NVLAP Lab Code 200087-0

Application For
Grant of Certification

FCC CFR47 Part 87 and Industry Canada RSS-141

For

Model: GMN-01078
IC M/N: GMN-01078
GPN: 011-03013-00

118-136.975 MHz

Aviation Communications Transceiver

FCC ID: IPH-0212800

IC: 1792A-0212800

For

Garmin International, Inc.

1200 East 151st Street

Olathe, KS 66062

FCC Site Registration: 90910, 315994

IC Test Site Registration: 3041A-1

Test Report Number 170102

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

Test Report For Application of Certification

For

Garmin International, Inc.

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

Mr. Doug Kealey
Regulatory and Environmental Affairs Manager

Model: GMN-01078
IC M/N: GMN-01078
GPN: 011-03013-00

Aviation Communications Transceiver

FCC ID: IPH-0212800
IC: 1792A-0212800
Frequency Range: 118-136.975 MHz

Test Date: January 2, 2017

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
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Revision History

Revision 1 Issued April 4, 2017

Forward

In accordance with the Federal Communications, Code of Federal Regulations dated October 31, 2016, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.915, 2.925, 2.926, 2.1031 through 2.1057, and Part 87, Subchapter D, Paragraphs 87.131 through 87.147, and Industry Canada RSS-141 Issue 2, June 2010 the following information is submitted for consideration on obtaining Grant of Certification.

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Requirements per CFR47 paragraphs 2.1031-2.1057 and RSS-141, Issue 2	Complies
Requirements per CFR47 paragraphs 87.131 and RSS-141 paragraph 5.1	Complies
Requirements per CFR47 paragraphs 87.133 and RSS-141 paragraph 5.1	Complies
Requirements per CFR47 paragraphs 87.135 and RSS-141 paragraph 5.1	Complies
Requirements per CFR47 paragraphs 87.139 and RSS-141 paragraph 5.2.2	Complies
Requirements per CFR47 paragraphs 87.141 and RSS-141 paragraph 5.1	Complies

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable paragraphs of Part 87, and RSS-141, Issue 2 the following is submitted for consideration in obtaining Grant of Certification. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.4-2014 and ANSI C63.26-2015.

Environmental Conditions

Ambient Temperature	19.6° C
Relative Humidity	36%
Atmospheric Pressure	1022.6 mb

Application for Certification

(1) The full name and mailing address of the manufacturer of the device and the applicant for certification.
Garmin International, Inc. 1200 East 151st Street Olathe, KS 66062

(2) FCC identifier. FCC I.D.: IPH-0212800 IC: 1792A-0212800

(3) A copy of the installation and operating instructions to be furnished the user. A draft copy of the instructions may be submitted if the actual document is not available. The actual document shall be furnished to the FCC when it becomes available.

Refer to exhibit for Draft Instruction Manual.

(4) Type or types of emission. 6k00A3E (25 kHz), 13K0A2D, 14K0G1D (5K60A3E for 8.33 K-kHz operation)

(5) Frequency range. 118-136.975 MHz (25 kHz channel operation), (118-136.992, 8.33 kHz channels)

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

20 W nominal, 43 dBm

(7) Maximum power rating as defined in the applicable part(s) of the rules.

Maximum allowable power output of 55 Watts as defined per CFR47 paragraph 87.131 and RSS-141 paragraph 5.1.

(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.

Power delivered into final amplifier 36.0 volts @ 2.5 amps (90 watts)

(9) Tune-up procedure over the power range, or at specific operating power levels.

Refer to Exhibit for Transceiver Alignment Procedure.

(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 Exhibit for Circuit information and theory of operation.

(11) A photograph or drawing of the equipment identification plate or label showing the information to be placed thereon.

Refer to Exhibit for Photograph or Drawing.

(12) Photographs (8″ × 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 Exhibit for Drawings of Components Layout and Chassis Drawings.

(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.

Detail Description of Digital Modulation: VDL Mode A (ACARS) – VDL Mode A modulation (ACARS) uses minimum shift keying (MSK) with 1200 and 2400 Hz tones to AM Modulate the transmitter. The data rate for ACARS is 2400 bps. VDL Mode 2 – VDL Mode 2 modulation is a differentially encoded eight phase shift keying (D8PSK) modulations providing a 31.5 kbps bit rate.

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

Data is contained in this application

(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 §2.1060 of this part.

Does not apply to this device or application.

(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 meet the emission limitations of §73.44.

Does not apply to this device or application.

(17) Applications for certification required by §25.129 of this chapter shall include any additional equipment test data required by that section.

Does not apply to this device or application.

(18) An application for certification of a software defined radio must include the information required by §2.944.

Does not apply to this device or 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.

Does not apply to this device or application.

(20) Before 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) may be marketed or sold, the manufacturer thereof shall have a Compliance Assessment Program Supplier's Declaration of Conformity and Summary Test Report or, alternatively, a document detailing how the manufacturer determined that its equipment complies with §90.548 of this chapter and that the equipment is interoperable across vendors. Submission of a 700 MHz narrowband radio for certification will constitute a representation by the manufacturer that the radio will be shown, by testing, to be interoperable across vendors before it is marketed or sold.

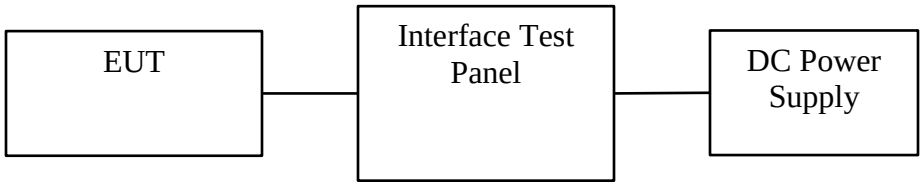
Does not apply to this device or application.

(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.

Data is contained in this application or application exhibits.

System Description

The GMN-01078 is an aeronautical navigational/communications transceiver. The authorized transmitter operational frequency band is 118.000 to 136.975 MHz (25 kHz mode). The device is marketed as Aircraft Remote Mounted Integrated Avionics Unit. The design includes an Aviation-Band VHF Transceiver with channel operational capability for 25 kHz or 8.33 kHz Channel Spacing. The design also provides VHF Data Link (VDL) in 2 modes (VDL Mode 1 (ACARS) and VDL Mode 2. The VDL operation allows for sending information between the aircraft and ground stations. In addition to the authorized frequency band and operational modes, the design provides for VHF operation in other frequency bands and services. This report documents operation for this application and authorization only as provided for in 47CFR 87.173. The additional operational capability to transmit in the 138-144 MHz, 148-149.9 MHz, or 150.5-150.8 MHz bands as well as frequency bands presented in 47CFR 87.173 are presented in 47CFR 87.147(f).



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 testing 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 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	5/16	5/17
☒ Cable	Time Microwave	750HF290-750 (L10M)	9kHz-40 GHz	10/16	10/17
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16	10/17
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16	10/17
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16	10/17
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/16	10/17
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/16	5/18
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/15	10/17
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/16	5/18
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16	10/17
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16	10/17
☐ Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/16	5/17
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/16	5/17
☐ Analyzer	HP	8562A (3051A05950)	9kHz-110GHz	5/16	5/17
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/16	5/17
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/16	5/17
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16	10/17
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16	10/17
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16	10/17

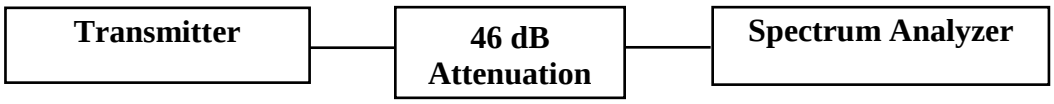
Transmitter Power Output

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, except as noted below:

If the power output is adjustable, measurements shall be made for the highest and lowest power levels. Output transmitter power is not user selectable.

Test Arrangement



The radio frequency power output was measured at the antenna terminal by placing 46-dB attenuation in the antenna line and observing the emission with the spectrum analyzer. The spectrum analyzer and attenuation offered an impedance of 50Ω to match the impedance of the standard antenna. A Rohde & Schwarz ESU40 Spectrum Analyzer was used to measure the radio frequency power at the antenna port. Data was taken in dBm and converted to watts as shown in the following Table. Refer to Figures 1 through 4 showing plots of output power of the transmitter across the frequency band. Data was taken per CFR47 Paragraph 2.1046(a) and applicable paragraphs of Part 87 and RSS-141.

P_{dBm} = power in dB above 1 milliwatt

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

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

Milliwatts $= 10^{(46.09/10)}$

= 40,644 mW

= 40.6 Watts Peak power

Table 1 Transmitter Power Results

Frequency	Input Power	P_{dBm}	P_{mw}	P_w
VHF Communications				
118.000	28 Vdc	42.78	18976	18.98
127.000	28 Vdc	42.90	19499	19.50
136.975	28 Vdc	43.35	21135	21.14
VHF (VDL Mode 1, ACARS)				
118.000	28 Vdc	43.03	20090	20.09
127.000	28 Vdc	42.79	19010	19.01
136.975	28 Vdc	43.65	23174	23.17
VHF (VDL Mode 2)				
118.000	28 Vdc	42.81	19099	19.10
127.000	28 Vdc	43.76	23768	23.77
136.975	28 Vdc	43.35	21627	21.63

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.131 and RSS-141 paragraph 5.1. There are no deviations to the specifications.

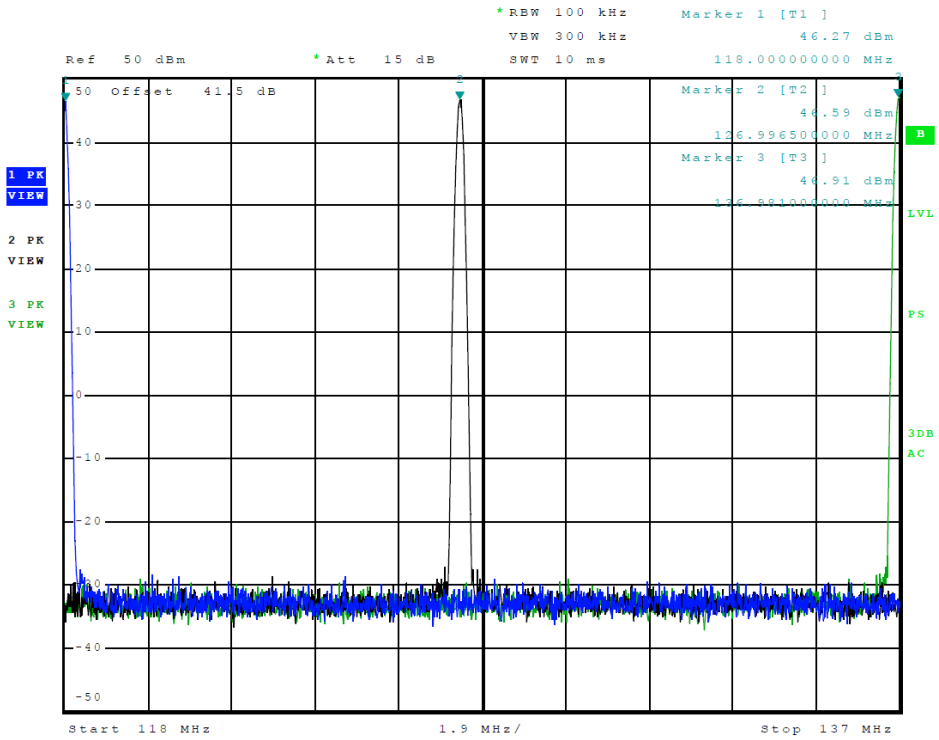


Figure 1 Power Output Across Frequency Band 118-136.750 MHz (25 kHz mode)

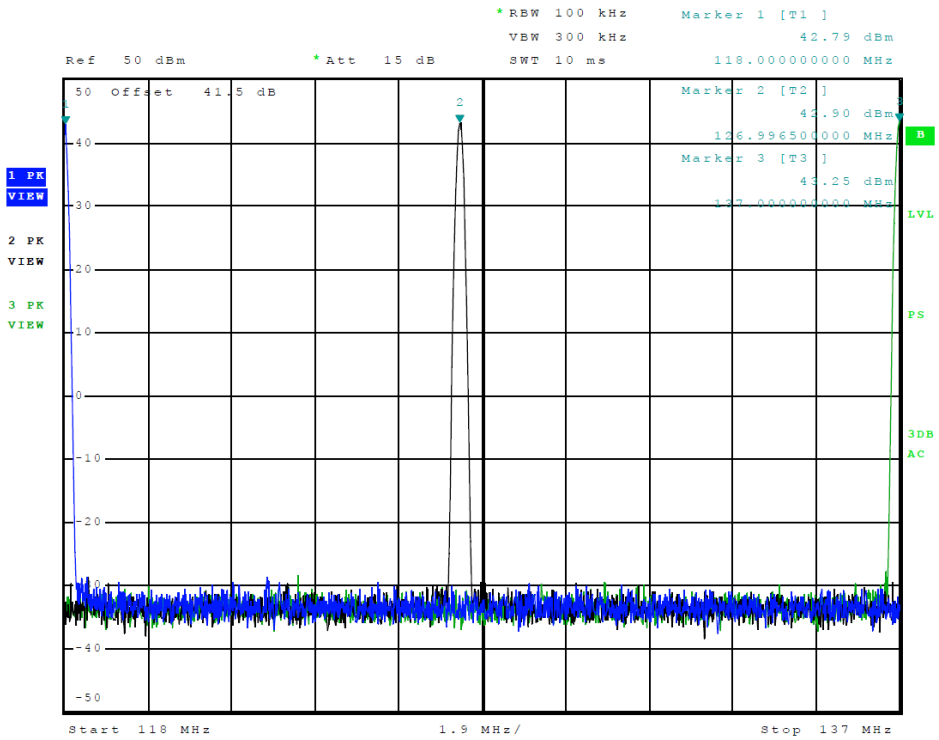


Figure 2 Power Output Across Frequency Band 118-136.991 MHz (8.33 kHz mode)

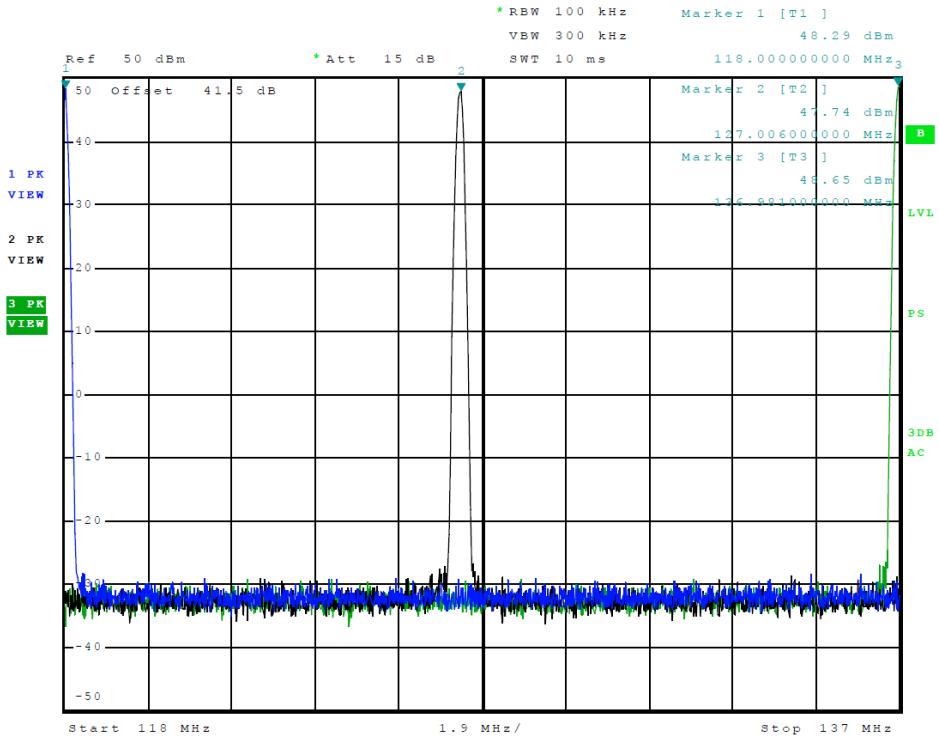


Figure 3 Power Output Across Frequency Band 118-136.750 MHz (ACARS mode)

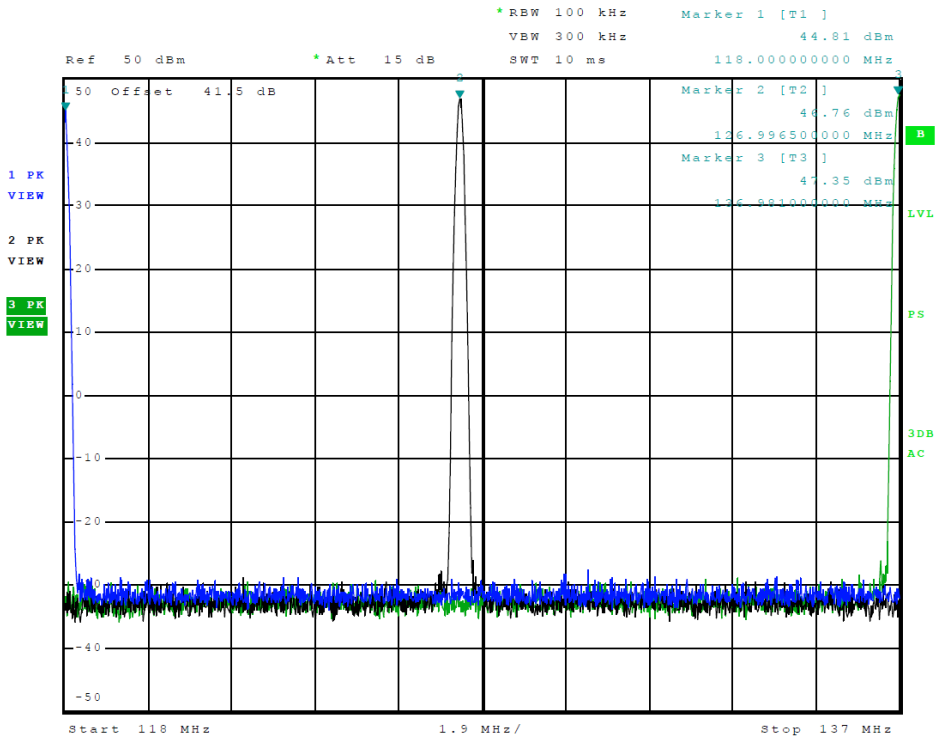


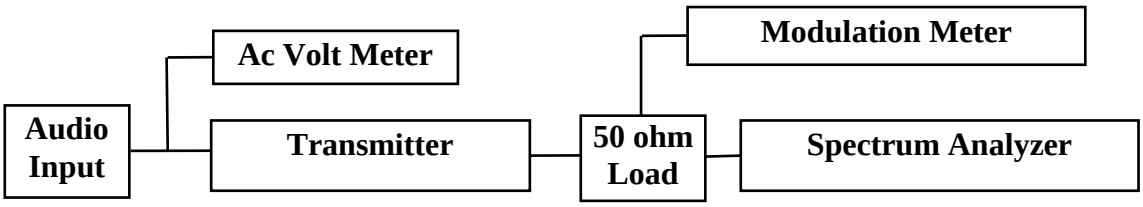
Figure 4 Power Output Across Frequency Band 118-136.750 MHz (VDL mode)

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 licensed, shall be submitted. The radio frequency output was coupled to a Spectrum Analyzer and a modulation meter. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its various modes. The modulation meter was used to measure the percent modulation.

Test Arrangement



Modulation Characteristic Results

Figure 5 shows the modulation characteristics of six frequencies while the input voltage was varied. The frequency was held constant and the percent modulation read from the modulation meter.

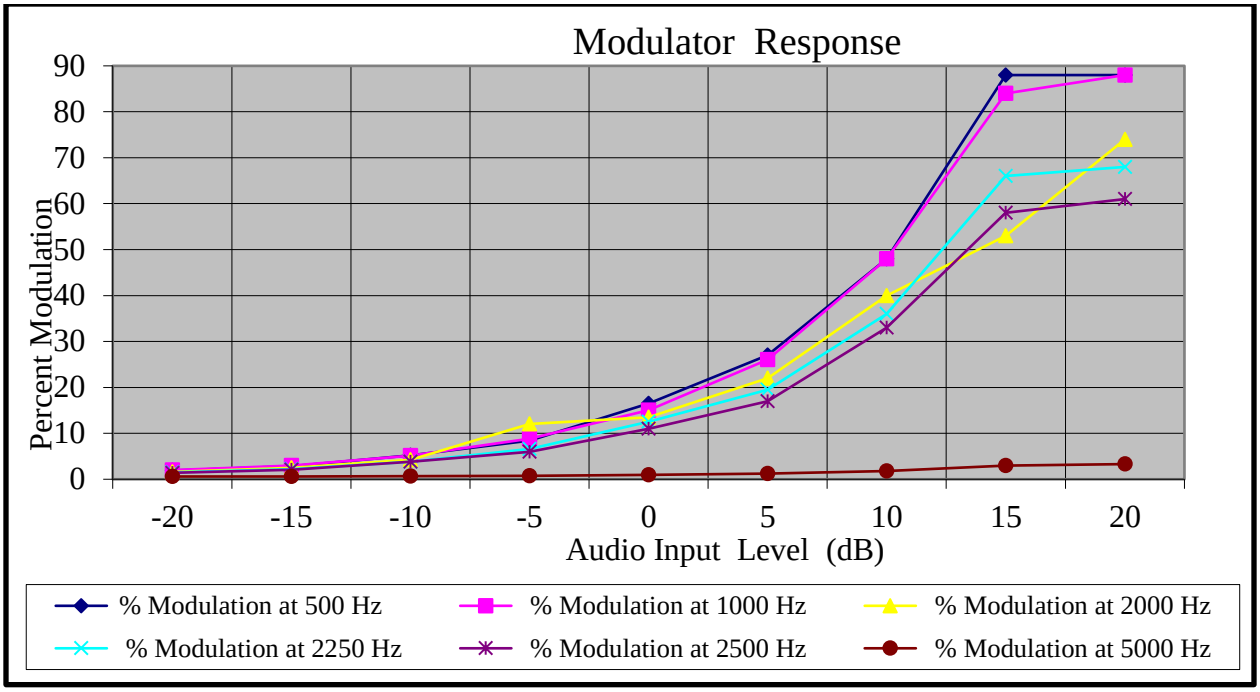


Figure 5 Modulation Characteristics

Figure 6 displays the graph made showing the audio frequency response of the modulator and figure 7 presents the frequency response of the low pass filter. The frequency generator was set to 1 kHz frequency 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 output voltage level was adjusted to maintain the 50% modulation. The output level required for 50% modulation then recorded. This level was normalized to the level required for 50% modulation at 1000 Hz.

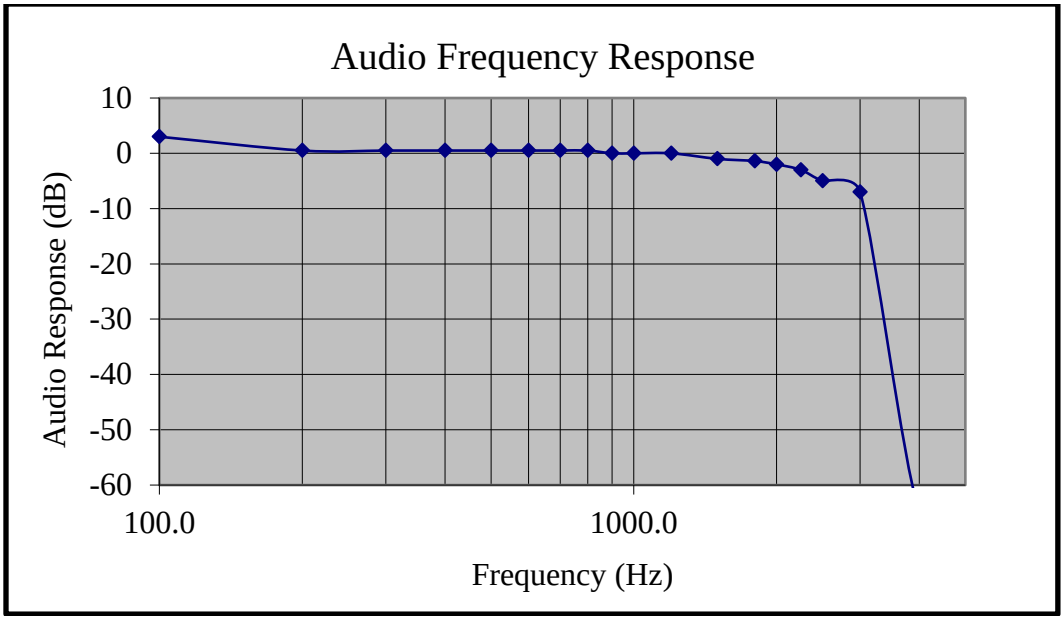


Figure 6 Audio Frequency Response / Modulation Characteristics

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

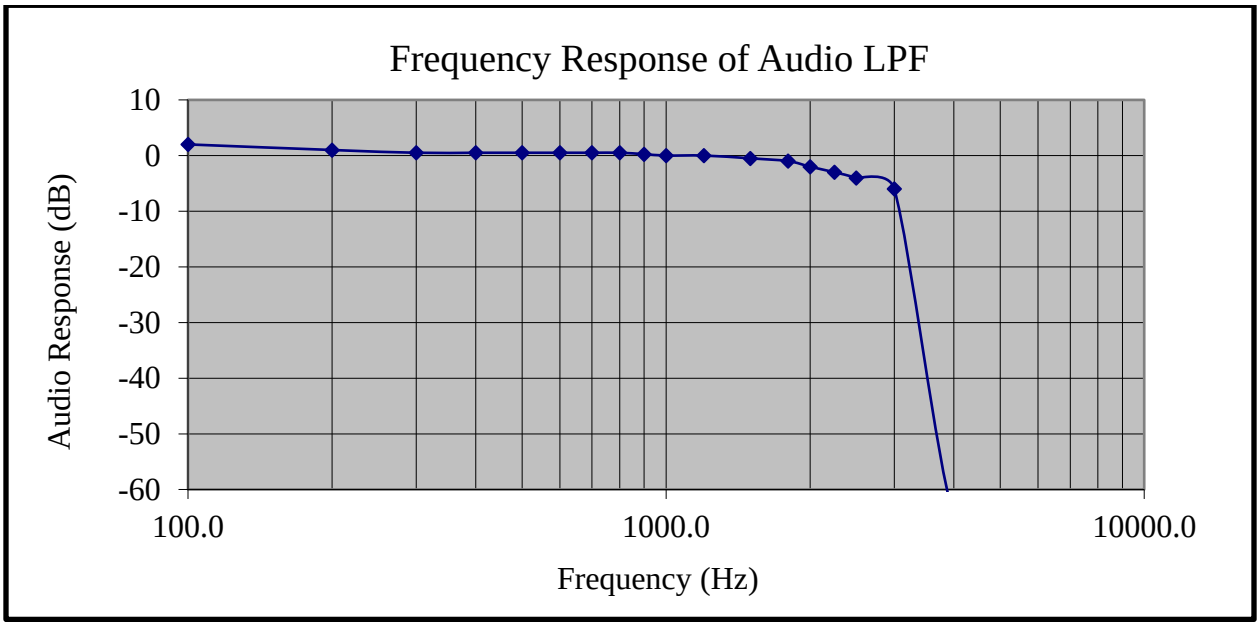


Figure 7 Frequency Response of Audio Low Pass Filter

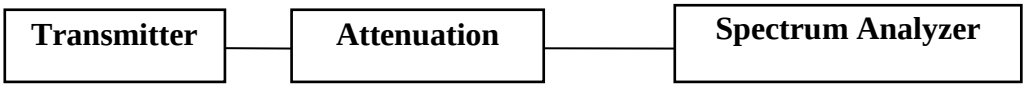
The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.141 and RSS-141. There are no deviations to the specifications.

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.

Test Arrangement



A Rohde & Schwarz ESU 40 spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in normal modes. Characteristics for audio communications were obtained with the EUT modulated by a frequency of 2500 Hz at a level 16 dB above 50% modulation. Other modulation schemes were measured using appropriate input signals as defined by other standards. The power ratio in dB representing 99% of the total mean power was recorded from the spectrum analyzer measurements. Refer to figures 8 through 11 displaying plots of 99% power occupied bandwidth measurements.

Table 2 Occupied Bandwidth Results

Frequency (MHz)	Occupied bandwidth (kHz)
118.000 (25 kHz mode)	5.400
127.000 (25 kHz mode)	5.400
136.975 (25 kHz mode)	5.400
118.000 (8.33 kHz mode)	5.440
127.000 (8.33 kHz mode)	5.440
136.975 (8.33 kHz mode)	5.440
127.000 (ACARS)	6.040
127.000 (VDL)	12.120

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.135 and RSS-141 paragraph 5.1. There are no deviations to the specifications.

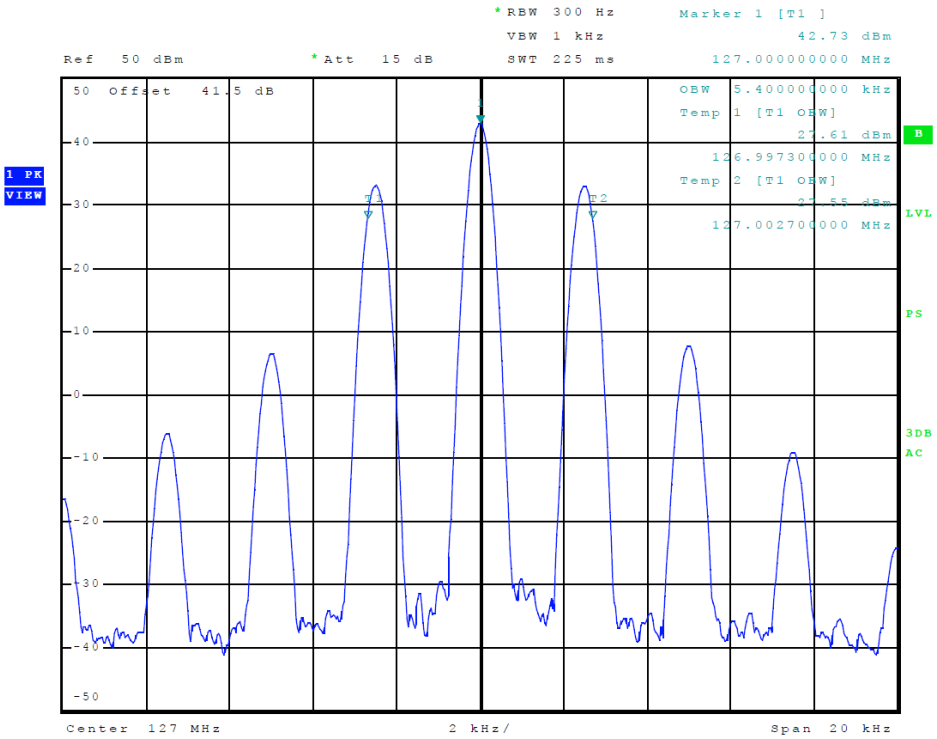


Figure 8 Occupied Band Width (25 kHz channels 118.000-136.975 MHz)

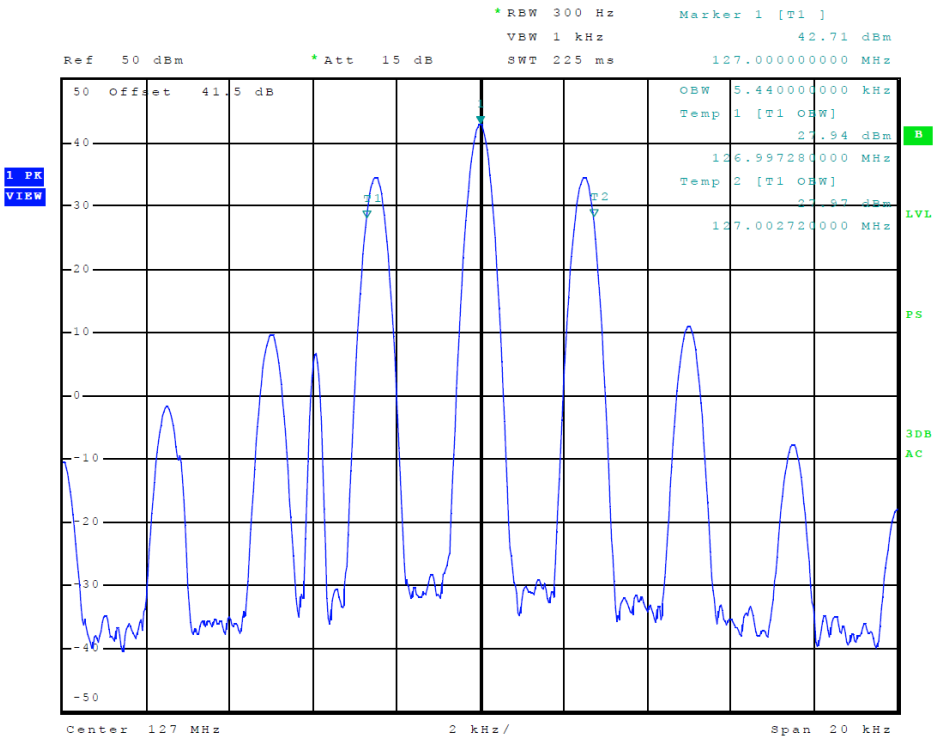


Figure 9 Occupied Band Width (8.33 kHz channels 118.000-136.991 MHz)

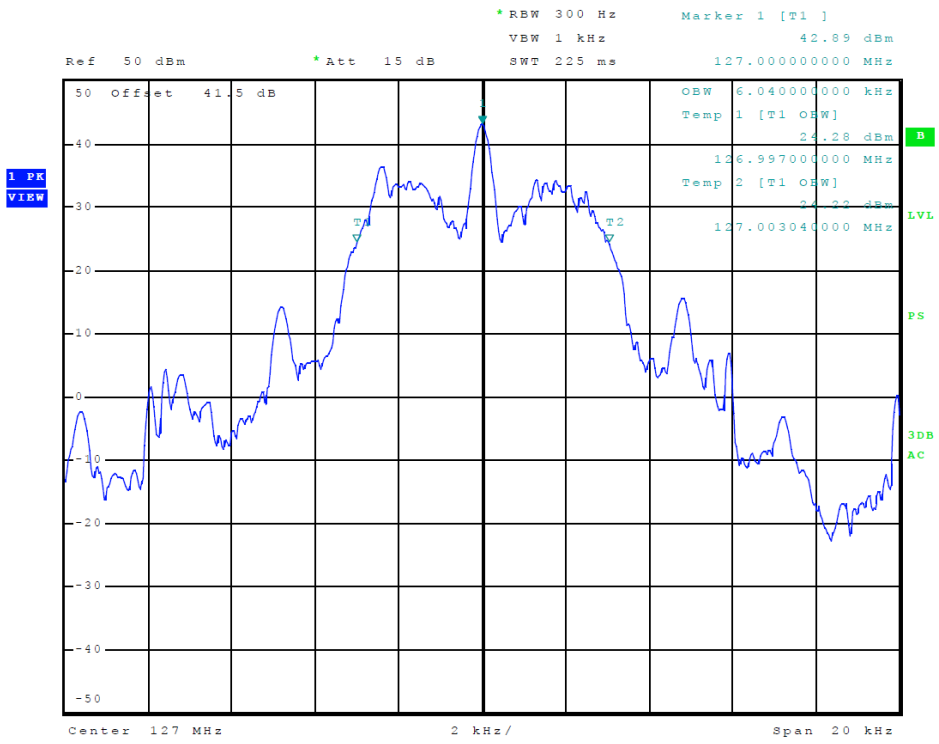


Figure 10 Occupied Band Width (ACARS mode, 118.000-136.975 MHz)

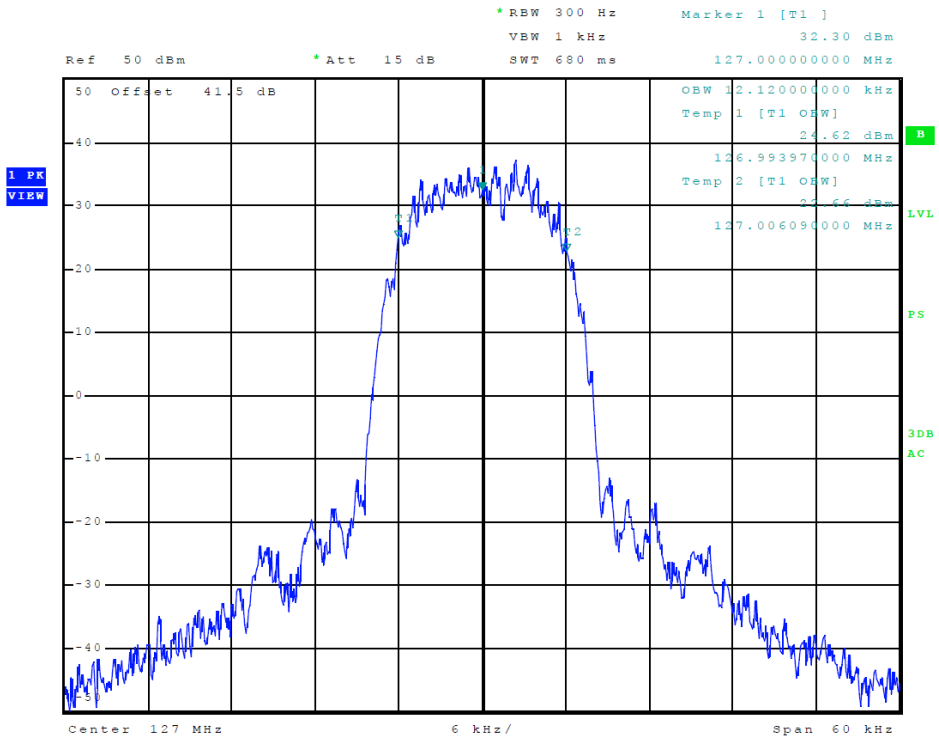


Figure 11 Occupied Band Width (VDL mode, 118.000-136.975 MHz)

Spurious Emissions at Antenna Terminals

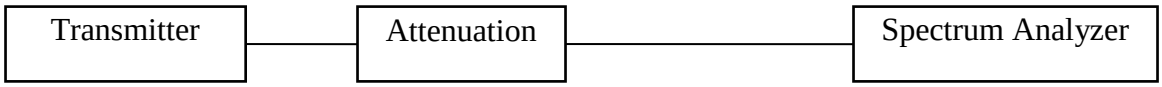
Measurements Required

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. Refer to figure 12 for plot of spurious emissions at antenna port and figure 13 for plot of emission mask. Refer to figures 14 and 15 for plots of adjacent channel power at the antenna port. All spurious emissions must be attenuated at least 43 +10log (Po) below the fundamental emission power level. The following equations represent the calculated attenuation offset level for the equipment operating with rated output power of 20 Watts.

Limit for 40.64 Watts transmitter

Limit (dBc) = 43 + 10 Log (Po)
= 43 + 10 Log (20)
= 56 dBc

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 1,500 MHz was observed and plot produced of the frequency spectrum displayed on the test equipment. Refer to figures 12 and 13 representing compliance of the antenna spurious emissions and emissions mask of the GMN-01078. Data was taken per CFR47 2.1051, 2.1057, and applicable paragraphs of Part 87.139, and RSS-141. There are no deviations to the specifications.

Table 3 Spurious Emissions at Antenna Terminal Results (Worst-case)

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
118.000	236.0	-20.22	-63.0
	354.0	-26.17	-69.0
	472.0	-72.39	-115.2
	590.0	-50.71	-93.5
	708.0	-70.75	-113.5
	826.0	-65.09	-107.9
127.000	254.0	-21.54	-64.4
	381.0	-27.62	-70.5
	508.0	-72.30	-115.2
	635.0	-52.80	-95.7
	762.0	-75.78	-118.7
	889.0	-75.19	-118.1
136.975	274.0	-27.62	-70.9
	410.9	-25.44	-68.7
	547.9	-66.50	-109.8
	684.9	-54.40	-97.7
	821.9	-74.16	-117.4
	958.8	-77.21	-120.5

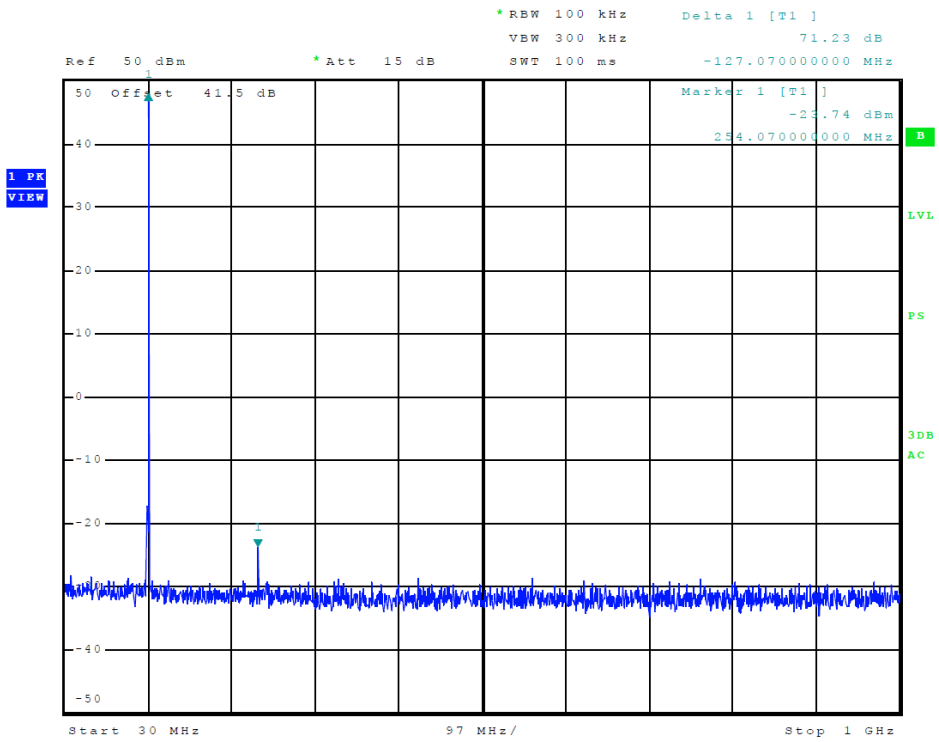


Figure 12 Spurious Emissions at Antenna Terminal 118-136.975 MHz (25 kHz)

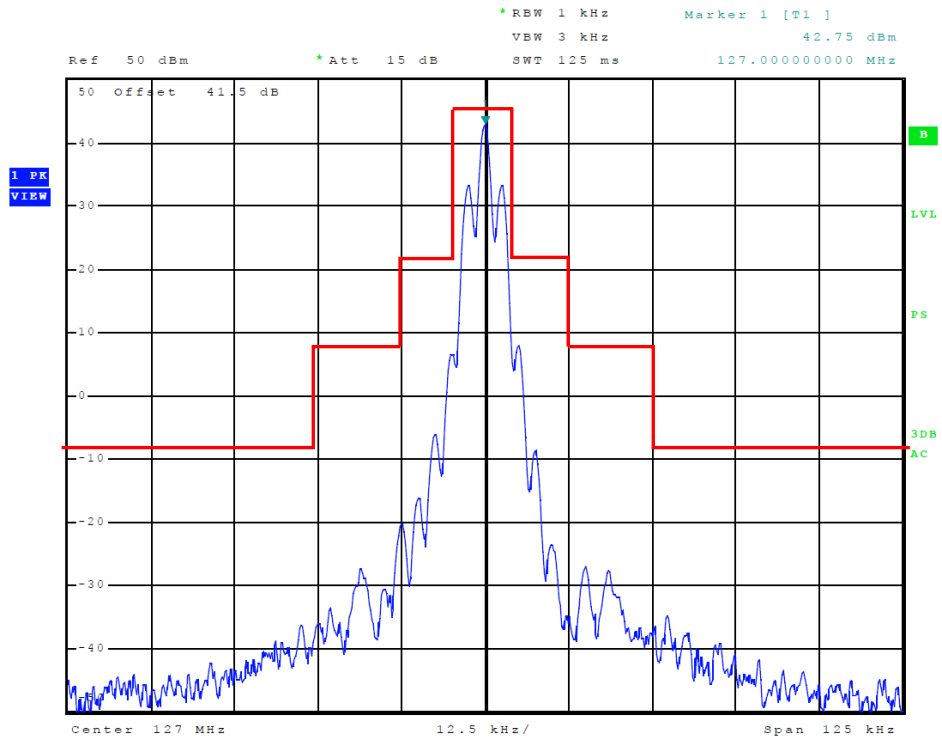


Figure 13 Emission Mask at Antenna Terminal 118-136.975 MHz (25 kHz)

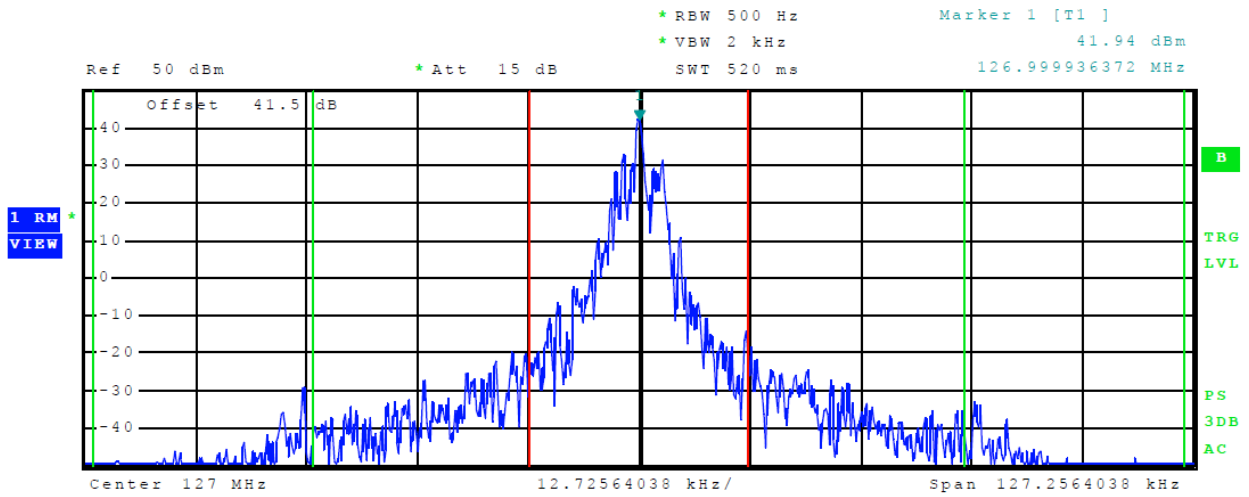


Figure 14 Adjacent Channel Power (ACARS)

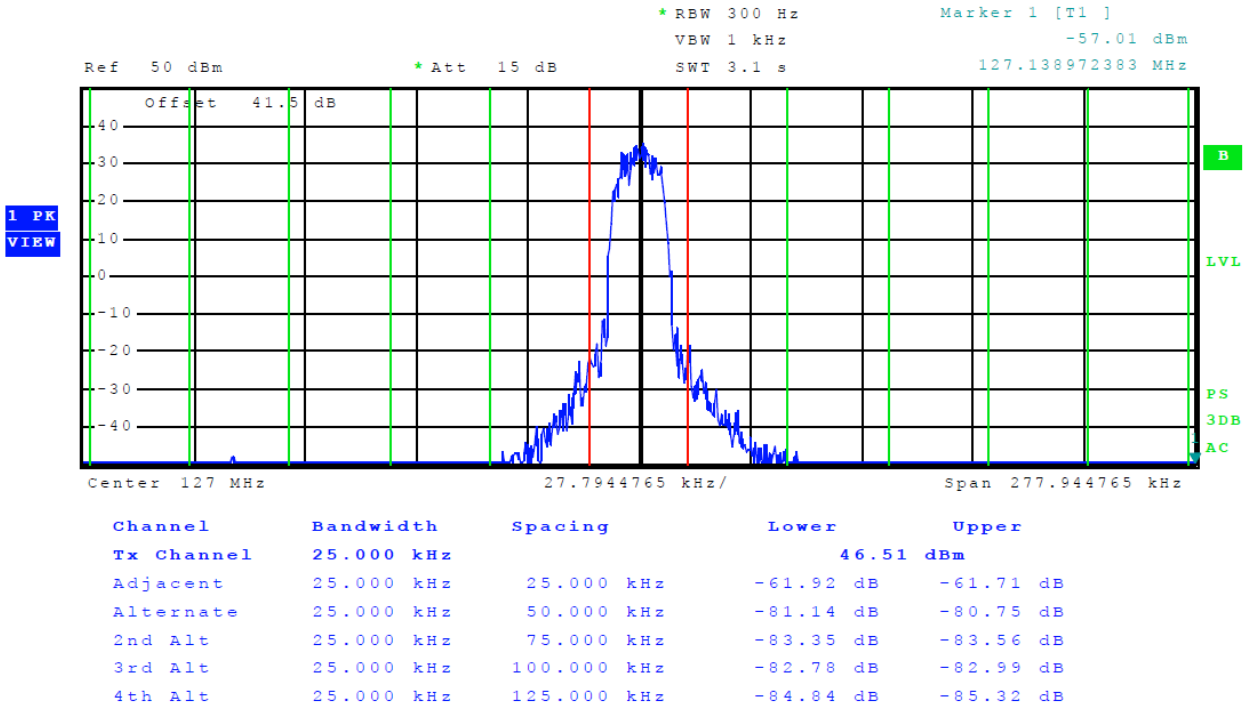


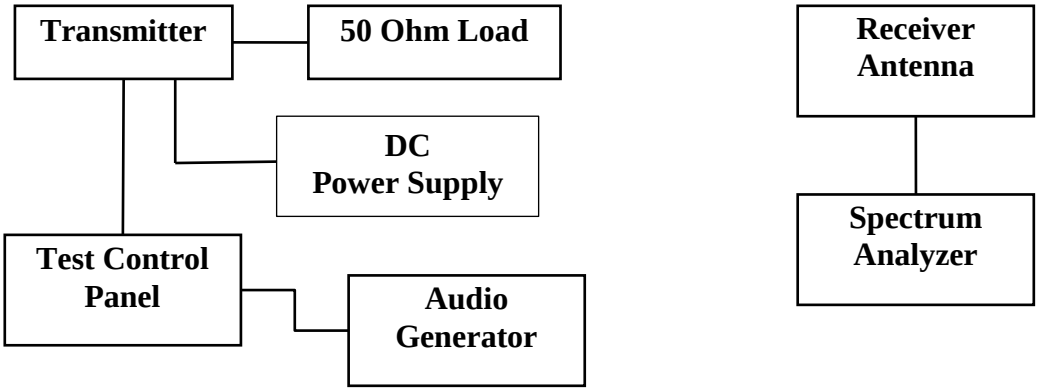
Figure 15 Adjacent Channel Power (VDL)

Field Strength of Spurious Radiation (Unwanted Emissions)

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. This equipment is typically remote mounted with interface cabling connecting the display control unit to the cabinet. The test sample offered for testing required interfacing with additional test control panels offering operation and communications with all functions of transmitter.

Test Arrangement



The test setup was assembled in a screen room for preliminary screening. The transmitter was placed on a supporting platform 0.8 meters above the ground plane and at a distance of 1 meter from the receive antenna, plots were taken of the general radiated emissions. A final radiated emission testing was performed with the transmitter placed on a supporting turntable platform 0.8 meters above the ground plane and at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. The EUT was operational and radiating into a 50Ω load. The receiving antenna was raised and lowered from 1m to 4m in height to obtain the maximum reading of spurious radiation from the EUT, cabinet, and interface cabling. 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, interface cabling, and test setup. The amplitude of each spurious emission was

maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. The frequency spectrum from 30 MHz to 1,500 MHz was investigated during radiated emissions testing. A Biconilog antenna was used for frequency measurements of 30 to 1000 MHz. A double-ridge horn antenna was used for frequencies of 1000 MHz to 2,000 MHz. Emission levels were measured and recorded from the spectrum analyzer in dBµV. Data was taken at the Rogers Labs, Inc. 3 meters open area test site (OATS). The transmitter was then removed and replaced with a substitution antenna, amplification as required, 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. A description of the test facility is on file with the FCC and Industry Canada (refer to annex for site registration letters).

All spurious emissions must be attenuated at least 43 +10log (Po) below the fundamental emission power level. The following equations represent the calculated attenuation levels for the equipment.

Limit 20 Watts = 43 + 10 Log (Po)
= 43 + 10 Log (20)
= 56.0 dBc

Requirement 43 dB less the limit 56 dBc equates to an absolute level of -13 dBm

Table 4 General Spurious Radiated Emission Results

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
65.9	27.4	39.3	-67.83	-65.03	-113.83	-111.03	-13
71.1	29.5	37.2	-65.73	-62.83	-111.73	-108.83	-13
166.3	24.1	29.8	-71.13	-70.73	-117.13	-116.73	-13
166.5	25.0	29.9	-70.23	-70.73	-116.23	-116.73	-13
181.3	29.5	36.1	-65.73	-64.43	-111.73	-110.43	-13

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequencies below 1000 MHz. Peak and Average amplitude emissions are recorded above for frequencies above 1000 MHz.

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.139, and RSS-141 paragraph 5. There are no deviations to the specifications. There are no deviations or exceptions to the specifications.

Table 5 Spurious Radiated Emission Results for 118.000 MHz Operation

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
236.00	19.4	24.9	-75.83	-70.33	-121.83	-116.33	-13
354.00	21.0	18.1	-74.23	-77.13	-120.23	-123.13	-13
472.00	16.5	17.2	-78.73	-78.03	-124.73	-124.03	-13
590.00	19.8	23.2	-75.43	-72.03	-121.43	-118.03	-13
708.00	23.4	24.0	-71.83	-71.23	-117.83	-117.23	-13
826.00	20.6	17.3	-74.63	-77.93	-120.63	-123.93	-13

Table 6 Spurious Radiated Emission Results for 127.000 MHz Operation

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
254.00	19.7	24.1	-75.53	-71.13	-121.53	-117.13	-13
381.00	19.3	18.6	-75.93	-76.63	-121.93	-122.63	-13
508.00	20.1	19.0	-75.13	-76.23	-121.13	-122.23	-13
635.00	19.7	23.4	-75.53	-71.83	-121.53	-117.83	-13
762.00	19.6	21.7	-75.63	-73.53	-121.63	-119.53	-13
889.00	22.1	23.3	-73.13	-71.93	-119.13	-117.93	-13

Table 7 Spurious Radiated Emission Results for 136.975 MHz Operation

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBm)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
273.95	22.7	18.8	-72.53	-76.43	-118.53	-122.43	-13
410.93	15.8	15.9	-79.43	-79.33	-125.43	-125.33	-13
547.90	15.8	16.5	-79.43	-78.73	-125.43	-124.73	-13
684.88	21.4	19.9	-73.83	-75.33	-119.83	-121.33	-13
821.85	21.8	20.3	-73.43	-74.93	-119.43	-120.93	-13
958.83	29.3	25.5	-65.93	-69.73	-111.93	-115.73	-13

Frequency Stability

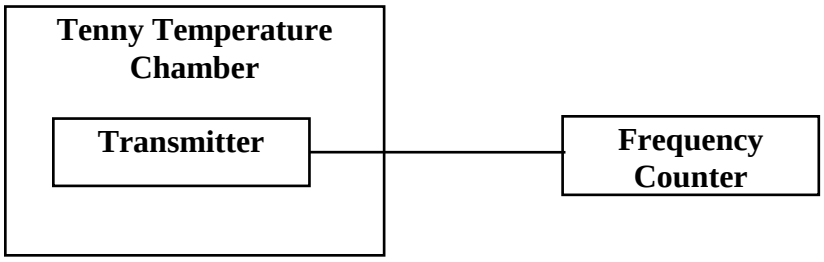
Measurements Required

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 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.

(2) 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.

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 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. The frequency was measured and the variation in parts per million calculated. Data was taken per CFR47 Paragraphs 2.1055 and applicable paragraphs of part 87.133 and RSS-141.

Table 8 Frequency Stability vs. Temperature Results

Frequency 127.000 MHz)	Frequency Stability Vs. Temperature Ambient Frequency (127.000000)								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	3	23	30	21	8	-4	-5	-2	7
PPM	0.024	0.181	0.236	0.165	0.063	-0.031	-0.039	-0.016	0.055
%	0.000%	0.002%	0.002%	0.002%	0.001%	0.000%	0.000%	0.000%	0.001%
Limit (PPM)	5	5	5	5	5	5	5	5	5

Table 9 Frequency Stability vs. Input Power Supply Voltage Results

Frequency (127.000 MHz)	Frequency Stability Vs. Voltage Variation 27.5 volts nominal; Results in Hz change		
Voltage V_{dc}	23.375	27.5	31.625
Change (Hz)	5	6	4
PPM	0.039	0.047	0.031
%	0.0004%	0.0005%	0.0003%
Limit (PPM)	5.0	5.0	5.0

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 87.133(d) and RSS-141 paragraph 5.1. There are no deviations or exceptions to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D FCC Test Site Registration Letter
- Annex E Industry Canada Test Site Registration Letter

Annex A Measurement Uncertainty Calculations

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	5/16	5/17
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/16	5/17
Spectrum Analyzer: HP 8591EM	5/16	5/17
Antenna: EMCO Biconilog Model: 3143	5/16	5/17
Antenna: Sunol Biconilog Model: JB6	10/16	10/17
Antenna: EMCO Log Periodic Model: 3147	10/16	10/17
Antenna: Com Power Model: AH-118	10/16	10/17
Antenna: Com Power Model: AH-840	5/16	5/18
Antenna: Antenna Research Biconical Model: BCD 235	10/16	10/17
Antenna: Com Power Model: AL-130	10/16	10/17
Antenna: EMCO 6509	10/16	10/17
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohm/0.1 µf	10/16	10/17
R.F. Preamp CPPA-102	10/16	10/17
Attenuator: HP Model: HP11509A	10/16	10/17
Attenuator: Mini Circuits Model: CAT-3	10/16	10/17
Attenuator: Mini Circuits Model: CAT-3	10/16	10/17
Cable: Belden RG-58 (L1)	10/16	10/17
Cable: Belden RG-58 (L2)	10/16	10/17
Cable: Belden 8268 (L3)	10/16	10/17
Cable: Time Microwave: 4M-750HF290-750	10/16	10/17
Cable: Time Microwave: 10M-750HF290-750	10/16	10/17
Frequency Counter: Leader LDC825	2/16	2/17
Oscilloscope Scope: Tektronix 2230	2/16	2/17
Wattmeter: Bird 43 with Load Bird 8085	2/16	2/17
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/16	2/17
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/16	2/17
R.F. Power Amp 65W Model: 470-A-1010	2/16	2/17
R.F. Power Amp 50W M185- 10-501	2/16	2/17
R.F. Power Amp A.R. Model: 10W 1010M7	2/16	2/17
R.F. Power Amp EIN Model: A301	2/16	2/17
LISN: Compliance Eng. Model 240/20	2/16	2/17
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/16	2/17
Antenna: EMCO Dipole Set 3121C	2/16	2/17
Antenna: C.D. B-101	2/16	2/17
Antenna: Solar 9229-1 & 9230-1	2/16	2/17
Audio Oscillator: H.P. 201CD	2/16	2/17
ESD Test Set 2010i	2/16	2/17
Fast Transient Burst Generator Model: EFT/B-101	2/16	2/17
Field Intensity Meter: EFM-018	2/16	2/17
KEYTEK Ecat Surge Generator	2/16	2/17
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.

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