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Testing
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Class 2 Permissive Change Engineering Test Report

FOR

Model: GMN-01216
1090 MHz
Aviation Transponder
FCC ID: IPH-02133

FOR

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Test Report Number: 180321A
FCC Designation: US5305
IC Test Site Registration: 3041A-1

Authorized Signatory: Scot D Rogers
Scot D. Rogers

NVLAP
Testing
NVLAP Lab Code 200087-0

ROGERS LABS, INC.

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

Class 2 Permissive Change Engineering Test Report

For

47 CFR, Parts 2 and 87
Licensed Non-Broadcast Transmitter

For

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Model: GMN-01216

Aviation Transponder
Frequency Range 1090 MHz

FCC ID: IPH-02133

Test Date: March 21, 2018

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

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Revisions

Revision 1 Issued July 26, 2018

Forward

The following information is submitted as documentation of compliance with regulations supporting Class 2 Permissible Change of Authorized Equipment. This product was authorized under 47CFR parts 2 and 87, licensed non-broadcast transmitter operations at 1090 MHz frequency.

Name of Applicant: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

Model: GMN-01216
FCC ID: IPH-02133

Opinion / Interpretation of Results

Tests Performed	Results
Antenna Port Conducted Emissions	Complies
Radiated Emissions	Complies

Summary of Results for Permissible Change

The EUT demonstrated compliance with the requirements of Class 2 Permissible Change.

Change to Equipment from Original Design

The information contained in this report address hardware modifications to replace obsolescent components. The modifications were required as component parts will no longer be available in the near future. The transmitter design remains electrically identical and functionally equivalent to the original equipment authorization. This report documents operation to demonstrate continued compliance with regulations.

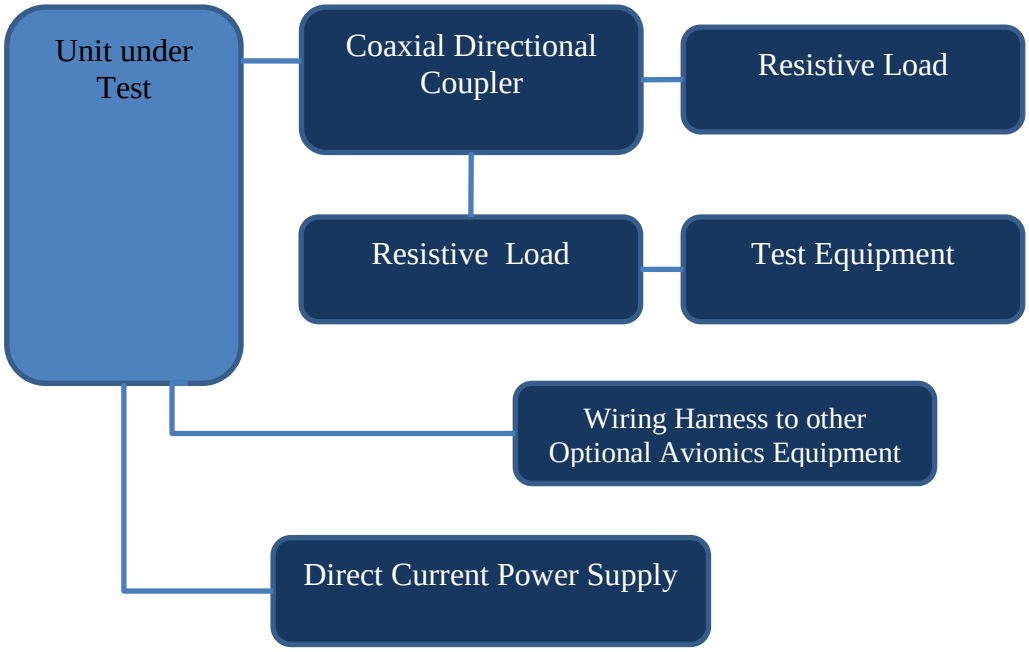
Equipment Tested

Equipment	Model / PN	Serial Number
EUT #1	GMN-0121611	3EG440000
EUT #2	GMN-0121611	3EG040007
Bench DC power supply	BK 1745	209C13
Laptop Computer	Latitude E6320	FCN03Q1

Equipment Function

The EUT is a Mode A and S avionics transponder, designed to be mounted remotely or within the panel of the aircraft. The design provides a response when it receives a radio-frequency interrogation to assist in identifying the aircraft. The unit operates on aviation-defined frequencies, receiving ground radar interrogations at 1030 MHz and transmitting a coded response of pulses back at 1090 MHz. This report documents operation for this application as authorized in 47CFR 87 Subparts D and F. Test results in this report relate only to the products described in this report.

Equipment Configuration



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-02133
3) (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. 8M94M1D
5) Frequency range. 1090 MHz
6) Range of operating power values or specific operating power levels, and description of any means provided for variation of operating power.

   363 Watts peak, 3.99 Watts average power for 28/14-volt installation / operation

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

   Maximum power output as determined by appropriate standards during certification per CFR 47 paragraph 87.131.

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 28.0 Volts @ 20.0 Amps (560 Watts peak)

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 Schematic 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 of Label exhibit

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 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.

Not applicable

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.

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, dated March 21, 2018: Part 2, Subpart J, Paragraphs 2.1043, applicable parts of paragraph 87, KDB 178919 D01 Permissive Change Policy v06, operation in the 1090 MHz Frequency band. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.26-2015.

Equipment Testing Procedures

Antenna Port Conducted Emission Test Procedure

The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed as required in the regulations and specified in ANSI C63.26-2015. Testing was completed on a laboratory bench in a shielded room. The active antenna port of the unlicensed wireless device was connected to appropriate attenuation and the spectrum analyzer.

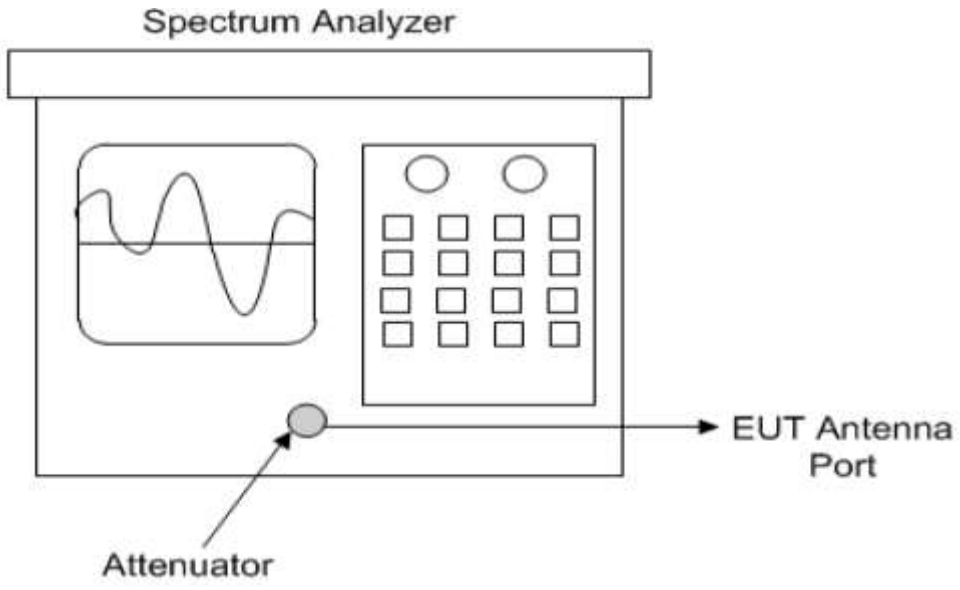


Diagram 1 Test arrangement for Antenna Port Conducted emissions

Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47CFR part 87 and specified in ANSI C63.26-2015. 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 permitting orientation in three orthogonal axes, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken and recorded. The frequency spectrum from 9 kHz to 11,000 MHz was searched for emissions during preliminary investigation. Refer to diagram two showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

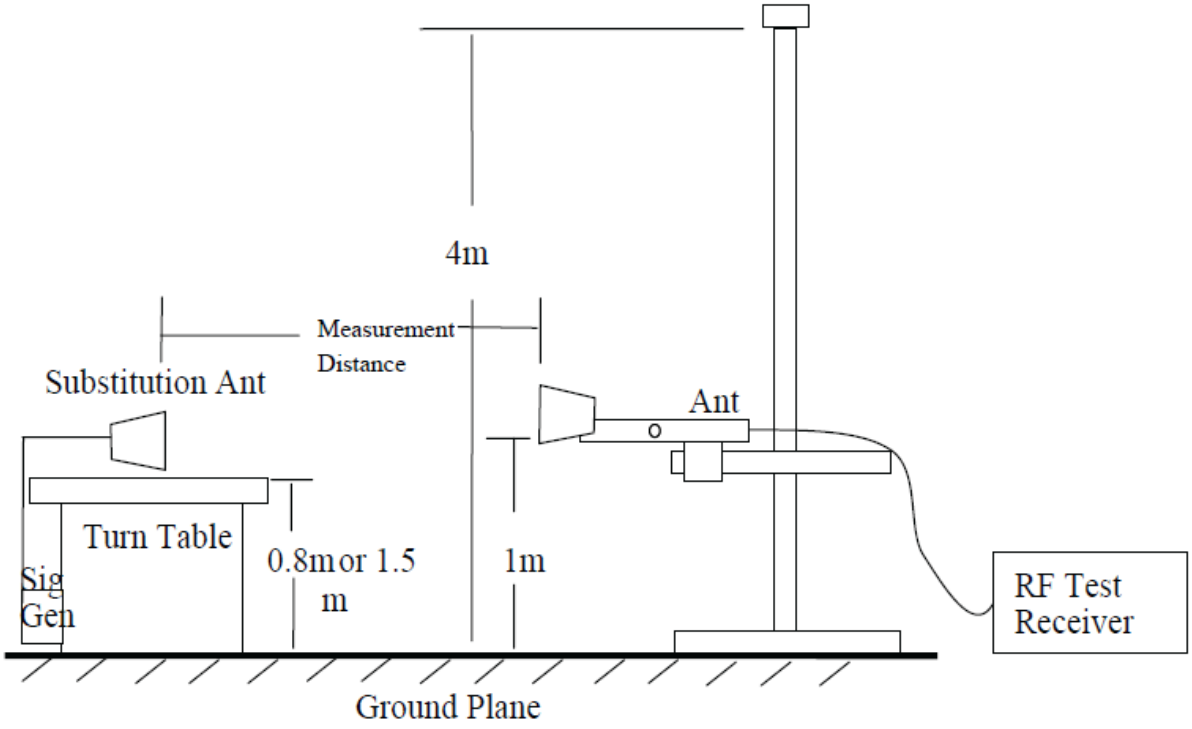


Diagram 2 Test arrangement for radiated emissions tested on Open Area Test Site (OATS)

Test Site Locations

Antenna Port Conducted — Antenna Port conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 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 West 259th Terrace, Louisburg, KS

NVLAP Accreditation — Lab code 200087-0

Units of Measurements

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

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses

RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB) - Gain (dB)

Environmental Conditions

Ambient Temperature	21.3° C
Relative Humidity	38%
Atmospheric Pressure	1015.1 mb

Statement of Modifications and Deviations

No modifications to the EUT were required during investigation for the equipment to demonstrate compliance with the CFR47, Part 2.1043 or Paragraph 87 requirements. There were no deviations to the specifications.

List of Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☐ LISN	FCC	FCC-LISN-50-2-10(1PA) (160611)	.15-30MHz	5/15/17	5/15/18
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/24/17	10/24/18
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/24/17	10/24/18
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/24/17	10/24/18
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/24/17	10/24/18
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/24/17	10/24/18
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/24/17	10/24/18
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/15/17	5/15/18
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/24/17	10/24/19
☐ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15/17	5/15/19
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/24/17	10/24/18
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/24/17	10/24/18
☐ Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/15/17	5/15/18
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/15/17	5/15/18
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	12/22/17	12/22/18
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/17	12/22/19
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/15/17	5/15/18
☐ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	5/15/17	5/15/18
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/15/17	5/15/18
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/24/17	10/24/18
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/24/17	10/24/18
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/24/17	10/24/18
☒ Power Meter	Agilent	N1911A with N1921A	0.05-18 GHz	5/15/17	5/15/18
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	5/15/17	5/15/18
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	5/15/17	5/15/18
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9G notch	30-1800 MHz	5/15/17	5/15/18
☒ Attenuator	Fairview	SA6NFNF100W-14 (1625)	30-1800 MHz	5/15/17	5/15/18
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	5/15/17	5/15/18
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	5/15/17	5/15/18
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14362)	30-6000 MHz	5/15/17	5/15/18
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	5/15/17	5/15/18
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14452)	30-6000 MHz	5/15/17	5/15/18
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	5/15/17	5/15/18
☒ Coupler	NARDA	3002-20	0.5GHz-3GHz	5/15/17	5/15/18

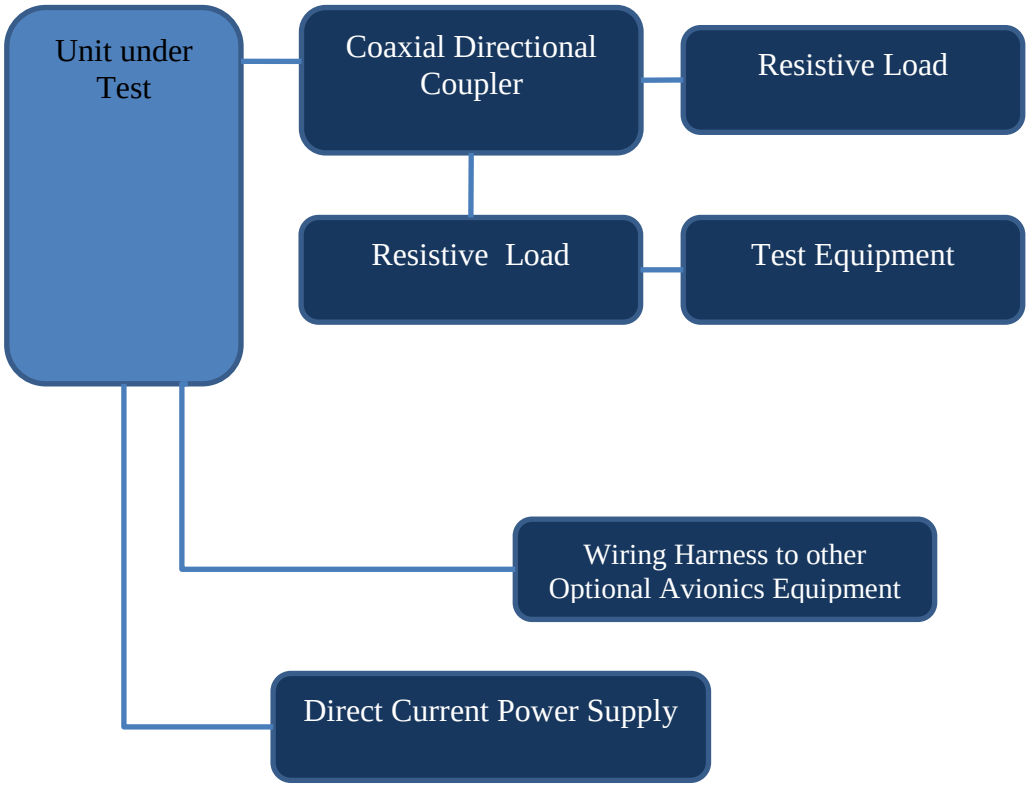
Transmitter Power Output

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 placing a power splitter and attenuation in the antenna line and observing the transmitter emissions with the spectrum analyzer. The spectrum analyzer and attenuation provided 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 one and two 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.

Peak Output Power:

P_{dBm} = power in dB above 1 milliwatt

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

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

	A-Mode	S-Mode
Milliwatts	$= 10^{(55.53/10)}$	$= 10^{(55.60/10)}$
	= 357,272.8 mW	= 363,078.0 mW
	= 357.3 Watts power	= 363.1 Watts power

Average output power is calculated using 1.1% duty cycle.

Average output power:

A-Mode	S-Mode
357.3*0.011 = 3.93W (ave)	363.1*0.011 = 3.99W (ave)

Table 1 Transmitter Power Results

Frequency (MHz)	P_{dBm} (Peak)	P_{mw} (Peak)	P_w (Peak)	P_w (Average)
1090 (A-Mode)	55.53	357,272.8	357.3	3.93
1090 (S-Mode)	55.60	363,078.0	363.1	3.99

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

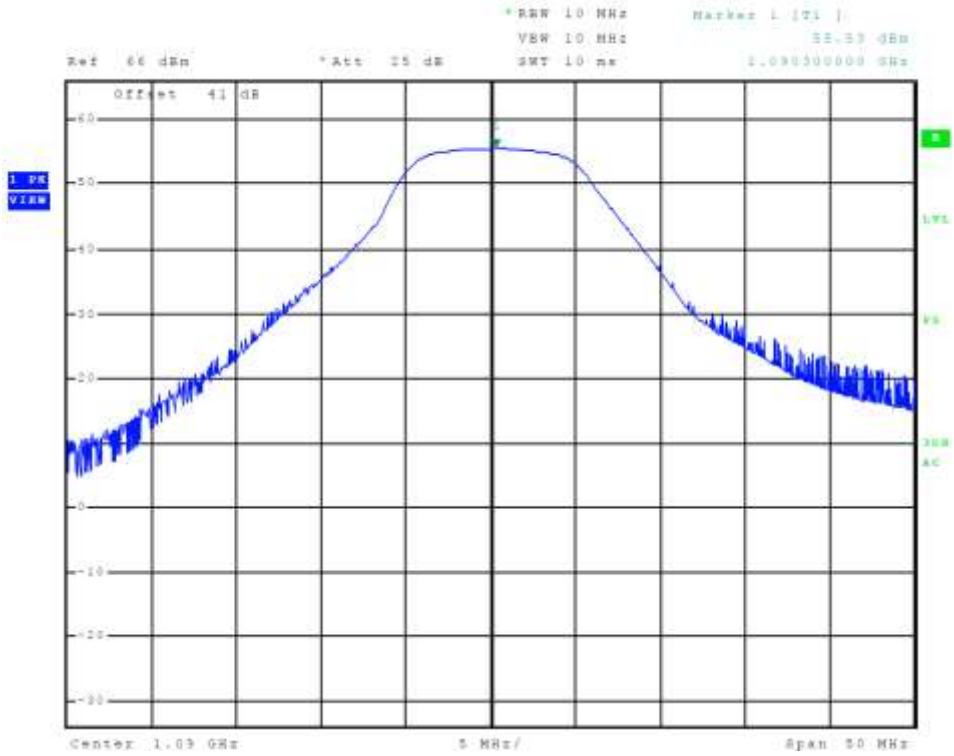


Figure 1 Maximum Power Output Mode-A

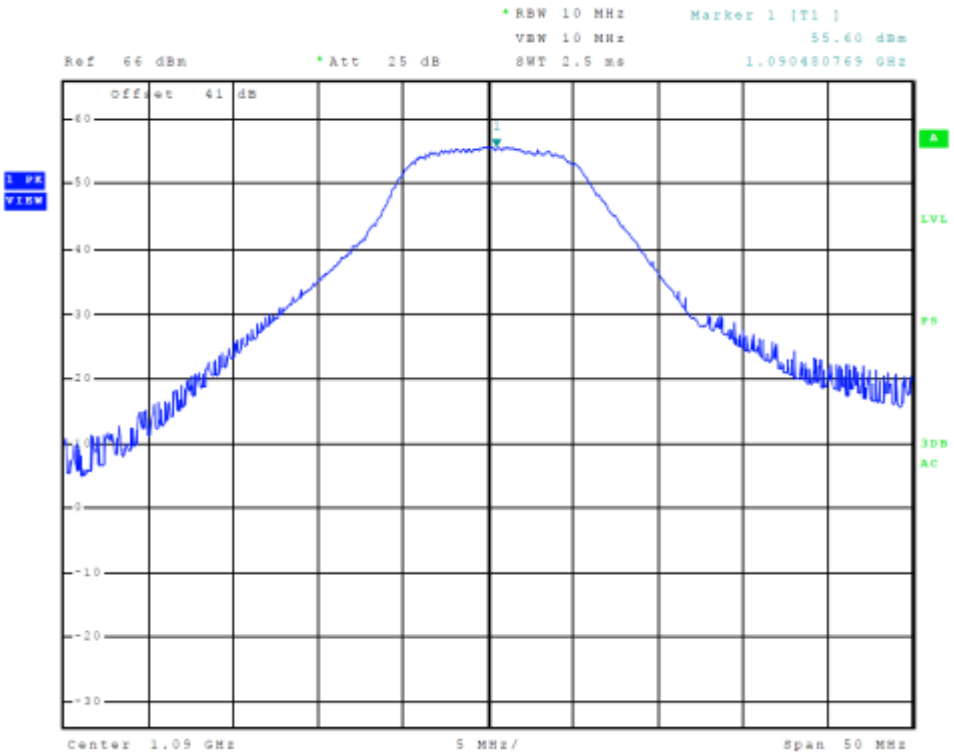


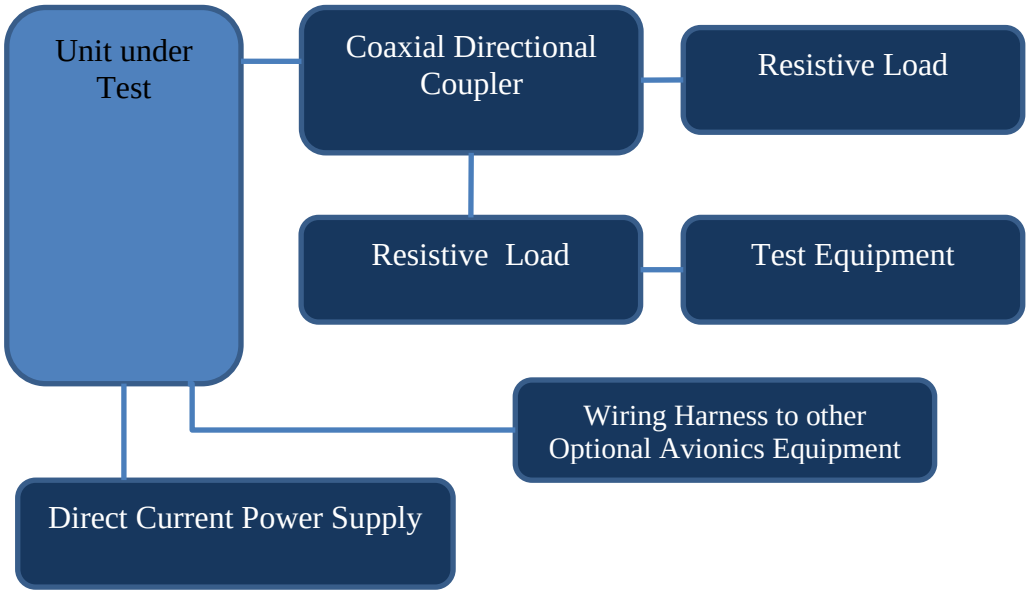
Figure 2 Maximum Power Output mode-S

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 spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in all normal modes. The EUT was set to transmit in normal modes while measurements were made. The power ratio in dB representing 99.5% of the total mean power was recorded from the spectrum analyzer. Refer to figures three and four showing the plot of the 99.5% power occupied bandwidth for operational modes.

Table 2 Occupied Bandwidth Results

Frequency (MHz)	Mode	Occupied bandwidth(MHz)
1090.00	Mode A	8,505.0
1090.00	Mode S	6,795.0

The requirements of 47CFR 2.1049(h) and applicable paragraphs of Part 87.135 are met. There are no deviations to the specifications.

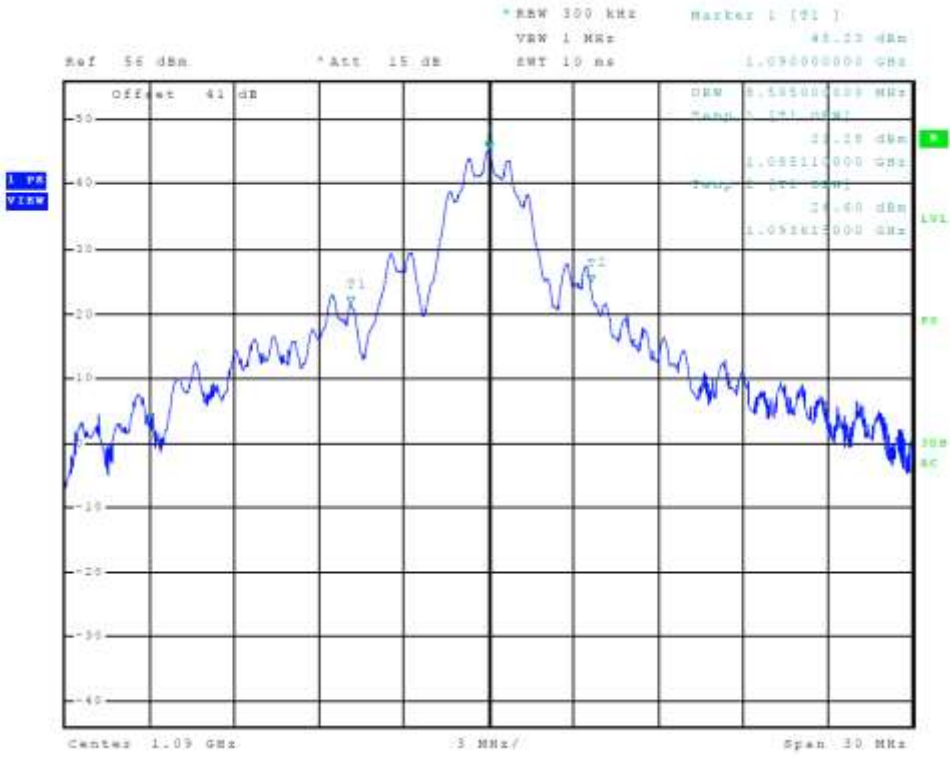


Figure 3 Occupied Band Width Mode A

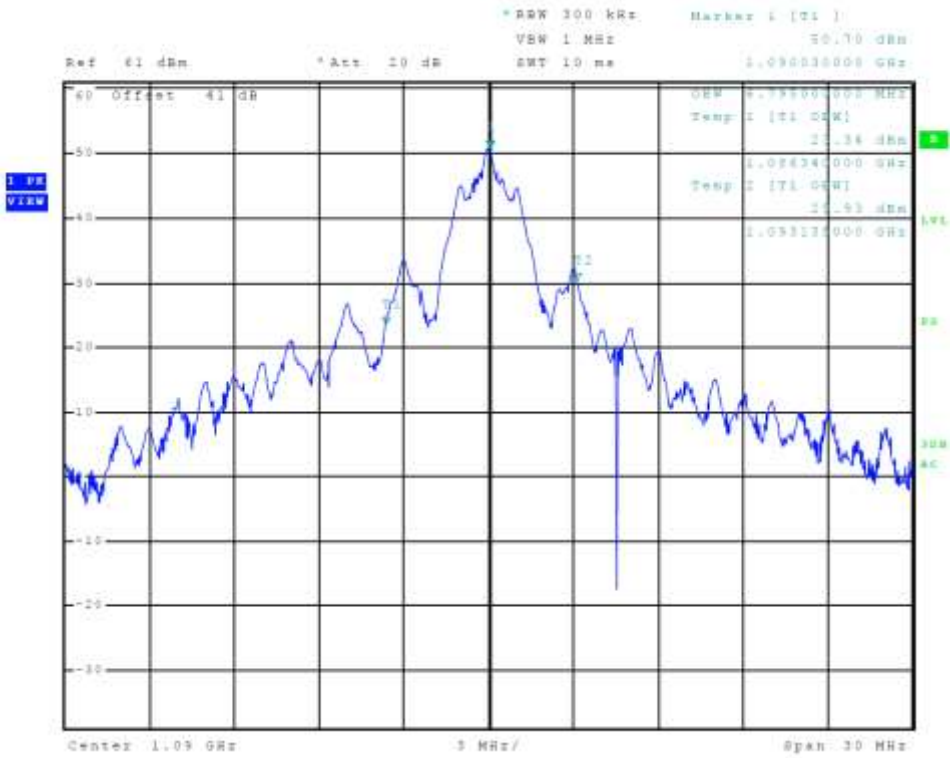


Figure 4 Occupied Band Width Mode S

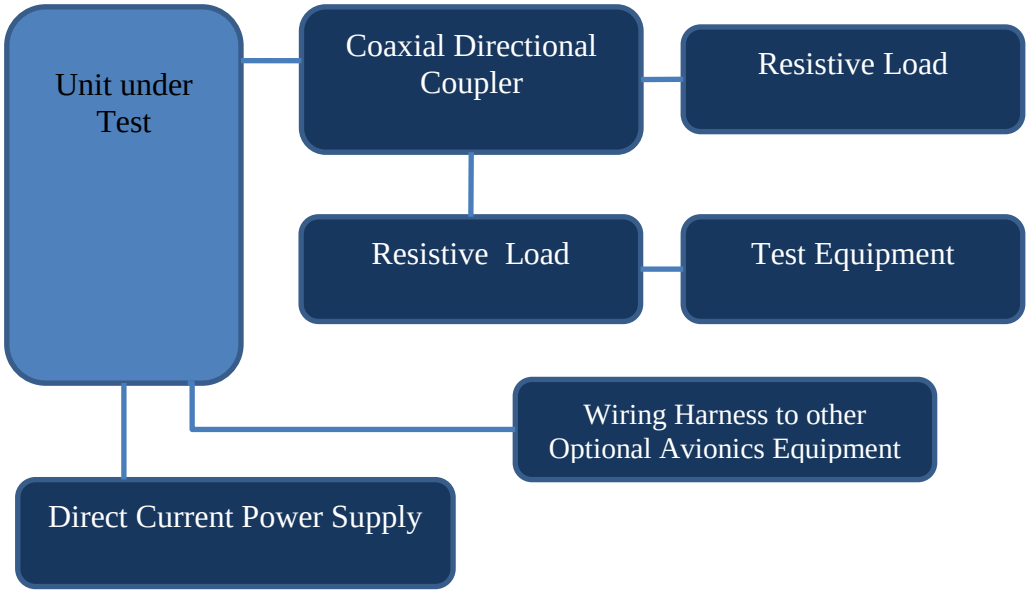
Spurious Emissions at Antenna Terminals

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. All spurious emissions must be attenuated at least 43 +10log (pY) [pY=mean power] below the fundamental emission power level. The following equations represent the calculated attenuation level for the equipment operating with rated average output power of 3.99 Watts.

Limit (dBc) = 43 + 10 Log (pY)
= 43 + 10 Log (3.99)
= 49.0 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 operated in all normal modes. The frequency spectrum from 30 MHz to 11,000 MHz was observed and plots produced of the frequency spectrum displayed on the test equipment. Refer to figures five through eleven for plots of the spurious emissions at antenna port. Data was taken per CFR47 2.1051, 2.1057, and applicable paragraphs of Part 87.139. There are no deviations to the specifications.

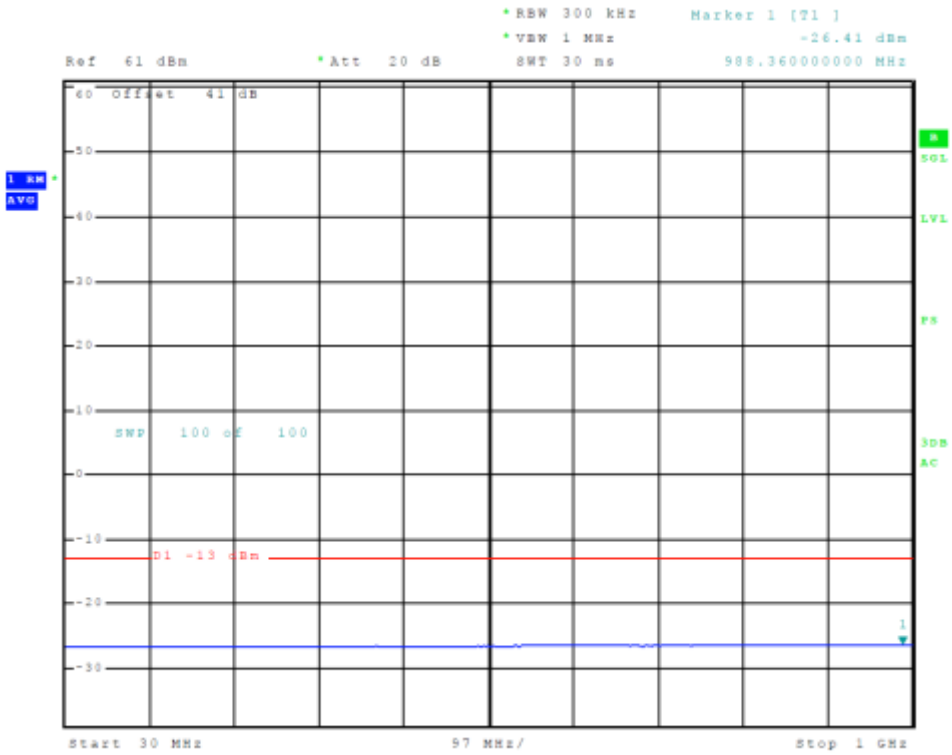


Figure 5 Spurious Emissions at Antenna Terminal

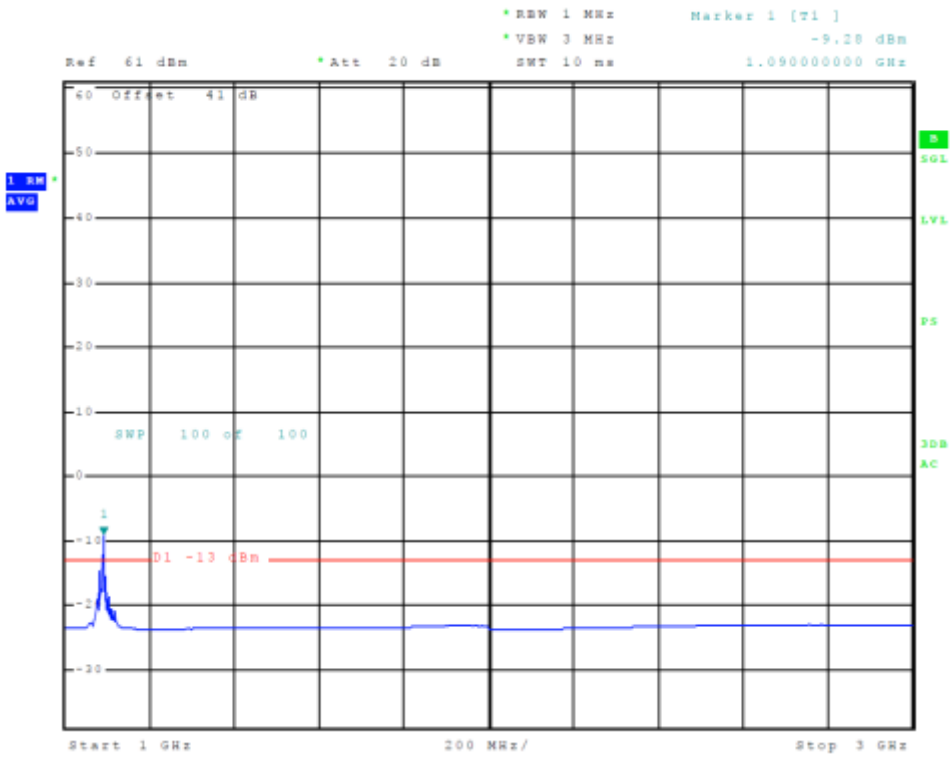


Figure 6 Spurious Emissions at Antenna Terminal

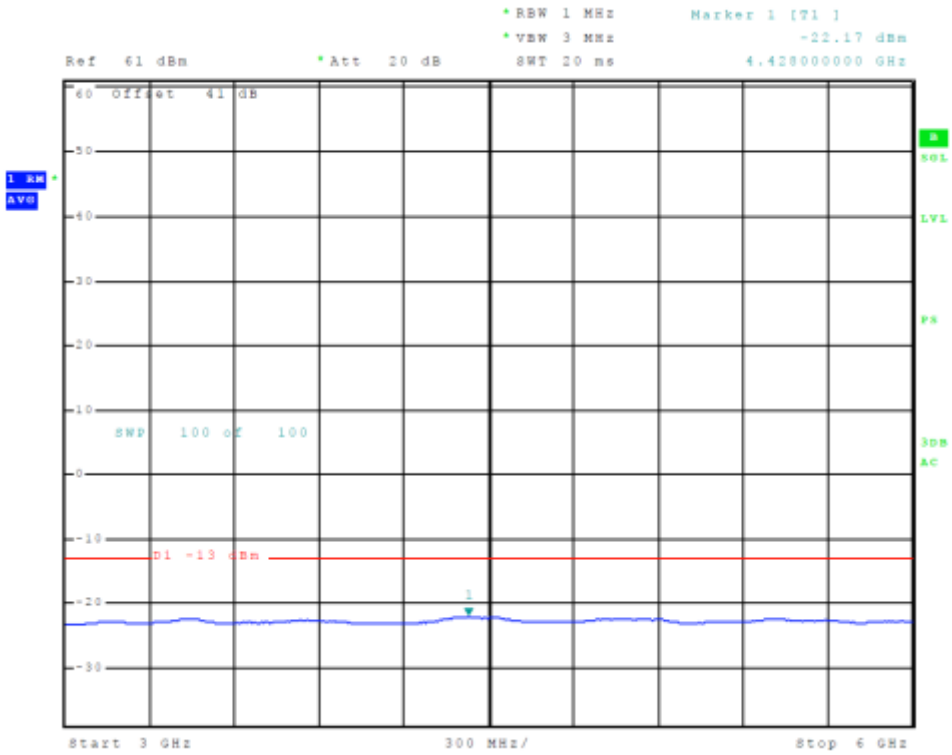


Figure 7 Spurious Emissions at Antenna Terminal

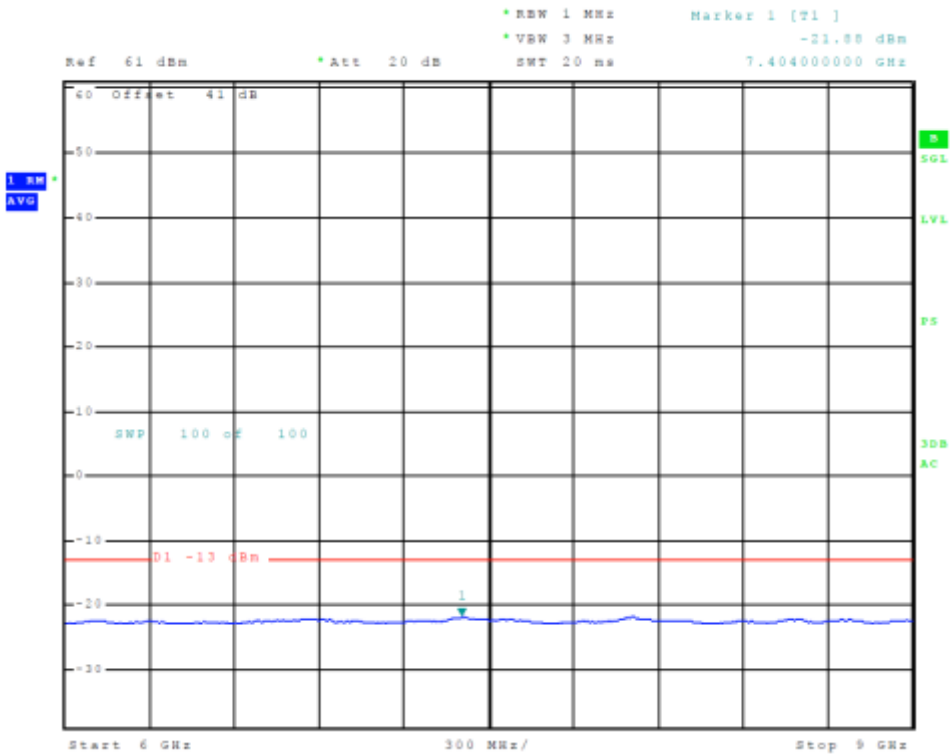


Figure 8 Spurious Emissions at Antenna Terminal

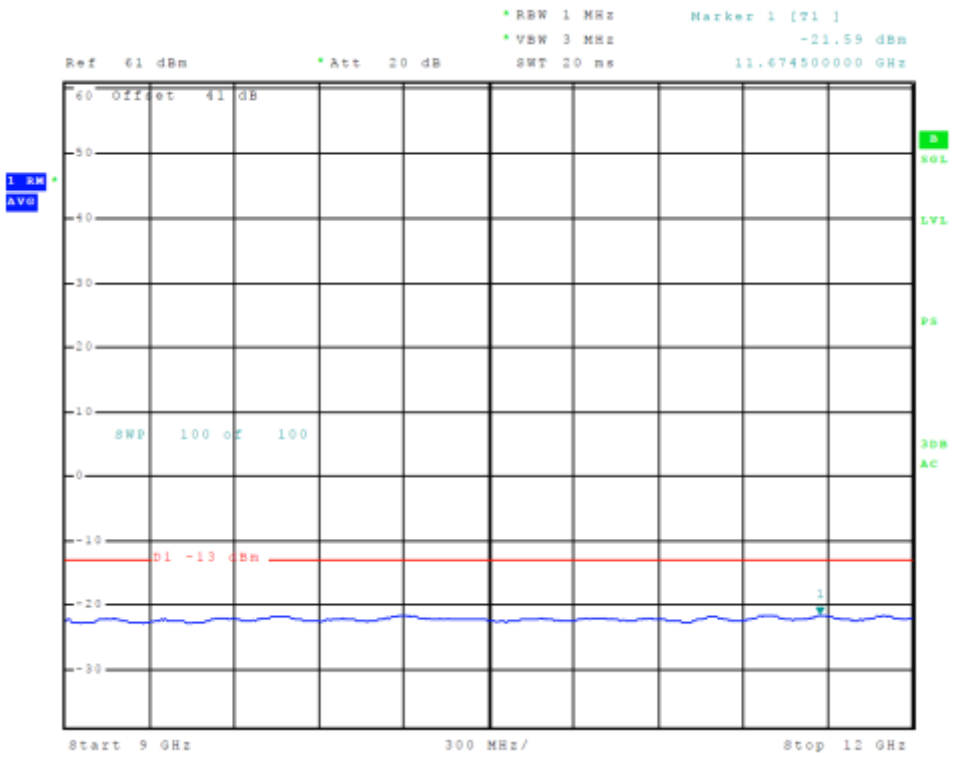


Figure 9 Spurious Emissions at Antenna Terminal

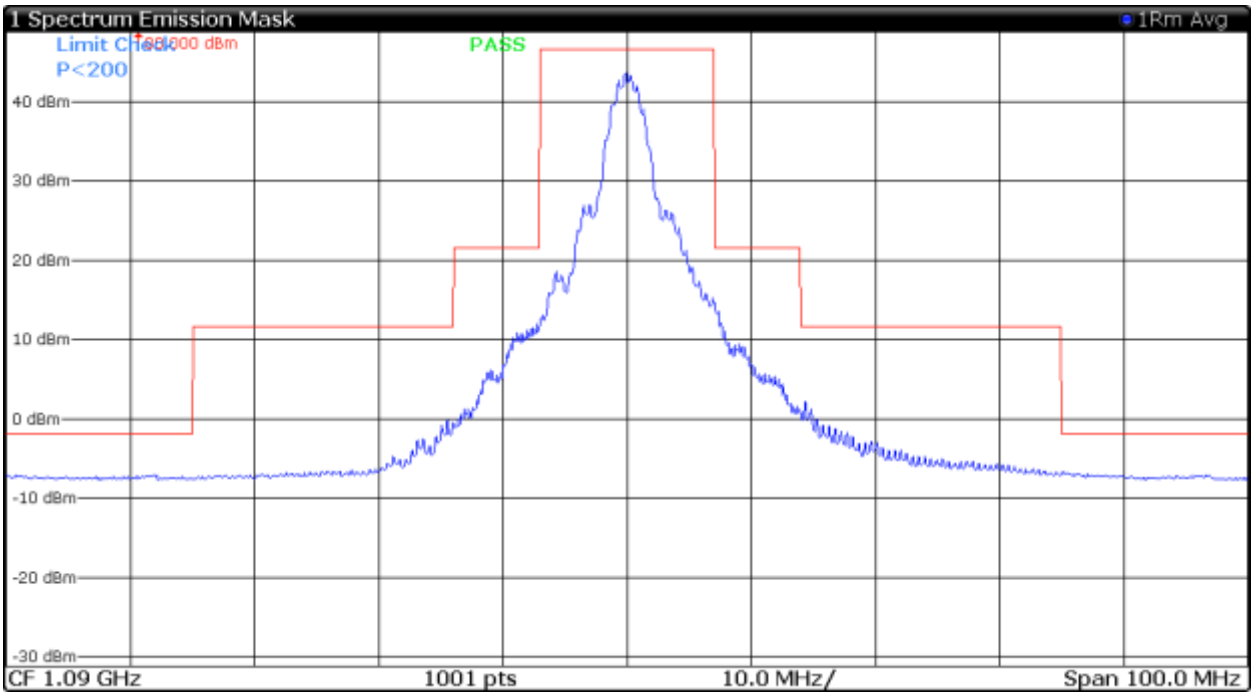


Figure 10 Emissions Mask (Mode-A)

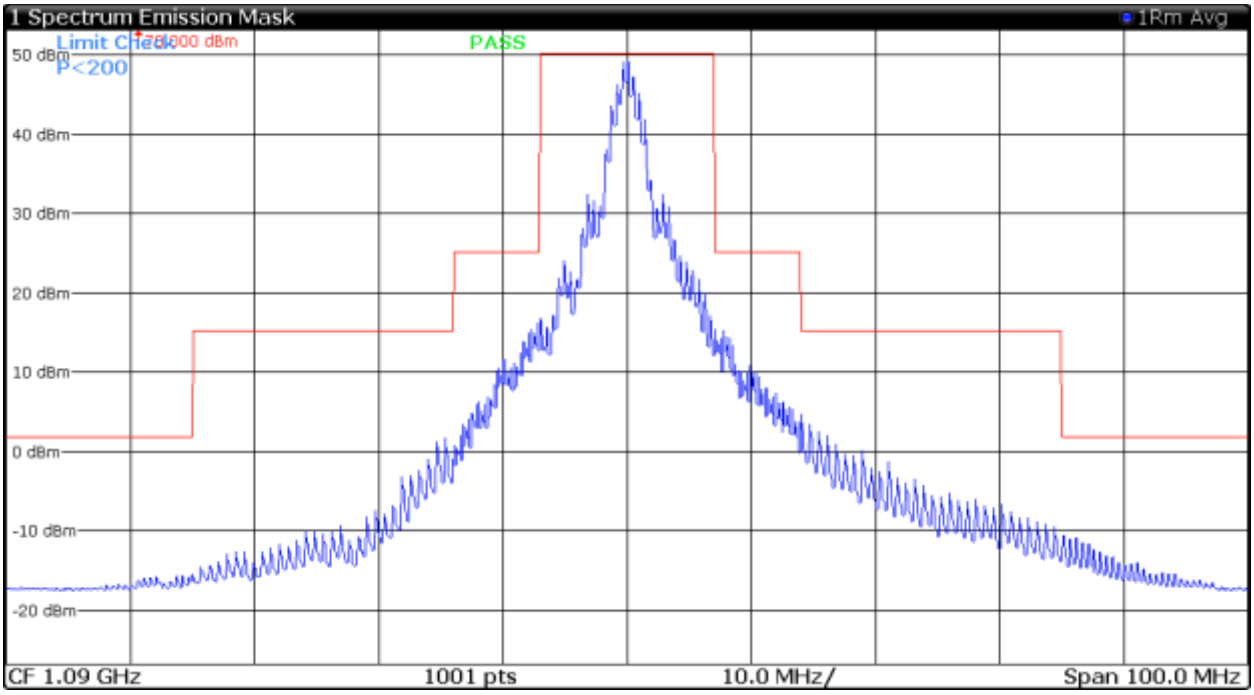


Figure 11 Emissions Mask (Mode-S)

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

Spurious Emissions Limit shall be attenuated at least 49.0 dB below fundamental carrier (dBc).

Limit (dBc) = 43 + 10 Log (Po)
= 43 + 10 Log (3.99)
= 49.0 dBc

Table 3 Spurious Emissions at Antenna Terminal Results Mode-A

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
1090.00	2180.0	-30.70	86.2
	3270.0	-38.90	94.4
	4360.0	-20.40	75.9
	5450.0	-48.00	103.5
	6540.0	-51.70	107.2
	7630.0	-35.00	90.5
	8720.0	-52.00	107.5
	9810.0	-36.40	91.9
	10900.0	-26.70	82.2

Table 4 Spurious Emissions at Antenna Terminal Results Mode-S

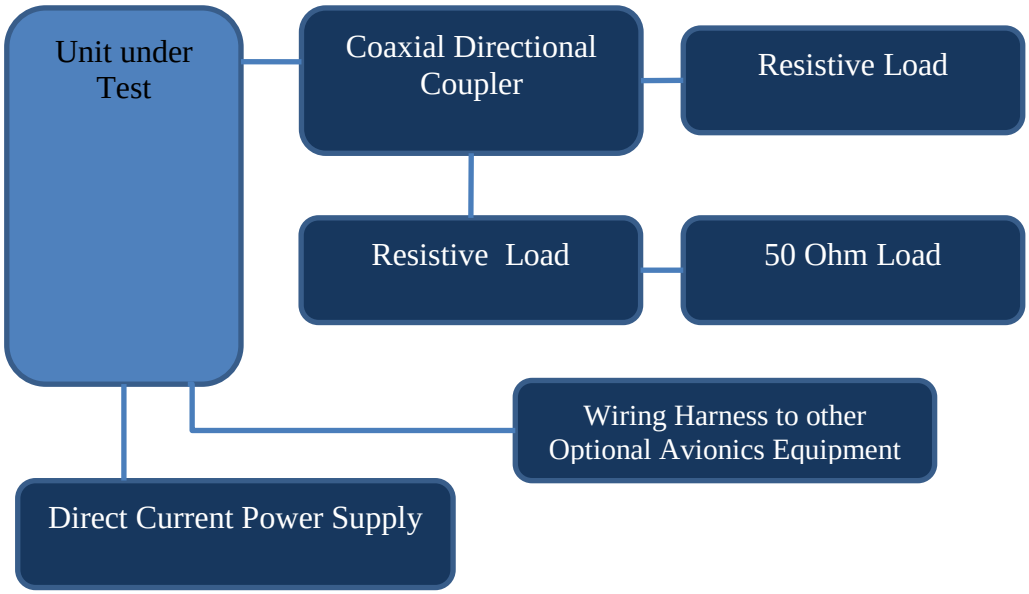
Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
1090.00	2180.0	-27.20	82.7
	3270.0	-37.80	93.3
	4360.0	-16.50	72.0
	5450.0	-46.30	101.8
	6540.0	-52.20	107.7
	7630.0	-31.10	86.6
	8720.0	-51.30	106.8
	9810.0	-31.20	86.7
	10900.0	-22.10	77.6

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. The sample offered for testing utilized interfacing with laptop computer to provide operational control with all functions of the 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. Final radiated emission testing was performed with the transmitter placed on a supporting turntable platform 0.8 meters above the ground plane at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. The EUT was operational and radiating into a 50Ω load during testing. 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 9 kHz to 11 GHz was investigated during radiated emissions testing. A loop antenna was used for measuring frequencies from 9 kHz to 30 MHz, a Broadband Hybrid antenna was used for frequency measurements of 30 to 1000 MHz. Double-ridge horns were used for measuring frequencies above 1000 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.

All spurious emissions must be attenuated at least 43 +10log (pY) [pY=mean power] below the fundamental emission power level. The following equation represents the calculated attenuation levels for the equipment.

Limit (dBc) = 43 + 10 Log (pY)
= 43 + 10 Log (3.99)
= 49.0 dBc

Requirement average output power 36.0 dBm less the requirement 49.0 dBc equates to an absolute level of -13 dBm.

Table 5 General Spurious Radiated Emission Results

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	
66.5	21.1	22.4	-73.63	-72.43	109.2	108.0	49.0
84.3	21.6	22.8	-71.83	-68.03	107.4	103.6	49.0
100.2	23.4	27.2	-71.33	-79.03	106.9	114.6	49.0
150.7	23.9	16.2	-76.53	-78.13	112.1	113.7	49.0
166.3	18.7	17.1	-75.93	-78.73	111.5	114.3	49.0
300.0	19.3	16.5	-75.33	-76.73	110.9	112.3	49.0
375.0	19.9	18.5	-55.73	-61.93	91.3	97.5	49.0
625.0	39.5	33.3	-68.53	-67.53	104.1	103.1	49.0
680.0	26.7	27.7	-73.63	-72.43	109.2	108.0	49.0

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.

Table 6 Spurious Radiated Emission Results Harmonics

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	
2180.0	28.2	28.8	-67.03	-66.43	102.6	102.0	49.0
3270.0	30.7	31.4	-64.53	-63.83	100.1	99.4	49.0
4360.0	36.5	34.9	-58.73	-60.33	94.3	95.9	49.0
5450.0	33.4	32.8	-61.83	-62.43	97.4	98.0	49.0
6540.0	32.4	32.3	-62.83	-62.93	98.4	98.5	49.0
7630.0	31.9	32.0	-63.33	-63.23	98.9	98.8	49.0

The EUT demonstrated compliance with specifications of CFR47 Paragraph 2.1053, 2.1057, and applicable Parts of 2 and 87.139. There are no deviations to the specifications. 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 Certificate of Accreditation
- Annex E Photographs of Equipment Tested

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 Cal Date(m/d/y)	Due
Spectrum Analyzer: Rohde & Schwarz ESU40	5/15/17	5/15/18
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/15/17	5/15/18
Spectrum Analyzer: HP 8591EM	5/15/17	5/15/18
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)	5/15/17	5/15/18
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)	5/15/17	5/15/18
Antenna: EMCO Log Periodic Model: 3147	10/24/17	10/24/18
Antenna: EMCO 6509	10/24/17	24/10/19
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohms/0.1 µf	10/24/17	10/24/18
R.F. Preamp CPPA-102	10/24/17	10/24/18
Attenuator: HP Model: HP11509A	10/24/17	10/24/18
Cable: Belden 8268 (L3)	10/24/17	10/24/18
Cable: Time Microwave: 4M-750HF290-750	10/24/17	10/24/18
Cable: Time Microwave: 10M-750HF290-750	10/24/17	10/24/18
Frequency Counter: Leader LDC825	2/23/18	2/23/19
Oscilloscope Scope: Tektronix 2230	2/23/18	2/23/19
Wattmeter: Bird 43 with Load Bird 8085	2/23/18	2/23/19
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/23/18	2/23/19
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/23/18	2/23/19
R.F. Power Amp 65W Model: 470-A-1010	2/23/18	2/23/19
R.F. Power Amp 50W M185- 10-501	2/23/18	2/23/19
R.F. Power Amp A.R. Model: 10W 1010M7	2/23/18	2/23/19
R.F. Power Amp EIN Model: A301	2/23/18	2/23/19
LISN: Compliance Eng. Model 240/20	2/23/18	2/23/19
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/23/18	2/23/19
Antenna: EMCO Dipole Set 3121C	2/23/18	2/23/19
Antenna: C.D. B-101	2/23/18	2/23/19
Antenna: Solar 9229-1 & 9230-1	2/23/18	2/23/19
Audio Oscillator: H.P. 201CD	2/23/18	2/23/19
ESD Test Set 2010i	2/23/18	2/23/19
Fast Transient Burst Generator Model: EFT/B-101	2/23/18	2/23/19
Field Intensity Meter: EFM-018	2/23/18	2/23/19
KEYTEK Ecat Surge Generator	2/23/18	2/23/19
Shielded Room Calibration not required		

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

Annex D Rogers Labs Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200087-0

Rogers Labs, Inc.
Louisburg, KS

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

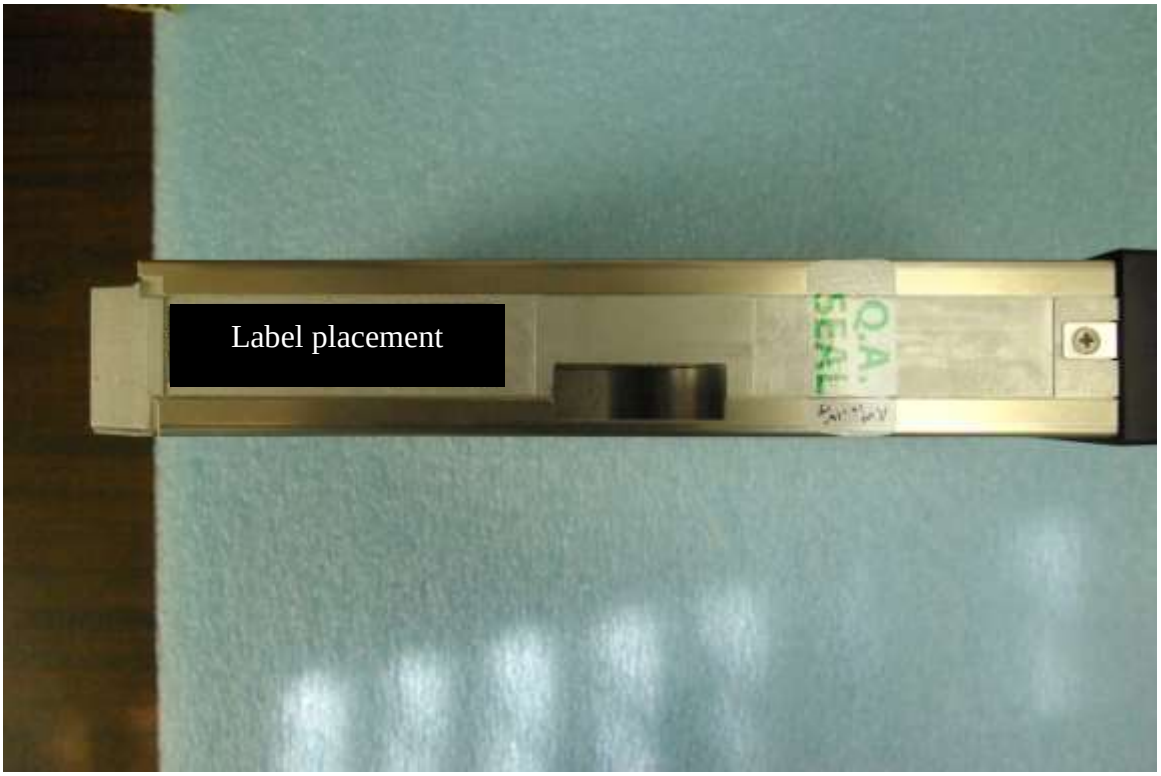
Electromagnetic Compatibility & Telecommunications

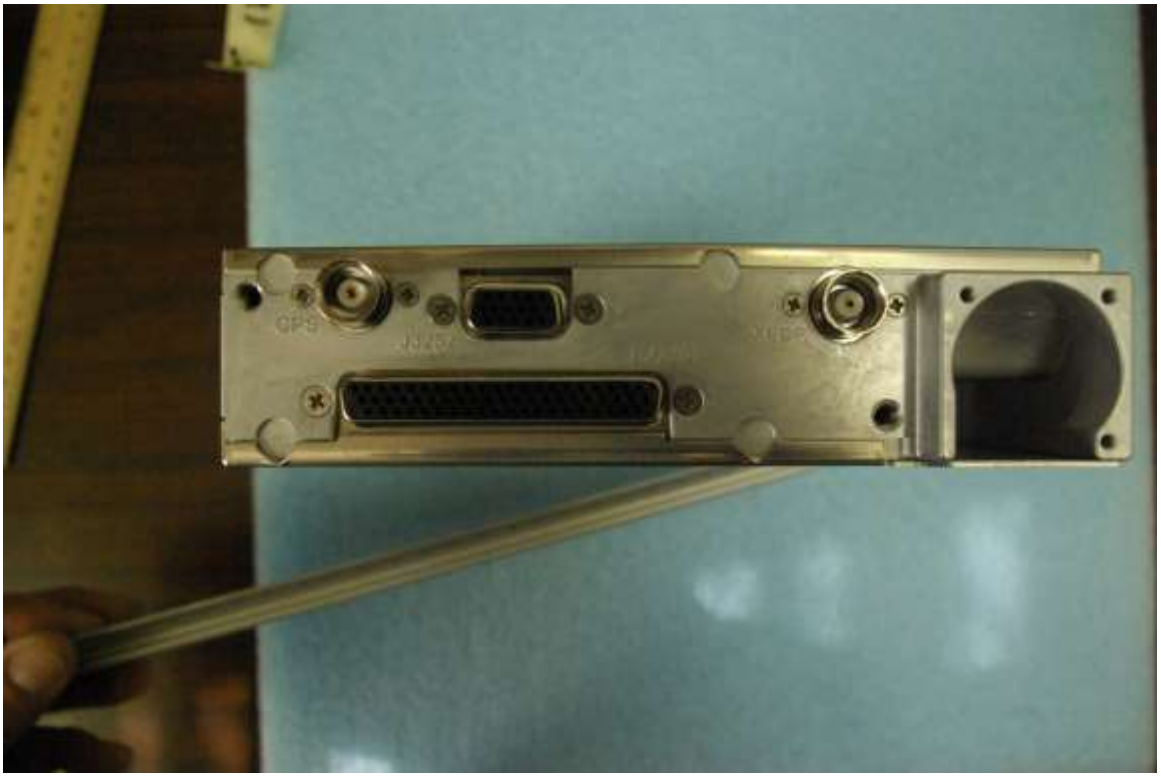
This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2018-02-21 through 2019-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

Annex E Photographs of Equipment


Label placement
Q.A.
SEAL



Photographs of EUT Support Equipment