

Rogers Labs, a division of The Compatibility Center LLC

7915 Nieman Rd.
Lenexa, KS 66214
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47CFR, PART 15C - Intentional Radiators
47CFR Paragraph 15.249 and
Industry Canada RSS-GEN Issue 5 and RSS-210 Issue 10
Application For Grant of Certification

Model: A04939

2402-2480 MHz

Low Power Digital Transmitter (DXX)

FCC ID: IPH-04939

IC: 1792A-04939

Garmin International, Inc.

1200 East 151st Street

Olathe, KS 66062

FCC Designation: US5305

ISED Registration: 3041A

Test Report Number: 240611

Test Date: June 11, 2024 – October 22, 2024

Authorized Signatory: 
Patrick Powell

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Test: 240611

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Test to: 47CFR 15C, RSS-Gen RSS-247

Revision 1

File: A04939 DXX TstRpt 240611 r1

Garmin International, Inc.

PMN: A04939

SN's: 8FU000046, 8FU000039

Date: October 25, 2024

Page 1 of 38

TABLE OF CONTENTS.....	2
REVISIONS.....	4
EXECUTIVE SUMMARY	5
OPINION / INTERPRETATION OF RESULTS	5
EQUIPMENT TESTED.....	6
Equipment Operational Modes.....	7
Equipment Function	8
Equipment Configuration.....	9
APPLICATION FOR CERTIFICATION.....	10
APPLICABLE STANDARDS.....	11
EQUIPMENT TESTING PROCEDURES	11
AC Line Conducted Emission Test Procedure	11
Radiated Emission Test Procedure.....	11
Antenna Port Conducted Emission Test Procedure.....	12
Diagram 1 Test arrangement for power-line conducted emissions.....	13
Diagram 2 Test arrangement for radiated emissions of tabletop equipment.....	14
Diagram 3 Test arrangement for radiated emissions tested in Semi-Anechoic Chamber (SAC) or Open Area Test Site (OATS).....	15
Diagram 4 Test arrangement for Antenna Port Conducted emissions.....	16
TEST SITE LOCATIONS	16
UNITS OF MEASUREMENTS	17
ENVIRONMENTAL CONDITIONS.....	17
STATEMENT OF MODIFICATIONS AND DEVIATIONS	17
INTENTIONAL RADIATORS.....	18

Antenna Requirements	18
Restricted Bands of Operation	18
Table 1 Radiated Emissions in Restricted Frequency Bands Data Mode 1 ANT (GFSK)	19
Summary of Results for Radiated Emissions in Restricted Bands	19
AC Line Conducted EMI Procedure	20
Figure 1 AC Line Conducted Emissions Data L1 (#2, EUT – Computer)	21
Figure 2 AC Line Conducted Emissions Data L2 (#2, EUT – Computer)	22
Table 2 AC Line Conducted Emissions Data L1 (#2, EUT – Computer)	23
Table 3 AC Line Conducted Emissions Data L2 (#2, EUT – Computer)	23
Summary of Results for AC Line Conducted Emissions	23
General Radiated Emissions Procedure	24
Table 4 General Radiated Emissions Data - Horizontal Polarization	25
Figure 3 Plot of General Radiated Emissions – Horizontal Polarization	25
Table 5 General Radiated Emissions Data - Vertical Polarization	26
Figure 4 Plot of General Radiated Emissions – Vertical Polarization	26
Summary of Results for General Radiated Emissions	27
Operation in the Band 2400 – 2483.5 MHz	27
Figure 5 Plot of Transmitter Emissions in 2402-2480 MHz Mode 1 ANT (GFSK)	28
Figure 6 Plot of Transmitter Emissions Low Band Edge Mode 1 ANT (GFSK)	29
Figure 7 Plot of Transmitter Emissions High Band Edge Mode 1 ANT (GFSK)	30
Figure 8 Plot of Transmitter 99% Occupied Bandwidth Mode 1 ANT (GFSK)	31
Transmitter Emissions Data	32
Table 6 Transmitter Radiated Emissions Mode 1 ANT (GFSK)	32
Summary of Results for Transmitter Radiated Emissions of Intentional Radiator	33
ANNEX	34
Annex A Measurement Uncertainty Calculations	35
Annex C Laboratory Certificate of Accreditation	38

Revisions

Revision 1 Issued October 22, 2024 - Initial Release

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Date: October 25, 2024

Page 4 of 38

Executive Summary

License Exempt Digital Transmission System Intentional Radiator operating under Title 47 Code of Federal Regulations (47 CFR) Paragraph 15.249 and Industry Canada RSS-210 Issue 10 and RSS-GEN Issue 5, Low Power (DXX) Digital Device transmitter operations in the 2400 – 2483.5 MHz frequency band.

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

PMN: A04939

FCC ID: IPH-04939 IC: 1792A-04939

Operating Frequency Range: 2402-2480 MHz

A04939 was chosen for transmitter configuration testing and used for final measurements.

Operational communication mode 16

Mode	Peak Power (dBμV/m@3m)	Average power (dBμV/m@3m)	Limit@3m (dBuV/m)	Margin	99% OBW (kHz)
Mode 16, ANT (GFSK)	97.7	66.9	94.0	-27.1	1,023.0

This report addresses EUT Operations as Low Power Transmitter (DXX) using transmitter modulation mode 16. Note, the production device utilizes an integral antenna system with the 2.4 GHz non-user accessible providing -0.5 dBi gain.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47 CFR 15.205, RSS-210 4.1	-16.8	Complies
Conducted Emissions per 47CFR 15.207, RSS-GEN 8.8	-13.16	Complies
Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9	-3.8	Complies
Harmonic Emissions per 47 CFR 15.249, RSS-210 B.10	-14.1	Complies

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Page 5 of 38

Equipment Tested

Model: A04939

Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT #1 Radiated	A04939	8FU000046
EUT #2 Antenna Port Conducted	A04939	8FU000039
Bare wire power cable	320-01599-02	N/A
Bare wire power cable	320-01485-01	N/A
Bare wire power cable	320-01599-12	N/A
USB Cable	320-01545-10	N/A
Remote	010-02974-00	N/A
GRR	010-013087-xx	N/A
Laptop Computer	Latitude 7480	EFSPSN2
USB Printer	Dell 0N5819	5D1SL61

Test results in this report relate only to the items tested. Worst-case configuration data recorded in this report.

The design may operate one transmitter chain at a time and is not capable of simultaneous transmission on more than one port.

Software (FVIN): 1.24 or higher; Antennas: 2.4 GHz PIFA (-0.5 dBi), 5.1 GHz PIFA (3.2 dBi), 5.7 GHz PIFA (3.6 dBi)

Equipment Operational Modes

Mode	Transmitter Operation
1	BT BR (GFSK)
2	BT (2EDR $\pi/4$ DQPSK)
3	BT (3EDR 8DPSK)
4	BT BLE (GMSK)
5	802.11b
6	802.11g
7	802.11n
8	U-NII-1 802.11a
9	U-NII-1 802.11n
10	U-NII-1 802.11n40
11	U-NII-1 802.11ac80
12	U-NII-3 802.11a
13	U-NII-3 802.11n
14	U-NII-3 802.11n40
15	U-NII-3 802.11ac80
16	ANT (GFSK)

Equipment Function

The EUT is a GPS receiver with graphical display and user interface design. The unit provides GPS reception, graphical display of location, navigation, and other information for the user. The design offers use as a hand-held, transportation mounted or portable configuration for use in navigational applications. The design incorporates transmitter circuitry operating in the 2402-2480, and 5150-5250 MHz frequency bands. The typical use configuration has the EUT mounted in a transportation vehicle and powered from the direct current vehicle power through direct, Cigarette Lights Adapter (CLA), or power mount interface cable. The design provides a Micro SD Card slot and USB-C interface port as presented below and wireless communications with compatible equipment. The EUT operates from direct current power provided from internal rechargeable battery or external power. External power may be supplied through the installation vehicles 12-volt power or compliant USB interface as documented this report. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interface connections than those presented in the configuration options as described by the manufacturer and presented below. For testing purposes, the EUT received power from both internal and external power options and configurations. During testing, the test system was configured to operate in a manufacturer defined mode. The manufacturer provided test software for testing transmitter and equipment function. The software provided ability to operate the transmitter at near 100% duty cycle for testing purposes. The testing mode of operation exceeds typical duty cycle operation of production equipment. As requested by the manufacturer the equipment was tested for emissions compliance using the available configurations with the worse-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.

Unit under Test

- 2) EUT connected to Bare wire PWR cable.

Unit under
Test

Bare wire PWR Cable
320-01599-02

- 3) EUT connected and powered through Group Ride Radio, Bare wire PWR, and remote.

Unit under Test

GRR
010-013087-xx

Bare wire PWR Cable
320-01485-01

Remote
010-02974-00

- 4) EUT connected to Bare wire PWR cable, and remote.

Unit under
Test

Bare wire PWR Cable
320-01599-12

Remote
010-02974-00

- 5) EUT connected to CLA Through USB cable.

Unit under Test

USB Cable
320-01545-10

Computer USB port

Application for Certification

- (1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062
- (2) Identification: HVIN: A04939
FCC ID: IPH-04939 IC: 1792A-04939
- (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 external direct current power provided from installation vehicle. The EUT provides interface ports for power, loads and communications as presented in this filing.
- (9) Transition Provisions of 47 CFR 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.
- (13) Applications for certification of U-NII devices in the 5.15-5.35 GHz and the 5.47-5.85 GHz bands must include a high-level operational description of the security procedures that control the radio frequency operating parameters and ensure that unauthorized modifications cannot be made. This requirement is not applicable to his DTS device.
- (14) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used. This information is provided in this report and Test Setup Exhibits provided with the application filing.

Applicable Standards

The following information is submitted in accordance with the eCFR Title 47 Code of Federal Regulations (47CFR), dated August 4, 2023: Part 2, Subpart J, Part 15C Paragraph 15.249, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2013. This report documents compliance with the EUT operations as Low Power Transmitter (DXX).

Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions were performed as required in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. 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 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 diagram one showing typical test arrangement and photographs in the test setup exhibit for EUT placement used during testing.

Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47 CFR 15C, RSS-210 Issue 10, and specified in ANSI C63.10-2013. The EUT was placed on a rotating 0.9 x 1.2-meter platform, elevated as required above the ground plane at a distance of 3 meters from the FSM antenna. EMI energy was maximized by equipment placement permitting orientation in three orthogonal axes, raising, and lowering the FSM antenna, changing the antenna polarization, and by rotating the turntable. Each emission was maximized before data was taken and recorded. The frequency spectrum from 9 kHz to 25,000 MHz was searched for emissions during preliminary investigation. Refer to diagrams one and two showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

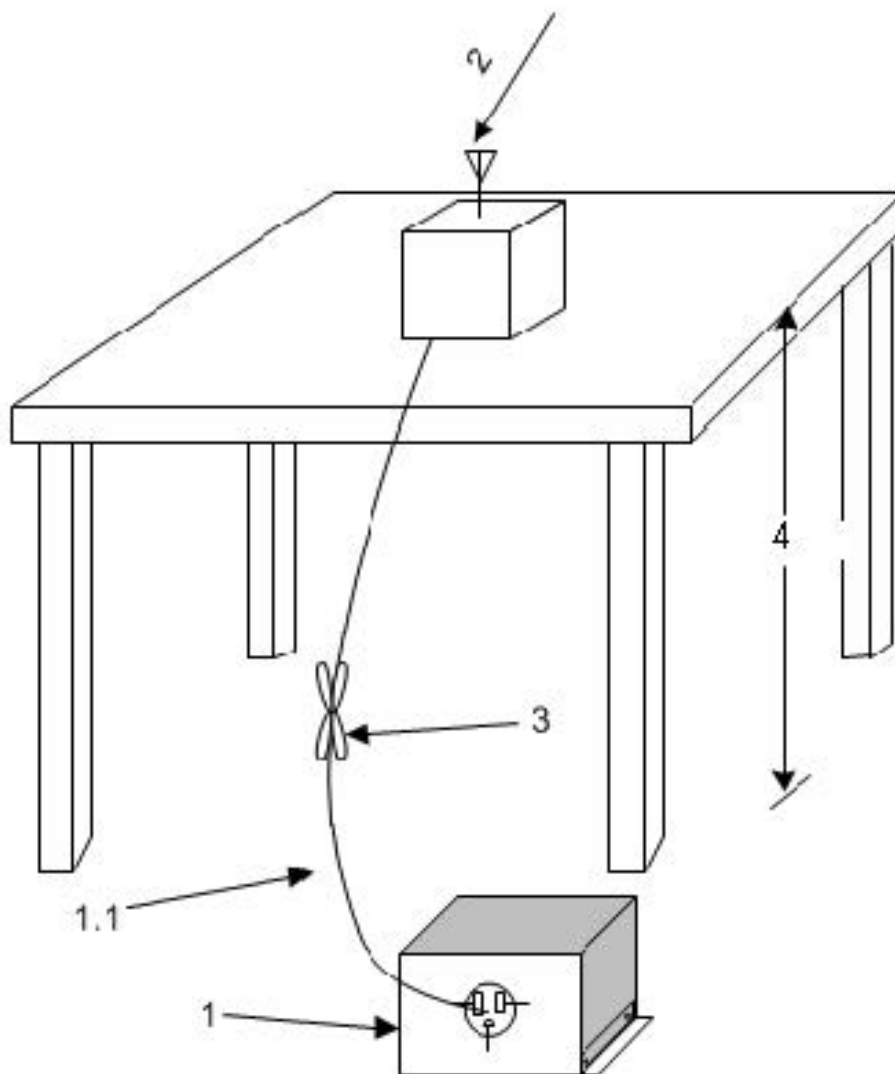
Antenna Port Conducted Emission Test Procedure

The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port. Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2013. Testing was completed on a laboratory bench in a shielded room. The active antenna port of the device was connected to appropriate attenuation and the spectrum analyzer. Refer to diagram three showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.



- Page 13 of 38

Diagram 2 Test arrangement for radiated emissions of tabletop equipment



1—A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).

1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.

2—Antenna can be integral or detachable, depending on the EUT (see 6.3.1).

3—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 6.3.1).

4—For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

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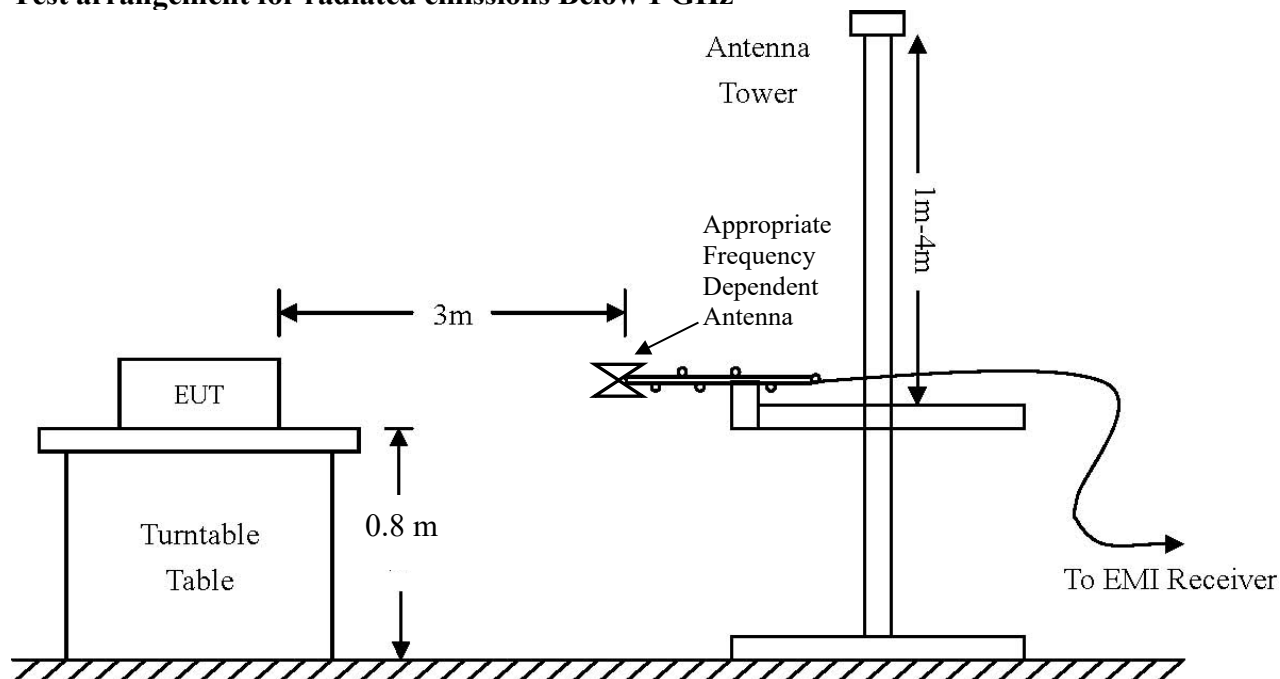
SN's: 8FU000046, 8FU000039

Date: October 25, 2024

Page 14 of 38

Diagram 3 Test arrangement for radiated emissions tested in Semi-Anechoic Chamber (SAC) or Open Area Test Site (OATS)

Test arrangement for radiated emissions Below 1 GHz



Test arrangement for radiated emissions Above 1 GHz

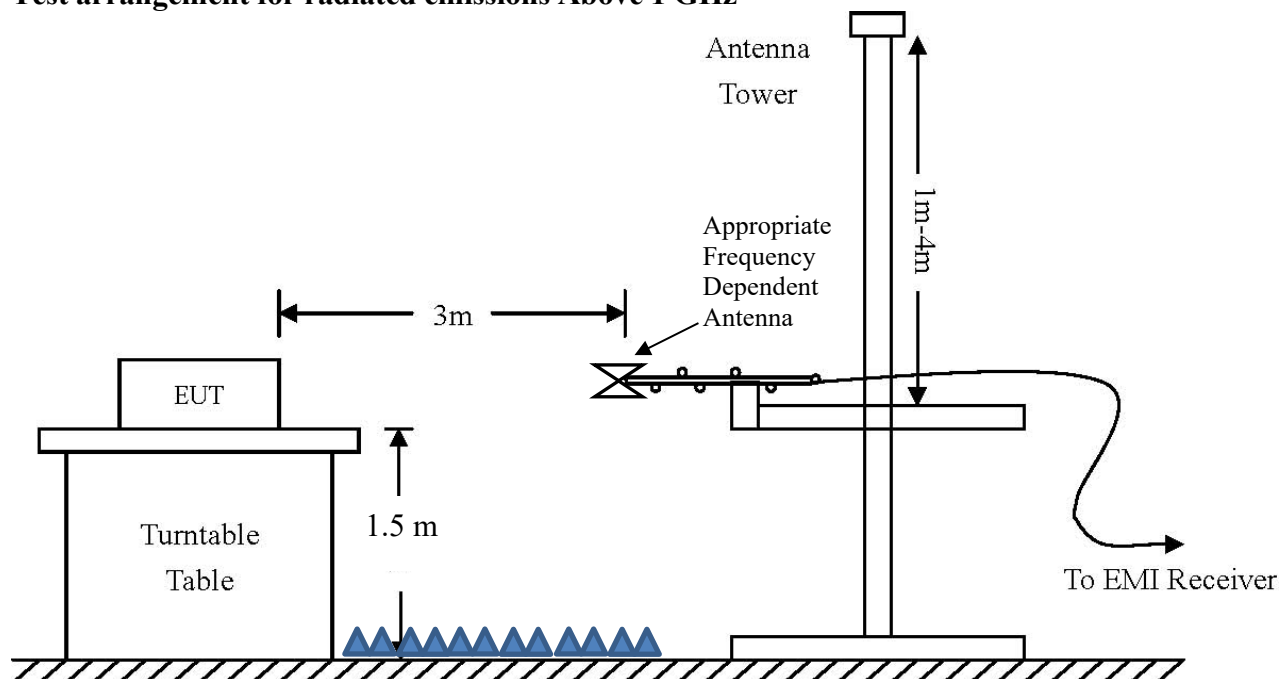
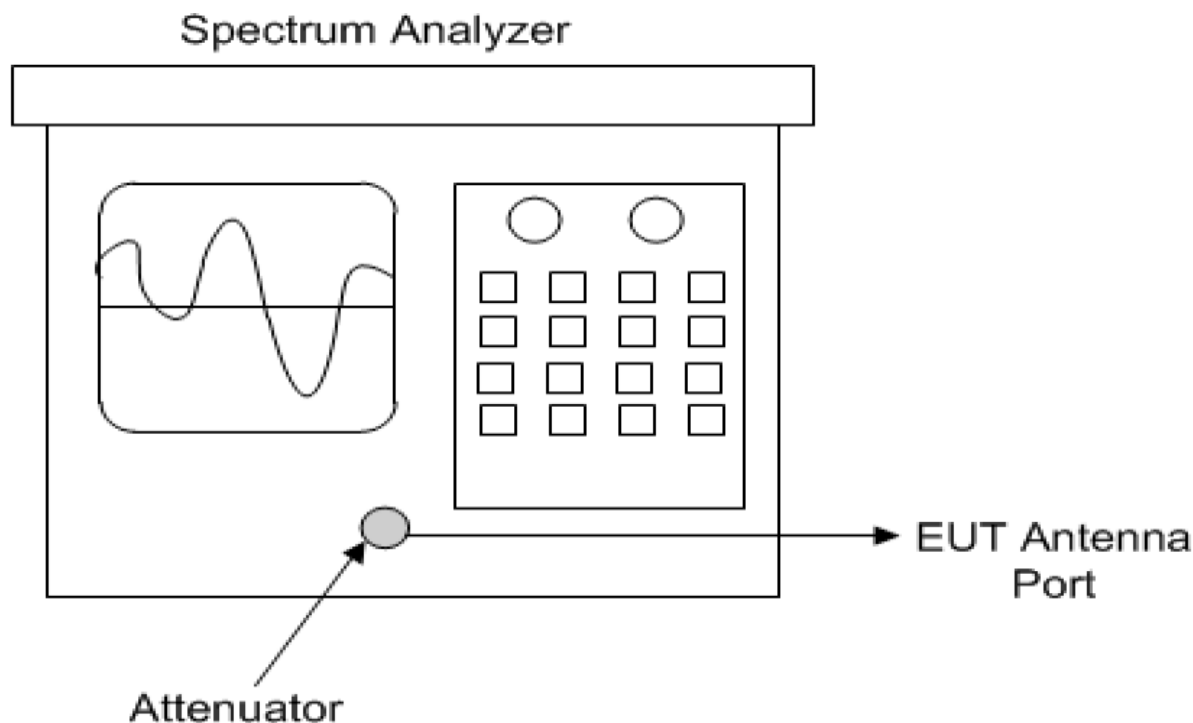


Diagram 4 Test arrangement for Antenna Port Conducted emissions



Test Site Locations

Conducted EMI AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).

Antenna port Antenna port conducted emissions testing was performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).

Radiated EMI The radiated emissions tests were performed at the 3 meters Semi-Anechoic Chamber (SAC) located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS or at the 3 meters Outdoor Area Test Site (OATS) in the satellite location.

Registered Site information: FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096

NVLAP Accreditation Lab code 200087-0

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Page 16 of 38

Units of Measurements

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

Antenna port Conducted Data is in dBm; dB referenced to one milliwatt

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

Note: Radiated limit may be expressed for measurement in dB μ V/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters.

Sample calculation demonstrates corrected field strength reading for Semi-Anechoic Chamber using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains

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

Environmental Conditions

Ambient Temperature 25.1° C

Relative Humidity 46.0 %

Atmospheric Pressure 1016.7 mb

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the 47 CFR Part 15C, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Intentional Radiators

The following information is submitted supporting compliance with the requirements of 47 CFR, Subpart C, paragraph 15.249, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5.

Per 47 CFR, Subpart A, paragraph 15.31, all testing was performed over three frequencies (1 near top, 1 near middle and 1 near bottom).

Antenna Requirements

The EUT incorporates integral non-user accessible systems. Production equipment 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 in the 3 meters Semi-Anechoic Chamber (SAC). The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated in the 3m SAC, using appropriate antennas or pyramidal horns, amplification stages, and receiver / 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 C63.10-2013 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed emission values consider the received radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

Table 1 Radiated Emissions in Restricted Frequency Bands Data Mode 1 ANT (GFSK)

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Average (dBμV/m)	Limit @ 3m (dBμV/m)	Horizontal Margin (dB)	Vertical Margin (dB)
2390.0	48.2	34.3	47.7	34.3	54.0	-19.7	-19.7
2483.5	48.5	34.9	48.8	34.9	54.0	-19.1	-19.1
4804.0	45.7	30.1	45.4	30.1	54.0	-23.9	-23.9
4914.0	45.4	30.0	46.3	30.1	54.0	-24.0	-23.9
4960.0	44.7	29.7	45.8	29.9	54.0	-24.3	-24.1
7206.0	46.1	32.2	46.7	32.2	54.0	-21.8	-21.8
7371.0	46.0	32.3	48.0	32.4	54.0	-21.7	-21.6
7440.0	45.2	32.1	45.7	32.1	54.0	-21.9	-21.9
12010.0	49.2	35.6	48.6	35.5	54.0	-18.4	-18.5
12285.0	50.7	37.2	50.1	37.2	54.0	-16.8	-16.8
12400.0	49.6	36.3	49.6	36.3	54.0	-17.7	-17.7

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

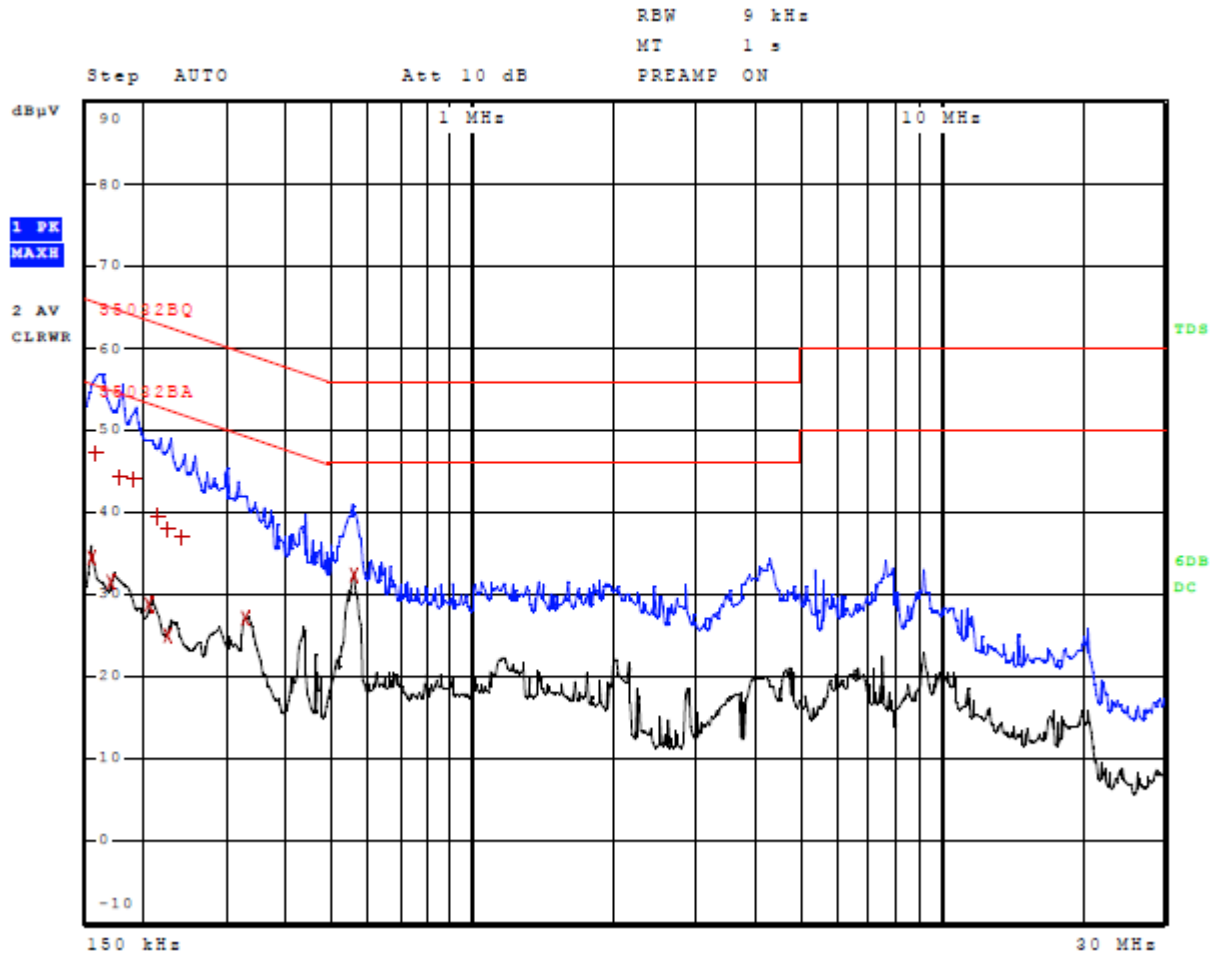
The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C and RSS-210 Issue 10 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -16.8 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted EMI Procedure

The EUT was arranged in typical equipment configurations as offered by the manufacturer and presented above in equipment configuration. AC Line Conducted emission testing was performed with the EUT placed on a 1 x 1.5-meter 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 AC line-conducted emissions followed the procedures of ANSI C63.10-2013. The EUT was configured as presented in the AC Line conducted configurations as directed by the manufacturer and presented above in equipment configuration. The AC adapter for the EUT was connected to the LISN for AC 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 test configuration. 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 and data recorded.

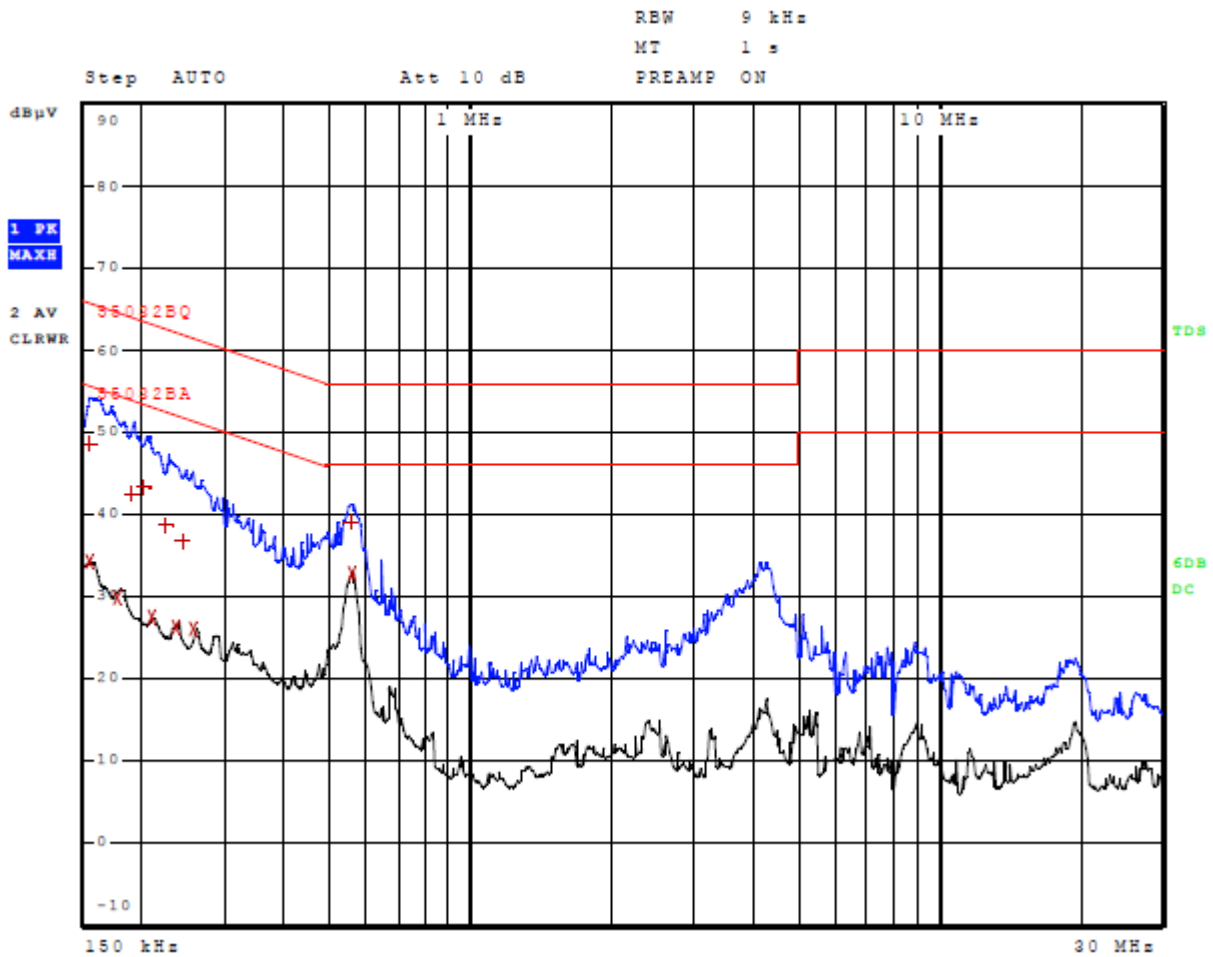
Refer to figure one and two for plots of the Configuration #2 EUT – USB Computer interface AC Line conducted emissions.

Figure 1 AC Line Conducted Emissions Data L1 (#2, EUT – Computer)



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

Figure 2 AC Line Conducted Emissions Data L2 (#2, EUT – Computer)



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

Table 2 AC Line Conducted Emissions Data L1 (#2, EUT – Computer)

Trace	Frequency	Level (dB μ V)	Detector	Delta Limit/dB
2	154.000000000 kHz	34.50	Average	-21.28
1	158.000000000 kHz	47.35	Quasi Peak	-18.22
2	170.000000000 kHz	31.58	Average	-23.38
1	178.000000000 kHz	44.27	Quasi Peak	-20.31
1	190.000000000 kHz	44.18	Quasi Peak	-19.86
2	206.000000000 kHz	28.82	Average	-24.55
1	214.000000000 kHz	39.48	Quasi Peak	-23.57
2	226.000000000 kHz	24.99	Average	-27.60
1	226.000000000 kHz	37.99	Quasi Peak	-24.61
1	242.000000000 kHz	36.98	Quasi Peak	-25.05
2	330.000000000 kHz	27.11	Average	-22.35
2	554.000000000 kHz	32.36	Average	-13.64

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

Table 3 AC Line Conducted Emissions Data L2 (#2, EUT – Computer)

Trace	Frequency	Level (dB μ V)	Detector	Delta Limit/dB
2	154.000000000 kHz	34.27	Average	-21.51
1	154.000000000 kHz	48.59	Quasi Peak	-17.19
2	178.000000000 kHz	29.89	Average	-24.69
1	190.000000000 kHz	42.41	Quasi Peak	-21.63
1	202.000000000 kHz	43.29	Quasi Peak	-20.24
2	210.000000000 kHz	27.40	Average	-25.80
1	226.000000000 kHz	38.62	Quasi Peak	-23.97
2	238.000000000 kHz	26.23	Average	-25.94
1	246.000000000 kHz	36.73	Quasi Peak	-25.16
2	258.000000000 kHz	25.95	Average	-25.55
1	550.000000000 kHz	38.97	Quasi Peak	-17.03
2	554.000000000 kHz	32.84	Average	-13.16

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 47CFR Part 15C and other applicable emissions requirements. The EUT configuration #2 demonstrated a minimum margin of -13.16 dB below the requirement. 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 manufacturer defined equipment configuration and operated with transmitter active during testing. 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 in the SAC before final radiated measurements were performed. Final data was taken with the EUT located in the SAC at 3 meters distance 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 above 1 GHz, notch filters and appropriate amplifiers and external mixers were utilized.

Table 4 General Radiated Emissions Data - Horizontal Polarization

Frequency (MHz)	Peak (dB μ V/m)	Quasi-Peak (dB μ V/m)	Limit @ 3m (dB μ V/m)	Margin (dBm)
253.22	37.041	33.94	47	-13.06
322.19	42.098	38.78	47	-8.22
362.15	43.104	39.61	47	-7.39
399.86	42.321	37.37	47	-9.63
403.91	43.402	38.84	47	-8.16
460.22	38.926	34.29	47	-12.71

Figure 3 Plot of General Radiated Emissions – Horizontal Polarization

ETS - Lindgren

Radiated Emissions, 30 MHz - 1 GHz

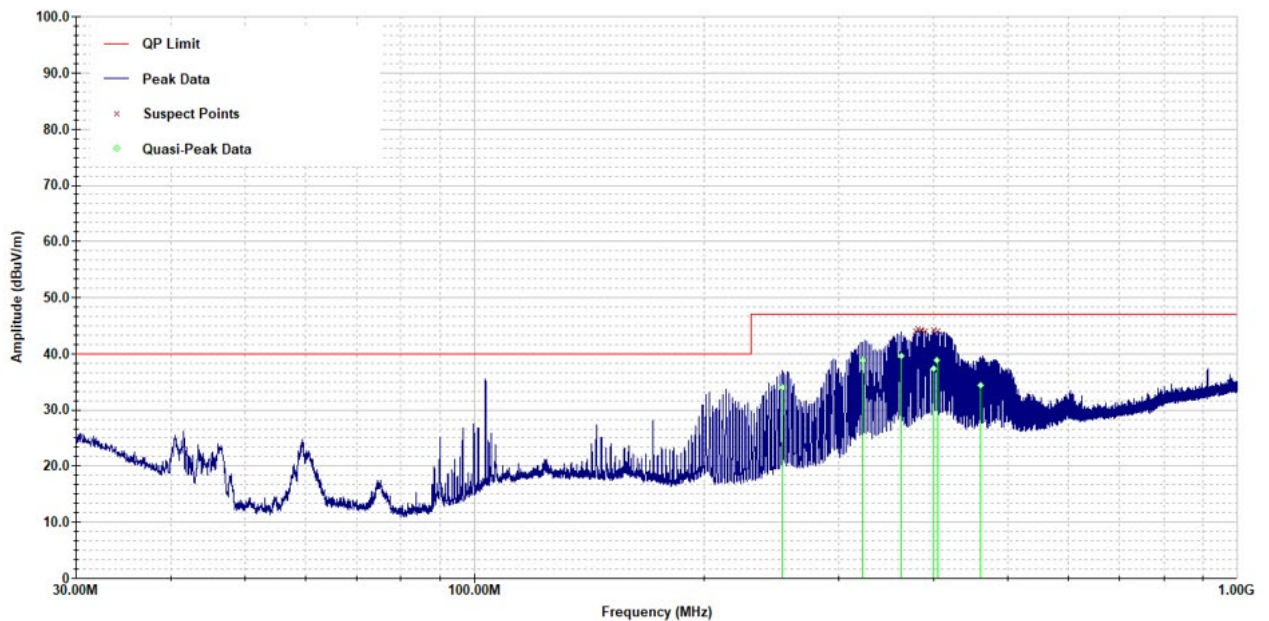
Horizontal Graph

Model # - Tread 2 A04939

Serial # - 3474385592

Test Mode - Tx

Operator - jc



test run 4 config 3 GRR bare wire pwr remote

Limit = CISPR 32 Class B

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7915 Nieman Road FCC ID: IPH-04939 IC: 1792A-04939

Lenexa, KS 66214

Test: 240611

Phone/Fax: (913) 660-0666

Test to: 47CFR 15C, RSS-Gen RSS-247

Revision 1

File: A04939 DXX TstRpt 240611 r1

Garmin International, Inc.

PMN: A04939

SN's: 8FU000046, 8FU000039

Date: October 25, 2024

Page 25 of 38

Table 5 General Radiated Emissions Data - Vertical Polarization

Frequency (MHz)	Peak (dB μ V/m)	Quasi-Peak (dB μ V/m)	Limit @ 3m (dB μ V/m)	Margin (dBm)
41.57	42.314	36.2	40	-3.8
43.4	36.936	28.5	40	-11.5
200.9	33.721	31.94	40	-8.06
253.22	37.082	35.05	47	-11.95
322.31	39.212	36	47	-11.00
403.82	41.592	38.47	47	-8.53

Figure 4 Plot of General Radiated Emissions – Vertical Polarization

ETS - Lindgren

Radiated Emissions, 30 MHz- 1 GHz

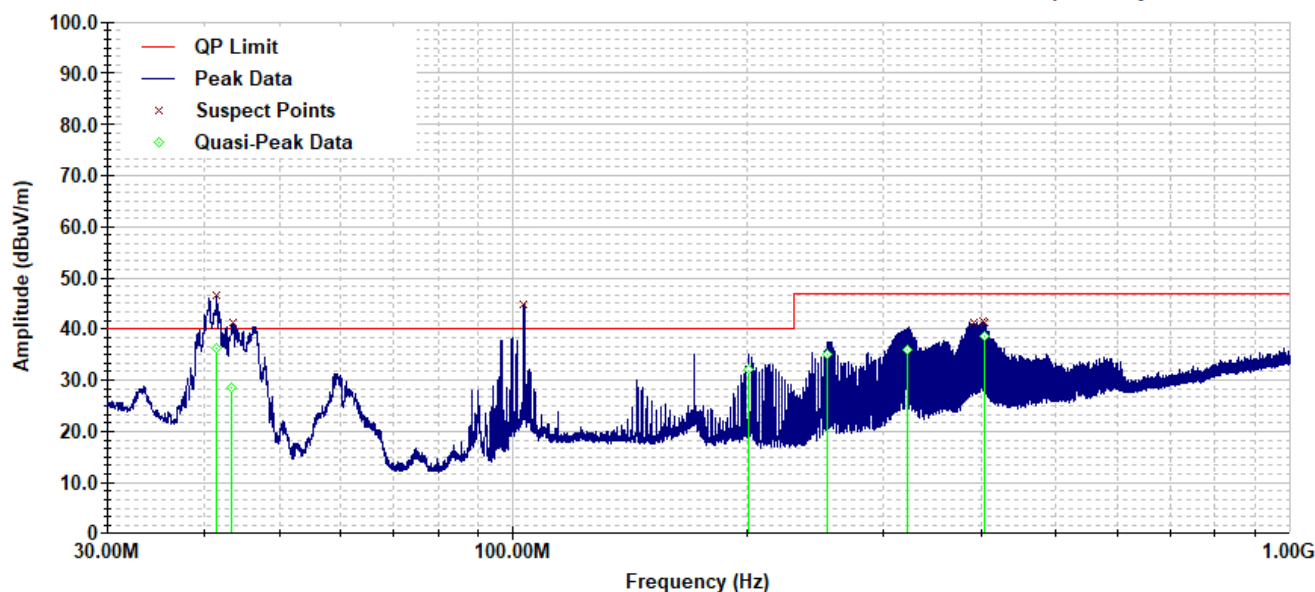
Vertical Graph

Model # - Tread 2 A04939

Serial # - 3474385592

Test Mode - Tx

Operator - jc



test run 4 config 3 GRR bare wire pwr remote

Limit = CISPR 32 Class B

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.

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Date: October 25, 2024

Page 26 of 38

Summary of Results for General Radiated Emissions

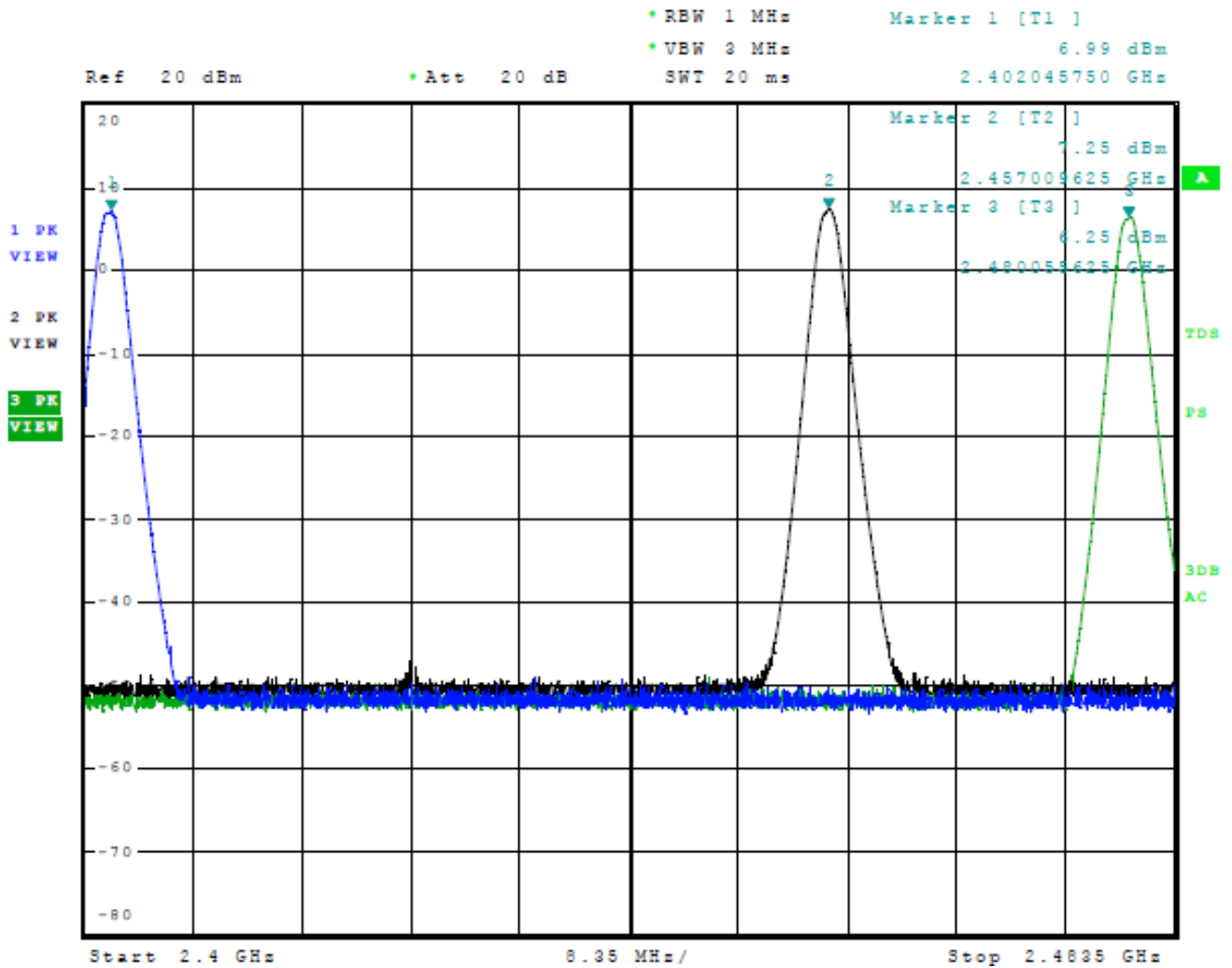
The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C paragraph 15.209, RSS-210 Issue 10, and RSS-GEN Issue 5 Intentional Radiators. The EUT worst-case transmitter configuration demonstrated a minimum margin of -3.8 dB below the requirements. Other emissions were 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 in the semi anechoic chamber (SAC) @ 3 meters. The amplitude of radiated emission was measured in the SAC at distance of 3 meters from the FSM antenna (radiated emission testing was performed on sample #1) representative of production equipment with integral antennas. The EUT was placed on a turntable elevated as required 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, whichever is the lesser attenuation. Antenna port emission plots were taken of transmitter performance for reference in this and other documentation using test sample #4. The amplitude of each radiated emission was maximized by equipment orientation and placement on the turn table, raising and lowering the FSM (Field Strength Measuring) antenna, changing the FSM antenna 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 dB μ V/m @ 3 meters.

Refer to figures five through eight showing plots of mode 1 taken of the 2402-2480 MHz transmitter operation displaying compliance with the specifications.

Figure 5 Plot of Transmitter Emissions in 2402-2480 MHz Mode 1 ANT (GFSK)



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Date: October 25, 2024

Page 28 of 38

Figure 6 Plot of Transmitter Emissions Low Band Edge Mode 1 ANT (GFSK)

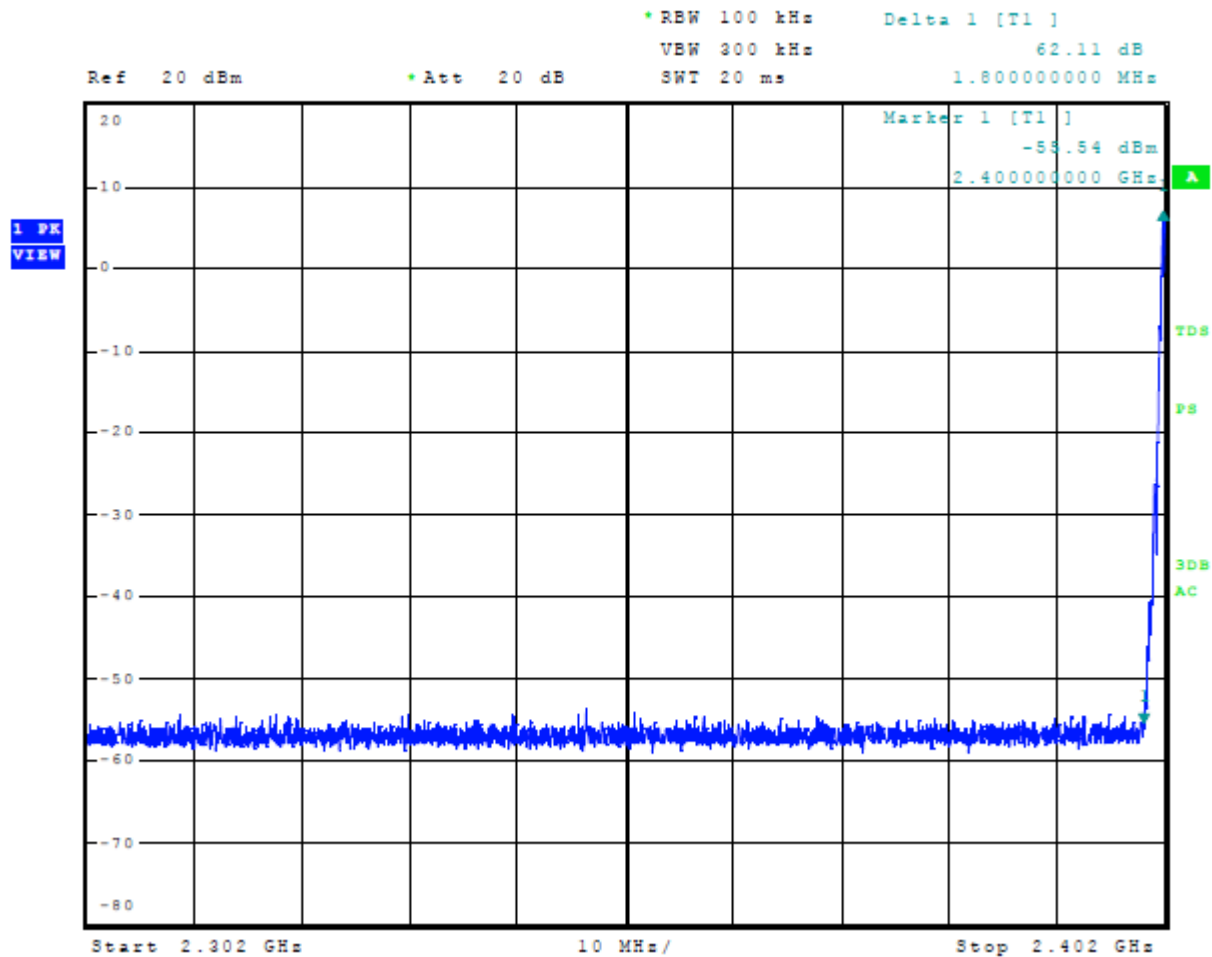
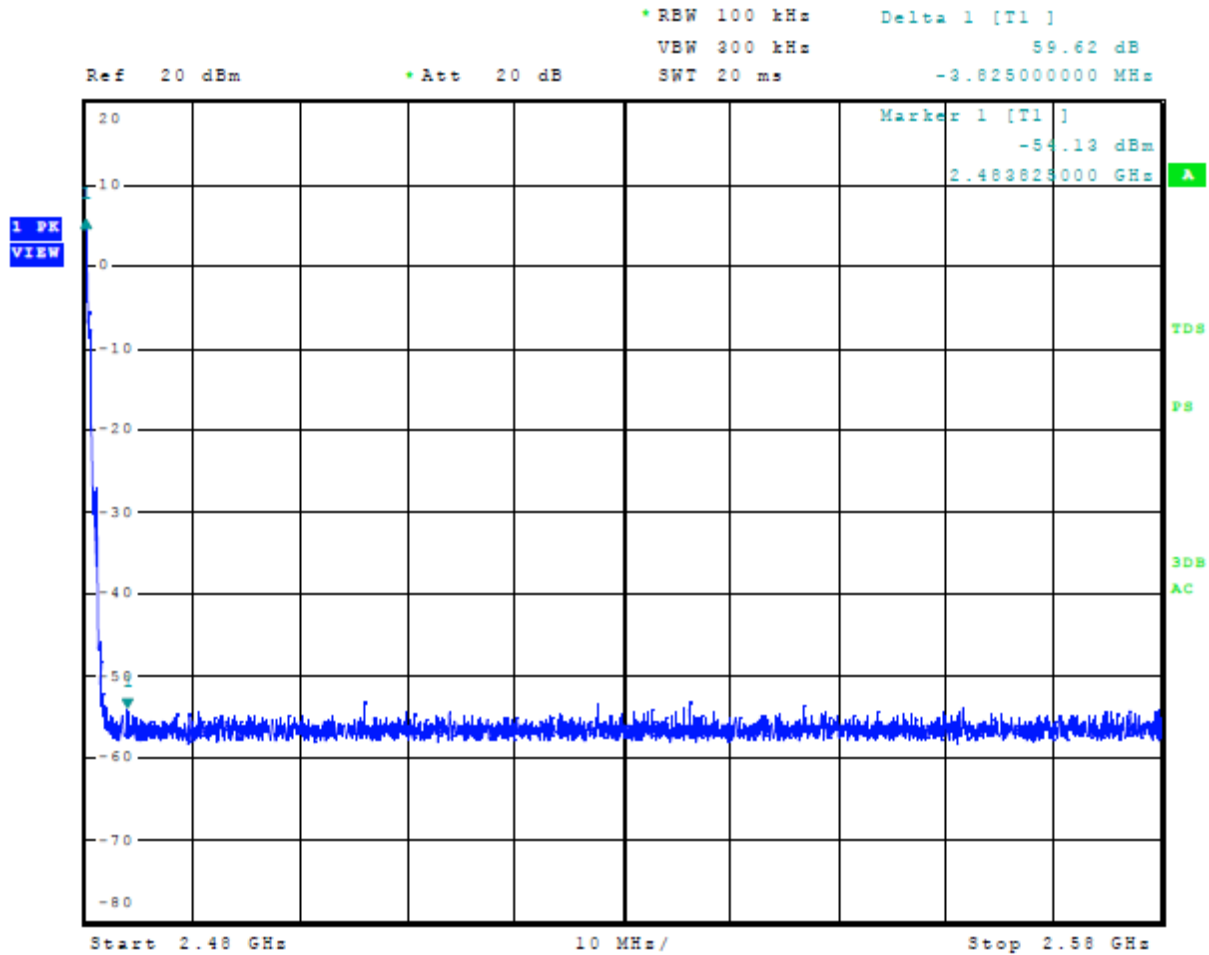


Figure 7 Plot of Transmitter Emissions High Band Edge Mode 1 ANT (GFSK)



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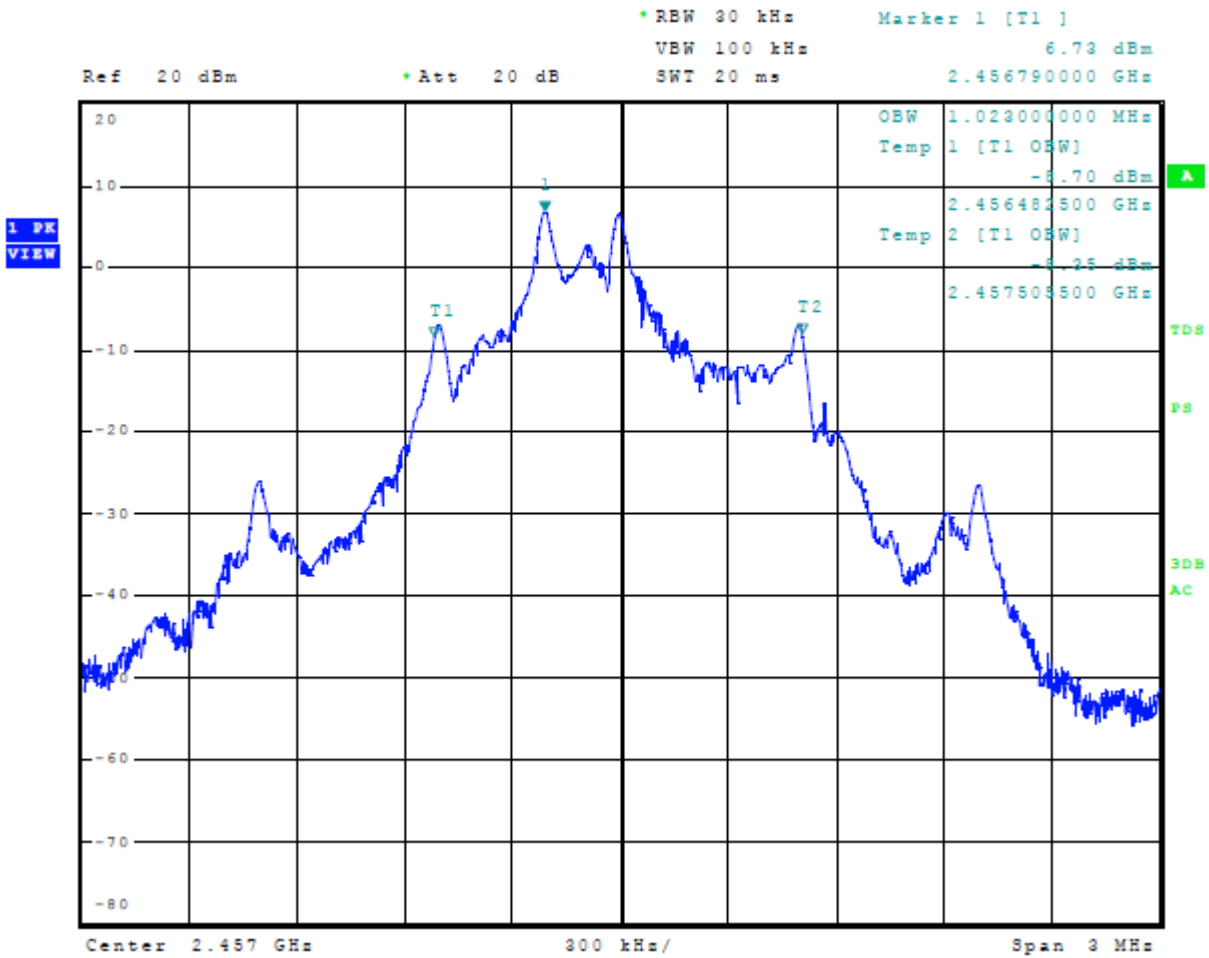
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SN's: 8FU000046, 8FU000039

Date: October 25, 2024

Page 30 of 38

Figure 8 Plot of Transmitter 99% Occupied Bandwidth Mode 1 ANT (GFSK)



Transmitter Emissions Data

Table 6 Transmitter Radiated Emissions Mode 1 ANT (GFSK)

Frequency in MHz	Horizontal Peak (dBμV/m)	Horizontal Average (dBμV/m)	Vertical Peak (dBμV/m)	Vertical Average (dBμV/m)	Limit @ 3m (dBμV/m)	Horizontal Margin (dB)	Vertical Margin (dB)
2402.0	95.0	64.2	97.2	66.3	94.0	-29.8	-27.7
4804.0	45.7	30.1	45.4	30.1	54.0	-23.9	-23.9
7206.0	46.1	32.2	46.7	32.2	54.0	-21.8	-21.8
9608.0	48.1	34.5	48.4	34.6	54.0	-19.5	-19.4
12010.0	49.2	35.6	48.6	35.5	54.0	-18.4	-18.5
14412.0	50.1	36.6	49.7	36.5	54.0	-17.4	-17.5
16814.0	53.1	39.9	53.8	39.9	54.0	-14.1	-14.1
2457.0	97.7	66.9	96.0	65.1	94.0	-27.1	-28.9
4914.0	45.4	30.0	46.3	30.1	54.0	-24.0	-23.9
7371.0	46.0	32.3	48.0	32.4	54.0	-21.7	-21.6
9828.0	48.2	35.0	48.8	35.0	54.0	-19.0	-19.0
12285.0	50.7	37.2	50.1	37.2	54.0	-16.8	-16.8
14742.0	50.1	36.2	50.2	36.2	54.0	-17.8	-17.8
17199.0	51.4	37.5	51.1	37.5	54.0	-16.5	-16.5
2480.0	94.1	63.1	96.3	65.5	94.0	-30.9	-28.5
4960.0	44.7	29.7	45.8	29.9	54.0	-24.3	-24.1
7440.0	45.2	32.1	45.7	32.1	54.0	-21.9	-21.9
9920.0	48.7	34.6	48.2	34.6	54.0	-19.4	-19.4
12400.0	49.6	36.3	49.6	36.3	54.0	-17.7	-17.7
14880.0	48.6	35.4	49.1	35.5	54.0	-18.6	-18.5
17360.0	50.8	37.5	51.4	37.5	54.0	-16.5	-16.5

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.

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Date: October 25, 2024

Revision 1

File: A04939 DXX TstRpt 240611 r1

Page 32 of 38

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15.249, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5 Intentional Radiator regulations. The EUT worst-case test sample configuration demonstrated minimum average margin of -27.1 dB below the average emission limit for the fundamental. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -14.1 dB below the limit. 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 Test Equipment
- Annex C Laboratory Certificate of Accreditation

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SN's: 8FU000046, 8FU000039

Date: October 25, 2024

Page 34 of 38

Annex A Measurement Uncertainty Calculations

The measurement uncertainty was calculated for all measurements listed in this test report according To CISPR 16–4. Result of measurement uncertainty calculations are recorded below. Component and process variability of production devices similar to those tested may result in additional deviations. The manufacturer has the sole responsibility of continued compliance.

Measurement	Expanded Measurement Uncertainty $U_{(lab)}$
3 Meter Horizontal 0.009-1000 MHz Measurements	4.16
3 Meter Vertical 0.009-1000 MHz Measurements	4.33
3 Meter Measurements 1-18 GHz	5.46
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6°C
Humidity	3%

Annex B Test Equipment

<u>Equipment</u>	<u>Manufacturer</u>	<u>Model (SN)</u>	<u>Band</u>	<u>Cal Date(m/d/y)</u>	<u>Due</u>
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	3/25/2024	3/25/2025
☐ LISN: Fischer Custom Communications Model:		FCC-LISN-50-16-2-08		3/25/2024	3/25/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/16/2024	9/16/2025
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/16/2024	9/16/2025
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/16/2024	9/16/2025
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/16/2024	9/16/2026
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/25/2024	3/25/2026
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	9/16/2024	9/16/2026
☒ Antenna	Com Power	AH-1840 (101046)	18-40 GHz	3/27/2023	3/27/2025
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	7/8/2024	7/8/2025
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/26/2024	1/26/2025
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☐ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/16/2024	9/16/2025
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/16/2024	9/16/2025
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
☒ Power meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/25/2024	3/25/2025
☒ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/25/2024	3/25/2025
☒ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/25/2024	3/25/2025
☒ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/25/2024	3/25/2025
☐ Attenuator	Fairview	SA6NFFNF100W-40 (1625)	30-18000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/25/2024	3/25/2025
☒ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/25/2024	3/25/2025
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/25/2024	3/25/2025

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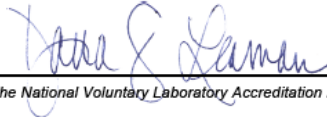
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File: A04939 DXX TstRpt 240611 r1

Page 36 of 38

<u>Equipment</u>	<u>Manufacturer</u>	<u>Model (SN)</u>	<u>Band</u>	<u>Cal Date(m/d/y)</u>	<u>Due</u>
☐ Frequency Counter: Leader		LDC-825 (8060153)		3/28/2023	3/28/2025
☐ ISN	Com-Power	Model ISN T-8 (600111)		3/25/2024	3/25/2025
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	9/16/2024	9/16/2025
☐ LISN:	Com-Power	Model LI-220A		9/16/2024	9/16/2026
☒ LISN:	Com-Power	Model LI-550C		9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/16/2024	9/16/2025
☒ Cable	Mini-Circuits	KBL-2M-LOW+ (23090329)	9kHz-40 GHz	3/25/2024	3/25/2025
☐ RF Filter	Micro-Tronics	BRC17663 (001)	9.3-9.5 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC19565 (001)	9.2-9.6 notch 30-1800 MHz	3/28/2023	3/28/2025
☒ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	3/25/2024	3/25/2025
☐ Wave Form Generator Keysight		33500B (MY57400128)		3/25/2024	3/25/2025
☐ Antenna: Solar		9229-1 & 9230-1		2/10/2024	2/10/2025
☐ CDN: Com-Power		Model CDN325E		10/11/2022	10/11/2024
☐ Oscilloscope Scope: Tektronix		MDO 4104		2/10/2024	2/10/2025
☐ EMC Transient Generator HVT		TR 3000		2/10/2024	2/10/2025
☐ AC Power Source (Ametech, California Instruments)				2/10/2024	2/10/2025
☒ Field Intensity Meter: EFM-018				2/10/2024	2/10/2025
☒ ESD Simulator: MZ-15				2/10/2024	2/10/2025
☒ Weather station Davis		6152 (A70927D44N)		7/11/2024	7/11/2025
☐ Injection Clamp Luthi Model EM101				not required	
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Temperature Chamber				not required	
☒ Shielded Room				not required	

Annex C Laboratory Certificate of Accreditation

United States Department of Commerce National Institute of Standards and Technology NVLAP[®] 	
Certificate of Accreditation to ISO/IEC 17025:2017	
NVLAP LAB CODE: 200087-0	
Rogers Labs, a division of The Compatibility Center LLC Lenexa, KS	
<i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i>	
Electromagnetic Compatibility & Telecommunications	
<i>This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated January 2009).</i>	
2024-03-18 through 2025-03-31 <i>Effective Dates</i>	  For the National Voluntary Laboratory Accreditation Program

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Page 38 of 38