Test report

452178-1TRFWL

Date of issue: March 22, 2022

Applicant:

Shenzhen Dalang Electronic Technology Co., Ltd

Product:

EVAWGIB

Model:

EV-JM8

Variant(s):

None

FCC ID: 2A4GWEVJM8

IC ID: 28199-EVJM8

Specifications:

- FCC 47 CFR Part 15, Subpart C – §15.247
  Operation within the bands 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5850 MHz
- Industry Canada RSS-247, Issue 2, February 2017
  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
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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	James Cunningham, EMC/MIL/WL Supervisor
Reviewed by	Juan M Gonzalez, Business Development Manager
Review date	March 22, 2022
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.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 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

1.2 Test methods

ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
558074 D01 DTS Measurement Guidance v03r02 (June 5, 2014)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

1.3 Exclusions

None.

1.4 Statement of compliance

Testing was performed against all relevant requirements of the test standard(s).

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See “Section 2 Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Issue Date	Details of changes made to test report
452178-1TRFEMC		Original report issued

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 [1]
§15.31(e)	Variation of power source	Pass
§15.203	Antenna requirement	Pass [2]
§15.215(c)	20 dB bandwidth	Not applicable

Note 1: The EUT is battery powered
Note 2: The antenna is integral to the EUT and cannot be removed

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 5275 – 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
6.7	99% Occupied bandwidth	Pass
7.3	Receiver radiated emission limits	Not applicable [1]
7.4	Receiver conducted emission limits	Not applicable [1]
8.8	Power Line Conducted Emissions Limits for License-Exempt Radio Apparatus	Pass [2]

Note 1: EUT is neither a stand-alone receiver nor a scanning receiver.
Note 2: The EUT is battery powered

Section 3 Equipment under test (EUT) details

3.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

3.2 Sample information

Receipt date	26-Jan-22
Nemko sample ID number	452178

3.3 Testing period

Test start date	26-Jan-22
Test end date	11-Mar-22

3.4 Applicant

Company name	Shenzhen Dalang Electronic Technology Co., Ltd
Address	Block 2, Chao Loft, Cultural and Creative Park, No 150 Hyayue Road, Dalang Street, Longhua District
City	Shenzhen
State	Guangdong
Postal/Zip code	518109
Country	China

3.5 Manufacturer

Company name	Shenzhen Dalang Electronic Technology Co., Ltd
Address	Block 2, Chao Loft, Cultural and Creative Park, No 150 Hyayue Road, Dalang Street, Longhua District
City	Shenzhen
State	Guangdong
Postal/Zip code	518109
Country	China

3.6 EUT information

Product name	EVAWGIB
Model	EV-JM8
Variant(s)	None
Serial number	None
Part number	None
Power requirements	3.7 VDC battery powered. Charged via 5 VDC USB
Description/theory of operation	Barcode scanner. Transportable handheld equipment with Bluetooth Low Energy transmitter, Class III apparatus. For IT environment intended for professional use.
Operational frequencies	2400 - 2483.5 MHz band
Software details	N/A
Operating band	2400 – 2483.5 MHz
Test frequencies	2402 MHz, 2440 MHz, 2480 MHz
Modulation type(s)	GFSK
Antenna type	Integrated
Antenna gain (declared)	0 dBi
Nominal channel spacing	1 MHz

3.7 EUT exercise and monitoring details

EUT description of the methods used to exercise the EUT:

- For antenna port tests, the wireless module was tested stand-alone with the antenna port connected via temporary antenna connector to the test equipment.
- For radiated tests, the full product was tested with a USB cable connected to a support laptop.
- AC conducted emissions were performed by commanding the full product to the appropriate operating mode and then connecting the product to the AC mains via USB adaptor.
- The wireless module was commanded to the appropriate operating mode via BT89X FCC Tool V1.3 software installed on a support laptop connected to the wireless module via USB->Serial adaptor.

3.8 EUT setup details

Table 3.8-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
USB wall charger	Apple	A1265	1X0474UFMQ8Q7	N/A

Table 3.8-2: *EUT interface ports*

Description	Qty.
USB	1

Table 3.8-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Support Laptop	Dell			

Table 3.8-4: *Inter-connection cables*

Cable description	From	To	Length (m)
USB	EUT	USB wall charger	1
USB (including USB->serial adaptor) (only present during device configuration, removed during testing)	EUT	Support laptop	1

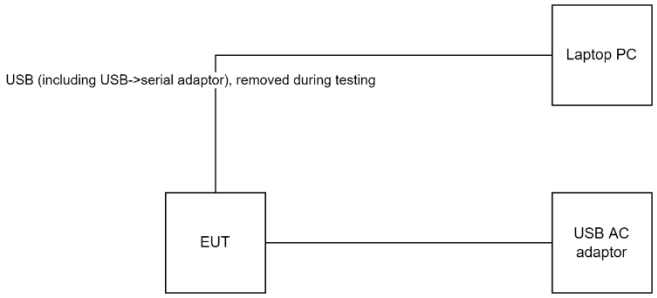

Figure 3.8-1: Test setup diagram (radiated emissions and AC conducted emissions tests)

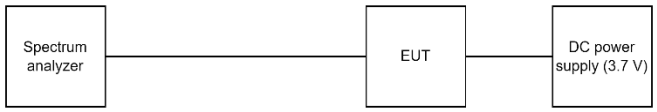

Figure 3.8-2: Test setup diagram (antenna port conducted tests)

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None.

4.2 Technical judgement

None.

4.3 Deviations from laboratory test procedures

None.

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.
Antenna, Bilog	Schaffner	CBL 6111D	1463	2 years	18-May-2022
DRG Horn (Medium)	ETS-Lindgren	3117-PA	E1160	2 years	26-Jan-2023
EMI Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 year	19-May-2022
System controller	Sunol Sciences	SC104V	E1191	NCR	NCR
Signal and Spectrum Analyzer	Rohde & Schwarz	FSW43	E1302	1 year	8-Nov-2022

Notes: N/A – not applicable
NCR – no calibration required
VOU – verify on use

Table 6.1-2: *Radiated emissions test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15

Notes: None

Section 8 Testing data

8.1 AC power line conducted emissions

8.1.1 References and limits

- FCC 47 CFR Part 15, Subpart C: §15.207
- RSS-Gen: 8.8
- Test method: ANSI C63.10-2014 §6.2

Table 8.1-1: *AC power line 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	January 6, 2022	Temperature	20 °C
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1015 mbar
Test location	☒ Ground plane ☐ Other:	Relative humidity	62 %

8.1.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested. Only the worst case (middle channel) is reported here.

8.1.4 Setup details

Port under test	AC power input
EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
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
Detector mode	– Peak (Preview measurement) – Quasi-peak and average (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak and average final measurement)

8.1.5 Test data

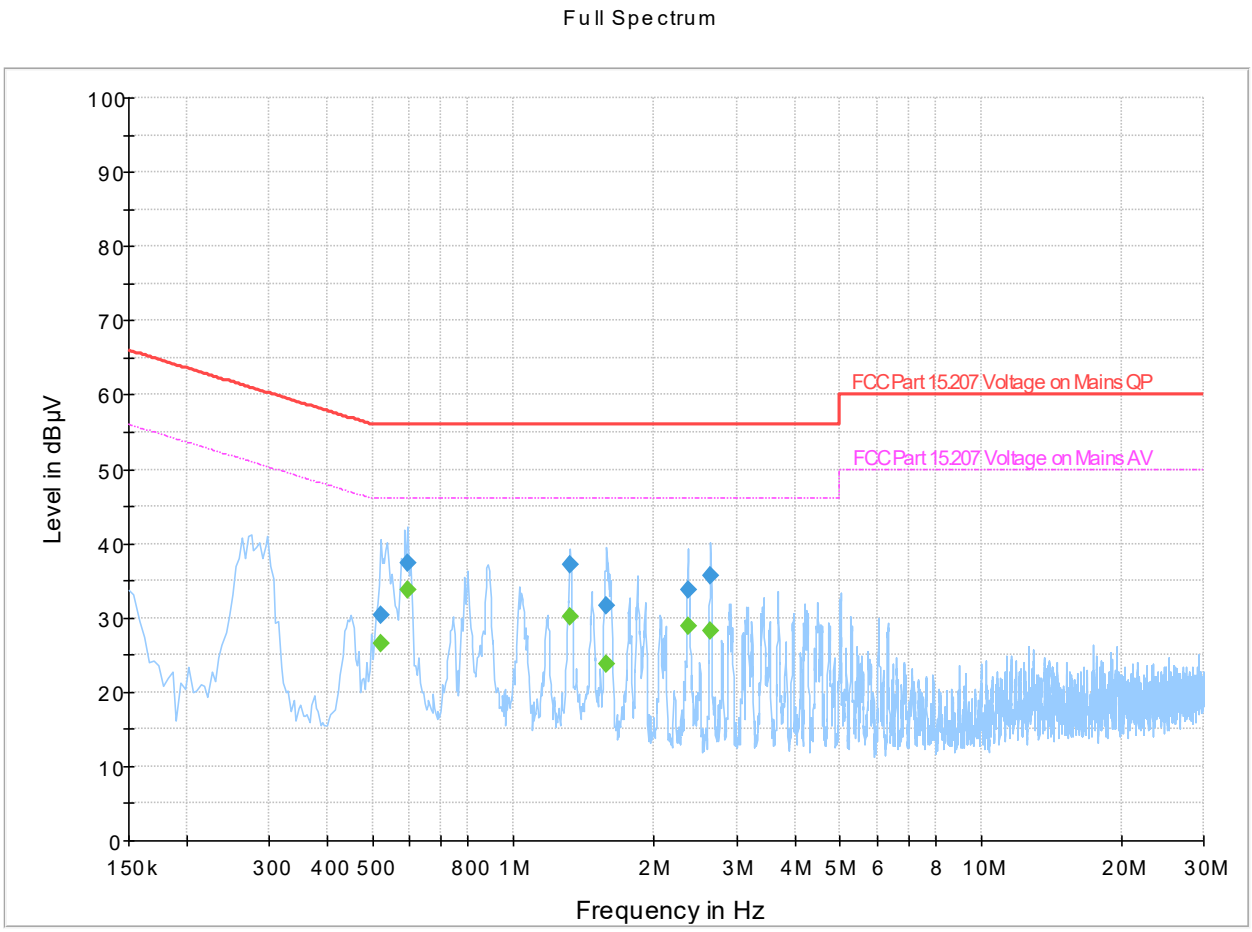

Figure 8.1-1: *Conducted emissions at mains port spectral plot (150 kHz - 30 MHz)*

Table 8.1-2*: Conducted emissions at mains port results*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.518000	30.34	---	56.00	25.66	5000.0	9.000	N	ON	19.4
0.518000	---	26.59	46.00	19.41	5000.0	9.000	N	ON	19.4
0.594000	37.46	---	56.00	18.54	5000.0	9.000	N	ON	19.4
0.594000	---	33.81	46.00	12.19	5000.0	9.000	N	ON	19.4
1.322000	37.07	---	56.00	18.93	5000.0	9.000	L1	ON	19.4
1.322000	---	30.13	46.00	15.87	5000.0	9.000	L1	ON	19.4
1.582000	---	23.77	46.00	22.23	5000.0	9.000	L1	ON	19.4
1.582000	31.60	---	56.00	24.40	5000.0	9.000	L1	ON	19.4
2.366000	33.80	---	56.00	22.20	5000.0	9.000	N	ON	19.3
2.366000	---	28.98	46.00	17.02	5000.0	9.000	N	ON	19.3
2.646000	---	28.25	46.00	17.75	5000.0	9.000	L1	ON	19.4
2.646000	35.58	---	56.00	20.42	5000.0	9.000	L1	ON	19.4

Notes:
[1] Result (dBµV) = receiver analyzer value (dBµV) + correction factor (dB).
[2] Correction factors = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

8.2 20 dB bandwidth

8.2.1 References and limits

- FCC 47 CFR Part 15, Subpart B: §15.215(c)
- Test method: ANSI C63.4-2014: §6.9.2

§15.215:
(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

8.2.2 Test summary

Verdict	Pass		
Test date	January 26, 2022	Temperature	21 °C
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1013 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	44 %

8.2.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested.

8.2.4 Setup details

EUT power input during test	3.7 V DC
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

Resolution bandwidth	20 kHz
Video bandwidth	100 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: *20 dB occupied bandwidth test data*

Test frequency (MHz)	Bandwidth (MHz)	Measured f_c (MHz)	Measured f_L (MHz)	Measured f_H (MHz)	Limit
2402	1.147	2401.804	2401.405	2402.551	f_H and f_L within 2400 – 2483.5 MHz
2440	1.147	2439.804	2439.401	2440.548	f_H and f_L within 2400 – 2483.5 MHz
2480	1.147	2479.804	2479.401	2480.548	f_H and f_L within 2400 – 2483.5 MHz

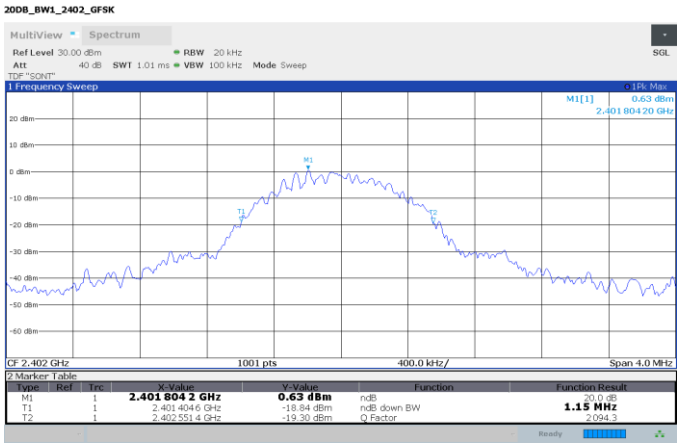

Figure 8.2-1: *20 dB occupied bandwidth, 2402 MHz*

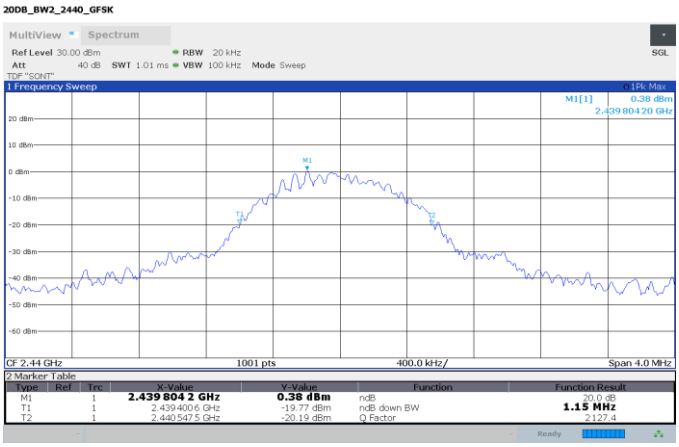

Figure 8.2-2: *20 dB occupied bandwidth, 2440 MHz*

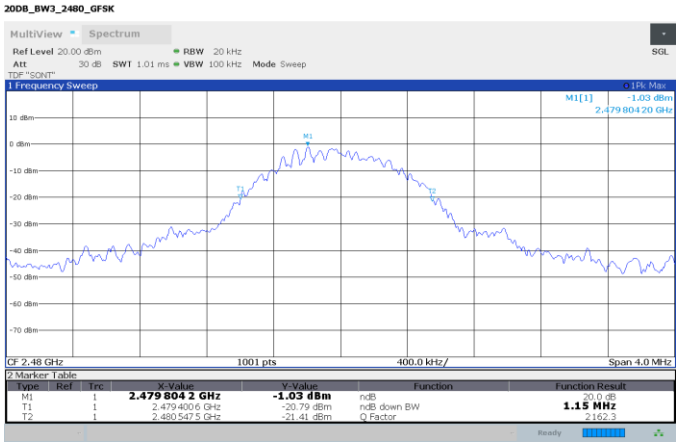

Figure 8.2-3: *20 dB occupied bandwidth, 2480 MHz*

8.3 Minimum 6 dB bandwidth for systems using digital modulation techniques

8.3.1 References and limits

- FCC 47 CFR Part 15, Subpart B: §15.247(a)(2)
- RSS-247: §5.2(a)
- Test method: 558074 D01 DTS Measurement Guidance §8.2 and ANSI C63.10 §11.8.2 (using built-in marker function of the spectrum analyzer)

§15.247:
(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.

RSS-247:
5.2 DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:
(a) The minimum 6 dB bandwidth shall be 500 kHz.

8.3.2 Test summary

Verdict	Pass		
Test date	January 26, 2022	Temperature	21 °C
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1013 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	44 %

8.3.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested.

8.3.4 Setup details

EUT power input during test	3.7 V DC
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

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

8.3.5 Test data

Table 8.3-1: *6 dB DTS bandwidth test data*

Test frequency (MHz)	Bandwidth (kHz)	Limit
2402	719.30	≥ 500 kHz
2440	735.30	≥ 500 kHz
2480	731.30	≥ 500 kHz

Figure 8.3-1: *6 dB DTS bandwidth, 2402 MHz*

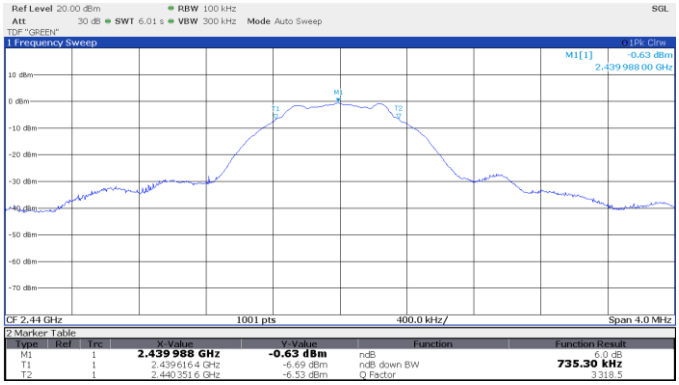

Figure 8.3-2: *6 dB DTS bandwidth, 2440 MHz*

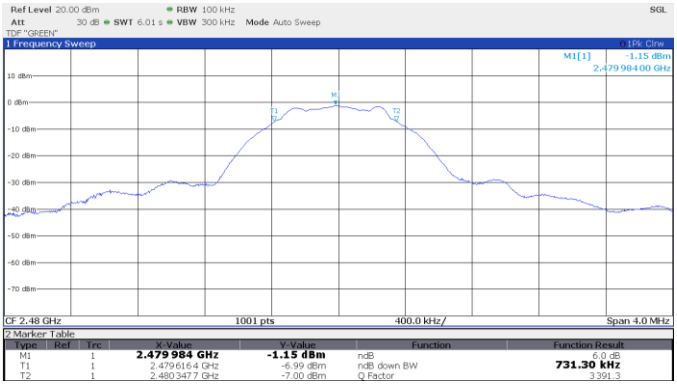

Figure 8.3-3: *6 dB DTS bandwidth, 2480 MHz*

8.4 Transmitter output power and EIRP requirements

8.4.1 References and limits

- FCC 47 CFR Part 15, Subpart B: §15.247(b)(3)
- RSS-247: §5.4(d)
- Test method: 558074 D01 DTS Measurement Guidance §8.3.1.1 and ANSI C63.10 §11.9.1.1 (RBW ≥ DTS bandwidth)

§15.247:

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

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

RSS-247:

5.4 Devices shall comply with the following requirements, where applicable:

(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 EIRP shall not exceed 4 W, except as provided in RSS 247 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.

8.4.2 Test summary

Verdict	Pass		
Test date	January 26, 2022	Temperature	21 °C
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1013 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	44 %

8.4.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested. EIRP = conducted power + declared antenna gain.

8.4.4 Setup details

EUT power input during test	3.7 V DC
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

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

8.4.5 Test data

Table 8.4-1: *Transmitter output power and EIRP test data*

Test frequency (MHz)	Peak conducted output power (dBm)	Conducted limit (dBm)	Antenna Gain (declared) (dBi)	EIRP (dBm)	EIRP limit (dBm)
2402	1.74	30.0	0.0	1.74	36.0
2440	0.74	30.0	0.0	0.74	36.0
2480	0.25	30.0	0.0	0.25	36.0

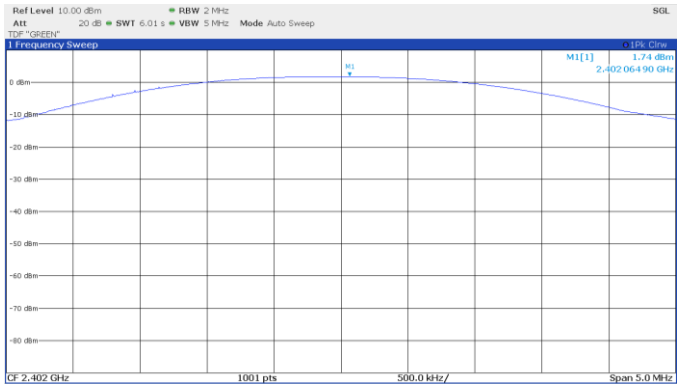

Figure 8.4-1: *Conducted output power, 2402 MHz*

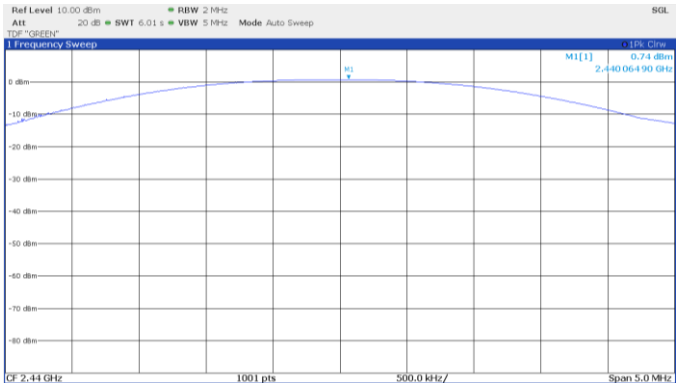

Figure 8.4-2: *Conducted output power, 2440 MHz*

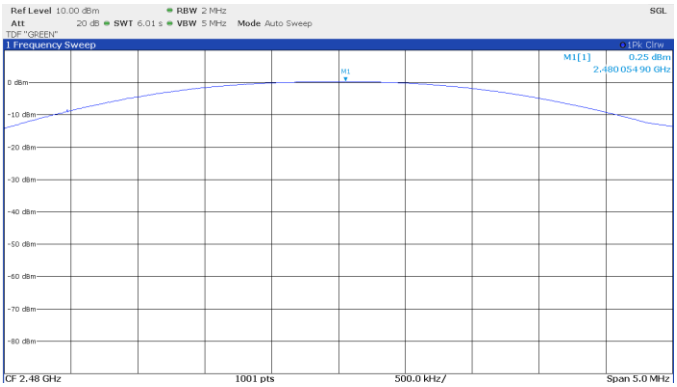

Figure 8.4-3: *Conducted output power, 2480 MHz*

8.5 Spurious emissions

8.5.1 References and limits

- FCC 47 CFR Part 15, Subpart B: §15.247(d)
- RSS-247: §5.5
- Test method: ANSI C63.10-2014 §6.10.4 (authorized band edge)
- Test method: ANSI C63.10-2014 §6.7 (antenna port conducted spurious emissions)
- Test method: ANSI C63.10-2014 §11.13 (radiated restricted band edge)
- Test method: ANSI C63.10-2014 §6.5, 6.6 (radiated emissions in restricted bands)

§15.247:

(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:

5.4 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 8.5-1: *FCC §15.209– Radiated emission limits*

Frequency, MHz	Field strength of emissions **µV/m**	**dBµV/m**	Measurement distance, 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 8.5-2: *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			

8.5.2 Test summary

Verdict	Pass		
Test date	January 26, 2022 (antenna port conducted) March 11, 2022 (radiated tests)	Temperature	21 °C (conducted) 20 °C (radiated)
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1013 mbar (conducted) 1012 mbar (radiated)
Test location	☒ Wireless bench ☐ 10 m semi-anechoic chamber ☒ 3 m semi-anechoic chamber ☐ Other:	Relative humidity	44 % (conducted) 54 % (radiated

8.5.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested. The spectrum was searched from 30 MHz to 26 GHz (above the 10th harmonic of the highest transmit frequency).

For radiated measurements, the EUT was investigated to identify the worst case orientation with respect to the fundamental transmitter power. All measurements were performed with the EUT in that worst-case orientation. In the frequency range 18 – 26 GHz, low, middle, and high channels were evaluated and there were no detectable emissions attributable to the EUT. Only the worst case (middle channel) is reported here.

8.5.4 Setup details

EUT power input during test	120 VAC / 60 Hz (via USB power adaptor) – radiated tests 3.7 V DC – antenna port conducted tests
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Spectrum analyzer settings (conducted emissions):

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

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)

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

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (preview measurements) Peak and average (final measurements)

8.5.5 Test data

Authorized band edge conducted emissions

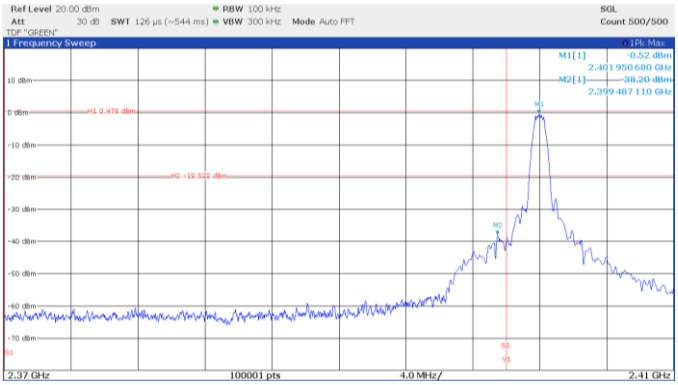

Figure 8.5-1: *Authorized band edge emissions, 2402 MHz*

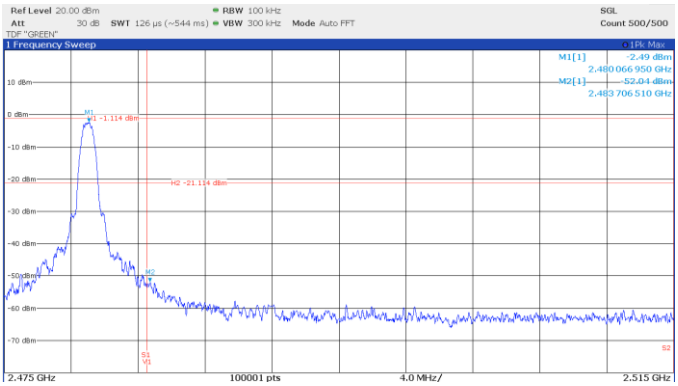

Figure 8.5-2: *Authorized band edge emissions, 2440 MHz*

Antenna port conducted spurious emissions

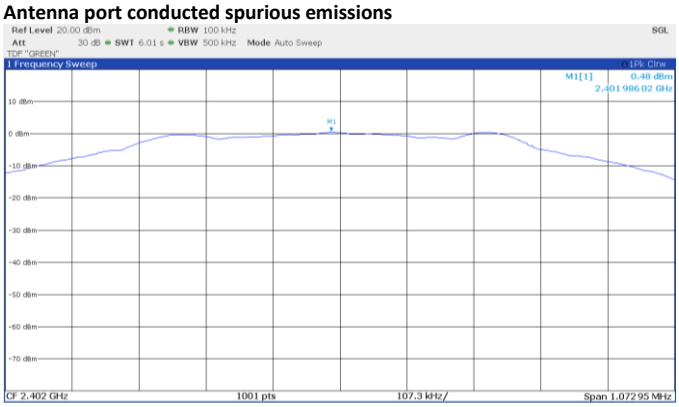

Figure 8.5-3: *Conducted power spectral density reference level, 2402 MHz*

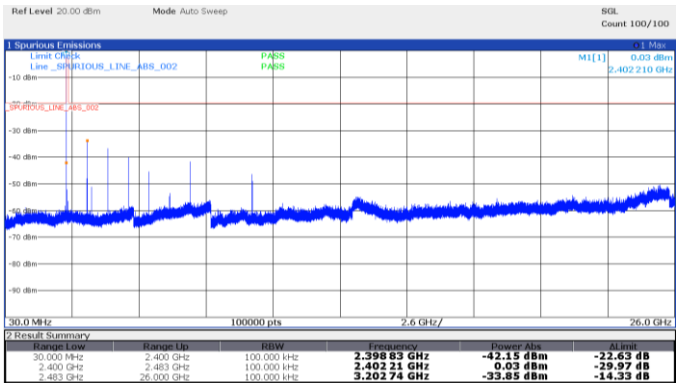

Figure 8.5-4: *Antenna port conducted spurious emissions, 2402 MHz*

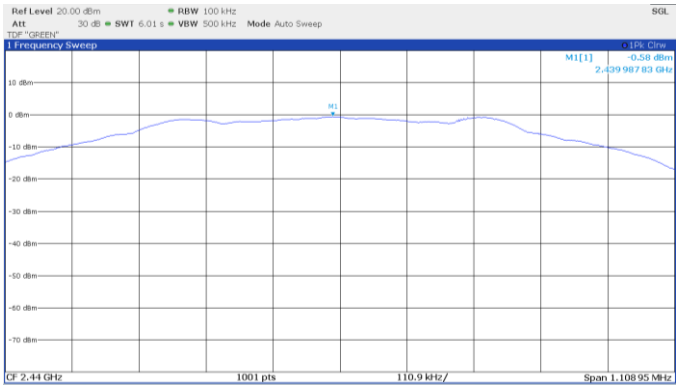

Figure 8.5-5: *Conducted power spectral density reference level, 2440 MHz*

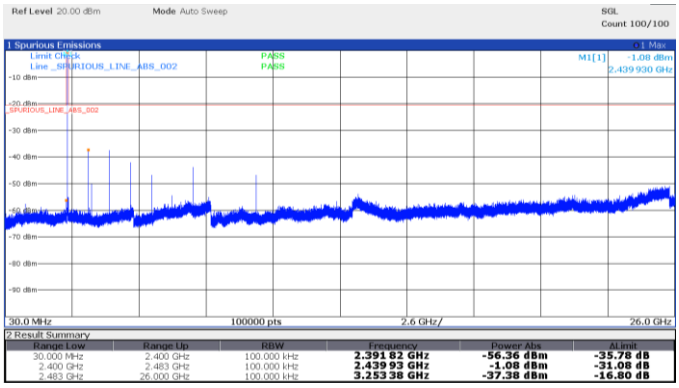

Figure 8.5-6: *Antenna port conducted spurious emissions, 2440 MHz*

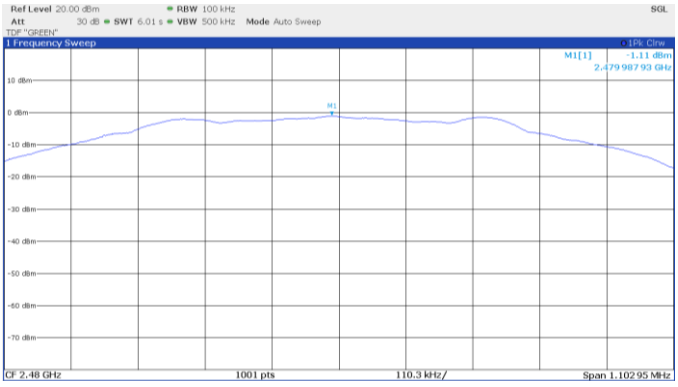

Figure 8.5-7: *Conducted power spectral density reference level, 2480 MHz*

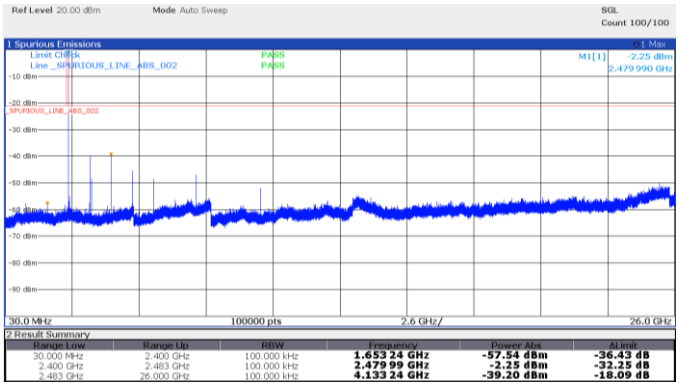

Figure 8.5-8: *Antenna port conducted spurious emissions, 2480 MHz*

Radiated restricted band edge emissions

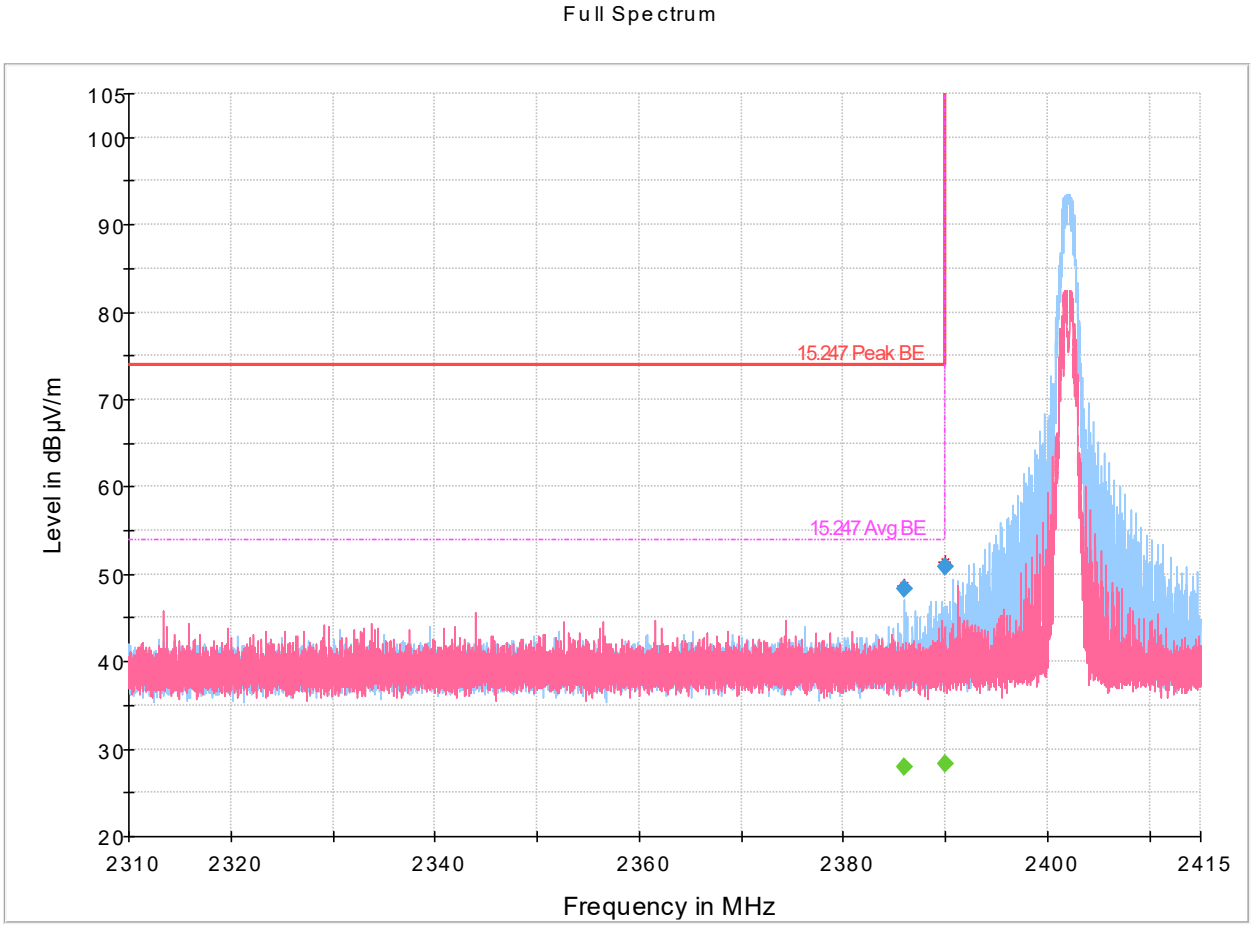

Figure 8.5-9: *Radiated emissions spectral plot (2.31 GHz - 2.415 GHz), restricted band edge - low*

Table 8.5-2*: Radiated emissions results, restricted band edge - low*

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)
2385.950000	---	28.02	53.90	25.88	5000.0	1000.000	114.0	H	132.0	-5.6
2385.950000	48.30	---	73.90	25.60	5000.0	1000.000	114.0	H	132.0	-5.6
2390.000000	---	28.21	53.90	25.69	5000.0	1000.000	144.0	V	120.0	-5.6
2390.000000	50.81	---	73.90	23.09	5000.0	1000.000	144.0	V	120.0	-5.6

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

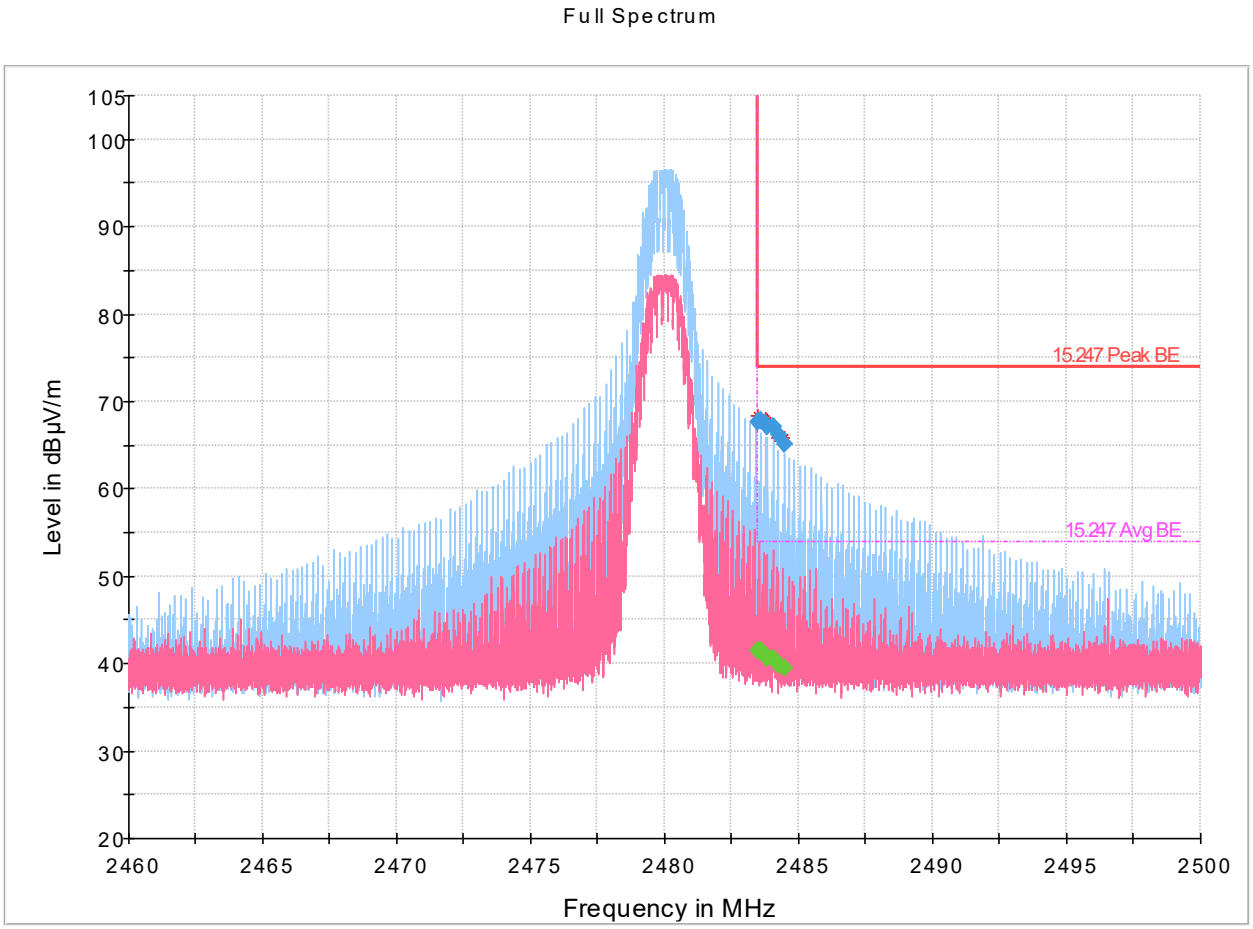

Figure 8.5-10: *Radiated emissions spectral plot (2.46 GHz - 2.5 GHz), restricted band edge - high*

Table 8.5-3*: Radiated emissions results, restricted band edge - high*

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	---	41.56	53.90	12.34	5000.0	1000.000	108.0	H	158.0	-5.4
2483.500000	67.67	---	73.90	6.23	5000.0	1000.000	108.0	H	158.0	-5.4
2483.586667	---	41.47	53.90	12.43	5000.0	1000.000	108.0	H	161.0	-5.4
2483.586667	67.77	---	73.90	6.13	5000.0	1000.000	108.0	H	161.0	-5.4
2483.788000	---	40.97	53.90	12.93	5000.0	1000.000	108.0	H	154.0	-5.4
2483.788000	67.54	---	73.90	6.36	5000.0	1000.000	108.0	H	154.0	-5.4
2483.850667	---	40.51	53.90	13.39	5000.0	1000.000	108.0	H	156.0	-5.4
2483.850667	67.11	---	73.90	6.79	5000.0	1000.000	108.0	H	156.0	-5.4
2484.052000	---	40.62	53.90	13.28	5000.0	1000.000	107.0	H	151.0	-5.4
2484.052000	67.14	---	73.90	6.76	5000.0	1000.000	107.0	H	151.0	-5.4
2484.252000	---	39.80	53.90	14.10	5000.0	1000.000	107.0	H	162.0	-5.4
2484.252000	66.12	---	73.90	7.78	5000.0	1000.000	107.0	H	162.0	-5.4
2484.450667	---	39.41	53.90	14.49	5000.0	1000.000	107.0	H	158.0	-5.4
2484.450667	65.08	---	73.90	8.82	5000.0	1000.000	107.0	H	158.0	-5.4

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Radiated emissions in restricted bands

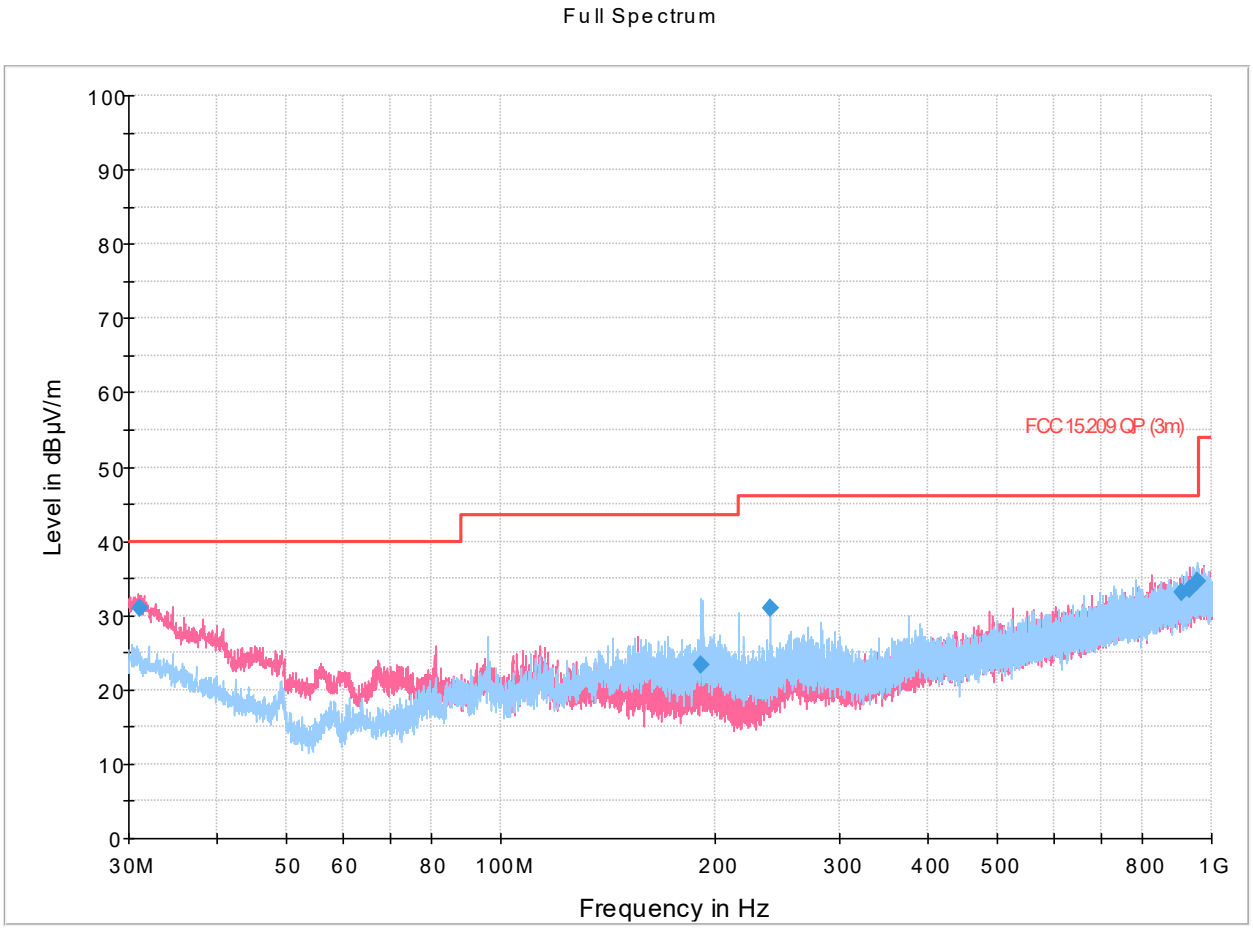

Figure 8.5-11: *Radiated emissions spectral plot (30 MHz - 1 GHz), 2402 MHz*

Table 8.5-4*: Radiated emissions results, 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)
31.070000	30.90	40.00	9.10	5000.0	120.000	109.0	V	250.0	25.9
191.303000	23.42	43.50	20.08	5000.0	120.000	165.0	H	96.0	17.3
239.977333	31.02	46.00	14.98	5000.0	120.000	109.0	H	300.0	19.9
908.021333	33.05	46.00	12.95	5000.0	120.000	198.0	H	144.0	33.3
932.276667	33.65	46.00	12.35	5000.0	120.000	280.0	V	69.0	33.8
956.363333	34.53	46.00	11.47	5000.0	120.000	381.0	H	22.0	34.7

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

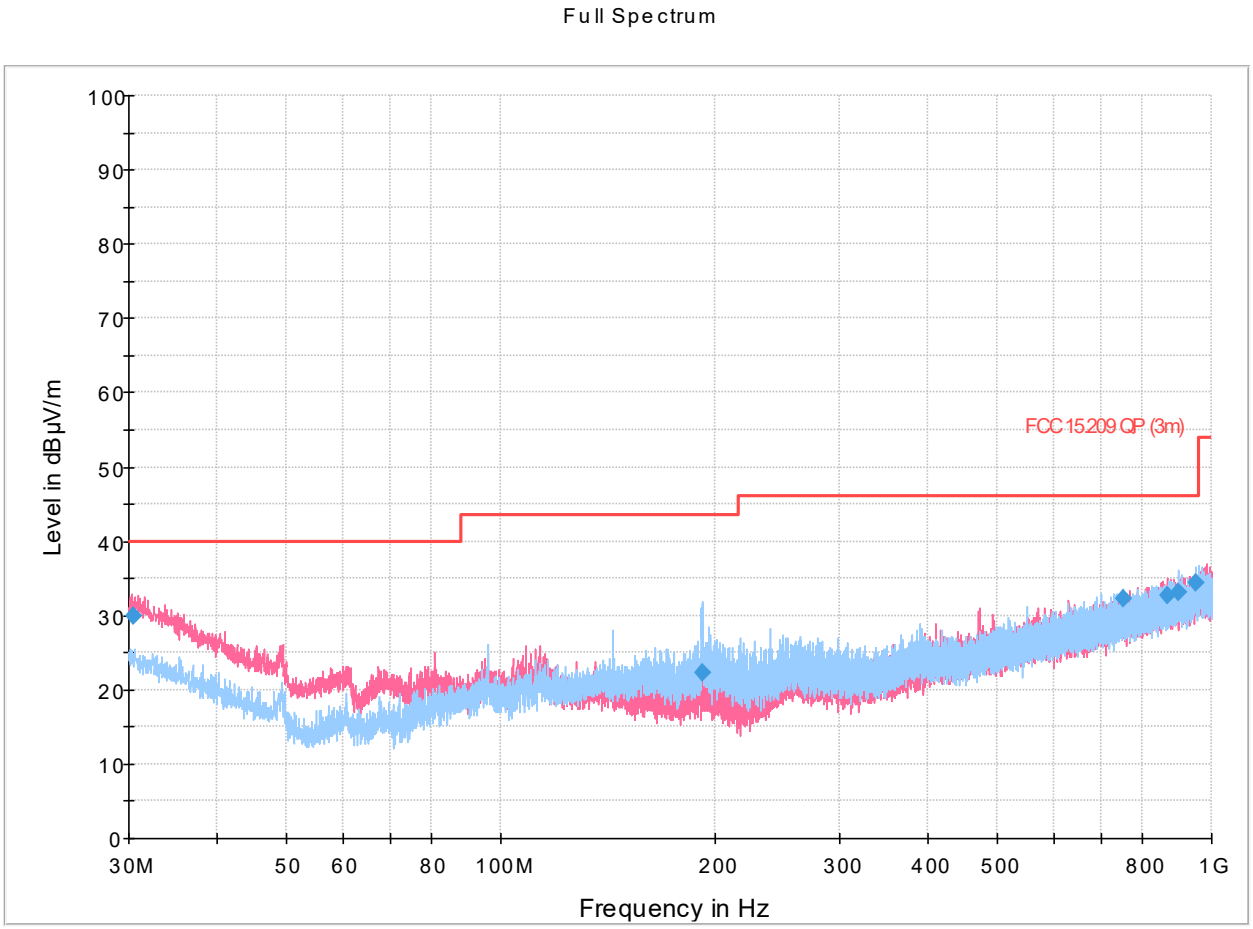

Figure 8.5-12: *Radiated emissions spectral plot (30 MHz - 1 GHz), 2440 MHz*

Table 8.5-5*: Radiated emissions results, 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)
30.500000	29.94	40.00	10.06	5000.0	120.000	118.0	V	179.0	26.3
192.676333	22.20	43.50	21.30	5000.0	120.000	298.0	H	70.0	17.3
750.018667	32.34	46.00	13.66	5000.0	120.000	100.0	H	299.0	31.5
865.132000	32.65	46.00	13.35	5000.0	120.000	304.0	V	222.0	33.0
897.312333	33.03	46.00	12.97	5000.0	120.000	245.0	H	23.0	33.2
950.316000	34.40	46.00	11.60	5000.0	120.000	109.0	H	39.0	34.6

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

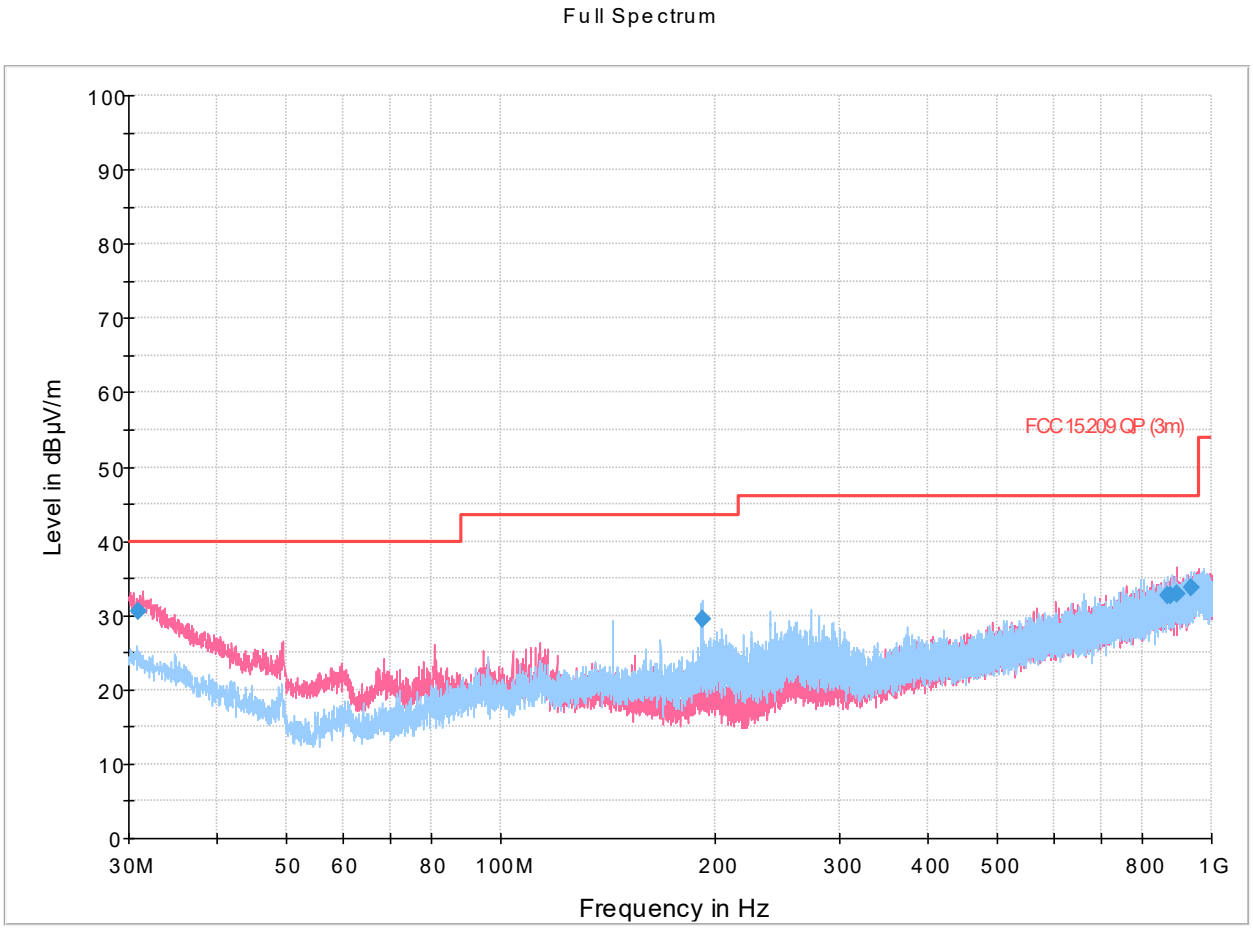

Figure 8.5-13: *Radiated emissions spectral plot (30 MHz - 1 GHz), 2480 MHz*

Table 8.5-6*: Radiated emissions results, 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)
30.858000	30.55	40.00	9.45	5000.0	120.000	100.0	V	135.0	26.1
192.025333	29.48	43.50	14.02	5000.0	120.000	109.0	H	258.0	17.3
866.671333	32.79	46.00	13.21	5000.0	120.000	388.0	H	70.0	33.1
877.854333	32.63	46.00	13.37	5000.0	120.000	151.0	H	101.0	32.9
895.901667	32.93	46.00	13.07	5000.0	120.000	387.0	V	224.0	33.2
935.164333	33.78	46.00	12.22	5000.0	120.000	118.0	H	11.0	34.0

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

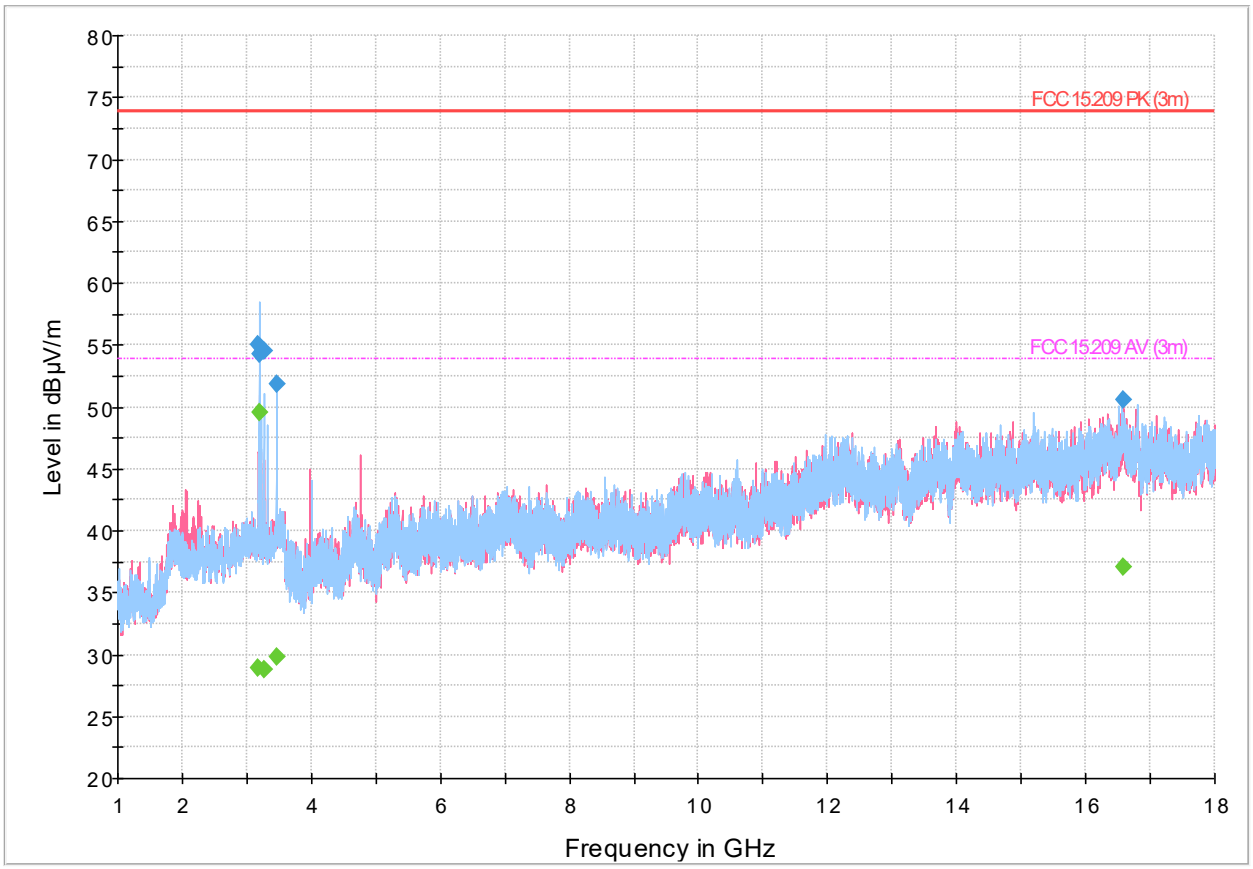

Figure 8.5-14: *Radiated emissions spectral plot (1 GHz - 18 GHz)*

Table 8.5-7*: Radiated emissions results*

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)
3185.400000	55.04	---	73.90	18.86	5000.0	1000.000	124.0	H	125.0	-3.5
3185.400000	---	28.98	53.90	24.92	5000.0	1000.000	124.0	H	125.0	-3.5
3202.633333	---	49.49	53.90	4.41	5000.0	1000.000	141.0	H	113.0	-3.4
3202.633333	54.29	---	73.90	19.61	5000.0	1000.000	141.0	H	113.0	-3.4
3260.600000	54.54	---	73.90	19.36	5000.0	1000.000	135.0	H	78.0	-3.1
3260.600000	---	28.81	53.90	25.09	5000.0	1000.000	135.0	H	78.0	-3.1
3455.366667	---	29.77	53.90	24.13	5000.0	1000.000	113.0	H	158.0	-2.6
3455.366667	51.86	---	73.90	22.04	5000.0	1000.000	113.0	H	158.0	-2.6
16585.100000	---	37.07	53.90	16.83	5000.0	1000.000	343.0	V	326.0	21.0
16585.100000	50.53	---	73.90	23.37	5000.0	1000.000	343.0	V	326.0	21.0

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.
A notch filter at 2.4 GHz was used to reduce the level of the fundamental emission and avoid overloading the receiver.

Full Spectrum

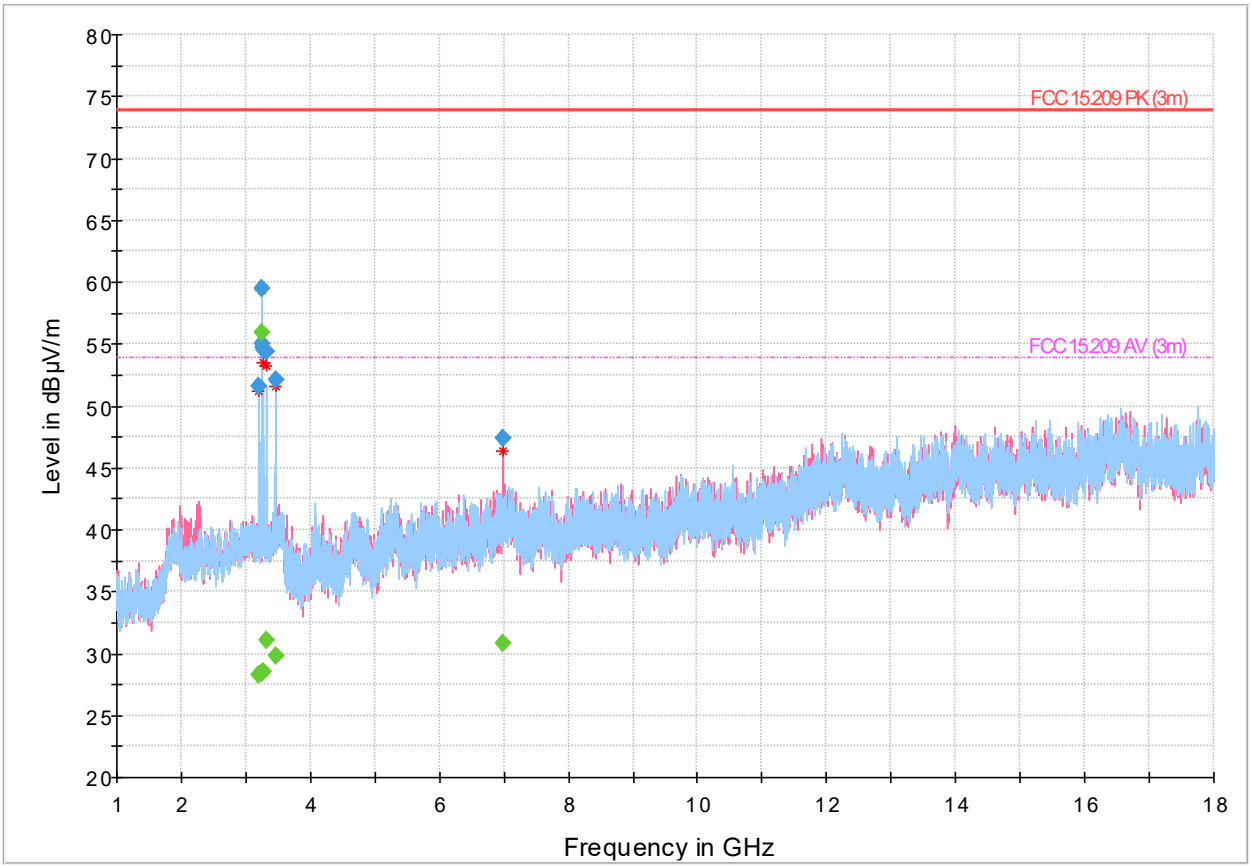

Figure 8.5-15: *Radiated emissions spectral plot (1 GHz - 18 GHz)*

Table 8.5-8*: Radiated emissions results*

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)
3194.700000	---	28.24	53.90	25.66	5000.0	1000.000	147.0	H	68.0	-3.4
3194.700000	51.54	---	73.90	22.36	5000.0	1000.000	147.0	H	68.0	-3.4
3244.966667	---	28.36	53.90	25.54	5000.0	1000.000	139.0	H	80.0	-3.1
3244.966667	54.98	---	73.90	18.92	5000.0	1000.000	139.0	H	80.0	-3.1
3253.466667	**---**	**55.88**	**53.90**	**-1.98**	**5000.0**	**1000.000**	**144.0**	**H**	**77.0**	**-3.1**
3253.466667	59.55	---	73.90	14.35	5000.0	1000.000	144.0	H	77.0	-3.1
3260.266667	54.48	---	73.90	19.42	5000.0	1000.000	141.0	H	124.0	-3.1
3260.266667	---	28.55	53.90	25.35	5000.0	1000.000	141.0	H	124.0	-3.1
3329.000000	---	31.02	53.90	22.88	5000.0	1000.000	145.0	H	159.0	-3.1
3329.000000	54.33	---	73.90	19.57	5000.0	1000.000	145.0	H	159.0	-3.1
3455.366667	52.13	---	73.90	21.77	5000.0	1000.000	151.0	H	154.0	-2.6
3455.366667	---	29.80	53.90	24.10	5000.0	1000.000	151.0	H	154.0	-2.6
6994.433333	---	30.82	53.90	23.08	5000.0	1000.000	140.0	V	0.0	4.0
6994.433333	47.37	---	73.90	26.53	5000.0	1000.000	140.0	V	0.0	4.0

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.
A notch filter at 2.4 GHz was used to reduce the level of the fundamental emission and avoid overloading the receiver.

Emission at 3253.46667 MHz does not meet the average limit. However, it is neither a harmonic of the fundamental frequency nor in a 15.205 restricted band. This emission does comply with the 20 dB down requirement in antenna port conducted spurious emissions measurements above.

Full Spectrum

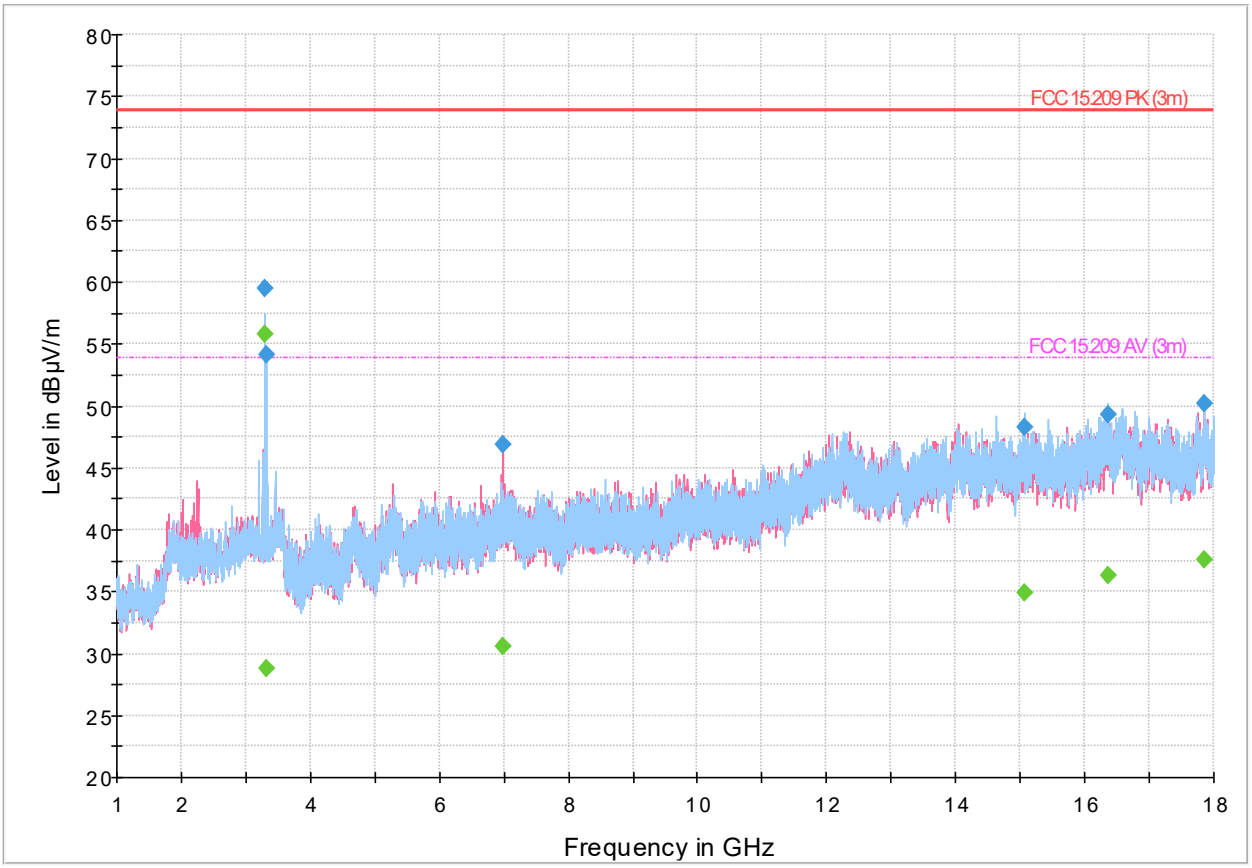

Figure 8.5-16: *Radiated emissions spectral plot (1 GHz - 18 GHz)*

Table 8.5-9*: Radiated emissions results*

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)
3306.733333	59.47	---	73.90	14.43	5000.0	1000.000	138.0	H	136.0	-3.3
3306.733333	**---**	**55.77**	**53.90**	**-1.87***	**5000.0**	**1000.000**	**138.0**	**H**	**136.0**	**-3.3**
3332.466667	---	28.74	53.90	25.16	5000.0	1000.000	135.0	H	136.0	-3.0
3332.466667	54.16	---	73.90	19.74	5000.0	1000.000	135.0	H	136.0	-3.0
6990.333333	46.83	---	73.90	27.07	5000.0	1000.000	137.0	V	355.0	3.9
6990.333333	---	30.60	53.90	23.30	5000.0	1000.000	137.0	V	355.0	3.9
15077.433333	48.34	---	73.90	25.56	5000.0	1000.000	399.0	H	43.0	16.5
15077.433333	---	34.91	53.90	18.99	5000.0	1000.000	399.0	H	43.0	16.5
16367.866667	---	36.28	53.90	17.62	5000.0	1000.000	202.0	H	333.0	20.3
16367.866667	49.32	---	73.90	24.58	5000.0	1000.000	202.0	H	333.0	20.3
17857.000000	50.25	---	73.90	23.65	5000.0	1000.000	274.0	V	353.0	21.3
17857.000000	---	37.58	53.90	16.32	5000.0	1000.000	274.0	V	353.0	21.3

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.
A notch filter at 2.4 GHz was used to reduce the level of the fundamental emission and avoid overloading the receiver.

***Emission at 3306.733333 MHz does not meet the average limit. However, it is neither a harmonic of the fundamental frequency nor in a 15.205 restricted band. This emission does comply with the 20 dB down requirement in antenna port conducted spurious emissions measurements above.**

Full Spectrum

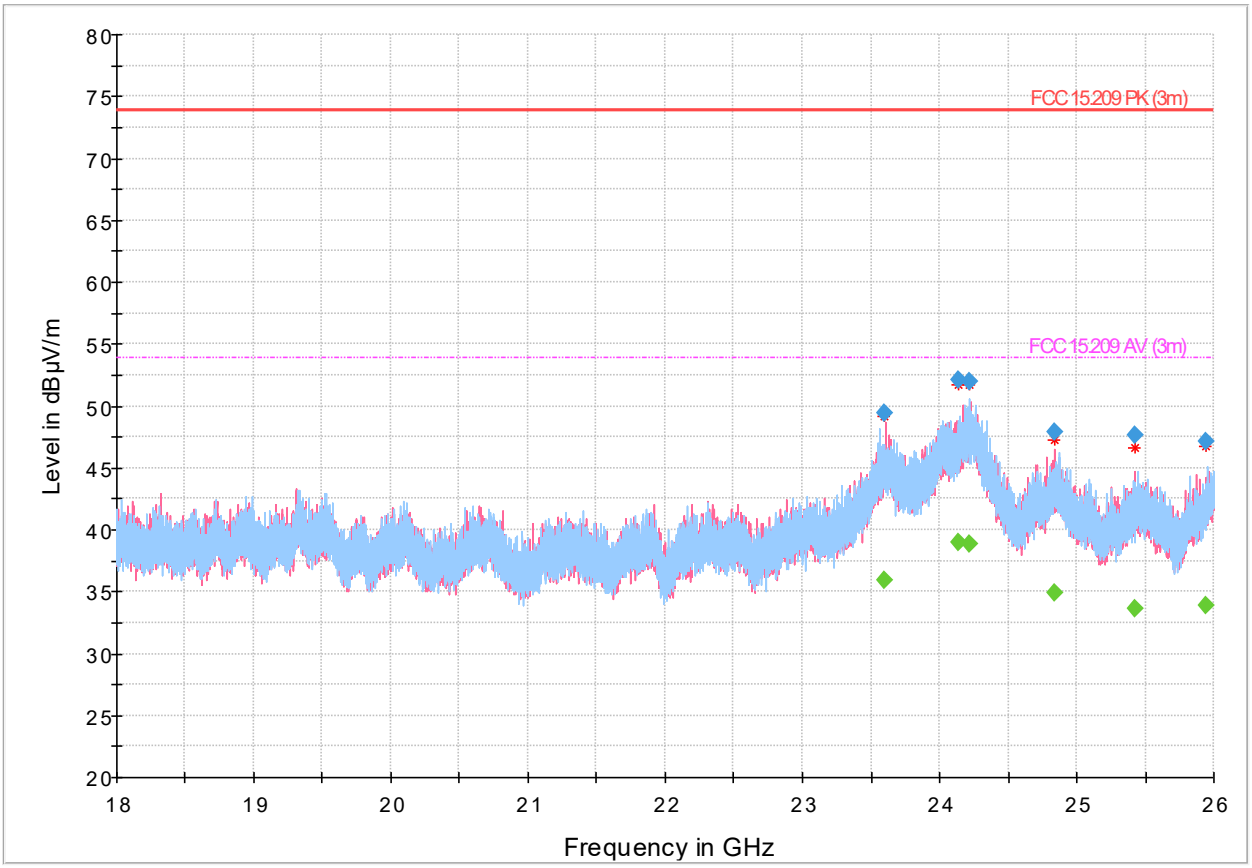

Figure 8.5-17: *Radiated emissions spectral plot (18 GHz - 26 GHz)*

Table 8.5-10*: Radiated emissions results*

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)
23601.433333	49.45	---	73.90	24.45	5000.0	1000.000	318.0	V	56.0	25.8
23601.433333	---	35.95	53.90	17.95	5000.0	1000.000	318.0	V	56.0	25.8
24140.766667	---	38.93	53.90	14.97	5000.0	1000.000	217.0	H	86.0	29.4
24140.766667	52.16	---	73.90	21.74	5000.0	1000.000	217.0	H	86.0	29.4
24219.833333	---	38.90	53.90	15.00	5000.0	1000.000	186.0	H	286.0	29.1
24219.833333	52.01	---	73.90	21.89	5000.0	1000.000	186.0	H	286.0	29.1
24843.566667	---	34.93	53.90	18.97	5000.0	1000.000	402.0	V	0.0	24.7
24843.566667	47.85	---	73.90	26.05	5000.0	1000.000	402.0	V	0.0	24.7
25430.900000	47.70	---	73.90	26.20	5000.0	1000.000	312.0	V	218.0	23.9
25430.900000	---	33.64	53.90	20.26	5000.0	1000.000	312.0	V	218.0	23.9
25947.500000	---	33.93	53.90	19.97	5000.0	1000.000	356.0	H	160.0	25.1
25947.500000	47.10	---	73.90	26.80	5000.0	1000.000	356.0	H	160.0	25.1

Notes: [1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

8.6 Power spectral density

8.6.1 References and limits

- FCC 47 CFR Part 15, Subpart B: §15.247(e)
- RSS-247: §5.2(b)
- Test method: ANSI C63.10 §11.10.2.1 (Method PKPSD)

§15.247:
(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:
5.4 DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400-2483.5 MHz:
(b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e., the power spectral density shall be determined using the same method as is used to determine the conducted output power).

8.6.2 Test summary

Verdict	Pass		
Test date	January 26, 2022	Temperature	21 °C
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1013 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	44 %

8.6.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested.

8.6.4 Setup details

EUT power input during test	3.7 V DC
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Spectrum analyzer settings:

Resolution bandwidth	3 kHz
Video bandwidth	10 kHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.6.5 Test data

Table 8.6-1: *Power spectral density test data*

Test frequency (MHz)	Measured power spectral density (dBm/3kHz)	Limit (dBm/3kHz)
2402	-12.28	30.0
2440	-12.72	30.0
2480	-12.80	30.0

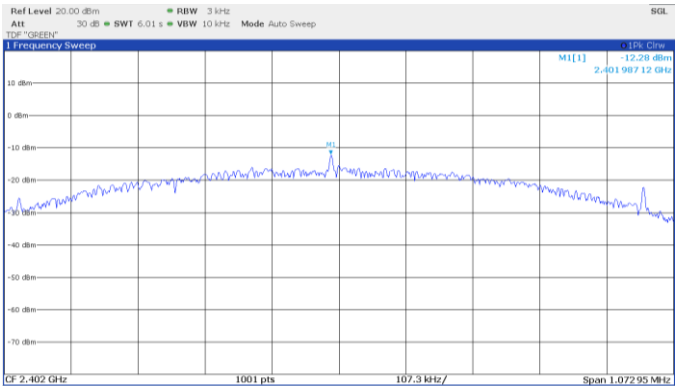

Figure 8.6-1: *Power spectral density, 2402 MHz*

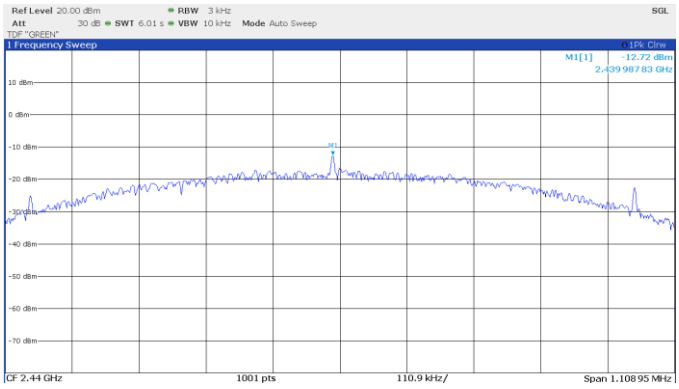

Figure 8.6-2: *Power spectral density, 2440 MHz*

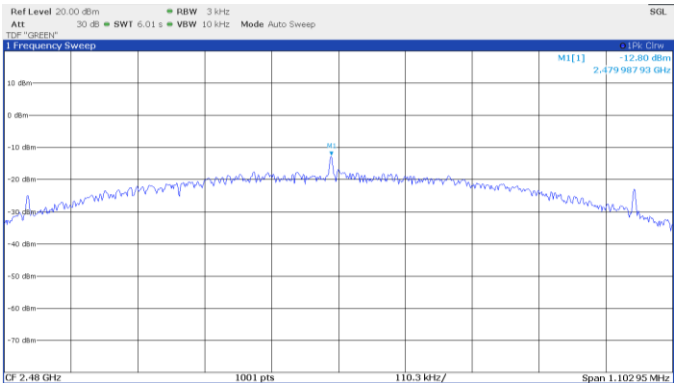

Figure 8.6-3: *Power spectral density, 2480 MHz*

8.7 99 % occupied bandwidth

8.7.1 References and limits

- RSS-Gen: §6.7
- Test method: ANSI C63.4-2014: §6.9.2

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.

8.7.2 Test summary

Verdict	Pass		
Test date	January 26, 2022	Temperature	21 °C
Test engineer	James Cunningham, EMC/MIL/WL Supervisor	Air pressure	1013 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	44 %

8.7.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested.

8.7.4 Setup details

EUT power input during test	3.7 v DC
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

Resolution bandwidth	20 kHz
Video bandwidth	100 kHz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.7.5 Test data

Table 8.7-1: *99 % occupied bandwidth test data*

Test frequency (MHz)	Bandwidth (MHz)	Measured f_c (MHz)	Measured f_L (MHz)	Measured f_H (MHz)	Limit
2402	1.057	2401.984	2401.467	2402.524	f_H and f_L within 2400 – 2483.5 MHz
2440	1.058	2439.984	2439.469	2440.527	f_H and f_L within 2400 – 2483.5 MHz
2480	1.058	2479.984	2479.470	2480.528	f_H and f_L within 2400 – 2483.5 MHz

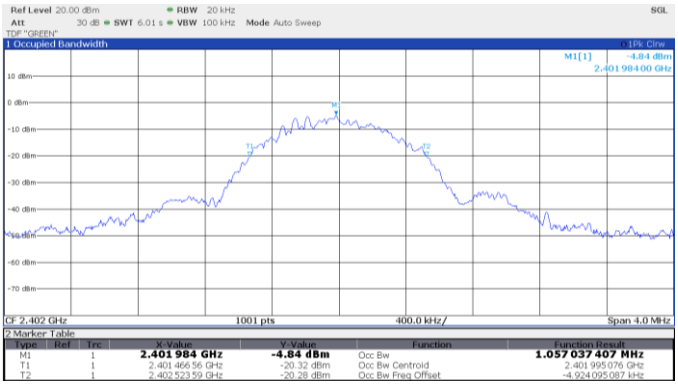

Figure 8.7-1: *99 % occupied bandwidth, 2402 MHz*

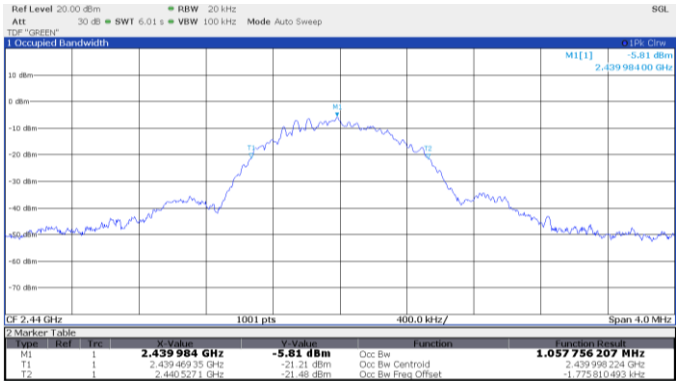

Figure 8.7-2: *99 % occupied bandwidth, 2440 MHz*

Figure 8.7-3: *99 % occupied bandwidth, 2480 MHz*

Section 9 Block diagrams of test setup

9.1 Radiated emission setup

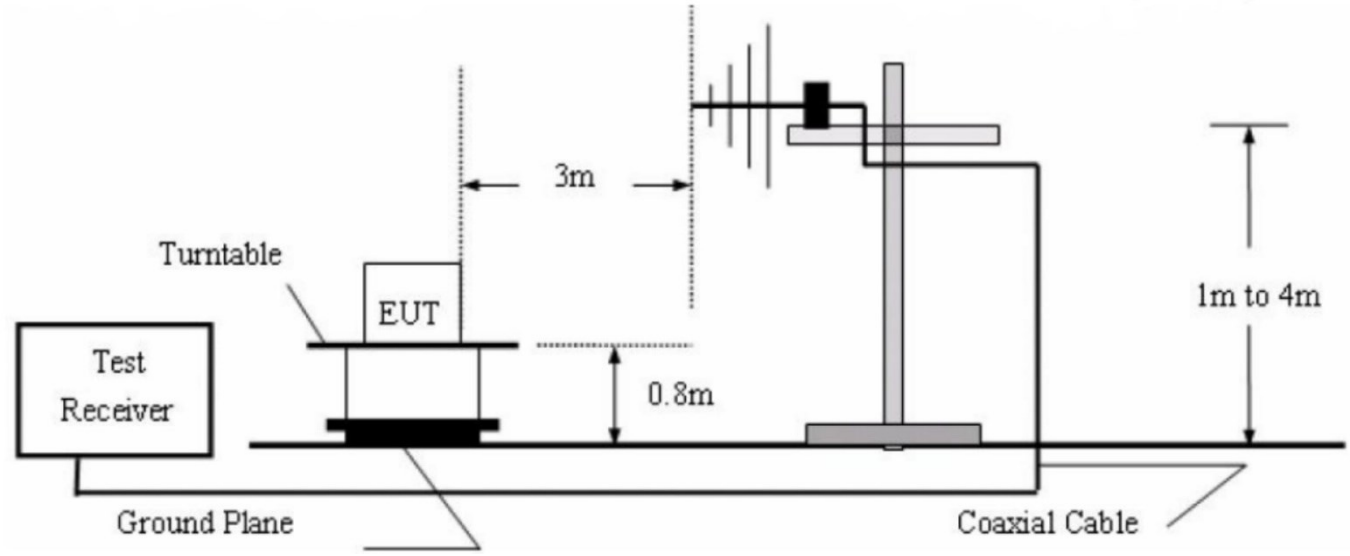

Figure 9.1-1: *Radiated emissions < 1 GHz*

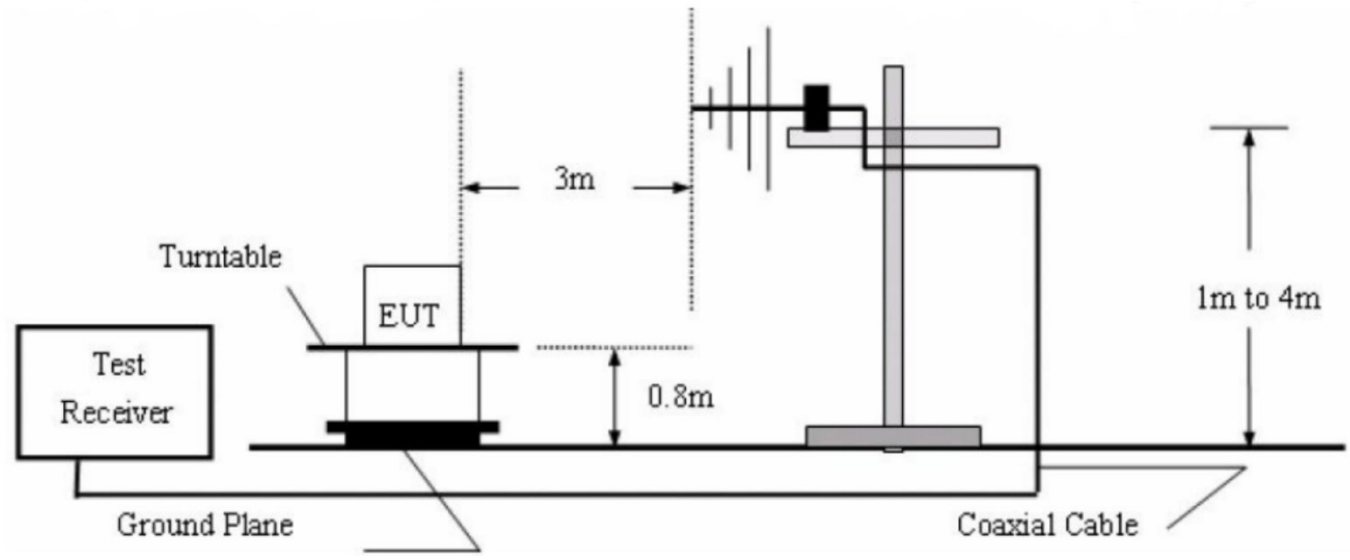

Figure 9.1-2: *Radiated emissions > 1 GHz*

9.2 AC conducted emissions test setup

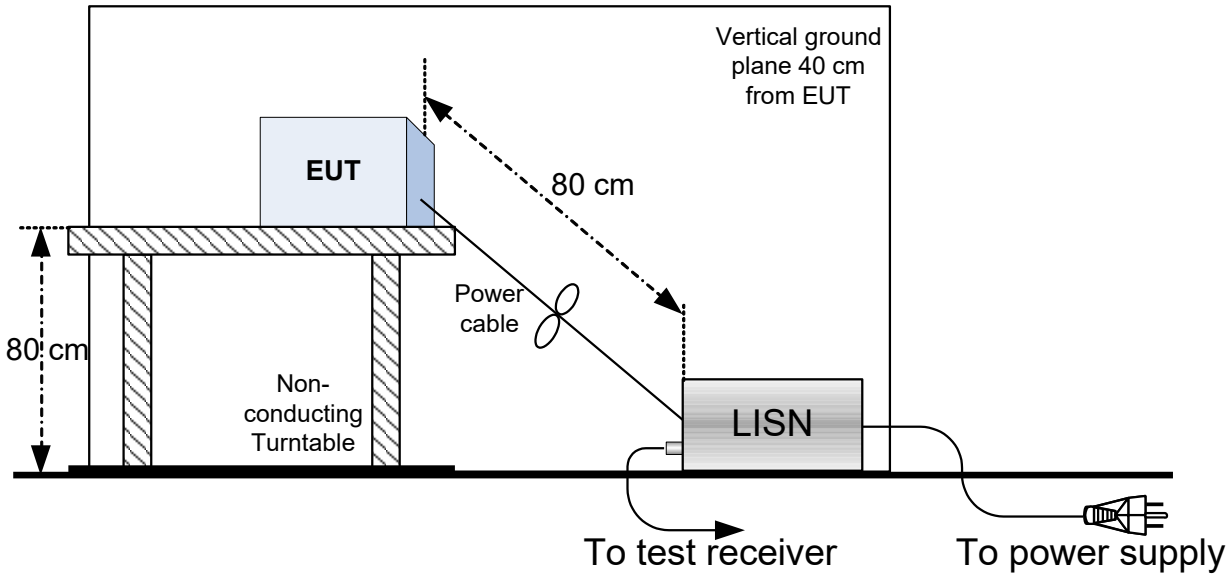

Figure 9.2-1: *AC conducted emissions setup*

End of test report