NVLAP Lab Code: 200087-0

Test Report

CFR47 Part 90 and Industry Canada RSS-137

Application for Grant of Certification

Model: Orion

Location and Monitoring Service Transmitter

902.25 - 903.75 and 910.00 – 921.50 MHz
FCC ID: 2AA7K-ORION
IC: 20068-ORION

FOR

STAR Systems International, Limited

Unit A01, 24/F, Gold King Industrial Building 35-41 Tai Lin Pai Road
Kwai Chung, New Territories
Hong Kong - SAR

Report Number 150203

Authorized Signatory: Scot D Rogers
Scot D. Rogers

NVLAP Lab Code: 200087-0

ROGERS LABS, INC.

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

Test Report For Application of Certification

For

STAR Systems International, Limited

Unit A01, 24/F, Gold King Industrial Building 35-41 Tai Lin Pai Road
Kwai Chung, New Territories
Hong Kong - SAR

Model: Orion

Location Monitoring Service Transmitter
Frequency: 902.25 - 903.75 and 910.00 – 921.50 MHz
FCC ID: 2AA7K-ORION
IC: 20068-ORION

Test Date: February 3, 2015

Certifying Engineer: Scot D Rogers

Scot D. Rogers
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Revision History

Revision 1 issued May 26, 2015

Executive Summary

The following information is submitted for consideration in obtaining Grant of Certification of CFR47 Paragraph 90 (M) and Industry Canada RSS-137 Location Monitoring Service (LMS) transmitter equipment.

Name of Applicant: STAR Systems International, Limited
Unit A01, 24/F, Gold King Industrial Building 35-41 Tai Lin Pai Road
Kwai Chung, New Territories
Hong Kong - SAR

Model: Orion

FCC ID: 2AA7K-ORION IC: 20068-ORION

Frequency of Operation: 902.25 - 903.75 and 910.0 - 921.5 MHz

Transmit Power 1.57 watts maximum,

Bandwidths 315kN0N, 815KL1D, 1M50L1D, 2M70L1D, and 1M76L1D

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Requirements per CFR47 paragraphs 2.1031-2.1057 and RSS-137, Issue 2	Complies
Requirements per CFR47 paragraphs 90.205 and RSS-137 paragraph 4.1	Complies
Requirements per CFR47 paragraphs 90.207 and RSS-141 paragraph 6.2	Complies
Requirements per CFR47 paragraphs 90.209 and RSS-141 paragraph 6.1	Complies
Requirements per CFR47 paragraphs 90.210 and RSS-141 paragraph 6.5	Complies
Requirements per CFR47 paragraphs 90.213 and RSS-141 paragraph 6.3	Complies

Application for Certification

1. Manufacturer: STAR Systems International, Limited
   Unit A01, 24/F, Gold King Industrial Building 35-41 Tai Lin Pai Road
   Kwai Chung, New Territories
   Hong Kong - SAR

2. Identification: Model: Orion

   FCC I.D.: 2AA7K-ORION IC: 20068-ORION

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

4. Emission Types: Single channel, CW-N0N, and/or Data, Modulated in width/duration –L1D

Frequency Range	Operational Mode	Emission Designator
902-25 – 903.75	CW	315kN0N
910.0 – 921.5	CW	315kN0N
912.75 – 918.75	EPC	815KL1D
912.75 – 918.75	Title 21	1M50L1D
914.75 – 916.75	CVISN	2M70L1D
914.75 – 916.75	IAG	1M76L1D

5. Frequency Range: 902.25 - 903.75 and 910.0 – 921.5 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 2 Watt (nominal) and power levels may be reduced in 1 dB increments (0-15 dB attenuation) offering output power level adjustable from 50 mW to 2 W.

7. Maximum power rating as defined in the applicable part(s) of the rules. As stated in CFR47, 90.205(k) the maximum permissible output power allowed is 30 watts.

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 EUT final amplification stage runs at a maximum of 12 volts with 1 amperes current.

9. Provide the 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 and technical exhibits 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 shall be provided. Refer to the identification label exhibit and information 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. Information about modulation is contained in Operational description exhibit.

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.

Equipment Tested

Equipment	Model / PN	S/N
EUT	Orion	4124359
AC Adapter	CPI (CP-2440)	Not Available
Laptop Computer	studio XPS	921LBN1

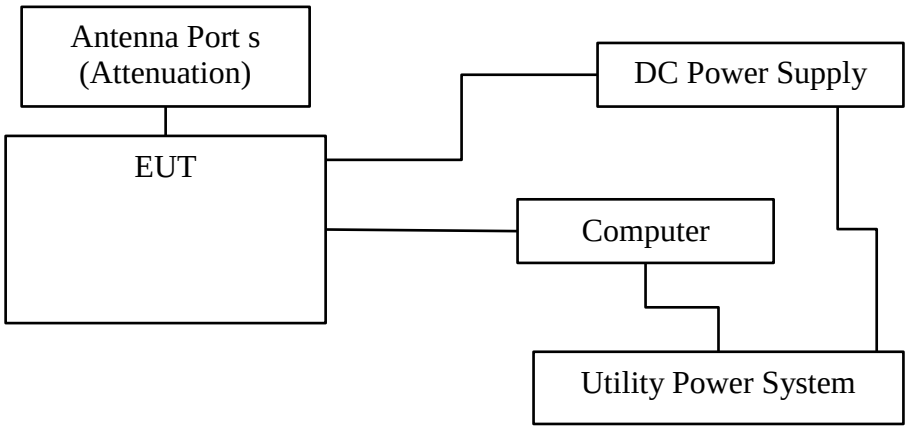
Notes: Orion Firmware information:
CPU Appl FW Version: OR.21.1.0.00.06
CPU Boot FW Version: OR.21.2.0.00.02
FPGA1 FW Version: E6.00.4.0.08.25
FPGA2 FW Version: E6.00.5.0.07.30
RF FPGA FW Version: E6.00.6.0.09.08

Test results in this report relate only to the items tested.

Equipment Operation and Test Setup

The EUT operates as location and monitoring transceiver equipment for industry. Operation of transmitter design utilizes industry standardized modulation schemes offering ability to read multiple RFID tags. This reader provides interfacing with compliant digital equipment through the Ethernet protocol for data collection and processing. The system may be configured with directional gain antenna systems not exceeding 14 dBi per manufacturer recommendation. The EUT installation software provides installer ability to configuration power attenuation to 15 dB.

Test Setup Diagram



Applicable Standards and Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2014, Part 2 Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057; 90.201 through 90.217, 90.350 through 90.363 and RSS-137 the following information is submitted. Test procedures used were the established Methods of Measurement of Radio-Noise Emissions as described in ANSI/TIA-603-C-2004.

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.

Environmental Conditions

Ambient Temperature	21.4 ° C
Relative Humidity	29%
Atmospheric Pressure	1036.2 mb

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	Comp. Design	FCC-LISN-2-MOD.CD (126)	.15-30MHz	10/14	10/15
☒ 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	Com Power	AH-118 (10110)	1-18 GHz	10/14	10/15
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/14	5/15
☒ 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	Standard	FXRY638A (621786)	10-18 GHz	5/14	5/15
☐ Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/14	5/15
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/14	5/15
☐ Analyzer	HP	8562A (3051A05950)	9kHz-110GHz	5/14	5/15
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/14	5/15
☒ 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

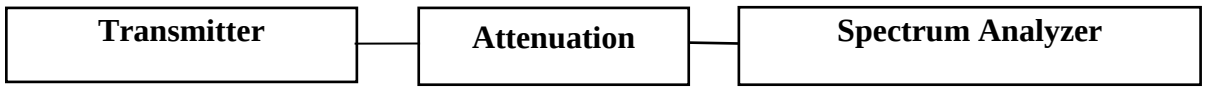
Transmitter Power Output

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, except as noted below:

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

Test Arrangement



The radio frequency power output was measured at the antenna terminal by replacing the antenna with cabling, spectrum analyzer and appropriate attenuation. The spectrum analyzer and attenuation offered 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. The data was taken in dBm and converted to watts as shown in the following Table. Refer to Figures 1 and 2 displaying the transmitter operation in frequency band. Data was taken per Paragraph 2.1046(a) and applicable paragraphs of Part 90 and RSS-137 paragraph 6.4. Refer to figures 1 and 2 displaying plots of transmitter output power.

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

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

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

Milliwatts = $10^{(31.97/10)}$

= 1,573.98 mW

= 1.57 Watts

Table 1 Transmitter Power Results

Frequency	Operation mode	$P_{dBm\ Max}$	Power Watts	$P_{dBm\ Min}$	Power Watts	OBW (kHz)
902.25	(CW)	31.97	1.57	16.97	0.05	315.0
903.75	(CW)	31.91	1.55	16.91	0.05	315.0
910.00	(CW)	31.92	1.56	16.92	0.05	315.0
921.50	(CW)	31.75	1.50	16.75	0.05	315.0
912.75	EPC	31.71	1.50	16.71	0.05	815.0
918.75	EPC	31.62	1.45	16.62	0.05	815.0
912.75	Title 21	31.80	1.51	16.80	0.05	1500.0
918.75	Title 21	31.62	1.45	16.62	0.05	1500.0
914.75	CVISN	31.67	1.47	16.67	0.05	2700.0
916.75	CVISN	31.65	1.46	16.65	0.05	2700.0
914.75	IAG	31.72	1.50	16.72	0.05	1762.5
916.75	IAG	31.70	1.48	16.70	0.05	1762.5

The EUT demonstrated compliance with the specifications of Paragraphs 2.1046(a), 90.205 and RSS-137. There are no deviations to the specifications.

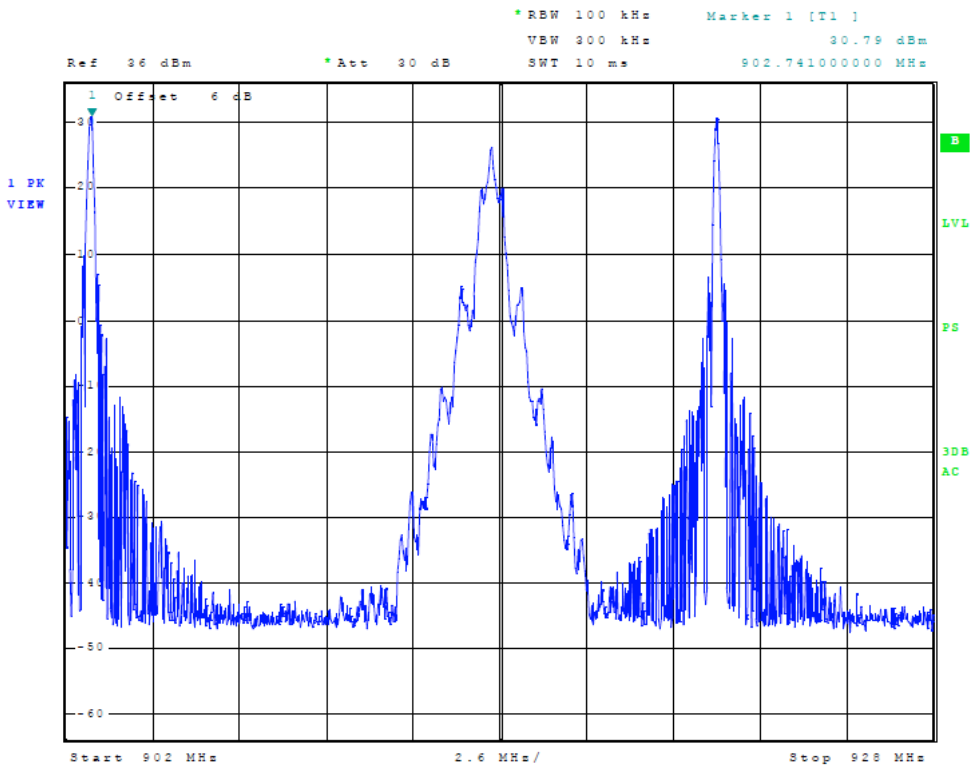


Figure 1 Power output at antenna terminal (CW operation)

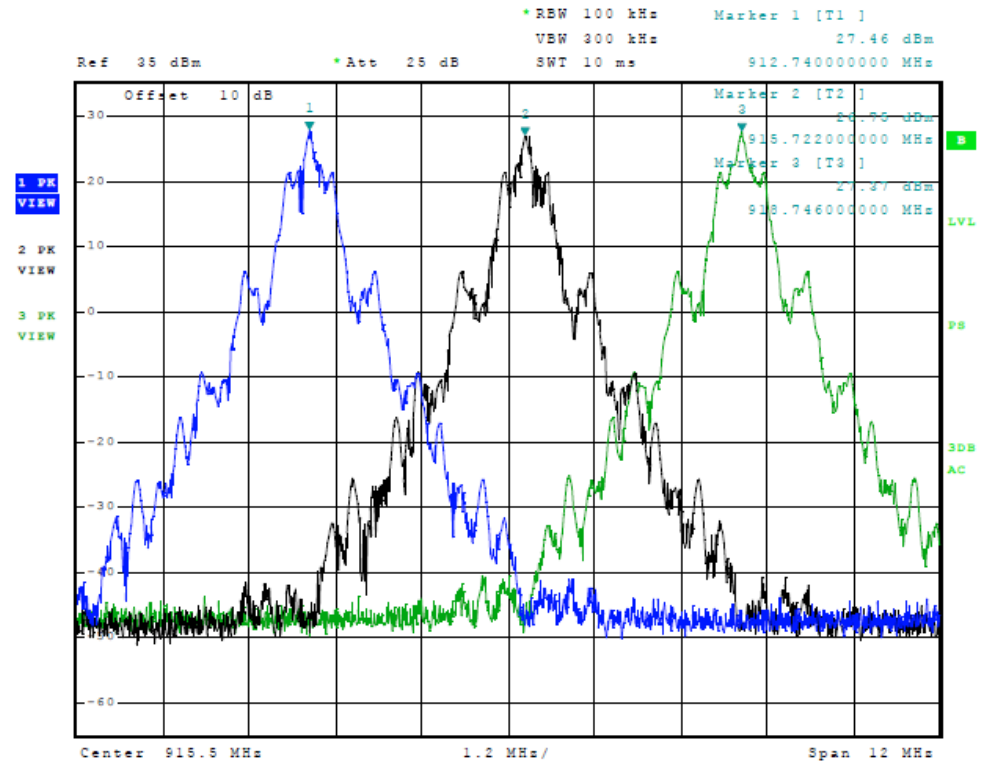


Figure 2 Power output at antenna terminal (Modulated operation)

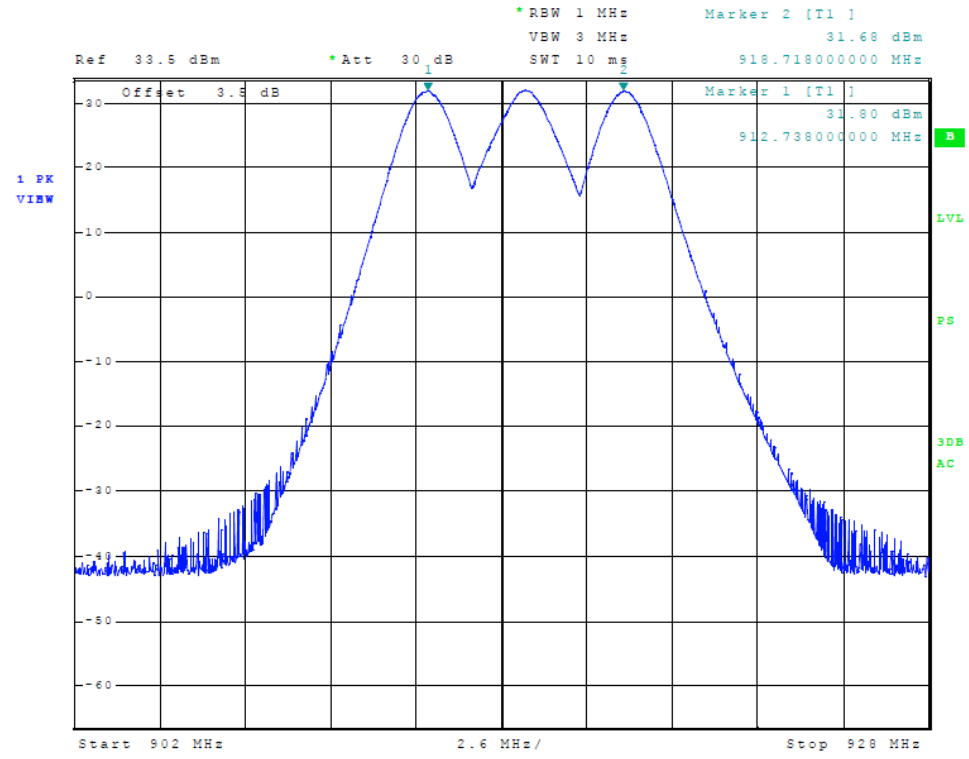


Figure 2a Power output at antenna terminal (Modulated operation)

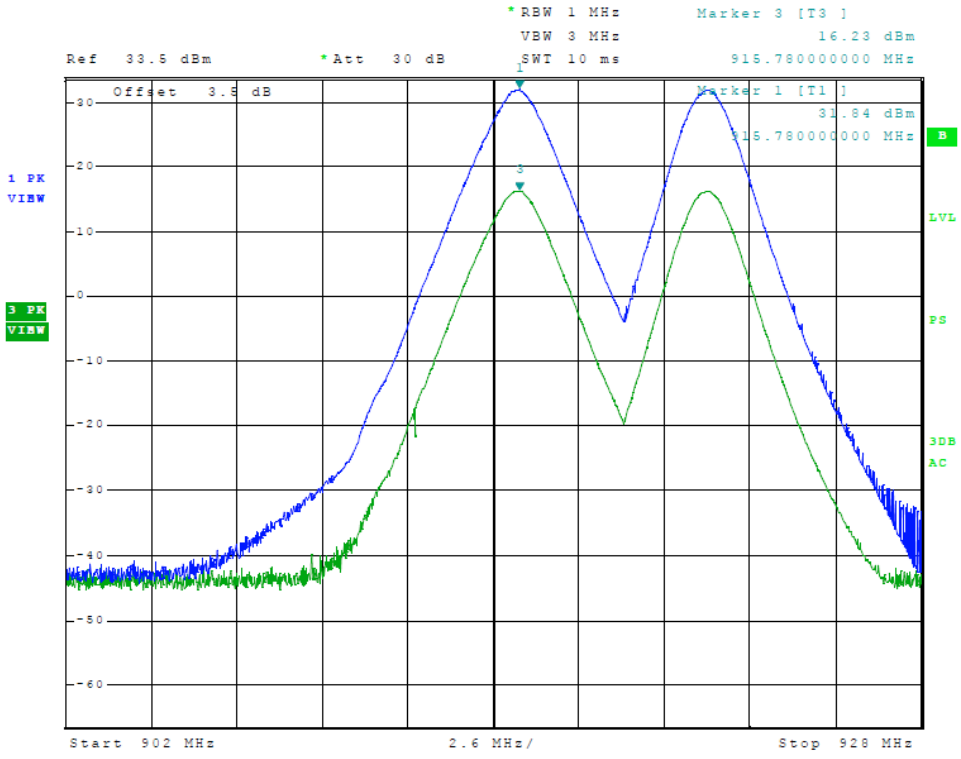


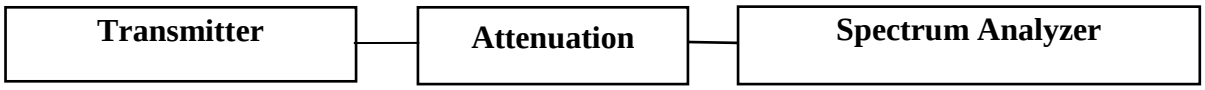
Figure 2b Power output at antenna terminal (0 and 15 dB attenuation)

Modulation Characteristics

Measurements Required

A curve or equivalent data that 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. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in its normal mode.

Results Modulation Characteristics

The transmitter operates in continuous wave (CW) and/or offering data transmitted signals modulated in amplitude/width/duration. The EUT demonstrated compliance with the specifications of Paragraphs 2.1046(a), 90.205 and RSS-137. 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. Refer to figures 3 through 7 displaying plots of occupied bandwidth measurements.

Test Arrangement

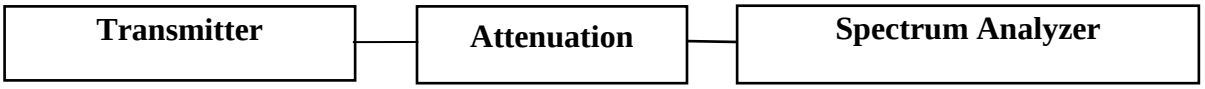


Table 2 Occupied Bandwidth Results

Operation Mode	Operational Frequency Band (MHz)	Occupied Bandwidth (kHz)
CW	902.2-903.75 and 910.00-921.50	315.0
EPC	912.75 - 918.75	815.0
Title 21	912.75 – 918.75	1500.0
CVISN	914.75 – 916.75	2700.0
IAG	914.75 – 916.75	1762.5

The EUT demonstrated compliance with the requirements of Paragraphs 2.1046(a) 90.209 and RSS-137 paragraph 6.1. There are no deviations to the specifications.

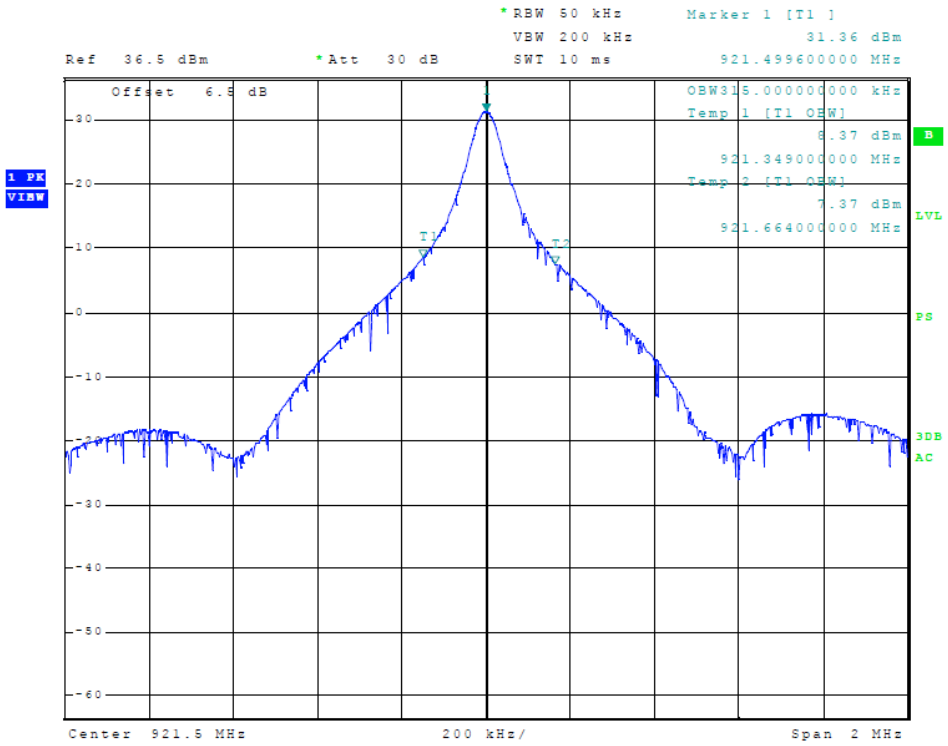


Figure 3 Occupied Bandwidth (CW)

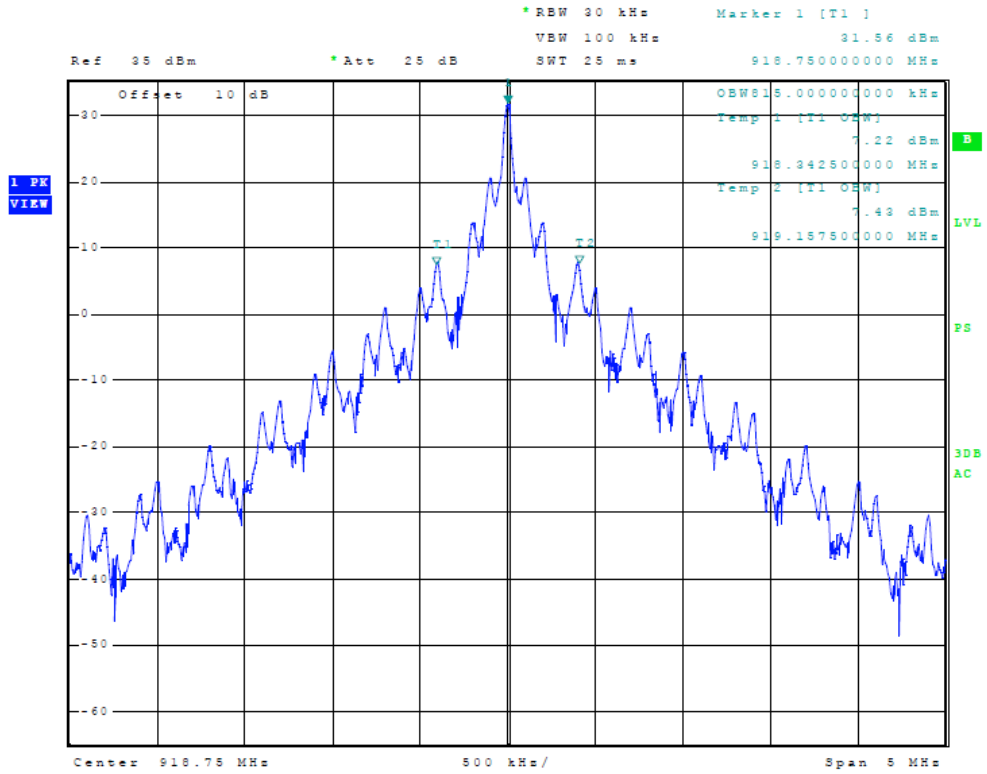


Figure 4 Occupied Bandwidth (EPC)

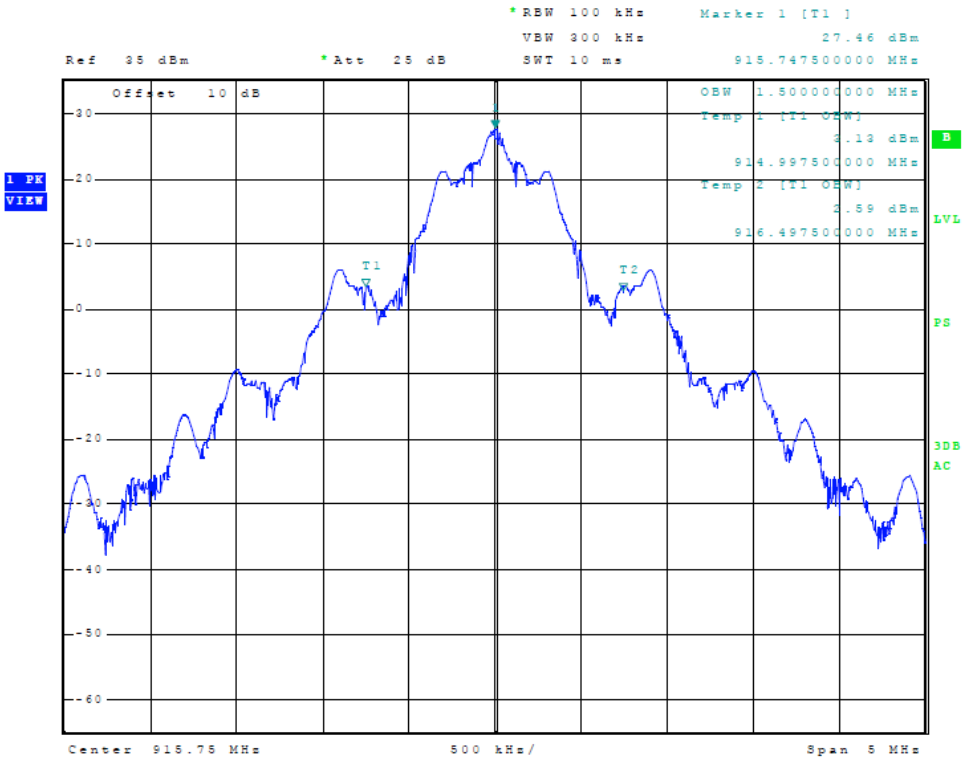


Figure 5 Occupied Bandwidth (Title 21)

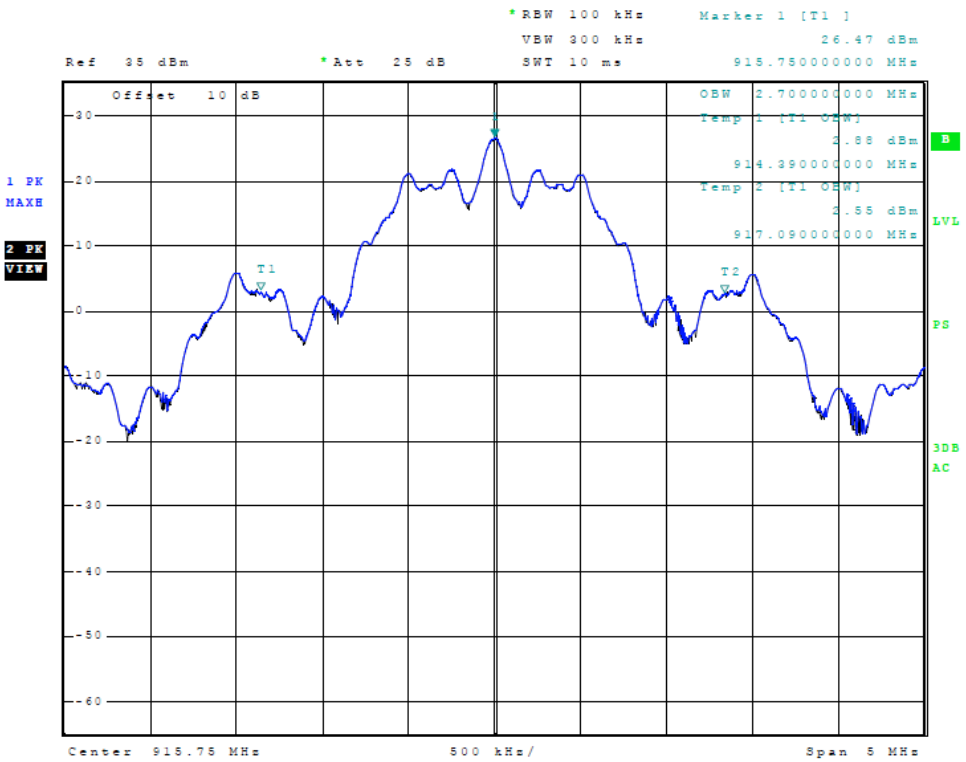


Figure 6 Occupied Bandwidth (CVISN)

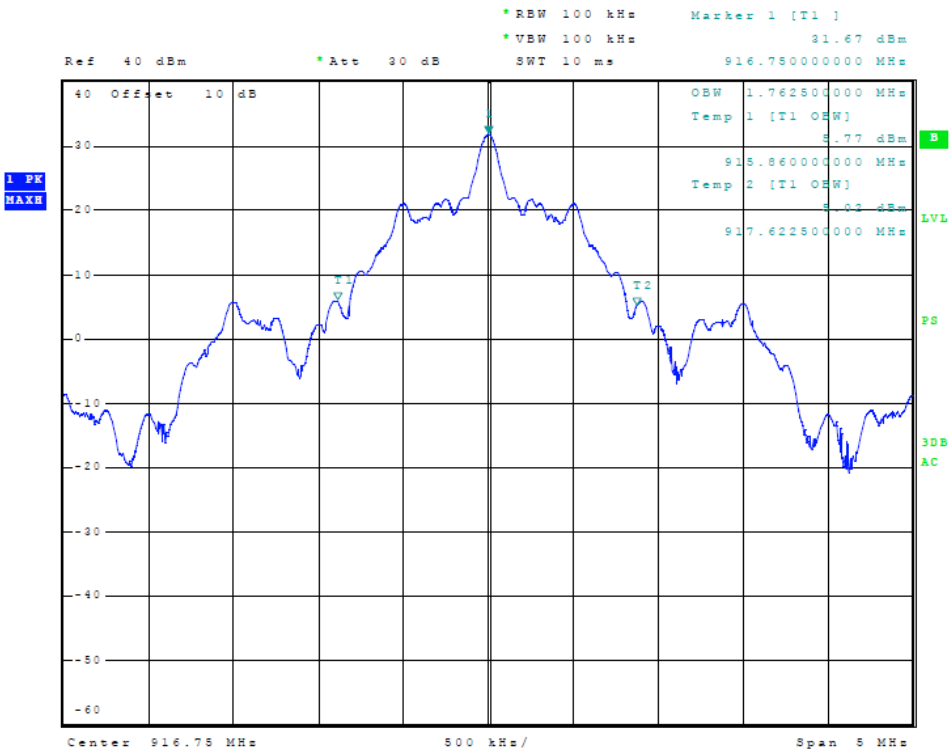


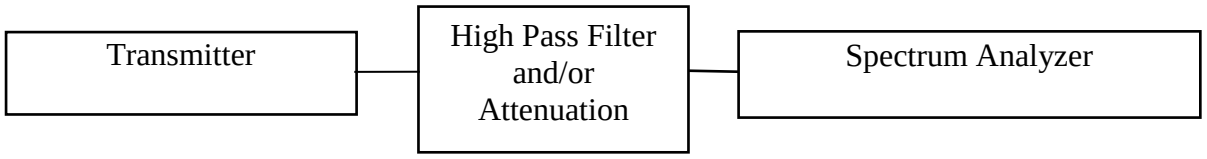
Figure 7 Occupied Bandwidth (IAG)

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. To gain dynamic range in the test equipment, a high pass filter attenuated the fundamental frequency of operation was used to observe the harmonic 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 30 MHz to 10 GHz was observed and plots produced of the frequency spectrum. Figures 8 through 11 represent plots of the antenna conducted spurious emissions measurements for the EUT. Data was taken per CFR47 2.1051 and applicable paragraphs of Part 90 and RSS-137. Refer to figures 8 through 11displaying plots of spurious emissions at antenna port.

Limit: Spurious emissions must be attenuated below the peak output power by the at least 55 + 10 Log (P_o) dB.

2.0-watt transmitter limit specifies the out of band emissions must be suppressed by at least 58.0 dBc.

Attenuation $= 55 + 10 \text{ Log}_{10}(P_w)$

$= 55 + 10 \text{ Log}_{10}(2.0)$

$= 58.0$ dBc

Table 3 Spurious Emissions at Antenna Terminal Data and Results

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
902.25	1804.5	-33.64	65.6
	2706.8	-37.69	69.6
	3609.0	-38.68	70.6
	4511.3	-38.38	70.3
	5413.5	-38.57	70.5
	6315.8	-38.08	70.0
910.00	1820.0	-33.99	65.9
	2730.0	-38.38	70.3
	3640.0	-38.72	70.6
	4550.0	-39.08	71.0
	5460.0	-38.92	70.8
	6370.0	-39.20	71.1
915.75	1831.5	-34.03	65.9
	2747.3	-38.57	70.5
	3663.0	-38.87	70.8
	4578.8	-39.15	71.1
	5494.5	-38.79	70.7
	6410.3	-37.59	69.5
921.50	1843.0	-34.10	66.0
	2764.5	-38.79	70.7
	3686.0	-38.30	70.2
	4607.5	-38.44	70.4
	5529.0	-37.93	69.9
	6450.5	-37.55	69.5

Data was taken per 2.1051 and applicable parts of CFR47 90.210 and RSS-137. The EUT demonstrated compliance with the specifications of Paragraphs CFR47 2.1051, 2.1057 and 90.210(k) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

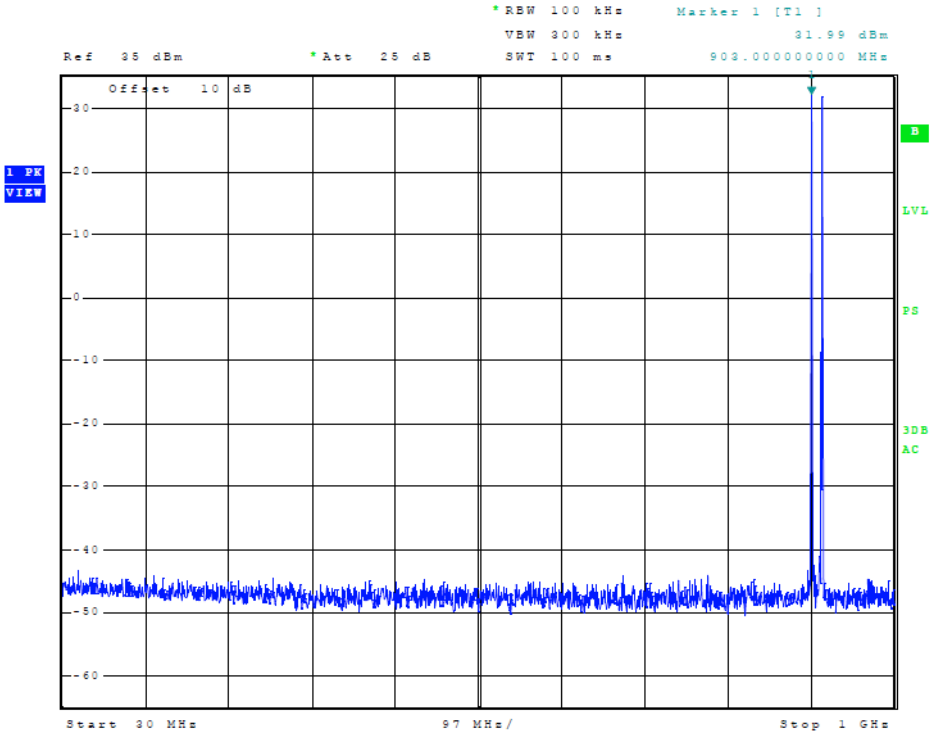


Figure 8 Spurious Emissions at Antenna Terminal

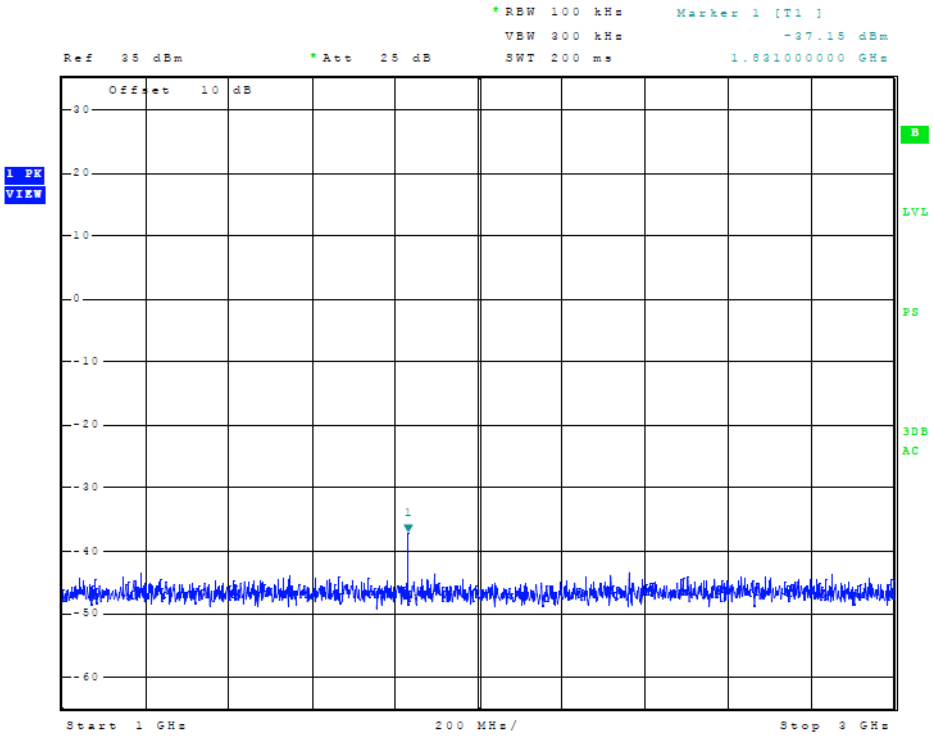


Figure 9 Spurious Emissions at Antenna Terminal

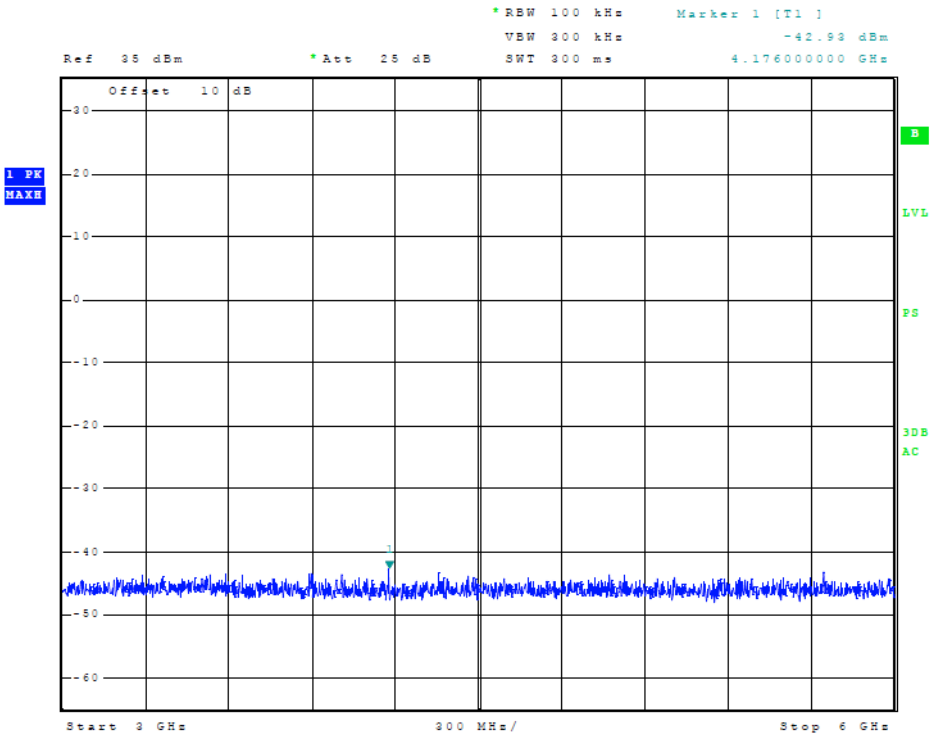


Figure 10 Spurious Emissions at Antenna Terminal

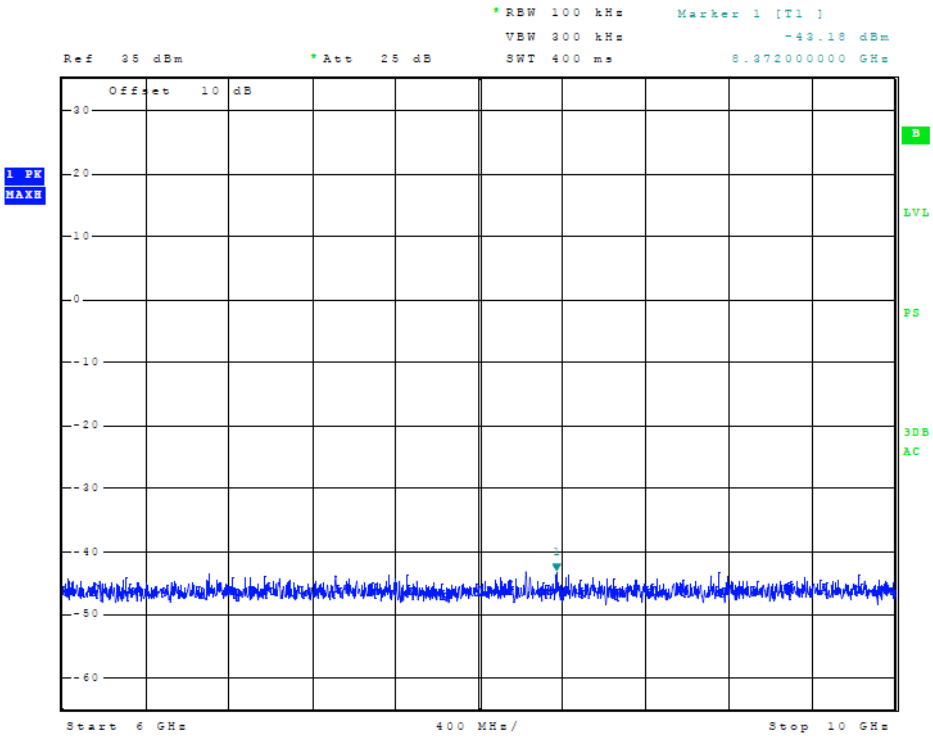


Figure 11 Spurious Emissions at Antenna Terminal

Emission Mask at Antenna Terminal

Measurements Required

Transmitters used in the radio services governed by this part must comply with the emissions masks outlined in this section. Paragraph 90.210(K) specifies the out of band emission limitations for this equipment. The spurious emissions at the antenna terminal for the device were measured at the maximum power output condition. The antenna port of the EUT was connected to the spectrum analyzer through coaxial cables and appropriate attenuation.

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 through normal modes with maximum output power. The frequency spectrum at the band edges were observed and plots produced. Refer to figures 12 through 18 for plots representing emission mask compliance at the band edges. Data was taken per CFR47 2.1051 and applicable parts of Part 90.210 (k) and RSS-137.

Results Emission Mask

The EUT demonstrated compliance with the specifications of Paragraphs CFR47 2.1051, 2.1057 and 90.210(k) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

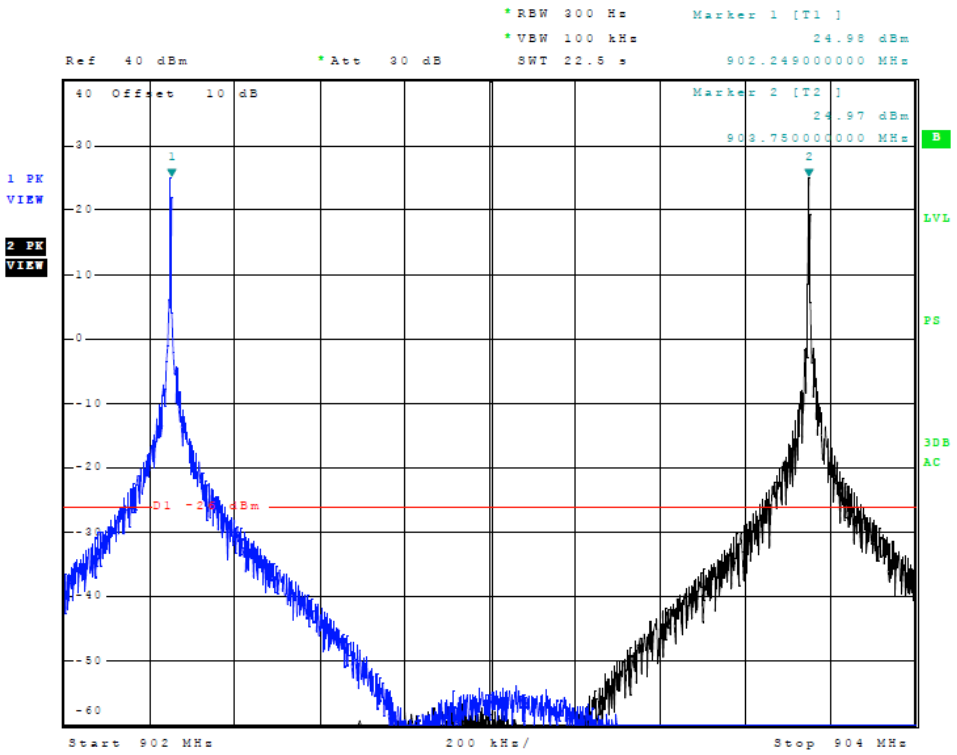


Figure 12 Emissions Mask at Antenna Terminal (CW)

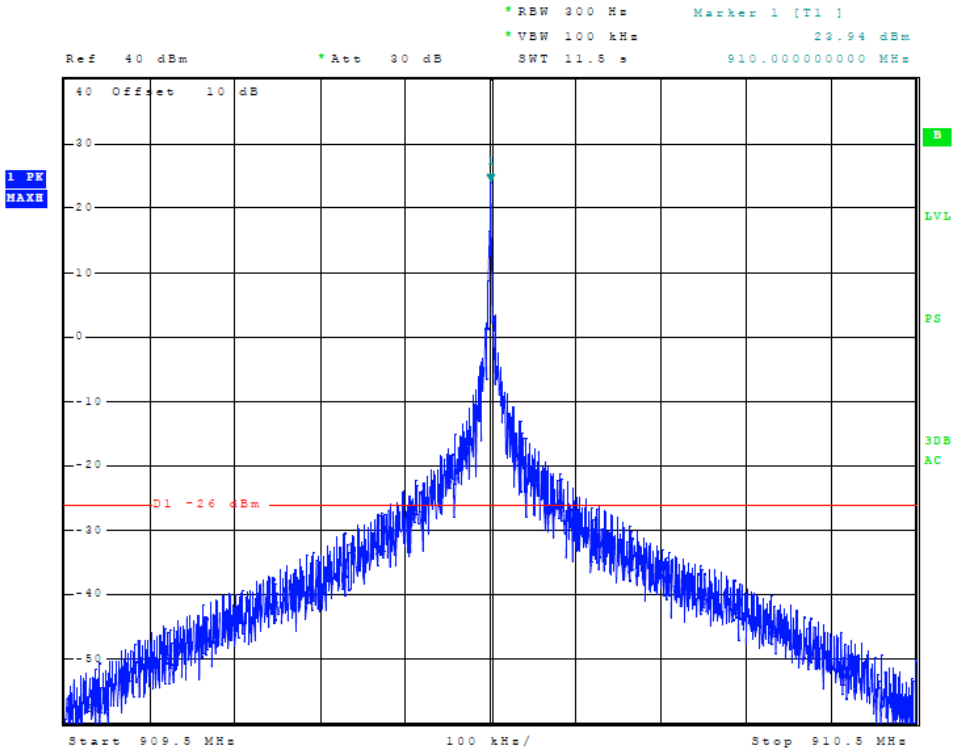


Figure 13 Emissions Mask at Antenna Terminal (CW)

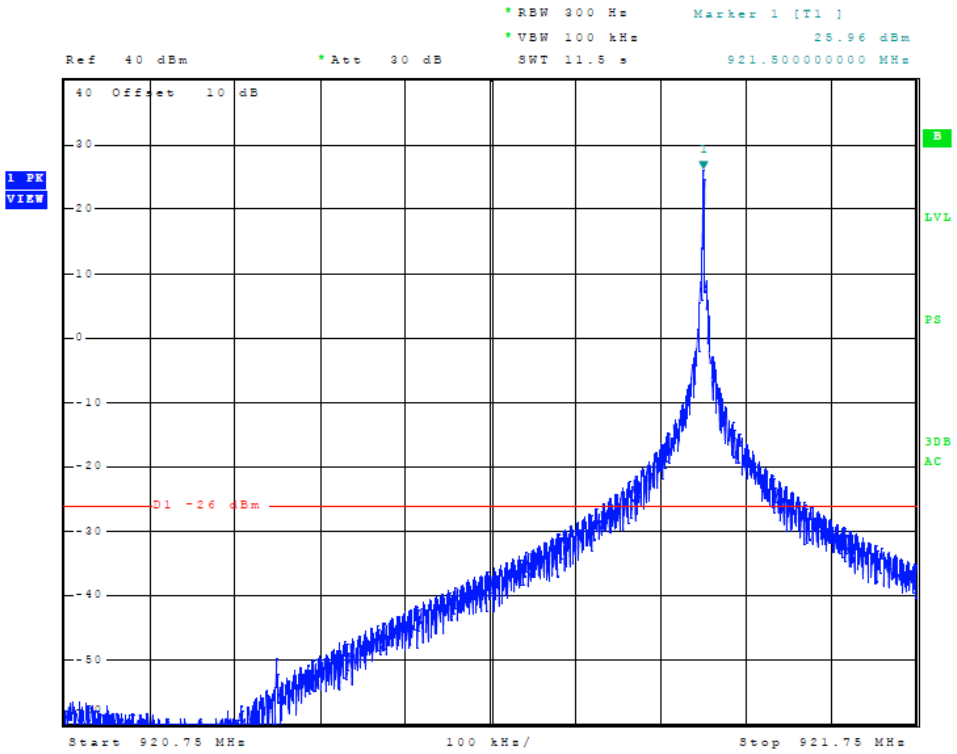


Figure 14 Emissions Mask at Antenna Terminal (CW)

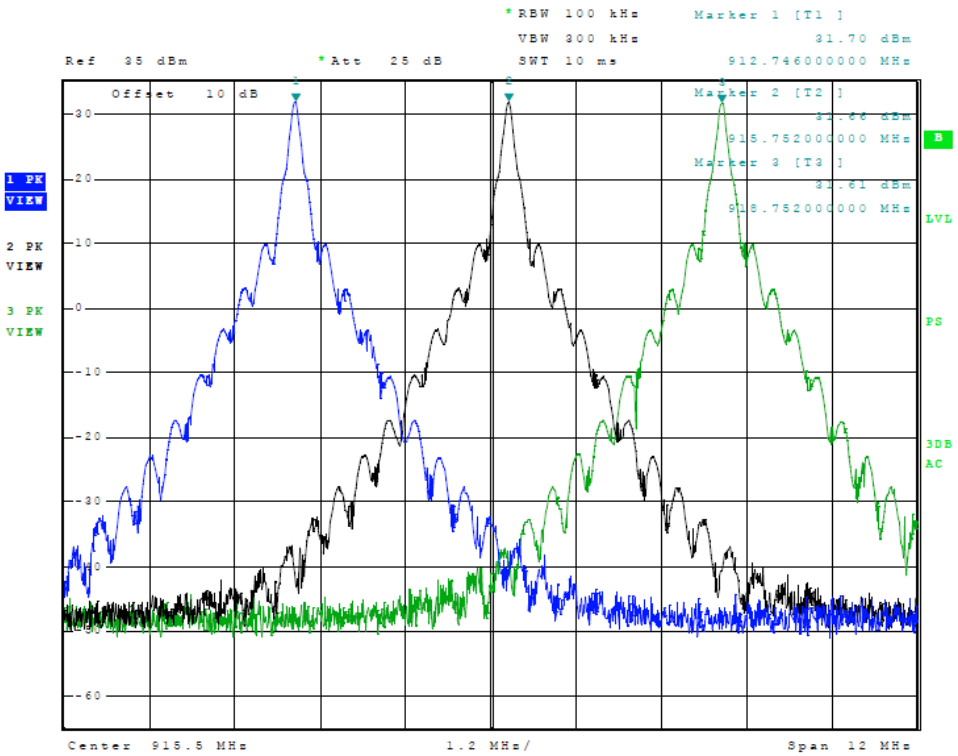


Figure 15 Emissions Mask at Antenna Terminal (EPC Modulation)

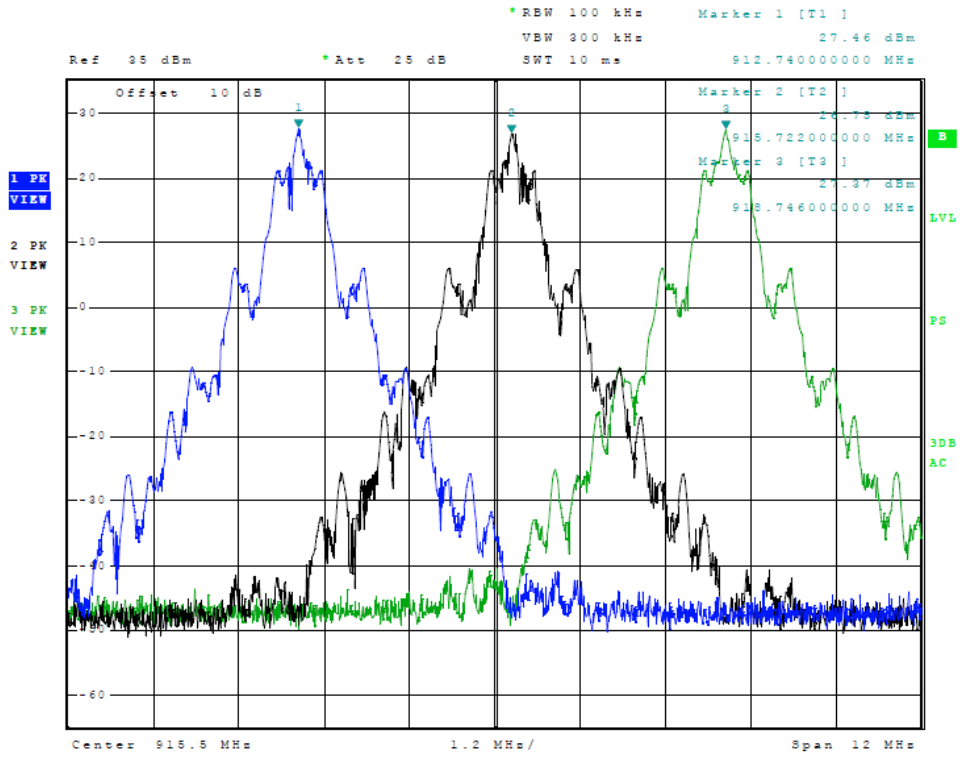


Figure 16 Emissions Mask at Antenna Terminal (Title 21 Modulation)

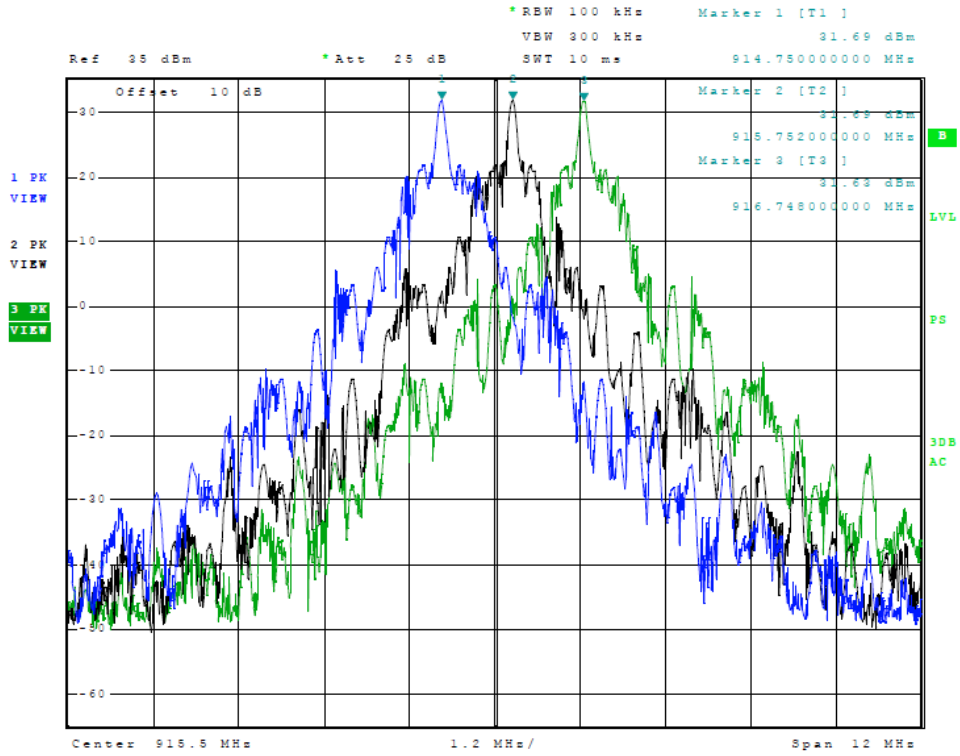


Figure 17 Emissions Mask at Antenna Terminal (CVISN Modulation)

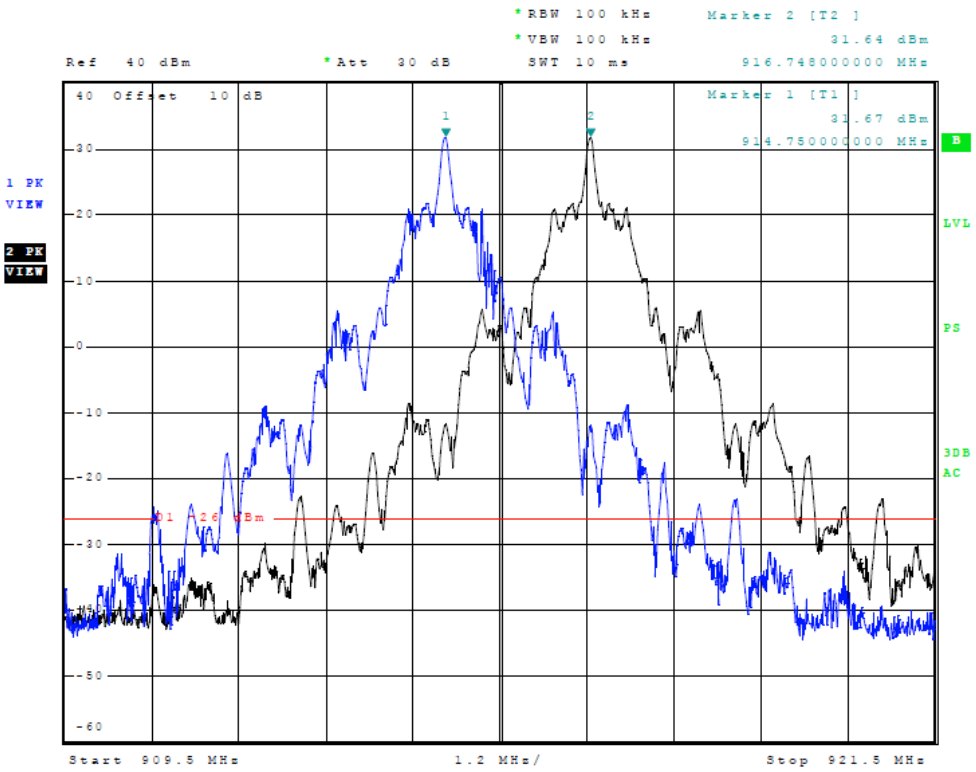


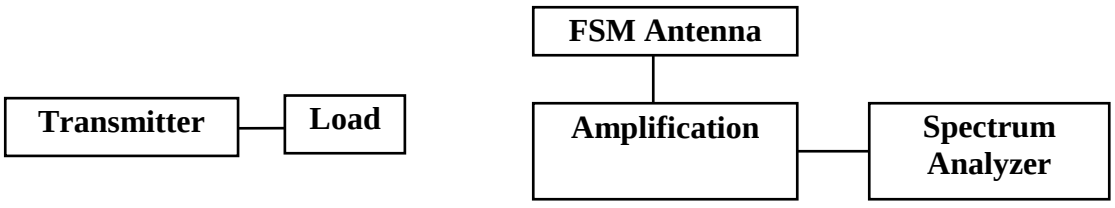
Figure 18 Emissions Mask at Antenna Terminal (IAG Modulation)

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.

Test Arrangement



Preliminary radiated emissions investigation was made in a screen room to determine frequencies of emissions. The transmitter spurious emissions were measured at the OATS with the antenna port connected to a 50-ohm load. The EUT was placed on a wooden turntable 0.8 meters above the ground plane 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 to maximize the emission. Data was measured and recorded for the maximum amplitude of each spurious emission. A Loop antenna was used to measure emissions in the 9 kHz to 30 MHz band, Biconilog antenna was used to measure radiated emissions for frequencies of 30 MHz to 1000 MHz, and pyramidal horn antennas for frequencies of 1 GHz to 10 GHz. The substitution method was used to measure harmonic spurious emissions. Harmonic emission levels from the EUT were measured and amplitude levels were recorded. The EUT transmitter was then removed and replaced with a substitution antenna, which was powered from a signal generator. The output 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 document with worst-case emissions presented.

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

> Limit = Amplitude of the spurious emission must be attenuated by this amount below the level of the fundamental. On any frequency removed from the assigned frequency outside the assigned sub-band edges: at least 55 + 10 Log (P_o) dB.
>
> 2.0 -watt transmitter limit specifies the level below the carrier must be suppressed more than 58.0 dB.

$$\begin{aligned} \text{Attenuation} &= 55 + 10\ \text{Log}_{10}(P_w) \\ &= 55 + 10\ \text{Log}_{10}(2.0) \\ &= 58.0\ \text{dBc} \end{aligned}$$

The radiated spurious emission below the carrier in dB is calculated from the following equation:

Decibels below Carrier = dBc

dBc = signal level required to reproduce measured emission - 10 Log_{10}[Tx power(W)/0.001]

example:

dBc = -63.1 - 10 Log_{10}[2.0/0.001] = -96.1, absolute value dBc= 96.1

Data was taken per 2.1051 and applicable parts of CFR47 90. The EUT demonstrated compliance with the specifications of Paragraphs CFR47 2.1051, 2.1057 and 90.210(k) and RSS-137 paragraph 6.5. There are no deviations to the specifications.

Table 4 General Spurious Radiated Emission Results (Worst-case)

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBc)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
125.0	48.8	43.3	-46.43	-51.93	79.43	84.93	58.0
144.0	50.7	42.2	-44.53	-53.03	77.53	86.03	58.0
250.0	41.3	42.3	-53.93	-52.93	86.93	85.93	58.0
325.0	48.9	40.0	-46.33	-55.23	79.33	88.23	58.0
350.0	49.5	45.6	-45.73	-49.63	78.73	82.63	58.0
375.0	47.2	40.5	-48.03	-54.73	81.03	87.73	58.0
400.0	47.6	46.4	-47.63	-48.83	80.63	81.83	58.0
432.0	51.2	47.6	-44.03	-47.63	77.03	80.63	58.0
550.0	51.6	51.4	-43.63	-43.83	76.63	76.83	58.0
575.0	49.9	52.3	-45.33	-42.93	78.33	75.93	58.0
576.0	47.6	47.9	-47.63	-47.33	80.63	80.33	58.0
600.0	49.6	52.1	-45.63	-43.13	78.63	76.13	58.0
624.0	56.1	55.5	-39.13	-39.73	72.13	72.73	58.0
625.0	47.4	44.2	-47.83	-51.03	80.83	84.03	58.0
650.0	52.9	47.7	-42.33	-47.53	75.33	80.53	58.0
675.0	54.7	47.7	-40.53	-47.53	73.53	80.53	58.0
700.0	51.6	41.5	-43.63	-53.73	76.63	86.73	58.0
720.0	56.0	50.4	-39.23	-44.83	72.23	77.83	58.0
725.0	52.1	45.0	-43.13	-50.23	76.13	83.23	58.0
960.0	48.5	53.8	-46.73	-41.43	79.73	74.43	58.0
1056.0	51.3	46.1	-43.93	-49.13	76.93	82.13	58.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Table 5 Results Spurious Radiation (worst-case)

Frequency	Amplitude of Emission (dBµV)		Signal Level to dipole required to Reproduce(dBm)		Emission level below carrier (dBc)		Limit (dBc)
MHz	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
902.25 MHz							
1804.50	26.2	38.6	-69.03	-56.63	101.0	88.6	58.0
2706.75	33.2	36.1	-62.03	-59.13	94.0	91.1	58.0
3609.00	27.5	29.4	-67.73	-65.83	99.7	97.8	58.0
4511.25	27.7	27.7	-67.53	-67.53	99.5	99.5	58.0
5413.50	41.4	46.9	-53.83	-48.33	85.8	80.3	58.0
6315.75	32.3	36.6	-62.93	-58.63	94.9	90.6	58.0
910.00 MHz							
1820.00	26.1	37.8	-69.13	-57.43	101.1	89.4	58.0
2730.00	28.9	32.5	-66.33	-62.73	98.3	94.7	58.0
3640.00	28.0	29.4	-67.23	-65.83	99.2	97.8	58.0
4550.00	26.9	28.1	-68.33	-67.13	100.3	99.1	58.0
5460.00	36.2	41.2	-59.03	-54.03	91.0	86.0	58.0
6370.00	33.6	33.5	-61.63	-61.73	93.6	93.7	58.0
915.75 MHz							
1831.50	37.2	41.6	-58.03	-53.63	90.0	85.6	58.0
2747.25	39.2	41.5	-56.03	-53.73	88.0	85.7	58.0
3663.00	28.2	28.2	-67.03	-67.03	99.0	99.0	58.0
4578.75	27.1	27.1	-68.13	-68.13	100.1	100.1	58.0
5494.50	34.7	34.3	-60.53	-60.93	92.5	92.9	58.0
6410.25	33.0	34.9	-62.23	-60.33	94.2	92.3	58.0
921.5 MHz							
1843.00	32.5	41.4	-62.73	-53.83	94.7	85.8	58.0
2764.50	38.5	41.4	-56.73	-53.83	88.7	85.8	58.0
3686.00	25.9	28.1	-69.33	-67.13	101.3	99.1	58.0
4607.50	26.8	26.8	-68.43	-68.43	100.4	100.4	58.0
5529.00	32.8	33.9	-62.43	-61.33	94.4	93.3	58.0
6450.50	33.3	37.3	-61.93	-57.93	93.9	89.9	58.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

Frequency Stability

Measurements Required

Pursuant to 90.213(a), Note 13, frequency stability testing is not required for this equipment. The equipment design incorporates frequency-determining components with acceptable operational frequency and tolerances rating. The equipment complies with the requirements of CFR47 part 90 and RSS-137 paragraph 6.3.

Annex

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

Positions Held:

Systems Engineer:	A/C Controls Mfg. Co., Inc.	6 Years
Electrical Engineer:	Rogers Consulting Labs, Inc.	5 Years
Electrical Engineer:	Rogers Labs, Inc.	Current

Educational Background:

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

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

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

NVLAP Lab Code: 200087-0

Annex D FCC Test Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

June 28, 2013

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: June 28, 2013

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

June 19, 2013

OUR FILE: 46405-3041
Submission No: 168037

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 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 **(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 C63.4-2003 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 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 "H"
Ottawa, Ontario K2H 8S2
Email: Bill.Payn@ic.gc.ca
Tel. No. (613) 990-3639
Fax. No. (613) 990-4752