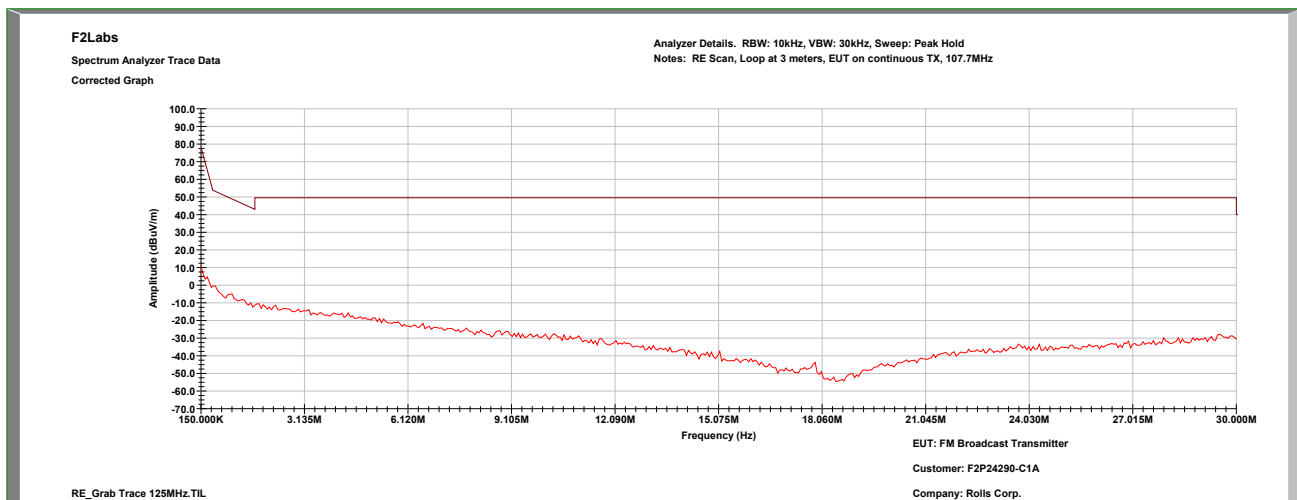


Test Date(s):	2021-03-19	Test Engineer(s):	J. Chiller
Standards:	CFR 47 Part 15.239(d) / Part 15.209	Air Temperature:	24.3°C
		Relative Humidity:	28%

Characterization Scan, 9 kHz to 150 kHz

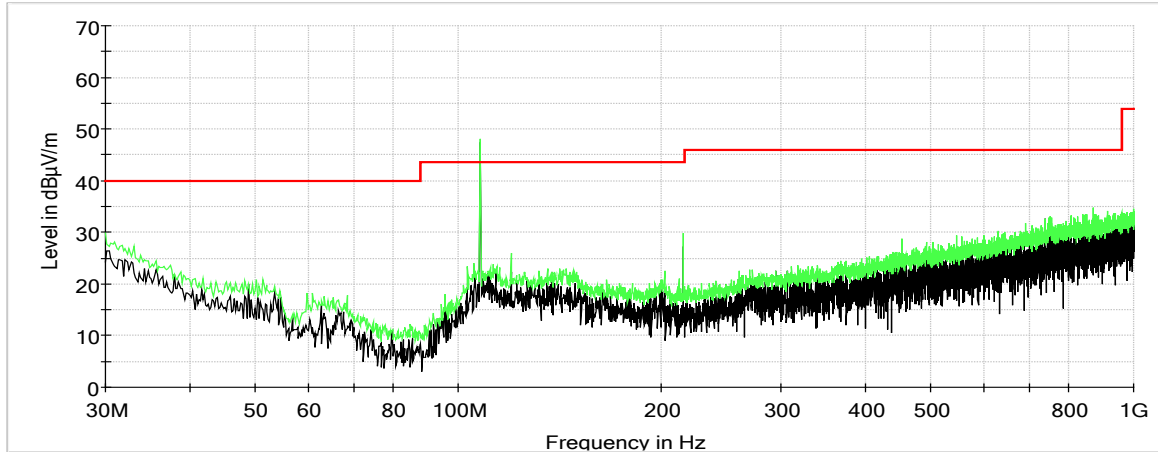


Characterization Scan, 150 kHz to 30 MHz

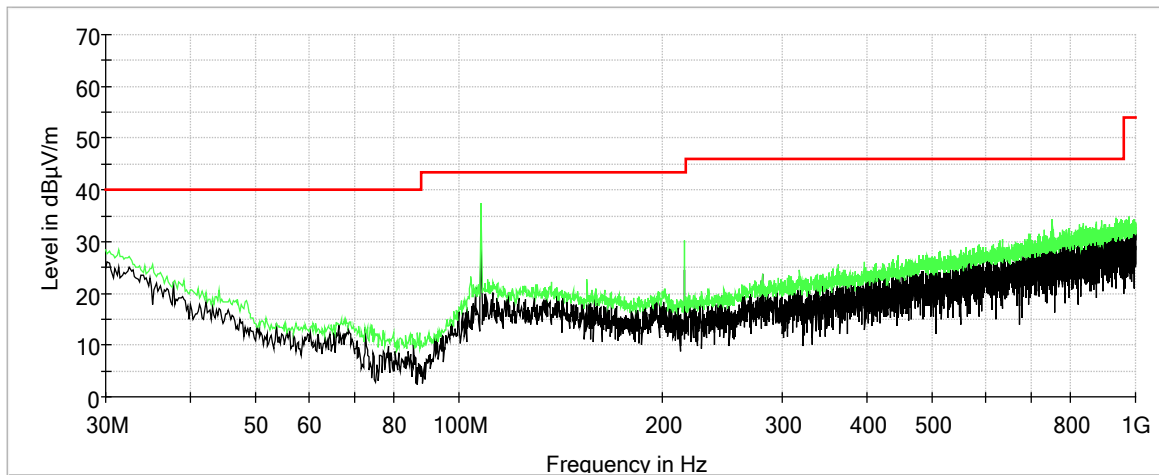




Characterization Scan, 30 MHz to 1000 MHz, Vertical

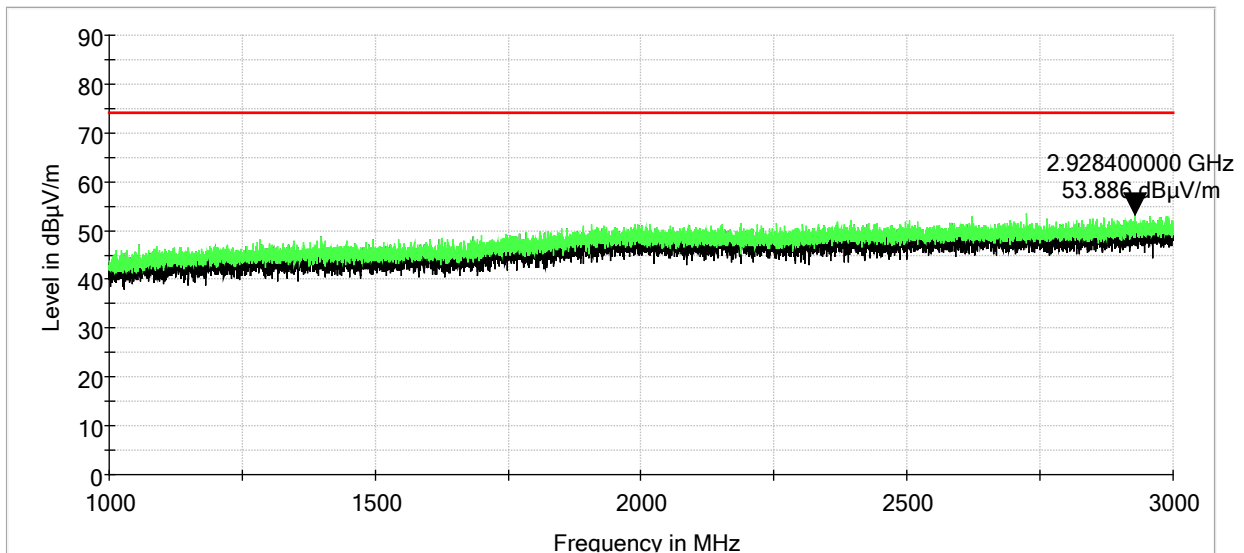


Characterization Scan, 30 MHz to 1000 MHz, Horizontal

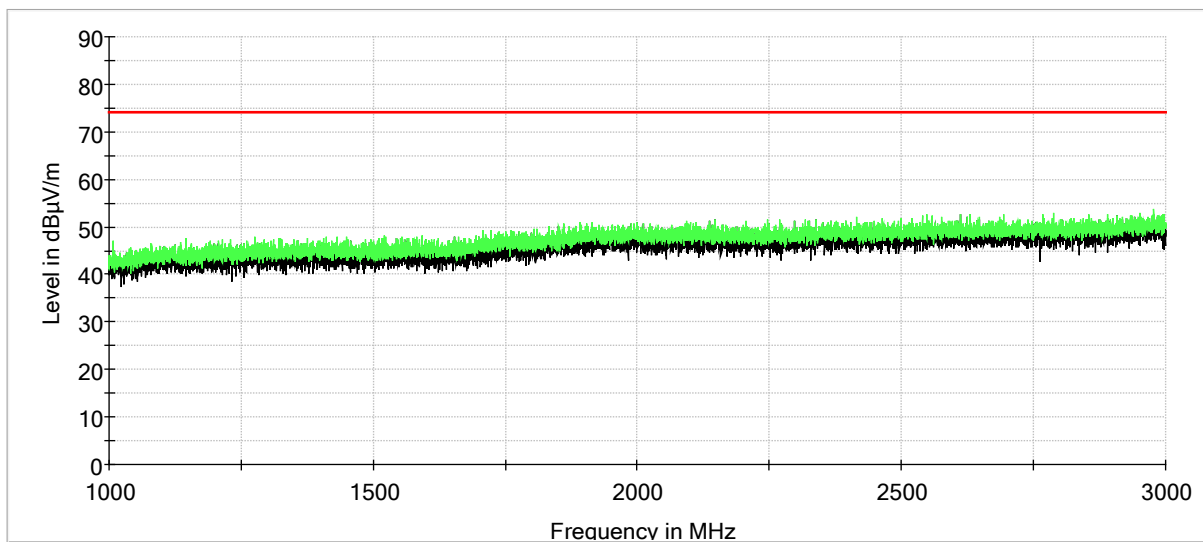




Characterization Scan: 1 GHz to 3 GHz, Vertical



Characterization Scan: 1 GHz to 3 GHz, Horizontal





7 VOLTAGE VARIATIONS

For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery. A nominal voltage of 110VAC was used.

RESULTS: The measurements were taken at the antenna connector using a conducted measurement to better show the fundamental frequency and its effect from the varied voltages. The results showed that the fundamental frequency did not move outside the frequency band and the field strength did not increase above the limit during the variations.



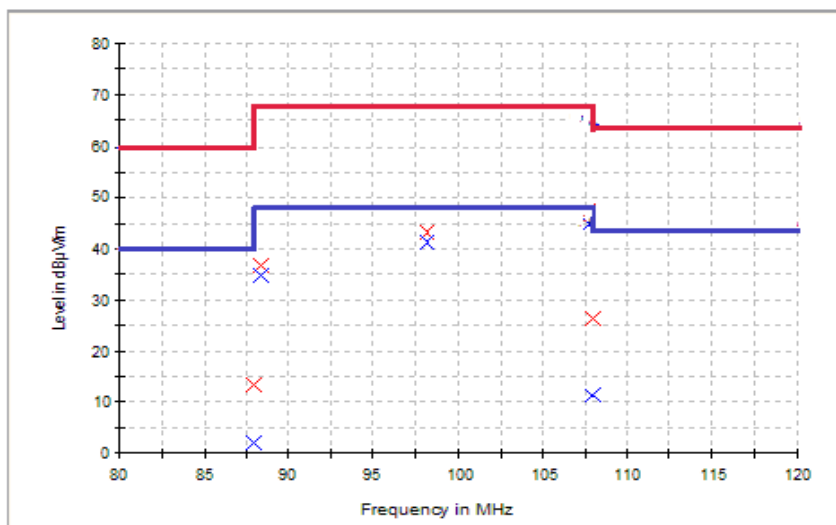
Test Date(s):	2021-05-12	Test Engineer:	J. Chiller
Rule:	CFR 47 Part 15.31(e)	Air Temperature:	23.7° C
Test Results:	Pass	Relative Humidity:	32%

85% - MaxPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV/m)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
88.000000	V	100.00	0.00	28.2	-15.0	13.20	60.0	-46.8
88.320000	V	100.00	0.00	51.9	-15.0	36.90	68.0	-31.1
98.120000	V	100.00	0.00	56.0	-12.7	43.30	68.0	-24.7
107.720000	V	100.00	0.00	57.0	-9.9	47.10	68.0	-20.9
108.000000	V	100.00	0.00	36.1	-9.8	26.30	63.5	-37.2

85% - AVG

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dBμV/m)	Correction Factors (dB)	Emission (dBμV/m)	Limit (dBμV/m)	Margin (dB)
88.000000	V	100.00	0.00	17.1	-15.0	2.1	40.0	-37.9
88.320000	V	100.00	0.00	49.7	-15.0	34.7	48.0	-13.3
98.120000	V	100.00	0.00	54.1	-12.7	41.4	48.0	-6.6
107.720000	V	100.00	0.00	54.9	-9.9	45.0	48.0	-3.0
108.000000	V	100.00	0.00	21.0	-9.8	11.2	43.5	-32.3



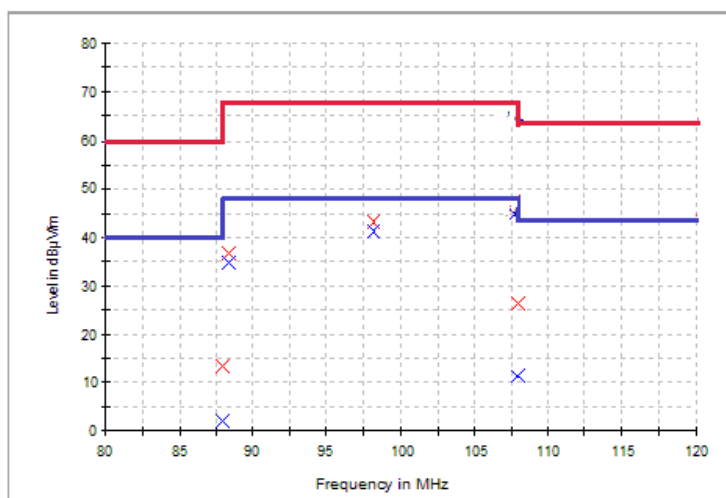


115% - MaxPeak

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dB μ V/m)	Correction Factors (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
88.000000	V	100.00	0.00	28.1	-15.0	13.1	60.0	-46.9
88.300000	V	100.00	0.00	53.4	-15.0	38.4	68.0	-29.6
98.100000	V	100.00	0.00	58.4	-12.7	45.7	68.0	-22.3
107.700000	V	100.00	0.00	57.2	-9.9	47.3	68.0	-20.7
108.000000	V	100.00	0.00	35.9	-9.8	26.1	63.5	-37.4

115% - AVG

Frequency (MHz)	Antenna Polarization	Antenna Height (cm)	Azimuth (degrees)	Reading (dB μ V/m)	Correction Factors (dB)	Emission (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
88.000000	V	100.00	0.00	16.9	-15.0	1.9	40.0	-38.1
88.300000	V	100.00	0.00	50.6	-15.0	35.6	48.0	-12.4
98.100000	V	100.00	0.00	55.0	-12.7	42.3	48.0	-5.7
107.700000	V	100.00	0.00	55.3	-9.9	45.4	48.0	-2.6
108.000000	V	100.00	0.00	21.1	-9.8	11.3	43.5	-32.2





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.

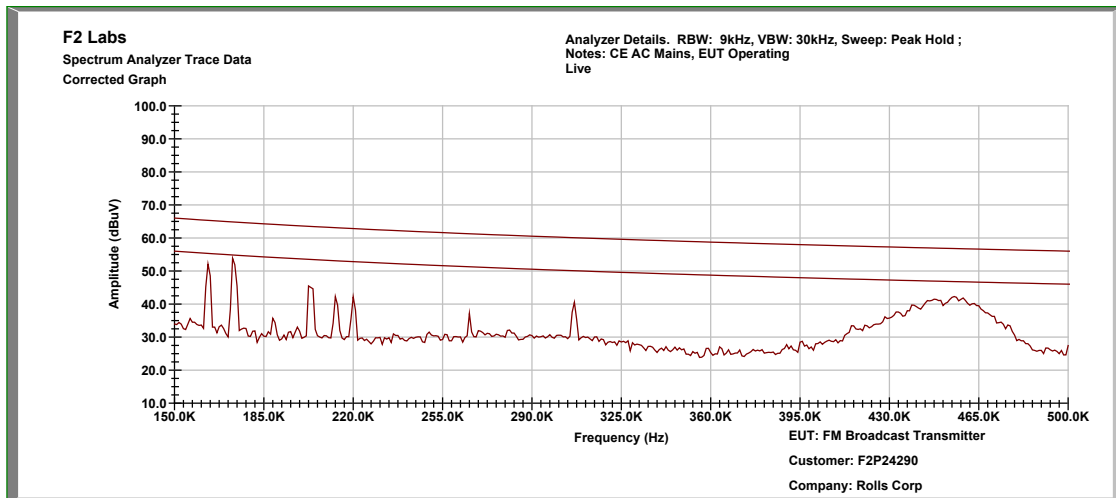


9.3 Conducted Emissions Test Data

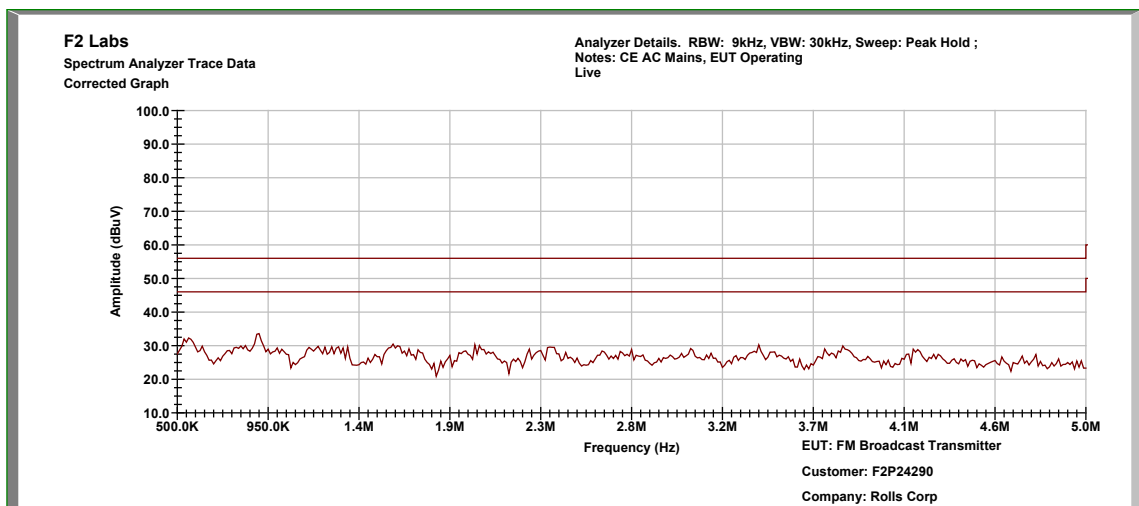
Test Date(s):	2020-11-09	Test Engineer:	R. Littell
Rule:	15.207	Air Temperature:	20.9° C
Test Results:	Complies	Relative Humidity:	36%

Note: The data below represents worst case results of all three channels.

Conducted Test – Live: 0.15 MHz to 0.5 MHz

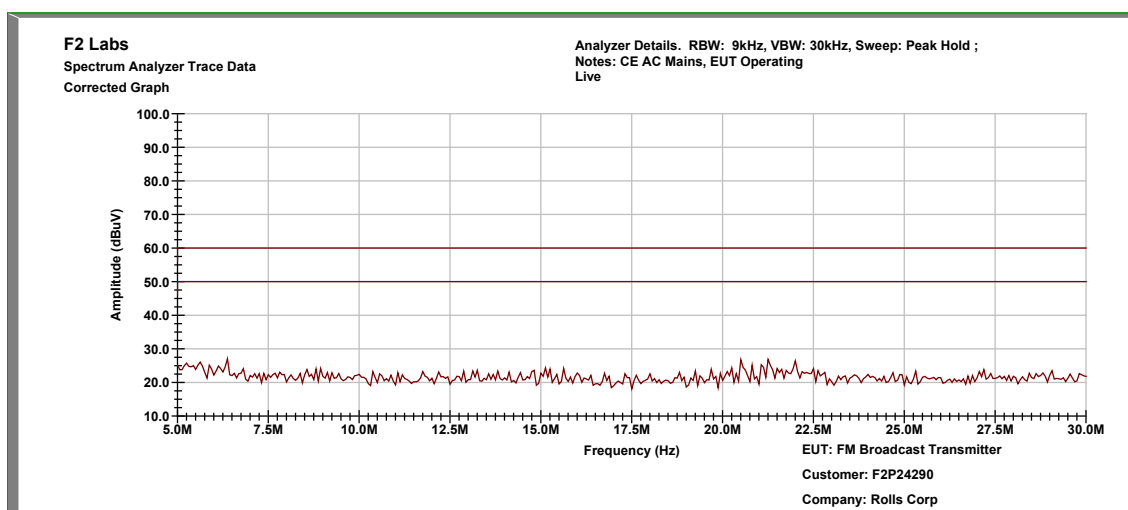


Conducted Test – Live: 0.5 MHz to 5.0 MHz





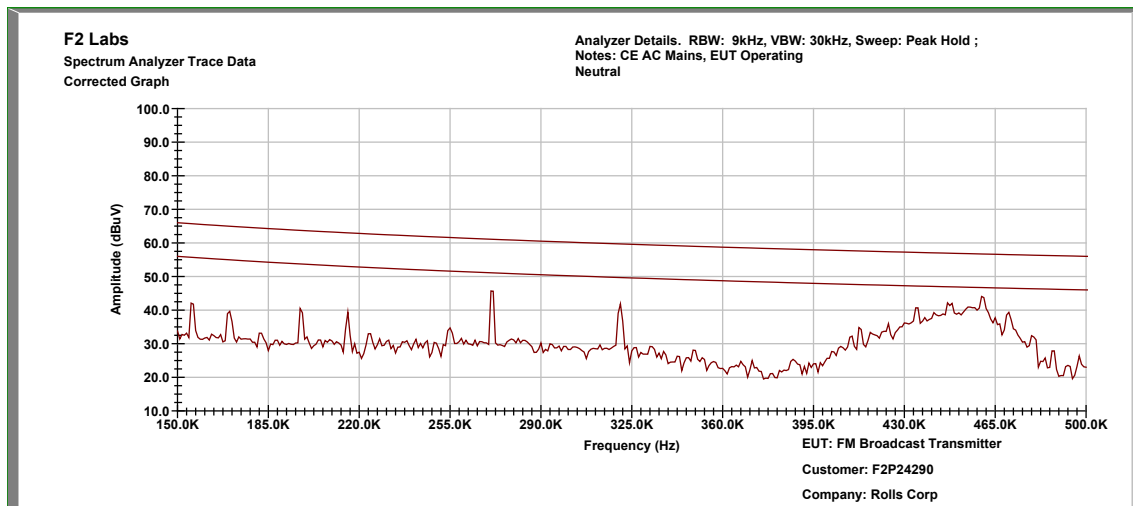
Conducted Test – Live: 5.0 MHz to 30.0 MHz



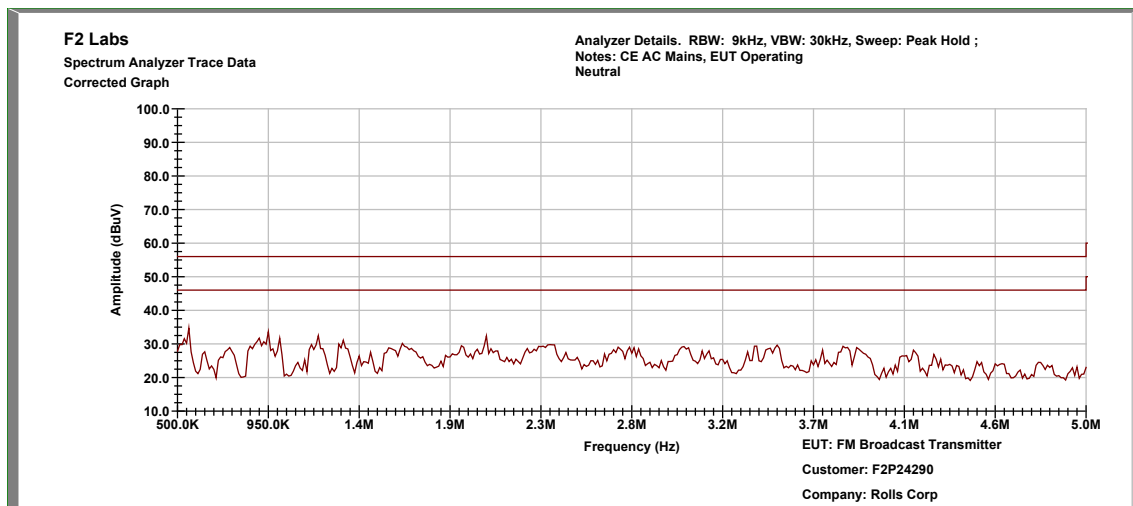
Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBμV)	Adjustment (dB)	Results (dBμV)	Limit (dBμV)	Margin (dB)
1	Live	0.163125	Quasi-Peak	21.67	11.030	32.70	65.304	-32.6
			Average	6.68	11.030	17.71	55.304	-37.6
2	Live	0.17275	Quasi-Peak	18.90	10.949	29.85	64.828	-35.0
			Average	5.97	10.949	16.92	54.828	-37.9
3	Live	0.455375	Quasi-Peak	27.95	10.278	38.23	56.776	-18.5
			Average	23.93	10.278	34.21	46.776	-12.6

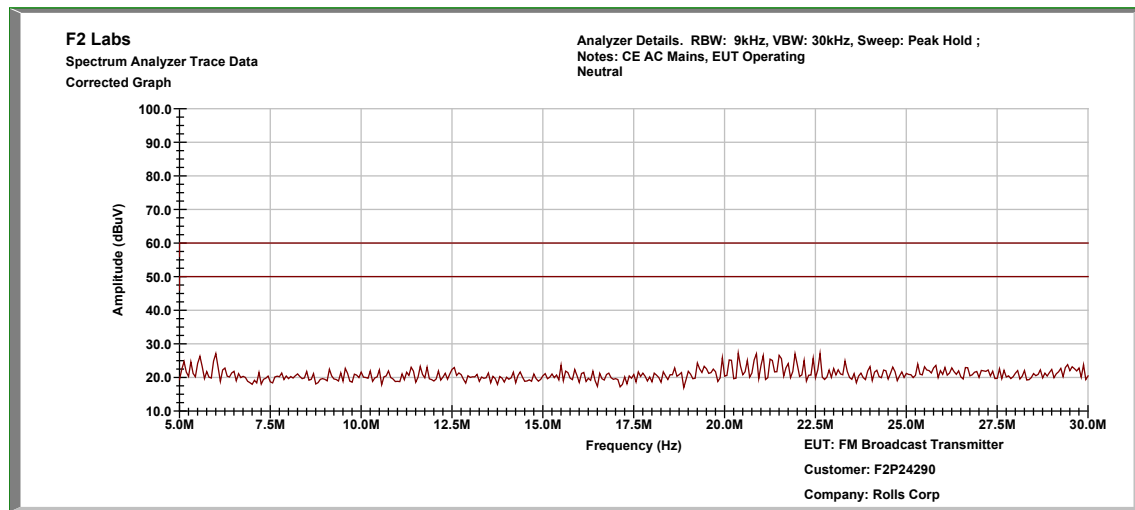


Conducted Test – Neutral: 0.15 MHz to 0.5 MHz



Conducted Test – Neutral: 0.5 MHz to 5.0 MHz



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

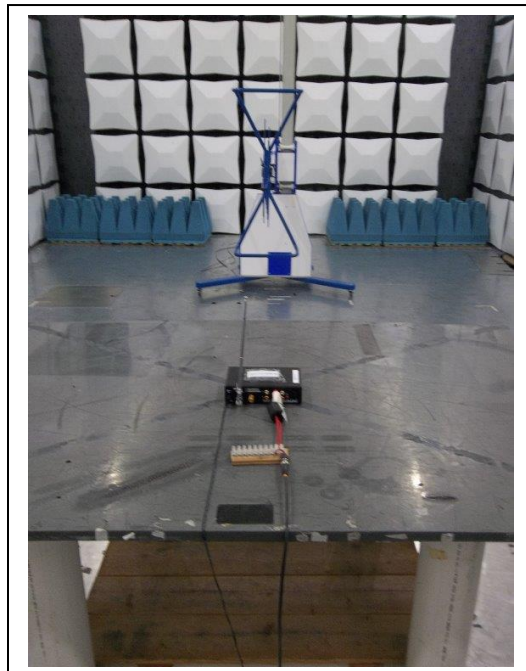
Top Discrete Measurements								
No.	Conductor	Frequency (MHz)	Detector	Level (dBμV)	Adjustment (dB)	Results (dBμV)	Limit (dBμV)	Margin (dB)
1	Neutral	0.460625	Quasi-Peak	29.1	10.090	39.19	56.682	-17.5
			Average	17.14	10.090	27.23	46.682	-19.5

10 PHOTOGRAPHS - TEST SETUPS

Radiated Spurious Emissions: 0.009 MHz to 0.15 MHz

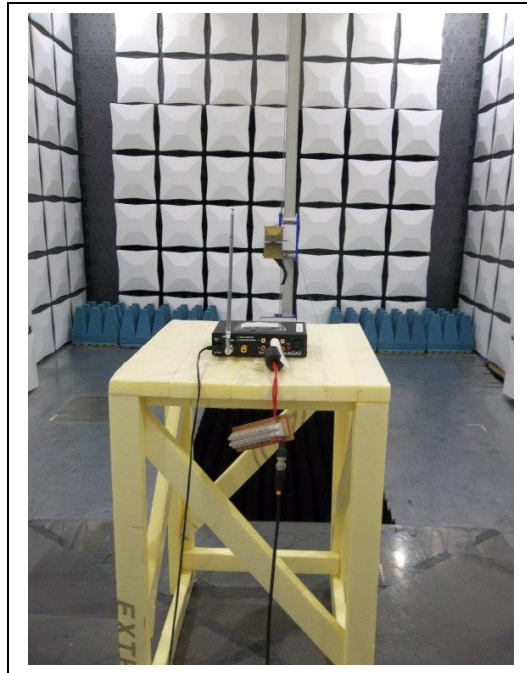


Radiated Spurious Emissions: 30 MHz to 1000 MHz



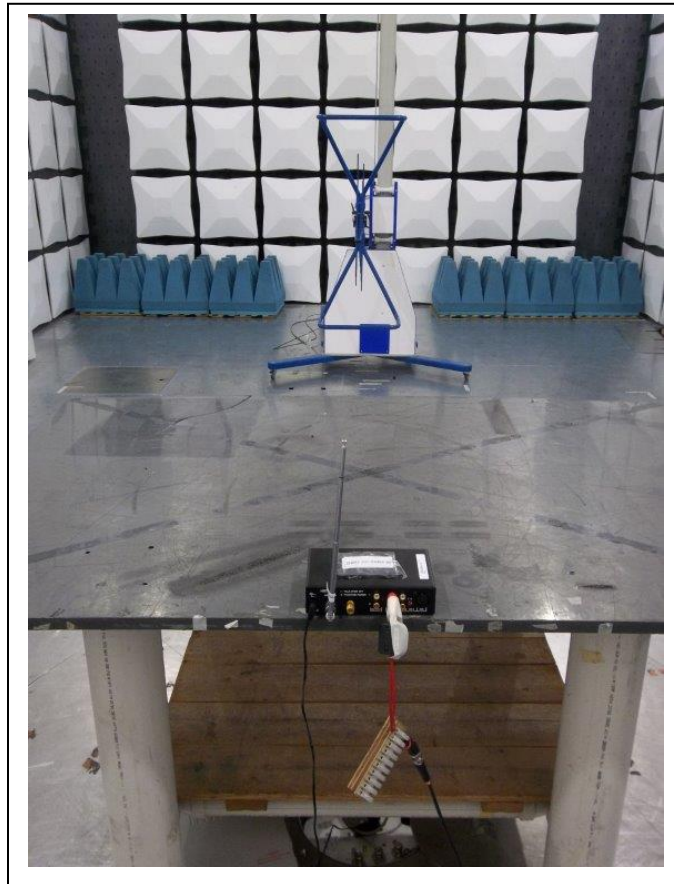


Radiated Spurious Emissions: 1 GHz to 3 GHz





Occupied Bandwidth



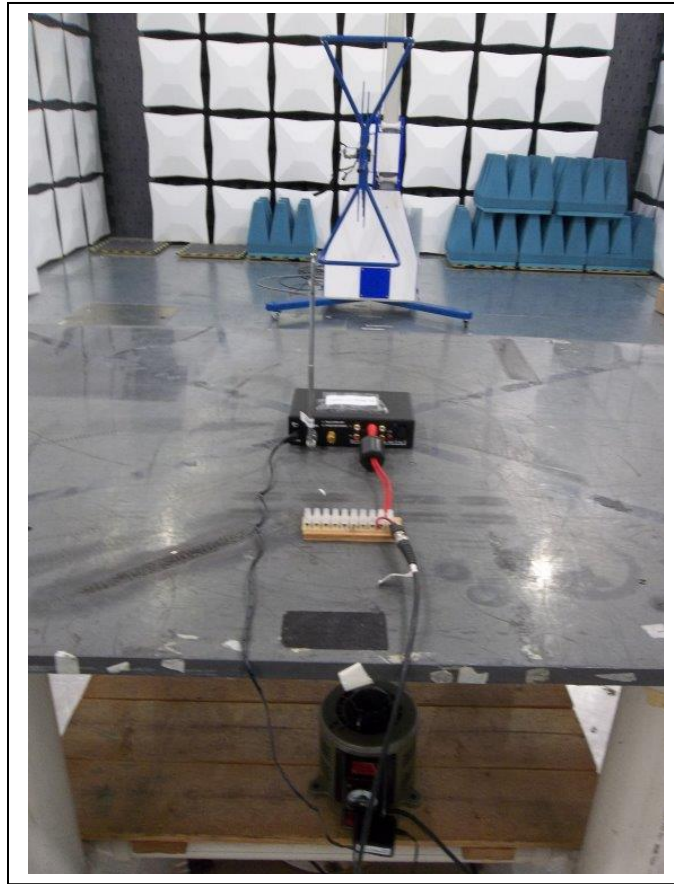


Field Strength of Emissions





Voltage Variations





Conducted Emissions

