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Test report

373054 - 1TRFWL

Date of issue: August 8, 2019

Applicant: Garmin International

Product: MFD and Black Box Remote

Models:
CL Model (Wi-Fi)

Variants:
CL0-1 MFD Interface (Interface Unit) - M/N C3545
CL-5 Display (Multi Display Assy.) – M/N A3545

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 10, December 2019 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, Test Engineer.
Reviewed by	Chip Fleury
Date	August 7, 2019
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 Canada's ISO/IEC 17025 accreditation.

Copyright notification

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Garmin International
Address	1200 East 151st Street
City	Olathe
Province/State	KS
Postal/Zip code	66062
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 10, December 2019, 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	Pass[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	Pass
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Not applicable

Notes: None

2.4 IC RSS-210, Issue 10, 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	April 7, 2019
Nemko sample ID number	373054

3.2 EUT information

Product name	MFD
Model	CL5 (radio) - M/N A3545
Model Varient	CL0-1 (radio) – M/N C3545
Serial number	N/A

3.3 Technical information

Operating band	Radio ANT TX/RX
Operating frequencies	2.4-GHz ISM band.
Occupied bandwidth (99 %)	812.40kHz (Worst Case at 2402MHz)
Power requirements	8 – 16 VDC
Transmitter information	Wi-Fi modulation 802.11b DSSS, data rate 11mb/s - 802.11g OFDM, data rate54mb/s - 802.11n-20 QAM, data rate 65mb/s ANT modulation GFSK Data rate 60kb/s
Antenna Information	Integral inverted F with 2dBi gain (same antenna for ANT and WIFI)
Software information	Beta Sofware ver 1.10, (3c60a29d) Garmin Ltd copyright 2018-2019

3.4 Product description and theory of operation

Digital display that shows information and performance data for Yamaha outboard motors. TX/RX Wi-Fi & ANT

3.5 EUT exercise details

Garmin MFD, Model: CL5 was tested while the ANT radio was in transmit mode at its highest power. 3 frequencies were measured: 2402MHz (Low Channel), 2441MHz (Mid Channel) and 2480MHz (High Channel). The tests were monitor through an ANT connection to the CL0 Remote Control.

Software and Firmware: The software used to configure for testing is called ANTware II and Beta Sofware ver 1.10, (3c60a29d) Garmin Ltd copyright 2018-2019

Input/Output signal levels – not applicable with this device the antenna is integral and the input/output levels are not adjustable. The EUT for testing was simply set in transmit mode.

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
NMEA Tee connectors	Garmin	N/A	N/A
Network Updater (LOAD)	Garmin	N/A	N/A
Remote Control	Garmin	CL0	N/A

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 ±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	1.38

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.	5/25/2020
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 yr.	4/18/2020
Antenna, Horn	EMCO	3115	1033	1 yr.	7/27/2019
Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	1 yr.	8/24/2019
Signal Generator	Rohde & Schwarz	SMB 100A	E1128	1 yr.	12/20/2019
RF Power Sensor	ETS Lindgren	7002-006	E1061	1 yr.	05/31/2020
Temperature/humidity chamber	CSZ Inc.	ZPH-32-2-2-H/AC	S1179	1 yr.	04/20/2020

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 µH/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:
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which 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 table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

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: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.1.2 Test summary

Test date	July 1, 2019	Temperature	24 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1001 mbar
Verdict	Pass	Relative humidity	51 %

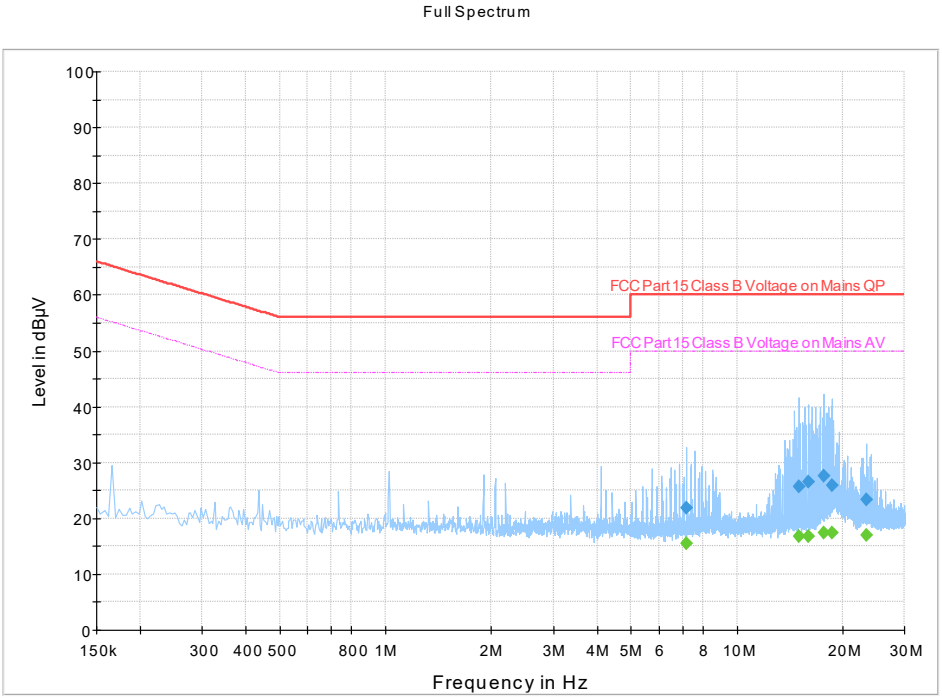
8.1.3 Observations, settings and special notes

None.

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

8.1.1 Test data



Plot 8.1-1: Conducted emissions – Model CL5 - ANT from 150KHz to 30MHz

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Corr. (dB)
7.206000	21.95	---	60.00	38.05	5000.0	9.000	Neg	ON
7.206000	---	15.41	50.00	34.59	5000.0	9.000	Neg	ON
15.006000	25.77	---	60.00	34.23	5000.0	9.000	Pos	ON
15.006000	---	16.72	50.00	33.28	5000.0	9.000	Pos	ON
15.962000	26.61	---	60.00	33.39	5000.0	9.000	Pos	ON
15.962000	---	16.78	50.00	33.22	5000.0	9.000	Pos	ON
17.710000	---	17.36	50.00	32.64	5000.0	9.000	Pos	ON
17.710000	27.55	---	60.00	32.45	5000.0	9.000	Pos	ON
18.634000	25.97	---	60.00	34.03	5000.0	9.000	Pos	ON
18.634000	---	17.43	50.00	32.57	5000.0	9.000	Pos	ON
23.418000	---	17.03	50.00	32.97	5000.0	9.000	Neg	ON
23.418000	23.27	---	60.00	36.73	5000.0	9.000	Neg	ON

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

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	July 31, 2019	Temperature	28 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	45 %

8.2.3 Observations, settings and special notes

None.

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 and 20 dB bandwidth results.

Fundamental frequency, MHz	99% bandwidth	20 dB bandwidth
2402	**812.40 kHz**	**746.70 kHz**
2441	**811.50 kHz**	**742.40 kHz**
2480	**807.90 kHz**	**755.40 kHz**

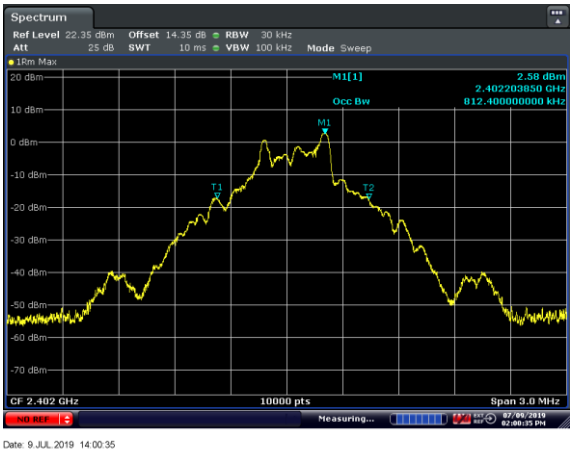


Figure 8.2-1: 99% bandwidth CL5 ANT - Low Channel

Figure 8.2-2: 20 dB bandwidth CL5 ANT - Low Channel

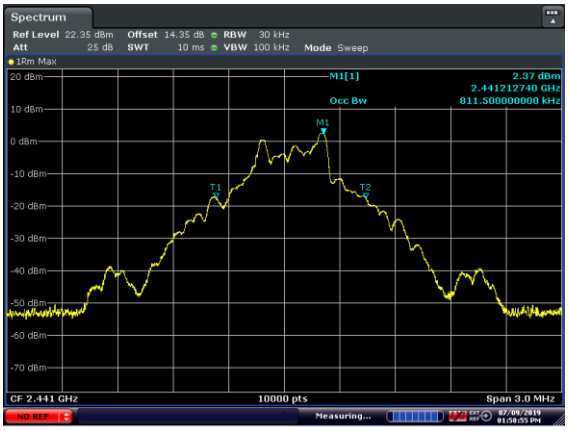


Figure 8.2-3: 99% bandwidth CL5 ANT - Mid Channel

Figure 8.2-4: 20 dB bandwidth CL5 ANT - Mid Channel

Figure 8.2-5: 99% bandwidth CL5 ANT - High Channel

Figure 8.2-6: 20 dB bandwidth CL5 ANT - High Channel

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		Field strength of harmonics	
	mV/m	dBµV/m	µV/m	dBµV/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	July 16, 2019	Temperature	28 °C
Test engineer	Andres Martinez, Test Engineer	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	45 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 18GHz. Radiated measurements were performed at 3m. A 2.4 Notch filter was used on the Spurious emissions scans.

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

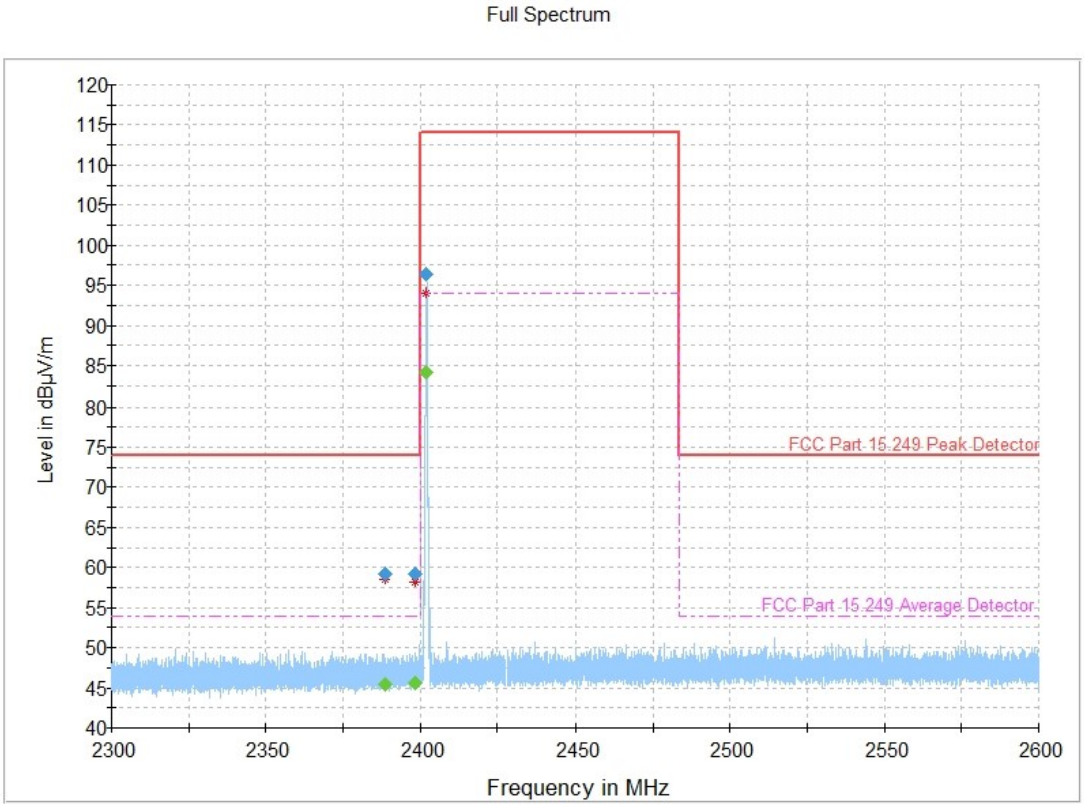


Figure 8.3-1: Field strength of Fundamental output power – Garmin CL5 ANT - Low Channel.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2401.860000	---	84.23	93.97	9.74	5000.0	1000.000	99.0	H	237.0	9.0
2401.860000	96.42	---	114.00	17.58	5000.0	1000.000	99.0	H	237.0	9.0

Figure 8.3-2: Field strength of Fundamental output power – Garmin CL5 ANT - Low Channel

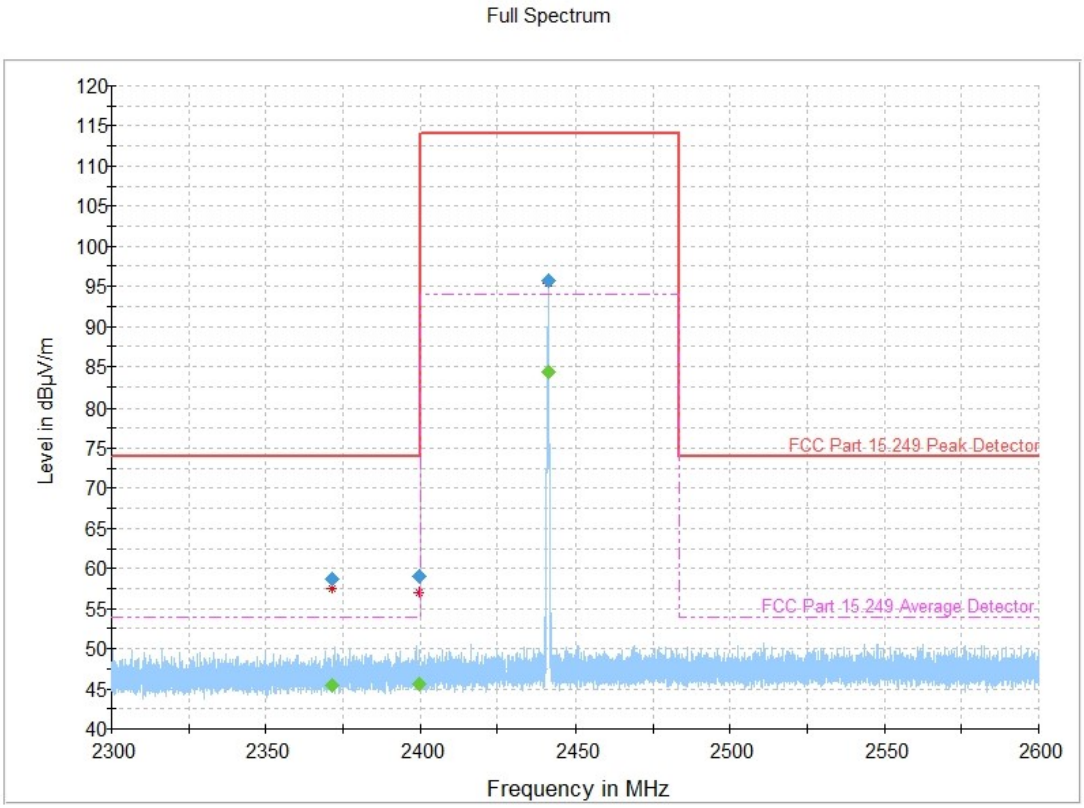


Figure 8.3-3: Field strength of Fundamental output power – Garmin CL5 ANT - Mid Channel.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2440.960000	95.64	---	114.00	18.36	5000.0	1000.000	154.0	H	195.0	9.4
2440.960000	---	84.28	93.97	9.69	5000.0	1000.000	154.0	H	195.0	9.4

Figure 8.3-4: Field strength of Fundamental output power – Garmin CL5 ANT - Mid Channel

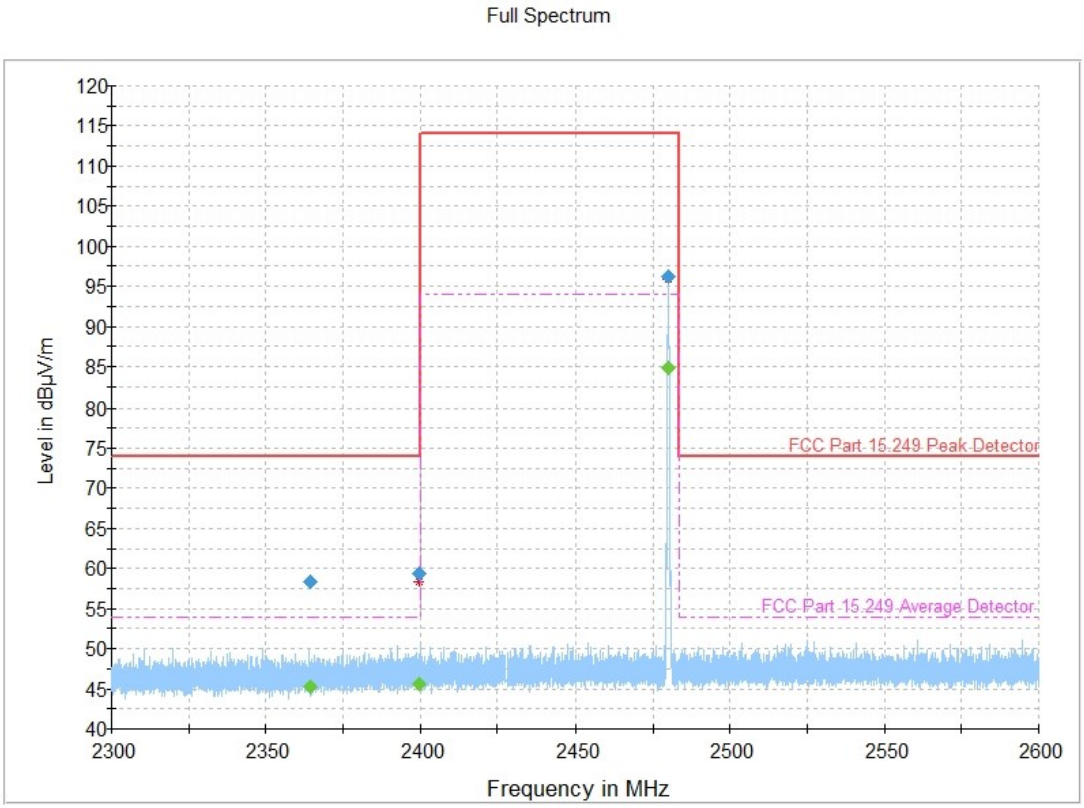


Figure 8.3-5: Field strength of Fundamental output power – Garmin CL5 Remote Control-ANT - High Channel.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2479.960000	96.25	---	114.00	17.75	5000.0	1000.000	103.0	V	185.0	9.5
2479.960000	---	84.88	93.97	9.09	5000.0	1000.000	103.0	V	185.0	9.5

Figure 8.3-6: Field strength of Fundamental output power – Garmin CL5 Remote Control ANT - High Channel

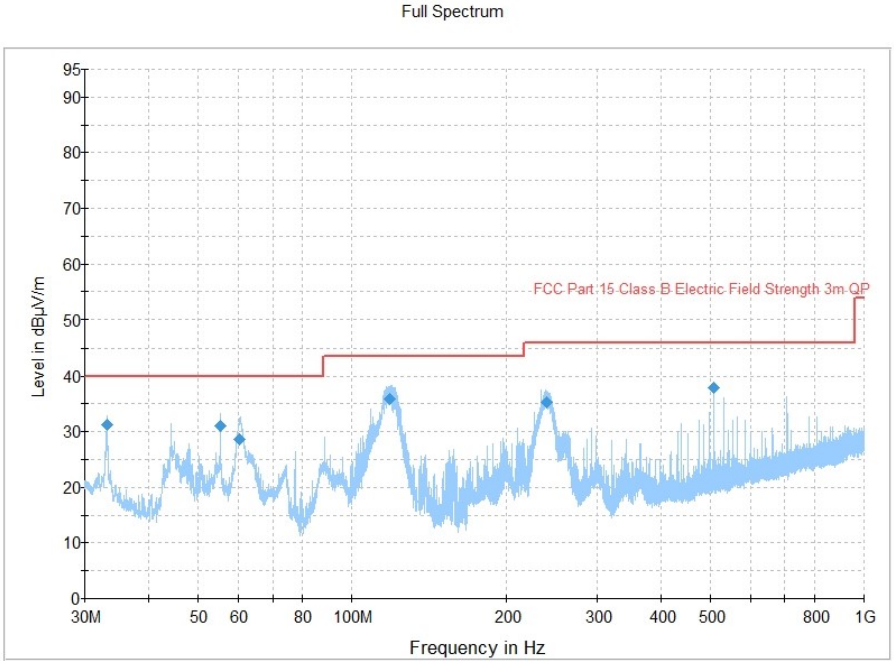


Figure 8.3-7: Field strength of spurious emissions 30MHz to 1GHz – Garmin CL5 ANT

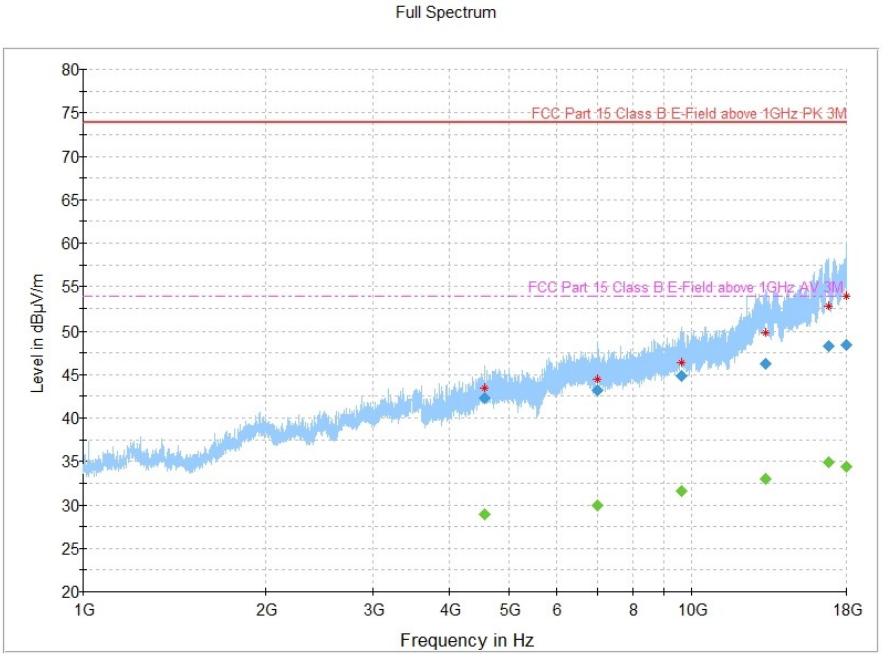


Figure 8.3-8: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL5 ANT – Low Channel

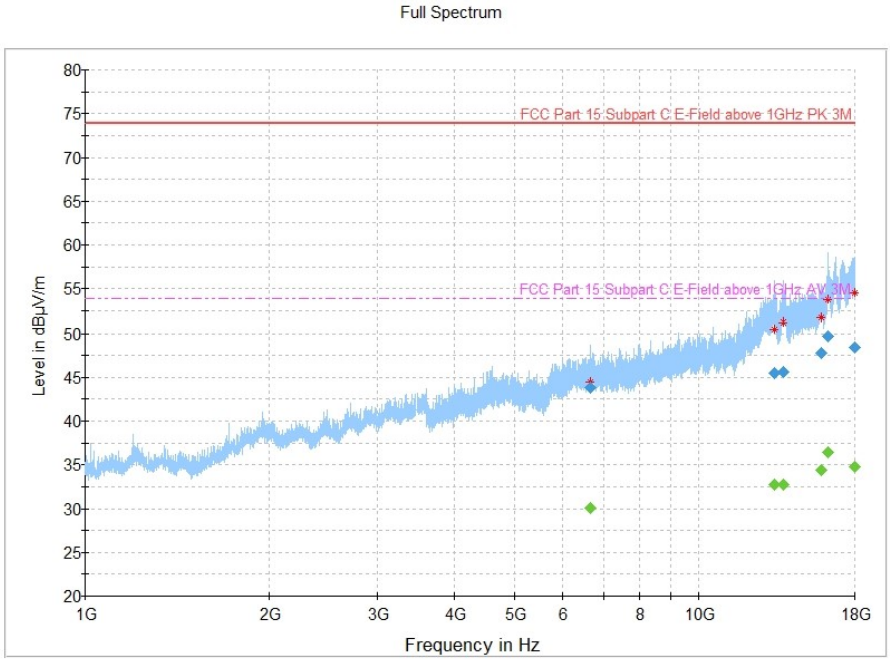


Figure 8.3-9: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL5 ANT – Mid Channel

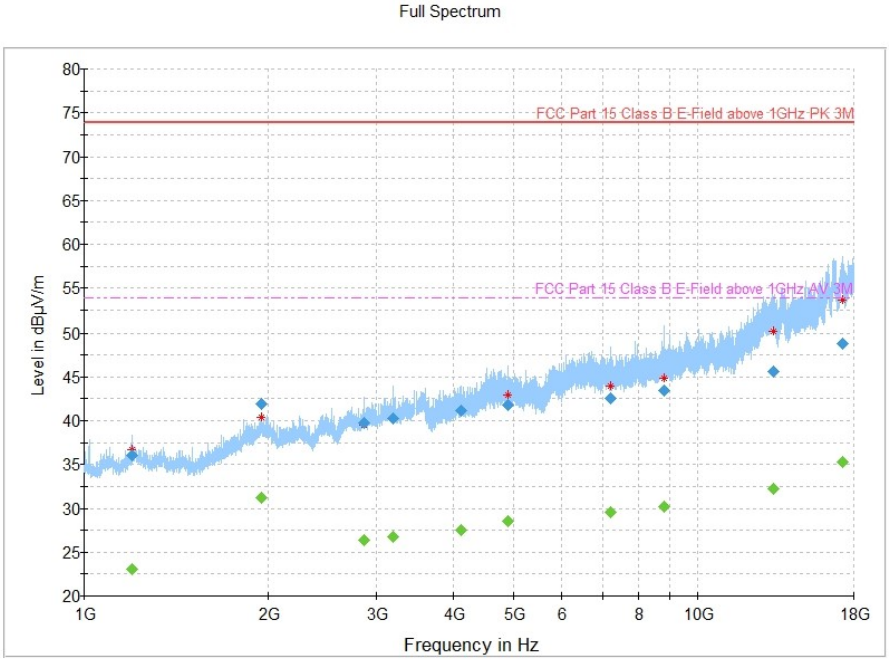


Figure 8.3-10: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL5 ANT – High Channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
33.168667	31.36	40.00	8.64	1000.0	120.000	104.0	V	179.0	19.0
55.284667	30.97	40.00	9.03	1000.0	120.000	314.0	V	338.0	7.9
60.282667	28.64	40.00	11.36	1000.0	120.000	113.0	V	12.0	6.9
118.710667	35.84	43.50	7.66	1000.0	120.000	164.0	H	97.0	13.4
239.275667	35.34	46.00	10.66	1000.0	120.000	112.0	V	65.0	14.1
508.719667	37.97	46.00	8.03	1000.0	120.000	163.0	H	71.0	21.6

Figure 8.3-11: Field strength of spurious emissions 30MHz to 1GHz – Garmin CL5 Remote Control ANT

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)
4560.733333	---	28.90	53.90	25.00	5000.0	1000.000	273.0	V	197.0	-3.1
4560.733333	42.33	---	73.90	31.57	5000.0	1000.000	273.0	V	197.0	-3.1
7017.300000	---	29.99	53.90	23.91	5000.0	1000.000	246.0	V	325.0	-0.6
7017.300000	43.20	---	73.90	30.70	5000.0	1000.000	246.0	V	325.0	-0.6
9620.033333	---	31.54	53.90	22.36	5000.0	1000.000	234.0	H	158.0	1.8
9620.033333	44.86	---	73.90	29.04	5000.0	1000.000	234.0	H	158.0	1.8
13228.533333	---	33.02	53.90	20.88	5000.0	1000.000	250.0	H	10.0	7.2
13228.533333	46.19	---	73.90	27.71	5000.0	1000.000	250.0	H	10.0	7.2
16821.233333	48.23	---	73.90	25.67	5000.0	1000.000	144.0	V	352.0	10.3
16821.233333	---	34.86	53.90	19.04	5000.0	1000.000	144.0	V	352.0	10.3
17984.300000	48.38	---	73.90	25.52	5000.0	1000.000	181.0	H	11.0	11.3
17984.300000	---	34.45	53.90	19.45	5000.0	1000.000	181.0	H	11.0	11.3

Figure 8.3-12: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL5 ANT – Low Channel

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)
6667.566667	43.85	---	73.90	30.05	5000.0	1000.000	291.0	V	327.0	-0.6
6667.566667	---	30.06	53.90	23.84	5000.0	1000.000	291.0	V	327.0	-0.6
13292.566667	45.52	---	73.90	28.38	5000.0	1000.000	125.0	V	65.0	7.3
13292.566667	---	32.73	53.90	21.17	5000.0	1000.000	125.0	V	65.0	7.3
13768.333333	45.64	---	73.90	28.26	5000.0	1000.000	166.0	V	7.0	7.8
13768.333333	---	32.70	53.90	21.20	5000.0	1000.000	166.0	V	7.0	7.8
15897.066667	---	34.35	53.90	19.55	5000.0	1000.000	237.0	H	20.0	8.5
15897.066667	47.82	---	73.90	26.08	5000.0	1000.000	237.0	H	20.0	8.5
16299.733333	---	36.46	53.90	17.44	5000.0	1000.000	116.0	V	10.0	10.3
16299.733333	49.74	---	73.90	24.16	5000.0	1000.000	116.0	V	10.0	10.3
17972.100000	48.40	---	73.90	25.50	5000.0	1000.000	115.0	V	282.0	11.3
17972.100000	---	34.78	53.90	19.12	5000.0	1000.000	115.0	V	282.0	11.3

Figure 8.3-13: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL5 ANT – Mid Channel

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)
1198.066667	36.05	---	73.90	37.85	5000.0	1000.000	125.0	H	326.0	-14.5
1198.066667	---	23.05	53.90	30.85	5000.0	1000.000	125.0	H	326.0	-14.5
1950.100000	---	31.24	53.90	22.66	5000.0	1000.000	115.0	H	199.0	-11.4
1950.100000	41.93	---	73.90	31.97	5000.0	1000.000	115.0	H	199.0	-11.4
2865.233333	39.71	---	73.90	34.19	5000.0	1000.000	136.0	V	232.0	-9.2
2865.233333	---	26.39	53.90	27.51	5000.0	1000.000	136.0	V	232.0	-9.2
3200.900000	---	26.80	53.90	27.10	5000.0	1000.000	241.0	V	10.0	-8.0
3200.900000	40.26	---	73.90	33.64	5000.0	1000.000	241.0	V	10.0	-8.0
4103.100000	---	27.51	53.90	26.39	5000.0	1000.000	250.0	H	266.0	-4.5
4103.100000	41.19	---	73.90	32.71	5000.0	1000.000	250.0	H	266.0	-4.5
4895.133333	41.77	---	73.90	32.13	5000.0	1000.000	133.0	H	286.0	-3.4
4895.133333	---	28.58	53.90	25.32	5000.0	1000.000	133.0	H	286.0	-3.4
7205.266667	42.54	---	73.90	31.36	5000.0	1000.000	189.0	V	28.0	-1.1
7205.266667	---	29.60	53.90	24.30	5000.0	1000.000	189.0	V	28.0	-1.1
8812.433333	---	30.19	53.90	23.71	5000.0	1000.000	123.0	V	177.0	0.7
8812.433333	43.47	---	73.90	30.43	5000.0	1000.000	123.0	V	177.0	0.7
13327.400000	45.66	---	73.90	28.24	5000.0	1000.000	189.0	H	65.0	7.1
13327.400000	---	32.20	53.90	21.70	5000.0	1000.000	189.0	H	65.0	7.1
17275.700000	48.77	---	73.90	25.13	5000.0	1000.000	224.0	V	25.0	11.0
17275.700000	---	35.28	53.90	18.62	5000.0	1000.000	224.0	V	25.0	11.0

Figure 8.3-14: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL5 ANT – High Channel

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	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 8.4-2: 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	July 9, 2019	Temperature	25 °C
Test engineer	Andres Martinez, Test Engineer	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	45 %

8.4.3 Observations, settings and special notes

None.

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

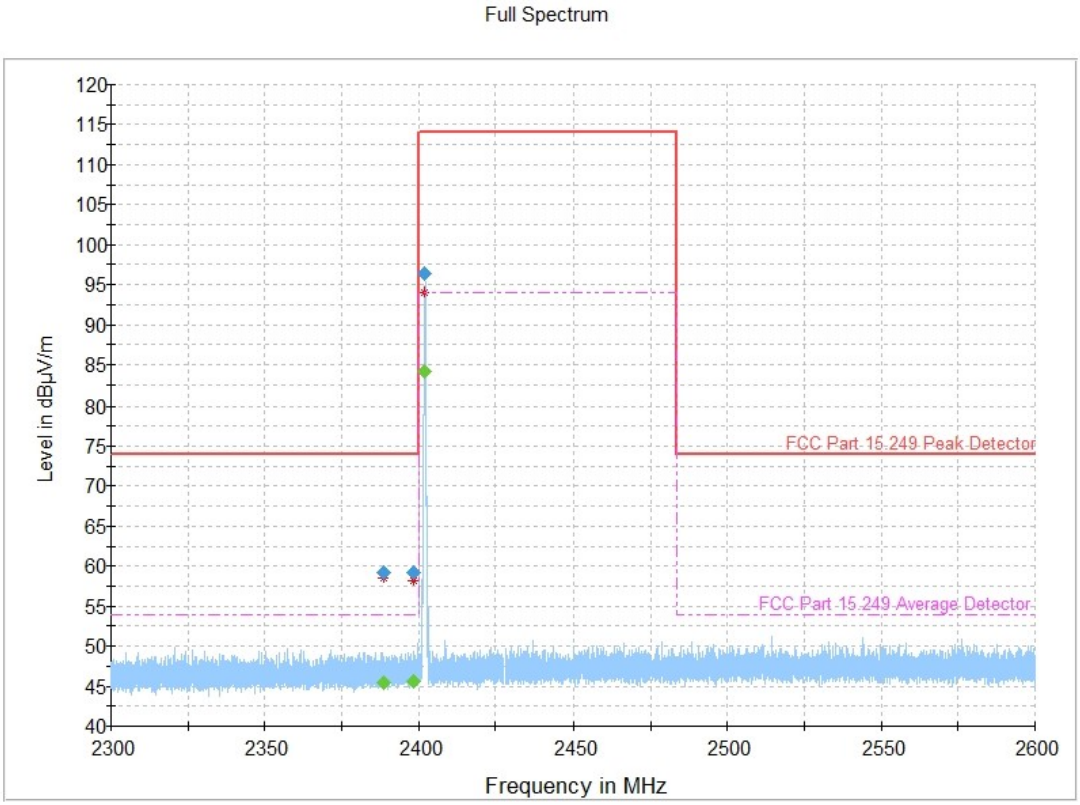


Figure 8.4-1: Field strength of emissions near band edges and restricted bands – Low Channel

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2388.520000	59.13	---	73.90	14.77	5000.0	1000.000	198.0	V	179.0	8.9
2388.520000	---	45.50	53.90	8.40	5000.0	1000.000	198.0	V	179.0	8.9
2398.360000	59.20	---	73.90	14.70	5000.0	1000.000	258.0	V	7.0	9.0
2398.360000	---	45.58	53.90	8.32	5000.0	1000.000	258.0	V	7.0	9.0
2401.860000	---	84.23	93.97	9.74	5000.0	1000.000	99.0	H	237.0	9.0
2401.860000	96.42	---	114.00	17.58	5000.0	1000.000	99.0	H	237.0	9.0

Figure 8.4-2: Field strength of emissions near band edges and restricted bands – Low Channel

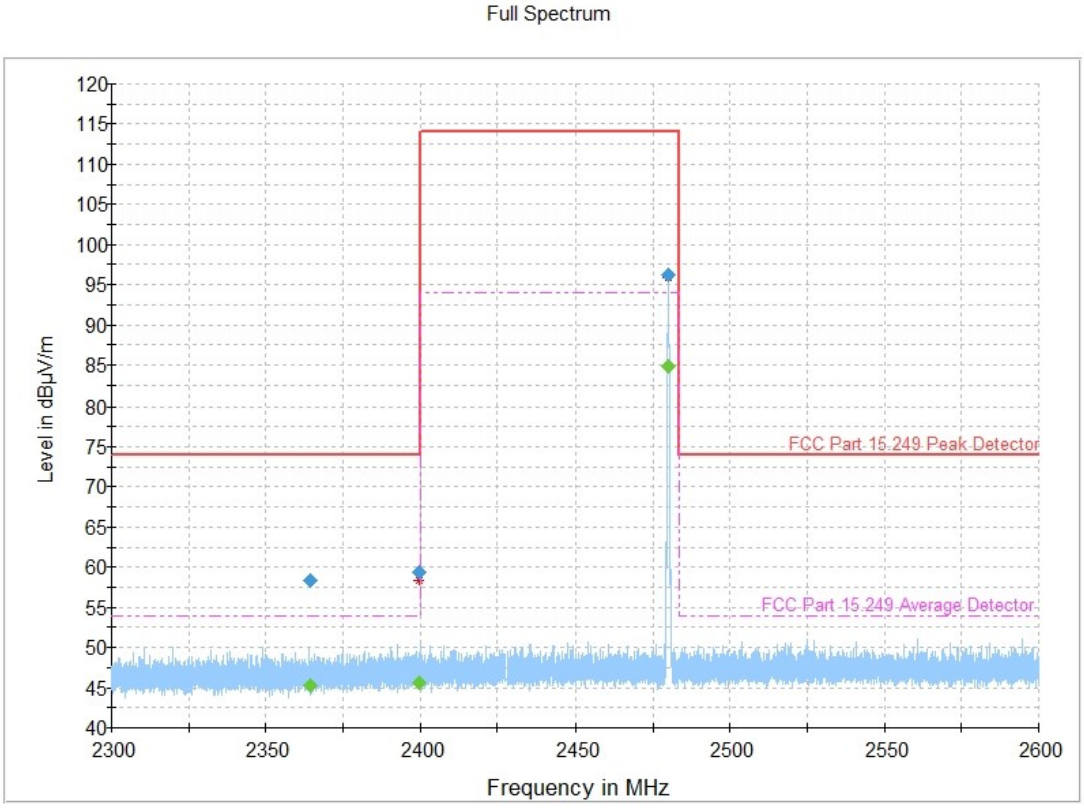


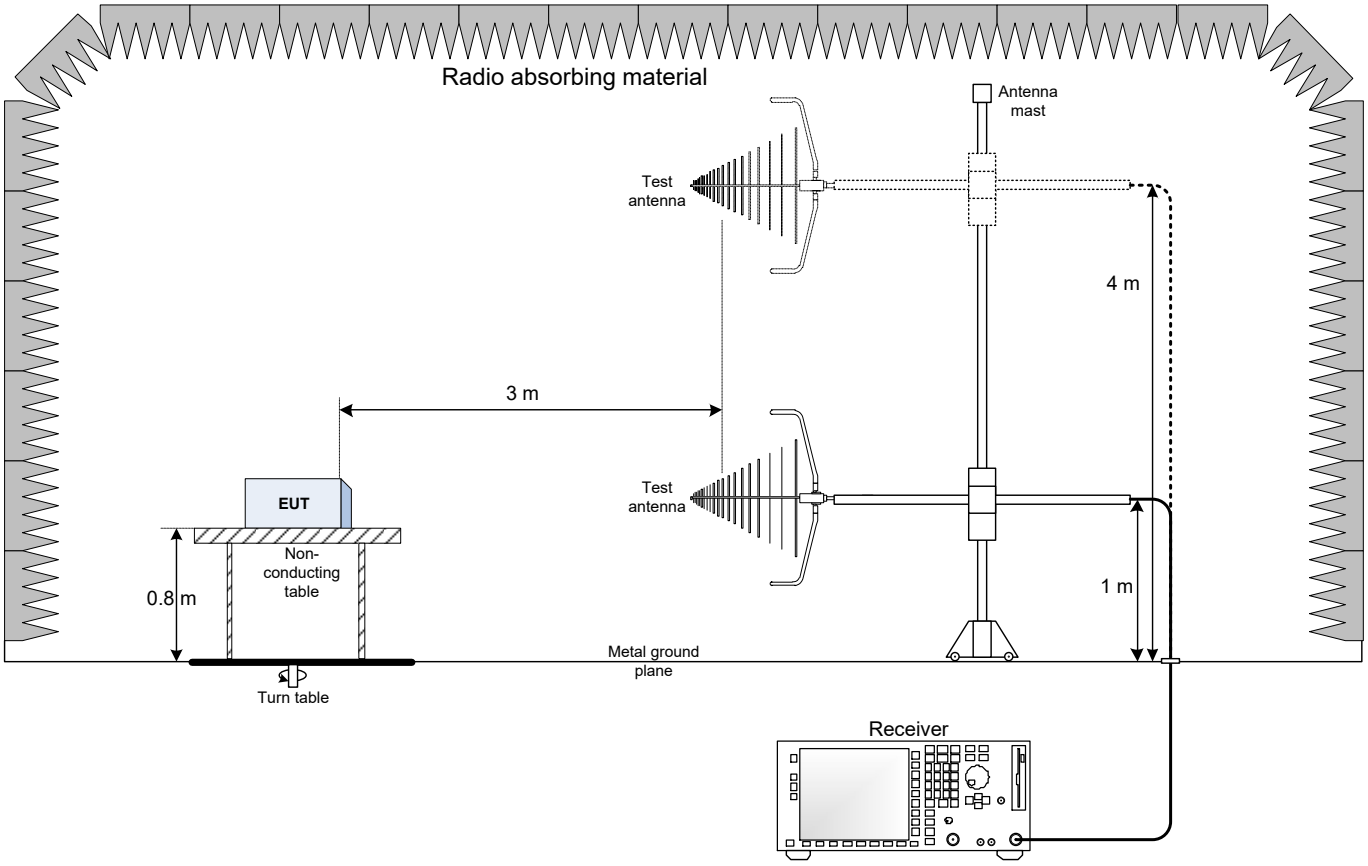
Figure 8.4-3: Field strength of emissions near band edges and restricted bands – High Channel

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2364.380000	---	45.34	53.90	8.56	5000.0	1000.000	111.0	H	167.0	8.8
2364.380000	58.37	---	73.90	15.53	5000.0	1000.000	111.0	H	167.0	8.8
2399.710000	59.37	---	73.90	14.53	5000.0	1000.000	207.0	V	95.0	9.0
2399.710000	---	45.59	53.90	8.31	5000.0	1000.000	207.0	V	95.0	9.0
2479.960000	96.25	---	114.00	17.75	5000.0	1000.000	103.0	V	185.0	9.5
2479.960000	---	84.88	93.97	9.09	5000.0	1000.000	103.0	V	185.0	9.5

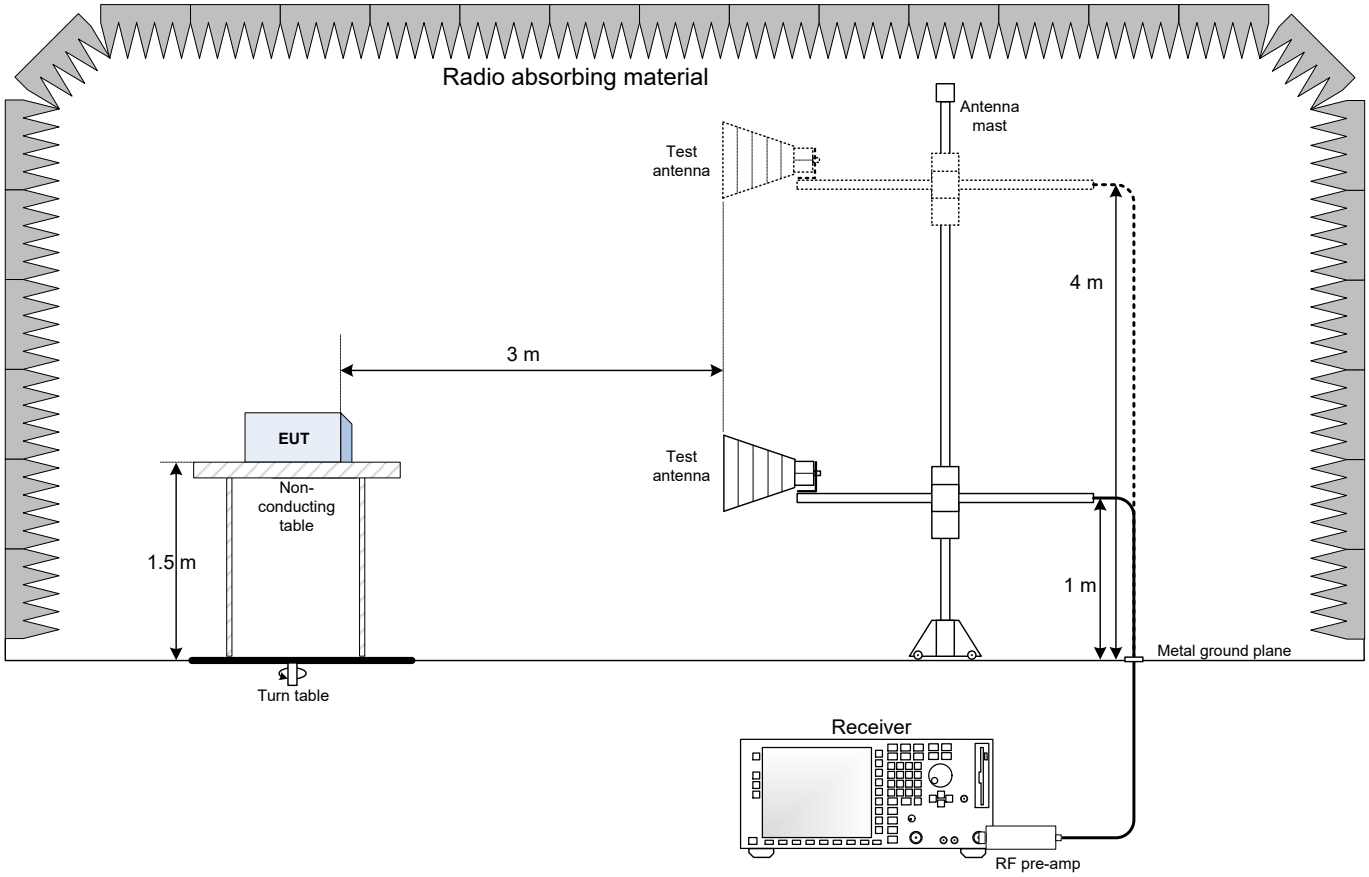
Figure 8.4-4: Field strength of emissions near band edges and restricted bands – High Channel

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