NVLAP®

Testing
NVLAP Lab Code 200087-0

Application for Grant of Certification

Modes A and S Aviation Transponder

Per 47CFR, Part 87

Model: TT26

FCC ID: VZI01629

1090 MHz

For

Trig Avionics Limited
Heriot Watt Research Park
Riccarton
Currie EH14 4AP United Kingdom

Test Report Number 170228

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

Engineering Test Report For Application of Certification For

Trig Avionics Limited

Heriot Watt Research Park
Riccarton
Currie EH14 4AP United Kingdom

Mr. Andrew Davis
CEO

Model: TT26

Modes A and S Aviation Transponder

Frequency Range: 1090 MHz

FCC ID: VZI01629

Test Date: 10 March 2017

Certifying Engineer: Scot D Rogers

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

Table of Contents

Revisions

Revision 1, Issued 10 March 2017 – updated test equipment list page 27

Revision 1, Issued 8 March 2017

Forward

In accordance with the Federal Communications, Code of Federal Regulations 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
Emissions Tests	
Requirements per 47CFR paragraphs 2.1031-2.1057	Complies
Requirements per 47CFR paragraphs 87.131	Complies
Requirements per 47CFR paragraphs 87.133	Complies
Requirements per 47CFR paragraphs 87.135	Complies
Requirements per 47CFR paragraphs 87.139	Complies
Requirements per 47CFR paragraphs 87.141	Complies

Equipment Tested

Equipment	Model / PN	Serial Number	FCC Identifier
EUT	TT26 01629	00017	VZI01629
EUT (Cntrl)	TC20 00649-00	01487	N/A
Test box	IFR6000	104001611	N/A
DC Supply	BK / 1902	17050190205	N/A

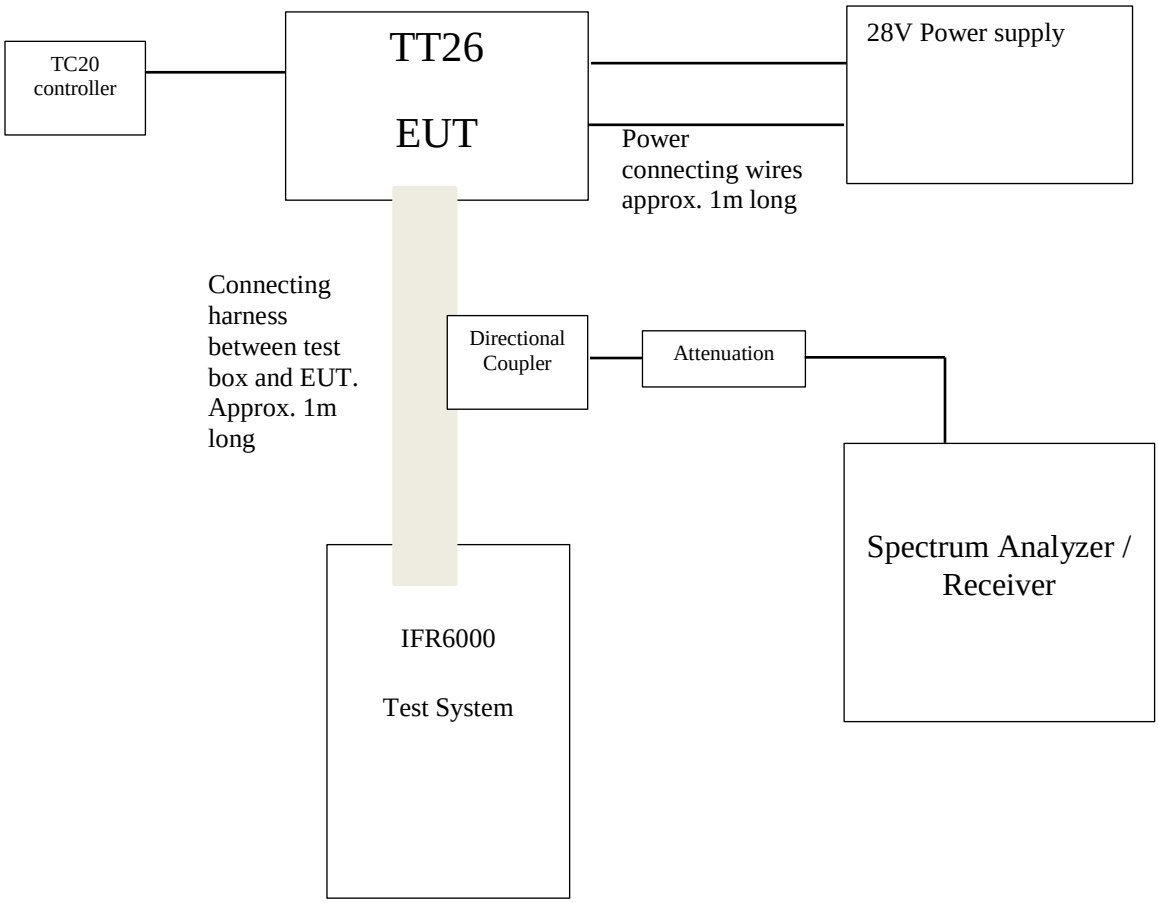
Test results in this report relate only to the items tested

Equipment Function and Configuration

The EUT is a mobile aeronautical mode a and Mode S transponder transceiver. The transmitter provides pulsed transmission signals at 1090 MHz. The TT26 ADS-B transponder system is an ED-73E compliant Mode S level 2els datalink transponder, with support for ADS-B extended squitter, elementary surveillance and SI codes, which also meets the relevant environmental requirements of ED-14G. The TT26 has a built in WAAS GPS receiver which meets the

requirements for DO-229D class Beta1, and provides a position source for ADS-B transmissions from the transponder. The ADS-B function meets DO-260B class B1S. The built-in pressure sensor provides altitude measurement up to 70,000 feet. The TT26 is controlled using a separate controller; the controller forms part of the system and is required for full compliance with the altimetry TSO and transponder TSO. The TT26 responds to both legacy Mode A/C interrogations and to Mode S interrogations from both ground radar and airborne collision avoidance systems. In all cases, the interrogations are received by the TT26 on 1030MHz, and replies are transmitted on 1090MHz.

Equipment Configuration



Application for Certification

1) Manufacturer: Trig Avionics Limited
Heriot Watt Research
Riccarton
Currie EH14 4AP
United Kingdom

2) Identification: FCC I.D.: VZI01629

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

4) Emission Type: Emissions designator 10M2V1D, 8M68V1D

5) Frequency Range: 1090 MHz

6) Operating Power Level: 260 Watt peak (nominal)
Average power calculation assumes 100 replies per second, each reply of 120 bits of data with 50% duty cycle 1 µS in length. This produces transmissions of 60 µS with 100 replies per second equals 6000 µS of transmission per second equating to a 0.006 ratio. The 1.56 Watts equals 260 Watts time 0.006 duty cycle.

7) Maximum P_o: 260 Watts (nominal peak power) and 1.56 Watt average delivered from this EUT. Maximum power output as determined by appropriate standards during certification per CFR 47 paragraph 87.131. The specifications of RTCA/DO-181D stipulate 125W peak minimum and 500W maximum RF peak output power.

8) Power into final amplifying circuitry: Maximum power delivered to final amplifier stage is 518.4 watts (48 volts at 10.8 amps).

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

10) Circuit Diagrams; description of circuits, frequency stability, spurious suppression, and power and modulation limiting: Refer to Exhibit for Circuit information 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 unit employs pulse modulation prescribed by FAA TSOC112. 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 47CFR paragraphs 2.1046 through 2.1057 are contained in this application.

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 47CFR 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.

Units of Measurements

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 Milliwatts

Test Site Locations

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

Environmental Conditions

Ambient Temperature	22.3° C
Relative Humidity	35%
Atmospheric Pressure	1018.5 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	FCC	FCC-LISN-50-2-10(1PA) (160611)	.15-30MHz	5/16	5/17
☒ Cable	Time Microwave	750HF290-750 (L10M)	9kHz-40 GHz	10/16	10/17
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16	10/17
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16	10/17
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16	10/17
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/16	10/17
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/16	5/18
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/15	10/17
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/16	5/18
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16	10/17
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16	10/17
☐ Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/16	5/17
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/16	5/17
☐ Analyzer	HP	8562A (3051A05950)	9kHz-110GHz	5/16	5/17
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/16	5/17
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/16	5/17
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16	10/17
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16	10/17
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16	10/17

System Description

The TT26 is an aeronautical Mode A and Mode S Transponder. The transmitter operational frequency band is 1090 MHz. The device is marketed as a remote mountable Aviation Transceiver. The design provides nominal peak power output of 260 Watts. The EUT transponder is an ADS-B transponder. A remote user interface with an LCD screen and simple mode selector and code entry feature is provided in the TT26 control unit. An integrated microcontroller performs the Mode S protocol functions, manages the transponder state, and controls the user interface.

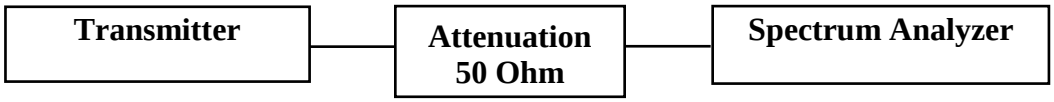
2.1046 Transmitter Power Output

Measurements Required

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

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

Test Arrangement



The radio frequency power output was measured at the antenna terminal by placing 74-dB attenuation in the antenna line and observing the emission with the spectrum analyzer. The spectrum analyzer offered an impedance of 50Ω to match the impedance of the standard antenna. A Rohde & Schwarz ESU40 Spectrum Analyzer was used to measure the radio frequency power at the antenna port. Data was taken in dBm and converted to watts as shown in the following Table. Refer to Figure 1 showing maximum output power of the transmitter in both low and high power mode. Data was taken per 47CFR Paragraph 2.1046(a) and applicable paragraphs of Part 87.

P_{dBm} = power in dB above 1 milliwatt

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

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

Milliwatts = $10^{(54.17/10)}$

= 261,216.1 mW

= 261.2 Watts Peak power

Table 1 Transmitter Power Results

Frequency	Input Power	P_{dBm}	P_{mw}	P_w
1090	28 V_{dc}	54.17	261,216.1	261.2

The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 2 and 87.131. There are no deviations to the specifications.

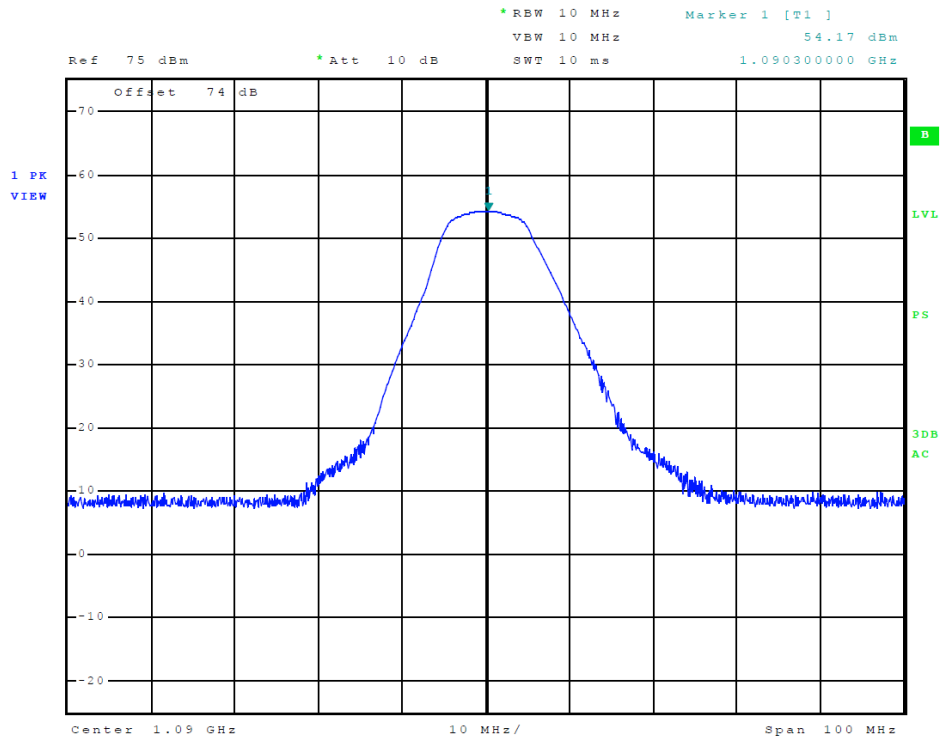


Figure 1 Transmitter Output across Frequency Band (Low and High Power)

2.1047 Modulation Characteristics

Measurements Required

A curve or equivalent data, which shows that the equipment will meet the modulation requirements of the rules, under which the equipment is licensed, shall be submitted. The modulation specifications are defined by the FAA TSO-C112 standard for use in the Mode A, and Mode S interrogations. 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.

Results

Figure 2 depicts display of oscilloscope screen display taken while the equipment was operating 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.

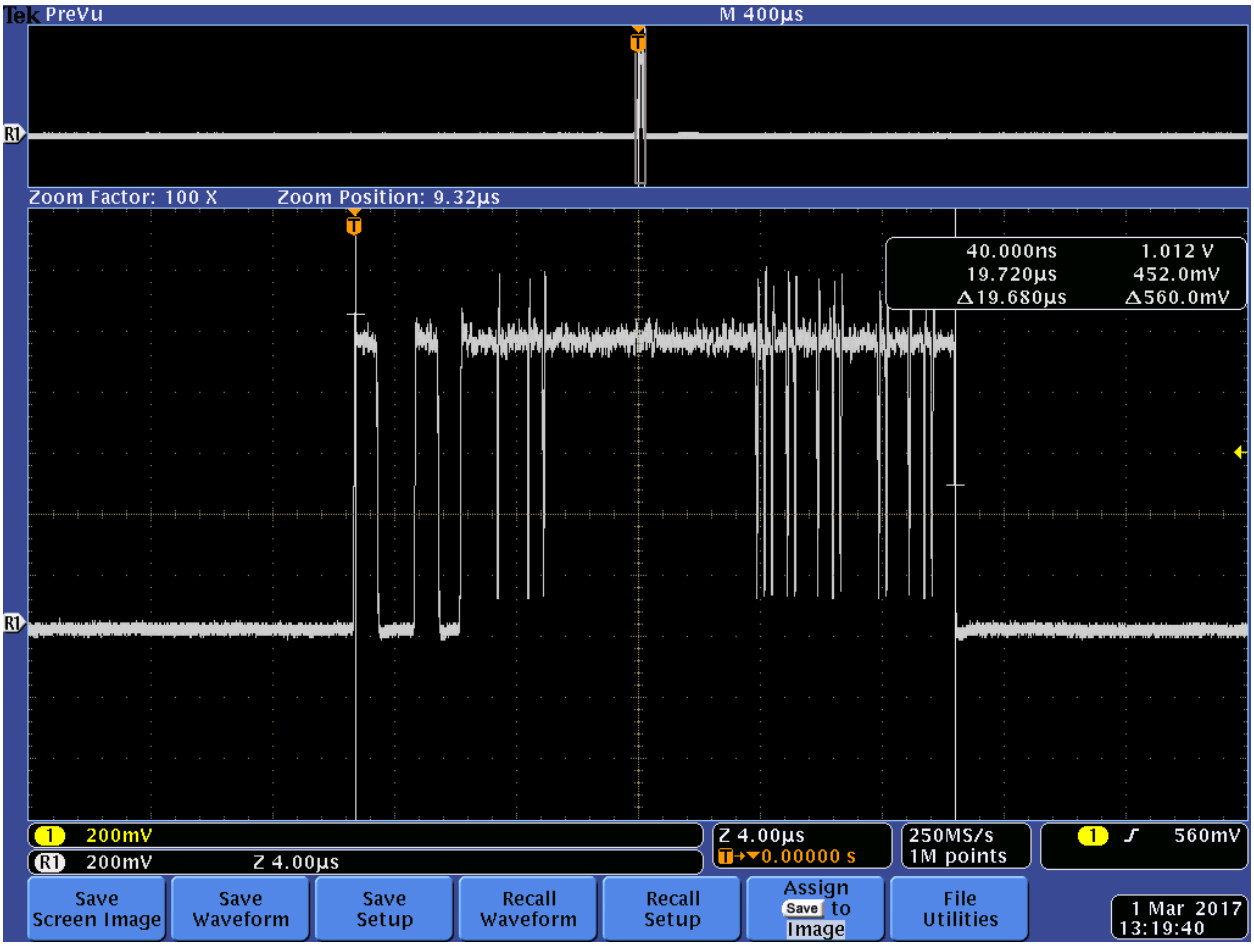


Figure 2 Audio Frequency Response / Modulation Characteristics

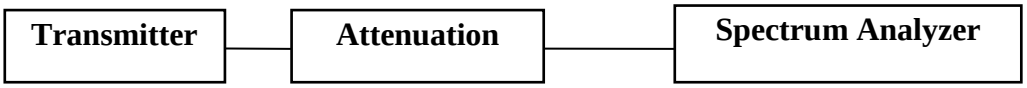
The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 2 and 87.141. There are no deviations to the specifications.

2.1049 Occupied Bandwidth

Measurements Required

The occupied bandwidth, that is the frequency bandwidth such that below its lower and above its upper frequency limits, the mean powers radiated are equal to 0.5 percent of the total mean power radiated by a given emission.

Test Arrangement



A Rohde & Schwarz ESU 40 spectrum analyzer was used to observe the radio frequency spectrum with the transmitter operating in normal modes. The EUT was connected to the test support equipment for interrogations allowing for transmitter function while measurements were recorded. Refer to figures 3 and 4 displaying plots of 99% power occupied bandwidth measurements.

Table 2 Occupied Bandwidth Results

Frequency (MHz)	Input Power	Occupied bandwidth (kHz)
1090	28 V_{dc}	10,200.0 (Mode A)
1090	28 V_{dc}	8,675.0 (Mode S)

The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 2 and 87.135. There are no deviations to the specifications.

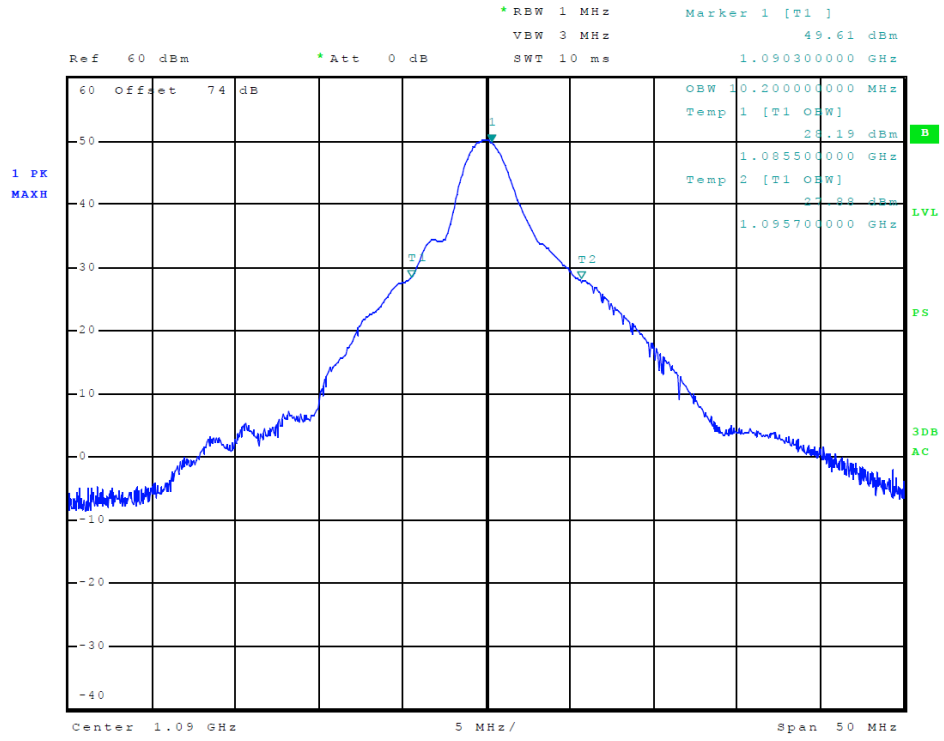


Figure 3 Occupied Band Width (Mode A operation)

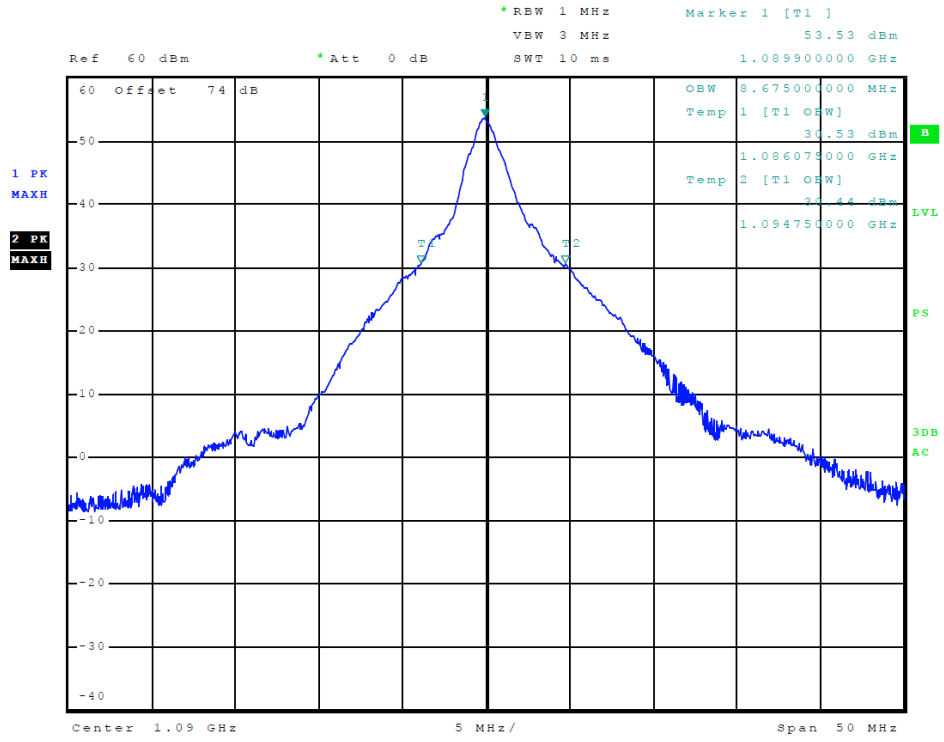


Figure 4 Occupied Band Width (Mode S operation)

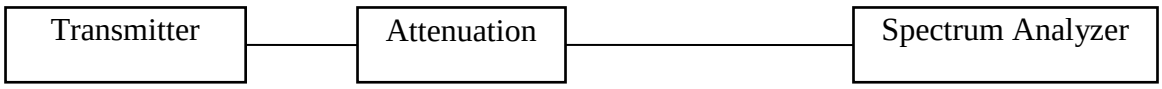
2.1051 Spurious Emissions at Antenna Terminals

Measurements Required

The radio frequency voltage or power generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Refer to figures 9 and 10 for plots of spurious emissions at antenna port and emission mask. All spurious emissions must be attenuated at least 43 +10log(Po) below the fundamental emission power level. The following equations represent the calculated attenuation offset level for the equipment.

1.56 Watts = 43 + 10 Log (Po)
= 43 + 10 Log (1.56)
= 44.9

Test Arrangement



The radio frequency output was coupled to a Rohde & Schwarz ESU40 Spectrum Analyzer during antenna port conducted emissions measurements. The spectrum analyzer was used to observe the radio frequency spectrum with the transmitter modulated per section 2.1049 and operated in all normal modes. The frequency spectrum from 30 MHz to 12,000 MHz was observed and plots produced of the frequency spectrum displayed on the test equipment. Figures 4 through 7 represent data for the antenna spurious emissions of the TT26. Data was taken per CFR47 2.1051, 2.1057, and applicable paragraphs of Part 87.139.

Results

The output of the unit was coupled to a Rohde & Schwarz ESU40 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(Po) below the fundamental emission power level. The following equations represent the calculated attenuation levels for the equipment.

1.56 W(ave) = 43 + 10 Log(Po)
= 43 + 10 Log(1.56)
= 44.9

Mode A

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dB)
1090.00	2180.0	-61.51	-115.7
	3270.0	-68.07	-122.2
	4360.0	-65.19	-119.4
	5450.0	-65.47	-119.6
	6540.0	-66.44	-120.6
	7630.0	-65.22	-119.4
	8720.0	-65.19	-119.4
	9810.0	-65.06	-119.2
	10900.0	-64.72	-118.9

Mode S

Channel MHz	Spurious Freq. (MHz)	Measured Level (dBm)	Level Below Carrier (dB)
1090.00	2180.0	-58.39	-112.6
	3270.0	-67.70	-121.9
	4360.0	-65.17	-119.3
	5450.0	-65.12	-119.3
	6540.0	-65.16	-119.3
	7630.0	-65.02	-119.2
	8720.0	-64.82	-119.0
	9810.0	-64.66	-118.8
	10900.0	-64.17	-118.3

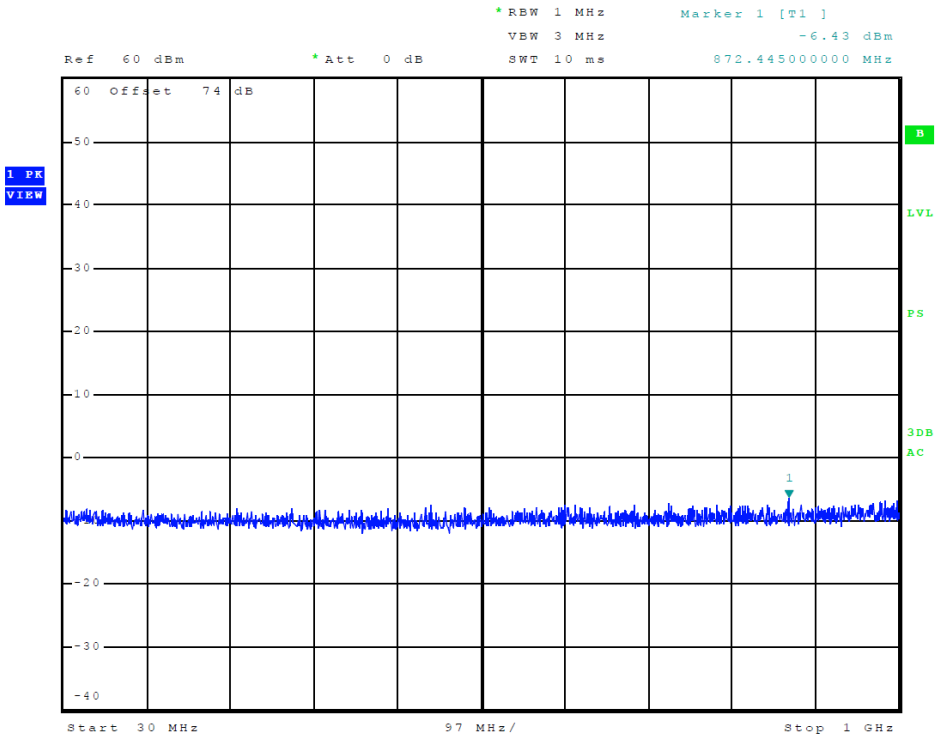


Figure 5 Spurious Emissions at Antenna Terminal

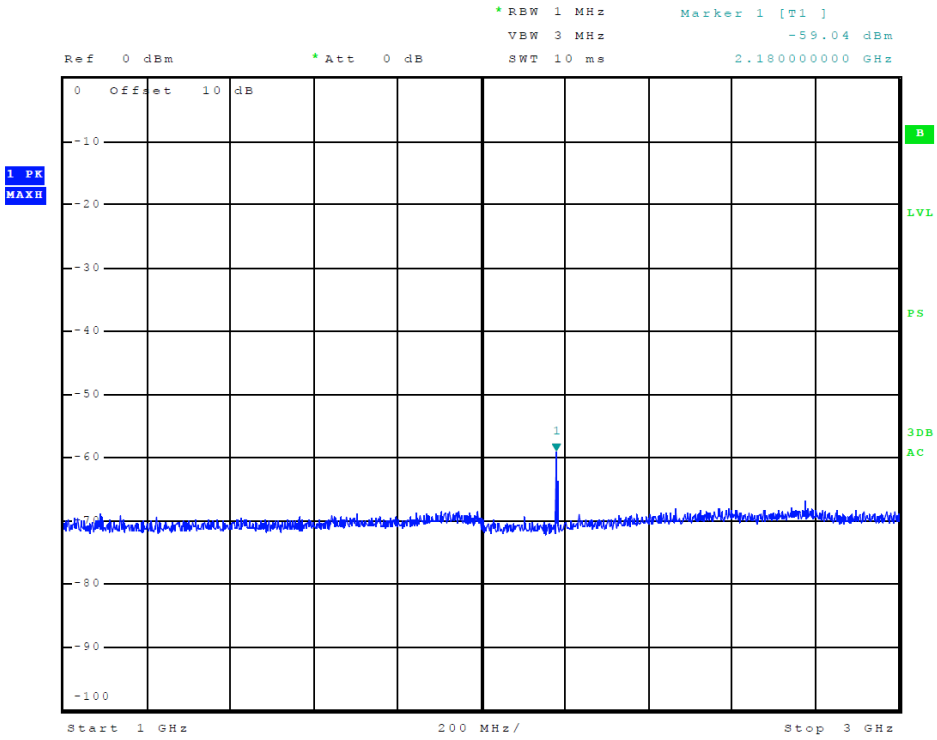


Figure 6 Spurious Emissions at Antenna Terminal

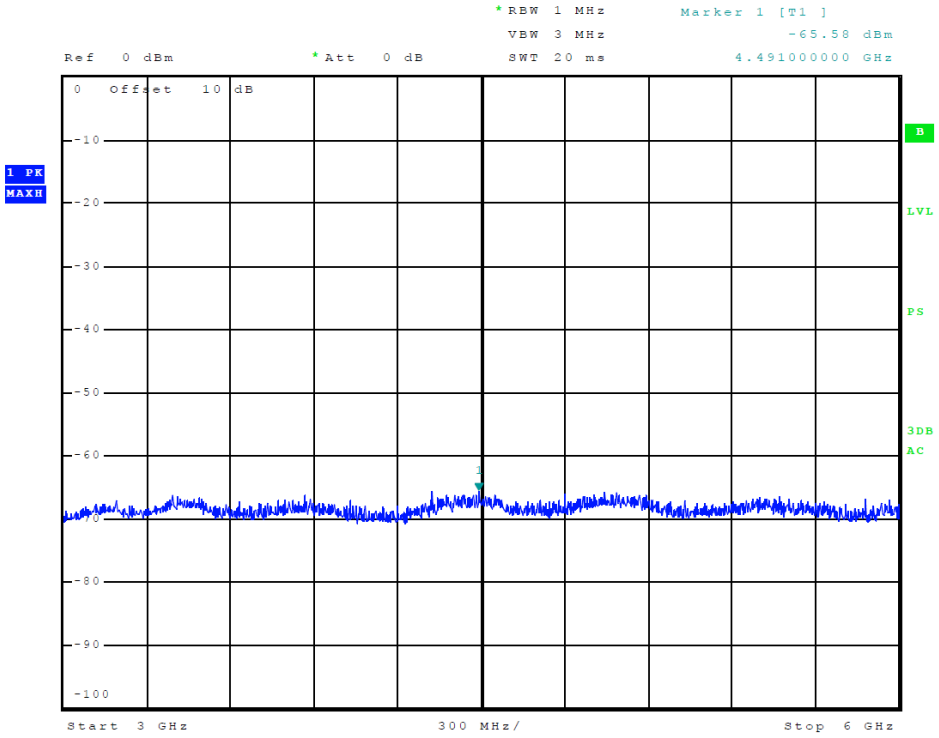


Figure 7 Spurious Emissions at Antenna Terminal

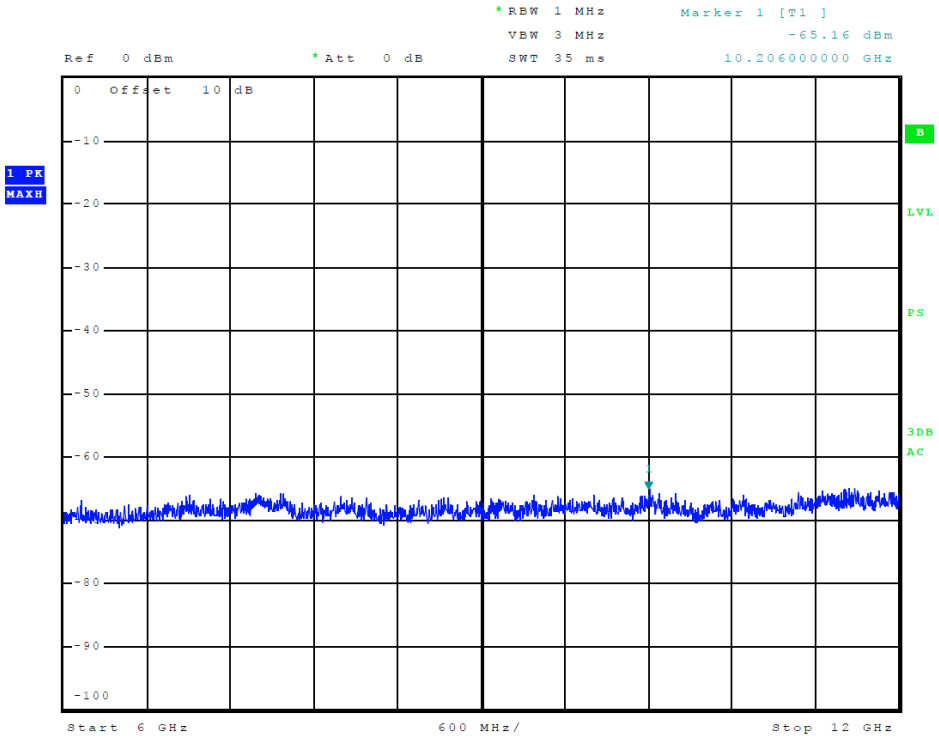


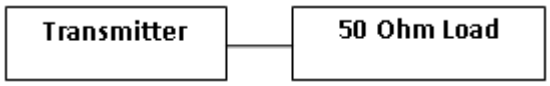
Figure 8 Spurious Emissions at Antenna Terminal

Field Strength of Spurious Radiation (Unwanted Emissions)

Measurements Required

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. This equipment may be remote mounted with interface cabling connecting the control head to the transmitter. The sample offered for testing required interfacing with additional test control panel and support equipment offering operation and communications with all functions of transmitter.

Test Arrangement



The test setup was assembled in a screen room for preliminary screening. The transmitter was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 1 meter from the receive antenna, plots were taken of the radiated emissions.

Final radiated emissions testing was performed with the transmitter placed on a foam platform 0.8 meters above the ground plane and at a distance of 3 meters from the Field Strength Measuring (FSM) antenna. The EUT was operational and radiating into a 50Ω load. The receiving antenna was raised and lowered from 1m to 4m in height to obtain the maximum reading of spurious radiation from the EUT, cabinet, and interface cabling. The turntable was rotated though 360 degrees to locate the position registering the highest amplitude of emission. The frequency spectrum was then searched for spurious emissions generated from the transmitter, interface cabling, and test setup. The amplitude of each spurious emission was maximized by raising and lowering the FSM antenna, and rotating the turntable before final data was recorded. The frequency spectrum from 9 kHz to 12,000 MHz was investigated during radiated emissions testing. A loop antenna was used for frequency band 9 kHz to 30 MHz, Biconilog antenna was used for frequency measurements of 30 to 1000 MHz. A double-ridge horn antenna was used for frequencies above 1000 MHz. Emission levels were measured and

recorded from the spectrum analyzer in dBµV. 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. Data was taken at the Rogers Labs, Inc. 3 meters open area test site (OATS). A description of the test facility is on file with the FCC and Industry Canada (refer to annex for site registration letters).

Spurious Radiated Emission Results

The EUT was connected to the 50-ohm load 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.

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

1.56 Watts = 43 + 10 Log (Po)
= 43 + 10 Log (1.56)
= 44.9

Spurious Emission Limit as presented below was calculated by subtracting the spurious limit form the total Transmit power.

1.56 Watts Limit = 31.9 – 44.9
= -13 dBm

Table 5 General Radiated Emissions unintentional radiator general limits

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)	Limit @ 3m (dBµV/m)
115.90	34.4	21.9	N/A	36.0	29.6	N/A	82
116.50	36.0	21.9	N/A	36.3	29.6	N/A	82
131.30	37.6	18.2	N/A	31.1	27.5	N/A	82
147.70	38.3	17.2	N/A	29.5	17.8	N/A	82
181.00	35.7	31.8	N/A	30.7	28.9	N/A	82
720.30	45.2	44.0	N/A	43.0	41.6	N/A	82
736.60	51.4	46.1	N/A	54.2	50.0	N/A	82
769.30	51.5	50.6	N/A	54.9	54.2	N/A	82

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.

The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 2 and 87.139. There are no deviations to the specifications. There are no deviations or exceptions to the specifications.

Frequency Stability

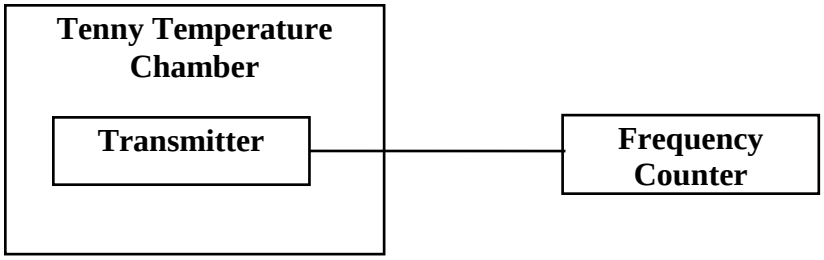
Measurements Required

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 inoperative (power switched "OFF"), the temperature of the test chamber shall be adjusted to +25°C. After a temperature stabilization period of one hour at +25°C, the transmitter shall be switched "ON" with standard test voltage applied.

Step 3: The carrier shall be keyed "ON", and the transmitter shall be operated at full radio frequency power output at the duty cycle, for which it is rated, for duration of at least 5 minutes. The radio frequency carrier frequency shall be monitored and measurements shall be recorded.

Step 4: The test procedures outlined in Steps 2 and 3, shall be repeated after stabilizing the transmitter at the environmental temperatures specified, -30°C to +50°C in 10-degree increments.

The frequency stability was measured with variations in the power supply voltage from 85 to 115 percent of the nominal value. A BK Precision DC Power Supply was used to vary the DC voltage for the power input from 23.80 to 32.20 for the 28-volt operation. The frequency was measured and the variation in parts per million calculated. Data was taken per 47CFR Paragraphs 2.1055 and applicable paragraphs of part 87.133.

Table 6 Frequency Stability Results

Frequency 127.500 MHz	Frequency Stability Vs Temperature								
Temperature °C	-30	-20	-10	0	+10	+20	+30	+40	+50
Change (Hz)	-253,000	-153,000	-206,000	-176,000	-160,000	-20,000	-253,000	-328,000	-303,000
PPM	-232.099	-140.360	-188.982	-161.460	-146.782	-18.348	-232.099	-300.903	-277.968
%	-0.023	-0.014	-0.019	-0.016	-0.015	-0.002	-0.023	-0.030	-0.028
Limit (MHz)	1	1	1	1	1	1	1	1	1

Frequency 127.500 MHz	Frequency Stability Vs Voltage Variation 28.0 volts nominal; Results In Hz change		
Voltage V_{dc}	23.8	24.0	32.2
Change (Hz)	0.0	0.0	0.0

The EUT demonstrated compliance with specifications of 47CFR Paragraph 2.1046(a) and applicable Parts of 87.133(d). There are no deviations or exceptions to the specifications.

Annex

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

Annex A Measurement Uncertainty Calculations

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

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

Annex B Rogers Labs Test Equipment List

List of Test Equipment	Calibration Date	Due
Spectrum Analyzer: Rohde & Schwarz ESU40	5/16	5/17
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520	5/16	5/17
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W		
Spectrum Analyzer: HP 8591EM	5/16	5/17
Antenna: EMCO Biconilog Model: 3143	5/16	5/17
Antenna: Sunol Biconilog Model: JB6	10/16	10/17
Antenna: EMCO Log Periodic Model: 3147	10/16	10/17
Antenna: Com Power Model: AH-118	10/16	10/17
Antenna: Com Power Model: AH-840	5/16	5/18
Antenna: Antenna Research Biconical Model: BCD 235	10/16	10/17
Antenna: Com Power Model: AL-130	10/16	10/17
Antenna: EMCO 6509	10/16	10/17
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohms/0.1 µf	10/16	10/17
R.F. Preamp CPPA-102	10/16	10/17
Attenuator: HP Model: HP11509A	10/16	10/17
Attenuator: Mini Circuits Model: CAT-3	10/16	10/17
Attenuator: Mini Circuits Model: CAT-3	10/16	10/17
Cable: Belden RG-58 (L1)	10/16	10/17
Cable: Belden RG-58 (L2)	10/16	10/17
Cable: Belden 8268 (L3)	10/16	10/17
Cable: Time Microwave: 4M-750HF290-750	10/16	10/17
Cable: Time Microwave: 10M-750HF290-750	10/16	10/17
Frequency Counter: Leader LDC825	2/17	2/18
Oscilloscope Scope: Tektronix 2230	2/17	2/18
Wattmeter: Bird 43 with Load Bird 8085	2/17	2/18
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/17	2/18
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/17	2/18
R.F. Power Amp 65W Model: 470-A-1010	2/17	2/18
R.F. Power Amp 50W M185- 10-501	2/17	2/18
R.F. Power Amp A.R. Model: 10W 1010M7	2/17	2/18
R.F. Power Amp EIN Model: A301	2/17	2/18
LISN: Compliance Eng. Model 240/20	2/17	2/18
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/17	2/18
Antenna: EMCO Dipole Set 3121C	2/17	2/18
Antenna: C.D. B-101	2/17	2/18
Antenna: Solar 9229-1 & 9230-1	2/17	2/18
Audio Oscillator: H.P. 201CD	2/17	2/18
ELGAR Model: 1751	2/17	2/18
ELGAR Model: TG 704A-3D	2/17	2/18
ESD Test Set 2010i	2/17	2/18
Fast Transient Burst Generator Model: EFT/B-101	2/17	2/18
Field Intensity Meter: EFM-018	2/17	2/18
KEYTEK Ecat Surge Generator	2/17	2/18
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

April 16, 2015

Registration Number: 90910

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

Attention: Scot Rogers,

Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: April 16, 2015

Dear Sir or Madam:

Your request for renewal of the registration of the subject measurement facility has been received. The information submitted has been placed in your file and the registration has been renewed. The name of your organization will remain on the list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that the file must be updated for any changes made to the facility and the registration must be renewed at least every three years.

Measurement facilities that have indicated that they are available to the public to perform measurement services on a fee basis may be found on the FCC website www.fcc.gov under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

NVLAP®

Testing
NVLAP Lab Code 200087-0

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

June 08, 2015

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

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

Attention: Mr. Scot D. Rogers

Dear Sir:

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

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

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2009 or later. A scope of accreditation indicating the accreditation by a recognized accreditation body to ANSI C63.4-2009 or later shall be accepted. Please indicate in a letter the previous assigned site number if applicable and the type of site (example: 3 metre OATS or 3 metre chamber). If the test facility is not accredited to ANSI C63.4-2009 or later, the test facility shall submit test data demonstrating full compliance with the ANSI standard. The Bureau will evaluate the filing to determine if recognition shall be granted.

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

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

Yours sincerely,

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