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: Catalyst 2

	Información (Information)
Tipo de equipo (Equipment type)	Portable Digital Transceiver
Marca (Brand)	Garmin GARMIN
Modelo (Model)	B04281
Tecnología o modulación (Technology or modulation)	BT (GFSK, π/4 DQPSK, 8DPSK), BLE (GMSK), WiFi 2.4GHz (802.11 b/g/n), WiFi 5.8GHz (802.11 a/n/ac)
Frecuencias (Frequencies)	BT (2402MHz-2480MHz), BLE (2402MHz- 2480MHz), WiFi 2.4GHz (2412MHz – 2462MHz), WiFi 5.8GHz (5745MHz – 5825 MHz)
Ganancia de antena (dBi) (Antenna gain (dBi)	BT PIFA (5.24 dBi), BLE PIFA (5.24 dBi), WiFi 2.4GHz PIFA (5.24 dBi), WiFi 5.8 GHz Loop (0.08 dBi)
P.i.r.e. (E.I R P.)	BT (10.01dBm, 10.02mW), BLE (8.25dBm, 6.68mW), WiFi 2.4GHz (21.24dBm, 133mW), WiFi 5.8GHz (16.41dBm, 43.75mW)
Módulos (Modules)	BT , BLE, WiFi 2.4GHz, WiFi 5.8GHz

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, a division of The Compatibility Center LLC

7915 Nieman Rd.
Lenexa, KS 66214
Phone / Fax (913) 660-0666

47CFR Paragraph 15.247 FHSS and Industry Canada RSS-GEN Issue 5 and RSS-247 Issue 4

Application For Grant of Certification

Model: B04281

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

FCC ID: IPH-B4281 IC: 1792A-B4281

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062
Jeff Hailey
Staff Compliance Engineer

Test Report Number: 250528
Test Date: May 28, 2025 – August 28, 2025

Authorized Signatory:

Patrick Powell
Rogers Labs, a division of The Compatibility Center LLC
FCC Designation: US5305
ISED Registration: 3041A

Revisions

Revision 1 Issued October 14, 2025

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 4 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: B04281

FCC ID: IPH-B4281 IC: 1792A-B4281

Operating Frequency Range: 2402-2480 MHz

Operation Direct Sequence Spread Spectrum (DSS) communication Mode 1

B04281 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 1, BT BR (GFSK)	0.003	972.0	1,050.0

This report addresses EUT Operations as Direct Sequence Spread Spectrum Transmitter using transmitter modulation in Mode 1 Note, the production device utilizes a non-user accessible integral antenna with 5.24 dBi gain.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47CFR 15.205, RSS-210 4.1	-9.4	Complies
Conducted Emissions as per 47CFR 15.207, RSS-GEN 8.8	-13.55	Complies
Radiated Emissions 47CFR 15.209, RSS-GEN 8.9	-3.3	Complies
Harmonic Emissions per 47CFR 15.247, RSS-247	-5.1	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 4

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.

Equipment Tested

Model: B04281

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

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

Equipment	Model / PN	Serial Number
EUT #1 Radiated	B04281	3514215240
EUT #2 Antenna Port Conducted	B04281	3514215200
AC/DC Wall mount power supply	362-00112-00	N/A
USB-A to C Cable, 1.5m	320-01535-30	N/A
USB-A to C Cable, 4m	320-01545-20	N/A
CLA	013-00797-03	N/A

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

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

Software (FVIN): 1.04 or higher: Antennas: BT/BLE PIFA (5.24 dBi), 2.4 GHz WiFi PIFA (5.24 dBi), 5.7 GHz PIFA (0.08 dBi)

Environmental Conditions

Ambient Temperature	20.9° C
Relative Humidity	45.0 %
Atmospheric Pressure	1018.4 mb

Equipment Operational Modes

Mode	Transmitter Operation
mode 1	BT BR (GFSK)
mode 2	BT (2EDR π/4 DQPSK)
mode 3	BT (3EDR 8DPSK)
mode 4	BT BLE (GMSK)
mode 5	802.11b
mode 6	802.11g
mode 7	802.11n
mode 12	U-NII-3 802.11a
mode 13	U-NII-3 802.11n
mode 14	U-NII-3 802.11n40
mode 15	U-NII-3 802.11ac80

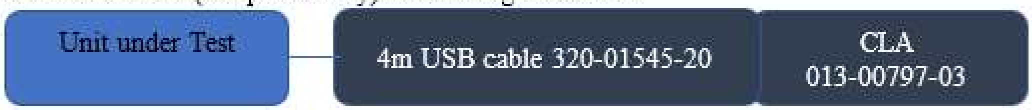
Equipment Function

The product operates from the internal battery or direct current power provided over the USB-C port. The design provides a Micro SD card slot and USB-C interface port as presented below and wireless communications with the compatible equipment. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interfaces connections other than those presented in the configuration options as described by the manufacturer and presented below.

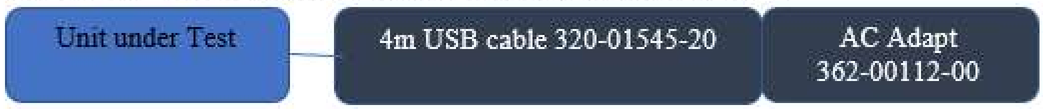
Equipment Configuration

1) UUT connected to (and powered by) CLA through USB cable

2) UUT connected to (and powered by) CLA through USB cable



3) UUT connected to (and powered by) AC adapter through USB cable



4) UUT connected to (and powered by) Computer through USB cable

5) UUT connected to (and powered by) AC adapter through USB cable

6) UUT powered battery

Application for Certification

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

(2) Identification: HVIN: B04281
FCC ID: IPH-B4281 IC: 1792A-B4281

(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 5.47-5.85 GHz band 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 February 15, 2024: Part 2, Subpart J, Part 15C Paragraph 15.247, RSS-247 Issue 4, and RSS-GEN Issue 5. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2020. This report documents compliance for the EUT operations as Frequency Hopping Spread Spectrum (DSS) Transmitter.

Test Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions were performed as required in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram one showing typical test arrangement and photographs in the test setup exhibit for EUT placement used during testing.

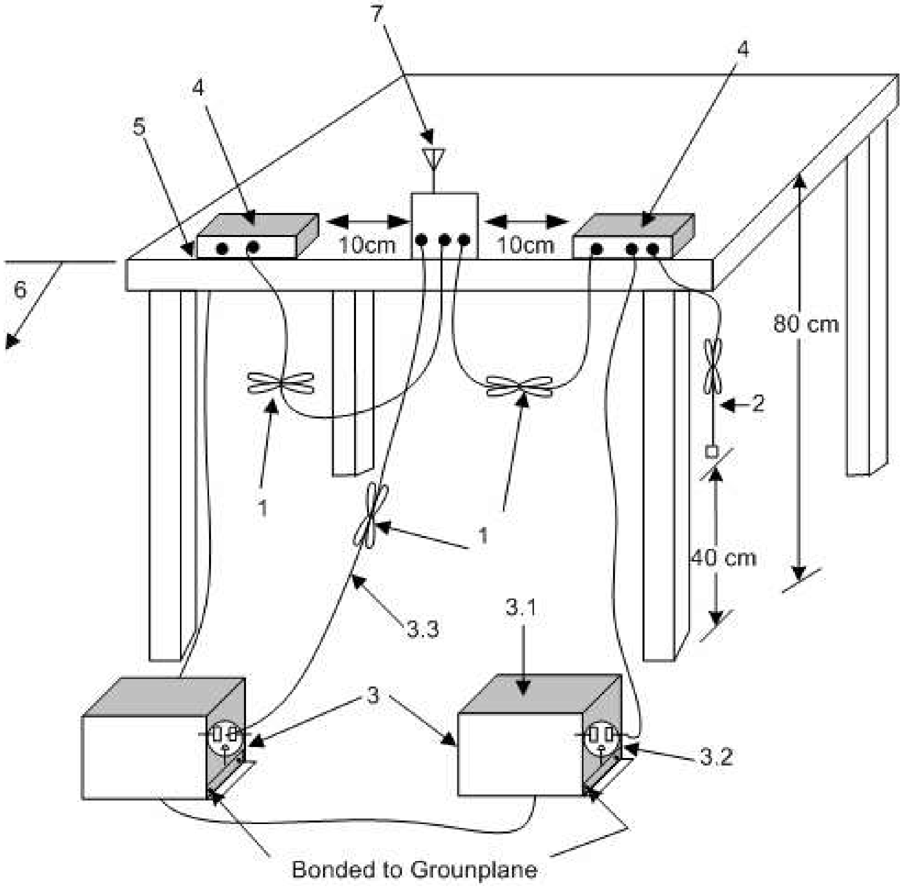
Radiated Emission Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 Issue 4, RSS-GEN and specified in ANSI C63.1c0-2020. 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. Per above requirements, the frequency spectrum from 9 kHz to 25,000 MHz was searched for emissions and all significant results reported. All other unreported findings were at least 20 dB below limits. Refer to diagrams two and three showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

Antenna Port Conducted Emission Test Procedure

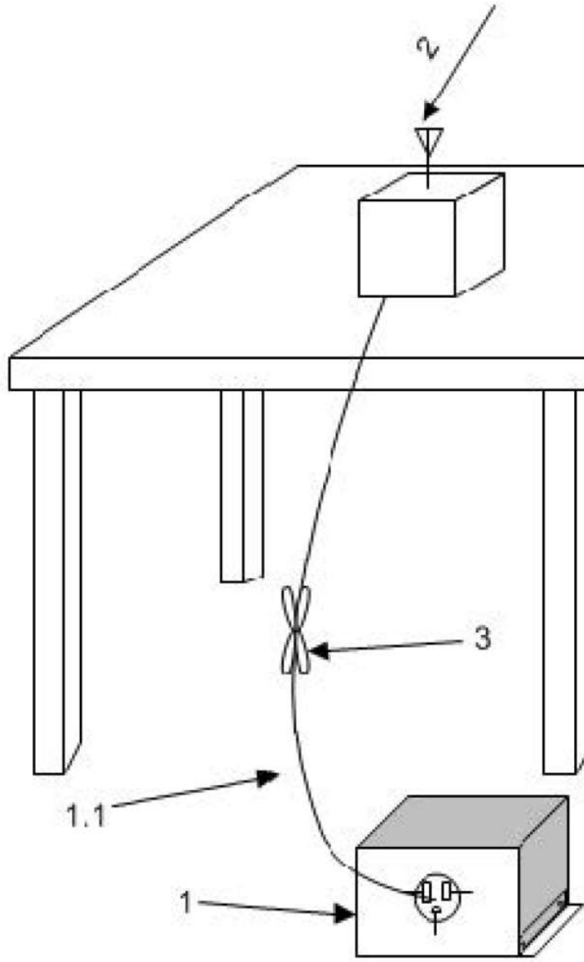
The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2020. Testing was 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 4 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

Diagram 1 Test arrangement for power-line conducted emissions



1. 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 (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3).
   3.1 All other equipment powered from additional LISN(s).
   3.2 Multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Non-EUT components of EUT system being tested.
5. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.3.1).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test

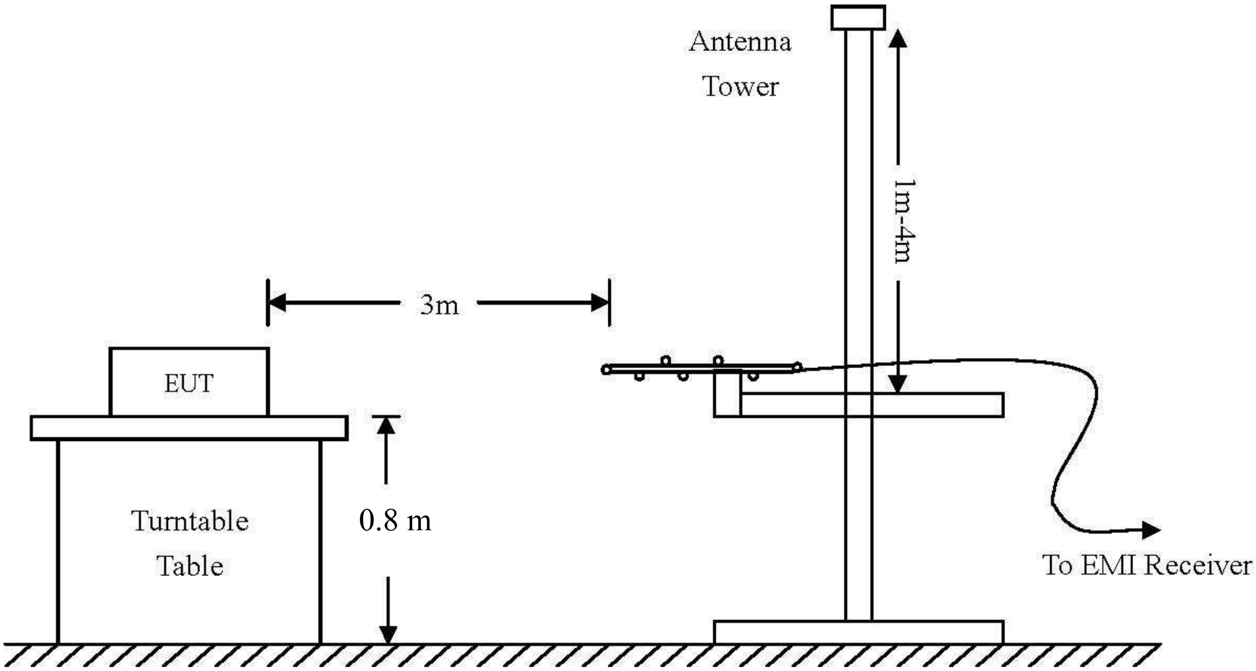
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



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

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

Below 1 GHz



Above 1 GHz:

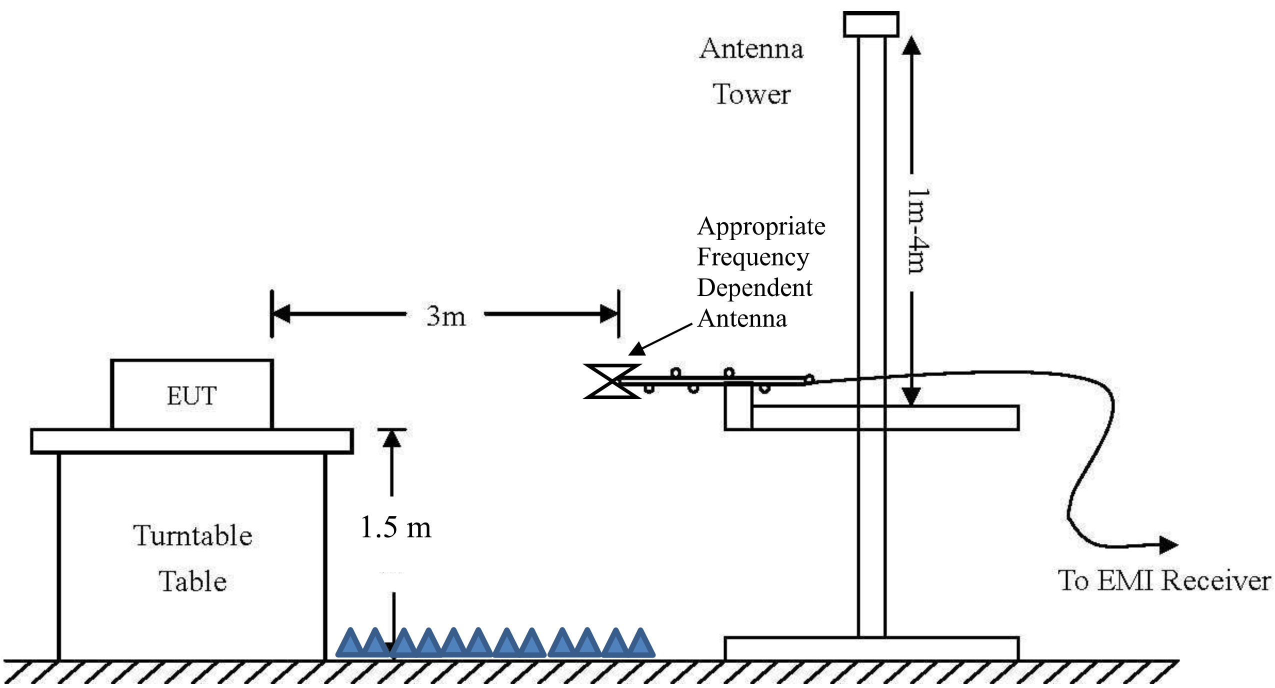
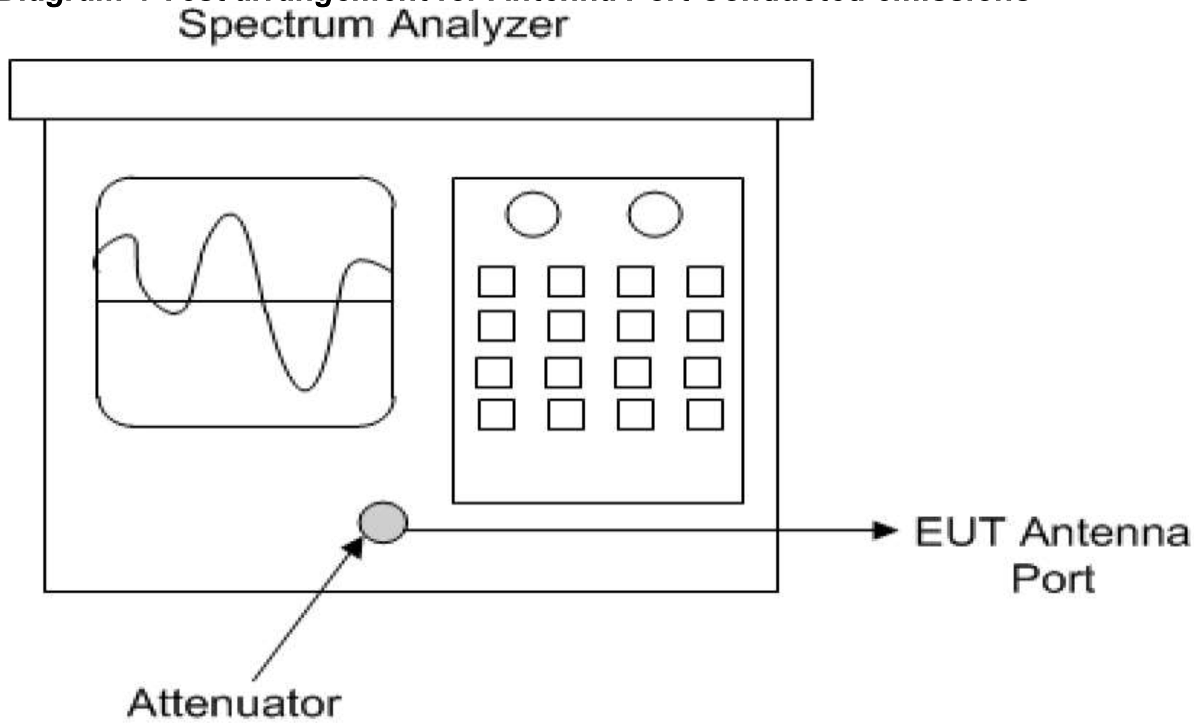


Diagram 4 Test arrangement for Antenna Port Conducted emissions



Test Site Locations

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

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

NVLAP Accreditation Lab code 200087-0

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: The limit is expressed for a 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 Semi-Anechoic Chamber using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured
A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains
RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHz
Loop Antenna	Broadband Biconilog	Horn
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 500 kHz	VBW = 3 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV
Antenna Height 1m	Antenna Height 1-4m	Antenna Height 1-4m

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 4, 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 4, 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 SAC. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the SAC, 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 C63.10-2020 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, BT BR (GFSK)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dB)	Vertical Margin (dB)
2390.0	44.1	30.5	43.5	30.0	54.0	-18.7	-18.8
2483.5	76.4	35.3	76.6	35.2	54.0	-19.4	-19.4
4804.0	47.3	34.6	47.6	34.6	54.0	-19.0	-19.0
4882.0	48.0	35.0	47.9	35.0	54.0	-19.4	-19.4
4960.0	47.9	34.6	47.7	34.6	54.0	-16.0	-16.0
7206.0	51.1	38.0	51.5	38.0	54.0	-15.6	-15.4
7323.0	51.2	38.4	52.0	38.6	54.0	-16.4	-16.3
7440.0	50.5	37.6	50.3	37.7	54.0	-10.7	-10.8
12010.0	55.9	43.3	56.9	43.2	54.0	-9.4	-9.4
12205.0	57.9	44.6	57.5	44.6	54.0	-9.5	-9.5
12400.0	57.4	44.5	57.9	44.5	54.0	-18.7	-18.8

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

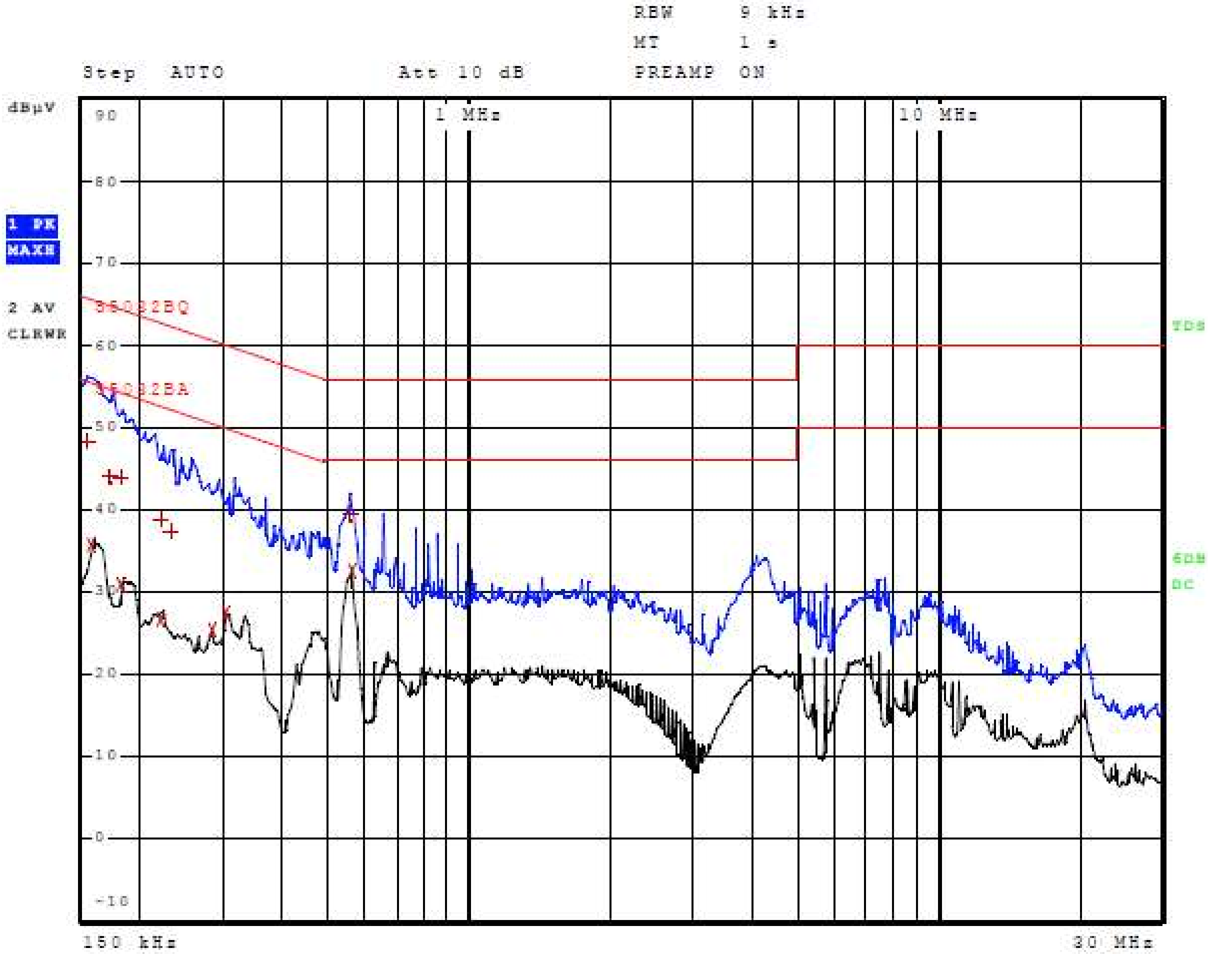
The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C and RSS-247 Issue 4 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -9.4 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes 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.

AC Line Conducted EMI Procedure

The EUT was arranged in typical equipment configurations as offered by manufacturer and presented above in equipment configuration. AC Line Conducted emission testing was performed with the EUT placed on a 1 x 1.5-meter bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the AC line-conducted emissions followed the procedures of ANSI C63.10-2020. The EUT was configured as presented in the AC Line conducted configurations as directed by the manufacturer and presented above in equipment configuration. The AC adapter for the EUT was connected to the LISN for AC line-conducted emissions testing. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the test configuration. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which demonstrated the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz and data recorded.

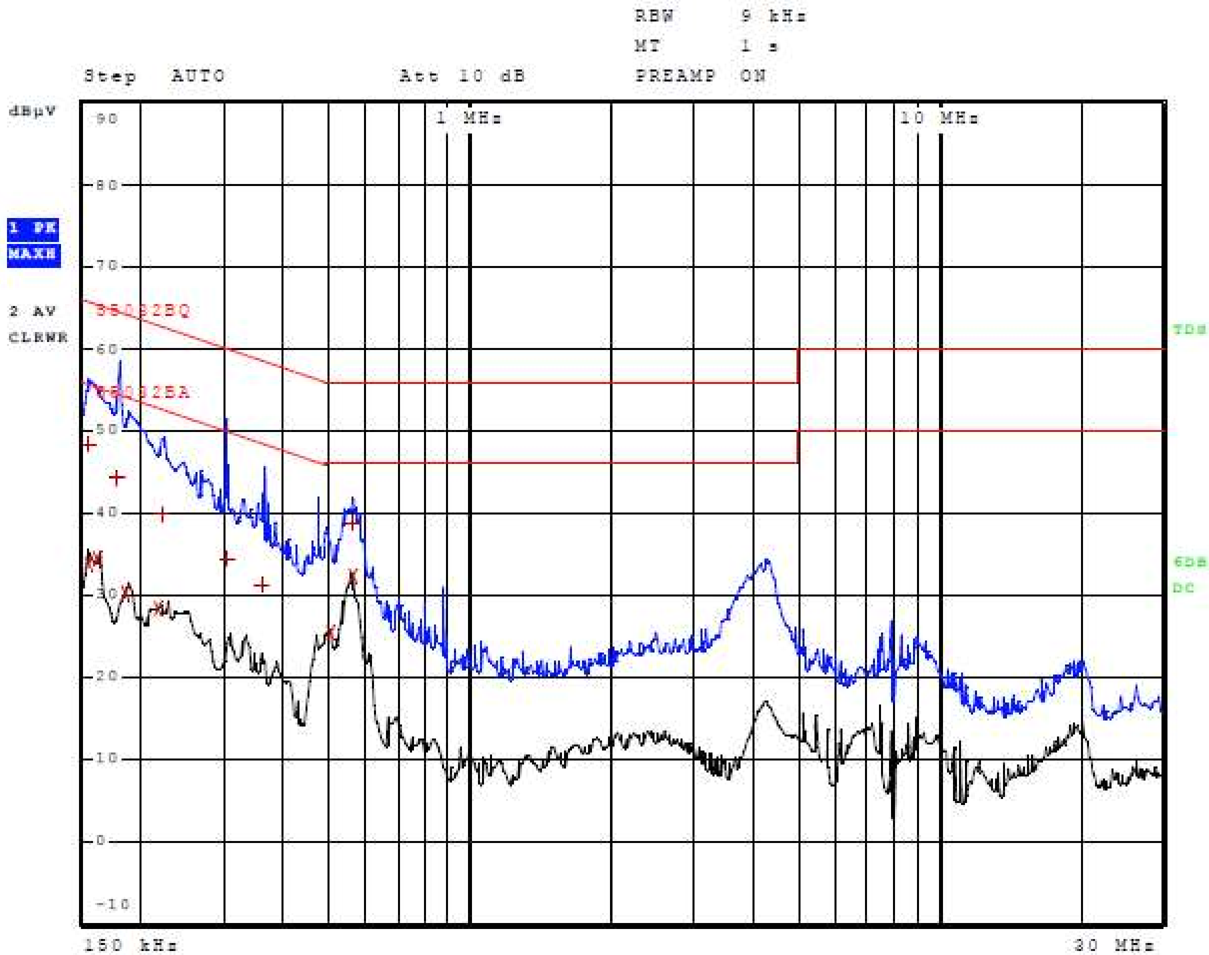
Refer to data in tables 2 and 3 and figures 1 and 2 for plots of the Configuration #4 EUT – Computer interface AC Line conducted emissions.

Figure 1 AC Line Conducted Emissions Data L1 (Config. #4, EUT – Computer)



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

Figure 2 AC Line Conducted Emissions Data L2 (Config. #4, EUT – Computer)



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

Table 2 AC Line Conducted Emissions Data L1 (Config. #4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	48.30	Quasi Peak	-17.48
2	158.000000000 kHz	35.65	Average	-19.92
1	174.000000000 kHz	44.10	Quasi Peak	-20.66
1	182.000000000 kHz	43.93	Quasi Peak	-20.47
2	182.000000000 kHz	30.77	Average	-23.62
2	222.000000000 kHz	26.65	Average	-26.09
1	222.000000000 kHz	38.89	Quasi Peak	-23.85
1	234.000000000 kHz	37.32	Quasi Peak	-24.99
2	282.000000000 kHz	25.30	Average	-25.46
2	306.000000000 kHz	27.53	Average	-22.55
1	554.000000000 kHz	39.38	Quasi Peak	-16.62
2	558.000000000 kHz	32.45	Average	-13.55

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

Table 3 AC Line Conducted Emissions Data L2 (Config. #4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	33.89	Average	-21.90
1	154.000000000 kHz	48.33	Quasi Peak	-17.45
2	162.000000000 kHz	34.36	Average	-21.00
1	178.000000000 kHz	44.31	Quasi Peak	-20.27
2	186.000000000 kHz	30.27	Average	-23.94
2	218.000000000 kHz	28.41	Average	-24.48
1	222.000000000 kHz	39.81	Quasi Peak	-22.93
1	302.000000000 kHz	34.45	Quasi Peak	-25.74
1	362.000000000 kHz	31.25	Quasi Peak	-27.44
2	502.000000000 kHz	25.46	Average	-20.54
2	558.000000000 kHz	32.25	Average	-13.75
1	562.000000000 kHz	38.87	Quasi Peak	-17.13

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

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47CFR Part 15C, RSS-247 and RSS-Gen. The EUT configuration #4 demonstrated a minimum margin of -13.55 dB below the requirement. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

General Radiated Emissions Procedure

Testing for the radiated emissions were performed as specified in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. For testing purposes, the EUT was arranged as presented in the applicable configuration diagrams above and operated through all modes as presented.

Exploratory radiated emissions measurements were performed in the SAC chamber or screen room, finding maximized emissions over frequency, EUT orientation, antenna height and polarity. This data is then used to focus the final radiated emissions measurements on these maximized points.

Final radiated emissions data were taken with the EUT located in the OATS or SAC at distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 6,000 MHz was searched for radiated emissions. Measured emission levels were maximized by EUT placement on the table, changing cable location, 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, Biconical, Broadband Biconilog, Log Periodic, and Double Ridge or Pyramidal Horns and mixers above 1 GHz.

Refer to tables 4 and 5 for general radiated emissions data and figures 3 and 4 for plots of the worst case radiated emissions taken in the SAC (30 MHz to 1 GHz).

Figure 3 Plot of General Radiated Emissions – Horizontal Polarization

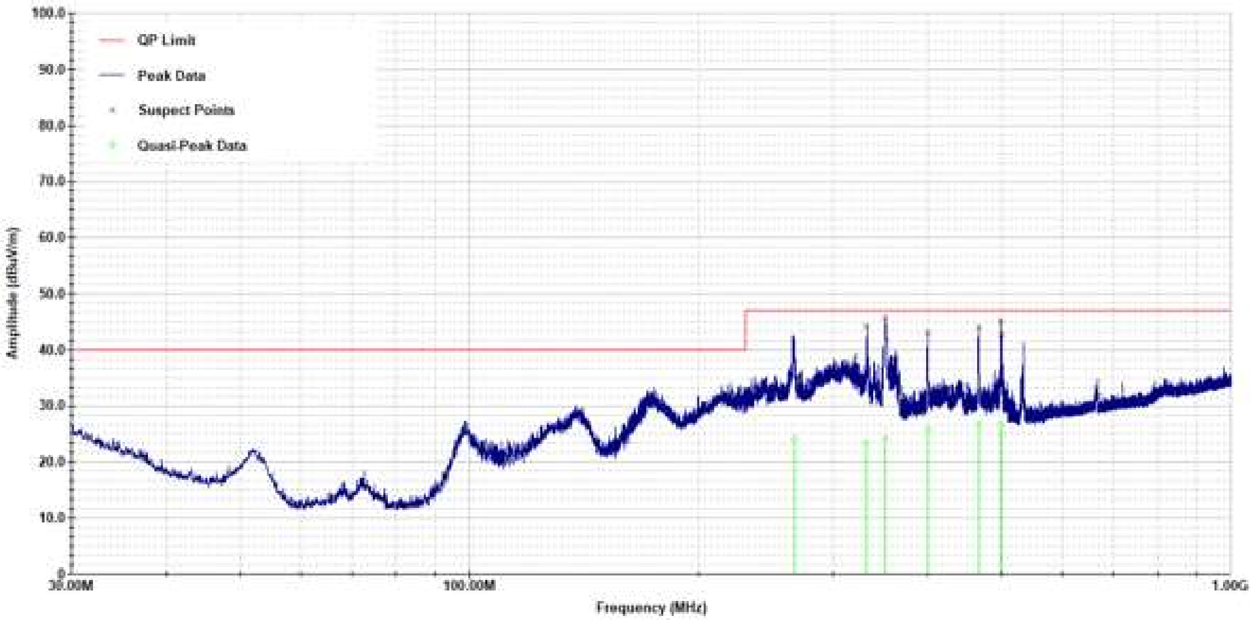


Figure 4 Plot of General Radiated Emissions – Vertical Polarization

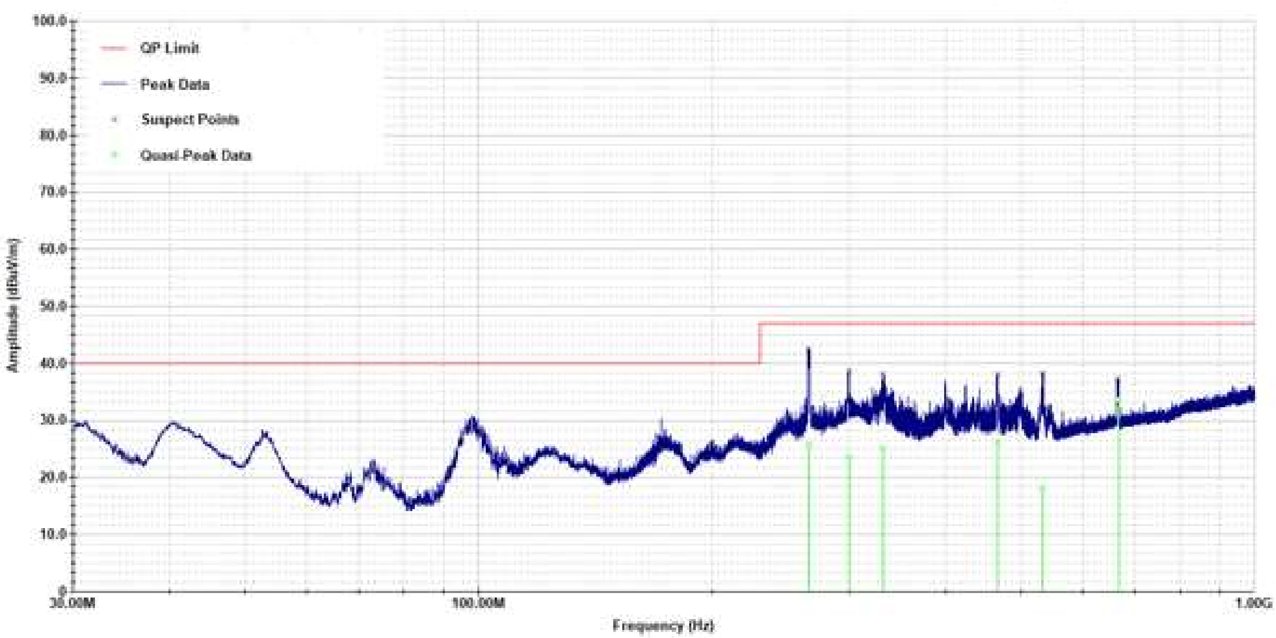


Table 4 General Radiated Emissions Data – Worst Case (Horizontal Polarization)

Frequency (MHz)	Peak (dBμV/m)	Quasi-Peak (dBμV/m)	Limit @ 3m (dBμV/m)	Margin (dBm)
267.1	30.8	24.2	47	-22.8
332.1	30.5	23.4	47	-23.6
351.2	32.1	24.1	47	-22.9
399.9	32.8	25.7	47	-21.3
466.6	33.7	26.8	47	-20.2
498.1	34.2	26.5	47	-20.5

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

Table 5 General Radiated Emissions Data – Worst Case (Vertical Polarization)

Frequency (MHz)	Peak (dBμV/m)	Quasi-Peak (dBμV/m)	Limit @ 3m (dBμV/m)	Margin (dBm)
266.5	32.8	25.7	47	-21.3
299.7	29.1	23.6	47	-23.5
331.6	30.9	25.1	47	-22.0
466.3	35.9	26.2	47	-20.8
532.6	24.7	17.9	47	-29.1
666.5	37.3	33.7	47	-13.3

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 11, and RSS-GEN Issue 5 Intentional Radiators. The EUT worst-case transmitter configuration demonstrated a minimum margin of -13.3 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 C63.10-2020 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 C63.10-2020. The 20-dB and 99% emission bandwidths were measured as described in C63.10-2020. The channel separation and the number of hopping channels were measured at the antenna port as described in C63.10-2020. 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 91 times in a 10 second period (273 times in a 30 second period). Transmitting each time for 141.7 µS which equates to an average time of occupancy of (273*141.7 µS) 38.7 mS over 30 seconds.

The 38.7 mS average time of occupancy over 30 seconds demonstrates compliance with the 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 5 through 16 showing plots taken of the 2402-2480 MHz BT BR (GFSK)

Frequency Hopping Spread Spectrum operation displaying compliance with the specifications.

Figure 5 Plot of Transmitter Emissions Operation in 2402-2480 MHz Mode 1, BT BR

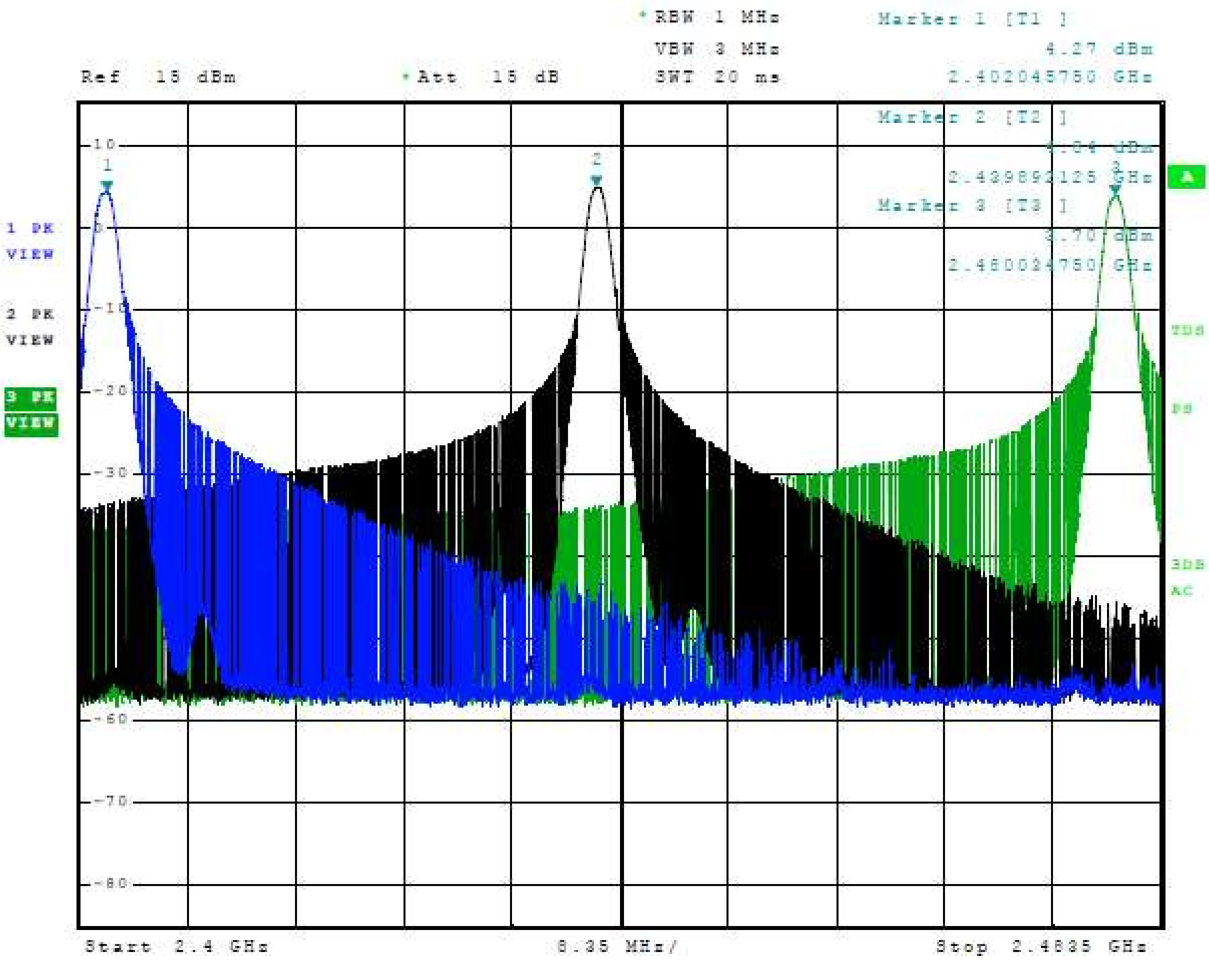


Figure 6 Plot of Transmitter Emissions 20-dB Occupied Bandwidth Mode 1, BT BR

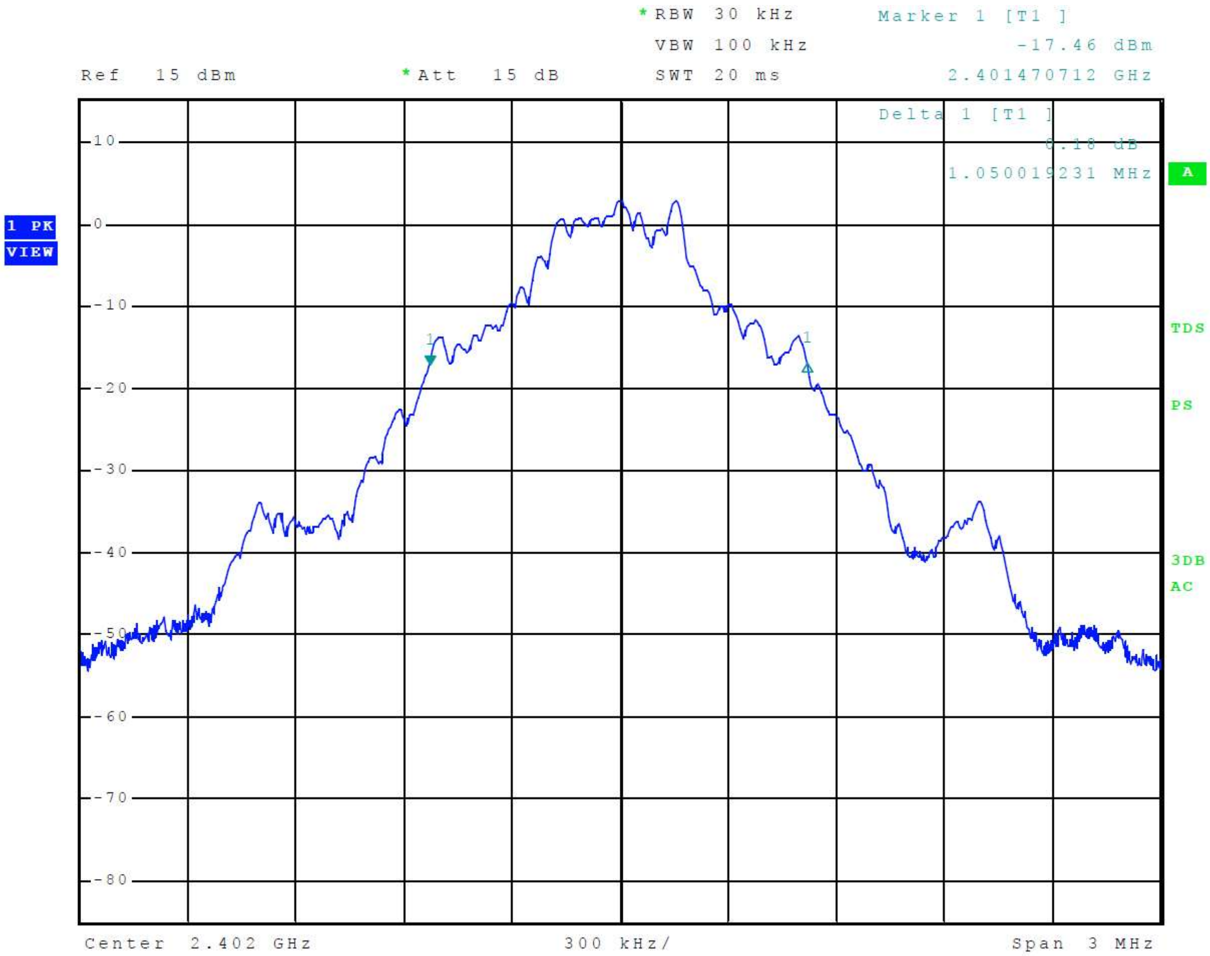


Figure 7 Plot of Transmitter Emissions 99% Occupied Bandwidth Mode 1, BT BR

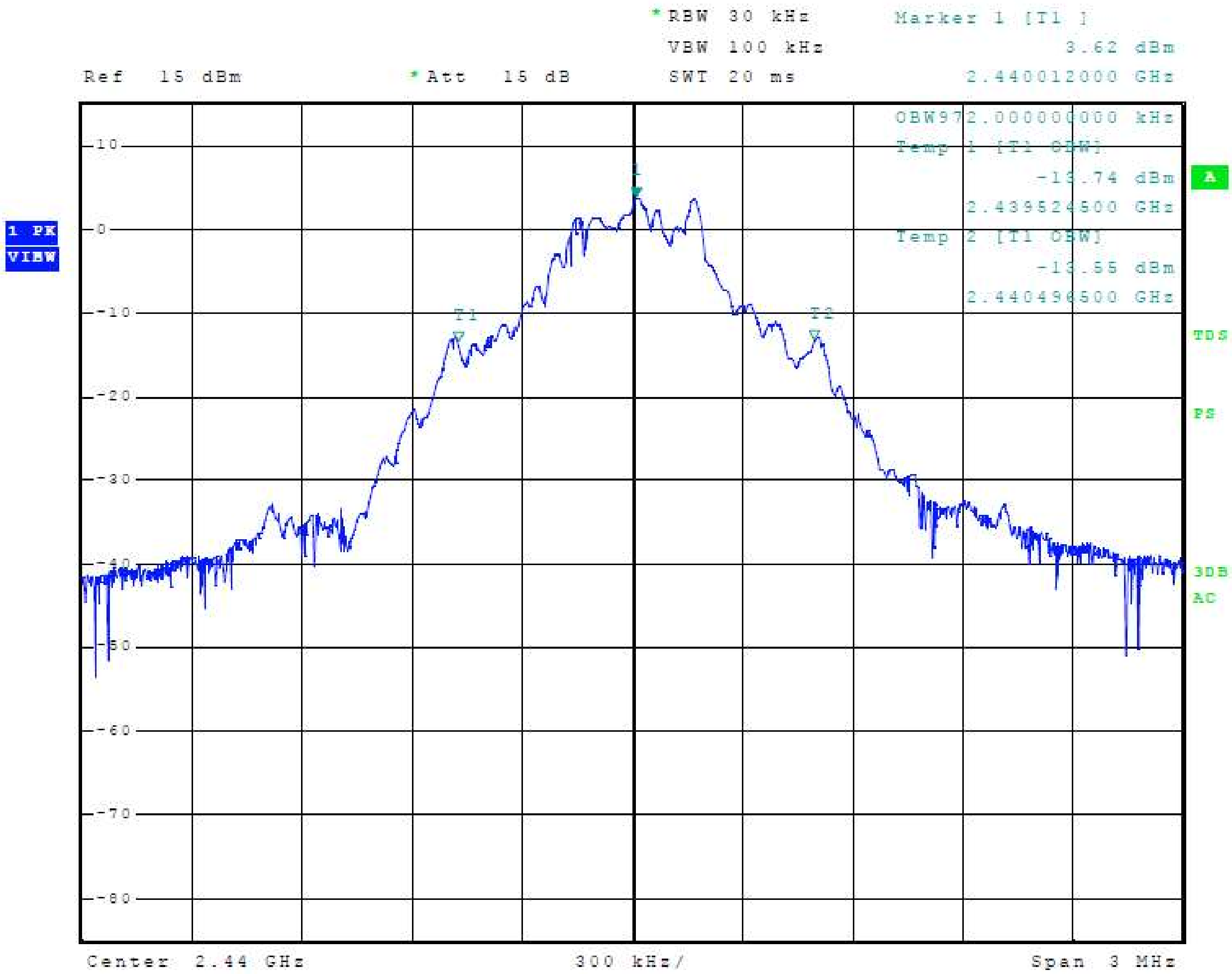


Figure 8 Plot of Number of Hopping Channels Mode 1 BT BR (GFSK)

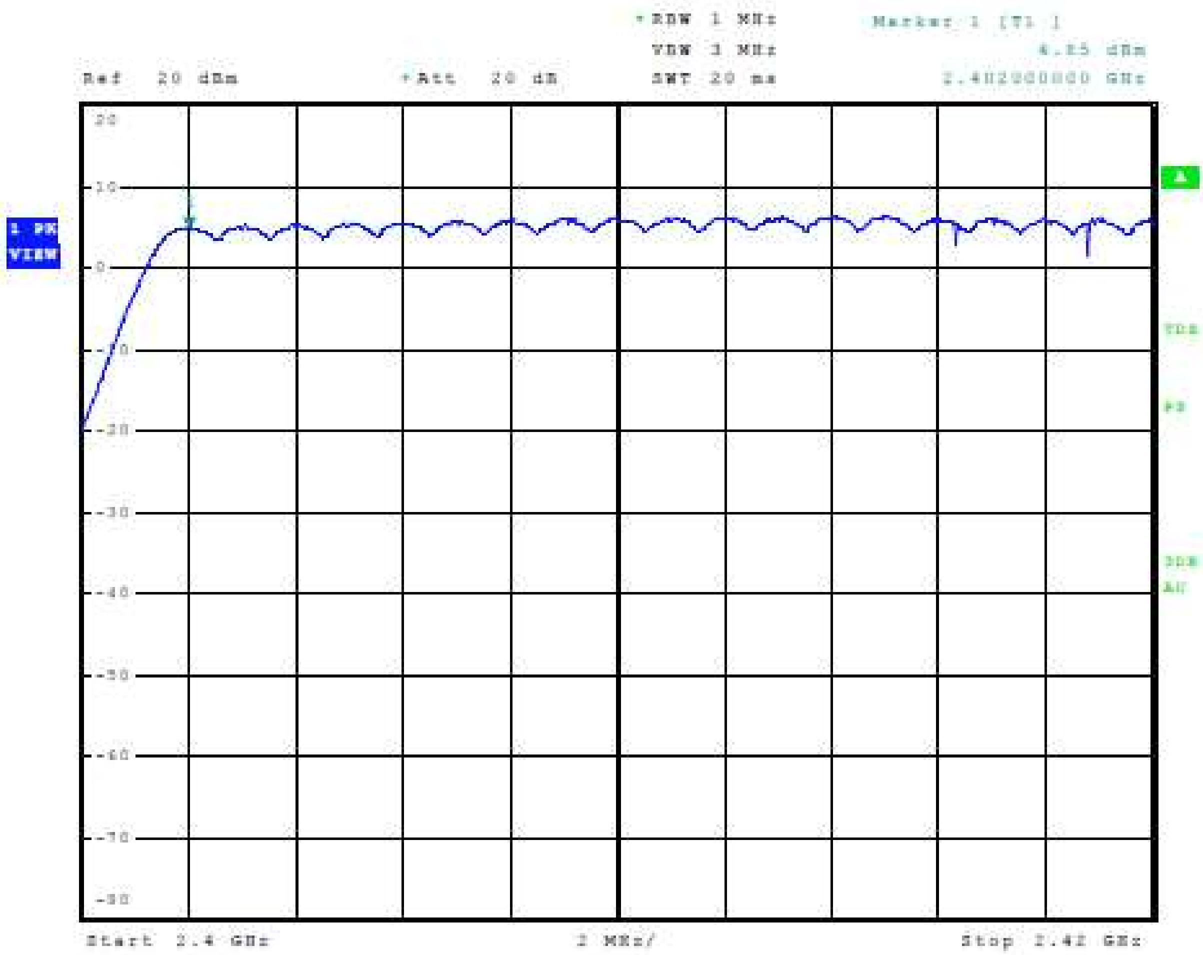


Figure 9 Plot of Number of Hopping Channels Mode 1 BT BR (GFSK)

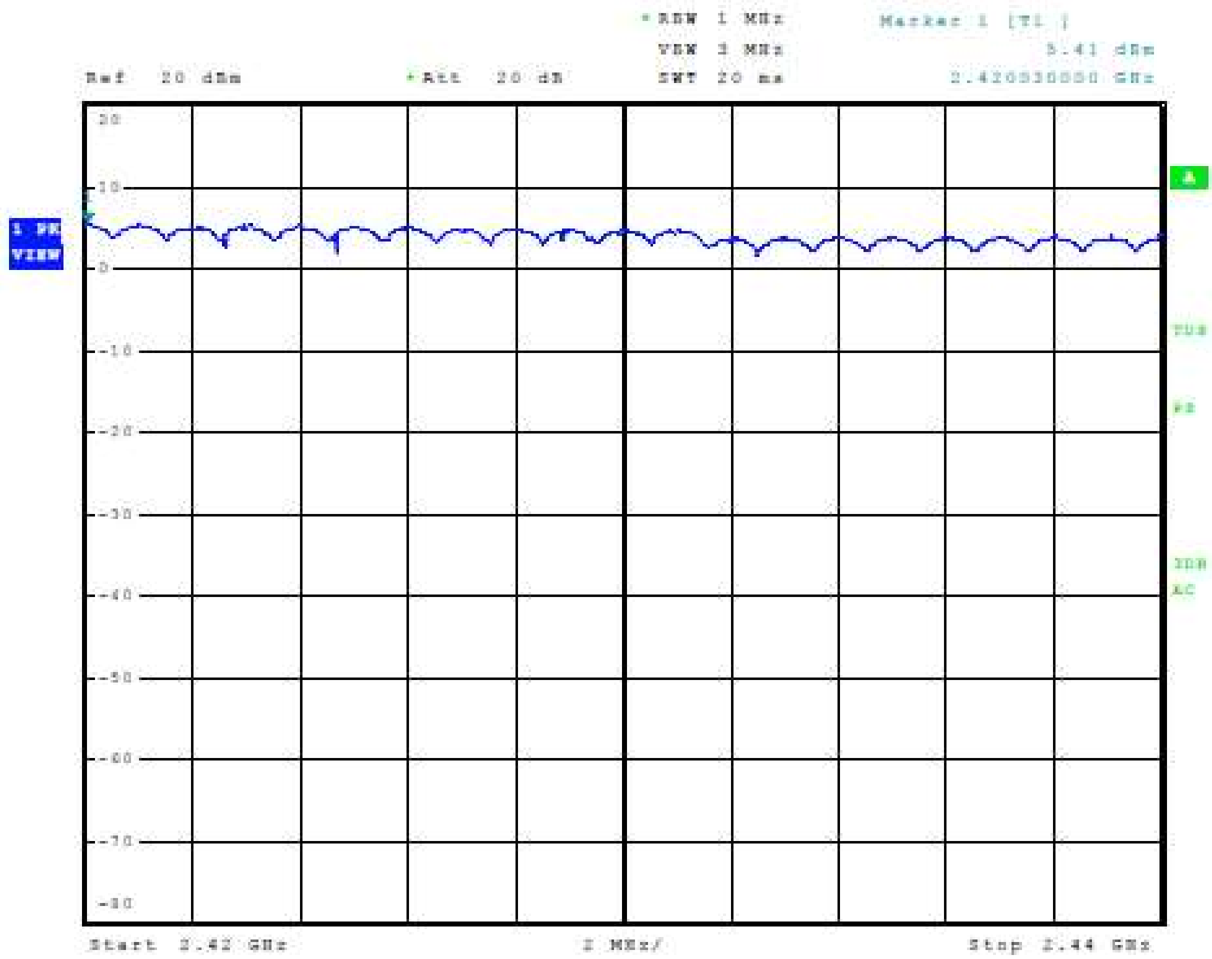


Figure 10 Plot of Number of Hopping Channels Mode 1 BT BR (GFSK)

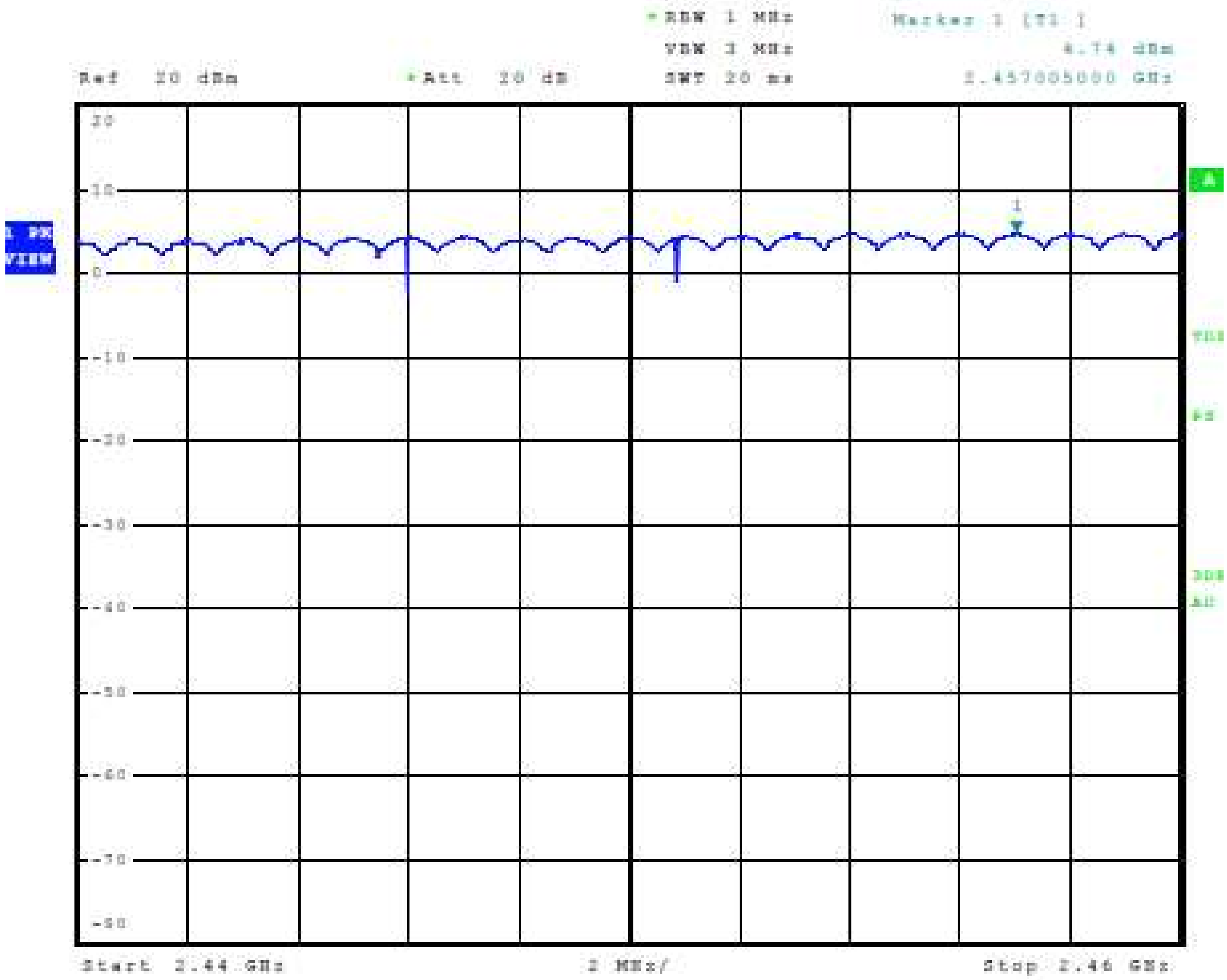


Figure 11 Plot of Number of Hopping Channels Mode 1 BT BR (GFSK)

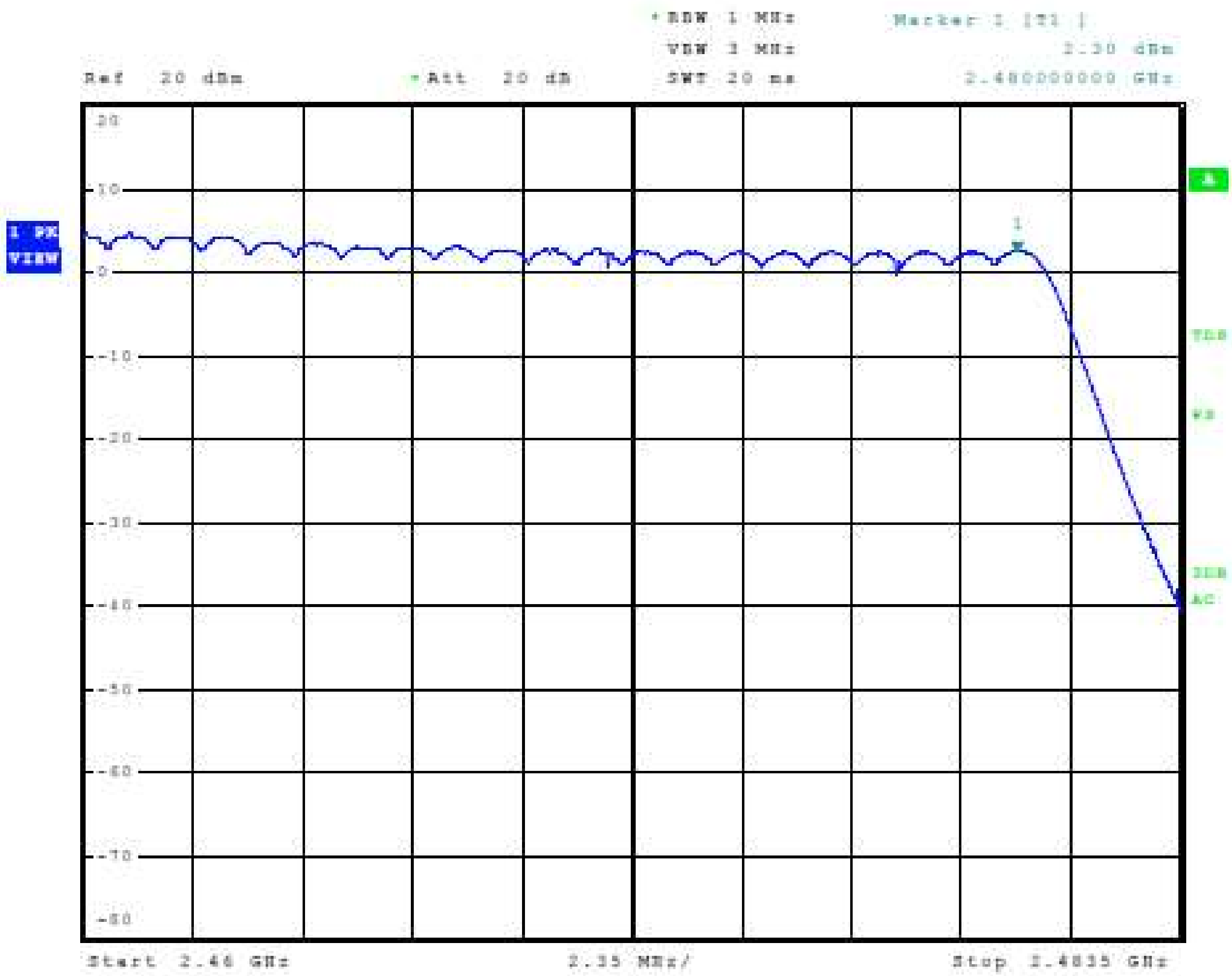


Figure 12 Plot of Dwell time On Channel Mode 1 BT BR (GFSK)

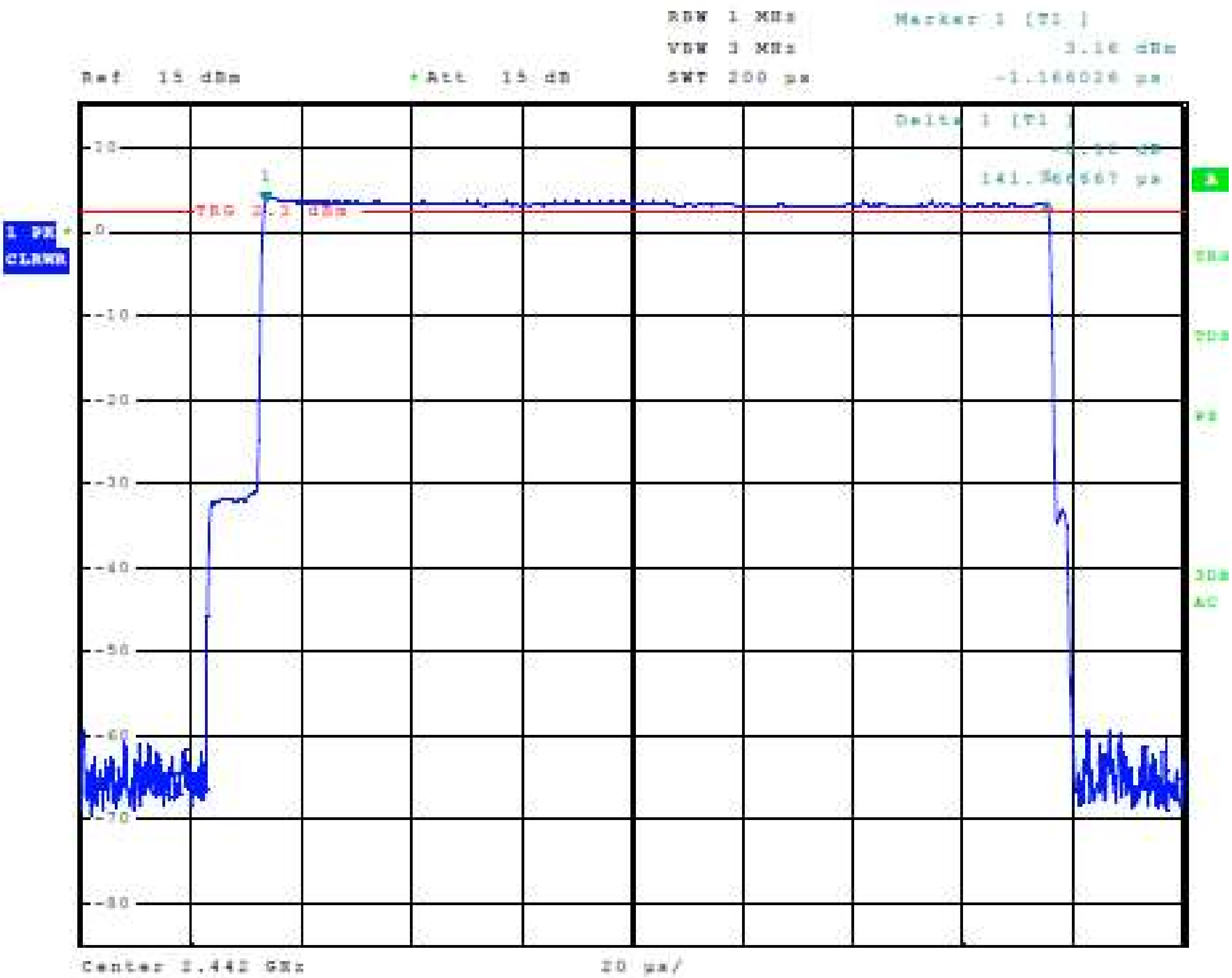


Figure 13 Plot of Channel Separation Mode 1 BT BR (GFSK)

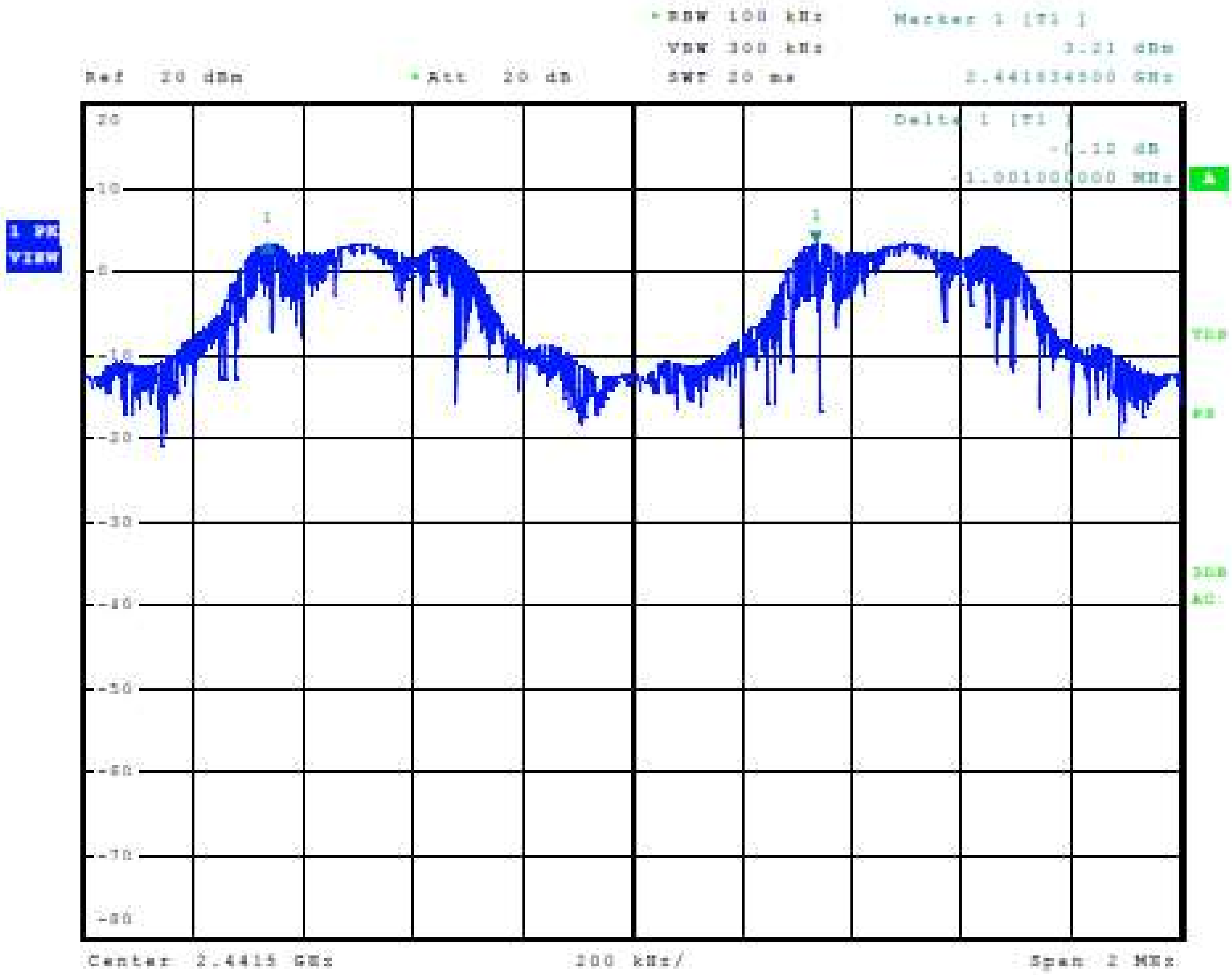
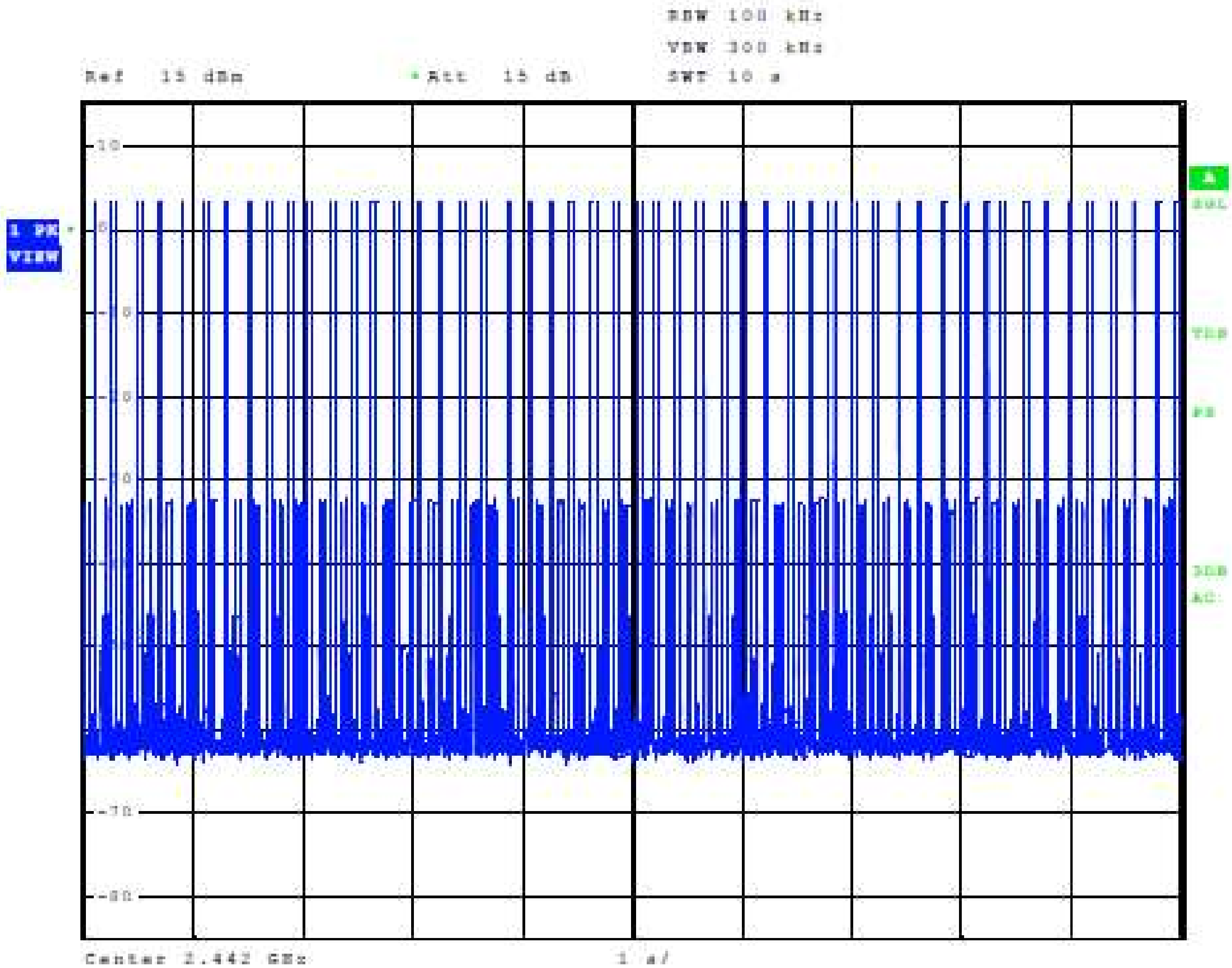


Figure 14 Plot of Number of Times on Channel over 10 Second Period Mode 1 BT BR (GFSK)



NVLAP Lab Code 200087-0

Figure 15 Plot of Transmitter Emissions Low Band Edge Mode 1, BT BR

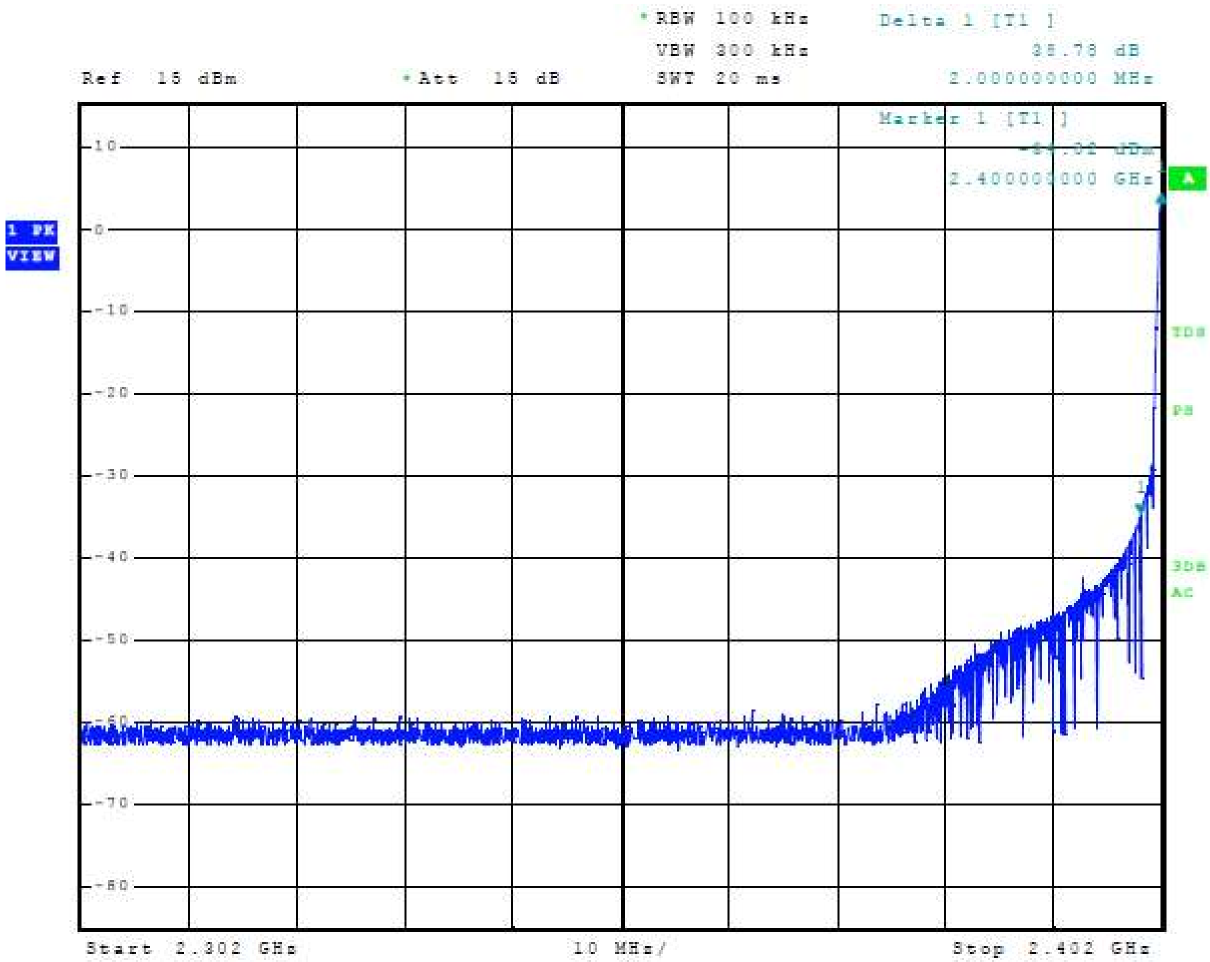


Figure 16 Plot of Transmitter Emissions High Band Edge Mode 1, BT BR

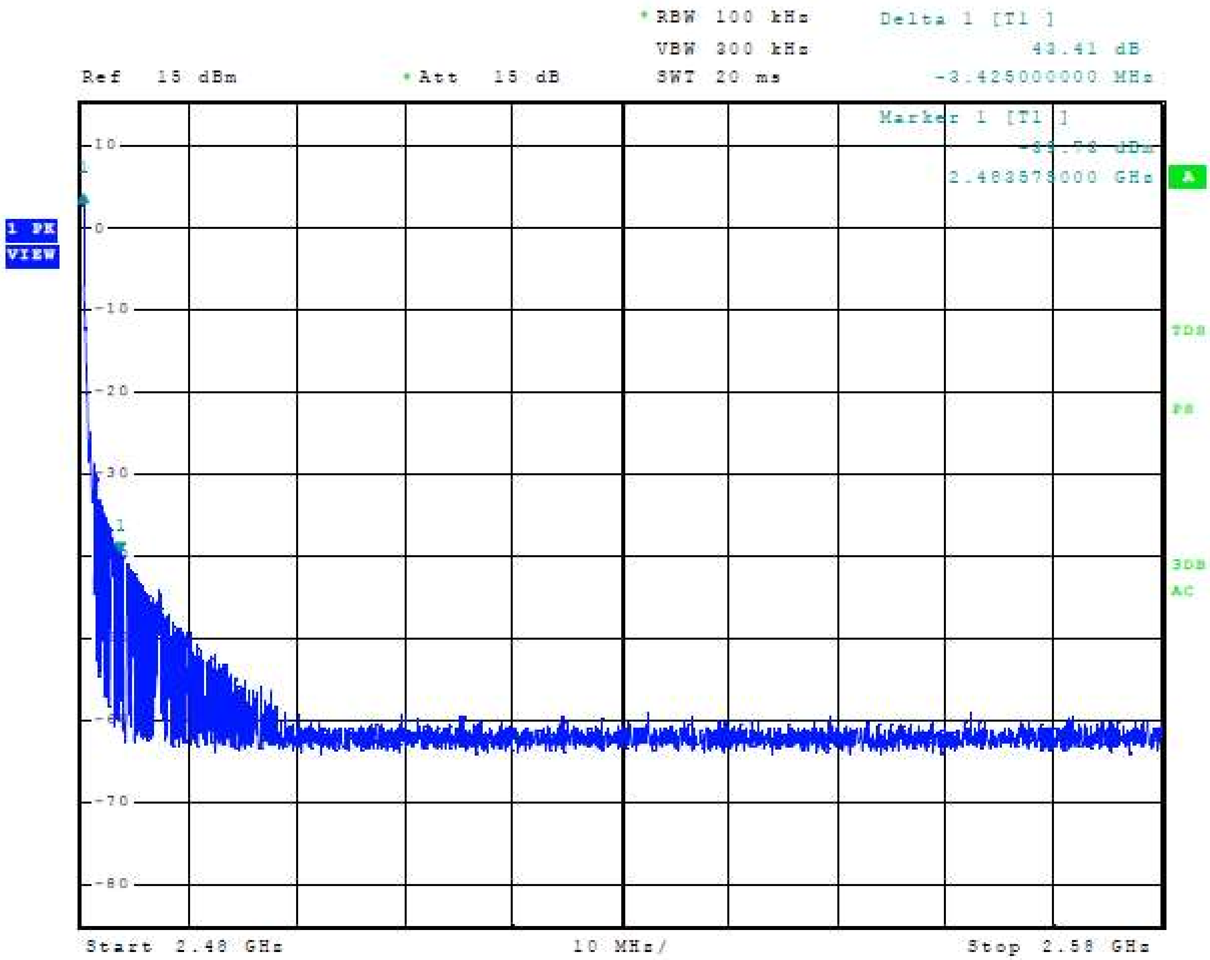


Table 6 Transmitter Radiated Emissions Mode 1, BT BR

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	47.3	34.6	47.6	34.6	54.0	-19.4	-19.4
7206.0	51.1	38.0	51.5	38.0	54.0	-16.0	-16.0
9608.0	54.2	41.3	54.5	41.3	54.0	-12.7	-12.7
12010.0	55.9	43.3	56.9	43.2	54.0	-10.7	-10.8
14412.0	57.4	44.3	57.3	44.4	54.0	-9.7	-9.6
16814.0	62.1	48.9	61.7	48.8	54.0	-5.1	-5.2
2440.0	--	--	--	--	--	--	--
4880.0	48.0	35.0	47.9	35.0	54.0	-19.0	-19.0
7320.0	51.2	38.4	52.0	38.6	54.0	-15.6	-15.4
9760.0	54.3	40.8	54.0	40.8	54.0	-13.2	-13.2
12200.0	57.9	44.6	57.5	44.6	54.0	-9.4	-9.4
14640.0	58.5	44.9	58.1	44.9	54.0	-9.1	-9.1
17080.0	61.0	48.2	62.0	48.2	54.0	-5.8	-5.8
2480.0	--	--	--	--	--	--	--
4960.0	47.9	34.6	47.7	34.6	54.0	-19.4	-19.4
7440.0	50.5	37.6	50.3	37.7	54.0	-16.4	-16.3
9920.0	54.0	41.5	54.4	41.5	54.0	-12.5	-12.5
12400.0	57.4	44.5	57.9	44.5	54.0	-9.5	-9.5
14880.0	58.0	45.1	58.3	45.1	54.0	-8.9	-8.9
17360.0	60.3	47.2	60.2	47.2	54.0	-6.8	-6.8

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

Table 7 Transmitter Antenna Port Conducted Data Mode 1, BT BR

Frequency MHz	Antenna Port Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	20-dB Occupied Bandwidth (kHz)
Mode 1, BT BR			
2402	0.003	971.3	1,050.0
2440	0.003	972.0	1,048.4
2480	0.003	969.8	1,049.8

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 4, and RSS-GEN Issue 5. The antenna port conducted output power measured was 0.003 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 -5.1 dB below the limit. No other radiated emissions were found in the restricted bands less than 20 dB below limits than those recorded in this report. Other emissions were present with amplitudes at least 20 dB below the limits.

Annex

- Annex A Measurement Uncertainty Calculations
- Annex B Test Equipment
- Annex C Laboratory Certificate of Accreditation

Annex A Measurement Uncertainty Calculations

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

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

Annex B Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	3/20/2025	3/20/2026
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/16/2024	9/16/2025
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/16/2024	9/16/2025
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/16/2024	9/16/2025
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/16/2024	9/16/2026
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/17/2025	3/17/2027
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	9/16/2024	9/16/2026
☒ Antenna	Com Power	AH-1840 (101046)	18-40 GHz	3/17/2025	3/17/2027
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	7/9/2025	7/9/2026
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/21/2025	1/21/2026
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☐ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/16/2024	9/16/2025
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/16/2024	9/16/2025
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
☒ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/19/2025	3/19/2026
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/21/2025	3/21/2026
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/21/2025	3/21/2026
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/21/2025	3/21/2026
☒ Weather station	Davis	6152 (A70927D44N)		11/4/2024	11/4/2025

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ Frequency Counter: Leader		LDC-825 (8060153)		3/19/2025	3/19/2026
☐ ISN	Com-Power	Model ISN T-8 (600111)		3/19/2025	3/19/2026
☐ LISN:	Com-Power	Model LI-220A		9/16/2024	9/16/2026
☒ LISN:	Com-Power	Model LI-550C		9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(4M)(281184)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/16/2024	9/16/2025
☒ Cable	Mini-Circuits	KBL-2M-LOW+ (23090329)	9kHz-40 GHz	3/22/2025	3/22/2026
☒ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	3/20/2025	3/20/2026
☐ Antenna:	Solar	9229-1 & 9230-1		2/5/2025	2/5/2026
☐ CDN:	Com-Power	Model CDN M325E		9/16/2024	9/16/2026
☐ Oscilloscope Scope: Tektronix		MDO 4104		2/5/2025	2/5/2026
☐ EMC Transient Generator HVT		TR 3000		2/5/2025	2/5/2026
☐ AC Power Source (Ametech, California Instruments)				2/5/2025	2/5/2026
☒ Field Intensity Meter: EFM-018				2/5/2025	2/5/2026
☒ ESD Simulator: MZ-15				2/5/2025	2/5/2026
☐ Injection Clamp Luthi Model EM101				not required	
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Temperature Chamber				not required	
☒ Shielded Room				not required	

Annex C Laboratory Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200087-0

Rogers Labs, a division of The Compatibility Center LLC
Lenexa, 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 on ISO/IEC 17025).

2025-03-11 through 2026-03-31
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program

NVLAP TESTING ilac-MRA
NVLAP Lab Code 200087-0

Rogers Labs, a division of The Compatibility Center LLC

7915 Nieman Rd.
Lenexa, KS 66214
Phone / Fax (913) 660-0666

47CFR, PART 15C - Intentional Radiators
47CFR Paragraph 15.247 and
Industry Canada RSS-247 Issue 4 and RSS-GEN Issue 5

Application For Grant of Certification

Model: B04281

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

FCC ID: IPH-B4281
IC: 1792A-B4281

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062
Jeff Hailey
Staff Compliance Engineer

Test Report Number: 250528
Test Date: May 28, 2025 – August 28, 2025
Authorized Signatory:

Patrick Powell
Rogers Labs, a division of The Compatibility Center LLC
FCC Designation: US5305
ISED Registration: 3041A

Revisions

Revision 1 Issued October 14, 2025

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 4, 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: B04281

FCC ID: IPH-B4281 IC: 1792A-B4281

Operating Frequency Range: 2402-2480 MHz

B04281 was chosen for transmitter configuration testing and used for final measurements.

Operational communication modes 2 through 7:

Mode	Power (Watts)	99% OBW (kHz)	6-dB OBW (kHz)
BT (2EDR π/4 DQPSK)	0.002	1,210.5	1,078.2
BT (3EDR 8DPSK)	0.003	1,203.8	1,078.4
BT BLE (GMSK)	0.002	1,055.3	711.0
802.11b	0.042	11,557.5	8,510.0
802.11g	0.037	17,430.0	15,855.0
802.11n	0.039	18,240.0	16,640.0

This report addresses EUT Operations as Digital Transmission System using transmitter modulations in modes 2 through 7. Note, the production device utilizes a non-user accessible integral antenna system with 5.24 dBi gain.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Band Emissions 15.205, RSS-GEN, RSS-247	-6.1	Complies
AC Line Emissions as per 47CFR 15.207, RSS-GEN 8.8	-13.55	Complies
Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9	-13.30	Complies
Harmonic Emissions per 47CFR 15.247, RSS-247	-5.2	Complies
Power Spectral Density per 47CFR 15.247, RSS-247	-6.6	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 4

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

Devices shall comply with the following requirements, where applicable:

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.

Equipment Tested

Model: B04281

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

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

Equipment	Model / PN	Serial Number
EUT #1 Radiated	B04281	3514215240
EUT #2 Antenna Port Conducted	B04281	3514215200
AC/DC Wall mount power supply	362-00112-00	N/A
USB-A to C Cable, 1.5m	320-01535-30	N/A
USB-A to C Cable, 4m	320-01545-20	N/A
CLA	013-00797-03	N/A

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

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

Software (FVIN): 1.04 or higher: Antennas: BT/BLE PIFA (5.24 dBi), 2.4 GHz WiFi PIFA (5.24 dBi), 5.7 GHz PIFA (0.08 dBi)

Environmental Conditions

Ambient Temperature	20.9° C
Relative Humidity	45.0 %
Atmospheric Pressure	1018.4 mb

Equipment Operational Modes

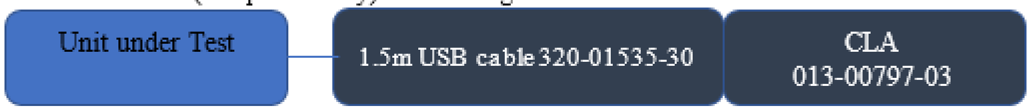
Mode	Transmitter Operation
mode 1	BT BR (GFSK)
mode 2	BT (2EDR π/4 DQPSK)
mode 3	BT (3EDR 8DPSK)
mode 4	BT BLE (GMSK)
mode 5	802.11b
mode 6	802.11g
mode 7	802.11n
mode 12	U-NII-3 802.11a
mode 13	U-NII-3 802.11n
mode 14	U-NII-3 802.11n40
mode 15	U-NII-3 802.11ac80

Equipment Function

The product operates from the internal battery or direct current power provided over the USB-C port. The design provides a Micro SD card slot and USB-C interface port as presented below and wireless communications with the compatible equipment. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interfaces connections other than those presented in the configuration options as described by the manufacturer and presented below.

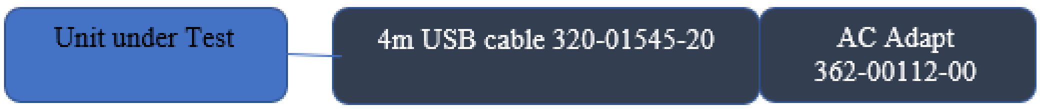
Equipment Configuration

1) UUT connected to (and powered by) CLA through USB cable



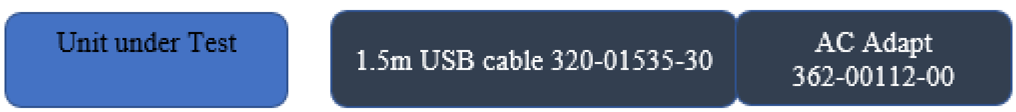
2) UUT connected to (and powered by) CLA through USB cable

3) UUT connected to (and powered by) AC adapter through USB cable

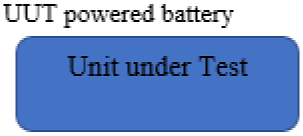


4) UUT connected to (and powered by) Computer through USB cable

5) UUT connected to (and powered by) AC adapter through USB cable



6) UUT powered battery



Application for Certification

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

(2) Identification: HVIN: B04281
FCC ID: IPH-B4281 IC: 1792A-B4281

(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 this 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.

Test Site Locations

Conducted EMI	AC line conducted emissions testing performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).
Antenna port	Antenna port conducted emissions testing was performed in a shielded screen room located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS (or satellite location).
Radiated EMI	The radiated emissions tests were performed at the 3 meters Semi-Anechoic Chamber (SAC) located at Rogers Labs, a division of The Compatibility Center LLC, 7915 Nieman Rd., Lenexa, KS or at the 3 meters Outdoor Area Test Site (OATS) in the satellite location.
Registered Site information:	FCC Site: US5305, ISED: 3041A, CAB Identifier: US0096
NVLAP Accreditation	Lab code 200087-0

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: The limit is expressed for a 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 Semi-Anechoic Chamber using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured

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

RFS (dBμV/m @ 3m) = FSM (dBμV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHz
Loop Antenna	Broadband Biconilog	Horn
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 500 kHz	VBW = 3 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV
Antenna Height 1m	Antenna Height 1-4m	Antenna Height 1-4m

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 4, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Applicable Standards

The following information is submitted in accordance with the eCFR (electronic Title 47 Code of Federal Regulations) (47CFR), dated October 18, 2024: Part 2, Subpart J, Part 15C Paragraph 15.247, RSS-247 Issue 4, and RSS-GEN Issue 5. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2020. This report documents compliance for the EUT operations as Digital Transmission Systems operation.

Intentional Radiators

The following information is submitted supporting compliance with the requirements of 47CFR, Subpart C, paragraph 15.247, Industry Canada RSS-247 Issue 4, 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.

Test Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions were performed as required in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram one showing typical test arrangement and photographs in the test setup exhibit for EUT placement used during testing.

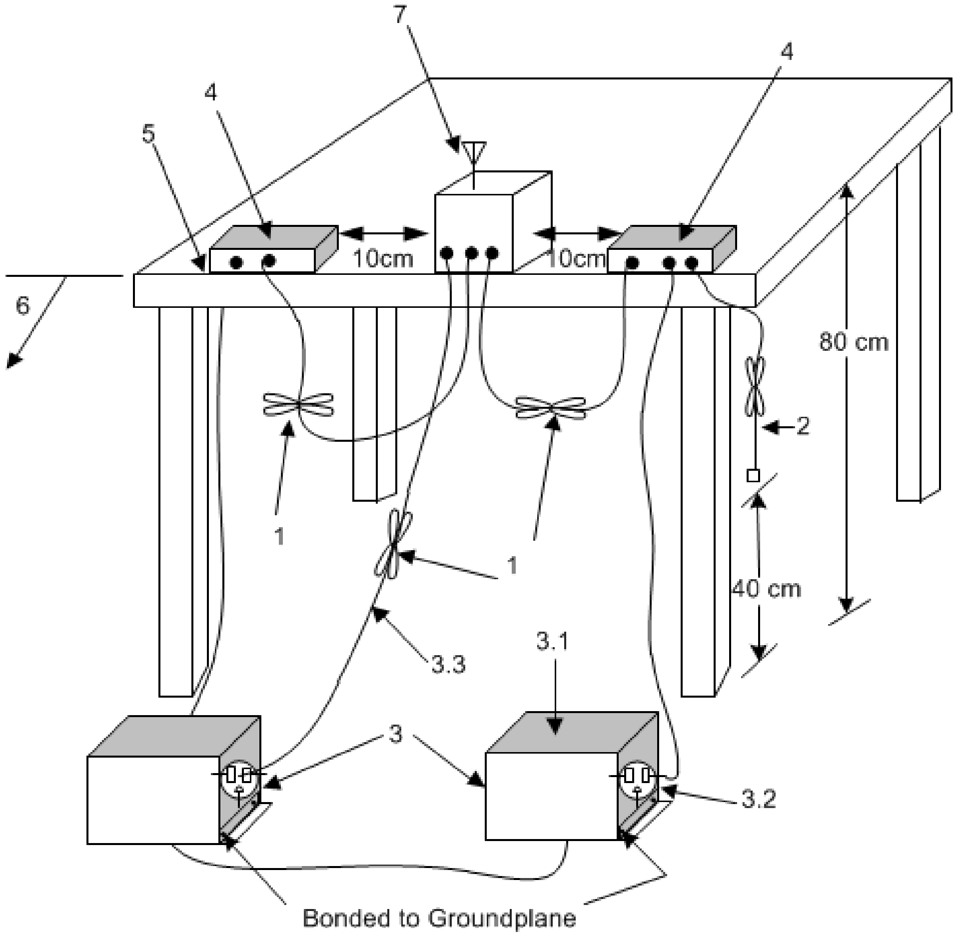
Radiated Emission Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 Issue 4, RSS-GEN and specified in ANSI C63.10-2020. 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 two and three showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

Antenna Port Conducted Emission Test Procedure

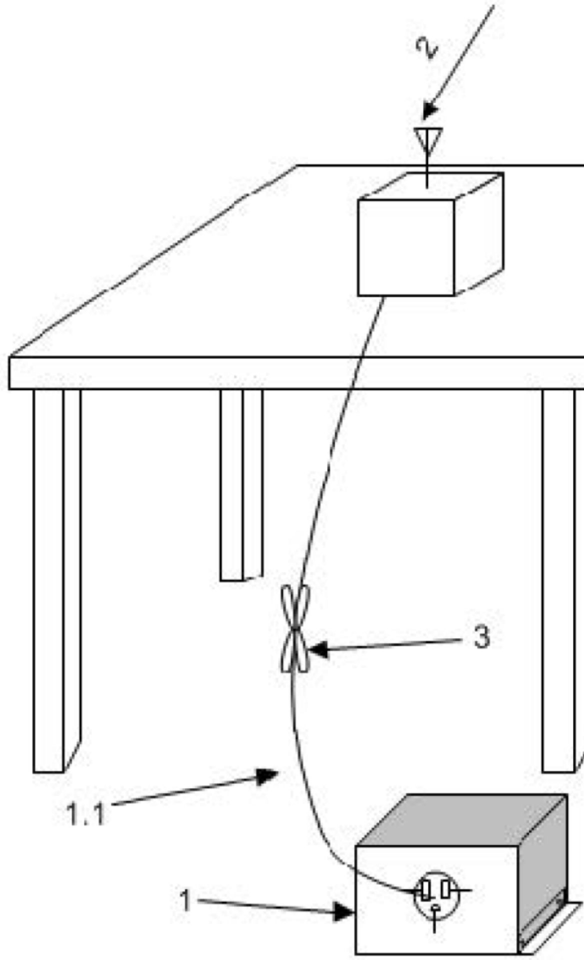
The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2020. Testing was 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 4 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

Diagram 1 Test arrangement for power-line conducted emissions



1. 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 (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3).
   3.1 All other equipment powered from additional LISN(s).
   3.2 Multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Non-EUT components of EUT system being tested.
5. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.3.1).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test

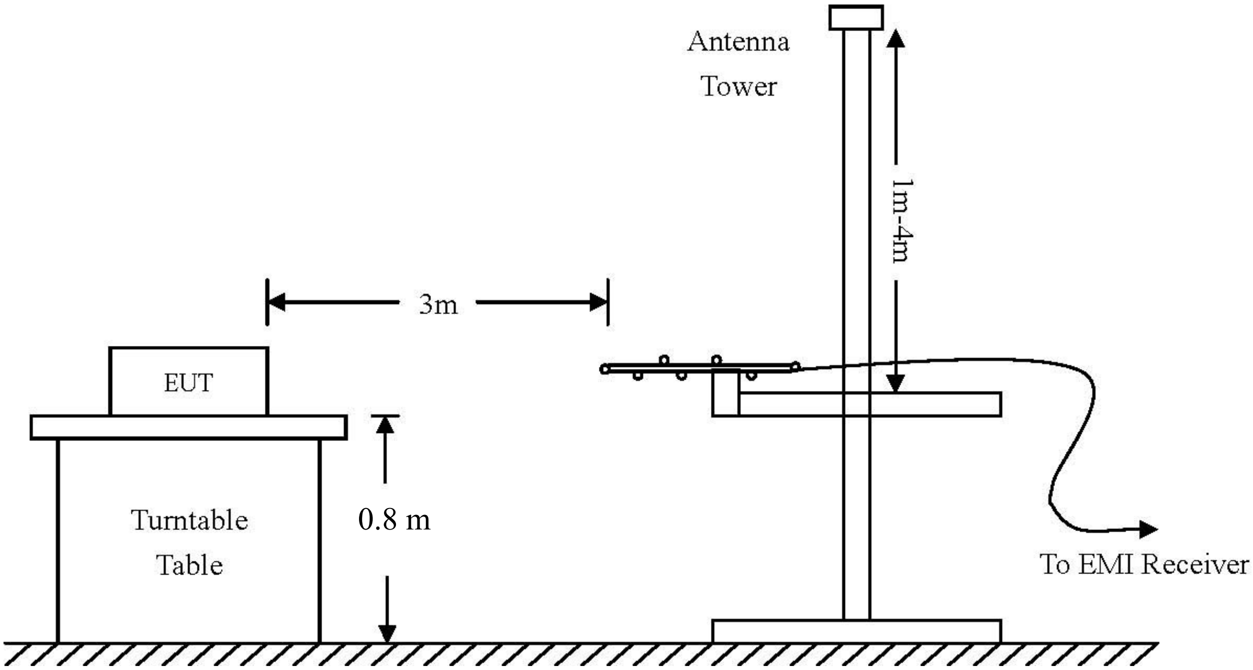
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



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

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

Below 1 GHz



Above 1 GHz:

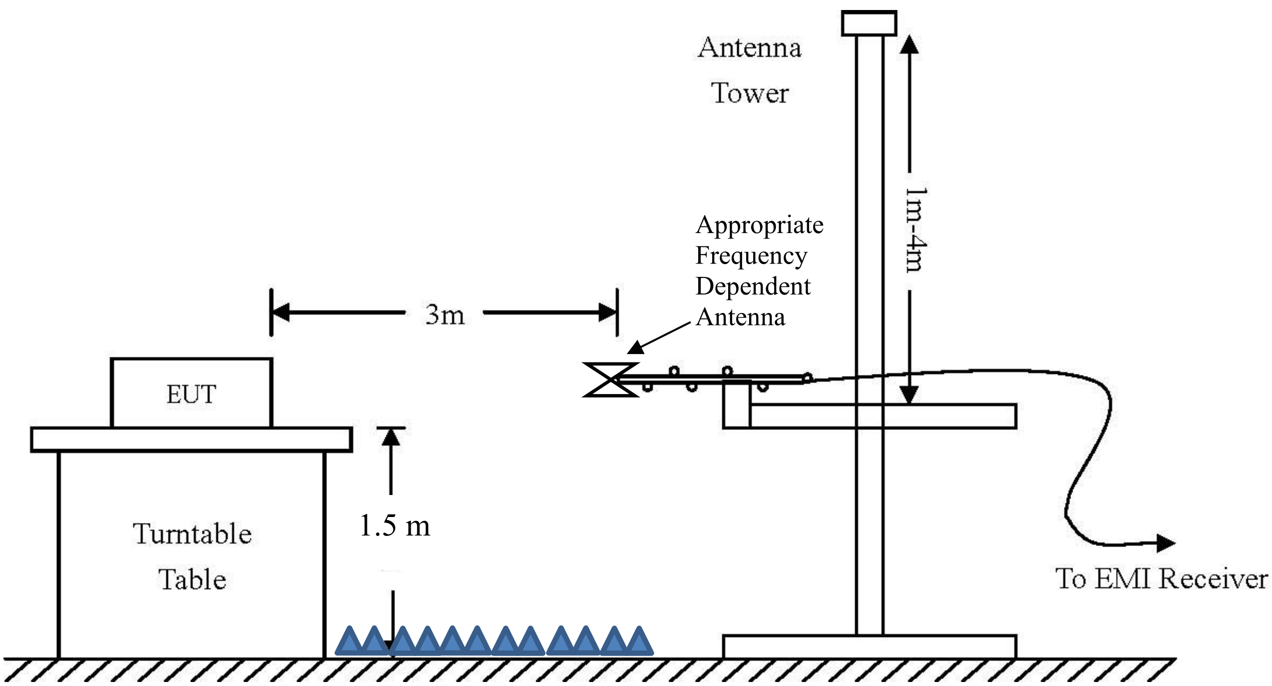
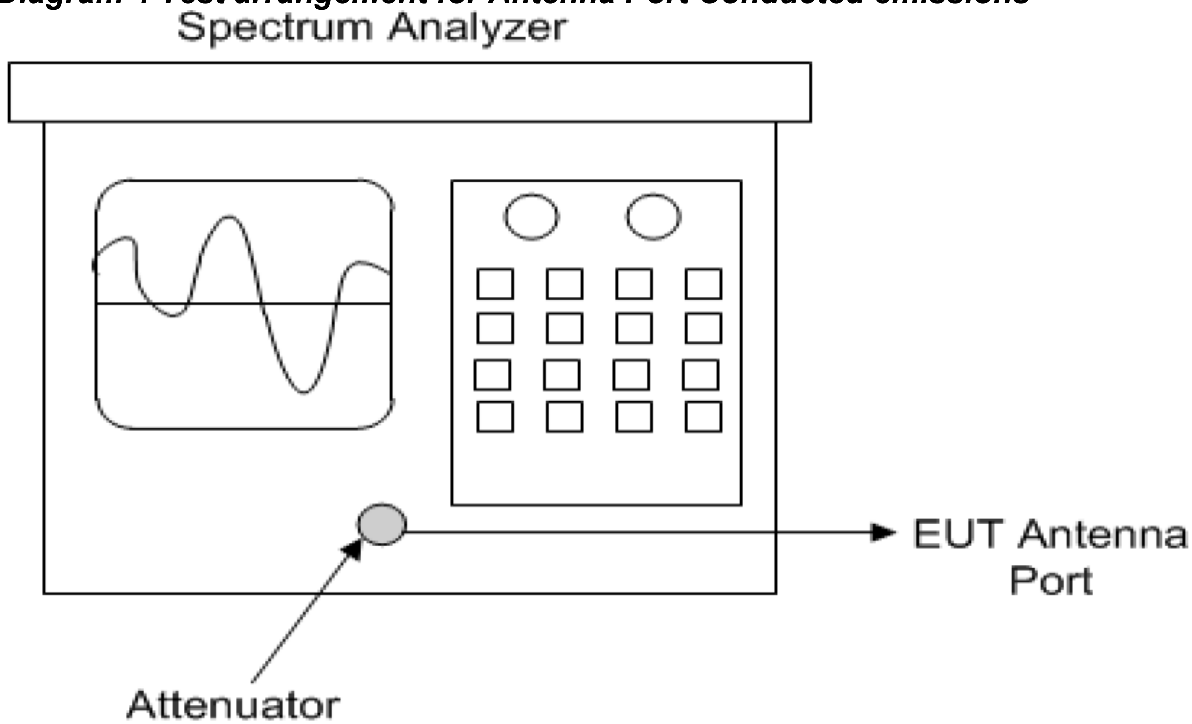


Diagram 4 Test arrangement for Antenna Port Conducted emissions



Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured at the SAC. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the SAC, 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 C63.10-2020 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 (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	65.6	30.3	62.1	30.1	54.0	-23.7	-23.9
2483.5	72.2	33.3	72.1	33.5	54.0	-20.7	-20.5
4804.0	47.8	34.6	47.7	34.6	54.0	-19.4	-19.4
4882.0	47.8	34.9	47.9	34.9	54.0	-19.1	-19.1
4960.0	47.9	34.6	48.1	34.6	54.0	-19.4	-19.4
7206.0	51.2	37.9	51.1	37.9	54.0	-16.1	-16.1
7323.0	51.0	38.3	51.6	38.3	54.0	-15.7	-15.7
7440.0	50.6	37.6	50.6	37.6	54.0	-16.4	-16.4
12010.0	56.3	43.1	56.5	43.1	54.0	-10.9	-10.9
12205.0	57.2	44.5	57.8	44.5	54.0	-9.5	-9.5
12400.0	57.4	44.5	57.2	44.5	54.0	-9.5	-9.5

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 2 Radiated Emissions in Restricted Frequency Bands Data Mode 3, 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	66.9	30.3	64.4	30.0	54.0	-23.7	-24.0
2483.5	74.6	33.5	74.4	33.6	54.0	-20.5	-20.4
4804.0	47.7	34.5	47.3	34.5	54.0	-19.5	-19.5
4882.0	48.7	34.9	48.3	34.9	54.0	-19.1	-19.1
4960.0	47.5	34.6	47.7	34.6	54.0	-19.4	-19.4
7206.0	50.6	37.9	51.0	37.9	54.0	-16.1	-16.1
7323.0	51.0	38.3	51.3	38.2	54.0	-15.7	-15.8
7440.0	51.1	37.9	50.9	37.6	54.0	-16.1	-16.4
12010.0	55.8	43.1	56.3	43.1	54.0	-10.9	-10.9
12205.0	57.5	44.5	57.4	44.5	54.0	-9.5	-9.5
12400.0	58.3	44.5	57.6	44.6	54.0	-9.5	-9.4

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 3 Radiated Emissions in Restricted Frequency Bands Data Mode 4, 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	43.8	30.2	44.1	30.0	54.0	-23.8	-24.0
2483.5	47.7	32.5	47.9	32.8	54.0	-21.5	-21.2
4804.0	48.8	34.6	48.5	34.6	54.0	-19.4	-19.4
4882.0	48.0	35.0	48.5	35.0	54.0	-19.0	-19.0
4960.0	48.1	34.7	48.2	34.7	54.0	-19.3	-19.3
7206.0	51.1	37.9	51.3	37.9	54.0	-16.1	-16.1
7323.0	51.4	38.3	51.1	38.4	54.0	-15.7	-15.6
7440.0	50.5	37.7	50.5	37.7	54.0	-16.3	-16.3
12010.0	57.0	43.2	56.8	43.2	54.0	-10.8	-10.8
12205.0	57.3	44.7	57.8	44.7	54.0	-9.3	-9.3
12400.0	57.6	44.7	57.4	44.7	54.0	-9.3	-9.3

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 Radiated Emissions in Restricted Frequency Bands Data Mode 5, 802.11b

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	51.5	37.3	50.7	36.8	54.0	-16.7	-17.2
2483.5	51.7	38.2	52.0	38.1	54.0	-15.8	-15.9
4824.0	47.8	34.6	47.7	34.7	54.0	-19.4	-19.3
4874.0	48.3	34.9	48.1	34.9	54.0	-19.1	-19.1
4924.0	47.7	34.9	47.8	34.8	54.0	-19.1	-19.2
7236.0	51.2	37.9	51.3	38.0	54.0	-16.1	-16.0
7311.0	51.2	38.3	51.0	38.3	54.0	-15.7	-15.7
7386.0	51.6	38.4	51.3	38.3	54.0	-15.6	-15.7
12060.0	57.0	43.7	57.0	43.5	54.0	-10.3	-10.5
12185.0	57.4	44.2	57.3	44.2	54.0	-9.8	-9.8
12310.0	58.7	45.5	59.0	45.5	54.0	-8.5	-8.5

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 5 Radiated Emissions in Restricted Frequency Bands Data Mode 6, 802.11g

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	64.3	46.7	63.2	46.1	54.0	-7.3	-7.9
2483.5	65.1	47.9	65.1	47.0	54.0	-6.1	-7.0
4824.0	47.4	34.6	47.9	34.7	54.0	-19.4	-19.3
4874.0	47.9	34.9	48.6	34.9	54.0	-19.1	-19.1
4924.0	48.1	34.8	47.7	34.8	54.0	-19.2	-19.2
7236.0	50.9	37.9	50.7	38.0	54.0	-16.1	-16.0
7311.0	50.8	38.3	51.2	38.4	54.0	-15.7	-15.6
7386.0	51.3	38.2	51.0	38.2	54.0	-15.8	-15.8
12060.0	56.6	43.7	56.8	43.6	54.0	-10.3	-10.4
12185.0	57.4	44.2	57.3	44.2	54.0	-9.8	-9.8
12310.0	58.4	45.3	58.5	45.3	54.0	-8.7	-8.7

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 6 Radiated Emissions in Restricted Frequency Bands Data Mode 7, 802.11n

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	68.1	47.6	67.3	46.8	54.0	-6.4	-7.2
2483.5	69.6	47.1	68.2	45.7	54.0	-6.9	-8.3
4824.0	47.8	34.6	47.6	34.6	54.0	-19.4	-19.4
4874.0	47.8	34.8	47.9	34.8	54.0	-19.2	-19.2
4924.0	47.4	34.7	47.7	34.7	54.0	-19.3	-19.3
7236.0	51.1	37.8	51.2	37.9	54.0	-16.2	-16.1
7311.0	51.7	38.2	51.4	38.2	54.0	-15.8	-15.8
7386.0	51.0	38.1	51.5	38.2	54.0	-15.9	-15.8
12060.0	56.6	43.5	56.4	43.5	54.0	-10.5	-10.5
12185.0	57.2	44.1	57.0	44.1	54.0	-9.9	-9.9
12310.0	57.6	45.2	57.9	45.2	54.0	-8.8	-8.8

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 Part 15C and RSS-247 Issue 4 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -6.1 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted EMI Procedure

The EUT was arranged in typical equipment configurations as offered by manufacturer and presented above in equipment configuration. AC Line Conducted emission testing was performed with the EUT placed on a 1 x 1.5-meter bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the AC line-conducted emissions followed the procedures of ANSI C63.10-2020. The EUT was configured as presented in the AC Line conducted configurations as directed by the manufacturer and presented above in equipment configuration. The AC adapter for the EUT was connected to the LISN for AC line-conducted emissions testing. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the test configuration. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which demonstrated the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz and data recorded.

Refer to data in tables 7 and 8 and figures 1 and 2 for plots of the Configuration #4 EUT – Computer interface AC Line conducted emissions.

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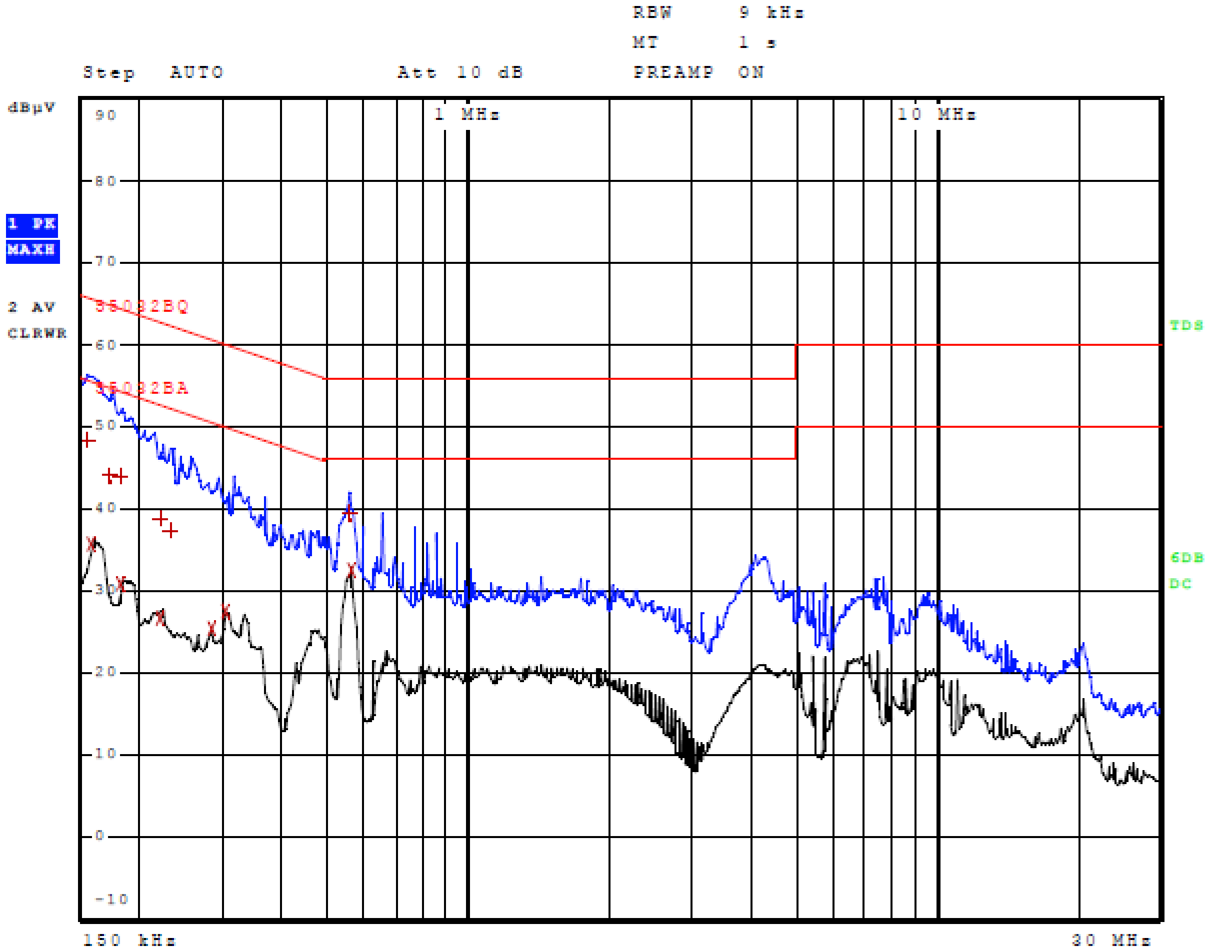
Figure 1 AC Line Conducted Emissions Data L1 (Config. #4, EUT – Computer)



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

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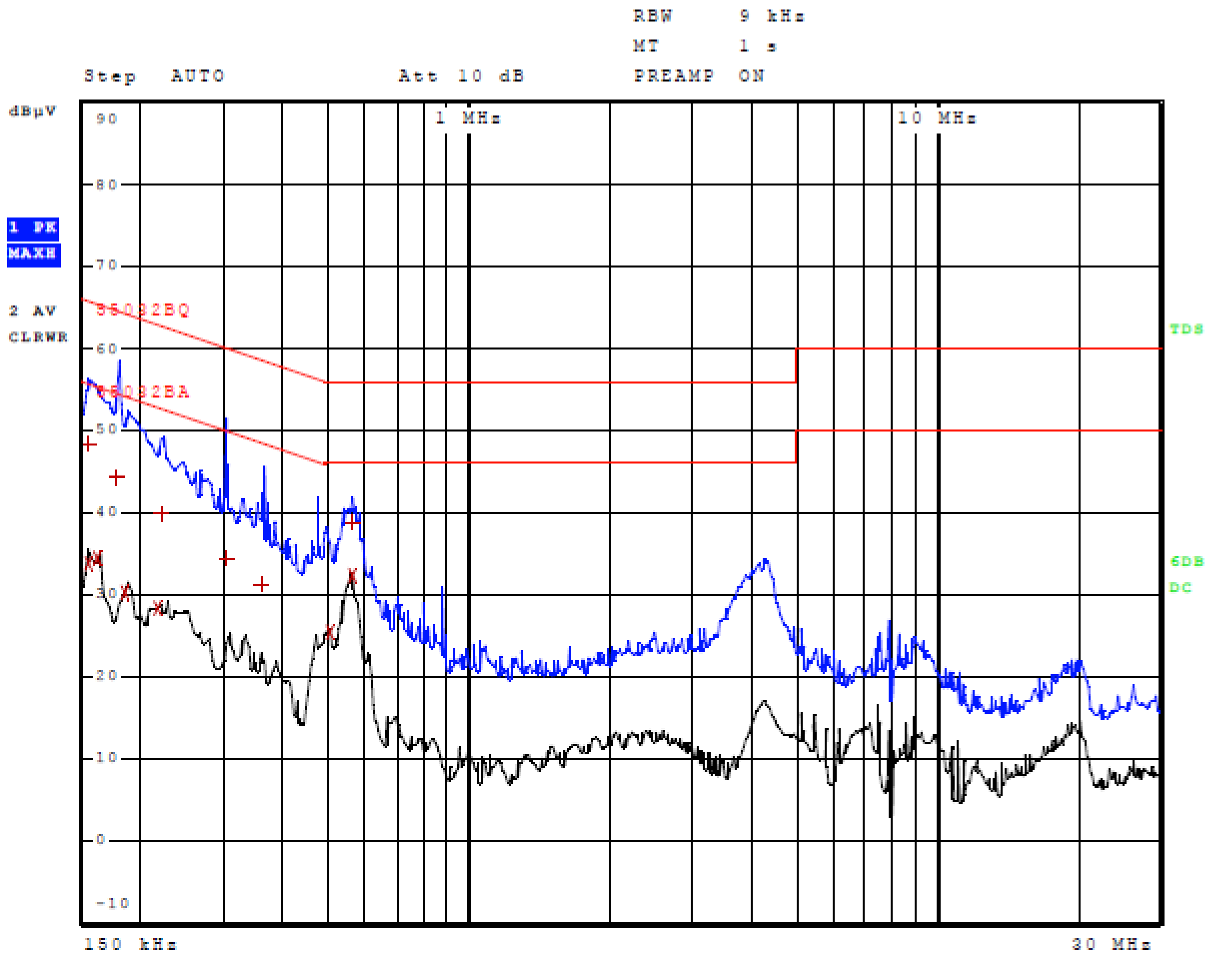
Figure 2 AC Line Conducted Emissions Data L2 (Config. #4, EUT – Computer)



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

Table 7 AC Line Conducted Emissions Data L1 (Config. #4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	48.30	Quasi Peak	-17.48
2	158.000000000 kHz	35.65	Average	-19.92
1	174.000000000 kHz	44.10	Quasi Peak	-20.66
1	182.000000000 kHz	43.93	Quasi Peak	-20.47
2	182.000000000 kHz	30.77	Average	-23.62
2	222.000000000 kHz	26.65	Average	-26.09
1	222.000000000 kHz	38.89	Quasi Peak	-23.85
1	234.000000000 kHz	37.32	Quasi Peak	-24.99
2	282.000000000 kHz	25.30	Average	-25.46
2	306.000000000 kHz	27.53	Average	-22.55
1	554.000000000 kHz	39.38	Quasi Peak	-16.62
2	558.000000000 kHz	32.45	Average	-13.55

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

Table 8 AC Line Conducted Emissions Data L2 (Config. #4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	33.89	Average	-21.90
1	154.000000000 kHz	48.33	Quasi Peak	-17.45
2	162.000000000 kHz	34.36	Average	-21.00
1	178.000000000 kHz	44.31	Quasi Peak	-20.27
2	186.000000000 kHz	30.27	Average	-23.94
2	218.000000000 kHz	28.41	Average	-24.48
1	222.000000000 kHz	39.81	Quasi Peak	-22.93
1	302.000000000 kHz	34.45	Quasi Peak	-25.74
1	362.000000000 kHz	31.25	Quasi Peak	-27.44
2	502.000000000 kHz	25.46	Average	-20.54
2	558.000000000 kHz	32.25	Average	-13.75
1	562.000000000 kHz	38.87	Quasi Peak	-17.13

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

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47CFR Part 15C, RSS-247 and RSS-Gen. The EUT configuration #4 demonstrated a minimum margin of -13.55 dB below the requirement. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

General Radiated Emissions Procedure

Testing for the radiated emissions were performed as specified in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. For testing purposes, the EUT was arranged as presented in the applicable configuration diagrams above and operated through all modes as presented.

Exploratory radiated emissions measurements were performed in the SAC chamber or screen room, finding maximized emissions over frequency, EUT orientation, antenna height and polarity. This data is then used to focus the final radiated emissions measurements on these maximized points.

Final radiated emissions data were taken with the EUT located in the OATS or SAC at distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 6,000 MHz was searched for radiated emissions. Measured emission levels were maximized by EUT placement on the table, changing cable location, 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, Biconical, Broadband Biconilog, Log Periodic, and Double Ridge or Pyramidal Horns and mixers above 1 GHz.

Refer to tables 9 and 10 for general radiated emissions data and figures 3 through 4 for plots of the worst case radiated emissions taken in the SAC (30 MHz to 1 GHz).

Figure 3 Plot of General Radiated Emissions – Horizontal Polarization

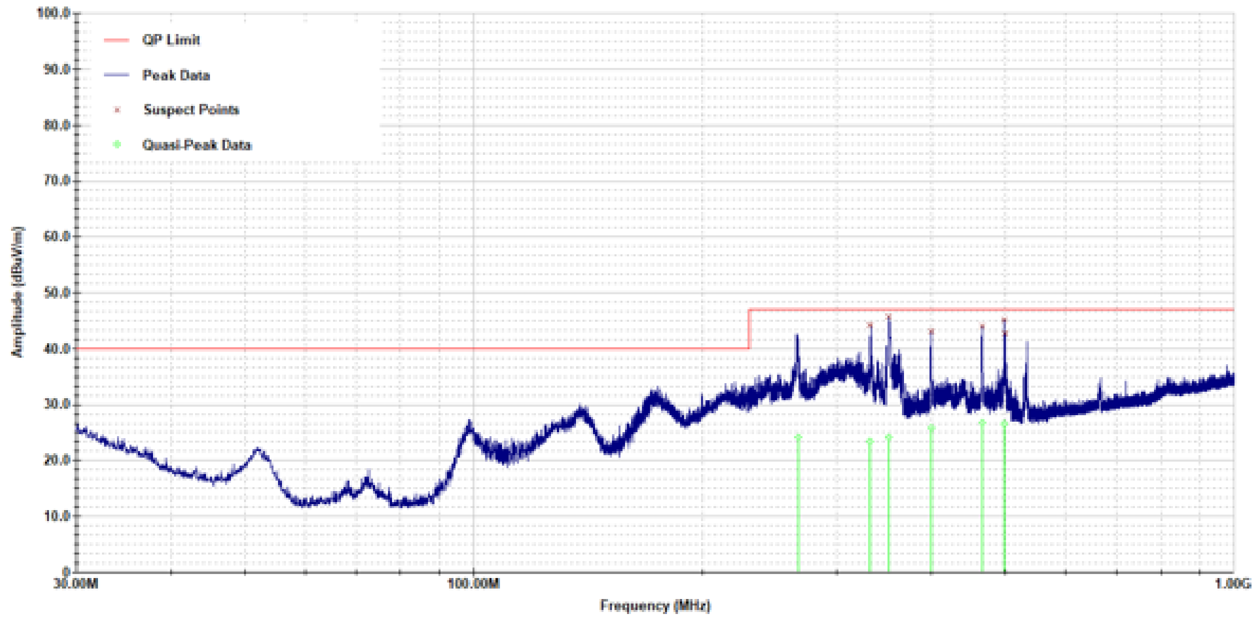


Figure 4 Plot of General Radiated Emissions – Vertical Polarization

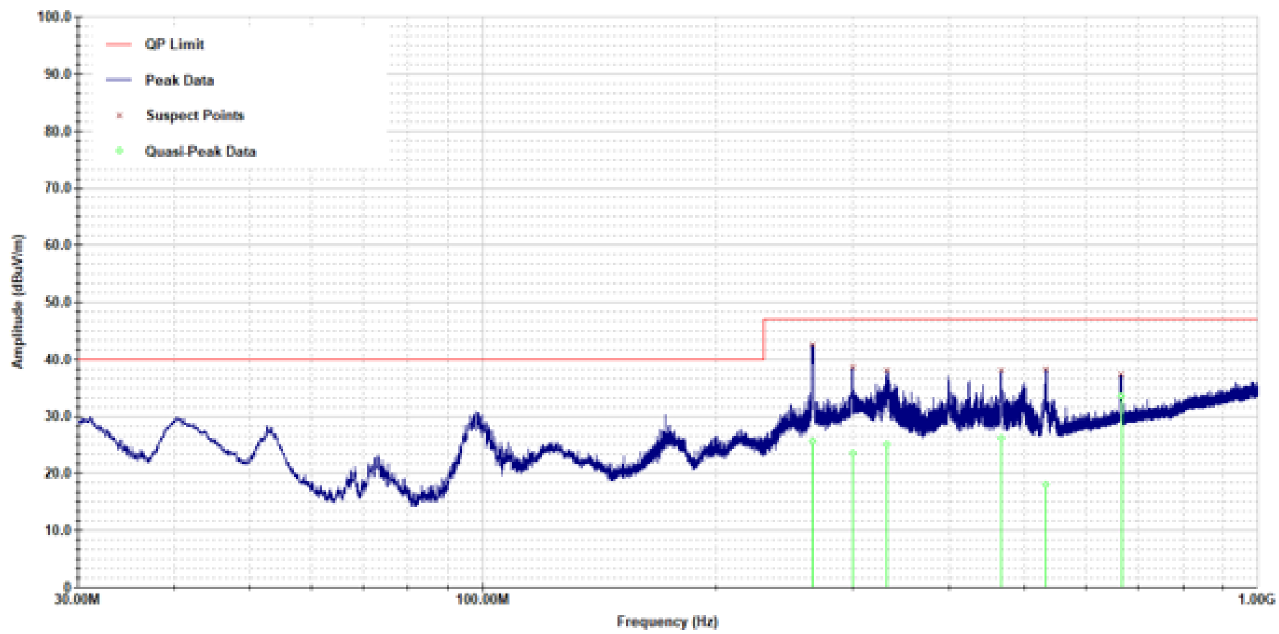


Table 9 General Radiated Emissions Data – Worst Case (Horizontal Polarization)

Frequency (MHz)	Peak (dBµV/m)	Quasi-Peak (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dBm)
267.1	30.8	24.2	47	-22.8
332.1	30.5	23.4	47	-23.6
351.2	32.1	24.1	47	-22.9
399.9	32.8	25.7	47	-21.3
466.6	33.7	26.8	47	-20.2
498.1	34.2	26.5	47	-20.5

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

Table 10 General Radiated Emissions Data – Worst Case (Vertical Polarization)

Frequency (MHz)	Peak (dBµV/m)	Quasi-Peak (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dBm)
266.5	32.8	25.7	47	-21.3
299.7	29.1	23.6	47	-23.5
331.6	30.9	25.1	47	-22.0
466.3	35.9	26.2	47	-20.8
532.6	24.7	17.9	47	-29.1
666.5	37.3	33.7	47	-13.3

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 4, and RSS-GEN Issue 5 Intentional Radiators. The EUT configuration demonstrated a minimum margin of -13.3 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 C63.10-2020 paragraph 6, and KDB 558074 were used during transmitter testing. Test sample EUT Antenna Port Conducted #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 KDB 558074 and ANSI C63.10-2020. Average power measured did not include any time intervals during which the transmitter was off or transmitting at a reduced power level. The peak Power Spectral Density (PKPSD) was measured as defined in KDB 558074 and ANSI C63.10-2020. DTS Emission bandwidth was measured as described in KDB 558074 and ANSI C63.10-2020. The amplitude of each harmonic and general radiated emission was measured on the SAC at distance of 3 meters from the FSM antenna (radiated emission testing was performed on EUT Radiated #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 EUT Antenna Port Conducted #2) for reference in this and other documentation. These are shown in figures 5 through 40.

Figure 5 Plot of Transmitter Operation in 2402-2480 MHz Mode 2, BT (2EDR π/4 DQPSK)

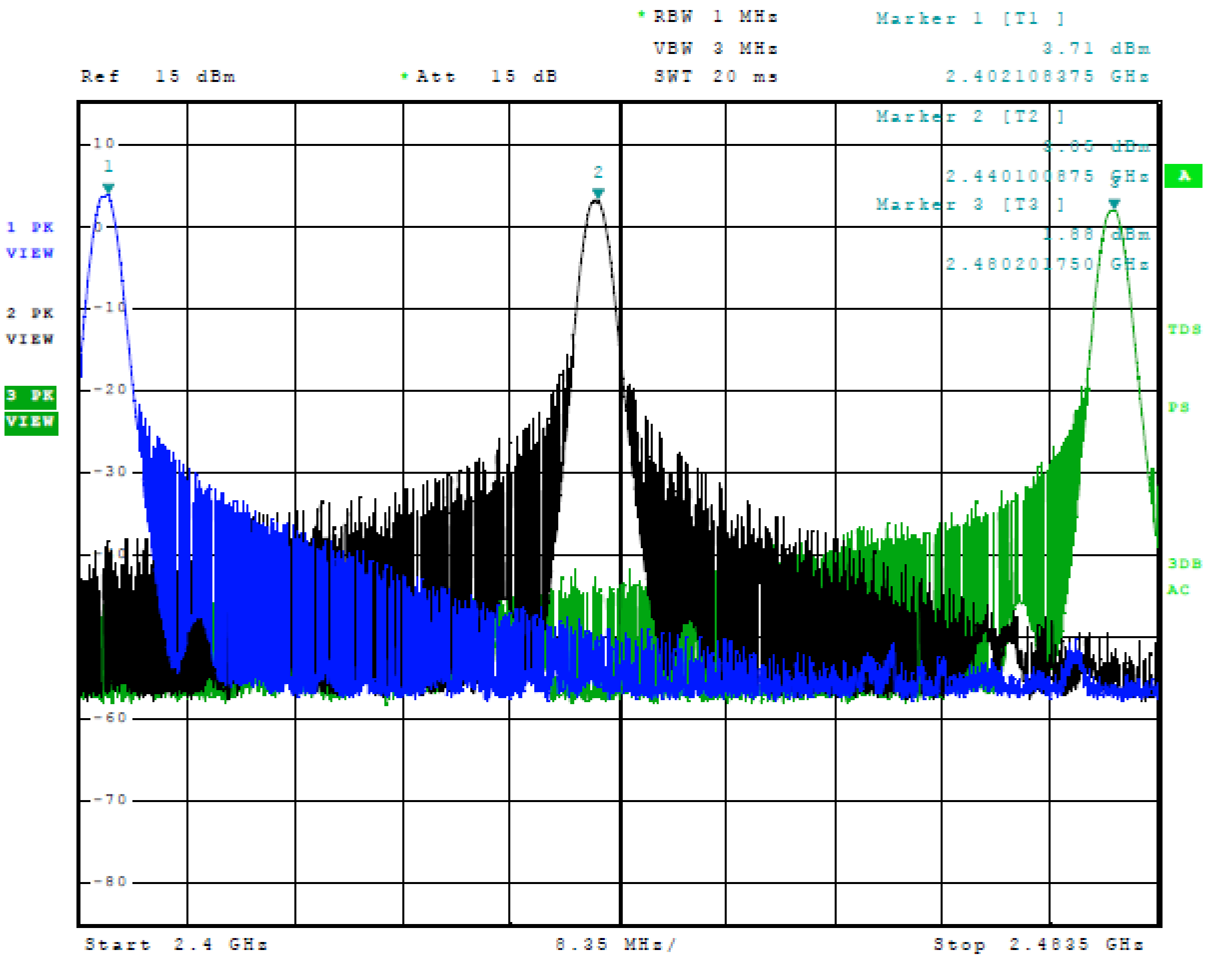


Figure 6 Plot of Transmitter Operation in 2402-2480 MHz Mode 3, BT (3EDR 8DPSK)

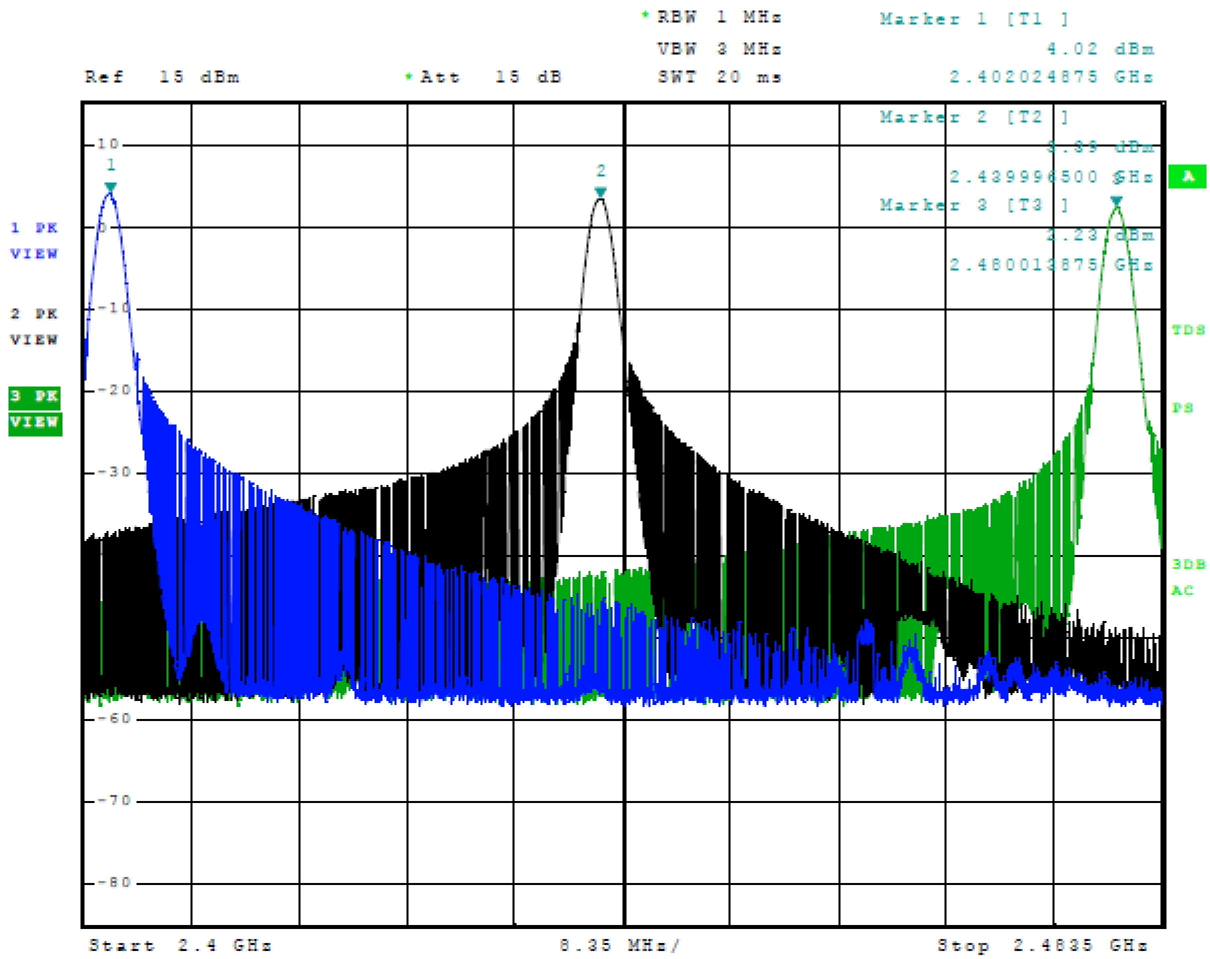


Figure 7 Plot of Transmitter Operation in 2402-2480 MHz Mode 4, BT BLE (GMSK)

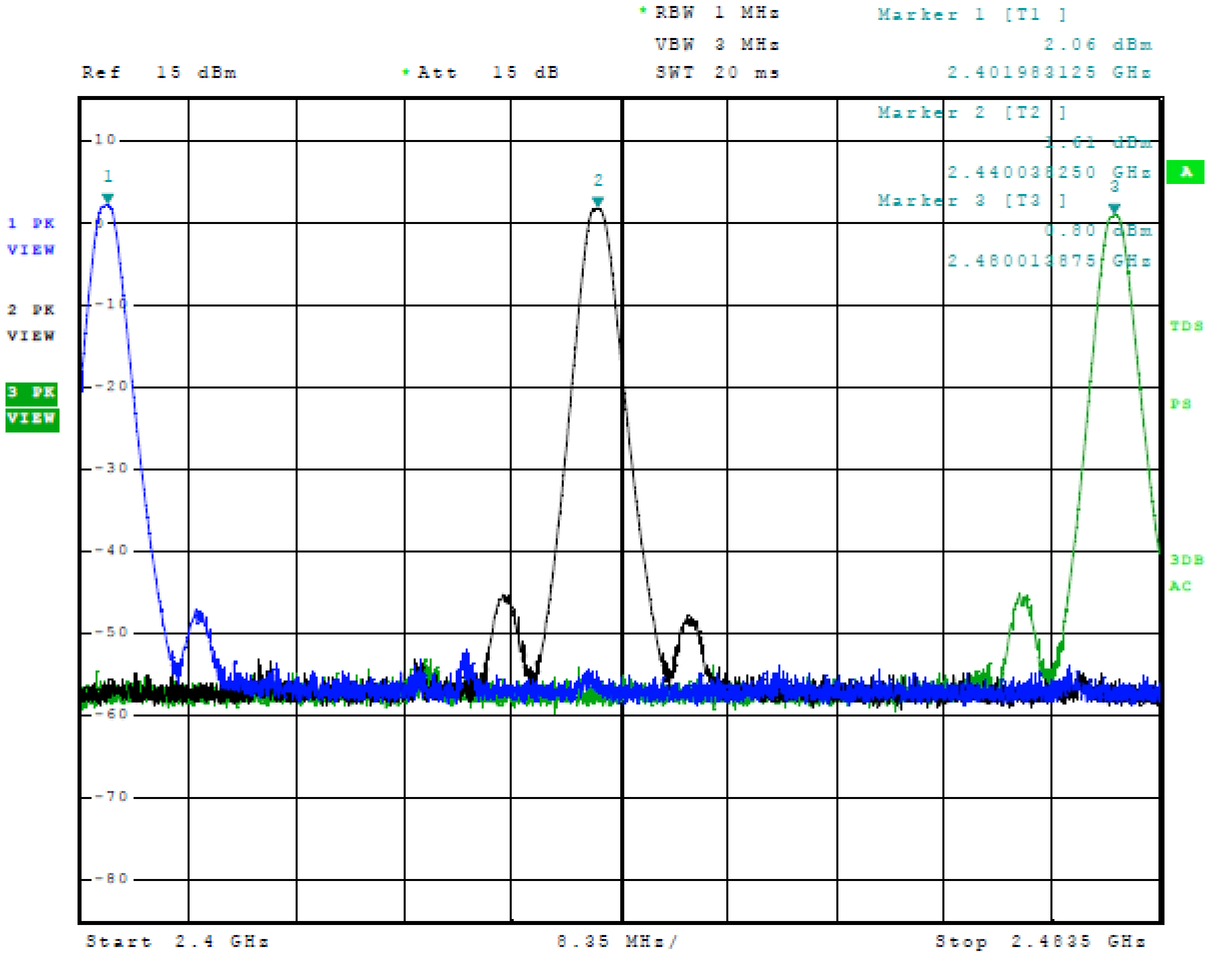


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Figure 8 Plot of Transmitter Operation in 2402-2480 MHz Mode 5, 802.11b

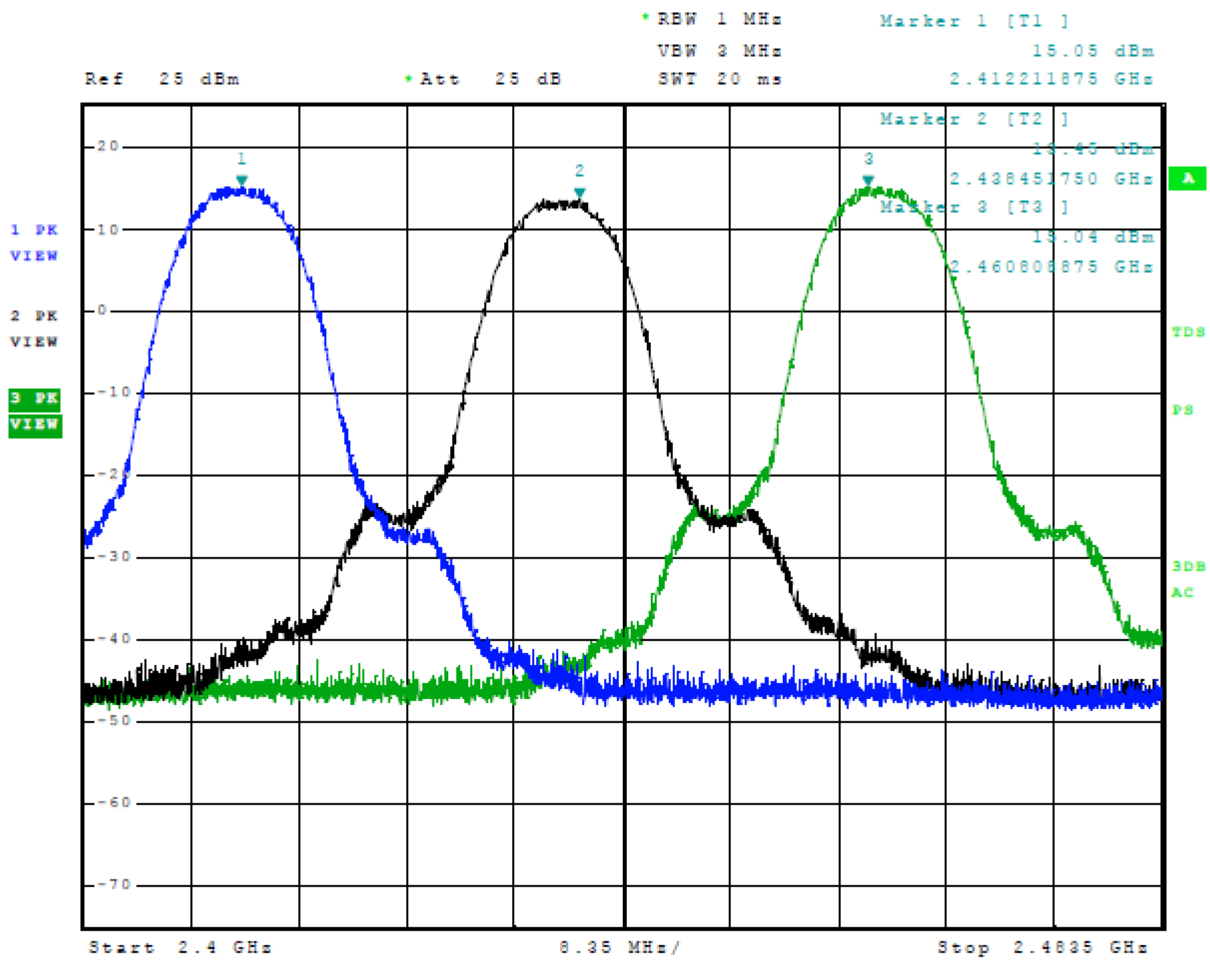

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Figure 9 Plot of Transmitter Operation in 2402-2480 MHz Mode 6, 802.11g

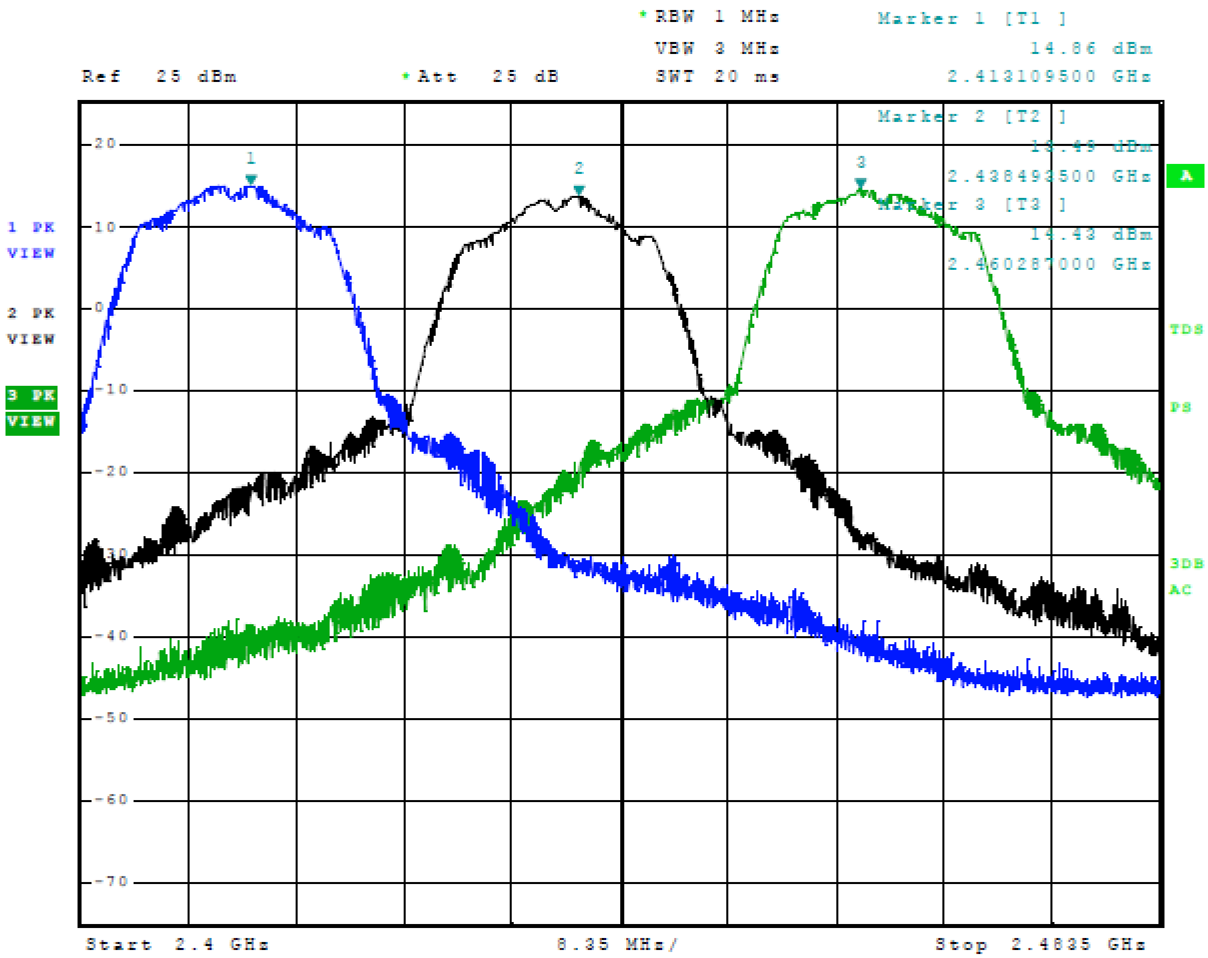

Figure 10 Plot of Transmitter Operation in 2402-2480 MHz Mode 7, 802.11n

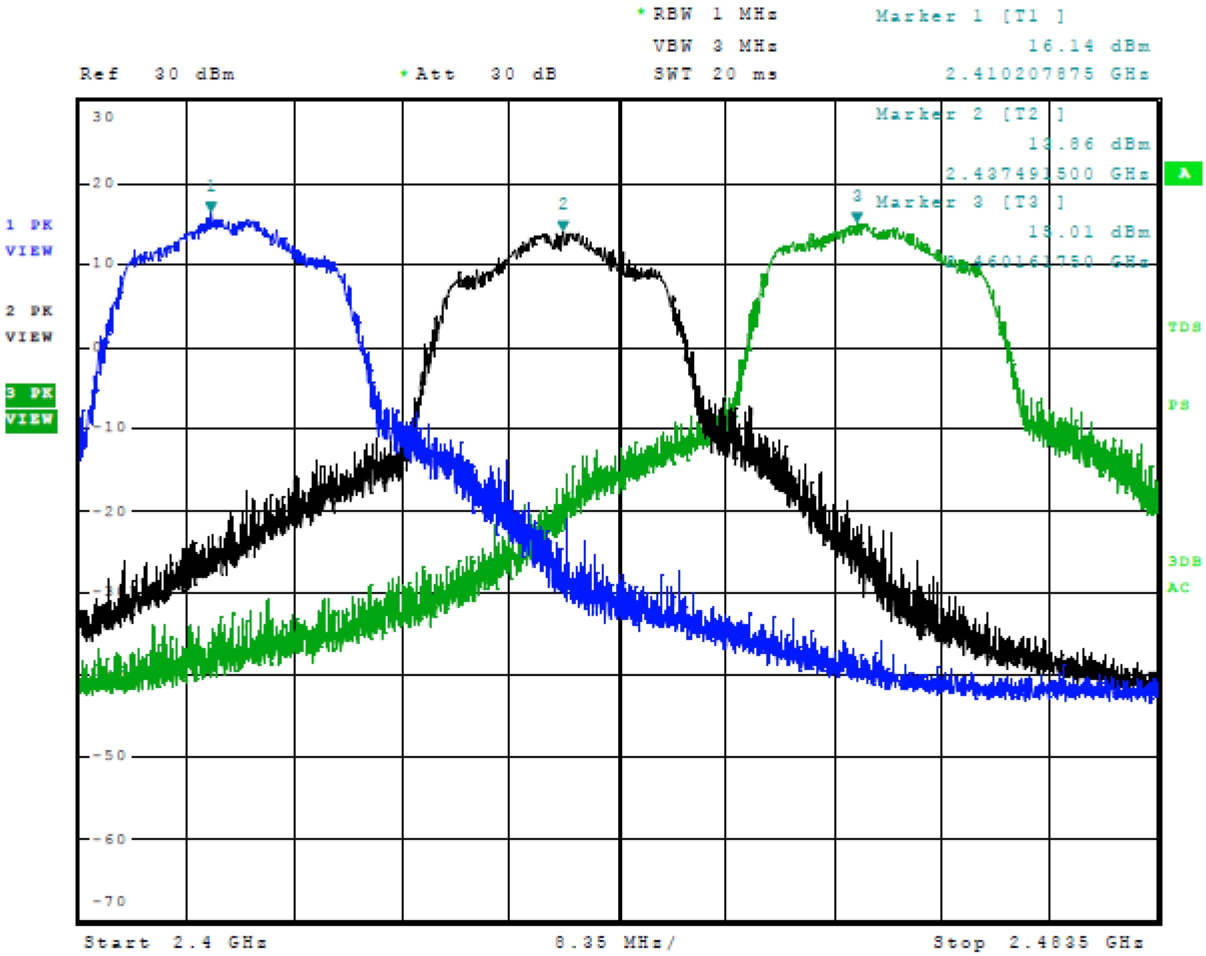

Figure 11 Plot of Emissions Low Band Edge Mode 2, BT (2EDR π/4 DQPSK)

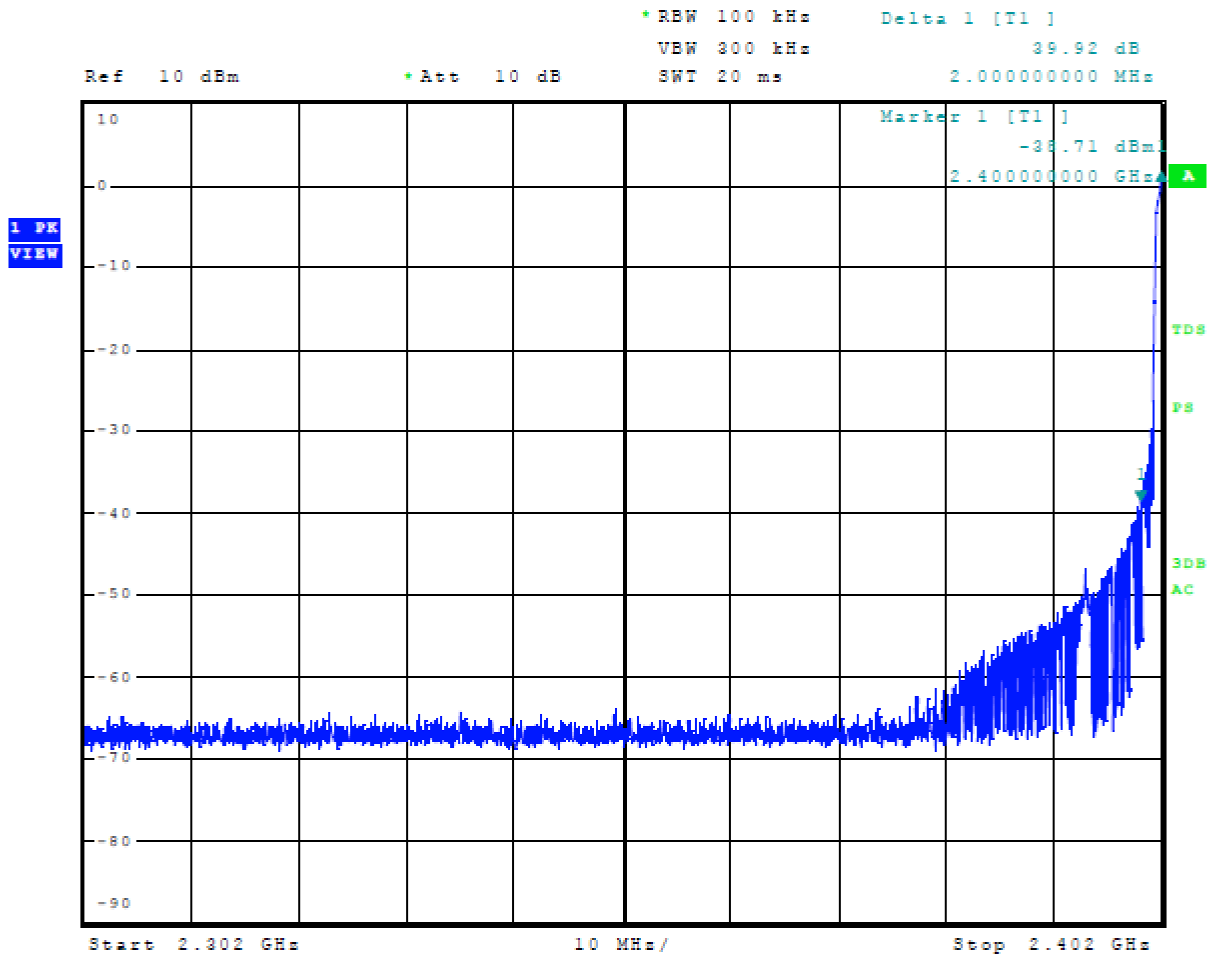

Figure 12 Plot of Emissions Low Band Edge Mode 3, BT (3EDR 8DPSK)

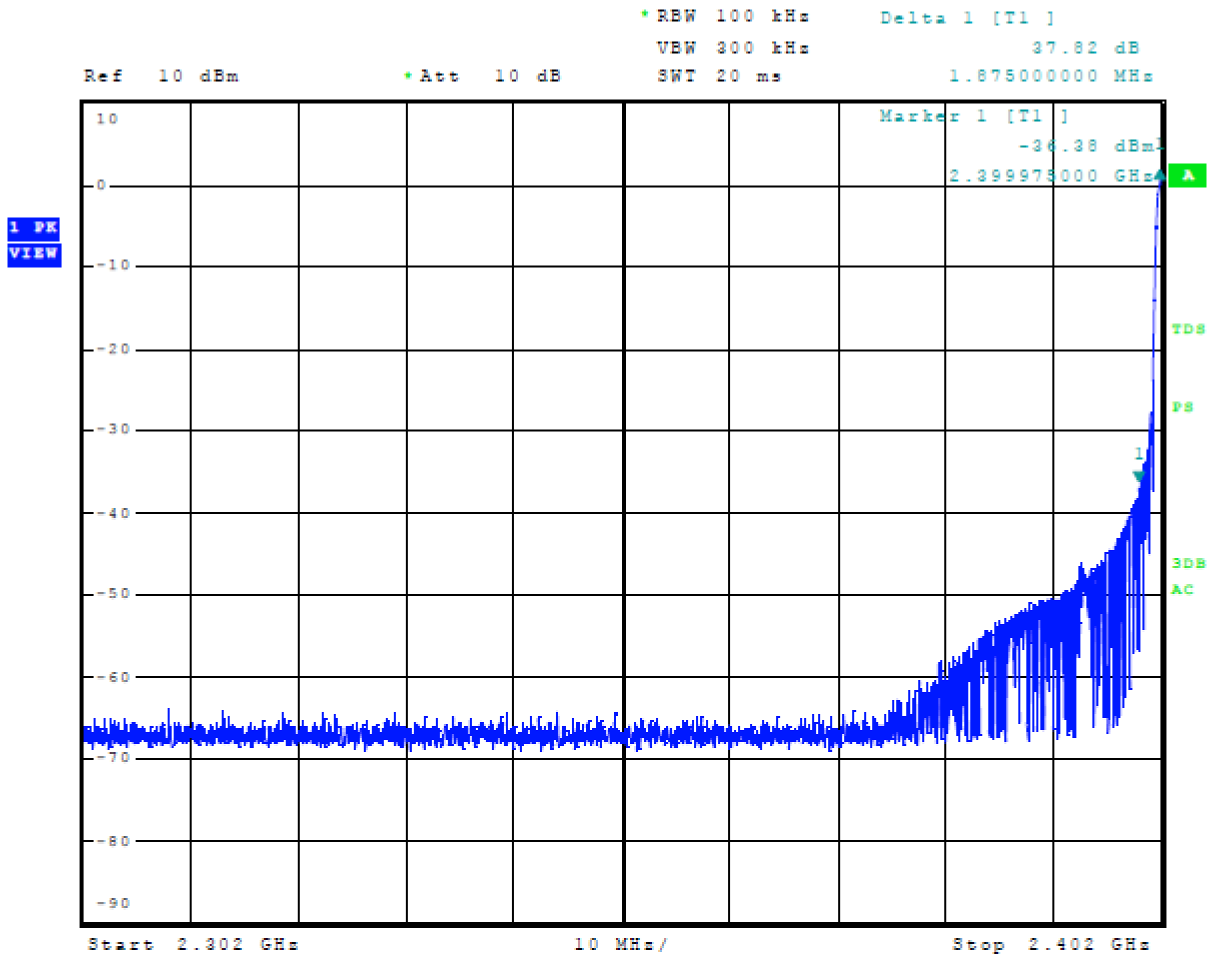

Figure 13 Plot of Emissions Low Band Edge Mode 4, BT BLE (GMSK)

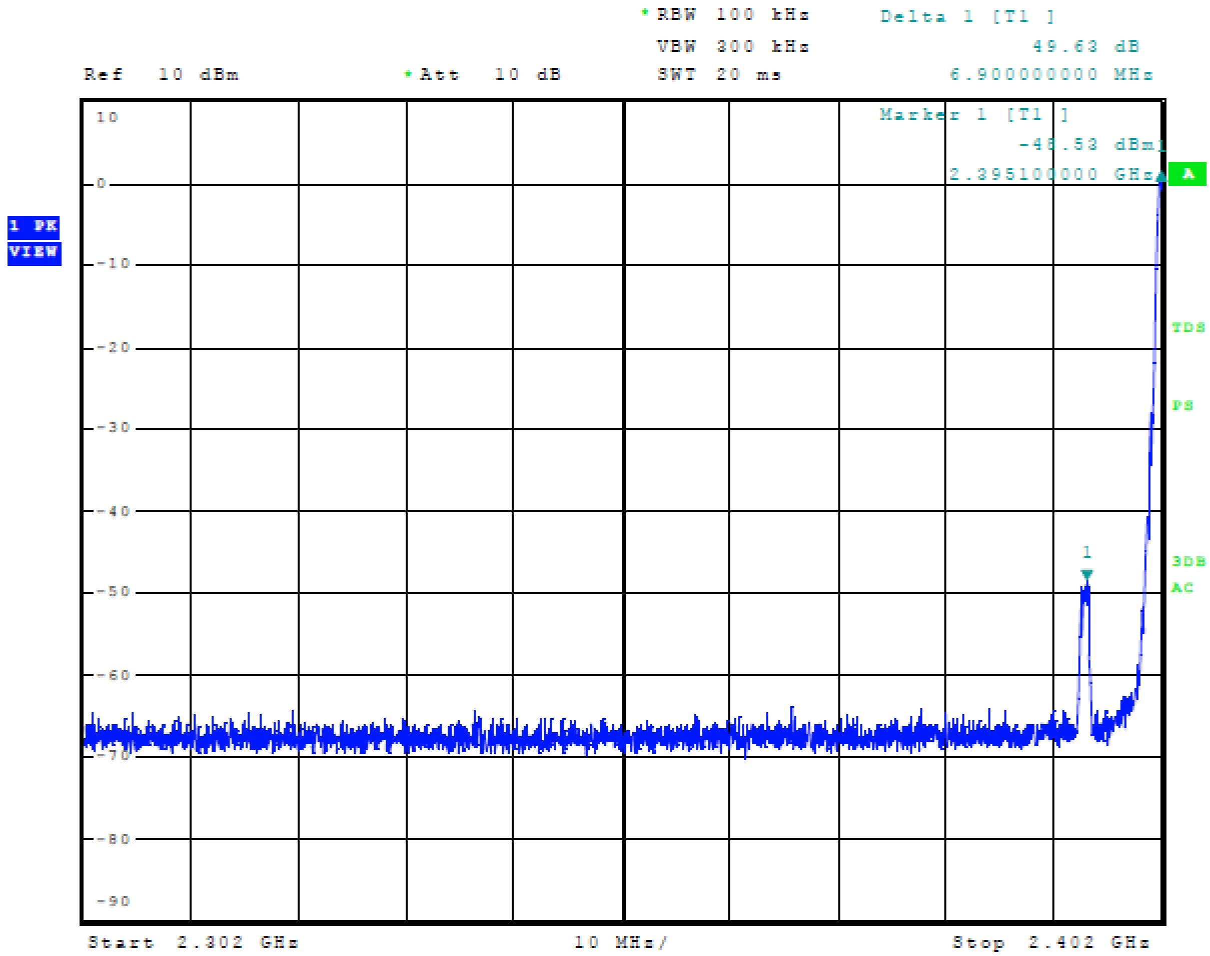

Figure 14 Plot of Emissions Low Band Edge Mode 5, 802.11b

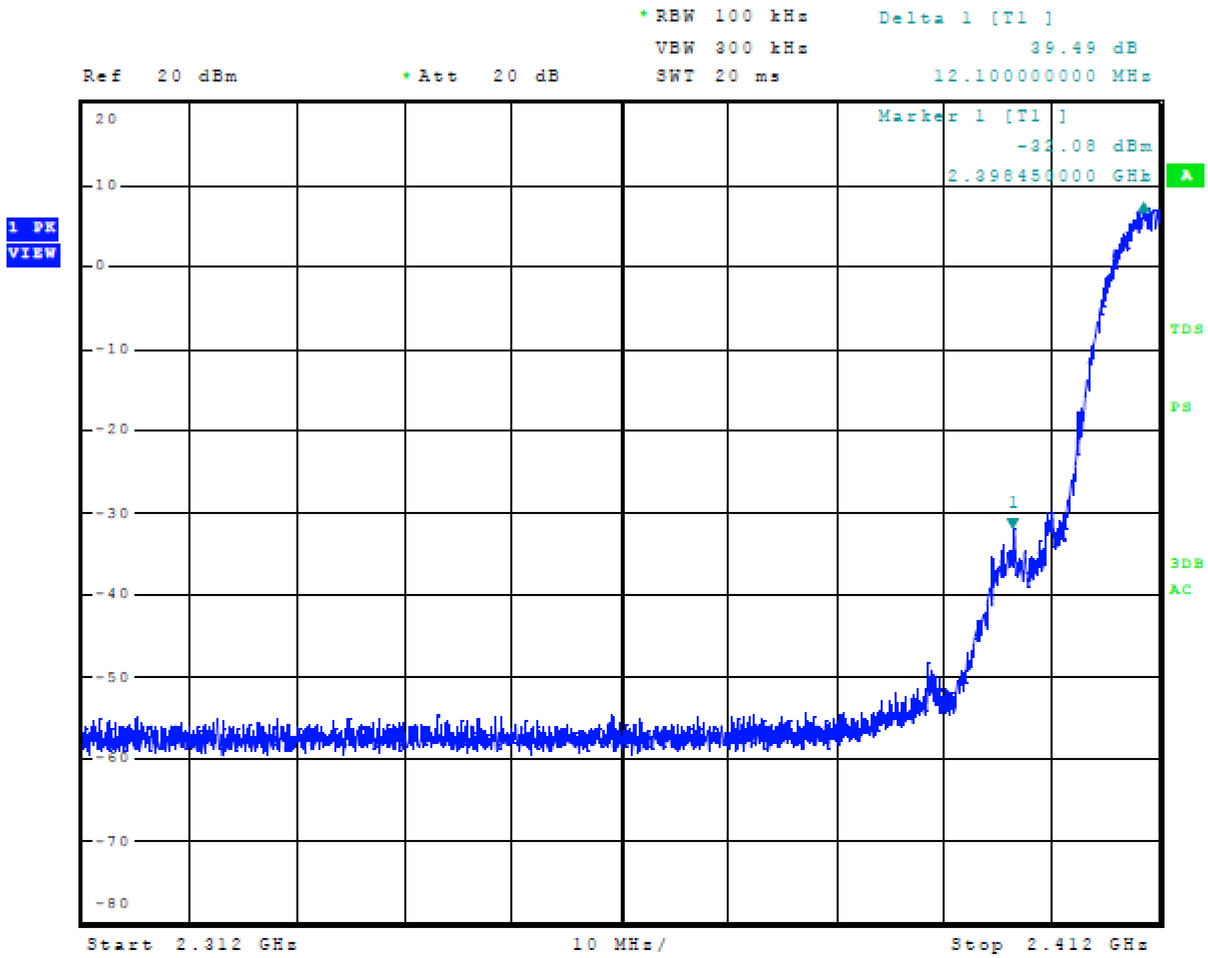

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Figure 15 Plot of Emissions Low Band Edge Mode 6, 802.11g

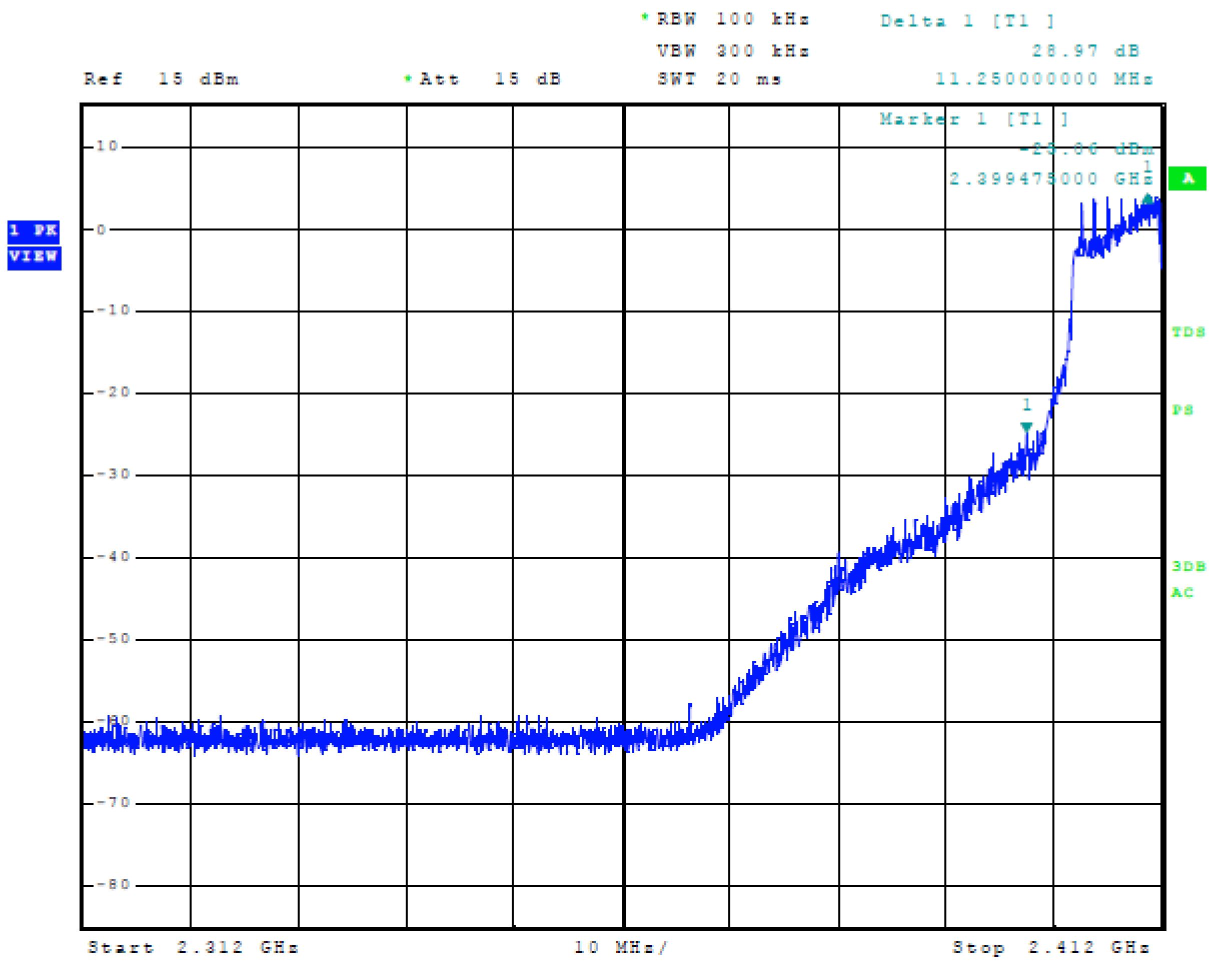

Figure 16 Plot of Emissions Low Band Edge Mode 7, 802.11n

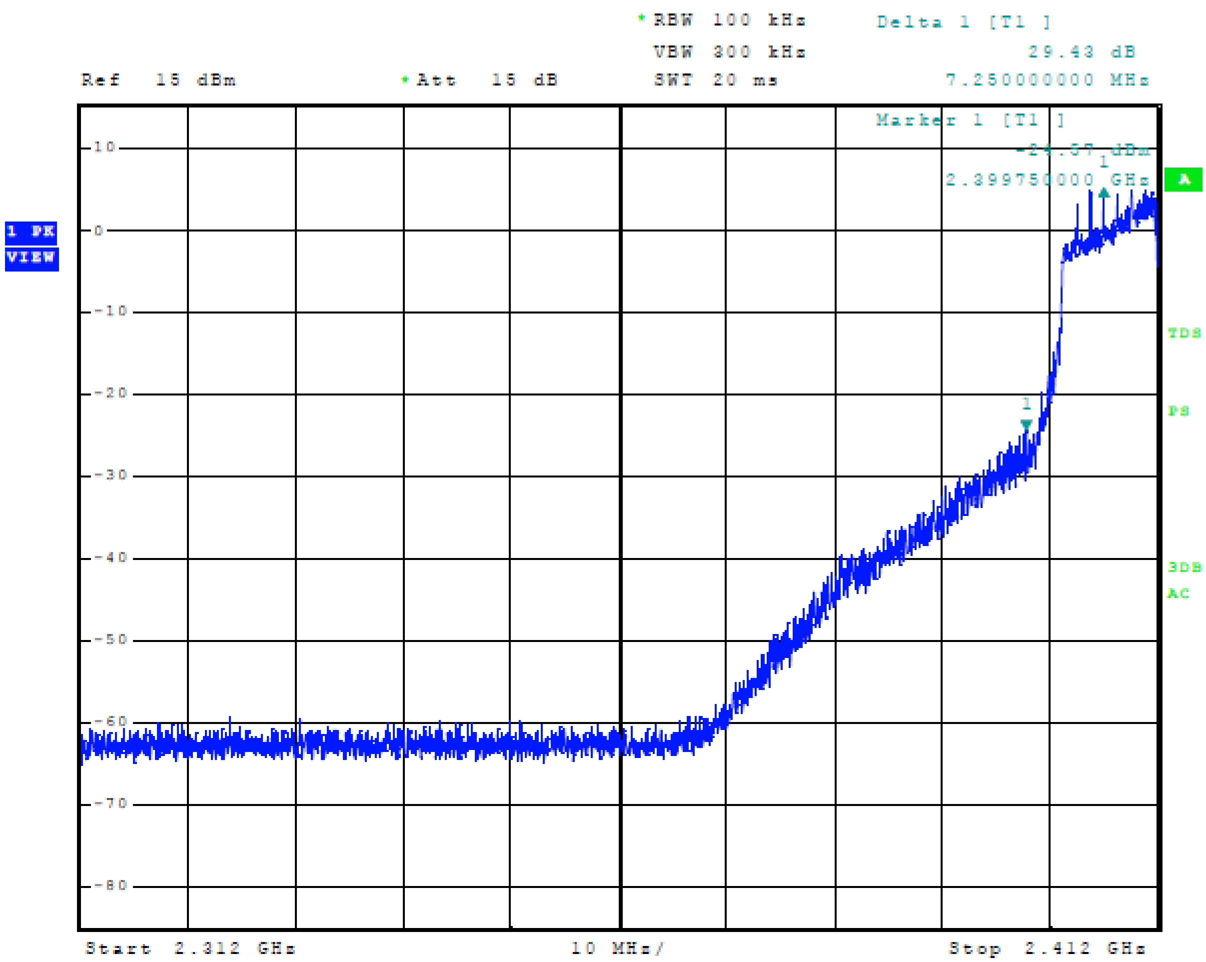

Figure 17 Plot of Transmitter Emissions High Band Edge Mode 2, BT (2EDR π/4 DQPSK)

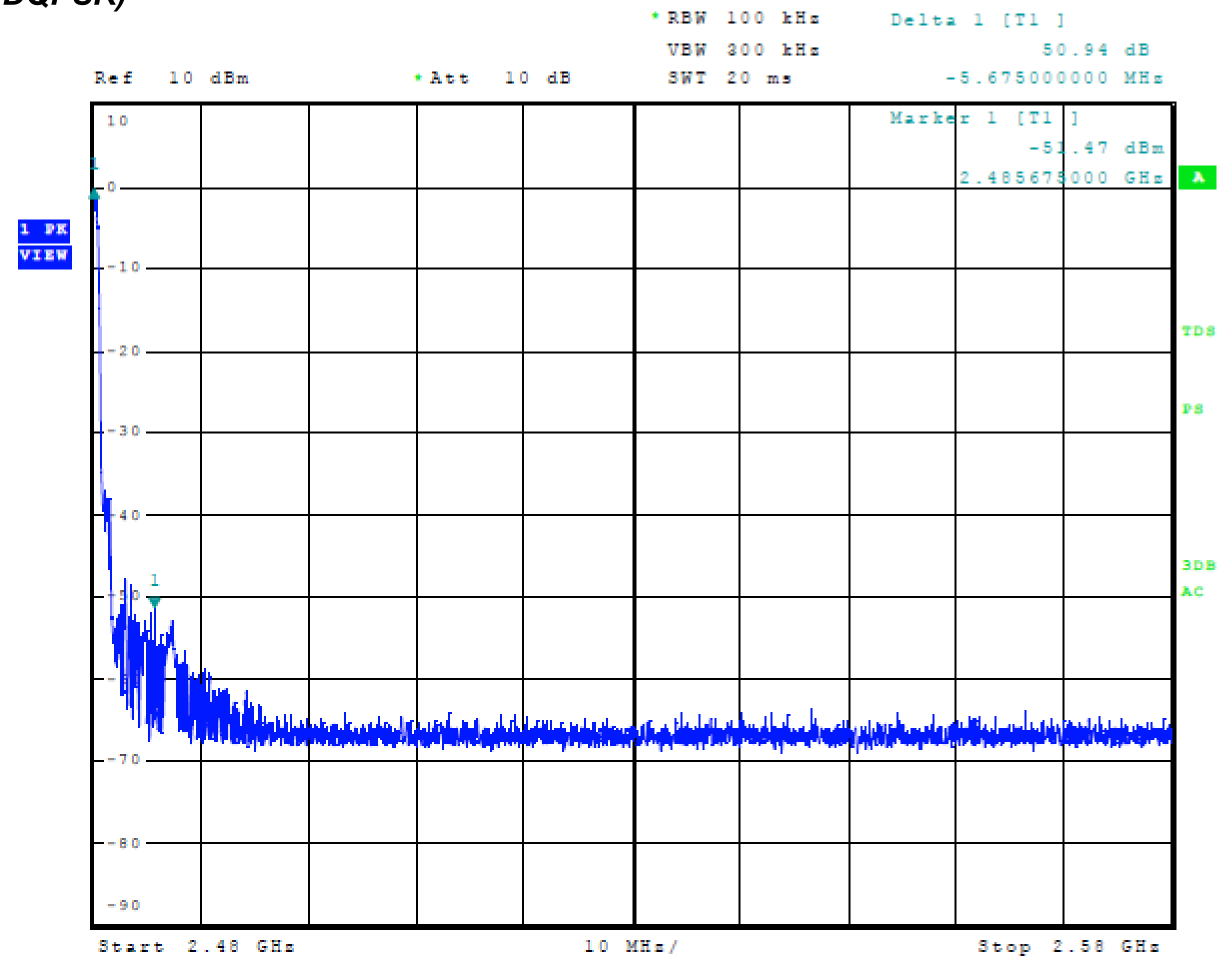

Figure 18 Plot of Transmitter Emissions High Band Edge Mode 3, BT (3EDR 8DPSK)

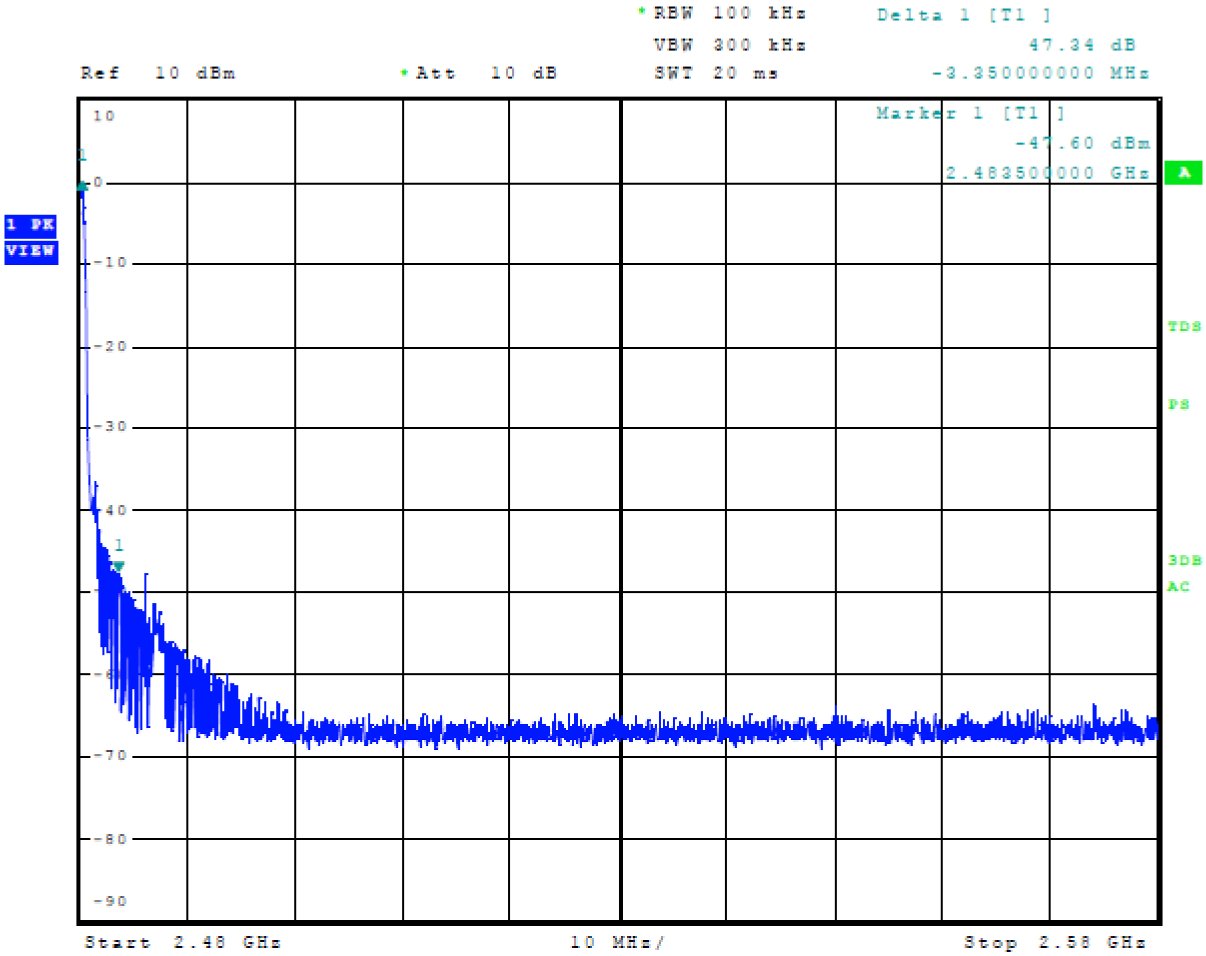

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Figure 19 Plot of Transmitter Emissions High Band Edge Mode 4, BT BLE (GMSK)

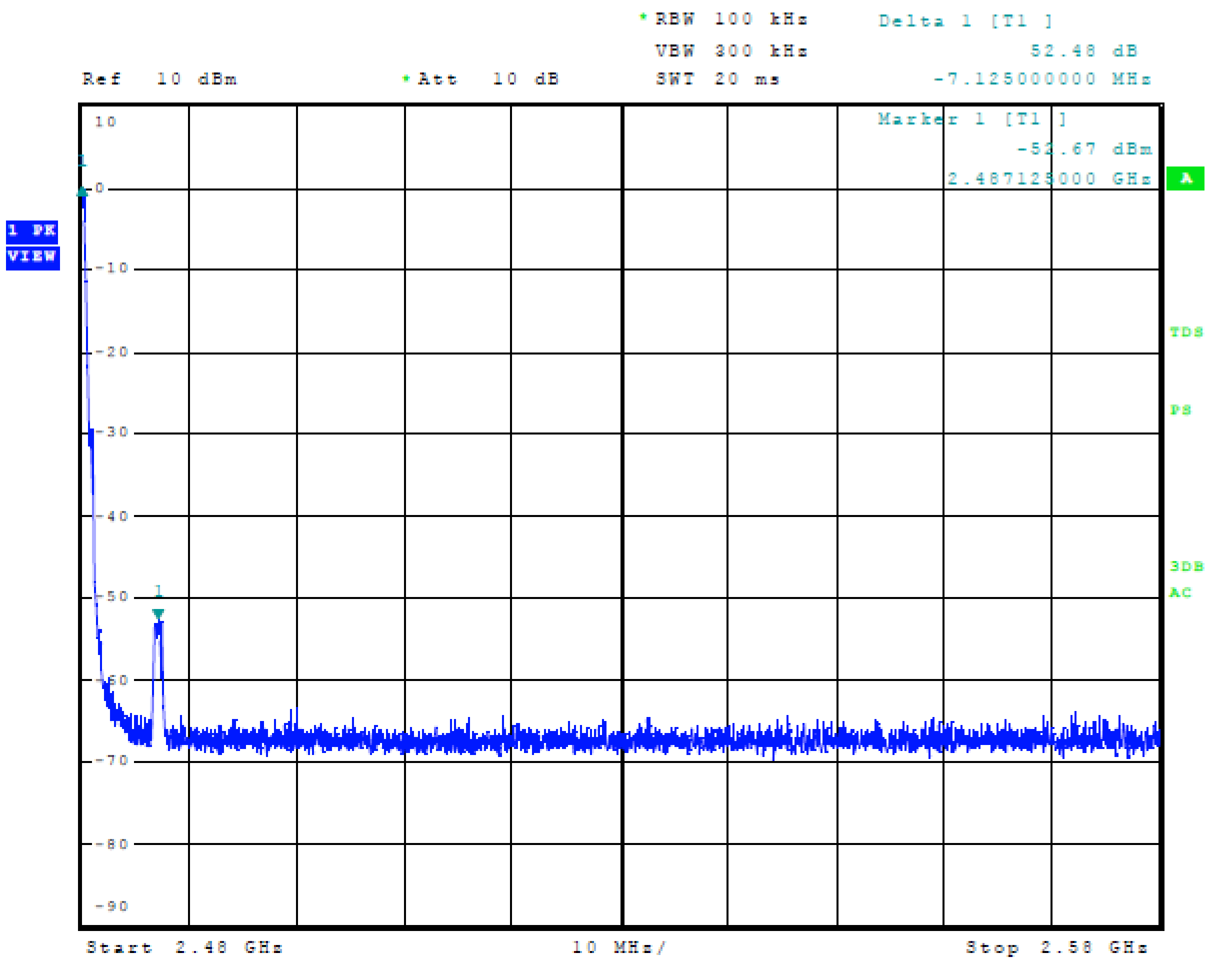

Figure 20 Plot of Transmitter Emissions High Band Edge Mode 5, 802.11b

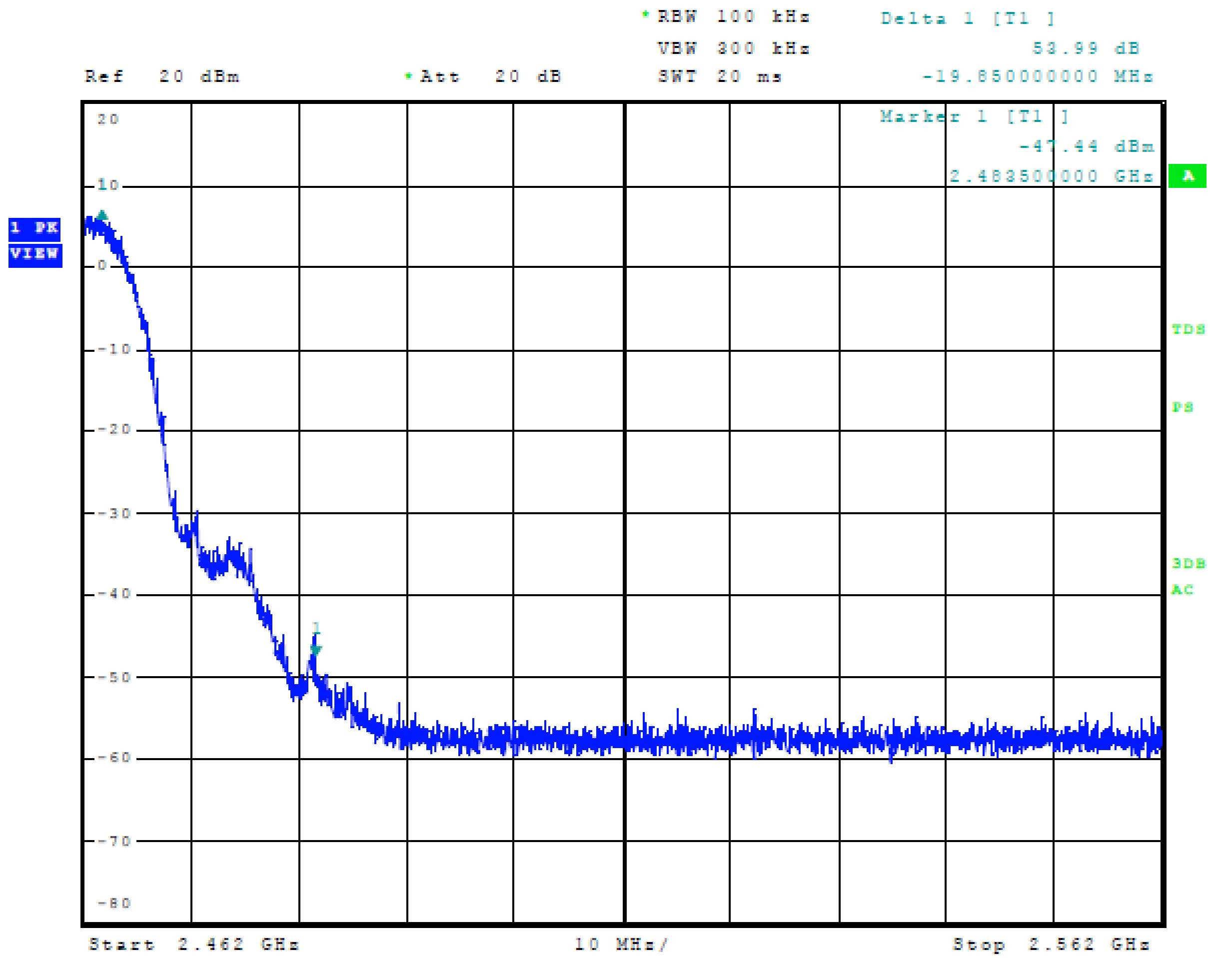

Figure 21 Plot of Transmitter Emissions High Band Edge Mode 6, 802.11g

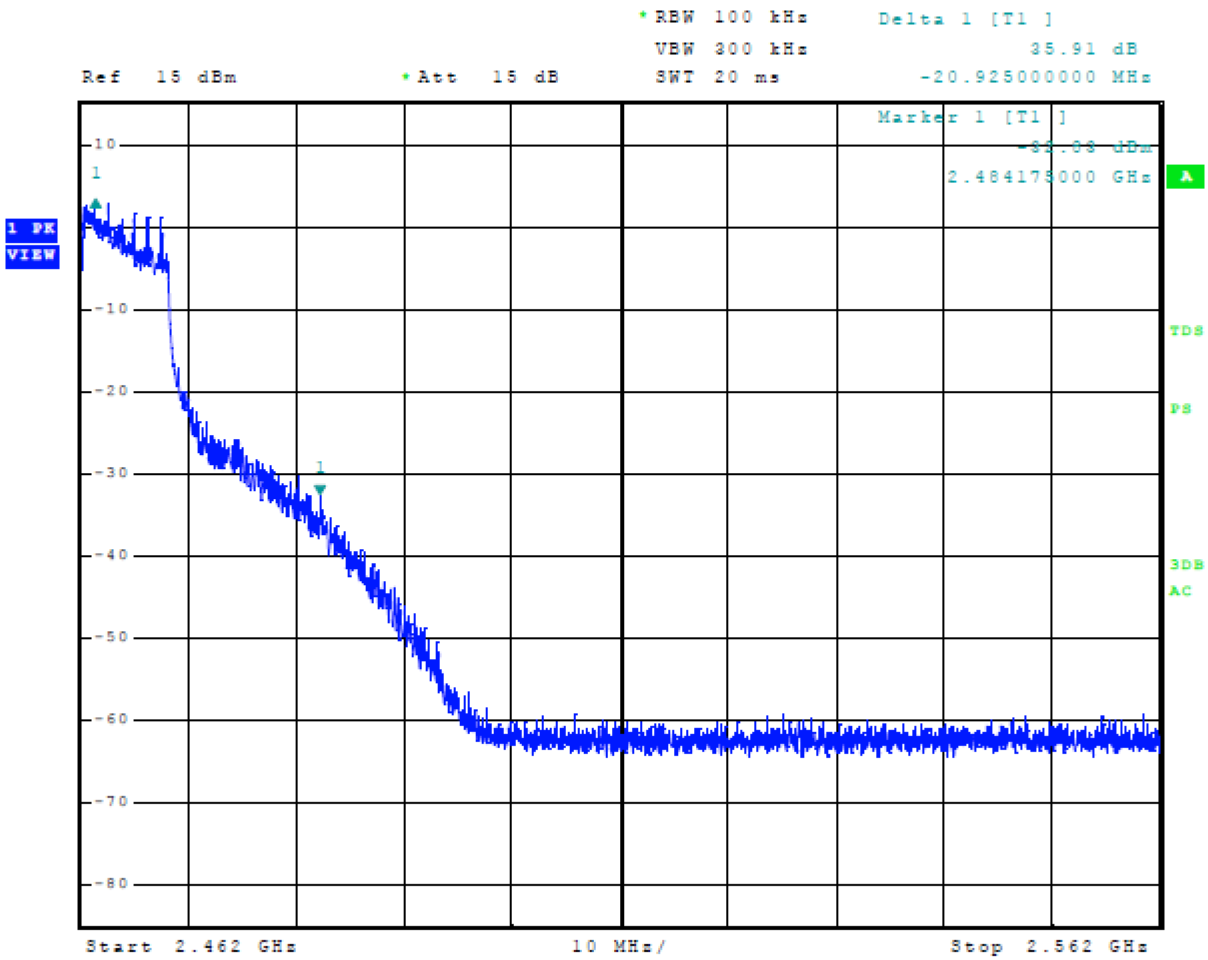

Figure 22 Plot of Transmitter Emissions High Band Edge Mode 7, 802.11n

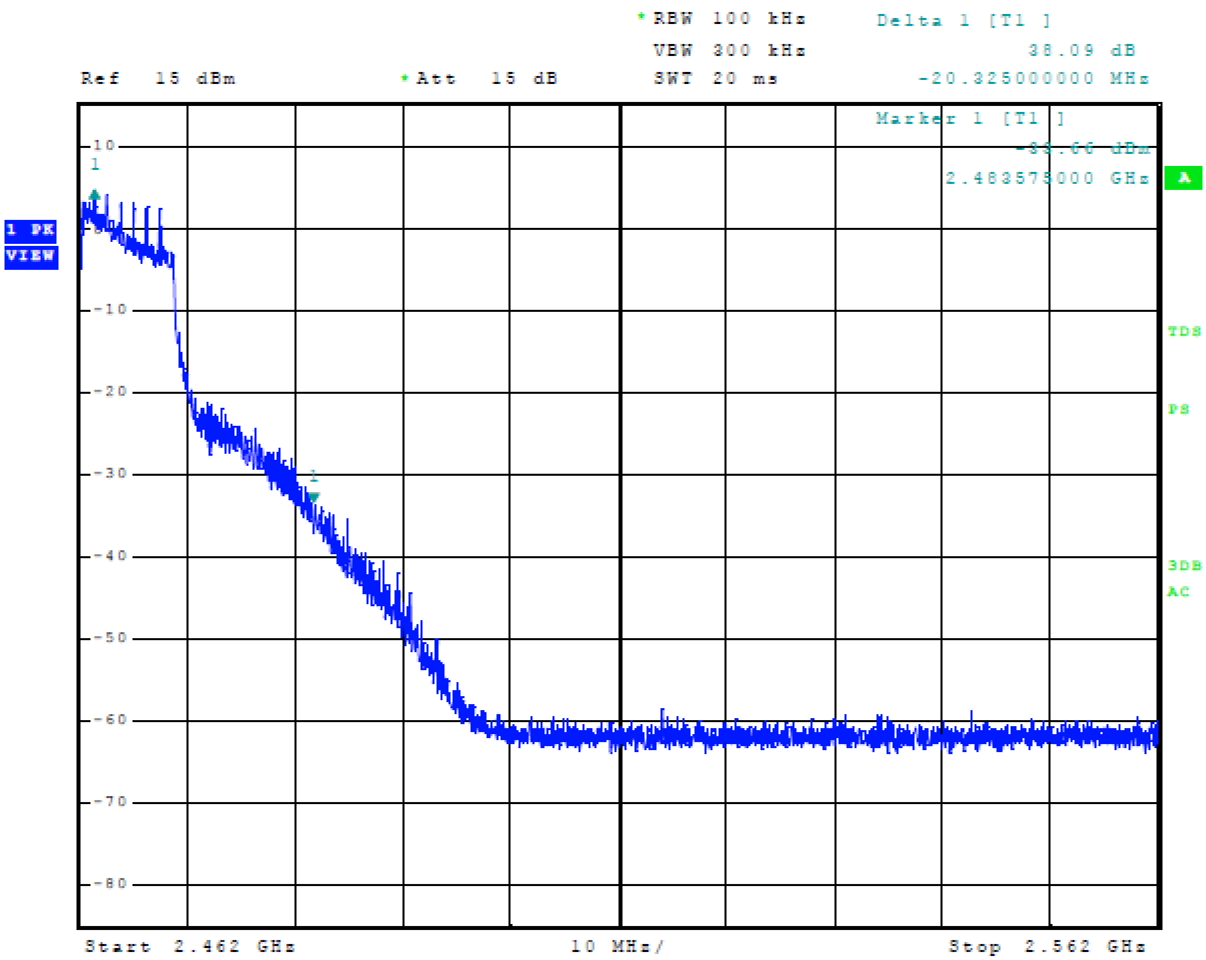

Figure 23 Plot of 6-dB Occupied Bandwidth Mode 2, BT (2EDR π/4 DQPSK)

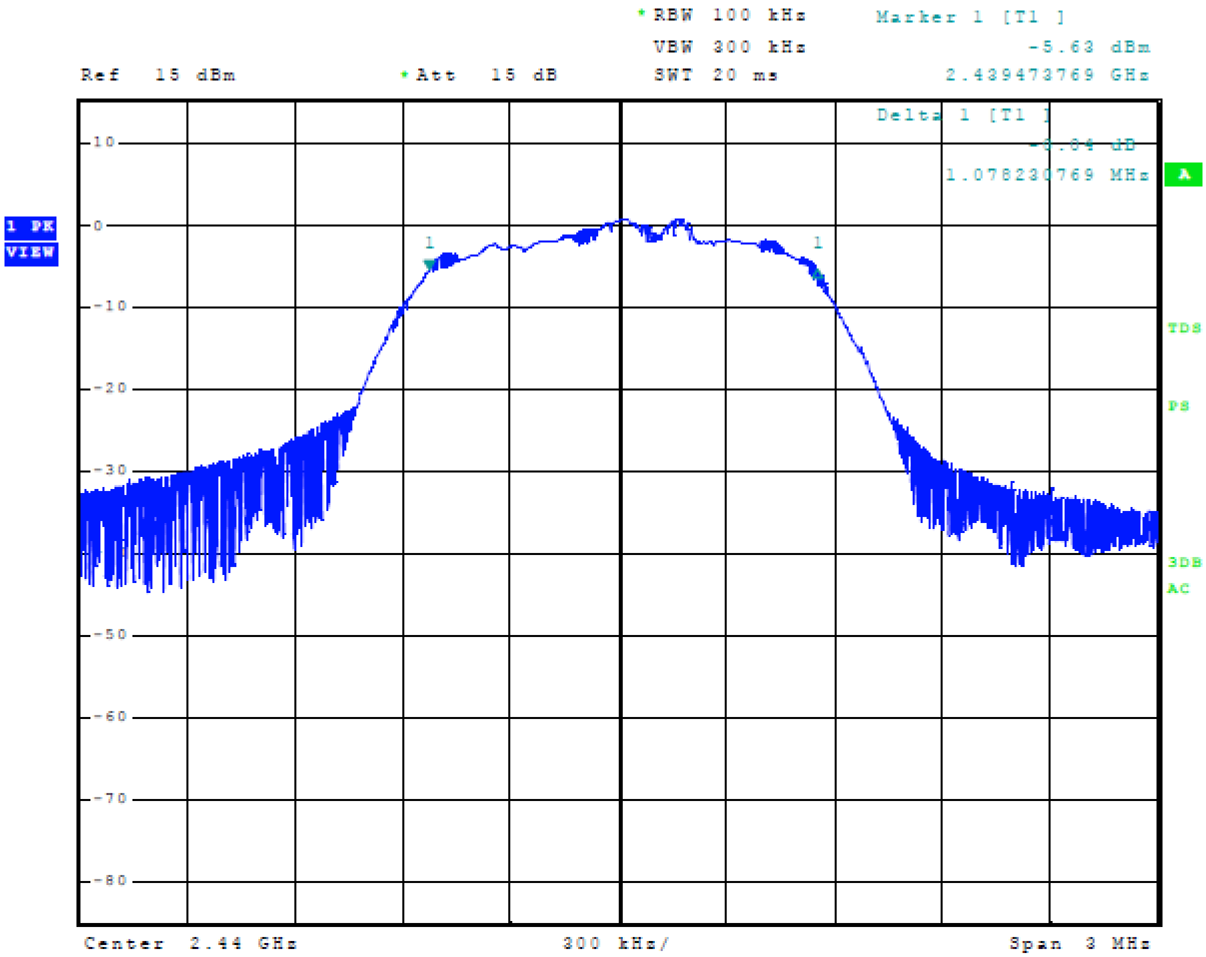

Figure 24 Plot of 99% Occupied Bandwidth Mode 2, BT (2EDR π/4 DQPSK)

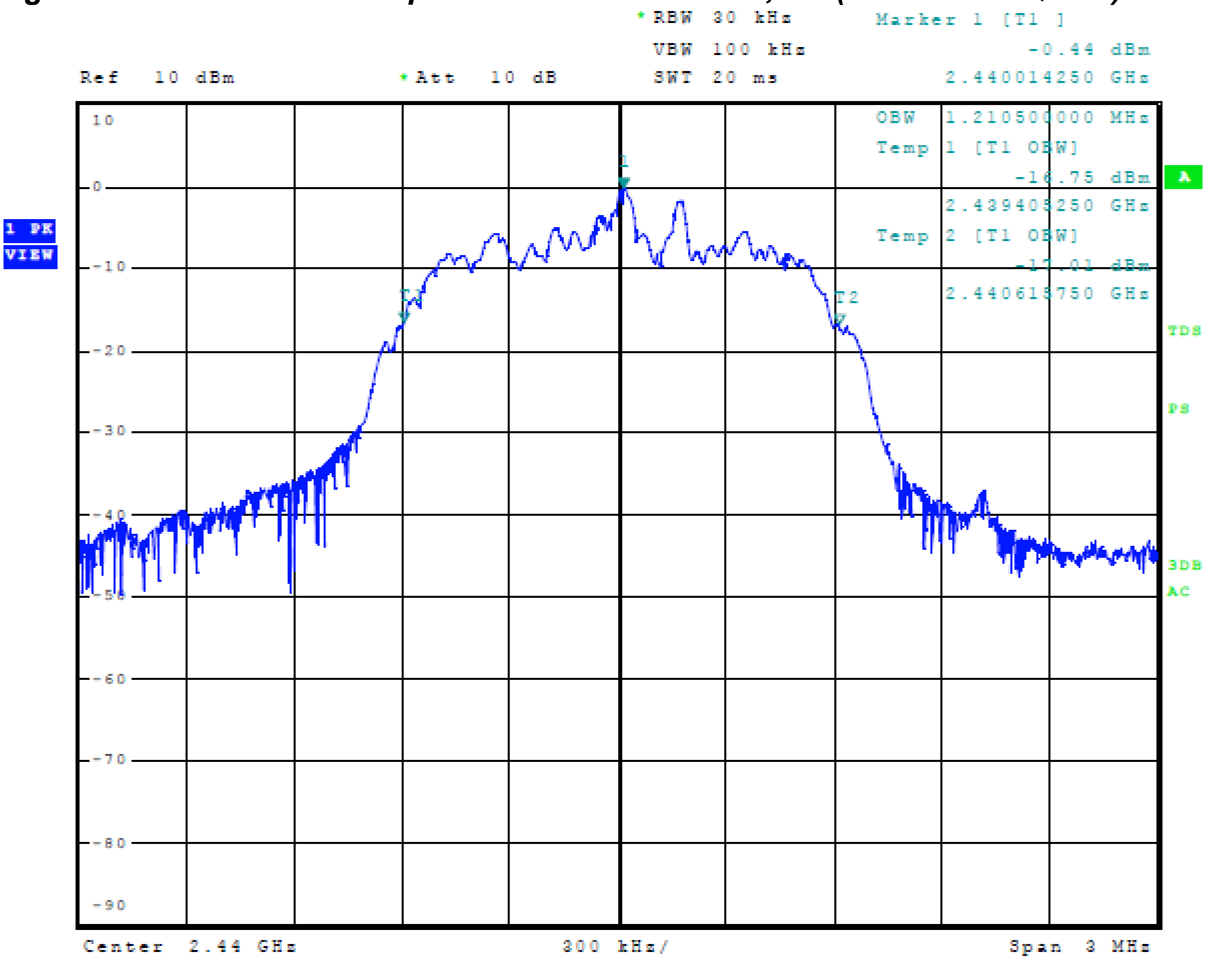

Figure 25 Plot of 6-dB Occupied Bandwidth Mode 3, BT (3EDR 8DPSK)

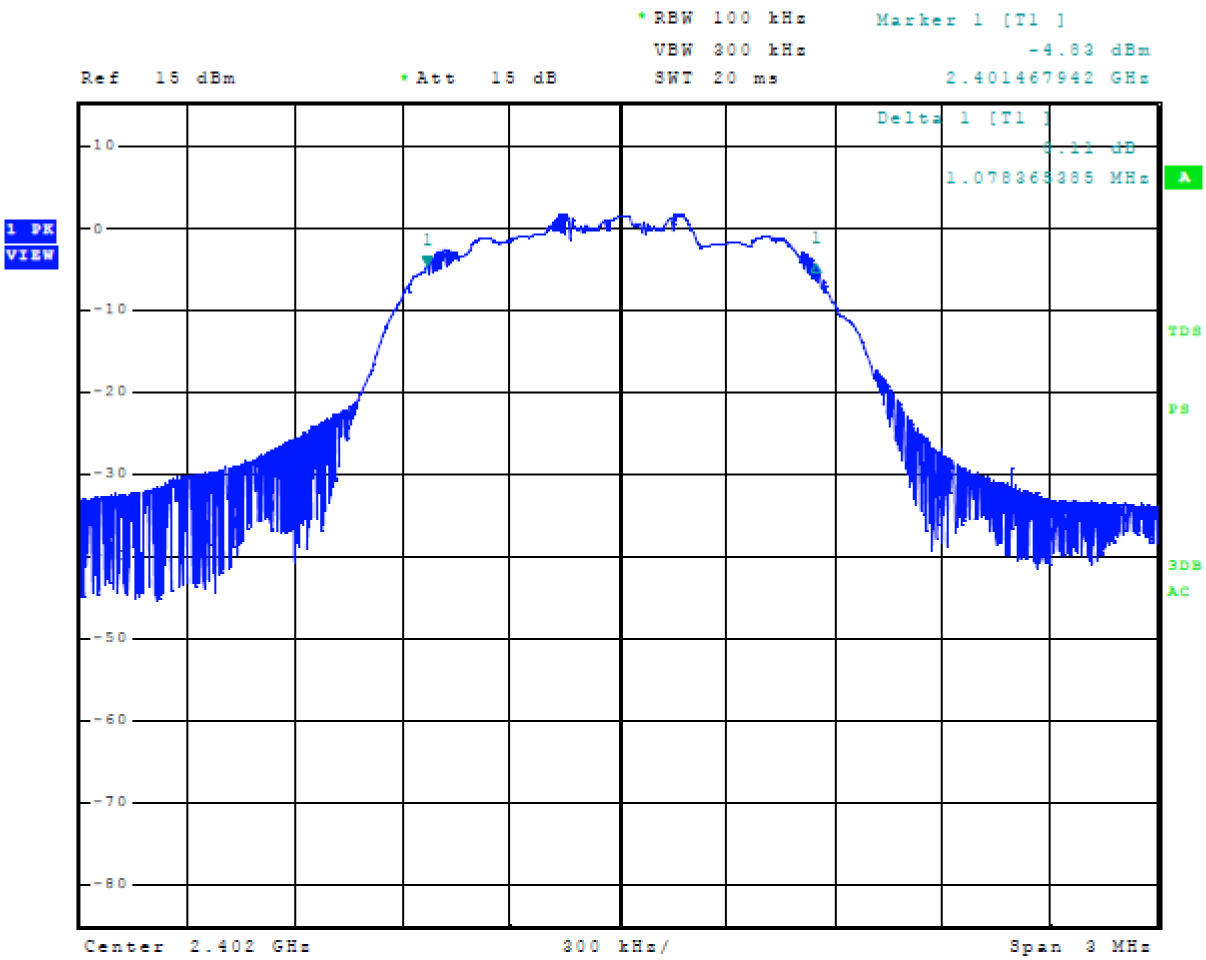

Figure 26 Plot of 99% Occupied Bandwidth Mode 3, BT (3EDR 8DPSK)

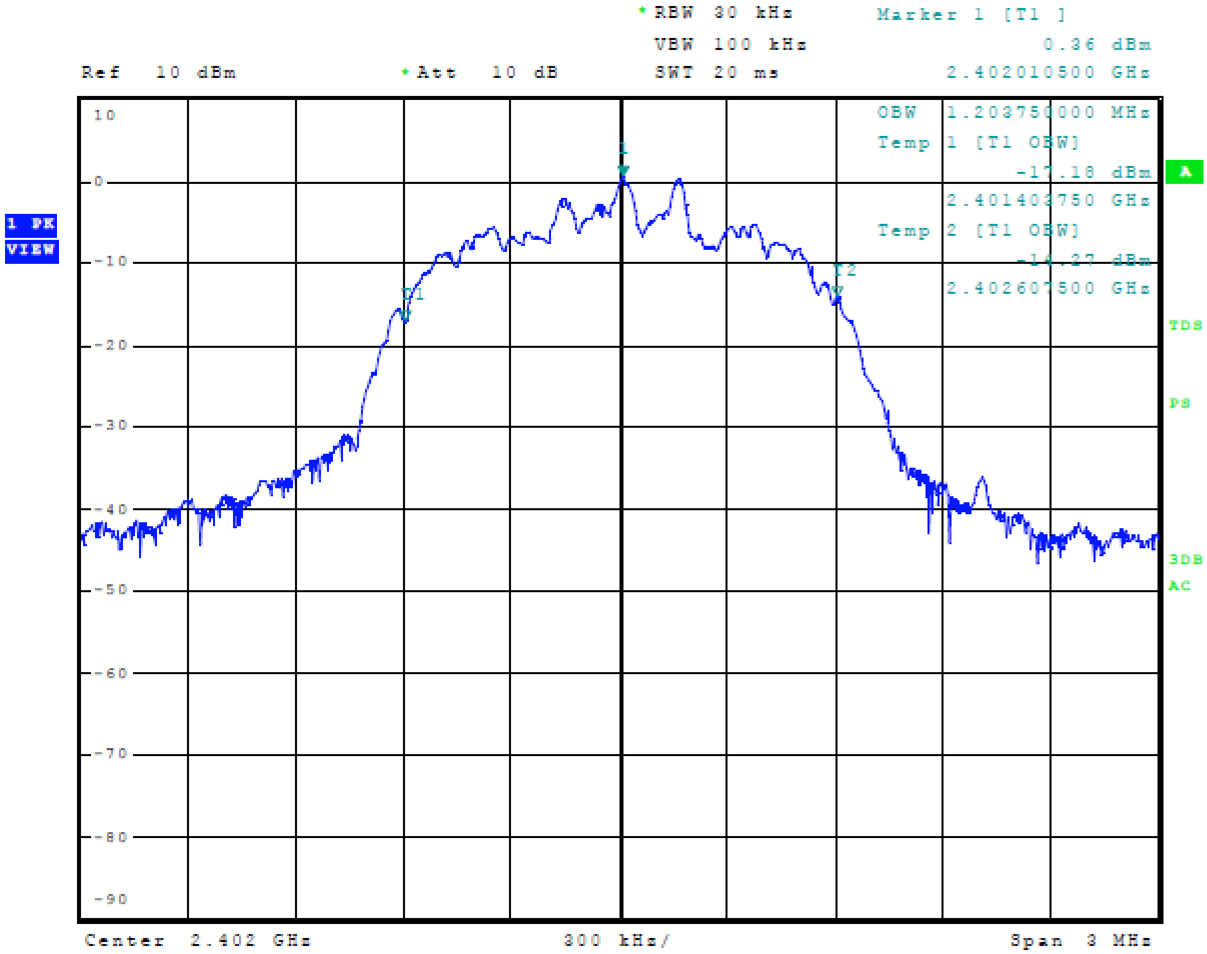

Figure 27 Plot of 6-dB Occupied Bandwidth Mode 4, BT BLE (GMSK)

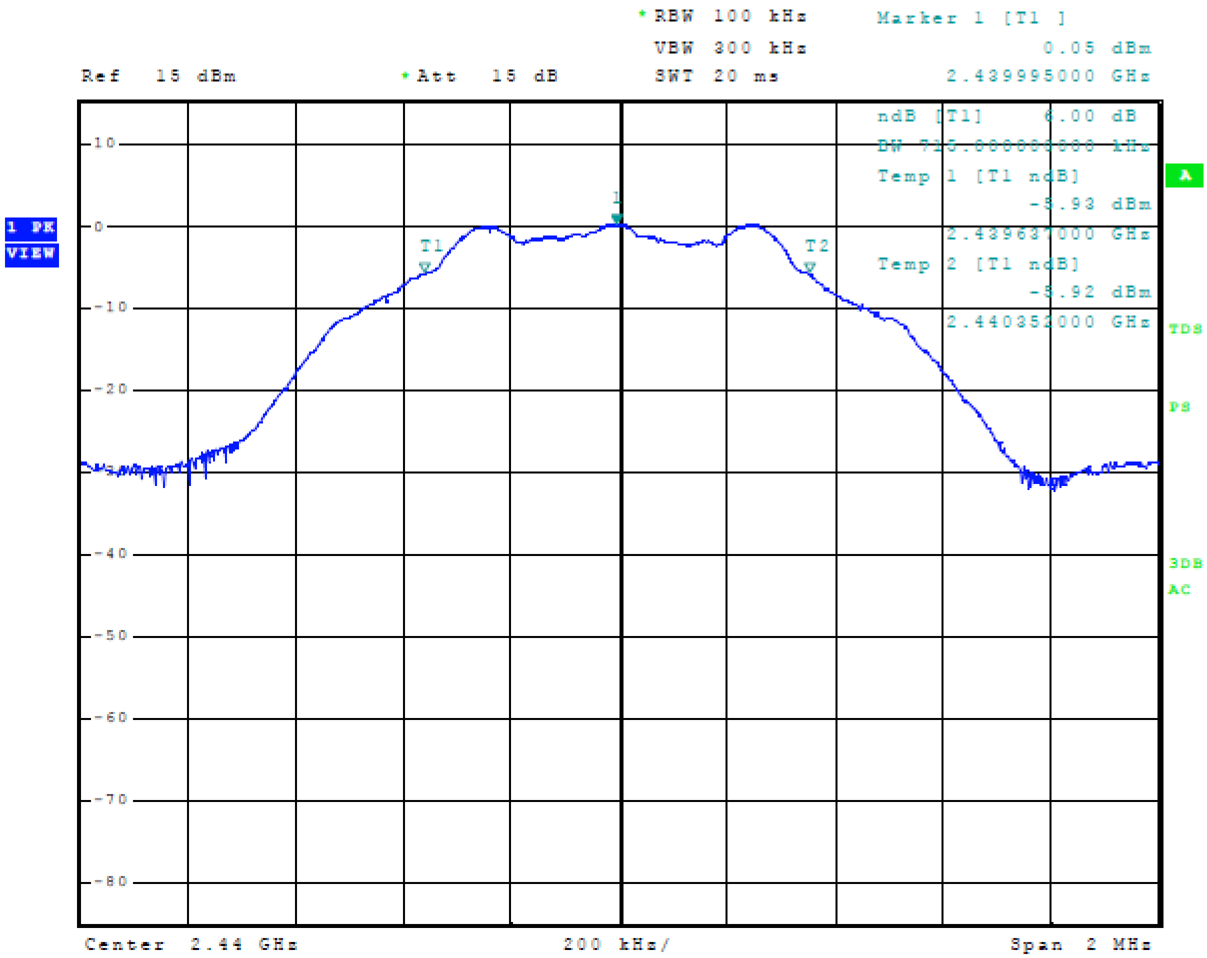

Figure 28 Plot of 99% Occupied Bandwidth Mode 4, BT BLE (GMSK)

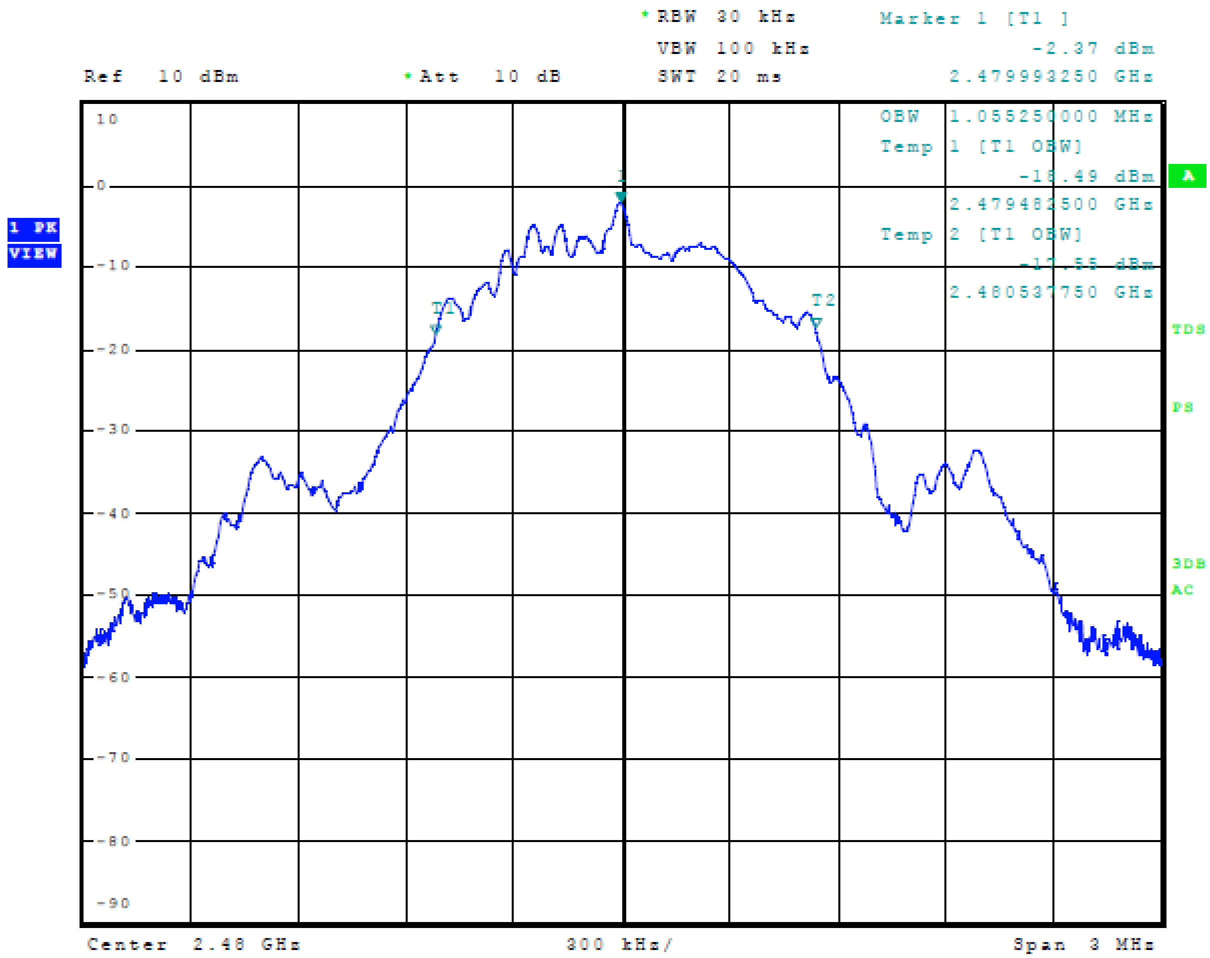

Figure 29 Plot of 6-dB Occupied Bandwidth Mode 5, 802.11b

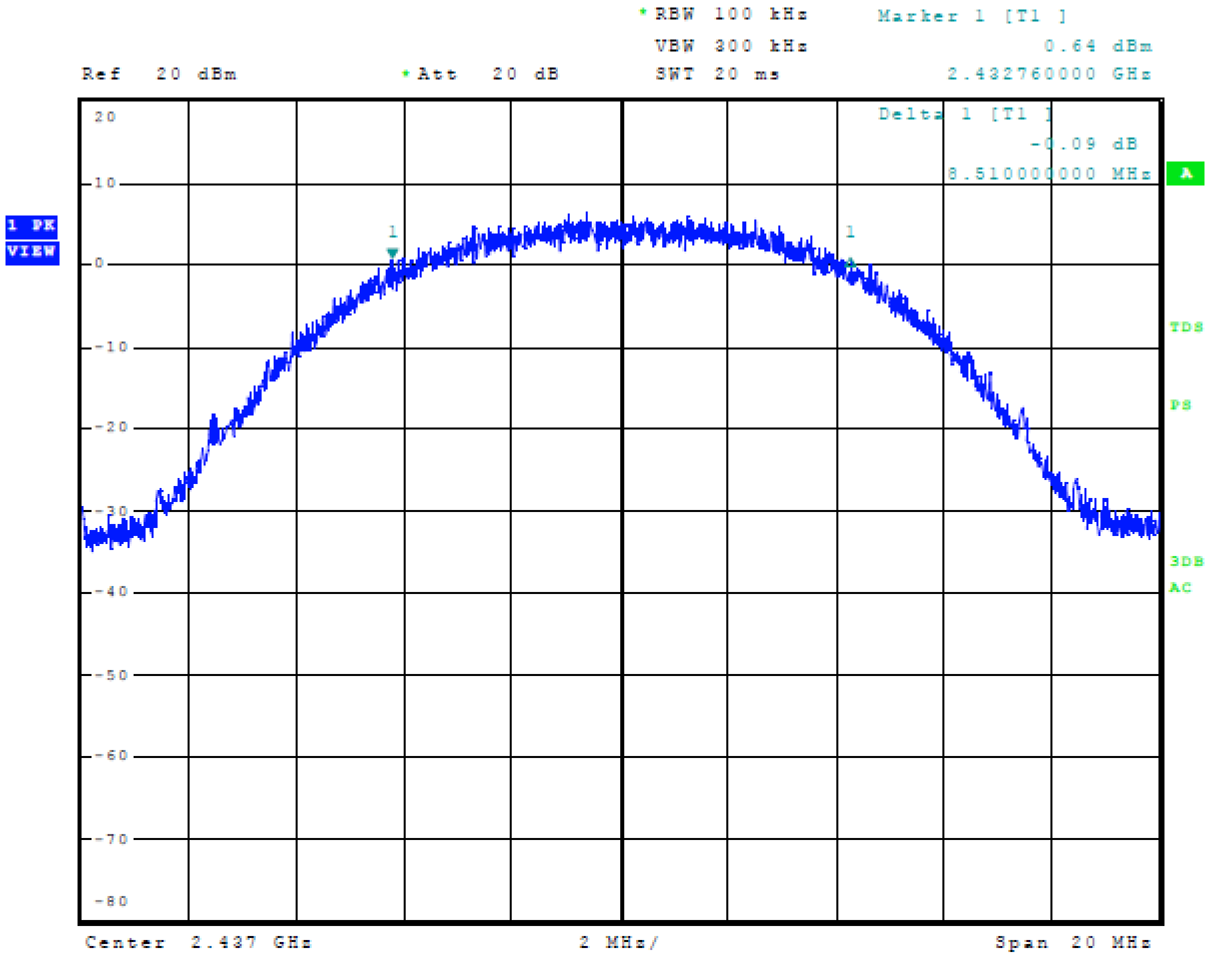

Figure 30 Plot of 99% Occupied Bandwidth Mode 5, 802.11b

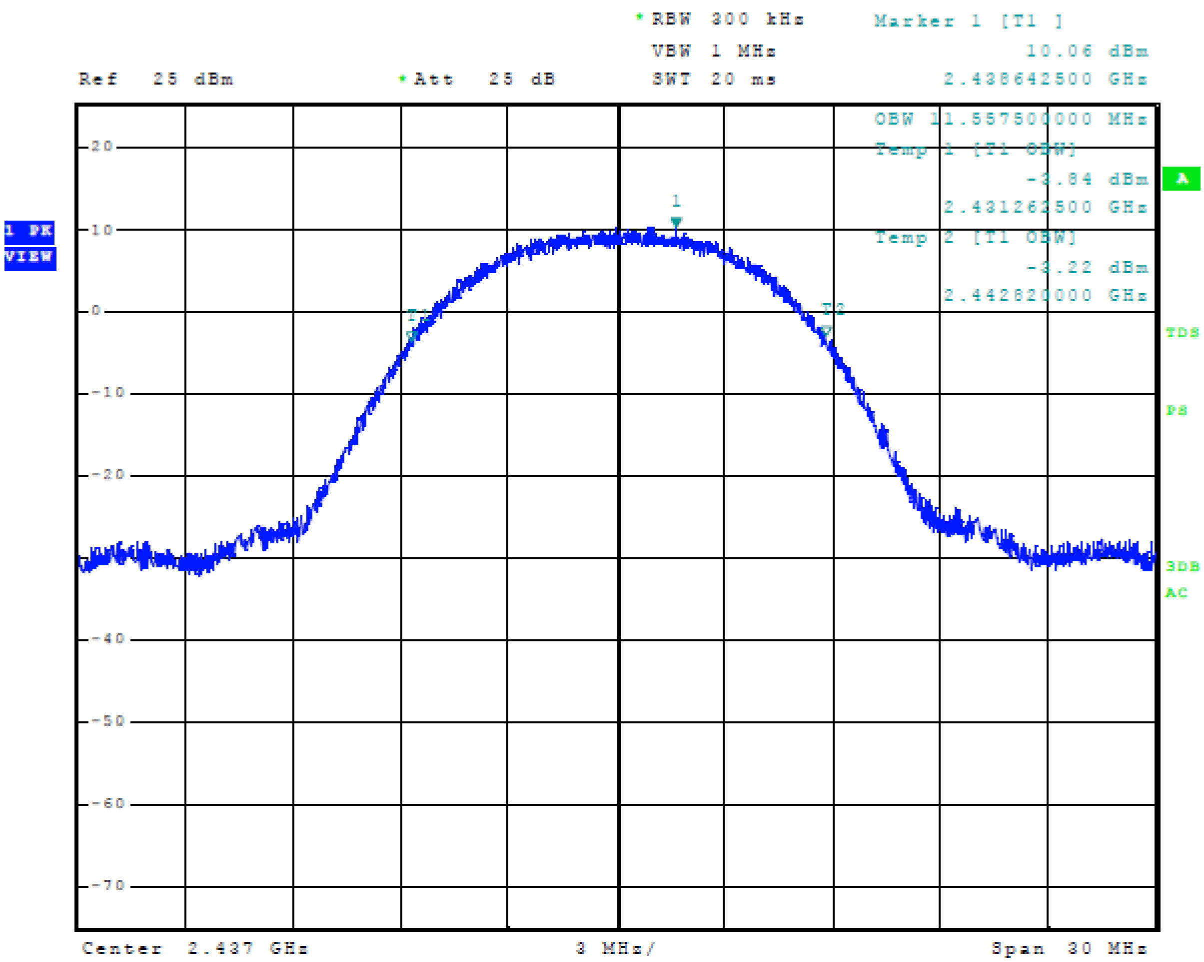

Figure 31 Plot of 6-dB Occupied Bandwidth Mode 6, 802.11g

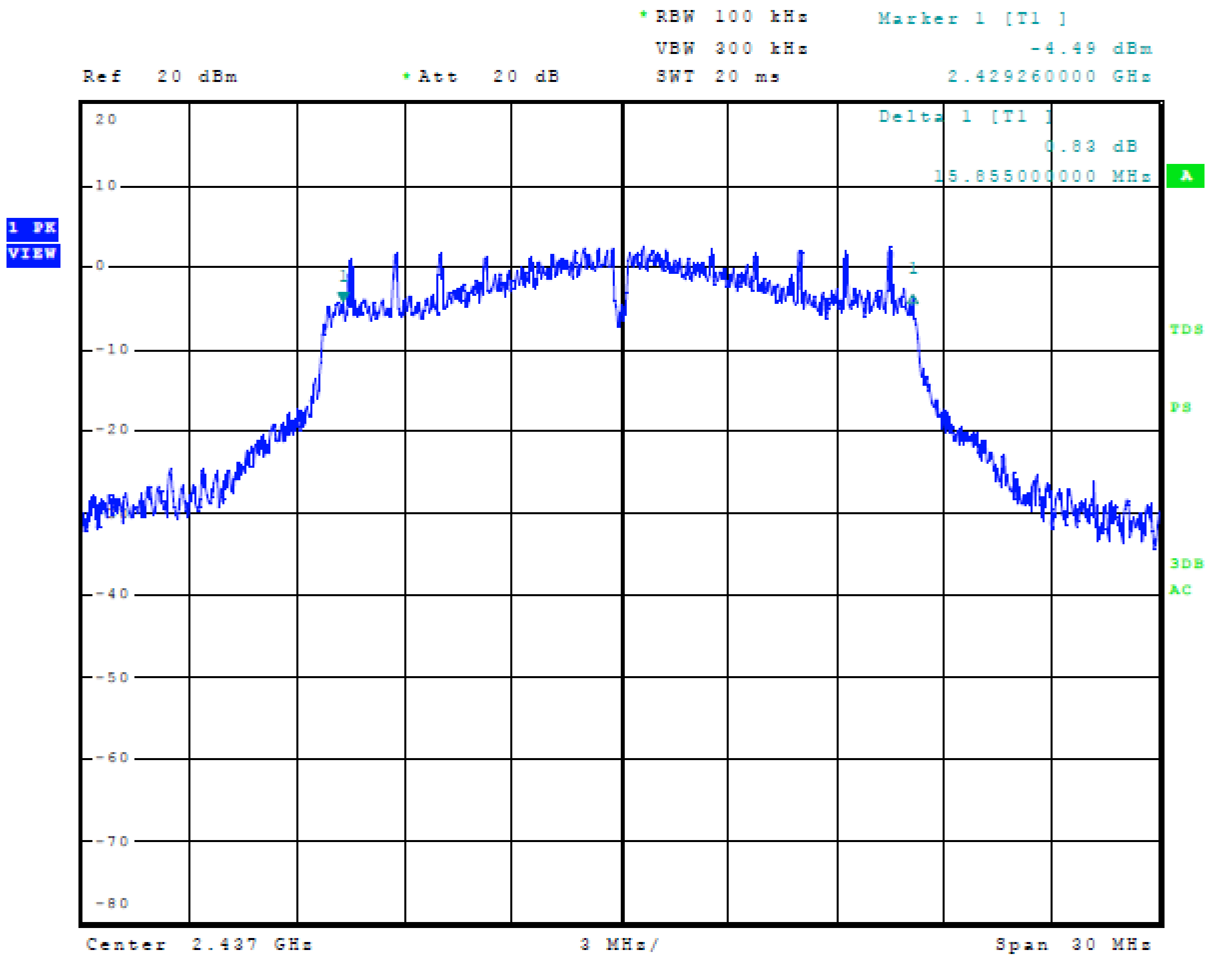

Figure 32 Plot of 99% Occupied Bandwidth Mode 6, 802.11g

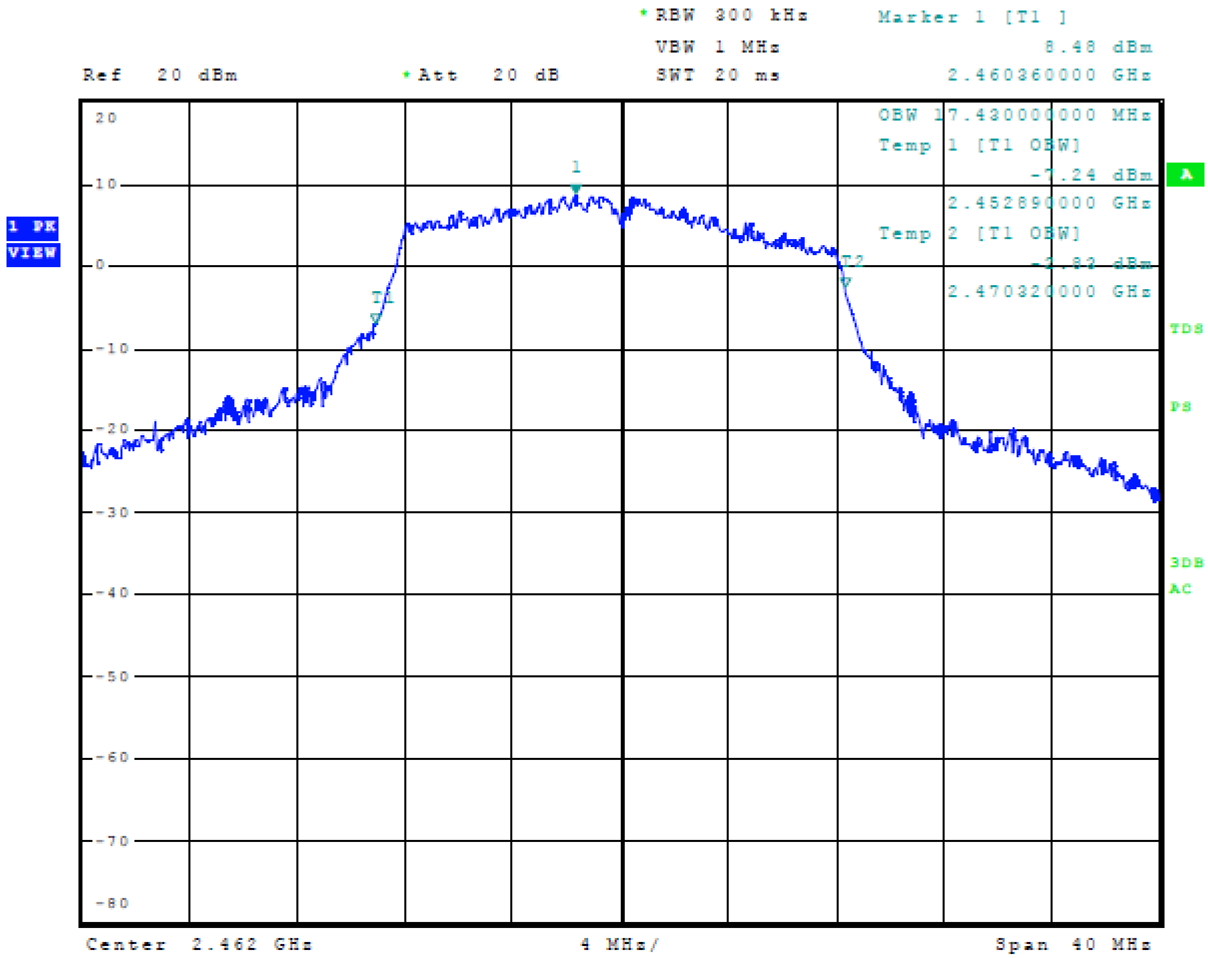

Figure 33 Plot of 6-dB Occupied Bandwidth Mode 7, 802.11n

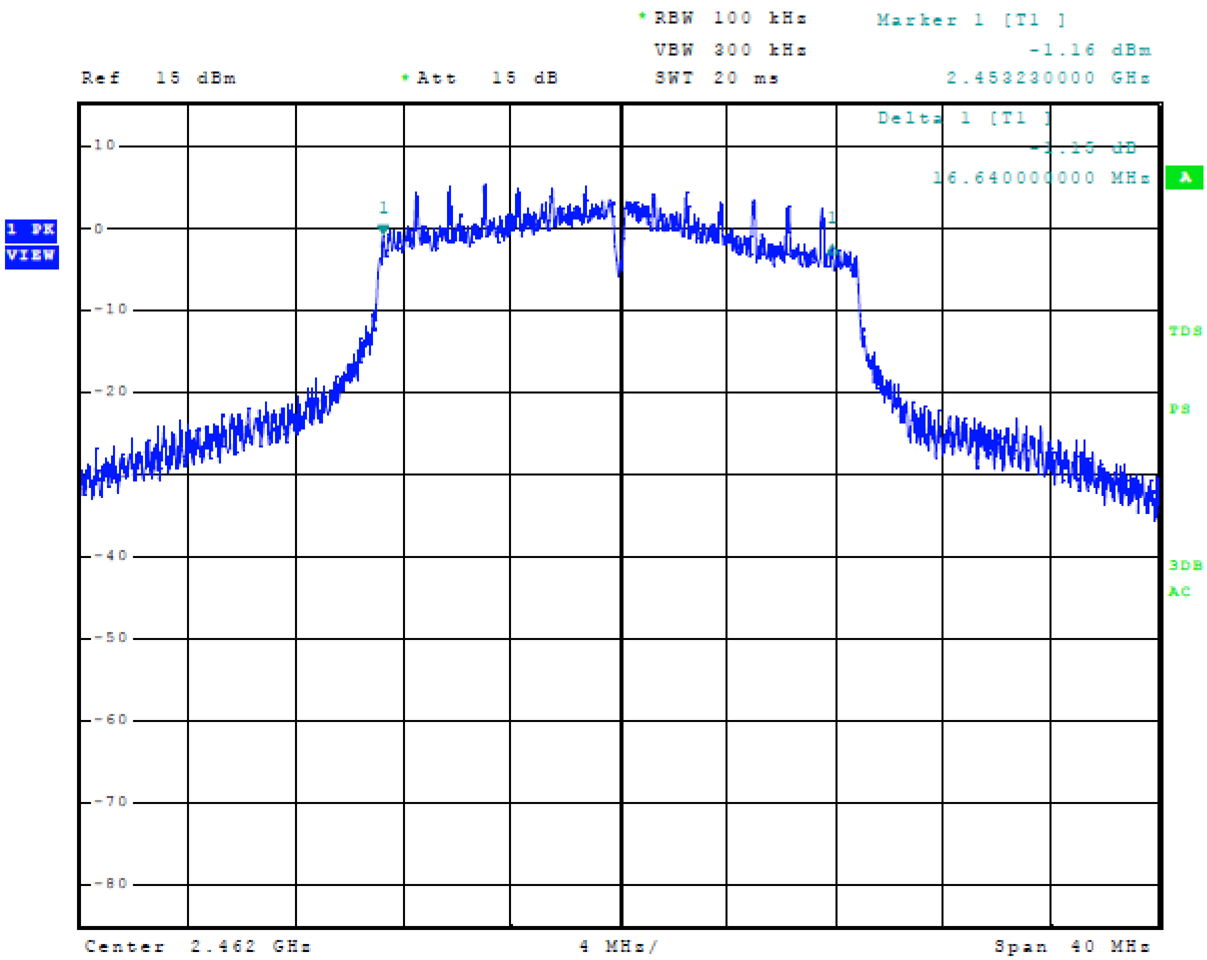

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Figure 34 Plot of 99% Occupied Bandwidth Mode 7, 802.11n

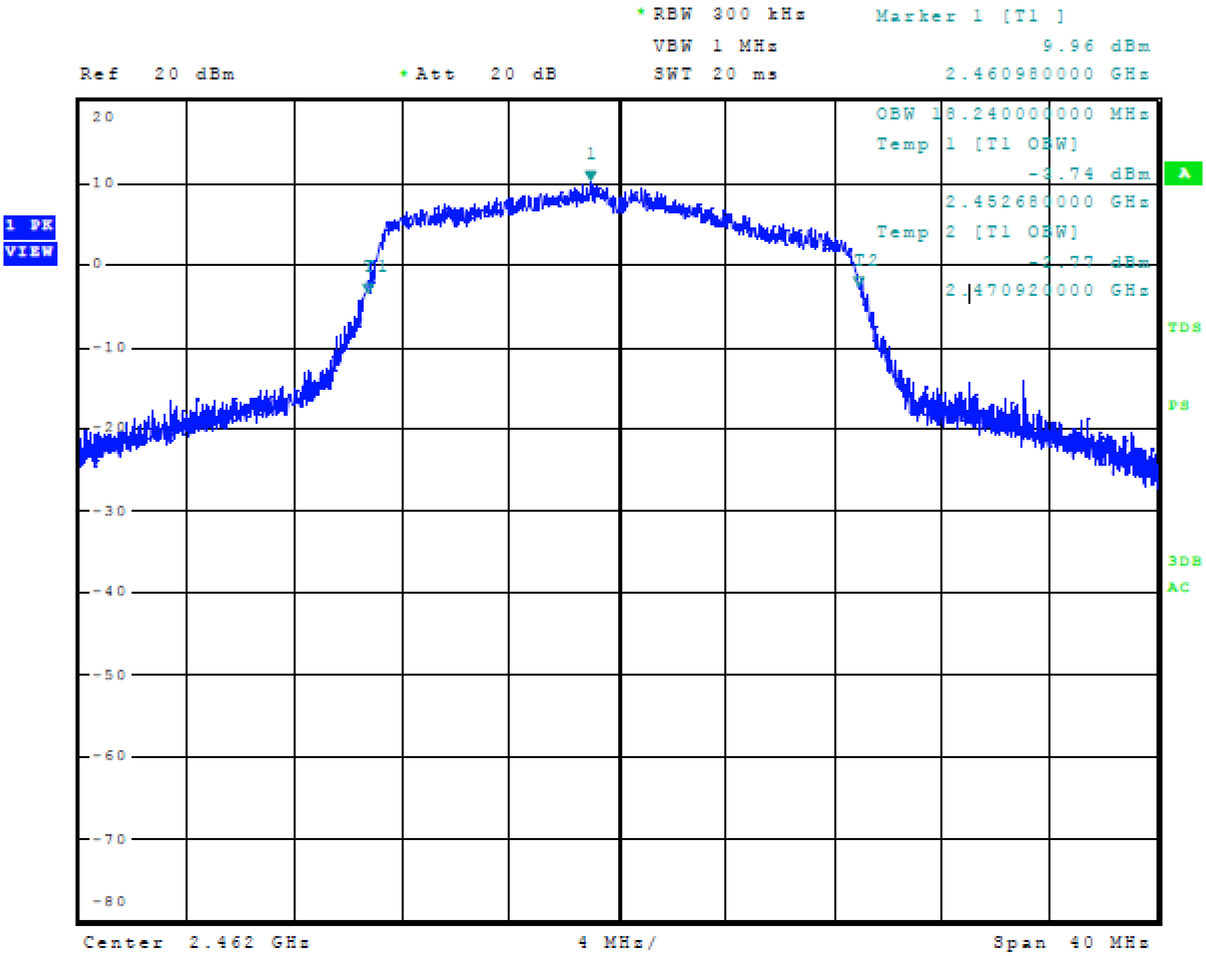


Figure 35 Plot of Transmitter Power Spectral Density Mode 2, BT (2EDR π/4 DQPSK)

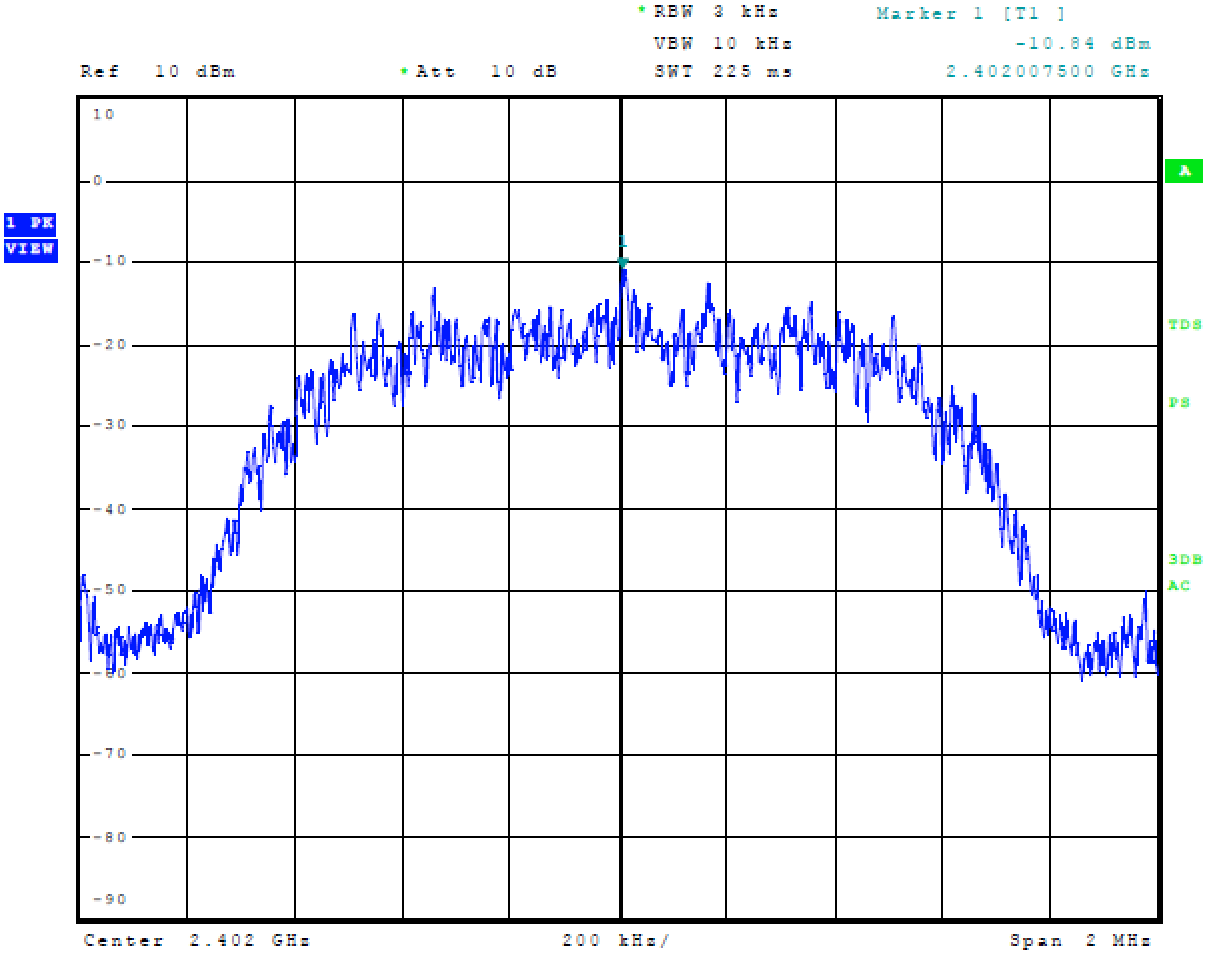


Figure 36 Plot of Transmitter Power Spectral Density Mode 3, BT (3EDR 8DPSK)

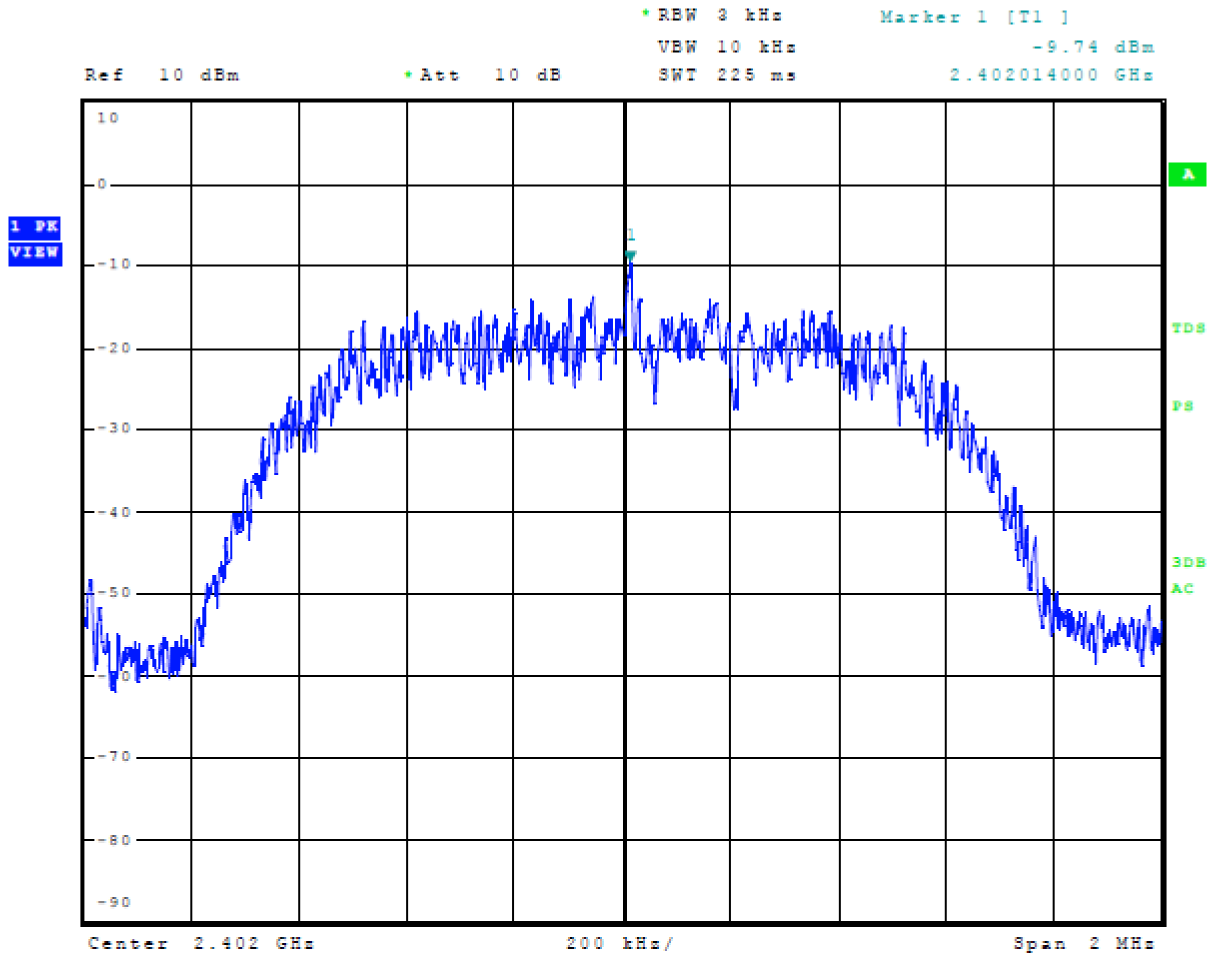


Figure 37 Plot of Transmitter Power Spectral Density Mode 4, BT BLE (GMSK)

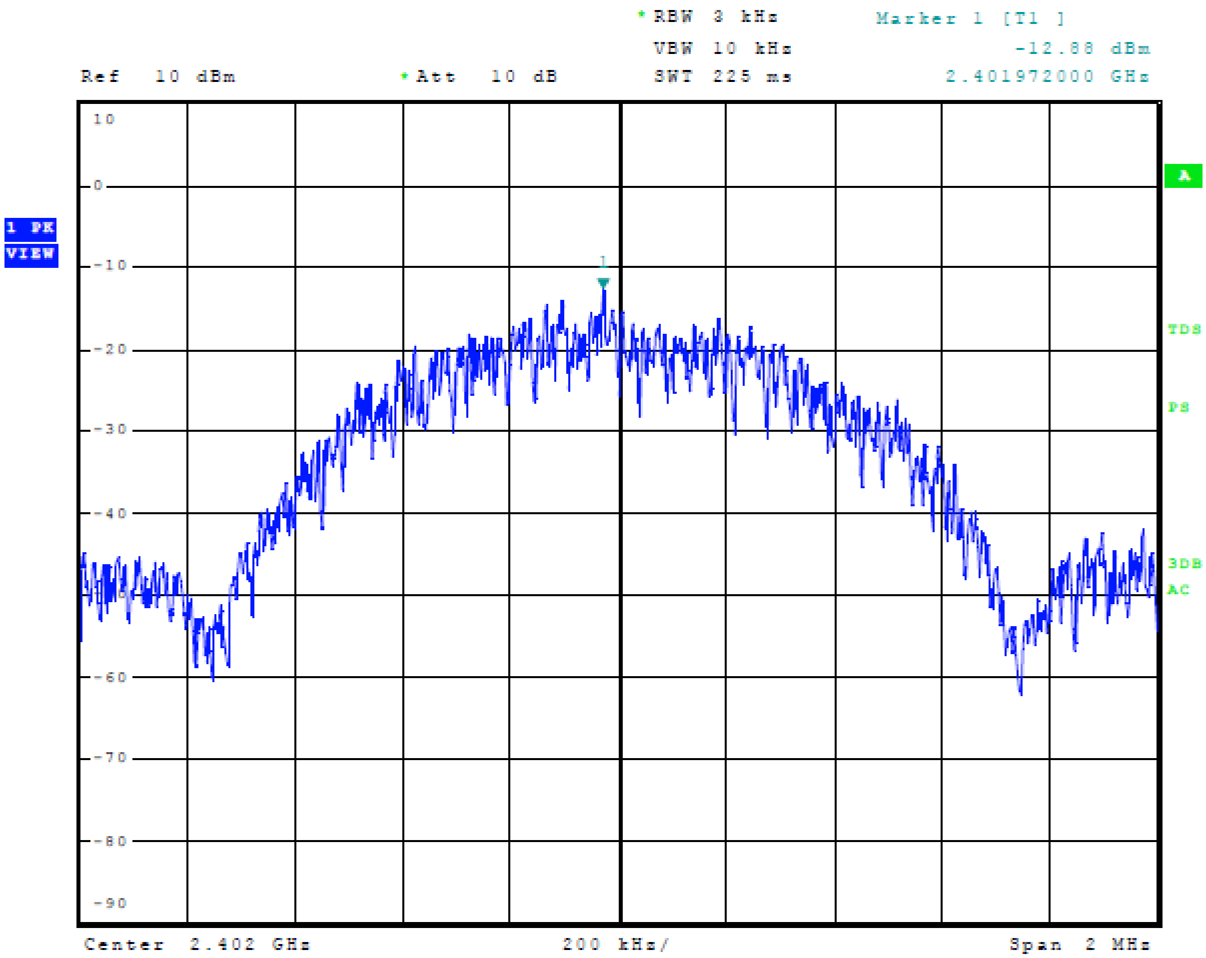


Figure 38 Plot of Transmitter Power Spectral Density Mode 5, 802.11b

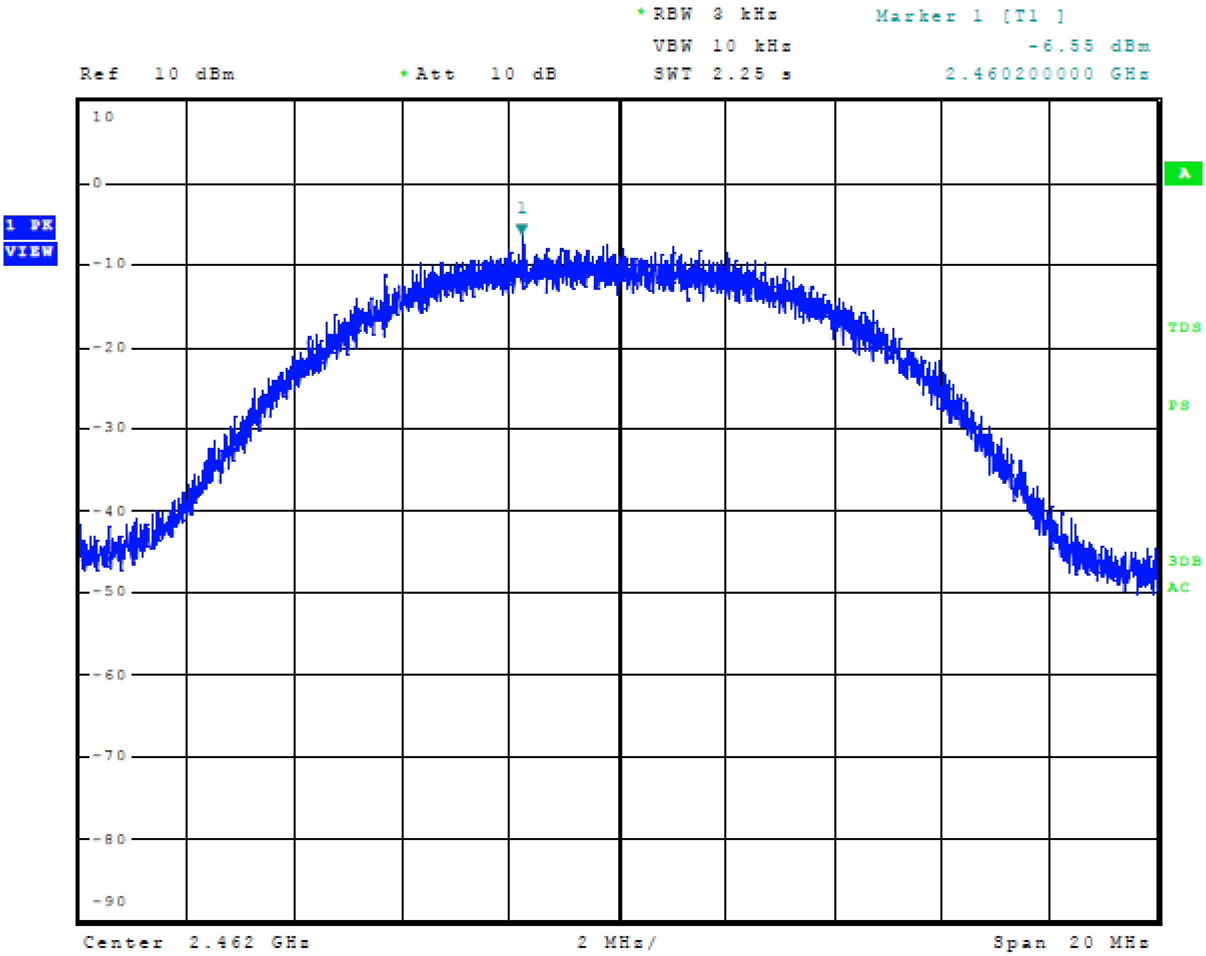


Figure 39 Plot of Transmitter Power Spectral Density Mode 6, 802.11g

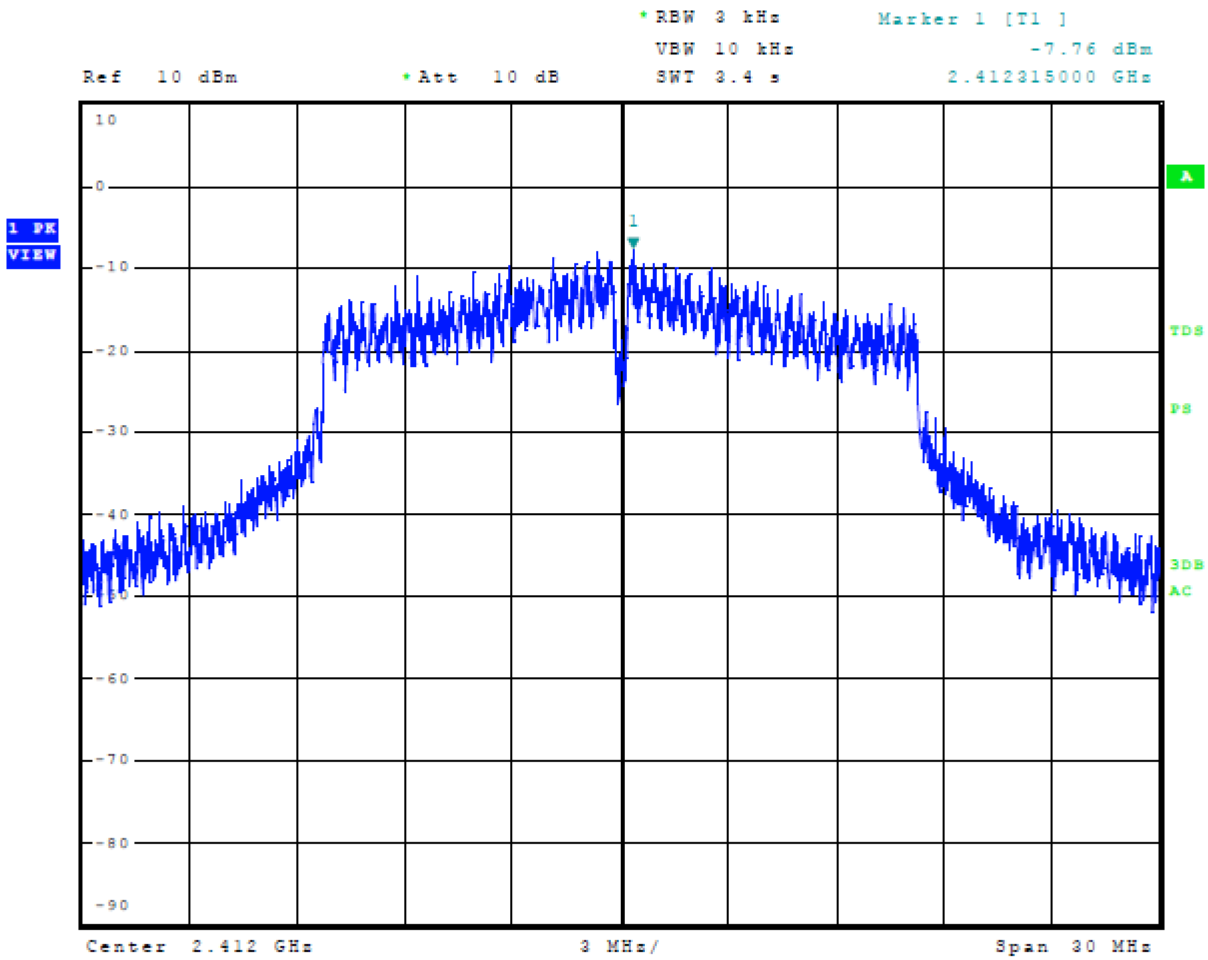
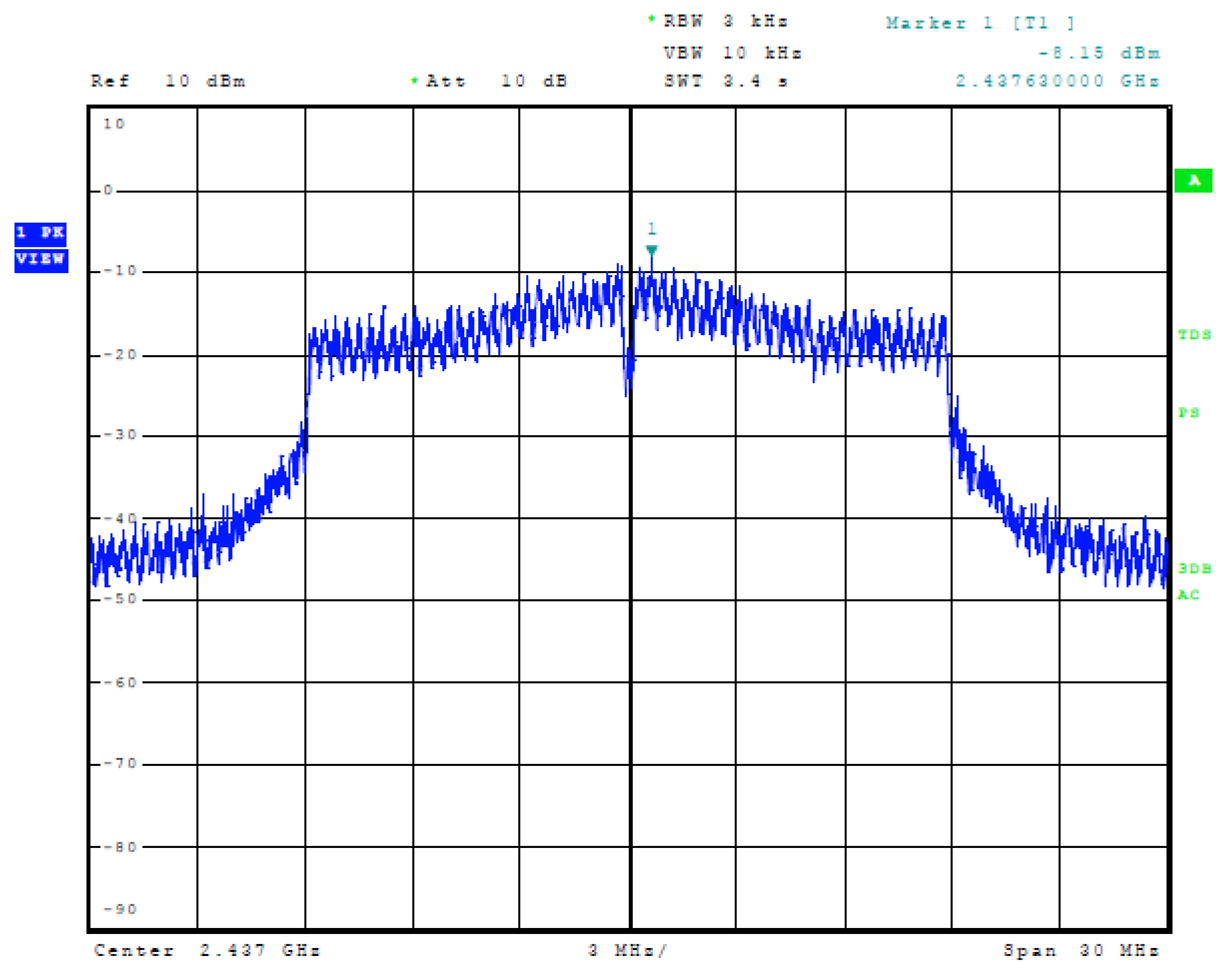


Figure 40 Plot of Transmitter Power Spectral Density Mode 7, 802.11n



Transmitter Emissions Data

Table 11 Transmitter Radiated Emissions Mode 2, 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	47.8	34.6	47.7	34.6	54.0	-19.4	-19.4
7206.0	51.2	37.9	51.1	37.9	54.0	-16.1	-16.1
9608.0	53.8	41.2	54.6	41.2	54.0	-12.8	-12.8
12010.0	56.3	43.1	56.5	43.1	54.0	-10.9	-10.9
14412.0	57.9	44.2	57.7	44.2	54.0	-9.8	-9.8
16814.0	61.6	48.6	61.5	48.6	54.0	-5.4	-5.4
2440.0	--	--	--	--	--	--	--
4880.0	47.8	34.9	47.9	34.9	54.0	-19.1	-19.1
7320.0	51.0	38.3	51.6	38.3	54.0	-15.7	-15.7
9760.0	53.7	40.7	54.2	40.7	54.0	-13.3	-13.3
12200.0	57.2	44.5	57.8	44.5	54.0	-9.5	-9.5
14640.0	57.5	44.7	58.1	44.7	54.0	-9.3	-9.3
17080.0	61.6	48.1	61.5	48.1	54.0	-5.9	-5.9
2480.0	--	--	--	--	--	--	--
4960.0	47.9	34.6	48.1	34.6	54.0	-19.4	-19.4
7440.0	50.6	37.6	50.6	37.6	54.0	-16.4	-16.4
9920.0	54.6	41.5	54.2	41.4	54.0	-12.5	-12.6
12400.0	57.4	44.5	57.2	44.5	54.0	-9.5	-9.5
14880.0	58.1	45.1	57.8	45.1	54.0	-8.9	-8.9
17360.0	60.6	47.2	59.7	47.2	54.0	-6.8	-6.8

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 12 Transmitter Radiated Emissions Mode 3, 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	47.7	34.5	47.3	34.5	54.0	-19.5	-19.5
7206.0	50.6	37.9	51.0	37.9	54.0	-16.1	-16.1
9608.0	54.2	41.2	54.3	41.2	54.0	-12.8	-12.8
12010.0	55.8	43.1	56.3	43.1	54.0	-10.9	-10.9
14412.0	56.9	44.1	56.8	44.1	54.0	-9.9	-9.9
16814.0	62.5	48.6	61.6	48.6	54.0	-5.4	-5.4
2440.0	--	--	--	--	--	--	--
4880.0	48.7	34.9	48.3	34.9	54.0	-19.1	-19.1
7320.0	51.0	38.3	51.3	38.2	54.0	-15.7	-15.8
9760.0	53.2	40.7	54.0	40.7	54.0	-13.3	-13.3
12200.0	57.5	44.5	57.4	44.5	54.0	-9.5	-9.5
14640.0	57.9	44.7	58.1	44.7	54.0	-9.3	-9.3
17080.0	62.2	48.1	61.4	48.1	54.0	-5.9	-5.9
2480.0	--	--	--	--	--	--	--
4960.0	47.5	34.6	47.7	34.6	54.0	-19.4	-19.4
7440.0	51.1	37.9	50.9	37.6	54.0	-16.1	-16.4
9920.0	55.4	41.5	55.1	41.5	54.0	-12.5	-12.5
12400.0	58.3	44.5	57.6	44.6	54.0	-9.5	-9.4
14880.0	58.5	45.1	58.7	45.2	54.0	-8.9	-8.8
17360.0	60.9	47.3	61.2	47.4	54.0	-6.7	-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 13 Transmitter Radiated Emissions Mode 4, 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	48.8	34.6	48.5	34.6	54.0	-19.4	-19.4
7206.0	51.1	37.9	51.3	37.9	54.0	-16.1	-16.1
9608.0	53.9	41.3	54.6	41.3	54.0	-12.7	-12.7
12010.0	57.0	43.2	56.8	43.2	54.0	-10.8	-10.8
14412.0	57.4	44.3	57.3	44.3	54.0	-9.7	-9.7
16814.0	61.2	48.7	61.7	48.8	54.0	-5.3	-5.2
2440.0	--	--	--	--	--	--	--
4880.0	48.0	35.0	48.5	35.0	54.0	-19.0	-19.0
7320.0	51.4	38.3	51.1	38.4	54.0	-15.7	-15.6
9760.0	54.1	40.8	54.9	40.8	54.0	-13.2	-13.2
12200.0	57.3	44.7	57.8	44.7	54.0	-9.3	-9.3
14640.0	58.1	45.0	58.6	45.0	54.0	-9.0	-9.0
17080.0	61.8	48.3	62.1	48.3	54.0	-5.7	-5.7
2480.0	--	--	--	--	--	--	--
4960.0	48.1	34.7	48.2	34.7	54.0	-19.3	-19.3
7440.0	50.5	37.7	50.5	37.7	54.0	-16.3	-16.3
9920.0	54.2	41.5	54.9	41.5	54.0	-12.5	-12.5
12400.0	57.6	44.7	57.4	44.7	54.0	-9.3	-9.3
14880.0	58.5	45.2	58.1	45.3	54.0	-8.8	-8.7
17360.0	60.6	47.4	60.2	47.3	54.0	-6.6	-6.7

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 14 Transmitter Radiated Emissions Mode 5, 802.11b

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	47.8	34.6	47.7	34.7	54.0	-19.4	-19.3
7236.0	51.2	37.9	51.3	38.0	54.0	-16.1	-16.0
9648.0	54.7	41.6	54.5	41.5	54.0	-12.4	-12.5
12060.0	57.0	43.7	57.0	43.5	54.0	-10.3	-10.5
14472.0	57.6	44.2	57.2	44.1	54.0	-9.8	-9.9
16884.0	61.3	48.1	61.5	48.2	54.0	-5.9	-5.8
2437.0	--	--	--	--	--	--	--
4874.0	48.3	34.9	48.1	34.9	54.0	-19.1	-19.1
7311.0	51.2	38.3	51.0	38.3	54.0	-15.7	-15.7
9748.0	53.8	40.9	53.8	40.9	54.0	-13.1	-13.1
12185.0	57.4	44.2	57.3	44.2	54.0	-9.8	-9.8
14622.0	57.7	44.5	57.1	44.5	54.0	-9.5	-9.5
17059.0	60.9	48.1	61.2	48.1	54.0	-5.9	-5.9
2462.0	--	--	--	--	--	--	--
4924.0	47.7	34.9	47.8	34.8	54.0	-19.1	-19.2
7386.0	51.6	38.4	51.3	38.3	54.0	-15.6	-15.7
9848.0	55.0	42.1	54.7	42.1	54.0	-11.9	-11.9
12310.0	58.7	45.5	59.0	45.5	54.0	-8.5	-8.5
14772.0	58.1	45.2	58.5	45.3	54.0	-8.8	-8.7
17234.0	60.8	47.7	61.1	47.7	54.0	-6.3	-6.3

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 15 Transmitter Radiated Emissions Mode 6, 802.11g

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	47.4	34.6	47.9	34.7	54.0	-19.4	-19.3
7236.0	50.9	37.9	50.7	38.0	54.0	-16.1	-16.0
9648.0	54.6	41.6	54.3	41.6	54.0	-12.4	-12.4
12060.0	56.6	43.7	56.8	43.6	54.0	-10.3	-10.4
14472.0	57.0	44.0	57.1	44.0	54.0	-10.0	-10.0
16884.0	61.3	48.2	61.0	48.3	54.0	-5.8	-5.7
2437.0	--	--	--	--	--	--	--
4874.0	47.9	34.9	48.6	34.9	54.0	-19.1	-19.1
7311.0	50.8	38.3	51.2	38.4	54.0	-15.7	-15.6
9748.0	53.9	40.8	53.9	40.9	54.0	-13.2	-13.1
12185.0	57.4	44.2	57.3	44.2	54.0	-9.8	-9.8
14622.0	57.6	44.5	58.1	44.5	54.0	-9.5	-9.5
17059.0	61.2	48.2	60.9	48.1	54.0	-5.8	-5.9
2462.0	--	--	--	--	--	--	--
4924.0	48.1	34.8	47.7	34.8	54.0	-19.2	-19.2
7386.0	51.3	38.2	51.0	38.2	54.0	-15.8	-15.8
9848.0	55.4	42.0	57.4	42.0	54.0	-12.0	-12.0
12310.0	58.4	45.3	58.5	45.3	54.0	-8.7	-8.7
14772.0	58.7	45.0	58.2	45.0	54.0	-9.0	-9.0
17234.0	60.5	47.3	60.4	47.4	54.0	-6.7	-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 16 Transmitter Radiated Emissions Mode 7, 802.11n

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	47.8	34.6	47.6	34.6	54.0	-19.4	-19.4
7236.0	51.1	37.8	51.2	37.9	54.0	-16.2	-16.1
9648.0	54.1	41.5	54.7	41.5	54.0	-12.5	-12.5
12060.0	56.6	43.5	56.4	43.5	54.0	-10.5	-10.5
14472.0	56.8	43.9	57.4	43.8	54.0	-10.1	-10.2
16884.0	61.1	48.0	60.8	48.0	54.0	-6.0	-6.0
2437.0	--	--	--	--	--	--	--
4874.0	47.8	34.8	47.9	34.8	54.0	-19.2	-19.2
7311.0	51.7	38.2	51.4	38.2	54.0	-15.8	-15.8
9748.0	53.3	40.8	53.8	40.8	54.0	-13.2	-13.2
12185.0	57.2	44.1	57.0	44.1	54.0	-9.9	-9.9
14622.0	57.5	44.4	57.1	44.4	54.0	-9.6	-9.6
17059.0	60.7	48.0	61.3	48.0	54.0	-6.0	-6.0
2462.0	--	--	--	--	--	--	--
4924.0	47.4	34.7	47.7	34.7	54.0	-19.3	-19.3
7386.0	51.0	38.1	51.5	38.2	54.0	-15.9	-15.8
9848.0	55.0	41.9	55.3	41.9	54.0	-12.1	-12.1
12310.0	57.6	45.2	57.9	45.2	54.0	-8.8	-8.8
14772.0	58.1	44.9	57.6	44.9	54.0	-9.1	-9.1
17234.0	60.0	47.2	60.5	47.2	54.0	-6.8	-6.8

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 17 Transmitter Antenna Port Conducted Data modes 2-4

Frequency MHz	Antenna Port Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	6-dB Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm)
Mode 2, BT (2EDR π/4 DQPSK)				
2402	0.002	1,210.5	1,076.3	-10.8
2440	0.002	1,210.5	1,078.2	-11.5
2480	0.002	1,209.0	1,072.3	-12.6
Mode 3, BT (3EDR 8DPSK)				
2402	0.003	1,203.8	1,078.4	-9.7
2440	0.002	1,201.5	1,074.6	-10.6
2480	0.002	1,200.8	1,072.1	-11.5
Mode 4, BT BLE (GMSK)				
2402	0.002	1,054.5	709.5	-12.9
2440	0.001	1,054.5	715.0	-13.5
2480	0.001	1,055.3	711.0	-14.4

Table 18 Transmitter Antenna Port Conducted Data modes 5 - 7

Frequency MHz	Antenna Port Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	6-dB Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm)
Mode 5, 802.11b				
2412	0.042	11,347.5	8,355.0	-7.0
2437	0.027	11,557.5	8,510.0	-8.7
2462	0.038	11,520.0	7,915.0	-6.6
Mode 6, 802.11g				
2412	0.037	16,990.0	15,757.5	-7.8
2437	0.024	17,120.0	15,855.0	-9.3
2462	0.033	17,430.0	15,690.0	-8.4
Mode 7, 802.11n				
2412	0.039	17,930.0	16,000.0	-8.3
2437	0.027	18,140.0	16,640.0	-8.2
2462	0.036	18,240.0	16,640.0	-8.5

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 4 and RSS-GEN Issue 5 emission requirements for Digital Transmission Systems. The highest average output power measured at the antenna port for modes 1 through 7 was 0.042 Watts. The highest peak power spectral density measured at the antenna port for modes 1 through 7 presented a minimum margin of -6.6 dB below the requirements. The EUT demonstrated a minimum margin of -5.2 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 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	5.46
3 Meter Measurements 18-40 GHz	5.16
10 Meter Horizontal Measurements 0.009-1000 MHz	4.15
10 Meter Vertical Measurements 0.009-1000 MHz	4.32
AC Line Conducted	1.75
Antenna Port Conducted power	1.17
Frequency Stability	1.00E-11
Temperature	1.6˚C
Humidity	3%

Annex B Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	3/20/2025	3/20/2026
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/16/2024	9/16/2025
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/16/2024	9/16/2025
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/16/2024	9/16/2025
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/16/2024	9/16/2026
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/17/2025	3/17/2027
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	9/16/2024	9/16/2026
☒ Antenna	Com Power	AH-1840 (101046)	18-40 GHz	3/17/2025	3/17/2027
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	7/9/2025	7/9/2026
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/21/2025	1/21/2026
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☐ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/16/2024	9/16/2025
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/16/2024	9/16/2025
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
☒ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/19/2025	3/19/2026
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/21/2025	3/21/2026
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/21/2025	3/21/2026
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/21/2025	3/21/2026
☒ Weather station	Davis	6152 (A70927D44N)		11/4/2024	11/4/2025

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ Frequency Counter: Leader		LDC-825 (8060153)		3/19/2025	3/19/2026
☐ ISN	Com-Power	Model ISN T-8 (600111)		3/19/2025	3/19/2026
☐ LISN:	Com-Power	Model LI-220A		9/16/2024	9/16/2026
☒ LISN:	Com-Power	Model LI-550C		9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(4M)(281184)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/16/2024	9/16/2025
☒ Cable	Mini-Circuits	KBL-2M-LOW+ (23090329)	9kHz-40 GHz	3/22/2025	3/22/2026
☒ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	3/20/2025	3/20/2026
☐ Antenna:	Solar	9229-1 & 9230-1		2/5/2025	2/5/2026
☐ CDN:	Com-Power	Model CDN M325E		9/16/2024	9/16/2026
☐ Oscilloscope Scope: Tektronix		MDO 4104		2/5/2025	2/5/2026
☐ EMC Transient Generator HVT		TR 3000		2/5/2025	2/5/2026
☐ AC Power Source (Ametech, California Instruments)				2/5/2025	2/5/2026
☒ Field Intensity Meter: EFM-018				2/5/2025	2/5/2026
☒ ESD Simulator: MZ-15				2/5/2025	2/5/2026
☐ Injection Clamp Luthi Model EM101				not required	
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Temperature Chamber				not required	
☒ Shielded Room				not required	

Annex C Laboratory Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200087-0

Rogers Labs, a division of The Compatibility Center LLC
Lenexa, 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 on ISO/IEC 17025).

2025-03-11 through 2026-03-31
Effective Dates

DEPARTMENT OF COMMERCE • UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program

NVLAP Lab Code 200087-0

Rogers Labs, a division of The Compatibility Center LLC

7915 Nieman Rd.
Lenexa, KS 66214
Phone / Fax (913) 660-0666

Unlicensed National Information Infrastructure (U-NII) and License-Exempt Local Area Network (LE-LAN) Devices, 47CFR, Part 15E (15.407)

Industry Canada RSS-247 Issue 4

Application For Grant of Certification

Model: B04281

Frequency Range: 5745-5825 MHz

License-Exempt U-NII, Local Area Network equipment, U-NII-3 operation

FCC ID: IPH-B4281

IC: 1792A-B4281

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062
Jeff Hailey
Staff Compliance Engineer

Test Report Number: 250528
Test Date: May 28, 2025 – August 28, 2025

Authorized Signatory:
Patrick Powell
Rogers Labs, a division of The Compatibility Center LLC
FCC Designation: US5305
ISED Registration: 3041A

Revisions

Revision 1 Issued October 16, 2025

Executive Summary

The following information is submitted for consideration in obtaining Equipment Grants of Certification for License Exempt, Unlicensed National Information Infrastructure (U-NII) Intentional Radiator operating under 47 CFR Paragraph 15E (15.407), U-NII-3 new rules, 5745-5825 MHz bands, and Industry Canada RSS-GEN Issue 5, and RSS-247 Issue 4, LE-LAN transmitter.

Name of Applicant:	Garmin International, Inc. 1200 East 151st Street Olathe, KS 66062
M/N: B04281	HVIN: B04281
FCC ID: IPH-B4281	Industry Canada ID: 1792A-B4281

Frequency Range: 5745-5825 MHz (U-NII-3 under new rules 15.407, 802.11a/n/n40/ac80) and limited transmitter operations per regulations for operation in Canada

Mode	Channel width	Average Conducted Power (W)	Average e.i.r.p. Power (W)	99% OBW (kHz)
Mode 12, U-NII-3 802.11a	20 MHz	0.043	0.044	18,030.0
Mode 13, U-NII-3 802.11n	20 MHz	0.042	0.043	18,620.0
Mode 14, U-NII-3 802.11n40	40 MHz	0.034	0.035	38,075.0
Mode 15, U-NII-3 802.11ac80	80 MHz	0.030	0.031	75,800.0

This report addresses EUT Operations as U-NII-3 transmitter using modulations defined above in modes 12 through 15.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Frequency Bands 15.205, RSS-GEN 8.10	-4.7	Complies
AC Line Conducted 15.207, RSS-GEN 7.2.4	-13.55	Complies
Radiated Emissions 15.209, RSS-GEN 7.2.5	-13.3	Complies
Harmonic Emissions per 15.407, RSS-247	-16.2	Complies

Equipment Tested

Model: B04281

Garmin International, Inc.	Garmin Corporation
1200 East 151st Street	No.68, Zhangshu 2nd Rd.
Olathe, KS 66062	Xizhi Dist., New Taipei City 221, Taiwan, R.O.C.

Equipment	Model / PN	Serial Number
EUT #1 Radiated	B04281	3514215240
EUT #2 Antenna Port Conducted	B04281	3514215200
AC/DC Wall mount power supply	362-00112-00	N/A
USB-A to C Cable, 1.5m	320-01535-30	N/A
USB-A to C Cable, 4m	320-01545-20	N/A
CLA	013-00797-03	N/A

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

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

Software (FVIN): 1.04 or higher: Antennas: BT/BLE PIFA (5.24 dBi), 2.4 GHz WiFi PIFA (5.24 dBi), 5.7 GHz PIFA (0.08 dBi)

Environmental Conditions

Ambient Temperature	20.9° C
Relative Humidity	45.0 %
Atmospheric Pressure	1018.4 mb

Equipment Operational Modes

Mode	Transmitter Operation
mode 1	BT BR (GFSK)
mode 2	BT (2EDR π/4 DQPSK)
mode 3	BT (3EDR 8DPSK)
mode 4	BT BLE (GMSK)
mode 5	802.11b
mode 6	802.11g
mode 7	802.11n
mode 12	U-NII-3 802.11a
mode 13	U-NII-3 802.11n
mode 14	U-NII-3 802.11n40
mode 15	U-NII-3 802.11ac80

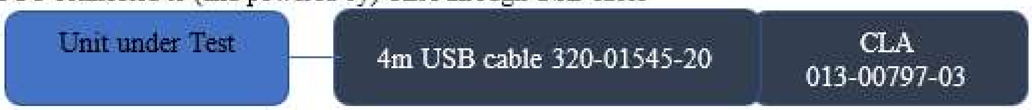
Equipment Function

The product operates from the internal battery or direct current power provided over the USB-C port. The design provides a Micro SD card slot and USB-C interface port as presented below and wireless communications with the compatible equipment. The EUT was arranged as described by the manufacturer emulating typical user configurations for testing purposes. The EUT offers no other interfaces connections other than those presented in the configuration options as described by the manufacturer and presented below.

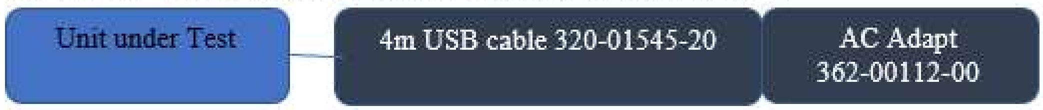
Equipment Configuration

1) UUT connected to (and powered by) CLA through USB cable

2) UUT connected to (and powered by) CLA through USB cable



3) UUT connected to (and powered by) AC adapter through USB cable



4) UUT connected to (and powered by) Computer through USB cable

5) UUT connected to (and powered by) AC adapter through USB cable

6) UUT powered battery

Applicant Company information

Applicants Company	Garmin International, Inc.
Applicants Address	1200 East 151st Street, Olathe, KS 66062
FCC Identifier	IPH-B4281
Industry Canada Identifier	1792A-B4281
Manufacturer Company	Garmin International, Inc.
Manufacturer Address	1200 East 151st Street, Olathe, KS 66062

Equipment information

Hardware Version Identification Number (HVIN): The HVIN identifies hardware specifications of a product version. The HVIN replaces the ISED Model Number in the legacy E-filing System. An HVIN is required for all products for certification applications.	B04281
Host Marketing Name (HMN) (if applicable): The HMN is the name or model number of a final product, which contains a certified radio module.	N/A
Brand Name	
Model Number	B04281
Test Rule Part(s)	47 CFR 15E, 15.407, RSS-247
Test Frequency Range	5.725-5.85 GHz
Project Number	250528
Submission Type	FCC: Certification, IC: Certification

Product Details

Items	Description
Product Type	Single chain 5 GHz U-NII-3
Radio Type	Transceiver
Power Type	Internal Rechargeable Battery or External Direct Current
Frequency Range	5725-5850 MHz
Channel Number	Channels 149, 151, 153, 155, 157, 159, 161, 165
Carrier Frequencies	Please refer to 802.11 Standard for Carrier Frequencies
Antenna	Integrated 2.36 dBi antenna PIFA (5.7G)
Communication Mode	Device provides 5 GHz, U-NII-3 operation
Beamforming Function	Without beamforming
Operating Mode	5725-5825 MHz (U-NII-3)

Antenna and Bandwidth

Antenna	Number of TX chains		
Bandwidth Mode	20 MHz	40 MHz	80 MHz
IEEE 802.11a	Single Chain	N/A	N/A
IEEE 802.11n	Single Chain	Single Chain	N/A
IEEE 802.11ac	N/A	Single Chain	Single Chain

Applicable Standards & Test Procedures

The following information is submitted in accordance with e-CFR dated October 18, 2024: Part 2, Subpart J, Part 15, Subpart 15E, Industry Canada RSS-GEN Issue 5, and RSS-247 Issue 4. Test procedures used are the established Methods of Measurement of Radio-Noise Emissions as described in ANSI C63.10-2020, KDB 789033 D02 General UNII Test Procedures New Rules v02r01, KDB 926956 v02, RSS-247 Issue 4, and RSS-GEN Issue 5.

Testing Procedures

AC Line Conducted Emission Test Procedure

Testing for the AC line-conducted emissions were performed as required in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. The test setup, including the EUT, was arranged in the test configurations as presented during testing. The test configuration was placed on a 1 x 1.5-meter bench, 0.8 meters high located in a screen room. The power lines of the system were isolated from the power source using a standard LISN with a 50-µHy choke. EMI was coupled to the spectrum analyzer through a 0.1 µF capacitor internal to the LISN. The LISN was positioned on the floor beneath the wooden bench supporting the EUT. The power lines and cables were draped over the back edge of the table. Refer to diagram one showing typical test arrangement and photographs in the test setup exhibit for EUT placement used during testing.

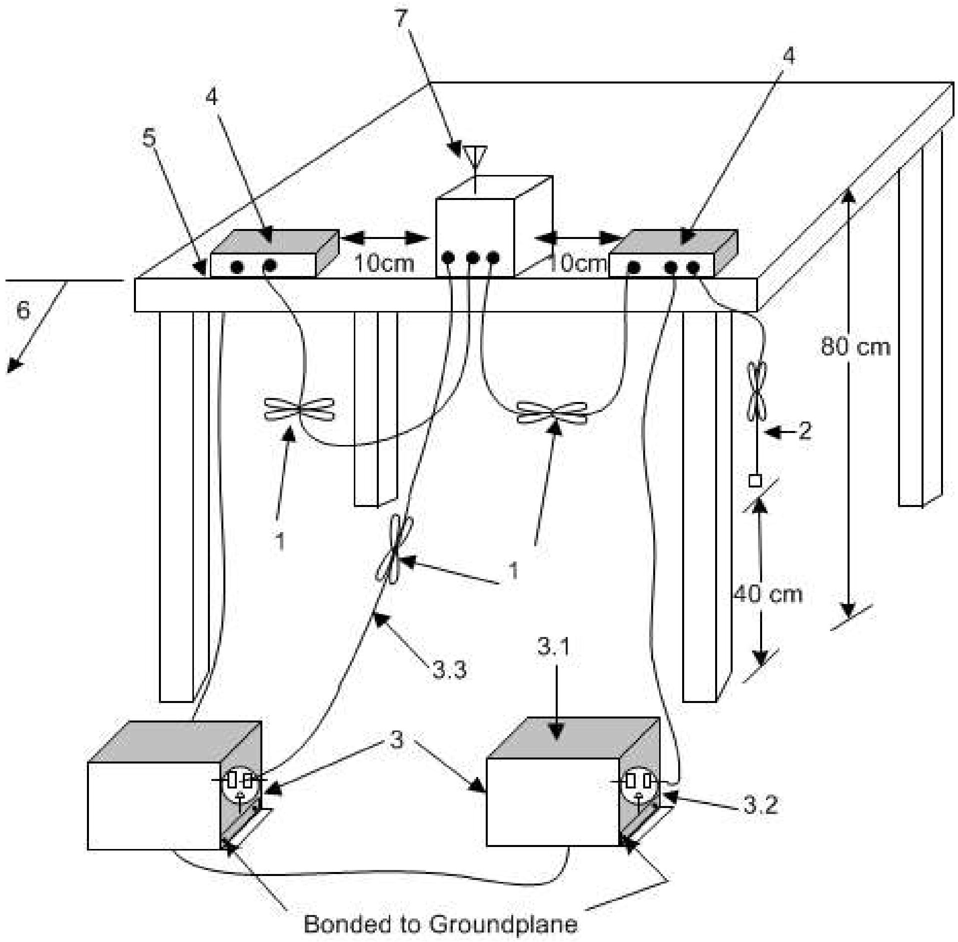
Radiated Emission Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 Issue 4, RSS-GEN and specified in ANSI C63.10-2020. 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 40,000 MHz was searched for emissions and all significant results reported. All other unreported findings were at least 20 dB below limits. Refer to diagrams two and three showing typical test setup. Refer to photographs in the test setup exhibits for specific EUT placement during testing.

Antenna Port Conducted Emission Test Procedure

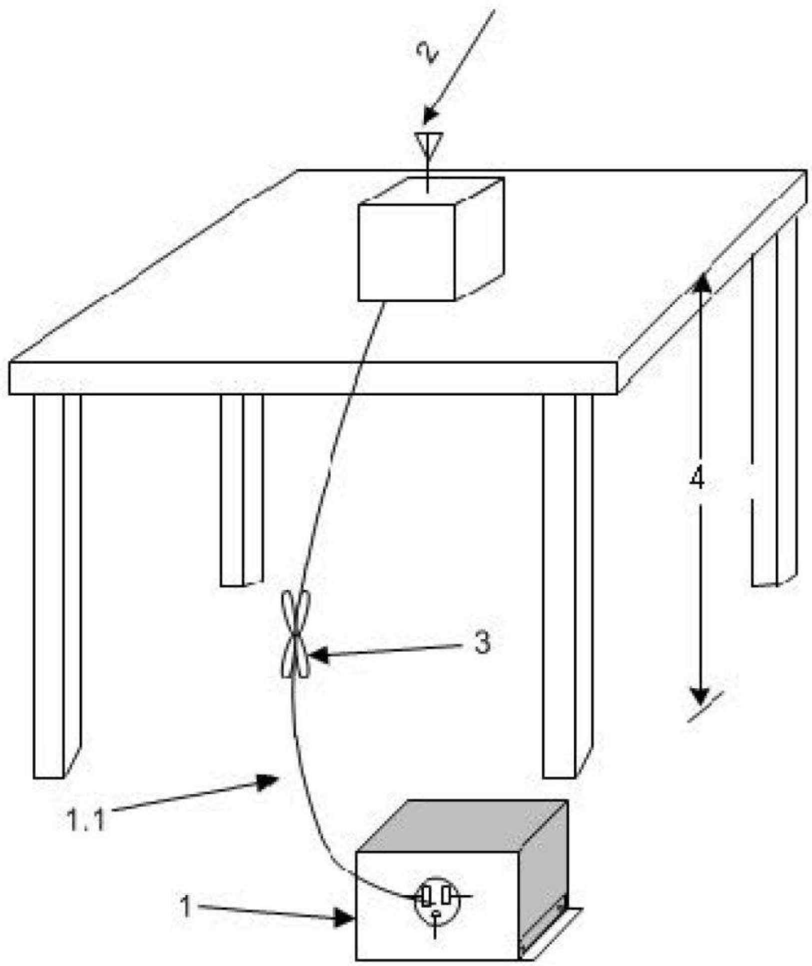
The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2020. Testing was 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 4 showing typical test arrangement and photographs in the test setup exhibits for specific EUT placement during testing.

Diagram 1 Test arrangement for power-line conducted emissions



1. 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 (see 6.2.3.1).
2. I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m (see 6.2.2).
3. EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω loads. LISN can be placed on top of, or immediately beneath, reference ground plane (see 6.2.2 and 6.2.3).
   3.1 All other equipment powered from additional LISN(s).
   3.2 Multiple-outlet strip can be used for multiple power cords of non-EUT equipment.
   3.3 LISN at least 80 cm from nearest part of EUT chassis.
4. Non-EUT components of EUT system being tested.
5. Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop (see 6.2.3.1).
6. Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane (see 6.2.2 for options).
7. Antenna may be integral or detachable. If detachable, the antenna shall be attached for this test

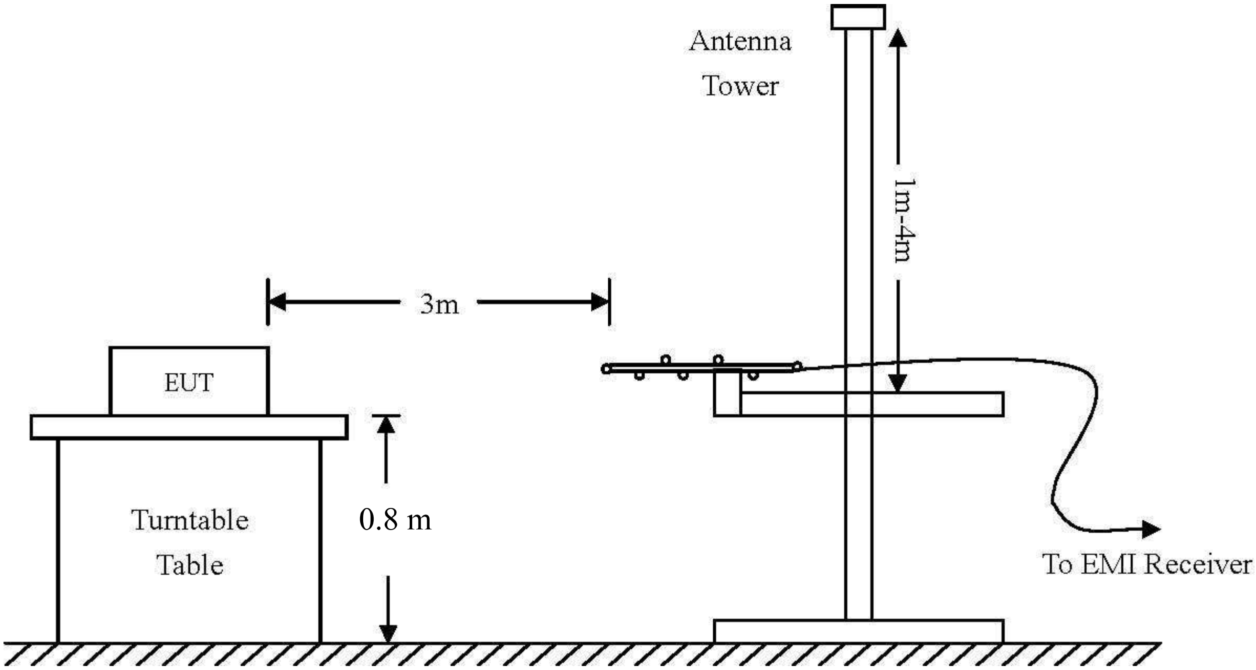
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



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

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

Below 1 GHz



Above 1 GHz:

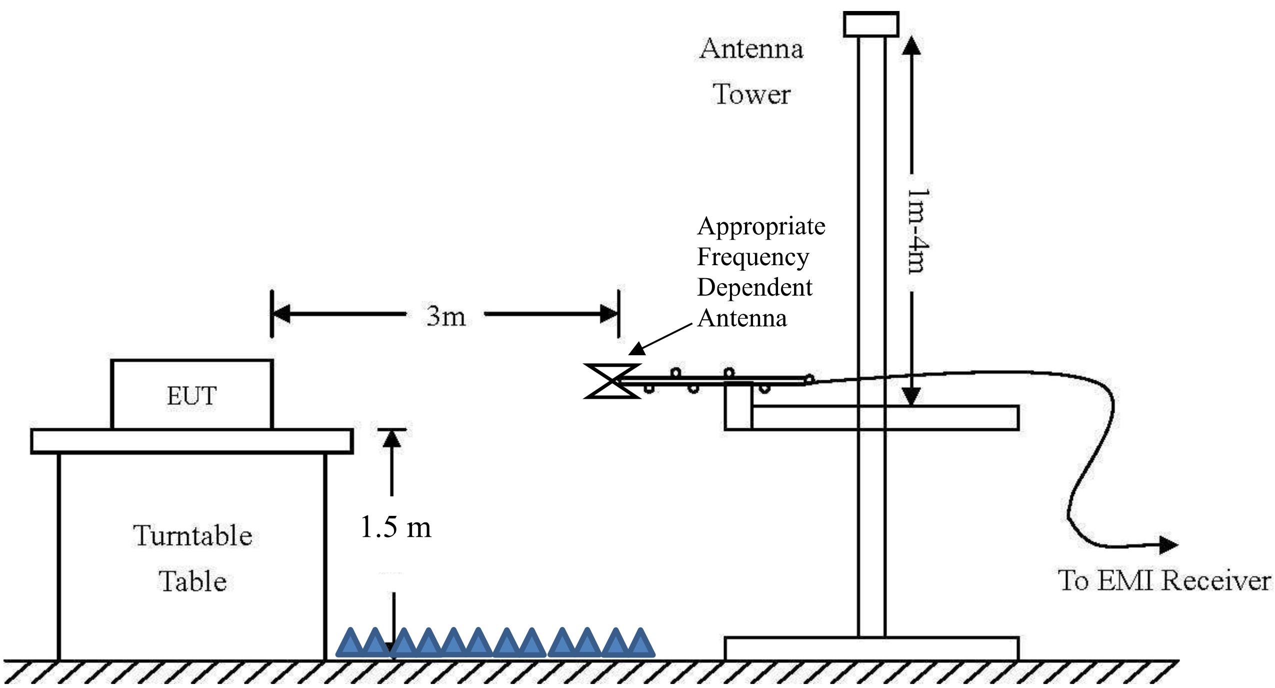
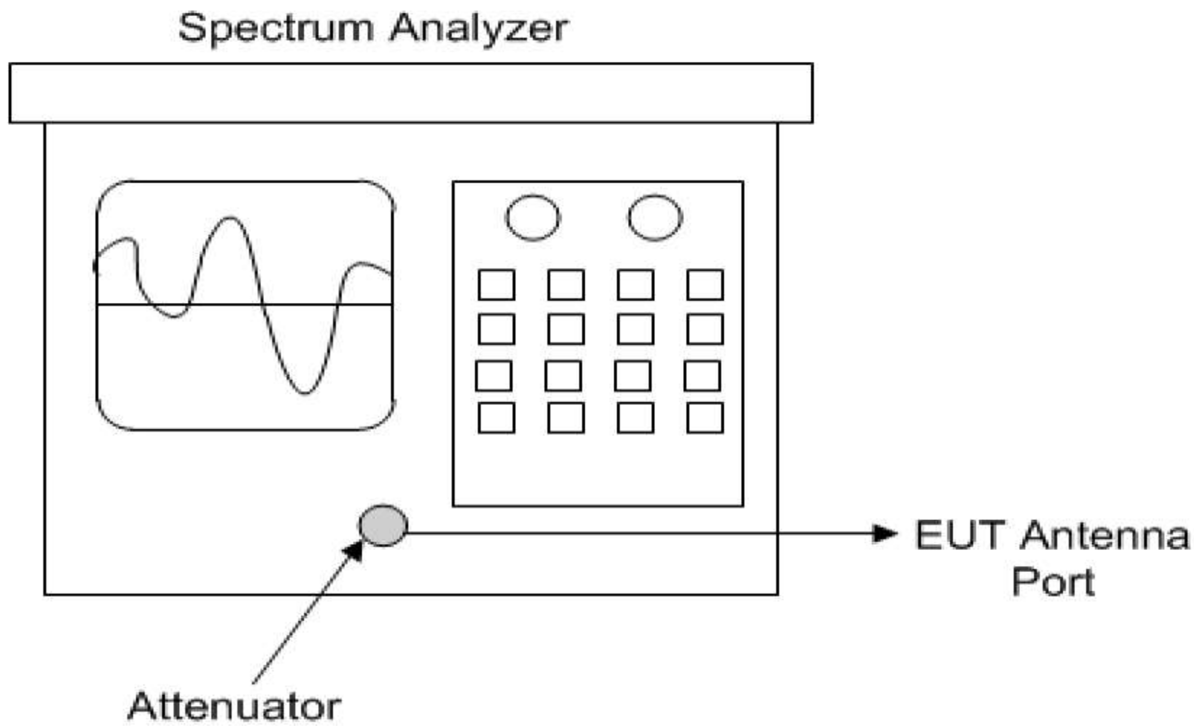


Diagram 4 Test arrangement for Antenna Port Conducted emissions



Test Site Locations

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

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

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

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

NVLAP Accreditation Lab code 200087-0

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: The limit is expressed for a 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 Semi-Anechoic Chamber using the measurement reading and correcting for receive antenna factor, cable losses, and amplifier gains.

Sample Calculation:

RFS = Radiated Field Strength, FSM = Field Strength Measured
A.F. = Receive antenna factor, Losses = attenuators/cable losses, Gain = amplification gains
RFS (dBµV/m @ 3m) = FSM (dBµV) + A.F. (dB/m) + Losses (dB) - Gain (dB)

Frequency: 9 kHz-30 MHz	Frequency: 30 MHz- 1 GHZ	Frequency: Above 1 GHz
Loop Antenna	Broadband Biconilog	Horn
RBW = 9 kHz	RBW = 120 kHz	RBW = 1 MHz
VBW = 30 kHz	VBW = 500 kHz	VBW = 3 MHz
Sweep time = Auto	Sweep time = Auto	Sweep time = Auto
Detector = PK, QP	Detector = PK, QP	Detector = PK, AV
Antenna Height 1m	Antenna Height 1-4m	Antenna Height 1-4m

Statement of Modifications and Deviations

No modifications to the EUT were required for the unit to demonstrate compliance with the 47 CFR Part 15E, RSS-Gen, and RSS-247 Issue 4, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Intentional Radiators

Antenna Requirements

The EUT incorporates integral antenna system and 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 or SAC. The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated at the OATS or SAC, 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 C63.10-2020 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 Data Mode 12 U-NII-3 (802.11a)

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)
Mode 11 U-NII-3 (802.11a)							
11490	57.4	43.8	59.8	43.9	54.0	-10.2	-10.1
11570	57.8	43.7	56.8	43.6	54.0	-10.3	-10.4
11650	57.2	43.8	57.3	43.7	54.0	-10.2	-10.3
22980	62.0	48.4	61.8	48.4	54.0	-5.6	-5.6

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 2 Harmonic Radiated Emissions in Restricted Bands Data Mode 13 U-NII-3 (802.11n)

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)
Mode 12 U-NII-3 (802.11n)							
11490	57.3	43.7	57.3	43.5	54.0	-10.3	-10.5
11570	57.8	43.4	57.4	43.6	54.0	-10.6	-10.4
11650	57.0	43.8	57.3	43.7	54.0	-10.2	-10.3
22980	62.1	48.3	61.6	48.3	54.0	-5.7	-5.7

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 3 Harmonic Radiated Emissions in Restricted Bands Data Mode 14 U-NII-3 (802.11n40)

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)
Mode 13 U-NII-3 (802.11n40)							
11510	57.4	44.0	57.1	43.9	54.0	-10.0	-10.1
11590	57.5	43.8	57.3	43.8	54.0	-10.2	-10.2
23020	62.7	48.9	62.5	48.9	54.0	-5.1	-5.1

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 4 Harmonic Radiated Emissions in Restricted Bands Data Mode 15 U-NII-3 (802.11ac80)

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)
Mode 15 U-NII-3 (802.11ac80)							
11550	57.1	43.7	57.2	43.5	54.0	-10.3	-10.5
23100	62.3	49.3	62.5	48.8	54.0	-4.7	-5.2

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

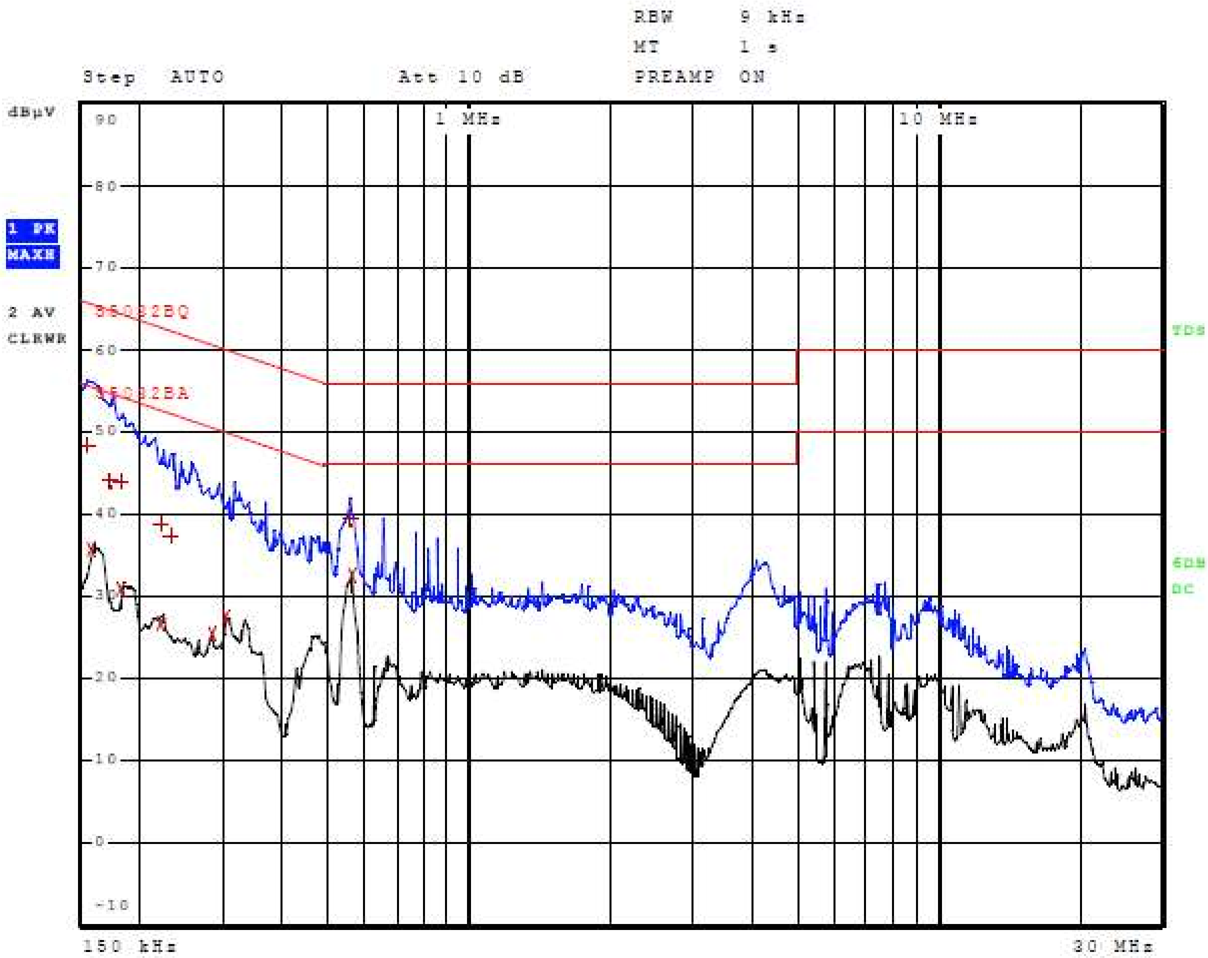
The EUT demonstrated compliance with the emissions requirements of 47 CFR 15.205, RSS-GEN Issue 5, and RSS-247 Issue 4. The EUT provided a worst-case minimum margin of -4.7 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. Worst-case emissions are reported with other emissions found in the restricted frequency bands at least 20 dB below the requirements.

AC Line Conducted EMI Procedure

The EUT was arranged in typical equipment configurations as offered by manufacturer and presented above in equipment configuration. AC Line Conducted emission testing was performed with the EUT placed on a 1 x 1.5-meter bench 80 cm above the conducting ground plane, floor of a screen room. The bench was positioned 40 cm away from the wall of the screen room. The LISN was positioned on the floor of the screen room 80-cm from the rear of the EUT. Testing for the AC line-conducted emissions followed the procedures of ANSI C63.10-2020. The EUT was configured as presented in the AC Line conducted configurations as directed by the manufacturer and presented above in equipment configuration. The AC adapter for the EUT was connected to the LISN for AC line-conducted emissions testing. A second LISN was positioned on the floor of the screen room 80-cm from the rear of the supporting equipment of the test configuration. All power cords except the EUT were then powered from the second LISN. EMI was coupled to the spectrum analyzer through a 0.1 μF capacitor, internal to the LISN. Power line conducted emissions testing was carried out individually for each current carrying conductor of the EUT. The excess length of lead between the system and the LISN receptacle was folded back and forth to form a bundle not exceeding 40 cm in length. The screen room, conducting ground plane, analyzer, and LISN were bonded together to the protective earth ground. Preliminary testing was performed to identify the frequencies of each of the emissions, which demonstrated the highest amplitudes. The cables were repositioned to obtain maximum amplitude of measured EMI level. Once the worst-case configuration was identified, plots were made of the EMI from 0.15 MHz to 30 MHz and data recorded.

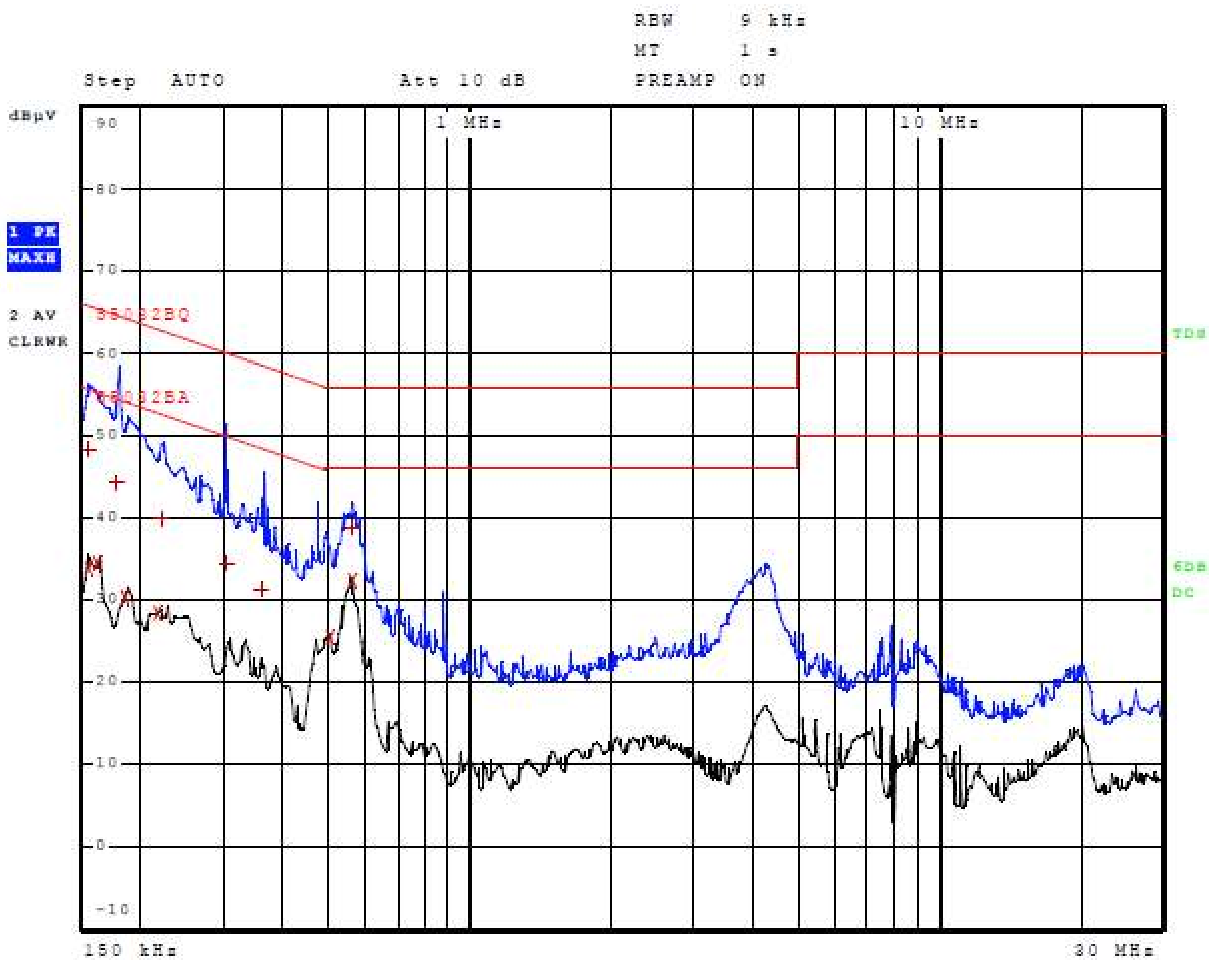
Refer to data in tables 5 and 6 and figures 1 and 2 for plots of the Configuration #4 EUT – USB Computer interface AC Line conducted emissions.

Figure 1 AC Line Conducted Emissions Data L1 (Config. #4, EUT – Computer)



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

Figure 2 AC Line Conducted Emissions Data L2 (Config. #4, EUT – Computer)



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

Table 5 AC Line Conducted Emissions Data L1 (Config. #4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
1	154.000000000 kHz	48.30	Quasi Peak	-17.48
2	158.000000000 kHz	35.65	Average	-19.92
1	174.000000000 kHz	44.10	Quasi Peak	-20.66
1	182.000000000 kHz	43.93	Quasi Peak	-20.47
2	182.000000000 kHz	30.77	Average	-23.62
2	222.000000000 kHz	26.65	Average	-26.09
1	222.000000000 kHz	38.89	Quasi Peak	-23.85
1	234.000000000 kHz	37.32	Quasi Peak	-24.99
2	282.000000000 kHz	25.30	Average	-25.46
2	306.000000000 kHz	27.53	Average	-22.55
1	554.000000000 kHz	39.38	Quasi Peak	-16.62
2	558.000000000 kHz	32.45	Average	-13.55

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

Table 6 AC Line Conducted Emissions Data L2 (Config. #4, EUT – Computer)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	33.89	Average	-21.90
1	154.000000000 kHz	48.33	Quasi Peak	-17.45
2	162.000000000 kHz	34.36	Average	-21.00
1	178.000000000 kHz	44.31	Quasi Peak	-20.27
2	186.000000000 kHz	30.27	Average	-23.94
2	218.000000000 kHz	28.41	Average	-24.48
1	222.000000000 kHz	39.81	Quasi Peak	-22.93
1	302.000000000 kHz	34.45	Quasi Peak	-25.74
1	362.000000000 kHz	31.25	Quasi Peak	-27.44
2	502.000000000 kHz	25.46	Average	-20.54
2	558.000000000 kHz	32.25	Average	-13.75
1	562.000000000 kHz	38.87	Quasi Peak	-17.13

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

Summary of Results for AC Line Conducted Emissions

The EUT demonstrated compliance with the AC Line Conducted Emissions requirements of 47CFR Part 15C, RSS-247 and RSS-Gen. The EUT configuration #4 demonstrated a minimum margin of -13.55 dB below the requirement. Other emissions were present with amplitudes at least 20 dB below the limit and worst-case amplitudes recorded.

General Radiated Emissions Procedure

Testing for the radiated emissions were performed as specified in CFR47 15B, RSS-GEN, and directed in ANSI C63.4-2014. For testing purposes, the EUT was arranged as presented in the applicable configuration diagrams above and operated through all modes as presented.

Exploratory radiated emissions measurements were performed in the SAC chamber or screen room, finding maximized emissions over frequency, EUT orientation, antenna height and polarity. This data is then used to focus the final radiated emissions measurements on these maximized points.

Final radiated emissions data were taken with the EUT located in the OATS or SAC at distance of 3 meters between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 6,000 MHz was searched for radiated emissions. Measured emission levels were maximized by EUT placement on the table, changing cable location, 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, Biconical, Broadband Biconilog, Log Periodic, and Double Ridge or Pyramidal Horns and mixers above 1 GHz.
Refer to data in tables 7 and 8 and figures 3 through 10 for plots of the Configuration #4 EUT – USB Computer interface, general radiated emissions.

Figure 3 Plot of General Radiated Emissions – Horizontal Polarization

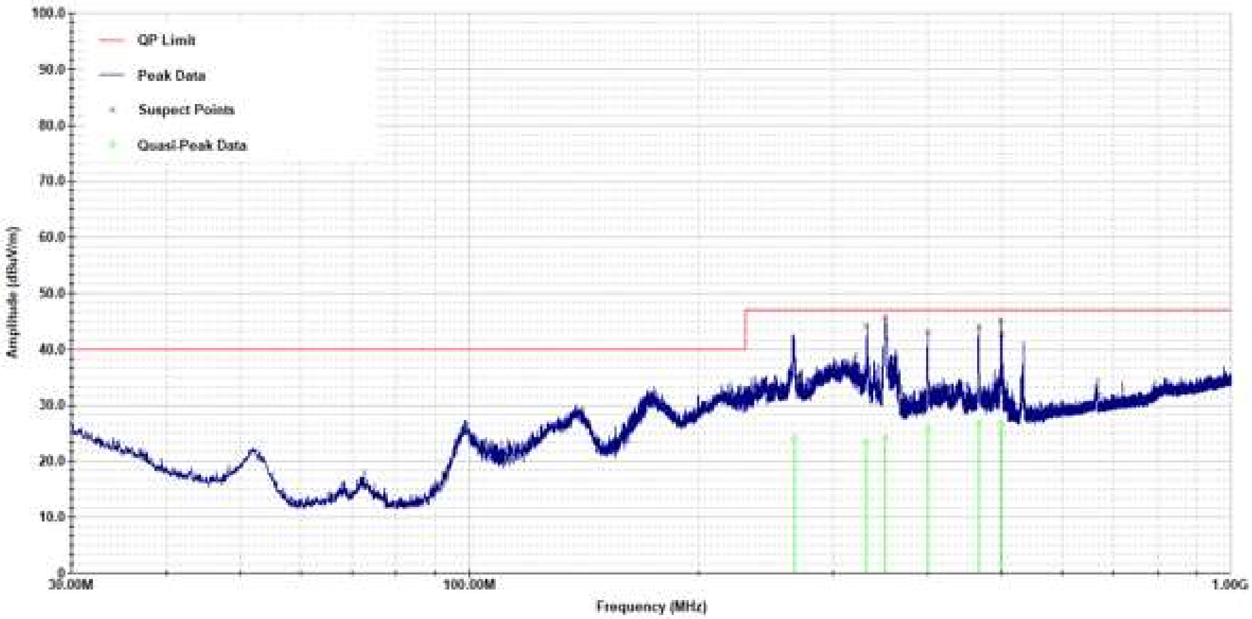


Figure 4 Plot of General Radiated Emissions – Vertical Polarization

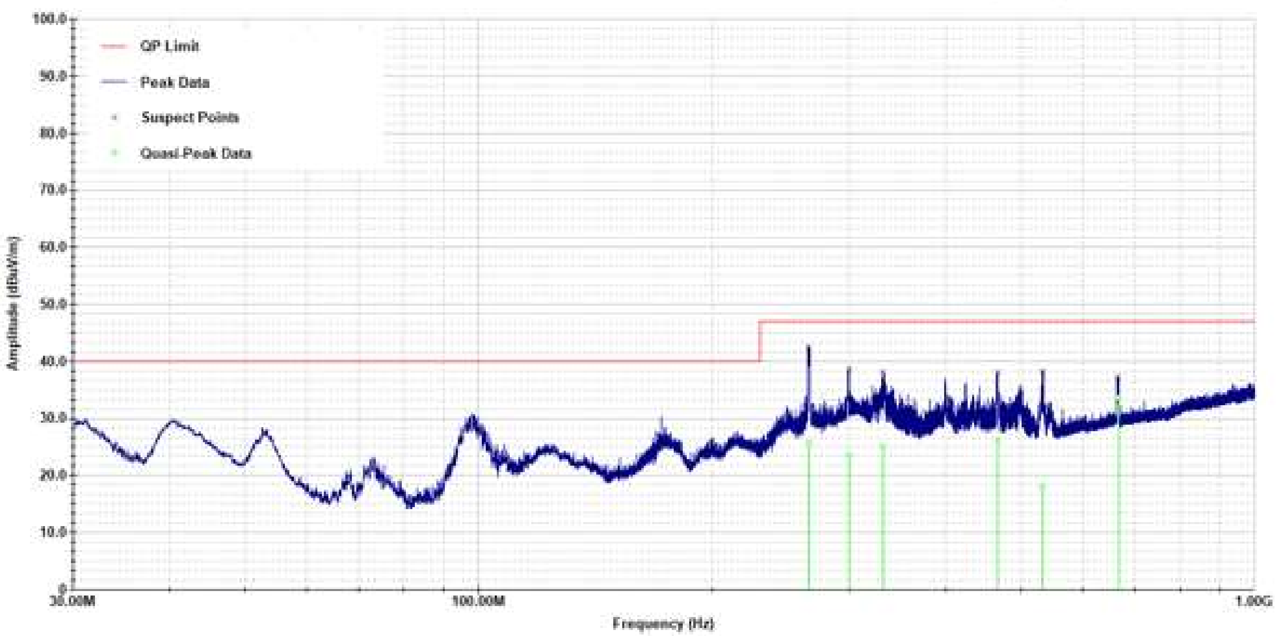


Figure 5 Radiated Emissions Plot taken in screen room (Config #4 / EUT – PC / 1 – 3 GHz)

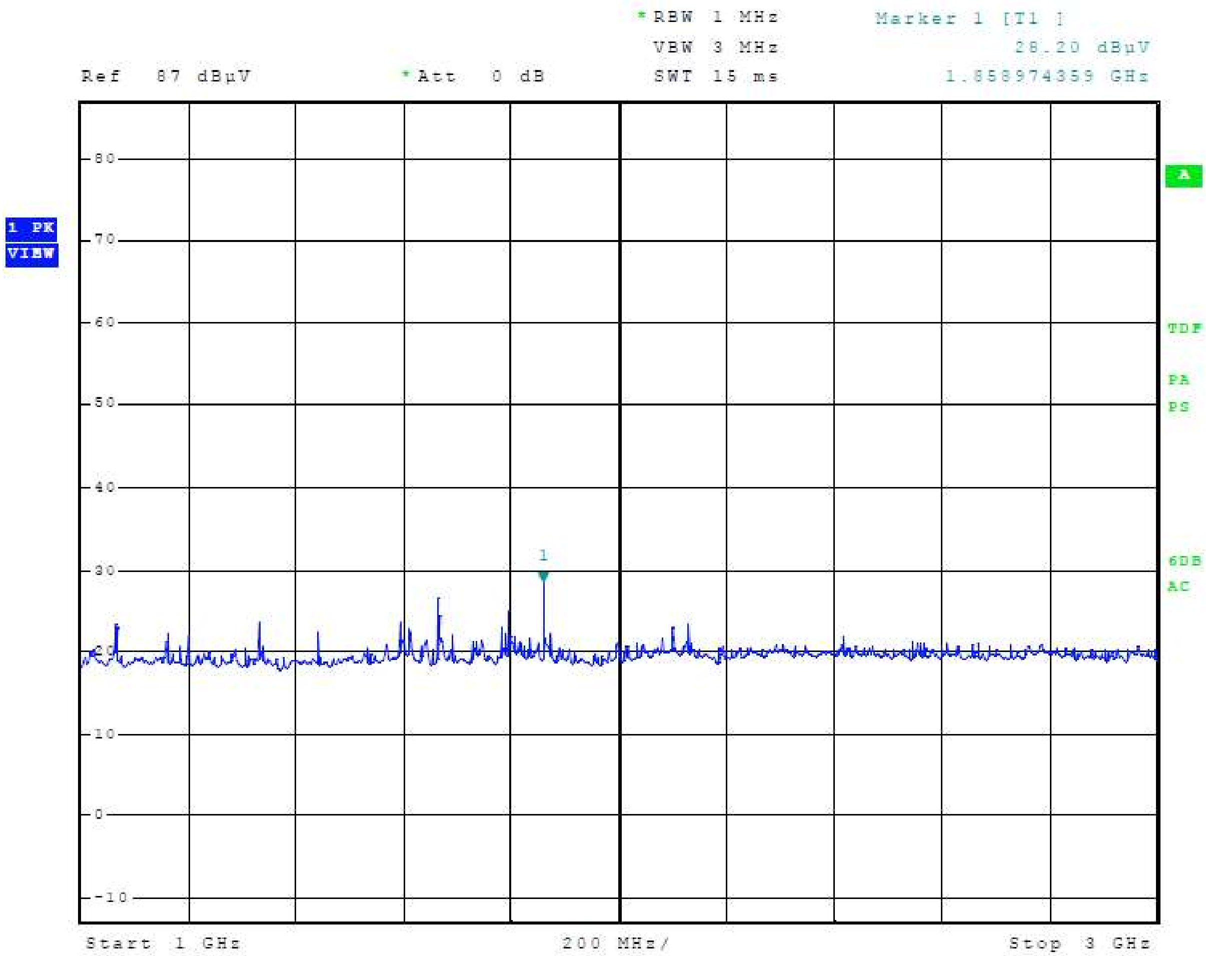


Figure 6 Radiated Emissions Plot taken in screen room (Config #4 / EUT – PC / 3 – 6 GHz)

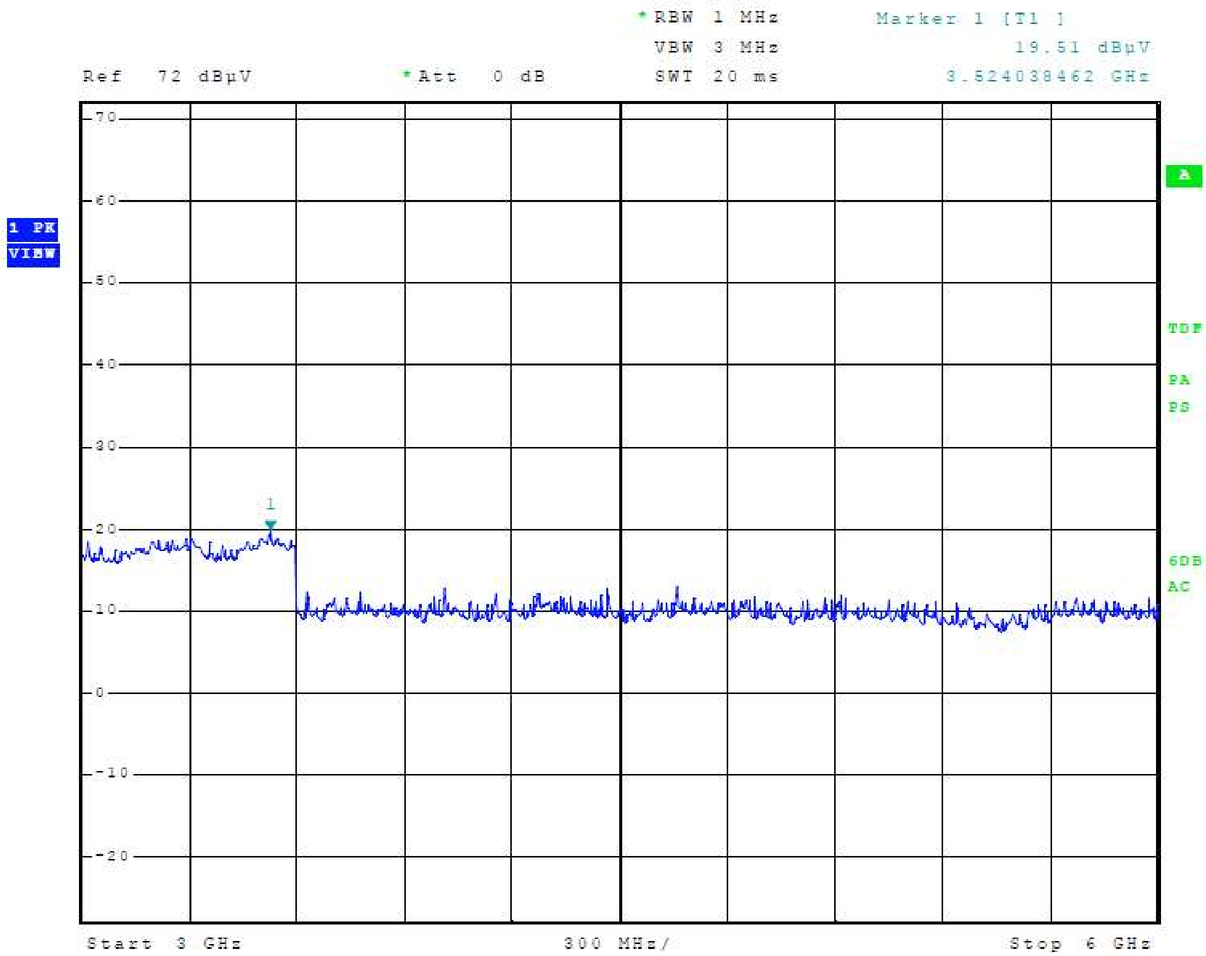


Figure 7 Radiated Emissions Plot taken in screen room (Config #4 / EUT – PC / 6 – 12 GHz)

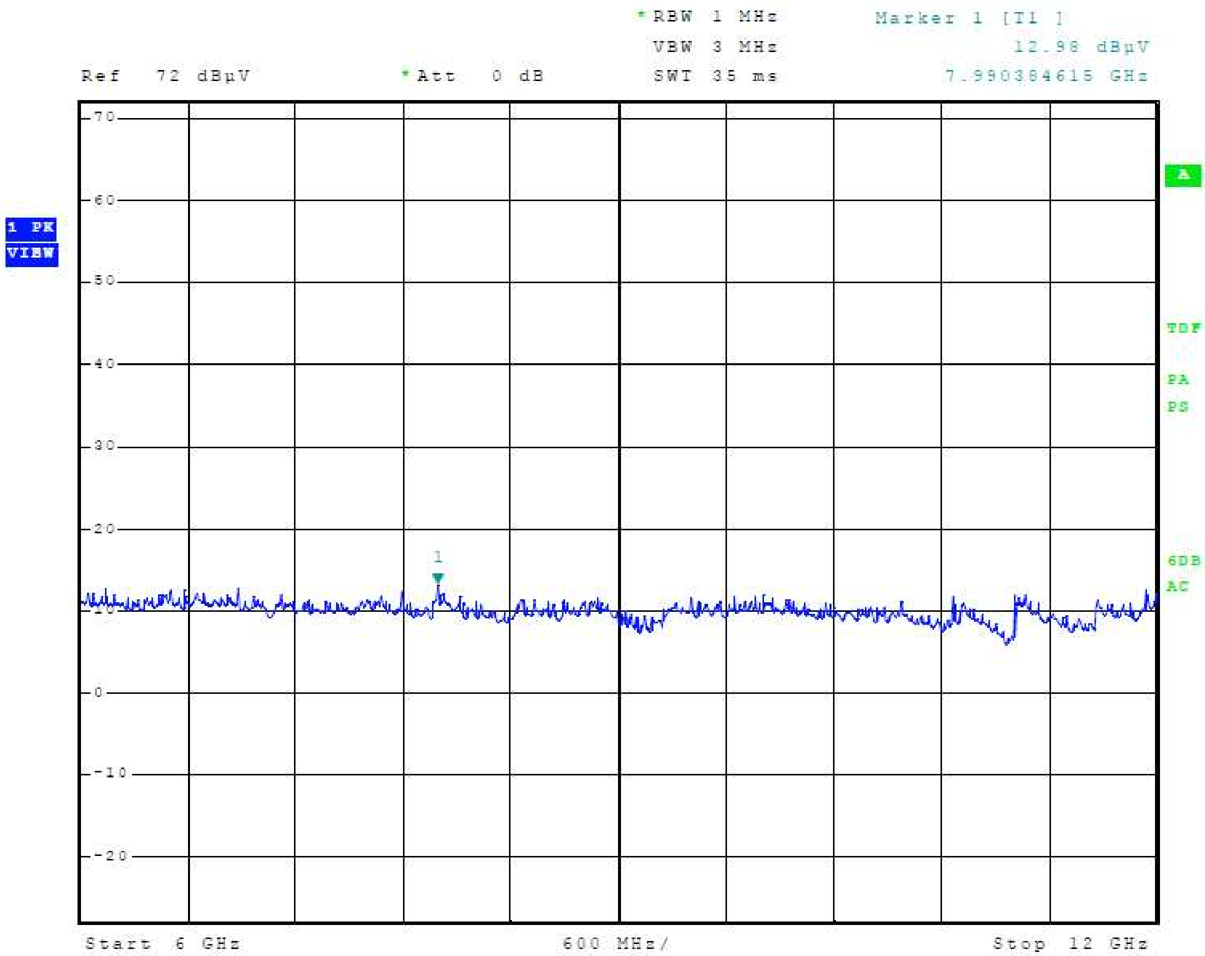


Figure 8 Radiated Emissions Plot taken in screen room (Config #4 / EUT – PC / 12 – 18 GHz)

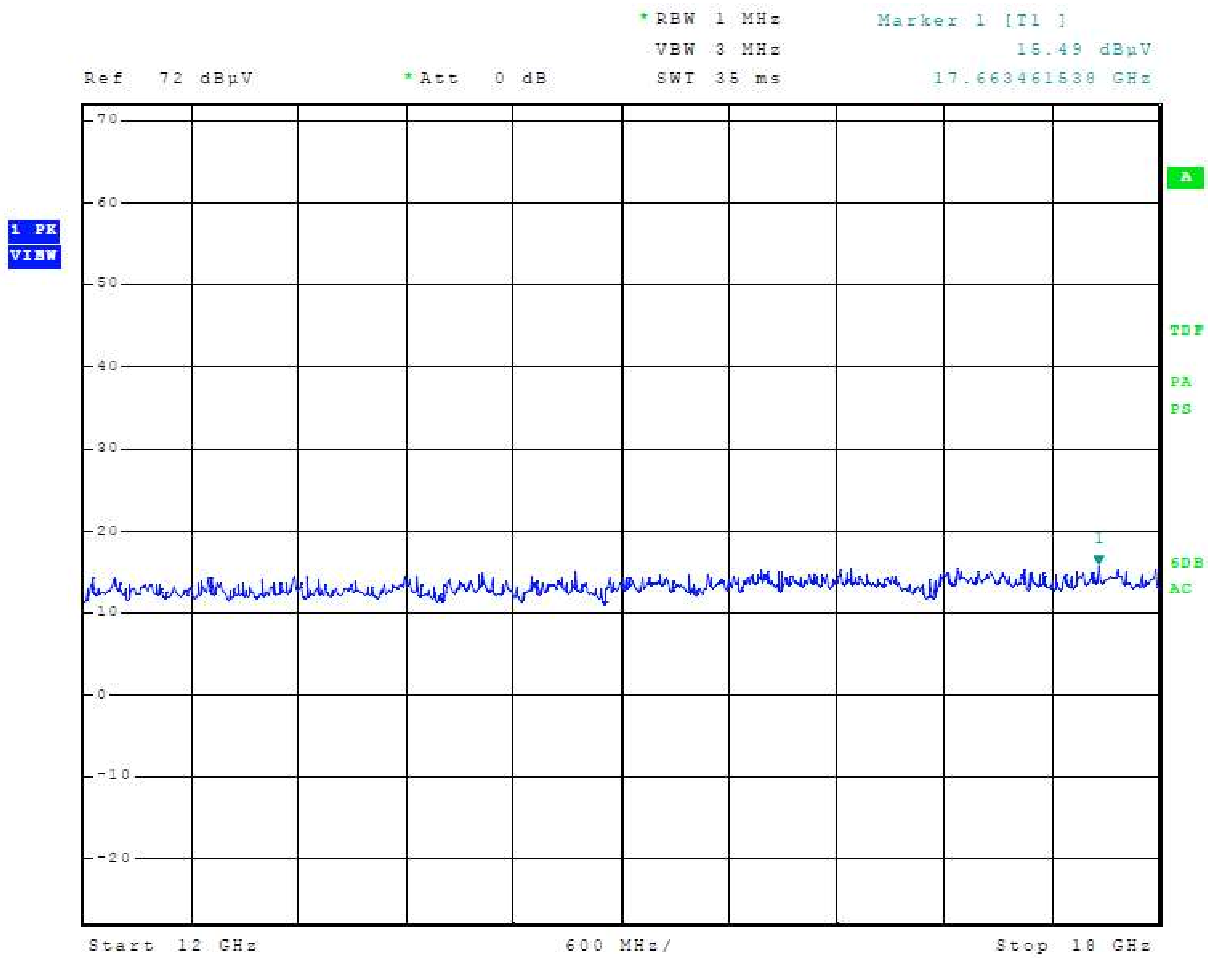


Figure 9 Radiated Emissions Plot taken in screen room (Config #4 / EUT – PC / 18 – 26.5 GHz)

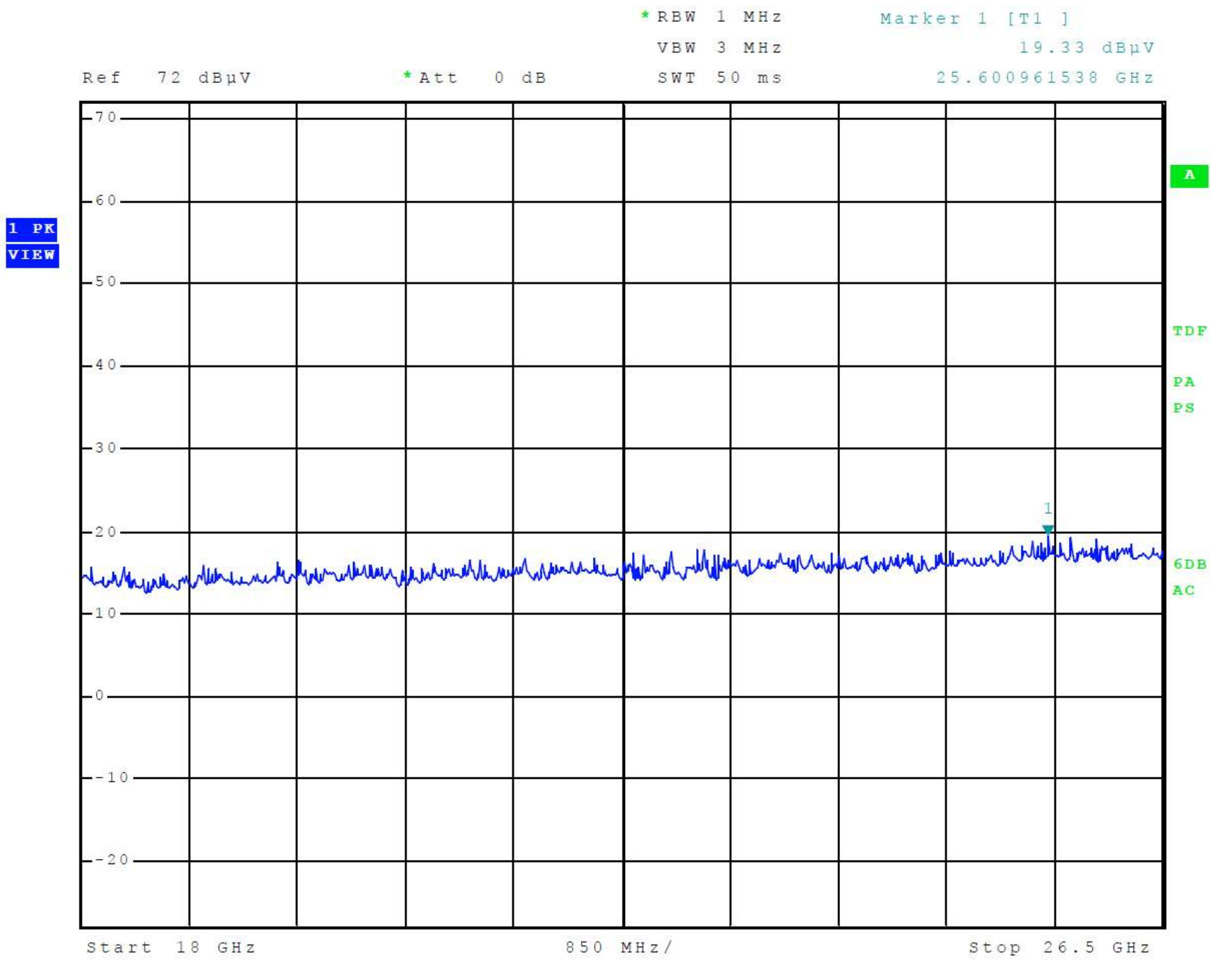


Figure 10 Radiated Emissions Plot taken in screen room (Config #4 / EUT – PC / 26.5 – 40 GHz)

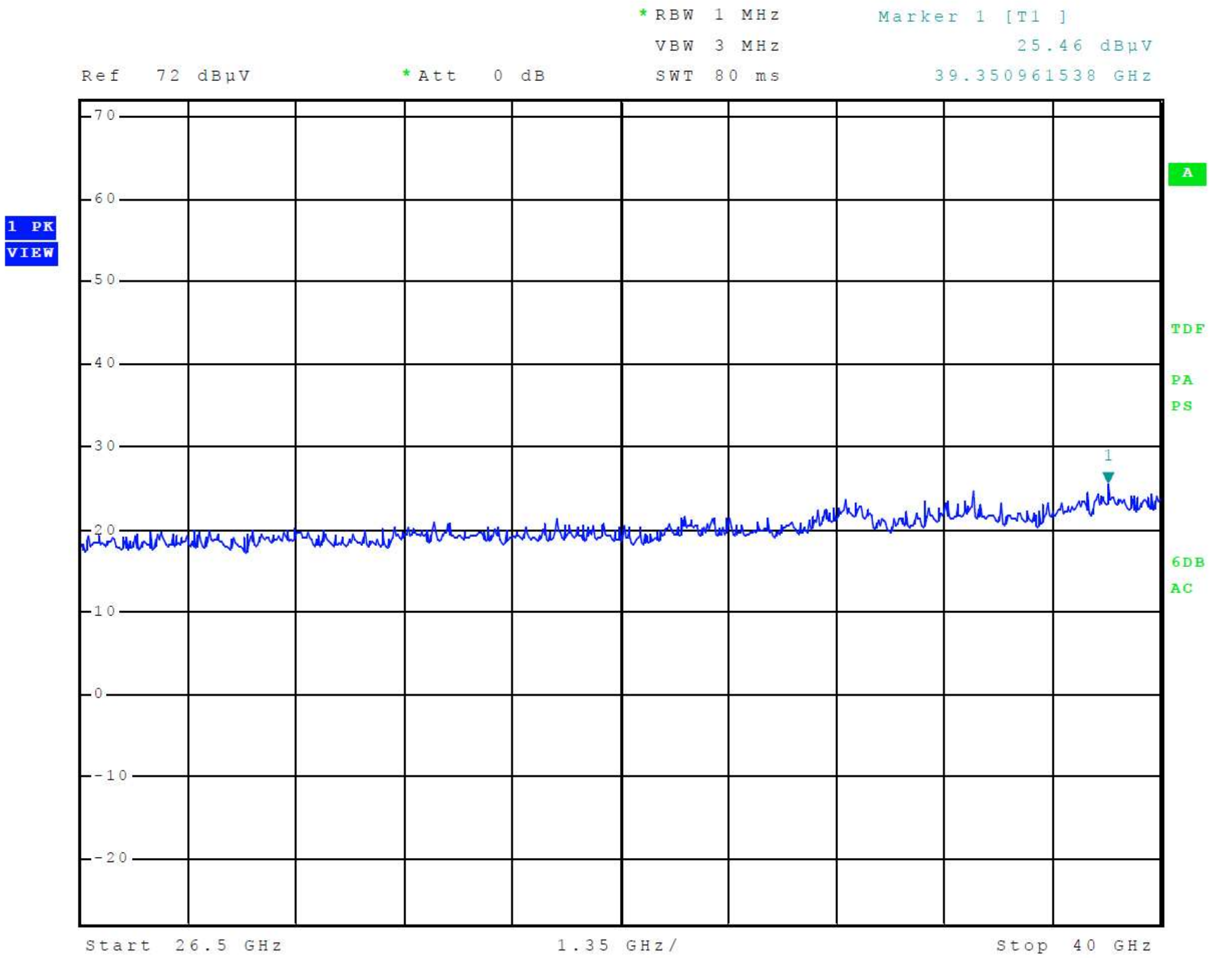


Table 7 General Radiated Emissions Data – Worst Case (Horizontal Polarization)

Frequency (MHz)	Peak (dBµV/m)	Quasi-Peak (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dBm)
267.1	30.8	24.2	47	-22.8
332.1	30.5	23.4	47	-23.6
351.2	32.1	24.1	47	-22.9
399.9	32.8	25.7	47	-21.3
466.6	33.7	26.8	47	-20.2
498.1	34.2	26.5	47	-20.5

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

Table 8 General Radiated Emissions Data – Worst Case (Vertical Polarization)

Frequency (MHz)	Peak (dBµV/m)	Quasi-Peak (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dBm)
266.5	32.8	25.7	47	-21.3
299.7	29.1	23.6	47	-23.5
331.6	30.9	25.1	47	-22.0
466.3	35.9	26.2	47	-20.8
532.6	24.7	17.9	47	-29.1
666.5	37.3	33.7	47	-13.3

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

Summary of Results for General Radiated Emissions

The EUT demonstrated compliance with the radiated emissions requirements of 47 CFR part 15 and Industry Canada RSS-247 Issue 4 Intentional Radiators. The EUT demonstrated a minimum margin of -13.3 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the 5725-5850 MHz Frequency U-NII-3 Bands

Testing followed FCC 789033 D02 General U-NII Test Procedures New Rules v02r01.

The manufacturer provided a second test sample which provided direct connection to the antenna port. A power meter was used to measure fundamental transmitter output power. A spectrum analyzer / receiver was used to produce plots and make other antenna port conducted measurements for compliance testing. Test software was provided to operate the transmitter. This software provided the ability to set test channel, operational mode, and modulation scheme. The antenna port was connected to coaxial cable with 50-ohm attenuator and receiver, spectrum analyzer, or power meter during testing. The design was also tested for radiated emissions using sample EUT Tx Radiated #1 representative of production equipment. Radiated emissions testing was performed on the Open Area Test Site (OATS) or Semi Anechoic Chamber (SAC) with the transmitter operating. The test sample was placed on a turntable elevated as required above the ground plane as required at a 3 meters distance from the FSM antenna located on the OATS or SAC for testing radiated emissions. The peak and quasi-peak amplitude of the frequencies below 1000 MHz were measured using a spectrum analyzer. The peak and average amplitude of emissions above 1000 MHz were measured using a spectrum analyzer. Emissions data was recorded from the measurement results. Data presented reflects measurement result corrected to account for measurement system gains and losses. Plots were made of transmitter performance for reference and demonstration of compliance. In addition, all Manufacturers of U-NII devices are responsible for ensuring frequency stability such that the emissions are maintained within the band of operation under all conditions of normal operation as specified in the user's manual. The manufacturer has attested the equipment operates within the required frequency spectrum under normal operational conditions. This report documents emissions governed under the U-NII-3 bands operating in the 5745-5825 MHz frequency bands.

47CFR 15.407 General Technical Requirements

(a) power limitations

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band

may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(11) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

(12) Power spectral density measurement. The maximum power spectral density is measured as either a conducted emission by direct connection of a calibrated test instrument to the equipment under test or a radiated measurement. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in all other bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.
(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(7) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(8) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(9) The provisions of §15.205 apply to intentional radiators operating under this section.

(10) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

(c) The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signalling information, or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(g) Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

RSS-247 Issue 4

6. Technical requirements for license-exempt local area network devices and digital transmission systems operating in the 5 GHz band

This section provides standards for License-Exempt Local Area Network (LE-LAN) devices operating in the bands 5150-5250 MHz, 5250-5350 MHz, 5470-5600 MHz, 5650-5725 MHz, and 5725-5850 MHz and for DTS's operating in the band 5725-5850 MHz that employ digital modulation technology but are not designed for LE-LAN operation.

Devices with occupied bandwidths which overlap different bands shall comply with all operational requirements for each band.

NVLAP Lab Code 200087-0

Figure 11 Plot of Transmitter Emissions Across 5725-5850 MHz Mode 12 U-NII-3 (802.11a)

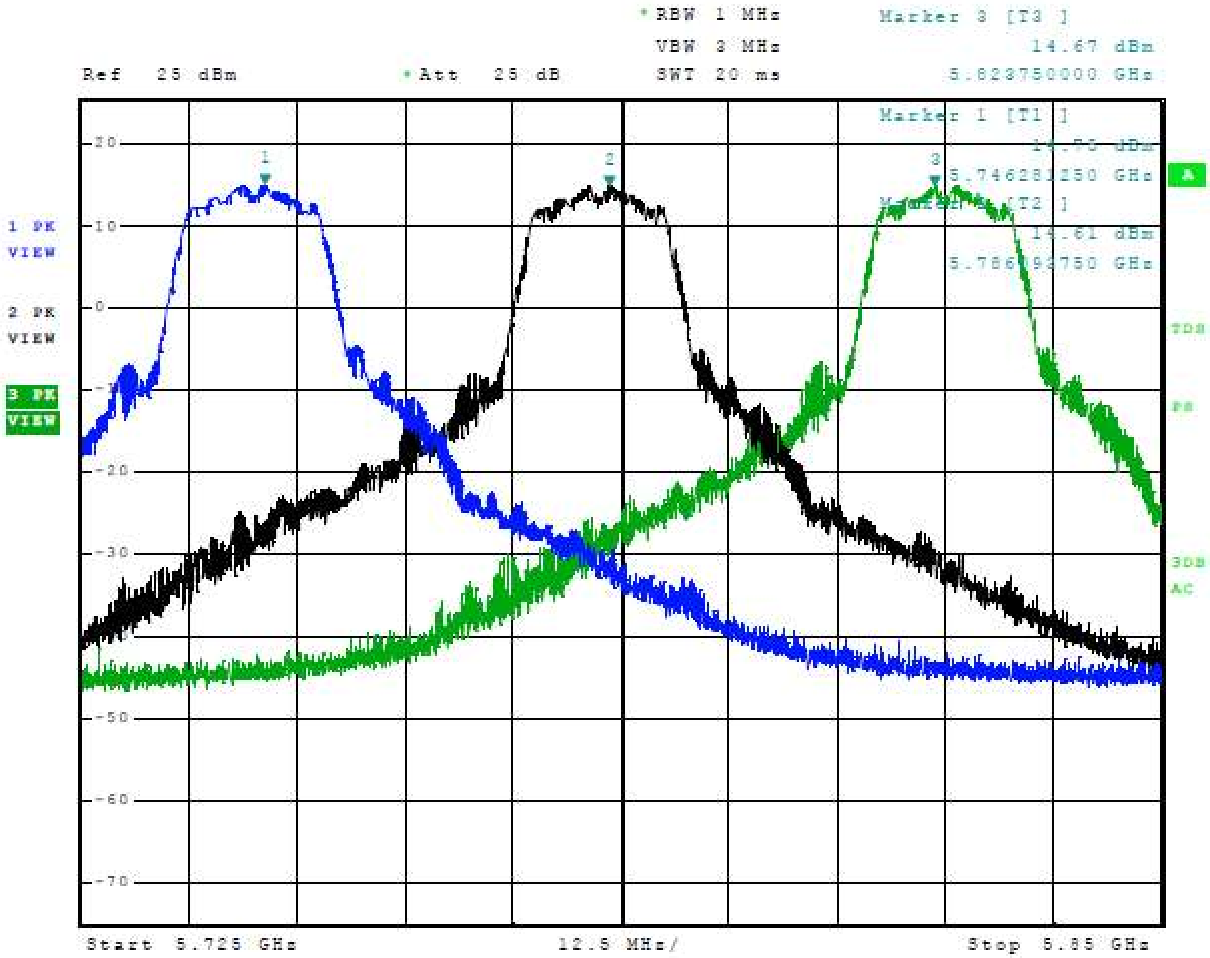


Figure 12 Plot of Transmitter Emissions Across 5725-5850 MHz Mode 13 U-NII-3 (802.11n)

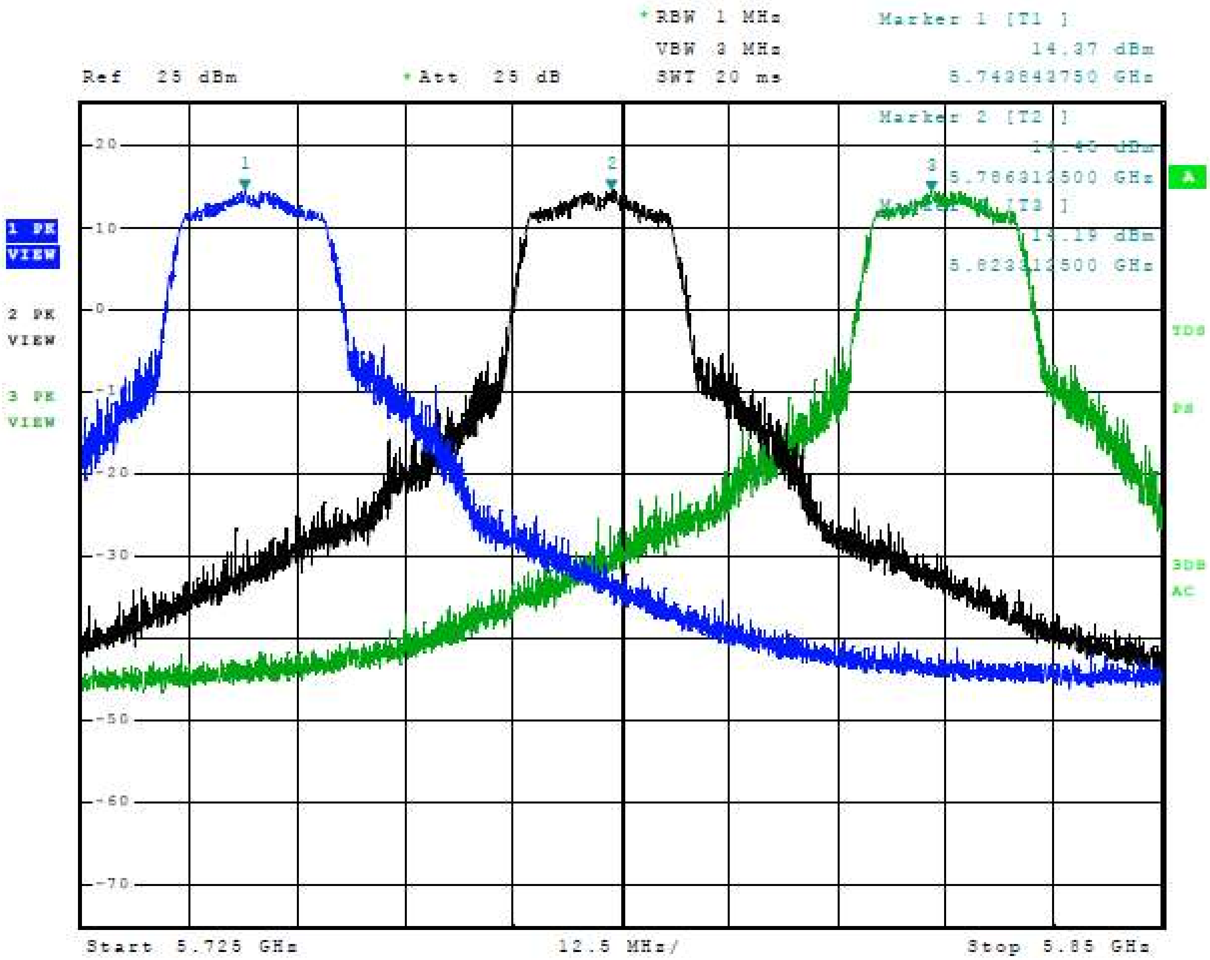
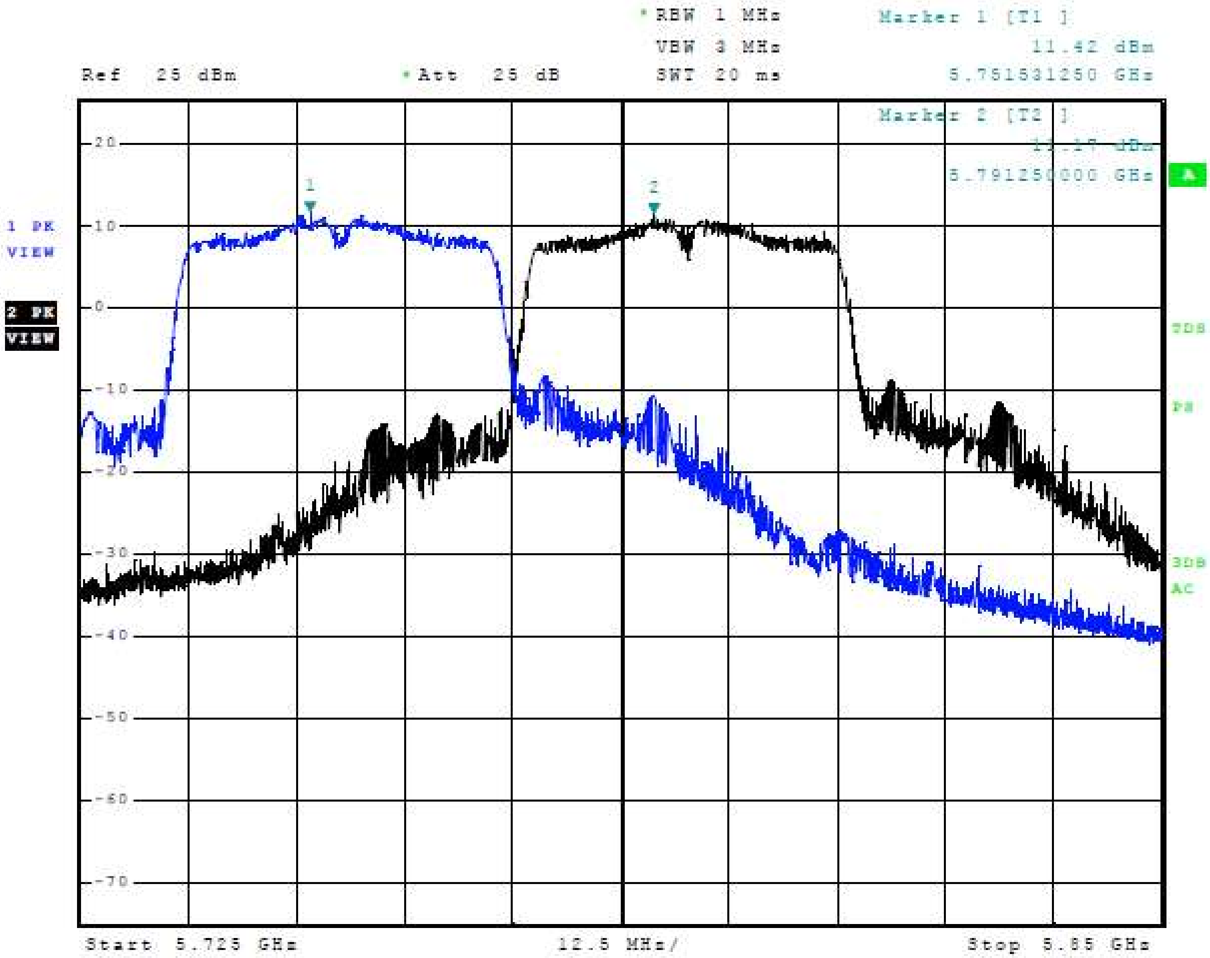


Figure 13 Plot of Transmitter Emissions Across 5725-5850 MHz Mode 14 U-NII-3 (802.11n40)



NVLAP Lab Code 200087-0

Figure 14 Plot of Transmitter Emissions Across 5725-5850 MHz Mode 15 U-NII-3 (802.11ac80)

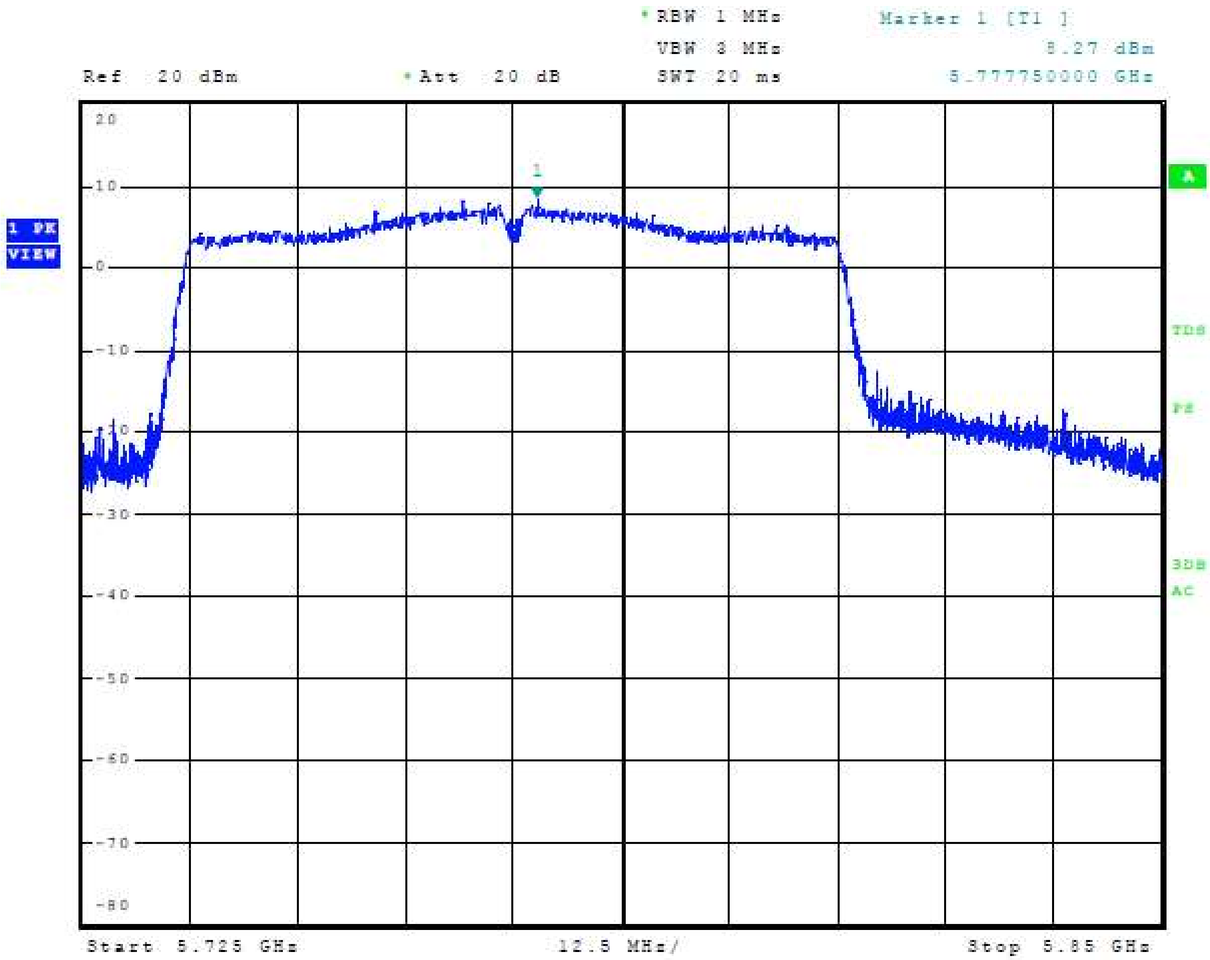


Figure 15 Plot of Lower Band Edge Across 5725-5850 MHz Mode 12 U-NII-3 (802.11a)

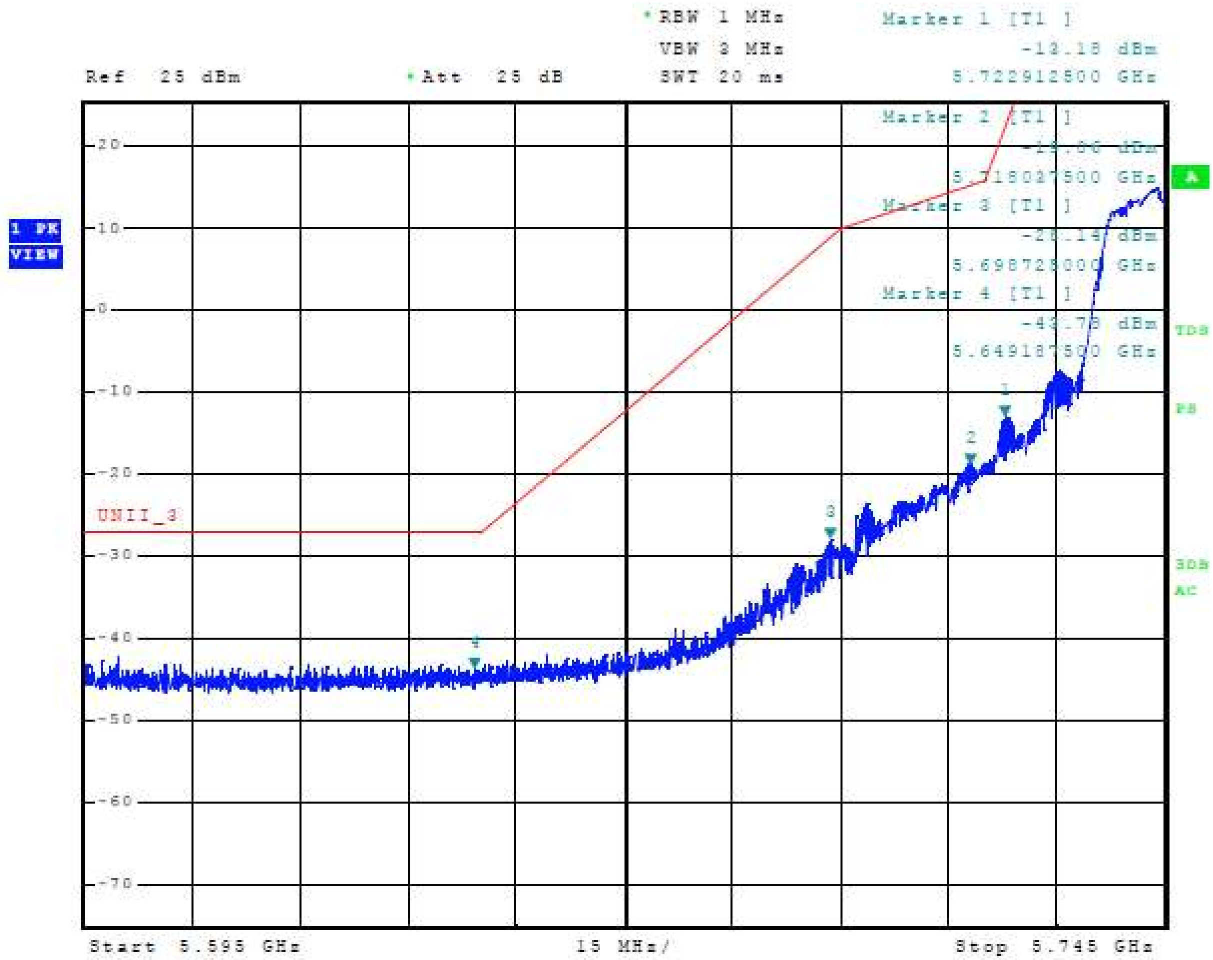
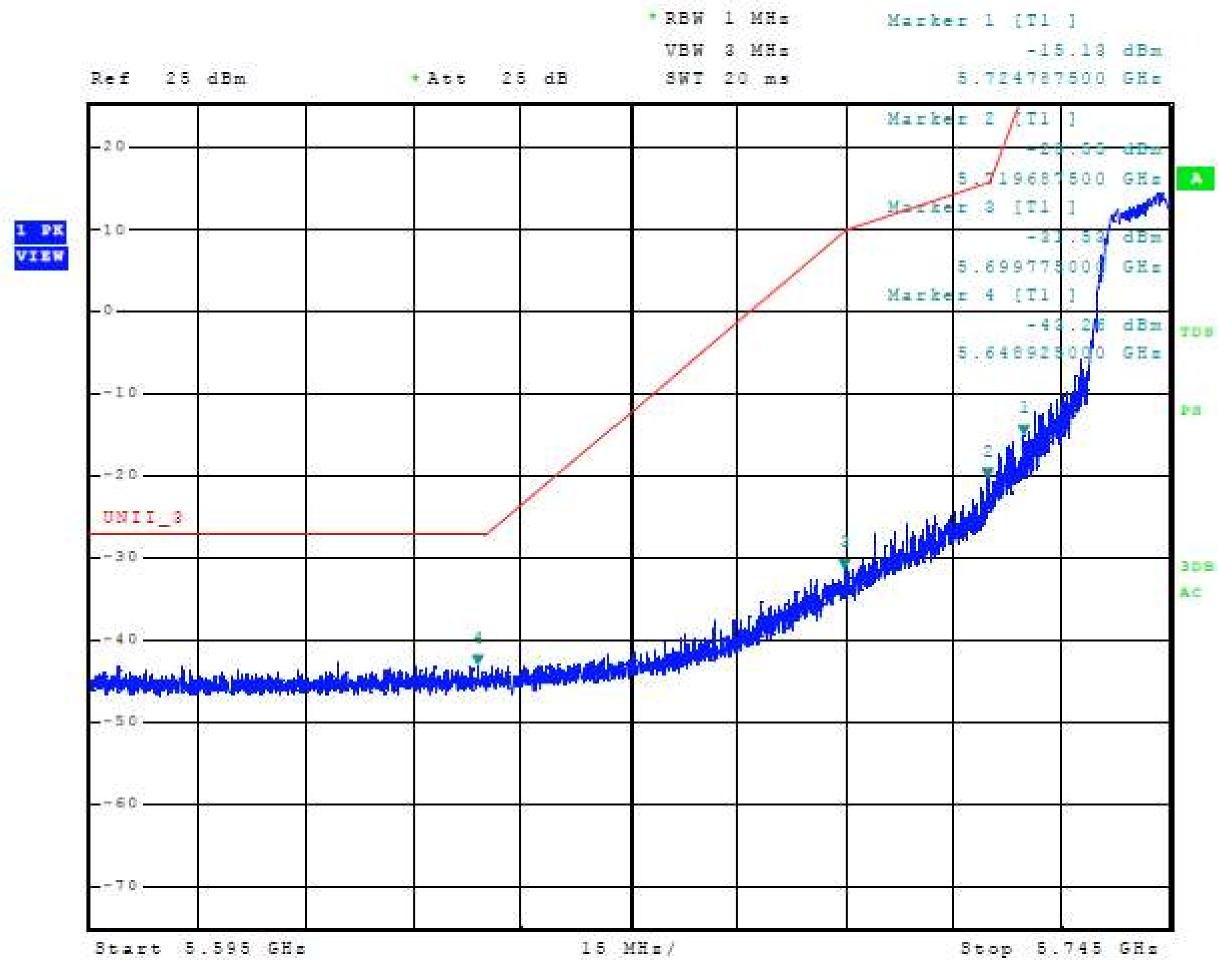


Figure 16 Plot of Lower Band Edge Across 5725-5850 MHz Mode 13 U-NII-3 (802.11n)



NVLAP Lab Code 200087-0

Figure 17 Plot of Lower Band Edge Across 5725-5850 MHz Mode 14 U-NII-3 (802.11n40)

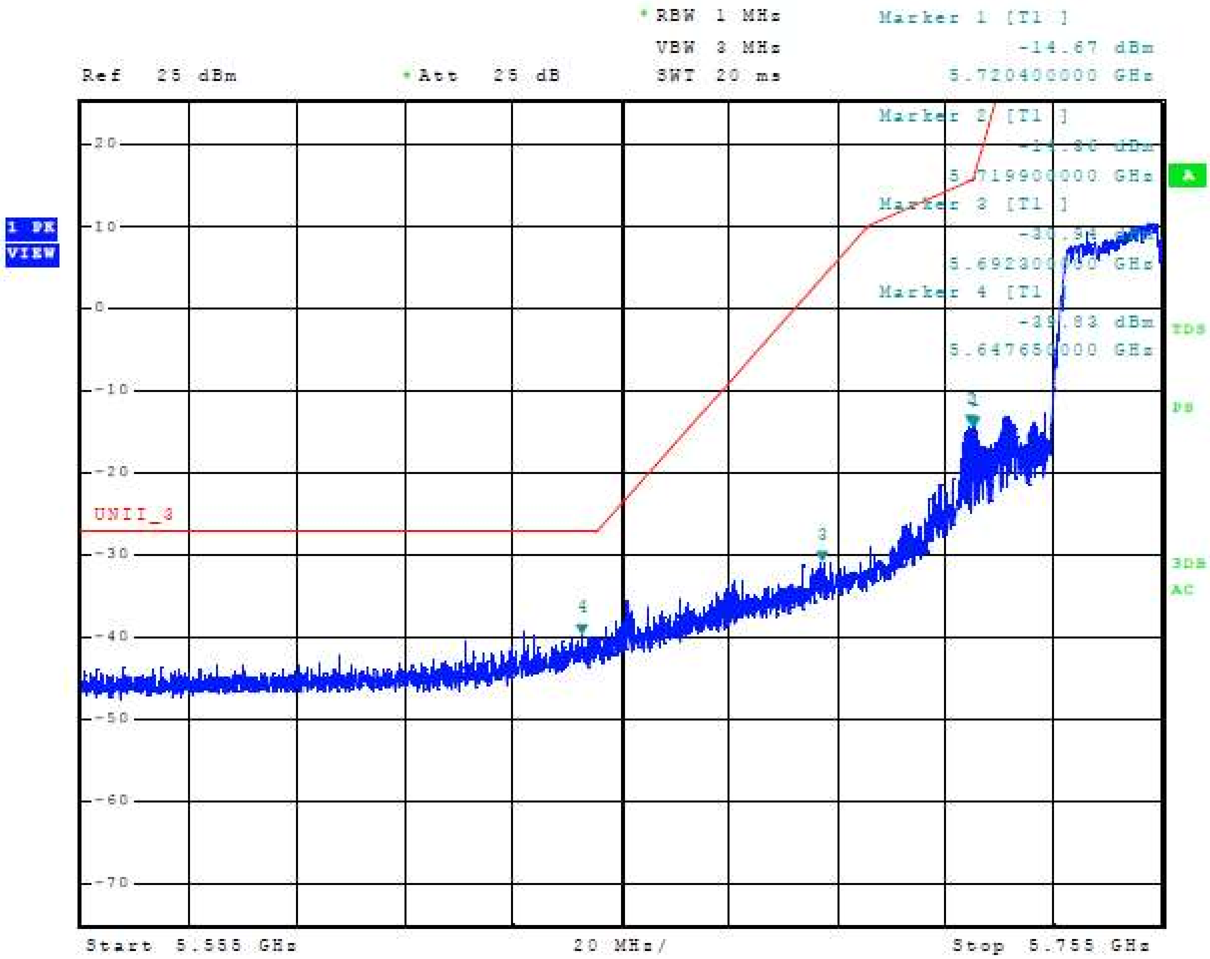


Figure 18 Plot of Lower Band Edge Across 5725-5850 MHz Mode 15 U-NII-3 (802.11ac80)

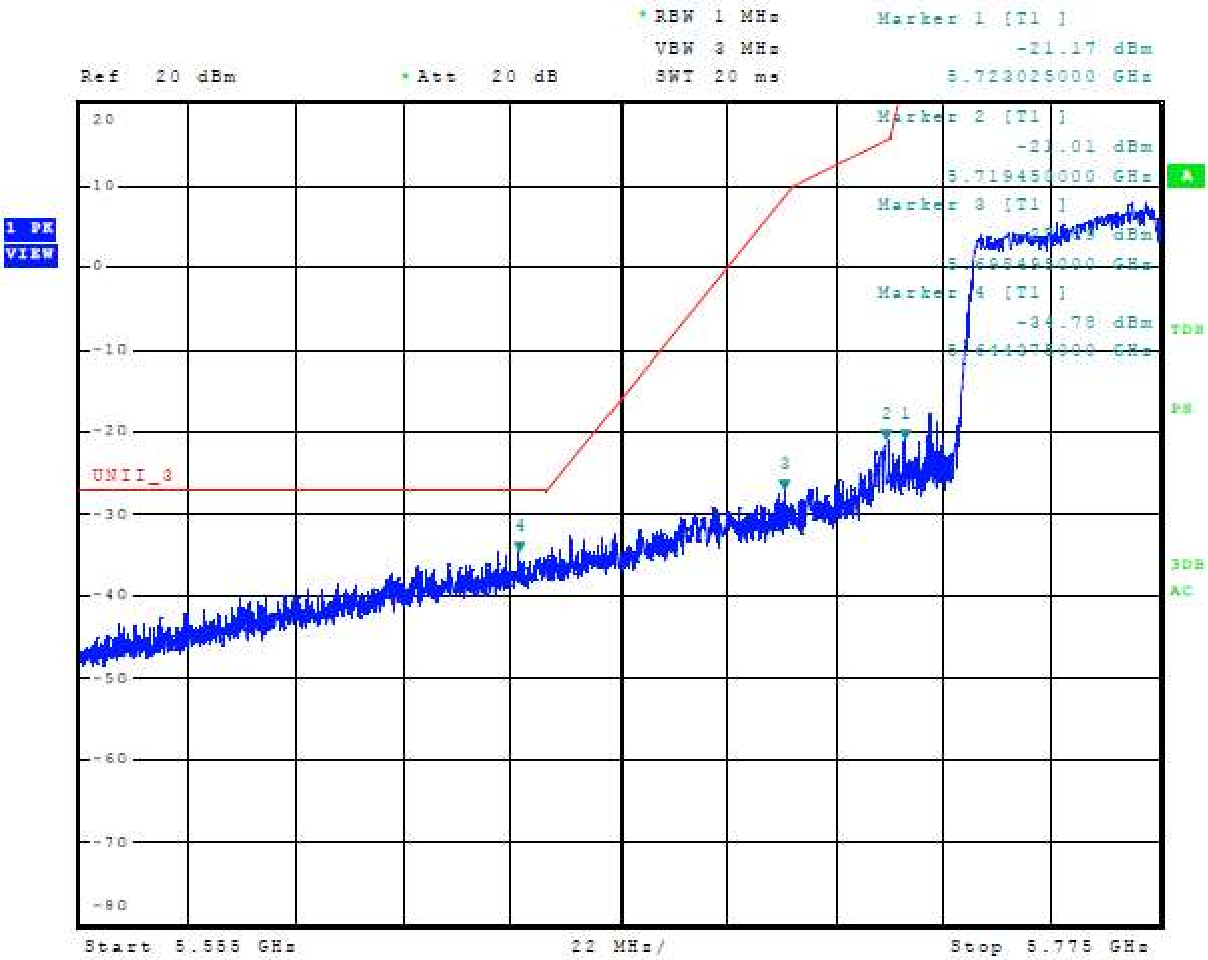


Figure 19 Plot of Upper Band Edge Across 5725-5850 MHz Mode 12 U-NII-3 (802.11a)

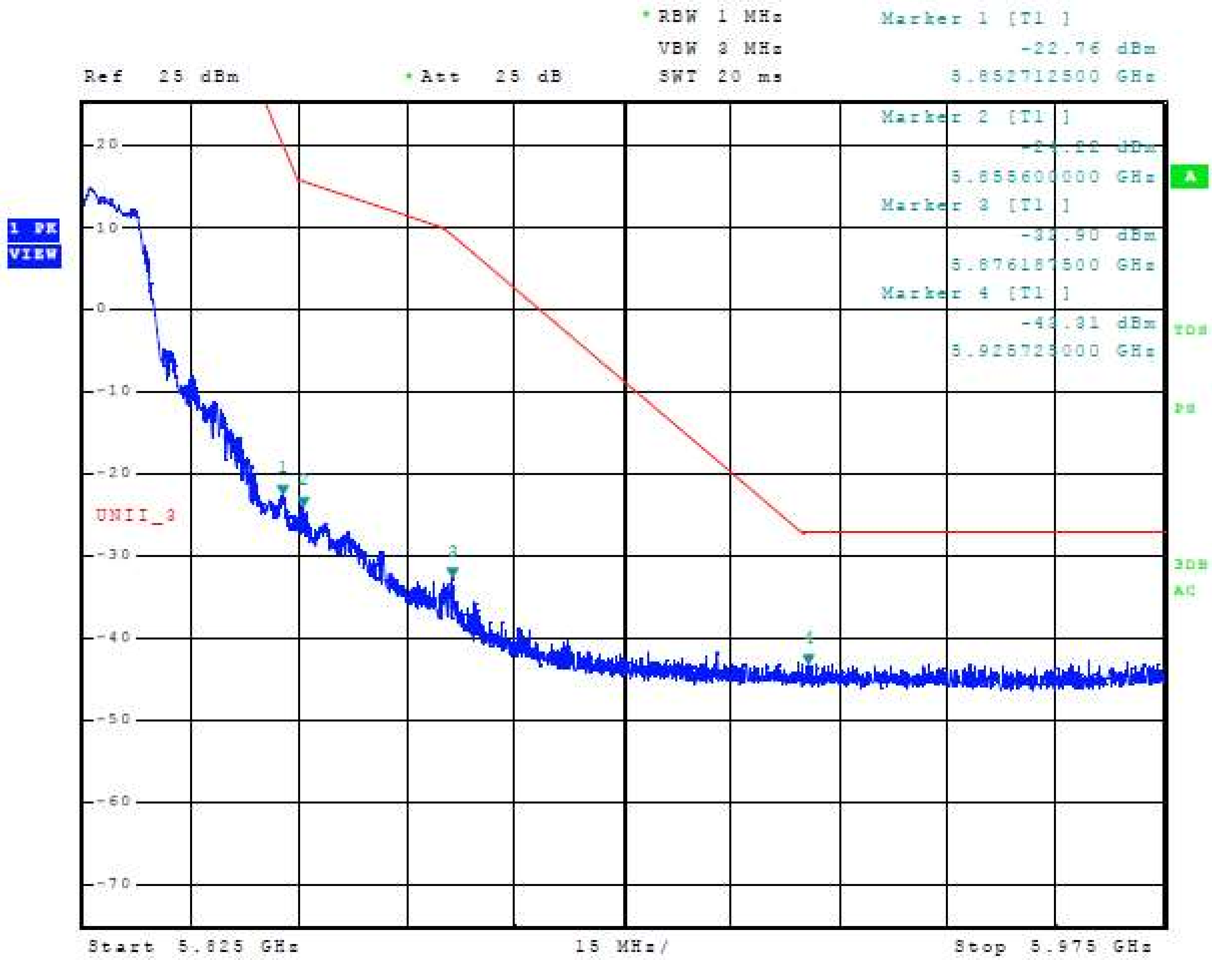


Figure 20 Plot of Upper Band Edge Across 5725-5850 MHz Mode 13 U-NII-3 (802.11n)

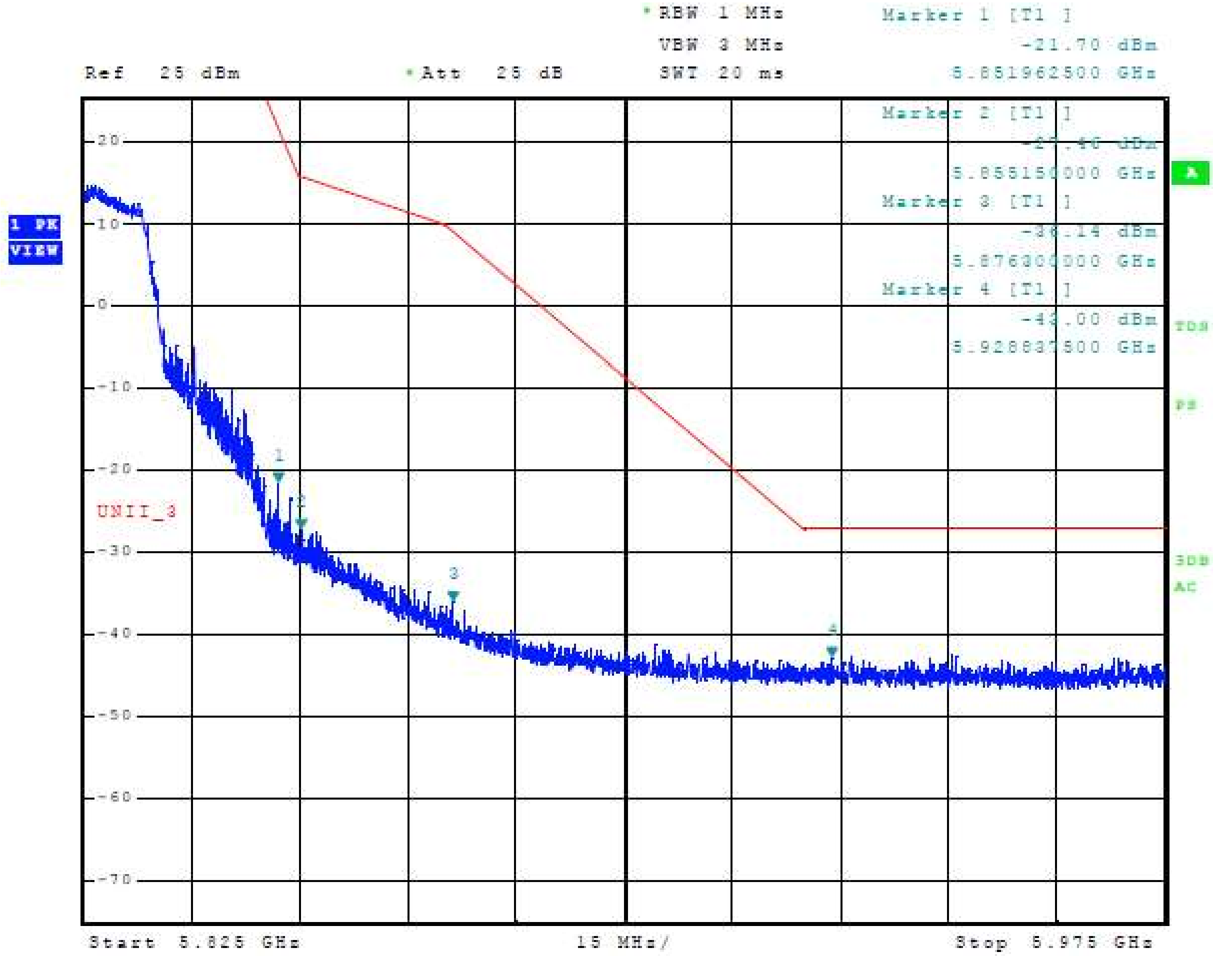


Figure 21 Plot of Upper Band Edge Across 5725-5850 MHz Mode 14 U-NII-3 (802.11n40)

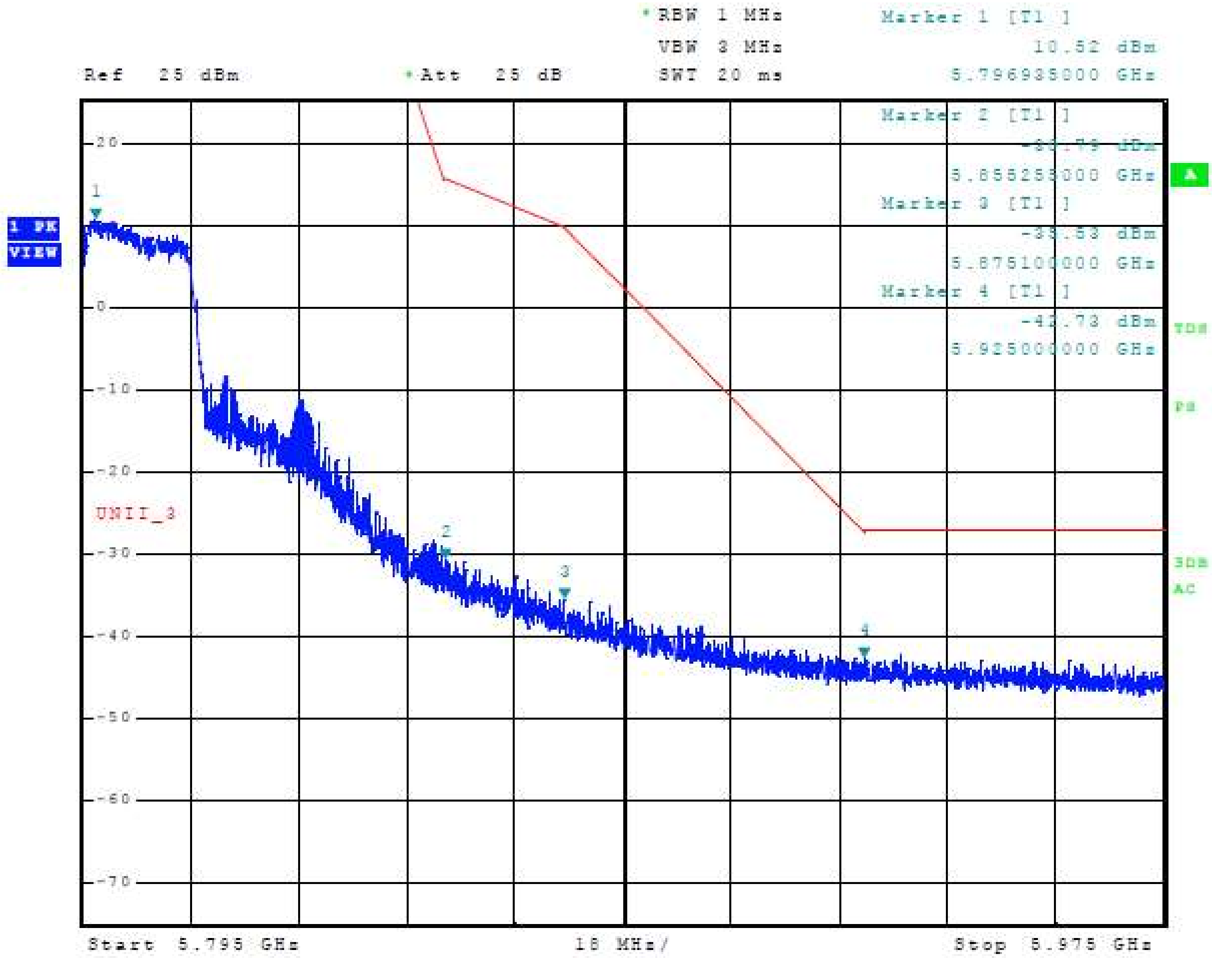


Figure 22 Plot of Upper Band Edge Across 5725-5850 MHz Mode 15 U-NII-3 (802.11ac80)

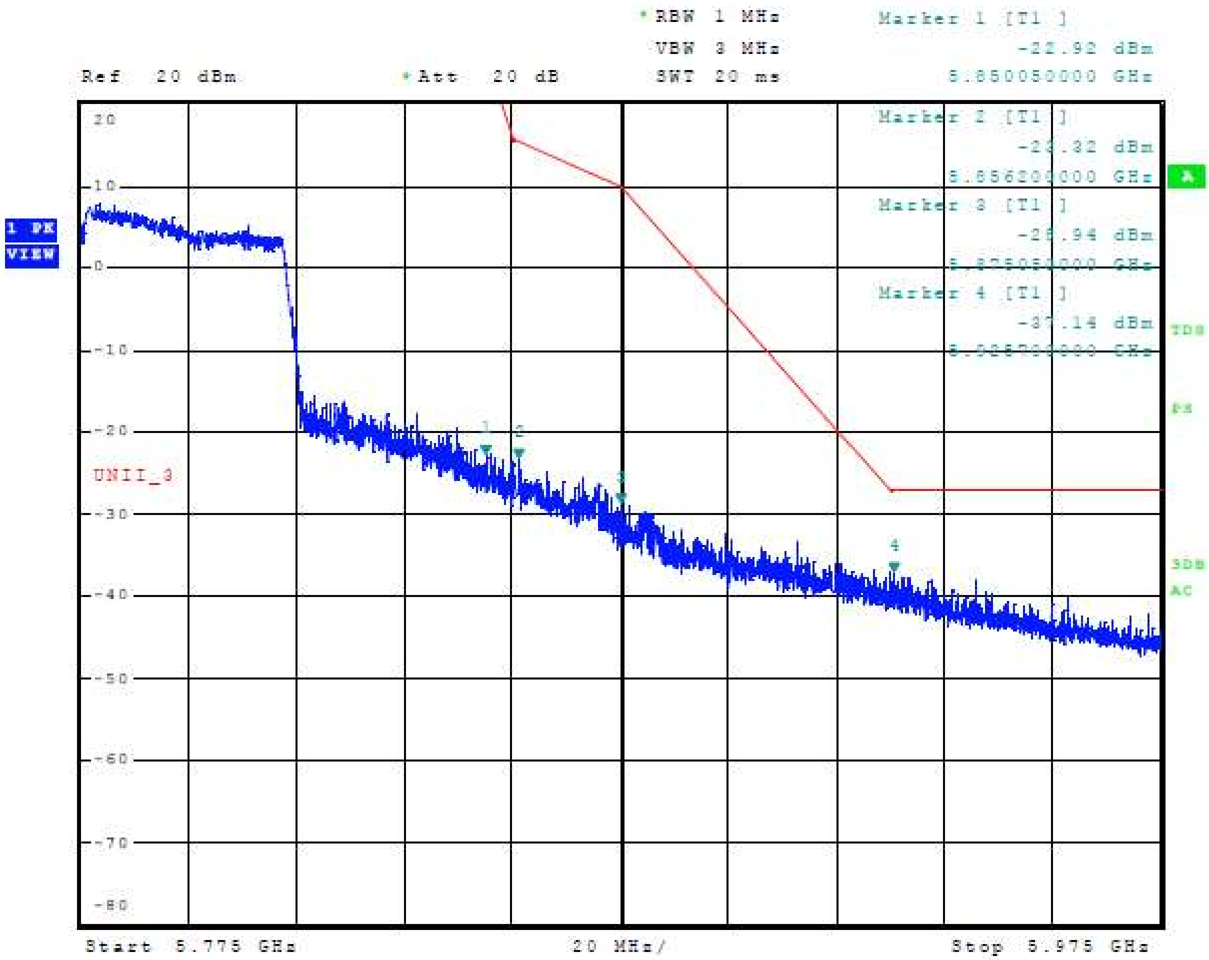


Figure 23 Plot of 99% Occupied Bandwidth 5725-5850 MHz Mode 12 U-NII-3 (802.11a)

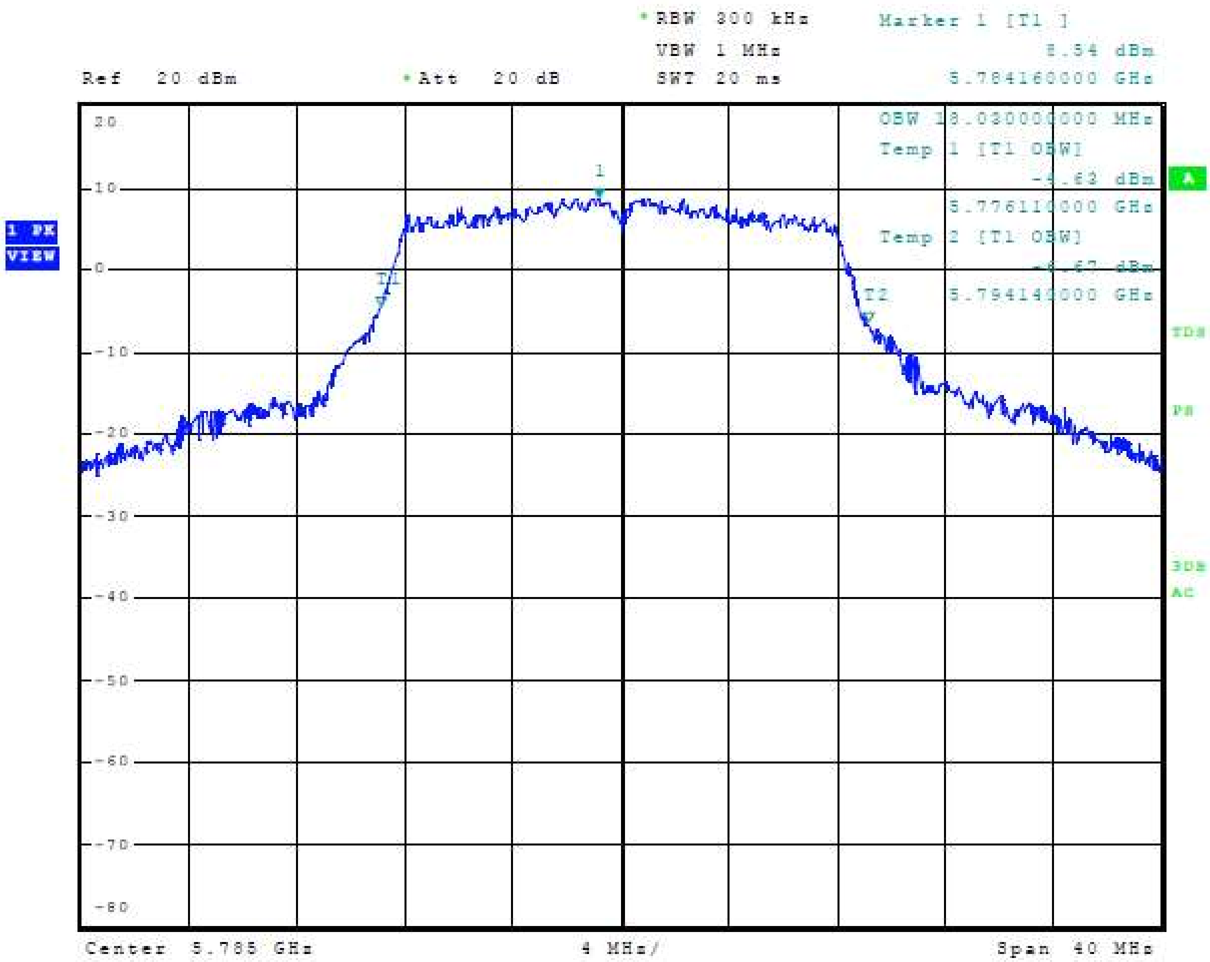


Figure 24 Plot of 99% Occupied Bandwidth 5725-5850 MHz Mode 13 U-NII-3 (802.11n)

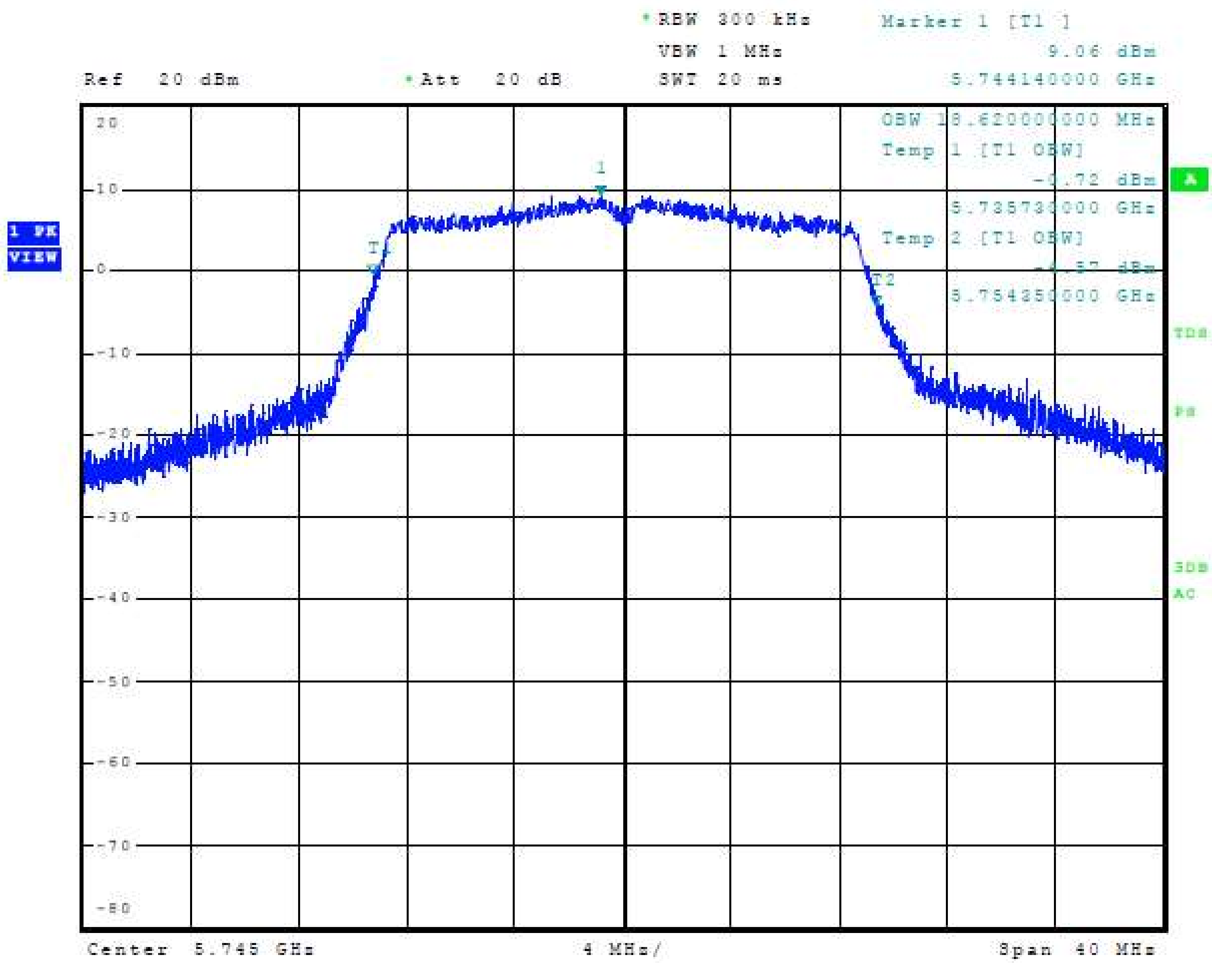
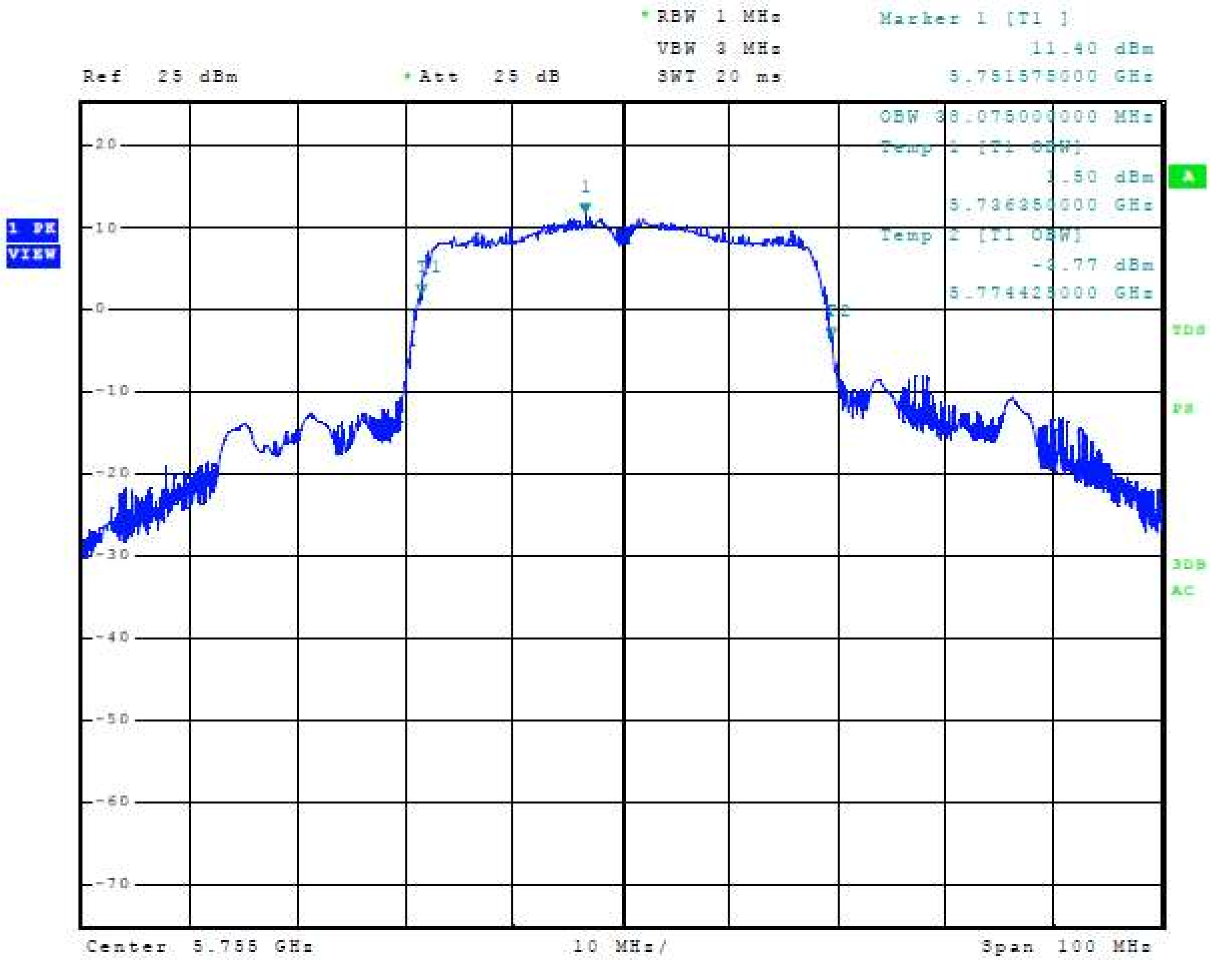


Figure 25 Plot of 99% Occupied Bandwidth 5725-5850 MHz Mode 14 U-NII-3 (802.11n40)



NVLAP Lab Code 200087-0

Figure 26 Plot of 99% Occupied Bandwidth 5725-5850 MHz Mode 15 U-NII-3 (802.11ac80)

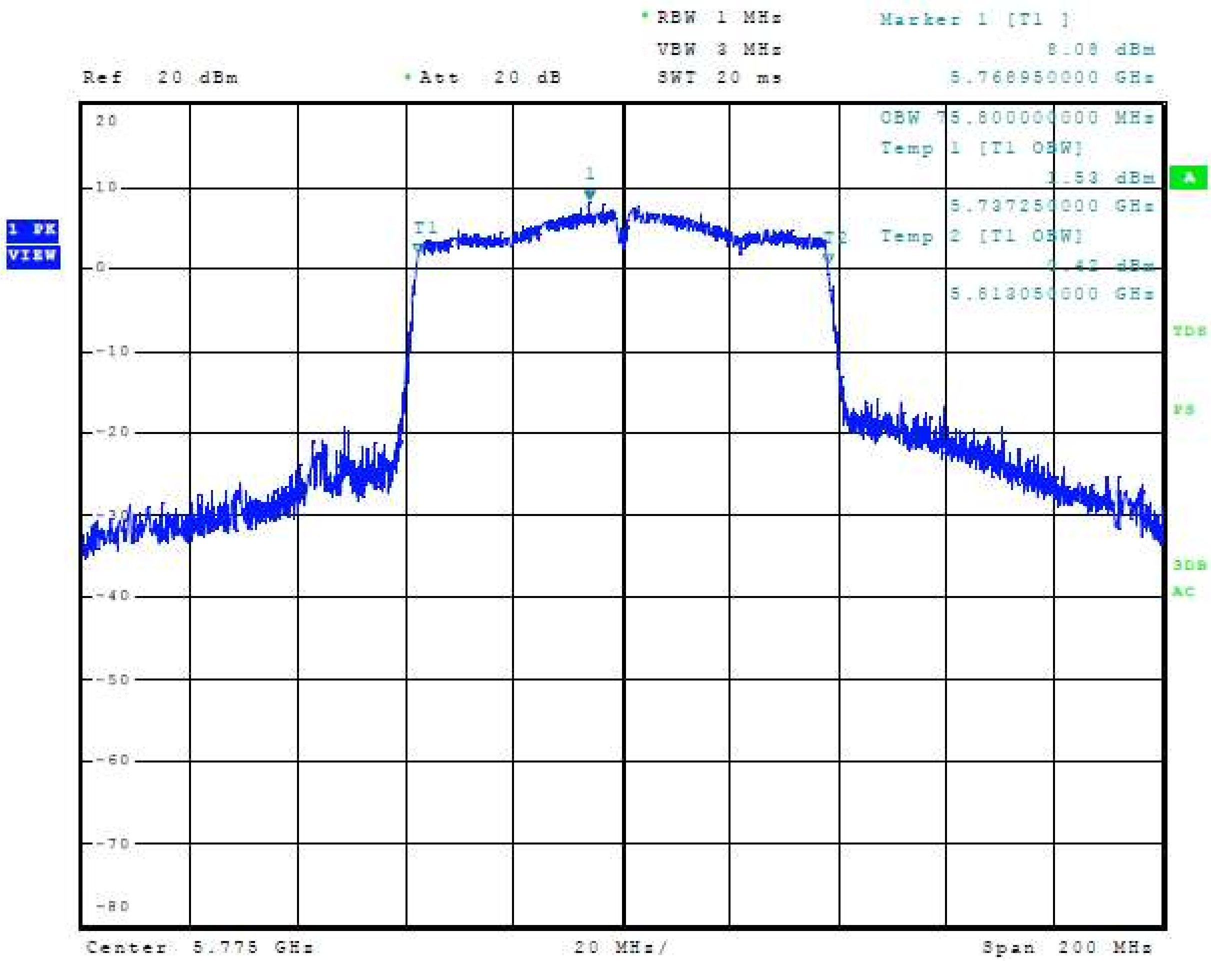


Figure 27 Plot of 6-dB Occupied Bandwidth 5725-5850 MHz Mode 11 U-NII-3 (802.11a)

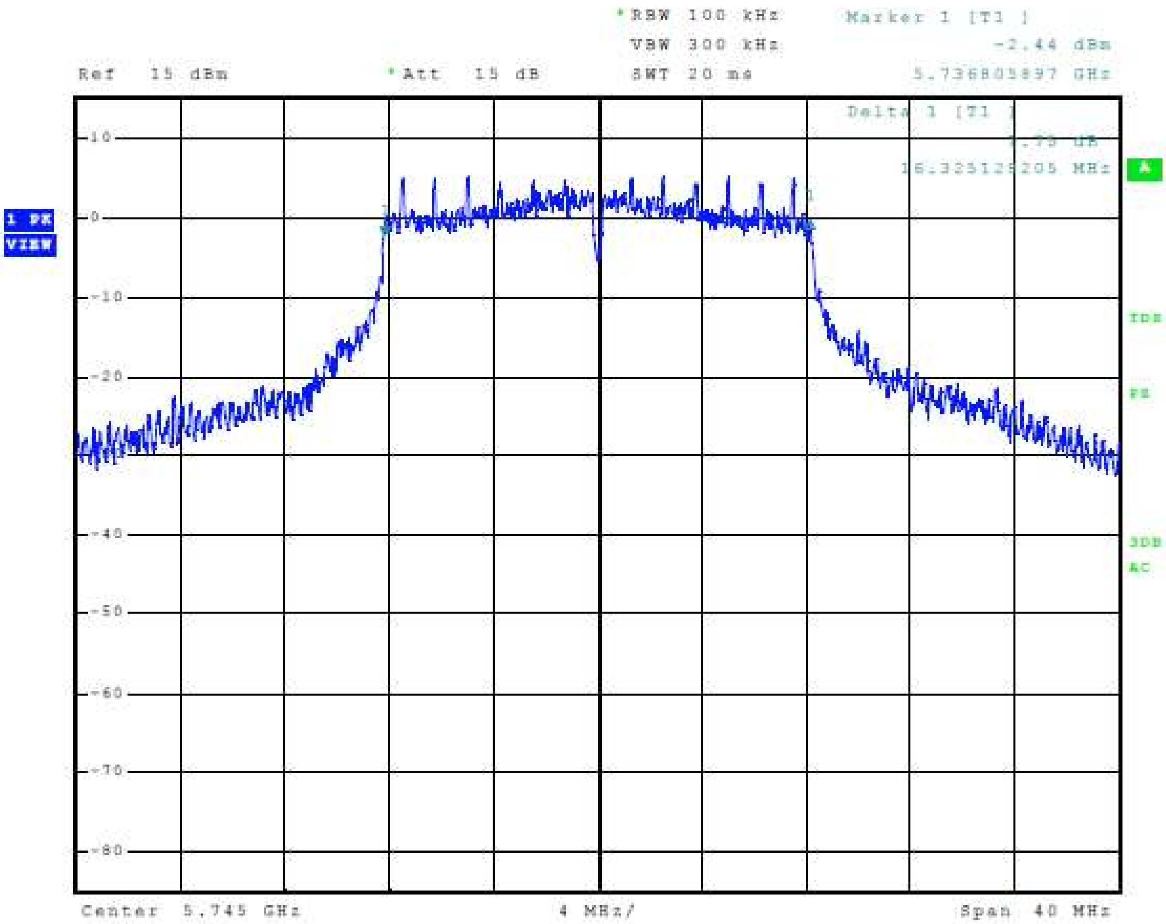
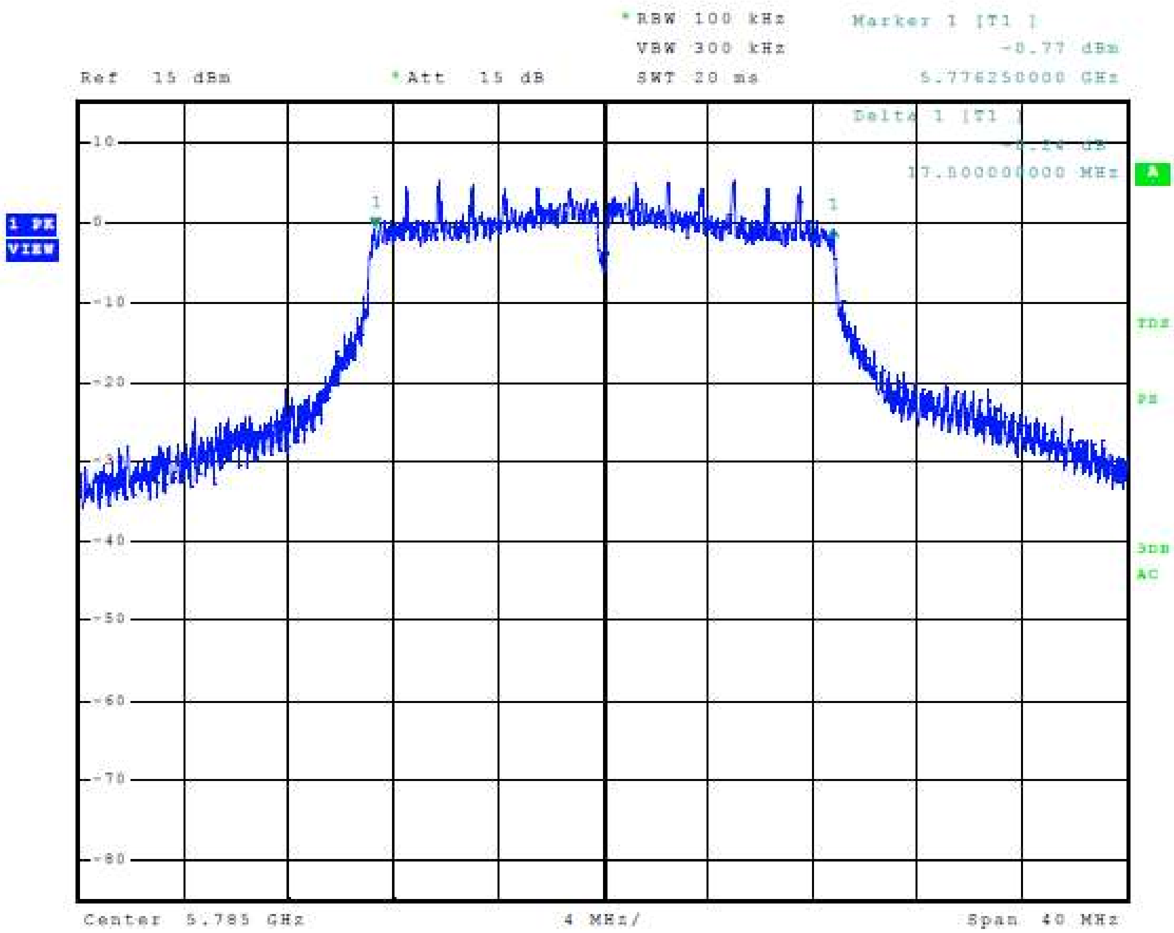


Figure 28 Plot of 6-dB Occupied Bandwidth 5725-5850 MHz Mode 12 U-NII-3 (802.11n)



NVLAP Lab Code 200087-0

Figure 29 Plot of 6-dB Occupied Bandwidth 5725-5850 MHz Mode 13 U-NII-3 (802.11n40)

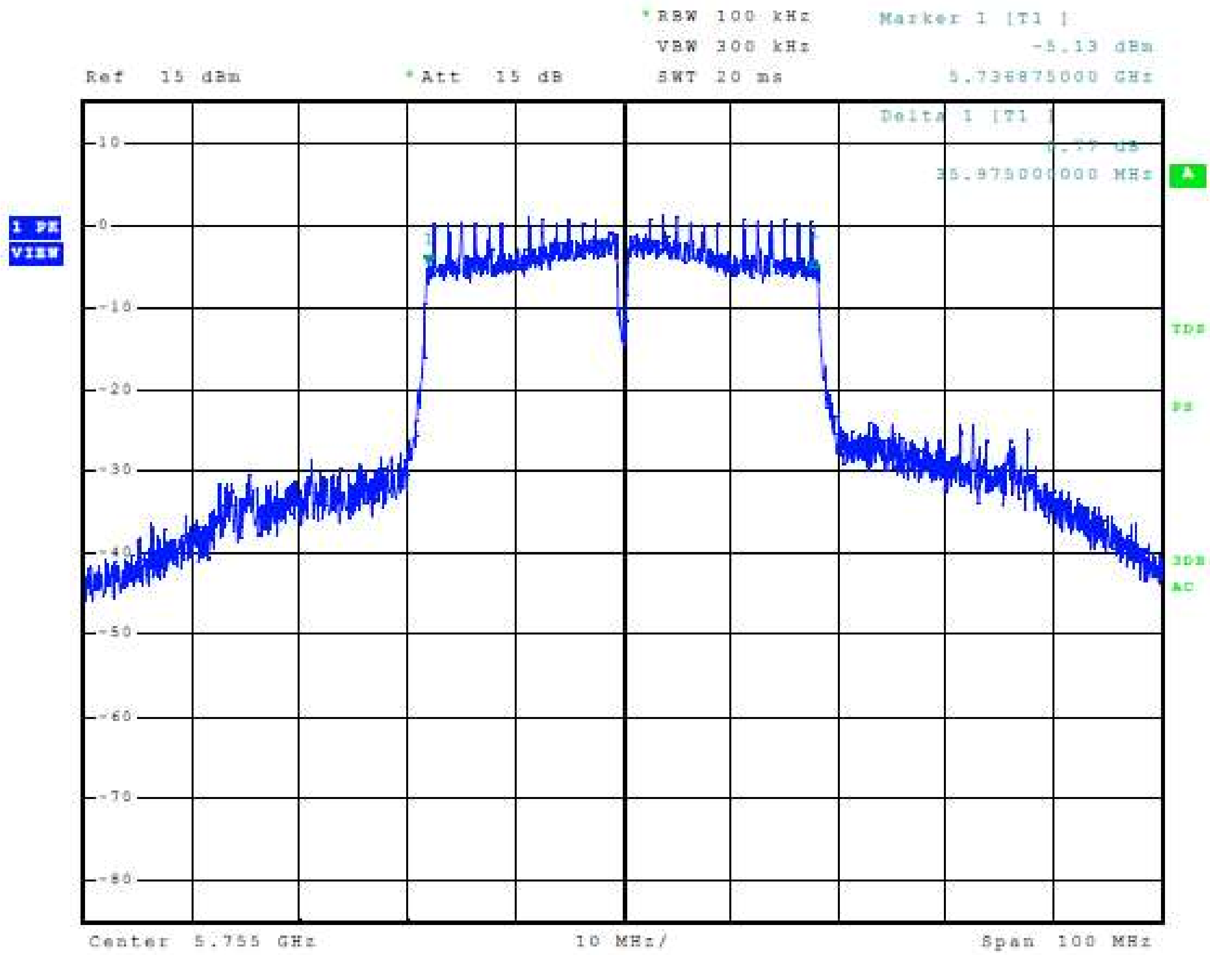


Figure 30 Plot of 6-dB Occupied Bandwidth 5725-5850 MHz Mode 15 U-NII-3 (802.11ac80)

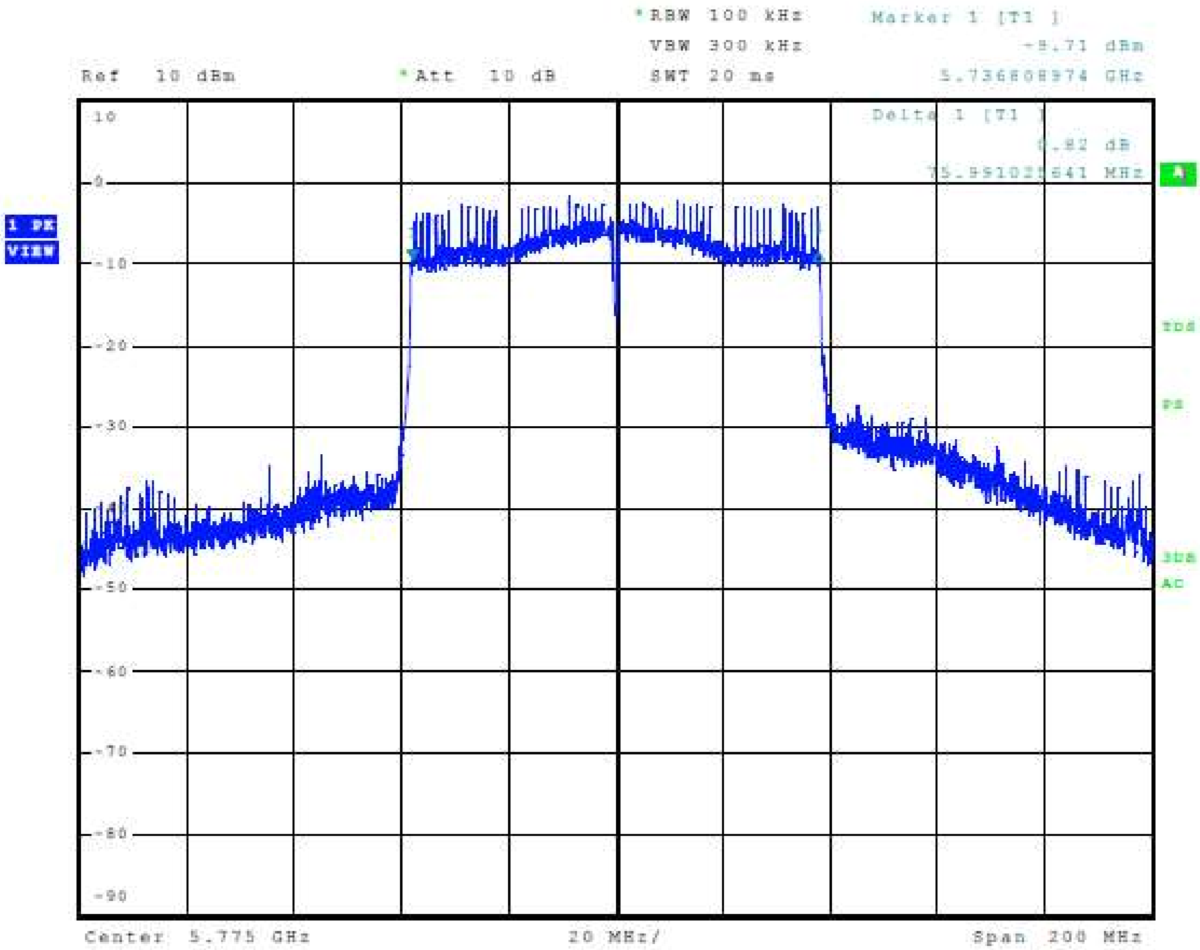


Table 9 Transmitter Radiated Emission 5725-5850 MHz Band, Mode 12 U-NII-3 (802.11a)

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)
5745.0	--	--	--	--	--	--	--
11490.0	57.4	43.8	59.8	43.9	68.3	-24.5	-24.4
17235.0	52.5	48.7	62.4	48.7	68.3	-19.6	-19.6
22980.0	62.0	48.4	61.8	48.4	68.3	-19.9	-19.9
28725.0	64.4	51.2	65.2	51.1	68.3	-17.1	-17.2
5785.0	--	--	--	--	--	--	--
11570.0	57.8	43.7	56.8	43.6	68.3	-24.6	-24.7
17355.0	62.8	48.1	61.2	48.1	68.3	-20.2	-20.2
23140.0	62.5	49.1	63.0	49.1	68.3	-19.2	-19.2
28925.0	64.5	51.4	64.9	51.4	68.3	-16.9	-16.9
5825.0	--	--	--	--	--	--	--
11650.0	57.2	43.8	57.3	43.7	68.3	-24.5	-24.6
17475.0	62.7	48.4	61.8	48.4	68.3	-19.9	-19.9
23300.0	61.9	48.4	62.0	48.5	68.3	-19.9	-19.8
29125.0	64.1	50.5	64.2	50.5	68.3	-17.8	-17.8
Band Edges							
5725.0	76.4	62.1	74.7	59.8	78.2	-16.1	-18.4
5850.0	59.6	44.8	63.7	49.0	78.2	-33.4	-29.2

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 Emission 5725-5850 MHz Band, Mode 13 U-NII-3 (802.11n)

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)
5745.0	--	--	--	--	--	--	--
11490.0	57.3	43.7	57.3	43.5	68.3	-24.6	-24.8
17235.0	61.6	48.4	61.8	48.2	68.3	-19.9	-20.1
22980.0	62.1	48.3	61.6	48.3	68.3	-20.0	-20.0
28725.0	64.3	50.9	64.7	51.1	68.3	-17.4	-17.2
5785.0	--	--	--	--	--	--	--
11570.0	57.8	43.4	57.4	43.6	68.3	-24.9	-24.7
17355.0	62.0	48.0	61.8	48.0	68.3	-20.3	-20.3
23140.0	63.3	49.0	63.9	49.0	68.3	-19.3	-19.3
28925.0	64.1	51.2	65.0	51.2	68.3	-17.1	-17.1
5825.0	--	--	--	--	--	--	--
11650.0	57.0	43.8	57.3	43.7	68.3	-24.5	-24.6
17475.0	61.5	48.4	61.6	48.3	68.3	-19.9	-20.0
23300.0	61.4	48.5	62.3	48.4	68.3	-19.8	-19.9
29125.0	63.7	50.3	63.9	50.3	68.3	-18.0	-18.0
Band Edges							
5725.0	75.2	58.4	75.2	59.0	78.2	-19.8	-19.2
5850.0	64.5	48.8	63.4	47.9	78.2	-29.4	-30.3

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 Emission 5725-5850 MHz Band, Mode 14 U-NII-3 (802.11n40)

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)
5755.0	--	--	--	--	--	--	--
11510.0	57.4	44.0	57.1	43.9	68.3	-24.3	-24.4
17265.0	61.5	48.2	62.2	48.2	68.3	-20.1	-20.1
23020.0	62.7	48.9	62.5	48.9	68.3	-19.4	-19.4
28775.0	65.6	52.1	65.7	52.0	68.3	-16.2	-16.3
5795.0	--	--	--	--	--	--	--
11590.0	57.5	43.8	57.3	43.8	68.3	-24.5	-24.5
17385.0	61.2	47.7	61.4	47.7	68.3	-20.6	-20.6
23180.0	62.6	48.9	62.6	48.9	68.3	-19.4	-19.4
28975.0	65.3	51.7	64.9	51.7	68.3	-16.6	-16.6
Band Edges							
5725.0	69.1	51.6	73.2	55.6	78.2	-26.6	-22.6
5850.0	61.1	45.0	59.6	44.1	78.2	-33.2	-34.1

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 12 Transmitter Radiated Emission 5725-5850 MHz Band, Mode 15 U-NII-3 (802.11ac80)

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)
5775.0	--	--	--	--	--	--	--
11550.0	57.1	43.7	57.2	43.5	68.3	-24.6	-24.8
17325.0	61.6	47.5	61.2	47.7	68.3	-20.8	-20.6
23100.0	62.3	49.3	62.5	48.8	68.3	-19.0	-19.5
28875.0	64.9	51.5	65.1	50.8	68.3	-16.8	-17.5
Band Edges							
5725.0	69.5	53.0	67.6	50.9	78.2	-25.2	-27.3
5850.0	65.5	49.4	62.2	46.3	78.2	-28.8	-31.9

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

Table 13 Transmitter Antenna Port Data Modes 12-15 (U-NII-3)

Frequency MHz	Antenna Port Conducted Average Output Power (Watts)	99% Occupied Bandwidth (kHz)	6-dB Occupied Bandwidth (kHz)	Peak Power Spectral Density (dBm/500kHz)
20 MHz Mode 12 U-NII-3 (802.11a)				
5745	0.043	17,930.0	16,325.1	11.0
5785	0.042	18,030.0	16,314.1	10.8
5825	0.041	17,980.0	16,289.5	10.9
20 MHz Mode 13 U-NII-3 (802.11n)				
5745	0.042	18,620.0	17,490.0	11.4
5785	0.041	18,397.5	17,500.0	11.1
5825	0.041	18,590.0	17,480.0	11.8
40 MHz Mode 14 (802.11n40) U-NII-3				
5755	0.034	38,075.0	37,975.0	7.3
5795	0.034	36,525.0	36,009.6	7.2
80 MHz Mode 15 U-NII-3 (802.11ac80)				
5775	0.030	75,800.0	75,991.0	4.3

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47 CFR Part 15.407 and Industry Canada RSS-247 Issue 4. The maximum average conducted power delivered to antenna was 0.043-Watts in the U-NII-3 Band. The radiated harmonic emissions provided a minimum margin of -16.2 dB below requirements. There were no other significantly measurable emissions in the restricted bands other than those presented 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 Additional Test Equipment
- Annex C Rogers Labs Certificate of Accreditation

Annex A Measurement Uncertainty Calculations

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

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

Annex B Test Equipment

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ LISN	FCC	FCC-LISN-50-25-10(1PA) (160611)	.15-30MHz	3/20/2025	3/20/2026
☐ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(303073)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☐ Cable	Belden	RG-58 (L2-CAT3-11509)	9kHz-30 MHz	9/16/2024	9/16/2025
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/16/2024	9/16/2025
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/16/2024	9/16/2025
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/16/2024	9/16/2025
☐ Antenna	ETS-Lindgren	3147 (40582)	200-1000MHz	9/16/2024	9/16/2026
☒ Antenna	ETS-Lindgren	3117 (200389)	1-18 GHz	3/17/2025	3/17/2027
☒ Antenna	Com Power	AH-118 (10110)	1-18 GHz	9/16/2024	9/16/2026
☒ Antenna	Com Power	AH-1840 (101046)	18-40 GHz	3/17/2025	3/17/2027
☒ Analyzer	Rohde & Schwarz	ESU40 (100108)	20Hz-40GHz	7/9/2025	7/9/2026
☒ Analyzer	Rohde & Schwarz	ESW44 (101534)	20Hz-44GHz	1/21/2025	1/21/2026
☐ Analyzer	Rohde & Schwarz	FS-Z60, 90, 140, and 220	40GHz-220GHz	12/22/2017	12/22/2027
☐ Amplifier	Com-Power	PA-010 (171003)	100Hz-30MHz	9/16/2024	9/16/2025
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/16/2024	9/16/2025
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/16/2024	9/16/2025
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/26/2023	9/26/2025
☒ Generator	Rohde & Schwarz	SMBV100A6 (260771)	20Hz-6 GHz	3/19/2025	3/19/2026
☐ RF Filter	Micro-Tronics	BRC50722 (009).9G notch	30-18000 MHz	3/21/2025	3/21/2026
☐ RF Filter	Micro-Tronics	HPM50117 (063) 3G HPF	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRM50702 (172) 2G notch	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRC50703 (G102) 5G notch	30-18000 MHz	3/21/2025	3/21/2026
☒ RF Filter	Micro-Tronics	BRC50705 (024) 5G notch	30-18000 MHz	3/21/2025	3/21/2026
☐ Attenuator	Fairview	SA6NFNF100W-40 (1625)	30-18000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1445)	30-6000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-3W2+ (1735)	30-6000 MHz	3/21/2025	3/21/2026
☒ Attenuator	Mini-Circuits	VAT-6W2+ (1438)	30-6000 MHz	3/21/2025	3/21/2026
☒ Weather station	Davis	6152 (A70927D44N)		11/4/2024	11/4/2025

Equipment	Manufacturer	Model (SN)	Band	Cal Date(m/d/y)	Due
☒ Frequency Counter: Leader		LDC-825 (8060153)		3/19/2025	3/19/2026
☐ ISN	Com-Power	Model ISN T-8 (600111)		3/19/2025	3/19/2026
☐ LISN:	Com-Power	Model LI-220A		9/16/2024	9/16/2026
☒ LISN:	Com-Power	Model LI-550C		9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(4M)(281184)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/16/2024	9/16/2025
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/16/2024	9/16/2025
☒ Cable	Mini-Circuits	KBL-2M-LOW+ (23090329)	9kHz-40 GHz	3/22/2025	3/22/2026
☒ Analyzer	HP	8562A (3051A05950)	9kHz-125GHz	3/20/2025	3/20/2026
☐ Antenna:	Solar	9229-1 & 9230-1		2/5/2025	2/5/2026
☐ CDN:	Com-Power	Model CDN M325E		9/16/2024	9/16/2026
☐ Oscilloscope Scope: Tektronix		MDO 4104		2/5/2025	2/5/2026
☐ EMC Transient Generator HVT		TR 3000		2/5/2025	2/5/2026
☐ AC Power Source (Ametech, California Instruments)				2/5/2025	2/5/2026
☒ Field Intensity Meter: EFM-018				2/5/2025	2/5/2026
☒ ESD Simulator: MZ-15				2/5/2025	2/5/2026
☐ Injection Clamp Luthi Model EM101				not required	
☐ R.F. Power Amp ACS 230-50W				not required	
☐ R.F. Power Amp EIN Model: A301				not required	
☐ R.F. Power Amp A.R. Model: 10W 1010M7				not required	
☐ R.F. Power Amp A.R. Model: 50U1000				not required	
☒ Temperature Chamber				not required	
☒ Shielded Room				not required	

Annex C Laboratory Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 200087-0

Rogers Labs, a division of The Compatibility Center LLC
Lenexa, 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 on ISO/IEC 17025).

2025-03-11 through 2026-03-31
Effective Dates

For the National Voluntary Laboratory Accreditation Program

RF Exposure Lab
802 N. Twin Oaks Valley Road, Suite 105 • San Marcos, CA 92069 • U.S.A.
TEL (760) 471-2100 • FAX (760) 471-2121
http://www.rfexposurelab.com

CERTIFICATE OF COMPLIANCE
SAR EVALUATION

Garmin International, Inc.	Dates of Test:		July 1-2, 2025
1200 E. 151st Street	Test Report Number:		SAR.20250701
Olathe, KS 66062			Revision D
		Lab Designation Number:	US1195

FCC ID:	IPH-B4281
Model(s):	B04281
Marketing Name:	B04281
Test Sample:	Engineering Unit Same as Production
Serial Number:	Eng 1
Equipment Type:	Portable Digital Transceiver
Classification:	Portable Transmitter Next to Body
TX Frequency Range:	2412 – 2462 MHz; 5745 – 5825 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	2450 MHz (b) – 16.50 dBm, 2450 MHz (g) – 16.50 dBm, 2450 MHz (n20) – 16.50 dBm, 5800 MHz (a) – 16.50 dBm, 5800 MHz (n20/40) – 16.00 dBm, 5800 MHz (ac80) – 16.00 dBm, 2450 MHz (BT) – 6.00 dBm Conducted
Signal Modulation:	DSSS, OFDM, GFSK
Antenna Type:	Internal Antenna (2.4 GHz Inverted F 5.24 dBi Gain, 5 GHz Loop 0.08 dBi Gain)
Application Type:	Certification
FCC Rule Parts:	Part 2, 15C, 15E
KDB Test Methodology:	KDB 447498 D01 v06, KDB 248227 v02r02
Maximum SAR Value:	1.29 W/kg Reported
Maximum Simultaneous Value:	1.44 W/kg Reported
Separation Distance to Probe:	0 mm

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for controlled environment/occupational limits specified in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields, IEEE Std.1528 – 2013 Recommended Practice and had been tested in accordance with the measurement procedures specified in KDB 447498 and KDB 248227 (See test report).

I attest to the accuracy of the data. All measurements were performed by myself or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RF Exposure Lab, LLC certifies that no party to this application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

Jay M. Moulton
Vice President

ACCREDITED
Testing Cert. # 2387.01

Table of Contents

Comment/Revision	Date
Original Release	July 3, 2025
Revision A – Editorial changes and correct tune up tolerance	October 7, 2025
Revision B – Correct BT/BLE maximum tune up power	October 10, 2025
Revision C – Change equipment type	October 10, 2025
Revision D – Increase BT/BLE tune up to 6 dBm and change BT/BLE technology to GFSK on page 4	October 14, 2025

Note: The latest version supersedes all previous versions listed in the above table. The latest version shall be used.

1. Introduction

This measurement report shows compliance of the Garmin International, Inc. Model B04281 FCC ID: IPH-B4281 with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices. The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices. [1]

The test results recorded herein are based on a single type test of Garmin International, Inc. Model B04281 and therefore apply only to the tested sample.

The test procedures, as described in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields, IEEE Std.1528 – 2013 Recommended Practice, KDB 447498 and KDB 248227 were employed.

The following table indicates all the wireless technologies operating in the B04281 Digital Transmission System Transceiver. The table also shows the tolerance for the power level for each mode.

Band	Technology	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
WLAN – 2.4 GHz	802.11b	N/A	N/A	16.50
WLAN – 2.4 GHz	802.11g	N/A	N/A	16.50
WLAN – 2.4 GHz	802.11n20	N/A	N/A	16.50
WLAN – 5 GHz	802.11a	N/A	N/A	16.50
WLAN – 5 GHz	802.11n20/n40	N/A	N/A	16.00
WLAN – 5 GHz	802.11ac80	N/A	N/A	16.00
Bluetooth – 2.4 GHz	GFSK	N/A	N/A	6.00

SAR Definition [5]

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (*dW*) absorbed by (dissipated in) an incremental mass (*dm*) contained in a volume element (*dV*) of a given density (ρ).

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right)$$

SAR is expressed in units of watts per kilogram (W/kg). *SAR* can be related to the electric field at a point by

$$SAR = \frac{\sigma \mid E \mid^2}{\rho}$$

where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

E = rms electric field strength (V/m)

2. SAR Measurement Setup

Robotic System

These measurements are performed using the DASY52 automated dosimetric assessment system. The DASY52 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Intel Core2 computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

System Hardware

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the HP Intel Core2 computer with Windows XP system and SAR Measurement Software DASY52, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

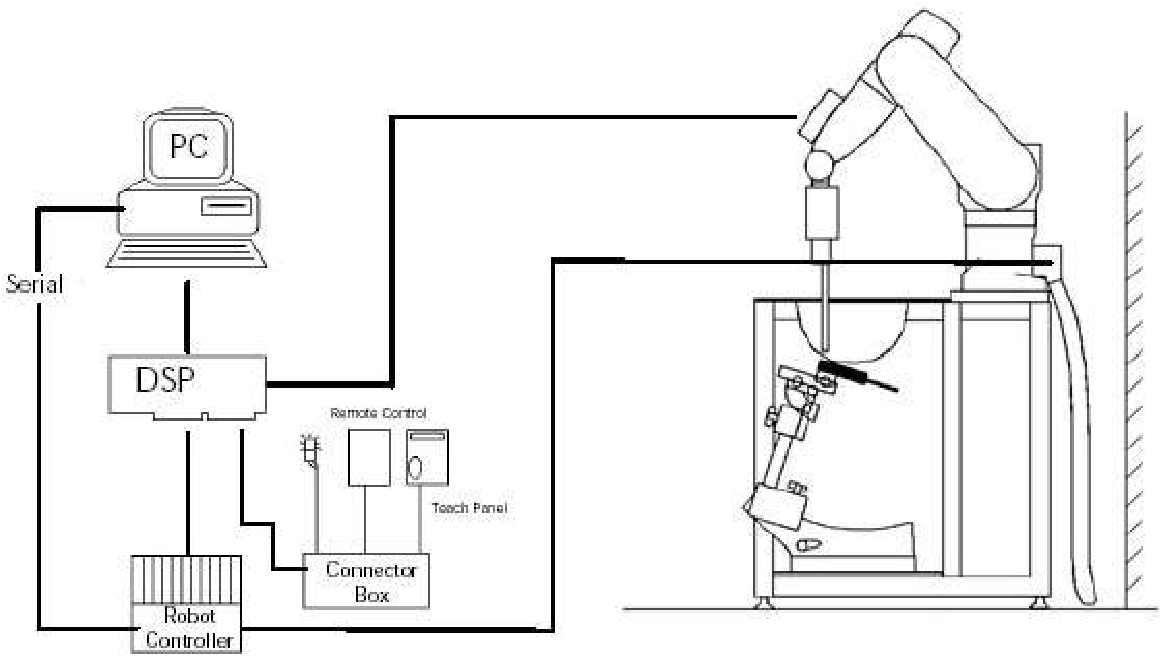


Figure 2.1 SAR Measurement System Setup

System Electronics

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

Probe Measurement System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 2.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip. (see Fig. 2.3) It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY52 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

DAE System

Probe Specifications

Calibration: In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of 450 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz

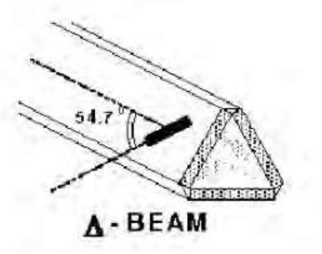


Figure 2.2 Triangular Probe Configurations

Frequency: 10 MHz to 6 GHz

Linearity: ±0.2dB (30 MHz to 6 GHz)

Dynamic: 10 mW/kg to 100 W/kg

Range: Linearity: ±0.2dB

Dimensions: Overall length: 330 mm

Tip length: 20 mm

Body diameter: 12 mm

Tip diameter: 2.5 mm

Distance from probe tip to sensor center: 1 mm

Figure 2.3 Probe Thick-Film Technique

Application: SAR Dosimetry Testing
Compliance tests of wireless device

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/-10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm^2.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor based temperature probe is used in conjunction with the E-field probe

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

$$\text{SAR} = \frac{|E|^2 \cdot \sigma}{\rho}$$

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to ΔT / Δt , the initial rate of tissue heating, before thermal diffusion takes place.
Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

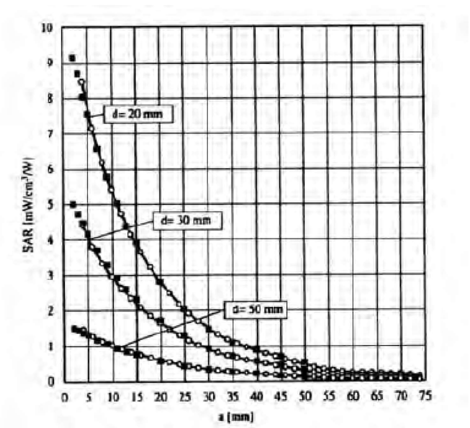


Figure 2.4 E-Field and Temperature Measurements at 900MHz

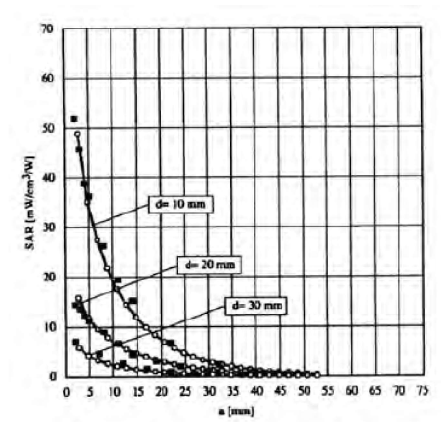


Figure 2.5 E-Field and Temperature Measurements at 1800MHz

Data Extrapolation

The DASY52 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

Scanning procedure

- The DASY installation includes predefined files with recommended procedures for measurements and system check. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

- The „reference“ and „drift“ measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. +/- 5 %.

- The highest integrated SAR value is the main concern in compliance test applications. These values can mostly be found at the inner surface of the phantom and cannot be measured directly due to the sensor offset in the probe. To extrapolate the surface values, the measurement distances to the surface must be known accurately. A distance error of 0.5mm could produce SAR errors of 6% at 1800 MHz. Using predefined locations for measurements is not accurate enough. Any shift of the phantom (e.g., slight deformations after filling it with liquid) would produce high uncertainties. For an automatic and accurate detection of the phantom surface, the DASY5 system uses the mechanical surface detection. The detection is always at touch, but the probe will move backward from the surface the indicated distance before starting the measurement.

- The „area scan“ measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The scan uses different grid spacings for different frequency measurements. Standard grid spacing for head measurements in frequency ranges ≤ 2GHz is 15 mm in x - and y- dimension. For higher frequencies a finer resolution is needed, thus for the grid spacing is reduced according the following table:

Area scan grid spacing for different frequency ranges	
Frequency range	Grid spacing
≤ 2 GHz	≤ 15 mm
2 – 4 GHz	≤ 12 mm
4 – 6 GHz	≤ 10 mm

Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation. Results of this coarse scan are shown in annex B.

- A „zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse“ scan. It uses a fine meshed grid where the robot moves the probe in steps along all the 3 axis (x,y and z-axis) starting at the bottom of the Phantom. The grid spacing for the cube measurement is varied according to the measured frequency range, the dimensions are given in the following table:

Zoom scan grid spacing and volume for different frequency ranges			
Frequency range	Grid spacing for x, y axis	Grid spacing for z axis	Minimum zoom scan volume
≤ 2 GHz	≤ 8 mm	≤ 5 mm	≥ 30 mm
2 – 3 GHz	≤ 5 mm	≤ 5 mm	≥ 28 mm
3 – 4 GHz	≤ 5 mm	≤ 4 mm	≥ 28 mm
4 – 5 GHz	≤ 4 mm	≤ 3 mm	≥ 25 mm
5 – 6 GHz	≤ 4 mm	≤ 2 mm	≥ 22 mm

DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in annex B. Test results relevant for the specified standard (see section 3) are shown in table form in section 7.

Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of all points in the three directions x, y and z. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 1 to 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 2.6)

Phantom Specification

Phantom: Flat Phantom (V5.0)
Shell Material: Vivac Composite
Thickness: 2.0 ± 0.2 mm

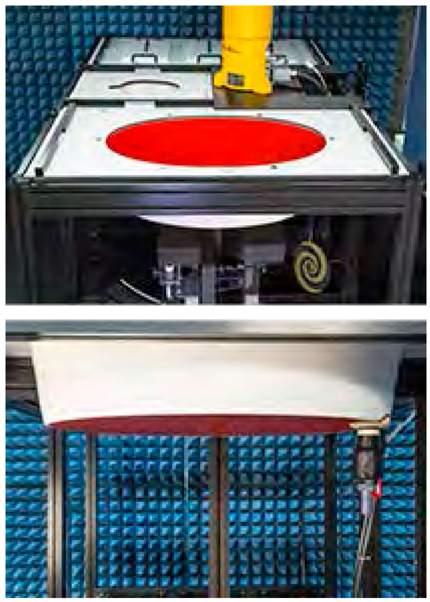


Figure 2.6 Flat Phantom

Device Holder for Transmitters

In combination with the Phantom the Mounting Device (see Fig. 2.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeat ably be positioned according to the FCC, CENELEC, IEC and IEEE specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Figure 2.7 Mounting Device

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

3. Probe and Dipole Calibration

See Appendix D and E.

4. Phantom & Simulating Tissue Specifications

Head Simulating Mixture Characterization

The head mixture consist of the material based on the table listed below. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue.

Table 4.1 Typical Composition of Ingredients for Tissue

Ingredients		Simulating Tissue	
		2450 MHz Head	5750 MHz Head
Mixing Percentage			
Water		Proprietary Mixture Procured from Speag	
Sugar			
Salt			
HEC			
Bactericide			
DGBE			
Dielectric Constant	Target	39.20	35.36
Conductivity (S/m)	Target	1.80	5.22

5. RF Exposure Limits [2]

Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 6.1 Human Exposure Limits

	UNCONTROLLED ENVIRONMENT General Population	CONTROLLED ENVIROMENT Professional Population
SPATIAL PEAK SAR[1] Head	1.60 W/kg	8.00 W/kg
SPATIAL AVERAGE SAR[2] Whole Body	0.08 W/kg	0.40 W/kg
SPATIAL PEAK SAR[3] Hands, Feet, Ankles, Wrists	4.00 W/kg	20.00 W/kg

[1] The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
[2] The Spatial Average value of the SAR averaged over the whole body.
[3] The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

6. Measurement Uncertainty

Measurement uncertainty table is not required per KDB 865664 D01 v01 section 2.8.2 page 12. SAR measurement uncertainty analysis is required in the SAR report only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR. The equivalent ratio (1.5/1.6) should be applied to extremity and occupational exposure conditions. The highest reported value is less than 1.5 W/kg. Therefore, the measurement uncertainty table SAR testing is not required.

7. SAR System Verification

Tissue Verification

Table 7.1 Measured Tissue Parameters

		2450 MHz Head		5750 MHz Head	
Date(s)		July 1, 2025		July 2, 2025	
Liquid Temperature (˚C)	20.0	Target	Measured	Target	Measured
Dielectric Constant: ε		39.20	38.21	35.36	34.38
Conductivity: σ		1.80	1.81	5.22	5.31

See Appendix A for data printout.

SAR System Verification

Prior to assessment, the system is verified to the ±10% of the specifications at the test frequency by using the system kit. Power is measured at 100 mW then normalized to 1 watt. (Graphic Plots Attached)

Table 7.2 System Dipole Validation Target & Measured

	Test Frequency	Targeted SAR_{1g} (W/kg)	Measure SAR_{1g} (W/kg)	Tissue Used for Verification	Deviation Target and Fast SAR to SAR (%)	Plot Number
01-Jul-2025	2450 MHz	53.30	52.10	Head	- 2.25	1
02-Jul-2025	5750 MHz	80.20	83.70	Head	+ 4.36	2

See Appendix A for data plots.

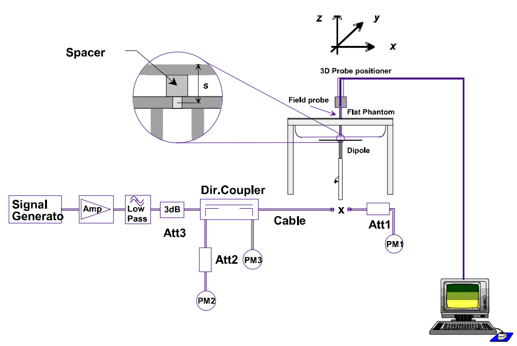


Figure 7.1 Dipole Validation Test Setup

8. SAR Test Data Summary

See Measurement Result Data Pages

See Appendix B for SAR Test Data Plots.
See Appendix C for SAR Test Setup Photos.

Procedures Used To Establish Test Signal

The device was either placed into simulated transmit mode using the manufacturer's test codes or the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

Device Test Condition

In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power unless otherwise noted. If a conducted power deviation of more than 5% occurred, the test was repeated. The power drift of each test is measured at the start of the test and again at the end of the test. The drift percentage is calculated by the formula ((end/start)-1)*100 and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

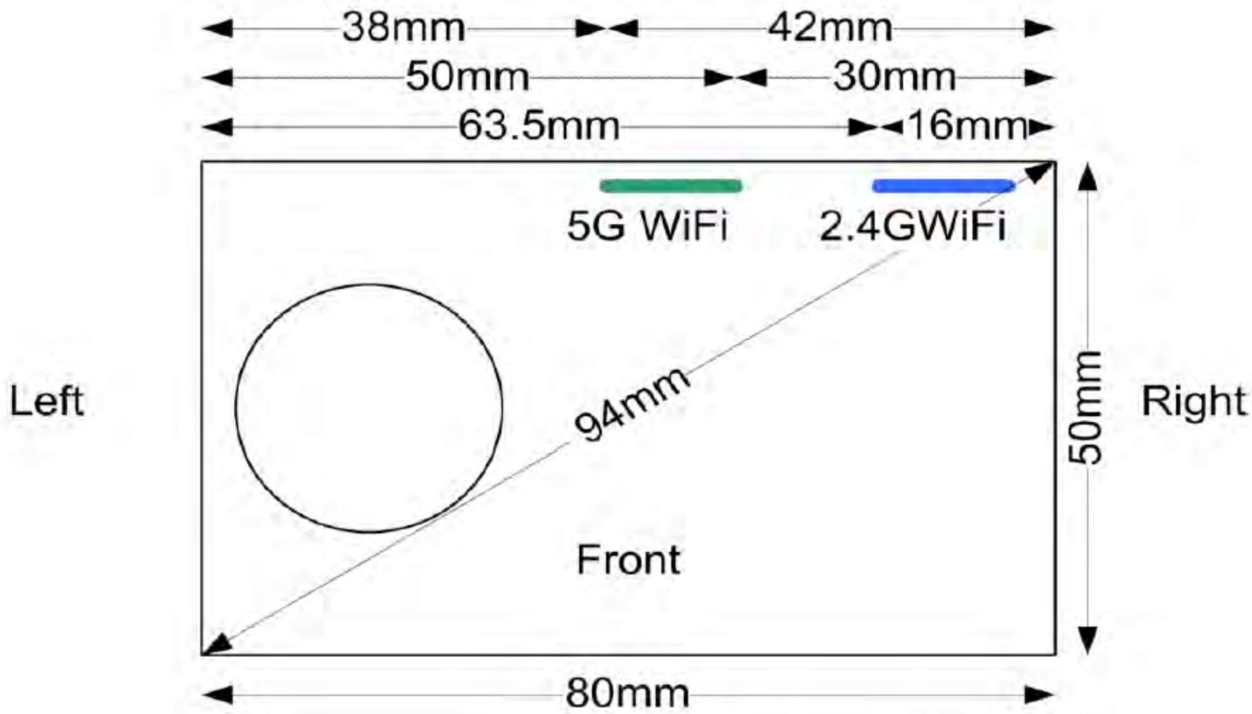
The EUT was tested in on all sides of the device where the antenna was required to be tested based on the exclusions in 47 CFR 1.1307 (B). All measurements were conducted with the side of the device in direct contact with the phantom.

The data rates used when evaluating the WiFi transmitter were the lowest data rates and widest bandwidth with the highest conduct power limit for each mode. The device was operating at its maximum output power for all measurements.

The BT/BLE transmitter is excluded from SAR testing. The limit is based on KDB447498 section 4.3.1 a) on page 12. The value for the exclusion is 10 mW. The maximum power for the transmitter is 6.0 dBm (4.0 mW). The maximum power for BT/BLE is 4.0 mW which is below the 10 mW limit; therefore, it is also excluded.

The antenna was on a minimum of 10 cm of Styrofoam during each test. The following is a pictorial drawing of the locations and separation distances.

Antenna Locations



Antenna	Top Edge (mm)	Left Edge (mm)	Bottom Edge (mm)	Right Edge (mm)	Depth (mm)
WLAN/BT	5.5	63.5	45.0	6.0	8.0
5GHz	5.5	38.0	45.0	30.0	15.0

Band	Mode	Channel	Frequency (MHz)	Avg Power (dBm)	Tune-up Pwr (dBm)
2450 MHz	802.11b	1	2412	15.20	16.50
		6	2437	14.81	16.50
		11	2462	15.57	16.50
	802.11g	1	2412	Not Required	16.50
		6	2437		16.50
		11	2462		16.50
	802.11n20	1	2412		16.50
		6	2437		16.50
		11	2462		16.50
5800 MHz	802.11a	149	5745	15.30	16.50
		153	5765	Not Required	16.50
		157	5785	15.03	16.50
		161	5805	Not Required	16.50
		165	5825	14.96	16.50
	802.11n20/40 802.11ac80	149	5745	Not Required	16.00
		153	5765		16.00
		157	5785		16.00
		161	5805		16.00
		165	5825		16.00

Band	Mode	Channel	Frequency (MHz)	Avg Power (dBm)	Tune-up Pwr (dBm)
2450 MHz	Bluetooth v5.1	0	2402	Not Required	6.00
		40	2440		6.00
		78	2480		6.00
		0	2402		6.00
		40	2440		6.00
		78	2480		6.00

9. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)*Tune-up Scaling Factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.

Plot No.	Band	Modulation	Test Position	Antenna	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	2.45 GHz	CCK	Front	Tx1	0mm	6	2437	14.81	16.50	0.214	0.32
	2.45 GHz	CCK	Back		0mm	6	2437	14.81	16.50	0.353	0.52
	2.45 GHz	CCK	Left		0mm	6	2437	14.81	16.50	0.0562	0.08
	2.45 GHz	CCK	Right		0mm	6	2437	14.81	16.50	0.396	0.58
	2.45 GHz	CCK	Top		0mm	1	2412	15.20	16.50	0.903	1.22
	2.45 GHz	CCK			0mm	6	2437	14.81	16.50	0.801	1.18
1	2.45 GHz	CCK			0mm	11	2462	15.57	16.50	1.04	1.29
	2.45 GHz	CCK	Bottom		0mm	6	2437	14.81	16.50	0.0756	0.11
	2.45 GHz	CCK	Repeat		0mm	11	2462	15.57	16.50	1.02	1.26
	5.75 GHz	OFDM	Front	Tx1	0mm	157	5785	15.03	16.50	0.71	1.00
	5.75 GHz	OFDM			0mm	165	5825	14.96	16.50	0.594	0.85
	5.75 GHz	OFDM	Back		0mm	157	5785	15.03	16.50	0.772	1.08
	5.75 GHz	OFDM			0mm	165	5825	14.96	16.50	0.564	0.80
	5.75 GHz	OFDM	Left		0mm	157	5785	15.03	16.50	0.0493	0.07
	5.75 GHz	OFDM	Right		0mm	157	5785	15.03	16.50	0.0274	0.04
	5.75 GHz	OFDM	Top		0mm	149	5745	15.30	16.50	0.892	1.18
2	5.75 GHz	OFDM			0mm	157	5785	15.03	16.50	0.904	1.27
	5.75 GHz	OFDM			0mm	165	5825	14.96	16.50	0.882	1.26
	5.75 GHz	OFDM	Bottom		0mm	157	5785	15.03	16.50	0.157	0.22
	5.75 GHz	OFDM	Repeat		0mm	157	5785	15.03	16.50	0.902	1.27

10. Simultaneous Transmission Analysis

Sim-Tx configuration for Main Unit

No.	Simultaneous Transmission Configuration	Exposure Positions
		Body
1	2.4 GHz + BT	Yes
2	5 GHz + BT	Yes

Body Exposure Conditions

Exposure Position	1	2	3	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)
	2.4GHz BT (Tx1)	2.4GHz WiFi (Tx1)	5GHz WiFi (Tx1)		
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)		
Front	0.15	0.32	1.00	0.47	1.15
Back	0.15	0.52	1.08	0.67	1.23
Left	0.15	0.08	0.07	0.23	0.22
Right	0.15	0.58	0.04	0.73	0.19
Top	0.15	1.29	1.27	1.44	1.42
Bottom	0.15	0.11	0.22	0.26	0.37

The Bluetooth/BLE are excluded based on low power as shown above. The maximum power is 6.0 dBm which is 4.0 mW.

When the transmitter is excluded, the value is estimated using the following formula for body.
[(max. power, mW / min. distance, mm) * [$\sqrt{f_{(GHz)}}$ / x = W/kg, where x=7.5
(4.0 / 5.5) * ($\sqrt{2.48}$ / 7.5) = 0.15 W/kg

The limit for body is 1.6 W/kg. All values are below this limit; therefore, the simultaneous evaluation in KDB 447498 D01 v06 is met.

11. Test Equipment List

Table 11.1 Equipment Specifications

Type	Calibration Due Date	Calibration Done Date	Serial Number
Staubli Robot TX60L	N/A	N/A	F07/55M6A1/A/01
Measurement Controller CS8c	N/A	N/A	1012
ELI4 Flat Phantom	N/A	N/A	1065
Device Holder	N/A	N/A	N/A
Data Acquisition Electronics 4	01/15/2026	01/15/2025	1321
SPEAG E-Field Probe EX3DV4	01/16/2026	01/16/2025	7530
Speag Validation Dipole D2450V2	05/06/2026	05/06/2024	829
Speag Validation Dipole D5GHzV2	05/08/2026	05/08/2024	1085
Agilent N1911A Power Meter	02/28/2026	02/28/2025	GB45100254
Agilent N1922A Power Sensor	02/28/2026	02/28/2025	MY45240464
Agilent (HP) 8596E Spectrum Analyzer	02/28/2026	02/28/2025	3826A01468
Agilent (HP) 83752A Synthesized Sweeper	02/28/2026	02/28/2025	3610A01048
Agilent (HP) 8753C Vector Network Analyzer	02/28/2026	02/28/2025	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	02/28/2026	02/28/2025	2904A00595
Copper Mountain R140 Vector Reflectometer	02/28/2026	02/28/2025	21390004
Agilent 778D Dual Directional Coupler	N/A	N/A	MY48220184
MiniCircuits BW-N20W5+ Fixed 20 dB Attenuator	N/A	N/A	N/A
MiniCircuits SPL-10.7+ Low Pass Filter	N/A	N/A	R8979513746
Aprel Dielectric Probe Assembly	N/A	N/A	0011
Head Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Head Equivalent Matter (5 GHz)	N/A	N/A	N/A

12. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape, and size of the body; the orientation of the body with respect to the field vectors; and, the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

13. References

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, August 1996

[2] ANSI/IEEE C95.1 – 1992, American National Standard Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz, New York: IEEE, 1992.

[3] ANSI/IEEE C95.3 – 2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 2002.

[4] IEEE Standard 1528 – 2013, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013.

Appendix A – System Validation Plots and Data

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************************************************************
Test Result for UIM Dielectric Parameter
Tue 01/Jul/2025
Freq   Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon  of  UIM
Test_s Sigma of UIM
************************************************************
```

Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.4100	39.26	1.76	38.31	1.76
2.4120	39.258	1.762	38.306	1.762*
2.4200	39.25	1.77	38.29	1.77
2.4300	39.24	1.78	38.27	1.78
2.4370	39.226	1.787	38.263	1.794*
2.4400	39.22	1.79	38.26	1.80
2.4420	39.216	1.792	38.25	1.802*
2.4500	39.20	1.80	38.21	1.81
2.4600	39.19	1.81	38.21	1.82
2.4620	39.186	1.812	38.206	1.822*
2.4700	39.17	1.82	38.19	1.83
2.4720	39.168	1.822	38.186	1.836*
2.4800	39.16	1.83	38.17	1.86

* value interpolated

****
Test Result for UIM Dielectric Parameter
Wed 02/Jul/2025
Freq Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
5.1000	36.10	4.55	35.14	4.59
5.1200	36.08	4.57	35.12	4.61
5.1400	36.05	4.59	35.09	4.63
5.1600	36.03	4.61	35.07	4.66
5.1800	36.01	4.63	35.05	4.68
5.2000	35.99	4.65	35.02	4.70
5.2200	35.96	4.68	35.00	4.72
5.2400	35.94	4.70	34.98	4.74
5.2500	35.93	4.71	34.965	4.755*
5.2600	35.92	4.72	34.95	4.77
5.2800	35.89	4.74	34.92	4.79
5.3000	35.87	4.76	34.89	4.81
5.3200	35.85	4.78	34.87	4.83
5.3400	35.83	4.80	34.85	4.86
5.3600	35.80	4.82	34.83	4.88
5.3800	35.78	4.84	34.80	4.90
5.4000	35.76	4.86	34.78	4.92
5.4200	35.73	4.88	34.76	4.95
5.4400	35.71	4.90	34.75	4.97
5.4600	35.69	4.92	34.72	4.99
5.4800	35.67	4.94	34.69	5.01
5.5000	35.64	4.96	34.66	5.03
5.5200	35.62	4.98	34.64	5.05
5.5400	35.60	5.00	34.62	5.07
5.5600	35.57	5.02	34.60	5.10
5.5800	35.55	5.04	34.57	5.12
5.6000	35.53	5.07	34.55	5.14
5.6200	35.51	5.09	34.52	5.16
5.6400	35.48	5.11	34.50	5.19
5.6600	35.46	5.13	34.48	5.21
5.6800	35.44	5.15	34.46	5.23
5.7000	35.41	5.17	34.43	5.25
5.7200	35.39	5.19	34.41	5.28
5.7400	35.37	5.21	34.39	5.30
5.7450	35.365	5.215	34.385	5.305*
5.7500	35.36	5.22	34.38	5.31*
5.7600	35.35	5.23	34.37	5.32
5.7800	35.32	5.25	34.35	5.34
5.7850	35.315	5.255	34.34	5.345*
5.8000	35.30	5.27	34.31	5.36
5.8200	35.28	5.29	34.29	5.39
5.8250	35.273	5.295	34.285	5.395*
5.8400	35.25	5.31	34.27	5.41
5.8600	35.23	5.33	34.25	5.43

* value interpolated

RF Exposure Lab

Plot 1

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN: 829

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450; Medium parameters used: f = 2450 MHz; σ = 1.81 S/m; ε_r = 38.21; ρ = 1000 kg/m^3
Phantom section: Flat Section

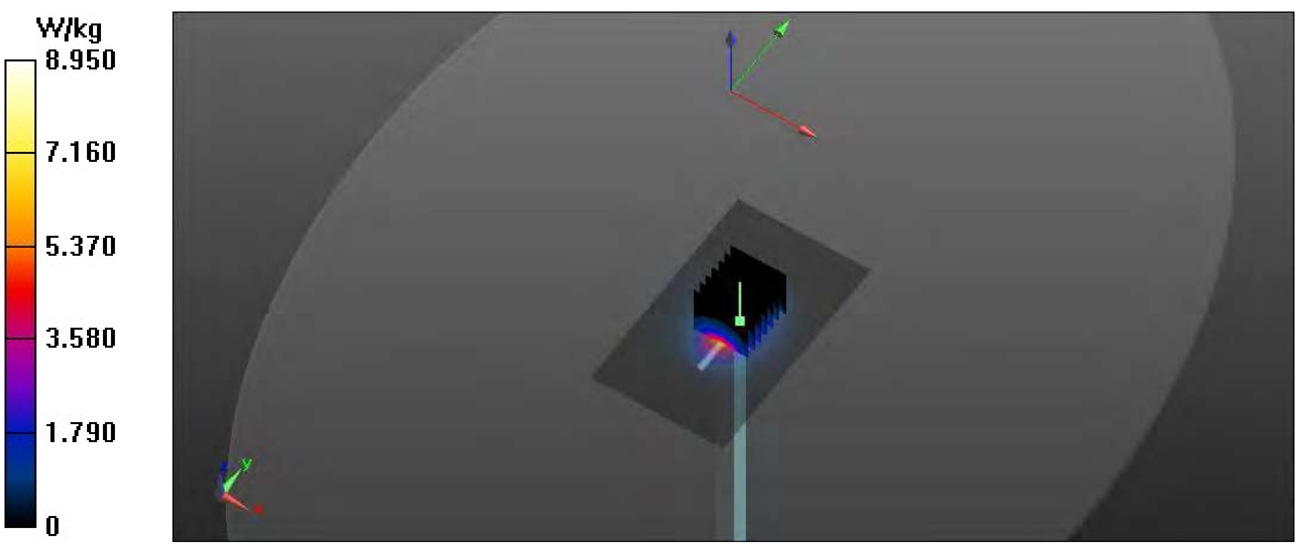
Test Date: Date: 7/1/2025; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 – SN7530; ConvF(7.18, 7.21, 7.46); Calibrated: 1/16/2025;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/15/2025
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.14 (7483)

Procedure Notes:

Head Verification/2450 MHz/Area Scan (61x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 8.67 W/kg

Head Verification/2450 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.027 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 11.04 W/kg
P_{in}= 100 mW
SAR(1 g) = 5.21 W/kg; SAR(10 g) = 2.49 W/kg
Smallest distance from peaks to all points 3 dB below = 9.6 mm
Ratio of SAR at M2 to SAR at M1 = 35.9%
Maximum value of SAR (measured) = 8.95 W/kg



RF Exposure Lab

Plot 2

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1085

Communication System: CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: HSL 3-6 GHz; Medium parameters used (interpolated): f = 5750 MHz; σ = 5.31 S/m; ε_r = 34.38; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 7/2/2025; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 – SN7530; ConvF(4.8, 4.82, 4.99); Calibrated: 1/16/2025;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/15/2025
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.14 (7483)

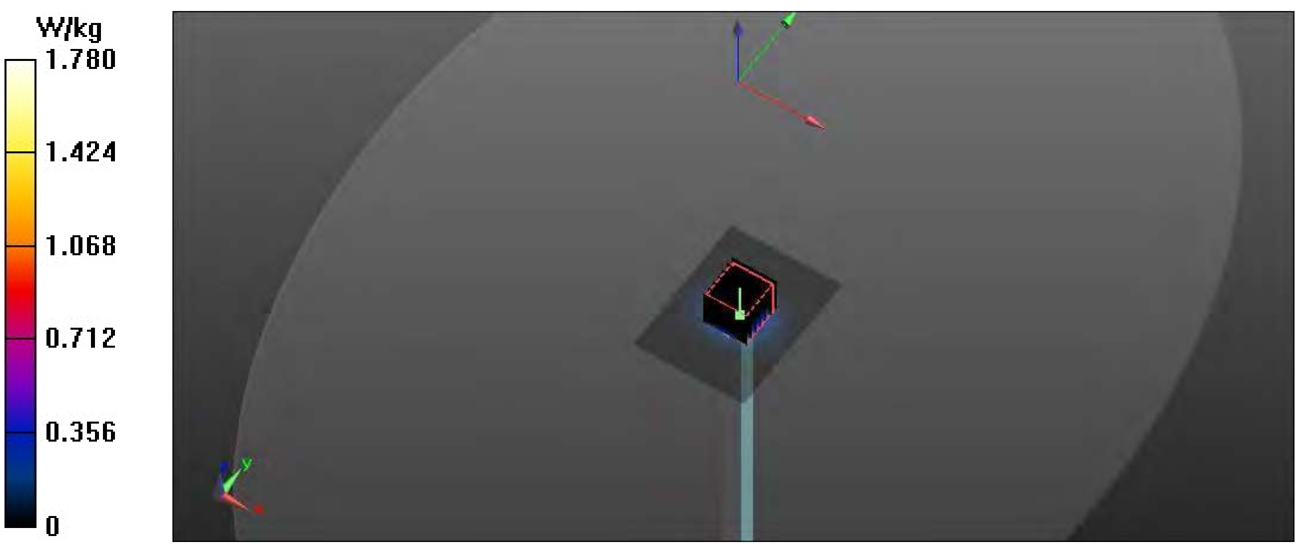
Procedure Notes:

Head Verification/5750 MHz/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.54 W/kg

Head Verification/5750 MHz/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 12.957 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 2.84 W/kg
Pin=10 mW
SAR(1 g) = 0.837 W/kg; SAR(10 g) = 0.239 W/kg
Smallest distance from peaks to all points 3 dB below = 10.9 mm
Ratio of SAR at M2 to SAR at M1 = 45.8%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.78 W/kg



Appendix B – SAR Test Data Plots

RF Exposure Lab

Plot 1

DUT: B04281; Type: Portable Digital Transceiver; Serial: Eng 1

Communication System: WiFi 802.11b (DSSS, 1 Mbps); Frequency: 2462 MHz; Duty Cycle: 1:1
Medium: HSL2450; Medium parameters used (interpolated): f = 2462 MHz; σ = 1.822 S/m; ε_r = 38.206; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 7/1/2025; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(7.18, 7.21, 7.46); Calibrated: 1/16/2025
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/15/2025
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.14 (7483)

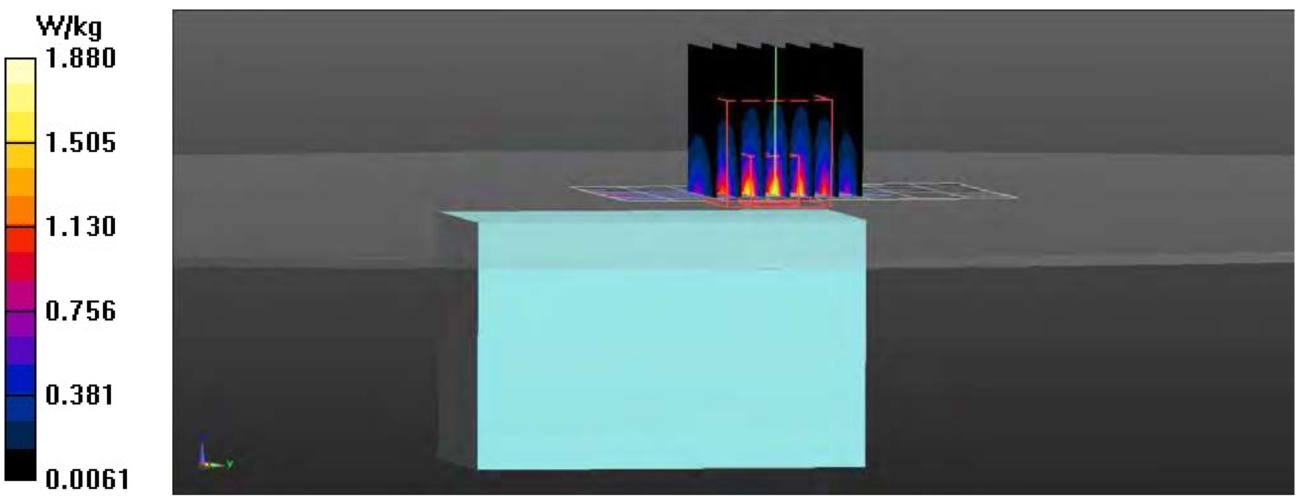
Procedure Notes:

2450 MHz/Top High/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.51 W/kg

2450 MHz/Top High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.66 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 2.51 W/kg
SAR(1 g) = 1.04 W/kg; SAR(10 g) = 0.403 W/kg
Smallest distance from peaks to all points 3 dB below = 6.4 mm
Ratio of SAR at M2 to SAR at M1 = 50.3%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.88 W/kg



RF Exposure Lab

Plot 2

DUT: B04281; Type: Portable Digital Transceiver; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5785 MHz; Duty Cycle: 1:1
Medium: HSL5GHz; Medium parameters used (interpolated): f = 5785 MHz; σ = 5.345 S/m; ε_r = 34.34; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 7/2/2025; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN7530; ConvF(4.8, 4.82, 4.99); Calibrated: 1/16/2025
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/15/2025
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.14 (7483)

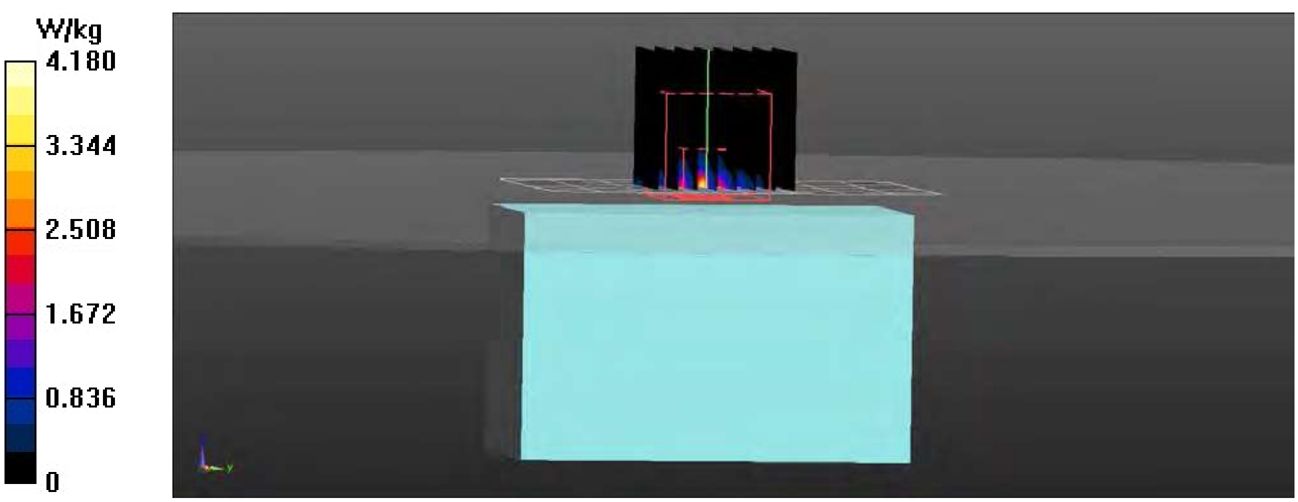
Procedure Notes:

5800 MHz/Top 157/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.15 W/kg

5800 MHz/Top 157/Zoom Scan (8x8x16)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 27.89 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 10.6 W/kg
SAR(1 g) = 0.904 W/kg; SAR(10 g) = 0.237 W/kg
Smallest distance from peaks to all points 3 dB below = 6.1 mm
Ratio of SAR at M2 to SAR at M1 = 32.5%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 4.18 W/kg



Appendix C – SAR Test Setup Photos

Photo Removed

Test Position Front 0 mm Gap

Photo Removed

Test Position Back 0 mm Gap

Photo Removed

Test Position Left 0 mm Gap

Photo Removed

Test Position Right 0 mm Gap

Photo Removed

Test Position Top 0 mm Gap

Photo Removed

Test Position Bottom 0 mm Gap

Photo Removed

Front of Device

Photo Removed

Back of Device

Appendix D – Probe Calibration Data Sheets

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
Servizio svizzero di taratura
S **Swiss Calibration Service**

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Exposure Lab**
San Marcos, USA

Certificate No. **EX-7530_Jan25**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:7530

Calibration procedure(s): QA CAL-01.v10, QA CAL-12.v10, QA CAL-14.v7, QA CAL-23.v6, QA CAL-25.v8
Calibration procedure for dosimetric E-field probes

Calibration date: January 16, 2025

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Calibration Date (Certificate No.)	Sched. Cal.
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Short [S6019i] + Attenuator [S6020i]	SN: L1119	26-Mar-24 (No. 217-04048)	Mar-25
OCP DAK-12	SN: 1016	24-Sept-24 (No. OCP-DAK12-1016_Sep24)	Sep-25
OCP DAK-3.5	SN: 1249	23-Sept-24 (No. OCP-DAK3.5-1249_Sep24)	Sep-25
Reference Probe EX3DV4	SN: 7349	10-Jan-25 (No. EX3-7349_Jan25)	Jan-26
DAE4	SN: 1301	07-Nov-24 (No. DAE4-1301_Nov24)	Nov-25

Secondary Standards	ID	Check Date (in house)	Sched. Check
ACAP 2020 Calibration Box	SN: L1404	30-Sept-24 (No. Report_ACAP2020E-Cave_20240930s)	Sep-25

	Name	Function	Signature
Calibrated by	Aidonia Georgiadou	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: January 16, 2025

Glossary

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices – Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z*: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal. DCP does not depend on frequency nor media.
- *PAR*: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters*: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ±50 MHz to ±100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Parameters of Probe: EX3DV4 - SN:7530

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu V/(V/m)^2$) [A]	0.42	0.53	0.43	±10.1%
DCP (mV) [B]	98.6	99.2	100.9	±4.7%

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B $dB\sqrt{\mu V}$	C	D dB	VR mV	Max dev.	Max Unc[E] $k = 2$
0	CW	X	0.00	0.00	1.00	0.00	137.5	±0.7%	±4.7%
		Y	0.00	0.00	1.00		135.3		
		Z	0.00	0.00	1.00		140.0		

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Linearization parameter uncertainty for maximum specified field strength.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Parameters of Probe: EX3DV4 - SN:7530

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	35.9°
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Note: Measurement distance from surface can be increased to 3–4 mm for an *Area Scan* job.

Parameters of Probe: EX3DV4 - SN:7530

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz)[C]	Relative Permittivity[F]	Conductivity[F] (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unc[H] ($k = 2$)
6	55.0	0.75	20.02	21.02	23.44	0.00	1.25	±13.3%
13	55.0	0.75	18.22	19.14	21.34	0.00	1.25	±13.3%
30	55.0	0.75	16.88	17.73	19.77	0.00	1.25	±13.3%
750	41.9	0.89	9.59	9.63	9.97	0.36	1.27	±11.0%
900	41.5	0.97	8.99	9.02	9.34	0.36	1.27	±11.0%
1750	40.1	1.37	7.96	7.99	8.28	0.35	1.27	±11.0%
1900	40.0	1.40	7.83	7.86	8.14	0.34	1.27	±11.0%
2300	39.5	1.67	7.46	7.49	7.76	0.34	1.27	±11.0%
2450	39.2	1.80	7.18	7.21	7.46	0.34	1.27	±11.0%
2600	39.0	1.96	7.06	7.09	7.34	0.34	1.27	±11.0%
5250	35.9	4.71	5.30	5.32	5.51	0.30	1.27	±13.1%
5600	35.5	5.07	4.75	4.77	4.94	0.27	1.27	±13.1%
5750	35.4	5.22	4.80	4.82	4.99	0.26	1.27	±13.1%

[C] Frequency validity above 300 MHz of ±100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ±50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ±10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4–9 MHz, and ConvF assessed at 13 MHz is 9–19 MHz. Above 5 GHz frequency validity can be extended to ±110 MHz.

[F] The probes are calibrated using tissue simulating liquids (TSL) that deviate for ε and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz and below ±2% for frequencies between 3–6 GHz at any distance larger than half the probe tip diameter from the boundary.

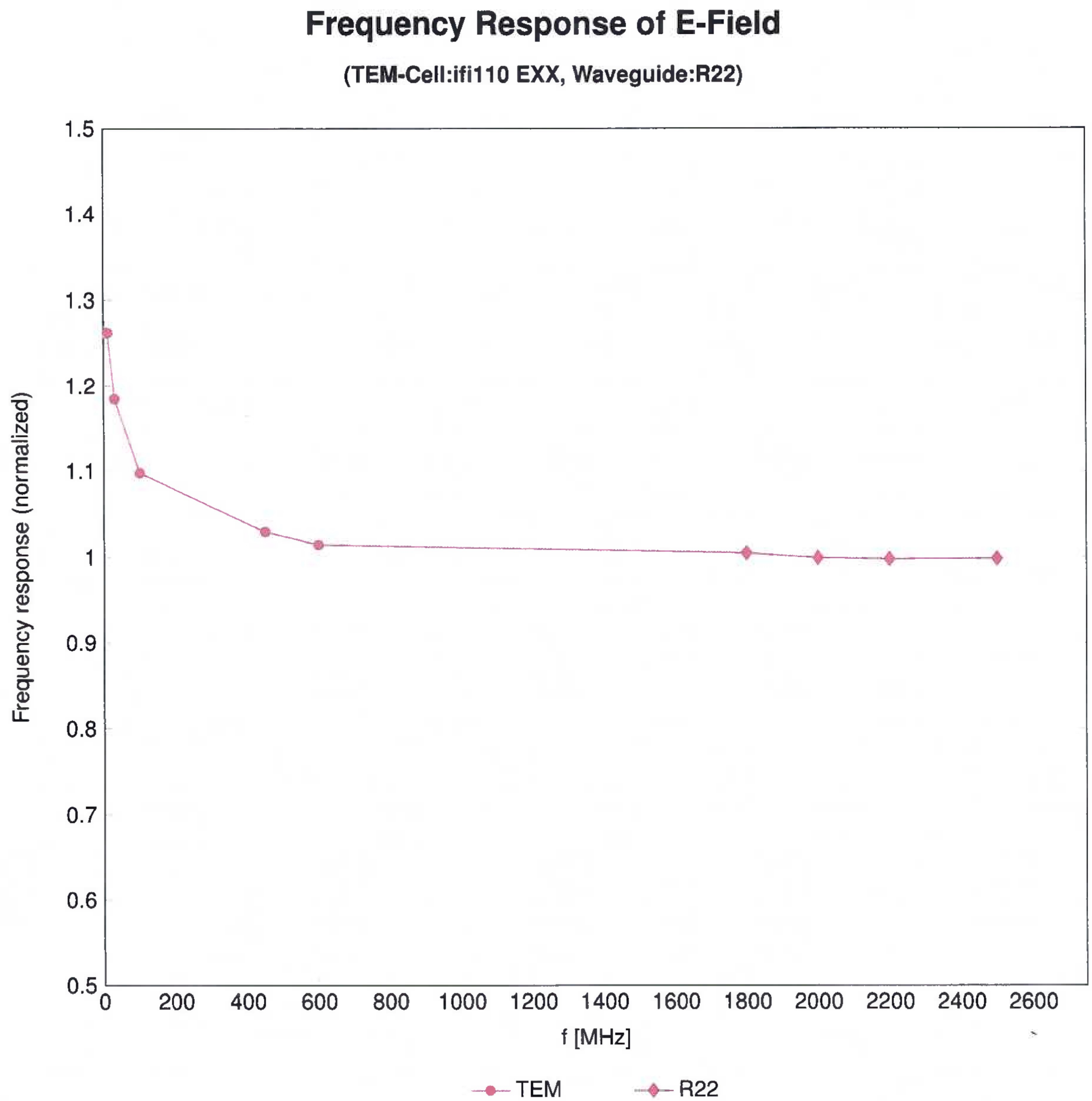
[H] The stated uncertainty is the total calibration uncertainty ($k = 2$) of Norm·ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

Parameters of Probe: EX3DV4 - SN:7530

Calibration Parameter Determined in Head Tissue Simulating Media

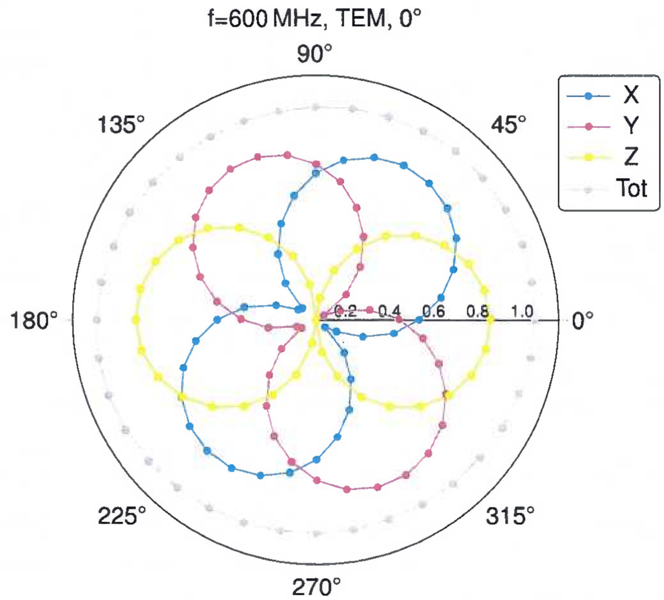
f (MHz)[C]	Relative Permittivity[F]	Conductivity[F] (S/m)	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unc[H] ($k = 2$)
6500	34.5	6.07	5.44	5.46	5.66	0.20	1.27	±18.6%

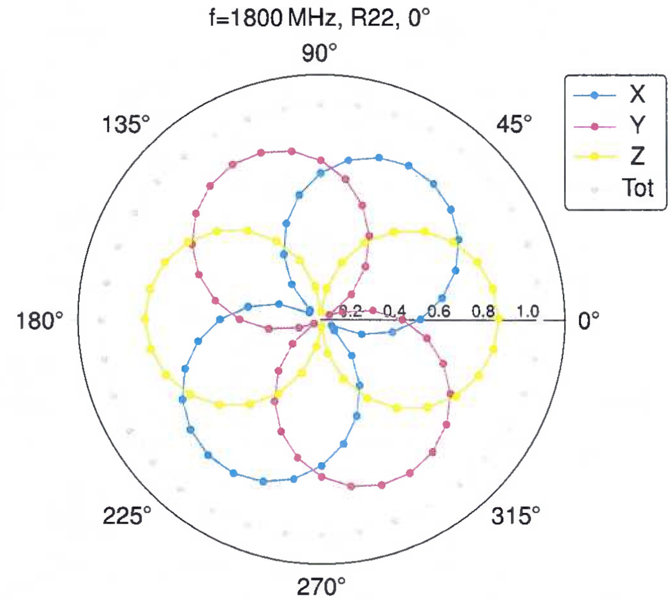
[C] Frequency validity at 6.5 GHz is −600/+700 MHz, and ±700 MHz at or above 7 GHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] The probes are calibrated using tissue simulating liquids (TSL) that deviate for ε and σ by less than ±10% from the target values (typically better than ±6%) and are valid for TSL with deviations of up to ±10%.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ±1% for frequencies below 3 GHz; below ±2% for frequencies between 3–6 GHz; and below ±4% for frequencies between 6–10 GHz at any distance larger than half the probe tip diameter from the boundary.
[H] The stated uncertainty is the total calibration uncertainty ($k = 2$) of Norm·ConvF. This is equivalent to the uncertainty component with the symbol CF in Table 9 of IEC/IEEE 62209-1528:2020.

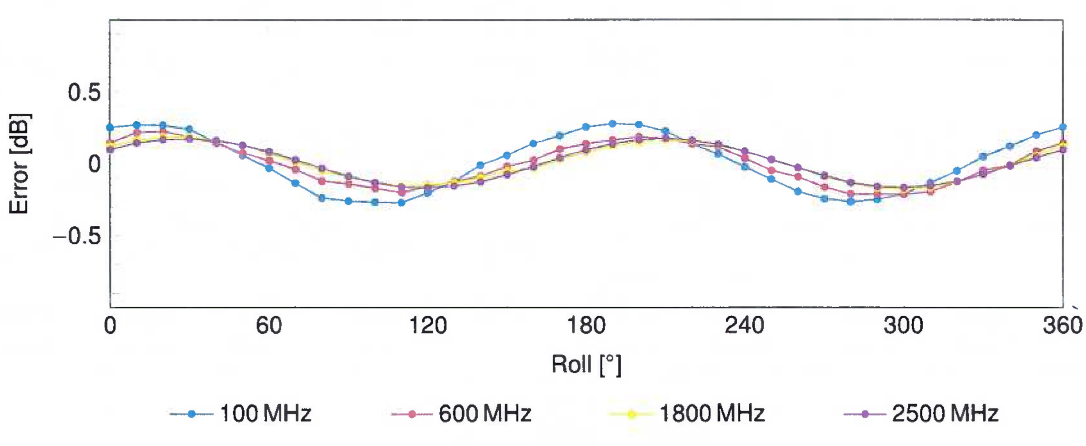


Uncertainty of Frequency Response of E-field: ±6.3% (k=2)

Receiving Pattern (ϕ), $\vartheta = 0°$



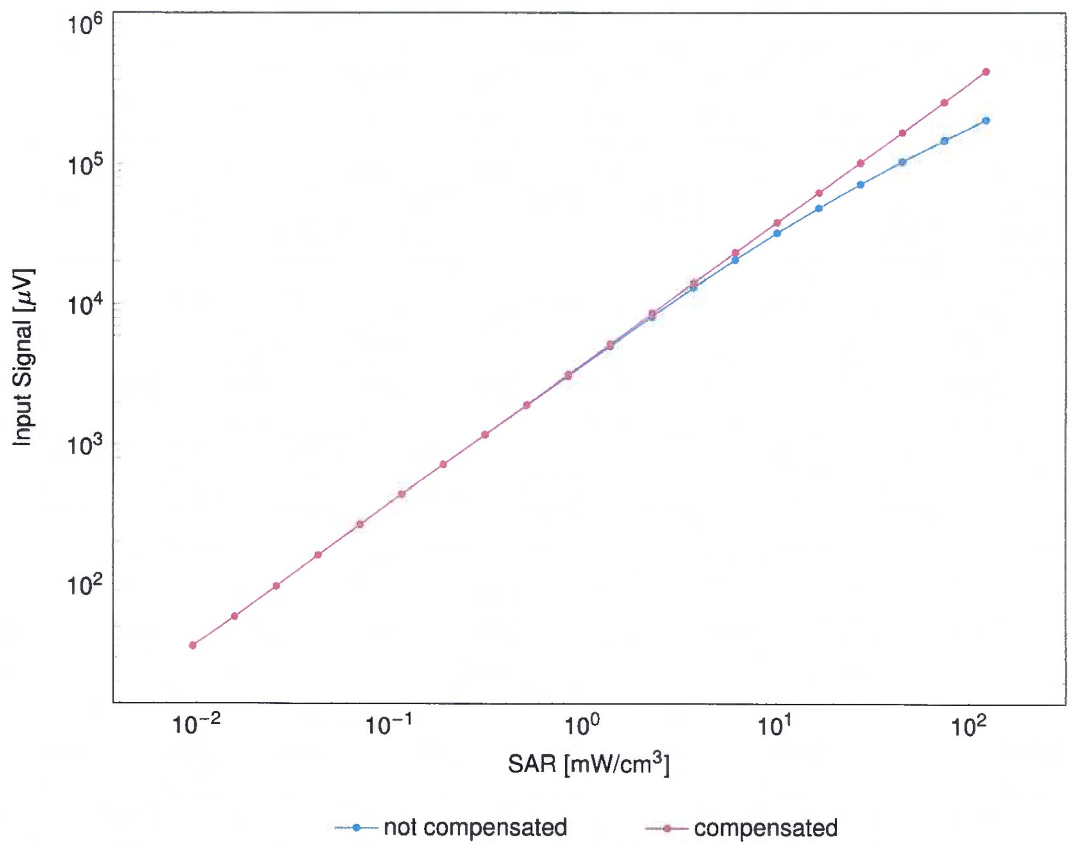


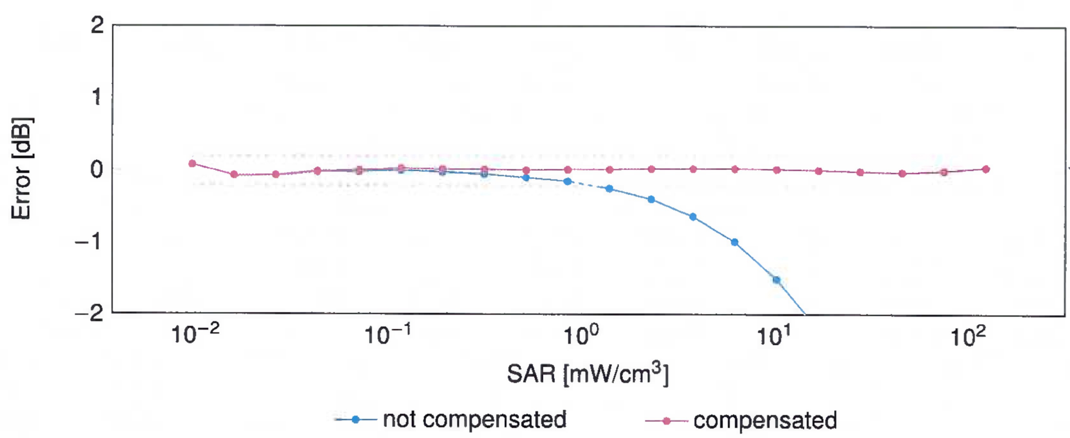


Uncertainty of Axial Isotropy Assessment: ±0.5% (k=2)

Dynamic Range f(SAR_{head})

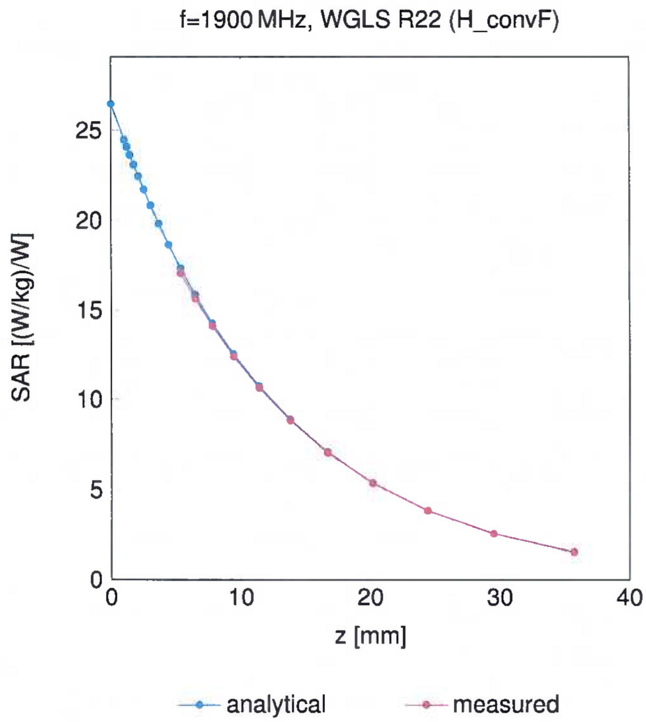
(TEM cell, f_{eval} = 1900 MHz)



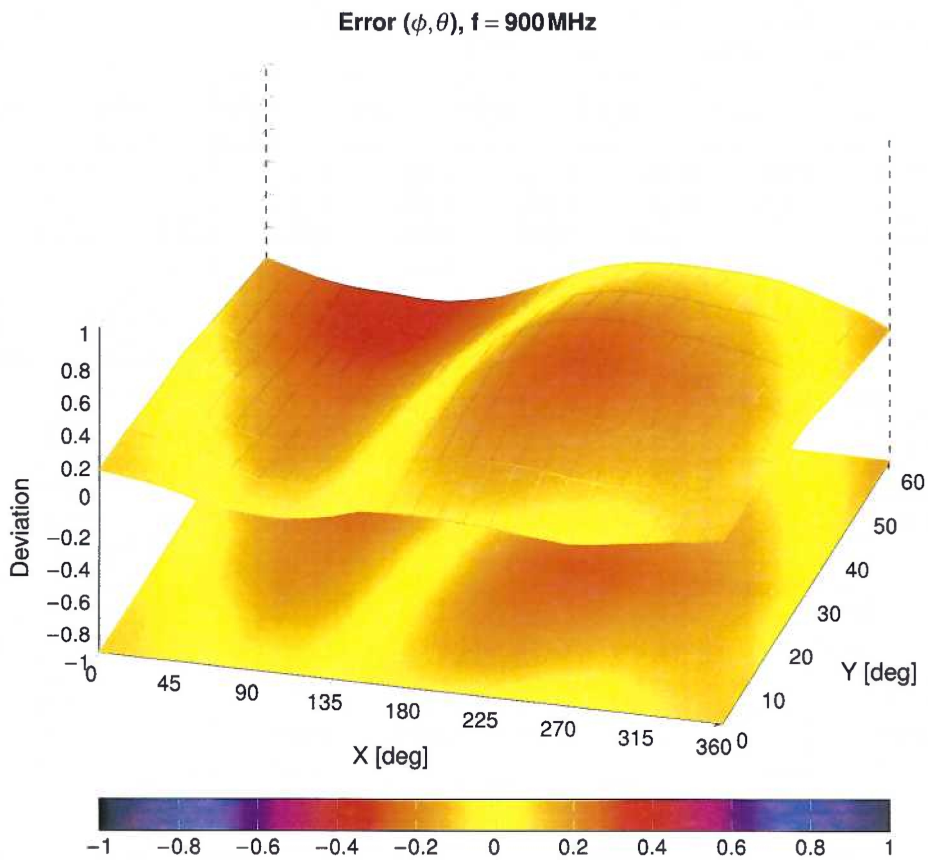


Uncertainty of Linearity Assessment: ±0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.6% (k=2)

Appendix E – Dipole Calibration Data Sheets

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S **Schweizerischer Kalibrierdienst**
C **Service suisse d'étalonnage**
S **Servizio svizzero di taratura**
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Exposure Lab**
San Marcos, USA

Certificate No. D2450V2-829_May24

CALIBRATION CERTIFICATE

Object: D2450V2 - SN:829

Calibration procedure(s): QA CAL-05.v12
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: May 06, 2024

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 7349	03-Nov-23 (No. EX3-7349_Nov23)	Nov-24
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: May 7, 2024

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.9 ± 6 %	1.88 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**53.3 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**25.0 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.9 Ω + 4.1 jΩ
Return Loss	- 25.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

Extended Calibration
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D2450V2 SN: 829 - Head						
Date of Measurement	Return Loss (dB)	Δ%	Impedance Real (Ω)	ΔΩ	Impedance Imaginary (jΩ)	ΔΩ
5/6/2024	-25.4		53.9		4.1	
5/6/2025	-26.3	3.5	54.6	0.7	3.8	-0.3

Date: 06.05.2024

Test Laboratory: SPEAG, Zurich, Switzerland

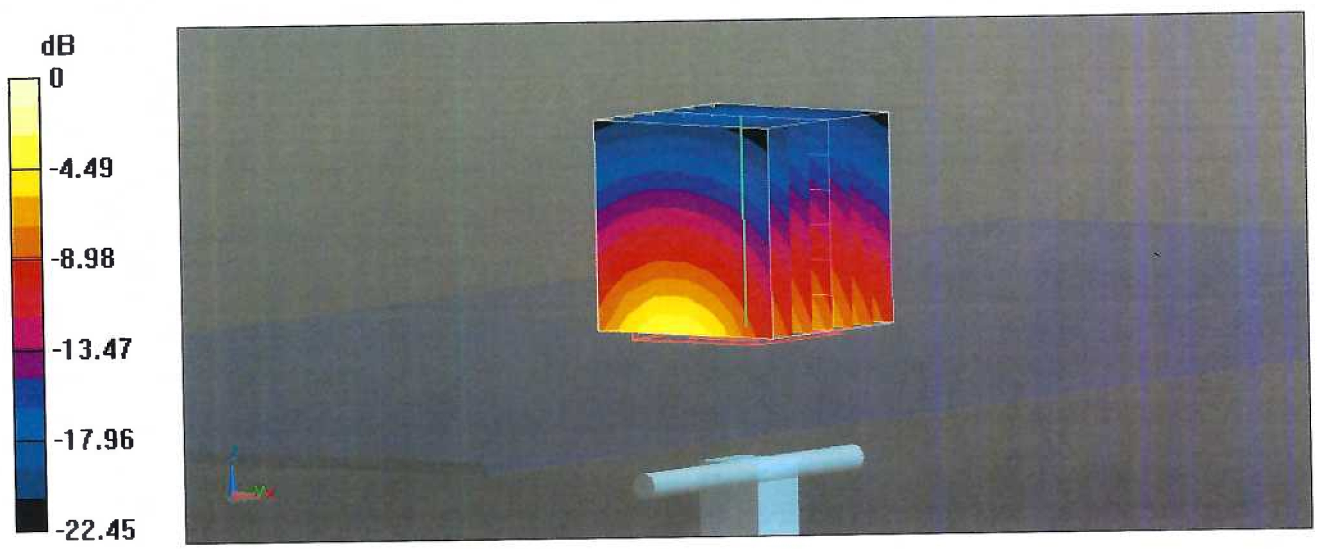
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:829

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.88 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

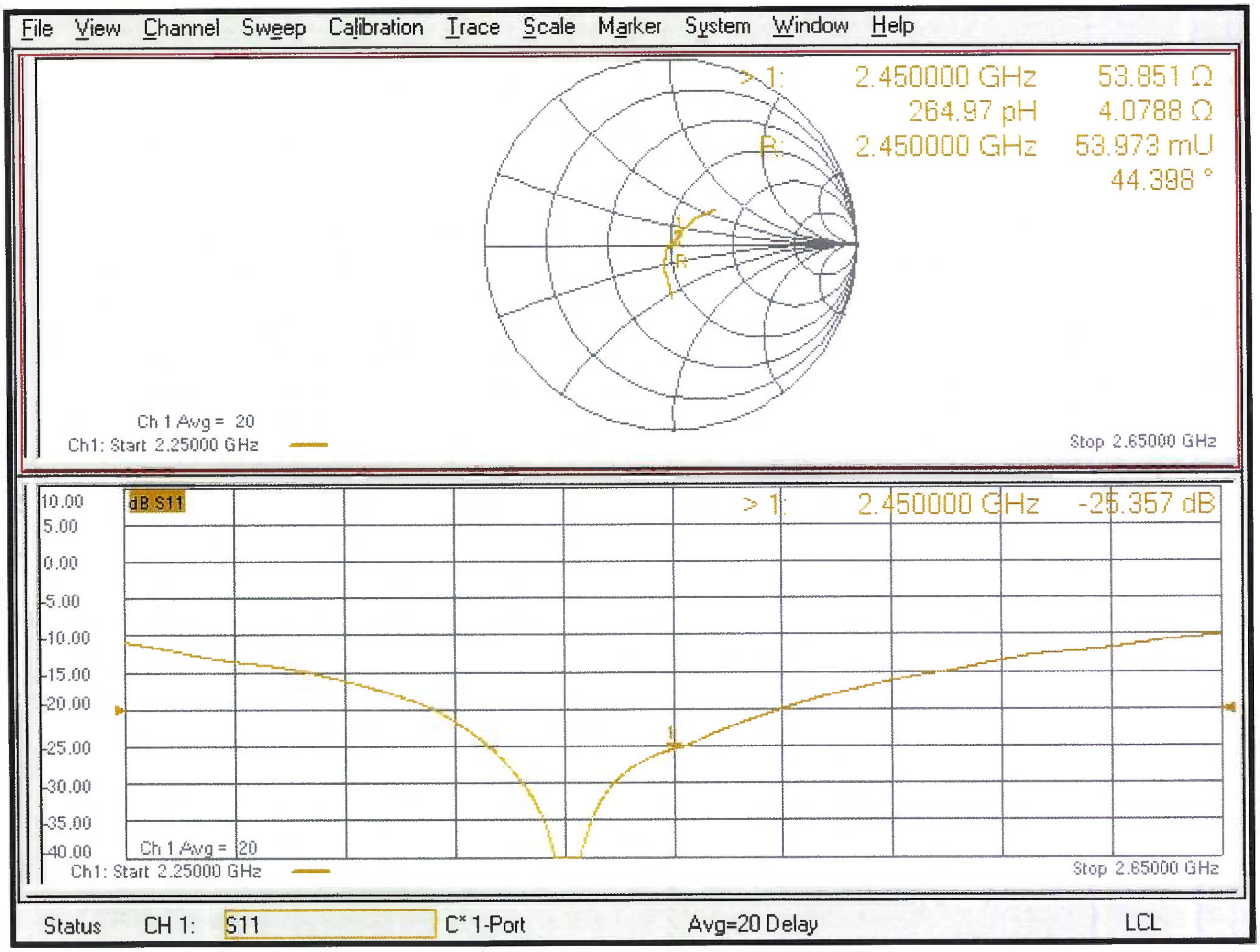
- Probe: EX3DV4 - SN7349; ConvF(7.96, 7.96, 7.96) @ 2450 MHz; Calibrated: 03.11.2023
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 116.7 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.36 W/kg
Smallest distance from peaks to all points 3 dB below = 9 mm
Ratio of SAR at M2 to SAR at M1 = 50.6%
Maximum value of SAR (measured) = 21.9 W/kg



0 dB = 21.9 W/kg = 13.40 dBW/kg

Impedance Measurement Plot for Head TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Exposure Lab**
San Marcos, USA

Certificate No. D5GHzV2-1085_May24

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN:1085
Calibration procedure(s)	QA CAL-22.v7 Calibration Procedure for SAR Validation Sources between 3-10 GHz
Calibration date:	May 08, 2024

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP2	SN: 104778	26-Mar-24 (No. 217-04036/04037)	Mar-25
Power sensor NRP-Z91	SN: 103244	26-Mar-24 (No. 217-04036)	Mar-25
Power sensor NRP-Z91	SN: 103245	26-Mar-24 (No. 217-04037)	Mar-25
Reference 20 dB Attenuator	SN: BH9394 (20k)	26-Mar-24 (No. 217-04046)	Mar-25
Type-N mismatch combination	SN: 310982 / 06327	26-Mar-24 (No. 217-04047)	Mar-25
Reference Probe EX3DV4	SN: 3503	07-Mar-24 (No. EX3-3503_Mar24)	Mar-25
DAE4	SN: 601	30-Jan-24 (No. DAE4-601_Jan24)	Jan-25

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
Power sensor HP 8481A	SN: MY41093315	07-Oct-15 (in house check Oct-22)	In house check: Oct-24
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-22)	In house check: Oct-24
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-22)	In house check: Oct-24

	Name	Function	Signature
Calibrated by:	Joanna Lleshaj	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: May 10, 2024

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEC/IEEE 62209-1528, "Measurement Procedure For The Assessment Of Specific Absorption Rate Of Human Exposure To Radio Frequency Fields From Hand-Held And Body-Worn Wireless Communication Devices - Part 1528: Human Models, Instrumentation And Procedures (Frequency Range of 4 MHz to 10 GHz)", October 2020.
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

c) DASY System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	V52.10.4
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.7 ± 6 %	4.58 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.0 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.1 ± 6 %	4.97 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**83.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.36 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**23.7 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.8 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.00 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.2 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.8 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	49.8 Ω - 4.2 jΩ
Return Loss	- 27.5 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	57.5 Ω - 3.5 jΩ
Return Loss	- 22.3 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	54.2 Ω + 0.0 jΩ
Return Loss	- 28.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.206 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

Extended Calibration
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

D5GHzV2 SN: 1085 - Head

Date of Measurement	Frequency	Return Loss (dB)	Δ%	Impedance Real (Ω)	ΔΩ	Impedance Imaginary (jΩ)	ΔΩ
5/8/2024	5250 MHz	-27.5		49.8		-4.2	
5/8/2025		-26.4	-4.0	51.6	1.8	-3.6	0.6
5/8/2024	5600 MHz	-22.3		57.5		-3.5	
5/8/2025		-23.7	6.3	56.2	-1.3	-3.8	-0.3
5/8/2024	5750 MHz	-28.0		54.2		0.0	
5/8/2025		-26.9	-3.9	53.6	-0.6	-1.5	-1.5

Date: 08.05.2024

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.58 S/m; ε_r = 36.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.97 S/m; ε_r = 36.1; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 5.14 S/m; ε_r = 35.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

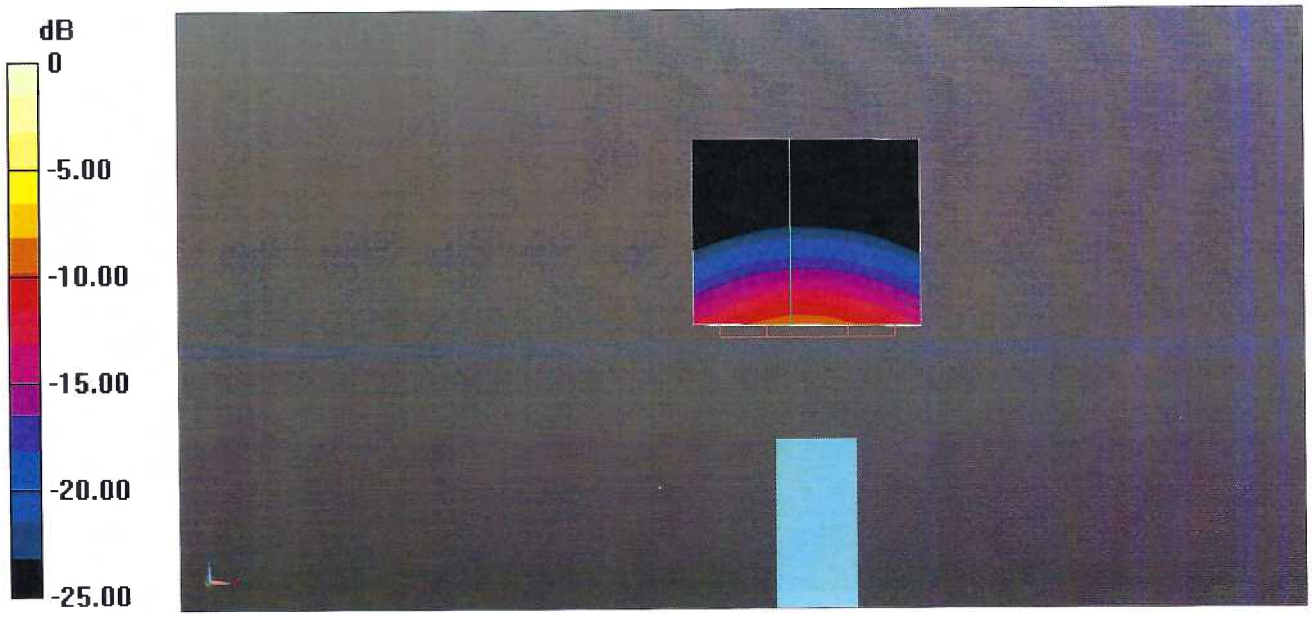
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.39, 5.39, 5.39) @ 5250 MHz, ConvF(5, 5, 5) @ 5600 MHz, ConvF(4.98, 4.98, 4.98) @ 5750 MHz; Calibrated: 07.03.2024
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2024
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.4(1535); SEMCAD X 14.6.14(7501)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.26 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 26.6 W/kg
SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.29 W/kg
Smallest distance from peaks to all points 3 dB below = 7.2 mm
Ratio of SAR at M2 to SAR at M1 = 71.3%
Maximum value of SAR (measured) = 18.3 W/kg

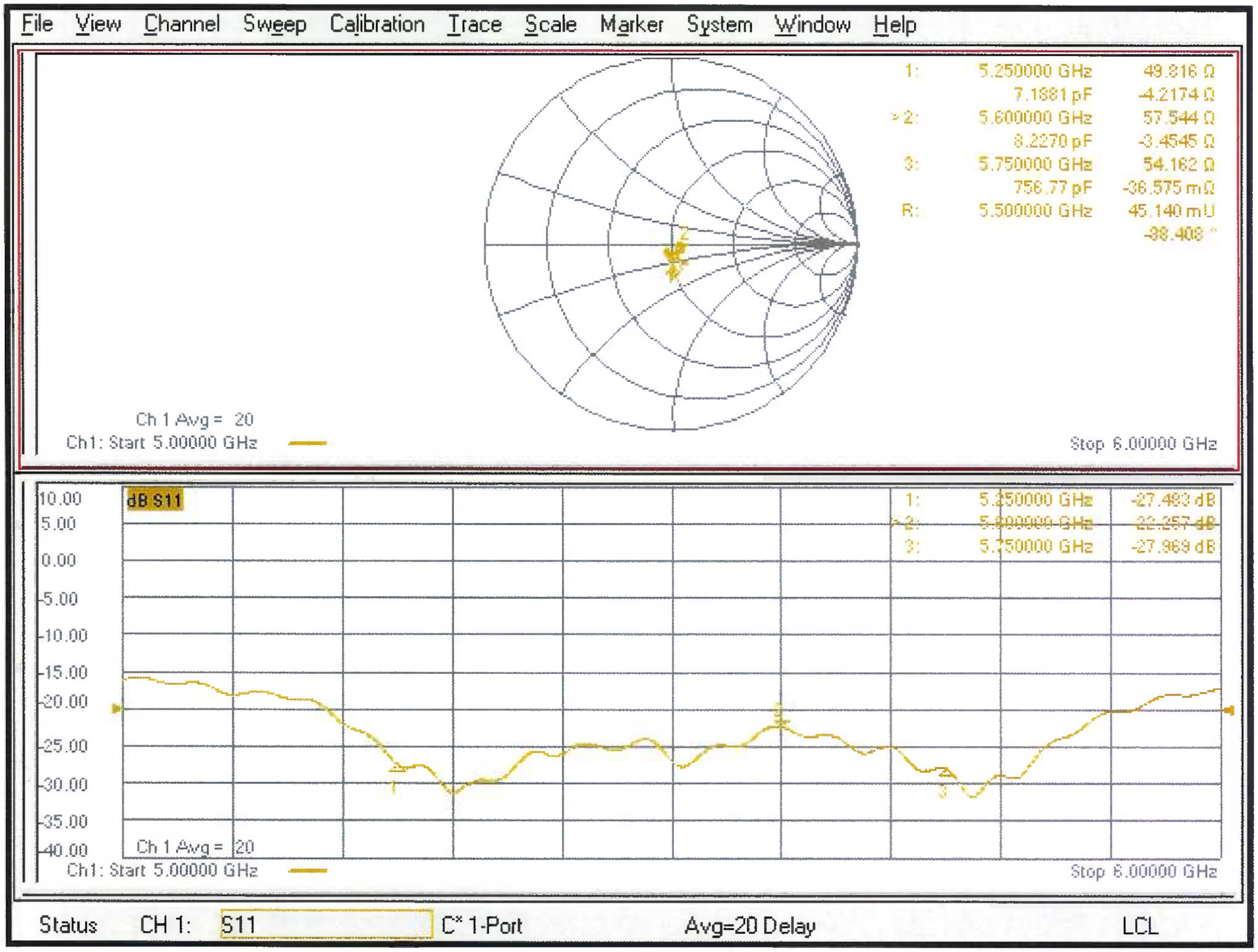
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 73.31 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 30.0 W/kg
SAR(1 g) = 8.28 W/kg; SAR(10 g) = 2.36 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 68.4%
Maximum value of SAR (measured) = 19.7 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 70.21 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 30.5 W/kg
SAR(1 g) = 8.00 W/kg; SAR(10 g) = 2.28 W/kg
Smallest distance from peaks to all points 3 dB below = 7.4 mm
Ratio of SAR at M2 to SAR at M1 = 66.6%
Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

Impedance Measurement Plot for Head TSL



Appendix F – DAE Calibration Data Sheets

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client **RF Exposure Lab**
San Marcos - USA

Certificate No: DAE4-1321_Jan25

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1321
Calibration procedure(s)	QA CAL-06.v30 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	January 15, 2025

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	27-Aug-24 (No:40547)	Aug-25
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	23-Jan-24 (in house check)	In house check: Jan-25
Calibrator Box V2.1	SE UMS 006 AA 1002	23-Jan-24 (in house check)	In house check: Jan-25

	Name	Function	Signature
Calibrated by:	Adrian Gehring	Laboratory Technician	
Approved by:	Sven Kühn	Technical Manager	

Issued: January 15, 2025

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	405.014 ± 0.02% (k=2)	404.843 ± 0.02% (k=2)	405.255 ± 0.02% (k=2)
Low Range	3.96697 ± 1.50% (k=2)	3.99549 ± 1.50% (k=2)	4.00450 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	243.0 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	199994.22	-0.43	-0.00
Channel X	+ Input	20003.49	0.94	0.00
Channel X	- Input	-19996.93	5.07	-0.03
Channel Y	+ Input	199992.70	-1.82	-0.00
Channel Y	+ Input	20001.78	-0.69	-0.00
Channel Y	- Input	-20003.67	-1.61	0.01
Channel Z	+ Input	199991.69	-2.75	-0.00
Channel Z	+ Input	20000.76	-1.84	-0.01
Channel Z	- Input	-20001.40	0.59	-0.00

Low Range		Reading (µV)	Difference (µV)	Error (%)
Channel X	+ Input	2001.09	-0.25	-0.01
Channel X	+ Input	203.11	1.43	0.71
Channel X	- Input	-197.68	0.33	-0.17
Channel Y	+ Input	2002.02	0.58	0.03
Channel Y	+ Input	200.50	-1.28	-0.64
Channel Y	- Input	-198.75	-0.71	0.36
Channel Z	+ Input	2001.53	0.20	0.01
Channel Z	+ Input	199.63	-1.99	-0.99
Channel Z	- Input	-198.77	-0.66	0.33

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	16.74	15.11
	- 200	-14.39	-16.02
Channel Y	200	1.53	1.31
	- 200	-3.33	-3.57
Channel Z	200	-13.96	-13.73
	- 200	12.34	12.23

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	0.73	-4.12
Channel Y	200	8.66	-	2.84
Channel Z	200	10.59	5.92	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15470	14859
Channel Y	15581	15755
Channel Z	16358	16164

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	1.26	0.17	2.34	0.48
Channel Y	-0.55	-1.80	0.88	0.56
Channel Z	-0.28	-1.50	1.50	0.58

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

Appendix G – Phantom Calibration Data Sheets

Schmid & Partner Engineering AG

s p e a g

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Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 4.0
Type No	QD OVA 001 B
Series No	1003 and higher
Manufacturer	Untersee Composites Knebelstrasse 8 CH-8268 Mannenbach, Switzerland

Tests

Complete tests were made on the prototype units QD OVA 001 AA 1001, QD OVA 001 AB 1002, pre-series units QD OVA 001 BA 1003-1005 as well as on the series units QD OVA 001 BB, 1006 ff.

Test	Requirement	Details	Units tested
Material thickness	Compliant with the standard requirements	Bottom plate: 2.0mm +/- 0.2mm	all
Material parameters	Dielectric parameters for required frequencies	< 6 GHz: Rel. permittivity = 4 +/-1, Loss tangent ≤ 0.05	Material sample
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions.	DGBE based simulating liquids. Observe Technical Note for material compatibility.	Equivalent phantoms, Material sample
Shape	Thickness of bottom material, Internal dimensions, Sagging compatible with standards from minimum frequency	Bottom elliptical 600 x 400 mm Depth 190 mm, Shape is within tolerance for filling height up to 155 mm, Eventual sagging is reduced or eliminated by support via DUT	Prototypes, Sample testing

Standards

[1] CENELEC EN 50361-2001, « Basic standard for the measurement of the Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz) », July 2001

[2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003

[3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005

[4] IEC 62209 – 2, Draft, "Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices – Human models, Instrumentation and Procedures – Part 2: Procedure to determine the Specific Absorption Rate (SAR) in the head and body for 30 MHz to 6 GHz Handheld and Body-Mounted Devices used in close proximity to the Body.", February 2005

[5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition January 2001

Based on the tests above, we certify that this item is in compliance with the standards [1] to [5] if operated according to the specific requirements and considering the thickness. The dimensions are fully compliant with [4] from 30 MHz to 6 GHz. For the other standards, the minimum lower frequency limit is limited due to the dimensional requirements ([1]: 450 MHz, [2]: 300 MHz, [3]: 800 MHz, [5]: 375 MHz) and possibly further by the dimensions of the DUT.

Date 28.4.2008 **Signature / Stamp**

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Appendix H – Validation Summary

Per FCC KDB 865664 D02 v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue equivalent media for system validation according to the procedures outlined in FCC KDB 865664 D01 v01r04 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point using the system that normally operates with the probe for routine SAR measurements and according to the required tissue equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

Table H-1
SAR System Validation Summary

SAR System #	Freq. (MHz)	Date	Probe S/N	Probe Type	Probe Cal. Point		Cond. (σ)	Perm. (ε_r)	CW Validation			Modulation Validation		
									Sens-itivity	Probe Linearity	Probe Isotropy	Modulation Type	Duty Factor	PAR
2	2450	01/28/2025	7530	EX3DV4	2450	Head	1.82	39.11	Pass	Pass	Pass	OFDM/TDD	Pass	Pass
2	5250	01/28/2025	7530	EX3DV4	5250	Head	4.73	35.65	Pass	Pass	Pass	OFDM	N/A	Pass
2	5600	01/28/2025	7530	EX3DV4	5600	Head	5.10	35.22	Pass	Pass	Pass	OFDM	N/A	Pass
2	5750	01/28/2025	7530	EX3DV4	5750	Head	5.29	35.01	Pass	Pass	Pass	OFDM	N/A	Pass

Antenna Data Sheet

Antenna Manufacturer Information:

Antenna(s) are manufactured and designed at Garmin headquarters located at 1200 E. 151st Street, Olathe, KS, 66062, USA. Garmin is an antenna manufacturer that specializes in antenna construction and has been a technology leader in high performance antenna design for over thirty years. State-of-the art equipment is used to design, measure, and analyze new designs that are superior to competitor designs and highly proprietary in nature.

Antenna Description:

This data sheet contains the antenna gain information for the B04281-A1/A2 for Garmin Model B04281. The approximate operational frequency band of these technologies is given, and the maximum gain within the frequency band is shown in table 1.

Table 1 Antenna Gain:

Antenna Model Number	Antenna Type	Antenna Maximum Gain @ Frequency	Antenna Approximate Frequency Band
B04281-A1	Inverted F	5.24 dBi @ 2480MHz	2402 to 2480 MHz
B04281-A2	Loop	0.08 dBi @ 5755 MHz	5725 to 5850 MHz

Additional Information:

Contact Garmin for other information regarding antenna design, dimensions, cable length, etc.