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Test report

Invention Planet Radar Module 341567A-TRFWL

Date of issue: February 6, 2018

Applicant: Invention Planet, LLC

Product: Smart Coach Radar Module

Model	Variants
SR1100	N/A

FCC ID: WZK-PR-1002

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247

  Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

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
Site number	FCC: US5058; IC: 2040B

Tested by	Nikolay Shtin, Senior Wireless Engineer
Reviewed by	Juan Manuel Gonzalez, Business Development Manager EMC/Wireless Division
Review date	February 6, 2018
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.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Invention Planet, LLC
Address	3535 Industrial Ave., Suite A4
City	Santa Rosa
Province/State	California
Postal/Zip code	95403
Country	USA

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

1.3 Test methods

ANSI C64.3-2014	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 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.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
	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[1]
§15.31(e)	Variation of power source	Pass
§15.203	Antenna requirement	Pass[2]
§15.205	Restricted bands of operation	Pass

Notes: [1] EUT is powered through USB/batteries and has no direct connection to the AC mains.

[2] The EUT uses trace antennas on PCB.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.247(a)(1)	20 dB bandwidth of the hopping channel	Not applicable
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Pass
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(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

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	December 11, 2017
Nemko sample ID number	21211

3.2 EUT information

Product name	Smart Coach Radar Module
Model	SR1100
Model variant	N/A
Serial number	N/A
FCC ID	WZK-PR-1002
IC Registration Number	N/A

3.3 Technical information

Frequency band	2400-2483.5 MHz
Frequency Min (MHz)	2402
Frequency Max (MHz)	2480
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted/ERP/EIRP	0.00163 (Conducted)
Field strength, Units @ distance	N/A
Measured BW (kHz) (6 dB)	709.3
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	GFSK
Emission classification (F1D, G1D, D1D)	W7D
Transmitter spurious, Units @ distance	50.18 dBµV/m @ 3m Peak / 47.84 dBµV/m @ 3m Average
Power requirements	3 VDC from 2xAAA batteries or 5 VDC through USB interface
Antenna information	PCB Inverted F Antenna, peak gain is 5.3 dBi. The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The Equipment Under Test (EUT) was an Invention Planet, LLC Smart Coach Radar Module . The EUT is a pocket-sized general purpose speed radar gun that can be used for many uses including traffic safety, radio controlled hobbies, motorsports, neighborhood safety, industrial safety, scientific research and much more. You decide what to measure and when, using one of two modes – snapshot or repeating – to accurately monitor the speeds of vehicles, radio controlled planes/cars, runners and any other moving object from 7-375 MPH (11-600 KPH). The EUT incorporates a low power radio operating in the 2400-2483.5 MHz ISM band.

3.5 EUT exercise details

A test software was used that allows the change of different RF modes/channels. EUT is set to fixed channel test mode with modulation.

RF conducted test was performed on unit with a temporary RF output port (50Ω SMA before antennas).

3.6 EUT setup diagram

Setup Photo in separate exhibit

Figure 3.6-1: *Radiated Emissions Test Setup – below 1GHz*

Setup Photo in separate exhibit

Figure 3.6-2: *Radiated Emissions Test Setup – above 1GHz*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
AC/DC USB Adapter	Phihong	PSA10F-050Q	N/A
Shielded high-speed USB cable	Copartner	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 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.
120VAC 60Hz

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.	7/28/2018
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 yr.	7/21/2018
Antenna, Horn	EMCO	3115	1033	1 yr.	7/27/2018
Spectrum Analyzer	Rohde & Schwarz	FSV40	E1120	1 yr.	7-27-2018
Signal Generator	Rohde & Schwarz	SMB 100A	E1128	1 yr.	9-13-2018
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

Section 8. Test Data

8.1 FCC 15.247(a) (2) Minimum 6 dB bandwidth

8.1.1 Definitions and limits

FCC 15.247:
(a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1.2 Test summary

Test date	December 12, 2017	Temperature	19 °C
Test engineer	Nikolay Shtin	Air pressure	1007 mbar
Verdict	Pass	Relative humidity	31.5 %

8.1.3 Observations, settings and special notes

Spectrum analyzer settings:

Resolution bandwidth	100 kHz
Video bandwidth	≥3 × RBW
Frequency span	5 MHz
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Table 8.1-1: *6 dB bandwidth results*

Modulation	Frequency, MHz	6dB bandwidth, kHz	Limit, kHz	Margin, kHz
GFSK	2402	709.3	500	209.3
	2442	709.3	500	209.3
	2480	709.3	500	209.3

Date: 12.DEC.2017 11:37:47

Figure 8.1-1: *6 dB bandwidth, Low CH*

Date: 12.DEC.2017 12:00:00

Figure 8.1-2: *6 dB bandwidth, Mid CH*

Date: 12.DEC.2017 11:55:13

Figure 8.1-3: *6 dB bandwidth, High CH*

8.2 FCC 15.247(b) Transmitter output power and e.i.r.p. requirements

8.2.1 Definitions and limits

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 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.

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

8.2.2 Test summary

Test date	December 12, 2017	Temperature	20 °C
Test engineer	Nikolay Shtin	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	56 %

8.2.3 Observations, settings and special notes

Peak Conducted Power Measured
Spectrum analyser settings:

Resolution bandwidth	≥ Channel BW (1MHz)
Video bandwidth	≥ 3 × RBW (3MHz)
Frequency span	≥ 3 x RBW (3MHz)
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: *Output power measurements results*

Modulation	Frequency, MHz	Conducted output power, dBm		Margin, dB	Max Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
GFSK	2402	2.11	30	27.89	5.3	7.76	36	28.24
	2440	1.70	30	28.30	5.3	7.00	36	29.00
	2480	1.35	30	28.65	5.3	6.65	36	29.35

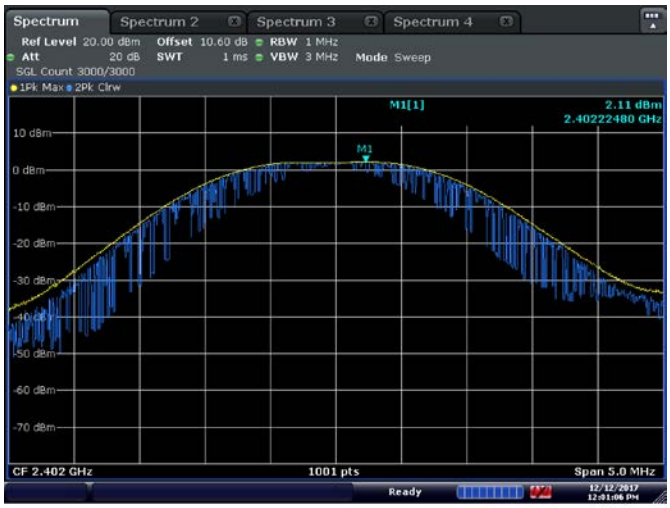

Figure 8.2-1: *Output Power, Low CH*

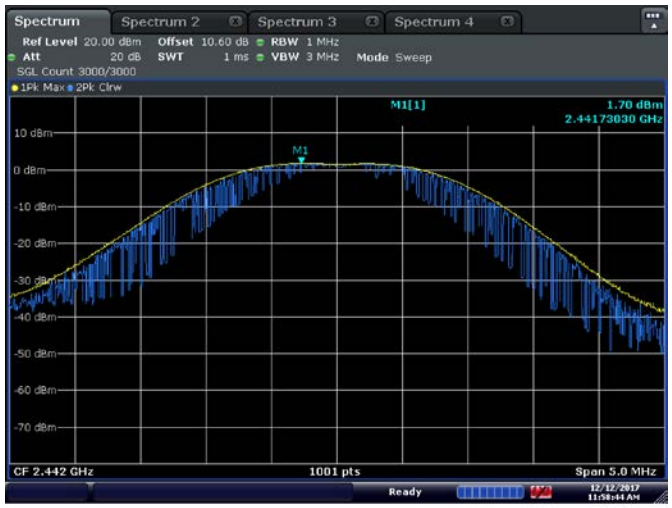

Figure 8.2-2: *Output Power, Mid CH*

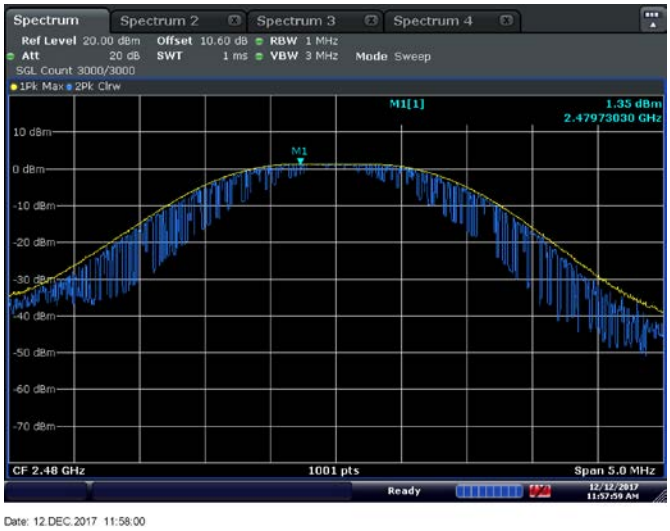

Figure 8.2-3: *Output Power, High CH*

8.3 FCC 15.247(d) Spurious (out-of-band) emissions

8.3.1 Definitions and limits

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)).

Table 8.3-1: *FCC §15.209 – Radiated emission limits*

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

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

Table 8.3-2: *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			

8.3.2 Test summary

Test date	December 12, 2016	Temperature	20 °C
Test engineer	Nikolay Shtin	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	55 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
EUT was set to transmit with 100 % duty cycle.
Antenna 0 path was selected for most radiated test cases as worst case.

Spectrum analyser settings for conducted spurious emissions measurements:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

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

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	AVG
Trace mode:	Max Hold

8.3.4 Test data

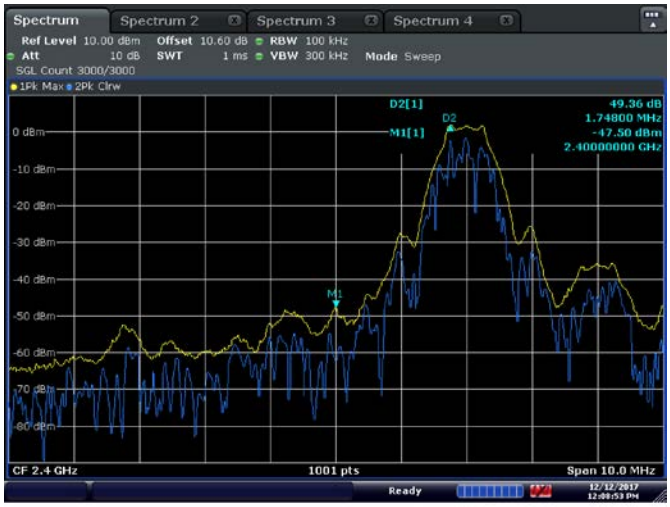

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Figure 8.3.1: *Band-edge Measurement, low channel*

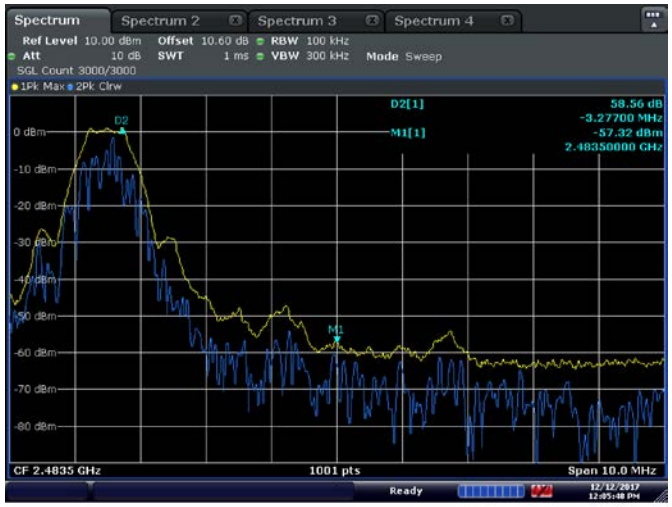

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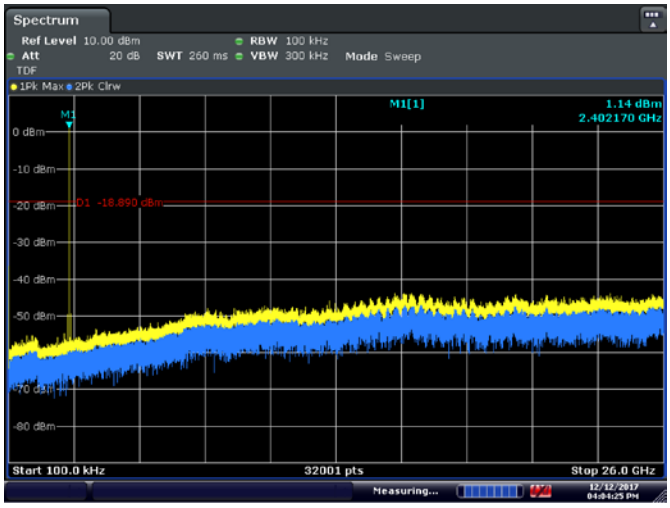
Figure 8.3.2: *Band-edge Measurement, high channel*



Date: 12.DEC.2017 16:04:26

Figure 8.3.3: *Conducted spurious emissions, low channel*

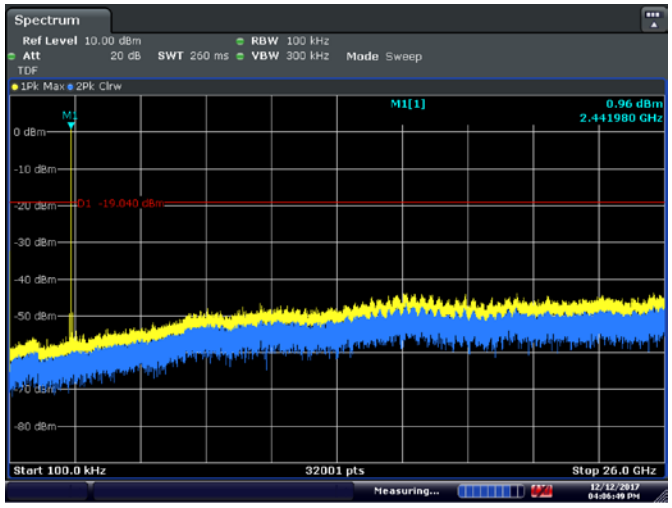


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Figure 8.3.4: *Conducted spurious emissions, mid channel*

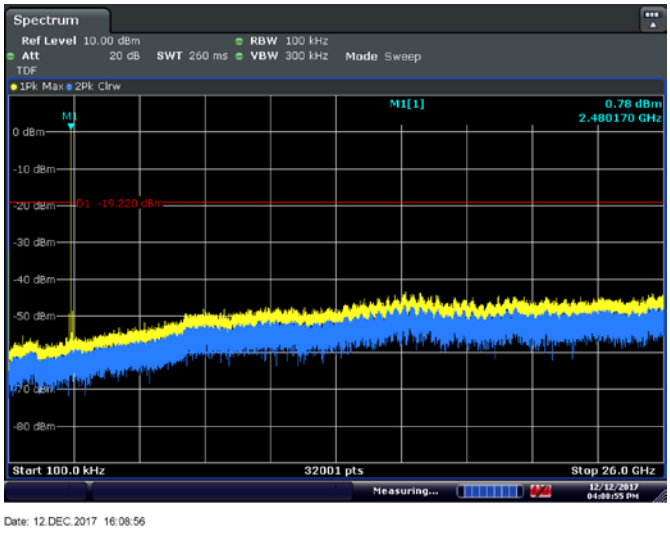

Figure 8.3.5: *Conducted spurious emissions, high channel*

Note: Peaks within 2400-2483.5MHz are transmitter fundamentals.

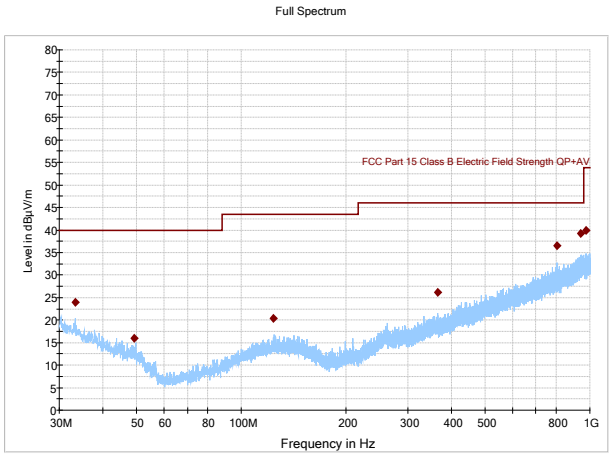

Figure 8.3.6: *Radiated spurious emissions, low channel, 30-1000MHz*

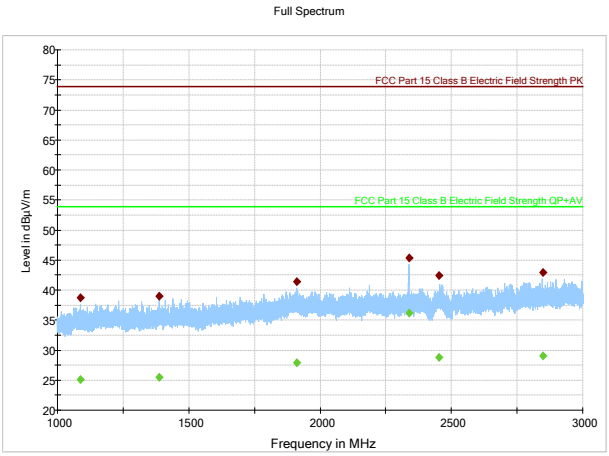

Figure 8.3.7: *Radiated spurious emissions, low channel, 1-3GHz*

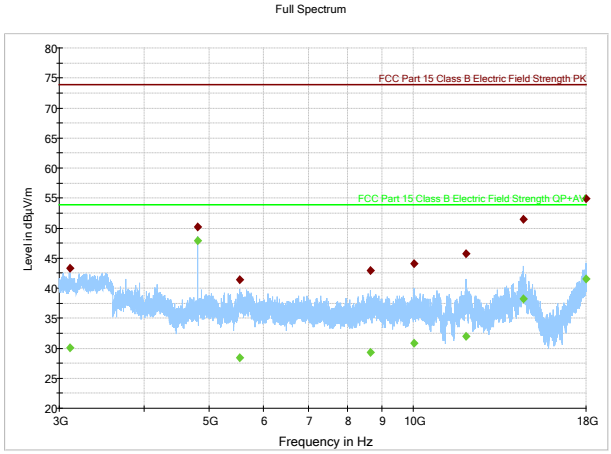

Figure 8.3.8: *Radiated spurious emissions, low channel, 3-18GHz*

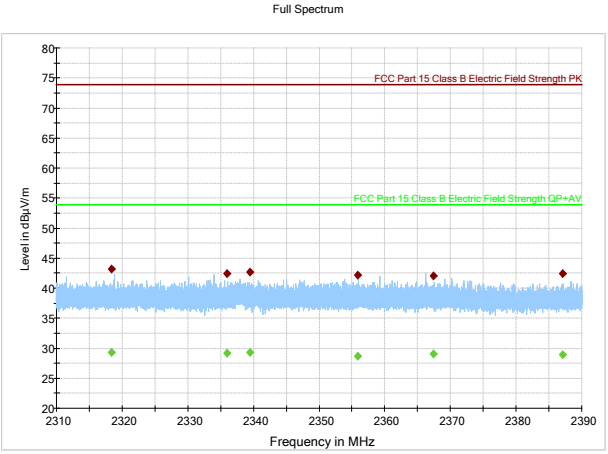

Figure 8.3.9: *Radiated spurious emissions in the 2.31-2.39GHz Restricted Band, low channel*

Table 8.3-3: *Radiated field strength measurement results for low channel 2402MHz*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
33.298000	23.97	40.00	16.03	5000.0	120.000	232.0	H	0.0
49.202500	15.89	40.00	24.11	5000.0	120.000	238.0	V	62.0
123.567500	20.38	43.50	23.12	5000.0	120.000	390.8	V	294.0
365.906000	26.22	46.00	19.78	5000.0	120.000	404.6	V	303.0
803.067000	36.44	46.00	9.56	5000.0	120.000	239.5	H	32.0
943.181000	39.31	46.00	6.69	5000.0	120.000	181.8	V	353.0
973.127500	39.92	53.90	13.98	5000.0	120.000	198.7	V	349.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1086.23333	38.74	---	73.90	35.16	5000.0	1000.000	410.0	H	154.0
1086.23333	---	25.10	53.90	28.80	5000.0	1000.000	410.0	H	154.0
1386.03333	---	25.45	53.90	28.45	5000.0	1000.000	227.1	H	0.0
1386.03333	38.97	---	73.90	34.93	5000.0	1000.000	227.1	H	0.0
1910.56666	---	27.87	53.90	26.03	5000.0	1000.000	396.0	V	184.0
1910.56666	41.37	---	73.90	32.53	5000.0	1000.000	396.0	V	184.0
2338.23333	---	36.22	53.90	17.68	5000.0	1000.000	109.6	H	264.0
2338.23333	45.29	---	73.90	28.61	5000.0	1000.000	109.6	H	264.0
2453.43333	---	28.85	53.90	25.05	5000.0	1000.000	404.6	V	26.0
2453.43333	42.39	---	73.90	31.51	5000.0	1000.000	404.6	V	26.0
2847.36666	42.93	---	73.90	30.97	5000.0	1000.000	371.7	H	282.0
2847.36666	---	29.01	53.90	24.89	5000.0	1000.000	371.7	H	282.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
3111.90000	---	30.08	53.90	23.82	5000.0	1000.000	385.1	H	55.0
3111.90000	43.26	---	73.90	30.64	5000.0	1000.000	385.1	H	55.0
4805.80000	50.18	---	73.90	23.72	5000.0	1000.000	117.5	V	252.0
4805.80000	---	47.84	53.90	6.06	5000.0	1000.000	117.5	V	252.0
5544.60000	41.35	---	73.90	32.55	5000.0	1000.000	377.7	V	185.0
5544.60000	---	28.41	53.90	25.49	5000.0	1000.000	377.7	V	185.0
8639.00000	42.96	---	73.90	30.94	5000.0	1000.000	297.2	V	0.0
8639.00000	---	29.29	53.90	24.61	5000.0	1000.000	297.2	V	0.0
10033.3000	44.04	---	73.90	29.86	5000.0	1000.000	253.6	H	0.0
10033.3000	---	30.83	53.90	23.07	5000.0	1000.000	253.6	H	0.0
11972.8000	---	32.02	53.90	21.88	5000.0	1000.000	149.0	V	334.0
11972.8000	45.67	---	73.90	28.23	5000.0	1000.000	149.0	V	334.0
14545.3000	51.49	---	73.90	22.41	5000.0	1000.000	380.0	V	0.0
14545.3000	---	38.16	53.90	15.74	5000.0	1000.000	380.0	V	0.0
17998.0000	54.96	---	73.90	18.94	5000.0	1000.000	189.2	H	191.0
17998.0000	---	41.54	53.90	12.36	5000.0	1000.000	189.2	H	191.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2318.37200	---	29.24	53.90	24.66	5000.0	1000.000	342.3	H	34.0
2318.37200	43.21	---	73.90	30.69	5000.0	1000.000	342.3	H	34.0
2335.92933	---	29.18	53.90	24.72	5000.0	1000.000	362.3	V	273.0
2335.92933	42.40	---	73.90	31.50	5000.0	1000.000	362.3	V	273.0
2339.48133	42.63	---	73.90	31.27	5000.0	1000.000	404.6	V	312.0
2339.48133	---	29.31	53.90	24.59	5000.0	1000.000	404.6	V	312.0
2355.85200	42.10	---	73.90	31.80	5000.0	1000.000	284.8	V	261.0
2355.85200	---	28.67	53.90	25.23	5000.0	1000.000	284.8	V	261.0
2367.35866	---	29.02	53.90	24.88	5000.0	1000.000	322.7	V	0.0
2367.35866	42.00	---	73.90	31.90	5000.0	1000.000	322.7	V	0.0
2387.11333	---	28.92	53.90	24.98	5000.0	1000.000	394.3	V	303.0
2387.11333	42.41	---	73.90	31.49	5000.0	1000.000	394.3	V	303.0

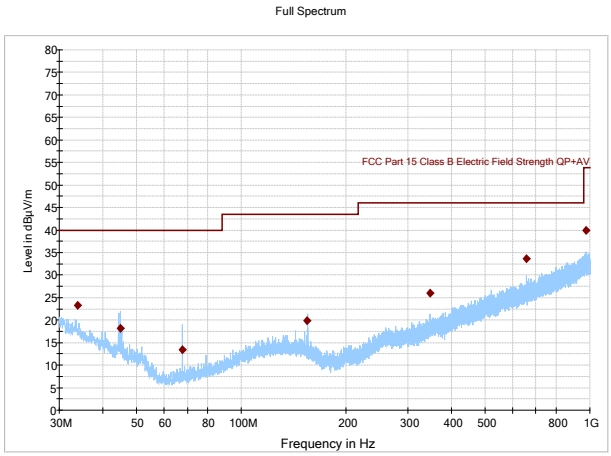

Figure 8.3.10: *Radiated spurious emissions, mid channel, 30-1000MHz*

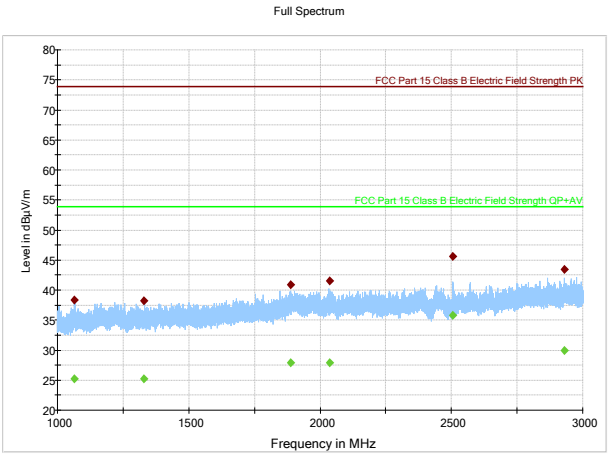

Figure 8.3.11: *Radiated spurious emissions, mid channel, 1-3GHz*

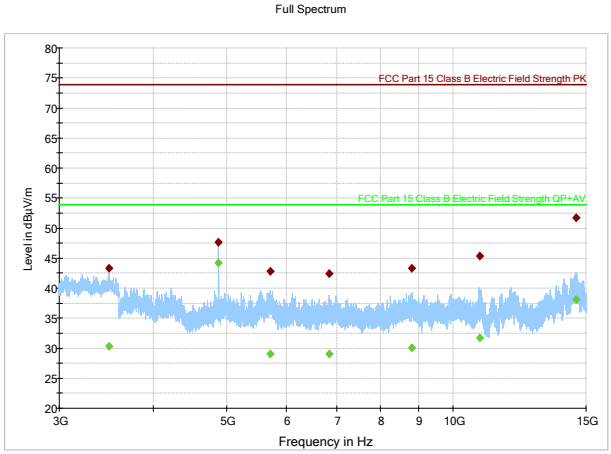

Figure 8.3.12: *Radiated spurious emissions, mid channel, 3-18GHz*

Table 8.3-4: *Radiated field strength measurement results for mid channel 2442 MHz*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
33.946500	23.35	40.00	16.65	5000.0	120.000	213.9	H	357.0
44.929500	18.10	40.00	21.90	5000.0	120.000	267.3	V	25.0
67.741500	13.39	40.00	26.61	5000.0	120.000	366.5	H	357.0
154.356500	19.81	43.50	23.69	5000.0	120.000	258.3	V	222.0
347.968500	26.03	46.00	19.97	5000.0	120.000	198.6	H	176.0
656.568000	33.66	46.00	12.34	5000.0	120.000	317.1	H	302.0
976.164500	39.98	53.90	13.92	5000.0	120.000	254.6	V	333.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1064.16666	38.34	---	73.90	35.56	5000.0	1000.000	404.6	V	18.0
1064.16666	---	25.18	53.90	28.72	5000.0	1000.000	404.6	V	18.0
1330.10000	---	25.23	53.90	28.67	5000.0	1000.000	364.3	H	353.0
1330.10000	38.20	---	73.90	35.70	5000.0	1000.000	364.3	H	353.0
1887.70000	40.83	---	73.90	33.07	5000.0	1000.000	404.6	V	303.0
1887.70000	---	27.95	53.90	25.95	5000.0	1000.000	404.6	V	303.0
2035.70000	41.51	---	73.90	32.39	5000.0	1000.000	396.7	V	108.0
2035.70000	---	27.84	53.90	26.06	5000.0	1000.000	396.7	V	108.0
2506.30000	---	35.74	53.90	18.16	5000.0	1000.000	107.4	H	266.0
2506.30000	45.54	---	73.90	28.36	5000.0	1000.000	107.4	H	266.0
2929.63333	43.49	---	73.90	30.41	5000.0	1000.000	391.3	V	86.0
2929.63333	---	29.89	53.90	24.01	5000.0	1000.000	391.3	V	86.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
3493.40000	43.31	---	73.90	30.59	5000.0	1000.000	410.0	H	351.0
3493.40000	---	30.35	53.90	23.55	5000.0	1000.000	410.0	H	351.0
4881.80000	---	44.17	53.90	9.73	5000.0	1000.000	98.0	V	253.0
4881.80000	47.66	---	73.90	26.24	5000.0	1000.000	98.0	V	253.0
5717.50000	42.87	---	73.90	31.03	5000.0	1000.000	404.6	V	222.0
5717.50000	---	29.07	53.90	24.83	5000.0	1000.000	404.6	V	222.0
6843.80000	42.38	---	73.90	31.52	5000.0	1000.000	404.6	V	310.0
6843.80000	---	29.01	53.90	24.89	5000.0	1000.000	404.6	V	310.0
8805.40000	43.35	---	73.90	30.55	5000.0	1000.000	311.8	V	176.0
8805.40000	---	30.03	53.90	23.87	5000.0	1000.000	311.8	V	176.0
10829.1000	---	31.74	53.90	22.16	5000.0	1000.000	244.0	H	244.0
10829.1000	45.33	---	73.90	28.57	5000.0	1000.000	244.0	H	244.0
14551.3000	51.72	---	73.90	22.18	5000.0	1000.000	236.0	V	192.0
14551.3000	---	38.10	53.90	15.80	5000.0	1000.000	236.0	V	192.0
17995.0000	55.24	---	73.90	18.66	5000.0	1000.000	404.6	V	176.0
17995.0000	---	41.51	53.90	12.39	5000.0	1000.000	404.6	V	176.0

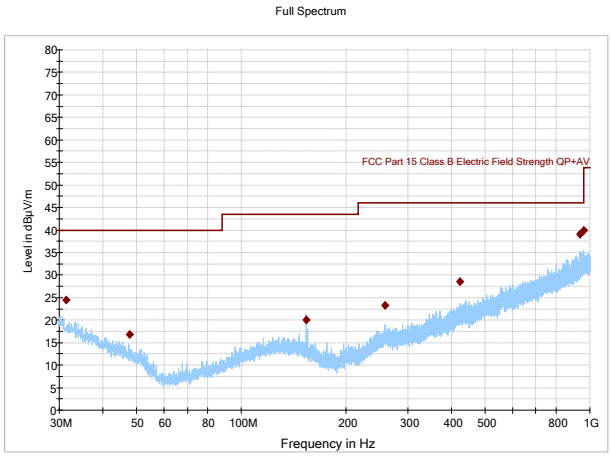

Figure 8.3.13: *Radiated spurious emissions, high channel, 30-1000MHz*

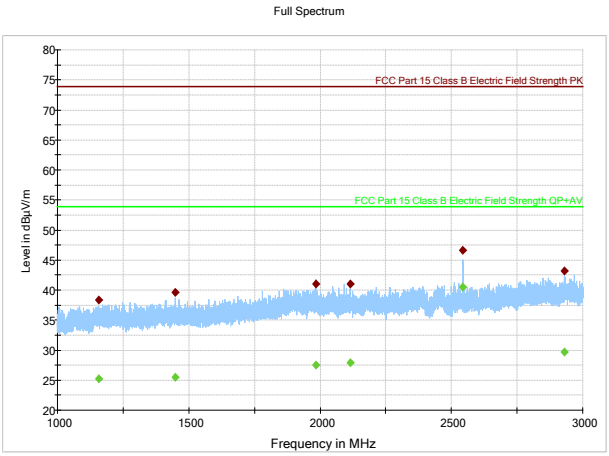

Figure 8.3.14: *Radiated spurious emissions, high channel, 1-3GHz*

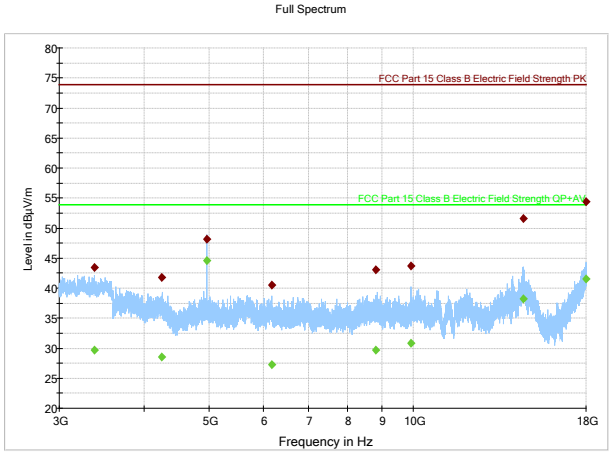

Figure 8.3.15: *Radiated spurious emissions, high channel, 3-18GHz*

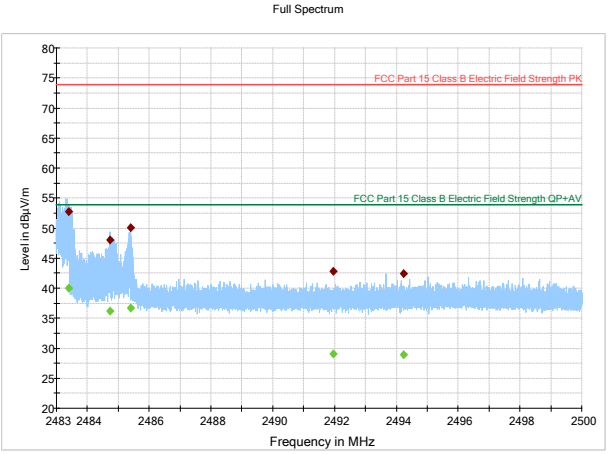

Figure 8.3.16: *Radiated spurious emissions in the 2.4835-2.5GHz Restricted Band, high channel*

Table 8.3-5: *Radiated field strength measurement results for high channel 2480MHz*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
31.441500	24.51	40.00	15.49	5000.0	120.000	195.7	H	101.0
47.748500	16.87	40.00	23.13	5000.0	120.000	113.5	V	0.0
153.123500	20.10	43.50	23.40	5000.0	120.000	110.9	V	146.0
258.732000	23.19	46.00	22.81	5000.0	120.000	146.3	V	146.0
424.610500	28.61	46.00	17.39	5000.0	120.000	281.7	H	322.0
934.788000	39.03	46.00	6.97	5000.0	120.000	245.4	H	84.0
961.225500	39.95	53.90	13.95	5000.0	120.000	272.0	V	0.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1155.83333	---	25.16	53.90	28.74	5000.0	1000.000	190.7	H	355.0
1155.83333	38.36	---	73.90	35.54	5000.0	1000.000	190.7	H	355.0
1449.56666	39.56	---	73.90	34.34	5000.0	1000.000	381.6	V	351.0
1449.56666	---	25.48	53.90	28.42	5000.0	1000.000	381.6	V	351.0
1983.30000	40.99	---	73.90	32.91	5000.0	1000.000	305.7	H	153.0
1983.30000	---	27.46	53.90	26.44	5000.0	1000.000	305.7	H	153.0
2114.70000	41.00	---	73.90	32.90	5000.0	1000.000	410.0	H	176.0
2114.70000	---	27.84	53.90	26.06	5000.0	1000.000	410.0	H	176.0
2543.96666	---	40.48	53.90	13.42	5000.0	1000.000	109.5	H	273.0
2543.96666	46.68	---	73.90	27.22	5000.0	1000.000	109.5	H	273.0
2928.70000	43.21	---	73.90	30.69	5000.0	1000.000	404.6	V	192.0
2928.70000	---	29.74	53.90	24.16	5000.0	1000.000	404.6	V	192.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
3381.90000	43.47	---	73.90	30.43	5000.0	1000.000	384.5	V	236.0
3381.90000	---	29.67	53.90	24.23	5000.0	1000.000	384.5	V	236.0
4256.00000	---	28.60	53.90	25.30	5000.0	1000.000	410.0	H	0.0
4256.00000	41.73	---	73.90	32.17	5000.0	1000.000	410.0	H	0.0
4957.90000	48.13	---	73.90	25.77	5000.0	1000.000	107.7	V	250.0
4957.90000	---	44.61	53.90	9.29	5000.0	1000.000	107.7	V	250.0
6179.40000	---	27.29	53.90	26.61	5000.0	1000.000	99.9	H	244.0
6179.40000	40.54	---	73.90	33.36	5000.0	1000.000	99.9	H	244.0
8808.50000	---	29.70	53.90	24.20	5000.0	1000.000	112.2	H	330.0
8808.50000	43.00	---	73.90	30.90	5000.0	1000.000	112.2	H	330.0
9924.40000	43.68	---	73.90	30.22	5000.0	1000.000	333.3	H	90.0
9924.40000	---	30.85	53.90	23.05	5000.0	1000.000	333.3	H	90.0
14529.0000	51.57	---	73.90	22.33	5000.0	1000.000	404.7	V	175.0
14529.0000	---	38.25	53.90	15.65	5000.0	1000.000	404.7	V	175.0
17997.3000	---	41.48	53.90	12.42	5000.0	1000.000	179.3	H	323.0
17997.3000	54.46	---	73.90	19.44	5000.0	1000.000	179.3	H	323.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2483.40000	---	39.99	53.90	13.91	5000.0	1000.000	109.3	H	264.0
2483.40000	52.78	---	73.90	21.12	5000.0	1000.000	109.3	H	264.0
2484.73716	---	36.18	53.90	17.72	5000.0	1000.000	98.0	H	260.0
2484.73716	48.06	---	73.90	25.84	5000.0	1000.000	98.0	H	260.0
2485.40740	50.06	---	73.90	23.84	5000.0	1000.000	252.3	H	0.0
2485.40740	---	36.72	53.90	17.18	5000.0	1000.000	252.3	H	0.0
2491.96806	42.81	---	73.90	31.09	5000.0	1000.000	404.6	V	146.0
2491.96806	---	29.03	53.90	24.87	5000.0	1000.000	404.6	V	146.0
2494.23990	42.43	---	73.90	31.47	5000.0	1000.000	323.2	V	97.0
2494.23990	---	28.92	53.90	24.98	5000.0	1000.000	323.2	V	97.0

8.4 FCC 15.247(e) Power Spectrum Density

8.4.1 Definitions and limits

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.

8.4.2 Test summary

Test date	December 12, 2016	Temperature	20 °C
Test engineer	Nikolay Shtin	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	55 %

8.4.3 Observations, settings and special notes

50kHz RBW

8.4.4 Test data

Table 8.4-1: *Power Spectrum Density*

Modulation	Frequency, MHz	Conducted PSD@50kHz, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
GFSK	2402	1.25	8	6.75	5.3	6.55	14	7.45
	2440	0.33	8	7.67	5.3	5.63	14	8.37
	2480	0.73	8	5.30	5.3	6.03	14	7.97

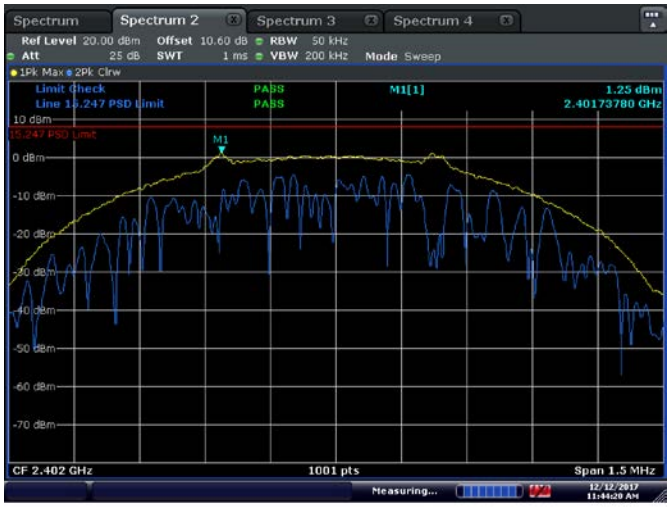

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Figure 8.4-1: *PSD, Low CH*

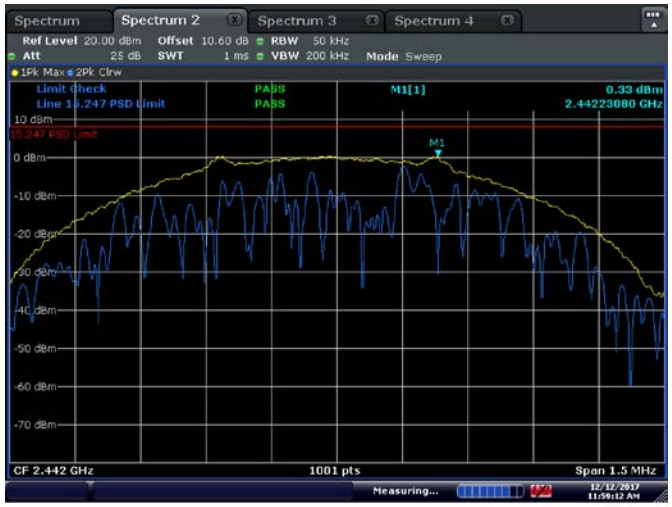

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Figure 8.4-2: *PSD, Mid CH*

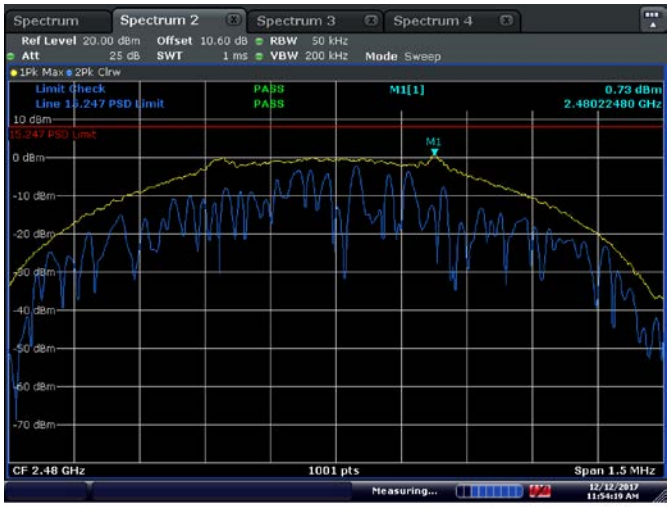

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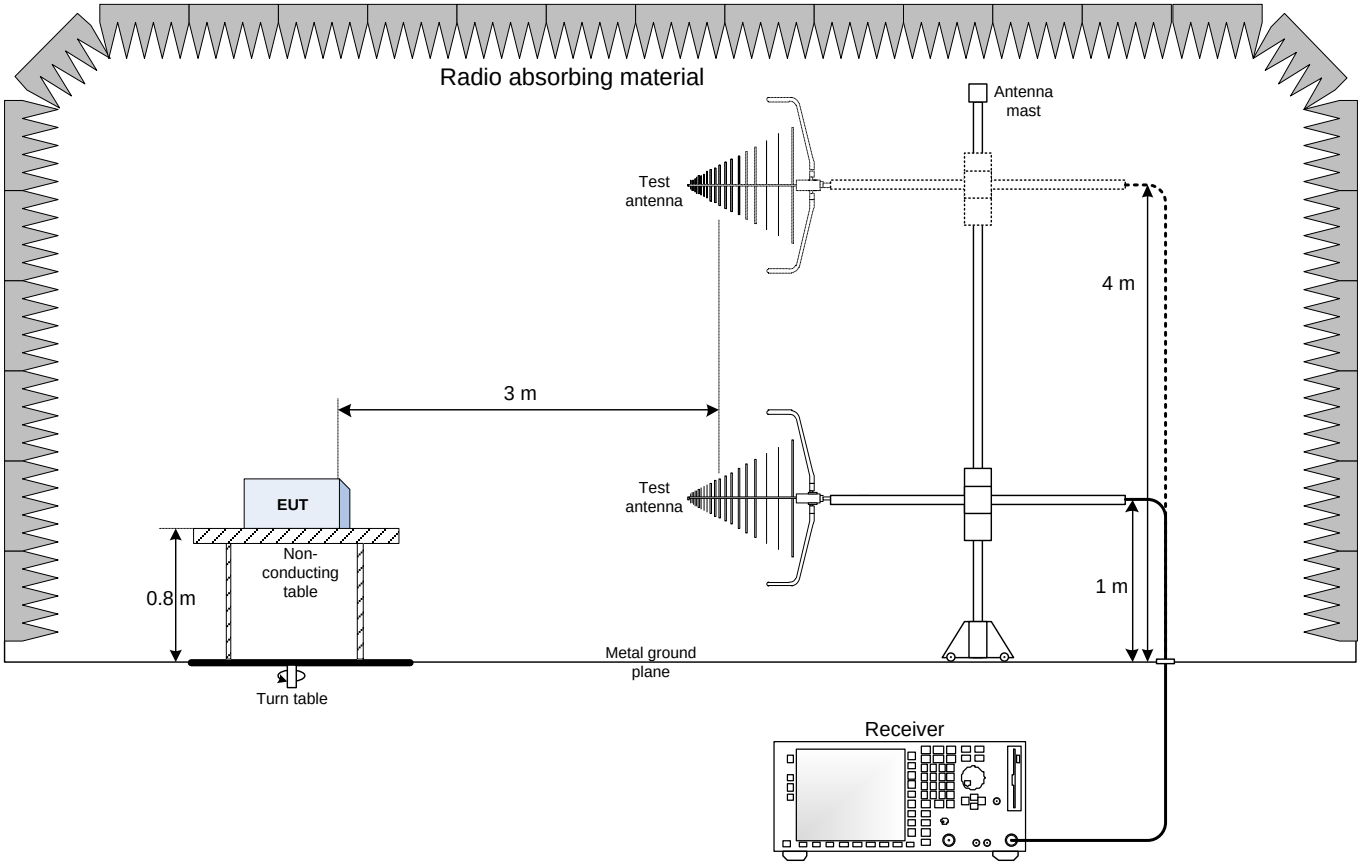
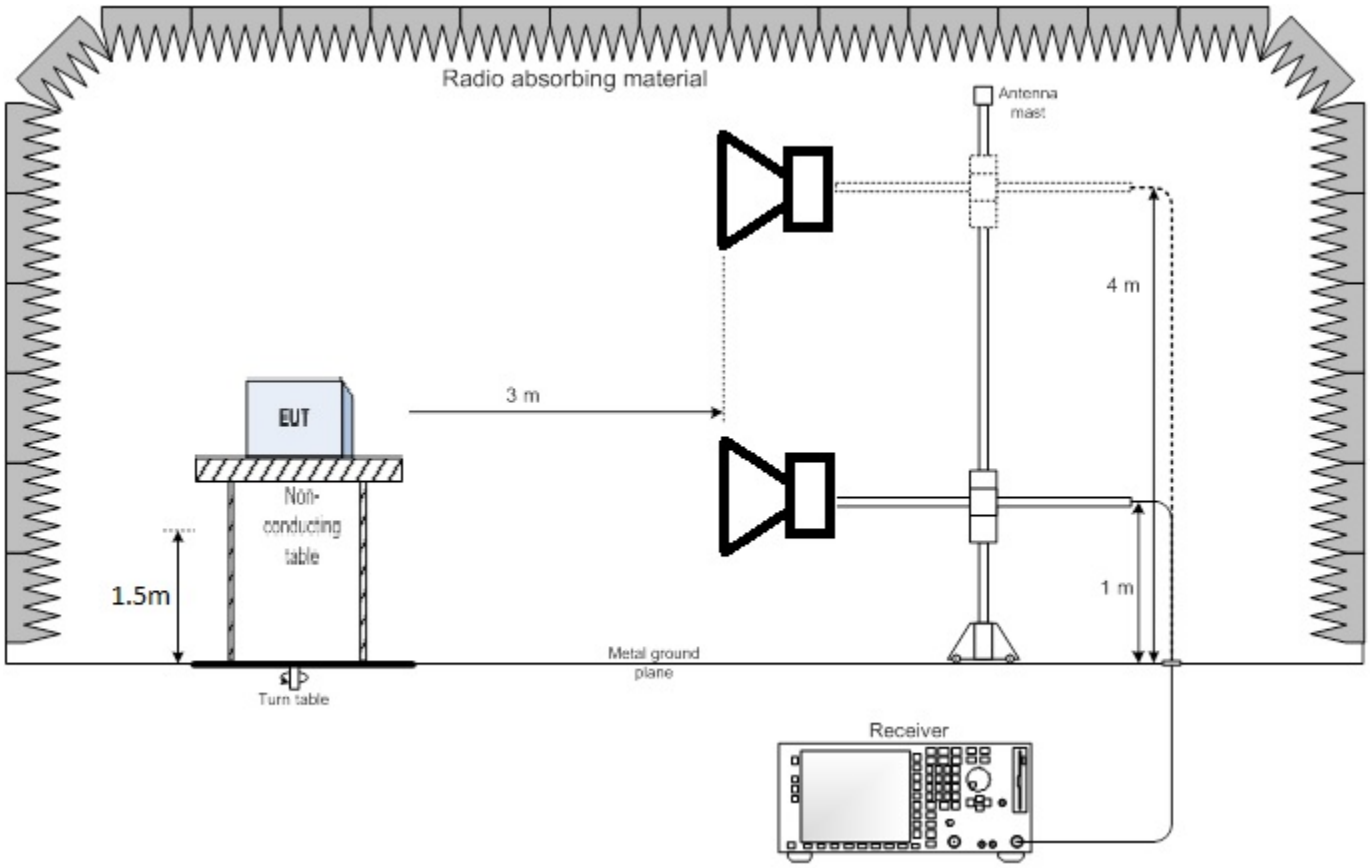
Figure 8.4-3: *PSD, High CH*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up – Below 1GHz



9.2 Radiated emissions set-up – Above 1GHz