

Application For Grant of Certification

Model: GMN-0121611
2402-2480 MHz
47 CFR, 15.249 and RSS-210
Low Power Transmitter

FCC ID: IPH-0225611
IC: 1792A-0225611

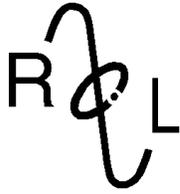
FOR

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

FCC Designation: US5305
IC Test Site Registration: 3041A-1
Test Report Number: 180320

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
47 CFR, PART 15C - Intentional Radiators Paragraph 15.249,
Industry Canada RSS-210 Issue 9, and RSS-GEN Issue 5
License Exempt Intentional Radiator

For
Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

Model: GMN-0121611

Low Power Transmitter

Frequency Range 2402-2480 MHz
FCC ID: IPH-0225611
IC: 1792A-0225611

Test Date: March 20, 2018

Certifying Engineer: *Scot D. Rogers*
Scot D. Rogers
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Rogers Labs, Inc.
4405 West 259th Terrace
Louisburg, KS 66053
Phone/Fax: (913) 837-3214
Revision 1

Garmin International, Inc.
Model: GMN-0121611
Test #: 180320
Test to: 47 CFR, 15C, RSS-Gen, RSS-210
File: IPH0225611 DXX TstRpt 180320

SN: 3EG440000, 3EG040007
FCC ID: IPH-0225611
IC: 1792A-0225611
Date: August 23, 2018
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Revision 1 Issued August 23, 2018

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Louisburg, KS 66053
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Foreword

The following information is submitted for consideration in obtaining Grant of Certification for low power intentional radiator per 47 CFR, Paragraph 15.249, Industry Canada RSS-210 Issue 9 and RSS-GEN Issue 5, low power 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

M/N: GMN-0121611

FCC ID: IPH-0225611

IC: 1792A-0225611

Operating power: 2402-2480 MHz Maximum Average power mode 1 (GFSK) 93.8 dB μ V/m @ 3 meters, mode 2 (2EDR) 91.2 dB μ V/m @3 meters, mode 3 (3EDR) 91.7 dB μ V/m @3 meters, mode 4 (BLE) 93.9 dB μ V/m @3 meters (and peak 94.8 dB μ V/m @ 3 meters), [99% OBW, mode 1 888.0 kHz, mode 2 1317.5 kHz, mode 3 1307.5 kHz, and mode 4 1027.5 kHz]

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47 CFR, 15.205, RSS-210 4.1	-5.4	Complies
AC Line Conducted 47 CFR, 15.207, RSS-GEN 8.8	N/A	Complies
Radiated Emissions 47 CFR, 15.209, RSS-GEN 8.9	-7.5	Complies
Harmonic Emissions per 47 CFR, 15.249, RSS-210 B10	-5.4	Complies

Equipment Tested

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT #1	GMN-0121611	3EG440000
EUT #2	GMN-0121611	3EG040007
Bench DC power supply	BK 1745	209C13
Laptop Computer	Latitude E6320	FCN03Q1

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

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Louisburg, KS 66053
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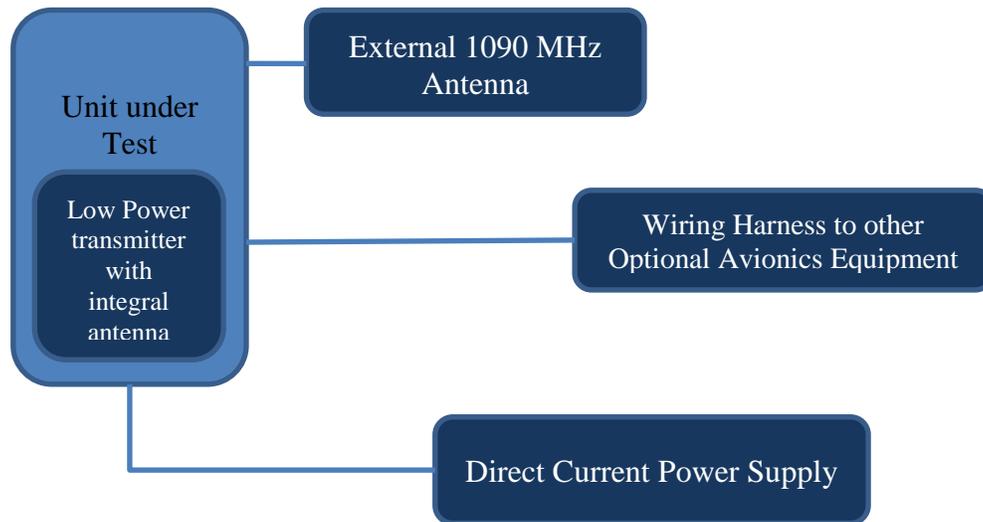
Equipment Function

The EUT is a Panel mount Mode A and S avionics transponder incorporating a low power 2402-2480 MHz transmitter. This design incorporates a low power transmitter providing additional wireless connectivity inside the aircraft with compatible equipment. The low power transmitter provides wireless communications with compatible equipment. The product operates from aircraft power only. The transponder portion of the design is addressed in other reports and documentation. This report addresses the low power portion of the design. The low power transmitter utilizes internal fixed antenna system and offers no provision for antenna replacement or modification. Two samples were provided for testing, one representative of production design, and the other modified for testing purposes replacing the integral antenna with a RF connection port. The test samples were provided with test software which provided testing personnel the ability to enable transmitter function on defined channels and operational modes. The antenna modification offered testing facility ability to connect test equipment to the temporary antenna port for antenna port conducted emission testing. 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 in the configuration options as presented and described by the manufacturer. For testing purposes, the EUT received power from a bench top DC power supply. 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. The test software provided high duty cycle transmission for testing purposes. The production product will not operate at the high duty cycles used during testing. Test results in this report relate only to the products described in this report.

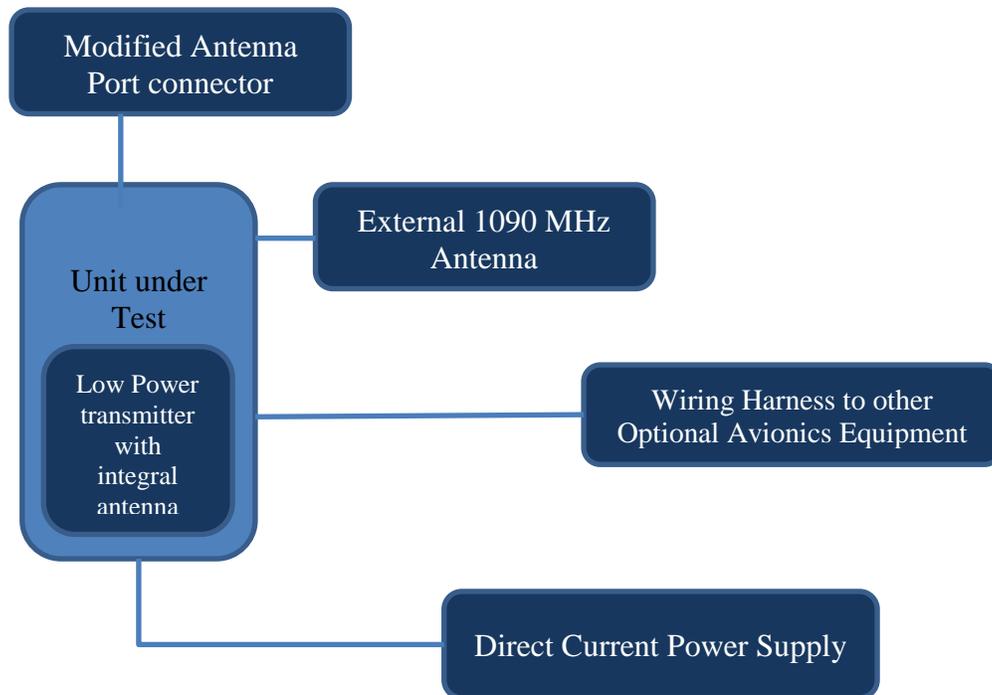
Equipment Configuration

- 1) EUT powered by Bench DC power supply and connected to interface cabling

Configuration #1 Integral antenna



Configuration #2 modified with Antenna Port Connector



Application for Certification

- (1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062
- (2) Identification: M/N: GMN-0121611
FCC ID: IPH-0225611 IC: 1792A-0225611
- (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 direct current power provided from installation aircraft Direct Current power. The design provides interface with other avionic equipment through the wiring harness as presented in this filing. The EUT offers no other connection ports than those presented in this filing.
- (9) For equipment subject to the provisions of part 15 of this chapter, the application shall indicate if the equipment is being authorized pursuant to the transition provisions in §15.37 of this chapter : 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 & Test Procedures

In accordance with the e-CFR Code of Federal Regulations Title 47, dated March 20, 2018: Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.915, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.249, Industry Canada RSS-210 Issue 9, and RSS-GEN Issue 5 operation in the 2400 – 2483.5 MHz Frequency band. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2013.

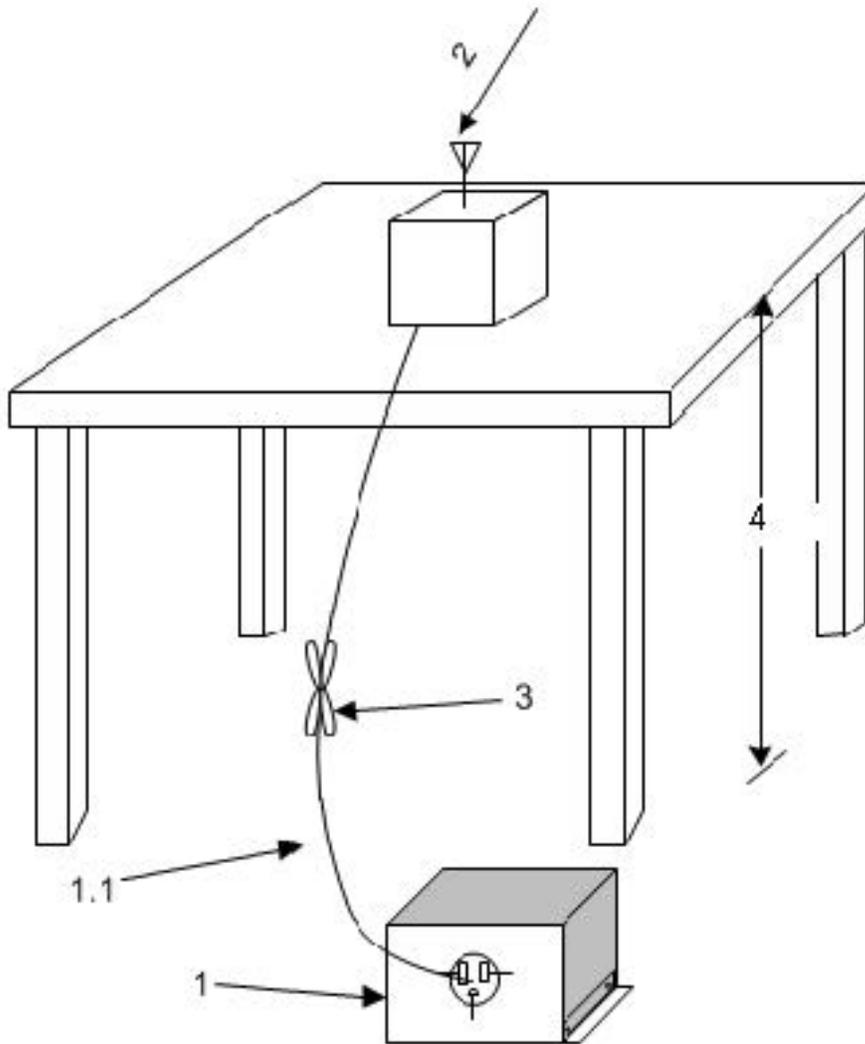
Testing Procedures

AC Line Conducted Emission Test Procedure

The EUT operates solely from direct current vehicle power and offers no provision for connection to Utility AC power system. Therefore, no AC Line conducted emissions test was required or performed.

Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47 CFR, 15C, RSS-210 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.



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).

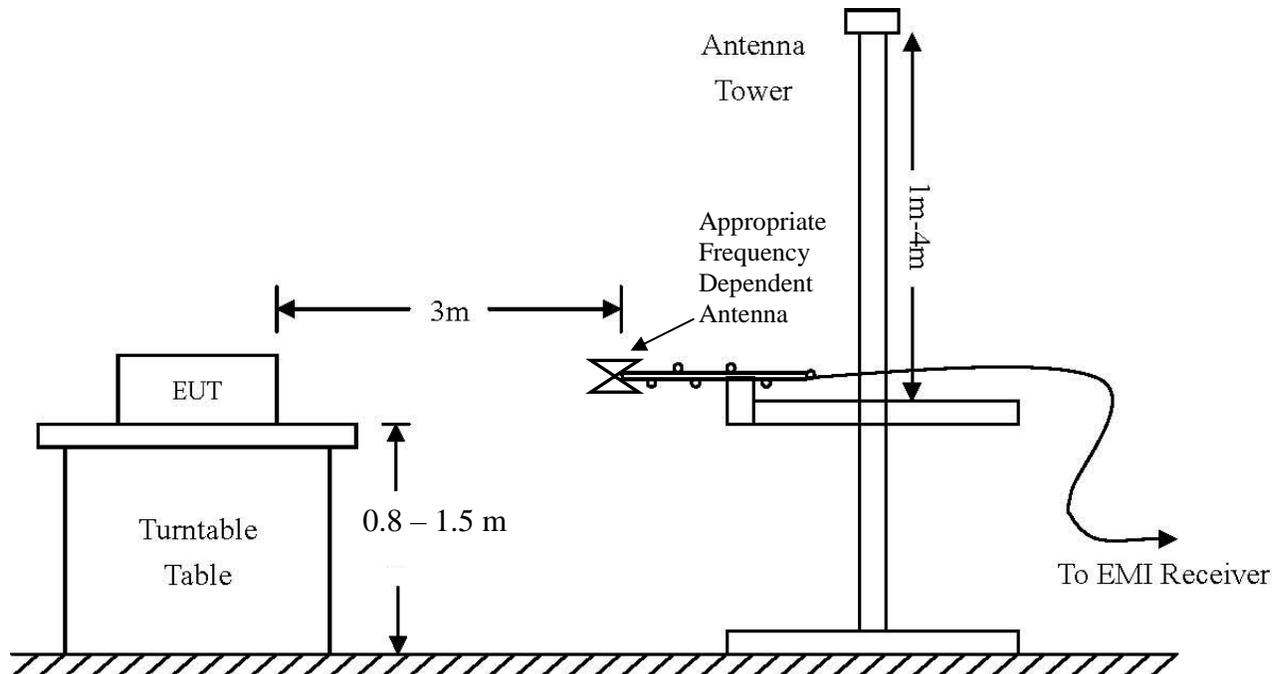
1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.

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).

Diagram 1 Test arrangement for radiated emissions of tabletop equipment



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

Diagram 2 Test arrangement for radiated emissions tested on Open Area Test Site (OATS)

Test Site Locations

Conducted EMI The AC power line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259th 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 West 259th Terrace, Louisburg, KS

Site Registration FCC Site Designation US5305, Industry Canada Registration: 3041A-1

NVLAP Accreditation Lab code 200087-0

Rogers Labs, Inc.	Garmin International, Inc.	SN: 3EG440000, 3EG040007
4405 West 259 th Terrace	Model: GMN-0121611	FCC ID: IPH-0225611
Louisburg, KS 66053	Test #: 180320	IC: 1792A-0225611
Phone/Fax: (913) 837-3214	Test to: 47 CFR, 15C, RSS-Gen, RSS-210	Date: August 23, 2018
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List of 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>
<input type="checkbox"/> LISN	FCC	FCC-LISN-50-2-10(1PA) (160611)	.15-30MHz	5/15/17	5/15/18
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/24/17	10/24/18
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/24/17	10/24/18
<input type="checkbox"/> Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/24/17	10/24/18
<input type="checkbox"/> Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/24/17	10/24/18
<input type="checkbox"/> Antenna	ARA	BCD-235-B (169)	20-350MHz	10/24/17	10/24/18
<input type="checkbox"/> Antenna	EMCO	3147 (40582)	200-1000MHz	10/24/17	10/24/18
<input checked="" type="checkbox"/> Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/15/17	5/15/18
<input type="checkbox"/> Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/24/17	10/24/19
<input checked="" type="checkbox"/> Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15/17	5/15/19
<input checked="" type="checkbox"/> Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/24/17	10/24/18
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/24/17	10/24/18
<input type="checkbox"/> Antenna	EMCO	3143 (9607-1277)	20-1200 MHz	5/15/17	5/15/18
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	5/15/17	5/15/18
<input type="checkbox"/> Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	12/22/17	12/22/18
<input type="checkbox"/> Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/17	12/22/19
<input type="checkbox"/> Analyzer	HP	8591EM (3628A00871)	9kHz-1.8GHz	5/15/17	5/15/18
<input type="checkbox"/> Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	5/15/17	5/15/18
<input type="checkbox"/> Analyzer	HP External Mixers	11571, 11970	25GHz-110GHz	5/15/17	5/15/18
<input checked="" type="checkbox"/> Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/24/17	10/24/18
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/24/17	10/24/18
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/24/17	10/24/18
<input type="checkbox"/> Power Mtr	Agilent	N1911A with N1921A	0.05-18 GHz	5/15/17	5/15/18
<input type="checkbox"/> Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	5/15/17	5/15/18
<input type="checkbox"/> Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	5/15/17	5/15/18
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC17663 (001) 9G notch	30-1800 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Fairview	SA6NFN100W-14 (1625)	30-1800 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (14362)	30-6000 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (14452)	30-6000 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	5/15/17	5/15/18
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	5/15/17	5/15/18
<input checked="" type="checkbox"/> Weather station	Davis	6312 (A70927D44N)		10/24/2017	10/24/2018

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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 (dB μ V/m @ 3m) = FSM (dB μ V) + A.F. (dB) - Gain (dB)

Environmental Conditions

Ambient Temperature 21.3° C

Relative Humidity 38%

Atmospheric Pressure 1015.1 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 9, 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 9 and RSS-GEN Issue 5.

Antenna Requirements

The EUT incorporates integral antenna system. 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 at the OATS. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the OATS, using appropriate antennas or pyramidal horns, amplification stages, and a spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.10-2013 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 Radiated Emissions in Restricted Frequency Bands Data (mode 1, GFSK)

Frequency in MHz	Horizontal Peak (dB μ V/m)	Horizontal Quasi-Peak (dB μ V/m)	Horizontal Average (dB μ V/m)	Vertical Peak (dB μ V/m)	Vertical Quasi-Peak (dB μ V/m)	Vertical Average (dB μ V/m)	Limit @ 3m (dB μ V/m)
2390.0	42.8	N/A	30.2	42.4	N/A	30.0	54.0
2483.5	52.1	N/A	32.7	47.6	N/A	31.6	54.0
4804.0	45.7	N/A	33.1	46.3	N/A	33.1	54.0
4880.0	46.7	N/A	33.8	47.5	N/A	36.9	54.0
4960.0	47.6	N/A	36.8	48.2	N/A	37.7	54.0
7206.0	46.0	N/A	33.7	47.4	N/A	37.2	54.0
7320.0	46.2	N/A	33.7	49.4	N/A	41.5	54.0
7440.0	45.6	N/A	33.2	48.3	N/A	38.4	54.0
12010.0	43.2	N/A	30.3	43.3	N/A	30.4	54.0
12200.0	44.7	N/A	31.6	44.8	N/A	31.6	54.0
12400.0	45.3	N/A	32.3	45.3	N/A	32.3	54.0

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

Table 2 Radiated Emissions in Restricted Frequency Bands Data (mode 2, 2EDR)

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	42.5	N/A	29.0	46.7	N/A	28.9	54.0
2483.5	52.8	N/A	38.4	45.2	N/A	29.2	54.0
4804.0	46.2	N/A	34.7	45.6	N/A	33.8	54.0
4880.0	46.1	N/A	35.1	48.2	N/A	37.9	54.0
4960.0	46.4	N/A	33.7	44.5	N/A	31.3	54.0
7206.0	47.3	N/A	34.7	50.5	N/A	41.8	54.0
7320.0	46.1	N/A	33.5	50.3	N/A	42.2	54.0
7440.0	46.5	N/A	33.8	47.5	N/A	35.6	54.0
12010.0	48.6	N/A	36.1	48.5	N/A	36.2	54.0
12200.0	49.3	N/A	36.4	49.5	N/A	36.5	54.0
12400.0	49.5	N/A	36.8	49.5	N/A	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 range below 1000 MHz. Peak and Average amplitude emissions are recorded for frequency range above 1000 MHz.

Table 3 Radiated Emissions in Restricted Frequency Bands Data (mode 3, 3EDR)

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	44.4	N/A	29.5	44.5	N/A	29.3	54.0
2483.5	55.6	N/A	39.7	52.1	N/A	37.5	54.0
4804.0	46.5	N/A	34.6	46.0	N/A	33.8	54.0
4880.0	45.7	N/A	33.8	48.5	N/A	37.1	54.0
4960.0	45.9	N/A	33.8	44.1	N/A	31.2	54.0
7206.0	46.7	N/A	34.3	51.7	N/A	41.8	54.0
7320.0	45.6	N/A	32.6	51.4	N/A	41.6	54.0
7440.0	45.7	N/A	32.9	47.6	N/A	35.8	54.0
12010.0	48.7	N/A	36.2	49.2	N/A	36.3	54.0
12200.0	49.8	N/A	36.4	50.6	N/A	36.7	54.0
12400.0	49.6	N/A	37.0	49.9	N/A	36.9	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.

Table 4 Radiated Emissions in Restricted Frequency Bands Data (mode 4, BLE)

Frequency in MHz	Horizontal Peak (dB μ V/m)	Horizontal Quasi-Peak (dB μ V/m)	Horizontal Average (dB μ V/m)	Vertical Peak (dB μ V/m)	Vertical Quasi-Peak (dB μ V/m)	Vertical Average (dB μ V/m)	Limit @ 3m (dB μ V/m)
2390.0	42.7	N/A	29.9	42.5	N/A	30.3	54.0
2483.5	45.4	N/A	32.9	44.8	N/A	32.0	54.0
4804.0	51.6	N/A	45.5	50.2	N/A	43.1	54.0
4880.0	48.9	N/A	39.9	49.0	N/A	42.4	54.0
4960.0	49.4	N/A	42.1	44.8	N/A	31.7	54.0
7206.0	47.3	N/A	33.3	55.8	N/A	48.6	54.0
7320.0	47.3	N/A	34.2	49.4	N/A	39.5	54.0
7440.0	46.4	N/A	33.5	49.1	N/A	38.2	54.0
12010.0	49.6	N/A	36.2	49.1	N/A	36.2	54.0
12200.0	48.6	N/A	35.9	49.3	N/A	36.9	54.0
12400.0	49.4	N/A	36.8	49.8	N/A	36.8	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 Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions in restricted frequency bands requirements of 47 CFR, Part 15C and RSS-210 Intentional Radiators. The EUT demonstrated worst-case minimum margins of -12.5 dB using mode 1 (GFSK), -11.8 using mode 2 (2EDR), -12.2 using mode 3 (3EDR) and -5.4 using mode 4 (BLE). All modes of operation demonstrated emissions below the requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

General Radiated Emissions Procedure

The EUT was arranged in a typical equipment configuration and operated through all available mode 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 at the OATS location before final radiated 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 Hybrid 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 5 General Radiated Emissions 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)
66.5	36.1	21.1	N/A	31.4	22.4	N/A	40.0
84.3	33.3	21.6	N/A	31.5	22.8	N/A	40.0
100.2	40.3	23.4	N/A	34.3	27.2	N/A	40.0
150.7	40.3	23.9	N/A	29.2	16.2	N/A	40.0
166.3	33.8	18.7	N/A	23.4	17.1	N/A	40.0
300.0	23.6	19.3	N/A	21.6	16.5	N/A	47.0
375.0	24.5	19.9	N/A	23.3	18.5	N/A	47.0
625.0	42.2	39.5	N/A	37.1	33.3	N/A	47.0
680.0	30.0	26.7	N/A	31.5	27.7	N/A	47.0
2180.0	65.3	N/A	35.2	60.1	N/A	32.2	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 47 CFR, Part 15C paragraph 15.209, RSS-210 and RSS-GEN Intentional Radiators. The EUT demonstrated a minimum margin of -7.5 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the Band 2400 – 2483.5 MHz

The transmitter output power; harmonics, and general emissions were measured on an open area test site @ 3 meters. 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. Emission requirements state the 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 #2. 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 representative of production with integral antenna (sample #1) with worst-case data provided. 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, Broadband Hybrid 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 one through sixteen showing plots taken of the 2402-2480 MHz transmitter performance displaying compliance with the specifications.

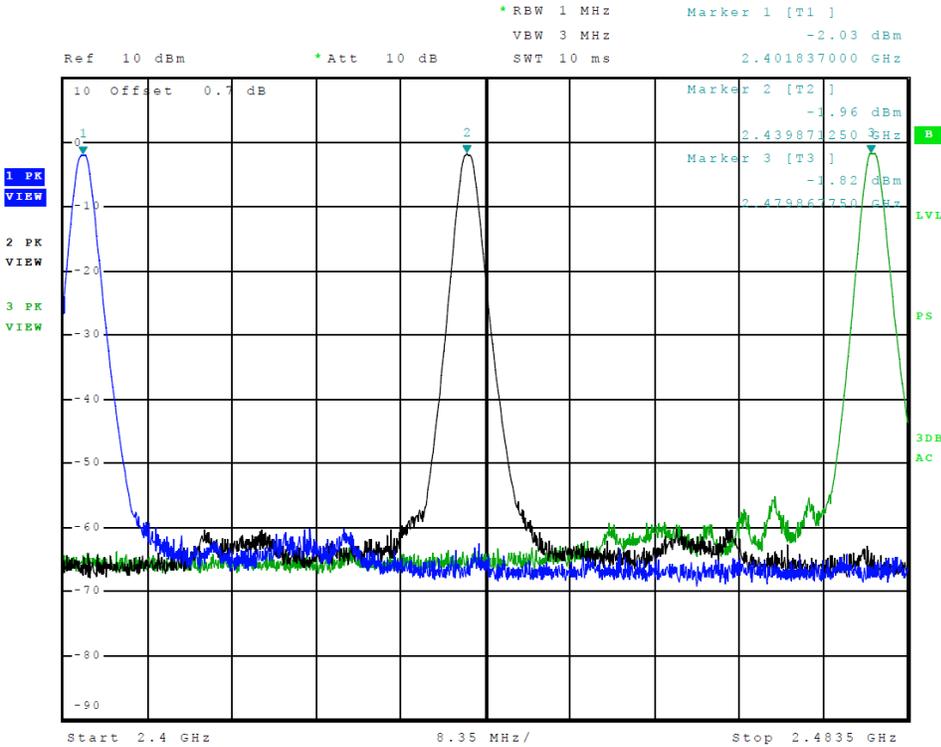


Figure 1 Plot of Transmitter Emissions (Operation in 2402-2480 MHz, mode 1, GFSK)

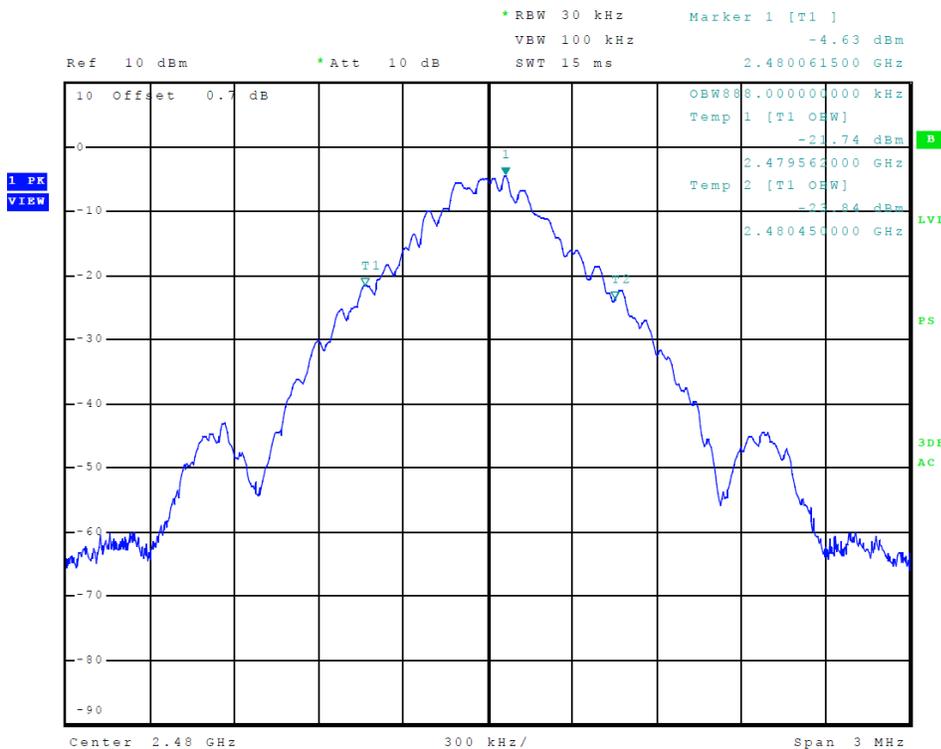


Figure 2 Plot of Transmitter Emissions (99% Occupied Bandwidth, mode 1, GFSK)

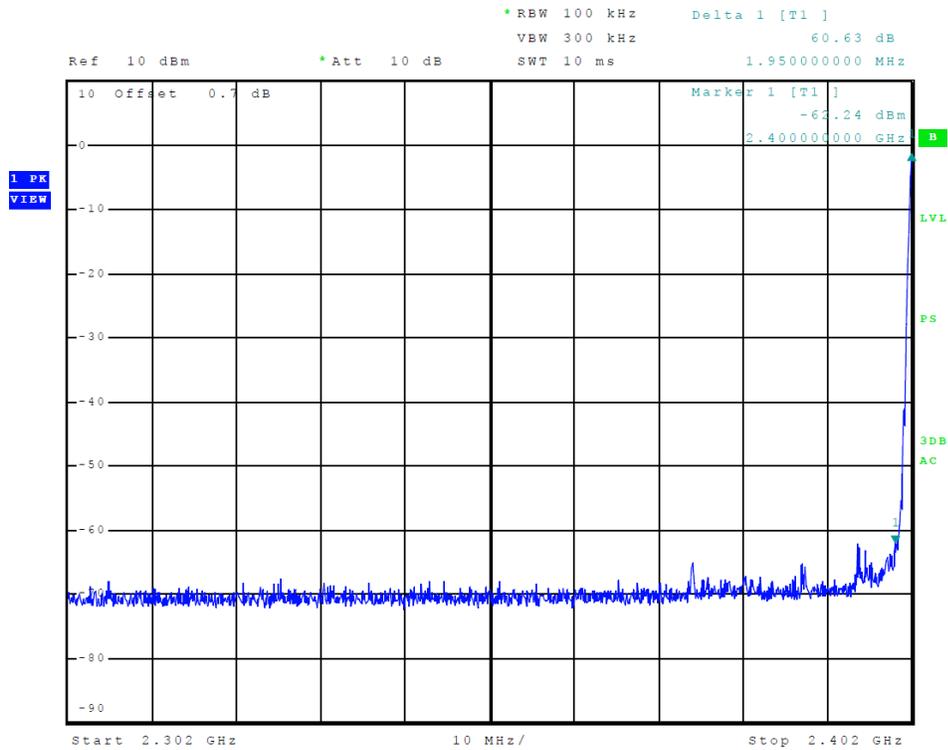


Figure 3 Plot of Transmitter Emissions (Low Band Edge, mode 1, GFSK)

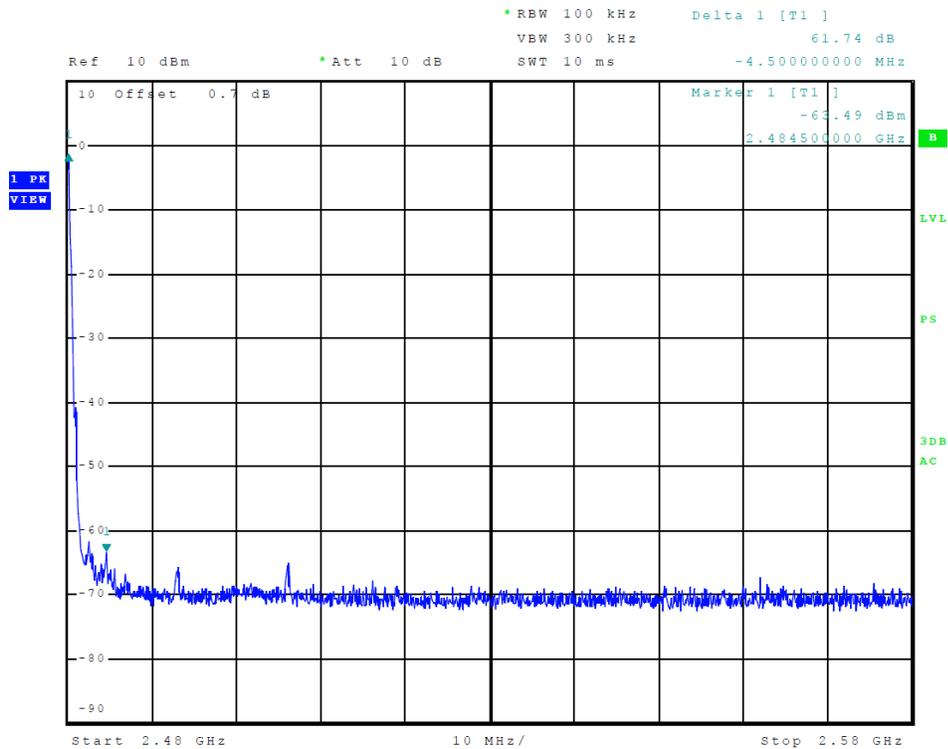


Figure 4 Plot of Transmitter Emissions (High Band Edge, mode 1, GFSK)

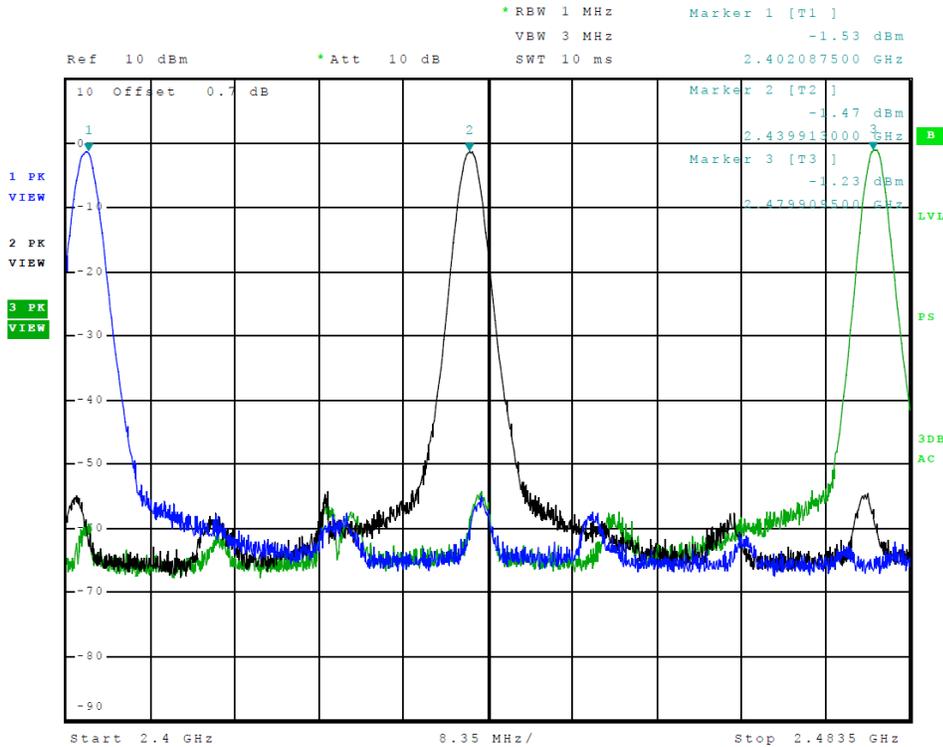


Figure 5 Plot of Transmitter Emissions (Operation in 2402-2480 MHz, mode 2, 2EDR)

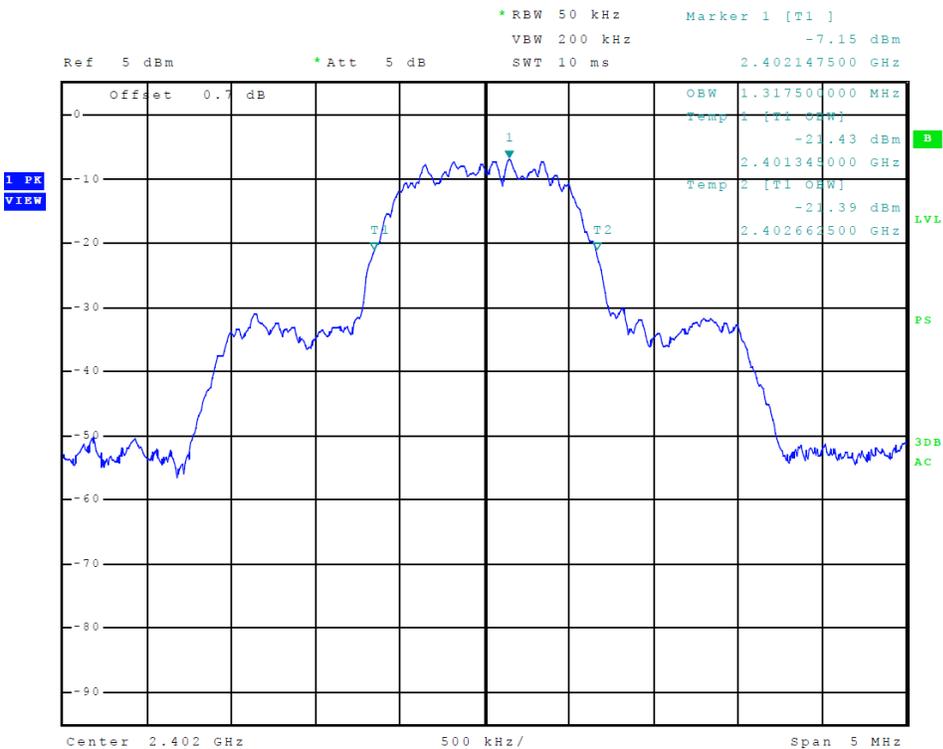


Figure 6 Plot of Transmitter Emissions (99% Occupied Bandwidth, mode 2, 2EDR)

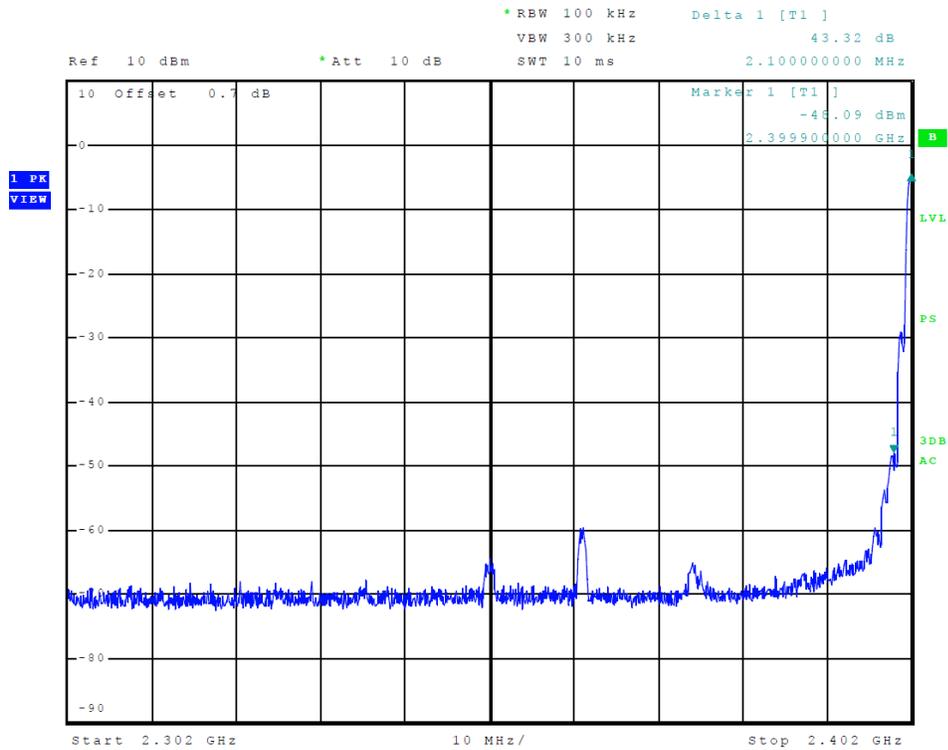


Figure 7 Plot of Transmitter Emissions (Low Band Edge, mode 2, 2EDR)

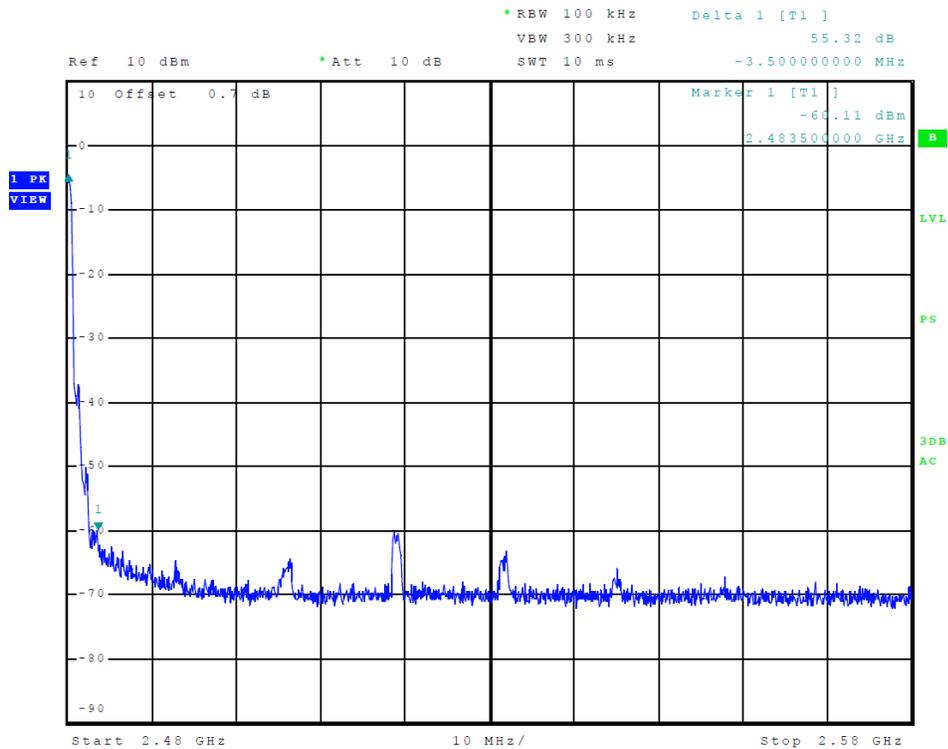


Figure 8 Plot of Transmitter Emissions (High Band Edge, mode 2, 2EDR)

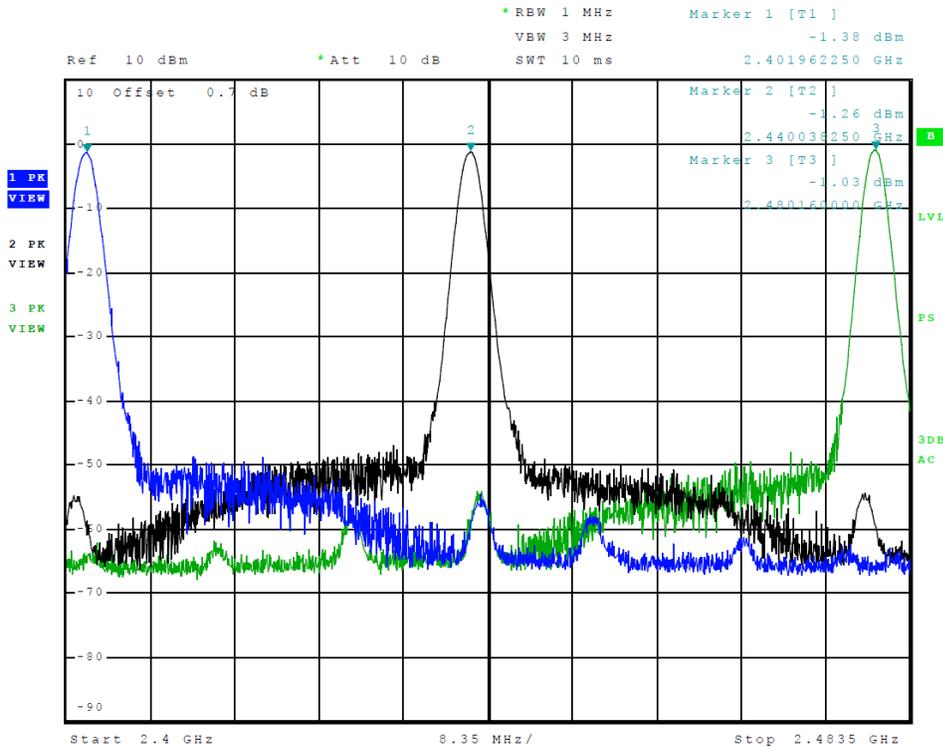


Figure 9 Plot of Transmitter Emissions (Operation in 2402-2480 MHz, mode 3, 3EDR)

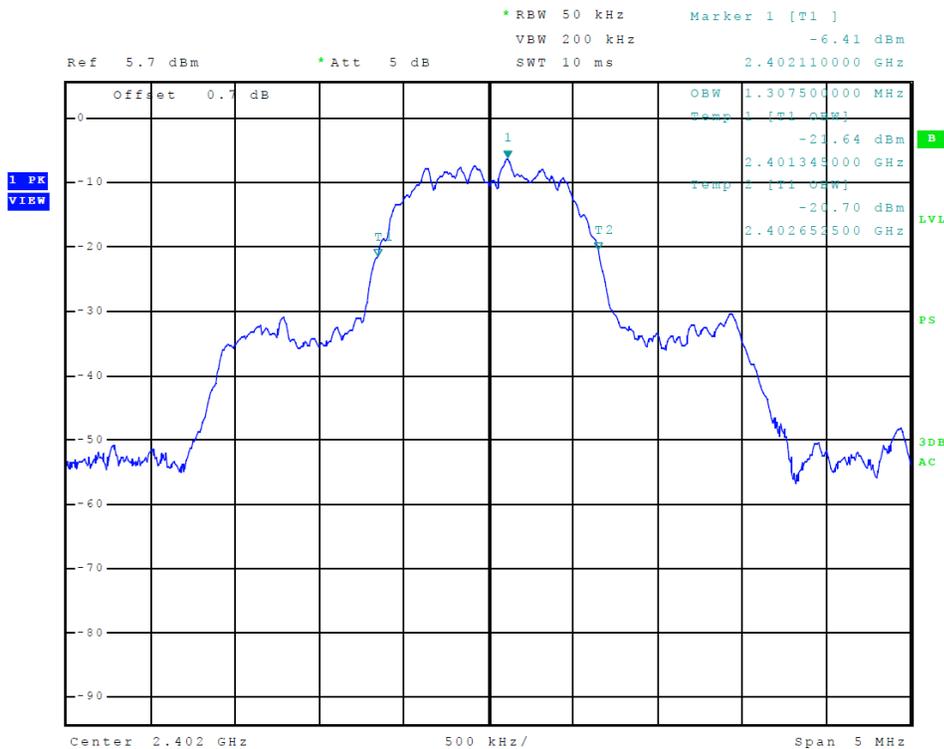


Figure 10 Plot of Transmitter Emissions (99% Occupied Bandwidth, mode 3, 3EDR)

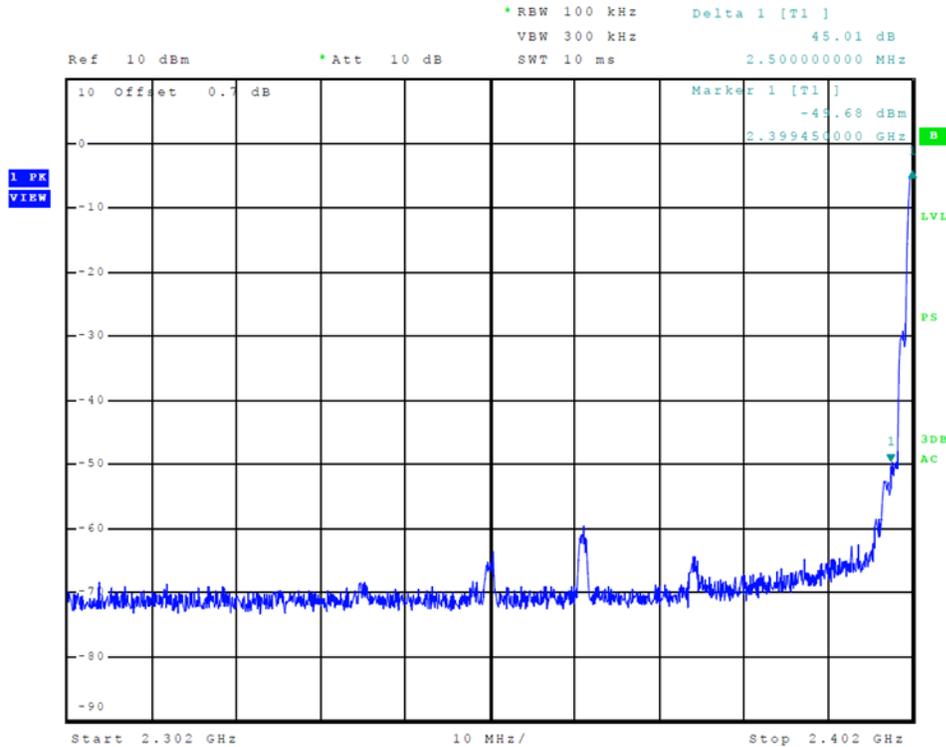


Figure 11 Plot of Transmitter Emissions (Low Band Edge, mode 3, 3EDR)

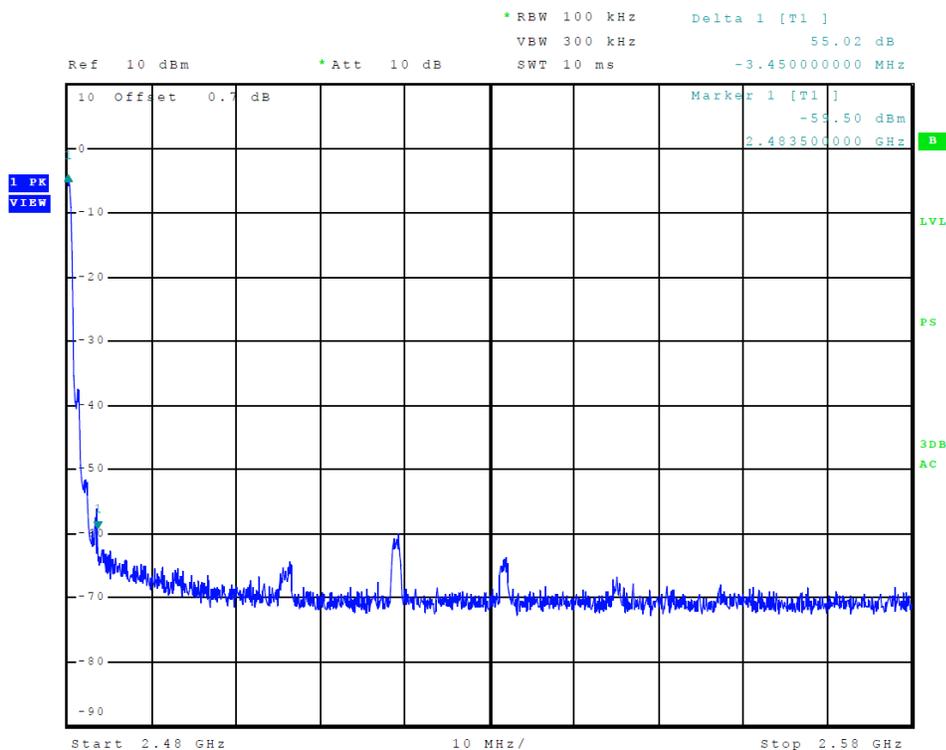


Figure 12 Plot of Transmitter Emissions (High Band Edge, mode 3, 3EDR)

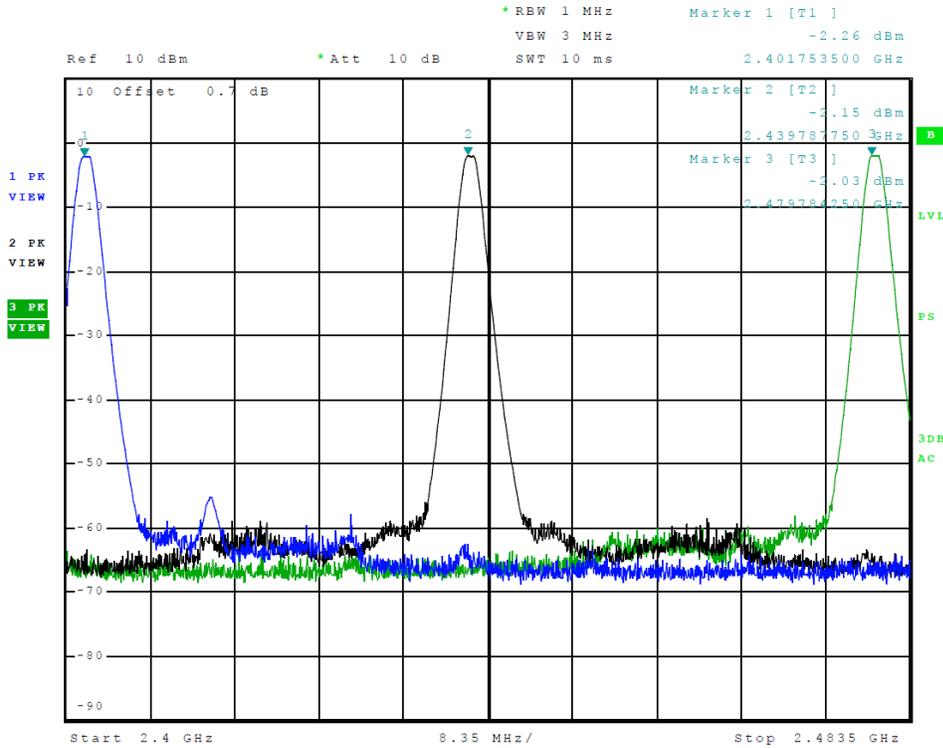


Figure 13 Plot of Transmitter Emissions (Operation in 2402-2480 MHz, mode 4, BLE)

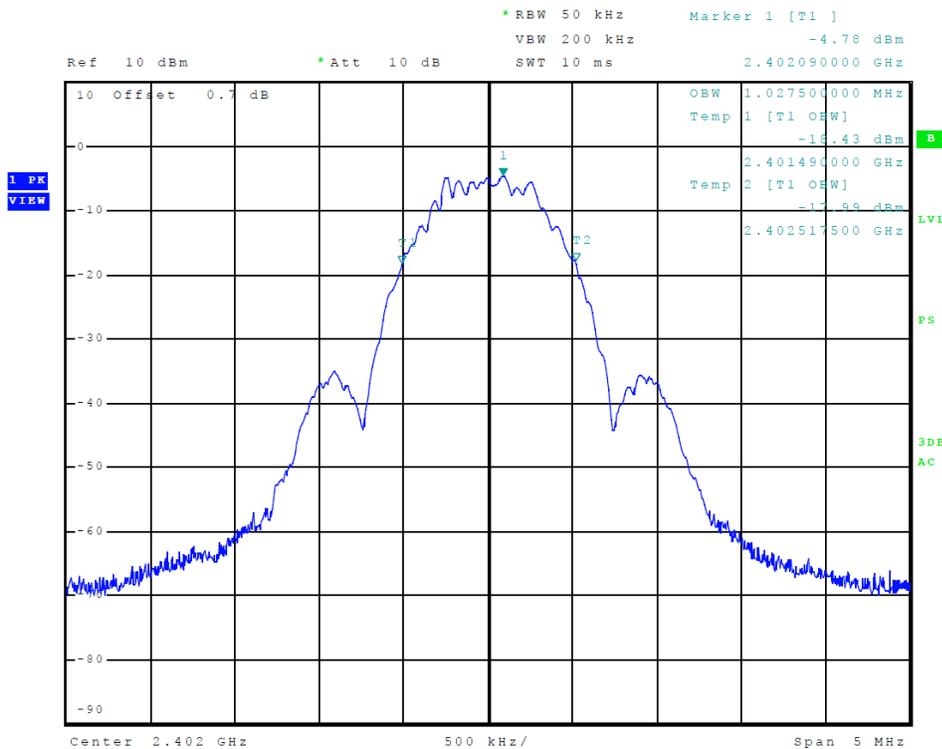


Figure 14 Plot of Transmitter Emissions (99% Occupied Bandwidth, mode 4, BLE)

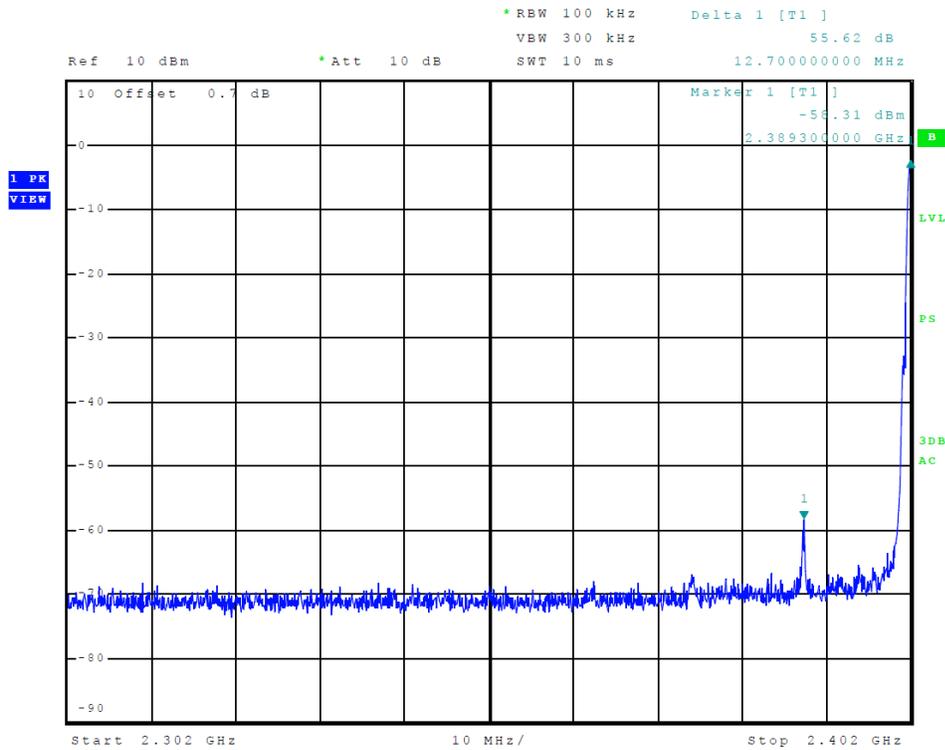


Figure 15 Plot of Transmitter Emissions (Low Band Edge, mode 4, BLE)

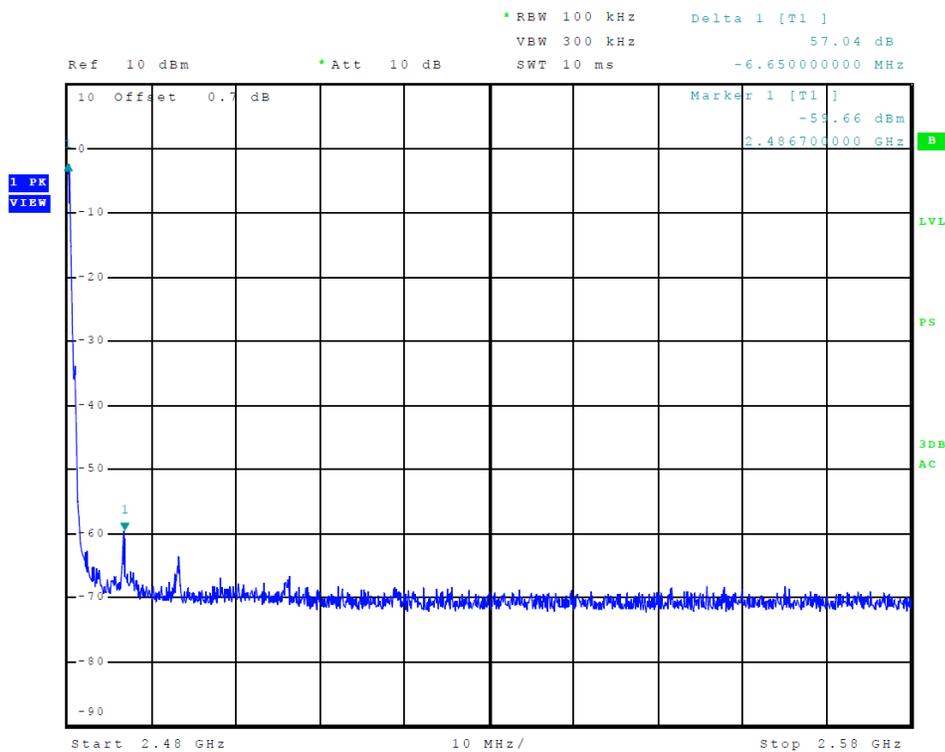


Figure 16 Plot of Transmitter Emissions (High Band Edge, mode 4, BLE)

Transmitter Emissions Data

Table 6 Transmitter Radiated Emissions (Worst-case) mode 1, GFSK

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	92.4	N/A	91.6	91.0	N/A	90.3	94.0
4804.0	45.7	N/A	33.1	46.3	N/A	33.1	54.0
7206.0	46.0	N/A	33.7	47.4	N/A	37.2	54.0
9608.0	44.4	N/A	31.8	44.6	N/A	31.6	54.0
12010.0	43.2	N/A	30.3	43.3	N/A	30.4	54.0
14412.0	44.0	N/A	30.5	43.8	N/A	30.8	54.0
16814.0	43.6	N/A	30.7	44.1	N/A	31.3	54.0
2440.0	94.1	N/A	93.4	92.1	N/A	91.4	94.0
4880.0	46.7	N/A	33.8	47.5	N/A	36.9	54.0
7320.0	46.2	N/A	33.7	49.4	N/A	41.5	54.0
9760.0	44.2	N/A	31.2	44.4	N/A	31.2	54.0
12200.0	44.7	N/A	31.6	44.8	N/A	31.6	54.0
14640.0	43.1	N/A	30.2	43.2	N/A	30.2	54.0
17080.0	43.3	N/A	30.5	43.6	N/A	30.5	54.0
2480.0	91.6	N/A	91.4	94.1	N/A	93.8	94.0
4960.0	47.6	N/A	36.8	48.2	N/A	37.7	54.0
7440.0	45.6	N/A	33.2	48.3	N/A	38.4	54.0
9920.0	44.4	N/A	31.2	44.5	N/A	31.3	54.0
12400.0	45.3	N/A	32.3	45.3	N/A	32.3	54.0
14880.0	43.4	N/A	30.5	43.6	N/A	30.4	54.0
17360.0	43.7	N/A	31.3	44.4	N/A	31.6	54.0

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

Table 7 Transmitter Radiated Emissions (Worst-case) mode 2, 2EDR

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	92.8	N/A	88.6	93.3	N/A	89.6	94.0
4804.0	46.2	N/A	34.7	45.6	N/A	33.8	54.0
7206.0	47.3	N/A	34.7	50.5	N/A	41.8	54.0
9608.0	46.7	N/A	33.8	47.1	N/A	33.7	54.0
12010.0	48.6	N/A	36.1	48.5	N/A	36.2	54.0
14412.0	50.5	N/A	37.7	50.6	N/A	37.8	54.0
16814.0	53.8	N/A	40.6	53.5	N/A	40.7	54.0
2440.0	94.3	N/A	90.7	93.2	N/A	89.6	94.0
4880.0	46.1	N/A	35.1	48.2	N/A	37.9	54.0
7320.0	46.1	N/A	33.5	50.3	N/A	42.2	54.0
9760.0	47.3	N/A	34.0	47.0	N/A	34.1	54.0
12200.0	49.3	N/A	36.4	49.5	N/A	36.5	54.0
14640.0	49.7	N/A	36.8	49.9	N/A	36.8	54.0
17080.0	54.7	N/A	41.5	54.3	N/A	41.6	54.0
2480.0	94.0	N/A	91.2	91.9	N/A	89.1	94.0
4960.0	46.4	N/A	33.7	44.5	N/A	31.3	54.0
7440.0	46.5	N/A	33.8	47.5	N/A	35.6	54.0
9920.0	47.2	N/A	33.9	46.4	N/A	33.9	54.0
12400.0	49.5	N/A	36.8	49.5	N/A	36.7	54.0
14880.0	49.7	N/A	36.9	49.7	N/A	36.8	54.0
17360.0	52.8	N/A	40.1	52.1	N/A	39.8	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.

Table 8 Transmitter Radiated Emissions (Worst-case) mode 3, 3EDR

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	94.5	N/A	90.1	93.5	N/A	89.2	94.0
4804.0	46.5	N/A	34.6	46.0	N/A	33.8	54.0
7206.0	46.7	N/A	34.3	51.7	N/A	41.8	54.0
9608.0	46.4	N/A	33.6	46.8	N/A	33.8	54.0
12010.0	48.7	N/A	36.2	49.2	N/A	36.3	54.0
14412.0	50.6	N/A	37.6	51.1	N/A	37.5	54.0
16814.0	53.6	N/A	40.6	54.2	N/A	40.7	54.0
2440.0	95.4	N/A	91.3	93.6	N/A	89.4	94.0
4880.0	45.7	N/A	33.8	48.5	N/A	37.1	54.0
7320.0	45.6	N/A	32.6	51.4	N/A	41.6	54.0
9760.0	46.5	N/A	33.8	47.2	N/A	34.0	54.0
12200.0	49.8	N/A	36.4	50.6	N/A	36.7	54.0
14640.0	50.6	N/A	36.9	49.6	N/A	37.0	54.0
17080.0	54.6	N/A	41.6	54.5	N/A	41.6	54.0
2480.0	95.0	N/A	91.7	92.3	N/A	89.0	94.0
4960.0	45.9	N/A	33.8	44.1	N/A	31.2	54.0
7440.0	45.7	N/A	32.9	47.6	N/A	35.8	54.0
9920.0	46.5	N/A	34.0	46.4	N/A	34.0	54.0
12400.0	49.6	N/A	37.0	49.9	N/A	36.9	54.0
14880.0	50.0	N/A	37.0	50.1	N/A	37.0	54.0
17360.0	52.9	N/A	40.2	53.0	N/A	39.7	54.0

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

Table 9 Transmitter Radiated Emissions (Worst-case) mode 4, BLE

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	90.4	94.1	N/A	92.7	94.0
4804.0	51.6	N/A	45.5	50.2	N/A	43.1	54.0
7206.0	47.3	N/A	33.3	55.8	N/A	48.6	54.0
9608.0	46.1	N/A	33.7	46.8	N/A	33.6	54.0
12010.0	49.6	N/A	36.2	49.1	N/A	36.2	54.0
14412.0	50.5	N/A	37.7	50.3	N/A	37.6	54.0
16814.0	53.4	N/A	40.7	53.1	N/A	40.7	54.0
2440.0	93.9	N/A	92.9	94.8	N/A	93.9	94.0
4880.0	48.9	N/A	39.9	49.0	N/A	42.4	54.0
7320.0	47.3	N/A	34.2	49.4	N/A	39.5	54.0
9760.0	47.1	N/A	36.6	47.1	N/A	34.6	54.0
12200.0	48.6	N/A	35.9	49.3	N/A	36.9	54.0
14640.0	50.0	N/A	36.8	50.0	N/A	37.2	54.0
17080.0	54.1	N/A	41.5	54.2	N/A	41.5	54.0
2480.0	94.7	N/A	93.9	94.7	N/A	93.9	94.0
4960.0	49.4	N/A	42.1	44.8	N/A	31.7	54.0
7440.0	46.4	N/A	33.5	49.1	N/A	38.2	54.0
9920.0	46.7	N/A	33.9	46.9	N/A	34.0	54.0
12400.0	49.4	N/A	36.8	49.8	N/A	36.8	54.0
14880.0	49.8	N/A	36.9	50.2	N/A	36.9	54.0
17360.0	53.3	N/A	40.5	53.4	N/A	40.5	54.0

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

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emission requirements of FCC 47 CFR, Part 15.249, Industry Canada RSS-GEN Issue 5, RSS-210 Issue 9 Intentional Radiator regulations. The EUT mode 1 GFSK modulation worst-case configuration demonstrated minimum average margin of -0.2 dB below the average emission limit for the fundamental. The EUT mode 2 2EDR modulation worst-case configuration demonstrated minimum average margin of -2.8 dB below the average emission limit for the fundamental. The EUT mode 3 3EDR modulation worst-case configuration demonstrated minimum average margin of -2.3 dB below the average emission limit for the fundamental. The EUT mode 4 BLE modulation worst-case configuration demonstrated minimum average margin of -0.1 dB below the average emission limit for the fundamental. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -5.4 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 Rogers Labs Test Equipment List
- Annex C Rogers Qualifications
- Annex D Rogers Labs Certificate of Accreditation

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 Cal Date(m/d/y)	Due
Spectrum Analyzer: Rohde & Schwarz ESU40	5/15/17	5/15/18
Spectrum Analyzer: HP 8562A, HP Adapters: 11518, 11519, and 11520	5/15/17	5/15/18
Mixers: 11517A, 11970A, 11970K, 11970U, 11970V, 11970W		
Spectrum Analyzer: HP 8591EM	5/15/17	5/15/18
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)	5/15/17	5/15/18
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)	5/15/17	5/15/18
Antenna: EMCO Log Periodic Model: 3147	10/24/17	10/24/18
Antenna: EMCO 6509	10/24/17	24/10/19
LISN: Compliance Design Model: FCC-LISN-2.Mod.cd, 50 µHy/50 ohms/0.1 µf	10/24/17	10/24/18
R.F. Preamp CPPA-102	10/24/17	10/24/18
Attenuator: HP Model: HP11509A	10/24/17	10/24/18
Cable: Belden 8268 (L3)	10/24/17	10/24/18
Cable: Time Microwave: 4M-750HF290-750	10/24/17	10/24/18
Cable: Time Microwave: 10M-750HF290-750	10/24/17	10/24/18
Frequency Counter: Leader LDC825	2/23/18	2/23/19
Oscilloscope Scope: Tektronix 2230	2/23/18	2/23/19
Wattmeter: Bird 43 with Load Bird 8085	2/23/18	2/23/19
Power Supplies: Sorensen SRL 20-25, SRL 40-25, DCR 150, DCR 140	2/23/18	2/23/19
R.F. Generators: HP 606A, HP 8614A, HP 8640B	2/23/18	2/23/19
R.F. Power Amp 65W Model: 470-A-1010	2/23/18	2/23/19
R.F. Power Amp 50W M185- 10-501	2/23/18	2/23/19
R.F. Power Amp A.R. Model: 10W 1010M7	2/23/18	2/23/19
R.F. Power Amp EIN Model: A301	2/23/18	2/23/19
LISN: Compliance Eng. Model 240/20	2/23/18	2/23/19
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08	2/23/18	2/23/19
Antenna: EMCO Dipole Set 3121C	2/23/18	2/23/19
Antenna: C.D. B-101	2/23/18	2/23/19
Antenna: Solar 9229-1 & 9230-1	2/23/18	2/23/19
Audio Oscillator: H.P. 201CD	2/23/18	2/23/19
ESD Test Set 2010i	2/23/18	2/23/19
Fast Transient Burst Generator Model: EFT/B-101	2/23/18	2/23/19
Field Intensity Meter: EFM-018	2/23/18	2/23/19
KEYTEK Ecat Surge Generator	2/23/18	2/23/19
Shielded Room Calibration not required		

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 27 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

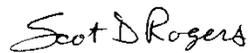
Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

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

Annex D Rogers Labs Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

Certificate of Accreditation to ISO/IEC 17025:2005

NVLAP LAB CODE: 200087-0

Rogers Labs, Inc.
Louisburg, KS

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services,
listed on the Scope of Accreditation, for:*

Electromagnetic Compatibility & Telecommunications

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005.
This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality
management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2018-02-21 through 2019-03-31
Effective Dates




For the National Voluntary Laboratory Accreditation Program

Rogers Labs, Inc.
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Revision 1

Garmin International, Inc.
Model: GMN-0121611
Test #: 180320
Test to: 47 CFR, 15C, RSS-Gen, RSS-210
File: IPH0225611 DXX TstRpt 180320

SN: 3EG440000, 3EG040007
FCC ID: IPH-0225611
IC: 1792A-0225611
Date: August 23, 2018
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