NVLAP Lab Code: 200087-0

Application Submittal Test Report
FCC and Industry Canada
Grant of Certification
Model: IFBT4VHF

Wireless Microphone Transmitter

FCC ID: DBZIFBT4VHF

IC: 8024A-IFBT4VHF

Frequency Range: 174.100-215.750 MHz

Operating under rule of 47CFR Part 74, Subpart H

And RSS-210, Issue 8, Amendment 1

FOR

LECTROSONICS, INC.

581 Laser Road
Rio Rancho, NM 87124
Test Report Number: 150821
IC Test Site Registration: 3041A-1

Certifying Engineer Scot D Rogers

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 FCC and Industry Canada

Lectrosonics, Inc.

581 Laser Road
Rio Rancho, NM 87124

Robert Cunnings

Model: IFBT4VHF

Wireless Microphone Transmitter

Frequency: 174.100-215.750 MHz
FCC ID: DBZIFBT4VHF
IC: 8024A-IFBT4VHF

Test Date: August 21, 2015

Authorized Signatory Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259TH Terrace
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Revisions

Revision 1 Issued October 19, 2015

Executive Summary

The following information is submitted for consideration in obtaining Grant of Certification for wireless microphone transmitter operating under rule of 47CFR paragraph 74 and Industry Canada RSS-210 Issue 8, Amendment 1.

Name of Applicant:

Lectrosonics Inc.
581 Laser Road
Rio Rancho, NM 87124

Model: IFBT4VHF Wireless Microphone Transmitter

FCC ID: DBZIFBT4VHF IC: 8024A-IFBT4VHF

Operating Power: Model IFBT4VHF 50.00 mW, OBW 192 kHz (Calculation) and 127.9 kHz measured, Emissions Designator: 192kF3E

Opinion / Interpretation of Results

Test Performed	Minimum Margin (dB)	Results
AC Line Conducted Emissions	-29.9	Complies
Transmitter Harmonics (per RSS-210 requirement)	-10.2	Complies

Equipment Under Test

Equipment	Model	FCC I.D.	IC: ID
EUT	IFBT4VHF	DBZIFBT4VHF	8024A-IFBT4VHF
AC/DC Adapter	CH20	N/A	N/A

Equipment Function and System Description

Equipment testing was performed on the model IFBT4VHF operating across the frequency band of 174.100-215.750 MHz. The design offers function as Wireless Microphone for local use in cue and control communications. The design provides operation in one two modes for compatibility, CP400 and IFB. The IFBT4VHF design operates from extern direct current power only over the range of 6-18 Vdc. An AC/DC power adapter was provided for testing purposes. The design utilizes female BNC antenna connection port for use with authorized antenna systems as documented in this filing. Testing was performed on two antenna models (Whip dipole and ¼-wave length Wire antenna (up to 3dB again in favored direction).

Equipment Configuration

Application for Certification

(1) Manufacturer: Lectrosonics, Inc.
581 Laser Road
Rio Rancho, NM 87124

(2) FCC and Industry Canada identifier FCC: DBZIFBT4VHF IC: 8024A-IFBT4VHF

(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 192KF3E

(5) Frequency range of operation 174.100-215.750 MHz

(6) Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power. 50 mW

(7) Maximum power rating as defined in the applicable part(s) of the rules. As stated in 47CFR, 74.861(e)(ii) and RSS-210 I8A1, the maximum output power 50 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 IFBT4VHF utilizes two power amplifiers each operating at 5.0 volts and 60.0 mA current for total current of 120mA.

(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.

(18) The device is not a software-defined radio and requirements of 2.944 do not apply to this application.

(19) Applications for certification of equipment operating under part 27 of this chapter, that a manufacturer is seeking to certify for operation in the:

(i) 1755-1780 MHz, 2155-2180 MHz, or both bands shall include a statement indicating compliance with the pairing of 1710-1780 and 2110-2180 MHz specified in §§27.5(h) and 27.75 of this chapter.

(ii) 1695-1710 MHz, 1755-1780 MHz, or both bands shall include a statement indicating compliance with §27.77 of this chapter.

(iii) 600 MHz band shall include a statement indicating compliance with §27.75 of this chapter.

(20) Applications for certification of equipment operating under part 90 of this chapter and capable of operating on the 700 MHz interoperability channels (See §90.531(b)(1) of this chapter) shall include a Compliance Assessment Program Supplier's Declaration of Conformity and Summary Test Report or, alternatively, shall include a document detailing how the applicant determined that its equipment complies with §90.548 of this chapter and that the equipment is interoperable across vendors.

(21) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used.

Applicable Standards & Test Procedures

This report is submitted in accordance with the Code of Federal Regulations, 47CFR dated October 1, 2014, 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 and the Industry Canada Radio Standards Specification RSS-210, Issue 8, Amendment 1. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2014 and ANSI C63.10-2013.

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.

Environmental Conditions

Ambient Temperature	22.8° C
Relative Humidity	44%
Atmospheric Pressure	1016.1 mbar

Radiated Emission Test Procedure

Testing for the radiated emissions were performed as defined in ANSI C63.4-2014 and/or ANSI C63.10-2013. The EUT was placed on a rotating 0.9 x 1.2-meter platform elevated as required 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.

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.

AC Line Conducted Emissions (0.150 -30 MHz)		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Emissions (30-1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions (Above 1000 MHz)		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

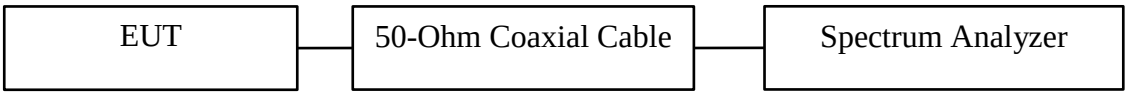
Equipment	Manufacturer	Model (SN)	Band	Cal Date	Due
☒ LISN	FCC	FCC-LISN-50-2-10(1PA) (160611)	.15-30MHz	6/15	5/16
☒ Cable	Time Microwave	750HF290-750 (L10M)	9kHz-40 GHz	10/14	10/15
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/14	10/15
☒ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/14	10/15
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/14	10/15
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/14	10/15
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/15	5/17
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/14	10/16
☐ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15	5/17
☒ Antenna	EMCO	6509 (9502-1374)	.001-30 MHz	10/14	10/15
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/14	10/15
☐ Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/15	5/16
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/15	5/16
☐ Analyzer	HP	8562A (3051A05950)	9kHz-110GHz	5/15	5/16
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/15	5/16
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/15	5/16
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/14	10/15
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/14	10/15
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/14	10/15

Transmitter 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 female BNC antenna port for use with authorized antenna system. The radio frequency power output was measured at the antenna port 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 at a three-meter distance on the OATS. Testing on the OATS was performed as follows, the radiated emission level of the EUT was maximized and 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 plot of the maximum output power of the transmitter. Data was taken per Paragraph 2.1046(a) and applicable paragraphs of Part 74 and RSS-210.

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 16.99 dBm = $10^{(16.99//10)}$
= 50.00 mW
= 0.050 Watts

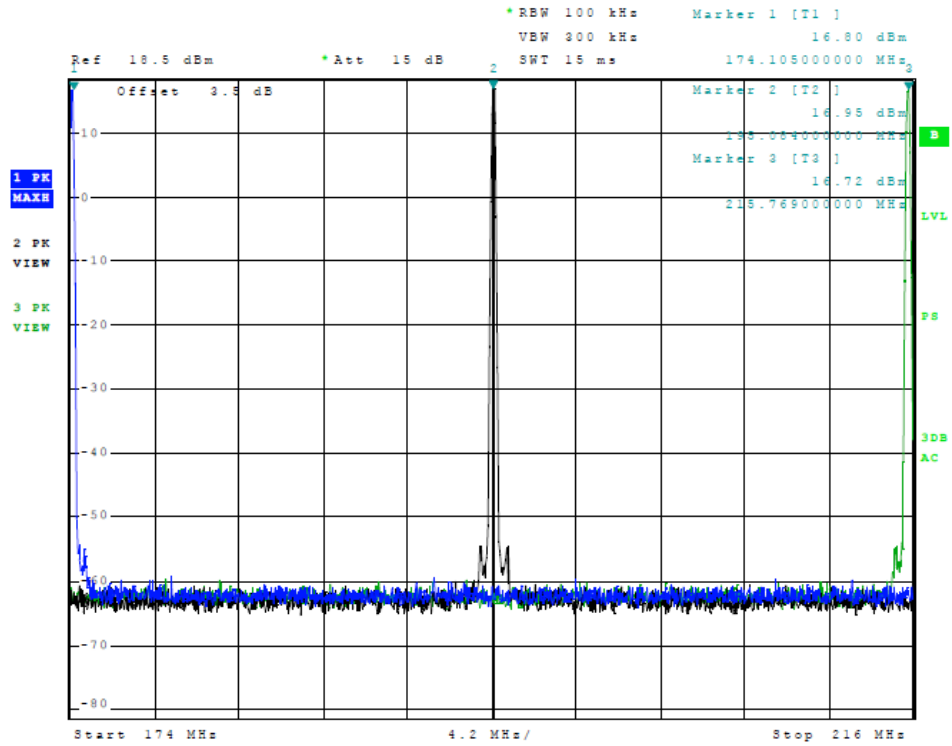


Figure One Power Output

Table 1 Radio Frequency Power Output Results

Frequency (MHz)	Power (dBm)	Calculated power in Watts P(w)
174.100	16.94	0.049
195.100	16.99	0.050
215.750	16.91	0.049

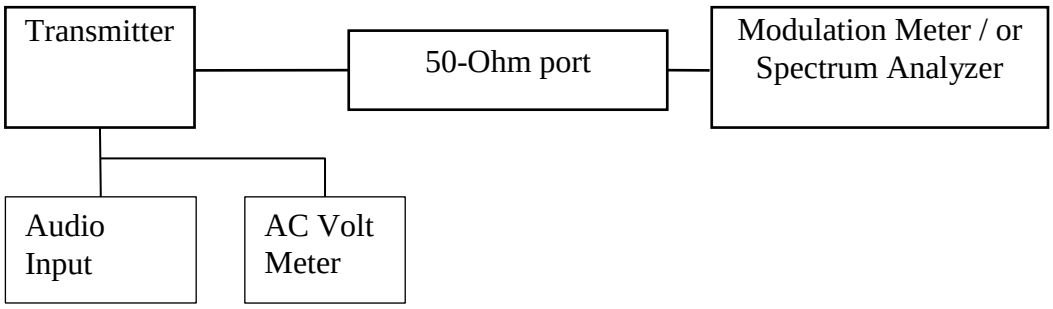
The EUT demonstrated compliance with specifications of RSS-210 and 47CFR Paragraph 2.1046(a) and applicable paragraphs of 74. There are no deviations to the specifications.

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.

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. Refer to figures one and two displaying the designs Audio Frequency Response and Low Pass Filter characteristics. The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable paragraphs of 74 and RSS-210. There are no deviations to the specifications.

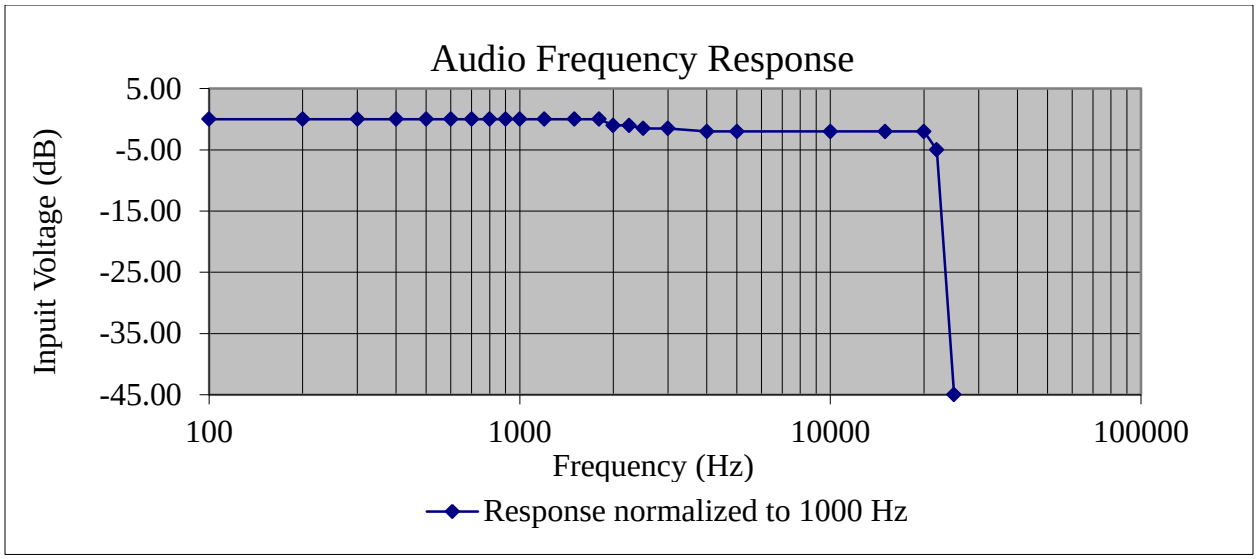


Figure Two Audio Frequency Response Characteristics

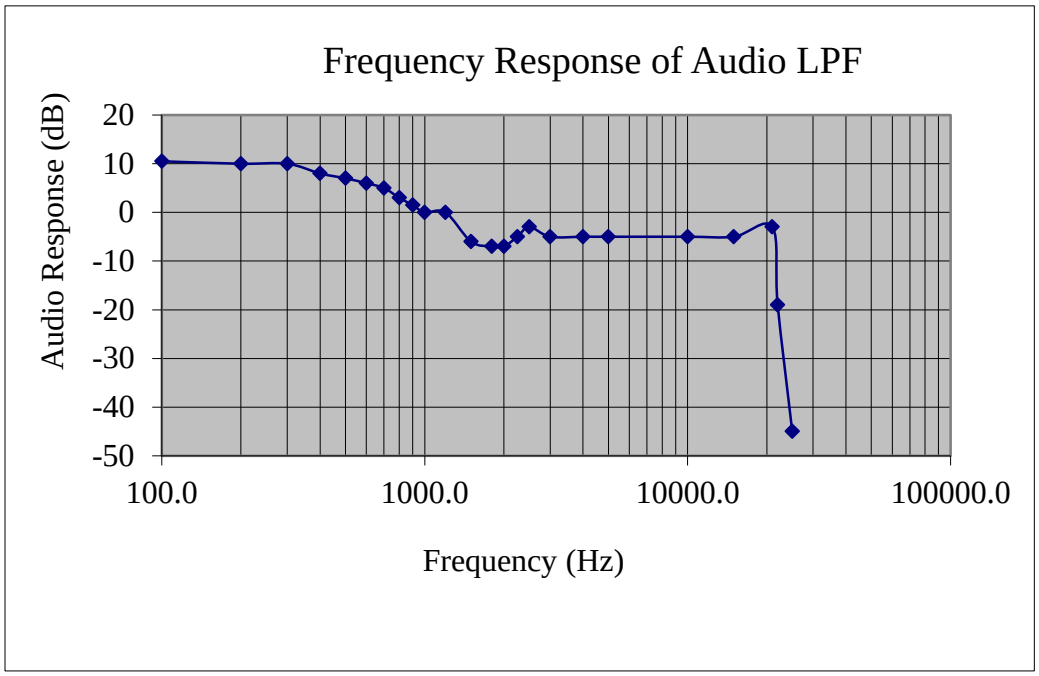


Figure Three Frequency Response of Audio low Pass Filter

Figures four and five display the frequency deviation response (operating in modes CP400 and IFB) 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.

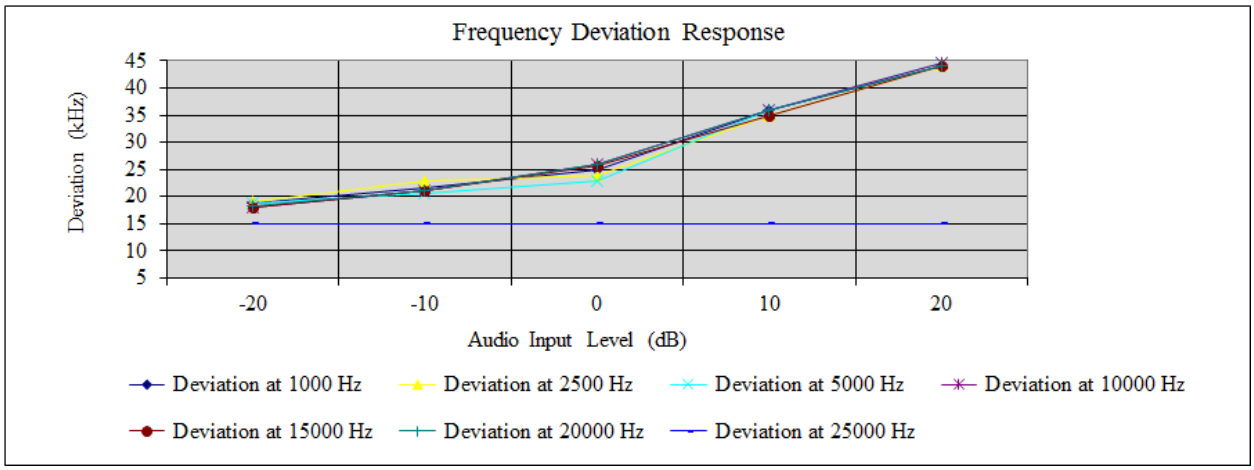


Figure Four Deviation Characteristics CP400 mode

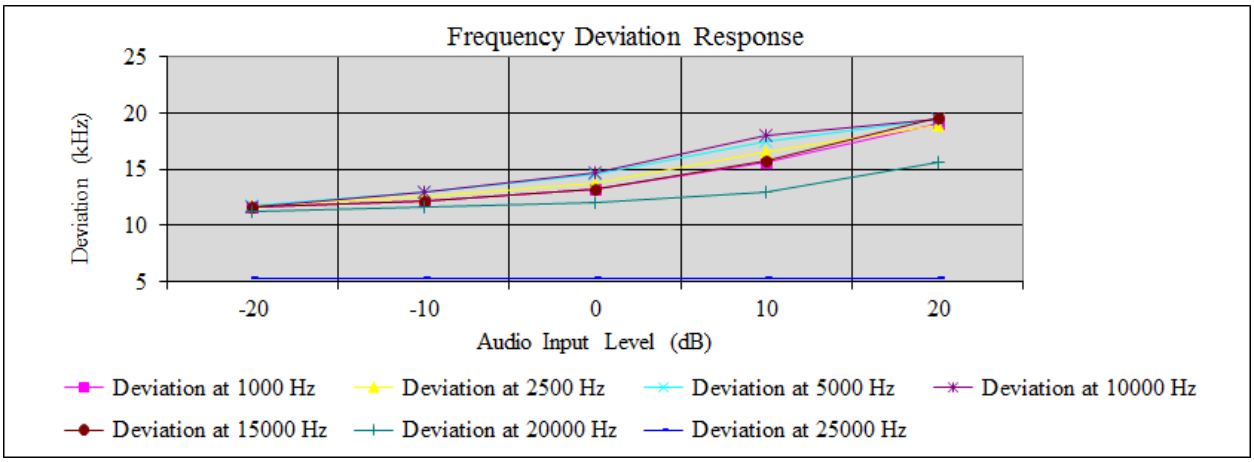


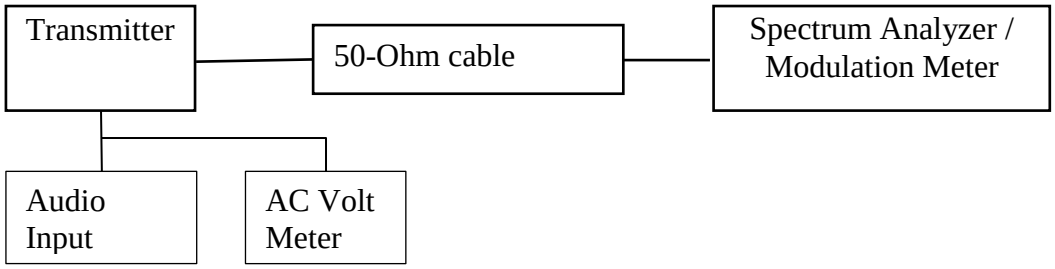
Figure Five Deviation Characteristics IFB mode

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. The power ratio in dB representing 99% 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 400 mode produced the widest occupied Bandwidth. Refer to figures six and seven displaying plots of the 99.5% power and spectral emissions masks for each modulation mode.

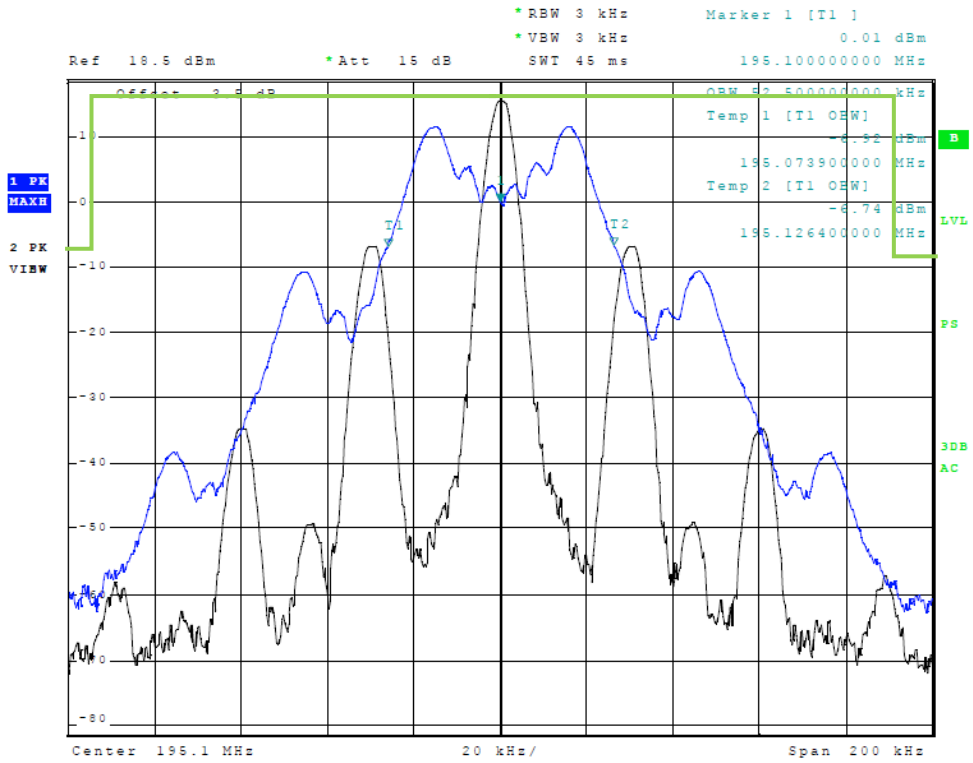


Figure Six Occupied Bandwidth Measurement with 2500 Hz input Mode IFB

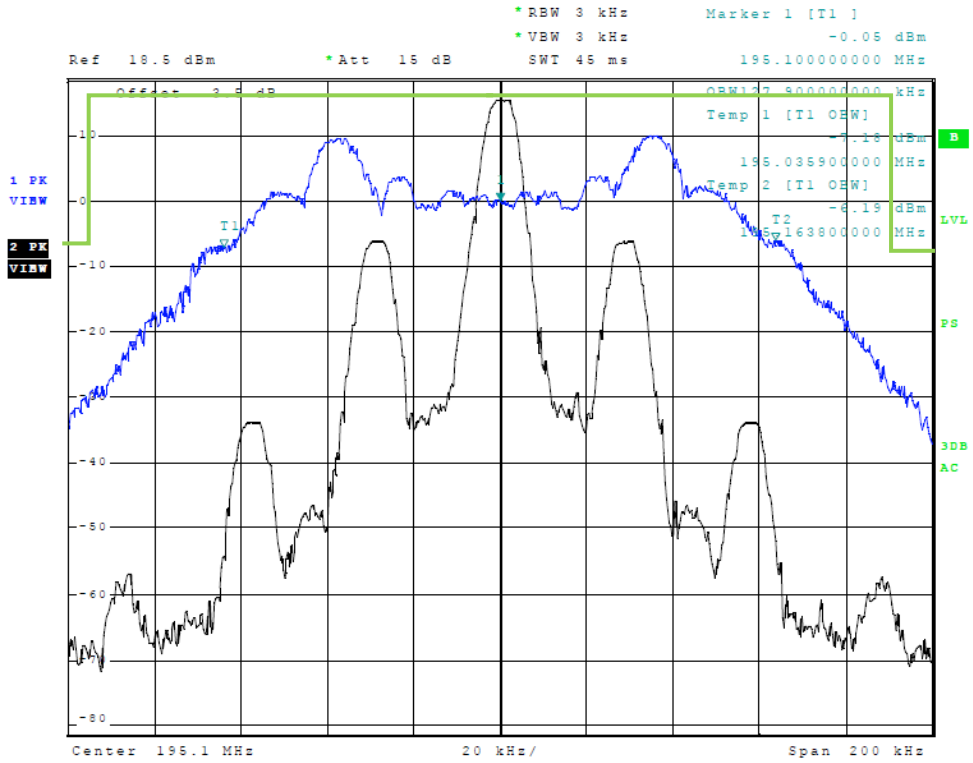


Figure Seven Occupied Bandwidth Measurement with 25,000 Hz input Mode CP400

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.

Table 2 Measured Occupied Bandwidth Results

Frequency (MHz)	Measured Occupied Bandwidth (kHz)
174.100	127.90
195.100	127.90
215.750	127.90

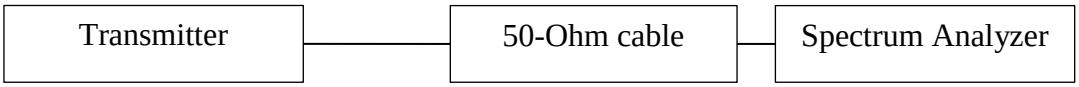
The EUT demonstrated compliance with specifications of RSS-210 and 47CFR Paragraph 2.1046 and applicable paragraphs of Paragraph 74. There are no deviations to the specifications.

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 provides BNC antenna port for antenna system. Refer to figures eight through ten for plots showing compliance with emission mask requirements. Note emission mask as required in RSS-210 is displayed in green. Mask as required in 47CFR paragraph 74.861(e) is displayed in blue.

Spurious Emissions 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 transmitter operating in its normal mode. The frequency spectrum from 9 kHz to 3 GHz was observed. Data was taken per 47CFR 2.1051 and applicable paragraphs of Part 74 and RSS-210

Spurious Emissions at Antenna Results

Data was taken as per 47CFR 2.1051 and applicable paragraphs of Part 74 and RSS-210.

47CFR 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 47CFR compliance.

47CFR Limit = 43 + 10Log (0.050) = 29.989 dBc
47CFR Limit = Transmitter power (dBm) – Limit (dBc)
47CFR Limit = 17.00 dBm – 30 dBc = -13.0 dBm

RSS-210 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-210 compliance.

RSS-210 Limit = 55+10Log (0.050) = 42.0 dBc
RSS-210 Limit = Transmitter power (dBm) – Limit (dBc)
RSS-210 Limit = 17.0 dBm – 42 dBc = -25.0 dBm

Table 3 Spurious Emissions Results

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
174.100	348.2	-30.39	-47.3
	522.3	-64.89	-81.8
	696.4	-73.00	-89.9
	870.5	-72.11	-89.1
	1044.6	-72.68	-89.6
	1218.7	-73.37	-90.3
195.100	390.2	-41.74	-58.7
	585.3	-70.12	-87.1
	780.4	-70.97	-88.0
	975.5	-70.98	-88.0
	1170.6	-71.52	-88.5
	1365.7	-71.93	-88.9
215.750	431.5	-50.99	-67.9
	647.3	-70.11	-87.0
	863.0	-72.55	-89.5
	1078.8	-72.42	-89.3
	1294.5	-72.27	-89.2
	1510.3	-72.12	-89.0

Data was taken per 2.1051 and applicable parts of 47CFR74 and RSS-210. The EUT demonstrated compliance with the specifications of Paragraphs 47CFR 2.1051, 2.1057 and 74.861 and RSS-210 paragraph 6.5. There are no deviations to the specifications.

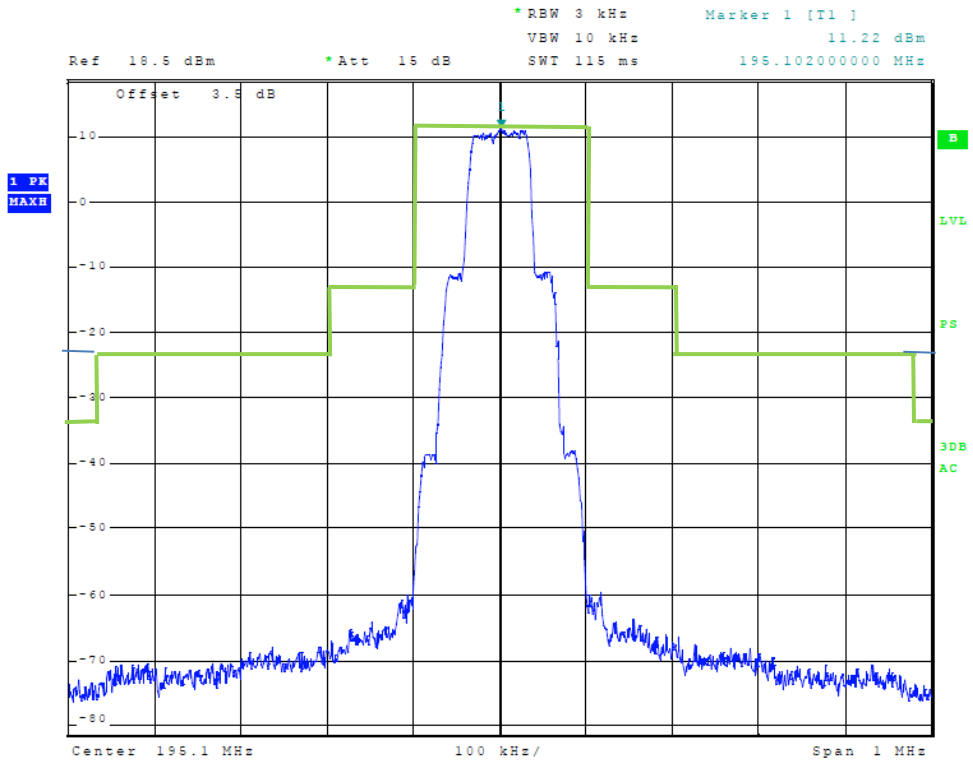


Figure Eight Emission Mask at Antenna Terminal CP400 Modulation

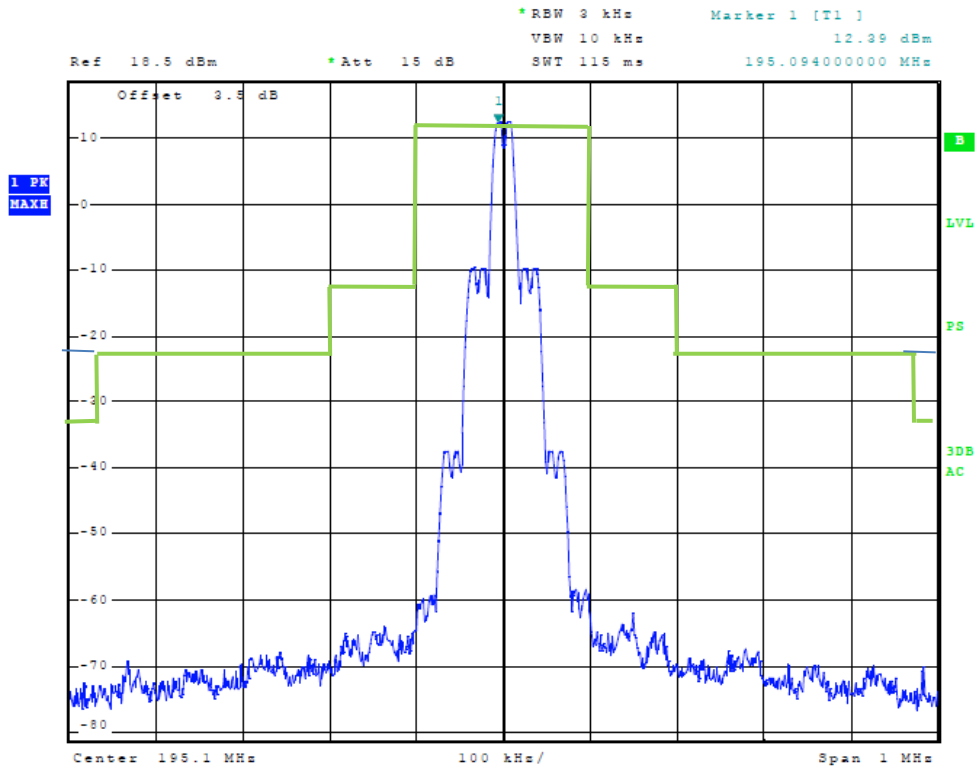


Figure Nine Emission Mask at Antenna Terminal IFB Modulation

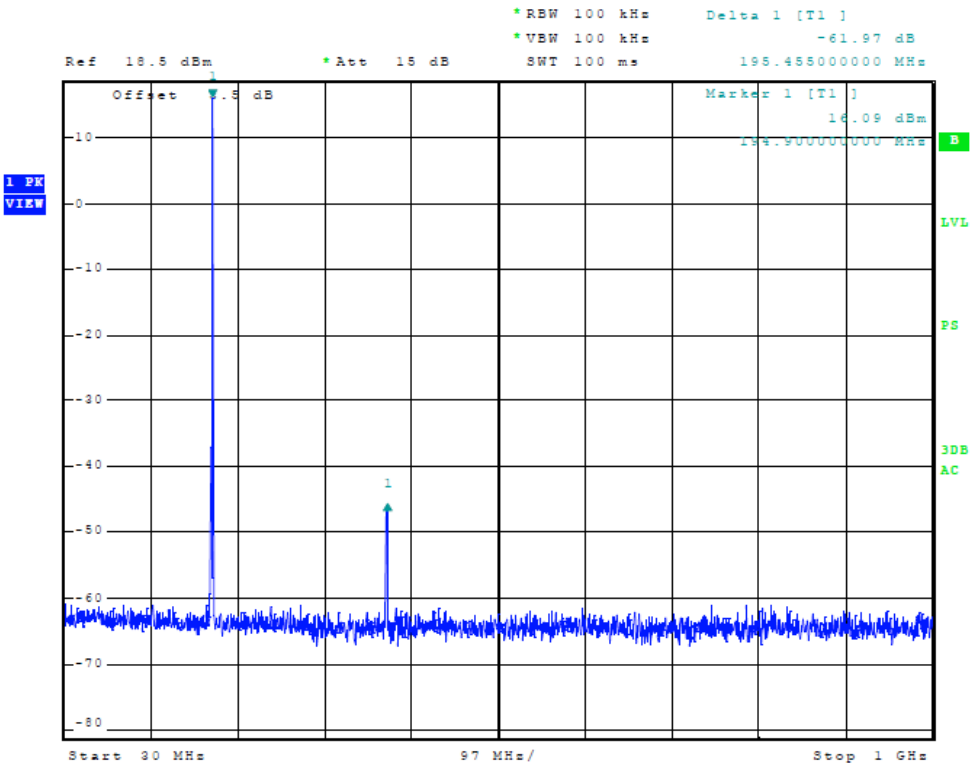


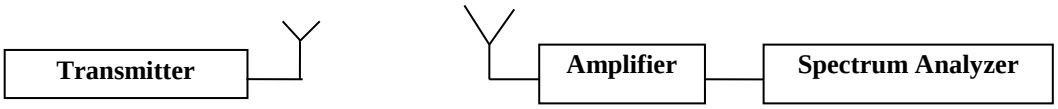
Figure Ten Emission Mask at Antenna Terminal Across frequency Band

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 each antenna option connected was placed on a turntable elevated as required 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 loop antenna was used for measuring emissions from 9 kHz to 30 MHz, Biconilog was used for frequencies of 30 MHz to 1000 MHz and pyramidal horn antennas used for frequencies above 1 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 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 (= 42.0 dBc).

Table 4 Field Strength of Spurious Radiation Results (Wire antenna)

Frequency of Emission	Amplitude of EUT Spurious emission		Signal level to substitution antenna required to reproduce		Emission level below carrier		47CFR Limit	RSS-210 Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical		
(MHz)	dBµV/m	dBµV/m	dBm	dBm	dBc	dBc	dBc	dBc
174.10	103.3	112.1	8.07	16.87	0	0	--	--
348.2	34.1	43.8	-61.1	-51.4	69.2	68.3	30.0	42.0
522.3	27.4	29.8	-67.8	-65.4	75.9	82.3	30.0	42.0
696.4	31.2	33.4	-64.0	-61.8	72.1	78.7	30.0	42.0
870.5	33.2	35.6	-62.0	-59.6	70.1	76.5	30.0	42.0
1044.6	37.8	37.8	-57.4	-57.4	65.5	74.3	30.0	42.0
1218.7	38.6	38.6	-56.6	-56.6	64.7	73.5	30.0	42.0
195.10	103.4	112.2	8.17	16.97	0	0	--	--
390.2	34.8	41.1	-60.4	-54.1	68.5	71.0	30.0	42.0
585.3	27.5	27.3	-67.7	-67.9	75.8	84.8	30.0	42.0
780.4	30.2	30.2	-65.0	-65.0	73.1	81.9	30.0	42.0
975.5	32.4	32.3	-62.8	-62.9	70.9	79.8	30.0	42.0
1170.6	36.8	36.9	-58.4	-58.3	66.5	75.2	30.0	42.0
1365.7	38.2	38.3	-57.0	-56.9	65.1	73.8	30.0	42.0
215.75	103.0	112.2	7.77	16.97	0	0	--	--
431.5	32.1	34.6	-63.1	-60.6	71.2	77.5	30.0	42.0
647.3	30.9	30.8	-64.3	-64.4	72.4	81.3	30.0	42.0
863.0	38.2	35.0	-57.0	-60.2	65.1	77.1	30.0	42.0
1078.8	38.0	38.0	-57.2	-57.2	65.3	74.1	30.0	42.0
1294.5	39.1	39.1	-56.1	-56.1	64.2	73.0	30.0	42.0
1510.3	40.2	40.2	-55.0	-55.0	63.1	71.9	30.0	42.0

The EUT demonstrated compliance with specifications of RSS-210 and 47CFR Paragraph 2.1046 and applicable paragraphs of Paragraph 74. There are no deviations to the specifications.

Table 5 Field Strength of Spurious Radiation Results (Whip antenna)

Frequency of Emission	Amplitude of EUT Spurious emission		Signal level to substitution antenna required to reproduce		Emission level below carrier		47CFR Limit	RSS-210 Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical		
(MHz)	dBµV/m	dBµV/m	dBm	dBm	dBc	dBc	dBc	dBc
174.10	103.9	112.1	8.67	16.87	1	0	--	--
348.2	26.5	42.6	-68.7	-52.6	76.8	69.5	30.0	42.0
522.3	27.5	27.4	-67.7	-67.8	75.8	84.7	30.0	42.0
696.4	31.2	31.2	-64.0	-64.0	72.1	80.9	30.0	42.0
870.5	35.3	33.9	-59.9	-61.3	68.0	78.2	30.0	42.0
1044.6	37.8	37.8	-57.4	-57.4	65.5	74.3	30.0	42.0
1218.7	38.6	38.6	-56.6	-56.6	64.7	73.5	30.0	42.0
195.10	102.8	112.2	7.57	16.97	-1	0	--	--
390.2	29.7	32.1	-65.5	-63.1	73.6	80.0	30.0	42.0
585.3	28.5	28.7	-66.7	-66.5	74.8	83.4	30.0	42.0
780.4	32.6	32.6	-62.6	-62.6	70.7	79.5	30.0	42.0
975.5	34.0	33.9	-61.2	-61.3	69.3	78.2	30.0	42.0
1170.6	38.4	38.4	-56.8	-56.8	64.9	73.7	30.0	42.0
1365.7	39.5	39.5	-55.7	-55.7	63.8	72.6	30.0	42.0
215.75	102.6	112.2	7.37	16.97	0	0	--	--
431.5	27.4	27.7	-67.8	-67.5	75.9	84.4	30.0	42.0
647.3	30.9	30.8	-64.3	-64.4	72.4	81.3	30.0	42.0
863.0	35.6	38.0	-59.6	-57.2	67.7	74.1	30.0	42.0
1078.8	37.6	37.9	-57.6	-57.3	65.7	74.2	30.0	42.0
1294.5	39.1	39.1	-56.1	-56.1	64.2	73.0	30.0	42.0
1510.3	40.2	40.2	-55.0	-55.0	63.1	71.9	30.0	42.0

The EUT demonstrated compliance with specifications of RSS-210 and 47CFR Paragraph 2.1046 and applicable paragraphs of Paragraph 74. There are no deviations to the specifications.

AC Line Conducted EMI Procedure 47CFR 15.107and RSS-GEN

The EUT was arranged in typical equipment configurations as offered by manufacturer. Testing was performed with the EUT placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the line-conducted emissions were the procedures of ANSI C63.4-2014. The AC adapter for the EUT was connected to the LISN for line-conducted emissions testing. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which demonstrated the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then data was recorded with maximum conducted emissions levels. Refer to figures eleven and twelve showing plots of the worst-case AC Line conducted emissions of the EUT powered with AC/DC Power Adapter.

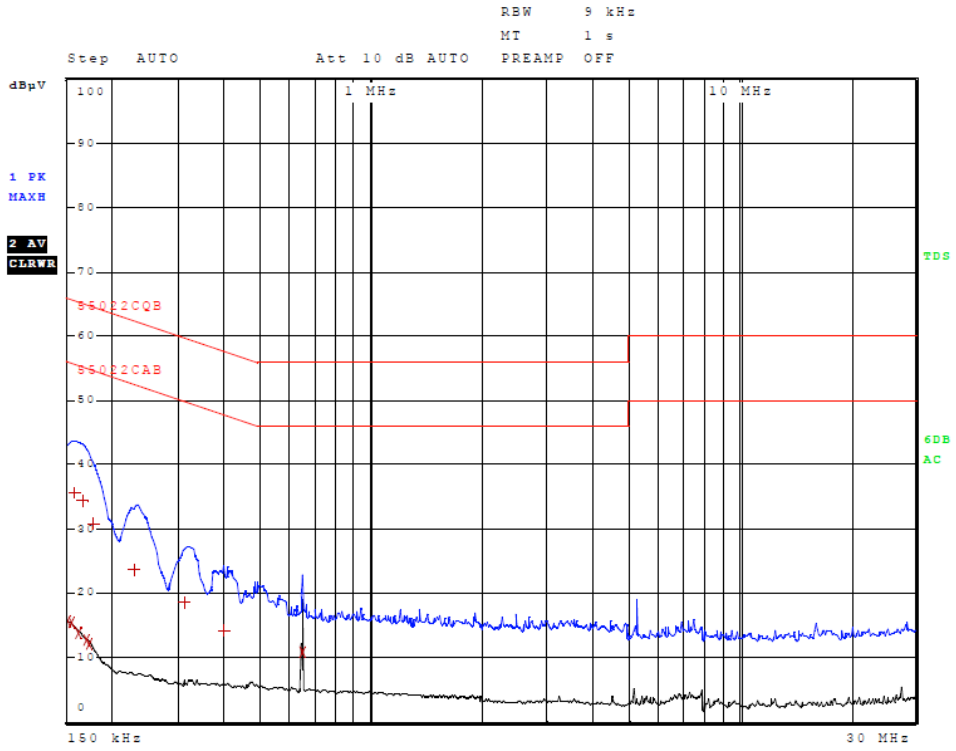


Figure Eleven AC Line Conducted emissions of EUT line 1

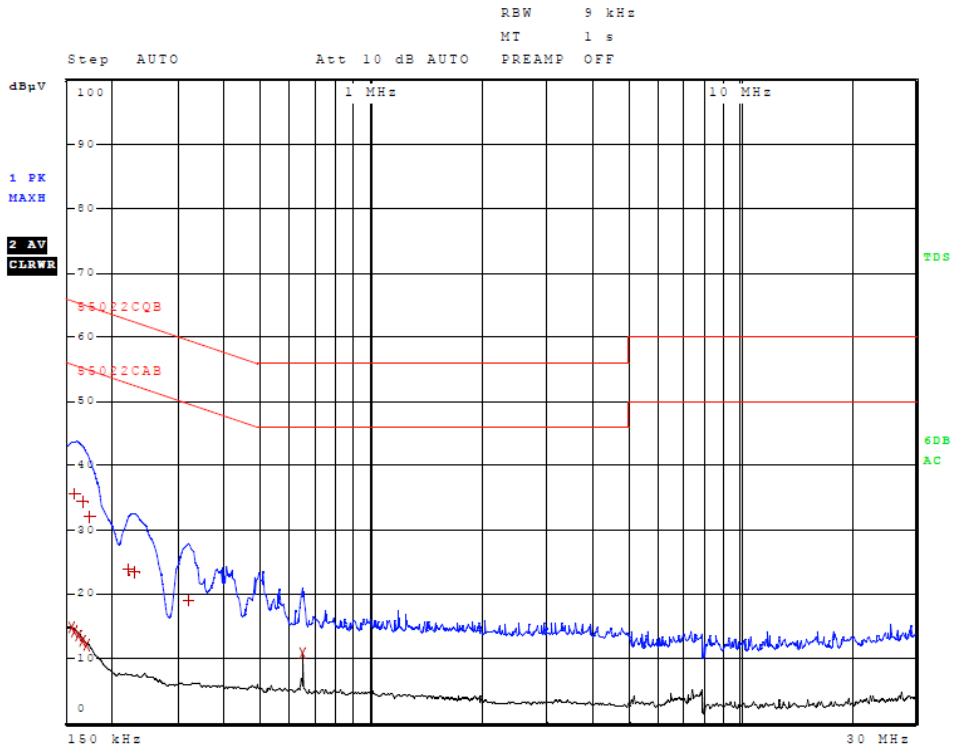


Figure Twelve AC Line Conducted emissions of EUT line 2

Table 6 AC Line Conducted Emissions Data L1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	150.000000000 kHz	15.71	Average	-40.29
2	154.000000000 kHz	15.37	Average	-40.41
1	158.000000000 kHz	35.62	Quasi Peak	-29.95
2	162.000000000 kHz	13.84	Average	-41.52
1	166.000000000 kHz	34.45	Quasi Peak	-30.71
2	170.000000000 kHz	12.70	Average	-42.27
2	174.000000000 kHz	12.01	Average	-42.76
1	178.000000000 kHz	30.81	Quasi Peak	-33.77
1	230.000000000 kHz	23.65	Quasi Peak	-38.80
1	314.000000000 kHz	18.50	Quasi Peak	-41.37
1	394.000000000 kHz	14.11	Quasi Peak	-43.87
2	646.000000000 kHz	10.73	Average	-35.27

Other emissions present had amplitudes at least 20 dB below the limit.

Table 7 AC Line Conducted Emissions Data L2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	14.79	Average	-40.99
1	158.000000000 kHz	35.55	Quasi Peak	-30.02
2	158.000000000 kHz	14.13	Average	-41.44
2	162.000000000 kHz	13.49	Average	-41.87
2	166.000000000 kHz	12.66	Average	-42.50
1	166.000000000 kHz	34.27	Quasi Peak	-30.89
2	170.000000000 kHz	12.02	Average	-42.94
1	174.000000000 kHz	32.07	Quasi Peak	-32.70
1	222.000000000 kHz	23.76	Quasi Peak	-38.98
1	230.000000000 kHz	23.45	Quasi Peak	-39.00
1	318.000000000 kHz	18.94	Quasi Peak	-40.81
2	646.000000000 kHz	10.87	Average	-35.13

Other emissions present had amplitudes at least 20 dB below the limit.

AC Line Conducted Emissions Results

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47CFR Part 15B, RSS-GEN Issue 4 and other applicable Class B emissions requirements. The IFBT4VHF worst-case configuration demonstrated a minimum margin of -29.9 dB below the FCC/CISPR Class B limit. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

Frequency Stability

Frequency Stability Measurements Required

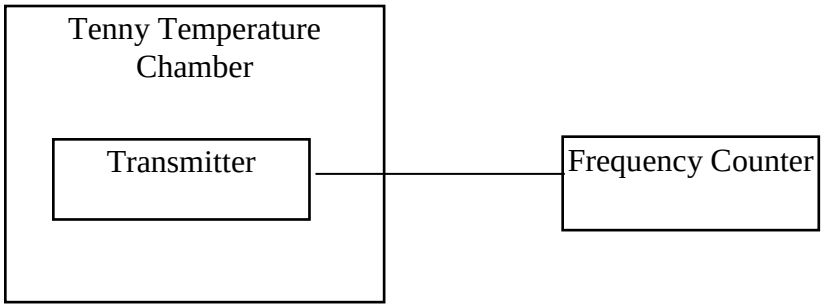
The frequency stability shall be measured with variations of ambient temperature from -30° to +50° centigrade. Measurements shall be made at the extremes of the temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components 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. An AC Power Supply was used to vary the AC voltage for the power input from 102.0 V_{ac} to 138.0 V^{ac}. 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-210.

Table 8 Frequency Stability Data and Results

Nominal frequency 195.09922 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)	470.0	290.0	420.0	610.0	290.0	-340.0	290.0	-660.0	720.0
PPM	2.4	1.5	2.2	3.1	1.5	-1.7	1.5	-3.4	3.7
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Limit 50 PPM (0.005%)									

Frequency 195.09922 MHz	Frequency Stability Vs Voltage Variation 120.0 volts nominal		
Voltage	102.0	120.0	138.0
Change (Hz)	0	0	0

Frequency 195.09922 MHz	Frequency Stability Vs Voltage Variation, 120.0Vac volts nominal Battery Endpoint Voltage ___ Vdc
Change(Hz)	N/A

The frequency tolerance of the transmitter shall be 0.005 percent (50 PPM) 47CFR, 74.861.

The EUT demonstrated compliance with specifications of RSS-210 and 47CFR 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

Measurement uncertainty calculations were made for the laboratory. Result of measurement uncertainty calculations are recorded below for AC line conducted and radiated emission measurements.

Measurement Uncertainty	$U_{(E)}$	$U_{(lab)}$
3 Meter Horizontal 30-200 MHz Measurements	2.08	4.16
3 Meter Vertical 30-200 MHz Measurements	2.16	4.33
3 Meter Vertical Measurements 200-1000 MHz	2.99	5.97
10 Meter Horizontal Measurements 30-200 MHz	2.07	4.15
10 Meter Vertical Measurements 30-200 MHz	2.06	4.13
10 Meter Horizontal Measurements 200-1000 MHz	2.32	4.64
10 Meter Vertical Measurements 200-1000 MHz	2.33	4.66
3 Meter Measurements 1-6 GHz	2.57	5.14
3 Meter Measurements 6-18 GHz	2.58	5.16
AC Line Conducted	1.72	3.43

Annex B Rogers Labs Test Equipment List

List of Test Equipment	Calibration Date	Due
Spectrum Analyzer: Rohde & Schwarz ESU40	5/15	5/16
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/15	5/16
Spectrum Analyzer: HP 8591EM	5/15	5/16
Antenna: EMCO Biconilog Model: 3143	5/15	5/16
Antenna: Sunol Biconilog Model: JB6	10/14	10/15
Antenna: EMCO Log Periodic Model: 3147	10/14	10/15
Antenna: Com Power Model: AH-118	10/14	10/16
Antenna: ETS-Lindgren Model: 3117	5/15	5/17
Antenna: Com Power Model: AH-840	5/15	5/17
Antenna: Antenna Research Biconical Model: BCD 235	10/14	10/15
Antenna: EMCO 6509	10/14	10/15
LISN: Compliance Design Model: FCC-LISN-50-25-2-10-CISPR16	6/15	5/16
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 μHy/50 ohm/0.1 μf	10/14	10/15
R.F. Preamp CPPA-102	10/14	10/15
Attenuator: HP Model: HP11509A	10/14	10/15
Attenuator: Mini Circuits Model: CAT-3	10/14	10/15
Attenuator: Mini Circuits Model: CAT-3	10/14	10/15
Cable: Belden RG-58 (L1)	10/14	10/15
Cable: Belden RG-58 (L2)	10/14	10/15
Cable: Belden 8268 (L3)	10/14	10/15
Cable: Time Microwave: 4M-750HF290-750	10/14	10/15
Cable: Time Microwave: 10M-750HF290-750	10/14	10/15
Frequency Counter: Leader LDC825	2/15	2/16
Oscilloscope Scope: Tektronix 2230	2/15	2/16
Wattmeter: Bird 43 with Load Bird 8085	2/15	2/16
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/15	2/16
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/15	2/16
R.F. Power Amp 65W Model: 470-A-1010	2/15	2/16
R.F. Power Amp 50W M185- 10-501	2/15	2/16
R.F. Power Amp A.R. Model: 10W 1010M7	2/15	2/16
R.F. Power Amp EIN Model: A301	2/15	2/16
LISN: Compliance Eng. Model 240/20	2/15	2/16
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/15	2/16
Antenna: EMCO Dipole Set 3121C	2/15	2/16
Antenna: C.D. B-101	2/15	2/16
Antenna: Solar 9229-1 & 9230-1	2/15	2/16
Audio Oscillator: H.P. 201CD	2/15	2/16
ELGAR Model: 1751	2/15	2/16
ELGAR Model: TG 704A-3D	2/15	2/16
ESD Test Set 2010i	2/15	2/16
Fast Transient Burst Generator Model: EFT/B-101	2/15	2/16
Field Intensity Meter: EFM-018	2/15	2/16

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.

Scot D Rogers

Scot D. Rogers

NVLAP Lab Code: 200087-0

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

April 16, 2015

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: April 16, 2015

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 Site Registration Letter

Industry Canada Industrie Canada

June 08, 2015

OUR FILE: 46405-3041
Authorization No: 010277847-001

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

Attention: Mr. Scot D. Rogers

Dear Sir:

The Bureau has received your application for the renewal of 3m 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 **(Site# 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;

- The company address code 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 C63.4-2009 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2009 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 C63.4-2009 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 three 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,

Bill Payn
For: Wireless Laboratory Manager
Certification and Engineering Bureau
3701 Carling Ave., Building 94
P.O. Box 11490, Station AH@
Ottawa, Ontario K2H 8S2
Email: certification.bureau@ic.gc.ca