Test report

REP0019265-3R1TRFWL

Date of issue: July 26, 2023

Applicant:
JTECH An HME Company

Product Description:
LinkWear Hub

Model:
LWHUB

PMN(s):
LWTX00100, LWTX00200

FCC ID:
WDC-JLWHUB

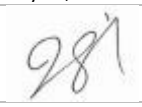
ISED Certification Number:
7752A-JLWHUB

Specifications:

- FCC 47 CFR Part 15, Subpart C – §15.247
  Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5727 – 5850 MHz
- Industry Canada RSS-247, Issue 2
  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943 Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Martha Espinoza, Wireless Test Engineer
Reviewed by	James Cunningham, EMC/MIL/WL Supervisor
Review date	July 26, 2023
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Applicant

Company name	JTECH An HME Company
Address	1400 Northbrook Parkway, Suite 320
City	Suwanee
Province/State	GA
Postal/Zip code	30024
Country	USA

1.2 Manufacturer

Company name	JTECH An HME Company
Address	1400 Northbrook Parkway, Suite 320
City	Suwanee
Province/State	GA
Postal/Zip code	30024
Country	USA

1.3 Test specifications

FCC 47 CFR Part 15, Subpart C – §15.247	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz
IC RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.4 Test methods

ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 DTS Measurement Guidance v05r02 (April 2019)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.5 Exclusions

None

1.6 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.7 Test report revision history

Table 1.7-1: *Test report revision history*

Revision #	Details of changes made to test report
REP0019265-3TRFWL	Original report issued
REP0019265-3R1TRFWL	Information from front page and page 6 was updated

Notes: None

Section 2 Summary of test results

2.1 FCC Part 15 Subpart C, general requirements

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass
§15.203	Antenna requirement	Pass

Notes: The integrated antenna is located within the protective cover of EUT

2.2 FCC Part 15.247

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(b)(4)	Transmitting antennas of directional gain greater than 6 dBi	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 IC RSS-247, Issue 2

Part	Test description	Verdict
5.1 (a)	Bandwidth of a frequency hopping channel	Not applicable
5.1 (b)	Minimum channel spacing for frequency hopping systems	Not applicable
5.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2 (a)	Minimum 6 dB bandwidth	Pass
5.2 (b)	Maximum power spectral density	Pass
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4 (a)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
5.4 (b)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.4 (c)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (d)	Systems employing digital modulation techniques	Pass
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Out-of-band emissions	Pass

2.4 IC RSS-GEN, Issue 5

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for License-Exempt Radio Apparatus	Pass

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 28, 2022
Nemko sample ID number	PRJ0019265

3.2 EUT information

Product description	LinkWear Hub
Model	LWHUB
Serial number	N/A
Part number	N/A
Variants	LWTX0010, LWTX00200 LWTX00100 and LWTX00200 are electrically identical except the latter contains an approved POCSAG module. All testing was performed on an LWTX00200 variant and is representative of both model variants.

3.3 Technical information

Frequency band	2400 – 2483.5 MHz
Minimum frequency (MHz)	2402
Maximum frequency (MHz)	2480
Type of modulation	GFSK
Power requirements	100-240V_{AC}, 50-60 Hz
Antenna information	Dipole Antenna detachable: 2.44 dBi Max Gain (2402 MHz = 1.84 dBi, 2440 MHz = 2.44 dBi, 2480 MHz = 1.61 dBi)

3.4 EUT exercise and monitoring details

The EUT was controlled by a support laptop running Smart RF studio 7 tool and set to transmit BLE signals at 5 dBm power level while on the Low, Middle, and High channels.

Table 3.4-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
N/A	N/A	N/A	N/A	N/A

Table 3.4-2: *EUT interface ports*

Description	Qty.
Ethernet port	1

Table 3.4-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
AC/DC Adapter	N/A	N/A	N/A	--
PCB development kit	Texas Instrument	N/A	N/A	--
Laptop	Dell	N/A	N/A	--

Table 3.4-4: *Inter-connection cables*

Cable description	From	To	Length (m)
USB	Support laptop	EUT	0.5

3.5 EUT setup diagram

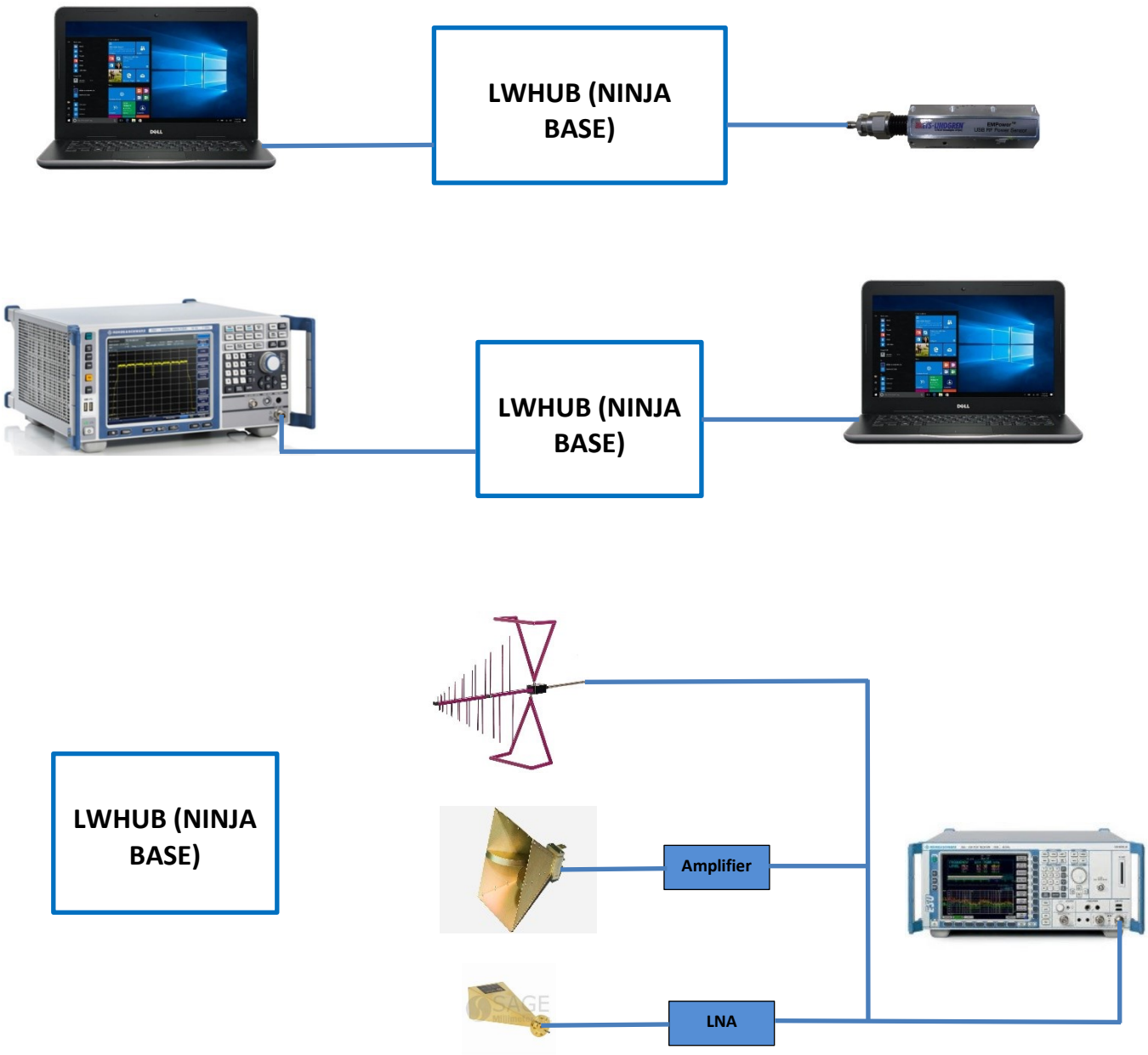


Figure 3.5-1: *Setup diagram*

Section 4 Engineering considerations

4.1 Surveyed power levels

The power setting in the Smart RF studio 7 is 5 dBm for all testing.

4.2 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.3 Technical judgment

None

4.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15-30 °C
Relative humidity	20-75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Table 6.1-1: *Measurement uncertainty calculations*

Measurement		**U_{cispr} dB**	**U_{lab} dB**
Conducted disturbance at AC mains and other port power using a V-AMN	9 kHz to 150 kHz	3.8	2.9
	150 kHz to 30 MHz	3.4	2.3
Conducted disturbance at telecommunication port using AAN	150 kHz to 30 MHz	5.0	4.3
Conducted disturbance at telecommunication port using CVP	150 kHz to 30 MHz	3.9	2.9
Conducted disturbance at telecommunication port using CP	150 kHz to 30 MHz	2.9	1.4
Conducted disturbance at telecommunication port using CP and CVP	150 kHz to 30 MHz	4.0	3.1
Radiated disturbance (electric field strength in a SAC)	30 MHz to 1 GHz	6.3	5.5
Radiated disturbance (electric field strength in a FAR)	1 GHz to 6 GHz	5.2	4.7
Radiated disturbance (electric field strength in a FAR)	6 GHz to 18 GHz	5.5	5.0

Notes: Compliance assessment:

If U_{lab} is less than or equal to U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit

If U_{lab} is greater than U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit

V-AMN: V type artificial mains network
AAN: Asymmetric artificial network
CP: Current probe
CVP: Capacitive voltage probe
SAC: Semi-anechoic chamber
FAR: Fully anechoic room

Section 7 Test Equipment

Table 6.1-1: *Test Equipment List*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESCI 7	E1026	1 year	03-22-2023
Transient Limiter	Hewlett-Packard	11947A	681	VOU	VOU
Two Line V-Network	Rohde & Schwarz	ENV216	E1019	1 year	09-30-2023
Signal and spectrum analyzer	Rohde & Schwarz	FSV40	E1120	2 years	12-09-2023
Power sensor	ETS Lindgren	7002-006	E1061	1 year	06-21-2023
EMI Test Receiver	Rohde & Schwarz	ESU40	E1131	1 year	03-02-2023
System Controller	Sunol Sciences	SC104V	E1191	NCR	NCR
Bilog Antenna (30-1000 MHz)	Schaffner	CBL 6111D	1763	2 years	04-01-2024
DRG Horn (1-18 GHz)	ETS-Lindgren	3117-PA	E1139	2 years	04-19-2023
Horn antenna (18-26 GHz)	Eravant	SAZ-2410-42-S1	EW107	1 year	11-22-2023
Low noise amplifier	Sage Millimeter, Inc.	SBL-1834034030-KFKF	E1228	VOU	VOU
2.4GHz notch filter	Micro-Tonics	HPM50110-01	E1142	NCR	NCR

Notes: NCR - no calibration required
VOU - verify on use

Table 6.1-2: *Test Software*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.10 (AC conducted emissions)
Rohde & Schwarz	EMC 32 V10.60.15 (radiated emissions)

Notes: None

Section 8 Testing data

8.1 FCC 15.207(a) and IC RSS-GEN, Issue 5 8.8 AC power line conducted emissions.

8.1.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.207(a)
RSS-Gen → §8.8

For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.

Table 8.1-1: *Conducted emissions limit.*

Frequency of emission, MHz	Conducted limit, dBµV	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - Decreases with the logarithm of the frequency.

8.1.2 Test summary

Verdict	Pass		
Test date	December 5, 2022	Temperature	20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1005 mbar
Test location	Ground Plane	Relative humidity	50 %

8.1.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).

Testing was performed according to ANSI C63.10 §6.2.

8.1.4 Setup details

Port under test	AC main
EUT setup configuration	Tabletop
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	– Peak (Preview measurement) – Quasi-peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak and Average preview measurement) – 5000 ms (Quasi-peak final measurement) – 5000 ms (CAverage final measurement)

8.1.5 Test data

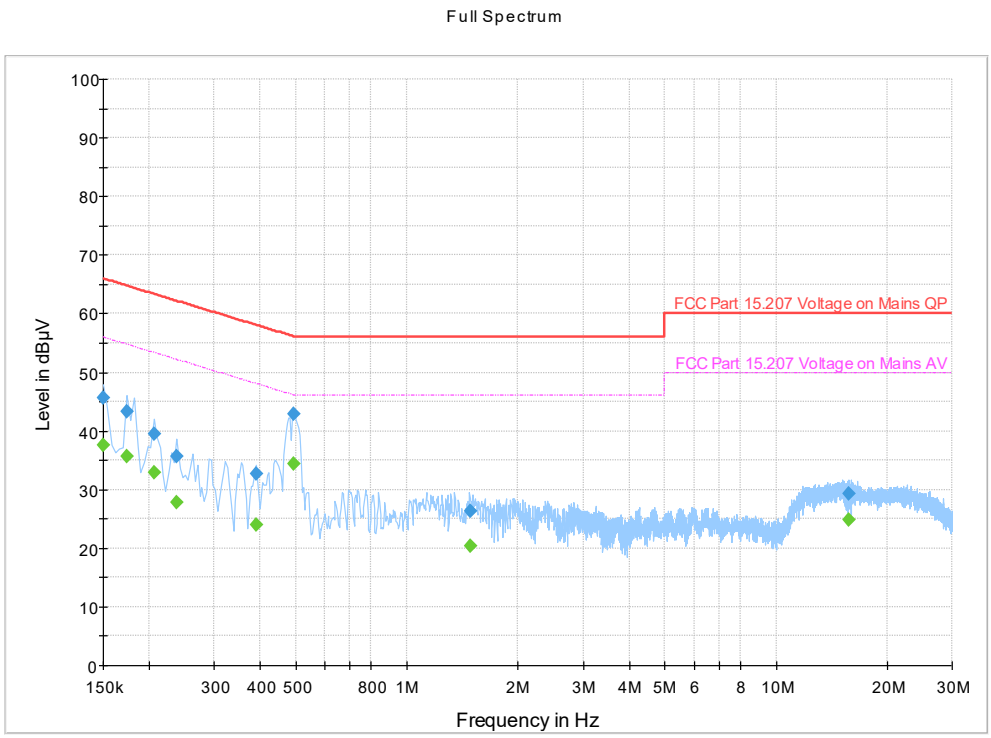


Figure 8.1-1: *AC conducted emissions spectral plot, Low channel: 2402 MHz.*

Table 8.1-2: *AC conducted emissions data, 150 kHz – 30 MHz, Low channel: 2402 MHz.*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	---	37.60	56.00	18.40	5000.0	9.000	N	ON	19.7
0.150000	45.58	---	66.00	20.42	5000.0	9.000	N	ON	19.7
0.174000	---	35.58	54.77	19.19	5000.0	9.000	N	ON	19.6
0.174000	43.27	---	64.77	21.50	5000.0	9.000	N	ON	19.6
0.206000	39.58	---	63.37	23.79	5000.0	9.000	N	ON	19.6
0.206000	---	32.99	53.37	20.38	5000.0	9.000	N	ON	19.6
0.238000	35.74	---	62.17	26.42	5000.0	9.000	N	ON	19.6
0.238000	---	27.76	52.17	24.41	5000.0	9.000	N	ON	19.6
0.390000	---	24.01	48.06	24.05	5000.0	9.000	N	ON	19.5
0.390000	32.76	---	58.06	25.30	5000.0	9.000	N	ON	19.5
0.494000	---	34.31	46.10	11.79	5000.0	9.000	N	ON	19.5
0.494000	42.82	---	56.10	13.28	5000.0	9.000	N	ON	19.5
1.482000	26.35	---	56.00	29.65	5000.0	9.000	L1	ON	19.5
1.482000	---	20.38	46.00	25.62	5000.0	9.000	L1	ON	19.5
15.690000	29.22	---	60.00	30.78	5000.0	9.000	L1	ON	20.3
15.690000	---	24.89	50.00	25.11	5000.0	9.000	L1	ON	20.3

Notes: Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)

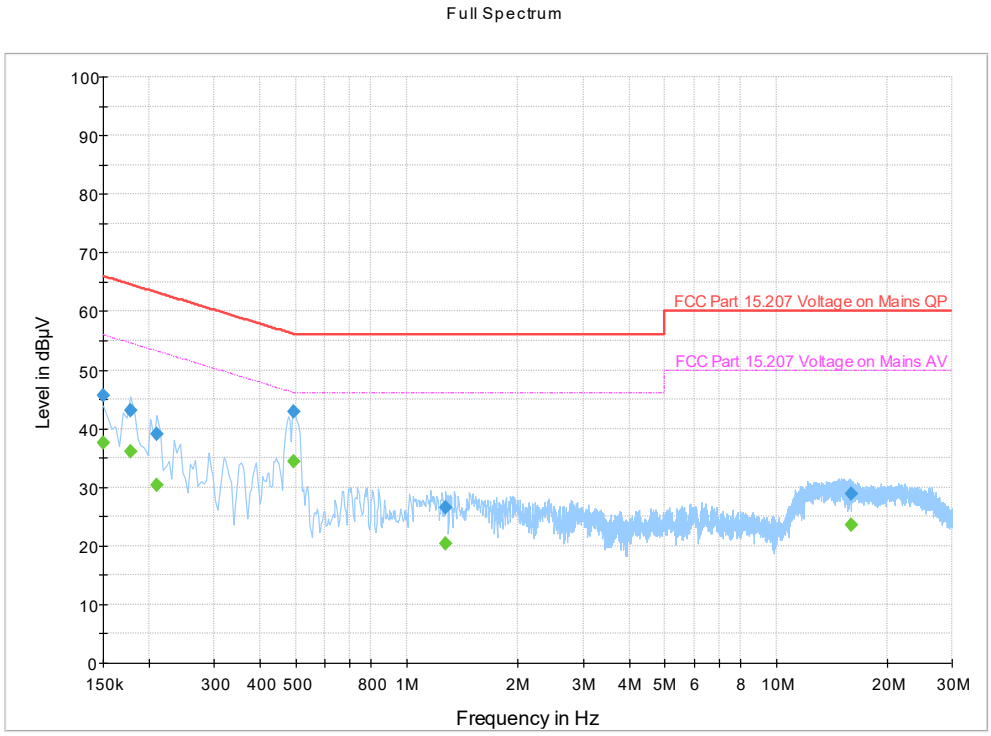


Figure 8.1-2: *AC conducted emissions spectral plot, Middle channel: 2440 MHz.*

Table 8.1-3: *AC conducted emissions data, 150 kHz – 30 MHz, Middle channel: 2440 MHz.*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	45.66	---	66.00	20.34	5000.0	9.000	N	ON	19.7
0.150000	---	37.61	56.00	18.39	5000.0	9.000	N	ON	19.7
0.178000	43.06	---	64.58	21.51	5000.0	9.000	N	ON	19.6
0.178000	---	36.14	54.58	18.44	5000.0	9.000	N	ON	19.6
0.210000	39.03	---	63.21	24.18	5000.0	9.000	N	ON	19.6
0.210000	---	30.41	53.21	22.79	5000.0	9.000	N	ON	19.6
0.494000	42.82	---	56.10	13.28	5000.0	9.000	N	ON	19.5
0.494000	---	34.34	46.10	11.76	5000.0	9.000	N	ON	19.5
1.274000	---	20.36	46.00	25.64	5000.0	9.000	L1	ON	19.5
1.274000	26.50	---	56.00	29.50	5000.0	9.000	L1	ON	19.5
16.010000	---	23.63	50.00	26.37	5000.0	9.000	L1	ON	20.3
16.010000	28.81	---	60.00	31.19	5000.0	9.000	L1	ON	20.3

Notes: Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)

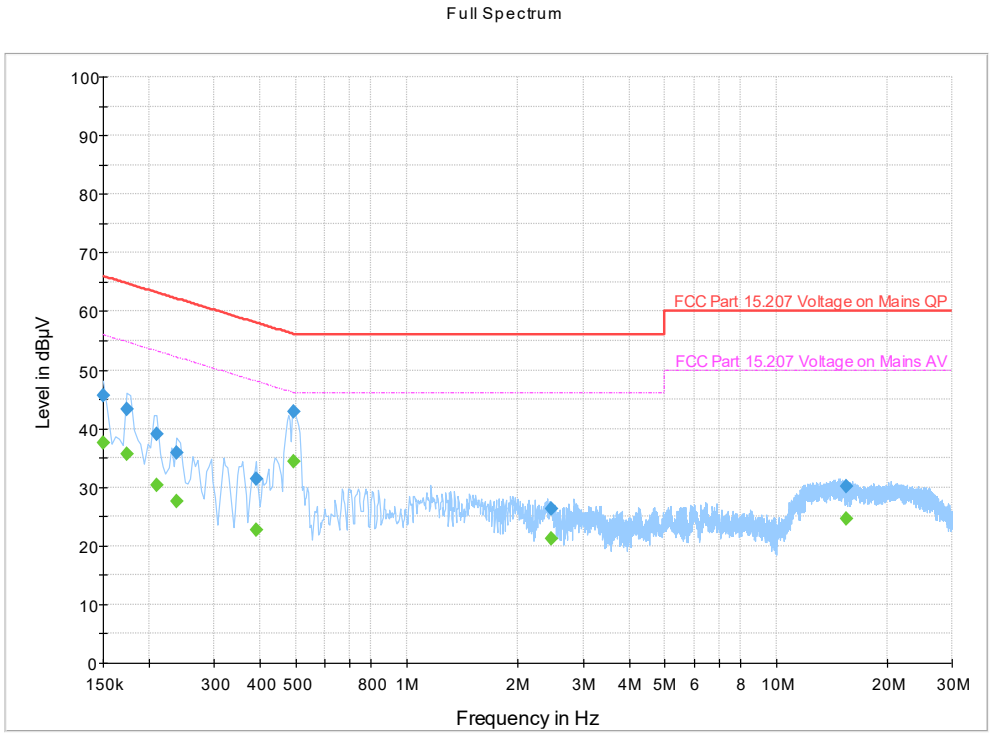


Figure 8.1-3: *AC conducted emissions spectral plot, High channel: 2480 MHz.*

Table 8.1-4: *AC conducted emissions data, 150 kHz – 30 MHz, High channel: 2480 MHz*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.150000	---	37.55	56.00	18.45	5000.0	9.000	N	ON	19.7
0.150000	45.60	---	66.00	20.40	5000.0	9.000	N	ON	19.7
0.174000	---	35.65	54.77	19.12	5000.0	9.000	N	ON	19.6
0.174000	43.35	---	64.77	21.42	5000.0	9.000	N	ON	19.6
0.210000	39.00	---	63.21	24.21	5000.0	9.000	N	ON	19.6
0.210000	---	30.27	53.21	22.93	5000.0	9.000	N	ON	19.6
0.238000	35.90	---	62.17	26.26	5000.0	9.000	N	ON	19.6
0.238000	---	27.70	52.17	24.47	5000.0	9.000	N	ON	19.6
0.390000	31.44	---	58.06	26.62	5000.0	9.000	L1	ON	19.5
0.390000	---	22.80	48.06	25.27	5000.0	9.000	L1	ON	19.5
0.494000	42.84	---	56.10	13.26	5000.0	9.000	N	ON	19.5
0.494000	---	34.43	46.10	11.67	5000.0	9.000	N	ON	19.5
2.462000	---	21.25	46.00	24.75	5000.0	9.000	L1	ON	19.5
2.462000	26.39	---	56.00	29.61	5000.0	9.000	L1	ON	19.5
15.450000	---	24.55	50.00	25.45	5000.0	9.000	N	ON	20.3
15.450000	30.06	---	60.00	29.94	5000.0	9.000	N	ON	20.3

Notes: Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)

8.2 FCC 15.247(a)(2) and RSS-247 5.2(1) Minimum 6 dB bandwidth for systems using digital modulation techniques References

8.2.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(a)(2)
RSS-247 → §5.2(a)

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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.

8.2.2 Test summary

Verdict	Pass		
Test date	November 30, 2022	Temperature	19 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1005 mbar
Test location	Wireless bench (Conducted)	Relative humidity	53 %

8.2.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).

8.2.4 Setup details

EUT setup configuration	Tabletop
Test facility	Wireless Bench
Measurement method	558074 D01 DTS Measurement Guidance §8.2 ANSI C63.10 §11.8.1 using built-in marker function of the spectrum analyzer

Receiver/spectrum analyzer settings:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.2.5 Test data

Table 8.2-1: *6 dB occupied bandwidth test data*

Test Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)
2402	665.885	> 500
2440	669.917	> 500
2480	674.229	> 500

8.2.5 Test data, continued

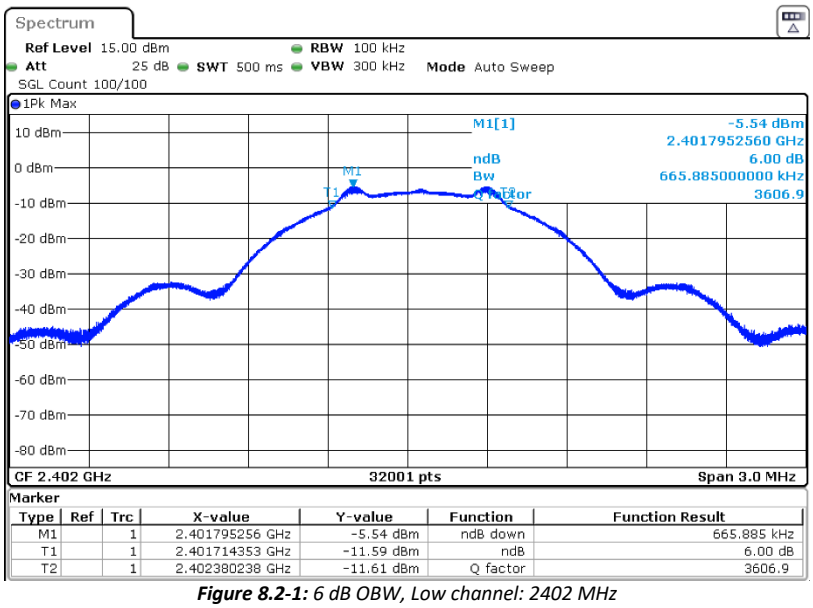


Figure 8.2-1: *6 dB OBW, Low channel: 2402 MHz*

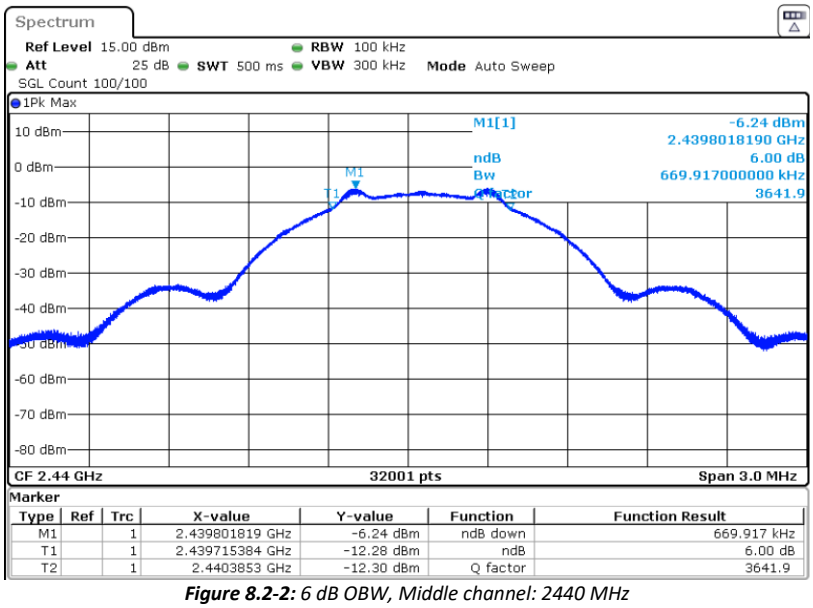


Figure 8.2-2: *6 dB OBW, Middle channel: 2440 MHz*

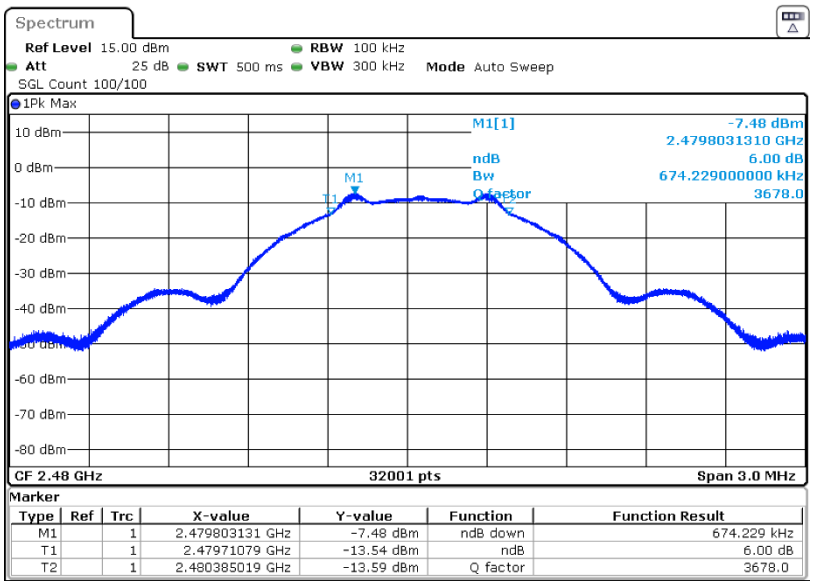


Figure 8.2-3: *6 dB OBW, High channel: 2480 MHz*

8.3 FCC 15.247(b) and RSS-247 5.4 (4) Transmitter output power and e.i.r.p. requirements

8.3.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(b)(2) / (3)

(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 W (30 dBm). 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.

(4) The conducted output power limit specified in paragraph (b) of this Section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this Section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this Section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247 → §5.4(d)

(d) For DTSs 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 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling 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 transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

8.3.2 Test summary

Verdict	Pass		
Test date	December 1, 2022	Temperature	20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1006 mbar
Test location	Wireless bench (Conducted)	Relative humidity	57 %

8.3.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).
The attenuation of the interconnecting path was included in the power meter software as a correction factor.
The antenna gain for each channel is: 2402 MHz = 1.84 dBi, 2440 MHz = 2.44 dBi, 2480 MHz = 1.61 dBi.
EIRP = Conducted Power + Declared Antenna Gain

8.3.4 Setup details

EUT setup configuration	Tabletop
Test facility	Wireless Bench
Measurement method	ANSI C63.10 §11.9.1.3 PKPM1 (Peak Power Meter) method

8.3.5 Test data

Table 8.3-1: *Output power*

Test Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Conducted Limit (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
2402	18.68	30.0	1.84	20.52	36.0
2440	18.32	30.0	2.44	20.76	36.0
2480	17.29	30.0	1.61	18.90	36.0

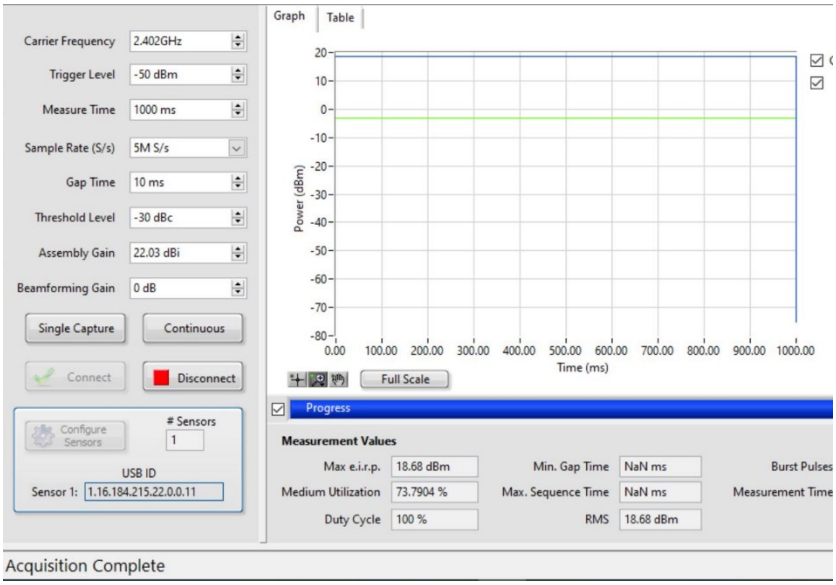


Figure 8.3-1: *Output power, Low channel: 2402 MHz*

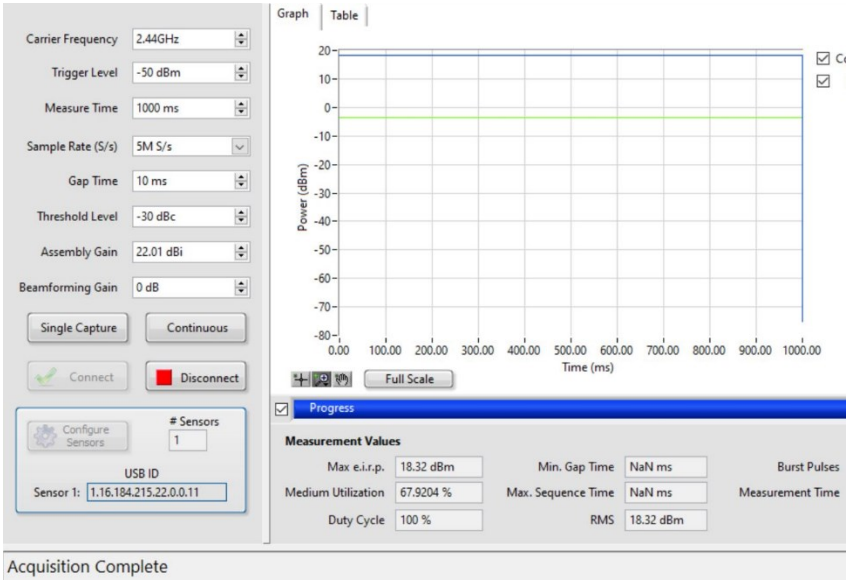


Figure 8.3-2: *Output power, Middle channel: 2440 MHz*

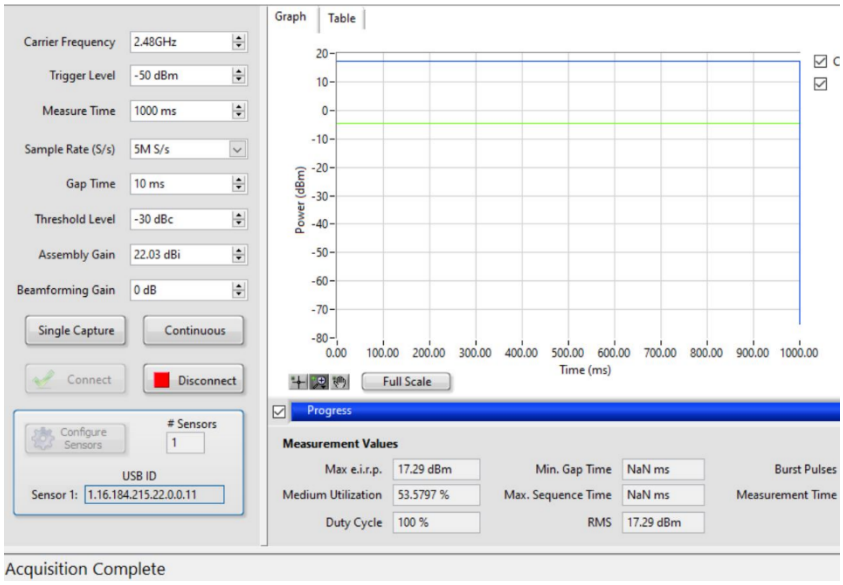


Figure 8.3-3: *Output power, High channel: 2480 MHz*

8.4 FCC Part 15.247(d) and RSS-247 5.5 Conducted band-edge spurious emissions.

8.4.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(d)

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

RSS-247 → §5.5

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.

8.4.2 Test summary

Verdict	Pass		
Test date	December 1, 2022	Temperature	20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1006 mbar
Test location	Wireless bench (Conducted)	Relative humidity	57 %

8.4.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).
For conducted measurements, an offset corresponding to the path losses was added in the spectrum analyzer.
In each measurement, the limit was derived by subtracting 20 dB from a power spectral density reference measurement and the frequency limit were the band limits: 2400 MHz for low channel and 2483.5 MHz for high channel.

8.4.4 Setup details

EUT setup configuration	Tabletop
Test facility	Wireless bench
Measurement details	Conducted band edge measurement performed as per C63.10 §6.10.4

Spectrum analyzer settings for conducted spurious emissions:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.4.5 Test data

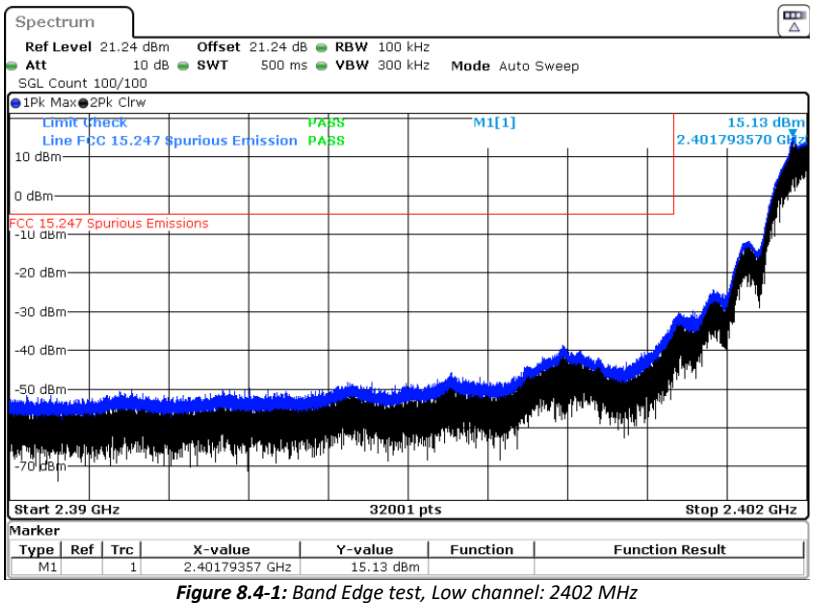


Figure 8.4-1: *Band Edge test, Low channel: 2402 MHz*

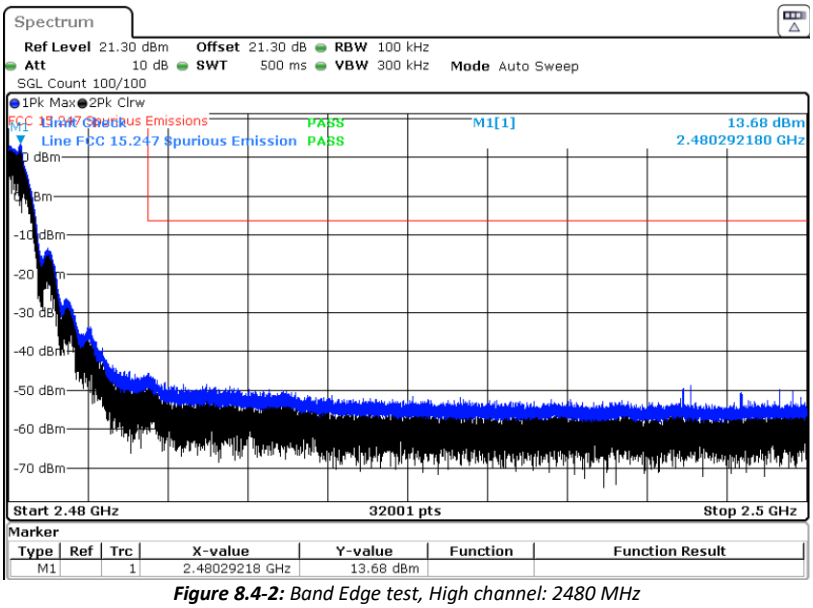


Figure 8.4-2: *Band Edge test, High channel: 2480 MHz*

8.5 FCC 15.247(d) and RSS-247 5.5 Conducted spurious emissions.

8.5.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(d)

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

RSS-247 → §5.5

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.

8.5.2 Test summary

Verdict	Pass		
Test date	December 1, 2022	Temperature	20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1006 mbar
Test location	Wireless bench (Conducted)	Relative humidity	57 %

8.5.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).
The spectrum was search from 100 kHz to 26 GHz (above the 10th harmonic of the highest transmit frequency of 2480 MHz).
For conducted measurements, an offset corresponding to the path losses was added in the spectrum analyzer.
In each measurement, the limit was derived by subtracting 20 dB from a power spectral density reference measurement.

8.5.4 Setup details

EUT setup configuration	Tabletop
Test facility	Wireless bench
Measurement details	Conducted spurious emissions measurement performed as per C63.10 §11.11.3

Spectrum analyzer settings for conducted spurious emissions:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.5.5 Test data

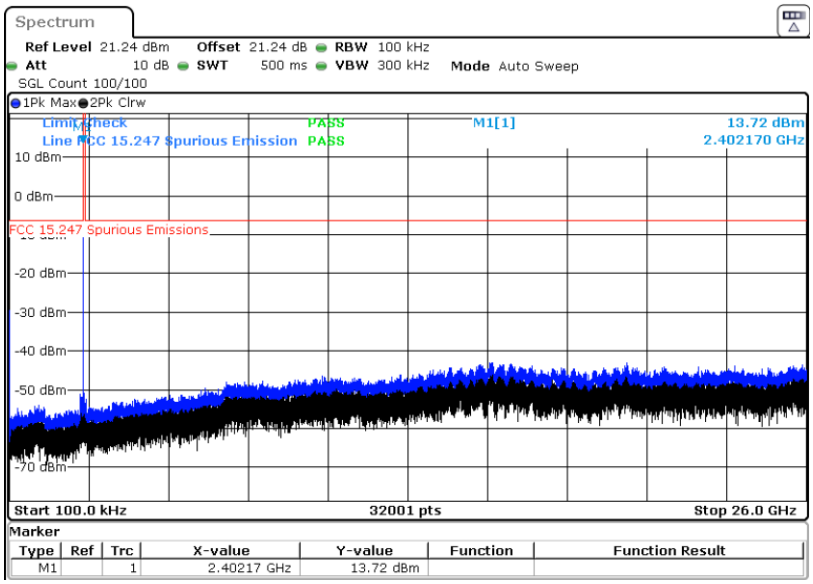


Figure 8.5-1: *Conducted spurious Emission, Low channel: 2402 MHz.*

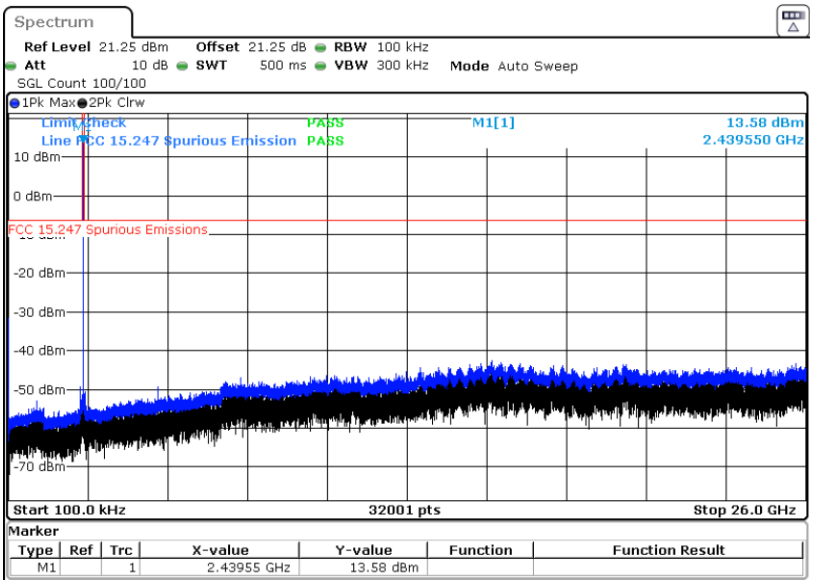


Figure 8.5-2: *Conducted spurious Emission, Middle channel: 2440 MHz.*

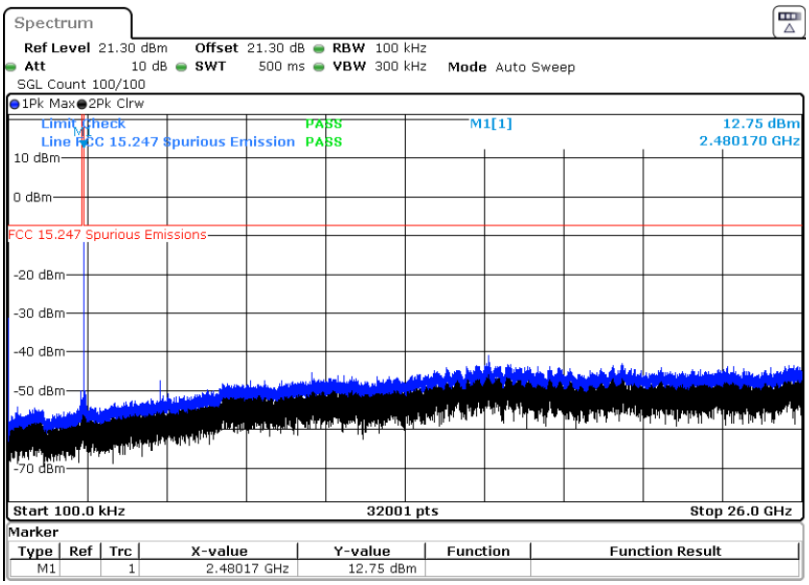


Figure 8.5-3: *Conducted spurious Emission, High channel: 2480 MHz.*

8.6 FCC 15.247(d) and RSS-247 5.5 Radiated restricted band-edges and spurious emission

8.6.1 Definition and limits

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(d)

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

RSS-247 → §5.5

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.

Table 8.6-1: *FCC §15.209– Radiated emission limits*

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Table 8.6-2: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.6.2 Test summary

Verdict	Pass		
Test date	December 2, 2022; December 5, 2022	Temperature	19 °C; 20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1001 mbar; 1006 mbar
Test location	3m semi-anechoic chamber (Radiated)	Relative humidity	55 %; 58 %

8.6.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).
The spectrum was search from 30 MHz to 26 GHz (10th harmonic approximately).
Radiated measurements were performed at a 3 m measurement distance.

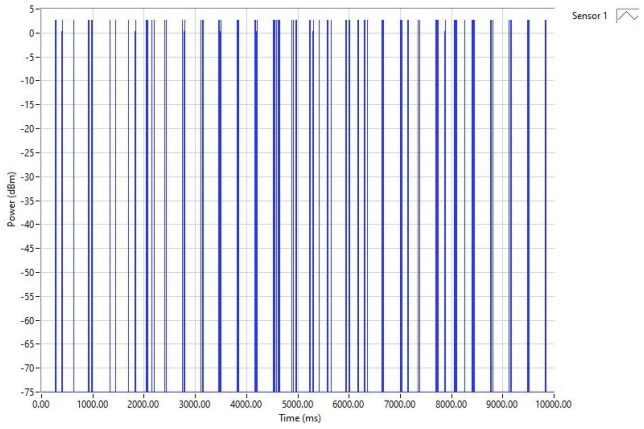
A correction factor related to duty cycle was added in the high channel (2480 MHz) of this model, specifically for transmitter harmonics in the range from 1-18 GHz. Duty cycle was measured using a sensor power and all the data was record but is not included in this document. Different modes were tested, and the maximum duty cycle recorded was selected as worst-case scenario. For this model the maximum duty cycle was:

The following operational use cases were investigated to identify the operational mode with the worst-case (highest) duty cycle operation:

- Hub, Standby mode
- Hub, Scanning
- Hub Pairing
- Hub, Paring of call button
- Hub, Pairing of Extend
- Hub, Assigning a role to a smartband
- Hub, call button assignment
- Hub, messaging smartband from UI
- Hub, messaging single smartband from call button
- Message multiple Smartbands from Call Button
- OTA update of Smartband
- OTA update of Call Button
- OTA update of Extend
- Unassign role of Smartband
- Unassign role of Call Button
- Delete Smartband from device list
- Delete Call Button from device list
- Deleting Extend from device list
- OTA update of Call Button

The output of the transmitter was monitored using a fast-sampling power meter (5 MSamples/second) over a period of 10 seconds (sufficiently long for the user operation to complete). The power meter data was analyzed and the worst case duty cycle over a 100 ms period was identified.

For this EUT the maximum duty cycle was: “Message multiple Smartbands from Call Button”. Below is the transmit power versus time:



And the exported record of transmitter on/off bursts:

Burst #	Combined Start Time (ms)	Combined Stop Time (ms)	Combined Power (dBm)	TxOn Time (ms)	TxOff Time (ms)
1	271.662	272.854	2.66	1.192	0.278
2	273.132	274.324	0.01	1.192	0.278
3	274.602	275.794	0.27	1.192	0.308
4	276.102	281.838	2.69	5.736	116.88
5	398.718	399.909	0.01	1.191	0.279
6	400.188	401.379	0.3	1.191	0.279
7	401.658	402.849	2.67	1.191	0.309
8	403.158	406.526	2.69	3.368	215.466
9	621.992	623.184	0.02	1.192	0.278
10	623.462	624.654	0.25	1.192	0.278
11	624.932	626.124	2.65	1.192	0.308
12	626.432	632.168	2.69	5.736	282.71
13	914.878	916.07	2.68	1.192	0.278
14	916.348	917.539	0.01	1.191	0.279
15	917.818	919.01	0.26	1.192	0.308
16	919.318	922.686	2.69	3.368	49.772
17	972.458	973.649	0.01	1.191	0.279
18	973.928	975.119	0.29	1.191	0.279
19	975.398	976.59	2.66	1.192	0.308
20	976.898	982.634	2.7	5.736	343.985
21	1326.619	1327.811	0.27	1.192	0.278
22	1328.089	1329.281	0.02	1.192	0.278
23	1329.559	1330.751	2.69	1.192	0.308
24	1331.059	1336.795	2.7	5.736	106.642
25	1443.437	1444.629	2.66	1.192	0.278
26	1444.907	1446.099	0.23	1.192	0.278
27	1446.377	1447.568	0	1.191	0.309
28	1447.877	1451.245	2.7	3.368	239.05
29	1690.295	1691.486	0.27	1.191	0.279
30	1691.765	1692.956	2.68	1.191	0.279
31	1693.235	1694.426	0.01	1.191	0.309
32	1694.735	1700.47	2.7	5.735	128.369
33	1828.839	1830.03	0.27	1.191	0.279
34	1830.309	1831.5	0.01	1.191	0.279
35	1831.779	1832.971	2.68	1.192	0.308
36	1833.279	1836.647	2.69	3.368	201.966
37	2038.613	2039.804	0.04	1.191	0.279
38	2040.083	2041.274	2.73	1.191	0.279
39	2041.553	2042.744	0.26	1.191	0.309
40	2043.053	2048.788	2.7	5.735	21.409
41	2070.197	2071.388	2.67	1.191	0.279
42	2071.667	2072.858	0.26	1.191	0.279
43	2073.137	2074.328	0.03	1.191	0.309
44	2074.637	2078.004	2.7	3.367	67.379
45	2145.383	2146.574	0.27	1.191	0.279
46	2146.853	2148.044	0	1.191	0.279
47	2148.323	2149.514	2.71	1.191	0.309
48	2149.823	2153.19	2.69	3.367	37.35
49	2190.54	2191.731	0.28	1.191	0.279
50	2192.01	2193.201	0.01	1.191	0.279
51	2193.48	2194.672	2.65	1.192	0.308
52	2194.98	2198.348	2.71	3.368	196.608
53	2394.956	2396.148	0.25	1.192	0.278
54	2396.426	2397.618	2.71	1.192	0.278
55	2397.896	2399.088	0.01	1.192	0.308
56	2399.396	2405.132	2.69	5.736	24.037
57	2429.169	2430.36	0.25	1.191	0.279
58	2430.639	2431.83	0	1.191	0.279
59	2432.109	2433.301	2.69	1.192	0.308
60	2433.609	2439.345	2.68	5.736	305.573
61	2744.918	2746.109	0.02	1.191	0.279
62	2746.388	2747.579	2.7	1.191	0.279
63	2747.858	2749.049	0.25	1.191	0.309
64	2749.358	2755.093	2.7	5.735	30.068
65	2785.161	2786.352	0.28	1.191	0.279
66	2786.631	2787.822	2.67	1.191	0.279
67	2788.101	2789.292	0	1.191	0.309
68	2789.601	2795.337	2.69	5.736	305.565
69	3100.902	3102.094	0.29	1.192	0.278
70	3102.372	3103.564	0.01	1.192	0.278
71	3103.842	3105.034	2.67	1.192	0.308

Burst #	Combined Start Time (ms)	Combined Stop Time (ms)	Combined Power (dBm)	TxOn Time (ms)	TxOff Time (ms)
72	3105.342	3111.078	2.7	5.736	29.007
73	3140.085	3141.276	0.01	1.191	0.279
74	3141.555	3142.746	0.28	1.191	0.279
75	3143.025	3144.216	2.7	1.191	0.309
76	3144.525	3150.26	2.7	5.735	307.582
77	3457.842	3459.034	0.27	1.192	0.278
78	3459.312	3460.504	2.71	1.192	0.278
79	3460.782	3461.974	0	1.192	0.308
80	3462.282	3468.018	2.69	5.736	22.037
81	3490.055	3491.247	0.03	1.192	0.278
82	3491.525	3492.717	0.25	1.192	0.278
83	3492.995	3494.187	2.67	1.192	0.308
84	3494.495	3500.231	2.69	5.736	314.643
85	3814.874	3816.066	0.28	1.192	0.278
86	3816.344	3817.536	0	1.192	0.278
87	3817.814	3819.006	2.67	1.192	0.308
88	3819.314	3825.05	2.69	5.736	13.037
89	3838.087	3839.278	2.67	1.191	0.279
90	3839.557	3840.748	0.26	1.191	0.279
91	3841.027	3842.218	0.03	1.191	0.309
92	3842.527	3848.263	2.69	5.736	314.573
93	4162.836	4164.027	0.02	1.191	0.279
94	4164.306	4165.497	0.3	1.191	0.279
95	4165.776	4166.967	2.72	1.191	0.309
96	4167.276	4173.011	2.7	5.735	26.037
97	4199.048	4200.239	0.28	1.191	0.279
98	4200.518	4201.709	0.01	1.191	0.279
99	4201.988	4203.18	2.68	1.192	0.308
100	4203.488	4209.224	2.69	5.736	315.643
101	4524.867	4526.059	0.32	1.192	0.278
102	4526.337	4527.529	0.02	1.192	0.278
103	4527.807	4528.999	2.67	1.192	0.308
104	4529.307	4535.043	2.71	5.736	12.976
105	4548.019	4549.21	0.27	1.191	0.279
106	4549.489	4550.68	2.71	1.191	0.279
107	4550.959	4552.15	0	1.191	0.309
108	4552.459	4558.194	2.7	5.735	21.695
109	4579.889	4581.08	0.02	1.191	0.279
110	4581.359	4582.55	0.27	1.191	0.279
111	4582.829	4584.02	2.67	1.191	0.309
112	4584.329	4587.696	2.69	3.367	24.062
113	4611.758	4612.95	0.26	1.192	0.278
114	4613.228	4614.419	0.04	1.191	0.279
115	4614.698	4615.89	2.67	1.192	0.308
116	4616.198	4619.566	2.7	3.368	14.062
117	4633.628	4634.819	0.01	1.191	0.279
118	4635.098	4636.289	2.67	1.191	0.279
119	4636.568	4637.759	0.24	1.191	0.309
120	4638.068	4641.436	2.67	3.368	233.498
121	4874.934	4876.125	0.27	1.191	0.279
122	4876.404	4877.595	0	1.191	0.279
123	4877.874	4879.065	2.66	1.191	0.309
124	4879.374	4885.109	2.68	5.735	22.007
125	4907.116	4908.307	2.67	1.191	0.279
126	4908.586	4909.777	0.27	1.191	0.279
127	4910.056	4911.247	-0.01	1.191	0.309
128	4911.556	4917.291	2.69	5.735	47.914
129	4965.205	4966.396	0.26	1.191	0.279
130	4966.675	4967.867	2.69	1.192	0.278
131	4968.145	4969.336	0.01	1.191	0.309
132	4969.645	4975.381	2.69	5.736	252.516
133	5227.897	5229.088	0.26	1.191	0.279
134	5229.367	5230.558	2.69	1.191	0.279
135	5230.837	5232.028	0	1.191	0.309
136	5232.337	5238.072	2.69	5.735	57.776
137	5295.848	5297.039	0.02	1.191	0.279
138	5297.318	5298.509	0.24	1.191	0.279
139	5298.788	5299.979	2.64	1.191	0.309
140	5300.288	5306.024	2.68	5.736	104.048
141	5410.072	5411.263	0	1.191	0.279
142	5411.542	5412.734	2.68	1.192	0.278
143	5413.012	5414.203	0.25	1.191	0.309

Burst #	Combined Start Time (ms)	Combined Stop Time (ms)	Combined Power (dBm)	TxOn Time (ms)	TxOff Time (ms)
144	5414.512	5417.88	2.69	3.368	158.973
145	5576.853	5578.044	0.02	1.191	0.279
146	5578.323	5579.514	0.24	1.191	0.279
147	5579.793	5580.984	2.69	1.191	0.309
148	5581.293	5587.028	2.7	5.735	59.776
149	5646.804	5647.995	0.31	1.191	0.279
150	5648.274	5649.466	2.72	1.192	0.278
151	5649.744	5650.935	0.01	1.191	0.309
152	5651.244	5656.98	2.69	5.736	276.926
153	5933.906	5935.097	0.27	1.191	0.279
154	5935.376	5936.567	-0.01	1.191	0.279
155	5936.846	5938.037	2.66	1.191	0.309
156	5938.346	5944.082	2.68	5.736	51.775
157	5995.857	5997.048	0.26	1.191	0.279
158	5997.327	5998.518	0.01	1.191	0.279
159	5998.797	5999.988	2.66	1.191	0.309
160	6000.297	6006.033	2.68	5.736	163.741
161	6169.774	6170.965	0.02	1.191	0.279
162	6171.244	6172.435	0.29	1.191	0.279
163	6172.714	6173.906	2.69	1.192	0.308
164	6174.214	6177.582	2.69	3.368	115.355
165	6292.937	6294.129	0.04	1.192	0.278
166	6294.407	6295.599	0.27	1.192	0.278
167	6295.877	6297.069	2.68	1.192	0.308
168	6297.377	6303.113	2.69	5.736	47.776
169	6350.889	6352.08	2.68	1.191	0.279
170	6352.359	6353.55	0.01	1.191	0.279
171	6353.829	6355.02	0.25	1.191	0.309
172	6355.329	6361.064	2.69	5.735	277.921
173	6638.985	6640.177	2.66	1.192	0.278
174	6640.455	6641.646	0.26	1.191	0.279
175	6641.925	6643.116	0.01	1.191	0.309
176	6643.425	6649.161	2.69	5.736	19.098
177	6668.259	6669.45	0.02	1.191	0.279
178	6669.729	6670.92	2.69	1.191	0.279
179	6671.199	6672.39	0.23	1.191	0.309
180	6672.699	6678.434	2.68	5.735	318.447
181	6996.881	6998.072	2.69	1.191	0.279
182	6998.351	6999.542	0.02	1.191	0.279
183	6999.821	7001.012	0.26	1.191	0.309
184	7001.321	7007.056	2.7	5.735	12.19
185	7019.246	7020.437	0	1.191	0.279
186	7020.716	7021.907	0.25	1.191	0.279
187	7022.186	7023.377	2.66	1.191	0.309
188	7023.686	7029.422	2.68	5.736	118.529
189	7147.951	7149.143	2.68	1.192	0.278
190	7149.421	7150.613	0.27	1.192	0.278
191	7150.891	7152.082	0	1.191	0.309
192	7152.391	7155.759	2.69	3.368	188.139
193	7343.898	7345.089	0.26	1.191	0.279
194	7345.368	7346.559	2.66	1.191	0.279
195	7346.838	7348.029	0	1.191	0.309
196	7348.338	7354.073	2.69	5.735	20.129
197	7374.202	7375.394	2.65	1.192	0.278
198	7375.672	7376.863	0	1.191	0.279
199	7377.142	7378.333	0.24	1.191	0.309
200	7378.642	7384.378	2.67	5.736	314.505
201	7698.883	7700.074	2.66	1.191	0.279
202	7700.353	7701.544	0.24	1.191	0.279
203	7701.823	7703.014	-0.01	1.191	0.309
204	7703.323	7709.058	2.69	5.735	15.129
205	7724.187	7725.378	0.26	1.191	0.279
206	7725.657	7726.848	0	1.191	0.279
207	7727.127	7728.318	2.64	1.191	0.309
208	7728.627	7734.363	2.67	5.736	136.711
209	7871.074	7872.265	0.25	1.191	0.279
210	7872.544	7873.735	0	1.191	0.279
211	7874.014	7875.205	2.66	1.191	0.309
212	7875.514	7878.881	2.68	3.367	175.993
213	8054.874	8056.066	2.66	1.192	0.278
214	8056.344	8057.535	0.23	1.191	0.279
215	8057.814	8059.005	-0.02	1.191	0.309

Burst #	Combined Start Time (ms)	Combined Stop Time (ms)	Combined Power (dBm)	TxOn Time (ms)	TxOff Time (ms)
216	8059.314	8065.05	2.67	5.736	24.128
217	8089.178	8090.37	0.23	1.192	0.278
218	8090.648	8091.84	-0.02	1.192	0.278
219	8092.118	8093.31	2.67	1.192	0.308
220	8093.618	8099.354	2.68	5.736	155.901
221	8255.255	8256.446	2.69	1.191	0.279
222	8256.725	8257.916	-0.03	1.191	0.279
223	8258.195	8259.386	0.23	1.191	0.309
224	8259.695	8263.062	2.68	3.367	138.836
225	8401.898	8403.09	0.25	1.192	0.278
226	8403.368	8404.56	2.67	1.192	0.279
227	8404.839	8406.03	-0.03	1.191	0.309
228	8406.339	8412.074	2.68	5.735	21.098
229	8433.172	8434.364	2.66	1.192	0.278
230	8434.642	8435.834	0.22	1.192	0.278
231	8436.112	8437.304	-0.02	1.192	0.308
232	8437.612	8443.348	2.67	5.736	318.472
233	8761.82	8763.011	0	1.191	0.279
234	8763.29	8764.482	2.66	1.192	0.278
235	8764.76	8765.951	0.24	1.191	0.309
236	8766.26	8771.996	2.67	5.736	28.128
237	8800.124	8801.316	2.69	1.192	0.278
238	8801.594	8802.785	-0.03	1.191	0.279
239	8803.064	8804.256	0.24	1.192	0.308
240	8804.564	8810.3	2.68	5.736	306.521
241	9116.821	9118.012	0.25	1.191	0.279
242	9118.291	9119.483	2.67	1.192	0.278
243	9119.761	9120.952	-0.01	1.191	0.309
244	9121.261	9126.997	2.68	5.736	24.128
245	9151.125	9152.317	2.67	1.192	0.278
246	9152.595	9153.787	0.22	1.192	0.278
247	9154.065	9155.257	-0.03	1.192	0.308
248	9155.565	9161.301	2.68	5.736	314.62
249	9475.921	9477.112	-0.02	1.191	0.279
250	9477.391	9478.583	2.66	1.192	0.278
251	9478.861	9480.052	0.23	1.191	0.309
252	9480.361	9486.097	2.67	5.736	16.189
253	9502.286	9503.477	-0.02	1.191	0.279
254	9503.756	9504.947	0.23	1.191	0.279
255	9505.226	9506.418	2.63	1.192	0.308
256	9506.726	9512.462	2.67	5.736	313.481
257	9825.943	9827.134	0	1.191	0.279
258	9827.413	9828.604	0.25	1.191	0.279
259	9828.883	9830.075	2.69	1.192	0.308
260	9830.383	9836.119	2.68	5.736	163.881

The worst-case duty cycle over 100 ms was calculated from the above data.

Maximum duty cycle = 32.50%
Correction factor related to duty cycle: 9.76 dB

8.6.4 Setup details

EUT setup configuration	Tabletop
Test facility	3M Chamber
Measurement details	Radiated spurious emissions measurement performed as per C63.10 §11.12

Receiver settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (preview measurements) Quasi-Peak (final measurements)
Trace mode	Max Hold

Receiver settings for radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Average and peak (final measurements)
Trace mode	Max Hold

8.6.5 Test data

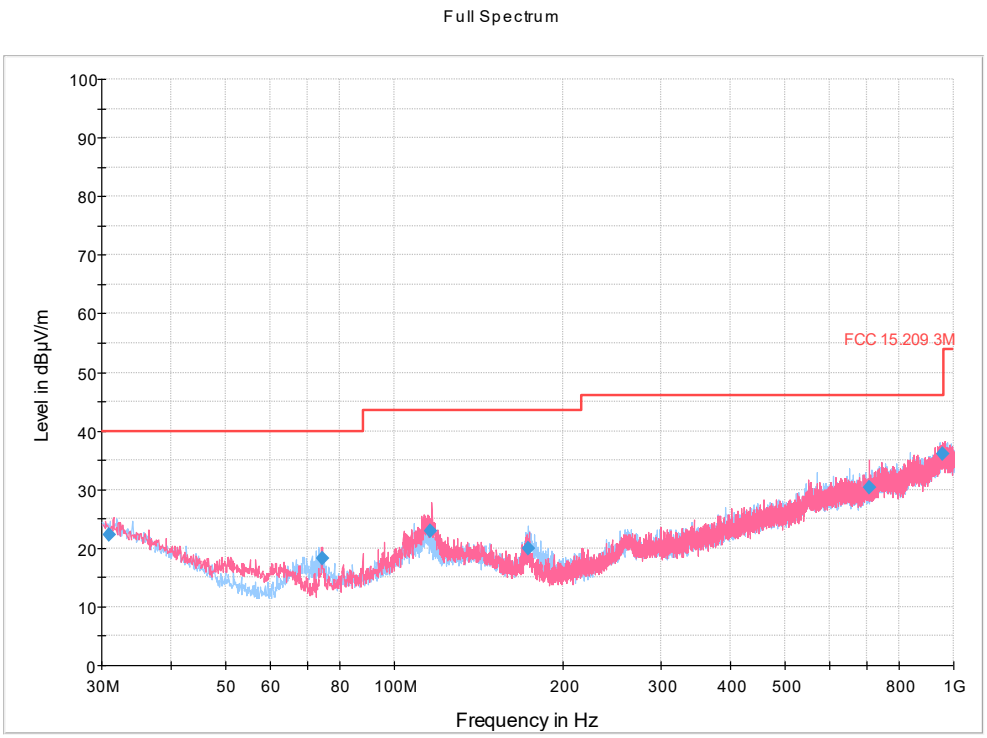


Figure 8.6-1: *Radiated spurious emissions plot, 30-1000 MHz, Low channel (2402 MHz)*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/ m)
30.872000	22.39	40.00	17.61	5000.0	120.000	266.0	V	347.0	24.9
74.466000	18.35	40.00	21.65	5000.0	120.000	126.0	V	135.0	13.8
116.192000	22.87	43.50	20.63	5000.0	120.000	112.0	V	121.0	18.5
173.720000	19.88	43.50	23.62	5000.0	120.000	328.0	H	154.0	17.1
705.421000	30.40	46.00	15.60	5000.0	120.000	111.0	V	72.0	30.7
955.328000	36.12	46.00	9.88	5000.0	120.000	104.0	V	82.0	36.2

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.

Table 8.6-3: *Radiated spurious emissions results, 30-1000 MHz, Low channel (2402 MHz)*

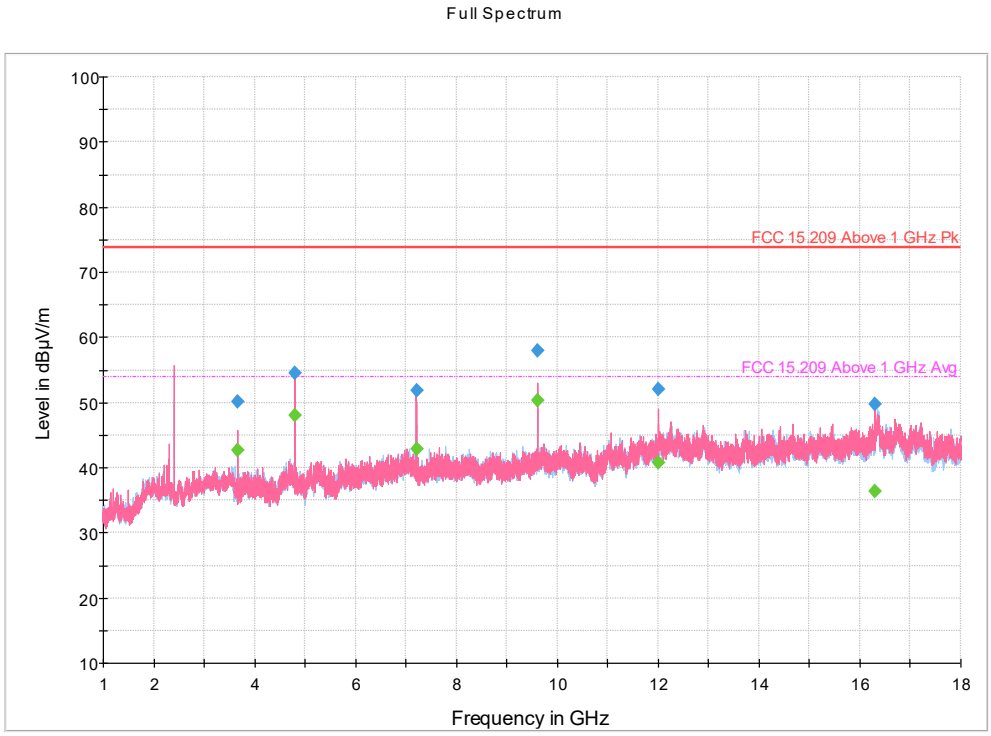


Figure 8.6-2: *Radiated spurious emissions plot, 1-18 GHz, Low channel (2402 MHz)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3657.522222	50.19	---	73.90	23.71	5000.0	1000.000	114.0	V	298.0	-5.5
3657.522222	---	42.59	53.90	11.31	5000.0	1000.000	114.0	V	298.0	-5.5
4803.677778	54.51	---	73.90	19.39	5000.0	1000.000	118.0	V	344.0	-2.3
4803.677778	---	47.94	53.90	5.96	5000.0	1000.000	118.0	V	344.0	-2.3
7207.000000	51.78	---	73.90	22.12	5000.0	1000.000	266.0	V	318.0	0.4
7207.000000	---	42.93	53.90	10.97	5000.0	1000.000	266.0	V	318.0	0.4
9609.122222	58.01	---	73.90	15.89	5000.0	1000.000	237.0	V	0.0	3.5
9609.122222	---	50.29	53.90	3.61	5000.0	1000.000	237.0	V	0.0	3.5
12008.877778	51.97	---	73.90	21.93	5000.0	1000.000	252.0	V	246.0	6.2
12008.877778	---	40.70	53.90	13.20	5000.0	1000.000	252.0	V	246.0	6.2
16302.755556	49.67	---	73.90	24.23	5000.0	1000.000	270.0	V	20.0	13.4
16302.755556	---	36.35	53.90	17.55	5000.0	1000.000	270.0	V	20.0	13.4

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.
[4] The fundamental signal is not part of the scope of this test. A 2.4 GHz notch filter was used for this measurement to avoid the saturation of the amplifier.

Table 8.6-4: *Radiated spurious emissions results, 1-18 GHz, Low channel (2402 MHz)*

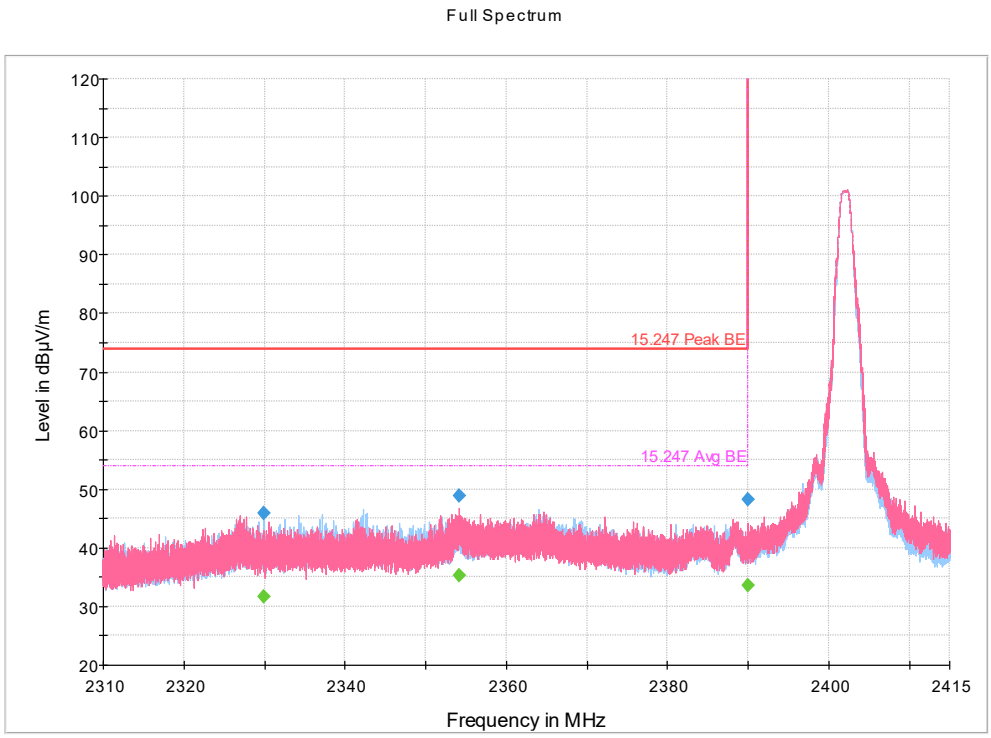


Figure 8.6-3: *Low band edge (Low channel: 2402 MHz) Radiated spurious emissions plot, 2310-2415 MHz.*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2329.890500	---	31.73	53.90	22.17	5000.0	1000.000	147.0	H	11.0	-10.3
2329.890500	45.86	---	73.90	28.04	5000.0	1000.000	147.0	H	11.0	-10.3
2354.198000	---	35.30	53.90	18.60	5000.0	1000.000	107.0	H	202.0	-10.1
2354.198000	48.79	---	73.90	25.11	5000.0	1000.000	107.0	H	202.0	-10.1
2390.000000	---	33.68	53.90	20.22	5000.0	1000.000	154.0	V	244.0	-10.0
2390.000000	48.21	---	73.90	25.69	5000.0	1000.000	154.0	V	244.0	-10.0

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)

Figure 8.6-5: *Low band edge (Low channel: 2402 MHz) Radiated spurious emissions results, 2310-2415 MHz.*

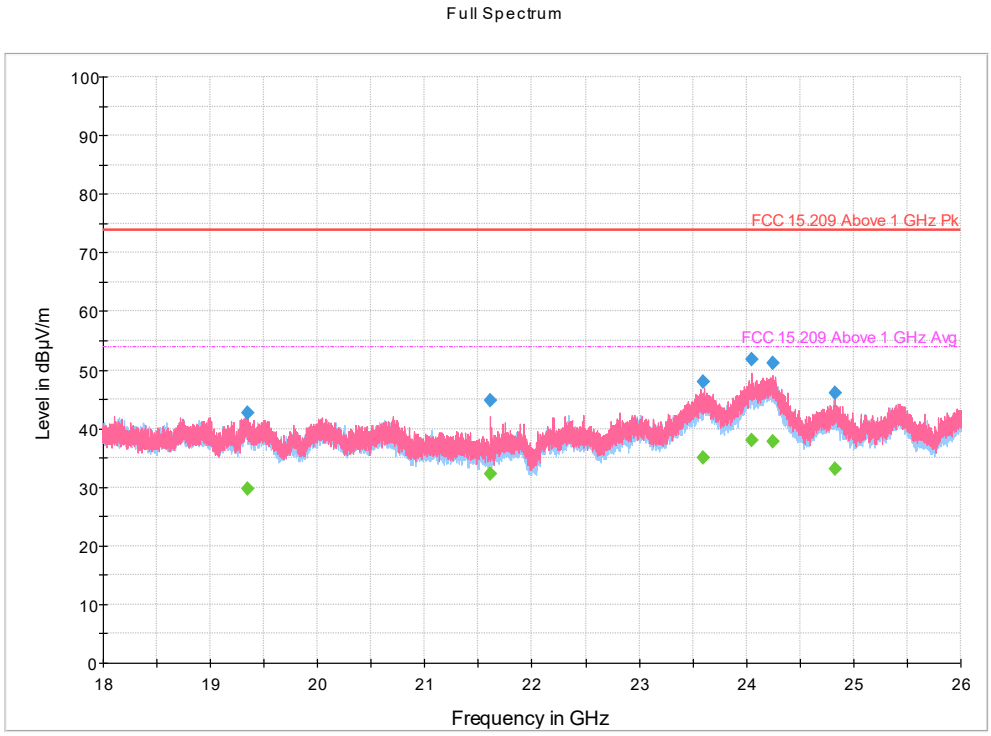


Figure 8.6-4: *Radiated spurious emissions plot, 18-26 GHz, Low channel (2402 MHz)*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19349.000000	---	29.83	53.90	24.07	5000.0	1000.000	373.0	V	46.0	16.7
19349.000000	42.69	---	73.90	31.21	5000.0	1000.000	373.0	V	46.0	16.7
21615.800000	---	32.18	53.90	21.72	5000.0	1000.000	100.0	V	302.0	17.1
21615.800000	44.70	---	73.90	29.20	5000.0	1000.000	100.0	V	302.0	17.1
23598.900000	---	34.93	53.90	18.97	5000.0	1000.000	254.0	V	164.0	23.8
23598.900000	47.92	---	73.90	25.98	5000.0	1000.000	254.0	V	164.0	23.8
24049.800000	---	38.10	53.90	15.80	5000.0	1000.000	155.0	V	34.0	27.6
24049.800000	51.70	---	73.90	22.20	5000.0	1000.000	155.0	V	34.0	27.6
24251.700000	---	37.82	53.90	16.08	5000.0	1000.000	373.0	V	342.0	26.9
24251.700000	51.16	---	73.90	22.74	5000.0	1000.000	373.0	V	342.0	26.9
24825.800000	---	33.14	53.90	20.76	5000.0	1000.000	334.0	V	150.0	22.3
24825.800000	46.14	---	73.90	27.76	5000.0	1000.000	334.0	V	150.0	22.3

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.

Table 8.6-6: *Radiated spurious emissions results, 18-26 GHz, Low channel (2402 MHz)*

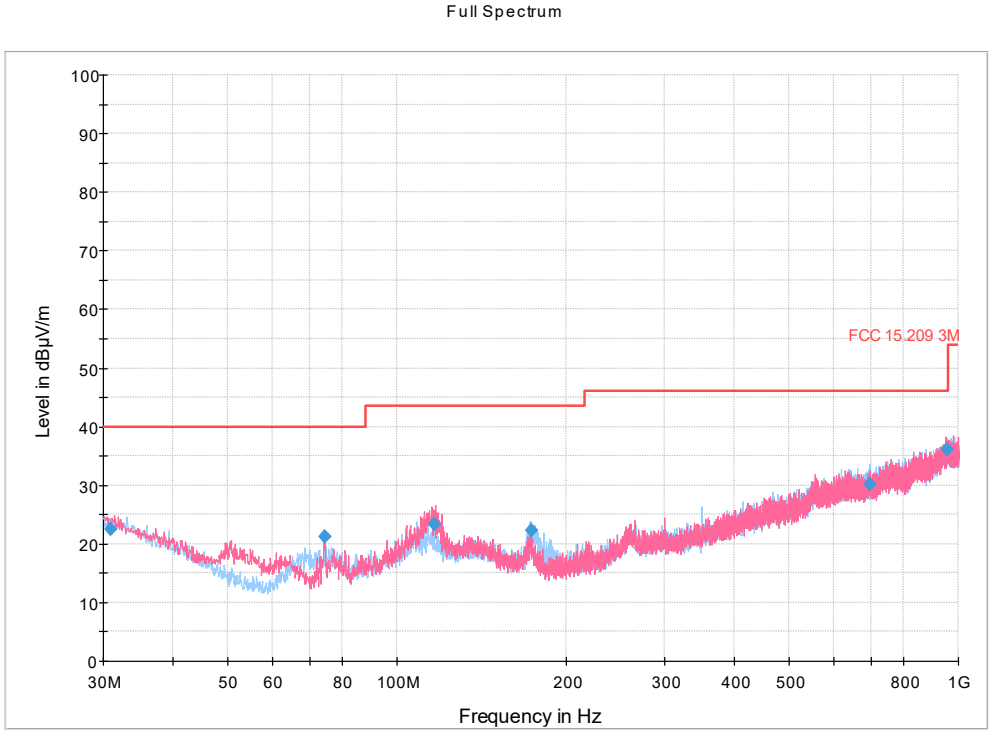


Figure 8.6-5: *Radiated spurious emissions plot, 30-1000 MHz, Middle channel (2440 MHz).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.880000	22.47	40.00	17.53	5000.0	120.000	202.0	V	278.0	24.9
74.312000	21.32	40.00	18.68	5000.0	120.000	119.0	V	248.0	13.7
116.677000	23.25	43.50	20.25	5000.0	120.000	114.0	V	108.0	18.5
173.766000	22.28	43.50	21.22	5000.0	120.000	201.0	H	160.0	17.1
696.584000	30.22	46.00	15.78	5000.0	120.000	376.0	H	300.0	30.6
953.950000	36.10	46.00	9.90	5000.0	120.000	272.0	V	97.0	36.2

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.

Table 8.6-7: *Radiated spurious emissions results, 30-1000 MHz, Middle channel (2440 MHz).*

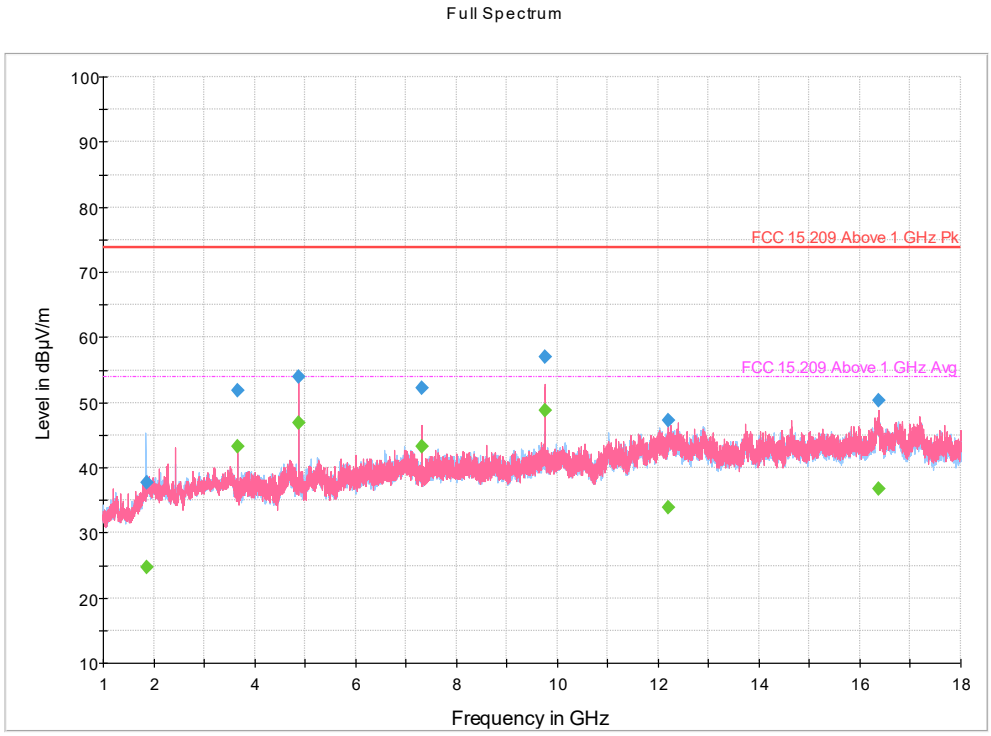


Figure 8.6-6: *Radiated spurious emissions plot, 1-18 GHz, Middle channel (2440 MHz).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1851.744444	---	24.79	53.90	29.11	5000.0	1000.000	215.0	H	48.0	-11.2
1851.744444	37.71	---	73.90	36.19	5000.0	1000.000	215.0	H	48.0	-11.2
3657.122222	51.92	---	73.90	21.98	5000.0	1000.000	104.0	V	303.0	-5.5
3657.122222	---	43.26	53.90	10.64	5000.0	1000.000	104.0	V	303.0	-5.5
4879.633333	---	46.88	53.90	7.02	5000.0	1000.000	119.0	V	312.0	-2.3
4879.633333	54.00	---	73.90	19.90	5000.0	1000.000	119.0	V	312.0	-2.3
7320.877778	52.26	---	73.90	21.64	5000.0	1000.000	260.0	V	317.0	0.6
7320.877778	---	43.20	53.90	10.70	5000.0	1000.000	260.0	V	317.0	0.6
9759.066667	---	48.88	53.90	5.02	5000.0	1000.000	229.0	V	0.0	3.6
9759.066667	56.91	---	73.90	16.99	5000.0	1000.000	229.0	V	0.0	3.6
12201.511111	47.18	---	73.90	26.72	5000.0	1000.000	207.0	H	224.0	6.8
12201.511111	---	33.87	53.90	20.03	5000.0	1000.000	207.0	H	224.0	6.8
16364.622222	50.24	---	73.90	23.66	5000.0	1000.000	203.0	V	189.0	13.0
16364.622222	---	36.83	53.90	17.07	5000.0	1000.000	203.0	V	189.0	13.0

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.
[4] The fundamental signal is not part of the scope of this test. A 2.4 GHz notch filter was used for this measurement to avoid the saturation of the amplifier.

Table 8.6-8: *Radiated spurious emissions results, 1-18 GHz, Middle channel (2440 MHz).*

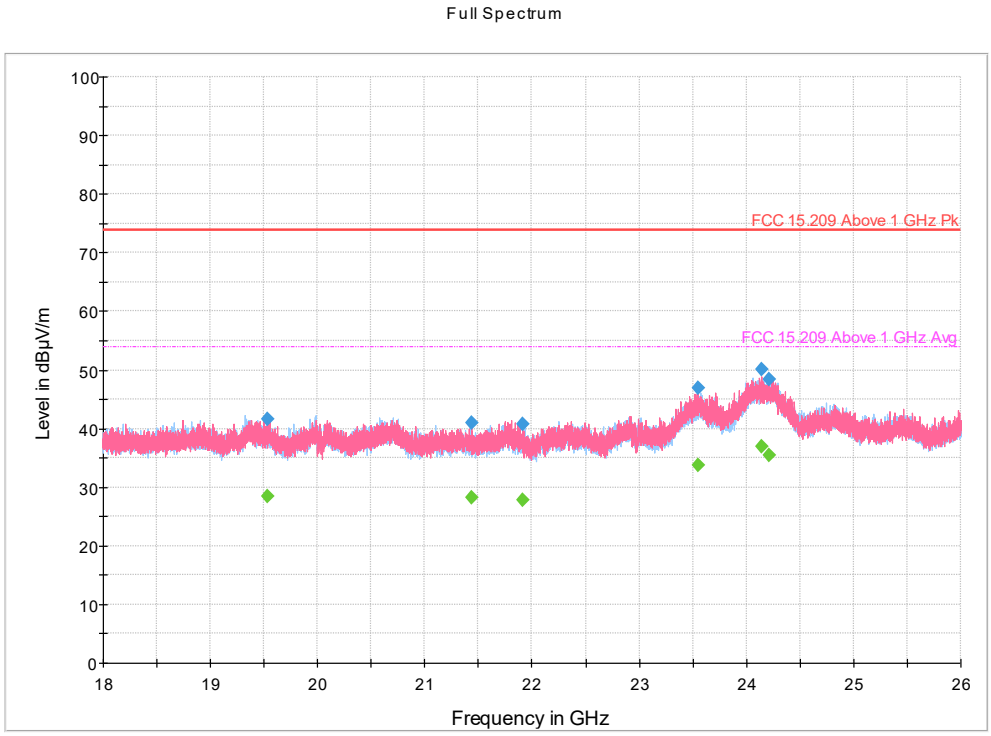


Figure 8.6-7: *Radiated spurious emissions plot, 18-26 GHz, Middle channel (2440 MHz).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19530.600000	41.62	---	73.90	32.28	5000.0	1000.000	338.0	V	0.0	16.3
19530.600000	---	28.46	53.90	25.44	5000.0	1000.000	338.0	V	0.0	16.3
21439.100000	---	28.16	53.90	25.74	5000.0	1000.000	324.0	V	162.0	16.9
21439.100000	41.03	---	73.90	32.87	5000.0	1000.000	324.0	V	162.0	16.9
21916.700000	40.76	---	73.90	33.14	5000.0	1000.000	281.0	H	293.0	17.1
21916.700000	---	27.82	53.90	26.08	5000.0	1000.000	281.0	H	293.0	17.1
23553.600000	---	33.66	53.90	20.24	5000.0	1000.000	163.0	V	186.0	23.7
23553.600000	46.91	---	73.90	26.99	5000.0	1000.000	163.0	V	186.0	23.7
24146.800000	50.20	---	73.90	23.70	5000.0	1000.000	316.0	V	329.0	27.3
24146.800000	---	36.85	53.90	17.05	5000.0	1000.000	316.0	V	329.0	27.3
24211.800000	48.33	---	73.90	25.57	5000.0	1000.000	350.0	H	135.0	27.1
24211.800000	---	35.54	53.90	18.36	5000.0	1000.000	350.0	H	135.0	27.1

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.

Table 8.6-9: *Radiated spurious emissions results, 18-26 GHz, Middle channel (2440 MHz).*

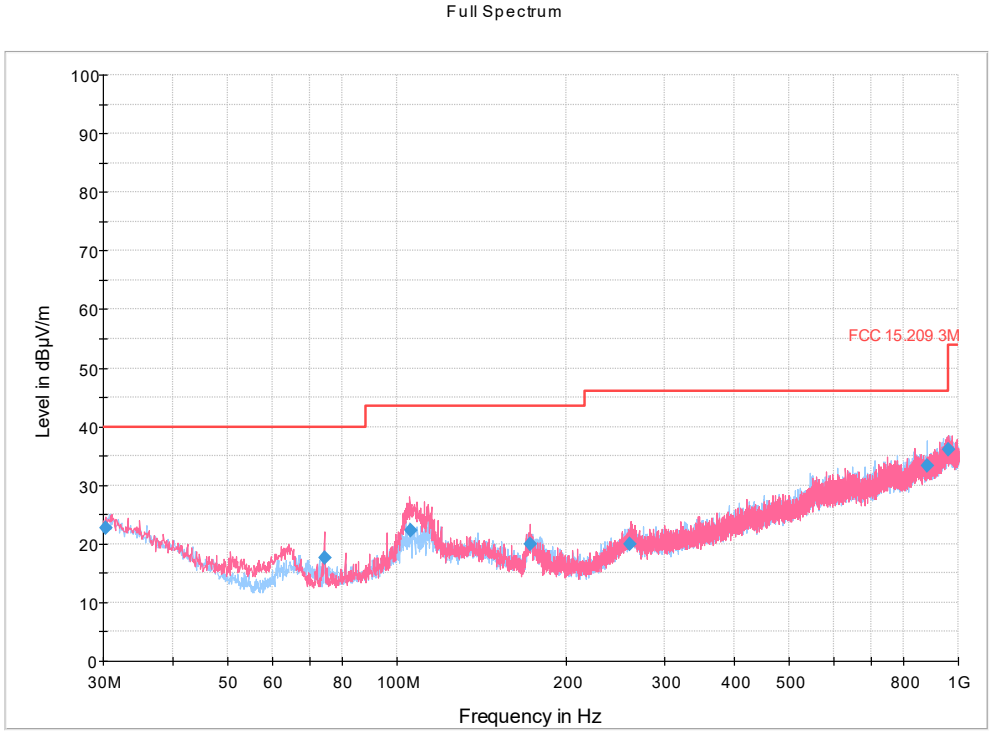


Figure 8.6-8: *Radiated spurious emissions plot, 30-1000 MHz, High channel (2480 MHz).*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.320000	22.61	40.00	17.39	5000.0	120.000	219.0	V	212.0	25.1
74.272000	17.69	40.00	22.31	5000.0	120.000	389.0	V	135.0	13.7
105.586000	22.35	43.50	21.15	5000.0	120.000	126.0	V	217.0	17.9
172.333000	20.01	43.50	23.49	5000.0	120.000	107.0	V	282.0	17.2
260.089000	19.98	46.00	26.02	5000.0	120.000	181.0	V	226.0	22.2
880.486000	33.32	46.00	12.68	5000.0	120.000	369.0	H	314.0	33.5
960.311000	36.15	53.90	17.75	5000.0	120.000	148.0	V	11.0	36.3

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.

Table 8.6-10: *Radiated spurious emissions results, 30-1000 MHz, High channel (2480 MHz).*

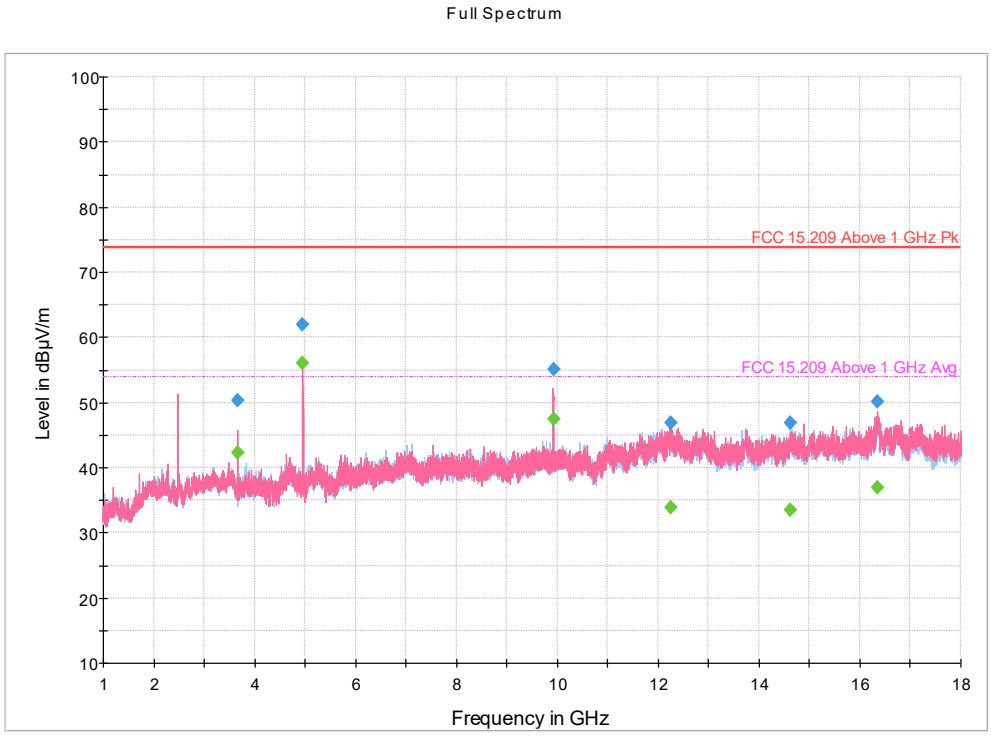


Figure 8.6-9: *Radiated spurious emissions plot, 1-18 GHz, High channel (2480 MHz).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
3657.522222	50.38	---	73.90	23.52	5000.0	1000.000	107.0	V	297.0	-5.5
3657.522222	---	42.33	53.90	11.57	5000.0	1000.000	107.0	V	297.0	-5.5
4959.655556	61.88	---	73.90	12.02	5000.0	1000.000	111.0	V	316.0	-2.4
4959.655556	---	**52.12****	53.90	1.78	5000.0	1000.000	111.0	V	316.0	-2.4
9920.933333	---	47.46	53.90	6.44	5000.0	1000.000	224.0	V	20.0	3.3
9920.933333	55.09	---	73.90	18.81	5000.0	1000.000	224.0	V	20.0	3.3
12252.000000	---	33.80	53.90	20.10	5000.0	1000.000	400.0	H	199.0	7.0
12252.000000	46.85	---	73.90	27.05	5000.0	1000.000	400.0	H	199.0	7.0
14627.133333	---	33.49	53.90	20.41	5000.0	1000.000	363.0	H	21.0	9.3
14627.133333	46.91	---	73.90	26.99	5000.0	1000.000	363.0	H	21.0	9.3
16346.966667	---	36.93	53.90	16.97	5000.0	1000.000	215.0	V	251.0	13.2
16346.966667	50.12	---	73.90	23.78	5000.0	1000.000	215.0	V	251.0	13.2

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.
[4] The fundamental signal is not part of the scope of this test. A 2.4 GHz notch filter was used for this measurement to avoid the saturation of the amplifier.

Table 8.6-11: *Radiated spurious emissions results, 1-18 GHz, High channel (2480 MHz).*

***Calculated average value using the duty cycle correction factor = 61.88 - 9.76 = 52.12 dBµV/m at 3m*

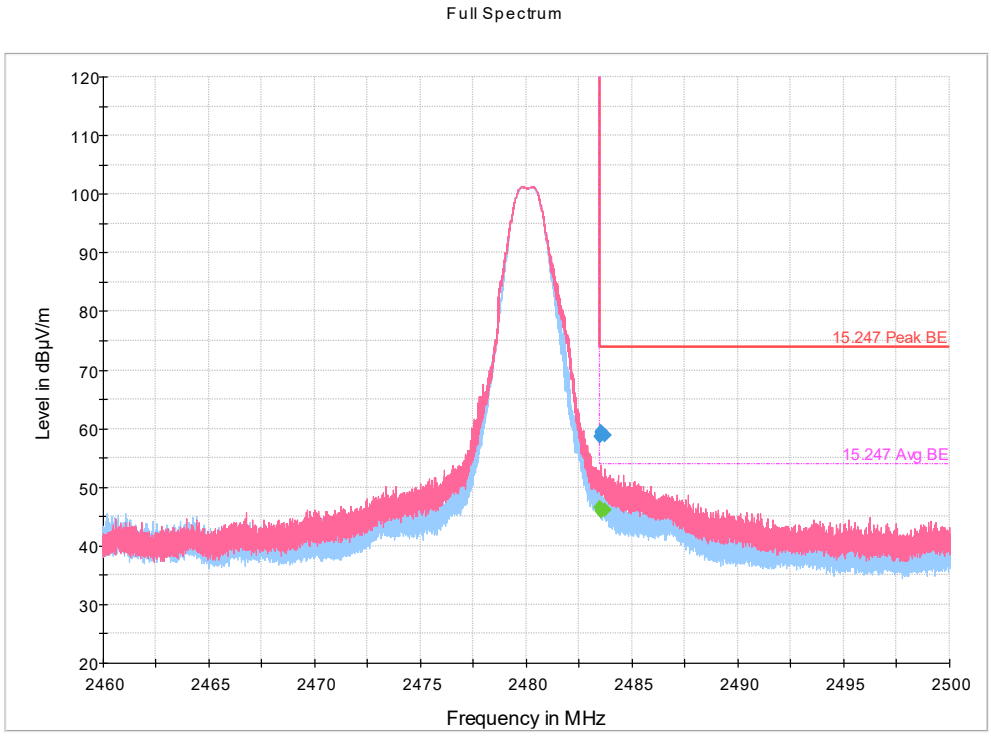


Figure 8.6-10: *High band edge (High channel: 2480 MHz) Radiated spurious emissions plot, 2460-2500 MHz.*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2483.500000	---	46.45	53.90	7.45	5000.0	1000.000	100.0	V	264.0	-9.7
2483.500000	58.69	---	73.90	15.21	5000.0	1000.000	100.0	V	264.0	-9.7
2483.530667	---	46.00	53.90	7.90	5000.0	1000.000	143.0	V	303.0	-9.7
2483.530667	59.22	---	73.90	14.68	5000.0	1000.000	143.0	V	303.0	-9.7
2483.558667	---	46.00	53.90	7.90	5000.0	1000.000	149.0	V	310.0	-9.7
2483.558667	59.43	---	73.90	14.47	5000.0	1000.000	149.0	V	310.0	-9.7
2483.684000	---	46.16	53.90	7.74	5000.0	1000.000	112.0	V	300.0	-9.7
2483.684000	58.93	---	73.90	14.97	5000.0	1000.000	112.0	V	300.0	-9.7

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)

Figure 8.6-12: *High band edge (High channel: 2480 MHz) Radiated spurious emissions results, 2460-2500 MHz.*

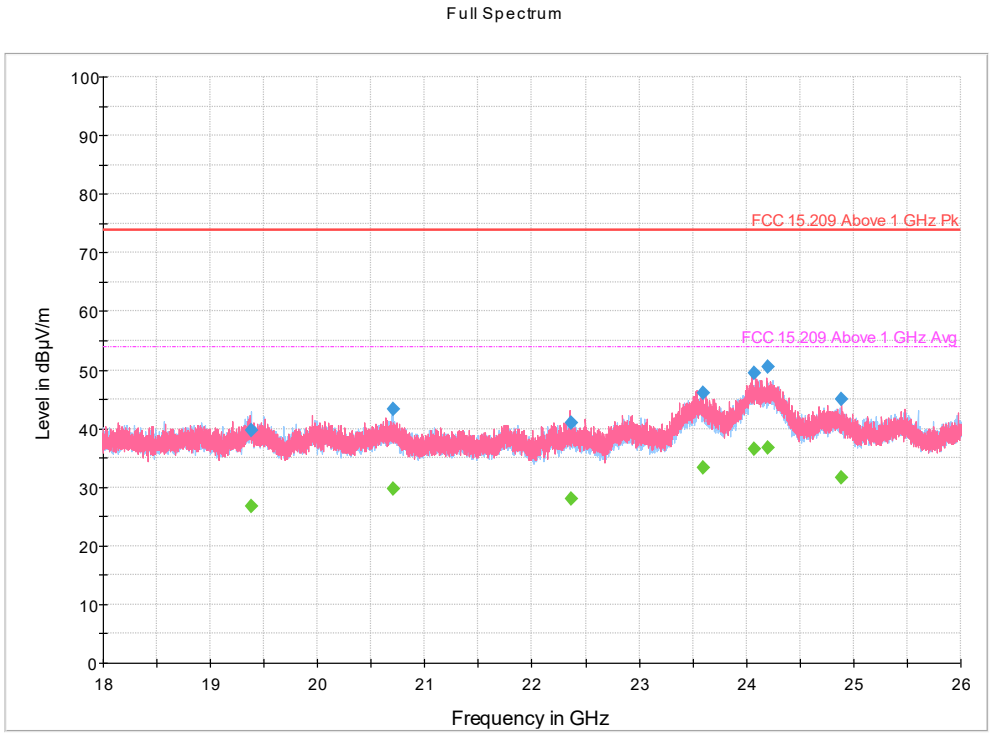


Figure 8.6-11: *Radiated spurious emissions plot, 18-26 GHz, High channel (2480 MHz).*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
19385.500000	---	26.74	53.90	27.16	5000.0	1000.000	311.0	H	174.0	16.6
19385.500000	39.68	---	73.90	34.22	5000.0	1000.000	311.0	H	174.0	16.6
20699.600000	---	29.77	53.90	24.13	5000.0	1000.000	104.0	H	137.0	18.3
20699.600000	43.26	---	73.90	30.64	5000.0	1000.000	104.0	H	137.0	18.3
22362.500000	---	27.96	53.90	25.94	5000.0	1000.000	353.0	V	352.0	17.5
22362.500000	41.03	---	73.90	32.87	5000.0	1000.000	353.0	V	352.0	17.5
23592.500000	46.15	---	73.90	27.75	5000.0	1000.000	358.0	V	342.0	23.8
23592.500000	---	33.29	53.90	20.61	5000.0	1000.000	358.0	V	342.0	23.8
24069.200000	---	36.43	53.90	17.47	5000.0	1000.000	259.0	V	202.0	27.5
24069.200000	49.44	---	73.90	24.46	5000.0	1000.000	259.0	V	202.0	27.5
24200.800000	50.56	---	73.90	23.34	5000.0	1000.000	272.0	V	101.0	27.1
24200.800000	---	36.81	53.90	17.09	5000.0	1000.000	272.0	V	101.0	27.1
24890.000000	---	31.69	53.90	22.21	5000.0	1000.000	279.0	V	161.0	22.3
24890.000000	44.93	---	73.90	28.97	5000.0	1000.000	279.0	V	161.0	22.3

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB)
[3] FCC 15.209 Limits are equivalent to FCC 15.247 Limits.

Table 8.6-13: *Radiated spurious emissions results, 18-26 GHz, High channel (2480 MHz).*

8.7 FCC 15.247(e) and RSS-247 5.2(b) Power spectral density of digital transmission system

8.7.1 References

Title 47 → Chapter I → Subchapter A → Part 15 → Subpart C → §15.247(e) / ANSI C63.10: 2013

(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 → §5.2(b)

(a) 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(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

8.7.2 Test summary

Verdict	Pass		
Test date	December 1, 2022	Temperature	20 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1006 mbar
Test location	Wireless bench (Conducted)	Relative humidity	57 %

8.7.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).
For conducted measurements, an offset corresponding to the path losses was added in the spectrum analyzer.

8.7.4 Setup details

EUT setup configuration	Tabletop
Test facility	Wireless Bench
Measurement details	Measurement performed as per C63.10 §11.10.2 (Method PKPSD)

Receiver/spectrum analyzer settings:

Resolution bandwidth	3 kHz
Video bandwidth	10 kHz (≥ 3 x RBW)
Frequency span	1 MHz (1.5 x DTS bandwidth)
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.7.5 Test data

Table 8.7-1: *Power spectral density of DTS*

Transmitter Frequency (MHz)	Measured Level (dBm/3 kHz)	Limit (dBm/3 kHz)
2402	6.21	8.00
2440	5.90	8.00
2480	4.48	8.00

8.7.6 Test data, continued

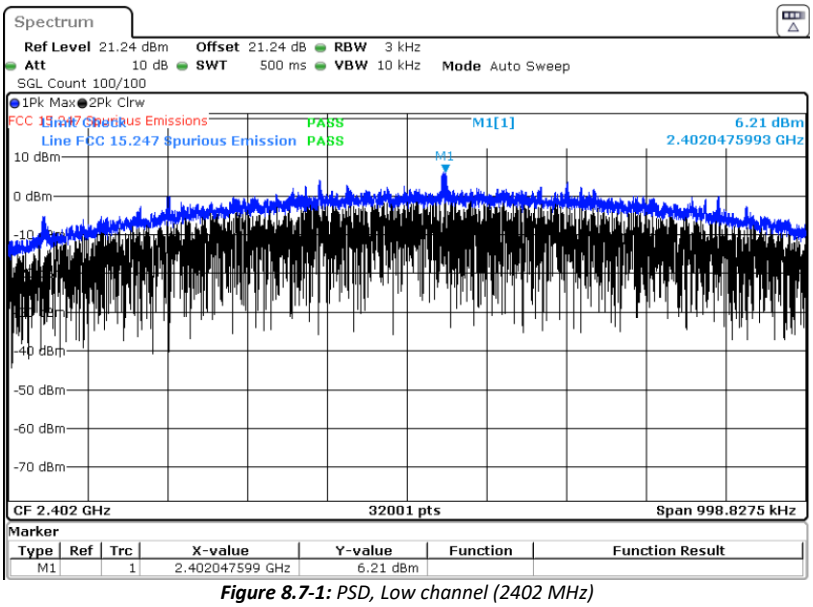


Figure 8.7-1: *PSD, Low channel (2402 MHz)*

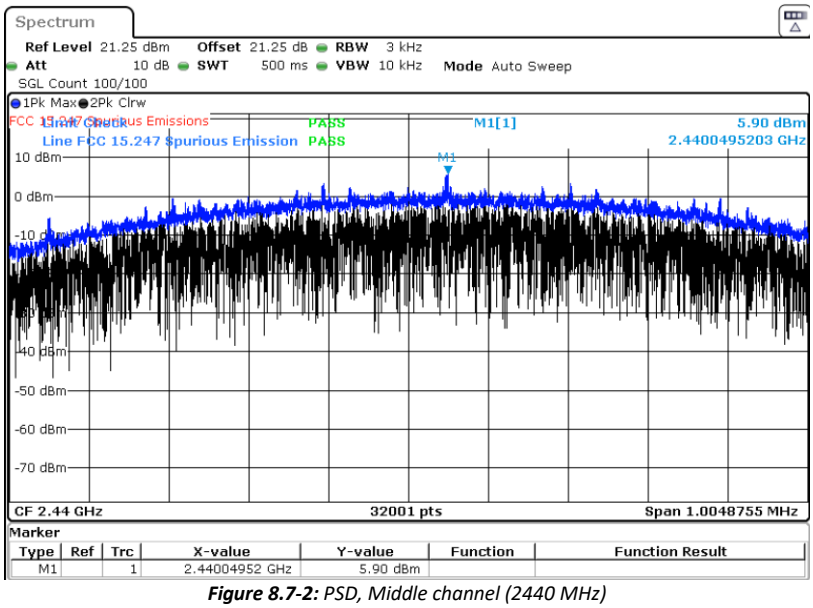


Figure 8.7-2: *PSD, Middle channel (2440 MHz)*

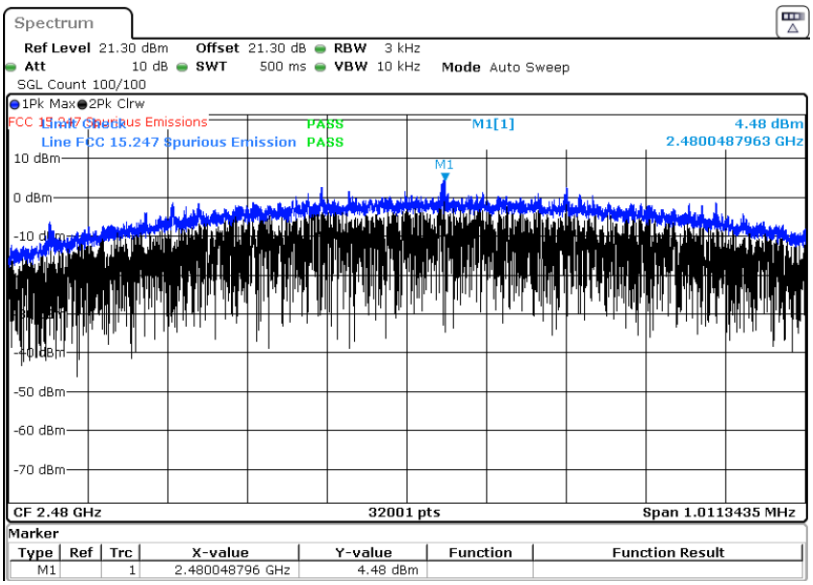


Figure 8.7-3: *PSD, High channel (2480 MHz)*

8.8 RSS-GEN 6.7 Occupied bandwidth (or 99% emission bandwidth)

8.8.1 References

RSS-Gen → §6.7

The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.8.2 Test summary

Test date	November 30, 2022	Temperature	19 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1005 mbar
Test location	Wireless bench (Conducted)	Relative humidity	53 %

8.8.3 Notes

Testing was performed with the BLE transmitter operating on a fixed channel at 5 dBm (software set up).

8.8.4 Setup details

EUT setup configuration	Tabletop
Test facility	Wireless Bench
Measurement details	Measurement performed as per C63.10 §6.9.3 using the built-in function of the spectrum analyzer

Receiver/spectrum analyzer settings:

Resolution bandwidth	1 – 5 % of OBW
Video bandwidth	3*RBW
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.8.5 Test data

Table 8.8-1: *99% Occupied bandwidth*

Transmitter Frequency (MHz)	99%Bandwidth (MHz)
2402	1.094809537
2440	1.098559420
2480	1.094497047

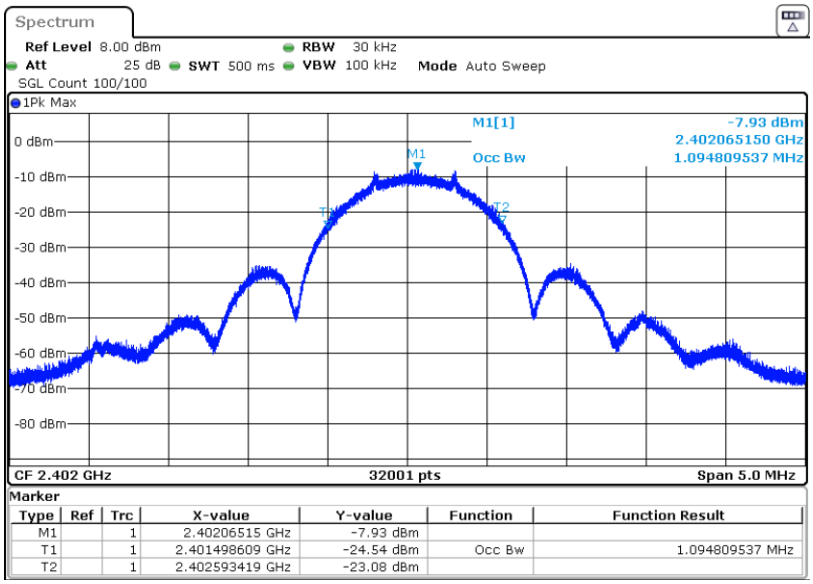


Figure 8.8-1: *99% OBW, Low channel (2402 MHz)*

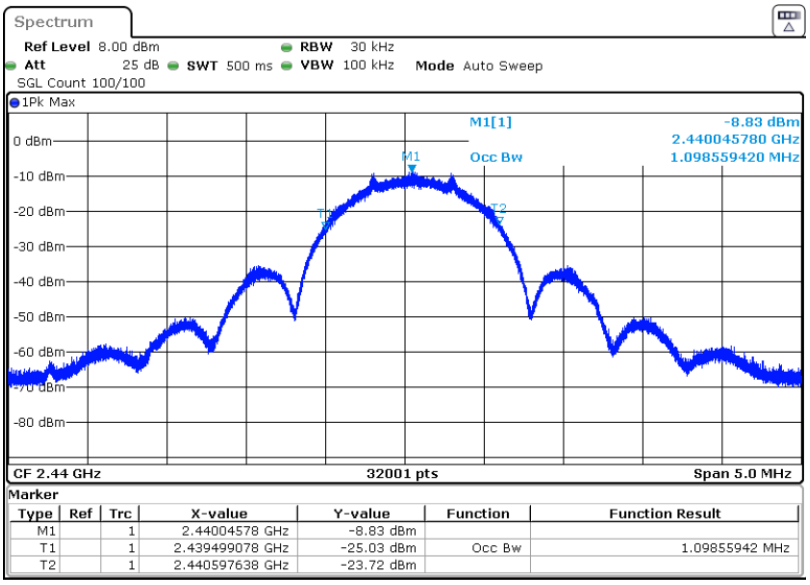


Figure 8.8-2: *99% OBW, Middle channel (2440 MHz)*

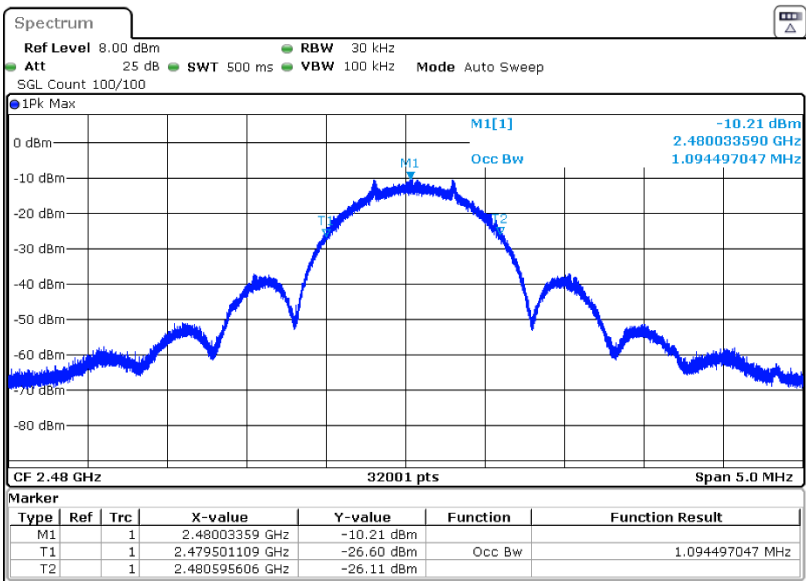


Figure 8.8-3: *99% OBW, High channel (2480 MHz)*

Section 9 Block diagrams of test set-ups

9.1 Radiated emissions set-up

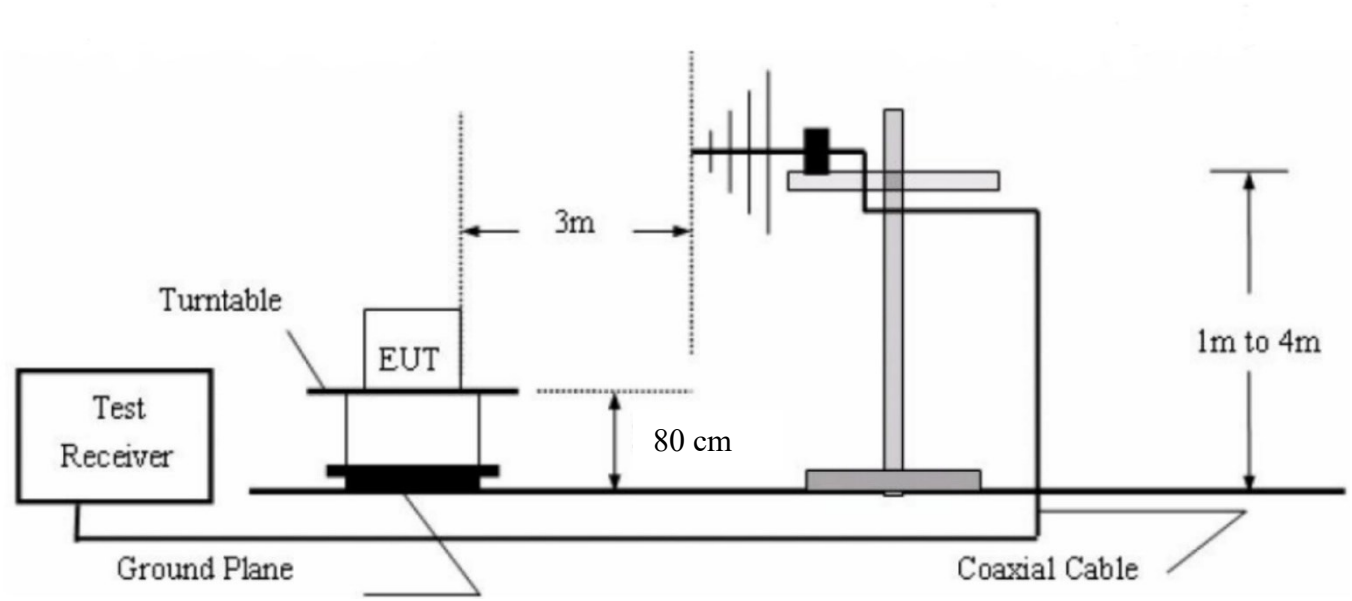


Figure 9.1-1: *30 MHz - 1000 MHz Setup*

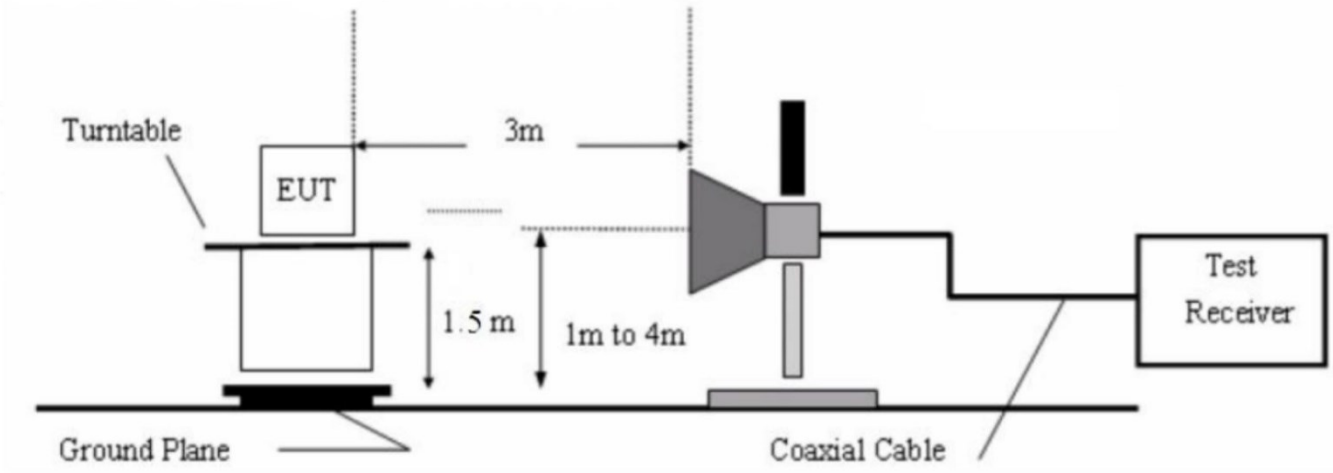


Figure 9.1-2: *1 GHz - 26 GHz Setup*

9.2 Conducted emissions set-up

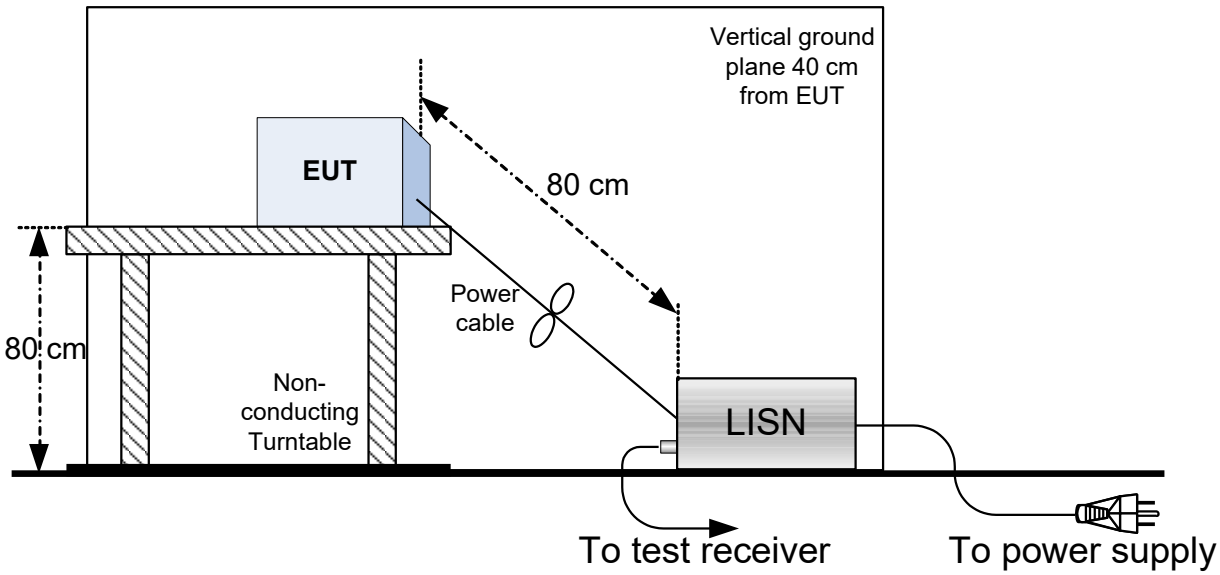


Figure 9.2-1: *150 kHz to 30 MHz Conducted Emissions Setup*