Application for Grant of Certification

FCC CFR47 Part 87

GMN-00736
Market Label: GTX 3000
GPN: 011-01997-00
1090 MHz
Aviation Transponder Equipment
FCC ID: IPH-01443

For

Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

Test Report Number 111129

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. Van Ruggles
Director of Quality Assurance

Market Label: GTX 3000, GPN: 011-01997-00
Aviation Transponder
Frequency Range: 1090 MHz

FCC ID: IPH-01443

Test Date: November 29, 2011

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th Terrace
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In accordance with the Federal Communications, Code of Federal Regulations dated October 1, 2010, 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 the following information is submitted for consideration in obtaining grant of certification.

Opinion / Interpretation of Results

Tests Performed	Results
Requirements per CFR47 paragraphs 2 2.1031-2.1057	Complies
Requirements per CFR47 paragraphs 87.131	Complies
Requirements per CFR47 paragraphs 87.133 (d)	Complies
Requirements per CFR47 paragraphs 87.135	Complies
Requirements per CFR47 paragraphs 87.139	Complies
Requirements per CFR47 paragraphs 87.141	Complies

Applicable Standards & Test Procedures

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2010, 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 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 C63.4-2009 and/or TIA/EIA 603-C (2004).

Environmental Conditions

Ambient Temperature 20.2° C

Relative Humidity 29%

Atmospheric Pressure 1022.6 mb

Application for Certification

(1) Manufacturer:

Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

(2) Identification: FCC I.D.: IPH-01443

(3) Instruction Book: Refer to exhibit for Draft Instruction Manual.

(4) Emission Type: Emissions designator 8M94M1D

(5) Frequency Range: 1090 MHz

(6) Operating Power Level: 500-Watts peak, 5 Watts (Average Power) delivered at antenna port. Average power calculation assumes 1% duty cycle, 1200 replies per second, ATCRBS 15 pulse replies with maximum allowed pulse width of 550 nS. The average power then calculated 500 Watts times 1% duty cycle results in 5-Watts average power.

(7) Maximum Po: Maximum power output as determined by appropriate standards during certification per CFR 47 paragraph 87.131. Per paragraph 2.2.3.2.d of DO-181D, the maximum RF peak power for all equipment shall be no more than 500 W peak power at the antenna terminals. Assuming 0 dB cable loss, this means the power out of the unit itself shall not exceed 500 W.

(8) Power into final amplifying circuitry: The final amplifier chain operates at 30 volts with peak current of 27.8 amps (834 watts peak).

(9) Tune Up Procedure for Output Power: Refer to Exhibit for Alignment Procedure.

(10) Circuit Diagrams; description of circuits, frequency stability, spurious suppression, and power and modulation limiting: Refer to Exhibit for Circuit Diagrams and theory of Operation.

(11) Photograph or drawing of the Identification Plate: Refer to Exhibit for Photograph or Drawing.

(12) Drawings of Construction and Layout: Refer to Exhibit for Drawings of Components Layout and Chassis Drawings.

(13) Detail Description of Digital Modulation: The modulation for the transmitted pulses is defined in RTCA DO-181D.

The following specifications apply to Modes A and C operation:

The unit employs pulse modulation prescribed by RTCA/DO-181D. This requires pulses of 0.45 ±0.10 microseconds for Mode A/C transmissions with rise times of 0.100-microsecond maximum and fall-times of 0.200 microseconds maximum for both. Twelve information pulses (binary data) shall be spaced in increments of 1.45 microseconds between two framing pulses spaced 20.3 microseconds apart. In addition, a Special Position Identification pulse shall occur at a pulse interval of 4.35 microseconds following the last framing pulse. The SPI pulse shall not be included when transmitting Mode C replies.

The following specifications apply to Mode-S operation

The unit employs pulse modulation prescribed by RTCA/DO-181D. This requires pulses of 0.500 ±0.050 microseconds for Mode S with rise times of 0.100-microsecond maximum and fall-times of 0.200 microseconds maximum for both. The maximum rated condition, Mode S reply, has a 120 microsecond length with four pulses in the first eight microseconds, which is called the preamble, and pulses of 0.5 or 1.0 microsecond length filling in the next 112 microseconds, which is called the data block. Binary data is coded by the pulse position in the one-microsecond frames

(14) Data required by CFR47 paragraphs 2.1046 through 2.1057 are contained in the report.

(15) External power amplifier requirements do not apply to this device or application.

(16) AM broadcast requirements do not apply to this device or application.

(17) Requirements of CFR47 paragraph 25.129 do not apply to this device or application.

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

System Description

The EUT is a remote mount Mode A, C and S avionics transponder. The design offers addition of altitude reporting, multiple transmit/receive ARINC 429, RS-232, analog, and discrete data ports. The unit operates on radar frequencies, receiving ground radar or TCAS interrogations at 1030 MHz and transmitting a coded response of pulses back at 1090 MHz.

Units of Measurements

AC Line Conducted EMI Data is in dBμV; dB referenced to one microvolt.

Radiated EMI Data is in dBμV/m; dB/m referenced to one microvolt per meter

Antenna Conducted Data is in dBm, dB referenced to one milliwatt

Test Site Locations

Conducted EMI	The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.
Radiated EMI	The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.
Site Approval	Refer to Annex for FCC Site Registration Letter, # 90910, and Industry Canada Site Registration Letter, IC3041A-1.

List of Test Equipment

A Rohde & Schwarz ESU 40 and/or Hewlett Packard 8591EM was used as the measuring device for emissions testing of frequencies below 1 GHz. A Rohde & Schwarz ESU 40 and/or Hewlett Packard 8562A was used as the measuring device for testing 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.

Emissions at Frequencies below 1000 MHz		
Conducted Emissions		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Radiated Emissions		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions at Frequencies above 1000 MHz		
RBW	Video BW	Detector Function
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/11	10/12
Antenna	ARA	BCD-235-B	10/11	10/12
Antenna	EMCO	3147	10/11	10/12
Antenna	Sunol	JB6	10/11	10/12
Antenna	Com Power	AH-118	10/11	10/12
Antenna	EMCO	3143	5/11	5/12
Analyzer	HP	8591EM	5/11	5/12
Analyzer	HP	8562A	5/11	5/12
Analyzer	Rohde & Schwarz	ESU40	5/11	5/12

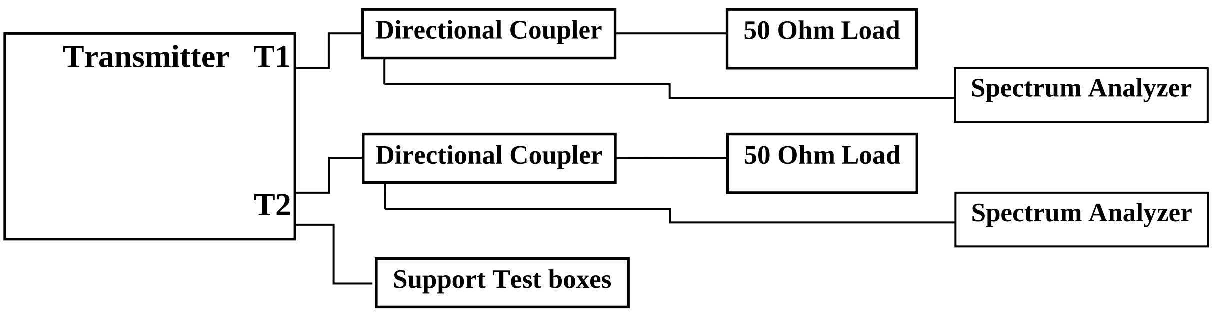
Radio Frequency Power Output

Measurements Required

Measurements shall be made to establish the radio frequency power delivered by the transmitter into the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun except as noted below:

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

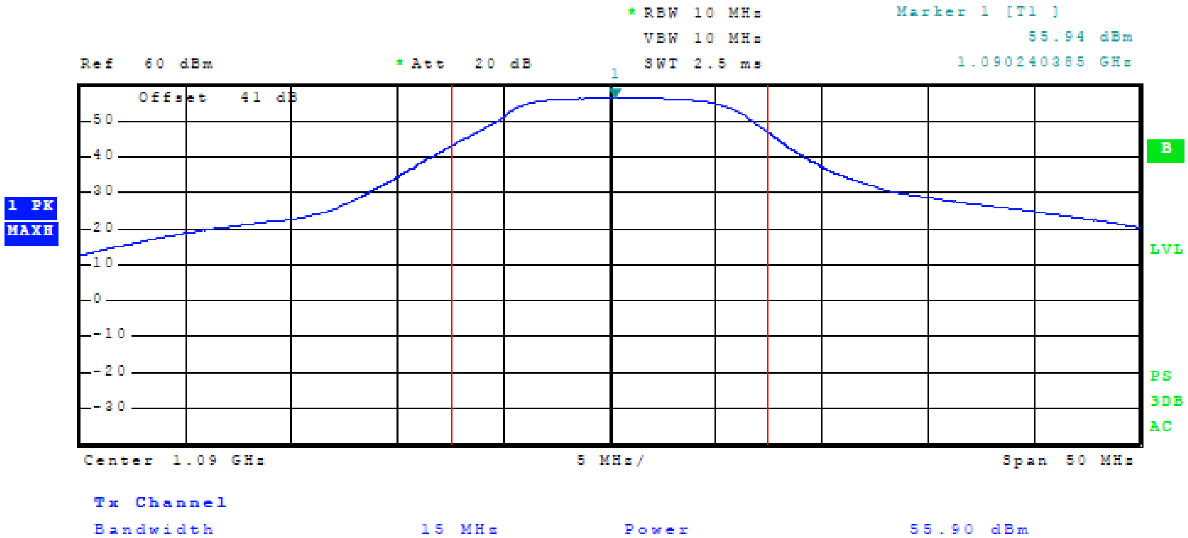
Test Arrangement



The radio frequency power output was measured at the antenna terminal by placing appropriate attenuation in the antenna line and observing the emission with the spectrum analyzer. The spectrum analyzer had an impedance of 50Ω to match the impedance of the standard antenna. A Rohde Schwarz ESU-40 and/or HP 8562A 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 Figure 1 showing the maximum output power of the transmitter. Data was taken per CFR47 Paragraph 2.1046(a) and applicable paragraphs of Part 87.

PdBm = power in dB above 1 milliwatt.
Milliwatts = $10^{(PdBm/10)}$
Watts = (Milliwatts) (0.001) (W/mW)
Milliwatts = $10^{(55.91/10)}$
= 389,942.0 mW
= 400 Watts Peak power

T1 (Top Port)



T2 (Bottom Port)

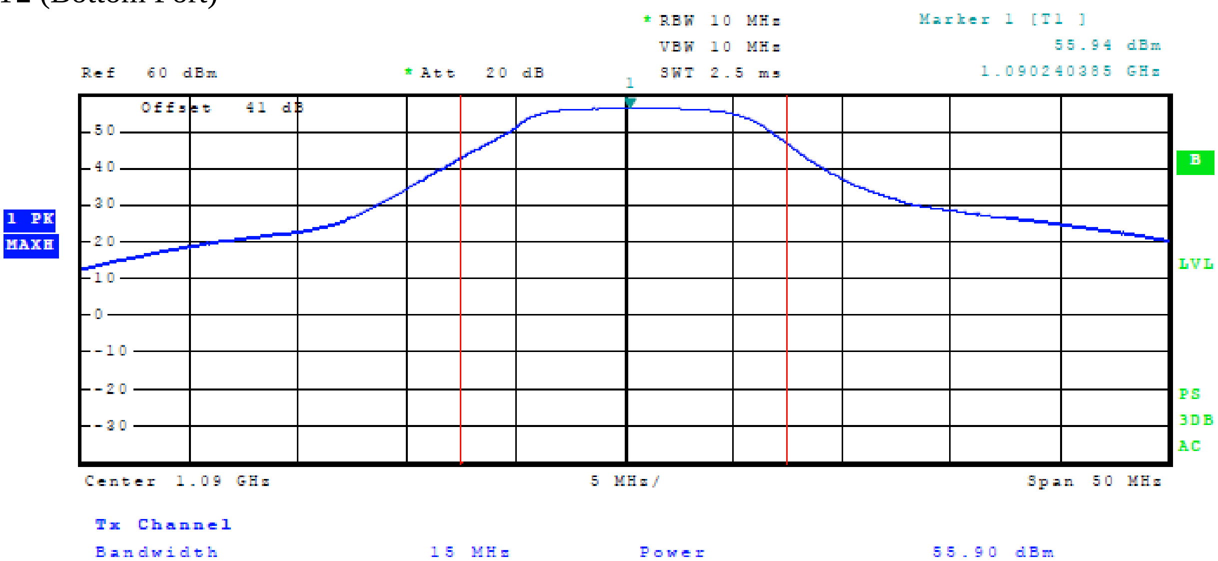


Figure 1 Maximum Power Output

Radio Frequency Power Output Results

Frequency (MHz)	Antenna Port	P (dBm)	P (mw)	P (Watts)
1090.0	T1	55.91	389,942.0	400
1090.0	T2	55.90	389,045.1	400

The specifications of CFR47 Paragraph 2.1046(a) and applicable Parts of 2 and 87.131 are met.

There are no deviations to the specifications.

Modulation Characteristics

Measurements Required

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules, under which the equipment is to be licensed, shall be submitted.

The modulation specifications are defined by the RTCA DO-181D. The following specifications apply to ATCRBS reply pulses:

Specification	Data	Unit
Rise Time (10%/90%)	50-100	ns
Fall Time (90%/10%)	50-200	ns
Pulse width	450 +/- 100	ns

The following specifications apply to Mode-S reply pulses:

Specification	Data	Unit
Rise Time (10%/90%)	50-100	ns
Fall Time (90%/10%)	50-200	ns
Pulse Width (preamble pulses)	500 +/- 50	ns
Pulse Width (data pulses)	500 +/- 50	ns
Pulse Width (data pulses)	1 +/- 0.05	us

Modulation Characteristics Results

Figures 2 through 4 depict oscilloscope screen display of interrogation reply pulses while equipment operational in normal modes. The requirements of CFR47 2.1049(c)(1) and applicable paragraphs of Part 87.141 are met. There are no deviations to the specifications.

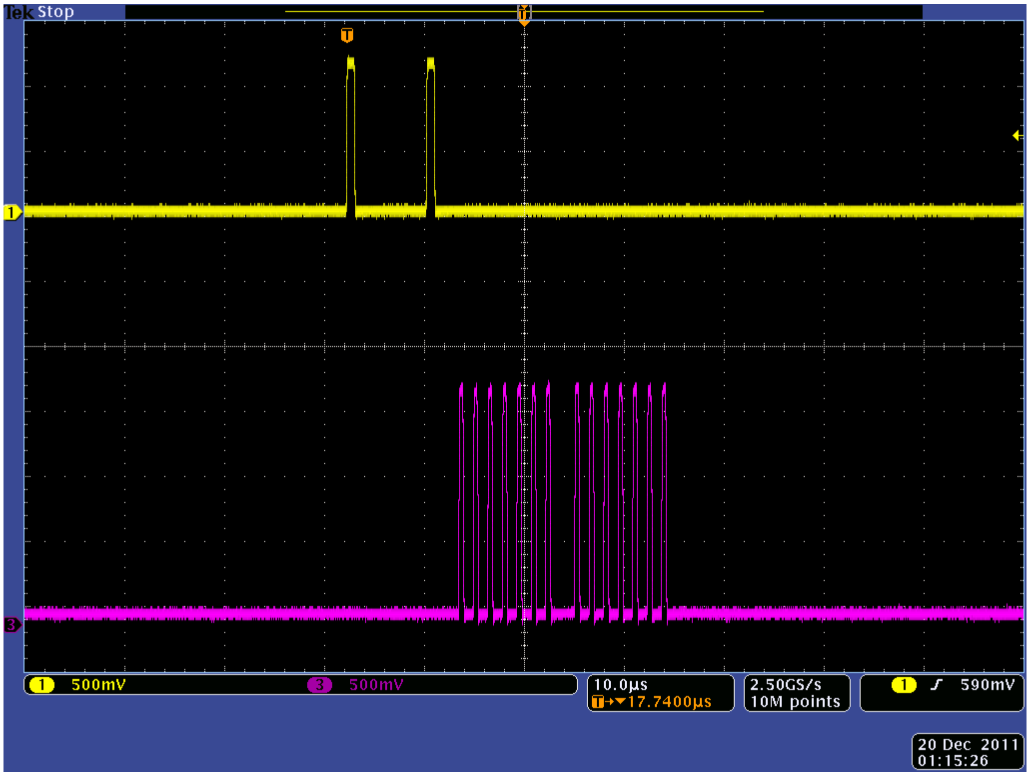


Figure 2 Plot of ATCRBS Reply

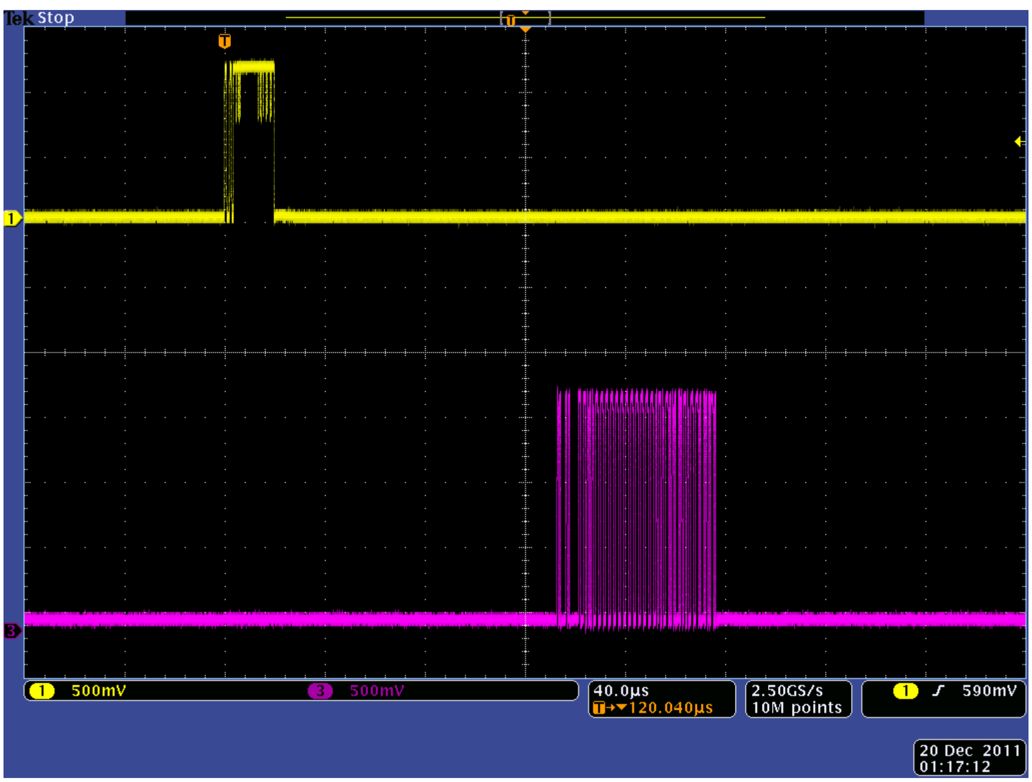


Figure 3 Plot of Mode S Short Reply

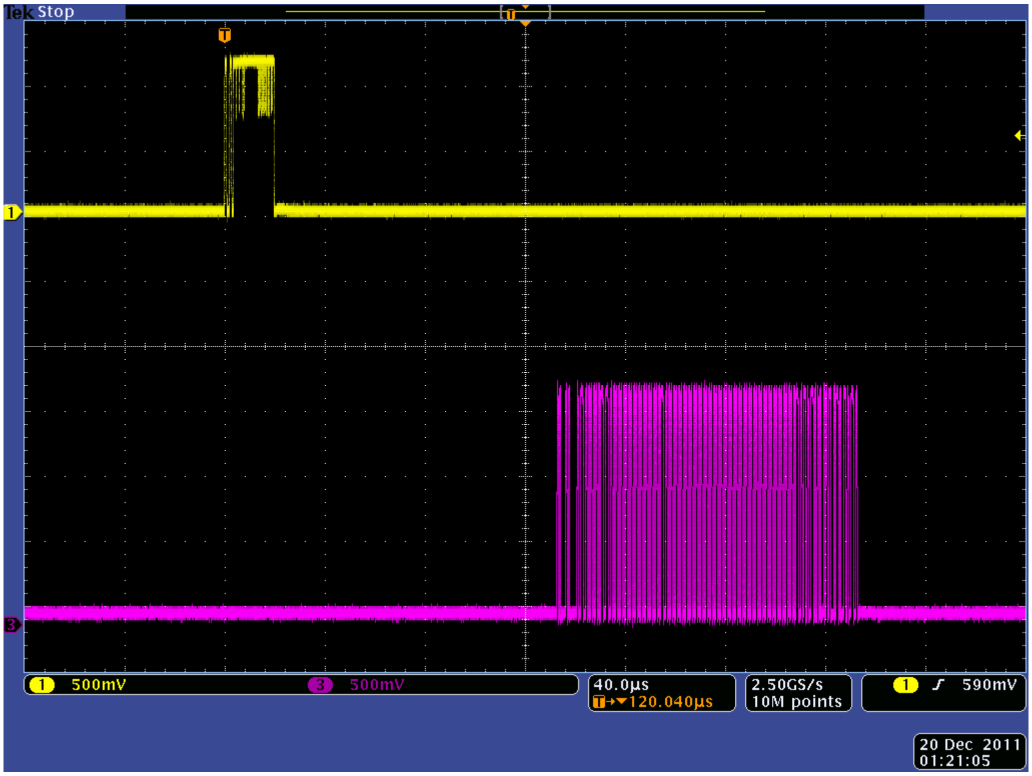


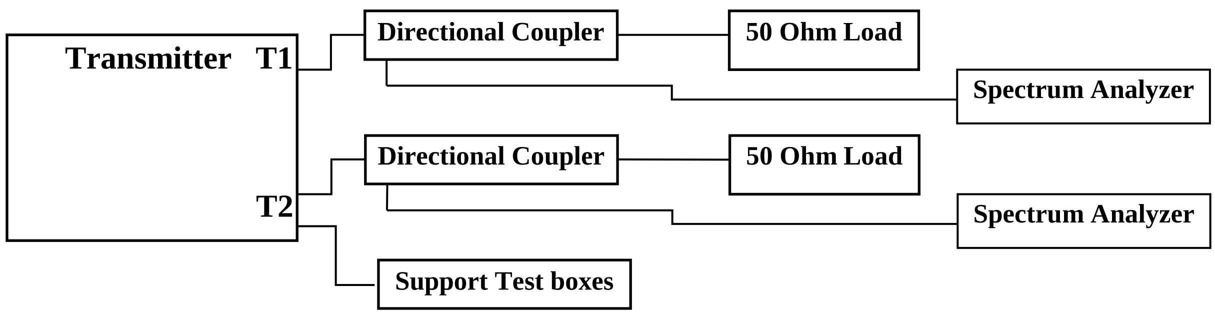
Figure 4 Plot of Mode S Long Reply

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 5 through 9 showing the plot of the 99.5% power occupied bandwidth for operational modes.

Occupied Bandwidth Results

Frequency (MHz)	Mode	Occupied bandwidth(MHz)
1090.00	Mode S - Short	8,141.2
1090.00	Mode S - Long	8,365.4
1090.00	Mode A – (7777)	8,878.2
1090.00	Mode A – (0000)	8,942.3

The requirements of CFR47 2.1049(h) and applicable paragraphs of Part 87.135 are met. There are no deviations to the specifications.

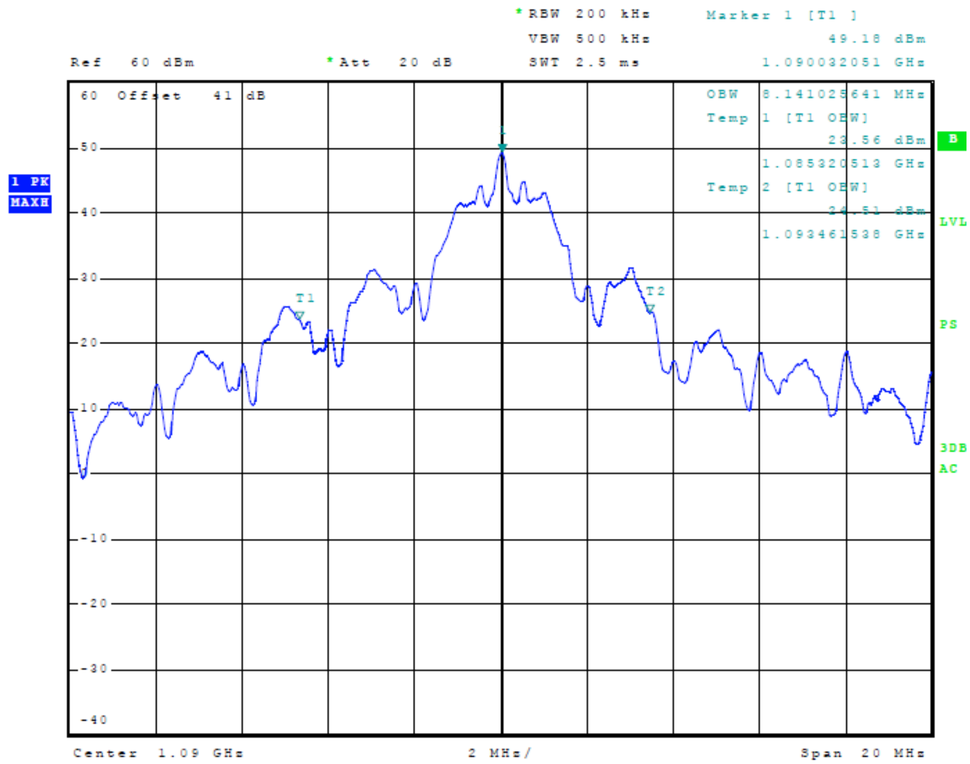


Figure 5 Mode S (short) Occupied Band Width

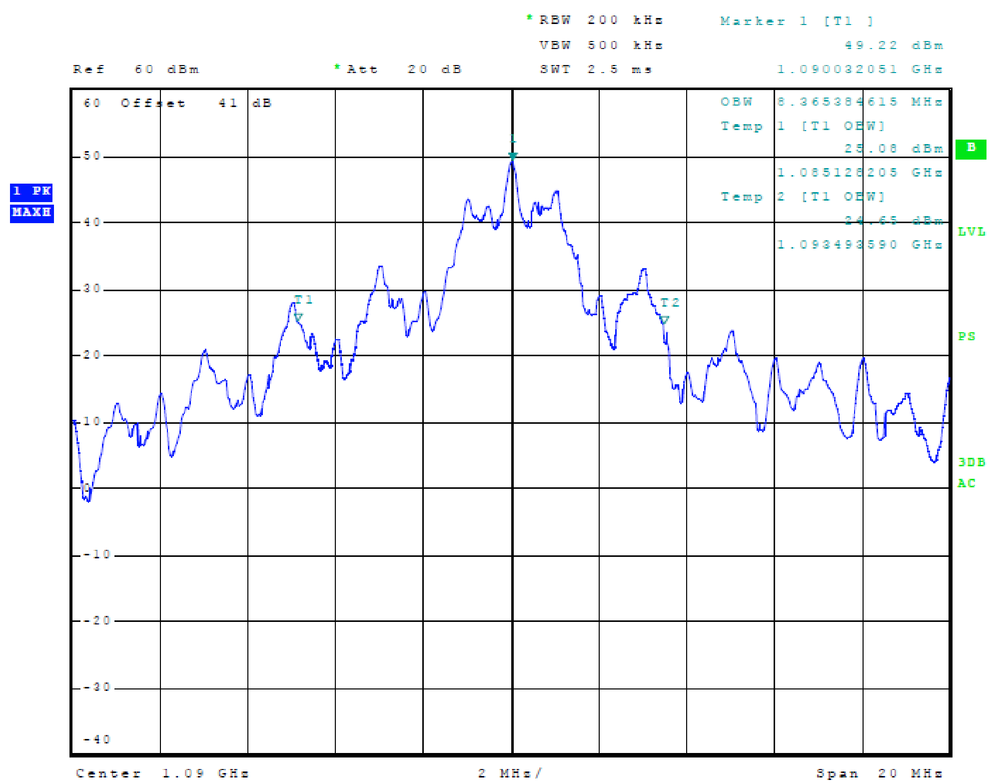


Figure 6 Mode S (Long) Occupied Band Width

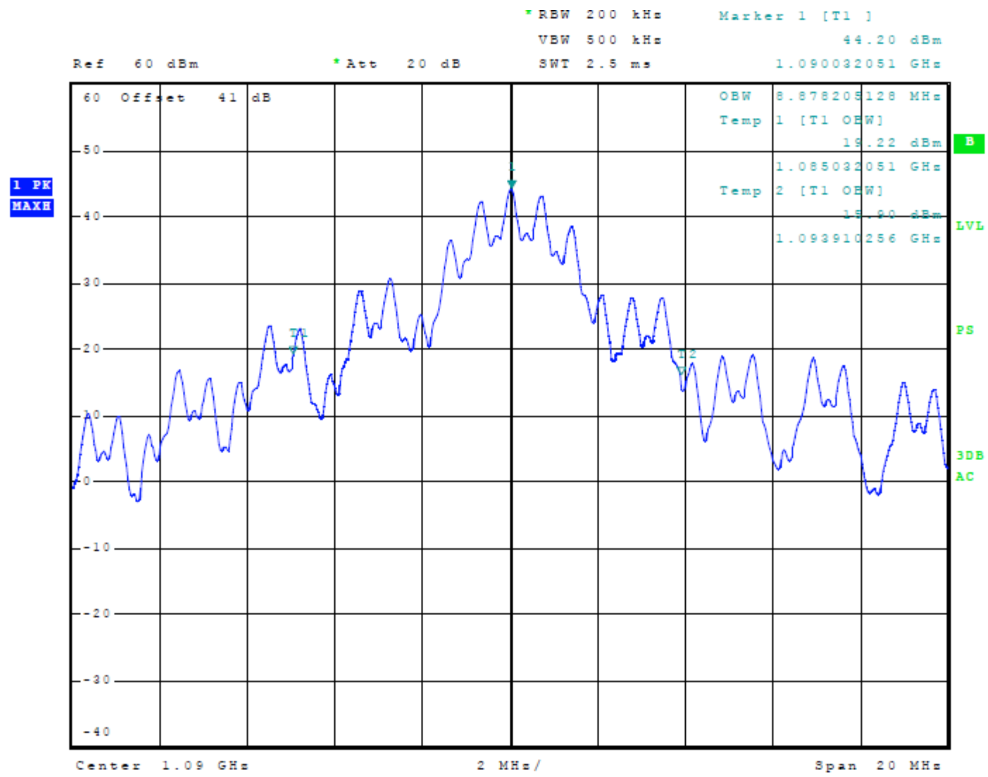


Figure 7 Mode A (7777) Occupied Band Width

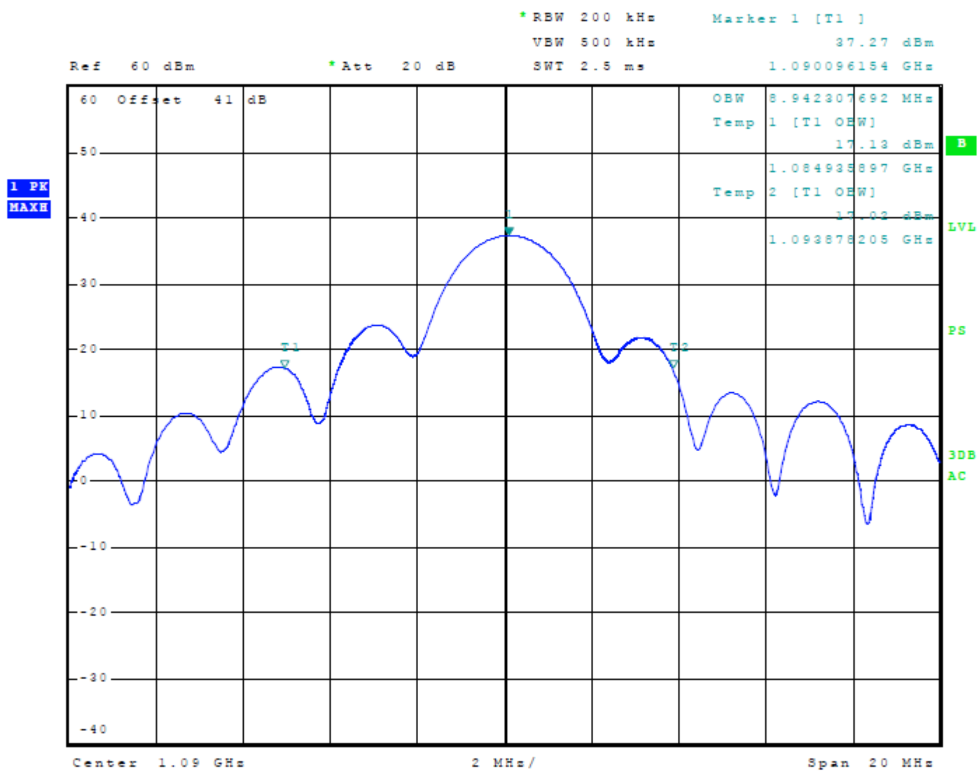


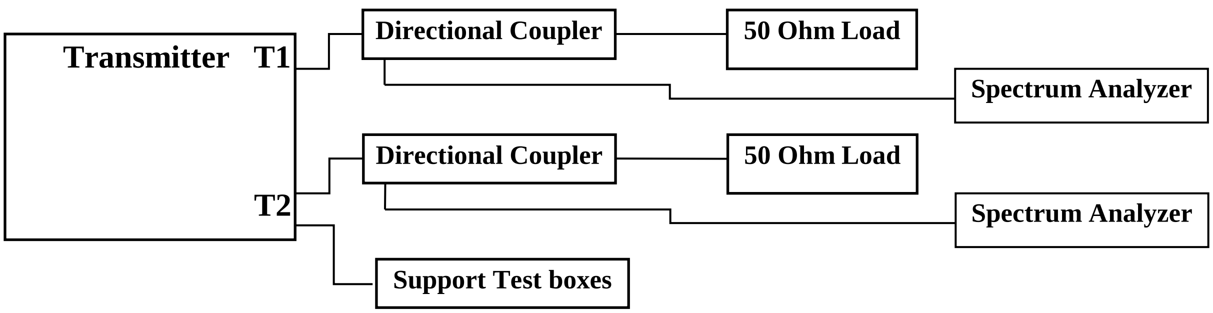
Figure 8 Mode A (0000) Occupied Band Width

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.

Test Arrangement



The radio frequency output was coupled to a Rohde & Schwarz ESU 40 Spectrum Analyzer. 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 12,000 MHz was observed during preliminary investigation. Figures 6 through 8 represent data for the worst-case antenna spurious emissions of the, GTX 3000. Data was taken per CFR47 2.1051, 2.1057, and applicable paragraphs of Part 87.139.

Antenna Port Spurious Emissions Results

The output of the unit was coupled to a Rohde & Schwarz ESU 40 Spectrum Analyzer and the frequency emissions were measured. Data was taken as per CFR47 2.1051 and applicable paragraphs of Part 87. Specifications of Paragraphs 2.1051, 2.1057 and applicable paragraphs of part 87.139 are met. There are no deviations to the specifications.

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 50 dB below fundamental carrier

= 43 + 10 Log(pY)
= 43 + 10 Log(5)
= 49.99
= 50 dBc

T1 Top Port

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
1090.00	2180.0	-22.28	-78.2
	3270.0	-32.38	-88.3
	4360.0	-31.22	-87.1
	5450.0	-31.52	-87.4
	6540.0	-31.69	-87.6
	7630.0	-31.39	-87.3
	8720.0	-31.16	-87.1
	9810.0	-31.81	-87.7
	10900.0	-31.69	-87.6

T2 bottom Port

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dBc)
1090.00	2180.0	-23.31	-79.2
	3270.0	-33.04	-88.9
	4360.0	-33.53	-89.4
	5450.0	-33.07	-89.0
	6540.0	-32.68	-88.6
	7630.0	-32.95	-88.9
	8720.0	-32.65	-88.6
	9810.0	-32.41	-88.3
	10900.0	-32.79	-88.7

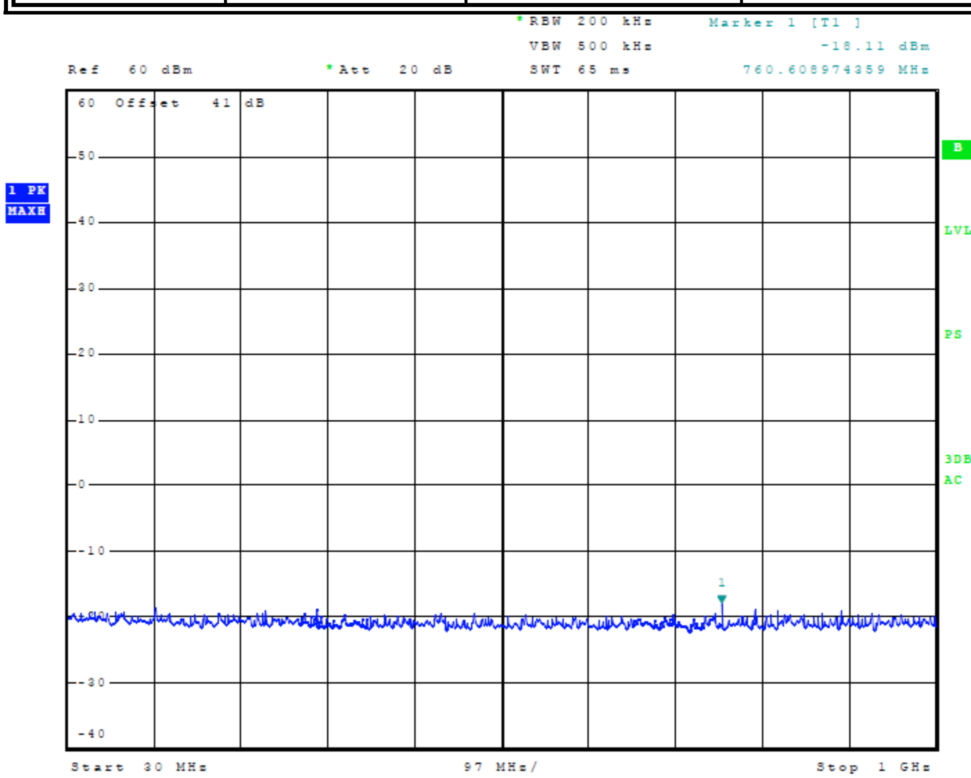


Figure 9 Spurious Emissions at Antenna Terminal

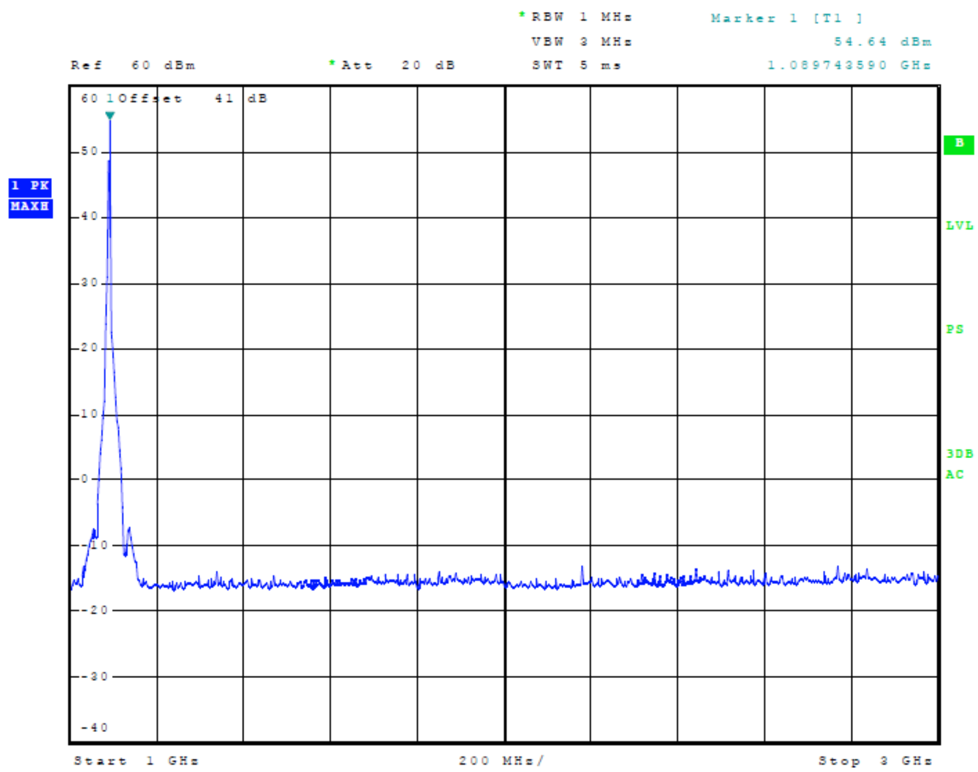


Figure 10 Spurious Emissions at Antenna Terminal

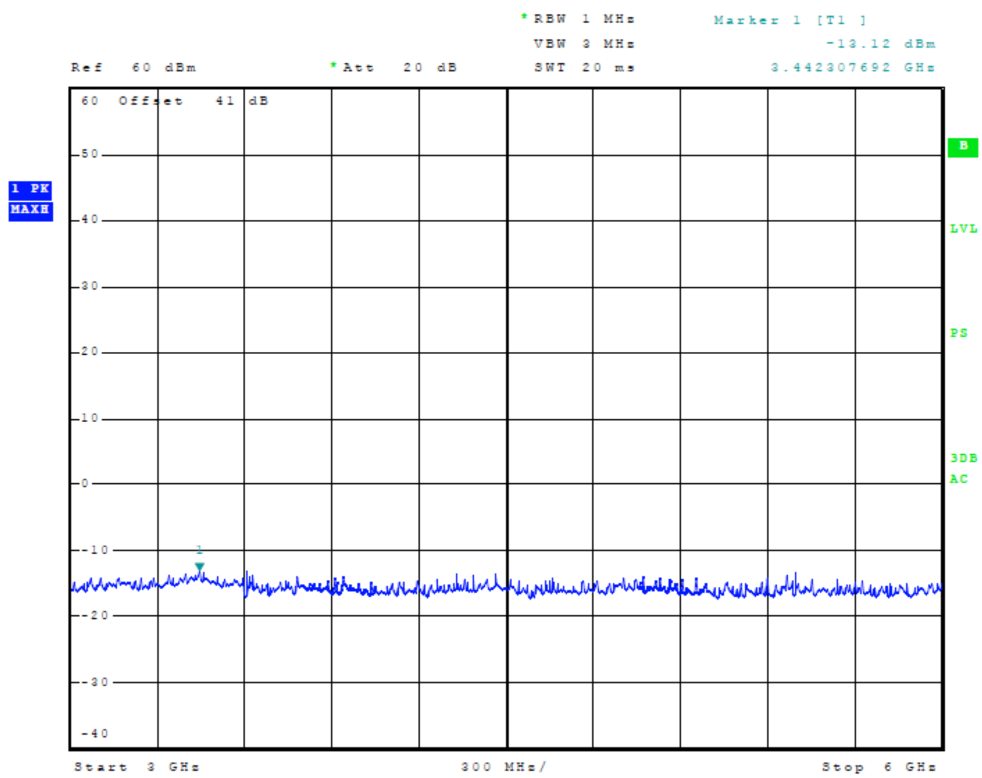


Figure 11 Spurious Emissions at Antenna Terminal

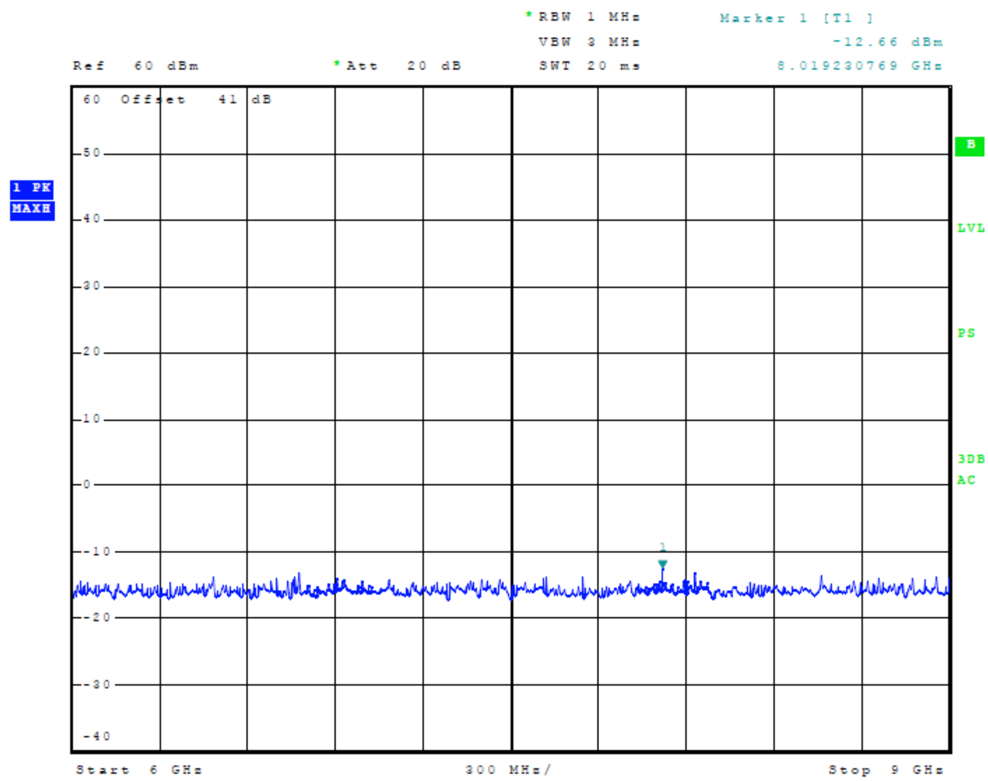


Figure 12 Spurious Emissions at Antenna Terminal

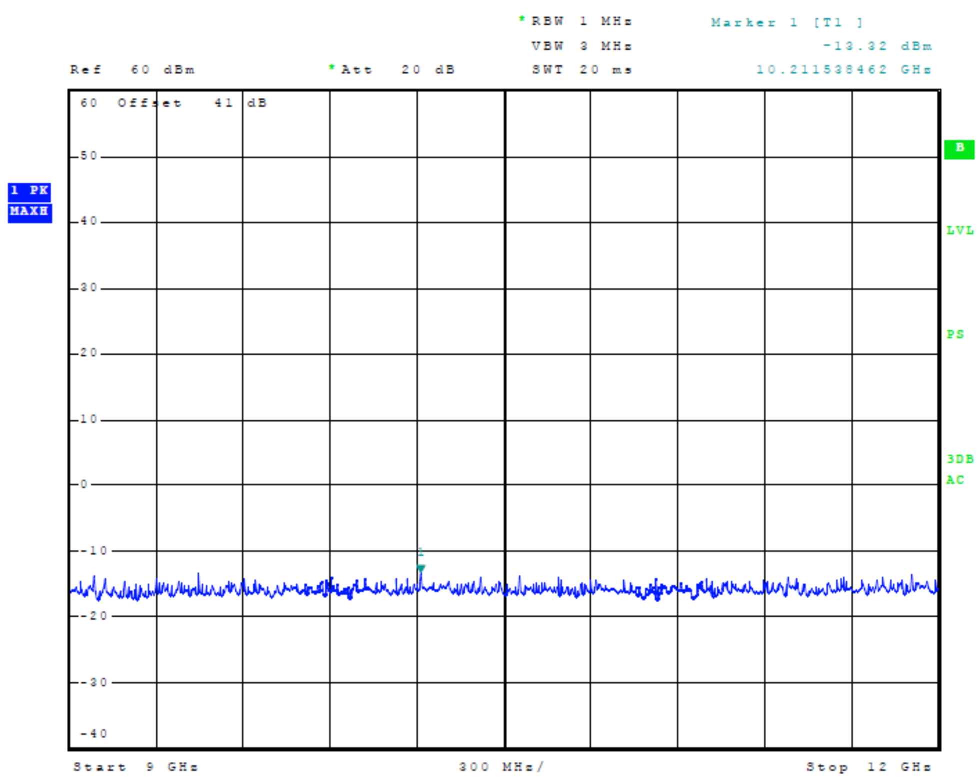


Figure 13 Spurious Emissions at Antenna Terminal

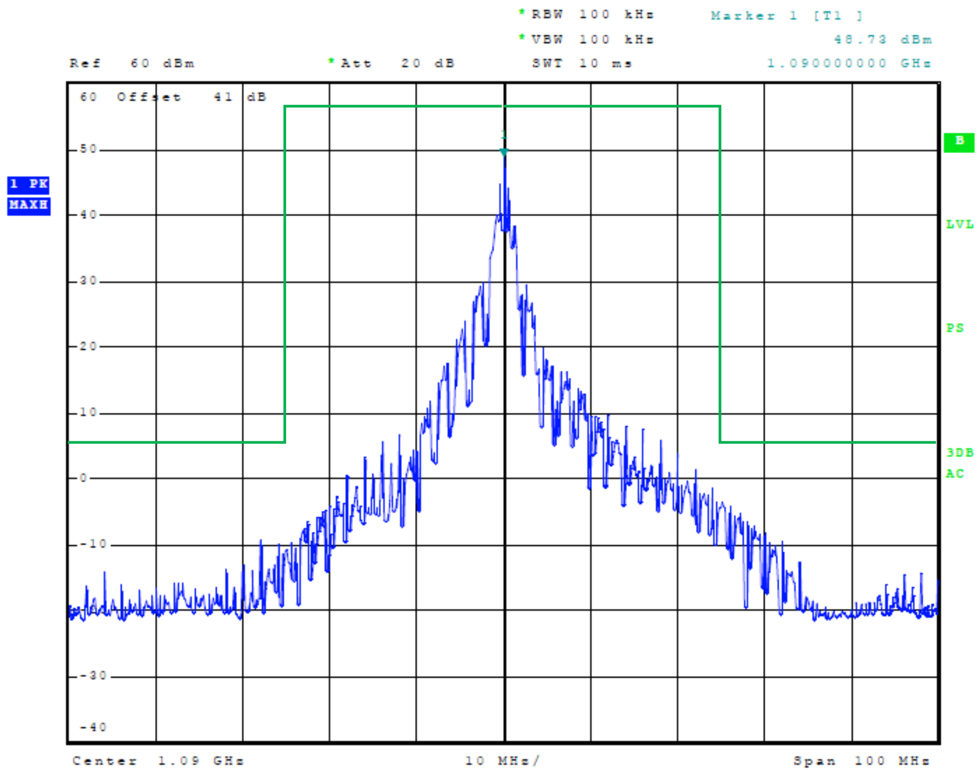


Figure 14 Emissions Mask (Mode-S (Short))

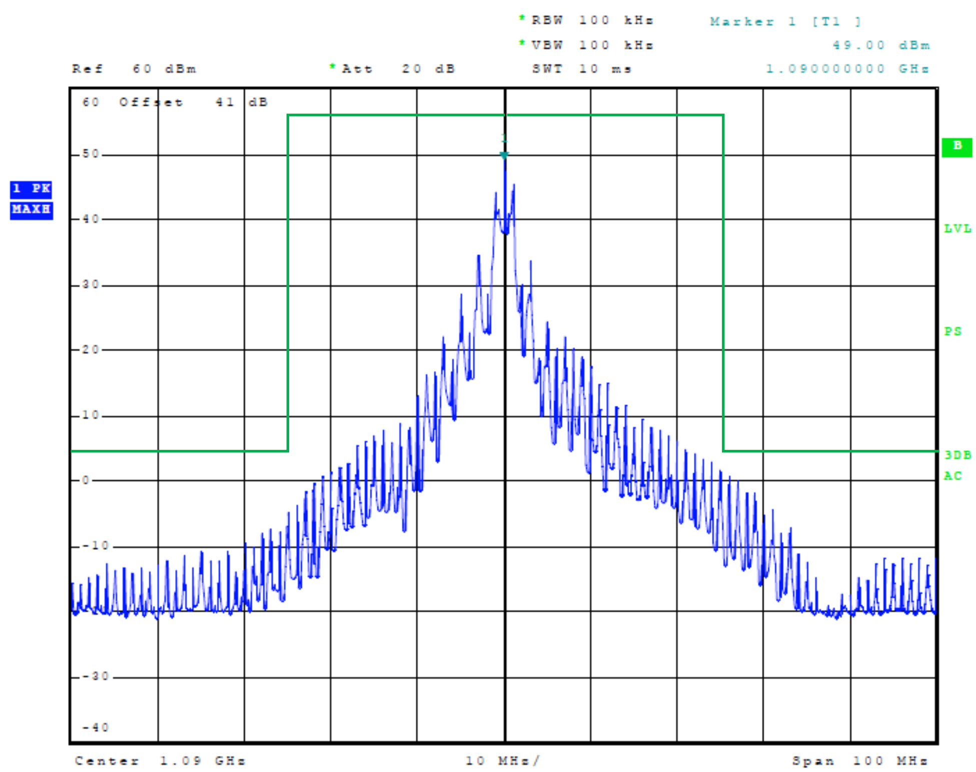


Figure 15 Emissions Mask (Mode-S (Long))

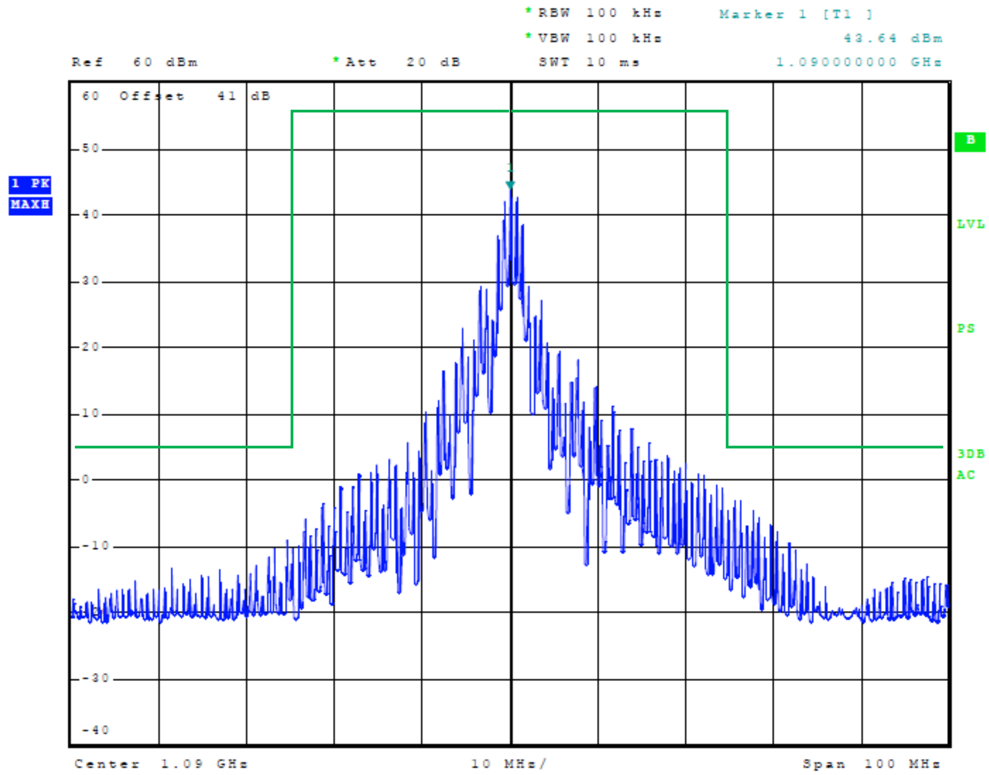


Figure 16 Emissions Mask (Mode-A (7777))

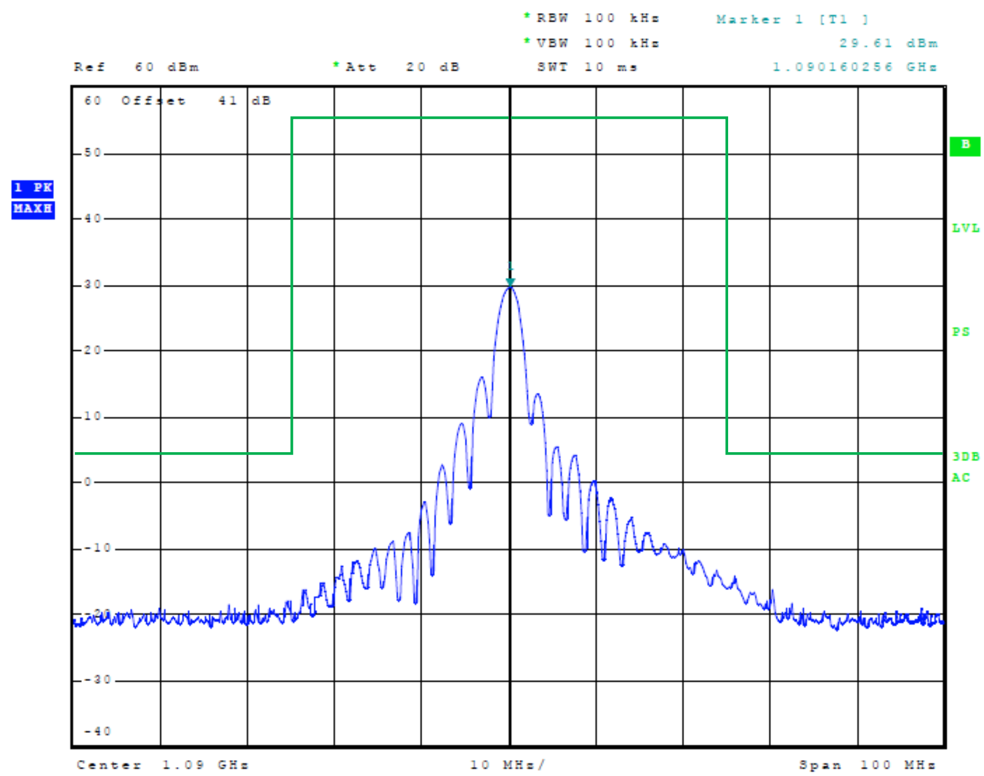


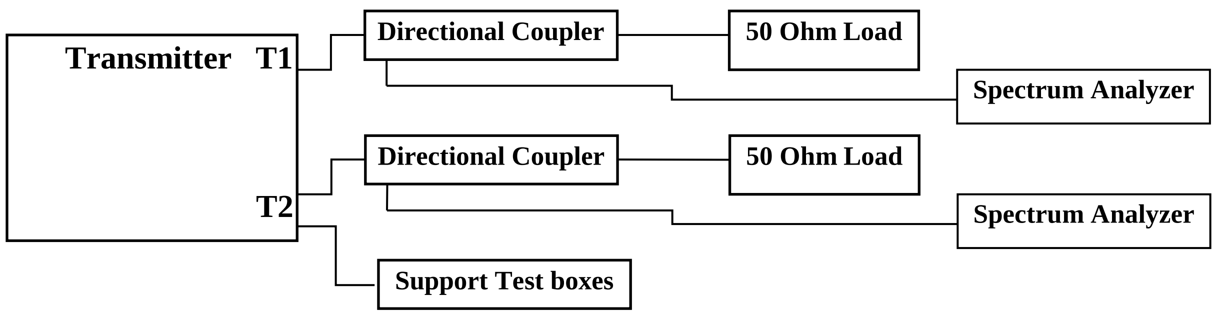
Figure 17 Emissions Mask (Mode-A (0000))

Field Strength of Spurious Radiation

Measurements Required

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. This equipment is typically incorporated into a rack of equipment, cabling attached to the cabinet. A test box was used to interface with the equipment for testing purposes. The test box offered transmitter control and continuously interrogated the unit during testing. The test set supplied the 50-ohm load for the antenna connections.

Test Arrangement



The test setup was assembled in a screen room for preliminary screening. The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 1 meter from the receive antenna, plots were made of the radiated emissions. During final radiated emissions, testing the transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. With the EUT modulated 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 9 kHz to 12,000 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 12,000 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).

Radiated Spurious Emissions Results

The EUT was connected to power and antenna load as required and operated in all available normal modes while radiated emissions testing were performed. The amplitude of each spurious emission was maximized and amplitude levels recorded while operating at the open area test site at a distance of 3-meters.

General Radiated Emissions

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Quasi-Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Quasi-Peak (dBμV/m)	Vertical Average (dBμV/m)	CFR47 15.109 General Emissions Limit @ 3m (dBμV/m)
74.0	29.5	23.6	N/A	26.3	18.9	N/A	40.0
74.5	30.7	22.9	N/A	27.9	20.0	N/A	40.0
120.0	27.5	22.0	N/A	28.3	22.8	N/A	43.5
150.0	29.1	18.4	N/A	24.3	18.2	N/A	43.5

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

Channel frequency 1090.00 MHz

Frequency of Emission	Amplitude of EUT Spurious emission		Signal level to substitution antenna required to reproduce		Emission level below carrier		CFR47 Limit
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	
(MHz)	dBµV/m	dBµV/m	dBm	dBm	dBc	dBc	dBc
2180.0	26.9	27.3	-64.63	-64.23	-120.5	-120.1	50
3270.0	28.3	28.2	-61.53	-61.63	-117.4	-117.5	50
4360.0	27.1	26.3	-60.83	-61.63	-116.7	-117.5	50
5450.0	26.9	26.9	-59.83	-59.83	-115.7	-115.7	50

Other Emissions present with amplitudes at least 20 dB below limit.

Specifications of CFR47 Paragraph 2.1053, 2.1057, applicable paragraphs of part 87.139 are met. There are no deviations or exceptions to the specifications.

Frequency Stability

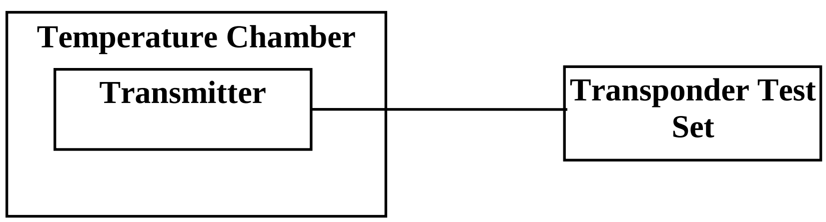
Measurements Required

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 located in the temperature chamber the temperature of the 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. CFR47 87.133 requires stability maintained at least 20 ppm.

Frequency Stability Results

Frequency 1089.9900 (MHz)	Frequency Stability Vs Temperature In Parts Per Million (PPM)								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (kHz)	0.0	10.0	10.0	0.0	0.0	0.0	-10.0	-10.0	-10.0
PPM	0	0	0	0	0	0	0	0	0
%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Frequency 1089.9900 (MHz)	Frequency Stability Vs Voltage Variation 14 or 28 volts nominal; Results In Hz		
Voltage Vdc	11.9	14.0	16.1
Change (Hz)	0	0	0
Voltage Vdc	23.8	28.0	32.2
Change (Hz)	0	0	0

Specifications of CFR47 Paragraphs 2.1055 and applicable paragraphs of part 87.133 are met. 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 Site Registration Letter
- Annex E Industry Canada Registration Letter

Annex A Measurement Uncertainty Calculations

Radiated Emissions Measurement Uncertainty Calculation

Measurement of vertically polarized radiated field strength over the frequency range 30 MHz to 1 GHz on an open area test site at 3m and 10m includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Antenna factor calibration	normal (k = 2)	±0.58
Cable loss calibration	normal (k = 2)	±0.2
Receiver specification	rectangular	±1.0
Antenna directivity	rectangular	±0.1
Antenna factor variation with height	rectangular	±2.0
Antenna factor frequency interpolation	rectangular	±0.1
Measurement distance variation	rectangular	±0.2
Site Imperfections	rectangular	±1.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{1.0}{2}\right]^2 + \left[\frac{0.2}{2}\right]^2 + \left[\frac{1.0^2 + 0.1^2 + 2.0^2 + 0.1^2 + 0.2^2 + 1.5^2}{3}\right]}$$

$U_c(y) = \pm\ 1.6$ dB

It is probable that $u_c(y) / s(q_k) > 3$, where $s(q_k)$ is estimated standard deviation from a sample of n readings unless the repeatability of the EUT is particularly poor, and a coverage factor of k = 2 will ensure that the level of confidence will be approximately 95%, therefore:

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

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

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.
1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.
1.3 The antenna factor uncertainty does not take account of antenna directivity.
1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.
1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.
1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect Biconical antennas).

The specified limits for the difference between measured site attenuation and the theoretical value (± 4 dB) were not included in total since the measurement of site attenuation includes uncertainty contributions already allowed for in this budget, such as antenna factor.

Conducted Measurements Uncertainty Calculation

Measurement of conducted emissions over the frequency range 9 kHz to 30 MHz includes following uncertainty:

Contribution	Probability Distribution	Uncertainty (dB)
Receiver specification	rectangular	±1.5
LISN coupling specification	rectangular	±1.5
Cable and input attenuator calibration	normal (k=2)	±0.5

Combined standard uncertainty $u_c(y)$ is

$$U_c(y) = \pm \sqrt{\left[\frac{0.5}{2}\right]^2 + \frac{1.5^2 + 1.5^2}{3}}$$

$U_c(y) = \pm 1.2$ dB

As with radiated field strength uncertainty, it is probable that $u_c(y) / s(q_k) > 3$ and a coverage factor of k = 2 will suffice, therefore:

$U = 2\ U_c(y) = 2 \times \pm 1.2$ dB $= \pm 2.4$ dB

Annex B Rogers Labs Test Equipment List

The test equipment is maintained in calibration and good operating condition. Use of this calibrated equipment ensures measurements are traceable to national standards.

List of Test Equipment	Calibration Date
Spectrum Analyzer: Rohde & Schwarz ESU40	5/11
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/11
Spectrum Analyzer: HP 8591EM	5/11
Antenna: EMCO Biconilog Model: 3143	5/11
Antenna: Sunol Biconilog Model: JB6	10/11
Antenna: EMCO Log Periodic Model: 3147	10/11
Antenna: Antenna Research Biconical Model: BCD 235	10/11
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 μHy/50 ohm/0.1 μf	10/11
R.F. Preamp CPPA-102	10/11
Attenuator: HP Model: HP11509A	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Cable: Belden RG-58 (L1)	10/11
Cable: Belden RG-58 (L2)	10/11
Cable: Belden 8268 (L3)	10/11
Cable: Time Microwave: 4M-750HF290-750	10/11
Cable: Time Microwave: 10M-750HF290-750	10/11
Frequency Counter: Leader LDC825	2/11
Oscilloscope Scope: Tektronix 2230	2/11
Wattmeter: Bird 43 with Load Bird 8085	2/11
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/11
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/11
R.F. Power Amp 65W Model: 470-A-1010	2/11
R.F. Power Amp 50W M185- 10-501	2/11
R.F. Power Amp A.R. Model: 10W 1010M7	2/11
R.F. Power Amp EIN Model: A301	2/11
LISN: Compliance Eng. Model 240/20	2/11
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/11
Antenna: EMCO Dipole Set 3121C	2/11
Antenna: C.D. B-101	2/11
Antenna: Solar 9229-1 & 9230-1	2/11
Antenna: EMCO 6509	2/11
Audio Oscillator: H.P. 201CD	2/11
Peavey Power Amp Model: IPS 801	2/11
ELGAR Model: 1751	2/11
ELGAR Model: TG 704A-3D	2/11
ESD Test Set 2010i	2/11
Fast Transient Burst Generator Model: EFT/B-101	2/11
Field Intensity Meter: EFM-018	2/11
KEYTEK Ecat Surge Generator	2/11
Shielded Room 5 M x 3 M x 3.0 M	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Engineering experience includes six years in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

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

Educational Background

1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.
2) Bachelor of Science Degree in Business Administration Kansas State University.
3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D Rogers

Scot D. Rogers

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION
Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

November 01, 2011

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: November 01, 2011

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

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

May 26, 2010

OUR FILE: 46405-3041
Submission No: 140719

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

Attention: Mr. Scot D. Rogers

Dear Sir/Madame:

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

- Your primary code is: **3041**

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

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

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

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

Yours sincerely,

Dalwinder Gill

Dalwinder Gill
For: Wireless Laboratory Manager
Certification and Engineering Bureau
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P.O. Box 11490, Station "H"
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