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MEASUREMENT REPORT FCC Part 15.247 / ISED RSS-247 ANT+

Applicant Name:
Garmin International Inc
1200 E. 151st. Street
Olathe, Kansas 66062
United States

Date of Testing:
5/30-7/14/2025
Test Report Issue Date:
7/15/2025
Test Site/Location:
Element lab., Columbia, MD, USA
Test Report Serial No.:
1M2505300056-02.IPH

FCC ID:	IPH-05071
IC:	1792A-05071
APPLICANT:	Garmin International Inc

Application Type:	Certification
Model/HVIN:	A05071
EUT Type:	Portable Digital Transceiver
Frequency Range:	2402 – 2480MHz
FCC Classification:	Digital Transmission System (DTS)
Test Procedure(s):	ANSI C63.10:2020

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10:2020. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me 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.

RJ Ortanez
Executive Vice President



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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Innovation, Science and Economic Development Canada.

1.2 Element Test Location

Measurements were conducted at the Element laboratory indicated in Section 1.3 below. All measurement facilities are compliant with the test site requirements specified in ANSI C63.4-2014 and KDB 414788 D01 v01r01.

1.3 Test Facility / Accreditations

Measurements were performed at Element lab located in Columbia, MD 21046, U.S.A.

- Element Washington DC LLC is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- Element Washington DC LLC TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- Element Washington DC LLC facility is a registered test laboratory with the site description on file with ISED (Wireless Test Lab number 2451B) and FCC (Designation Number US1113)
- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreements (MRAs).

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Garmin Portable Digital Transceiver FCC ID: IPH-05071**. The test data contained in this report pertains only to the emissions due to the EUT's ANT+ transmitter.

Test Device Serial No.: 602617541, 602617691, 602617772, 608867659

2.2 Device Capabilities

This device contains the following capabilities:

ANT/BLE – 2.4 GHz

Ch.	Frequency (MHz)
00	2402
:	:
38	2440
:	:
78	2480

Table 2-1. Frequency/ Channel Operations

Notes:

1. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 3MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of ANSI C63.10-2020 and KDB 558074 D01 v05r02. The RBW and VBW were both greater than 50\T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Mode	Duty Cycle [%]	Radiated DCCF [dB]
ANT+	94.56	0.24

Table 2-2. Measured Duty Cycles

2.3 Antenna Description

Following antenna was used for the testing.

Frequency [GHz]	Antenna Gain (dBi)
2.4	1.83

Table 2-3. Antenna Peak Gain

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2.4 Test Configuration

The EUT was tested per the guidance of ANSI C63.10:2020. ANSI C63.10:2020 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing. The AC line conducted testing was performed with the EUT powered via a USB cord connected to a power adapter. See Sections 3.2 for AC line conducted emissions test setups, 3.3 for radiated emissions test setups, and 7.2, 7.3, 7.4, 7.5, and 7.6 for antenna port conducted emissions test setups.

2.5 Software and Firmware

The test was conducted with firmware version 0.13 installed on the EUT.

2.6 EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and no modifications were made during testing.

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3.0 DESCRIPTION OF TESTS

3.1 Evaluation Procedure

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10:2020) was used in the measurement of the EUT.

Deviation from measurement procedure.....None

3.2 AC Line Conducted Emissions

The line-conducted facility is located inside a 10'x16'x9' shielded enclosure. The shielded enclosure is manufactured by ETS Lindgren RF Enclosures. The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. The external power line filter is an ETS Lindgren Model LPRX-4X30 (100dB Attenuation, 14kHz-18GHz) and the two EMI/RFI filters are ETS Lindgren Model LRW-2030-S1 (100dB Minimum Insertion Loss, 14kHz – 10GHz). These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference groundplane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The spectrum was scanned from 150kHz to 30MHz with a spectrum analyzer. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions is used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

Line conducted emissions test results are shown in Section 7.10. The EMI Receiver mode of the Agilent MXE was used to perform AC line conducted emissions testing.

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3.3 Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. The test site inside the chamber is a 6m x 5.2m elliptical, obstruction-free area in accordance with Figure 5.7 of Clause 5 in ANSI C63.4-2014. Absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections for measurements above 1GHz. An 80cm tall test table made of Styrodur is placed on top of the turn table. For measurements above 1GHz, an additional Styrodur pedestal is placed on top of the test table to bring the total table height to 1.5m.

For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33 depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up was placed on top of the 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, mode of operation, turntable azimuth, and receive antenna height was noted for each frequency found.

Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions.

All radiated measurements are performed in a chamber that meets the site requirements per ANSI C63.4-2014. Additionally, radiated emissions below 30MHz are also validated on an Open Area Test Site to assert correlation with the chamber measurements per the requirements of KDB 474788 D01.

3.4 Environmental Conditions

The temperature is controlled within range of 15°C to 35°C. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.”

- The antennas of the EUT are **permanently attached**.
- There are no provisions for connection to an external antenna.

Conclusion:

The EUT complies with the requirement of §15.203.

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5.0 MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10:2020. All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95% level of confidence. The measurement uncertainty shown below meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Contribution	Expanded Uncertainty (\pm dB)
Conducted Bench Top Measurements	1.13
Line Conducted Disturbance	3.09
Radiated Disturbance (<1GHz)	4.98
Radiated Disturbance (>1GHz)	5.07
Radiated Disturbance (>18GHz)	5.09

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6.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST). Measurements antennas used during testing were calibrated in accordance to the requirements of ANSI C63.5-2017.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	MD 1M-40	EMC Cable and Switch System	2/25/2025	Annual	2/25/2026	MD 1M-40
-	AP2	EMC Cable and Switch System	2/25/2025	Annual	2/25/2026	AP2
-	WL25-1	Conducted Cable Set (25GHz)	2/25/2025	Annual	2/25/2026	WL25-1
-	WL25-2	Conducted Cable Set (25GHz)	2/25/2025	Annual	2/25/2026	WL25-2
-	ETS	EMC Cable and Switch System	2/25/2025	Annual	2/25/2026	ETS
Agilent	N9038A	MXE EMI Receiver	9/16/2024	Annual	9/16/2025	MY51210133
Agilent	N9030A	PXA Signal Analyzer (44GHz)	10/16/2024	Annual	10/16/2025	MY49430494
Anritsu	MA2411B	Pulse Power Sensor	7/1/2024	Annual	7/1/2025	1911105
EMCO	3115	Horn Antenna (1-18GHz)	9/6/2024	Biennial	9/6/2026	9704-5182
EMCO	3116	Horn Antenna (18-40GHz)	7/5/2023	Biennial	7/5/2025	9203-2178
Rohde & Schwarz	ESU26	EMI Test Receiver (26.5GHz)	10/16/2024	Annual	10/16/2025	100342
Rohde & Schwarz	HFH2-Z2E	Loop Antenna	6/4/2024	Biennial	6/4/2026	100854
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	9/11/2024	Biennial	9/11/2026	A051107
Sunol	DRH-118	Horn Antenna (1-18GHz)	2/21/2024	Biennial	2/21/2026	A050307

Table 6-1. Test Equipment Calibration Table

Component	Serial Number
MegaPhase Cable TM26-S1S1-36	18160103 003
Pasternack 6dB Attenuator PE7005-6	N/A

Table 6-2. WL25-1 Conducted Cable Set Components

Component	Serial Number
MiniCircuits Cable CBL-2FT-SMSM+	77743
MCL 6dB Attenuator BW-S6W2+	1314

Table 6-3. WL25-2 Conducted Cable Set Components

Component	Serial Number
Pasternack Cable RG214/U	111815
Sucoflex Cable 106A	246420-001
MegaPhase (CAGE 1GVT4) Cable GR18-N5N5-24	14042714 001
MegaPhase (CAGE 1GVT4) Cable NC29-N1N1-324	20502201 001
Rohde & Schwarz SF Unit	102134
Minicircuits Cable CBL=0.5M-NMNM+	15440

Table 6-4. ETS EMC Cable and Switch System Components

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Component	Serial Number
MiniCircuits Cable CBL-0.5M-SMNM+	47261
Micro-Coax Utilflex Cable UFB311A-Q-3346-50U50U MFR 64639	231978-001
Micro-Coax Utilflex Cable UFB311A-1-0629-50U50U MFR 64639	231986-002
MegaPhase (CAGE 1GVT4) Cable NC29-N1N1-324	19046401 001
Megaphase (CAGE 1GVT4) Flex Cable 10511-1	15044701-006
Micro-Coax Utilflex Cable UFB311A-Q-3346-50U50U MFR 64639	231978-002
Micro-Coax Utilflex Cable UFB311A-1-0629-50U50U MFR 64639	231986-004
Micro-Coax Utilflex Cable UFB142A-0-0629-5GU200 MFR 64639	232069-001
Rohde & Schwarz SF Unit	102138
Rohde & Schwarz OSP130 Open Switch and Control Unit	101181
Micro-Coax Utilflex Cable UFB311A-Q-3346-50U50U MFR 64639	231978-003
Micro-Coax Utilflex Cable UFB311A-1-0629-50U50U MFR 64639	231986-003
Rohde & Schwarz TS-PR8 Pre-Amplifier	102335

Table 6-5. AP2 EMC Cable and Switch System Components

Component	Serial Number
MegaPhase Cable TM40-K1K1-30	20233002-004
UTIPLEX Cable	64639 232063-001
Rohde & Schwarz Pre-amp RS-PR1840 18G-40G	9037.7670.02

Table 6-6. MD 1M 18-40 EMC Cable and Switch System Components

Note:

For equipment listed above that has a calibration date or calibration due date that falls within the test date range, care was taken to ensure that this equipment was used after the calibration date and before the calibration due date.

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7.0 TEST RESULTS

7.1 Summary

Company Name: Garmin International Inc
 FCC ID: IPH-05071
 IC: 1792A-05071
 Method/System: Digital Transmission System (DTS)
 Number of Channels: 79

FCC Part Section(s)	RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	RSS-247 [5.2]	6dB Bandwidth & Occupied Bandwidth	> 500kHz	CONDUCTED	PASS	Section 7.2
15.247(b)(3)	RSS-247 [5.4(4)]	Transmitter Output Power	< 1 Watt		PASS	Sections 7.3
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8dBm / 3kHz Band		PASS	Section 7.4
15.247(d)	RSS-247 [5.5]	Band Edge / Out-of-Band Emissions	≥ 20dBc		PASS	Sections 7.5, 7.6
15.205 15.209	RSS-Gen [8.9]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209 (RSS-Gen [8.9])	RADIATED	PASS	Sections 7.7, 7.8, 7.9
15.207	RSS-Gen [8.8]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits (RSS-Gen[8.8])	LINE CONDUCTED	PASS	Section 7.10

Table 7-1. Summary of Test Results

Notes:

- 1) All modes of operation were investigated. The test results shown in the following sections represent the worst case emissions.
- 2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
- 3) For radiated band edge, automated test software was used to measure emissions and capture the corresponding plots necessary to show compliance. The measurement software utilized is Element “Chamber Automation,” Version 1.5.0.
- 4) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables, attenuators, and couplers.

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7.2 6dB Bandwidth & Occupied Bandwidth Measurement – ANT+
§15.247(a.2); RSS-247 [5.2]

Test Overview and Limit

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

Test Procedure Used

ANSI C63.10:2020 – Section 6.9.3; Section 11.8.2 Option 2

Test Settings - 6dB Bandwidth

1. The signal analyzers’ automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 6dB bandwidth measurement. The “X” dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

Test Settings - Occupied Bandwidth

1. The signal analyzer’s automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 – 5% of the expected OBW
3. VBW ≥ 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple

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7. The trace was allowed to stabilize
8. If necessary, steps 2 – 7 were repeated after changing the RBW such that it would be within 1 – 5% of the 99% occupied bandwidth observed in Step 7

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-1. Test Instrument & Measurement Setup

Test Notes

None

Frequency [MHz]	Channel No.	Mode	Measured Occupied Bandwidth [kHz]	Measured 6dB Bandwidth [kHz]	Minimum 6dB Bandwidth [kHz]	Pass / Fail
2402	0	ANT+	961.60	501.0	500	Pass
2440	38	ANT+	988.88	507.1	500	Pass
2480	78	ANT+	988.30	505.0	500	Pass

Table 7-2. Conducted 6dB & Occupied Bandwidth Measurements

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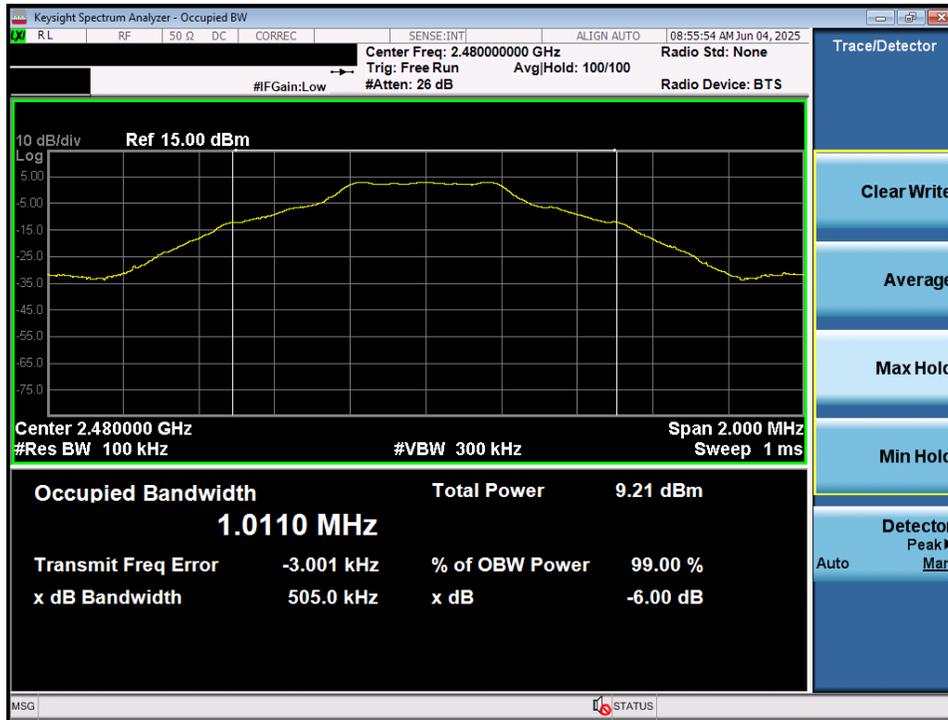


Plot 7-1. 6dB Bandwidth Plot (ANT+ – Ch. 0)



Plot 7-2. 6dB Bandwidth Plot (ANT+ – Ch. 38)

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Plot 7-3. 6dB Bandwidth Plot (ANT+ – Ch. 78)

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Plot 7-4. Occupied Bandwidth Plot (ANT+ – Ch. 0)



Plot 7-5. Occupied Bandwidth Plot (ANT+ – Ch. 38)

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Plot 7-6. Occupied Bandwidth Plot (ANT+ – Ch. 78)

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7.3 Output Power Measurement – ANT+ §15.247(b.3); RSS-247 [5.4(4)]

Test Overview and Limits

The transmitter antenna terminal of the EUT is connected to the input of a spectrum analyzer. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

Test Procedure Used

ANSI C63.10:2020 – Section 11.9.1.1

Test Settings

1. RBW = 3MHz
2. VBW = 50MHz
3. Span $\geq 3 \times$ RBW
4. Sweep = auto couple
5. Detector = Peak
6. Trace mode = max hold
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-2. Test Instrument & Measurement Setup

Test Notes

None

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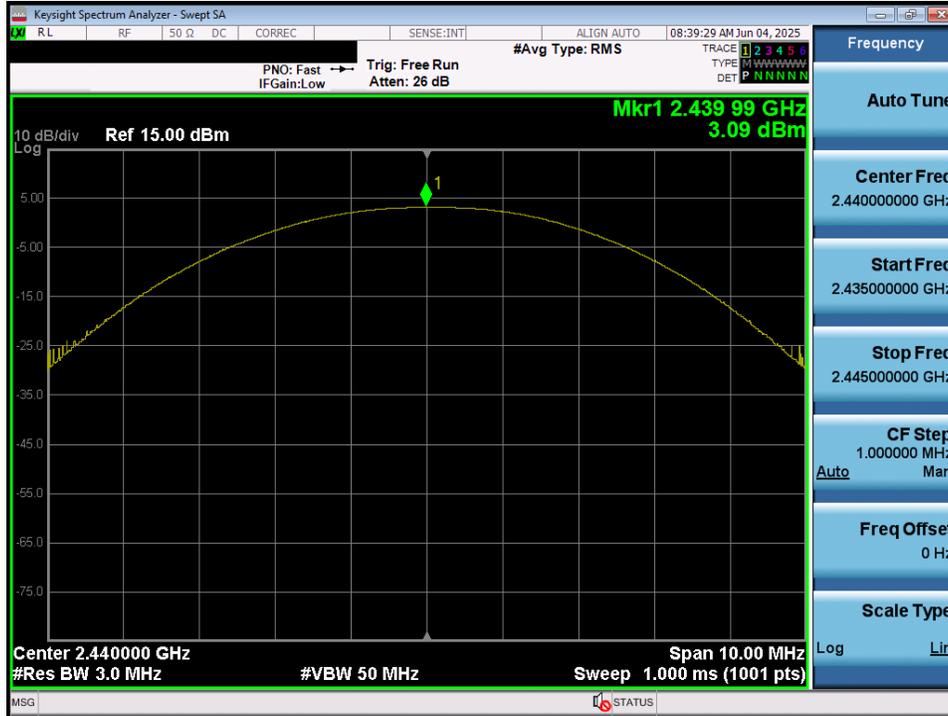
Frequency [MHz]	Channel No.	Mode	Peak Conducted Power	
			[dBm]	[mW]
2402	0	ANT+	3.09	2.035
2440	38	ANT+	3.09	2.038
2480	78	ANT+	2.98	1.985

Table 7-3. Conducted Output Power Measurements (ANT+)



Plot 7-7. Peak Power Plot (ANT+ – Ch. 0)

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Plot 7-8. Peak Power Plot (ANT+ – Ch. 38)



Plot 7-9. Peak Power Plot (ANT+ – Ch. 78)

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7.4 Power Spectral Density – ANT+ §15.247(e); RSS-247 [5.2]

Test Overview and Limit

The peak power density is measured with a spectrum analyzer connected to the antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Test Procedure Used

ANSI C63.10:2020 – Section 11.10.2 Method PKPSD

Test Settings

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz
4. VBW = 1MHz
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-3. Test Instrument & Measurement Setup

Test Notes

None

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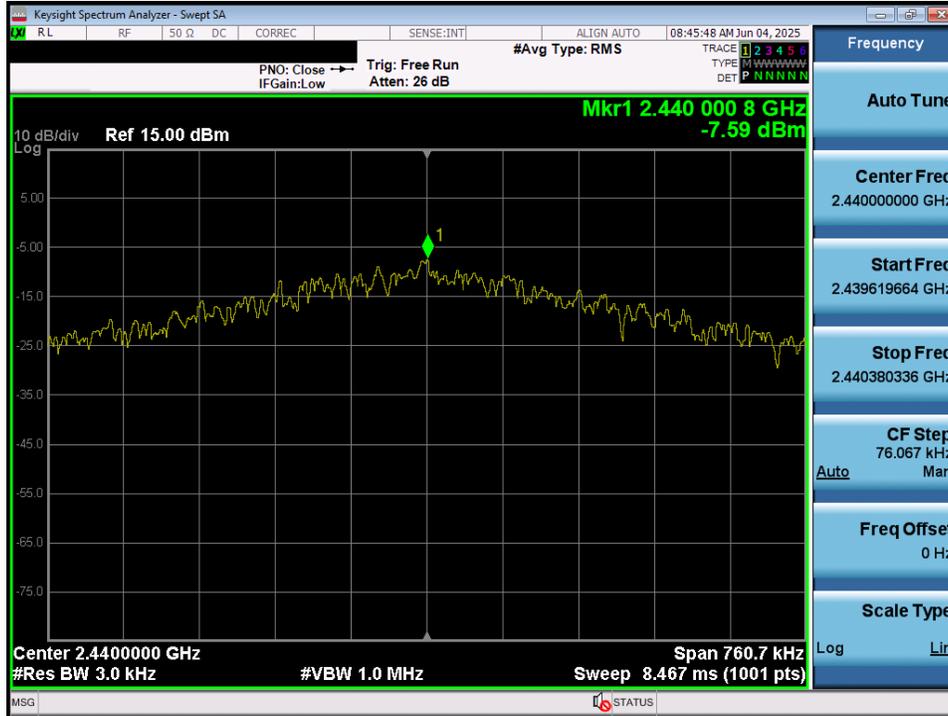
Frequency [MHz]	Channel No.	Mode	Measured Power Spectral Density [dBm]	Maximum Permissible Power Density [dBm / 3kHz]	Margin [dB]
2402	0	ANT+	-7.69	8.0	-15.69
2440	38	ANT+	-7.59	8.0	-15.59
2480	78	ANT+	-7.83	8.0	-15.83

Table 7-4. Conducted Power Density Measurements



Plot 7-10. Power Spectral Density Plot (ANT+ – Ch. 0)

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Plot 7-11. Power Spectral Density Plot (ANT+ – Ch. 38)



Plot 7-12. Power Spectral Density Plot (ANT+ – Ch. 78)

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7.5 Conducted Emissions at the Band Edge

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

For the following out of band conducted spurious emissions plots at the band edge, the EUT was set to transmit at maximum power with the largest packet size available. These settings produced the worst-case emissions.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth.

Test Procedure Used

ANSI C63.10:2020 – Section 11.11.3

Test Settings

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot
2. Span was set large enough so as to capture all out of band emissions near the band edge
3. RBW = 100kHz
4. VBW = 300kHz
5. Detector = Peak
6. Number of sweep points $\geq 2 \times \text{Span/RBW}$
7. Trace mode = max hold
8. Sweep time = auto couple
9. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



Figure 7-4. Test Instrument & Measurement Setup

Test Notes

None

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7.6 Conducted Spurious Emissions

§15.247(d); RSS-247 [5.5]

Test Overview and Limit

For the following out of band conducted spurious emissions plots, the EUT was set to transmit at maximum power with the largest packet size available. The worst case spurious emissions were found in this configuration.

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the procedure in Section 8.5 of KDB 558074 D01 v05r02 and Section 11.11.3 of ANSI C63.10:2020.

Test Procedure Used

ANSI C63.10:2020 – Section 11.11.3

Test Settings

1. Start frequency was set to 30MHz and stop frequency was set to 25GHz (separated into two plots per channel)
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = Peak
5. Trace mode = max hold
6. Sweep time = auto couple
7. The trace was allowed to stabilize

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



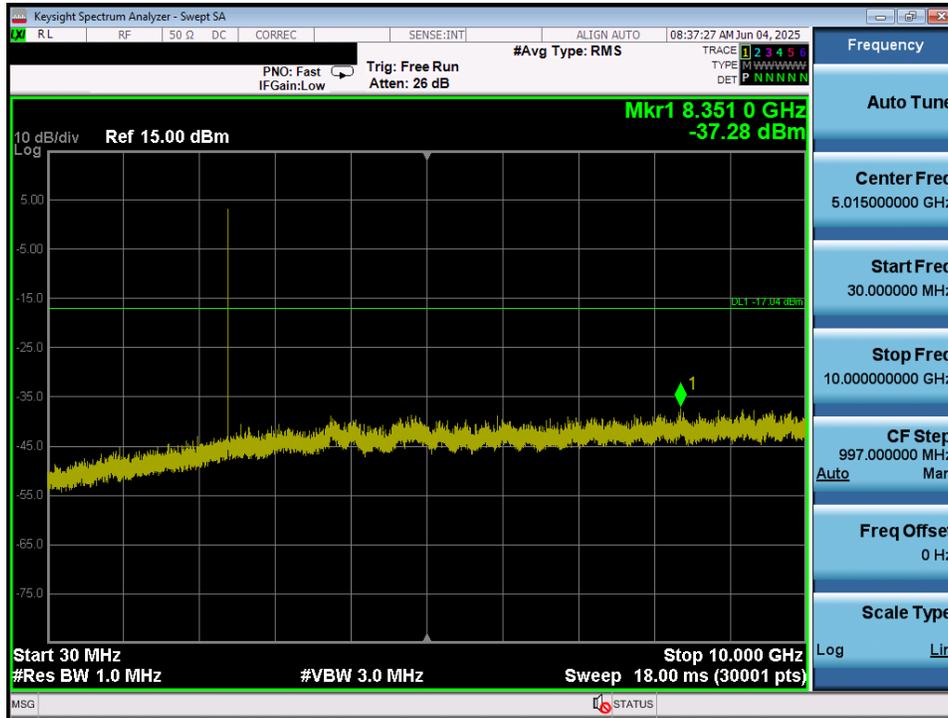
Figure 7-5. Test Instrument & Measurement Setup

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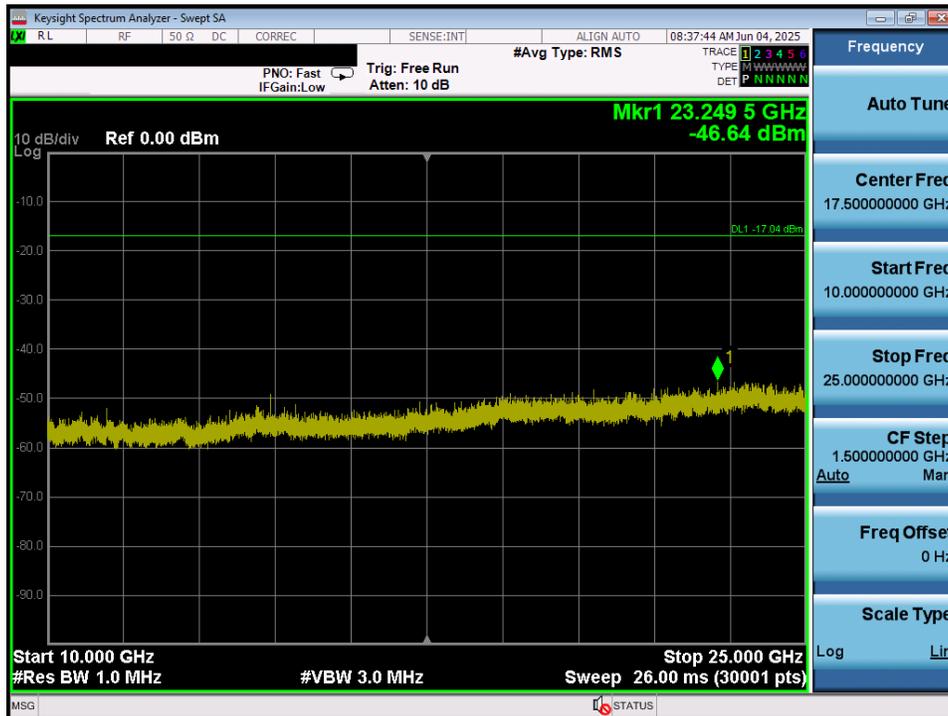
Test Notes

1. RBW was set to 1MHz rather than 100kHz in order to increase the measurement speed.
2. The display line shown in the following plots denotes the limit at 20dB below the fundamental emission level measured in a 100kHz bandwidth. However, since the traces in the following plots are measured with a 1MHz RBW, the display line may not necessarily appear to be 20dB below the level of the fundamental in a 1MHz bandwidth.
3. For plots showing conducted spurious emissions near the limit, the frequencies were investigated with a reduced RBW to ensure that no emissions were present.

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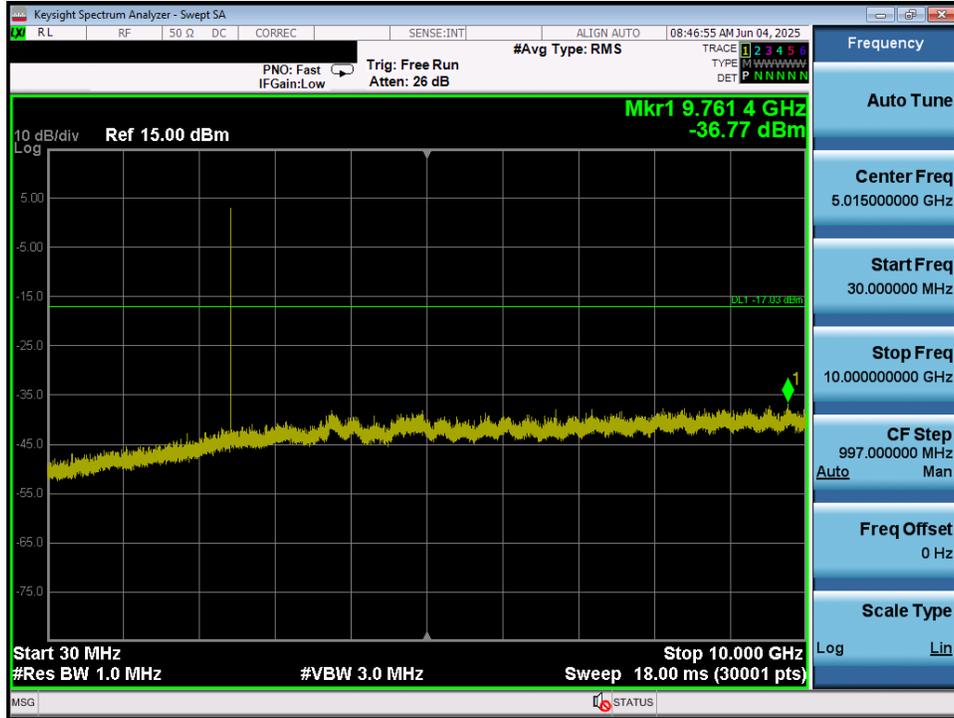


Plot 7-15. Conducted Spurious Plot (ANT+ – Ch. 0)

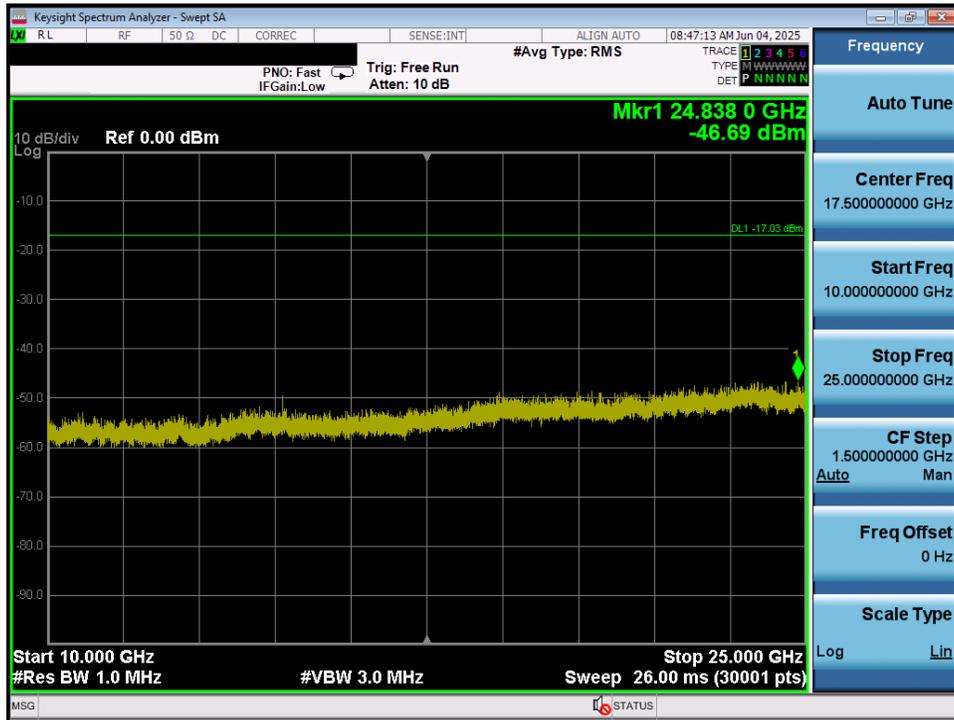


Plot 7-16. Conducted Spurious Plot (ANT+ – Ch. 0)

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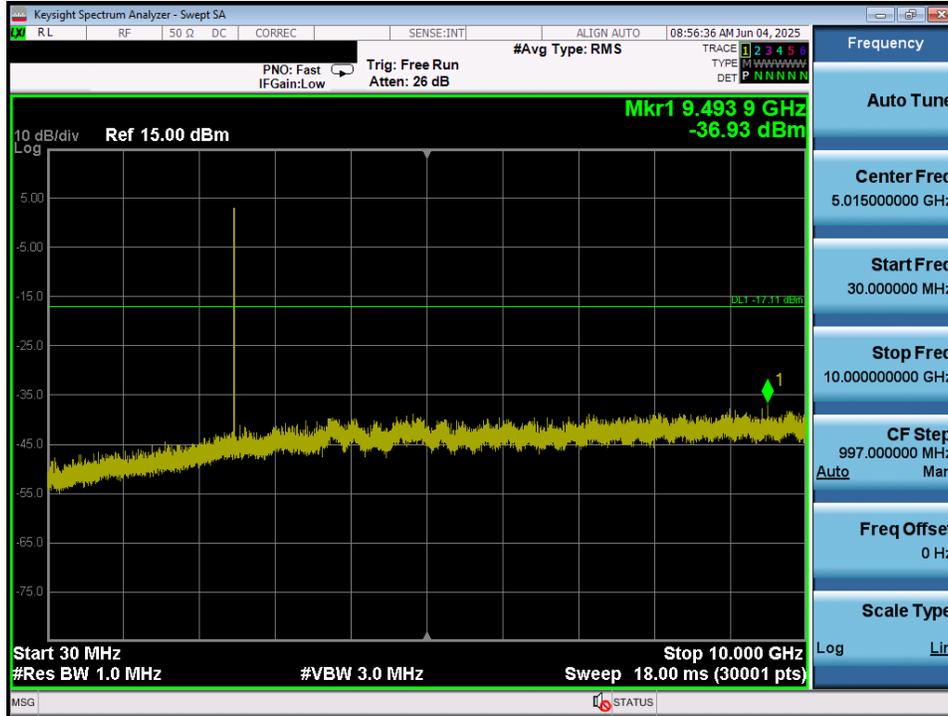


Plot 7-17. Conducted Spurious Plot (ANT+ – Ch. 38)

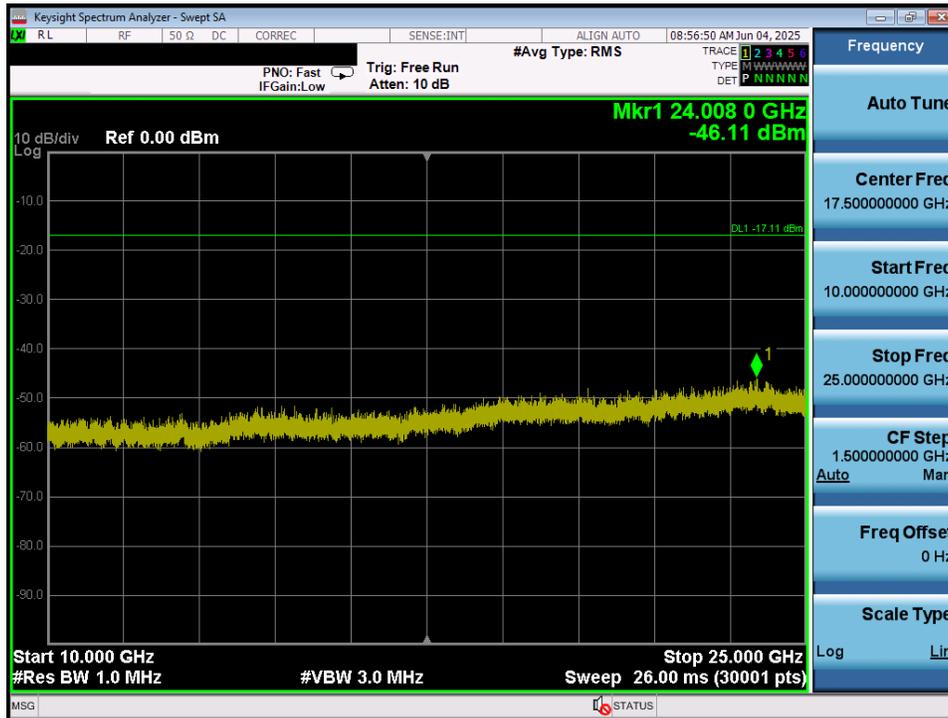


Plot 7-18. Conducted Spurious Plot (ANT+ – Ch. 38)

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Plot 7-19. Conducted Spurious Plot (ANT+ – Ch. 78)



Plot 7-20. Conducted Spurious Plot (ANT+ – Ch. 78)

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7.7 Radiated Spurious Emission Measurements

§15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-5 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [$\mu\text{V/m}$]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-5. Radiated Limits

Test Procedures Used

ANSI C63.10:2020 – Section 6.6.4.3

Test Settings

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3kHz > 1/T
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to run for at least 50 times (1/duty cycle) traces

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Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in Table 7-6 below
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Frequency	RBW
9 – 150kHz	200 – 300Hz
0.15 – 30MHz	9 – 10kHz
30 – 1000MHz	100 – 120kHz
> 1000MHz	1MHz

Table 7-6. RBW as a Function of Frequency

Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

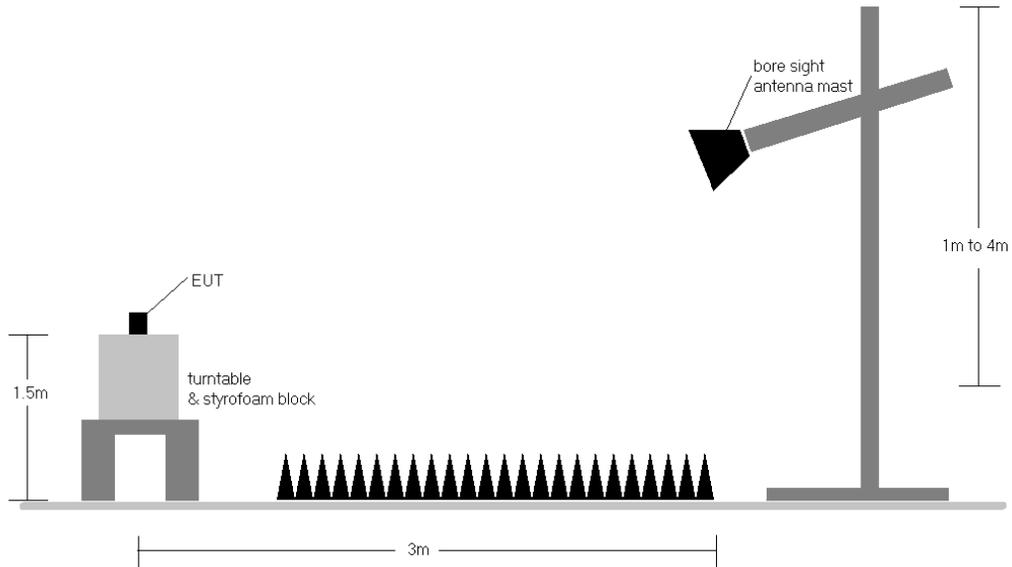


Figure 7-6. Radiated Test Setup >1GHz

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Test Notes

1. The optional test procedures for antenna port conducted measurements of unwanted emissions per the guidance of ANSI C63.10:2020 Section 11.12.2 were not used to evaluate this device for compliance to radiated limits. All radiated spurious emissions levels were measured in a radiated test setup.
2. All emissions lying in restricted bands specified in §15.205 and Section 8.10 of RSS-Gen are below the limit shown in Table 7-5.
3. The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
4. This unit was tested with its standard battery.
5. The spectrum is measured from 9kHz to the 10th harmonic of the fundamental frequency of the transmitter using CISPR quasi peak detector below 1GHz. Above 1 GHz, average and peak measurements were taken using linearly polarized horn antennas. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
6. Average measurements were recorded using a VBW of 3kHz, per Section 4.1.4.2.3 of ANSI C63.10:2020, since 1/T is equal to just under 3kHz. This method was used because the EUT could not be configured to operate with a duty cycle > 98%. Both average and peak measurements were made using a peak detector
7. Emissions below 18GHz were measured at a 3 meter test distance while emissions above 18GHz were measured at a 1 meter test distance with the application of a distance correction factor.
8. No significant radiated band edge emissions were found in the 2310 – 2390MHz restricted band.
9. The "-" shown in the following RSE tables are used to denote a noise floor measurement.

Sample Calculations

Determining Spurious Emissions Levels

- Field Strength Level $_{[dB_{\mu V/m}]}$ = Analyzer Level $_{[dBm]}$ + 107 + AFCL $_{[dB/m]}$
- AFCL $_{[dB/m]}$ = Antenna Factor $_{[dB/m]}$ + Cable Loss $_{[dB]}$
- Margin $_{[dB]}$ = Field Strength Level $_{[dB_{\mu V/m}]}$ – Limit $_{[dB_{\mu V/m}]}$

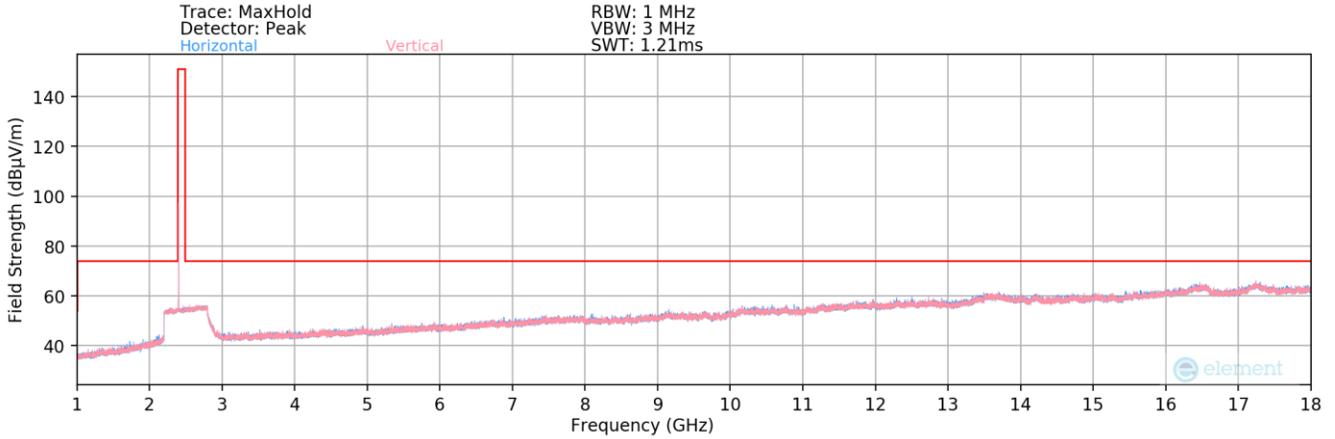
Radiated Band Edge Measurement Offset

- The amplitude offset shown in the radiated restricted band edge plots in Section 7.8 was calculated using the formula:

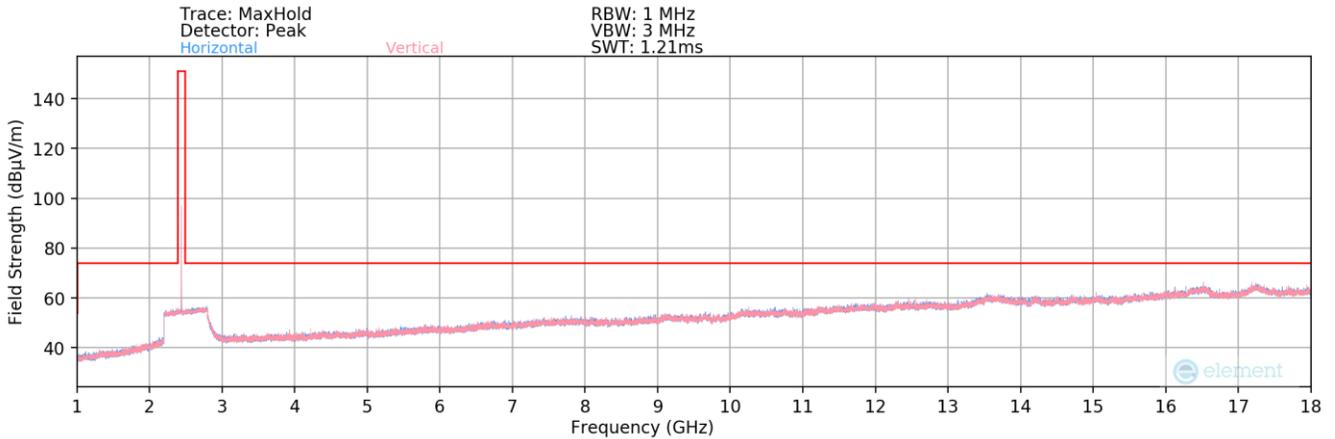
$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + \text{Attenuator}) - \text{Preamplifier Gain}$$

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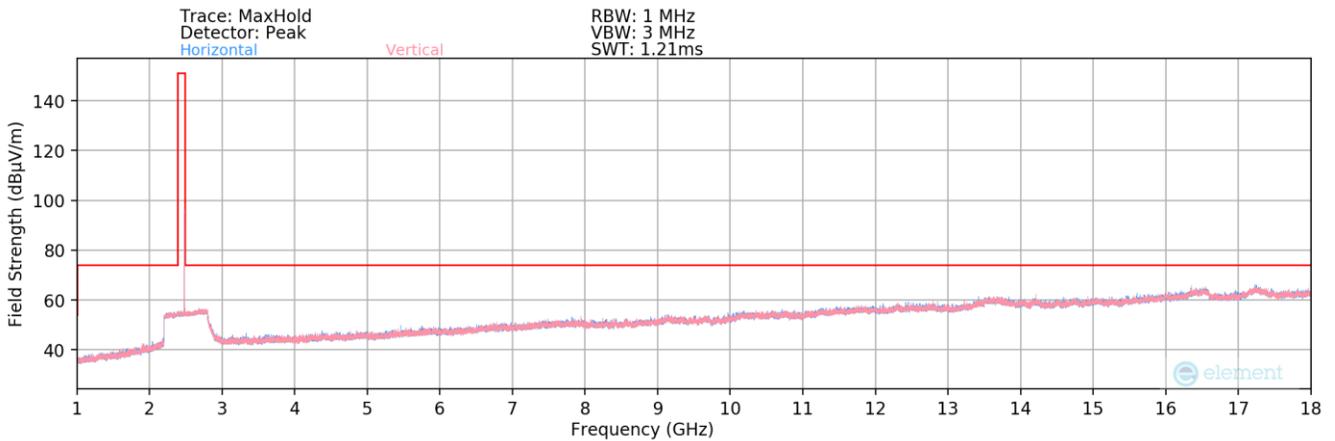
Radiated Spurious Emission Measurements
 §15.205 §15.209 §15.247(d)



Plot 7-21. Radiated Spurious Plot above 1GHz (ANT+ - Ch. 0)

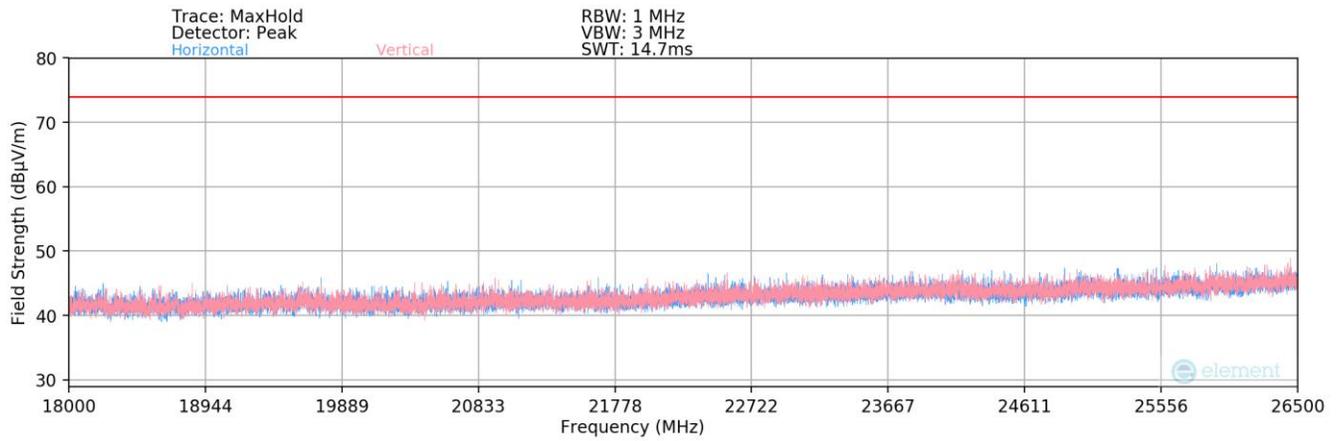


Plot 7-22. Radiated Spurious Plot above 1GHz (ANT+ - Ch. 38)



Plot 7-23. Radiated Spurious Plot above 1GHz (ANT+ - Ch. 78)

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Plot 7-24. Radiated Spurious Plot above 18GHz (ANT+ – Ch. 38)

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Radiated Spurious Emission Measurements
 §15.205 §15.209 §15.247(d); RSS-Gen [8.9]

Mode: ANT+
 Distance of Measurements: 3 Meters
 Operating Frequency: 2402MHz
 Channel: 0

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4804.00	Avg	H	105	83	-80.61	9.36	35.75	53.98	-18.23
4804.00	Peak	H	105	83	-69.64	9.36	46.72	73.98	-27.26
12010.00	Avg	H	107	322	-84.96	22.39	44.43	53.98	-9.55
12010.00	Peak	H	107	322	-73.53	22.39	55.86	73.98	-18.12

Table 7-7. Radiated Measurements @ 3 meters

Mode: ANT+
 Distance of Measurements: 3 Meters
 Operating Frequency: 2441MHz
 Channel: 38

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4880.00	Avg	H	110	65	-80.95	9.79	35.84	53.98	-18.14
4880.00	Peak	H	110	65	-69.99	9.79	46.80	73.98	-27.18
7320.00	Avg	H	-	-	-84.05	15.17	38.12	53.98	-15.86
7320.00	Peak	H	-	-	-71.45	15.17	50.72	73.98	-23.26
12200.00	Avg	H	284	324	-84.44	22.95	45.51	53.98	-8.47
12200.00	Peak	H	284	324	-72.77	22.95	57.18	73.98	-16.80

Table 7-8. Radiated Measurements @ 3 meters

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Mode: ANT+
 Distance of Measurements: 3 Meters
 Operating Frequency: 2480MHz
 Channel: 78

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
4960.00	Avg	H	120	61	-82.11	9.74	34.63	53.98	-19.35
4960.00	Peak	H	120	61	-69.53	9.74	47.21	73.98	-26.77
7440.00	Avg	H	-	-	-84.09	15.40	38.31	53.98	-15.67
7440.00	Peak	H	-	-	-71.82	15.40	50.58	73.98	-23.40
12400.00	Avg	H	333	331	-83.69	23.06	46.37	53.98	-7.61
12400.00	Peak	H	333	331	-72.69	23.06	57.37	73.98	-16.61

Table 7-9. Radiated Measurements @ 3 meters

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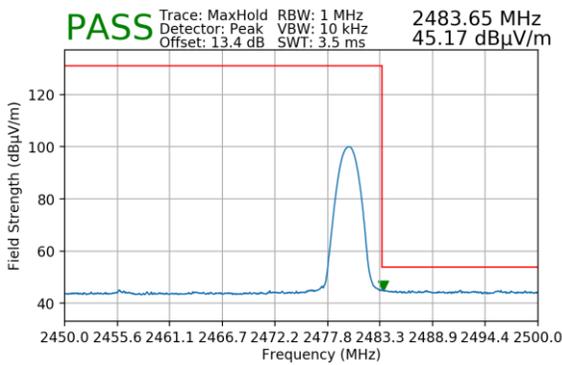
7.8 Radiated Restricted Band Edge Measurements §15.205 §15.209; RSS-Gen [8.9]

The radiated restricted band edge measurements are measured with an EMI test receiver connected to the receive antenna while the EUT is transmitting.

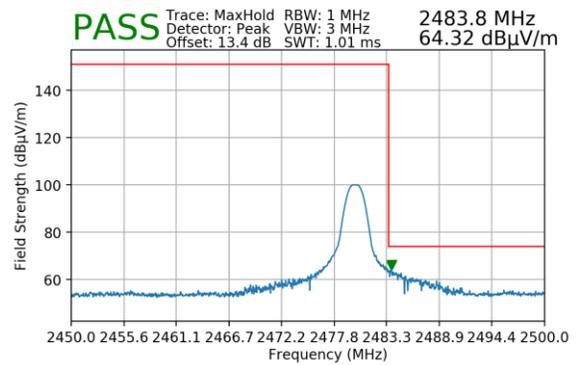
The amplitude offset shown in the following plots for average measurements was calculated using the formula:

$$\text{Offset (dB)} = (\text{Antenna Factor} + \text{Cable Loss} + \text{Attenuator}) - \text{Preamplifier Gain}$$

Mode:	ANT+
Measurement Distance:	3 Meters
Operating Frequency:	2480MHz
Channel:	78



Plot 7-25. Radiated Restricted Upper Band Edge Measurement (Average)



Plot 7-26. Radiated Restricted Upper Band Edge Measurement (Peak)

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7.9 Radiated Spurious Emissions Measurements – Below 1GHz

§15.209; RSS-Gen [8.9]

Test Overview and Limit

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for radiated spurious emissions. Only the radiated emissions of the configuration that produced the worst-case emissions are reported in this section.

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR and Table 6 of RSS-Gen (8.10) must not exceed the limits shown in Table 7-10 per Section 15.209 and RSS-Gen (8.9).

Frequency	Field Strength [$\mu\text{V/m}$]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3

Table 7-10. Radiated Limits

Test Procedures Used

ANSI C63.10:2020

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 120kHz (for emissions from 30MHz – 1GHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

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Test Setup

The EUT and measurement equipment were set up as shown in the diagrams below.

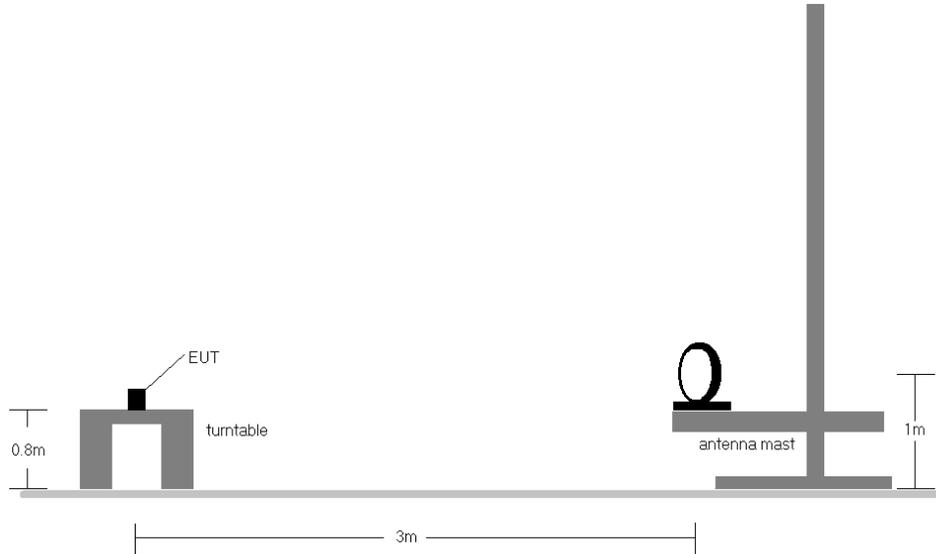


Figure 7-7. Radiated Test Setup < 30Mhz

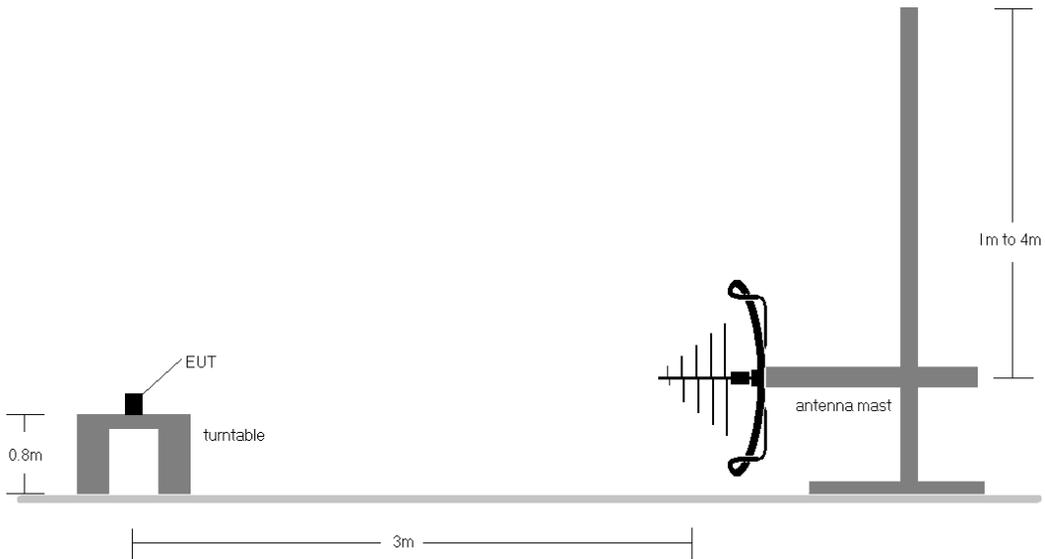


Figure 7-8. Radiated Test Setup < 1GHz

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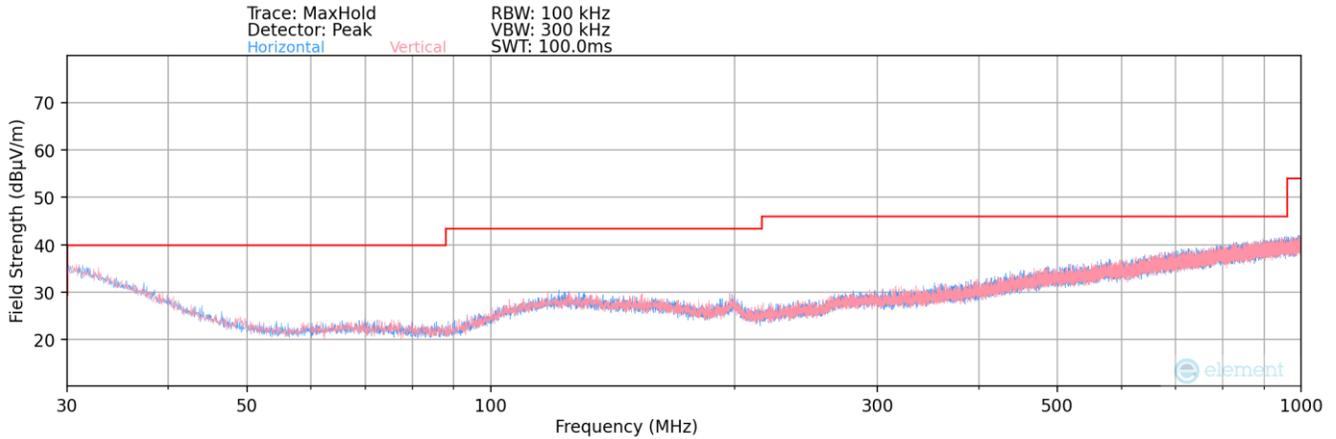
Test Notes

1. All emissions lying in restricted bands specified in §15.205 and RSS-Gen(8.10) are below the limit shown in Table 7-10.
2. The broadband receive antenna is manipulated through vertical and horizontal polarizations during the tests. The EUT is manipulated through three orthogonal planes.
3. This unit was tested with its standard battery.
4. The spectrum is investigated using a peak detector and final measurements are recorded using CISPR quasi peak detector. The worst-case emissions are reported however emissions whose levels were not within 20dB of the respective limits were not reported.
5. Emissions were measured at a 3 meter test distance.
6. Emissions are investigated while operating on the center channel of the mode, band, and modulation that produced the worst case results during the transmitter spurious emissions testing.
7. No spurious emissions were detected within 20dB of the limit below 30MHz.
8. The results recorded using the broadband antenna is known to correlate with the results obtained by using a tuned dipole with an acceptable degree of accuracy. The VSWR for the measurement antenna was found to be less than 2:1.
9. The wide spectrum spurious emissions plots shown on the following pages are used only for the purpose of emission identification. There were no emissions detected in the 30MHz – 1GHz frequency range, as shown in the subsequent plots.

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Radiated Spurious Emissions Measurements (Below 1GHz)

§15.209; RSS-Gen [8.9]



Plot 7-27. Radiated Spurious Plot below 1GHz

Frequency [MHz]	Detector	Ant. Pol. [H/V]	Antenna Height [cm]	Turntable Azimuth [degree]	Analyzer Level [dBm]	AFCL [dB/m]	Field Strength [dBµV/m]	Limit [dBµV/m]	Margin [dB]
196.85	Quasi-Peak	V	-	-	-97.55	19.75	29.20	43.52	-14.32

Table 7-11. Radiated Spurious Emissions below 1GHz

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7.10 Line-Conducted Test Data

§15.207; RSS-Gen [8.8]

Test Overview and Limit

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

All conducted emissions must not exceed the limits shown in the table below, per Section 15.207 and RSS-Gen (8.8).

Frequency of emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Table 7-12. Conducted Limits

*Decreases with the logarithm of the frequency.

Test Procedures Used

ANSI C63.10:2020, Section 6.2

Test Settings

Quasi-Peak Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = quasi-peak
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

Average Field Strength Measurements

1. Analyzer center frequency was set to the frequency of the spurious emission of interest
2. RBW = 9kHz (for emissions from 150kHz – 30MHz)
3. Detector = RMS
4. Sweep time = auto couple
5. Trace mode = max hold
6. Trace was allowed to stabilize

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Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.

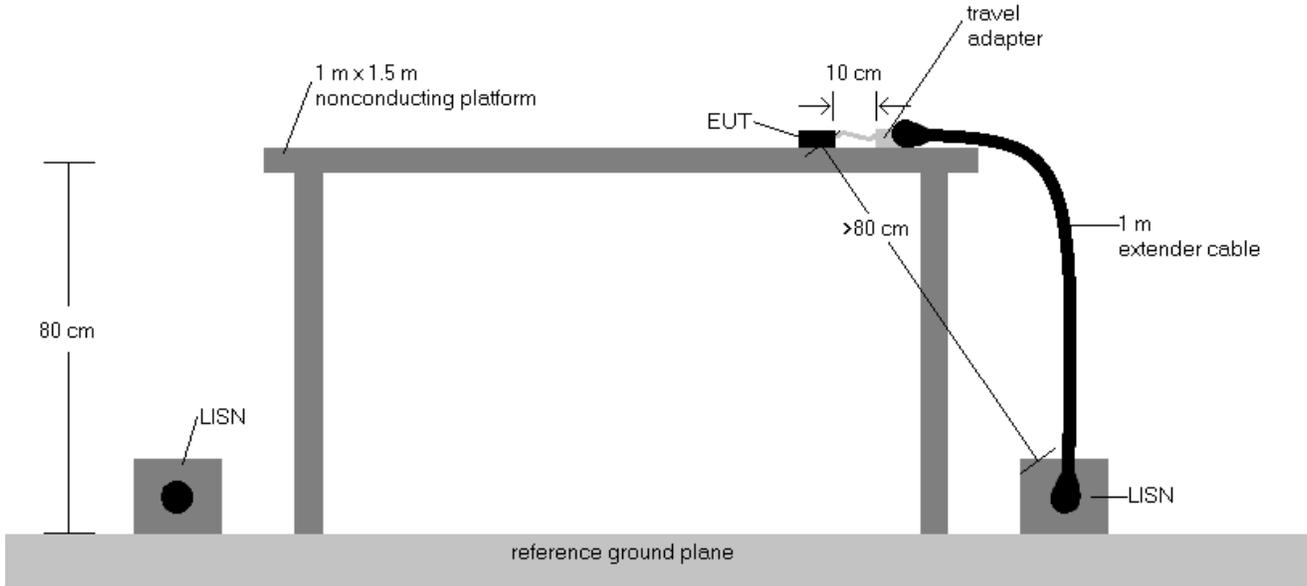
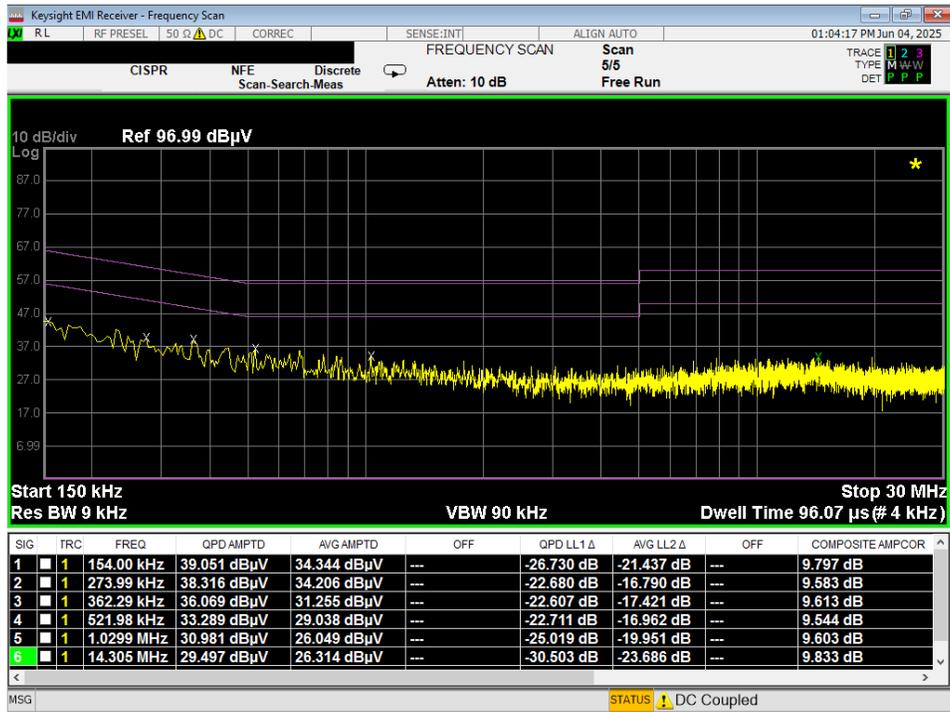


Figure 7-9. Test Instrument & Measurement Setup

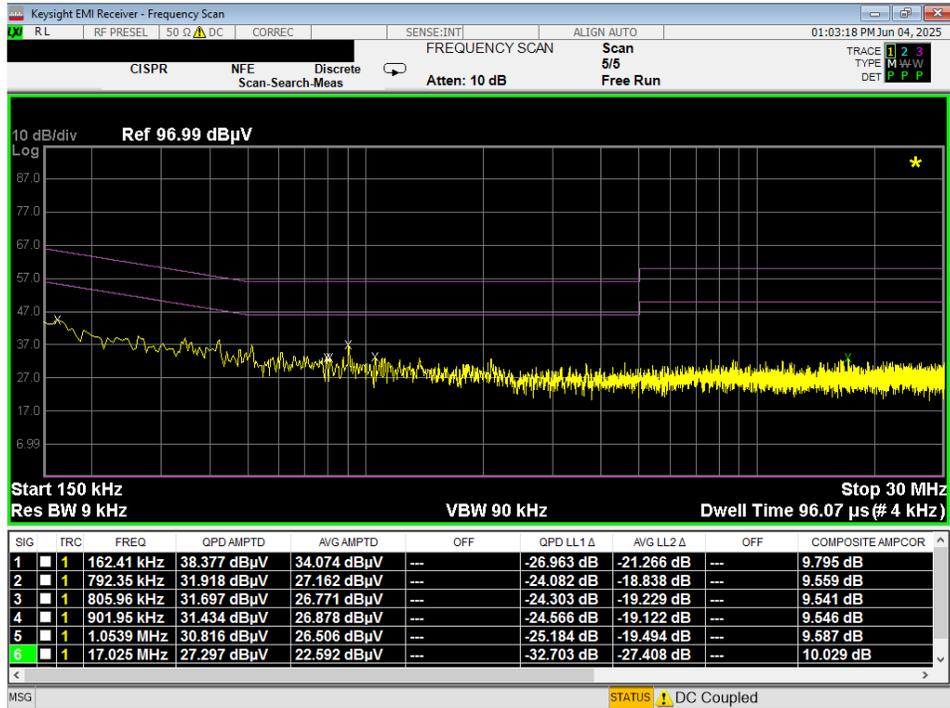
Test Notes

1. All modes of operation were investigated and the worst-case emissions are reported using mid channel. The emissions found were not affected by the choice of channel used during testing.
2. The limit for an intentional radiator from 150kHz to 30MHz are specified in Part 15.207 and RSS-Gen (8.8).
3. $\text{Corr. (dB)} = \text{Cable loss (dB)} + \text{LISN insertion factor (dB)}$
4. $\text{QP/AV Level (dB}\mu\text{V)} = \text{QP/AV Analyzer/Receiver Level (dB}\mu\text{V)} + \text{Corr. (dB)}$
5. $\text{Margin (dB)} = \text{QP/AV Limit (dB}\mu\text{V)} - \text{QP/AV Level (dB}\mu\text{V)}$
6. Traces shown in plot are made using a peak detector.
7. Deviations to the Specifications: None.

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Plot 7-28. Line Conducted Plot with ANT+ (L1)



Plot 7-29. Line Conducted Plot with ANT+ (N)

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8.0 CONCLUSION

The data collected relate only the item(s) tested and show that the **Garmin Portable Digital Transceiver FCC ID: IPH-05071** is in compliance with Part 15 Subpart C (15.247) of the FCC Rules and RSS-247 of the ISED Rules.

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