NVLAP Lab Code: 200087-0

Application Submittal Test Report

Industry Canada and FCC

Grant of Certification

Model: HHM

Wireless Microphone Transmitter

FCC ID: DBZHHM

IC: 8024A-HHM

Frequency Range: 614.4 - 691.1 MHz

Operating under rule of RSS-123, Issue 2

and CFR47 Part 74, Subpart H

FOR

LECTROSONICS, INC.

581 Laser Road
Rio Rancho, NM 87124
Test Report Number: 111114M

Authorized Signatory Scot D Rogers
Scot D. Rogers

NVLAP Lab Code: 200087-0

ROGERS LABS, INC.
4405 West 259th Terrace
Louisburg, KS 66053
Phone / Fax (913) 837-3214

Engineering Test Report For Application of Certification For Industry Canada and FCC

Lectrosonics, Inc.

581 Laser Road
Rio Rancho, NM 87124

Larry Fisher
President

Model: HHM

Wireless Microphone Transmitter

Frequency: 614.4 - 691.1 MHz
FCC ID: DBZHHM
IC: 8024A-HHM

Test Date: November 14, 2011

Certifying Engineer Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
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The following information is submitted for consideration in obtaining Grant of Certification for wireless microphone transmitter operating under rule of Industry Canada RSS-123 Issue 2, and CFR47 paragraph 74.

Name of Applicant:

Lectrosonics Inc.
581 Laser Road
Rio Rancho, NM 87124

Model: HHM Wireless Microphone Transmitter

IC: 8024A-HHM FCC ID: DBZHHM

Operating Power: Model HHM 100 mW, OBW 180 kHz, Emissions Designator: 180kF3E

Opinion / Interpretation of Results

Test Performed	Minimum Margin (dB)	Results
AC Line Conducted Emissions	N/A	Complies
Transmit Harmonics (per RSS-123 requirement)	-14.9	Complies

Applicable Standards & Test Procedures

In accordance with the Industry Canada Radio Standards Specification RSS-123, Issue 2, and the Code of Federal Regulations, CFR47 dated October 1, 2010, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.925, 2.926, 2.1031 through 2.1057 and; Part 74 Subpart H; Paragraphs 74.801 through 74.861 the following report is submitted. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2009 and/or TIA/EIA 603-C (2004).

Environmental Conditions

Ambient Temperature	21.3° C
Relative Humidity	36%
Atmospheric Pressure	1005.8 mbar

Application for Certification

(1) The full name and mailing address of the manufacturer of the device and the applicant for certification.

Lectrosonics, Inc.
581 Laser Road
Rio Rancho, NM 87124

(2) FCC and Industry Canada identifier FCC: DBZHHM IC: 8024A-HHM

(3) A copy of the installation and operating instructions to be furnished the user. Refer to the instruction manual furnished with this application for details.

(4) Type or types of emission 180KF3E

(5) Frequency range of operation 614.4 - 691.1 MHz

(6) Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power. The output power is factory set to maximum of 100 mW. The EUT offers provision for operator variation of the output power of either 50 mW or 100 mW.

(7) Maximum power rating as defined in the applicable part(s) of the rules. As stated in CFR47, 74.861(e)(ii) and RSS-123, the maximum permissible output power allowed is 250 mW.

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range. The HHM final amplification stage runs at 3.2 volts with 67 mA current producing 214.4 mW power.

(9) Tune-up procedure over the power range, or at specific operating power levels. Refer to the tune-up procedure furnished with this application for details.

(10) A schematic diagram and a description of all circuitry and devices provided for determining and stabilizing frequency, for suppression of spurious radiation, for limiting modulation, and for limiting power. Refer to the schematics exhibit furnished with this application for details.

(11) A photograph or drawing of the equipment identification plate or label showing the information to be placed thereon. Refer to the FCC identification label exhibit furnished with this application for details.

(12) Photographs (8" x 10") of the equipment of sufficient clarity to reveal equipment construction and layout, including meters, if any, and labels for controls and meters and sufficient views of the internal construction to define component placement and chassis assembly. Insofar as these requirements are met by photographs or drawings contained in instruction manuals

supplied with the certification request, additional photographs are necessary only to complete the required showing. Refer to the exhibits of this report and or additional information furnished with the application for details.

(13) For equipment employing digital modulation techniques, a detailed description of the modulation system to be used, including the response characteristics (frequency, phase, and amplitude) of any filters provided, and a description of the modulating wave train, shall be submitted for the maximum rated conditions under which the equipment will be operated. The unit does not use digital modulation. The design utilizes digital processing preparing the audio for transmission and then converts it back to audio before transmission.

(14) The data required by Sections 2.1046 through 2.1057, inclusive, measured in accordance with the procedures set out in Section 2.1041.

(15) The application for certification of an external radio frequency power amplifier under Part 97 of this chapter need not be accompanied by the data required by Paragraph (b)(14) of this section. In lieu thereof, measurements shall be submitted to show compliance with the technical specifications in Subpart C of Part 97 of this chapter and such information as required by Section 2.1060 of this part. This paragraph does not apply to this equipment.

(16) An application for certification of an AM broadcast stereophonic exciter-generator intended for interfacing with existing certified, or formerly type accepted or notified transmitters must include measurements made on a complete stereophonic transmitter. The instruction book must include complete specifications and circuit requirements for interconnecting with existing transmitters. The instruction book must also provide a full description of the equipment and measurement procedures to monitor modulation and to verify that the combination of stereo exciter-generator and transmitter meets the emission limitations of section 73.44. This paragraph does not apply to this equipment.

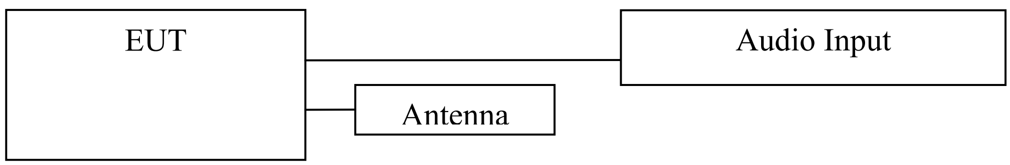
(17) A single application may be filed for a composite system that incorporates devices subject to certification under multiple rule parts; however, the appropriate fee must be included for each device. Separate applications must be filed if different FCC Identifiers will be used for each device.

Equipment Tested

Equipment	Model	FCC I.D.	IC: ID
EUT	HHM	DBZHHM	8024A-HHM

Equipment Function and System Description

Equipment testing was performed on the model HHM operating in the frequency band of 614.4 - 691.1 MHz. The design offers function as Wireless Microphone for local use in cue and control communications. The frequency band of operation is covered using equipment typically capable of tuning through 25.5 MHz blocks. The HHM design operates from two internal 1.5-volt replaceable batteries. The design offers no provision for connection to utility power. New batteries were installed powering the test sample during testing.



Equipment and Cable Configurations

Antenna Port Conducted Emission Test Procedure

Testing for antenna port conducted emissions were performed on test samples using the manufacturer supplied test fixture. The test fixture replaces the antenna element for use in manufacturing as the EUT is sold with manufacturer-attached antenna located at base of microphone.

Radiated Emission Test Procedure

Testing for the radiated emissions were performed as defined in sections 8.3 and 13.1 of ANSI C63.4-2009 and/or TIA/EIA 603-C (2004). The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. Refer to photographs in the exhibits for EUT placement.

Units of Measurements

AC Line Conducted EMI	Data is in dBμV; dB referenced to one microvolt.
Radiated EMI	Data is in dBμV/m; dB/m referenced to one microvolt per meter
Antenna Conducted	Data is in dBm, dB referenced to one milliwatt

Test Site Locations

Conducted EMI — The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.

Radiated EMI — The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.

Site Registration — Refer to Annex for FCC Site Registration Letter, # 90910, and Industry Canada Site Registration Letter, IC3041A-1.

List of Test Equipment

A Rohde & Schwarz ESU40 and/or Hewlett Packard 8591EM Spectrum Analyzer was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rohde & 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.

Analyzer Settings		
AC Line Conducted Emissions:		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak/Quasi Peak
Radiated Emissions 30-1000 MHz		
RBW	AVG. BW	Detector Function
100 kHz	100 kHz	Peak
120 kHz	300 kHz	Peak/Quasi Peak
Radiated Emissions Above 1000 MHz		
RBW	Video BW	Detector Function
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	Sunol	JB6	10/11	10/12
Antenna	Com Power	AH-118	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

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

Radio Frequency Power Output Test Arrangement

The design utilizes a semi-permanently attached antenna system for use. A test fixture, supplied by the manufacturer, offered access for antenna port conducted emissions testing. The radio frequency power output was measured at both the antenna port and also three-meter distance on a registered Open Area Test Site (OATS) using the substitution method. A Rohde & Schwarz ESU40 Spectrum Analyzer was used to measure the radio frequency power produced by the EUT (antenna port conducted and at a three-meters distance on the OATS). Testing on the OATS was performed as follows, the radiated emission level was recorded, and the EUT was removed from the table and replaced by a substitution antenna driven by a frequency generator. 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 replaced by the spectrum analyzer to accurately record the generators power output. This power output level was then recorded. This procedure was repeated for all frequencies of interest with the data taken reported below. Refer to Figure one showing the maximum output power of the transmitter. Data was taken per Paragraph 2.1046(a) and applicable paragraphs of Part 74 and RSS-123.

Power in dBm was converted to power in Watts using the following formula.

Power (dBm) = power in dB above 1 milliwatt
Milliwatts = $10^{(\text{Power dBm}/10)}$
Watts = Power in Milliwatts times 0.001
Example 19.70 dBm $= 10^{(19.70/10)}$
$= 93.33$ mW
$= 0.10$ Watts

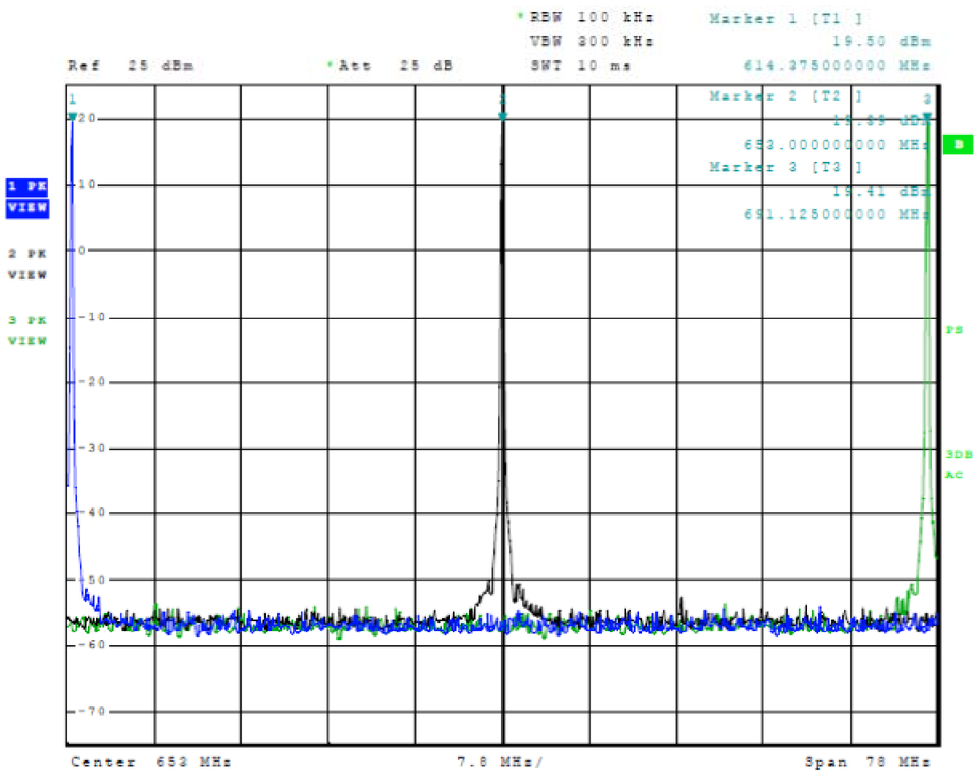


Figure One Power Output

Radio Frequency Power Output Results

Antenna Port Conducted

Frequency (MHz)	Antenna Port Conducted (dBm)	Calculated power in Watts P(w)
614.400	19.70	0.1
653.000	19.39	0.1
691.100	19.41	0.1

Radiated Emissions results from 3-meter OATS

Frequency (MHz)	Amplitude of EUT at 3 m (dBµV/m)	Power required from generator to reproduce level (dBm)	Calculated power in Watts P(w)
614.400	114.6	19.37	0.1
653.000	114.6	19.37	0.1
691.100	114.7	19.47	0.1

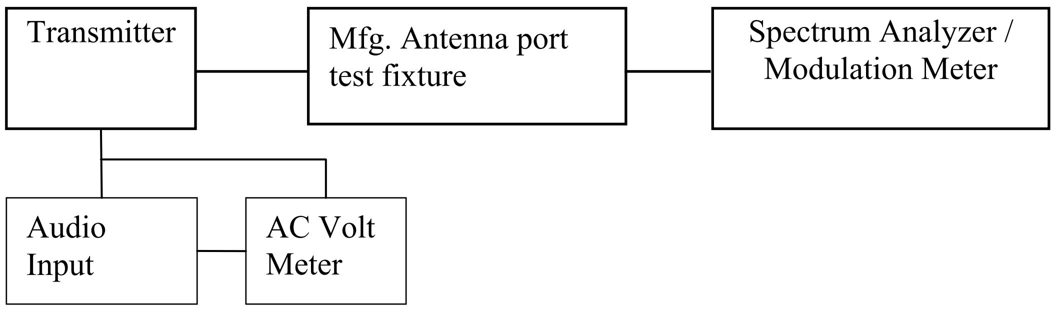
The EUT demonstrated compliance with specifications of RSS-123 and CFR47 Paragraph 2.1046(a) and applicable paragraphs of 74. There are no deviations to the specifications.

Modulation Characteristics

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 was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer and a modulation meter. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its standard mode(s). The modulation meter was used to measure the frequency deviation or percent modulation.

Modulation Characteristic Results

Figure two displays the graph made showing the audio frequency response of the modulator. The frequency generator was set to 1 kHz and injected into the audio input port of the EUT. The input voltage amplitude was adjusted to obtain 50% modulation at 1000 Hz. This level was then taken as the 0-dB reference. The frequency of the generator was then varied and the voltage input level recorded while holding the output modulation level constant. The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable paragraphs of 74 and RSS-123. There are no deviations to the specifications.

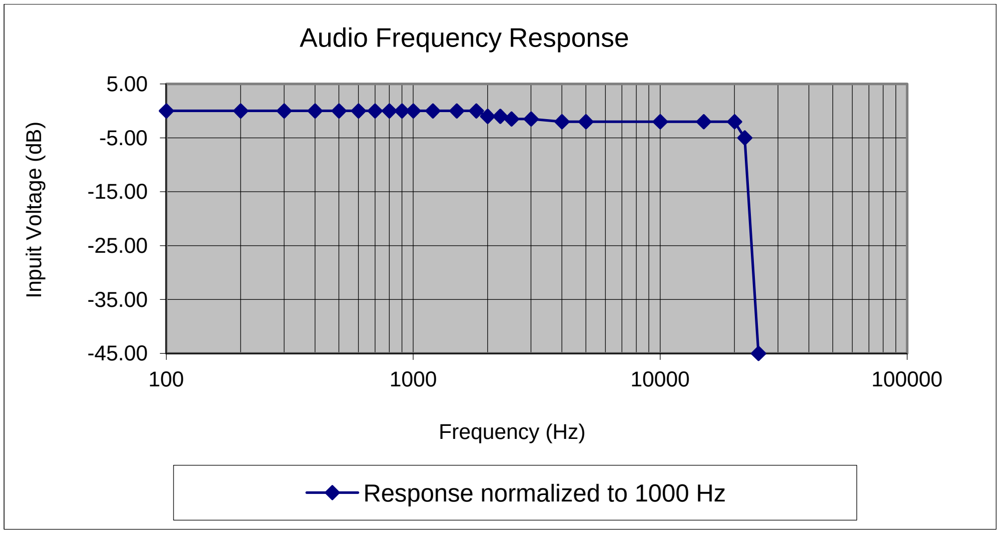


Figure Two Audio Frequency Response Characteristics

Figure three displays the frequency deviation response (operating as mode CP 6) for each of seven frequencies while the input voltage was varied. The frequency was held constant and the frequency deviation was read from the deviation meter.

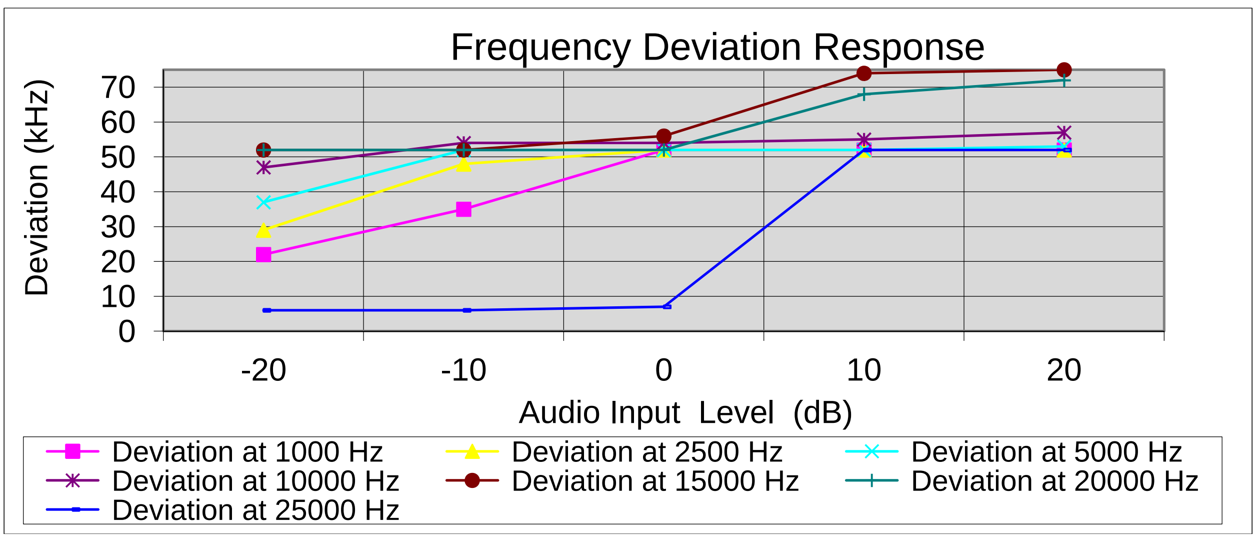


Figure Three Deviation Characteristics

Figure 4 displays the frequency response of the audio low pass filter.

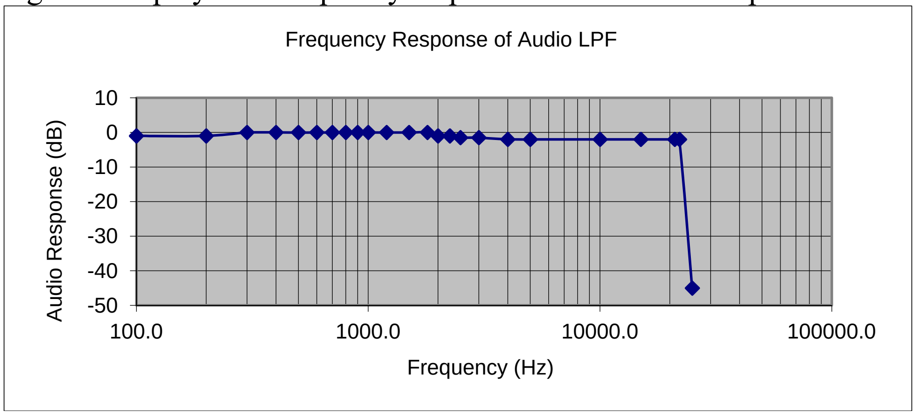


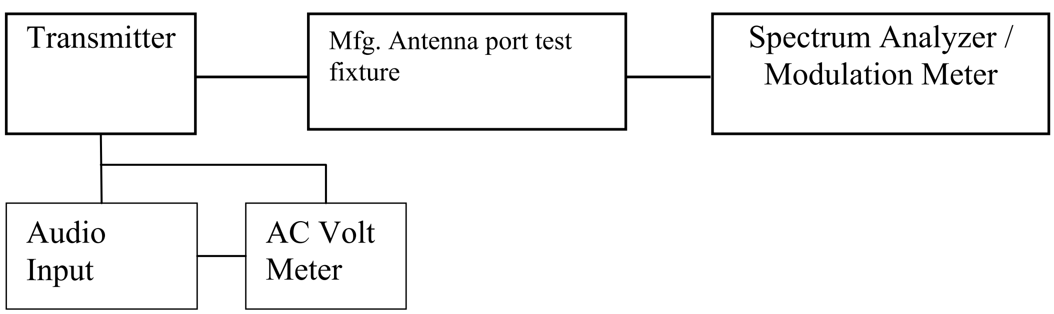
Figure Four Frequency Response of Audio low Pass Filter

Occupied Bandwidth

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.

Occupied Bandwidth Test Arrangement



A spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating through all normal modes, modulated by a frequency of 2,500 Hz and again at 21,000 Hz. The power ratio in dB representing 99.5% of the total mean power was recorded from the spectrum analyzer. All modes of operation were investigated and worst-case data presented. Operation in CP 3 mode produced the widest occupied Bandwidths. Refer to figures five and six displaying plots of the 99.5% power and spectral emissions masks for each of the three operational output power modes.

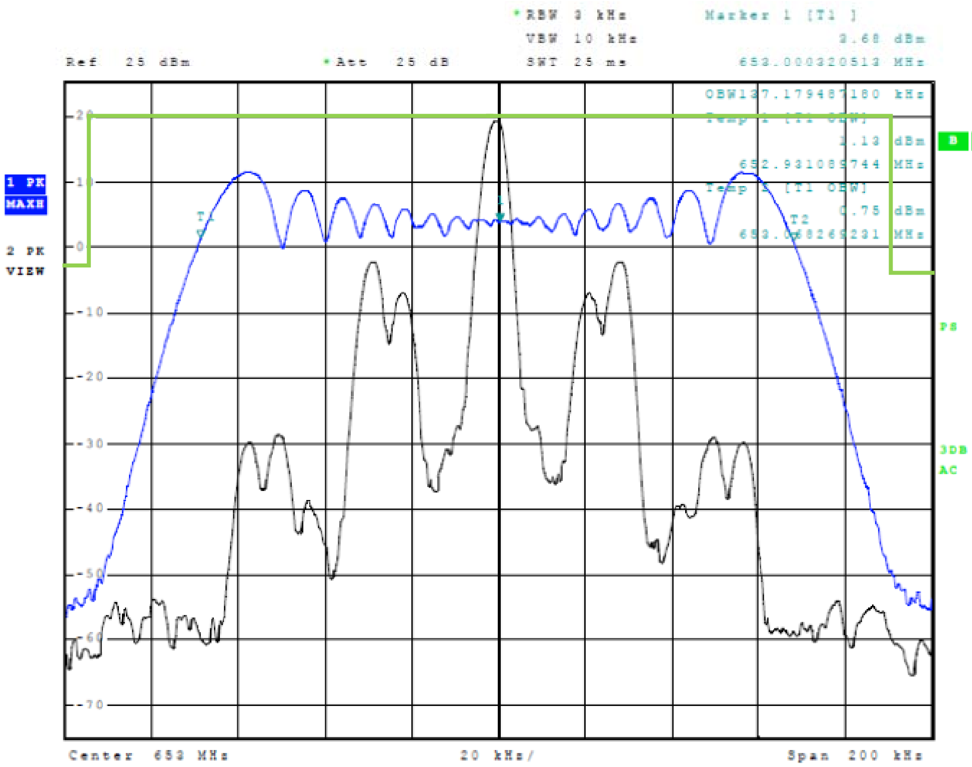


Figure Five Occupied Bandwidth Measurement with 2500 Hz input

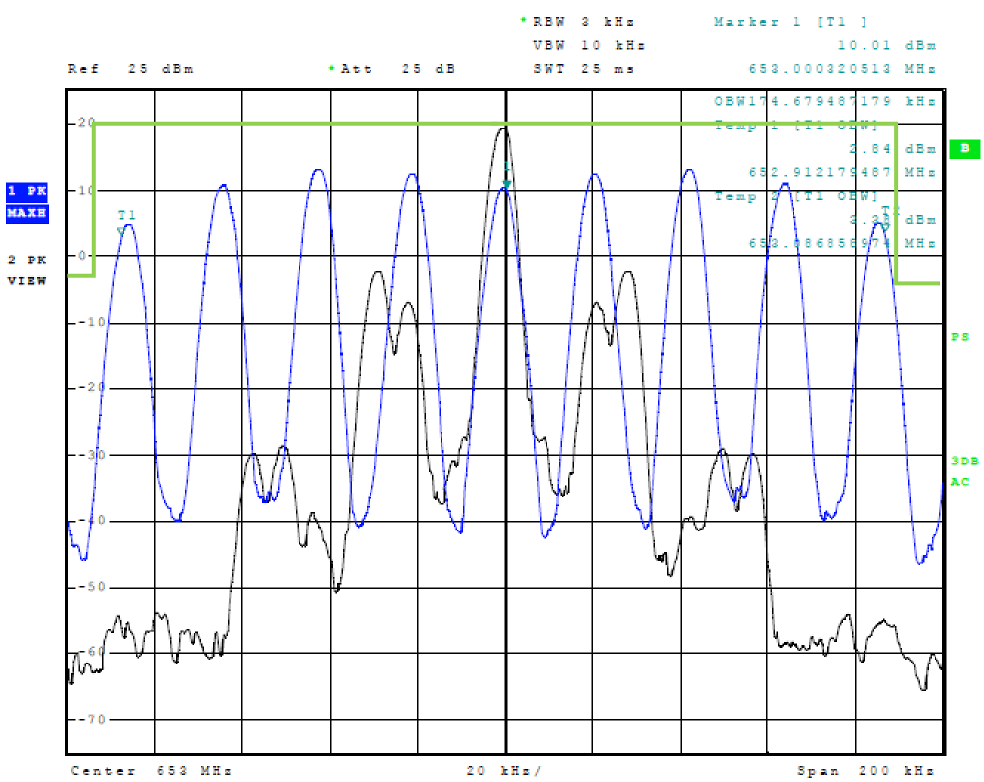


Figure Six Occupied Bandwidth Measurement with 21,000 Hz input

Occupied Bandwidth Results

The necessary bandwidth for this sound broadcasting class of equipment is calculated from the equation Bn=2M+2KD (k=1, M=21,000 and D=75,000). This equates to a necessary bandwidth of 192 kHz. The limiting circuitry of the device reduces the measured bandwidth due to the constant frequency signal wave used at the input.

Frequency (MHz)	Measured Occupied Bandwidth (kHz)
614.400	173.89
653.000	174.67
691.100	173.85

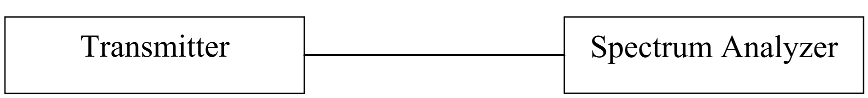
The EUT demonstrated compliance with specifications of RSS-123 and CFR47 Paragraph 2.1046 and applicable paragraphs of Paragraph 74. There are no deviations to the specifications.

Spurious Emissions at Antenna Terminals

Spurious Emissions 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. The EUT utilizes a permanently attached antenna system, therefore demonstration of compliance demonstrated from the radiated field strength measurements

Spurious Emissions at Antenna Port Test Arrangement



The radio frequency output was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer during antenna port conducted emissions measurements. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter modulated per section 2.1049 and operated in all normal modes. The frequency spectrum from 30 MHz to 6,000 MHz was observed and plots produced of the frequency spectrum displayed on the test equipment. Figures seven through ten represent data for the antenna spurious emissions of the EUT. Data was taken per CFR47 2.1051, 2.1057, and applicable paragraphs CFR47 paragraph 74 and RSS-123.

Spurious Emissions at Antenna Results

The output of the unit was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer and the frequency emissions measured. Data was taken as per CFR47 2.1051 and applicable paragraphs of Part 74 and RSS-123.

CFR47 requires spurious emissions be attenuated at least 43 +10log (P_{MEAN}) below the fundamental emission power level. The following equations represent the calculated attenuation level and limit for CFR47 compliance.

CFR47 Limit = 43 + 10Log (0.100) = 33.0 dBc
CFR47 Limit = Transmitter power (dBm) – Limit (dBc)
CFR47 Limit = 20.0 dBm – 33 dBc = -13.0 dBm

Example: Margin = Measured emission level (dBm) - Limit (dBm)
CFR47 margin = -46.47 – (-13.0)
= -33

RSS-123 requires spurious emissions be attenuated at least 55 +10log (P_{MEAN}) below the fundamental emission power level. The following equations represent the calculated attenuation level and limit for RSS-123 compliance.

RSS-123 Limit = 55+10Log (0.100) = 45.0 dBc
RSS-123 Limit = Transmitter power (dBm) – Limit (dBc)
RSS-123 Limit = 20.0 dBm – 45 dBc = -25.0 dBm

Example: Margin = Measured emission level (dBm) - Limit (dBm)
RSS-123 margin = -46.47 – (-25.0)
= -21

Channel MHz	Spurious Frequency (MHz)	Measured Level (dBm)	Level Below Carrier (dB)	Margin (dB) CFR47	Margin (dB) RSS-123
614.400	1228.8	-46.15	-65.9	-33.2	-21.2
	1843.2	-39.87	-59.6	-26.9	-14.9
	2457.6	-47.35	-67.1	-34.4	-22.4
	3072.0	-49.41	-69.1	-36.4	-24.4
	3686.4	-47.53	-67.2	-34.5	-22.5
	4300.8	-42.18	-61.9	-29.2	-17.2
	4915.2	-49.37	-69.1	-36.4	-24.4
	5529.6	-48.51	-68.2	-35.5	-23.5
	6144.0	-51.53	-71.2	-38.5	-26.5
653.000	1306.0	-46.73	-66.1	-33.4	-21.4
	1959.0	-40.31	-59.7	-27.0	-15.0
	2612.0	-47.81	-67.2	-34.5	-22.5
	3265.0	-49.97	-69.4	-36.7	-24.7
	3918.0	-47.81	-67.2	-34.5	-22.5
	4571.0	-41.29	-60.7	-28.0	-16.0
	5224.0	-49.93	-69.3	-36.6	-24.6
	5877.0	-48.35	-67.7	-35.0	-23.0
	6530.0	-51.46	-70.9	-38.2	-26.2
691.100	1382.2	-46.86	-66.3	-33.6	-21.6
	2073.3	-40.33	-59.7	-27.0	-15.0
	2764.4	-48.25	-67.7	-35.0	-23.0
	3455.5	-50.26	-69.7	-37.0	-25.0
	4146.6	-47.84	-67.3	-34.6	-22.6
	4837.7	-41.06	-60.5	-27.8	-15.8
	5528.8	-49.87	-69.3	-36.6	-24.6
	6219.9	-48.34	-67.8	-35.1	-23.1
	6911.0	-51.06	-70.5	-37.8	-25.8

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046 and applicable paragraphs of Paragraph 74 and RSS-123. There are no deviations to the specifications.

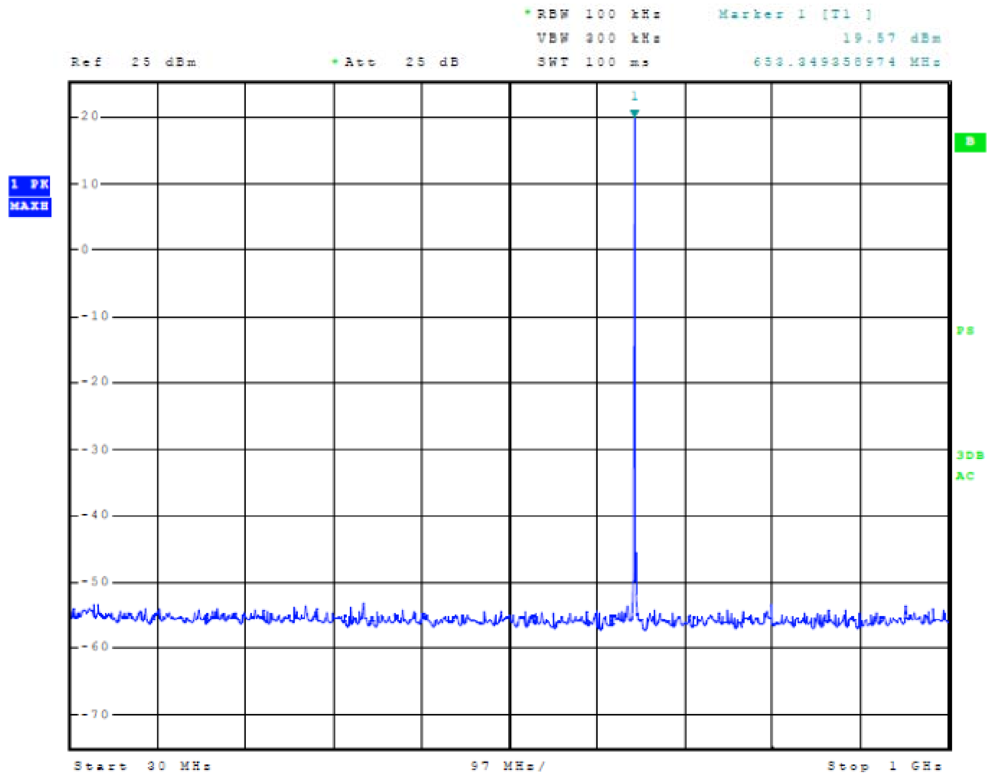


Figure Seven Spurious Emissions at Antenna Terminal

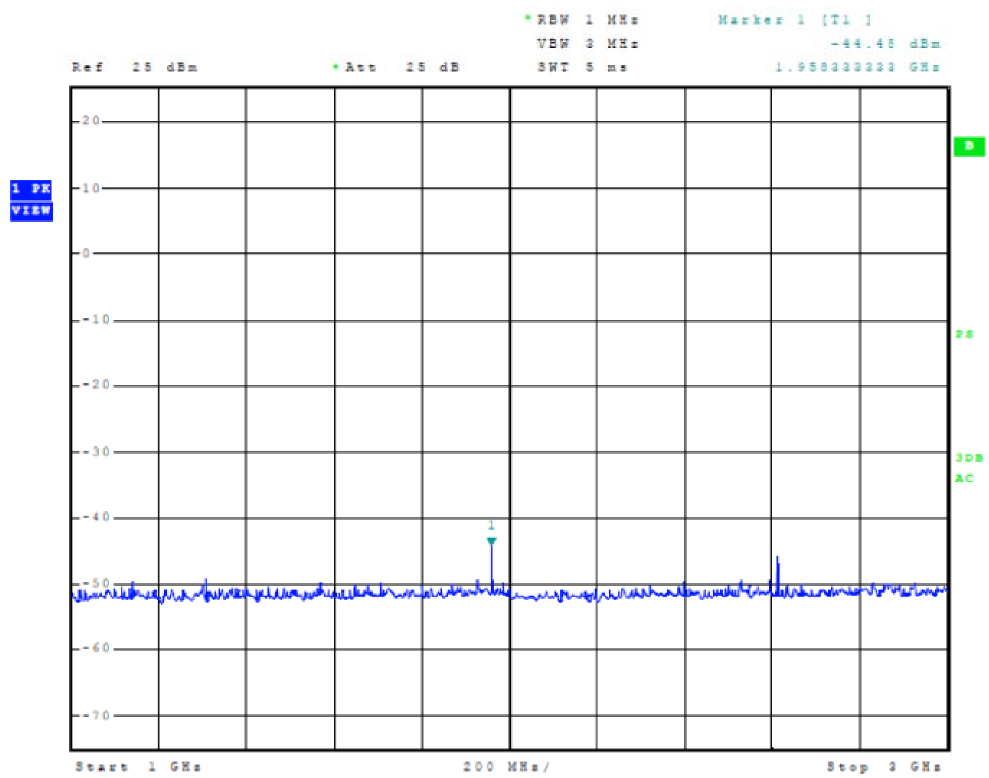


Figure Eight Spurious Emissions at Antenna Terminal

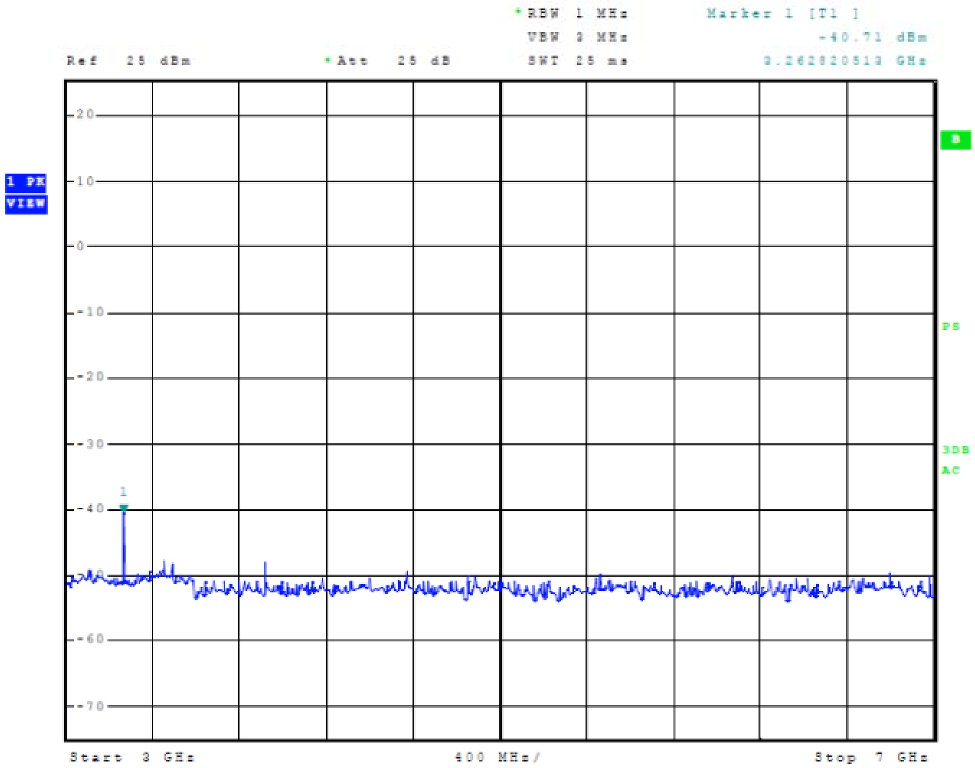


Figure Nine Spurious Emissions at Antenna Terminal

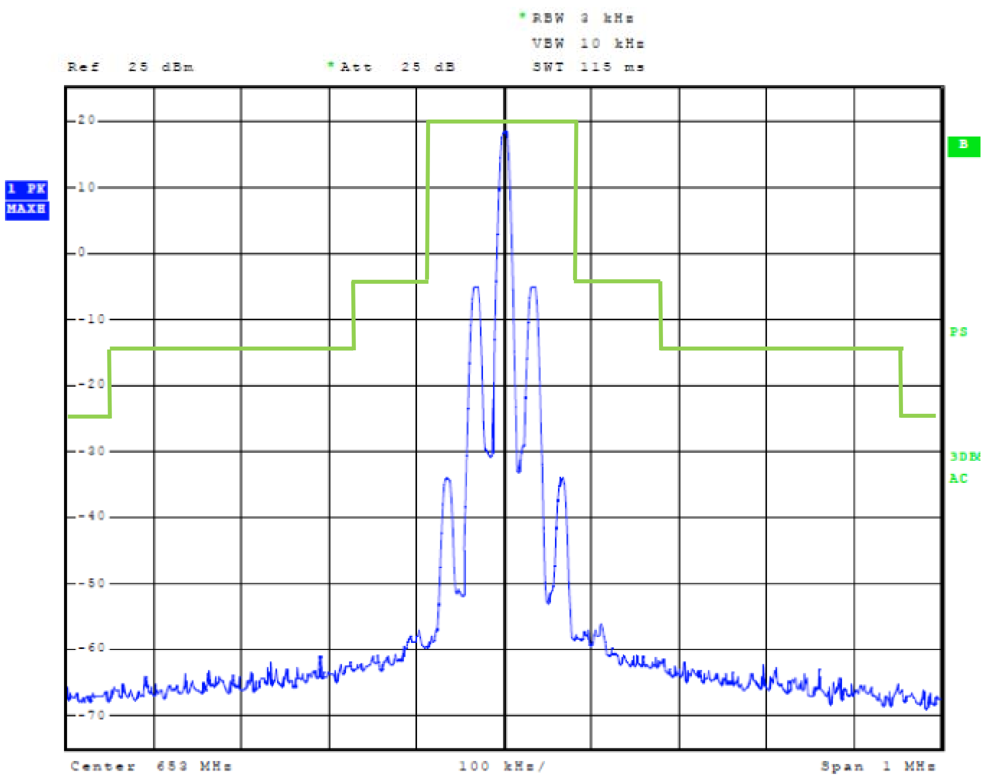


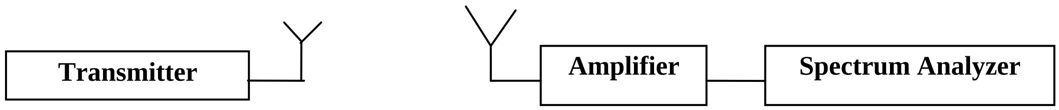
Figure Ten Emission Mask at Antenna Terminal

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.

Field Strength of Spurious Radiation Test Arrangement



The transmitter, with the permanent antenna attached, was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter. Raising and lowering the FSM antenna and rotating the turntable before final data was recorded maximized the measured amplitude of each spurious emission. A Biconilog antenna was used for frequencies of 30 MHz to 1000 MHz and pyramidal horn antennas used for frequencies of 1 GHz to 40 GHz. The substitution method was used to measure the radiated spurious emissions. Emission levels from the EUT were measured and amplitude levels were recorded. The EUT transmitter was 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 gain in the substitution antenna. The testing procedures used conform to the procedures stated in the TIA/EIA 603-C (2004) document. The most stringent limit for the spurious emissions defined in the standards is presented as: 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 55 + 10 Log (Po) dB (= 45.0 dBc).

Field Strength of Spurious Radiation Results

Frequency of Emission	Amplitude of EUT Spurious emission		Signal level to substitution antenna required to reproduce		Emission level below carrier		CFR47 Limit	RSS-123 Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical		
(MHz)	dBμV/m	dBμV/m	dBm	dBm	dBc	dBc	dBc	dBc
614.4	114.1	114.6	18.87	19.37	0	0	0	0
1228.8	24.8	24.8	-70.4	-70.4	-89.3	-89.8	-33.0	-45.0
1843.2	31.3	31.2	-63.9	-64.0	-82.8	-83.4	-33.0	-45.0
2457.6	30.6	30.6	-64.6	-64.6	-83.5	-84.0	-33.0	-45.0
3072.0	32.5	32.5	-62.7	-62.7	-81.6	-82.1	-33.0	-45.0
3686.4	34.1	34.1	-61.1	-61.1	-80.0	-80.5	-33.0	-45.0
653.0	114.2	114.6	18.97	19.37	0	0	0	0
1306.0	29.2	28.2	-66.0	-67.0	-85.0	-86.4	-33.0	-45.0
1959.0	30.0	39.9	-65.2	-55.3	-84.2	-74.7	-33.0	-45.0
2612.0	33.3	33.5	-61.9	-61.7	-80.9	-81.1	-33.0	-45.0
3265.0	31.4	33.5	-63.8	-61.7	-82.8	-81.1	-33.0	-45.0
3918.0	32.0	32.0	-63.2	-63.2	-82.2	-82.6	-33.0	-45.0
691.1	114.1	114.7	18.87	19.47	0	0	0	0
1382.2	32.4	32.5	-62.8	-62.7	-81.7	-82.2	-33.0	-45.0
2073.3	29.2	32.3	-66.0	-62.9	-84.9	-82.4	-33.0	-45.0
2764.4	33.0	32.9	-62.2	-62.3	-81.1	-81.8	-33.0	-45.0
3455.5	30.3	30.2	-64.9	-65.0	-83.8	-84.5	-33.0	-45.0
4146.6	32.7	32.8	-62.5	-62.4	-81.4	-81.9	-33.0	-45.0

The EUT demonstrated compliance with specifications of RSS-123 and CFR47 Paragraph 2.1046 and applicable paragraphs of Paragraph 74. There are no deviations to the specifications.

Frequency Stability

Frequency Stability Measurements Required

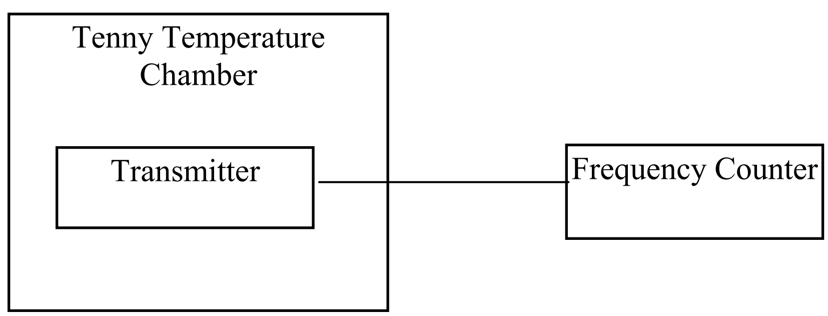
The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components 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.

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

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.

Frequency Stability Test Arrangement



The measurement procedure outlined below shall be followed.

Step 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 frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value. A BK Precision 1670A DC Power Supply was used to vary the DC voltage for the power input from 2.55 Vdc to 3.45 Vdc. The frequency was measured and the variation in parts per million was calculated. Data was taken per Paragraphs 2.1055 and applicable paragraphs of parts 2, 74.861, and RSS-123.

Frequency Stability Data and Results

Nominal frequency 653.00058 MHz	Frequency Stability Vs Temperature In Parts Per Million (PPM) and percent (limit=0.005%)								
Temperature	-30	-20	-10	0	10	20	30	40	50
Change (Hz)	-2180.0	-1210.0	-480.0	60.0	2160.0	2510.0	3030.0	3070.0	2600.0
PPM	-3.3	-1.9	-0.7	0.1	3.3	3.8	4.6	4.7	4.0
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Limit 50 PPM (0.005%)									

Frequency 653.00058 MHz	Frequency Stability Vs Voltage Variation 3.0 volts nominal		
Voltage	2.55	3.00	3.45
Change (Hz)	0.0	0.0	0.0

Frequency 653.00058 MHz	Frequency Stability Vs Voltage Variation, 3.0 volts nominal Battery Endpoint Voltage 2.40 Vdc
Change(Hz)	0.0

The frequency tolerance of the transmitter shall be 0.005 percent (50 PPM) per RSS-123 and CFR47, 74.861.

The EUT demonstrated compliance with specifications of RSS-123 and CFR47 Paragraph 2.1046 and applicable paragraphs of Paragraph 74. 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 Registration Letter
- Annex E Industry Canada Site Registration 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:

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

$U = 2\, U_c(y) = 2 \times \pm 1.6 \text{ dB} = \pm 3.2 \text{ dB}$

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 Rogers Labs Test Equipment List

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: 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	2/11
Oscilloscope Scope: Tektronix 2230	2/11
Wattmeter: Bird 43 with Load Bird 8085	2/11
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/11
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/11
R.F. Power Amp 65W Model: 470-A-1010	2/11
R.F. Power Amp 50W M185- 10-501	2/11
R.F. Power Amp A.R. Model: 10W 1010M7	2/11
R.F. Power Amp EIN Model: A301	2/11
LISN: Compliance Eng. Model 240/20	2/11
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/11
Antenna: EMCO Dipole Set 3121C	2/11
Antenna: C.D. B-101	2/11
Antenna: Solar 9229-1 & 9230-1	2/11
Antenna: EMCO 6509	2/11
Audio Oscillator: H.P. 201CD	2/11
Peavey Power Amp Model: IPS 801	2/11
ELGAR Model: 1751	2/11
ELGAR Model: TG 704A-3D	2/11
ESD Test Set 2010i	2/11
Fast Transient Burst Generator Model: EFT/B-101	2/11
Field Intensity Meter: EFM-018	2/11
KEYTEK Ecat Surge Generator	2/11
Shielded Room 5 M x 3 M x 3.0 M	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Engineering experience includes six years 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.

Annex D FCC Test Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

May 18, 2010

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: May 18, 2010

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

NVLAP Lab Code: 200087-0

Annex E Industry Canada Test Site Registration Letter

Industry Canada Industrie Canada

May 26, 2010

OUR FILE: 46405-3041
Submission No: 140719

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

Attention: Mr. Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the renewal of a 3/10m OATS. Be advised that the information received was satisfactory to Industry Canada. The following number(s) is now associated to the site(s) for which registration / renewal was sought **(3041A-1).** Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please keep for your records the following information;

- Your primary code is: **3041**

- The company number associated to the site(s) located at the above address is: **3041A**

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2003 or later shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 metre OATS or 3 metre chamber). If the test facility is not accredited to ANSI C63.4-2003 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

The frequency for re-validation of the test site and the information that is required to be filed or retained by the testing party shall comply with the requirements established by the accrediting organization. However, in all cases, test site re-validation shall occur on an interval not to exceed two years. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;
http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/h_tt00052e.html.

If you have any questions, you may contact the Bureau by e-mail at certification.bureau@ic.gc.ca Please reference our file and submission number above for all correspondence.

Yours sincerely,

Dalwinder Gill

Dalwinder Gill
For: Wireless Laboratory Manager
Certification and Engineering Bureau
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