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: inReach Mini 3

	Información (Information)
Tipo de equipo (Equipment type)	Portable Digital Transceiver
Marca (Brand)	Garmin GARMIN
Modelo (Model)	AA4998
Tecnología o modulación (Technology or modulation)	ANT (GFSK), BLE (GMSK)
Frecuencias (Frequencies)	ANT (2402MHz-2480MHz), BLE (2402MHz- 2480MHz)
Ganancia de antena (dBi) (Antenna gain (dBi)	ANT PIFA (-0.01 dBi), BLE PIFA (-0.01 dBi)
P.i.r.e. (E.I R P.)	ANT (-3.55dBm, 0.44mW), BLE (3dBm, 1.99mW),
Módulos (Modules)	BT , BLE

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.

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 3 and RSS-GEN Issue 5

Application For Grant of Certification

Model: AA4998

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

FCC ID: IPH-A4998
IC: 1792A-A4998

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062
Dan Irish
Lead Compliance Engineer

Test Report Number: 250910
Test Date: September 10, 2025 – September 30, 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

Revision 2 Issued October 27, 2025 – TCB review corrections.

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 3, 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: AA4998

FCC ID: IPH-A4998 IC: 1792A-A4998

Operating Frequency Range: 2402-2480 MHz

AA4998 was chosen for transmitter configuration testing and used for final measurements.

Operational communication modes 2 - 3:

Mode	Power (Watts)	99% OBW (kHz)	6-dB OBW (kHz)
Mode 2: BT BLE 1M (GMSK)	0.002	1,045.5	699.0
Mode 3: BT BLE 2M (GMSK)	0.002	2,037.5	1,166.7

This report addresses EUT Operations as Digital Transmission System using transmitter modulations in modes 2 - 3.

Note, the production device utilizes a non-user accessible integral antenna system with -0.01 dBi gain.

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Band Emissions 15.205, RSS-GEN, RSS-247	-9.5	Complies
AC Line Emissions as per 47CFR 15.207, RSS-GEN 8.8	-15.12	Complies
Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9	-6.0	Complies
Harmonic Emissions per 47CFR 15.247, RSS-247	-3.4	Complies
Power Spectral Density per 47CFR 15.247, RSS-247	-23.0	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 3

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: AA4998

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	A04998	3609390344
EUT #2 Antenna Port Conducted	A04998	3609390347
AC/DC Wall mount power supply	AQ27A-59CFA	N/A
USB-C to C Cable, 0.5m	320-01642-00	N/A
Sub-Assy Carabiner Tether, spine 2.0	011-06468-00	N/A
Carabiner, symmetric, four-sided, 60mm gray	013-00717-00	N/A

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

The design is capable of simultaneously transmitting on the MES (Iridium) and 2.4 GHz ISM ports (either BLE or ANT, one at a time).

Software (FVIN): 0.41 or higher: Antennas: 2.4 GHz PIFA (-0.01 dBi), 1.6 GHz antenna: Quad-helical (2.01 dBi)

Environmental Conditions

Ambient Temperature	22.2° C
Relative Humidity	43.0 %
Atmospheric Pressure	1012.6 mb

Equipment Operational Modes

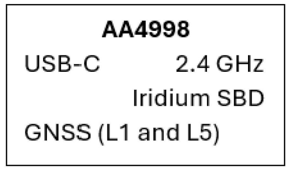
Mode	Transmitter Operation
mode 1	ANT (GFSK)
mode 2	BT BLE 1M (GMSK)
mode 3	BT BLE 2M (GMSK)

Equipment Function

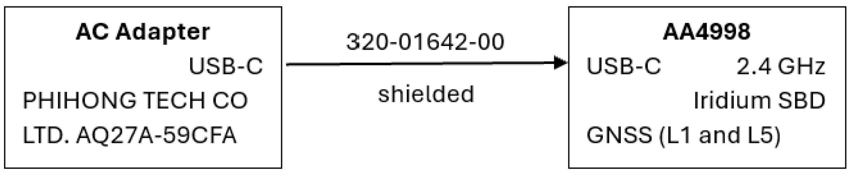
The EUT is a hand held transceiver with operation capability in the 2402-2480 MHz frequency band and 1600 MHz Satellite communications band, via inclusion of Iridium pre-certified module (FCC ID: IPH-03302; IC ID: 1792A-03302). The design provides 2.4 GHz wireless communications capabilities with compatible wireless equipment as well as offering ability to send data using the satellite link. The product operates from internal rechargeable battery only and provides USB-C interface connection port for use with AC adapter or computer equipment. Recharge of internal battery is accomplished with the use of the USB interface cable which may be connected to compliant USB interface port, AC adapter or DC adapter for battery recharge. The design utilizes internal fixed antenna system and offers no provision for antenna replacement or modification. Two samples were provided for testing, one representative of production design and the other modified for testing purposes replacing integral antenna with RF connection port. Test samples were provided with test software enabling testing personnel ability to enable transmitter function on defined channels and operational modes. The antenna modification offered testing facility ability to connect test equipment to the temporary antenna port for antenna port conducted emission testing. The EUT was arranged as described by the manufacturer for testing purposes. The EUT offers no other interface connections than those in the configuration options shown below as described by the manufacturer. For testing purposes, the EUT received power from freshly charged internal battery and configured to operate in available modes. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration

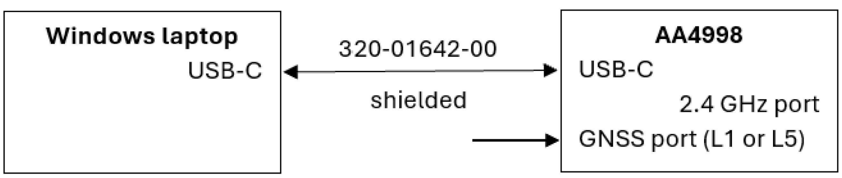
Config. 1: Battery Powered



Config 2: AC-charging



Config 3: Laptop-connected, Media Transfer Protocol (MTP), USB 2



Application for Certification

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

(2) Identification: HVIN: AA4998
FCC ID: IPH-A4998 IC: 1792A-A4998

(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 3, 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 3, 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 3, 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.

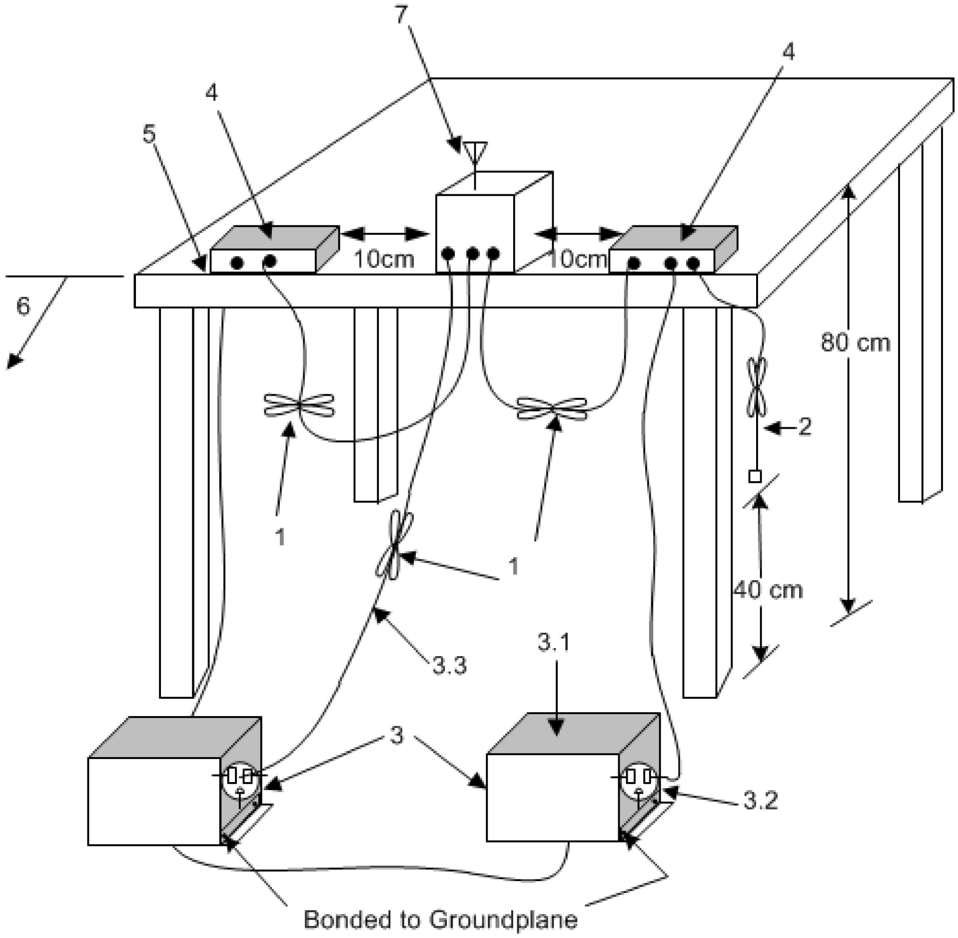
Radiated Emission Procedure

Radiated emissions testing was performed as required in 47CFR 15C, RSS-247 Issue 3, 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

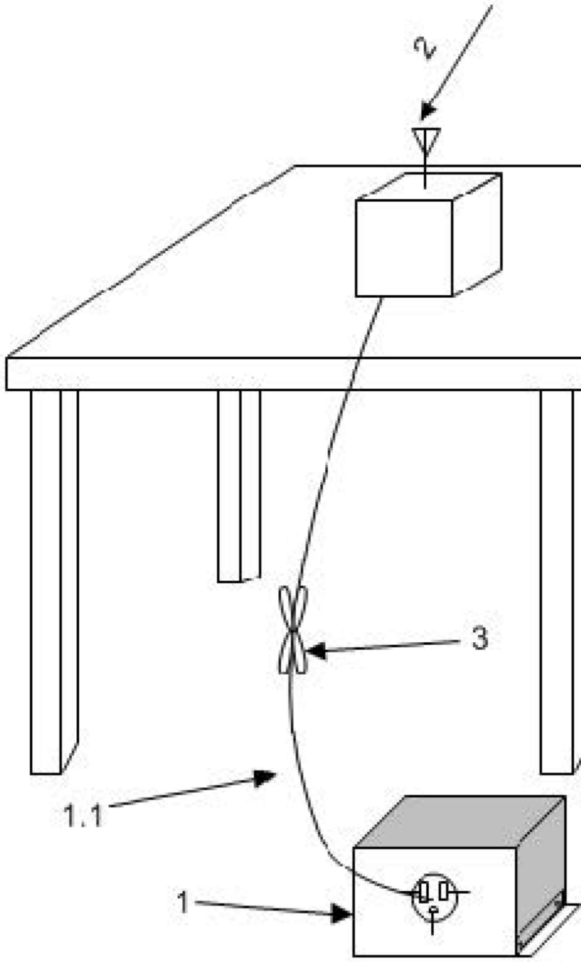
The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2020. Testing was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

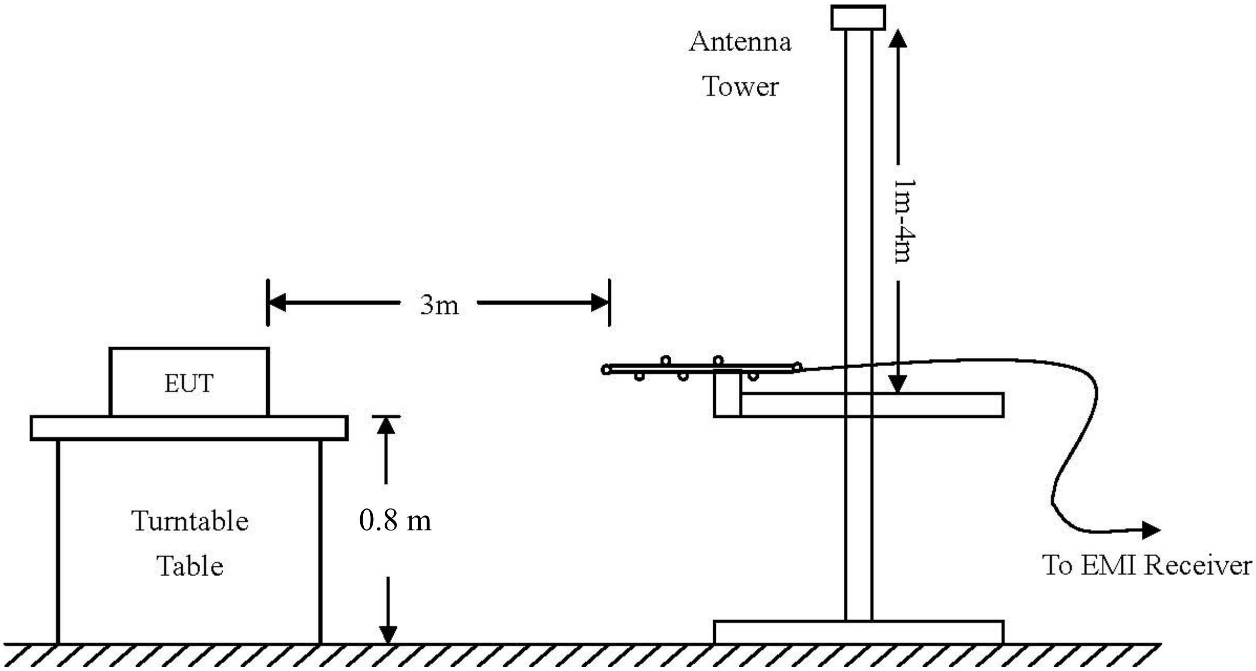
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



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:

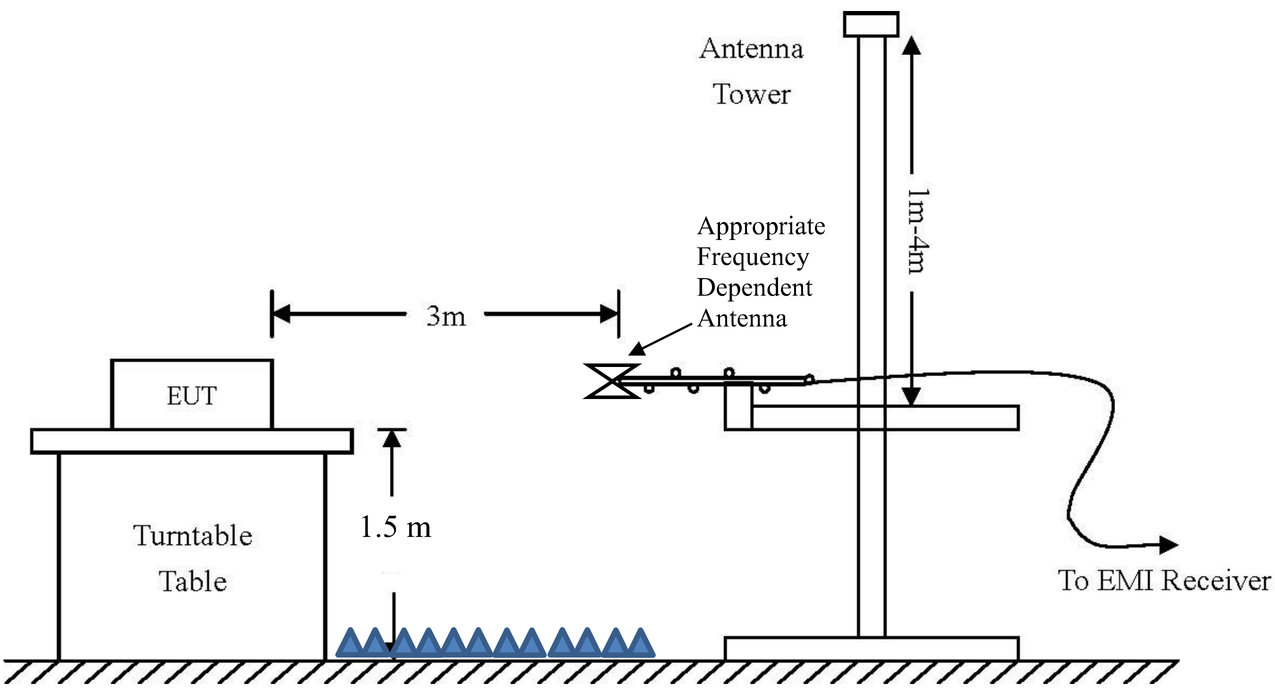
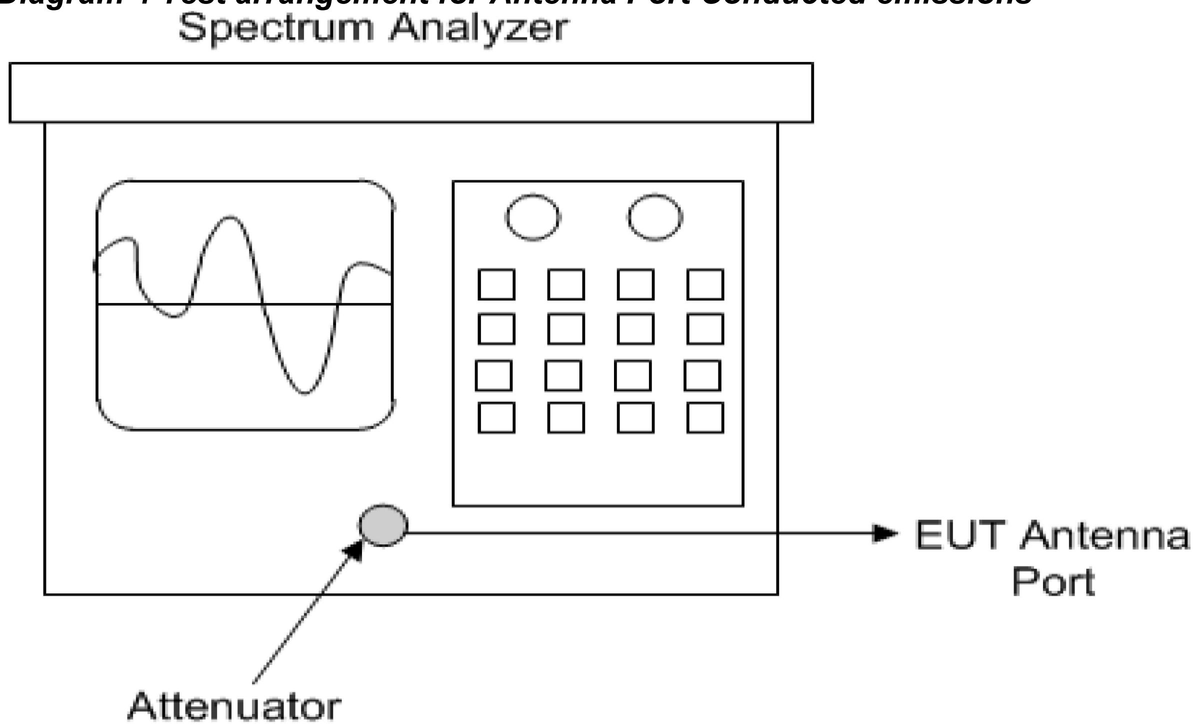


Diagram 4 Test arrangement for Antenna Port Conducted emissions



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 BLE 1M (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	44.0	30.4	43.5	30.2	54.0	-23.6	-23.8
2483.5	47.6	30.7	45.0	30.4	54.0	-23.3	-23.6
4804.0	47.7	34.0	47.6	34.0	54.0	-20.0	-20.0
4880.0	49.0	35.1	48.5	34.3	54.0	-18.9	-19.7
4960.0	48.9	35.1	48.9	34.7	54.0	-18.9	-19.3
7206.0	51.3	37.5	50.8	37.5	54.0	-16.5	-16.5
7320.0	52.3	37.8	51.7	37.8	54.0	-16.2	-16.2
7440.0	51.2	37.7	51.6	37.6	54.0	-16.3	-16.4
12010.0	56.9	43.0	57.1	43.2	54.0	-11.0	-10.8
12200.0	57.6	44.5	58.0	44.5	54.0	-9.5	-9.5
12400.0	58.3	44.5	58.1	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 BLE 2M (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	44.0	30.1	43.8	30.1	54.0	-23.9	-23.9
2483.5	47.7	30.8	45.1	30.5	54.0	-23.2	-23.5
4804.0	48.7	34.2	48.6	34.0	54.0	-19.8	-20.0
4880.0	48.4	34.6	47.9	34.4	54.0	-19.4	-19.6
4960.0	48.5	34.6	48.3	34.6	54.0	-19.4	-19.4
7206.0	51.2	37.7	51.2	37.7	54.0	-16.3	-16.3
7320.0	52.0	38.2	51.7	38.2	54.0	-15.8	-15.8
7440.0	51.2	37.6	51.0	37.6	54.0	-16.4	-16.4
12010.0	57.2	43.3	56.8	43.4	54.0	-10.7	-10.6
12200.0	58.5	44.1	57.9	44.1	54.0	-9.9	-9.9
12400.0	57.7	44.2	58.4	44.3	54.0	-9.8	-9.7

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.

Summary of Results for Radiated Emissions in Restricted Bands

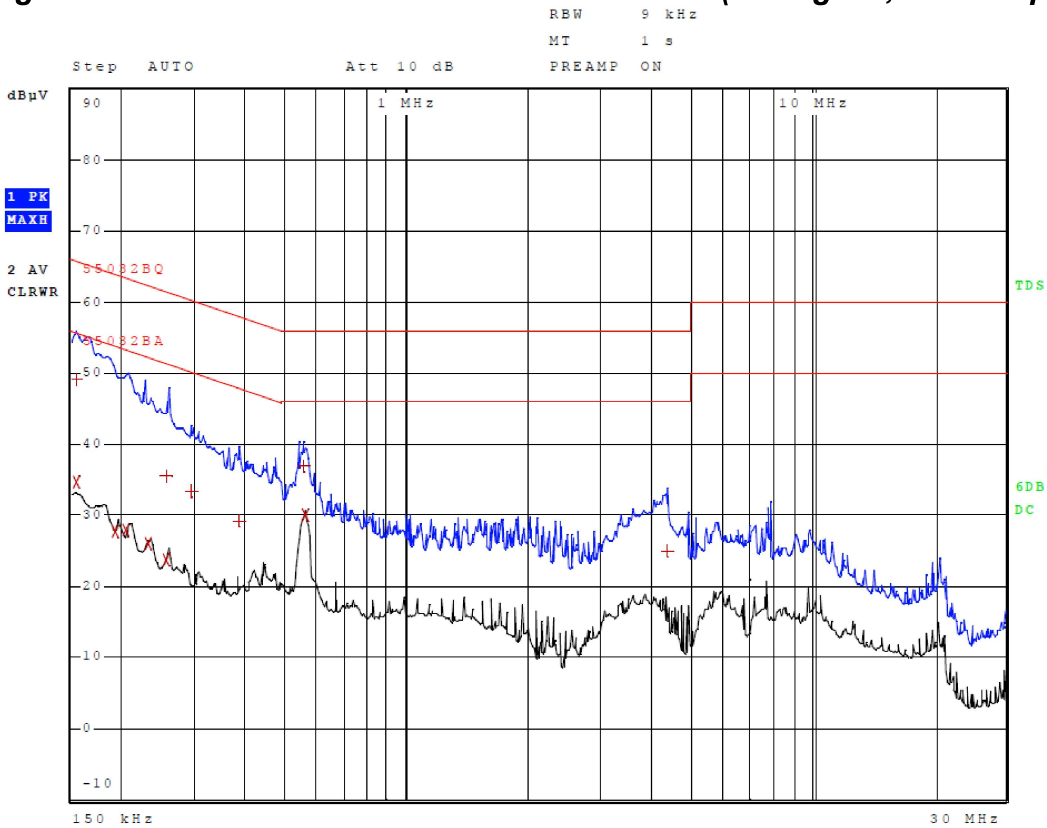
The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C and RSS-247 Issue 3 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -9.5 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average amplitudes were checked for compliance with the regulations. 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.

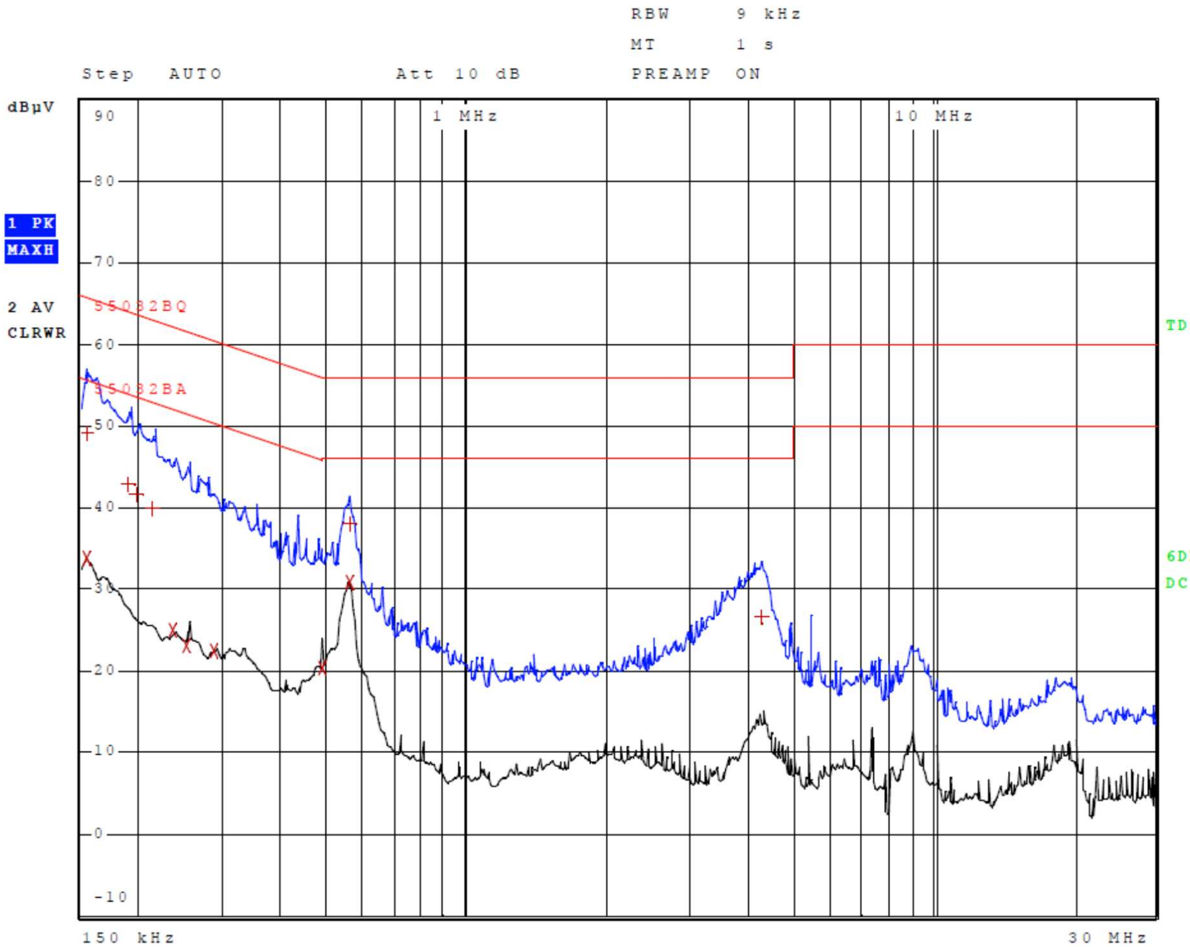
Refer to data in tables 3 and 4 and figures 1 and 2 for plots of the Configuration #3 EUT –laptop connected AC Line conducted emissions.

Figure 1 AC Line Conducted Emissions Data L1 (Config. #3, EUT – laptop)



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

Figure 2 AC Line Conducted Emissions Data L2 (Config. #3, EUT – laptop)



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

Table 3 AC Line Conducted Emissions Data L1 (Config. #3, EUT – laptop)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	34.55	Average	-21.23
1	154.000000000 kHz	49.24	Quasi Peak	-16.54
2	194.000000000 kHz	27.71	Average	-26.15
2	206.000000000 kHz	28.02	Average	-25.35
2	234.000000000 kHz	25.94	Average	-26.37
2	258.000000000 kHz	23.77	Average	-27.73
1	258.000000000 kHz	35.52	Quasi Peak	-25.97
1	294.000000000 kHz	33.39	Quasi Peak	-27.03
1	386.000000000 kHz	29.22	Quasi Peak	-28.93
1	554.000000000 kHz	36.95	Quasi Peak	-19.05
2	558.000000000 kHz	30.05	Average	-15.95
1	4.382000000 MHz	24.99	Quasi Peak	-31.01

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

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

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	33.85	Average	-21.93
1	154.000000000 kHz	49.12	Quasi Peak	-16.66
1	190.000000000 kHz	42.90	Quasi Peak	-21.14
1	198.000000000 kHz	41.66	Quasi Peak	-22.04
1	214.000000000 kHz	39.86	Quasi Peak	-23.19
2	238.000000000 kHz	25.06	Average	-27.11
2	254.000000000 kHz	23.17	Average	-28.46
2	290.000000000 kHz	22.41	Average	-28.11
2	490.000000000 kHz	20.45	Average	-25.72
2	558.000000000 kHz	30.88	Average	-15.12
1	558.000000000 kHz	37.98	Quasi Peak	-18.02
1	4.294000000 MHz	26.65	Quasi Peak	-29.35

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 #3 demonstrated a minimum margin of -15.12 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 5 and 6 for general radiated emissions data and figures 3 through 9 for plots of the radiated emissions with all Tx-on and in worst case configuration #2. The spectrum from 30MHz to 40GHz was checked for emissions and these are the maximum found.

Figure 3 Plot of General Radiated Emissions – Horizontal Polarization

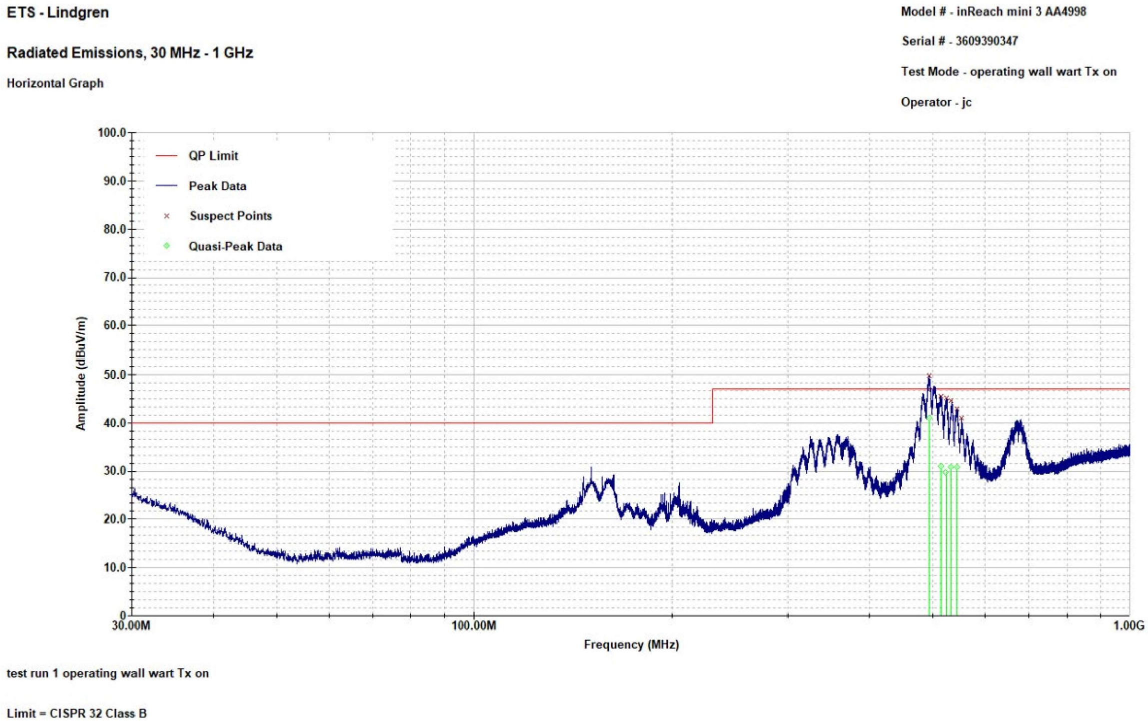


Figure 4 Plot of General Radiated Emissions – Vertical Polarization

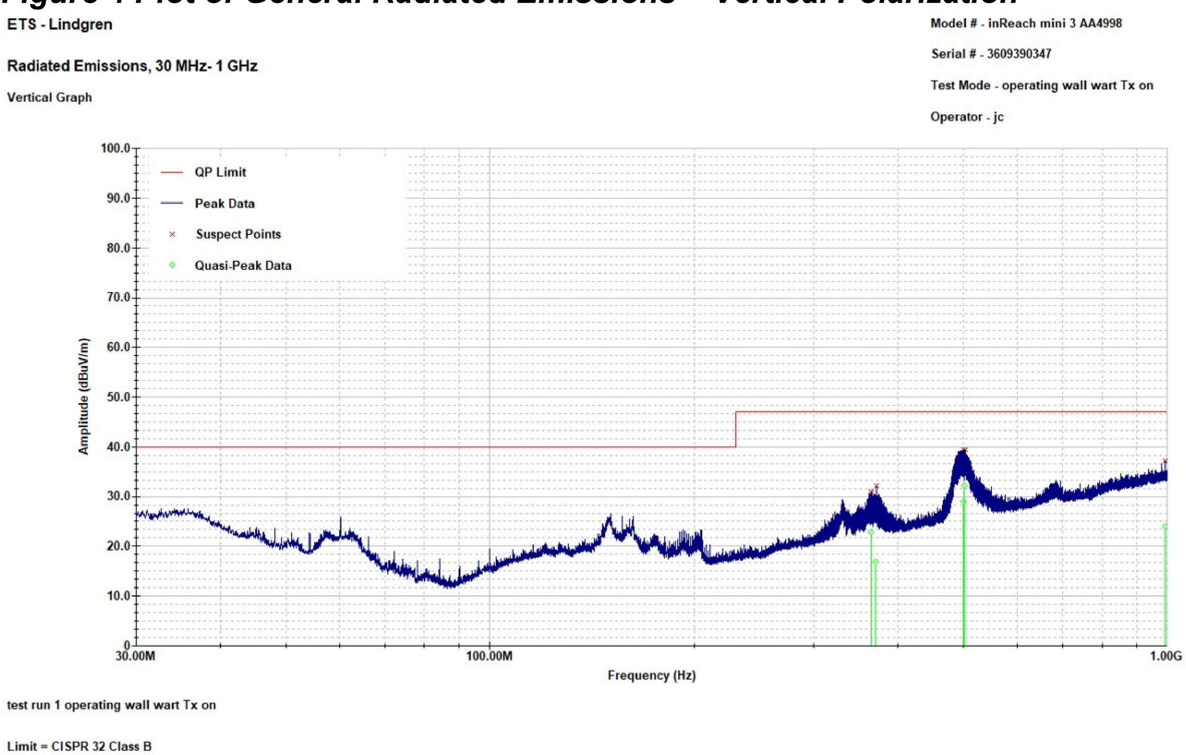


Table 5 General Radiated Emissions Data – Worst Case (Horizontal Polarization)

Frequency (MHz)	Peak (dBμV/m)	Quasi-Peak (dBμV/m)	Limit @ 3m (dBμV/m)	Margin (dBm)
493.3	45.9	41.0	47	-6.0
513.7	39.1	31.0	47	-16.0
523.1	37.3	29.8	47	-17.2
532.7	36.8	30.8	47	-16.2
543.6	37.5	30.9	47	-16.1

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

Table 6 General Radiated Emissions Data – Worst Case (Vertical Polarization)

Frequency (MHz)	Peak (dBμV/m)	Quasi-Peak (dBμV/m)	Limit @ 3m (dBμV/m)	Margin (dBm)
364.8	21.9	22.9	47	-24.1
370.9	25.2	16.9	47	-30.1
499.3	33.3	28.9	47	-18.1
501.8	28.9	32.2	47	-14.8
992.8	32.3	23.9	47	-23.1

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

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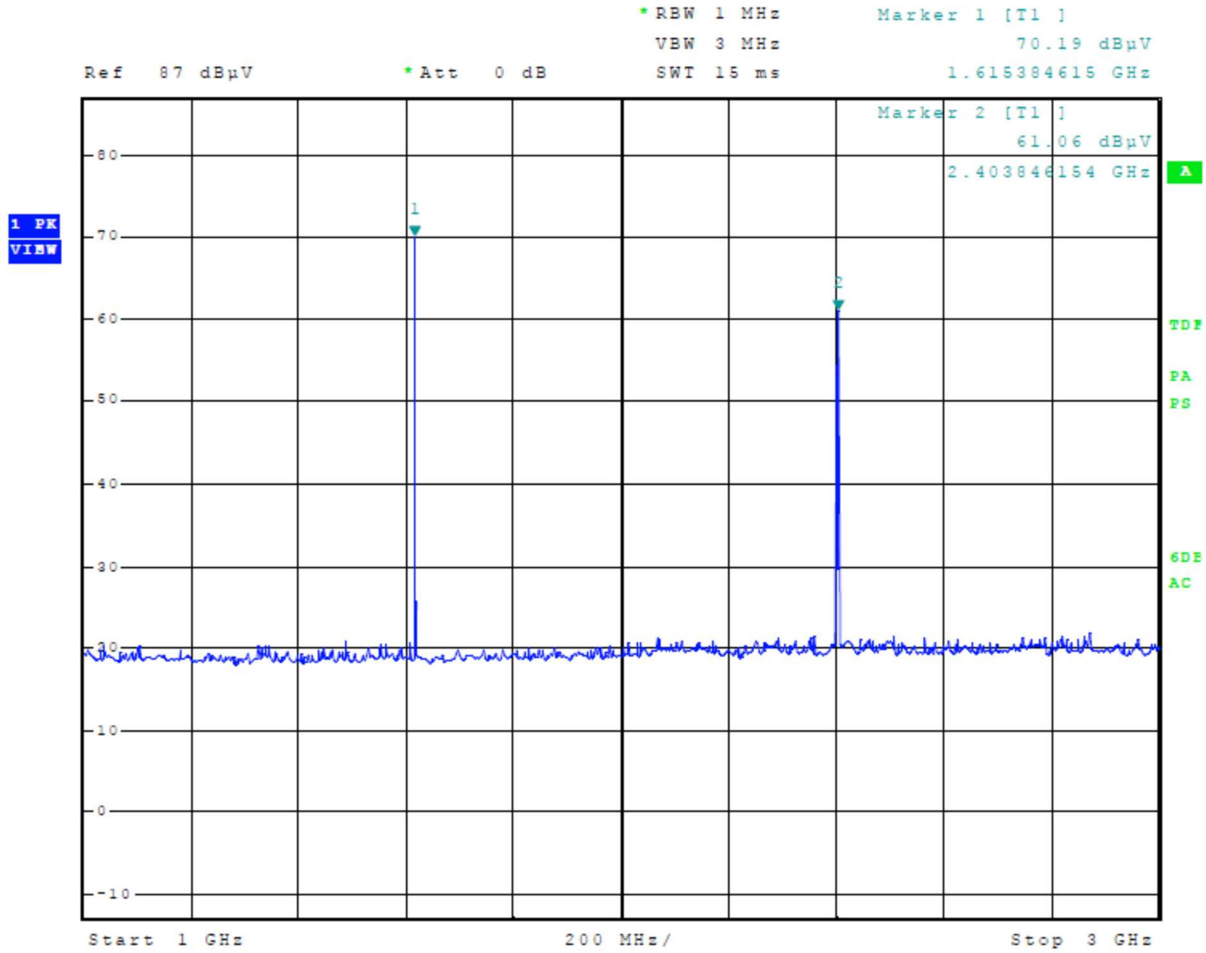
Figure 5 Plot of General Radiated Emissions (1 GHz – 3 GHz) All Tx On



Note: Marker 1 is Iridium fundamental; Marker 2 is BLE fundamental.

Figure 6 Plot of General Radiated Emissions (3 GHz – 6 GHz) All Tx On

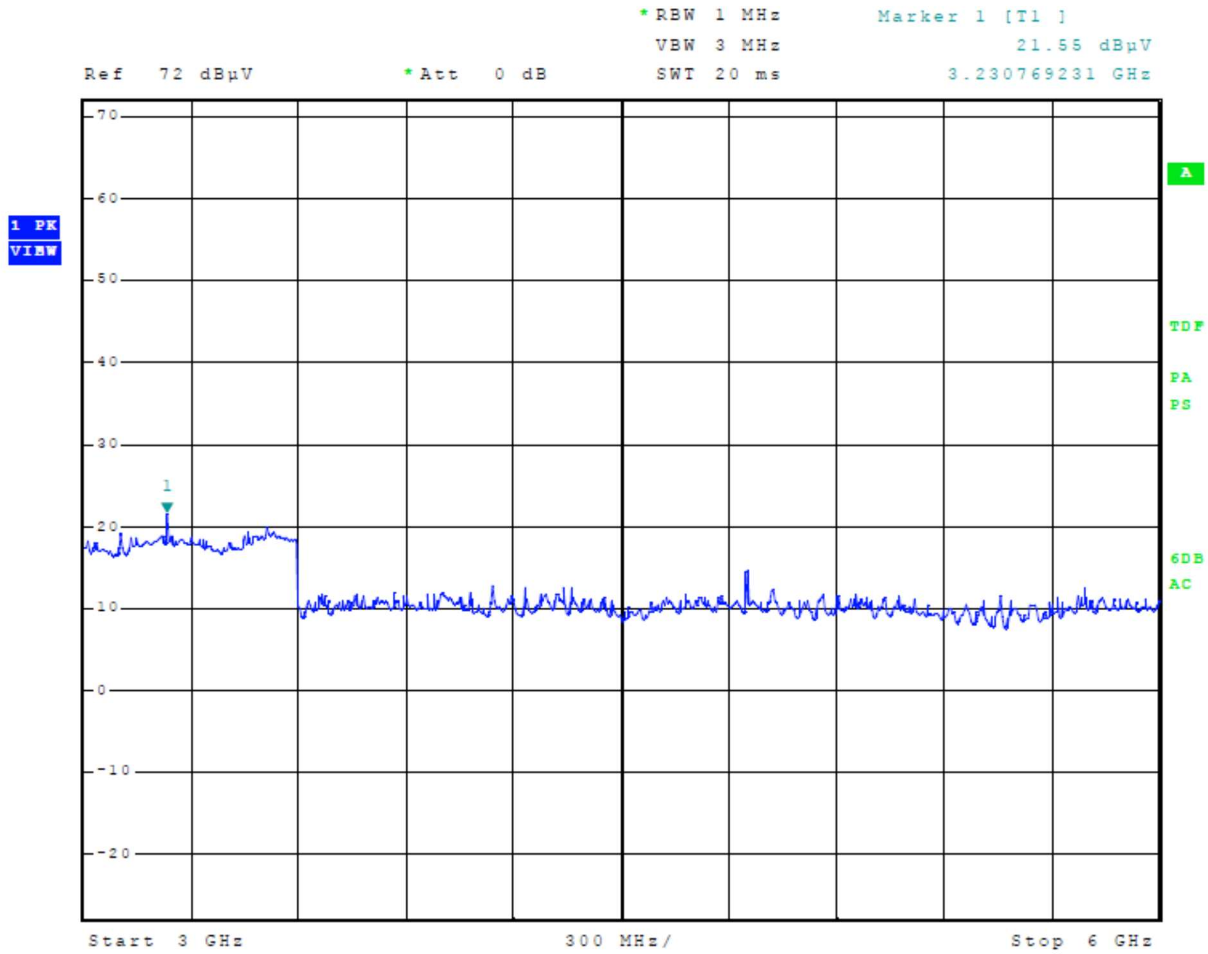


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Figure 7 Plot of General Radiated Emissions (6 GHz – 12 GHz) All Tx On

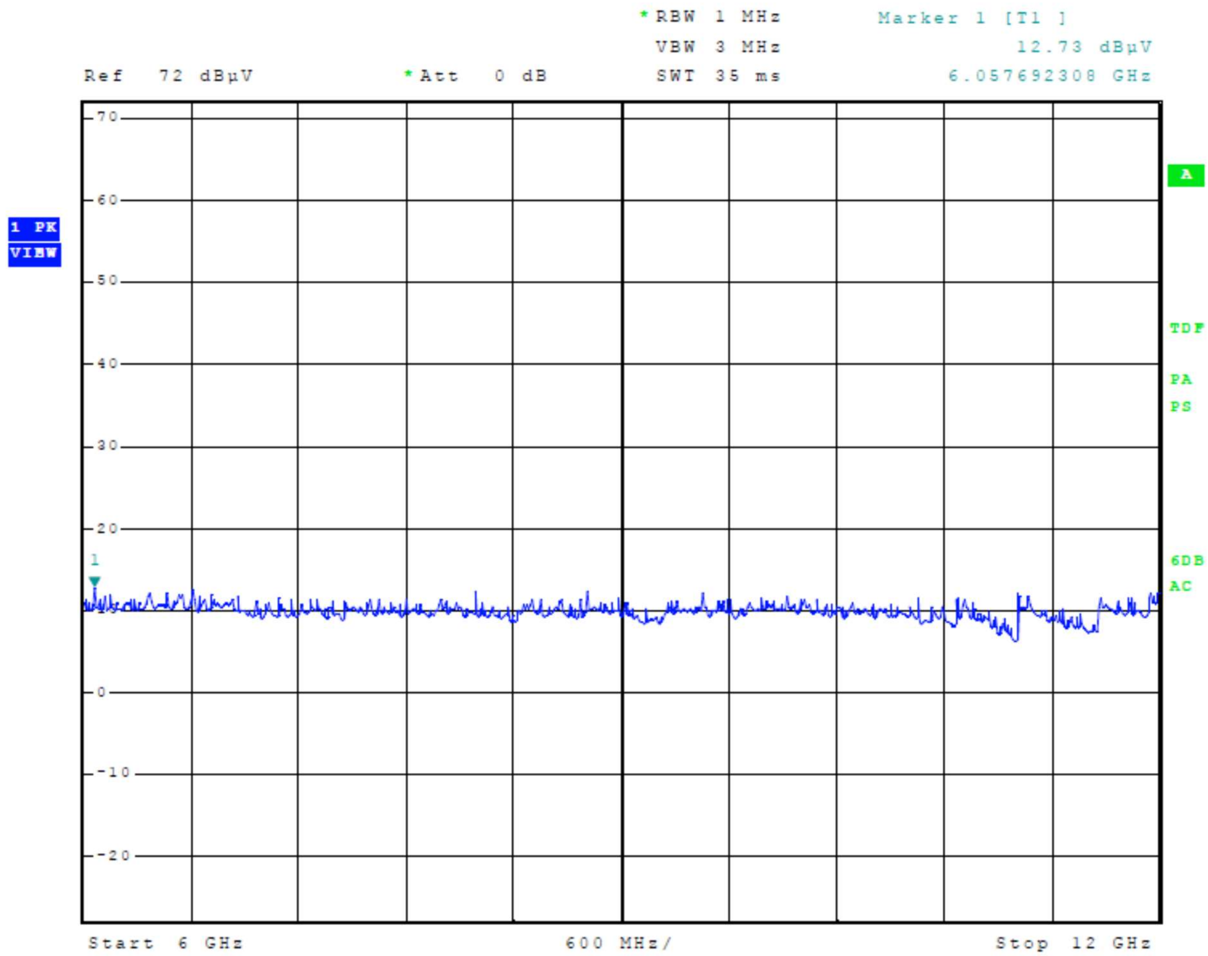


Figure 8 Plot of General Radiated Emissions (12 GHz – 18 GHz) All Tx On

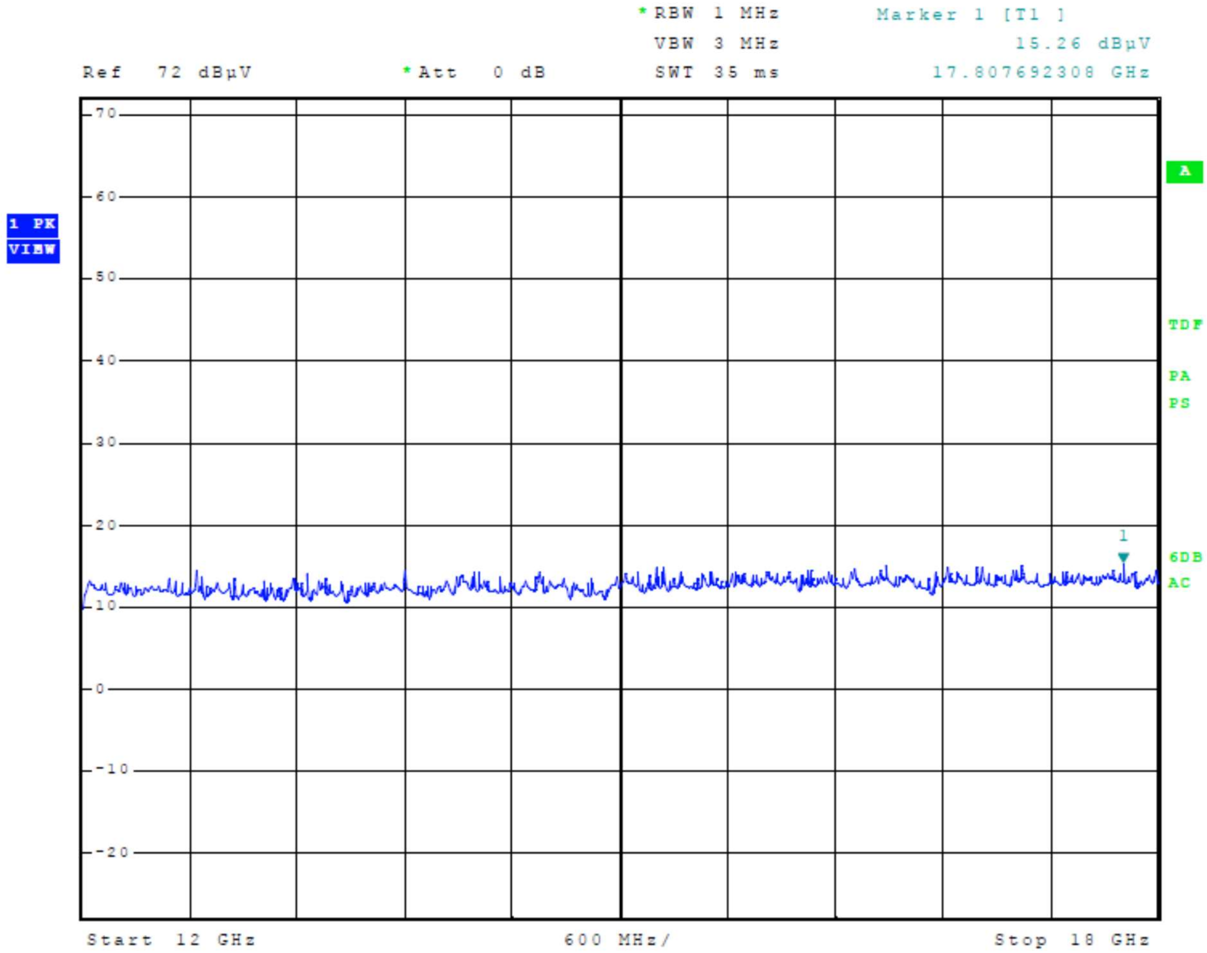
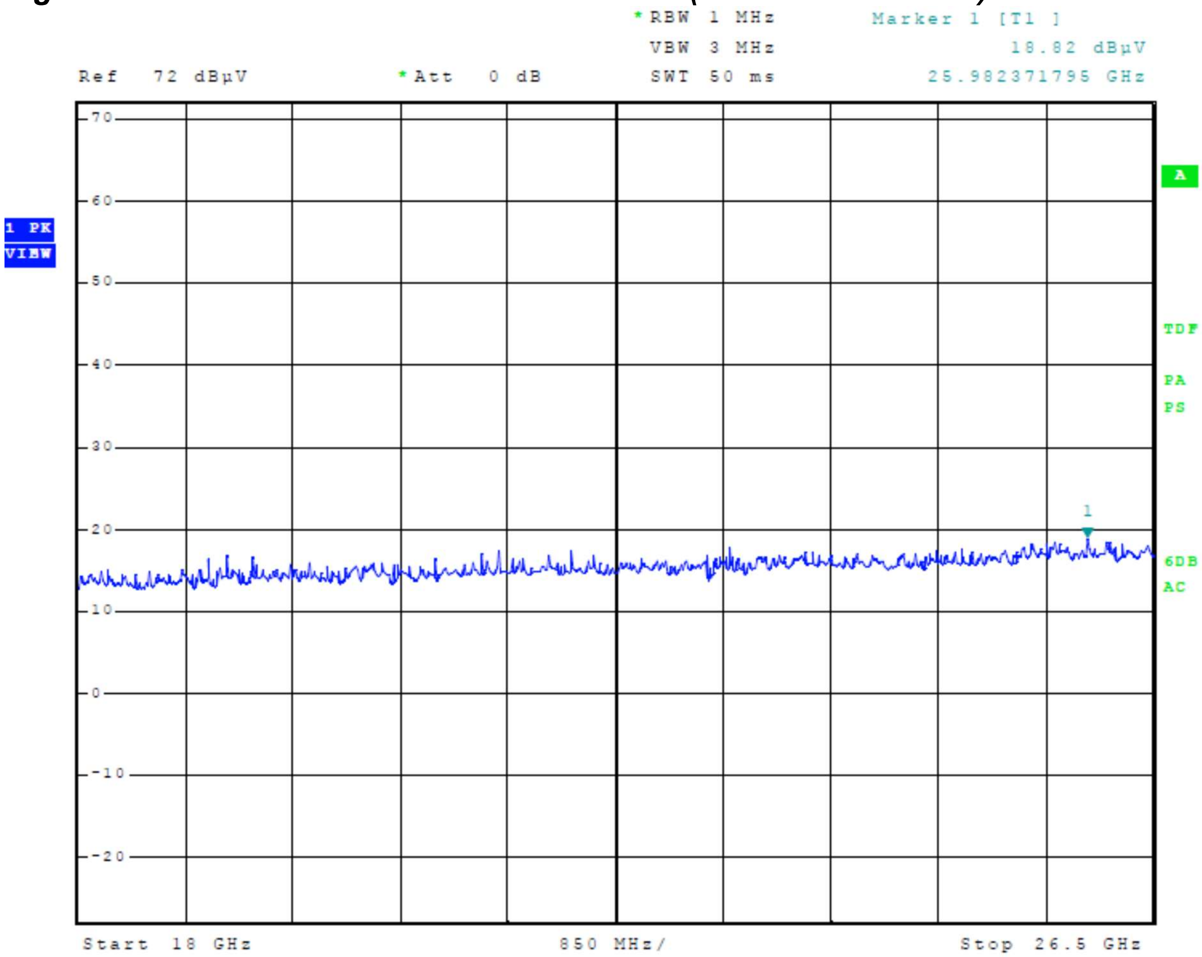


Figure 9 Plot of General Radiated Emissions (18 GHz – 26.5 GHz) All Tx On



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 3, and RSS-GEN Issue 5 Intentional Radiators. The EUT configuration demonstrated a minimum margin of -6.0 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 10 through 21.

Figure 10 Plot of Transmitter Operation in 2402-2480 MHz Mode 2, BT BLE 1M (GMSK)

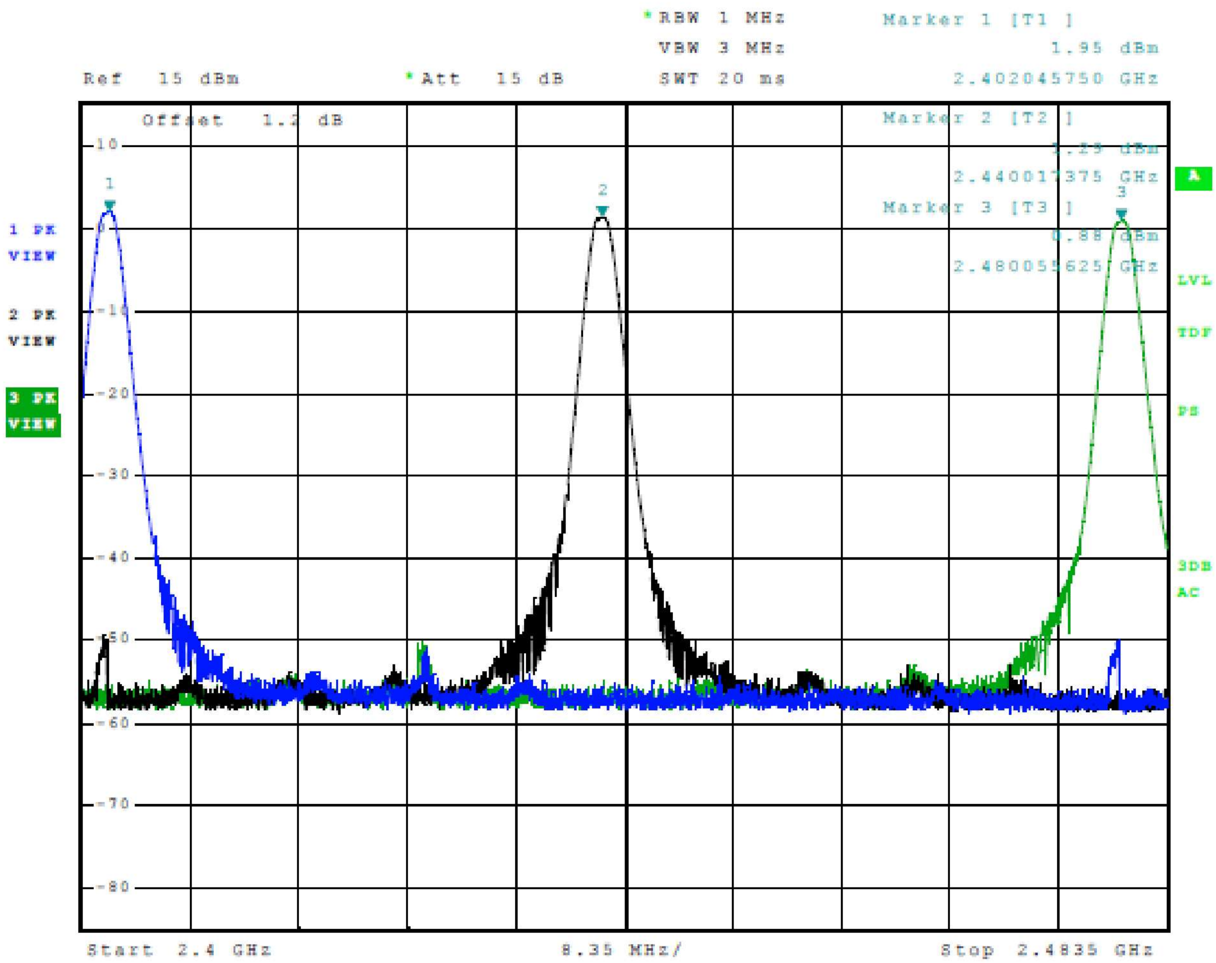


Figure 11 Plot of Transmitter Operation in 2402-2480 MHz Mode 3, BT BLE 2M (GMSK)

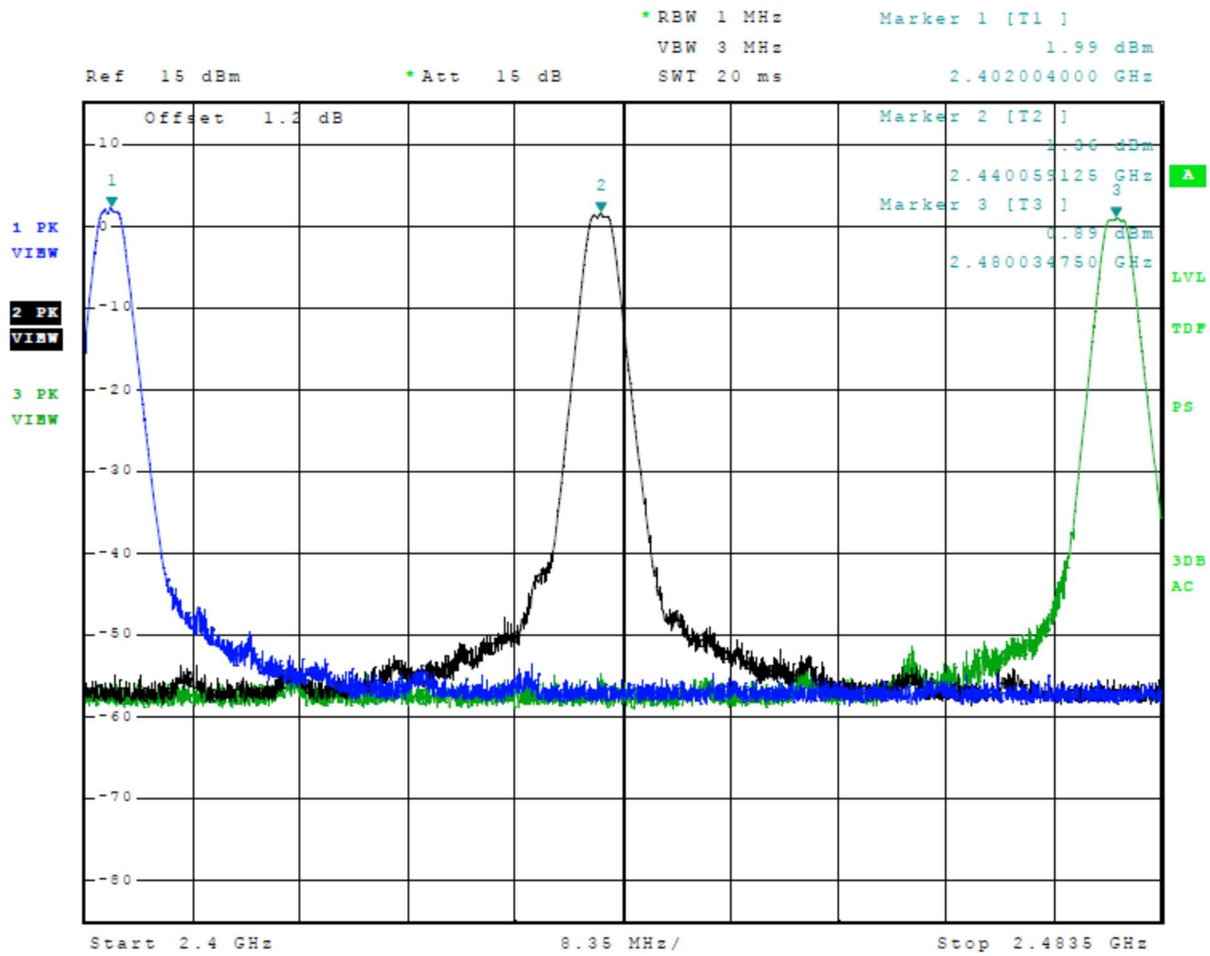


Figure 12 Plot of Emissions Low Band Edge Mode 2, BT BLE 1M (GMSK)

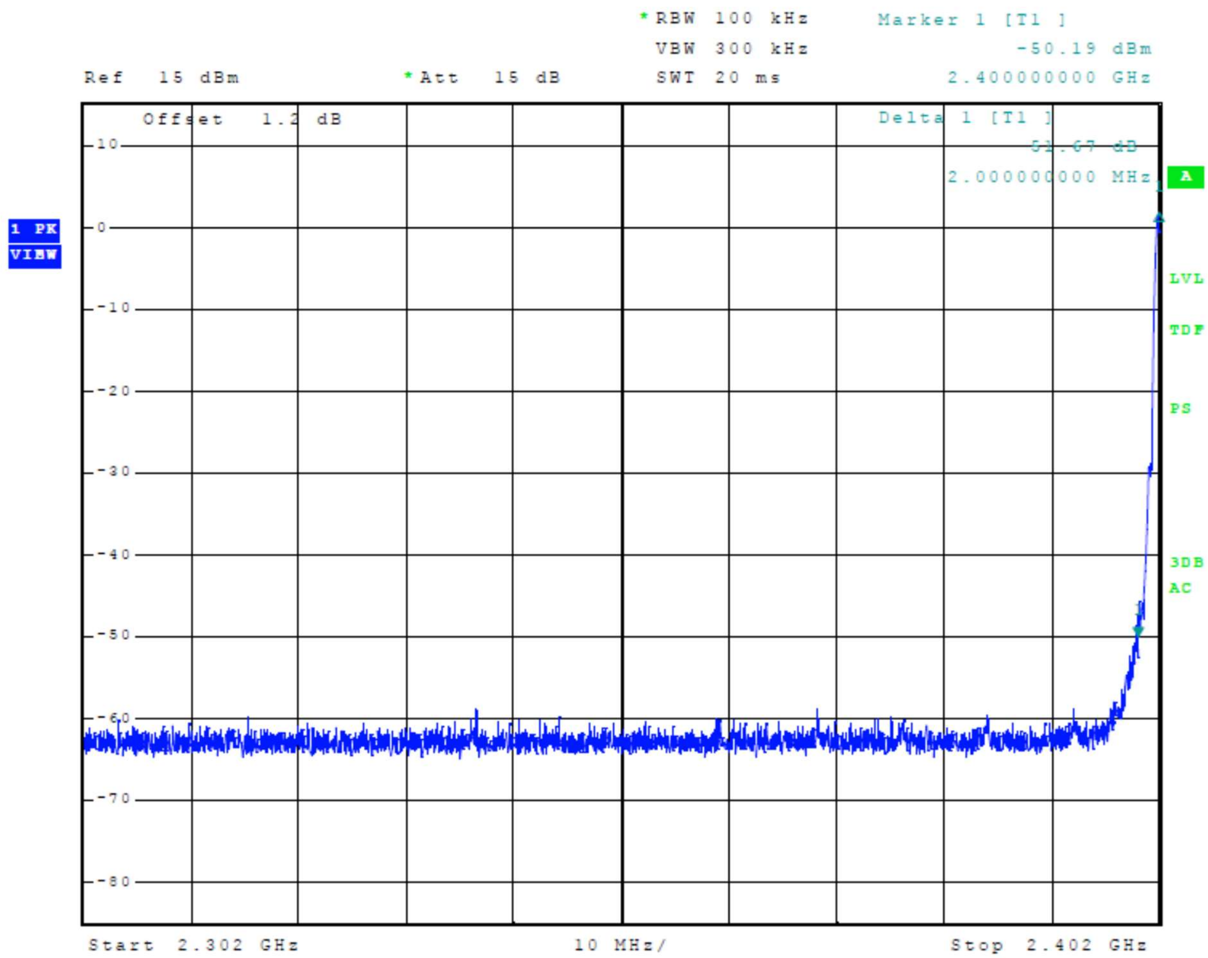


Figure 13 Plot of Emissions Low Band Edge Mode 3, BT BLE 2M (GMSK)

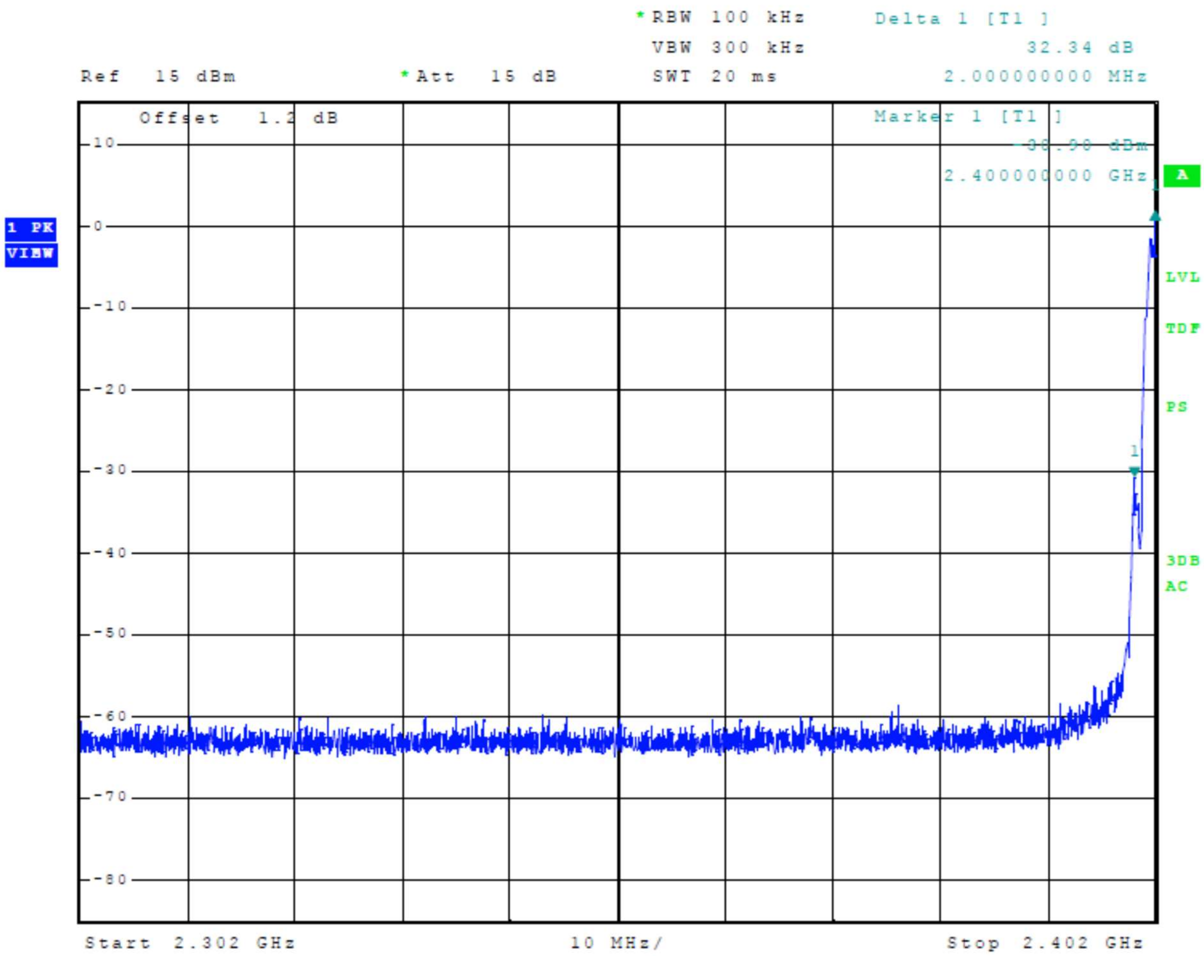


Figure 14 Plot of Transmitter Emissions High Band Edge Mode 2, BT BLE 1M (GMSK)

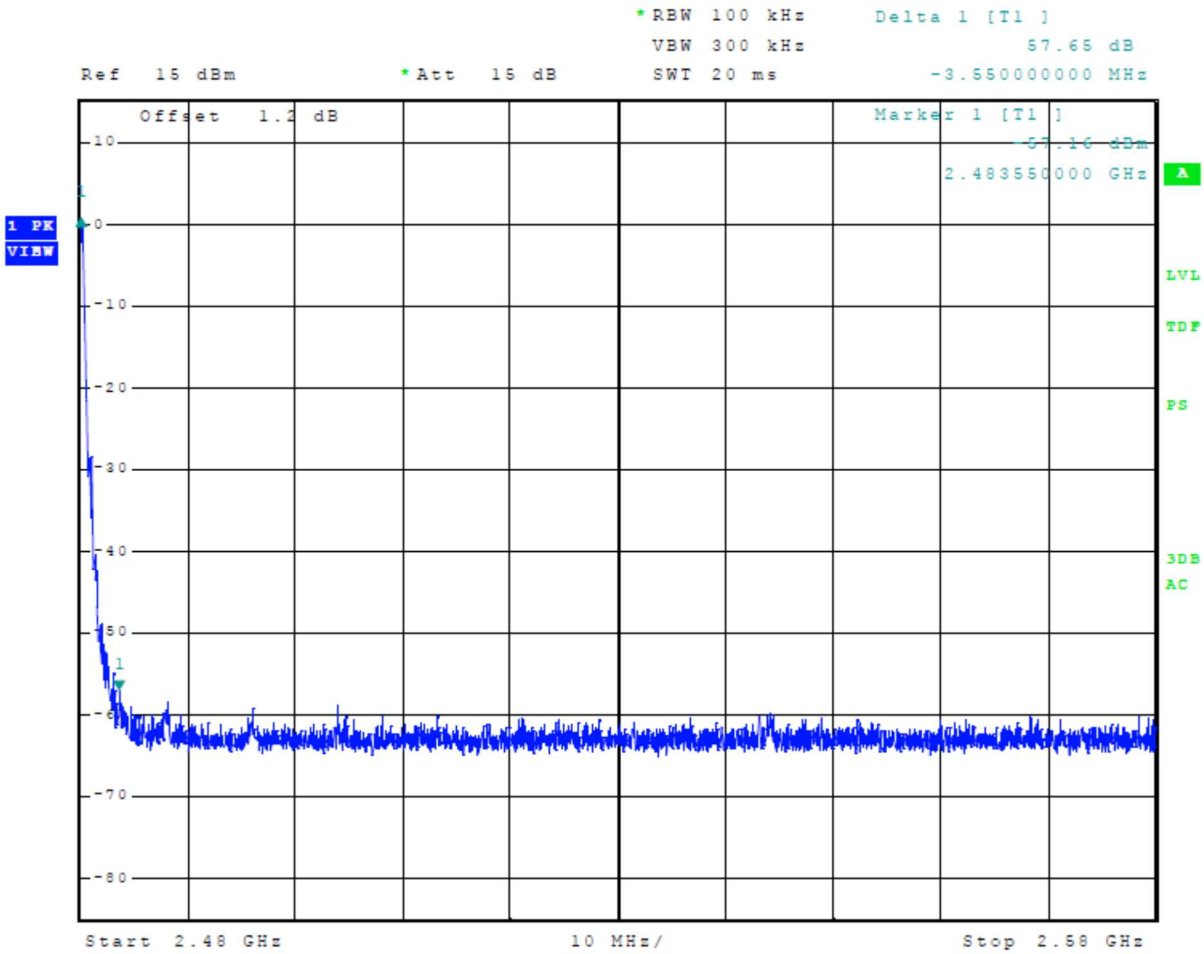


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Figure 15 Plot of Transmitter Emissions High Band Edge Mode 3, BT BLE 2M (GMSK)

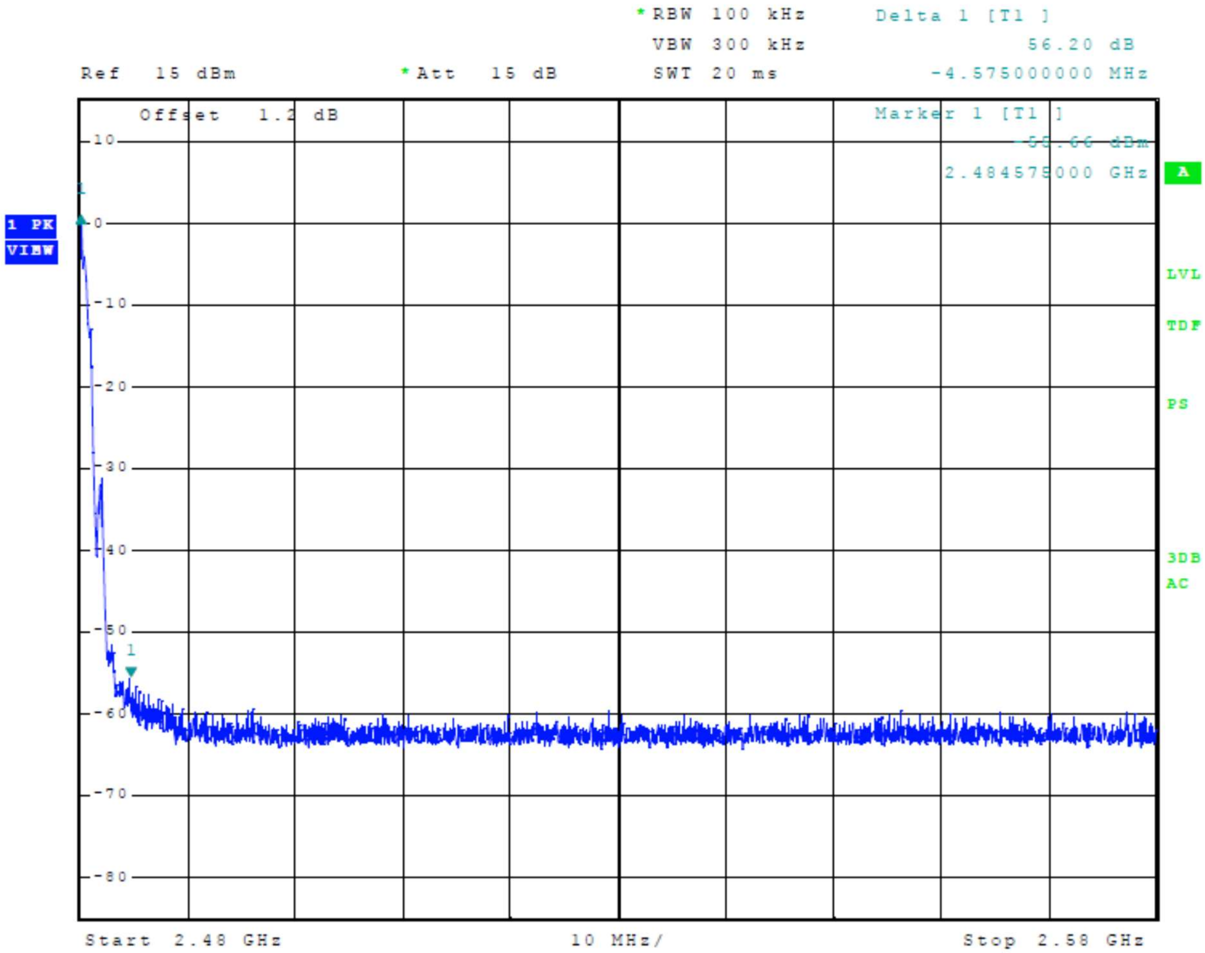


Figure 16 Plot of 6-dB Occupied Bandwidth Mode 2, BT BLE 1M (GMSK)

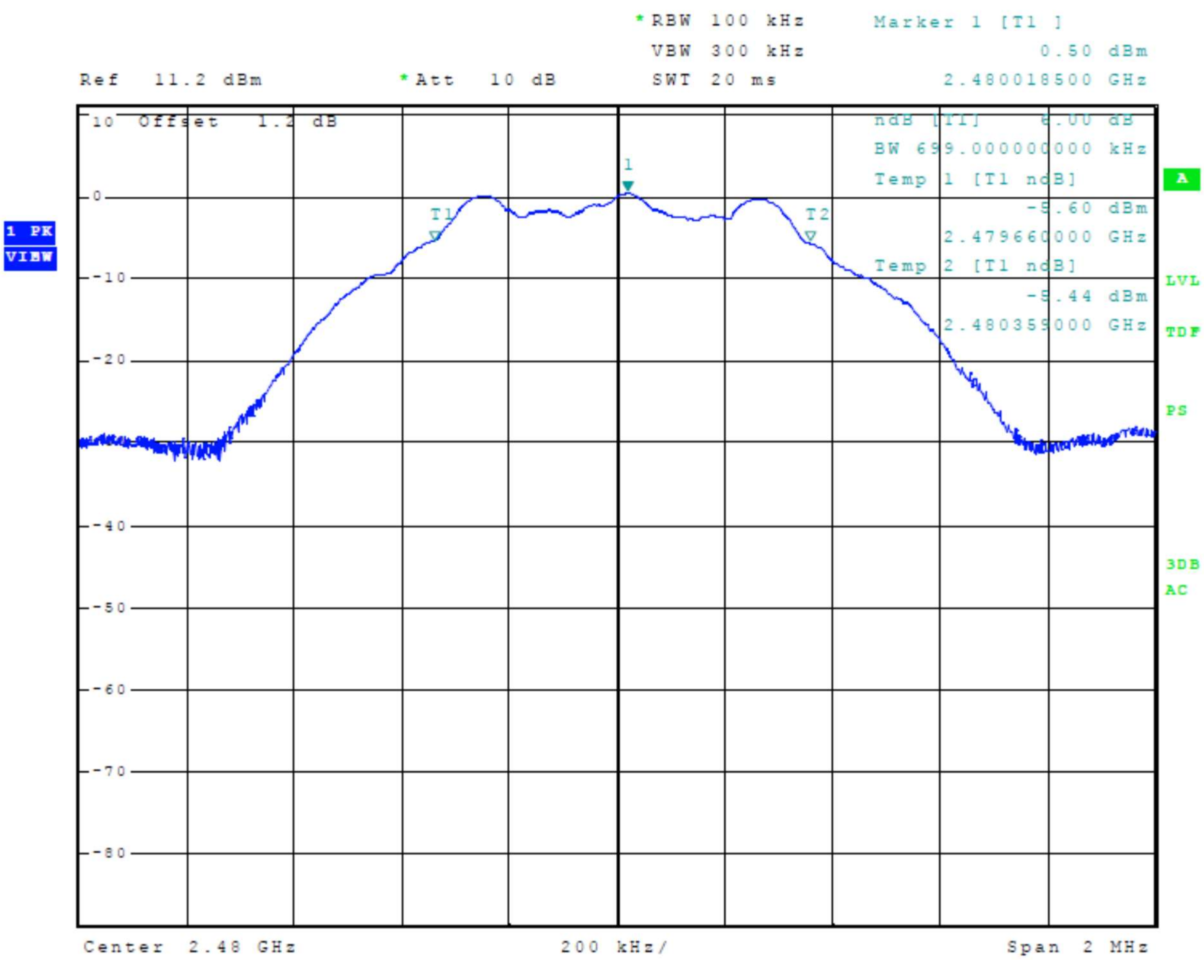


Figure 17 Plot of 99% Occupied Bandwidth Mode 2, BT BLE 1M (GMSK)

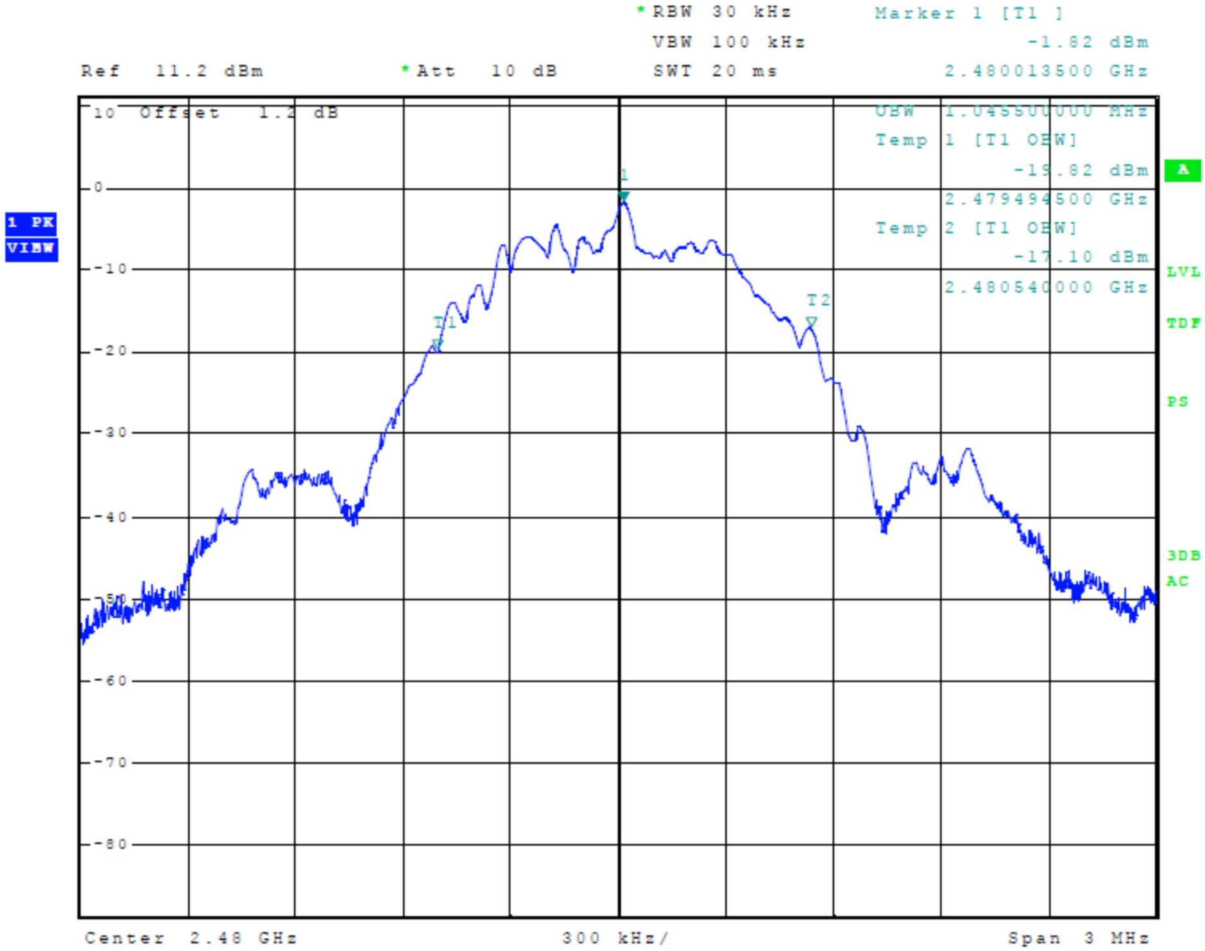


Figure 18 Plot of 6-dB Occupied Bandwidth Mode 3, BT BLE 2M (GMSK)

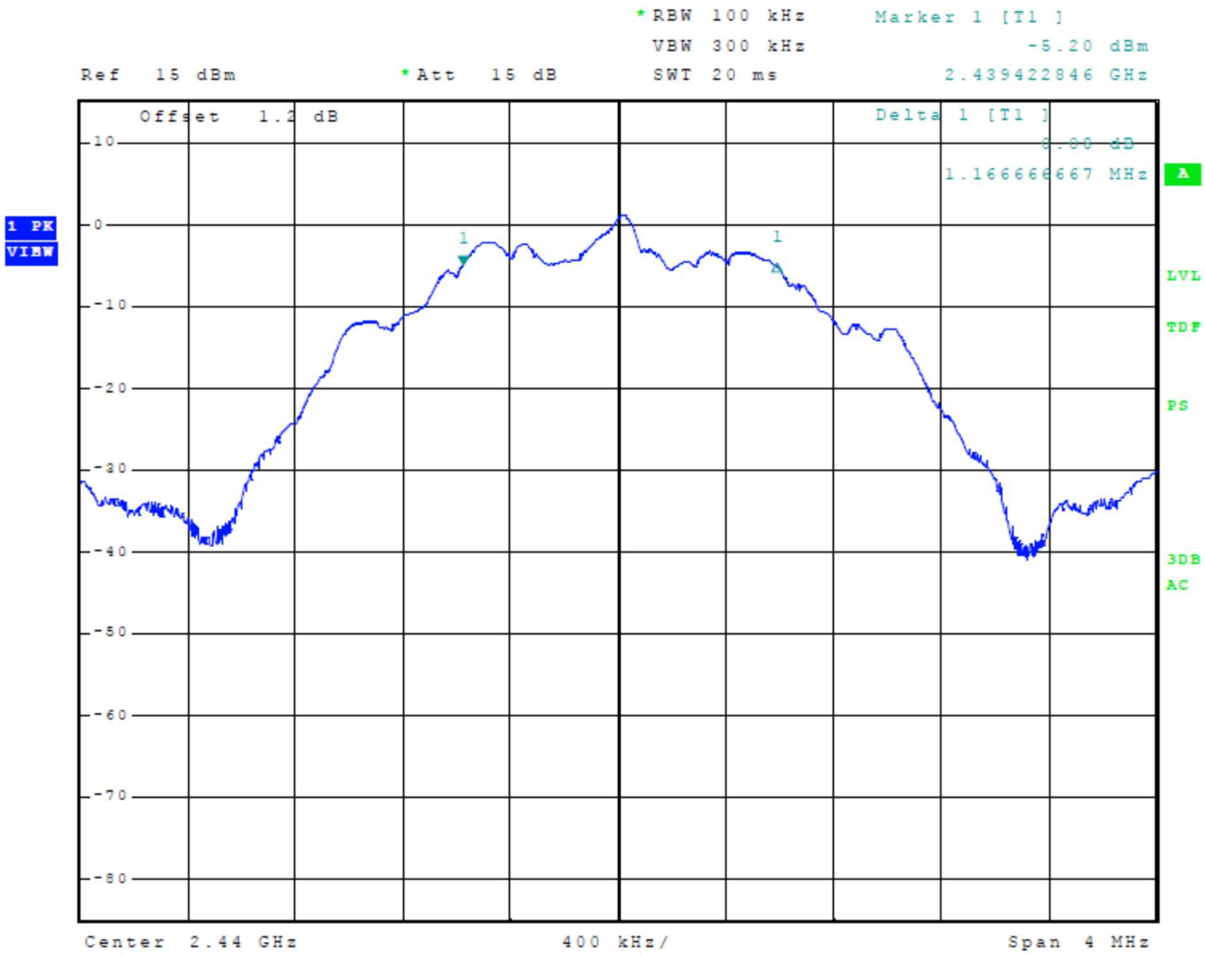


Figure 19 Plot of 99% Occupied Bandwidth Mode 3, BT BLE 2M (GMSK)

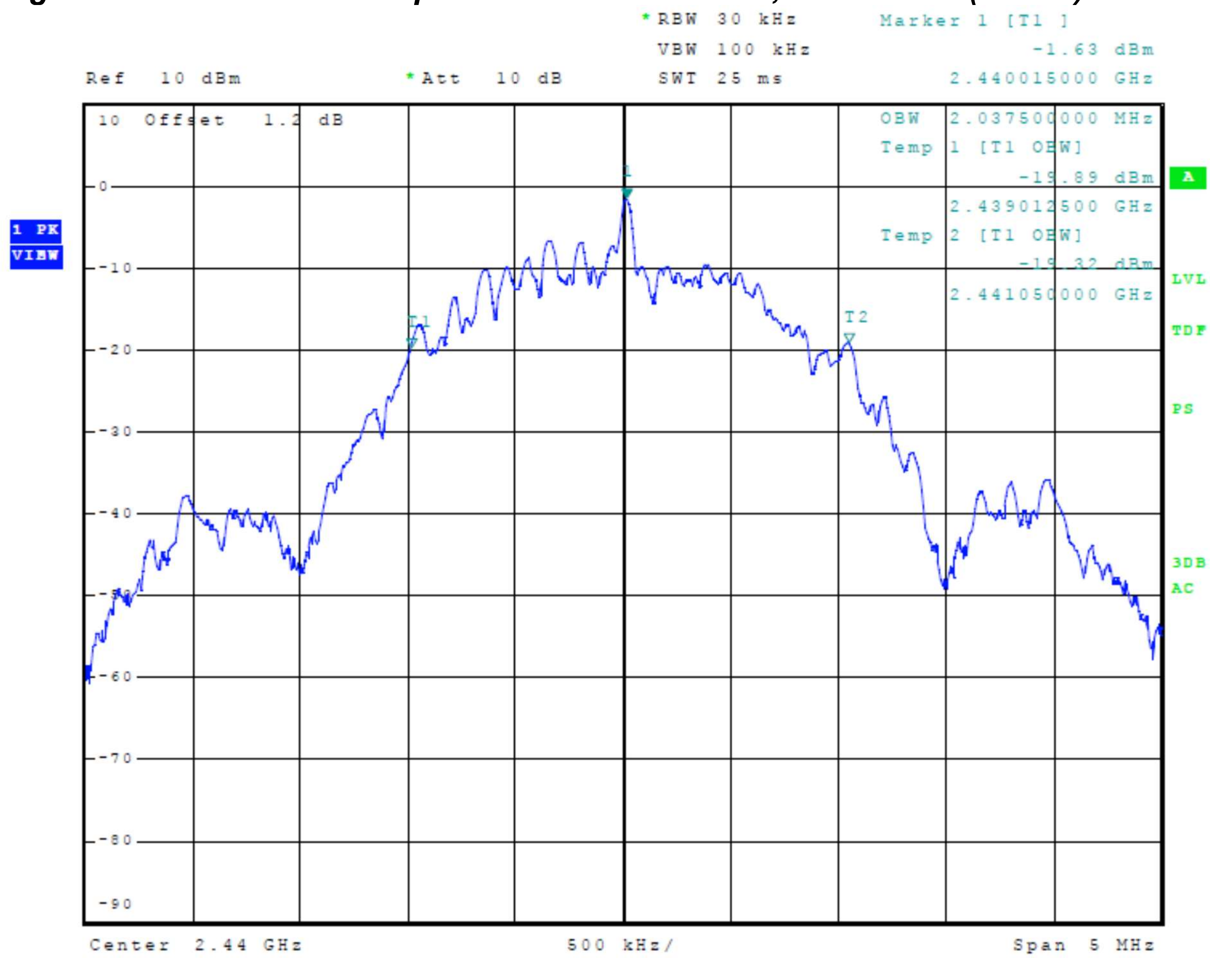


Figure 20 Plot of Transmitter Power Spectral Density Mode 2, BT BLE 1M (GMSK)

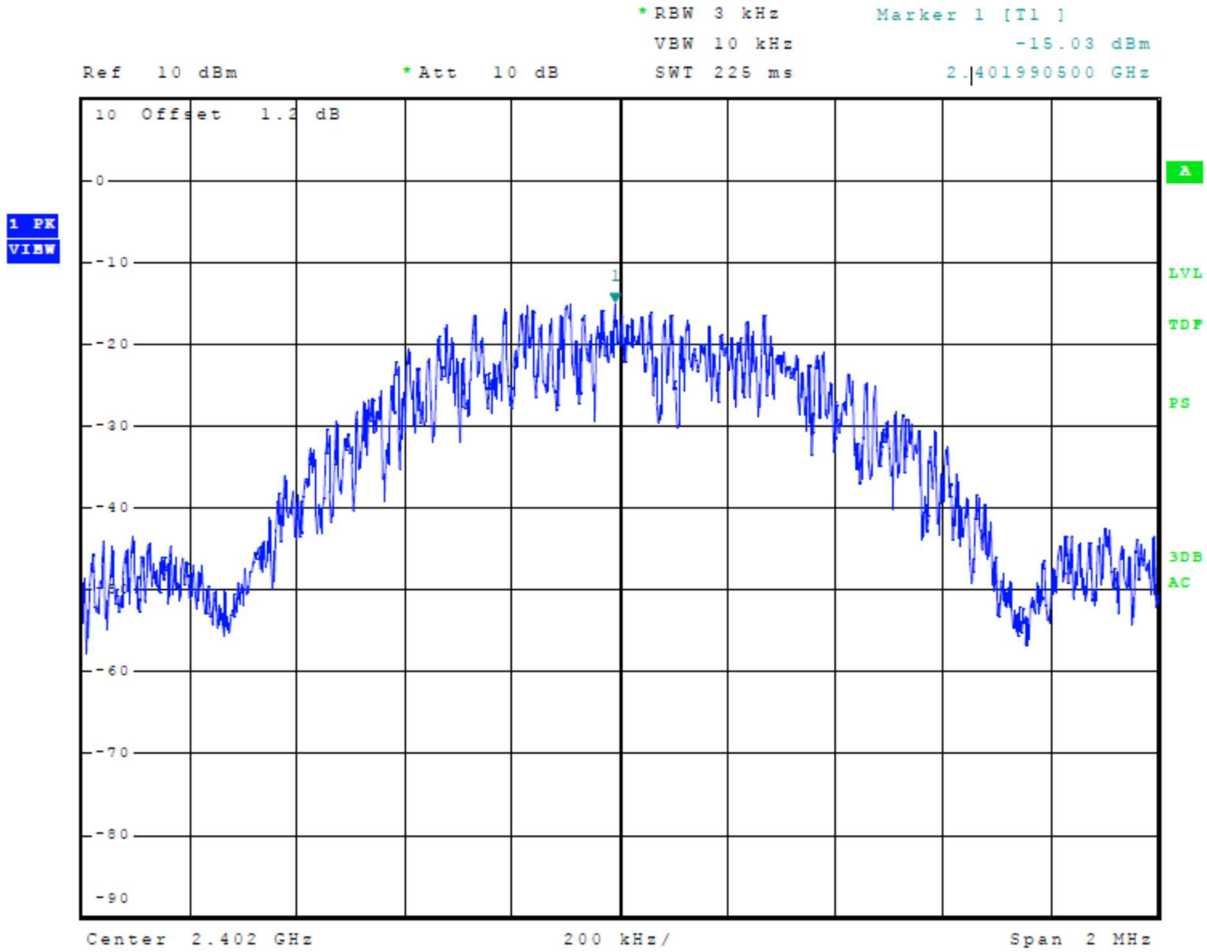
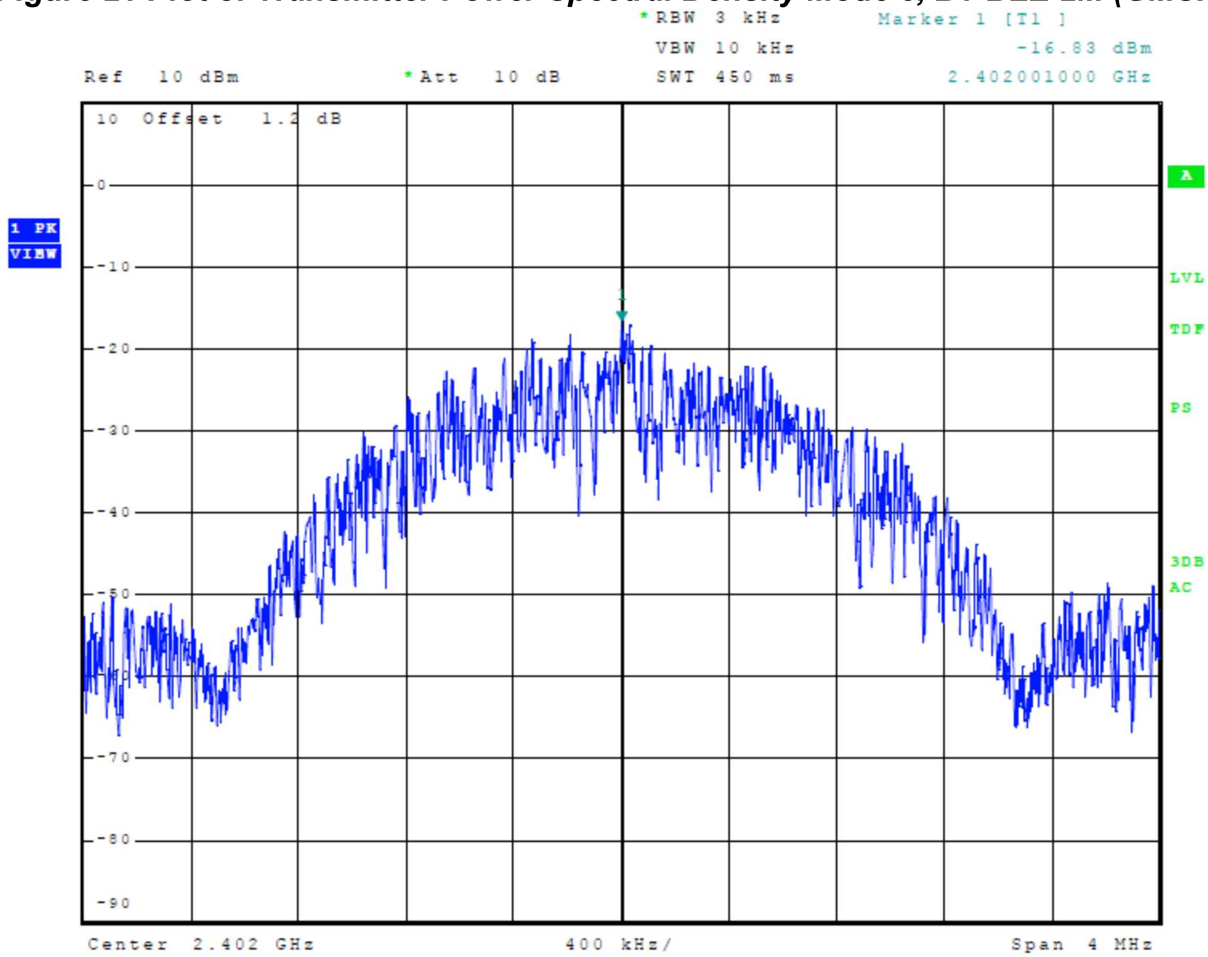


Figure 21 Plot of Transmitter Power Spectral Density Mode 3, BT BLE 2M (GMSK)



Transmitter Emissions Data

Table 7 Transmitter Radiated Emissions Mode 2, BT BLE 1M (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	47.7	34.0	47.6	34.0	54.0	-20.0	-20.0
7206.0	51.3	37.5	50.8	37.5	54.0	-16.5	-16.5
9608.0	54.7	41.0	54.4	41.0	54.0	-13.0	-13.0
12010.0	56.9	43.0	57.1	43.2	54.0	-11.0	-10.8
14412.0	59.8	45.5	59.1	45.6	54.0	-8.5	-8.4
16814.0	63.7	50.5	64.1	50.6	54.0	-3.5	-3.4
2440.0	--	--	--	--	--	--	--
4880.0	49.0	35.1	48.5	34.3	54.0	-18.9	-19.7
7320.0	52.3	37.8	51.7	37.8	54.0	-16.2	-16.2
9760.0	54.2	40.9	54.7	40.9	54.0	-13.1	-13.1
12200.0	57.6	44.5	58.0	44.5	54.0	-9.5	-9.5
14640.0	59.6	46.1	59.8	46.1	54.0	-7.9	-7.9
17080.0	63.1	49.5	63.3	49.4	54.0	-4.5	-4.6
2480.0	--	--	--	--	--	--	--
4960.0	48.9	35.1	48.9	34.7	54.0	-18.9	-19.3
7440.0	51.2	37.7	51.6	37.6	54.0	-16.3	-16.4
9920.0	55.4	41.5	54.9	41.5	54.0	-12.5	-12.5
12400.0	58.3	44.5	58.1	44.5	54.0	-9.5	-9.5
14880.0	60.3	46.5	60.2	46.5	54.0	-7.5	-7.5
17360.0	62.9	49.1	62.9	49.1	54.0	-4.9	-4.9

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 8 Transmitter Radiated Emissions Mode 3, BT BLE 2M (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	48.7	34.2	48.6	34.0	54.0	-19.8	-20.0
7206.0	51.2	37.7	51.2	37.7	54.0	-16.3	-16.3
9608.0	54.3	41.2	54.6	41.2	54.0	-12.8	-12.8
12010.0	57.2	43.3	56.8	43.4	54.0	-10.7	-10.6
14412.0	59.1	45.5	58.7	45.5	54.0	-8.5	-8.5
16814.0	63.6	50.3	63.4	50.0	54.0	-3.7	-4.0
2440.0	--	--	--	--	--	--	--
4880.0	48.4	34.6	47.9	34.4	54.0	-19.4	-19.6
7320.0	52.0	38.2	51.7	38.2	54.0	-15.8	-15.8
9760.0	54.3	40.8	54.3	40.8	54.0	-13.2	-13.2
12200.0	58.5	44.1	57.9	44.1	54.0	-9.9	-9.9
14640.0	59.4	46.0	59.8	46.0	54.0	-8.0	-8.0
17080.0	62.5	49.3	63.0	49.3	54.0	-4.7	-4.7
2480.0	--	--	--	--	--	--	--
4960.0	48.5	34.6	48.3	34.6	54.0	-19.4	-19.4
7440.0	51.2	37.6	51.0	37.6	54.0	-16.4	-16.4
9920.0	54.7	41.2	54.5	41.2	54.0	-12.8	-12.8
12400.0	57.7	44.2	58.4	44.3	54.0	-9.8	-9.7
14880.0	60.3	46.6	60.3	46.6	54.0	-7.4	-7.4
17360.0	63.0	49.2	62.8	49.1	54.0	-4.8	-4.9

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 9 Transmitter Antenna Port Conducted Data modes 2-3

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 BLE 1M (GMSK)				
2402	0.002	1,040.3	696.5	-15.0
2440	0.001	1,044.0	694.5	-15.7
2480	0.001	1,045.5	699.0	-16.2
Mode 3, BT BLE 2M (GMSK)				
2402	0.002	2,032.5	1,161.0	-16.8
2440	0.001	2,037.5	1,166.7	-17.5
2480	0.001	2,035.0	1,164.2	-17.9

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 3 and RSS-GEN Issue 5 emission requirements for Digital Transmission Systems. The highest average output power measured at the antenna port for modes 2 through 3 was 0.002 Watts. The highest peak power spectral density measured at the antenna port for modes 2 through 3 presented a minimum margin of -23.0 dB below the requirements. The EUT demonstrated a minimum margin of -3.4 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	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/9/2025	9/9/2026
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/2/2025	9/2/2026
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/2/2025	9/2/2026
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/2/2025	9/2/2026
☐ 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	9/9/2025	9/9/2026
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/9/2025	9/9/2026
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/9/2025	9/9/2026
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/9/2025	9/9/2026
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/9/2025	9/9/2026
☒ 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	9/16/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(4M)(281184)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/9/2025	9/9/2026
☒ 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).

DEPARTMENT OF COMMERCE • UNITED STATES OF AMERICA

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

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 15.249 and
Industry Canada RSS-GEN Issue 5 and RSS-210 Issue 11
Application For Grant of Certification

Model: AA4998

2402-2480 MHz
Low Power Digital Transmitter (DXX)

FCC ID: IPH-A4998 IC: 1792A-A4998

Garmin International, Inc.

1200 East 151st Street
Olathe, KS 66062
Dan Irish
Lead Compliance Engineer

Test Report Number: 250910
Test Date: September 10, 2025 – September 30, 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

Revision 2 Issued October 27, 2025 – TCB review corrections.

Executive Summary

License Exempt Digital Transmission System Intentional Radiator operating under Title 47 Code of Federal Regulations (47 CFR) Paragraph 15.249 and Industry Canada RSS-210 Issue 11 and RSS-GEN Issue 5, Low Power (DXX) Digital Device transmitter operations in the 2400 – 2483.5 MHz frequency band.

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

PMN: AA4998

FCC ID: IPH-A4998 IC: 1792A-A4998

Operating Frequency Range: 2402-2480 MHz

AA4998 was chosen for transmitter configuration testing and used for final measurements.

Operational communication mode 1

Mode	Peak Power (dBµV/m@3m)	Average power (dBµV/m@3m)	Limit@3m (dBuV/m)	Margin	99% OBW (kHz)
Mode 1, ANT (GFSK)	91.7	90.7	94.0	-3.3	987.8

This report addresses EUT Operations as Low Power Transmitter (DXX) using transmitter modulation mode 1. Note, the production device utilizes two non-user accessible integral antennas with 2.4 GHz PIFA (-0.01 dBi) and 1.6 GHz Quad-helical (2.01 dBi)

Opinion / Interpretation of Results

Tests Performed	Margin (dB)	Results
Restricted Bands 47 CFR 15.205, RSS-210 4.1	-9.0	Complies
Conducted Emissions per 47CFR 15.207, RSS-GEN 8.8	-15.12	Complies
Radiated Emissions 47 CFR 15.209, RSS-GEN 8.9	-6.0	Complies
Harmonic Emissions per 47 CFR 15.249, RSS-210 B.10	-2.6	Complies

Equipment Tested

Model: AA4998

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	A04998	3609390344
EUT #2 Antenna Port Conducted	A04998	3609390347
AC/DC Wall mount power supply	AQ27A-59CFA	N/A
USB-C to C Cable, 0.5m	320-01642-00	N/A
Sub-Assy Carabiner Tether, spine 2.0	011-06468-00	N/A
Carabiner, symmetric, four-sided, 60mm gray	013-00717-00	N/A

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

The design is capable of simultaneously transmitting on the MES (Iridium) and 2.4 GHz ISM ports (either BLE or ANT, one at a time).

Software (FVIN): 0.41 or higher: Antennas: 2.4 GHz PIFA (-0.01 dBi), 1.6 GHz Quad-helical (2.01 dBi)

Environmental Conditions

Ambient Temperature	22.2° C
Relative Humidity	43.0 %
Atmospheric Pressure	1012.6 mb

Equipment Operational Modes

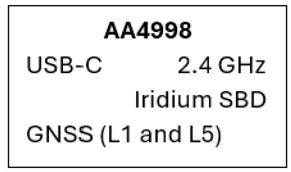
Mode	Transmitter Operation
mode 1	ANT (GFSK)
mode 2	BT BLE 1M (GMSK)
mode 3	BT BLE 2M (GMSK)

Equipment Function

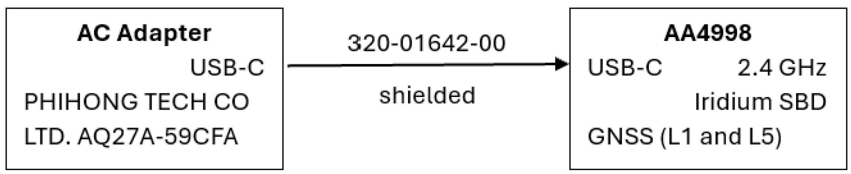
The EUT is a hand held transceiver with operation capability in the 2402-2480 MHz frequency band and 1600 MHz Satellite communications band, via inclusion of Iridium pre-certified module (FCC ID: IPH-03302; IC ID: 1792A-03302). The design provides 2.4 GHz wireless communications capabilities with compatible wireless equipment as well as offering ability to send data using the satellite link. The product operates from internal rechargeable battery only and provides USB-C interface connection port for use with AC adapter or computer equipment. Recharge of internal battery is accomplished with the use of the USB interface cable which may be connected to compliant USB interface port, AC adapter or DC adapter for battery recharge. The design utilizes internal fixed antenna system and offers no provision for antenna replacement or modification. Two samples were provided for testing, one representative of production design and the other modified for testing purposes replacing integral antenna with RF connection port. Test samples were provided with test software enabling testing personnel ability to enable transmitter function on defined channels and operational modes. The antenna modification offered testing facility ability to connect test equipment to the temporary antenna port for antenna port conducted emission testing. The EUT was arranged as described by the manufacturer for testing purposes. The EUT offers no other interface connections than those in the configuration options shown below as described by the manufacturer. For testing purposes, the EUT received power from freshly charged internal battery and configured to operate in available modes. As requested by the manufacturer and required by regulations, the equipment was tested for emissions compliance using the available configurations with the worst-case data presented. Test results in this report relate only to the products described in this report.

Equipment Configuration

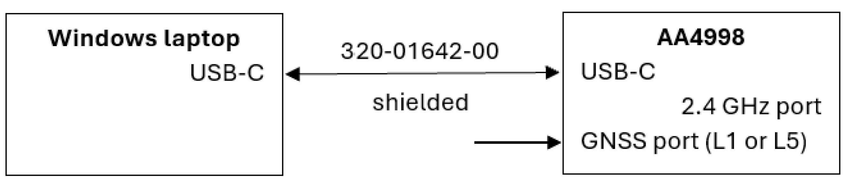
Config. 1: Battery Powered



Config 2: AC-charging



Config 3: Laptop-connected, Media Transfer Protocol (MTP), USB 2



Application for Certification

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

(2) Identification: HVIN: AA4998
FCC ID: IPH-A4998 IC: 1792A-A4998

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

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

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

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

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

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

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

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

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

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

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

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

Applicable Standards

The following information is submitted in accordance with the eCFR Title 47 Code of Federal Regulations (47CFR), dated November 18, 2024: Part 2, Subpart J, Part 15C Paragraph 15.249, Industry Canada RSS-210 Issue 11, 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 with the EUT operations as Low Power Transmitter (DXX).

Equipment 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.

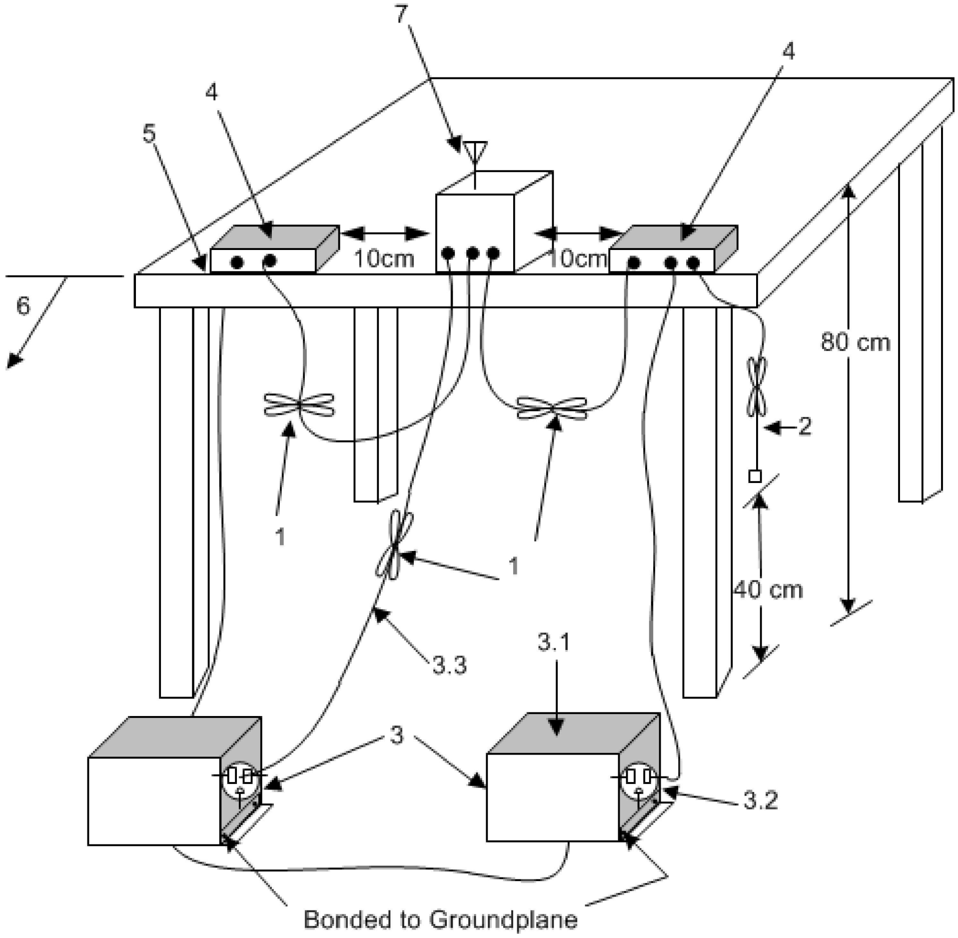
Radiated Emission Test Procedure

Radiated emissions testing was performed as required in 47 CFR 15C, RSS-210 Issue 11, and specified in ANSI C63.10-2020. The EUT was placed in a semi-anechoic chamber 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

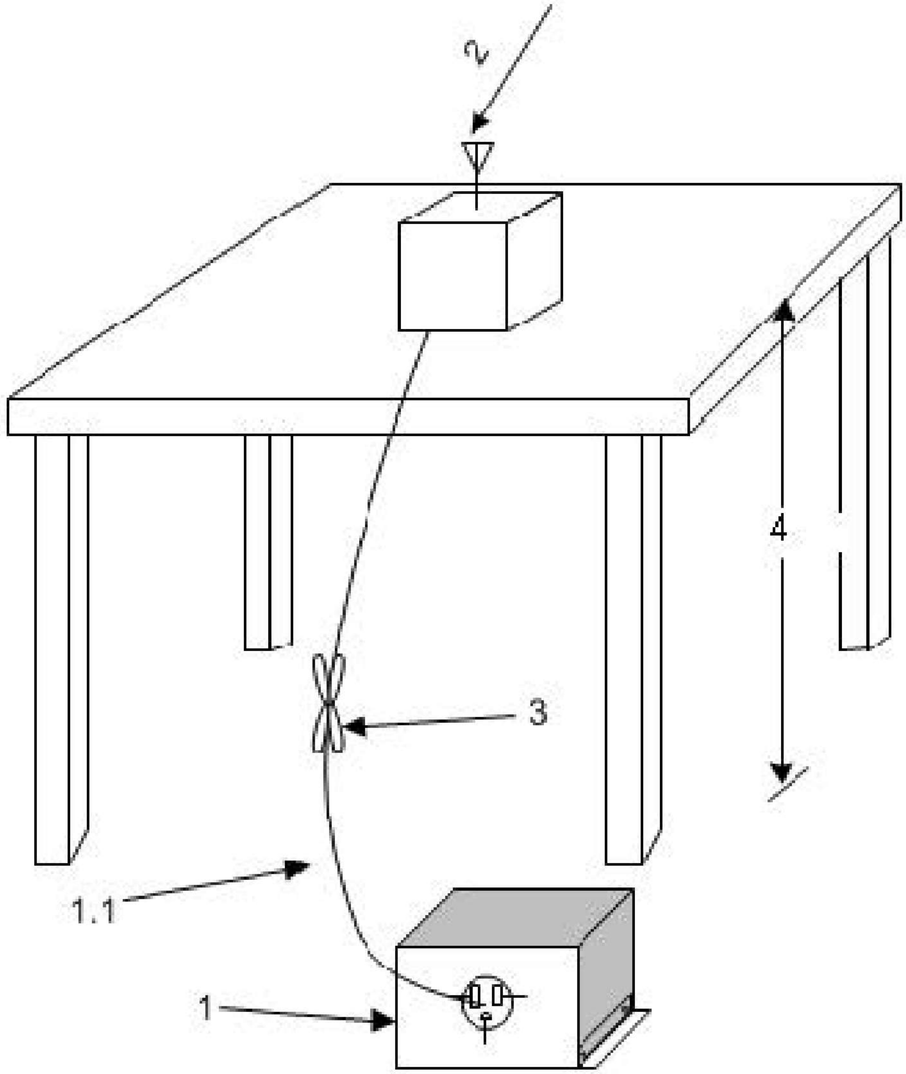
The EUT was assembled as required for operation placed on a benchtop. This configuration provided the ability to connect test equipment to the provided test antenna port Antenna Port conducted emissions testing was performed presented in the regulations and specified in ANSI C63.10-2020. Testing was 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 three 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

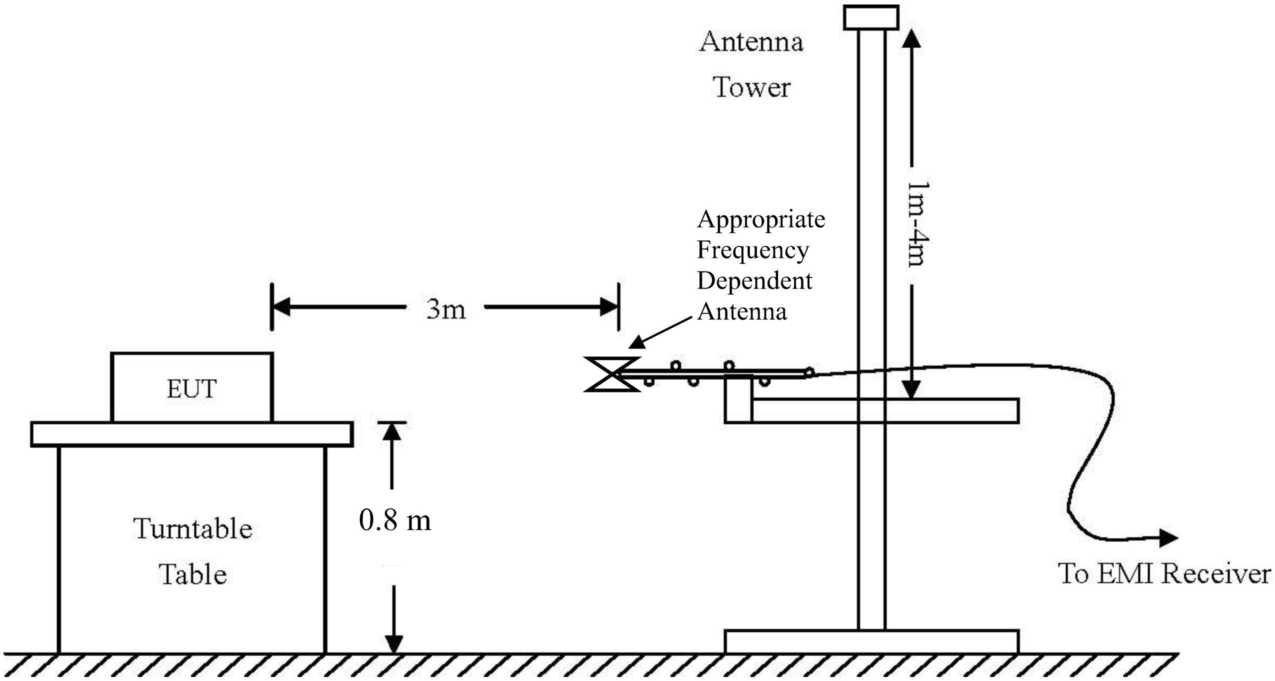
Diagram 2 Test arrangement for radiated emissions of tabletop equipment



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) or Open Area Test Site (OATS)

Test arrangement for radiated emissions Below 1 GHz



Test arrangement for radiated emissions Above 1 GHz

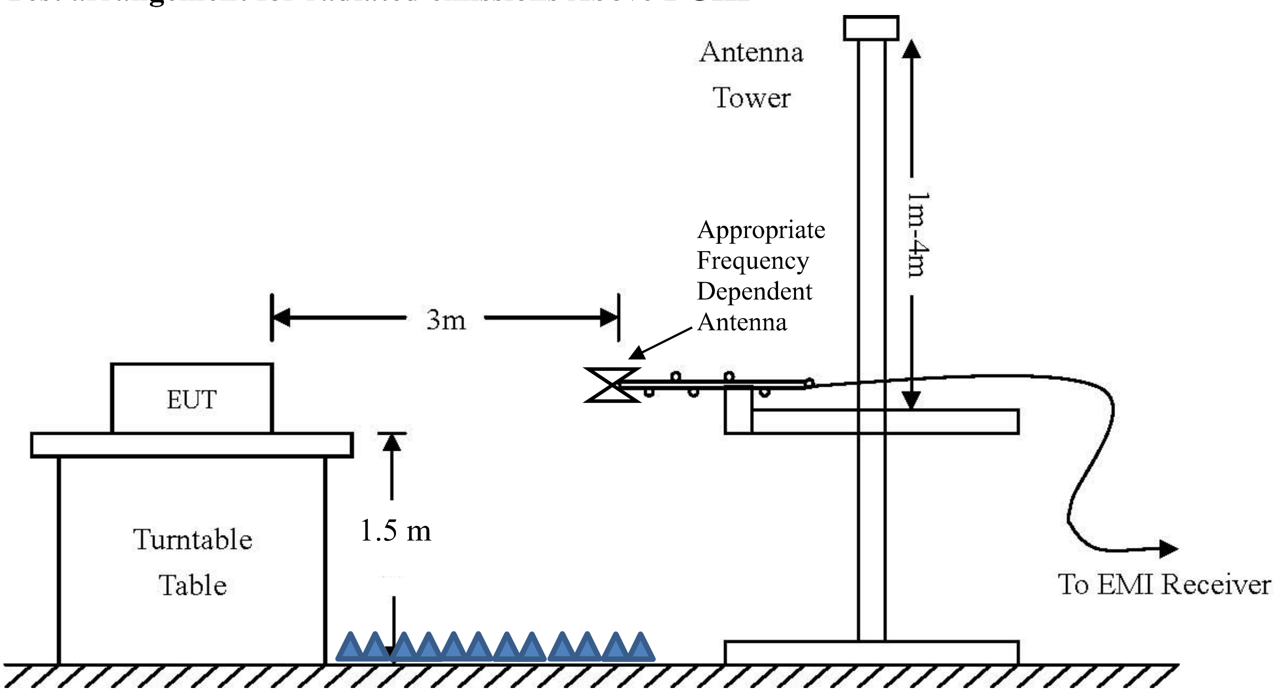
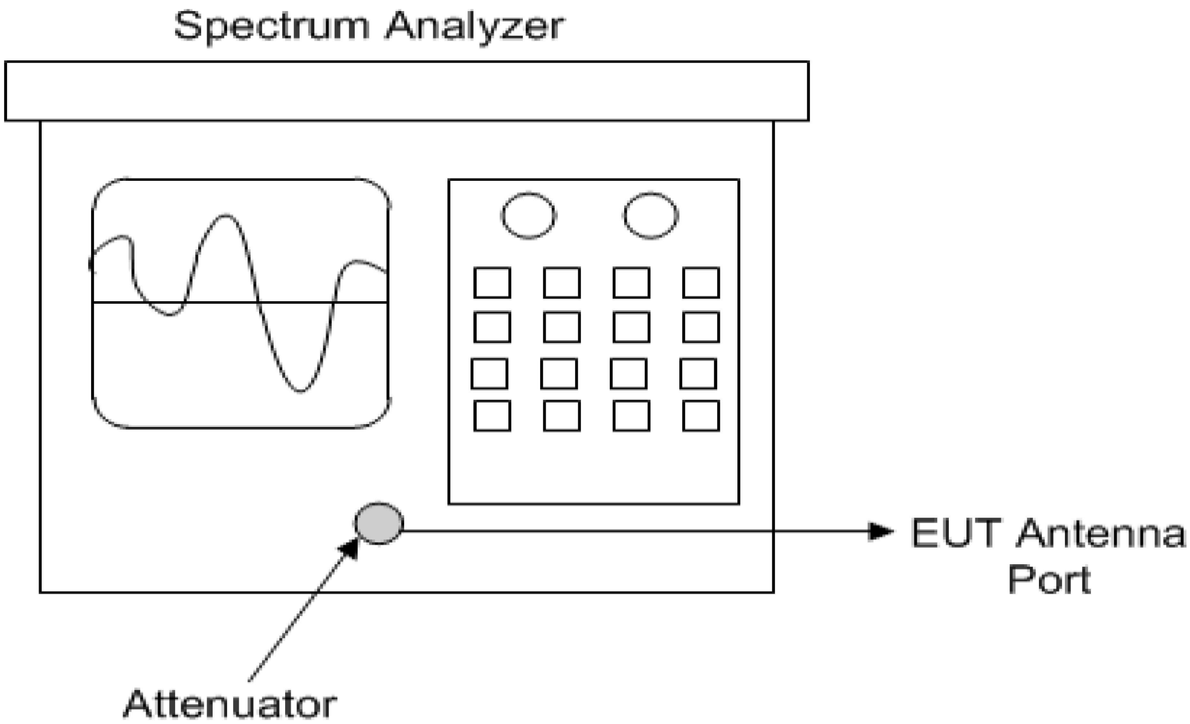


Diagram 4 Test arrangement for Antenna Port Conducted emissions



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: Radiated limit may be expressed for measurement in dBμV/m when the measurement is taken at a distance of 3 or 10 meters. Data taken for this report was taken at distance of 3 meters. Sample calculation demonstrates corrected field strength reading for 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)

Statement of Modifications and Deviations

No modifications to the EUT were required for the equipment to demonstrate compliance with the 47 CFR Part 15C, Industry Canada RSS-210 Issue 11, and RSS-GEN Issue 5 emission requirements. There were no deviations to the specifications.

Intentional Radiators

The following information is submitted supporting compliance with the requirements of 47 CFR, Subpart C, paragraph 15.249, Industry Canada RSS-210 Issue 11, and RSS-GEN Issue 5.

Per 47 CFR, Subpart A, paragraph 15.31, all testing was performed over three frequencies (1 near top, 1 near middle and 1 near bottom).

Antenna Requirements

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

Restricted Bands of Operation

Spurious emissions falling in the restricted frequency bands of operation were measured in the 3 meters Semi-Anechoic Chamber (SAC). The EUT utilizes frequency, determining circuitry, which generates harmonics falling in the restricted bands. Emissions were investigated in the 3m SAC, using appropriate antennas or pyramidal horns, amplification stages, and receiver / spectrum analyzer. Peak and average amplitudes of frequencies above 1000 MHz were compared to the required limits with worst-case data presented below. Test procedures of ANSI C63.10-2020 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 ANT (GFSK)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dB)	Vertical Margin (dB)
2390.0	43.7	30.4	43.6	30.4	54.0	-23.6	-23.6
2483.5	45.1	30.9	44.9	30.8	54.0	-23.1	-23.2
4804.0	47.8	34.6	47.5	34.3	54.0	-19.4	-19.7
4914.0	49.0	35.4	47.9	35.5	54.0	-18.6	-18.5
4960.0	48.9	36.1	48.5	36.4	54.0	-17.9	-17.6
7206.0	51.0	37.8	51.4	37.8	54.0	-16.2	-16.2
7371.0	50.9	38.1	51.4	38.1	54.0	-15.9	-15.9
7440.0	51.3	37.8	50.8	37.9	54.0	-16.2	-16.1
12010.0	56.7	44.1	57.4	44.2	54.0	-9.9	-9.8
12285.0	58.2	44.9	57.6	44.9	54.0	-9.1	-9.1
12400.0	58.0	45.0	58.1	45.0	54.0	-9.0	-9.0

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

Summary of Results for Radiated Emissions in Restricted Bands

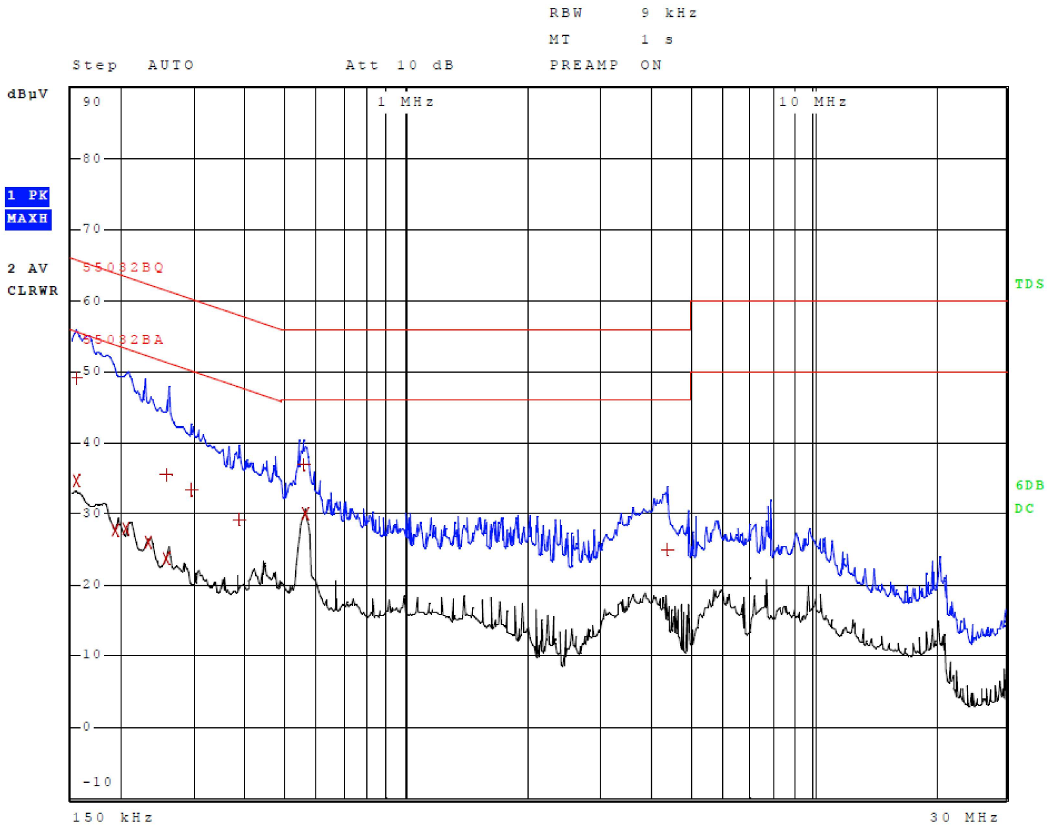
The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C and RSS-210 Issue 11 Intentional Radiator requirements. The EUT demonstrated a worst-case minimum margin of -9.0 dB below the emissions requirements in restricted frequency bands. Peak, Quasi-peak, and average 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.

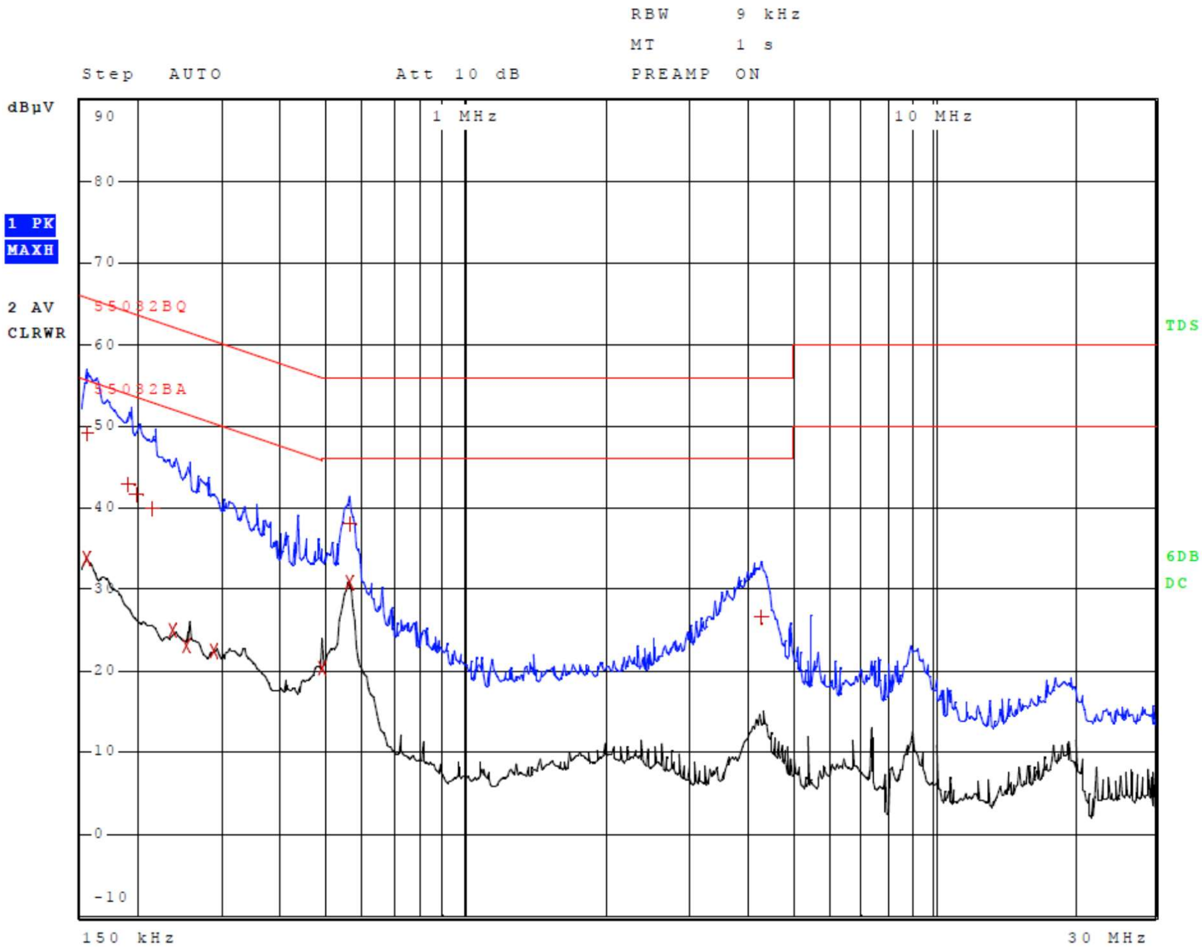
Refer to data in tables 2 and 3 and figures 1 and 2 for plots of the Configuration #3 EUT –laptop connected AC Line conducted emissions.

Figure 1 AC Line Conducted Emissions Data L1 (Config. #3, EUT – laptop)



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

Figure 2 AC Line Conducted Emissions Data L2 (Config. #3, EUT – laptop)



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

Table 2 AC Line Conducted Emissions Data L1 (Config. #3, EUT – laptop)

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	34.55	Average	-21.23
1	154.000000000 kHz	49.24	Quasi Peak	-16.54
2	194.000000000 kHz	27.71	Average	-26.15
2	206.000000000 kHz	28.02	Average	-25.35
2	234.000000000 kHz	25.94	Average	-26.37
2	258.000000000 kHz	23.77	Average	-27.73
1	258.000000000 kHz	35.52	Quasi Peak	-25.97
1	294.000000000 kHz	33.39	Quasi Peak	-27.03
1	386.000000000 kHz	29.22	Quasi Peak	-28.93
1	554.000000000 kHz	36.95	Quasi Peak	-19.05
2	558.000000000 kHz	30.05	Average	-15.95
1	4.382000000 MHz	24.99	Quasi Peak	-31.01

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

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

Trace	Frequency	Level (dBµV)	Detector	Delta Limit/dB
2	154.000000000 kHz	33.85	Average	-21.93
1	154.000000000 kHz	49.12	Quasi Peak	-16.66
1	190.000000000 kHz	42.90	Quasi Peak	-21.14
1	198.000000000 kHz	41.66	Quasi Peak	-22.04
1	214.000000000 kHz	39.86	Quasi Peak	-23.19
2	238.000000000 kHz	25.06	Average	-27.11
2	254.000000000 kHz	23.17	Average	-28.46
2	290.000000000 kHz	22.41	Average	-28.11
2	490.000000000 kHz	20.45	Average	-25.72
2	558.000000000 kHz	30.88	Average	-15.12
1	558.000000000 kHz	37.98	Quasi Peak	-18.02
1	4.294000000 MHz	26.65	Quasi Peak	-29.35

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 #3 demonstrated a minimum margin of -15.12 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

The EUT was arranged in a manufacturer defined equipment configuration and operated with transmitter active during testing. Preliminary testing was performed in a screen room with the EUT positioned 1 meter from the FSM. Radiated emissions measurements were performed to identify the frequencies which produced the highest emissions. Each radiated emission was then maximized in the SAC before final radiated measurements were performed. Final data was taken with the EUT located in the SAC at 3 meters distance between the EUT and the receiving antenna. The frequency spectrum from 9 kHz to 25,000 MHz was searched for general radiated emissions. Measured emission levels were maximized by EUT placement on the table, rotating the turntable through 360 degrees, varying the antenna height between 1 and 4 meters above the ground plane and changing antenna position between horizontal and vertical polarization. Antennas used were Loop from 9 kHz to 30 MHz, Broadband Biconical from 30 to 200 MHz, Biconilog from 30 to 1000 MHz, Log Periodic from 200 MHz to 1 GHz and or double Ridge or pyramidal horns and mixers above 1 GHz, notch filters and appropriate amplifiers and external mixers were utilized.

Refer to tables 4 and 5 for general radiated emissions data and figures 3 through 9 for plots of the radiated emissions with all Tx-on and in worst case configuration #2. The spectrum from 30MHz to 40GHz was checked for emissions and these are the maximum found.

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)
493.3	45.9	41.0	47	-6.0
513.7	39.1	31.0	47	-16.0
523.1	37.3	29.8	47	-17.2
532.7	36.8	30.8	47	-16.2
543.6	37.5	30.9	47	-16.1

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

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

Frequency (MHz)	Peak (dBµV/m)	Quasi-Peak (dBµV/m)	Limit @ 3m (dBµV/m)	Margin (dBm)
364.8	21.9	22.9	47	-24.1
370.9	25.2	16.9	47	-30.1
499.3	33.3	28.9	47	-18.1
501.8	28.9	32.2	47	-14.8
992.8	32.3	23.9	47	-23.1

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

Figure 3 Plot of General Radiated Emissions (30 MHz – 1 GHz) – Horizontal Polarization

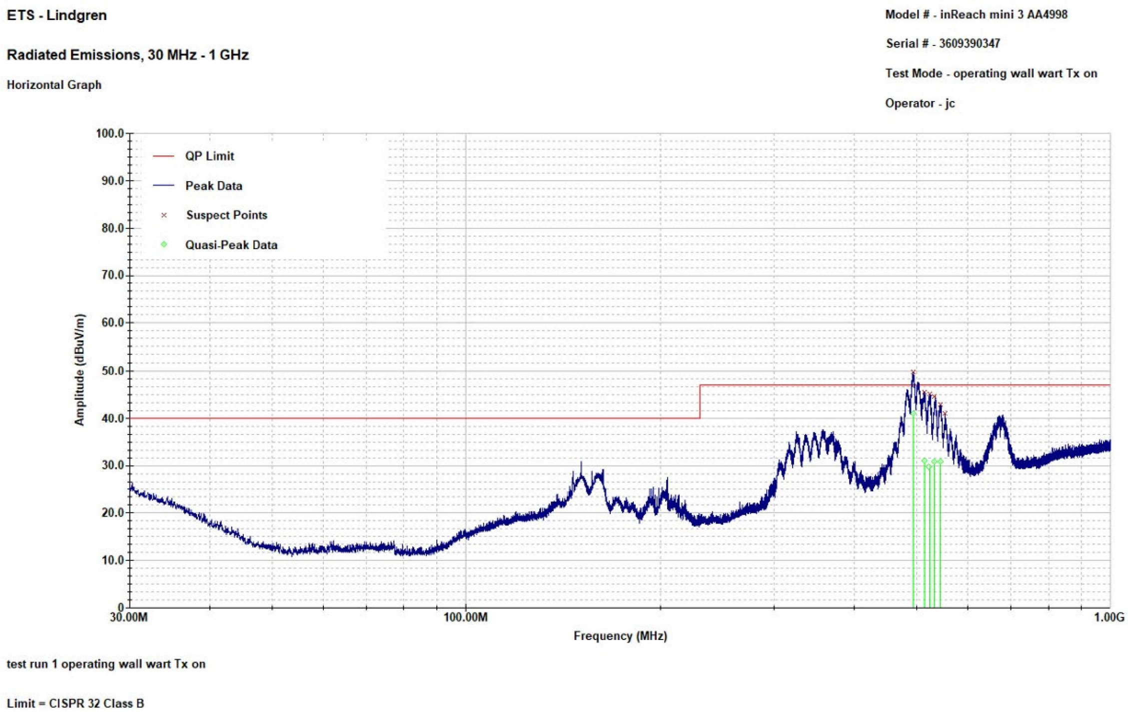


Figure 4 Plot of General Radiated Emissions (30 MHz – 1 GHz) – Vertical Polarization

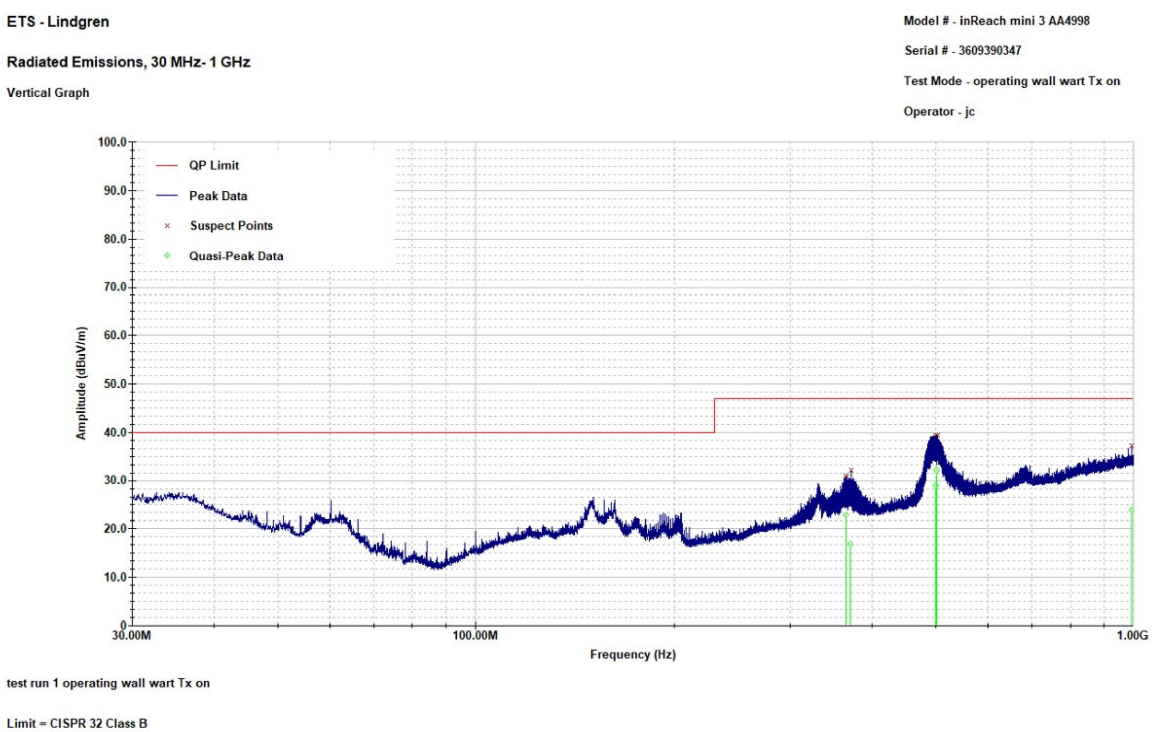
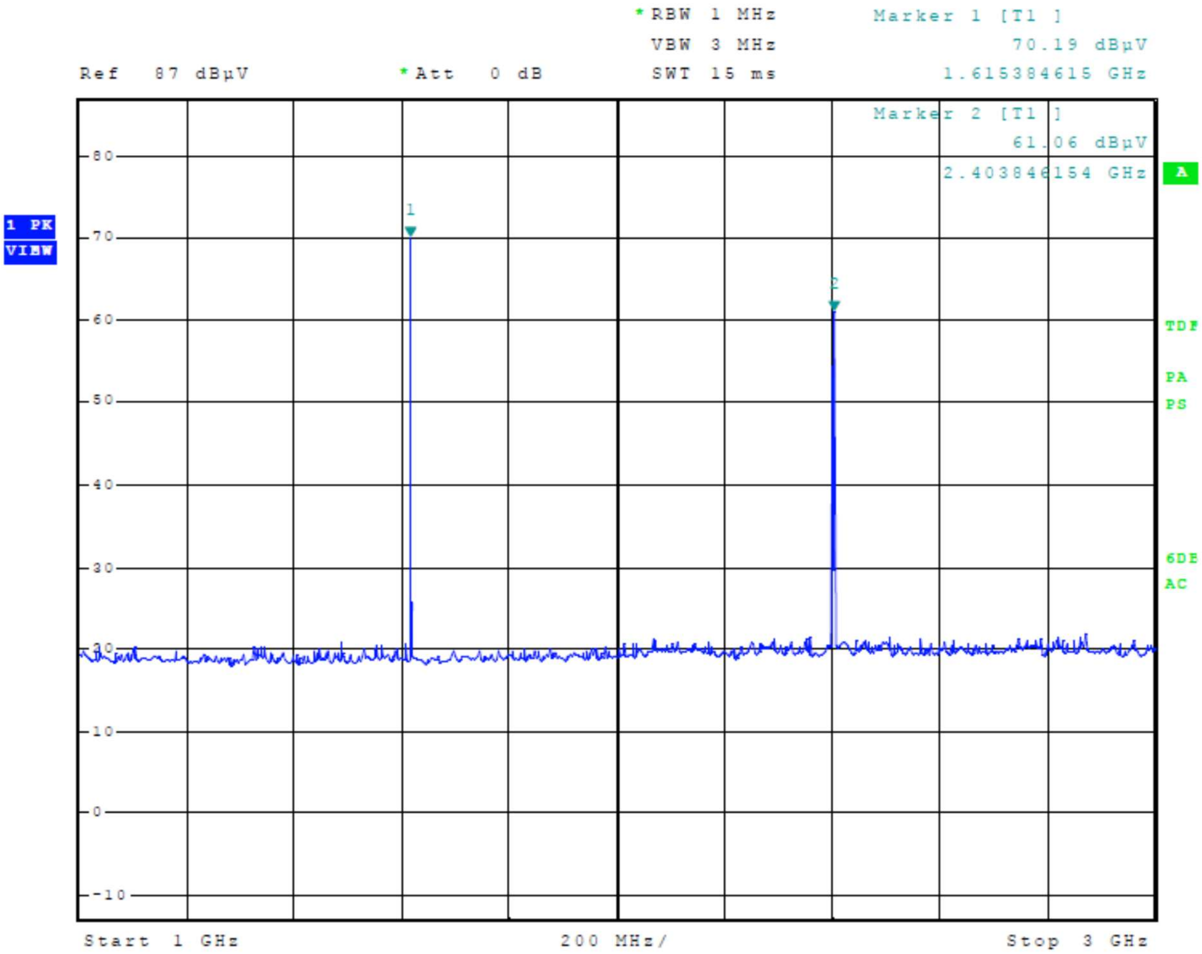


Figure 5 Plot of General Radiated Emissions (1 GHz – 3 GHz) All Tx On



Note: Marker 1 is Iridium fundamental; Marker 2 is BLE fundamental.

Figure 6 Plot of General Radiated Emissions (3 GHz – 6 GHz) All Tx On

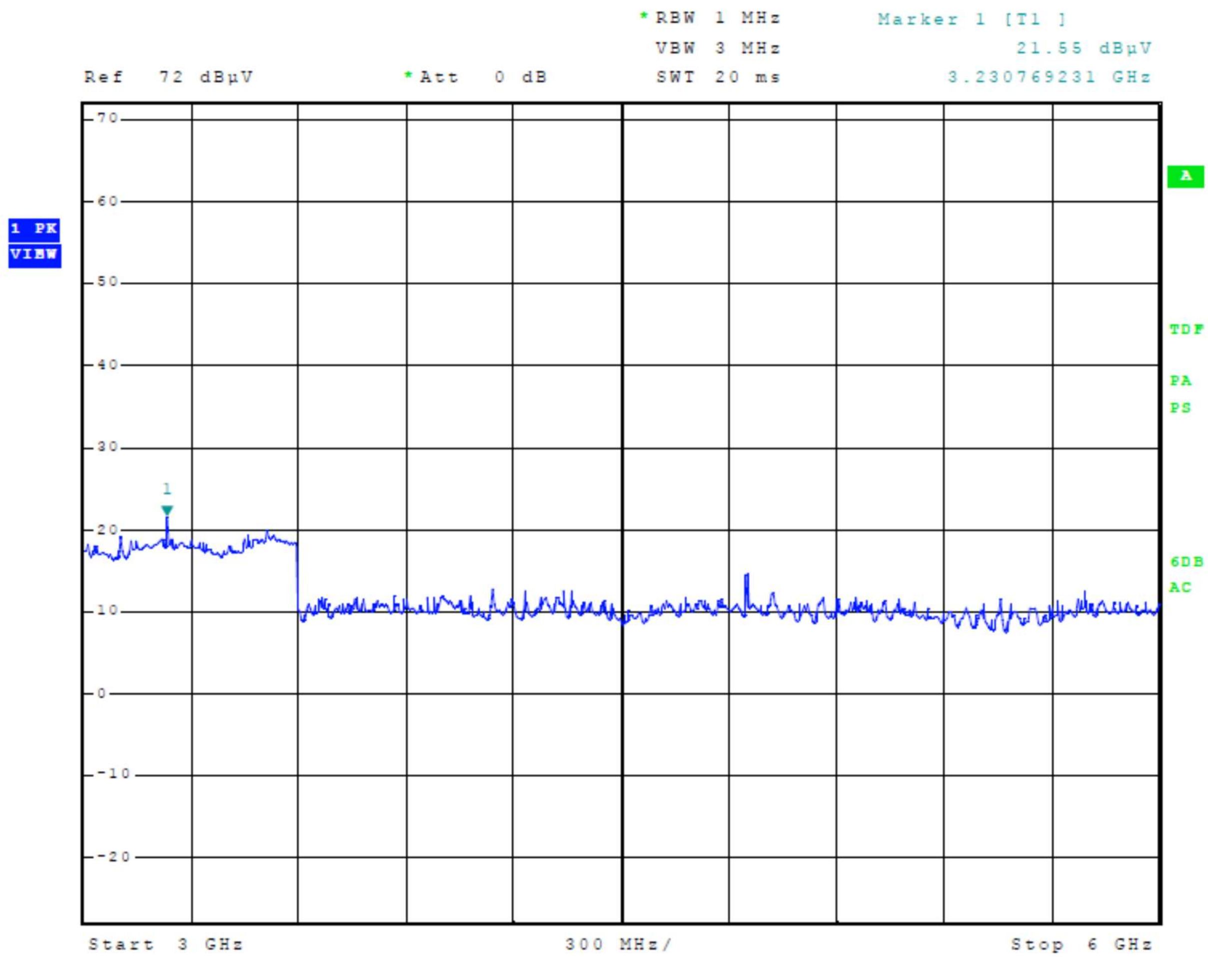


Figure 7 Plot of General Radiated Emissions (6 GHz – 12 GHz) All Tx On

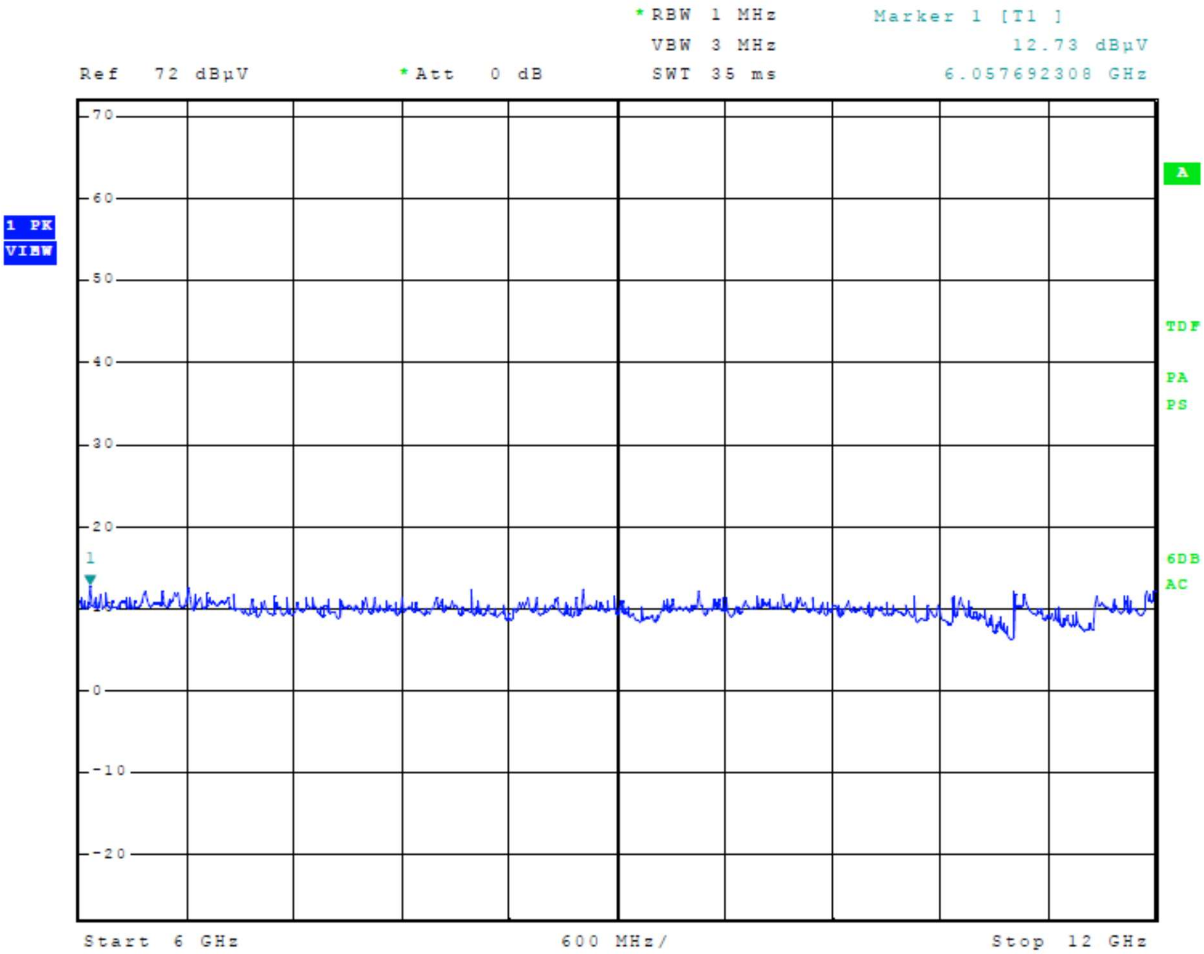


Figure 8 Plot of General Radiated Emissions (12 GHz – 18 GHz) All Tx On

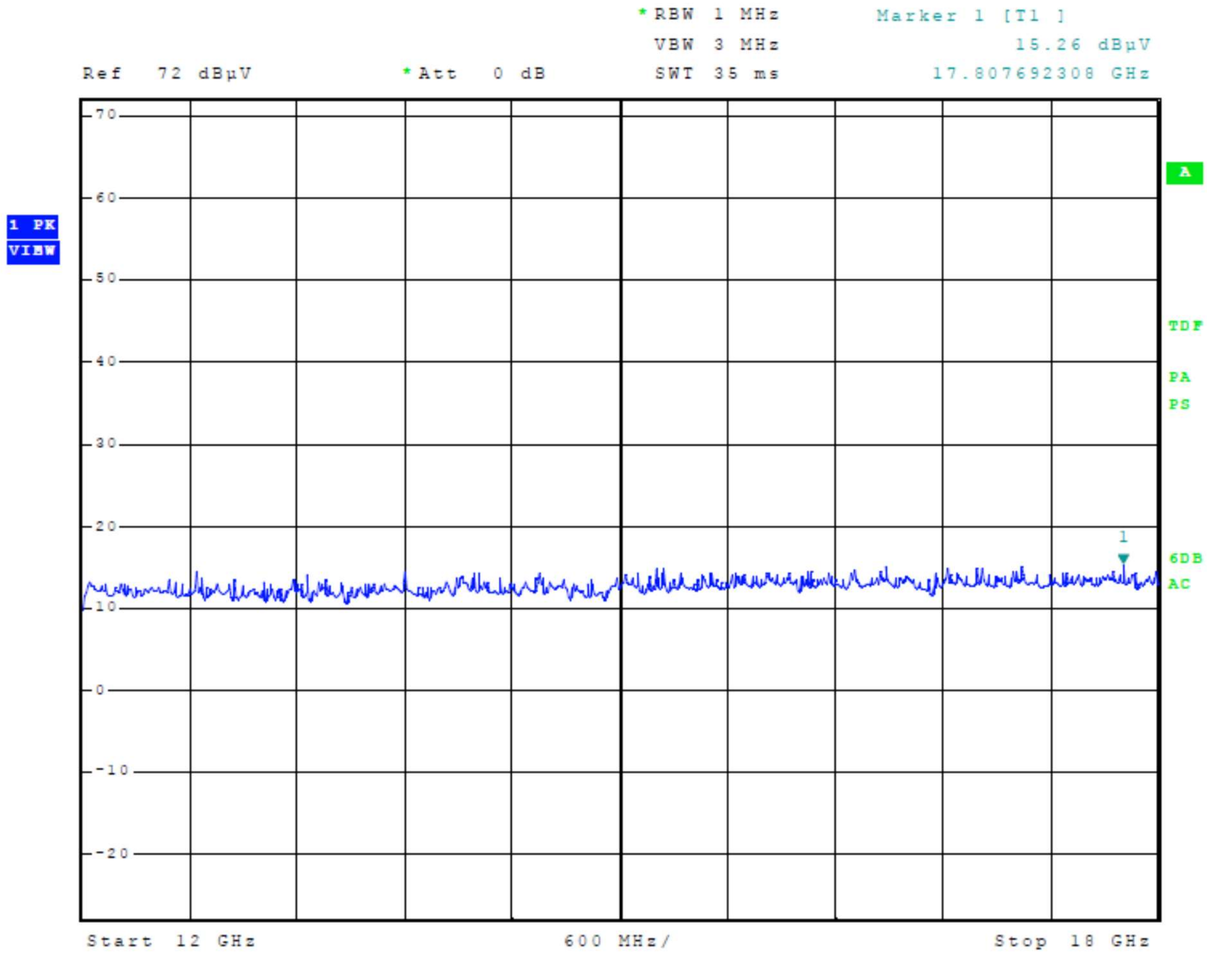
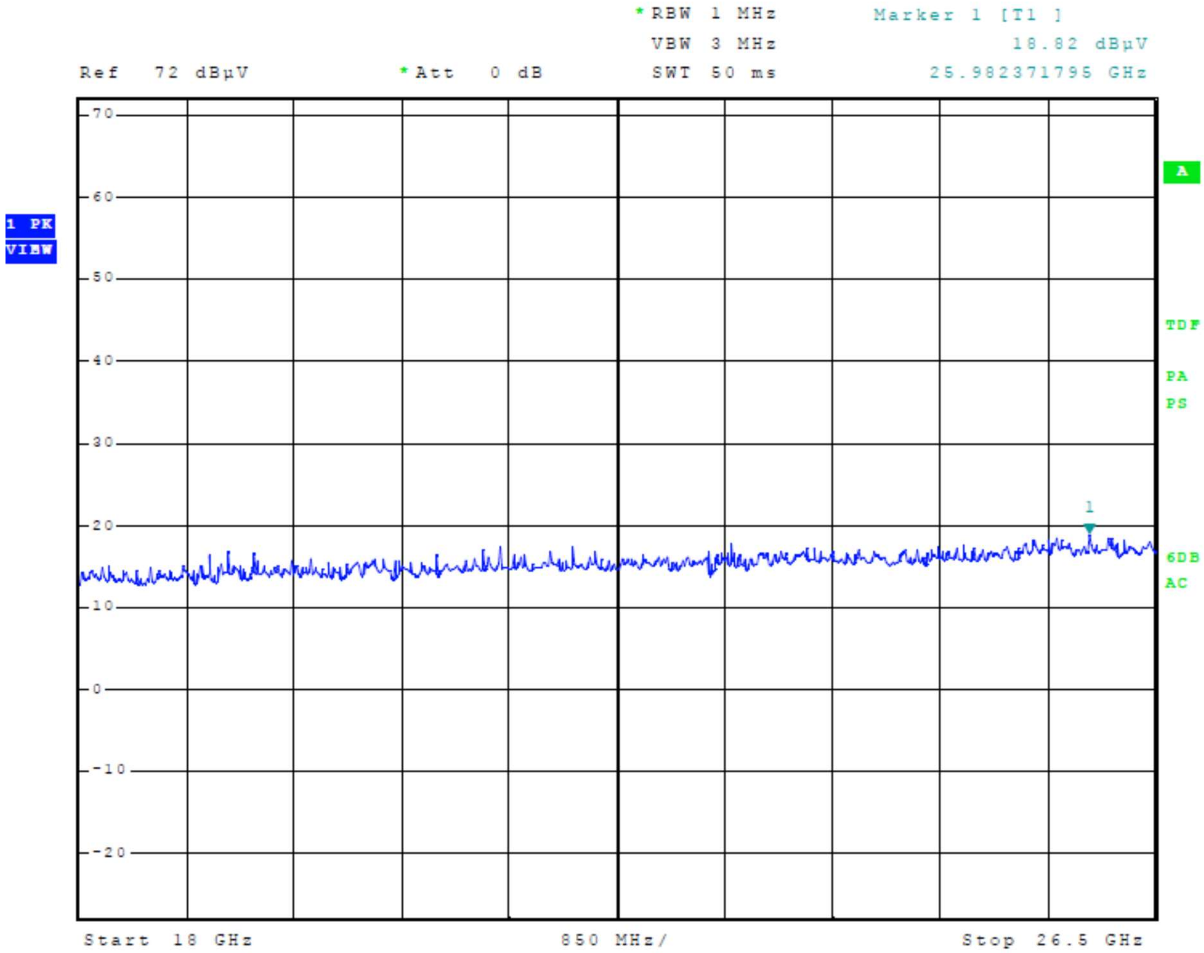


Figure 9 Plot of General Radiated Emissions (18 GHz – 26.5 GHz) All Tx On



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

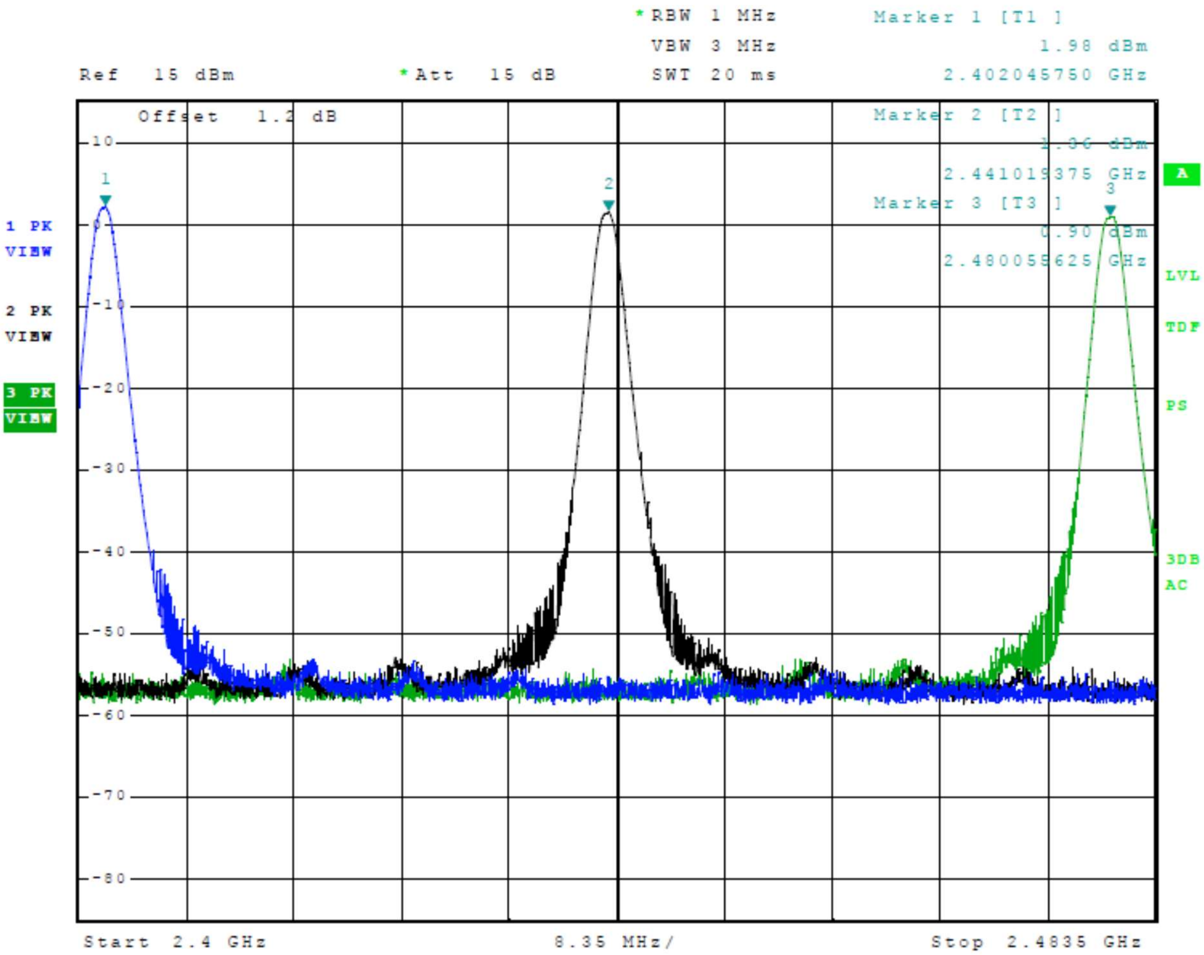
The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15C paragraph 15.209, RSS-210 Issue 11, and RSS-GEN Issue 5 Intentional Radiators. The EUT worst-case transmitter configuration demonstrated a minimum margin of -6.0 dB below the requirements. Other emissions were present with amplitudes at least 20 dB below the Limits.

Operation in the Band 2400 – 2483.5 MHz

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

Refer to figures 10 through 13 showing plots of mode 1 taken of the 2402-2480 MHz transmitter operation displaying compliance with the specifications.

Figure 10 Plot of Transmitter Emissions in 2402-2480 MHz Mode 1 ANT (GFSK)



NVLAP Lab Code 200087-0

Figure 11 Plot of Transmitter Emissions Low Band Edge Mode 1 ANT (GFSK)

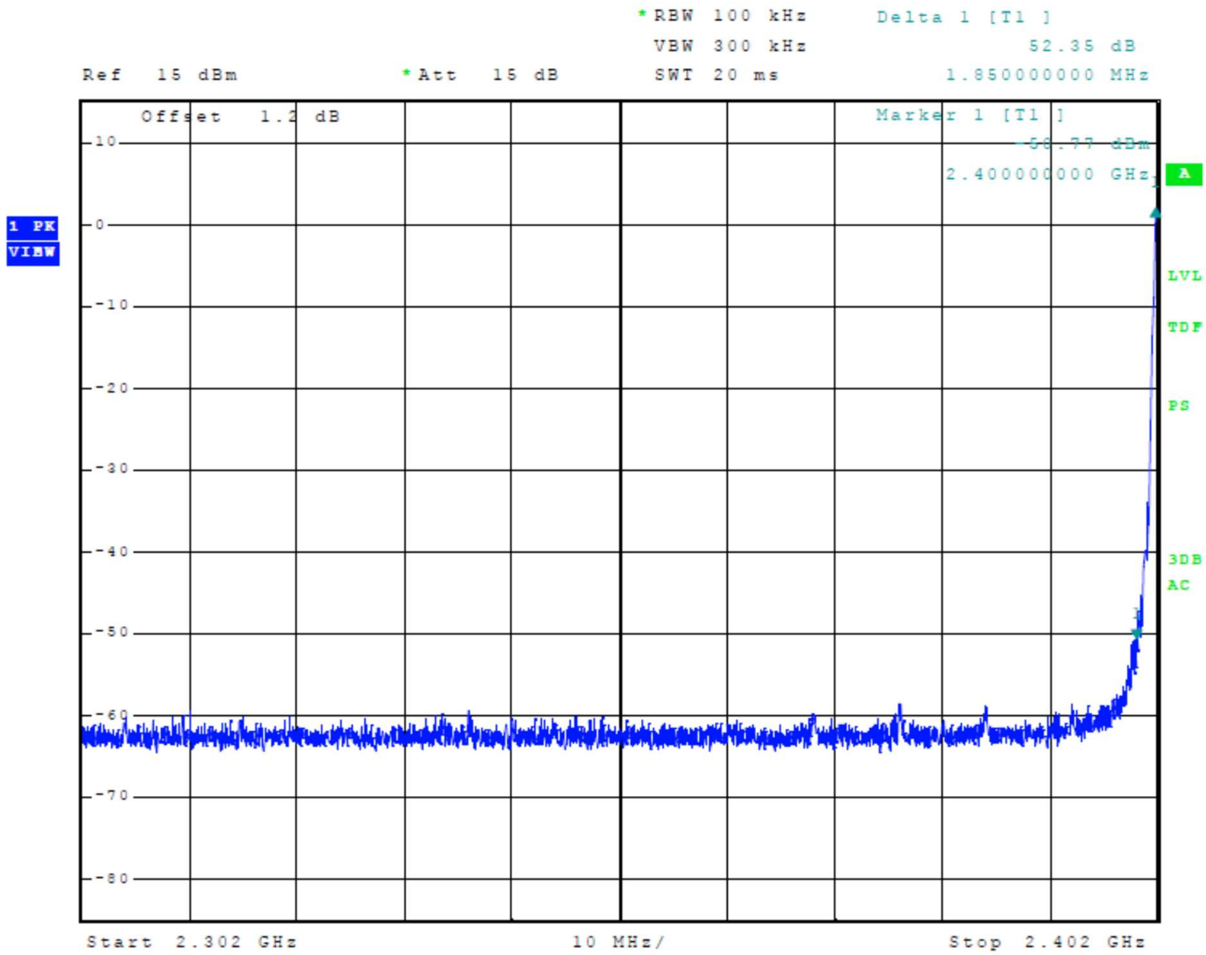


Figure 12 Plot of Transmitter Emissions High Band Edge Mode 1 ANT (GFSK)

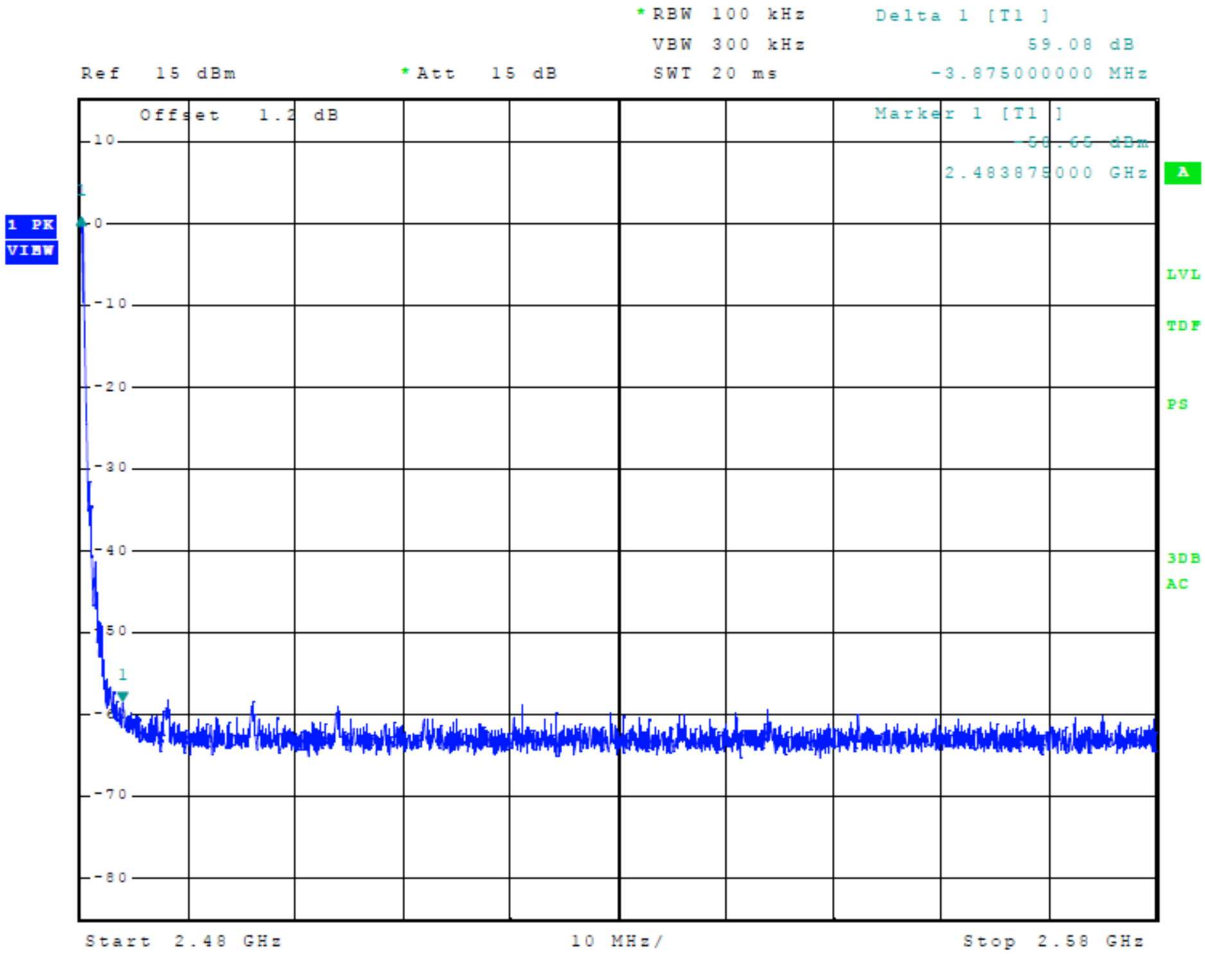
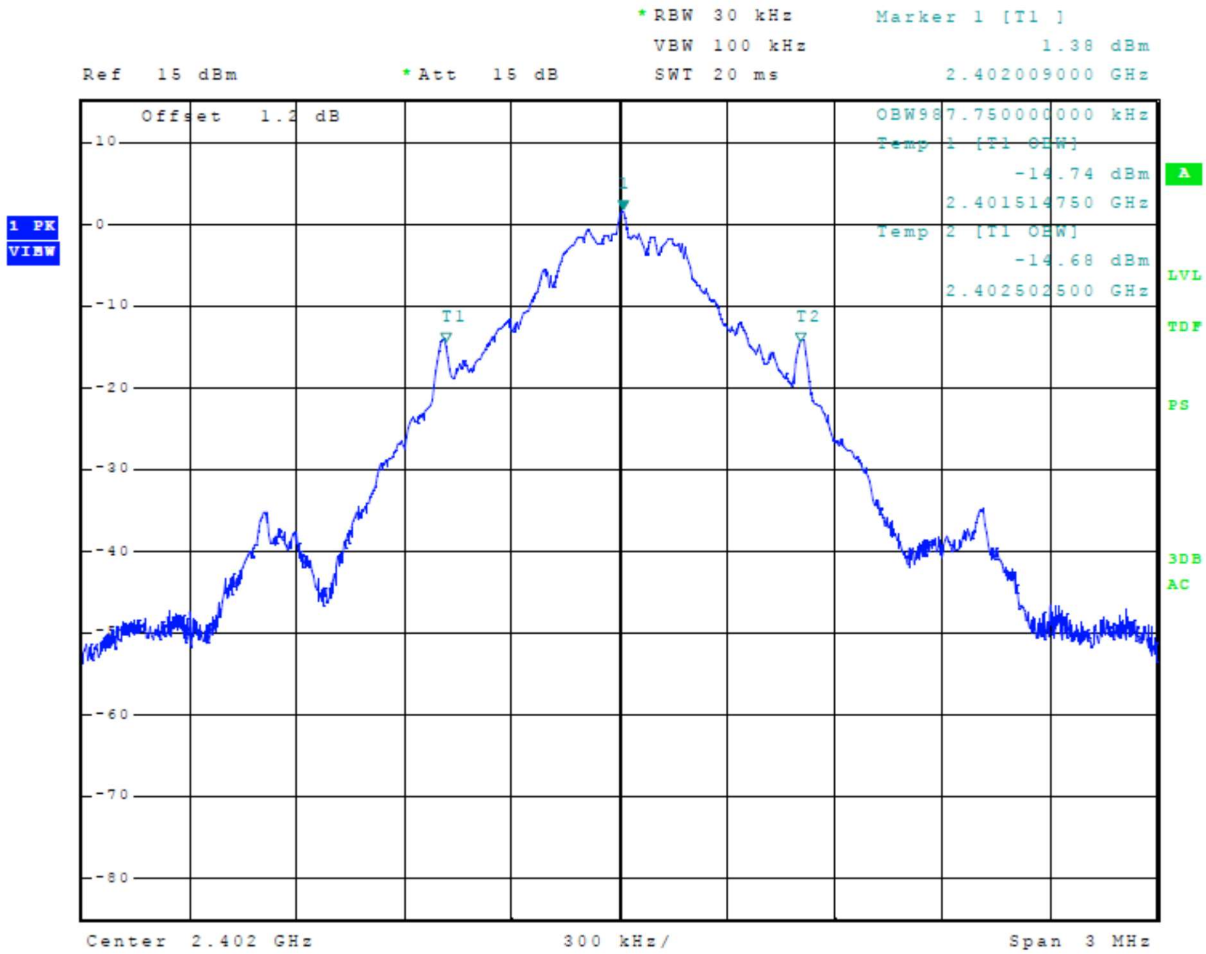


Figure 13 Plot of Transmitter 99% Occupied Bandwidth Mode 1 ANT (GFSK)



Transmitter Emissions Data

Table 6 Transmitter Radiated Emissions Mode 1 ANT (GFSK)

Frequency in MHz	Horizontal Peak (dBµV/m)	Horizontal Average (dBµV/m)	Vertical Peak (dBµV/m)	Vertical Average (dBµV/m)	Limit @ 3m (dBµV/m)	Horizontal Margin (dB)	Vertical Margin (dB)
2402.0	91.4	90.5	91.7	90.7	94.0	-3.5	-3.3
4804.0	47.8	34.6	47.5	34.3	54.0	-19.4	-19.7
7206.0	51.0	37.8	51.4	37.8	54.0	-16.2	-16.2
9608.0	54.2	41.3	55.1	41.3	54.0	-12.7	-12.7
12010.0	56.7	44.1	57.4	44.2	54.0	-9.9	-9.8
14412.0	59.4	46.4	59.9	46.4	54.0	-7.6	-7.6
16814.0	64.5	51.4	64.2	51.4	54.0	-2.6	-2.6
2441.0	87.1	86.1	87.3	86.2	94.0	-7.9	-7.8
4882.0	49.0	35.4	47.9	35.5	54.0	-18.6	-18.5
7323.0	50.9	38.1	51.4	38.1	54.0	-15.9	-15.9
9764.0	54.7	41.3	54.1	41.2	54.0	-12.7	-12.8
12205.0	58.2	44.9	57.6	44.9	54.0	-9.1	-9.1
14646.0	60.1	46.7	59.3	46.8	54.0	-7.3	-7.2
17087.0	62.5	49.6	62.3	49.6	54.0	-4.4	-4.4
2480.0	85.0	84.1	83.9	83.0	94.0	-9.9	-11.0
4960.0	48.9	36.1	48.5	36.4	54.0	-17.9	-17.6
7440.0	51.3	37.8	50.8	37.9	54.0	-16.2	-16.1
9920.0	54.7	41.8	54.9	41.8	54.0	-12.2	-12.2
12400.0	58.0	45.0	58.1	45.0	54.0	-9.0	-9.0
14880.0	60.1	47.3	60.4	47.3	54.0	-6.7	-6.7
17360.0	63.3	49.9	62.6	49.9	54.0	-4.1	-4.1

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

Summary of Results for Transmitter Radiated Emissions of Intentional Radiator

The EUT demonstrated compliance with the radiated emissions requirements of 47CFR Part 15.249, Industry Canada RSS-210 Issue 11, and RSS-GEN Issue 5 Intentional Radiator regulations. The EUT worst-case test sample configuration demonstrated minimum average margin of -3.3 dB below the average emission limit for the fundamental. The EUT worst-case configuration demonstrated minimum radiated harmonic emission margin of -2.6 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	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303069)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Belden	RG-58 (L1-CAT3-11509)	9kHz-30 MHz	9/9/2025	9/9/2026
☒ Antenna	Com Power	AL-130 (121055)	.001-30 MHz	9/2/2025	9/2/2026
☐ Antenna:	EMCO	6509	.001-30 MHz	9/16/2024	9/16/2026
☒ Antenna	ARA	BCD-235-B (169)	20-350MHz	9/2/2025	9/2/2026
☒ Antenna	Sunol	JB-6 (A100709)	30-1000 MHz	9/2/2025	9/2/2026
☐ 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	9/9/2025	9/9/2026
☐ Amplifier	Com-Power	CPPA-102 (01254)	1-1000 MHz	9/9/2025	9/9/2026
☒ Amplifier	Com-Power	PAM-118A (551014)	0.5-18 GHz	9/9/2025	9/9/2026
☒ Amplifier	Com-Power	PAM-840A (461328)	18-40 GHz	9/9/2025	9/9/2026
☒ Pwr Sensor	Rohde & Schwarz	NRP33T	0.05-33 GHz	9/9/2025	9/9/2026
☒ 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	9/16/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(1.5M)(303072)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L1M)(281183)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(4M)(281184)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Huber & Suhner Inc.	Sucoflex102ea(L10M)(317546)	9kHz-40 GHz	9/9/2025	9/9/2026
☒ Cable	Time Microwave	4M-750HF290-750 (L4M)	9kHz-24 GHz	9/9/2025	9/9/2026
☒ 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

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: September 8-9, 2025
1200 E. 151st Street	Test Report Number: SAR.20250901
Olathe, KS 66062	Revision B
	Lab Designation Number: US1195

FCC ID:	IPH-A4998
Model(s):	AA4998
Marketing Name:	AA4998
Test Sample:	Engineering Unit Same as Production
Serial Number:	3609390302
Equipment Type:	Short-Range Device and Mobile Earth Station
Classification:	Portable Transmitter Next to Body
TX Frequency Range:	1616 – 1626 MHz; 2400 – 2480 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	1640 MHz – 32.2 dBm, 2450 MHz (BT) – 3.5 dBm, 2450 MHz (ANT) – 3.5 dBm Conducted
Signal Modulation:	DE-QPSK, QPSK, GFSK, GMSK
Antenna Type:	External Antenna (1.64 GHz Quad Helical 2.01 dBi Gain); Internal Antenna (2.4 GHz Inverted F -0.01 dBi Gain)
Application Type:	Certification
FCC Rule Parts:	Part 2, 15C, 25
KDB Test Methodology:	KDB 447498 D01 v06
Maximum SAR Value:	1.40 W/kg Reported
Maximum Simultaneous Value:	1.50 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 (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	October 7, 2025
Revision A – Correct the serial number, correct the date in the verification table, correct the equipment type, correct the rule parts and delete a paragraph on page 19 that does not apply	October 15, 2025
Revision B – Redact photos	October 22, 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 AA4998 FCC ID: IPH-A4998 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 AA4998 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 were employed.

The following table indicates all the wireless technologies operating in the AA4998 Short-Range Device and Mobile Earth Station. The table also shows the tolerance for the power level for each mode.

Band	Technology	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
1640 MHz	DE-QPSK/MES	N/A	N/A	32.2
Bluetooth	BLE	N/A	N/A	3.5
Ant	Ant	N/A	N/A	3.5

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.

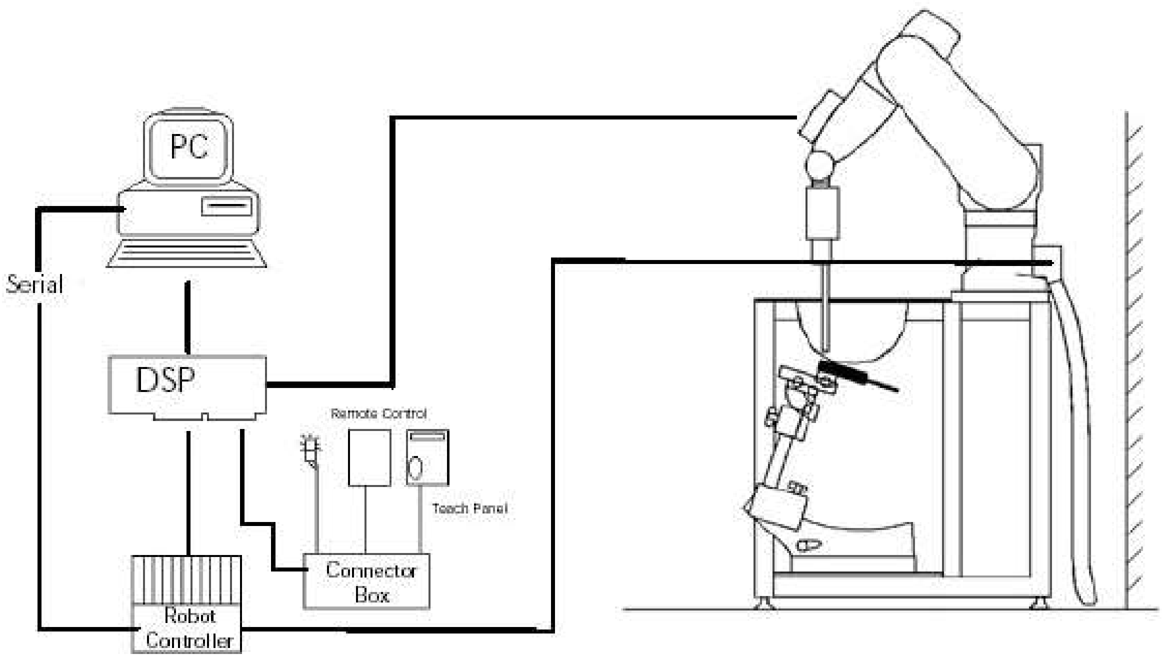


Figure 2.1 SAR Measurement System Setup

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 below.

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

Frequency: 10 MHz to 6 GHz

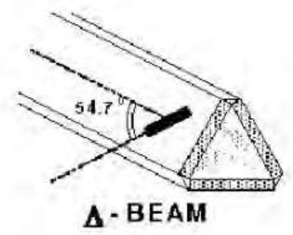


Figure 2.2 Triangular Probe Configurations

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 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

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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

where:

σ = simulated tissue conductivity,

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

SAR is proportional to $\Delta T / \Delta t$, 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;

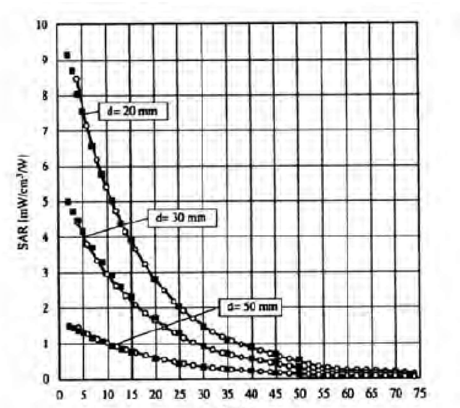


Figure 2.4 E-Field and Temperature Measurements at 900MHz

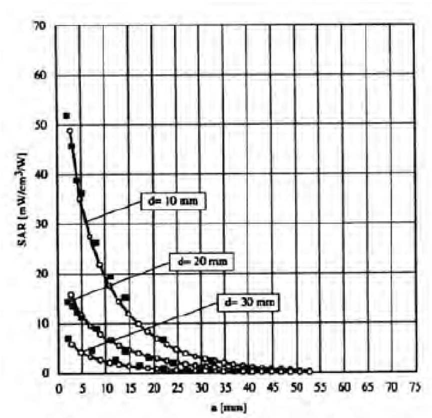


Figure 2.5 E-Field and Temperature Measurements at 1800MHz

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

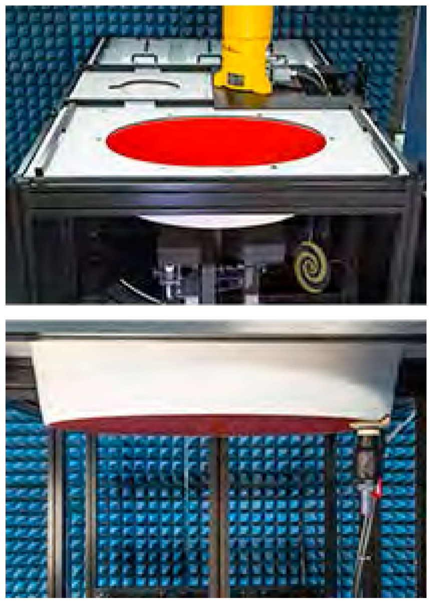


Figure 2.6 Flat Phantom

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
		1640 MHz Head
Mixing Percentage		
Water		Proprietary Purchased From Speag
Sugar		
Salt		
HEC		
Bactericide		
DGBE		
Dielectric Constant	Target	40.23
Conductivity (S/m)	Target	1.30

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

		1640 MHz Head	
Date(s)		Sept. 8, 2025	
Liquid Temperature (˚C)	20.0	Target	Measured
Dielectric Constant: ε		40.23	39.20
Conductivity: σ		1.30	1.33

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
08-Sep-2025	1640 MHz	34.30	35.10	Head	+ 2.33	1

See Appendix A for data plots.

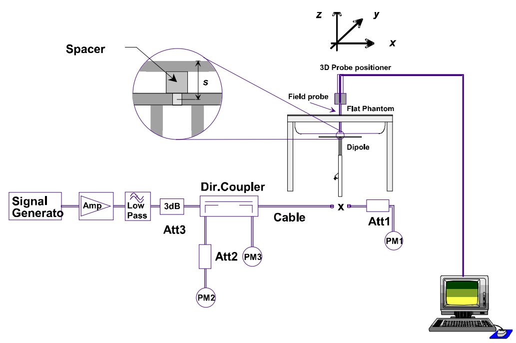


Figure 7.1 Dipole Validation Test Setup

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 on all six sides of the device in contact with the ELI Flat phantom for measurements. All measurements were conducted with the side of the device in direct contact with the phantom. All further test reductions are shown on page 21. The device does allow for simultaneous Tx with the BT or ANT but not both. See the photo in Appendix C for a pictorial of the setups.

The transmitter has a maximum duty cycle of 9.2%. The transmitter was operating at the 9.2% duty cycle for the measurements.

The BLE and ANT use the same circuitry for operation. Therefore, only the BLE was evaluated for this report and the BLE evaluation will cover the ANT transmitter as both are at the same power level.

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

Image Removed

Table 8.1 Test Reduction Table

Mode	Side	Required Channel	Tested/Reduced
1620 MHz	Back	1 – 1616 MHz	Tested
		125 – 1621 MHz	Tested
		240 – 1626 MHz	Tested
	Front	1 – 1616 MHz	Reduced[1]
		125 – 1621 MHz	Tested
		240 – 1626 MHz	Reduced[1]
	Left	1 – 1616 MHz	Tested
		125 – 1621 MHz	Tested
		240 – 1626 MHz	Tested
	Right	1 – 1616 MHz	Reduced[1]
		125 – 1621 MHz	Tested
		240 – 1626 MHz	Reduced[1]
	Top	1 – 1616 MHz	Tested
		125 – 1621 MHz	Tested
		240 – 1626 MHz	Tested
	Bottom	1 – 1616 MHz	Reduced[1]
		125 – 1621 MHz	Tested
		240 – 1626 MHz	Reduced[1]

Reduced[1] – When the reported SAR is <0.8 W/kg, the remaining channels are excluded based on KDB447498 v06.

Band	Mode	Channel	Frequency (MHz)	Avg Power (dBm)	Tune-up Pwr (dBm)
1640 MHz	DE-QPSK	1	1616.02	31.24	32.2
		125	1620.98	31.14	32.2
		240	1625.98	30.97	32.2

Band	Mode	Channel	Frequency (MHz)	Avg Power (dBm)	Tune-up Pwr (dBm)
2450 MHz	BLE	0	2404	Not Required	3.5
		17	2440		3.5
		36	2478		3.5
	ANT	1	2402		3.5
		39	2440		3.5
		78	2480		3.5

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)
	1.6 GHz	QPSK	Back	Tx1	0mm	Low	1616	31.24	32.2	0.913	1.14
	1.6 GHz	QPSK			0mm	Mid	1621	31.14	32.2	0.929	1.19
	1.6 GHz	QPSK			0mm	High	1626	30.97	32.2	0.766	1.02
	1.6 GHz	QPSK	Front		0mm	Mid	1621	31.14	32.2	0.780	1.00
1	1.6 GHz	QPSK	Left		0mm	Low	1616	31.24	32.2	1.12	1.40
	1.6 GHz	QPSK			0mm	Mid	1621	31.14	32.2	1.09	1.39
	1.6 GHz	QPSK			0mm	High	1626	30.97	32.2	1.05	1.39
	1.6 GHz	QPSK	Right		0mm	Mid	1621	31.14	32.2	0.153	0.20
	1.6 GHz	QPSK	Top		0mm	Low	1616	31.24	32.2	1.04	1.30
	1.6 GHz	QPSK			0mm	Mid	1621	31.14	32.2	1.08	1.38
	1.6 GHz	QPSK			0mm	High	1626	30.97	32.2	0.984	1.31
	1.6 GHz	QPSK	Bottom		0mm	Mid	1621	31.14	32.2	0.0112	0.01
	1.6 GHz	QPSK	Repeat		0mm	Low	1616	31.24	32.2	1.10	1.37

10. Simultaneous Transmission Analysis

Sim-Tx configuration for Main Unit

No.	Simultaneous Transmission Configuration	Exposure Positions
		Body
1	1.64 GHz + BT	Yes

Body Exposure Conditions

Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)
	1.6GHz Iridium	2.4GHz BLE	
	1g SAR (W/kg)	1g SAR (W/kg)	
Back	1.19	0.10	1.29
Front	1.00	0.10	1.10
Left	1.40	0.10	1.50
Right	0.20	0.10	0.30
Top	1.38	0.10	1.48
Bottom	0.01	0.10	0.11

The ANT and BLE transmitters were excluded due to low power. Therefore, the BLE was calculated for the simultaneous evaluation as shown below. Both the ANT and BLE transmit at the same maximum power and they cannot transmit simultaneously.

[(max. power, mW)/(min. distance, mm)] * [$\sqrt{f_{(GHz)}}$/7.5) = (2.3/5) * ($\sqrt{2.48}$/7.5) = 0.10

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	02/11/2026	02/11/2025	3662
Speag Validation Dipole D1640V2	02/05/2026	02/05/2025	330
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 (1640 MHz)	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

```
**************************************************************
Test Result for UIM Dielectric Parameter
Mon 08/Sep/2025
Freq   Frequency(GHz)
FCC_eH FCC Limits for Head Epsilon
FCC_sH FCC Limits for Head Sigma
Test_e Epsilon  of  UIM
Test_s Sigma of UIM
**************************************************************
Freq          FCC_eH FCC_sH Test_e Test_s
1.6100        40.29  1.28   39.25  1.30
1.6160        40.278 1.286  39.244 1.306*
1.6200        40.27  1.29   39.24  1.31
1.6210        40.268 1.29   39.237 1.311*
1.6260        40.258 1.29   39.222 1.316*
1.6300        40.25  1.29   39.21  1.32
1.6400        40.23  1.30   39.20  1.33
1.6500        40.21  1.31   39.19  1.34
1.6600        40.21  1.32   39.17  1.35
1.6700        40.22  1.33   39.15  1.36

* value interpolated
```

RF Exposure Lab

Plot 1

DUT: D1640V2 - SN330; Type: D1640V2; Serial: 330

Communication System: CW; Frequency: 1640 MHz; Duty Cycle: 1:1
Medium: HSL1640; Medium parameters used: f = 1640 MHz; σ = 1.33 S/m; ε_r = 39.2; ρ = 1000 kg/m^3
Phantom section: Flat Section

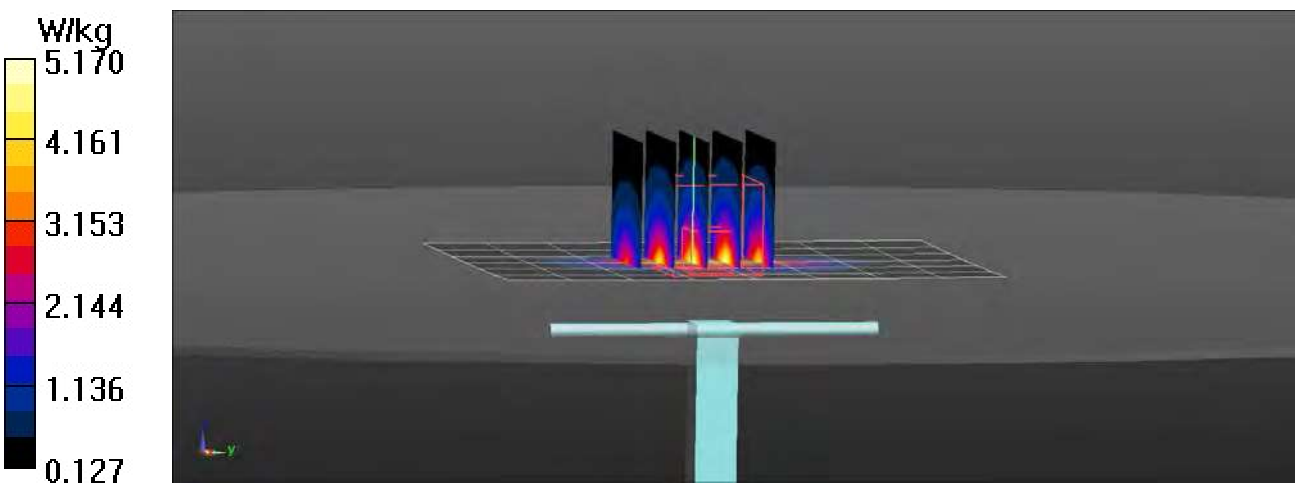
Test Date: Date: 9/8/2025; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.69, 7.88, 6.72); Calibrated: 2/11/2025
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:

1640 MHz Verification/Mid/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 4.91 W/kg

1640 MHz Verification/Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.53 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 6.29 W/kg
SAR(1 g) = 3.51 W/kg; SAR(10 g) = 1.92 W/kg
P_{IN} = 100 mW
Smallest distance from peaks to all points 3 dB below = 11.2 mm
Ratio of SAR at M2 to SAR at M1 = 60.4%
Maximum value of SAR (measured) = 5.17 W/kg



Appendix B – SAR Test Data Plots

RF Exposure Lab

Plot 1

DUT: AA4998; Type: Short-Range Device and Mobile Earth Station; Serial: 3609390302

Communication System: FDMA-FM; Frequency: 1616.02 MHz; Duty Cycle: 1:10.86957
Medium: HSL1600; Medium parameters used (interpolated): f = 1616.02 MHz; σ = 1.306 S/m; ε_r = 39.244; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 9/8/2025; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.69, 7.88, 6.72); Calibrated: 2/11/2025
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 (4); SEMCAD X Version 14.6.14 (7483)

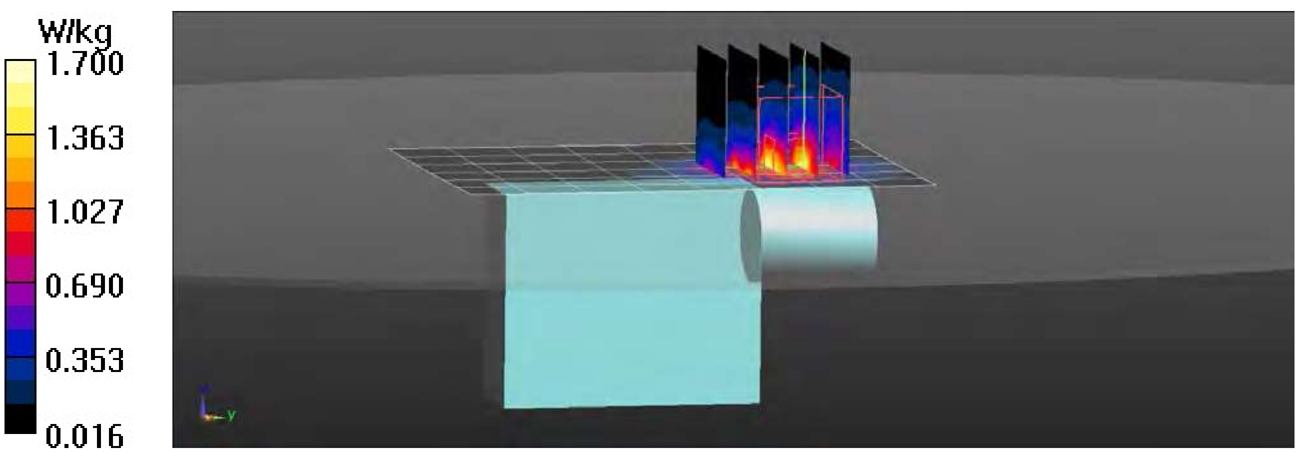
Procedure Notes:

AA4998 Iridium/Left Low/Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.56 W/kg

AA4998 Iridium/Left Low/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.65 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 2.06 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.652 W/kg
Smallest distance from peaks to all points 3 dB below = 10.2 mm
Ratio of SAR at M2 to SAR at M1 = 64.9%

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.70 W/kg



Appendix C – SAR Test Setup Photos

Photo Removed

Test Position Back 0 mm Gap

Photo Removed

Test Position Front 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-3662_Feb25**

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3662

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: February 11, 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	Paulo Pina	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: February 11, 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:3662

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc ($k = 2$)
Norm ($\mu V/(V/m)^2$) [A]	0.41	0.49	0.52	±10.1%
DCP (mV) [B]	100.1	99.9	98.3	±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	147.1	±0.9%	±4.7%
		Y	0.00	0.00	1.00		147.2		
		Z	0.00	0.00	1.00		134.4		

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 Page 5).
[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:3662

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle	77.7°
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:3662

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] ($k = 2$)
150	52.3	0.76	11.34	11.71	10.15	0.00	1.25	±13.3%
220	49.0	0.81	10.99	11.34	9.84	0.00	1.25	±13.3%
450	43.5	0.87	10.18	10.18	10.18	0.16	1.30	±13.3%
750	41.9	0.89	8.66	8.87	7.56	0.36	1.27	±11.0%
900	41.5	0.97	8.35	8.54	7.29	0.35	1.27	±11.0%
1640	40.2	1.31	7.69	7.88	6.72	0.34	1.27	±11.0%
1750	40.1	1.37	7.56	7.74	6.60	0.34	1.27	±11.0%
1900	40.0	1.40	7.28	7.45	6.36	0.34	1.27	±11.0%
2300	39.5	1.67	7.61	7.79	6.64	0.34	1.27	±11.0%
2450	39.2	1.80	7.18	7.35	6.27	0.33	1.27	±11.0%
2600	39.0	1.96	7.31	7.48	6.38	0.33	1.27	±11.0%
5250	35.9	4.71	5.84	5.98	5.10	0.30	1.27	±13.1%
5600	35.5	5.07	5.19	5.31	4.53	0.27	1.27	±13.1%
5750	35.4	5.22	5.35	5.48	4.67	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.

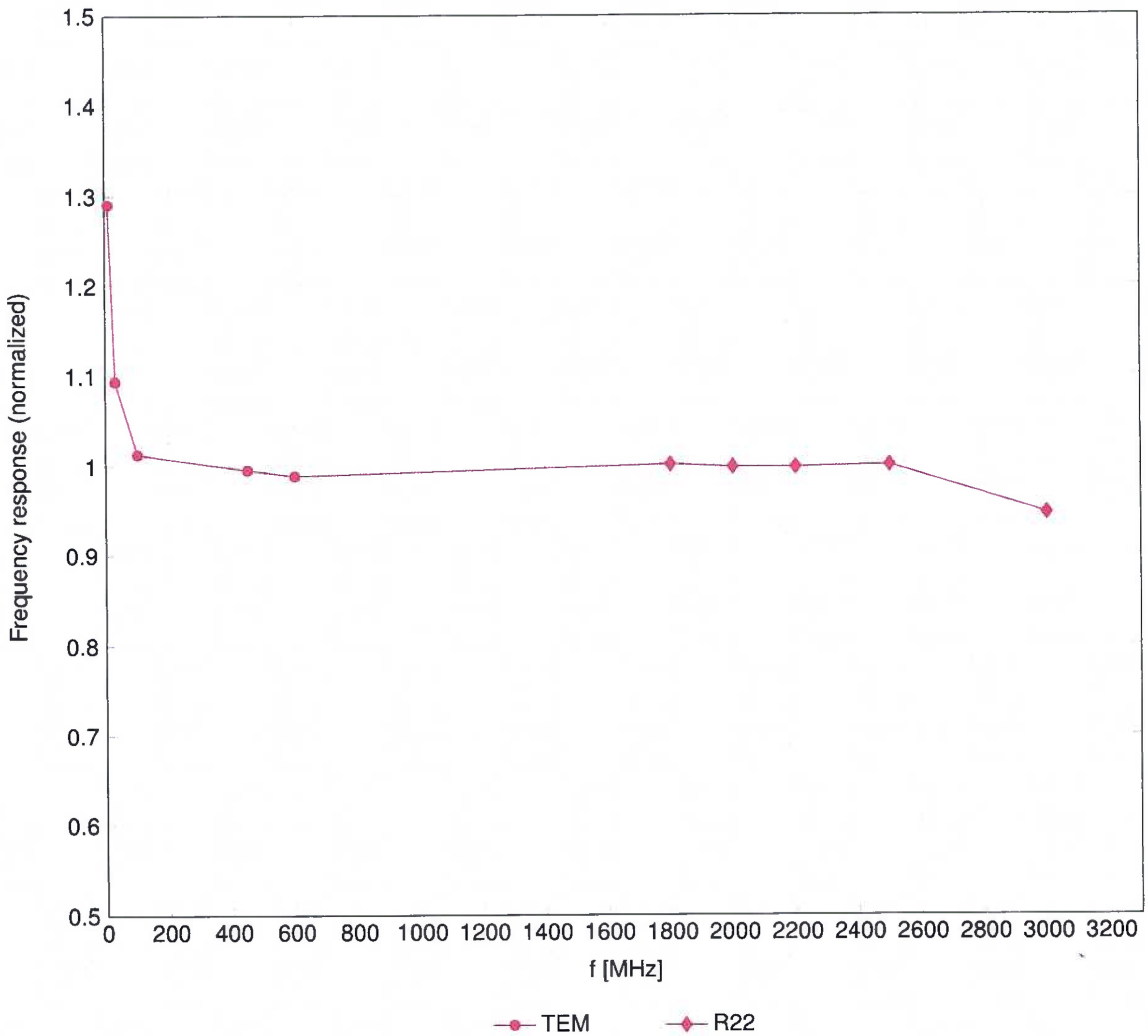
[F] The probes are calibrated using tissue simulating liquids (TSL) that deviate for ε and σ by less than ±5% from the target values (typically better than ±3%) and are valid for TSL with deviations of up to ±10% if SAR correction is applied.

[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.

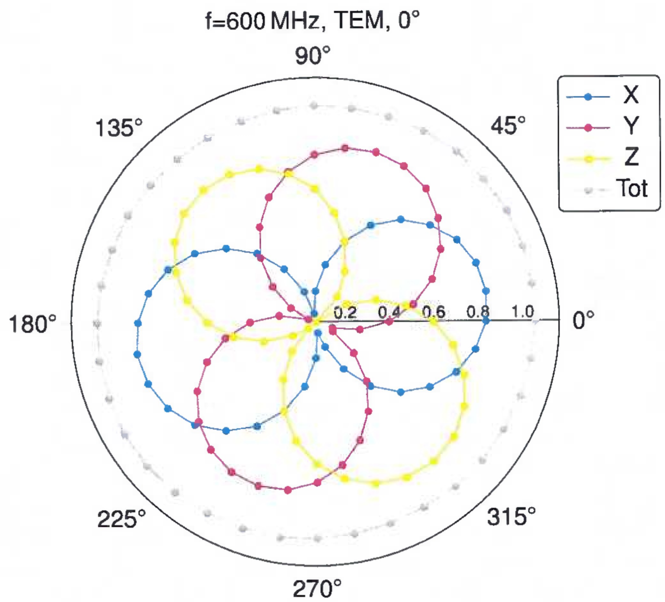
Frequency Response of E-Field

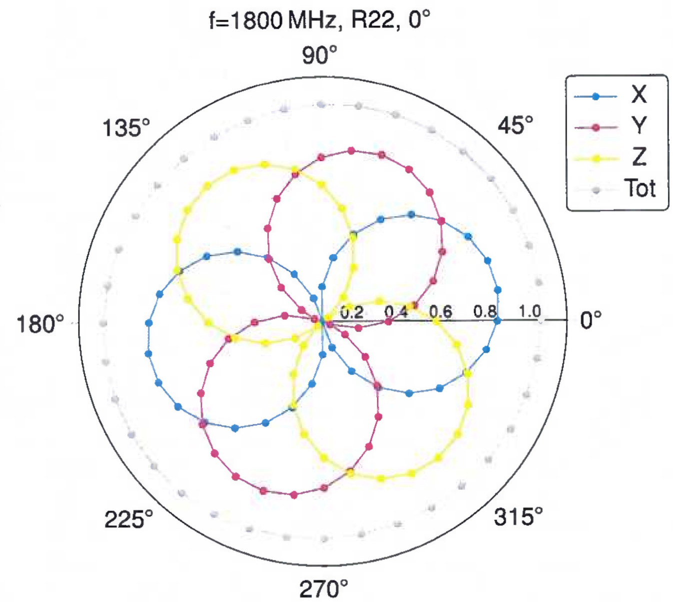
(TEM-Cell:ifi110 EXX, Waveguide:R22)

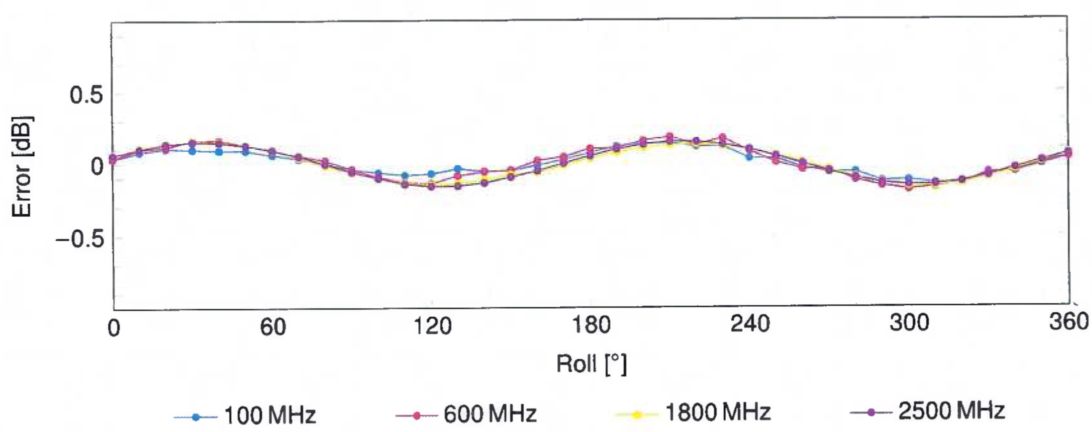


Uncertainty of Frequency Response of E-field: ±6.3% (k=2)

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



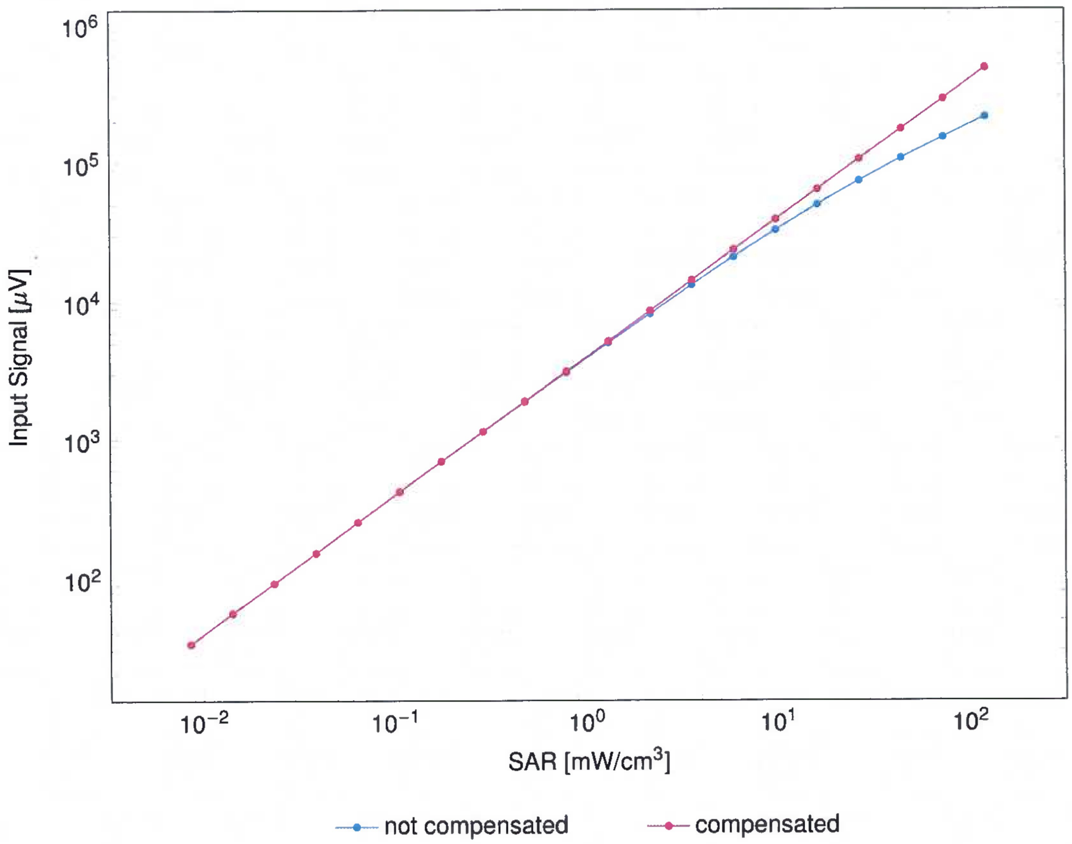


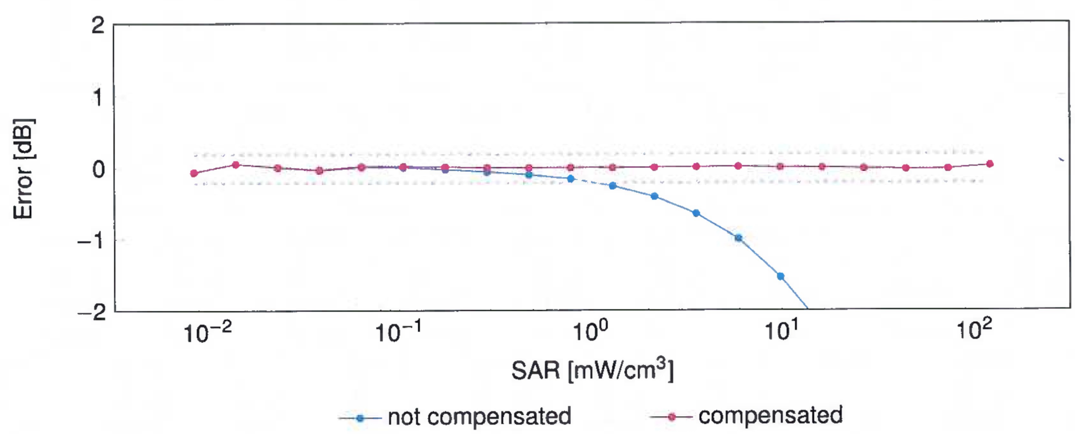


Uncertainty of Axial Isotropy Assessment: ±0.5% (k=2)

Dynamic Range f(SAR_{head})

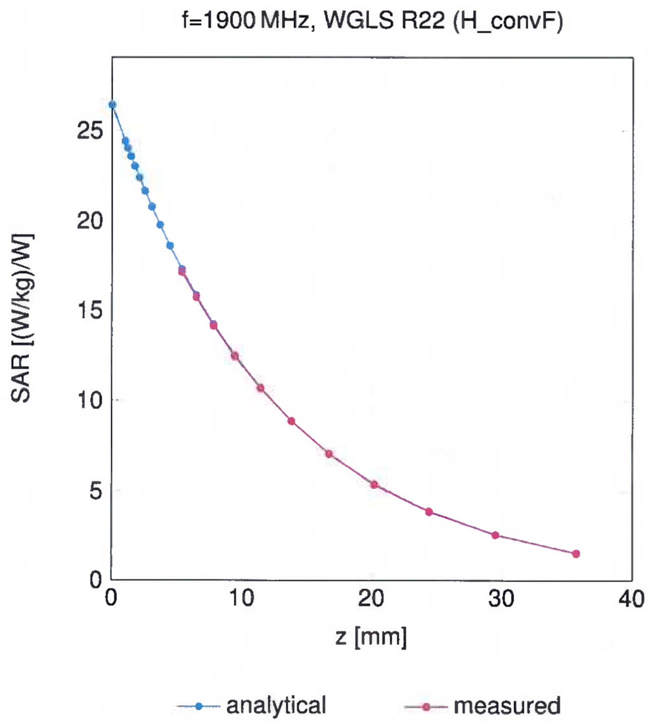
(TEM cell, f_{eval} = 1900 MHz)





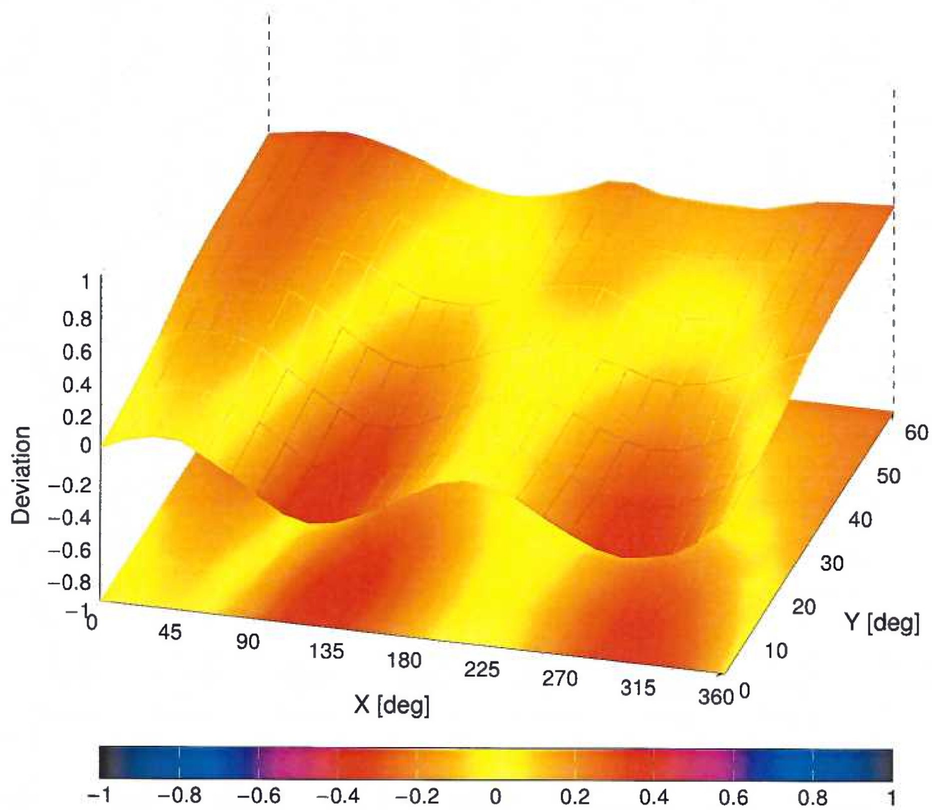
Uncertainty of Linearity Assessment: ±0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900 MHz



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
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. **D1640V2-330_Feb25**

CALIBRATION CERTIFICATE

Object: D1640V2 - SN: 330

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

Calibration date: February 5, 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 Cal
Power Sensor R&S NRP-33T	SN: 100967	28-Mar-24 (No. 217-04038)	Mar-25
Power Sensor R&S NRP18A	SN: 101859	22-Jul-24 (No. 4030A315008547)	Jul-25
Spectrum Analyzer R&S FSV40	SN: 101832	29-Jan-25 (No. 4030A315009658)	Jan-26
Mismatch; Short [S4188] Attenuator [S4423]	SN: 1152	28-Mar-24 (No. 217-04050)	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
DAE4ip	SN: 1836	28-Oct-24 (No. DAE4ip-1836_Oct24)	Oct-25

Secondary Standards	ID	Check Date (in house)	Scheduled Check
ACAD Source Box	SN: 1000	28-May-24 (No. 675-ACAD_Source_Box-240528)	May-25
Signal Generator R&S SMB100A	SN: 182081	28-May-24 (No. 675-CAL16-S4588-240528)	May-25
Mismatch; SMA	SN: 1102	22-May-24 (No. 675-Mismatch_SMA-240522)	May-25

	Name	Function	Signature
Calibrated by	Claudio Leubler	Laboratory Technician	
Approved by	Sven Kühn	Technical Manager	

Issued: February 6, 2025

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

- 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.
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation

- 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 dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss*: These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay*: One-way delay between the SMA connector and the antenna feed point. 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	DASY8 Module SAR	16.4.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with spacer
Zoom Scan Resolution	dx, dy = 6mm, dz = 1.5mm	Graded Ratio = 1.5 mm (Z direction)
Frequency	1640MHz ±1MHz	

Head TSL parameters at 1640 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.2	1.31 mho/m
Measured Head TSL parameters	(22.0 ±0.2)°C	39.9 ±6%	1.26 mho/m ±6%
Head TSL temperature change during test	< 0.5 °C		

SAR result with Head TSL at 1640 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	8.61 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	34.3 W/kg ±17.0% (k = 2)

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR for nominal Head TSL parameters	24 dBm input power	4.70 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	18.7 W/kg ±16.5% (k = 2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 1640 MHz

Impedance	53.4 Ω + 0.2 jΩ
Return Loss	-29.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.213 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

System Performance Check Report

Summary

Dipole	Frequency [MHz]	TSL	Power [dBm]
D1640V2 - SN330	1640	HSL	24

Exposure Conditions

Phantom Section, TSL	Test Distance [mm]	Band	Group, UID	Frequency [MHz], Channel Number	Conversion Factor	TSL Conductivity [S/m]	TSL Permittivity
Flat	10		CW, 0--	1640, 0	7.84	1.26	39.9

Hardware Setup

Phantom	TSL, Measured Date	Probe, Calibration Date	DAE, Calibration Date
MFP V8.0 Center	HSL, 2025-02-05	EX3DV4 - SN7349, 2025-01-10	DAE4ip Sn1836, 2024-10-28

Scans Setup

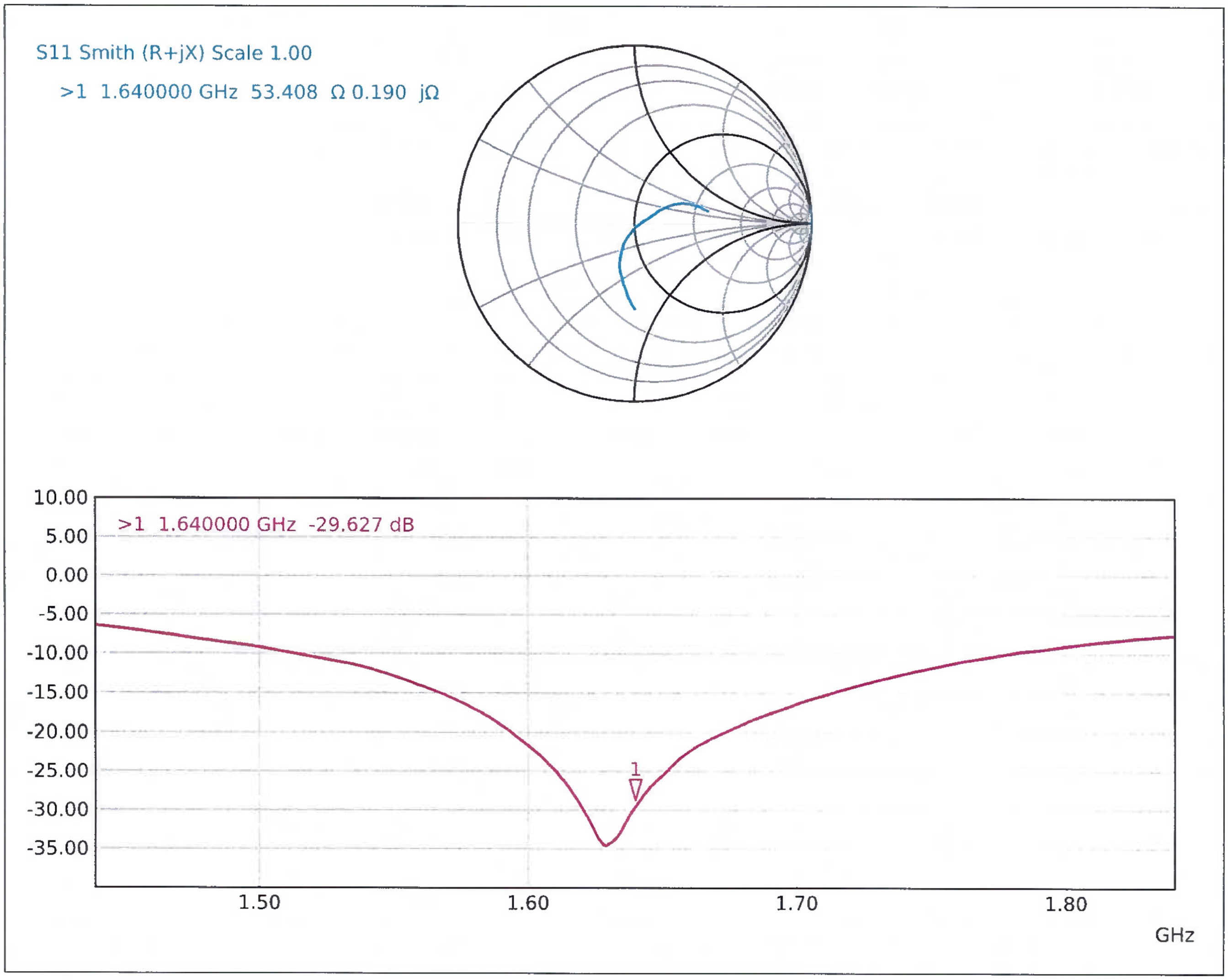
	Zoom Scan
Grid Extents [mm]	30 x 30 x 30
Grid Steps [mm]	6.0 x 6.0 x 1.5
Sensor Surface [mm]	1.4
Graded Grid	Yes
Grading Ratio	1.5
MAIA	N/A
Surface Detection	VMS + 6p
Scan Method	Measured

Measurement Results

	Zoom Scan
Date	2025-02-05
psSAR1g [W/Kg]	8.61
psSAR10g [W/Kg]	4.70
Power Drift [dB]	0.00
Power Scaling	Disabled
Scaling Factor [dB]	
TSL Correction	Positive / Negative

0 dB = 14.7 W/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	i.V.

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

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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	1640	02/28/2025	3662	EX3DV4	1640	Head	1.35	39.86	Pass	Pass	Pass	CW	Pass	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 AA4998-A1/A2 for Garmin Model AA4998. 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	Type	Maximum Gain	Approximate Frequency Band
AA4998-A1	Inverted-F, PCB	-0.01 dBi	2402 to 2480 MHz
AA4998-A2	Quad-helical	2.01 dBi	1616 to 1626 MHz

NOTE: Antenna Gain is listed as N/A in the table when the specific antenna is only used for radios where the applicable rule parts are measured as a radiated field strength, and/or there are no rules pertaining to antenna gain limits.

Additional Information:

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