NVLAP
Testing
NVLAP Lab Code 200087-0

Application For Grant of Certification

FOR

Model: E4FHSS
902-928 MHz (FHSs)
Frequency Hopping Systems
FCC ID: FIH0596465PT15
IC: 1584A-0596465PT15

FOR

Transcore

Amtech Technology Center
8600 Jefferson Street, NE
Albuquerque, NM 87113

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

Test Report Number: 180521

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 Grant of Certification Application

47CFR, PART 15C - Intentional Radiators
47CFR Paragraph 15.247 and
Industry Canada RSS-GEN and RSS-247
License Exempt Intentional Radiator

For

Transcore

Amtech Technology Center
8600 Jefferson Street, NE
Albuquerque, NM 87113

Frequency Hopping Systems
Model: E4FHSS

Frequency Range 902-928 MHz
FCC ID: FIH0596465PT15
IC: 1584A-0596465PT15

Test Date: May 21, 2018

Certifying Engineer: Scot D Rogers

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Revisions

Revision 2 Issued June 22, 2018 – addressed concern with company name presentation
Revision 1 Issued June 19, 2018

Foreword

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Frequency Hopping Systems Intentional Radiator operating under Code of Federal Regulations Title 47 (47CFR) Paragraph 15.247 and Industry Canada RSS-247 Issue 2, and RSS-GEN Issue 5 operation in the 902-928 MHz band.

Name of Applicant: Transcore
Amtech Technology Center
8600 Jefferson Street, NE
Albuquerque, NM 87113

M/N: E4FHSS
FCC ID: FIH0596465PT15 IC: 1584A-0596465PT15
Frequency Range: 902.5-927.5 MHz output power 0.251 W,
(20-dB Occupied bandwidth 221.5 kHz)

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Test 1 Restricted Bands	-19.6	Complies
Test 2 AC Line Emissions	-5.1	Complies
Test 3 General Radiated Emissions	-9.0	Complies
Test 4 Channel Spacing	N/A	Complies
Test 5 Number of Hopping Channels	N/A	Complies
Test 6 Dwell time on Channel	N/A	Complies
Test 7 Maximum Peak Power	N/A	Complies
Test 8 Operation with Directional Gain	N/A	Complies
Test 9 Out of Band Emissions	N/A	Complies

Equipment Tested

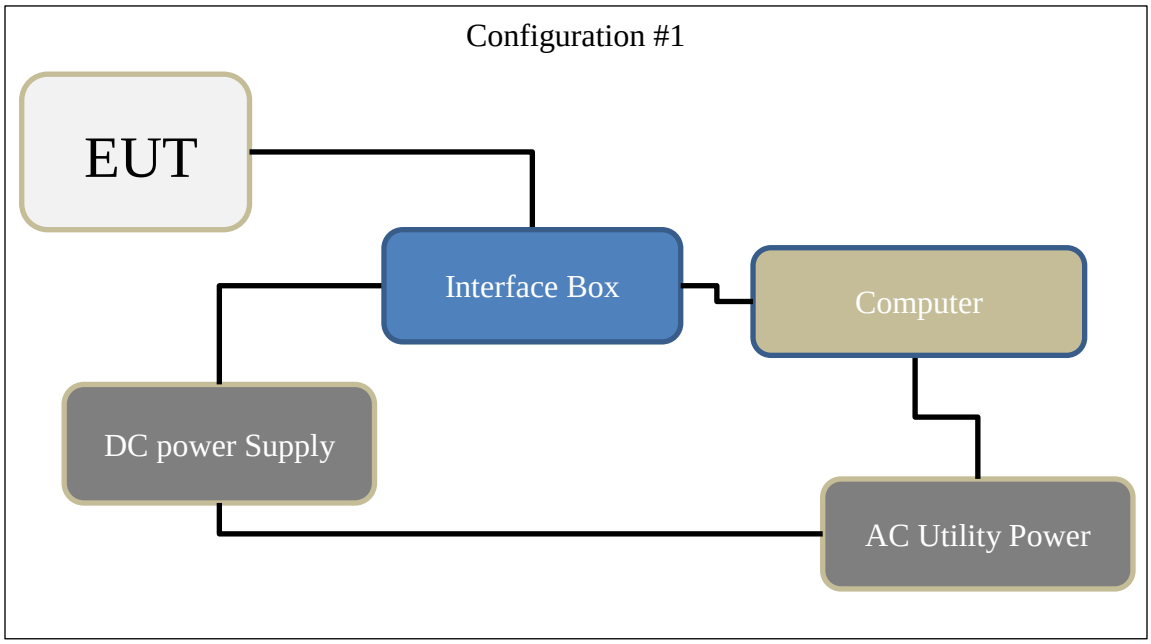
Equipment	Model	Serial number
EUT	E4FHSS	ENG1
EUT #2	E4FHSS	ENG2
Inter Face Test Box	Manufacturer supplied	N/A
Bench DC power supply	BK 1745	209C13
Computer	Dell Studio XPS	921LBN1

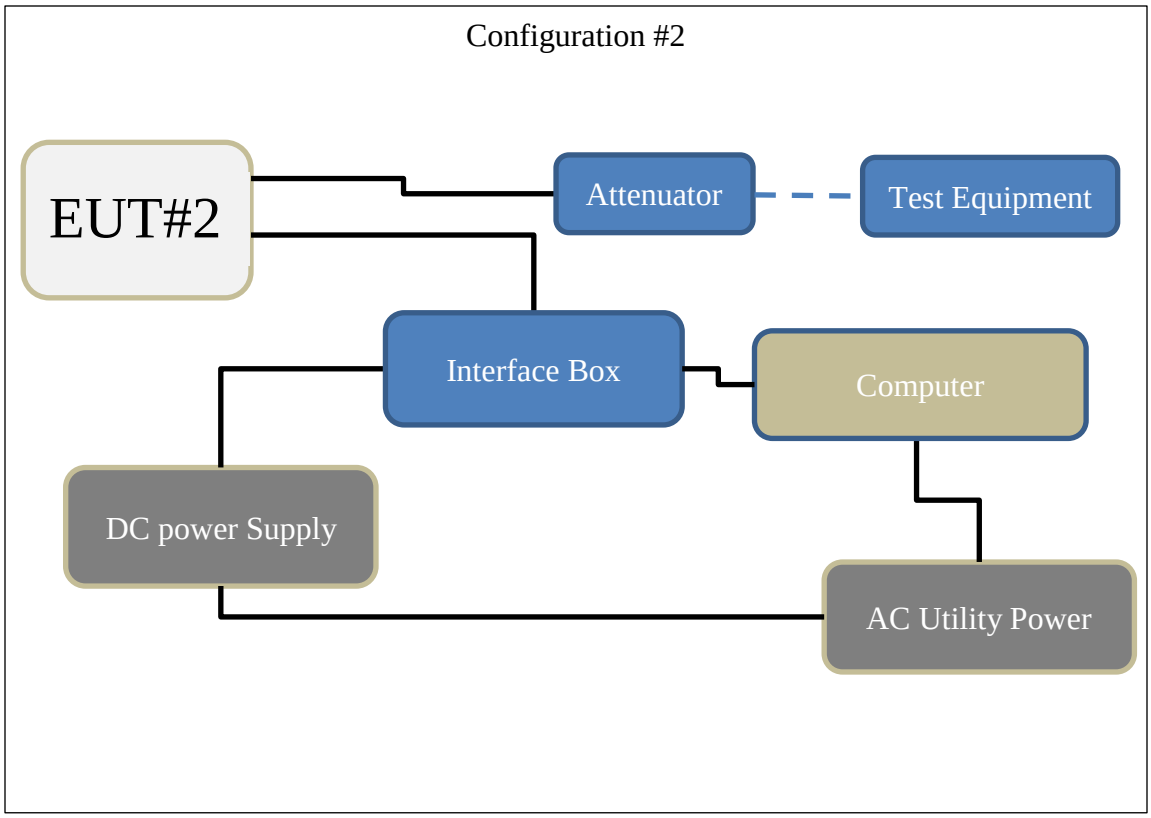
Test results in this report relate only to the items tested.

Equipment Function and Configuration

The EUT is a 902-928 MHz Frequency Hopping System designed for use in reading RFID tag applications. The system operates from 16-20VAC or 16-28VDC and provides single interface port accommodating power and serial interface for communications. The production design incorporates a fixed internal 10.3-dBi gain panel antenna. Two samples were provided for testing, sample 1 a production design with internal antenna, and sample 2 with the integral antenna replaced with antenna port connector. Sample 2 provided the 50-ohm antenna port which was used during antenna port conducted emission measurement. Software was provided which allowed testing personnel operational control of the transmitter for testing purposes. The tests sample was loaded with manufacturer software Version 1.10H. For description of the frequency hopping algorithm reference documentation provided in the Operational Description exhibit. The EUT was arranged as described by the manufacturer emulating typical use configuration for testing purposes. The EUT offers no other interface connections than those documented in the configuration options presented. For testing purposes, the EUT received power from external direct current bench power supply and was configured to operate in available modes. During testing all interface connections were appropriately terminated. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Use Configuration





Applicant Company information

Applicants Company	Transcore
Applicants Address	Amtech Technology Center 8600 Jefferson Street, NE, Albuquerque, NM 87113
FCC ID:	FIH0596465PT15
Industry Canada Identifier	1584A-0596465PT15
Manufacturer Company	Transcore
Manufacturer Address	Amtech Technology Center 8600 Jefferson Street, NE, Albuquerque, NM 87113

Equipment information

Product Marketing Name (PMN): The PMN is the name or model number under which the product will be marketed/offered for sale in Canada. If the product has PMN, it must be provided.	E4FHSS
Unique Product Number (UPN): The applicant made up of a maximum of 11 alphanumeric characters (A-Z, 0-9), assigns the UPN.	E4FHSS
Hardware Version Identification Number (HVIN): The HVIN identifies hardware specifications of a product version. The HVIN replaces the ISED Model Number in the legacy E-filing System. An HVIN is required for all products for certification applications.	E4FHSS
Host Marketing Name (HMN) (if applicable): The HMN is the name or model number of a final product, which contains a certified radio module.	
Brand Name	
Model Number	E4FHSS
Test Rule Part(s)	47CFR 15C, 15.247, RSS-247
Test Frequency Range	902.5-927.5 MHz
Project Number	180521
Submission Type	Certification

Product Details

Items	Description
Product Type	902-928 Frequency Hopping system
Radio Type	Transceiver
Power Type	16-20VAC, 47-63Hz, 16-28VDC
Frequency Range	902.5-927.5 MHz
Maximum Conducted Output Power	0.251 Watts
Antenna	Integral Panel antenna (10.3 dBi)

Accessories

None	

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the 47CFR Part 15C, RSS-Gen, and RSS-247 emission requirements. There were no deviations to the specifications.

Application for Certification

(1) Manufacturer: Transcore
Amtech Technology Center
8600 Jefferson Street, NE
Albuquerque, NM 87113

(2) Identification: M/N: E4FHSS

FCC ID: FIH0596465PT15 IC: 1584A-0596465PT15

(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 or low voltage AC power transformer. The EUT provides single interface connector for power and communications. During testing, the EUT was powered from Direct current bench power supply and communications through serial interface.

(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.

(13) Applications for certification of U-NII devices in the 5.15-5.35 GHz and the 5.47-5.85 GHz bands must include a high-level operational description of the security procedures that control the radio frequency operating parameters and ensure that unauthorized modifications cannot be made. This requirement is not applicable to his FHSs device.

(14) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used. This information is provided in this report and Test Setup Exhibits provided with the application filing.

Applicable Standards & Test Procedures

The following information is submitted in accordance with e-CFR dated May 21, 2018, Part 2, Subpart J, Part 15, Subpart 15C paragraph 15.247, Industry Canada RSS-GEN issue 5, and RSS-247 Issue 2. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2013, RSS-247 Issue 2, and RSS-GEN Issue 5.

- 47CFR Part 15, Subpart 15C paragraph 15.247
- RSS-247 Issue 2
- RSS-Gen Issue 5
- ANSI C63.10-2013

Testing Procedures

AC Line Conducted Emission Test Procedure

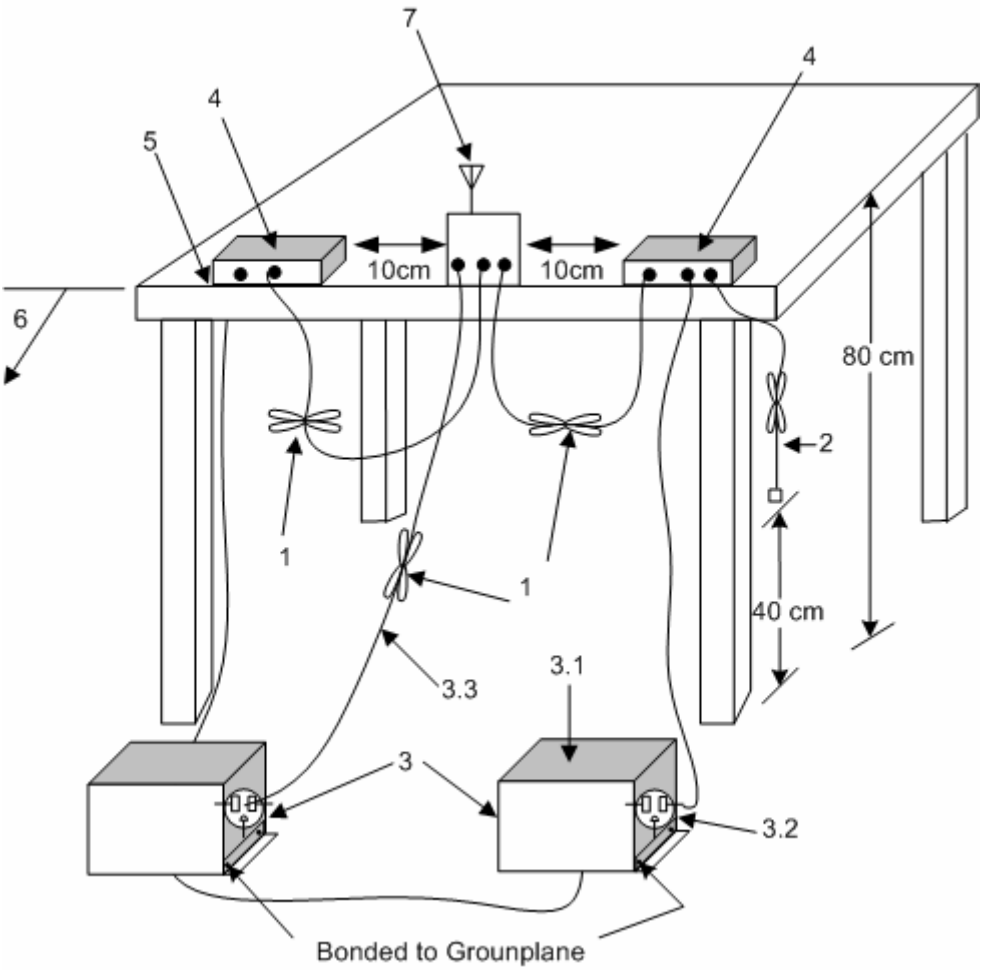
AC line-conducted emissions testing was performed as required in 47CFR 15C, RSS-247 and specified in ANSI C63.10-2013. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter bench, 0.8 meters high located 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 one showing typical test arrangement and photographs in exhibits for EUT placement used during testing.

Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 and specified in ANSI C63.10-2013. The EUT was placed on a rotating 0.9 x 1.2-meter platform, elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. EMI energy was maximized by equipment placement permitting orientation in three orthogonal axes, raising and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken using a spectrum analyzer. The frequency spectrum from 9 kHz to 10,000 MHz was searched for during preliminary investigation. Refer to diagrams two and three showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

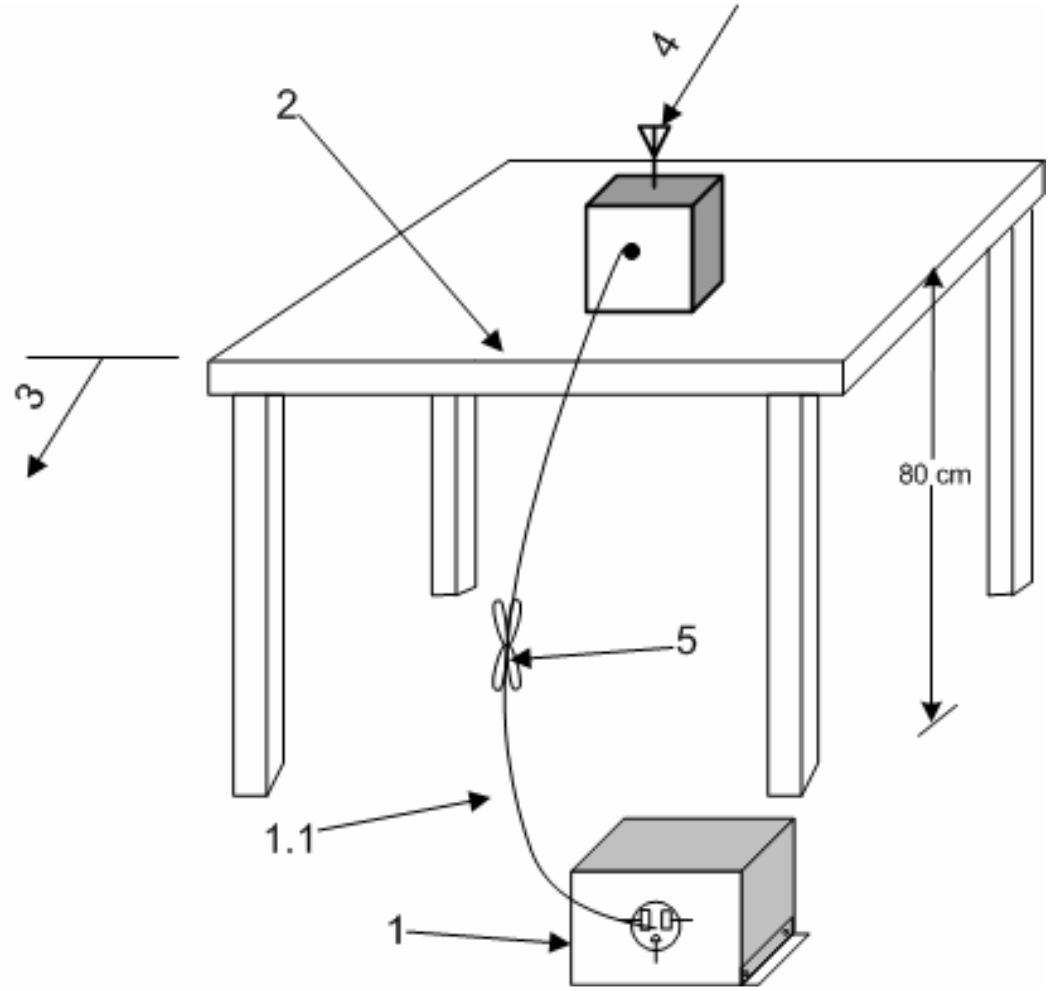
Antenna Port Conducted Emission Test Procedure

The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed on test sample #2 as required in the regulations and specified in ANSI C63.10-2013. Testing was completed on a laboratory bench in a shielded room. The active antenna port of the unlicensed wireless device was connected to appropriate attenuation and the spectrum analyzer. Refer to diagram four showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.



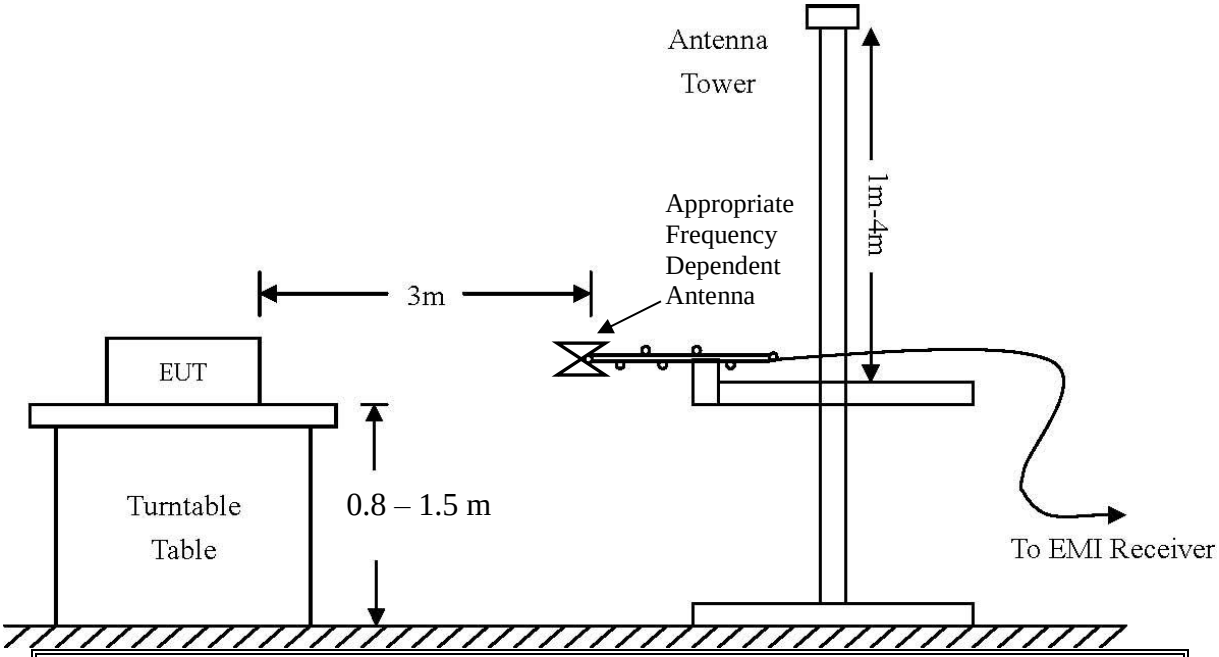
1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long see (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if 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



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

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

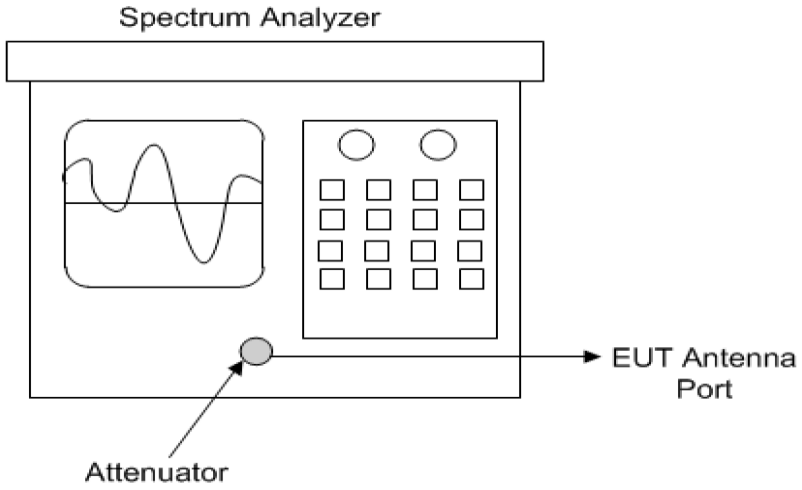


Diagram 4 Test arrangement for Antenna Port Conducted emissions

List of Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-2-10(1PA) (160611)	.15-30MHz	5/2/2018	5/2/2019
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,	.15-30MHz	10/24/2017	10/24/2018
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)9kHz-40 GHz		10/24/2017	10/24/2018
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)9kHz-40 GHz		10/24/2017	10/24/2018
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)9kHz-40 GHz		10/24/2017	10/24/2018
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/24/2017	10/24/2018
☒ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/24/2017	10/24/2018
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/24/2017	10/24/2018
☐ Antenna	EMCO	3147 (40582)	200-1000MHz	10/24/2017	10/24/2018
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/24/2017	10/24/2019
☐ Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15/2017	5/15/2019
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/24/2017	10/24/2018
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/24/2017	10/24/2018
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/2/2018	5/2/2019
☐ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	12/22/2017	12/22/2018
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
☐ Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/2/2018	5/2/2019
☐ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	5/2/2018	5/2/2019
☐ Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/2/2018	5/2/2019
☒ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/24/2017	10/24/2018
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/24/2017	10/24/2018
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/24/2017	10/24/2018
☐ Power Mtr	Agilent	N1911A with N1921A	0.05-18 GHz	5/2/2018	5/2/2019
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	5/2/2018	5/2/2019
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	5/2/2018	5/2/2019
☒ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9G notch	30-1800 MHz	5/2/2018	5/2/2019
☐ Attenuator	Fairview	SA6NFNF100W-14 (1625)	30-1800 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14362)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-3W2+ (14452)	30-6000 MHz	5/2/2018	5/2/2019
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	5/2/2018	5/2/2019
☒ Attenuator	JFW Industries	50FH-010-10 (1)	30-18000 MHz	5/2/2018	5/2/2019
☒ Weather station	Davis	6312 (A70927D44N)		10/24/2017	10/24/2018

Test Site Locations

Conducted EMI	**C**onducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS
Radiated EMI	Radiated emissions testing performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259th Terrace, Louisburg, KS
NVLAP Accreditation	Lab code 200087-0

Units of Measurements

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

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured
A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses
RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB) - Gain (dB)

Environmental Conditions

Ambient Temperature	24.0° C
Relative Humidity	44%
Atmospheric Pressure	1016.3 mb

Intentional Radiators

The following information is submitted in support demonstration of compliance with the requirements of 47CFR, Subpart C, paragraph 15.247, Industry Canada RSS-247 Issue 2, and RSS-Gen Issue 5.

Antenna Requirements 47CFR 15.203

The EUT incorporates integral antenna system and offers no provision for connection to alternate antenna system. The antenna connection point complies with the unique antenna connection requirements. There are no deviations or exceptions to the specification.

Test 1 Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a 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 C63.10-2013 paragraph 6 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed emission values consider the received radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

Table 1 Harmonic Radiated Emissions in Restricted Bands (Worst-case)

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)
2706.8	43.5	N/A	30.5	43.6	N/A	30.5	54.0
2730.0	43.0	N/A	30.3	43.6	N/A	30.4	54.0
2764.5	42.7	N/A	29.9	43.0	N/A	30.0	54.0
3609.0	43.6	N/A	31.0	44.2	N/A	31.0	54.0
3640.0	44.5	N/A	32.1	44.5	N/A	32.1	54.0
3686.0	45.3	N/A	32.6	45.7	N/A	32.6	54.0
4511.3	44.7	N/A	31.8	44.5	N/A	31.8	54.0
4550.0	45.7	N/A	32.0	45.0	N/A	32.0	54.0
4607.5	47.5	N/A	34.4	47.0	N/A	34.4	54.0

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C RSS-Gen, and RSS-247 Intentional Radiators. The EUT demonstrated a worst-case minimum radiated emission in restricted bands providing a minimum margin of -19.6 dB below the radiated emissions requirements. 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.

Test 2 AC Line Conducted Emissions Procedure

The EUT was arranged in typical equipment configurations with interface to AC power. Testing was performed with the EUT 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. Testing for the line-conducted emissions were the procedures of ANSI C63.10-2013 paragraph 6. The AC adapter for the computer was connected to the LISN for line-conducted emissions testing. 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 computer 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 was carried out individually for each current carrying conductor. 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 frequencies of each of the emissions, which demonstrated the highest amplitudes. 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 data was recorded with maximum conducted emissions levels.

Refer to figures one and two showing plots of the AC line conducted emissions.

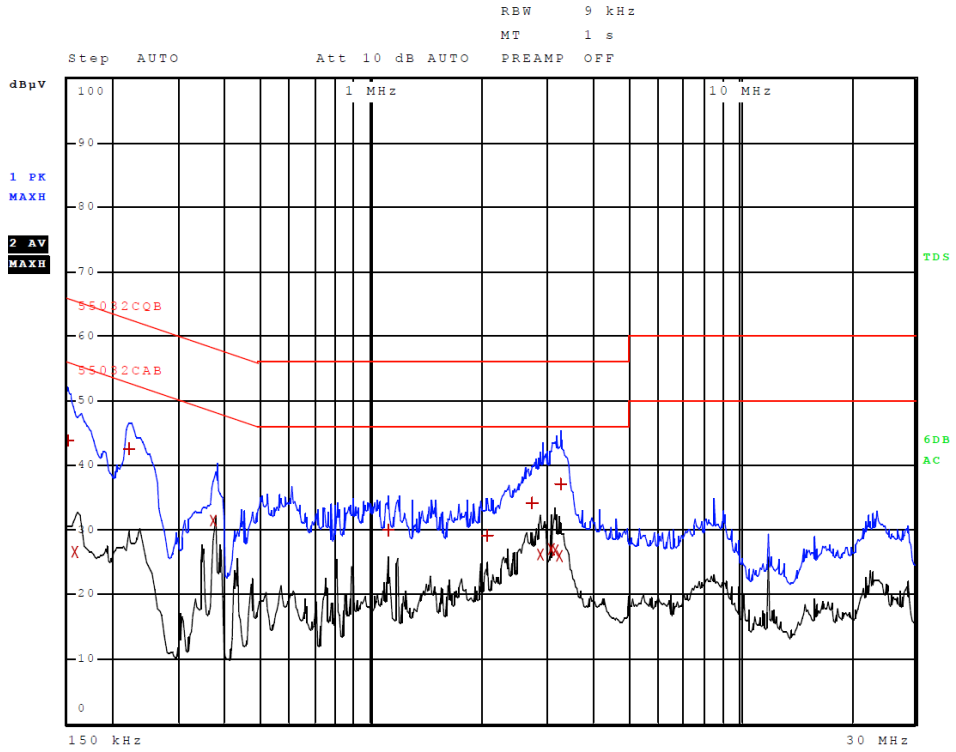


Figure 1 AC Line Conducted emissions of EUT line 1

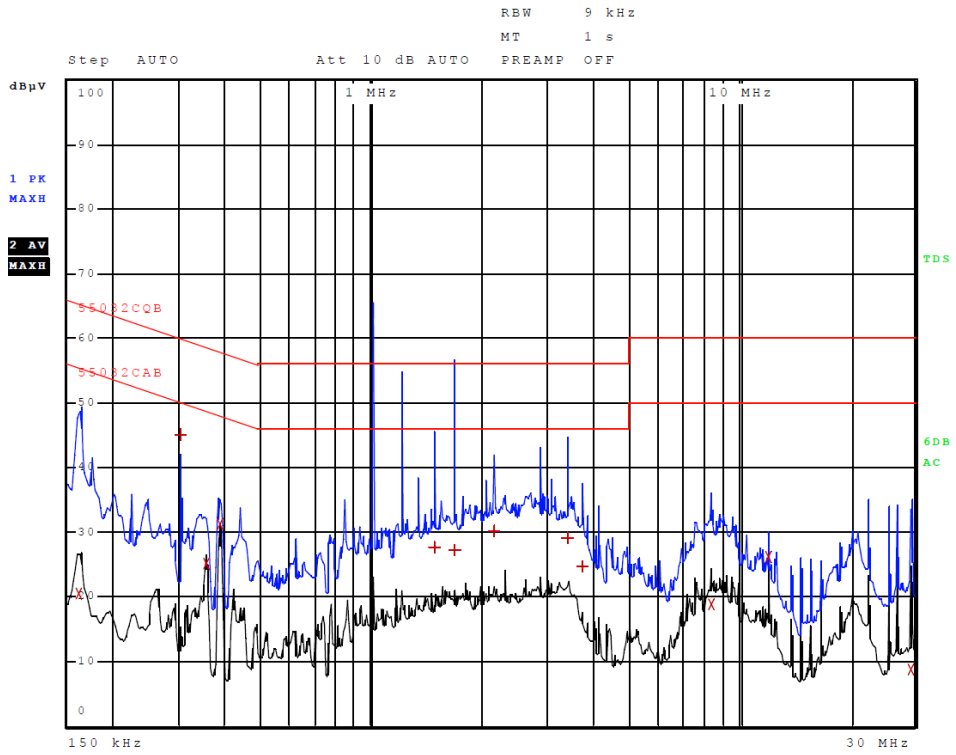


Figure 2 AC Line Conducted emissions of EUT line 2

Table 2 AC Line Conducted Emissions Data L1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	43.86	Quasi Peak	-12.14
2	158.000000000 kHz	26.49	Average	-39.07
1	222.000000000 kHz	42.50	Quasi Peak	-10.24
2	374.000000000 kHz	31.47	Average	-26.94
1	1.106000000 MHz	29.85	Quasi Peak	-16.15
1	2.070000000 MHz	29.16	Quasi Peak	-16.84
1	2.722000000 MHz	34.05	Quasi Peak	-11.95
2	2.882000000 MHz	26.17	Average	-29.83
2	3.090000000 MHz	27.05	Average	-28.95
2	3.162000000 MHz	26.72	Average	-29.28
2	3.234000000 MHz	25.96	Average	-30.04
1	3.266000000 MHz	37.16	Quasi Peak	-8.84

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

Table 3 AC Line Conducted Emissions Data L2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	162.000000000 kHz	20.55	Average	-44.82
1	302.000000000 kHz	45.06	Quasi Peak	-5.13
2	354.000000000 kHz	25.10	Average	-33.77
2	386.000000000 kHz	31.29	Average	-26.86
1	1.482000000 MHz	27.58	Quasi Peak	-18.42
1	1.686000000 MHz	27.30	Quasi Peak	-18.70
1	2.158000000 MHz	30.12	Quasi Peak	-15.88
1	3.398000000 MHz	29.15	Quasi Peak	-16.85
1	3.730000000 MHz	24.78	Quasi Peak	-21.22
2	8.384000000 MHz	18.84	Average	-41.16
2	12.016000000 MHz	26.07	Average	-33.93
2	29.304000000 MHz	8.76	Average	-51.24

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

Summary of Results for AC Line Conducted Emissions Results

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47CFR Part 15C, Industry Canada RSS-247 and RSS-GEN. The worst-case configuration demonstrated a minimum margin of -5.1 dB below the FCC/IC requirements. Other emissions were present with amplitudes at least 20-dB below the limit and worst-case amplitudes recorded.

Test 3 General Radiated Emissions Procedure

The EUT was arranged in a typical equipment configuration and operated through all available mode during testing. 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 measurements were performed. Final data was taken with the EUT located on the OATS at 3 meters distance between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 10,000 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 above 1 GHz, notch filters and appropriate amplifiers and external mixers were utilized.

Table 4 General Radiated Emissions 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)
51.1	21.0	15.2	N/A	25.5	21.0	N/A	40.0
80.0	21.0	15.3	N/A	23.5	18.4	N/A	40.0
132.9	25.1	19.6	N/A	20.3	15.2	N/A	40.0
135.5	23.5	17.1	N/A	20.0	13.7	N/A	40.0
156.1	26.8	18.0	N/A	23.1	18.5	N/A	40.0
200.0	28.9	26.1	N/A	24.9	20.2	N/A	40.0
340.0	29.6	27.9	N/A	28.5	26.5	N/A	47.0
380.0	33.6	32.4	N/A	32.3	30.9	N/A	47.0
490.7	36.2	32.1	N/A	40.1	36.4	N/A	47.0
500.0	33.7	31.0	N/A	29.5	26.7	N/A	47.0
551.6	31.7	26.0	N/A	32.9	28.7	N/A	47.0
560.0	33.8	28.3	N/A	33.7	28.5	N/A	47.0

Other emissions present had amplitudes at least 20-dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded for frequency range below 1000 MHz. Peak and Average amplitude emissions are recorded 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, RSS-247 and RSS-GEN Intentional Radiators. The EUT demonstrated a minimum margin of -10.6 dB below the requirements. Other emissions were present with amplitudes at least 20-dB below the Limits.

Operation in the Band 902-928 MHz

The EUT is Frequency Hopping System operating in the 902-928 MHz band. Demonstration of compliance with the requirements of 47CFR 15.247 and RSS-247 are contained in this report. Two test samples were provided to complete the required testing; 1) a production design and 2) a modified sample which had integral antenna replaced with 50-ohm connection port. Both samples were provided with test software which allowed configuring transmitter operation for testing purposes. Radiated emissions were measured on the Open Area Test Site (OATS) at a three-meter distance using sample #1. Harmonic radiated emission measurements were taken while EUT was operated in hopping mode. The EUT was placed on a 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. The test system gains and losses were accounted for in the measurement results presented. Antenna port conducted emission measurements were taken on sample #2. Testing procedures defined in ANSI C63.10-2013 were utilized during compliance testing. These procedures provide for antenna port measurement or measurement of maximum field strength and conversion calculations for comparison with requirements. The power output was measured at the antenna port. Data presented below represents worst-case emissions from all modes investigated during testing. Refer to figures three through fifteen presenting plots of the EUT performance displaying compliance with the specifications.

Test 4 Channel Spacing

Requirements

47CFR 15.247(a)(1)(i), and RSS-247 5.1(c)

> (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20-dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20-dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.
>
> > (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

RSS-247 Issue 5 paragraph 5.1 Frequency hopping systems (FHS) (c)

> For FHSs in the band 902-928 MHz: if the 20-dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20-dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz

Result

Channel spacing is 250 kHz

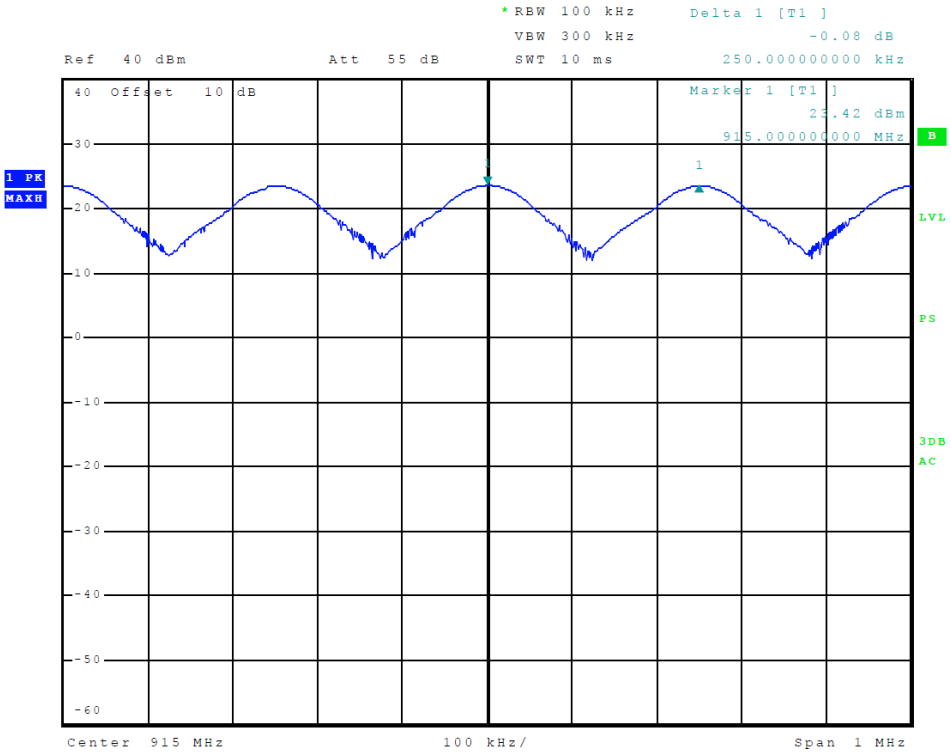


Figure 3 Plot of Channel Spacing

Summary of Results for Channel Spacing

The EUT demonstrated compliance with the Channel Spacing requirements of 47CFR Part 15C and RSS-247 Intentional Radiators. The EUT utilizes channels spaced 250 kHz apart.

Test 5 Number of hopping frequencies

Requirements

47CFR 15.247(a)(1)(i), and RSS-247 5.1(c)

> (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20-dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20-dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20-dB bandwidth of the hopping channel is 500 kHz.

RSS-247 Issue 5 paragraph 5.1 Frequency hopping systems (FHS) (c)

> For FHSs in the band 902-928 MHz: if the 20-dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20-dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20-dB bandwidth of the hopping channel shall be 500 kHz.

Result

The transmitter provides operation across the frequency band utilizing more than the required 50 channels. Plots below provide evidence the product transmits on 100 frequencies separated by 250 kHz.

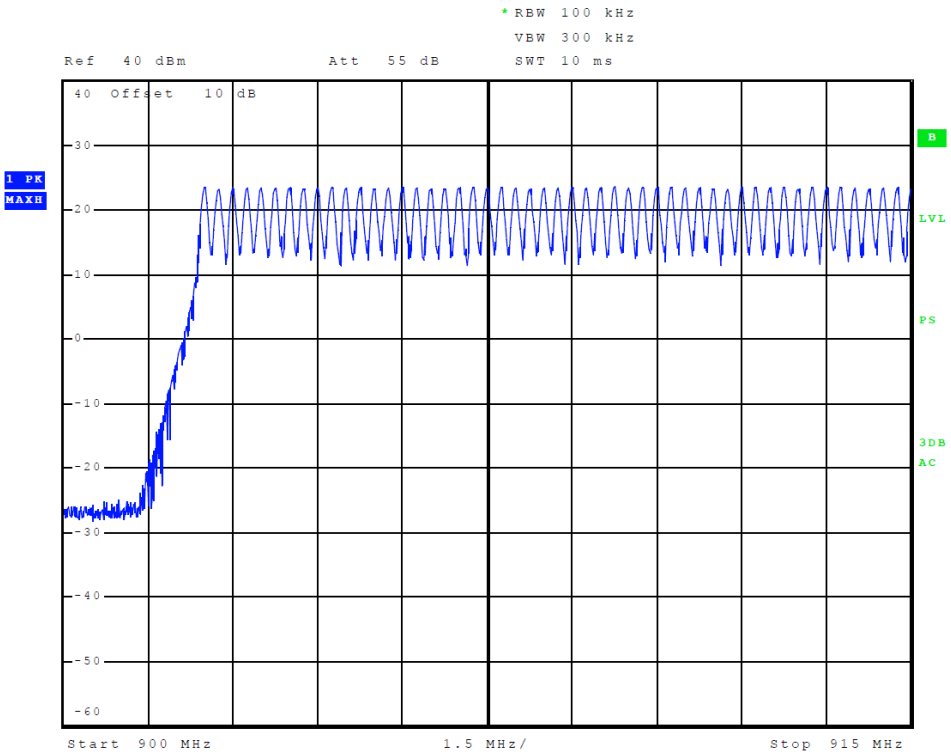


Figure 4 Number of hopping frequencies (Lower band)

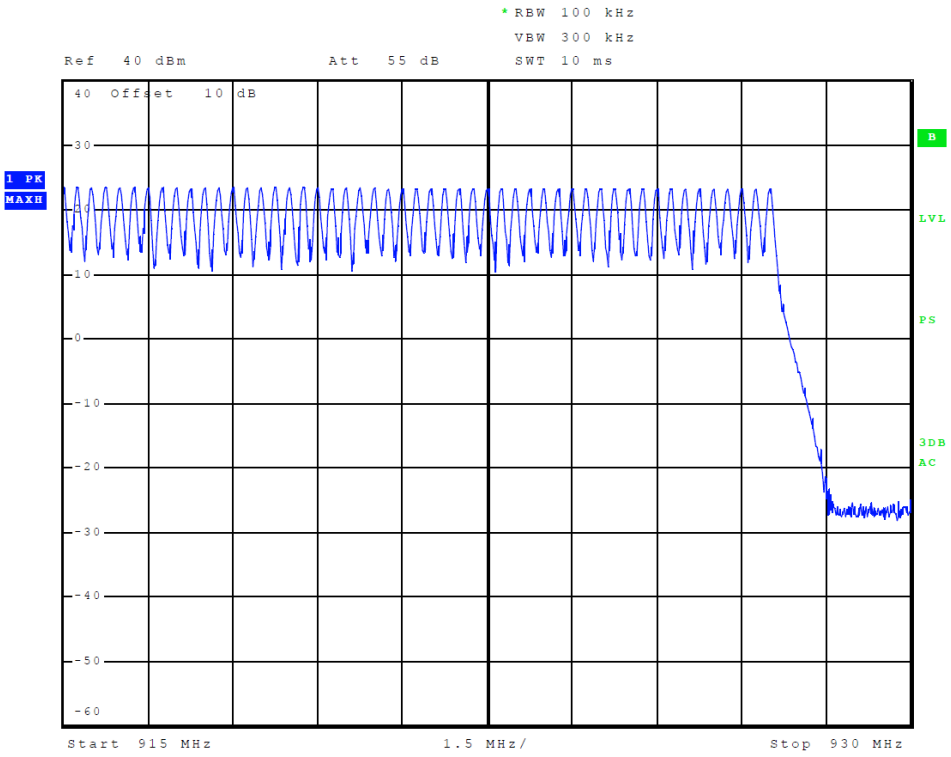


Figure 5 Number of hopping frequencies (Upper band)

Summary of Results for number of hopping channels

The EUT demonstrated compliance with the number of channel requirements of 47CFR Part 15C and RSS-247 Intentional Radiators. The EUT may utilize 100 hopping channels.

Test 6 Dwell time and Time on Chanel

Requirements

47CFR 15.247(a)(1)(i), and RSS-247 5.1(c)

> (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20-dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20-dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20-dB bandwidth of the hopping channel is 500 kHz.

RSS-247 Issue 5 paragraph 5.1 Frequency hopping systems (FHS) (c)

> For FHSs in the band 902-928 MHz: if the 20-dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20-dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20-dB bandwidth of the hopping channel shall be 500 kHz.

Result

Average occupancy time Requirement:

> Average time of occupancy on any channel shall not be greater than 400 mS (0.4 seconds) within a 20 second period.

Dwell Time on channel: The unit resides on channel 10 times over 20 seconds, each time transmitting for 25.4 mS which equates to average time of occupancy of less than

> 10 (times in 20 S) *25.4 mS (channel on time) = 254 mS

254 mS operational time demonstrates compliance with requirement of less than 400 mS over 20 second period.

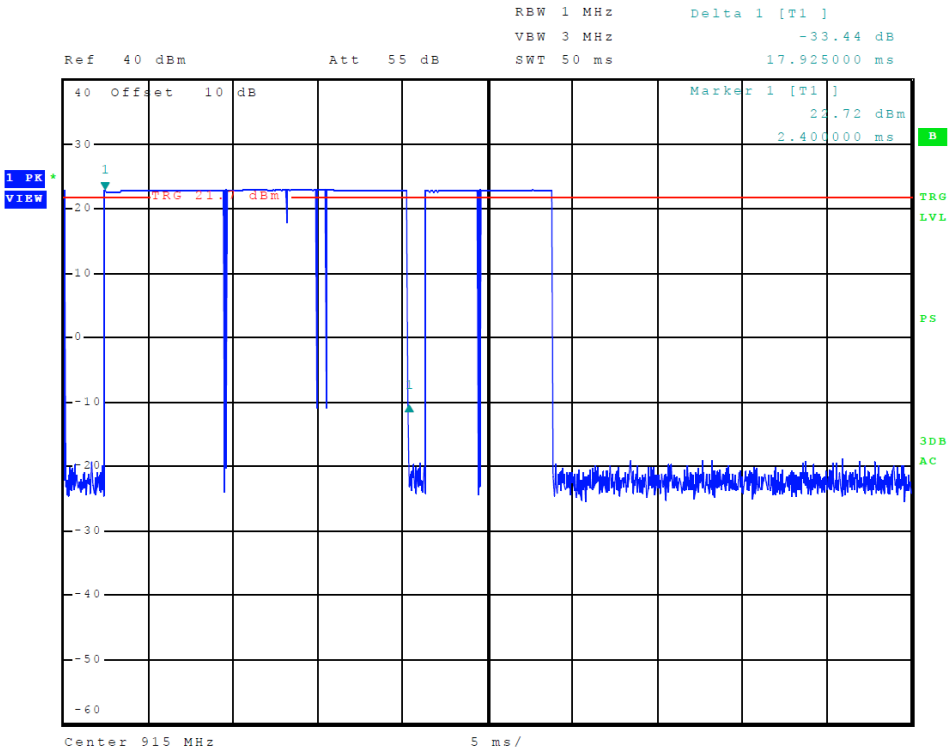


Figure 6 Dwell Time on Channel

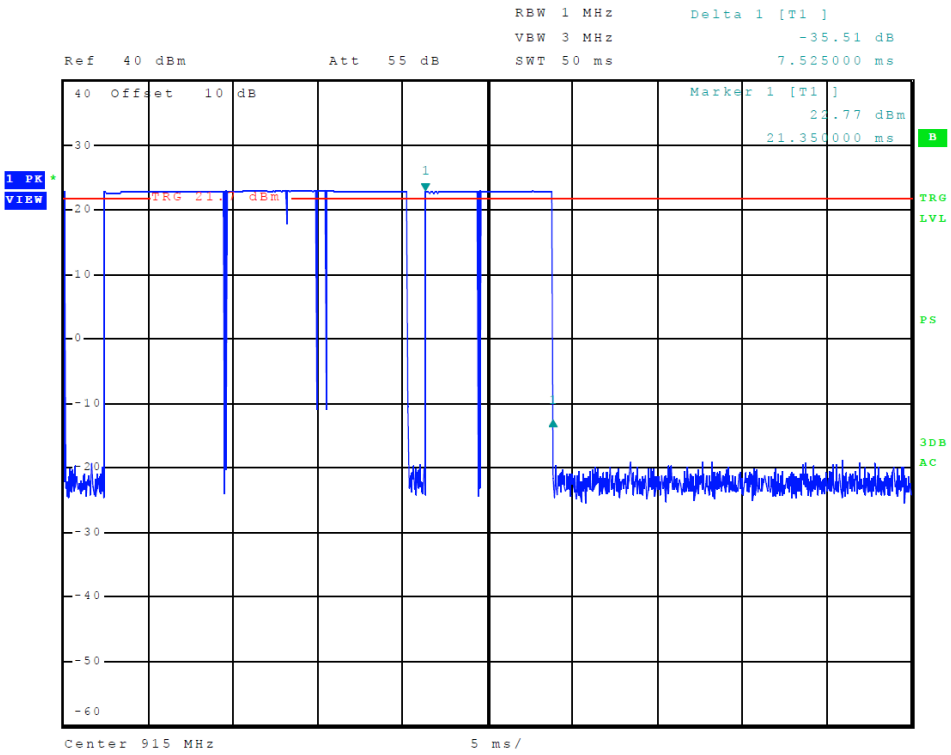


Figure 7 Dwell Time on Channel

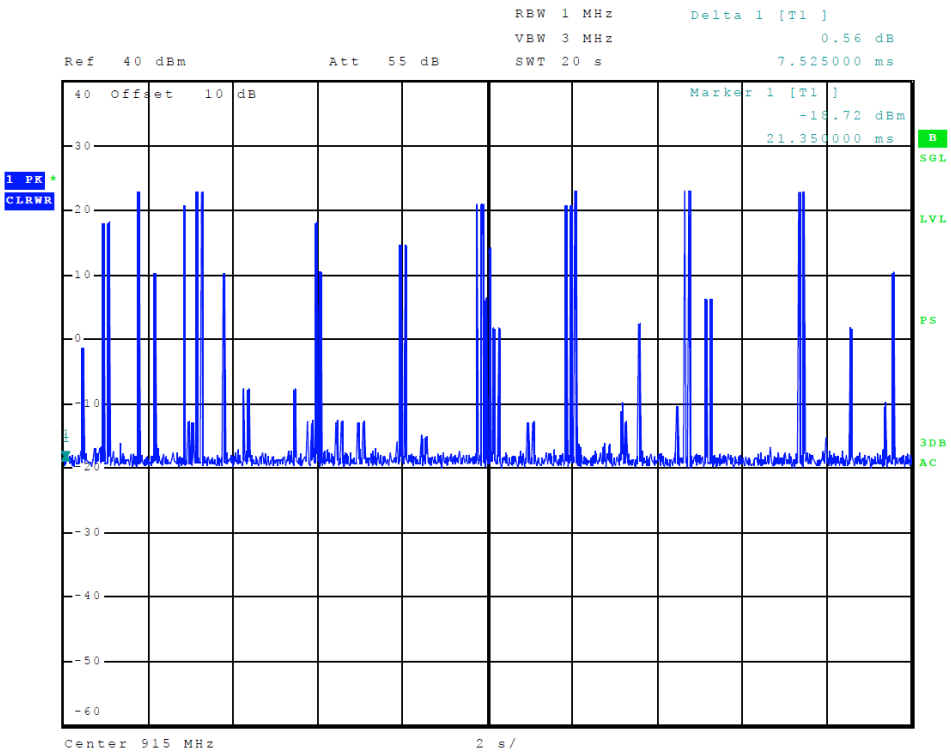


Figure 8 Number of times on channel in 20 seconds

Summary of Results for dwell time on channel

The EUT demonstrated compliance with the number of channel requirements of 47CFR Part 15C and RSS-247 Intentional Radiators. The EUT operates dwelling on channel 254 mS in a 20 second time frame not exceeding 400 mS in 20 second period.

Test 7 Maximum peak conducted output power

Requirements

47CFR 15.247(b)(2) and (4), and RSS-247 5.4(a)

> (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
>
> (2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.
>
> (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 Issue 5 paragraph 5 5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements

> Devices shall comply with the following requirements, where applicable:
>
> a) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

Result

Design provides 250 mW (nominal) power to the antenna

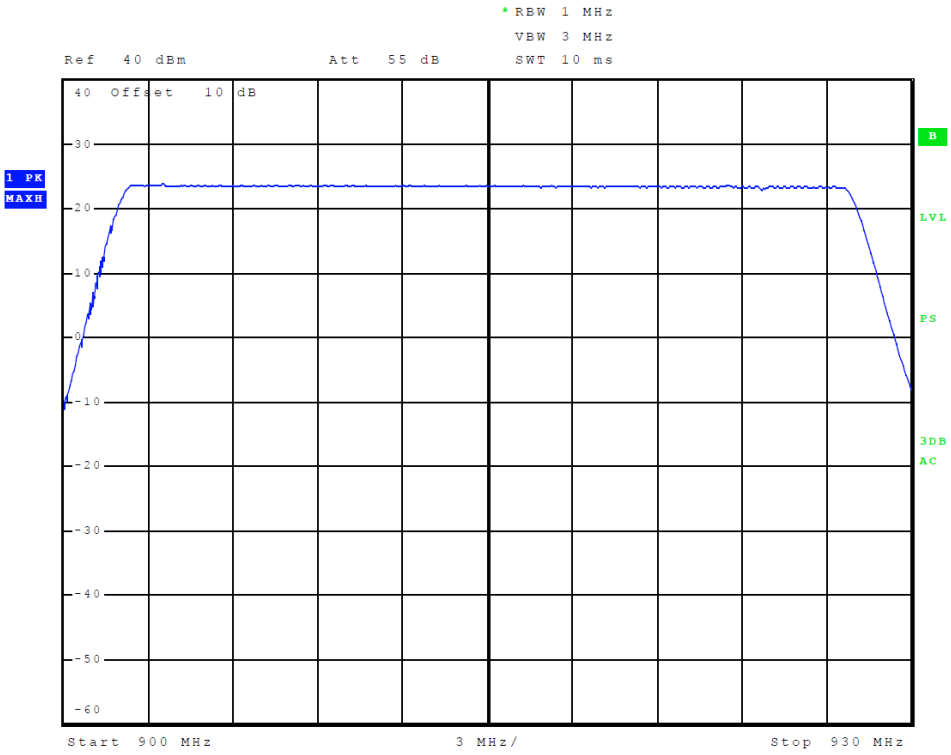


Figure 9 Plot of Maximum Peak Conducted Output Power

Data of Maximum Peak Conducted output power

Frequency (MHz)	Antenna Port Output Power (Watts)
902.5	0.251
915.0	0.251
927.5	0.249

Summary of Results for Maximum Peak Conducted output power

The EUT demonstrated compliance with the maximum peak conducted output power requirements of 47CFR Part 15C and RSS-247 Intentional Radiators. The EUT may utilize 100 hopping channels.

Test 8 Operation with Directional Antenna Gains greater than 6dBi

Requirements

47CFR 15.247(c)(1), and RSS-247 5.4(a)

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

RSS-247 Issue 2 paragraph 5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements

Devices shall comply with the following requirements, where applicable:

a) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

Result

The design remains within the 1-watt power supplied to 6dBi gain antenna

Summary of Results for Maximum Peak Conducted output power

The EUT demonstrated compliance with the requirements of equipment using directional antenna gains greater than 6 dBi requirement of 47CFR Part 15C and RSS-247 Intentional Radiators. The EUT provides 251 mW (24 dBm) output power into the 10.3 dBi Gain antenna which produces e.i.r.p. not exceeding 4Watts (36 dBm).

Test 9 Out of Band Emissions

Requirements

47CFR 15.247(d), and RSS-247 5.5

> (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 Issue 2 paragraph 5.5 Unwanted emissions

> In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

Result

The RF power produced by the design are at least 20 dB below the in-band power in any 100 kHz bandwidth

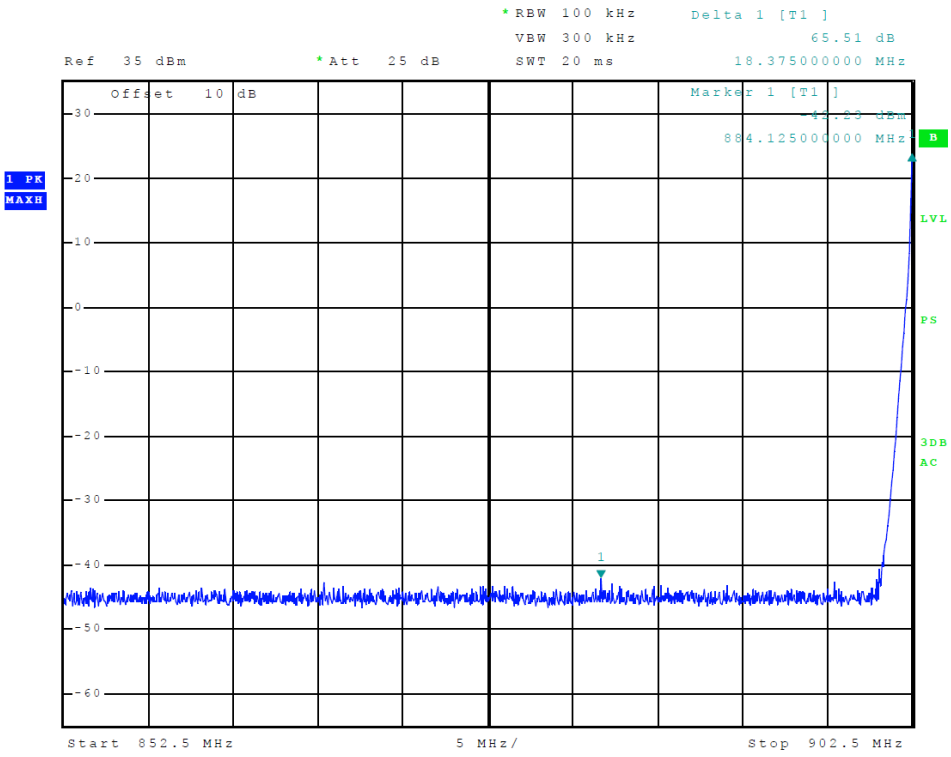


Figure 10 Plot of Lower Band Edge (hopping disabled)

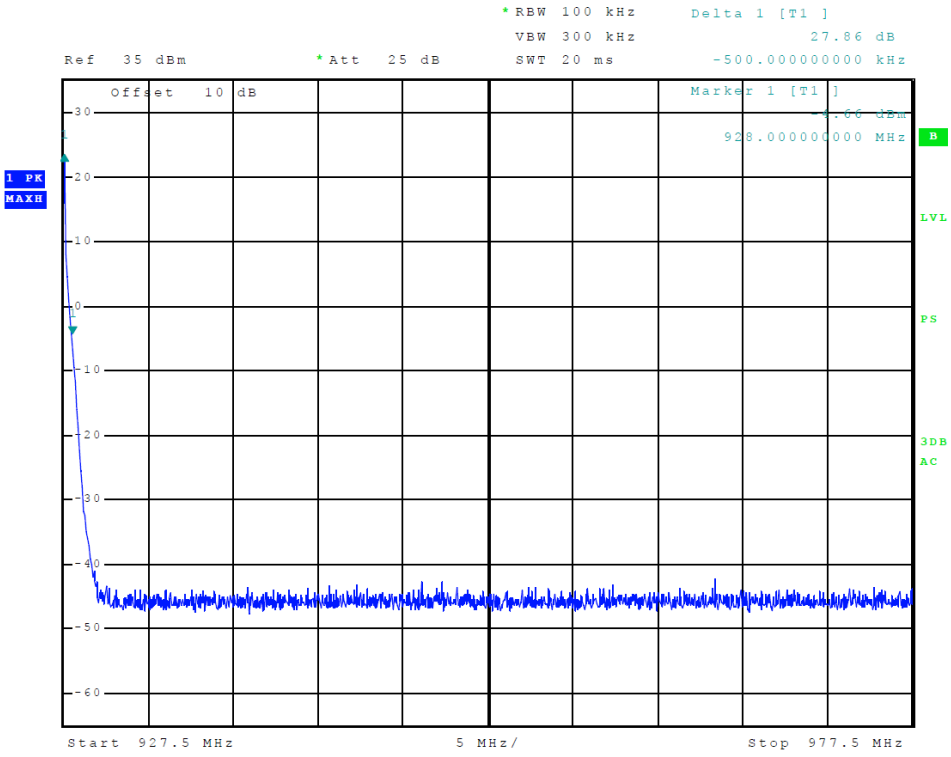


Figure 11 Plot of Upper Band Edge (hopping disabled)

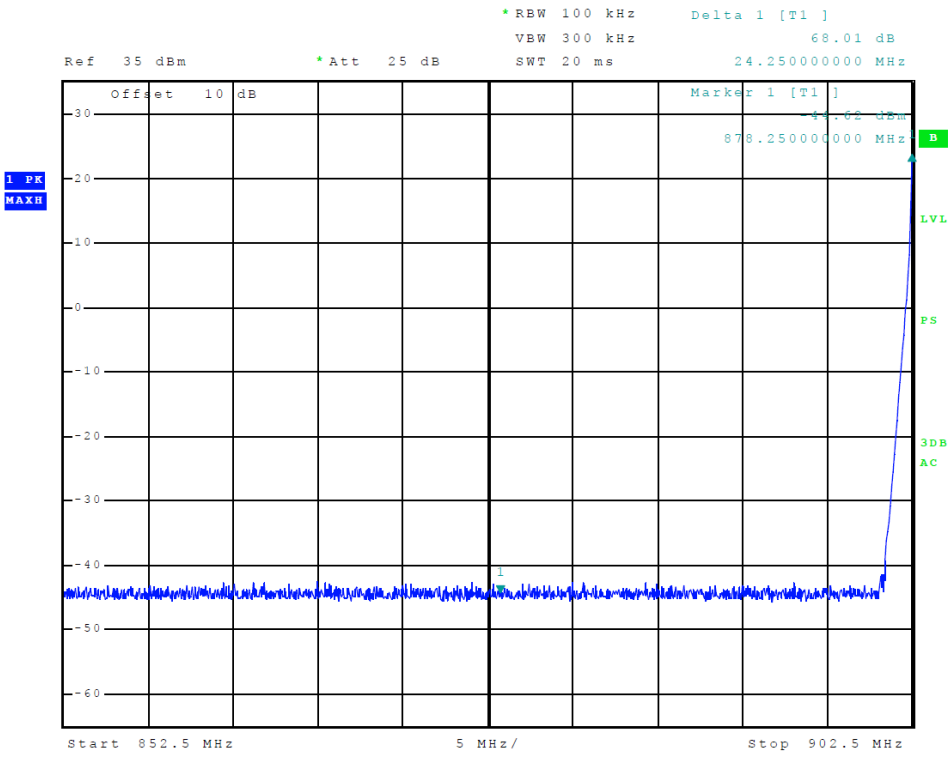


Figure 12 Plot of Lower Band Edge (hopping enabled)

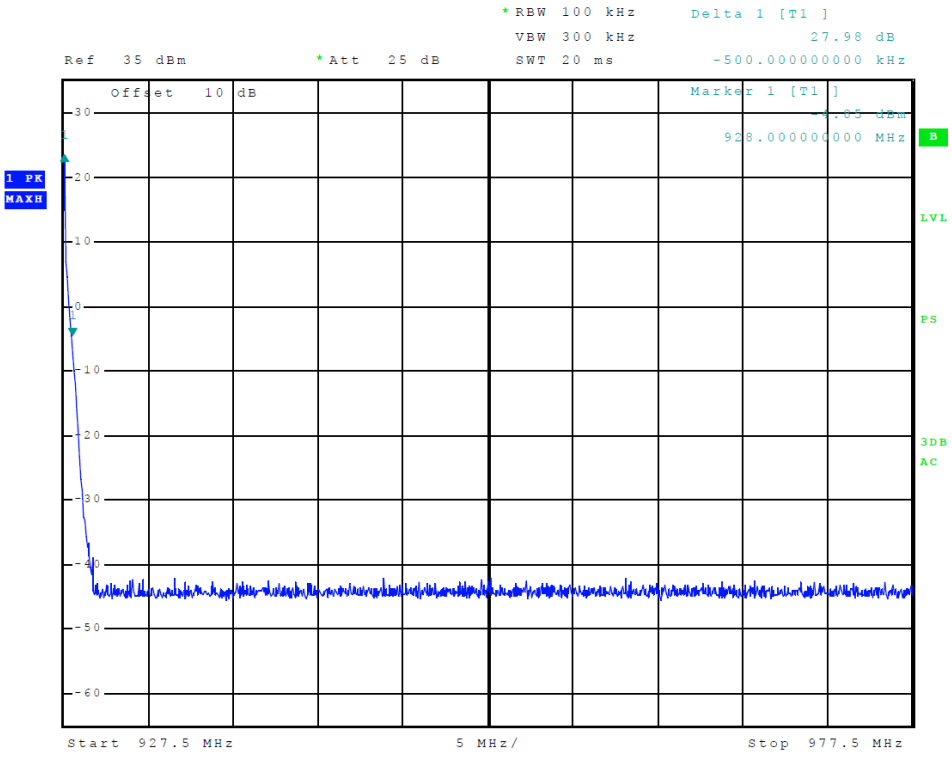


Figure 13 Plot of Upper Band Edge (hopping enabled)

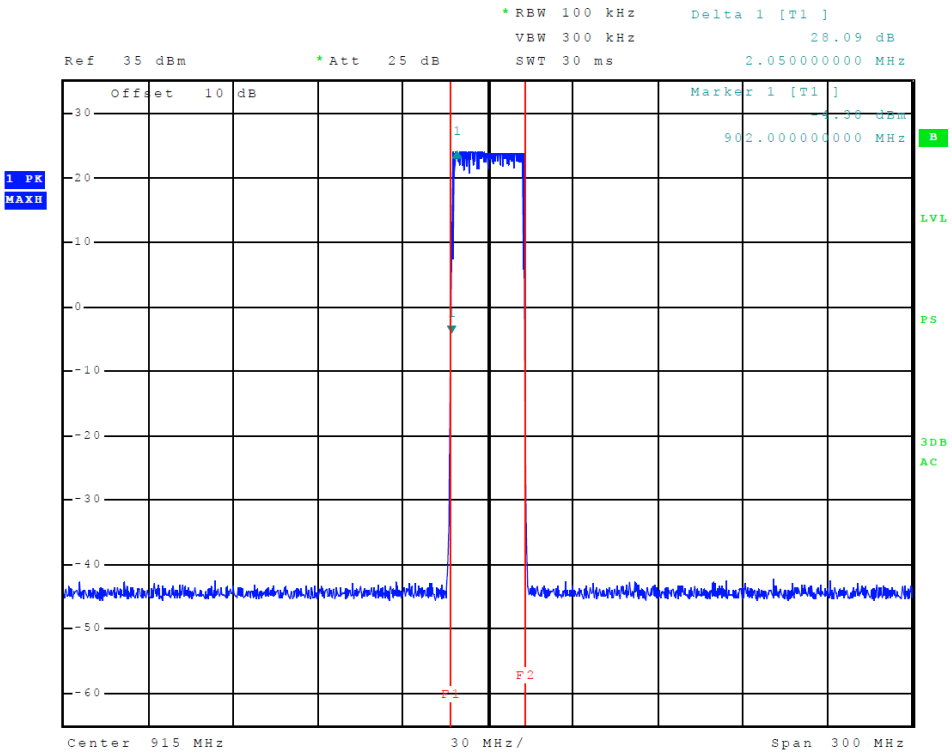


Figure 14 Plot of 100 kHz emissions outside operating band Lower Band edge (hopping enabled)

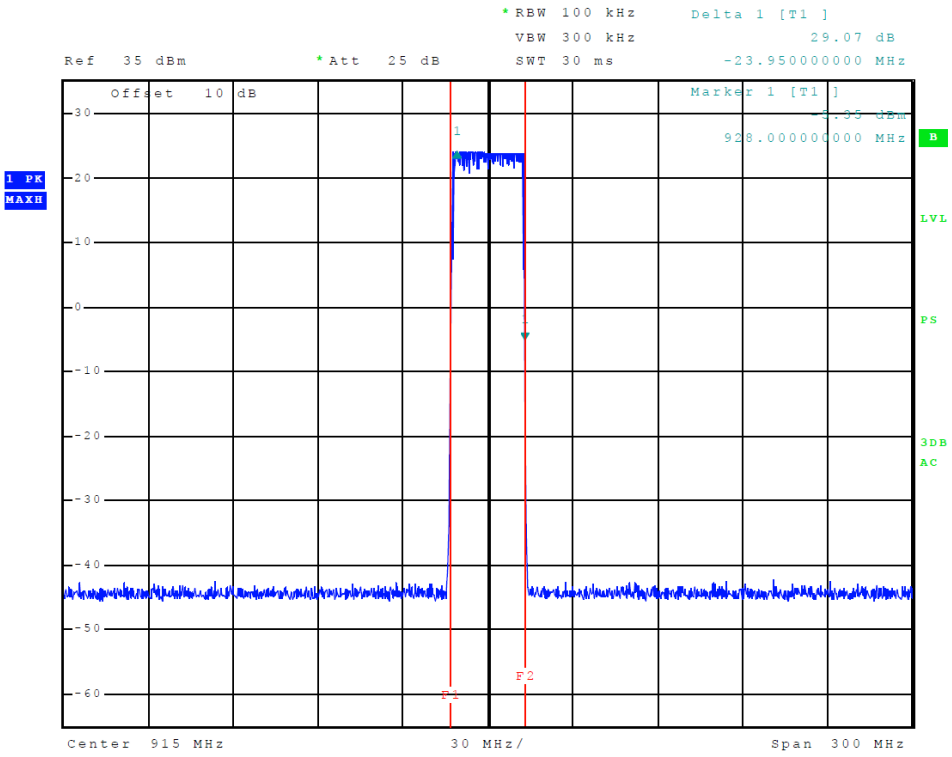


Figure 15 Plot of 100 kHz emissions outside operating band Upper Band edge (hopping enabled)

Data Radiated Transmitter Emissions

Table 5 Transmitter Radiated Emissions Worst-case Data

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
902.25	--	--	--	--	--
1804.50	46.9	32.7	42.3	29.1	54.0
2706.75	43.5	30.5	43.6	30.5	54.0
3609.00	43.6	31.0	44.2	31.0	54.0
4511.25	44.7	31.8	44.5	31.8	54.0
5413.50	48.0	34.7	47.2	34.6	54.0
6315.75	48.5	35.7	49.2	35.7	54.0
910.00	--	--	--	--	--
1820.00	47.2	33.9	41.9	28.8	54.0
2730.00	43.0	30.3	43.6	30.4	54.0
3640.00	44.5	32.1	44.5	32.1	54.0
4550.00	45.7	32.0	45.0	32.0	54.0
5460.00	48.4	35.6	48.4	35.6	54.0
6370.00	49.9	36.9	49.8	36.9	54.0
927.50	--	--	--	--	--
1855.00	46.0	32.5	42.2	29.0	54.0
2782.50	42.7	29.9	43.0	30.0	54.0
3710.00	45.3	32.6	45.7	32.6	54.0
4637.50	47.5	34.4	47.0	34.4	54.0
5565.00	48.3	34.9	47.8	35.0	54.0
6492.50	50.6	37.5	50.2	37.5	54.0

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

Table 6 Transmitter Antenna Port Conducted Data

Frequency MHz	Antenna Port Output Power (dBm)	Antenna Port Output Power (Watts)	20-dB Occupied Bandwidth (kHz)
902.5	23.99	0.251	221.5
910.0	24.00	0.251	221.5
927.5	23.95	0.248	220.5

Summary of Results for Out of Band Emissions

The EUT demonstrated compliance with the out of band emissions requirements of 47CFR Part 15C and RSS-247 Intentional Radiators. The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15.247, RSS-GEN, and RSS-247 Frequency Hopping Systems. Antenna port conducted output power of 0.251-Watts was measured at the antenna port of test sample #2. The EUT demonstrated a minimum margin of -16.5 dB below the harmonic emissions requirements. 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.

Test 10 Channel Use requirements

Requirements

47CFR 15.247(g), and RSS-247 5.5

> (g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

RSS-247 Issue 2 paragraph 5.1 Frequency hopping systems (FHS)

> FHSs are not required to employ all available hopping frequencies during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the requirements in this section in case the transmitter is presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of frequency hopping equipment and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Result

The design utilizes 101 channels operating from 902.5 MHz to 927.5 MHz each channel separated by 250 kHz.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D Rogers Labs Certificate of Accreditation

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 (m/d/y)	Due
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)	5/2/2018	5/2/2019
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)	5/2/2018	5/2/2019
Antenna: EMCO 6509	10/24/2017	10/24/2018
Antenna: EMCO 3143 (9607-1277) 20-1200 MHz	5/2/2018	5/2/2019
Antenna: EMCO Dipole Set 3121C	2/23/2018	2/23/2019
Antenna: C.D. B-101	2/23/2018	2/23/2019
Antenna: Solar 9229-1 & 9230-1	2/23/2018	2/23/2019
Cable: Belden 8268 (L3)	10/24/2017	10/24/2018
Cable: Time Microwave: 4M-750HF290-750	10/24/2017	10/24/2018
Frequency Counter: Leader LDC-825 (8060153	5/2/2018	5/2/2019
Oscilloscope Scope: Tektronix 2230	2/23/2018	2/23/2019
Wattmeter: Bird 43 with Load Bird 8085	2/23/2018	2/23/2019
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/23/2018	2/23/2019
R.F. Generator: SMB100A6 s/n 100623	5/2/2018	5/2/2019
R.F. Generator: SBMBV100A s/n: 260771	5/2/2018	5/2/2019
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/23/2018	2/23/2019
R.F. Power Amp 65W Model: 470-A-1010	2/23/2018	2/23/2019
R.F. Power Amp 50W M185- 10-501	2/23/2018	2/23/2019
R.F. Power Amp A.R. Model: 10W 1010M7	2/23/2018	2/23/2019
R.F. Power Amp EIN Model: A301	2/23/2018	2/23/2019
LISN: Compliance Eng. Model 240/20	5/2/2018	15/50/19
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	5/2/2018	5/2/2019
Audio Oscillator: H.P. 201CD	2/23/2018	2/23/2019
ESD Test Set 2010i	2/23/2018	2/23/2019
Oscilloscope Scope: Tektronix MDO 4104	2/23/2018	2/23/2019
EMC Transient Generator HVT TR 3000	2/23/2018	2/23/2019
AC Power Source (Ametech, California Instruments)	2/23/2018	2/23/2019
Fast Transient Burst Generator Model: EFT/B-101	2/23/2018	2/23/2019
Field Intensity Meter: EFM-018	2/23/2018	2/23/2019
KEYTEK Ecat Surge Generator	2/23/2018	2/23/2019
ESD Simulator: MZ-15	2/23/2018	2/23/2019
Shielded Room not required		

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 27 years' experience in the field of electronics. Engineering experience includes six years in the automated controls industry and remaining years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

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

Educational Background

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

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

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

Scot D Rogers
Scot D. Rogers

Annex D Rogers Labs Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200087-0

Rogers Labs, Inc.
Louisburg, KS

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

Electromagnetic Compatibility & Telecommunications

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

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

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program