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Chamber of Commerce
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telefication

FCC Test report for parts 15.107, 15.109, 15.207, 15.209, 15.247, 15.407

Product name : W1600

Applicant : CLB Research B.V.

FCC ID : 2AWOF 128300

Contains: 2ABCB-RPI3AP

Test report No. : 200400315 001 Ver 1.0

Laboratory information

Accreditation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Telefication is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001.

Telefication is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.
The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

Telefication is a registered Conformity Assessment body (CAB) under the Japan-EC MRA (Agreement on Mutual Recognition between Japan and the European Community). The registration number is: 201.

Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Telefication Netherlands.

Testing Location

Test Site	Telefication BV
Test Site location	Edisonstraat 12a 6902 PK Zevenaar The Netherlands Tel. +31316583180 Fax. +31316583189
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.5	24-11-2020	First draft	PvW
v1.0	08-02-2021	Initial release version	PvW

Table of Contents

Summary of Test results

FCC	Description	Section in report	Verdict
15.407(b) 15.247(d) 15.209 (a) 15.109 (a)	Radiated spurious emissions	3.1	Pass
15.205 (a)	Spurious emissions in the restricted bands	3.1	Pass
15.107 (a) 15.207 (c)	Conducted spurious emissions on AC mains	3.2	Pass

1 General Description

1.1 Applicant

Client name:	CLB Research B.V.
Address	G.G. Schipperstraat 24, the Netherlands
Zip code:	1483 GE, De Rijp
Telephone:	+31 162 582 900
E-mail:	Rcommandeur@clb.nl
Contact name:	Ruud Commandeur

1.2 Manufacturer

Client name:	CLB Research B.V.
Address	G.G. Schipperstraat 24, the Netherlands
Zip code:	1483 GE, De Rijp
Telephone:	+31 162 582 900
E-mail:	Rcommandeur@clb.nl
Contact name:	Ruud Commandeur

1.3 Tested Equipment Under Test (EUT)

Product name:	W1600
Brand name:	CLB
FCC ID:	2AWOF 128300 Contains: 2ABCB-RPI3AP
Product type:	Wireless Acoustic Monitoring Module
Model(s):	W1600
Batch and/or serial No.	--
Software version:	--
Hardware version:	CLB128305
Date of receipt:	24-06-2020
Tests started:	11-08-2020
Testing ended:	14-08-2020

1.4 Product specifications of Equipment under test

Tx Frequency:	BLE: 2400 – 2483.5 MHz 802.11b/g/n: 2400 – 2483.5 MHz 802.11a/ac: 5150 – 5350 MHz and 5470 – 5850 MHz
Rx frequency:	BLE: 2400 – 2483.5 MHz 802.11b/g/n: 2400 – 2483.5 MHz 802.11a/ac: 5150 – 5350 MHz and 5470 – 5850 MHz
Antenna type	PCB antenna
Type of modulation:	BLE: According to BLE specs 802.11b/g/n: According to IEEE 802.11 specs 802.11a/ac: According to IEEE 802.11 specs

1.5 Environmental conditions

Test date	11-08-2020	12-08-2020	13-08-2020	14-08-2020
Ambient temperature	28.1°C	27.9°C	27.1°C	26.7°C
Humidity	42.9%	42.5%	50.8%	51.0%

1.6 Measurement standards

- ANSI C63.4:2014
- ANSI C63.10:2013

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.107
- FCC Part 15 Subpart C §15.109
- FCC Part 15 Subpart C §15.207
- FCC Part 15 Subpart C §15.209
- FCC Part 15 Subpart C §15.247
- FCC Part 15 Subpart E §15.407

1.8 Observation and remarks

The device contains FCC ID: 2ABCB-RPI3AP.
Spurious emissions in the 9 kHz – 30 MHz range have been tested for the worst case mode only (802.11b)
Spurious emissions in the 30 MHz – 26 GHz range have been tested for the worst case mode for each technology (BLE, 802.11b and 802.11ac)
Spurious emissions in the 26 – 40 GHz range have been tested for the worst case 802.11ac channel only (165)

1.9 Conclusions

The sample of the product showed NO NON-COMPLIANCES to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards".*

All conducted tests are performed by:

Name : P. van Wanrooij, BASc

Review of test methods and report by:

Name : ing. P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 17-06-2021

Name : ing P.A. Suringa

Function : Senior test engineer

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

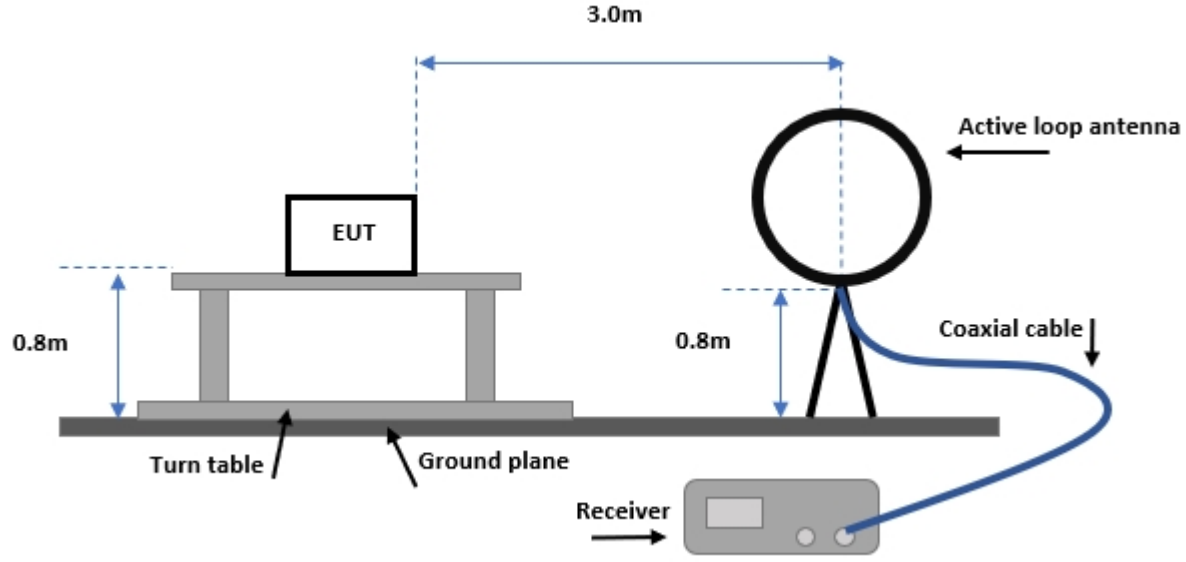
The applicant provided test mode firmware for the BLE and WLAN radio, in which it was possible to configure the radio to transmit continuously. The selected technologies for testing are based on the worst case configuration with regards to spurious emissions.

Tested channels

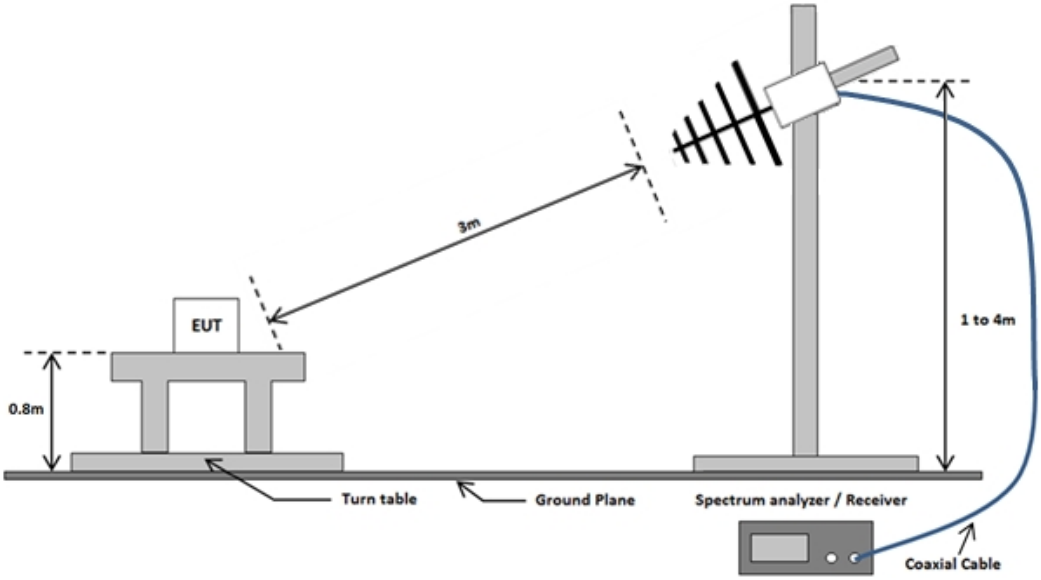
Technology	Channel	Frequency (MHz)
BLE	37 (low)	2402
	18 (mid)	2440
	39 (high)	2480
802.11b	1 (low)	2412
	7 (mid)	2442
	13 (high)	2472
802.11ac	36 (low)	5180
	64 (mid)	5320
	400 (high)	5500
	165 (highest)	5825

2.2 Test setups

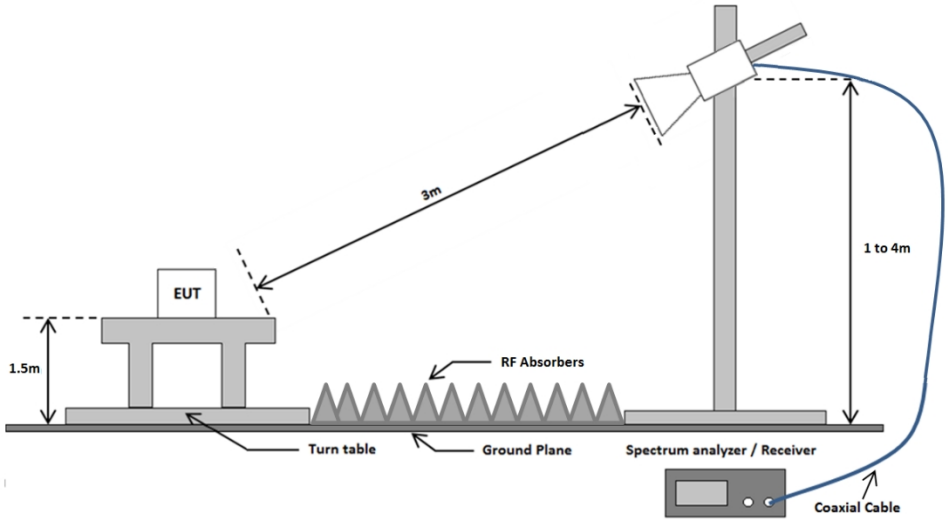
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz

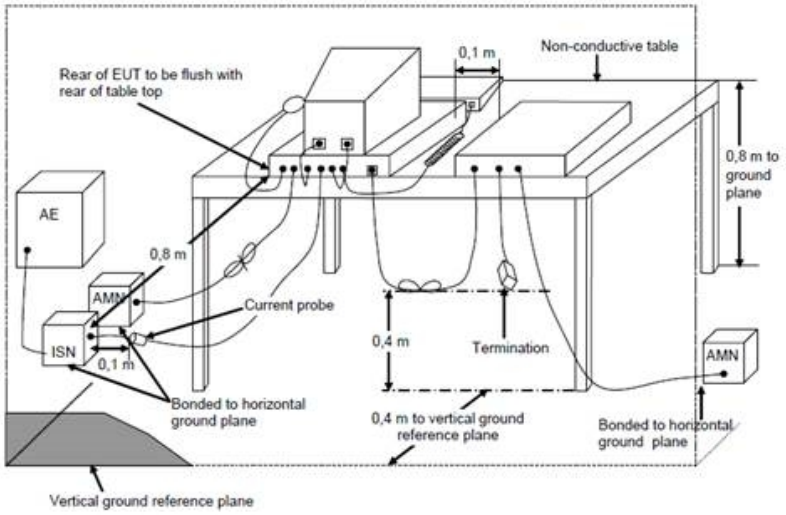


Radiated emissions test setup above 1 GHz



Conducted emissions test setup

Emissions test at AC mains



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
EMI Receiver	Rohde & Schwarz	ESCI	TE11128	3.2
EMI Receiver	Rohde & Schwarz	ESR7	TE01220	3.1
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	TE01140	3.1
7.0 GHz HPF	Wainwright	WHKX7.0/18G-8SS	TE01141	3.1
Active loop antenna	EMCO	6502	TE11171	3.1
Biconilog antenna	Chase	CBL6112A	TE00967	3.1
Horn antenna	EMCO	3115	TE00531	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	TE11175	3.1
Preamplifier	MITEQ	JS4-18004000-33-8P	TE 11131	3.1
Horn antenna	Flann Microwave	20240-25	TE 00818	3.1

2.4 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 Radiated spurious emissions

3.1.1 Limit

According to 15.209 and 15.247

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	20*{log[2400]-log[F(kHz)]}	300*
0.490 – 1.705	24000/F(kHz)	20*{log[24000]-log[F(kHz)]}	30*
1.705 – 13.11 14.01 – 30.0	30	29.5	30*
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

*Note: Limit lines in the plots corrected to 3m measurement distance according to the method described in ANSI C63.10-2013, clause 6.4

According to 15.407

Frequency (GHz)	Operating frequency band (GHz)	Emission limit e.i.r.p outside of transmission band (dBm/MHz)	Field strength (dBµV/m)	Measurement distance (m)
1 – 40	5.15 – 5.25	-27	68.2	3
1 - 40	5.25 – 5.35	-27	68.2	3

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.1.4 Test procedure

9 kHz – 30 MHz: According to ANSI C63.4-2014, section 5.4.2 and 8.2.3
30 MHz to 26.5 GHz: According to ANSI C63.4-2014, section 8.3

9 kHz to 30 MHz: IRN 026 – Method 10
30 MHz to 1 GHz: IRN 026 – Method 1
1 GHz to 18 GHz: IRN 026 – Method 2
18 to 26.5 GHz: IRN 026 – Method 3
26.5 to 40 GHz: IRN 026 – Method 4

3.1.5 Measurement Uncertainty

Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB
18 – 30 GHz	Horizontal	±4.9 dB
	Vertical	±4.9 dB
30 – 40 GHz	Horizontal	±4.5 dB
	Vertical	±4.5 dB

3.1.6 Results of the radiated spurious emissions measurement of 802.11b

Measured peaks 30 – 1000 MHz Middle channel

Frequency	Polarization	Height	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference
911,604 MHz	Vertical	4 m	9,5 dBµV/m	46 dBµV/m	-36,5 dB

Measured peaks 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
3,62 GHz	Horizontal	2,7 m	44,7 dBµV/m	36,7 dBµV/m	74 dBµV/m	54 dBµV/m	-29,3 dB	-17,3 dB
4,824 GHz	Vertical	3,8 m	48,9 dBµV/m	44,3 dBµV/m	74 dBµV/m	54 dBµV/m	-25,1 dB	-9,7 dB
7,235 GHz	Vertical	2,2 m	52,5 dBµV/m	45,8 dBµV/m	74 dBµV/m	54 dBµV/m	-21,5 dB	-8,2 dB

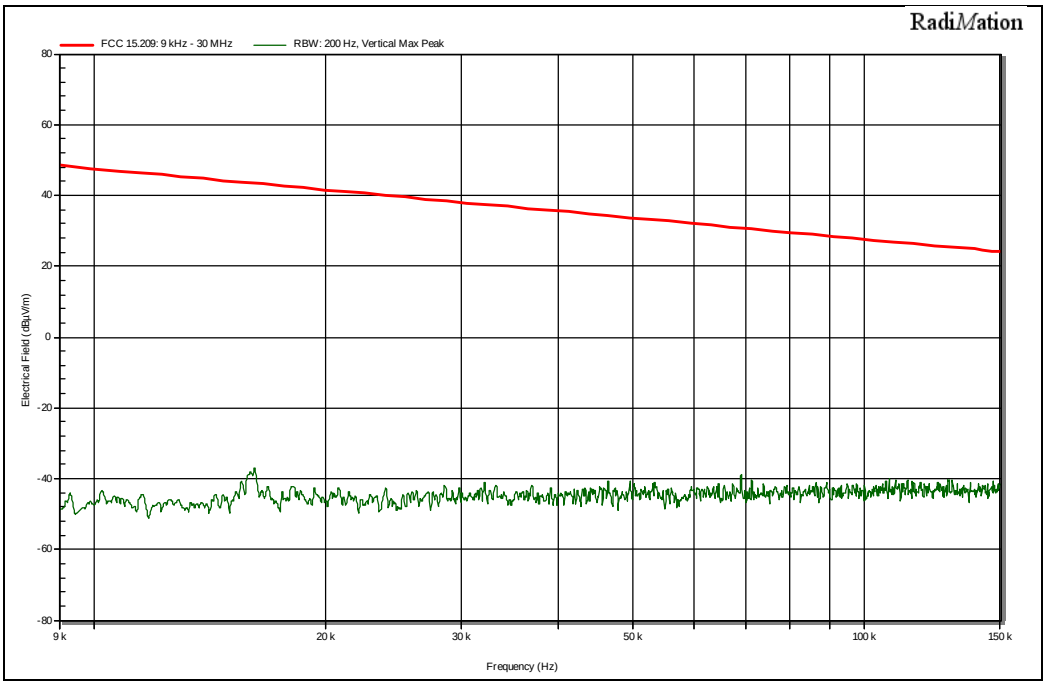
Measured peaks 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,944 GHz	Horizontal	1 m	54,1 dBµV/m	51 dBµV/m	74 dBµV/m	54 dBµV/m	-19,9 dB	-3,0 dB

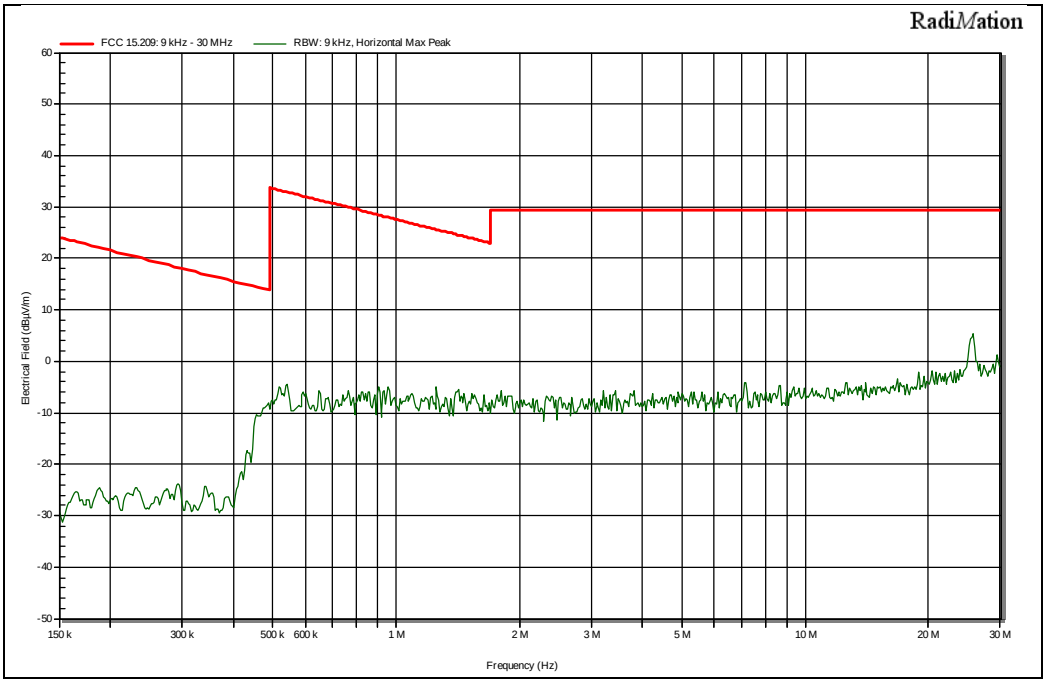
3.1.7 Plots of the Radiated Spurious Emissions Measurement of 802.11b

9 kHz to 150 kHz

Parallel

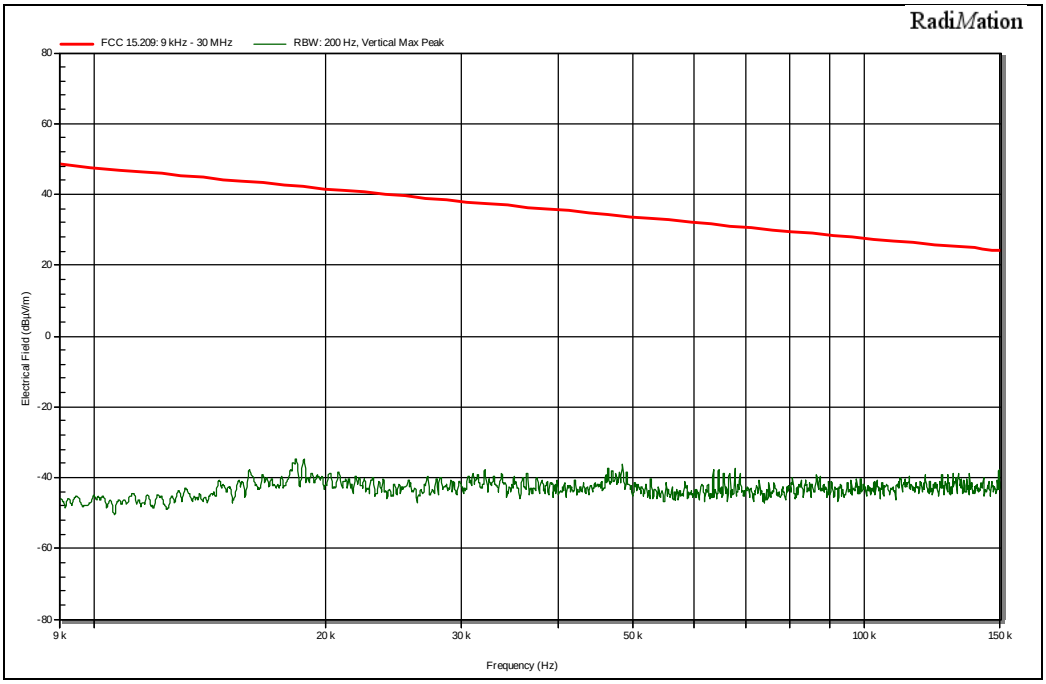


150 kHz to 30 MHz

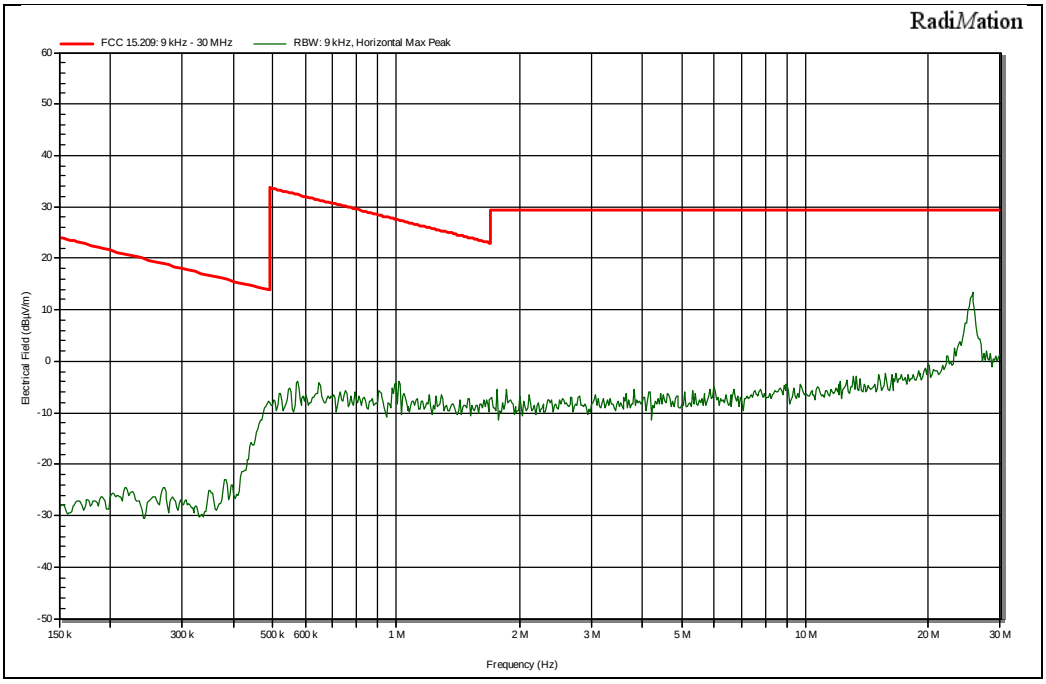


9 kHz to 150 kHz

Parallel

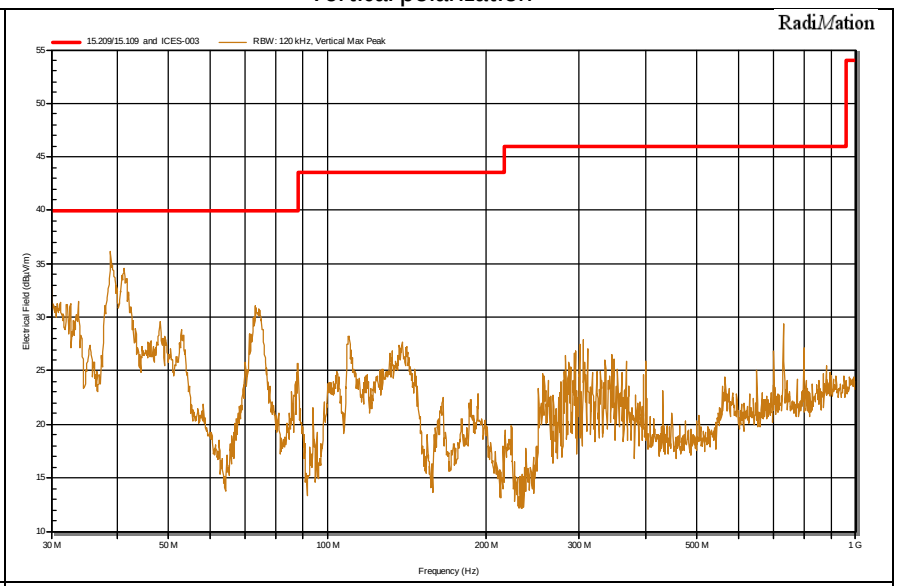
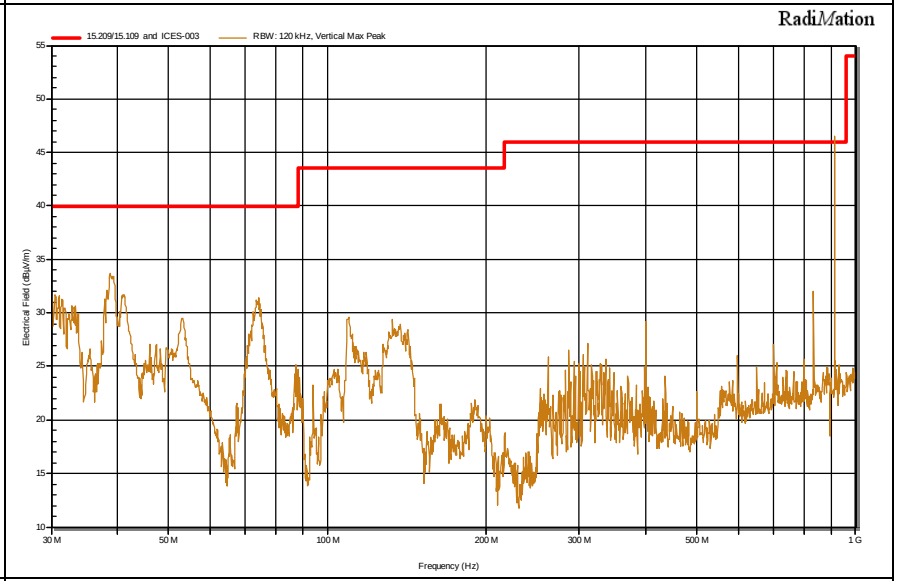
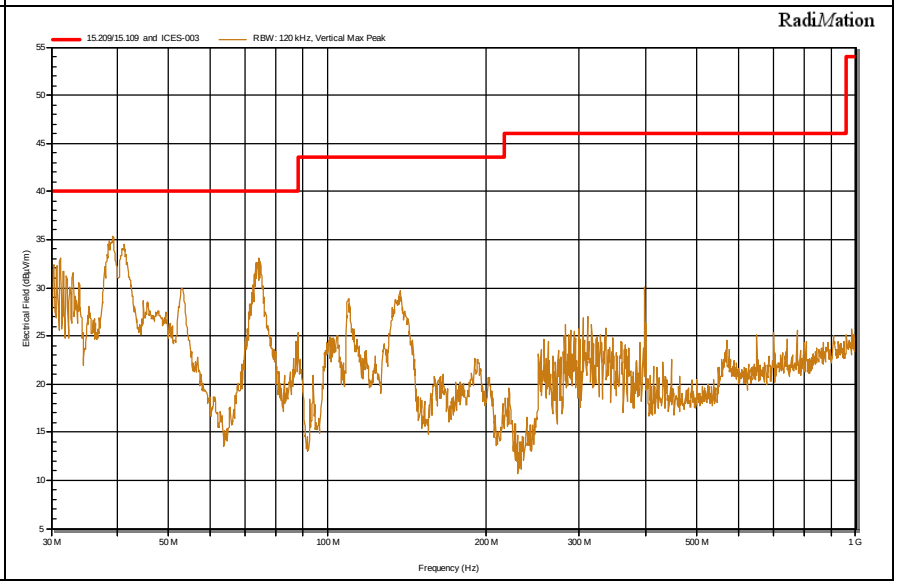


150 kHz to 30 MHz



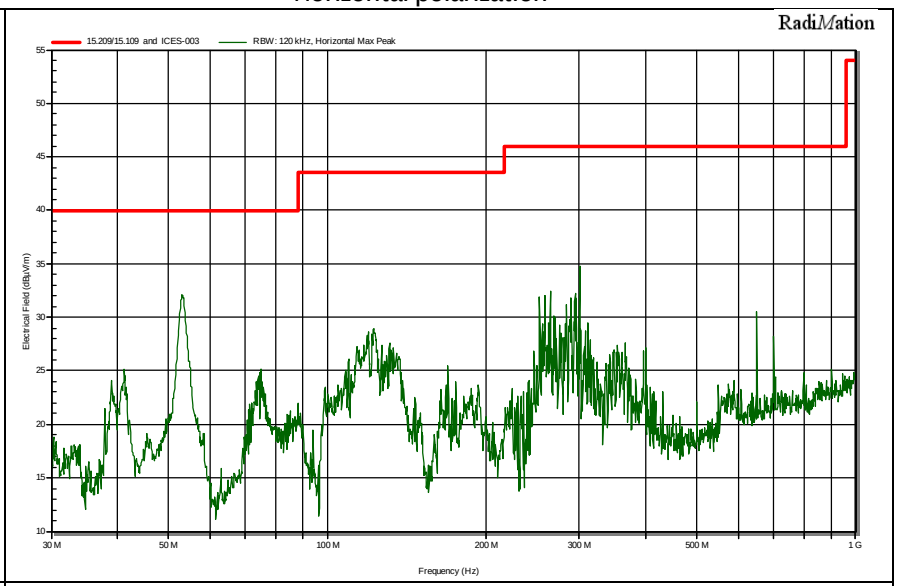
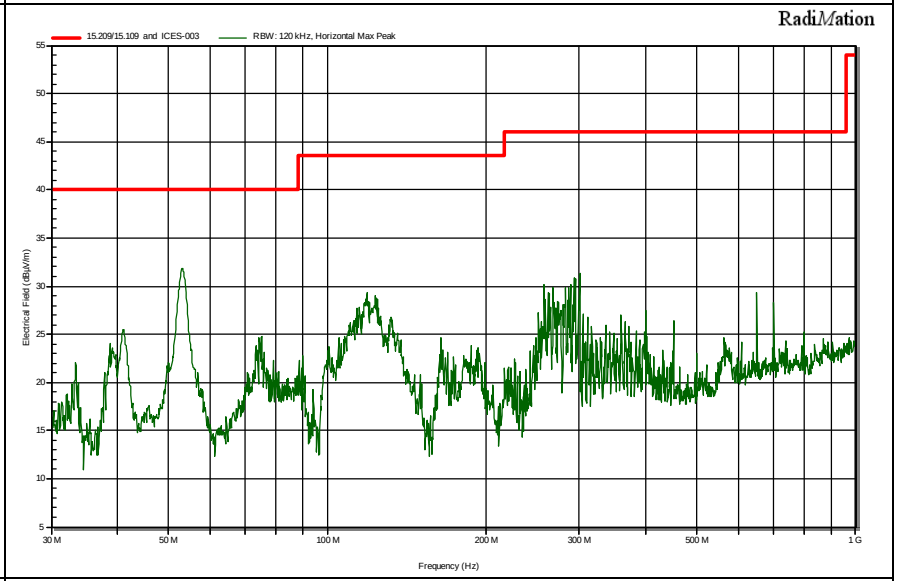
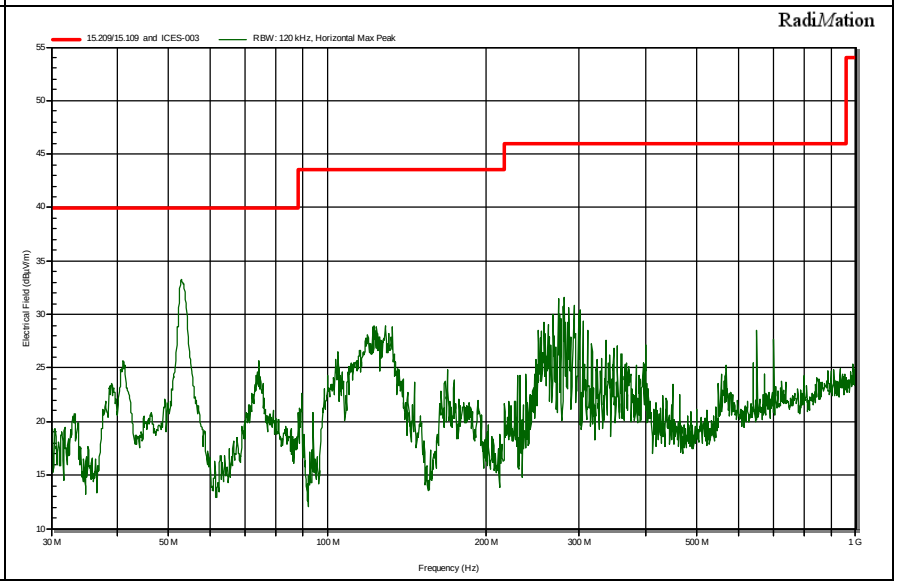
30 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

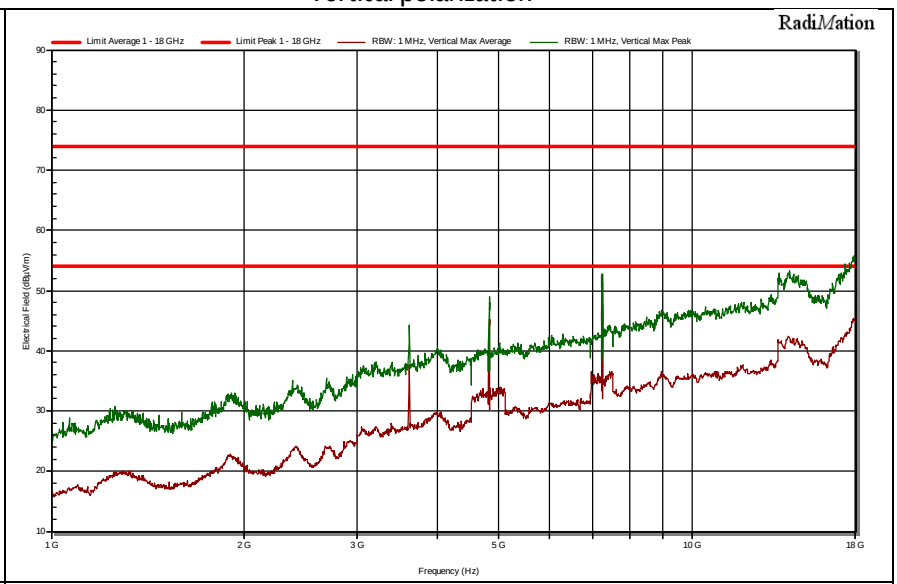
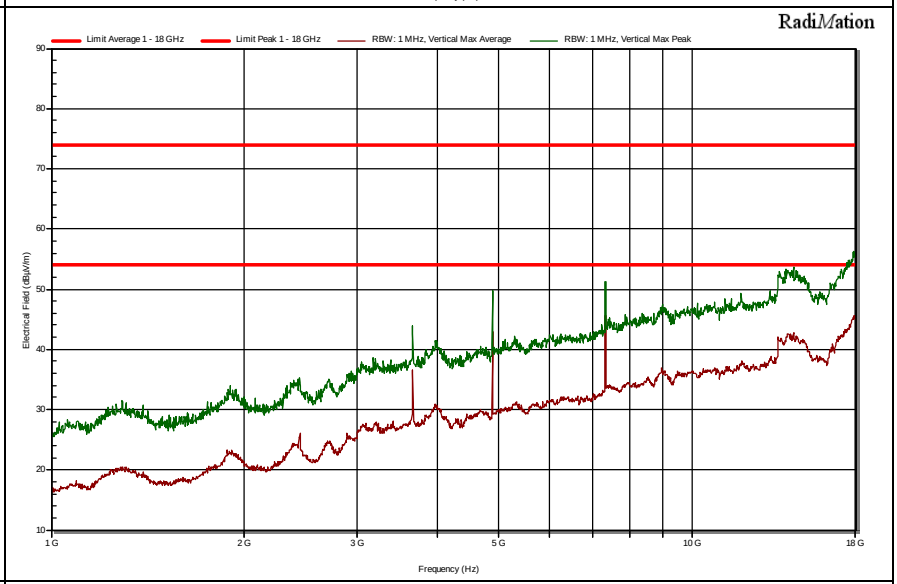
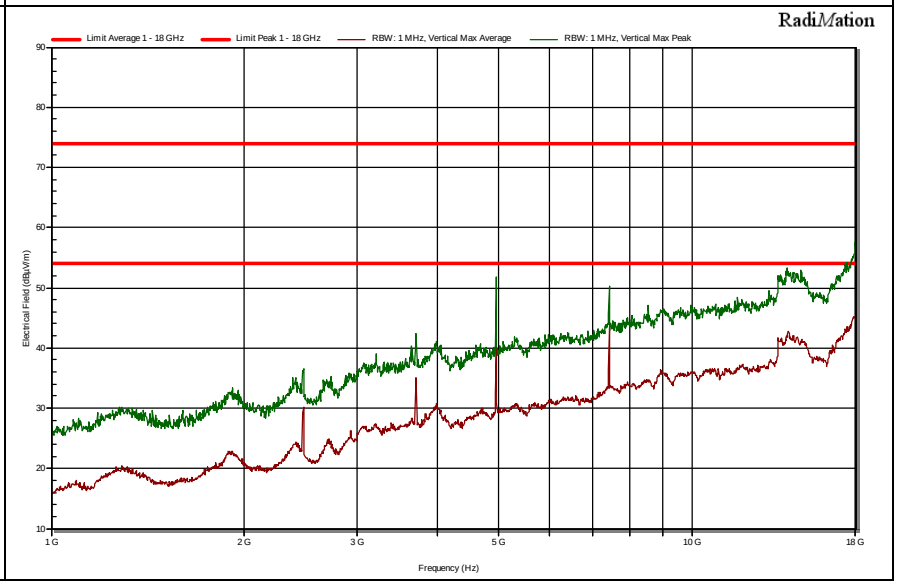
30 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

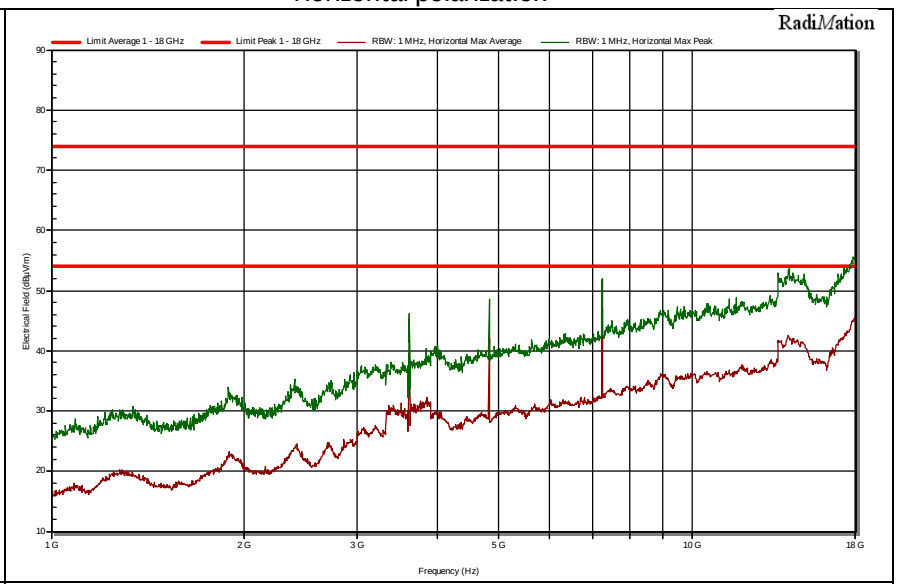
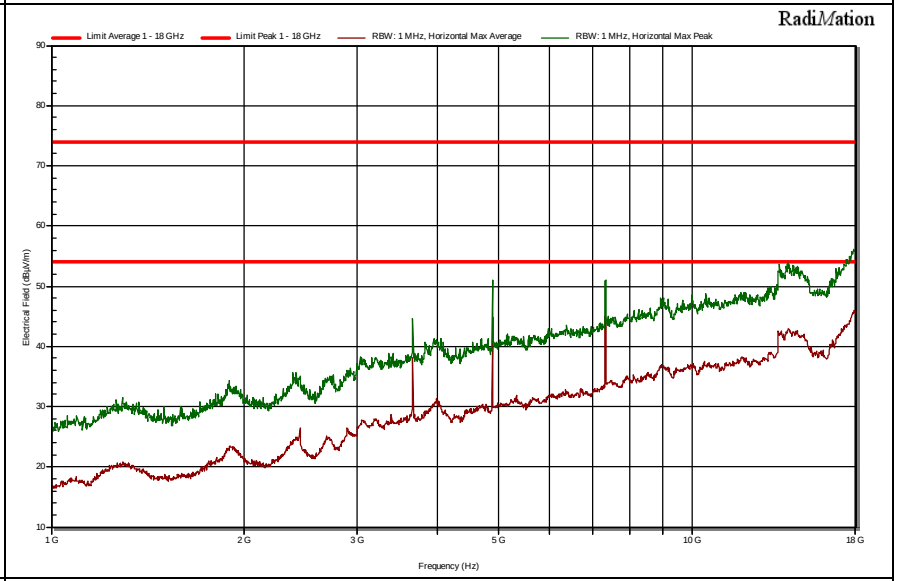
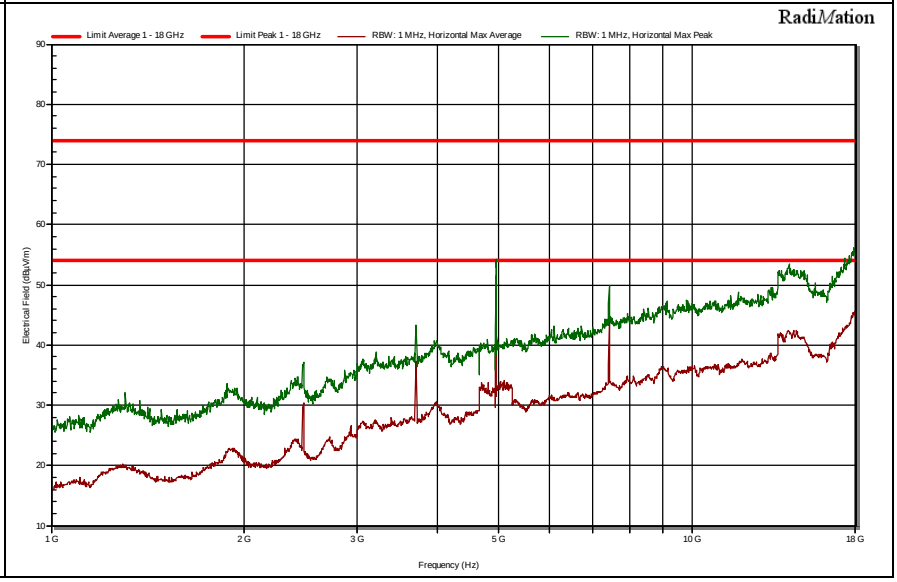
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

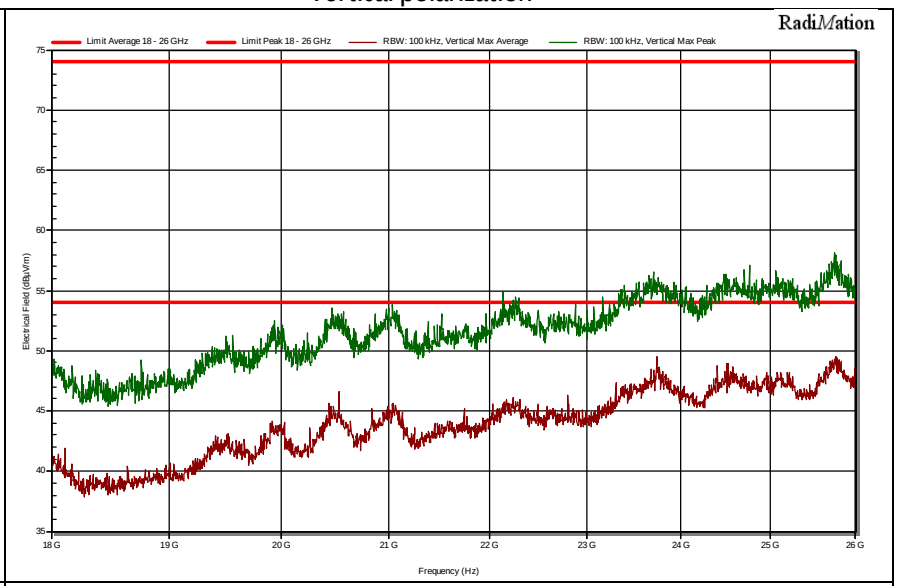
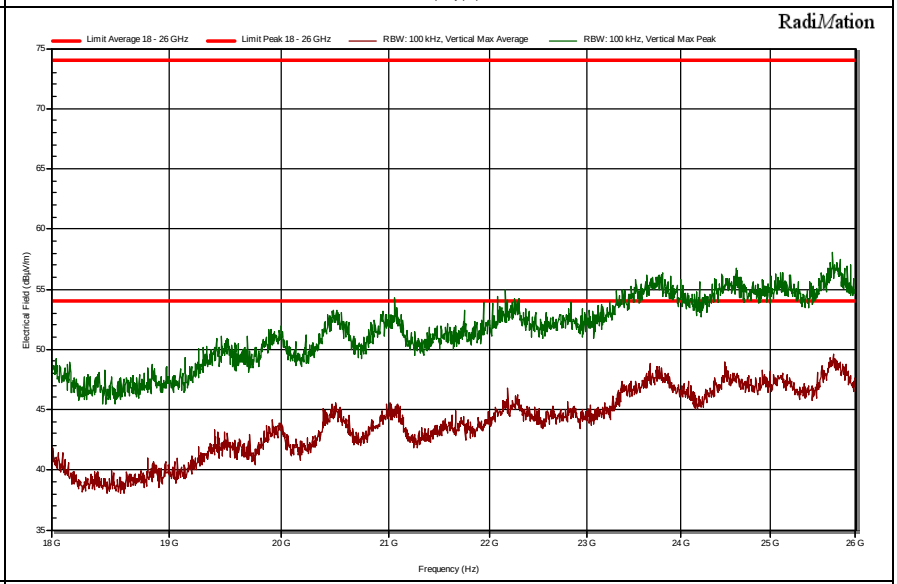
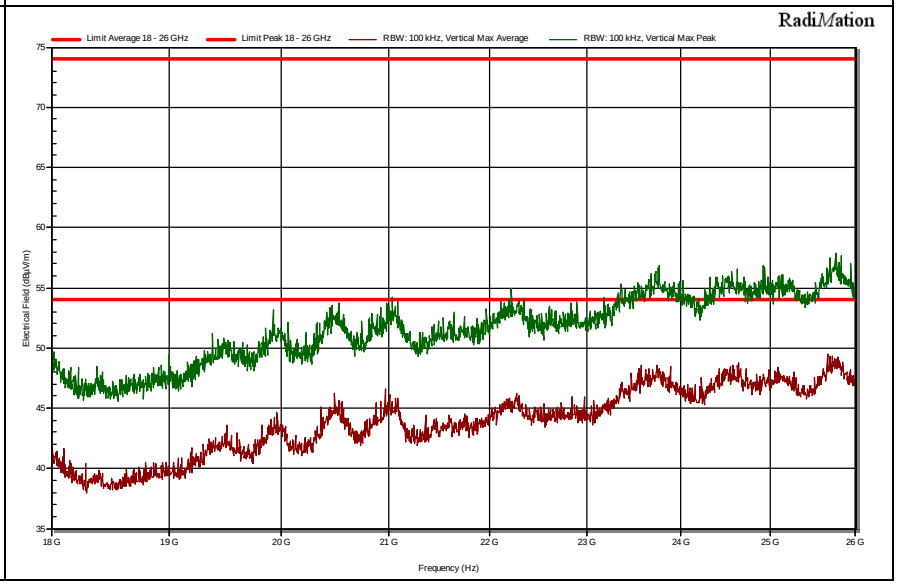
1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

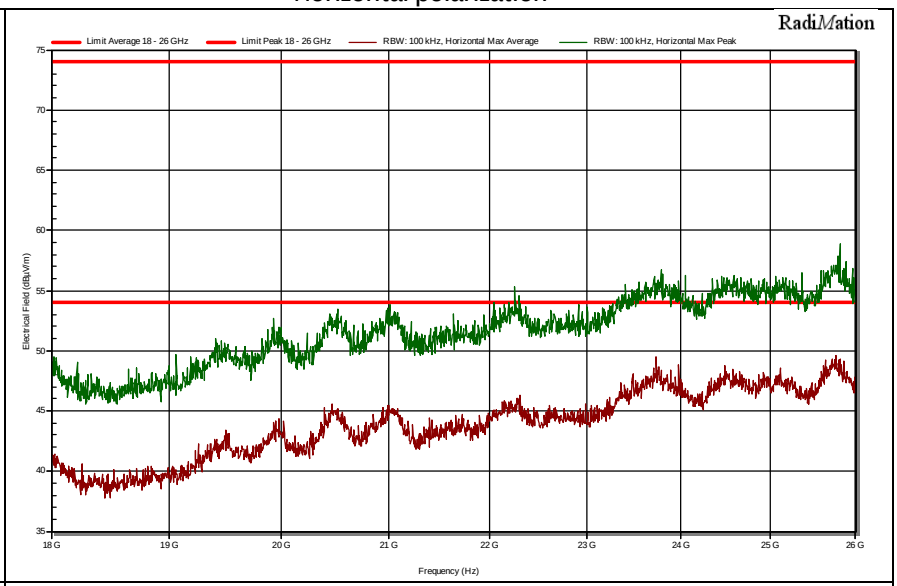
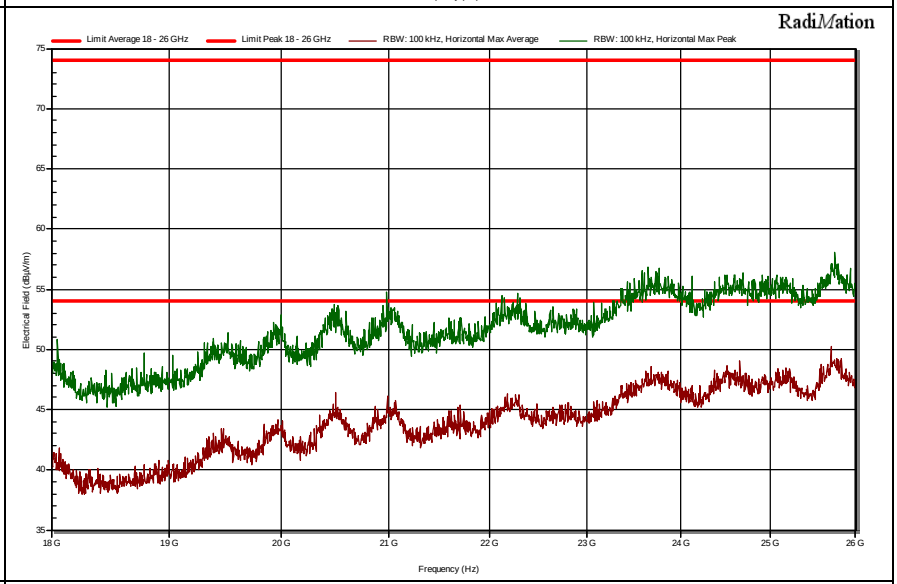
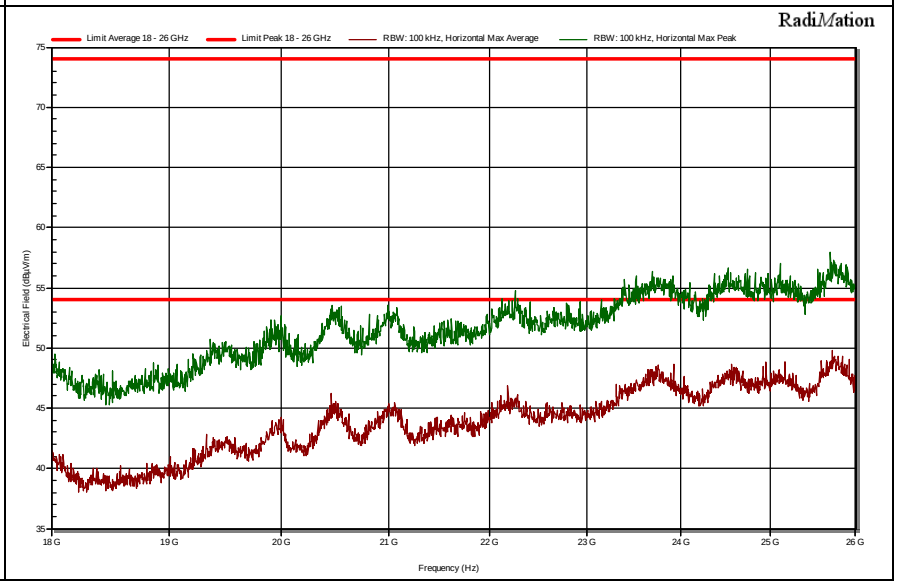
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

3.1.8 Results of the radiated spurious emissions measurement of BLE

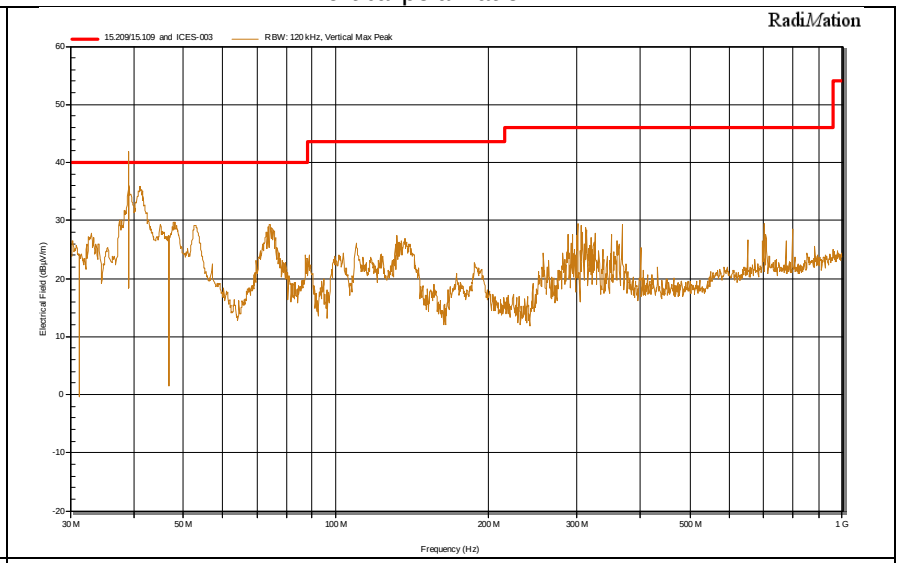
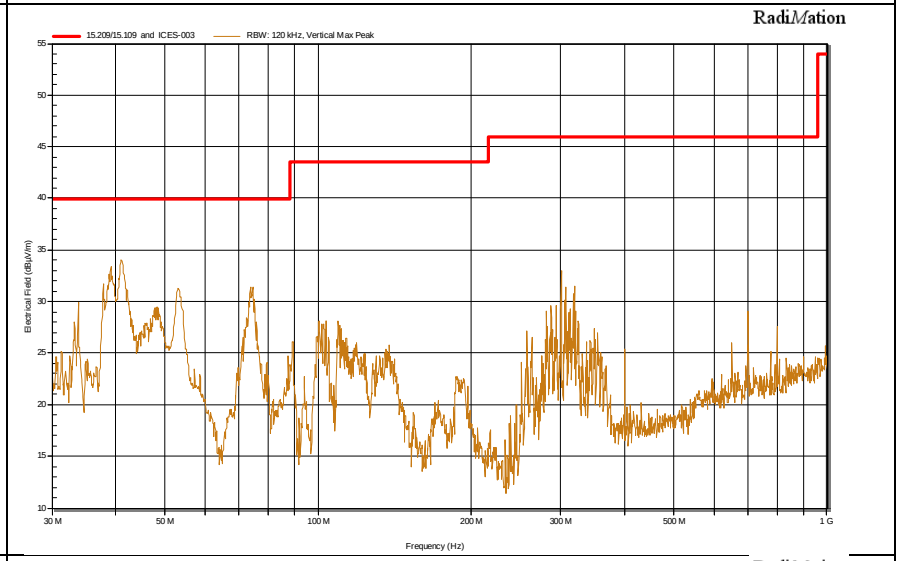
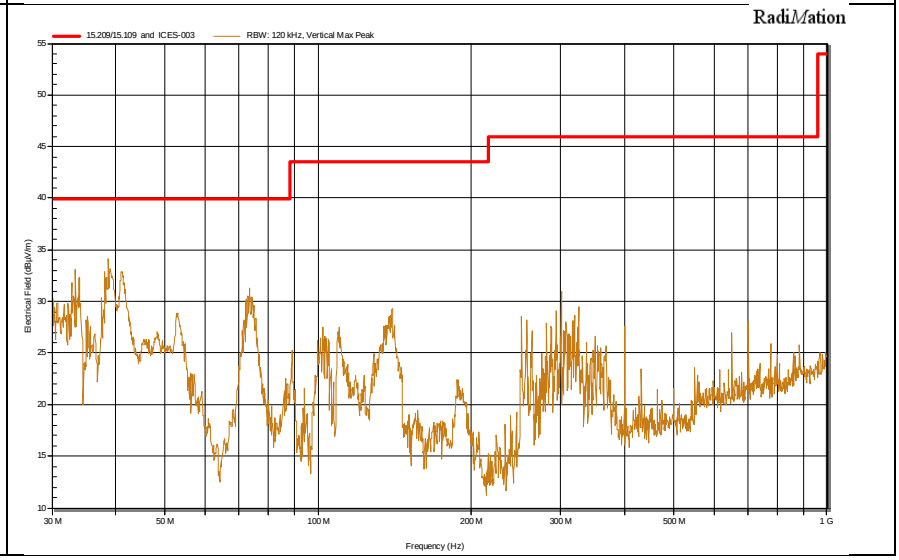
Measured peaks Vertical 30 – 1000 MHz Low channel

Frequency	Polarization	Height	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference
39,105 MHz	Vertical	1,2 m	36,8 dBµV/m	40 dBµV/m	-3,2 dB

3.1.9 Plots of the Radiated Spurious Emissions Measurement of BLE

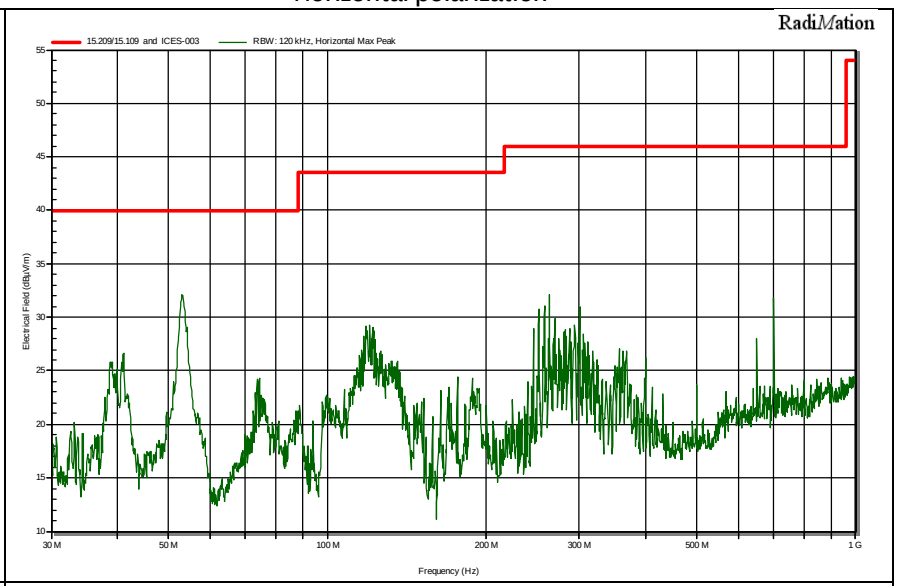
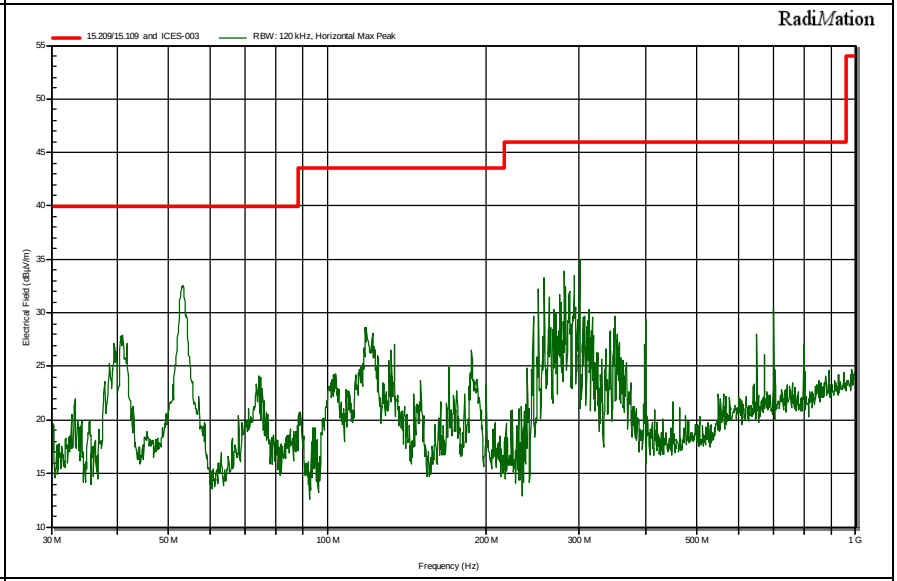
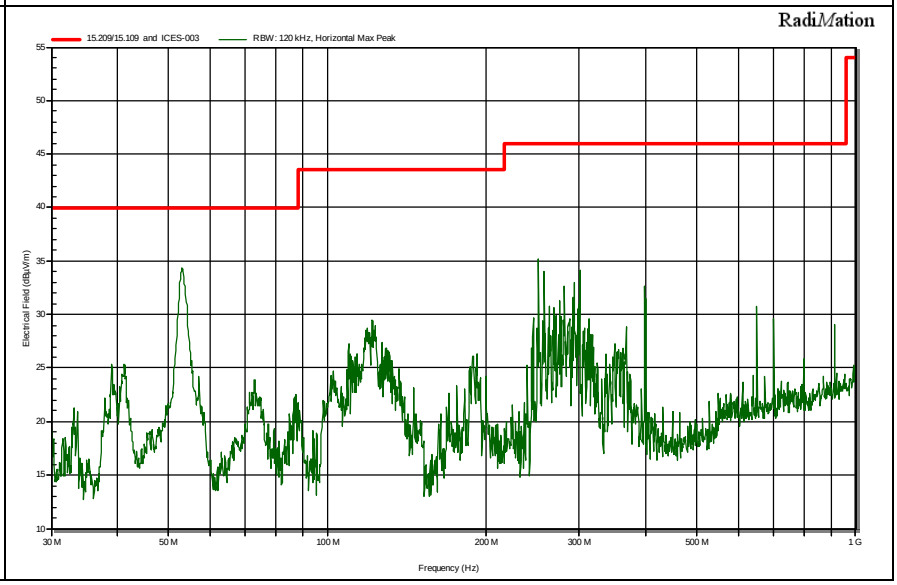
30 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

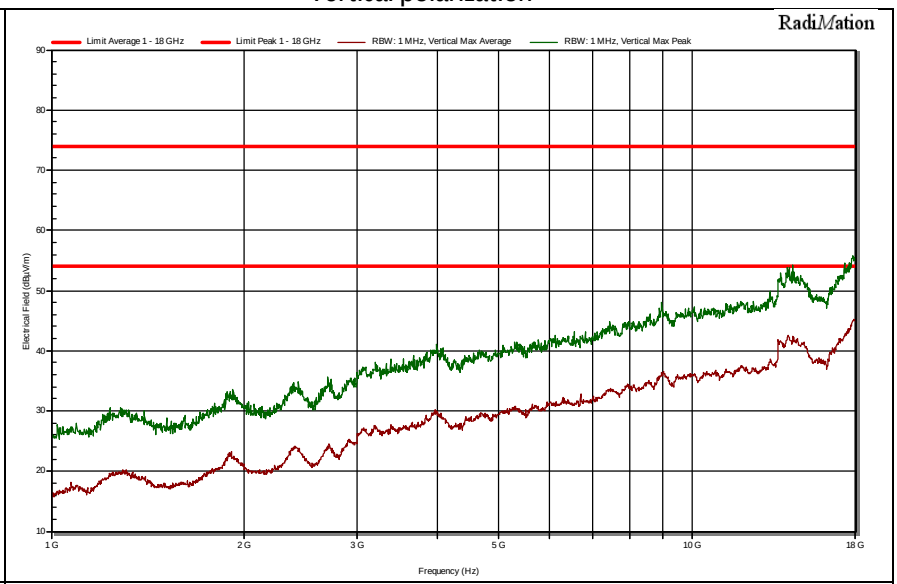
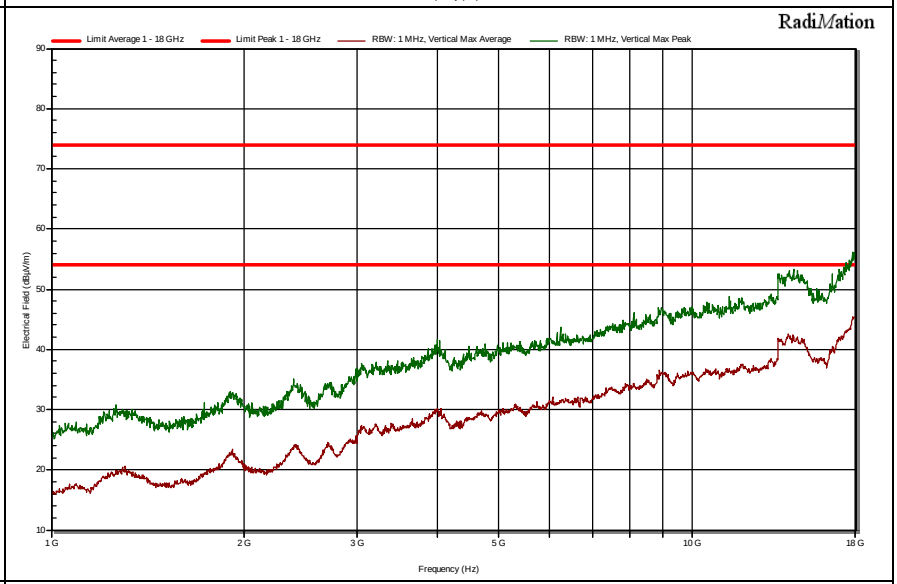
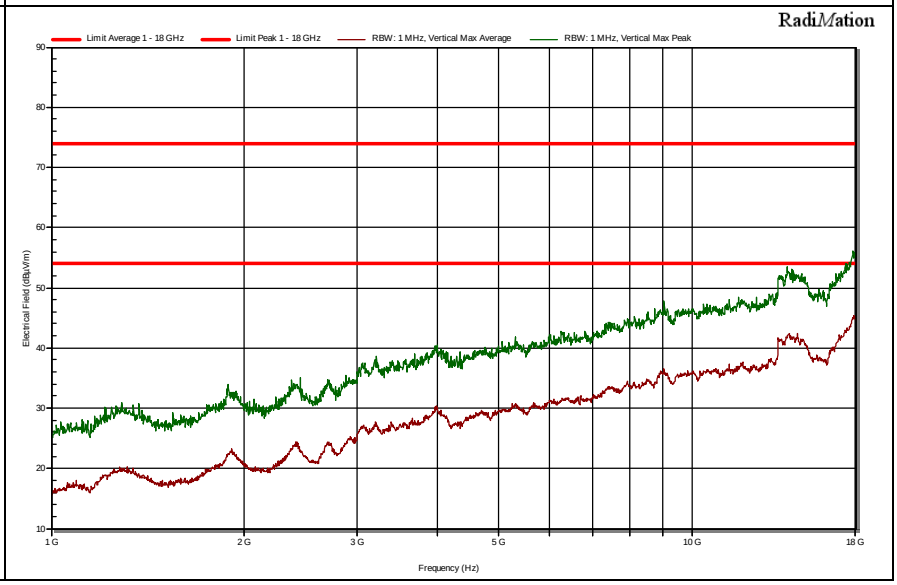
30 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

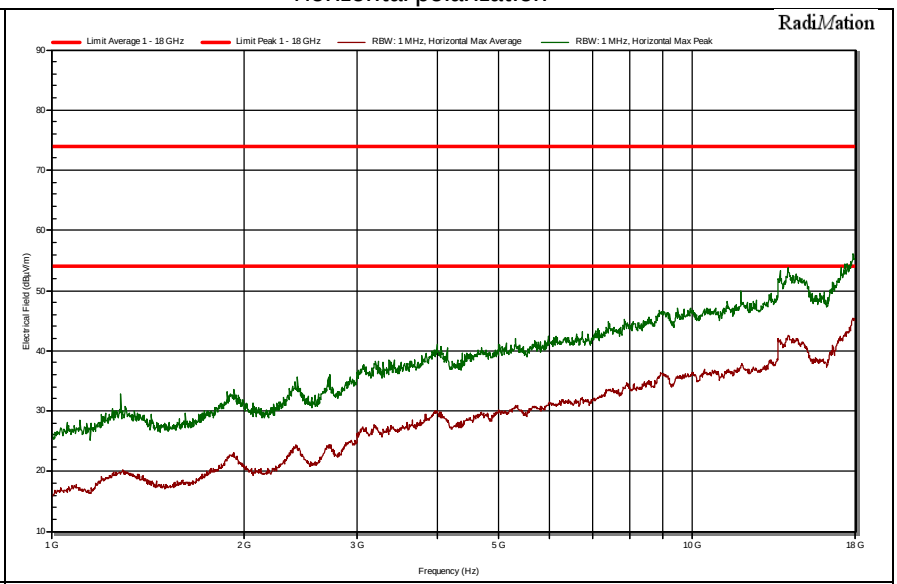
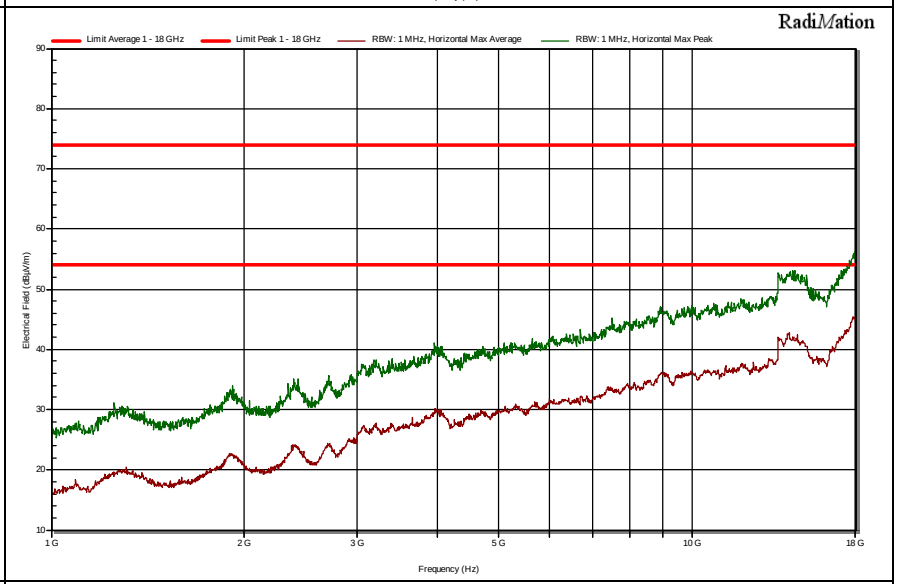
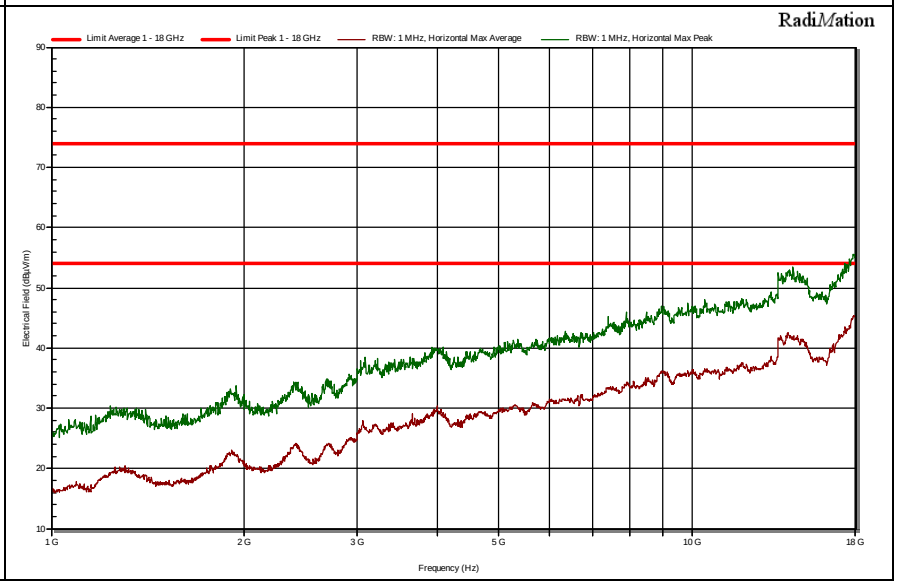
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

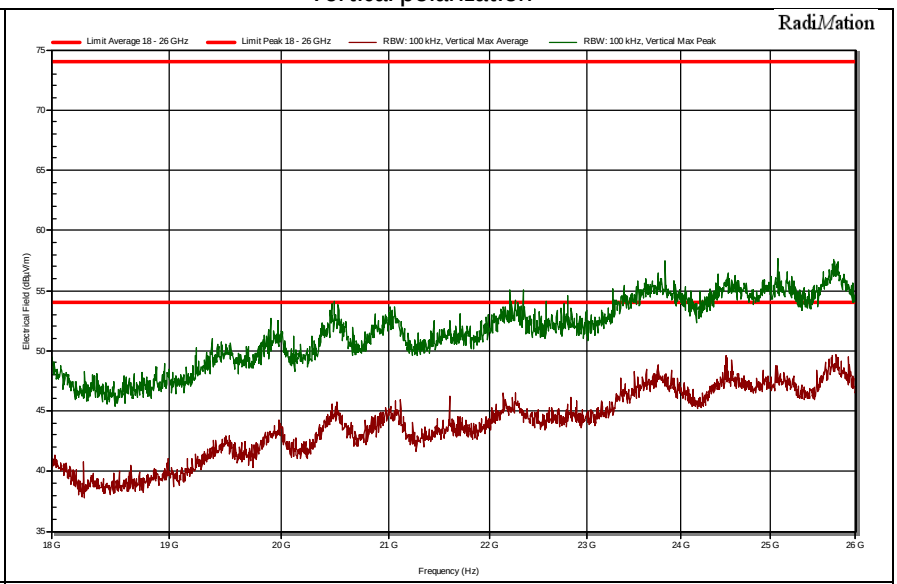
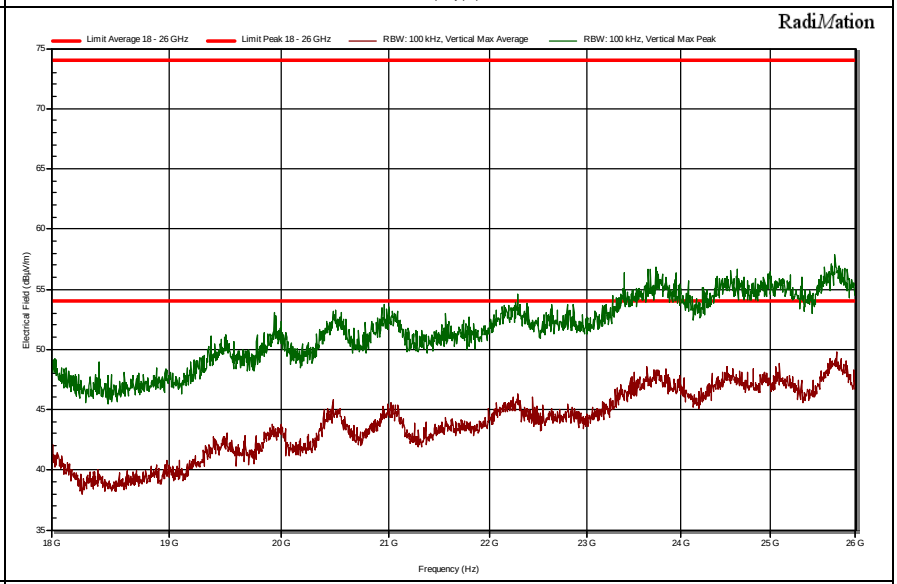
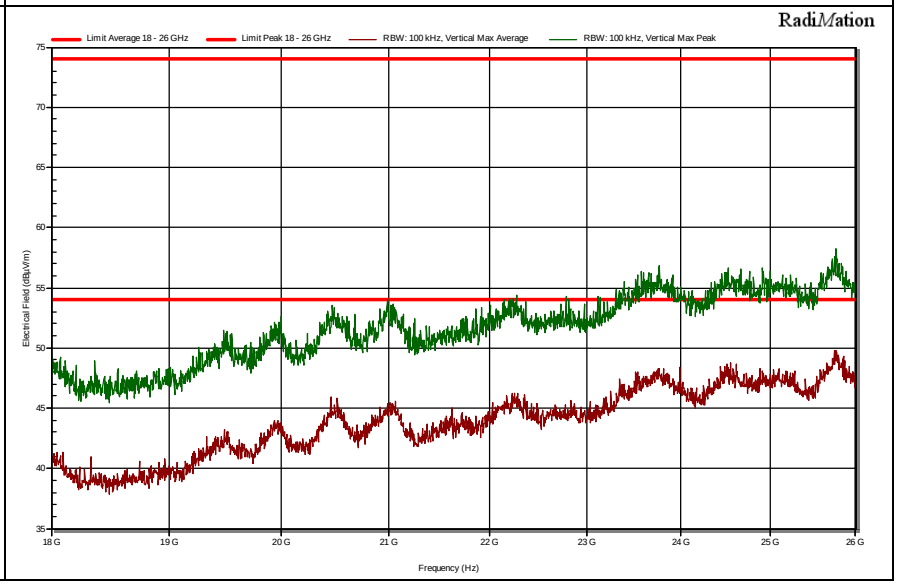
1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

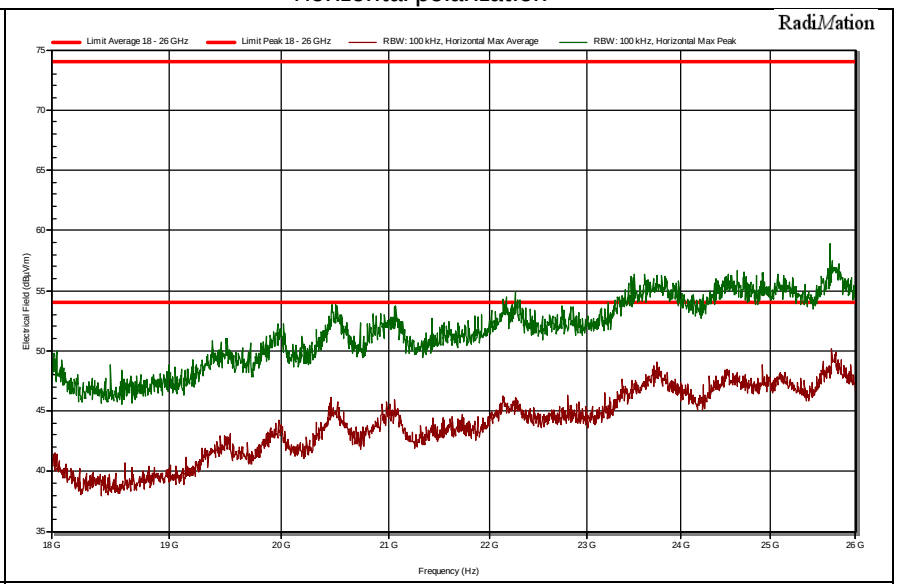
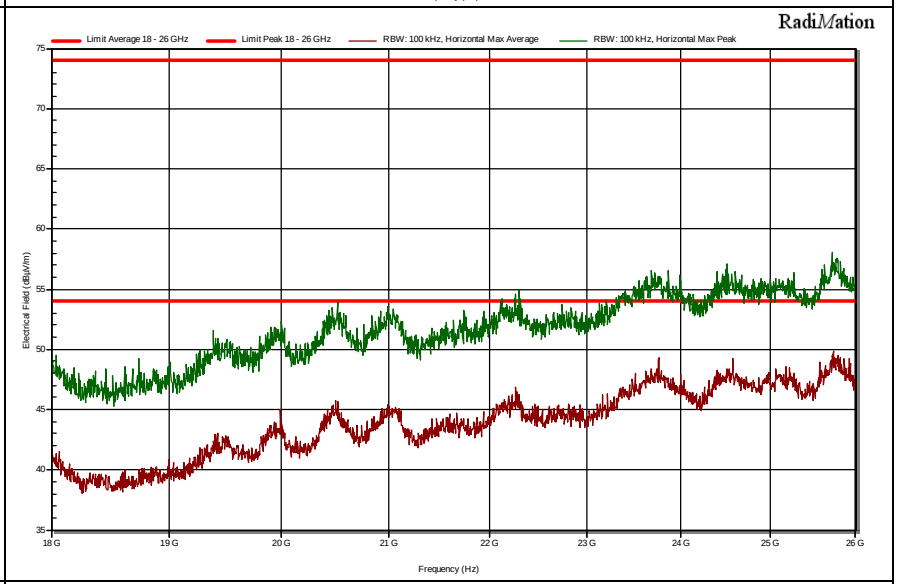
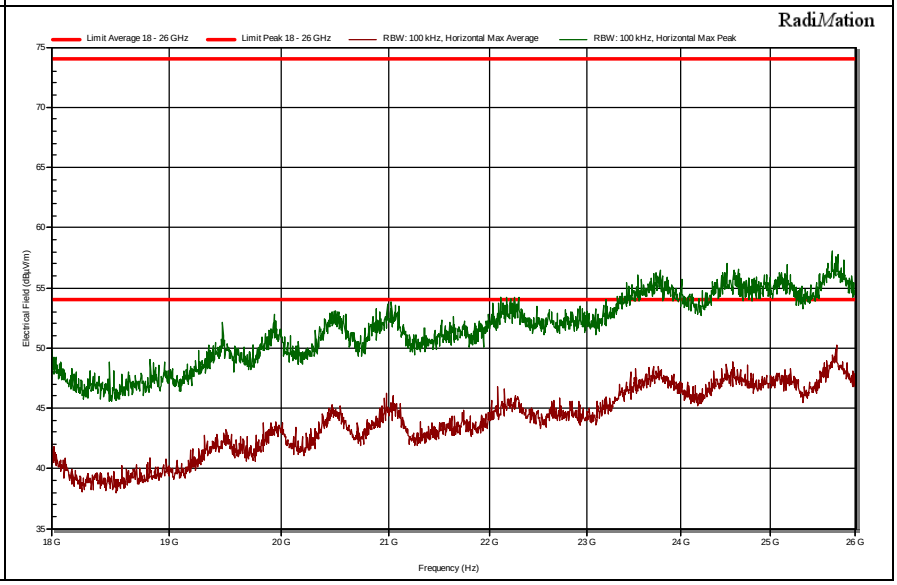
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

3.1.10 Results of the Radiated Spurious Emissions Measurement of 802.11ac

Measured peaks 30 – 1000 MHz High channel

Frequency	Polarization	Height	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference
39,038 MHz	Vertical	2,7 m	34 dBµV/m	40 dBµV/m	-6,0 dB

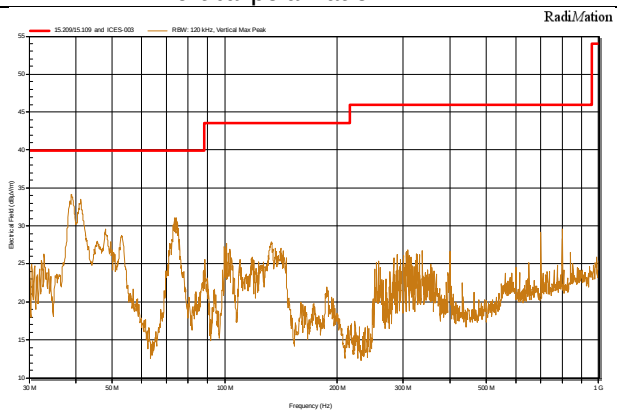
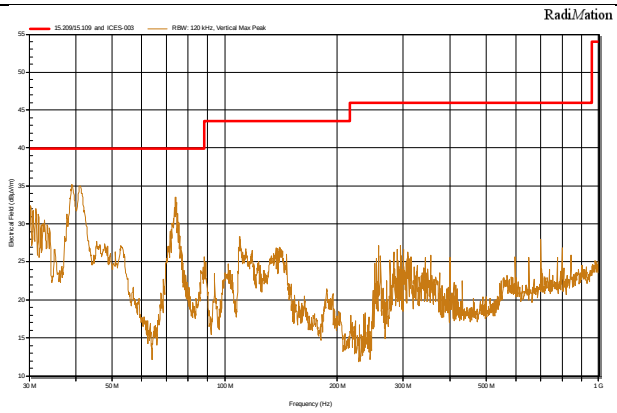
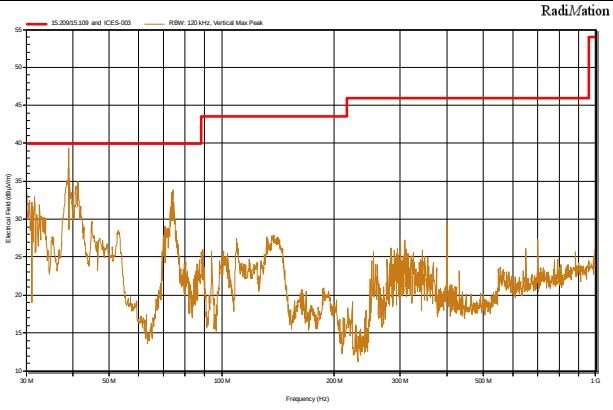
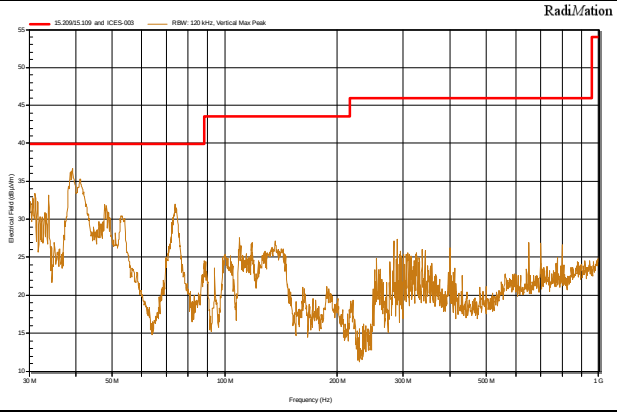
Measured peaks 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
5,318 GHz	Vertical	3 m	50,8 dBµV/m	41,2 dBµV/m	88,2 dBµV/m	68,2 dBµV/m	-37,4 dB	-27,0 dB

3.1.11 Plots of the Radiated Spurious Emissions Measurement of 802.11ac

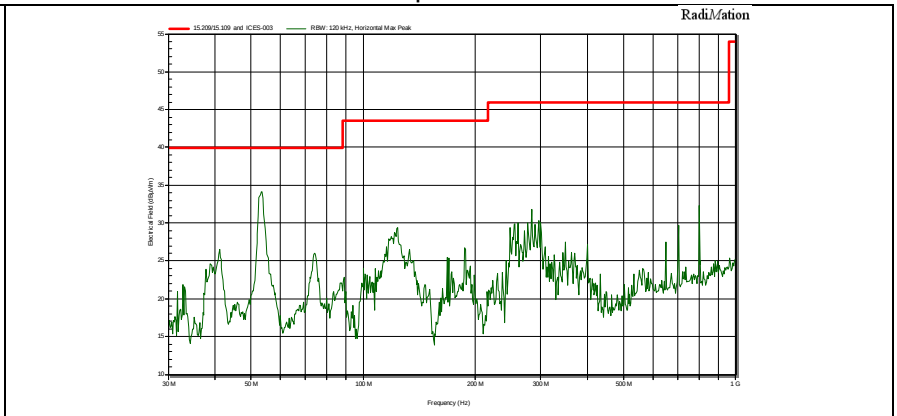
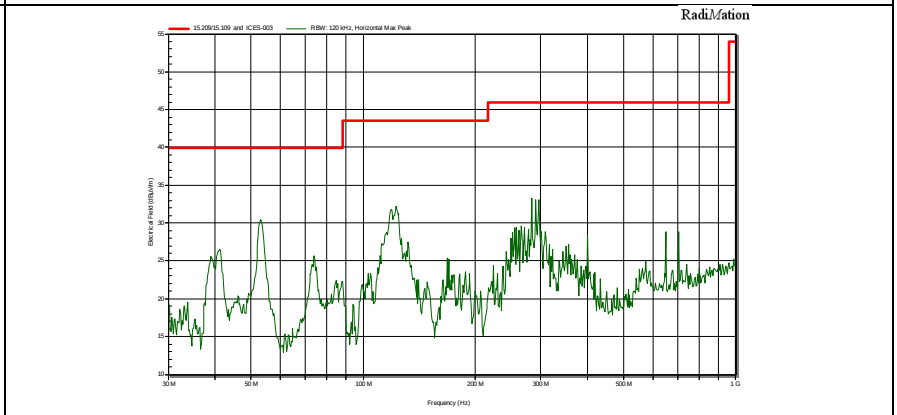
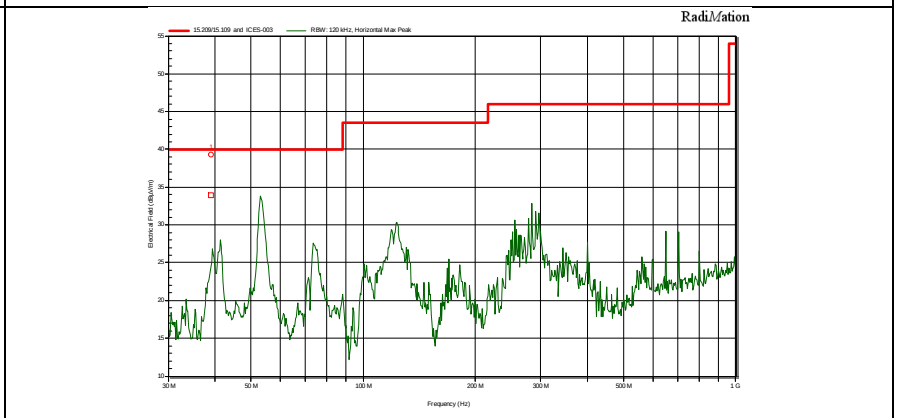
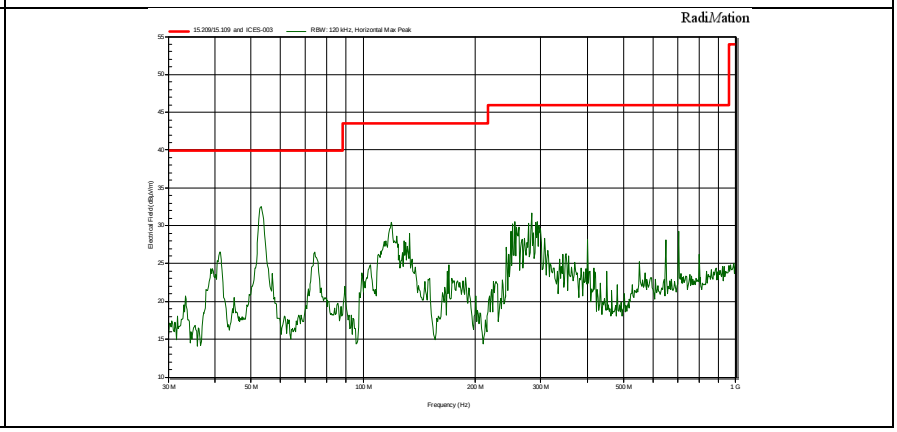
30 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	
Highest ch	

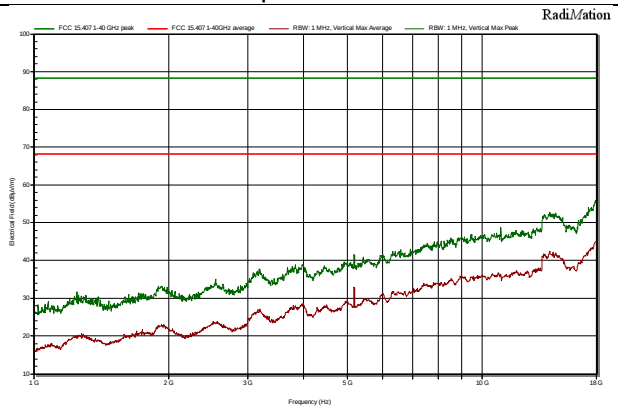
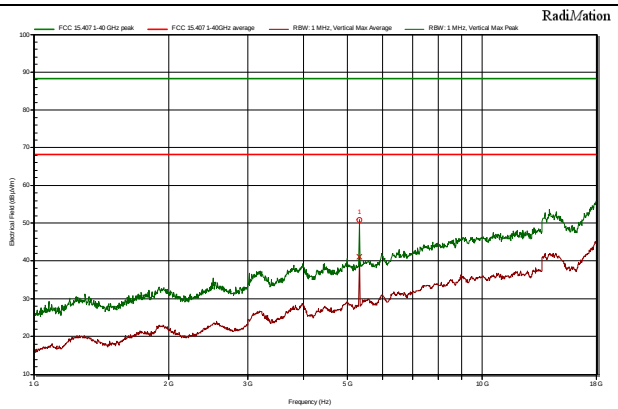
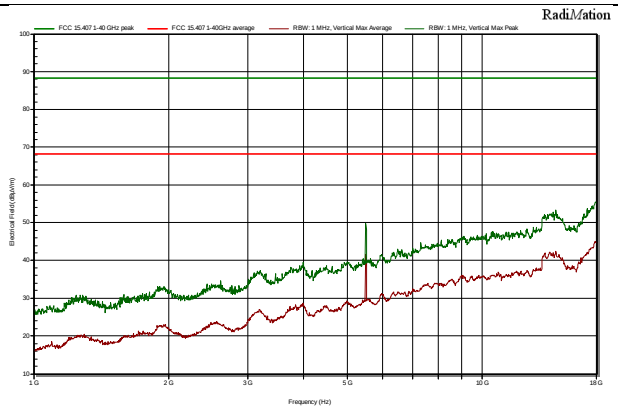
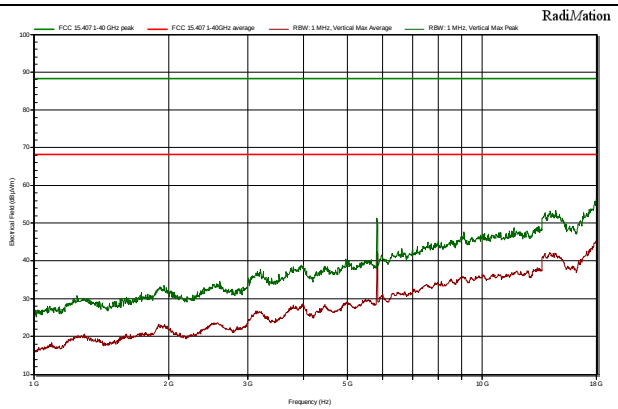
30 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	
Highest ch	

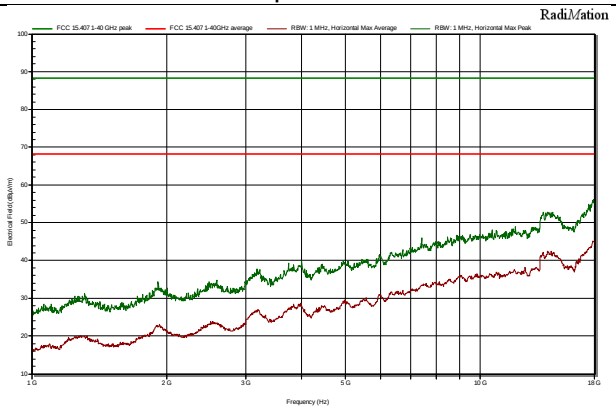
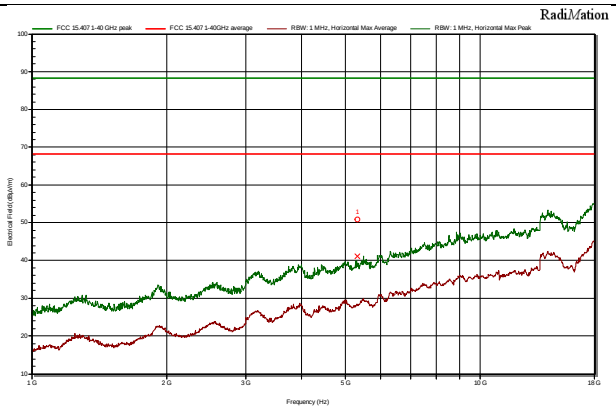
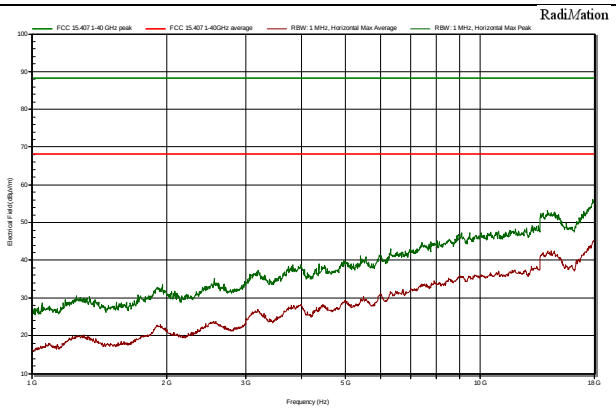
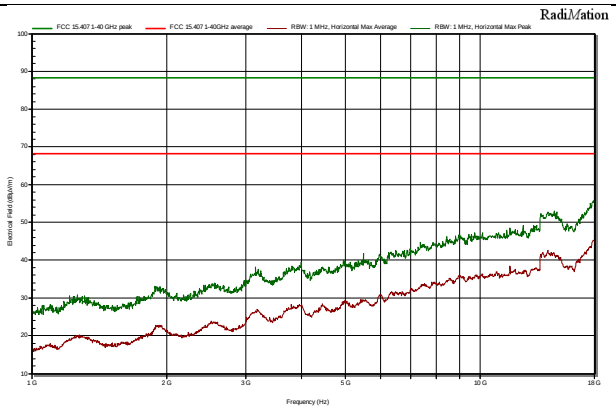
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	
Highest ch	

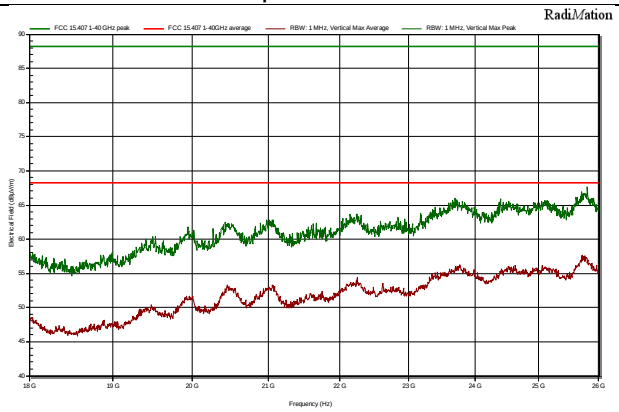
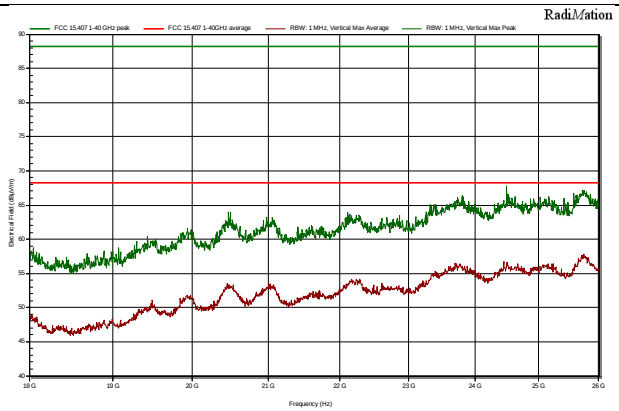
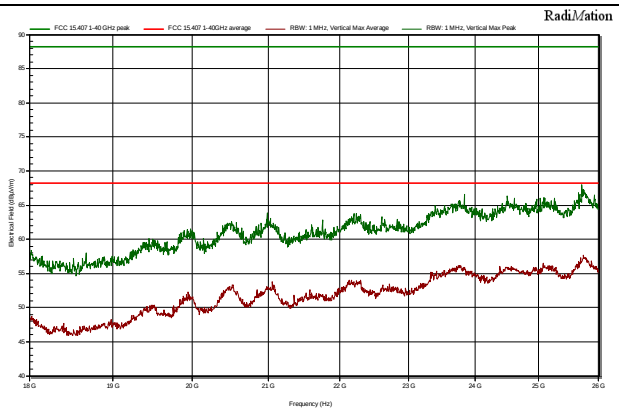
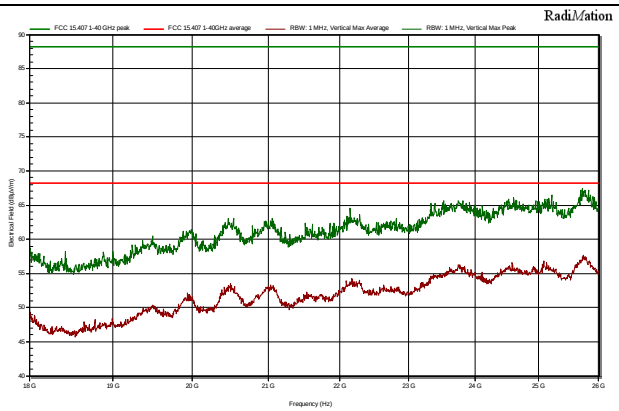
1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	
Highest	

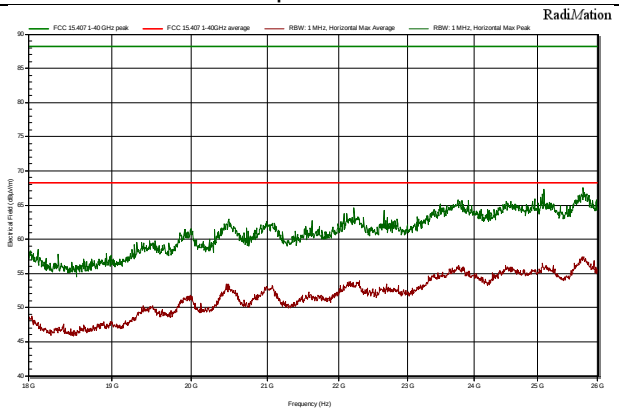
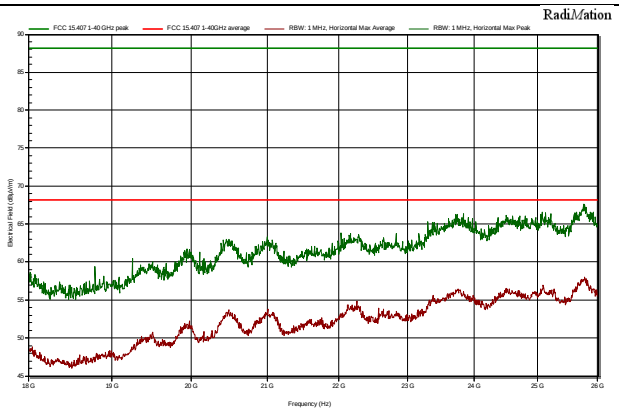
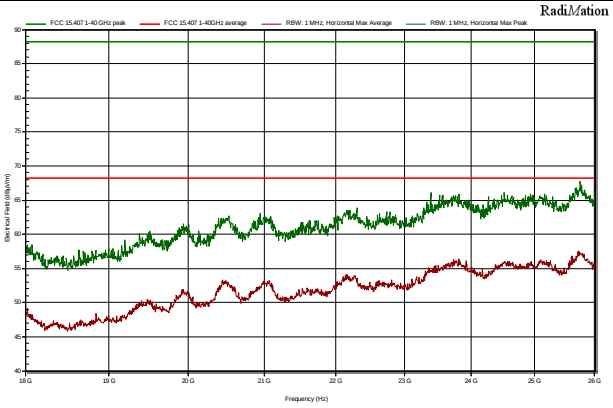
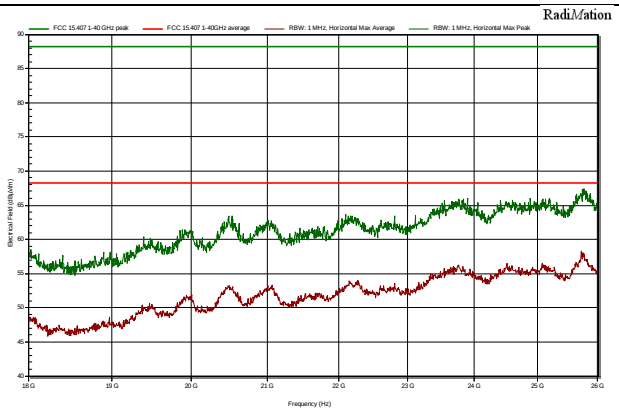
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	
Highest ch	

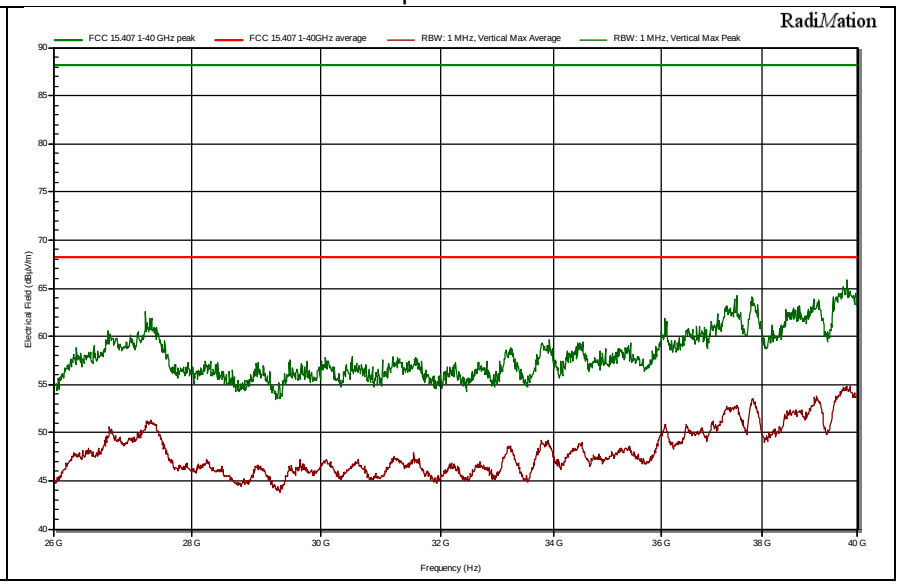
18 GHz to 26 GHz

Horizontal polarization

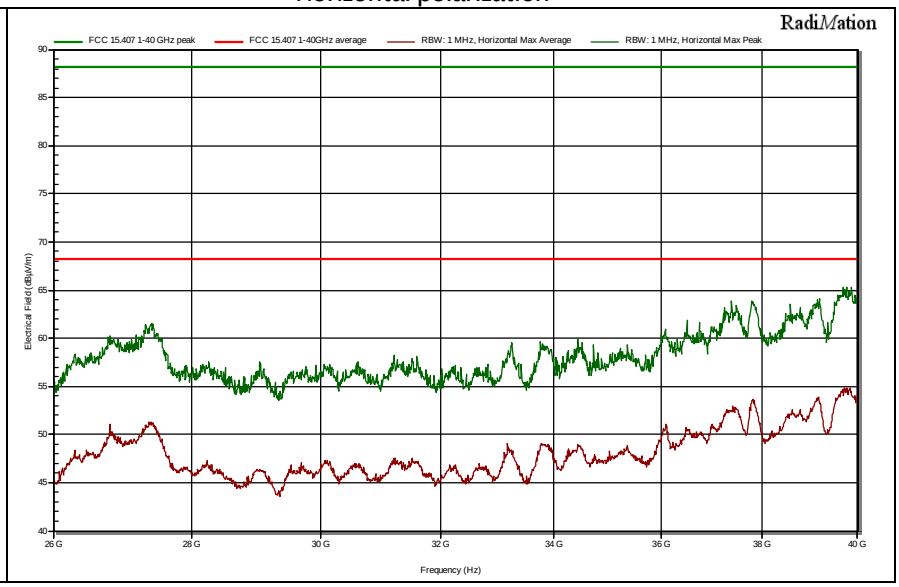
Low ch	
Mid ch	
High ch	
Highest ch	

26 to 40 GHz

Vertical polarization

Highest ch	

Horizontal polarization

Highest ch	

3.2 Conducted emissions

3.2.1 Limit

According to 15.207 (c)

Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

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

*Decreases with the logarithm of the frequency.

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.2.4 Test procedure

According to ANSI C63.4: 2014, section 13.3
IRN 029 – Method 1

3.2.5 Test results of the AC mains conducted measurement

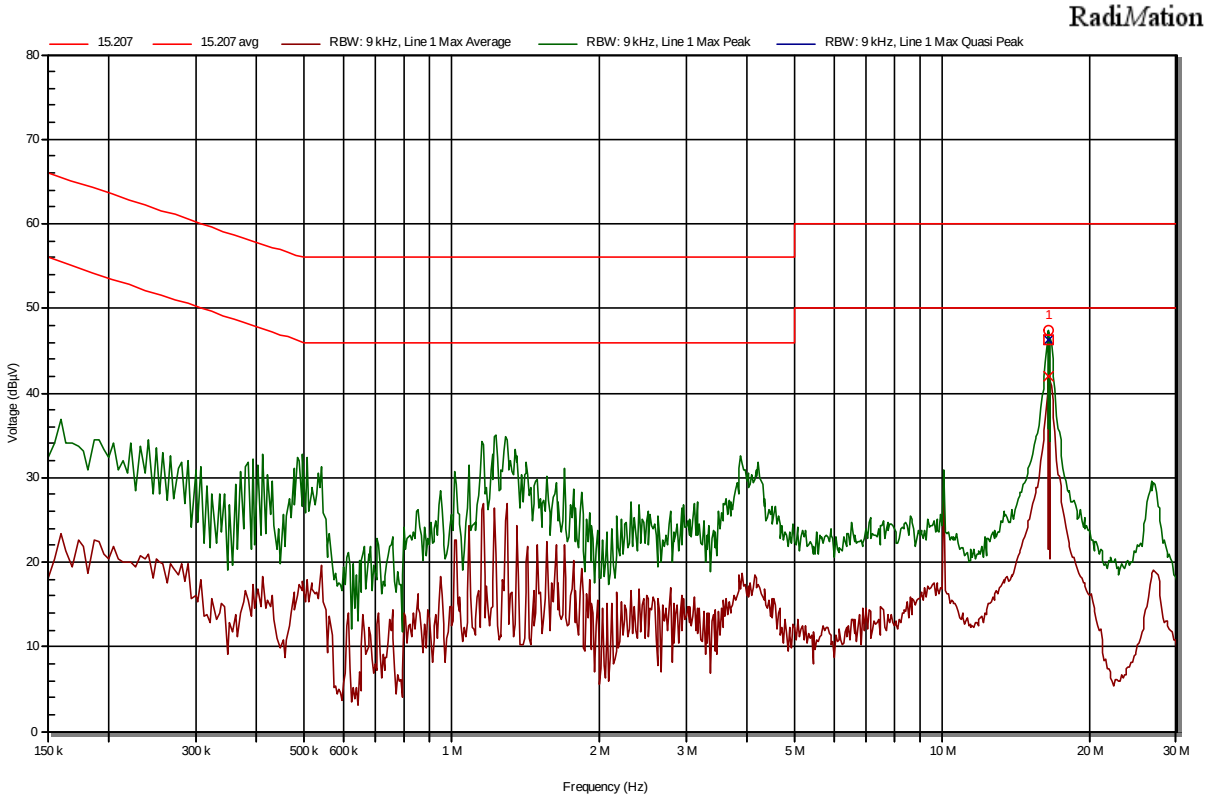
See next page.

3.2.6 Measurement uncertainty

+/- 3.6 dB

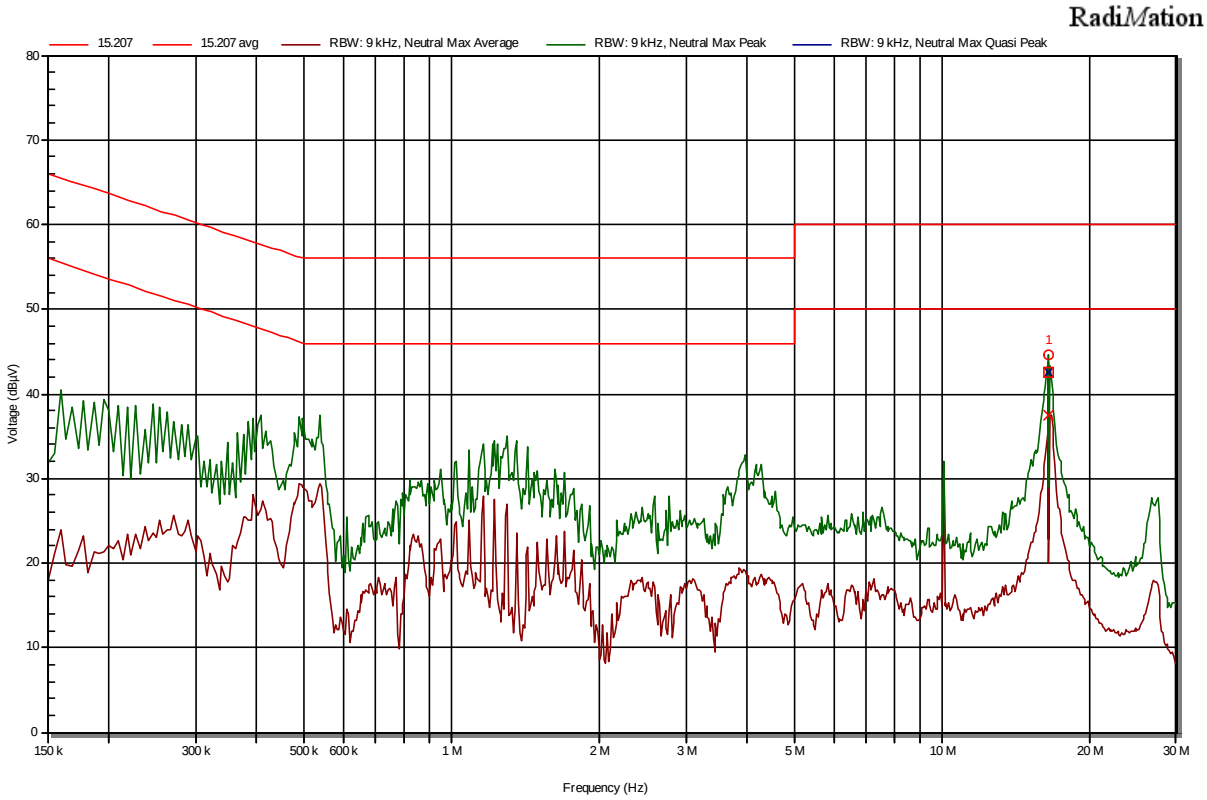
3.2.7 Plots of the AC mains conducted spurious measurement

Phase



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Average	Average Limit	Status
1	16,518 MHz	46,3 dBµV	60 dBµV	41,9 dBµV	50 dBµV	Pass

Neutral



Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Average	Average Limit	Status
1	16,471 MHz	42,6 dBµV	60 dBµV	37,5 dBµV	50 dBµV	Pass

4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Conducted emission Measurement:

U_{lisn} (dBµV) = U (dBµV) + Corr. (dB)

Where:
U = Measuring receiver voltage
LISN insertion loss = Voltage division factor of LISN
Corr. = sum of single correction factors of used LISN, cables and pulse limiter.
Linear interpolation will be used for frequencies in between the values in the table.

Frequency (Mhz)	Voltage division LISN (db)	Insertion Loss Pulse limiter (dB)	Cable loss (dB)	Corr. (dB)
	TE 00208 SN: 892785/004 Rohde & Schwarz ESH3-Z5	TE 00756 SN: 5SM03153 Rohde & Schwarz ESH3-Z2	TE 11134	
0,15	0,09	9,87	0,02	9,98
0,2	0,1	9,87	0,03	10
0,3	0,1	9,87	0,03	10
0,5	0,1	9,87	0,08	10,05
0,7	0,12	9,87	0,25	10,24
0,8	0,12	9,87	0,25	10,24
1	0,13	9,87	0,11	10,11
2	0,16	9,87	0,15	10,18
3	0,19	9,87	0,21	10,27
5	0,26	9,88	0,21	10,35
7	0,36	9,89	0,25	10,5
8	0,39	9,89	0,25	10,53
10	0,46	9,91	0,29	10,66
15	0,77	9,93	0,34	11,04
20	0,95	9,96	0,37	11,28
25	1,12	9,99	0,43	11,54
30	1,1	10,04	0,45	11,59

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + Corr. (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).
Linear interpolation will be used for frequencies in between the values in the table.
Tables shows an extract of the values.

Frequency (Mhz)	AF (dB/m) TE 00967 Chase CBL6112A SN: 2308	Cable loss (dB) Id: SAR cable	Corr. (dB)
30	18,6	0,68	19,28
100	10,7	1,15	11,85
150	10,6	1,41	12,01
200	9,3	1,63	10,93
250	12,6	1,93	14,53
300	13,3	2,12	15,42
350	14,6	2,2	16,8
400	15,5	2,29	17,79
450	16,9	2,53	19,43
500	17,5	2,67	20,17
550	18,4	2,9	21,3
600	18,8	3,02	21,82
650	19,2	3,09	22,29
700	19	3,22	22,22
750	19,8	3,56	23,36
800	19,7	3,69	23,39
900	20,4	3,81	24,21
950	20,8	3,91	24,71
1000	21,2	4,3	25,5

Frequency (Mhz)	AF (dB/m) TE 00531 Emco 3115 SN: 9412-4377	Gain (dB) TE 11132 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) TE 01315	Corr. (dB)
1000	23,6	40,4	2,0	66
1500	25,1	40,5	2,4	68
2000	27,1	40,5	2,7	70,3
2500	28,6	40,7	3,2	72,5
3000	30,5	40,7	3,2	74,4
3500	31,2	40,7	3,4	75,3
4000	32,7	40,9	4,9	78,5
4500	32,4	40,9	4,4	77,7
5000	33,2	40,7	4,6	78,5
5500	34,0	40,5	4,5	79
6000	34,6	40,0	5,2	79,8
6500	34,3	39,4	5,9	79,6
7000	35,2	38,6	5,7	79,5
7500	36,4	39,2	5,9	81,5
8000	37,0	38,9	6,3	82,2
8500	37,5	38,4	6,4	82,3
9000	38,1	37,4	6,5	82
9500	37,8	37,0	7,1	81,9
10000	38,2	36,5	7,3	82
10500	38,1	36,7	7,6	82,4
11000	38,3	36,9	8,3	83,5
11500	38,5	37,6	8,1	84,2
12000	39,1	38,3	8,4	85,8
12500	38,7	38,5	8,3	85,5
13000	39,2	38,9	9,2	87,3
13500	40,5	40,2	8,3	89
14000	41,1	40,0	8,2	89,3
14500	41,4	40,1	8,2	89,7
15000	40,2	41,4	8,3	89,9
15500	37,9	41,4	8,6	87,9
16000	37,5	42,8	9,2	89,5
16500	38,6	42,3	8,8	89,7
17000	41,1	43,1	9,4	93,6
17500	42,7	43,2	9,4	95,3
18000	44,0	44,2	9,8	98

Frequency (Mhz)	AF (dB/m) TE 00531 Emco 3115 SN: 9412-4377	Gain (dB) TE 11132 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) TE 01315	Corr. (dB)
18000	31,3	26,2	9,8	67,3
19000	31,5	26,1	9,6	67,2
20000	31,7	25,9	11	68,6
21000	31,9	24,3	10,7	66,9
22000	32,1	18,3	10,5	60,9
23000	32,2	18,9	10,8	61,9
24000	32,3	23,6	11,4	67,3
25000	32,4	24,5	11,6	68,5
26000	32,5	25,3	11,7	69,5