

# Application For Grant of Certification

FOR

FOR

Model: M4AUND00  
2402-2480 MHz (DTS)

Broadband Digital Transmission System Module

FCC ID: IPH-02438

IC: 1792A-02438

FOR

## Garmin International, Inc.

1200 East 151st Street  
Olathe, KS 66062

Test Report Number: 140327

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



# **ROGERS LABS, INC.**

4405 West 259<sup>th</sup> Terrace  
Louisburg, KS 66053  
Phone / Fax (913) 837-3214

## Engineering Test Report For Grant of Certification Application

FOR  
CFR 47, PART 15C - Intentional Radiators  
CFR 47 Paragraph 15.247 and  
Industry Canada RSS-210  
License Exempt Intentional Radiator Module

For

## **Garmin International, Inc.**

1200 East 151st Street  
Olathe, KS 66062

Broadband Digital Transmission System Module  
Model: M4AUND00  
Frequency Range 2402-2480 MHz  
FCC ID#: IPH-02438  
IC: 1792A-02438

Test Date: March 27, 2014

Certifying Engineer:

*Scot D. Rogers*

Scot D. Rogers  
Rogers Labs, Inc.  
4405 West 259<sup>th</sup> Terrace  
Louisburg, KS 66053  
Telephone/Facsimile: (913) 837-3214

This report shall not be reproduced except in full, without the written approval of the laboratory.  
This report must not be used by the client to claim product certification, approval, or  
endorsement by NVLAP, NIST, or any agency of the Federal Government.



# Table Of Contents

**TABLE OF CONTENTS..... 3**

**REVISIONS..... 4**

**FORWARD ..... 5**

**OPINION / INTERPRETATION OF RESULTS ..... 5**

**EQUIPMENT TESTED..... 5**

**EQUIPMENT FUNCTION AND CONFIGURATION..... 6**

    Equipment Configuration.....6

**APPLICATION FOR CERTIFICATION..... 7**

**APPLICABLE STANDARDS & TEST PROCEDURES ..... 8**

**EQUIPMENT TESTING PROCEDURES ..... 8**

    AC Line Conducted Emission Test Procedure .....8

    Radiated Emission Test Procedure.....8

        Diagram 1 Test arrangement for Conducted emissions .....9

        Diagram 2 Test arrangement for radiated emissions of tabletop equipment.....10

        Diagram 3 Test arrangement for radiated emissions tested on Open Area Test Site (OATS).....11

**TEST SITE LOCATIONS ..... 11**

**LIST OF TEST EQUIPMENT ..... 12**

**UNITS OF MEASUREMENTS ..... 13**

**ENVIRONMENTAL CONDITIONS..... 13**

**INTENTIONAL RADIATORS..... 13**

    Antenna Requirements .....13

    Restricted Bands of Operation.....13

        Table 1 Harmonic Radiated Emissions in Restricted Bands Data (BT) .....14

        Table 2 Harmonic Radiated Emissions in Restricted Bands Data (802.11 worst-case).....15

**Summary of Results for Radiated Emissions in Restricted Bands .....15**

    General Radiated Emissions Procedure.....16

        Table 3 General Radiated Emissions from EUT Data (Highest Emissions).....16

**Summary of Results for General Radiated Emissions .....16**



**Operation in the Band 2400 – 2483.5 MHz .....17**

Figure 1 Plot of Transmitter Emissions in Operational Frequency (BT Mode).....18

Figure 2 Plot of Transmitter Emissions in Operational Frequency (802.11 Mode).....18

Figure 3 Plot of Transmitter Emissions Low Band Edge (802.11 b-mode).....19

Figure 4 Plot of Transmitter Low Band Edge (802.11 g-mode) .....19

Figure 5 Plot of Transmitter High Band Edge (802.11 b-mode) .....20

Figure 6 Plot of Transmitter High Band Edge (802.11 g-mode) .....20

**Transmitter Emissions Data.....21**

Table 4 Transmitter Radiated Emission (BT mode) .....21

Table 5 Transmitter Radiated Emission (802.11 mode) .....22

Table 6 Transmitter Antenna Port Power .....23

**Summary of Results for Transmitter Radiated Emissions of Intentional Radiator .....23**

**STATEMENT OF MODIFICATIONS AND DEVIATIONS ..... 23**

**ANNEX..... 24**

**Annex A Measurement Uncertainty Calculations .....25**

**Annex B Rogers Labs Test Equipment List.....26**

**Annex C Rogers Qualifications .....27**

**Annex D FCC Site Registration Letter .....28**

**Annex E Industry Canada Site Registration Letter .....29**

## Revisions

Revision 1 Issued July 22, 2014



## Forward

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator module operating under Code of Federal Regulations Title 47 (CFR 47) Paragraph 15.247 and Industry Canada RSS-210, operation in the 2400 – 2483.5 MHz band.

Name of Applicant: Garmin International, Inc.  
1200 East 151st Street  
Olathe, KS 66062

Model: M4AUND00

FCC I.D.: IPH-02438 Industry Canada ID: 1792A-02438

Frequency Range (BT): 2402-2480 MHz with power level 0.005 Watt,

Occupied Bandwidth: occupied bandwidth 1,117 kHz,

Frequency Range (W-Fi, 802.11): 2412-2462 MHz with power level 0.060 Watt,

Occupied Bandwidth: occupied bandwidth 16,850 kHz,

## Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Emissions as per CFR 47 paragraphs 2 and 15.205	-7.5	Complies
Emissions as per CFR 47 paragraphs 2 and 15.207	N/A	Complies
Emissions as per CFR 47 paragraphs 2 and 15.209	-11.2	Complies
Harmonic Emissions per CFR 47 15.247	-6.3	Complies
Peak Power Spectral Density per CFR 47 15.247	-6.2	Complies

## Equipment Tested

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT (#1)	M4AUND00	38812-91343
EUT (#2)	M4AUND00	38812-91342
EUT Test Fixture	Test Fixture	ENG001

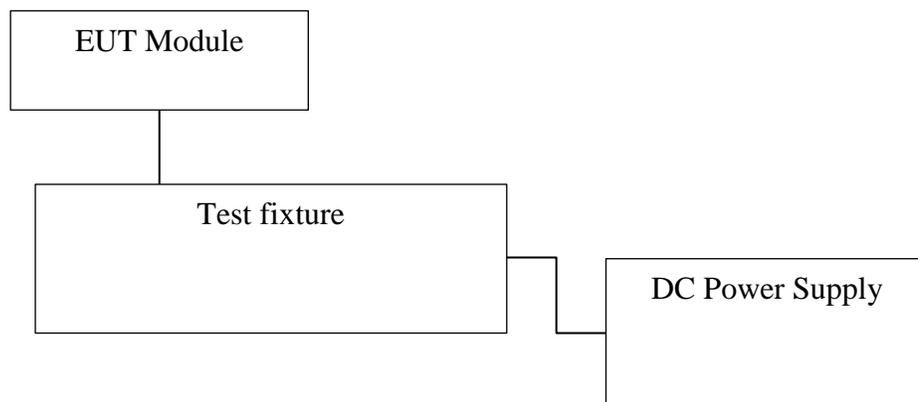
Test results in this report relate only to the items tested.

## Equipment Function and Configuration

The EUT is a low power limited single-modular transmitter with operation capability in the 2402-2480 MHz frequency band. The design utilizes internal fixed antenna system and offers no provision for antenna replacement or modification. The module is designed for incorporation into manufacturer’s designs to provide wireless interface capabilities into products. Use of the modular design offers the manufacturer the ability to enhance product design by incorporating wireless connectivity quickly. The design offers wireless interface capabilities with compliant equipment and operates from direct current power supplied from the supporting system. During testing, the EUT was positioned outside any enclosure and interfaced with supporting test fixture as described by the manufacturer. The EUT offers no other interface connections than those in the configuration option shown below as described by the manufacturer. Two test samples were provided for testing, 1) representative of production design and 2) replaced integral antenna with coaxial cable and SMA connector. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance with the module placed outside any enclosure, set to transmit at frequencies across the full band and modulation modes with worst-case data presented. Test results in this report relate only to the products described in this report.

### Equipment Configuration

1. EUT (M4AUND00) connected to test fixture and external DC power supply





## Application for Certification

- (1) Manufacturer: Garmin International, Inc.  
1200 East 151st Street  
Olathe, KS 66062
- (2) Identification: Model: M4AUND00  
FCC I.D.: IPH-02438 IC ID: 1792A-02438
- (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 and communications supplied from support interface (or test fixture) direct current power. The EUT offers no other connection ports than those presented in this filing.
- (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, 2013, 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 Paragraphs 15.212, 15.247, and RSS-210 the following information is submitted. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2009, FCC KDB documents KDB 558074 D01 v03r02 and KDB 913591. The system operates from direct current power supplied from supporting product and offers no provision for connection to utility power system. The modular design is for use in Garmin manufactured products as described in the associated filing. Testing of the radiated emissions was performed as required including procedures in section 6 of ANSI C63.10-2009.

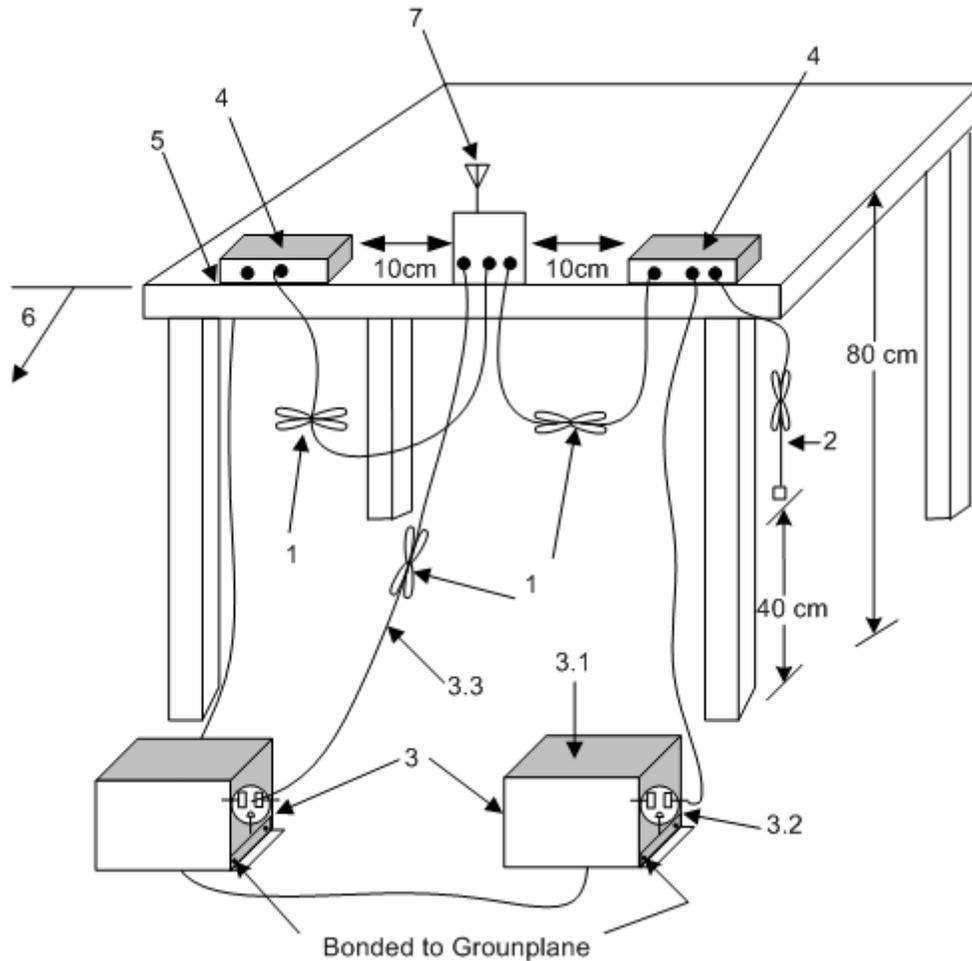
## **Equipment Testing Procedures**

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

The unit operates solely from Direct Current (DC) Power and offers no provision for connection to utility AC power systems. Therefore, no AC power line conducted emissions test is required or performed.

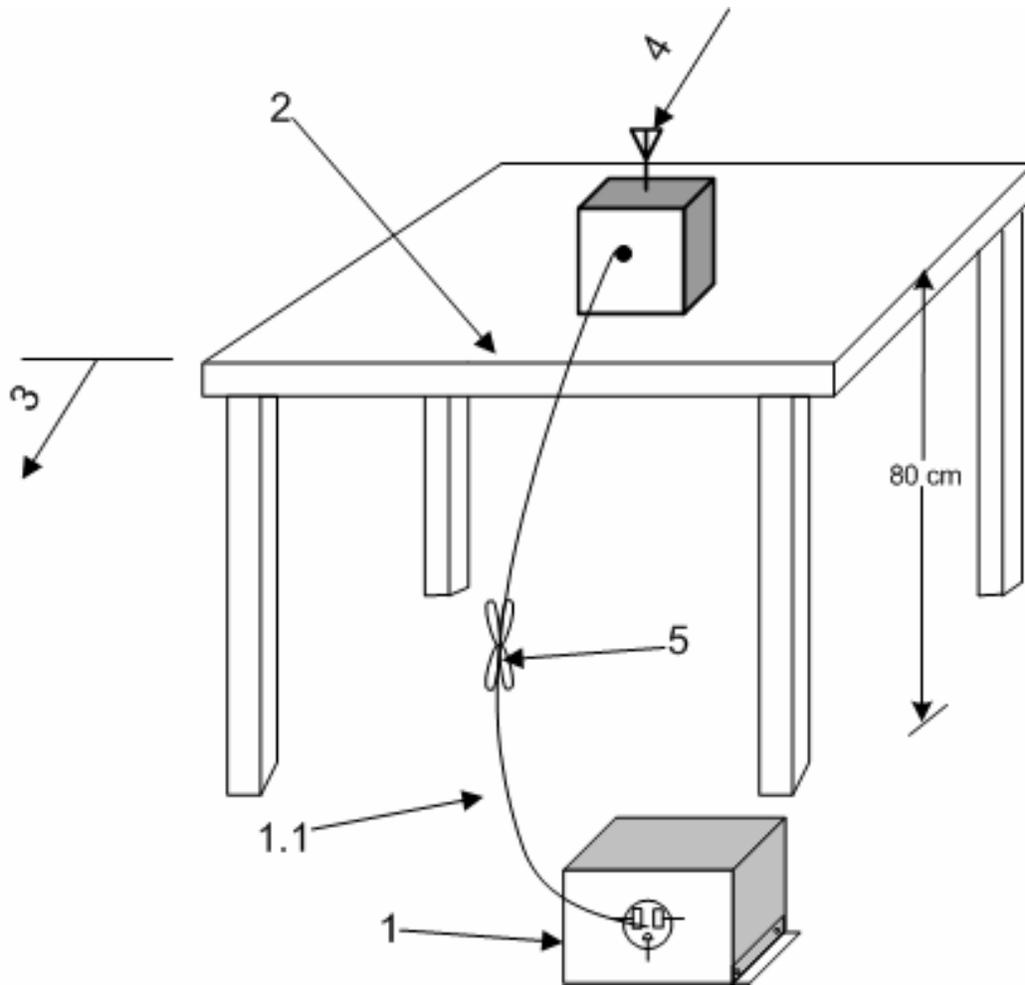
### ***Radiated Emission Test Procedure***

The EUT was placed on a rotating 1 x 1.5-meter wooden platform, 0.8 meters above the ground plane at a distance of 3 meters from the FSM antenna. Radiated emissions testing was performed as required in CFR47 15, RSS-210 and specified in section 6 of ANSI C63.10-2009. 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. The frequency spectrum from 9 kHz to 25,000 MHz was searched for during preliminary investigation. Refer to diagrams 2 and 3 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.



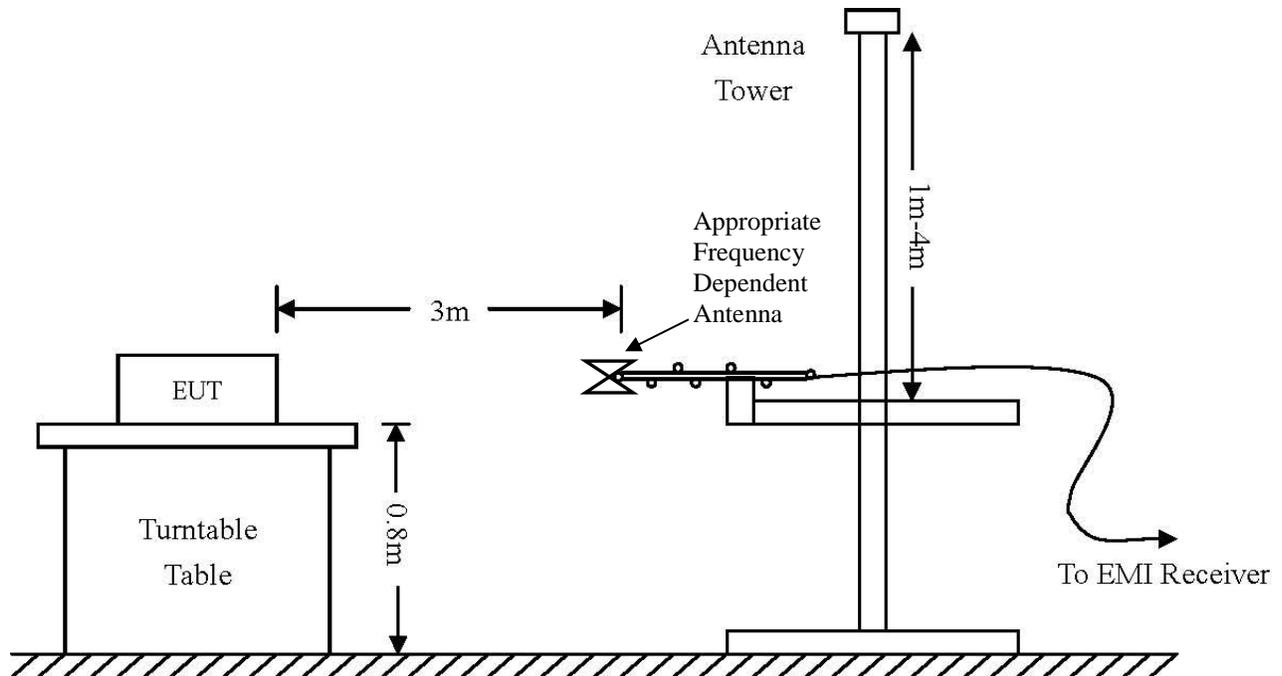
1. Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long see (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if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

**Diagram 1 Test arrangement for Conducted emissions**



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

**Diagram 2 Test arrangement for radiated emissions of tabletop equipment**



Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHZ
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 120 kHz	VBW = 1 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV

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

### Test Site Locations

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

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

Garmin International, Inc.  
Model: M4AUND00  
Test #: 140327  
Test to: CFR47 (15.247), RSS-210 (DTS)  
File: Garmin M4AUND00 DTS TstRpt 140327

SN: 38812-91343  
FCC ID#: IPH-02438  
IC: 1792A-02438  
Date: July 22, 2014  
Page 11 of 29

## 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 (SN)</u>	<u>Band</u>	<u>Cal Date</u>	<u>Due</u>
<input type="checkbox"/> LISN	Comp. Design	FCC-LISN-2-MOD.CD (126)	.15-30MHz	10/13	10/14
<input checked="" type="checkbox"/> Cable	Time Microwave	750HF290-750 (L10M)	9kHz-40 GHz	10/13	10/14
<input type="checkbox"/> Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/13	10/14
<input type="checkbox"/> Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/13	10/14
<input type="checkbox"/> Antenna	ARA	BCD-235-B (169)	20-350MHz	10/13	10/14
<input type="checkbox"/> Antenna	EMCO	3147 (40582)	200-1000MHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/13	5/14
<input checked="" type="checkbox"/> Antenna	EMCO	6509 (9502-1374)	.001-30 MHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Standard	FXRY638A (621786)	10-18 GHz	5/13	5/14
<input type="checkbox"/> Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/13	5/14
<input type="checkbox"/> Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/13	5/14
<input type="checkbox"/> Analyzer	HP	8562A (3051A05950)	9kHz-110GHz	5/13	5/14
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/13	5/14
<input checked="" type="checkbox"/> Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/13	10/14
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/13	10/14
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/13	10/14



## 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 (dB $\mu$ V/m @ 3m) = FSM (dB $\mu$ V) + A.F. (dB) - Gain (dB)

## Environmental Conditions

Ambient Temperature	21.0° C
Relative Humidity	35%
Atmospheric Pressure	101024.3 mb

## Intentional Radiators

As per CFR47, Subpart C, paragraphs 15.212, 15.247 and RSS-210 the following information is submitted.

### ***Antenna Requirements***

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

### ***Restricted Bands of Operation***

Spurious emissions falling in the restricted frequency bands of operation were measured at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.10-2009 paragraph 6 and KDB 558074 paragraph 10.2 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed emission values take into account the received radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

**Table 1 Harmonic Radiated Emissions in Restricted Bands Data (BT)**

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	46.0	N/A	33.8	47.8	N/A	34.0	54.0
2483.5	52.8	N/A	39.4	54.4	N/A	41.5	54.0
4804.0	50.1	N/A	37.3	50.4	N/A	37.3	54.0
4882.0	50.3	N/A	37.1	49.9	N/A	37.2	54.0
4960.0	52.2	N/A	41.0	52.1	N/A	40.3	54.0
7206.0	53.1	N/A	40.4	53.3	N/A	40.4	54.0
7323.0	53.3	N/A	40.5	54.6	N/A	40.5	54.0
7440.0	52.4	N/A	39.9	52.7	N/A	40.3	54.0
12010.0	54.5	N/A	42.0	54.3	N/A	41.9	54.0
12205.0	54.4	N/A	41.1	54.4	N/A	41.6	54.0
12400.0	55.0	N/A	42.3	55.2	N/A	42.7	54.0

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

**Table 2 Harmonic Radiated Emissions in Restricted Bands Data (802.11 worst-case)**

Frequency in MHz	Horizontal Peak (dB $\mu$ V/m)	Horizontal Quasi-Peak (dB $\mu$ V/m)	Horizontal Average (dB $\mu$ V/m)	Vertical Peak (dB $\mu$ V/m)	Vertical Quasi-Peak (dB $\mu$ V/m)	Vertical Average (dB $\mu$ V/m)	Limit @ 3m (dB $\mu$ V/m)
2390.0	59.9	N/A	43.3	62.2	N/A	46.5	54.0
2483.5	60.2	N/A	45.2	63.4	N/A	44.0	54.0
4824.0	51.5	N/A	39.5	49.7	N/A	36.8	54.0
4874.0	51.0	N/A	39.4	50.2	N/A	37.0	54.0
4924.0	51.6	N/A	40.7	50.4	N/A	37.4	54.0
7236.0	53.8	N/A	41.2	54.0	N/A	40.9	54.0
7311.0	53.4	N/A	40.4	52.7	N/A	40.4	54.0
7386.0	52.8	N/A	40.2	52.9	N/A	40.2	54.0
12060.0	54.2	N/A	41.7	54.4	N/A	42.1	54.0
12185.0	54.4	N/A	41.7	54.1	N/A	41.1	54.0
12310.0	55.0	N/A	42.6	56.1	N/A	43.3	54.0

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

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

The EUT demonstrated compliance with the radiated emissions requirements of CFR 47 Part 15C and RSS-210 Intentional Radiators. The EUT (BT mode) demonstrated a worst-case minimum harmonic margin of -11.3 dB below the radiated emissions requirements and general emission of -6.3 dB below requirements in restricted frequency bands. The EUT (Wi-Fi mode) demonstrated a worst-case minimum harmonic margin of -7.5 dB below the radiated emissions requirements and general emission of -6.3 dB below 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.

**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. 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.

**Table 3 General Radiated Emissions from EUT Data (Highest Emissions)**

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Quasi-Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Quasi-Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
120.0	32.6	31.4	N/A	28.2	26.3	N/A	43.5
167.0	35.6	32.3	N/A	32.4	29.8	N/A	43.5

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

**Summary of Results for General Radiated Emissions**

The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15C paragraph 15.209 and RSS-210 Intentional Radiators. The EUT demonstrated a minimum margin of -11.2 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 transmitter output power; harmonic and general emissions were measured on an open area test site @ 3 meters. Test procedures of ANSI C63.10-2009 paragraph 6 were used during testing. 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 amplitude of each radiated emission was measured on the OATS at a distance of 3 meters from the FSM antenna (testing was performed on sample 1 representative of production with integral antenna). Each radiated emission was maximized by varying the FSM antenna height and polarization, and by rotating the turntable. The worst-case amplitude of each emission was then recorded from the analyzer display. The peak and quasi-peak amplitude of frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of frequencies above 1000 MHz were measured using a spectrum analyzer. A Loop antenna was used for measuring emissions from 0.009 to 30 MHz, Biconilog Antenna for 30 to 1000 MHz, Double-Ridge, and/or Pyramidal Horn Antennas from 1 GHz to 25 GHz. Emissions were measured in dB $\mu$ V/m @ 3 meters. Test sample #2 was provided for testing antenna port conducted emissions. This sample was modified by replacing the internal antenna with a 50-ohm antenna port connector for testing purposes. Plots were taken of transmitter performance (using sample #2) for reference in this and other documentation.

Refer to figures one through six showing plots taken of the 2402-2480 MHz operation performance displaying compliance with the specifications.

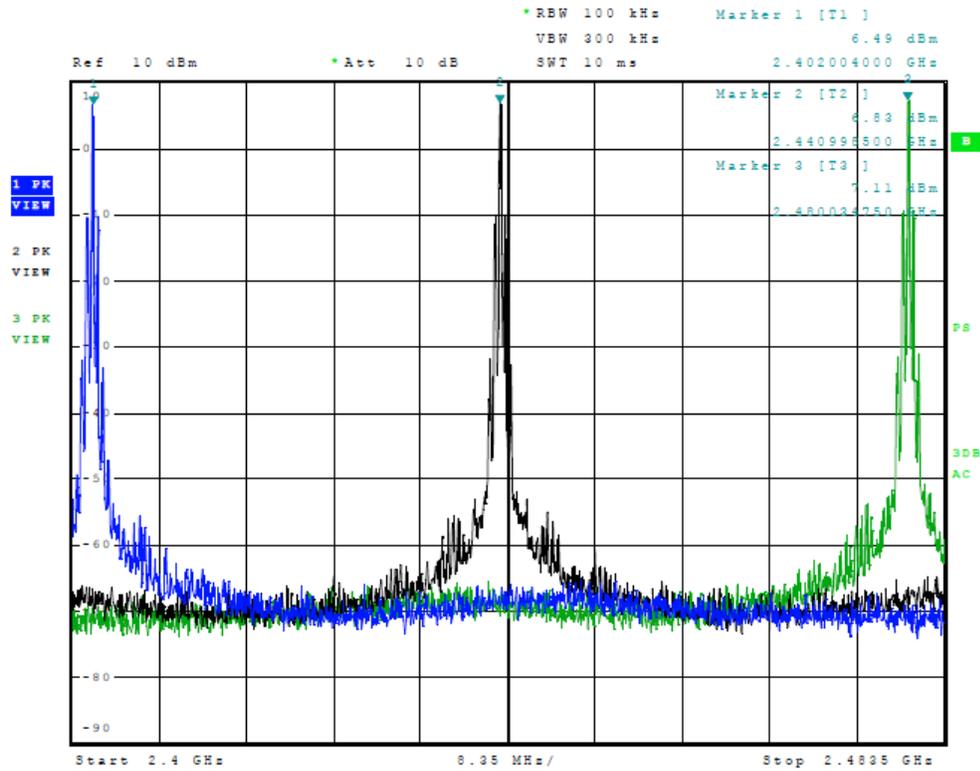


Figure 1 Plot of Transmitter Emissions in Operational Frequency (BT Mode)

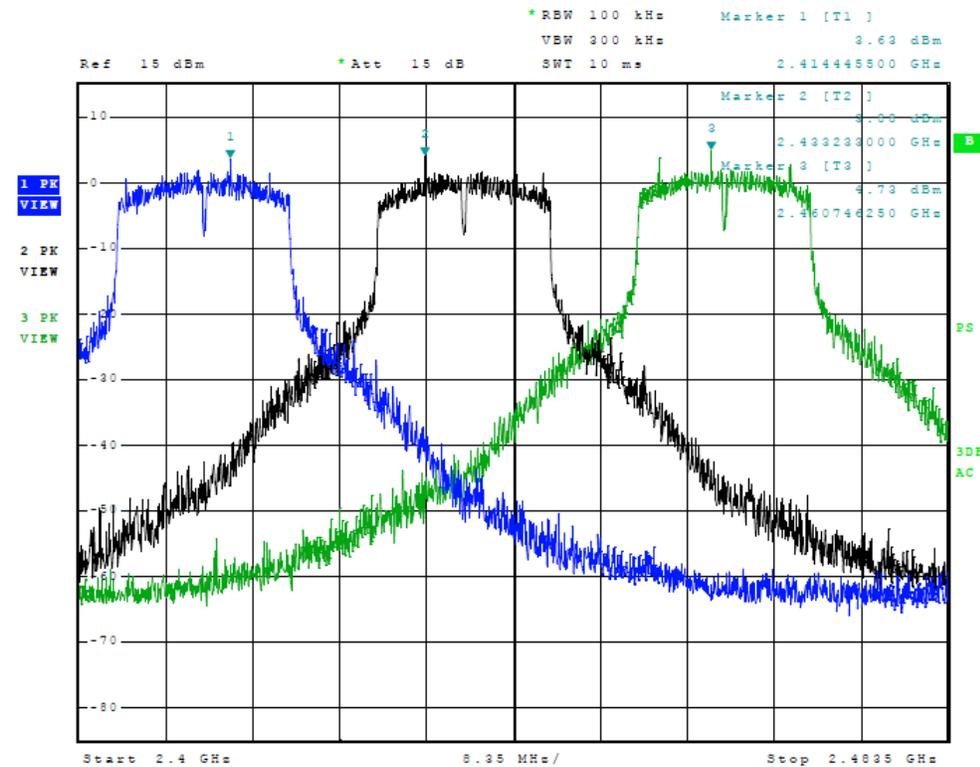


Figure 2 Plot of Transmitter Emissions in Operational Frequency (802.11 Mode)



Figure 3 Plot of Transmitter Emissions Low Band Edge (802.11 b-mode)

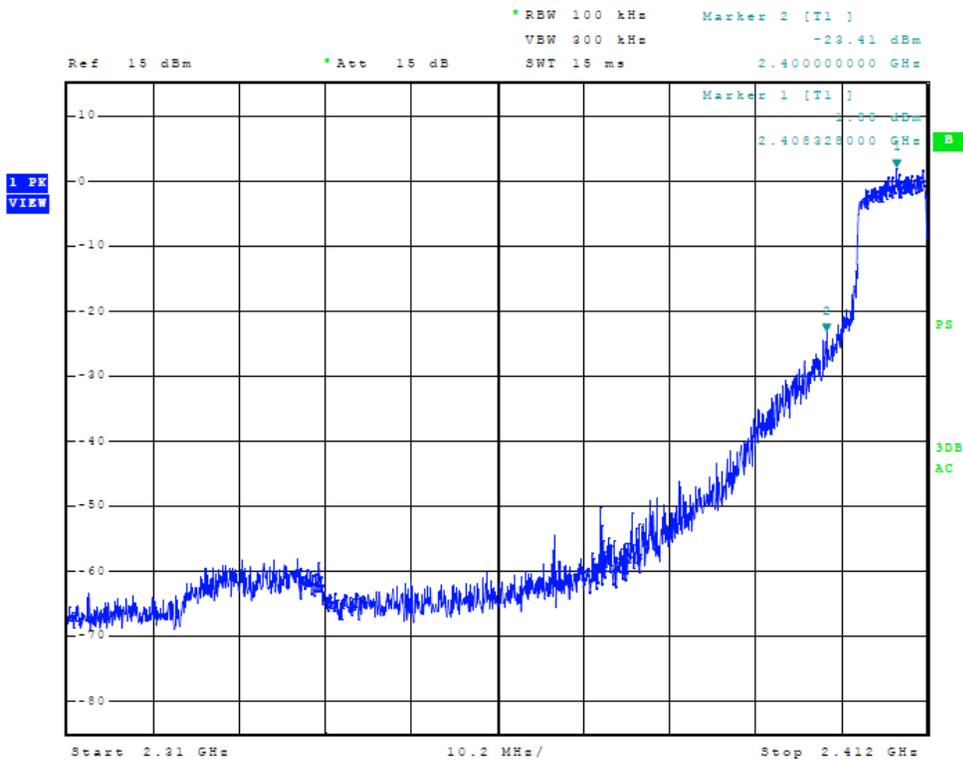


Figure 4 Plot of Transmitter Low Band Edge (802.11 g-mode)



Figure 5 Plot of Transmitter High Band Edge (802.11 b-mode)

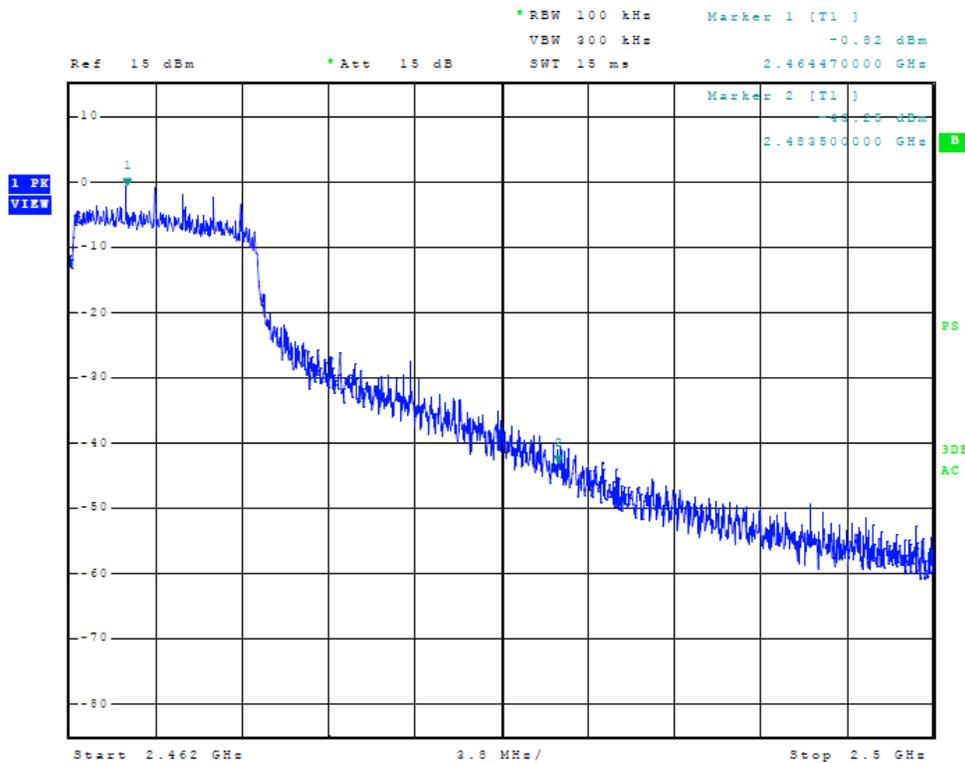


Figure 6 Plot of Transmitter High Band Edge (802.11 g-mode)

**Transmitter Emissions Data**

**Table 4 Transmitter Radiated Emission (BT mode)**

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)
2402.0	--	--	--	--	--
4804.0	50.1	37.3	50.4	37.3	54.0
7206.0	53.1	40.4	53.3	40.4	54.0
9608.0	54.1	41.0	53.5	40.8	54.0
12010.0	54.5	42.0	54.3	41.9	54.0
14412.0	58.0	45.4	58.5	45.4	54.0
16814.0	57.8	45.1	58.3	45.2	54.0
2441.0	--	--	--	--	--
4882.0	50.3	37.1	49.9	37.2	54.0
7323.0	53.3	40.5	54.6	40.5	54.0
9764.0	54.8	43.0	54.1	42.7	54.0
12205.0	54.4	41.1	54.4	41.6	54.0
14646.0	59.4	46.3	59.5	46.7	54.0
17087.0	57.0	43.9	57.0	43.9	54.0
2480.0	--	--	--	--	--
4960.0	52.2	41.0	52.1	40.3	54.0
7440.0	52.4	39.9	52.7	40.3	54.0
9920.0	54.8	44.0	54.4	44.8	54.0
12400.0	55.0	42.3	55.2	42.7	54.0
14880.0	58.1	45.0	58.8	45.4	54.0
17360.0	60.9	47.7	60.3	47.6	54.0

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

**Table 5 Transmitter Radiated Emission (802.11 mode)**

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	--	--	--	--	--
4824.0	51.5	39.5	49.7	36.8	54.0
7236.0	53.8	41.2	54.0	40.9	54.0
9648.0	54.6	41.2	54.7	41.9	54.0
12060.0	54.2	41.7	54.4	42.1	54.0
14472.0	58.3	45.3	58.4	45.6	54.0
16884.0	56.1	43.8	56.1	43.7	54.0
2437.0	--	--	--	--	--
4874.0	51.0	39.4	50.2	37.0	54.0
7311.0	53.4	40.4	52.7	40.4	54.0
9748.0	53.4	41.0	52.8	40.6	54.0
12185.0	54.4	41.7	54.1	41.1	54.0
14622.0	59.7	47.3	59.3	46.8	54.0
17059.0	55.9	43.6	56.6	43.6	54.0
2462.0	--	--	--	--	--
4924.0	51.6	40.7	50.4	37.4	54.0
7386.0	52.8	40.2	52.9	40.2	54.0
9848.0	54.4	42.2	53.8	41.4	54.0
12310.0	55.0	42.6	56.1	43.3	54.0
14772.0	58.1	45.6	58.2	45.7	54.0
17234.0	59.1	46.0	58.2	46.0	54.0

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

**Table 6 Transmitter Antenna Port Power**

Frequency MHz	Conducted Antenna Port Output Power (dBm / watts)	6-dB Occupied Bandwidth (kHz)	Power Spectral Density (dBm)
BT Mode			
2402	6.6 / 0.005	1,117	1.3
2441	6.9 / 0.005	1,117	1.5
2480	6.8 / 0.005	1,117	1.8
802.11 B-Mode			
2412	17.01 / 0.050	10,600	-1.2
2437	17.47 / 0.055	10,800	-0.3
2462	17.74 / 0.060	10,640	-1.8
802.11 G-Mode			
2412	16.88 / 0.050	16,800	-5.5
2437	16.89 / 0.050	16,750	-4.7
2462	17.01 / 0.050	16,800	-5.1

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

The EUT demonstrated compliance with the radiated emissions requirements of CFR47 Part 15.247 and RSS-210 Digital Transmission Systems. Measured Peak conducted power of 17.7 dBm, 0.060 Watts for 802.11 operations in 2412-2462 MHz and 6.9 dBm, 0.005 Watts for BT operation. The peak power spectral density presented a minimum margin of -6.2 dB below the requirements. The EUT demonstrated a minimum margin of -6.3 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 and RSS-210 emission requirements. 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**

Measurement uncertainty calculations were made for the laboratory. Result of measurement uncertainty calculations are recorded below for AC line conducted and radiated emission measurements.

Measurement Uncertainty	$U_{(E)}$	$U_{(lab)}$
3 Meter Horizontal 30-200 MHz Measurements	2.08	4.16
3 Meter Vertical 30-200 MHz Measurements	2.16	4.33
3 Meter Vertical Measurements 200-1000 MHz	2.99	5.97
10 Meter Horizontal Measurements 30-200 MHz	2.07	4.15
10 Meter Vertical Measurements 30-200 MHz	2.06	4.13
10 Meter Horizontal Measurements 200-1000 MHz	2.32	4.64
10 Meter Vertical Measurements 200-1000 MHz	2.33	4.66
3 Meter Measurements 1-6 GHz	2.57	5.14
3 Meter Measurements 6-18 GHz	2.58	5.16
AC Line Conducted	1.72	3.43



**Annex B Rogers Labs Test Equipment List**

List of Test Equipment	Calibration Date
Spectrum Analyzer: Rohde & Schwarz ESU40	5/13
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W	5/13
Spectrum Analyzer: HP 8591EM	5/13
Antenna: EMCO Biconilog Model: 3143	5/13
Antenna: Sunol Biconilog Model: JB6	10/13
Antenna: EMCO Log Periodic Model: 3147	10/13
Antenna: Com Power Model: AH-118	10/13
Antenna: Com Power Model: AH-840	10/13
Antenna: Antenna Research Biconical Model: BCD 235	10/13
Antenna: EMCO 6509	10/13
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohm/0.1 µf	10/13
R.F. Preamp CPPA-102	10/13
Attenuator: HP Model: HP11509A	10/13
Attenuator: Mini Circuits Model: CAT-3	10/13
Attenuator: Mini Circuits Model: CAT-3	10/13
Cable: Belden RG-58 (L1)	10/13
Cable: Belden RG-58 (L2)	10/13
Cable: Belden 8268 (L3)	10/13
Cable: Time Microwave: 4M-750HF290-750	10/13
Cable: Time Microwave: 10M-750HF290-750	10/13
Frequency Counter: Leader LDC825	2/14
Oscilloscope Scope: Tektronix 2230	2/14
Wattmeter: Bird 43 with Load Bird 8085	2/14
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/14
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/14
R.F. Power Amp 65W Model: 470-A-1010	2/14
R.F. Power Amp 50W M185- 10-501	2/14
R.F. Power Amp A.R. Model: 10W 1010M7	2/14
R.F. Power Amp EIN Model: A301	2/14
LISN: Compliance Eng. Model 240/20	2/14
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/14
Antenna: EMCO Dipole Set 3121C	2/14
Antenna: C.D. B-101	2/14
Antenna: Solar 9229-1 & 9230-1	2/14
Audio Oscillator: H.P. 201CD	2/14
ELGAR Model: 1751	2/14
ELGAR Model: TG 704A-3D	2/14
ESD Test Set 2010i	2/14
Fast Transient Burst Generator Model: EFT/B-101	2/14
Field Intensity Meter: EFM-018	2/14
KEYTEK Ecat Surge Generator	2/14
Shielded Room 5 M x 3 M x 3.0 M	



## **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**

June 28, 2013

Registration Number: 90910

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

Attention: Scot Rogers,

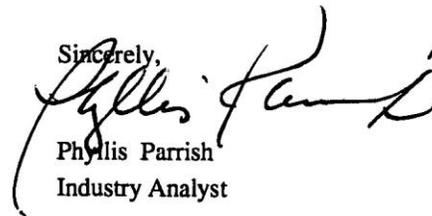
Re: Measurement facility located at Louisburg  
3 & 10 meter site  
Date of Renewal: June 28, 2013

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

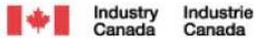
Garmin International, Inc.  
Model: M4AUND00  
Test #: 140327  
Test to: CFR47 (15.247), RSS-210 (DTS)  
File: Garmin M4AUND00 DTS TstRpt 140327

SN: 38812-91343  
FCC ID#: IPH-02438  
IC: 1792A-02438  
Date: July 22, 2014  
Page 28 of 29



NVLAP Lab Code 200087-0

## Annex E Industry Canada Site Registration Letter



June 19, 2013

OUR FILE: 46405-3041

Submission No: 168037

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

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

Dear Sir:

The Bureau has received your application for the renewal of 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,

Bill Payn  
For: Wireless Laboratory Manager  
**Certification and Engineering Bureau**  
3701 Carling Ave., Building 94  
P.O. Box 11490, Station "H"  
Ottawa, Ontario K2H 8S2  
Email: [Bill.Payn@ic.gc.ca](mailto:Bill.Payn@ic.gc.ca)  
Tel. No. (613) 990-3639  
Fax. No. (613) 990-4752

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

Garmin International, Inc.  
Model: M4AUND00  
Test #: 140327  
Test to: CFR47 (15.247), RSS-210 (DTS)  
File: Garmin M4AUND00 DTS TstRpt 140327

SN: 38812-91343  
FCC ID#: IPH-02438  
IC: 1792A-02438  
Date: July 22, 2014  
Page 29 of 29