NVLAP Lab Code 200087-0


# *ROGERS LABS, INC.*

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Louisburg, KS 66053
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## 47 CFR, PART 15C - Intentional Radiators
## 47 CFR Paragraph 15.249 and
## Industry Canada RSS-GEN Issue 5 and RSS-210 Issue 10

# Application For Grant of Certification

# Models: A03873, B03873

2402-2480 MHz (DXX)
Low Power Digital Transmitter

## FCC ID: IPH-03873
## IC: 1792A-03873

# Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

FCC Designation: US5305
ISED Registration: 3041A-1

Test Report Number: 200713_14

Test Date: July 13, 2020

Authorized Signatory: Scot D Rogers
Scot D. Rogers

## Table of Contents

## Revisions

Revision 1 Issued October 26, 2020

## 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 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’s: A03873, B03873

FCC ID: IPH-03873 IC: 1792A-03873

Operating Frequency Range: 2402-2480 MHz

Operational communication modes

| Mode | Peak Power (dBµV/m@3m) | Average power (dBµV/m@3m) | 99% OBW (kHz) |
|---|---|---|---|
| Mode 1, ANT (GFSK) | 93.7 | 65.6 | 937.5 |

This report addresses EUT Operation as Low Power Device using transmitter modulation defined above in mode 1

## Opinion / Interpretation of Results

| Tests Performed | Margin (dB) | Results |
|---|---|---|
| Restricted Bands 47 CFR 15.205, RSS-210 4.1 | -6.5 | Complies |
| Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9 | -1.7 | Complies |
| Harmonic Emissions per 47 CFR 15.249, RSS-210 B.10 | -2.8 | Complies |

## Equipment Tested

Model: A03873, B03873

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

Garmin Corporation
No.68, Zhangshu 2nd Rd.
Xizhi Dist., New Taipei City 221, Taiwan, R.O.C.

| Equipment | Model / PN | Serial Number |
|---|---|---|
| EUT | A03873 | 3336556891 |
| EUT2 | A03873 | 3333597072 |
| EUT | B03873 | 3336556773 |
| XDCR | GT54UHD-TM | 4943397875002500 |
| GVC #1 | GVC 20 | 5JW000058 |
| USB Interface | Cable and Flash Drive | N/A |
| Interface Cables | Mfg. Provided NMEA | N/A |
| CVBS Cables | Cable and termination | N/A |
| DC Power Supply | BK 1745 | 209C13 |

Operational communication modes

| Mode | Transmitter Operation |
|---|---|
| 1 | ANT (GFSK) |
| 2 | BT BLE(GMSK) |
| 3 | 802.11b (CCK/DSSS) |
| 4 | 802.11g (OFDM) |
| 5 | 802.11n (MCS) |

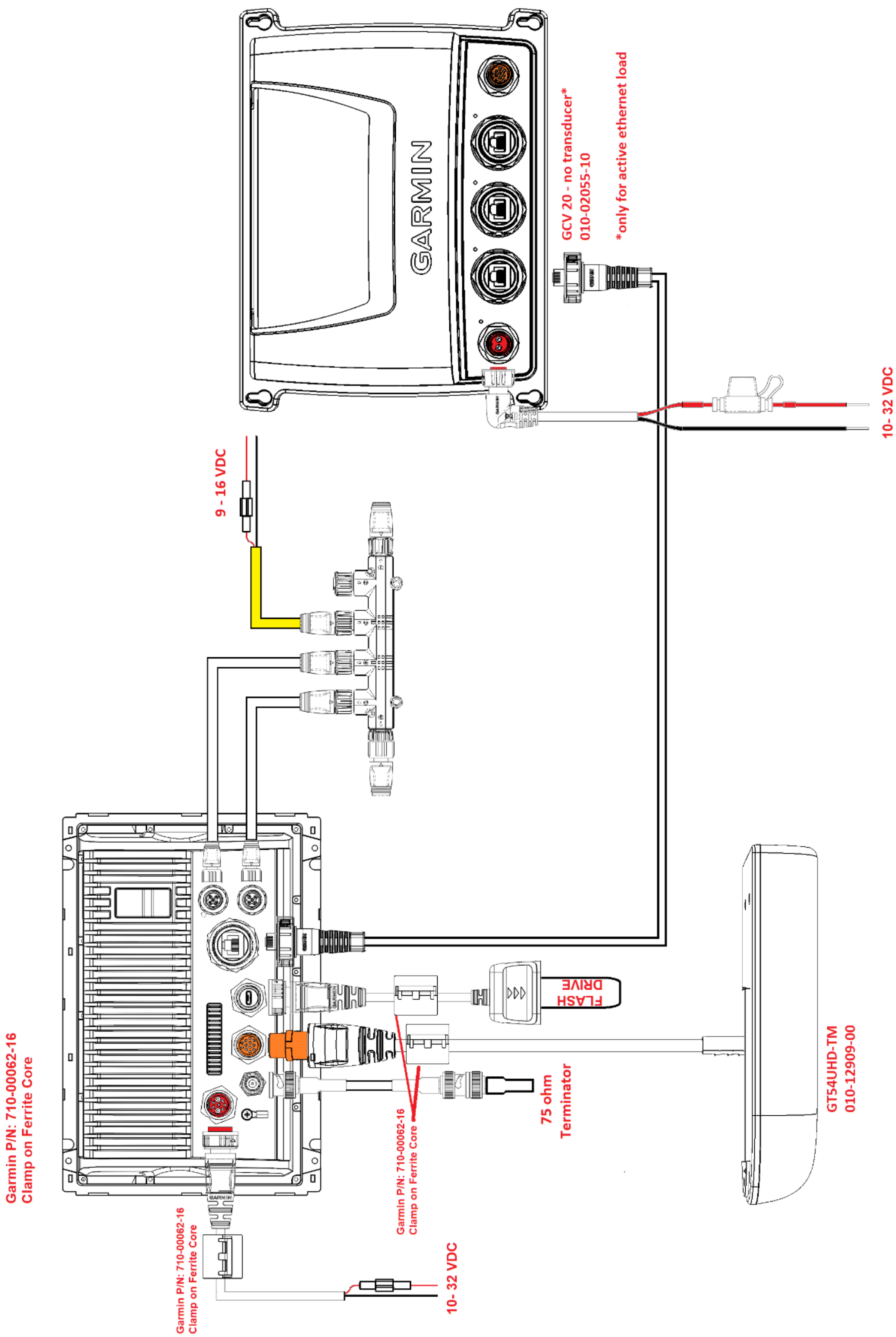
Software: v21.43, ANT-PIFA (4.3 dBi), BLE/802.11 – PIFA (2.5 dBi)

Test results in this report relate only to the items tested and operating in mode 1.  Worst-case configuration data recorded in this report.

### *Equipment Function*

The EUT is a mobile mounted GPS enabled display for use in the marine environment. The device provides GPS reception and display of navigation and other information to the user. The design provides interface connection ports including, a USB, DC Power, Garmin Marine Network port, SONAR, NMEA 2000, J1939, and CVBS IN. The design incorporates two transmitters providing multiple wireless communication operations including low power and higher power Digital Transmission System. The device provides operation across the 2402-2480 MHz band as well as higher output power across the reduced frequency band of 2412-2462 MHz. The design provides wireless communications with compatible ANT, Bluetooth® (BT) Low Energy (BLE), and 802.11b/g/n devices using GFSK, GMSK, DSSS, OFDM, and Modulation and Coding Schemes (MCS) modulations. The product operates from external direct current power only and offers no provision to interface with utility power systems. The design utilizes internal fixed antenna systems and offers no provision for antenna replacement or modification. The ANT transmitter utilizes a Printed Inverted F Antenna (PIFA) design providing 4.3 dBi gain with the BLE and 802.11 transmitter using a PIFA antenna with 2.5 dBi gain. Three samples were provided for testing, EUT#1 representative of A03873 production design, EUT#2 modified for testing purposes replacing the integral 2.4 GHz antenna with RF connection port and EUT#3 representative of the B03873 production design. Test samples were provided with test software enabling testing personnel the ability to operate the transmitter functions on defined channels and operational modes. The test software enabled near 100% transmit duty cycle for testing purposes. The antenna modification offered the 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 for testing purposes. The design provides no other interface options than those as presented below in the configuration diagrams. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. For testing purposes, the EUT received powered from external power supply and configured to operate in available modes. As requested by the manufacturer the equipment was tested for compliance using the available configurations with the worst-case data presented. This report documents the performed testing and results for applicable configurations and product modes of operation. Test results in this report relate only to the products described in this report.

## *Equipment Configuration*



## Application for Certification

(1) Manufacturer: Garmin International, Inc.
1200 East 151st Street
Olathe, KS 66062

(2) Identification: M/N's: A03873, B03873
FCC ID: IPH-03873 IC: 1792A-03873

(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 offers interface ports for power 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 & Test Procedures

The following information is submitted in accordance with the eCFR Code of Federal Regulations Title 47 (47CFR), dated July 13, 2020: 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 for the EUT operations as Low Power Transmitter.

# Testing Procedures

## *AC Line Conducted Emission Test Procedure*

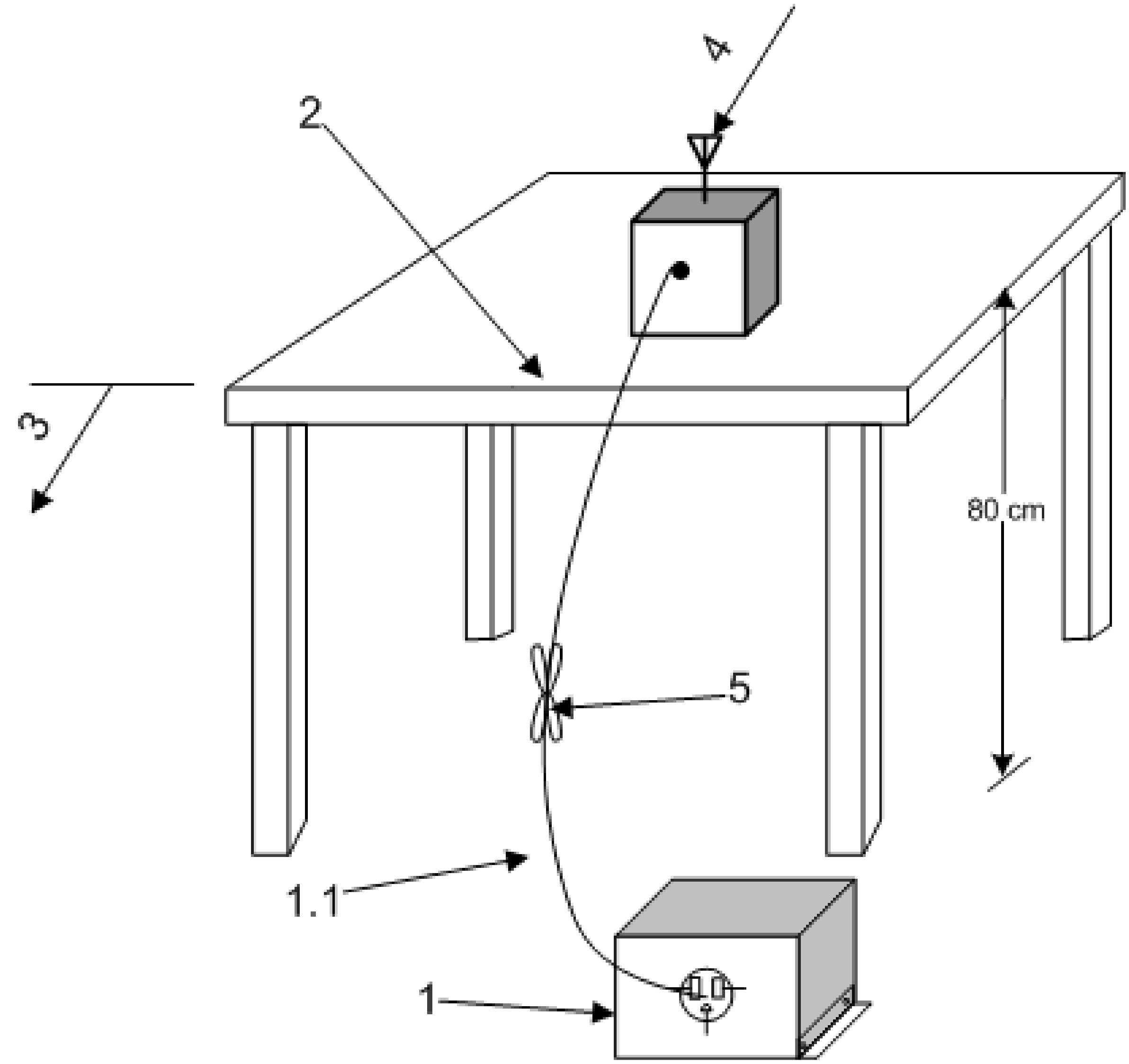
The design operates form direct current power only and provides no to interface with utility AAC power system, Therefore, no AC line conducted emissions testing was required or performed.

## *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.

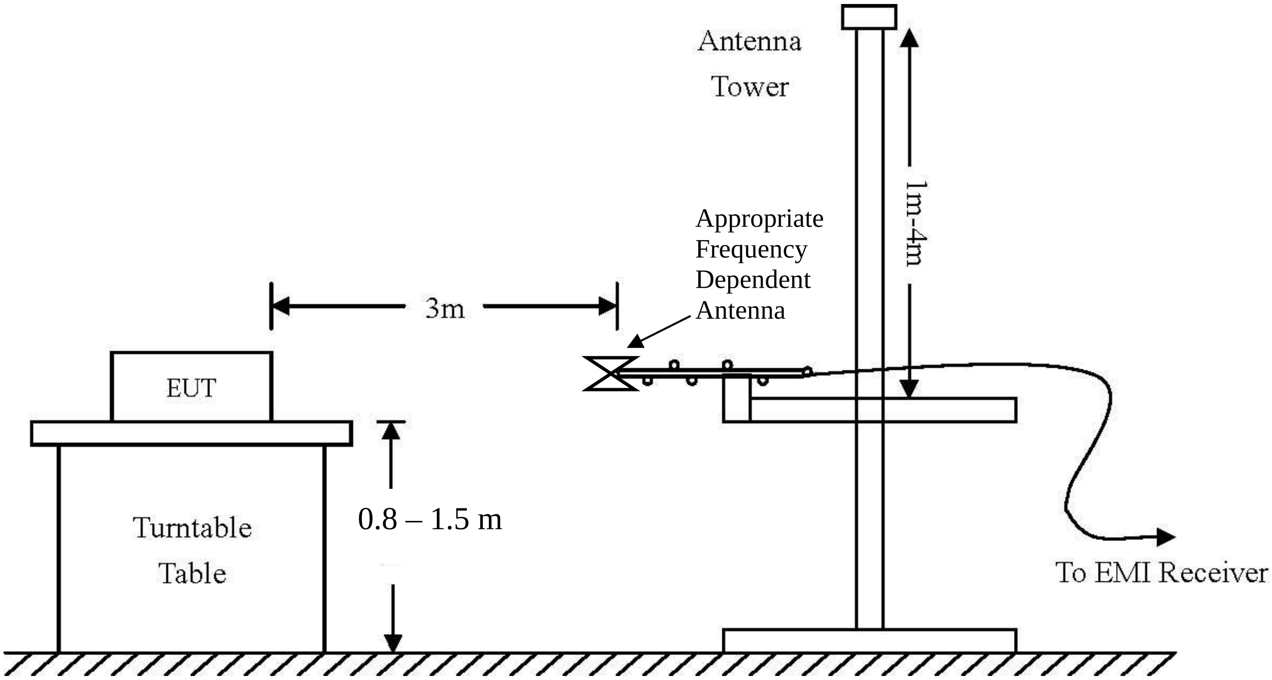
## *Antenna Port Conducted Emission Test Procedure*

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.




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**




| 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)**

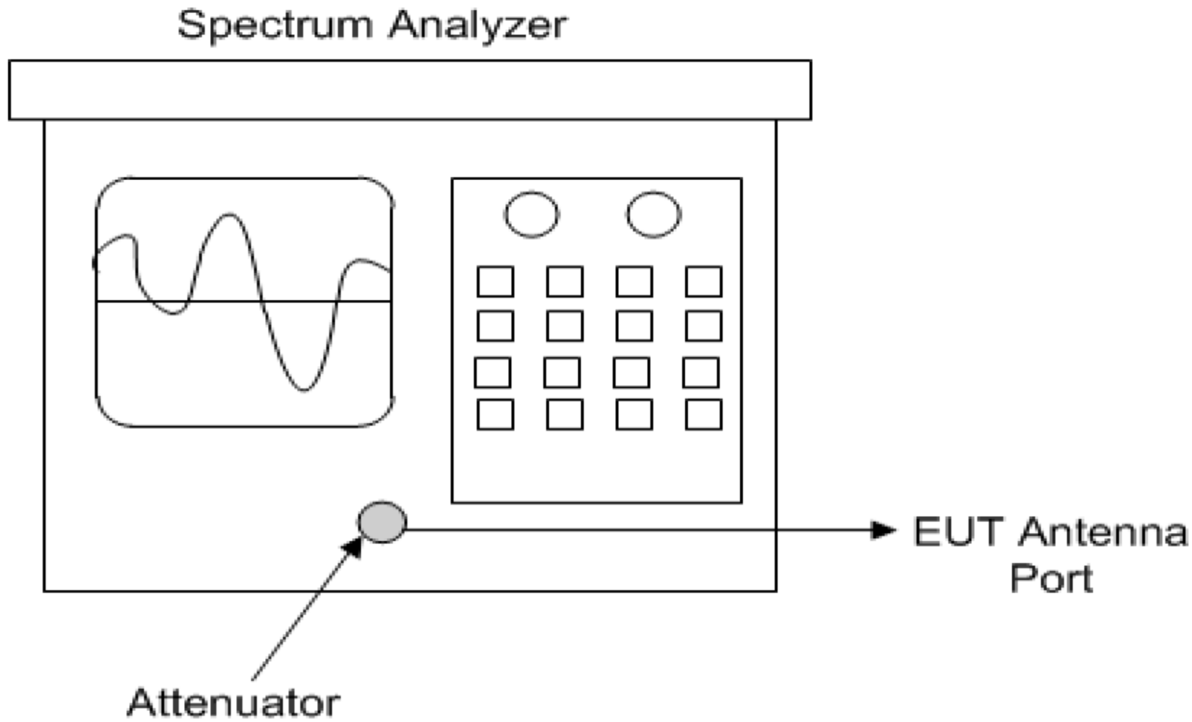



**Diagram 3 Test arrangement for Antenna Port Conducted emissions**

## Test Site Locations

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

Antenna port — Antenna port conducted emissions testing was 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

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

NVLAP Accreditation Lab code 200087-0

## Units of Measurements

Conducted EMI Data presented in dBµV; dB referenced to one microvolt

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

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

Note: Radiated limit may be expressed for measurement in dBµV/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 Open Area Test Site 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 (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

## Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 23.9° C |
| Relative Humidity | 46% |
| Atmospheric Pressure | 1015.7 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.

## *Antenna Requirements*

The EUT incorporates integral chip 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 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 | 44.1 | 30.4 | 44.0 | 30.5 | 54.0 | -23.6 | -23.5 |
| 2483.5 | 53.2 | 31.3 | 48.3 | 31.1 | 54.0 | -22.7 | -22.9 |
| 4804.0 | 49.4 | 35.9 | 49.5 | 36.0 | 54.0 | -18.1 | -18.0 |
| 4914.0 | 48.6 | 35.7 | 49.1 | 35.7 | 54.0 | -18.3 | -18.3 |
| 4960.0 | 48.9 | 36.0 | 49.3 | 35.9 | 54.0 | -18.0 | -18.1 |
| 7206.0 | 52.5 | 39.6 | 52.5 | 39.7 | 54.0 | -14.4 | -14.3 |
| 7371.0 | 52.4 | 39.6 | 52.6 | 39.8 | 54.0 | -14.4 | -14.2 |
| 7440.0 | 53.3 | 40.0 | 53.2 | 40.0 | 54.0 | -14.0 | -14.0 |
| 12010.0 | 58.4 | 45.5 | 58.3 | 45.4 | 54.0 | -8.5 | -8.6 |
| 12285.0 | 59.1 | 45.8 | 60.1 | 47.5 | 54.0 | -8.2 | -6.5 |
| 12400.0 | 58.7 | 45.4 | 59.8 | 46.1 | 54.0 | -8.6 | -7.9 |

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 47 CFR Part 15C and RSS-210 Issue 10 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -6.5 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.

### *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 on the OATS 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 2 General Radiated Emissions Data**

| Frequency (MHz) | Horizontal Peak (dBµV/m) | Horizontal Quasi-Peak (dBµV/m) | Vertical Peak (dBµV/m) | Vertical Quasi-Peak (dBµV/m) | Limit @ 3m (dBµV/m) | Horizontal Margin (dB) | Vertical Margin (dB) |
|---|---|---|---|---|---|---|---|
| 75.2 | 38.9 | 30.3 | 42.4 | 31.0 | 40.0 | -9.7 | -9.0 |
| 77.5 | 40.4 | 30.3 | 40.1 | 30.4 | 40.0 | -9.7 | -9.6 |
| 80.0 | 45.2 | 32.1 | 54.8 | 38.1 | 40.0 | -7.9 | -1.9 |
| 114.2 | 44.3 | 35.0 | 44.6 | 35.0 | 40.0 | -5.0 | -5.0 |
| 120.0 | 45.4 | 36.4 | 47.2 | 36.6 | 40.0 | -3.6 | -3.4 |
| 123.0 | 44.3 | 35.5 | 44.4 | 35.4 | 40.0 | -4.5 | -4.6 |
| 155.7 | 43.1 | 34.1 | 42.7 | 34.1 | 40.0 | -5.9 | -5.9 |
| 200.0 | 48.1 | 36.9 | 45.5 | 35.2 | 40.0 | -3.1 | -4.8 |
| 560.0 | 52.8 | 45.3 | 51.2 | 43.0 | 47.0 | -1.7 | -4.0 |

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 Issue 10, and RSS-GEN Issue 5 Intentional Radiators. The EUT configuration demonstrated a minimum margin of -1.7 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 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, Biconilog Antenna for 30 to 1000 MHz, Double-Ridge, and/or Pyramidal Horn Antennas from 1 GHz to 25 GHz. Emissions were measured in dBµV/m @ 3 meters.

Refer to figures one through four showing plots taken of the 2402-2480 MHz transmitter operation displaying compliance with the specifications.

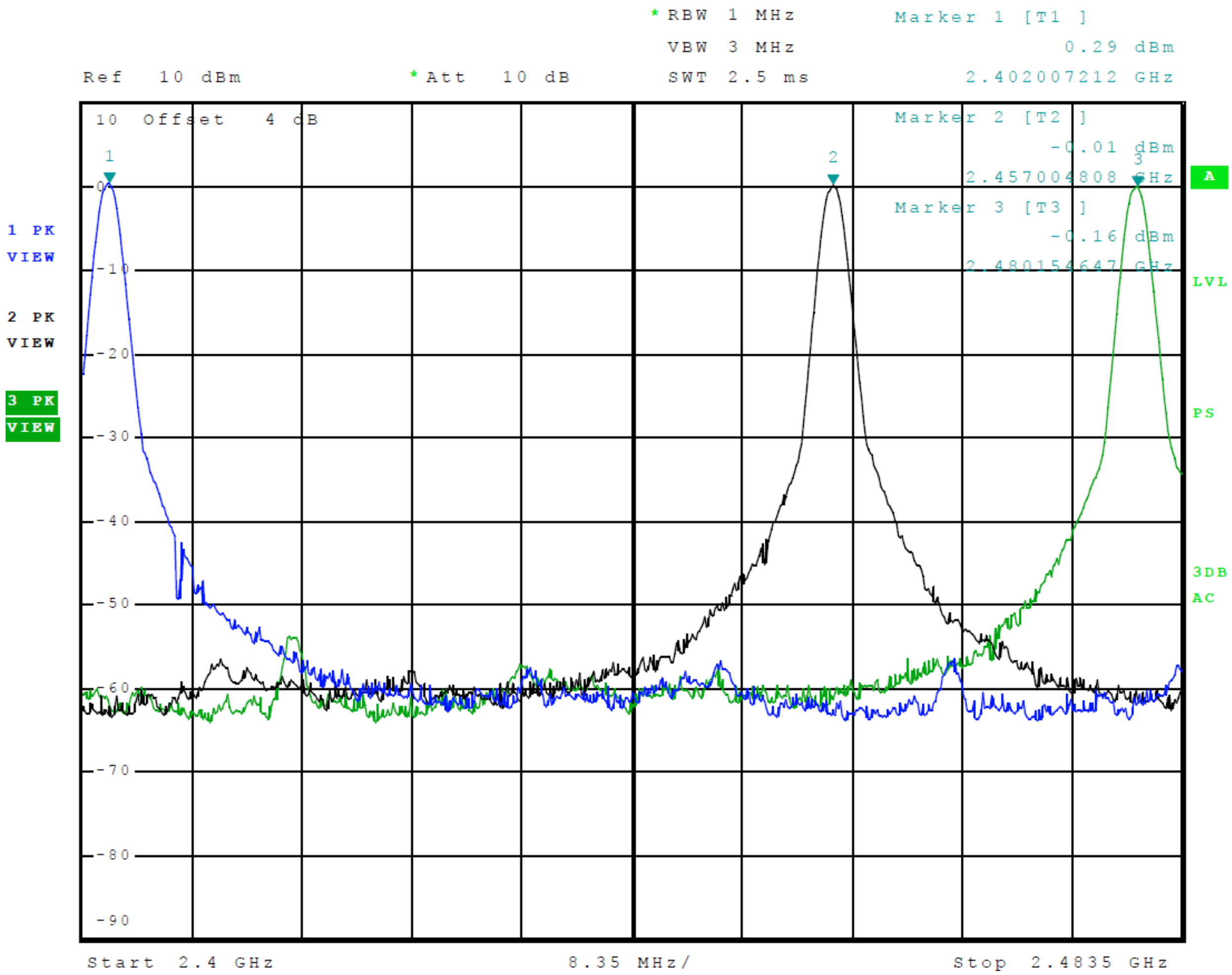



**Figure 1 Plot of Transmitter Emissions Operation in 2402-2480 MHz Mode 1 ANT (GFSK)**

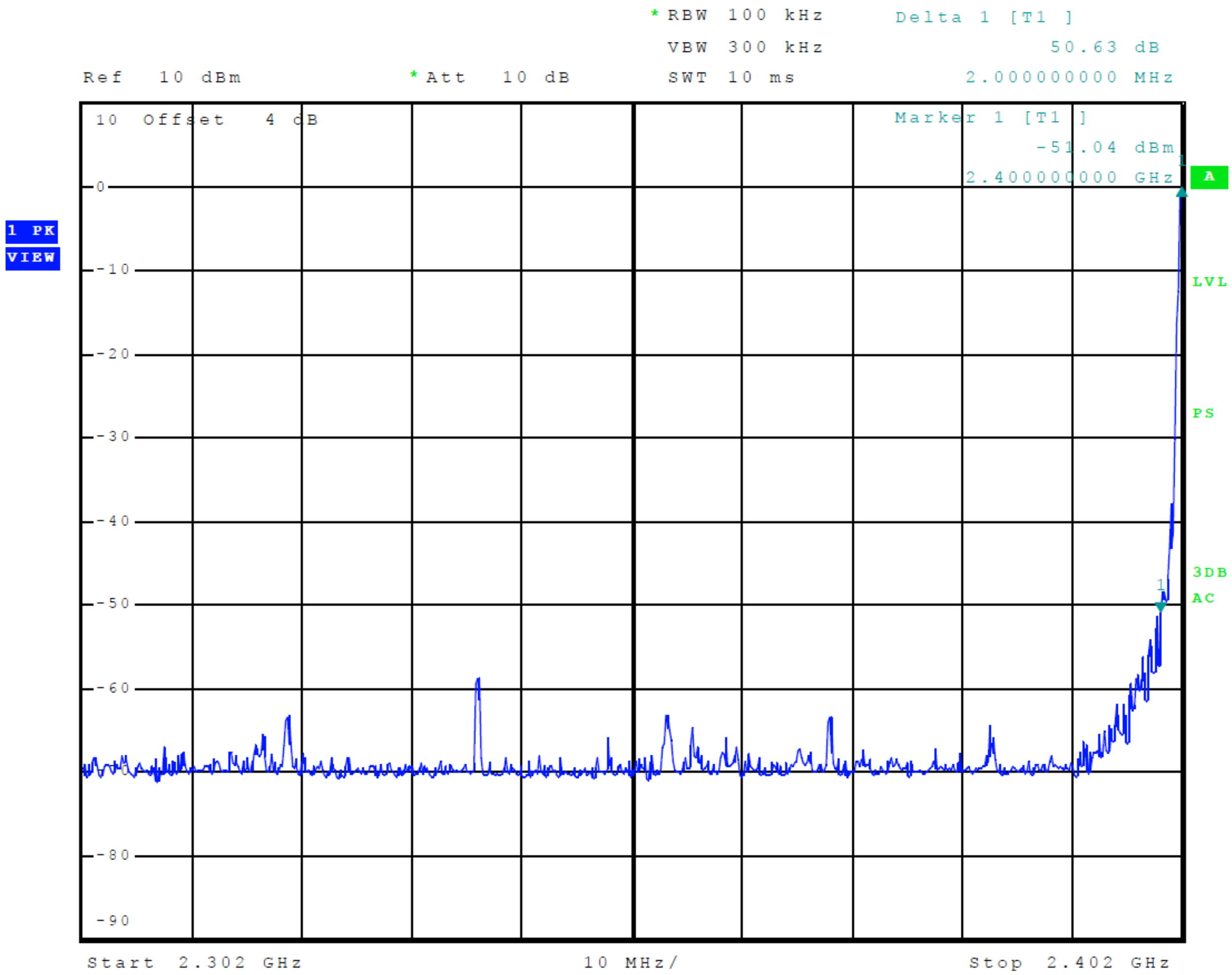



**Figure 2 Plot of Transmitter Emissions Low Band Edge Mode 1 ANT (GFSK)**

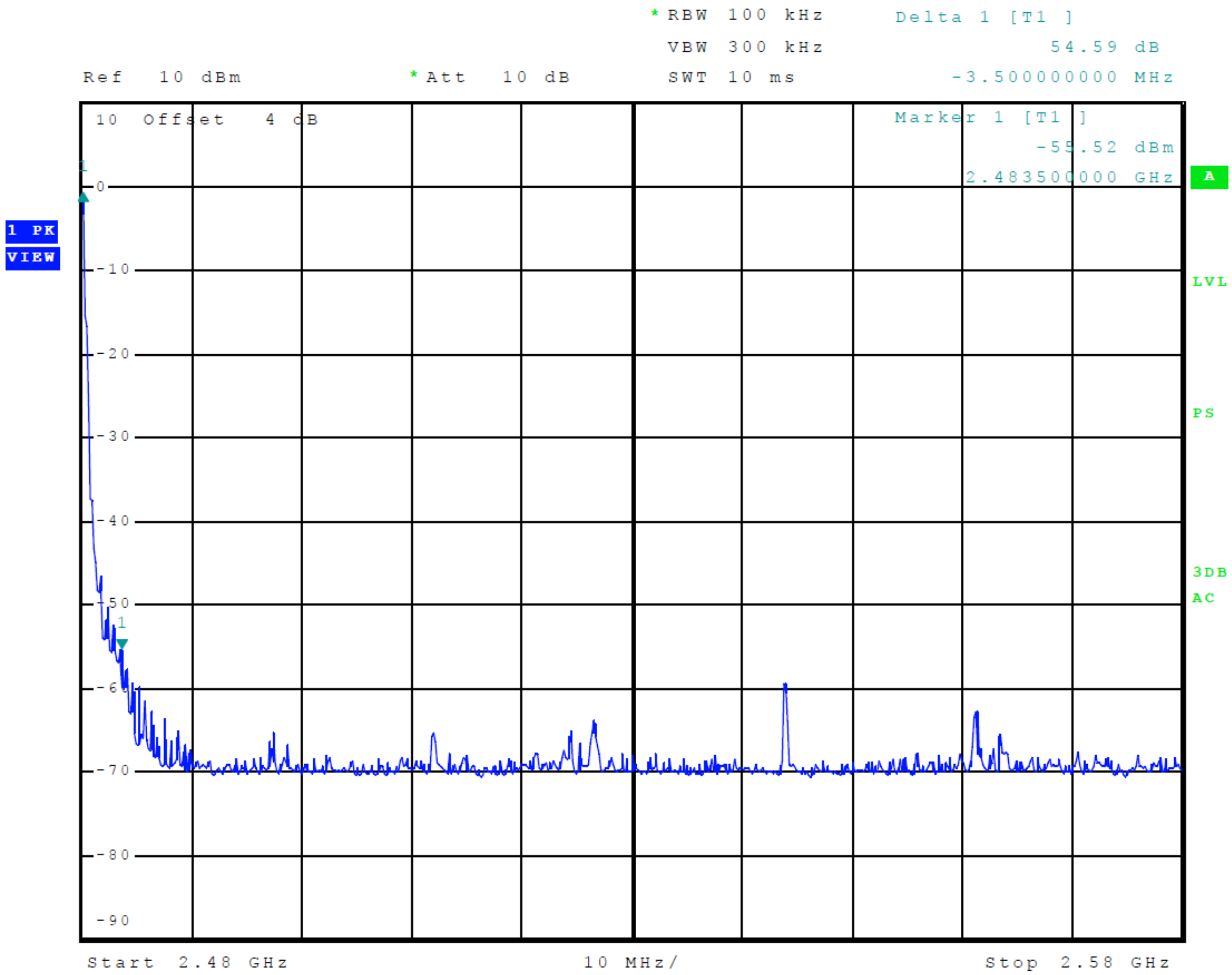



**Figure 3 Plot of Transmitter Emissions High Band Edge Mode 1 ANT (GFSK)**

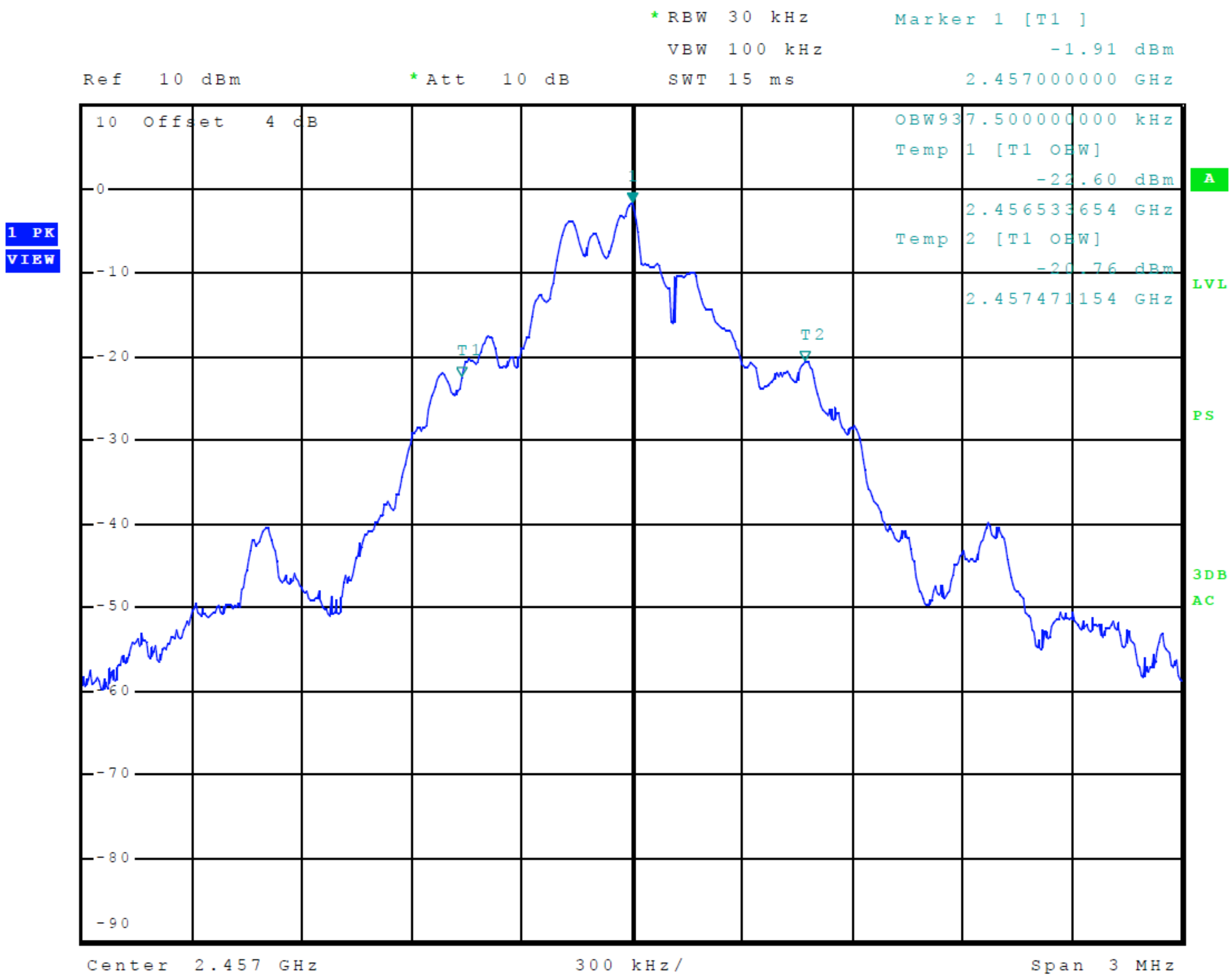



**Figure 4 Plot of Transmitter Emissions 99% Occupied Bandwidth Mode 1 ANT (GFSK)**

***Transmitter Emissions Data***

**Table 3 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 | 92.9 | 64.7 | 87.0 | 58.4 | 94.0 | -29.3 | -35.6 |
| 4804.0 | 49.4 | 35.9 | 49.5 | 36.0 | 54.0 | -18.1 | -18.0 |
| 7206.0 | 52.5 | 39.6 | 52.5 | 39.7 | 54.0 | -14.4 | -14.3 |
| 9608.0 | 55.7 | 42.5 | 55.5 | 42.5 | 54.0 | -11.5 | -11.5 |
| 12010.0 | 58.4 | 45.5 | 58.3 | 45.4 | 54.0 | -8.5 | -8.6 |
| 14412.0 | 61.1 | 48.2 | 61.5 | 48.3 | 54.0 | -5.8 | -5.7 |
| 16814.0 | 63.9 | 51.1 | 64.2 | 51.2 | 54.0 | -2.9 | -2.8 |
| 2457.0 | 93.6 | 65.4 | 87.6 | 59.7 | 94.0 | -28.6 | -34.3 |
| 4914.0 | 48.6 | 35.7 | 49.1 | 35.7 | 54.0 | -18.3 | -18.3 |
| 7371.0 | 52.4 | 39.6 | 52.6 | 39.8 | 54.0 | -14.4 | -14.2 |
| 9828.0 | 55.6 | 42.7 | 55.6 | 42.5 | 54.0 | -11.3 | -11.5 |
| 12285.0 | 59.1 | 45.8 | 60.1 | 47.5 | 54.0 | -8.2 | -6.5 |
| 14742.0 | 61.9 | 48.9 | 61.5 | 48.9 | 54.0 | -5.1 | -5.1 |
| 17199.0 | 63.6 | 50.4 | 64.0 | 50.5 | 54.0 | -3.6 | -3.5 |
| 2480.0 | 93.7 | 65.6 | 87.5 | 59.5 | 94.0 | -28.4 | -34.5 |
| 4960.0 | 48.9 | 36.0 | 49.3 | 35.9 | 54.0 | -18.0 | -18.1 |
| 7440.0 | 53.3 | 40.0 | 53.2 | 40.0 | 54.0 | -14.0 | -14.0 |
| 9920.0 | 55.5 | 42.5 | 55.0 | 42.2 | 54.0 | -11.5 | -11.8 |
| 12400.0 | 58.7 | 45.4 | 59.8 | 46.1 | 54.0 | -8.6 | -7.9 |
| 14880.0 | 61.3 | 48.5 | 61.2 | 48.4 | 54.0 | -5.5 | -5.6 |
| 17360.0 | 63.9 | 51.0 | 63.5 | 50.6 | 54.0 | -3.0 | -3.4 |

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 10 and RSS-GEN Issue 5 Intentional Radiator regulations. The EUT worst-case test sample configuration demonstrated minimum average margin of -28.4 dB below the average emission limit for the fundamental. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -2.8 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 Rogers Qualifications
- Annex D Laboratory 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  Test Equipment*

| Equipment | Manufacturer | Model (SN) | Band | Cal Date(m/d/y) | Due |
|---|---|---|---|---|---|
| ☐ LISN | FCC | FCC-LISN-50-25-10(1PA) (160611) | .15-30MHz | 4/21/2020 | 4/21/2021 |
| ☐ LISN | Compliance Design | FCC-LISN-2.Mod.cd,(126) | .15-30MHz | 10/14/2019 | 10/14/2020 |
| ☒ Cable | Huber & Suhner Inc. | Sucoflex102ea(L10M)(303073) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Huber & Suhner Inc. | Sucoflex102ea(1.5M)(303069) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☒ Cable | Huber & Suhner Inc. | Sucoflex102ea(1.5M)(303070) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Belden | RG-58 (L1-CAT3-11509) | 9kHz-30 MHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Belden | RG-58 (L2-CAT3-11509) | 9kHz-30 MHz | 10/14/2019 | 10/14/2020 |
| ☒ Antenna | Com Power | AL-130 (121055) | .001-30 MHz | 10/14/2019 | 10/14/2020 |
| ☐ Antenna: | EMCO | 6509 | .001-30 MHz | 10/16/2018 | 10/16/2020 |
| ☐ Antenna | ARA | BCD-235-B (169) | 20-350MHz | 10/14/2019 | 10/14/2020 |
| ☐ Antenna: | Schwarzbeck Model: | BBA 9106/VHBB 9124 (9124-627) | | 4/21/2020 | 4/21/2021 |
| ☒ Antenna | Sunol | JB-6 (A100709) | 30-1000 MHz | 10/14/2019 | 10/14/2020 |
| ☐ Antenna | ETS-Lindgren | 3147 (40582) | 200-1000MHz | 10/14/2019 | 10/14/2020 |
| ☐ Antenna: | Schwarzbeck Model: | VULP 9118 A (VULP 9118 A-534) | | 4/21/2020 | 4/21/2021 |
| ☒ Antenna | ETS-Lindgren | 3117 (200389) | 1-18 GHz | 4/21/2020 | 4/23/2022 |
| ☐ Antenna | Com Power | AH-118 (10110) | 1-18 GHz | 10/14/2019 | 10/14/2020 |
| ☒ Antenna | Com Power | AH-840 (101046) | 18-40 GHz | 4/21/2020 | 4/21/2021 |
| ☒ Analyzer | Rohde & Schwarz | ESU40 (100108) | 20Hz-40GHz | 5/15/2020 | 5/15/2021 |
| ☒ Analyzer | Rohde & Schwarz | ESW44 (101534) | 20Hz-44GHz | 1/27/2020 | 1/27/2021 |
| ☐ 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 | 10/14/2019 | 10/14/2020 |
| ☒ Amplifier | Com-Power | CPPA-102 (01254) | 1-1000 MHz | 10/14/2019 | 10/14/2020 |
| ☒ Amplifier | Com-Power | PAM-118A (551014) | 0.5-18 GHz | 10/14/2019 | 10/14/2020 |
| ☒ Amplifier | Com-Power | PAM-840A (461328) | 18-40 GHz | 10/14/2019 | 10/14/2020 |
| ☒ Power Meter | Agilent | N1911A with N1921A | 0.05-40 GHz | 4/21/2020 | 4/21/2021 |
| ☐ Generator | Rohde & Schwarz | SMB100A6 (100150) | 20Hz-6 GHz | 4/21/2020 | 4/21/2021 |
| ☐ Generator | Rohde & Schwarz | SMBV100A6 (260771) | 20Hz-6 GHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | BRC50722 (009).9G notch | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | HPM50114 (017)1.5G HPF | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☒ RF Filter | Micro-Tronics | HPM50117 (063) 3G HPF | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | HPM50105 (059) 6G HPF | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | BRM50702 (172) 2G notch | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | BRC50703 (G102) 5G notch | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | BRC50705 (024) 5G notch | 30-18000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ Attenuator | Fairview | SA6NFNF100W-40 (1625) | 30-18000 MHz | 4/21/2020 | 4/18/2021 |
| ☒ Attenuator | Mini-Circuits | VAT-3W2+ (1436) | 30-6000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ Attenuator | Mini-Circuits | VAT-3W2+ (1445) | 30-6000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ Attenuator | Mini-Circuits | VAT-3W2+ (1735) | 30-6000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ Attenuator | Mini-Circuits | VAT-6W2+ (1438) | 30-6000 MHz | 4/21/2020 | 4/21/2021 |
| ☐ Attenuator | Mini-Circuits | VAT-6W2+ (1736) | 30-6000 MHz | 4/21/2020 | 4/21/2021 |
| ☒ Weather station | Davis | 6312 (A81120N075) | | 11/4/2019 | 11/4/2020 |

List of Test Equipment Calibration Date (m/d/y) Due

| | | | | | |
|---|---|---|---|---|---|
| ☐ Frequency Counter: Leader LDC-825 (8060153 | | | | 4/21/2020 | 4/21/2021 |
| ☐ LISN: Com-Power Model LI-220A | | | | 10/14/2019 | 10/14/2020 |
| ☐ LISN: Com-Power Model LI-550C | | | | 10/14/2019 | 10/14/2020 |
| ☐ ISN: Com-Power Model ISN T-8 | | | | 4/21/2020 | 4/21/2021 |
| ☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08 | | | | 4/21/2020 | 4/21/2021 |
| ☐ Cable | Huber & Suhner Inc. | Sucoflex102ea(1.5M)(303070) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Huber & Suhner Inc. | Sucoflex102ea(1.5M)(303072) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Huber & Suhner Inc. | Sucoflex102ea(L4M)(281184) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Huber & Suhner Inc. | Sucoflex102ea(L10M)(317546) | 9kHz-40 GHz | 10/14/2019 | 10/14/2020 |
| ☐ Cable | Time Microwave | 4M-750HF290-750 (4M) | 9kHz-24 GHz | 10/14/2019 | 10/14/2020 |
| ☐ RF Filter | Micro-Tronics | BRC17663 (001) 9.3-9.5 notch | 30-1800 MHz | 4/21/2020 | 4/21/2021 |
| ☐ RF Filter | Micro-Tronics | BRC19565 (001) 9.2-9.6 notch | 30-1800 MHz | 10/16/2018 | 4/21/2021 |
| ☐ Analyzer | HP | 8562A (3051A05950) | 9kHz-125GHz | 4/21/2020 | 4/21/2021 |
| ☐ Analyzer | HP External Mixers | 11571, 11970 | 25GHz-110GHz | 4/18/2015 | 4/18/2025 |
| ☐ Analyzer | HP | 8591EM (3628A00871) | | 4/21/2020 | 4/21/2021 |
| ☐ Antenna: Solar 9229-1 & 9230-1 | | | | 2/22/2020 | 2/22/2021 |
| ☐ CDN: Com-Power Model CDN325E | | | | 10/14/2019 | 10/14/2020 |
| ☐ Injection Clamp Luthi Model EM101 | | | | 10/14/2019 | 10/14/2020 |
| ☐ Oscilloscope Scope: Tektronix MDO 4104 | | | | 2/22/2020 | 2/22/2021 |
| ☐ EMC Transient Generator HVT TR 3000 | | | | 2/22/2020 | 2/22/2021 |
| ☐ AC Power Source (Ametech, California Instruments) | | | | 2/22/2020 | 2/22/2021 |
| ☐ Field Intensity Meter: EFM-018 | | | | 2/22/2020 | 2/22/2021 |
| ☐ ESD Simulator: MZ-15 | | | | 2/22/2020 | 2/22/2021 |
| ☐ 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 | |
| ☒ Shielded Room | | | | not required | |

## *Annex C Rogers Qualifications*

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

**Rogers Labs, Inc.**

Mr. Rogers has approximately 35 years' experience in the field of electronics. Working experience includes six years working in the automated controls industry and 6 years working with the design, development and testing of radio communications and electronic equipment.

Positions Held:

| | | |
|---|---|---|
| Systems Engineer: | A/C Controls Mfg. Co., Inc. | 6 Years |
| Electrical Engineer: | Rogers Consulting Labs, Inc. | 5 Years |
| Electrical Engineer: | Rogers Labs, Inc. | Current |

Educational Background:

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

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

## *Annex D Laboratory Certificate of Accreditation*

**United States Department of Commerce**
**National Institute of Standards and Technology**

# Certificate of Accreditation to ISO/IEC 17025:2017

**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 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

2020-02-25 through 2021-03-31
*Effective Dates*

*For the National Voluntary Laboratory Accreditation Program*