

**SUBMITTAL  
APPLICATION  
REPORT  
FOR  
GRANT OF CERTIFICATION**

FOR

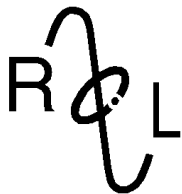
**Model: RouterBoard 951-2n  
2412-2462 MHz  
Broadband Digital Transmission System  
FCC ID: TV7RB951-2N**

FOR

**MIKROTIKLS SIA**  
Pernavas 46  
Riga, Latvia LV-1009

**Test Report Number: 120314**

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



## **ROGERS LABS, INC.**

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Louisburg, KS 66053  
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# Engineering Test Report For Grant of Certification Application

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

For

## **MIKROTIKLS SIA**

Pernavas 46  
Riga, Latvia LV-1009

Broadband Digital Transmission System  
Model: RouterBoard 951-2n  
Frequency Range 2412-2462 MHz  
FCC ID#: TV7RB951-2N

Test Date: March 14, 2012

Certifying Engineer: *Scot D. Rogers*

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## Forward

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator operating under CFR 47 Paragraph 15.247.

Name of Applicant: Mikrotiks SIA  
Pernavas 46  
Riga, Latvia LV-1009

Model: RouterBoard 951-2n

FCC I.D.: TV7RB951-2N FRN: 0014 43 1100

Frequency Range: 2412-2462 MHz (5, 10, 20 MHz channel operation), 2422-2452 MHz (40 MHz channel operation)

Operating Power: 0.063-Watts output power, 18 dBm

## Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Emissions as per CFR 47 paragraphs 2 and 15.205	-7.3	Complies
Emissions as per CFR 47 paragraphs 2 and 15.207	-16.4	Complies
Emissions as per CFR 47 paragraphs 2 and 15.209	-5.5	Complies
Harmonic Emissions per CFR 47 15.247	-7.3	Complies
Peak Power Spectral Density per CFR 47 15.247	-13.6	Complies

## Environmental Conditions

Ambient Temperature 21.2° C  
Relative Humidity 51%  
Atmospheric Pressure 1013.3 mb

## Equipment Tested

<u>Equipment</u>	<u>Model</u>	<u>FCC I.D.</u>
EUT	RouterBoard 951-2n	TV7RB951-2N
AC Adapter	NLB100120W1A	9551
Dell Studio XPS	921LBN1	N/A

## Application for Certification

- (1) Manufacturer: Mikrotiks SIA  
Pernavas 46  
Riga, Latvia LV-1009
- (2) Identification: Model: RouterBoard 951-2n  
  
FCC I.D.: TV7RB951-2N
- (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. The EUT offers connection ports for power and network interface only. During testing, the EUT was connected to CPU through network cable. The EUT received power supplied from external AC/DC adapter.
- (9) Transition Provisions of CFR47 15.37 are not requested.
- (10) Not Applicable. The unit is not a scanning receiver.
- (11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.
- (12) The equipment is not software defined and this section is not applicable.

## Applicable Standards & Test Procedures

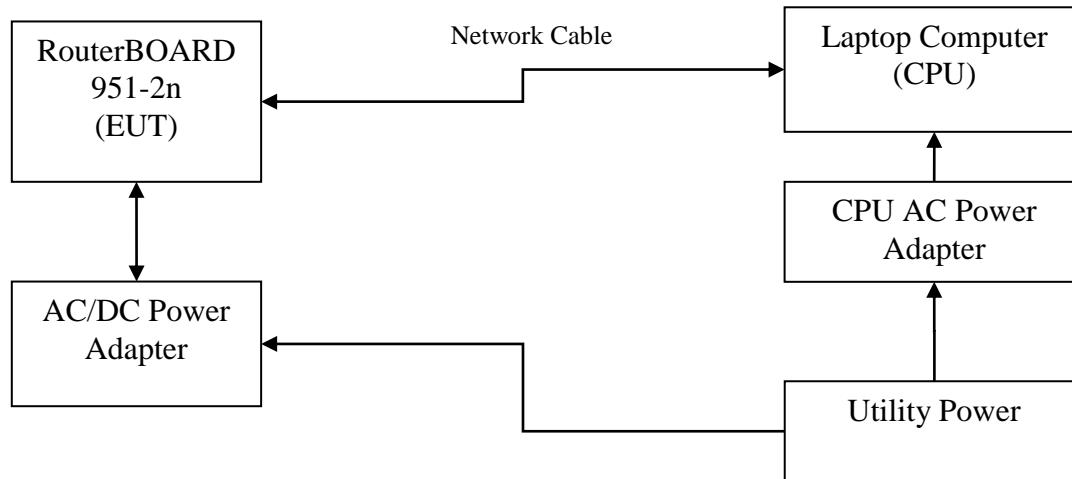
In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2011, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247 the following information is submitted.

Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2009 Document, FCC documents KDB 718828, KDB 558074, DA00-1407, and DA00-705. Testing for the AC line-conducted emissions were performed as defined in sections 7 and 13.1.3, testing of the radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4-2009. Testing of the intentional radiated emissions was performed as defined in section 13 of ANSI C63.4-2009.

## Equipment Function and Configuration

The EUT is a 2412-2462 MHz Digital Transmission System transmitters used to transmit data in applications offering broadband wireless connectivity. The equipment is marketed for use to incorporate a wireless link to exchange data information from one point to another. For testing purposes, the RouterBoard 951-2n transceiver was connected to the manufacturer supplied AC/DC power adapter and communicating to the laptop computer through network interface. This configuration offered operational control of the transmitter and communications over the network interface between the EUT and supporting computer system. The RouterBoard 951-2n receives power from the supplied AC/DC power adapter connected to utility power systems. The EUT offers connection port for power input and network interface only and requires power supplied from external source AC/DC adapter or POE, no other interfacing options are provided. For testing purposes, the RouterBoard 951-2n received powered from the AC/DC adapter and configured to transmit in available data modes. The device is produced with integral antenna system only. The antenna system complies with requirements for unique antenna connection port.

## Equipment Configuration



## 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. 259<sup>th</sup> 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. 259<sup>th</sup> Terrace, Louisburg, KS

**Site Registration**      Refer to Annex for Site Registration Letters

**NVLAP Accreditation**      Lab code 200087-0

## Units of Measurements

**Conducted EMI**      Data is in dB $\mu$ V; dB referenced to one microvolt

**Radiated EMI**      Data is in dB $\mu$ V/m; dB/m referenced to one microvolt per meter

**Sample Calculation:**

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses

$RFS \text{ (dB}\mu\text{V/m @ 3m)} = FSM \text{ (dB}\mu\text{V)} + A.F. \text{ (dB)} - \text{Gain (dB)}$





## **Test Procedures**

### ***AC Line Conducted Emission Test Procedure***

The EUT operates from DC power only and must be connected to an approved AC/DC adapter for operation. For testing purposes, the manufacturer supplied AC/DC power adapter was used to power the EUT and system. Testing for the AC line-conducted emissions testing was performed as defined in sections 7 and 13.1.3 of ANSI C63.4-2009. The test setup including the EUT was arranged in typical equipment configurations 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- $\mu$ Hy choke. EMI was coupled to the spectrum analyzer through a 0.1  $\mu$ 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***

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 required by CFR47 15 and specified in sections 8 and 13.1.4 of ANSI C63.4-2009. 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.

## List of Test Equipment

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

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

<u>Equipment</u>	<u>Manufacturer</u>	<u>Model</u>	<u>Calibration Date</u>	<u>Due</u>
LISN	Comp. Design	FCC-LISN-2-MOD.CD	10/11	10/12
Antenna	ARA	BCD-235-B	10/11	10/12
Antenna	EMCO	3147	10/11	10/12
Antenna	EMCO	3147	10/11	10/12
Antenna	Com Power	AH-118	10/11	10/12
Analyzer	HP	8591EM	5/11	5/12
Analyzer	HP	8562A	5/11	5/12
Analyzer	Rohde & Schwarz	ESU40	5/11	5/12



## **Intentional Radiators**

As per CFR47, Subpart C, paragraph 15.247 the following information is submitted.

### ***Antenna Requirements***

The EUT incorporates integral antenna system and offers no provision for connection to alternate system. The antenna connection point complies with the unique antenna connection requirements. The requirements of 15.203 are fulfilled; 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 on the OATS. Measurements were made for each antenna option. Emissions other than transmitter harmonics measured similar for all configurations and are presented below. Harmonic emissions, in restricted bands, were measured for each antenna style offered and recorded. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were measured 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.

### General Radiated Emissions in Restricted Bands Data (General)

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Quasi-Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Quasi-Peak (dBμV/m)	Vertical Average (dBμV/m)	Limit @ 3m (dBμV/m)
129.6	24.5	18.4	N/A	32.9	27.8	N/A	43.5
136.6	33.7	23.1	N/A	31.8	27.2	N/A	43.5
166.5	38.0	34.8	N/A	35.2	30.6	N/A	43.5
246.7	35.2	31.9	N/A	36.6	31.3	N/A	46.0
252.0	33.8	29.2	N/A	36.5	32.2	N/A	46.0
1000.0	41.5	39.5	N/A	39.0	37.5	N/A	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

### Harmonic Radiated Emissions in Restricted Bands Data

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Quasi-Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Quasi-Peak (dBμV/m)	Vertical Average (dBμV/m)	Limit @ 3m (dBμV/m)
2390.0	60.8	N/A	44.7	59.1	N/A	41.4	54.0
2483.5	46.5	N/A	31.8	63.9	N/A	41.8	54.0
4824.0	49.8	N/A	36.8	51.0	N/A	40.6	54.0
4874.0	51.4	N/A	41.1	53.9	N/A	46.7	54.0
4924.0	54.0	N/A	16.6	16.1	N/A	40.1	54.0
7236.0	48.2	N/A	34.8	47.4	N/A	34.8	54.0
7311.0	46.8	N/A	33.3	45.7	N/A	33.3	54.0
7386.0	54.0	N/A	16.6	16.1	N/A	31.1	54.0
12060.0	47.9	N/A	35.4	47.8	N/A	35.4	54.0
12185.0	47.5	N/A	34.2	47.1	N/A	34.2	54.0
12310.0	46.8	N/A	33.9	47.0	N/A	34.0	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

## ***Summary of Results for Radiated Emissions in Restricted Bands***

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C Intentional Radiators. The EUT demonstrated a minimum margin of -7.3 dB below the radiated emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

## ***AC Line Conducted Emissions Procedure***

The EUT was arranged in a typical equipment configuration and placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. The manufacturer supplied 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  $\mu$ F 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 and two for plots of the EUT powered by AC/DC adapter, AC Power Line conducted emissions.

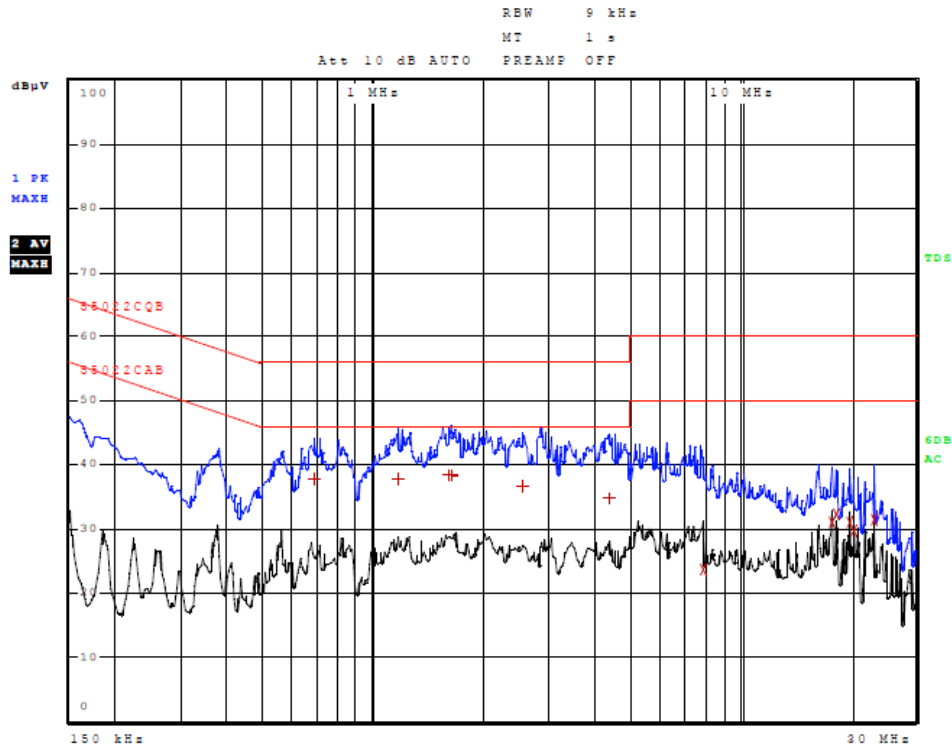


Figure One AC Line Conducted Emissions Line 1

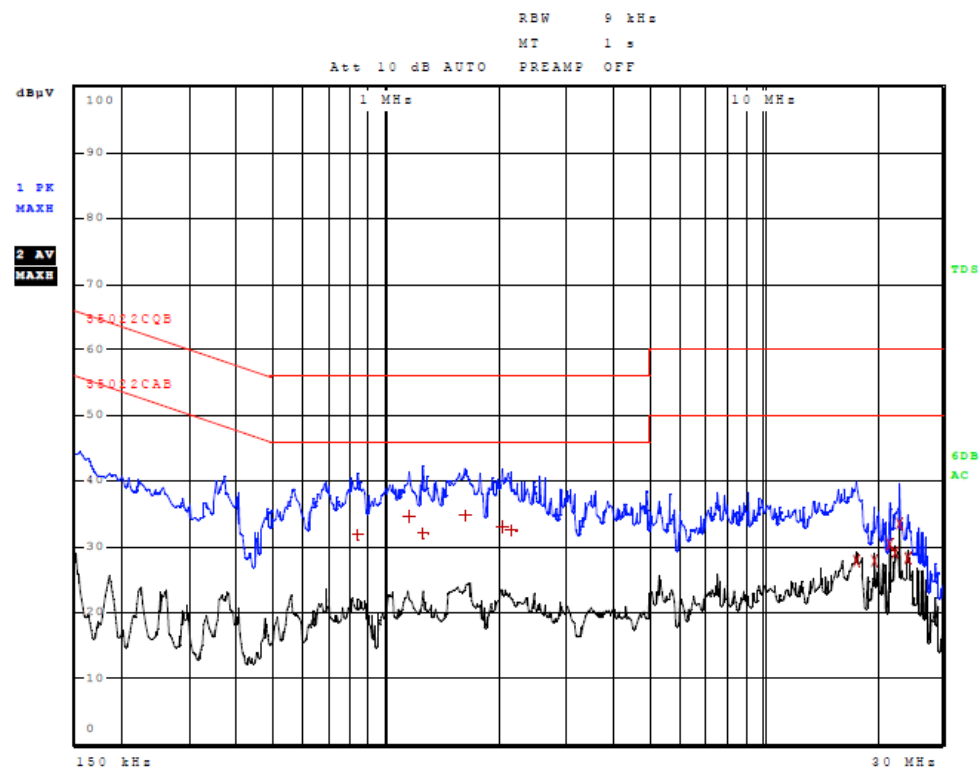


Figure Two AC Line Conducted Emissions Line 2

## AC Line Conducted Emissions Data (Highest Emissions)

Line 1

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	686.000000000 kHz	37.68	Quasi Peak	-18.32
1	1.166000000 MHz	37.72	Quasi Peak	-18.28
1	1.602000000 MHz	38.29	Quasi Peak	-17.71
1	1.630000000 MHz	38.39	Quasi Peak	-17.61
1	2.550000000 MHz	36.69	Quasi Peak	-19.31
1	4.406000000 MHz	34.73	Quasi Peak	-21.27
2	7.896000000 MHz	23.62	Average	-26.38
2	17.692000000 MHz	31.05	Average	-18.95
2	18.244000000 MHz	32.25	Average	-17.75
2	19.708000000 MHz	31.01	Average	-18.99
2	20.260000000 MHz	29.67	Average	-20.33
2	23.128000000 MHz	31.49	Average	-18.51

Line 2

Trace	Frequency	Level (dBμV)	Detector	Delta Limit/dB
1	834.000000000 kHz	31.81	Quasi Peak	-24.19
1	1.146000000 MHz	34.59	Quasi Peak	-21.41
1	1.254000000 MHz	32.08	Quasi Peak	-23.92
1	1.614000000 MHz	34.70	Quasi Peak	-21.30
1	2.026000000 MHz	33.16	Quasi Peak	-22.84
1	2.134000000 MHz	32.55	Quasi Peak	-23.45
2	17.692000000 MHz	27.82	Average	-22.18
2	19.708000000 MHz	27.82	Average	-22.18
2	21.664000000 MHz	30.27	Average	-19.73
2	22.456000000 MHz	29.02	Average	-20.98
2	23.128000000 MHz	33.54	Average	-16.46
2	24.348000000 MHz	28.25	Average	-21.75

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

## Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance to the conducted emissions requirements of CFR47 Part 15C equipment. The EUT demonstrated minimum margin of -16.4 dB below the limit.

Measurements were taken using the peak, quasi peak, and average, measurement function for each emissions amplitude and were below the limits stated in the specification. Other emissions were present with recorded data representing worst-case amplitudes.



### ***General Radiated Emissions Procedure***

The EUT was arranged in a 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. Each radiated emission was then maximized at the OATS location before final radiated emissions measurements were performed. Final data was taken with the EUT located at the OATS at a distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 25,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Loop from 9 kHz to 30 MHz, Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 1 GHz and or double Ridge or pyramidal horns and mixers from 1 GHz to 40 GHz, notch filters and appropriate amplifiers and external mixers were utilized.



### General Radiated Emissions from EUT Data (Highest Emissions all antenna options)

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Quasi-Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Quasi-Peak (dBμV/m)	Vertical Average (dBμV/m)	Limit @ 3m (dBμV/m)
56.0	N/A	24.9	N/A	N/A	26.8	N/A	40.0
129.6	N/A	18.4	N/A	N/A	27.8	N/A	43.5
136.6	N/A	23.1	N/A	N/A	27.2	N/A	43.5
166.5	N/A	34.8	N/A	N/A	30.6	N/A	43.5
175.5	N/A	32.3	N/A	N/A	27.8	N/A	43.5
181.4	N/A	31.3	N/A	N/A	27.9	N/A	43.5
182.2	N/A	30.6	N/A	N/A	28.7	N/A	43.5
200.0	N/A	38.0	N/A	N/A	38.1	N/A	43.5
214.7	N/A	31.4	N/A	N/A	28.8	N/A	43.5
218.8	N/A	31.2	N/A	N/A	26.2	N/A	46.0
220.0	N/A	28.8	N/A	N/A	26.0	N/A	46.0
246.7	N/A	31.9	N/A	N/A	31.3	N/A	46.0
252.0	N/A	29.2	N/A	N/A	32.2	N/A	46.0
1000.0	41.5	39.5	N/A	39.0	37.5	N/A	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

### Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15C paragraph 15.209 Intentional Radiators. The EUT demonstrated a minimum margin of -5.5 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

## **Operation in the Band 2400 – 2483.5 MHz**

The power output was measured at the open area test site at a three-meter distance. The EUT was placed on a wooden turntable 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. The peak and quasi-peak amplitude of the frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of emissions above 1000 MHz including were measured using a spectrum analyzer. Emissions data was recorded from the measurement results. Plots were made of transmitter performance for reference purposes. Refer to figures three through eight showing plots taken of the EUT performance displaying compliance with the specifications. As this product utilizes permanently attached antenna it offers no provision for antenna port measurements. Test procedures as defined in publications KDB 558074 and ANSI C63.10-2009 were utilized for compliance testing. These procedures utilize measurement of maximum field strength and conversion calculation for comparison.

1. Calculate the transmitter's peak power using the following equation:

$$P = (E * d)^2 / (30 * G)$$

Where: E = the measured maximum field strength in V/m.

G = the numeric gain of the transmitting antenna over an isotropic radiator.

d = the distance in meters from which the field strength was measured.

P = the power in watts

Setting the RBW > 6dB bandwidth of the emission or using a peak power meter

2. Emission Bandwidth was measured in compliance with KDB 558074 paragraph 5.1.1.
3. Maximum Peak Output Power was measured in compliance with KDB 558074 paragraph 5.2.1.2.
4. Maximum Power Spectral Density was measured in compliance with KDB 558074 paragraph 5.3.1.
5. Maximum Unwanted Emissions Levels were measured in compliance with KDB 558074 and CFR47 paragraph 15C at 3-meters distance located on the OATS.

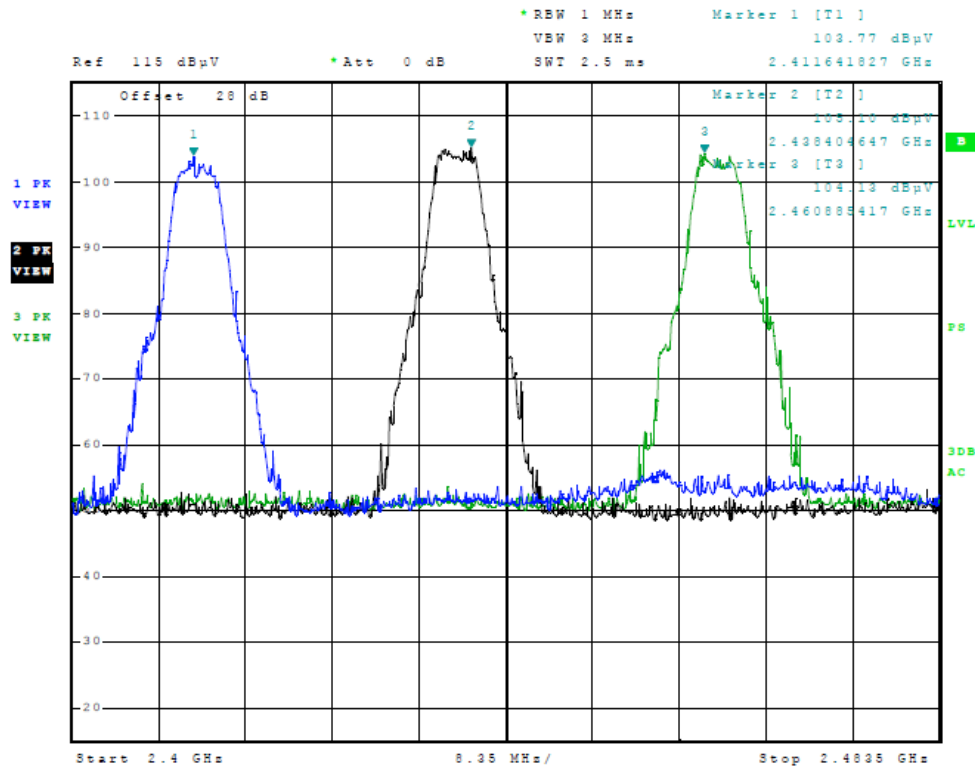


Figure Three Plot of Transmitter Emissions (Across Operational Band, 5 MHz Mode)

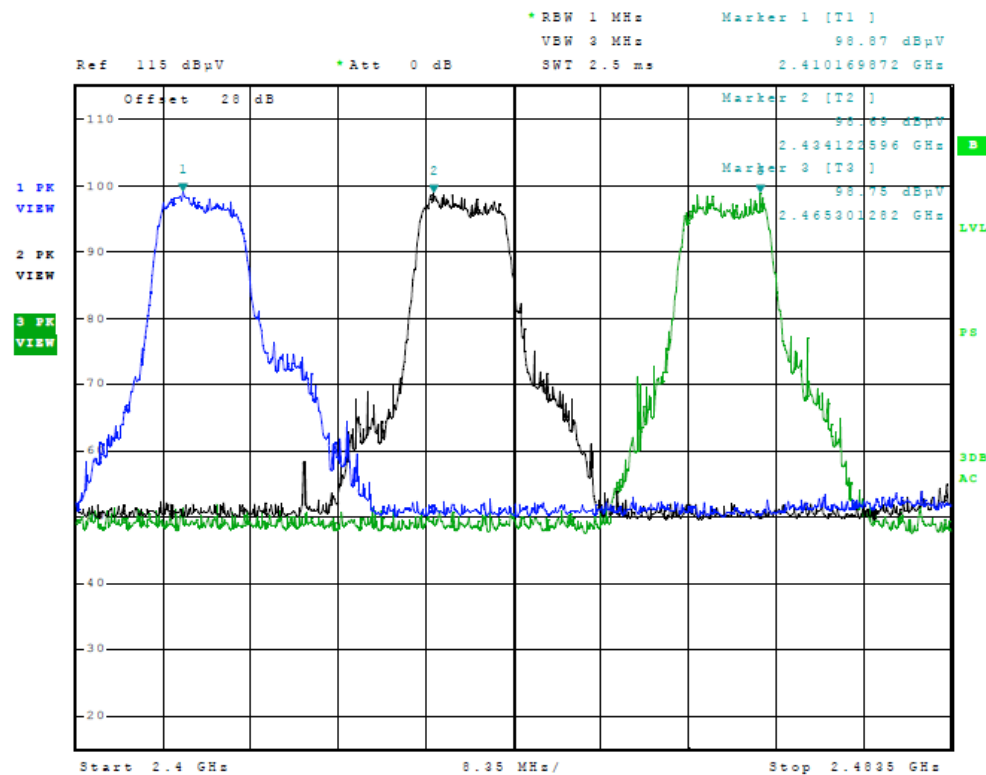
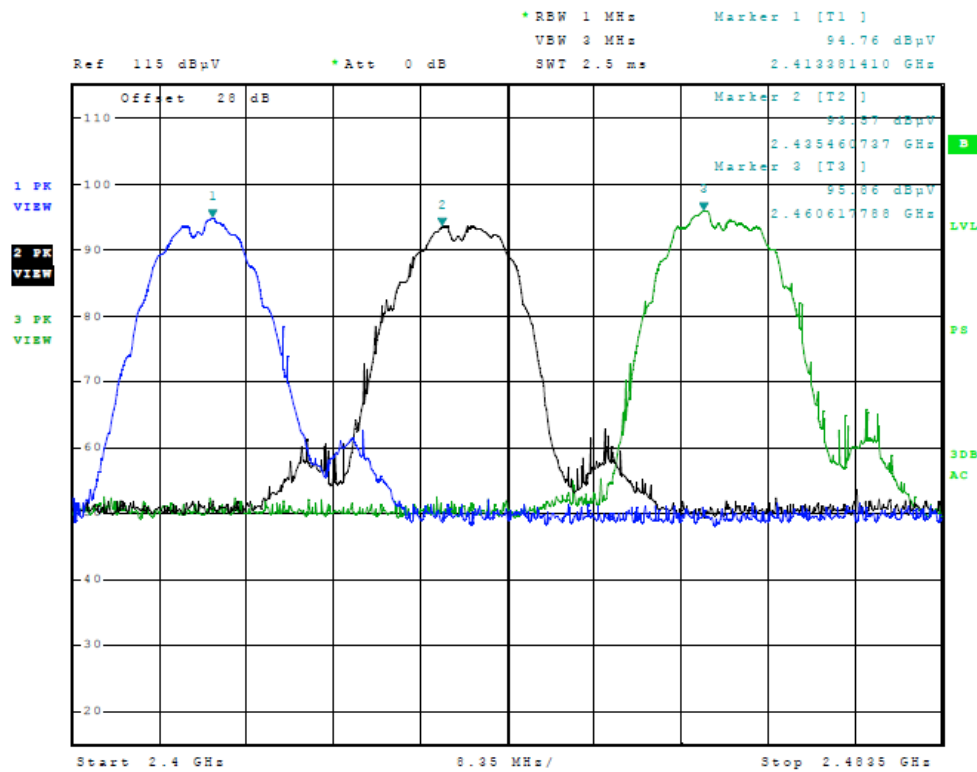
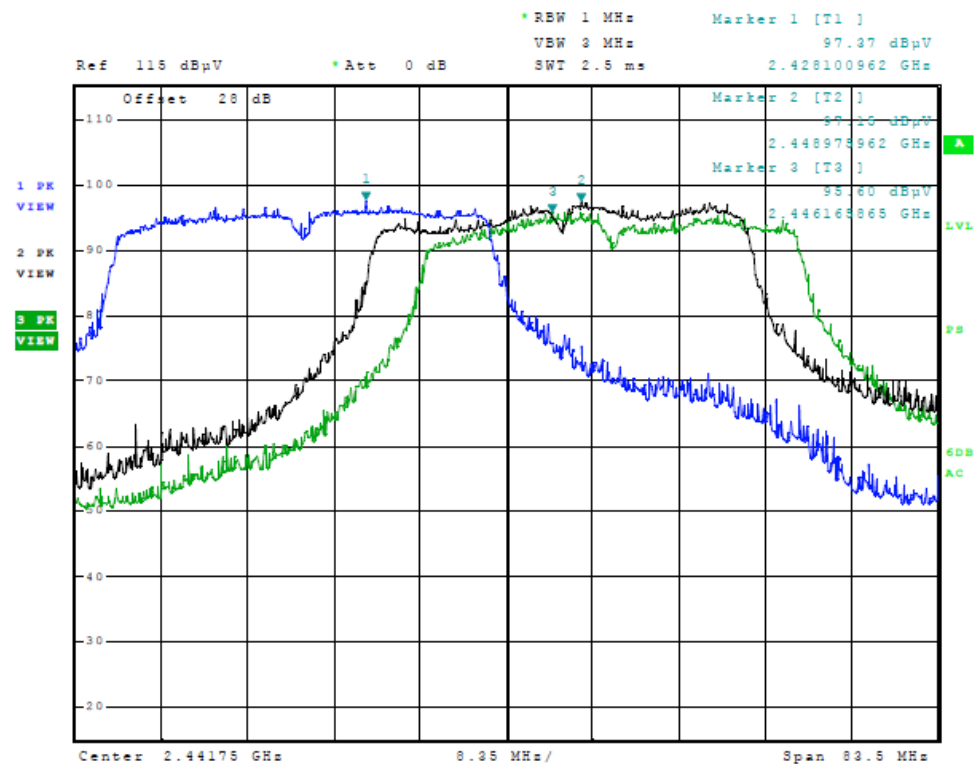


Figure Four Plot of Transmitter Emissions (Across Operational Band, 10 MHz Mode)



**Figure Five Plot of Transmitter Emissions (Across Operational Band, 20 MHz Mode)**



**Figure Six Plot of Transmitter Emissions (Across Operational Band, 40 MHz Mode)**

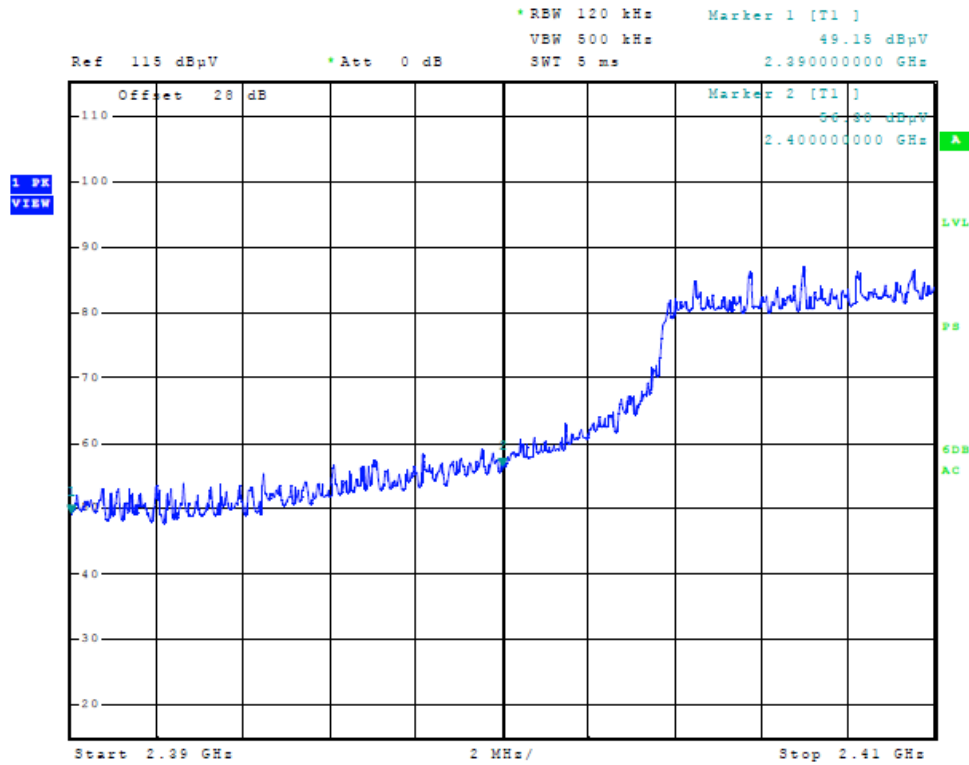


Figure Seven Plot of Low Band Edge

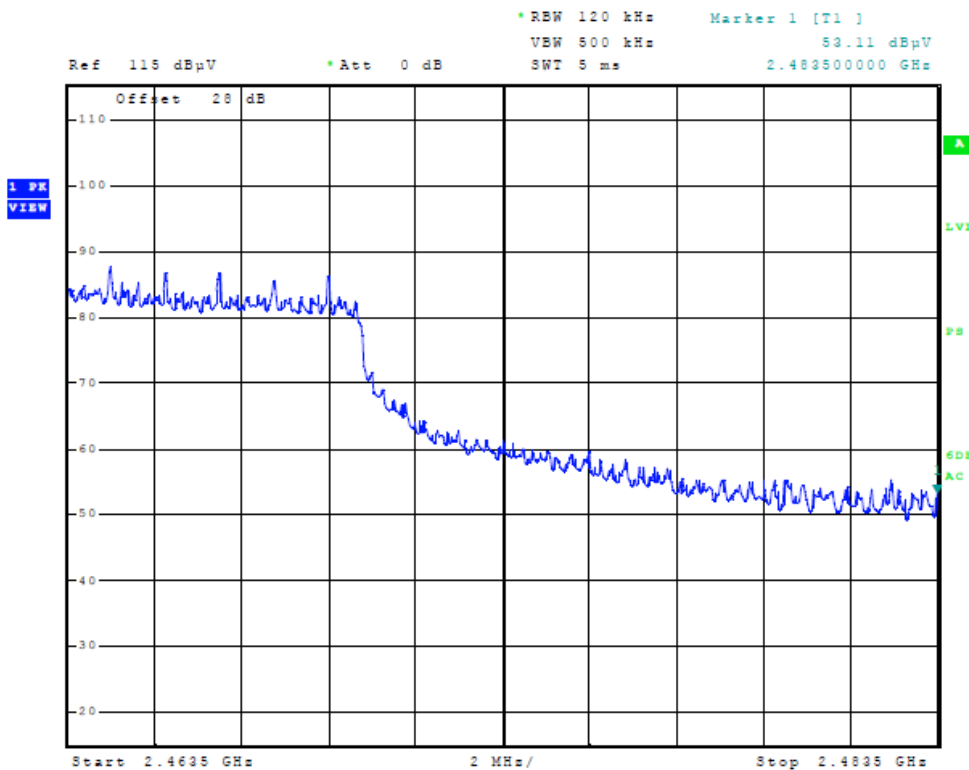


Figure Eight Plot of High Band Edge

**Transmitter Emissions Data****Calculated Transmitter Antenna Port Power**

Frequency MHz	Calculated Conducted Antenna Port Output Power (Watts)	Occupied Bandwidth (MHz)	Calculated Power Spectral Density (dBm) (3kHz/100kHz)
5 MHz Channel			
2412	0.0357	4,230.8	-8.72
2437	0.0340	4,230.8	-8.92
2462	0.0348	4,230.8	-8.73
10 MHz Channel			
2412	0.0339	8,596.2	-9.39
2437	0.0343	8,576.9	-9.71
2462	0.0368	8,615.4	-9.99
20 MHz Channel			
2412	0.0625	17,628.2	-6.1
2437	0.0571	17,227.6	-5.6
2462	0.0586	17,307.7	-6.1
40 MHz Channel			
2422	0.0200	37,179.5	-11.82
2447	0.0200	37,099.4	-11.82
2452	0.0183	37,419.9	-11.53

# Transmitter Radiated Emission

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Average (dBμV/m)	Limit @ 3m (dBμV/m)
2412.0	118.0	--	116.6	--	--
4824.0	49.8	36.8	51.0	40.6	54.0
7236.0	48.2	34.8	47.4	34.8	54.0
9648.0	49.6	36.8	49.5	36.8	54.0
12060.0	47.9	35.4	47.8	35.4	54.0
14472.0	47.3	36.6	47.8	35.8	54.0
16884.0	47.0	34.4	47.3	34.2	54.0
2437.0	117.6	--	116.4	--	--
4874.0	51.4	41.1	53.9	46.7	54.0
7311.0	46.8	33.3	45.7	33.3	54.0
9748.0	49.4	36.5	49.4	36.4	54.0
12185.0	47.5	34.2	47.1	34.2	54.0
14622.0	48.5	36.1	49.2	35.2	54.0
17059.0	48.2	35.7	49.2	36.2	54.0
2462.0	117.7	--	115.6	--	--
4924.0	48.7	36.2	49.8	40.1	54.0
7386.0	44.0	31.0	44.7	31.1	54.0
9848.0	48.4	35.2	47.7	35.3	54.0
12310.0	46.8	33.9	47.0	34.0	54.0
14772.0	47.2	36.5	46.8	34.9	54.0
17234.0	49.4	37.2	49.4	37.3	54.0

Other emissions present had amplitudes at least 20 dB below the limit. Peak and Quasi-Peak amplitude emissions are recorded above for frequency range of 30-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.



## **Summary of Results for Transmitter Radiated Emissions of Intentional Radiator**

The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15.247. Calculated Antenna port conducted power of 17.96 dBm, 0.0625 Watts. The peak power spectral density presented a minimum margin of -13.6 dB below the requirements. The EUT demonstrated a minimum margin of -7.3 dB below the harmonic emissions requirements. There were no other significantly measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. There were no other deviations or exceptions to the requirements.

## **Statement of Modifications and Deviations**

No modifications to the EUT were required for the unit to demonstrate compliance with the CFR47 Part 15C emissions standards. There were no deviations to the specifications.





NVLAP Lab Code 200087-0

## **Annex**

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

## Annex A Measurement Uncertainty Calculations

### 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 ( $\pm 4$  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	$\pm 1.5$
LISN coupling specification	rectangular	$\pm 1.5$
Cable and input attenuator calibration	normal (k=2)	$\pm 0.5$
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 Rogers Labs Test Equipment List

The test equipment 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
Spectrum Analyzer: Rohde & Schwarz ESU40	5/11
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520	5/11
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	
Spectrum Analyzer: HP 8591EM	5/11
Antenna: EMCO Biconilog Model: 3143	5/11
Antenna: Sunol Biconilog Model: JB6	10/11
Antenna: EMCO Log Periodic Model: 3147	10/11
Antenna: Antenna Research Biconical Model: BCD 235	10/11
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 $\mu$ Hy/50 ohm/0.1 $\mu$ f	10/11
R.F. Preamp CPPA-102	10/11
Attenuator: HP Model: HP11509A	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Attenuator: Mini Circuits Model: CAT-3	10/11
Cable: Belden RG-58 (L1)	10/11
Cable: Belden RG-58 (L2)	10/11
Cable: Belden 8268 (L3)	10/11
Cable: Time Microwave: 4M-750HF290-750	10/11
Cable: Time Microwave: 10M-750HF290-750	10/11
Frequency Counter: Leader LDC825	2/12
Oscilloscope Scope: Tektronix 2230	2/12
Wattmeter: Bird 43 with Load Bird 8085	2/12
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/12
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/12
R.F. Power Amp 65W Model: 470-A-1010	2/12
R.F. Power Amp 50W M185- 10-501	2/12
R.F. Power Amp A.R. Model: 10W 1010M7	2/12
R.F. Power Amp EIN Model: A301	2/12
LISN: Compliance Eng. Model 240/20	2/12
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/12
Antenna: EMCO Dipole Set 3121C	2/12
Antenna: C.D. B-101	2/12
Antenna: Solar 9229-1 & 9230-1	2/12
Antenna: EMCO 6509	2/12
Audio Oscillator: H.P. 201CD	2/12
Peavey Power Amp Model: IPS 801	2/12
ELGAR Model: 1751	2/12
ELGAR Model: TG 704A-3D	2/12
ESD Test Set 2010i	2/12
Fast Transient Burst Generator Model: EFT/B-101	2/12
Field Intensity Meter: EFM-018	2/12
KEYTEK Ecat Surge Generator	2/12
Shielded Room 5 M x 3 M x 3.0 M	

Rogers Labs, Inc.

4405 W. 259th Terrace

Louisburg, KS 66053

Phone/Fax: (913) 837-3214

Revision 1

Mikrotikls SIA

Model: RouterBoard 951-2n

Test #: 120314

Test to: CFR47 (15.247)

File: Mikrotikls RB951 2n TstRpt 120314

SN: 35D70283C9DA/207

FCC ID#: TV7RB951-2N

Date: May 8, 2012

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## ***Annex C Rogers Qualifications***

***Scot D. Rogers, Engineer***

### **Rogers Labs, Inc.**

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

#### **Positions Held**

Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

#### **Educational Background**

- 1) Bachelor of Science Degree in Electrical Engineering from Kansas State University.
- 2) Bachelor of Science Degree in Business Administration Kansas State University.
- 3) Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming.

Scot D. Rogers



NVLAP Lab Code 200087-0

**Annex D FCC Site Registration Letter**

**FEDERAL COMMUNICATIONS COMMISSION**

**Laboratory Division  
7435 Oakland Mills Road  
Columbia, MD 21046**

November 01, 2011

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: November 01, 2011

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](http://www.fcc.gov) under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish  
Industry Analyst

Rogers Labs, Inc.  
4405 W. 259th Terrace  
Louisburg, KS 66053  
Phone/Fax: (913) 837-3214  
Revision 1

Mikrotikls SIA  
Model: RouterBoard 951-2n  
Test #: 120314  
Test to: CFR47 (15.247)  
File: Mikrotikls RB951 2n TstRpt 120314

SN: 35D70283C9DA/207  
FCC ID#: TV7RB951-2N  
Date: May 8, 2012  
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NVLAP Lab Code 200087-0

## Annex E Industry Canada Site Registration Letter



December 28, 2011

OUR FILE: 46405-3041

Submission No: 152685

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

**Attention:** Mr. Scot D. Rogers

Dear Sir/Madame:

The Bureau has received your application for the renewal of 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 ( **Site# 3041A-1** ). Please reference the appropriate site number in the body of test reports containing measurements performed on the site. In addition, please keep for your records the following information;

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

Furthermore, to obtain or renew a unique site number, the applicant shall demonstrate that the site has been accredited to ANSI C63.4-2003 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 three years**. There is no fee or form associated with an OATS filing. OATS submissions are encouraged to be submitted electronically to the Bureau using the following URL;

[http://strategis.ic.gc.ca/epic/internet/inceb-bhst.nsf/en/h\\_tt00052e.html](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](mailto:certification.bureau@ic.gc.ca) Please reference our file and submission number above for all correspondence.

Yours sincerely,

Dalwinder Gill  
For: Wireless Laboratory Manager  
**Certification and Engineering Bureau**  
3701 Carling Ave., Building 94  
P.O. Box 11490, Station "H"  
Ottawa, Ontario K2H 8S2  
Email: [dalwinder.gill@ic.gc.ca](mailto:dalwinder.gill@ic.gc.ca)  
Tel. No. (613) 998-8363  
Fax. No. (613) 990-4752

Rogers Labs, Inc.  
4405 W. 259th Terrace  
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Mikrotikls SIA  
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