



Test report

360200 - 1TRFWL

Date of issue: October 30, 2018

Applicant: Culligan International Company

Product: ClearLink Pro

EUT Model: CulRF-M5

Host Models: ClearLink Pro (Includes ClearLink D + ClearLink PB + ClearLink D-WiFi)

FCC ID: V7U-010330CL IC Registration number: 6510B-010330CL

Specifications:

FCC 47 CFR Part 15.249

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.

RSS-210 Issue 9, August 2016 Annex B.10

License-Exempt Radio Apparatus: Category 1 Equipment

Test location

Company name	Nemko USA, Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
Province	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com

Tested by Andre Martinez, Wireless Test Engineer.

Reviewed by Chip Fleury

Date October 30, 2018

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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Culligan International Company
Address	9399 West Higgins Road Suite 100
City	Rosemont
Province/State	IL
Postal/Zip code	60018
Country	United States

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.249 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.
RSS-210 Issue 9, August 2016, Annex B.10 Devices operating in 902–928, 2400–2483.5 and 5725–5875 MHz

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed 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.

1.4 Exclusions

None

1.5 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Not applicable ¹
§15.203	Antenna requirement	Not applicable ²
§15.215(c)	20 dB bandwidth	Pass

Notes: ¹ Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

² The Antennas are located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.249(a)	Radiated emissions not in restricted bands	Pass
§15.249(b)	Fixed Point-to-Point operation in the 24.0–24.25 GHz band	Not applicable
§15.249(d)	Spurious emissions (except harmonics)	Pass

Notes: None

2.3 IC RSS-GEN, Issue 4, test results

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

Notes: ¹ According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 IC RSS-210, Issue 9, test results

Part	Test description	Verdict
§B.10(a)	Field strength: Fundamental and Harmonics	Pass
§B.10(b)	Radiated emissions except Harmonic emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	September 30, 2018
Nemko sample ID number	360200

3.2 EUT information

Product name	Wireless Filtration Control System
Model (Module)	CulRF-M5
Host Models	ClearLink D, ClearLink PB, ClearLink D-WiFi
Serial number	N/A

3.3 Technical information

Operating band	FHSS & Wi-Fi
Operating frequencies	2.463GHz
Occupied bandwidth (99 %)	2014.0 kHz
Power requirements	5V, 1A and 3 VDC (Batteries)
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The Module CulRF-M5 is installed in the following hosts. Clearlink D and Clearlink PB and Clearlink D-WiFi. The WiFi module in the Clearlink D-WiFi is a pre-approved b/g/n radio (D-Wi-Fi).

3.5 EUT exercise details

Full Testing of one model (Model Clearlink D-Wi-Fi) and limited verification in 2 models (Clearlink D and Clearlink PB). EUT was set to fixed channel test mode transmitting modulated signal at maximum power.

3.6 EUT setup diagram

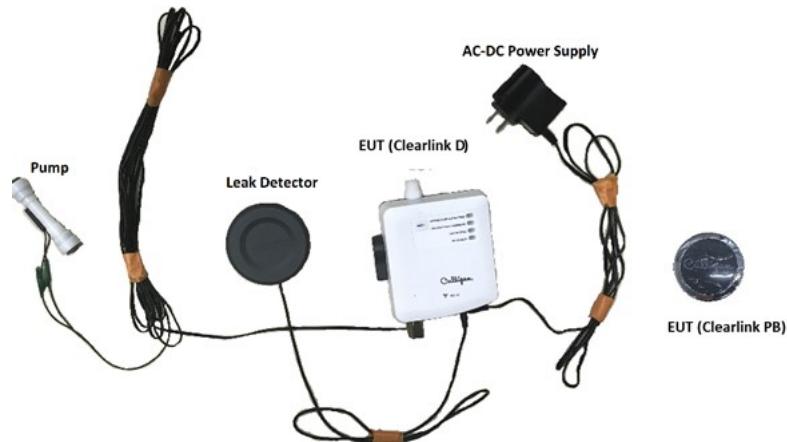


Figure 3.6-1: Setup diagram

3.7 EUT Support Equipment

Table 3.7-1: EUT Support Equipment

Description	Brand name	Model/Part number	Serial number
Router	Asus	RT-N66U	E4IA08020580
Cellphone	ZTE	N/A	N/A
Pump	Culligan	N/A	N/A
Leak Detector	Culligan	N/A	N/A
Push Button	Culligan	N/A	N/A

Cable description	From	To	Length (m)
DC Power cable	EUT	AC-DC Power Supply	1.5
DC Power and IO cable	EUT	Leak detector	0.90
DC Power and IO cable	EUT	Pump	5.00

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 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	860–1060 mbar

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 present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1121	1 yr.	7/28/2019
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 yr.	7/21/2019
Antenna, Horn	EMCO	3115	1033	1 yr.	7/27/2019
Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	1 yr.	7/27/2019
Signal Generator	Rohde & Schwarz	SMB 100A	E1128	1 yr.	9/13/2019
High-pass filter	Wainwright Instruments GMBH	WHKX12-2493-2770-18000-60SS	N/A	N/A	Verified with FSV40
Band reject filter	Wainwright Instruments GMBH	WRCGV10-2363.5-2400-2483.5-2520-60SS	N/A	N/A	Verified with FSV40
RF Power Sensor	ETS Lindgren	7002-006	E1061	1 yr.	04/16/2019
Temperature/humidity chamber	CSZ Inc.	ZPH-32-2-2-H/AC	S1179	1 yr.	03/21/2019

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator 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 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

IC:

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

Table 8.1-1: Conducted emissions limit

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

Note: * - The level decreases linearly with the logarithm of the frequency.

** - A linear average detector is required.

8.1.2 Test summary

Test date	October 9, 2018	Temperature	24 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	51 %

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

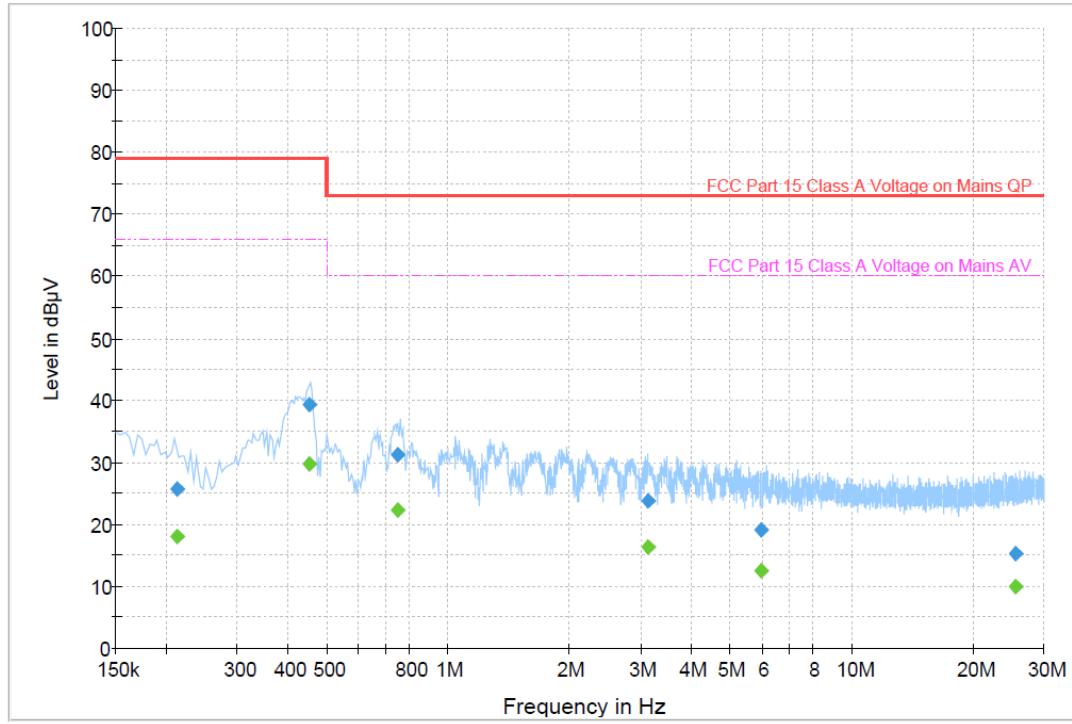
A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Test receiver settings:

Frequency span	150 kHz to 30 MHz
Detector mode	Peak and Average (preview mode); Quasi-Peak and Average (final measurements)
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold

Measurement time 1000 ms

8.1.4 Test data



Plot 8.1-1: Conducted emissions – Model D-Wi-Fi = 150KHz to 30MHz

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Corr. (dB)
0.212500	---	17.97	66.00	48.03	5000.0	9.000	ON	19.5
0.212500	25.65	---	79.00	53.35	5000.0	9.000	ON	19.5
0.452500	---	29.78	66.00	36.22	5000.0	9.000	ON	19.5
0.452500	39.19	---	79.00	39.81	5000.0	9.000	ON	19.5
0.748500	---	22.40	60.00	37.61	5000.0	9.000	ON	19.5
0.748500	31.30	---	73.00	41.70	5000.0	9.000	ON	19.5
3.136500	---	16.41	60.00	43.59	5000.0	9.000	ON	19.5
3.136500	23.71	---	73.00	49.29	5000.0	9.000	ON	19.5
5.956500	---	12.55	60.00	47.45	5000.0	9.000	ON	19.5
5.956500	19.02	---	73.00	53.98	5000.0	9.000	ON	19.5
25.416500	---	10.08	60.00	49.92	5000.0	9.000	ON	20.0
25.416500	15.37	---	73.00	57.63	5000.0	9.000	ON	20.0

Note: 39.19 dBμV = 19.69 dBμV (receiver reading) + 19.5 Corr dB (9.3 (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

Table 8.1-2: Quasi-Peak and Average conducted emissions results on both phase lines

Note: Graph represents elements from both L1 and L2

8.2 FCC 15.215(c) and RSS-Gen 6.7 Occupied (Emission) bandwidth

8.2.1 Definitions and limits

FCC

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. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

IC

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..

8.2.2 Test summary

Test date	October 9, 2018	Temperature	24 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	51 %

8.2.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	1 to 5% of Occupied Bandwidth
Video bandwidth	RBW × 3
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: 99% dB, 26 and 20 dB bandwidth results Clearlink D-Wi-Fi (the Clearlink D and Clearlink PB bandwidths were nearly identical!)

Fundamental frequency, MHz	99% bandwidth	26 dB bandwidth	20 dB bandwidth
2463	2014.0 kHz	2004.0 kHz	1559.2 kHz

Section 8
Test name
Specification

Testing data
 Occupied (Emission) bandwidth
 FCC 15 Subpart C and RSS-Gen Section 6.7



Figure 8.2-1: 99% bandwidth Clearlink Model D-Wi-Fi



Figure 8.2-2: 26 dB bandwidth Clearlink Model D-Wi-Fi



Figure 8.2-3: 20 dB bandwidth Clearlink Model D-Wi-Fi

8.3 FCC 15.249(a) RSS 210 B.10(a) and (b) Field strength of Fundamental, harmonics and spurious emissions

8.3.1 Definitions and limits

FCC:

The field strength of emissions from intentional radiators shall comply with the following table. Field strength limits are specified at 3 meters.

IC:

The field strength measured at 3 meters shall not exceed the limits in the following table.

Table 8.3-1: Field strength limits

Fundamental frequencies, MHz	Field strength of fundamental mV/m	Field strength of harmonics dB μ V/m	Field strength of harmonics μ V/m	Field strength of harmonics dB μ V/m
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24000–24250	250	108	2500	68

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

8.3.2 Test summary

Test date	October 10, 2018	Temperature	24 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	51 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 10th harmonic of fundamental frequency. Radiated measurements were performed at 3m.

Three orthogonal positions were evaluated during prescans and only the worst case position was used for final and formal testing.

Evaluation scans noted the Clearlink D with WiFi output power was the same or slightly higher than the Clearlink D and Clearlink PB so it was used for final formal results.

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Quasi-Peak
Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

Spectrum analyzer settings for average measurements at the frequencies above 1000 MHz:

Detector mode	Average
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

8.3.4 Test data

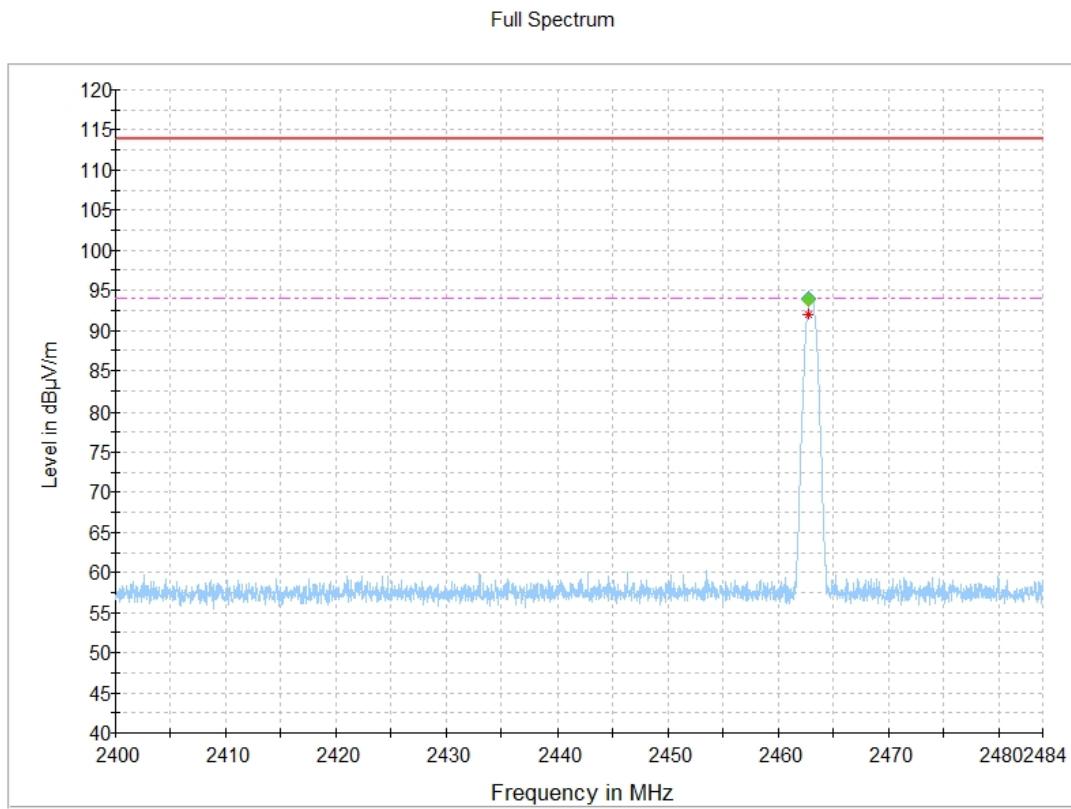


Figure 8.3-1: Field strength of Fundamental output power – Clearlink D-Wi-Fi

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)	Comment
2462.800000	---	93.81	93.97	0.16	5000.0	1000.000	132.0	H	263.0	10.7	
2462.800000	93.96	---	113.97	20.01	5000.0	1000.000	132.0	H	263.0	10.7	

Figure 8.3-2: Field strength of Fundamental output power – Clearlink D-Wi-Fi

Note: Three orientations were evaluated with pre-scans and the worst case was used for final testing. Clearlink D and Clearlink PB measured output power were = or < than the measured value above by no more than 1.5dB.

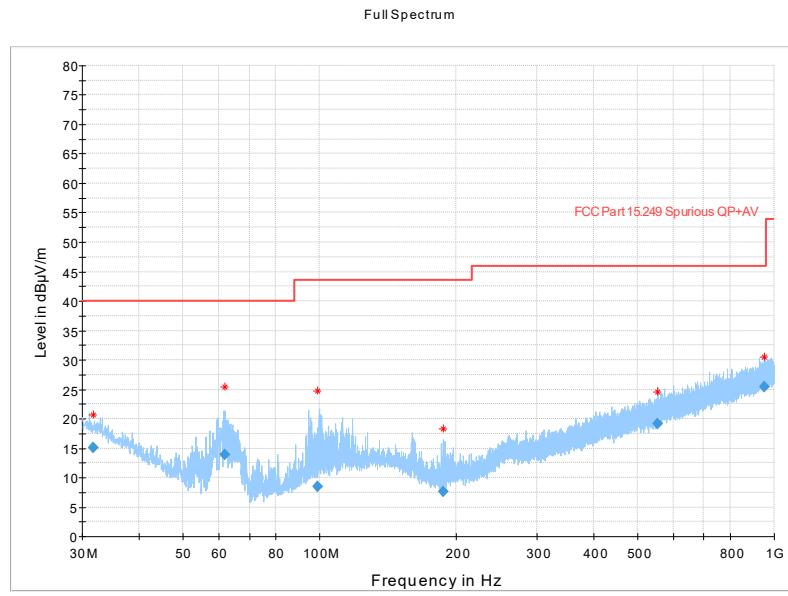


Figure 8.3-3: Field strength of spurious emissions 30MHz to 1GHz – Clearlink D-Wi-Fi

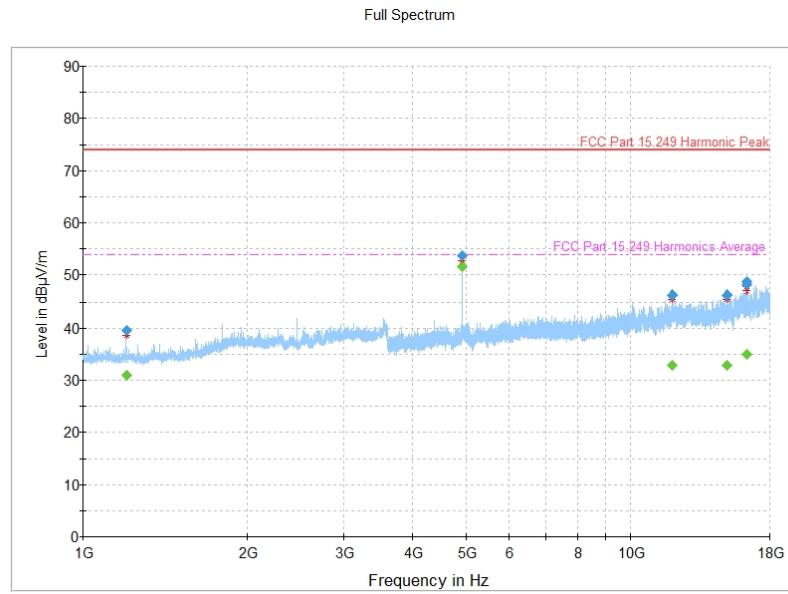


Figure 8.3-4: Field strength of spurious emissions 1GHz to 18GHz – Clearlink D-Wi-Fi

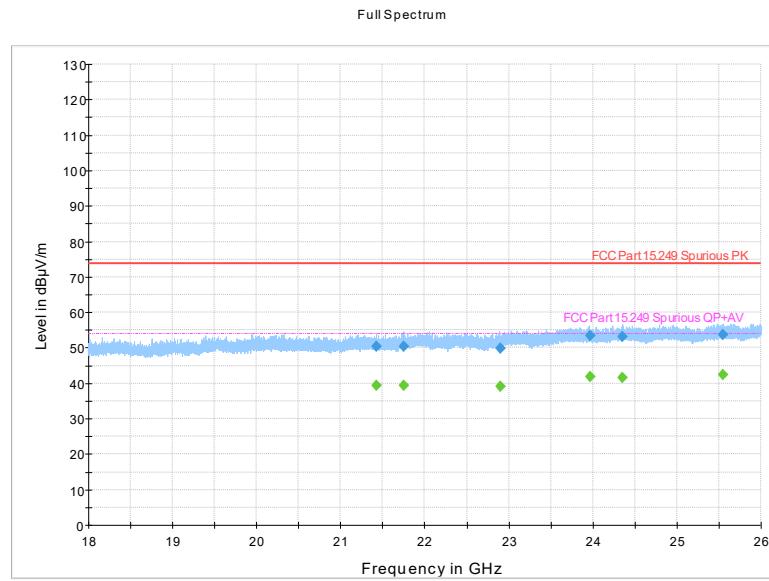


Figure 8.3-5: Field strength of spurious emissions 18GHz to 26GHz – Clearlink D-Wi-Fi

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
31.707000	15.15	40.00	24.85	5000.0	120.000	159.8	H	86.0	19.8
61.708000	13.94	40.00	26.06	5000.0	120.000	157.0	V	25.0	6.9
98.906000	8.43	43.50	35.07	5000.0	120.000	284.1	V	0.0	11.7
186.525500	7.68	43.50	35.82	5000.0	120.000	289.0	V	123.0	11.0
553.778000	19.22	46.00	26.78	5000.0	120.000	366.9	V	270.0	22.6
951.771000	25.36	46.00	20.64	5000.0	120.000	382.7	H	282.0	28.6

Table 8.3-1: Field strength of spurious emissions 30MHz to 1GHz – Clearlink D-Wi-Fi

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1200.233333	---	31.03	53.97	22.94	5000.0	1000.000	252.0	H	281.0	-14.7
1200.233333	39.49	---	73.90	34.41	5000.0	1000.000	252.0	H	281.0	-14.7
4926.066667	53.76	---	73.90	20.14	5000.0	1000.000	156.0	H	313.0	-4.1
4926.066667	---	51.51	53.97	2.46	5000.0	1000.000	156.0	H	313.0	-4.1
11944.066667	---	32.85	53.97	21.12	5000.0	1000.000	126.0	H	118.0	6.2
11944.066667	46.19	---	73.90	27.71	5000.0	1000.000	126.0	H	118.0	6.2
15016.100000	---	32.85	53.97	21.12	5000.0	1000.000	103.0	V	148.0	7.4
15016.100000	46.26	---	73.90	27.64	5000.0	1000.000	103.0	V	148.0	7.4
16373.966667	48.22	---	73.90	25.68	5000.0	1000.000	193.0	V	21.0	11.1
16373.966667	---	34.94	53.97	19.03	5000.0	1000.000	193.0	V	21.0	11.1
16376.366667	---	35.01	53.97	18.96	5000.0	1000.000	133.0	V	0.0	11.1
16376.366667	48.71	---	73.90	25.19	5000.0	1000.000	133.0	V	0.0	11.1

Table 8.3-2: Field strength of spurious emissions 1GHz to 18GHz – Clearlink D-Wi-Fi

Frequency (MHz)	MaxPeak (dB μ V/m)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
21428.333333	---	39.34	53.90	14.56	10.0	1000.000	135.1	V	81.0	39.2
21428.333333	50.36	---	73.90	23.54	10.0	1000.000	135.1	V	81.0	39.2
21755.916667	---	39.51	53.90	14.39	10.0	1000.000	112.7	V	117.0	39.2
21755.916667	50.44	---	73.90	23.46	10.0	1000.000	112.7	V	117.0	39.2
22894.366667	---	39.22	53.90	14.68	10.0	1000.000	150.5	V	44.0	39.9
22894.366667	49.74	---	73.90	24.16	10.0	1000.000	150.5	V	44.0	39.9
23964.483333	53.32	---	73.90	20.58	10.0	1000.000	150.1	H	313.0	40.4
23964.483333	---	41.85	53.90	12.05	10.0	1000.000	150.1	H	313.0	40.4
24352.383333	53.28	---	73.90	20.62	10.0	1000.000	109.1	H	247.0	40.4
24352.383333	---	41.61	53.90	12.29	10.0	1000.000	109.1	H	247.0	40.4
25549.350000	---	42.52	53.90	11.38	10.0	1000.000	175.0	V	285.0	40.7
25549.350000	53.58	---	73.90	20.32	10.0	1000.000	175.0	V	285.0	40.7

Table 8.3-3: Field strength of spurious emissions 18GHz to 26GHz – Clearlink D-Wi-Fi

8.4 FCC 15.249(d) and RSS-210 B10 (b) Emissions at the Band Edges

8.4.1 Definitions and limits

FCC

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

IC

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

Table 8.4-1: 15.209 and RSS-Gen emissions field strength limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dB μ V/m	
0.009–0.490	2400/F	67.6 – 20 × log ₁₀ (F)	300
0.490–1.705	24000/F	87.6 – 20 × 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 8.4-2: IC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in table above and above 38.6 GHz are designated for low-power license-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.4-3: 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			

8.4.2 Test summary

Test date	October 10, 2018	Temperature	24 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	41 %

8.4.3 Observations, settings and special notes

The spectrum was searched from 30 kHz to 10th harmonic of the fundamental frequency.

Radiated measurements were performed at 3 m.

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

Detector mode	Peak
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

Spectrum analyzer settings for average measurements at the frequencies above 1000 MHz:

Detector mode	Average
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Trace mode	Max Hold

8.4.4 Test data

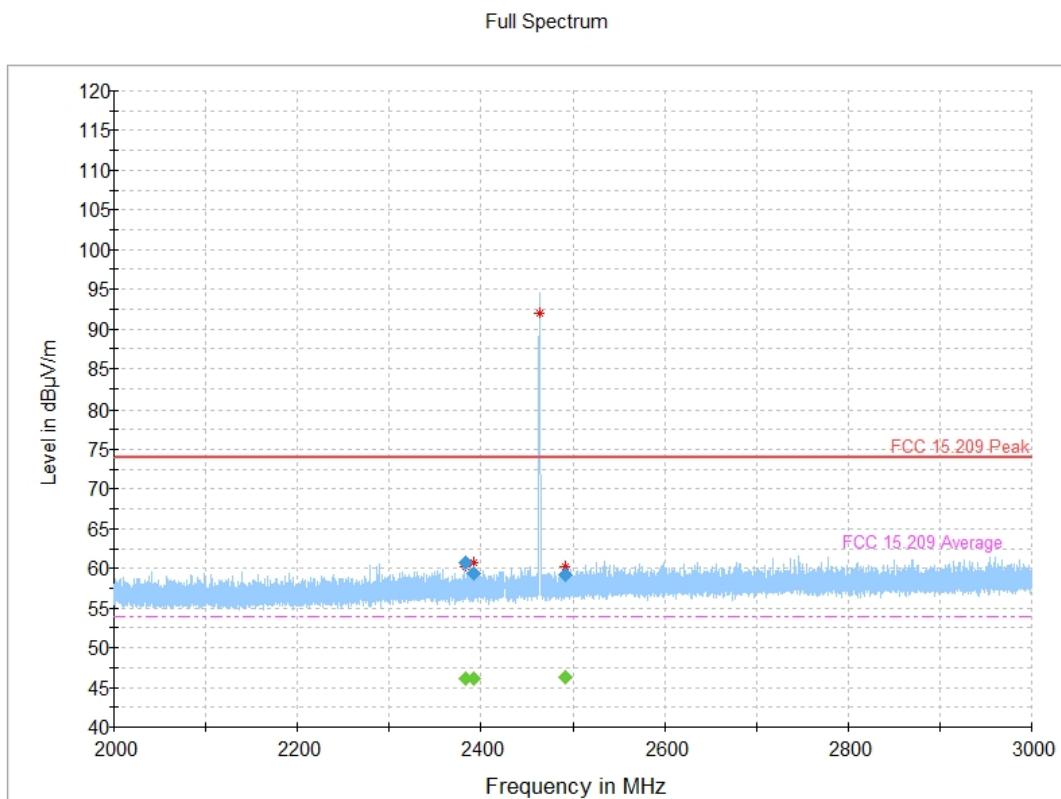


Figure 8.4-1: Field strength of emissions near band edges

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2384.133333	60.65	---	73.90	13.25	5000.0	1000.000	274.0	H	23.0	10.4
2384.133333	---	46.17	53.90	7.73	5000.0	1000.000	274.0	H	23.0	10.4
2393.366667	59.39	---	73.90	14.51	5000.0	1000.000	185.0	V	175.0	10.4
2393.366667	---	46.08	53.90	7.82	5000.0	1000.000	185.0	V	175.0	10.4
2490.666667	---	46.27	53.90	7.63	5000.0	1000.000	130.0	H	196.0	10.8
2490.666667	59.13	---	73.90	14.77	5000.0	1000.000	130.0	H	196.0	10.8

Figure 8.4-2: Field strength of emissions near band edges

Note: all measurement results indicated in the plot were taken with a peak detector, which is more stringent measurement, and still comply with quasi-peak limit.

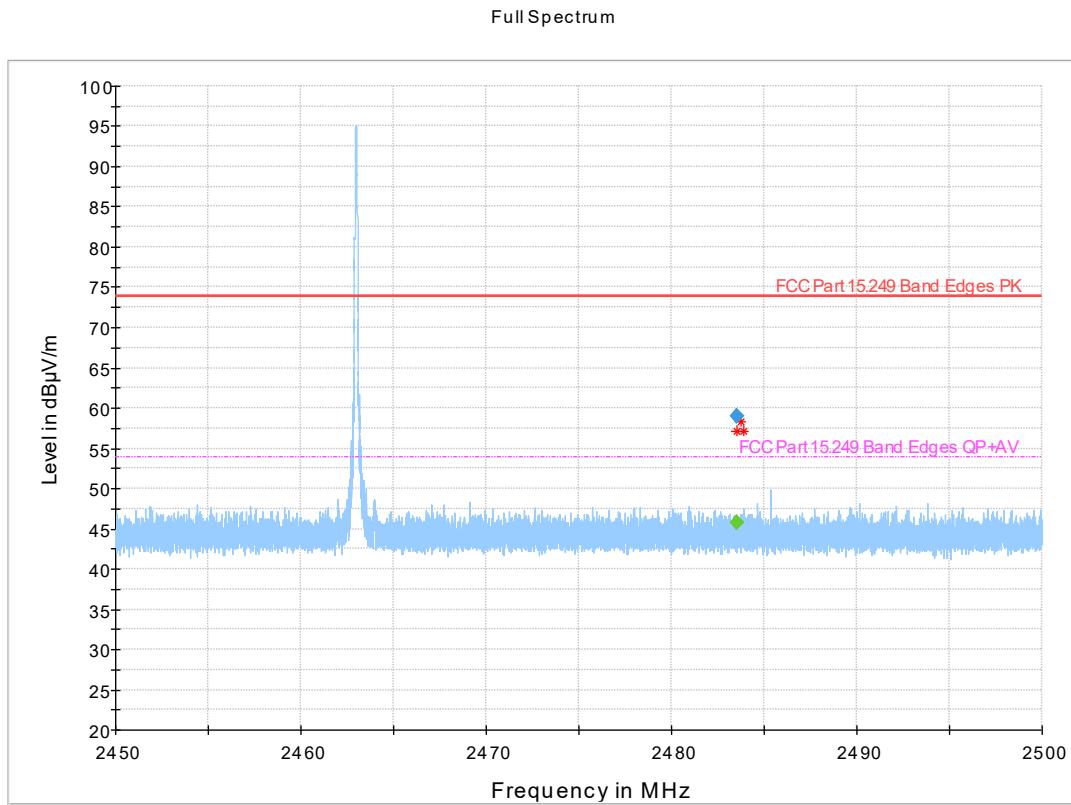


Figure 8.4-3: Field strength of emissions at High band edge

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Comment
2483.548333	---	45.71	53.90	8.19	5000.0	1000.000	118.2	H	300.0	10.5	11:24:24 AM - 10/9/201
2483.548333	58.94	---	73.90	14.96	5000.0	1000.000	118.2	H	300.0	10.5	11:24:24 AM - 10/9/201

Figure 8.4-4: Field strength of emissions at High band edge

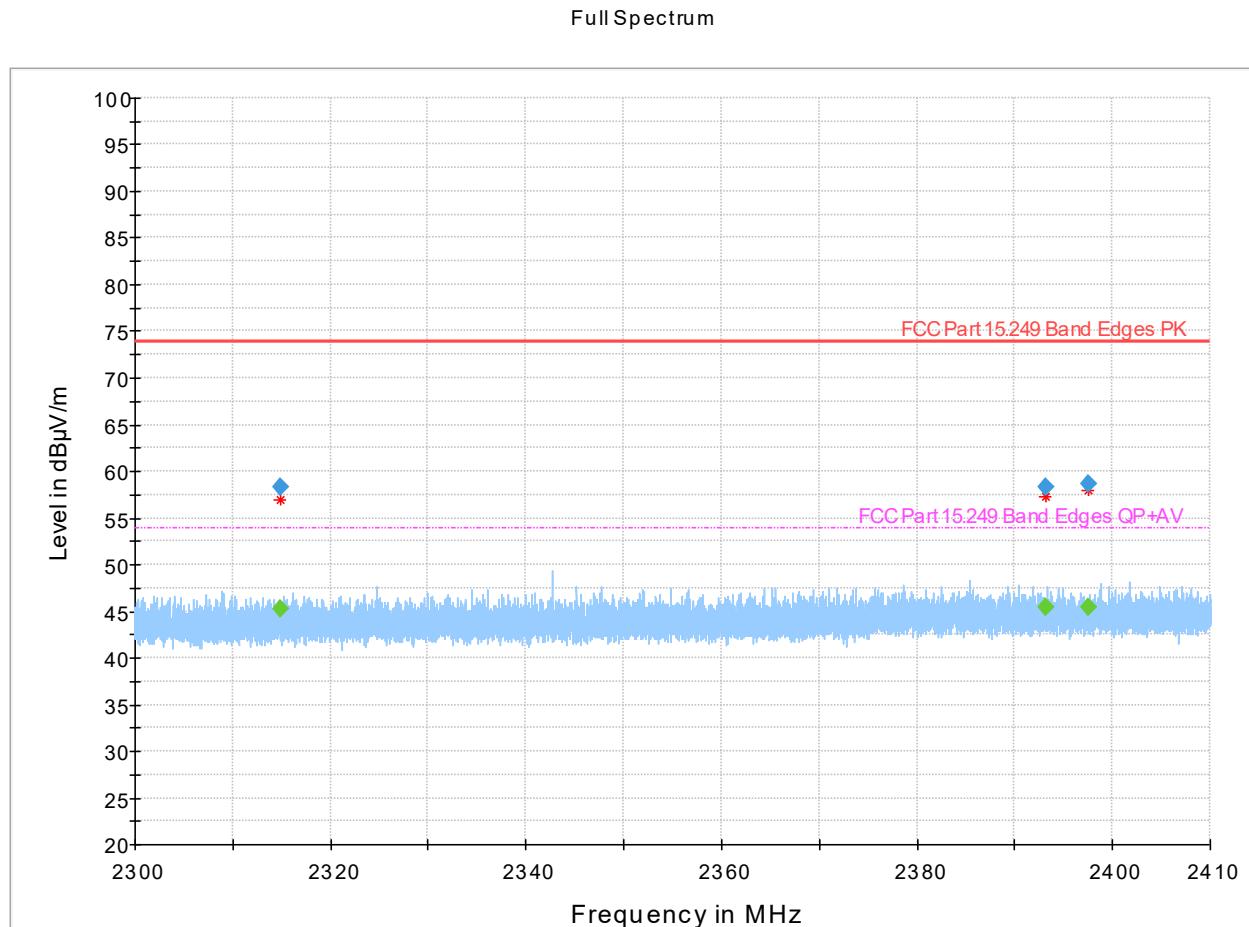


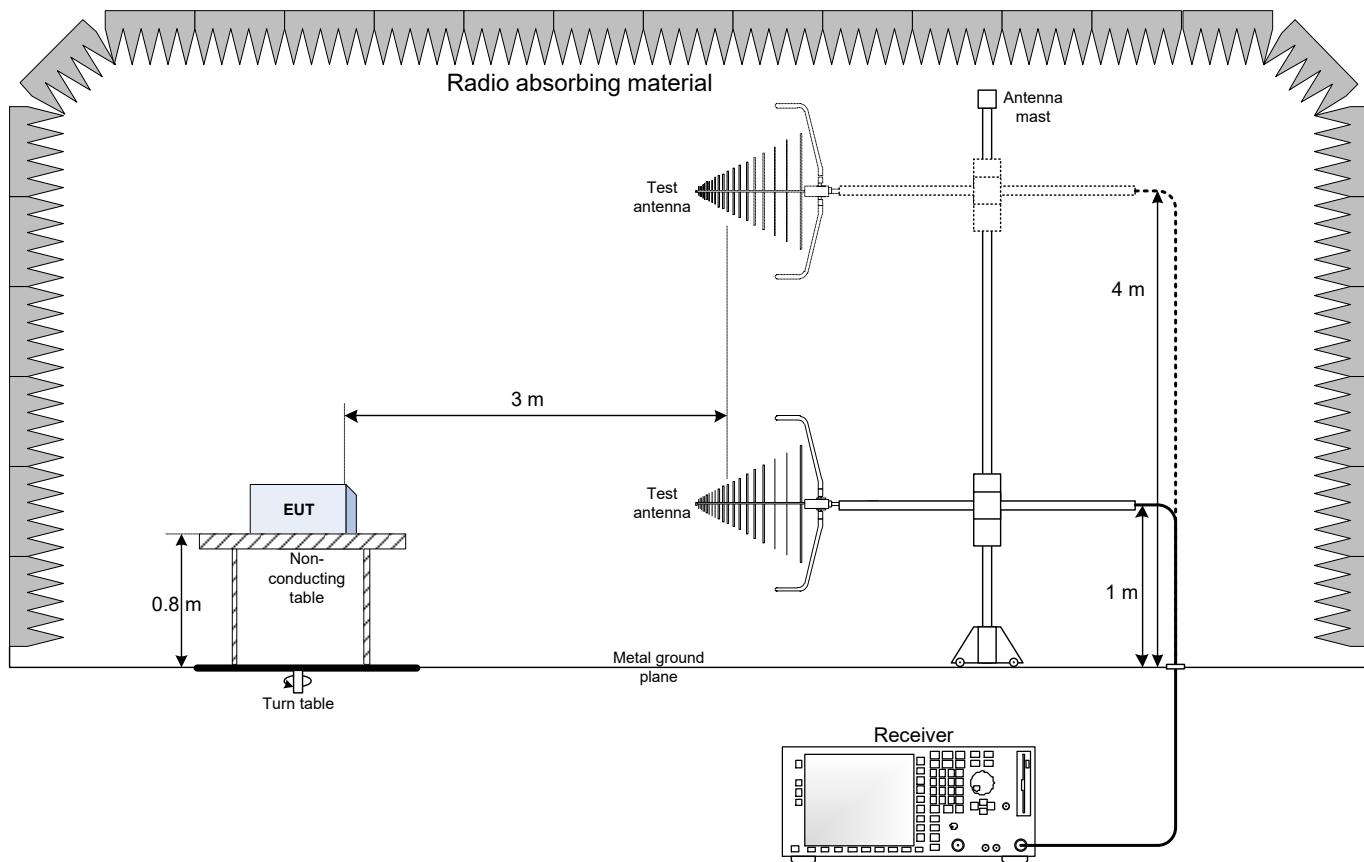
Figure 8.4-5: Field strength of emissions at Low band edge and restricted band

Frequency (MHz)	MaxPeak (dB μ V/m)	CAverage (dB μ V/m)		Limit (dB μ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Co
2314.832000	---	45.22		53.90	8.68	5000.0	1000.000	236.1	V	124.0	9.9	11:44:32
2314.832000	58.34	---		73.90	15.56	5000.0	1000.000	236.1	V	124.0	9.9	11:44:32
2393.216667	---	45.47		53.90	8.43	5000.0	1000.000	328.7	V	0.0	10.2	11:46:46
2393.216667	58.38	---		73.90	15.52	5000.0	1000.000	328.7	V	0.0	10.2	11:46:45
2397.549667	---	45.48		53.90	8.42	5000.0	1000.000	334.3	V	85.0	10.2	11:49:29
2397.549667	58.71	---		73.90	15.19	5000.0	1000.000	334.3	V	85.0	10.2	11:49:29

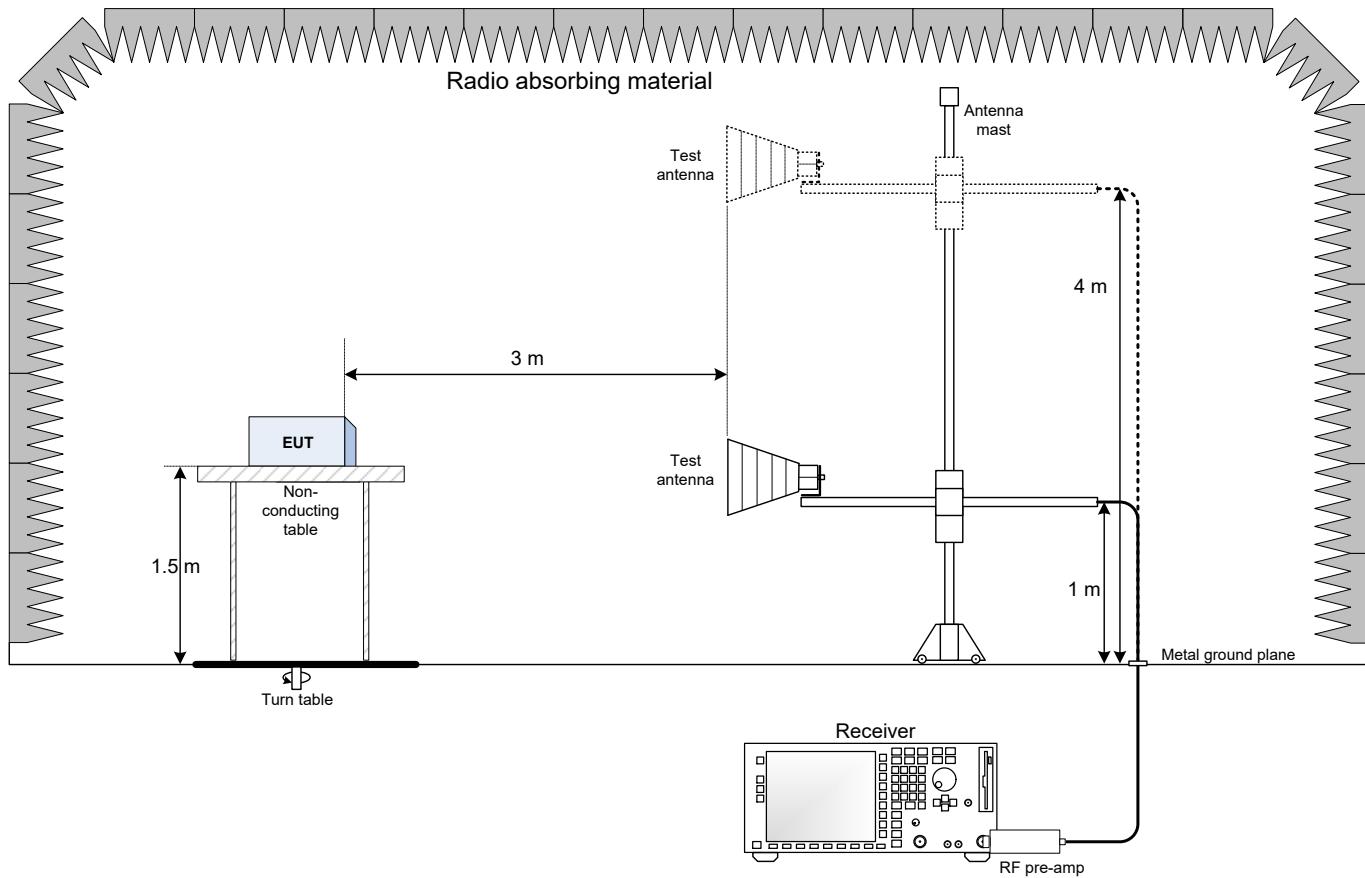
Figure 8.4-6: Field strength of emissions at Low band edge and restricted band

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up

