

Application For Grant of Certification

FOR

FOR

Models: F4ACGQ00, O4AHGQ00
2412-2462 MHz (DTS)

Broadband Digital Transmission System

FCC ID: IPH-02276

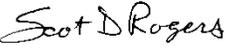
IC: 1792A-02276

FOR

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Test Report Number: 131028

Authorized Signatory: 
Scot D. Rogers



ROGERS LABS, INC.

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

Engineering Test Report For Grant of Certification Application

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

For

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Broadband Digital Transmission System
Models: F4ACGQ00, O4AHGQ00
Frequency Range 2412-2462 MHz
FCC ID#: IPH-02276
IC: 1792A-02276

Test Date: October 28, 2013

Certifying Engineer:

Scot D. Rogers

Scot D. Rogers
Rogers Labs, Inc.
4405 West 259th 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.....7

APPLICATION FOR CERTIFICATION..... 8

APPLICABLE STANDARDS & TEST PROCEDURES 9

EQUIPMENT TESTING PROCEDURES 9

AC Line Conducted Emission Test Procedure9

 Diagram 1 Test arrangement for Conducted emissions10

Radiated Emission Test Procedure.....11

 Diagram 2 Test arrangement for radiated emissions of tabletop equipment.....11

 Diagram 3 Test arrangement for radiated emissions tested on Open Area Test Site (OATS).....12

TEST SITE LOCATIONS 13

UNITS OF MEASUREMENTS 13

ENVIRONMENTAL CONDITIONS..... 13

LIST OF TEST EQUIPMENT 14

INTENTIONAL RADIATORS..... 15

Antenna Requirements15

Restricted Bands of Operation.....15

 Table 1 Harmonic Radiated Emissions in Restricted Bands Data16

Summary of Results for Radiated Emissions in Restricted Bands16

AC Line Conducted EMI Procedure17

 Figure 1 AC Line Conducted emissions of EUT line 1 (EUT AC Adapter)18

 Figure 2 AC Line Conducted emissions of EUT line 2 (EUT AC Adapter)18

 Figure 3 AC Line Conducted emissions of EUT line 1 (EUT-USB-CPU).....19



Figure 4 AC Line Conducted emissions of EUT line 2 (EUT-USB-CPU).....19

Table 2 AC Line Conducted Emissions Data L1 (EUT-AC Adapter).....20

Table 3 AC Line Conducted Emissions Data L2 (EUT-AC Adapter).....20

Table 4 AC Line Conducted Emissions Data L1 (EUT-USB-CPU)21

Table 5 AC Line Conducted Emissions Data L2 (EUT-USB-CPU)21

Summary of Results for AC Line Conducted Emissions Results.....21

General Radiated Emissions Procedure22

Table 6 General Radiated Emissions from EUT Data (Highest Emissions).....23

Summary of Results for General Radiated Emissions23

Operation in the Band 2400 – 2483.5 MHz23

Figure 5 Plot of Transmitter Emissions in Operational Frequency (802.11 B-Mode).....24

Figure 6 Plot of Transmitter Emissions in Operational Frequency (802.11 G-Mode).....24

Figure 7 Plot of Transmitter Emissions Occupied Bandwidth (802.11 B-Mode).....25

Figure 8 Plot of Transmitter Occupied Bandwidth (802.11 G-Mode).....25

Figure 9 Plot of Transmitter Emissions Low Band Edge (b-mode).....26

Figure 10 Plot of Transmitter Low Band Edge (g-mode).....26

Figure 11 Plot of Transmitter High Band Edge (b-mode)27

Figure 12 Plot of Transmitter High Band Edge (g-mode)27

Figure 13 Plot of Transmitter Output Power28

Figure 14 Plot of Transmitter Output Power28

Figure 15 Plot of Transmitter Output Power28

Transmitter Emissions Data.....29

Table 7 Transmitter Radiated Emission.....29

Table 8 Transmitter Antenna Port Power30

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator.....30

STATEMENT OF MODIFICATIONS AND DEVIATIONS 30

ANNEX..... 31

Annex A Measurement Uncertainty Calculations.....32

Annex B Rogers Labs Test Equipment List.....33

Annex C Rogers Qualifications34

Annex D FCC Site Registration Letter.....35

Annex E Industry Canada Site Registration Letter36

Revisions

Revision 1 Issued January 8, 2014



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 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

Models: F4ACGQ00, O4AHGQ00

FCC I.D.: IPH-02276 Industry Canada ID: 1792A-02276

Frequency Range: 2412-2462 MHz with power level 0.03 Watt

Occupied Bandwidth: occupied bandwidth 16,368 kHz,

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Emissions as per CFR 47 paragraphs 2 and 15.205	-13.6	Complies
Emissions as per CFR 47 paragraphs 2 and 15.207	-10.7	Complies
Emissions as per CFR 47 paragraphs 2 and 15.209	-11.2	Complies
Harmonic Emissions per CFR 47 15.247	-13.6	Complies
Peak Power Spectral Density per CFR 47 15.247	-5.4	Complies

Equipment Tested

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT (sample #1)	F4ACGQ00, O4AHGQ00	92
EUT (sample #1)	F4ACGQ00, O4AHGQ00	91
AC Adapter	362-00072-00	N/A
USB Micro Cable	325-00541-01	N/A
Laptop Computer	Dell PP18L	00019241
USB Printer	Dell 0N5819	5D1SL61

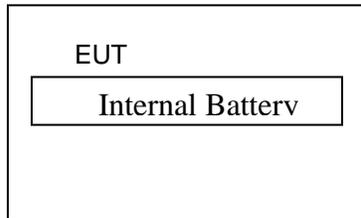
Test results in this report relate only to the items tested.

Equipment Function and Configuration

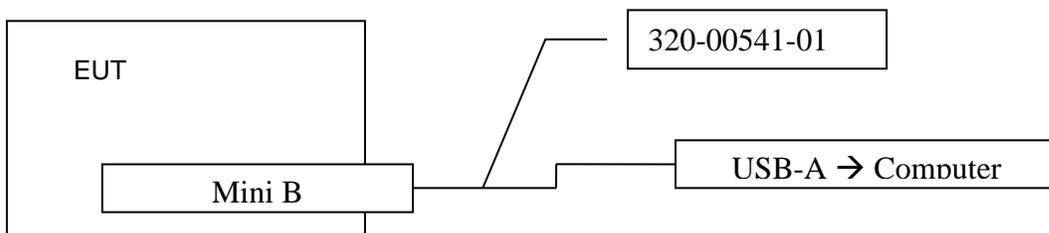
The EUT is a portable GPS navigation computer system providing mapping display and interface options as presented below in configuration diagrams. The design incorporates a Digital Transmission System transmitter with operation capability in the 2412-2462 MHz frequency bands. The design provides multiple communication protocol operation with single active channel/protocol at any time. The design utilizes internal fixed antenna system and offers no provision for antenna replacement or modification. Two samples were provided for testing purposes both using test software enabling transmitter function for testing. One test sample was modified with external antenna port for testing. The design offers interface capabilities wirelessly with compliant equipment and operates from internal or externally supplied direct current power. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interface connections as described by the manufacturer than those in the configuration options shown below. For testing purposes, the EUT received powered from internal rechargeable battery and/or applicable external power source and was configured to operate in available modes. During testing all interface connections were appropriately terminated. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration

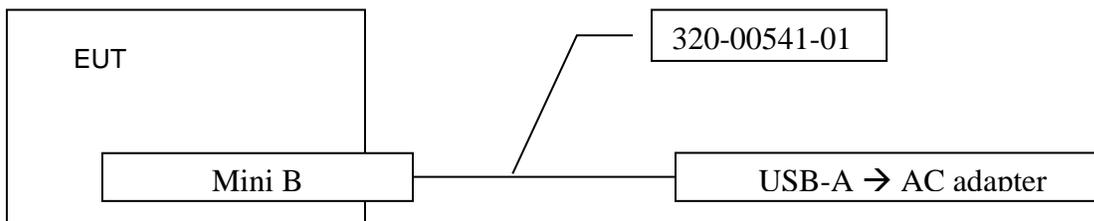
1. EUT operating off internal battery.



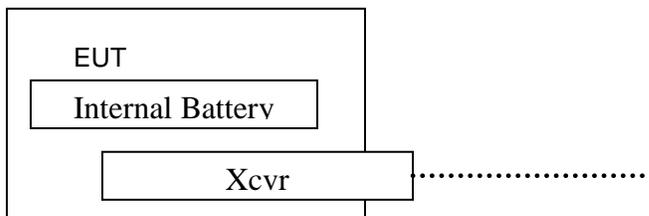
2. EUT internal battery charged by PC through mini B USB cable (GPN: 320-00541-01).



3. EUT internal battery charged by AC adapter (GPN: 362-00072-00) through mini B USB cable (GPN: 320-00541-01).



4. EUT transmitting data through compliant wireless communication and powered by internal batteries.





Application for Certification

- (1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062
- (2) Identification: Models: F4ACGQ00, O4AHGQ00
FCC I.D.: IPH-02276 IC ID: 1792A-02276
- (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 internal battery or direct current power supplied from authorized source. Additional optional accessory interface capabilities are provided through USB port. 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

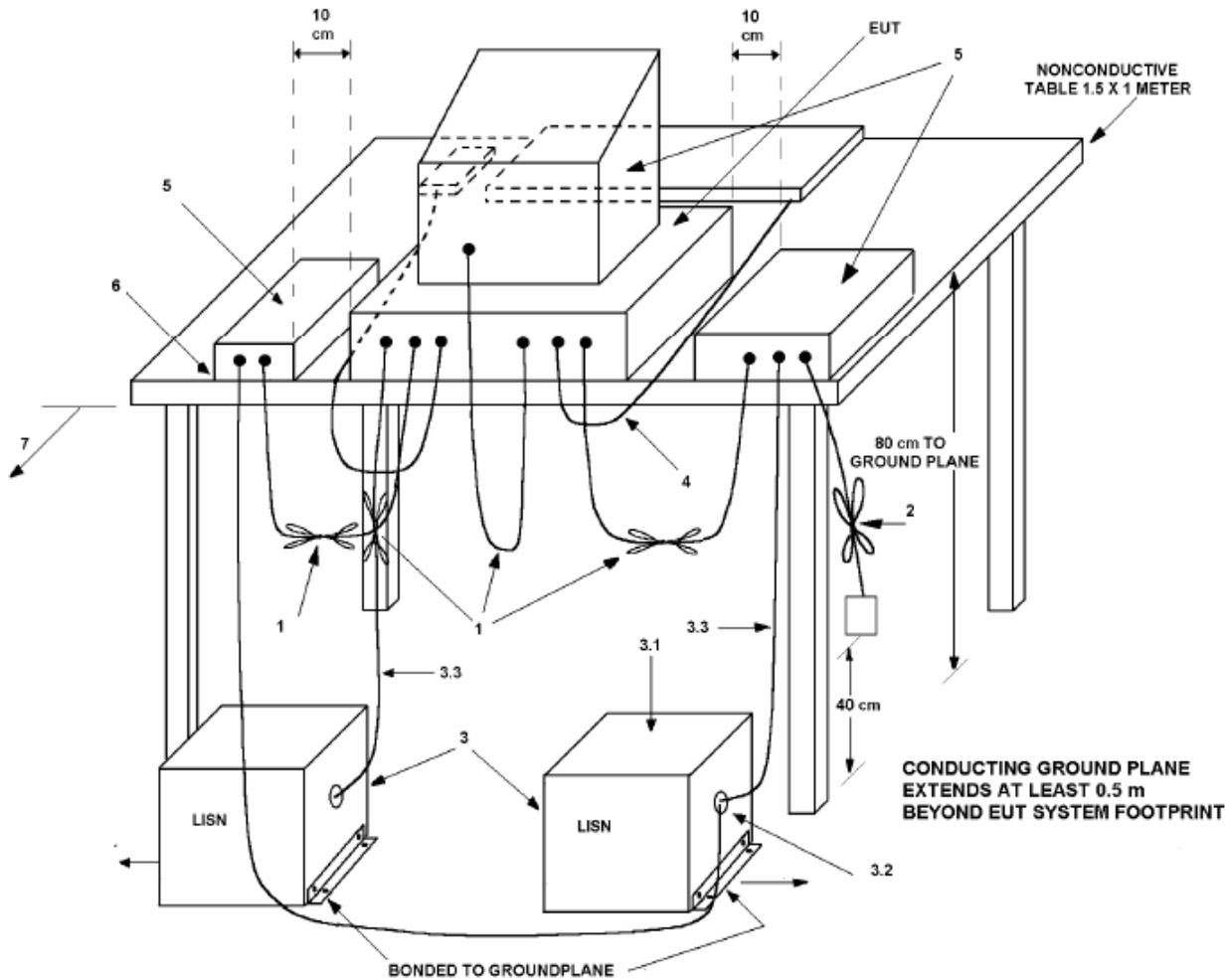
In accordance with the Federal Communications Code of Federal Regulations, dated October 1, 2013, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.247, and RSS-210 the following information is submitted. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.4-2009, ANSI C63.10-2009, FCC KDB documents KDB 558074 D01 v03r01 and KDB 913591. The system operates from direct current rechargeable battery power and offers provision for connection to utility power systems or compliant equipment. 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 radiated emissions was performed as defined in sections 8 and 13.1.4 of ANSI C63.4-2009. Testing of the radiated emissions was performed as required including procedures in section 13 of ANSI C63.4-2009.

Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions was performed as defined in sections 7.2.4 and 13.3 of ANSI C63.4-2009. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter 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. Refer to photographs in exhibits for EUT placement used during testing.

Diagram 1 Test arrangement for Conducted emissions

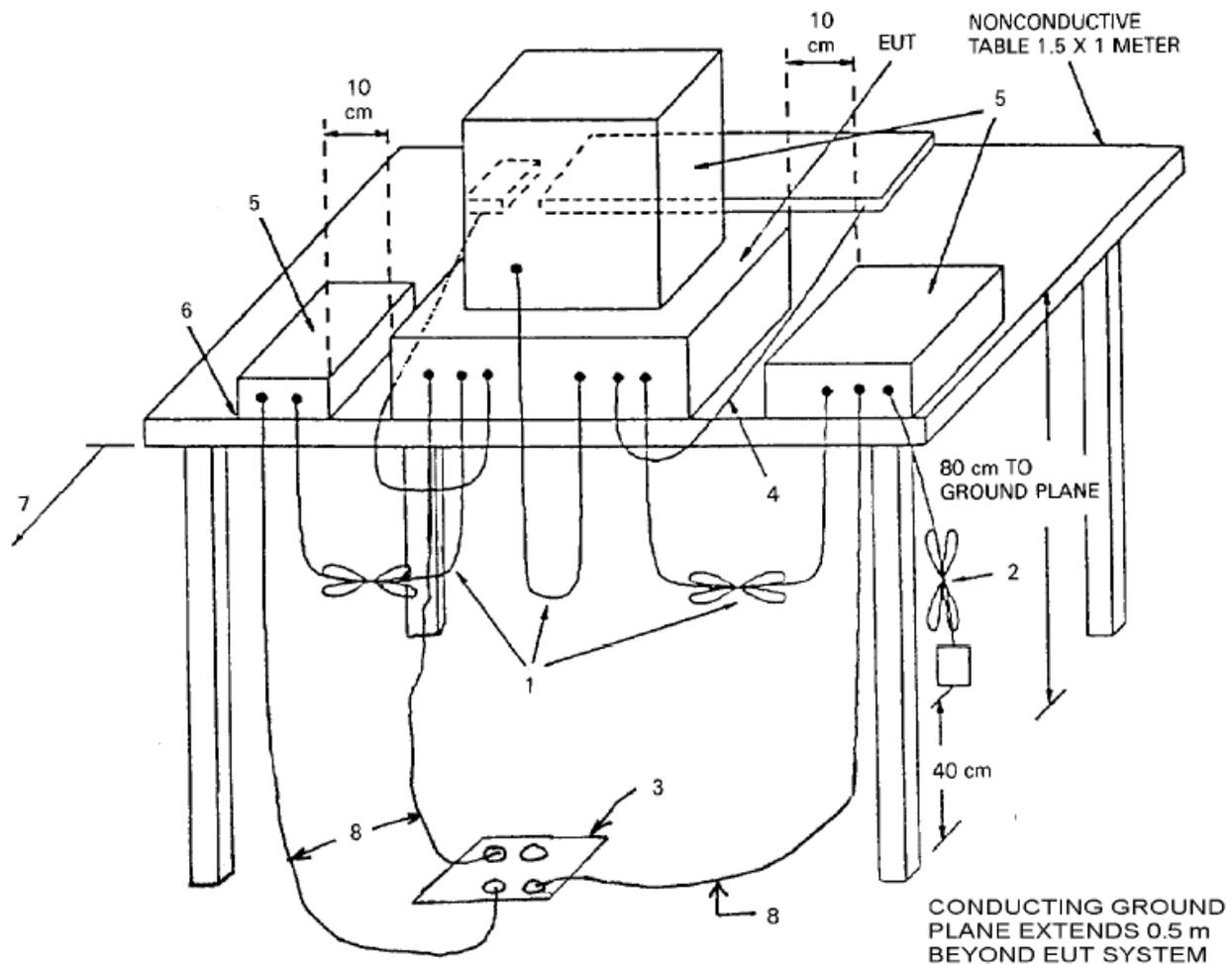


1. Interconnecting cables that hang closer than 40 cm to the ground plane were folded back and forth in the center forming a bundle 30 cm to 40 cm long.
2. Input/output (I/O) cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
3. EUT connected to one LISN. Unused LISN measuring port connectors are terminated into 50 Ω loads. LISN is placed on top of and bonded to reference ground plane.
 - 3.1 All other equipment powered from additional LISN(s).
 - 3.2 Multiple outlet strips can be used for multiple power cords of non-EUT equipment.
 - 3.3 LISN is positioned at least 80 cm from nearest part of EUT chassis.
4. Cables of hand-operated devices, such as keyboards, mice, and so on, shall be placed as for normal use.
5. Non-EUT components of EUT system being tested.
6. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.
7. Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 5.2.2 for options).

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 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. 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.

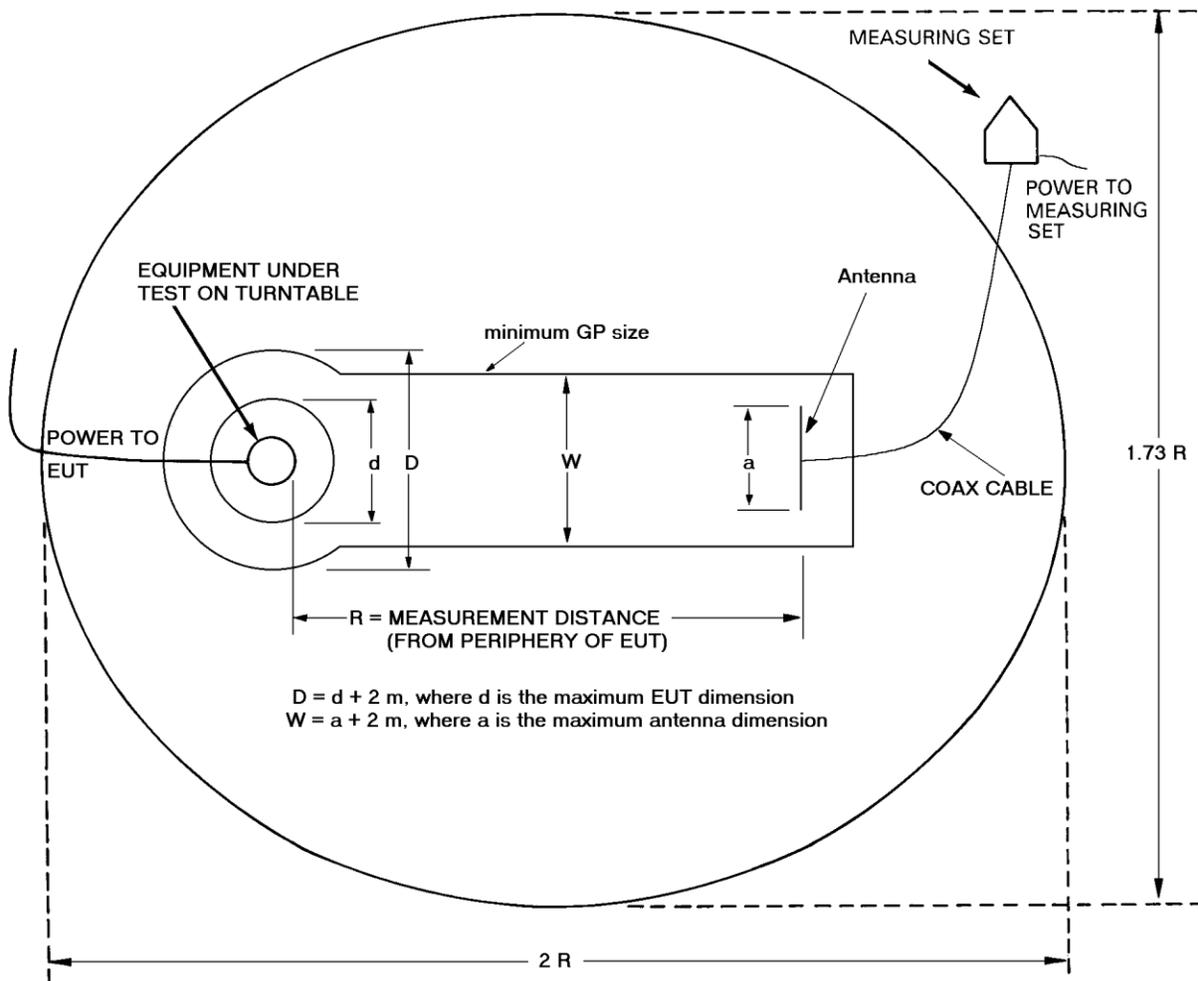
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



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.

2. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated if required using the correct terminating impedance. The total length shall not exceed 1 m.
3. If LISNs are kept in the test setup for radiated emissions, it is preferred that they be installed under the ground plane with the receptacle flush with the ground plane.
4. Cables of hand-operated devices, such as keyboards, mice, and so on, shall be placed as for normal use.
5. Non-EUT components of EUT system being tested.
6. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (possibly center of table for transmitter equipment).
7. No vertical conducting plane used.
8. Power cords drape to the floor and are routed over to receptacle.

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



AREA DIMENSIONS =	R = 3m	R = 10 m	R = 30 m
	6 m x 5.2 m	20 m x 17.3 m	60 m x 52 m



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 th 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 th 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 μ V; dB referenced to one microvolt
Radiated EMI	Data is in dB μ 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
$$RFS \text{ (dB}\mu\text{V/m @ 3m)} = FSM \text{ (dB}\mu\text{V)} + A.F. \text{ (dB)} - \text{Gain (dB)}$$

Environmental Conditions

Ambient Temperature	20.9° C
Relative Humidity	31%
Atmospheric Pressure	1020.3 mb

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>Band</u>	<u>Cal Date</u>	<u>Due</u>
<input checked="" type="checkbox"/> LISN	Comp. Design	FCC-LISN-2-MOD.CD	.15-30MHz	10/13	10/14
<input type="checkbox"/> Antenna	ARA	BCD-235-B	20-350MHz	10/13	10/14
<input type="checkbox"/> Antenna	EMCO	3147	200-1000MHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Com Power	AH-118	1-18 GHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Com Power	AH-840	18-40 GHz	5/13	5/14
<input checked="" type="checkbox"/> Antenna	EMCO	6509	.001-30 MHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6	30-1000 MHz	10/13	10/14
<input checked="" type="checkbox"/> Antenna	Standard	FXRY638A	10-18 GHz	5/13	5/14
<input type="checkbox"/> Antenna	EMCO	3143	20-1200 MHz	5/13	5/14
<input type="checkbox"/> Analyzer	HP	8591EM	9kHz-1.8GHz	5/13	5/14
<input type="checkbox"/> Analyzer	HP	8562A	9kHz-110GHz	5/13	5/14
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40	20Hz-40GHz	5/13	5/14
<input checked="" type="checkbox"/> Amplifier	Com-Power	PA-010	100Hz-30MHz	10/13	10/14
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102	1-1000 MHz	10/13	10/14
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-118A	0.5-18 GHz	10/13	10/14



Intentional Radiators

As per CFR47, Subpart C, paragraph 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 system. The antenna connection point complies with the unique antenna connection requirements. The unique antenna connection requirements 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 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 C63.4-2009 paragraphs 13.1 and 8.3.1.2 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

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	41.8	N/A	32.4	40.1	N/A	30.5	54.0
2483.5	41.0	N/A	28.5	43.3	N/A	29.0	54.0
4824.0	46.2	N/A	33.5	47.3	N/A	34.3	54.0
4874.0	46.3	N/A	32.9	46.8	N/A	33.8	54.0
4924.0	43.7	N/A	32.1	44.2	N/A	35.0	54.0
7236.0	49.6	N/A	38.3	52.9	N/A	40.4	54.0
7311.0	47.7	N/A	37.7	52.0	N/A	38.8	54.0
7386.0	47.9	N/A	37.8	52.0	N/A	39.8	54.0
12060.0	46.8	N/A	36.5	49.6	N/A	38.6	54.0
12185.0	48.8	N/A	36.0	50.6	N/A	38.6	54.0
12310.0	48.5	N/A	35.9	51.0	N/A	38.5	54.0

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

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 demonstrated a worst-case minimum harmonic margin of -13.6 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.



AC Line Conducted EMI Procedure

The EUT was arranged in typical equipment configurations as offered by manufacturer. Testing was performed with the EUT placed on a 1 x 1.5-meter wooden bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the line-conducted emissions were the procedures of ANSI C63.4-2009 paragraphs 13.3 and 7.2.4. The AC adapter 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. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which demonstrated the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz then data was recorded with maximum conducted emissions levels. Refer to figures one and two showing plots of the worst-case AC Line conducted emissions of the AC Adapter while charging the EUT. Refer to figures three and four showing plots of the worst-case AC Line conducted emissions of the EUT-USB-CPU configuration.

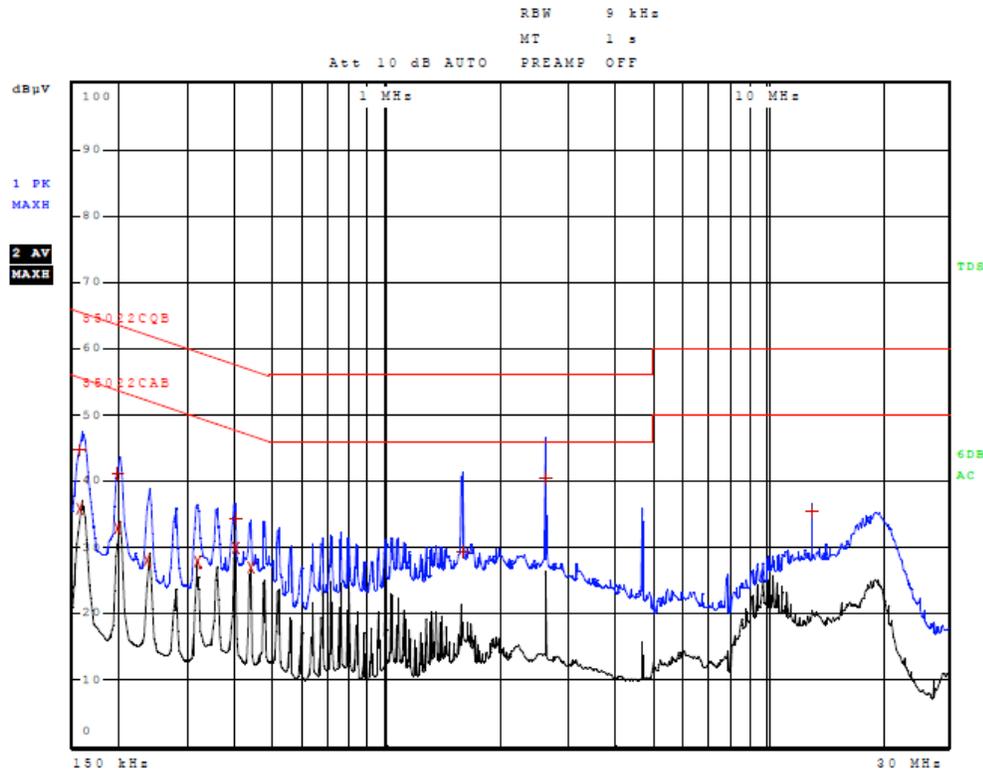


Figure 1 AC Line Conducted emissions of EUT line 1 (EUT AC Adapter)

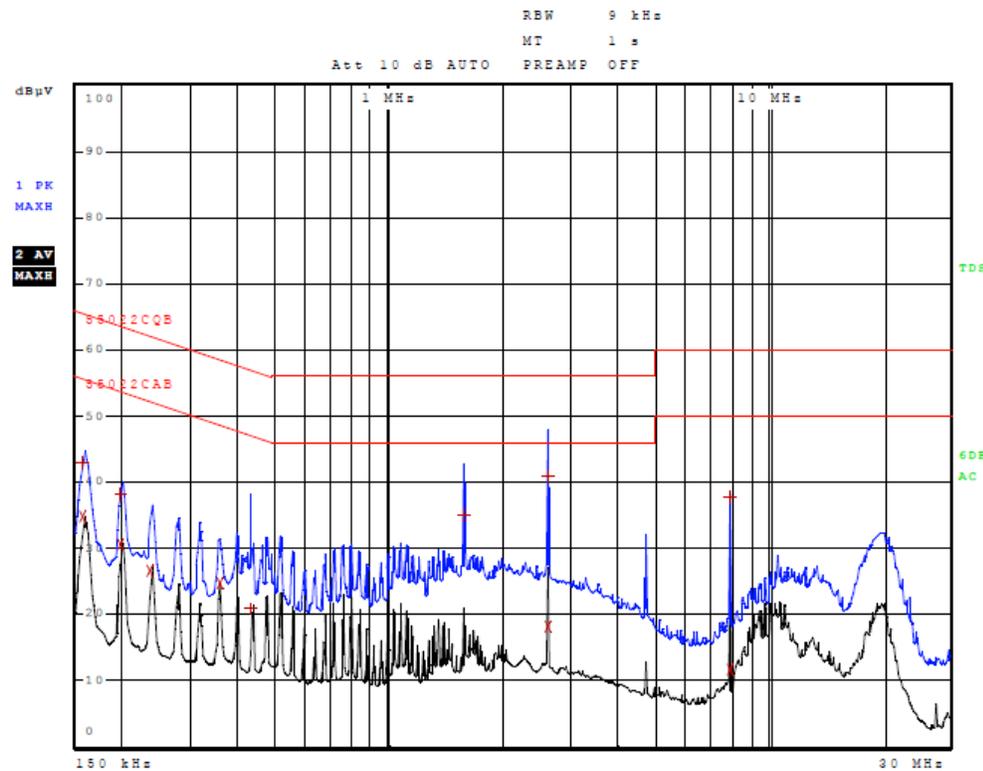


Figure 2 AC Line Conducted emissions of EUT line 2 (EUT AC Adapter)

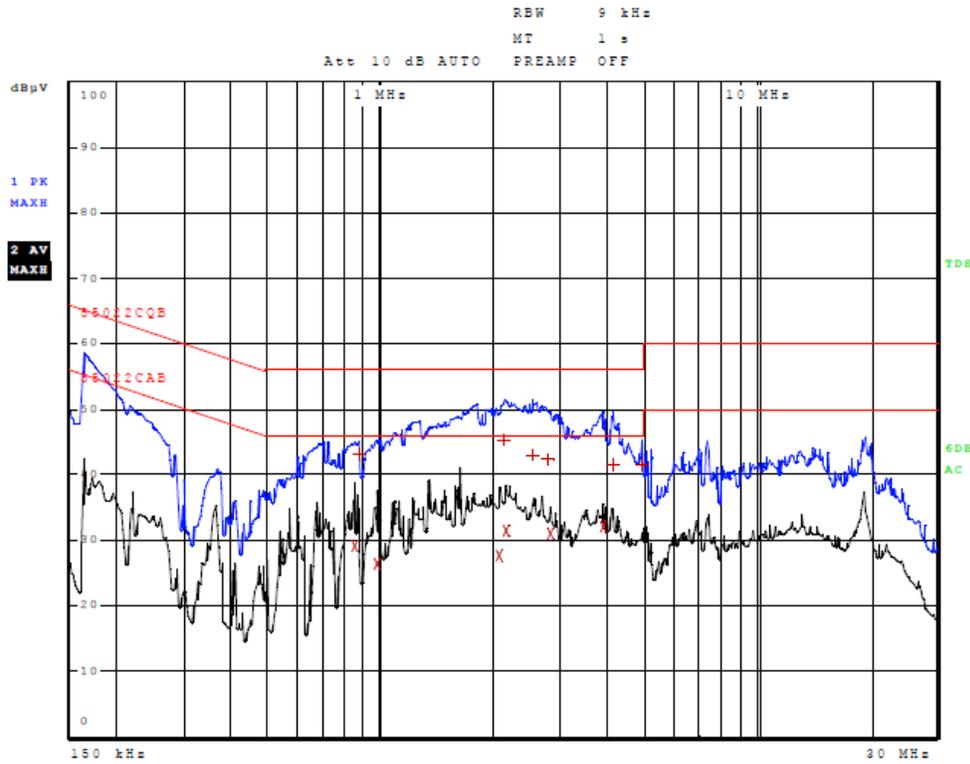


Figure 3 AC Line Conducted emissions of EUT line 1 (EUT-USB-CPU)

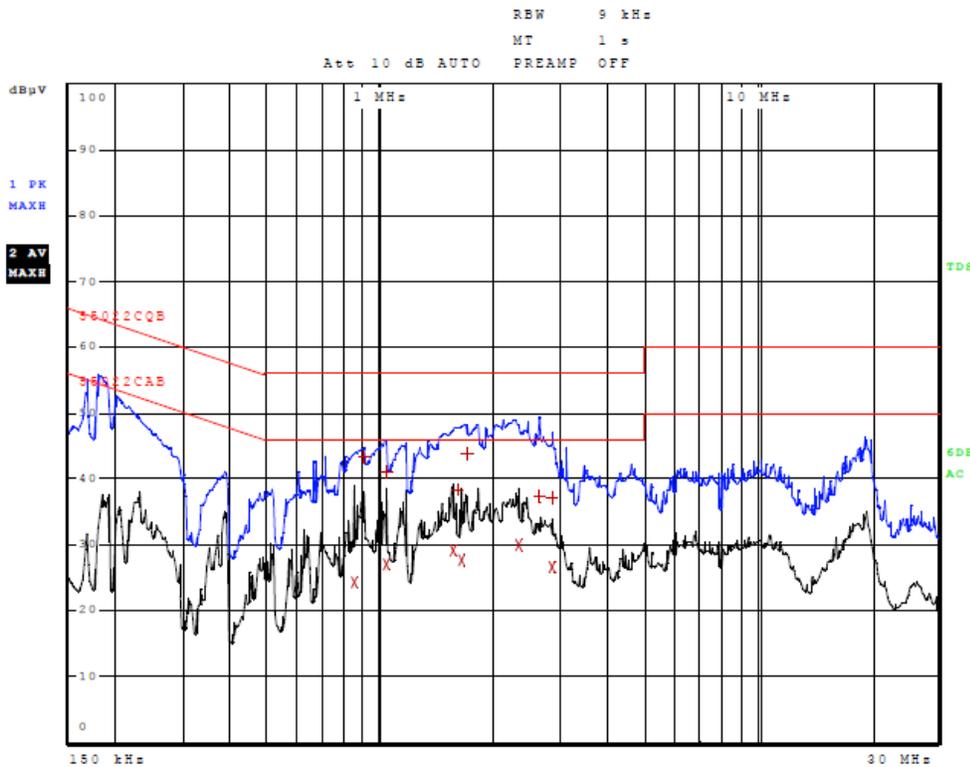


Figure 4 AC Line Conducted emissions of EUT line 2 (EUT-USB-CPU)



Table 2 AC Line Conducted Emissions Data L1 (EUT-AC Adapter)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	158.000000000 kHz	35.87	Average	-19.70
1	158.000000000 kHz	44.55	Quasi Peak	-21.02
2	198.000000000 kHz	32.90	Average	-20.80
1	198.000000000 kHz	41.11	Quasi Peak	-22.58
2	238.000000000 kHz	28.03	Average	-24.14
2	318.000000000 kHz	27.82	Average	-21.94
2	398.000000000 kHz	29.88	Average	-18.02
1	398.000000000 kHz	34.32	Quasi Peak	-23.57
2	438.000000000 kHz	27.10	Average	-20.00
1	1.582000000 MHz	29.35	Quasi Peak	-26.65
1	2.630000000 MHz	40.37	Quasi Peak	-15.63
1	13.140000000 MHz	35.33	Quasi Peak	-24.67

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

Table 3 AC Line Conducted Emissions Data L2 (EUT-AC Adapter)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	158.000000000 kHz	34.69	Average	-20.88
1	158.000000000 kHz	42.86	Quasi Peak	-22.71
2	198.000000000 kHz	30.53	Average	-23.16
1	198.000000000 kHz	38.12	Quasi Peak	-25.58
2	238.000000000 kHz	26.61	Average	-25.56
2	358.000000000 kHz	24.62	Average	-24.15
1	430.000000000 kHz	20.87	Quasi Peak	-36.38
1	1.574000000 MHz	35.06	Quasi Peak	-20.94
2	2.626000000 MHz	18.14	Average	-27.86
1	2.626000000 MHz	40.78	Quasi Peak	-15.22
1	7.884000000 MHz	37.80	Quasi Peak	-22.20
2	7.888000000 MHz	11.60	Average	-38.40

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



Table 4 AC Line Conducted Emissions Data L1 (EUT-USB-CPU)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	850.000000000 kHz	29.00	Average	-17.00
1	874.000000000 kHz	43.26	Quasi Peak	-12.74
2	974.000000000 kHz	26.28	Average	-19.72
2	2.058000000 MHz	27.59	Average	-18.41
1	2.110000000 MHz	45.24	Quasi Peak	-10.76
2	2.150000000 MHz	31.47	Average	-14.53
1	2.542000000 MHz	42.86	Quasi Peak	-13.14
1	2.782000000 MHz	42.25	Quasi Peak	-13.75
2	2.818000000 MHz	31.03	Average	-14.97
2	3.890000000 MHz	32.03	Average	-13.97
1	4.134000000 MHz	41.60	Quasi Peak	-14.40
1	4.958000000 MHz	41.44	Quasi Peak	-14.56

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

Table 5 AC Line Conducted Emissions Data L2 (EUT-USB-CPU)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	854.000000000 kHz	24.18	Average	-21.82
1	906.000000000 kHz	43.47	Quasi Peak	-12.53
1	1.034000000 MHz	41.17	Quasi Peak	-14.83
2	1.034000000 MHz	26.93	Average	-19.07
2	1.554000000 MHz	29.09	Average	-16.91
1	1.594000000 MHz	38.35	Quasi Peak	-17.65
2	1.638000000 MHz	27.70	Average	-18.30
1	1.694000000 MHz	43.77	Quasi Peak	-12.23
2	2.322000000 MHz	30.02	Average	-15.98
1	2.642000000 MHz	37.36	Quasi Peak	-18.64
1	2.850000000 MHz	37.12	Quasi Peak	-18.88
2	2.862000000 MHz	26.60	Average	-19.40

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

Summary of Results for AC Line Conducted Emissions Results

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of CFR 47 Part 15B and other applicable Class B emissions requirements. The EUT AC Adapter worst-case configuration demonstrated a minimum margin of -15.2 dB below the FCC/CISPR Class B limit. The EUT-USB-CPU worst-case configuration demonstrated a minimum margin of -10.7 dB below the FCC/CISPR Class B limit. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.



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 6 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
2390.0	41.8	N/A	32.4	40.1	N/A	30.5	54.0
2400.0	54.2	N/A	32.7	53.5	N/A	32.1	54.0

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

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of 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 was measured at the temporary test antenna port. EUT radiated emissions were 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. 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. Refer to figures five through fifteen showing plots taken of the EUT transmitter performance displaying compliance with the specifications. Test procedures as defined in publications KDB 558074 and ANSI C63.10-2009 were utilized during compliance testing. These procedures utilize measurement of maximum field strength and conversion calculation for comparison with requirements.

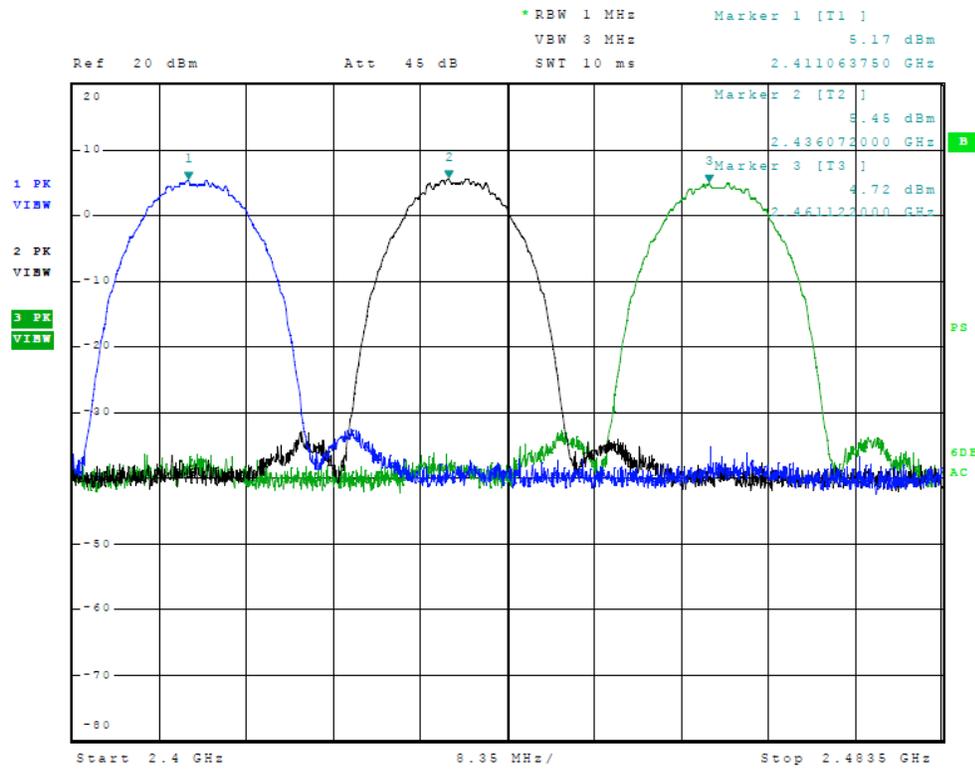


Figure 5 Plot of Transmitter Emissions in Operational Frequency (802.11 B-Mode)

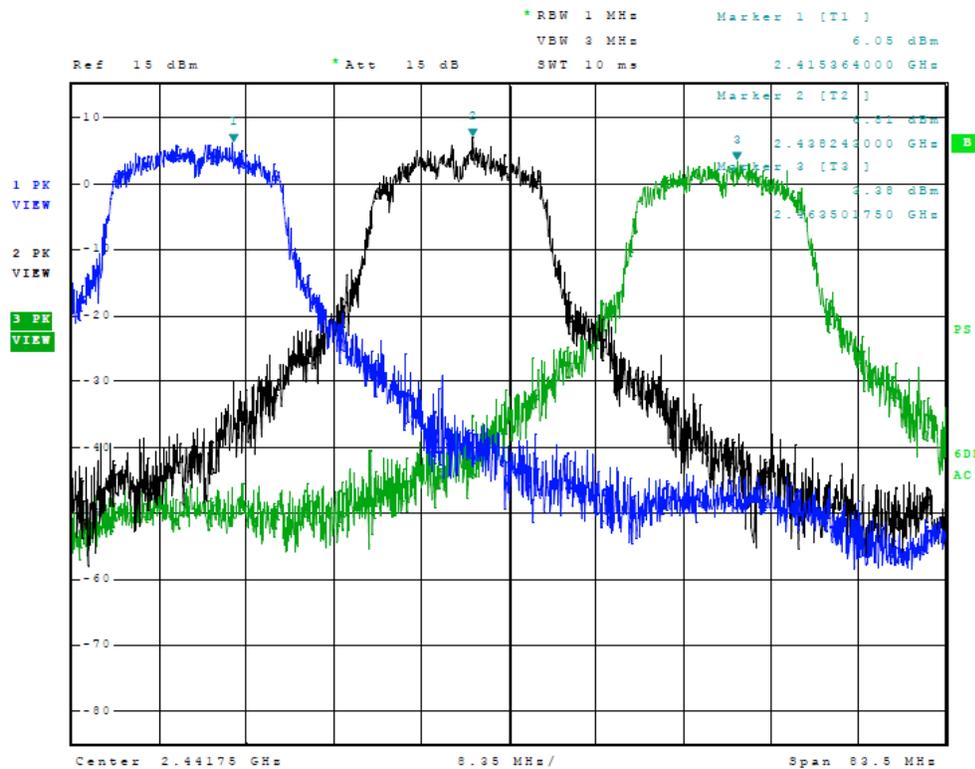


Figure 6 Plot of Transmitter Emissions in Operational Frequency (802.11 G-Mode)

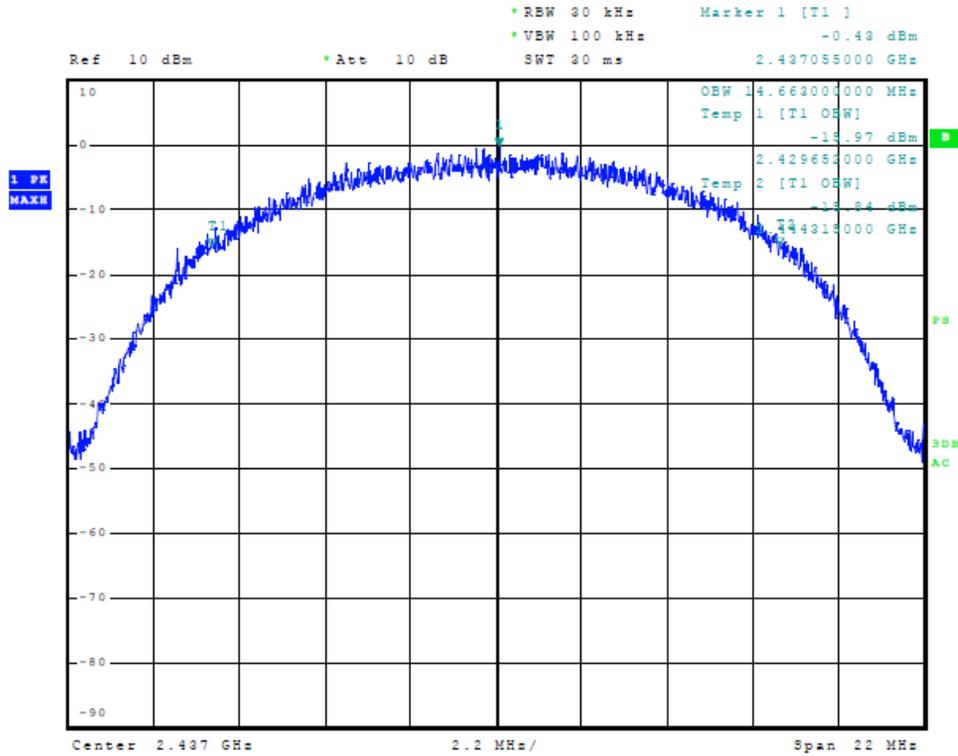


Figure 7 Plot of Transmitter Emissions Occupied Bandwidth (802.11 B-Mode)

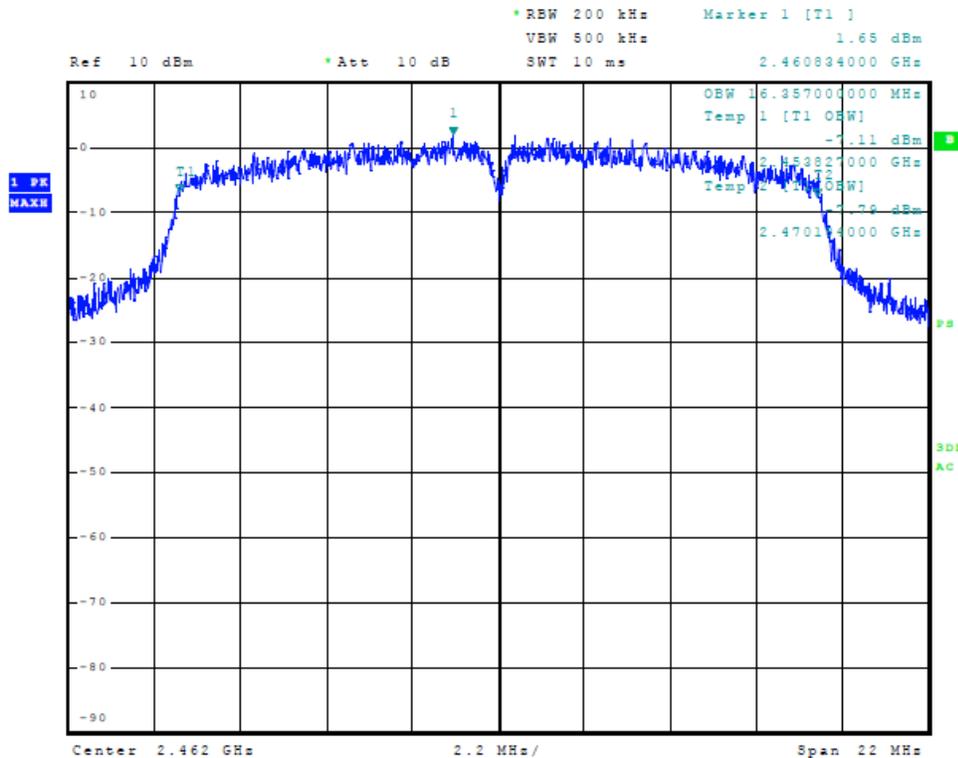


Figure 8 Plot of Transmitter Occupied Bandwidth (802.11 G-Mode)

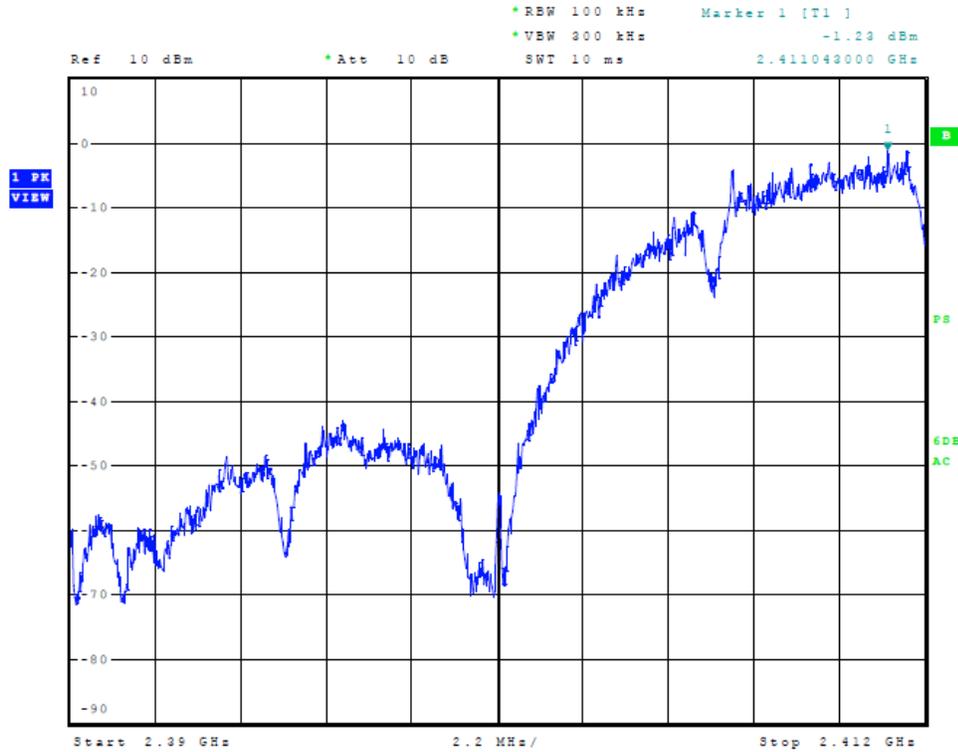


Figure 9 Plot of Transmitter Emissions Low Band Edge (b-mode)

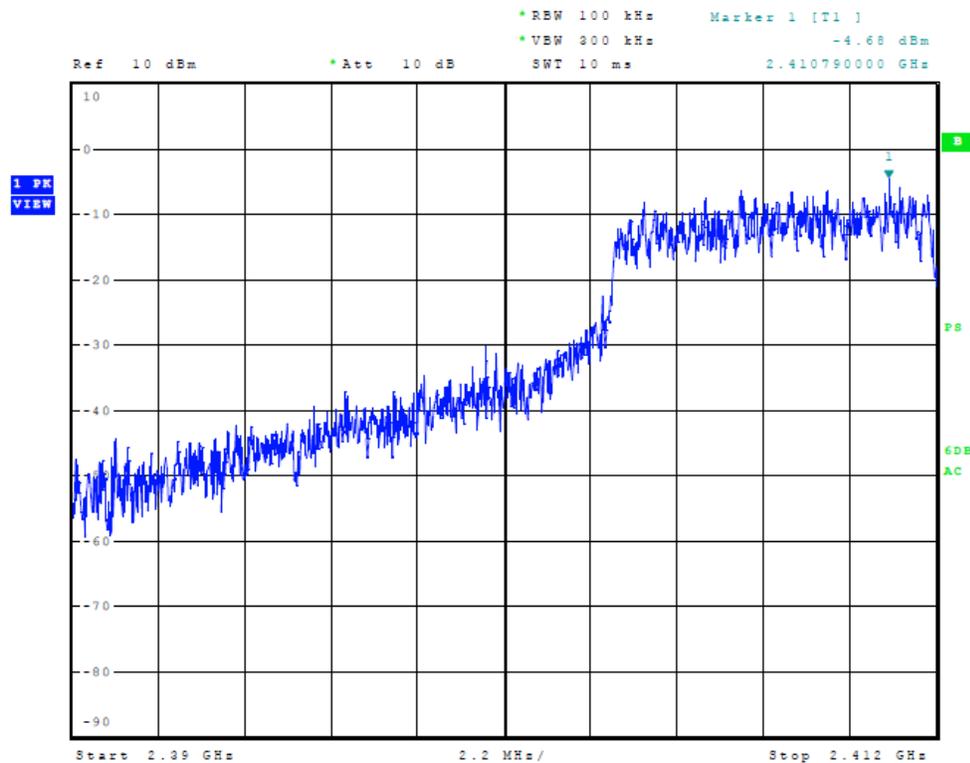


Figure 10 Plot of Transmitter Low Band Edge (g-mode)



Figure 11 Plot of Transmitter High Band Edge (b-mode)

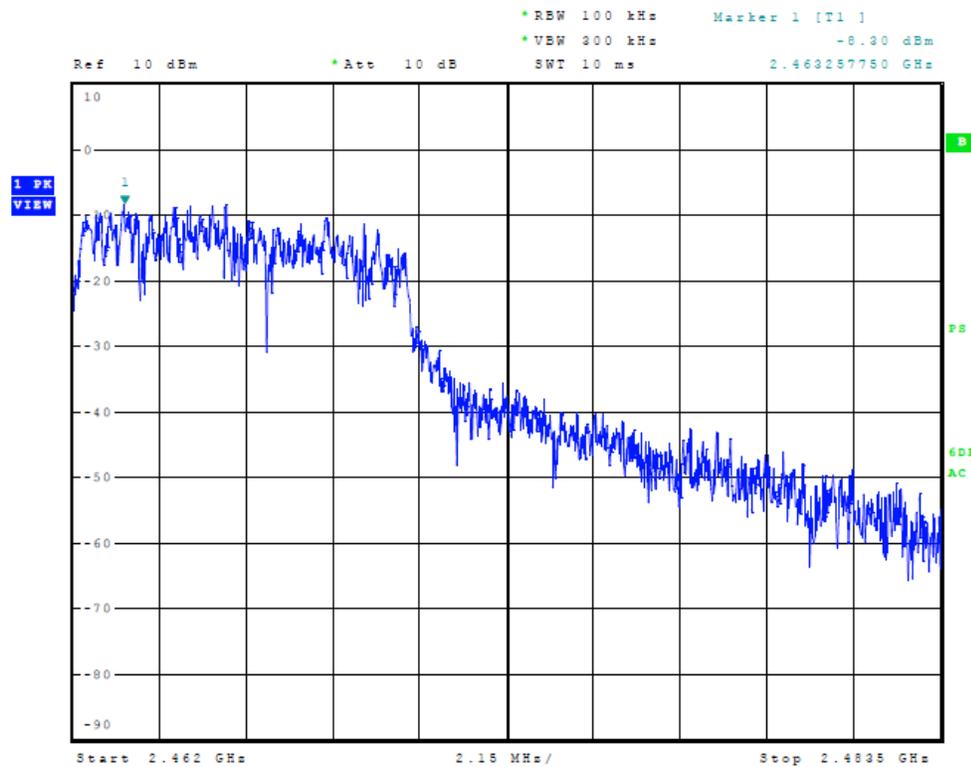


Figure 12 Plot of Transmitter High Band Edge (g-mode)

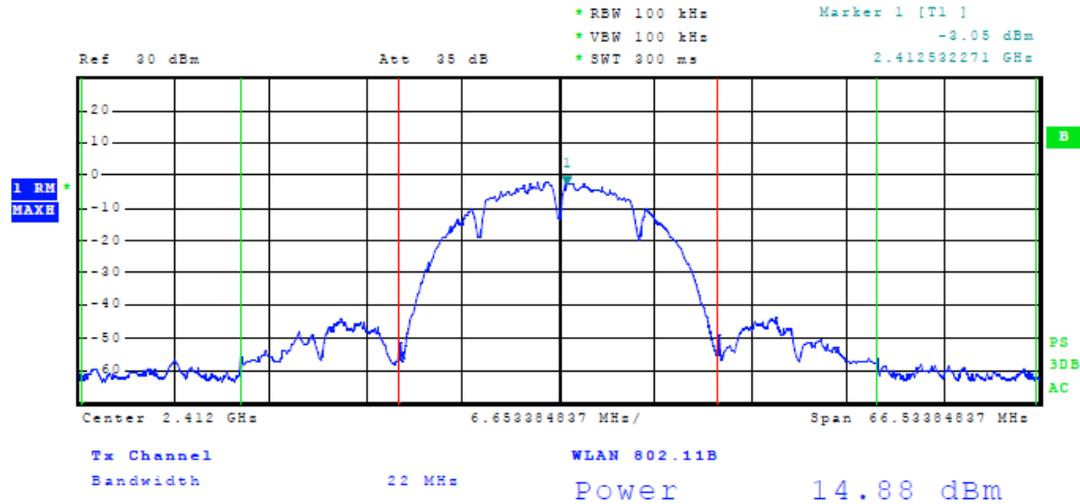


Figure 13 Plot of Transmitter Output Power

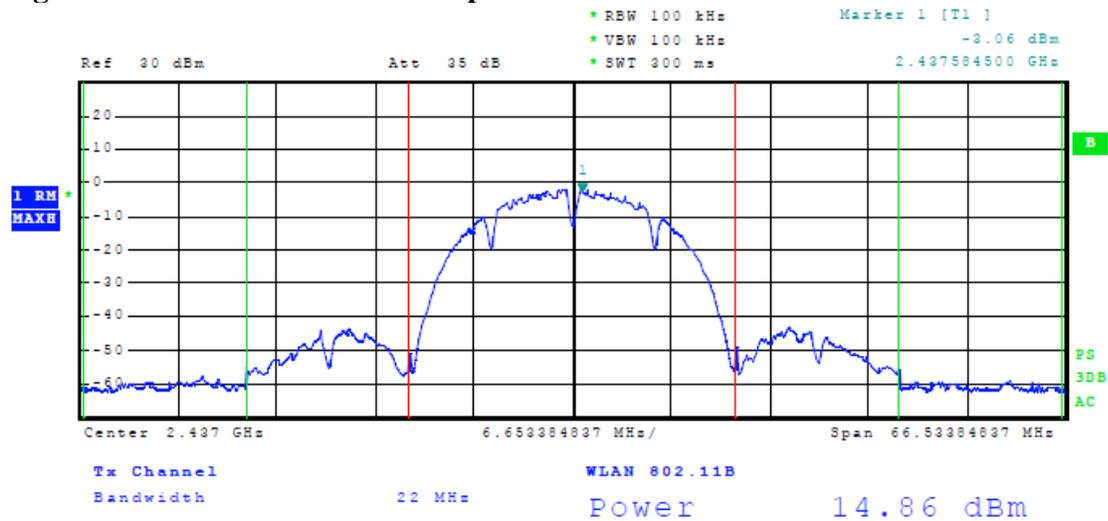


Figure 14 Plot of Transmitter Output Power

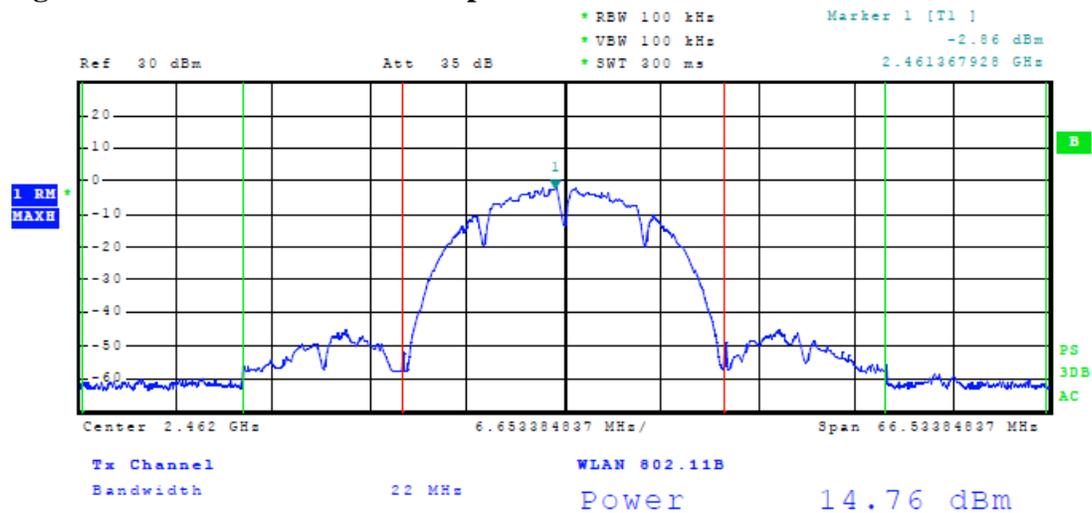


Figure 15 Plot of Transmitter Output Power

Transmitter Emissions Data

Table 7 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	--	--	--	--	--
4824.0	46.2	33.5	47.3	34.3	54.0
7236.0	49.6	38.3	52.9	40.4	54.0
9648.0	43.0	30.4	43.2	32.2	54.0
12060.0	46.8	36.5	49.6	38.6	54.0
14472.0	39.8	34.6	40.9	36.1	54.0
16884.0	45.1	32.2	45.8	32.9	54.0
2437.0	--	--	--	--	--
4874.0	46.3	32.9	46.8	33.8	54.0
7311.0	47.7	37.7	52.0	38.8	54.0
9748.0	42.8	31.5	43.1	34.8	54.0
12185.0	48.8	36.0	50.6	38.6	54.0
14622.0	43.7	36.7	50.1	37.0	54.0
17059.0	46.7	33.2	46.8	33.5	54.0
2462.0	--	--	--	--	--
4924.0	43.7	32.1	44.2	35.0	54.0
7386.0	47.9	37.8	52.0	39.8	54.0
9848.0	43.3	32.1	45.2	33.6	54.0
12310.0	48.5	35.9	51.0	38.5	54.0
14772.0	44.4	34.5	48.1	36.6	54.0
17234.0	47.9	35.1	49.5	36.7	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 8 Transmitter Antenna Port Power

Frequency MHz	Conducted Antenna Port Output Power (dBm)	6-dB Occupied Bandwidth (kHz)	Power Spectral Density (dBm)
802.11 B-Mode			
2412	14.88	14,586	2.26
2437	14.86	14,641	2.36
2462	14.76	14,608	2.51
802.11 G-Mode			
2412	13.9	16,335	-2.39
2437	14.0	16,302	-1.15
2462	13.8	16,368	-1.68

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 14.88 dBm, 0.031 Watts for operation in 2412-2462 MHz. The peak power spectral density presented a minimum margin of -5.4 dB below the requirements. The EUT demonstrated a minimum margin of -13.6 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 μ Hy/50 ohm/0.1 μ f	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	2/13
Oscilloscope Scope: Tektronix 2230	2/13
Wattmeter: Bird 43 with Load Bird 8085	2/13
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/13
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/13
R.F. Power Amp 65W Model: 470-A-1010	2/13
R.F. Power Amp 50W M185- 10-501	2/13
R.F. Power Amp A.R. Model: 10W 1010M7	2/13
R.F. Power Amp EIN Model: A301	2/13
LISN: Compliance Eng. Model 240/20	2/13
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/13
Antenna: EMCO Dipole Set 3121C	2/13
Antenna: C.D. B-101	2/13
Antenna: Solar 9229-1 & 9230-1	2/13
Audio Oscillator: H.P. 201CD	2/13
ELGAR Model: 1751	2/13
ELGAR Model: TG 704A-3D	2/13
ESD Test Set 2010i	2/13
Fast Transient Burst Generator Model: EFT/B-101	2/13
Field Intensity Meter: EFM-018	2/13
KEYTEK Ecat Surge Generator	2/13
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,

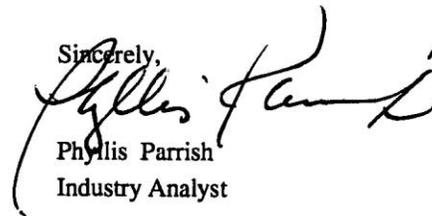
Re: Measurement facility located at Louisburg
3 & 10 meter site
Date of Renewal: June 28, 2013

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 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

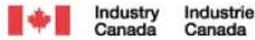
Garmin International, Inc.
Models: F4ACGQ00, O4AHGQ00
Test #: 131028
Test to: CFR47 (15.247), RSS-210 (DTS)
File: Garmin O4AHGQ00 DTS TstRpt 131028

SN: 92
FCC ID#: IPH-02276
IC: 1792A-02276
Date: January 15, 2014
Page 35 of 36



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.

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

Yours sincerely,

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
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.
Models: F4ACGQ00, O4AHGQ00
Test #: 131028
Test to: CFR47 (15.247), RSS-210 (DTS)
File: Garmin O4AHGQ00 DTS TstRpt 131028

SN: 92
FCC ID#: IPH-02276
IC: 1792A-02276
Date: January 15, 2014
Page 36 of 36