HEADQUARTERS: 914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230 • PHONE (410) 354-3300 • FAX (410) 354-3313

May 12, 2021

NoiseAware
2800 Routh St, Suite 215
Dallas, TX 75201

Dear Jake Umbrage,

Enclosed is the EMC Wireless test report for compliance testing of the NoiseAware, Gen3.1 Collector as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), FCC Part 15 Subpart C for Intentional Radiators.

Thank you for using the services of Eurofins Electrical and Electronic Testing NA, Inc. If you have any questions regarding these results or if Eurofins Electrical and Electronic Testing NA, Inc. can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS ELECTRICAL AND ELECTRONIC TESTING NA, INC.

Michelle Tawmging

Michelle Tawmging
Documentation Department

Reference: (\NoiseAware\WIRA111308A-FCC247 DSS Rev. 1)

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TESTING CERT #0591.06

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Eurofins Electrical and Electronic Testing NA, Inc. is part of the Eurofins Electrical & Electronics (E&E) global compliance network.

Electromagnetic Compatibility Criteria
Test Report

for the

NoiseAware
Gen3.1 Collector

Tested under
the FCC Certification Rules
contained in
Title 47 of the CFR, Parts 15 Subpart C
15.247 for Intentional Radiators

Report: WIRA111308A-FCC247 DSS Rev. 1

May 12, 2021

Prepared For:

NoiseAware
2800 Routh St, Suite 215
Dallas, TX 75201

Prepared By:
Eurofins Electrical and Electronic Testing NA, Inc.
13501 McCallen Pass, Austin, TX 78753

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Electromagnetic Compatibility Criteria
Test Report

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15.247 for Intentional Radiators

Adan Arab, Project Engineer
Electromagnetic Compatibility Lab

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 under normal use and maintenance.

Jonathan Tavira,
Director, Electromagnetic Compatibility Lab

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Report Status Sheet

Revision	Report Date	Reason for Revision
∅	April 20, 2021	Initial Issue.
1	May 12, 2021	Implemented TCB Revisions.

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Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the NoiseAware Gen3.1 Collector, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Gen3.1 Collector. NoiseAware should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Gen3.1 Collector, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with NoiseAware, purchase order number 210108-1. All tests were conducted using measurement procedure ANSI C63.10-2013.

FCC Reference 47 CFR Part 15.247:2020	Description	Compliance
Title 47 of the CFR, Part 15 §15.203	Antenna Requirement	Complaint
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Complaint
Title 47 of the CFR, Part 15 §15.247(a)(1)	20 dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)(i)	Average Time of Occupancy (Dwell Time)	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)(i)	Number of RF Channels	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)(i)	RF Channel Separation	Compliant
Title 47 of the CFR, Part 15 §15.247(b)(2)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	Radiated Spurious Emissions	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	Spurious Conducted Emissions	Not Applicable
Title 47 of the CFR, Part 15 §15.247(g) & (h)	Declaration Statements for FHSS	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	Maximum Permissible Exposure (MPE)	Compliant

Figure 1: Executive Summary of EMC Part 15.247 ComplianceTesting

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Equipment Configuration

A. Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by NoiseAware to perform testing on the Gen3.1 Collector, under NoiseAware's purchase order number 210108-1.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the NoiseAware, Gen3.1 Collector`.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Gen3.1 Collector	
Model(s) Covered:	Gen3.1 Collector	
EUT Specifications:	Primary Power: 120VAC/60Hz	
	FCC ID: 2AQIP-NA3N301	
	Type of Modulations:	DHICF
	Equipment Code:	DSS
	Peak RF Output Power:	21.56 dBm
	EUT Frequency Ranges:	902-928 MHz
	Antenna Gain:	1 dBi
	Antenna Type:	Ceramic Chip
	EUT Software as tested:	Custom Software Version 2.0.0
	Support Software:	VNC Viewer
Analysis:	The results obtained relate only to the item(s) tested.	
Environmental Test Conditions:	Temperature: 15-35º C	
	Relative Humidity: 30-60%	
	Barometric Pressure: 860-1060 mbar	
Evaluated by:	Adan Arab	
Report Date(s):	May 12, 2021	

Figure 2: EUT Summary Table

B. References

CFR 47, Part 15, Subpart C	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
ANSI C63.4:2014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ISO/IEC 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
KDB 558074 v05r02	Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247

Figure 3: References

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C. Test Site

All testing was performed at Eurofins Electrical and Electronic Testing NA, Inc., 13501 McCallen Pass, Austin, TX 78753. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at Eurofins Electrical and Electronic Testing NA, Inc.

D. Measurement Uncertainty

Test Method	Typical Expanded Uncertainty	K	Confidence Level
RF Frequencies	±4.52 Hz	2	95%
RF Power Radiated Emissions	±3.01 dB	2	95%
Radiated Emissions, (30 MHz – 1 GHz)	±2.95 dB	2	95%
Radiated Emissions, (1 GHz – 18 GHz)	±3.54 dB	2	95%

Figure 4: Uncertainty Calculations Summary

E. Description of Test Sample

The NoiseAware Gen3.1 Collector, Equipment Under Test (EUT), is a WiFi-enabled noise monitoring device that mounts to most common US power outlets with an included screw. The device monitors volume levels and also acts as a gateway for the Outdoor Noise Sensor (Gen 3 Node), receiving data over Sub-1 GHz and relaying it over WiFi. It is intended to be used by professional property managers in indoor areas of short-term rental residences.

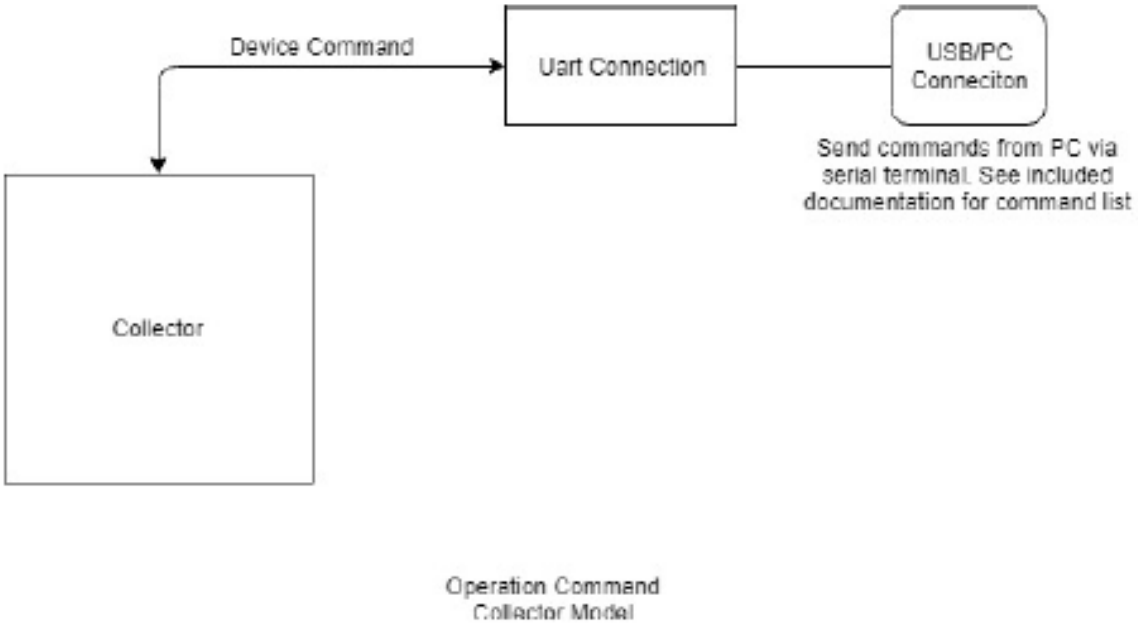

Figure 5: Block Diagram of Test Configuration

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F. Equipment Configuration

The EUT was set up as outlined in Figure 5, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Slot #	Name / Description	Model Number	Part Number	Serial Number	Rev. #
1	N/A	Gen3.1 Collector	NA3N101	N/A	N/A	N/A

Figure 6: Equipment Configuration

G. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name/Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
1	Raspberry Pi	Raspberry Pii	B v1.1	N/A
2	Laptop	BOCCONI	N3350	N/A
3	Ethernet USB Adapter	BOCCONI	N/A	N/A
4	Outdoor Sensor	NoiseAware	NA3N102	N/A
The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.				

Figure 7: Support Equipment

H. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Desc. or reason for none	QTY	Length as tested (m)	Max Length (m)	Shielded?	Termination Box ID & Port Name
1	Power	Power adaptor	2	0.1	N/A	No	AC Mains
2	Pi 2 USB Port	USB	2	1	N/A	No	AC/DC Adapter
3	Pi 2 Ethernet port	Ethernet	1	0.5	N/A	No	Support PC

Figure 8: Port and Cabling Information

I. Mode of Operation

We will provide several samples that demonstrate the different modes. When you click the VNC Tool you will see multiple icons corresponding to the provided different samples. When you click the outdoor shortcut, it opens the RF testing interface, choose executive terminal, the Menu has two working modes, choose SGIGA Test mode and you will see the EUT is flashed with a debug enabled firmware for testing. The EUT flashing is completed, these options will be available to change the Modulation, channels and enable or disable Hopping mode. When you choose a specific channel, modulation and power setting then click start will start the operation. These modes will be 902.2 MHz, 915MHz and 927.8 MHz single channels, Low, mid, High. Frequency hopping scan from 902-928. These modes can all be used to measure characteristics of the RF system during normal operation while stop will reset the sensor back to normal mode.

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J. Method of Monitoring EUT Operation

While the device is powered, the LED indicator at the rear of the device indicates two modes of operation: 1) During normal operation the LED is off. 2) During setup mode the LED will blink periodically to indicate it is broadcasting a discoverable AP. The LED will blink quickly and then turn off when device has been set up successfully. The device can be reset into setup mode by depressing the button on the side of the device.

K. Modifications

a) Modifications to EUT
No modifications were made to the EUT.

b) Modifications to Test Standard
No modifications were made to the test standard.

L. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to NoiseAware upon completion of testing.

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.203 Antenna Requirement

Test Requirement: **§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

Results: The EUT as tested is **compliant** the criteria of §15.203. Gen3.1 Collector Utilizes Integral Ceramic Chip Antenna which is not accessible to the end user with the gain of 1 dBi as declared by the manufacturer. The EUT is complaint with the provisions of section 15.203.

Antenna Gain	Antenna Type
1 dBi	Ceramic Chip Antenna

Figure 9: Antenna List

Test Engineer(s): Adan Arab

Test Date(s): March 16, 2021

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.207(a) Conducted Emissions Limits

Test Requirement(s): **§ 15.207 (a):** 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 30MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Σ 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 range (MHz)	§ 15.207(a), Conducted Limit (dBµV)	
	Quasi-Peak	Average
* 0.15 - 0.5	66 - 56	56 - 46
0.5 - 5	56	46
5 - 30	60	50

Figure 10: Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)

Note: *Decreases with the logarithm of the frequency.

Test Procedure: The EUT was placed on a 0.8m high non-conductive table. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 µH Line Impedance Stabilization Network (LISN). An EMI receiver, connected to the measurement port of the LISN. The EMI receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013*. All peak emissions close to the limit were re-measured using a quasi-peak and/or average detector as appropriate.

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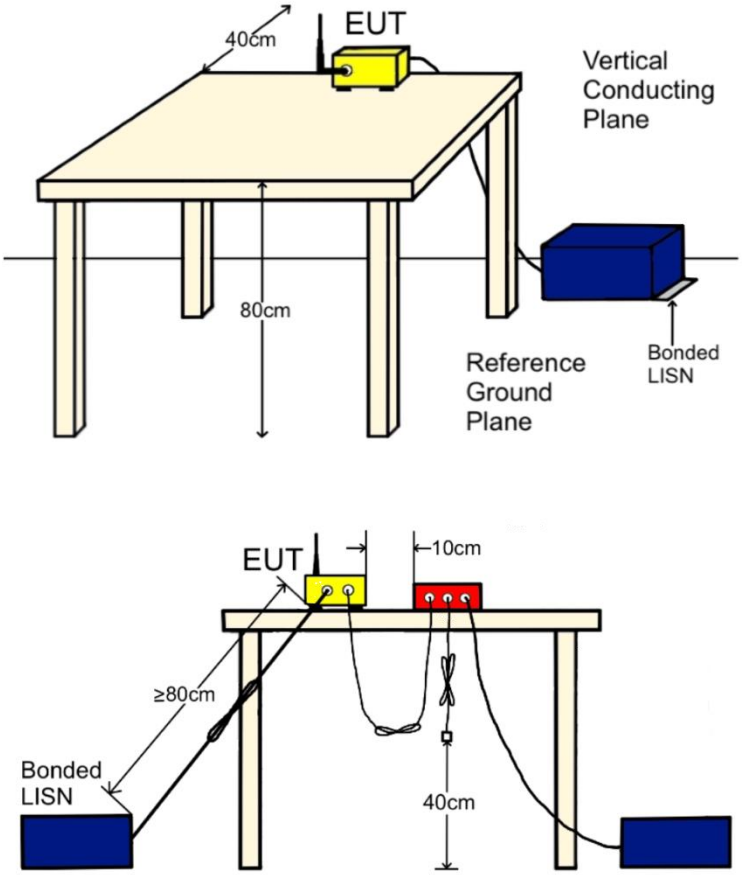

Figure 11: CEV Test Setup

Test Results: The EUT was **compliant** with this requirement **§ 15.207 (a)**. Measured emissions were below applicable limits. Photographs of test setup and the test results are presented below.

Test Engineer(s): Adan Arab

Test Date(s): March 15, 2021

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15.207(a) Conducted Emissions Test Results

Meas. Location	Meas. m	Limit	Result
Bonding measurement from LISN ground to ground plane	1.9 mΩ	< 2.5 mΩ	Pass

Line Name	Freq (MHz)	QP Amplitude (dBµV)	QP Limit (dBµV)	Margin (dB)	Pass	Average Amplitude (dBµV)	Average Limit (dBµV)	Margin (dB)	Result
Line_ 120VAC 60Hz	0.414	45.8	57.591	-11.791	Pass	32.9	47.591	-14.691	Pass
Line_ 120VAC 60Hz	0.358	46.5	58.794	-12.294	Pass	34	48.794	-14.794	Pass
Line_ 120VAC 60Hz	0.394	45.1	58.001	-12.901	Pass	32.9	48.001	-15.101	Pass
Line_ 120VAC 60Hz	1.974	35.5	56	-20.5	Pass	24.4	46	-21.6	Pass
Line_ 120VAC 60Hz	0.338	41.9	59.271	-17.371	Pass	27.5	49.271	-21.771	Pass
Line_ 120VAC 60Hz	0.178	40.1	64.582	-24.482	Pass	29.1	54.582	-25.482	Pass
Neutral_ 120VAC 60Hz	0.386	45.1	58.171	-13.071	Pass	33.5	48.171	-14.671	Pass
Neutral_ 120VAC 60Hz	0.350	43.6	58.982	-15.382	Pass	32.2	48.982	-16.782	Pass
Neutral_ 120VAC 60Hz	0.422	43.8	57.432	-13.632	Pass	32.2	47.432	-15.232	Pass
Neutral_ 120VAC 60Hz	0.166	40.8	65.16	-24.36	Pass	26.9	55.16	-28.26	Pass
Neutral_ 120VAC 60Hz	1.850	33.1	56	-22.9	Pass	28.4	46	-17.6	Pass
Neutral_ 120VAC 60Hz	0.278	34.9	60.889	-25.989	Pass	26.3	50.889	-24.589	Pass

Figure 12: Conducted Emissions, Test Data

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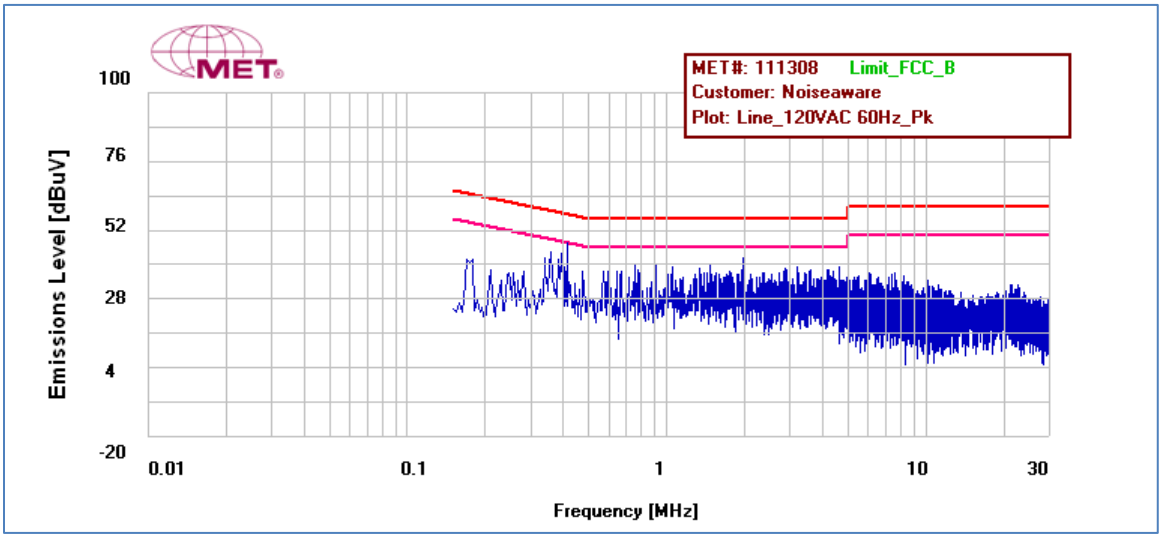

Figure 13: Conducted Emissions, Line Plot

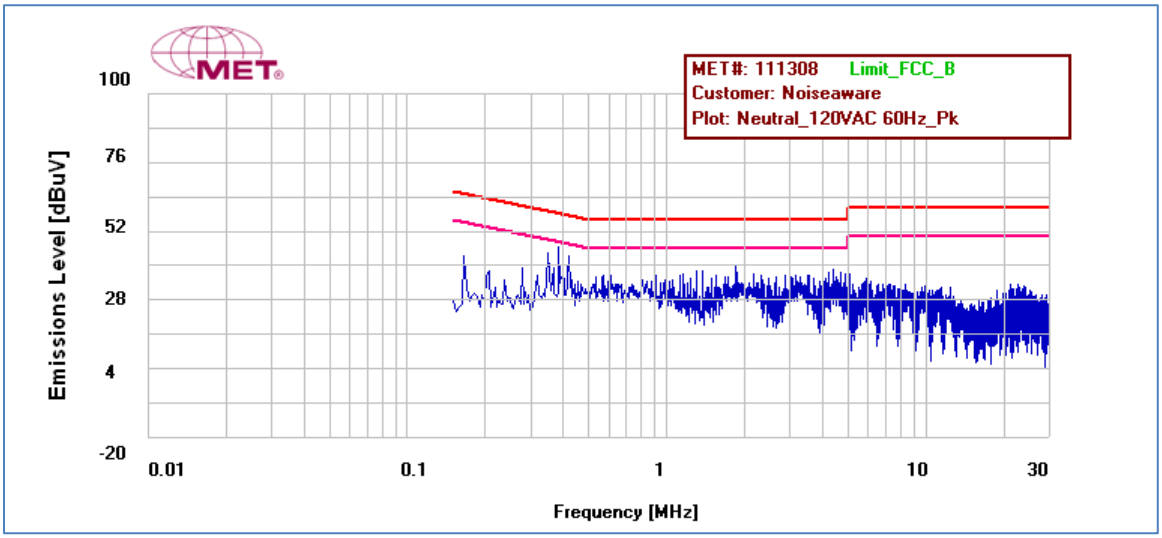

Figure 14: Conducted Emissions, Neutral Plot

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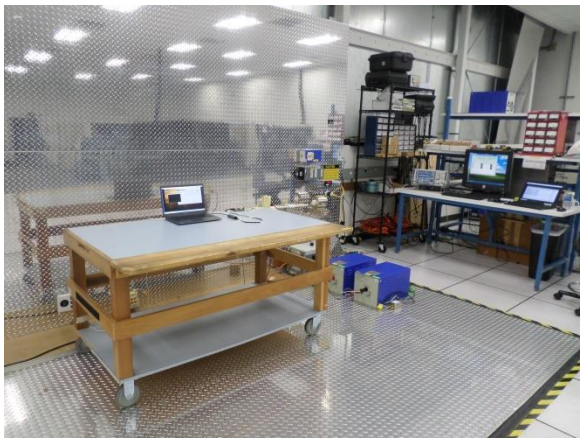

Figure 15: Conducted Emissions, Setup Front View

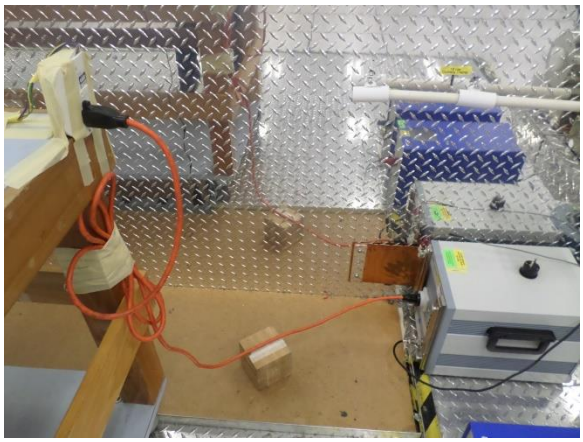

Figure 16: Conducted Emissions, Setup LISN View

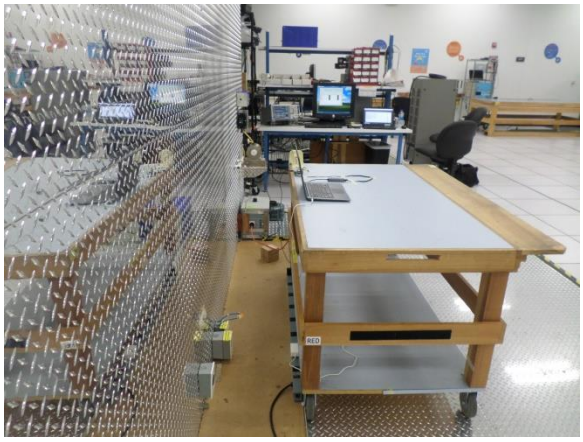

Figure 17: Conducted Emissions, Setup Rear View

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) 20 dB Occupied Bandwidth

Test Requirements: **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. For DTS, the minimum 6 dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Test Procedure: The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1-5% of the total emission bandwidth. The 20 dB bandwidth was measured and recorded.

Test Results The EUT was **compliant** with the requirement of this section § 15.247 (a)(1). The measured 20 dB occupied Bandwidth test result and test plots are recorded below.

Test Engineer(s): Adan Arab

Test Date(s): March 13, 2021

Center Frequency (MHz)	20 dB Occupied Bandwidth (KHz)
902.2	85.813
915	85.022
927.8	85.824

Figure 18: 20 dB Occupied Bandwidth, Test Results

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20 dB Occupied Bandwidth Test Results

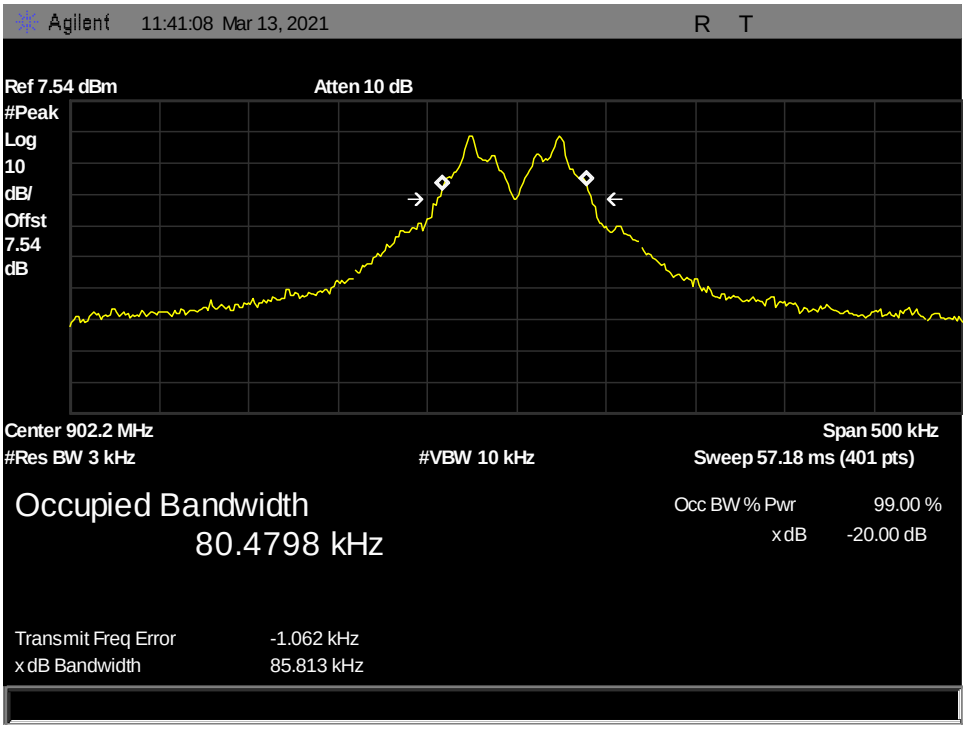

Figure 19: 20 dB Occupied Bandwidth, 902.2 MHz – Low Channel

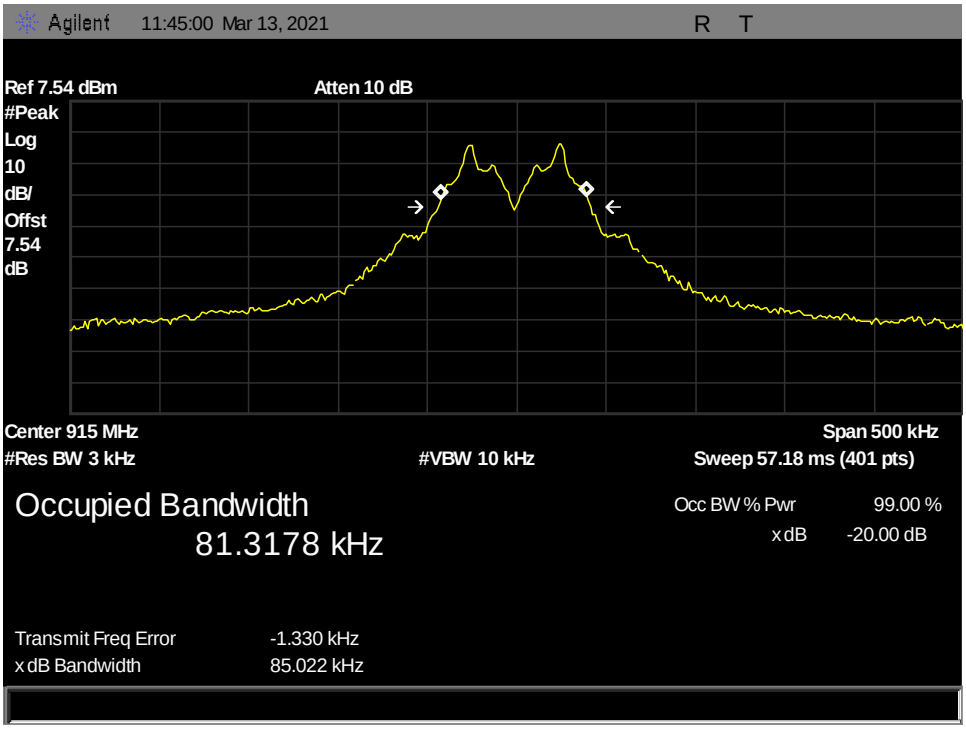

Figure 20: 20 dB Occupied Bandwidth, 915 MHz – Mid Channel

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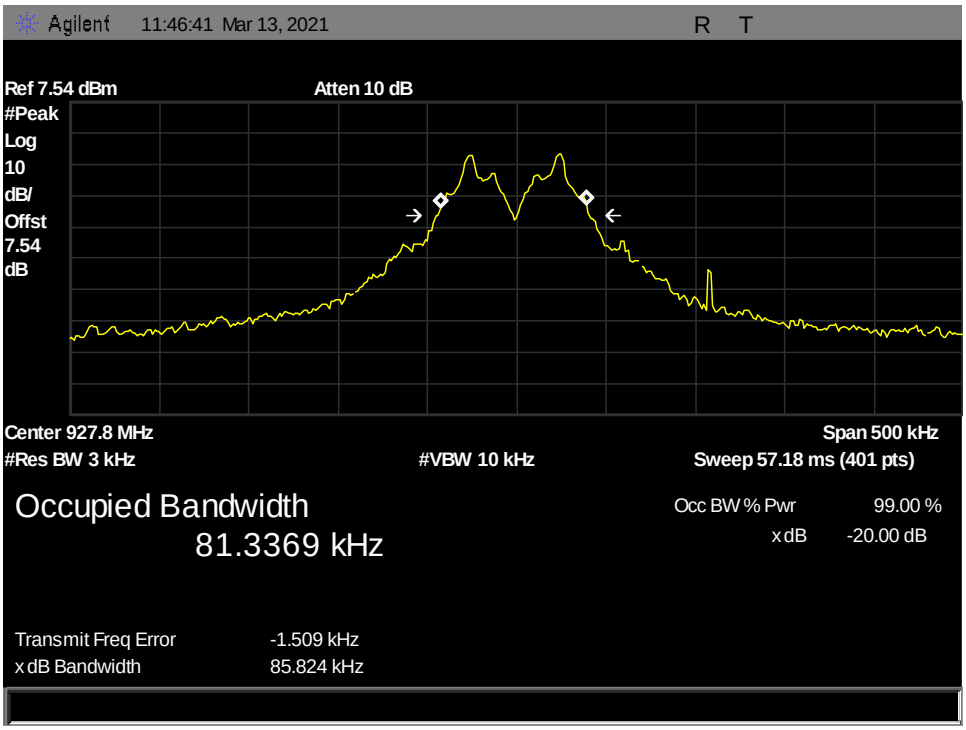

Figure 21: 20 dB Occupied Bandwidth, 927.8 MHz – High Channel

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) **Average Time of Occupancy (Dwell Time)**

Test Requirements: § 15.247(a)(1)((i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure: The EUT had its hopping function enabled. Procedure 7.8.4 from ANSI C63.10 – 2013 was used to compute the unit's dwell time.

Remarks: The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Test Results The EUT was **Complaint** with the requirements of section § 15.247(a)(1) ((i). The measured Average Time of Occupancy test result and test plots are recorded below.

Test Engineer(s): Adan Arab

Test Date(s): March 13, 2021

Hopping Period = Number of Channels*0.4 s = 129*0.4 s = 51.6 s

Burst Duration = Hopping period* duration per hop = 51.6 s*0.01s = 0.516 s

Number of Burst per period = 14

Dwell time = 14 * (0.516/20) = 0.3612

Dwell Time						
Frequency Range (MHz)	**Number of Channels**	**Number of Bursts per Period**	**Burst duration (s)**	**Dwell Time (s)**	**Limit (s)**	**Margin**
902-928	129	14	0.516	0.3162	0.400	-0.0388

Figure 22: Average Time of Occupancy

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Dwell Time:

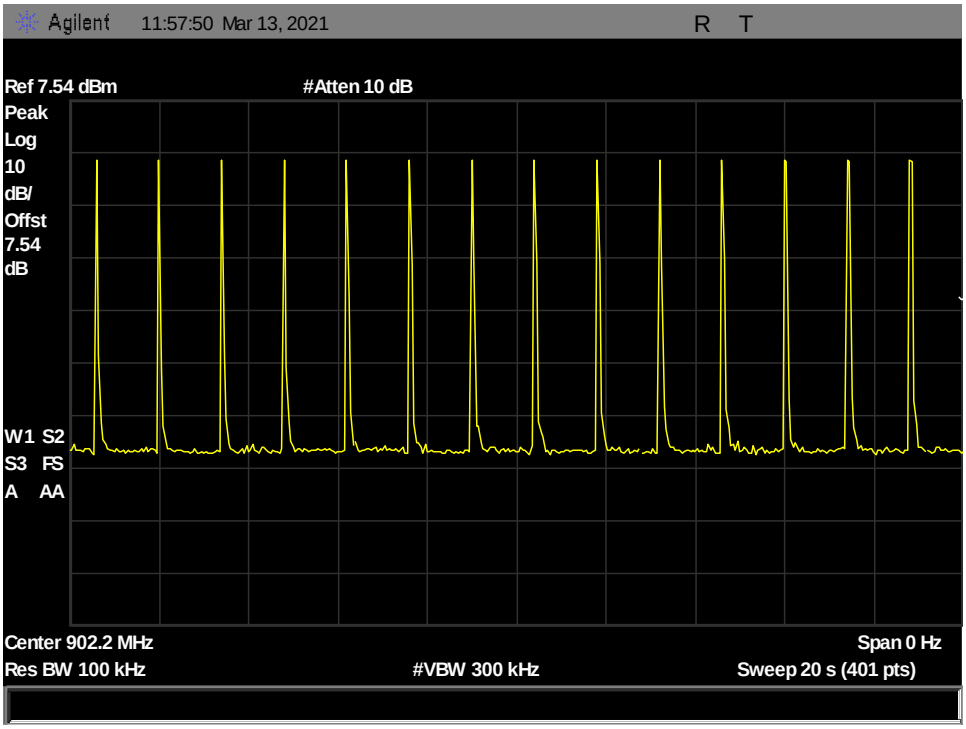

Figure 23: Dwell Time, 13 Pulses – 20S period

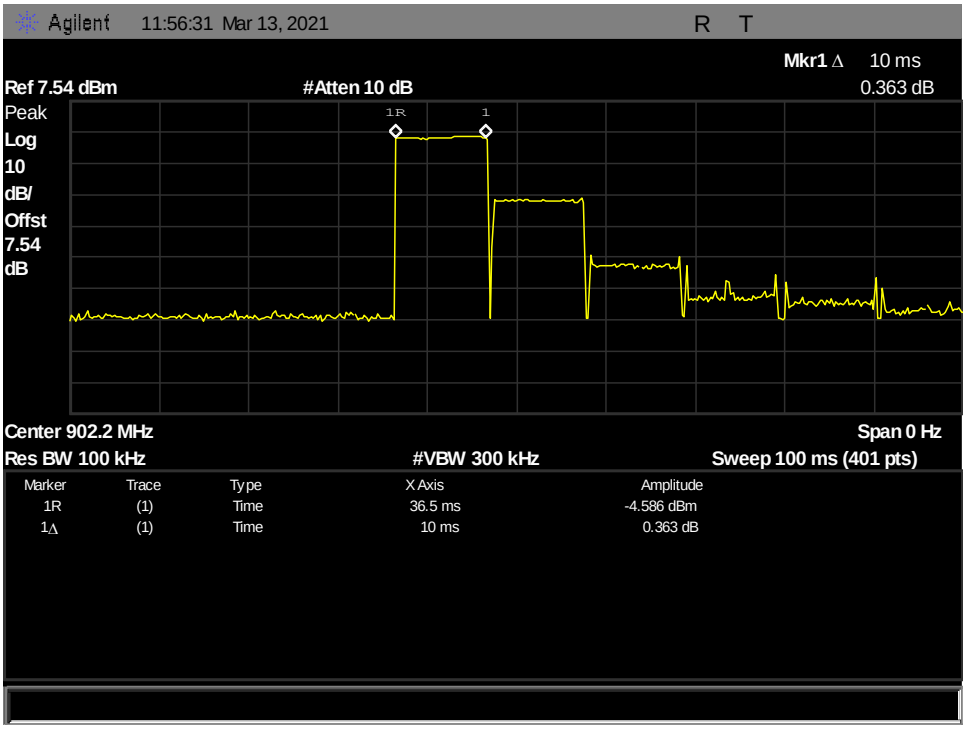

Figure 24: Dwell Time, Single Pulse – 100 ms Period

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1)	**Number of RF Channels**
Test Requirements:	§ 15.247(a)(1)(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.
Test Procedure:	The EUT had its hopping function enabled. Procedure 7.8.3 from ANSI C63.10 – 2013 was used to count the number of hopping channels.
Test Results	The EUT was compliant with § 15.247 (a)(1)(i). Total hopping channels are 129. The EUT meets the specifications of Section 15.247(a) (1) (i) for Number of Hopping Channels, when the 20 dB occupied Bandwidth is less than 250 KHz
Test Engineer(s):	Adan Arab
Test Date(s):	March 13, 2021

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Number of RF Channels, 902-909.9 MHz - 39 Channels

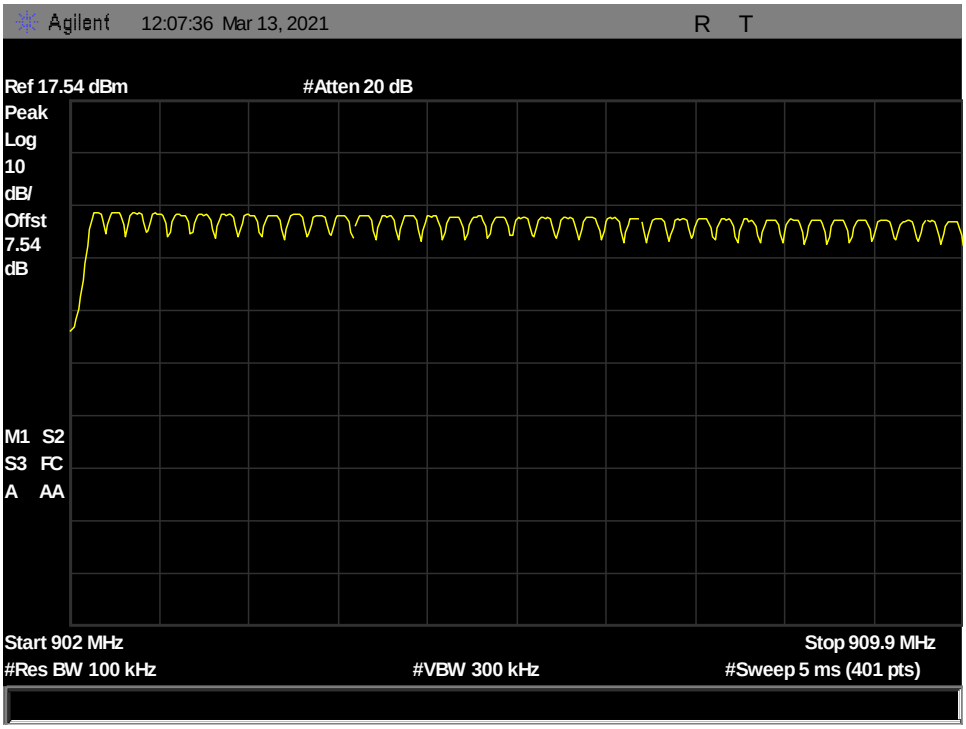

Figure 25: Number of RF Channels, 902-909.9 MHz - 39 Channels

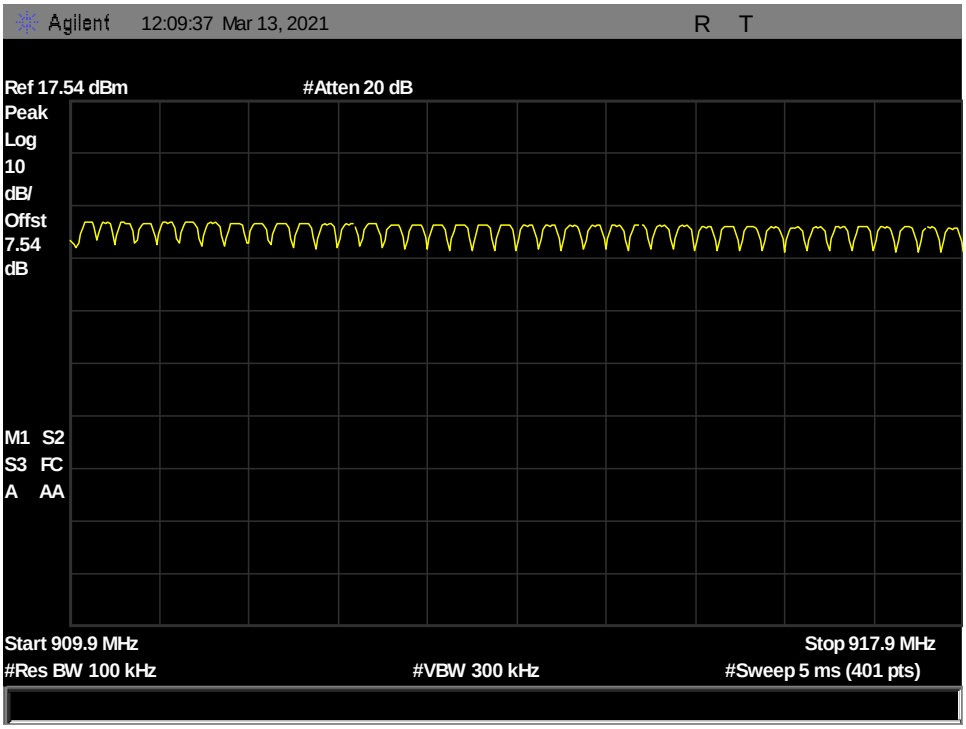

Figure 26: Number of RF Channels, 909.9-917.9 MHz - 40 Channels

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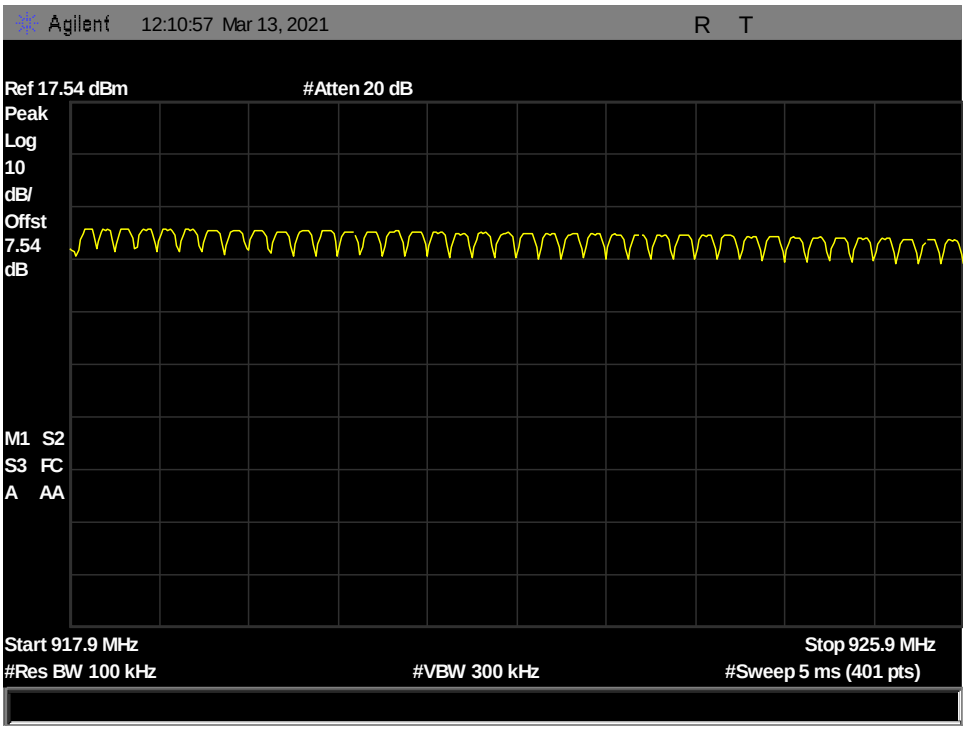

Figure 27: Number of RF Channels, 917.9-925.9 MHz - 40 Channels

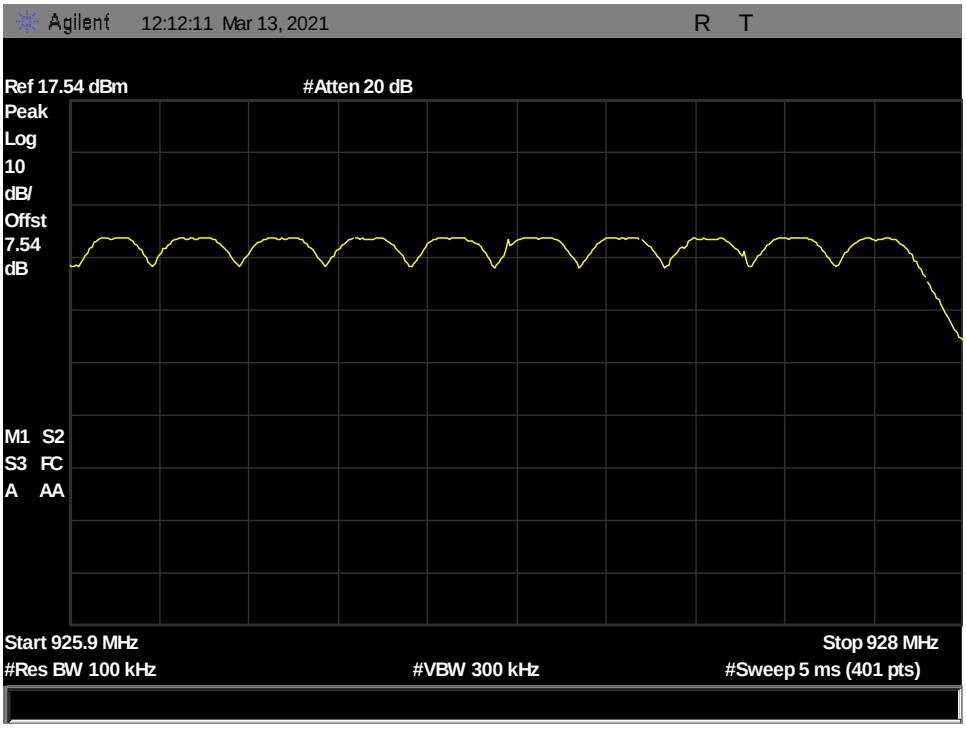

Figure 28: Number of RF Channels, 925.9-928 MHz - 10 Channels

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1)(i) RF Channel Separation

Requirement: § 15.247(a)(1)(i) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Procedure: The EUT had its hopping function enabled. Procedure 7.8.2 from ANSI C63.10 – 2013 was used to measure the channel separation.

Test Results The EUT was **compliant** with § 15.247 (a)(1). Total measured channel separation is 202.5 KHz. The EUT meets the specifications of Section 15.247(a) (1) (i).

Test Engineer(s): Adan Arab

Test Date(s): March 13, 2021

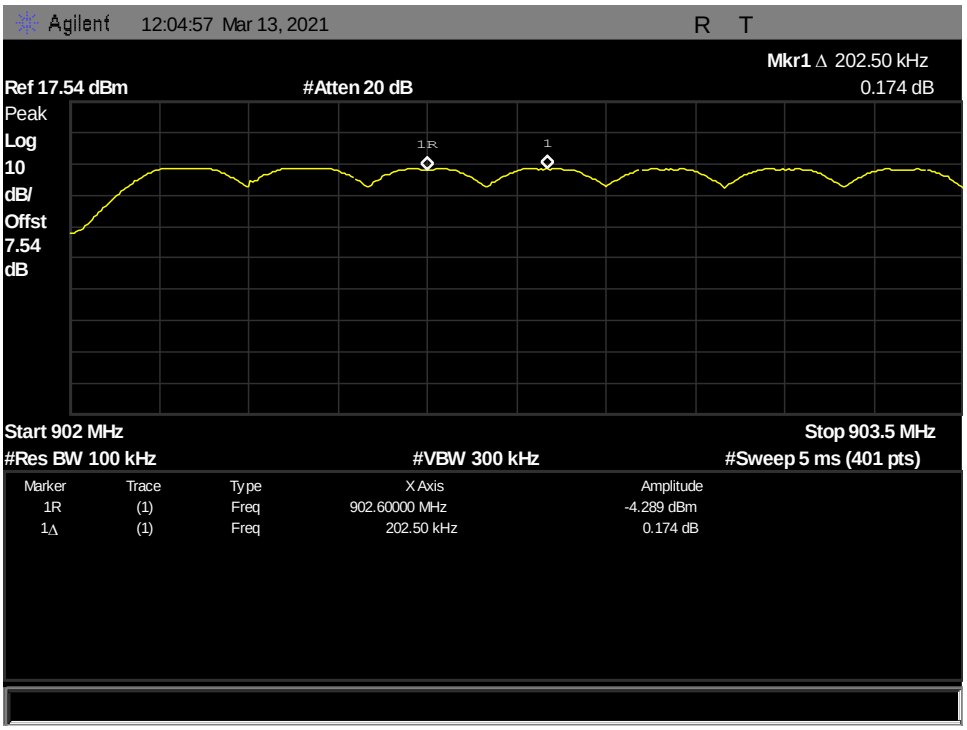

Figure 29: RF Channel Separation, 202.5 KHz

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output

Test Requirements:

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Test Procedure: The EUT was measured at the low, mid and high channels of each band transmitting at max power. Procedure 7.8.5 from ANSI C63.10-2013 was used to measure the peak power output.

The EUT was place on a non-conductive table 10m from the receiving antenna and the measured field strength is corrected to 1m distance using EIRP conversion formula from ANSI C63.10. The EUT possessed an integral antenna that did not make it possible to perform conducted RF measurements. Power measurements were then taken as a field strength and converted to conducted EIRP value.

The conversion was performed using the following formula:

EIRP (dBm) = E (dBuV/m) + 20log(d) – 104.77 + G_R
EIRP (dBm) = E (dBuV/m) + 20log(10) – 104.77 + 4.7
EIRP (dBm) = P (dBm) + G (dBi)
P(dBm) = EIRP – G (dBi)

Where, P is conducted power
E is field strength.
d is the distance measured, which is 10 meter
G_R is ground reflection factor, 4.7 dB for frequencies between 30 MHz and 1000 MHz.
G is antenna gain, 1 dBi.

Test Results: The EUT was **compliant** with the Peak Power Output limits of **§15.247(b)**. No anomalies noted.

Test Engineer(s): Adan Arab

Test Date(s): March 13, 2021

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Freq (MHz)	Field Strength (dBuV/m)	Conducted Power EIRP (dBm)	Antenna Gain (dBi)	Conducted Power (dBm)	Limit (dBm)	Margin	Result
902.20	102.63	22.56	1	21.56	30	-8.44	Pass
915.00	100.51	20.44	1	19.44	30	-10.56	Pass
927.80	98.24	18.17	1	17.17	30	-12.83	Pass

Figure 30**: Peak Output Power, Test Results**

Peak Power Output Test Results:

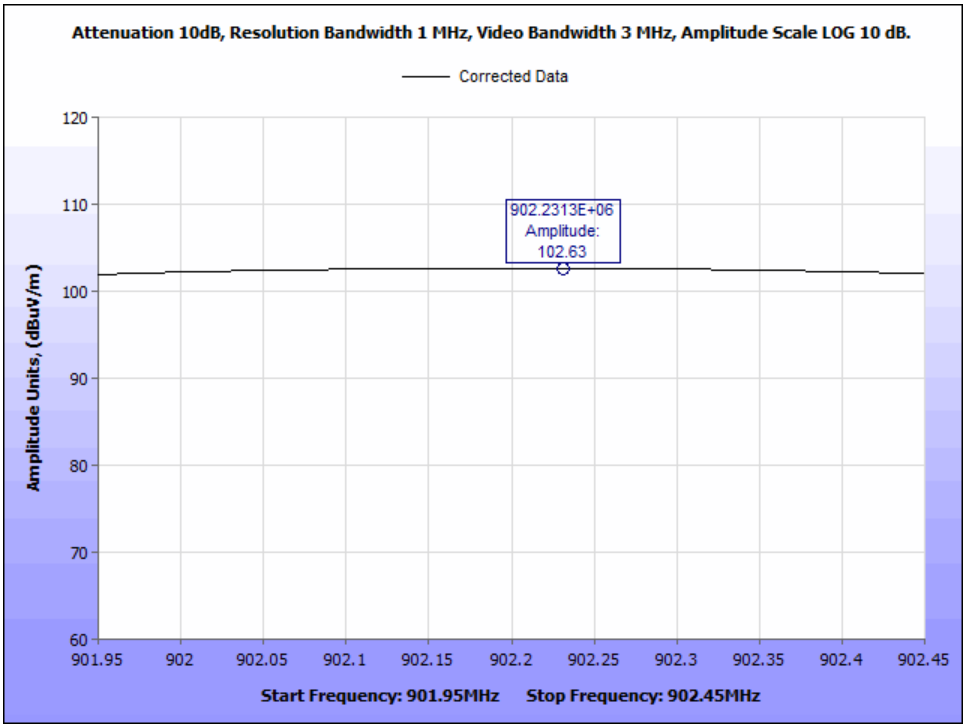

Figure 31: Peak Power Output, 902.2 MHz – Low Channel

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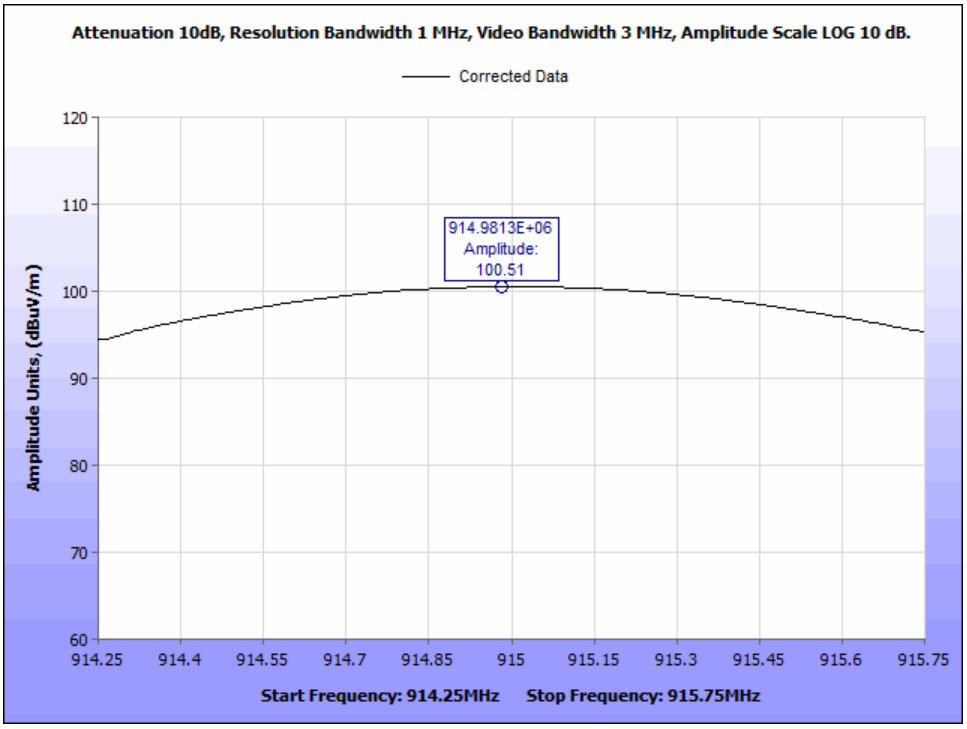

Figure 32: Peak Power Output, 915 MHz – Mid Channel

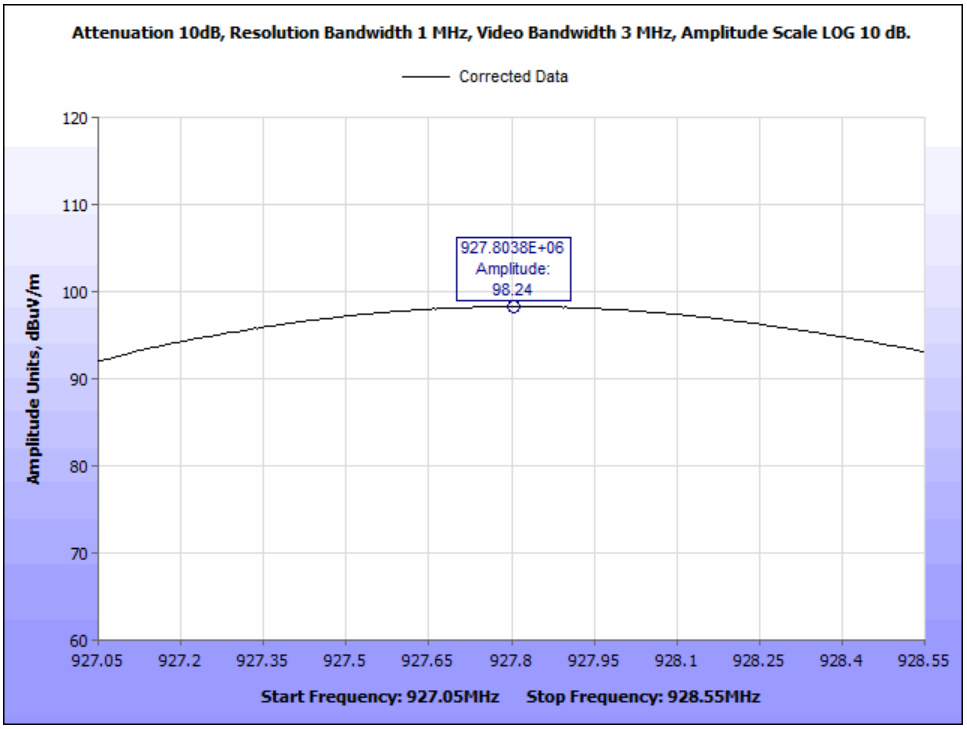

Figure 33: Peak Power Output, 927.8 MHz, High Channel

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

Test Requirements: **§15.247(d); §15.205:** Emissions outside the frequency band.

§15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

§15.205(a): Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110----------	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505----------	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905----------	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128----------	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775----------	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775----------	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218----------	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825----------	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225----------	123–138	2200–2300	14.47–14.5
8.291–8.294----------	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366----------	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675----------	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475----------	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293----------	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025----------	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725----------	322–335.4	3600–4400	([2])
13.36-13.41			

Figure 34: Restricted Bands of Operation

[1] Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.
[2] Above 38.6

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Test Requirement(s): **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Figure 36.

Frequency (MHz)	§ 15.209(a),Radiated Emission Limits (dBµV) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

Figure 35: Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)

Test Procedure: The transmitter was set to the mid channel at the highest output power and placed on a 0.8 m high non-conductive table inside in a semi-anechoic chamber. For frequencies below 1GHz Measurements were performed at 10m from the EUT and frequencies above 1GHz the measurement were performed at 3m from the EUT with the EUT rotated 360 degrees and varying the adjustable antenna mast with 1 m to 4 m height to determine worst case orientation for maximum emissions. Measurement were repeated the measurement at the low and highest channels.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

For frequencies from 1 GHz to 10 GHz, measurements were made 3m from the EUT using a peak and Average detector with a 1 MHz bandwidth.

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35(b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

The EUT possessed an integral antenna, therefore Spurious Emissions in 100 KHz Bandwidth was performed using a radiated setup.

EUT Field Strength Final Amplitude = Raw Amplitude – Preamp gain + Antenna Factor + Cable Loss – Distance Correction Factor.

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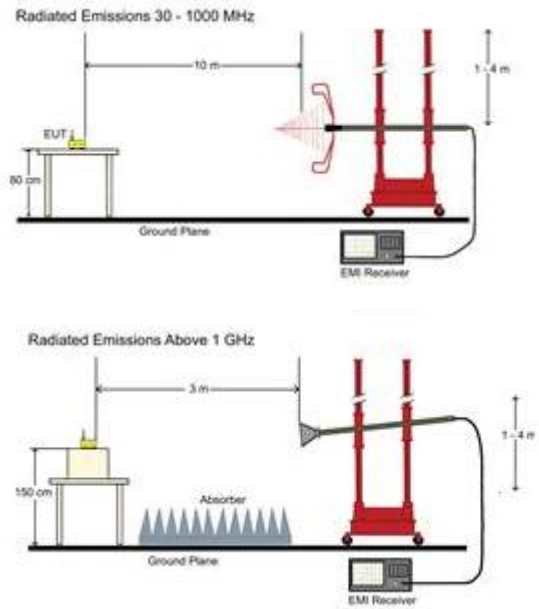

Figure 36: Radiated Spurious Emissions Test Setup

Test Results: The EUT was **compliant** with the Radiated Spurious Emission limits of **§15.247(d)**. The Measured emissions were below applicable limits.

Test Engineer(s): Adan Arab

Test Date(s): March 3, 2021

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Radiated Spurious Emissions Test Results

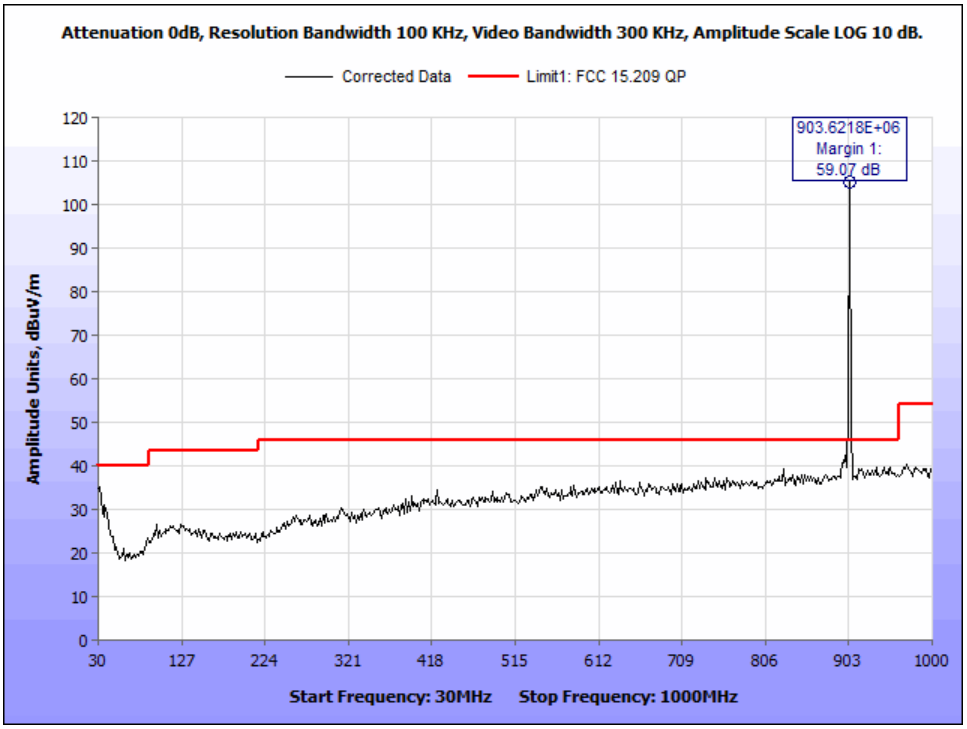

Figure 37: Radiated Spurious Emissions, 902.2 MHz - 30MHz-1000MHz - Horizontal

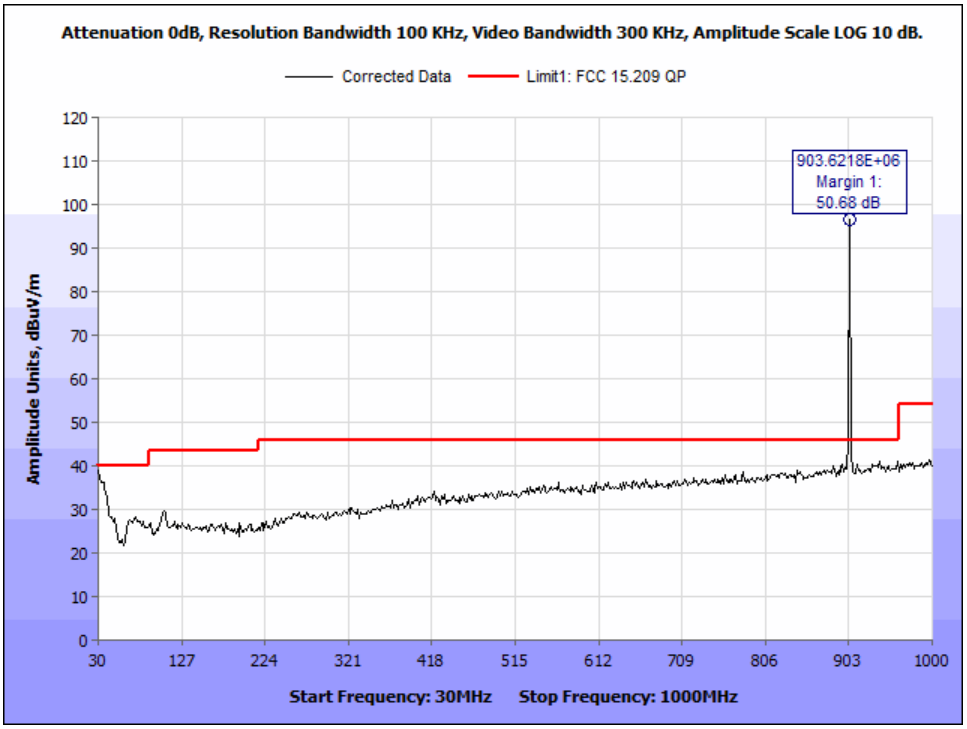

Figure 38: Radiated Spurious Emissions, 902.2 MHz - 30MHz-1000MHz – Vertical

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Frequency (MHz)	Uncorrected Amplitude (dBuV)	Antenna polarity	Antenna Height (cm)	Azimuth (Degrees)	Distance Correction Factor (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude dBuV/m	Limit (dBuV/m)	Margin (dB)	Comments
30.0000	30.95	V	100	27	10.46	22.3	-24.82	38.89	40	-1.11	
31.5545	27.44	H	400	196	10.46	21.92	-24.72	35.1	40	-4.9	
31.5545	30.60	V	200	0	10.46	21.37	-24.72	37.7	40	-2.3	
898.9583	26.74	H	158	247	10.46	24.7	-19.64	42.25	46	-3.75	
903.6218	89.52	H	300	334	10.46	24.7	-19.61	105.07	46	59.07	See Note*
903.6218	80.76	V	200	129	10.46	25.06	-19.61	96.68	46	50.68	See Note*
Note: Emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section.											

Figure 39: Radiated Spurious Emissions, 902.2 MHz - 30-1000 MHz – Test Results

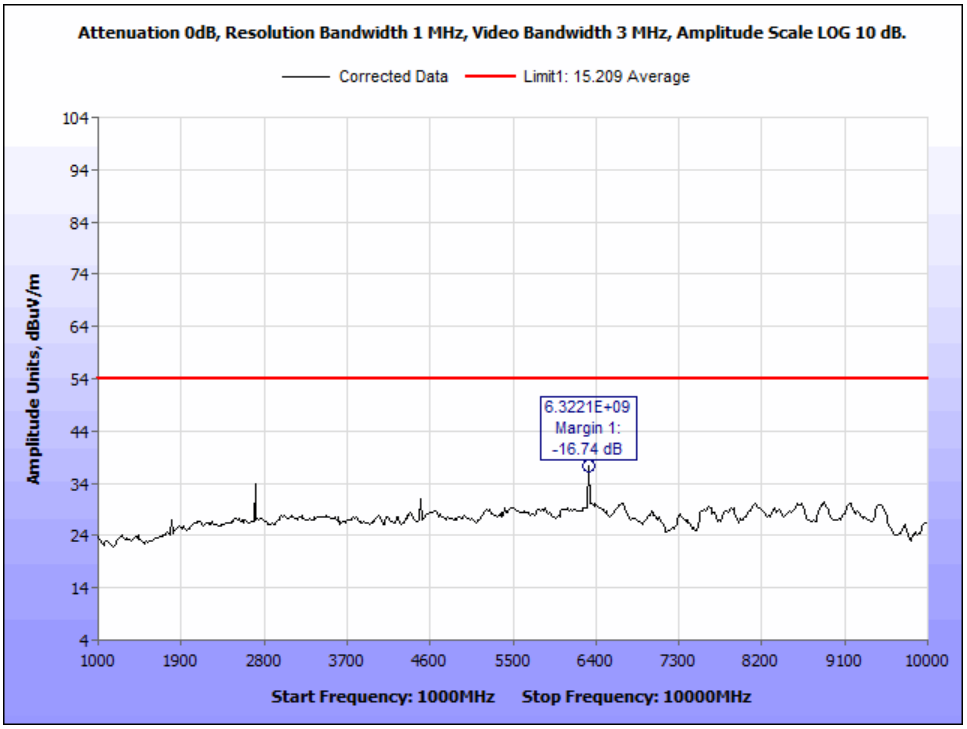

Figure 40: Radiated Spurious Emissions, 902.2 MHz - 1GHz-10GHz - Average - Horizontal

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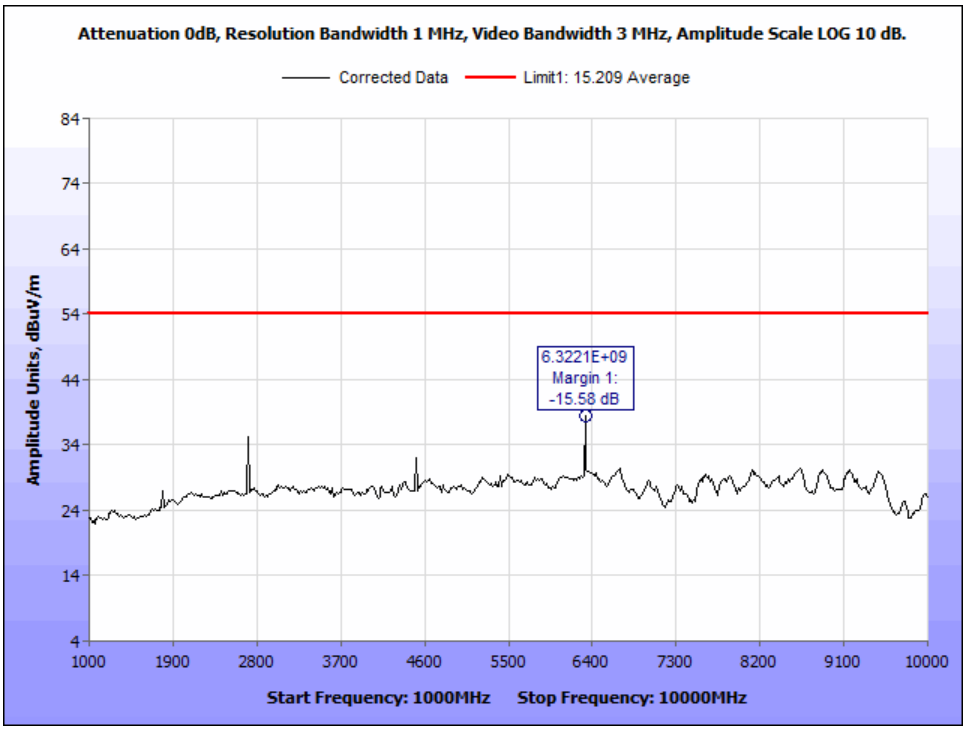

Figure 41: Radiated Spurious Emissions, 902.2 MHz - 1GHz-10GHz - Average - Vertical

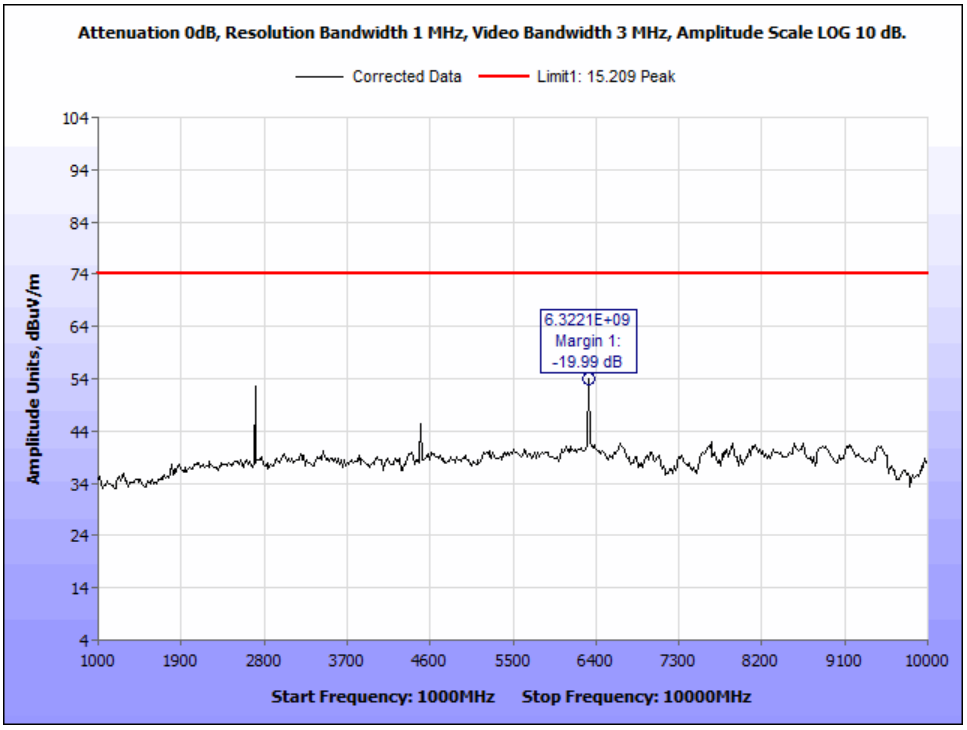

Figure 42: Radiated Spurious Emissions, 902.2 MHz - 1GHz-10GHz - Horizontal

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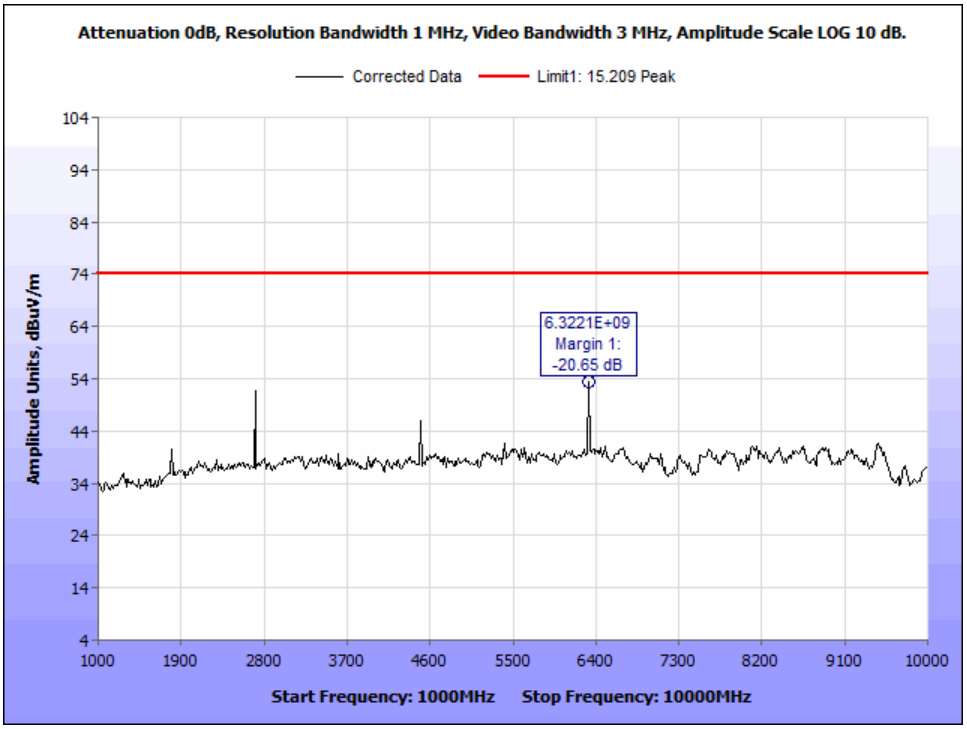

Figure 43: Radiated Spurious Emissions, 902.2 MHz - 1GHz-10GHz - Peak – Vertical

Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Antenna Height (cm)	Azimuth (Degrees)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit 1, 15.209 Average (dBuV/m)	Limit 2, 15.209 Peak (dBuV/m)	Margin 1, (dB)	Margin 2, (dB)
6.3221	41.71	H	150	69	35.25	-39.7	37.26	54	--	-16.74	--
2.7019	37.31	H	350	192	32.31	-35.68	33.93	54	--	-20.07	--
6.3221	42.86	V	250	147	35.27	-39.7	38.42	54	--	-15.58	--
2.7019	38.67	V	350	259	32.27	-35.68	35.26	54	--	-18.74	--
4.5048	36.81	V	300	299	33.58	-38.33	32.05	54	--	-21.95	--
6.3221	58.46	V	200	229	35.25	-39.7	54.01		74		-19.99

Figure 44: Radiated Spurious Emissions, 902.2 MHz – 1GHz-10GHz – Test Results

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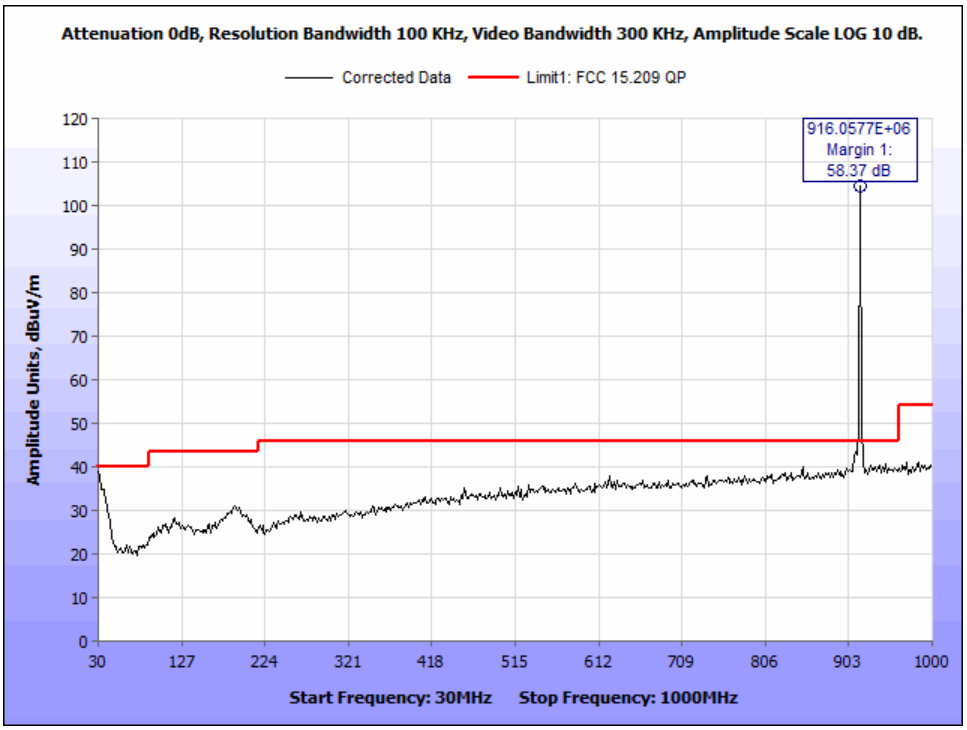

Figure 45: Radiated Spurious Emissions, 915 MHz - 30MHz-1000MHz - Horizontal

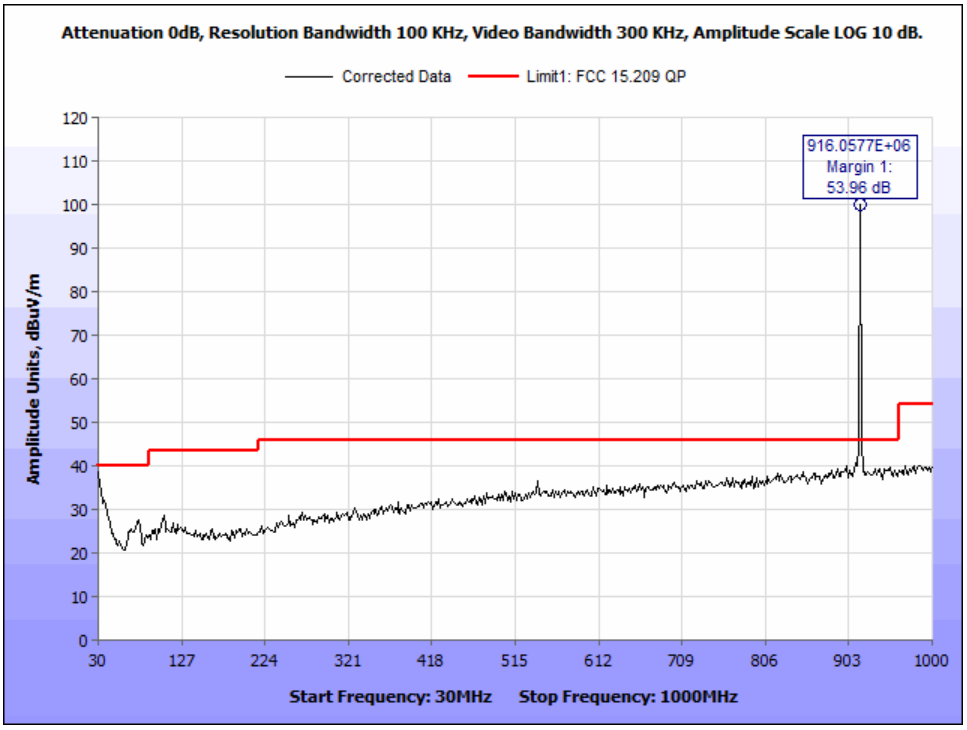

Figure 46: Radiated Spurious Emissions, 915 MHz - 30MHz-1000MHz – Vertical

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Frequency (MHz)	Uncorrected Amplitude (dBuV)	Antenna polarity	Antenna Height (cm)	Azimuth (Degrees)	Distance Correction Factor (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude dBuV/m	Limit (dBuV/m)	Margin (dB)	Comments
30.0000	30.95	V	200	302	10.46	22.3	-24.82	38.89	40	-1.11	
31.5545	27.44	H	100	50	10.46	21.92	-24.72	35.1	40	-4.9	
31.5545	30.6	V	100	110	10.46	21.37	-24.72	37.7	40	-2.3	
898.9583	26.74	H	300	190	10.46	24.7	-19.64	42.25	46	-3.75	
903.6218	89.52	H	200	127	10.46	24.7	-19.61	105.07	46	59.07	See Note*
903.6218	80.76	V	100	227	10.46	25.06	-19.61	96.68	46	50.68	See Note*
Note: Emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section.											

Figure 47: Radiated Spurious Emissions, 915 MHz - 30-1000 MHz – Test Results

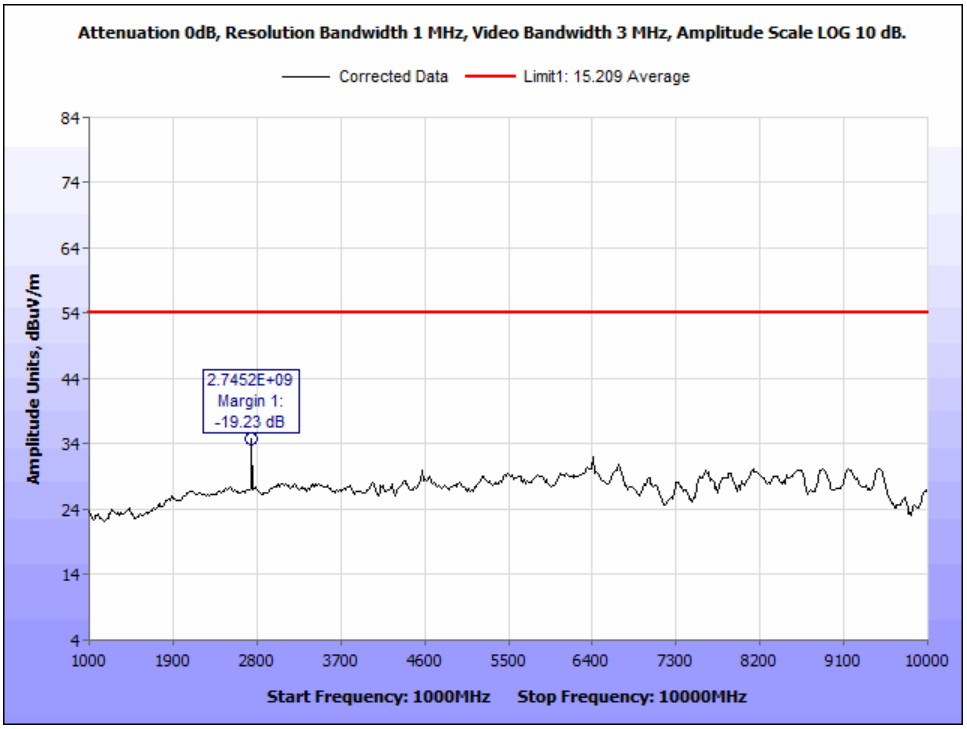

Figure 48: Radiated Spurious Emissions, 915 MHz - 1GHz-10GHz - Average – Horizontal

Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Antenna Height (cm)	Azimuth (Degrees)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit, 15.209 Average (dBuV/m)	Margin, (dB)
2.7452	38.31	H	200	229	32.22	-35.76	34.77	54	-19.23

Figure 49: Radiated Spurious Emissions, 915 MHz – 1GHz-10GHz – Test Results

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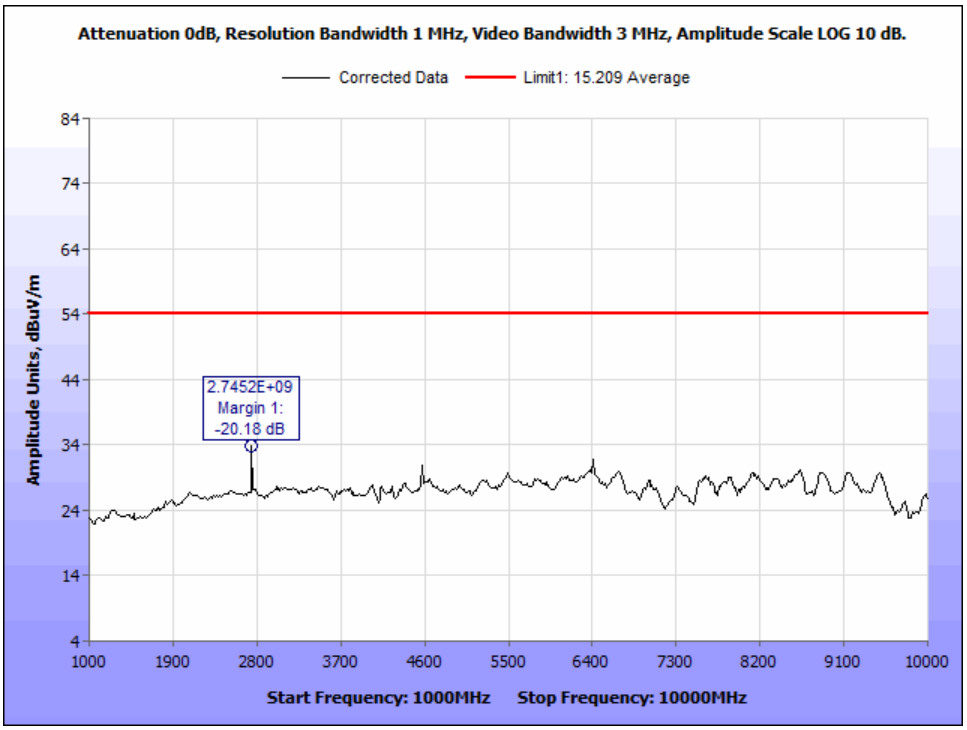

Figure 50: Radiated Spurious Emissions, 915 MHz - 1GHz-10GHz - Average - Vertical

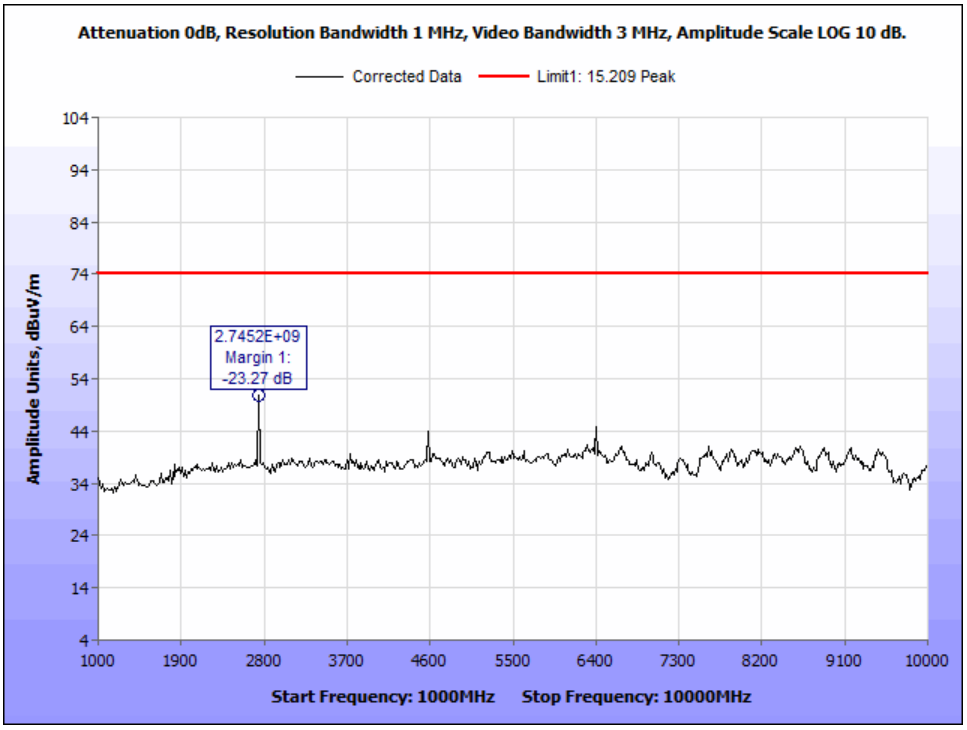

Figure 51: Radiated Spurious Emissions, 915 MHz - 1GHz-10GHz - Peak - Horizontal

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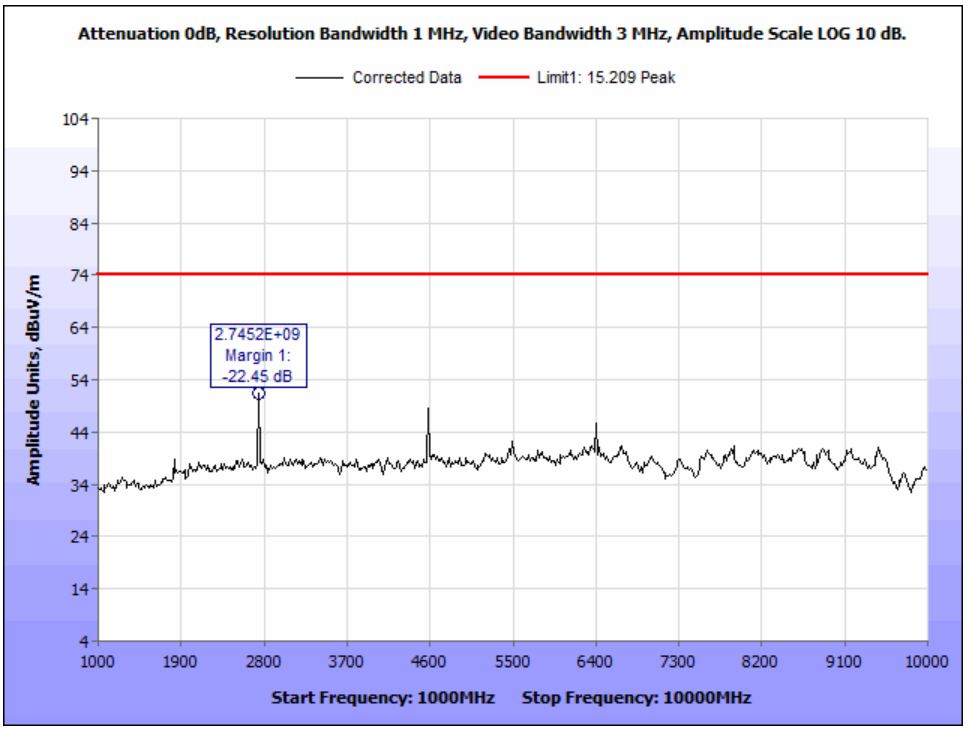

Figure 52: Radiated Spurious Emissions, 915 MHz - 1GHz-10GHz - Peak - Vertical

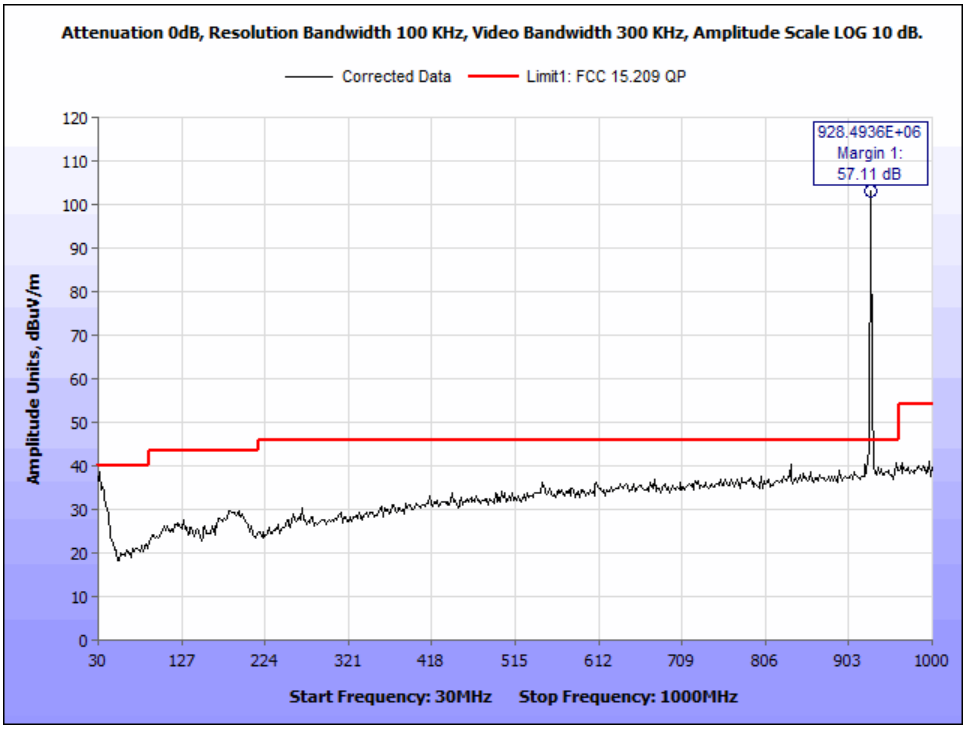

Figure 53: Radiated Spurious Emissions, 927.8 MHz - 30MHz-1000MHz - Horizontal

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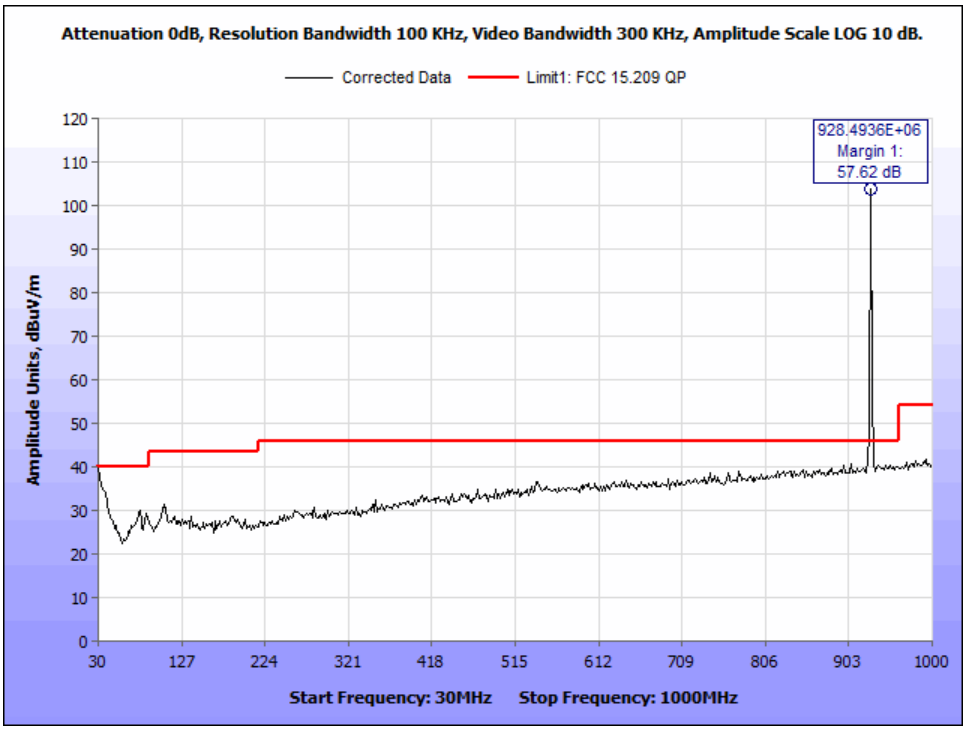

Figure 54: Radiated Spurious Emissions, 927.8 MHz - 30MHz-1000MHz – Vertical

Frequency (MHz)	Uncorrected Amplitude (dBuV)	Antenna polarity	Antenna Height (cm)	Azimuth (Degrees)	Distance Correction Factor (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude dBuV/m	Limit (dBuV/m)	Margin (dB)	Comments
30.0000	30.47	H	150	150	10.46	22.8	-24.82	38.91	40	-1.09	
30.0000	30.68	V	150	277	10.46	22.3	-24.82	38.62	40	-1.38	
31.5545	30.73	H	200	210	10.46	21.92	-24.72	38.39	40	-1.61	
31.5545	28.52	V	200	104	10.46	21.37	-24.72	35.63	40	-4.37	
916.0577	88.6	H	250	312	10.46	24.8	-19.49	104.37	46	58.37	See Note*
916.0577	83.69	V	100	130	10.46	25.3	-19.49	99.96	46	53.96	See Note*
Note: Emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section.											

Figure 55: Radiated Spurious Emissions, 927.8 MHz - 30-1000 MHz – Test Results

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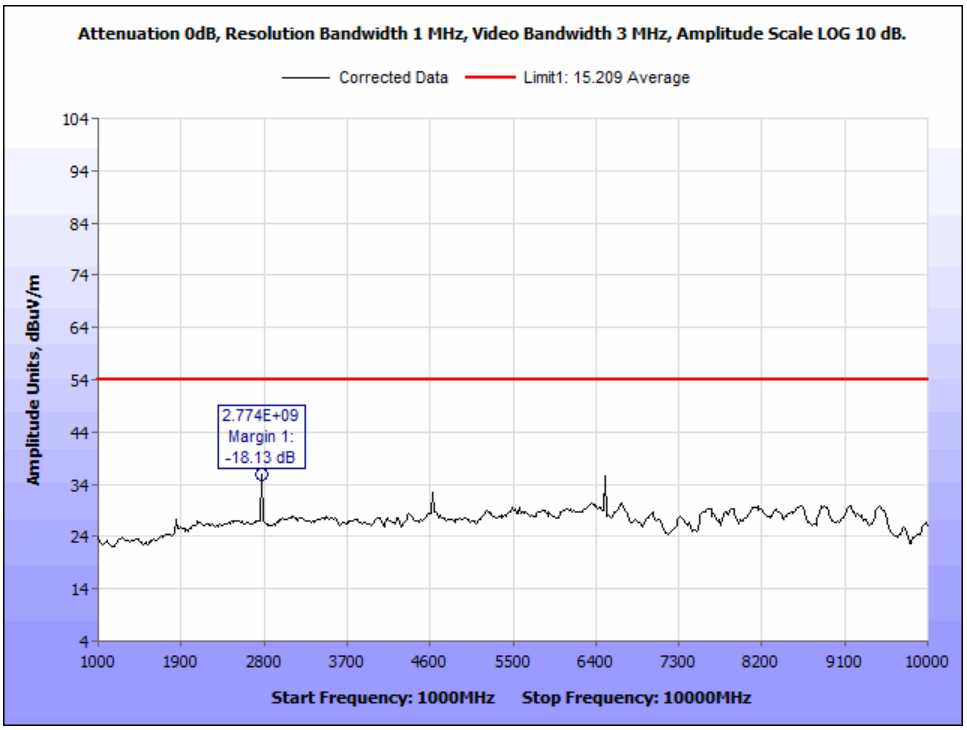

Figure 56: Radiated Spurious Emissions, 927.8 MHz - 1GHz-10GHz - Average - Horizontal

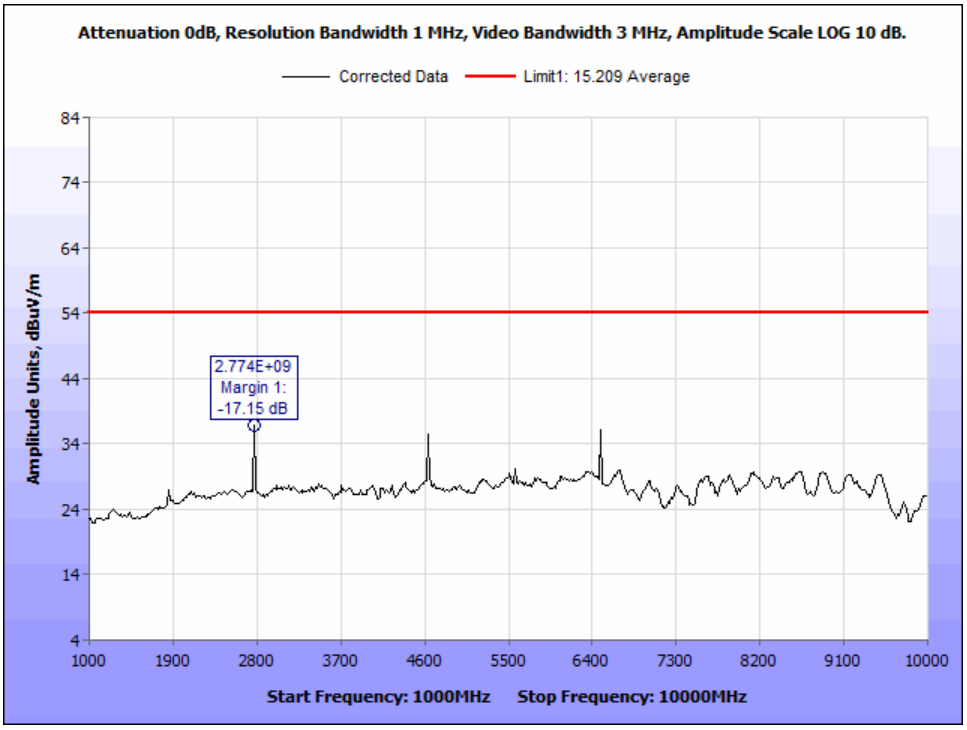

Figure 57: Radiated Spurious Emissions, 927.8 MHz - 1GHz-10GHz - Average – Vertical

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Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Antenna Height (cm)	Azimuth (Degrees)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit, 15.209 Average (dBuV/m)	Margin, (dB)
2.774	39.54	H	150	69	32.14	-35.81	35.87	54	-18.13
6.4952	40.43	H	350	192	35.3	-40.05	35.68	54	-18.32
4.6346	37.29	H	250	147	33.78	-38.62	32.45	54	-21.55
2.7740	40.53	V	350	259	32.13	-35.81	36.85	54	-17.15
6.4952	40.84	V	300	299	35.33	-40.05	36.11	54	-17.89
4.6346	40.41	V	200	229	33.75	-38.62	35.54	54	-18.46

Figure 58: Radiated Spurious Emissions, 927.8 MHz – 1GHz-10GHz – Test Results

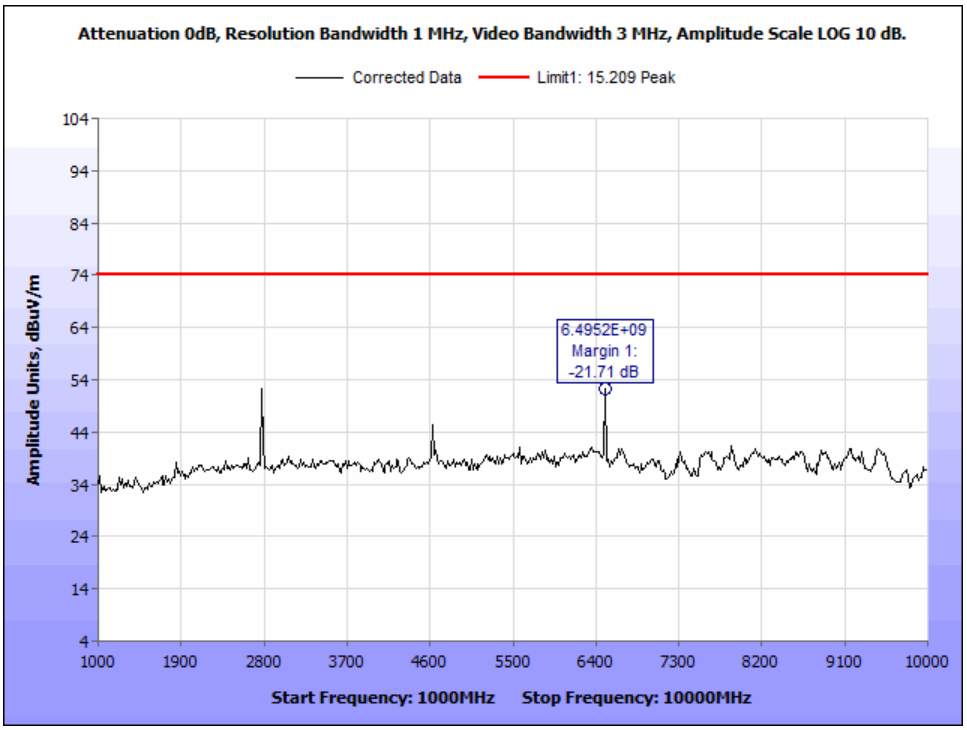

Figure 59: Radiated Spurious Emissions, 927.8 MHz - 1GHz-10GHz - Peak - Horizontal

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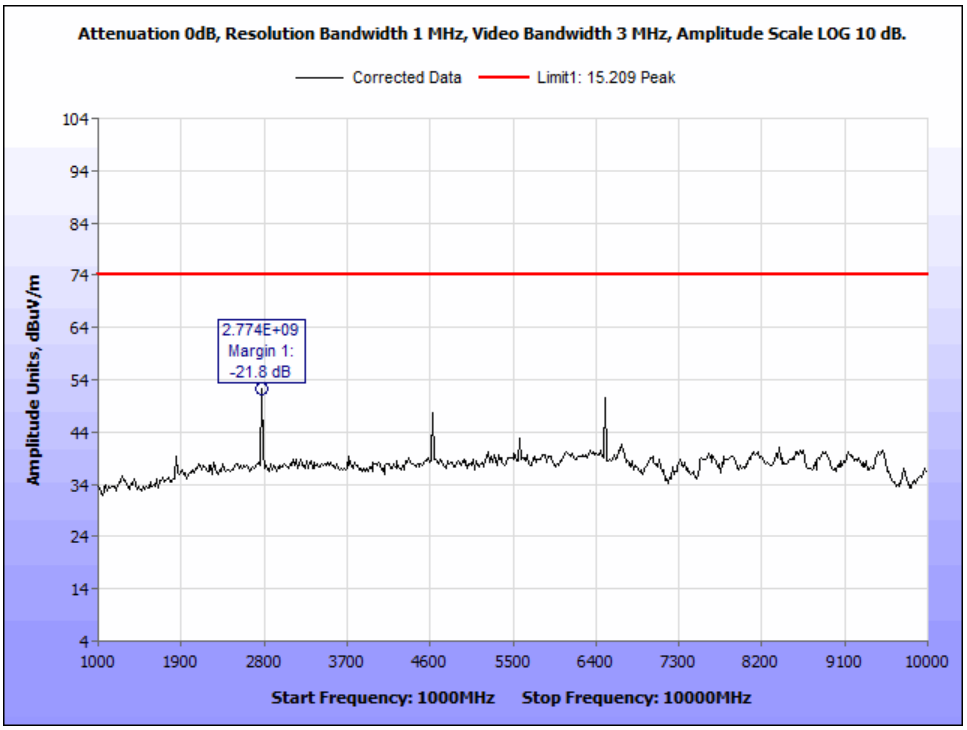

Figure 60: Radiated Spurious Emissions, 927.8 MHz - 1GHz-10GHz - Peak - Vertical

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Radiated Band Edge Measurements

Test Procedures: The transmitter was turned. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance.

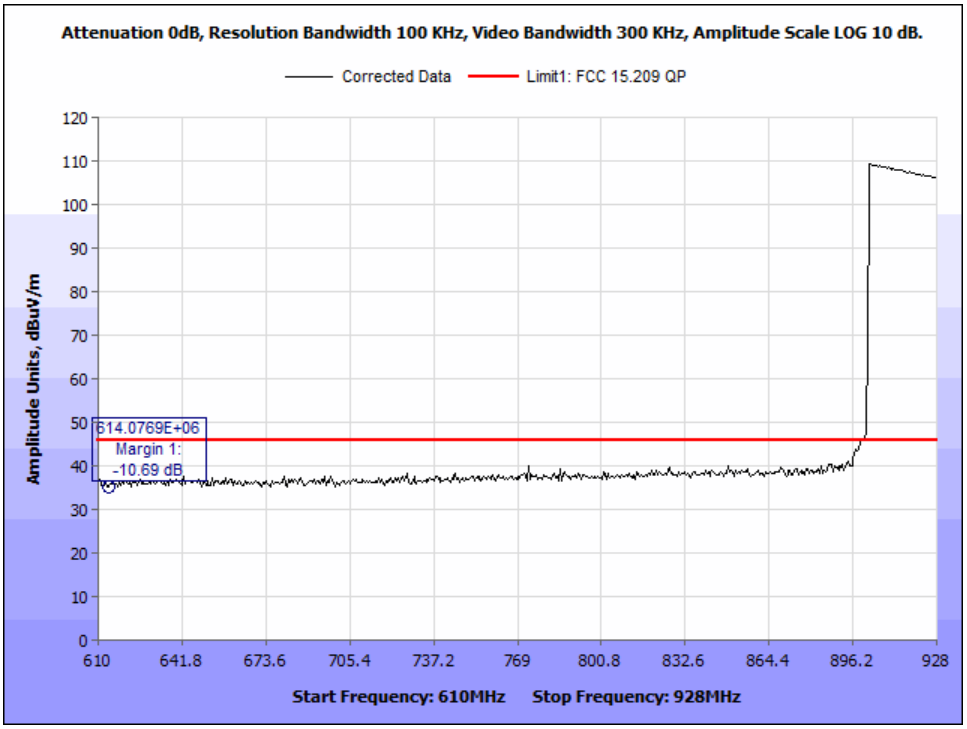

Figure 61: Radiated Restricted Band Edge, Peak , Low Edge, Horizontal (Hopping).

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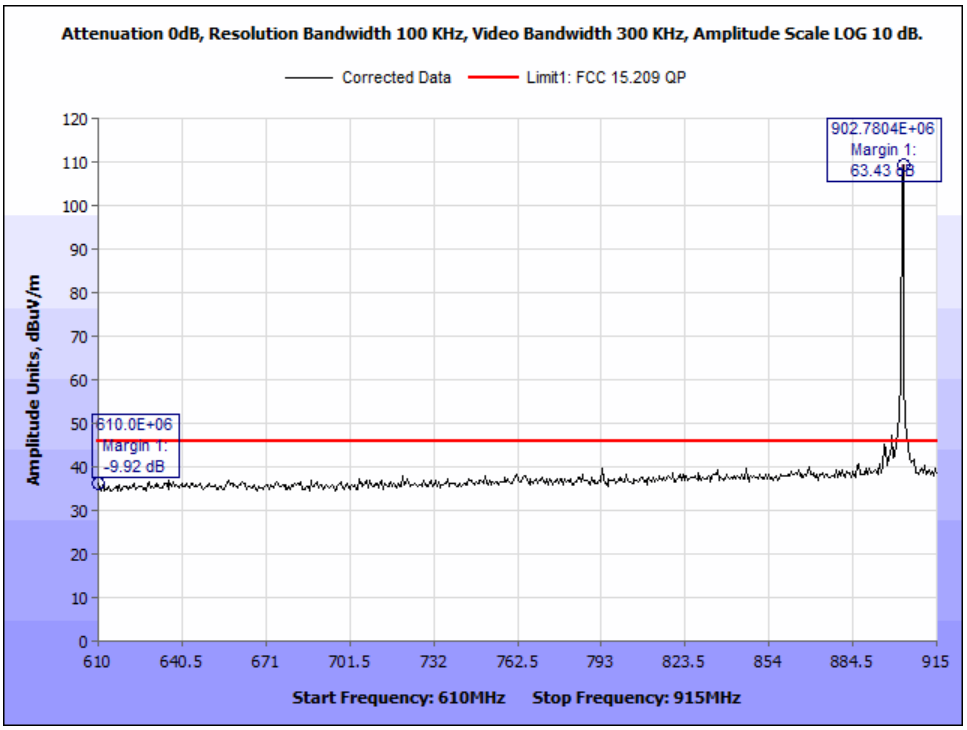

Figure 62: Radiated Restricted Band Edge, Peak , 902.2 MHz –Low Edge, Horizontal

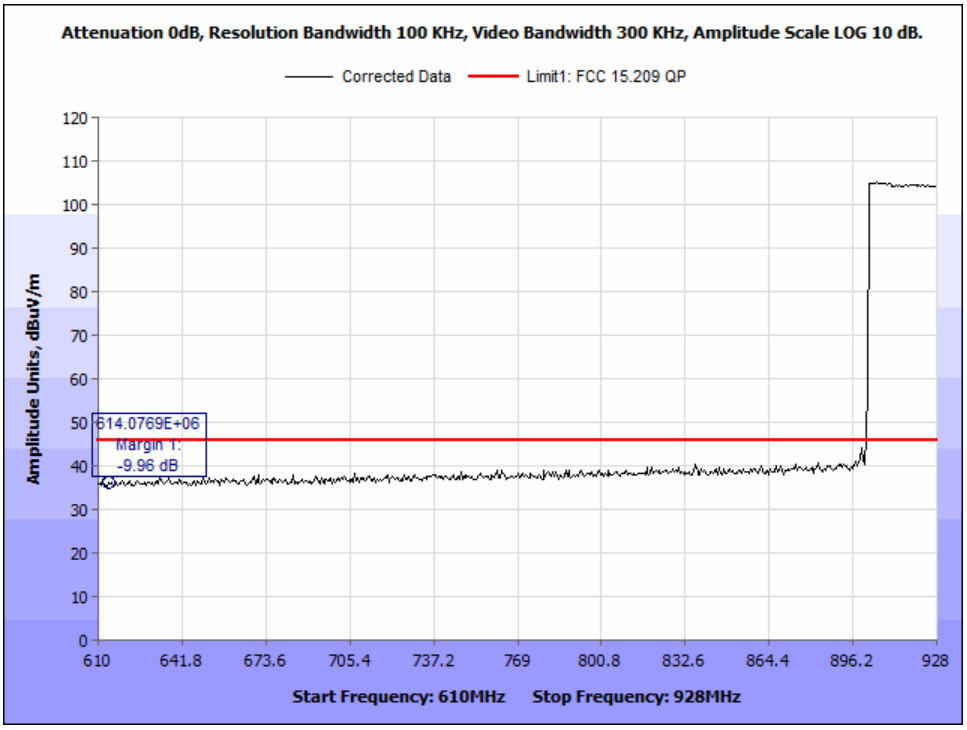

Figure 63: Radiated Restricted Band Edge, Peak , 902.2 MHz – Low Edge, Vertical (Hopping).

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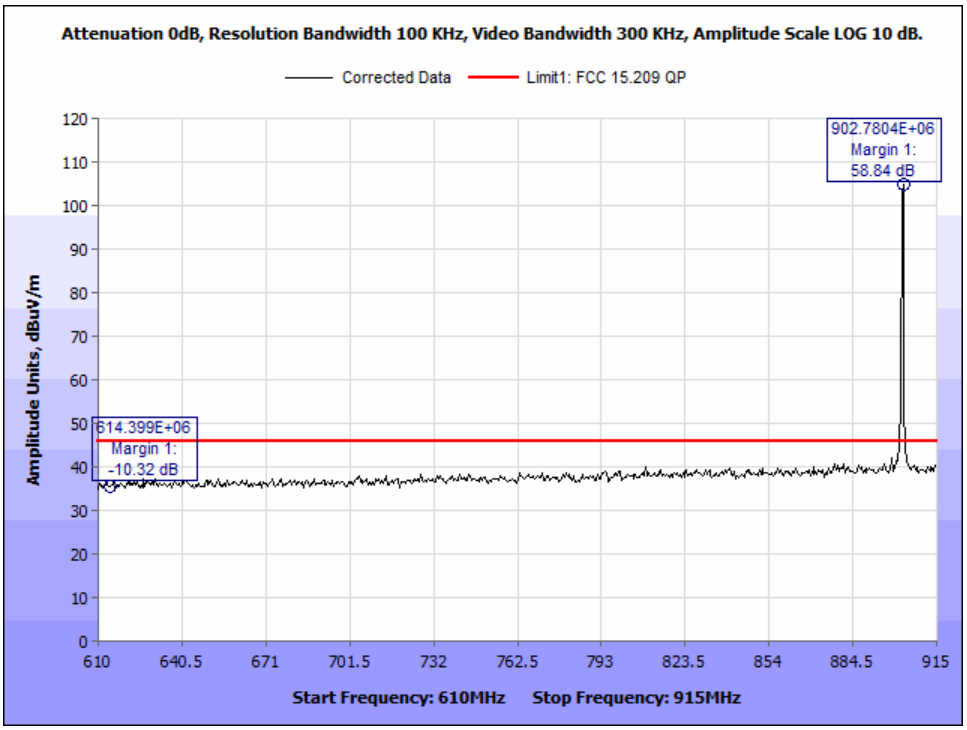

Figure 64: Radiated Restricted Band Edge, Peak , 902.2 MHz – Low Edge, Vertical

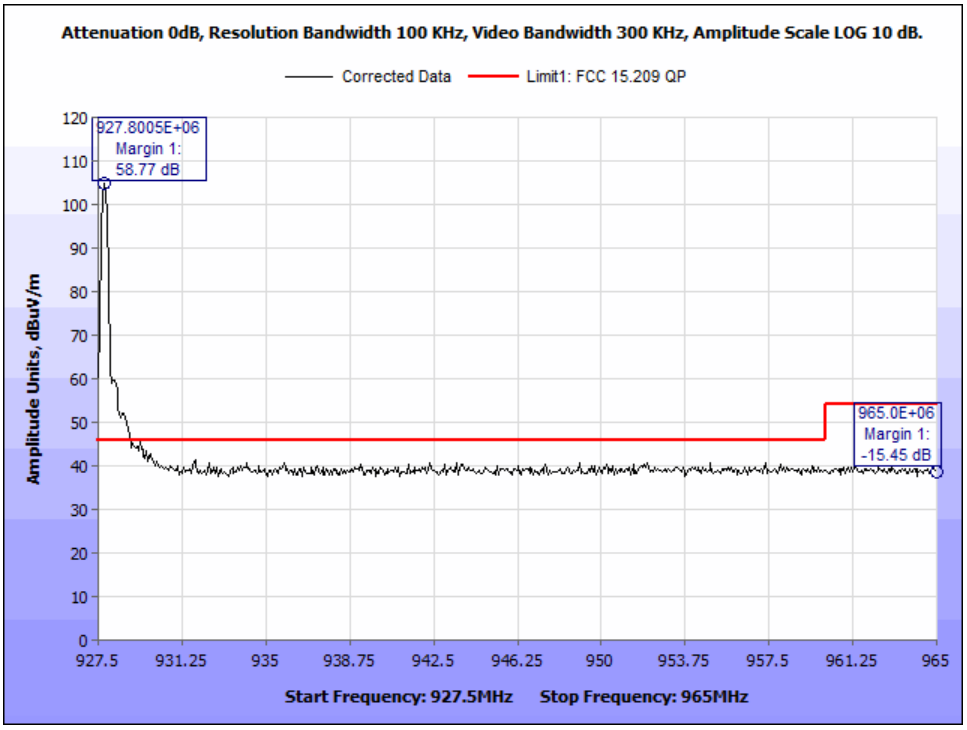

Figure 65: Radiated Restricted Band Edge, Peak , High Edge, Horizontal

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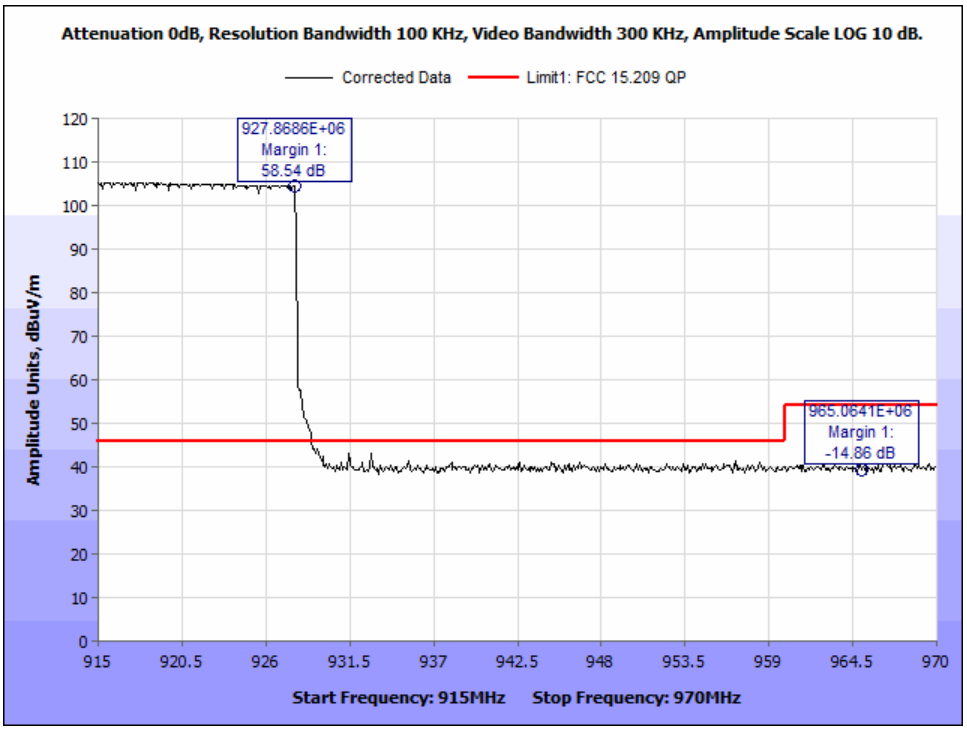

Figure 66: Radiated Restricted Band Edge, Peak, High Edge, Horizontal (Hopping).

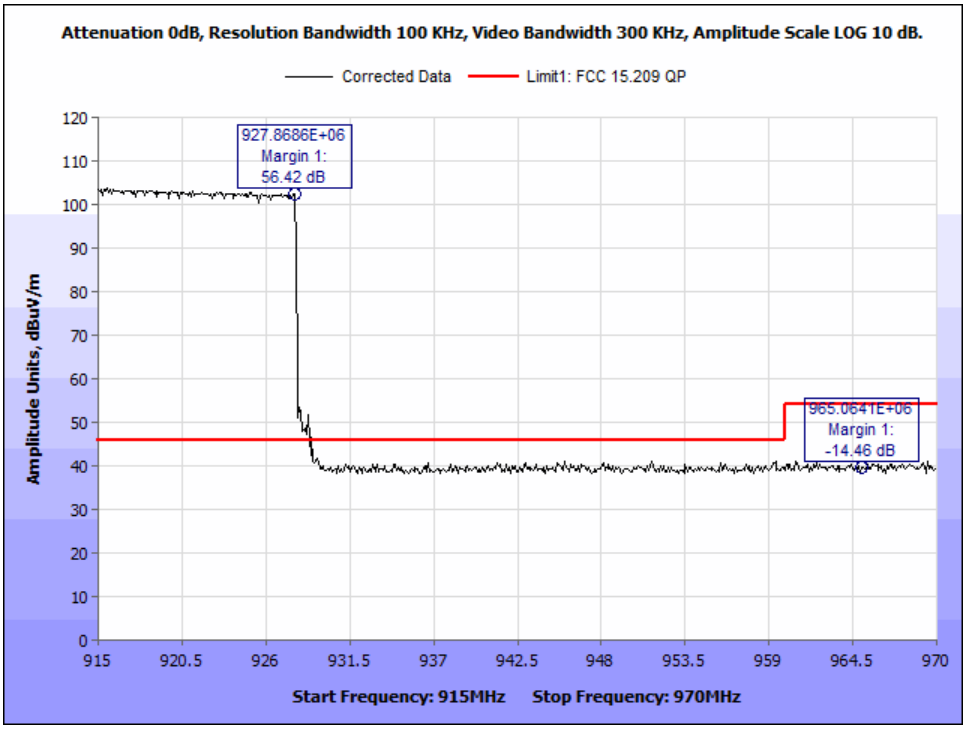

Figure 67: Radiated Restricted Band Edge, Peak – High Edge, Vertical (Hopping)

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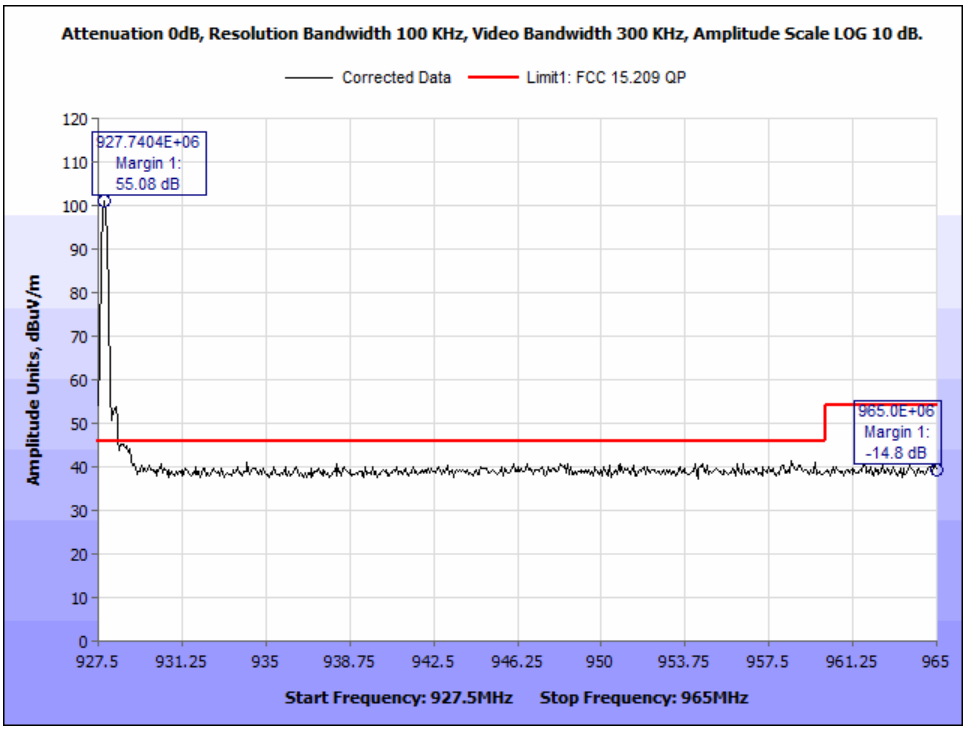

Figure 68: Radiated Restricted Band Edge, Peak, 927.8 MHz – High Edge Vertical

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100 KHz Bandwidth Radiated Spurious Emissions Test Results

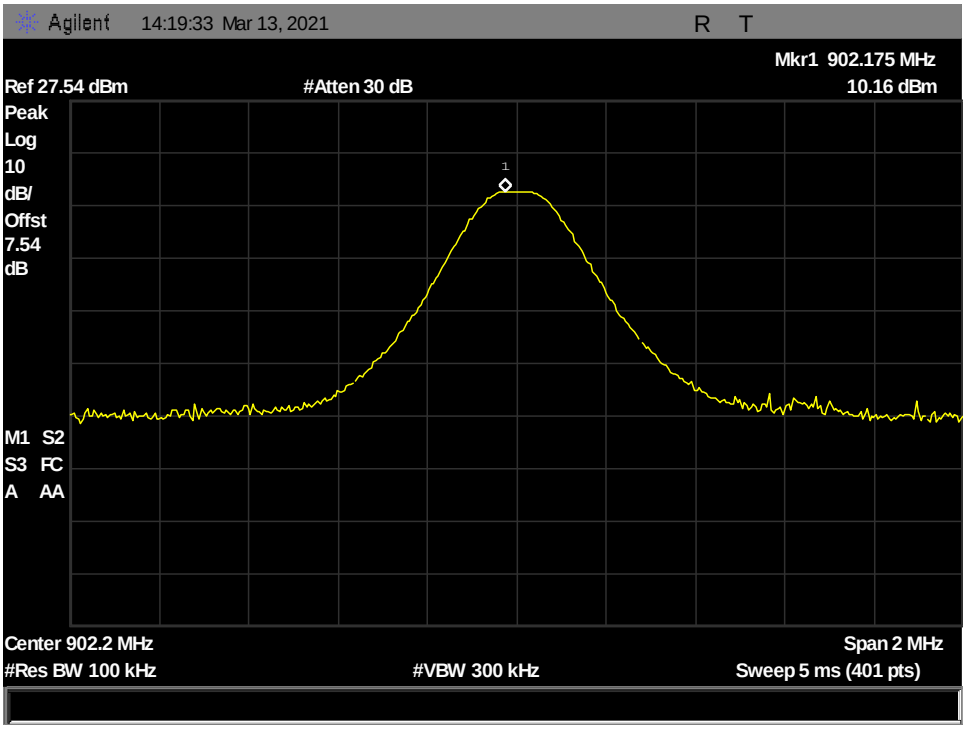

Figure 69: Radiated Spurious Emissions, Low Channel 902.2 MHz, 100KHz, RBW Reference Level

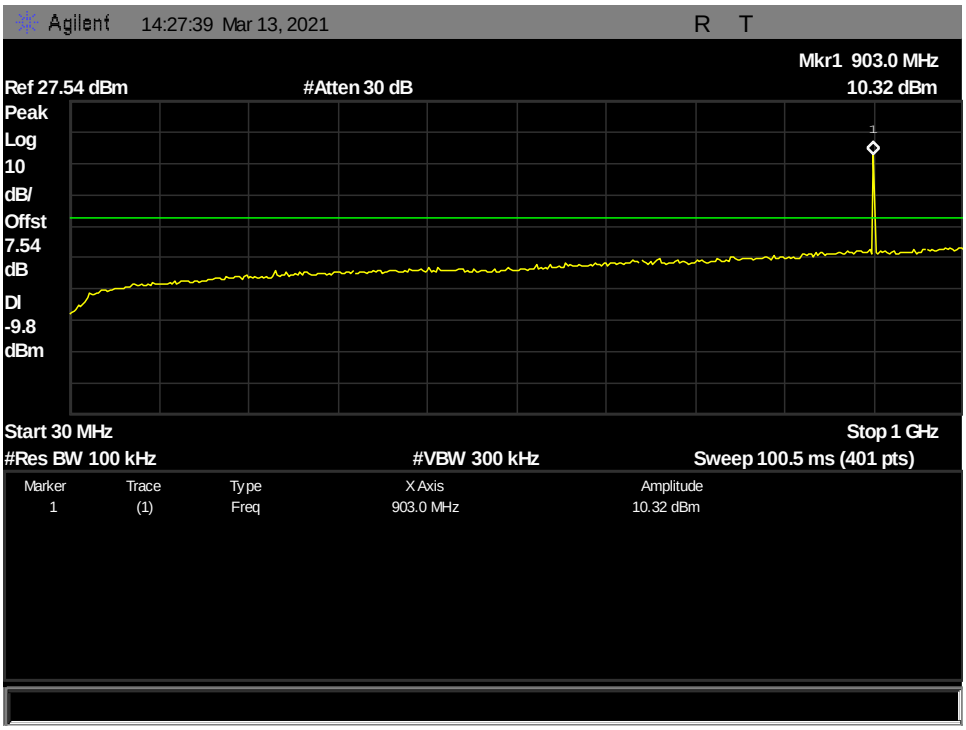

Figure 70: Radiated Spurious Emissions, Low Channel 902.2 MHz, 30MHz-1GHz

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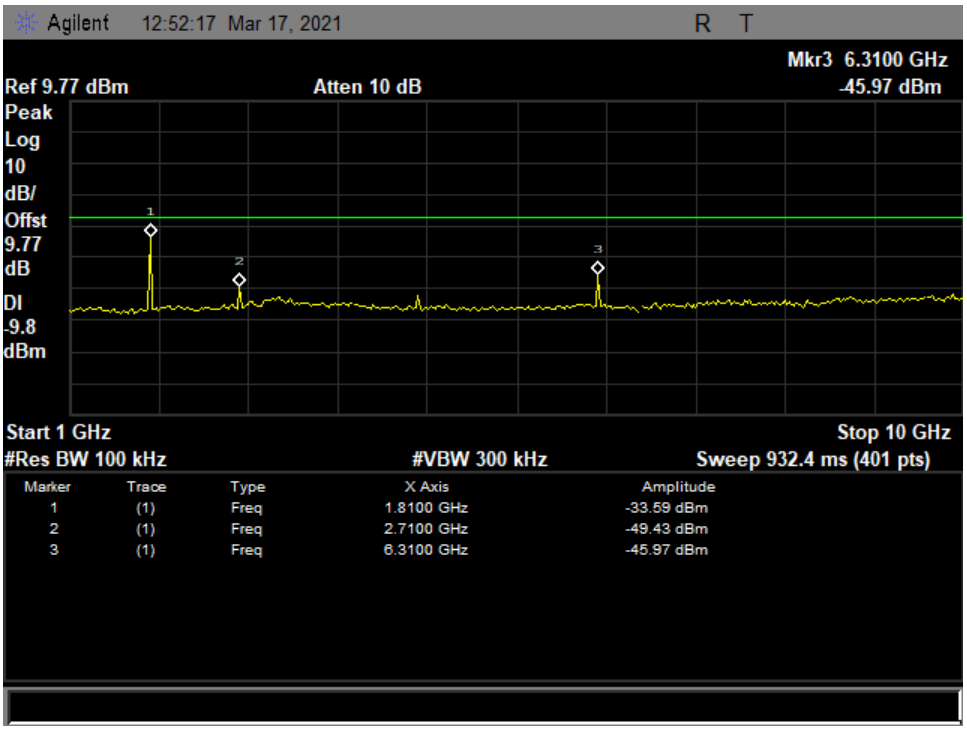

Figure 71: Radiated Spurious Emissions, Low Channel 902.2 MHz, 1GHz-10GHz

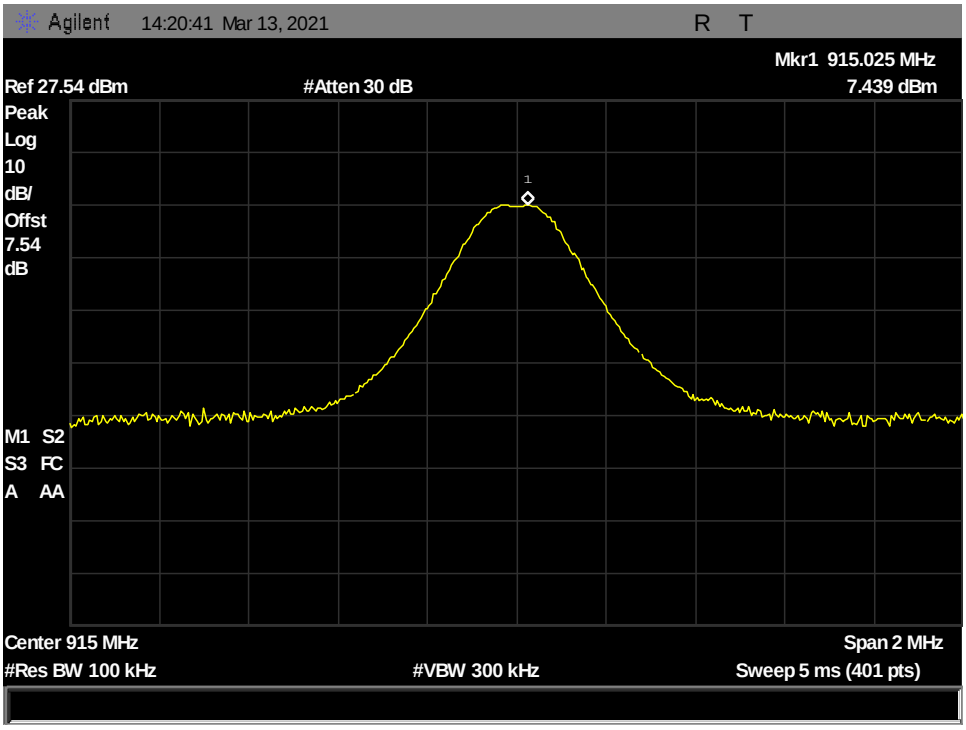

Figure 72: Radiated Spurious Emissions, Mid Channel 915 MHz, 100KHz, RBW Reference Level

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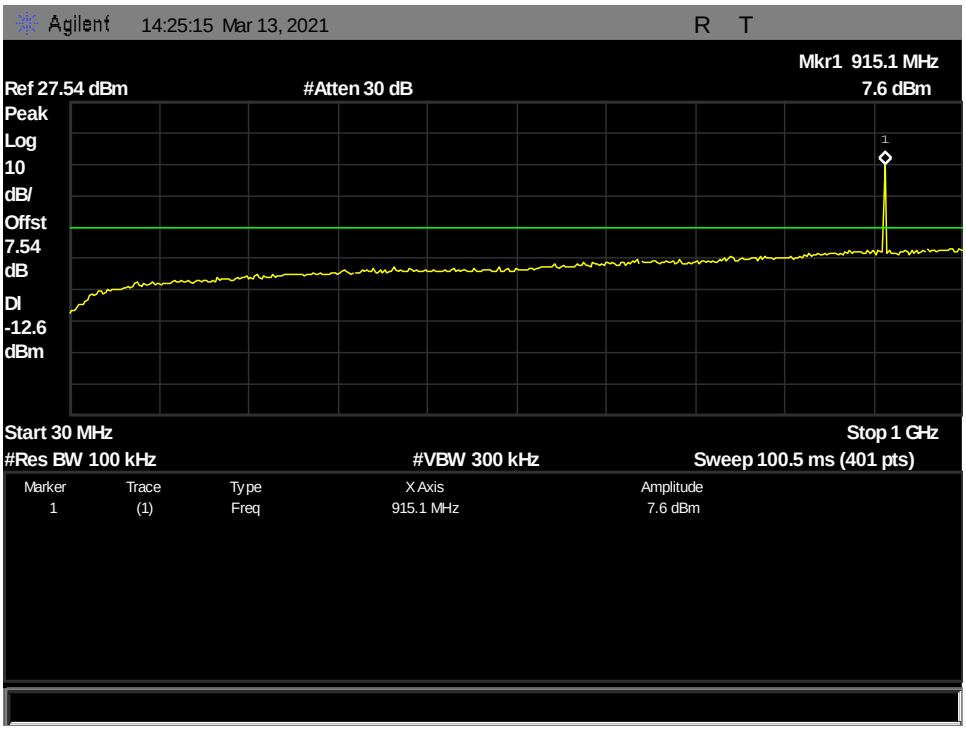

Figure 73: Radiated Spurious Emissions, Mid Channel 915 MHz, 30MHz-1GHz

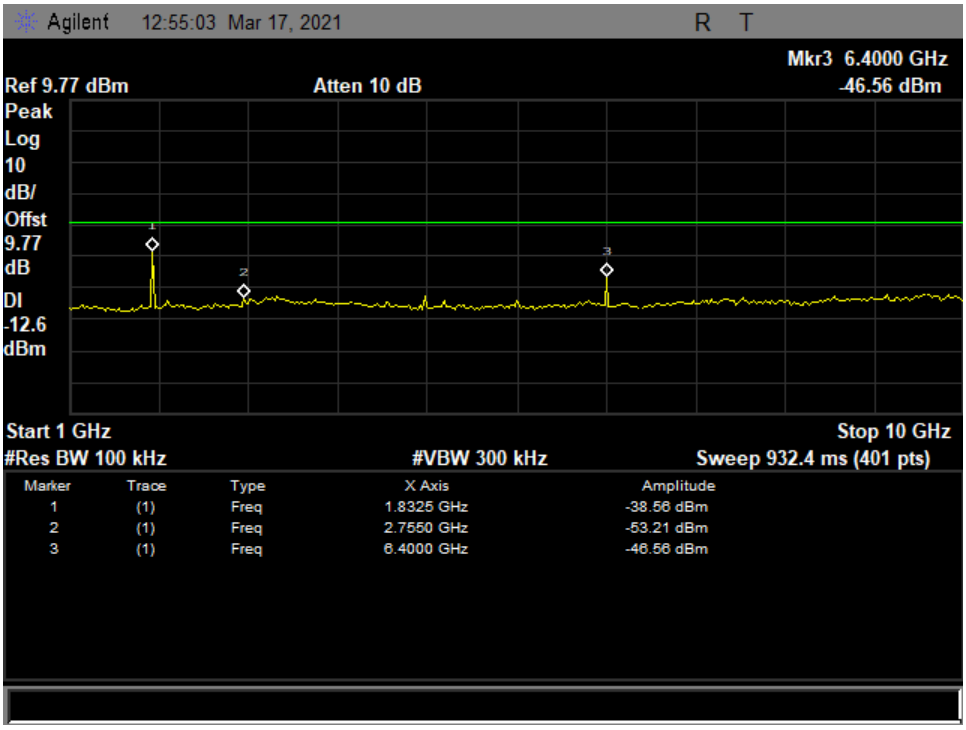

Figure 74: Radiated Spurious Emissions, Mid Channel 915 MHz, 1GHz-10GHz

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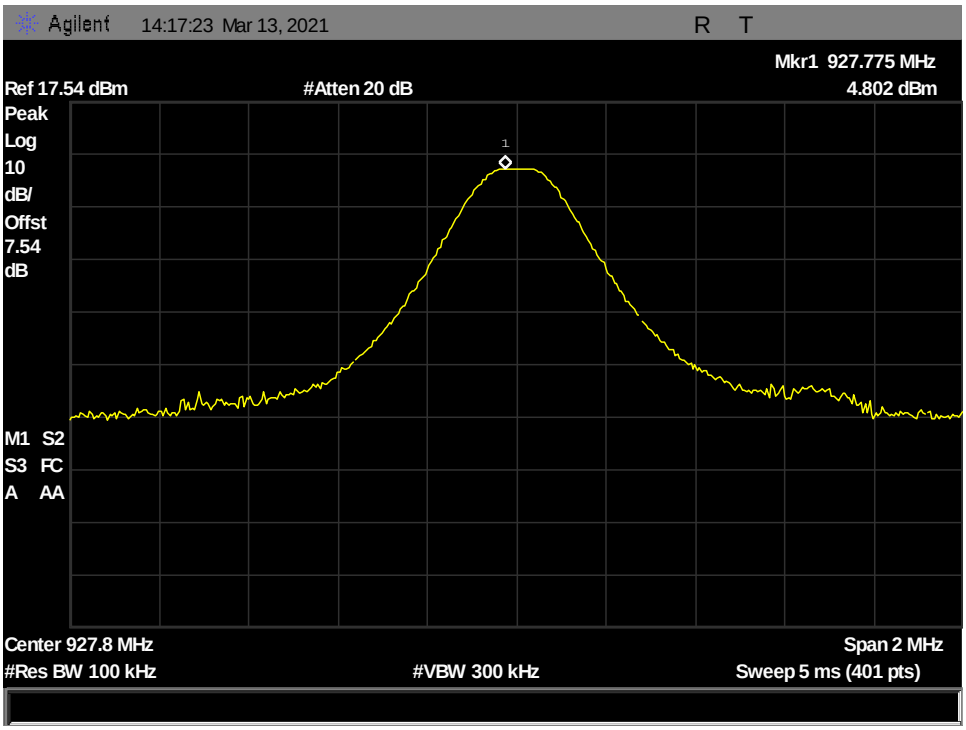

Figure 75: Radiated Spurious Emissions, High Channel 927.8 MHz, 100KHz, RBW Reference Level

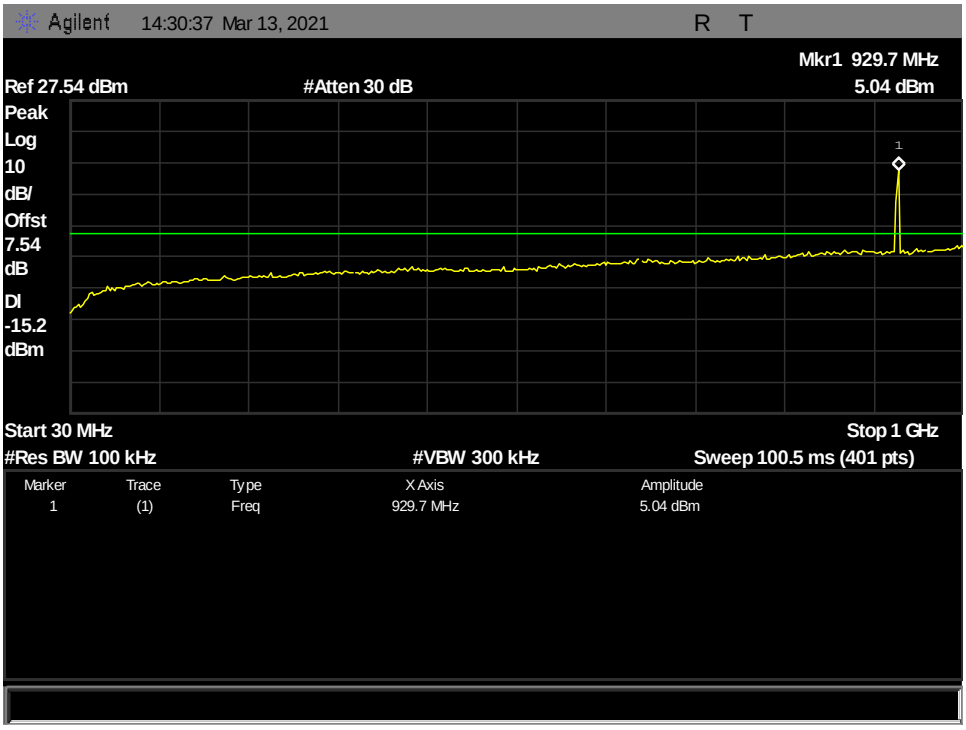

Figure 76: Radiated Spurious Emissions, High Channel 927.8 MHz, 30MHz-1GHz

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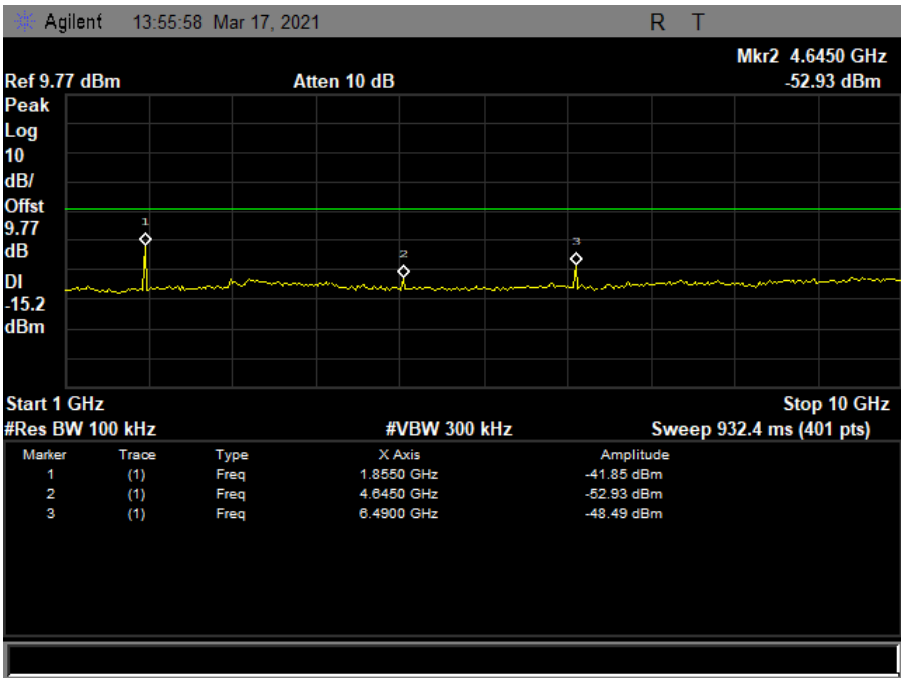

Figure 77: Radiated Spurious Emissions, High Channel 927.8 MHz, 1GHz-10GHz

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100 KHz Bandwidth Radiated Band Edge Test Results:

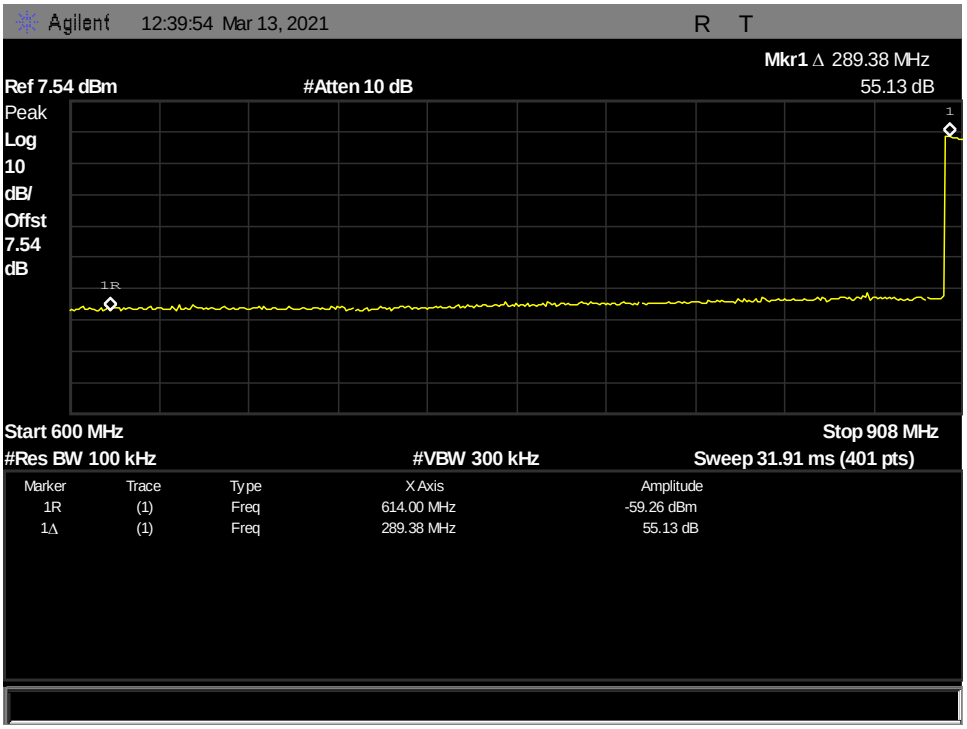

Figure 78: Radiated Band Edge, Low Edge (Hopping)

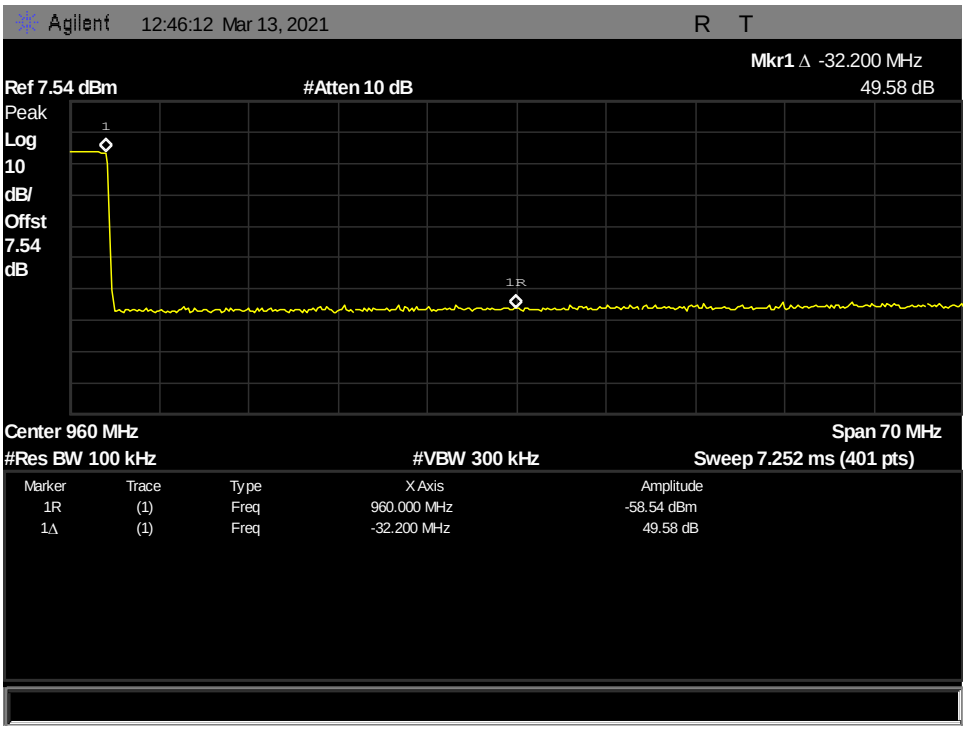

Figure 79: Radiated Band Edge, High Edge (Hopping)

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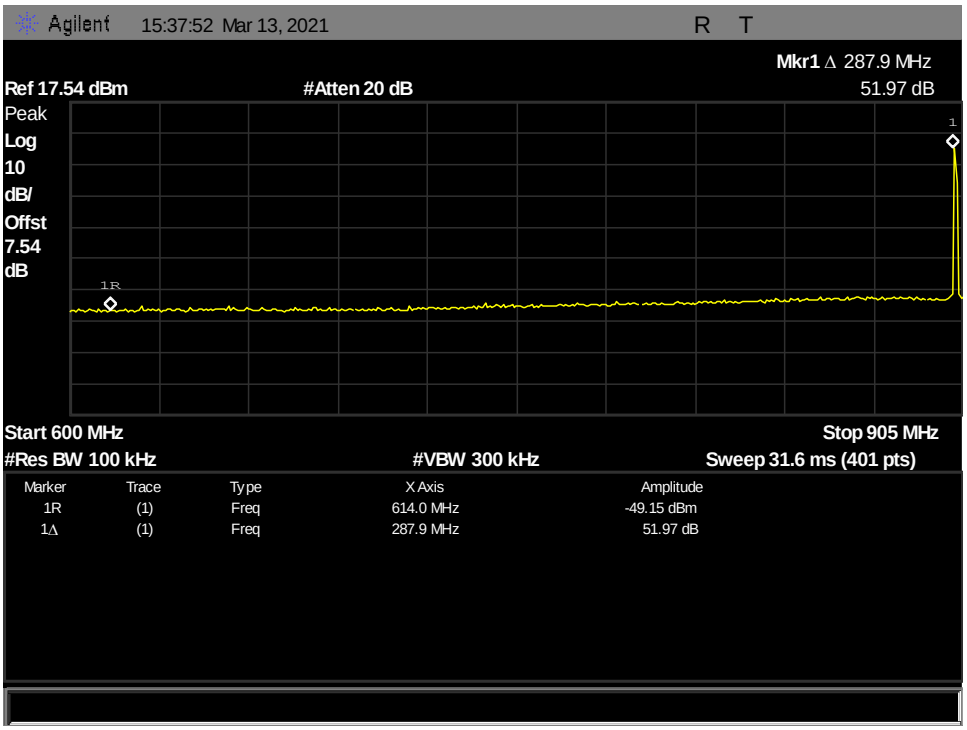

Figure 80: Radiated Band Edge, Low Edge 902.2 MHz

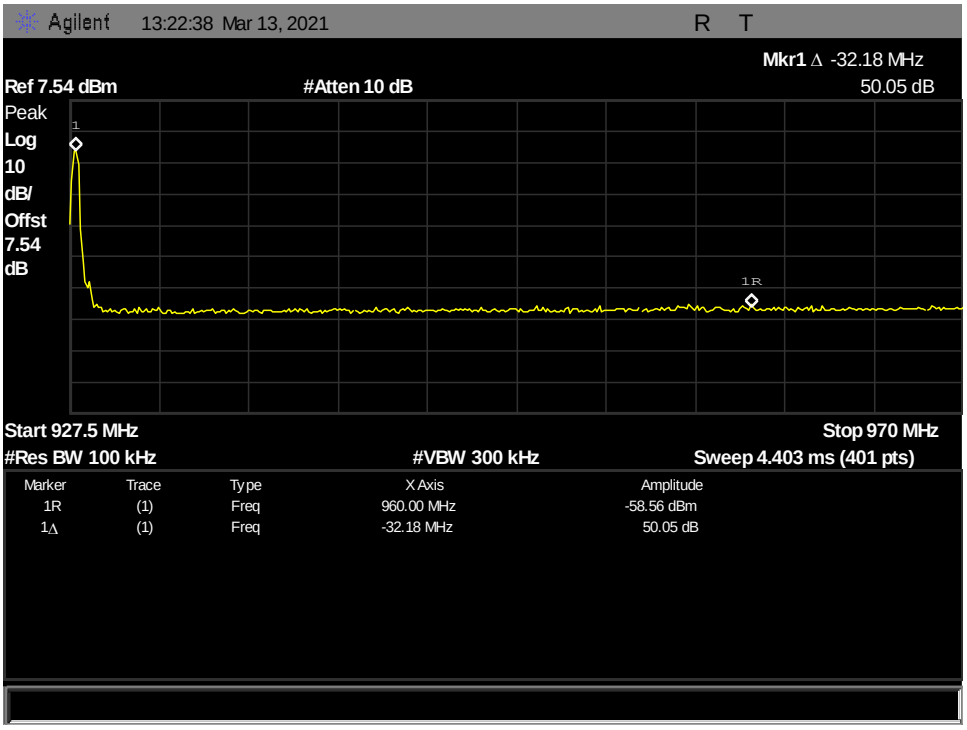

Figure 81: Radiated Band Edge, High Edge 927.8 MHz

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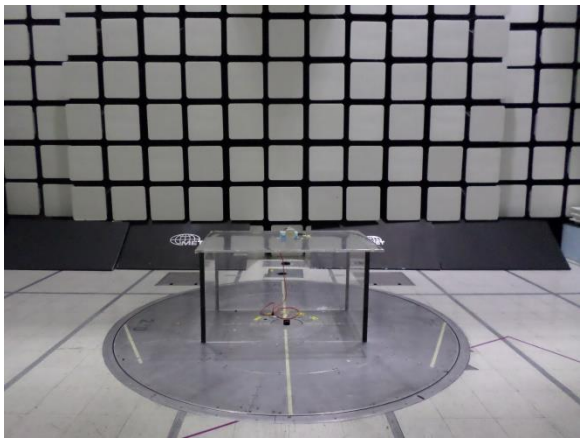

Figure 82: Radiated Spurious Emissions, 30MHz-1000MHz - Setup Front View

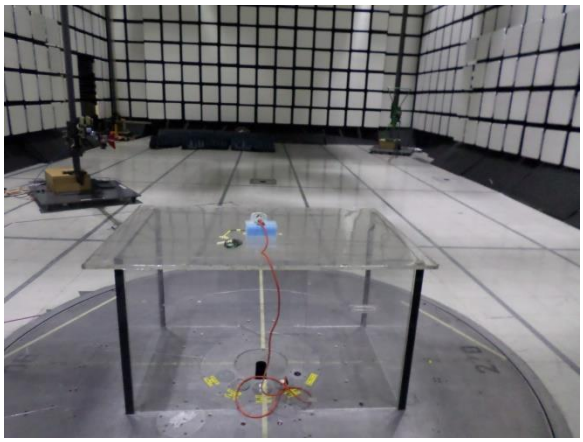

Figure 83: Radiated Spurious Emissions, 30MHz-1000MHz - Setup Rear View

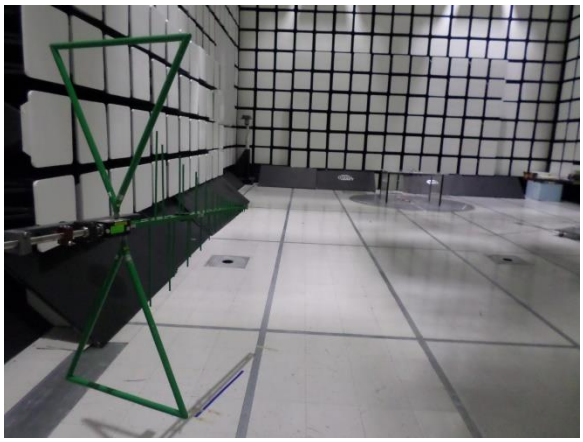

Figure 84: Radiated Spurious Emissions, 30MHz-1000MHz - Setup Antenna View

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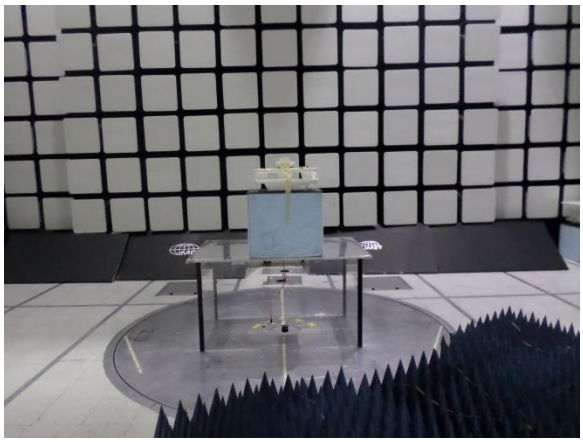

Figure 85: Radiated Spurious Emissions, 1GHz-10GHz - Setup Front View

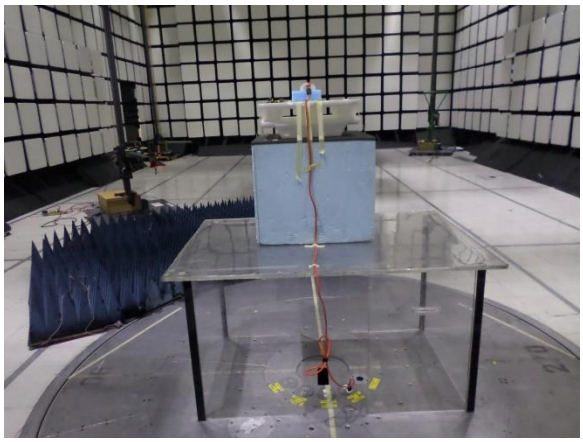

Figure 86: Radiated Spurious Emissions, 1GHz-10GHz - Setup Rear View

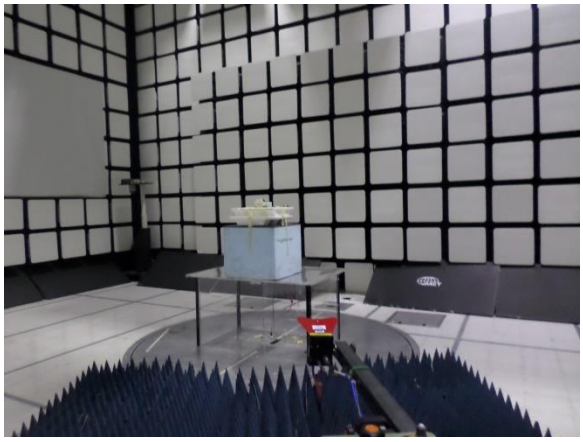

Figure 87: Radiated Spurious Emissions, 1GHz-10GHz - Setup Antenna View

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(g)(h) Declaration Statements for FHSS

NOISEAWARE™

NoiseAware, Inc.

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RE: DECLARATION STATEMENT FOR FHSS **INDOOR NOISE SENSOR, FCC# 2AQIP-NA3N301**

Compliance for section 15.247(g):

The 915MHz system-on-chip (SOC) within the NoiseAware Indoor Noise Sensor (Gen3.1 Collector) device complies with the IEEE 802.15.4e standard and uses a Time Synchronized Channel Hopping (TSCH) MAC. According to this specification, the device transmits packets with a pseudorandom hopping pattern across 129 channels when presented with continuous data. Short burst transmissions from the system are also transmitted with pseudorandom frequency hopping.

Compliance for section 15.247(h):

The IEEE 802.15.4e compliant SOC does not use intelligence to adapt its hopset to avoid occupied channels, and it does not coordinate with any other FHSS systems to avoid simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Please contact me if there is any information you may need.

Sincerely,

Garrett Dobbs, Head of Product

04/08/21

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Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(i) Maximum Permissible Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit: EUT's operating frequencies @ 2400-2483.5 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{(PG / 4\pi S)}$$

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)

FCC									
Frequency (MHz)	Conducted Power (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
902.2	21.56	143.219	1	1.259	0.03587	1	0.96413	20	Pass

Figure 88: RF Human Exposure, Test Results

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

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Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2017.

ASSET #	NOMENCLATURE	MANUFACTURER	MODEL	LAST CAL	CAL DUE
1A1065	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESCI	06/22/2020	06/22/2021
1A1177	PULSE LIMITER	ROHDE & SCHWARZ	ESH3-Z2	06/10/2020	06/10/2021
1A1227	TRUE RMS METER	FLUKE	114	10/16/2020	10/16/2021
1A1119	CONDUCTED EMISSIONS GROUND PLANE	N/A	N/A	06/10/2020	06/10/2021
1A1149	DC MILLIOHM METER	GW INSTEK	GOM-802	06/10/2020	06/10/2021
1A1169	TEMP, HUMIDITY, AND PRESSURE RECORDER	OMEGA	OM-CP-PRHTEMP2000	02/19/2021	02/19/2022
1A1184	SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	08/24/2020	08/24/2021
1A1083	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESU40	10/16/2020	10/16/2021
1A1050	BILOG ANTENNA (30-1000 MHZ)	SUNOL SCIENCES CORP	JB3	12/01/2020	12/01/2022
1A1183	DOUBLE RIDGED WAVEGUIDE ANTENNA (1-18 GHZ)	ETS LINDGREN	3117	06/01/2020	06/01/2022
1A1099	1A1099	GENERATOR	COM-POWER CORP	SEE NOTE	SEE NOTE
1A1044	1A1044	GENERATOR	COM-POWER CORP	SEE NOTE	SEE NOTE
1A1088	PRE-AMP	ROHDE & SCHWARZ	TS-PR1	SEE NOTE	SEE NOTE
1A1080	MULTI-DEVICE CONTROLLER	ETS-EMCO	2090	SEE NOTE	SEE NOTE
1A1073	MULTI-DEVICE CONTROLLER	ETS-EMCO	2090	SEE NOTE	SEE NOTE
1A1180	PRE-AMP	MITEQ	AMF-7D-01001800-22-10P	SEE NOTE	SEE NOTE
1A1106	10M SEMI-ANECHOIC CHAMBER	LINDGREN	N/A	SEE NOTE	SEE NOTE

Figure 89: Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

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End of Report

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