

SUBMITTAL APPLICATION REPORT

FOR
FCC And INDUSTRY CANADA
GRANT OF CERTIFICATION

FOR

Model: XT50 Transceiver
902 - 928 MHz FHSS Transmitter

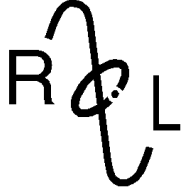
FCC ID: CCKPC0096
IC: 5251A-PC0096

FOR

DIGITAL MONITORING PRODUCTS, INC.
2500 North Partnership Boulevard
Springfield, MO 65802-6310

Test Report Number: 080529

Authorized Signatory: *Scot D Rogers*
Scot D. Rogers




ROGERS LABS, INC.

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**ENGINEERING TEST REPORT
FOR
APPLICATION of
GRANT of CERTIFICATION
FOR
CFR47, PART 15C - INTENTIONAL RADIATORS
Paragraph 15.247 and Industry Canada, RSS-210
Frequency Hopping Spread Spectrum Transmitter
For
DIGITAL MONITORING PRODUCTS, INC.
2500 North Partnership Boulevard
Springfield, MO 65802-6310
Terry Shelton,**

Model: XT50 Transceiver
Frequency 902-928 MHz
FCC ID#: CCKPC0096, IC: 5251A-PC0096

Test Date: May 29, 2008

Certifying Engineer: 
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Table of Contents

TABLE OF CONTENTS..... 3

FORWARD 5

OPINION / INTERPRETATION OF RESULTS 5

ENVIRONMENTAL CONDITIONS..... 5

2.1033(B) APPLICATION FOR CERTIFICATION 6

APPLICABLE STANDARDS & TEST PROCEDURES 7

EQUIPMENT TESTED 7

EQUIPMENT FUNCTION AND TESTING PROCEDURES 7

EQUIPMENT AND CABLE CONFIGURATIONS 8

 AC Line Conducted Emission Test Procedure8

 Radiated Emission Test Procedure.....8

UNITS OF MEASUREMENTS 8

TEST SITE LOCATIONS 8

LIST OF TEST EQUIPMENT 9

SUBPART B – UNINTENTIONAL RADIATORS 10

 Figure one Conducted Emissions of Line 1 Taken in the Screen Room11

 Figure two Conducted Emissions of Line 2 Taken in the Screen Room11

Radiated EMI12

 Figure three Plot of General Radiated Emissions13

 Figure four Plot of General Radiated Emissions13

 Figure five Plot of General Radiated Emissions14

 Figure six Plot of General Radiated Emissions14

 Figure seven Plot of General Radiated Emissions15

Conducted Emissions Data (7 Highest Emissions)15

 General Radiated Emissions Data from EUT16

Summary of Results for Conducted Emissions16

Summary of Results for Radiated Emissions16

Statement of Modifications and Deviations17

SUBPART C - INTENTIONAL RADIATORS 17

15.203 Antenna Requirements17

15.205 Restricted Bands of Operation.....17

 Radiated Emissions Data in Restricted Bands (15.205)18

Summary of Results for Radiated Emissions in Restricted Bands18

15.209 Radiated Emissions Limits; General Requirements19

 Radiated EMI.....19

 General Radiated Emissions Data from EUT (15.209)20

Summary of Results for Radiated Emissions20



15.247 Operation in the Band 902-928 MHz21

Figure eight Plot of output Power and number of channels in band24

Figure nine Plot of Occupied Bandwidth low frequency24

Figure ten Plot of Occupied Bandwidth middle frequency25

Figure eleven Plot of Occupied Bandwidth high frequency.....25

Figure twelve Plot of Channel Spacing26

Figure thirteen Plot of Dwell Time on channel26

Figure fourteen Plot of Channel Occupancy over 20-second period.....27

Figure fifteen Plot of lower frequency band edge27

Figure sixteen Plot of higher frequency band edge28

Radiated Emissions Data per 15.24729

Summary of Results for Radiated Emissions of Intentional Radiator30

Statement of Modifications and Deviations30

ANNEX..... 31

Annex A Measurement Uncertainty Calculations.....32

Annex B Test Equipment List For Rogers Labs, Inc.....34

Annex C Qualifications.....35

Annex D FCC Site Approval Letter36



Forward

The following information is submitted for consideration in obtaining a Grant of Certification for a frequency hopping spread spectrum intentional radiator operating under CFR47 Paragraph 15.247 and Industry Canada standard RSS-210.

Name of Applicant:

Digital Monitoring Products, Inc.

2500 North Partnership Boulevard

Springfield, MO 65802-6310

Model: XT50 Transceiver wireless transceiver.

FCC I.D.: CCKPC0096 IC: 5251A-PC0096

Frequency Range: 902-928 MHz.

Operating Power: 11 dBm antenna port conducted power, 105.6 dBµV/m @ 3-meters (3-meter radiated measurement).

Opinion / Interpretation of Results

Tests Performed	Results
Emissions Tests	
Emissions as per CFR47 paragraphs 2 and 15.205	Complies
Emissions as per CFR47 paragraphs 2 and 15.209	Complies
Emissions as per CFR47 paragraphs 2 and 15.247	Complies

Environmental Conditions

Ambient Temperature	22.8° C
Relative Humidity	49%
Atmospheric Pressure	30.22 in Hg

2.1033(b) Application for Certification

- (1) Manufacturer: Digital Monitoring Products, Inc.
2500 North Partnership Boulevard
Springfield, MO 65802-6310
- (2) Identification: Model: XT50 Wireless Transceiver
FCC I.D.: CCKPC0096
IC: 5251A-PC0096
- (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) No Peripheral Equipment was Necessary.
- (9) Transition Provisions of 15.37 are not being requested.
- (10) Equipment is not a scanning receiver and this section is not applicable.
- (11) The equipment does not operate in the 59 – 64 GHz frequency band and this section is not applicable.
- (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, 2007, 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 standard 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 and/or TIA/EIA 603-1.

Equipment Tested

<u>Equipment</u>	<u>Model</u>	<u>FCC ID</u>	<u>IC</u>
EUT	XT50	CCKPC0096	5251A-PC0096

Equipment Function and Testing Procedures

The EUT is a 902-928 MHz radio transmitter used to wirelessly interface with remote sensors offering state/alarm conditions for use in an alarm panel installation. The XT50 Transceiver is the central control panel used for interfacing alarm conditions in installation environments. The EUT communicates with remote sensors and other compliant equipment. The unit is marketed for use to incorporate a wireless link in an alarm system solution. Test software was installed in a test sample allowing for special testing requirements and purposes. The modified software allowed the transmitter to be set to transmit on channels dependant on activation of a temporary switch attached to the EUT. The unit operates from external AC power and incorporates connection to battery supply for power outage occurrences. The unit has provision to connect to external auxiliary equipment through relay point contacts or other complaint equipment.

Equipment and Cable Configurations

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions was performed as defined in section 7.2.4 of ANSI C63.4. The unit typically operates from the supplied AC power adapter offering provision to connect to utility power. 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- μ Hy choke. EMI was coupled to the spectrum analyzer through a 0.1 μ F 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

Testing for the unintentional radiated emissions was performed as defined in section 8 of ANSI C63.4. 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. 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 exhibits for EUT placement.

Units of Measurements

Conducted EMI Data is in dB μ V; dB referenced to one microvolt.

Radiated EMI Data is in dB μ V/m; dB/m referenced to one microvolt per meter.

Test Site Locations

Conducted EMI The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 W. 259th Terrace, Louisburg, KS.

Radiated EMI The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 W. 259th Terrace,



Louisburg, KS.

Site Approval

Refer to Annex for FCC Site Registration Letter, # 90910

List of Test Equipment

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

HP 8591 EM ANALYZER SETTINGS		
CONDUCTED EMISSIONS		
RBW	AVG. BW	DETECTOR FUNCTION
9 kHz	30 kHz	Peak / Quasi Peak
RADIATED EMISSIONS		
RBW	AVG. BW	DETECTOR FUNCTION
120 kHz	300 kHz	Peak / Quasi Peak
HP 8562A ANALYZER SETTINGS		
RBW	VIDEO BW	DETECTOR FUNCTION
100 kHz	100 kHz	PEAK
1 MHz	1 MHz	Peak / Average

EQUIPMENT	MFG.	MODEL	CAL. DATE	DUE.
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/07	10/08
LISN	Comp. Design	1762	2/07	2/08
Antenna	ARA	BCD-235-B	10/07	10/08
Antenna	EMCO	3147	10/07	10/08
Antenna	EMCO	3143	5/08	5/09
Analyzer	HP	8591EM	5/08	5/09
Analyzer	HP	8562A	5/08	5/09

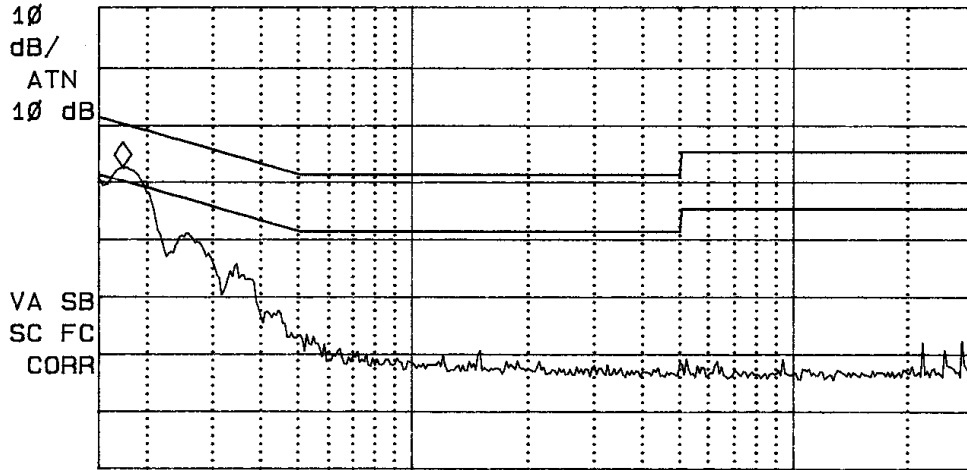
Subpart B – Unintentional Radiators

The unit typically receives power from the supplied AC power adapter offering provision to connect to utility power during operation. The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT and test system. Testing for the line-conducted emissions testing was as follows. The power line for the EUT 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 EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μ F capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. Plots were made of the frequency spectrum from 0.15 MHz to 30 MHz for the preliminary testing. Refer to figures one and two for plots of the EUT AC line conducted emissions frequency spectrum taken in the screen room.

MARKER
170 kHz
57.31 dB μ V

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 170 kHz
57.31 dB μ V

REF OFFST 7.0 dB
LOG REF 85.0 dB μ V



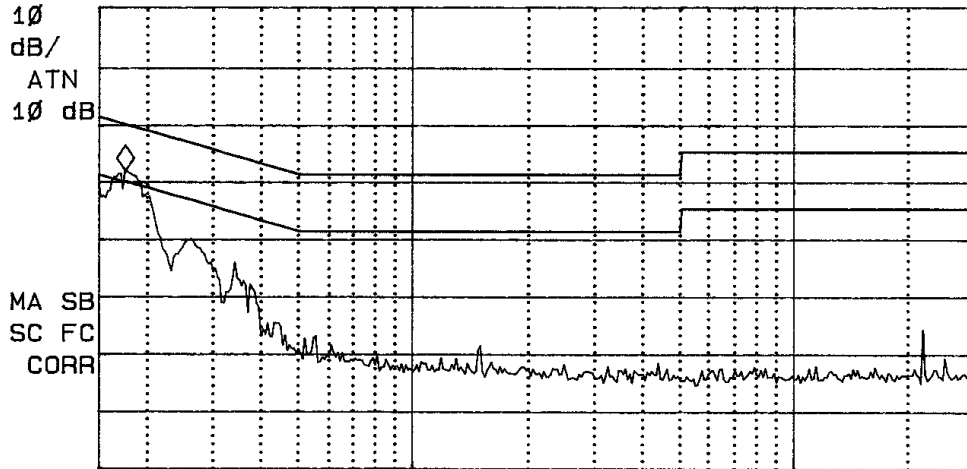
START 150 kHz STOP 30.00 MHz
#IF BW 9.0 kHz AVG BW 30 kHz SWP 1.40 sec

Figure one Conducted Emissions of Line 1 Taken in the Screen Room

MARKER
180 kHz
56.72 dB μ V

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 180 kHz
56.72 dB μ V

REF OFFST 7.0 dB
LOG REF 85.0 dB μ V



START 150 kHz STOP 30.00 MHz
#IF BW 9.0 kHz AVG BW 30 kHz SWP 1.40 sec

Figure two Conducted Emissions of Line 2 Taken in the Screen Room

Radiated EMI

The EUT was arranged in a typical equipment configuration and operated through all of its various modes. 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 frequency spectrum from 30 MHz to 12,000 MHz for the preliminary testing. Refer to figures three through seven showing plots of the radiated emissions spectrum taken in a screen room. 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 12,000 MHz was searched for 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 12 GHz, notch filters and appropriate amplifiers were utilized.

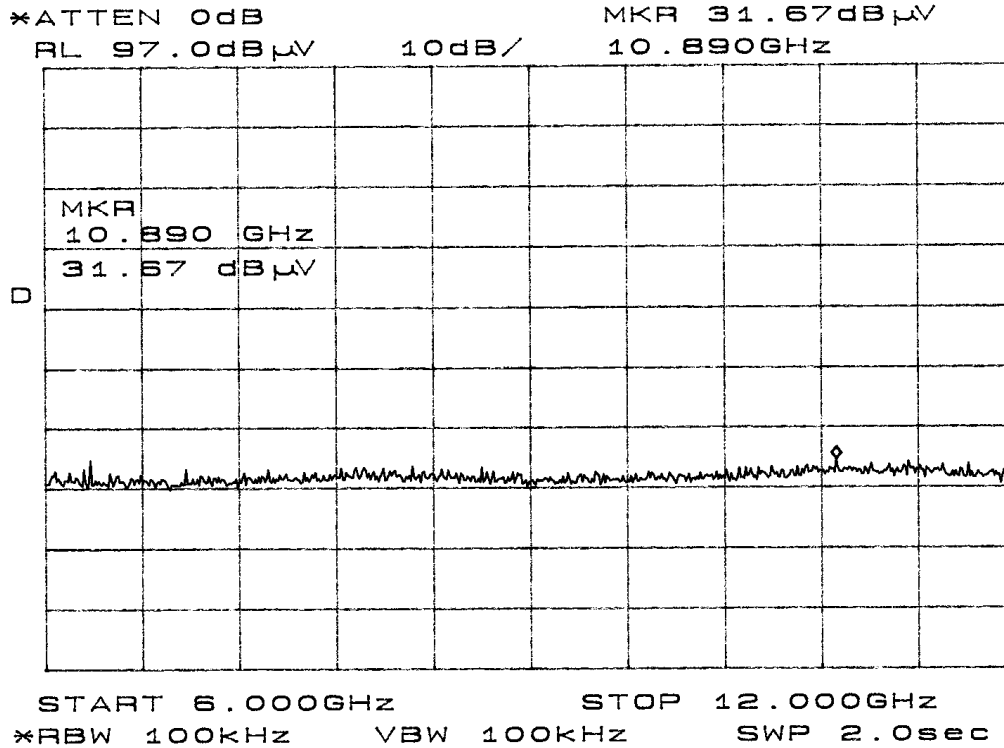


Figure seven Plot of General Radiated Emissions

Conducted Emissions Data (7 Highest Emissions)

Frequency band (MHz)	L1 Level (dBµV)			L2 Level (dBµV)			CISPR 22 Q.P./AVE Limit(dBµV)
	Peak	Q.P.	AVE	Peak	Q.P.	AVE	
0.15 - 0.5	57.3	50.6	20.7	56.7	50.1	20.3	66 / 56
0.5 - 5	30.9	22.1	13.4	26.9	24.3	20.6	56 / 46
5 - 10	20.6	16.3	10.0	20.8	16.4	10.4	60 / 50
10 - 15	21.1	16.2	9.8	21.7	16.2	9.9	60 / 50
15 - 20	21.1	15.8	9.6	21.2	16.1	9.6	60 / 50
20 - 25	27.4	24.5	21.9	29.7	27.2	25.4	60 / 50
25 - 30	29.0	26.3	24.1	20.8	16.0	9.8	60 / 50

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

General Radiated Emissions Data from EUT

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)
74.2	60.2	60.7	7.8	30	38.0	38.5	40.0
100.0	51.0	56.9	7.2	30	28.2	34.1	43.5
123.4	58.9	60.4	7.6	30	36.5	38.0	43.5
123.9	59.1	61.0	7.6	30	36.7	38.6	43.5
124.4	59.0	57.6	7.6	30	36.6	35.2	43.5
124.9	57.9	57.2	7.6	30	35.5	34.8	43.5
125.4	58.1	56.3	7.6	30	35.7	33.9	43.5
144.0	52.5	42.6	12.1	30	34.6	24.7	43.5
150.0	55.7	44.7	10.2	30	35.9	24.9	43.5
350.0	41.6	48.0	15.4	30	27.0	33.4	46.0
400.0	36.9	43.0	16.6	30	23.5	29.6	46.0
650.0	42.5	45.9	20.5	30	33.0	36.4	46.0

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

Summary of Results for Conducted Emissions

The conducted emissions for the EUT meet the requirements for CISPR 22, CFR47, and Industry Canada requirements. The XT50 test configuration had a 15.4 dB minimum margin below the CISPR quasi peak limit, and a 25.4 dB minimum margin below the CISPR average limit. Other emissions were present with recorded data representing the worst-case amplitudes.

Summary of Results for Radiated Emissions

The radiated emissions for the EUT meet the requirements for CISPR 22, CFR47, and Industry Canada requirements. The EUT had at least a 1.5 dB minimum margin below the limit. Other emissions were present with amplitudes at least 20 dB below the limit.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to meet the CISPR 22, CFR47, and Industry Canada requirements. There were no deviations or exceptions to the specifications.

Subpart C - Intentional Radiators

As per CFR47 Part 15, Subpart C, paragraphs 15.203, 15.205, 15.209, 15.247 and RSS-210 the following information is submitted.

15.203 Antenna Requirements

The equipment is professionally installed and maintained. The unit is produced with a unique antenna connection used by authorized service personnel and professional installers only. The equipment offers no provision for user service, replacement, or antenna modification. The requirements of 15.203 are fulfilled and there are no deviations or exceptions to the specification.

15.205 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:

$$\begin{aligned}
 \text{RFS (dB}\mu\text{V/m @ 3m)} &= \text{FSM(dB}\mu\text{V)} + \text{A.F.(dB)} - \text{Gain(dB)} \\
 &= 60.2 + 7.8 - 30 \\
 &= 38.0
 \end{aligned}$$

Radiated Emissions Data in Restricted Bands (15.205)

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)
74.2	60.2	60.7	7.8	30	38.0	38.5	40.0
123.4	58.9	60.4	7.6	30	36.5	38.0	43.5
123.9	59.1	61.0	7.6	30	36.7	38.6	43.5
124.4	59.0	57.6	7.6	30	36.6	35.2	43.5
124.9	57.9	57.2	7.6	30	35.5	34.8	43.5
125.4	58.1	56.3	7.6	30	35.7	33.9	43.5
150.0	55.7	44.7	10.2	30	35.9	24.9	43.5
400.0	36.9	43.0	16.6	30	23.5	29.6	46.0
2710.0	21.5	21.0	34.4	30	25.9	25.4	54.0
2745.0	23.3	22.1	34.3	30	27.6	26.4	54.0
2781.6	21.0	20.5	34.3	30	25.3	24.8	54.0
3613.4	20.0	18.7	37.5	30	27.5	26.2	54.0
3660.0	20.1	21.1	37.9	30	28.0	29.0	54.0
3708.6	20.8	19.7	38.4	30	29.2	28.1	54.0
4516.5	29.3	31.8	41.6	30	40.9	43.4	54.0
4575.0	29.3	31.8	41.6	30	40.9	43.4	54.0
4635.7	25.3	23.8	41.9	30	37.2	35.7	54.0

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

Summary of Results for Radiated Emissions in Restricted Bands

The radiated emissions for the EUT meet the requirements for FCC Part 15C Intentional Radiators. The EUT had a 1.5 dB minimum margin below the limits. Both average and peak amplitudes above 1000 MHz were checked for compliance with the regulations. No other

emissions where found in the restricted frequency bands. Other emissions were present with amplitudes at least 20 dB below the FCC Limits.

15.209 Radiated Emissions Limits; General Requirements

Radiated EMI

The EUT was arranged in a typical equipment configuration and operated through all of its various modes. 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. Emissions were checked in the screen room from 30 to 12,000 MHz and plots were made of the frequency spectrum from 30 MHz to 12,000 MHz for the preliminary testing. The highest radiated emission was then re-maximized at this location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the open area test site at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 30 MHz to 12,000 MHz was searched for 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 polarization between horizontal and vertical. Antennas used were Broadband Biconical from 30 MHz to 200 MHz, Biconilog from 30 MHz to 1000 MHz, Log Periodic from 200 MHz to 5 GHz, and/or Pyramidal Horns from 4 GHz to 12 GHz.

General Radiated Emissions Data from EUT (15.209)

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)
74.2	60.2	60.7	7.8	30	38.0	38.5	40.0
100.0	51.0	56.9	7.2	30	28.2	34.1	43.5
123.4	58.9	60.4	7.6	30	36.5	38.0	43.5
123.9	59.1	61.0	7.6	30	36.7	38.6	43.5
124.4	59.0	57.6	7.6	30	36.6	35.2	43.5
124.9	57.9	57.2	7.6	30	35.5	34.8	43.5
125.4	58.1	56.3	7.6	30	35.7	33.9	43.5
144.0	52.5	42.6	12.1	30	34.6	24.7	43.5
150.0	55.7	44.7	10.2	30	35.9	24.9	43.5
350.0	41.6	48.0	15.4	30	27.0	33.4	46.0
400.0	36.9	43.0	16.6	30	23.5	29.6	46.0
650.0	42.5	45.9	20.5	30	33.0	36.4	46.0

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

Summary of Results for Radiated Emissions

The radiated emissions for the EUT meet the requirements for CFR47 Part 15C, and Industry Canada requirements. The EUT had at least a 1.5 dB minimum margin below the limit. Other emissions were present with amplitudes at least 20 dB below the limit.

15.247 Operation in the Band 902-928 MHz

The power output was measured on an Open Area Test Site at a 3 meters distance. The EUT 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 and quasi-peak 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 eight through sixteen for plots of the spectrum analyzer display demonstrating compliance to the specifications. The EUT is a frequency hopping spread spectrum intentional radiator utilizing at least 50 hopping channels. Figure eight demonstrates antenna port power output and number of channels used in 902-928 MHz frequency band. Figures nine through eleven demonstrate occupied bandwidth at three frequencies in the 902-928 MHz band. The 20-dB bandwidth of 83 kHz complies with the requirement of less than 250 kHz wide and utilizing at least 50 hopping frequencies. Figure twelve demonstrates the 450 kHz channel spacing in the 902-928 MHz band. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a twenty-second-time period. Figures thirteen and fourteen demonstrate dwell time on channel and number of times on channel in a 20-second period. These plots demonstrate the 30.5 mS dwell time and twelve times on channel in a 20-second period. The dwell time on channel in a 20-second period may then be calculated as 396 mS ($30.5 \text{ ms} \times 13 = 396 \text{ mS}$). Information showing compliance for time of channel occupancy and hopping sequence are displayed below. For multiple systems to coexist properly, each system within range of another is assigned a unique number between 1 and 52. That number is multiplied by the hop sequence is modified by multiplying each hop number by a system number (1-52) and using that value modulo 61 as the hop number. For example, rather than hopping 0,1,2,3,4, a system with a system number of 3 would use hop sequence 0,3,6,9,12..., which would lead to the channel sequence 0, 27, 6, 1, 44... This allows up to 52 systems to coexist because of the unique hopping sequence of each.



Pseudorandom hopping sequence

The system53 hop channels. They are evenly spaced between 903.3257 MHz and 927.0271 MHz. They are listed, in order, below:

0	903.3257	1	911.4079	3	919.4901
1	903.7747	1	911.8569	3	919.9391
2	904.2237	2	912.3059	3	920.3881
3	904.6727	2	912.7549	3	920.8372
4	905.1217	2	913.2040	4	921.2862
5	905.5707	2	913.6530	4	921.7352
6	906.0198	2	914.1020	4	922.1842
7	906.4688	2	914.5510	4	922.6332
8	906.9178	2	915.0000	4	923.0822
9	907.3668	2	915.4490	4	923.5312
10	907.8158	2	915.8980	4	923.9802
11	908.2648	2	916.3470	4	924.4293
12	908.7138	3	916.7960	4	924.8783
13	909.1628	3	917.2451	4	925.3273
14	909.6119	3	917.6941	5	925.7763
15	910.0609	3	918.1431	5	926.2253
16	910.5099	3	918.5921	5	926.6743
17	910.9589	3	919.0411		

The order is determined by cycling through the numbers in order, and generating a channel number to use with the following equation:

$$\text{Channel \#} = \text{Hop XOR (Hop * 8) AND 0x3F}$$

If Channel > 5, try again

Where Hop is the sequence 0,1,2,3,4,5,6,7,8,9,10,11,5,0,1

This generates the channel number 0, 9, 18, 27, 36, 45, 67, 8, 1, 26, 19...

A complete cycle is as follows:

0	903.3257	2	904.2237	4	905.1217
9	907.3668	11	908.2648	13	909.1628
18	911.4079	52	926.6743	22	913.204
27	915.449	21	912.7549	31	917.2451
36	919.4901	38	920.3881	40	921.2862
45	923.5312	47	924.4293	33	918.1431
6	906.0198	24	914.102	42	922.1842
7	906.4688	17	910.9589	51	926.2253
8	906.9178	10	907.8158	12	908.7138
1	903.7747	3	904.6727	5	905.5707
26	915	28	915.898	30	916.796
19	911.8569	29	916.347	23	913.653
44	923.0822	46	923.9802	48	924.8783
37	919.9391	39	920.8372	49	925.3273
14	909.6119	32	917.6941	34	918.5921
15	910.0609	41	921.7352	43	922.6332
16	910.5099	50	925.7763	20	912.3059
25	914.551	35	919.0411		



The maximum peak output power of the unit was measured at the antenna port and OATS at a distance of three meters. The amplitudes of each emission and spurious emission were measured at a distance of 3 meters from the FSM antenna at the OATS. The amplitude of each emission 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, Log Periodic Antenna for 200 to 5000 MHz, and Pyramidal Horn Antennas from 4 GHz to 12 GHz. Emissions were measured in dB μ V/m at three meters. The amplitude of each measured emission 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 25 GHz. Emissions were measured in dB μ V/m @ 3 meters. The power output was measured at the antenna port and radiated emission at open area test site at a three-meter distance. Data was taken per Paragraph 2.1046(a), 15.247 and RSS-210. The 902 and 928 MHz band edges are protected due to the 903 – 927 MHz channels used for frequency of operation. Figures fifteen and sixteen demonstrate band edge compliance.

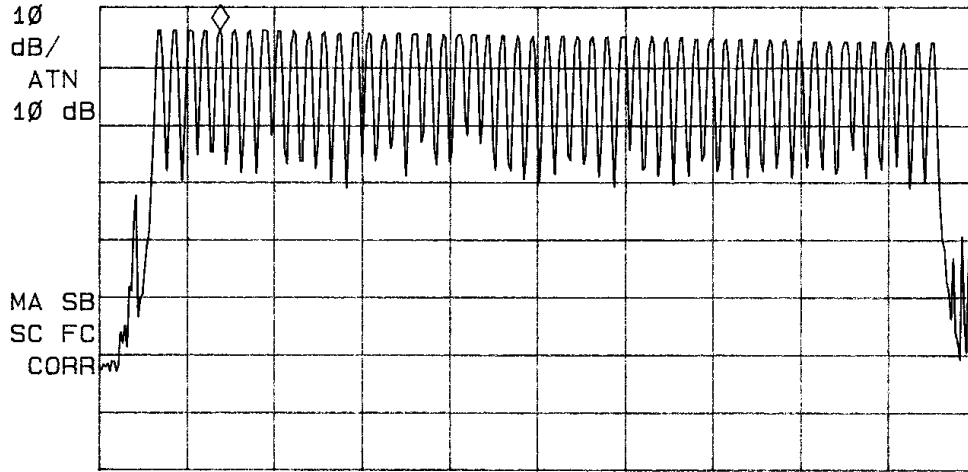
Sample Calculation

$$\begin{aligned} \text{RFS (dB}\mu\text{V/m @ 3m)} &= \text{FSM(dB}\mu\text{V)} + \text{A.F.(dB)} - \text{Gain(dB)} \\ &= 111.8 + 23.3 - 0 \\ &= 105.1 \end{aligned}$$

MARKER
905.14 MHz
6.02 dBm

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 905.14 MHz
6.02 dBm

REF OFFST 10.0 dB
LOG REF 10.0 dBm



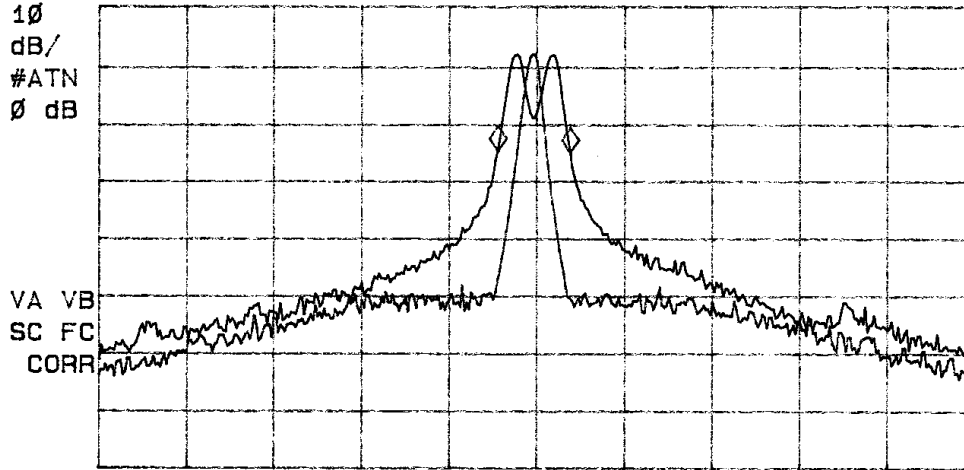
START 901.50 MHz STOP 928.00 MHz
#IF BW 120 kHz AVG BW 300 kHz SWP 20.0 msec

Figure eight Plot of output Power and number of channels in band

MARKER Δ
83 kHz
-.32 dB

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 83 kHz
-.32 dB

LOG REF 97.0 dBμV

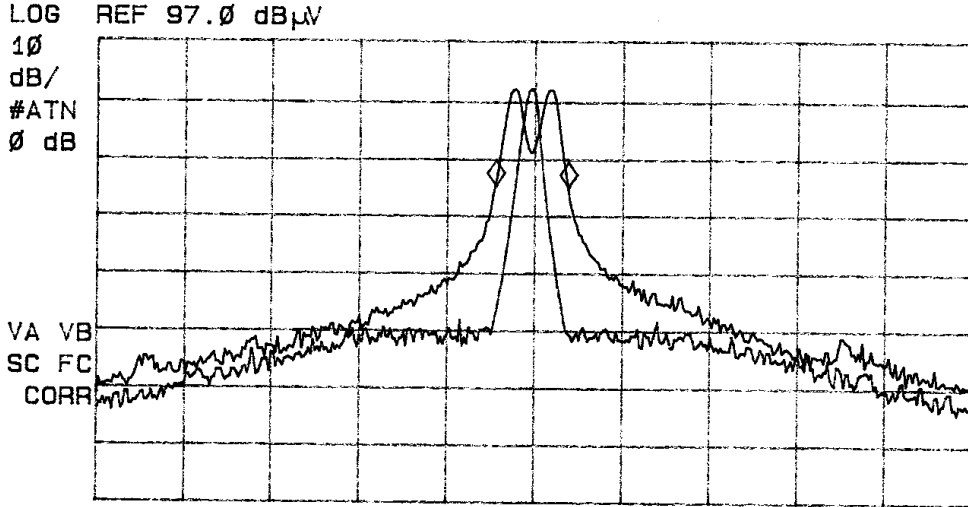


CENTER 903.333 MHz SPAN 1.000 MHz
#IF BW 10 kHz AVG BW 10 kHz SWP 30.0 msec

Figure nine Plot of Occupied Bandwidth low frequency

MARKER Δ
83 kHz
-.32 dB

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 83 kHz
-.32 dB

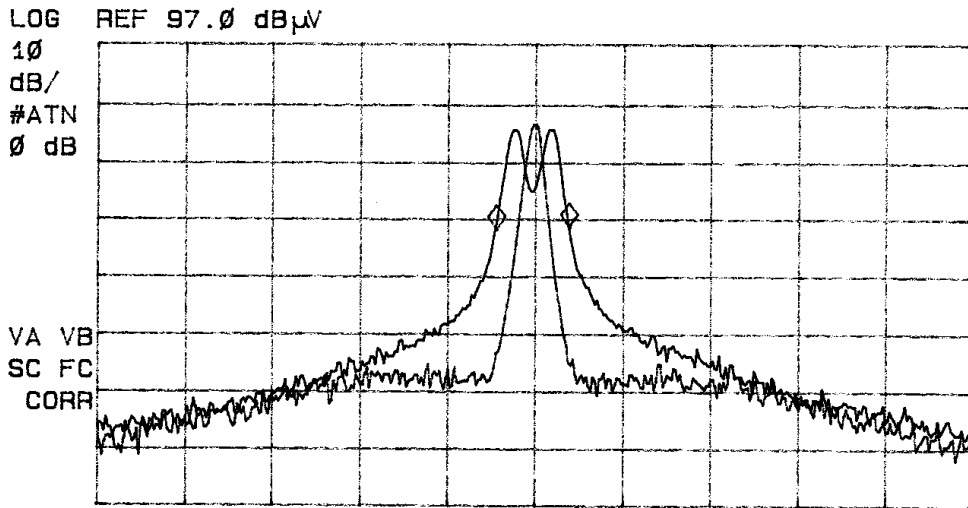


CENTER 915.880 MHz SPAN 1.000 MHz
#IF BW 10 kHz AVG BW 10 kHz SWP 30.0 msec

Figure ten Plot of Occupied Bandwidth middle frequency

MARKER Δ
83 kHz
.40 dB

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 83 kHz
.40 dB



CENTER 927.130 MHz SPAN 1.000 MHz
#IF BW 10 kHz AVG BW 10 kHz SWP 30.0 msec

Figure eleven Plot of Occupied Bandwidth high frequency

MARKER Δ
 450 kHz
 -.04 dB

ACTV DET: PEAK
 MEAS DET: PEAK QP
 MKR 450 kHz
 -.04 dB

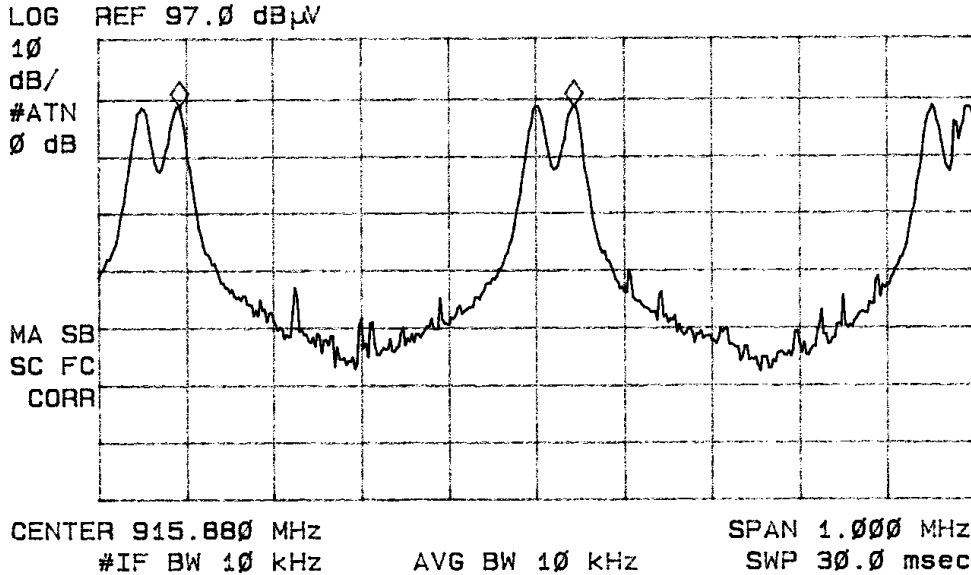


Figure twelve Plot of Channel Spacing

MARKER Δ
 30.500 msec
 -43.17 dB

ACTV DET: PEAK
 MEAS DET: PEAK QP
 MKR 30.500 msec
 -43.17 dB

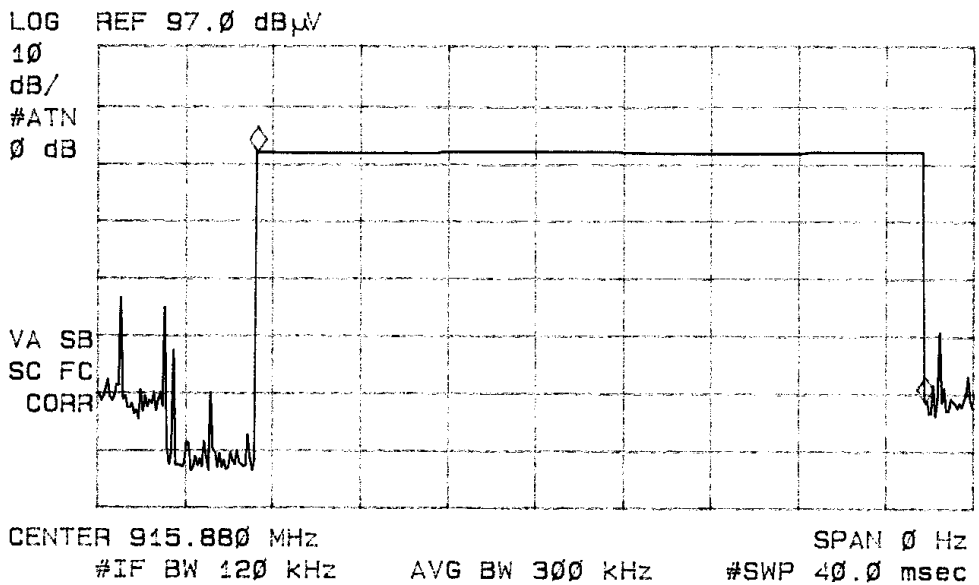


Figure thirteen Plot of Dwell Time on channel

MARKER
50.000 msec
83.27 dB μ V

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 50.000 msec
83.27 dB μ V

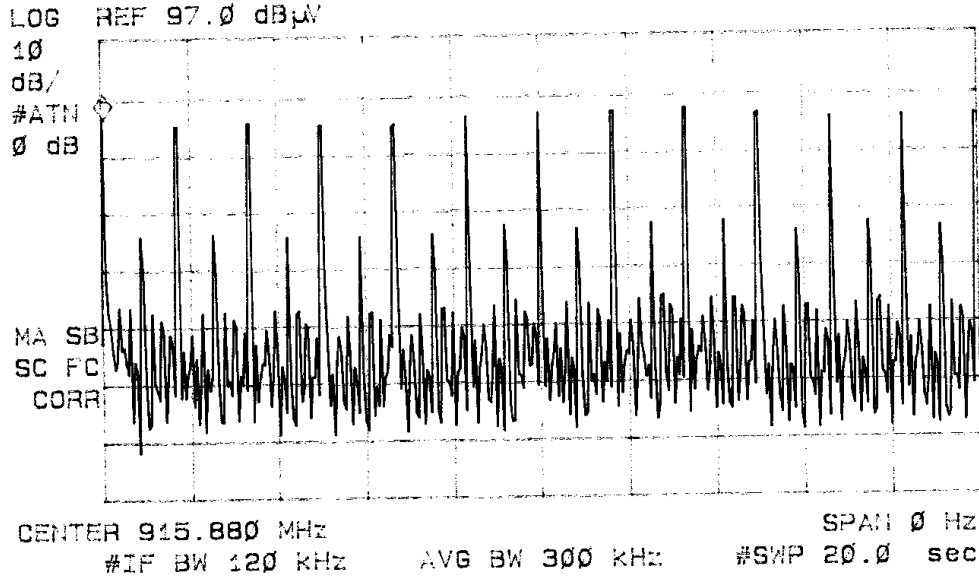


Figure fourteen Plot of Channel Occupancy over 20-second period

MARKER
903.313 MHz
86.00 dB μ V

ACTV DET: PEAK
MEAS DET: PEAK QP
MKR 903.313 MHz
86.00 dB μ V

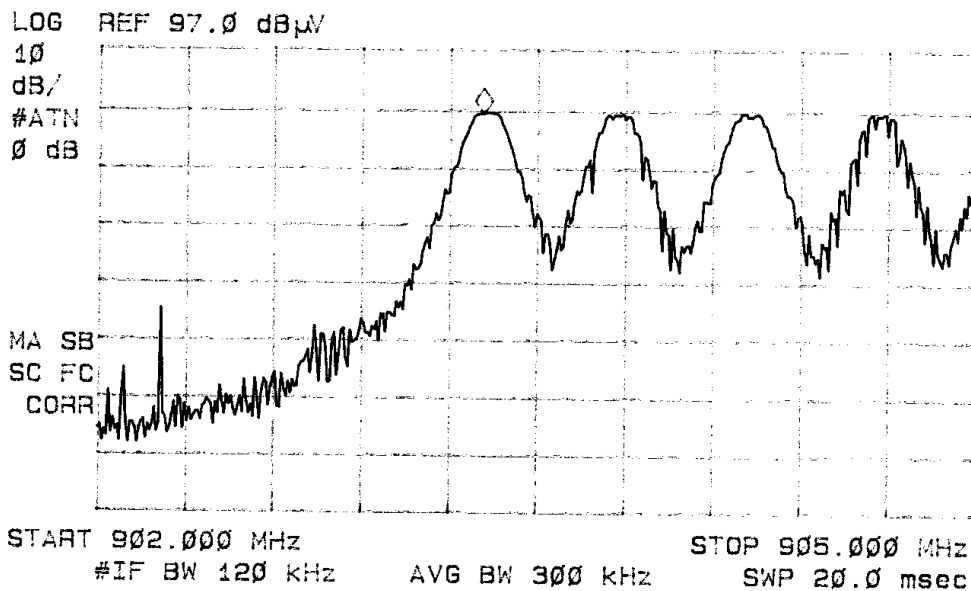


Figure fifteen Plot of lower frequency band edge

MARKER
 926.658 MHz
 81.81 dB μ V

ACTV DET: PEAK
 MEAS DET: PEAK QP
 MKR 926.658 MHz
 81.81 dB μ V

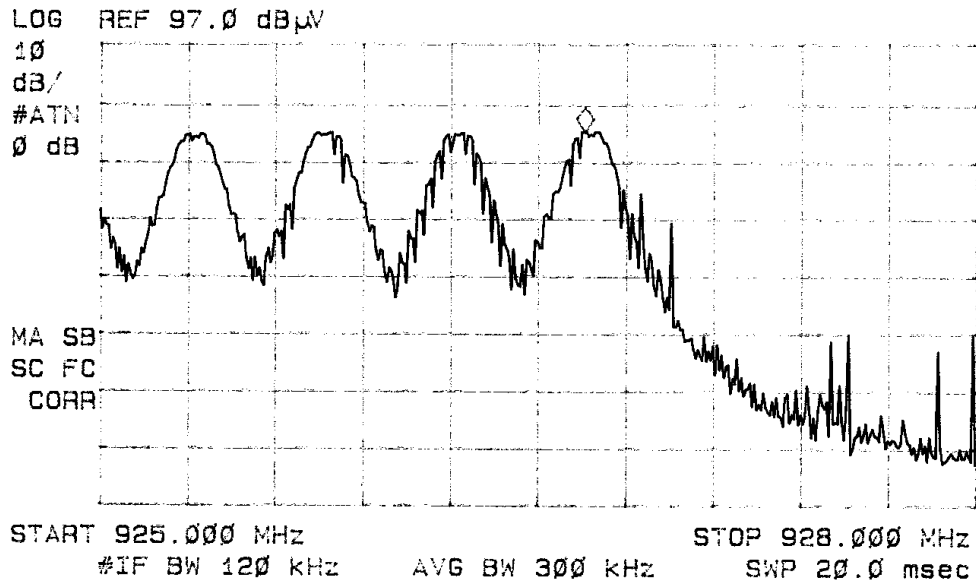


Figure sixteen Plot of higher frequency band edge

Radiated Emissions Data per 15.247

Emission Frequency (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)
903.4	108.8	112.3	23.3	30	102.1	105.6	125.2
1806.8	27.0	24.6	29.3	30	26.3	23.9	54.0
2710.2	21.5	21.0	34.4	30	25.9	25.4	54.0
3613.6	20.0	18.7	37.5	30	27.5	26.2	54.0
4517.0	23.8	23.8	41.1	30	34.9	34.9	54.0
915.9	108.0	111.2	23.3	30	101.3	104.5	125.2
1831.8	23.8	24.3	29.5	30	23.3	23.8	54.0
2747.7	23.3	22.1	34.3	30	27.6	26.4	54.0
3663.6	20.1	21.1	37.9	30	28.0	29.0	54.0
4579.5	29.3	31.8	41.6	30	40.9	43.4	54.0
927.0	107.9	111.1	23.5	30	101.4	104.6	125.2
1854.0	25.2	22.0	29.3	30	24.5	21.3	54.0
2781.0	21.0	20.5	34.3	30	25.3	24.8	54.0
3708.0	20.8	19.7	38.4	30	29.2	28.1	54.0
4635.0	25.3	23.8	41.9	30	37.2	35.7	54.0
Band Edge Compliance							
902.0	30.4	43	23.3	30	23.7	36.3	46.0
928.0	32.9	35.5	23.5	30	26.4	29.0	46.0

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

Summary of Results for Radiated Emissions of Intentional Radiator

The EUT had the highest emission of 105.6 dB μ V/m at 3 meters at the fundamental frequency of operation. The EUT had a worst-case of 10.6 dB margin below the limit for the harmonic emissions. The radiated emissions for the EUT meet the requirements for CFR47 Part 15.247 Intentional Radiators and RSS-210. 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 limits. The specifications of 15.247 and RSS-210 were met; there are no deviations or exceptions to the requirements.

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to meet the CFR47 Part 15C or RSS-210 emissions standards. There were no deviations to the specifications.



NVLAP Lab Code 200087-0

Annex

- Annex A, Measurement Uncertainty Calculations
- Annex B, Test Equipment List.
- Annex C, Rogers Qualifications.
- Annex D, FCC Site Approval 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

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

$$U_c(y) = \pm 1.6 \text{ dB}$$

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:

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

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

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

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

$$U_c(y) = \pm 1.2 \text{ dB}$$

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:

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



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	2/08
Wattmeter: Bird 43 with Load Bird 8085	2/08
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/08
H/V Power Supply: Fluke Model: 408B (SN: 573)	2/08
R.F. Generator: HP 606A	2/08
R.F. Generator: HP 8614A	2/08
R.F. Generator: HP 8640B	2/08
Spectrum Analyzer: HP 8562A,	5/08
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	
HP Adapters: 11518, 11519, 11520	
Spectrum Analyzer: HP 8591EM	5/08
Frequency Counter: Leader LDC825	2/08
Antenna: EMCO Biconilog Model: 3143	5/08
Antenna: EMCO Log Periodic Model: 3147	10/07
Antenna: Antenna Research Biconical Model: BCD 235	10/07
Antenna: EMCO Dipole Set 3121C	2/08
Antenna: C.D. B-101	2/08
Antenna: Solar 9229-1 & 9230-1	2/08
Antenna: EMCO 6509	2/08
Audio Oscillator: H.P. 201CD	2/08
R.F. Power Amp 65W Model: 470-A-1010	2/08
R.F. Power Amp 50W M185- 10-501	2/08
R.F. PreAmp CPPA-102	2/08
LISN 50 µHy/50 ohm/0.1 µf	10/07
LISN Compliance Eng. 240/20	2/08
LISN Fischer Custom Communications FCC-LISN-50-16-2-08	2/08
Peavey Power Amp Model: IPS 801	2/08
Power Amp A.R. Model: 10W 1010M7	2/08
Power Amp EIN Model: A301	2/08
ELGAR Model: 1751	2/08
ELGAR Model: TG 704A-3D	2/08
ESD Test Set 2010i	2/08
Fast Transient Burst Generator Model: EFT/B-101	2/08
Current Probe: Singer CP-105	2/08
Current Probe: Solar 9108-1N	2/08
Field Intensity Meter: EFM-018	2/08
KEYTEK Ecat Surge Generator	2/08
Shielded Room 5 M x 3 M x 3.0 M	

Annex C 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:

- 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



NVLAP Lab Code 200087-0

Annex D FCC Site Approval Letter

FEDERAL COMMUNICATIONS COMMISSION

Laboratory Division
7435 Oakland Mills Road
Columbia, MD 21046

May 16, 2006

Registration Number: 90910

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

Attention: Scot Rogers

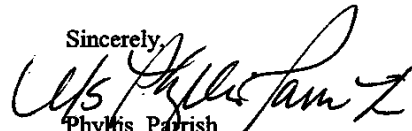
Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: May 16, 2006

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 Parish
Information Technician