NVLAP Lab Code 200087-0

APPLICATION

For

GRANT OF CERTIFICATION

FOR

MODEL: 011-02883-00

FCC ID: IPH-01997

FOR

GARMIN INTERNATIONAL, INC.

1200 East 151st Street

Olathe, KS 66062

Test Report Number 120423

Authorized Signatory: Scott D Rogers

NVLAP Lab Code 200087-0

Rogers Labs, Inc.

4405 West 259th Terrace
Louisburg, KS 66053
Telephone / Fax (913) 837-3214

Application for Certification Test Report

For

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062
Phone: (913) 397-8200

Mr. Paul Phrommany
Compliance Engineer

Model: 011-02883-00

MURS Transmitter

Frequency: 151.820, 151.880, 151.940, 154.570, and 154.600 MHz

FCC ID: IPH-01997

Test Date: April 23, 2012

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Telephone/Facsimile: (913) 837-3214

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The device is governed by CFR47 rule Part 95 subpart E for MURS transmitter. In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2011, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.915, 2.925, 2.926, 2.1031 through 2.1057, applicable paragraphs of Part 95, the following information is submitted.

Applicant Gamin International, Inc.
1200 East 151st Street
Olathe, KS 66062

Model 011-02883-00

FCC ID IPH-01997

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Emissions as per CFR47 Part 2, paragraphs 2.1033 through 2.1057	Complies
Emissions as per CFR47 Part 95, Paragraph 95.632	Complies

Environmental Conditions

Ambient Temperature	18.6° C
Relative Humidity	37%
Atmospheric Pressure	1010.9 mb

Applicable Standards & Test Procedures

In accordance with the Federal Communications Commission, Code of Federal Regulations CFR47, dated October 1, 2011, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, applicable parts of paragraph 95, the following information is submitted for consideration in obtaining certification.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4-2009 Document.

List of Test Equipment

A Rohde and Schwarz ESU40 and/or Hewlett Packard 8591EM was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rohde and Schwarz ESU40 and/or Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

HP 8591 EM Analyzer Settings		
Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Radiated Emissions		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
HP 8562A Analyzer Settings		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/11	10/12
Antenna	ARA	BCD-235-B	10/11	10/12
Antenna	EMCO	3147	10/11	10/12
Antenna	EMCO	3143	5/11	5/12
Analyzer	HP	8591EM	5/11	5/12
Analyzer	HP	8562A	5/11	5/12
Analyzer	Rohde & Schwarz	ESU40	5/11	5/12

Equipment Tested

Equipment	Serial Number	FCC I.D. #
011-02883-00 (Short antenna)	FP-2	IPH-01997
011-02883-00 (Long antenna)	FP-7	IPH-01997
011-02883-00 (SMA port)	1FP-1	IPH-01997

SMA port sample was modified allowing access to antenna port for antenna port conducted measurement.

Equipment Function and Configuration

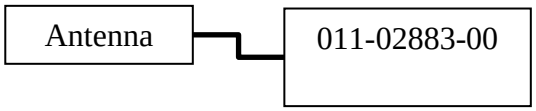
Equipment Function

The 011-02883-00 transmitter is designed as collar for placement on animals. The design offers transmitter function while attached to the collar or harness allowing sports enthusiast to monitor location and track the animal wearing the transmitter harness. The EUT incorporates VHF transmitter section operating on the authorized MURS frequencies governed by rule of CFR47 95.632. The MURS transmissions are received on the synchronized receiver carried by the sports enthusiast allowing monitoring and tracking location of the transmitter. The EUT enclosure is sealed prohibiting access inside. This approach hardens the equipment to adverse conditions the tracked animal may experience. Channel selection for the MURS transmission is limited to the approved MURS channels of operation. The EUT does not offer end user ability to alter transmitter power or adjustment. The internal battery may be recharged using the approved charging accessories. Interface options include battery charging through use of either AC/DC

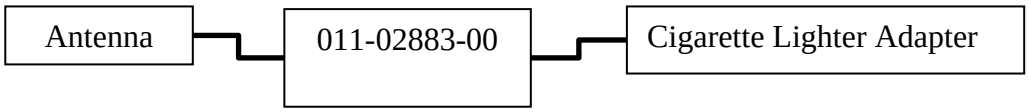
wall adapter, USB interfaced to computer, or DC car/cigarette lighter adapter as shown in the configuration diagrams below. Antennas are permanently attached to the EUT at the transmitter with two antenna options were available and tested.

Equipment Configuration

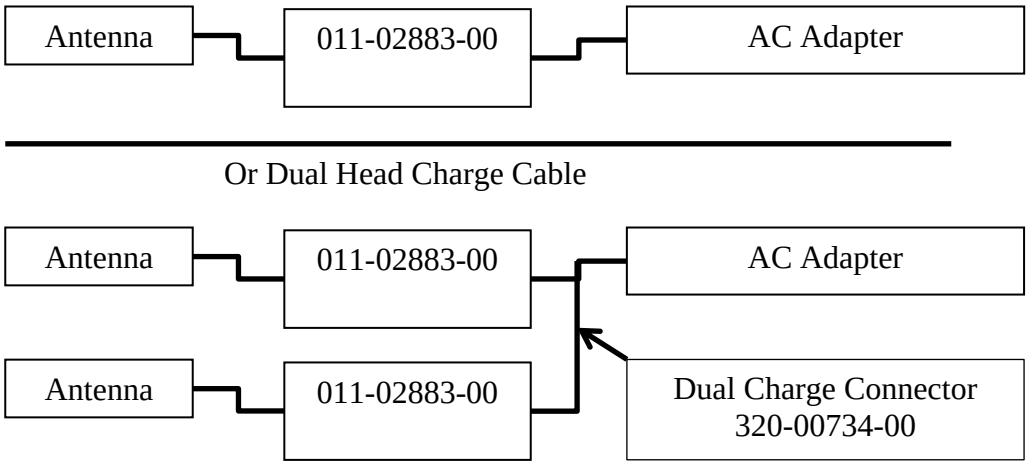
1. 011-02883-00 (GPN: 011-02883-00) with either standard length antenna (GPN: 700-00034-51) or long antenna (700-00034-52)



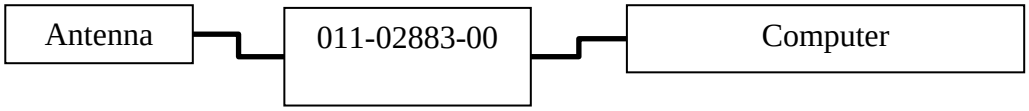
2. 011-02883-00 (GPN: 011-02883-00) with either standard length antenna (GPN: 700-00034-51) or long antenna (700-00034-52) connected to CLA (320-00239-52).



3. 011-02883-00 (GPN: 011-02883-00) connected to AC Adapter (GPN: 362-00069-00) through dual Charge Interface Cable (320-00734-00).



4. 011-02883-00 (GPN: 011-02883-00) connected to computer through USB cable (GPN: 320-00541-01). Note: Unit remains in battery charge mode with transmit disabled when connected to USB cable.



CFR47 2.1033(c) Application for Certification

(1) Manufacturer: Garmin International, Inc.
1200 East 151st Street, Olathe, KS 66062, Phone: (913) 397-8200

(2) FCC Identification: Model: 011-02883-00
FCC ID: IPH-01997 S/N: FP-2, FP-7

(3) Copy of the installation and operating manual:
Refer to exhibit for Draft Instruction Manual.

(4) Emission Type: 7k37F2D

(5) Frequency Range: MURS Transmitter operating on assigned frequencies of 151.820, 151.880, 151.940, 154.570 and 154.600 MHz

(6) Operating Power Level: 2.0 Watts MURS

(7) Max Power allowed as defined in 95.639(h): 2.0 Watts MURS

(8) Power into final amplifier: 2.0 Watt MURS: 4.95 Watts (3.3V @ 1.5A)

(9) Tune Up Procedure for Output Power: Refer to Exhibit for Transmitter Alignment Procedure.

(10) Circuit Diagrams; description of circuits, frequency stability, spurious suppression, and power and modulation limiting: Refer to Exhibit for Circuit Diagrams. Refer to Exhibit for Theory of Operation.

(11) Photograph or drawing of the Identification Plate: Refer to Exhibit for Photograph or Drawing.

(12) Drawings of Construction and Layout: Refer to Exhibit for Information of Components Layout and Chassis Drawings.

(13) Detail Description of Digital Modulation: Details of modulation and description are contained in confidential exhibit Operational Description.

(14) Data required by 2.1046 through 2.1057 is reported in this document.

(15) Application for certification of an external radio power amplifier operating under part 97 of this chapter. This specification is not applicable to this device.

(16) Application for certification of AM broadcast transmitter. This specification is not applicable to this device.

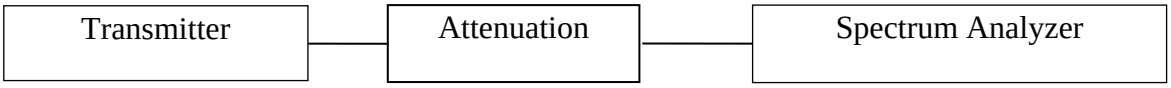
CFR47 2.1046 RF Power Output

Measurements Required

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below:

If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

Test Arrangement



The manufacturer supplied a test sample modified for antenna port conducted testing purposes. The sample replaced the antenna with a 50-ohm port allowing for antenna-conducted emissions measurements. The radio frequency power output of the MURS transmitter was measured at the test antenna terminal by replacing the antenna with coaxial cable, attenuation, and connected to a spectrum analyzer. The attenuator and spectrum analyzer offered an impedance of 50 Ohms to match the impedance of the standard antenna. A Rohde & Schwarz ESU40 was used to measure the radio frequency power at the antenna port. The data was taken in dBm and converted to watts as shown in the following table. Refer to figure one showing the output power of the MURS transmitter at the antenna terminal. Data was taken per Paragraph 2.1046(a) and applicable parts of Part 95.

P_{dBm} = power in dB above 1 milliwatt.

Milliwatts = $10^{(PdBm/10)}$

Watts = (Milliwatts) x (0.001)(W/mW)

32.87 dBm = $10^{(32.77/10)}$
= 1,892.3 mW
= 1.9 Watts

MURS Transmitter Antenna Port Output Power Results

Frequency	PdBm	Pmw	Pw
151.820	32.77	1,892.3	1.9
151.940	32.87	1,936.4	1.9
154.600	32.93	1,963.4	2.0

Data was taken using the antenna substitution method per TIA/EIA-603. Utilizing the available antenna options, the radio frequency output power was measured at a three-meter distance on a registered Open Area Test Site (OATS) using the substitution method. An ESU40 Receiver/Spectrum Analyzer was used to measure the radio frequency power produced by the EUT at a distance of three-meters. The level was recorded and the EUT was removed from the table and replaced by a substitution antenna driven by a frequency generator and amplification stages. The generator output level was then increased until the amplitude level produced by the substitution system measured the same as previously recorded from the EUT. The antenna was removed and output power then measured. This power output level was then recorded, as the power required for reproducing the measured level. This procedure was repeated for all frequencies of interest with the data taken reported below. The testing procedures used conform to the procedures stated in the TIA/EIA-603 document.

Substitution method radiated power Data using production unit and antenna

Frequency of Emission	Amplitude of emission		Signal level to dipole required to reproduce	
	Horizontal	Vertical	Horizontal	Vertical
(MHz)	dBμV	dBμV	dBm	dBm
151.880	106.6	117.8	21.4	32.7
154.600	104.4	115.3	22.0	32.9

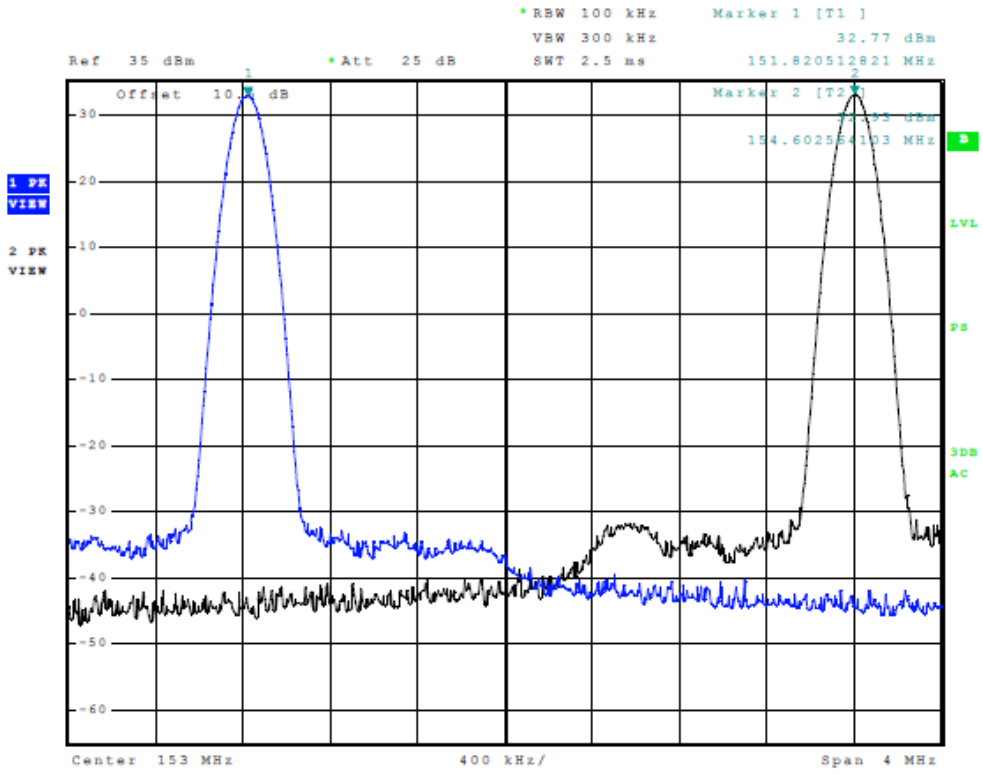


Figure 1 Power Output at antenna terminal of MURS Transmitter

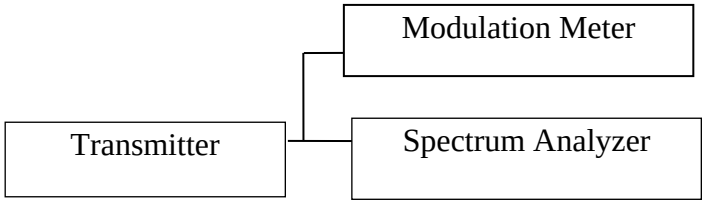
The EUT demonstrated compliance with the specifications of Paragraph 2.1046(a) and applicable Parts of 95. There are no deviations to the specifications.

CFR 47 2.1047 Modulation Characteristics

Measurements Required

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules, under which the equipment is to be licensed, shall be submitted.

Test Arrangement



The radio frequency output would be coupled to Spectrum Analyzer and modulation meter. The spectrum analyzer would be used to observe the radio frequency spectrum with the transmitter operating in its various modes. The modulation meter would be used to measure the percent modulation or frequency deviation.

Modulation Characteristic Results

The MURS Transmitter broadcasts only digital information as detailed in submitted exhibits and offers no provision for connection of external audio inputs. Modulation information is recorded in this and other documentation for reference. Therefore, no modulation characteristics were measured or reported.

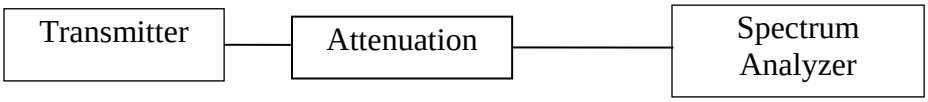
The EUT demonstrated compliance with the specifications of Paragraph 2.1047 and applicable parts of 95.

CFR 47 2.1049 Occupied Bandwidth

Measurements Required

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission. Plots were taken with the unit operating in all test modes representing normal modes with digital data formats of zeros, ones, random, and alternating zero-one.

Test Arrangement



Occupied Bandwidth Results

fc (MHz)	Data Mode	Occupied Bandwidth (kHz)
151.820	0101	7.37
151.820	0000	7.29
151.820	1111	7.31
154.600	0101	7.29
154.600	0000	7.21
154.600	1111	7.25

A spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating through the test sample modes representing all normal modes. The test sample provided transmit operation streaming either random, all zero, all ones, or alternating one-zero sequence. The power ratio in dB representing 99% of the total mean power was recorded from the spectrum analyzer. Refer to figures two through four for plots showing the occupied bandwidth.

The EUT demonstrated compliance with the specifications of Paragraph 2.1049 and applicable Parts of 95. There are no deviations to the specifications

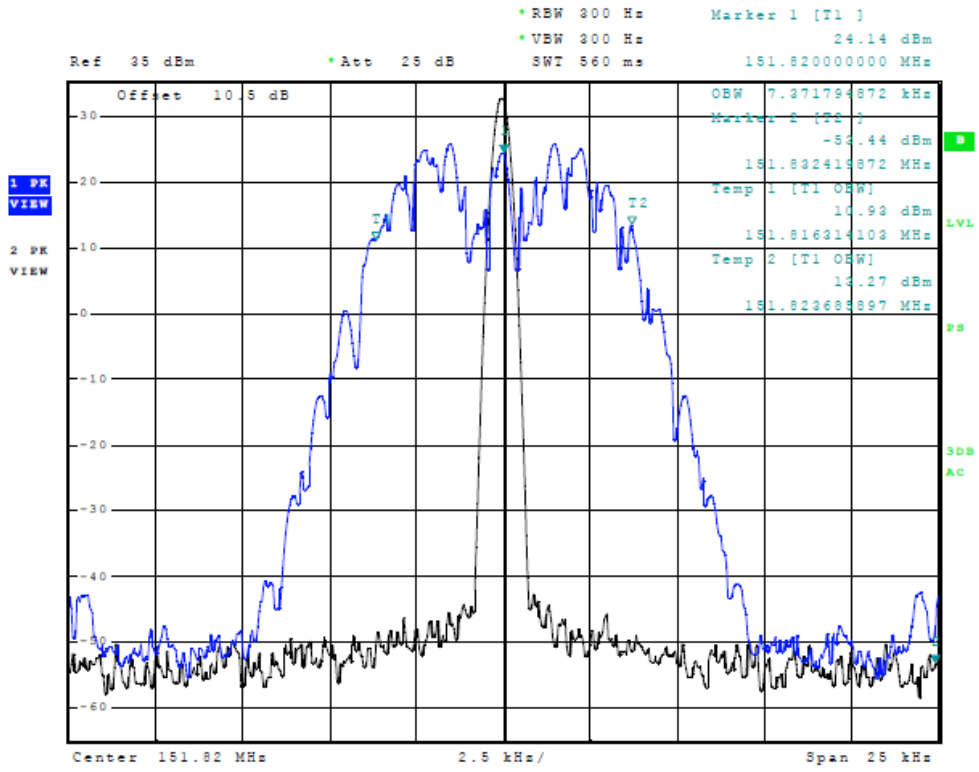


Figure 2 Occupied Band Width (Data 0101)

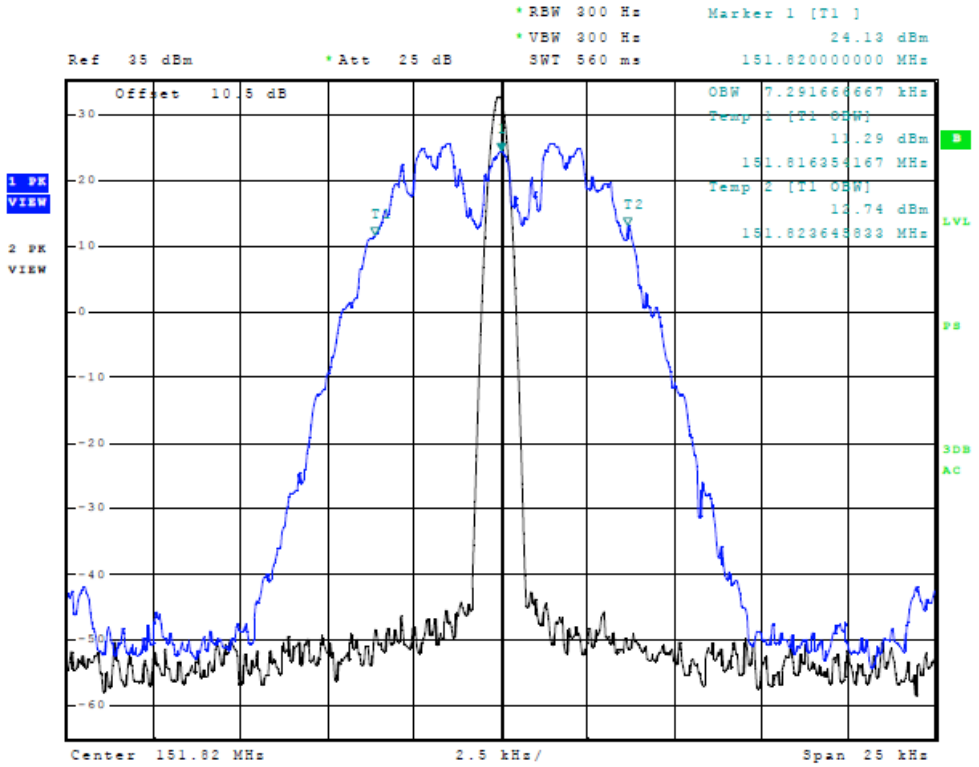


Figure 3 Occupied Band Width (Random Data)

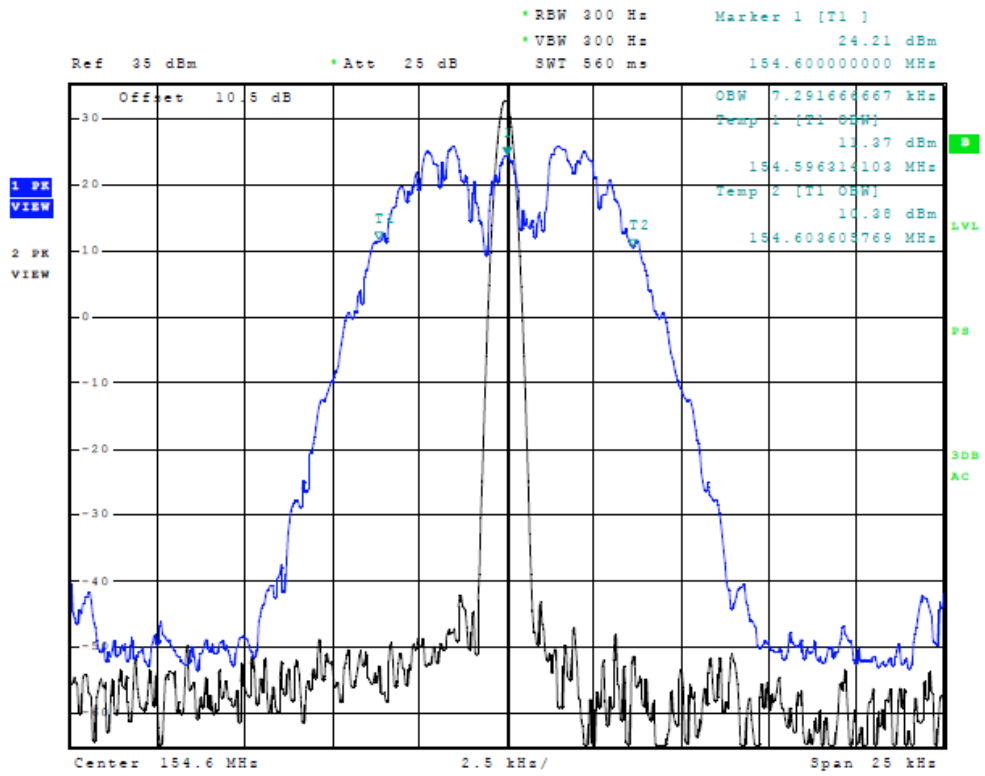


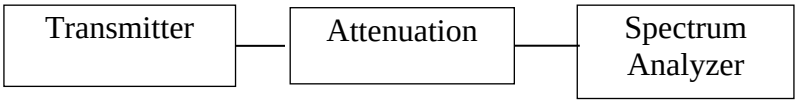
Figure 4 Occupied Band Width (Data 0000)

CFR47 2.1051 Spurious Emissions at Antenna Terminals

Measurements Required

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna.

Test Arrangement



The radio frequency output was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer. The spectrum analyzer was used to observe the radio frequency spectrum with the MURS transmitter operated in available modes. The frequency spectrum from 30 MHz to 1.6 GHz was observed and a plot produced of the frequency spectrum. Figures five and six represent data for the 011-02883-00 operating while transmitting data. Data was taken per 2.1051, 2.1057, and applicable paragraphs of Part and 95.

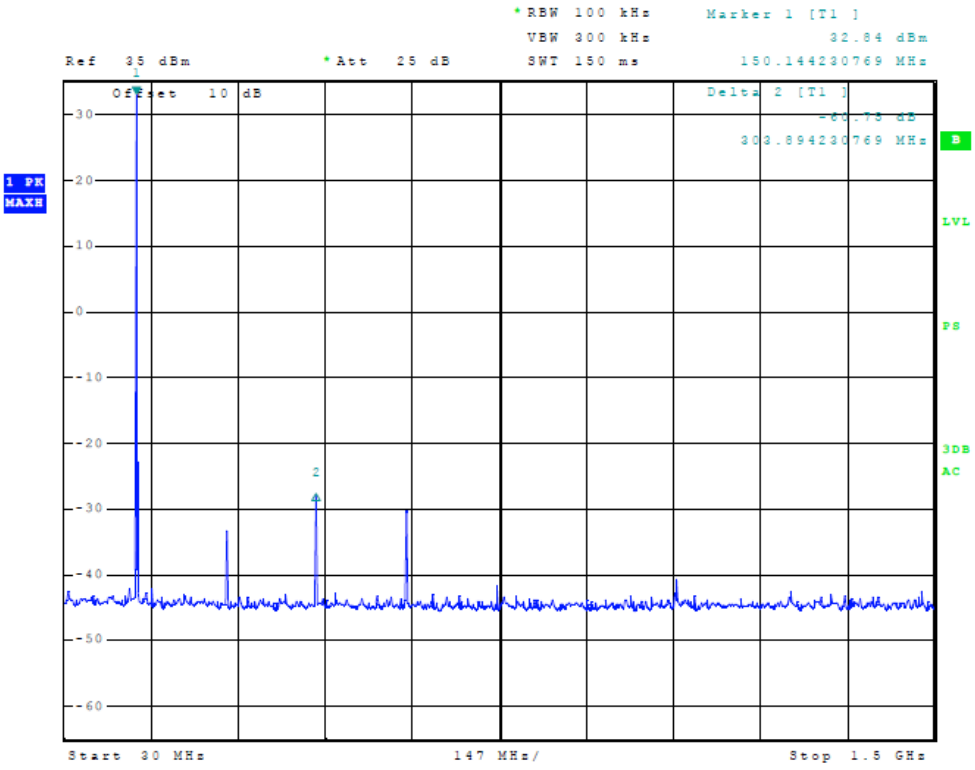


Figure 5 Spurious Emissions at Antenna Terminal

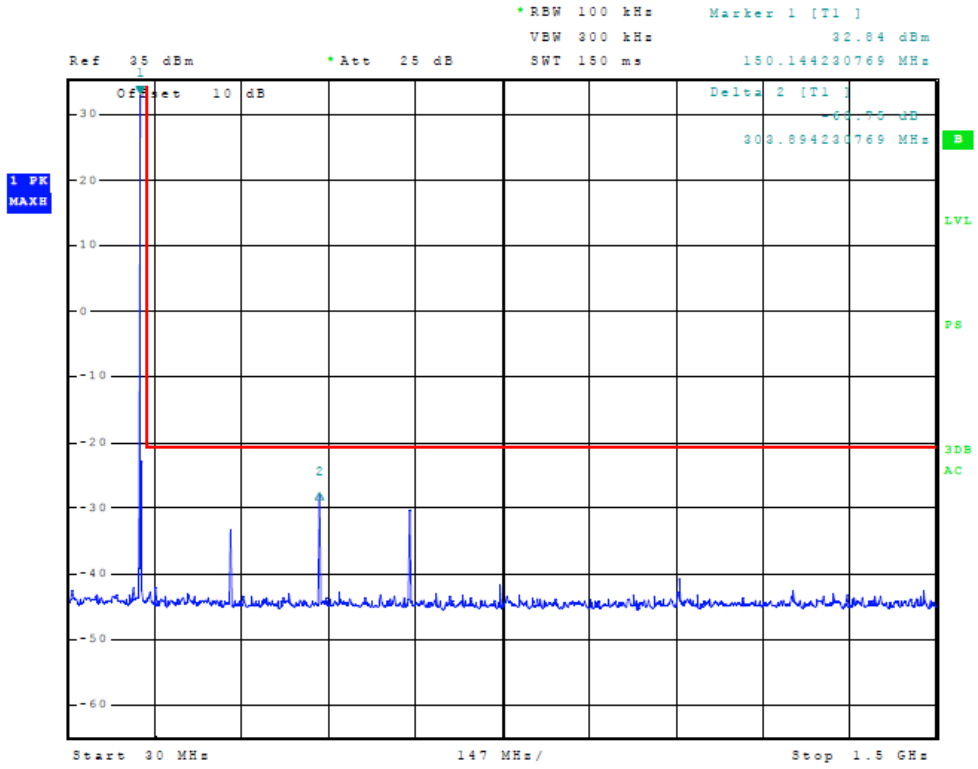


Figure 6 Emission Mask

Spurious Emissions at Antenna Terminal Results

The output of the MURS transmitter was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer and the frequency emissions were measured. Data was taken as per 2.1051 and applicable paragraphs of Part 95.

Spurious emissions removed from the center frequency by more than 12.5 kHz must be attenuated at least 50+10log (P_o) dBc.

2.0 Watt = 50 + 10 Log (P_o)
= 50 + 10 Log (2)
= 53.0 dBc
Harmonic emission level must be less than 33-53 = -20 dBm absolute

Antenna Spurious Emissions Results

Channel MHz	Spurious Freq. (MHz)	Level Below Carrier (dB)	Channel MHz	Spurious Freq. (MHz)	Level Below Carrier (dB)
151.820	303.64	-61.37	154.600	309.20	-58.20
	455.46	-38.84		463.80	-40.26
	607.28	-44.00		618.40	-46.65
	759.10	-56.67		773.00	-57.65
	910.92	-87.19		927.60	-84.41
	1062.74	-57.66		1082.20	-57.35
	1214.56	-73.53		1236.80	-76.66
	1366.38	-68.69		1391.40	-72.27
	1518.20	-85.87		1546.00	-92.53

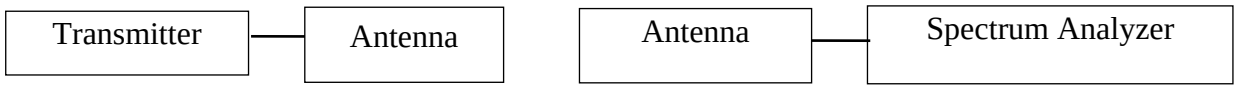
The EUT demonstrated compliance with the specifications of Paragraphs 2.1051, 2.1057 and applicable paragraphs of part 95. There are no deviations to the specifications.

CFR47 2.1053 Field Strength of Spurious Radiation

Measurements Required

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation.

Test Arrangement



The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. With the MURS transmitter radiating into the standard antenna, the receiving antenna was raised and lowered from 1m to 4m to obtain the maximum reading of spurious radiation from the EUT on the spectrum analyzer. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude of emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. A Biconilog antenna was used for frequency measurements of 30 to 1000 MHz. Pyramidal horn antennas were used for frequencies of 1 GHz to 40 GHz. Emission levels were measured and recorded from the spectrum analyzer in dBμV. The transmitter was then removed and replaced with a substitution antenna and signal generator. The signal from the generator was then adjusted such that the amplitude received was the same as that previously recorded for each frequency. This step was repeated for both horizontal and vertical polarizations. The power in dBm required to produce the desired signal level was then recorded from the signal generator. The power in dBm was then calculated by reducing the previous readings by the power loss in the cable and further corrected for the gain in the substitution antenna. Data was taken at the Rogers Labs, Inc. 3 meters open area test site (OATS). A description of the test facility is on file with the FCC, Reference 90910. The testing procedures used conform to the procedures stated in the TIA/EIA-603 document.

The limits for the spurious radiated emissions are defined by the following equation.

Limit = Amplitude of the spurious emission must be attenuated by this amount below the level of the fundamental. On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth: at least 50 + 10 Log (Po) dBc.

2-watt MURS transmitter.

Attenuation = 50 + 10 Log10(Pw)
= 50 + 10 Log10(2)
= 53.0 dBc

Limit = spurious emission must be at least 53 dB below the fundamental MURS emission.

Field Strength of Spurious Radiation Results

The EUT was set to transmit at the desired frequency. The amplitude of each spurious emission was then maximized and recorded. The transmitter produces 2.0-watts (MURS) of output power (33 dBm). Then the radiated spurious emission in dB was calculated from the following equation.

Emission Level Below Carrier (dB) = ELBC
ELBC (dB) = Effective Transmitter power – signal level required to reproduce emission
example:
ELBC = 10 Log10[2.0/0.001]-(-52.6) = 85.6 dBc

Using the measured radiated emissions levels for each fundamental, the level below the carrier for each polarization and frequency could be represented using the following

ELBC = 21.4 - (-45.3) = 66.7 dBc

Spurious Radiated Emission Results, Long Antenna, Channel frequency 151.880

Frequency of Emission	Amplitude of Spurious emission		Signal level to dipole required to reproduce		Emission level below carrier (ELBC)		Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
(MHz)	dBμV	dBμV	dBm	dBm	dBc	dBc	dBc
151.880	106.5	117.8	21.8	32.7	0	0	0
303.77	66.9	59.6	-45.3	-52.6	66.7	85.3	53
455.65	63.9	57.3	-43.9	-50.5	65.3	83.2	53
607.52	54.1	61.4	-51.2	-43.9	72.6	76.6	53
759.40	50.7	65.5	-53.0	-38.2	74.4	70.9	53
911.30	41.4	48.6	-60.6	-53.4	82.0	86.1	53
1063.20	49.6	43.5	-45.7	-51.8	67.1	84.5	53
1215.00	46.3	44.8	-48.0	-49.5	69.4	82.2	53
1366.90	47.1	41.6	-46.7	-52.2	68.1	84.9	53
1518.80	36.9	27.5	-57.7	-67.1	79.1	99.8	53

Spurious Radiated Emission Results, Long Antenna, Channel frequency 154.600

Frequency of Emission	Amplitude of Spurious emission		Signal level to dipole required to reproduce		Emission level below carrier		Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
(MHz)	dBμV	dBμV	dBm	dBm	dBc	dBc	dBc
154.60	104.4	115.3	22.0	32.9	0	0	0
309.20	45.9	61.9	-64.9	-48.9	86.9	81.8	53
463.80	64.2	62.2	-43.3	-45.3	65.3	78.2	53
618.40	58.0	65.5	-47.2	-39.7	69.2	72.6	53
773.00	58.5	59.2	-45.1	-44.4	67.1	77.3	53
927.60	44.9	42.9	-57.1	-59.1	79.1	92.0	53
1082.20	41.3	45.2	-53.4	-49.5	75.4	82.4	53
1236.80	16.5	19.2	-77.8	-75.1	99.8	108.0	53
1391.40	39.4	33.6	-54.7	-60.5	76.7	93.4	53
1546.00	34.8	34.7	-59.8	-59.9	81.8	92.8	53

Spurious Radiated Emission Results, Short Antenna, Channel frequency 151.880

Frequency of Emission	Amplitude of Spurious emission		Signal level to dipole required to reproduce		Emission level below carrier (ELBC)		Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
(MHz)	dBμV	dBμV	dBm	dBm	dBc	dBc	dBc
151.880	105.4	117.2	20.3	32.1	0	0	0
303.77	64.2	67.1	-48.0	-45.1	68.3	77.2	53
455.65	70.1	65.4	-37.7	-42.4	58.0	74.5	53
607.52	57.5	53.5	-47.8	-51.8	68.1	83.9	53
759.40	68.3	61.8	-35.4	-41.9	55.7	74.0	53
911.30	36.9	34.3	-65.1	-67.7	85.4	99.8	53
1063.20	43.8	48.4	-51.5	-46.9	71.8	79.0	53
1215.00	32.6	40.1	-61.7	-54.2	82.0	86.3	53
1366.90	40.5	38.3	-53.3	-55.5	73.6	87.6	53
1518.80	20.5	32.8	-74.1	-61.8	94.4	93.9	53

Spurious Radiated Emission Results, Short Antenna, Channel frequency 154.600

Frequency of Emission	Amplitude of Spurious emission		Signal level to dipole required to reproduce		Emission level below carrier		Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
(MHz)	dBμV	dBμV	dBm	dBm	dBc	dBc	dBc
154.60	104.2	115.1	-42.3	-45.0	0	0	0
309.20	68.5	65.8	-38.7	-45.7	64.1	77.7	53
463.80	68.8	61.8	-53.6	-36.0	60.5	78.4	53
618.40	51.6	69.2	-50.1	-39.5	75.4	68.7	53
773.00	53.5	64.1	-53.5	-51.5	71.9	72.2	53
927.60	48.5	50.5	-45.0	-40.0	75.3	84.2	53
1082.20	49.7	54.7	-45.2	-51.1	66.8	72.7	53
1236.80	49.1	43.2	-53.2	-48.8	67.0	83.8	53
1391.40	40.9	45.3	-61.4	-51.6	75.0	81.5	53
1546.00	33.2	43.0	-42.3	-45.0	83.2	84.3	53

Spurious Emission Results (General)

Emission Frequency (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)

All other measured spurious emissions where 20 dB or more below the specified limit.

The EUT demonstrated compliance with the specifications of Paragraph 2.1053, 2.1057, applicable paragraphs of part 2 and 95. There are no deviations to the specifications.

2.1055 Frequency Stability

Measurements Required

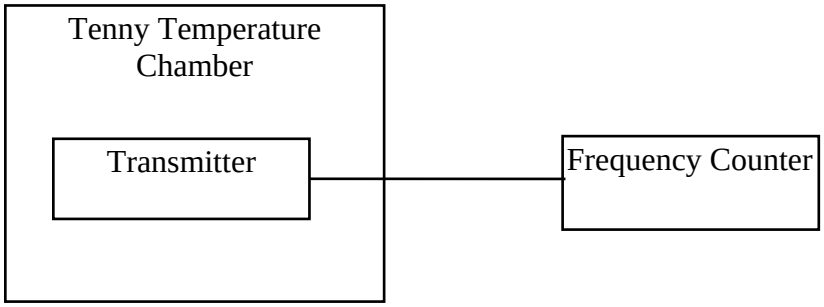
The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. In addition to temperature stability, the frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, batteries powered equipment, reduce primary supply voltage to the battery-operating end point, which shall be specified by the manufacturer.

The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided.

Test Arrangement



The measurement procedure outlined below shall be followed:

Steps 1: The transmitter shall be installed in an environmental test chamber whose temperature is controllable. Provision shall be made to measure the frequency of the transmitter.

Step 2: With the transmitter inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a temperature stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.

Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated unmodulated at full radio frequency power output at the duty cycle, for which it is rated, for duration of at least 5 minutes. The radio frequency carrier frequency shall be monitored and measurements shall be recorded.

Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to 50°C in 10-degree increments.

The test sample was powered on and allowed to operate to the end of battery life allowing for battery endpoint stability to be measured. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.1055 and applicable paragraphs of part 95.

Frequency Stability Results

Frequency (MHz) 154.6000	Frequency Stability Vs Temperature In Parts Per Million (Ppm)								
	Temperature in °C								
	-30	-20	-10	0	+10	+20	+30	+40	+50
Δ (Hz)	-20.0	-30.0	-40.0	-30.0	-20.0	-10.0	-30.0	-50.0	-30.0
PPM	-0.129	-0.194	-0.259	-0.194	-0.129	-0.065	-0.194	-0.323	-0.194
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Frequency In MHz	Frequency Stability Vs Voltage Endpoint 3.30 Volts Nominal; Results In Ppm Battery Endpoint Voltage 3.0 Vdc
154.6000	0.0

The EUT demonstrated compliance with the specifications of Paragraphs 2.1055 and applicable paragraphs of parts 2 and 95. There are no deviations to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment List.
- Annex C Rogers Qualifications.
- Annex D FCC Site Approval Letter

Annex A Measurement Uncertainty Calculations

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$U_c(y) = \pm 1.6$ dB

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore:

$$s(q_k) = \sqrt{\frac{1}{(n-1)} \sum_{k-1}^{n} (q_k - \bar{q})^2}$$

$U = 2\ U_c(y) = 2 \times \pm 1.6$ dB $= \pm 3.2$ dB

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.

1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.

1.3 The antenna factor uncertainty does not take account of antenna directivity.

1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.

1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.

1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect Biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	±1.5
LISN coupling specification	rectangular	±1.5
Cable and input attenuator calibration	normal (k=2)	±0.5

Combined standard uncertainty $u_C(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$U_C(y) = \pm 1.2$ dB

As with radiated field strength uncertainty, it is probable that $u_C(y) / s(q_k) > 3$ and a coverage factor of k = 2 will suffice, therefore:

$U = 2\ U_C(y) = 2 \times \pm 1.2$ dB $= \pm 2.4$ dB

Annex B Test Equipment List For Rogers Labs, Inc.

List of Test Equipment	Calibration Date
Spectrum Analyzer: Rohde & Schwarz ESU40	5/11
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/11
Spectrum Analyzer: HP 8591EM	5/11
Antenna: EMCO Biconilog Model: 3143	5/11
Antenna: Sunol Biconilog Model: JB6	10/11
Antenna: EMCO Log Periodic Model: 3147	10/11
Antenna: Com Power Model: AH-118	10/11
Antenna: Antenna Research Biconical Model: BCD 235	10/11
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohm/0.1 µf	10/11
R.F. Preamp CPPA-102	10/11
Attenuator: HP Model: HP11509A	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Cable: Belden RG-58 (L1)	10/11
Cable: Belden RG-58 (L2)	10/11
Cable: Belden 8268 (L3)	10/11
Cable: Time Microwave: 4M-750HF290-750	10/11
Cable: Time Microwave: 10M-750HF290-750	10/11
Frequency Counter: Leader LDC825	2/12
Oscilloscope Scope: Tektronix 2230	2/12
Wattmeter: Bird 43 with Load Bird 8085	2/12
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/12
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/12
R.F. Power Amp 65W Model: 470-A-1010	2/12
R.F. Power Amp 50W M185- 10-501	2/12
R.F. Power Amp A.R. Model: 10W 1010M7	2/12
R.F. Power Amp EIN Model: A301	2/12
LISN: Compliance Eng. Model 240/20	2/12
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/12
Antenna: EMCO Dipole Set 3121C	2/12
Antenna: C.D. B-101	2/12
Antenna: Solar 9229-1 & 9230-1	2/12
Antenna: EMCO 6509	2/12
Audio Oscillator: H.P. 201CD	2/12
ELGAR Model: 1751	2/12
ELGAR Model: TG 704A-3D	2/12
ESD Test Set 2010i	2/12
Fast Transient Burst Generator Model: EFT/B-101	2/12
Field Intensity Meter: EFM-018	2/12
KEYTEK Ecat Surge Generator	2/12
Shielded Room 5 M x 3 M x 3.0 M	

Annex C Qualifications

SCOT D. ROGERS, ENGINEER

ROGERS LABS, INC.

Mr. Rogers has approximately 17 years' experience in the field of electronics. Work experience includes six years working in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held:

Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background:

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University

2) Bachelor of Science Degree in Business Administration Kansas State University

3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

NVLAP Lab Code 200087-0

Annex D FCC Test Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

November 01, 2011

Registration Number: 90910

Rogers Labs, Inc.
4405 West 259th Terrace,
Louisburg, KS 66053

Attention: Scot Rogers,

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: November 01, 2011

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst