NVLAP Lab Code 200087-0

Submittal Application Report

FOR
GRANT OF CERTIFICATION

FOR

Models: S06RPR18L and S06RPR18H
5726.8-5848.2 MHz
Broadband Digital Transmission System
FCC ID: W9Z-58F2D
IC: 8855A-58F2D

FOR

SAF Tehnika AS
24a, Ganibu dambis
Riga, Latvia, LV-1005

Test Report Number: 150617

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

Engineering Test Report for Grant of Certification Application

FOR

47CFR, PART 15C - Intentional Radiators
47CFR Paragraph 15.247
License Exempt Intentional Radiator

For

SAF Tehnika AS

24a, Ganibu dambis
Riga, Latvia, LV-1005

Broadband Digital Transmission System

Models: S06RPR18L and S06RPR18H
Frequency Range 5726.8-5848.2 MHz
FCC ID#: W9Z-58F2D
IC: 8855A-58F2D

Test Date: June 17, 2015

Certifying Engineer: Scot D Rogers

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Rogers Labs, Inc.
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Revisions

Revision 1 Issued July 20, 2015

Forward

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator operating under 47CFR Paragraph 15.247 Digital Modulation transmitter 5745 – 5825 MHz band.

Name of Applicant: SAF Tehnika AS
24a, Ganibu dambis
Riga, Latvia, LV-1005

FRN: 0014 43 1100

Models: S06RPR18L and S06RPR18H

FCC ID: W9Z-58F2D IC: 8855A-58F2D

Transmitter details: Peak Output Power 0.550 Watts, modulations: 4QAM: 27 dBm, 16QAM: 26 dBm, 32QAM: 25 dBm, and 64QAM: 23 dBm

Channel Width (kHz)	Frequency Band (MHz)	99% Occupied Bandwidth
3500	5726.8-5848.2	3,255
5000	5727.5-5847.5	4,470
7000	5728.55-5846.5	6,510
10000	5730.0-5845.0	9,200
14000	5732.0-5843.0	12,888
2000	5735.0-5840.0	18,495
28000	5739.0-5836.0	25,500
30000	5740.0-5835.0	26,950

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Emissions as per 47CFR paragraphs 2 and 15.205	-2.4	Complies
Emissions as per 47CFR paragraphs 2 and 15.207	-18.6	Complies
Emissions as per 47CFR paragraphs 2 and 15.209	-2.2	Complies
Harmonic Emissions per 47CFR 15.247	-12.3	Complies
Peak Power Spectral Density per 47CFR 15.247	-5.9	Complies

Equipment Tested

Equipment	Model	FCC I.D.
EUT	S06RPR18L and S06RPR18H	W9Z-58F2D
Indoor Unit (power)	S0GIPTO1	N/A
AC Adapter	10AB4811	N/A
Laptop Computer	Dell Studio XPS	N/A

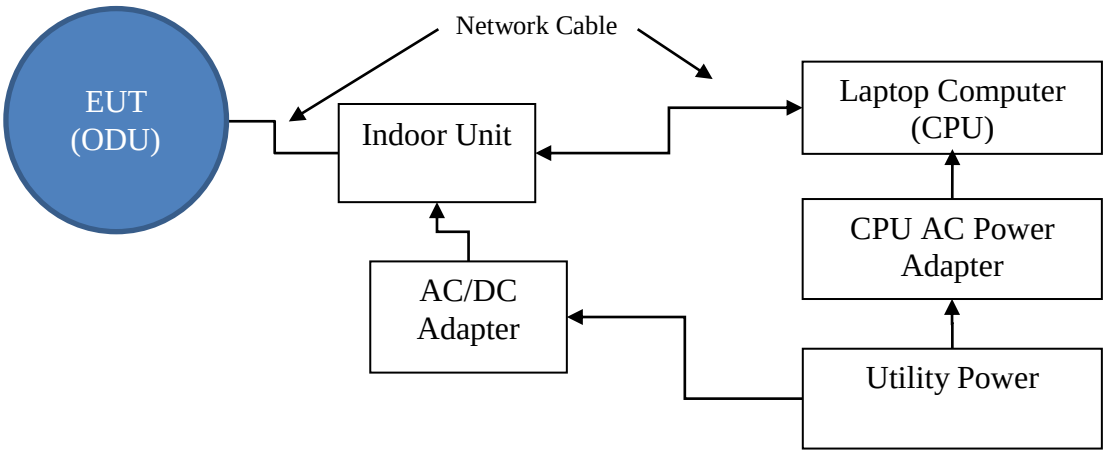
Test results in this report relate only to the items tested.

Equipment Function and Configuration

The EUT is a 5726.8-5848.2 MHz Digital Transmission System used to transmit data in point to point applications. The S06RPR18L and S06RPR18H are designed as an Outdoor Unit (ODU) providing for long distance digital communication transmissions. The EUT requires direct current power supplied through the coaxial cable interface from compliant Indoor Unit (IDU) equipment. An installation would use a low side transmitter at one location and high side transmitter at the next providing for use of full duplex communications. All up and down conversions are processed in the EUT supplying IDU with baseband data for processing. The EUT was tested using a manufacturer supplied IDU that provided EUT power and multiple interface ports for connection to network and associated equipment. The IDU received power from its associated AC/DC power supply. The EUT is designed for use with directional antenna systems. Compliance testing was performed to accommodate use of dish antenna systems of 42-dBi gain or less. The design provides for operation using channel widths in the range of 3800-30000 kHz. Software allows installer to select channel width and frequency, modulation, reduce power by 20 dB in 1 dB steps. Antenna port conducted testing was performed demonstrating compliance with regulations. Radiated emissions testing were performed with the transmitter port terminated with 50-ohm load. AC line conducted emissions testing was performed on the AC/DC adapter of the supporting equipment. A laptop computer was used to interface with the EUT and provide control and communications with the EUT and system. This configuration provided operational control of the transmitter and communications over the network interface

between the EUT and supporting system. The S06RPR18L and S06RPR18H provide female type n-female connectors for connection with antenna and IDU as well as a female BNC connector as service port. No other interfacing options are provided than those described in this filing. For testing purposes, the S06RPR18L and S06RPR18H received power through the Power over Coaxial cable interface and configured to transmit in available data modes. Test results in this report relate only to the products described in this report.

Equipment Configuration



Application for Certification

(1) Manufacturer: SAF Tehnika AS
24a, Ganibu dambis
Riga, Latvia, LV-1005

(2) Identification: Models: S06RPR18L and S06RPR18H

FCC I.D.: W9Z-58F2D IC: 8855A-58F2D

(3) Instruction Book:

Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:

Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:

Refer to Exhibit of Operational Description.

(6) Report of Measurements:

Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:

Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from direct current power received from compliant Indoor Unit providing 48 Vdc over coaxial cable. The EUT provides single female N-type connector for power and communications and single female N-type connector for connection with antenna. During testing, the EUT was connected to the IDU through a coaxial cable and 50 ohm load on antenna port. The EUT received power supplied from external IDU.

(9) Transition Provisions of 47CFR 15.37 are not requested

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

(12) The equipment is not software defined and this section is not applicable.

Applicable Standards & Test Procedures

The following information is submitted in accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2014, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2009, KDB 558074 D01 v03r02, and KDB 913591. Testing for the AC line-conducted and radiated emissions testing were performed as defined in ANSI C63.10-2009.

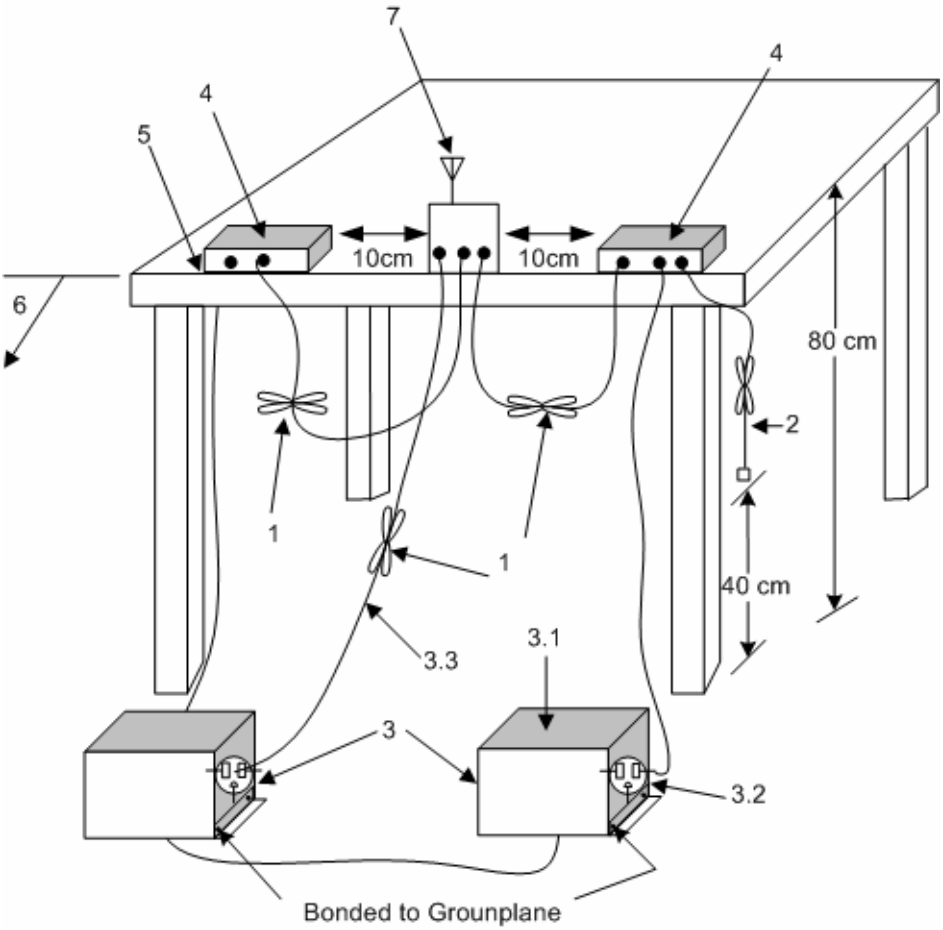
Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions was performed as defined in ANSI C63.10-2009. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter wooden bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram 1 showing typical test arrangement and photographs in exhibits for EUT placement used during testing.

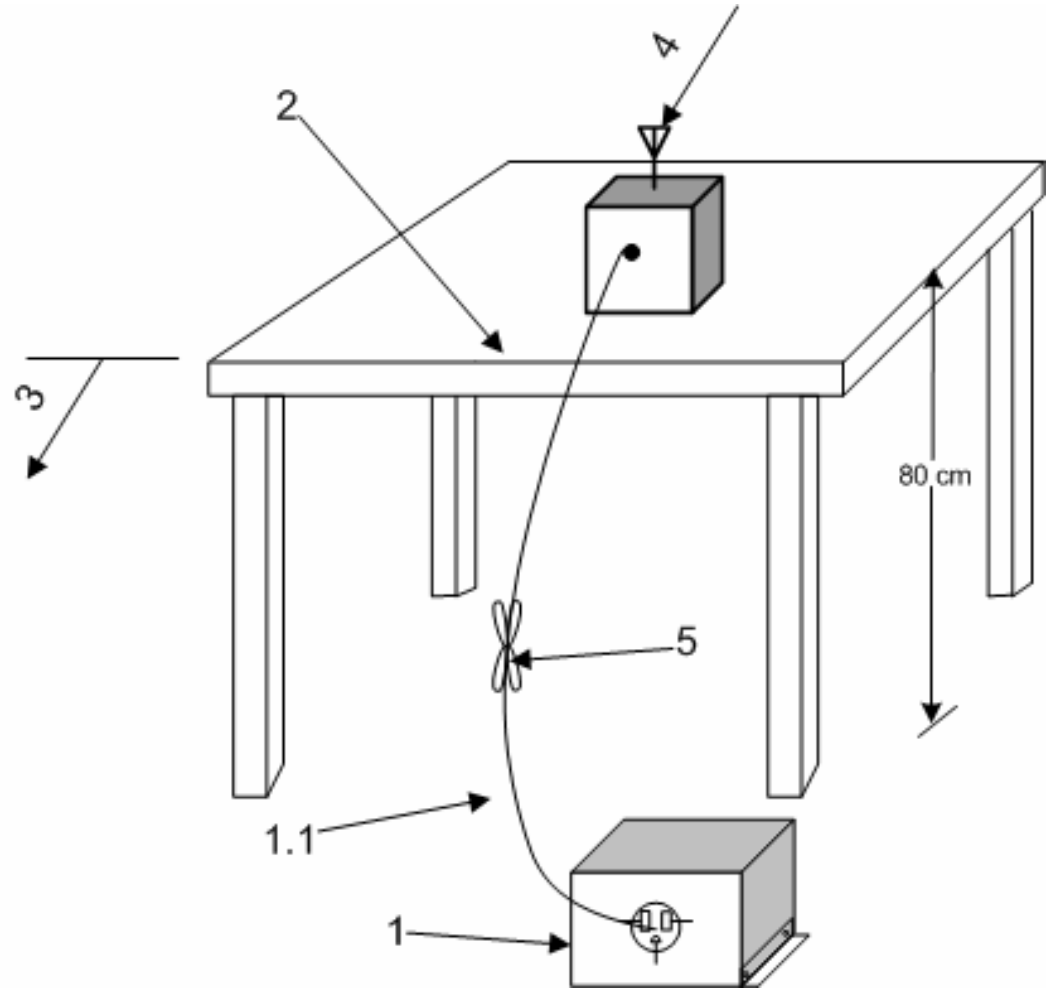
Radiated Emission Test Procedure

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. Radiated emission testing was performed as required in 47CFR paragraph 15C as specified in ANSI C63.10-2009 and referenced KDB documents. EMI energy was maximized by equipment placement, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. The frequency spectrum from 9 kHz to 60,000 MHz was searched for during preliminary investigation. Refer to diagrams 2 and 3 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.



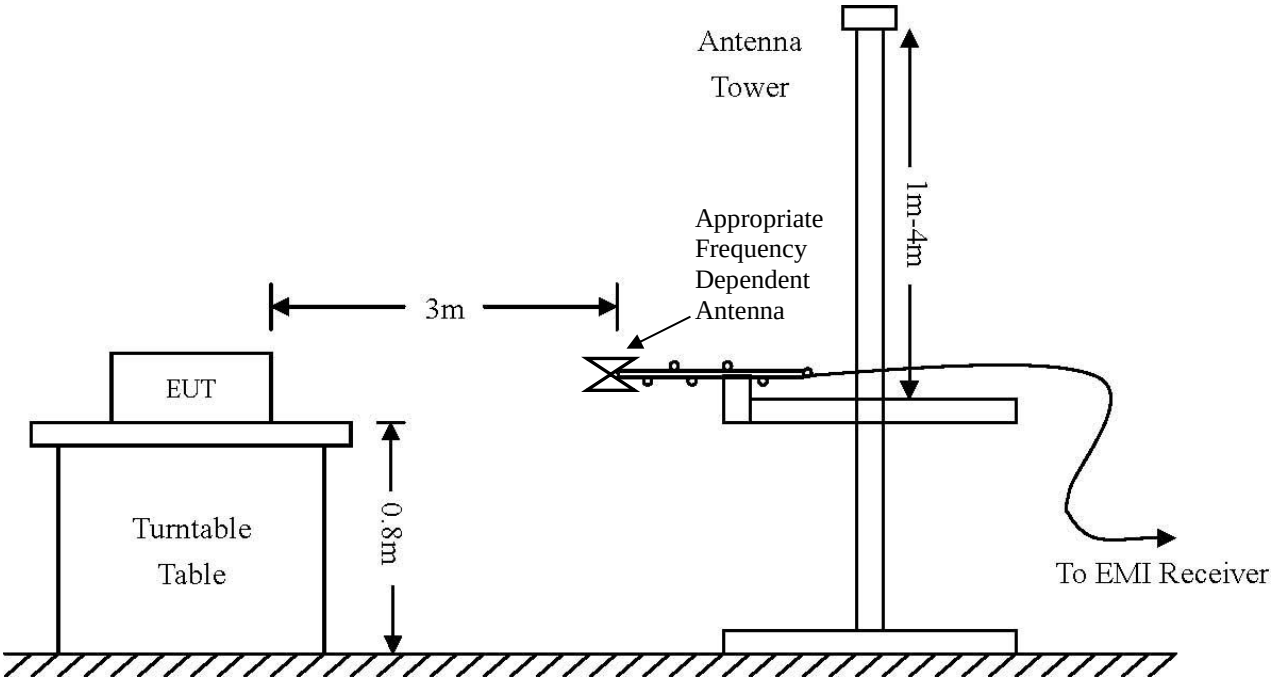
1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long see (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3).
   3.1 All other equipment powered from additional LISN(s).
   3.2 Multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3 LISN at least 80 cm from nearest part of EUT chassis
4. Non-EUT components of EUT system being tested
5. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.3.1).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test.

Diagram 1 Test arrangement for Conducted emissions



1. A LISN is optional for radiated measurements between 30 MHz to 1000 MHz, but not allowed for measurements below 30 MHz and above 1000 MHz (See 6.4.3, 6.5.1, and 6.6.3). If used, connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50Ω. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3.1).
   1.1 LISN spaced at least 80 cm from nearest part of EUT chassis.
2. The EUT shall be placed in the center of the table to the extent possible (See 6.2.3.1 and 6.3.4).
3. A vertical conducting plane, if used for conducted tests per 6.2.2, shall be removed for radiated emission tests.
4. Antenna may be integral or detachable, depending on the EUT.
5. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.

Diagram 2 Test arrangement for radiated emissions of tabletop equipment



Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHz
Loop Antenna	Broadband Biconilog	Horn
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 120 kHz	VBW = 1 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV
Antenna Height 1m	Antenna Height 1-4m	Antenna Height 1-4m

Diagram 3 Test arrangement for radiated emissions tested on Open Area Test Site (OATS)

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 Registration — Refer to Annex for Site Registration Letters

NVLAP Accreditation — Lab code 200087-0

List of Test Equipment

A Rohde and Schwarz ESU40 and/or Hewlett Packard 8591EM was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rohde and Schwarz ESU40 and/or Hewlett Packard 8562A Spectrum Analyzer was used as the measuring device for testing the emissions at frequencies above 1 GHz. The analyzer settings used are described in the following table. Refer to the appendix for a complete list of test equipment.

AC Line Conducted Emissions (0.150 -30 MHz)		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Emissions (30-1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions (Above 1000 MHz)		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

Equipment	Manufacturer	Model (SN)	Band	Cal Date	Due
☒ LISN	Comp. Design	FCC-LISN-2-MOD.CD (126)	.15-30MHz	10/14	10/15
☒ Cable	Time Microwave	750HF290-750 (L10M)	9kHz-40 GHz	10/14	10/15
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/14	10/15
☒ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/14	10/15
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/14	10/15
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/14	10/15
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/14	10/15
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15	5/17
☒ Antenna	EMCO	6509 (9502-1374)	.001-30 MHz	10/14	10/15
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/14	10/15
☒ Antenna	Standard	FXRY638A (621786)	10-18 GHz	5/15	5/17
☐ Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/15	5/16
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/15	5/16
☒ Analyzer	HP	8562A (3051A05950)	9kHz-110GHz	5/15	5/16
☒ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/15	5/16
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/15	5/16
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/14	10/15
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/14	10/15
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/14	10/15

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	22.5° C
Relative Humidity	56%
Atmospheric Pressure	1017.7 mb

Intentional Radiators

As per 47CFR, Subpart C, paragraph 15.247 the following information is submitted.

Antenna Requirements

The EUT offers female N-type connector for use with authorized antenna systems only. The design is marketed for professional installation and use as described in accompanying documentation. The antenna connection point complies with the unique antenna connection requirements.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at the antenna port with radiated emissions measured on the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in restricted bands. Emissions were investigated at the antenna port and OATS, using appropriate antennas or pyramidal horns, amplification stages, and spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.10-2009 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed radiated emission values take into account the measured radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

Table 1 Radiated Emissions in Restricted Bands Data

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)
125.0	39.0	36.4	N/A	42.5	41.1	N/A	43.5
250.0	42.7	38.8	N/A	35.8	33.4	N/A	46.0
260.0	37.9	33.2	N/A	30.2	25.5	N/A	46.0
1000.0	51.7	N/A	48.2	53.8	N/A	51.5	54.0
1125.0	42.6	N/A	38.4	47.4	N/A	45.0	54.0
Calculated from antenna port conducted data per KDB 558074							
11453.6	36.0	N/A	N/A	N/A	N/A	N/A	54.0
11506.5	41.7	N/A	N/A	N/A	N/A	N/A	54.0
11696.4	40.1	N/A	N/A	N/A	N/A	N/A	54.0

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the emissions requirements of 47CFR Part 15C Intentional Radiators. The EUT provided a worst-case minimum margin of -2.4 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted Emissions Procedure

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied supporting equipment, which provided direct current power to the EUT and was connected to the LISN. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the EUT. All power cords except the EUT support equipment power the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor, internal to the LISN. Power line conducted emissions testing were carried out individually for each current carrying conductor of the EUT support equipment. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequency of each emission displaying the highest amplitude. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then the data was recorded with maximum conducted emissions levels. Refer to figures one and two for plots of the EUT support equipment AC Line Conducted emissions.

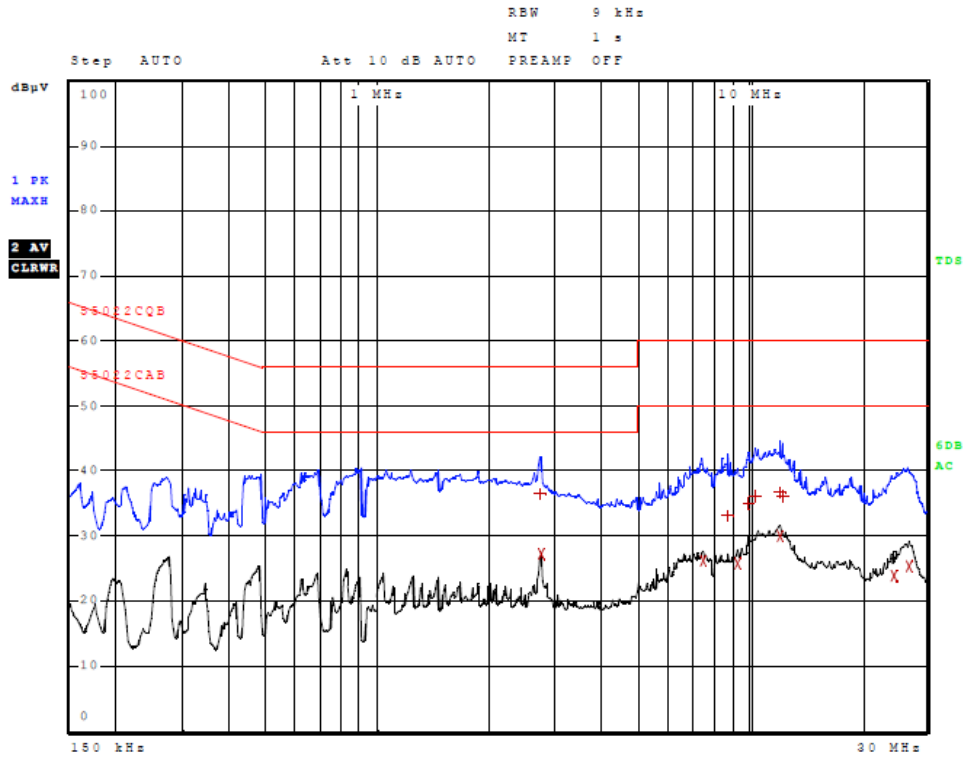


Figure 1 AC Line Conducted Emissions Line 1

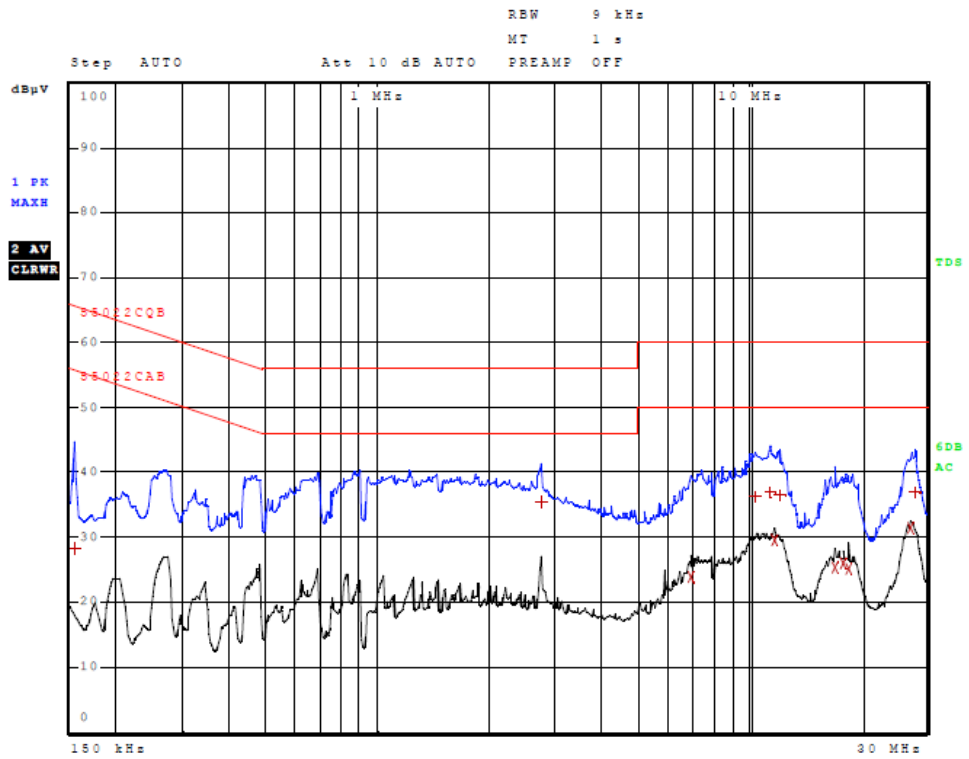


Figure 2 AC Line Conducted Emissions Line 2

Table 2 AC Line Conducted Emissions Data (Highest Emissions Line L1)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	2.742000000 MHz	36.53	Quasi Peak	-19.47
2	2.746000000 MHz	27.17	Average	-18.83
2	7.492000000 MHz	26.13	Average	-23.87
1	8.756000000 MHz	33.15	Quasi Peak	-26.85
2	9.280000000 MHz	25.78	Average	-24.22
1	9.916000000 MHz	34.99	Quasi Peak	-25.01
1	10.392000000 MHz	36.04	Quasi Peak	-23.96
1	12.048000000 MHz	36.56	Quasi Peak	-23.44
2	12.124000000 MHz	29.91	Average	-20.09
1	12.320000000 MHz	36.06	Quasi Peak	-23.94
2	24.420000000 MHz	23.87	Average	-26.13
2	26.868000000 MHz	25.40	Average	-24.60

Other emissions present had amplitudes at least 20 dB below the limit.

Table 3 AC Line Conducted Emissions Data (Highest Emissions Line L2)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	28.32	Quasi Peak	-37.46
1	2.754000000 MHz	35.41	Quasi Peak	-20.59
2	6.952000000 MHz	23.81	Average	-26.19
1	10.412000000 MHz	36.14	Quasi Peak	-23.86
1	11.392000000 MHz	36.79	Quasi Peak	-23.21
2	11.660000000 MHz	29.58	Average	-20.42
1	12.084000000 MHz	36.37	Quasi Peak	-23.63
2	16.952000000 MHz	25.37	Average	-24.63
2	17.816000000 MHz	25.95	Average	-24.05
2	18.476000000 MHz	25.08	Average	-24.92
2	27.100000000 MHz	31.32	Average	-18.68
1	27.816000000 MHz	36.91	Quasi Peak	-23.09

Other emissions present had amplitudes at least 20 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT test system demonstrated compliance to the conducted emissions requirements of 47CFR Part 15C. The EUT demonstrated minimum margin of -18.6 dB below the limit. Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.

General Radiated Emissions Procedure

The EUT was arranged in a testing configuration replacing the high gain dish with a 50-ohm termination load at antenna port and operated through all available modes with worst-case data recorded. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies, which produced the highest emissions. Each radiated emission was then maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 60,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Loop from 9 kHz to 30 MHz, Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 1 GHz and or Double Ridge or pyramidal horns and mixers from 1 GHz to 60 GHz, notch filters, and appropriate amplifiers and external mixers were utilized.

Table 4 General Radiated Emissions from EUT Data (Highest 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)	Limit @ 3m (dBµV/m)
101.0	36.0	30.0	N/A	36.7	30.6	N/A	43.5
125.0	39.0	36.4	N/A	42.5	41.1	N/A	43.5
215.8	29.5	23.9	N/A	31.6	26.7	N/A	43.5
216.5	30.0	23.7	N/A	31.8	27.8	N/A	43.5
217.4	29.2	23.7	N/A	32.2	27.6	N/A	46.0
218.1	28.8	23.5	N/A	32.1	26.9	N/A	46.0
219.7	29.5	23.9	N/A	32.0	26.6	N/A	46.0
226.7	30.2	24.4	N/A	32.9	28.0	N/A	46.0
230.0	35.2	30.3	N/A	35.8	26.3	N/A	46.0
250.0	42.7	38.8	N/A	35.8	33.4	N/A	46.0
260.0	37.9	33.2	N/A	30.2	25.5	N/A	46.0
300.0	36.5	34.4	N/A	36.0	34.7	N/A	46.0
348.5	46.8	42.8	N/A	48.0	43.8	N/A	46.0
351.3	48.6	43.2	N/A	49.8	43.8	N/A	46.0
1000.0	51.7	N/A	48.2	53.8	N/A	51.5	54.0
1125.0	42.6	N/A	38.4	47.4	N/A	45.0	54.0

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

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C paragraph 15.209 Intentional Radiators. The EUT demonstrated a minimum margin of -2.2 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the 5725-5850 MHz Frequency Band

Per regulations antenna-port conducted measurements may be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required. The EUT was tested for compliance following the procedures defined in referenced ANSI in addition to the FCC KDB 558074 v03r02. Harmonic emission compliance was determined using the antenna port conducted measurement, adding the transmit antenna gain (42 dBi), and accounting for ground reflections as provided in the regulations. Using this approach the EUT may be used with antennas of 42 dBi or less gain. Transmitter output was measured at the antenna port with worst-case emissions data presented. Peak Power Spectral Density (PKPSD) was measured at the antenna port using the procedure defined in KDB 558074 v03r02 section 10.2 PKPSD as provided for in 10.1. Radiated emissions were also measured on the Open Area Test Site (OATS) at a three-meter distance. The EUT was placed on a wooden turntable elevated as required above the ground plane at a distance of 3 meters from the FSM antenna located on the OATS. The peak and quasi-peak amplitude of the frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of emissions above 1000 MHz were measured using a spectrum analyzer. Emissions data was recorded from the measurement results. Data presented reflects measurement result corrected to account for measurement system gains and losses. Plots were made of transmitter performance for reference purposes.

Refer to figures three through twenty-two showing plots of the EUT performance displaying compliance with the specifications.

Calculated radiated emissions Per KDB 558074 method paragraph 12.2

Per regulations antenna-port conducted measurements were used for demonstrating compliance in the restricted frequency bands. Antenna port conducted measurements were performed from 30 MHz to 60 GHz. Proper impedance matching was ensured and the additional radiated test for cabinet/case spurious emissions was performed. Example calculation is provided

a) Measure the conducted output power
b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level
c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz)
d) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$$E = EIRP - 20\log D + 104.8$$

Where:

E = electric field strength in dBµV/m,
EIRP = equivalent isotropic radiated power in dBm
D = specified measurement distance in meters.

e) Compare the resultant electric field strength level to the applicable limit

The highest amplitude harmonic antenna port emission measured -95.53 dBm and 42-dBi gain antenna. Using the highest harmonic value and measurement distance of 3 meters, the emission is calculated as follows

$$E= -53.53 - 20\log (3) + 104.8$$

E= 41.73 dBµV/m at 3 meters which is below the limit of 54 dBµV/m at 3 meters requirement

All other harmonic emissions presented with lower amplitudes, which equates to having higher margins.

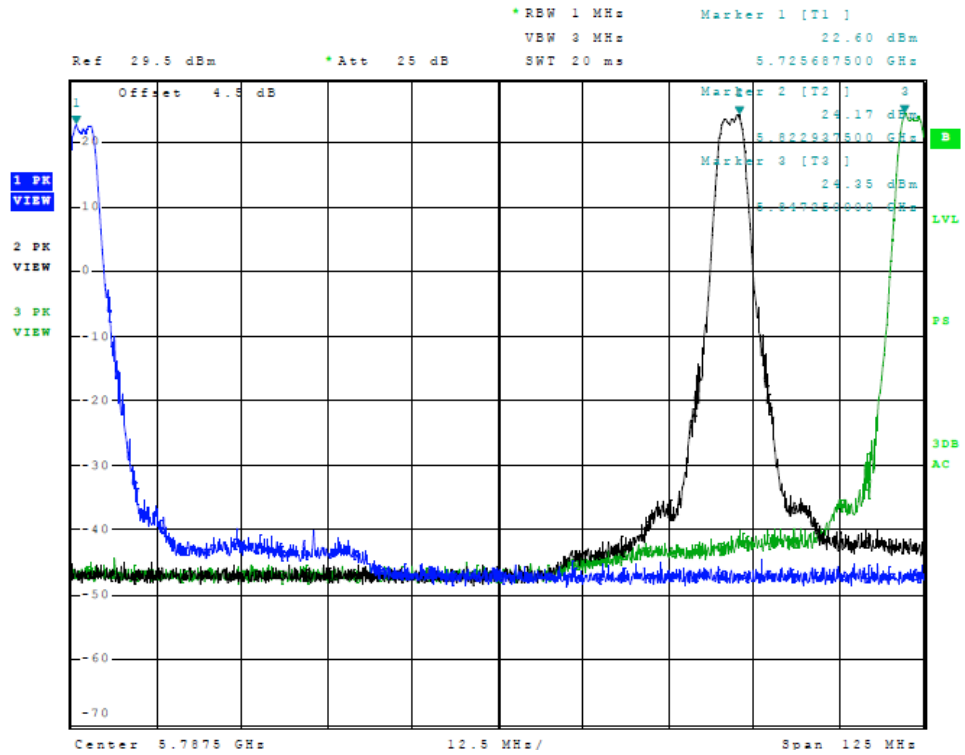


Figure 3 Plot of Transmitter Emissions (Across Operational Band, 3.5 MHz Channel)

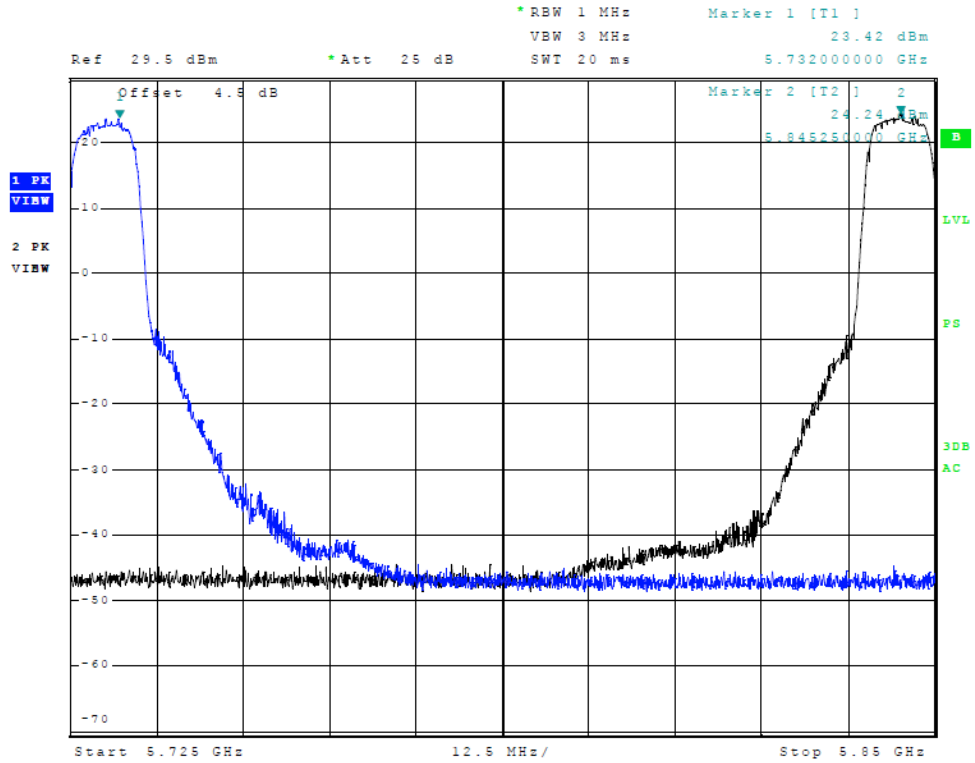


Figure 4 Plot of Transmitter Emissions (Across Operational Band, 10 MHz Channel)

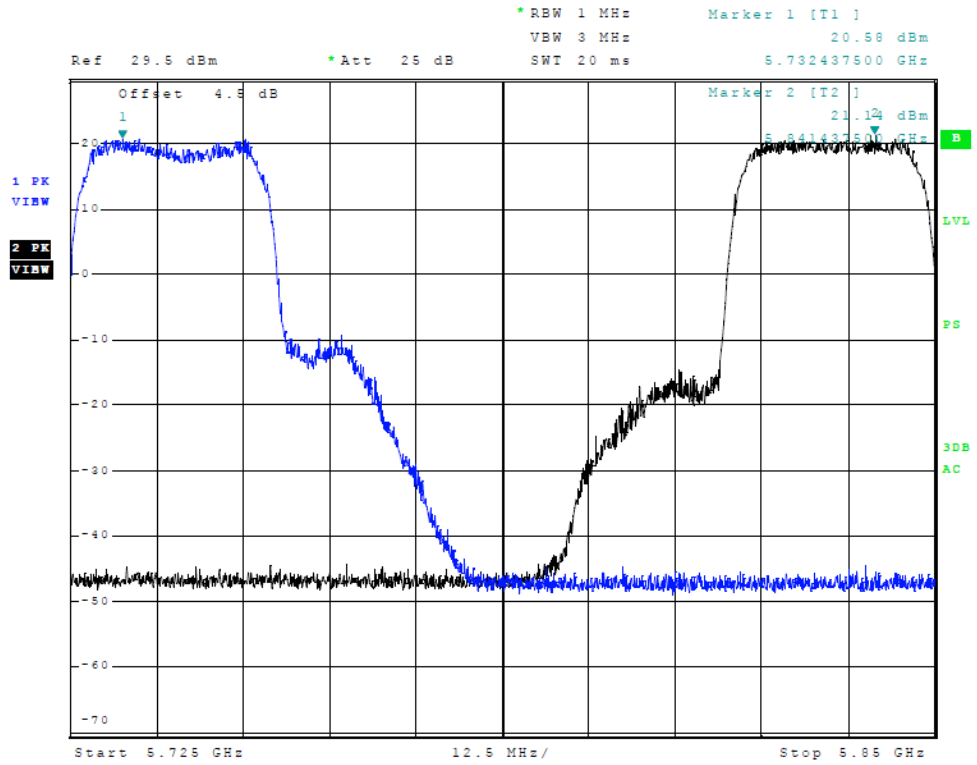


Figure 5 Plot of Transmitter Emissions (Across Operational Band, 30 MHz Channel)

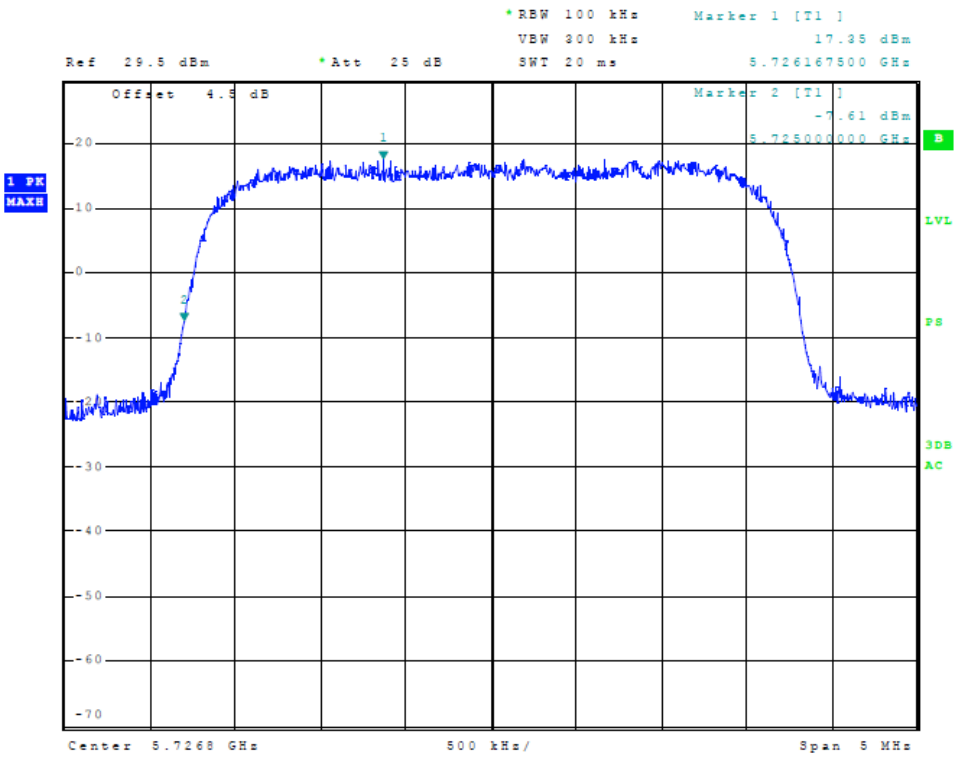


Figure 6 Plot of Transmitter Low Band Edge (3.5 MHz Channel)

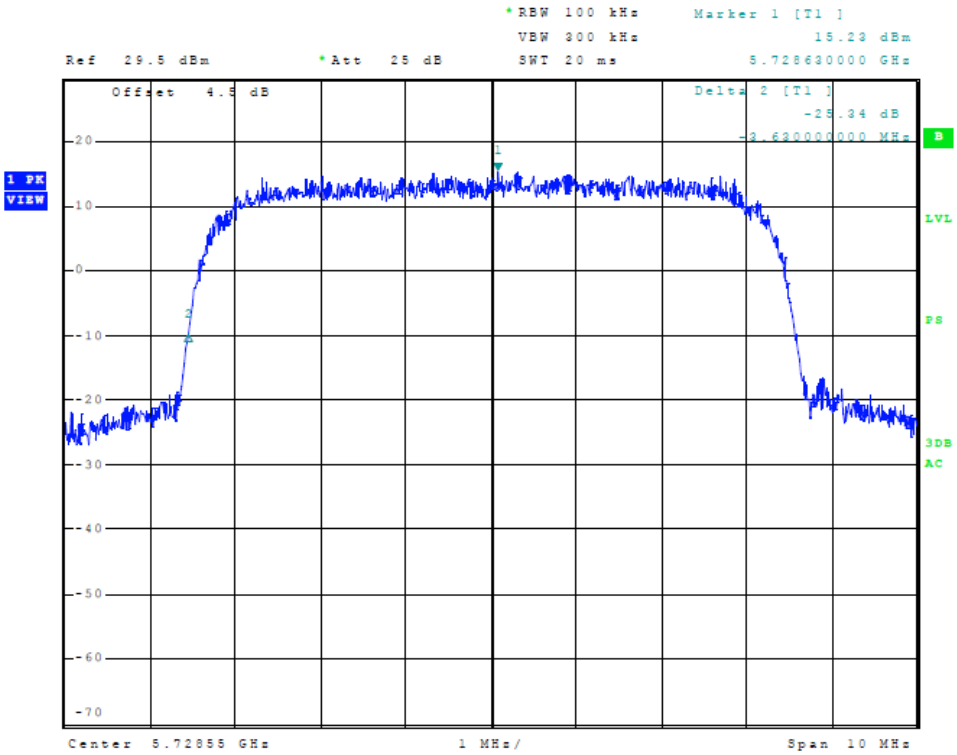


Figure 7 Plot of Transmitter Low Band Edge (7.0 MHz Channel)

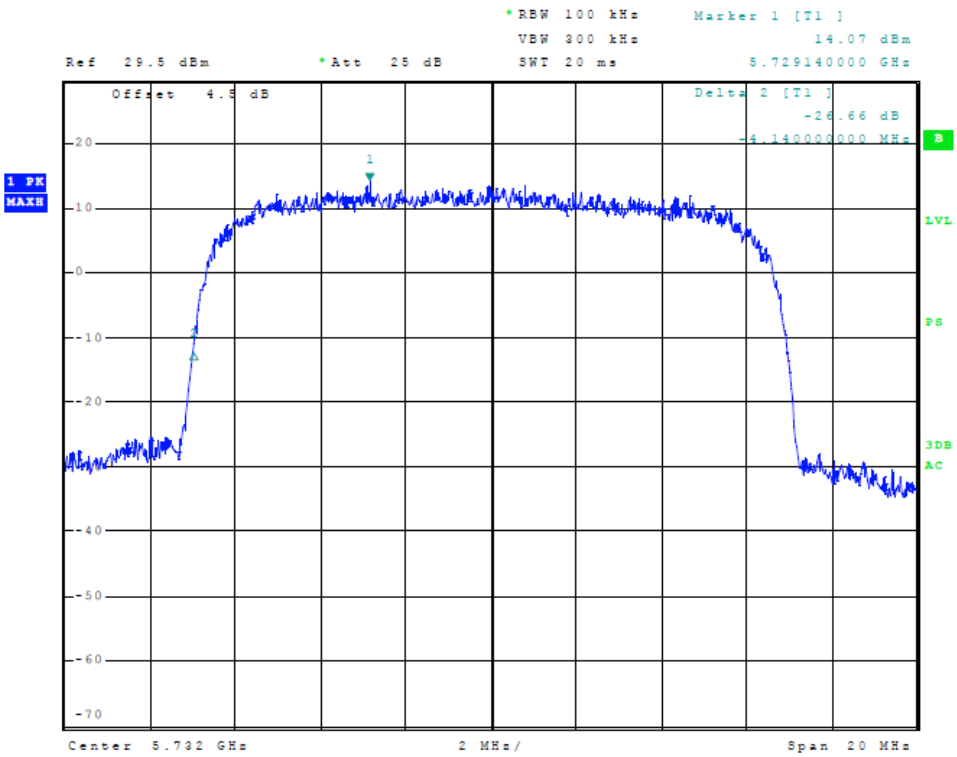


Figure 8 Plot of Transmitter Low Band Edge (10 MHz Channel)

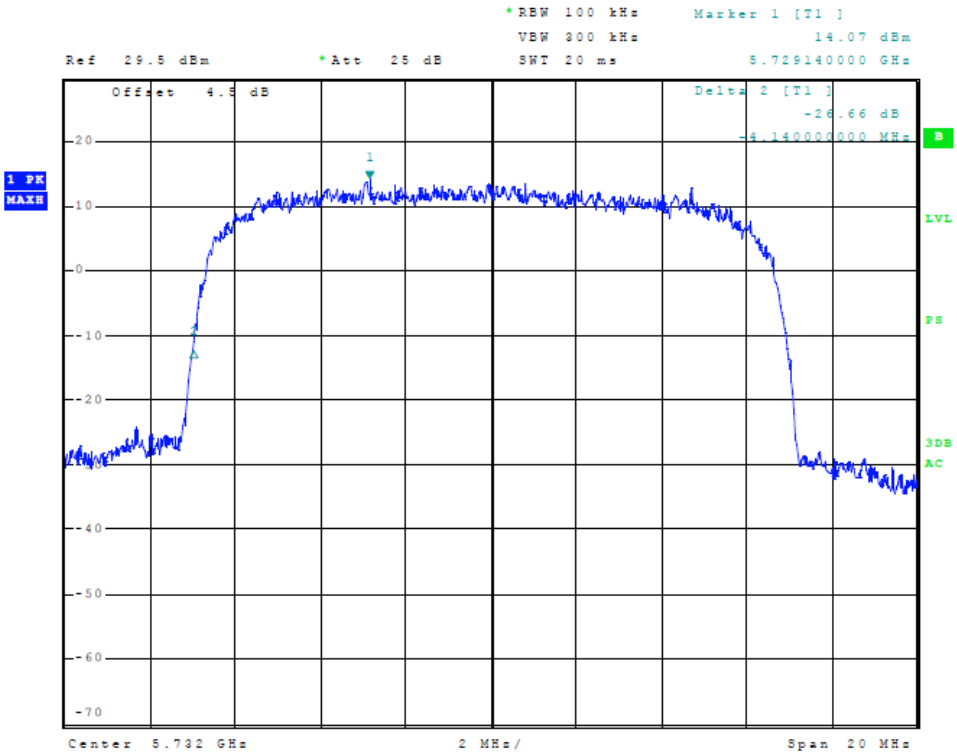


Figure 9 Plot of Transmitter Low Band Edge (14 MHz Channel)

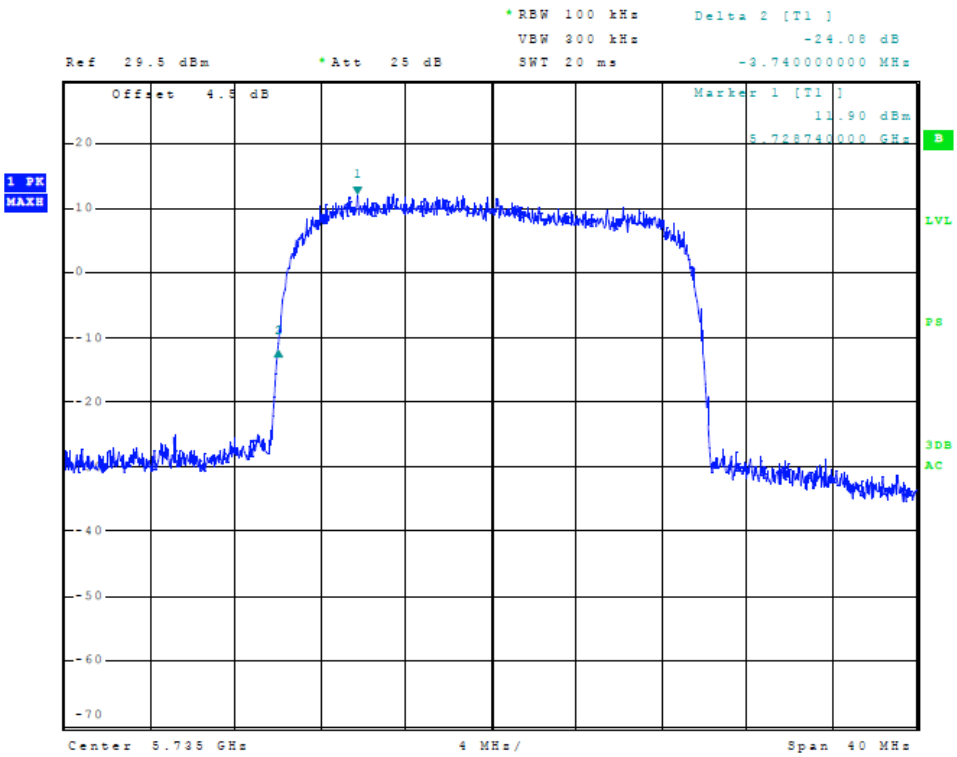


Figure 10 Plot of Transmitter Low Band Edge (20 MHz Channel)

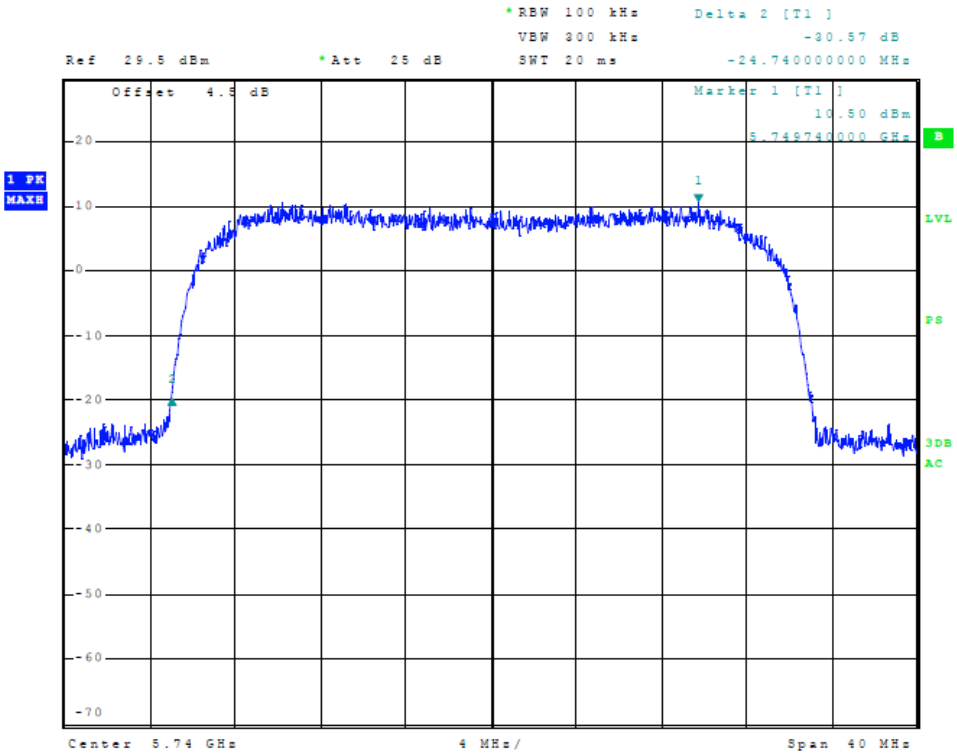


Figure 11 Plot of Transmitter Low Band Edge (28 MHz Channel)

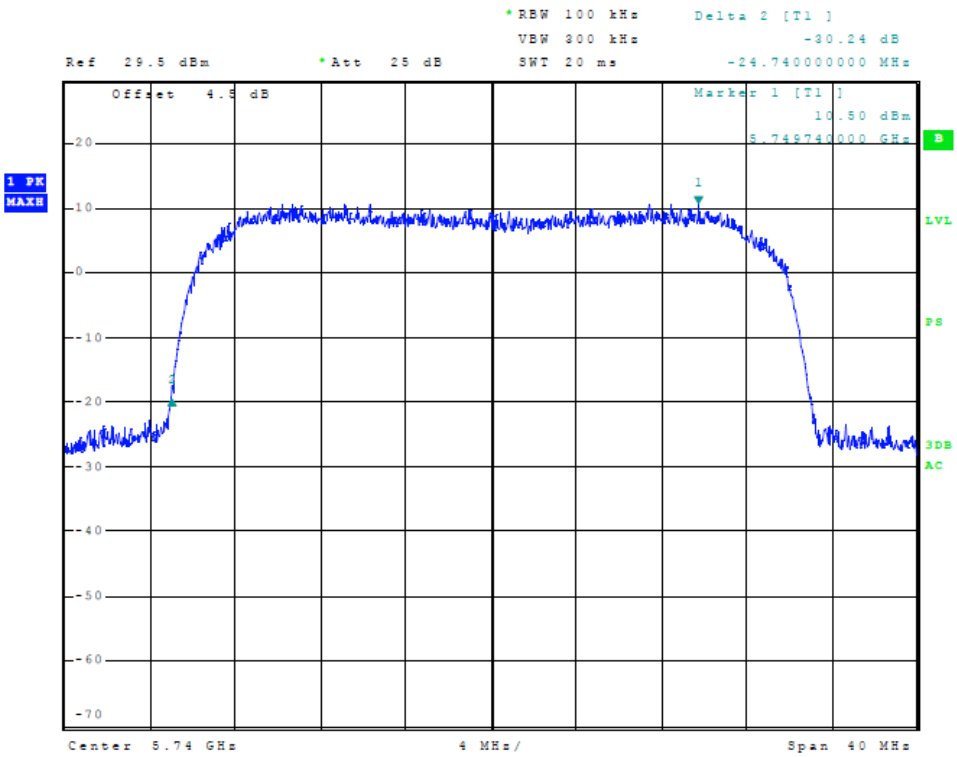


Figure 12 Plot of Transmitter Low Band Edge (30 MHz Channel)

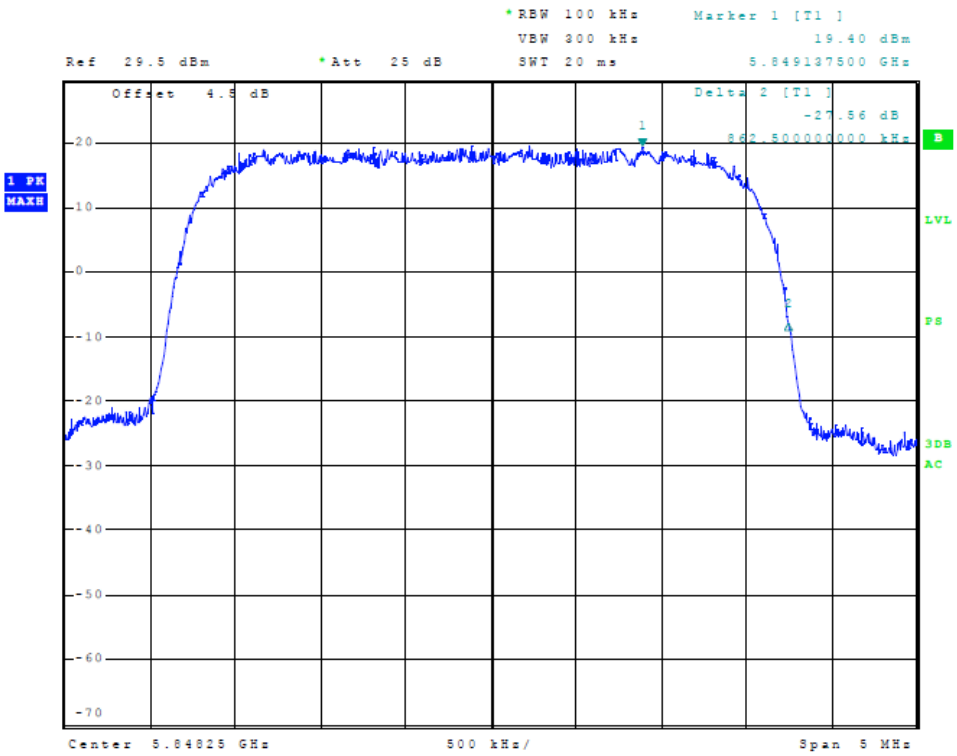


Figure 13 Plot of Transmitter High Band Edge (3.5 MHz Channel)

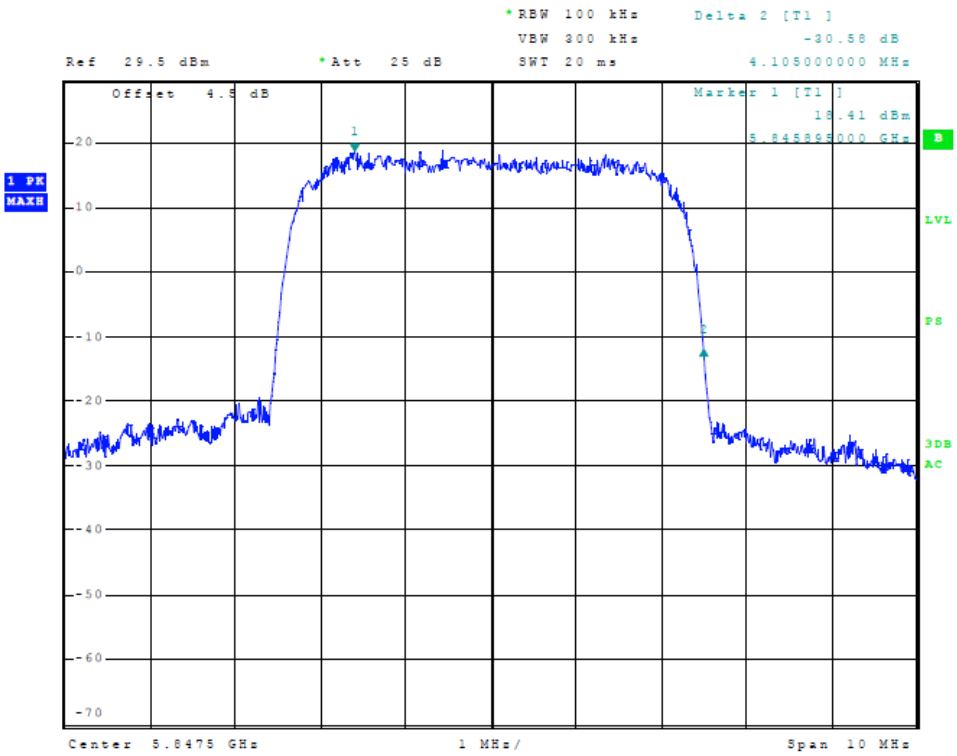


Figure 14 Plot of Transmitter High Band Edge (5 MHz Channel)

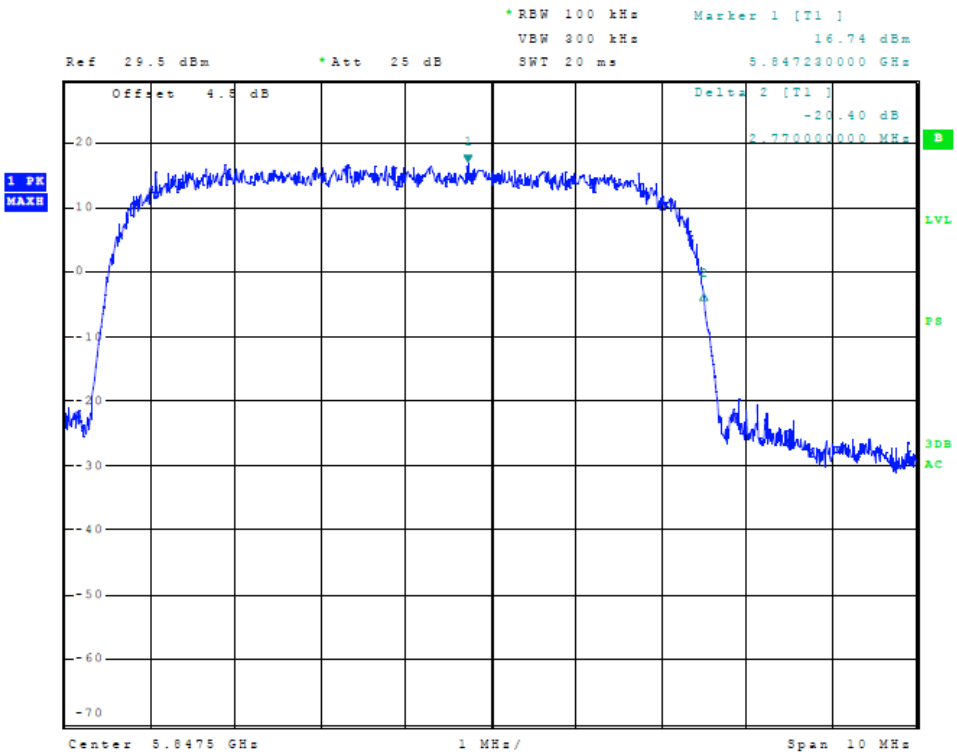


Figure 15 Plot of Transmitter High Band Edge (7 MHz Channel)

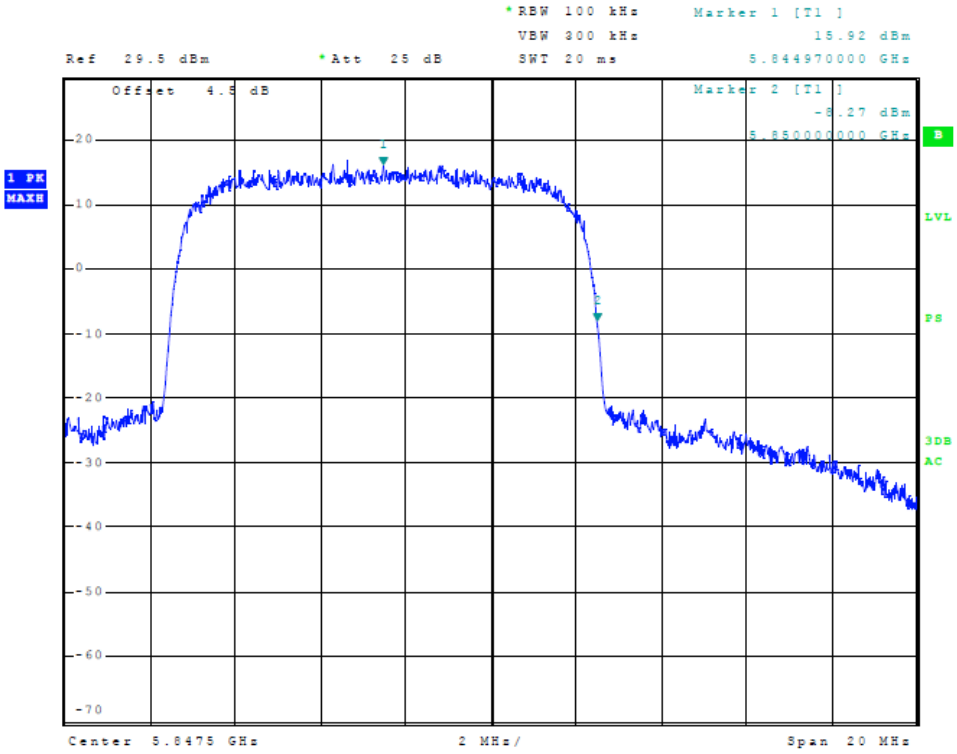


Figure 16 Plot of Transmitter High Band Edge (10 MHz Channel)

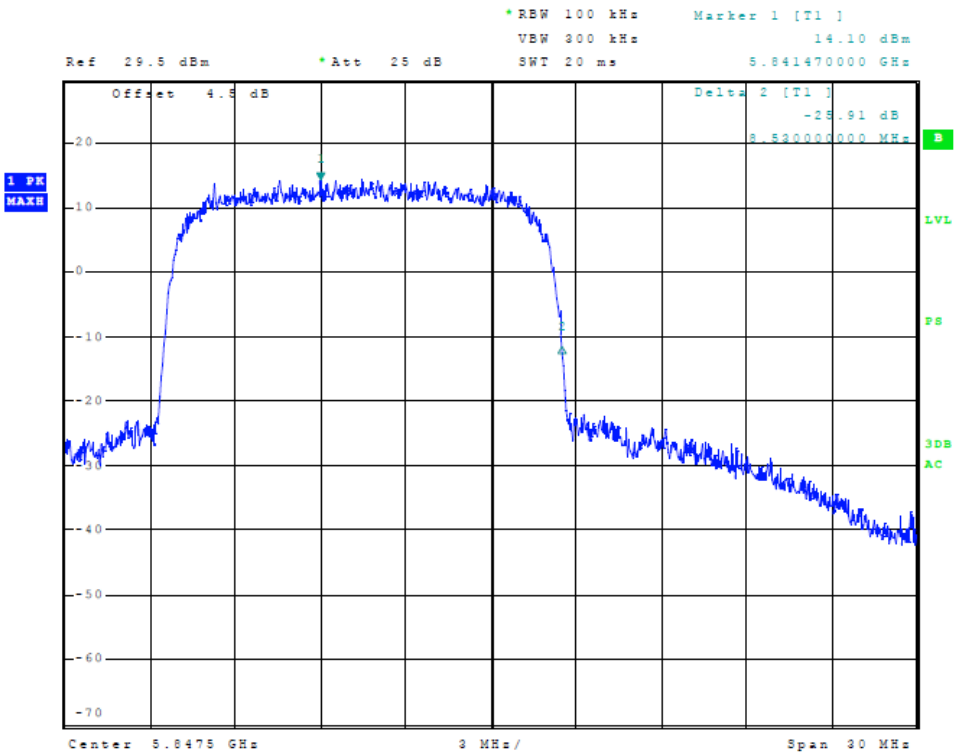


Figure 17 Plot of Transmitter High Band Edge (14 MHz Channel)

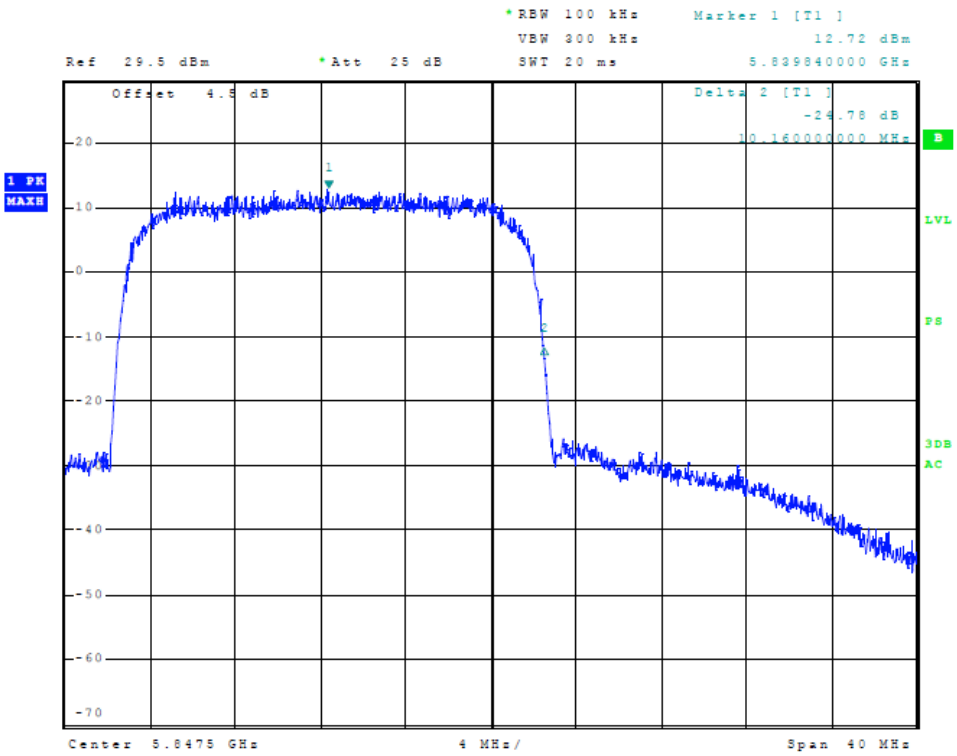


Figure 18 Plot of Transmitter High Band Edge (20 MHz Channel)

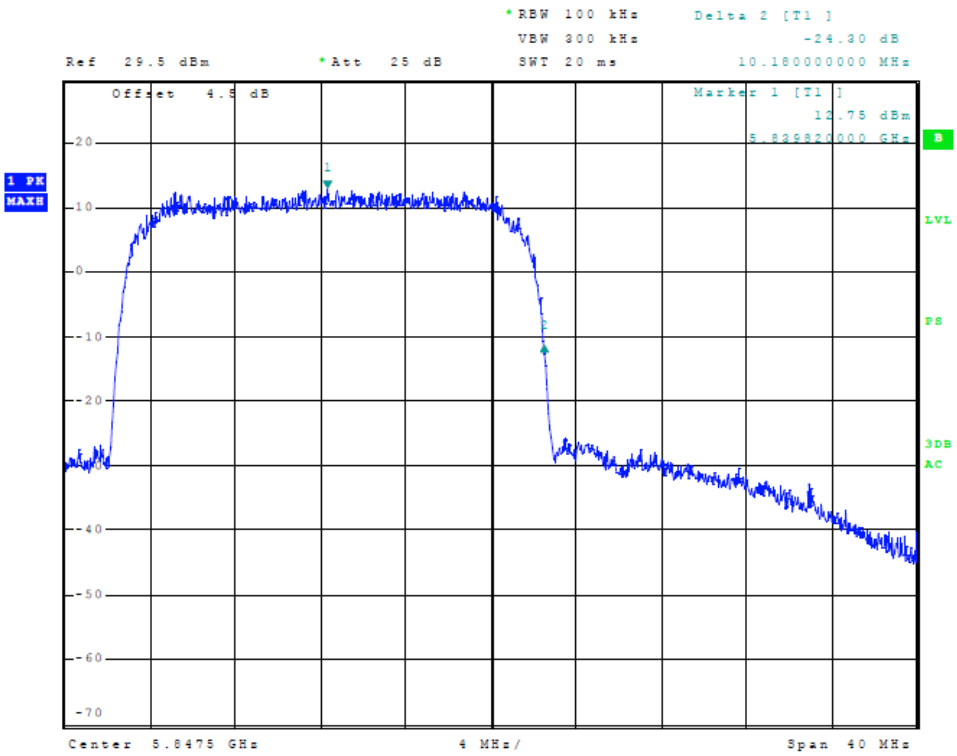


Figure 19 Plot of Transmitter High Band Edge (28 MHz Channel)

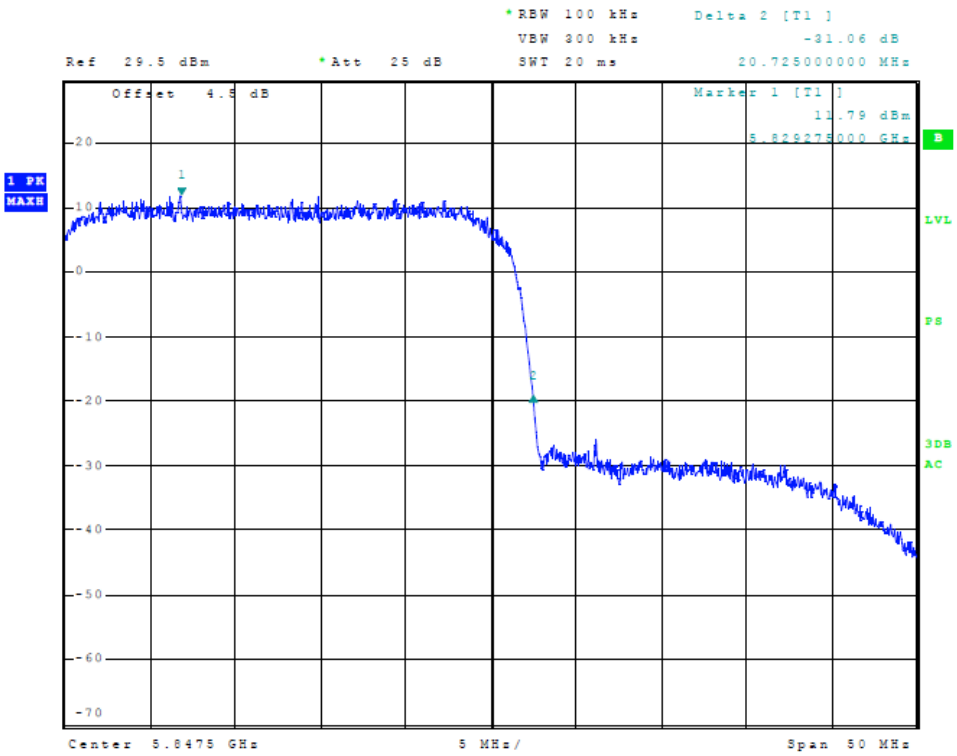


Figure 20 Plot of Transmitter High Band Edge (30 MHz Channel)

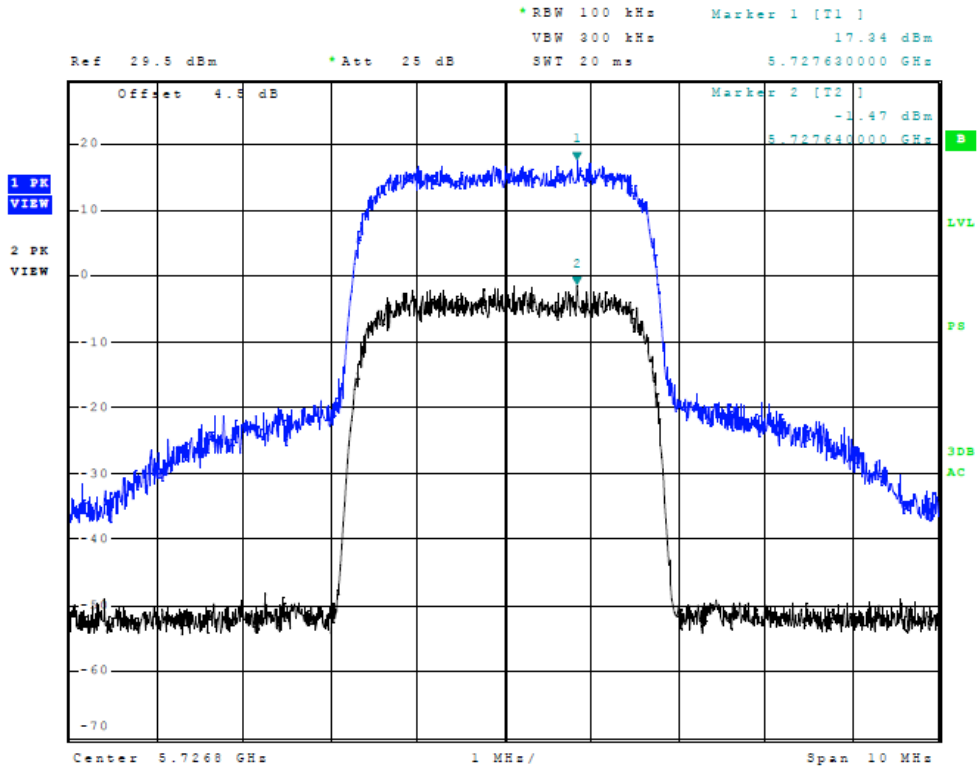


Figure 21 Plot of Transmitter Power Variation (3.5 MHz Channel)

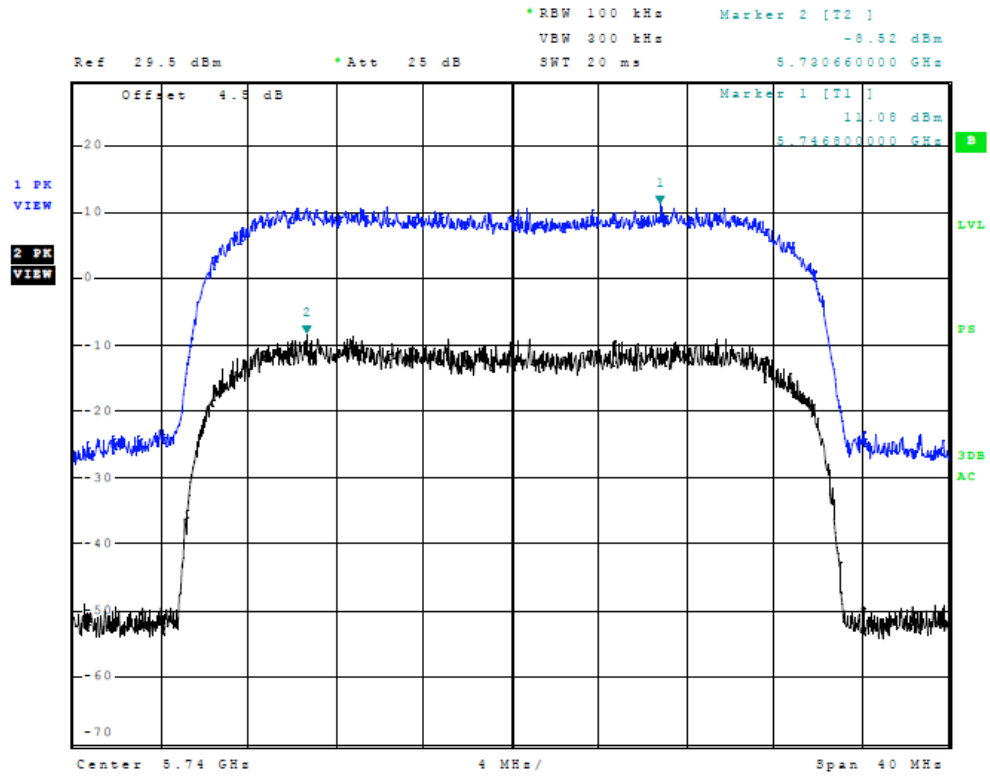


Figure 22 Plot of Transmitter Power Reduction (30 MHz Channel)

Transmitter Emissions Data

Table 5 Transmitter Radiated Emission

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
5726.8	--	--	--	--	--
11453.6	52.4	39.7	52.6	39.5	54.0
17180.4	58.2	45.2	58.3	45.6	54.0
22907.2	11.8	-0.8	11.8	-0.7	54.0
28634.0	15.6	3.1	16.1	3.1	54.0
5753.3	--	--	--	--	--
11506.5	51.1	38.3	51.3	38.5	54.0
17259.8	56.1	43.6	56.2	43.6	54.0
23013.0	12.7	0.1	12.4	-0.3	54.0
28766.3	15.7	3.3	16.2	3.4	54.0
5848.2	--	--	--	--	--
11696.4	49.9	37.4	49.9	37.3	54.0
17544.6	53.0	40.6	53.3	40.6	54.0
23392.8	12.6	-0.5	12.6	-0.6	54.0
29241.0	15.6	3.3	15.8	3.3	54.0

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

Table 6 Antenna Port Conducted Power and Transmitter Parameters

Channel Width	Maximum Conducted Power		Minimum Conducted Power		Occupied Bandwidth (kHz)		Maximum Power Spectral Density
(MHz)	(Watts)	(dBm)	(Watts)	(dBm)	6-dB	99%	(dBm)
3500	0.550	27.404	0.005	7.17	3,145	3,255	2.12
5000	0.547	27.381	0.005	7.14	4,100	4,470	0.81
7000	0.547	27.382	0.005	7.11	6,113	6,510	-0.31
10,000	0.547	27.381	0.005	7.03	8,300	9,200	-0.45
14,000	0.547	27.381	0.005	7.01	12,350	12,888	-0.84
20,000	0.547	27.382	0.005	7.16	17,820	18,495	-3.33
28,000	0.547	27.382	0.005	7.12	23,860	25,500	-4.88
30,000	0.547	27.383	0.005	7.10	24,775	26,950	-5.47

Table 7 Antenna Port Conducted Emissions (worst-case)

Frequency	dBm	Frequency	dBm	Frequency	dBm
5,726.8	27.38	5,753.3	27.40	5,848.2	27.38
11,453.6	-101.30	11,506.5	-95.53	11,696.4	-97.90
17,180.4	-104.10	17,259.8	-103.10	17,544.6	-106.70
22,907.2	-106.80	23,013.0	-105.80	23,392.8	-104.50
28,634.0	-102.80	28,766.3	-100.60	29,241.0	-104.20

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15.247. The peak antenna port conducted power was 0.550 watts (27.404 dBm). The worst-case peak power spectral density presented a minimum margin of -5.88 dB below the requirements. The calculated minimum margin below harmonic emissions requirements was -12.3 dB. General radiated emissions of supporting equipment provided -2.2 dB margin. There were no other significantly measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. There were no other deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the 47CFR Part 15C emissions requirements. There were no deviations or modifications 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 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	5/15	5/16
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520	5/15	5/16
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W		
Spectrum Analyzer: HP 8591EM	5/15	5/16
Antenna: EMCO Biconilog Model: 3143	5/15	5/16
Antenna: Sunol Biconilog Model: JB6	10/14	10/15
Antenna: EMCO Log Periodic Model: 3147	10/14	10/15
Antenna: Com Power Model: AH-118	10/14	10/16
Antenna: Com Power Model: AH-840	5/15	5/17
Antenna: Antenna Research Biconical Model: BCD 235	10/14	10/15
Antenna: EMCO 6509	10/14	10/15
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 μHy/50 ohm/0.1 μf	10/14	10/15
R.F. Preamp CPPA-102	10/14	10/15
Attenuator: HP Model: HP11509A	10/14	10/15
Attenuator: Mini Circuits Model: CAT-3	10/14	10/15
Attenuator: Mini Circuits Model: CAT-3	10/14	10/15
Cable: Belden RG-58 (L1)	10/14	10/15
Cable: Belden RG-58 (L2)	10/14	10/15
Cable: Belden 8268 (L3)	10/14	10/15
Cable: Time Microwave: 4M-750HF290-750	10/14	10/15
Cable: Time Microwave: 10M-750HF290-750	10/14	10/15
Frequency Counter: Leader LDC825	2/15	2/16
Oscilloscope Scope: Tektronix 2230	2/15	2/16
Wattmeter: Bird 43 with Load Bird 8085	2/15	2/16
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/15	2/16
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/15	2/16
R.F. Power Amp 65W Model: 470-A-1010	2/15	2/16
R.F. Power Amp 50W M185- 10-501	2/15	2/16
R.F. Power Amp A.R. Model: 10W 1010M7	2/15	2/16
R.F. Power Amp EIN Model: A301	2/15	2/16
LISN: Compliance Eng. Model 240/20	2/15	2/16
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/15	2/16
Antenna: EMCO Dipole Set 3121C	2/15	2/16
Antenna: C.D. B-101	2/15	2/16
Antenna: Solar 9229-1 & 9230-1	2/15	2/16
Audio Oscillator: H.P. 201CD	2/15	2/16
ELGAR Model: 1751	2/15	2/16
ELGAR Model: TG 704A-3D	2/15	2/16
ESD Test Set 2010i	2/15	2/16
Fast Transient Burst Generator Model: EFT/B-101	2/15	2/16
Field Intensity Meter: EFM-018	2/15	2/16
KEYTEK Ecat Surge Generator	2/15	2/16

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

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

Positions Held

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

Educational Background

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

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

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

Scot D Rogers

Scot D. Rogers

NVLAP Lab Code 200087-0

Annex D FCC Site Registration Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

April 16, 2015

Registration Number: 90910

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

Attention: Scot Rogers,

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

Dear Sir or Madam:

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

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

Sincerely,

Phyllis Parrish
Industry Analyst

NVLAP Lab Code 200087-0

Annex E Industry Canada Site Registration Letter

Industry Canada Industrie Canada

June 08, 2015

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

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

Attention: Mr. Scot D. Rogers

Dear Sir:

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

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

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

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

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

Yours sincerely,

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