

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, Gen 3.1 Node 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
Documentation Department

Reference: (\NoiseAware\WIRA111308B-FCC247 DSS Rev. 1)



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Electromagnetic Compatibility Criteria Test Report

for the

**NoiseAware
Gen 3.1 Node**

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

Report: WIRA111308B-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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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

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 Gen 3.1 Node, 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 Gen 3.1 Node. NoiseAware should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Gen 3.1 Node, 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	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	Conducted Emission Limits	Not Applicable
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 Compliance Testing

Equipment Configuration

A. Overview

Eurofins Electrical and Electronic Testing NA, Inc. was contracted by NoiseAware to perform testing on the Gen 3.1 Node, 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, Gen 3.1 Node.

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

Model(s) Tested:	Gen 3.1 Node
Model(s) Covered:	Gen 3.1 Node
EUT Specifications:	Primary Power: 3.3 VDC
	FCC ID: 2AQIP-NA3N302
	Type of Modulations:
	DHICF
	Equipment Code:
	DSS
	Peak RF Output Power:
	18.37 dBm
	EUT Frequency Ranges:
	902-928 MHz
Analysis:	Antenna Gain:
	1 dBi
	Antenna Type:
	Ceramic Chip
	EUT Software as tested:
	Custom Software Version 2.0.0
	Support Software:
	VNC Viewer
	The results obtained relate only to the item(s) tested.
Environmental Test Conditions:	Temperature: 15-35°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

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%
Radiated Emissions, (30 MHz – 1 GHz)	± 2.95 dB	2	95%
Radiated Emissions, (1 GHz – 18 GHz)	± 3.54 dB	2	95%
RF Power Radiated Emissions	± 3.01 dB	2	95%

Figure 4: Uncertainty Calculations Summary

E. Description of Test Sample

The NoiseAware Gen 3.1 Node, Equipment Under Test (EUT), is a battery-powered noise monitoring device that can be mounted in a wide range of locations with a screw, zip-ties, or mounting tape. This device monitors volume levels and reports volume data to a paired Indoor Noise Sensor (Gen 3.1 Collector). It is intended to be used by professional property managers in outdoor areas of short-term rental residences.

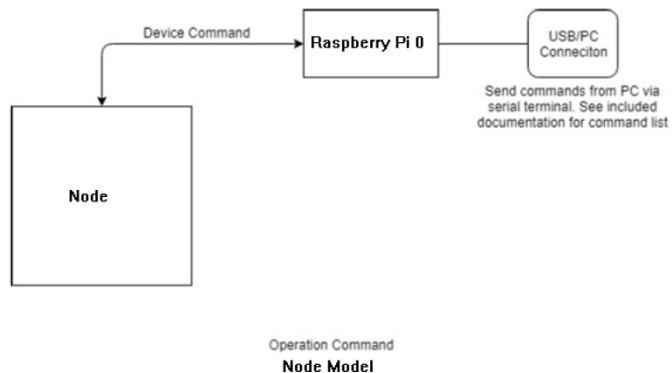


Figure 5: Block Diagram of Test Configuration

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	Name / Description	Model Number	Part Number	Serial Number	Revision
1	Gen 3.1 Node	NA3N102	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
2	Raspberry Pi	Raspberry Pi	Zero V1.3	N/A
3	GP Lithium Battery	GP	CR123A 3V	N/A
4	Laptop	BOCCONI	N3350	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
5	USB (support equipment only, not EUT)	USB	1	1	1	N/A	Pi Zero USB

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.

J. Method of Monitoring EUT Operation

The device has an LED indicator near the battery tray: 1) During normal operation the LED is off. In normal operation the device will either operate in 'orphan mode' and will poll for a Gen 3.1 Collector device to pair with, or in 'paired mode' and will monitor and transmit volume data to the paired Gen 3.1 Collector. The LED will blink quickly only when batteries are installed to indicate the device has successfully powered on.

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.

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** with the criteria of §15.203. Gen3.1 Node 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

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 μ H/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 (dB μ V)	
	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 0.8 m-high wooden table inside a screen room. 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 μ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMC/field intensity meter.

Test Result:

This test was **not applicable**. EUT is battery-powered.

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, March 16, 2021

Center Frequency (MHz)	20 dB Occupied Bandwidth (KHz)
902.2	90.357
915	89.187
927.8	89.474

Figure 11: 20 dB Occupied Bandwidth, Test Results

20 dB Occupied Bandwidth Test Results

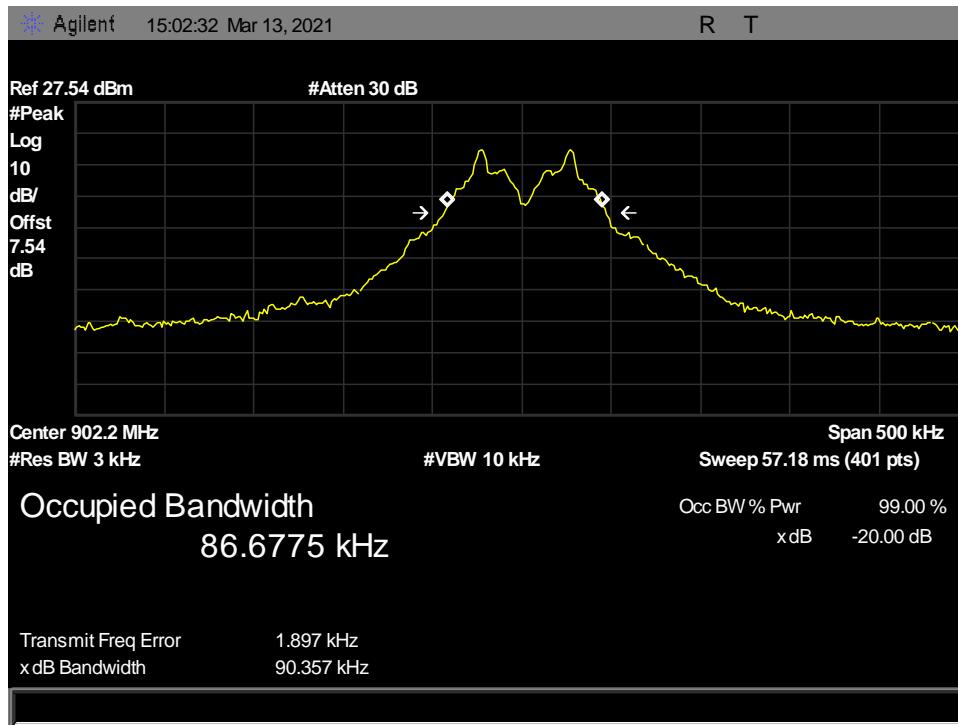


Figure 12: 20 dB Occupied Bandwidth, 902.2 MHz – Low Channel

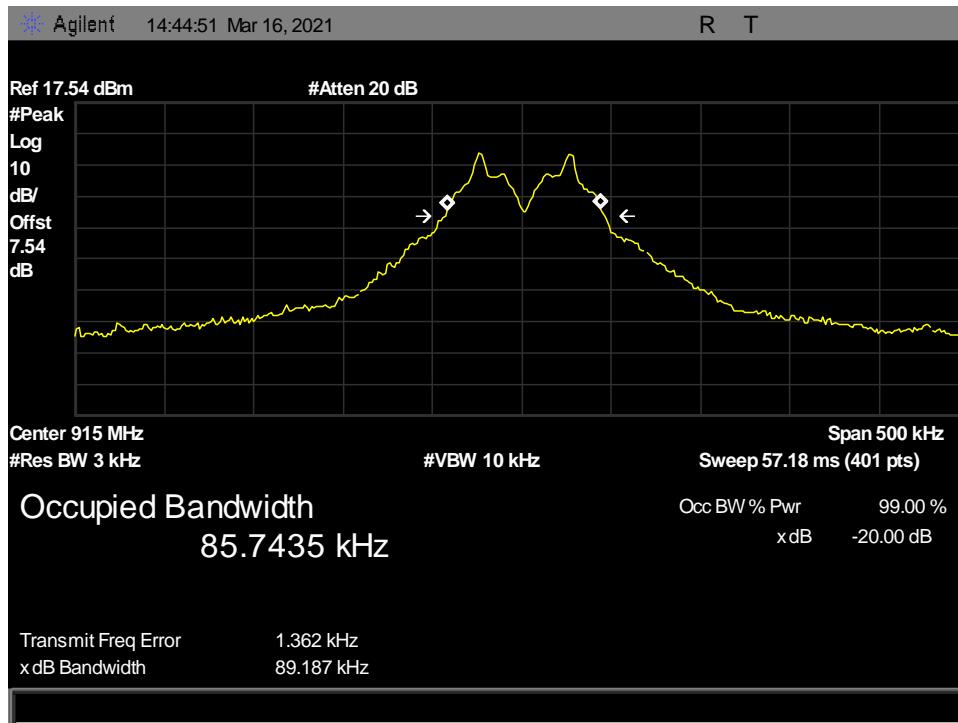


Figure 13: 20 dB Occupied Bandwidth, 915 MHz – Mid Channel

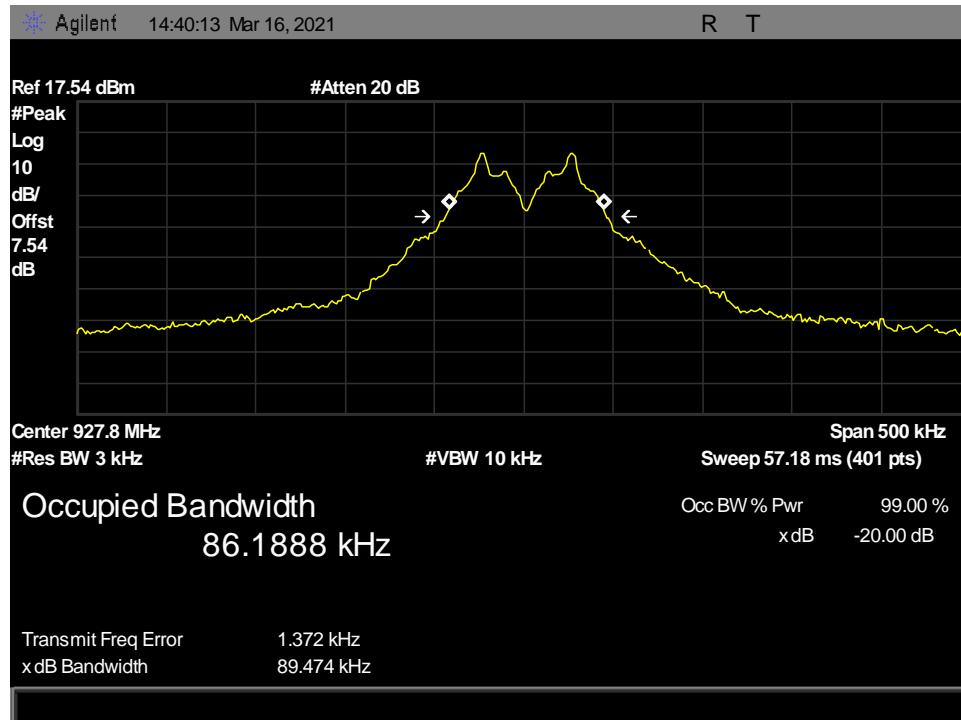


Figure 14: 20 dB Occupied Bandwidth, 927.8 MHz – High Channel

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):

February 25, 2021

$$\text{Hopping Period} = \text{Number of Channels} * 0.4 \text{ s} = 129 * 0.4 \text{ s} = 51.6 \text{ s}$$

$$\text{Burst Duration} = \text{Hopping period} * \text{duration per hop} = 51.6 \text{ s} * 0.01 \text{ s} = 0.516 \text{ s}$$

$$\text{Number of Burst per period} = 14$$

$$\text{Dwell time} = 14 * (0.516/20) = 0.3612$$

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 15: Average Time of Occupancy

Dwell Time

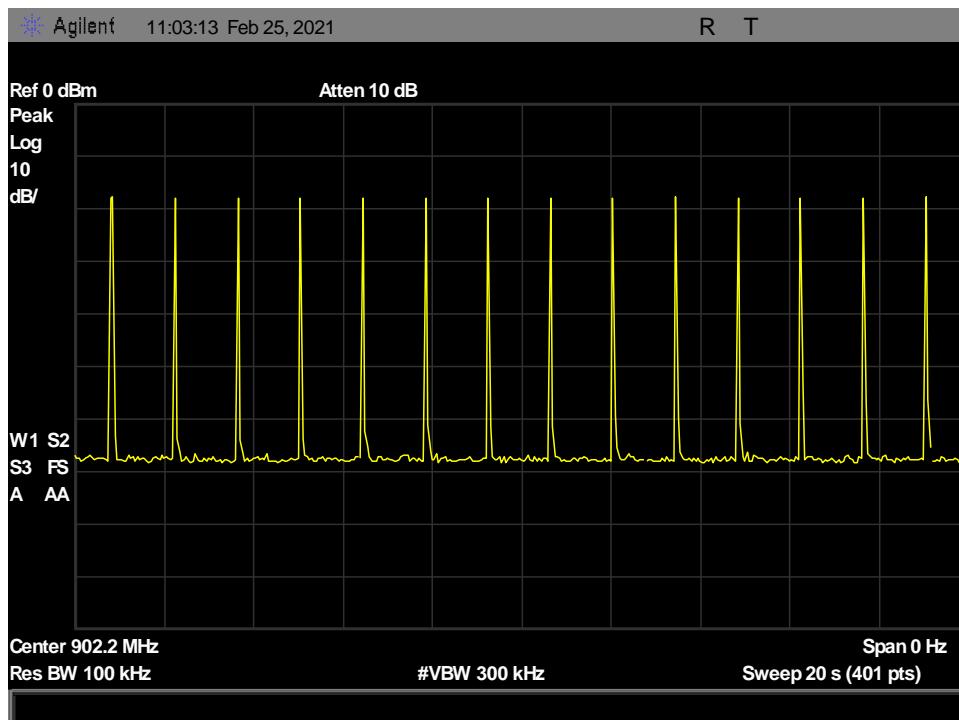


Figure 16: Dwell Time, 13 Pulses – 20s period

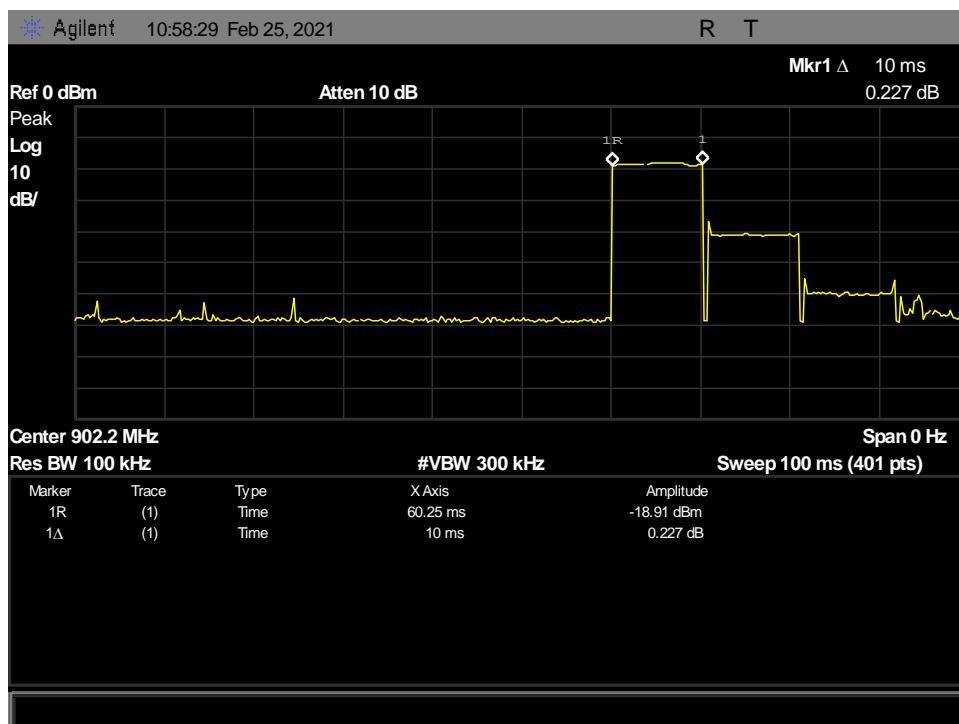


Figure 17: Dwell Time, Single Pulse – 100 ms period

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 16, 2021

Number of RF Channels Test Results

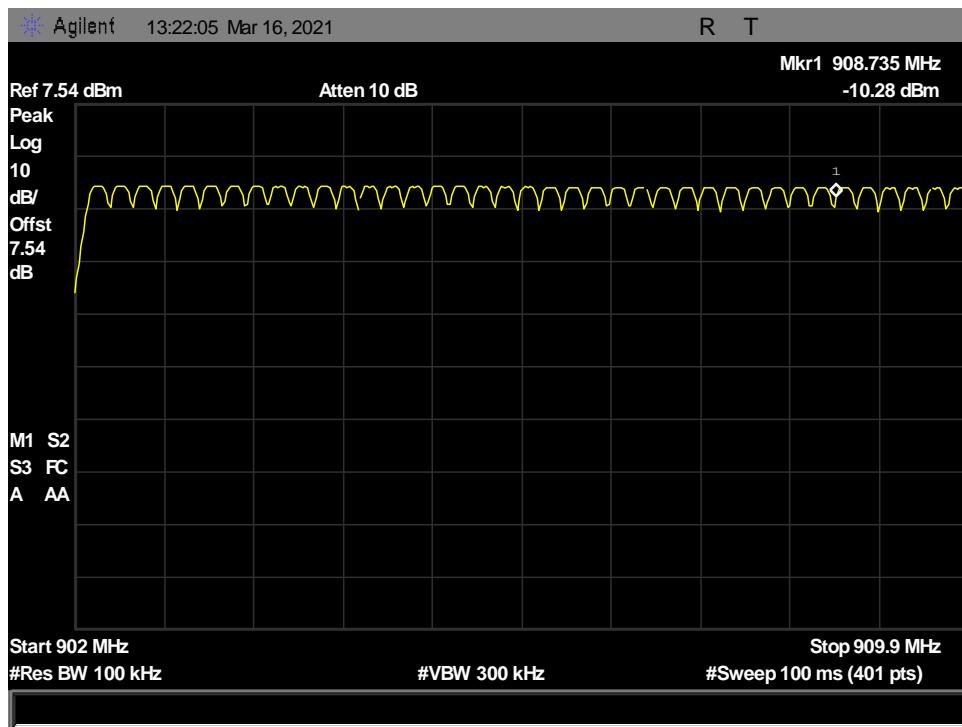


Figure 18: Number of RF Channels, 902-909.9 MHz - 39 Channels

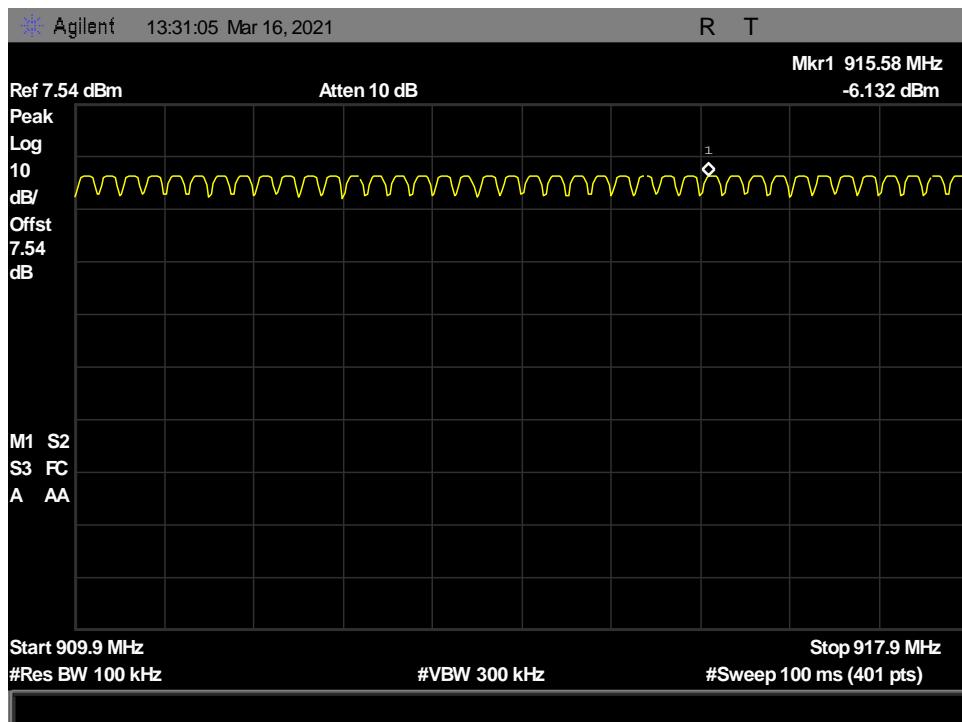


Figure 19: Number of RF Channels, 909.9-917.9 MHz - 40 Channels

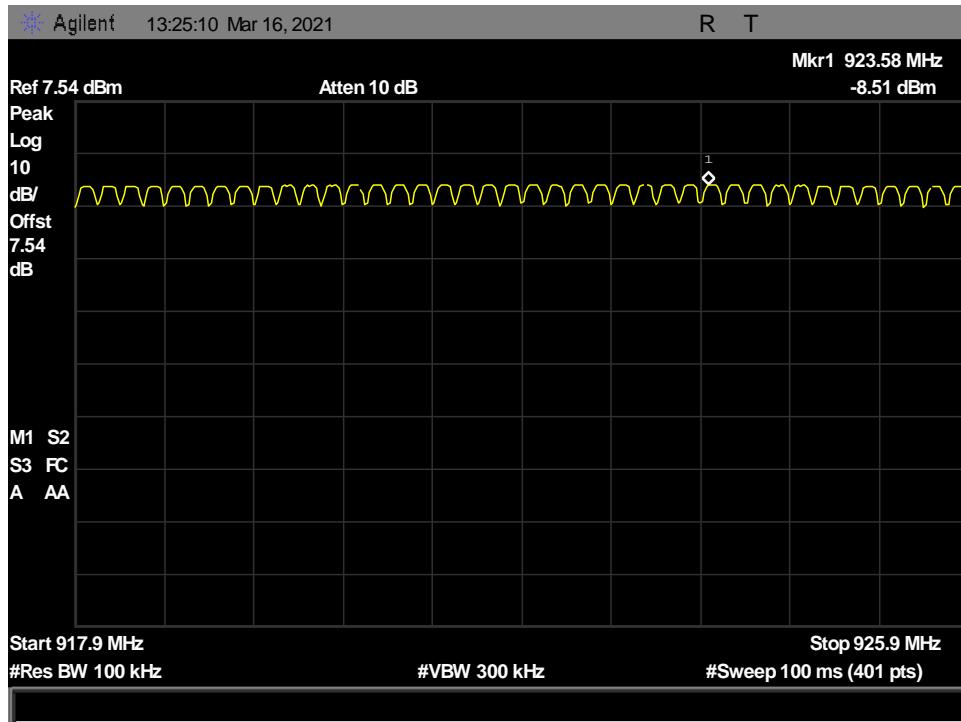


Figure 20: Number of RF Channels, 917.9-925.9 MHz - 40 Channels

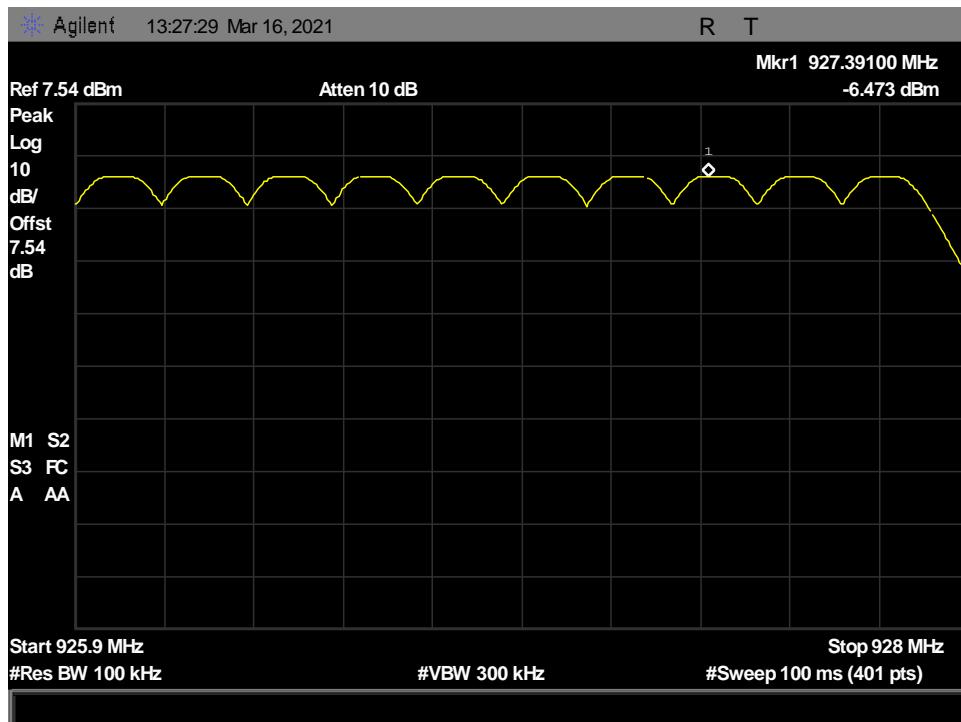


Figure 21: Number of RF Channels, 925.9-928 MHz - 10 Channels

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(a)(1) RF Channel Separation

Requirement: § 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.

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 the requirement of section § 15.247 (a)(1). Total measured channel separation is 201.5 KHz. The EUT meets the specifications of Section 15.247(a) (1) (i).

Test Engineer(s): Adan Arab

Test Date(s): March 16, 2021

RF Channel Separation Test Results

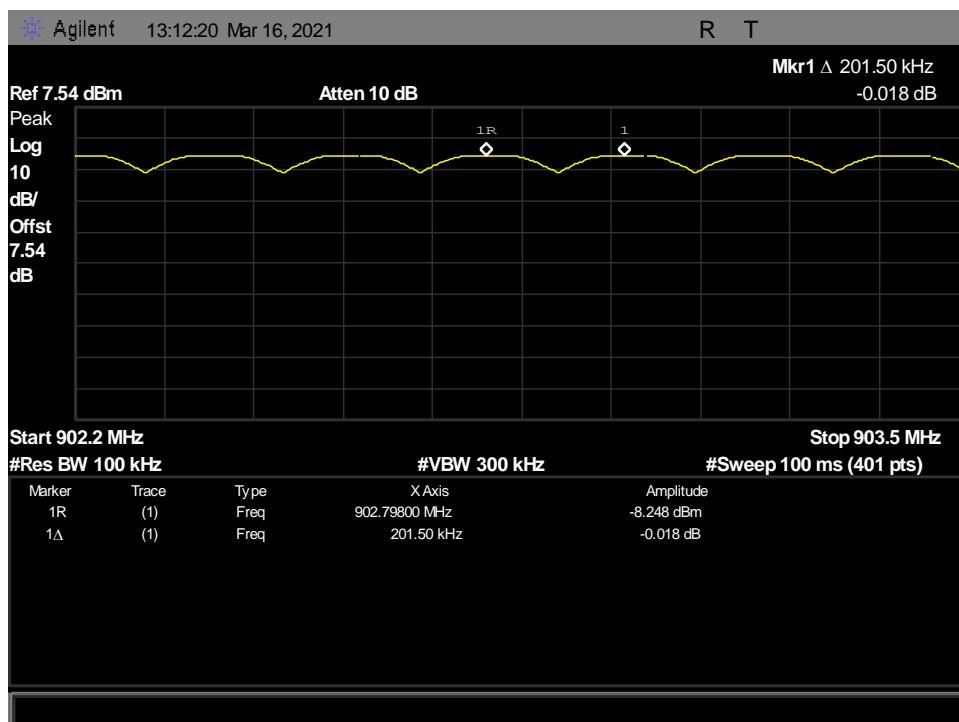


Figure 22: RF Channel Separation, 201.50 KHz

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.

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 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:

$$\text{EIRP (dBm)} = \text{E (dBuV/m)} + 20\log(d) - 104.77 + G_R$$

$$\text{EIRP (dBm)} = \text{E (dBuV/m)} + 20\log(10) - 104.77 + 4.7$$

$$\text{EIRP (dBm)} = \text{P (dBm)} + \text{G (dBi)}$$

$$\text{P(dBm)} = \text{EIRP} - \text{G (dBi)}$$

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 16, 2021

Freq (MHz)	Field Strength (dBuV/m)	Power EIRP (dBm)	Antenna Gain (dBi)	Conducted Power (dBm)	Limit (dBm)	Margin	Result
902.20	99.44	19.37	1	18.37	30	-11.63	Pass
915.00	99.29	19.22	1	18.22	30	-11.78	Pass
927.80	99.00	18.93	1	17.93	30	-12.07	Pass

Figure 23: Peak Output Power, Test Results

Peak Power Output Test Results

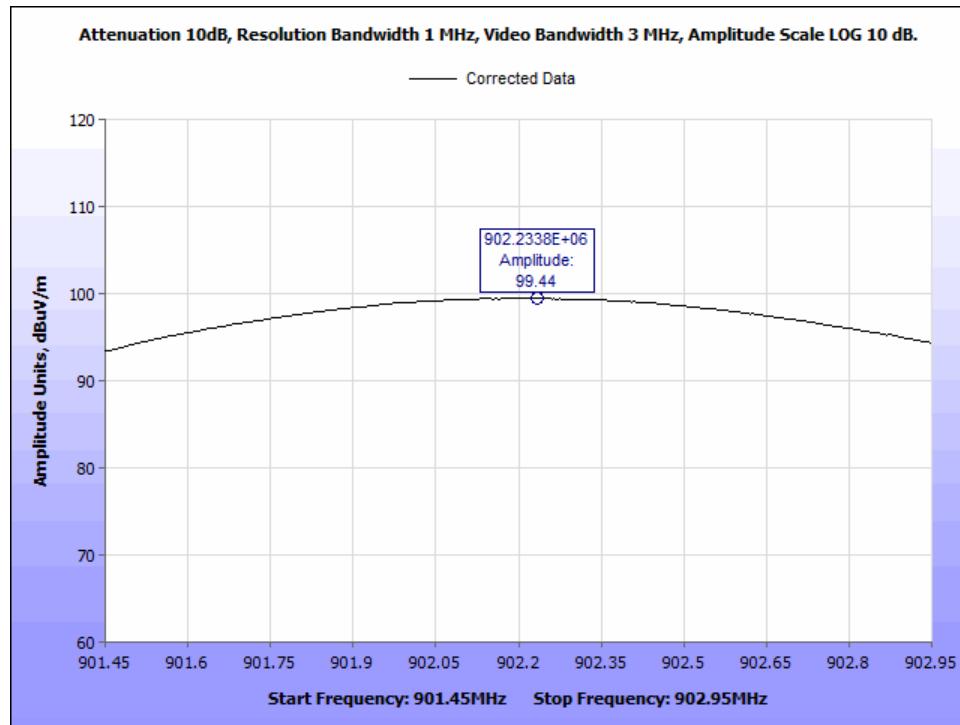


Figure 24: Peak Power Output, 902.2 MHz – Low Channel

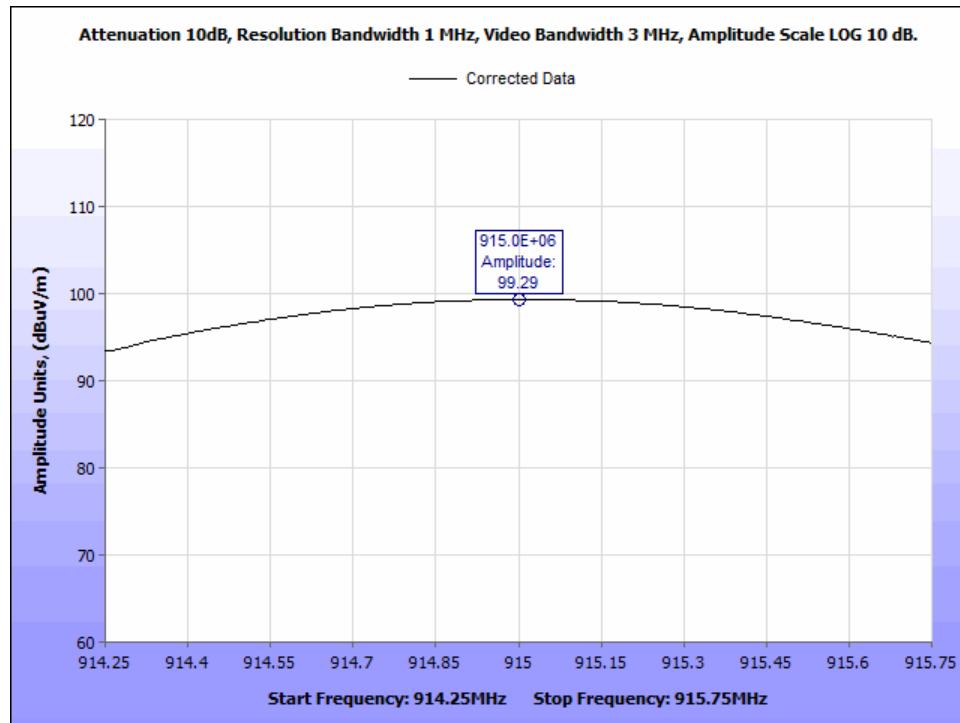


Figure 25: Peak Power Output, 915 MHz – Mid Channel

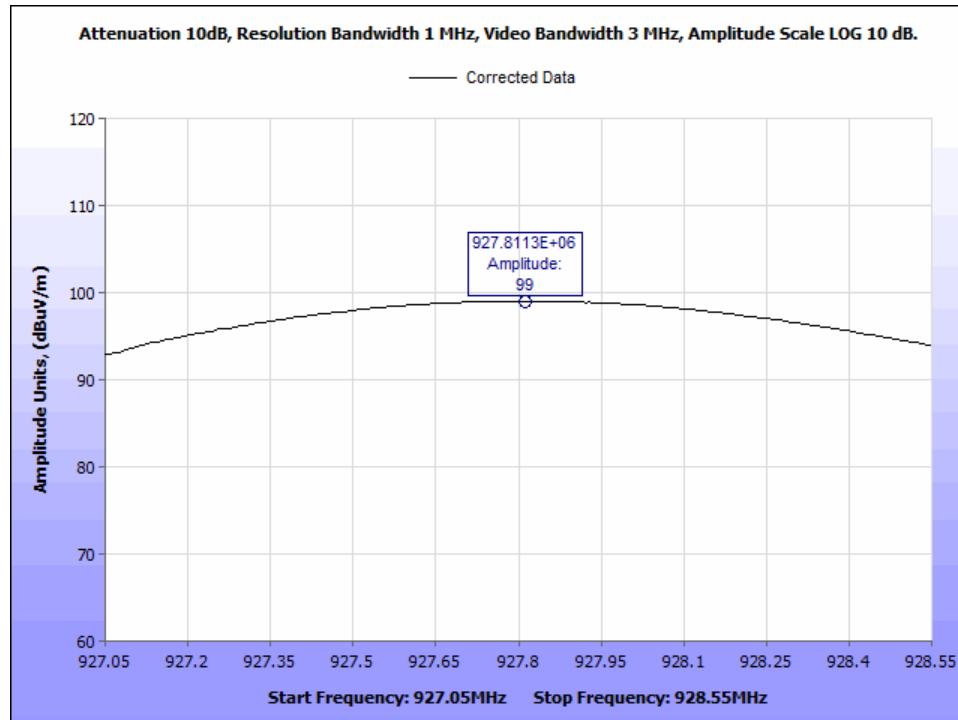


Figure 26: Peak Power Output, 927.8 MHz – High Channel

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 27: Restricted Bands of Operation

¹ Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.

² Above 38.6

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 29.

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

Figure 28: 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.

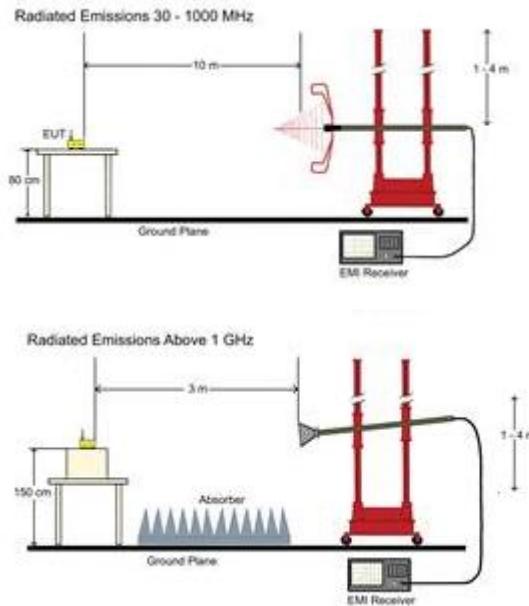


Figure 29: Radiated Spurious Emissions Test Setup

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

Test Engineer(s): Adan Arab

Test Date(s): March 3, March 16, 2021

Radiated Spurious Emissions Test Results

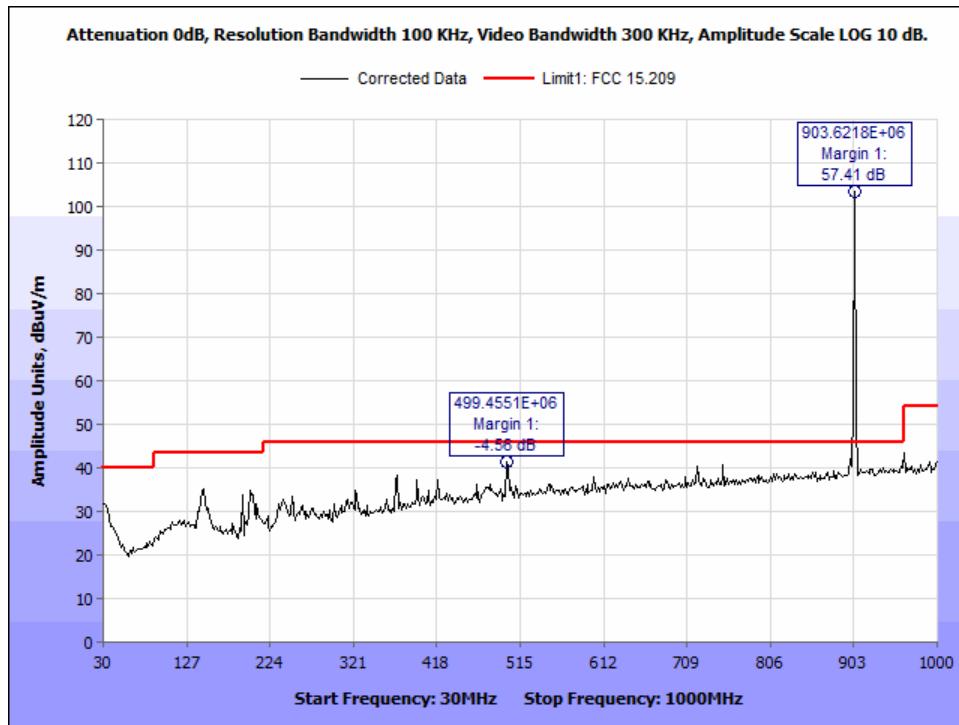


Figure 30: Radiated Emissions Limits, 902.2 MHz - 30MHz-1000MHz - Horizontal

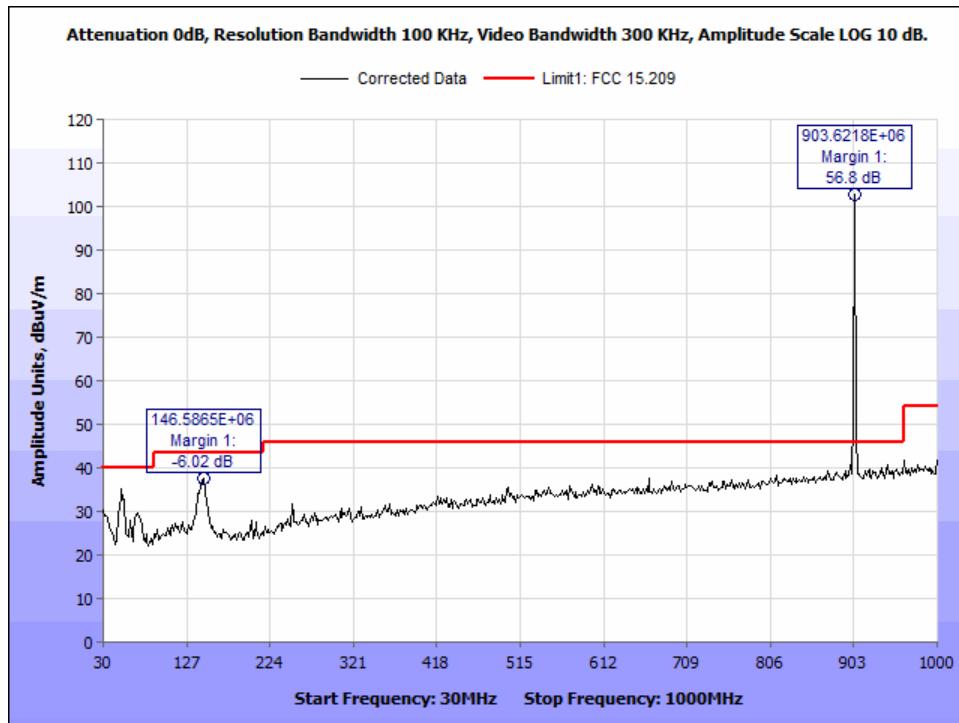


Figure 31: Radiated Emissions Limits, 902.2 MHz - 30MHz-1000MHz – Vertical

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
51.7628	37.640	V	100	0	10.46	11.59	-24.38	35.32	40	-4.68	
146.5865	35.850	V	146	134	10.46	14.54	-23.37	37.48	43.5	-6.02	
499.4551	31.140	H	300	122	10.46	21.5	-21.66	41.44	46	-4.56	
898.9583	26.500	H	100	88	10.46	24.7	-19.64	42.02	46	-3.98	
903.6218	87.860	H	400	78	10.46	24.7	-19.61	103.41	46	57.41	See Note
903.6218	86.880	V	180	95	10.46	25.06	-19.61	102.80	46	56.80	See Note

Note: Emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section.

Figure 32: Radiated Spurious Emissions, 902.2 MHz - 30-1000 MHz – Test Results

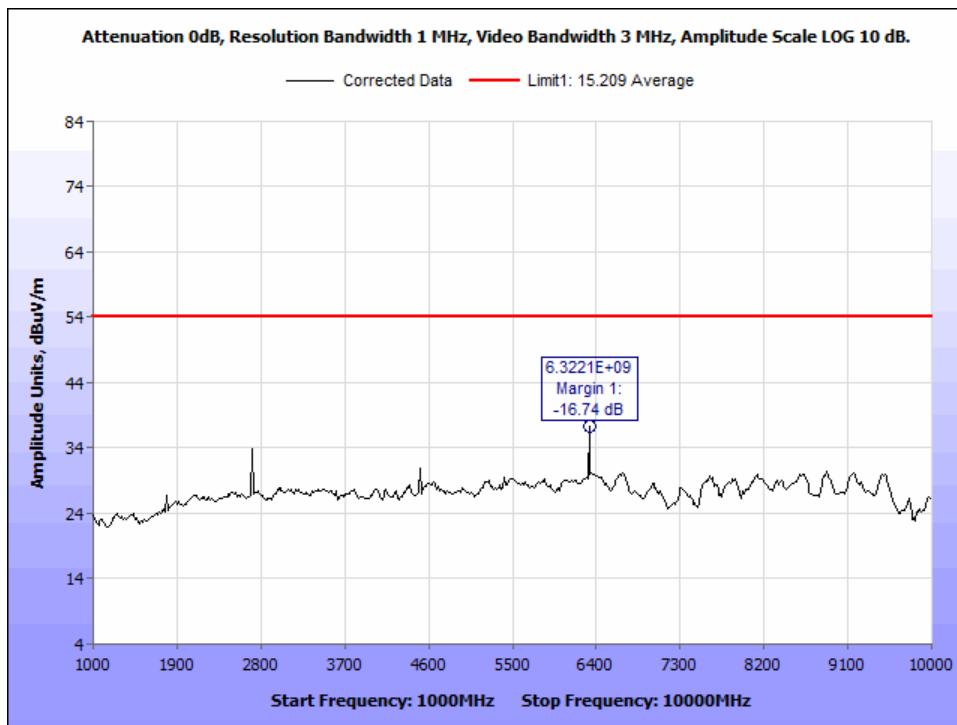


Figure 33: Radiated Emissions Limits, 902.2 MHz - 1GHz-10GHz - Average - Horizontal

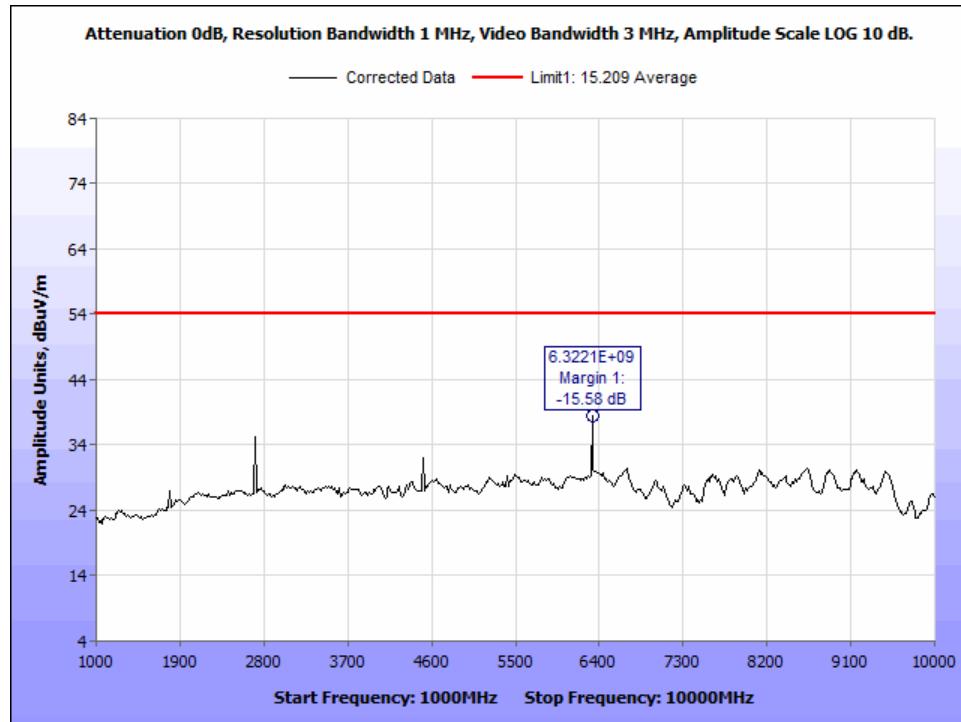


Figure 34: Radiated Emissions Limits, 902.2 MHz - 1GHz-10GHz - Average - Vertical

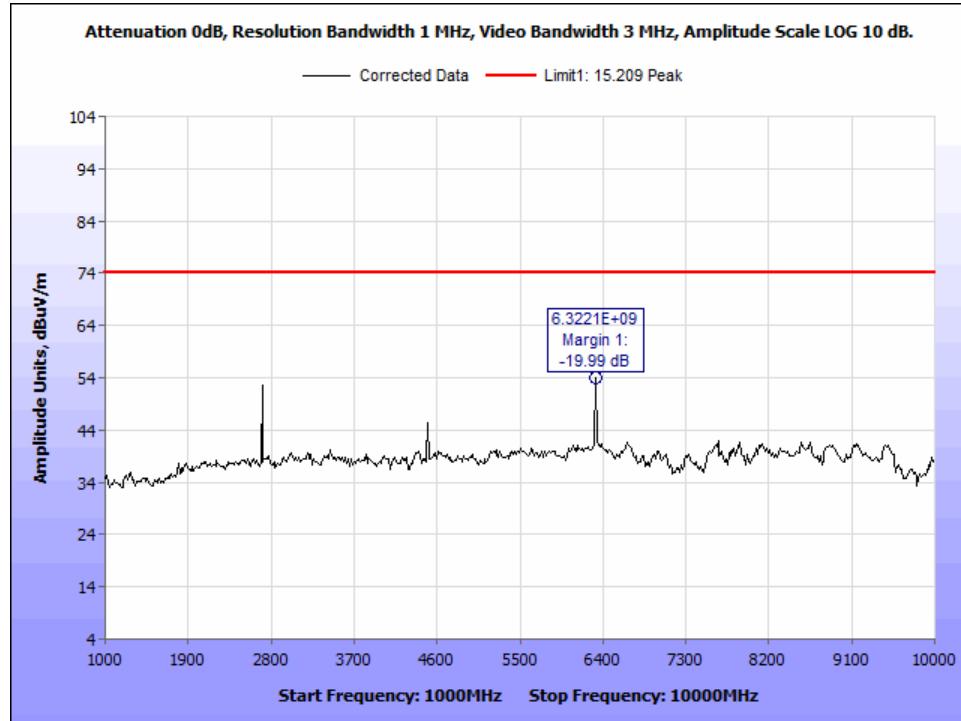


Figure 35: Radiated Emissions Limits, 902.2 MHz - 1GHz-10GHz - Horizontal

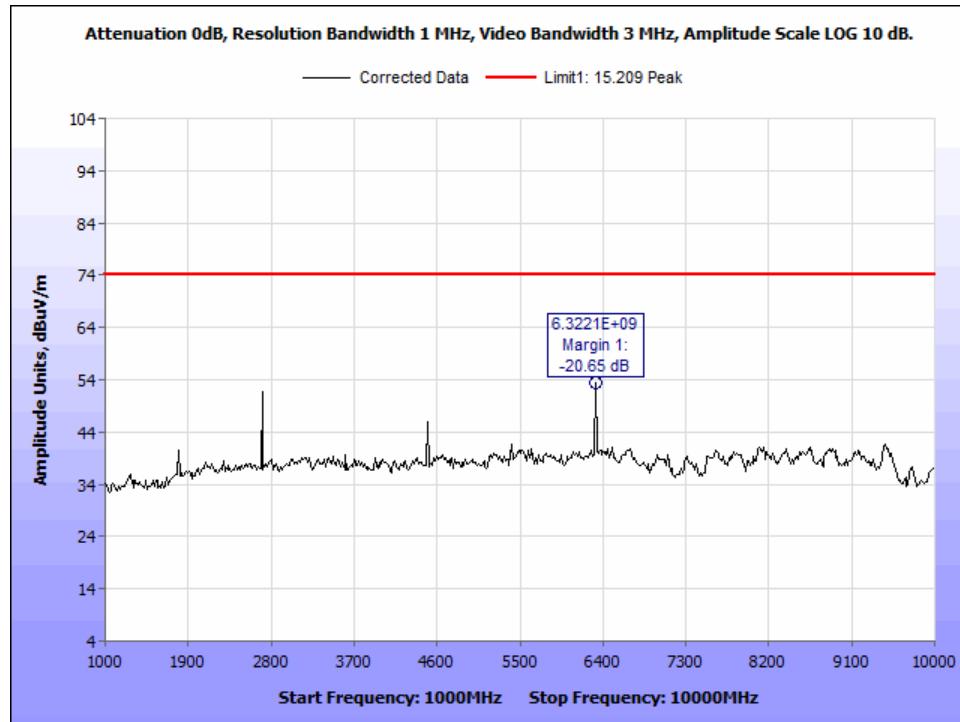


Figure 36: Radiated Emissions Limits, 902.2 MHz - 1GHz-10GHz - Peak – Vertical

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	100	0	35.25	-39.7	37.26	54	--	-16.74	--
6.3221	42.86	V	400	197	35.27	-39.7	38.42	54	--	-15.58	--
2.7019	38.67	V	250	320	32.27	-35.68	35.26	54	--	-18.74	--
6.3221	58.46	H	320	0	35.25	-39.7	54.01	--	74	--	-19.99

Figure 37: Radiated Spurious Emissions, 902.2 MHz – 1GHz-10GHz – Test Results

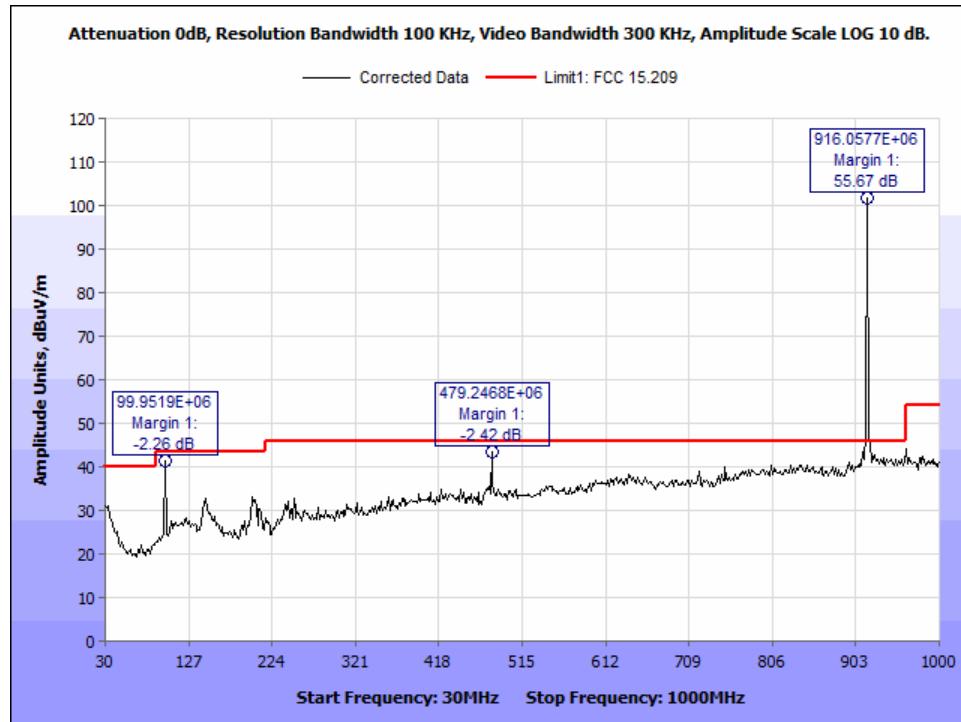


Figure 38: Radiated Emissions Limits, 915 MHz - 30MHz-1000MHz - Horizontal

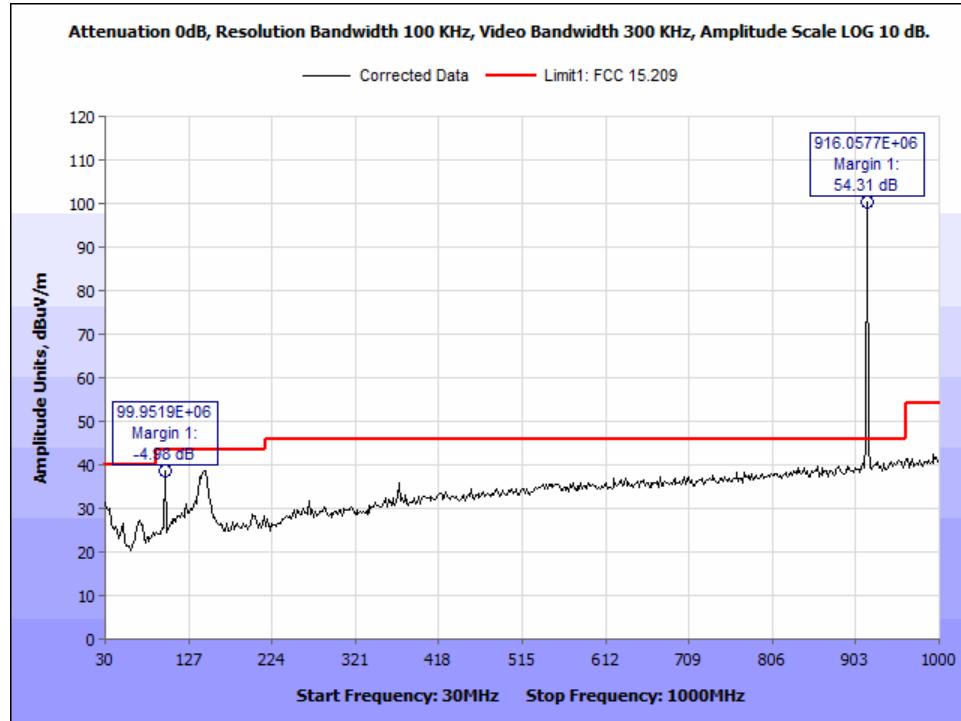


Figure 39: Radiated Emissions Limits, 915 MHz - 30MHz-1000MHz – Vertical

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
99.9519	39.520	H	100	27	10.46	14.99	-23.73	41.24	43.5	-2.26	
99.9519	37.190	V	200	0	10.46	14.6	-23.73	38.52	43.5	-4.98	
146.5865	37.070	V	158	247	10.46	14.54	-23.37	38.7	43.5	-4.80	
479.2468	33.440	H	400	196	10.46	21.4	-21.72	43.58	46	-2.42	
916.0577	85.910	H	200	129	10.46	24.8	-19.49	101.67	46	55.67	See Note
916.0577	84.040	V	300	334	10.46	25.3	-19.49	100.31	46	54.31	See Note

Note: Emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section.

Figure 40: Radiated Spurious Emissions, 915 MHz - 30-1000 MHz – Test Results

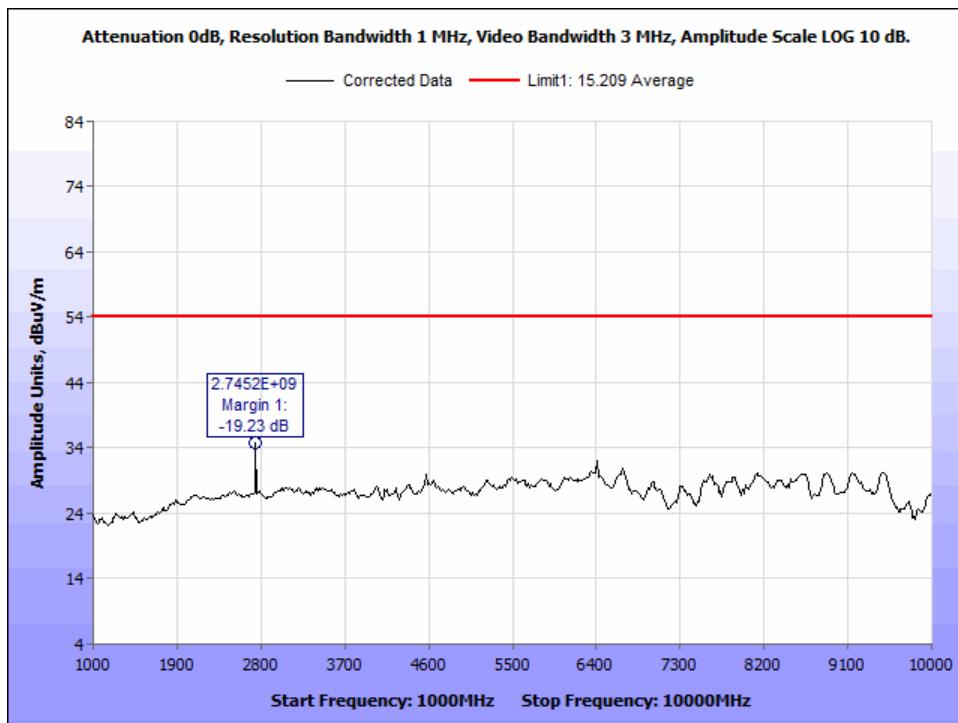


Figure 41: Radiated Emissions Limits, 915 MHz - 1GHz-10GHz - Average - Horizontal

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	100	0	32.22	-35.76	34.77	54	-19.23

Figure 42: Radiated Spurious Emissions, 915 MHz – 1GHz-10GHz – Test Results

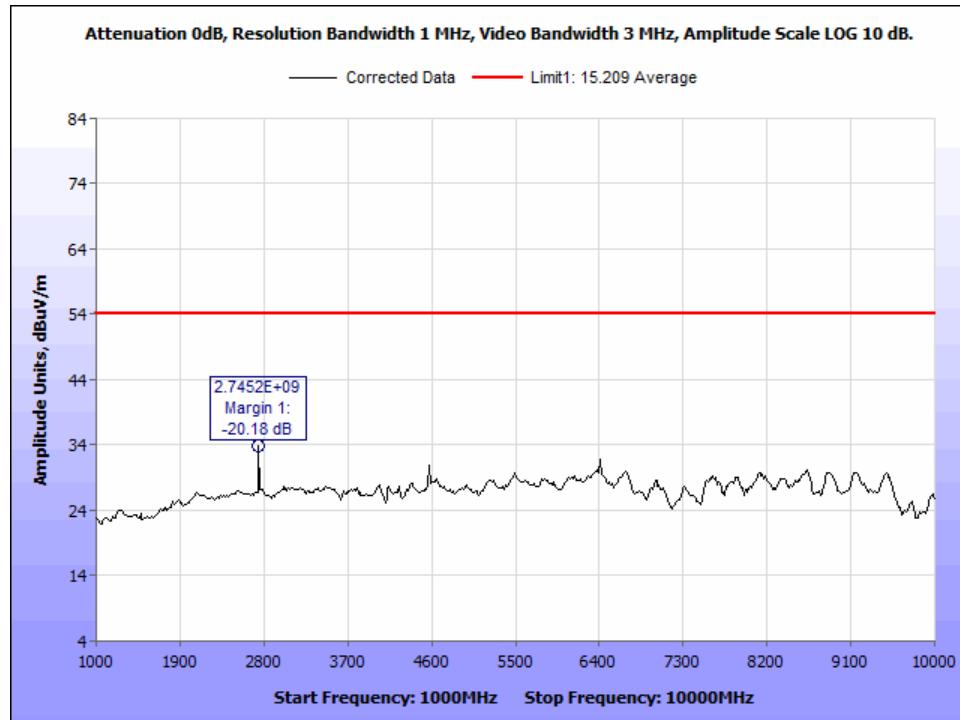


Figure 43: Radiated Emissions Limits, 915 MHz - 1GHz-10GHz - Average - Vertical

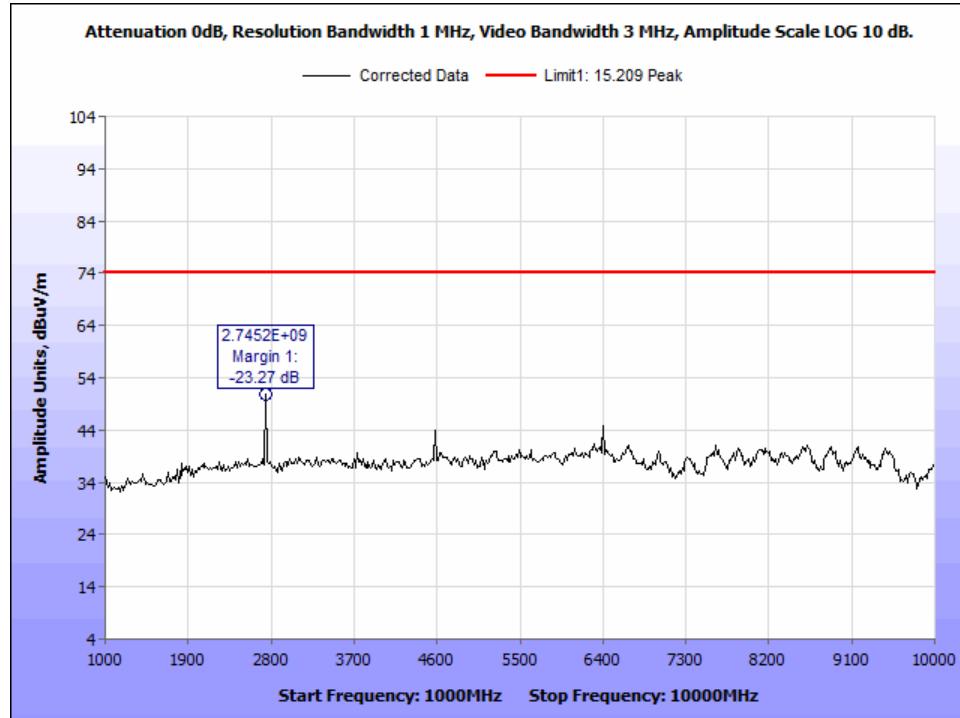


Figure 44: Radiated Emissions Limits, 915 MHz - 1GHz-10GHz - Peak - Horizontal

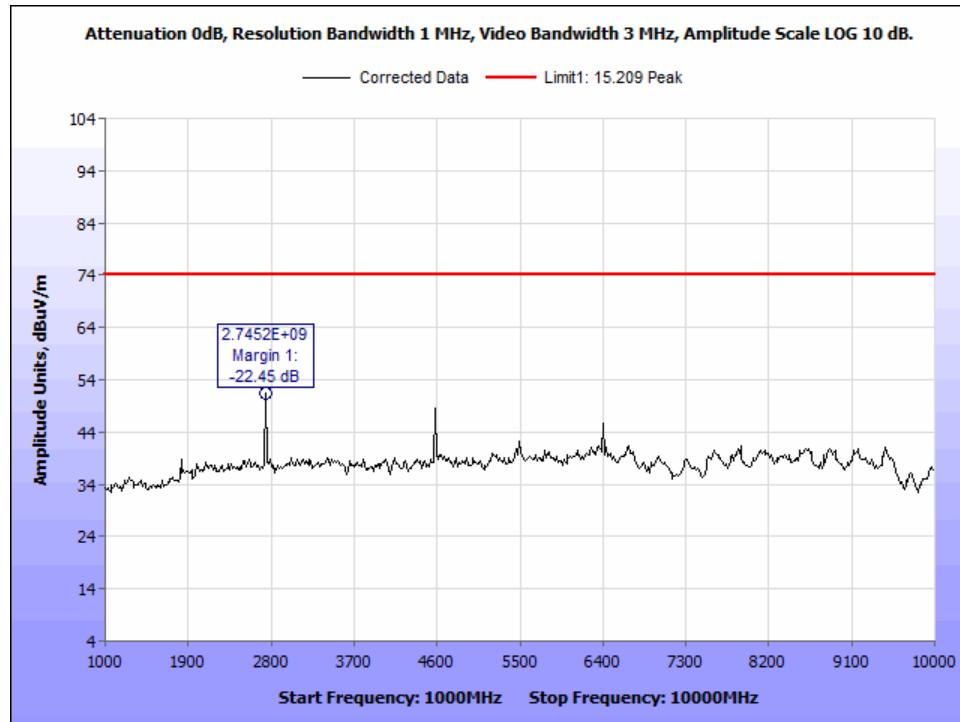


Figure 45: Radiated Emissions Limits, 915 MHz - 1GHz-10GHz - Peak – Vertical

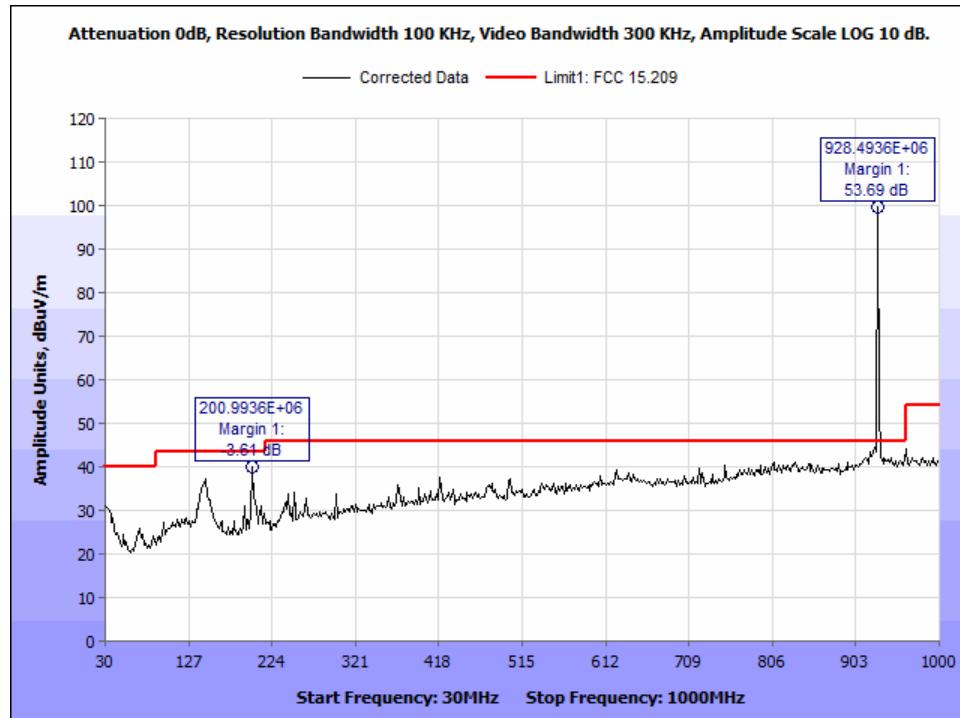


Figure 46: Radiated Emissions Limits, 927.8 MHz - 30MHz-1000MHz - Horizontal

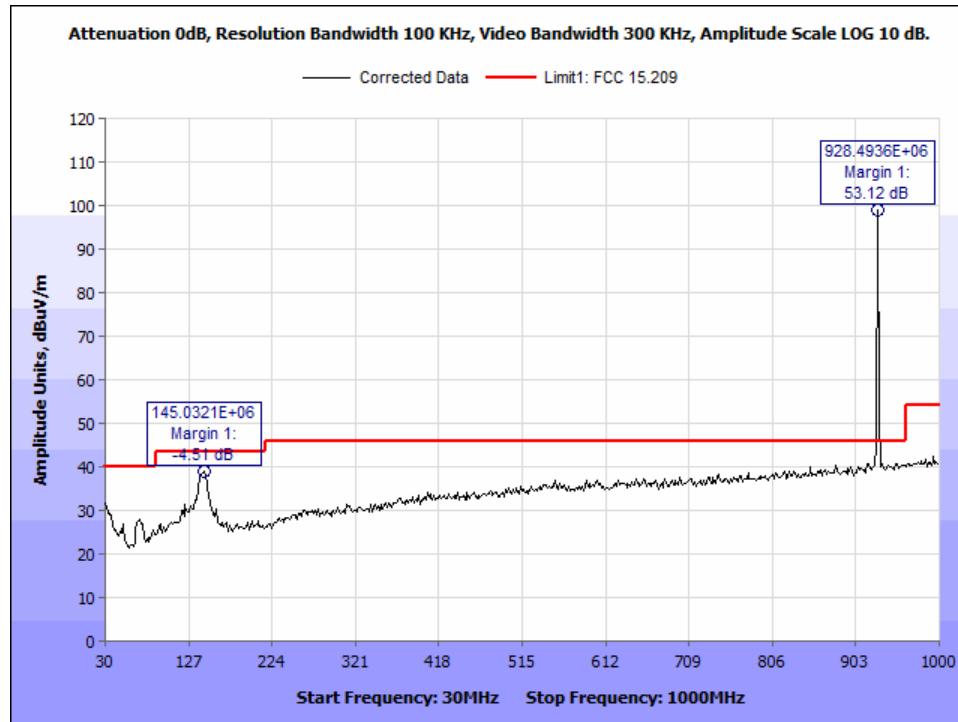


Figure 47: Radiated Emissions Limits, 927.8 MHz - 30MHz-1000MHz – Vertical

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
143.4776	36.59	V	300	334	10.46	14.9	-23.39	38.56	43.5	-4.94	
145.0321	37.22	V	158	247	10.46	14.7	-23.38	38.99	43.5	-4.51	
200.9936	38.74	H	400	196	10.46	13.7	-23.01	39.89	43.5	-3.61	
807.2436	26.88	H	200	129	10.46	24.02	-20.22	41.15	46	-4.85	
928.4936	83.53	H	100	27	10.46	25.1	-19.4	99.69	46	53.69	See Note
928.4936	82.66	V	200	0	10.46	25.4	-19.4	99.12	46	53.12	See Note

Note: Emissions over the limit were caused by an intentional transmitter and are not subject to the requirements of this section.

Figure 48: Radiated Spurious Emissions, 927.8 MHz - 30-1000 MHz – Test Results

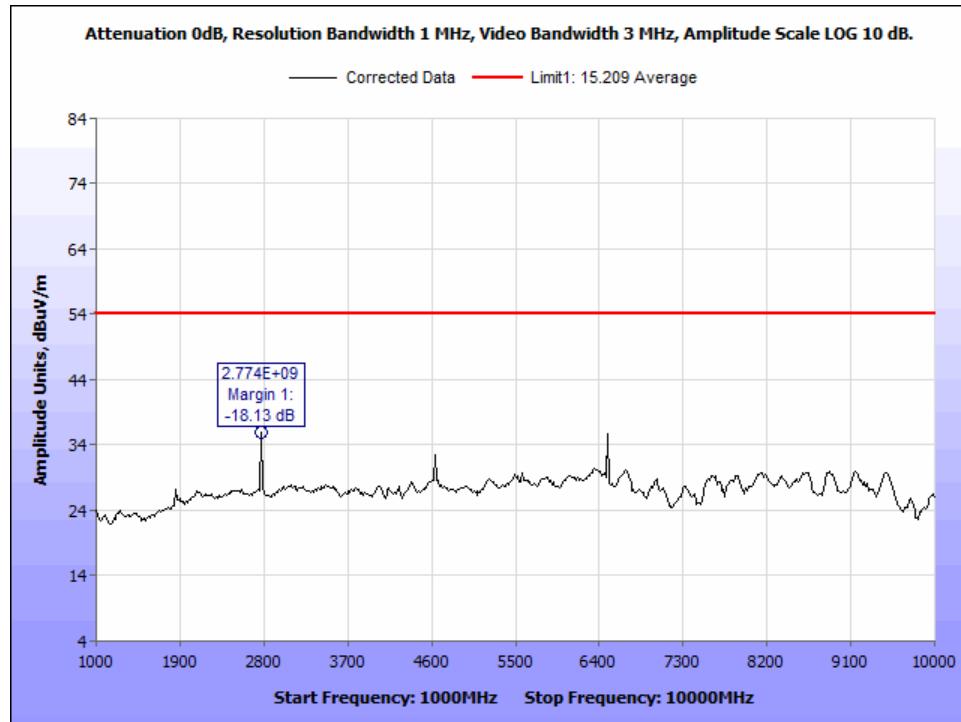


Figure 49: Radiated Emissions Limits, 927.8 MHz - 1GHz-10GHz - Average - Horizontal

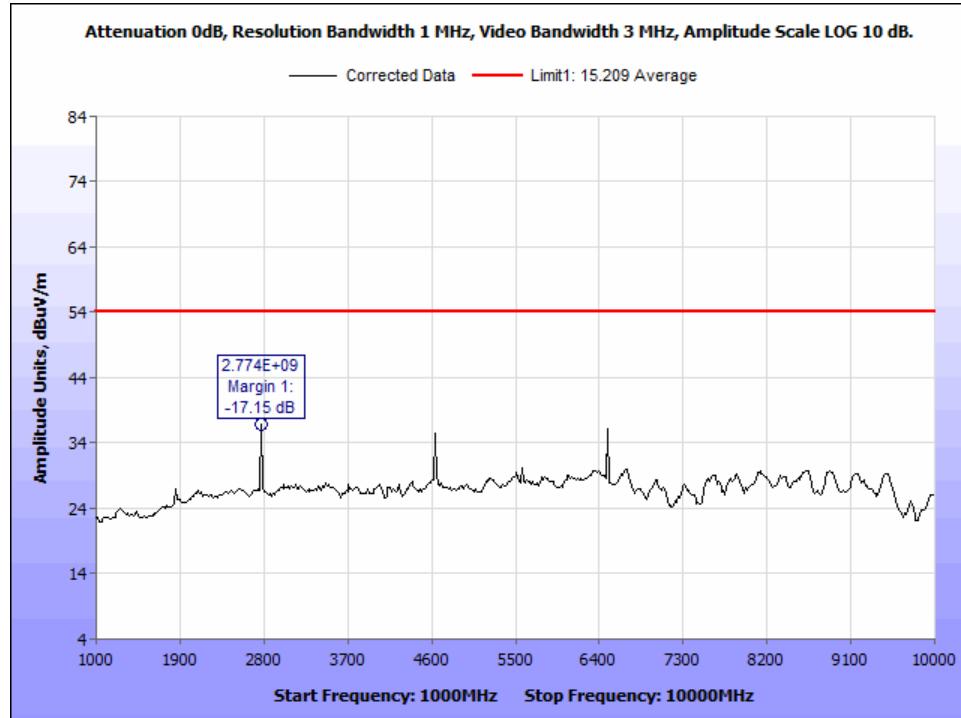


Figure 50: Radiated Emissions Limits, 927.8 MHz - 1GHz-10GHz - Average - Vertical

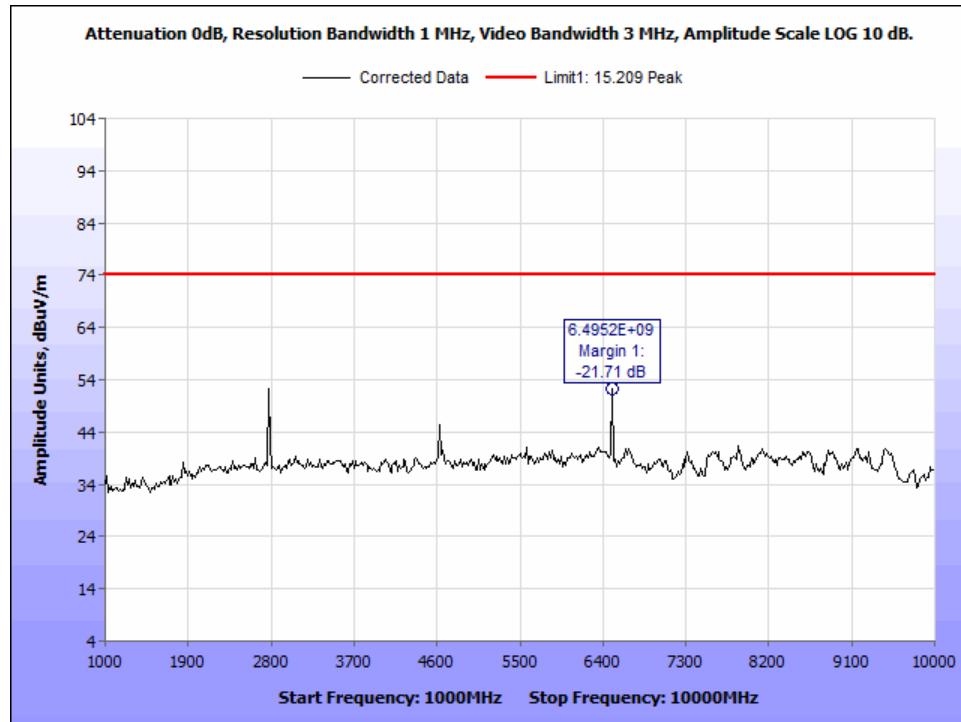


Figure 51: Radiated Emissions Limits, 927.8 MHz - 1GHz-10GHz - Peak - Horizontal

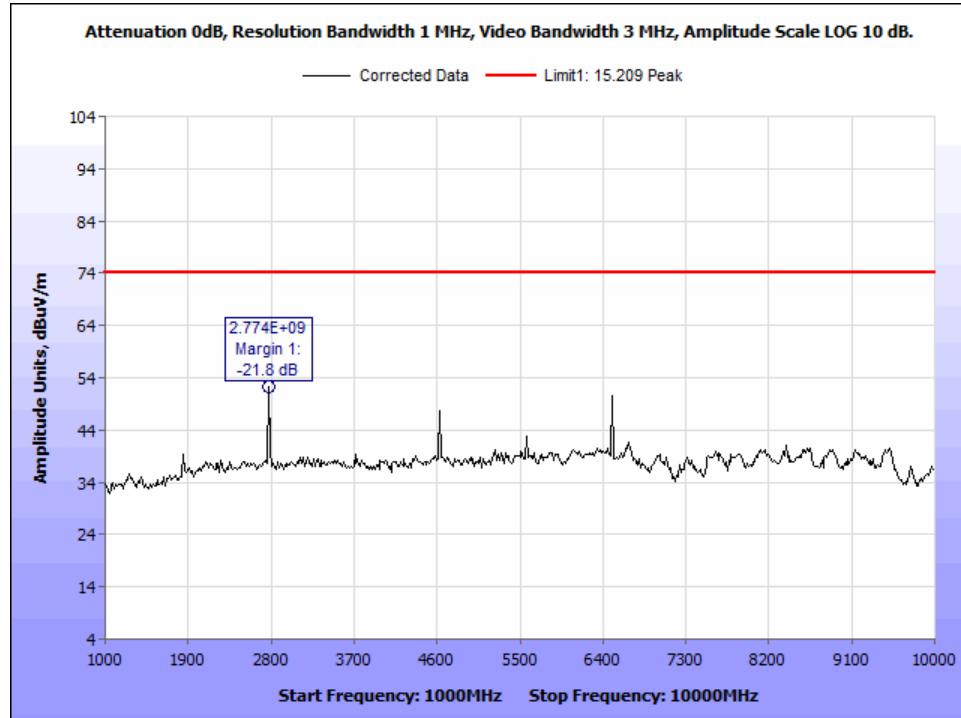


Figure 52: Radiated Emissions Limits, 927.8 MHz - 1GHz-10GHz - Peak – Vertical

Frequency (GHz)	Uncorrected Amplitude (dBuV)	Antenna Polarity	Antenna Height (cm)	Azimuth (Degrees)	Antenna Factor (dB/m)	Preamp Factor (dB)	Corrected Amplitude (dBuV/m)	Limit, 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 53: Radiated Spurious Emissions, 927.8 MHz – 1GHz-10GHz – Test Results

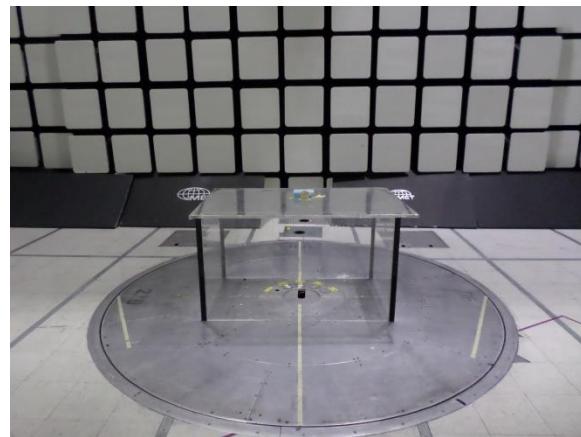


Figure 54: Radiated Emissions Limits, 30MHz-1000MHz - Setup Front View

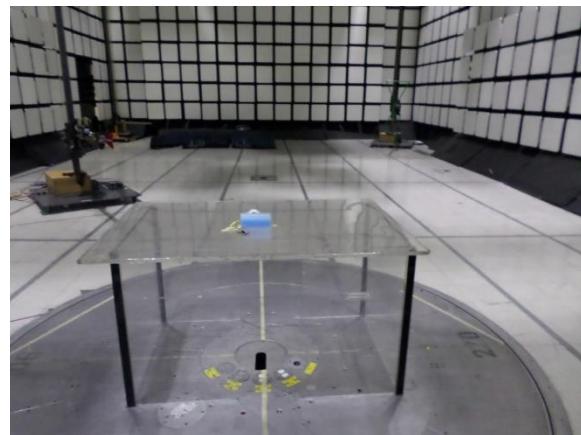


Figure 55: Radiated Emissions Limits, 30MHz-1000MHz - Setup Rear View



Figure 56: Radiated Emissions Limits, 30MHz-1000MHz - Setup Antenna View

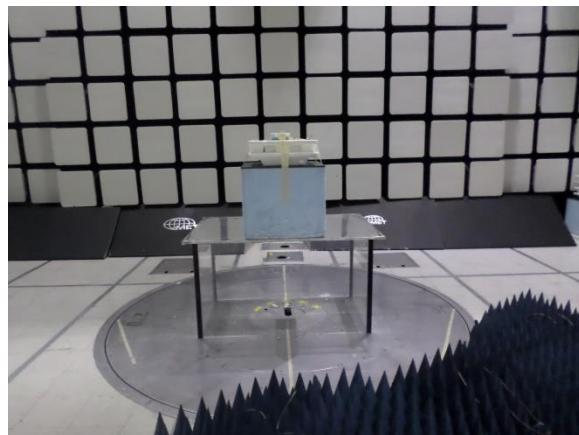


Figure 57: Radiated Emissions Limits, 1GHz-10GHz - Setup Front View

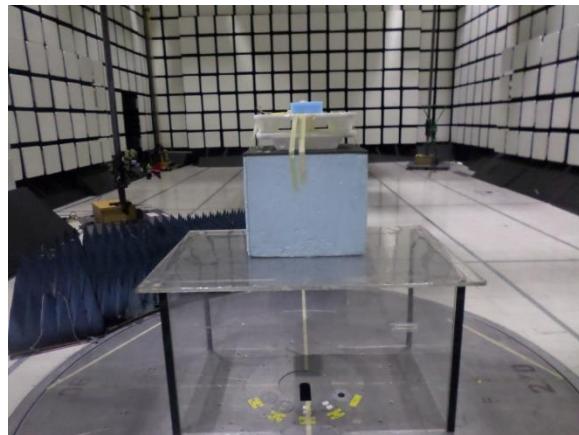


Figure 58: Radiated Emissions Limits, 1GHz-10GHz - Setup Rear View

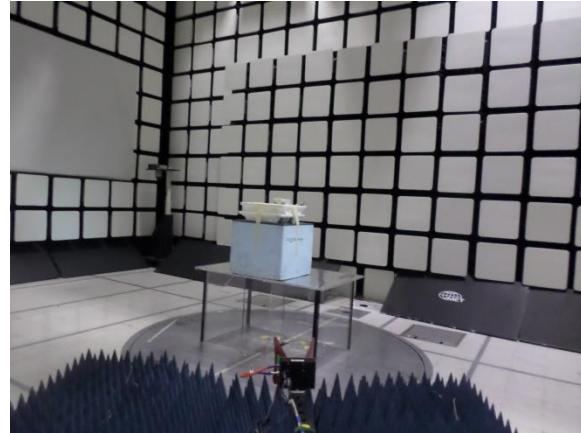


Figure 59: Radiated Emissions Limits, 1GHz-10GHz - Setup Antenna View

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.

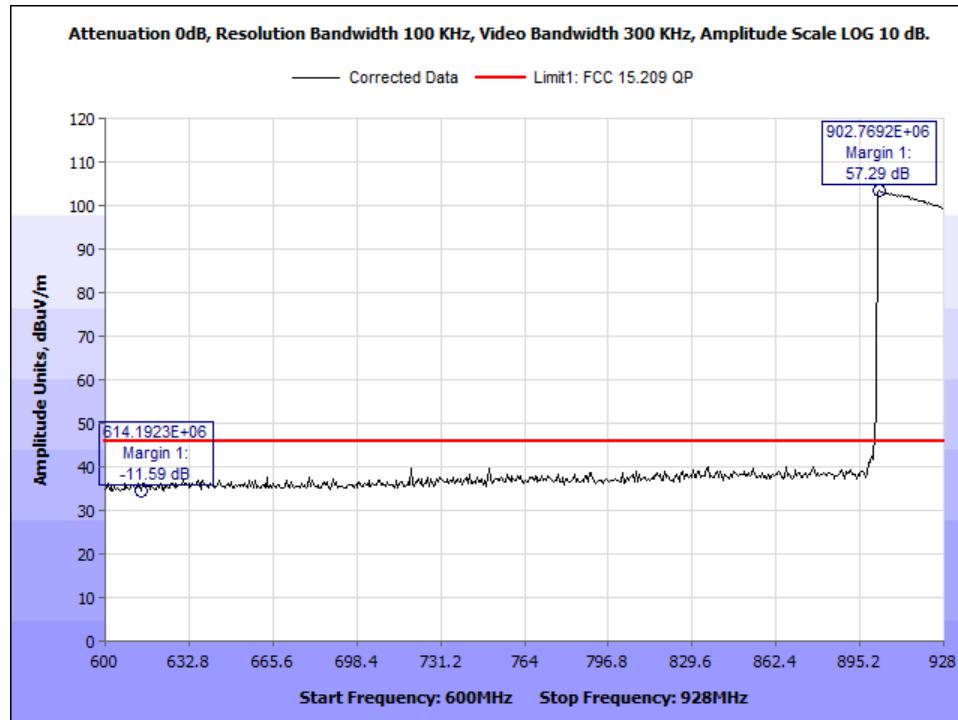


Figure 60: Radiated Restricted Band Edge, Peak, Low Edge, Horizontal (Hopping)

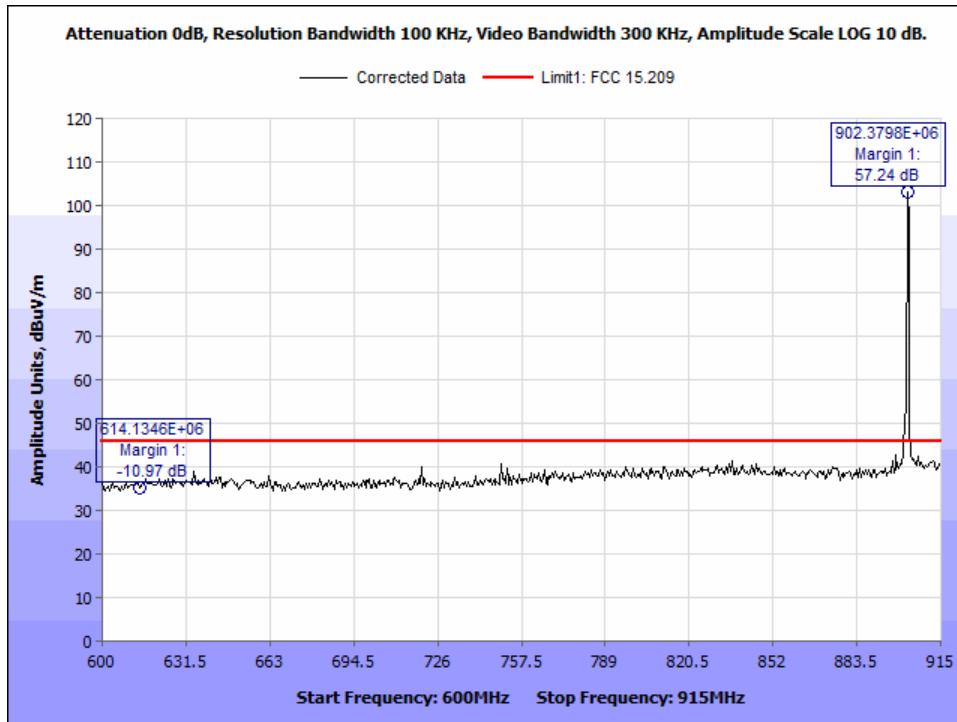


Figure 61: Radiated Restricted Band Edge, Peak, 902.2 MHz –Low Edge, Horizontal

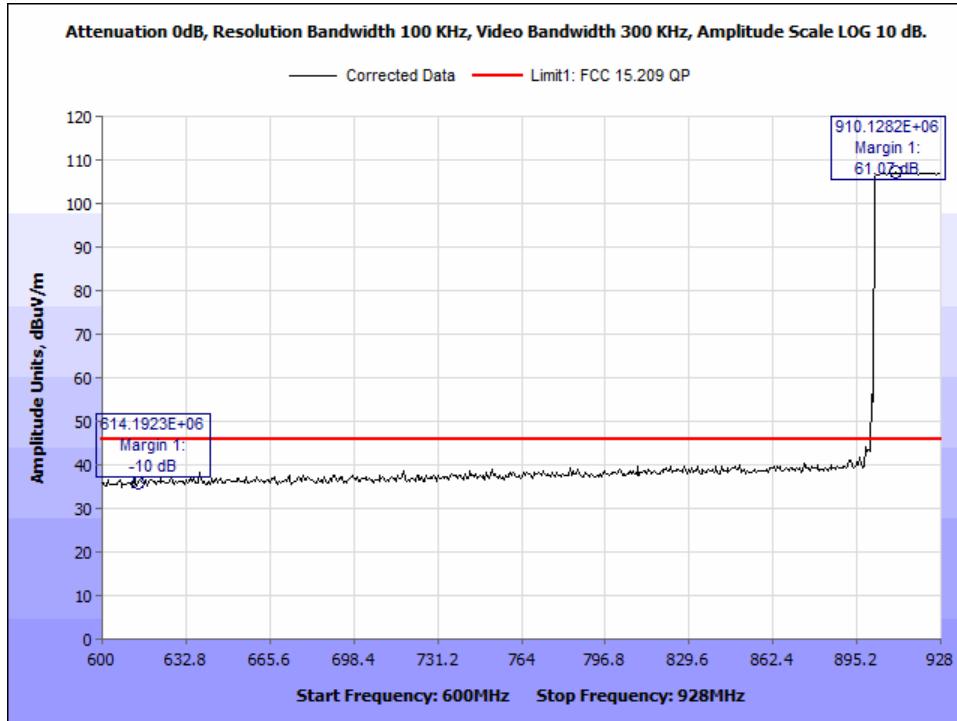


Figure 62: Radiated Restricted Band Edge, Peak, 902.2 MHz – Low Edge, Vertical (Hopping)

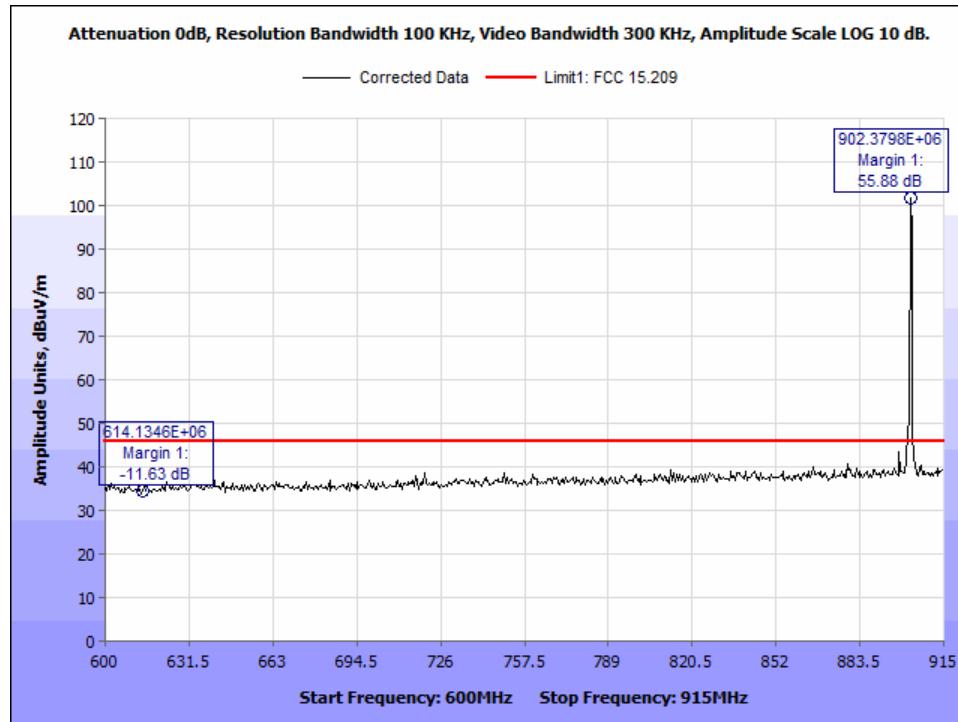


Figure 63: Radiated Restricted Band Edge, Peak, 902.2 MHz – Low Edge, Vertical

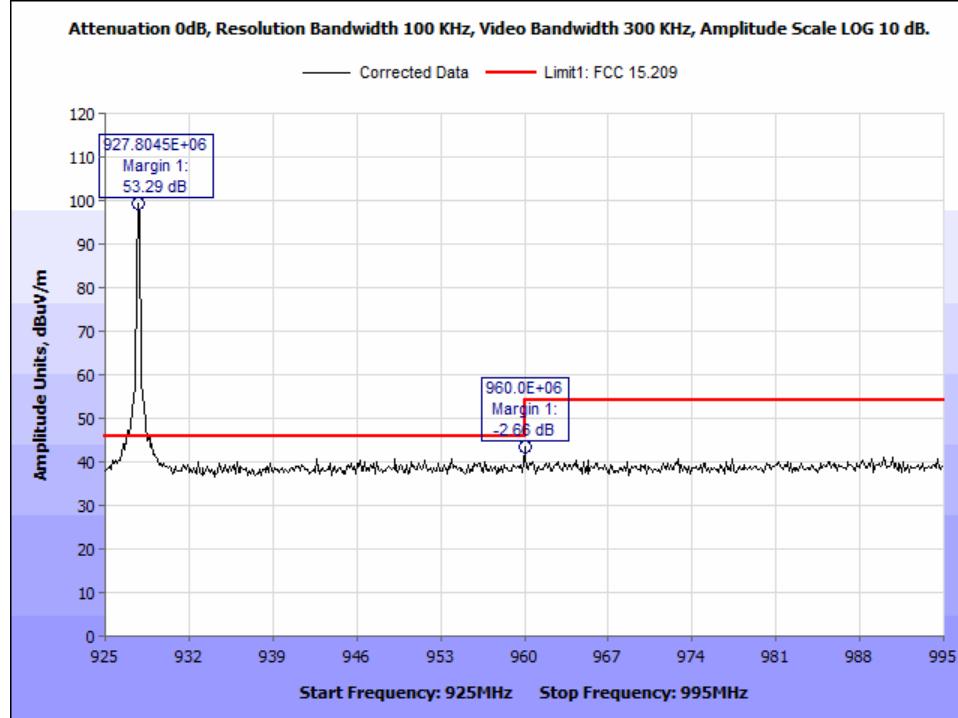


Figure 64: Radiated Restricted Band Edge, Peak, High Edge, Horizontal

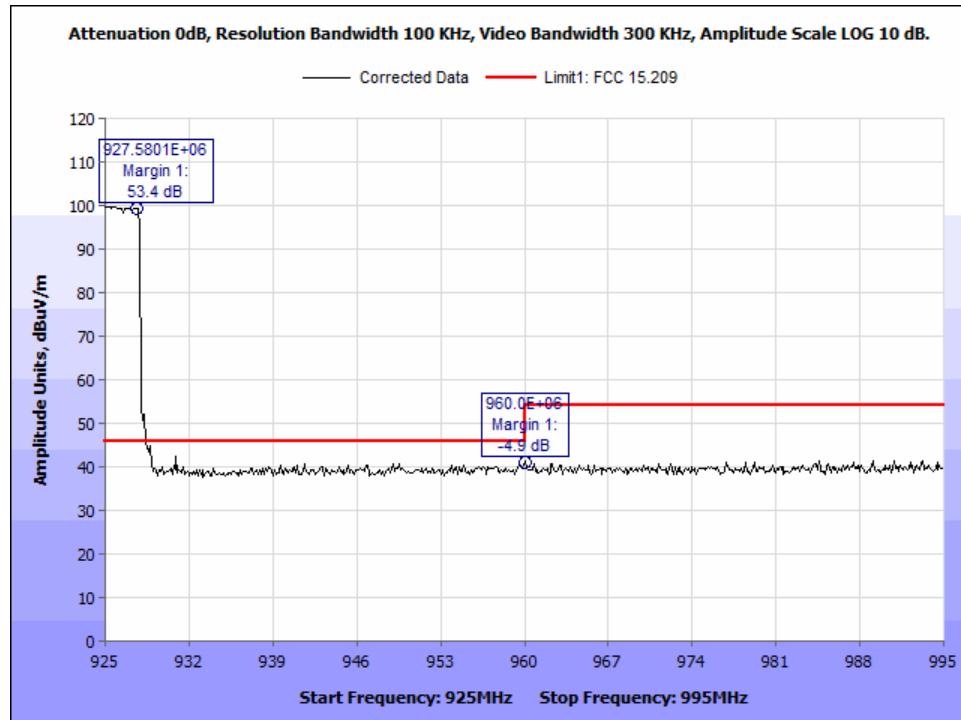


Figure 65: Radiated Restricted Band Edge, Peak, High Edge, Horizontal (Hopping)

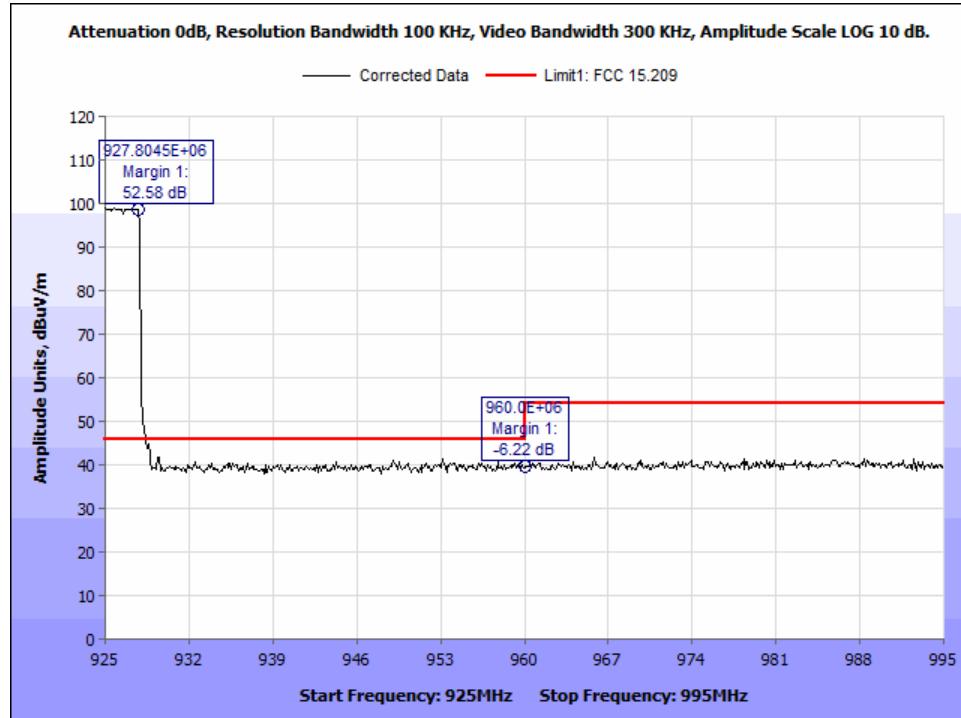


Figure 66: Radiated Restricted Band Edge, Peak – High Edge, Vertical (Hopping)

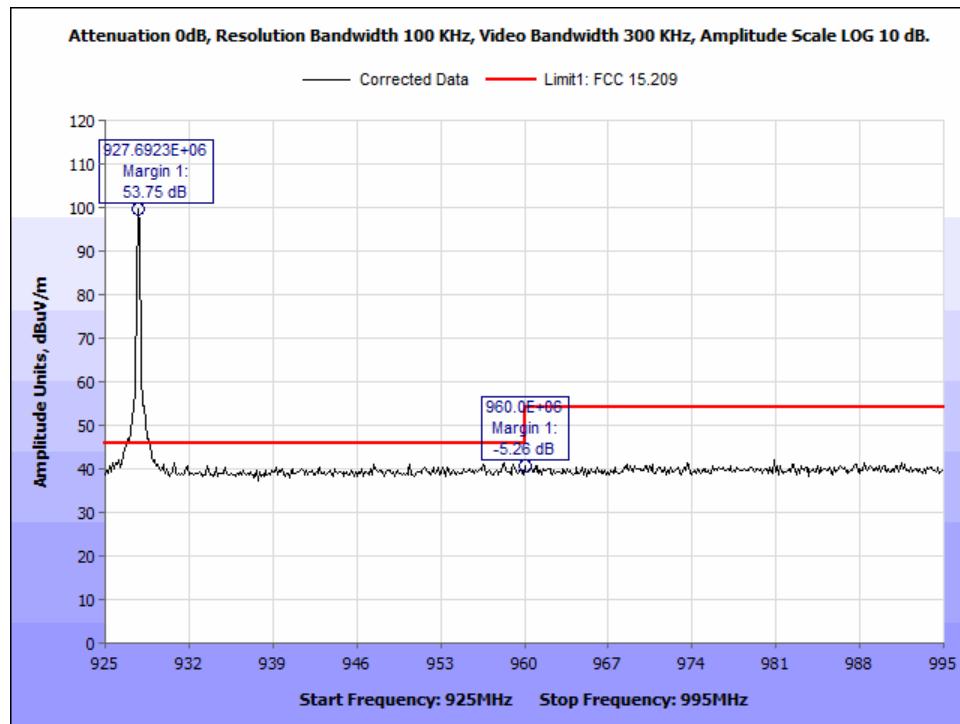


Figure 67: Radiated Restricted Band Edge, Peak, 927.8 MHz – High Edge Vertical

100 KHz Bandwidth Radiated Spurious Emissions Test Results

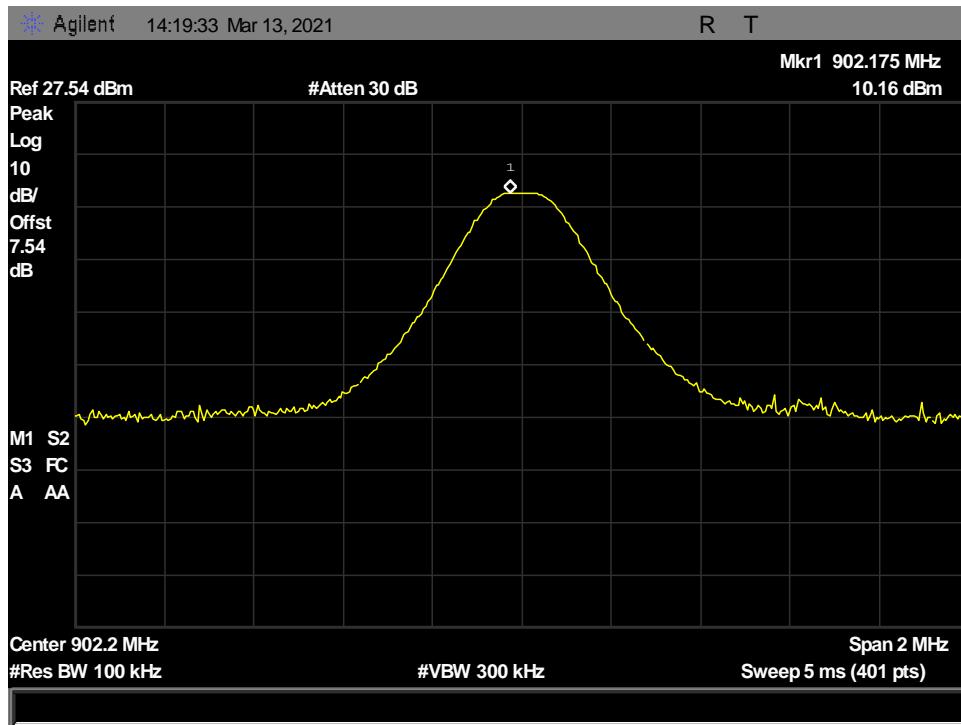


Figure 68: Radiated Spurious Emissions, Lower Channel 902.2 MHz, 100KHz, RBW Reference Level

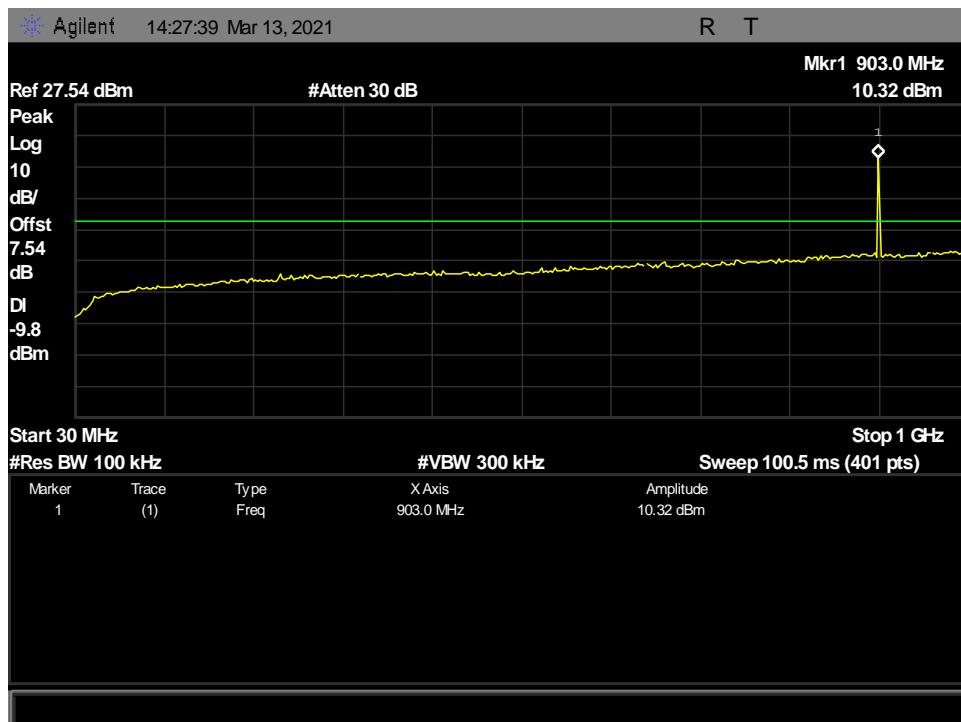


Figure 69: Radiated Spurious Emissions, Lower Channel 902.2 MHz, 30MHz-1GHz

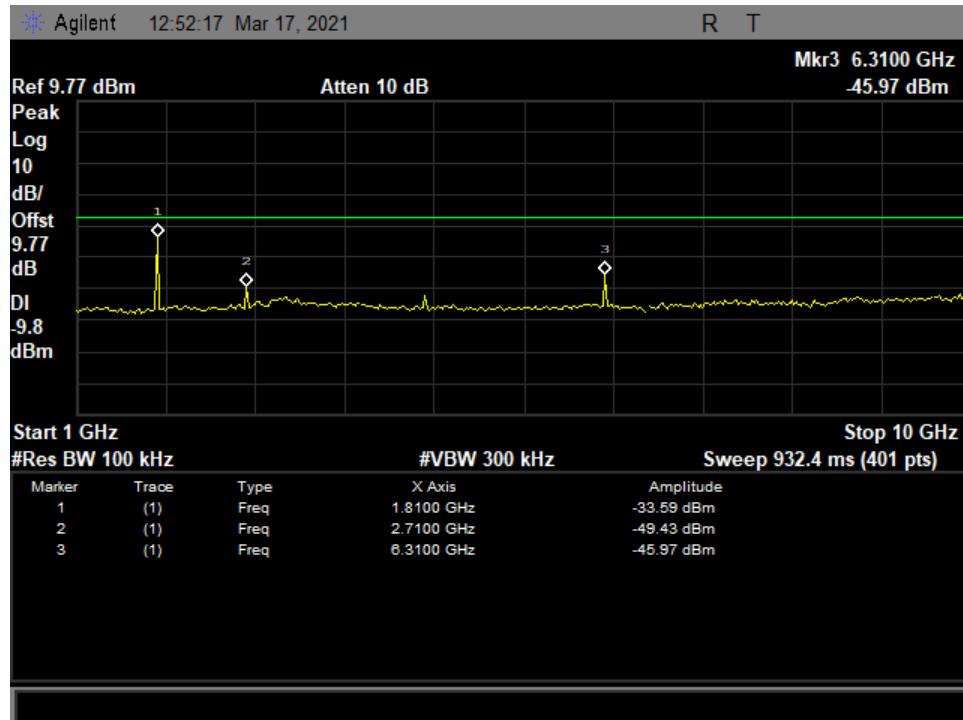


Figure 70: Radiated Spurious Emissions, Lower Channel 902.2 MHz, 1GHz-10GHz

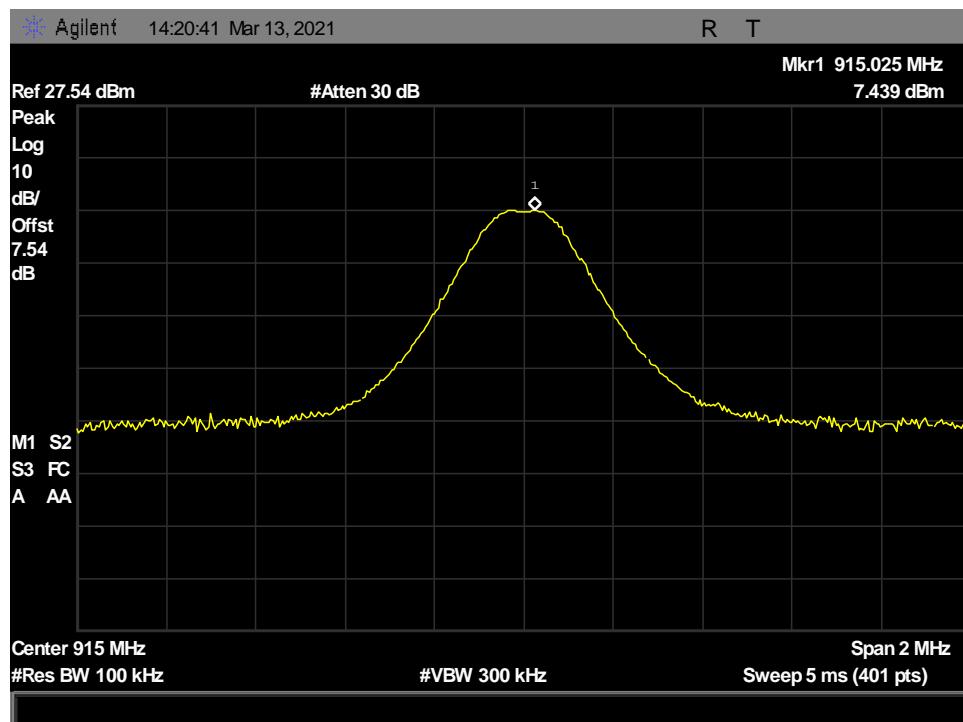


Figure 71: Radiated Spurious Emissions, Middle Channel 915 MHz, 100KHz, RBW Reference Level

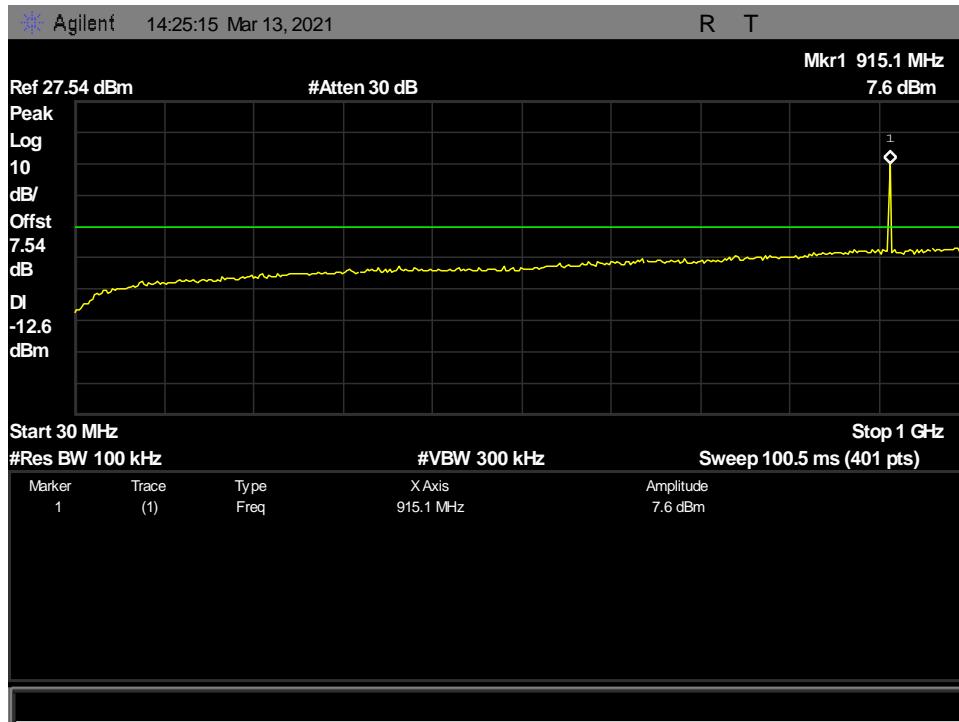


Figure 72: Radiated Spurious Emissions, Middle Channel 915 MHz, 30MHz-1GHz

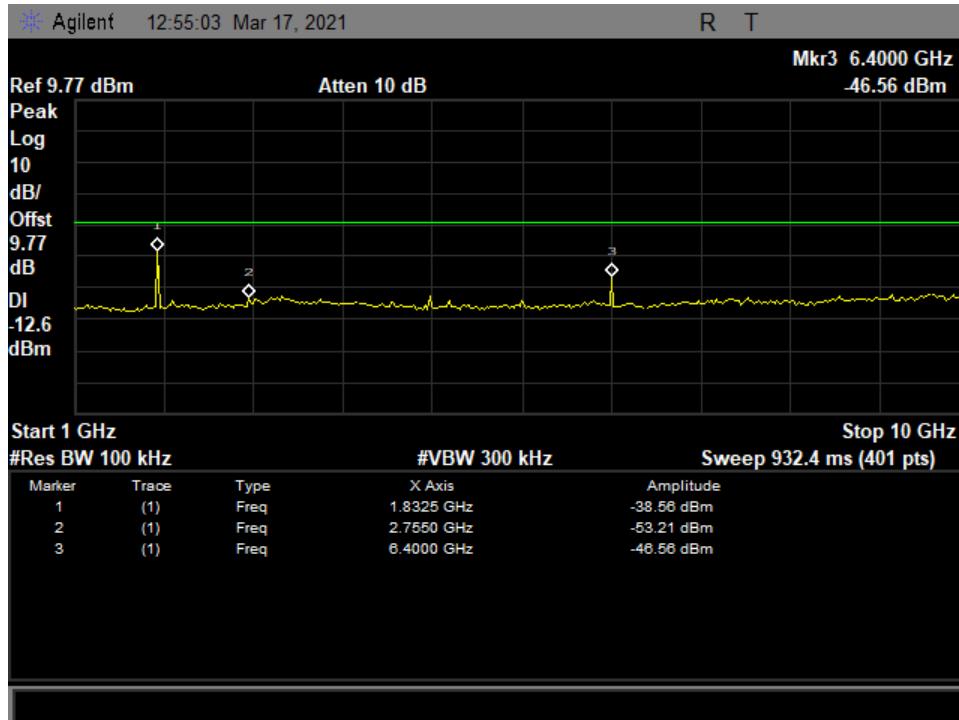


Figure 73: Radiated Spurious Emissions, Middle Channel 915 MHz, 1GHz-10GHz

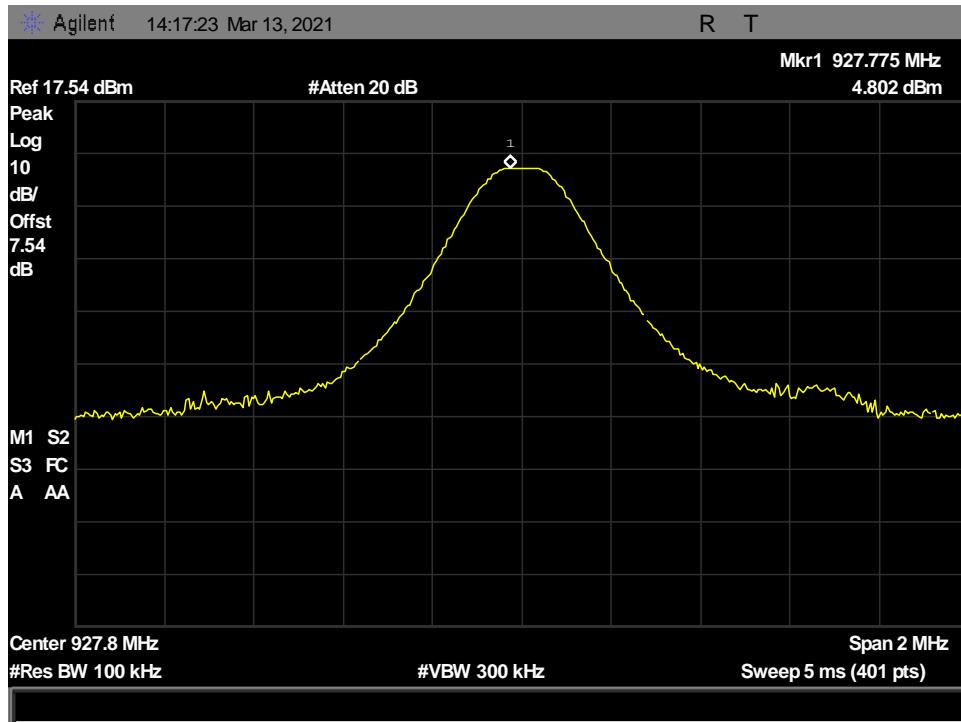


Figure 74: Radiated Spurious Emissions, Upper Channel 927.8 MHz, 100KHz, RBW Reference Level

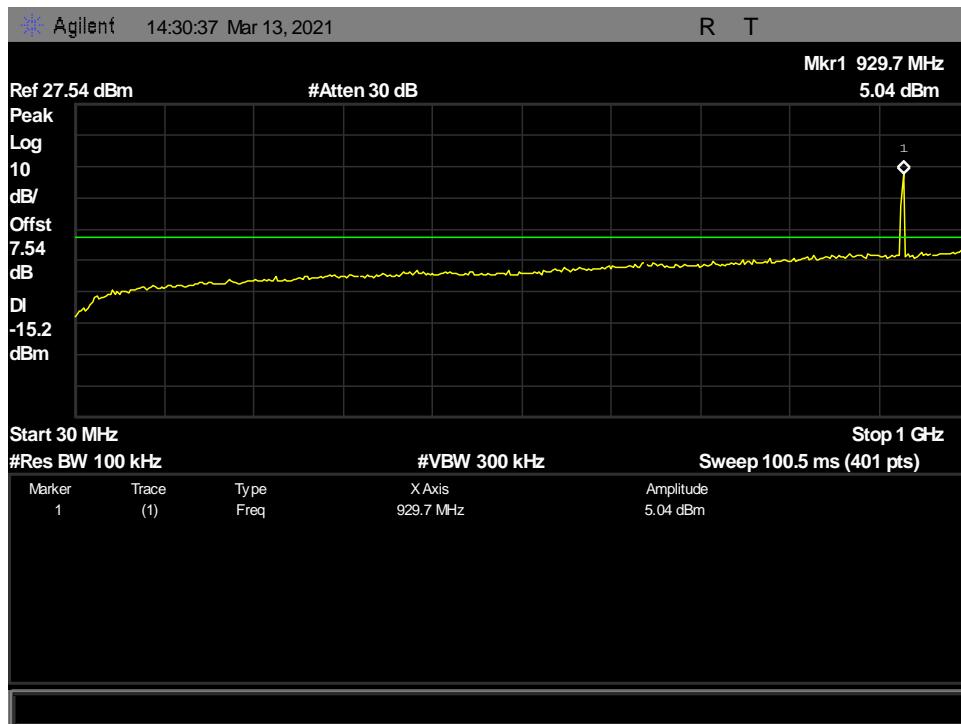


Figure 75: Radiated Spurious Emissions, High Channel 927.8 MHz, 30MHz-1GHz

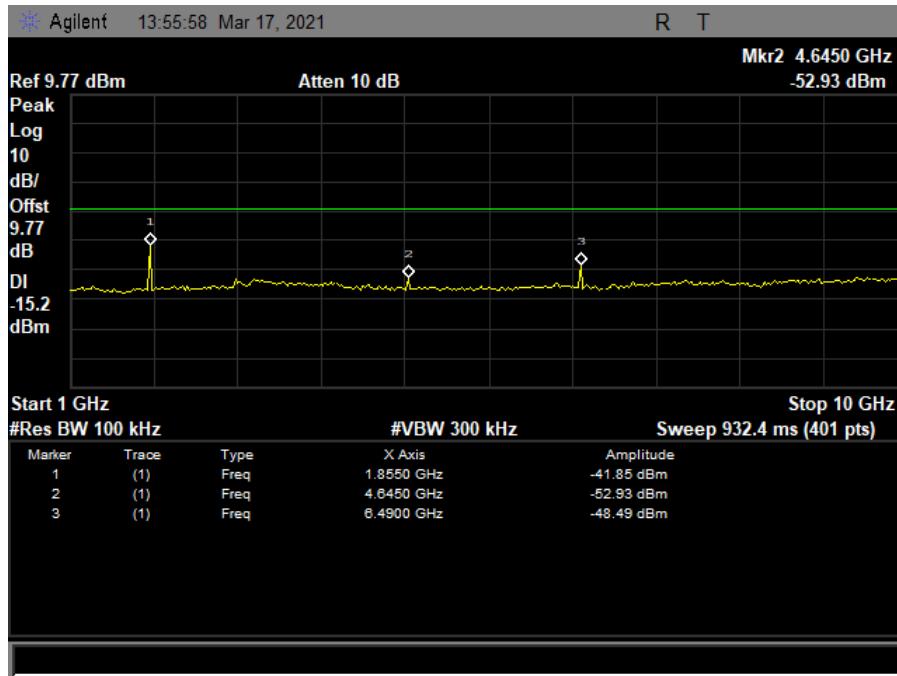


Figure 76: Radiated Spurious Emissions, High Channel 927.8 MHz, 1GHz-10GHz

Conducted Band Edge Test Results

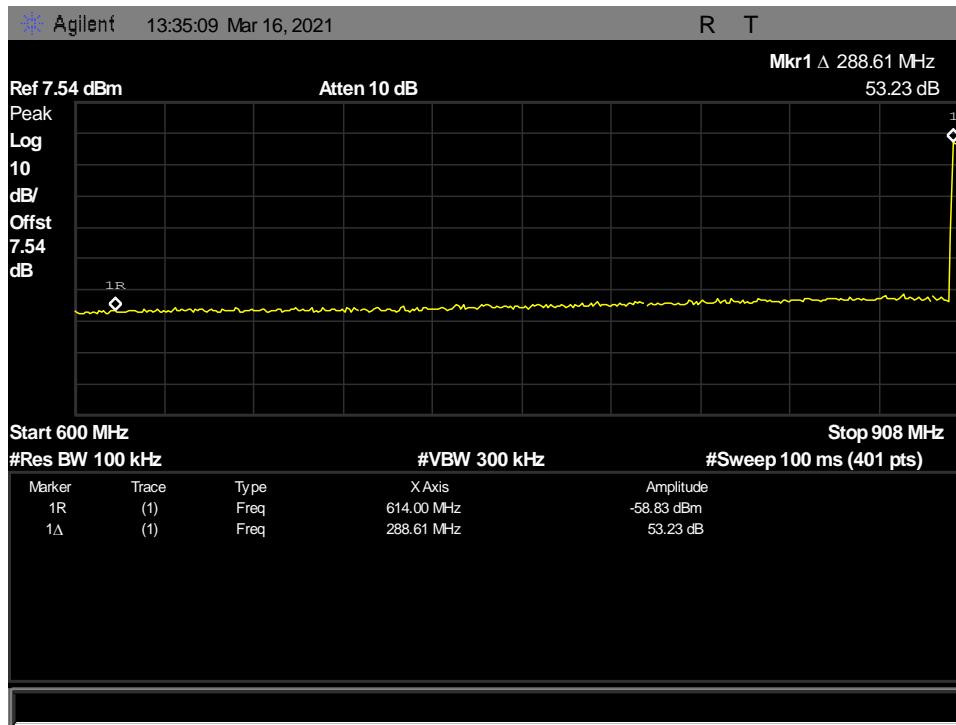


Figure 77: Radiated Band Edge, Low Edge (Hopping)

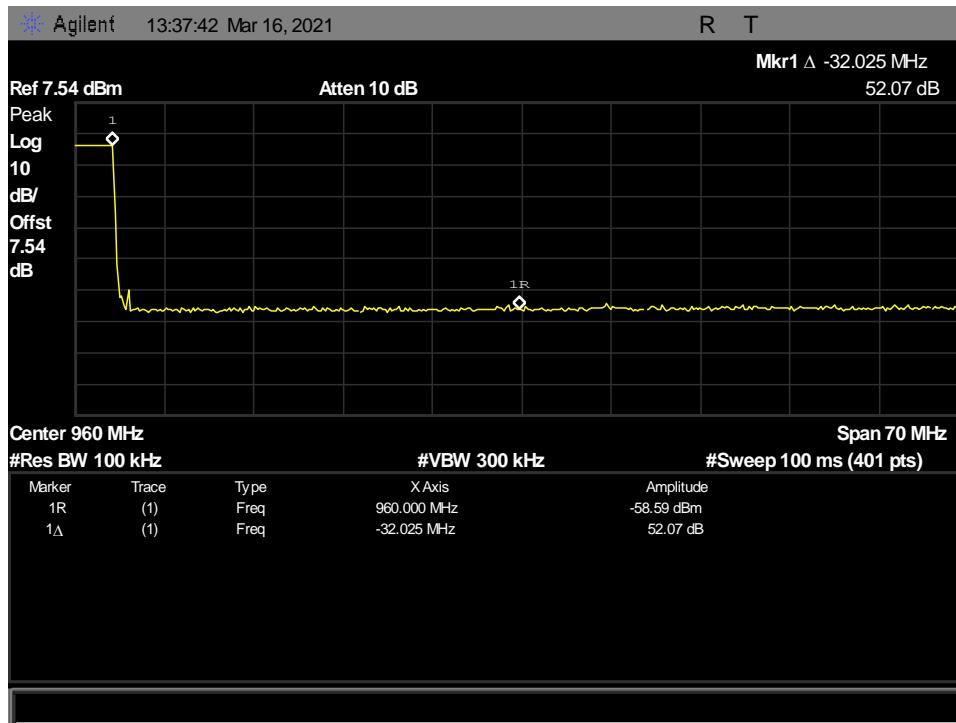


Figure 78: Radiated Band Edge, High Edge (Hopping)

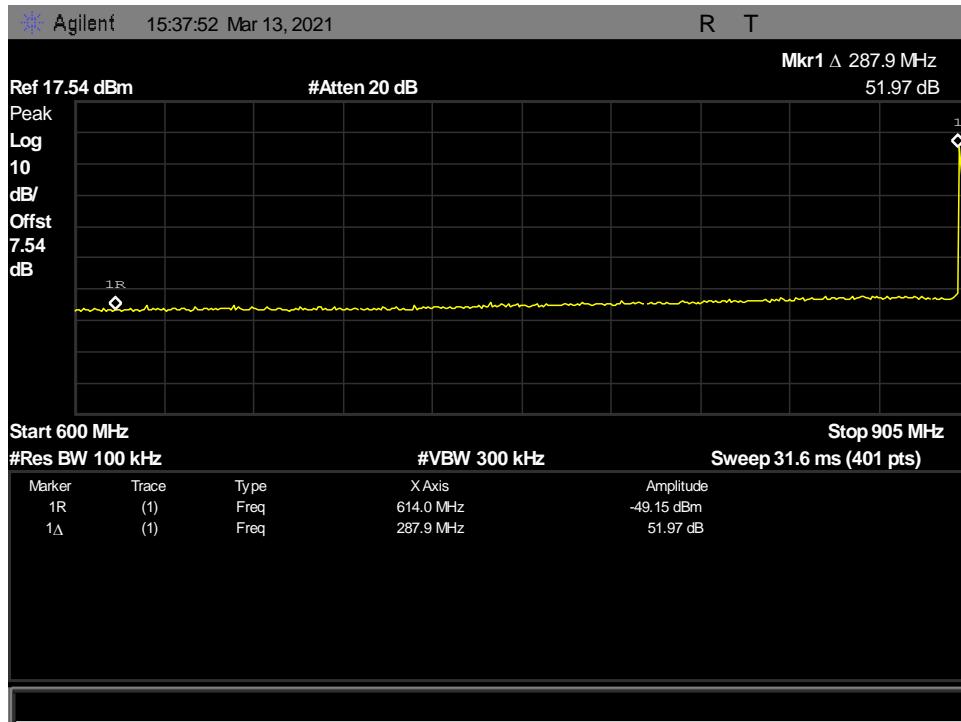


Figure 79: Radiated Band Edge, Low Edge 902.2 MHz

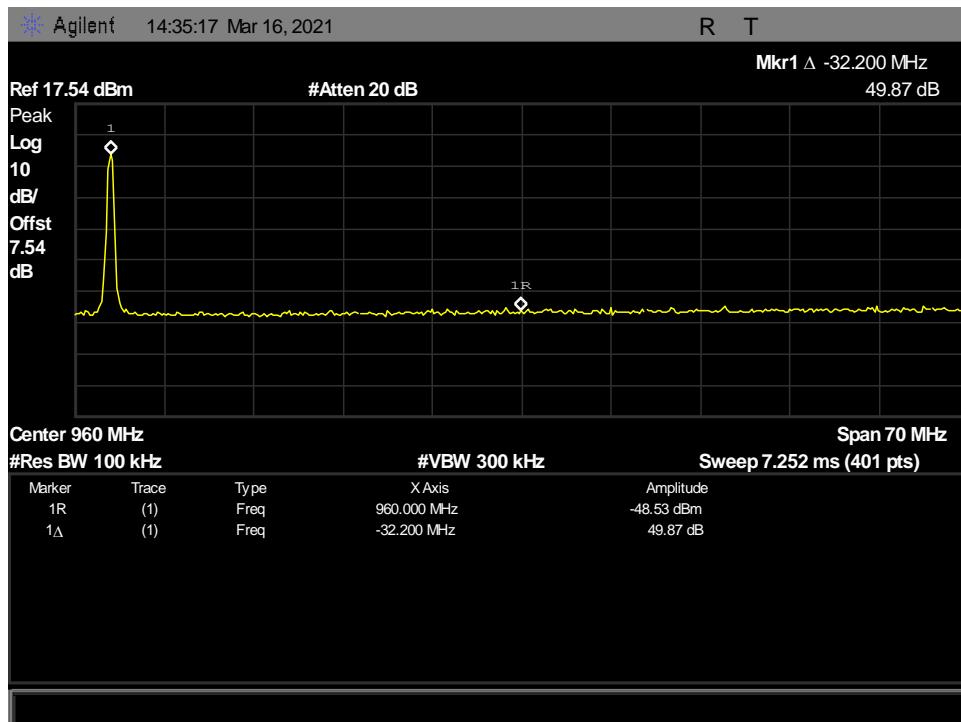


Figure 80: Radiated Band Edge, High Edge 927.8 MHz

Electromagnetic Compatibility Criteria for Intentional Radiators

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



NOISEAWARE™

NoiseAware, Inc.

3106 Commerce St., #100, Dallas, TX 75226 | +1 (888) 847-5538 | info@noiseaware.io

8 April, 2021**RE: DECLARATION STATEMENT FOR FHSS OUTDOOR NOISE SENSOR, FCC# 2AQIP-NA3N302**Compliance for section 15.247(g):

The 915MHz system-on-chip (SOC) within the NoiseAware Outdoor Noise Sensor (Gen3.1 Node) 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

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/cm² or 10 W/m²**

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/cm²)
 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	18.37	68.707	1	1.259	0.01721	1	0.98279	20	Pass

Figure 81: 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.

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 #	EQUIPMENT	MANUFACTURER	MODEL	LAST CAL	CAL DUE
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	
1A1044	1A1044	GENERATOR	COM-POWER CORP	SEE NOTE	
1A1088	PRE-AMP	ROHDE & SCHWARZ	TS-PR1	SEE NOTE	
1A1080	MULTI-DEVICE CONTROLLER	ETS-EMCO	2090	SEE NOTE	
1A1073	MULTI-DEVICE CONTROLLER	ETS-EMCO	2090	SEE NOTE	
1A1180	PRE-AMP	MITEQ	AMF-7D-01001800-22-10P	SEE NOTE	
1A1106	10M SEMI-ANECHOIC CHAMBER	LINDGREN	N/A	SEE NOTE	

Figure 82: Test Equipment List

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

End of Report