

# Application For Grant of Certification

Model: A03672  
2402-2480 MHz  
47 CFR 15.249 and RSS-210  
Low Power Transmitter

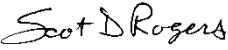
FCC ID: IPH-03672  
IC: 1792A-03672

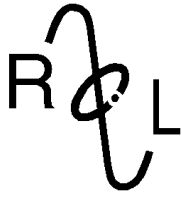
FOR

## Garmin International, Inc.

1200 East 151st Street  
Olathe, KS 66062

FCC Designation: US5305  
IC Test Site Registration: 3041A-1  
Test Report Number: 190218

Authorized Signatory:   
Scot D. Rogers



## **ROGERS LABS, INC.**

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

# Engineering Test Report For Grant of Certification Application

for  
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: A03672

### Low Power Transmitter

Frequency Range 2402-2480 MHz  
FCC ID: IPH-03672  
IC: 1792A-03672

Test Date: February 18, 2019

Certifying Engineer: *Scot D. Rogers*  
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Rogers Labs, Inc.  
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Louisburg, KS 66053  
Phone/Fax: (913) 837-3214  
Revision 3

Garmin International, Inc.  
Model: A03672  
Test: 190218  
Test to: CFR47 15.249, RSS-210, RSS-Gen  
File: A03672 DXX TstRpt A03672 r3

SN's: 3989371048 / 3989371063  
FCC ID: IPH-03672  
IC: 1792A-03672  
Date: April 8, 2019  
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## Revisions

Revision 3 Issued April 8, 2019 – Updated report to address Model Name correction  
 Revision 2 Issued March 28, 2019 – Updated Table of Contents  
 Revision 1 Issued March 19, 2019

## 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: A03672

FCC ID: IPH-03672 IC: 1792A-03672

Frequency Range: Both Tx 1 and Tx 2 operate across the 2402-2480 MHz band

Operating Frequency Range: 2402-2480 MHz

Mode	Average power (dB $\mu$ V/m@3m)	99% OBW (kHz)
Tx 1 (GFSK)	94.0	885
Tx 2 (GFSK)	91.7	880

This report addresses EUT Operations using GFSK modulation operating as a Low Power Transmitter

## Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47 CFR 15.205, RSS-210 2.2	-9.5	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	-7.4	Complies
Harmonic Emissions per 47 CFR 15.249, RSS-210 A2.9	-4.4	Complies

Tests performed include

47CFR

§15.249 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter), (dB $\mu$ V/m@3m)	Field strength of harmonics (microvolts/meter), (dB $\mu$ V/m@3m)
902-928 MHz	50, (94 dB $\mu$ V/m@3m)	500, (54 dB $\mu$ V/m@3m)
2400-2483.5 MHz	50, (94 dB $\mu$ V/m@3m)	500, (54 dB $\mu$ V/m@3m)
5725-5875 MHz	50, (94 dB $\mu$ V/m@3m)	500, (54 dB $\mu$ V/m@3m)
24.0-24.25 GHz	250, (108 dB $\mu$ V/m@3m)	2500, (68 dB $\mu$ V/m@3m)

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency 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.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

## Equipment Tested

<u>Equipment</u>	<u>Model / PN</u>	<u>Serial Number</u>
EUT	A03672	3989371048
EUT#2	A03672	3989371063
Interface Cable	OEM Wiring Harness N/A	

This reports documents test result for the two transmitters when providing communications as Low Power Transmitters. Test results in this report relate only to the items tested

SW Version: 0.62

## **Equipment Function and Configuration**

The EUT is a digital display unit providing vehicle information and touch screen input for the user. The design is vehicle mounted for use as a mobile transportation device. The design incorporates two transmitter circuitries operating in the 2402-2480 MHz band. The design offers cabled interface capabilities for the installation vehicle wiring harness as well as and wireless communications with compatible equipment. The EUT operates form direct current power provided by the installation vehicle and offers no provision for interface with utility AC power or other equipment as documented in this report. The transmitters designs provide wireless communications across the 2402-2480 MHz band. The design incorporates two transmitter systems providing communication modes including Bluetooth® Basic Rate (GFSK), 2EDR (PI/4 DQPSK), 3EDR (8DPSK), and BLE (GMSK). The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. Both transmitters were operational during testing to investigate intermodulation or collocation concerns. The EUT offers no other interface connections than those in the configuration option shown below as described by the manufacturer. For testing purposes, the EUT received power from external DC supply. During testing, the test system was configured to operate in manufacturer defined modes. Two samples were provided for testing, one representative of production hardware design, and the other modified for testing purposes replacing the integral antennas with RF connection ports. The antenna modifications offered testing facility the ability to connect test equipment to the temporary antenna ports for testing antenna port conducted emissions. The test samples were provided with test software enabling testing personnel the ability to enable transmitter functions on defined channels and modes. The test software enabled near 100% transmit duty cycle for testing purposes. As requested by the manufacturer and required by regulations, 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) Unit operating off internal battery

Unit under Test



## Application for Certification

- (1) Manufacturer: Garmin International, Inc.  
1200 East 151st Street  
Olathe, KS 66062
- (2) Identification: M/N: A03672  
FCC ID: IPH-03672 IC: 1792A-03672
- (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 by installation vehicle. The EUT offers other interface ports for connection with vehicle system 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 & Test Procedures

In accordance with the e-CFR Code of Federal Regulations Title 47, dated February 18, 2019: Part 2, Subpart J, Paragraphs 2.907, 2.911, 2.913, 2.925, 2.926, 2.1031 through 2.1057, and applicable parts of paragraph 15, Part 15C Paragraph 15.249, 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.

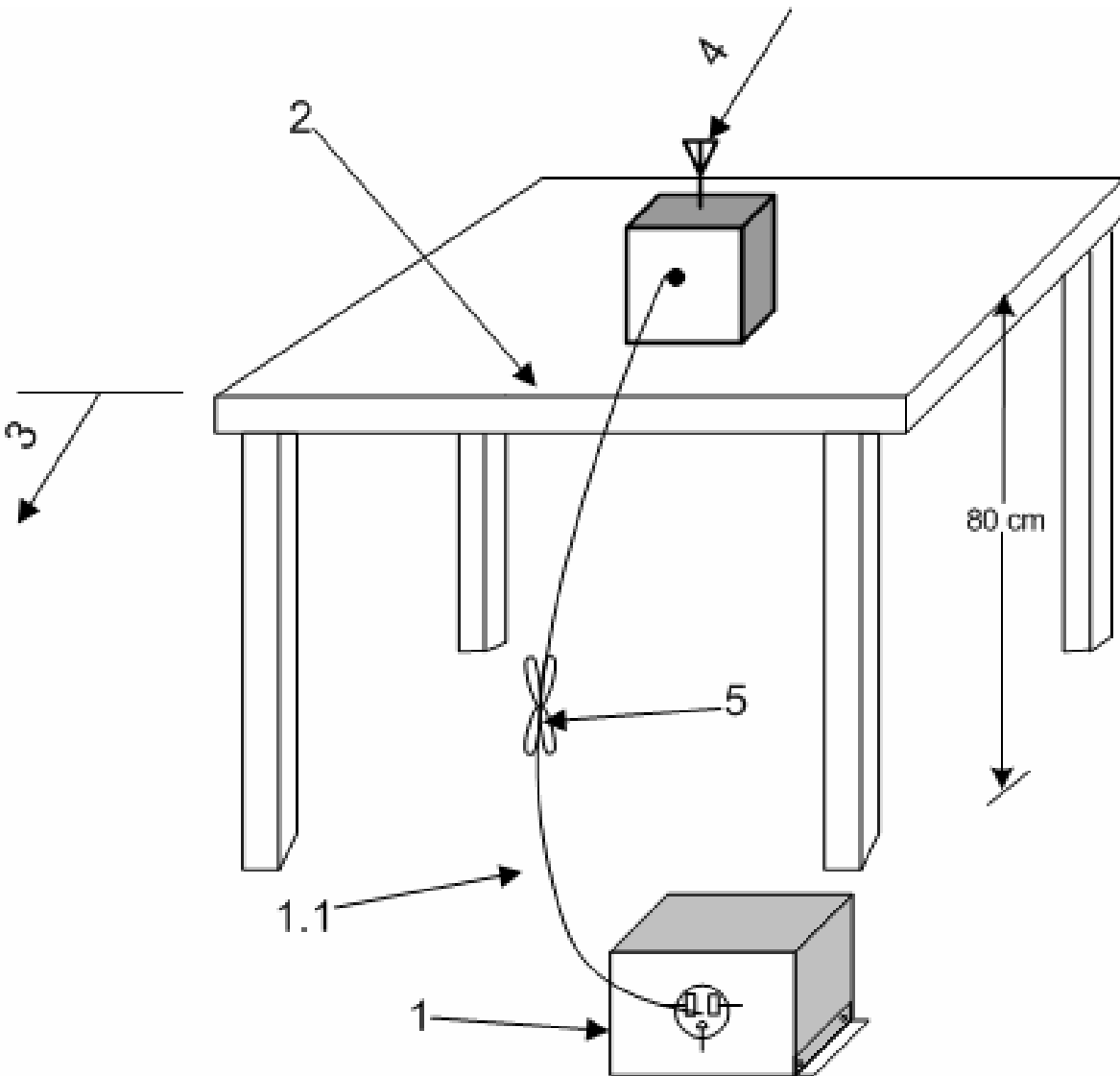
## Testing Procedures

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

The EUT operates on direct current power only provided by the aircraft installation. Therefore, no AC line conducted emission testing 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  $\Omega$  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).

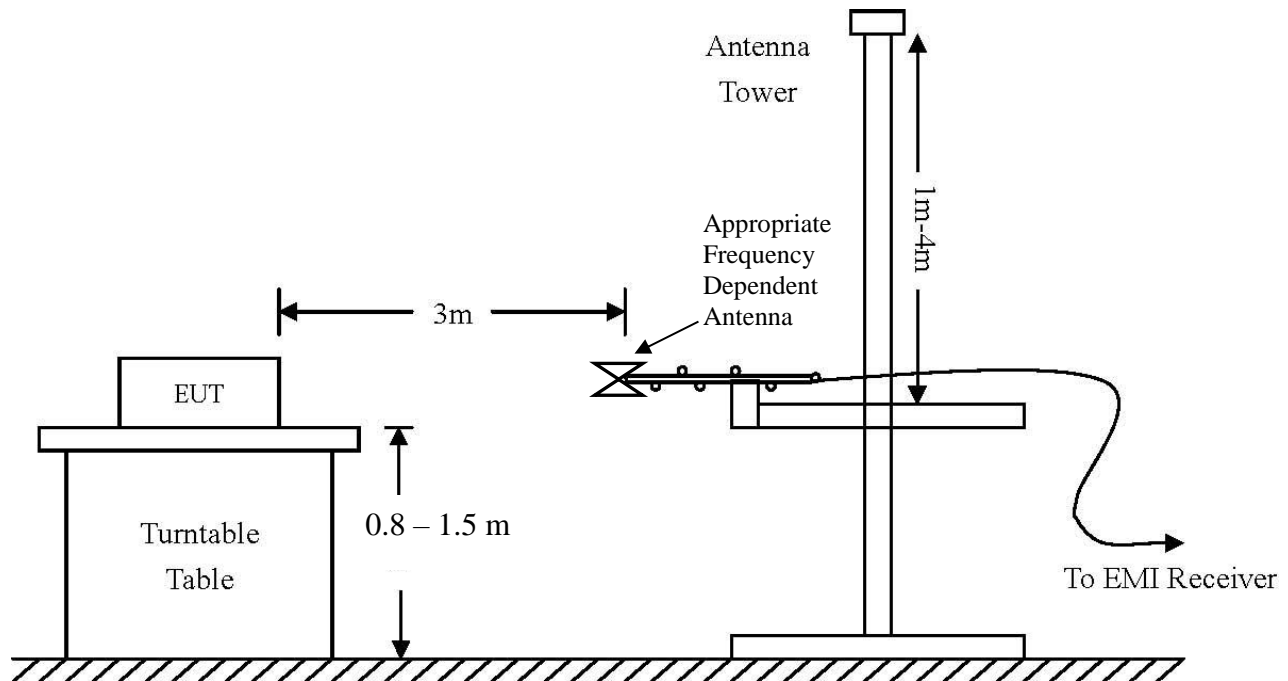
1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.

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



AC Line Conducted Emissions (0.150 -30 MHz)		
RBW	AVG. BW	Detector Function
9 kHz	30 kHz	Peak / Quasi Peak
Emissions (30-1000 MHz)		
RBW	AVG. BW	Detector Function
120 kHz	300 kHz	Peak / Quasi Peak
Emissions (Above 1000 MHz)		
RBW	Video BW	Detector Function
100 kHz	100 kHz	Peak
1 MHz	1 MHz	Peak / Average

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

## Test Site Locations

**Conducted EMI** AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, Inc., 4405 West 259<sup>th</sup> Terrace, Louisburg, KS

**Radiated EMI** The radiated emissions tests were performed at the 3 meters, Open Area Test Site (OATS) located at Rogers Labs, Inc., 4405 West 259<sup>th</sup> Terrace, Louisburg, KS

**Registered Site #** FCC Site: US5305 and Industry Canada Registration: 3041A-1

**NVLAP Accreditation** Lab code 200087-0

Rogers Labs, Inc.  
4405 West 259<sup>th</sup> Terrace  
Louisburg, KS 66053  
Phone/Fax: (913) 837-3214  
Revision 3

Garmin International, Inc.  
Model: A03672  
Test: 190218  
Test to: CFR47 15.249, RSS-210, RSS-Gen  
File: A03672 DXX TstRpt A03672 r3

SN's: 3989371048 / 3989371063  
FCC ID: IPH-03672  
IC: 1792A-03672  
Date: April 8, 2019  
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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-50-25-10(1PA) (160611)	.15-30MHz	5/2/2018	5/2/2019
<input type="checkbox"/> LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126)	.15-30MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303071)	9kHz-40 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Antenna	ARA	BCD-235-B (169)	20-350MHz	10/16/2018	10/16/2019
<input type="checkbox"/> Antenna	EMCO	3147 (40582)	200-1000MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	5/2/2018	5/2/2020
<input type="checkbox"/> Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/16/2018	10/24/2019
<input checked="" type="checkbox"/> Antenna	Com Power	AH-840 (101046)	18-40 GHz	5/15/2017	5/15/2019
<input checked="" type="checkbox"/> Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	1/31/2019	1/31/2020
<input type="checkbox"/> Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	12/22/2017	12/22/2018
<input type="checkbox"/> Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/16/2018	10/16/2019
<input checked="" type="checkbox"/> Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/16/2018	10/16/2019
<input type="checkbox"/> Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	5/2/2018	5/2/2019
<input type="checkbox"/> Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	5/2/2018	5/2/2019
<input type="checkbox"/> Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-1800 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-1800 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-1800 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	Fairview	SA6NFN100W-14 (1625)	30-1800 MHz	5/2/2018	5/2/2019
<input checked="" type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	5/2/2018	5/2/2019
<input checked="" type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (14362)	30-6000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-3W2+ (14452)	30-6000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	5/2/2018	5/2/2019
<input type="checkbox"/> Attenuator	JFW Industries	50FH-010-10 (1)	30-18000 MHz	5/2/2018	5/2/2019
<input checked="" type="checkbox"/> Weather station	Davis	6312 (A81120N075)		10/26/2018	10/26/2019

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## Units of Measurements

Conducted EMI            Data is in dB $\mu$ V; dB referenced to one microvolt

Radiated EMI            Data is in dB $\mu$ V/m; dB/m referenced to one microvolt per meter

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

A.F. = Receive antenna factor, Gain = amplification gains and/or cable losses

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

## Environmental Conditions

Ambient Temperature            19.3° C

Relative Humidity                31%

Atmospheric Pressure            1035.2 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, 15.249, 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 worse-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 Tx 1 (GFSK)**

Frequency in MHz	Horizontal Peak (dB $\mu$ V/m)	Horizontal Quasi-Peak (dB $\mu$ V/m)	Horizontal Average (dB $\mu$ V/m)	Vertical Peak (dB $\mu$ V/m)	Vertical Quasi-Peak (dB $\mu$ V/m)	Vertical Average (dB $\mu$ V/m)	Limit @ 3m (dB $\mu$ V/m)
2390.0	34.1	N/A	20.9	33.1	N/A	20.8	54.0
2483.5	47.5	N/A	35.2	45.5	N/A	33.0	54.0
4804.0	47.3	N/A	34.8	48.1	N/A	34.9	54.0
4882.0	47.3	N/A	34.6	47.6	N/A	34.6	54.0
4960.0	47.4	N/A	34.7	47.9	N/A	34.9	54.0
7206.0	51.4	N/A	38.3	51.6	N/A	38.4	54.0
7323.0	51.4	N/A	38.4	51.3	N/A	38.4	54.0
7440.0	51.6	N/A	38.2	50.5	N/A	38.1	54.0
12010.0	57.0	N/A	44.2	57.0	N/A	44.1	54.0
12205.0	57.1	N/A	44.4	57.1	N/A	44.4	54.0
12400.0	57.7	N/A	44.3	56.9	N/A	44.5	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.

**Table 2 Radiated Emissions in Restricted Frequency Bands Data Tx 2 (GFSK)**

Frequency in MHz	Horizontal Peak (dB $\mu$ V/m)	Horizontal Quasi-Peak (dB $\mu$ V/m)	Horizontal Average (dB $\mu$ V/m)	Vertical Peak (dB $\mu$ V/m)	Vertical Quasi-Peak (dB $\mu$ V/m)	Vertical Average (dB $\mu$ V/m)	Limit @ 3m (dB $\mu$ V/m)
2390.0	43.4	N/A	30.6	43.6	N/A	30.6	54.0
2483.5	55.3	N/A	31.7	44.7	N/A	31.3	54.0
4804.0	47.3	N/A	34.7	47.5	N/A	34.7	54.0
4882.0	47.3	N/A	34.4	47.4	N/A	34.6	54.0
4960.0	48.2	N/A	34.7	48.3	N/A	34.7	54.0
7206.0	51.0	N/A	38.0	51.3	N/A	38.0	54.0
7323.0	50.9	N/A	38.2	51.3	N/A	38.2	54.0
7440.0	51.5	N/A	38.1	50.8	N/A	38.1	54.0
12010.0	57.2	N/A	44.2	57.9	N/A	44.2	54.0
12205.0	57.2	N/A	44.1	57.1	N/A	44.1	54.0
12400.0	57.7	N/A	44.3	57.6	N/A	44.4	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 requirements of 47 CFR Part 15C and RSS-210 Intentional Radiator requirements. The EUT demonstrated a worse-case minimum margin of -9.5 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worse-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 typical equipment configurations and operated through available modes 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 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 3 General Radiated Emissions Data**

Frequency in MHz	Horizontal Peak (dB $\mu$ V/m)	Horizontal Quasi-Peak (dB $\mu$ V/m)	Horizontal Average (dB $\mu$ V/m)	Vertical Peak (dB $\mu$ V/m)	Vertical Quasi-Peak (dB $\mu$ V/m)	Vertical Average (dB $\mu$ V/m)	Limit @ 3m (dB $\mu$ V/m)
181.5	36.2	29.8	N/A	32.6	24.7	N/A	40.0
199.0	37.0	32.6	N/A	27.0	21.9	N/A	40.0
223.4	36.4	31.2	N/A	30.9	25.3	N/A	40.0
239.8	27.5	20.5	N/A	26.5	20.8	N/A	47.0
245.3	35.0	30.7	N/A	31.0	23.9	N/A	47.0
257.4	38.0	33.6	N/A	34.3	26.8	N/A	47.0
273.2	40.0	35.4	N/A	33.4	28.8	N/A	47.0
297.1	32.2	27.6	N/A	33.1	27.9	N/A	47.0
320.3	39.2	34.4	N/A	36.5	30.9	N/A	47.0
339.6	43.4	38.2	N/A	35.2	30.6	N/A	47.0
347.0	38.8	33.9	N/A	30.6	25.9	N/A	47.0
397.4	36.2	31.2	N/A	30.6	25.3	N/A	47.0
419.2	36.4	32.1	N/A	33.8	28.2	N/A	47.0
423.5	38.8	34.4	N/A	41.3	36.6	N/A	47.0
427.9	39.0	34.6	N/A	38.1	33.5	N/A	47.0

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 -7.4 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

### **Operation in the Band 2400 – 2483.5 MHz**

The transmitter output power; harmonic and general emissions were measured on an open area test site @ 3 meters. 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 #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 worse-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, Biconilog Antenna for 30 to 1000 MHz, Double-Ridge, and/or Pyramidal Horn Antennas from 1 GHz to 25 GHz. Emissions were measured in dB $\mu$ V/m @ 3 meters.

Refer to figures one through four showing plots taken of the 2402-2480 MHz Tx 1 (GFSK) transmitter operation displaying compliance with the specifications. Refer to figures five through eight showing plots taken of the 2402-2480 MHz Tx 2 (GFSK) transmitter operation displaying compliance with the specifications.

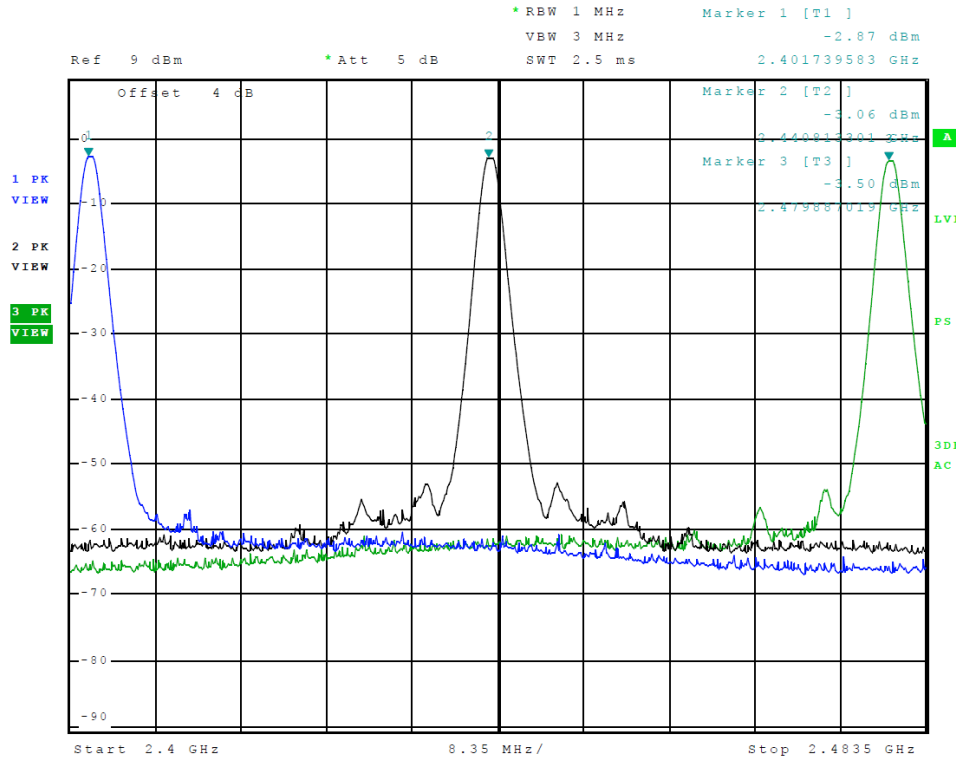


Figure 1 Plot of Transmitter Emissions Operation in 2402-2480 MHz Tx 1 (GFSK)

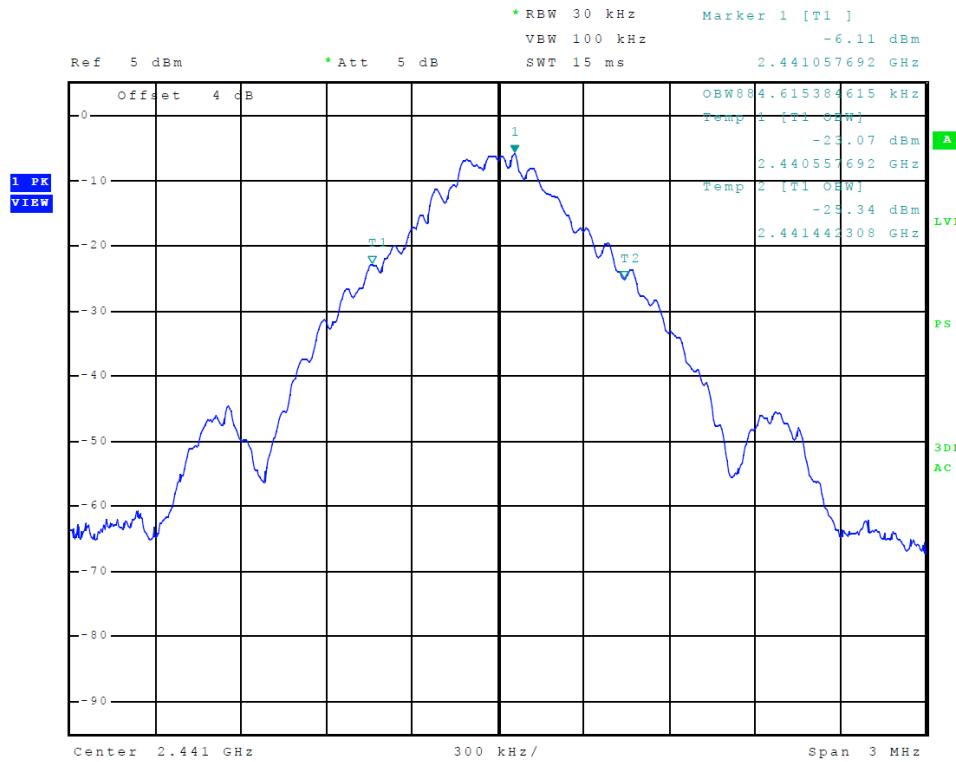
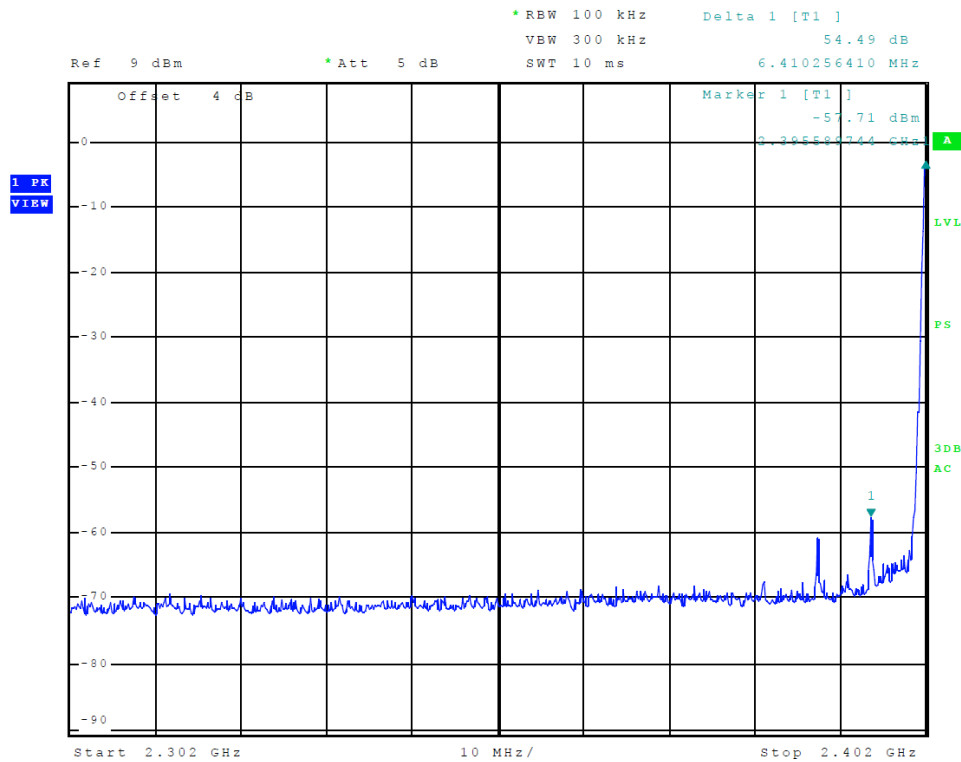
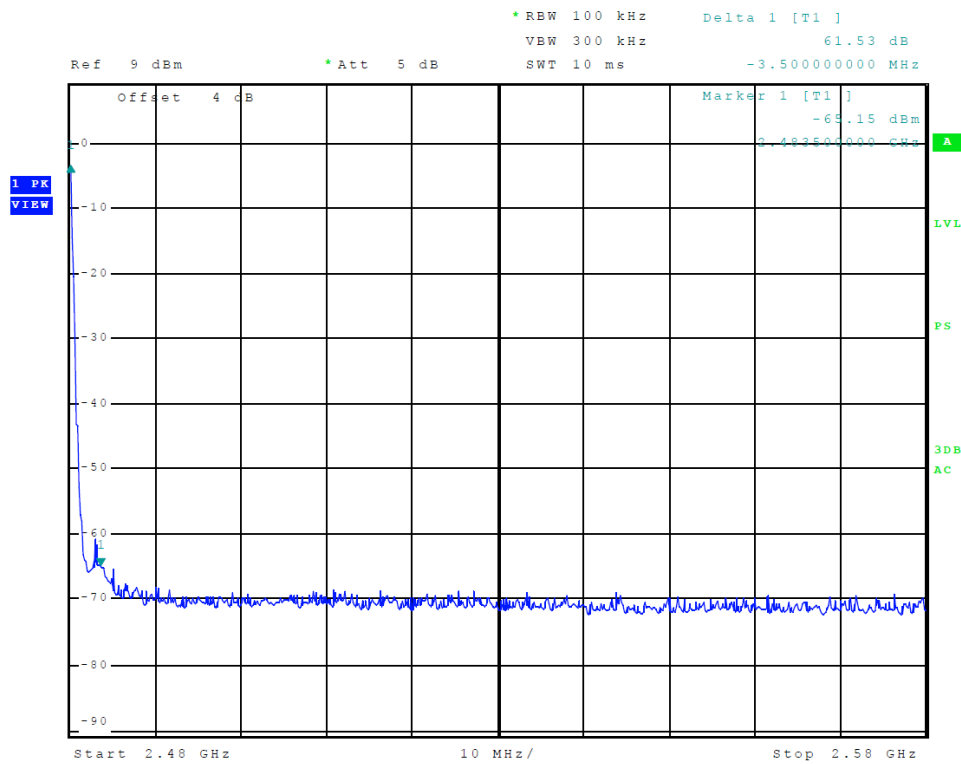


Figure 2 Plot of Transmitter Emissions 99% Occupied Bandwidth Tx 1 (GMSK)



**Figure 3 Plot of Transmitter Emissions Low Band Edge Tx 1 (GFSK)**



**Figure 4 Plot of Transmitter Emissions High Band Edge Tx 1 (GFSK)**

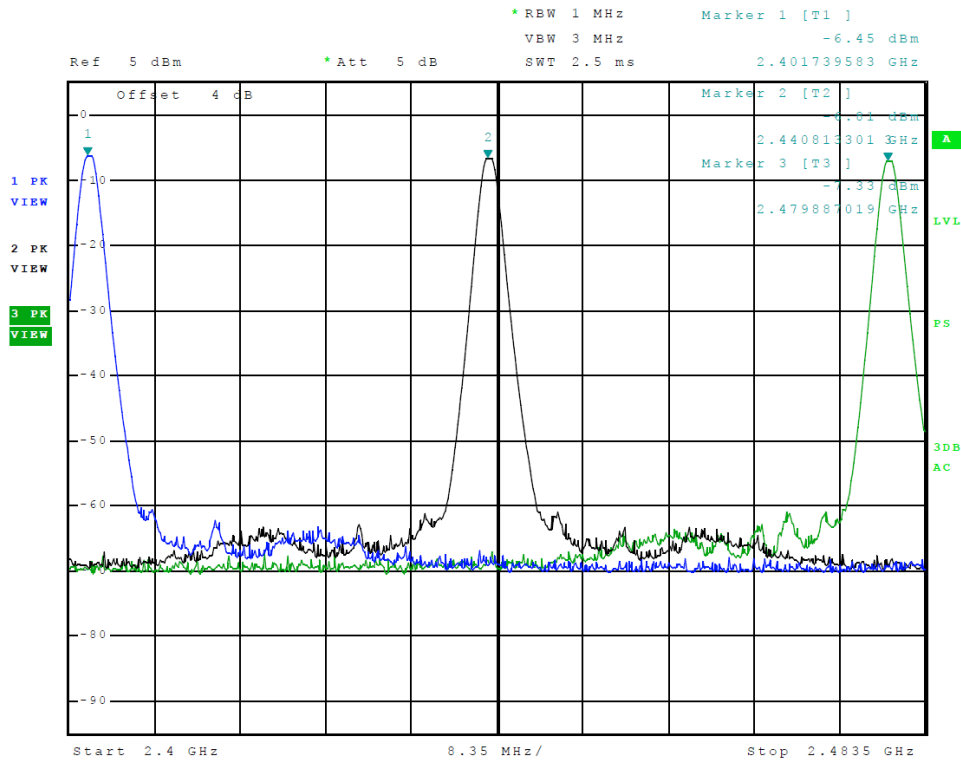


Figure 5 Plot of Transmitter Emissions Operation in 2402-2480 MHz Tx 2 (GFSK)

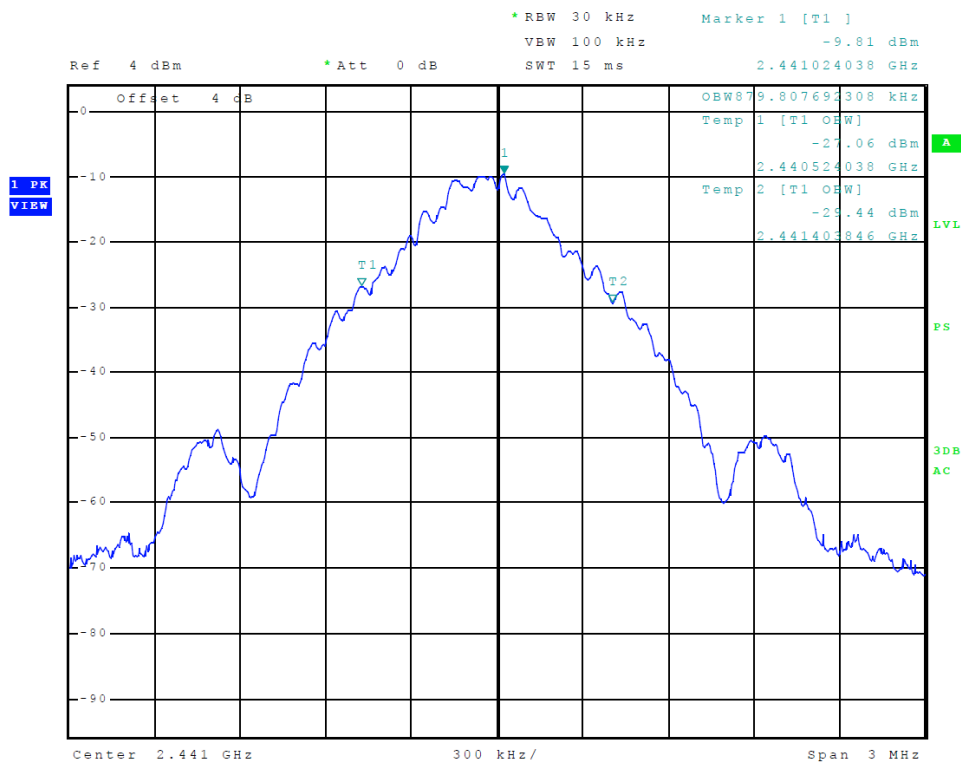
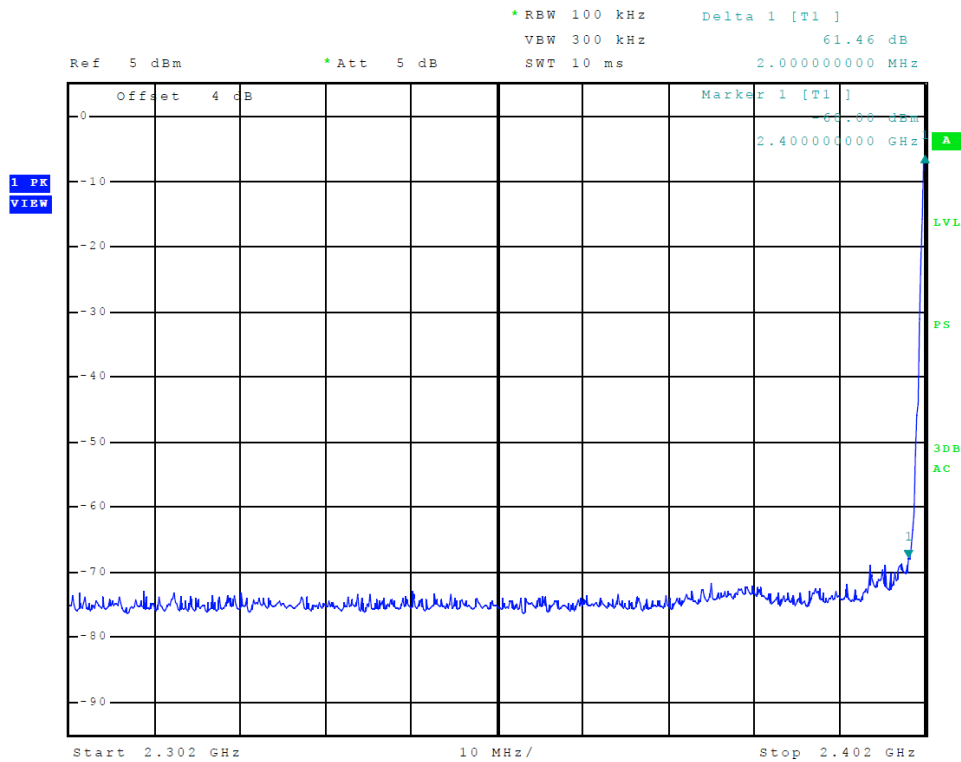
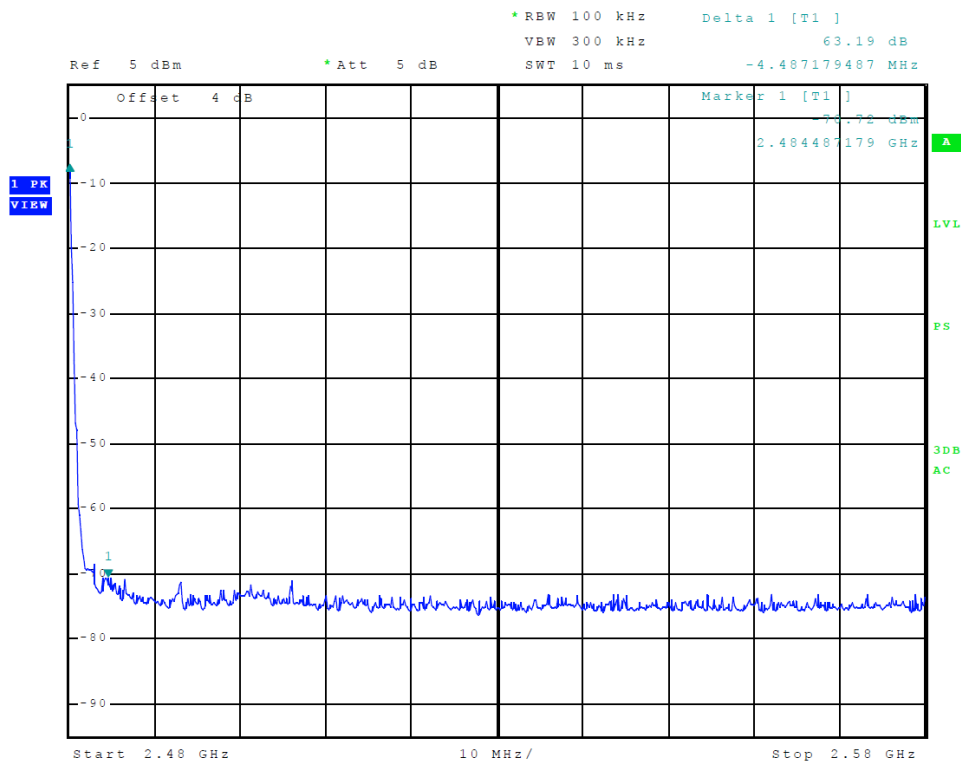


Figure 6 Plot of Transmitter Emissions 99% Occupied Bandwidth Tx 2 (GMSK)



**Figure 7 Plot of Transmitter Emissions Low Band Edge Tx 2 (GFSK)**



**Figure 8 Plot of Transmitter Emissions High Band Edge Tx 2 (GFSK)**

**Transmitter Emissions Data**

**Table 4 Transmitter Radiated Emissions Tx 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	89.9	N/A	89.5	85.7	N/A	85.1	94.0
4804.0	47.3	N/A	34.8	48.1	N/A	34.9	54.0
7206.0	51.4	N/A	38.3	51.6	N/A	38.4	54.0
9608.0	53.4	N/A	40.8	53.5	N/A	40.7	54.0
12010.0	57.0	N/A	44.2	57.0	N/A	44.1	54.0
14412.0	59.4	N/A	46.4	59.2	N/A	46.3	54.0
16814.0	62.7	N/A	49.6	62.4	N/A	49.6	54.0
2441.0	92.5	N/A	92.2	89.2	N/A	88.4	94.0
4882.0	47.3	N/A	34.6	47.6	N/A	34.6	54.0
7323.0	51.4	N/A	38.4	51.3	N/A	38.4	54.0
9764.0	53.7	N/A	40.4	53.3	N/A	40.5	54.0
12205.0	57.1	N/A	44.4	57.1	N/A	44.4	54.0
14646.0	59.7	N/A	46.8	59.7	N/A	46.8	54.0
17087.0	62.1	N/A	49.5	62.5	N/A	49.6	54.0
2480.0	94.4	N/A	94.0	90.4	N/A	89.9	94.0
4960.0	47.4	N/A	34.7	47.9	N/A	34.9	54.0
7440.0	51.6	N/A	38.2	50.5	N/A	38.1	54.0
9920.0	53.9	N/A	40.5	53.2	N/A	40.3	54.0
12400.0	57.7	N/A	44.3	56.9	N/A	44.5	54.0
14880.0	59.5	N/A	46.4	60.0	N/A	46.4	54.0
17360.0	61.7	N/A	49.0	62.1	N/A	48.9	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 5 Transmitter Radiated Emissions Tx 2 (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	82.3	N/A	78.5	85.9	N/A	85.2	94.0
4804.0	47.3	N/A	34.7	47.5	N/A	34.7	54.0
7206.0	51.0	N/A	38.0	51.3	N/A	38.0	54.0
9608.0	53.3	N/A	40.3	53.5	N/A	40.2	54.0
12010.0	57.2	N/A	44.2	57.9	N/A	44.2	54.0
14412.0	59.6	N/A	46.3	59.1	N/A	46.3	54.0
16814.0	62.7	N/A	49.3	62.0	N/A	49.3	54.0
2441.0	83.8	N/A	81.5	88.8	N/A	87.5	94.0
4882.0	47.3	N/A	34.4	47.4	N/A	34.6	54.0
7323.0	50.9	N/A	38.2	51.3	N/A	38.2	54.0
9764.0	53.6	N/A	40.0	52.8	N/A	39.9	54.0
12205.0	57.2	N/A	44.1	57.1	N/A	44.1	54.0
14646.0	60.5	N/A	46.7	59.5	N/A	46.6	54.0
17087.0	62.2	N/A	49.2	62.1	N/A	49.3	54.0
2480.0	86.6	N/A	85.7	92.2	N/A	91.7	94.0
4960.0	48.2	N/A	34.7	48.3	N/A	34.7	54.0
7440.0	51.5	N/A	38.1	50.8	N/A	38.1	54.0
9920.0	52.6	N/A	39.9	52.9	N/A	40.0	54.0
12400.0	57.7	N/A	44.3	57.6	N/A	44.4	54.0
14880.0	59.2	N/A	46.4	59.3	N/A	46.4	54.0
17360.0	62.3	N/A	48.8	62.0	N/A	48.8	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 Transmitter Radiated Emissions of Intentional Radiator***

The EUT demonstrated compliance with the radiated emissions requirements of FCC 47 CFR Part 15.249, Industry Canada RSS-210 Issue 9 and RSS-GEN Issue 5 Intentional Radiator regulations. The EUT worst-case test sample configuration demonstrated minimum average margin of 0 dB below the average emission limit for the fundamental. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -4.4 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 Additional Test Equipment
- Annex C Rogers Qualifications
- Annex D Rogers Labs Certificate of Accreditation

## 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	5.14
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 Additional Test Equipment**

List of Test Equipment	Calibration	<u>Date (m/d/y)</u>	<u>Due</u>
Antenna: Schwarzbeck Model: BBA 9106/VHBB 9124 (9124-627)		5/2/2018	5/2/2019
Antenna: Schwarzbeck Model: VULP 9118 A (VULP 9118 A-534)		5/2/2018	5/2/2019
Antenna: EMCO 6509		10/16/2018	10/16/2020
Antenna: EMCO 3143 (9607-1277) 20-1200 MHz		5/2/2018	5/2/2019
Antenna: EMCO Dipole Set 3121C		2/23/2018	2/23/2019
Antenna: C.D. B-101		2/23/2018	2/23/2019
Antenna: Solar 9229-1 & 9230-1		2/23/2018	2/23/2019
Cable: Belden 8268 (L3)		10/16/2018	10/16/2019
Cable: Time Microwave: 4M-750HF290-750		10/16/2018	10/16/2019
Frequency Counter: Leader LDC-825 (8060153)		5/2/2018	5/2/2019
Oscilloscope Scope: Tektronix 2230		2/23/2018	2/23/2019
Wattmeter: Bird 43 with Load Bird 8085		2/23/2018	2/23/2019
R.F. Generator: SMB100A6 s/n 100623		5/2/2018	5/2/2019
R.F. Generator: SBMBV100A s/n: 260771		5/2/2018	5/2/2019
R.F. Generators: HP 606A, HP 8614A, HP 8640B		2/23/2018	2/23/2019
R.F. Power Amp 65W Model: 470-A-1010		2/23/2018	2/23/2019
R.F. Power Amp 50W M185- 10-501		2/23/2018	2/23/2019
R.F. Power Amp A.R. Model: 10W 1010M7		2/23/2018	2/23/2019
R.F. Power Amp EIN Model: A301		2/23/2018	2/23/2019
LISN: Compliance Eng. Model 240/20		5/2/2018	5/2/2019
LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08		5/2/2018	5/2/2019
Audio Oscillator: H.P. 201CD		2/23/2018	2/23/2019
ESD Test Set 2010i		2/23/2018	2/23/2019
Oscilloscope Scope: Tektronix MDO 4104		2/23/2018	2/23/2019
EMC Transient Generator HVT TR 3000		2/23/2018	2/23/2019
AC Power Source (Ametek, California Instruments)		2/23/2018	2/23/2019
Fast Transient Burst Generator Model: EFT/B-101		2/23/2018	2/23/2019
Field Intensity Meter: EFM-018		2/23/2018	2/23/2019
KEYTEK Ecat Surge Generator		2/23/2018	2/23/2019
ESD Simulator: MZ-15		2/23/2018	2/23/2019
Shielded Room not required			

Rogers Labs, Inc.  
4405 West 259<sup>th</sup> Terrace  
Louisburg, KS 66053  
Phone/Fax: (913) 837-3214  
Revision 3

Garmin International, Inc.  
Model: A03672  
Test: 190218  
Test to: CFR47 15.249, RSS-210, RSS-Gen  
File: A03672 DXX TstRpt A03672 r3

SN's: 3989371048 / 3989371063  
FCC ID: IPH-03672  
IC: 1792A-03672  
Date: April 8, 2019  
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## **Annex C Rogers Qualifications**

**Scot D. Rogers, Engineer**

### **Rogers Labs, Inc.**

Mr. Rogers has approximately 30 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

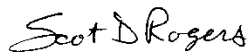
Systems Engineer: A/C Controls Mfg. Co., Inc. 6 Years

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®**

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**Certificate of Accreditation to ISO/IEC 17025:2005**

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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 Communiqué dated January 2009).*

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



  
*For the National Voluntary Laboratory Accreditation Program*

Rogers Labs, Inc.  
4405 West 259<sup>th</sup> Terrace  
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FCC ID: IPH-03672  
IC: 1792A-03672  
Date: April 8, 2019  
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