NVLAP Lab Code 200087-0

# Application For
# Grant of Certification

FOR

## Model: **F3AGGB00**

## GPN 011-02945-00

## Low Power Transmitter

## FCC ID: IPH-02251

## IC: 1792A-02251

FOR

## GARMIN INTERNATIONAL, INC.

1200 East 151st Street

Olathe, KS 66062

Test Report Number 130110

Authorized Signatory: Scot D Rogers

Scot D. Rogers

NVLAP Lab Code 200087-0

**ROGERS LABS, INC.**

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

# Test Report for Application of Certification

For

## GARMIN INTERNATIONAL, INC.

1200 East 151st Street
Olathe, KS 66062

Phone: (913) 397-8200

Mr. Van Ruggles
Director of Quality Assurance

## Model: F3AGGB00

## Low Power Transmitter

Frequency Range: 2,402-2,480 MHz

FCC ID: IPH-02251
IC: 1792A-02251

Test Report Number: 130110

Test Date: January 10, 2013

Authorized Signatory: Scot D Rogers

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

# Table of Contents

## Revisions

Revision 1 issued March 11, 2013

## Forward

The following information is submitted for consideration in obtaining Grant of Certification for low power intentional radiator per CFR 47 Paragraph 15.249, 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: F3AGGB00

FCC ID: IPH-02251 Industry Canada ID: 1792A-02251

Frequency Range: 2,402-2,480 MHz

Operating Power: maximum average power 91.0 dBµV/m @ 3 meters (and peak 91.9 dBµV/m @ 3 meters), 6-dB occupied bandwidth 452.0 kHz

## Applicable Standards & Test Procedures

In accordance with the Federal Communications Commission and Code of Federal Regulations CFR 47, dated October 1, 2012, Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, applicable parts of paragraph 15, Part 15C paragraph 15.249, and Industry Canada RSS-210, the following information is submitted. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in the ANSI C63.4-2009 Document.

## Opinion / Interpretation of Results

| Test Performed | Minimum Margin (dB) | Results |
|---|---|---|
| Antenna requirement per CFR 47 15.203, RSS-210 | NA | Complies |
| Restricted Bands Emissions as per CFR 47 15.205 | -12.1 | Complies |
| AC Line Conducted Emissions as per CFR 47 15.207 | -12.2 | Complies |
| Radiated Emissions as per CFR 47 15.209 | -23.0 | Complies |
| Emissions per CFR 47 15.249 (Harmonics) | -9.2 | Complies |
| Emissions per RSS-210 | As Documented | Complies |

## Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with CFR 47 Part 15C, or RSS-210 Emissions Requirements. There were no deviations or modification to the specifications.

## Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.3° C |
| Relative Humidity | 28% |
| Atmospheric Pressure | 1012.3 mb |

## Units of Measurements

Conducted EMI: Data is in dBµV; dB referenced to one microvolt.

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

Radiated Emissions Calculations:

Note: The limit is expressed for a measurement in dBµV/m when the measurement is taken at a distance of 3 meters. Data taken for this report was taken at a distance of 3 meters.

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

## Test Site Locations

| | |
|---|---|
| Conducted EMI | Rogers Labs, Inc. located at 4405 W. 259th Terrace, Louisburg, KS. |
| Radiated EMI | Performed at Rogers Labs, Inc. 3 meters Open Area Test Site (OATS) located at 4405 W. 259th Terrace, Louisburg, KS. |
| Site Registration | Refer to Annex for FCC Site Registration Letter, Reference 90910, Industry Canada Site Registration Reference 3041A-1 |
| Accreditation | NVLAP Accreditation Lab Code 200087-0 |

## List of Test Equipment

A Rohde and Schwarz ESU40, Hewlett Packard 8591EM and or 8562A Spectrum Analyzer was used as the measuring equipment for emissions testing. The analyzer settings used are described in the following table. Refer to the annex for a complete list of Test Equipment.

| Spectrum Analyzer Settings | | |
|---|---|---|
| AC Line Conducted Emissions | | |
| RBW | AVG. BW | Detector Function |
| 9 kHz | 30 kHz | Peak/Quasi Peak |
| Radiated Emissions (30 – 1000 MHz) | | |
| RBW | AVG. BW | Detector Function |
| 120 kHz | 300 kHz | Peak/Quasi Peak |
| Spectrum Analyzer Settings | | |
| Radiated Emissions (1 – 40 GHz) | | |
| RBW | AVG. BW | Detector Function |
| 1 MHz | 1 MHz | Peak/Average |
| Antenna Conducted Emissions | | |
| RBW | AVG. BW | Detector Function |
| 120 kHz | 300 kHz | Peak |

| Equipment | Manufacturer | Model | Band | Cal Date | Due |
|---|---|---|---|---|---|
| ☒ LISN | Comp. Design | FCC-LISN-2-MOD.CD | .15-30MHz | 10/12 | 10/13 |
| ☐ Antenna | ARA | BCD-235-B | 20-350MHz | 10/12 | 10/13 |
| ☐ Antenna | EMCO | 3147 | 200-1000MHz | 10/12 | 10/13 |
| ☒ Antenna | Com Power | AH-118 | 1-18 GHz | 10/12 | 10/13 |
| ☒ Antenna | Com Power | AH-840 | 18-40 GHz | 10/12 | 10/13 |
| ☒ Antenna | Standard | FXRY638A | 10-18 GHz | 3/12 | 5/13 |
| ☒ Antenna | EMCO | 6509 | .001-30 MHz | 2/12 | 2/13 |
| ☐ Antenna | EMCO | 3143 | 20-1200 MHz | 5/12 | 5/13 |
| ☒ Antenna | Sunol | JB-6 | 30-1000 MHz | 5/12 | 5/13 |
| ☐ Analyzer | HP | 8591EM | 9kHz-1.8GHz | 5/12 | 5/13 |
| ☐ Analyzer | HP | 8562A | 9kHz-110GHz | 5/12 | 5/13 |
| ☒ Analyzer | Rohde & Schwarz | ESU40 | 20Hz-40GHz | 5/12 | 5/13 |
| ☒ Amplifier | Com-Power | PA-010 | 100Hz-30MHz | 10/12 | 10/13 |
| ☒ Amplifier | Com-Power | CPPA-102 | 1-1000 MHz | 10/12 | 10/13 |
| ☒ Amplifier | Com-Power | PA-22 | 0.5-22 GHz | 10/12 | 10/13 |

## Application for Certification

(1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062
Telephone: (913) 397-8200

(2) Identification: FCC I.D.: IPH-02251 IC: 1792A-02251

(3) Copy of the installation and operating manual: Refer to exhibit for Draft Instruction Manual.

(4) Description of Circuit Functions, Device Operation: Refer to operational description exhibit for circuit device operation.

(5) Block Diagram with Frequencies: Refer to exhibit for Block Diagram

(6) Report of measurements demonstrating compliance with the pertinent FCC/IC technical requirements provided in this report.

(7) Photographs of equipment are provided in other application exhibits.

(8) Peripheral equipment or accessories for the equipment. Optional equipment available for the EUT includes and USB cable for interface with AC power adapter or computer. The available configuration options were investigated for this and other reports in compliance with required standards with worst-case data presented.

(9) Transition Provisions of 15.37 are not being requested

(10) The equipment is not a scanning receiver.

(11) The equipment is not a transmitter operating in the 59-64 GHz frequency range.

(12) The equipment is not software defined and this section is not applicable.

## Equipment Tested Setup, Function and Configurations

| Equipment | Model/GPN | Serial Number | FCC ID |
|---|---|---|---|
| F3AGGB00 (EUT) | 011-03133-00 | 3859899478 | IPH-02251 |
| F3AGGB00 (Sample 2) | 011-03133-00 | 3859899406 | IPH-02251 |
| AC Adapter | 362-00072-00 | N/A | N/A |
| USB Interface Cable | 320-00787-00 | N/A | N/A |
| Laptop Computer | Dell Studio XPS | 921LBN1 | N/A |
| USB Printer | Dell 0N5819 | 5D1SL61 | N/A |

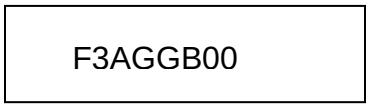
Test results in this report relate only to the items tested.

### *Equipment Function and Test Setup*

The EUT is a GPS receiver offering reception of location, navigation, and other information for the user. The design incorporates a low power transmitter with operation capability in the 2,402-2,480 MHz frequency band (CFR 47 15.249 and RSS-210). The GPS design offers use as a portable configuration for use in navigational aid applications. The equipment offers wireless communication capability with compliant 2,402-2,480 MHz equipment. Two samples were supplied for testing, one production design and the other modified for testing purposes replacing integral antenna with RF connection port. Both samples were provided with test software enabling testing personnel ability to enable transmitter function on defined channels. The antenna modification offered testing facility ability to connect transmitter antenna port to test equipment for antenna port conducted emissions testing. The EUT was arranged as typical user equipment configurations for testing purposes. The transmitter offers no other interface connections than those in the configuration diagrams shown below. The unit operates from internal battery. Battery recharge is accomplished with use of interface cable and connection to AC adapter or compliant USB port as presented. 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.

***EUT Configuration Options***

F3AGGB00 (011-03133-00) operating off internal Li-Ion Battery.




F3AGGB00 (011-03133-00) internal battery charged by AC adapter (GPN: 362-00072-00) through USB cable (GPN: 320-00787-00).


F3AGGB00 (011-03133-00) internal battery charged by PC through mini B USB cable (GPN: 320-00541-01).

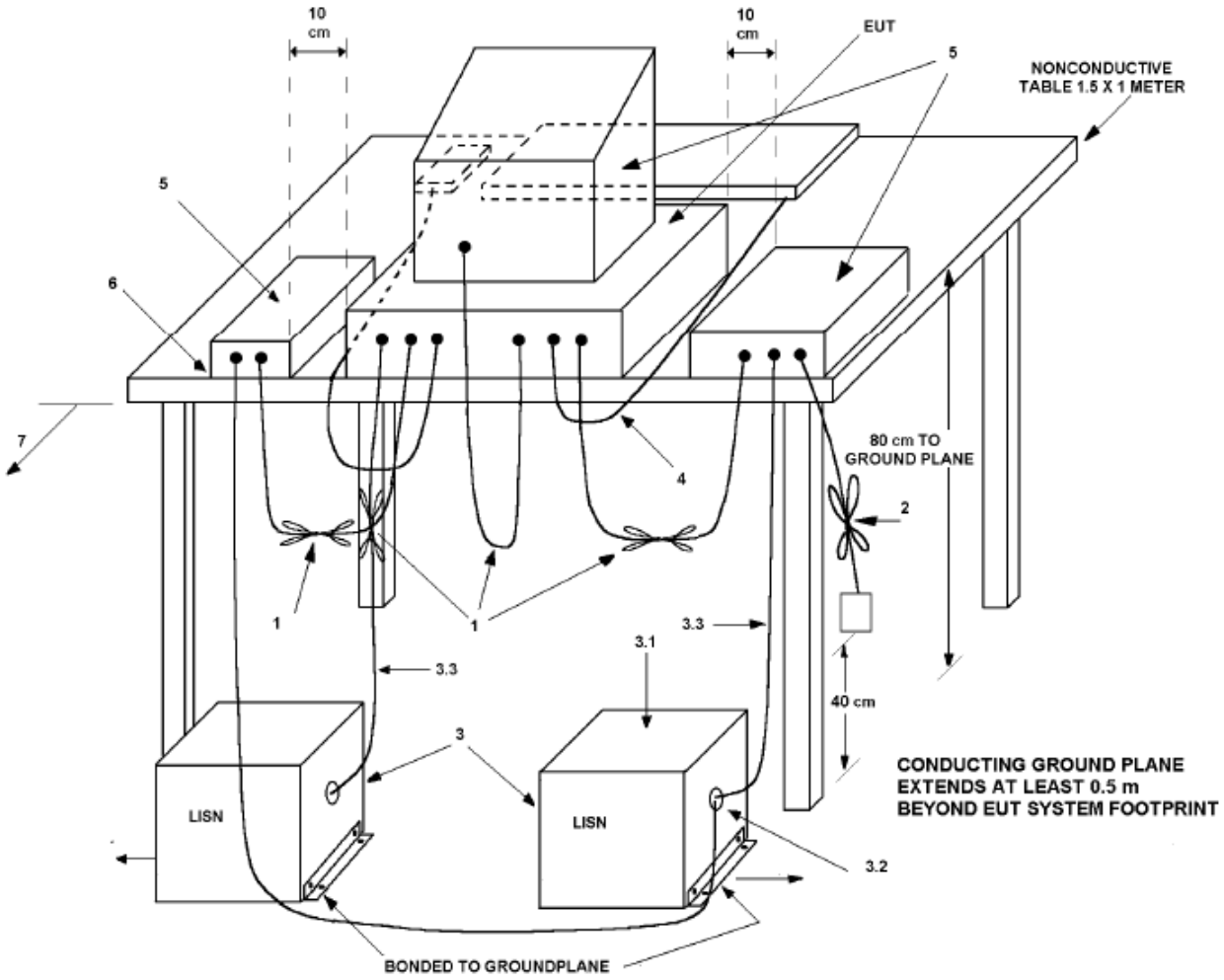

## Subpart C - Intentional Radiators

As per CFR 47 Part 15, Subpart C and RSS-210 the following information is submitted for consideration in obtaining grant of certification for unlicensed intentional radiators.

## 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-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. 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.

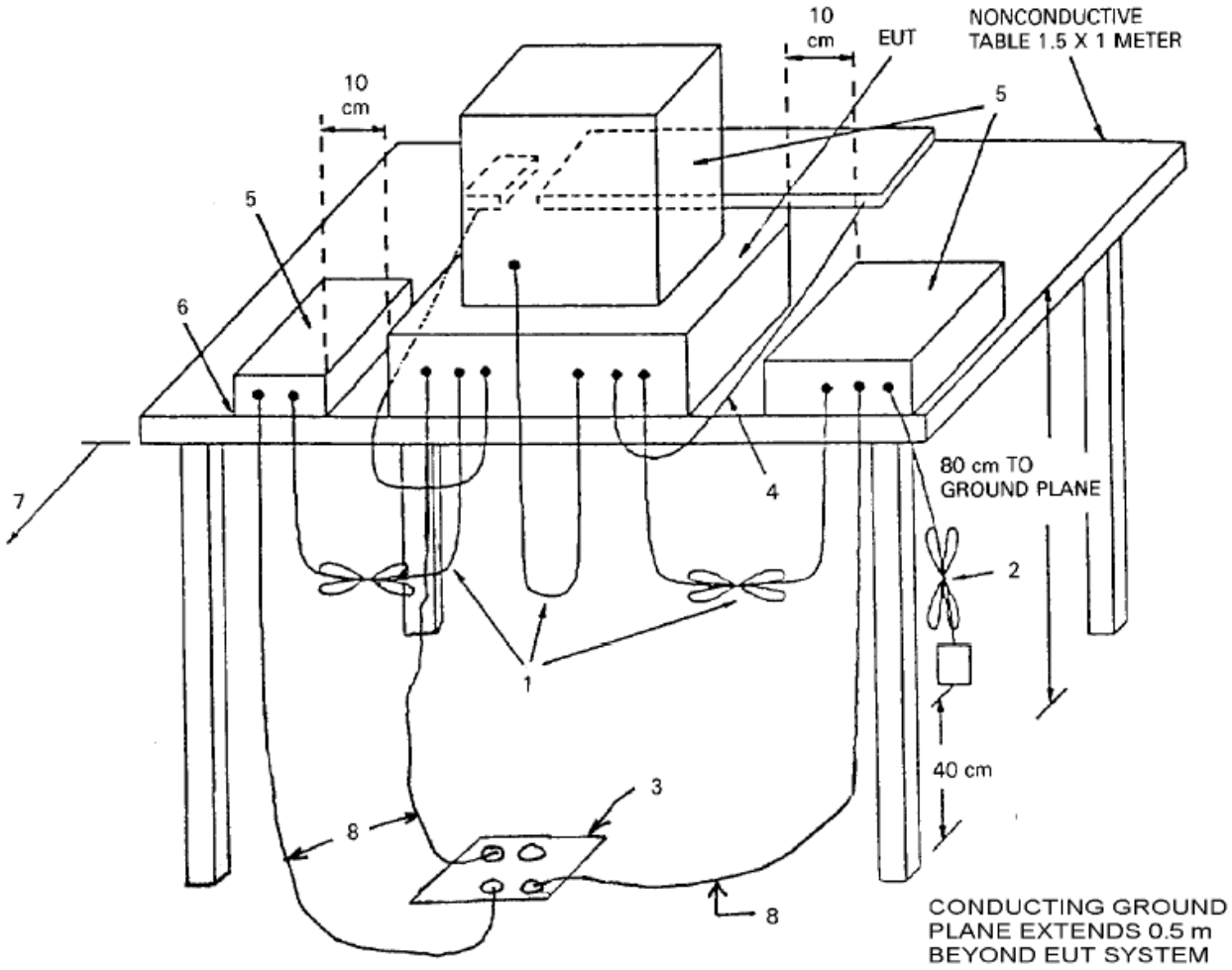
3.1 All other equipment powered from additional LISN(s).
3.2 Multiple outlet strips can be used for multiple power cords of non-EUT equipment.
3.3 LISN is positioned at least 80 cm from nearest part of EUT chassis.

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. 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.

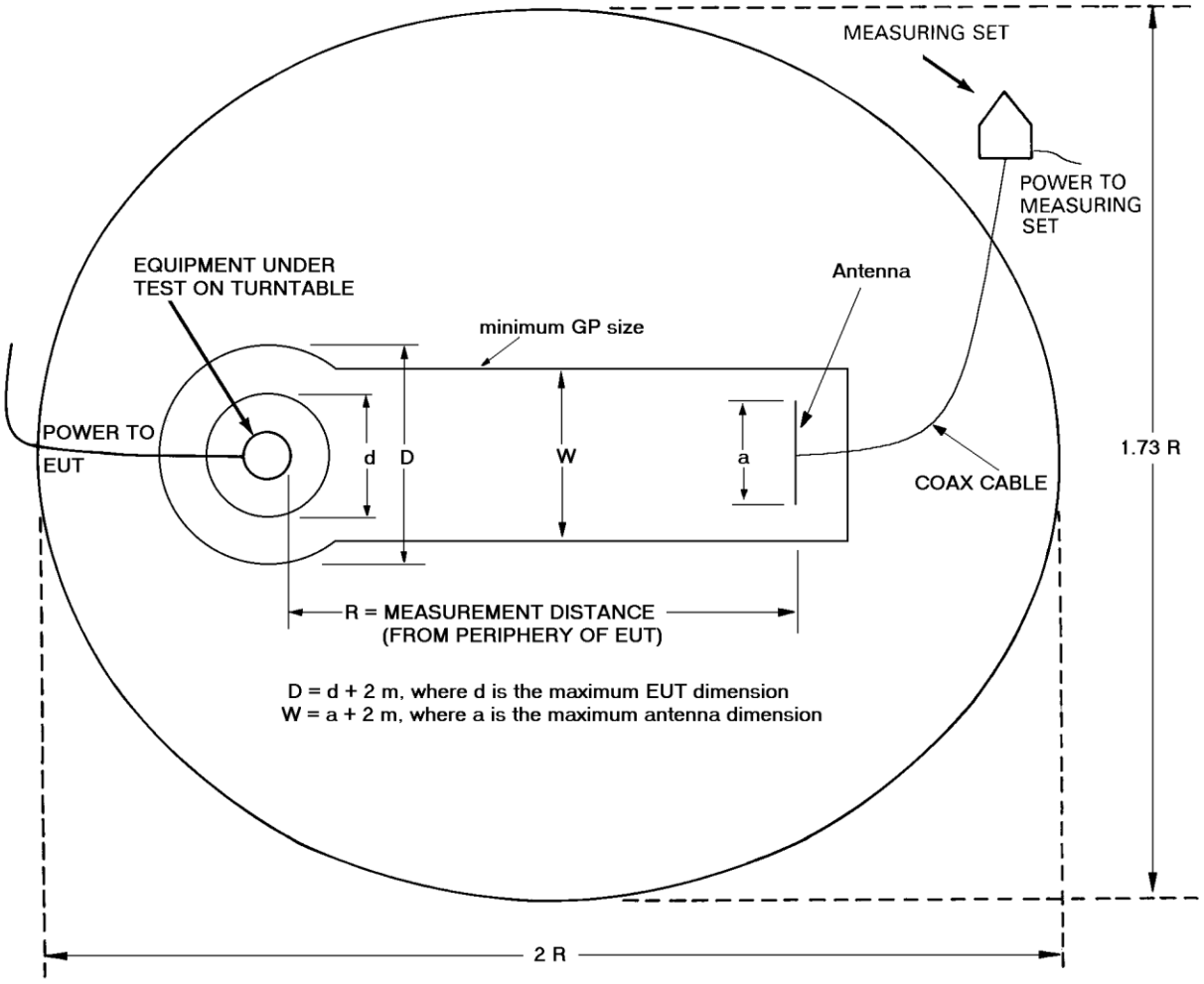
***Diagram 2 Test arrangement for radiated emissions of tabletop equipment***




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 |

## Antenna Requirements

The unit is produced with permanently attached antenna located inside the sealed case. No provisions for modification or alterations of the antenna configuration are available to the end user. The EUT demonstrates compliance with the unique antenna connection requirements of CFR47 15.203 and other relevant standards. 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 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.

### *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 | 42.6 | N/A | 29.9 | 42.9 | N/A | 29.6 | 54.0 |
| 2483.5 | 46.2 | N/A | 33.9 | 45.3 | N/A | 33.5 | 54.0 |
| 4804.0 | 49.0 | N/A | 38.4 | 47.9 | N/A | 35.0 | 54.0 |
| 4882.0 | 46.7 | N/A | 34.8 | 47.5 | N/A | 35.4 | 54.0 |
| 4960.0 | 48.9 | N/A | 38.7 | 47.2 | N/A | 34.8 | 54.0 |
| 7206.0 | 52.5 | N/A | 41.9 | 49.6 | N/A | 37.0 | 54.0 |
| 7323.0 | 48.1 | N/A | 35.5 | 49.1 | N/A | 37.1 | 54.0 |
| 7440.0 | 49.3 | N/A | 36.6 | 49.4 | N/A | 36.2 | 54.0 |
| 12010.0 | 49.5 | N/A | 36.9 | 49.5 | N/A | 36.7 | 54.0 |
| 12205.0 | 50.2 | N/A | 37.4 | 49.4 | N/A | 36.5 | 54.0 |
| 12400.0 | 50.3 | N/A | 37.9 | 50.3 | N/A | 37.7 | 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 26-1000 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 FCC CFR 47 Part 15.205 and RSS-210 restricted bands of operation. The EUT worst-case configuration demonstrated minimum margin of -12.01 dB below the CFR 47 and RSS-210 limits. Other emissions were present with amplitudes at least 20 dB below the required limits.

### *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 µF 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 options while charging the EUT. Refer to figures three and four showing plots of the worst-case AC Line conducted emissions of the laptop AC Adapter while charging the EUT**.**

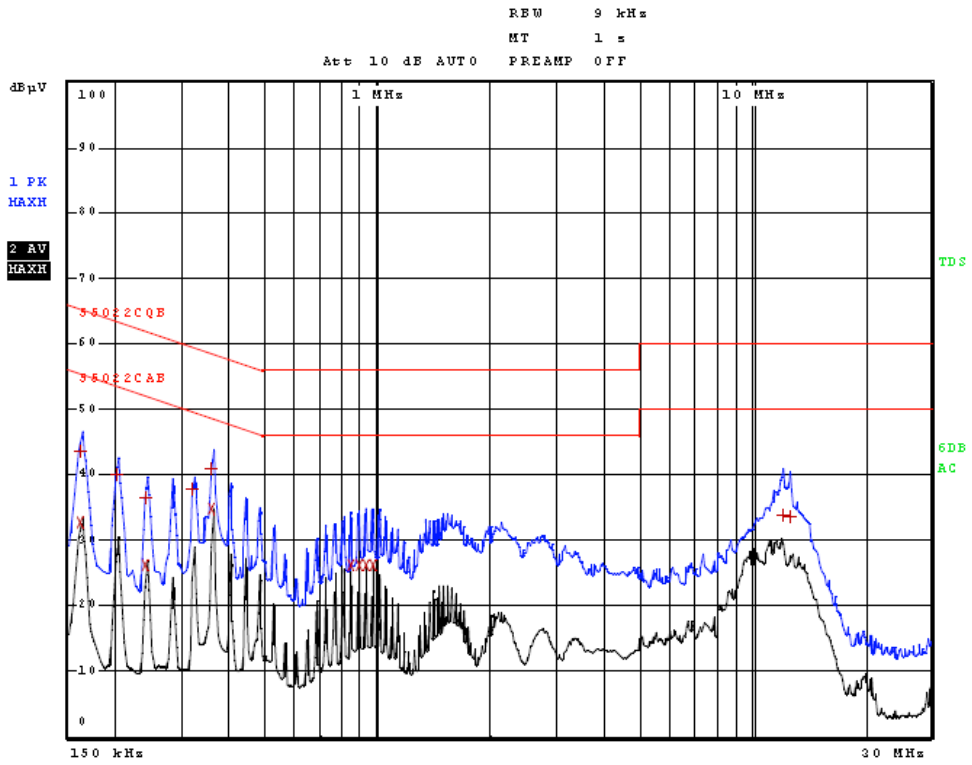



**Figure One AC Line Conducted emissions of EUT line 1 (EUT AC Adapter)**

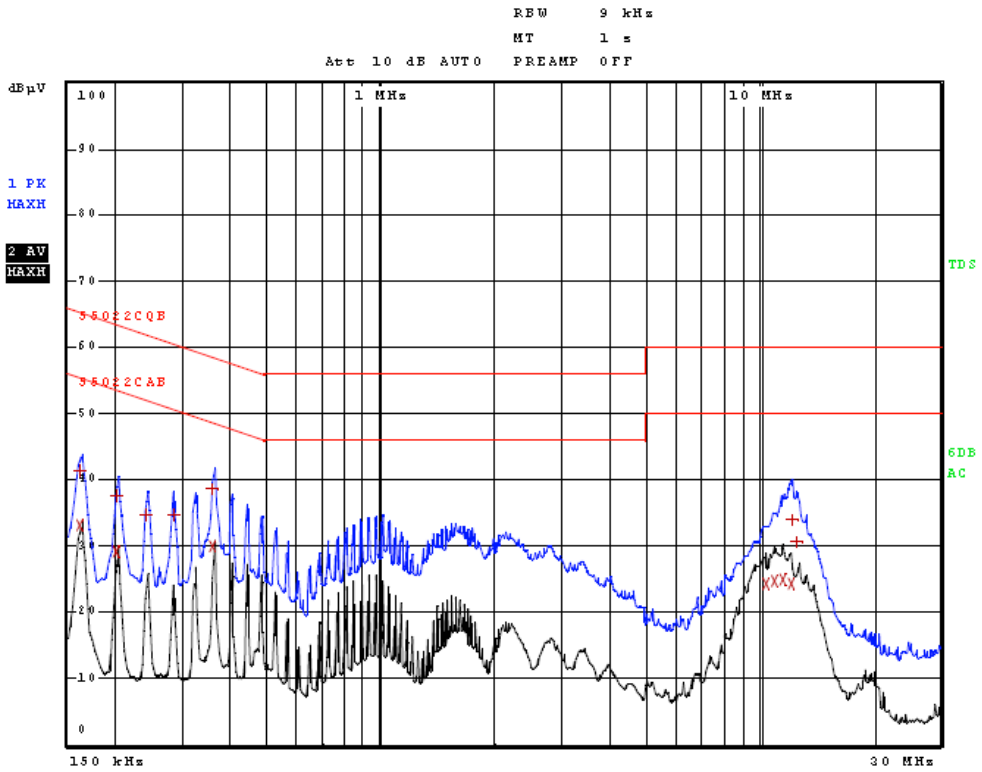



**Figure Two AC Line Conducted emissions of EUT line 2 (EUT AC Adapter)**

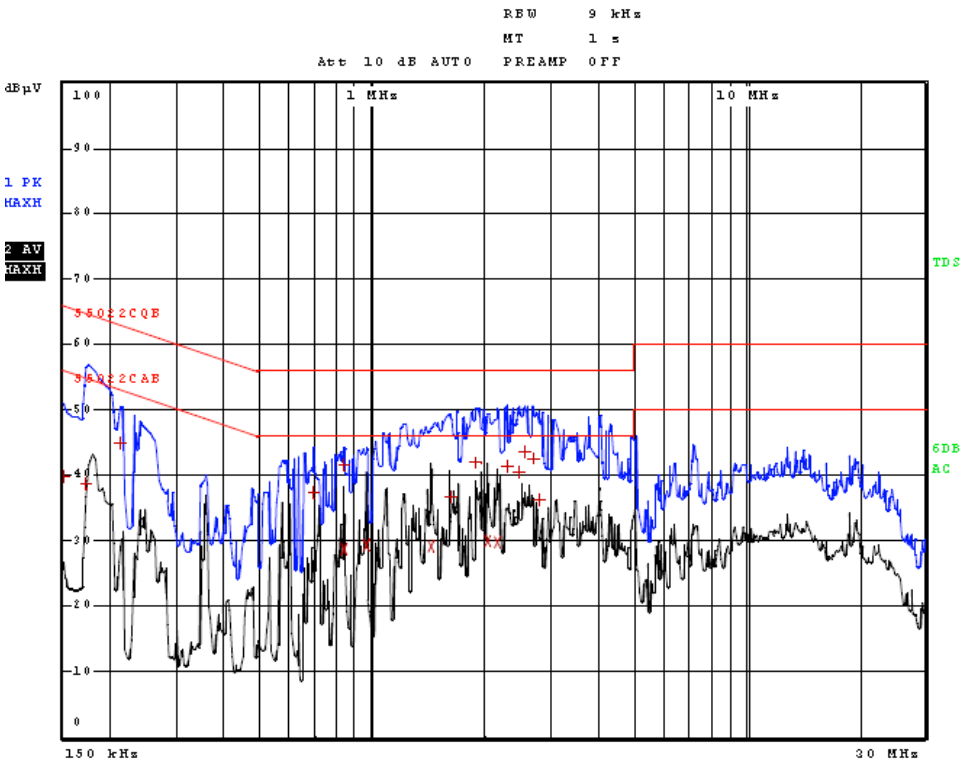



**Figure Three AC Line Conducted emissions of EUT line 1 (EUT – USB -CPU AC Adapter)**

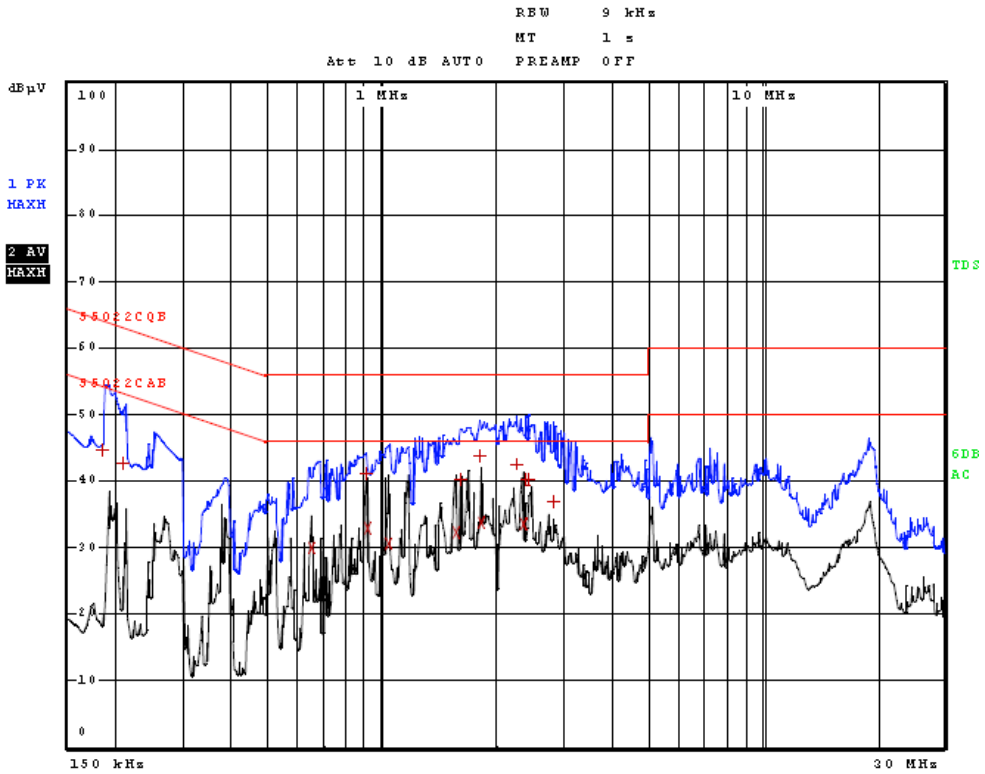



**Figure Four AC Line Conducted emissions of EUT line 2 (EUT – USB -CPU AC Adapter)**

**Data AC Line Conducted Emissions**

Line 1 (EUT AC Adapter)

| Trace | Frequency | Level (dBµV) | Detector | Delta Limit/dB |
|---|---|---|---|---|
| 1 | 162.000000000 kHz | 43.54 | Quasi Peak | -21.82 |
| 2 | 162.000000000 kHz | 32.59 | Average | -22.77 |
| 1 | 202.000000000 kHz | 39.96 | Quasi Peak | -23.56 |
| 2 | 242.000000000 kHz | 26.25 | Average | -25.78 |
| 1 | 242.000000000 kHz | 36.48 | Quasi Peak | -25.55 |
| 1 | 322.000000000 kHz | 37.74 | Quasi Peak | -21.92 |
| 2 | 362.000000000 kHz | 34.66 | Average | -14.02 |
| 1 | 362.000000000 kHz | 40.96 | Quasi Peak | -17.72 |
| 2 | 846.000000000 kHz | 26.07 | Average | -19.93 |
| 2 | 886.000000000 kHz | 26.16 | Average | -19.84 |
| 2 | 926.000000000 kHz | 26.23 | Average | -19.77 |
| 2 | 966.000000000 kHz | 26.07 | Average | -19.93 |
| 1 | 12.056000000 MHz | 33.66 | Quasi Peak | -26.34 |
| 1 | 12.596000000 MHz | 33.54 | Quasi Peak | -26.46 |

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

Line 2 (EUT AC Adapter)

| Trace | Frequency | Level (dBµV) | Detector | Delta Limit/dB |
|---|---|---|---|---|
| 2 | 162.000000000 kHz | 33.01 | Average | -22.35 |
| 1 | 162.000000000 kHz | 41.35 | Quasi Peak | -24.01 |
| 1 | 202.000000000 kHz | 37.52 | Quasi Peak | -26.00 |
| 2 | 202.000000000 kHz | 29.09 | Average | -24.44 |
| 1 | 242.000000000 kHz | 34.71 | Quasi Peak | -27.32 |
| 1 | 282.000000000 kHz | 34.80 | Quasi Peak | -25.96 |
| 2 | 362.000000000 kHz | 29.86 | Average | -18.82 |
| 1 | 362.000000000 kHz | 38.45 | Quasi Peak | -20.24 |
| 2 | 10.392000000 MHz | 24.33 | Average | -25.67 |
| 2 | 10.876000000 MHz | 24.71 | Average | -25.29 |
| 2 | 11.480000000 MHz | 24.96 | Average | -25.04 |
| 2 | 12.084000000 MHz | 24.30 | Average | -25.70 |
| 1 | 12.164000000 MHz | 33.89 | Quasi Peak | -26.11 |
| 1 | 12.464000000 MHz | 30.59 | Quasi Peak | -29.41 |

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

Line 1 (EUT –USB -CPU AC Adapter)

| Trace | Frequency | Level (dBµV) | Detector | Delta Limit/dB |
|---|---|---|---|---|
| 1 | 150.000000000 kHz | 39.81 | Quasi Peak | -26.19 |
| 1 | 174.000000000 kHz | 38.73 | Quasi Peak | -26.04 |
| 1 | 214.000000000 kHz | 44.85 | Quasi Peak | -18.19 |
| 1 | 694.000000000 kHz | 37.34 | Quasi Peak | -18.66 |
| 1 | 838.000000000 kHz | 41.46 | Quasi Peak | -14.54 |
| 2 | 838.000000000 kHz | 28.57 | Average | -17.43 |
| 2 | 962.000000000 kHz | 29.34 | Average | -16.66 |
| 2 | 1.434000000 MHz | 29.13 | Average | -16.87 |
| 1 | 1.606000000 MHz | 36.71 | Quasi Peak | -19.29 |
| 1 | 1.886000000 MHz | 41.81 | Quasi Peak | -14.19 |
| 2 | 2.030000000 MHz | 29.99 | Average | -16.01 |
| 2 | 2.154000000 MHz | 29.77 | Average | -16.23 |
| 1 | 2.278000000 MHz | 41.21 | Quasi Peak | -14.79 |
| 1 | 2.462000000 MHz | 40.48 | Quasi Peak | -15.52 |
| 1 | 2.562000000 MHz | 43.60 | Quasi Peak | -12.40 |
| 1 | 2.682000000 MHz | 42.53 | Quasi Peak | -13.47 |
| 1 | 2.782000000 MHz | 36.14 | Quasi Peak | -19.86 |

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

Line 2 (EUT –USB -CPU AC Adapter)

| Trace | Frequency | Level (dBµV) | Detector | Delta Limit/dB |
|---|---|---|---|---|
| 1 | 186.000000000 kHz | 44.66 | Quasi Peak | -19.56 |
| 1 | 210.000000000 kHz | 42.72 | Quasi Peak | -20.49 |
| 2 | 650.000000000 kHz | 29.95 | Average | -16.05 |
| 1 | 902.000000000 kHz | 41.03 | Quasi Peak | -14.97 |
| 2 | 910.000000000 kHz | 32.87 | Average | -13.13 |
| 2 | 1.038000000 MHz | 30.56 | Average | -15.44 |
| 2 | 1.562000000 MHz | 32.14 | Average | -13.86 |
| 1 | 1.602000000 MHz | 40.26 | Quasi Peak | -15.74 |
| 1 | 1.806000000 MHz | 43.75 | Quasi Peak | -12.25 |
| 2 | 1.822000000 MHz | 33.69 | Average | -12.31 |
| 1 | 2.254000000 MHz | 42.58 | Quasi Peak | -13.42 |
| 2 | 2.342000000 MHz | 33.54 | Average | -12.46 |
| 1 | 2.382000000 MHz | 40.19 | Quasi Peak | -15.81 |
| 1 | 2.430000000 MHz | 40.29 | Quasi Peak | -15.71 |
| 1 | 2.802000000 MHz | 36.90 | Quasi Peak | -19.10 |

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

### *Summary of Results for AC Line Conducted Emissions*

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of CFR 47 Part 15B, RSS-GEN, and other applicable standards. The EUT worst-case configuration demonstrated a minimum margin of -12.2 dB below the limit. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

### *General Radiated EMI Testing Procedure*

EUT radiated emissions were investigated while arranged in all typical equipment configurations and operated through all applicable modes. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Investigations were performed to identify the frequencies, which produced the highest radiated emissions. Radiated emission investigations were performed from 9 kHz to 25,000 MHz with the EUT positioned in three orthogonal axes per regulations. Frequencies of interest were recorded for use during testing on the OATS. Each emission was then maximized at the OATS site before final radiated emissions measurements were performed. Final data was taken with the EUT located at the open field test site at a distance of 3 meters between the EUT and the receiving antenna. Test procedures of ANSI C63.4-2009 paragraphs 13.1 and 8.3.1.2 were used during radiated emissions testing. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Measured emission levels were maximized by EUT placement on the table, changing cable location, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna polarization between horizontal and vertical. Antennas used were Loop from 0.09 to 30 MHz, Broadband Biconical from 30 MHz to 200 MHz, Log Periodic from 200 MHz to 1 GHz, and/or Biconilog from 30 MHz to 1000 MHz, Double-Ridge, and/or Pyramidal Horns from 1 GHz to 25 GHz, and amplification stages.

### *General Radiated Emissions Data (worst-case)*

| 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) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

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 9 kHz to 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 general radiated emissions requirements of FCC Part 15C, RSS-210 and other applicable standards for Intentional Radiators. The EUT worst-case configuration demonstrated minimum margin of at least 20 dB below the general radiated emissions limit. Other emissions were present with amplitudes at least 20 dB below the Limits.

## Operation in the Band 2,400-2,483.5 MHz

The transmitter output power; harmonic and general emissions were measured on an open area test site @ 3 meters. Test procedures of ANSI C63.4-2009 paragraphs 13.1 and 8.3.1.2 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 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. The amplitude of each emission was then recorded from the analyzer display. Emissions radiated outside of the specified bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in 15.209, whichever is the lesser attenuation. Plots were taken of transmitter performance for reference in this and other documentation. Refer to figures five through eight showing the frequency and amplitude of worst-case emissions as displayed on the spectrum analyzer. 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). The amplitude of each radiated emission was maximized by varying the FSM antenna height, polarization, and by rotating the turntable. 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 dBµV/m @ 3 meters.

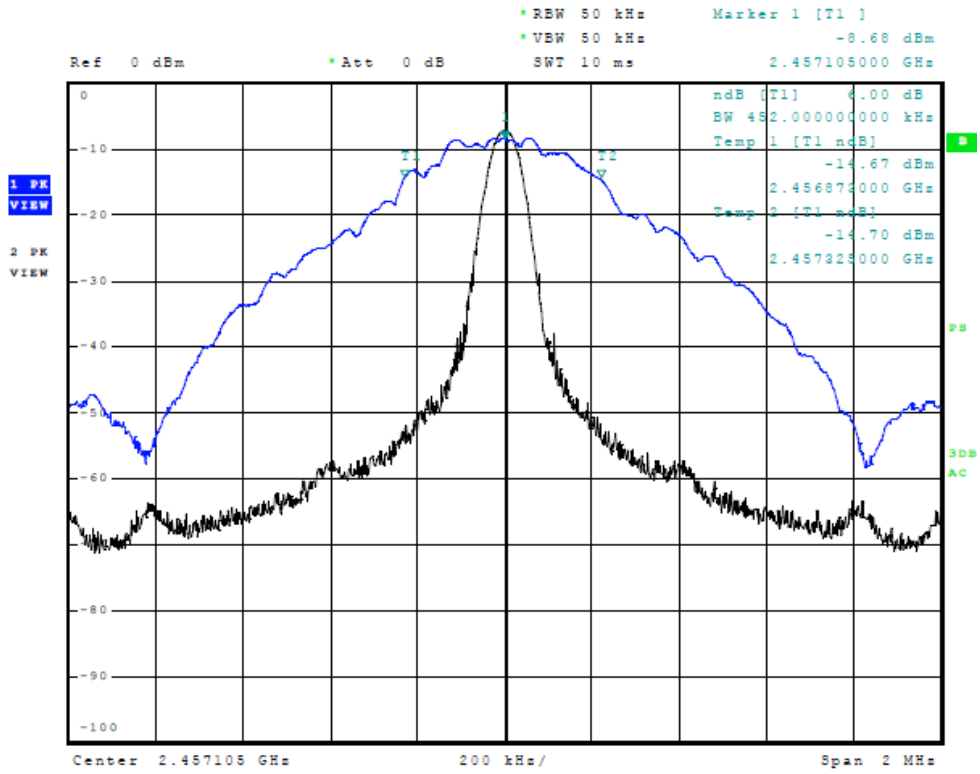



**Figure Five Plot of Occupied Bandwidth**

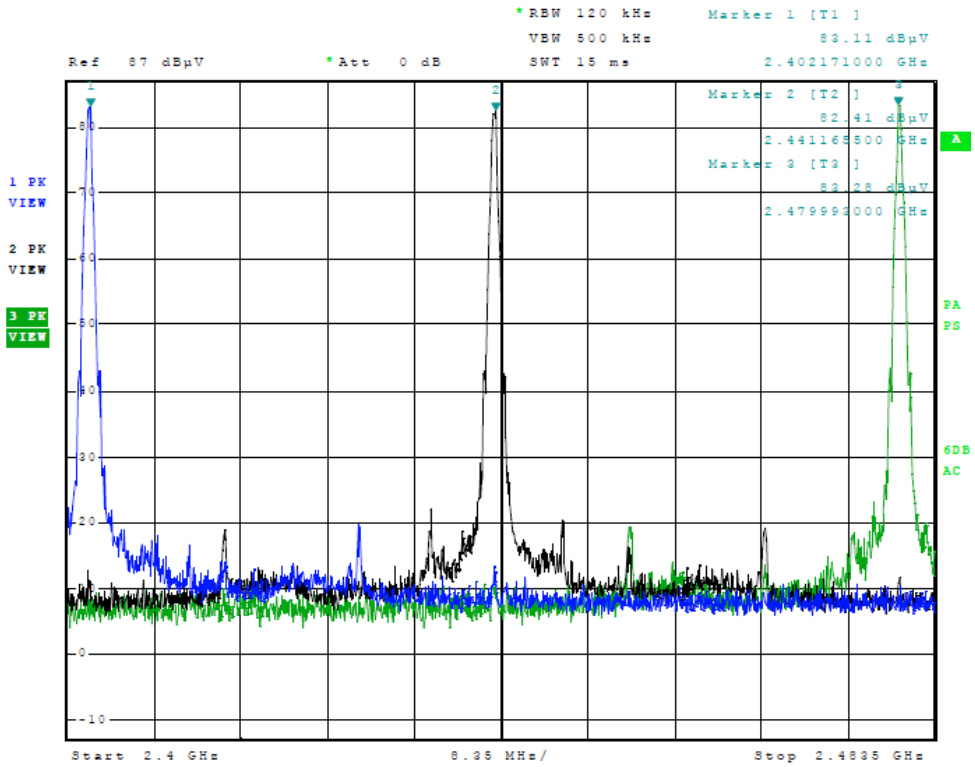



**Figure Six Plot of Operation across frequency band**

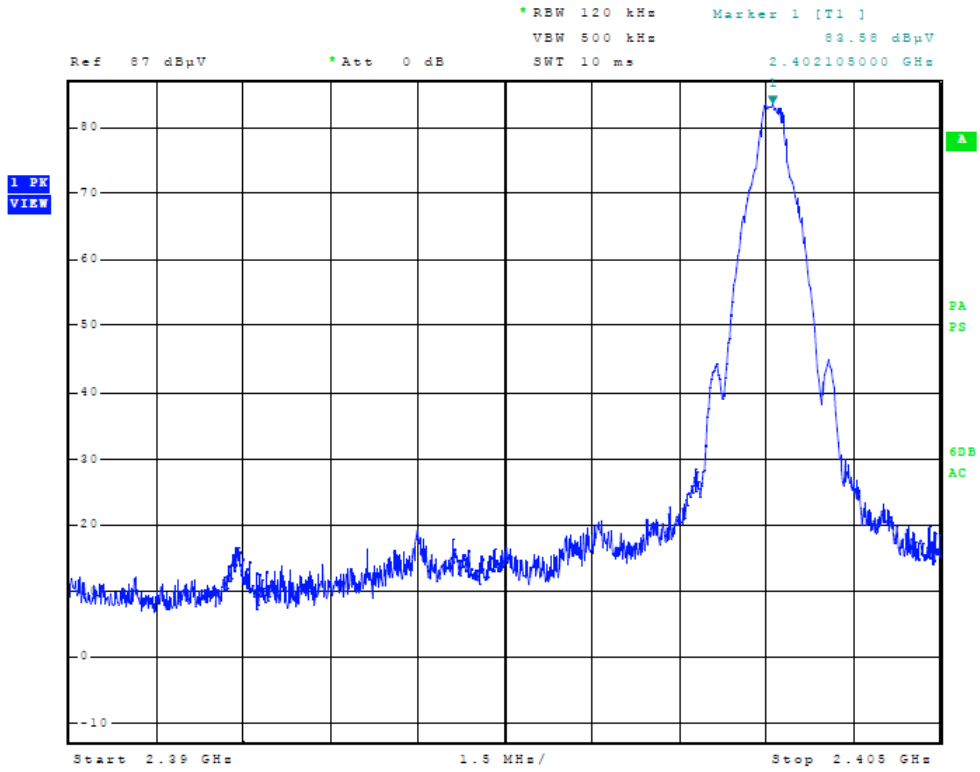



**Figure Seven Plot of Lower Band Edge**

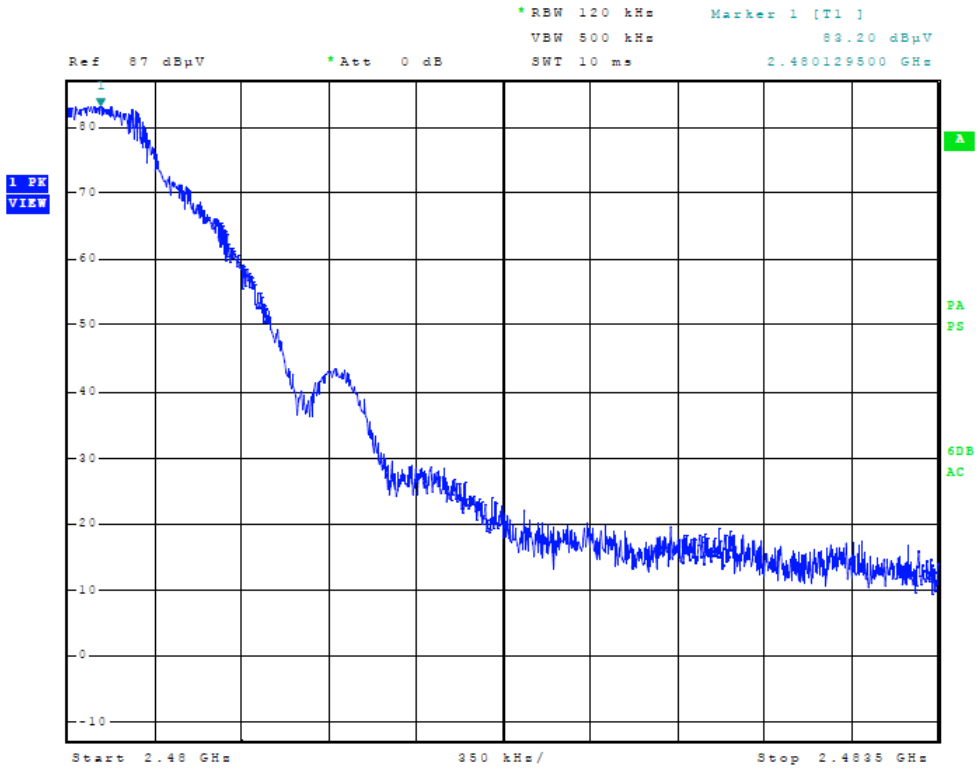



**Figure Eight Plot of Upper Band Edge**

## *Transmitter Radiated Emissions Data*

**Transmitter Radiated 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) |
|---|---|---|---|---|---|---|---|
| 2402.0 | 91.7 | N/A | 90.5 | 90.0 | N/A | 89.0 | 94.0 |
| 4804.0 | 49.0 | N/A | 38.4 | 47.9 | N/A | 35.0 | 54.0 |
| 7206.0 | 52.5 | N/A | 41.9 | 49.6 | N/A | 37.0 | 54.0 |
| 9608.0 | 50.6 | N/A | 37.9 | 50.7 | N/A | 37.9 | 54.0 |
| 12010.0 | 49.5 | N/A | 36.9 | 49.5 | N/A | 36.7 | 54.0 |
| 14412.0 | 55.7 | N/A | 43.3 | 56.4 | N/A | 43.3 | 54.0 |
| 2441.0 | 91.9 | N/A | 90.7 | 90.8 | N/A | 89.3 | 94.0 |
| 4882.0 | 46.7 | N/A | 34.8 | 47.5 | N/A | 35.4 | 54.0 |
| 7323.0 | 48.1 | N/A | 35.5 | 49.1 | N/A | 37.1 | 54.0 |
| 9764.0 | 49.9 | N/A | 37.6 | 50.5 | N/A | 37.5 | 54.0 |
| 12205.0 | 50.2 | N/A | 37.4 | 49.4 | N/A | 36.5 | 54.0 |
| 14646.0 | 57.5 | N/A | 44.8 | 56.8 | N/A | 44.4 | 54.0 |
| 2480.0 | 91.9 | N/A | 91.0 | 89.7 | N/A | 89.0 | 94.0 |
| 4960.0 | 48.9 | N/A | 38.7 | 47.2 | N/A | 34.8 | 54.0 |
| 7440.0 | 49.3 | N/A | 36.6 | 49.4 | N/A | 36.2 | 54.0 |
| 9920.0 | 49.7 | N/A | 36.9 | 49.3 | N/A | 36.8 | 54.0 |
| 12400.0 | 50.3 | N/A | 37.9 | 50.3 | N/A | 37.7 | 54.0 |
| 14880.0 | 54.0 | N/A | 42.1 | 55.4 | N/A | 41.9 | 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 26-1000 MHz. Peak and Average amplitude emissions are recorded above for frequency range above 1000 MHz.

**Transmitter Antenna Port Conducted Emissions Data**

| Frequency MHz | Antenna Conducted Output Power dBm | Occupied Bandwidth kHz |
|---|---|---|
| 2402.0 | -1.67 | 450.0 |
| 2441.0 | -1.73 | 452.0 |
| 2480.0 | -1.78 | 450.0 |

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

The EUT demonstrated compliance with the radiated emissions requirements of FCC CFR 47 Part 15.249, RSS-210 and other applicable standards for Intentional Radiators. The EUT worst-case configuration demonstrated minimum margin of -3.0 dB below the limit for average emission limit. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -9.2 dB below the limits. No other radiated emissions were found in the restricted bands less than 20 dB below limits than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the limits.

## Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D FCC Test Site Registration Letter
- Annex E Industry Canada Test 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 | 5/12 |
| Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520 Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W | 5/12 |
| Spectrum Analyzer: HP 8591EM | 5/12 |
| Antenna: EMCO Biconilog Model: 3143 | 5/12 |
| Antenna: Sunol Biconilog Model: JB6 | 10/12 |
| Antenna: EMCO Log Periodic Model: 3147 | 10/12 |
| Antenna: Com Power Model: AH-118 | 10/12 |
| Antenna: Antenna Research Biconical Model: BCD 235 | 10/12 |
| LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohm/0.1 µf | 10/12 |
| R.F. Preamp CPPA-102 | 10/12 |
| Attenuator: HP Model: HP11509A | 10/12 |
| Attenuator: Mini Circuits Model: CAT-3 | 10/12 |
| Attenuator: Mini Circuits Model: CAT-3 | 10/12 |
| Cable: Belden RG-58 (L1) | 10/12 |
| Cable: Belden RG-58 (L2) | 10/12 |
| Cable: Belden 8268 (L3) | 10/12 |
| Cable: Time Microwave: 4M-750HF290-750 | 10/12 |
| Cable: Time Microwave: 10M-750HF290-750 | 10/12 |
| 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 |
| 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 | |

## *Annex C Rogers Qualifications*

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

**Rogers Labs, Inc.**

Mr. Rogers has approximately 17-years' experience in the field of electronics. Six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

Positions Held

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

Electrical Engineer: Rogers Consulting Labs, Inc. 5 Years

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

Several Specialized Training courses and seminars pertaining to Microprocessors and Software programming

NVLAP Lab Code 200087-0

## *Annex D FCC Test 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 under E-Filing, OET Equipment Authorization Electronic Filing, Test Firms.

Sincerely,

Phyllis Parrish
Industry Analyst

NVLAP Lab Code 200087-0

## *Annex E Industry Canada Test Site Registration Letter*

Industry Canada Industrie Canada

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.

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

Yours sincerely,

Dalwinder Gill

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
Tel. No. (613) 998-8363
Fax. No. (613) 990-4752