NVLAP Lab Code 200087-0

SUBMITTAL APPLICATION REPORT

FOR GRANT OF CERTIFICATION

FOR

Model: LT1110-10
902-928 MHz
FHSS/Digital Modulation Transceiver
FCC ID: KQL-111010
IC: 2268C-111010

FOR

Laird Technologies

11160 Thompson Avenue
Lenexa KS 66219

Test Report Number: 100714

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

CFR 47, Part 15C - Intentional Radiator, Paragraph 15.247 and
Industry Canada RSS-210
License Exempt Intentional Radiator

For

Laird Technologies
11160 Thompson Avenue
Lenexa KS 66219

Daniel Waters
Engineering Specialist

Frequency Hopping Spread Spectrum / Digital Modulation Transceiver
Model: LT1110-10
Frequency Range 902-928 MHz
FCC ID#: KQL-111010
IC: 2268C-111010

Test Date: July 14, 2010

Certifying Engineer: Scot D Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
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The following information is submitted for consideration in obtaining Grant of Certification for a License Exempt Intentional Radiator operating under CFR 47 Paragraph 15.247 and RSS-210. The frequency hopping spread spectrum / Digital Modulation transceiver design offers low cost solution for remote wireless communications.

Name of Applicant: Laird Technologies, 11160 Thompson Avenue, Lenexa KS 66219

Model: LT1110-10 Note: The design offers operation as 13 channels Digital Modulation or 53 channels frequency hopping device and may be used with authorized antenna configurations as documented.

FCC I.D.: KQL-111010 FRN: 0006 3090 82 IC: 2268C-111010

Frequency Range: FHSS (902.3-927.6 MHz) or Digital Modulation (903-926.8 MHz)

Operating Power: 0.008 Watt antenna port conducted, 118.0 dBµV/m @ 3-meters (3- meter radiated measurement 15 dBi Yagi), 20 dB Occupied Bandwidth 483.97 kHz (FHSS) and 617.00 kHz (Digital Modulation), and worst-case receiver radiated emission 20.5 dBµV/m @ 3-meters

Equipment Tested

Equipment	Model	S/N	FCC I.D.#
EUT	LT1110-10 (SMT U.FL)	ENG PRM210	KQL-111010
EUT	LT1110-10 (SMT Chip)	ENG PRM211	KQL-111010
EUT	LT1110-10 (Pluggable U.FL)	ENG PRM220	KQL-111010
EUT	LT1110-10 (Pluggable Chip)	ENG PRM221	KQL-111010
AC Adapter	WR9QC2000LCP-N-NA	N/A	N/A
CPU	HPCRUSA-02T1-75	N/A	N/A
Antenna (SMT Chip)	0915AT43A0026	N/A	N/A
Antenna (Dipole)	S467FL-6-PX-915S	N/A	N/A
Antenna (Omni)	SG104N-915	N/A	N/A
Antenna (Yagi)	PC9013N	N/A	N/A

Opinion / Interpretation of Results

Tests Performed	Minimum Margin (dB)	Result
Emissions as per CFR 47 paragraphs 2 and 15.205	-21.5	Complies
Emissions as per CFR 47 paragraphs 2 and 15.207	-28.0	Complies
Emissions as per CFR 47 paragraphs 2 and 15.209	-4.2	Complies
Emissions as per CFR 47 paragraphs 2 and 15.247	-21.5 (Harmonics)	Complies
Emissions as per RSS-210 Issue 7, Dated June 2007	As Documented	Complies

Environmental Conditions

Ambient Temperature	23.3° C
Relative Humidity	53%
Atmospheric Pressure	1013.4 mb

2.1033(b) Application for Certification

(1) Manufacturer: Laird Technologies
11160 Thompson Avenue
Lenexa KS 66219

(2) Identification: Model: LT1110-10

FCC ID: KQL-111010 IC: 2268C-111010

(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 power received from authorized AC/DC power adapter and offer communications through RS-232 interface. The EUT was connected and communicating with CPU through the RS-232 interface support equipment during testing.

(9) Transition Provisions of 15.37 are not being 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

In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2009, 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, and Industry Canada RSS-210 the following information is submitted.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI 63.4-2003 Document, FCC documents DA00-1407 and DA00-705, RSS-210 and/or TIA/EIA 603-1. Testing for the AC line-conducted emissions were performed as defined in sections 7 and 13.1.3, testing of the radiated emission was performed as defined in sections 8 and 13.1.4 of ANSI C63.4.

Equipment, Function and Testing Procedures

The EUT is a 902-928 MHz frequency hopping spread spectrum / Digital Modulation transceiver used to transmit data in applications offering remote wireless connectivity. The unit is marketed for use to incorporate a wireless link to exchange data information from one point to another. For testing purposes the LT1110-10 was interfaced to support equipment through the RS-232 interface and communicating to the laptop computer allowing for operational control of the transceiver and data communications. Operation may be set for communications for one of two modes:

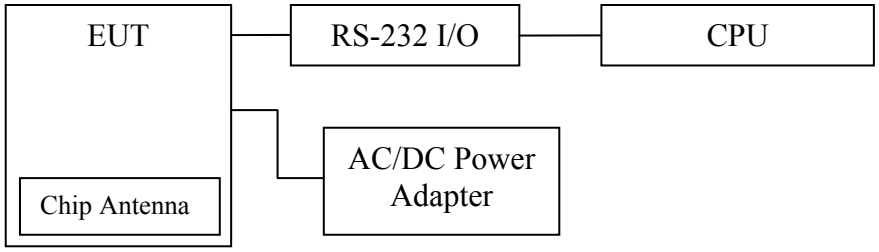
1. 53 hops with 230 kbps RF data rate

2. Digital Modulation with 500 kbps RF data rate

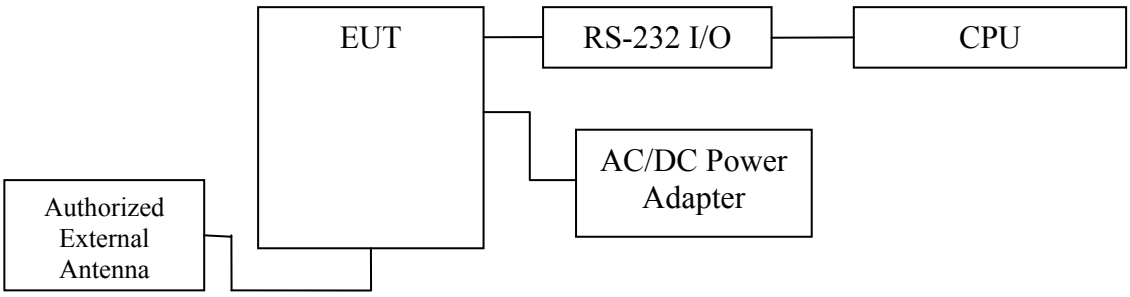
The LT1110-10 receives power form the authorized external AC/DC power adapter and may communicate through RS-232 interface to compliant digital equipment. No other interfacing options are provided on the design. For testing purposes the LT1110-10 and support equipment were powered from the AC power adapter and set to transmit through all data modes available. The device is marketed for low cost wireless solution and used with approved antennas only. The design complies with the unique antenna connection requirements.

Equipment and Cable Configurations

Configuration 1



Configuration 2



AC Line Conducted Emission Test Procedure

The LT1110-10 operates from DC power only and must receive power from the authorized AC power adapter for operation. Two configurations were tested for compliance to utility power line conducted emissions. For testing purposes, the manufacturer supplied AC power adapter for the EUT was used to power the EUT. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4. The test setup including the EUT was arranged in a typical equipment configuration and 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.

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. Testing for the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4. 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. Refer to photographs in the test setup exhibits for EUT placement during testing.

Units of Measurements

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

Test Site Locations

Conducted EMI	The AC power line conducted emissions testing were 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 FCC and Industry Canada Site Registration Letters
NVLAP	Lab code 200087-0

Test Equipment and Settings

A Rohde & Schwarz ESU40 and/or Hewlett Packard 8591EM Spectrum Analyzer was used as the measuring device for the emissions testing of frequencies below 1 GHz. A Rohde & 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 annex for a complete list of test equipment.

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

Equipment	Manufacturer	Model	Calibration Date	Due
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/09	10/10
Antenna	ARA	BCD-235-B	10/09	10/10
Antenna	EMCO	3147	10/09	10/10
Antenna	EMCO	3143	5/10	5/11
Analyzer	HP	8591EM	5/10	5/11
Analyzer	HP	8562A	5/10	5/11
Analyzer	Rohde & Schwarz	ESU40	5/10	5/11

Subpart C - Intentional Radiators

As per CFR 47, Subpart C, paragraph 15.247 and RSS-210 the following information is submitted.

Antenna Requirements

The equipment is produced with unique U.FL antenna connector to be used with approved antenna structures or SMT antenna chip on PCB. The antenna connection point complies with the unique antenna connection requirements. The requirements of 15.203 are fulfilled and there are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at a distance of three meters at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were checked at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. No other significant emission was observed which fell into the restricted bands of operation.

Sample Calculations:

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

RFS = Radiated Field Strength calculated

FSM = Field Strength Measured

A.F. = Receive Antenna Factor

Gain = Amplifier gains and Cable losses in system

Radiated Emissions in Restricted Bands Data (2 dBi Dipole) (worst-case)

Digital Modulation

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	13.7	15.0	34.3	25.0	23.0	24.3	54.0
2744.7	14.1	14.5	34.3	25.0	23.4	23.8	54.0
2780.4	14.5	14.4	34.3	25.0	16.6	23.7	54.0
3612.0	11.9	11.7	37.2	25.0	24.1	23.9	54.0
3659.6	13.1	13.0	37.4	25.0	25.5	25.4	54.0
3707.2	13.0	13.0	37.4	25.0	16.6	25.4	54.0
4515.0	13.2	13.1	41.9	25.0	30.1	30.0	54.0
4574.5	13.0	12.9	42.7	25.0	30.7	30.6	54.0
4634.0	14.0	14.0	42.8	25.0	16.6	31.8	54.0

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

53 hop set

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	14.0	14.7	34.3	25.0	23.3	24.0	54.0
2745.0	13.8	13.9	34.3	25.0	23.1	23.2	54.0
2782.8	14.3	14.1	34.3	25.0	16.6	23.4	54.0
3612.0	12.8	12.8	37.2	25.0	25.0	25.0	54.0
3660.0	12.5	12.5	37.4	25.0	24.9	24.9	54.0
3710.4	12.8	12.7	37.4	25.0	16.6	25.1	54.0
4515.0	12.4	12.3	41.9	25.0	29.3	29.2	54.0
4575.0	13.4	13.5	42.7	25.0	31.1	31.2	54.0
4638.0	13.4	13.5	42.8	25.0	16.6	31.3	54.0

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

Radiated Emissions in Restricted Bands Data (Chip Antenna) (worst-case)

Digital Modulation

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	13.8	13.9	34.3	25.0	23.1	23.2	54.0
2744.7	14.0	14.1	34.3	25.0	23.3	23.4	54.0
2780.4	14.4	14.4	34.3	25.0	16.6	23.7	54.0
3612.0	12.8	12.8	37.2	25.0	25.0	25.0	54.0
3659.6	13.0	13.0	37.4	25.0	25.4	25.4	54.0
3707.2	13.1	13.1	37.4	25.0	16.6	25.5	54.0
4515.0	13.3	13.3	41.9	25.0	30.2	30.2	54.0
4574.5	13.8	13.7	42.7	25.0	31.5	31.4	54.0
4634.0	14.3	14.4	42.8	25.0	16.6	32.2	54.0

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

53 hop set

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	14.2	14.0	34.3	25.0	23.5	23.3	54.0
2745.0	14.1	14.0	34.3	25.0	23.4	23.3	54.0
2782.8	14.6	14.9	34.3	25.0	16.6	24.2	54.0
3612.0	12.4	12.5	37.2	25.0	24.6	24.7	54.0
3660.0	12.9	12.8	37.4	25.0	25.3	25.2	54.0
3710.4	13.2	13.1	37.4	25.0	16.6	25.5	54.0
4515.0	12.5	12.5	41.9	25.0	29.4	29.4	54.0
4575.0	13.5	13.5	42.7	25.0	31.2	31.2	54.0
4638.0	13.7	13.7	42.8	25.0	16.6	31.5	54.0

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

Radiated Emissions in Restricted Bands Data (9 dBi Omni) (worst-case)

Digital Modulation

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	13.9	13.8	34.3	25.0	23.2	23.1	54.0
2744.7	14.0	13.8	34.3	25.0	23.3	23.1	54.0
2780.4	14.5	14.4	34.3	25.0	16.6	23.7	54.0
3612.0	12.6	12.6	37.2	25.0	24.8	24.8	54.0
3659.6	12.9	12.8	37.4	25.0	25.3	25.2	54.0
3707.2	13.3	13.0	37.4	25.0	16.6	25.4	54.0
4515.0	13.2	13.2	41.9	25.0	30.1	30.1	54.0
4574.5	13.0	13.1	42.7	25.0	30.7	30.8	54.0
4634.0	14.5	13.9	42.8	25.0	16.6	31.7	54.0

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

53 hop set

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	14.8	14.1	34.3	25.0	24.1	23.4	54.0
2745.0	14.7	14.7	34.3	25.0	24.0	24.0	54.0
2782.8	15.5	15.0	34.3	25.0	16.6	24.3	54.0
3612.0	12.6	12.6	37.2	25.0	24.8	24.8	54.0
3660.0	13.1	13.1	37.4	25.0	25.5	25.5	54.0
3710.4	13.2	13.3	37.4	25.0	16.6	25.7	54.0
4515.0	12.9	12.8	41.9	25.0	29.8	29.7	54.0
4575.0	13.6	13.7	42.7	25.0	31.3	31.4	54.0
4638.0	13.9	13.8	42.8	25.0	16.6	31.6	54.0

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

Radiated Emissions in Restricted Bands Data (15 dBi Yagi) (worst-case)

Digital Modulation

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2709.0	13.8	13.8	34.3	25.0	23.1	23.1	54.0
2744.7	13.8	13.8	34.3	25.0	23.1	23.1	54.0
2780.4	14.4	13.7	34.3	25.0	16.6	23.0	54.0
3612.0	11.8	11.6	37.2	25.0	24.0	23.8	54.0
3659.6	12.6	12.6	37.4	25.0	25.0	25.0	54.0
3707.2	13.1	13.0	37.4	25.0	16.6	25.4	54.0
4515.0	13.0	12.9	41.9	25.0	29.9	29.8	54.0
4574.5	13.7	13.6	42.7	25.0	31.4	31.3	54.0
4634.0	13.5	14.7	42.8	25.0	16.6	32.5	54.0

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

53 hop set

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	FCC Class B Limit @ 3m (dBµV/m)
2706.9	13.8	16.1	34.3	25.0	23.1	25.4	54.0
2745.0	14.1	16.0	34.3	25.0	23.4	25.3	54.0
2782.8	14.4	17.3	34.3	25.0	16.6	26.6	54.0
3609.2	12.6	12.5	37.2	25.0	24.8	24.7	54.0
3660.0	13.1	13.1	37.4	25.0	25.5	25.5	54.0
3710.4	13.1	13.2	37.4	25.0	16.6	25.6	54.0
4511.5	12.6	12.6	41.9	25.0	29.5	29.5	54.0
4575.0	13.7	13.7	42.7	25.0	31.4	31.4	54.0
4638.0	13.8	13.8	42.8	25.0	16.6	31.6	54.0

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C Intentional Radiators. The EUT demonstrated a minimum margin of 21.5 dB below the requirements. 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 Testing Procedure

The EUT was arranged in the test setup configuration emulating typical equipment configurations 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 AC power adapter for the EUT 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 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. 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 radio frequency 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 through four demonstrating plots of the AC Line conducted emissions.

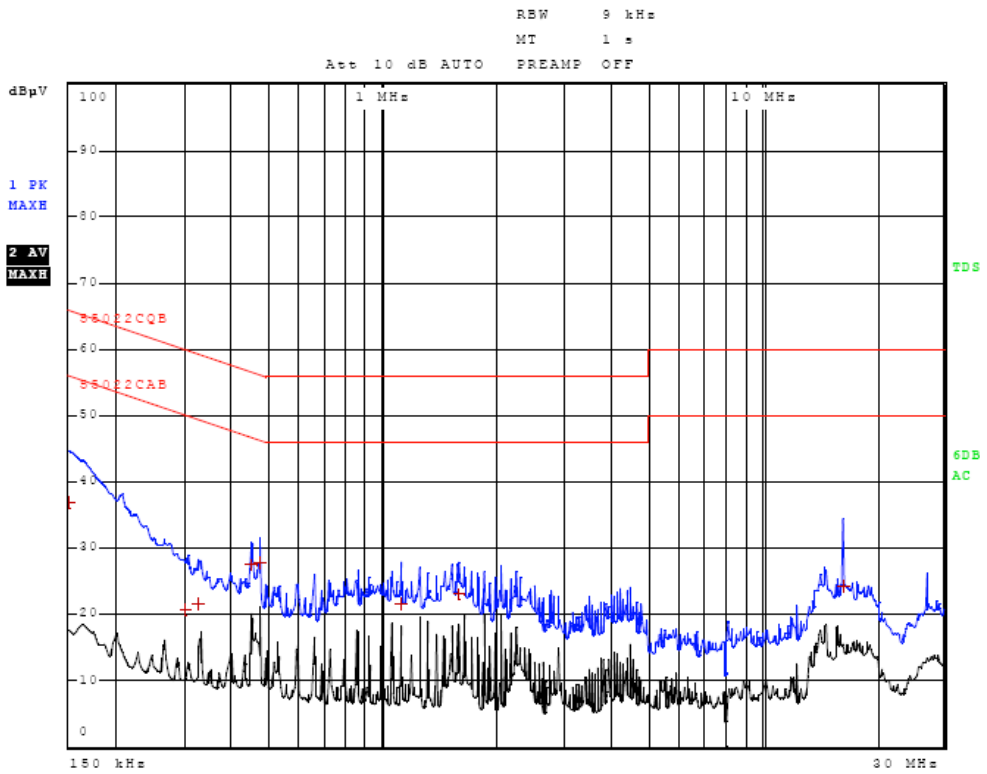


Figure One AC Line Conducted Emissions Line 1 (53 Hop FHSS)

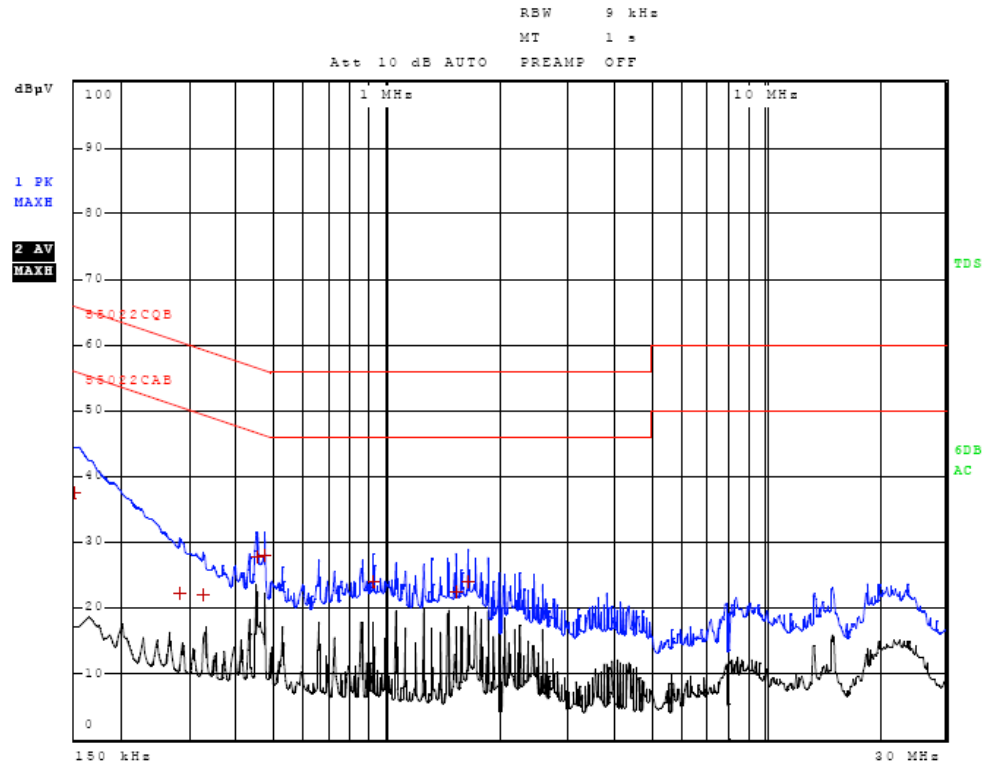


Figure Two AC Line Conducted Emissions Line 2 (53 Hop FHSS)

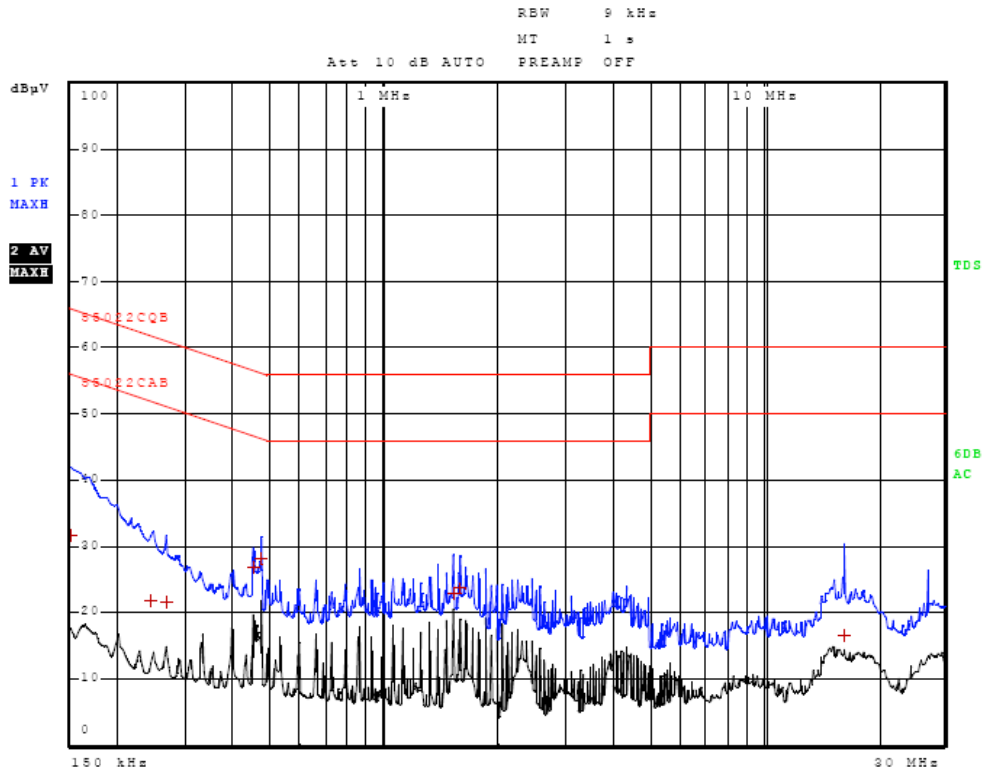


Figure Three AC Line Conducted Emissions Line 1 (Digital Modulation)

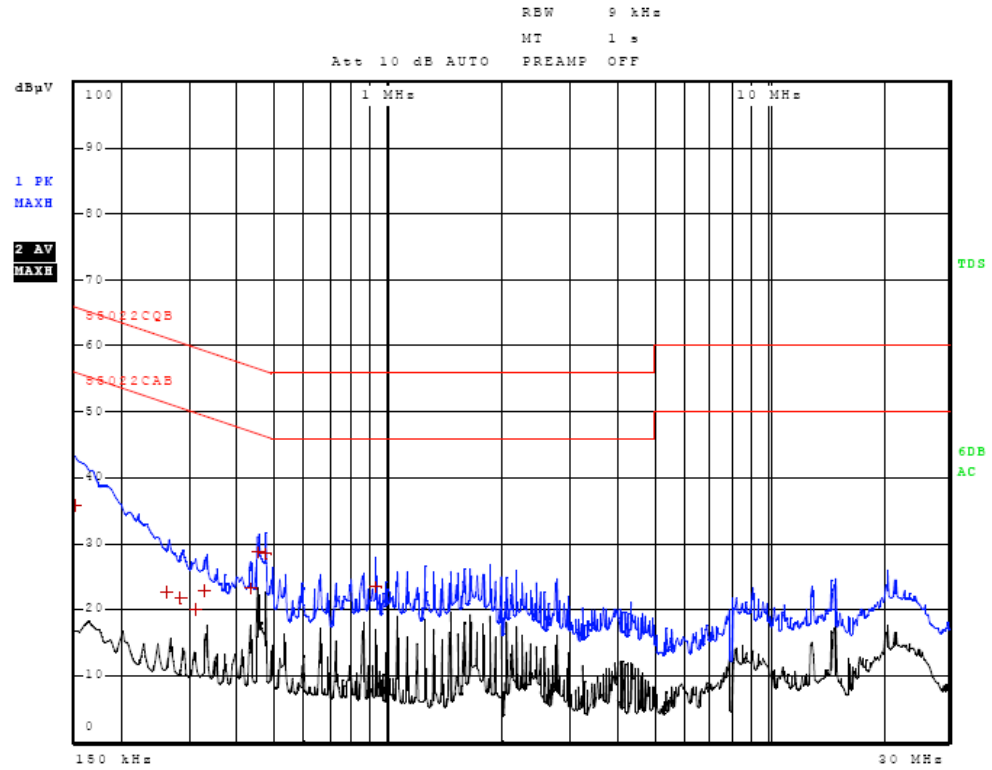


Figure Four AC Line Conducted Emissions Line 2 (Digital Modulation)

AC Line Conducted Emissions Data (53 Hop FHSS)

Line 1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	36.90	Quasi Peak	-29.10
1	306.000000000 kHz	20.66	Quasi Peak	-39.42
1	326.000000000 kHz	21.52	Quasi Peak	-38.03
1	450.000000000 kHz	27.52	Quasi Peak	-29.36
1	470.000000000 kHz	27.91	Quasi Peak	-28.61
1	1.118000000 MHz	21.53	Quasi Peak	-34.47
1	1.582000000 MHz	23.00	Quasi Peak	-33.00
1	16.252000000 MHz	24.36	Quasi Peak	-35.64

Line 2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	37.41	Quasi Peak	-28.59
1	282.000000000 kHz	22.23	Quasi Peak	-38.53
1	326.000000000 kHz	21.90	Quasi Peak	-37.66
1	454.000000000 kHz	27.92	Quasi Peak	-28.89
1	474.000000000 kHz	28.10	Quasi Peak	-28.34
1	922.000000000 kHz	23.97	Quasi Peak	-32.03
1	1.514000000 MHz	22.38	Quasi Peak	-33.62
1	1.646000000 MHz	24.12	Quasi Peak	-31.88

Other emissions present had amplitudes at least 10 dB below the limit.

AC Line Conducted Emissions Data (Digital Modulation)

Line 1

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	31.63	Quasi Peak	-34.37
1	246.000000000 kHz	21.77	Quasi Peak	-40.12
1	266.000000000 kHz	21.58	Quasi Peak	-39.67
1	450.000000000 kHz	26.88	Quasi Peak	-29.99
1	470.000000000 kHz	28.04	Quasi Peak	-28.48
1	1.518000000 MHz	22.79	Quasi Peak	-33.21
1	1.582000000 MHz	23.73	Quasi Peak	-32.27
1	16.272000000 MHz	16.58	Quasi Peak	-43.42

Line 2

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	150.000000000 kHz	35.91	Quasi Peak	-30.09
1	262.000000000 kHz	22.57	Quasi Peak	-38.79
1	286.000000000 kHz	21.65	Quasi Peak	-38.99
1	310.000000000 kHz	20.10	Quasi Peak	-39.87
1	330.000000000 kHz	22.85	Quasi Peak	-36.60
1	430.000000000 kHz	23.14	Quasi Peak	-34.11
1	450.000000000 kHz	28.73	Quasi Peak	-28.14
1	470.000000000 kHz	28.45	Quasi Peak	-28.07
1	922.000000000 kHz	23.34	Quasi Peak	-32.66

Other emissions present had amplitudes at least 10 dB below the limit.

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the conducted emissions requirements for CISPR 22, RSS-210, and CFR 47 Part 15C equipment. The EUT demonstrated minimum margin of 28.0 dB below the Quasi-Peak 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 Testing Procedure

The EUT was arranged in the test system configuration emulating typical equipment configuration 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. Plots were made of the radiated frequency spectrum from 30 MHz to 25,000 MHz for the preliminary testing. Refer to figures five through twelve for plots of the general radiated emissions spectrum taken in a screen room (note plots are for reference only, data was taken at 3 meters OATS). The highest radiated emission was then re-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 30 MHz to 20,000 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 Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 5 GHz and or, pyramidal horns and mixers from 4 GHz to 30 GHz, notch filters and appropriate amplifiers were utilized.

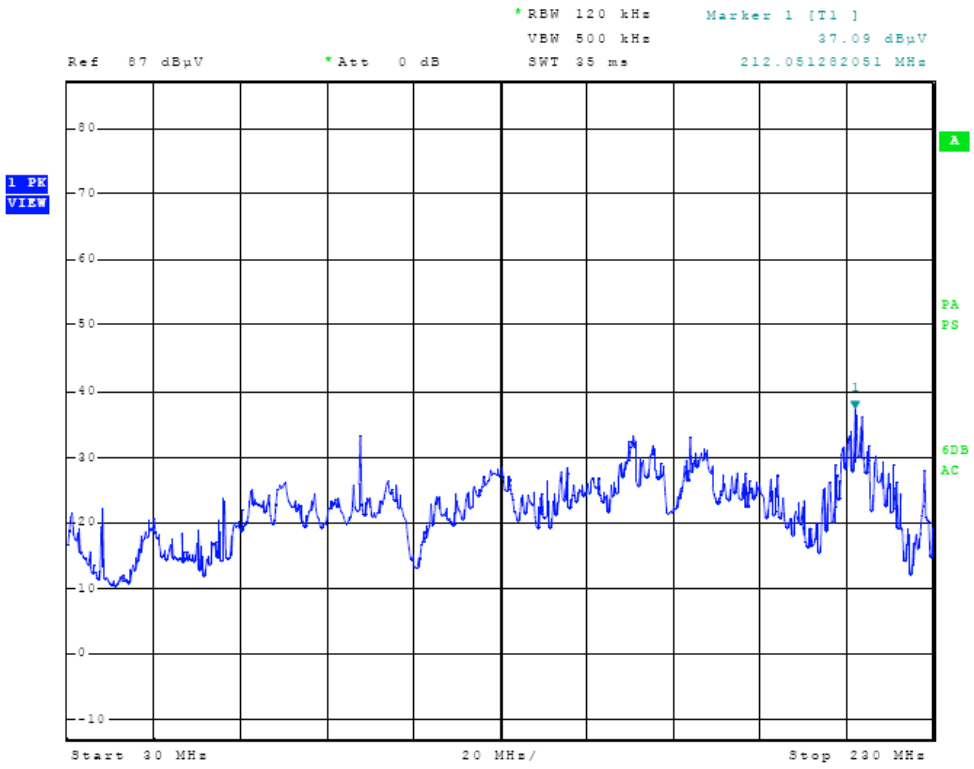


Figure Five General Radiated Emissions taken at 1 meter in screen room (FHSS)

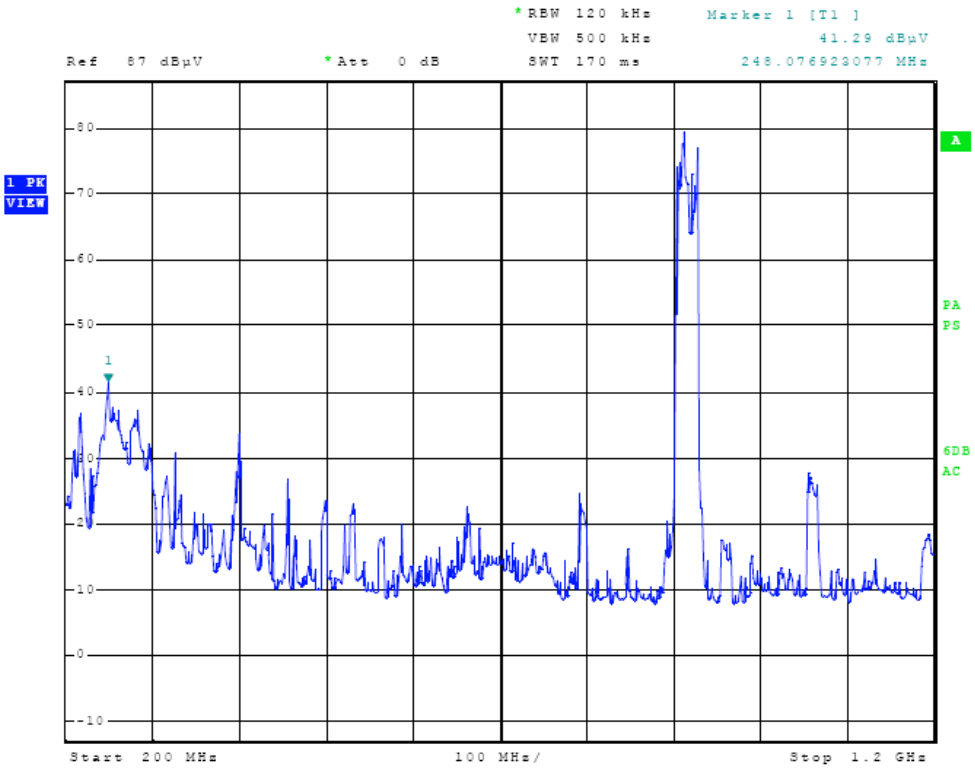


Figure Six General Radiated Emissions taken at 1 meter in screen room (FHSS)

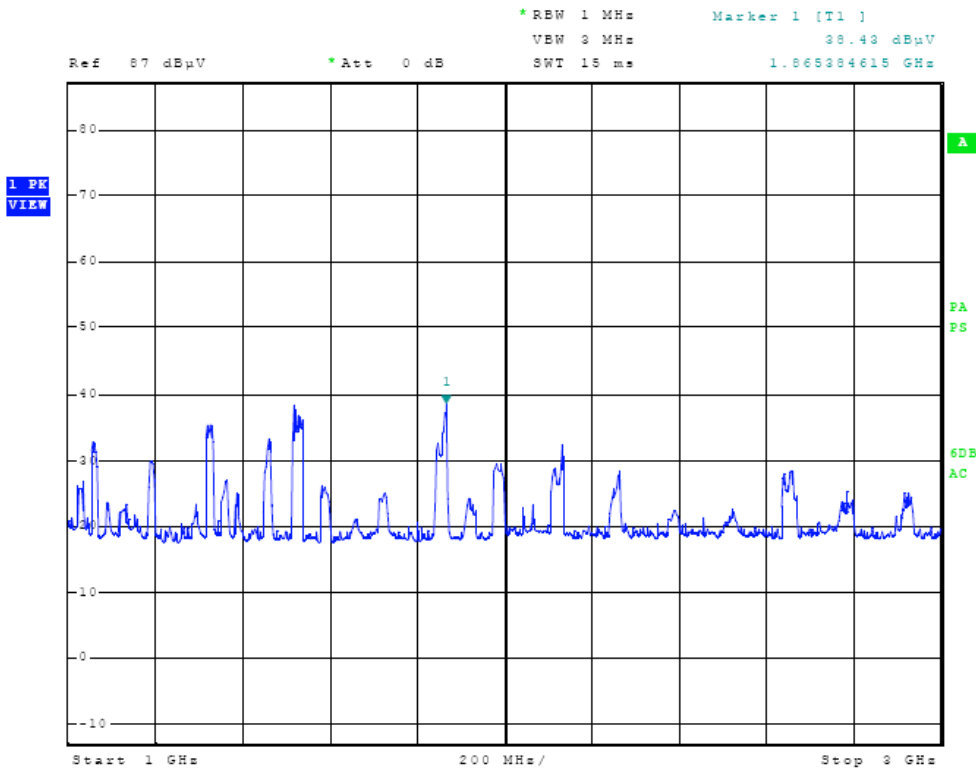


Figure Seven General Radiated Emissions taken at 1 meter in screen room (FHSS)

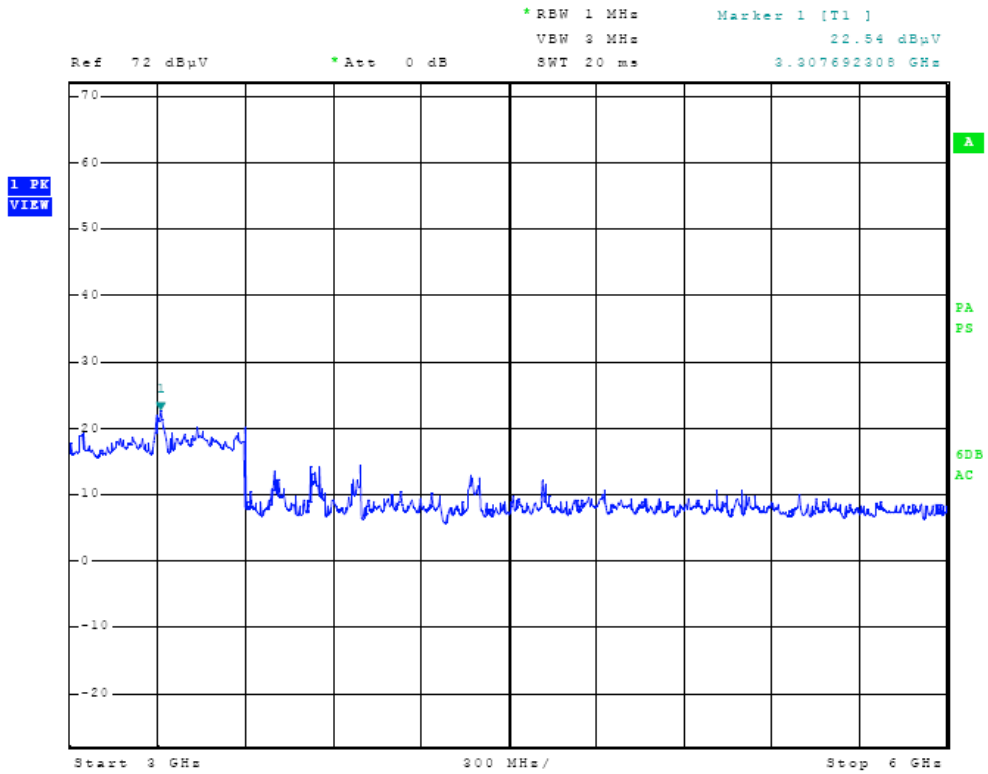


Figure Eight General Radiated Emissions taken at 1 meter in screen room (FHSS)

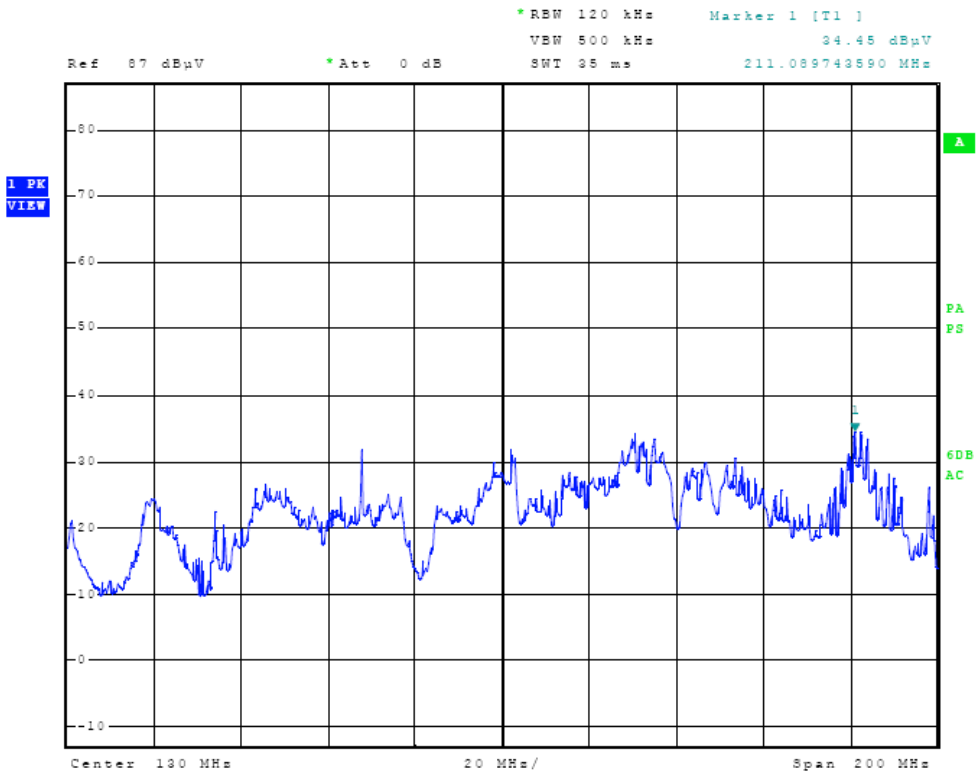


Figure Nine General Radiated Emissions taken at 1 meter in screen room (Digital Mod)

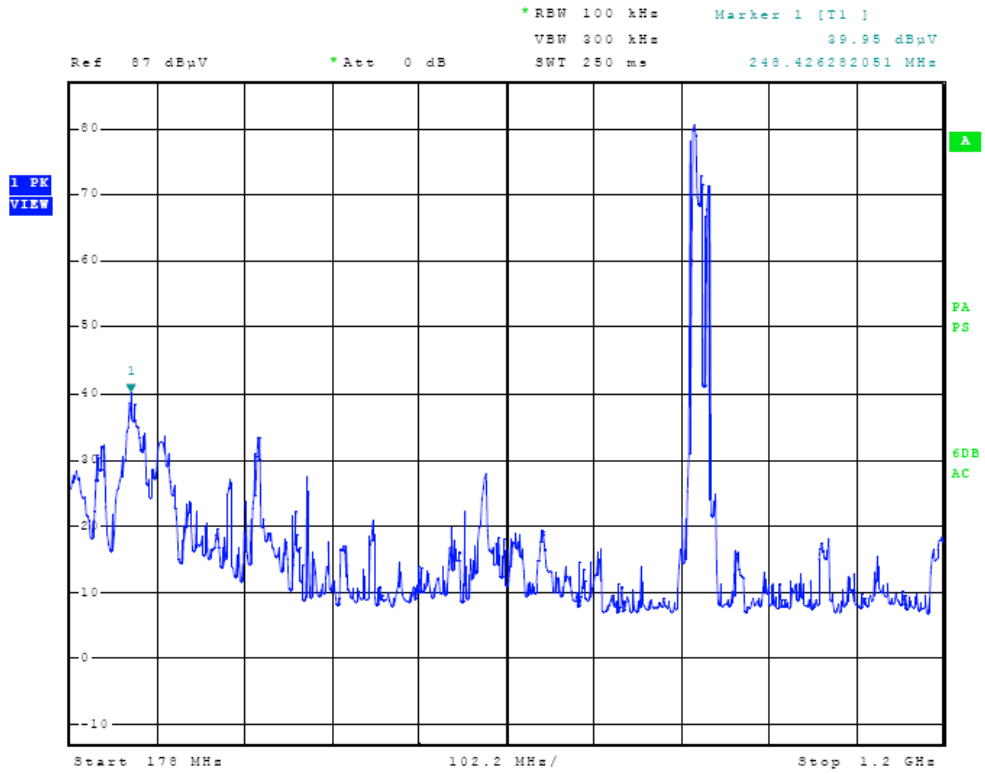


Figure Ten General Radiated Emissions taken at 1 meter in screen room (Digital Mod)

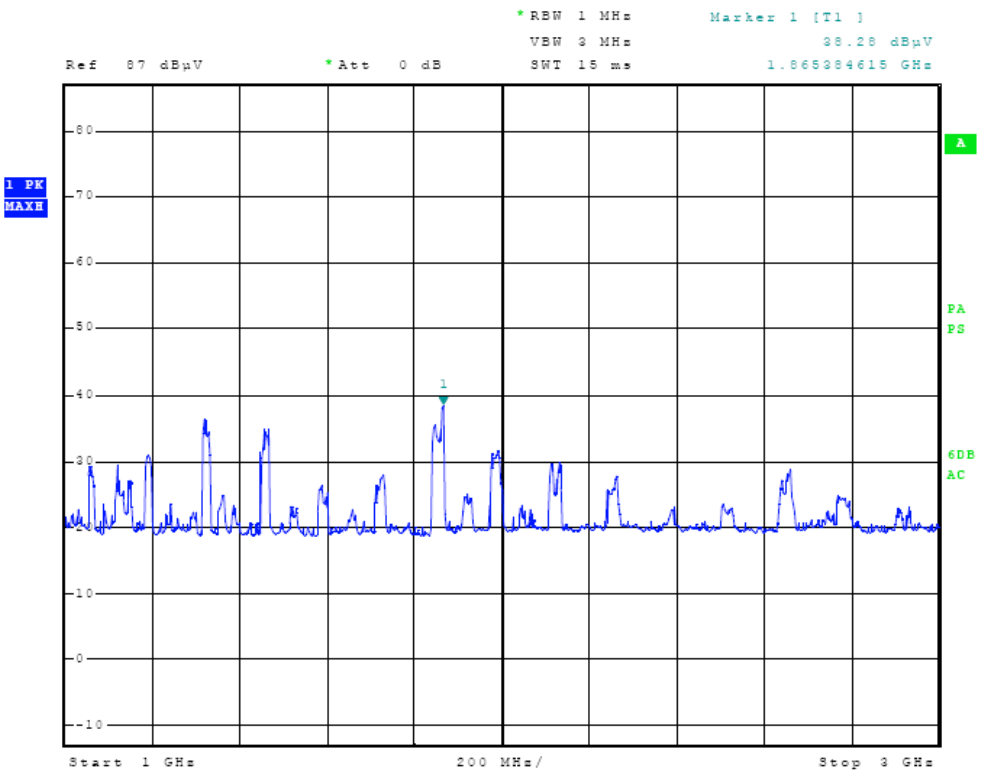


Figure Eleven General Radiated Emissions taken at 1 meter in screen room (Digital Mod)

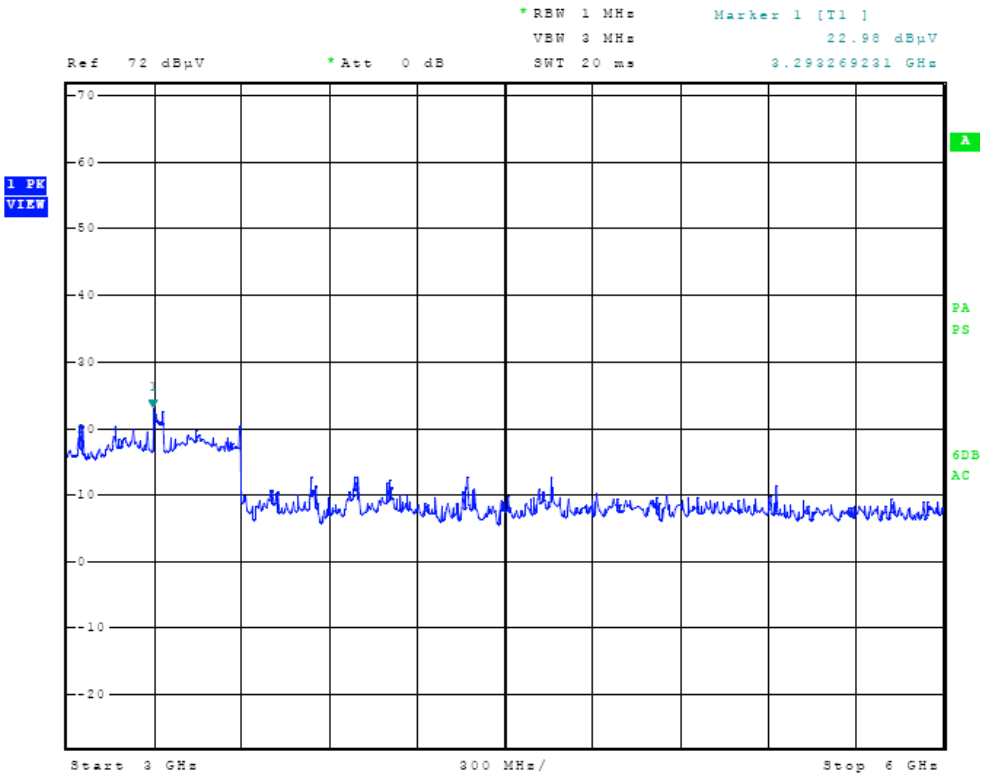


Figure Twelve General Radiated Emissions taken at 1 meter in screen room (Digital Mod)

Radiated Emissions from EUT Data (Highest Emissions)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
97.6	47.4	50.1	7.3	30	24.7	27.4	40.0
128.8	42.6	47.0	8.0	30	20.6	25.0	43.5
161.9	41.8	49.8	8.6	30	20.4	28.4	43.5
169.7	46.3	48.0	8.7	30	25.0	26.7	43.5
210.9	56.8	50.8	11.0	30	37.8	31.8	43.5
212.4	58.1	51.8	11.0	30	39.1	32.8	43.5
213.5	58.3	51.9	11.0	30	39.3	32.9	43.5
216.9	54.8	49.1	11.1	30	35.9	30.2	43.5
248.9	53.5	51.7	12.2	30	35.7	33.9	46.0
253.6	50.7	51.5	12.3	30	33.0	33.8	46.0
265.6	54.2	54.0	13.0	30	37.2	37.0	46.0
285.7	47.9	42.8	13.2	30	31.1	26.0	46.0
290.3	44.2	38.1	13.7	30	27.9	21.8	46.0
398.8	40.7	46.4	16.4	30	27.1	32.8	46.0
1317.0	17.9	18.0	24.8	25	17.7	17.8	54.0
1455.0	17.9	19.1	26.6	25	19.5	20.7	54.0
1846.0	17.4	17.7	25.8	25	18.2	18.5	54.0
1865.0	17.8	18.1	25.8	25	18.6	18.9	54.0
1977.0	18.0	17.9	29.8	25	22.8	22.7	54.0
3293.0	15.8	16.0	30.3	25	21.1	21.3	54.0
3326.0	16.3	16.5	30.3	25	21.6	21.8	54.0

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

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C paragraph 15.209 and RSS-210 Intentional Radiators. The EUT demonstrated a minimum margin of 4.2 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Receiver Antenna Power Conduction Limits

Receivers which provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of 15.109 with the antenna terminals shielded and terminated with a termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in 15.33 shall not exceed 2.0 nanowatts (-57 dBm). The antenna port was connected to a spectrum analyzer for testing the antenna-conducted emissions. The antenna connection under test was connected to the spectrum analyzer through a short coaxial cable. The spectrum analyzer provided the 50-ohm load for the antenna port. The frequency spectrum was investigated at the antenna port with the worst case data presented. Refer to figures thirteen through sixteen showing the spectrum analyzer display of worst-case receiver antenna conduction emissions. Antenna Port conducted emissions data is shown below. Compliance to receiver radiated emissions requirements were tested both at antenna port and 3 meter OATS with worst-case data presented.

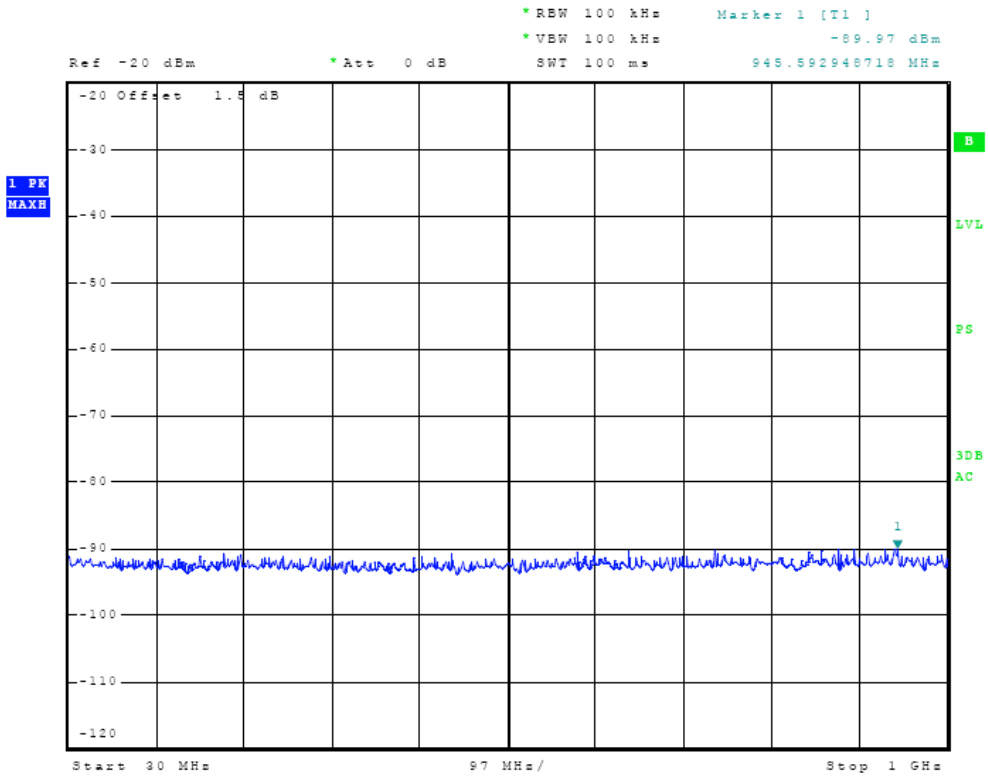


Figure Thirteen Receiver Antenna Port Conducted Emissions

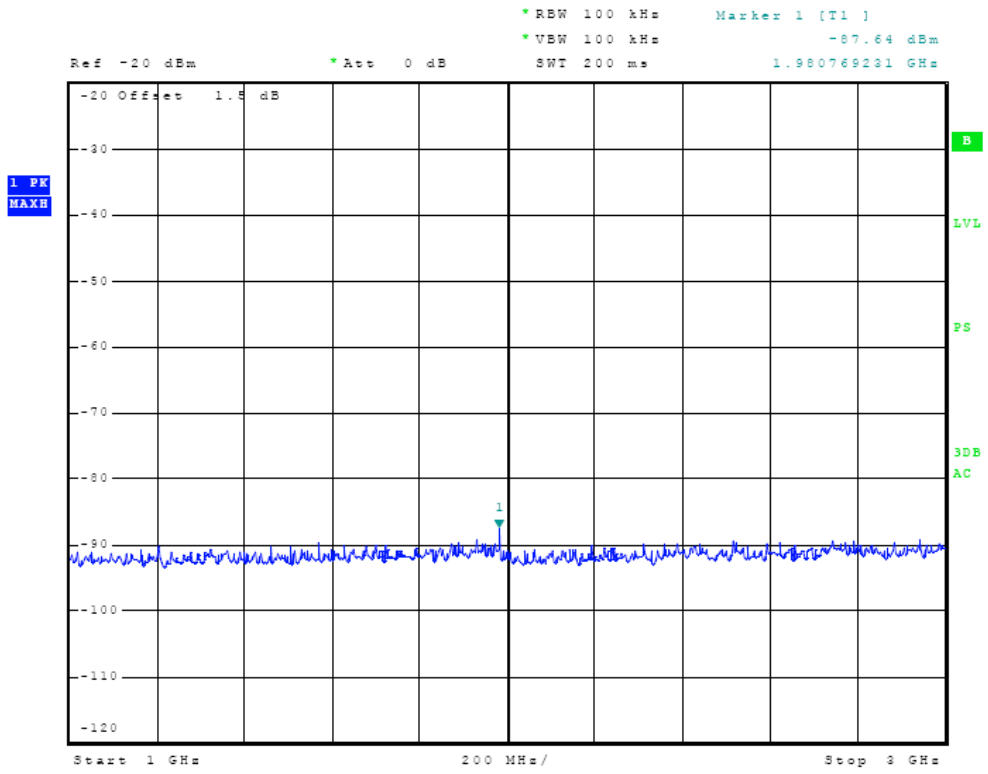


Figure Fourteen Receiver Antenna Port Conducted Emissions

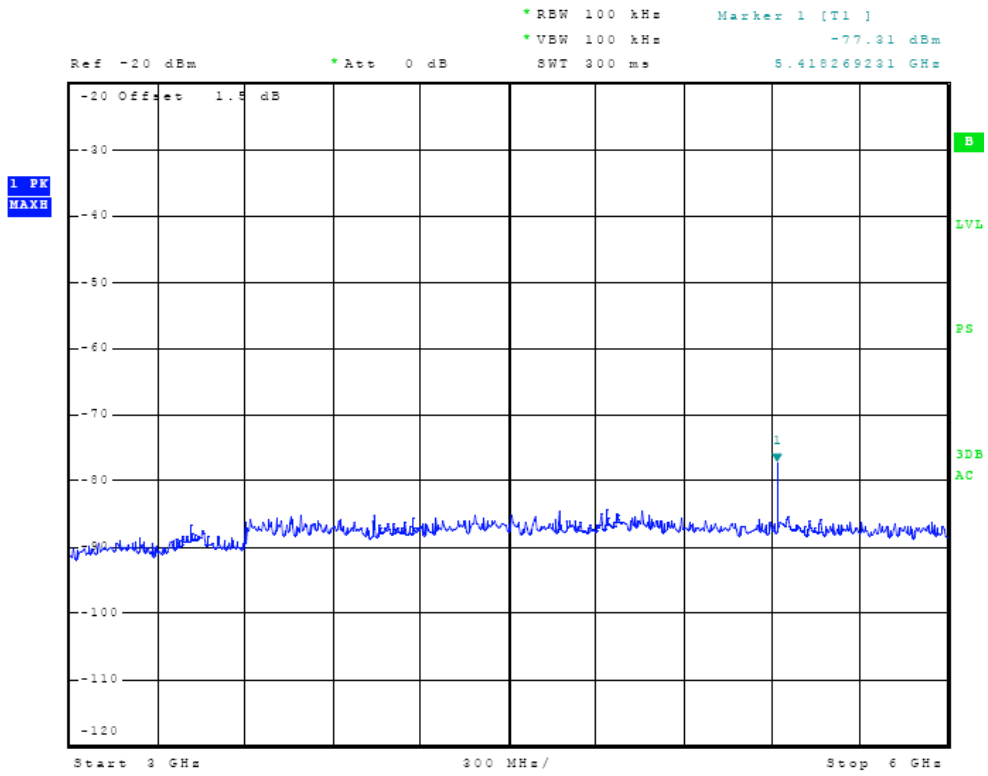


Figure Fifteen Receiver Antenna Port Conducted Emissions

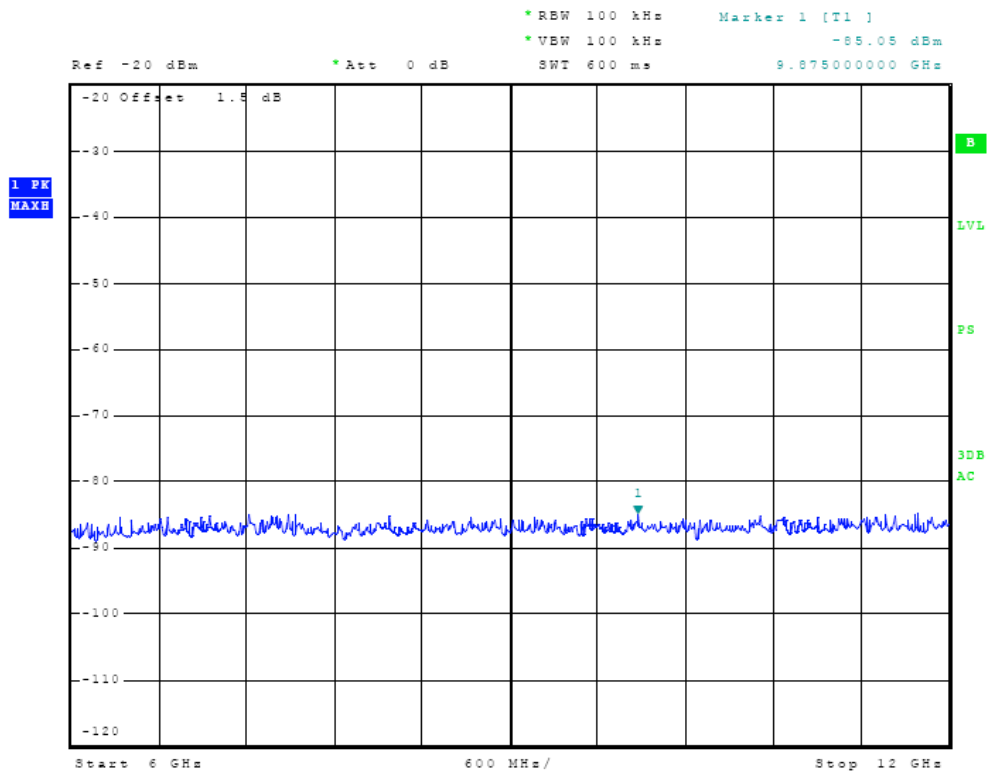


Figure Sixteen Receiver Antenna Port Conducted Emissions

Receiver Antenna Conducted Emissions Data

Frequency (MHz)	Emission Level (dBm)	Limit (dBm)	Margin (dB)
902.1	-106.6	-57.0	-49.6
1804.1	-90.3	-57.0	-33.3
914.7	-105.9	-57.0	-48.9
1829.4	-89.9	-57.0	-32.9
927.3	-105.3	-57.0	-48.3
1854.6	-89.8	-57.0	-32.8

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

Receiver Radiated Emissions Data

Emission Freq. (MHz)	FSM Horz. (dBµV)	FSM Vert. (dBµV)	Ant. Factor (dB)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
902.1	17.7	17.6	23.3	30	11.0	10.9	46.0
1804.2	15.8	16.1	29.4	25	20.2	20.5	54.0
914.7	17.6	17.7	23.4	30	11.0	11.1	46.0
1829.4	15.7	16.0	29.3	25	20.0	20.3	54.0
927.3	17.6	17.5	23.4	30	11.0	10.9	46.0
1854.6	15.6	15.8	29.4	25	20.0	20.1	54.0

Other emissions were present with amplitudes at least 20 dB below limits.

Summary of Results for Receiver Emissions

The EUT demonstrated compliance with the antenna conducted emissions requirements of CFR 47 Part 15B and RSS-GEN with an antenna port conducted minimum margin of 32.8 dB below requirements. The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15B and RSS-GEN with a minimum 33.5 dB margin below requirements. Other emissions were present with amplitudes at least 20 dB below the CFR 47 15B and RSS-GEN limits.

Operation in the Band 902-928 MHz

The power output was measured at the antenna port and again on the Open Area Test Site at a 3 meters distance utilizing the antenna configurations listed. The EUT and test fixture was placed on a wooden turntable 0.8 meters above the ground plane and at a distance of 3 meters from the FSM antenna. The peak, quasi-peak and average amplitude of the carrier frequency was measured using a spectrum analyzer. The peak and average amplitude of the spurious emissions above 1000 MHz were measured using a spectrum analyzer then data was recorded from the analyzer display. Refer to figures seventeen through forty for plots of the transmitter emissions taken at the antenna port demonstrating compliance to the specifications. The EUT functions as frequency hopping spread spectrum utilizing 53 hopping channels or digitally modulated intentional radiator. The average time of occupancy on any FHSS frequency shall not be greater than 0.4 seconds within a 20 second period. Dwell time may be calculated as time on channel multiplied by the number of times on channel within defined time period (example 9.3 mS x 32 times on channel equates to 0.3 seconds). Figures thirty-five and thirty-six demonstrate compliance with dwell time on channel. As described in the operational description exhibit, the equipment complies with requirements of channel occupancy. The 902 and 928 MHz band edges are protected due to the lowest and highest channels used for frequency of operation. Figures thirty-seven through forty and radiated emissions measurements demonstrate compliance at band edges. The amplitude of each emission was maximized by varying the FSM antenna height, polarization, and by rotating the turntable. Emissions were measured in dBμV/m at three meters. The amplitude of each radiated emission measured was maximized by varying the FSM antenna height, polarization, and by rotating the turntable. A Biconilog Antenna was used for measuring emissions from 30 to 1000 MHz, a Log Periodic Antenna for 200 to 5000 MHz, and Double Ridge and/or Pyramidal Horn Antennas from 4 GHz to 20 GHz. Data was taken per CFR 47 Paragraphs 2.1046(a), 15.247 and RSS-210.

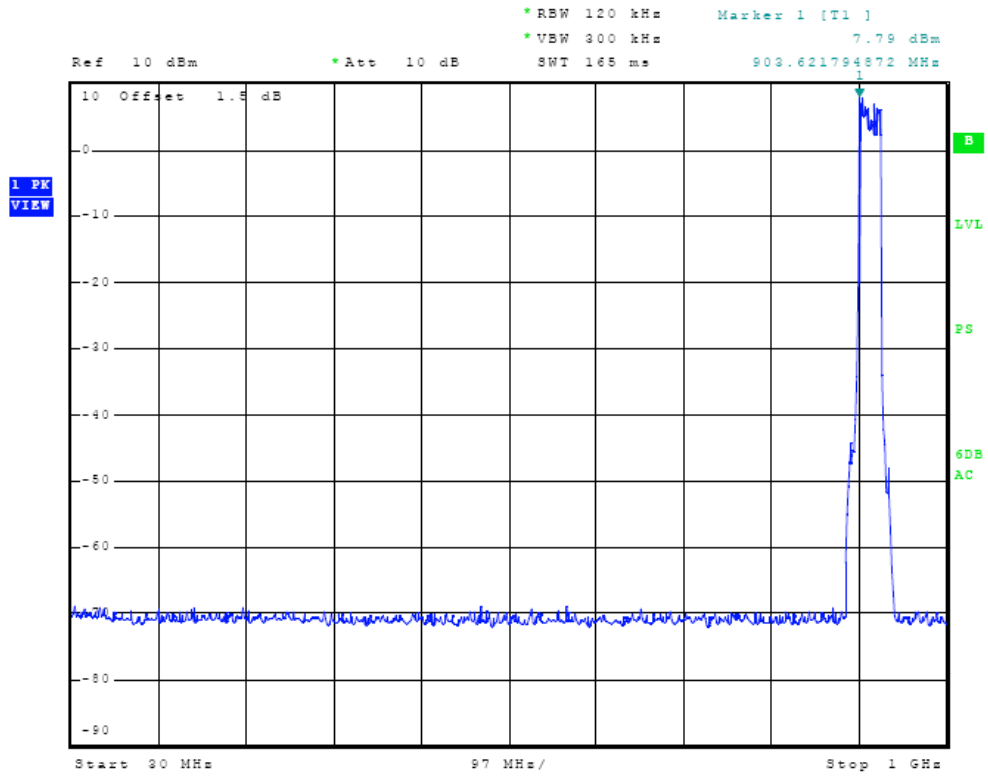


Figure Seventeen Plot of Antenna Port Conducted Emissions (Digital Modulation)

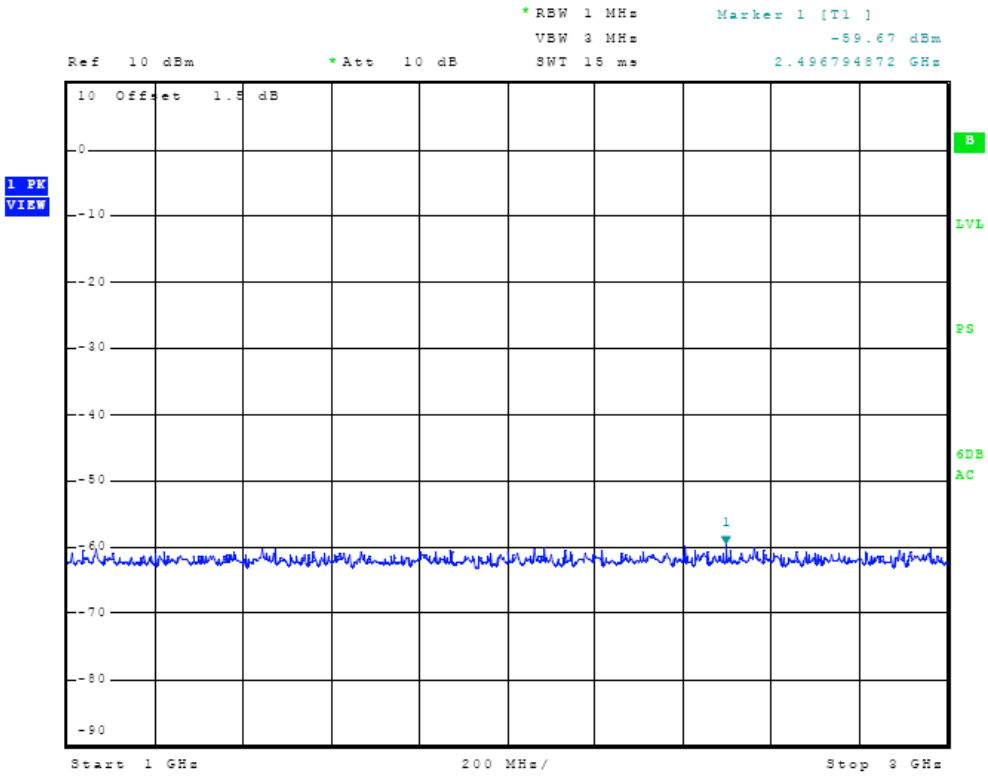


Figure Eighteen Plot of Antenna Port Conducted Emissions (Digital Modulation)

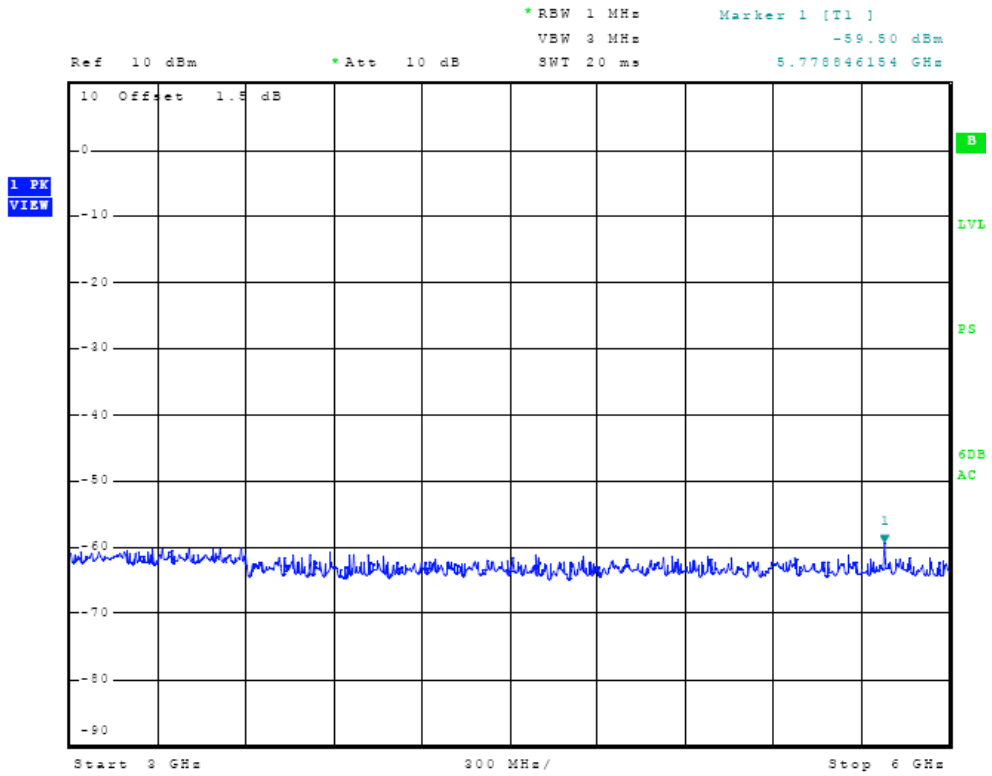


Figure Nineteen Plot of Antenna Port Conducted Emissions (Digital Modulation)

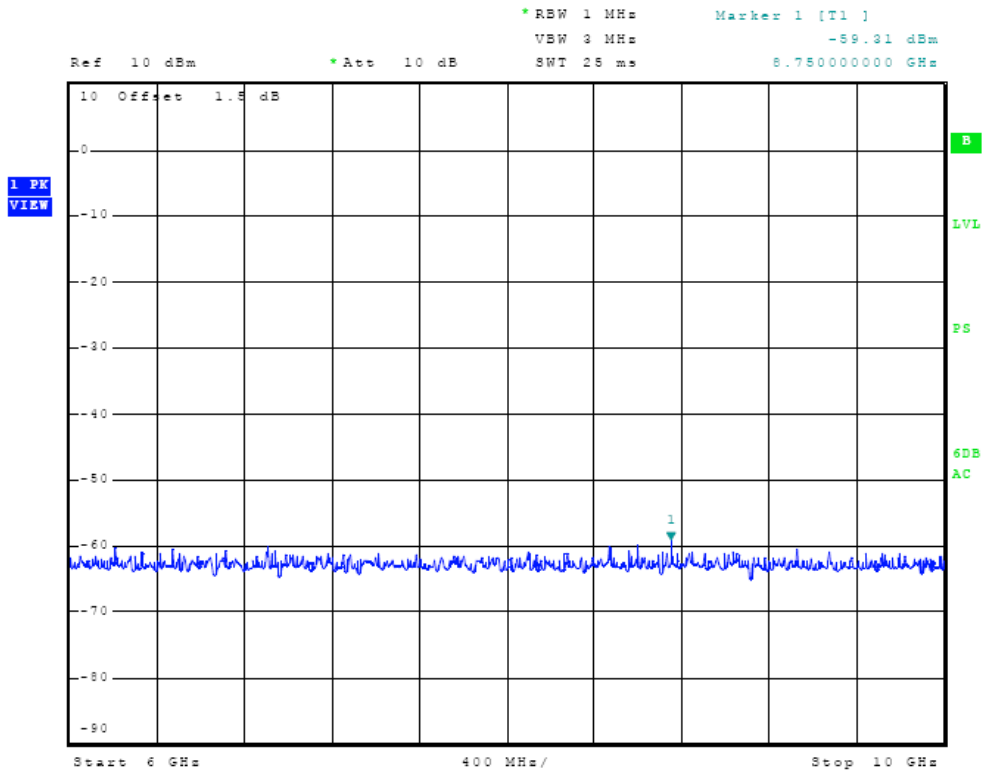


Figure Twenty Plot of Antenna Port Conducted Emissions (Digital Modulation)

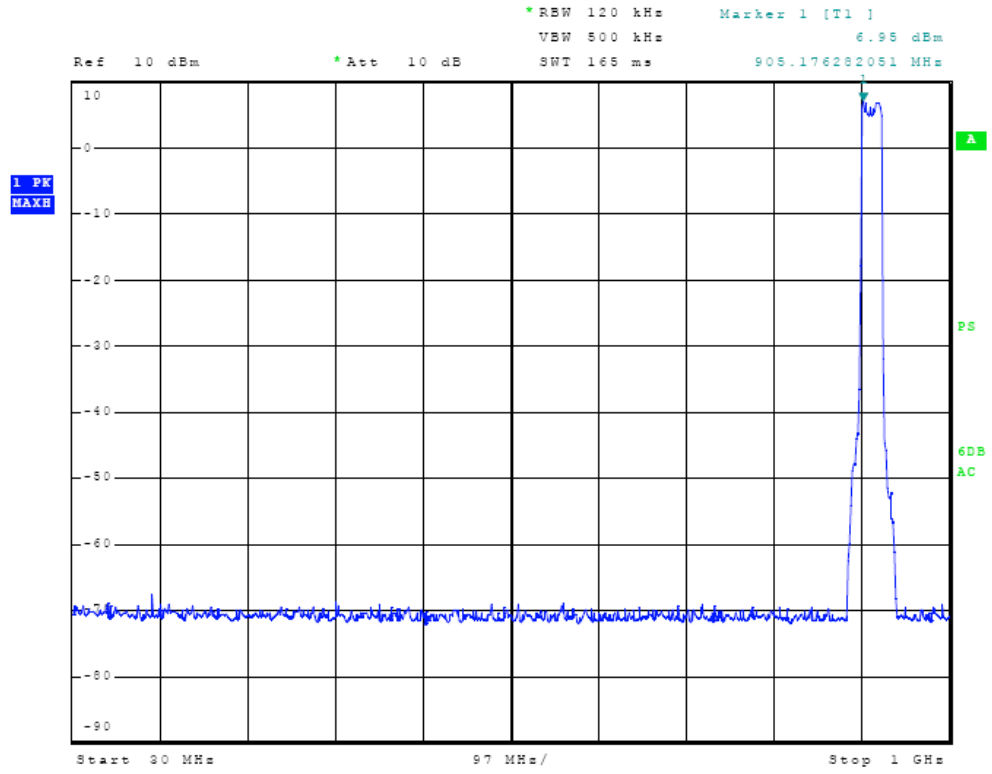


Figure Twenty-one Plot of Antenna Port Conducted Emissions (FHSS)

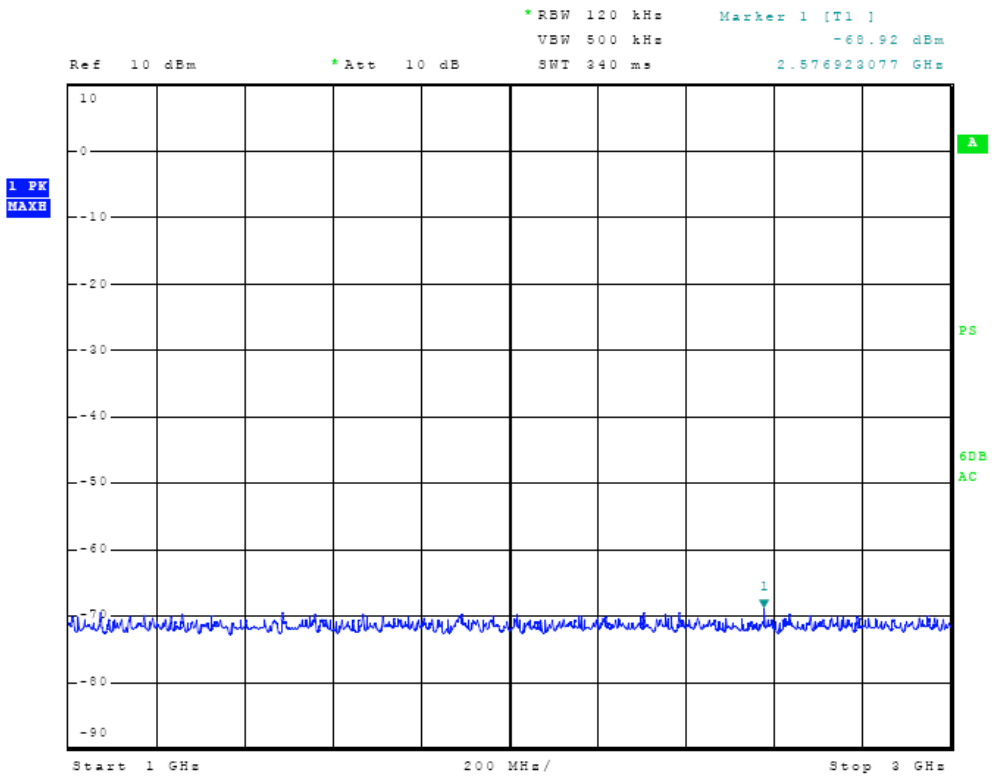


Figure Twenty-two Plot of Antenna Port Conducted Emissions (FHSS)

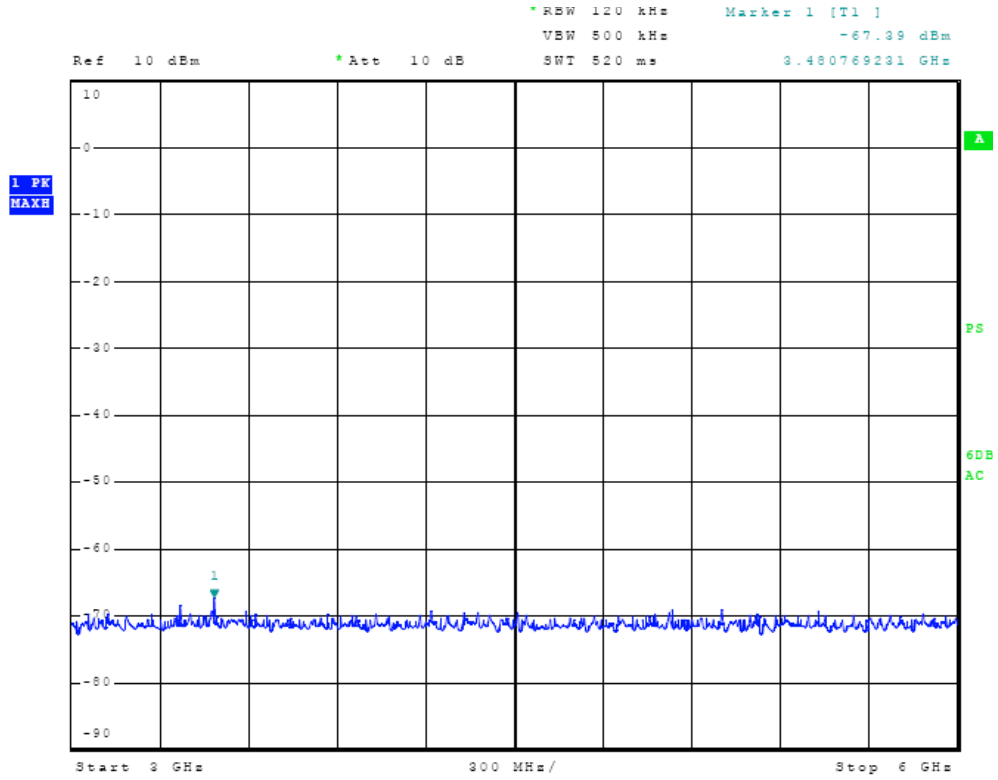


Figure Twenty-three Plot of Antenna Port Conducted Emissions (FHSS)

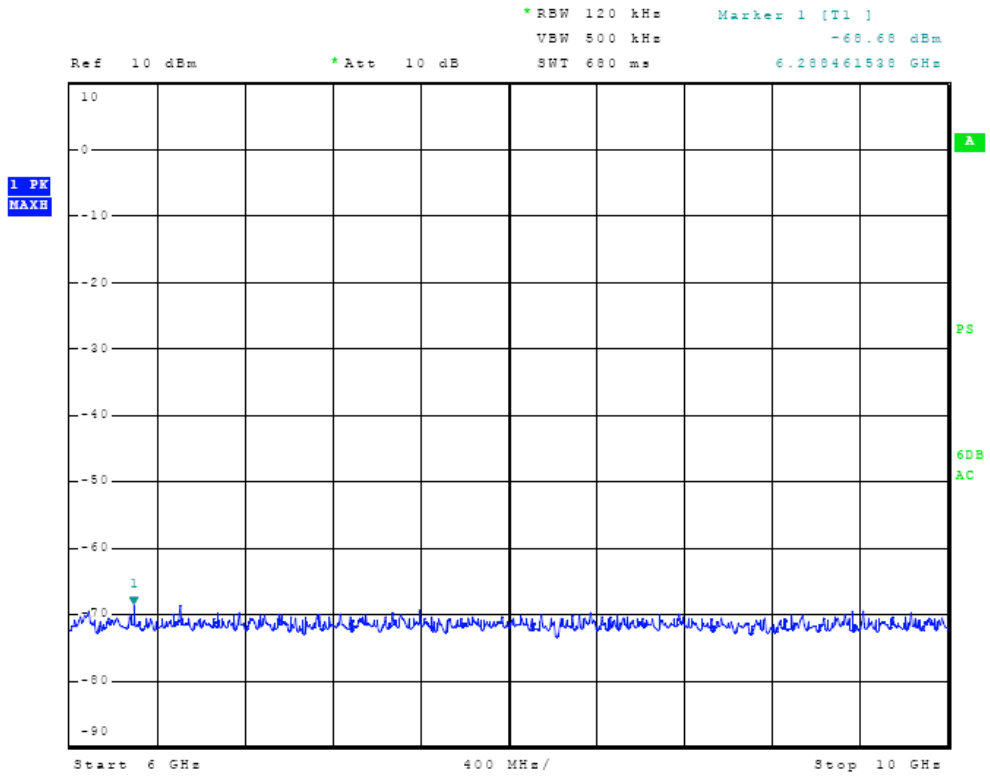


Figure Twenty-four Plot of Antenna Port Conducted Emissions (FHSS)

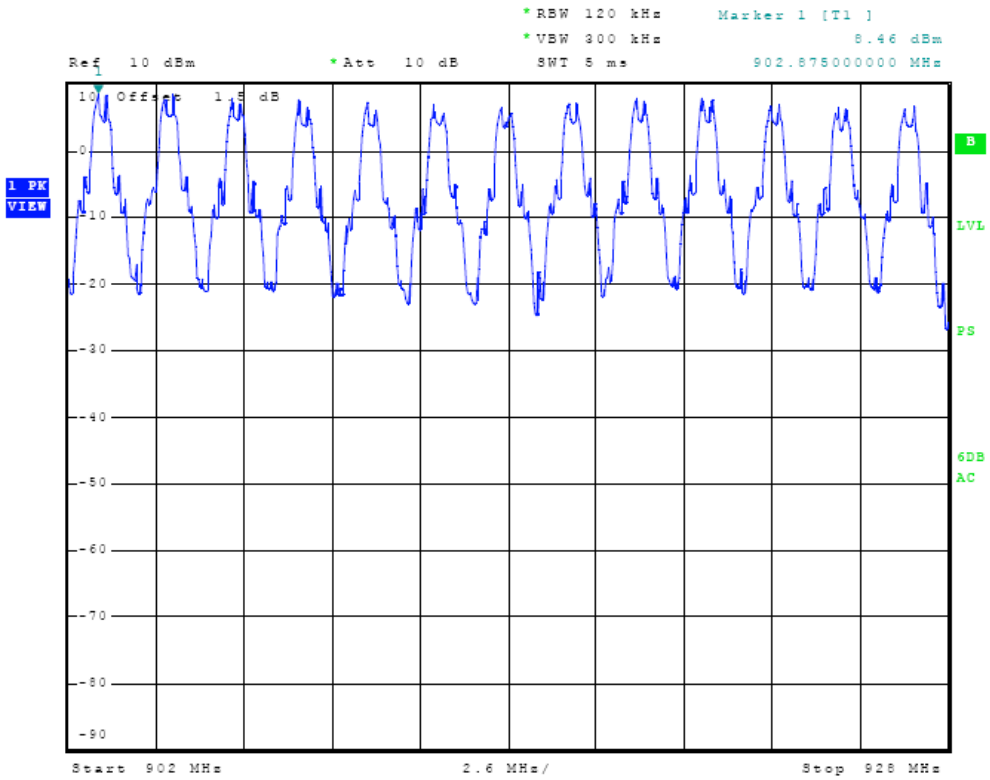


Figure Twenty-five Plot of Operation Across Operational Band (Digital Modulation)

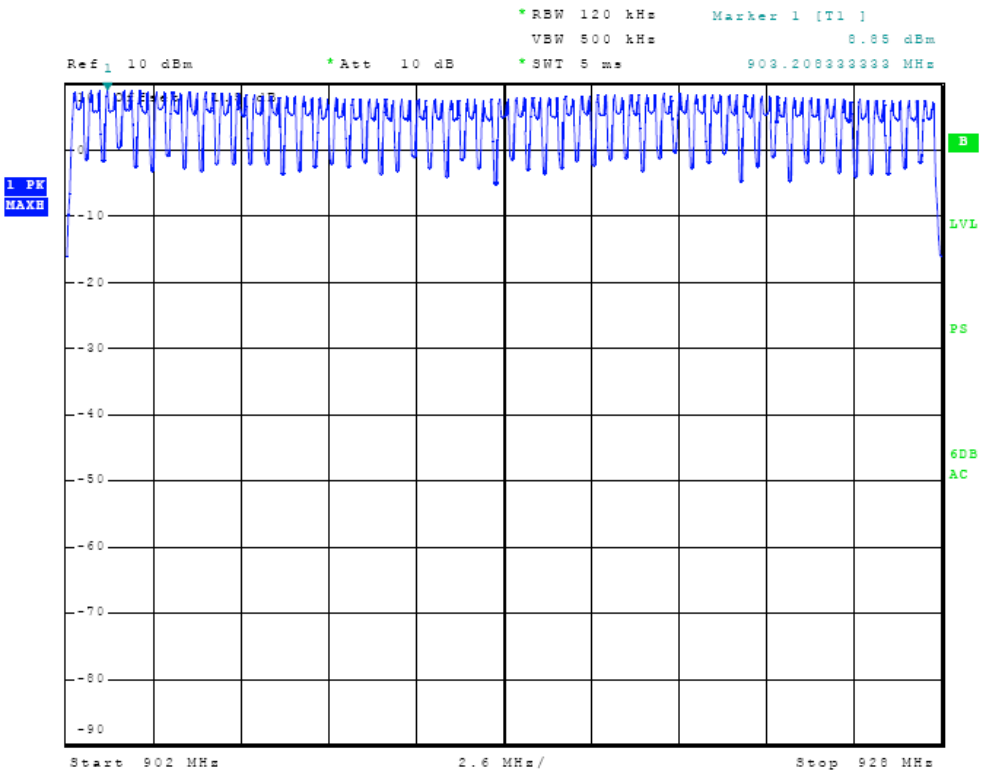


Figure Twenty-six Plot of Operation Across Operational Band (FHSS)

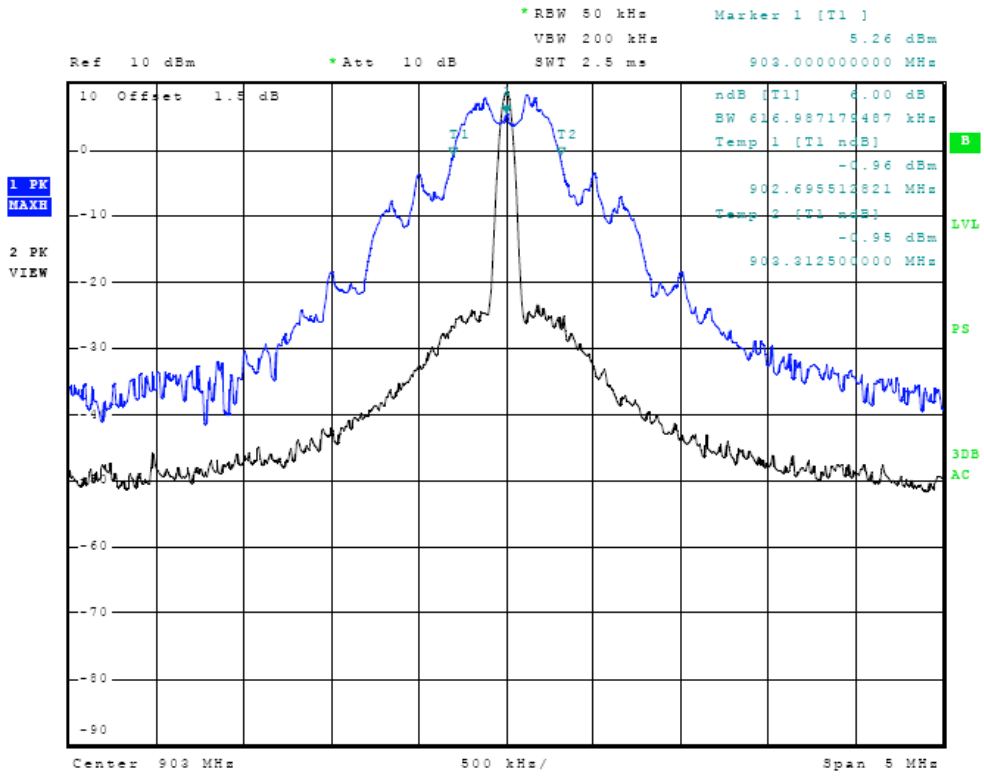


Figure Twenty-seven Plot of 6 dB Occupied Bandwidth (Digital Modulation)

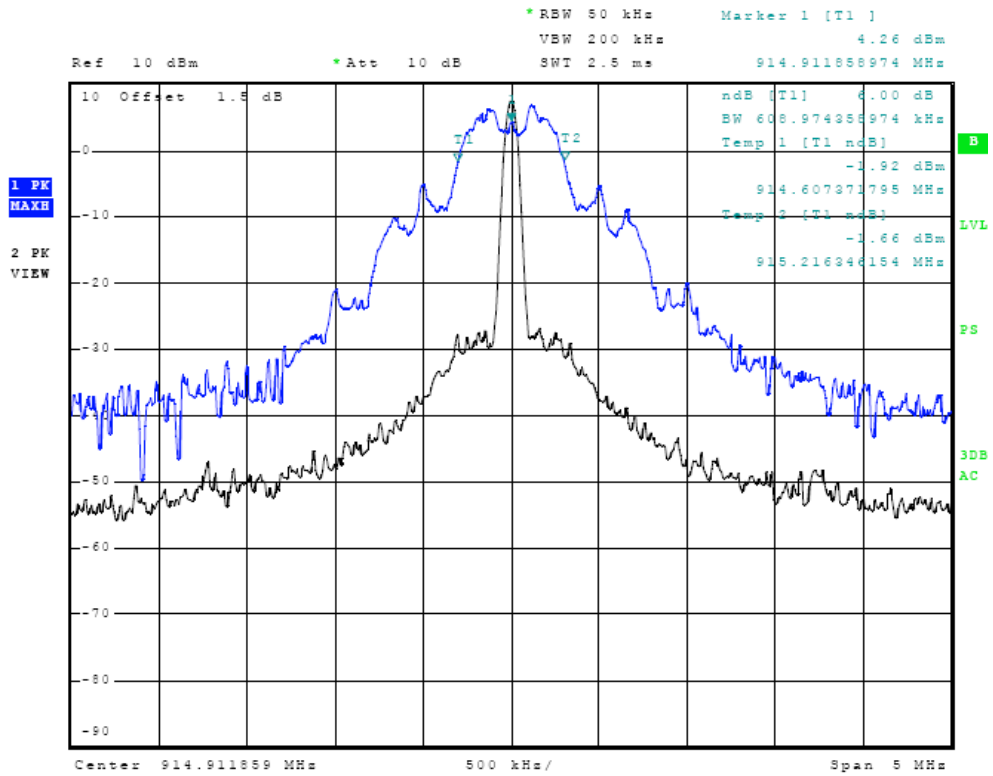


Figure Twenty-eight Plot of 6 dB Occupied Bandwidth (Digital Modulation)

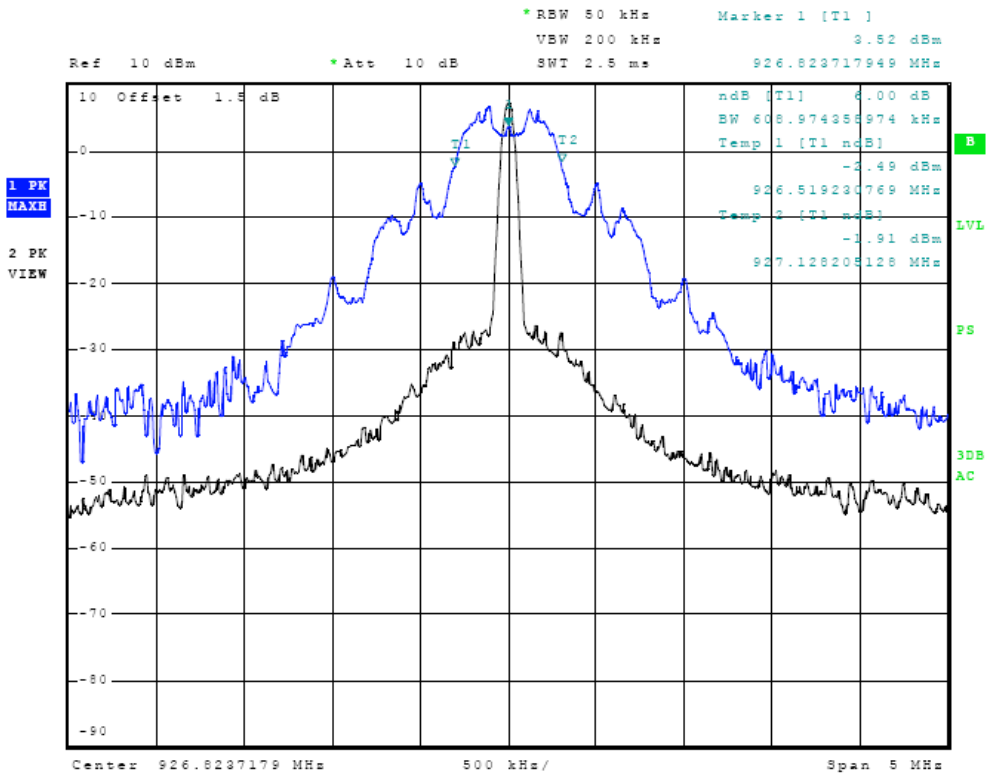


Figure Twenty-nine Plot of 6 dB Occupied Bandwidth (Digital Modulation)

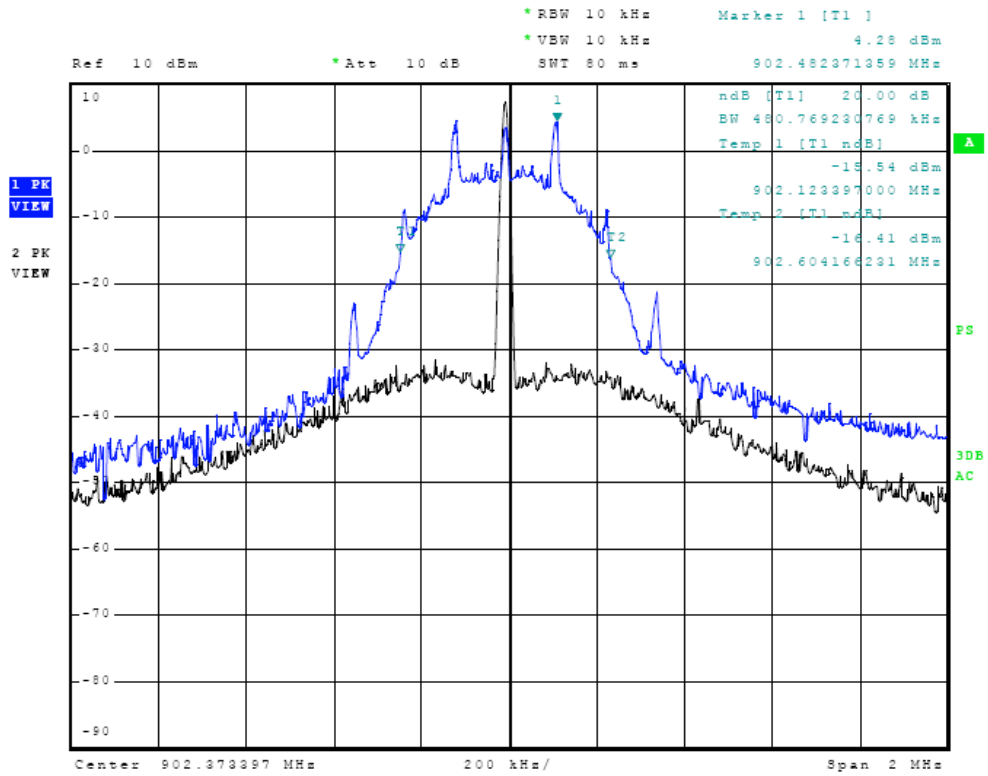


Figure Thirty Plot of 20 dB Occupied Bandwidth (FHSS)

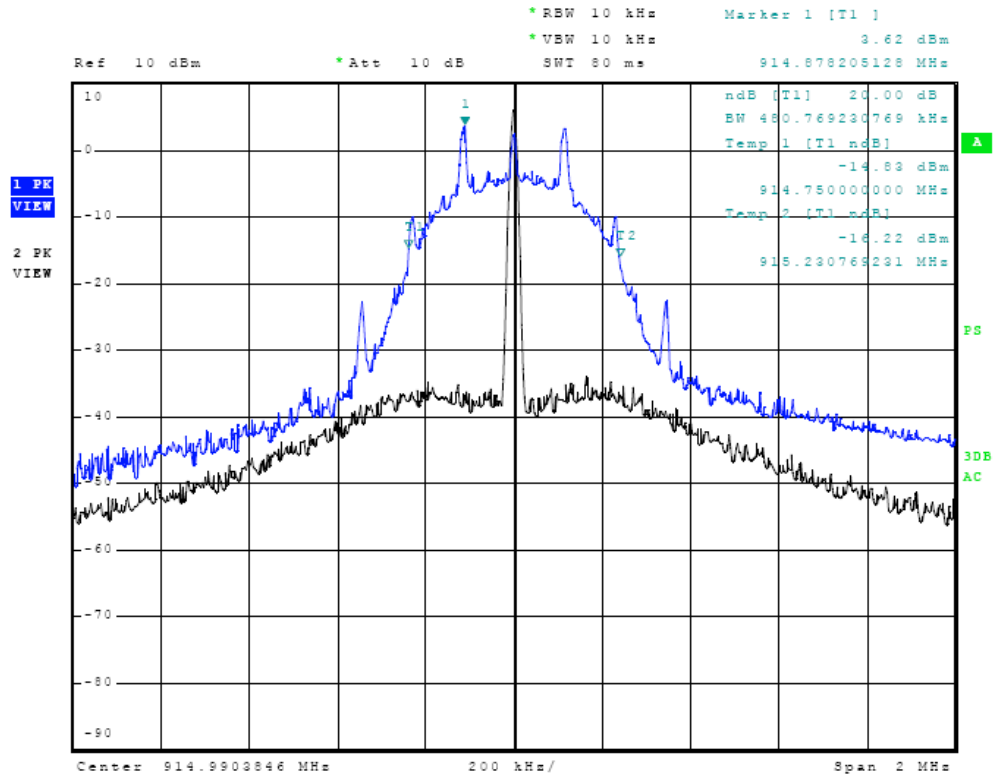


Figure Thirty-one Plot of 20 dB Occupied Bandwidth (FHSS)

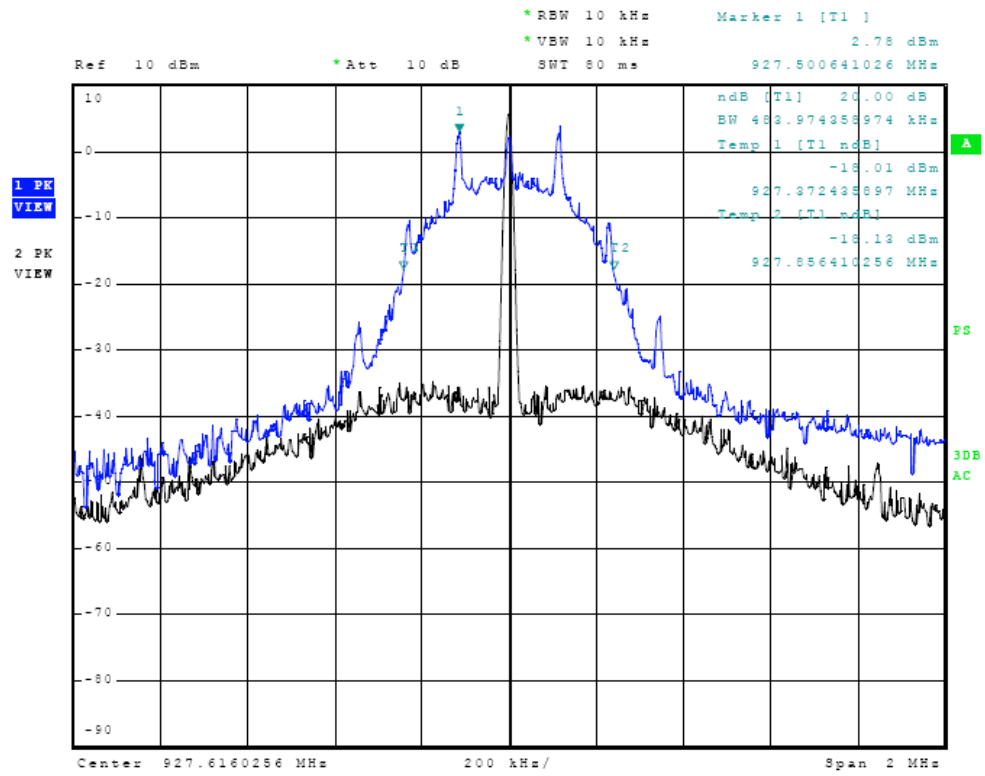


Figure Thirty-two Plot of 20 dB Occupied Bandwidth (FHSS)

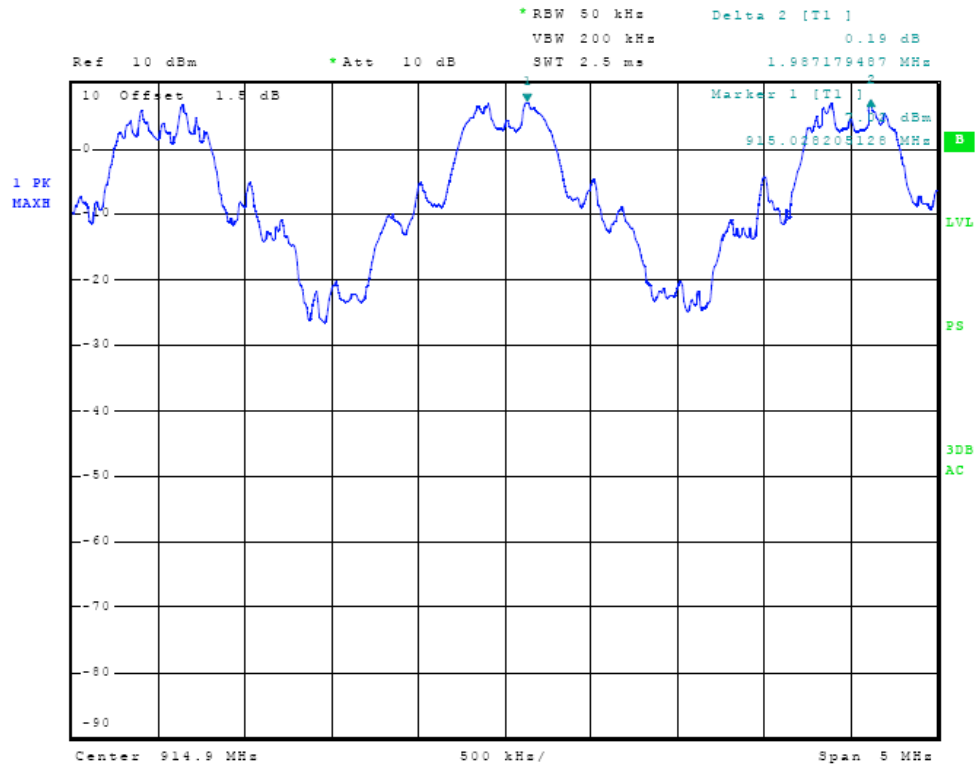


Figure Thirty-three Plot of Channel Spacing (Digital Modulation)

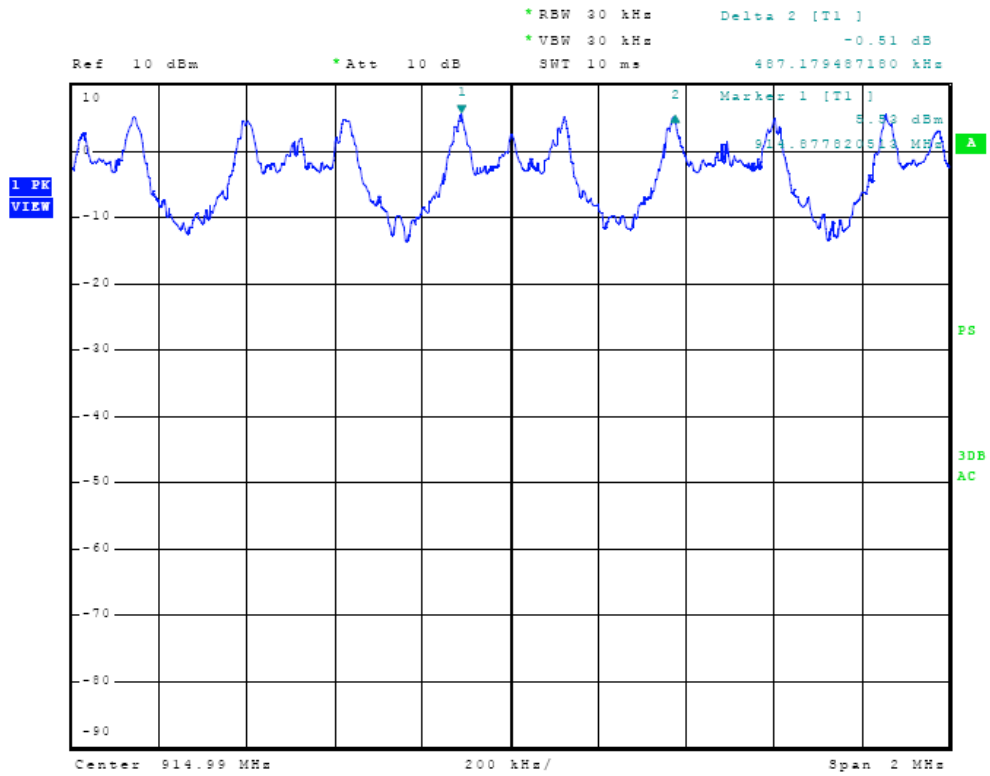


Figure Thirty-four Plot of Channel Spacing (FHSS)

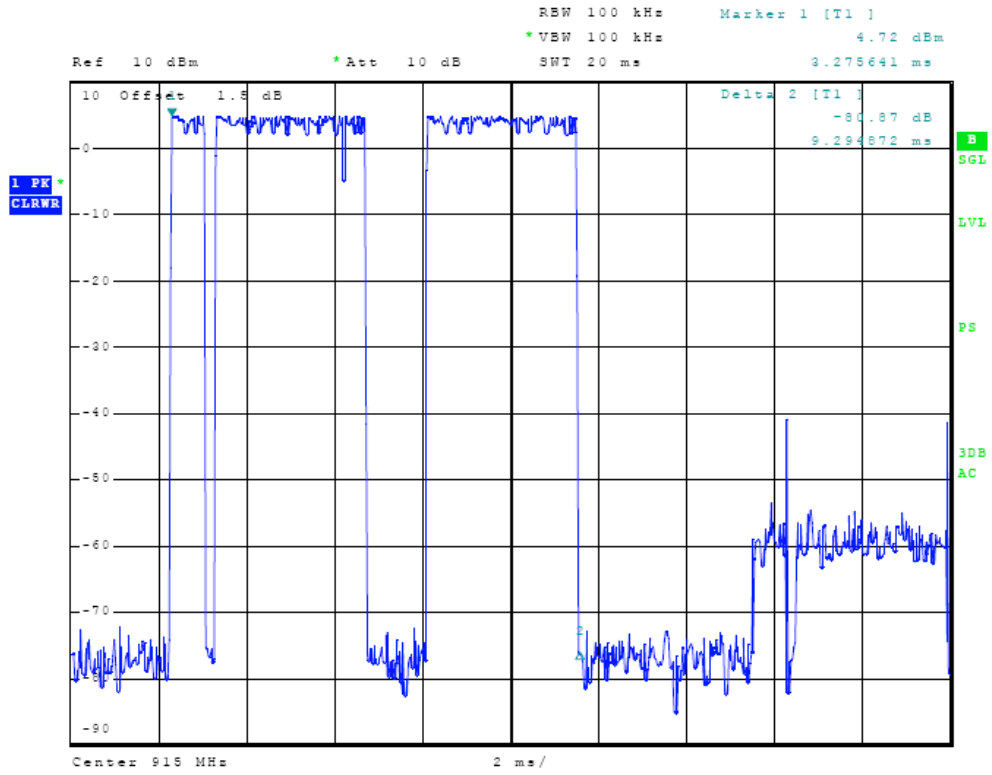


Figure Thirty-five Plot of Dwell time on Channel (FHSS)

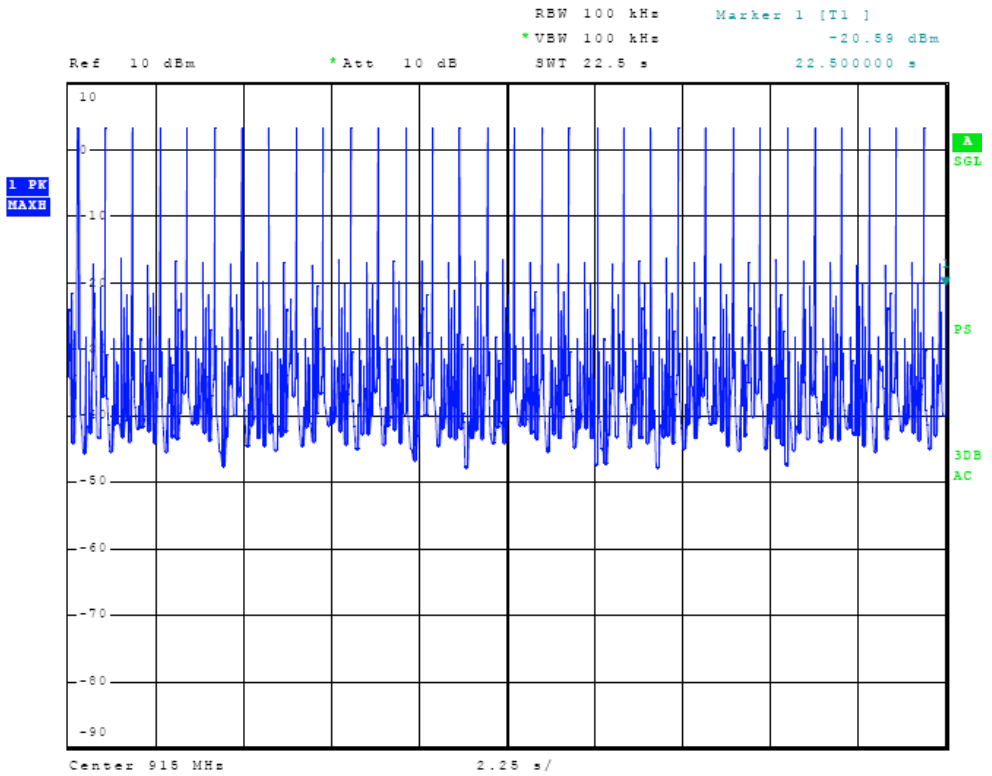


Figure Thirty-six Plot of Channel Occupancy (FHSS)

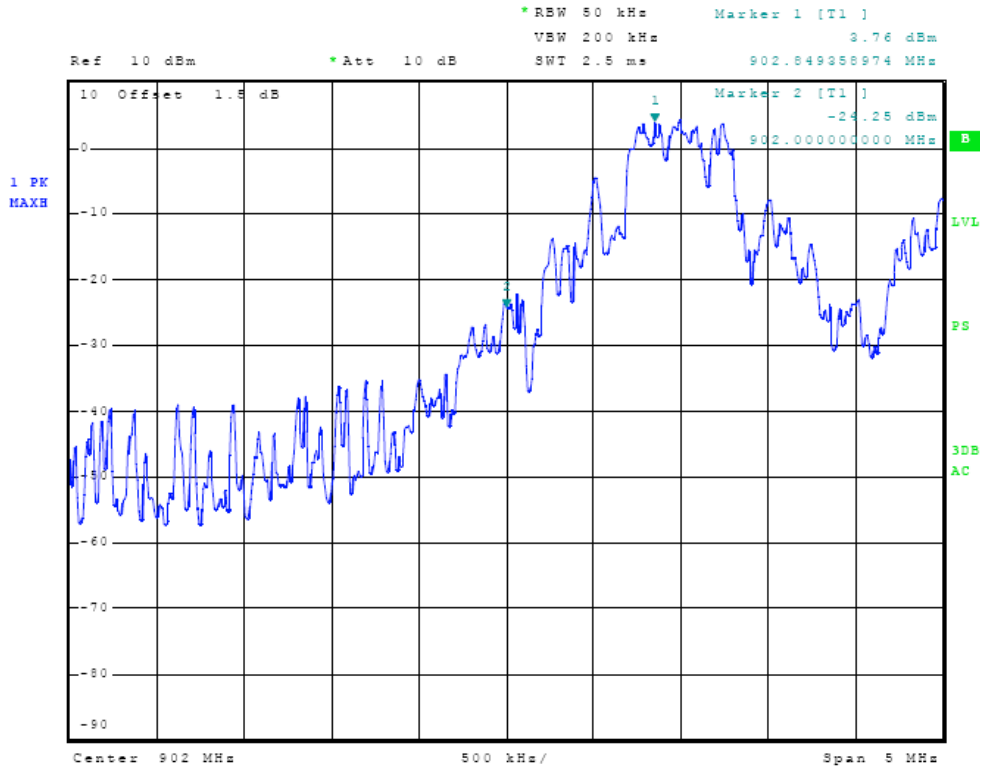


Figure Thirty-seven Plot of Low Band Edge (Digital Modulation)

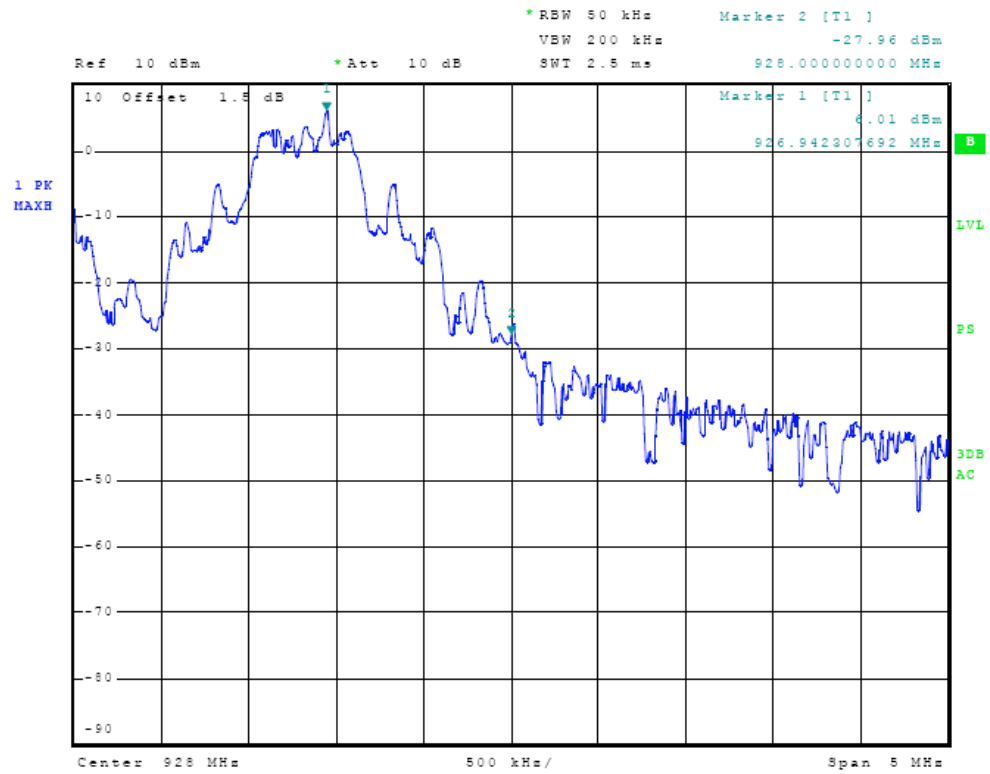


Figure Thirty-eight Plot of High Band Edge (Digital Modulation)

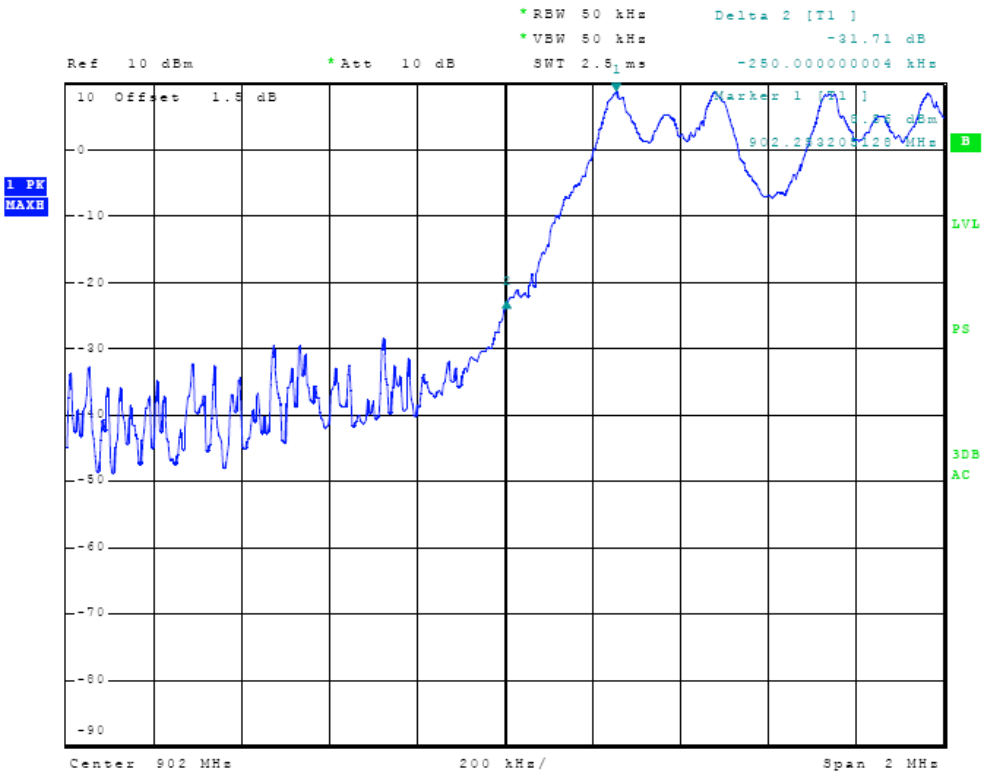


Figure Thirty-nine Plot of Low Band Edge (FHSS)

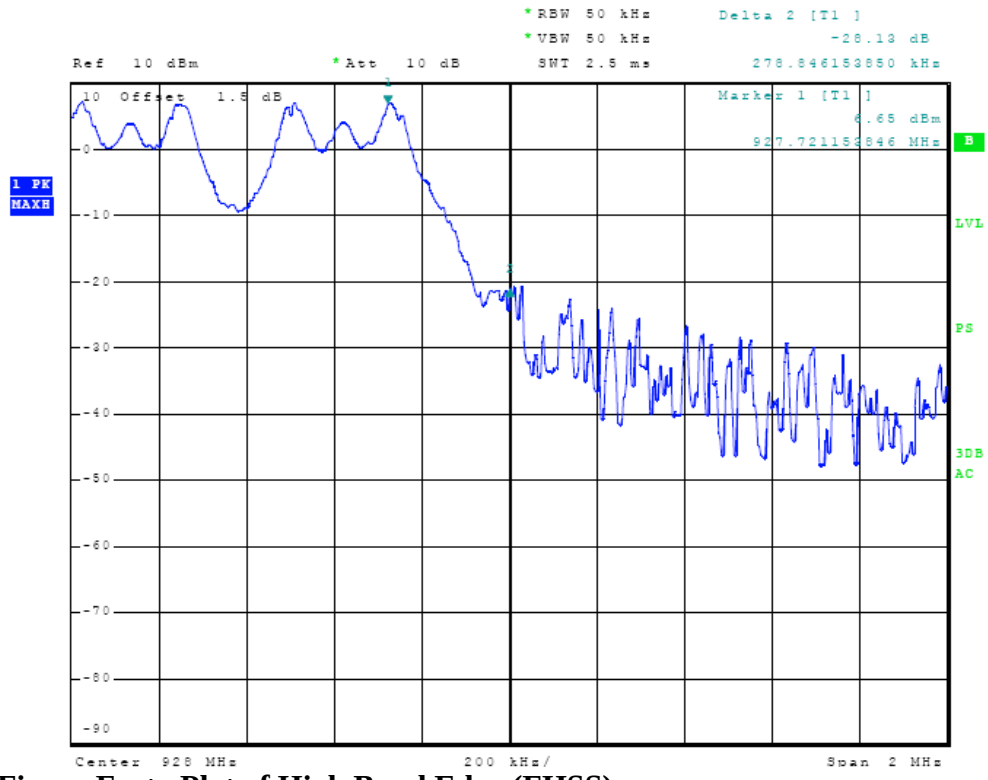


Figure Forty Plot of High Band Edge (FHSS)

Transmitter Radiated Emissions Data (2 dBi Dipole Antenna, Digital Modulation)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	65.0	79.8	23.3	0	88.3	103.1	--
1806.0	13.5	13.5	29.4	25	17.9	17.9	54.0
2709.0	13.7	15.0	34.3	25	23.0	24.3	54.0
3612.0	11.9	11.7	37.2	25	24.1	23.9	54.0
4515.0	13.2	13.1	41.9	25	30.1	30.0	54.0
914.9	68.0	79.7	23.4	0	91.4	103.1	--
1829.8	13.6	13.6	29.3	25	17.9	17.9	54.0
2744.7	14.1	14.5	34.3	25	23.4	23.8	54.0
3659.6	13.1	13.0	37.4	25	25.5	25.4	54.0
4574.5	13.0	12.9	42.7	25	30.7	30.6	54.0
926.8	65.9	79.2	23.4	0	89.3	102.6	--
1853.6	14.0	13.7	29.4	25	18.4	18.1	54.0
2780.4	14.5	14.4	34.3	25	23.8	23.7	54.0
3707.2	13.0	13.0	37.4	25	25.4	25.4	54.0
4634.0	14.0	14.0	42.8	25	31.8	31.8	54.0

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

Transmitter Radiated Emissions Data (SMT Chip antenna, Digital Modulation)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	77.4	64.2	23.3	0	100.7	87.5	--
1806.0	13.5	13.6	29.4	25	17.9	18.0	54.0
2709.0	13.8	13.9	34.3	25	23.1	23.2	54.0
3612.0	12.8	12.8	37.2	25	25.0	25.0	54.0
4515.0	13.3	13.3	41.9	25	30.2	30.2	54.0
914.9	77.2	64.8	23.4	0	100.6	88.2	--
1829.8	13.7	13.7	29.3	25	18.0	18.0	54.0
2744.7	14.0	14.1	34.3	25	23.3	23.4	54.0
3659.6	13.0	13.0	37.4	25	25.4	25.4	54.0
4574.5	13.8	13.7	42.7	25	31.5	31.4	54.0
926.8	77.5	62.4	23.4	0	100.9	85.8	--
1853.6	14.1	13.8	29.4	25	18.5	18.2	54.0
2780.4	14.4	14.4	34.3	25	23.7	23.7	54.0
3707.2	13.1	13.1	37.4	25	25.5	25.5	54.0
4634.0	14.3	14.4	42.8	25	32.1	32.2	54.0

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

Transmitter Radiated Emissions Data (9 dBi Omni Antenna, Digital Modulation)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	69.0	82.5	23.3	0	92.3	105.8	--
1806.0	13.9	13.8	29.4	25	18.3	18.2	54.0
2709.0	13.9	13.8	34.3	25	23.2	23.1	54.0
3612.0	12.6	12.6	37.2	25	24.8	24.8	54.0
4515.0	13.2	13.2	41.9	25	30.1	30.1	54.0
914.9	69.9	82.1	23.4	0	93.3	105.5	--
1829.8	13.3	13.3	29.3	25	17.6	17.6	54.0
2744.7	14.0	13.8	34.3	25	23.3	23.1	54.0
3659.6	12.9	12.8	37.4	25	25.3	25.2	54.0
4574.5	13.0	13.1	42.7	25	30.7	30.8	54.0
926.8	68.5	81.0	23.4	0	91.9	104.4	--
1853.6	13.5	13.4	29.4	25	17.9	17.8	54.0
2780.4	14.5	14.4	34.3	25	23.8	23.7	54.0
3707.2	13.3	13.0	37.4	25	25.7	25.4	54.0
4634.0	14.5	13.9	42.8	25	32.3	31.7	54.0

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

Transmitter Radiated Emissions Data (15 dBi Yagi Antenna, Digital Modulation)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	78.1	93.0	23.3	0	101.4	116.3	--
1806.0	13.4	13.5	29.4	25	17.8	17.9	54.0
2709.0	13.8	13.8	34.3	25	23.1	23.1	54.0
3612.0	11.8	11.6	37.2	25	24.0	23.8	54.0
4515.0	13.0	12.9	41.9	25	29.9	29.8	54.0
914.9	77.7	91.4	23.4	0	101.1	114.8	--
1829.8	13.7	13.6	29.3	25	18.0	17.9	54.0
2744.7	13.8	13.8	34.3	25	23.1	23.1	54.0
3659.6	12.6	12.6	37.4	25	25.0	25.0	54.0
4574.5	13.7	13.6	42.7	25	31.4	31.3	54.0
926.8	77.3	90.6	23.4	0	100.7	114.0	--
1853.6	15.2	13.2	29.4	25	19.6	17.6	54.0
2780.4	14.4	13.7	34.3	25	23.7	23.0	54.0
3707.2	13.1	13.0	37.4	25	25.5	25.4	54.0
4634.0	13.5	14.7	42.8	25	31.3	32.5	54.0

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

Transmitter Radiated Emissions Data (2 dBi Dipole Antenna, FHSS)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	71.5	79.2	23.3	0	94.8	102.5	--
1806.0	14.0	14.2	29.4	25	18.4	18.6	54.0
2709.0	14.0	14.7	34.3	25	23.3	24.0	54.0
3612.0	12.8	12.8	37.2	25	25.0	25.0	54.0
4515.0	12.4	12.3	41.9	25	29.3	29.2	54.0
915.0	69.3	78.9	23.4	0	92.7	102.3	--
1830.0	13.7	13.6	29.3	25	18.0	17.9	54.0
2745.0	13.8	13.9	34.3	25	23.1	23.2	54.0
3660.0	12.5	12.5	37.4	25	24.9	24.9	54.0
4575.0	13.4	13.5	42.7	25	31.1	31.2	54.0
927.6	69.2	78.1	23.4	0	92.6	101.5	--
1855.2	13.4	13.9	29.4	25	17.8	18.3	54.0
2782.8	14.3	14.1	34.3	25	23.6	23.4	54.0
3710.4	12.8	12.7	37.4	25	25.2	25.1	54.0
4638.0	13.4	13.5	42.8	25	31.2	31.3	54.0

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

Transmitter Radiated Emissions Data (SMT Chip antenna, FHSS)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	76.8	63.5	23.3	0	100.1	86.8	--
1806.0	13.8	13.8	29.4	25	18.2	18.2	54.0
2709.0	14.2	14.0	34.3	25	23.5	23.3	54.0
3612.0	12.4	12.5	37.2	25	24.6	24.7	54.0
4515.0	12.5	12.5	41.9	25	29.4	29.4	54.0
915.0	76.6	64.1	23.4	0	100.0	87.5	--
1830.0	13.6	13.6	29.3	25	17.9	17.9	54.0
2745.0	14.1	14.0	34.3	25	23.4	23.3	54.0
3660.0	12.9	12.8	37.4	25	25.3	25.2	54.0
4575.0	13.5	13.5	42.7	25	31.2	31.2	54.0
927.6	75.2	62.4	23.4	0	98.6	85.8	--
1855.2	13.3	13.3	29.4	25	17.7	17.7	54.0
2782.8	14.6	14.9	34.3	25	23.9	24.2	54.0
3710.4	13.2	13.1	37.4	25	25.6	25.5	54.0
4638.0	13.7	13.7	42.8	25	31.5	31.5	54.0

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

Transmitter Radiated Emissions Data (9 dBi Omni Antenna, FHSS)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	69.5	81.5	23.3	0	92.8	104.8	--
1806.0	13.7	14.0	29.4	25	18.1	18.4	54.0
2709.0	14.8	14.1	34.3	25	24.1	23.4	54.0
3612.0	12.6	12.6	37.2	25	24.8	24.8	54.0
4515.0	12.9	12.8	41.9	25	29.8	29.7	54.0
915.0	68.5	80.9	23.4	0	91.9	104.3	--
1830.0	13.7	13.7	29.3	25	18.0	18.0	54.0
2745.0	14.7	14.7	34.3	25	24.0	24.0	54.0
3660.0	13.1	13.1	37.4	25	25.5	25.5	54.0
4575.0	13.6	13.7	42.7	25	31.3	31.4	54.0
927.6	67.8	79.8	23.4	0	91.2	103.2	--
1855.2	13.9	13.3	29.4	25	18.3	17.7	54.0
2782.8	15.5	15.0	34.3	25	24.8	24.3	54.0
3710.4	13.2	13.3	37.4	25	25.6	25.7	54.0
4638.0	13.9	13.8	42.8	25	31.7	31.6	54.0

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

Transmitter Radiated Emissions Data (15 dBi Yagi Antenna, FHSS)

Frequency in MHz	FSM Horz. (dBµV)	FSM Vert. (dBµV)	A.F. (dB/m)	Amp. Gain (dB)	RFS Horz. @ 3m (dBµV/m)	RFS Vert. @ 3m (dBµV/m)	Limit @ 3m (dBµV/m)
903.0	75.1	94.7	23.3	0	98.4	118.0	--
1806.0	13.6	13.6	29.4	25	18.0	18.0	54.0
2709.0	13.8	16.1	34.3	25	23.1	25.4	54.0
3612.0	12.6	12.5	37.2	25	24.8	24.7	54.0
4515.0	12.6	12.6	41.9	25	29.5	29.5	54.0
915.0	72.7	93.6	23.4	0	96.1	117.0	--
1830.0	13.6	16.6	29.3	25	17.9	20.9	54.0
2745.0	14.1	16.0	34.3	25	23.4	25.3	54.0
3660.0	13.1	13.1	37.4	25	25.5	25.5	54.0
4575.0	13.7	13.7	42.7	25	31.4	31.4	54.0
927.6	68.6	92.2	23.4	0	92.0	115.6	--
1855.2	14.3	14.0	29.4	25	18.7	18.4	54.0
2782.8	14.4	17.3	34.3	25	23.7	26.6	54.0
3710.4	13.1	13.2	37.4	25	25.5	25.6	54.0
4638.0	13.8	13.8	42.8	25	31.6	31.6	54.0

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

Transmitter Antenna Conducted Emissions Data

The antenna conducted output power, power spectral density, dwell time on channel, and 6-dB bandwidth for digital modulation equipment and 20-dB bandwidth for FHSS equipment were measured while operating in available modes. The data reported below represents the worst-case operational conditions.

Digital Modulation

Frequency MHz	Antenna Conducted Output Power dBm	Antenna Conducted Output Power mW	Power Spectral Density (dBm)	Occupied Bandwidth kHz
903.0	8.61	7.26	-0.77	616.987
914.9	7.41	5.51	-2.27	608.974
926.8	7.20	5.25	-2.60	608.974

FHSS

Frequency MHz	Antenna Conducted Output Power dBm	Antenna Conducted Output Power mW	Dwell time on channel (mS)	Occupied Bandwidth kHz
902.3	8.77	7.53	9.3	480.769
915.0	7.76	5.97	9.3	480.769
927.6	6.87	4.86	9.3	483.974

Summary of Results for Radiated Emissions of Intentional Radiator

The EUT demonstrated maximum antenna conducted output power of 8 milliwatts (at antenna port) and highest radiated emission of 118.0 dBµV/m at 3 meters. The EUT demonstrated a worst-case of 21.5 dB margin below the limit for harmonic emissions. The EUT demonstrated compliance with the radiated emissions requirements for CFR 47 Part 15.247 and RSS-210 Intentional Radiators. There are no 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. The EUT demonstrated compliance with the specifications of 15.247 and RSS-210. There were no deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the CFR 47 Part 15C and RSS-210 emissions standards. There were no deviations to the specifications.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B 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

Radiated Emissions Measurement Uncertainty Calculation

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

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

Combined standard uncertainty $u_c(y)$ is

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

$U_c(y) = \pm 1.6$ dB

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

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

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

Notes:

1.1 Uncertainties for the antenna and cable were estimated, based on a normal probability distribution with k = 2.

1.2 The receiver uncertainty was obtained from the manufacturer's specification for which a rectangular distribution was assumed.

1.3 The antenna factor uncertainty does not take account of antenna directivity.

1.4 The antenna factor varies with height and since the height was not always the same in use as when the antenna was calibrated an additional uncertainty is added.

1.5 The uncertainty in the measurement distance is relatively small but has some effect on the received signal strength. The increase in measurement distance as the antenna height is increased is an inevitable consequence of the test method and is therefore not considered a contribution to uncertainty.

1.6 Site imperfections are difficult to quantify but may include the following contributions:
-Unwanted reflections from adjacent objects.
-Ground plane imperfections: reflection coefficient, flatness, and edge effects.
-Losses or reflections from "transparent" cabins for the EUT or site coverings.
-Earth currents in antenna cable (mainly effect biconical antennas).

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

Conducted Measurements Uncertainty Calculation

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

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

Combined standard uncertainty $u_c(y)$ is

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

$U_c(y) = \pm 1.2$ dB

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

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

Annex B Test Equipment List For Rogers Labs, Inc.

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

List of Test Equipment	Calibration Date
Oscilloscope Scope: Tektronix 2230	2/10
Wattmeter: Bird 43 with Load Bird 8085	2/10
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/10
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/10
R.F. Generator: HP 606A	2/10
R.F. Generator: HP 8614A	2/10
R.F. Generator: HP 8640B	2/10
Spectrum Analyzer: Rohde & Schwarz ESU40	5/10
Spectrum Analyzer: HP 8562A, Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W HP Adapters: 11518, 11519, 11520	5/10
Spectrum Analyzer: HP 8591EM	5/10
Frequency Counter: Leader LDC825	2/10
Antenna: EMCO Biconilog Model: 3143	5/10
Antenna: EMCO Log Periodic Model: 3147	10/09
Antenna: Antenna Research Biconical Model: BCD 235	10/09
Antenna: EMCO Dipole Set 3121C	2/10
Antenna: C.D. B-101	2/10
Antenna: Solar 9229-1 & 9230-1	2/10
Antenna: EMCO 6509	2/10
Audio Oscillator: H.P. 201CD	2/10
R.F. Power Amp 65W Model: 470-A-1010	2/10
R.F. Power Amp 50W M185- 10-501	2/10
R.F. PreAmp CPPA-102	2/10
LISN 50 µHy/50 ohm/0.1 µf	10/09
LISN Compliance Eng. 240/20	2/10
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/10
Peavey Power Amp Model: IPS 801	2/10
Power Amp A.R. Model: 10W 1010M7	2/10
Power Amp EIN Model: A301	2/10
ELGAR Model: 1751	2/10
ELGAR Model: TG 704A-3D	2/10
ESD Test Set 2010i	2/10
Fast Transient Burst Generator Model: EFT/B-101	2/10
Current Probe: Singer CP-105	2/10
Current Probe: Solar 9108-1N	2/10
Field Intensity Meter: EFM-018	2/10
KEYTEK Ecat Surge Generator	2/10

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 17 years experience in the field of electronics. Six years working in the automated controls industry and 6 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

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

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

May 18, 2010

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: May 18, 2010

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

May 26, 2010

OUR FILE: 46405-3041
Submission No: 140719

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

Attention: Mr. Scot D. Rogers

Dear Sir/Madame:

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

- Your primary code is: **3041**

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

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

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

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

Yours sincerely,

Dalwinder Gill

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