GARMIN
Garmin International, Inc.
1200 East 151st Street
Olathe, Kansas 66062
P: 913-397-8200 F: 913-397-8282

16-Feb-26

Manufacturer: Garmin International, Inc.
Address: 1200 E. 151st St.
Olathe, KS 66062-3426
U.S.A.
Chile Representative: Matías Rodríguez Correa
Rosario Norte 660 piso 24, Las Condes Santiago
Province CP 7550083, Chile
Contact Email: matias.rodriguez@garmin.com

Subject: SUBTEL, Chile (Resolution 737) Certification Compliance 2026

Commercial Name: GPSMAP 9010, GPSMAP 9013, GPSMAP 9017

	Información (Information)
Tipo de equipo (Equipment type)	Portable Digital Transceiver
Marca (Brand)	Garmin GARMIN.
Modelo (Model)	A04277, B04277, C04277
Tecnología o modulación (Technology or modulation)	ANT(GFSK), BT (GFSK, π/4 DQPSK, 8DPSK), BLE (GFSK), WiFi 2.4GHz (802.11 b/g/n),
Frecuencias (Frequencies)	ANT (2402MHz – 2480MHz), BT (2402MHz-2480MHz), BLE (2402MHz-2480MHz), WiFi 2.4GHz (2412MHz – 2462MHz
Ganancia de antena (dBi) (Antenna gain (dBi)	ANT (4.65 dBi), BT (5.74dBi), BLE (5.74dBi) WiFi 2.4GHz (0.90 dBi),
P.i.r.e. (E.I R P.)	ANT (dBm, 0.94mW), BT (14.77dBm, 29.99mW), BLE (14.77dBm, 29.99mW), WiFi 2.4GHz (16.46dBm, 44.25mW),
Módulos (Modules)	ANT, BT, BLE, WiFi 2.4GHz,

Declaration of Conformity Statement: the equipment previously identified complies with the provisions established in the Technical Standard for Small Range Equipment, approved by Exempt Resolution No.1,985 of 2017, of the Undersecretary of Telecommunications.

Declaración de conformidad: El equipo anteriormente identificado cumple con las disposiciones establecidas en la Norma Técnica para Equipos de Corto Alcance, aprobada mediante la Resolución Exenta N° 1.985 de 2017, de la Subsecretaría de Telecomunicaciones.

NVLAP Lab Code 200087-0

ROGERS LABS, INC.

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

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

Application For Grant of Certification

Model: 04277

2402-2480 MHz
Low Power Digital Transmitter (DXX)

FCC ID: IPH-04277

IC: 1792A-04277

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

FCC Designation: US5305
ISED Registration: 3041A

Test Report Number: 230404

Test Date: April 4 to August 4, 2023

Authorized Signatory: Scot D Rogers
Scot D. Rogers

Revisions

Revision 1 Issued Issued September 1, 2023

Executive Summary

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

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

PMN: A04277, B04277, C04277, D04277
FCC ID: IPH-04277 IC: 1792A-04277
Operating Frequency Range: 2402-2480 MHz

D04277 was chosen for transmitter configuration testing and used for final measurements.

Operational communication mode 1

Mode	Peak Power (dBµV/m@3m)	Average power (dBµV/m@3m)	99% OBW (kHz)
Mode 1, ANT (GFSK)	95.0	91.7	986.3

This report addresses EUT Operations as Low Power Transmitter (DXX) using transmitter modulation mode 1. Note, the production device utilizes an integral antenna system with the 2.4 GHz non-user accessible providing 4.7 dBi gain.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47 CFR 15.205, RSS-210 4.1	-5.9	Complies
Emissions as per 47CFR 15.207, RSS-GEN 8.8	N/A	N/A
Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9	-0.9	Complies
Harmonic Emissions per 47 CFR 15.249, RSS-210 B.10	-1.9	Complies

Equipment Tested

Model: 04277

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

Equipment	Model / PN	Serial Number
EUT Tx Radiated	D04277	85W000016
EUT General Emissions	D04277	85W000016
EUT Antenna Port Conducted	D04277	3438712904
DC power Cable (<80cm)	Garmin 2-pin	N/A
DC power Cable (2cm)	Garmin 2-pin	N/A
Garmin Network Switch	011-05723-00	3378916849
5-pin NMEA 2000 Cable	Garmin NMEA Cable	N/A
Temperature Sensor	GTEMP10-TH	4QM000022
External SIM Card Reader	Garmin Card Reader	N/A
Garmin HDMI Cable	Garmin HDMI Cable	N/A
Garmin CVBS Cable	Garmin HDMI Cable	N/A
Garmin Network Cable (6m)	320-00372-03	N/A
FireStick	E9L29Y	N/A
FireStick	E9L29Y	N/A
DC power Cable (2.3m)	Garmin 2-pin	N/A
DC Power Supply	BK 1745	209C13

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

Software: 31.65, Antenna: 2.4 GHz non-user accessible providing 4.7 dBi gain

Equipment Operational Modes

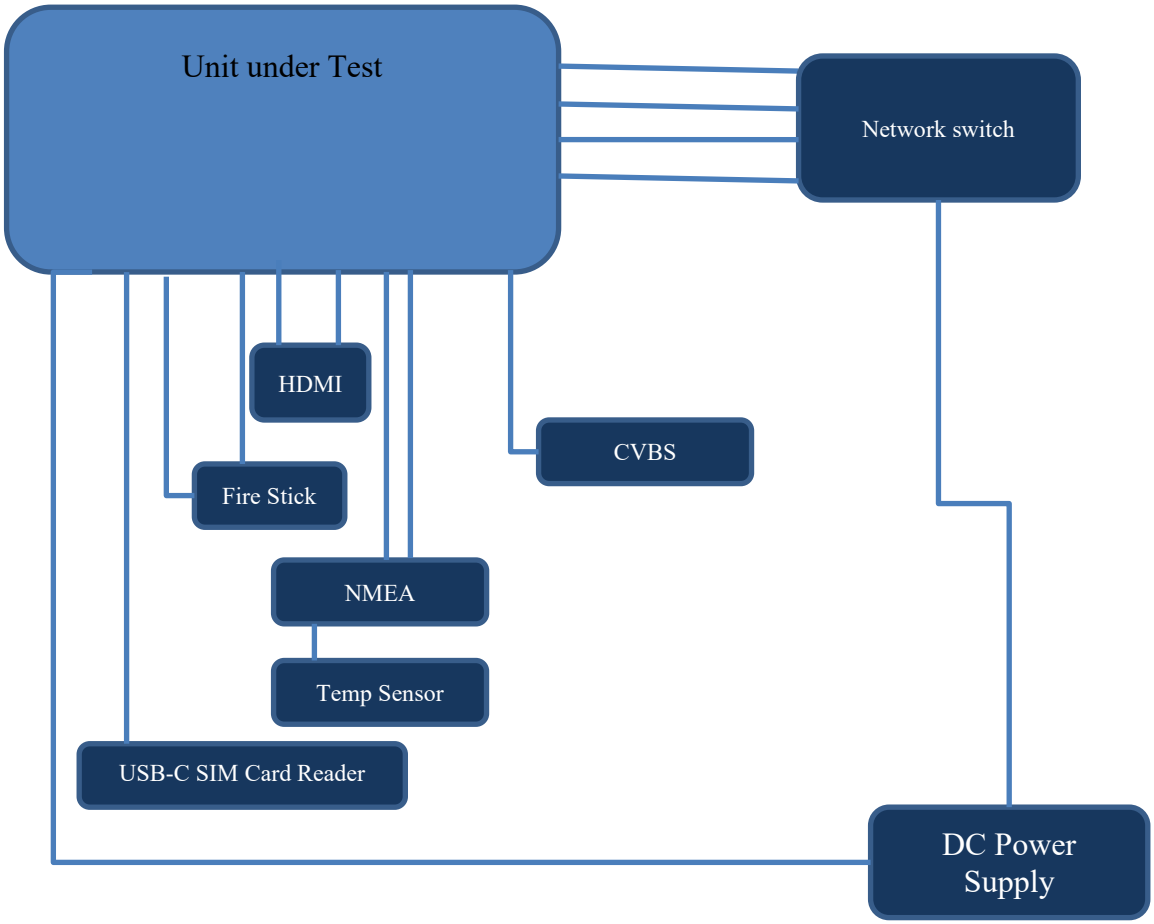
Mode	Transmitter Operation
1	ANT (GFSK)
2	BT BR (GFSK)
3	BT 2EDR (π/4-DQPSK)
4	BT 3EDR (8DPSK)
5	BT BLE (GMSK)
6	802.11b (DSSS/CCK)
7	802.11g, (OFDM)
8	802.11n (MCS)

Equipment Function

The EUT is a Control Panel Display with RF and wired communication capability. The unit provides touchscreen graphical display for the user interface. The design incorporates transmitter circuitry operating in the 2402-2480 MHz frequency band. The typical use configuration has the EUT and powered from direct current power. The design provides interface capability as presented below and wireless communications with compatible equipment. The design contains four collocated transmitters each providing specific functionality. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interface connections than those presented in the configuration options as described by the manufacturer and presented below. For testing purposes, the EUT received power from external direct current power supply. During testing, the test system was configured to operate in a manufacturer defined modes. The manufacturer provided test software for testing transmitter and equipment function. The software provided the ability to operate the transmitters at near 100% duty cycle for testing purposes. The testing mode of operation exceeds typical duty cycle operation of production equipment. As requested by the manufacturer the equipment was

tested for emissions compliance using the available configurations with the worst-case data presented. 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: HVIN: 04277
FCC ID: IPH-04277 IC: 1792A-04277

(3) Instruction Book:
Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:
Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:
Refer to Exhibit of Operational Description.

(6) Report of Measurements:
Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:
Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from external direct current power provided from installation vehicle. The EUT provides interface ports for power, loads and communications as presented in this filing.

(9) Transition Provisions of 47 CFR 15.37 are not requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

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

(13) Applications for certification of U-NII devices in the 5.15-5.35 GHz and the 5.47-5.85 GHz bands must include a high-level operational description of the security procedures that control the radio frequency operating parameters and ensure that unauthorized modifications cannot be made. This requirement is not applicable to his DTS device.

(14) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used. This information is provided in this report and Test Setup Exhibits provided with the application filing.

Applicable Standards

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

Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

The design operates from Direct Current power only and offers no provision to interface with Utility AC Power systems. Therefore, No AC Line conducted emissions testing was required or preformed.

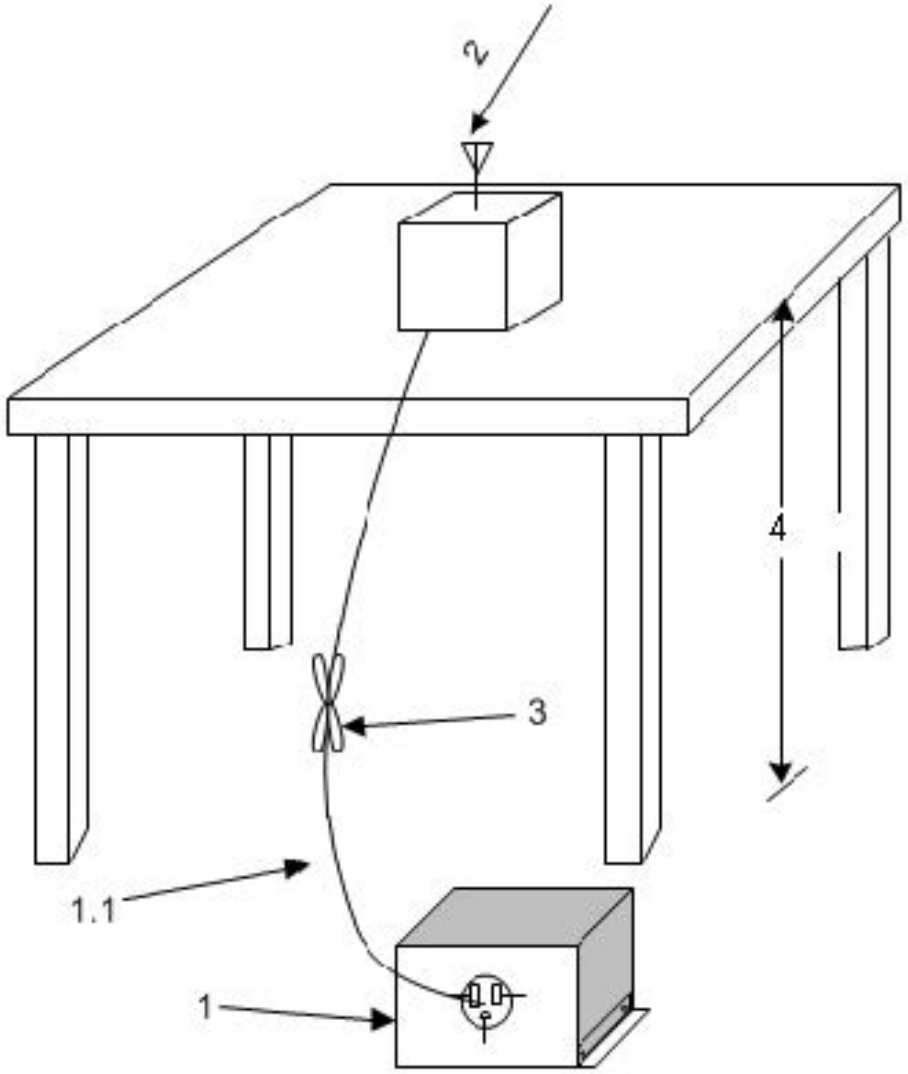
Radiated Emission Test Procedure

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.

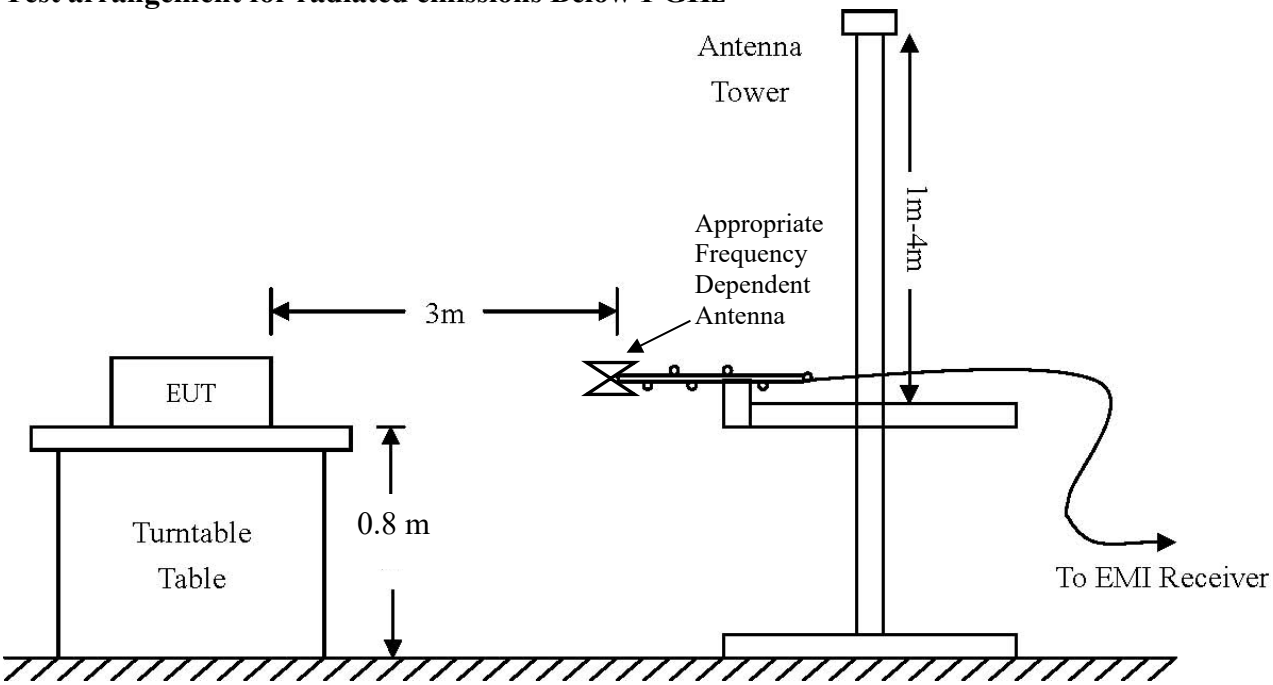
Diagram 1 Test arrangement for radiated emissions of tabletop equipment



1—A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).
1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.
2—Antenna can be integral or detachable, depending on the EUT (see 6.3.1).
3—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.3.1).
4—For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

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

Test arrangement for radiated emissions Below 1 GHz



Test arrangement for radiated emissions Above 1 GHz

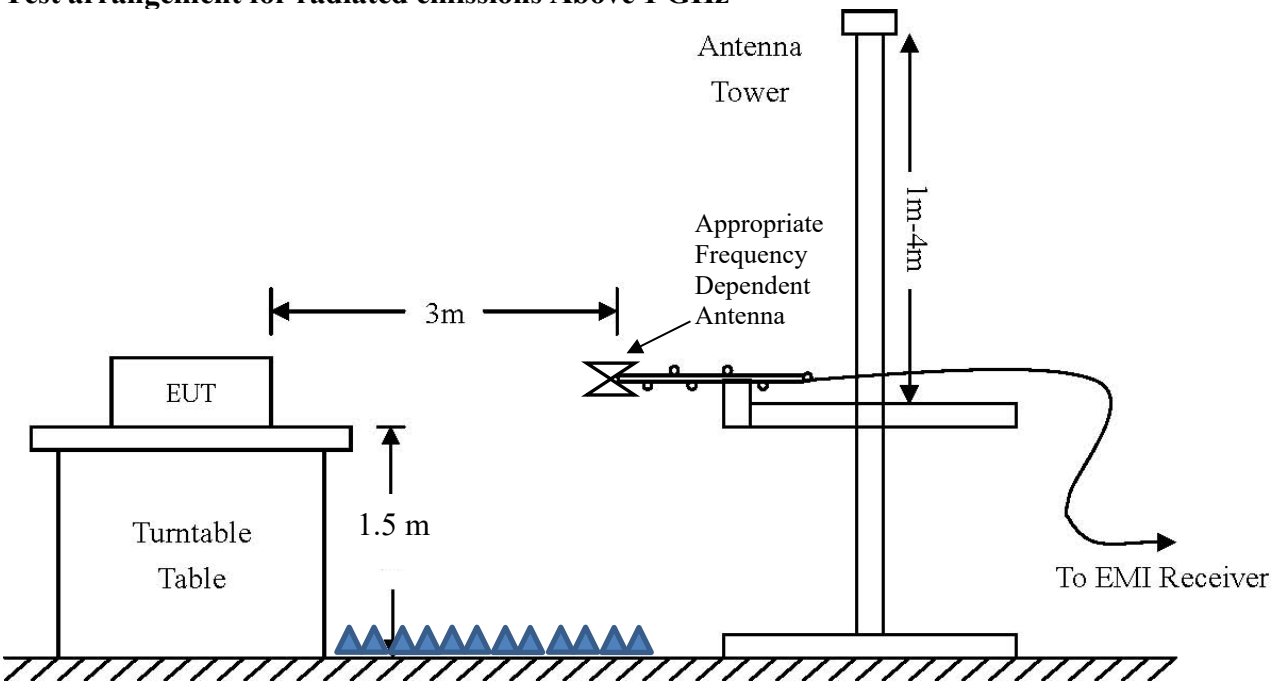
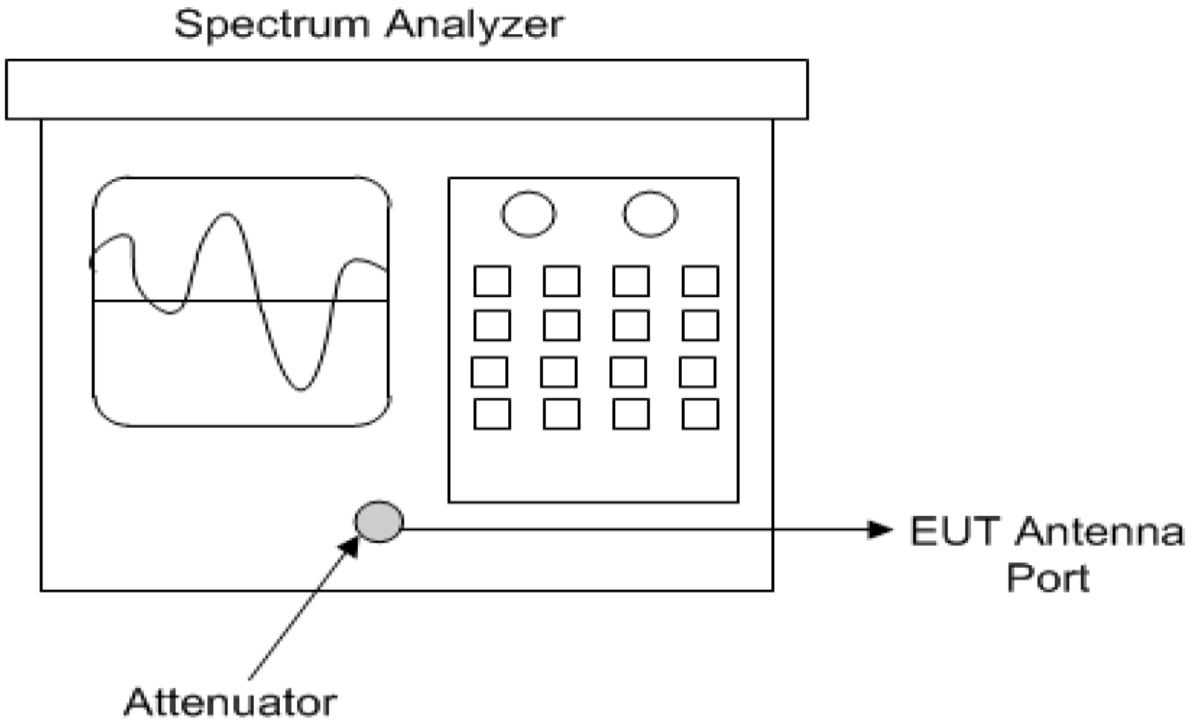


Diagram 3 Test arrangement for Antenna Port Conducted emissions



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 19.8 - 21.7° C

Relative Humidity 31 - 38.0 %

Atmospheric Pressure 1012.3 – 1033.7 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 non-user accessible systems. Production equipment offers no provision for connection to alternate antenna system. The antenna connection point complies with the unique antenna connection requirements. There are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured 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 receiver / spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.10-2013 were used during testing. No other significant emission was observed which fell into the restricted bands of operation. Computed emission values consider the received radiated field strength, receive antenna correction factor, amplifier gain stage, and test system cable losses.

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

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dB)	Vertical Margin (dB)
2390.0	45.3	31.0	44.8	31.1	54.0	-23.0	-22.9
2483.5	64.7	32.4	64.5	33.3	54.0	-21.6	-20.7
4804.0	53.5	43.3	51.0	37.8	54.0	-10.7	-16.2
4914.0	52.7	42.1	51.7	38.8	54.0	-11.9	-15.2
4960.0	52.8	43.5	51.0	37.9	54.0	-10.5	-16.1
7206.0	54.0	40.5	54.5	40.5	54.0	-13.5	-13.5
7371.0	54.2	40.4	53.7	40.4	54.0	-13.6	-13.6
7440.0	54.5	40.6	53.8	40.7	54.0	-13.4	-13.3
12010.0	60.9	47.2	60.5	47.0	54.0	-6.8	-7.0
12285.0	61.3	48.1	61.5	48.1	54.0	-5.9	-5.9
12400.0	60.6	47.6	60.7	47.5	54.0	-6.4	-6.5

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C and RSS-210 Issue 10 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -5.9 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 manufacturer defined equipment configuration and operated with transmitter active during testing. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies which produced the highest emissions. Each radiated emission was then maximized 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)
77.5	40.8	35.3	36.4	31.6	40.0	-4.7	-8.4
129.4	41.0	38.2	41.5	38.5	43.5	-5.3	-5.0
168.1	39.7	37.3	39.8	37.8	43.5	-6.2	-5.7
199.6	36.0	30.2	34.3	29.8	43.5	-13.3	-13.7
204.8	38.1	33.3	37.0	32.5	43.5	-10.2	-11.0
215.6	44.7	39.9	41.7	37.2	43.5	-3.6	-6.3
215.7	40.6	36.0	42.6	38.1	43.5	-7.5	-5.4
219.3	47.6	43.5	43.4	38.7	46.0	-2.5	-7.3
221.0	48.1	39.7	39.7	35.8	46.0	-6.3	-10.2
221.0	44.5	40.3	46.0	41.2	46.0	-5.7	-4.8
224.0	43.6	38.4	37.9	33.9	46.0	-7.6	-12.1
225.7	45.3	42.3	42.3	37.6	46.0	-3.7	-8.4
225.7	45.6	40.7	44.1	39.5	46.0	-5.3	-6.5
229.6	45.4	41.9	45.5	41.2	46.0	-4.1	-4.8
231.9	42.3	37.8	43.9	39.4	46.0	-8.2	-6.6
250.0	41.4	38.7	38.3	34.8	46.0	-7.3	-11.2
342.1	38.0	32.4	35.2	29.2	46.0	-13.6	-16.8
445.0	38.0	34.8	36.2	32.5	46.0	-11.2	-13.5
476.8	45.2	42.0	42.4	38.5	46.0	-4.0	-7.5
720.0	43.9	39.5	42.3	39.1	46.0	-6.5	-6.9
890.1	44.1	39.5	41.3	35.0	46.0	-6.5	-11.0
891.0	49.1	45.1	45.6	41.4	46.0	-0.9	-4.6

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 47CFR Part 15C paragraph 15.209, RSS-210 Issue 10, and RSS-GEN Issue 5 Intentional Radiators. The EUT worst-case transmitter configuration demonstrated a minimum margin of -0.9 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 (OATS) @ 3 meters. The amplitude of radiated emission was measured on the OATS at distance of 3 meters from the FSM antenna (radiated emission testing was performed on sample #1) representative of production equipment with integral antennas. The EUT was placed on a turntable elevated as required above the ground plane and at a distance of 3 meters from the FSM antenna. The peak and quasi-peak amplitude of frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of frequencies above 1000 MHz were measured using a spectrum analyzer. The amplitude of each emission was then recorded from the analyzer display. Emissions radiated outside of the specified bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits, whichever is the lesser attenuation. Antenna port emission plots were taken of transmitter performance for reference in this and other documentation using test sample #4. The amplitude of each radiated emission was maximized by equipment orientation and placement on the turn table, raising and lowering the FSM (Field Strength Measuring) antenna, changing the FSM antenna polarization, and by rotating the turntable. A Loop antenna was used for measuring emissions from 0.009 to 30 MHz, Biconilog Antenna for 30 to 1000 MHz, Double-Ridge, and/or Pyramidal Horn Antennas from 1 GHz to 25 GHz. Emissions were measured in dBµV/m @ 3 meters.

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

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

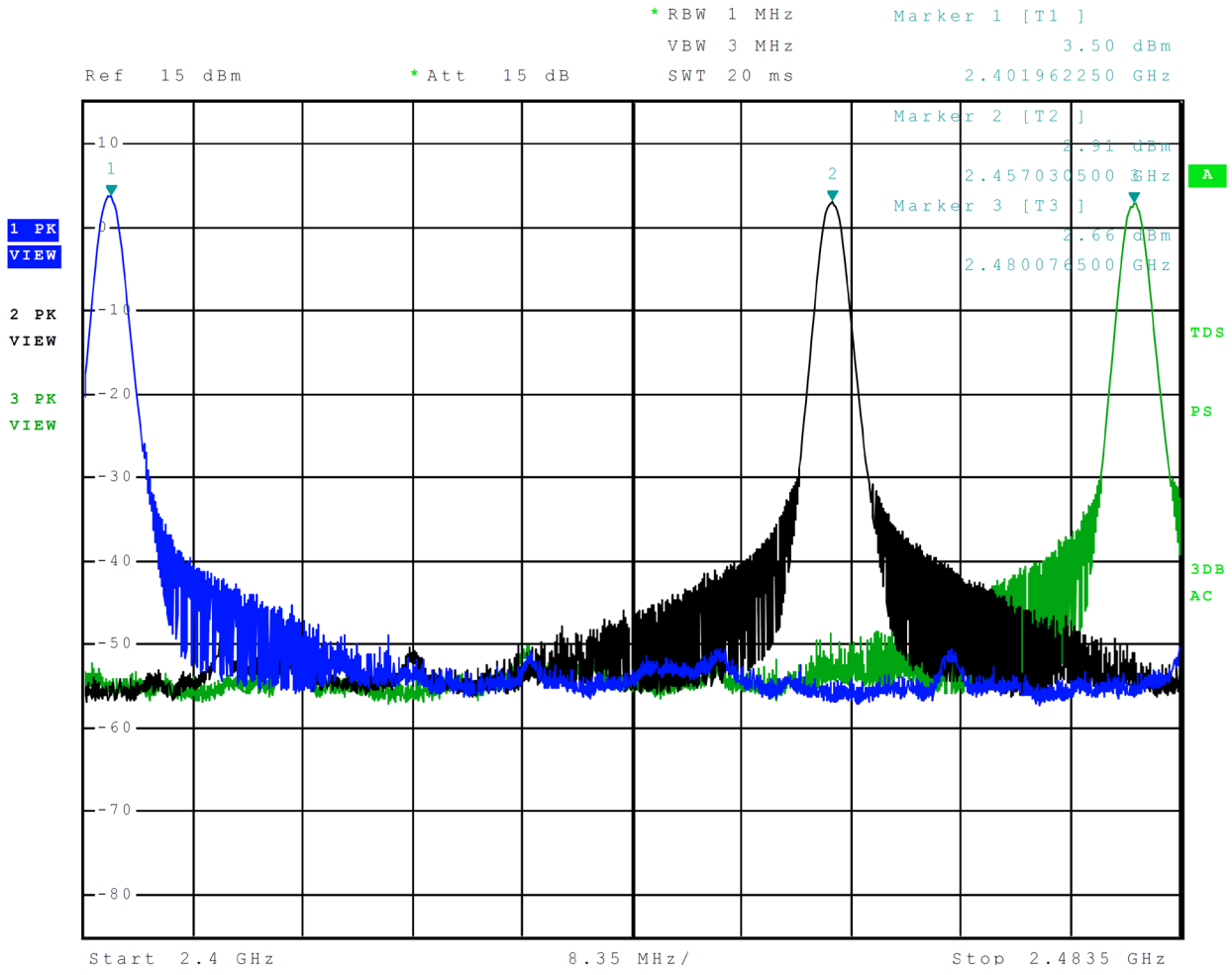


Figure 2 Plot of Transmitter Emissions Low Band Edge Mode 1 ANT (GFSK)

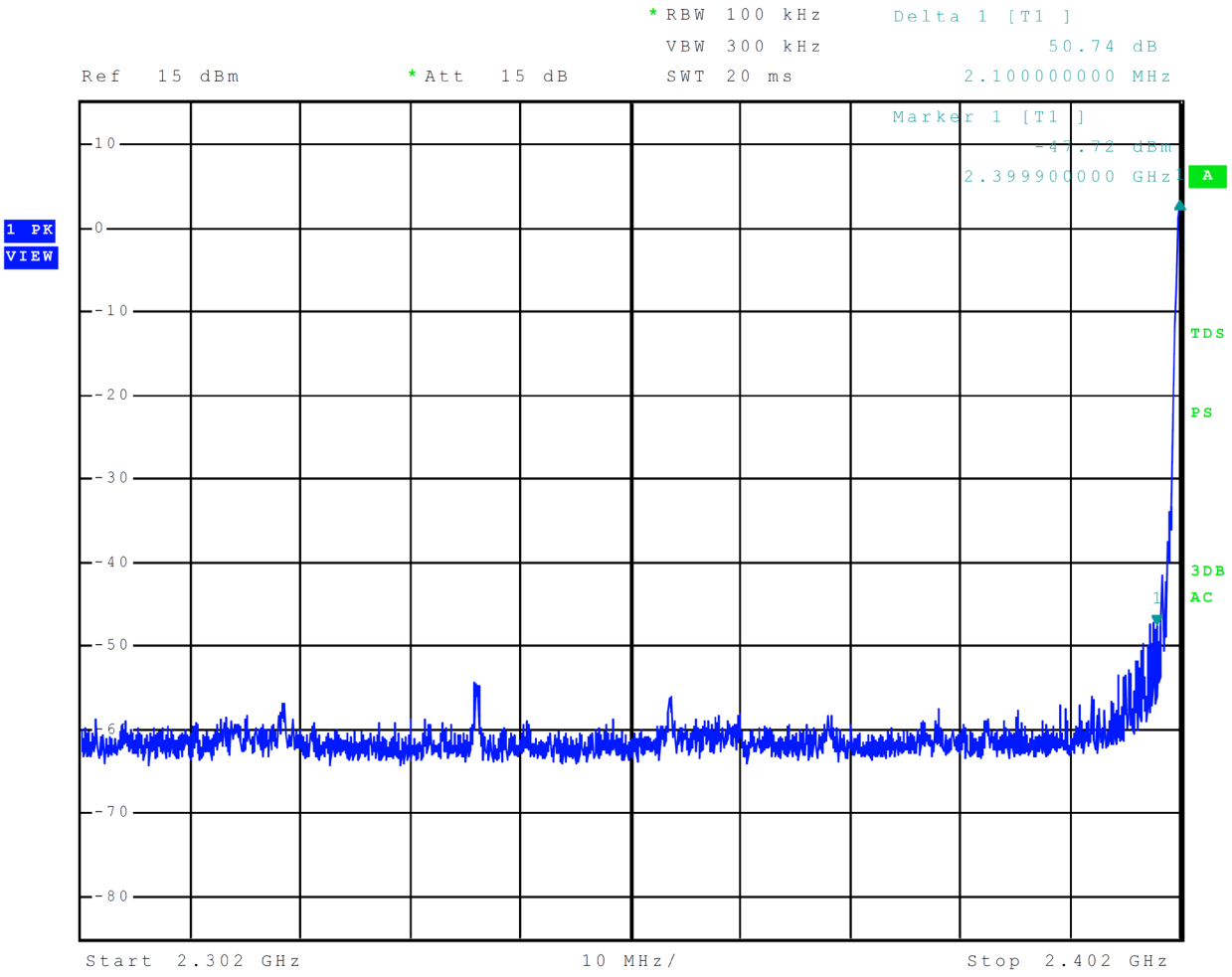


Figure 3 Plot of Transmitter Emissions High Band Edge Mode 1 ANT (GFSK)

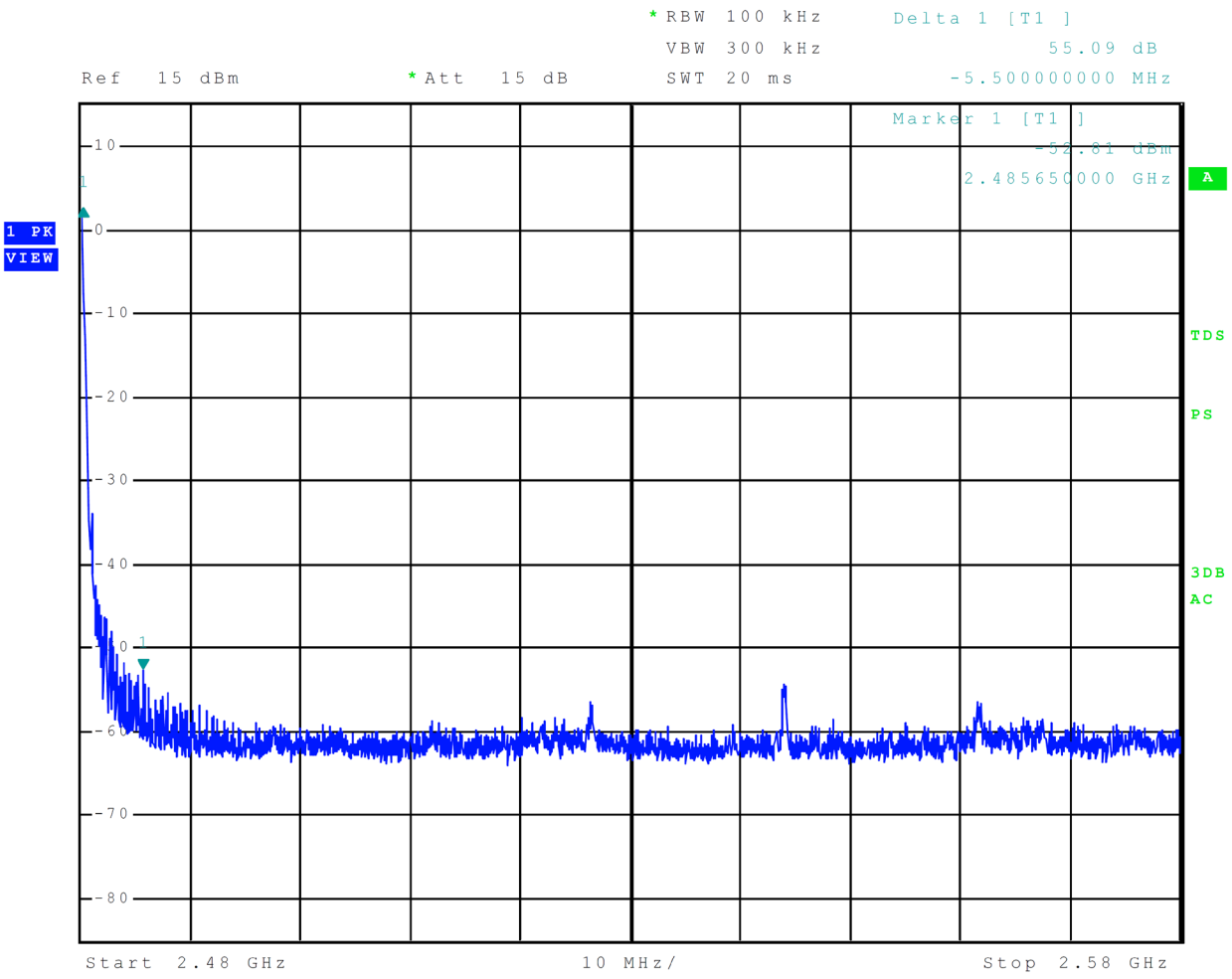
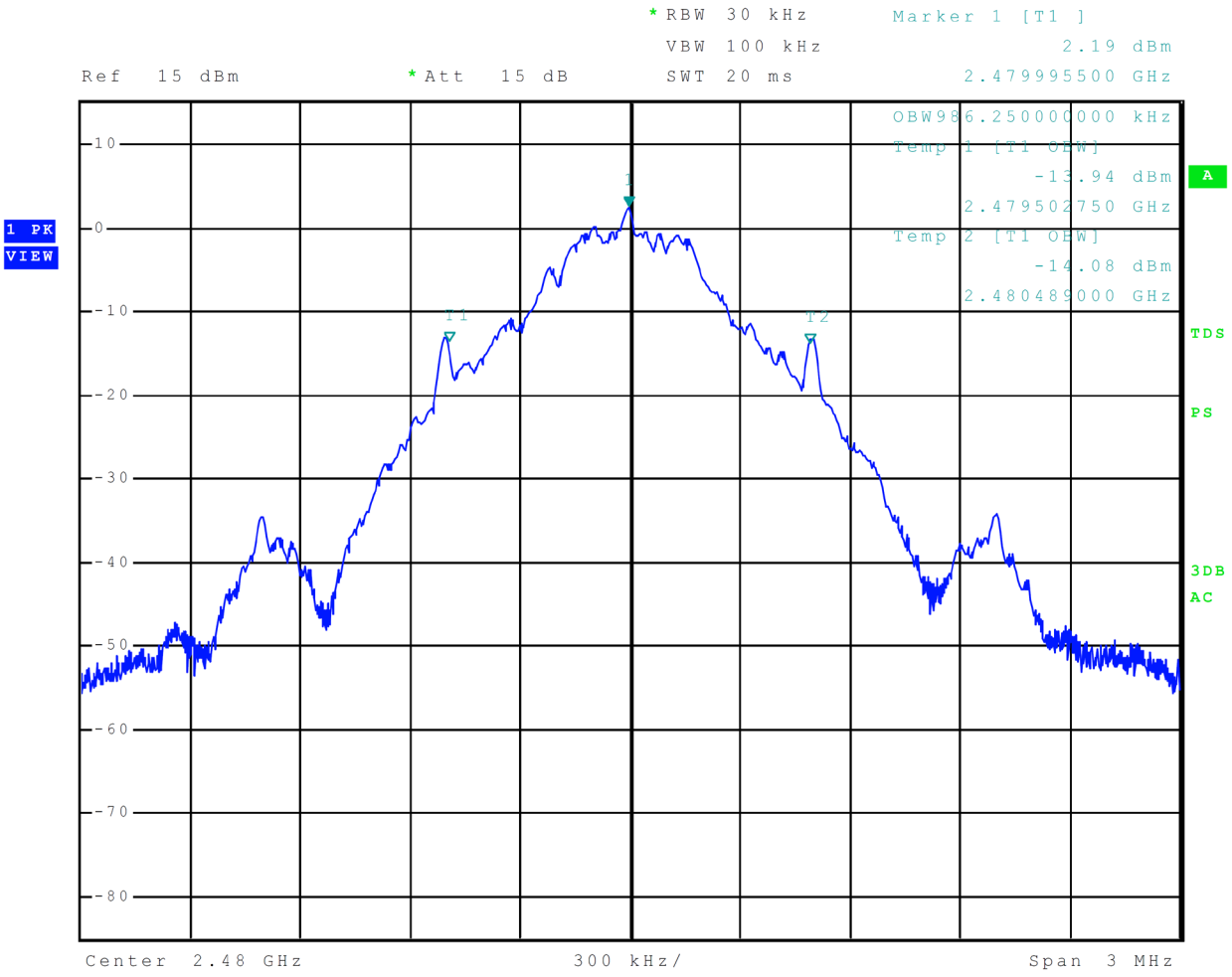


Figure 4 Plot of Transmitter 99% Occupied Bandwidth Mode 1 ANT (GFSK)



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	92.4	90.7	92.9	91.4	94.0	-3.3	-2.6
4804.0	53.5	43.3	51.0	37.8	54.0	-10.7	-16.2
7206.0	54.0	40.5	54.5	40.5	54.0	-13.5	-13.5
9608.0	57.4	44.2	58.1	43.8	54.0	-9.8	-10.2
12010.0	60.9	47.2	60.5	47.0	54.0	-6.8	-7.0
14412.0	61.5	48.3	61.4	48.4	54.0	-5.7	-5.6
16814.0	66.2	51.6	66.4	52.0	54.0	-2.4	-2.0
2457.0	91.8	89.6	95.0	91.7	94.0	-4.4	-2.3
4914.0	52.7	42.1	51.7	38.8	54.0	-11.9	-15.2
7371.0	54.2	40.4	53.7	40.4	54.0	-13.6	-13.6
9828.0	57.1	44.2	57.4	44.2	54.0	-9.8	-9.8
12285.0	61.3	48.1	61.5	48.1	54.0	-5.9	-5.9
14742.0	62.6	49.4	63.2	49.5	54.0	-4.6	-4.5
17199.0	64.0	51.4	64.6	51.4	54.0	-2.6	-2.6
2480.0	90.5	89.5	92.2	91.2	94.0	-4.5	-2.8
4960.0	52.8	43.5	51.0	37.9	54.0	-10.5	-16.1
7440.0	54.5	40.6	53.8	40.7	54.0	-13.4	-13.3
9920.0	57.6	44.0	57.3	44.0	54.0	-10.0	-10.0
12400.0	60.6	47.6	60.7	47.5	54.0	-6.4	-6.5
14880.0	62.0	49.1	62.6	49.1	54.0	-4.9	-4.9
17360.0	66.3	52.1	65.6	52.0	54.0	-1.9	-2.0

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 47CFR Part 15.249, Industry Canada RSS-210 Issue 10, and RSS-GEN Issue 5 Intentional Radiator regulations. The EUT worst-case test sample configuration demonstrated minimum average margin of -2.3 dB below the average emission limit for the fundamental. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -1.9 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. The results 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	3/28/2023	3/28/2024
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				3/28/2023	3/28/2024
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/11/2022	10/11/2023
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/11/2022	10/11/2023
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/11/2022	10/11/2023
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/11/2022	10/11/2023
☐ Antenna:	EMCO	6509	.001-30 MHz	10/14/2020	10/11/2023
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/11/2022	10/11/2023
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/11/2022	10/11/2023
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	10/11/2022	10/11/2024
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/28/2022	3/29/2024
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/11/2022	10/11/2024
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	3/27/2023	3/27/2025
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	6/26/2023	6/26/2024
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/25/2023	1/25/2024
☐ 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	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/11/2022	10/11/2023
☐ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	8/31/2022	8/31/2023
☐ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/28/2023	3/28/2025
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/28/2023	3/28/2024
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/28/2023	3/28/2024
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	3/28/2023	3/28/2025
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/28/2023	3/28/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/28/2023	3/28/2024
☒ Weather station	Davis	6312 (A81120N075)		10/11/2022	10/11/2023

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List of Test Equipment			Calibration Date (m/d/y)	Due
☐ Frequency Counter: Leader LDC-825 (8060153			3/28/2023	3/28/2025
☐ ISN:	Com-Power Model ISN T-8		3/28/2023	3/28/2024
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126) .15-30MHz	10/11/2022	10/11/2024
☐ LISN:	Com-Power Model LI-220A		3/29/2023	3/29/2025
☐ LISN:	Com-Power Model LI-550C		10/11/2022	10/11/2024
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Time Microwave	4M-750HF290-750 (4M) 9kHz-24 GHz	10/11/2022	10/11/2023
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ Analyzer	HP	8562A (3051A05950) 9kHz-125GHz	3/28/2023	3/28/2024
☐ Wave Form Generator Keysight		33512B (MY57400128)	3/29/2022	3/29/2024
☐ Antenna:	Solar 9229-1 & 9230-1		2/18/2023	2/18/2024
☐ CDN:	Com-Power Model CDN325E		10/11/2022	10/11/2024
☐ Oscilloscope Scope: Tektronix MDO 4104			2/18/2023	2/18/2024
☐ EMC Transient Generator HVT TR 3000			2/18/2023	2/18/2024
☐ AC Power Source (Ametech, California Instruments)			2/18/2023	2/18/2024
☐ Field Intensity Meter: EFM-018			2/18/2023	2/18/2024
☐ ESD Simulator: MZ-15			2/18/2023	2/18/2024
☐ Injection Clamp Luthi Model EM101			not required	
☐ R.F. Power Amp ACS 230-50W			not required	
☐ R.F. Power Amp EIN Model: A301			not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7			not required	
☐ R.F. Power Amp A.R. Model: 50U1000			not required	
☐ Temperature Chamber			not required	
☒ Shielded Room			not required	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 37 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.

Electrical Engineer: Rogers Consulting Labs, Inc.

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).

2023-03-16 through 2024-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

NVLAP Lab Code 200087-0

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

Application For Grant of Certification

47CFR Paragraph 15.247 FHSS and
Industry Canada RSS-GEN Issue 5 and RSS-247 Issue 2

Model: 04277

2402-2480 MHz (DSSS)
Frequency Hopping Spread Spectrum
License Exempt Intentional Radiator

FCC ID: IPH-04277
IC: 1792A-04277

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

FCC Designation: US5305
ISED Registration: 3041A

Test Report Number: 230404

Test Date: April 4 to August 4, 2023

Authorized Signatory: Scot D Rogers
Scot D. Rogers

Revisions

Revision 1 Issued Issued September 1, 2023

Executive Summary

License Exempt Digital Transmission System Intentional Radiator operating under Title 47 of the Code of Federal Regulations (47CFR) Paragraph 15.247 and Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5, Frequency Hopping Spread Spectrum (FHSS) or Direct Sequence Spread Spectrum (DSS) transmitter operations in the 2400-2483.5 MHz frequency band.

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

PMN: A04277, B04277, C04277, D04277

FCC ID: IPH-04277 IC: 1792A-04277

Operating Frequency Range: 2402-2480 MHz

Operation Direct Sequence Spread Spectrum (DSS) communication mode 2

D04277 was chosen for transmitter configuration testing and used for final measurements.

Mode	Antenna Port Conducted Power Watts	99% OBW (kHz)	20-dB OBW (kHz)
Mode 2, BT BR (GFSK)	0.008	964.5	1,048.1

This report addresses EUT Operations as Direct Sequence Spread Spectrum Transmitter using transmitter modulation in mode 2. Note, the production device utilizes integral non-user accessible antenna system providing 5.7 dBi gain.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47CFR 15.205, RSS-210 4.1	-5.4	Complies
Emissions as per 47CFR 15.207, RSS-GEN 8.8	N/A	Complies
Radiated Emissions 47CFR 15.209, RSS-GEN 8.9	-0.9	Complies
Harmonic Emissions per 47CFR 15.247, RSS-247	-0.8	Complies

Tests performed include
47CFR
§15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20-dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20-dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(c) Operation with directional antenna gains greater than 6 dBi.

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 Issue 2

5.1 Frequency hopping systems (FHS)

FHSs employ a spread spectrum technology in which the carrier is modulated with coded information in a conventional manner, causing a conventional spreading of the radio frequency (RF) energy around the carrier frequency. The carrier frequency is not fixed, but changes at fixed intervals under the direction of a coded sequence.

FHSs are not required to employ all available hopping frequencies during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the requirements in this section in case the transmitter is presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of frequency hopping equipment and must distribute its transmissions over the minimum number of hopping channels specified in this section.

Incorporation of intelligence into an FHS that enables it to recognize other users of the band and to avoid occupied frequencies is permitted provided that the FHS does it individually and independently chooses or adapts its hopset. The coordination of FHSs in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

The following applies to FHSs in each of the three bands:

a) The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. The system's radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

b) FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

c) For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

d)FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

e)FHSs operating in the band 5725-5850 MHz shall use at least 75 hopping channels. The maximum20 dB bandwidth of the hopping channel shall be 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30-second period.

NVLAP Lab Code 200087-0

Equipment Tested

Model: 04277

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

Equipment	Model / PN	Serial Number
EUT Tx Radiated	D04277	85W000016
EUT General Emissions	D04277	85W000016
EUT Antenna Port Conducted	D04277	3438712904
DC power Cable (<80cm)	Garmin 2-pin	N/A
DC power Cable (2cm)	Garmin 2-pin	N/A
Garmin Network Switch	011-05723-00	3378916849
5-pin NMEA 2000 Cable	Garmin NMEA Cable	N/A
Temperature Sensor	GTEMP10-TH	4QM000022
External SIM Card Reader	Garmin Card Reader	N/A
Garmin HDMI Cable	Garmin HDMI Cable	N/A
Garmin CVBS Cable	Garmin HDMI Cable	N/A
Garmin Network Cable (6m)	320-00372-03	N/A
FireStick	E9L29Y	N/A
FireStick	E9L29Y	N/A
DC power Cable (2.3m)	Garmin 2-pin	N/A
DC Power Supply	BK 1745	209C13

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

Software: 31.65, Antenna: 2.4 GHz non-user accessible providing 5.7 dBi gain

Equipment Operational Modes

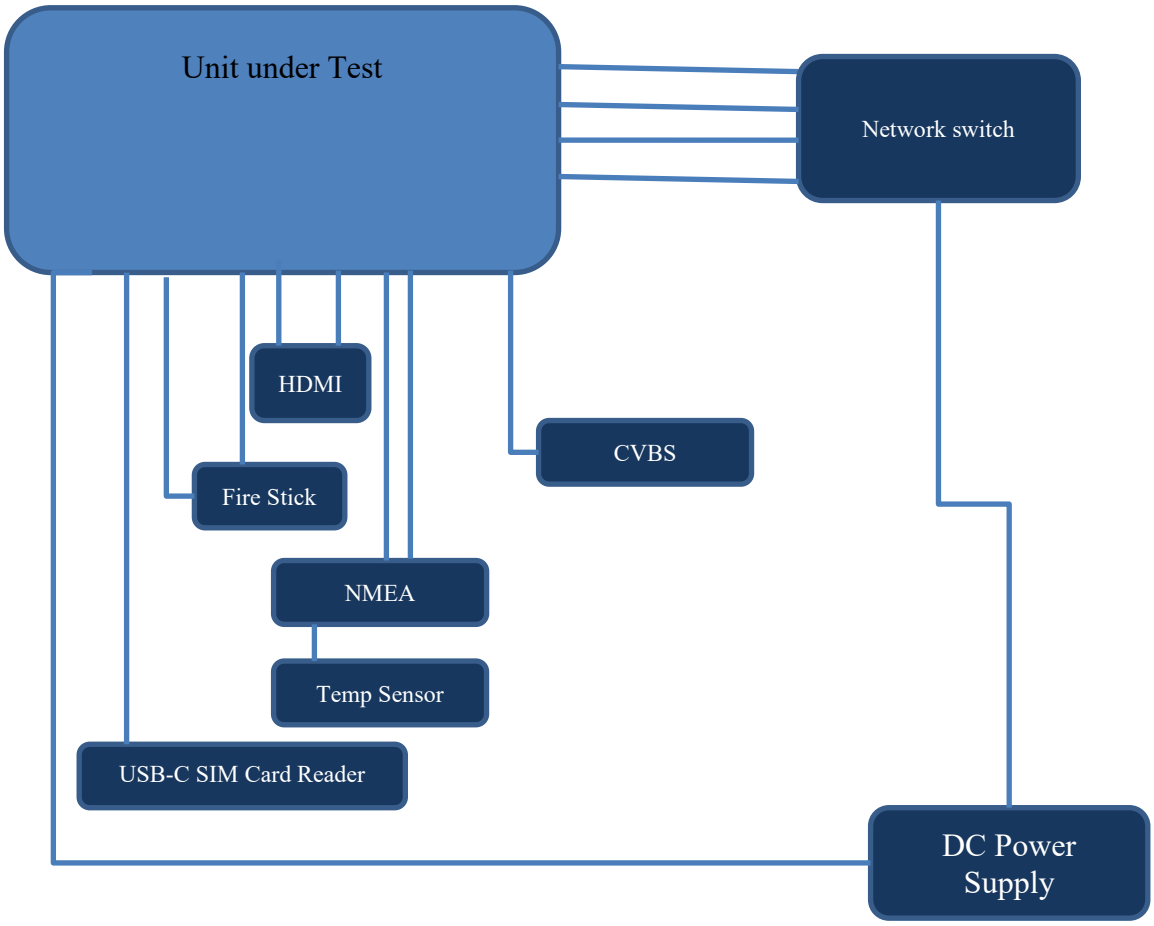
Mode	Transmitter Operation
1	ANT (GFSK)
2	BT BR (GFSK)
3	BT 2EDR (π/4-DQPSK)
4	BT 3EDR (8DPSK)
5	BT BLE (GMSK)
6	802.11b (DSSS/CCK)
7	802.11g, (OFDM)
8	802.11n (MCS)

Equipment Function

The EUT is a Control Panel Display with RF and wired communication capability. The unit provides touchscreen graphical display for the user interface. The design incorporates transmitter circuitry operating in the 2402-2480 MHz frequency band. The typical use configuration has the EUT and powered from direct current power. The design provides interface capability as presented below and wireless communications with compatible equipment. The design contains four collocated transmitters each providing specific functionality. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interface connections than those presented in the configuration options as described by the manufacturer and presented below. For testing purposes, the EUT received power from external direct current power supply. During testing, the test system was configured to operate in a manufacturer defined modes. The manufacturer provided test software for testing transmitter and equipment function. The software provided the ability to operate the transmitters at near 100% duty cycle for testing purposes. The testing mode of operation exceeds typical duty cycle operation of production equipment. As requested by the manufacturer the equipment was

tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration



NVLAP Lab Code 200087-0

Application for Certification

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

(2) Identification: HVIN: 04277
FCC ID: IPH-04277 IC: 1792A-04277

(3) Instruction Book:
Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:
Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:
Refer to Exhibit of Operational Description.

(6) Report of Measurements:
Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:
Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from external direct current power provided from installation vehicle. The EUT provides interface ports for power, loads and communications as presented in this filing.

(9) Transition Provisions of 47CFR 15.37 are not requested.

(10) Not Applicable. The unit is not a scanning receiver.

(11) Not Applicable. The EUT does not operate in the 59 – 64 GHz frequency band.

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

(13) Applications for certification of U-NII devices in the 5.15-5.35 GHz and the 5.47-5.85 GHz bands must include a high-level operational description of the security procedures that control the radio frequency operating parameters and ensure that unauthorized modifications cannot be made. This requirement is not applicable to his DTS device.

(14) Contain at least one drawing or photograph showing the test set-up for each of the required types of tests applicable to the device for which certification is requested. These drawings or photographs must show enough detail to confirm other information contained in the test report. Any photographs used must be focused originals without glare or dark spots and must clearly show the test configuration used. This information is provided in this report and Test Setup Exhibits provided with the application filing.

Applicable Standards

The following information is submitted in accordance with the eCFR (electronic Title 47 Code of Federal Regulations) (47CFR), dated August 4, 2023: Part 2, Subpart J, Part 15C Paragraph 15.247, RSS-247 Issue 2, 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 Frequency Hopping Spread Spectrum (DSS) Transmitter.

Equipment Testing Procedures

AC Line Conducted Emission Test Procedure

The design operates from Direct Current power only and offers no provision to interface with Utility AC Power systems. Therefore, No AC Line conducted emissions testing was required or preformed.

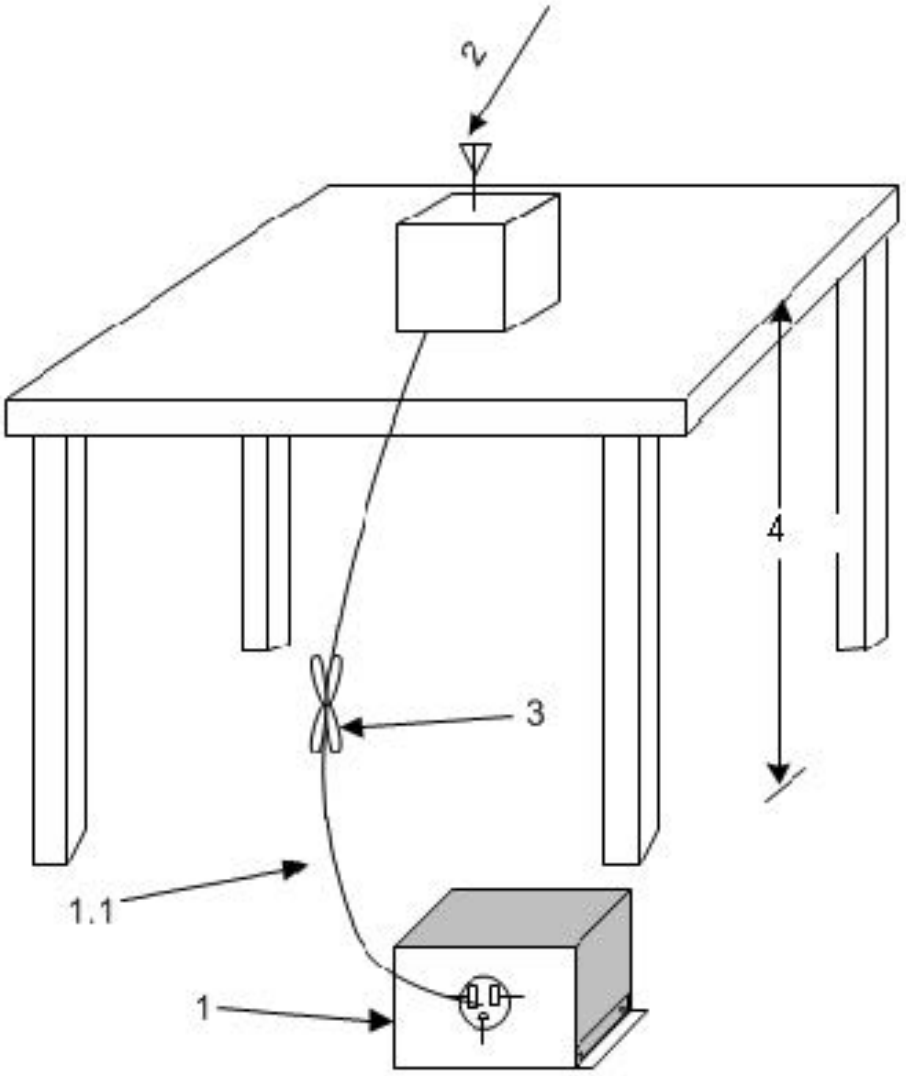
Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 Issue 2, RSS-GEN 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 and 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 as presented in this document 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 four showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

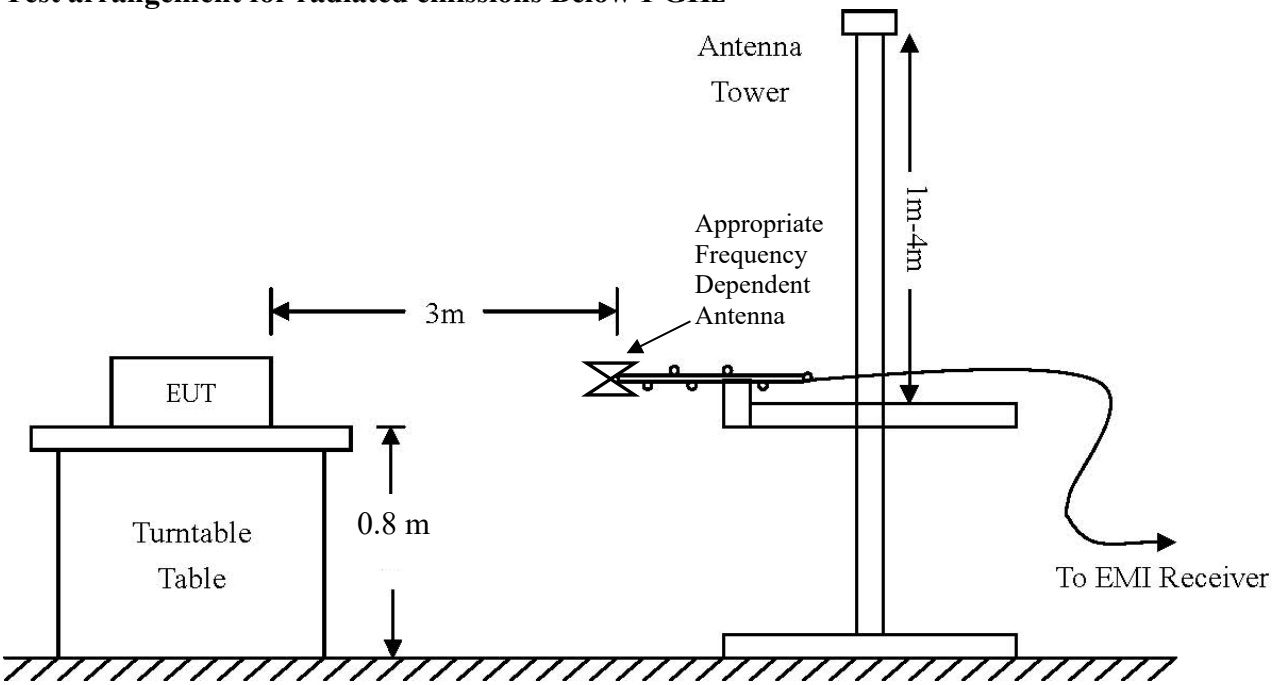
Diagram 1 Test arrangement for radiated emissions of tabletop equipment



1—A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).
1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.
2—Antenna can be integral or detachable, depending on the EUT (see 6.3.1).
3—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.3.1).
4—For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

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

Test arrangement for radiated emissions Below 1 GHz



Test arrangement for radiated emissions Above 1 GHz

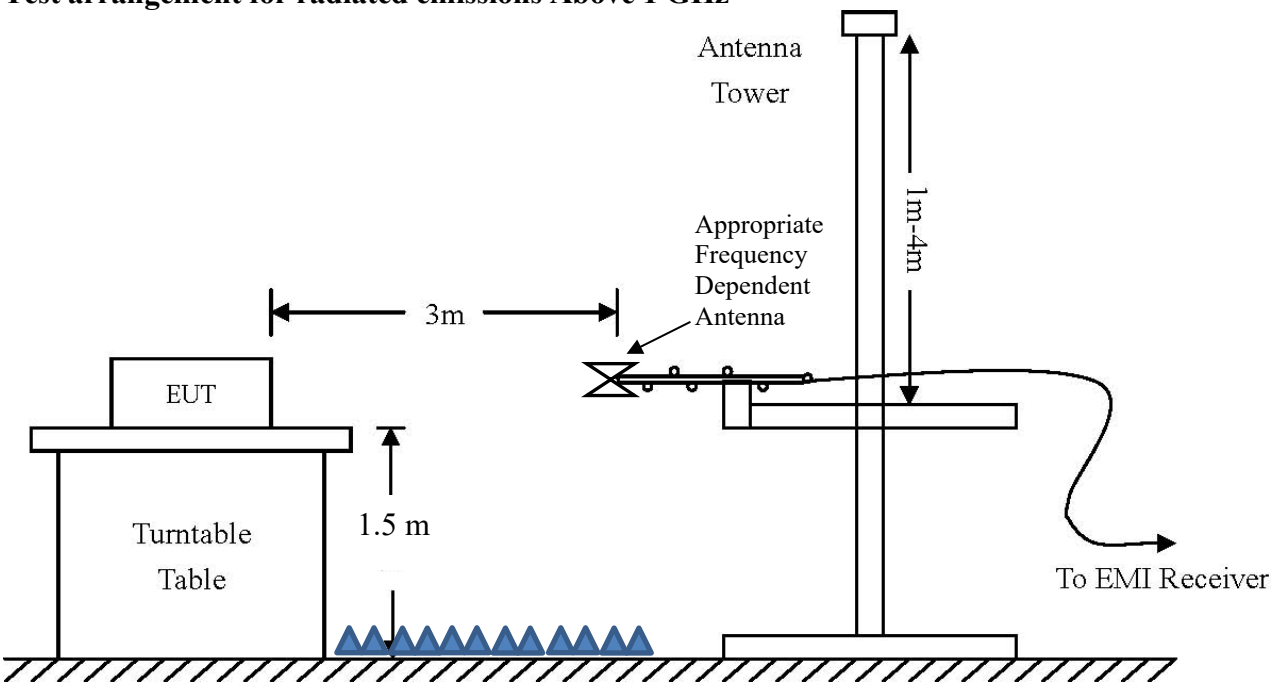
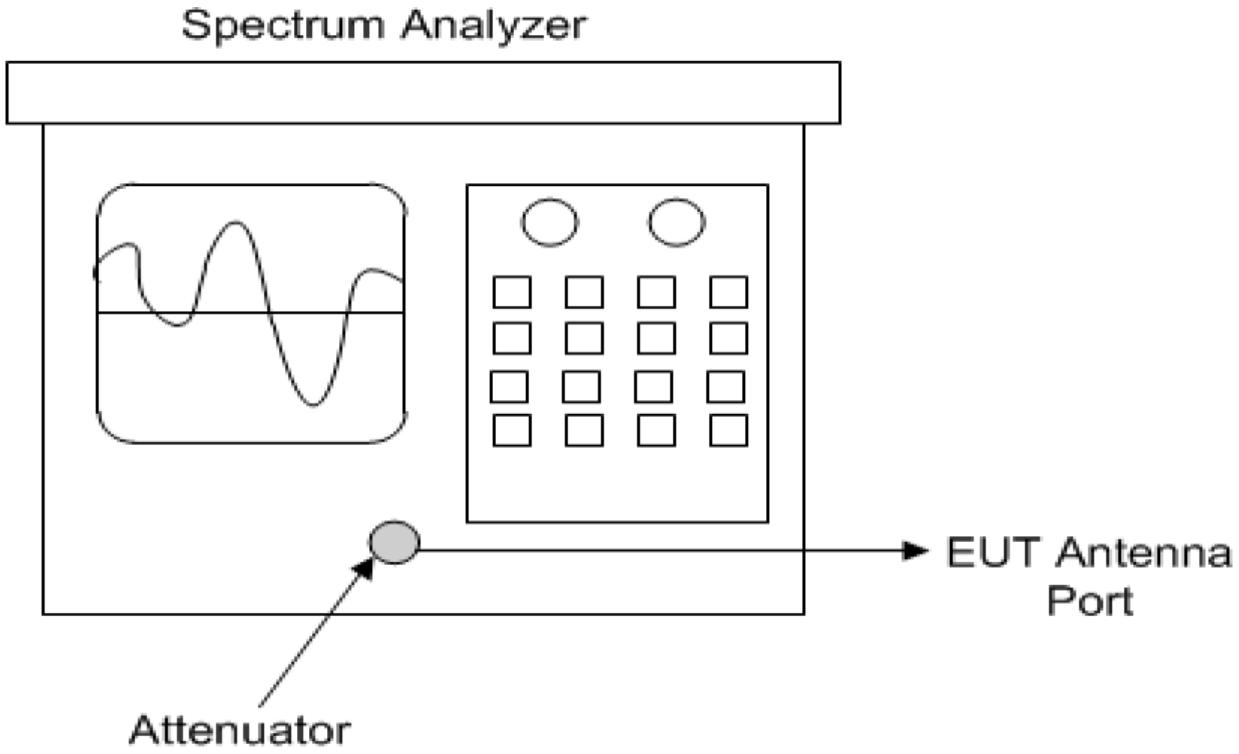


Diagram 3 Test arrangement for Antenna Port Conducted emissions



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 19.8 - 21.7° C

Relative Humidity 31 - 38.0 %

Atmospheric Pressure 1012.3 – 1033.7 mb

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the 47CFR Part 15C, Industry Canada RSS-247 Issue 2, 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 47CFR, Subpart C, paragraph 15.247, Industry Canada RSS-247 Issue 2, and RSS-GEN Issue 5.

Antenna Requirements

The EUT incorporates integral non-user accessible 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 2, BT BR

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	44.7	30.7	44.5	31.0	54.0	-23.3	-23.0
2483.5	47.4	31.7	70.2	33.2	54.0	-22.3	-20.8
4804.0	50.4	36.7	51.0	37.5	54.0	-17.3	-16.5
4882.0	50.8	37.3	51.1	37.2	54.0	-16.7	-16.8
4960.0	51.2	37.7	50.4	37.0	54.0	-16.3	-17.0
7206.0	53.6	40.7	53.8	40.1	54.0	-13.3	-13.9
7323.0	53.7	40.1	53.6	40.0	54.0	-13.9	-14.0
7440.0	58.0	48.6	53.2	40.3	54.0	-5.4	-13.7
12010.0	61.0	47.2	60.1	46.6	54.0	-6.8	-7.4
12205.0	60.8	48.0	61.2	48.0	54.0	-6.0	-6.0
12400.0	60.5	47.6	61.6	47.5	54.0	-6.4	-6.5

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C and RSS-247 Issue 2 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -5.4 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 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 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)
77.5	40.8	35.3	36.4	31.6	40.0	-4.7	-8.4
129.4	41.0	38.2	41.5	38.5	43.5	-5.3	-5.0
168.1	39.7	37.3	39.8	37.8	43.5	-6.2	-5.7
199.6	36.0	30.2	34.3	29.8	43.5	-13.3	-13.7
204.8	38.1	33.3	37.0	32.5	43.5	-10.2	-11.0
215.6	44.7	39.9	41.7	37.2	43.5	-3.6	-6.3
215.7	40.6	36.0	42.6	38.1	43.5	-7.5	-5.4
219.3	47.6	43.5	43.4	38.7	46.0	-2.5	-7.3
221.0	48.1	39.7	39.7	35.8	46.0	-6.3	-10.2
221.0	44.5	40.3	46.0	41.2	46.0	-5.7	-4.8
224.0	43.6	38.4	37.9	33.9	46.0	-7.6	-12.1
225.7	45.3	42.3	42.3	37.6	46.0	-3.7	-8.4
225.7	45.6	40.7	44.1	39.5	46.0	-5.3	-6.5
229.6	45.4	41.9	45.5	41.2	46.0	-4.1	-4.8
231.9	42.3	37.8	43.9	39.4	46.0	-8.2	-6.6
250.0	41.4	38.7	38.3	34.8	46.0	-7.3	-11.2
342.1	38.0	32.4	35.2	29.2	46.0	-13.6	-16.8
445.0	38.0	34.8	36.2	32.5	46.0	-11.2	-13.5
476.8	45.2	42.0	42.4	38.5	46.0	-4.0	-7.5
720.0	43.9	39.5	42.3	39.1	46.0	-6.5	-6.9
890.1	44.1	39.5	41.3	35.0	46.0	-6.5	-11.0
891.0	49.1	45.1	45.6	41.4	46.0	-0.9	-4.6

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 47CFR Part 15C paragraph 15.209, RSS-247 Issue 2, and RSS-GEN Issue 5 Intentional Radiators. The EUT configuration demonstrated a minimum margin of -0.9 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

Test procedures of ANSI C63.10-2013 and KDB 558074 D01 15.247 Meas Guidance v05 were used during transmitter testing. The transmitter peak power was measured at the antenna port as described in ANSI C63.10-2013. The 20-dB and 99% emission bandwidths were measured as described in C63.10-2013. The channel separation and the number of hopping channels were measured at the antenna port as described in C63.10-2013. The system utilizes at least 15 channels with average time of occupancy on any channel not exceeding 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. The transmitter radiated spurious and general emissions were measured on an open area test site @ 3 meters. During radiated emissions measurements, the EUT sample #1 was placed on a turntable elevated as required above the ground plane at a distance of 3 meters from the measurement antenna. The amplitude of each emission was then recorded from the measurement results. The test system gains and losses were accounted for in the measurement results presented. 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. Antenna port conducted emission data and plots were taken using test sample #2.

Requirement: Average occupancy time Requirement:

> Average time of occupancy on any channel shall not be greater than 400 mS (0.4 seconds) within a 30 second period (0.4 times the number of hopping channels of 79).

Time on channel: The design resides on channel 300 times in a 30 second period. Transmitting each time for 182.8 µS which equates to an average time of occupancy of (300*182.8 µS) 54.8 mS over 30 seconds.

The 54.8 mS average time of occupancy demonstrates compliance with requirement of less than 400 mS in 30 second period. Additional Frequency Hopping detail may be found in the operational description exhibits.

Refer to figures one through eleven showing plots taken of the 2402-2480 MHz BT BR (GFSK) Frequency Hopping Spread Spectrum operation displaying compliance with the specifications.

Figure 1 Plot of Transmitter Emissions Operation in 2402-2480 MHz Mode 2, BT BR

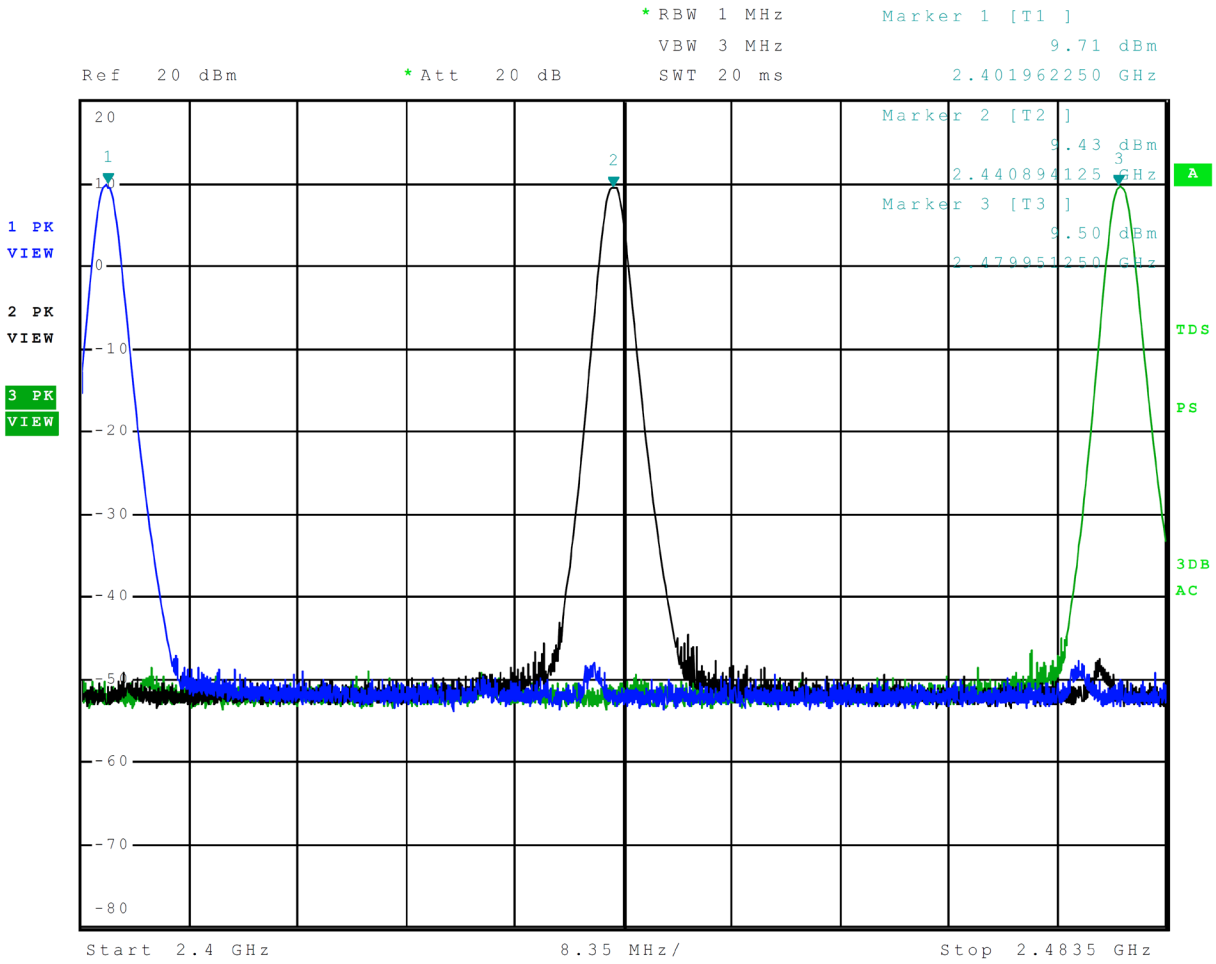


Figure 2 Plot of Transmitter Emissions 20-dB Occupied Bandwidth Mode 2, BT BR

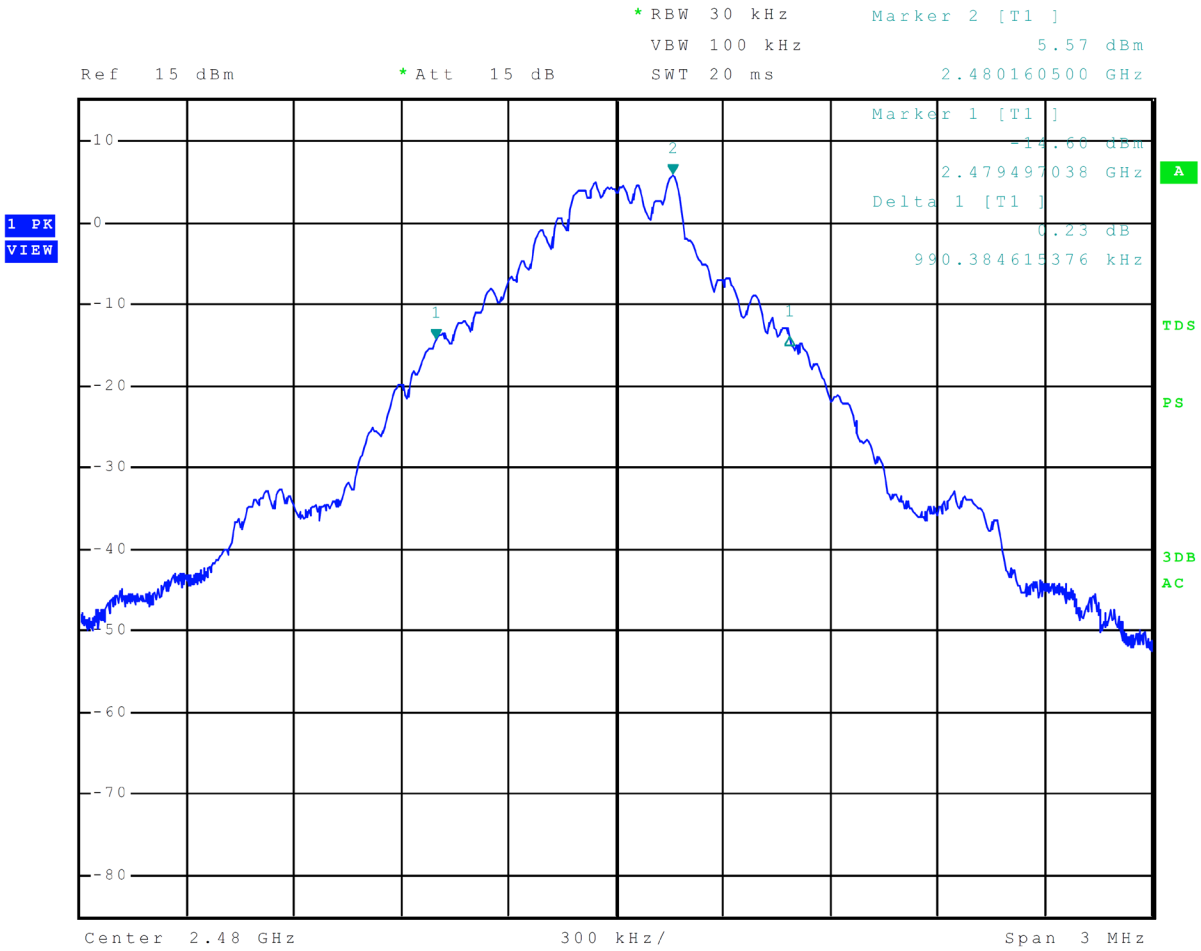


Figure 3 Plot of Transmitter Emissions 99% Occupied Bandwidth Mode 2, BT BR

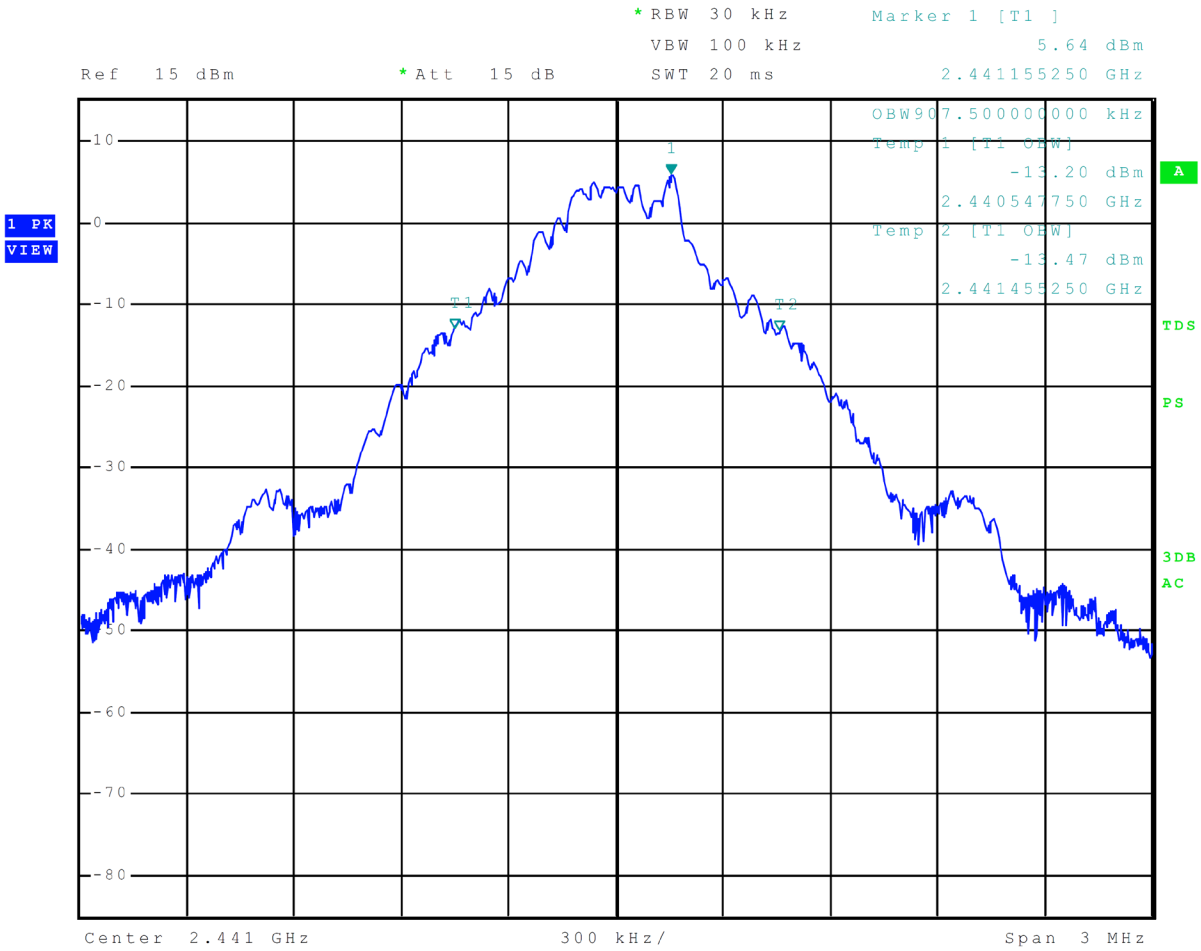


Figure 4 Plot of Number of Hopping Channels Mode 2, BT BR

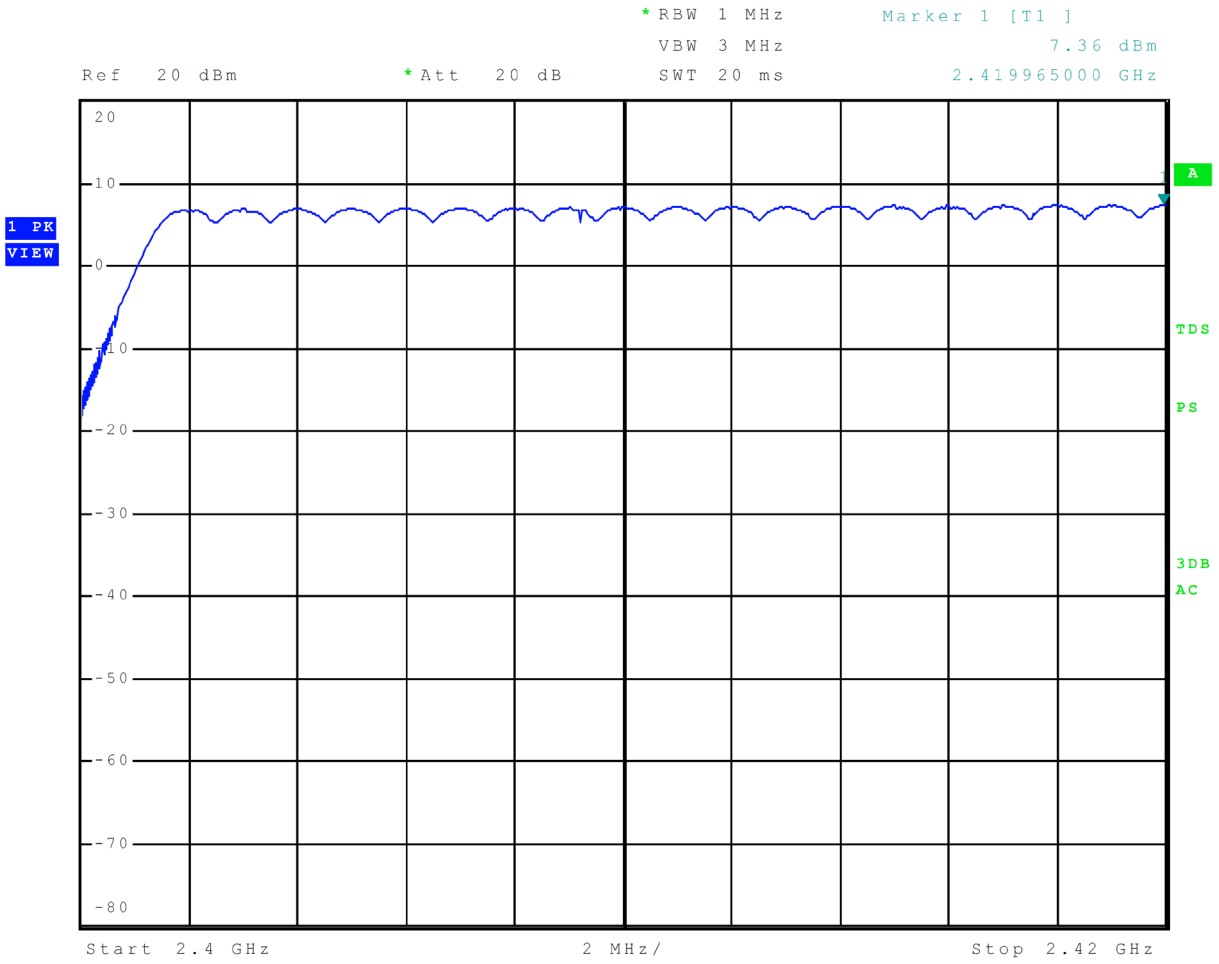


Figure 5 Plot of Number of Hopping Channels Mode 2, BT BR

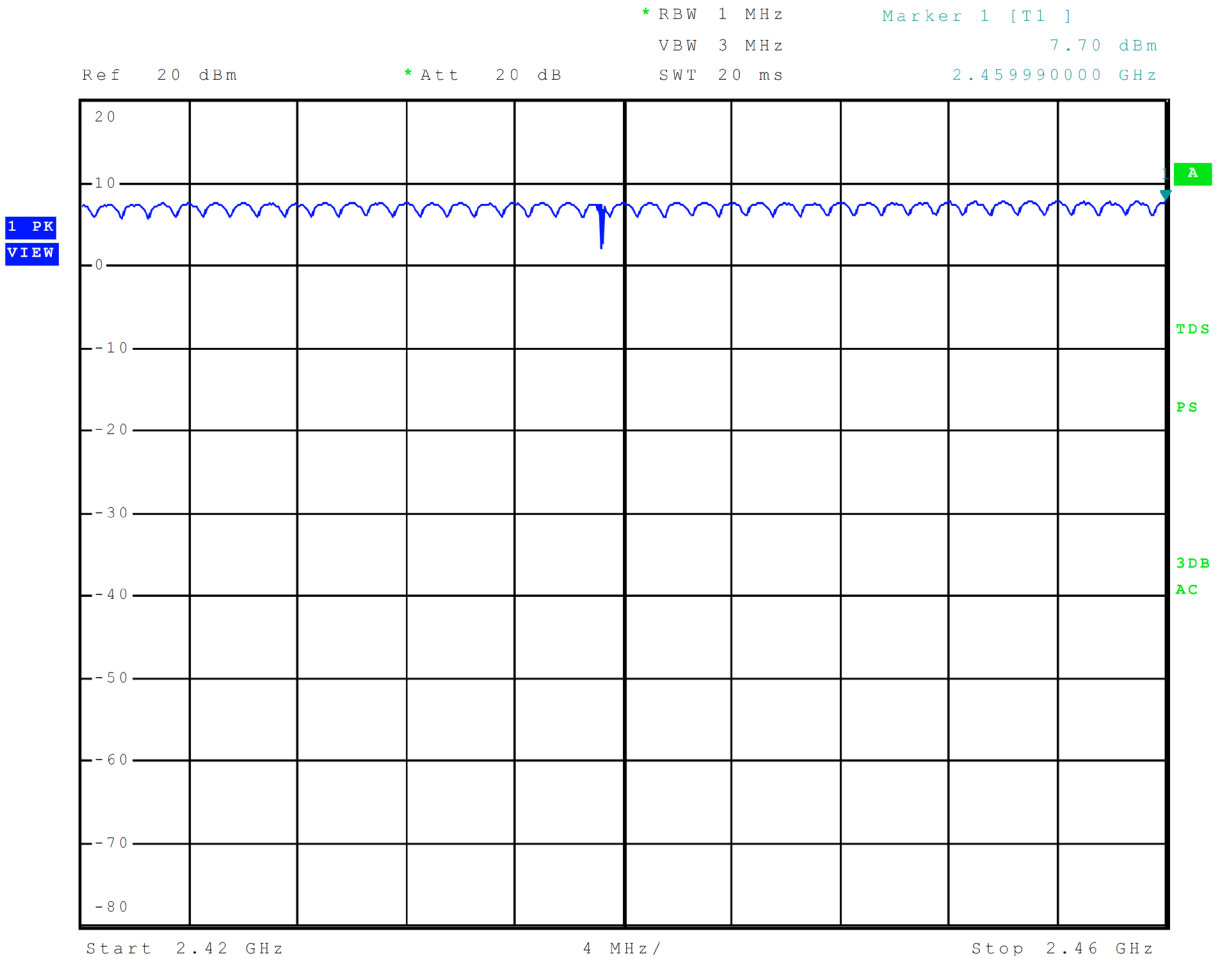


Figure 6 Plot of Number of Hopping Channels Mode 2, BT BR

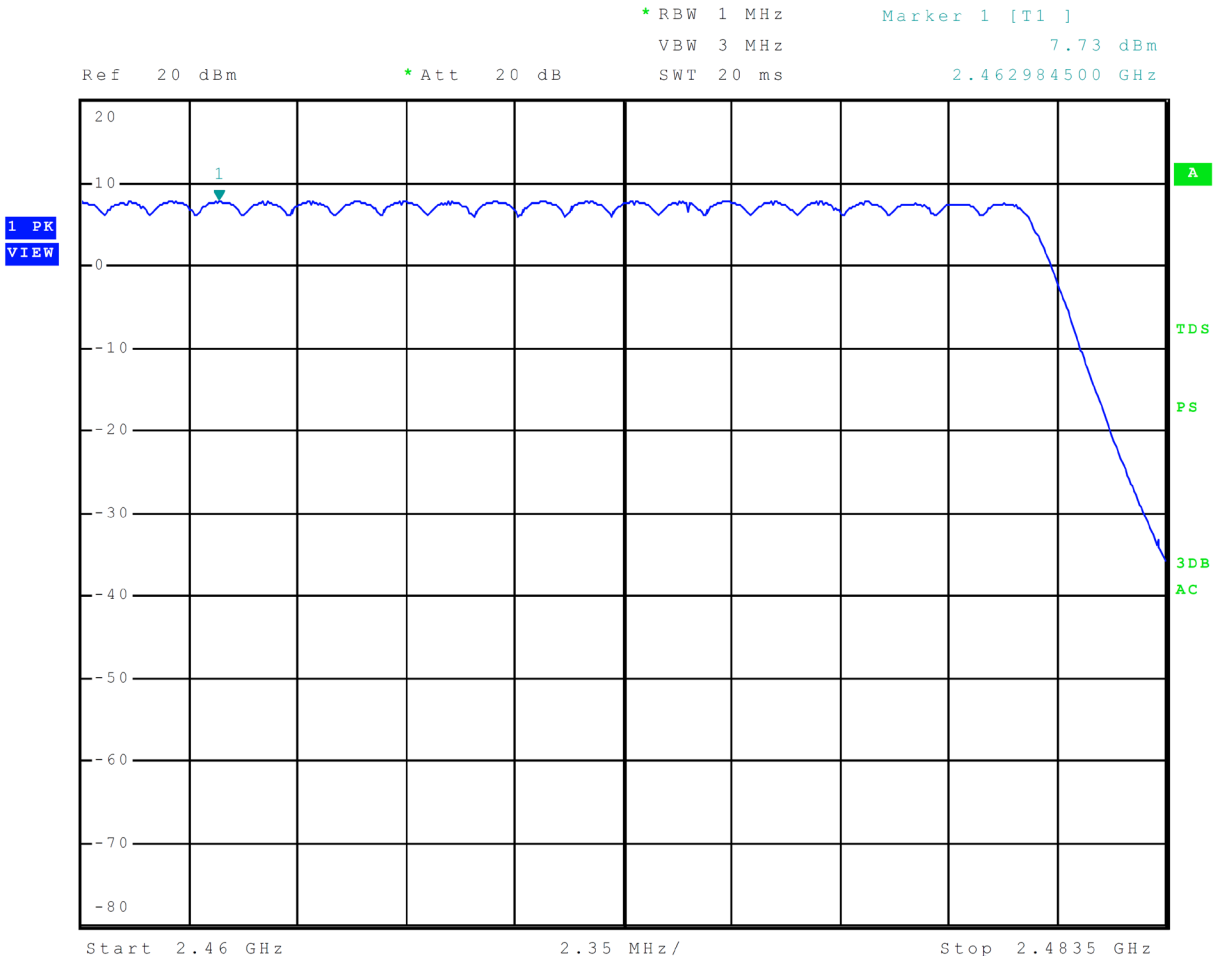


Figure 7 Plot of Channel Separation Mode 2, BT BR

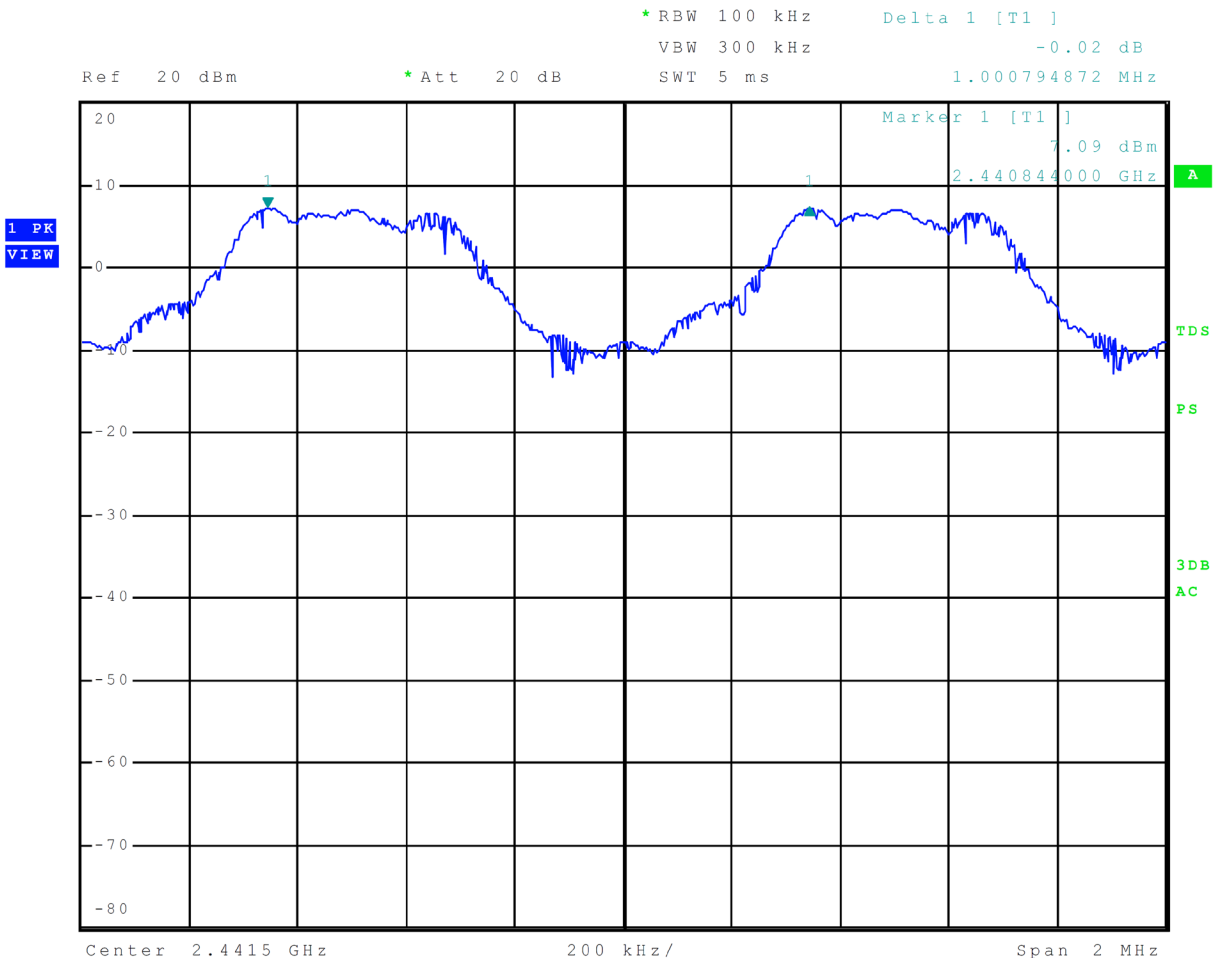


Figure 8 Plot of Dwell time On Channel Mode 2, BT BR

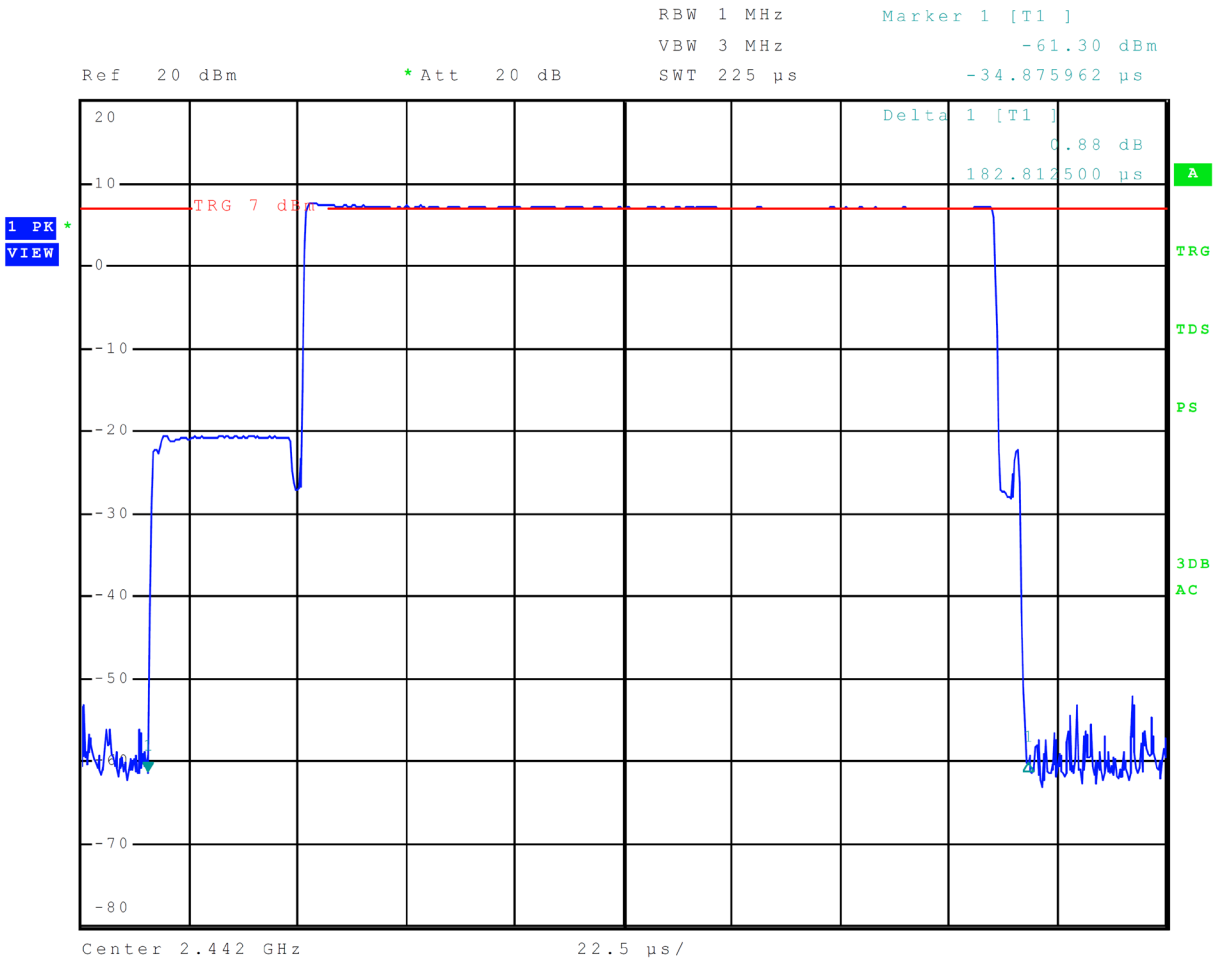


Figure 9 Plot of Number of Times on Channel over 10 Second Period Mode 2, BT BR

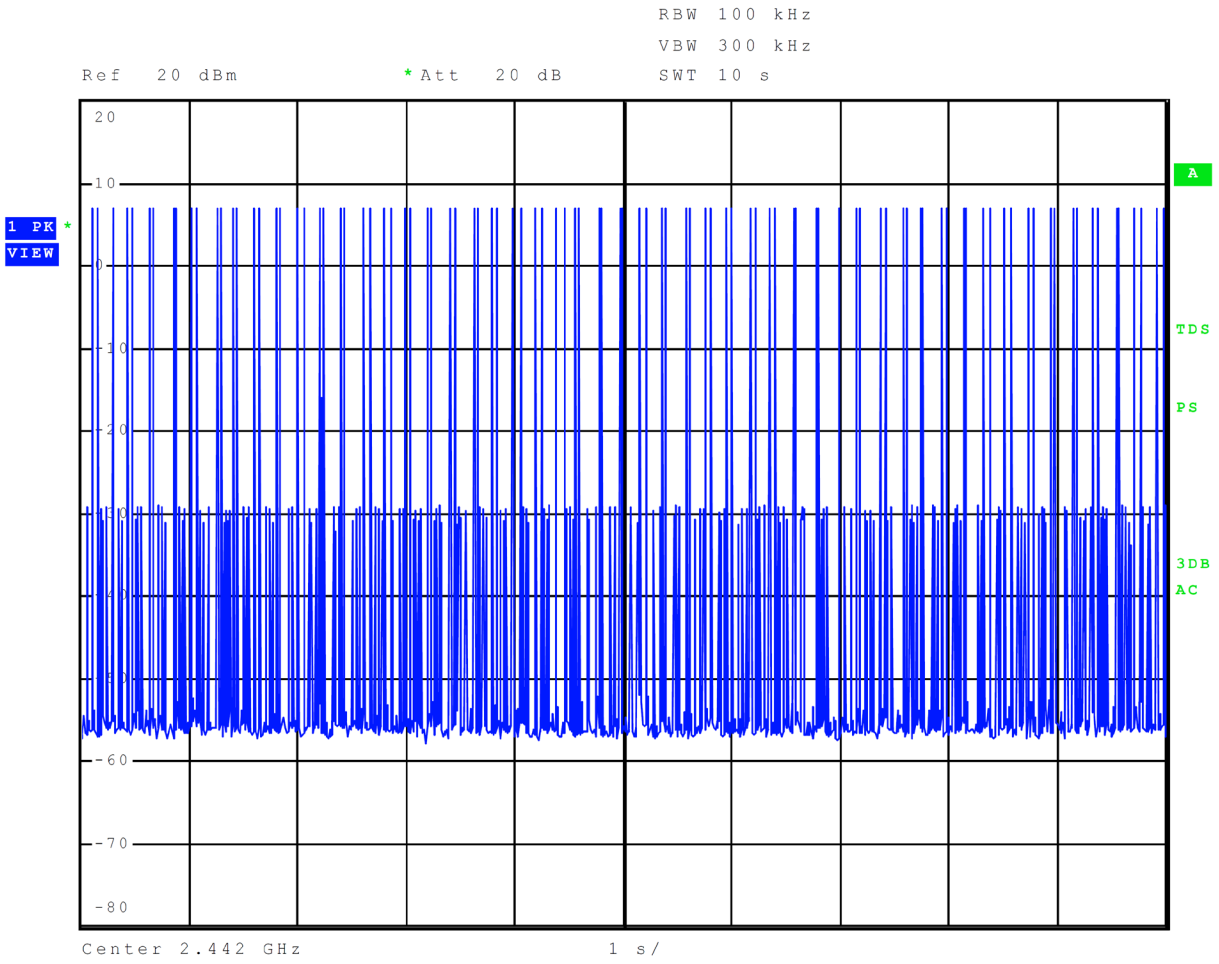


Figure 10 Plot of Transmitter Emissions Low Band Edge Mode 2, BT BR

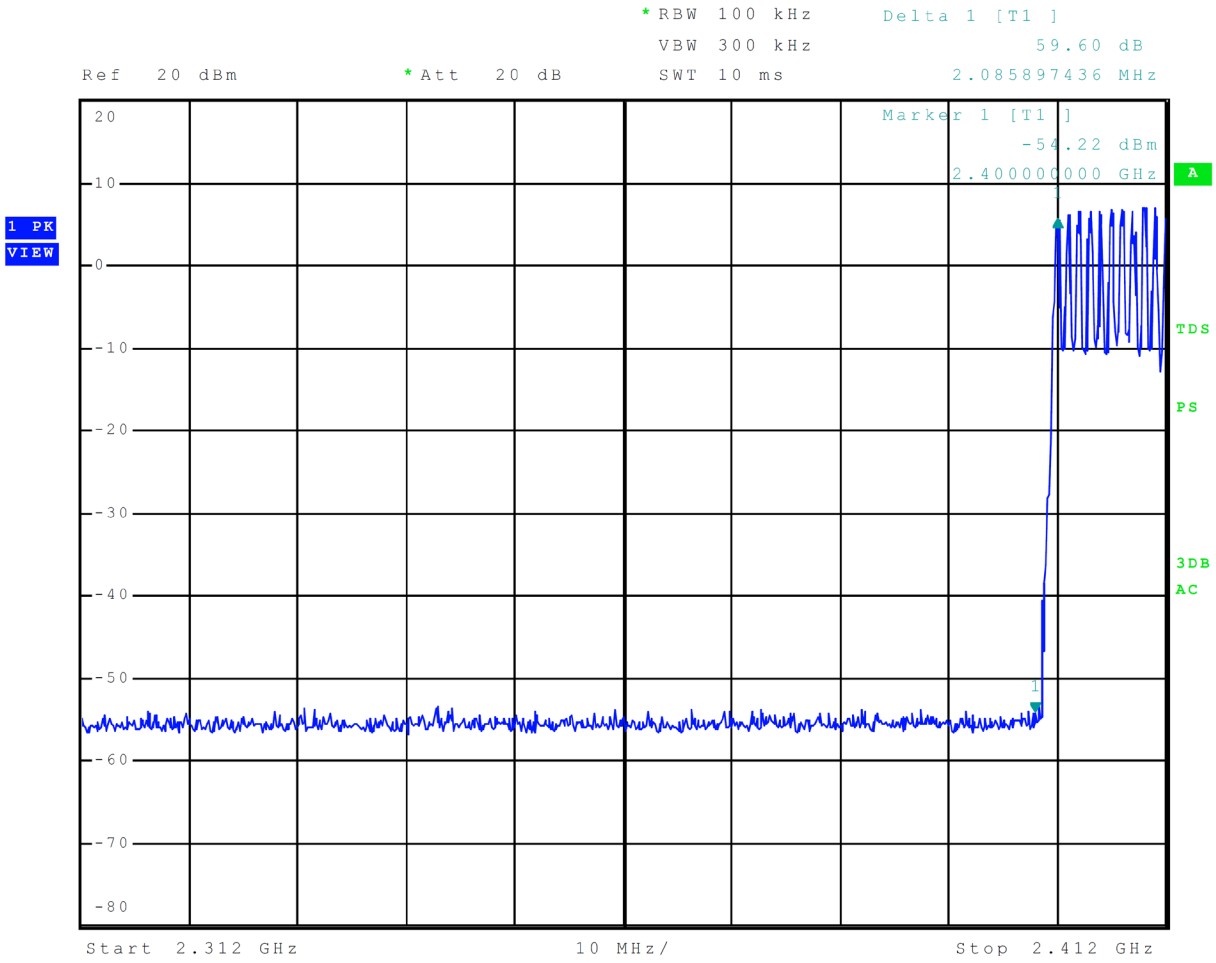
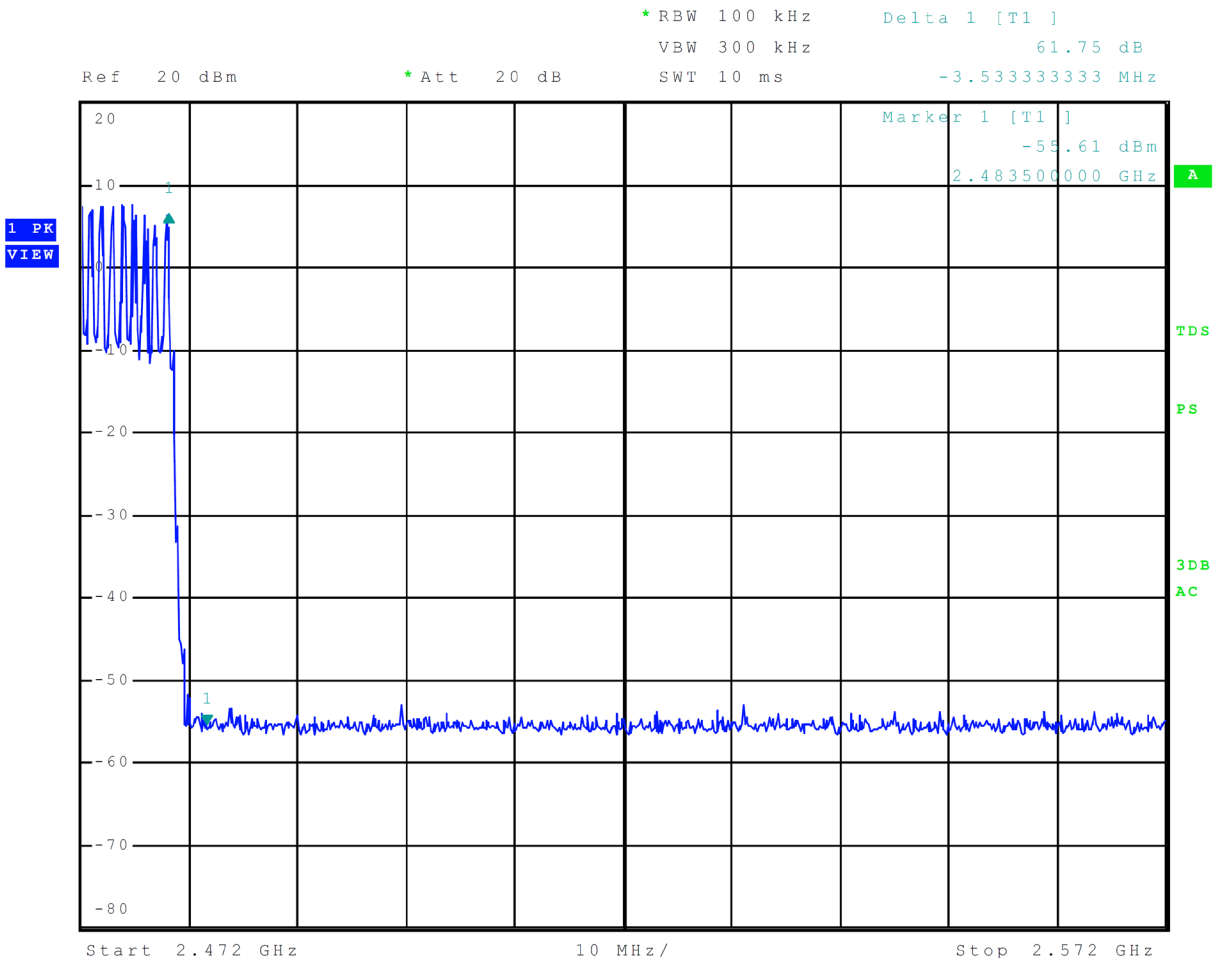


Figure 11 Plot of Transmitter Emissions High Band Edge Mode 2, BT BR



Transmitter Emissions Data

Table 3 Transmitter Radiated Emissions Mode 2, BT BR

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	--	--	--	--	--	--	--
4804.0	50.4	36.7	51.0	37.5	54.0	-17.3	-16.5
7206.0	53.6	40.7	53.8	40.1	54.0	-13.3	-13.9
9608.0	57.6	44.0	58.5	45.1	54.0	-10.0	-8.9
12010.0	61.0	47.2	60.1	46.6	54.0	-6.8	-7.4
14412.0	61.6	48.5	62.6	48.5	54.0	-5.5	-5.5
16814.0	66.1	53.1	66.1	53.2	54.0	-0.9	-0.8
2441.0	--	--	--	--	--	--	--
4882.0	50.8	37.3	51.1	37.2	54.0	-16.7	-16.8
7323.0	53.7	40.1	53.6	40.0	54.0	-13.9	-14.0
9764.0	57.7	44.2	57.3	43.7	54.0	-9.8	-10.3
12205.0	60.8	48.0	61.2	48.0	54.0	-6.0	-6.0
14646.0	63.0	49.3	60.0	47.3	54.0	-4.7	-6.7
17087.0	65.3	52.2	65.3	52.1	54.0	-1.8	-1.9
2480.0	--	--	--	--	--	--	--
4960.0	51.2	37.7	50.4	37.0	54.0	-16.3	-17.0
7440.0	58.0	48.6	53.2	40.3	54.0	-5.4	-13.7
9920.0	58.2	44.1	57.4	44.0	54.0	-9.9	-10.0
12400.0	60.5	47.6	61.6	47.5	54.0	-6.4	-6.5
14880.0	62.5	49.1	61.8	49.1	54.0	-4.9	-4.9
17360.0	65.1	51.9	64.9	51.9	54.0	-2.1	-2.1

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 Transmitter Antenna Port Conducted Data Mode 2, BT BR

Frequency MHz	Antenna Port Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	20-dB Occupied Bandwidth (kHz)
Mode 2, BT BR			
2402	0.006	963.8	1,048.1
2441	0.008	964.5	1,038.5
2480	0.005	963.8	1,048.1

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Paragraph 15.247, Industry Canada RSS-247 Issue 2, and RSS-GEN Issue 5. The antenna port conducted output power measured was 0.008 Watts. The unit utilizes 79 hopping channels with the average time of occupancy less than 0.4 seconds over the required time. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -0.8 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	3/28/2023	3/28/2024
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				3/28/2023	3/28/2024
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/11/2022	10/11/2023
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/11/2022	10/11/2023
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/11/2022	10/11/2023
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/11/2022	10/11/2023
☐ Antenna:	EMCO	6509	.001-30 MHz	10/14/2020	10/11/2023
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/11/2022	10/11/2023
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/11/2022	10/11/2023
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	10/11/2022	10/11/2024
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/28/2022	3/29/2024
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/11/2022	10/11/2024
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	3/27/2023	3/27/2025
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	6/26/2023	6/26/2024
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/25/2023	1/25/2024
☐ 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	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/11/2022	10/11/2023
☐ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	8/31/2022	8/31/2023
☐ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/28/2023	3/28/2025
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/28/2023	3/28/2024
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/28/2023	3/28/2024
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	3/28/2023	3/28/2025
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/28/2023	3/28/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/28/2023	3/28/2024
☒ Weather station	Davis	6312 (A81120N075)		10/11/2022	10/11/2023

List of Test Equipment			Calibration Date (m/d/y)	Due
☐ Frequency Counter: Leader LDC-825 (8060153			3/28/2023	3/28/2025
☐ ISN:	Com-Power Model ISN T-8		3/28/2023	3/28/2024
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126) .15-30MHz	10/11/2022	10/11/2024
☐ LISN:	Com-Power Model LI-220A		3/29/2023	3/29/2025
☐ LISN:	Com-Power Model LI-550C		10/11/2022	10/11/2024
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Time Microwave	4M-750HF290-750 (4M) 9kHz-24 GHz	10/11/2022	10/11/2023
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ Analyzer	HP	8562A (3051A05950) 9kHz-125GHz	3/28/2023	3/28/2024
☐ Wave Form Generator Keysight		33512B (MY57400128)	3/29/2022	3/29/2024
☐ Antenna:	Solar 9229-1 & 9230-1		2/18/2023	2/18/2024
☐ CDN:	Com-Power Model CDN325E		10/11/2022	10/11/2024
☐ Oscilloscope Scope: Tektronix MDO 4104			2/18/2023	2/18/2024
☐ EMC Transient Generator HVT TR 3000			2/18/2023	2/18/2024
☐ AC Power Source (Ametech, California Instruments)			2/18/2023	2/18/2024
☐ Field Intensity Meter: EFM-018			2/18/2023	2/18/2024
☐ ESD Simulator: MZ-15			2/18/2023	2/18/2024
☐ Injection Clamp Luthi Model EM101			not required	
☐ R.F. Power Amp ACS 230-50W			not required	
☐ R.F. Power Amp EIN Model: A301			not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7			not required	
☐ R.F. Power Amp A.R. Model: 50U1000			not required	
☐ Temperature Chamber			not required	
☒ Shielded Room			not required	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 37 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.

Electrical Engineer: Rogers Consulting Labs, Inc.

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background:

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

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

NVLAP Lab Code 200087-0

Annex D 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).

2023-03-16 through 2024-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

NVLAP Lab Code 200087-0

ROGERS LABS, INC.

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

47CFR, PART 15C - Intentional Radiators
47CFR Paragraph 15.247 and
Industry Canada RSS-247 Issue 2 and RSS-GEN Issue 5

Application For Grant of Certification

Model: 04277

2402-2480 and 2412-2462 MHz
Digital Transmission System (DTS)

FCC ID: IPH-04277
IC: 1792A-04277

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062

FCC Designation: US5305
ISED Registration: 3041A

Test Report Number: 230404

Test Date: April 4 to August 4, 2023

Authorized Signatory: Scot D Rogers
Scot D. Rogers

Revisions

Revision 1 Issued Issued September 1, 2023

Executive Summary

The following information is submitted for consideration in obtaining Grant of Certification for License Exempt Digital Transmission System Intentional Radiator operating under Code of Federal Regulations Title 47 (47CFR) Part 15C paragraph 15.247, Industry Canada RSS-247 Issue 2, and RSS-GEN Issue 5, operation in the 2400 – 2483.5 MHz band.

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

PMN: A04277, B04277, C04277, D04277
FCC ID: IPH-04277 IC: 1792A-04277
Frequency Range: operation in the 2402-2480 and 2412-2462 MHz band

D04277 was chosen for transmitter configuration testing and used for final measurements.

Operational communication modes 3 through 8

Mode	Power (Watts)	99% OBW (kHz)	6-dB OBW (kHz)
Mode 3, BT 2EDR (π/4-DQPSK)	0.007	1,227.0	1,067.3
Mode 4, BT 3EDR (8DPSK)	0.007	1,230.0	1,062.5
Mode 5, BT BLE (GMSK)	0.008	1,053.0	719.0
Mode 6, 802.11b (CCK, DSSS)	0.036	10,874.5	7,844.0
Mode 7, 802.11g (OFDM)	0.030	17,280.0	16,397.7
Mode 8, 802.11n (MCS)	0.026	18,350.0	17,618.2

This report addresses EUT Operations as Digital Transmission System using transmitter modulations in modes 3 through 8. Note, the production device utilizes integral non-user accessible antenna systems with 5.7 dBi gain for modes 3, 4, and 5, and.0.9 for modes 6, 7, and 8.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Emissions 15.205, RSS-GEN, RSS-247	-2.9	Complies
Emissions as per 47CFR 15.207, RSS-GEN 8.8	N/A	Complies
Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9	-0.9	Complies
Harmonic Emissions per 47CFR 15.247, RSS-247	-0.9	Complies
Power Spectral Density per 47CFR 15.247, RSS-247	-14.4	Complies

Tests performed include
47CFR
15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one-Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in

accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

RSS-247 Issue 2

5.2 Digital transmission systems

DTS's include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz

a)The minimum 6 dB bandwidth shall be 500 kHz.

b)The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d),(i.e., the power spectral density shall be determined using the same method as is used to determine the conducted output power).

5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.) requirements

d) For DTS's employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

5.5 Unwanted emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

NVLAP Lab Code 200087-0

Equipment Tested

Model: 04277

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

Equipment	Model / PN	Serial Number
EUT Tx Radiated	D04277	85W000016
EUT General Emissions	D04277	85W000016
EUT Antenna Port Conducted	D04277	3438712904
DC power Cable (<80cm)	Garmin 2-pin	N/A
DC power Cable (2cm)	Garmin 2-pin	N/A
Garmin Network Switch	011-05723-00	3378916849
5-pin NMEA 2000 Cable	Garmin NMEA Cable	N/A
Temperature Sensor	GTEMP10-TH	4QM000022
External SIM Card Reader	Garmin Card Reader	N/A
Garmin HDMI Cable	Garmin HDMI Cable	N/A
Garmin CVBS Cable	Garmin HDMI Cable	N/A
Garmin Network Cable (6m)	320-00372-03	N/A
FireStick	E9L29Y	N/A
FireStick	E9L29Y	N/A
DC power Cable (2.3m)	Garmin 2-pin	N/A
DC Power Supply	BK 1745	209C13

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

Software: 31.65, Antenna: the production device utilizes integral non-user accessible antenna systems with 5.7 dBi gain for modes 3, 4, and 5, and.0.9 dBi gain for modes 6, 7, and 8.

Equipment Operational Modes

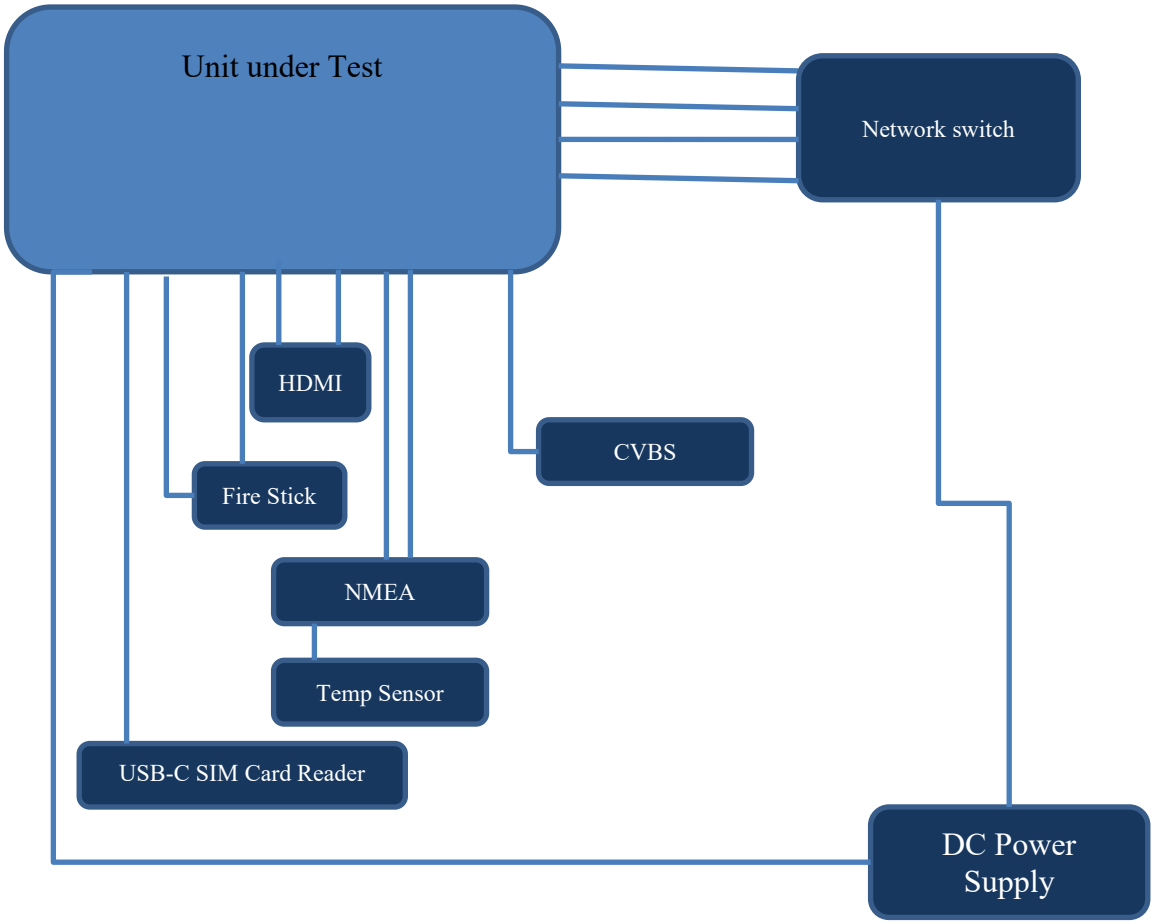
Mode	Transmitter Operation
1	ANT (GFSK)
2	BT BR (GFSK)
3	BT 2EDR (π/4-DQPSK)
4	BT 3EDR (8DPSK)
5	BT BLE (GMSK)
6	802.11b (DSSS/CCK)
7	802.11g, (OFDM)
8	802.11n (MCS)

Equipment Function

The EUT is a Control Panel Display with RF and wired communication capability. The unit provides touchscreen graphical display for the user interface. The design incorporates transmitter circuitry operating in the 2402-2480 MHz frequency band. The typical use configuration has the EUT and powered from direct current power. The design provides interface capability as presented below and wireless communications with compatible equipment. The design contains four collocated transmitters each providing specific functionality. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interface connections than those presented in the configuration options as described by the manufacturer and presented below. For testing purposes, the EUT received power from external direct current power supply. During testing, the test system was configured to operate in a manufacturer defined modes. The manufacturer provided test software for testing transmitter and equipment function. The software provided the ability to operate the transmitters at near 100% duty cycle for testing purposes. The testing mode of operation exceeds typical duty cycle operation of production equipment. As requested by the manufacturer the equipment was

tested for emissions compliance using the available configurations with the worst-case data presented. 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: HVIN: 04277
FCC ID: IPH-04277 IC: 1792A-04277

(3) Instruction Book:
Refer to Exhibit for Instruction Manual.

(4) Description of Circuit Functions:
Refer to Exhibit of Operational Description.

(5) Block Diagram with Frequencies:
Refer to Exhibit of Operational Description.

(6) Report of Measurements:
Report of measurements follows in this Report.

(7) Photographs: Construction, Component Placement, etc.:
Refer to Exhibit for photographs of equipment.

(8) List of Peripheral Equipment Necessary for operation. The equipment operates from external direct current power provided from installation vehicle. The EUT provides interface ports for power, loads and communications as presented in this filing.

(9) Transition Provisions of 47CFR 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 Title 47 Code of Federal Regulations (47CFR), dated August 4, 2023: Part 2, Subpart J, Part 15C Paragraph 15.247, Industry Canada RSS-247 Issue 2, 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 Digital Transmission Systems operation.

Testing Procedures

AC Line Conducted Emission Test Procedure

The design operates from Direct Current power only and offers no provision to interface with Utility AC Power systems. Therefore, No AC Line conducted emissions testing was required or preformed.

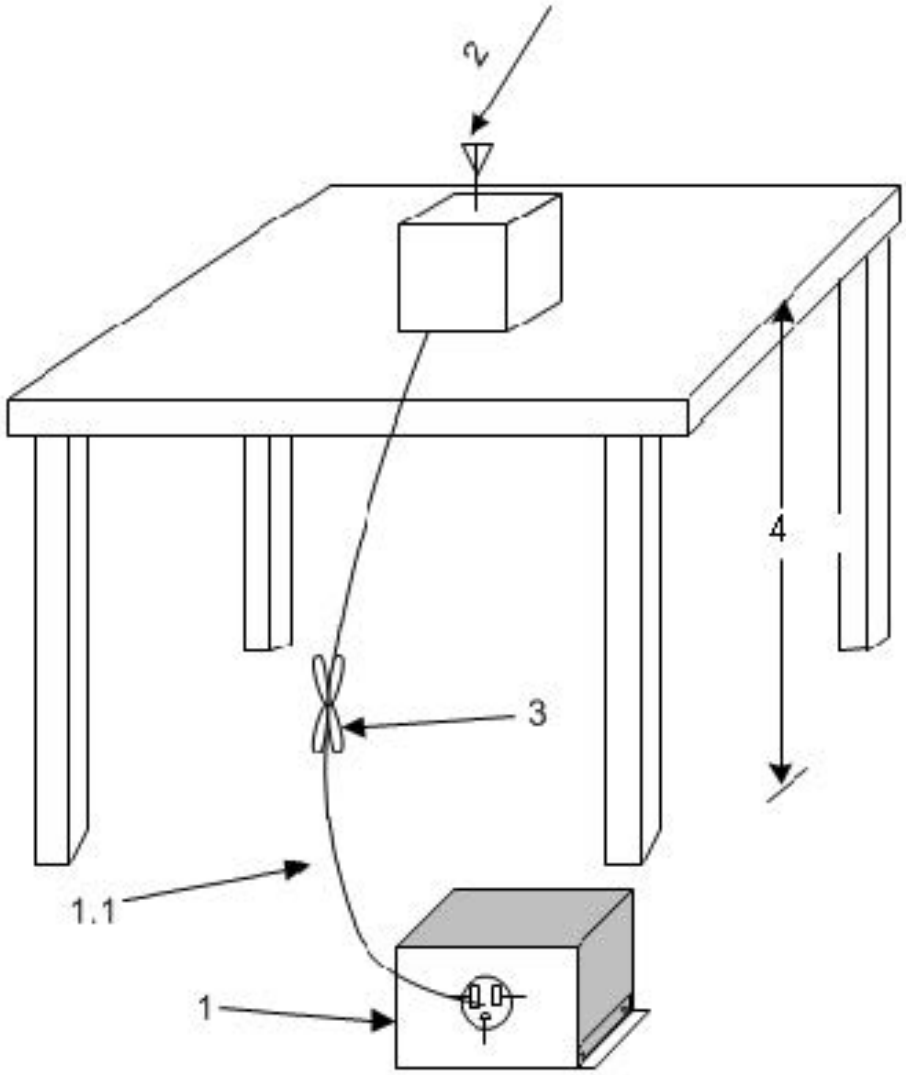
Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 Issue 2, RSS-GEN 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 and 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 as presented in this document 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.

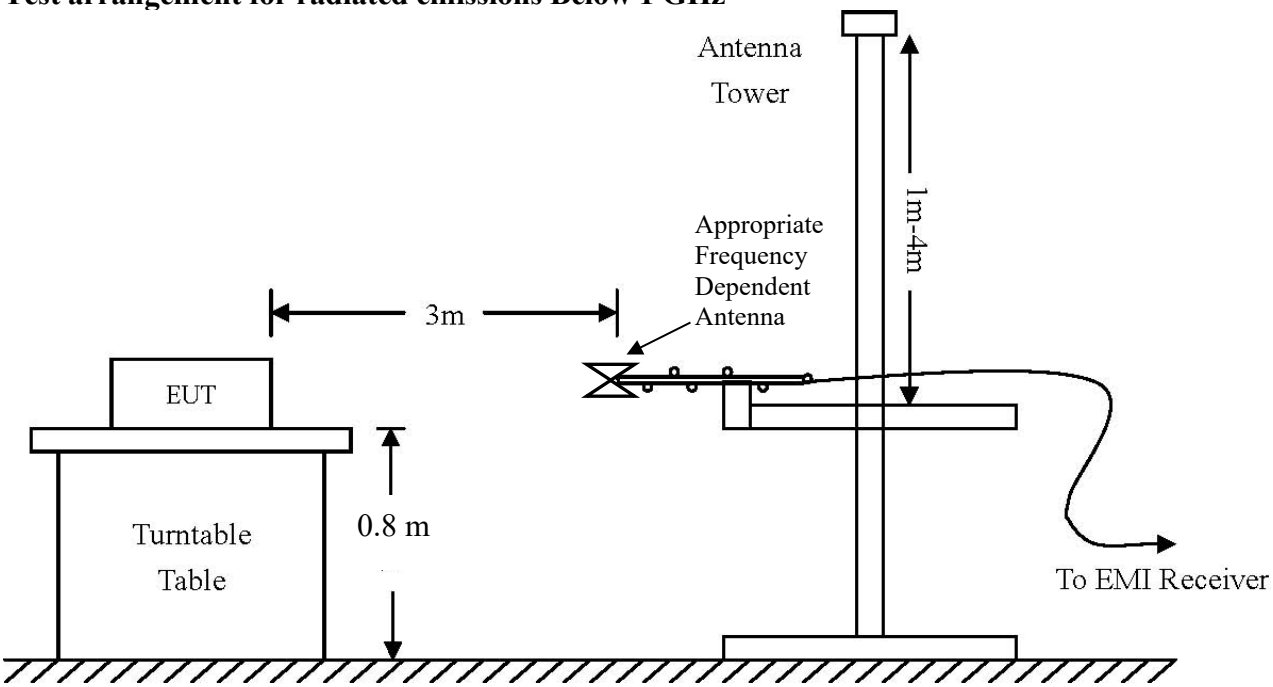
Diagram 1 Test arrangement for radiated emissions of tabletop equipment



1—A LISN is optional for radiated measurements between 30 MHz and 1000 MHz but not allowed for measurements below 30 MHz and above 1000 MHz (see 6.3.1). If used, then connect EUT to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. The LISN may be placed on top of, or immediately beneath, the reference ground plane (see 6.2.2 and 6.2.3.2).
1.1—LISN spaced at least 80 cm from the nearest part of the EUT chassis.
2—Antenna can be integral or detachable, depending on the EUT (see 6.3.1).
3—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long (see 6.3.1).
4—For emission measurements at or below 1 GHz, the table height shall be 80 cm. For emission measurements above 1 GHz, the table height shall be 1.5 m for measurements, except as otherwise specified (see 6.3.1 and 6.6.3.1).

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

Test arrangement for radiated emissions Below 1 GHz



Test arrangement for radiated emissions Above 1 GHz

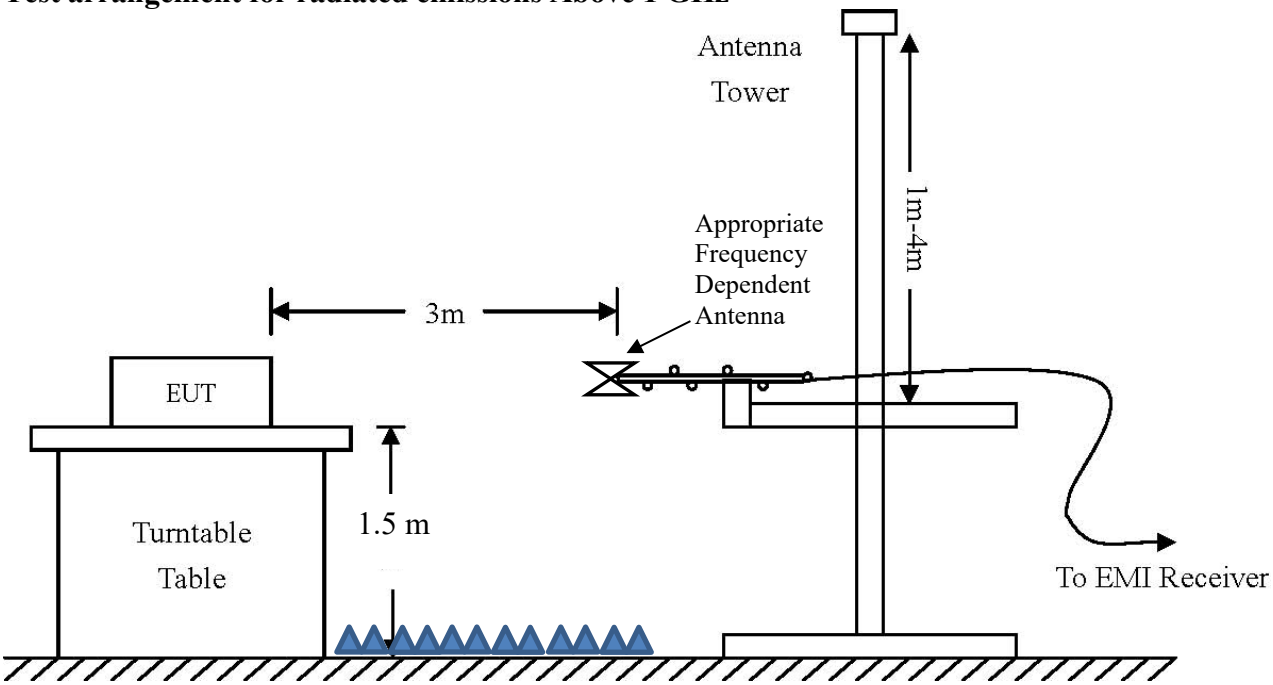
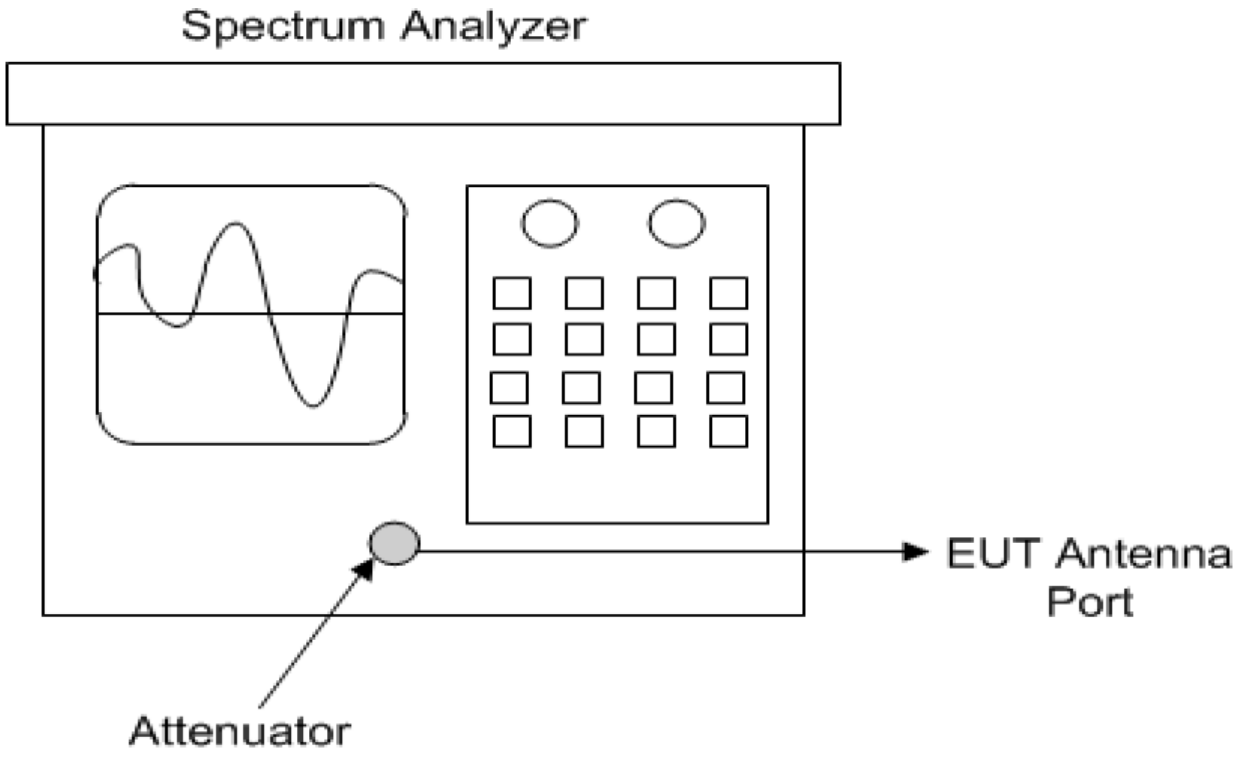


Diagram 3 Test arrangement for Antenna Port Conducted emissions



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 and test system 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 19.8 - 21.7° C

Relative Humidity 31 - 38.0 %

Atmospheric Pressure 1012.3 – 1033.7 mb

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with 47CFR Part 15C, RSS-247 Issue 2, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Intentional Radiators

The following information is submitted in support demonstration of compliance with the requirements of 47CFR, Paragraph 15 Subpart C, paragraph 15.247, Industry Canada RSS-247 Issue 2, and RSS-GEN Issue 5.

Antenna Requirements

The EUT incorporates integral non-user accessible systems. Production equipment offers no provision for connection to alternate antenna system. The antenna connection point complies with the unique antenna connection requirements. There are no deviations or exceptions to the specification.

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured 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 Harmonic Radiated Emissions in Restricted Bands Mode 3, BT 2EDR (π/4-DQPSK)

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	44.2	30.5	44.2	30.8	54.0	-23.5	-23.2
2483.5	46.9	32.4	44.7	31.5	54.0	-21.6	-22.5
4804.0	47.6	36.6	49.8	37.0	54.0	-17.4	-17.0
4880.0	49.6	36.6	50.1	36.7	54.0	-17.4	-17.3
4960.0	50.1	36.7	49.9	36.7	54.0	-17.3	-17.3
7206.0	60.1	49.2	53.9	40.9	54.0	-4.8	-13.1
7320.0	60.8	51.1	53.3	40.6	54.0	-2.9	-13.4
7440.0	56.3	43.9	55.9	43.9	54.0	-10.1	-10.1
12010.0	60.1	47.0	59.4	46.9	54.0	-7.0	-7.1
12200.0	50.9	47.9	60.5	47.9	54.0	-6.1	-6.1
12400.0	60.1	47.6	60.3	47.6	54.0	-6.4	-6.4

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.

Table 2 Harmonic Radiated Emissions in Restricted Bands Mode 4, BT 3EDR (8DPSK)

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	43.8	30.7	43.6	30.5	54.0	-23.3	-23.5
2483.5	50.0	34.5	45.1	31.6	54.0	-19.5	-22.4
4804.0	49.5	36.5	49.8	36.5	54.0	-17.5	-17.5
4880.0	50.1	36.8	49.6	36.6	54.0	-17.2	-17.4
4960.0	49.9	36.6	50.8	36.9	54.0	-17.4	-17.1
7206.0	60.8	48.2	53.2	40.4	54.0	-5.8	-13.6
7320.0	53.8	41.5	53.7	40.2	54.0	-12.5	-13.8
7440.0	56.0	43.2	53.6	40.9	54.0	-10.8	-13.1
12010.0	59.4	46.7	59.4	46.7	54.0	-7.3	-7.3
12200.0	60.4	47.9	60.8	47.9	54.0	-6.1	-6.1
12400.0	60.1	47.5	60.5	47.5	54.0	-6.5	-6.5

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.

Table 3 Harmonic Radiated Emissions in Restricted Bands Mode 5, BT BLE (GMSK)

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	45.4	30.9	45.8	30.9	54.0	-23.1	-23.1
2483.5	57.9	34.1	48.3	31.8	54.0	-19.9	-22.2
4804.0	51.1	36.9	50.3	36.7	54.0	-17.1	-17.3
4880.0	50.8	36.8	50.1	36.6	54.0	-17.2	-17.4
4960.0	51.4	37.2	50.2	36.4	54.0	-16.8	-17.6
7206.0	56.0	43.9	55.1	41.3	54.0	-10.1	-12.7
7320.0	55.9	42.4	56.5	43.1	54.0	-11.6	-10.9
7440.0	57.8	44.5	53.7	40.7	54.0	-9.5	-13.3
12010.0	60.4	47.0	60.0	46.9	54.0	-7.0	-7.1
12200.0	61.2	47.7	60.8	47.8	54.0	-6.3	-6.2
12400.0	60.9	47.4	61.3	47.4	54.0	-6.6	-6.6

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.

Table 4 Harmonic Radiated Emissions in Restricted Bands Mode 6, 802.11b (DSSS/CCK)

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	49.1	35.1	49.8	35.6	54.0	-18.9	-18.4
2483.5	47.0	34.0	50.0	36.6	54.0	-20.0	-17.4
4824.0	49.6	36.1	50.0	36.0	54.0	-17.9	-18.0
4874.0	49.5	36.2	50.0	36.2	54.0	-17.8	-17.8
4924.0	50.1	36.3	49.3	36.3	54.0	-17.7	-17.7
7236.0	53.6	40.6	56.0	42.5	54.0	-13.4	-11.5
7311.0	56.7	43.3	55.0	41.4	54.0	-10.7	-12.6
7386.0	53.7	40.9	53.9	40.4	54.0	-13.1	-13.6
12060.0	60.5	47.7	59.0	46.7	54.0	-6.3	-7.3
12185.0	60.9	47.6	60.2	47.6	54.0	-6.4	-6.4
12310.0	60.9	47.7	60.8	47.9	54.0	-6.3	-6.1

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.

Table 5 Harmonic Radiated Emissions in Restricted Bands Mode 7, 802.11g (OFDM)

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	47.2	32.9	47.7	33.1	54.0	-21.1	-20.9
2483.5	46.2	33.0	49.6	34.7	54.0	-21.0	-19.3
4824.0	49.5	36.3	49.3	36.3	54.0	-17.7	-17.7
4874.0	50.0	36.3	50.3	36.2	54.0	-17.7	-17.8
4924.0	49.9	36.4	49.9	36.4	54.0	-17.6	-17.6
7236.0	55.0	41.9	54.9	42.0	54.0	-12.1	-12.0
7311.0	55.9	42.8	54.0	40.9	54.0	-11.2	-13.1
7386.0	58.3	44.5	57.0	43.6	54.0	-9.5	-10.4
12060.0	60.0	46.8	59.8	46.7	54.0	-7.2	-7.3
12185.0	60.2	47.7	61.2	47.9	54.0	-6.3	-6.1
12310.0	61.2	47.9	60.9	48.0	54.0	-6.1	-6.0

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.

Table 6 Harmonic Radiated Emissions in Restricted Bands Mode 8, 802.11n (MSC)

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	47.8	32.7	50.1	34.0	54.0	-21.3	-20.0
2483.5	48.6	33.3	48.2	34.1	54.0	-20.7	-19.9
4824.0	49.5	36.5	49.8	36.4	54.0	-17.5	-17.6
4874.0	50.1	36.7	50.1	36.7	54.0	-17.3	-17.3
4924.0	49.6	36.6	49.7	36.6	54.0	-17.4	-17.4
7236.0	53.3	40.6	53.5	40.6	54.0	-13.4	-13.4
7311.0	53.4	40.6	53.3	40.6	54.0	-13.4	-13.4
7386.0	53.5	40.6	53.5	40.6	54.0	-13.4	-13.4
12060.0	59.6	46.8	59.0	46.9	54.0	-7.2	-7.1
12185.0	60.6	47.9	60.5	47.9	54.0	-6.1	-6.1
12310.0	61.2	48.2	60.5	48.2	54.0	-5.8	-5.8

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

Summary of Results for Radiated Emissions in Restricted Bands

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Paragraph 15, Subpart 15C, RSS-247 Issue 2, and RSS-GEN Issue 5 emission requirements. The EUT worst-case operations demonstrated a minimum radiated emission margin of -2.9 dB 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 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 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 7 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)
77.5	40.8	35.3	36.4	31.6	40.0	-4.7	-8.4
129.4	41.0	38.2	41.5	38.5	43.5	-5.3	-5.0
168.1	39.7	37.3	39.8	37.8	43.5	-6.2	-5.7
199.6	36.0	30.2	34.3	29.8	43.5	-13.3	-13.7
204.8	38.1	33.3	37.0	32.5	43.5	-10.2	-11.0
215.6	44.7	39.9	41.7	37.2	43.5	-3.6	-6.3
215.7	40.6	36.0	42.6	38.1	43.5	-7.5	-5.4
219.3	47.6	43.5	43.4	38.7	46.0	-2.5	-7.3
221.0	48.1	39.7	39.7	35.8	46.0	-6.3	-10.2
221.0	44.5	40.3	46.0	41.2	46.0	-5.7	-4.8
224.0	43.6	38.4	37.9	33.9	46.0	-7.6	-12.1
225.7	45.3	42.3	42.3	37.6	46.0	-3.7	-8.4
225.7	45.6	40.7	44.1	39.5	46.0	-5.3	-6.5
229.6	45.4	41.9	45.5	41.2	46.0	-4.1	-4.8
231.9	42.3	37.8	43.9	39.4	46.0	-8.2	-6.6
250.0	41.4	38.7	38.3	34.8	46.0	-7.3	-11.2
342.1	38.0	32.4	35.2	29.2	46.0	-13.6	-16.8
445.0	38.0	34.8	36.2	32.5	46.0	-11.2	-13.5
476.8	45.2	42.0	42.4	38.5	46.0	-4.0	-7.5
720.0	43.9	39.5	42.3	39.1	46.0	-6.5	-6.9
890.1	44.1	39.5	41.3	35.0	46.0	-6.5	-11.0
891.0	49.1	45.1	45.6	41.4	46.0	-0.9	-4.6

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 47CFR Paragraph 15.209, RSS-247 Issue 2 and RSS-GEN Issue 5 emission requirements. The EUT worst-case transmitter configuration demonstrated a minimum margin of -0.9 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

Test procedures of ANSI C63.10-2013 paragraph 6, and KDB 558074 v05r02 were used during transmitter testing. Test sample #2 was provided for testing antenna port conducted emissions. This sample was modified by replacing the internal antenna with a 50-ohm antenna port connector and attenuator for testing purposes. The transmitter peak and average power was measured at the antenna port using a wideband RF power meter as described in ANSI C63.10-2013 and KDB 558074. Average power measured did not include any time intervals during which the transmitter was off or transmitting at a reduced power level. The Power Spectral Density (PSD) was measured as required in ANSI C63.10-2013 and KDB 558074. DTS Emission bandwidth was measured as required in ANSI C63.10-2013 and KDB 558074. The amplitude of each harmonic and general radiated emission was measured on the OATS at distance of 3 meters from the FSM antenna (radiated emission testing was performed on sample #1 representative of production equipment with integral antenna). The EUT was positioned on supporting turntable elevated as required above the ground plane, at a distance of 3 meters from the FSM antenna. Radiated emission investigations were performed from 9 kHz to 25,000 MHz. Each radiated emission was maximized by varying the FSM antenna height and polarization, and by rotating the turntable. The worst-case amplitude of each emission was then recorded from the analyzer display. 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. 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. Radiated Emissions were measured in dBµV/m @ 3 meters. Plots were taken of transmitter performance (using sample #2, s/n:3432028971) for reference in this and other documentation displaying compliance with the specifications.

Figure 1 Plot of Transmitter Emissions in 2402-2480 MHz Mode 3, BT 2EDR (π/4-DQPSK)

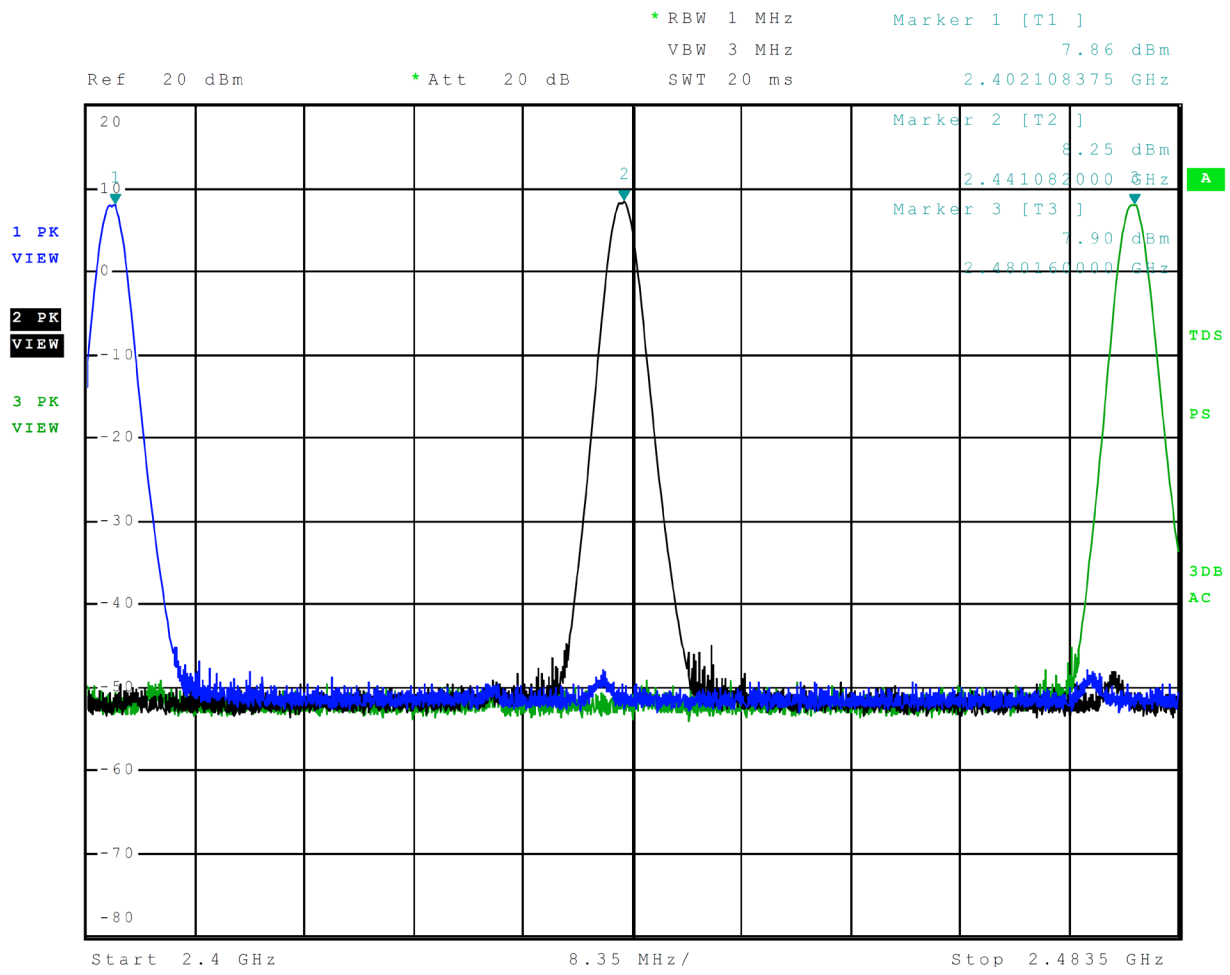


Figure 2 Plot of Transmitter Emissions in 2402-2480 MHz Mode 4, BT 3EDR (8DPSK)

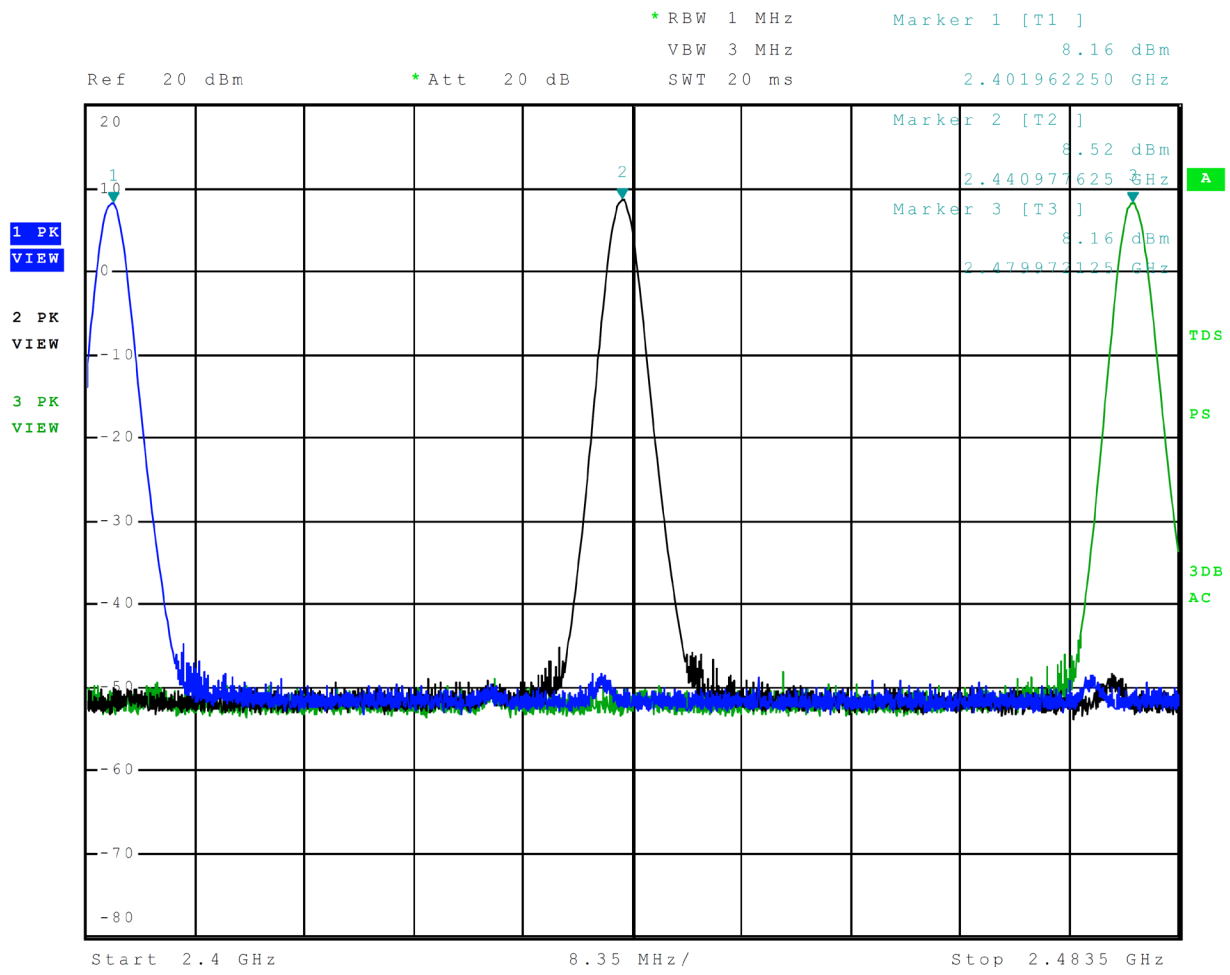


Figure 3 Plot of Transmitter Emissions in 2402-2480 MHz Mode 5, BT BLE (GMSK)

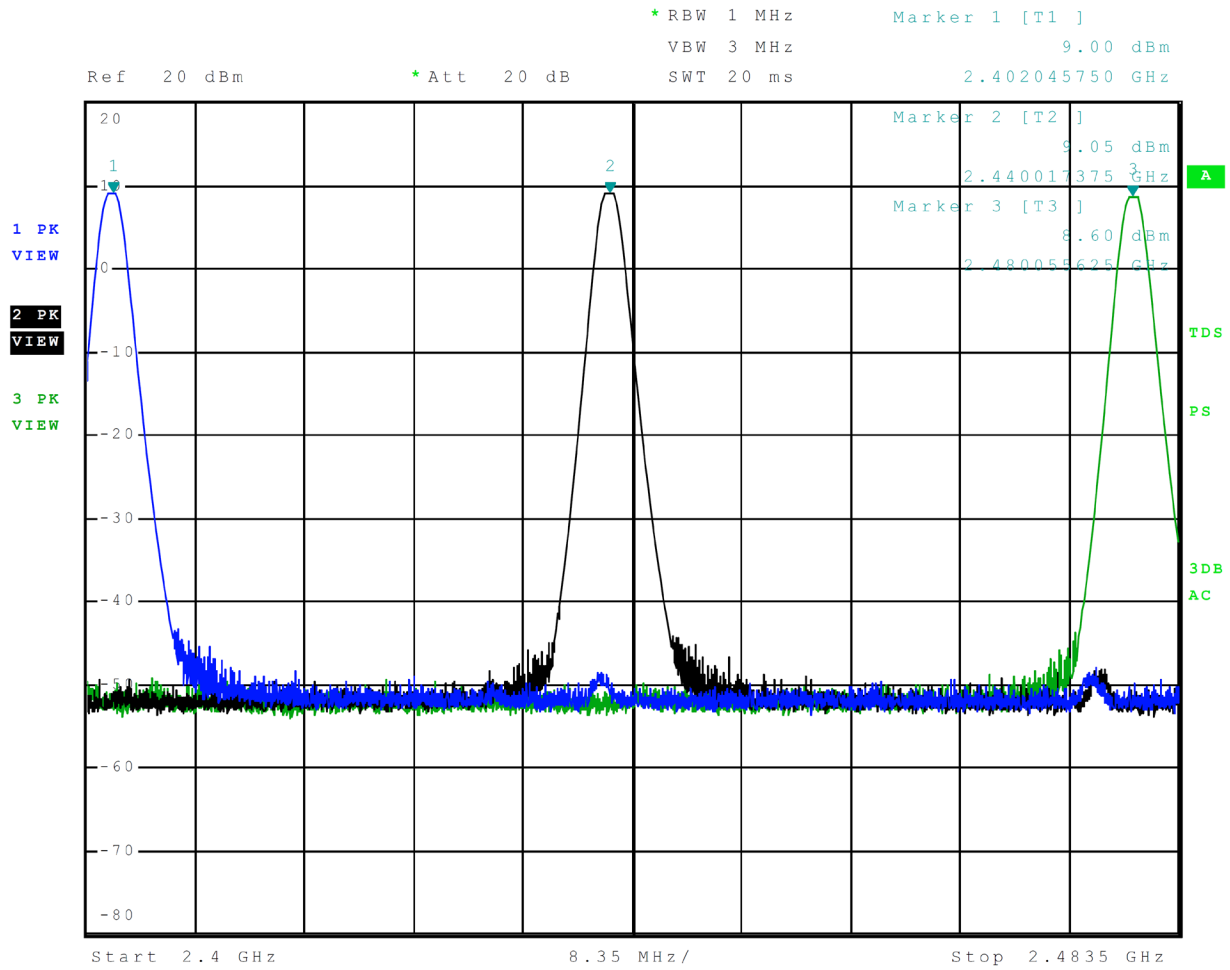


Figure 4 Plot of Transmitter Operation in 2412-2462 MHz Mode 6, 802.11b (DSSS/CCK)

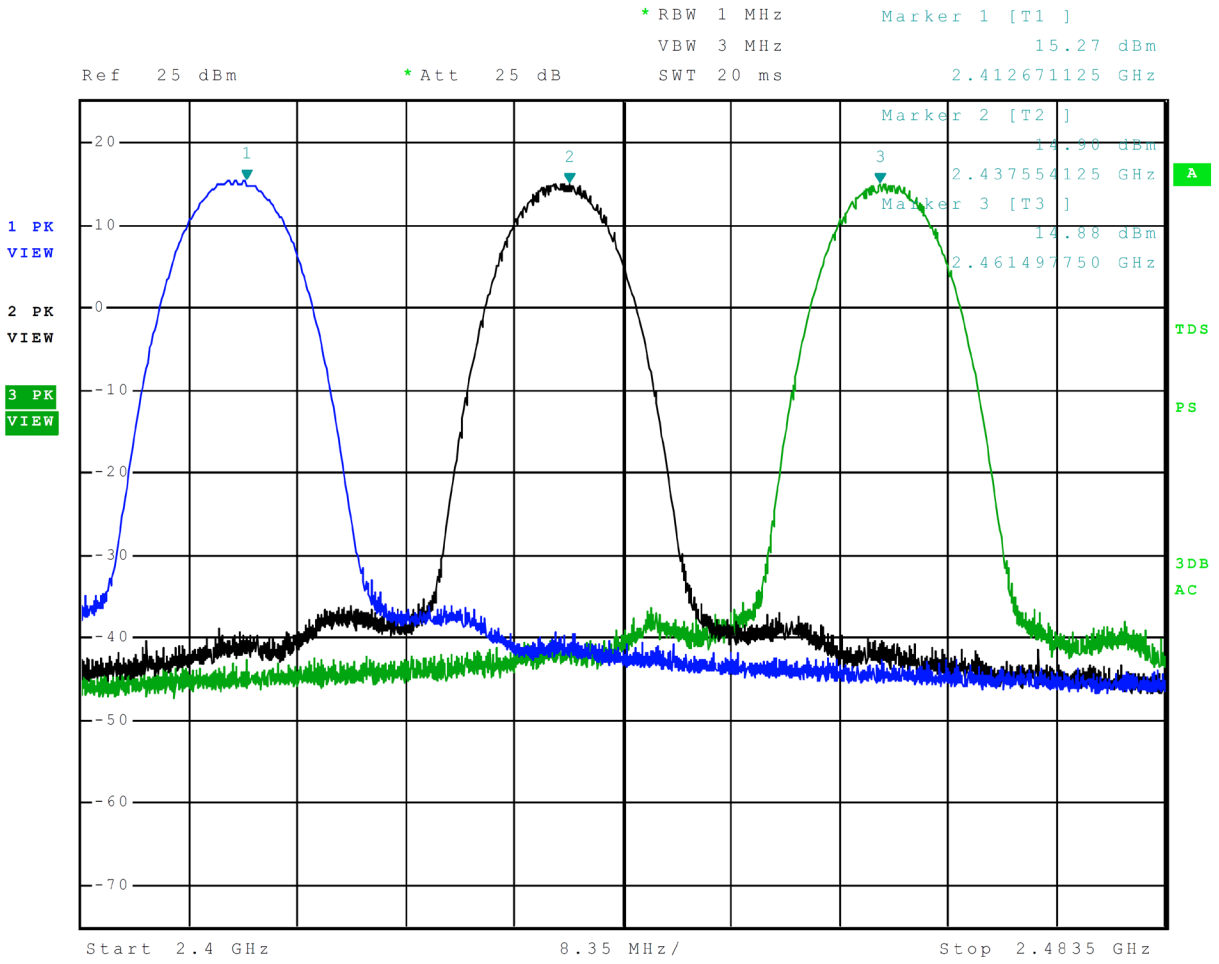


Figure 5 Plot of Transmitter Operation in 2412-2462 MHz Mode 7, 802.11g (OFDM)

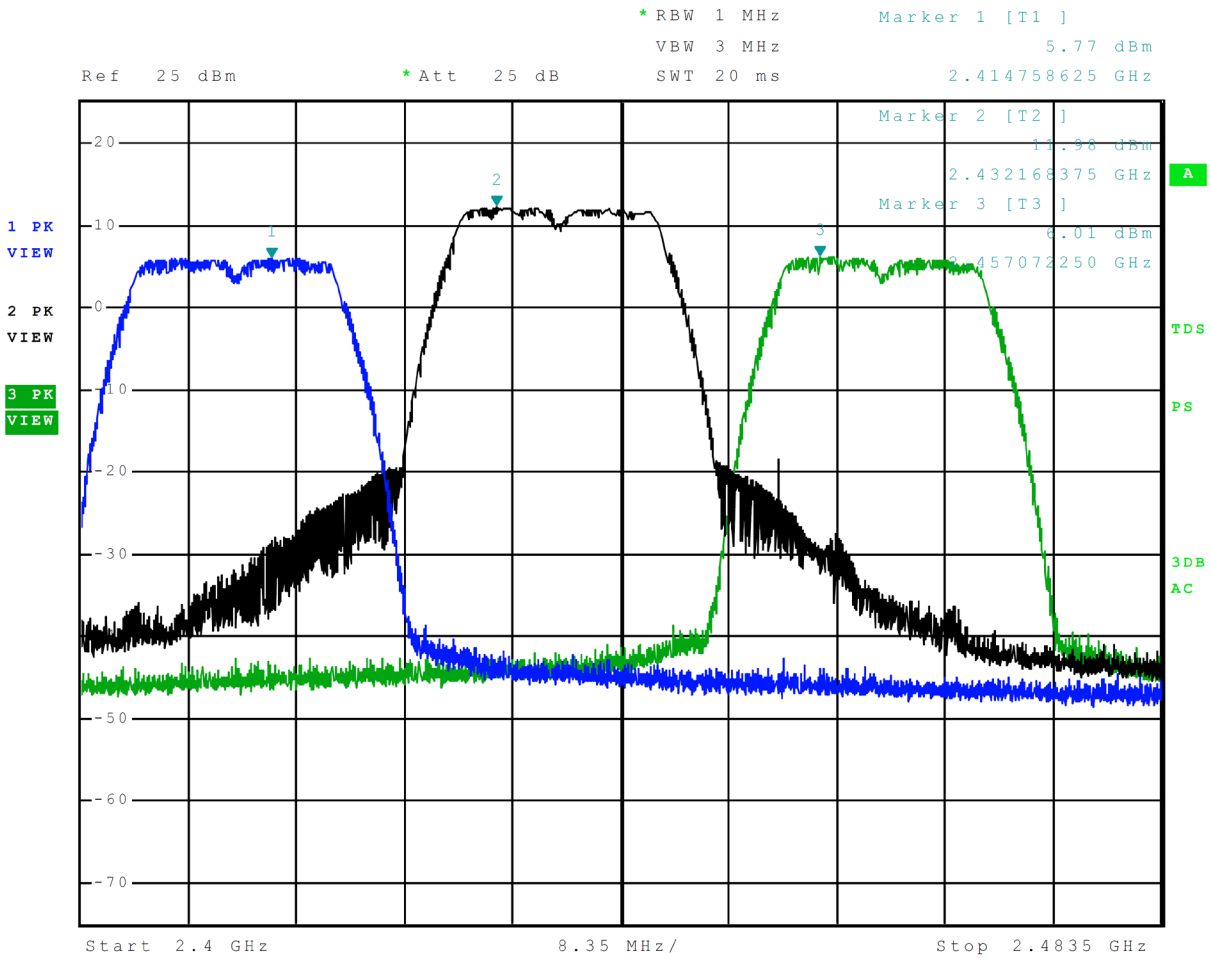


Figure 6 Plot of Transmitter Operation in 2412-2462 MHz Mode 8, 802.11n (MSC)

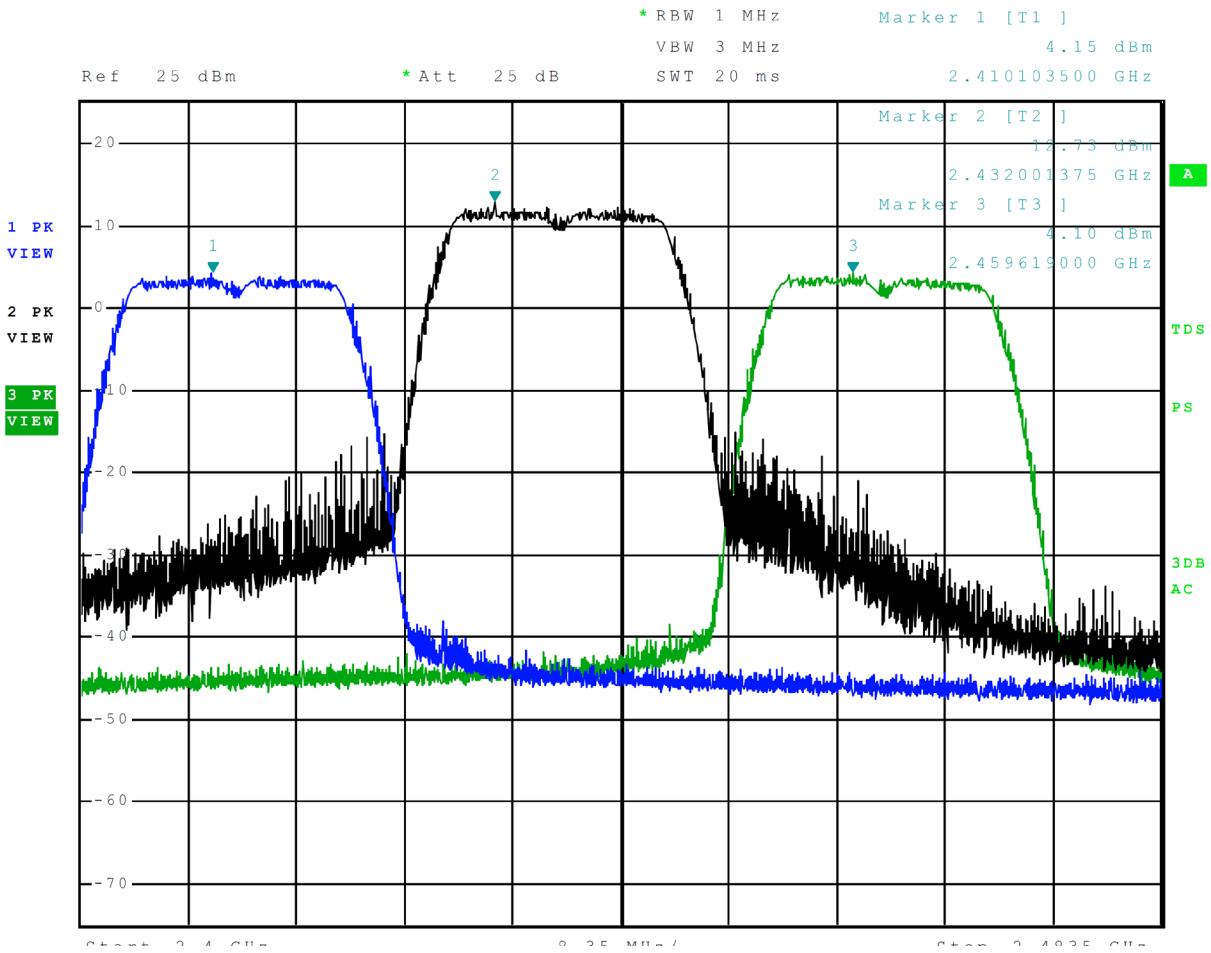


Figure 7 Plot of Transmitter Emissions Low Band Edge Mode 3, BT 2EDR (π/4-DQPSK)

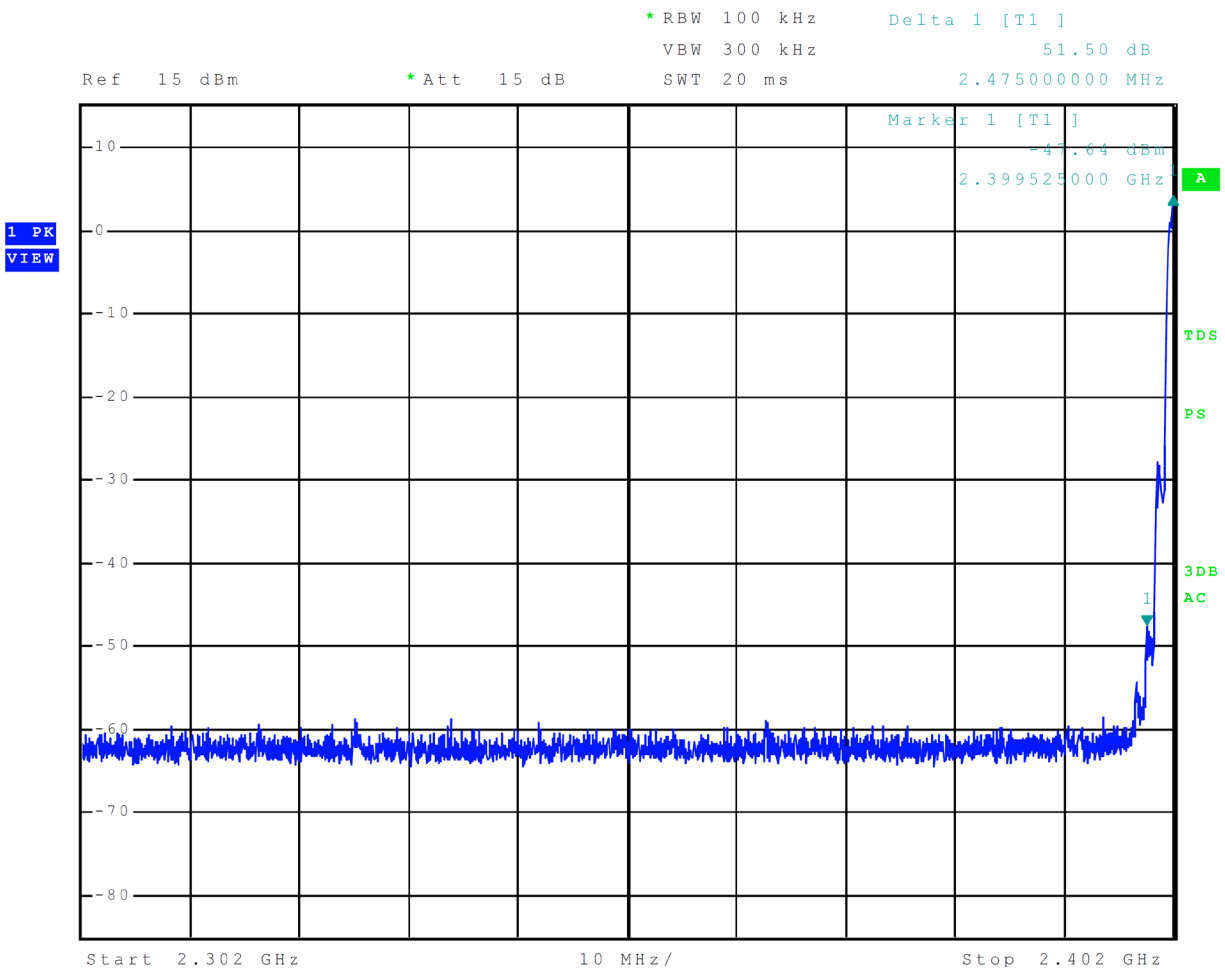


Figure 8 Plot of Transmitter Emissions Low Band Edge Mode 4, BT 3EDR (8DPSK)

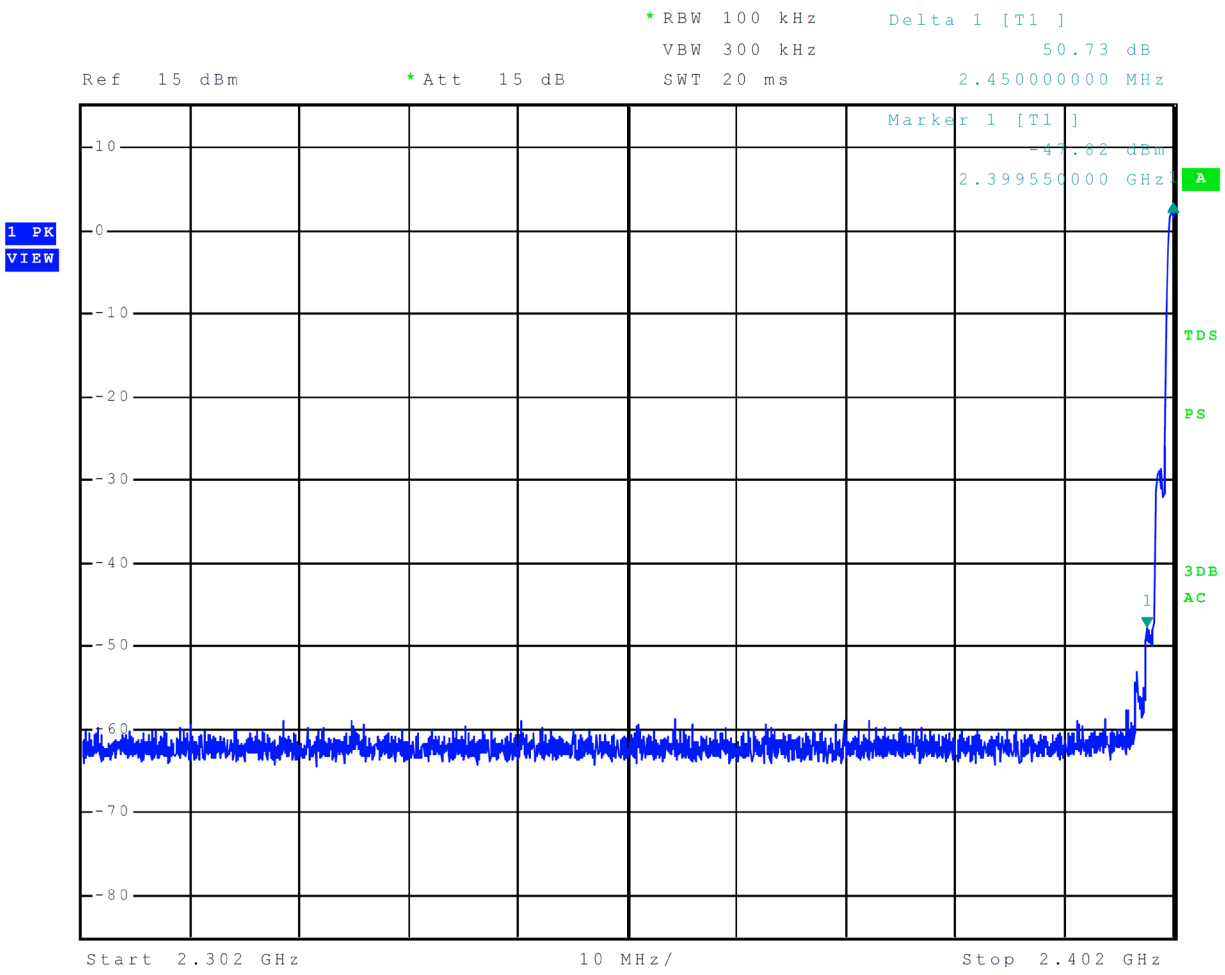


Figure 9 Plot of Transmitter Emissions Low Band Edge Mode 5, BT BLE (GMSK)

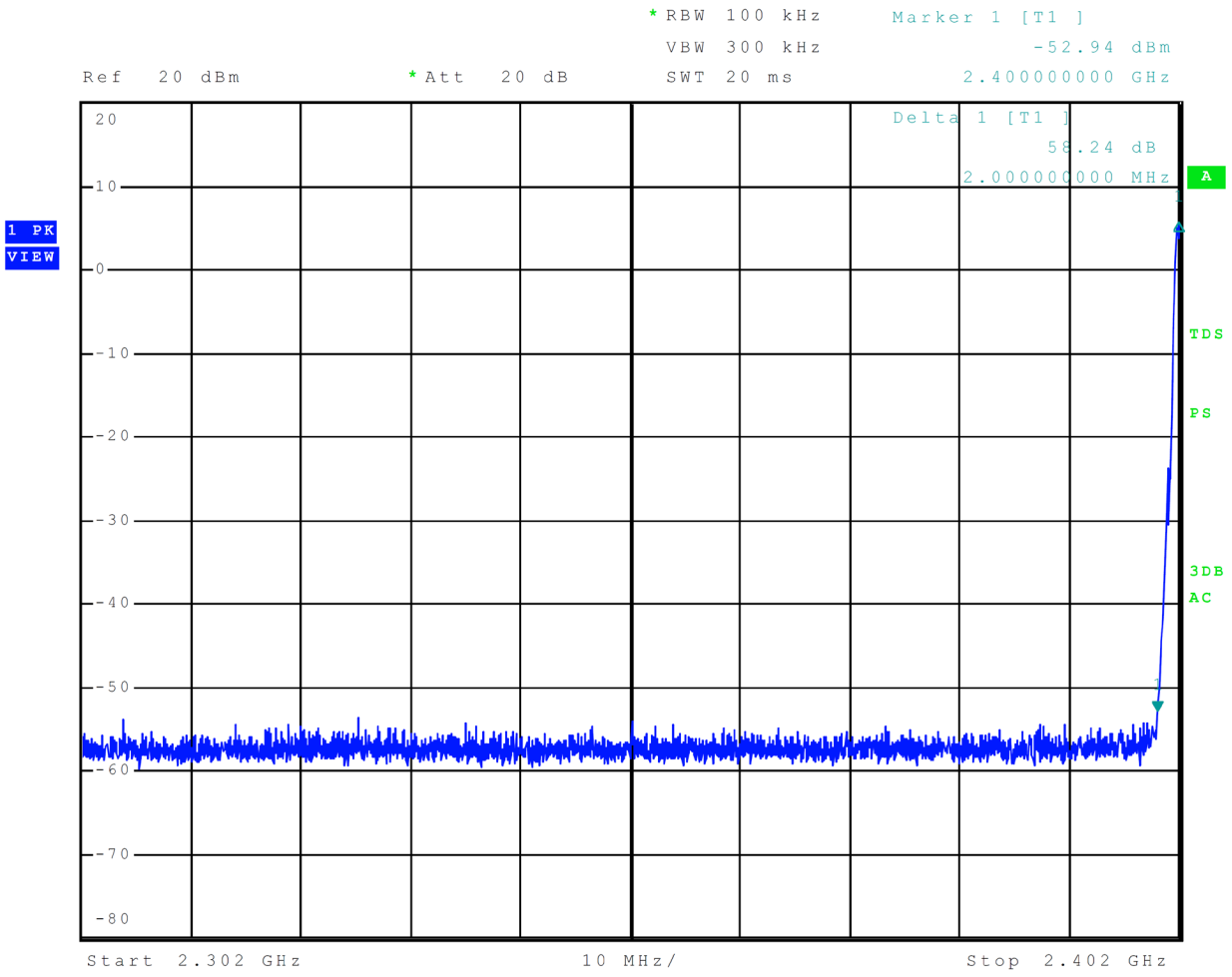


Figure 10 Plot of Transmitter Emissions Low Band Edge Mode 6, 802.11b (DSSS/CCK)

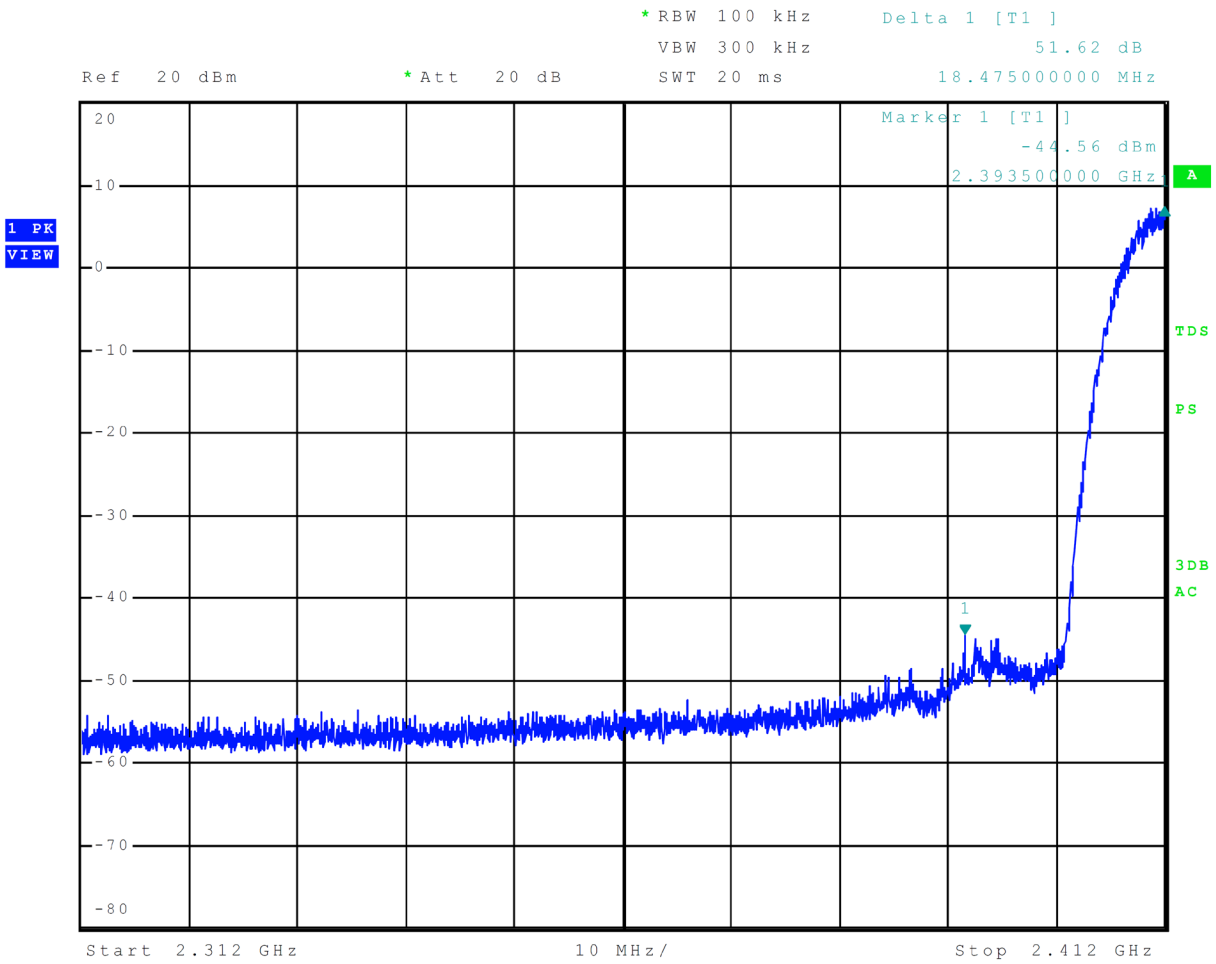


Figure 11 Plot of Transmitter Emissions Low Band Edge Mode 7, 802.11g (OFDM)

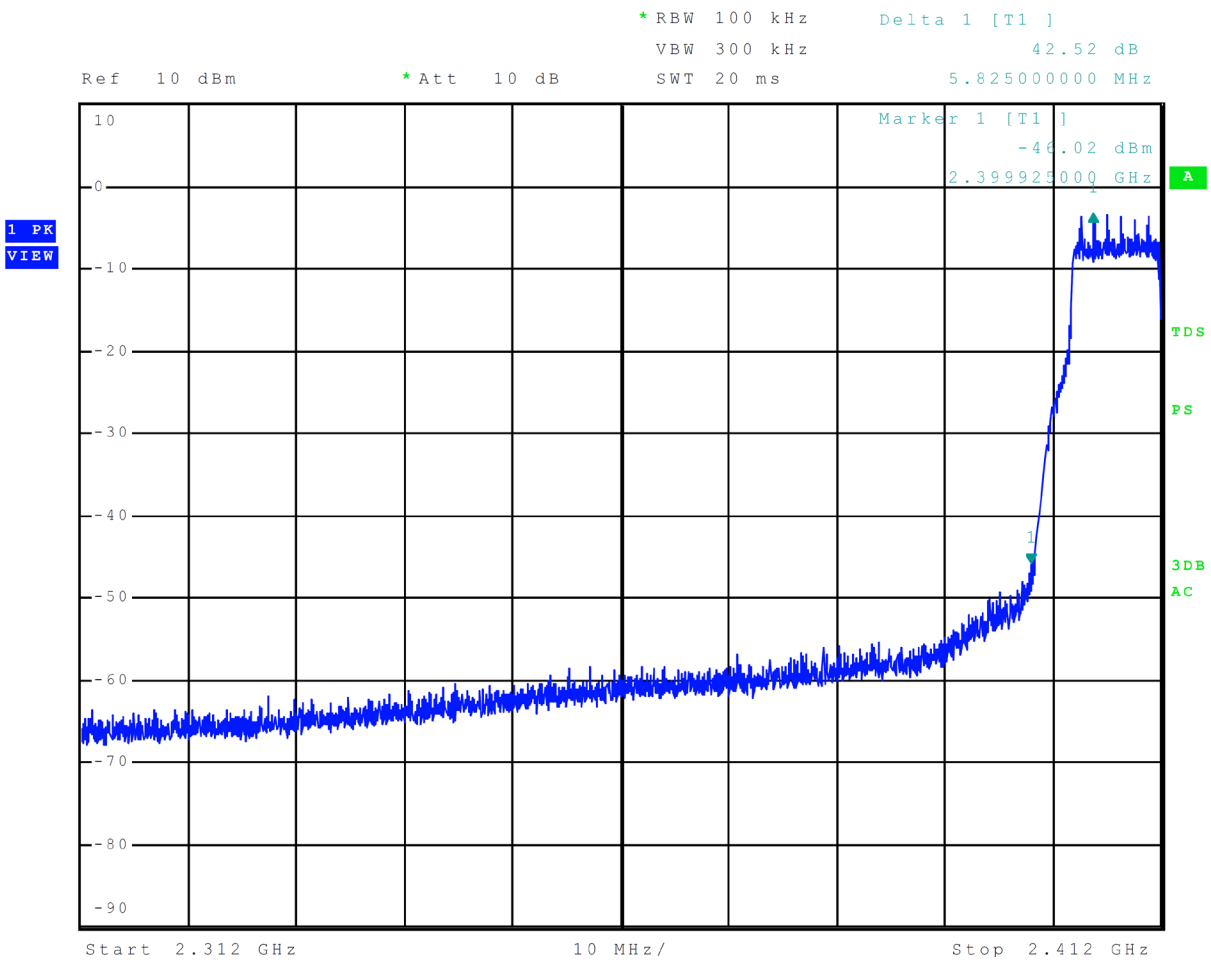


Figure 12 Plot of Transmitter Emissions Low Band Edge Mode 8, 802.11n (MSC)

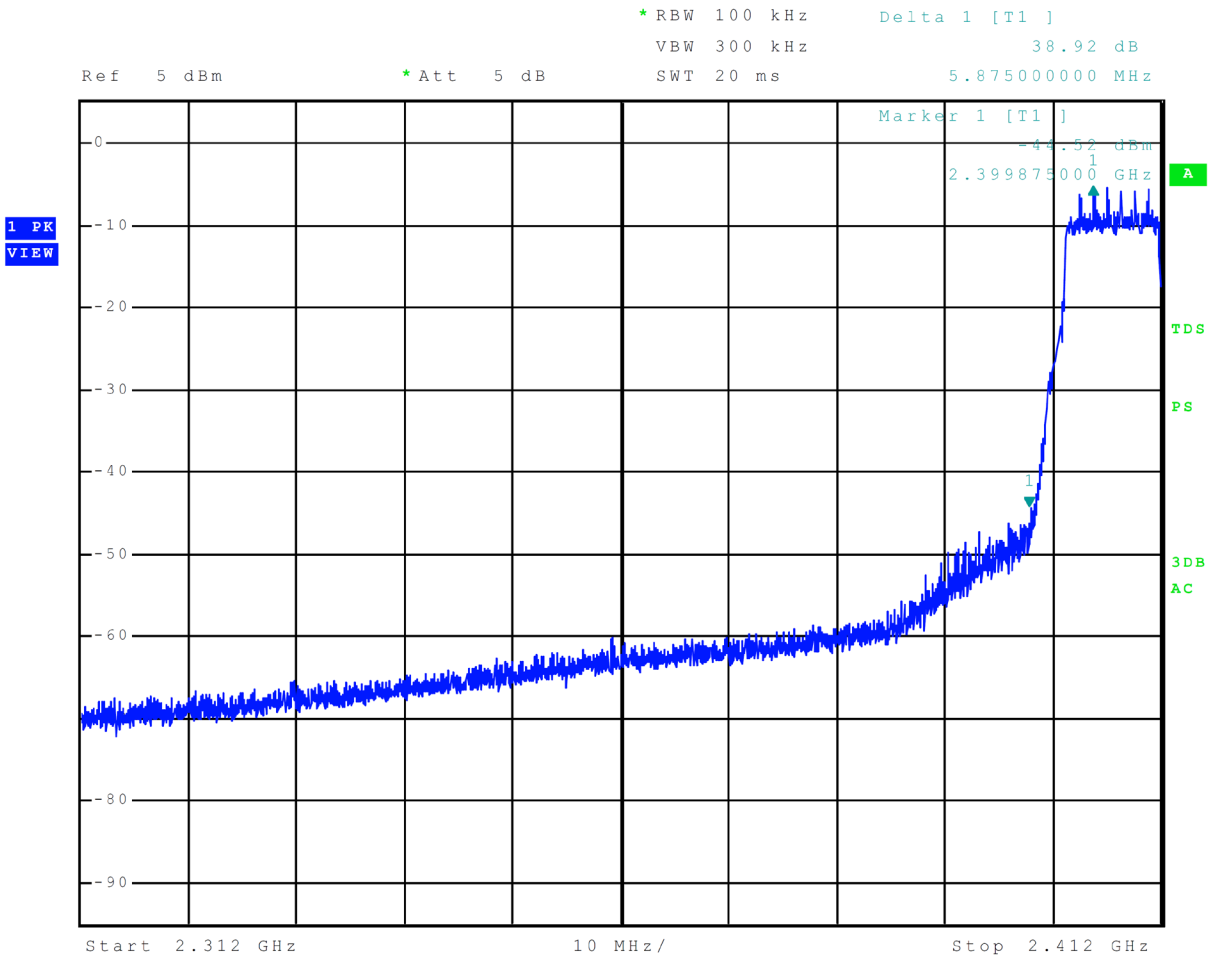


Figure 13 Plot of Transmitter Emissions High Band Edge Mode 3, BT 2EDR (π/4-DQPSK)

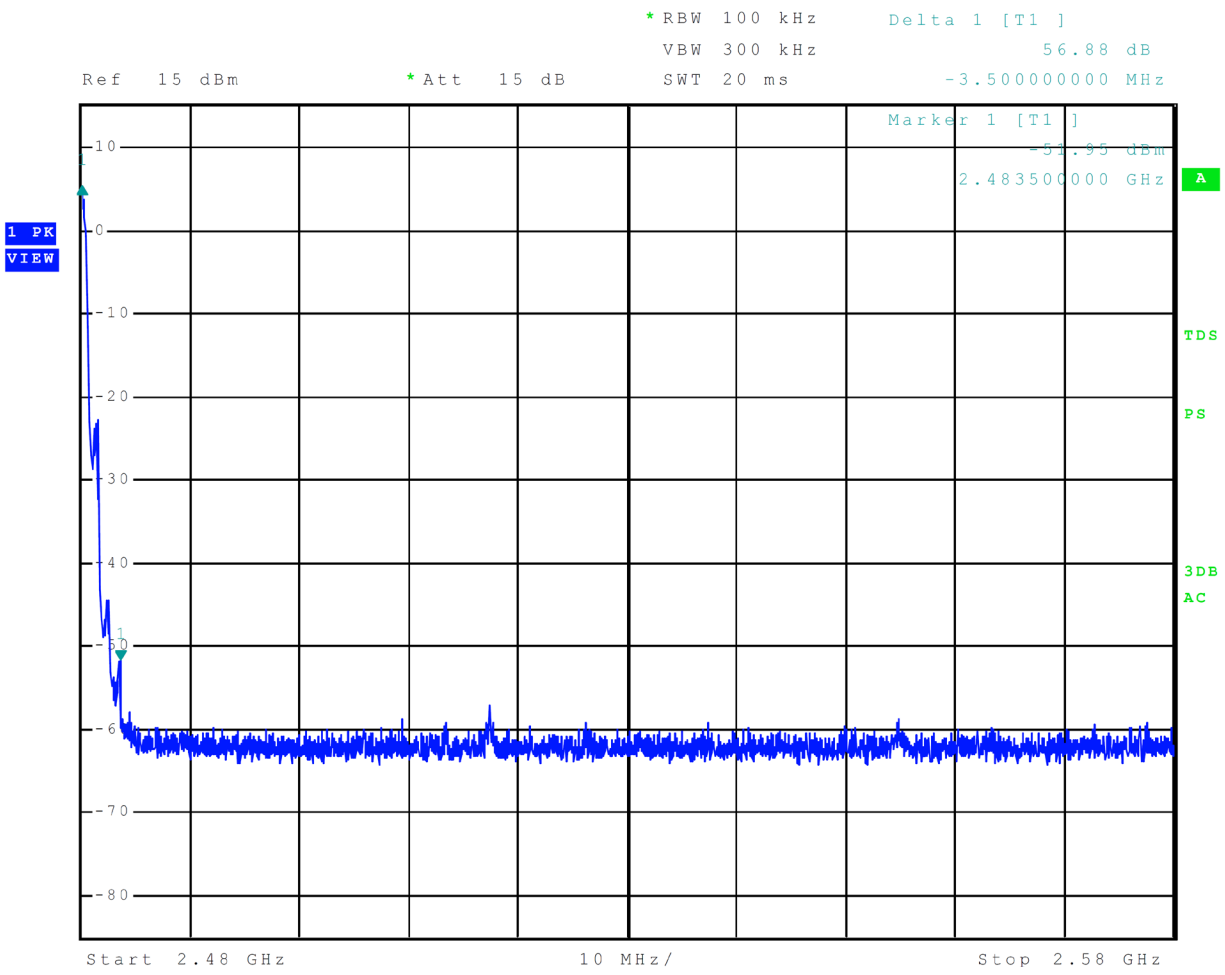


Figure 14 Plot of Transmitter Emissions High Band Edge Mode 4, BT 3EDR (8DPSK)

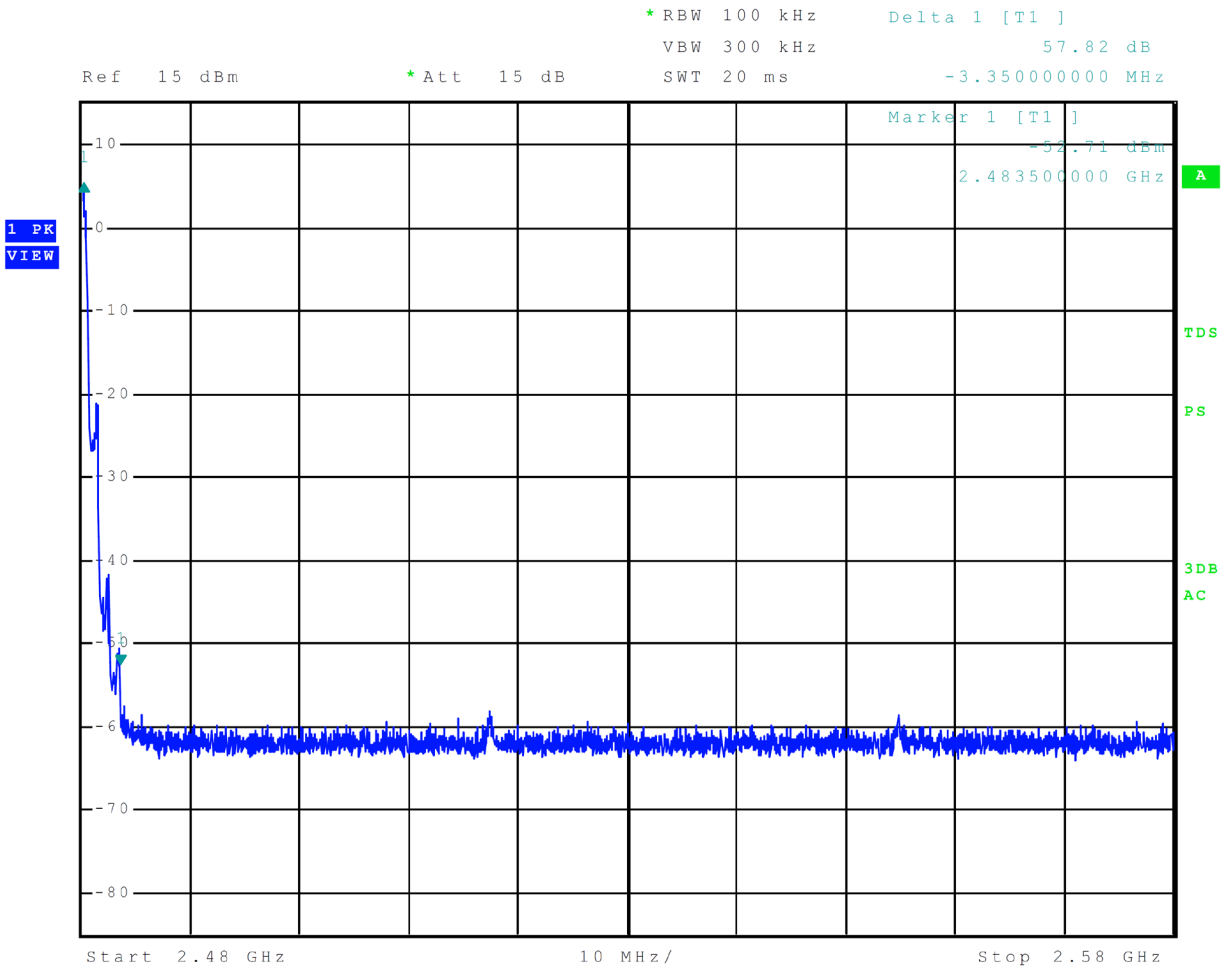


Figure 15 Plot of Transmitter Emissions High Band Edge Mode 5, BT BLE (GMSK)

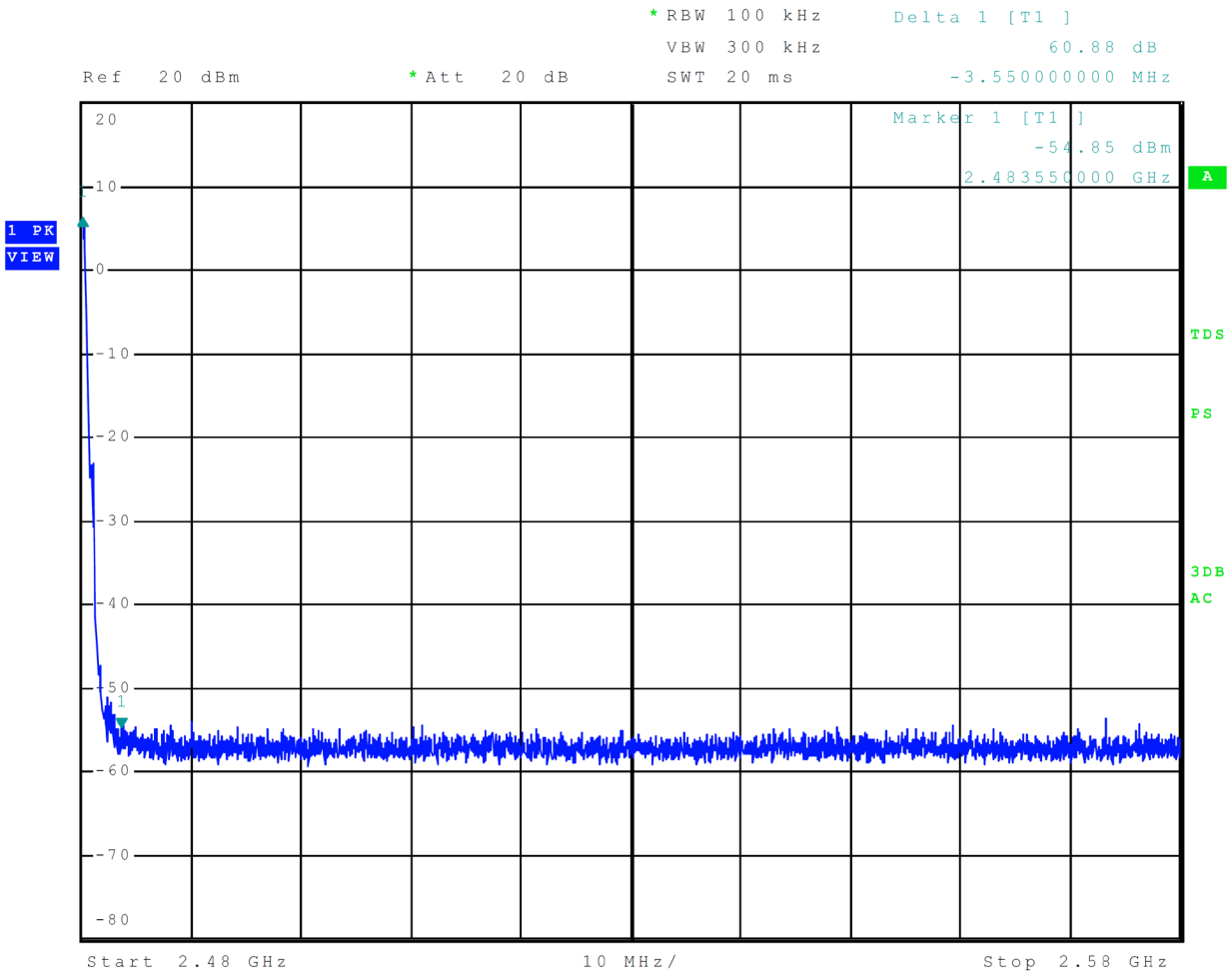


Figure 16 Plot of Transmitter Emissions High Band Edge Mode 6, 802.11b (DSSS/CCK)

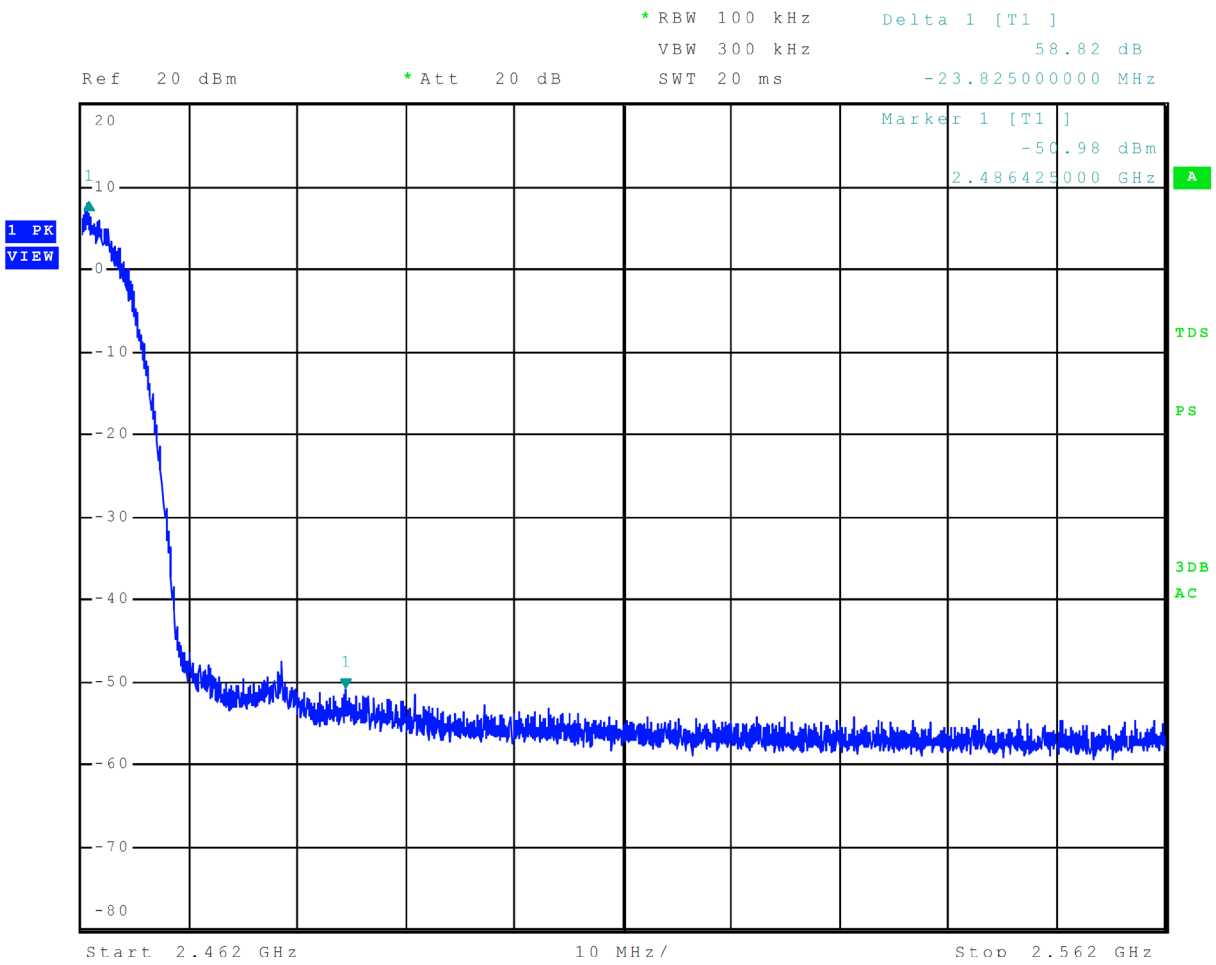


Figure 17 Plot of Transmitter Emissions High Band Edge Mode 7, 802.11g (OFDM)

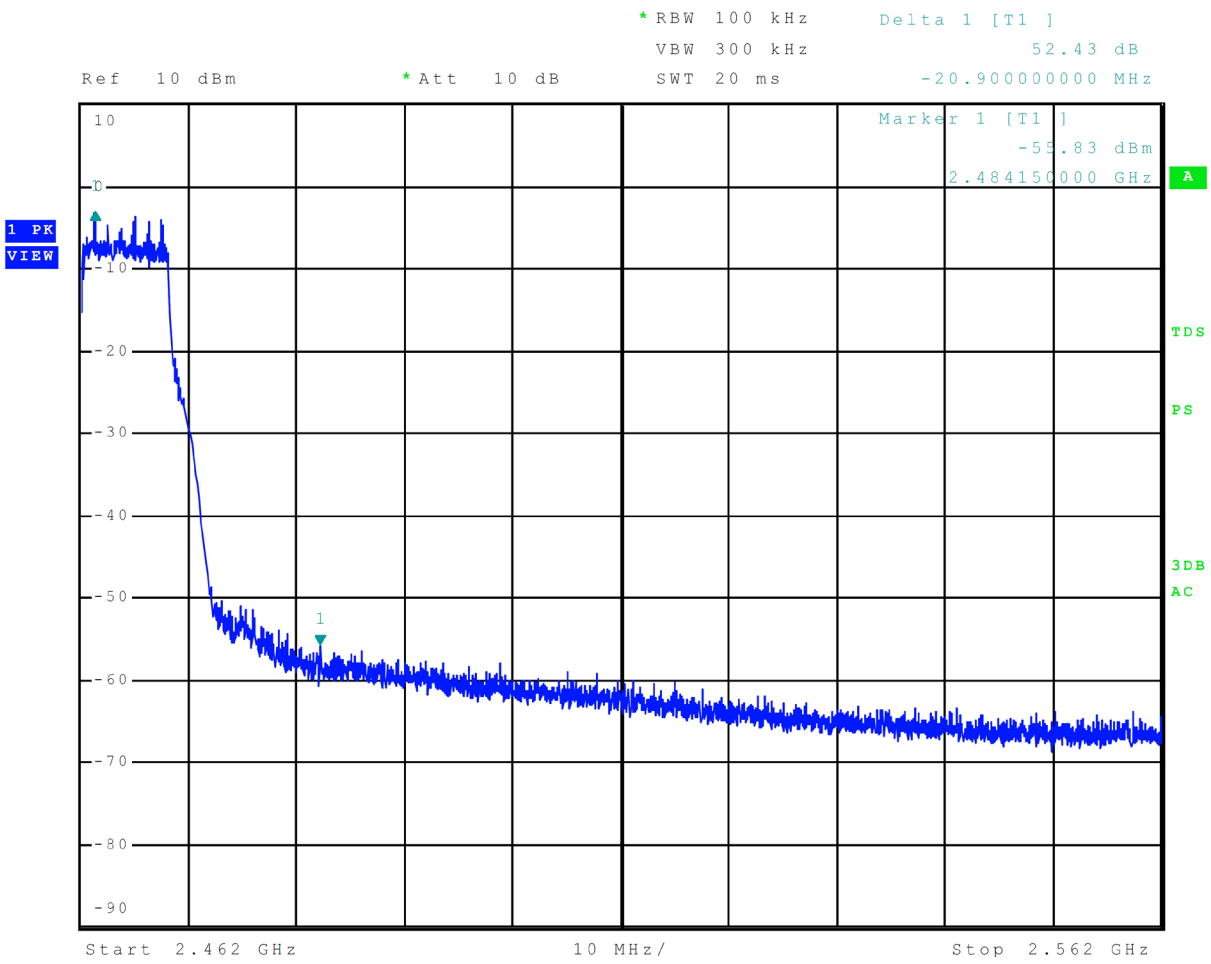


Figure 18 Plot of Transmitter Emissions High Band Edge Mode 8, 802.11n (MSC)

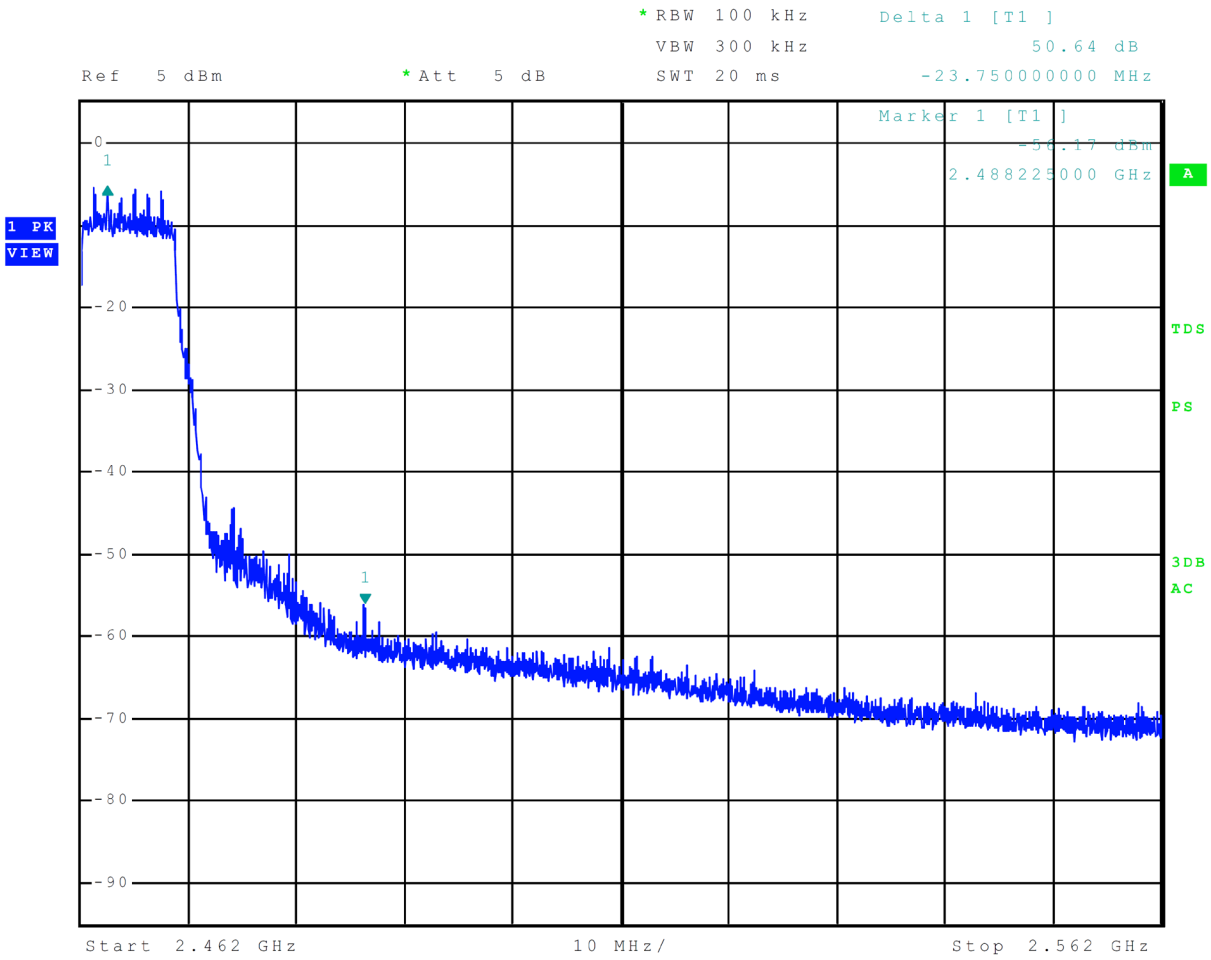


Figure 19 Plot of 6-dB Occupied Bandwidth Mode 3, BT 2EDR (π/4-DQPSK)

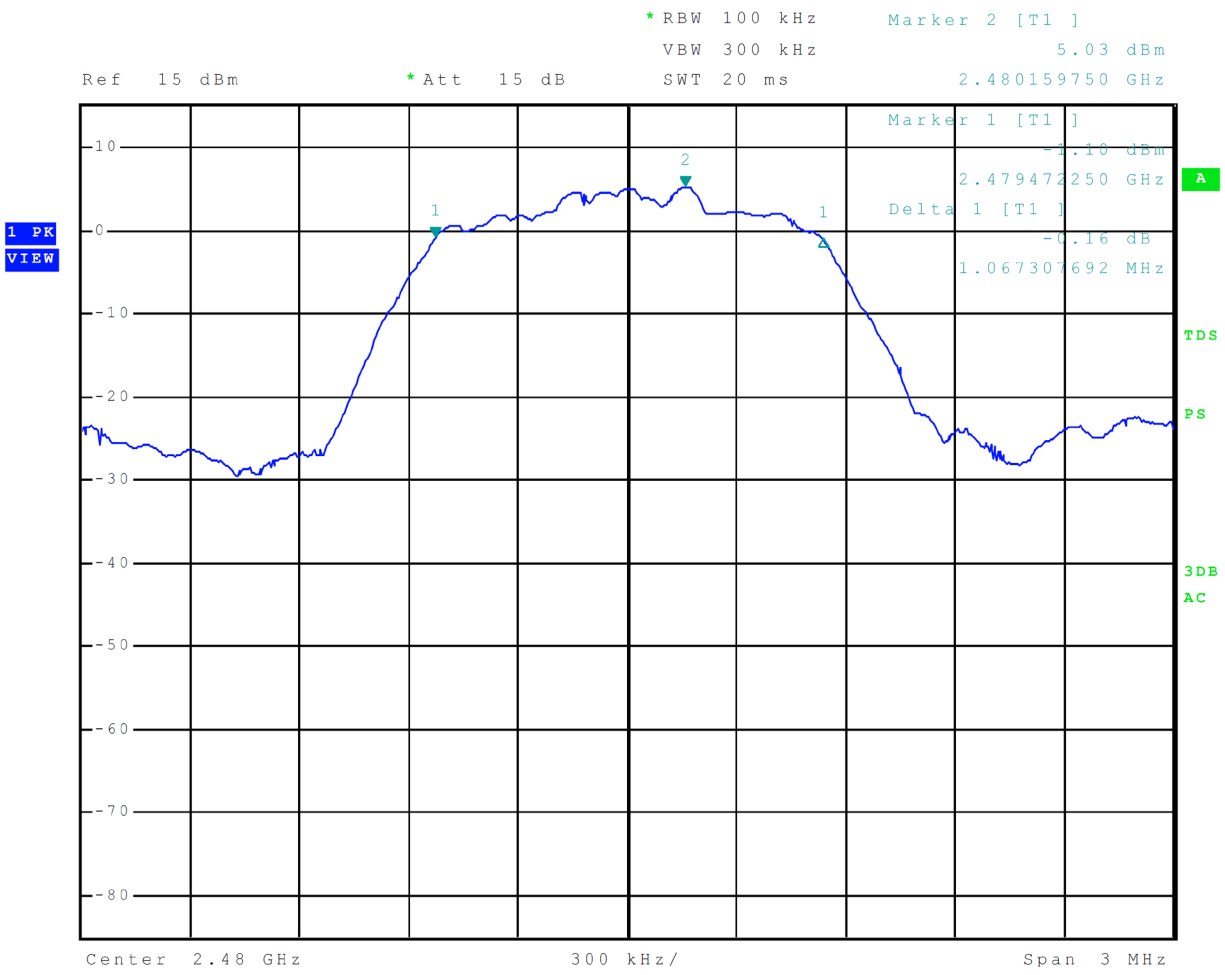


Figure 20 Plot of 99% Occupied Bandwidth Mode 3, BT 2EDR (π/4-DQPSK)

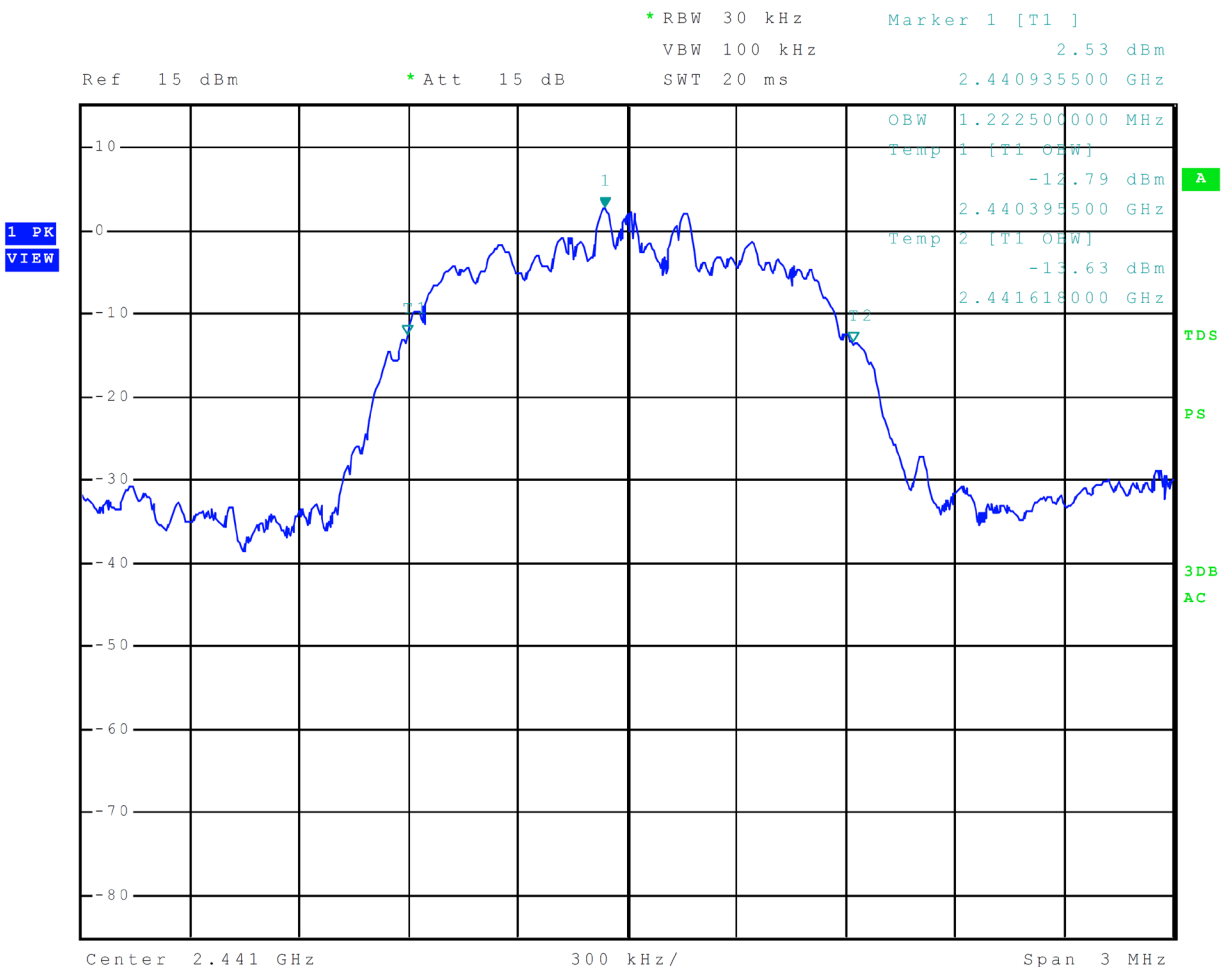


Figure 21 Plot of 6-dB Occupied Bandwidth Mode 4, BT 3EDR (8DPSK)

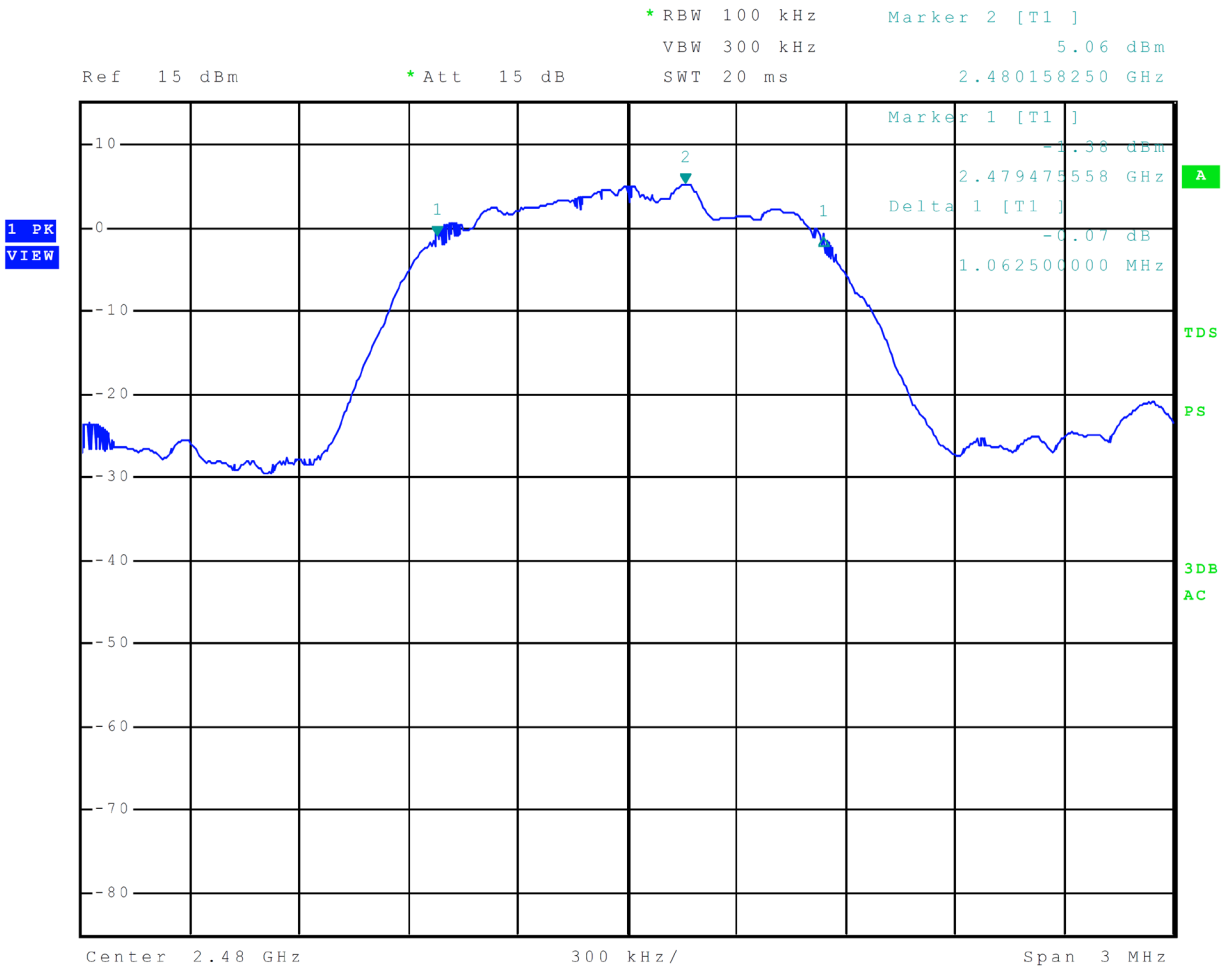


Figure 22 Plot of 99% Occupied Bandwidth Mode 4, BT 3EDR (8DPSK)

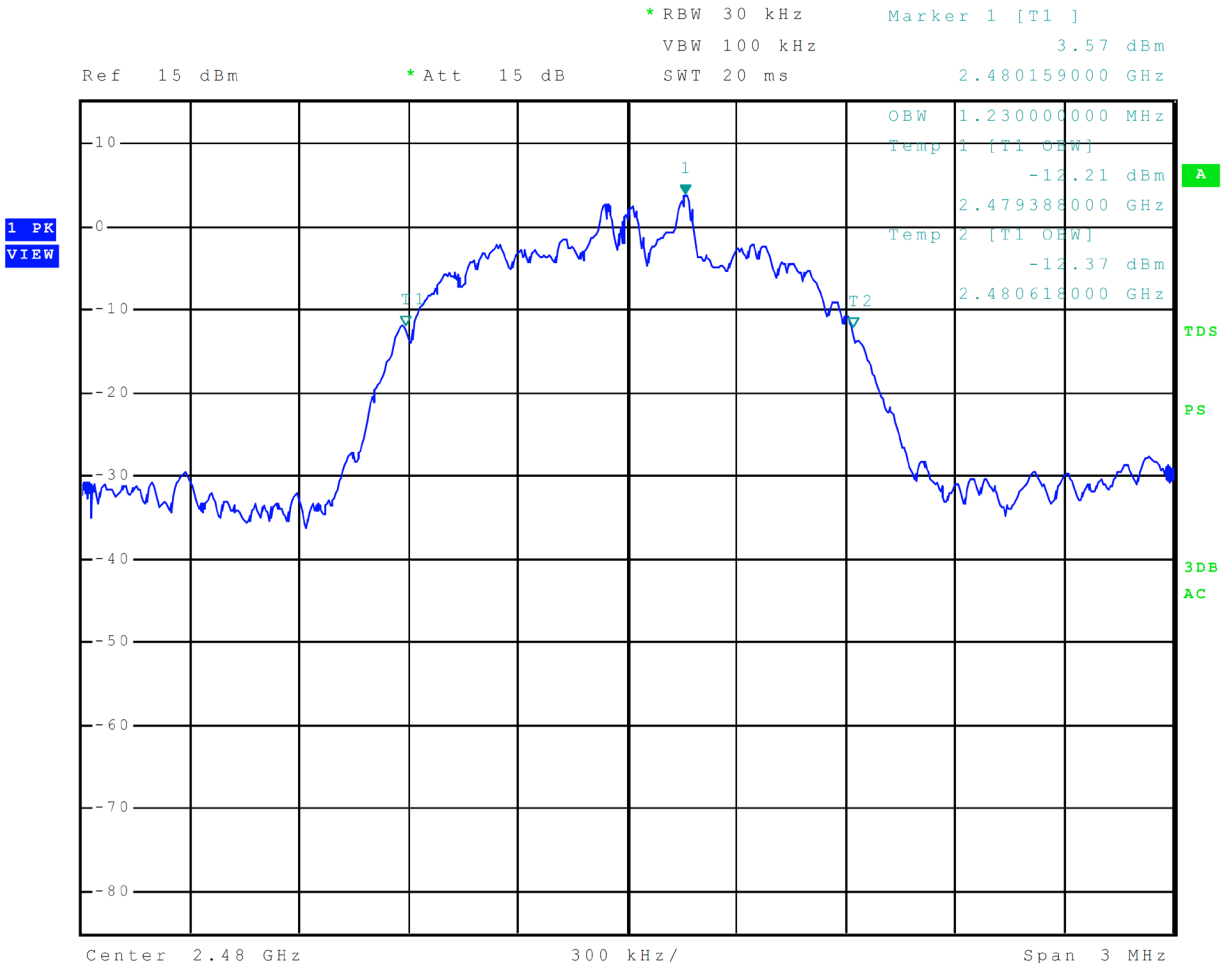


Figure 23 Plot of 6-dB Occupied Bandwidth Mode 5, BT BLE (GMSK)

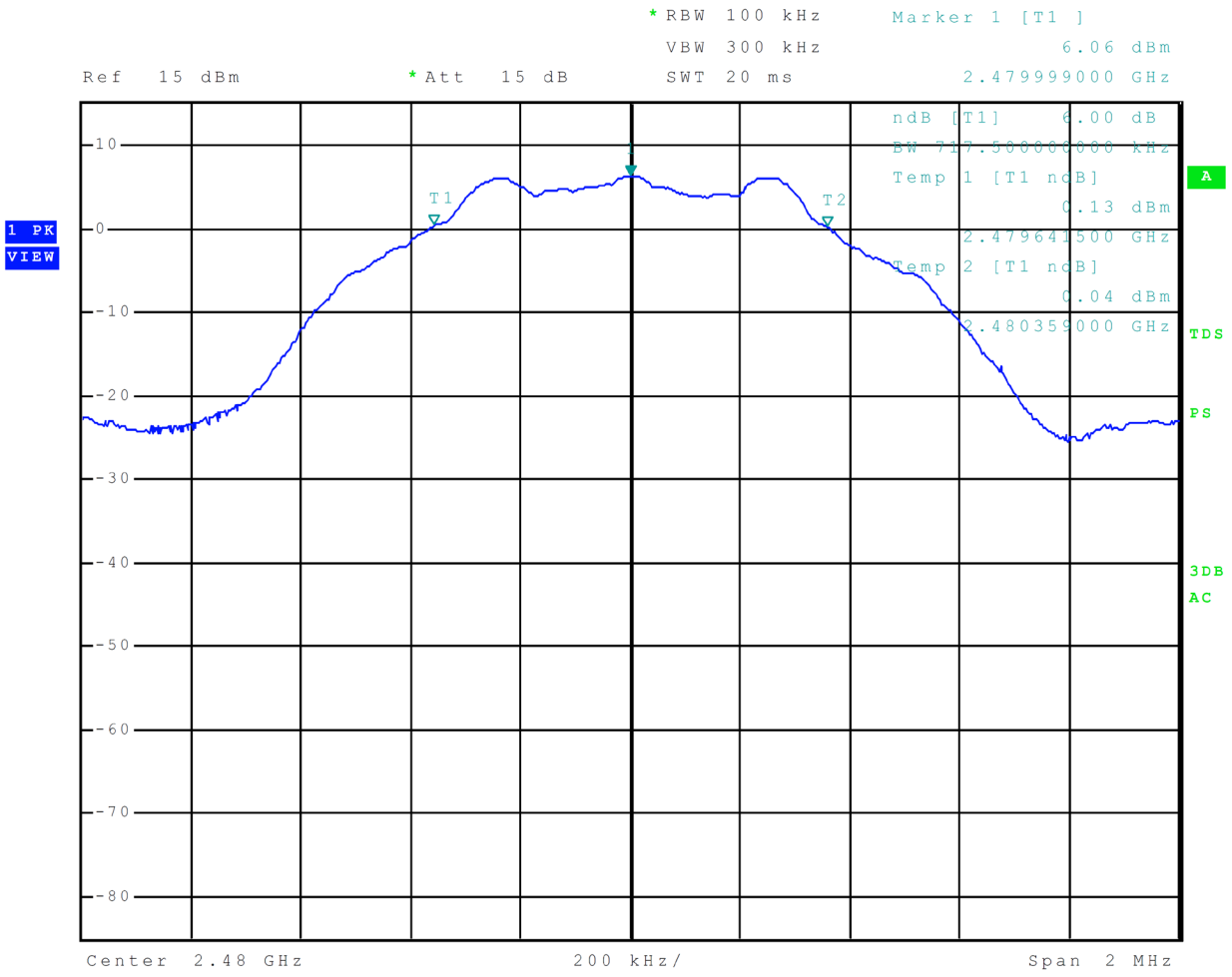


Figure 24 Plot of 99% Occupied Bandwidth Mode 5, BT BLE (GMSK)

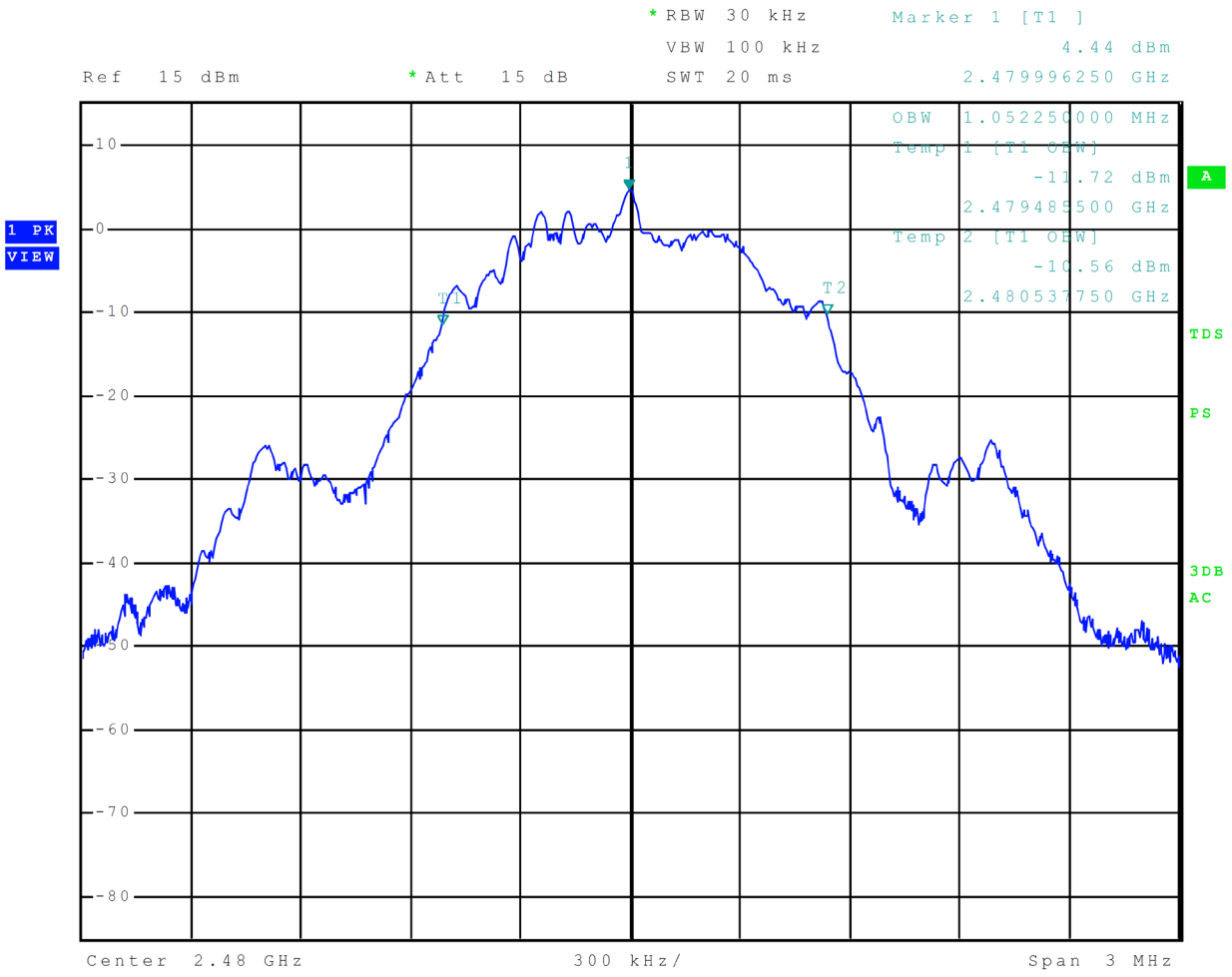


Figure 25 Plot of 6-dB Occupied Bandwidth Mode 6, 802.11b (DSSS/CCK)

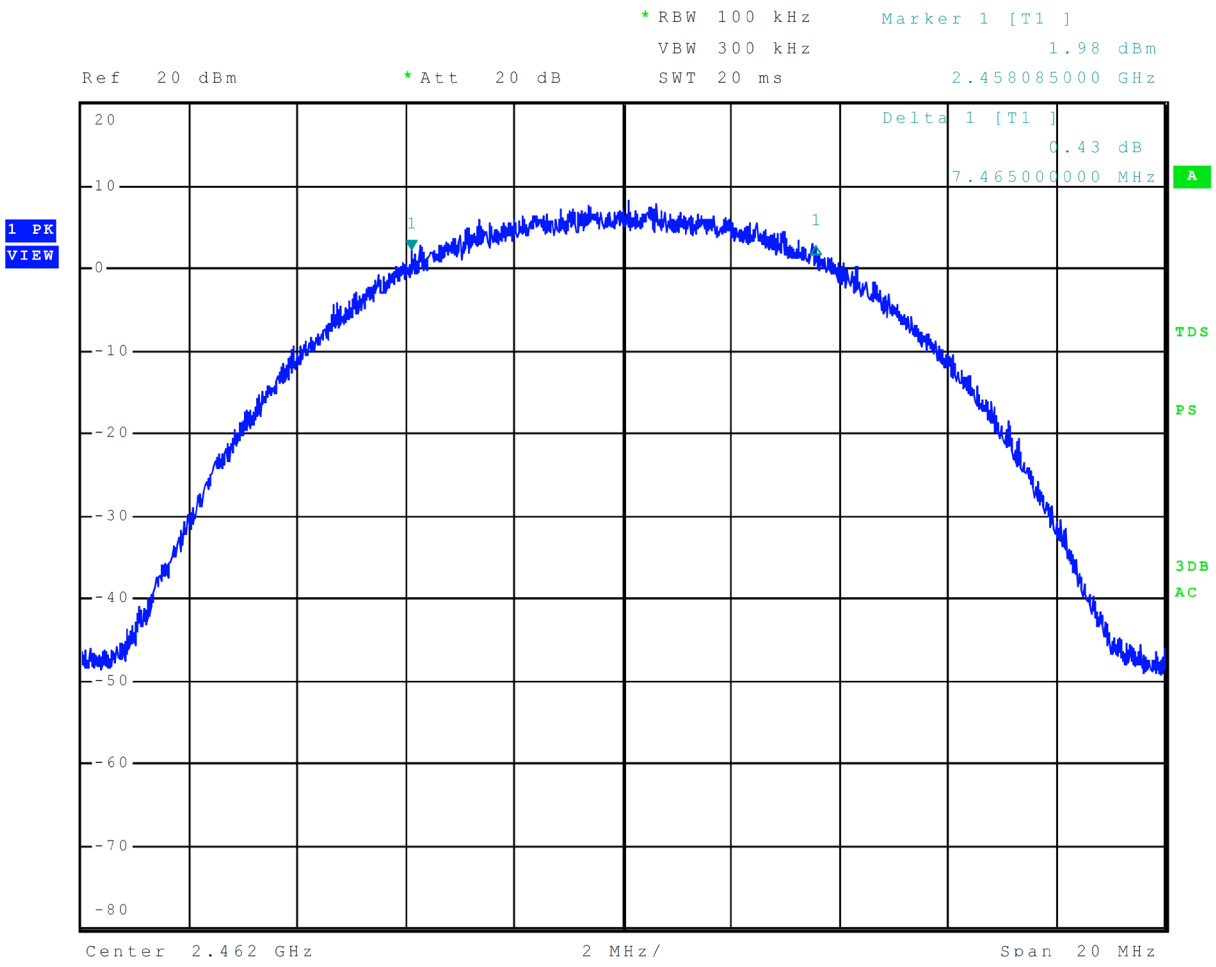


Figure 26 Plot of 99% Occupied Bandwidth Mode 6, 802.11b (DSSS/CCK)

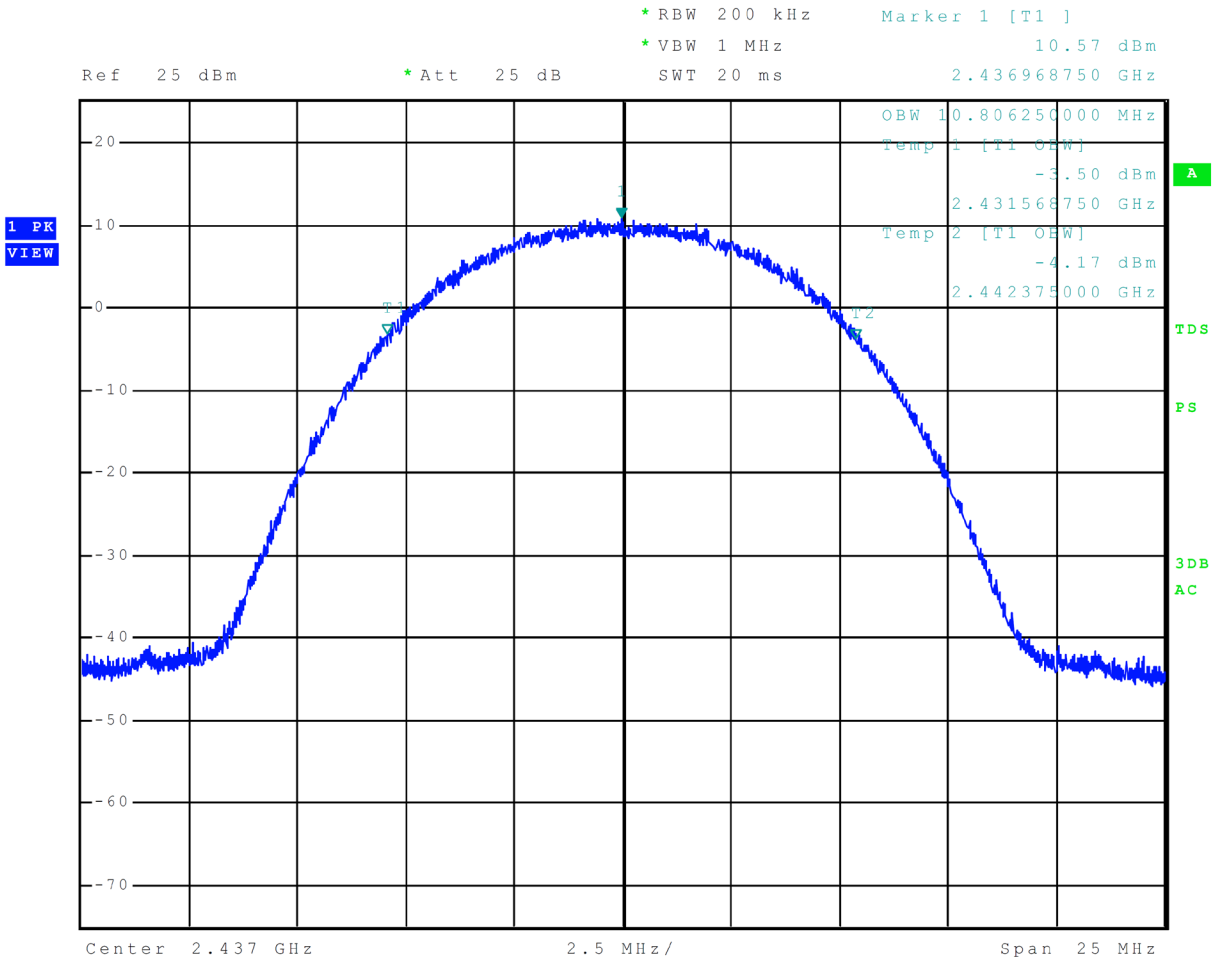


Figure 27 Plot of 6-dB Occupied Bandwidth Mode 7, 802.11g (OFDM)

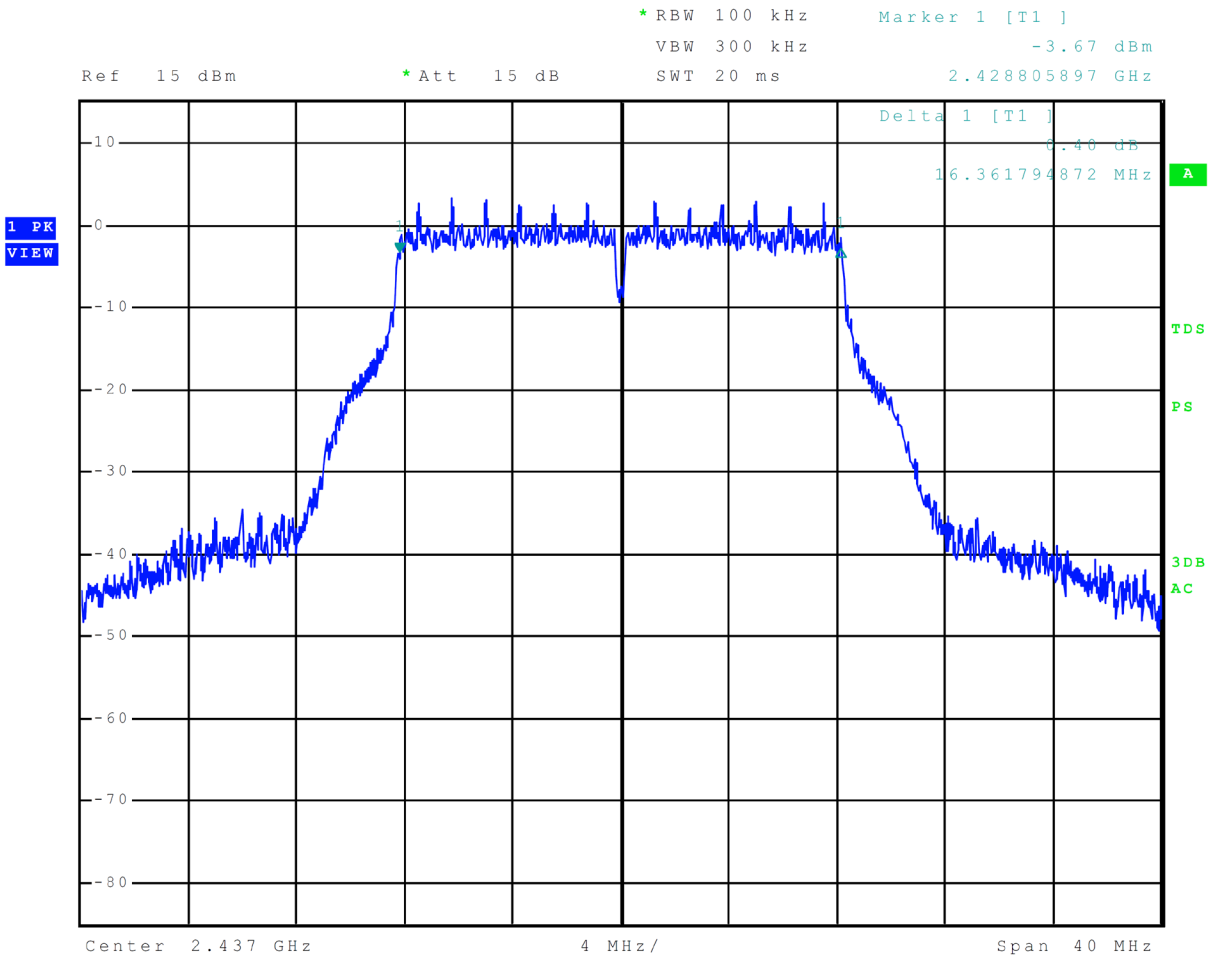


Figure 28 Plot of 99% Occupied Bandwidth Mode 7, 802.11g (OFDM)

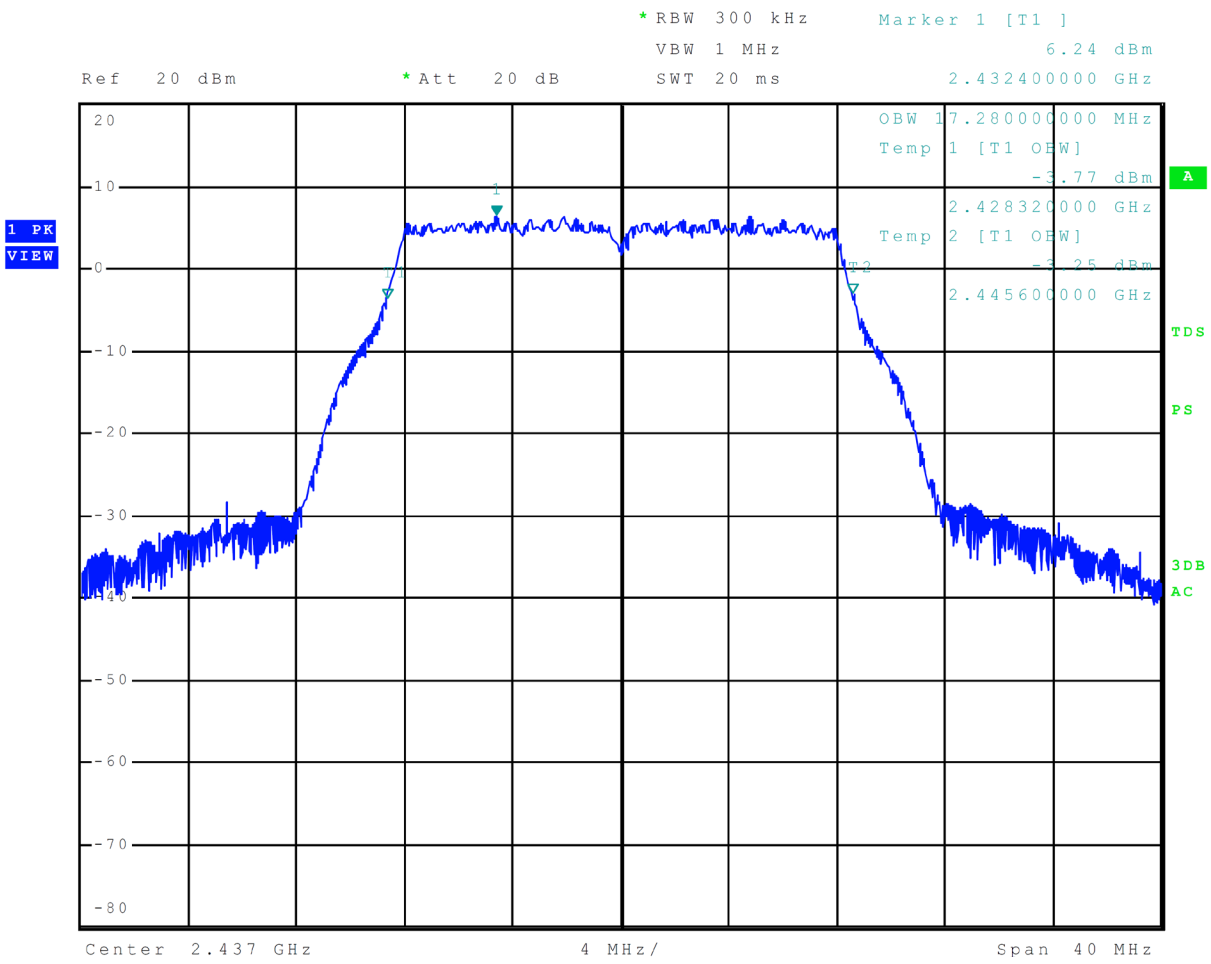


Figure 29 Plot of 6-dB Occupied Bandwidth Mode 8, 802.11n (MSC)

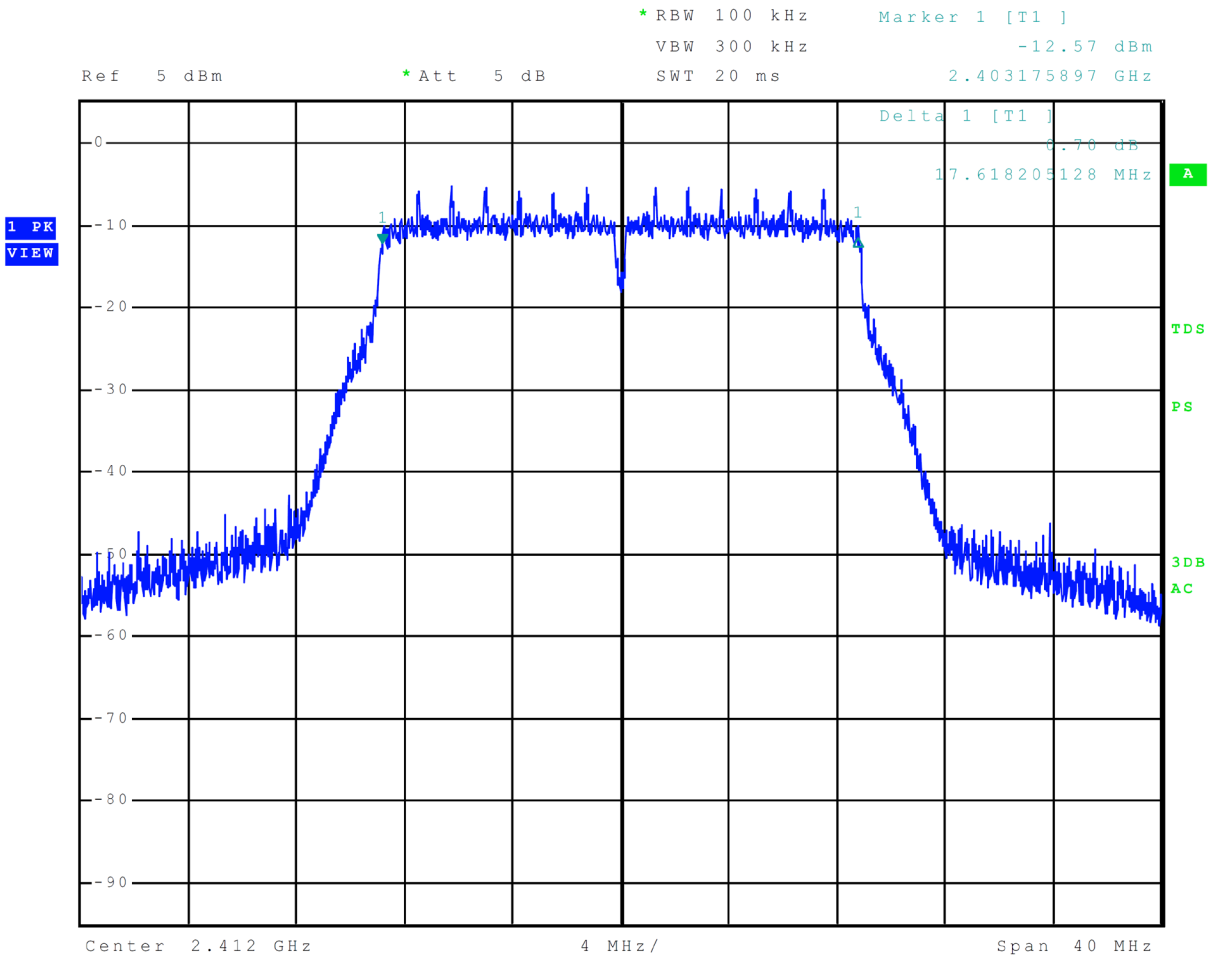


Figure 30 Plot of 99% Occupied Bandwidth Mode 8, 802.11n (MSC)

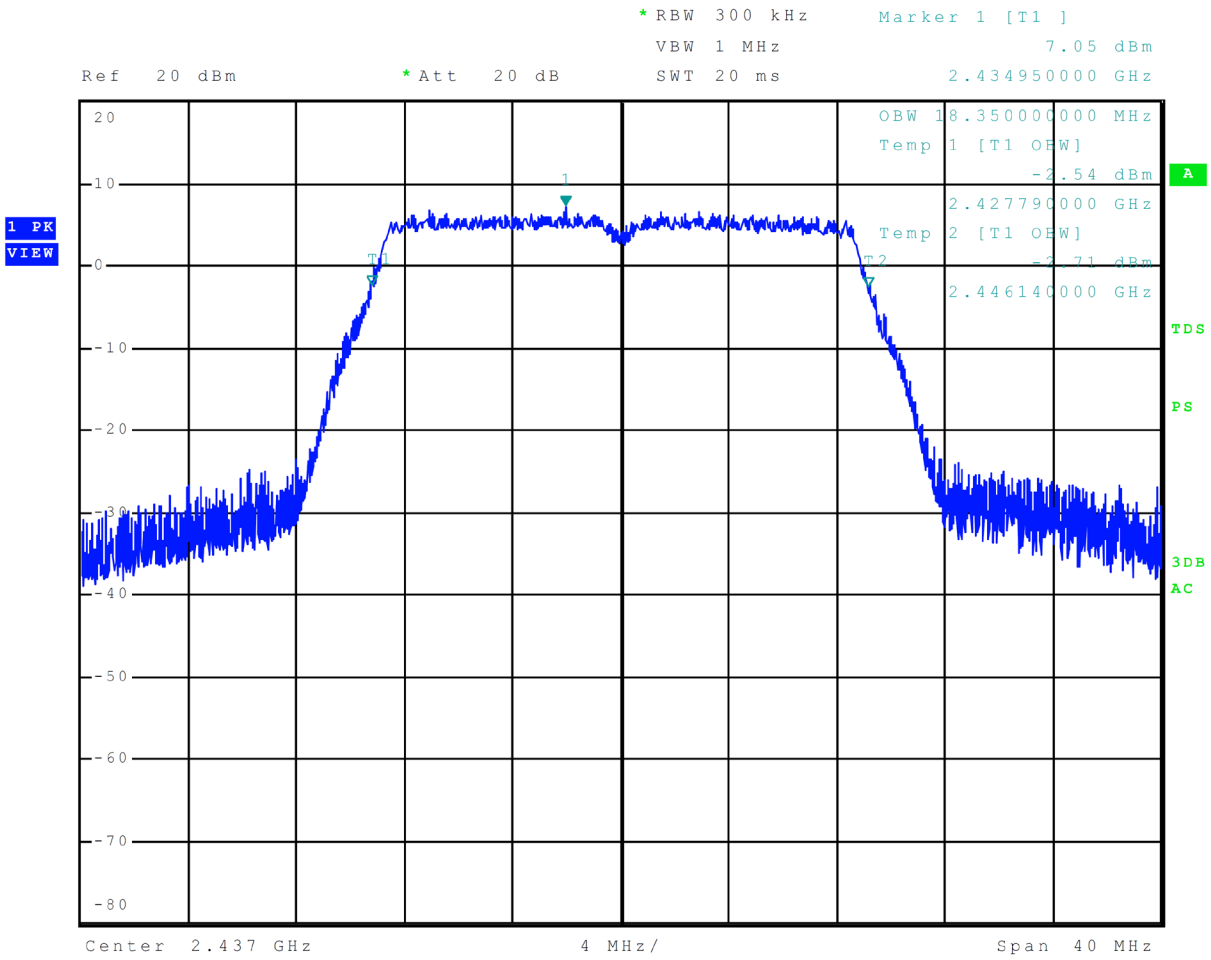


Figure 31 Plot of Transmitter Power Spectral Density Mode 3, BT 2EDR (π/4-DQPSK)

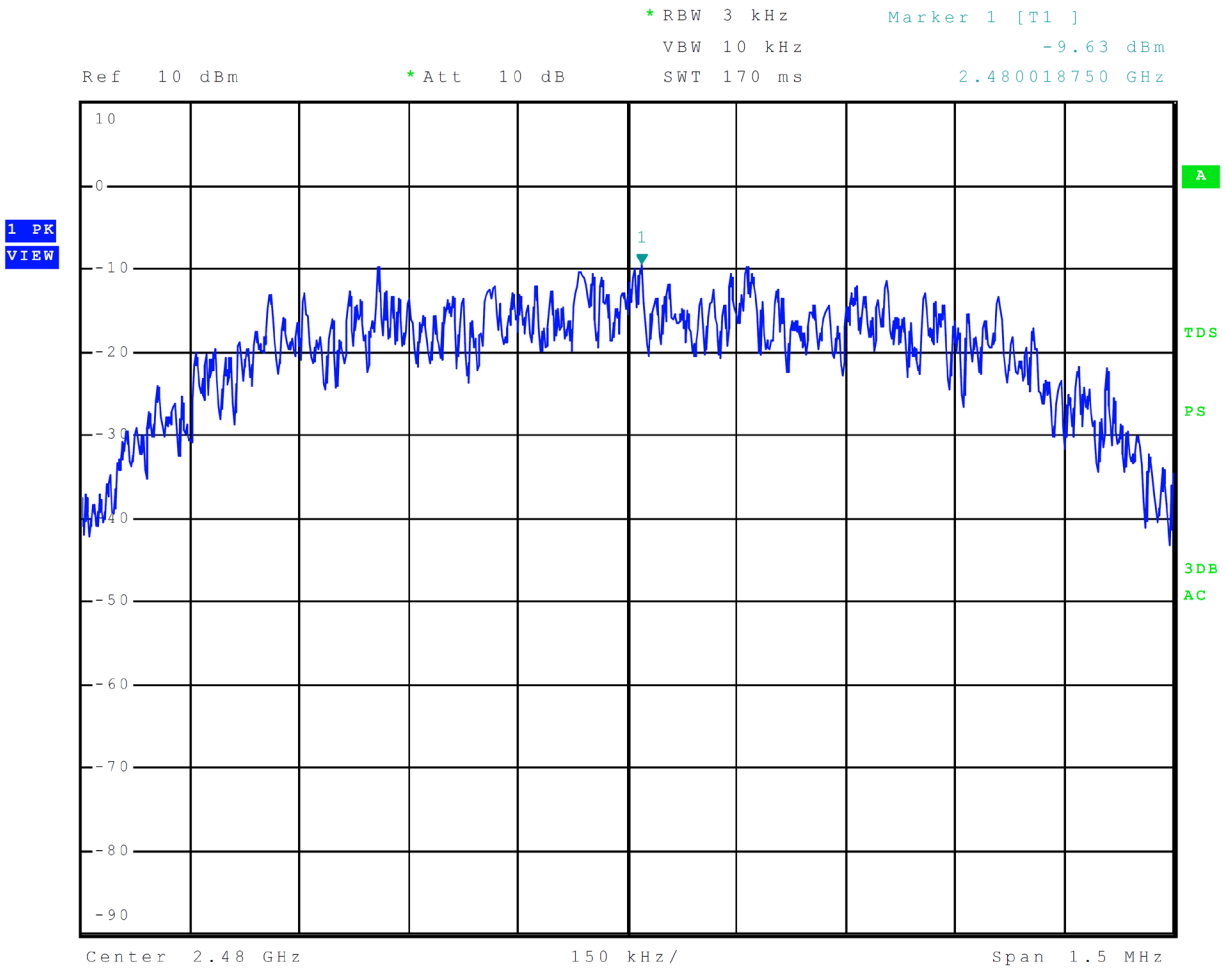


Figure 32 Plot of Transmitter Power Spectral Density Mode 4, BT 3EDR (8DPSK)

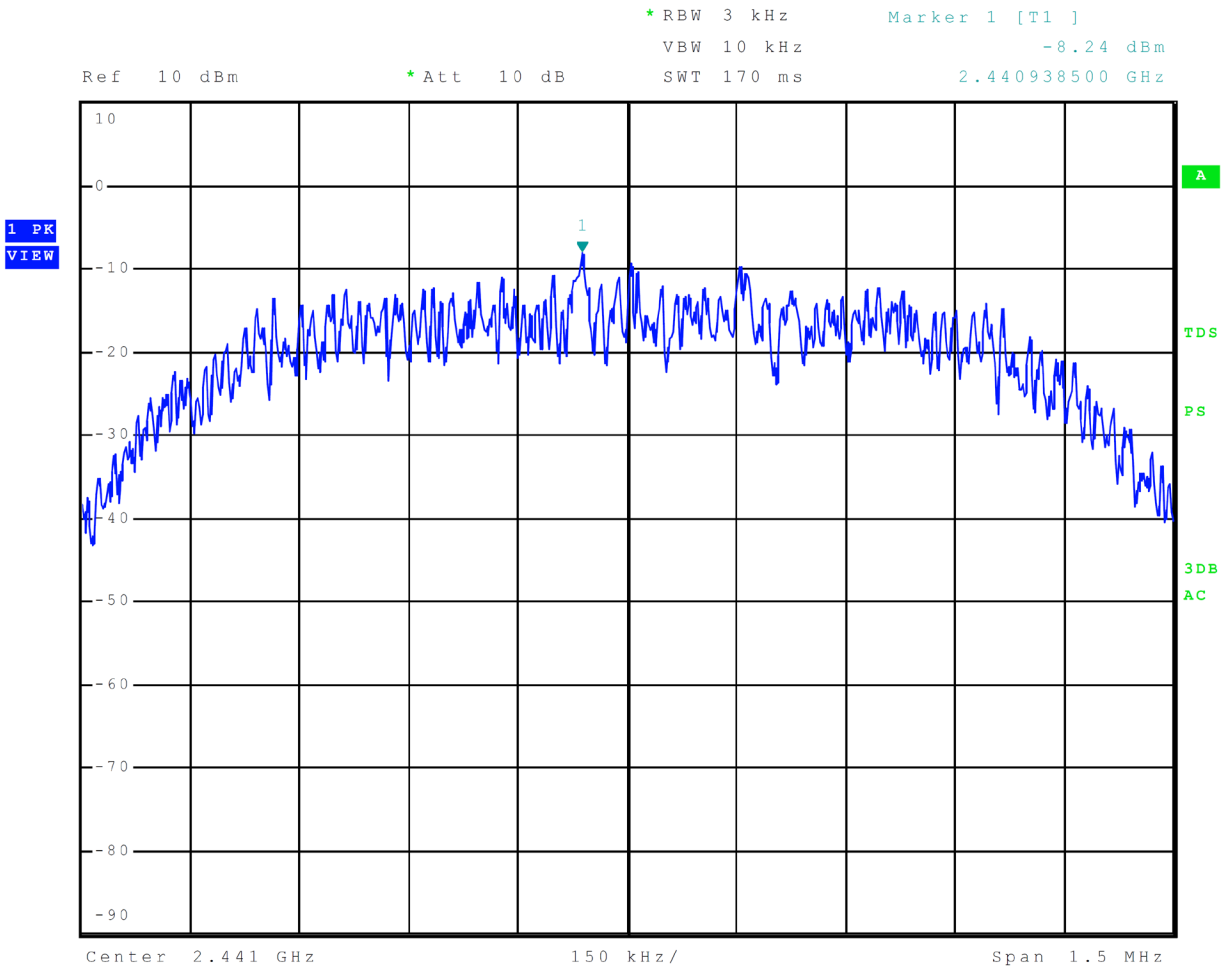


Figure 33 Plot of Transmitter Power Spectral Density Mode 5, BT BLE (GMSK)

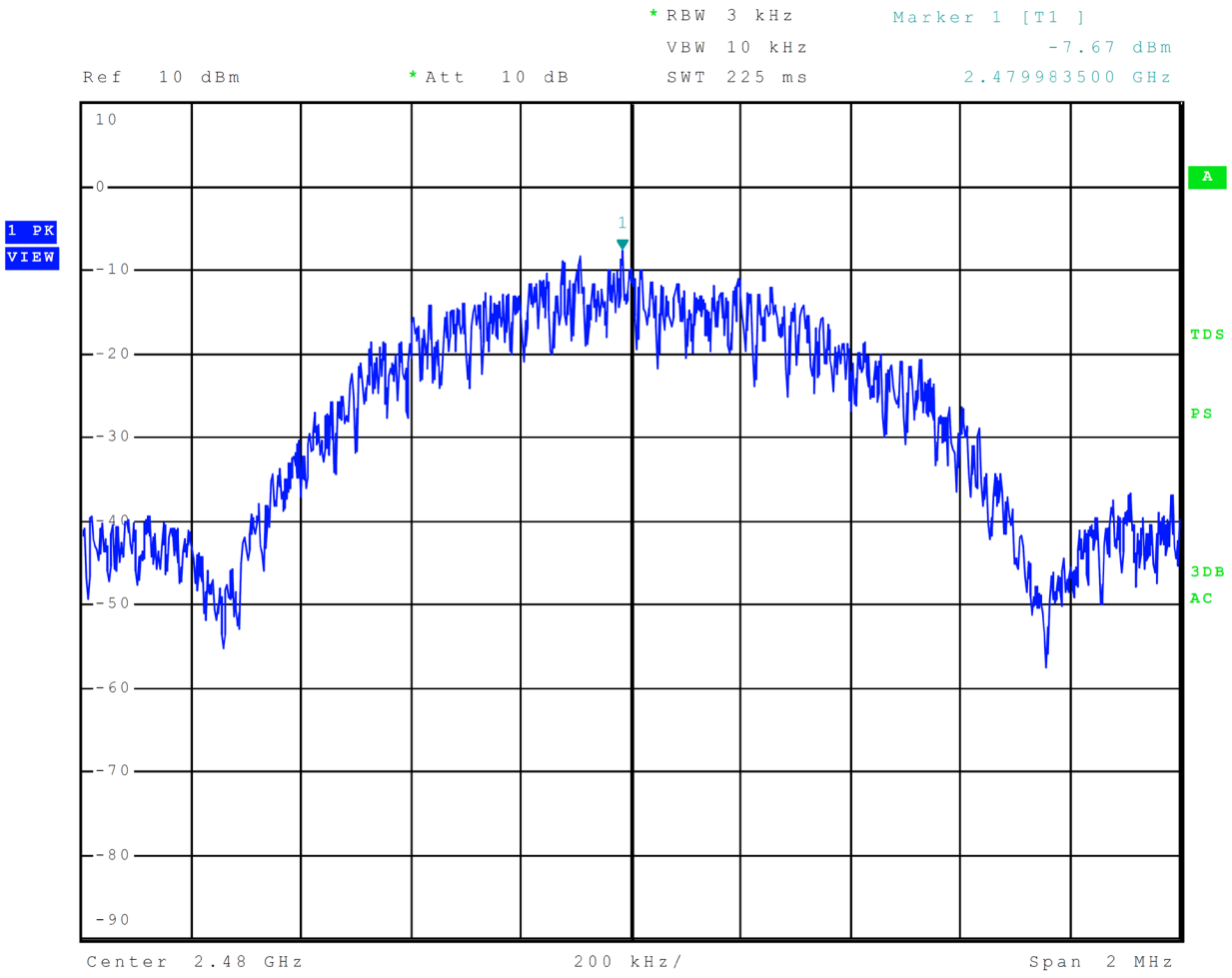


Figure 34 Plot of Transmitter Power Spectral Density Mode 6, 802.11b (DSSS/CCK)

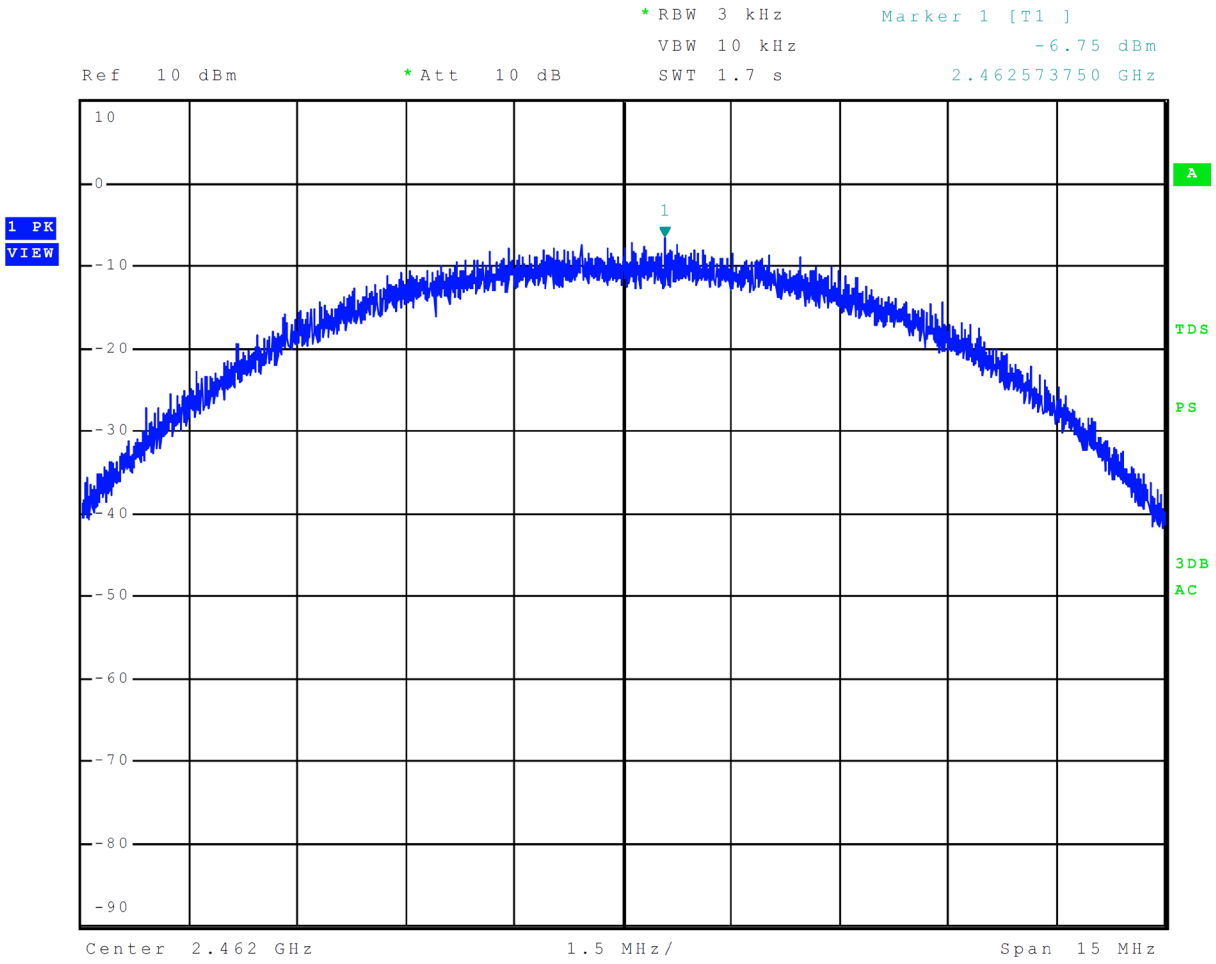


Figure 35 Plot of Transmitter Power Spectral Density Mode 7, 802.11g (OFDM)

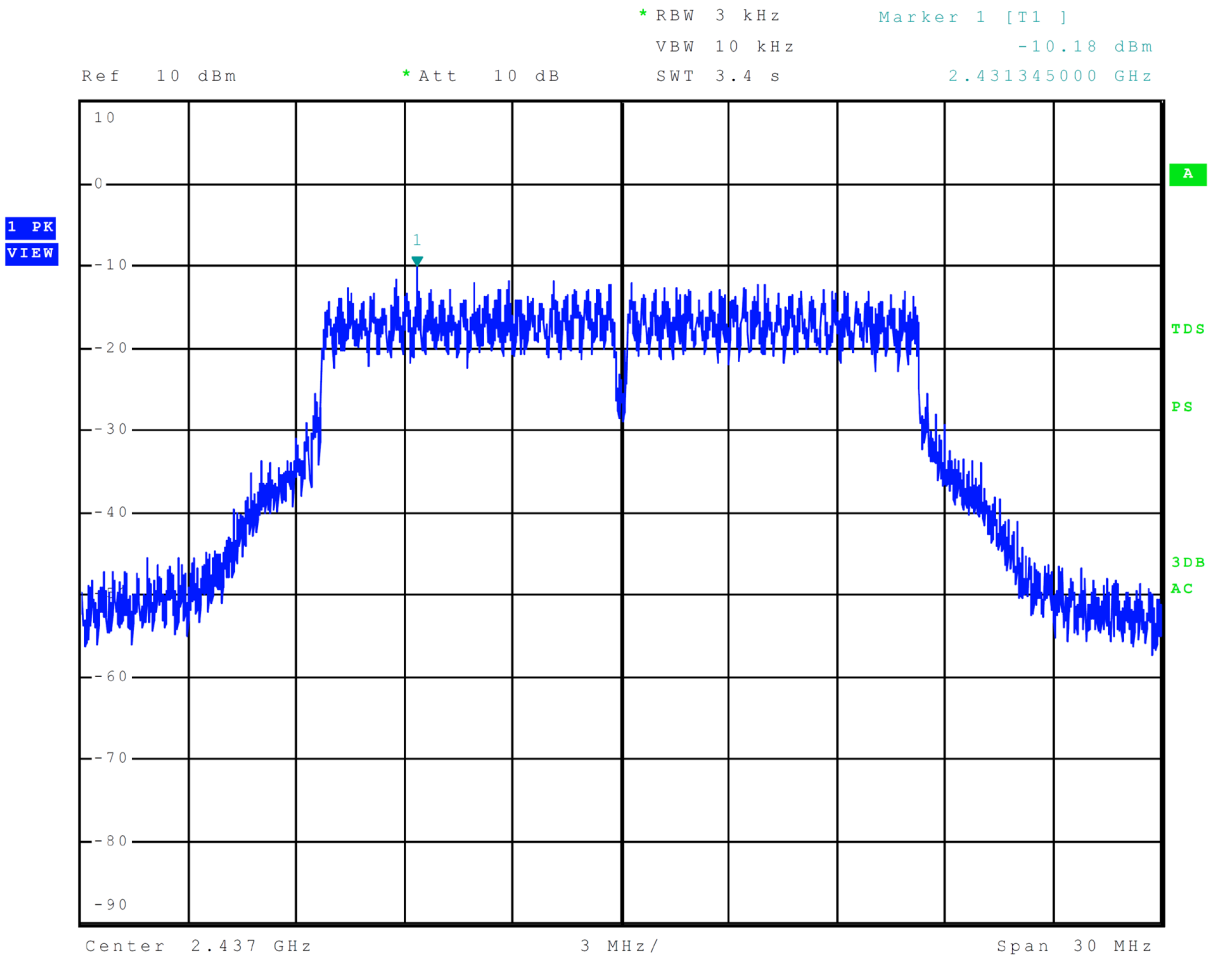
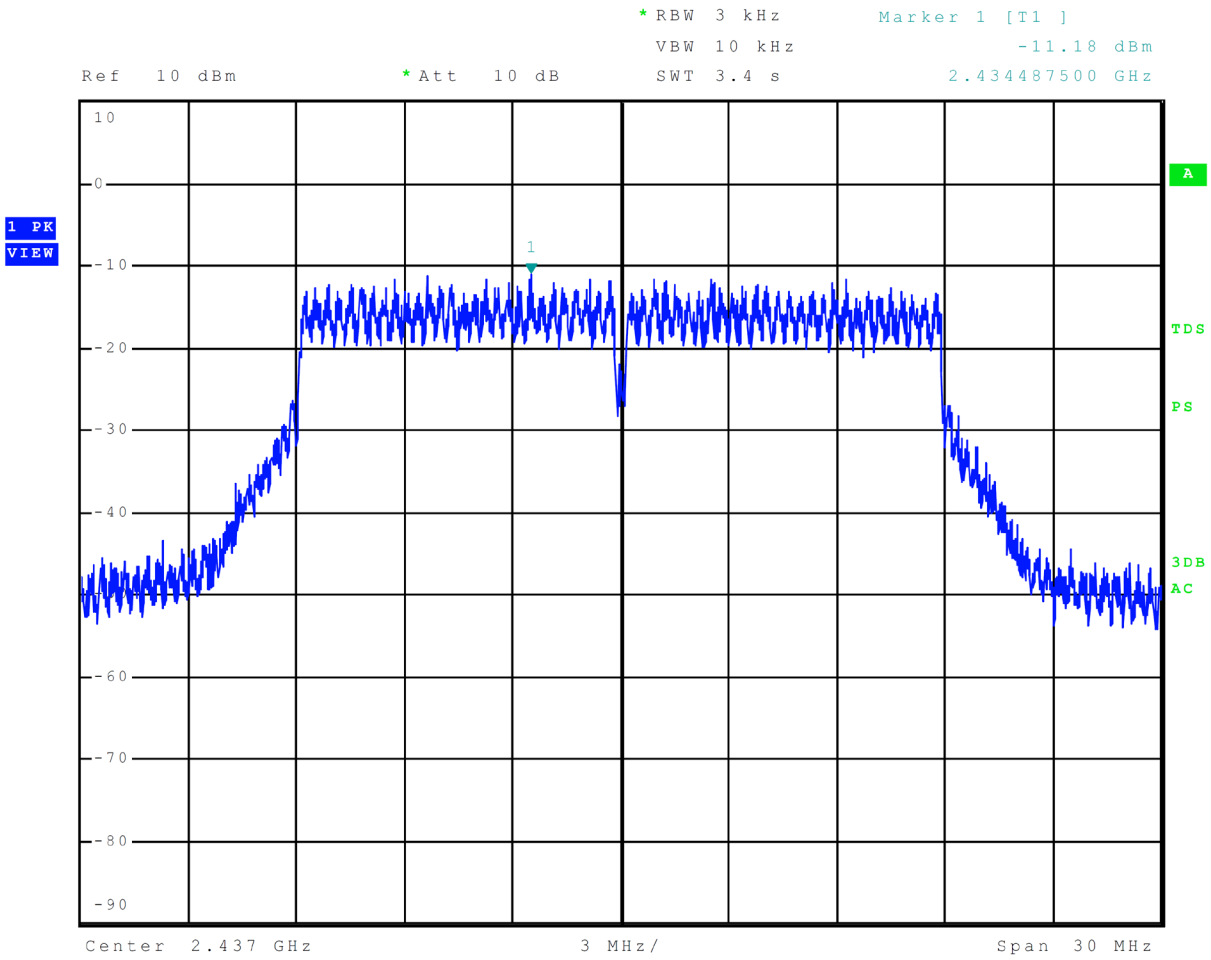


Figure 36 Plot of Transmitter Power Spectral Density Mode 8, 802.11n (MSC)



Transmitter Emissions Data

Table 8 Transmitter Radiated Emissions Mode 3, BT 2EDR (π/4-DQPSK)

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	--	--	--	--	--	--	--
4804.0	47.6	36.6	49.8	37.0	54.0	-17.4	-17.0
7206.0	60.1	49.2	53.9	40.9	54.0	-4.8	-13.1
9608.0	57.2	44.2	56.8	43.9	54.0	-9.8	-10.1
12010.0	60.1	47.0	59.4	46.9	54.0	-7.0	-7.1
14412.0	61.3	48.4	60.9	48.2	54.0	-5.6	-5.8
16814.0	65.4	52.9	65.4	52.6	54.0	-1.1	-1.4
2440.0	--	--	--	--	--	--	--
4880.0	49.6	36.6	50.1	36.7	54.0	-17.4	-17.3
7320.0	60.8	51.1	53.3	40.6	54.0	-2.9	-13.4
9760.0	56.6	43.6	56.8	43.6	54.0	-10.4	-10.4
12200.0	50.9	47.9	60.5	47.9	54.0	-6.1	-6.1
14640.0	61.6	48.9	61.7	48.9	54.0	-5.1	-5.1
17080.0	64.2	51.7	64.9	51.8	54.0	-2.3	-2.2
2480.0	--	--	--	--	--	--	--
4960.0	50.1	36.7	49.9	36.7	54.0	-17.3	-17.3
7440.0	56.3	43.9	55.9	43.9	54.0	-10.1	-10.1
9920.0	57.1	44.1	56.5	44.1	54.0	-9.9	-9.9
12400.0	60.1	47.6	60.3	47.6	54.0	-6.4	-6.4
14880.0	61.9	48.8	62.1	48.9	54.0	-5.2	-5.1
17360.0	64.1	51.4	63.9	51.4	54.0	-2.6	-2.6

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.

Table 9 Transmitter Radiated Emissions Mode 4, BT 3EDR (8DPSK)

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	--	--	--	--	--	--	--
4804.0	49.5	36.5	49.8	36.5	54.0	-17.5	-17.5
7206.0	60.8	48.2	53.2	40.4	54.0	-5.8	-13.6
9608.0	56.6	43.8	56.6	43.6	54.0	-10.2	-10.4
12010.0	59.4	46.7	59.4	46.7	54.0	-7.3	-7.3
14412.0	60.8	48.1	60.3	48.0	54.0	-5.9	-6.0
16814.0	65.4	52.6	65.2	52.4	54.0	-1.4	-1.6
2440.0	--	--	--	--	--	--	--
4880.0	50.1	36.8	49.6	36.6	54.0	-17.2	-17.4
7320.0	53.8	41.5	53.7	40.2	54.0	-12.5	-13.8
9760.0	58.2	45.1	56.4	43.6	54.0	-8.9	-10.4
12200.0	60.4	47.9	60.8	47.9	54.0	-6.1	-6.1
14640.0	61.2	48.9	61.8	49.0	54.0	-5.1	-5.0
17080.0	64.7	51.8	65.2	51.9	54.0	-2.2	-2.1
2480.0	--	--	--	--	--	--	--
4960.0	49.9	36.6	50.8	36.9	54.0	-17.4	-17.1
7440.0	56.0	43.2	53.6	40.9	54.0	-10.8	-13.1
9920.0	56.7	44.0	56.5	43.9	54.0	-10.0	-10.1
12400.0	60.1	47.5	60.5	47.5	54.0	-6.5	-6.5
14880.0	61.2	48.7	61.3	48.6	54.0	-5.3	-5.4
17360.0	64.1	51.5	64.2	51.3	54.0	-2.5	-2.7

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

Table 10 Transmitter Radiated Emissions Mode 5, BT BLE (GMSK)

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	--	--	--	--	--	--	--
4804.0	51.1	36.9	50.3	36.7	54.0	-17.1	-17.3
7206.0	56.0	43.9	55.1	41.3	54.0	-10.1	-12.7
9608.0	63.1	48.0	57.7	43.9	54.0	-6.0	-10.1
12010.0	60.4	47.0	60.0	46.9	54.0	-7.0	-7.1
14412.0	61.7	48.4	62.3	48.3	54.0	-5.6	-5.7
16814.0	66.5	53.1	66.5	53.0	54.0	-0.9	-1.0
2440.0	--	--	--	--	--	--	--
4880.0	50.8	36.8	50.1	36.6	54.0	-17.2	-17.4
7320.0	55.9	42.4	56.5	43.1	54.0	-11.6	-10.9
9760.0	58.7	44.1	56.8	43.4	54.0	-9.9	-10.6
12200.0	61.2	47.7	60.8	47.8	54.0	-6.3	-6.2
14640.0	62.7	49.1	62.4	49.1	54.0	-4.9	-4.9
17080.0	65.5	52.1	65.1	52.0	54.0	-1.9	-2.0
2480.0	--	--	--	--	--	--	--
4960.0	51.4	37.2	50.2	36.4	54.0	-16.8	-17.6
7440.0	57.8	44.5	53.7	40.7	54.0	-9.5	-13.3
9920.0	57.8	44.0	57.4	43.9	54.0	-10.0	-10.1
12400.0	60.9	47.4	61.3	47.4	54.0	-6.6	-6.6
14880.0	62.6	49.0	62.3	49.0	54.0	-5.0	-5.0
17360.0	65.3	51.9	65.3	51.9	54.0	-2.1	-2.1

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.

Table 11 Transmitter Radiated Emissions Mode 6, 802.11b (DSSS/CCK))

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)
2412.0	--	--	--	--	--	--	--
4824.0	49.6	36.1	50.0	36.0	54.0	-17.9	-18.0
7236.0	53.6	40.6	56.0	42.5	54.0	-13.4	-11.5
9648.0	56.6	44.0	56.0	43.7	54.0	-10.0	-10.3
12060.0	60.5	47.7	59.0	46.7	54.0	-6.3	-7.3
14472.0	61.2	48.1	60.7	47.8	54.0	-5.9	-6.2
16884.0	65.5	52.3	65.0	52.3	54.0	-1.7	-1.7
2437.0	--	--	--	--	--	--	--
4874.0	49.5	36.2	50.0	36.2	54.0	-17.8	-17.8
7311.0	56.7	43.3	55.0	41.4	54.0	-10.7	-12.6
9748.0	56.3	43.3	56.5	43.3	54.0	-10.7	-10.7
12185.0	60.9	47.6	60.2	47.6	54.0	-6.4	-6.4
14622.0	61.7	48.8	62.5	48.8	54.0	-5.2	-5.2
17059.0	64.6	51.6	64.5	51.6	54.0	-2.4	-2.4
2462.0	--	--	--	--	--	--	--
4924.0	50.1	36.3	49.3	36.3	54.0	-17.7	-17.7
7386.0	53.7	40.9	53.9	40.4	54.0	-13.1	-13.6
9848.0	56.8	44.0	56.6	44.0	54.0	-10.0	-10.0
12310.0	60.9	47.7	60.8	47.9	54.0	-6.3	-6.1
14772.0	62.0	49.0	62.2	48.9	54.0	-5.0	-5.1
17234.0	64.1	51.1	64.0	51.0	54.0	-2.9	-3.0

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.

Table 12 Transmitter Radiated Emissions Mode 7, 802.11g (OFDM)

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)
2412.0	--	--	--	--	--	--	--
4824.0	49.5	36.3	49.3	36.3	54.0	-17.7	-17.7
7236.0	55.0	41.9	54.9	42.0	54.0	-12.1	-12.0
9648.0	56.4	43.8	56.2	43.7	54.0	-10.2	-10.3
12060.0	60.0	46.8	59.8	46.7	54.0	-7.2	-7.3
14472.0	61.0	48.0	60.6	48.0	54.0	-6.0	-6.0
16884.0	65.7	52.5	65.5	52.5	54.0	-1.5	-1.5
2437.0	--	--	--	--	--	--	--
4874.0	50.0	36.3	50.3	36.2	54.0	-17.7	-17.8
7311.0	55.9	42.8	54.0	40.9	54.0	-11.2	-13.1
9748.0	56.3	43.4	57.3	43.4	54.0	-10.6	-10.6
12185.0	60.2	47.7	61.2	47.9	54.0	-6.3	-6.1
14622.0	61.9	48.9	62.1	49.0	54.0	-5.1	-5.0
17059.0	64.4	51.7	64.8	51.8	54.0	-2.3	-2.2
2462.0	--	--	--	--	--	--	--
4924.0	49.9	36.4	49.9	36.4	54.0	-17.6	-17.6
7386.0	58.3	44.5	57.0	43.6	54.0	-9.5	-10.4
9848.0	57.6	44.2	57.6	44.3	54.0	-9.8	-9.7
12310.0	61.2	47.9	60.9	48.0	54.0	-6.1	-6.0
14772.0	62.4	49.1	62.4	49.2	54.0	-4.9	-4.8
17234.0	64.8	51.2	64.1	51.2	54.0	-2.8	-2.8

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.

Table 13 Transmitter Radiated Emissions Mode 8, 802.11n (MSC)

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)
2412.0	--	--	--	--	--	--	--
4824.0	49.5	36.5	49.8	36.4	54.0	-17.5	-17.6
7236.0	53.3	40.6	53.5	40.6	54.0	-13.4	-13.4
9648.0	56.7	43.9	56.5	43.9	54.0	-10.1	-10.1
12060.0	59.6	46.8	59.0	46.9	54.0	-7.2	-7.1
14472.0	60.9	48.1	61.0	48.5	54.0	-5.9	-5.5
16884.0	65.1	52.1	64.7	52.0	54.0	-1.9	-2.0
2437.0	--	--	--	--	--	--	--
4874.0	50.1	36.7	50.1	36.7	54.0	-17.3	-17.3
7311.0	53.4	40.6	53.3	40.6	54.0	-13.4	-13.4
9748.0	56.3	43.7	56.3	43.6	54.0	-10.3	-10.4
12185.0	60.6	47.9	60.5	47.9	54.0	-6.1	-6.1
14622.0	62.1	49.4	61.6	49.3	54.0	-4.6	-4.7
17059.0	65.7	52.8	65.3	52.7	54.0	-1.2	-1.3
2462.0	--	--	--	--	--	--	--
4924.0	49.6	36.6	49.7	36.6	54.0	-17.4	-17.4
7386.0	53.5	40.6	53.5	40.6	54.0	-13.4	-13.4
9848.0	56.9	44.4	57.2	44.4	54.0	-9.6	-9.6
12310.0	61.2	48.2	60.5	48.2	54.0	-5.8	-5.8
14772.0	62.0	49.5	62.4	49.5	54.0	-4.5	-4.5
17234.0	64.1	51.5	64.2	51.5	54.0	-2.5	-2.5

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.

Table 14 Transmitter Antenna Port Conducted Data modes 3, 4 and 5

Frequency MHz	Antenna Port Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	6-dB Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm)
Mode 3, BT 2EDR (π/4-DQPSK)				
2402	0.006	1,218.8	1,048.1	-10.3
2441	0.007	1,222.5	1,057.7	-9.5
2480	0.006	1,227.0	1,067.3	-9.6
Mode 4, BT 3EDR (8DPSK)				
2402	0.007	1,222.5	1,062.5	-9.0
2441	0.007	1,227.8	1,062.5	-8.2
2480	0.007	1,230.0	1,062.5	-8.1
Mode 5, BT BLE (GMSK)				
2402	0.008	1,053.0	719.0	-8.2
2440	0.008	1,053.0	711.0	-7.6
2480	0.007	1,052.3	717.5	-7.7

Table 15 Transmitter Antenna Port Conducted Data modes 6, 7 and 8

Frequency MHz	Antenna Port Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	6-dB Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm)
Mode 6, 802.11b (DSSS/CCK)				
2412	0.037	10,844.6	7,611.0	-7.4
2437	0.036	10,874.5	7,202.0	-7.3
2462	0.036	10,801.7	7,844.0	-6.4
Mode 7, 802.11g (OFDM)				
2412	0.007	17,250.0	16,397.7	-16.7
2437	0.030	17,280.0	16,361.8	-10.2
2462	0.007	17,260.0	16,352.6	-16.1
Mode 8, 802.11n (MSC)				
2412	0.004	18,300.0	17,618.2	-19.2
2437	0.026	18,350.0	17,549.5	-11.2
2462	0.004	18,310.0	17,574.1	-19.2

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated and conducted emission requirements of 47CFR Subpart 15C Paragraph 15.247, RSS-247 Issue 2 and RSS-GEN Issue 5 emission requirements for Digital Transmission Systems. The highest average output power measured at the antenna port for modes 3,4, and 5 was 0.008 Watts. The highest peak power spectral density measured at the antenna port for modes 3,4, and 5 presented a minimum margin of -15.6 dB below the requirements. The highest average output power measured at the antenna port for modes 6,7, and 8 was 0.037 Watts. The highest peak power spectral density measured at the antenna port for modes 6,7, and 8 presented a minimum margin of -14.4 dB below the requirements. The EUT demonstrated a minimum margin of -0.9 dB below the harmonic emissions requirements. There were no other significantly measurable emissions in the restricted bands other than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the requirements. There were no other deviations or exceptions to the requirements.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B 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. The results 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	3/28/2023	3/28/2024
☐ LISN: Fischer Custom Communications Model: FCC-LISN-50-16-2-08				3/28/2023	3/28/2024
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	10/11/2022	10/11/2023
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303070)	9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	10/11/2022	10/11/2023
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	10/11/2022	10/11/2023
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	10/11/2022	10/11/2023
☐ Antenna:	EMCO	6509	.001-30 MHz	10/14/2020	10/11/2023
☐ Antenna	ARA	BCD-235-B (169)	20-350MHz	10/11/2022	10/11/2023
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	10/11/2022	10/11/2023
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	10/11/2022	10/11/2024
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/28/2022	3/29/2024
☐ Antenna	Com Power	AH-118 (10110)	1-18 GHz	10/11/2022	10/11/2024
☒ Antenna	Com Power	AH-840 (101046)	18-40 GHz	3/27/2023	3/27/2025
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	6/26/2023	6/26/2024
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/25/2023	1/25/2024
☐ 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	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	10/11/2022	10/11/2023
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	10/11/2022	10/11/2023
☐ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	8/31/2022	8/31/2023
☐ Power Meter	Agilent	N1911A with N1921A	0.05-40 GHz	3/28/2023	3/28/2025
☐ Generator	Rohde & Schwarz	SMB100A6 (100150)	20Hz-6 GHz	3/28/2023	3/28/2024
☐ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/28/2023	3/28/2024
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50114 (017)1.5G HPF	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	HPM50105 (059) 6G HPF	30-18000 MHz	3/28/2023	3/28/2025
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/28/2023	3/28/2025
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1436)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/28/2023	3/28/2024
☐ Attenuator	Mini-Circuits	VAT-6W2+ (1736)	30-6000 MHz	3/28/2023	3/28/2024
☒ Weather station	Davis	6312 (A81120N075)		10/11/2022	10/11/2023

NVLAP Lab Code 200087-0

List of Test Equipment			Calibration Date (m/d/y)	Due
☐ Frequency Counter: Leader LDC-825 (8060153			3/28/2023	3/28/2025
☐ ISN:	Com-Power Model ISN T-8		3/28/2023	3/28/2024
☐ LISN	Compliance Design	FCC-LISN-2.Mod.cd,(126) .15-30MHz	10/11/2022	10/11/2024
☐ LISN:	Com-Power Model LI-220A		3/29/2023	3/29/2025
☐ LISN:	Com-Power Model LI-550C		10/11/2022	10/11/2024
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L4M)(281184) 9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)9kHz-40 GHz	10/11/2022	10/11/2023
☐ Cable	Time Microwave	4M-750HF290-750 (4M) 9kHz-24 GHz	10/11/2022	10/11/2023
☐ RF Filter	Micro-Tronics	BRC17663 (001) 9.3-9.5 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ RF Filter	Micro-Tronics	BRC19565 (001) 9.2-9.6 notch 30-1800 MHz	3/28/2023	3/28/2025
☐ Analyzer	HP	8562A (3051A05950) 9kHz-125GHz	3/28/2023	3/28/2024
☐ Wave Form Generator Keysight		33512B (MY57400128)	3/29/2022	3/29/2024
☐ Antenna:	Solar 9229-1 & 9230-1		2/18/2023	2/18/2024
☐ CDN:	Com-Power Model CDN325E		10/11/2022	10/11/2024
☐ Oscilloscope Scope: Tektronix MDO 4104			2/18/2023	2/18/2024
☐ EMC Transient Generator HVT TR 3000			2/18/2023	2/18/2024
☐ AC Power Source (Ametech, California Instruments)			2/18/2023	2/18/2024
☐ Field Intensity Meter: EFM-018			2/18/2023	2/18/2024
☐ ESD Simulator: MZ-15			2/18/2023	2/18/2024
☐ Injection Clamp Luthi Model EM101			not required	
☐ R.F. Power Amp ACS 230-50W			not required	
☐ R.F. Power Amp EIN Model: A301			not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7			not required	
☐ R.F. Power Amp A.R. Model: 50U1000			not required	
☐ Temperature Chamber			not required	
☒ Shielded Room			not required	

Annex C Rogers Qualifications

Scot D. Rogers, Engineer

Rogers Labs, Inc.

Mr. Rogers has approximately 37 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.

Electrical Engineer: Rogers Consulting Labs, Inc.

Electrical Engineer: Rogers Labs, Inc. Current

Educational Background:

Bachelor of Science Degree in Electrical Engineering from Kansas State University

Bachelor of Science Degree in Business Administration Kansas State University

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

NVLAP Lab Code 200087-0

Annex D 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).

2023-03-16 through 2024-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

Antenna Gain Information: A04277, B04277, C04277, D04277

Equipment Description:

This report contains the antenna gain information for the antennas for Garmin Model A04277, B04277, C04277, and D04277. The approximate operational frequency band of these technologies is given, and the maximum gain within the frequency band is reported.

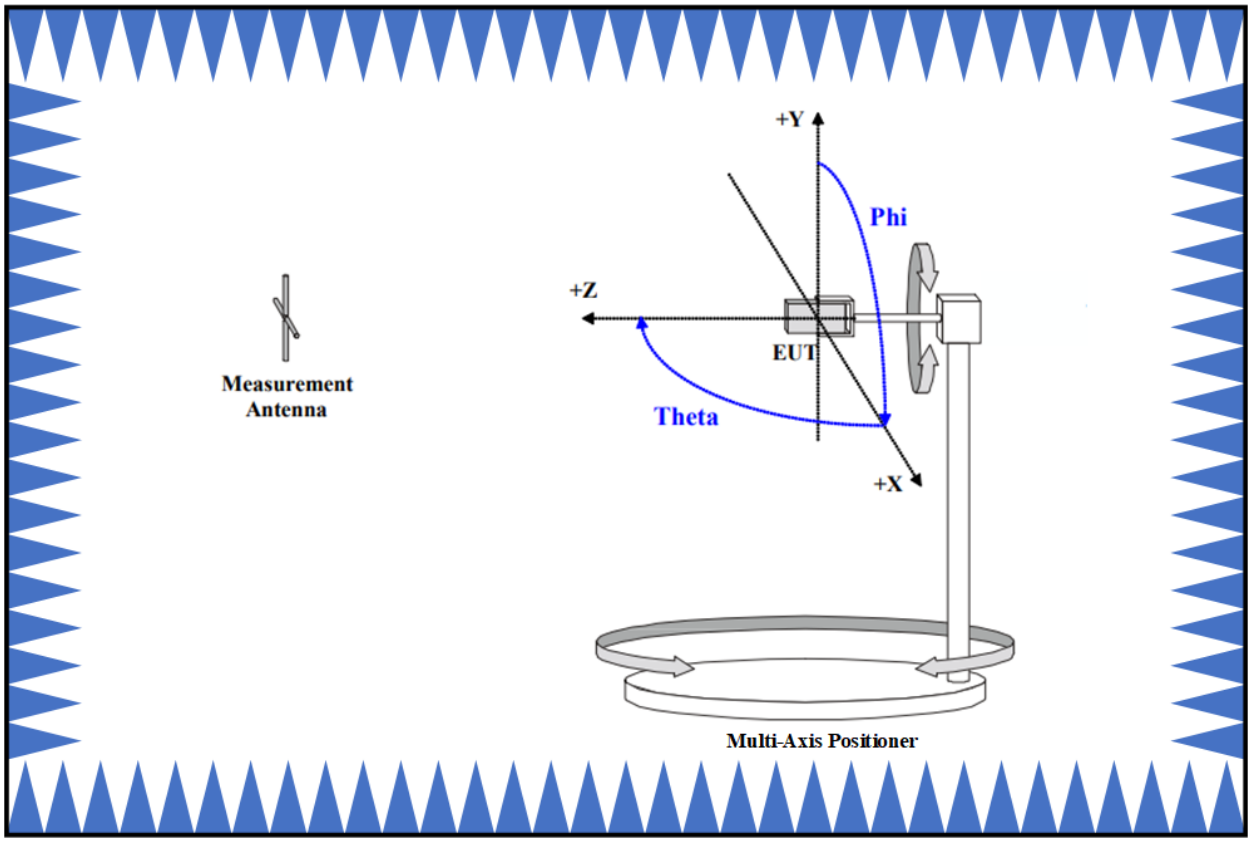
Reported Data:

Antenna	Gain @ Frequency	Approximate Frequency Band
Bluetooth	5.74 dBi @ 2400 MHz	2400 to 2480 MHz
ANT	4.65 dBi @ 2460 MHz	2400 to 2480 MHz
WiFi 0	0.90 dBi @ 2460 MHz	2400 to 2480 MHz
WiFi 1	0.90 dBi @ 2460 MHz	2400 to 2480 MHz

Procedure:

Garmin uses an ETS-Lindgren AMS-8500 3D Fully Anechoic Automated Antenna Measurement System. The measurement chamber is fully anechoic and contains both the Equipment Under Test (EUT) and the measurement antenna. The EUT is mounted on a Multi-Axis Positioner, which can orient the antenna in all orientations relative to the measurement antenna. The measurement antenna is dual-polarized and measures both horizontal and vertical polarization simultaneously. The other equipment includes a Vector Signal Generator, a multi-channel Vector Network Analyzer, and a control PC. Data is taken and analyzed using EMQuest Data Acquisition and Analysis Software. The output includes the maximum 3D antenna gain within the frequency band.

Setup:



Equipment List:

3D Chamber PC interfaced to Test Equipment
EMQuest Software w/ Required Drivers for Equipment Installed
AMS-8500 Anechoic Wireless Test Chamber
Dual Polarization Measurement Antenna (ETS 3164)
Multi-Axis Positioning System (MAPS)
Multi-Axis Positioning Controller (ETS EMCO Model 2090)
Network Analyzer (Agilent E5017C)
Automated RF Switch Controller (Agilent)

Additional Information:

Information regarding antenna design, dimension, cable length, etc. is provided in the Confidential Operation Description exhibit.

	Model:	4277	Test Number:	230405D					
MPE Calculator	RF Exposure uses EIRP for calculation. EIRP is based on TX power added to the antenna gain in dBi.								
	dBi = dB gain compared to an isotropic radiator.								
	S = power density in mW/cm^2								
	Peak Transmitter Output power (mW)		2						
	Peak Transmitter Output power (W)		0.002						
Output Power for 100% duty Cycle operation (Watts)	100		0.0022		Antenna Gain (dBi)	4.7			
	Output Power for 0.417% duty Cycle operation (Watts)		0.0022		Antenna Gain (Numeric)	2.95			
Tx Frequency (MHz)	2402	Calcualtion power (Watts)	0.0022		dBd + 2.17 = dBi	dBi to dBd	2.2		
						Antenna Gain (dBd)	2.53		
Cable Loss (dB)	0.0	Adjusted Power (dBm)	3.50			Antenna minus cable (dBi)	4.70		
						Antenna Gain (Numeric)	2.95		
	Calculated ERP (mw)	4.009				EIRP = Po(dBM) + Gain (dB)			
	Calculated EIRP (mw)	6.607				Radiated (EIRP) dBm	8.200		
						ERP = EIRP - 2.17 dB			
						Radiated (ERP) dBm	6.030		

Power density (S) mW/cm^2 = EIRP / (4 p r^2)

r (cm) EIRP (mW)

	Occupational Limit	FCC radio frequency radiation exposure limits per 1.1310		
5	mW/cm^2	Frequency (MHz)	Occupational Limit (mW/cm^2)	Public Limit (mW/cm^2)
50	W/m^2	30-300	1	0.2
	General Public Limit	300-1,500	f/300	f/1500
1	mW/cm^2	1,500-10,000	5	1
10	W/m^2			

	Occupational Limit			
$0.6455f^{0.5}$	W/m^2	IC radio frequency radiation exposure limits per RSS-102		
39.4	W/m^2	Frequency (MHz)	Occupational Limit (W/m^2)	Public Limit (W/m^2)
	General Public Limit	100-6,000	$0.6455f^{0.5}$	
$0.02619f^{0.6834}$	W/m^2	6,000-15,000	50	
5.4	W/m^2	48-300		1.291
		300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

f = Transmit Frequecny (MHz)			f (MHz) =	2402 MHz
P_T = Power Input to Antenna (mW)			P_T (mW) =	2.2387 mW
Duty cycle (percentage of operation)			% =	100 %
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)			P_A (mW) =	2.24 mW
G_N = Numeric Gain of the Antenna			GN (numeric) =	2.95 numeric
S_{20} = Power Density of device at 20cm (mW/m^2)		$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (mW/m^2) =	0.00 mW/m^2
S_{20} = Power Density of device at 20cm (W/m^2)		$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (W/m^2) =	0.01 W/m^2
S_L = Power Density Limit (W/m^2)			S_L (W/m^2)=	5.351 W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm)		$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	1.0 cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2)		$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	5.35 W/m^2
R_{20} = 20cm			R20=	20 cm
	For Complaince with Canada General Population Limits, User Manual must indicate a minimum seperation distance of			1.0 cm
	Or in Meters for Complaince with Canada General Population Limits, a minimum seperation distance of			0.01 Meters

Summary: Standalone MPE Calculations and Summary								
Band 1, (MHz)	Tx Duty Cycle (%)	Tx Frequeny (MHz)	Power Total (mW)	Antenna Gain (numeric)	S_L (W/m^2)	S_{20} (W/m^2)	R_C (cm)	S_C (W/m^2)
2400-2483.5	100	2402	2.24	2.95	5.351	0.01	1.0	5.35
Band 2, (MHz)	Tx Duty Cycle (%)	Tx Frequeny (MHz)	Power Total (mW)	Antenna Gain (dBi)	SL (W/m2)	S20 (W/m2)	RC (cm)	SC (W/m2)
2400-2483.5	100	2402	9.53	3.72	5.351	0.07	2.3	5.35
Band 3, (MHz)	Tx Duty Cycle (%)	Tx Frequeny (MHz)	Power Total (mW)	Antenna Gain (dBi)	SL (W/m2)	S20 (W/m2)	RC (cm)	SC (W/m2)
2400-2483.5	100	2412	36.90	1.23	5.366	0.09	2.6	5.37
Band 4, (MHz)	Tx Duty Cycle (%)	Tx Frequeny (MHz)	Power Total (mW)	Antenna Gain (dBi)	SL (W/m2)	S20 (W/m2)	RC (cm)	SC (W/m2)

Simlutaneous MPE Calculation				
	Transmitter 1	Transmitter 2	Transmitter 3	Transmitter 4
Tx Frequeny (MHz)	2402	0	2412	
S_{20} (W/m^2)	0.01	0.07	0.09	
S_L (W/m^2)	5.351	5.351	5.366	
Power Ratio (S_L / S_{20})	0.002	0.013	0.017	
Sum of Power Ratios at 20cm (0.002 + 0.013+0.017)				0.032
Requirement = Σ of MPE Ratio ≤ 1				Therefore the design is Exempt

	HVIN:	4277	Test Number: 230405D				
MPE Calculator	RF Exposure uses EIRP for calculation. EIRP is based on TX power added to the antenna gain in dBi.						
	dBi = dB gain compared to an isotropic radiator.						
	S = power density in mW/cm^2						
		Transmitter Output power (mW)	17.7				
		Transmitter Output power (W)	0.010				
Output Power for 100% duty Cycle operation (Watts)		100	0.010		Antenna Gain (dBi)	5.7	
	Output Power for 100% duty Cycle operation (Watts)		0.010		Antenna Gain (Numeric)	3.72	
Tx Frequency (MHz)	2402	Calculation power (Watts)	0.010	dBd + 2.17 = dBi	dBi to dBd	2.17	
					Antenna Gain (dBd)	3.53	
Cable Loss (dB)	0.0	Adjusted Power (dBm)	9.79		Antenna minus cable (dBi)	5.70	
					Antenna Gain (Numeric)	3.72	
	Calculated ERP (mw)	21.478			EIRP = Po(dBm) + Gain (dB)		
	Calculated EIRP (mw)	35.400			Radiated (EIRP) dBm	15.490	
					ERP = EIRP - 2.17 dB		
					Radiated (ERP) dBm	13.320	

Power density (S) mW/cm^2 = $\frac{EIRP}{4 p r^2}$

r (cm) EIRP (mW)

	Occupational Limit	FCC radio frequency radiation exposure limits per 1.1310		
5	mW/cm^2	Frequency (MHz)	Occupational Limit (mW/cm^2)	Public Limit (mW/cm^2)
50.0	W/m^2	30-300	1	0.2
	General Public Limit	300-1,500	f/300	f/1500
1	mW/cm^2	1,500-10,000	5	1
10.0	W/m^2			

	Occupational Limit			
$0.6455f^{0.5}$	W/m^2	IC radio frequency radiation exposure limits per RSS-102		
31.6	W/m^2	Frequency (MHz)	Occupational Limit (W/m^2)	Public Limit (W/m^2)
	General Public Limit	100-6,000	$0.6455f^{0.5}$	
$0.02619f^{0.6834}$	W/m^2	6,000-15,000	50	
5.35	W/m^2	48-300		1.291
		300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

					General Public	Occupational	
f = Transmit Frequency (MHz)			f (MHz) =	2402	2402	MHz
P_T = Power Input to Antenna (mW)			P_T (mW) =	9.5280	9.5280	mW
Duty cycle (percentage of operation)			% =	100	100	%
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)			P_A (mW) =	9.53	9.53	mW
G_N = Numeric Gain of the Antenna			GN (numeric) =	3.72	3.72	numeric
S_{20} = Power Density of device at 20cm (mW/m^2)		$S_{20}=(P_A G_N)/(4\pi R_{20})^2$	S_{20} (mW/m^2) =	0.01	0.01	mW/m^2
S_{20} = Power Density of device at 20cm (W/m^2)		$S_{20}=(P_A G_N)/(4\pi R_{20})^2$	S_{20} (W/m^2) =	0.07	0.07	W/m^2
S_L = Power Density Limit (W/m^2) FCC			S_L (W/m^2)=	10.000	50.000	W/m^2
S_L = Power Density Limit (W/m^2) Canada			S_L (W/m^2)=	5.351	31.636	W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm) FCC		$R_C=\sqrt{(P_A G_N/4\pi S_L)}$	R_C (cm) =	1.7	0.8	cm
R_C = Minimum distance to the Radiating Element for Compliance (cm) Canada		$R_C=\sqrt{(P_A G_N/4\pi S_L)}$	R_C (cm) =	2.3	0.9	cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) FCC		$S_C=(P_A G_N)/(4\pi R_C)^2$	S_C (W/m^2) =	10.00	50.00	W/m^2
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) Canada		$S_C=(P_A G_N)/(4\pi R_C)^2$	S_C (W/m^2) =	5.35	31.64	W/m^2
R_{20} = 20cm			R20=	20	20	cm

For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of 2.3 cm

Or in Meters for Compliance with Canada General Populations Limits, a minimum separation distance of 0.02 Meters

Summary: Standalone MPE Calculations and Summary					Public Limit		Public	
	Tx Duty Cycle (%)	Tx Frequency (MHz)	Power Total (mW)	Antenna Gain (numeric)	S_L (W/m^2)	S_{20} (W/m^2)	R_C (cm)	S_C (W/m^2)
FCC	100	2402	10	3.72	10.000	0.07	1.7	10.00
Canada	100	2402	10	3.72	5.351	0.07	2.3	5.35

		Limit	Overall Minimum (cm)	Overall Minimum (inches)
	Public	Occupational		
FCC (cm)	1.7	0.8		
FCC (inches)	1.0	1.0		
Canada (cm)	2.3	0.9		
Canada (inches)	1.0	1.0		

Overall Minimum Limit Public	Overall Minumu Limit Occuppational
3 cm	1 cm
2 inches	1 inches

	HVIN:	4277	Test Number: 230405D					
MPE Calculator	RF Exposure uses EIRP for calculation. EIRP is based on TX power added to the antenna gain in dBi.							
	dBi = dB gain compared to an isotropic radiator.							
	S = power density in mW/cm^2							
		Transmitter Output power (mW)	17.7					
		Transmitter Output power (W)	0.037					
Output Power for % duty Cycle operation (Watts)		100	0.037		Antenna Gain (dBi)	0.9		
	Output Power for 100% duty Cycle operation (Watts)		0.037		Antenna Gain (Numeric)	1.23		
Tx Frequency (MHz)	2412	Calculation power (Watts)	0.037	dBd + 2.17 = dBi	dBi to dBd	2.17		
					Antenna Gain (dBd)	-1.27		
Cable Loss (dB)	0.0	Adjusted Power (dBm)	15.67		Antenna minus cable (dBi)	0.90		
					Antenna Gain (Numeric)	1.23		
	Calculated ERP (mw)	27.542			EIRP = Po(dBm) + Gain (dB)			
	Calculated EIRP (mw)	45.394			Radiated (EIRP) dBm	16.570		
					ERP = EIRP - 2.17 dB			
					Radiated (ERP) dBm	14.400		

Power density (S) mW/cm² = EIRP / (4 p r^2)

r (cm) EIRP (mW)

	Occupational Limit	FCC radio frequency radiation exposure limits per 1.1310		
5	mW/cm^2	Frequency (MHz)	Occupational Limit (mW/cm^2)	Public Limit (mW/cm^2)
50.0	W/m^2	30-300	1	0.2
	General Public Limit	300-1,500	f/300	f/1500
1	mW/cm^2	1,500-10,000	5	1
10.0	W/m^2			

	Occupational Limit			
$0.6455f^{0.5}$	W/m^2	IC radio frequency radiation exposure limits per RSS-102		
31.7	W/m^2	Frequency (MHz)	Occupational Limit (W/m^2)	Public Limit (W/m^2)
	General Public Limit	100-6,000	$0.6455f^{0.5}$	
$0.02619f^{0.6834}$	W/m^2	6,000-15,000	50	
5.37	W/m^2	48-300		1.291
		300-6,000		$0.02619f^{0.6834}$
		6,000-15,000	50	10

				General Public	Occupational	
f = Transmit Frequency (MHz)			f (MHz) =	2412	2412	MHz
P_T = Power Input to Antenna (mW)			P_T (mW) =	36.8978	36.8978	mW
Duty cycle (percentage of operation)			% =	100	100	%
P_A = Adjusted Power due to Duty cycle or Cable Loss (mW)			P_A (mW) =	36.90	36.90	mW
G_N = Numeric Gain of the Antenna			GN (numeric) =	1.23	1.23	numeric
S_{20} = Power Density of device at 20cm (mW/m^2)		$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (mW/m^2) =	0.01	0.01	mW/m^2
S_{20} = Power Density of device at 20cm (W/m^2)		$S_{20}=(P_AG_N)/(4\pi R_{20})^2$	S_{20} (W/m^2) =	0.09	0.09	W/m^2
S_L = Power Density Limit (W/m^2) FCC			S_L (W/m^2)=	10.000	50.000	W/m^2
S_L = Power Density Limit (W/m^2) Canada			S_L (W/m^2)=	5.366	31.702	W/m^2
R_C = Minimum distance to the Radiating Element for Compliance (cm) FCC		$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	1.9	0.8	cm
R_C = Minimum distance to the Radiating Element for Compliance (cm) Canada		$R_C=\sqrt{(P_AG_N/4\pi S_L)}$	R_C (cm) =	2.6	1.1	cm
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) FCC		$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	10.00	50.00	W/m^2
S_C = Power Density of the device at the Compliance Distance R_C (W/m^2) Canada		$S_C=(P_AG_N)/(4\pi R_C)^2$	S_C (W/m^2) =	5.37	31.70	W/m^2
R_{20} = 20cm			R20=	20	20	cm

For Compliance with Canada General Population Limits, User Manual must indicate a minimum separation distance of 2.6 cm

Or in Meters for Compliance with Canada General Population Limits, a minimum separation distance of 0.03 Meters

Summary: Standalone MPE Calculations and Summary					Public Limit		Public	
	Tx Duty Cycle (%)	Tx Frequency (MHz)	Power Total (mW)	Antenna Gain (numeric)	S_L (W/m^2)	S_{20} (W/m^2)	R_C (cm)	S_C (W/m^2)
FCC	100	2412	37	1.23	10.000	0.09	1.9	10.00
Canada	100	2412	37	1.23	5.366	0.09	2.6	5.37

		Limit		Overall Minimum (cm)	Overall Minimum (inches)
		Public	Occupational		
	FCC (cm)	1.9	0.8		
	FCC (inches)	1.0	1.0		
	Canada (cm)	2.6	1.1		
	Canada (inches)	2.0	1.0		

Overall Minimum Limit Public	Overall Minumu Limit Occuppational
3 cm	2 cm
2 inches	1 inches