Testing Tomorrow's Technology

Class 2 Permissive Change Test Report

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart C, paragraphs 15.207, 15.209 and 15.247

And

RSS-247 Issue 3: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

For the

Copeland Cold Chain LP

Model Number: UWL02G

FCC ID: WPEUWL02G
IC: 8031A-UWL02G

UST Project: 23-0221
Issue Date: April 26, 2024

Total Pages: 41

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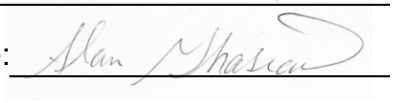
Testing Tomorrow's Technology

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date: April 26, 2024

NVLAP LAB CODE 200162-0

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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Copeland Cold Chain LP
MODEL: UWL02G
FCC ID: WPEUWL02G
IC: 8031A-UWL02G
DATE: April 26, 2024

This report concerns (check one): ☐ Original ☒Class II Permissive Change

Equipment type: 900 MHz ISM Radio Transceiver Module.

Technical Information:

Radio Technology:	DTS
Frequency of Operation (MHz):	902.75 – 927.25
Output Power (dBm):	2.6
Type of Modulation:	FSK
Data/Bit Rate:	100 kbps
Antenna Gain (dBi):	2.0
Software used to program EUT:	SSH
EUT firmware:	N/A
Power setting:	“Default”

Report prepared by:

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1 General Information

1.1 Purpose of this Report

This report is prepared to demonstrate that the modifications made to the EUT (Equipment Under Test) do not impact its performance in a manner necessitating full retesting and submission under a new FCC or IC ID as a new product.

The modification consists of the following: The microprocessor, MCU, for the product has been replace one that is designed to be the successor of the microprocess that was previously being used. The part number for the previous MCU is MSP430G2513. The part number for the new MCU is MSP430FR2475. An additional update made to the product involves the battery holder and the conductive pad that the battery sits on. The surface area of the conductive pad has been increased to cover the entire footprint of the battery. Based on the changes the EUT was tested for continued compliance with Part 15.247 and RSS-247 requirements. The updates were deemed to have an impact on the radiated spurious emissions characteristics of the radio; therefore, testing was performed to show that the limits were not exceeded and that the EUT continues to be in compliance. The results of the testing are presented in this test report.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on September 18, 2023 in good operating condition.

1.3 Product Description

The Equipment under Test is the Copeland Cold Chain LP model GO Wireless logger model UWL02G. It is a time and temperature data logger designed for commercial applications. The EUT also incorporates a 902 -928 MHz transceiver for wireless communication with a base station unit.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v03r05 for Digital Transmission Systems Operating Under section 15.247.

Digital RF conducted and radiated emissions data below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was set to 3 times the RBW or as required per the standard throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5301. Additionally, this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC Equipment Authorizations:

a) Verification as a digital device under Part 15 Subpart B.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID	CABLES P/D
EUT/ Copeland	UWL02G	Engineering Sample	FCC ID: WPEUWL02G IC: 8031A-UWL02G	None

S= Shielded, U= Unshielded, P= Power, D= Data

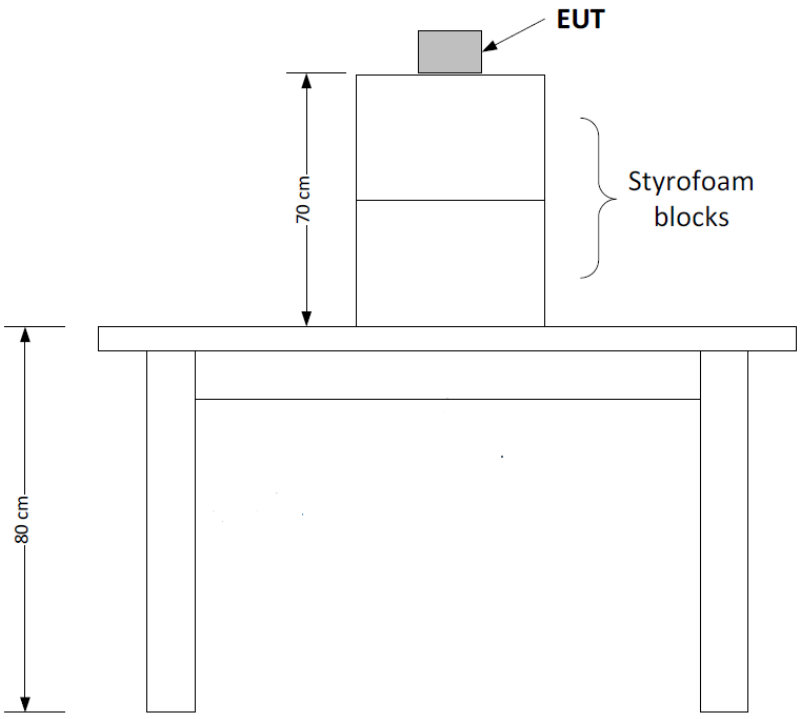

Figure 1. Block Diagram of Test Configuration

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herein.

Table 2. Test Instruments

TEST INSTRUMENT	MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	CALIBRATION DUE DATE
Spectrum Analyzer	Agilent	E4407B	US41442935	9/21/2024 2 yr.
Spectrum Analyzer	Rigol*	DSA815	DSA8A180300138	1/6/2024 2 yr.
Rf Preamp 100 Khz To 1.3 Ghz	Hewlett-Packard	8447D	1937A02980	7/20/2024
Preamp 1.0 Ghz To 26.0 Ghz	Hewlett-Packard*	8449B	3008A00480	3/03/2024
Loop Antenna	ETS Lindgren	6502	9810-3246	12/7/2024 2 yr.
Biconical Antenna	EMCO	3110B	9307-1431	1/13/2025 2 yr.
Log Periodic Antenna	EMCO	3146	9110-3236	12/13/2023 2 yr.
Horn Antenna	EMCO	3115	9107-3723	4/28/2024 2 yr.
High Pass Filter	Microwave Circuits	H3R020G2	001DC9528	8/2/2024
LISN X 2	Solar Electronics	9247-50-TS-50-N	955824 and 955825	4/28/2024

* Instrument calibration date was valid at time of testing.

The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech to bring the EUT into compliance with FCC Part 15.247 or IC RSS-210 requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m), RSS-Gen 6.8)

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated, with the device operating at the number of frequencies in each band specified in Table 3.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 902.75 to 927.25 MHz, 3 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33, RSS-Gen 6.13)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10th harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35, RSS-Gen 6.9, 6.13)

The radiated and conducted emissions limits shown herein are based on the following:

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.6 EUT Antenna Requirements (CFR 15.203, RSS-Gen 6.7)

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.

Table 4. Antenna

Manufacturer	Model	Type	Gain (dBi)	Connector
Copeland	N/A	Trace	+0.0	Trace

2.7 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d), RSS-247, 5.5)

On the test site, the EUT was placed on top of a non-conductive table, 80 cm above the floor for measurements below 1 GHz and 150 cm above the floor for measurements > 1 GHz. The EUT was also evaluated in three orthogonal positions to determine the worst case position. The front of the EUT faced the measurement antenna located 3 meters away. Each signal measured was maximized by raising and lowering the receive antenna between 1 and 4 meters in height while monitoring the ever changing spectrum analyzer display (with channel A in the Clear-Write mode and channel B in the Max-Hold mode) for the largest signal visible. That exact antenna height where the signal was maximized was recorded for reproducibility purposes. Also, the EUT was rotated about its Y-axis while monitoring the Spectrum Analyzer display for maximum. The EUT azimuth was recorded for reproducibility purposes. The EUT was measured when both maxima were simultaneously satisfied.

For radiated measurements, the EUT was set into a continuous transmission mode. Below 1 GHz, the RBW of the measuring instrument was set equal to 120 kHz. Peak measurements above 1 GHz were measured using a RBW = 1 MHz, with a VBW ≥ RBW. The results of peak radiated spurious emissions falling within restricted bands are given in Table 6below.

For Average measurements above 1 GHz, the emissions were measured using RBW = 1 MHz and VBW = 10 Hz or the duty cycle correction factor was applied to the Peak recorded value.

Table 5. Peak Radiated Fundamental & Harmonic Emissions

Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	PK Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector
Low Channel - PEAK							
902.70	77.74	25.95	103.69	--	3.0m./HORZ	--	**PK**
1805.00	70.17	-9.55	60.62	74.0	3.0m./HORZ	13.4	**PK**
2708.00*	52.28	-5.15	47.13	74.0	3.0m./HORZ	26.9	**PK**
3610.00*	52.02	-2.66	49.36	74.0	3.0m./HORZ	24.6	**PK**
4513.00	52.66	-0.82	51.84	74.0	3.0m./HORZ	22.2	**PK**
5416.00	62.46	3.03	65.49	74.0	3.0m./HORZ	8.5	**PK**
Mid Channel – PEAK							
915.00	78.15	26.19	104.34	--	3.0m./HORZ	--	**PK**
1830.00	69.39	-9.23	60.16	74.0	3.0m./HORZ	13.8	**PK**
2745.00*	52.64	-4.99	47.65	74.0	3.0m./HORZ	26.4	**PK**
3661.00*	52.01	-2.72	49.29	74.0	3.0m./HORZ	24.7	**PK**
4576.00	52.32	-0.46	51.86	74.0	3.0m./HORZ	22.1	**PK**
5491.00	61.22	3.18	64.40	74.0	3.0m./HORZ	9.6	**PK**
High Channel– PEAK0							
927.25	78.54	26.27	104.81	--	3.0m./HORZ	--	**PK**
1854.00	69.80	-9.18	60.62	74.0	3.0m./HORZ	13.4	**PK**
2782.00*	52.93	-5.04	47.89	74.0	3.0m./HORZ	26.1	**PK**
3709.00*	52.48	-2.15	50.33	74.0	3.0m./HORZ	23.7	**PK**
4636.00	50.40	-0.44	49.96	74.0	3.0m./HORZ	24.0	**PK**
5563.00	59.00	3.28	62.28	74.0	3.0m./HORZ	11.7	**PK**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209& 15.247.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 902.7 MHz:

Magnitude of Measured Frequency	77.74	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	25.95	dB/m
Corrected Result	103.69	dBuV/m

Test Date: September 20, 2023
Tested By
Signature: Ian Charboneau Name: Ian Charboneau

Table 6. Average Radiated Fundamental & Harmonic Emissions

Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB/m)	Corrected Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	Detector
Low Channel - Average							
902.75	57.41	25.95	83.36	--	3.0m./HORZ	--	**AVG**
1805.00	40.99	-9.55	31.44	54.0	3.0m./HORZ	22.6	**AVG**
2708.00*	33.38	-5.15	28.23	54.0	3.0m./HORZ	25.8	**AVG**
3610.00*	32.27	-2.66	29.61	54.0	3.0m./HORZ	24.4	**AVG**
4513.00	32.51	-0.82	31.69	54.0	3.0m./HORZ	22.3	**AVG**
5416.00	43.75	3.03	46.78	54.0	3.0m./HORZ	7.2	**AVG**
Mid Channel–Average							
915.00	58.34	26.19	84.53	--	3.0m./HORZ	--	**AVG**
1830.00	41.29	-9.23	32.06	54.0	3.0m./HORZ	21.9	**AVG**
2745.00*	33.40	-4.99	28.41	54.0	3.0m./HORZ	25.6	**AVG**
3661.00*	32.76	-2.72	30.04	54.0	3.0m./HORZ	24.0	**AVG**
4576.00	33.01	-0.46	32.55	54.0	3.0m./HORZ	21.5	**AVG**
5491.00	43.22	3.18	46.40	54.0	3.0m./HORZ	7.6	**AVG**
7322.00	41.29	-9.23	32.06	54.0	3.0m./HORZ	21.9	**AVG**
High Channel–Average							
927.25	59.21	26.27	85.48	--	3.0m./HORZ	--	**AVG**
1854.00	41.08	-9.23	31.85	54.0	3.0m./HORZ	22.1	**AVG**
2782.00*	34.16	-5.04	29.12	54.0	3.0m./HORZ	24.9	**AVG**
3709.00*	32.60	-2.72	29.88	54.0	3.0m./HORZ	24.1	**AVG**
4636.00	32.07	-0.46	31.61	54.0	3.0m./HORZ	22.4	**AVG**
5563.00	41.38	3.18	44.56	54.0	3.0m./HORZ	9.4	**AVG**

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 CFR 15.35.
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. The EUT was placed in three orthogonal positions, tested while broadcasting from each antenna, and the transmitter was in constant broadcast mode, with a duty cycle of greater than 98%. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 902.75MHz:

Magnitude of Measured Frequency	57.41	dBuV
+Additional Factor (filter + duty cycle)	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	25.95	dB/m
Corrected Result	83.36	dBuV/m

Test Date: September 20, 2023

Tested By
Signature: Ian Charboneau Name: Ian Charboneau

2.8 Band Edge Measurements (CFR 15.247(d), RSS-247, 5.5)

Band Edge measurements are made following the guidelines in ANSI C63.10-2013 Clause 6.10 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Restricted band and band edge test is performed as radiated measurements. The test instrument used for testing has both Peak and Average detection. In consideration of Clause 5.8 of ANSI C63.10-2013, the EUT antenna is connected to its antenna port during testing. The EUT was set to its highest rated output power level during testing. The results are collected and presented below.

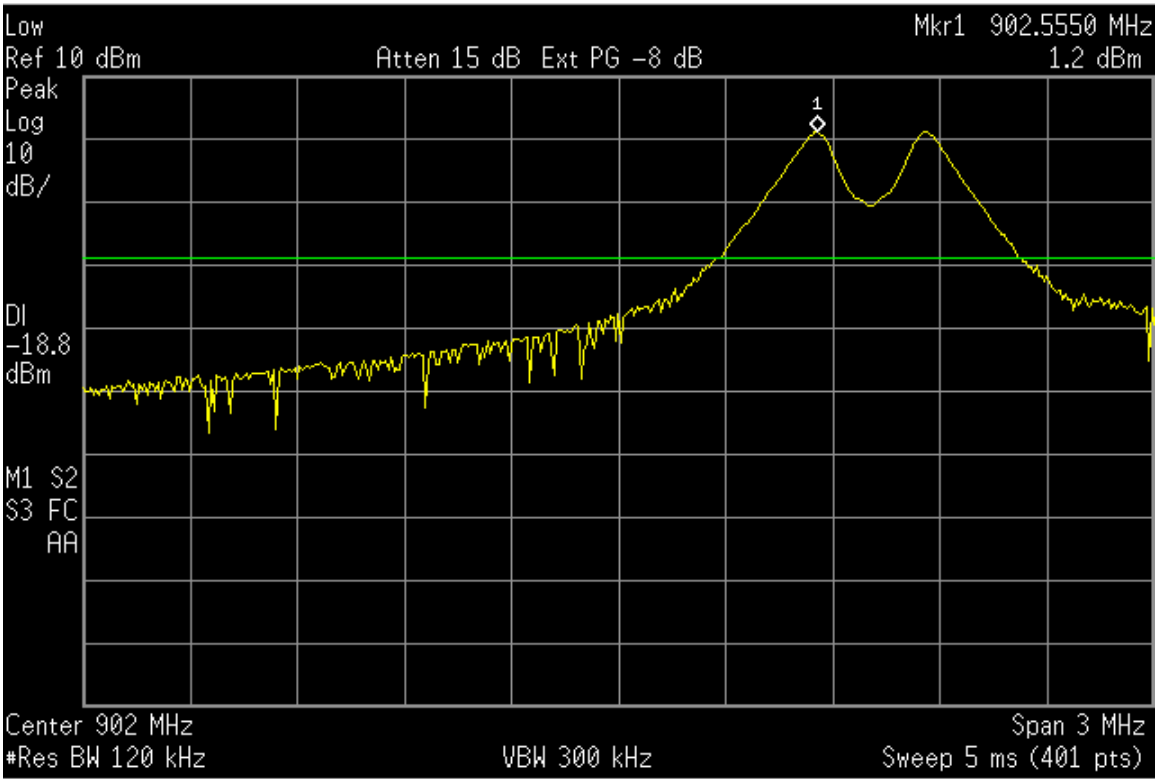

Figure 2. Band Edge Compliance Low Channel Delta - Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	30.33	dB
Band Edge Limit	20.00	dB
Band Edge Margin	10.33	dB

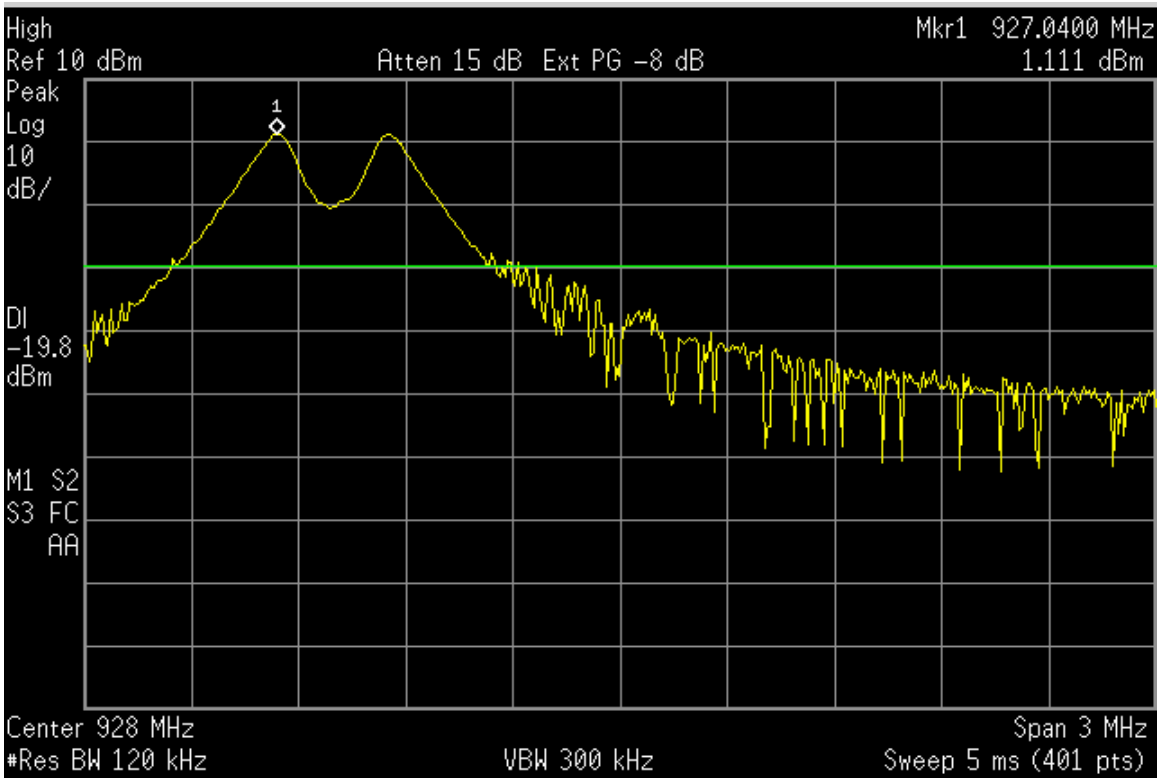

Figure 3. Band Edge Compliance High Channel Delta - Peak

Lower band edge must be 20 dB below the fundamental. This requirement is met.

Measured Result	28.51	dB
Band Edge Limit	20.00	dB
Band Edge Margin	8.51	dB

2.9 Six (6) dB Bandwidth (CFR 15.247(a)(2), RSS-247, 5.2(a))

The EUT antenna port was connected to a spectrum analyzer having a 50 Ω input impedance. Measurements were performed per ANSI C63.10-2013, clause 11.8. The RBW was set to 100 kHz and the VBW ≥ RBW. The results of this test are given in the table below and figures below.

Table 7. Six (6) dB Bandwidth

Frequency (MHz)	6 dB Bandwidth (KHz)	Minimum FCC Bandwidth (KHz)
902.75	529.32	500
913.75	522.53	500
927.25	535.18	500

Test Date: October 10, 2023

Tested By
Signature:  Name: Ian Charboneau

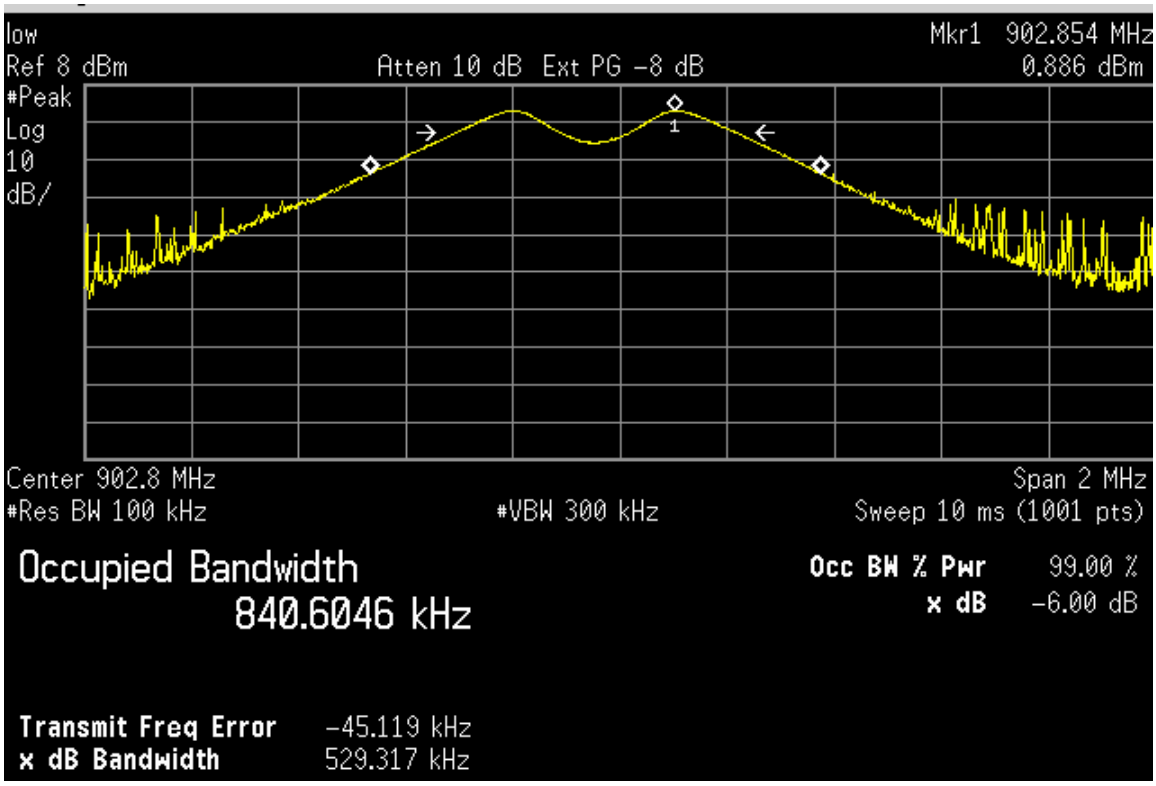

Figure 4. 6 dB Bandwidth Low Channel

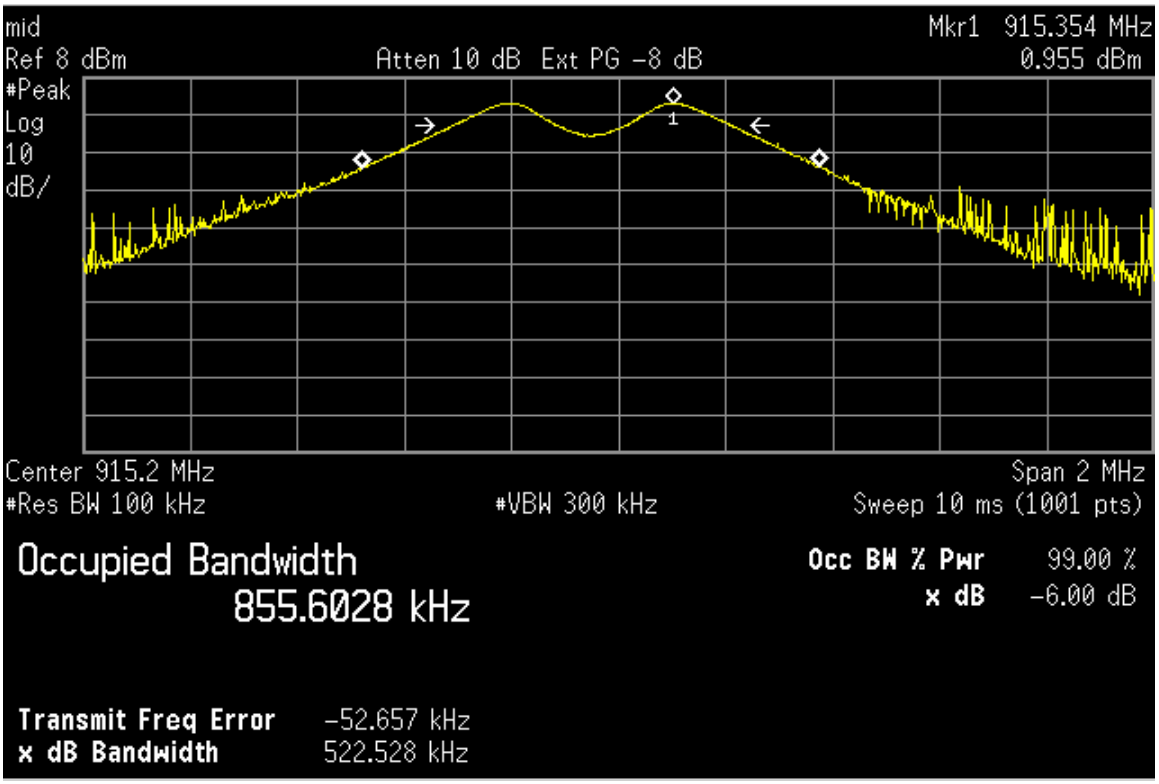

Figure 5. 6 dB Bandwidth Mid Channel

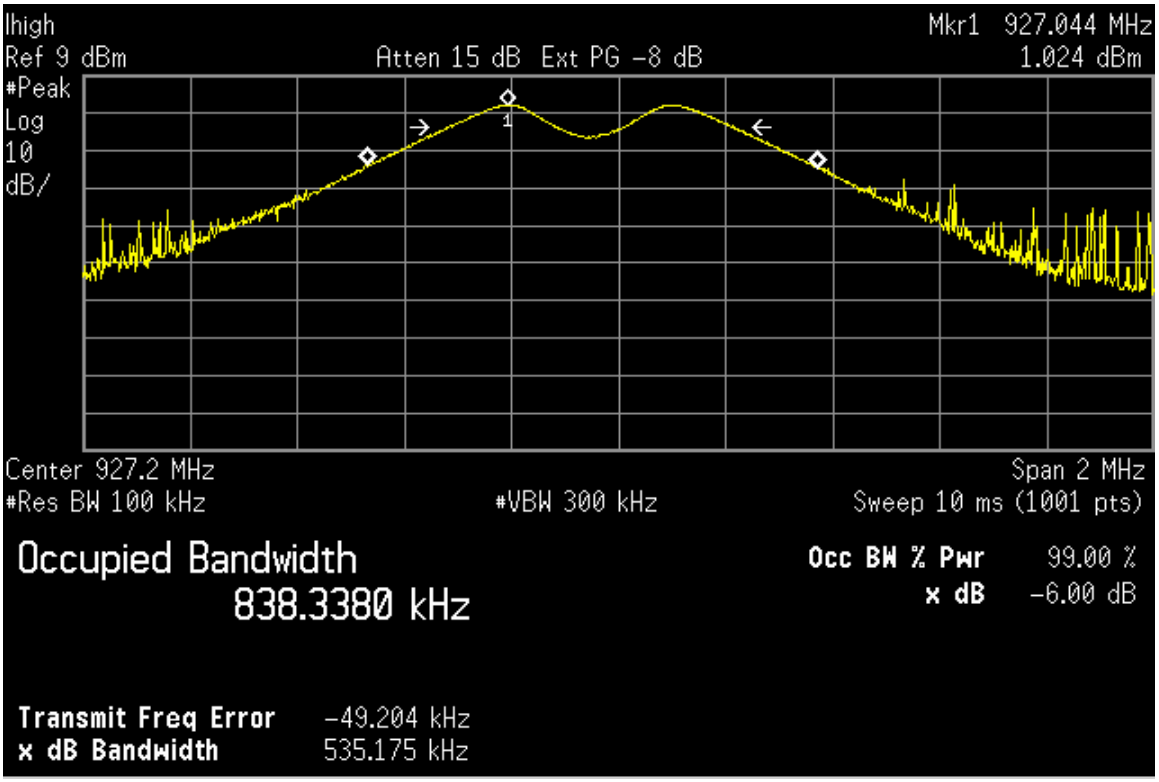

Figure 6. 6 dB Bandwidth High Channel

2.10 Occupied Bandwidth, (99% bandwidth)(RSS-GEN (6.6))

The EUT antenna port was connected to a spectrum analyzer having a 50Ω input impedance. Measurements were performed similar to the method of FCC, KDB Publication No. 558074 v03r05 for a bandwidth of 20 dB. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 17 and presented in the figures in section 2.12 above.

Table 8. 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)
902.75	0.627
913.75	0.635
927.25	0.626

Test Date: October 10, 2023

Tested By
Signature: Ian Charboneau Name: Ian Charboneau

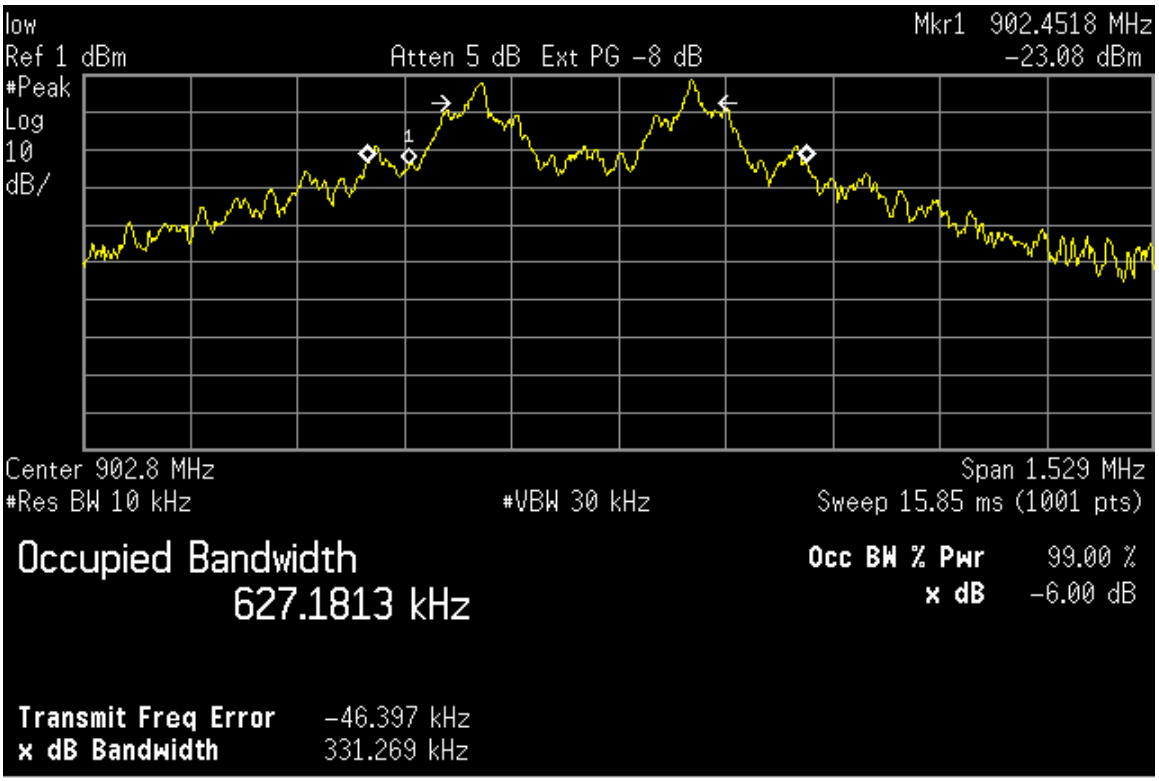

Figure 7. 99% Occupied Bandwidth Low Channel

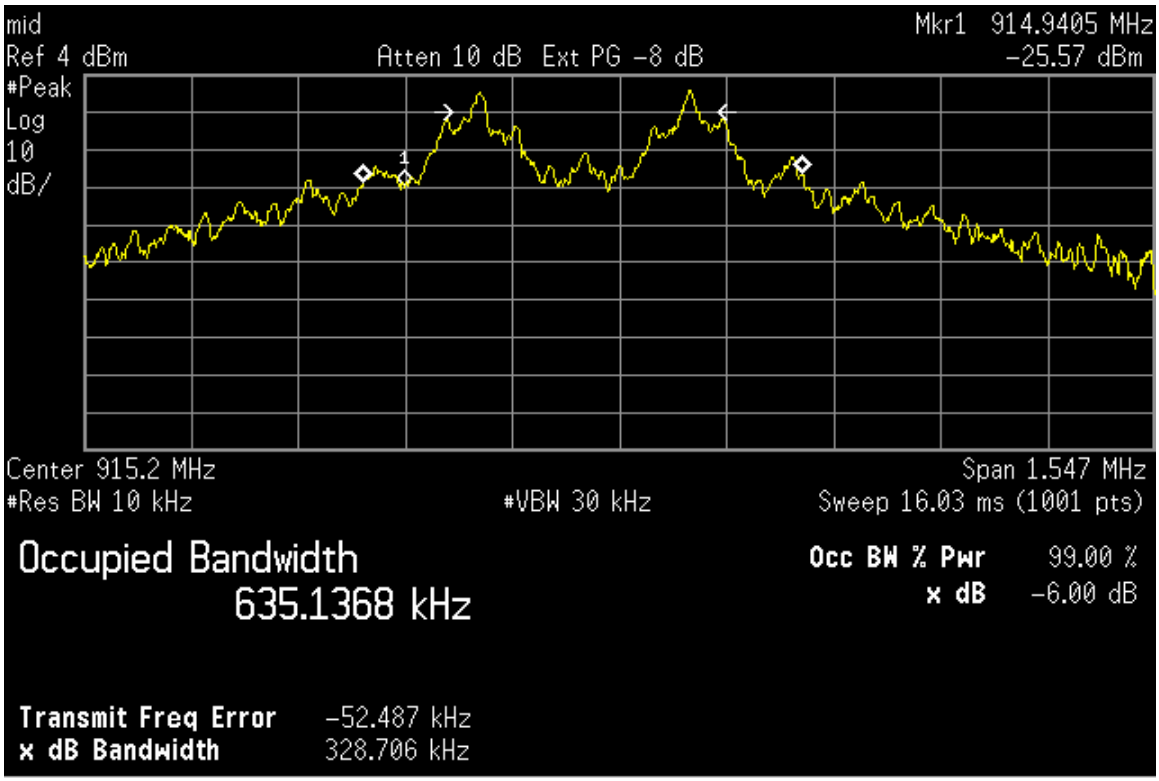

Figure 8. 99% Occupied Bandwidth Mid Channel

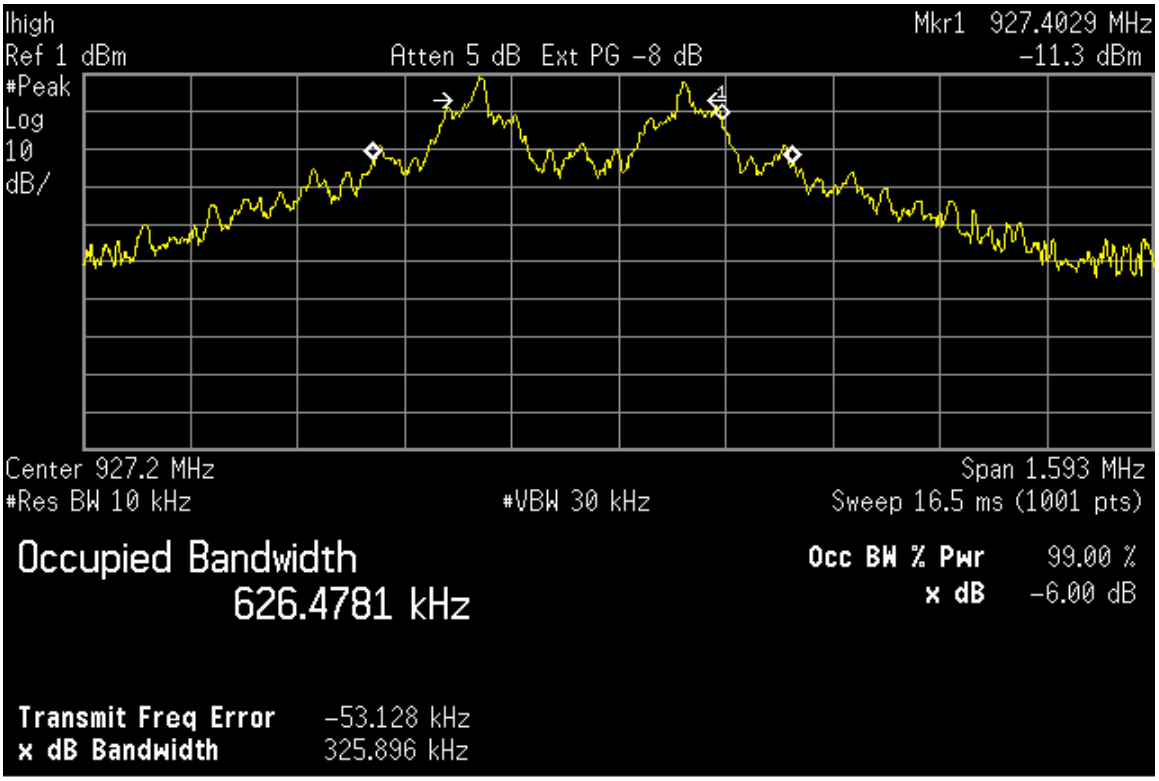

Figure 9. 99% Occupied Bandwidth High Channel

2.11 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))

The transmitter was programmed to operate at a maximum output power across the bandwidth. For this test the output power of the radio was set to the default value, +2.6 dBm.

Peak power was measured per ANSI C63.10-2013 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, and attenuators to the antenna output terminals on the EUT. The spectrum analyzer was set to a RBW of1 MHz, and the VBW ≥ RBW. Peak antenna conducted output power is tabulated in the table below.

Table 9. Peak Antenna Conducted Output Power per Part 15.247 (b)(3)

Frequency of Fundamental (MHz)	Raw Test Data dBm	Converted Data (mW)	FCC Limit (mW Maximum)
902.75	1.043	1.271	1000
915.75	1.150	1.303	1000
927.25	1.118	1.294	1000

Test Date: October 10, 2023

Tested By
Signature: Ian Charboneau Name: Ian Charboneau

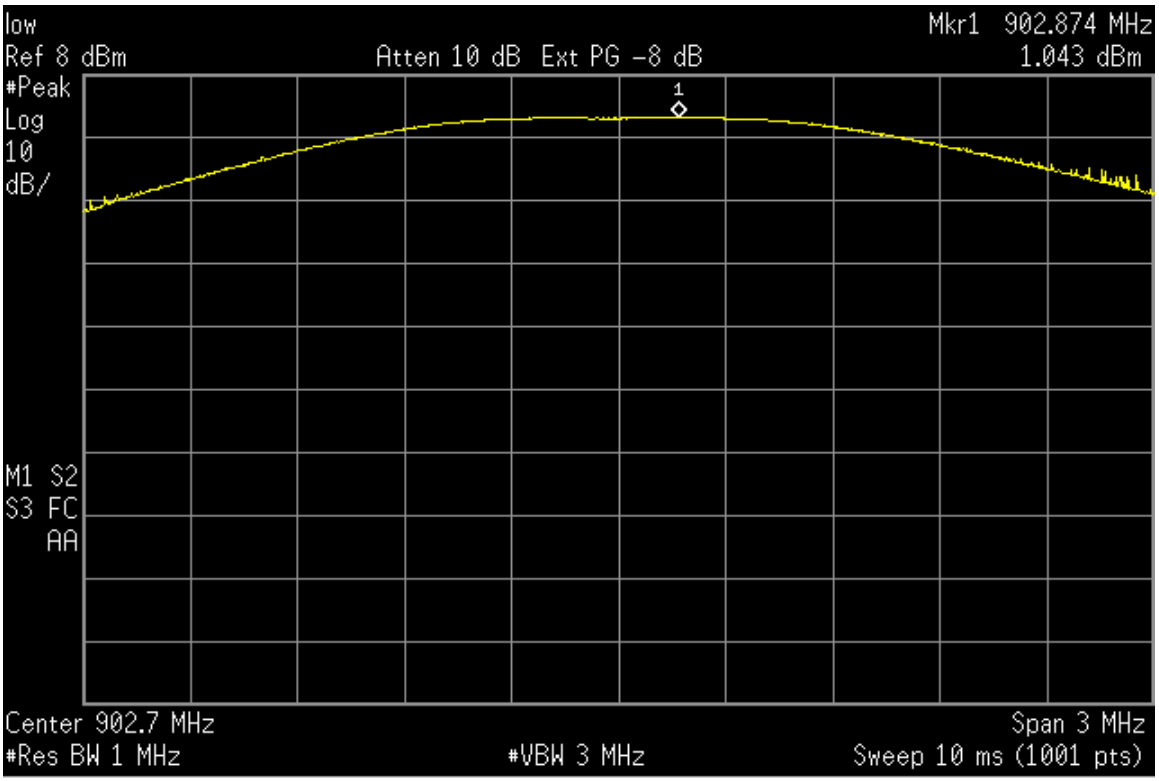

Figure 10. Peak Antenna Conducted Output Power, Low Channel

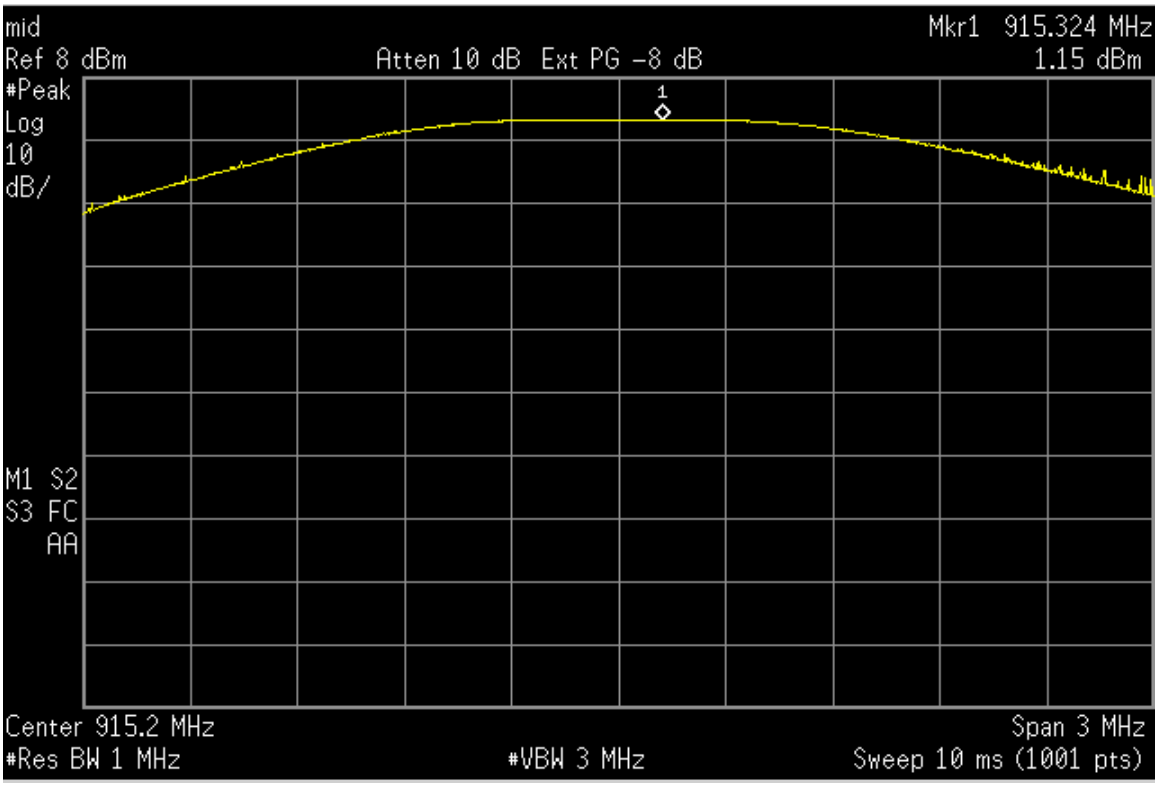

Figure 11. Peak Antenna Conducted Output Power, Mid Channel

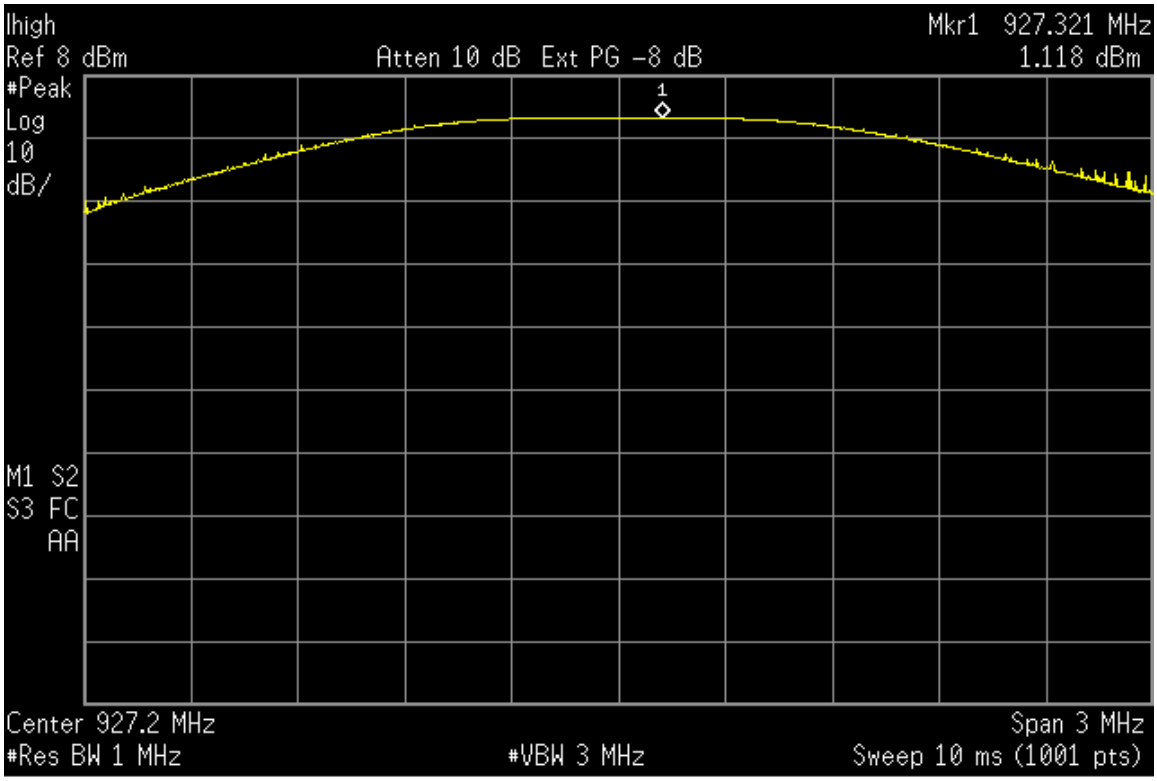

Figure 12. Peak Antenna Conducted Output Power, High Channel

2.12 Power Spectral Density (CFR 15.247(e), RSS-247, 5.2(b))

The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of ANSI C63.10-2013. The RBW was set to 3 kHz and the Video Bandwidth was set to ≥ RBW. The trace capture time was set to (Span/3 kHz).

In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in the table below and figures below. All are less than +8 dBm per 3 kHz band. See figures below.

Table 10. Power Spectral Density for Low, Mid and High Bands

Frequency (MHz)	Measured Result (dBm/3kHz)	FCC Limit (dBm/3 kHz)
902.75	-1.386	+8.0
915.75	-0.025	+8.0
927.25	-1.374	+8.0

Note: dBm/Hz correct to dBm/kHz using the following formula, 10 log RBW ref/RBW measured.

Test Date: October 10, 2023

Tested By
Signature: Ian Charboneau Name: Ian Charboneau

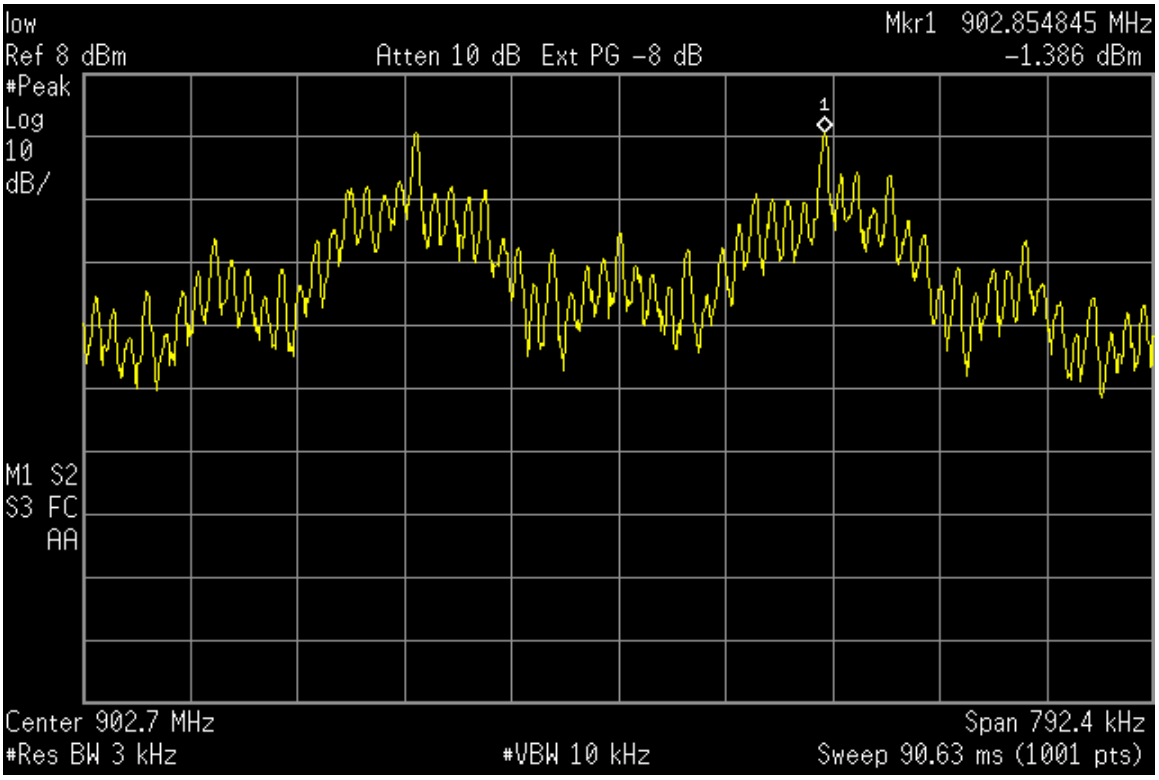

Figure 13. Power Spectral Density, Low Channel

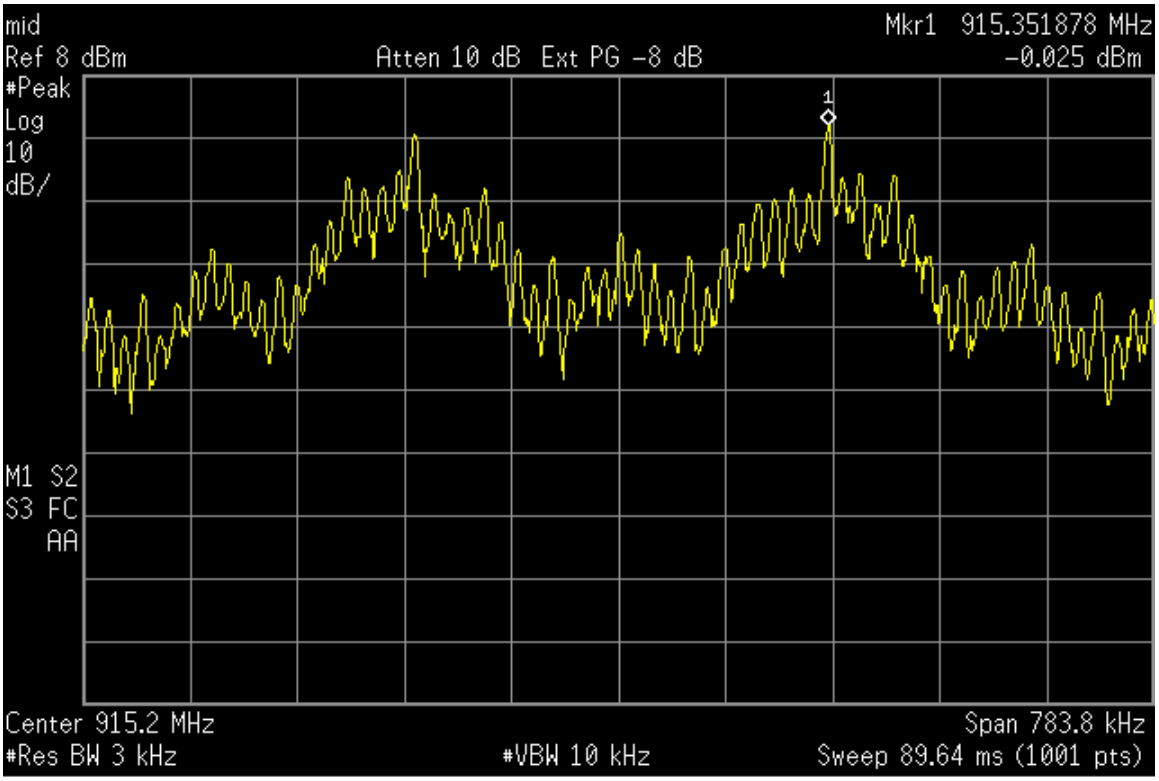

Figure 14. Power Spectral Density, Mid Channel

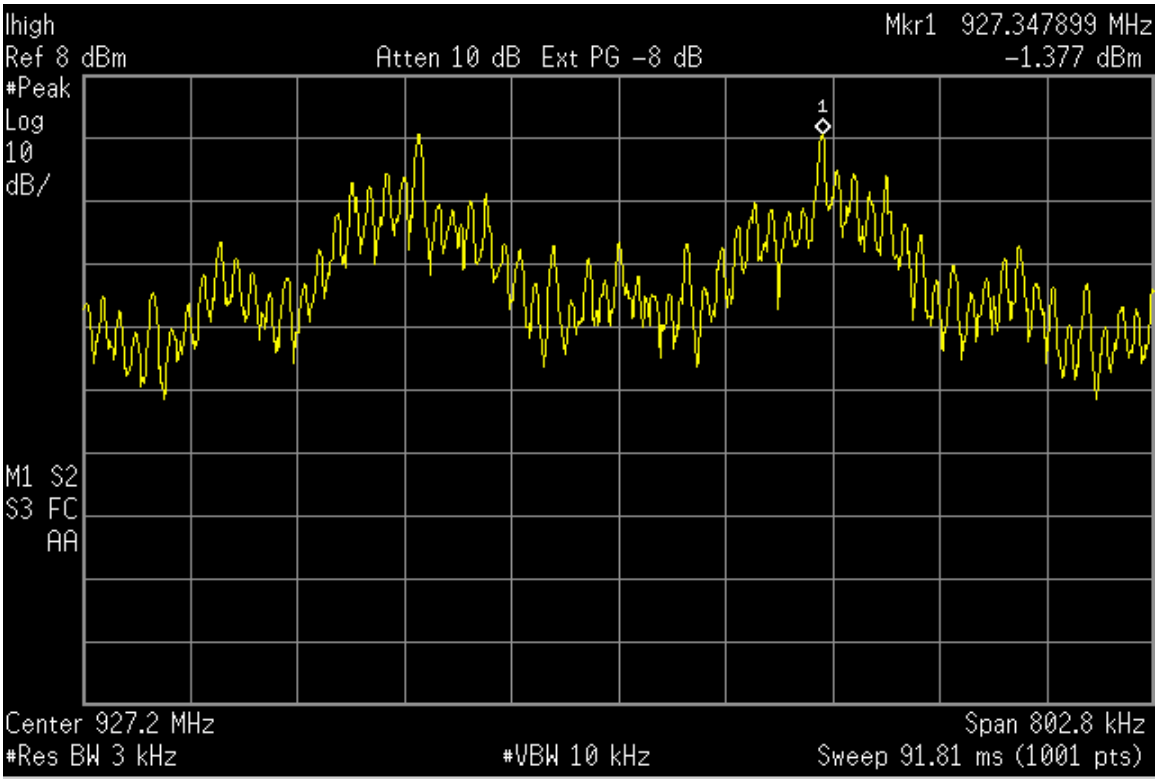

Figure 15. Power Spectral Density, High Channel

2.13 Intentional Radiator, Radiated Emissions (CFR 15.209, RSS-Gen, 8.9)

The test data provided herein is to support the verification requirement for radiated emissions coming for the EUT in a transmitting state per 15.209 and were investigated from 9kHz or the lowest operating clock frequency to 25 GHz and tested as detailed in ANSI C63.10:2013, Clause 6.4-6.6.

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated Loop Antenna and per the requirements of ANSI C63.10:2013.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

The worst-case radiated emission was greater than 20.0 dB below the specification limit. The results are shown in the table following. These results are meant to show that this EUT has met the intentional transmitter requirements of CFR Part 15.209.

Any emissions found that were outside the restricted bands were compared to limits based on Part 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under 15.247(b)(3), the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required.

Table 11. Spurious Radiated Emissions (150 kHz-30MHz)

Test: FCC Part 15.209							
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance / Polarization**	**Margin (dB)**	**DETECTOR PK / QP/AVG**
All emissions were more than 20 dB below the applicable limit.							

AF = antenna factor.
CL = cable loss.
PA = preamplifier gain.

Sample Calculation: N/A

Test Date: September 26, 2023

Tested By
Signature:  Name: Ian Charboneau

Table 12. Spurious Radiated Emissions (30 MHz – 1 GHz), Part 15.209(a)

Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP/AVG
All emissions more than 20db below limit or less than 6dB above noise floor							

AF is antenna factor. CL is cable loss. PA is preamplifier gain.

Test Date: September 26, 2023

Tested By
Signature: Ian Charboneau Name: Ian Charboneau

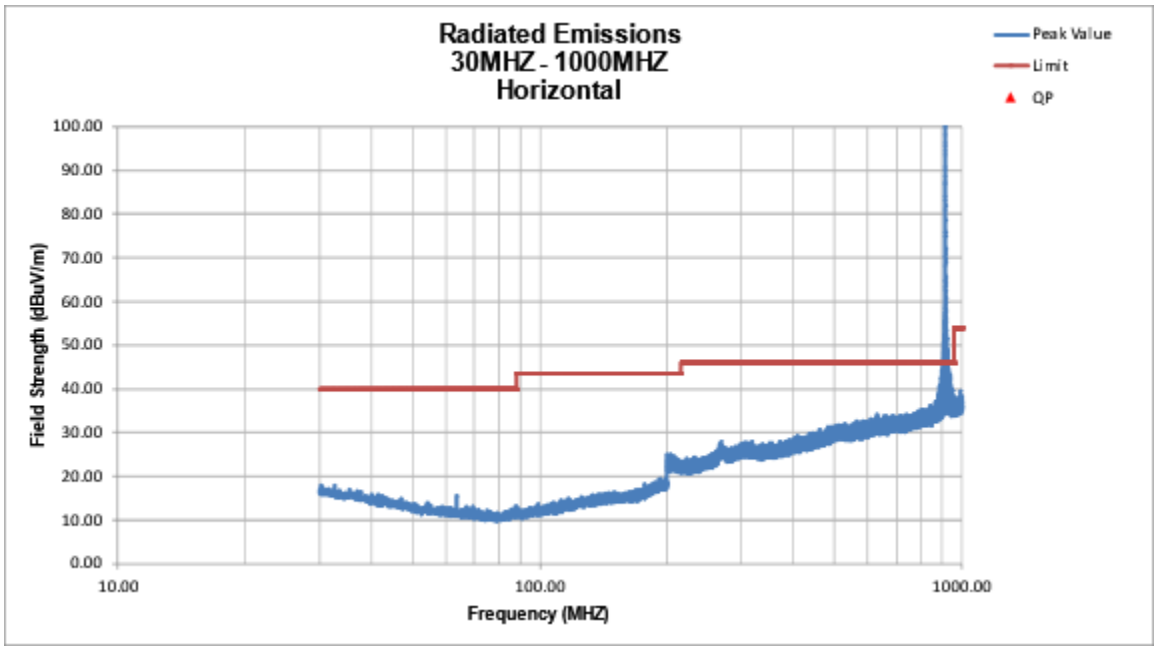

Figure 16. Radiated Emissions RX, 30 MHz - 1000 MHz – Horizontal

*GREEN is 15.247(d) limit.

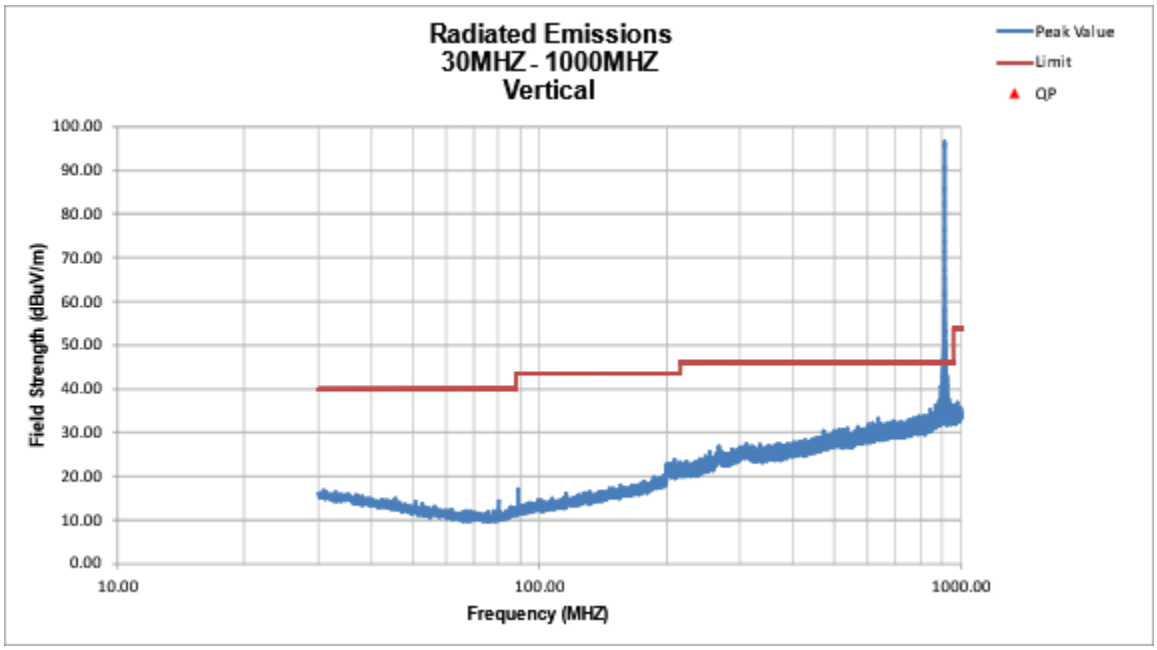

Figure 17. Radiated Emissions RX, 30 MHz - 1000 MHz - Vertical

*GREEN is 15.247(d) limit.

Table 13. Spurious Radiated Emissions – (Above 1 GHz)

Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP/AVG
1830.57	33.99	-8.90	25.09	54.0	3.0m./HORZ	28.9	**AVG**
5490.34	43.22	0.82	44.04	54.0	1.0m./HORZ	10.0	**AVG**
6405.35	42.22	2.87	45.09	54.0	1.0m./HORZ	8.9	**PK**
7319.92	38.30	4.35	42.65	54.0	1.0m./HORZ	11.4	**PK**
1830.57	41.29	-8.79	32.50	54.0	3.0m./VERT	21.5	**AVG**
4576.96	46.88	-2.28	44.60	54.0	3.0m./VERT	9.4	**PK**
5492.22	37.57	0.77	38.34	54.0	1.0m./VERT	15.7	**AVG**
6407.22	42.20	2.85	45.04	54.0	1.0m./VERT	9.0	**PK**
7322.54	38.05	4.39	42.44	54.0	1.0m./VERT	11.6	**PK**

Note: Measurement at 1 meters corrected using inverse extrapolation factor of -9.5 dB to correct the value for 3 meter.

Sample Calculation at 1830.57MHz:

Magnitude of Measured Frequency	33.99	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-8.90	dB/m
Corrected Result	25.09	dBuV/m

Test Date: September 25, 2023

Tested By
Signature: Ian Charboneau Name: Ian Charboneau

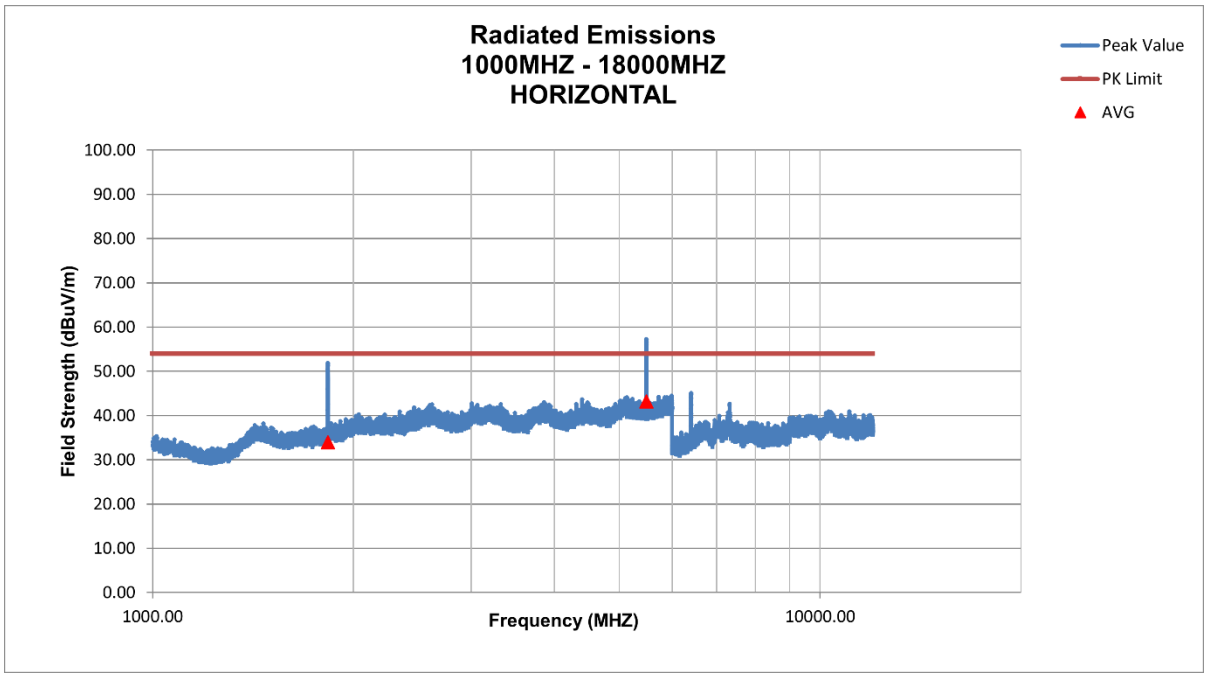

Figure 18.Radiated Emissions RX, 1 GHz - 12 GHz – Horizontal

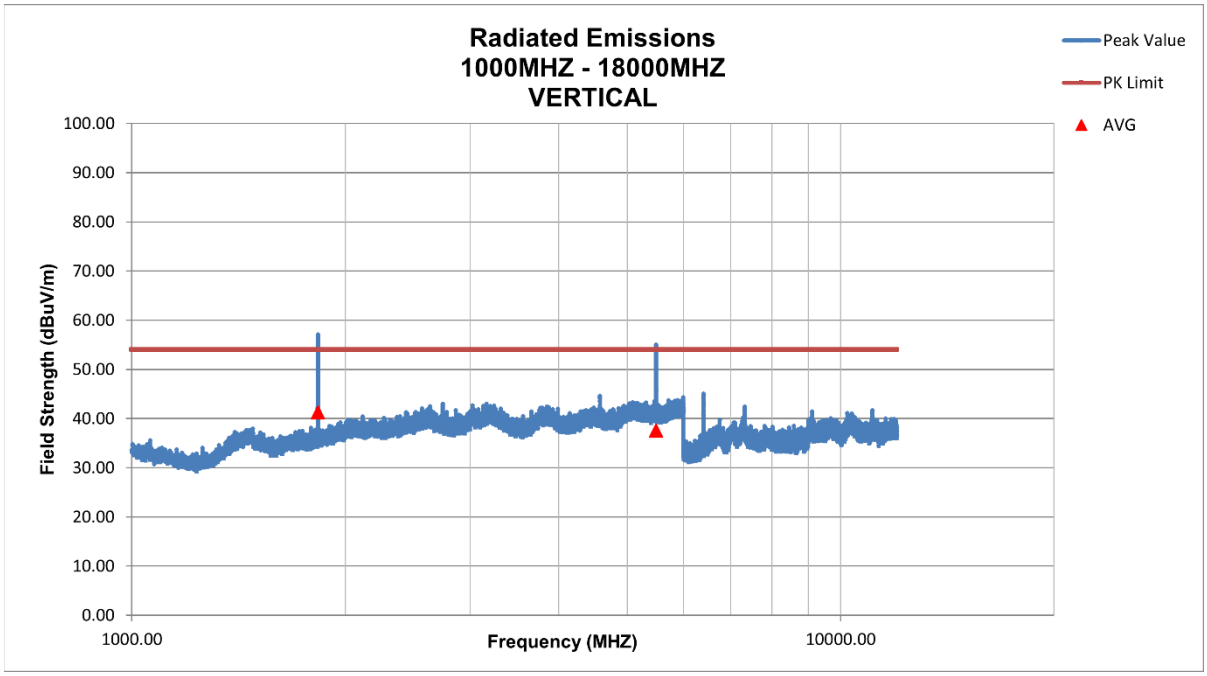

Figure 19.Radiated Emissions RX, 1 GHz - 12 GHz – Vertical

2.14 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.14.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.85 dB.

2.14.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.2 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.2 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.2 dB.

3 Conclusions

The EUT is deemed to have met the requirements of the standards cited within the test report when tested as detailed in the present test report.