Testing Tomorrow's Technology

May 5, 2015

Ms. Cindy Allen
Radio Systems Corporation
10427 Electric Avenue
Knoxville, TN 37932

Dear Ms. Allen:

Enclosed herewith, please find Radio Systems Corporation's file copy of the FCC Part 95 Certification Report for the Radio Systems Corporation GPSC GEN2 Base Station, Model 300-3048.

Please keep the report in your files as proof that the product has been successfully tested.

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
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Testing Tomorrow's Technology

Report of

Title 47 CFR Part 95 Subpart J, Multi User Radio Services (MURS) and TIA-603-C (2004) Land Mobile FM or PM- Communications Equipment Measurement and Performance Standard

For the
Radio Systems Corporation

Family Name: GPSC Mobile
Model Name: GPSC GEN2 BASE STATION
Model: 300-3048
FCC ID: KE3-3003048

Issue Date: May 5, 2015
Test Dates: April 24-30, 2015

UST Project No.: 15-0116

Total Number of Pages Contained in this Report: 19

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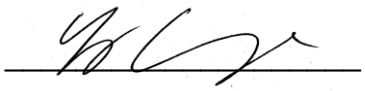
I certify that I am authorized to sign for the test facility and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: 

Name: George Yang

Title: Laboratory Manager

Date: May 5, 2015

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 Corporation GPSC Mobile, Model 300-3048, Invisible Fence Brand Base Station. The product is a GPS pet containment base reference station that collects ephemeris data and computes pseudo range corrections and relays these to GPS mobile units via 151.82 MHz. The product also indicates base station and GPS mobile unit status.

Rated Maximum Output Power: 16.2 dBm
Measured Conducted Output Power: 15.7 dBm
Modulation type: GFSK
Data Rate: 3600 bps
Frequency Deviation: 1482 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-C (2004). 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

The Open Area Test Site (OATS) used to collect the radiated data is located at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC under Site Registration number 186022.

1.5 Test Equipment

Table 1 describes test equipment used to evaluate this product.

Table 1. Test Instruments

Instrument Type	Manufacturer	Model	Serial Number	Last Calibration Date
Spectrum Analyzer	Agilent	E4407B	US41442935	1/28/2015
RF Preamp	Hewlett-Packard	8449B	3008A00480	12/5/2014
RF Preamp	Hewlett-Packard	8447D	1937A02980	12/4/2014
Loop Antenna	AH Systems	SAS-200/562	142	9/12/2013 2 year cal
Biconical Antenna	EMCO	3110B	9306-1708	11/24/2014 2 year cal
Biconical Antenna	EMCO	3110B	9307-1431	2/11/2013 2 year cal Ext. 90 Days
Log Periodic Antenna	EMCO	3146	9305-3600	7/1/2014 2 year cal
Log Periodic Antenna	EMCO	3146	9110-3236	11/19/2014 2 year cal
Horn Antenna	A.H. Systems	SAS-571	605	7/23/2013 2 year cal
Environmental Chamber	Thermotron	SM16	17095	4/24/2013 2 yr cal Extended 30 days
Regulated Power Supply	TekPower	HY1803D	1072531	Verified with Fluke Meter
LISN (x2)	Solar Electronics	8028-50-TS24-BNC	910495 & 910494	12/26/2014
Spectrum Analyzer	Hewlett-Packard	8593E	N/A	1/6/2015
Multimeter (Graphical)	Fluke	867B	DM7060268	6/19/2014
Signal Generator	Hewlett-Packard	8648B	364U01679	Verified with Agilent Spectrum Analyzer

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.

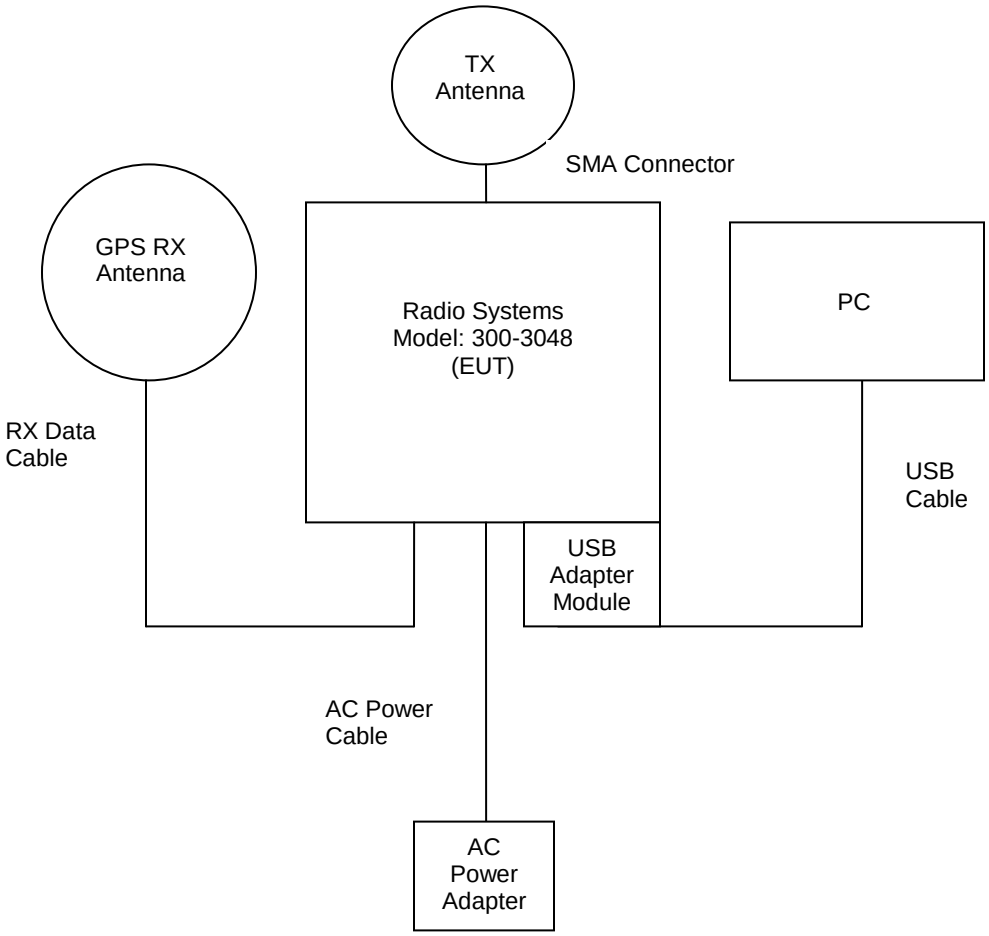

Figure 1. Test Configuration Block Diagram

Table 2. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/ IC ID:	CABLES P/D
GPSC Gen 2 Base Station (EUT) Radio Systems	300-3048	Engineering Sample	FCC: KE3-3003048 IC: N/A	3 m UD 1 m UP 1 m UD
USB Adapter Module Radio Systems	NA	NA	NA	1 m UD
Laptop Dell	Various	Various	Various	1 m UD
AC Power Adapter Radio Systems	SPS-02C5-0.75C-US	N/A	N/A	1 m UP
GPS Receiver Radio Systems	N/A	Engineering Sample	N/A	3 m UD
Antenna (See Antenna Table)	-	-	-	-

P = Power; D = Data U = Unshielded

Table 3. Antennas

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	PART NUMBER	GAIN dB_i	TYPE OF CONNECTOR
TX Antenna	Radio Systems	External Loop	100-1130 Rev 0	-1	SMA

2 Output Power

2.1 Maximum Transmitter Power (FCC 2.1046 & 95.639(h))

Maximum Transmitter Power was measured using the conducted method. The RF port where the antenna is terminated was connected to a short RF cable and attenuator. The SMA connector was directly connected to a spectrum analyzer. The EUT was set up to transmit a 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 spectrum analyzer's scale was adjusted to account for any cable loss and the attenuator. 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 95.639(h).

2.1.2 Measured Fundamental Signal

The maximum output power of the EUT as measured below is .0367 W.
15.65 dBm into 50 ohm measurement system = 36.7 mW <<2 Watts
Antenna gain = -1 dBi
EIRP = 15.65 – 1 = 14.65 dBm = 0.0292 W << 2 Watts

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

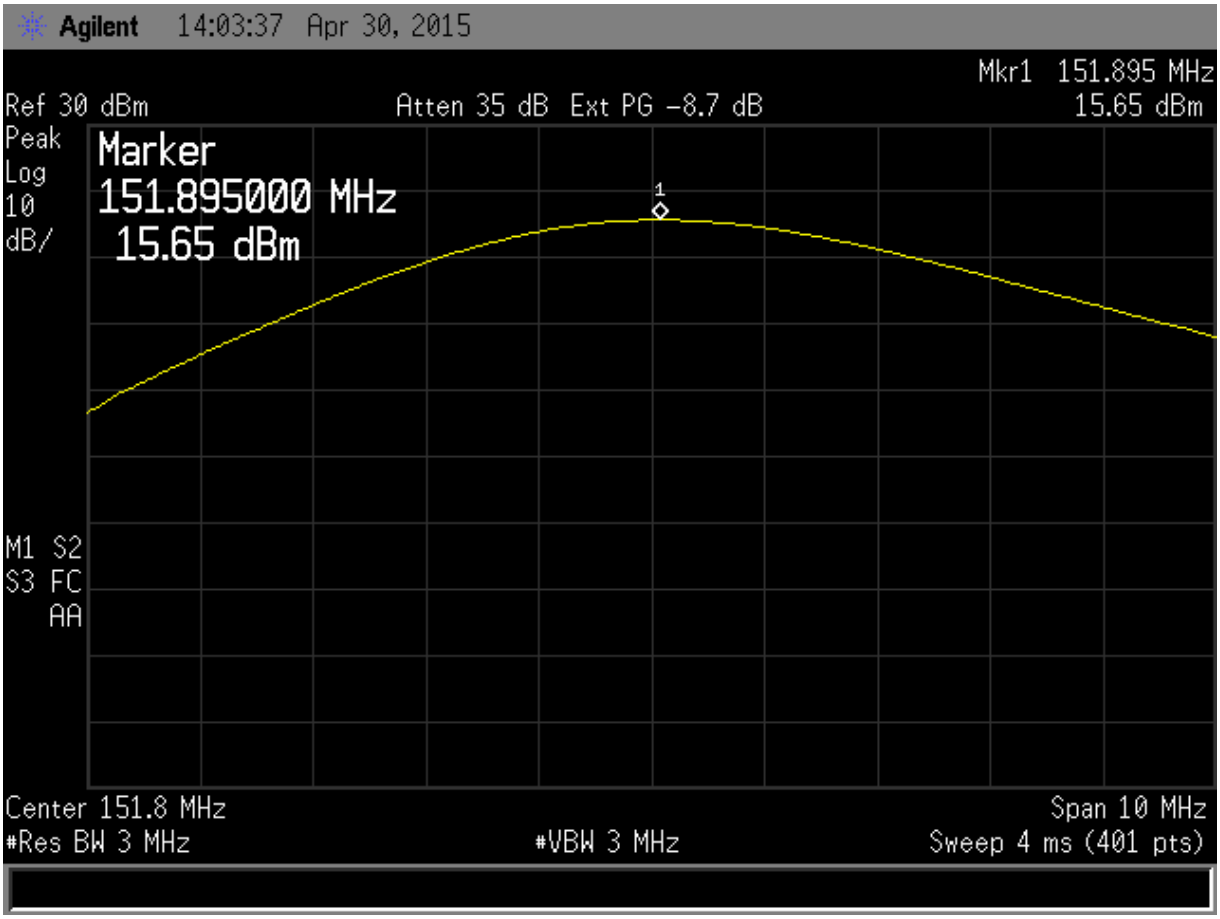

Figure 2. Measured Conducted Power

Test Date: May 5, 2015

Tested By
Signature: _____ Name: Carrie Fincannon

3 Emissions Bandwidth (Part 95.633(f)(1))

The EUT was modulated by its own internal sources. The Bandwidth of the Fundamental was measured using a spectrum analyzer, as shown below. A 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 6.944 kHz.

3.1 Maximum Authorized Bandwidth

The maximum authorized Bandwidth per 95.633 (f)(1) = 11.25 kHz. The EUT was found to comply with the Maximum Authorized Bandwidth since 6.944 kHz < 11.25 kHz.

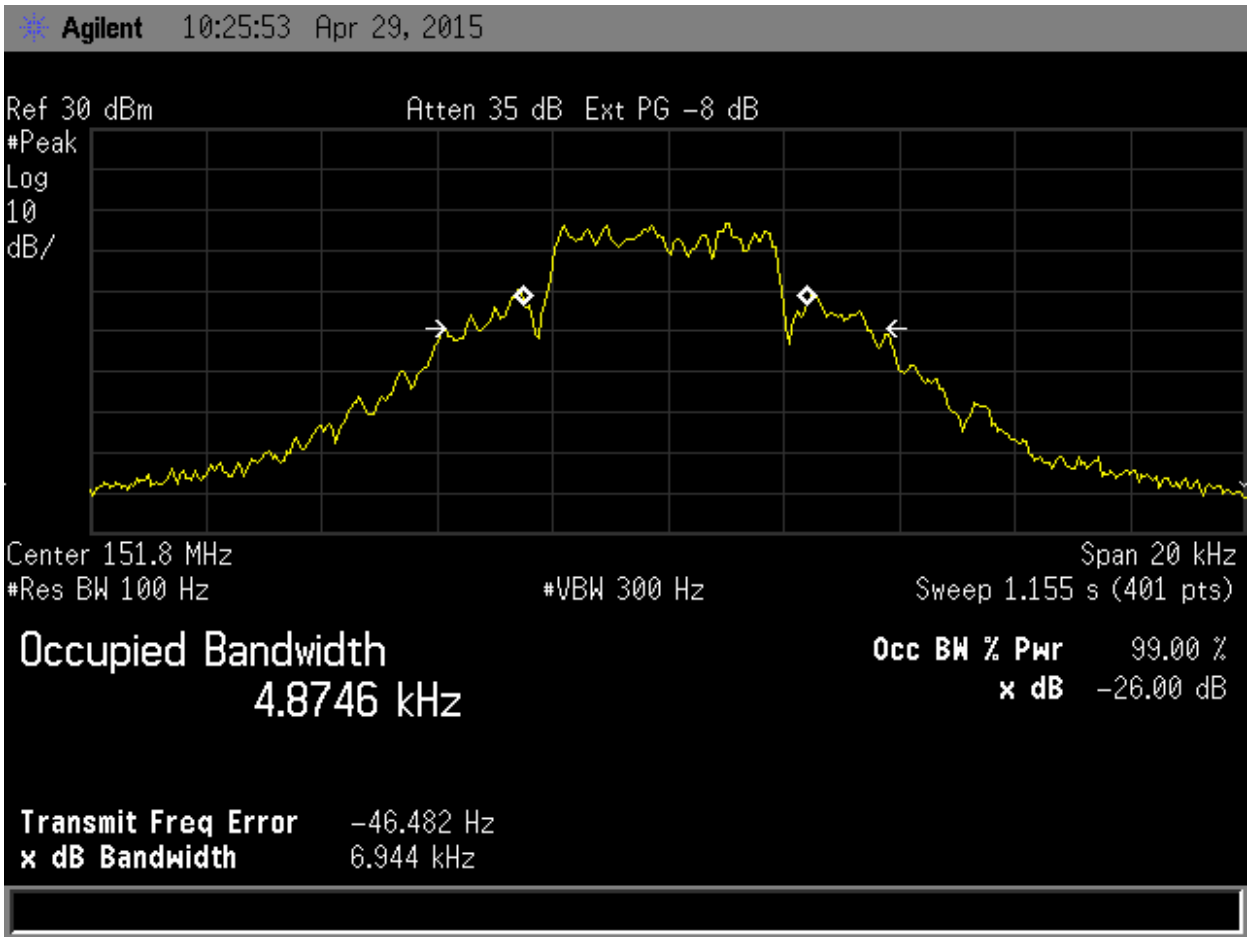

Figure 3. Bandwidth Measurement

Test Date: April 29, 2015

Tested By
Signature: _____ Name: Carrie Fincannon

4 Unwanted Radiation Emissions (CFR 95.635 (e))

This requirement is from 47 CFR Part 2, Subpart J, Sections 1053 and 95.635(e). 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 95.635(e) transmitters designed to operate in the MURS band shall comply with *"Emission Mask 1* : For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

> "(i) On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o: Zero dB.
> (ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least $7.27(f_d - 2.88$ kHz) dB.
> (iii) 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: at least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation."

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.

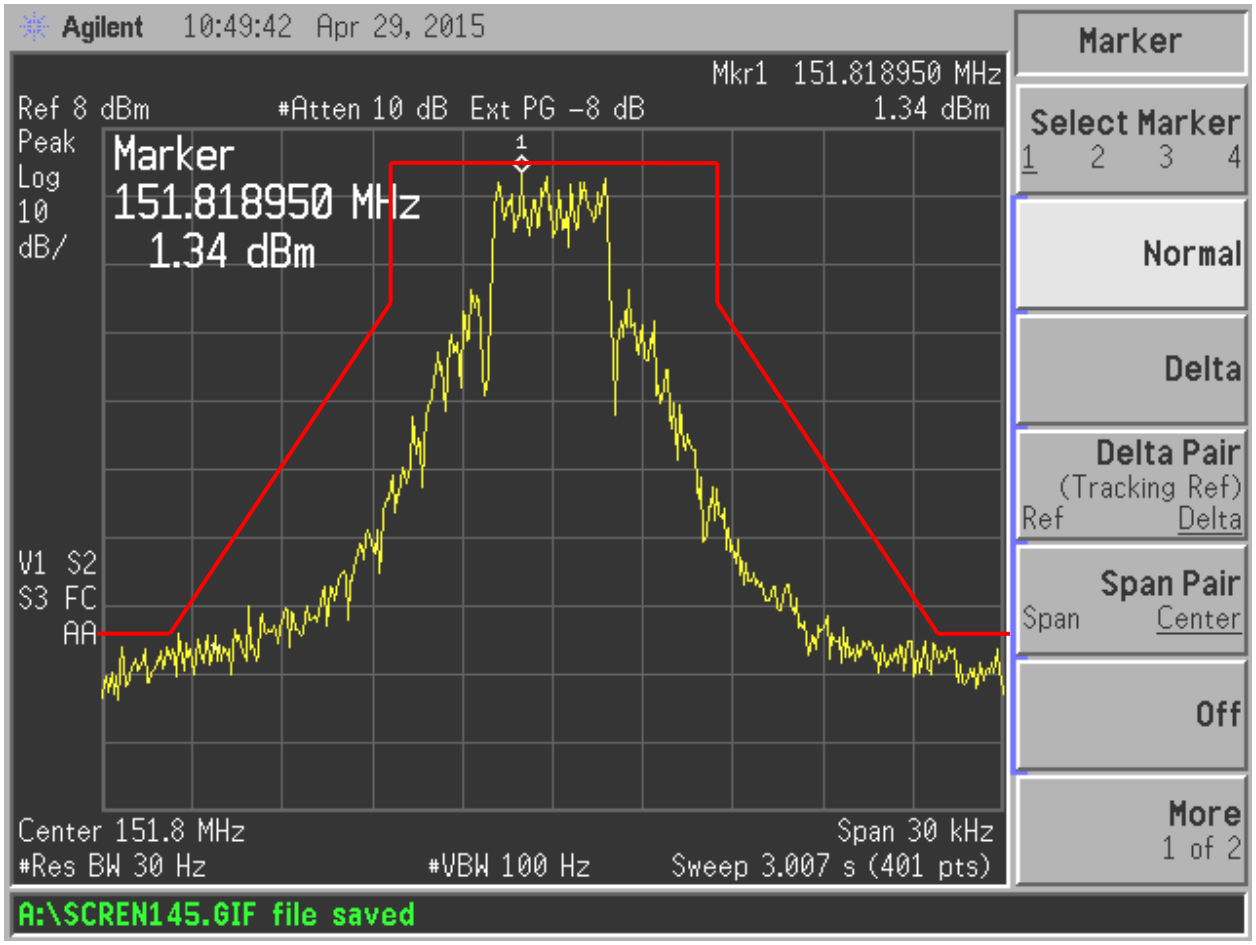

Figure 4. Transmitter Spurious Emissions at Antenna Terminals

Test Date: April 29, 2015

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Signature: _____ Name: Carrie Fincannon

5 Field Strength of Spurious Radiation, (FCC 2.1051 & 95.635(b))

5.1 Test Method

Spurious emissions were evaluated by the substitution method from 30 MHz up to tenth harmonic of the fundamental 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 information: 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 Conducted Output Power= 0.0367 Watts = 15.65 dBm
Attenuation Calculation = 50 + 10Log(0.0316) = 35.65
Power Limit = 15.65 dBm – 35.65 dB = -20 dBm

5.3 Test Results

Table 4. Field Strength of Spurious Radiation Up to 10th Harmonic

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 Relative to Dipole (dB)	RF Power into TX antenna (dBm) (SG Value-CL)	RF Power into substitution TX antenna (dBm)	Limit (dBm)	Margin Below Limit (dB)
52.05	72.28	72.45	-0.17	0.92	-8.34	-30.25	-39.68	-20	19.68
55.78	73.37	72.94	0.43	0.92	-7.54	-29.81	-37.84	-20	17.84
58.93	73.6	73.25	0.35	0.92	-6.74	-32.75	-40.06	-20	20.06
303.64	74.59	76.97	-2.38	2.58	1.46	-34.08	-37.58	-20	17.58
455.49	53.00	54.44	-1.44	3.21	3.76	-47.13	-48.02	-20	28.02
607.29	53.41	53.25	0.16	3.79	4.06	-56.72	-56.29	-20	36.29
759.11	49.18	49.32	-0.14	4.26	3.96	-56.53	-56.97	-20	36.97
No other emissions within 20 dB of limit were detected.									

Sample Calculation at 52.05 MHz:

SG Power Into TX Antenna	-30.25 (dBm)
+ TX Gain	-8.34 (dB)
+Difference between recreated and Actual	-0.17 (dB)
-TX Cable Loss	-0.92 (dB)
RF Power Into TX Antenna	-39.68 (dBm)
Limit	-20.00 (dBm)
RF Power into TX Antenna	-39.68 (dBm)
Margin	19.68 (dB)

Test Date: April 27-28, 2015

Tested By
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6 Frequency Stability (CFR 2.1055, 95.632(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.

The battery for the EUT was removed and the EUT was powered with a variable DC power supply. The voltage was varied between the nominal operating voltage 85 % of the nominal value and 115 % of the nominal value. The fundamental frequency for each voltage setting was compared to the nominal voltage ambient temperature measurement and reported as compared to the limit.

6.2 FCC Limits

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 6.94 the limit applied was 5.0 ppm.

6.3 Test Results

Table 5. Frequency Deviation/Stability

Temperature (˚C)	Measured Frequency (MHz)	Allocated Frequency (MHz)	Deviation (ppm)	Limit (ppm)
-30	151.819900	151.819788	0.74	5.00
-20	151.819850	151.819788	0.41	5.00
-10	151.819838	151.819788	0.33	5.00
0	151.819838	151.819788	0.33	5.00
10	151.819800	151.819788	0.08	5.00
20	151.819788	151.819788	0.00	5.00
30	151.819763	151.819788	0.16	5.00
40	151.819750	151.819788	0.25	5.00
50	151.819725	151.819788	0.41	5.00

Actual TX Frequency was: 151.819788 MHz

Sample Calculation at -30˚C

$$\text{Deviation} = \frac{|(151.819788 - 151.819900)|}{151.819900} = 0.00000074 = 0.74 \text{ ppm} < 5\text{ppm}$$

Table 6. Voltage Deviation/Stability

Voltage Variation	Measured Frequency (MHz)	Allocated Frequency (MHz)	Deviation (ppm)	Limit (ppm)
85%	151.819910	151.819900	0.07	5.00
100%	151.819900	151.819900	0.00	5.00
115%	151.819885	151.819900	0.10	5.00

Sample Calculation at 85%

$$\text{Deviation} = \frac{|(151.819900 - 151.819910)|}{151.819910} = 0.00000007 = 0.07 \text{ ppm} < 5 \text{ ppm}$$

Test Date: April 29-30, 2015

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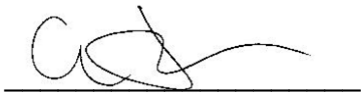
Signature:  Name: Carrie Fincannon