Testing Tomorrow's Technology

June 17, 2024

Ms. Debbie LeMaster
Radio Systems Corporation
10427 Petsafe Way
Knoxville, TN 37932

Dear Ms. LeMaster:

Enclosed herewith, please find Radio Systems Corporation's file copy of the FCC Part 95 Certification Report for the Radio Systems Corporation Model RFA-635 Collar. The Collar is part of a larger system under SKU number PIF00-17933. For the purpose of this report, only the Collar was evaluated.

Please keep the report in your files as proof that the product has been successfully tested and evaluated for compliance with Part 95 Subpart J.

If you have any questions, please don't hesitate to call. Thank you very much for your business.

Sincerely,

Alan Ghasiani
Consulting Engineer - President

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

Testing Tomorrow's Technology

Report of

Title 47 CFR Part 95 Subpart J,
Multi User Radio Services (MURS) and
TIA-603-E (2016) Land Mobile FM or PM- Communications Equipment
Measurement and Performance Standard

For the
Radio Systems Corporation

Model: RFA-635
FCC ID: KE3-3003791

Issue Date: June 17, 2024

Test Dates: June 10-13, 2024

UST Project No.: 24-0045

Total Number of Pages Contained in this Report: 19

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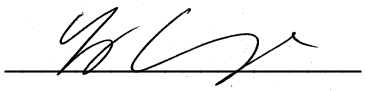
I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: 

Name: George Yang

Title: Laboratory Manager

Date: June 17, 2024

NVLAP TESTING

NVLAP LAB CODE 200162-0

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1 General Information

1.1 Product Description

The Equipment under Test (EUT) is the Radio Systems model RFA-635 Collar. The EUT is part of the PetSafe Guardian GPS Dog Fence model PIF00-17933. The Guardian GPS Dog Fence system uses GPS technology to keep a pet dog within a boundary designed by the owner. The system consists of three main parts: the My PetSafe® app, the base unit and the collar(EUT). The base unit is the hub for communication with your dog's collar. The base unit and collar communicate with one another through a two-way radio frequency (RF) link while the collar is within range of the base unit (about 300 feet).

MURS Radio specifications, Fundamental frequency: 151.82 MHz
Measured Output Power (ERP): -16.27dBm
Modulation type: GFSK
Data Rate: 3.6 kbps
Frequency Deviation: 1428 Hz

1.2 Related Submittal(s)/Grant(s)

The EUT is subject to the following authorizations:

a) Certification as a 151.82 MHz, MURS transmitter per FCC Part 2, Subpart J and Part 95, Subpart J, MURS and Subpart E, Technical Requirements.
b) Verification under 15.101 as a digital device and receiver.

1.3 Test Methodology

These measurements were conducted in accordance with the requirements of Title 47 CFR Part 95, Subpart E and TIA-603-E (2016). All measurements are in terms of peak values unless stated otherwise. The measurement system video bandwidth was set to at least three times that of the resolution bandwidth to prevent the introduction of amplitude smoothing throughout the evaluation process. If interconnecting cables are part of the measurement setup, then they were manipulated as necessary to maximize emissions. A block diagram of the tested system is shown in Figure 1.

1.4 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 under registration number US5301. US Tech is an accredited laboratory under the National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code: 200162-0.

The shielded semi anechoic EMC Chamber and the conducted disturbance measurement facilities used to collect the radiated and conducted emissions data are located at 3505 Francis Circle, Alpharetta, GA (USA). These test sites meet the requirements given in ANSI C63.4:2014.

1.4.1 Radiated Emissions Test Site (Shielded Semi Anechoic EMC Chamber)

The radiated emissions disturbance measurement facility consists of an 8.5 m long by 5.5 m wide and 5.6 m high shielded semi anechoic EMC Chamber. The chamber is lined with ferrite core and RF absorbers. The quiet zone is 2.0 m.

The test facility layout is shown in the figure below. A remotely controlled 2.0 m diameter flush-mounted turntable is provided for rotating (through at least 360 degrees) the EUT. A non-conductive table, 1.5 m long by 1.0 m wide by 0.8 m high is used in conjunction with the turntable for tabletop equipment. Electrical service for the EUT is provided through openings at the center of the turntable.

Provision for receiving antenna power and data wires is provided by junction boxes placed at the perimeter of the chamber. The receive antenna mast is remotely controlled and can be varied in height from 1 m to 4 m.

Power and data cables for the radiated disturbance measurement facility are run through PVC tubing under the raised floor or are laid directly upon the ground plane.

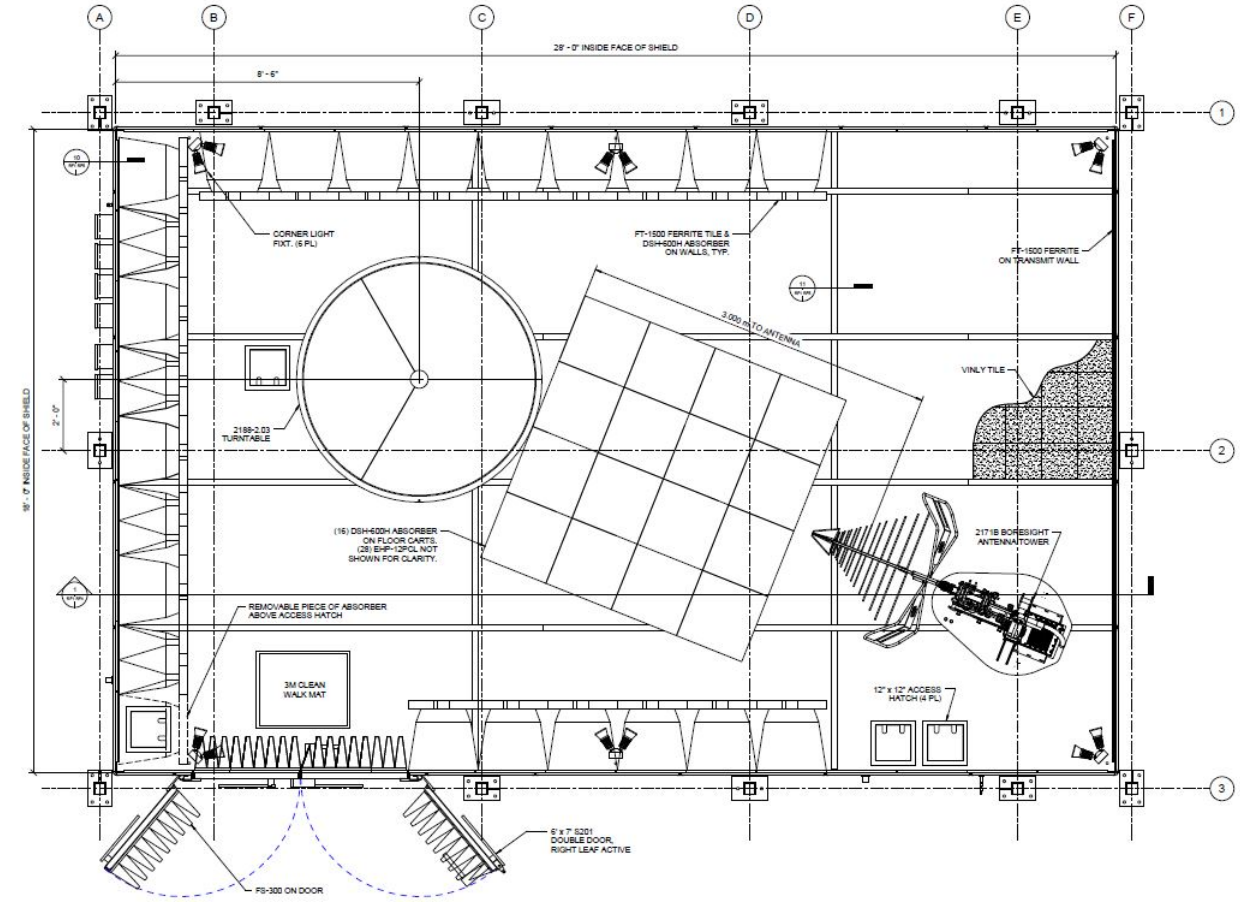


Figure 1. Radiated Emissions Disturbance Measurement Facility Diagram

1.5 Test Equipment

Table 1 describes test equipment used to evaluate this product.

Table 1. Test Instruments

INSTRUMENT TYPE	MANUFACTURER	MODEL	SERIAL NUMBER	CALIBRATION DUE DATE
Spectrum Analyzer	Agilent	E4440A	MY45304803	2/22/2026 2 yr.
RF Preamp	Hewlett-Packard	8449B	3008A00914	3/4/2025
RF Preamp	Hewlett-Packard	8447D	1937A01611	6/17/2025
Loop Antenna	ETS Lindgren	6502	9810-3246	12/7/2024 2 yr.
Biconical Antenna	EMCO	3110B	9306-1708	8/17/2024 extended
Biconical Antenna	EMCO	3110B	9307-1431	1/13/2025 2 yr.
Log Periodic Antenna	EMCO	3146	9305-3600	3/13/2026 2 yr.
Log Periodic Antenna	EMCO	3146	9110-3236	12/13/2024 extended
Horn Antenna	A. H. Systems	SAS-571	605	7/12/2024 extended
Horn Antenna	EMCO	3115	9107-3723	3/13/2025 2 yr.
Environmental Chamber	Thermotron	SM16	17095	4/17/2025 2 yr.
LISN (x2)	Solar Electronics	8028-50-TS24-BNC	955824 & 955825	4/28/2025
Spectrum Analyzer	Rigol	DSA815	DSA8A180300138	2/22/2026 2 yr.
Signal Generator	Rhode & Schwarz	SMJ100A	101567	3/29/2026 2 yr.

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

1.6 Modifications to EUT

No modifications were necessary to bring the EUT into compliance with FCC Part 95 Subpart J.

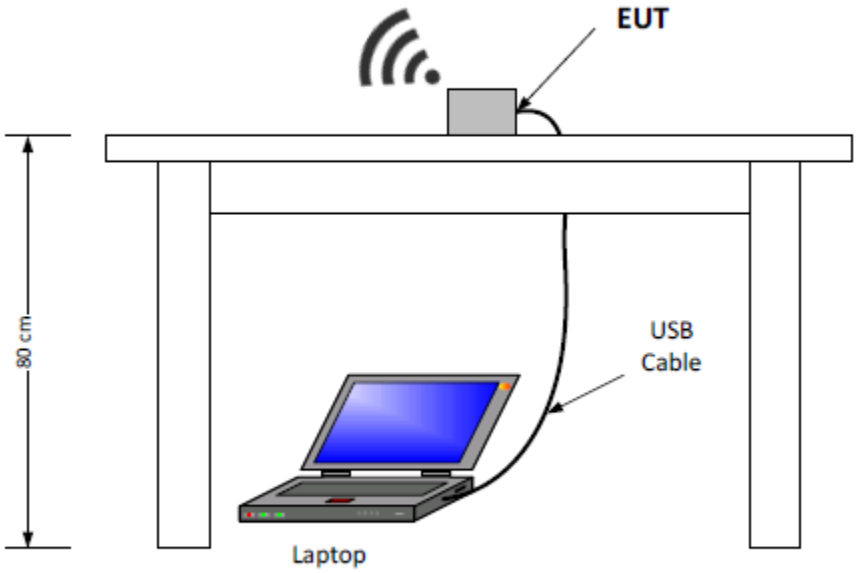


Figure 2. Test Configuration Block Diagram

Note 1: Laptop is only used to program radio to continuously transmit. It is not required foe normal operation.

Table 2. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/ IC ID:	CABLES P/D
Radio Systems Corporation (EUT)	RFA-635	Engineering Sample	FCC ID: KE3-3003791	PU/DU
Salom AC/DC Adaptor	SSW-3538US	23305N	N/A	P
Lenovo Laptop	82C6	PF2FRG6z	N/A	P/D

P = Power; D = Data U = Unshielded

Table 3. Antennas

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	PART NUMBER	GAIN dB_i	TYPE OF CONNECTOR
Antenna	Radio Systems Corp	Chip	100-1130	-25.0	Soldered

2 Output Power

2.1 Maximum Transmitter Power (FCC 2.1046 & 95.2767)

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. The exact antenna height with a maximized signal was recorded for reproducibility purposes. Also, the EUT was rotated about its Z-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.

The maximum power was measured using the radiated method. The EUT was setup to transmit a continuous signal with >98% duty cycle. The receiver and video bandwidth on the spectrum analyzer was maximized and the span was sufficiently large enough to capture the peak emissions. The peak measurement of the signal was recorded.

2.1.1 Maximum Power Allowed

The maximum power allowed is 2 Watts (or 33 dBm) per FCC 95.2767.

2.1.2 Measured Fundamental Signal

The maximum output power of the EUT as measured below is 2.36e-05 W.

-16.27 dBm into 50-ohm measurement system = 0.0235 mW <<2 Watts
Antenna gain = -25 dBi

ERP = -16.27 - 25 = -41.27dBm = 7.46e-08 W << 2 Watts

The EUT was determined to comply with the Maximum Allowed Power.

Table 4. Maximum Output Power

Frequency MHz	Maximum RX Reading (Units A)	Recreated Reading During Substitution (Using Same Units A) - Ideally 0	Difference Column A - B	TX Cable Loss (dB)	TX Gain (dBi)	TX Gain Relative to Dipole (dBd)	RF Power into TX antenna (dB)	RF Power into substitution TX antenna corrected by TX Gain Relative to Dipole and TX Cable (dBm) ERP	Limit (dBm) ERP	Margin Below Limit (dB)
151.82	72	72	0	1.1	-1.04	-15	-16.28	33	49.28	72

Sample Calculation at 151.82 MHz:

SG Power into TX antenna	5.00 (dBm)
+ TX Gain	1.10 (dB)
+ Difference between recreated and actual	0.04 (dB)
+ TX Cable Loss	-0.24 (dB)
RF Power into TX Antenna	+3.76 (dBm)
Limit	33.00 (dBm)
RF Power Into TX Antenna	- 3.76 (dBm)
Margin	39.24 (dBm)

Test Date: June 11, 2024

Tested By
Signature:  Name: Gabriel Medina

3 Emissions Bandwidth (Part 95.2773(a))

The EUT was modulated by its own internal sources. The Bandwidth of the Fundamental was measured using a spectrum analyzer, as shown below. An RBW that was > 1% of the authorized bandwidth was used to measure the EUT's bandwidth.

Using the Emission Bandwidth measurement technique of ANSI C63.10-2009 as a guide, the measurement of the Emission Bandwidth is found to be 4.10 kHz.

3.1 Maximum Authorized Bandwidth

The maximum authorized Bandwidth per 95.2773 (a) = 11.25 kHz. The EUT was found to comply with the Maximum Authorized Bandwidth since 4.10 kHz < 11.25 kHz.

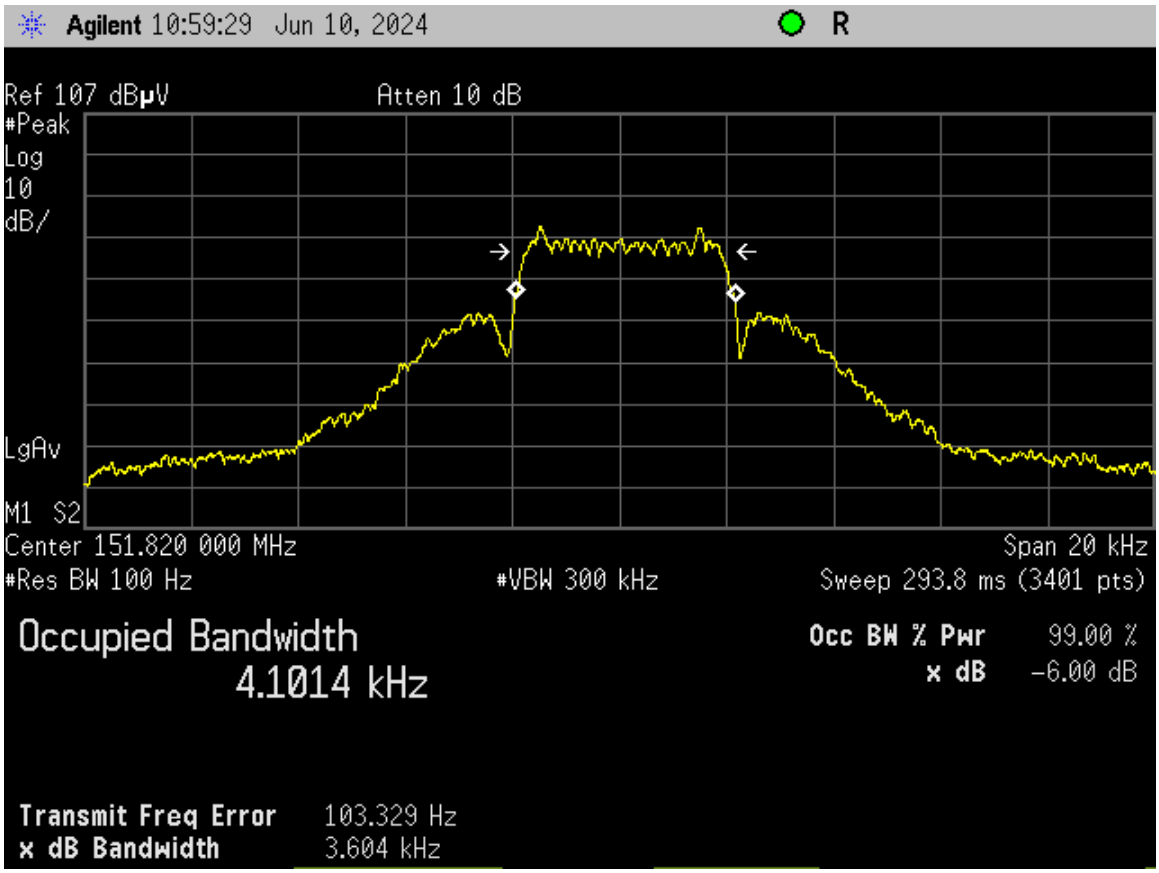


Figure 3. Bandwidth Measurement

Test Date: June 10, 2024

Tested By
Signature: Name: Gabriel Medina

4 Unwanted Radiation Emissions (CFR 95.2779 (a)(b)(c))

This requirement is from 47 CFR Part 2, Subpart J, Sections 1053 and 95.2779(b). The power of each unwanted emission shall be less than TP (Transmitter Power) as specified in paragraph 5.2 below.

4.1 Test Method

These emissions were measured on the Spectrum Analyzer via a short RF cable soldered to the RF output port of the transmitter circuit board.

4.2 FCC Limits

Per CFR Part 95.2779(b), the power of unwanted emissions must be attenuated below the transmitter output power in Watts (P) by at least:

(1) 7.27(f_d−2.88 kHz) dB on any frequency removed from the channel center frequency by a displacement frequency (f_d in kHz) that is more than 5.625 kHz, but not more than 12.5 kHz.
(2) 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation, on any frequency removed from the channel center frequency by more than 12.5 kHz.

4.3 Test Results

The EUT is designed to operate at 151.8200 MHz and is assumed not to be using any audio low pass filter circuits, therefore only Emissions Mask 1 was applied.

The measured emissions comply with the specified mask as shown below.

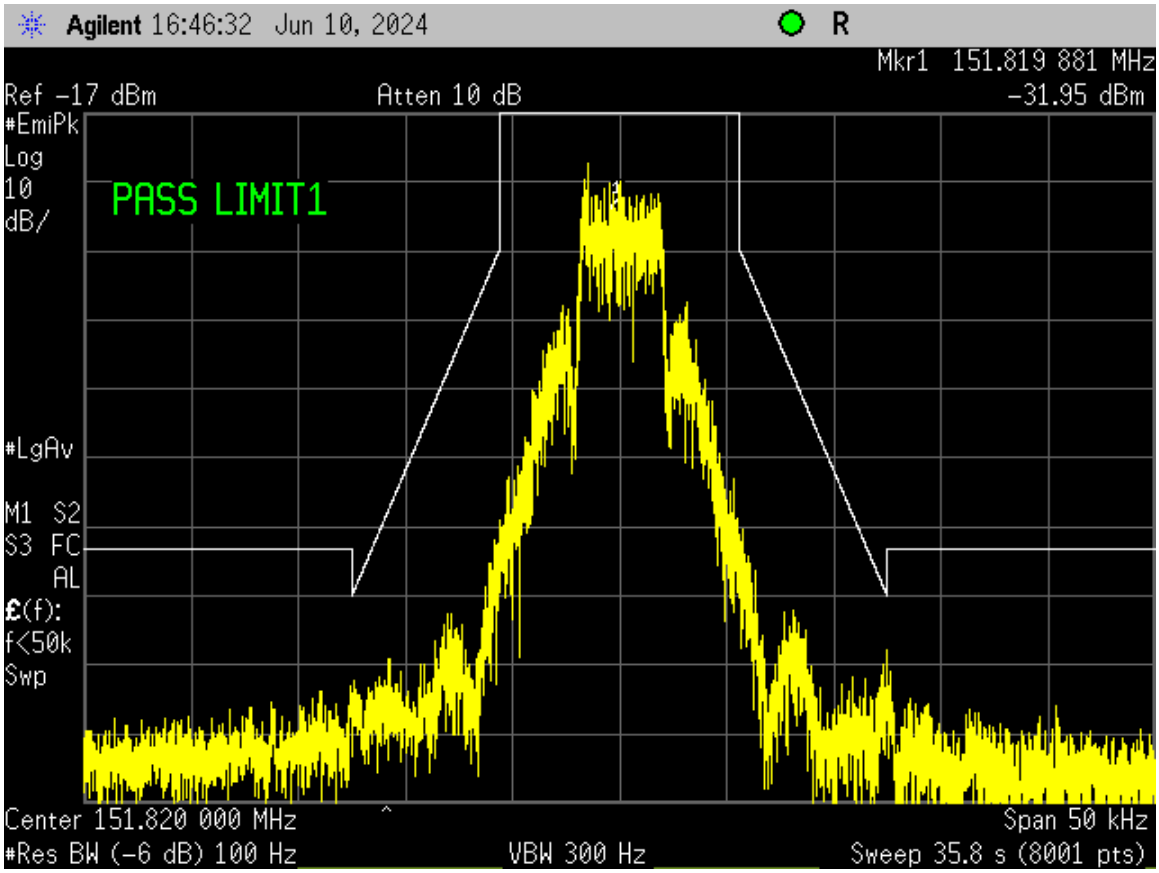


Figure 4. Emissions Mask 1

Test Date: June 10, 2024

Tested By
Signature: Name: Gabriel Medina

5 Field Strength of Spurious Radiation, (FCC 2.1051 & 95.2779(b)(2))

5.1 Test Method

Spurious emissions were evaluated by the substitution method from 30 MHz to 1.0 GHz at a EUT to antenna distance of 3 meters. The EUT was tested in the far field. Measurements for 30 to 1000 MHz were made with the analyzer's bandwidth set to 120 kHz. Measurements above 1000 MHz were made with analyzer's bandwidth set to 1 MHz and 3 MHz. Since the EUT is part of a portable handheld configuration, the EUT was rotated through the three orthogonal planes to produce the highest emissions relative to the limits. Results are shown in the Table below.

5.2 FCC Limits

The limit is determined using the following method. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz, the limit will be at least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

Measured ERP Power = 0.00238 Watts = 3.76 dBm
Attenuation Calculation = 50 + 10Log(0.0000235) = 3.71
Power Limit = -16.28 dBm – 3.71 dB = -20 dBm

5.3 Test Results

Table 5. Field Strength of Spurious Radiation

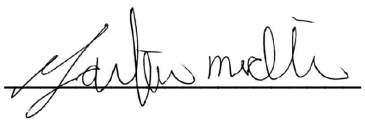
Frequency MHz	Maximum RX Reading (Units A)	Recreated Reading During Substitution (Using Same Units A) - Ideally 0	Difference Column A - B	TX Cable Loss (dB)	TX Gain (dBi)	TX Gain Relative to Dipole (dBd)	RF Power into TX antenna (dBm) (SG Value-CL)	RF Power into substitution TX antenna (dBm)	Limit (dBm)	Margin Below Limit (dB)
62.60	34.41	34.40	0.01	0.15	-3.5	-5.64	-79.00	-84.78	-20.00	64.78
303.63	69.99	69.84	0.15	0.37	4.2	2.06	-38.00	-36.16	-20.00	16.16
443.43	46.10	46.10	0.00	0.50	5.8	3.66	-66.00	-62.84	-20.00	42.84
503.47	39.04	39.47	-0.43	0.57	5	2.86	-70.00	-68.14	-20.00	48.14
223.82	55.10	55.13	-0.03	0.31	5.3	3.16	-60.70	-57.89	-20.00	37.89
All other emissions were 20 dB or greater below the applicable limit.										

Sample Calculation at 62.60 MHz:

SG Power Into TX Antenna	-79.00 (dBm)
+ TX Gain	-3.50 (dB)
+Difference between recreated and Actual	-0.01 (dB)
-TX Cable Loss	-0.15 (dB)
RF Power Into TX Antenna	-84.78 (dBm)

Limit	-20.00 (dBm)
RF Power into TX Antenna	-84.78 (dBm)
Margin	64.78 (dB)

Test Date: June 11, 2024

Tested By
Signature:  Name: Gabriel Medina

6 Frequency Stability (CFR 2.1055, 95.2765(a)(b))

6.1 Test Method

The EUT was tested in the Thermotron Environmental Chamber. The humidity was tested to a relative value of no more than 50%. The temperature was varied between -30°C to +50°C in 10° increments. All measurements were referenced back to the frequency measured at +20°C. At each set point the temperature was allowed to stabilize for no less than 30 minutes before measurements were recorded and the temperature changed.

6.2 FCC Limits

Per CFR 95.2765 (a)(b) MURS transmitters must maintain a frequency stability of 5.0 ppm, or 2.0 ppm if designed to operate with a 6.25 kHz bandwidth. Since this EUT was measured to have a bandwidth of 4.10 the limit applied was 5.0 ppm.

6.3 Test Results

Table 6. Frequency Deviation/Stability

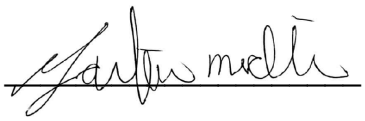
Temperature (˚C)	Measured Frequency (MHz)	Allocated Frequency (MHz)	Deviation (ppm)	Limit (ppm)
-30	151.8190	151.8195	3.3	5.00
-20	151.8193	151.8195	1.6	5.00
-10	151.8198	151.8195	1.6	5.00
0	151.8188	151.8195	4.5	5.00
10	151.8190	151.8195	3.3	5.00
20 (low voltage)	151.8198	151.8195	1.6	5.00
20 (Nominal voltage)	151.8195	151.8195	0.0	5.00
20 (High voltage)	151.8193	151.8195	1.6	5.00
30	151.8188	151.8195	4.9	5.00
40	151.8200	151.8195	3.3	5.00
50	151.8188	151.8195	4.9	5.00

Actual TX Frequency was: 151.8195 MHz

Sample Calculation at -30˚C

$$\text{Deviation} = \frac{|(151.8190 - 151.8195)|}{151.8195} = 0.00000330 = 3.3 \text{ ppm} < 5\text{ppm}$$

Test Date: June 12-13, 2024

Tested By
Signature:  Name: Gabriel Medina