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Test report

373052 - 1TRFWL

Date of issue: October 21, 2019

Applicant: Garmin International

Product: Black Box Remote

Model: CL0 remote – M/N 03708

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, Test Engineer.
Reviewed by	Chip Fleury
Date	October 21, 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

Table of contents

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 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	Not applicable
§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 5, 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	Not applicable

Notes: None

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	April 7, 2019
Nemko sample ID number	373052

3.2 EUT information

Product name	Black Box Remote
Model	CL0 remote
Model Number	03708
Serial number	N/A

Two CL0 remotes were provided for testing. A conducted port sample and a sample to be used for Radiated emissions testing
The conducted port sample was used in Occupied Bandwidth testing. All other testing was performed with the radiated sample

3.3 Technical information

Operating band	Radio ANT TX/RX
Operating frequencies	2.4-GHz ISM band.
Occupied bandwidth (99 %)	927.5 kHz on low channel.
Power requirements	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

CL0 interfaces Yamaha engine data to the Garmin network without a display. CL0 remote interfaces with the CL0 unit to remotely change parameters on the CL0

Garmin Declaration of Duty Cycle

These designs use Gaussian Frequency Shift Keying (GFSK) modulation scheme to transmit data using ANT protocols at a maximum data rate of 2Mbps and a maximum message rate of approximately 300Hz for ANT. The maximum transmit duty cycle is ~13.3%.

The duty cycle reduction is added to the measurements as a -17.52dB reduction in dBµV/m reported levels. This is calculated from: DC = 20 Log (.133)

3.5 EUT exercise details

Garmin Black Box Remote, Model: CL0 remote run with 2 AA batteries while the ANT radio was transmitting at its highest power. 3 frequencies were measured: 2402MHz (Low Channel), 2441MHz (Mid Channel) and 2480MHz (High Channel).

Operating conditions: The EUT is a remote control and Garmin provided a sample which when turned on would allow testing at maximum output power and can change the channels to test High, mid and low transmitter frequencies.

Software and Firmware: The software used to configure for testing is called ANTware II

Input/Output signal levels – not applicable the device is a remote control with no input/output ports. The EUT for testing was simply set in transmit mode.

3.6 EUT setup diagram

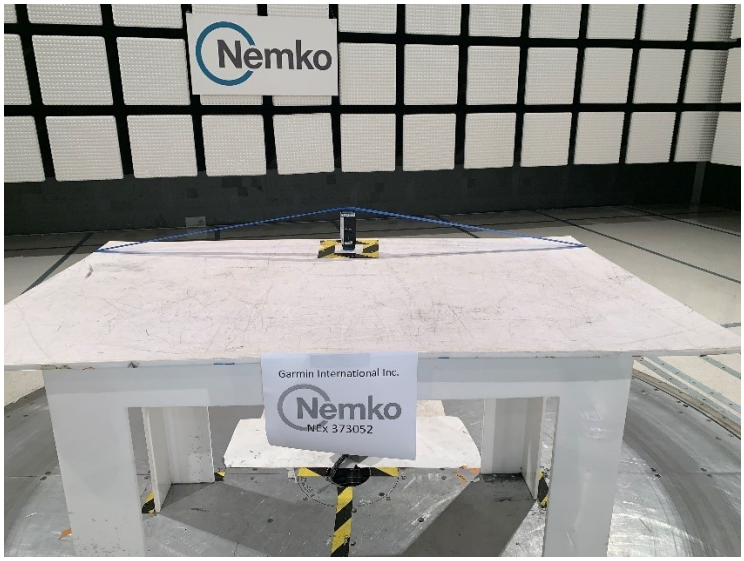


Figure 3.6-1: Setup diagram

3.7 EUT Support Equipment

Table 3.7-1: EUT Support Equipment

Description	Brand name	Model/Part number	Serial number
N/A	N/A	N/A	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
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.	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	Not applicable.	Temperature	24 °C
Test engineer	Andres Martinez, Wireless Test Engineer	Air pressure	1001 mbar
Verdict	Not applicable	Relative humidity	51 %

8.1.3 Observations, settings and special notes

EUT only receives power from 2 AA batteries.

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

8.2 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

Measurements were made as conducted port measurements with the EUT supplied by Garmin

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	**943.56 kHz**	**907.05 kHz**
2441	**944.47 kHz**	**912.46 kHz**
2480	**944.65 kHz**	**912.46 kHz**

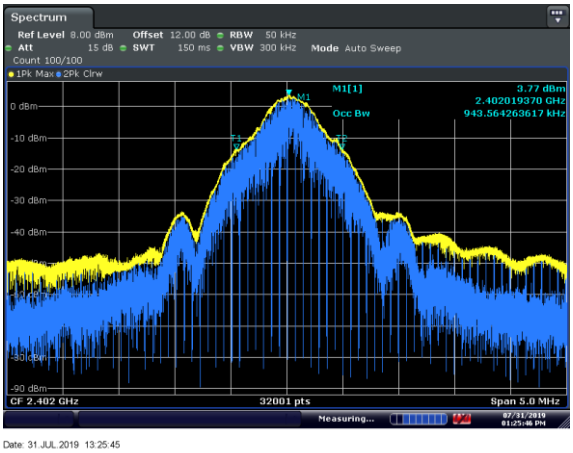


Figure 8.2-1: 99% bandwidth CLO Remote-ANT - Low Channel

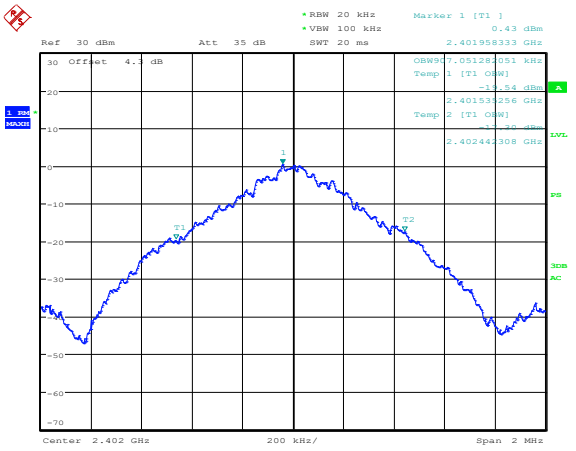


Figure 8.2-2: 20 dB bandwidth CLO Remote ANT - Low Channel

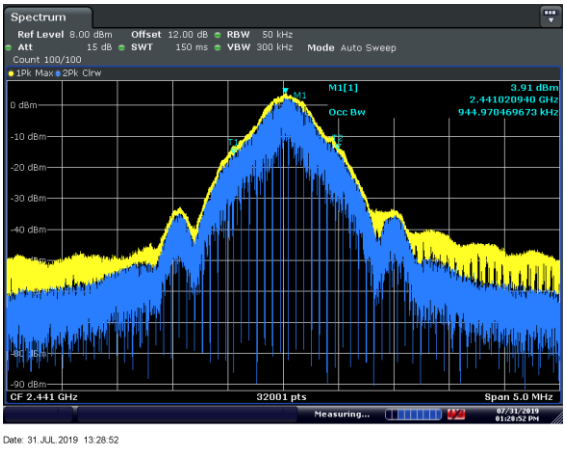


Figure 8.2-3: 99% bandwidth CLO Remote-ANT - Mid Channel

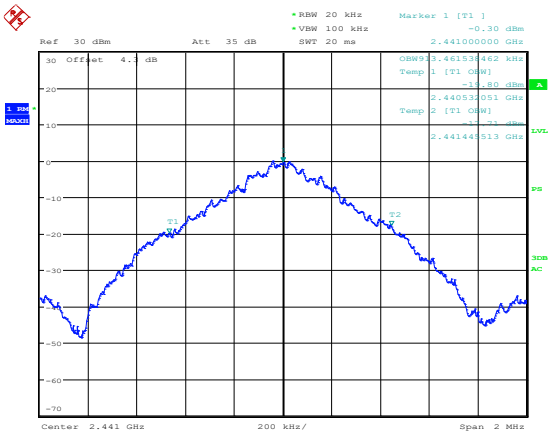


Figure 8.2-4: 20 dB bandwidth CLO Remote ANT - Mid Channel

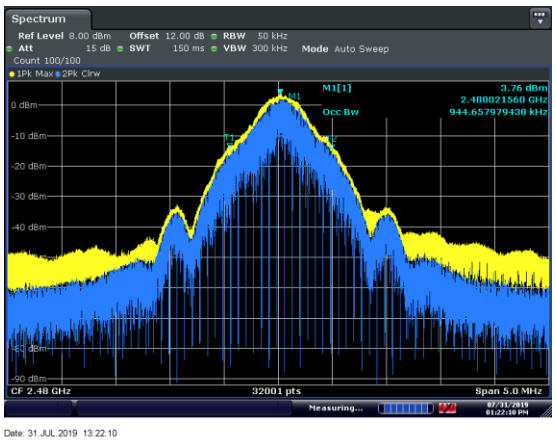


Figure 8.2-5: 99% bandwidth CLO Remote-ANT - High Channel

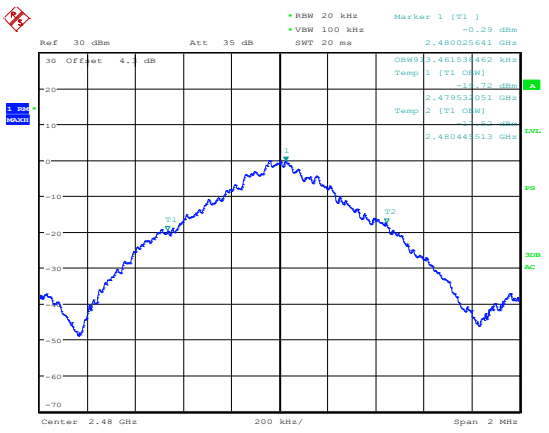


Figure 8.2-6: 20 dB bandwidth CLO Remote ANT - High Channel

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 7, 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.
Three orthogonal positions were evaluated during pre-scans and only the worst-case position was used for final and formal testing.
The Garmin Remote Control has a duty cycle of -17.52dB. This value will be adjusted in the Fundamental and Spurious table measurements.

For justification of Duty Cycle reductions see Section 3.4

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

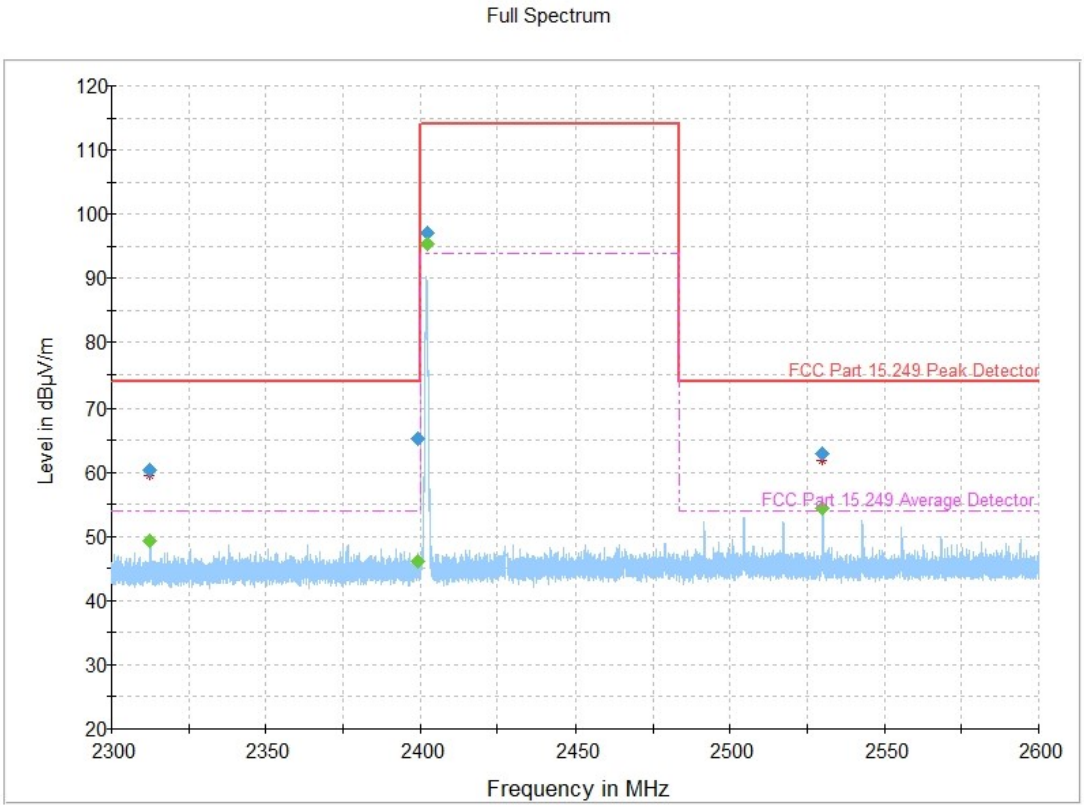


Figure 8.3-1: Field strength of Fundamental output power – Garmin CL0 Remote Control-ANT - Low Channel.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Duty Cycle (dB)	Av Meas with Duty Cycle (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2402.200000	97.16	---			114.00	16.84	5000.0	1000.000	290.0	V	209.0	9.0
2402.200000	---	95.44	17.52	77.92	93.97	**16.05***	5000.0	1000.000	290.0	V	209.0	9.0

Table 8.3-2: Field strength of Fundamental output power – Garmin CL0 Remote Control ANT - Low Channel

Note: (*) Adjusted value with 17.52dB duty cycle See table below.

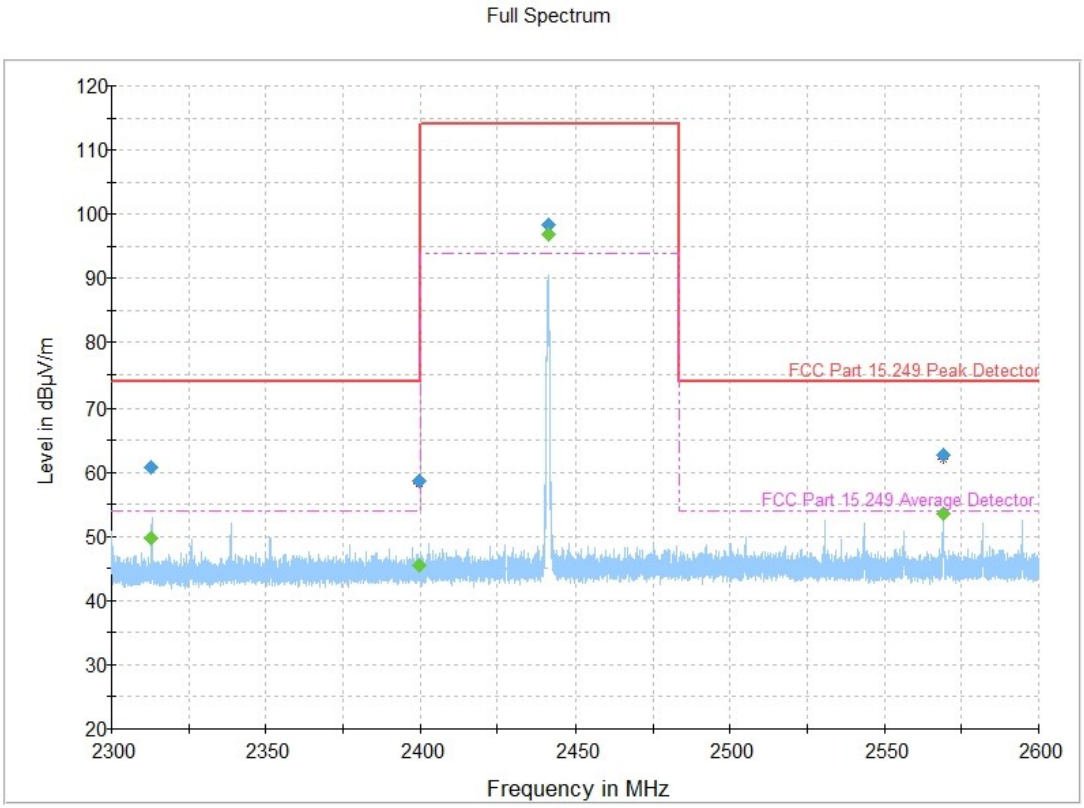


Figure 8.3-3: Field strength of Fundamental output power – Garmin CL0 Remote Control-ANT - Mid Channel.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Duty Cycle (dB)	Av Meas with Duty Cycle (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2441.19000	---	96.87	17.52	79.35	93.97	**14.62***	5000.0	1000.000	144.0	V	175.0	9.4
2441.19000	98.43	---			114.00	15.57	5000.0	1000.000	144.0	V	175.0	9.4

Table 8.3-4: Field strength of Fundamental output power – Garmin CL0 Remote Control ANT - Mid Channel

Note: (*) Adjusted value with 17.52dB duty cycle. See table below.

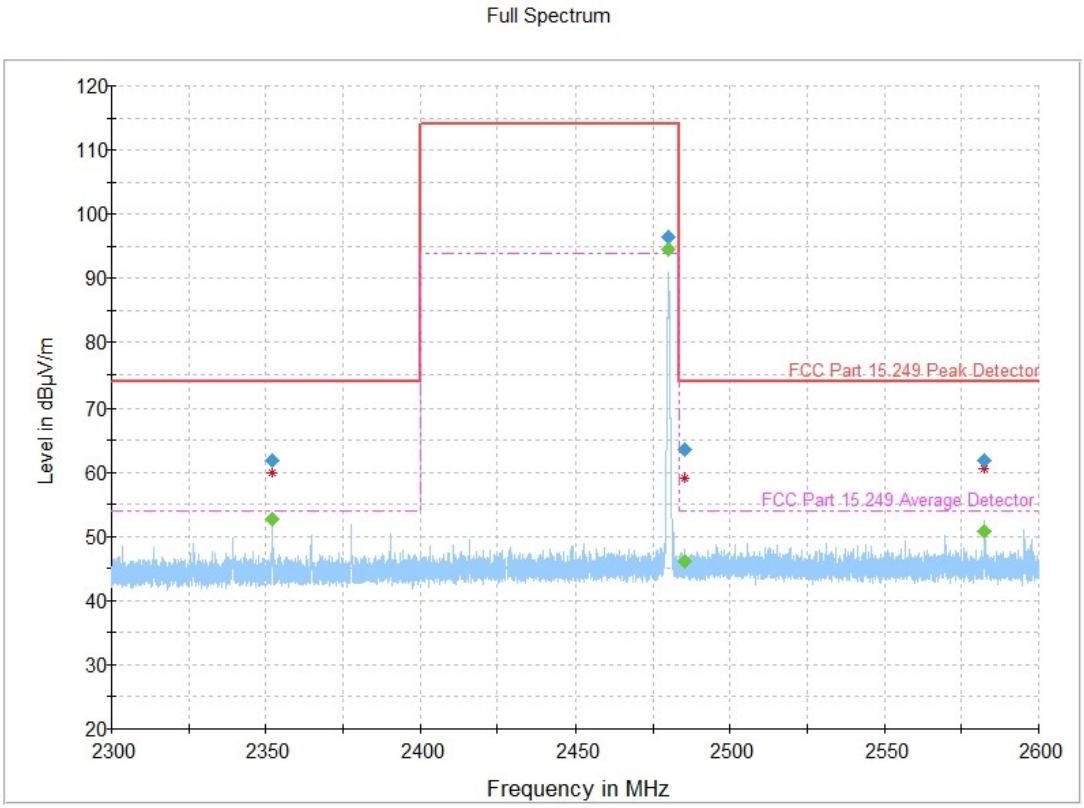


Figure 8.3-5: Field strength of Fundamental output power – Garmin CL0 Remote Control-ANT - High Channel.

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Duty Cycle (dB)	Av Meas with Duty Cycle (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2480.22000	---	94.57	17.52	77.05	93.97	**16.92***	5000.0	1000.000	146.0	V	180.0	9.5
2480.22000	96.34	---			114.00	17.66	5000.0	1000.000	146.0	V	180.0	9.5

Table 8.3-6: Field strength of Fundamental output power – Garmin CL0 Remote Control ANT - High Channel

Note: (*) Adjusted value with 17.52dB duty cycle. See table below.

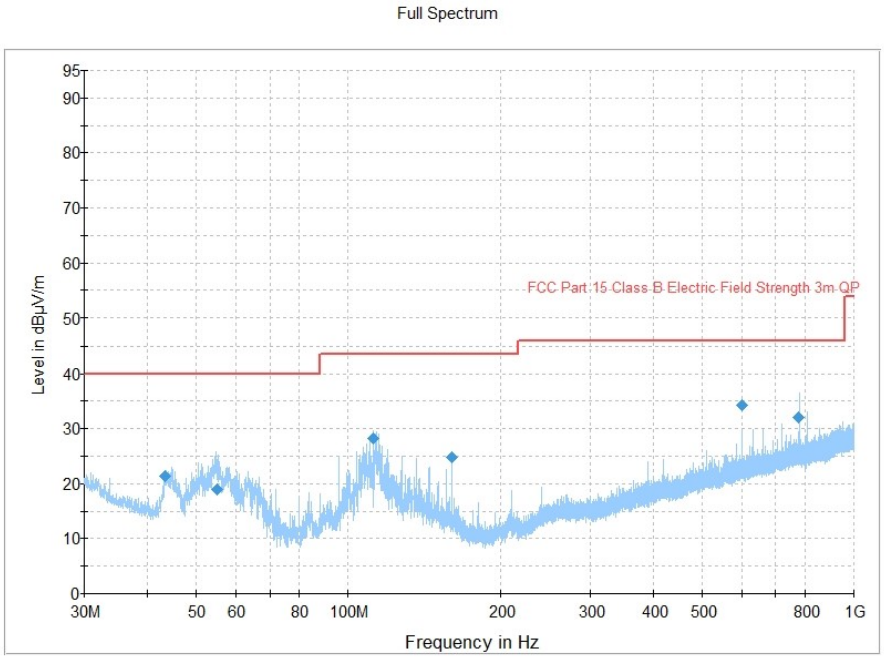


Figure 8.3-7: Field strength of spurious emissions 30MHz to 1GHz – Garmin CL0 Remote Control ANT

Note: *See table below for duty cycle*.

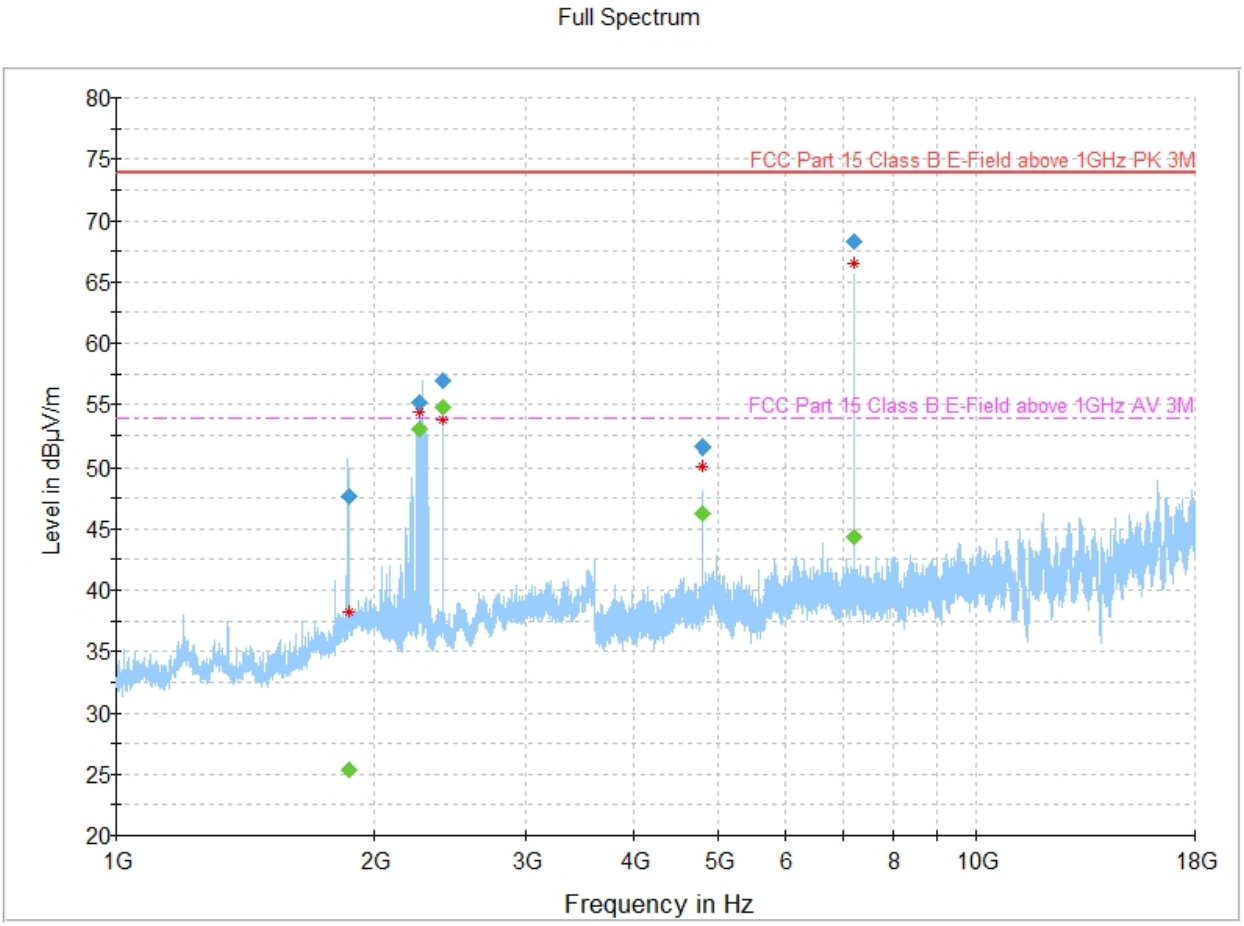


Figure 8.3-8: Field strength of spurious emissions 1GHz to 18GHz – Garmin CLo Remote Control ANT – Low Channel

Note: *See table below for duty cycle.*

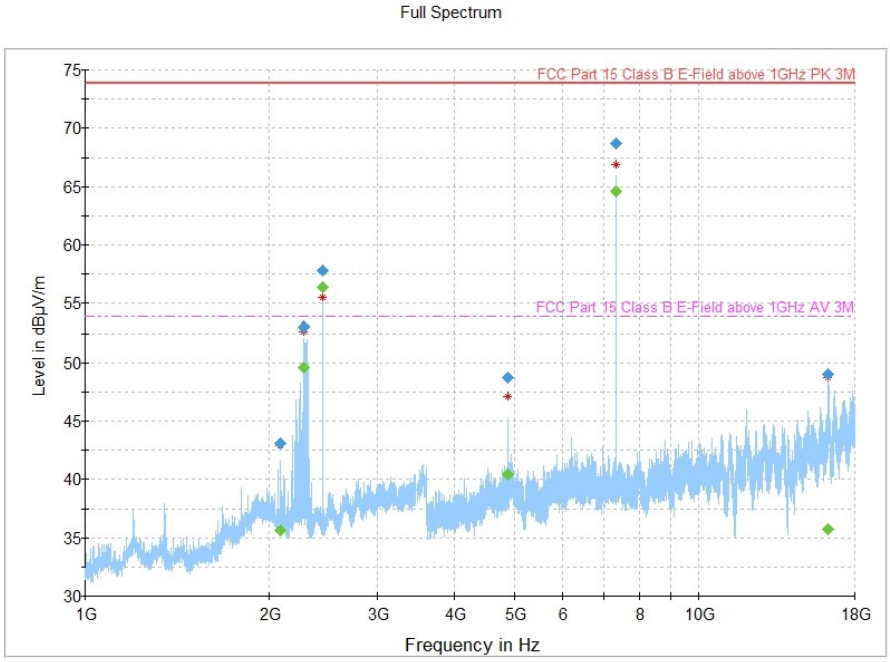


Figure 8.3-9: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL0 Remote Control ANT – Mid Channel

Note: *See table below for duty cycle.*

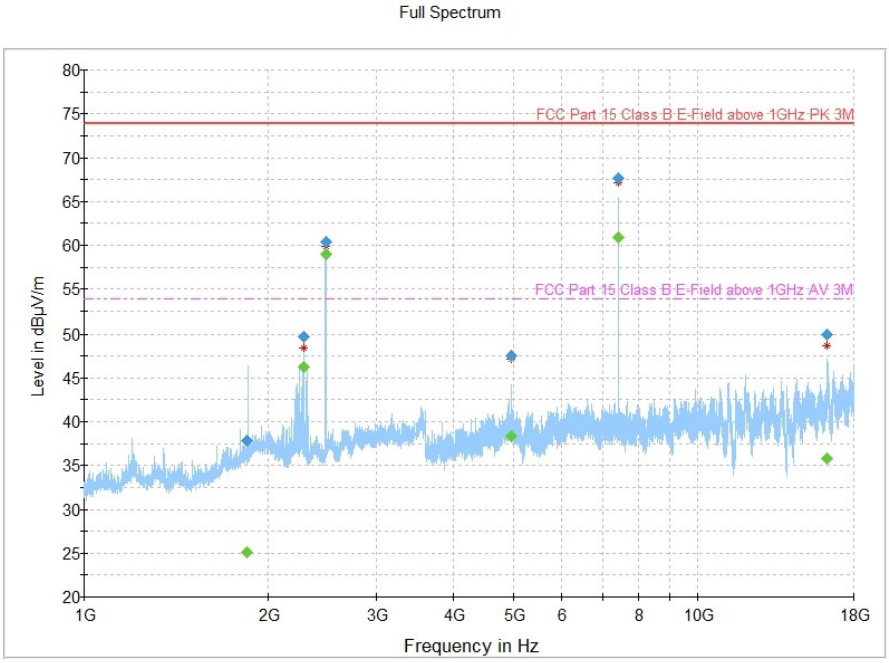


Figure 8.3-10: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL0 Remote Control ANT – High Channel

Note: *See table below for duty cycle.*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
43.471667	21.32	40.00	18.68	1000.0	120.000	103.0	V	157.0	13.3
55.079667	18.90	40.00	21.10	1000.0	120.000	309.0	V	6.0	8.0
112.037333	28.25	43.50	15.25	1000.0	120.000	368.0	V	13.0	13.0
160.012333	24.73	43.50	18.77	1000.0	120.000	400.0	V	221.0	12.8
600.004333	34.21	46.00	11.79	1000.0	120.000	260.0	H	153.0	23.4
777.554000	32.02	46.00	13.98	1000.0	120.000	250.0	H	281.0	25.6

Table 8.3-11: Field strength of spurious emissions 30MHz to 1GHz – Garmin CL0 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)	Comment
1867.366667	---	25.41	53.90	28.49	5000.0	1000.000	133.0	V	92.0	-12.0	
1867.366667	47.70	---	73.90	26.20	5000.0	1000.000	133.0	V	92.0	-12.0	
2261.233333	55.22	---	73.90	18.68	5000.0	1000.000	139.0	H	325.0	-11.5	
2261.233333	---	52.94	53.90	0.96	5000.0	1000.000	139.0	H	325.0	-11.5	
2402.166667	FUNDAMENTAL										
2402.166667											
4804.266667	51.59	---	73.90	22.31	5000.0	1000.000	114.0	V	222.0	-3.1	
4804.266667	---	46.25	53.90	7.65	5000.0	1000.000	114.0	V	222.0	-3.1	
7205.566667	68.34		73.90	5.56	5000.0	1000.000	132.0	V	-2.0	-1.1	
7205.566667	---	44.27*	53.90	9.63	5000.0	1000.000	132.0	V	-2.0	-1.1	Duty Cycle Corrected

Table 8.3-12: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL0 Remote Control ANT – Low Channel

Note: (*) Adjusted value with 17.52dB duty cycle.

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Duty Cycle (dB)	Av Meas with Duty Cycle (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2082.56666	---	35.68			53.90	18.22	5000.0	1000.000	131.0	H	316.0	-12.2
2082.56666	43.11	---			73.90	30.79	5000.0	1000.000	131.0	H	316.0	-12.2
2274.83333	---	49.56			53.90	4.34	5000.0	1000.000	107.0	H	316.0	-11.4
2274.83333	53.03	---			73.90	20.87	5000.0	1000.000	107.0	H	316.0	-11.4
2441.03333	**FUNDAMENTAL**											
2441.03333												
4882.46666	48.69	---			73.90	25.21	5000.0	1000.000	132.0	V	240.0	-3.3
4882.46666	---	40.39			53.90	13,51	5000.0	1000.000	132.0	V	240.0	-3.3
7323.10000	68.72	---			73.90	5.18	5000.0	1000.000	224.0	H	5.0	-1.0
7323.10000	---	64.61	17.52	47.09	53.90	**6.81***	5000.0	1000.000	224.0	H	5.0	-1.0
16301.0000	---	35.74	17.52	18.22	53.90	**35.70***	5000.0	1000.000	219.0	V	268.0	10.3
16301.0000	49.06	---			73.90	24.84	5000.0	1000.000	219.0	V	268.0	10.3

Table 8.3-13: Field strength of spurious emissions 1GHz to 18GHz – Garmin CL0 Remote Control ANT – Mid Channel

Note: (*) Adjusted value with 17.52dB duty cycle.

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Duty Cycle (dB)	Av Meas with Duty Cycle (dB)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1846.73333	---	25.13			53.90	28.77	5000.0	1000.000	221.0	H	310.0	-12.2
1846.73333	37.85	---			73.90	36.06	5000.0	1000.000	221.0	H	310.0	-12.2
2288.03333	---	46.29			53.90	7.61	5000.0	1000.000	153.0	H	311.0	-11.5
2288.03333	49.66	---			73.90	24.24	5000.0	1000.000	153.0	H	311.0	-11.5
2479.96666	**FUNDAMENTAL**											
2479.96666												
4959.86666	47.54	---			73.90	26.36	5000.0	1000.000	116.0	V	220.0	-3.5
4959.86666	---	38.34			53.90	15.56	5000.0	1000.000	116.0	V	220.0	-3.5
7439.60000	67.59	---			73.90	6.31	5000.0	1000.000	209.0	H	4.0	-0.5
7439.60000	---	60.95	17.52	43.43	53.90	**10.47***	5000.0	1000.000	209.0	H	4.0	-0.5
16304.2333	49.99	---			73.90	23.91	5000.0	1000.000	103.0	H	9.0	10.3
16304.2333	---	35.75	17.52	18.23	53.90	35.67	5000.0	1000.000	103.0	H	9.0	10.3

Table 8.3-14: Field strength of spurious emissions 1GHz to 18GHz – Garmin CLo Remote Control ANT – High Channel

Note: (*) Adjusted value with 17.52dB duty cycle.

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 10, 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

The Garmin Remote Control has a duty cycle of -17.52dB. This value will be adjusted in the table measurements.

For justification of Duty Cycle reductions see Section 3.4

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

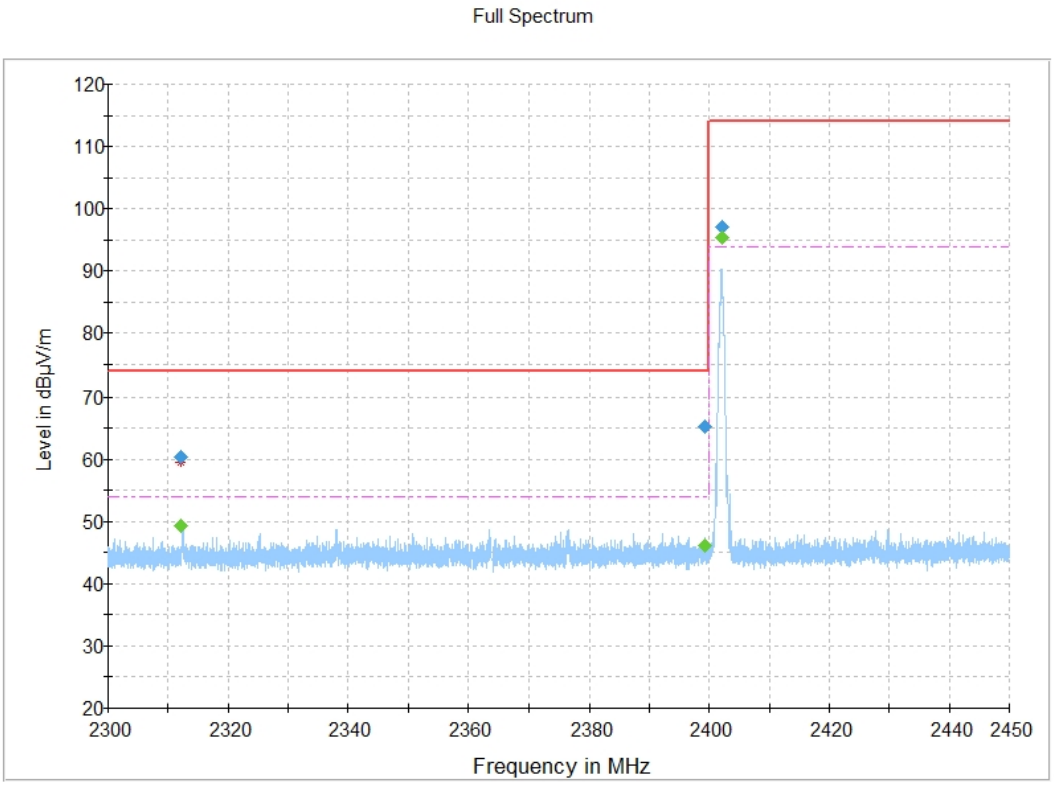


Figure 8.4-1: Field strength of emissions near band edges and restricted bands – Low Channel

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)
2312.230000	60.39	---	73.90	13.51	5000.0	1000.000	203.0	V	5.0	8.5
2312.230000	---	49.26	53.90	4.64	5000.0	1000.000	203.0	V	5.0	8.5
2399.290000	65.28	---	73.90	8.62	5000.0	1000.000	141.0	V	87.0	9.0
2399.290000	---	46.12	53.90	7.78	5000.0	1000.000	141.0	V	87.0	9.0

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

Note: (*) Adjusted value with 17.52dB duty cycle.

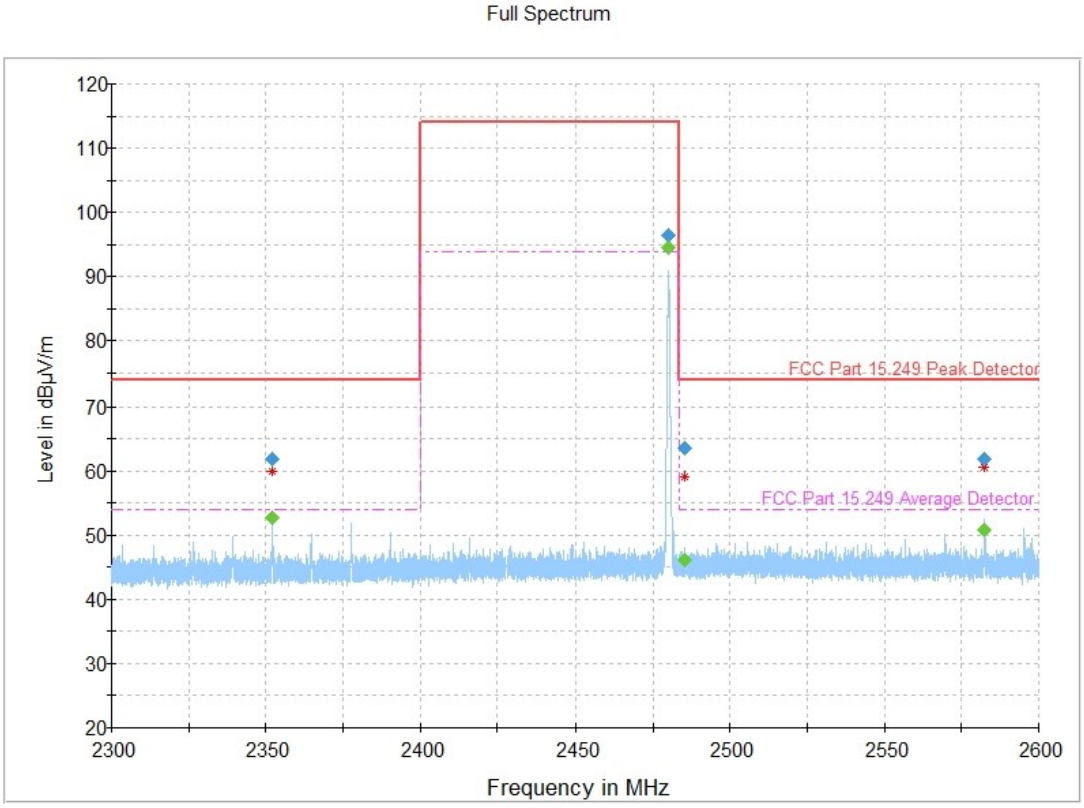


Figure 8.4-3: Field strength of emissions near band edges and restricted bands – High Channel

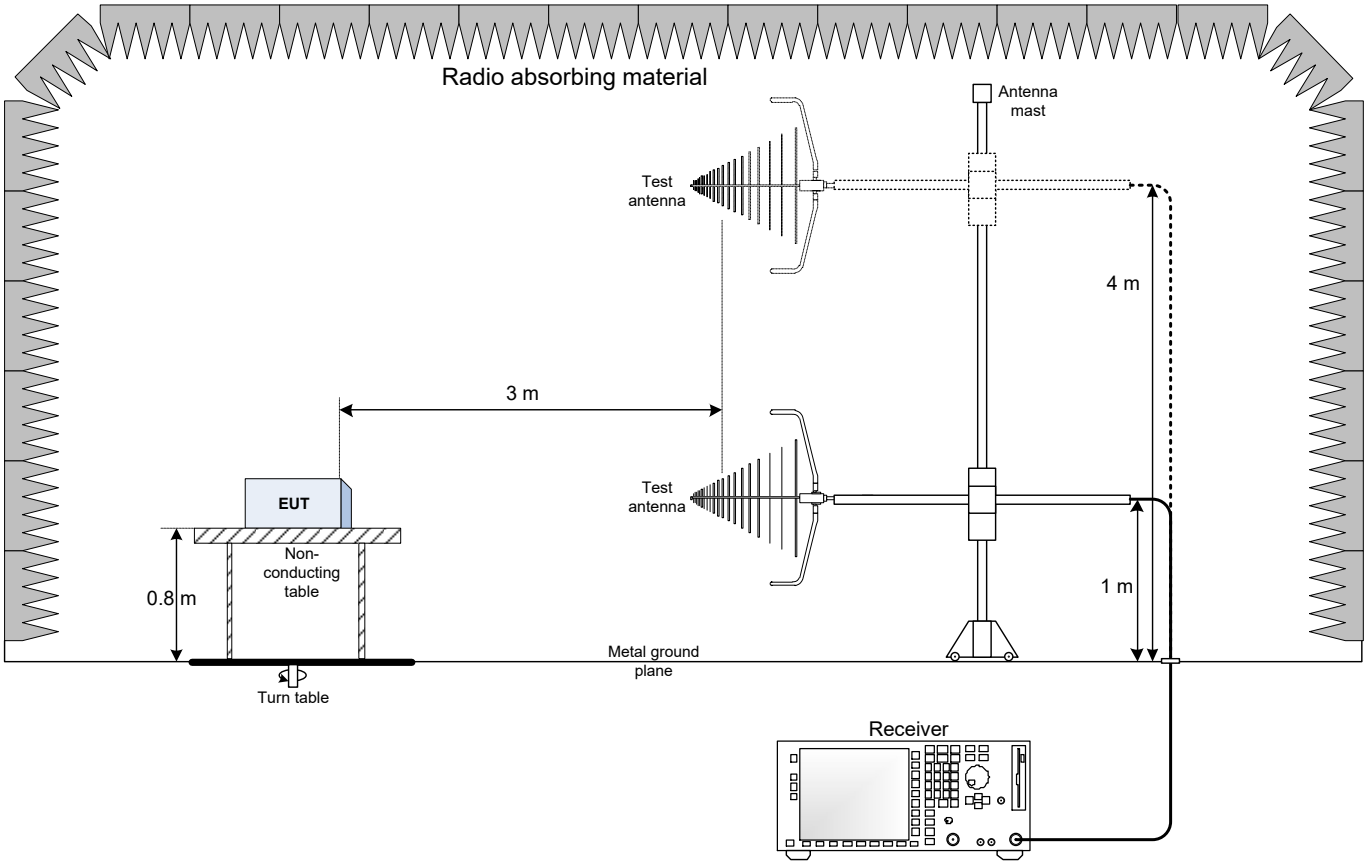
Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
2351.900000	61.92	---	73.90	11.99	5000.0	1000.000	128.0	V	188.0	8.7
2351.900000	---	52.74	53.90	1.16	5000.0	1000.000	128.0	V	188.0	8.7
2485.270000	63.45	---	73.90	10.45	5000.0	1000.000	210.0	V	279.0	9.5
2485.270000	---	46.10	53.90	7.80	5000.0	1000.000	210.0	V	279.0	9.5
2582.280000	---	50.75	53.90	3.15	5000.0	1000.000	114.0	V	148.0	9.6
2582.280000	61.91	---	73.90	11.99	5000.0	1000.000	114.0	V	148.0	9.6

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

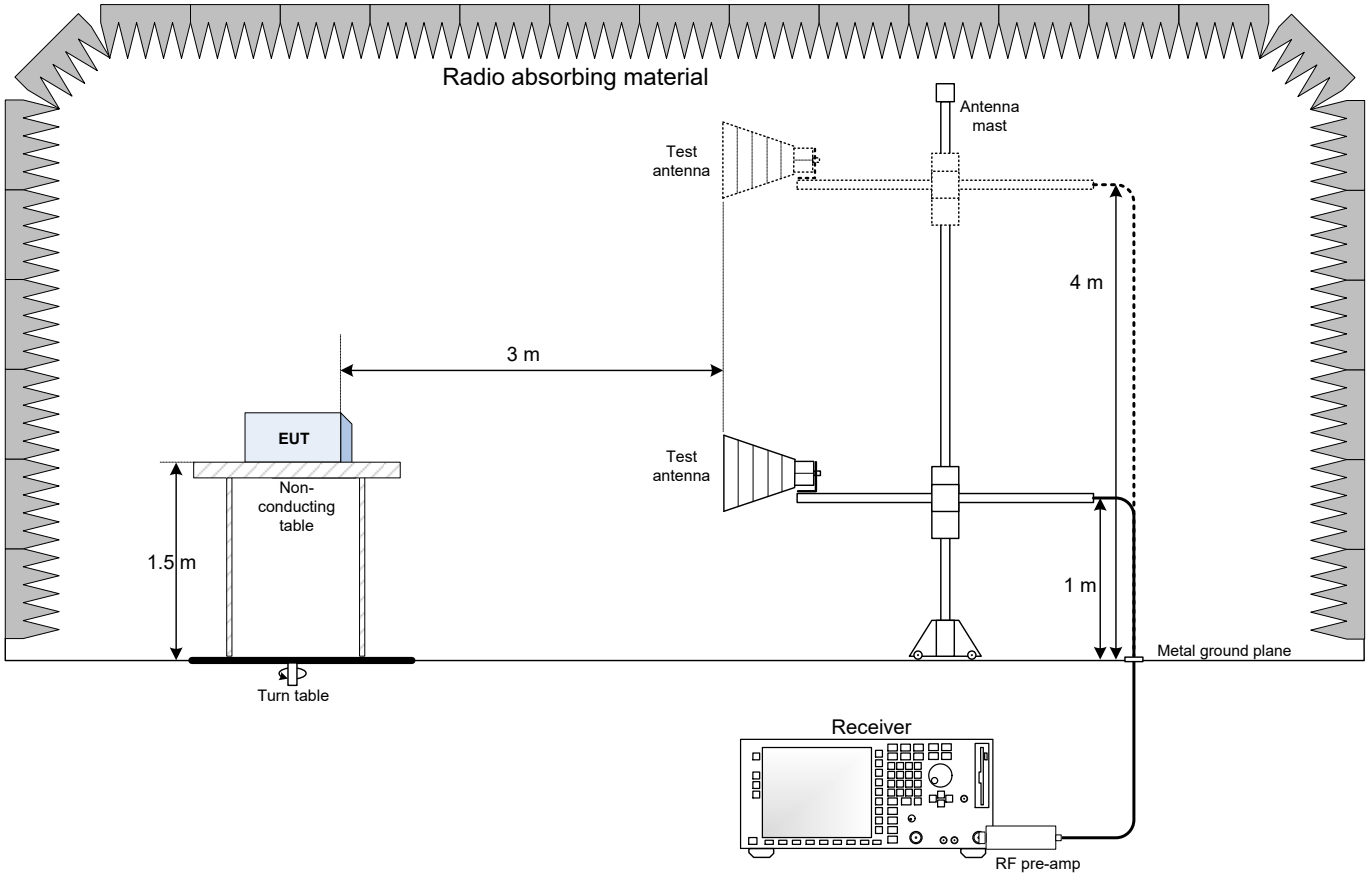
Note: (*) Adjusted value with 17.52dB duty cycle.

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