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The Netherlands
Chamber of Commerce
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telefication

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

Product name : Aquarius 2S

Applicant : Tyro Products B.V.

FCC ID : SQLRXTX-03

Test report No. : 200900474 002 v2.00

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.

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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	Kiwa Telefication BV
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	06-01-2020	First draft	RvB
v1.00	04-03-2021	Release version	RvB
v2.00	20-05-2021	FCC id change	RvB

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Summary of Test results

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

1 General Description

1.1 Applicant

Client name:	Tyro Products B.V.
Address	Bedrijvenpark Twente 299, 7602 KK Almelo
Telephone:	0546 588790
E-mail:	m.krisman@tyroremotes.eu
Contact name:	Mr. M. Krisman

1.2 Manufacturer

Manufacturer name:	Tyro Products B.V.
Address:	Bedrijvenpark Twente 299, 7602 KK Almelo
Telephone:	0546 588790
E-mail:	m.krisman@tyroremotes.eu
Contact name:	Mr. M. Krisman

1.3 Tested Equipment Under Test (EUT)

Product name:	Aquarius 2S
Brand name:	Tyro Remotes
FCC ID:	SQLRXTX-03
Product type:	Remote control receiver
Model(s):	Aquarius 2S
Batch and/or serial No.	--
Software version:	--
Hardware version:	--
Date of receipt	25-10-2020
Tests started:	25-10-2020
Testing ended:	01-12-2020

1.4 Product specifications of Equipment under test

Tx Frequency:	902 - 928 MHz
Rx frequency:	902 - 928 MHz
Antenna type	SMA or FLex antenna, 5 dBi or 1.2 dBi
Type of modulation:	GFSK
Emission designator	61K4G1D

Note: antenna gain declared by the client.

1.5 Environmental conditions

Test date	25-10-2021	26-10-2020	01-12-2020
Ambient temperature	21.3°C	21.1°C	19.9°C
Humidity	32.5%	38.5%	29.7%

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

1.8 Observation and remarks

The EUT contains FCC id: SQLRXTX-02. See Telefication test report 191001881 001 for the results of FCC id: SQLRXTX-02. Therefore only Radiated and Conducted spurious emission are included in this report.
The same module used for 191001881 001 testing has been used in this report.
The EUT is DC Powered, Conducted emissions tested on an AC powered Host.

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 : ing. R. van Barneveld

Review of test methods and report by:

Name : P. van Wanrooij, BASc

The above conclusions have been verified by the following signatory:

Date : 20-05-2021

Name : P. van Wanrooij

Function : Test Engineer

Signature :

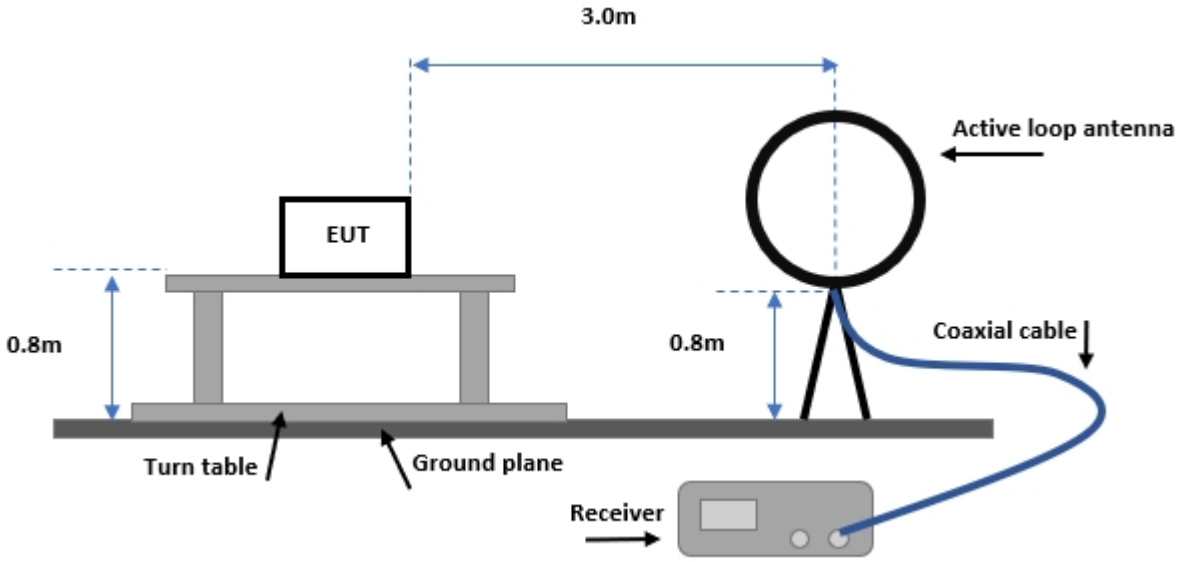
2 Test configuration of the Equipment Under Test

2.1 Test mode

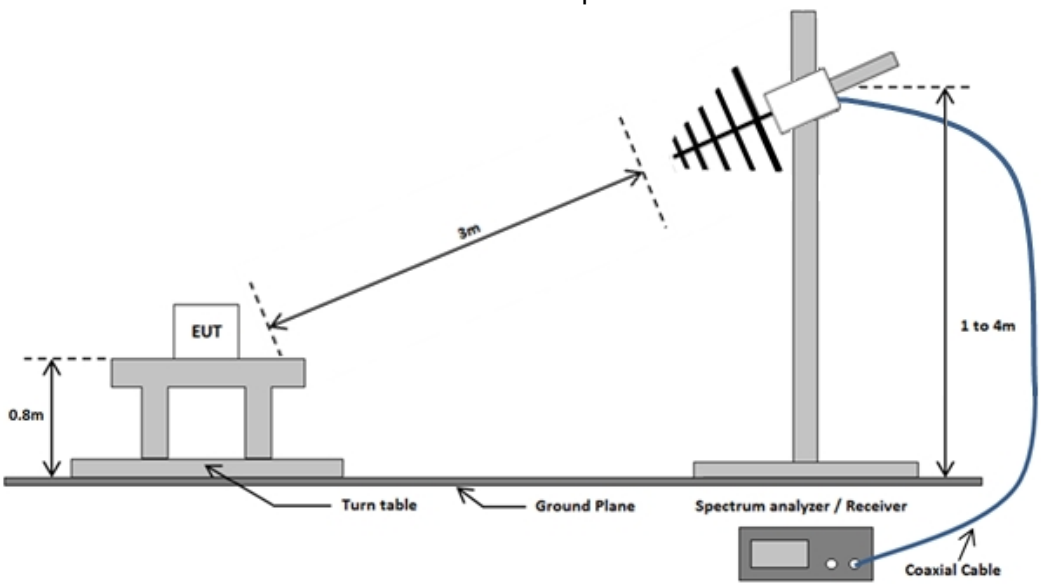
The applicant provided test mode firmware for the radio, in which it was possible to configure the radio to transmit continuously.

2.2 Test setups

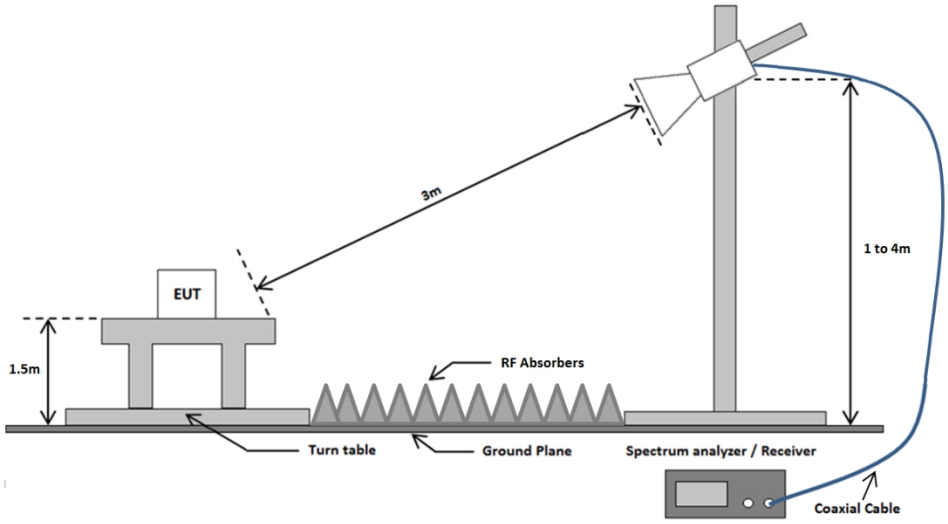
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz

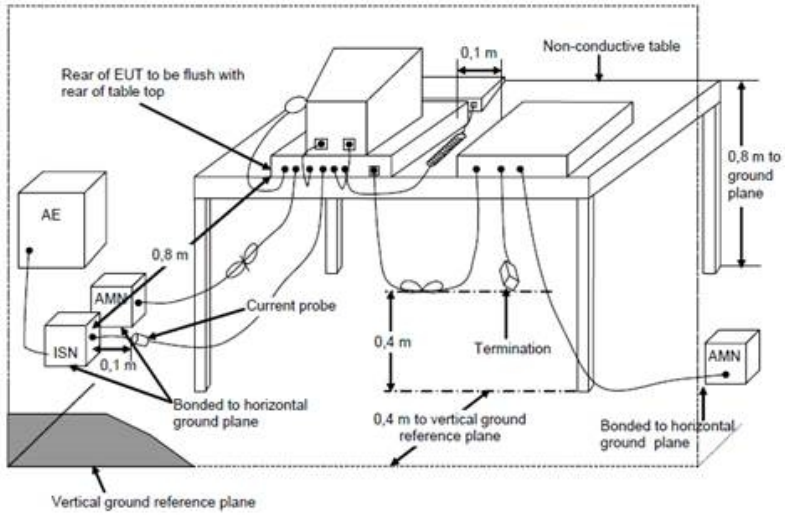


Radiated emissions test setup above 1 GHz



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
Two line V-network	Rohde & Schwarz	ENV216	TE11176	3.2
EMI Receiver	Rohde & Schwarz	ESR7	TE01220	3.1
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
1.1 GHz HPF	Wainwright	WHK1.1/15G-10EF	TE01139	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

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

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

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

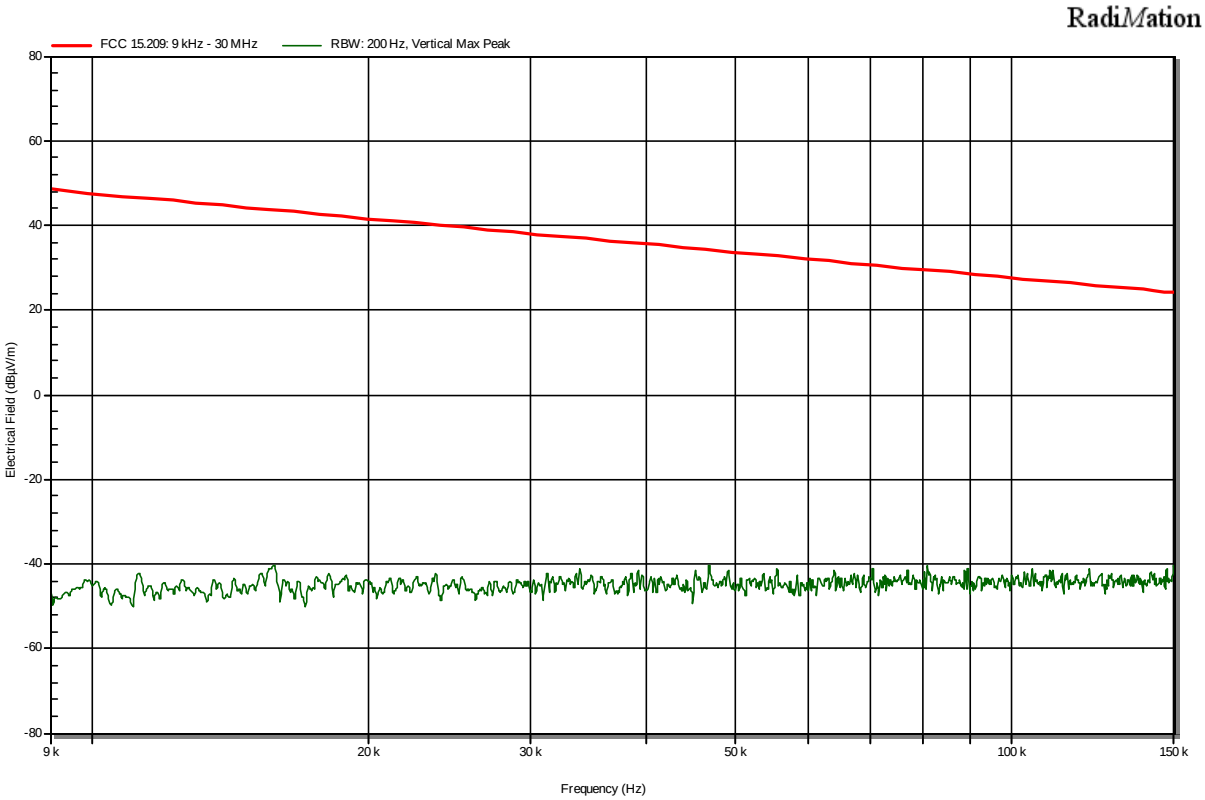
9 kHz to 30 MHz: IRN 026 – Method 10
30 MHz to 1 GHz: IRN 026 – Method 1
1 GHz to 18 GHz: IRN 026 – Method 2

3.1.5 Measurement Uncertainty

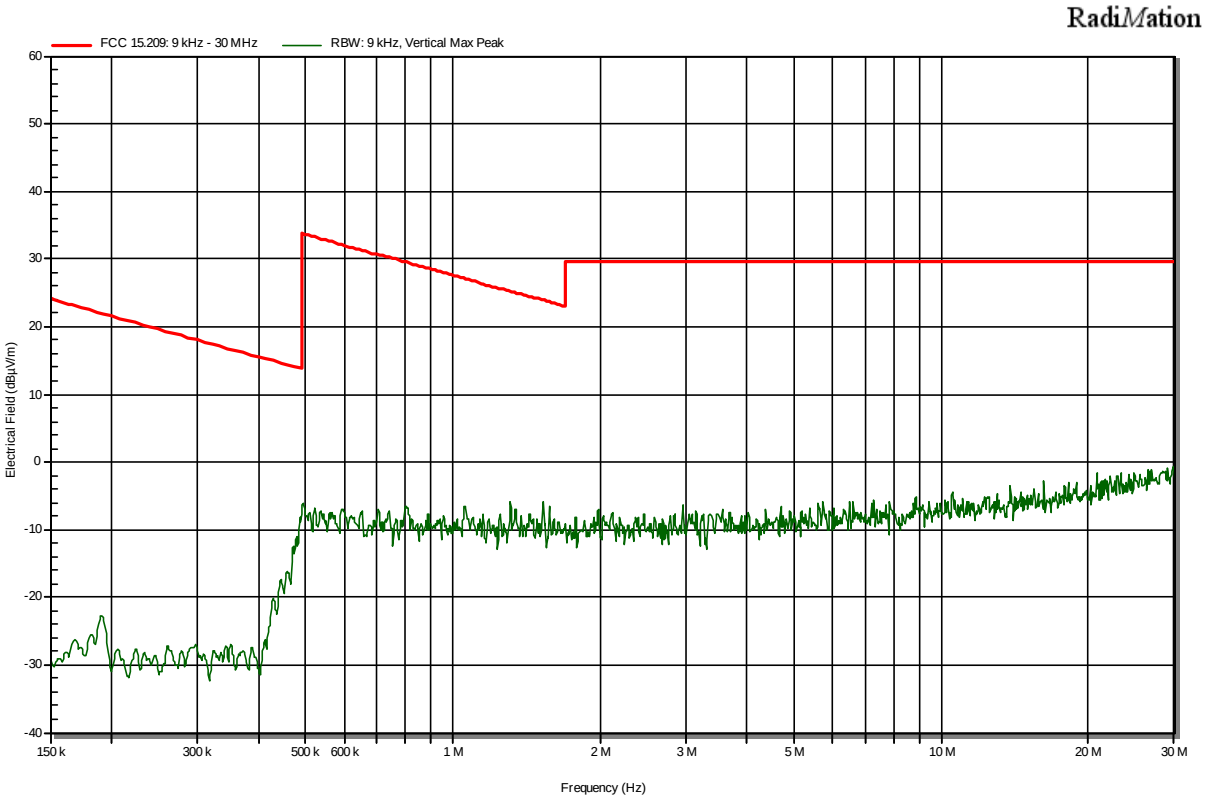
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB

3.1.6 Plots of the Radiated Spurious Emissions Measurement

9 – 150 kHz

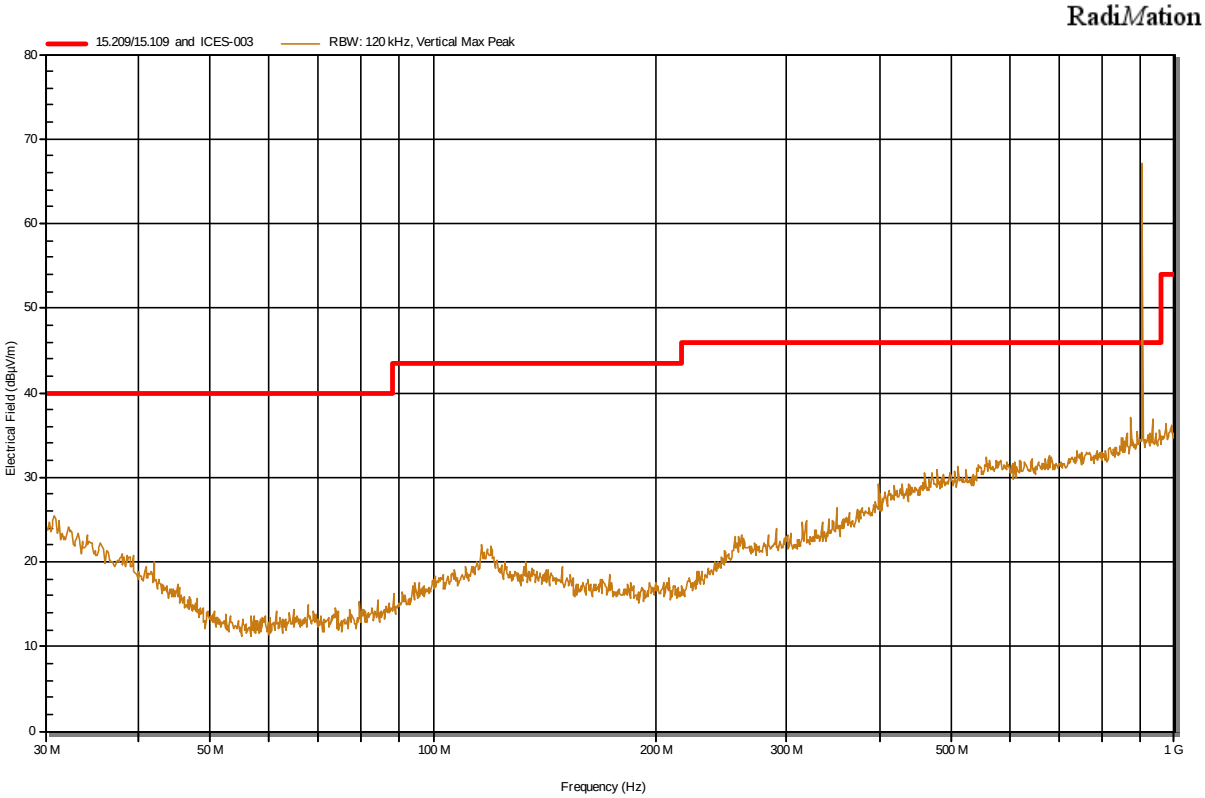


150 kHz – 30 MHz

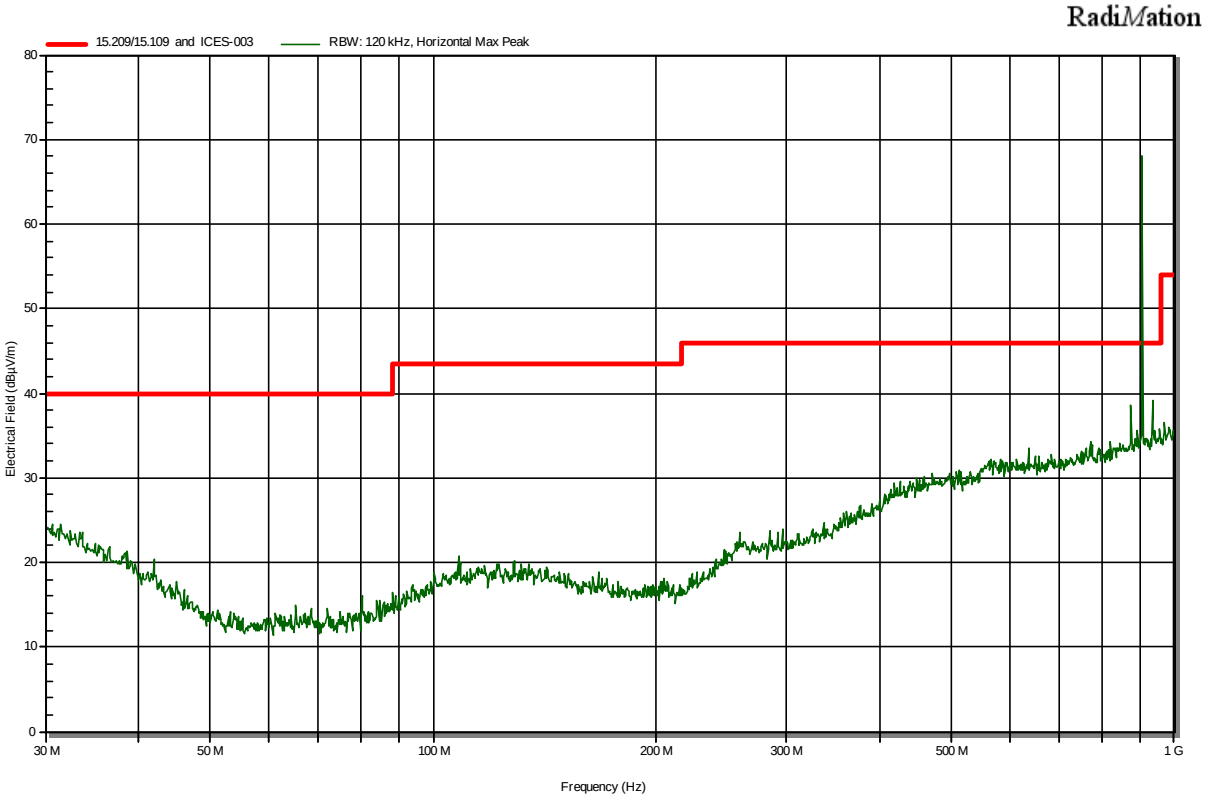


30 -1000 MHz
Low channel

Vertical polarization



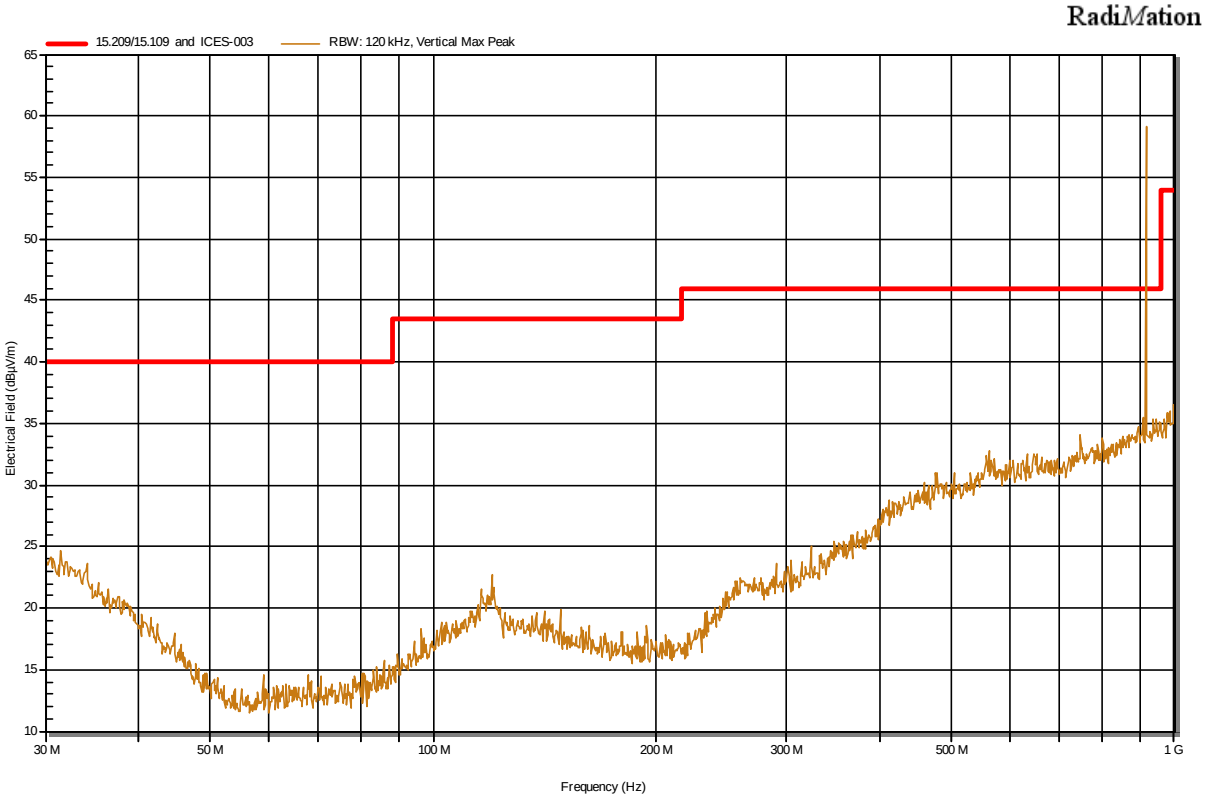
Horizontal polarization



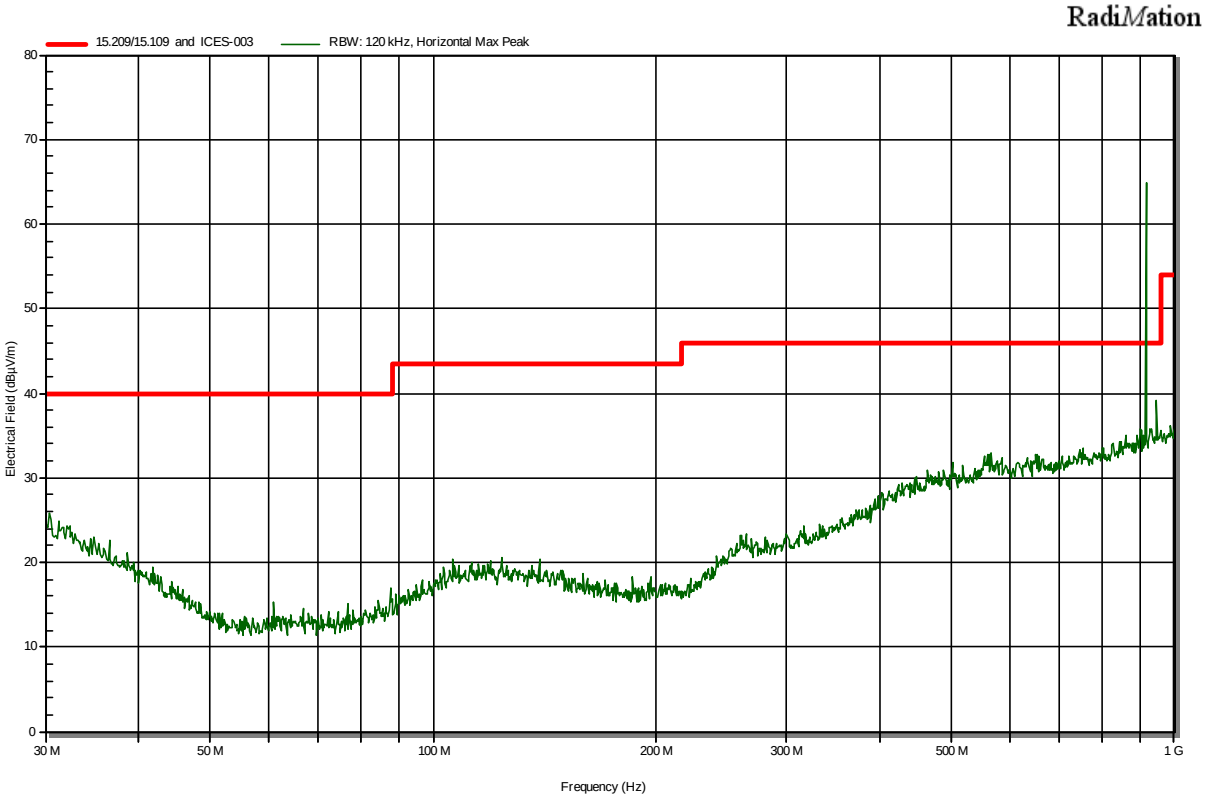
Note: the peak seen in the 900 MHz range is the transmission frequency, and is not subject to the spurious emission limit.

30 -1000 MHz
Middle channel

Vertical polarization



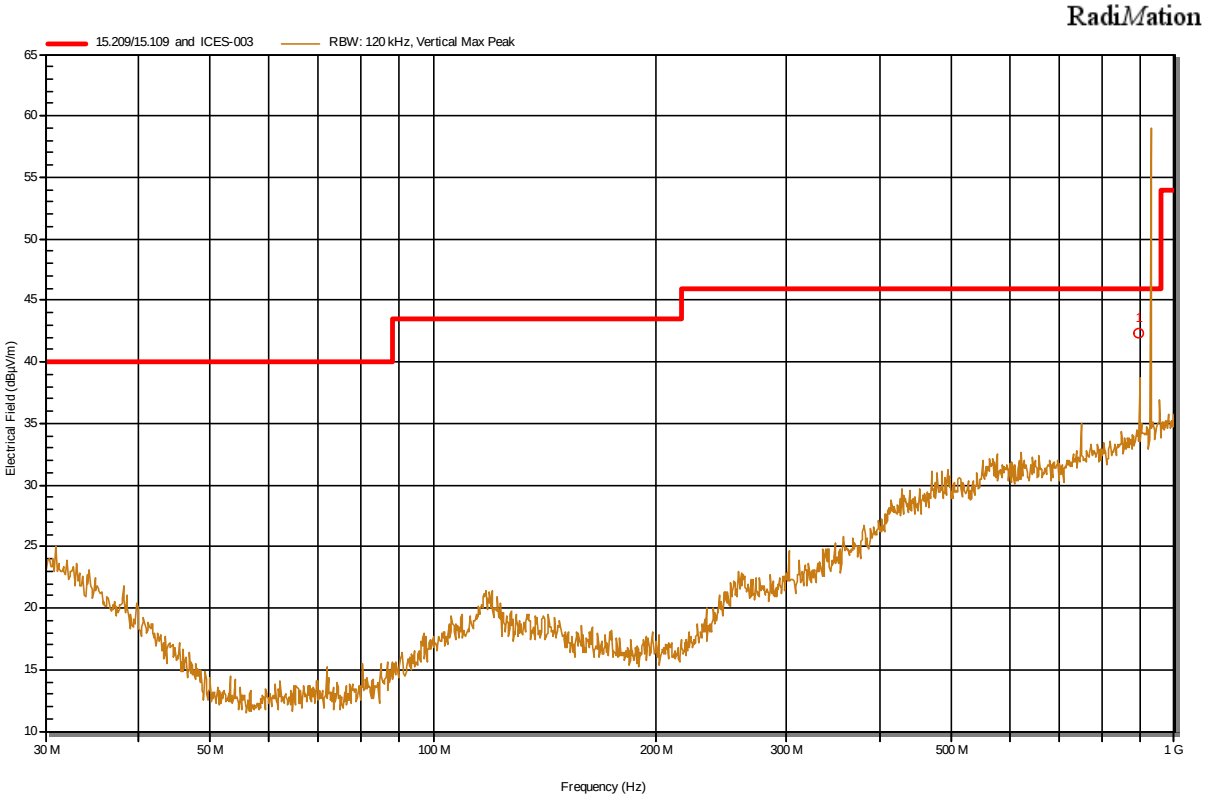
Horizontal polarization



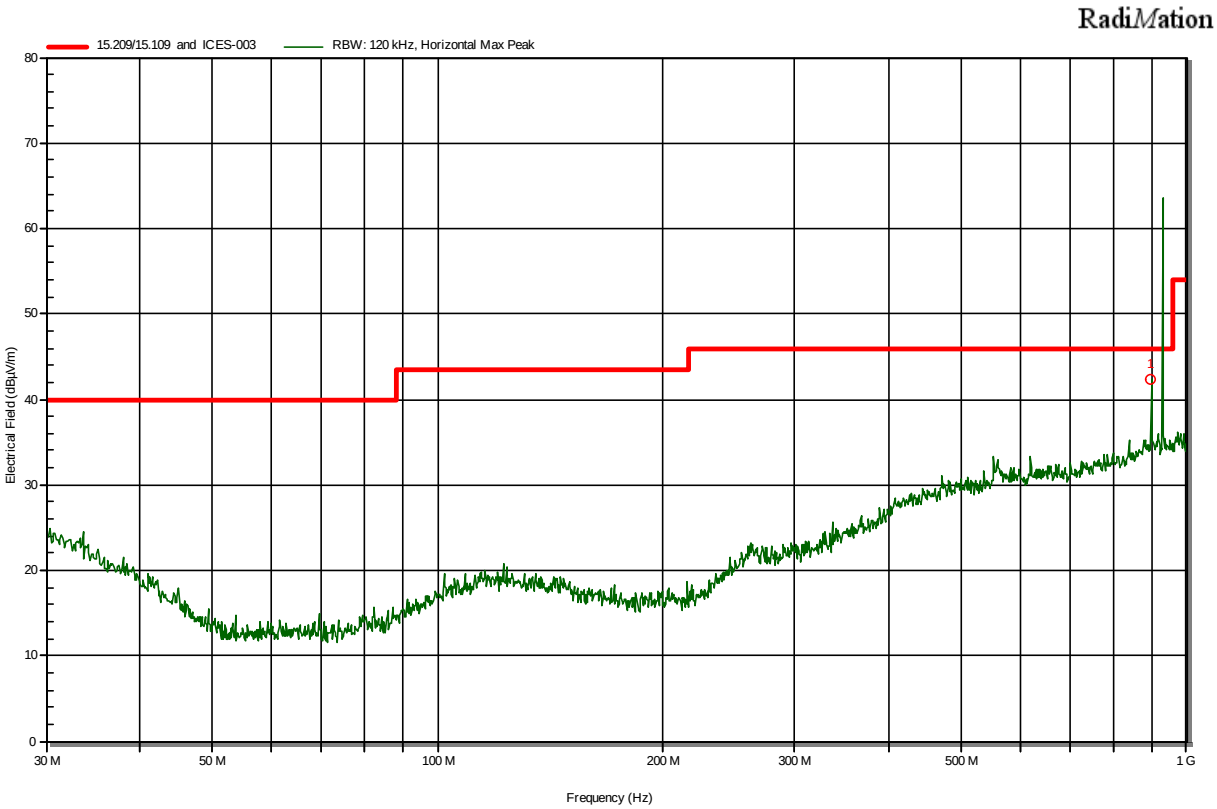
Note: the peak seen in the 900 MHz range is the transmission frequency, and is not subject to the spurious emission limit.

30 -1000 MHz
High channel

Vertical polarization



Horizontal polarization



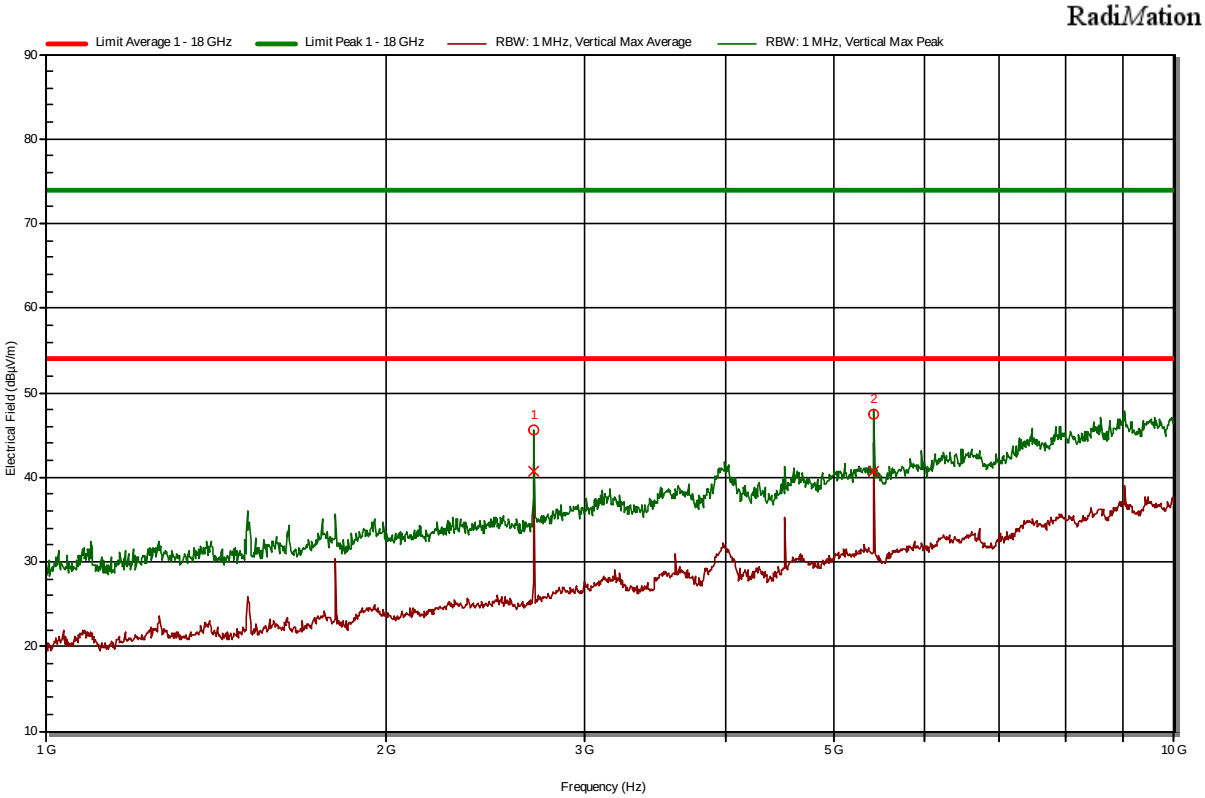
Note: the peak seen in the 900 MHz range is the transmission frequency, and is not subject to the spurious emission limit.

Measured Peaks
High channel

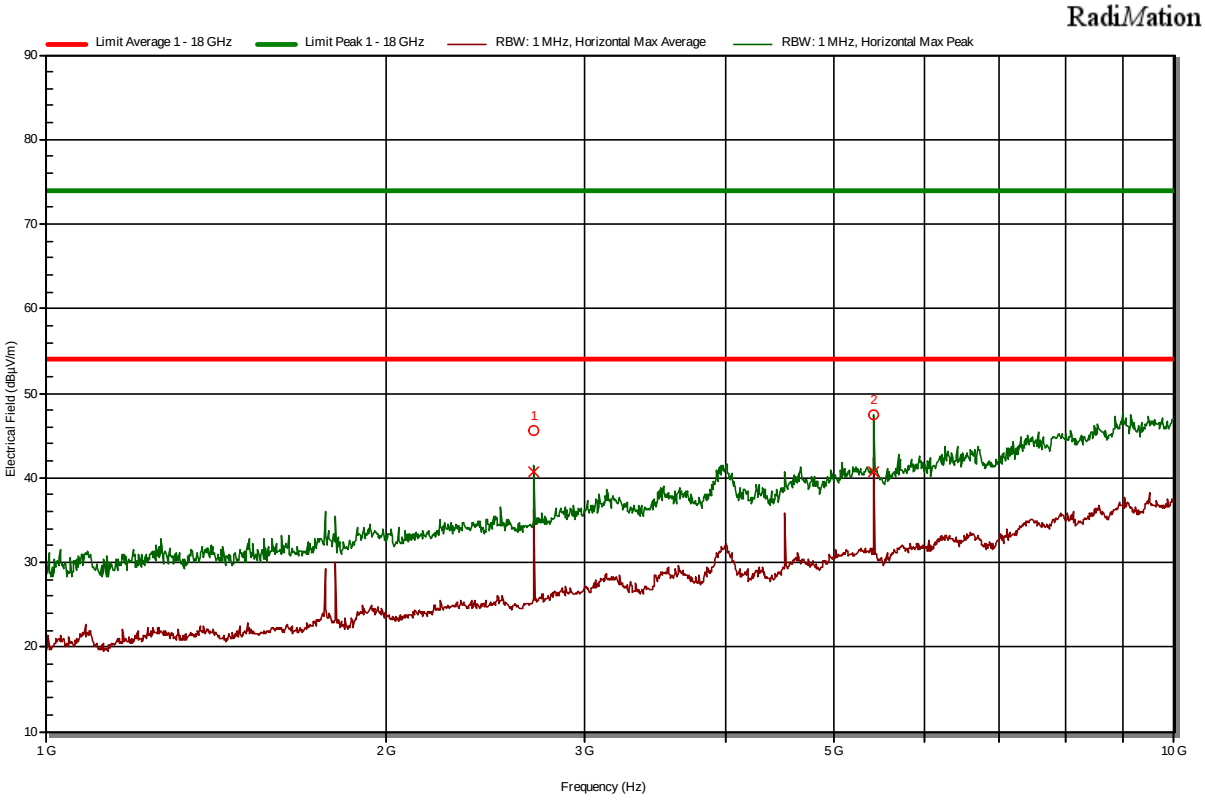
Frequency	Peak	Peak Limit	Status	Angle	Height	Polarization
897,059 MHz	42,3 dBµV/m	46 dBµV/m	Pass	240 degrees	2 m	Horizontal

1 -10 GHz
Low channel

Vertical polarization

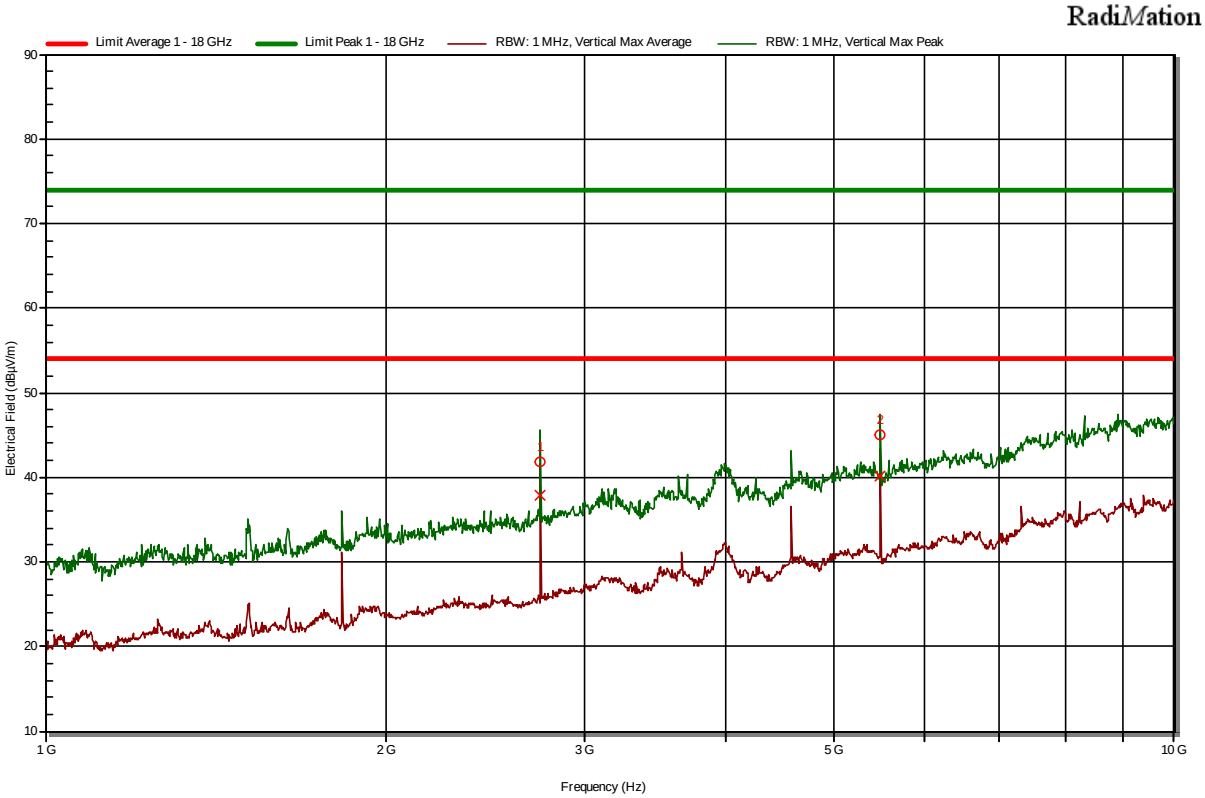


Horizontal polarization

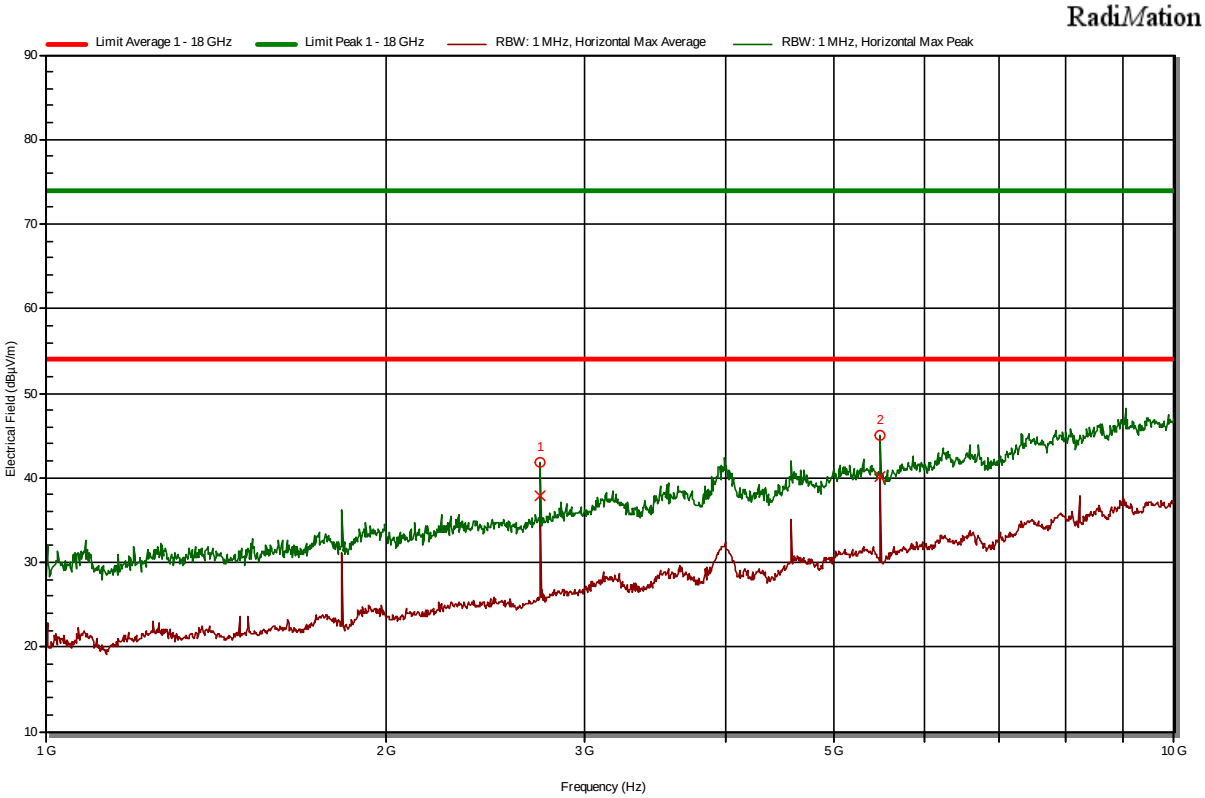


1 -10 GHz
Middle channel

Vertical polarization

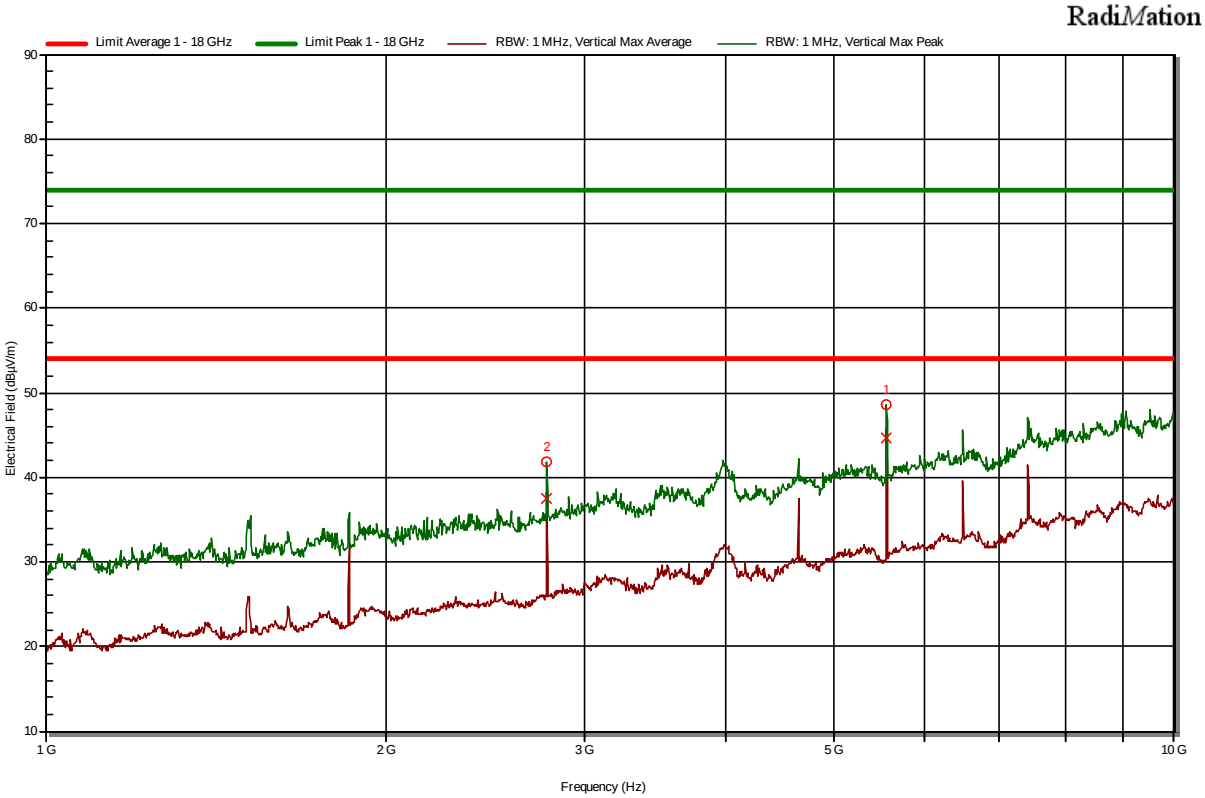


Horizontal polarization

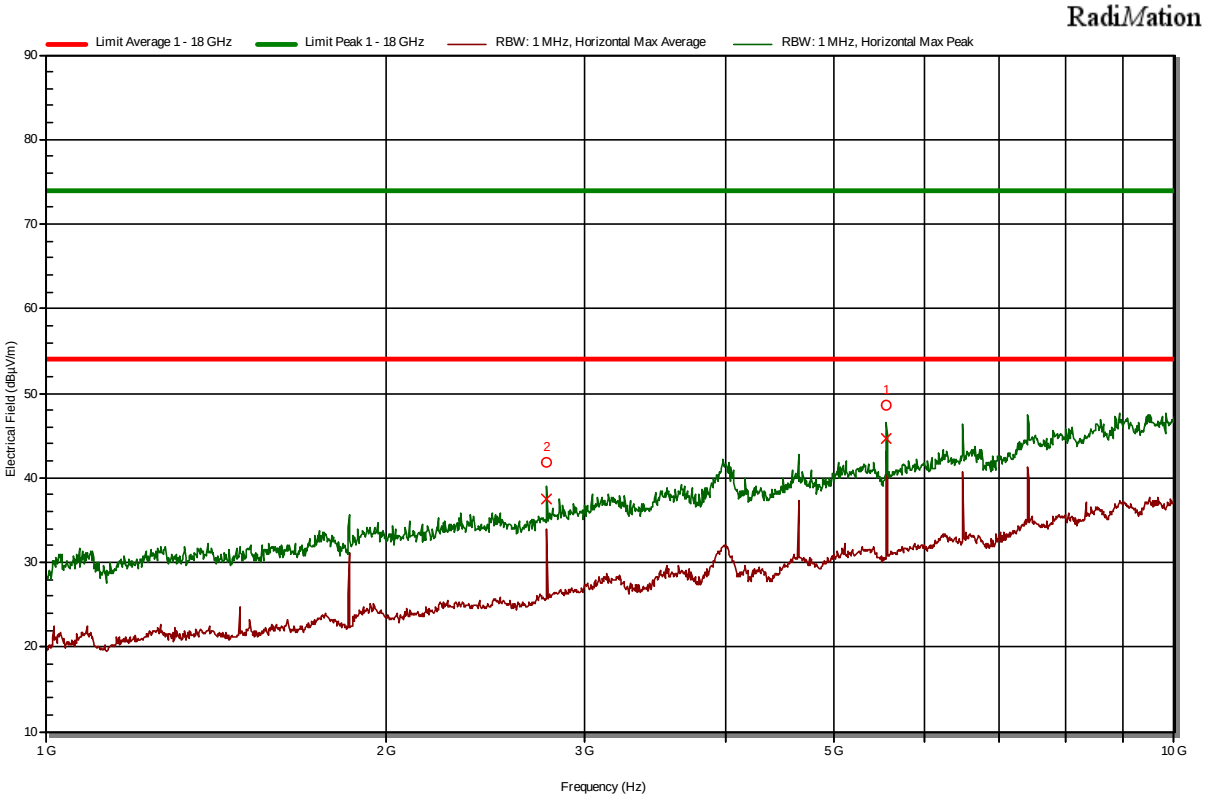


1 -10 GHz
High channel

Vertical polarization



Horizontal polarization



Measured Peaks

Low Channel

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
2,708 GHz	45,5 dBµV/m	74 dBµV/m	40,7 dBµV/m	54 dBµV/m	Pass	309 degrees	3,5 m	Vertical
5,416 GHz	47,4 dBµV/m	74 dBµV/m	40,7 dBµV/m	54 dBµV/m	Pass	344 degrees	4 m	Horizontal

Middle Channel

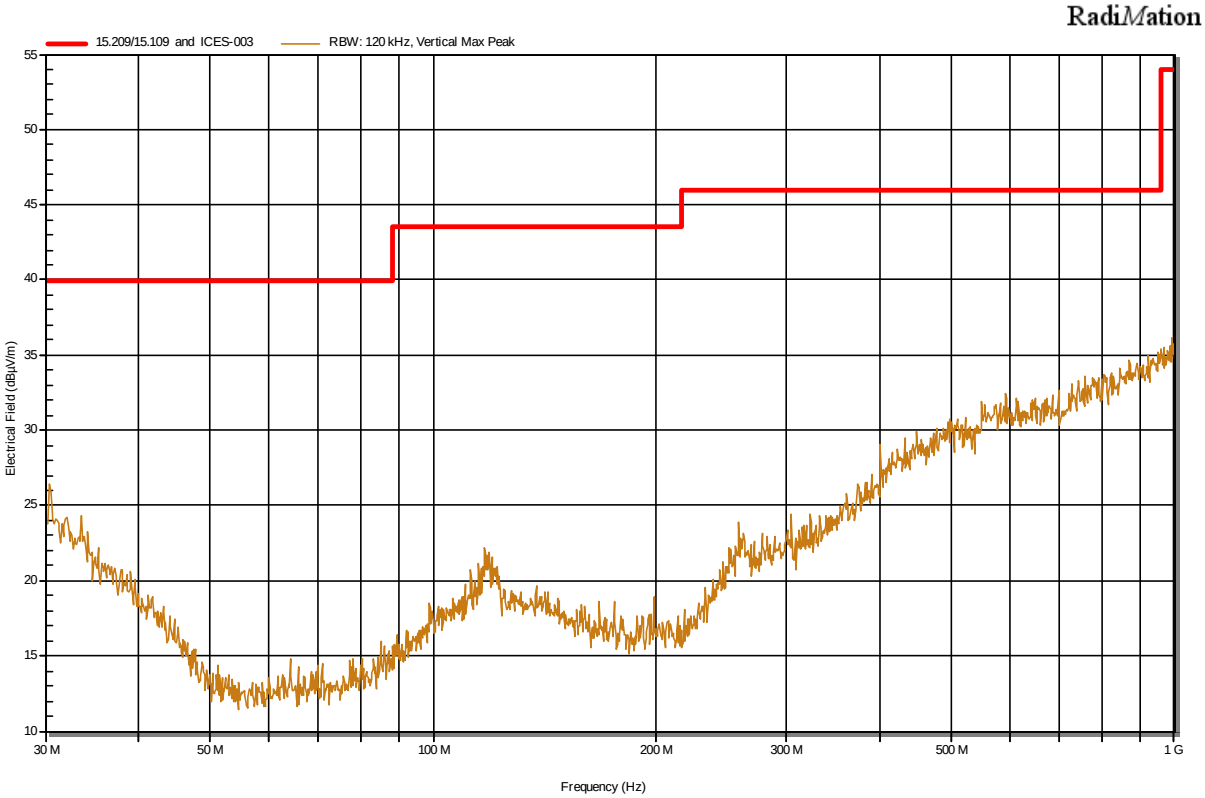
Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
2,744 GHz	41,8 dBµV/m	74 dBµV/m	37,9 dBµV/m	54 dBµV/m	Pass	277 degrees	3 m	Horizontal
5,488 GHz	45 dBµV/m	74 dBµV/m	40,2 dBµV/m	54 dBµV/m	Pass	0 degrees	4 m	Horizontal

High Channel

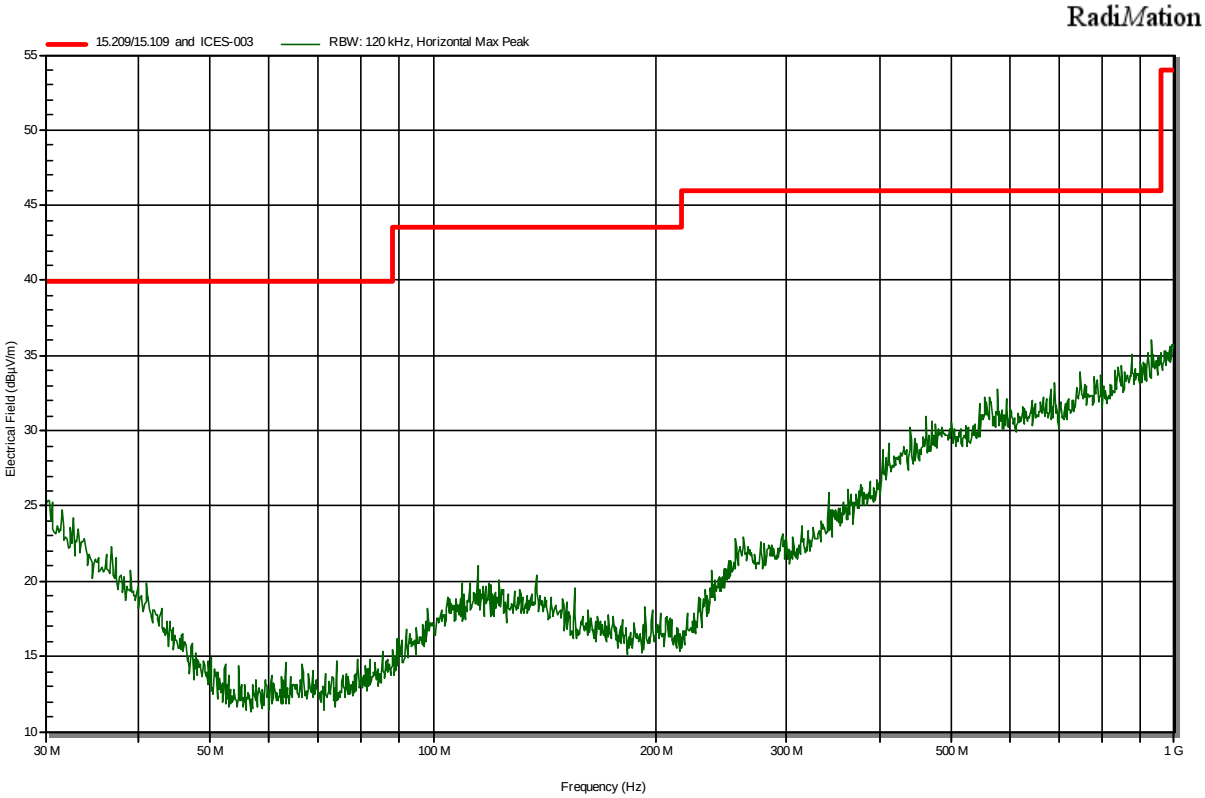
Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
5,562 GHz	48,6 dBµV/m	74 dBµV/m	44,7 dBµV/m	54 dBµV/m	Pass	44 degrees	2 m	Vertical
2,781 GHz	41,7 dBµV/m	74 dBµV/m	37,6 dBµV/m	54 dBµV/m	Pass	308 degrees	4 m	Vertical

30 -1000 MHz (RX)
Low channel

Vertical polarization

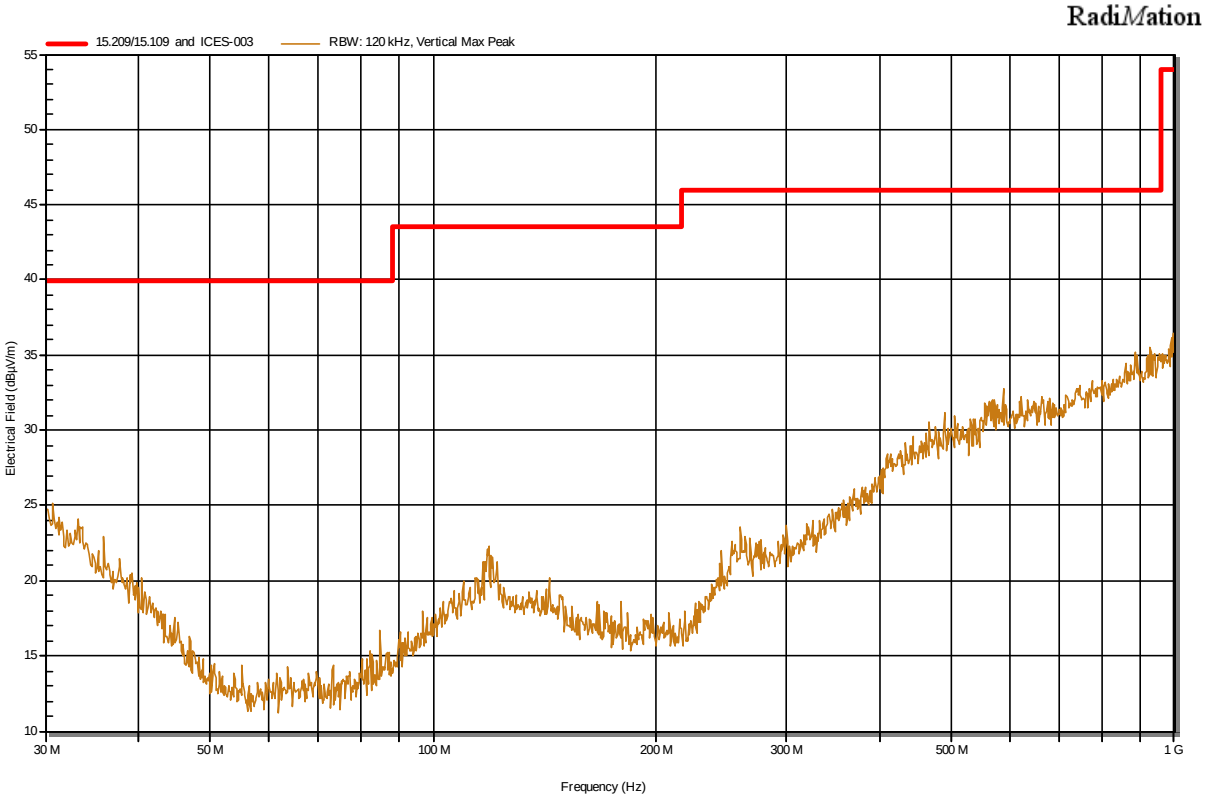


Horizontal polarization

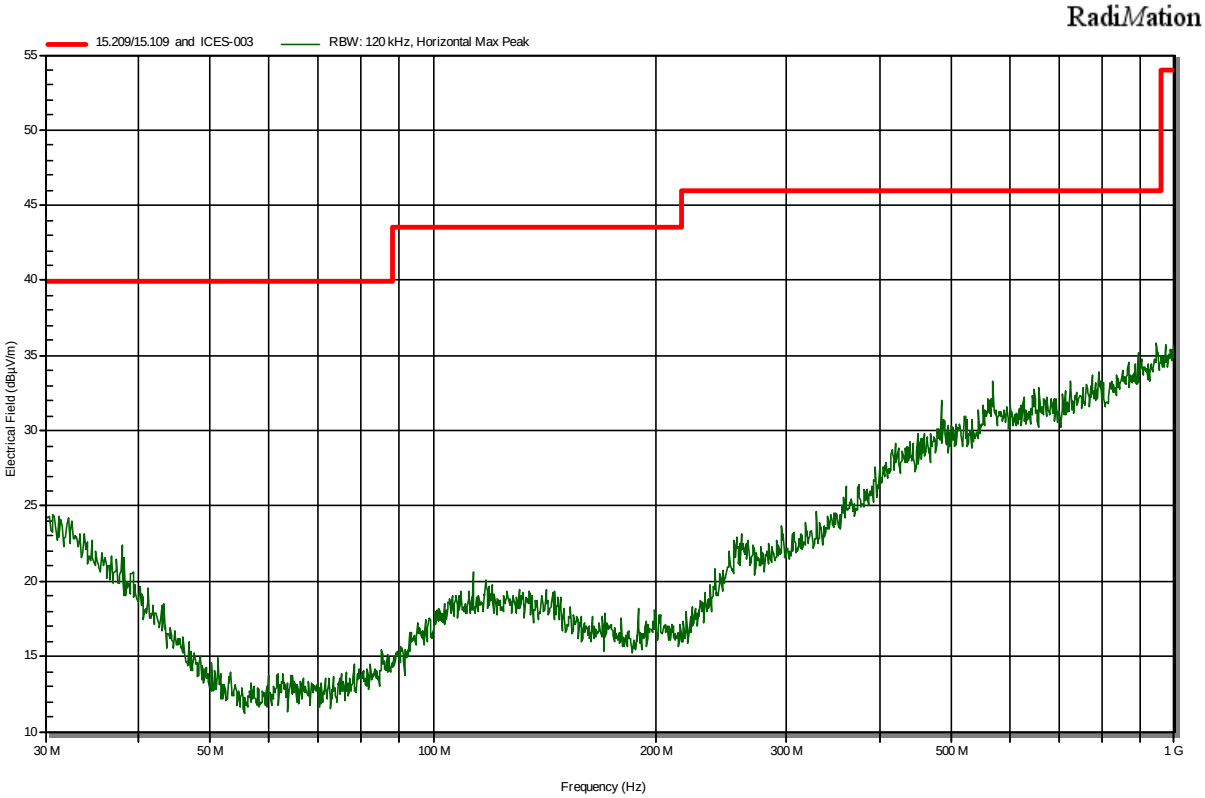


30 -1000 MHz (RX)
Middle channel

Vertical polarization

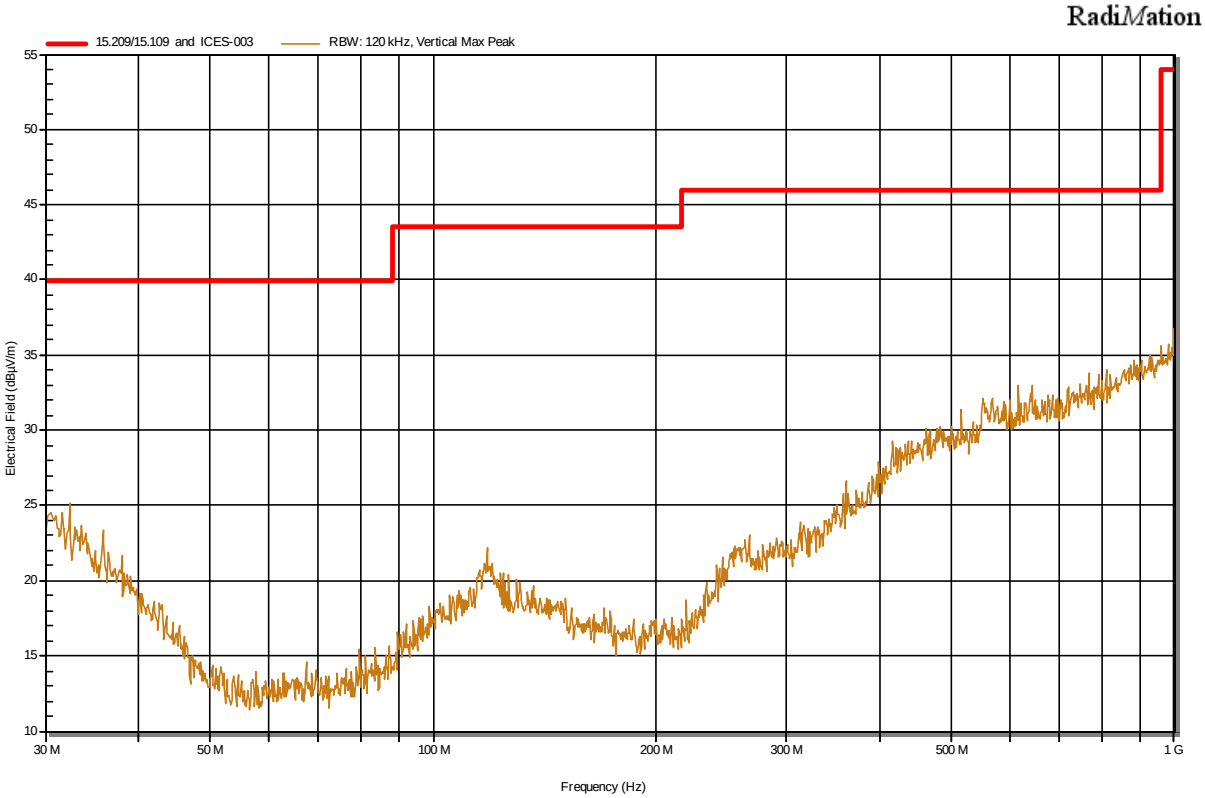


Horizontal polarization

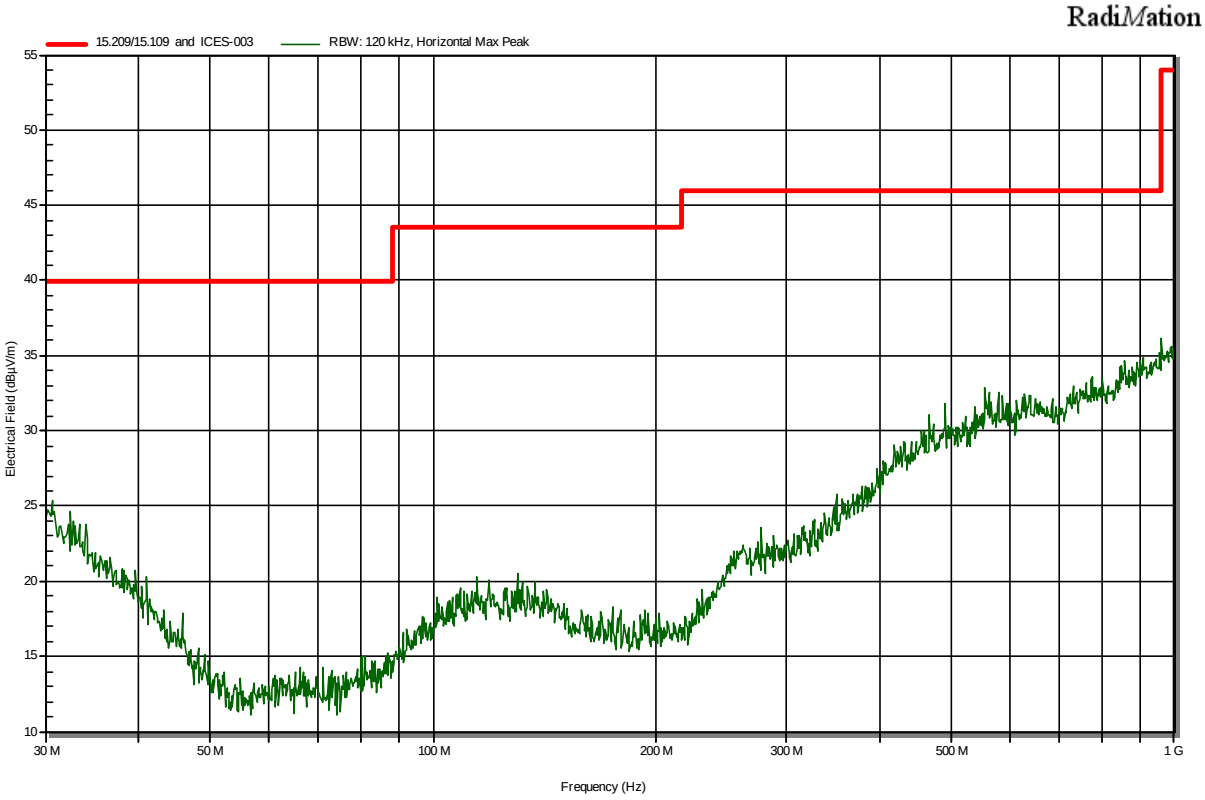


30 -1000 MHz (RX)
High channel

Vertical polarization

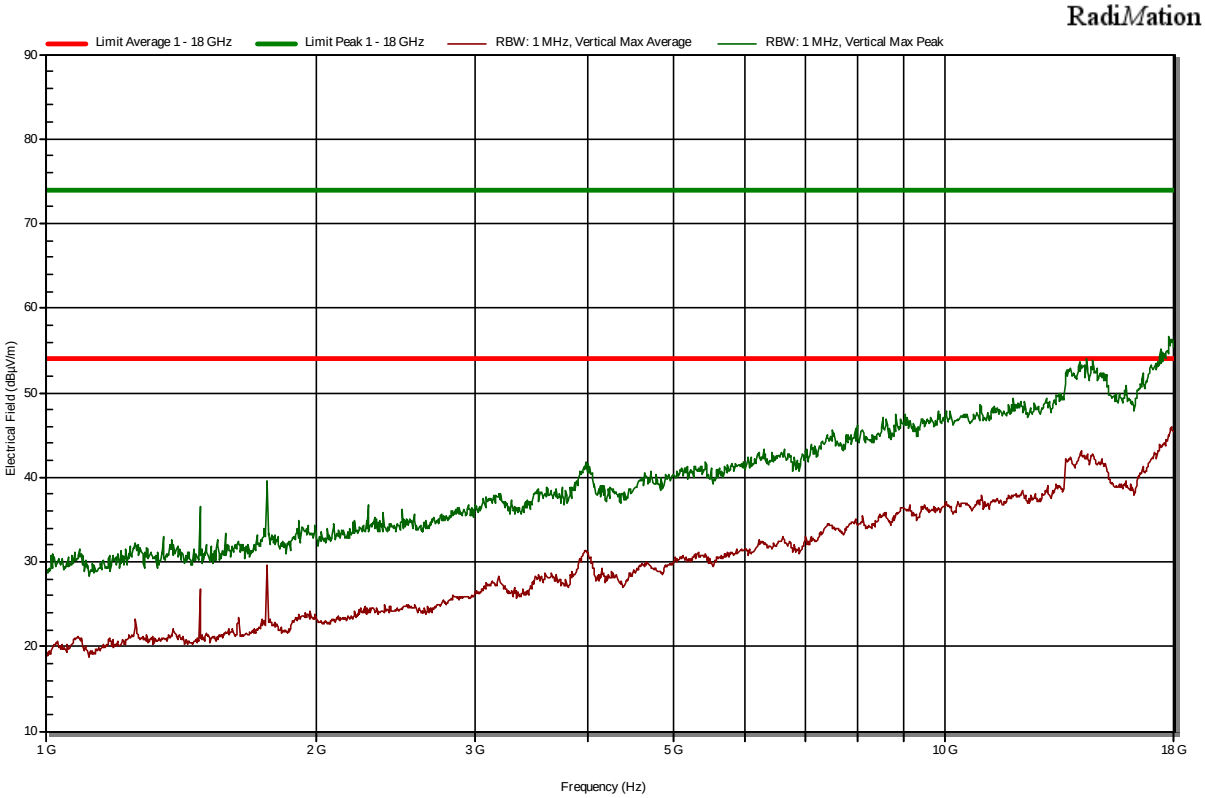


Horizontal polarization

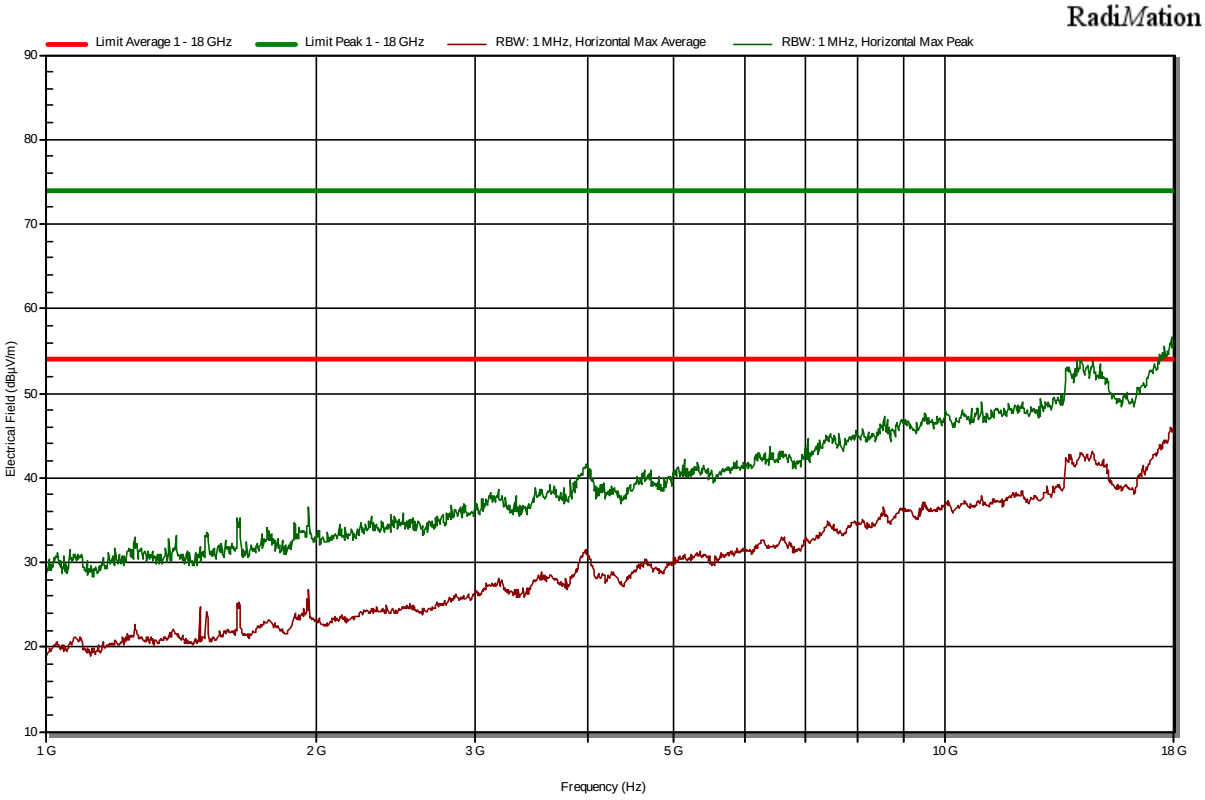


1 -10 GHz (RX)
Low channel

Vertical polarization

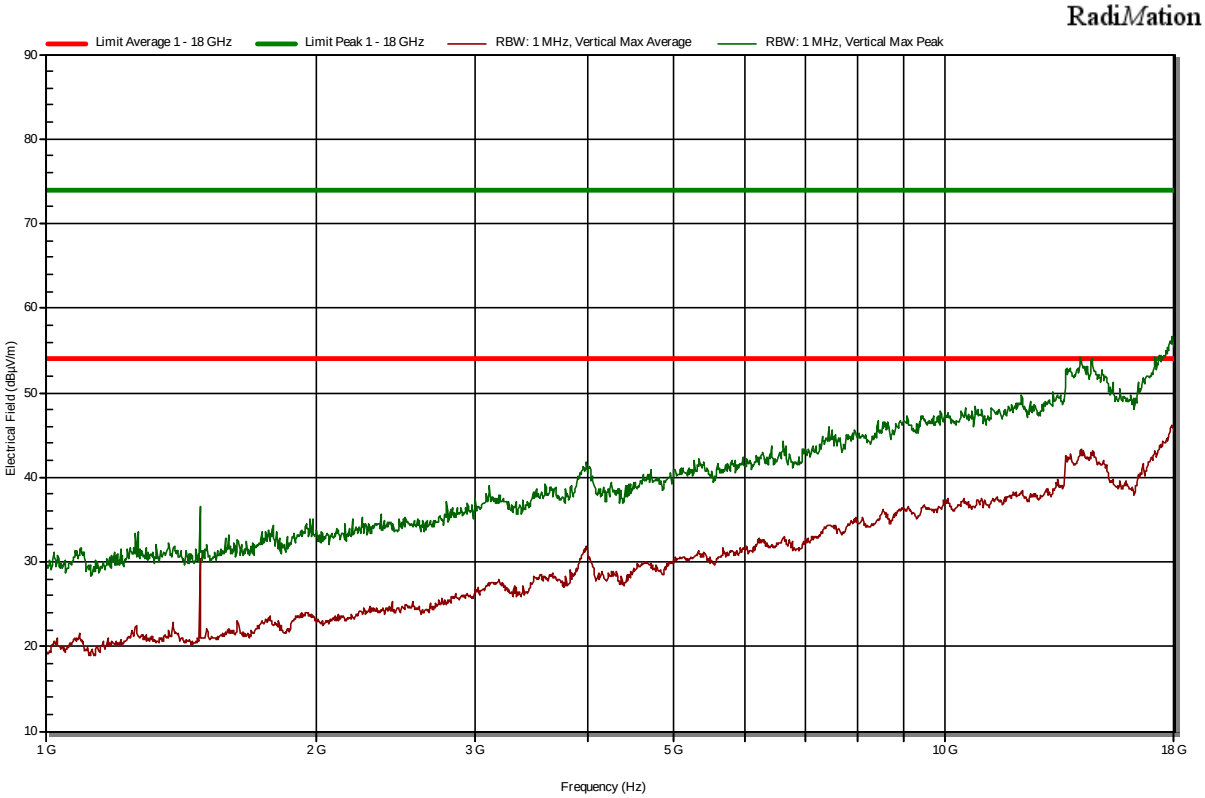


Horizontal polarization

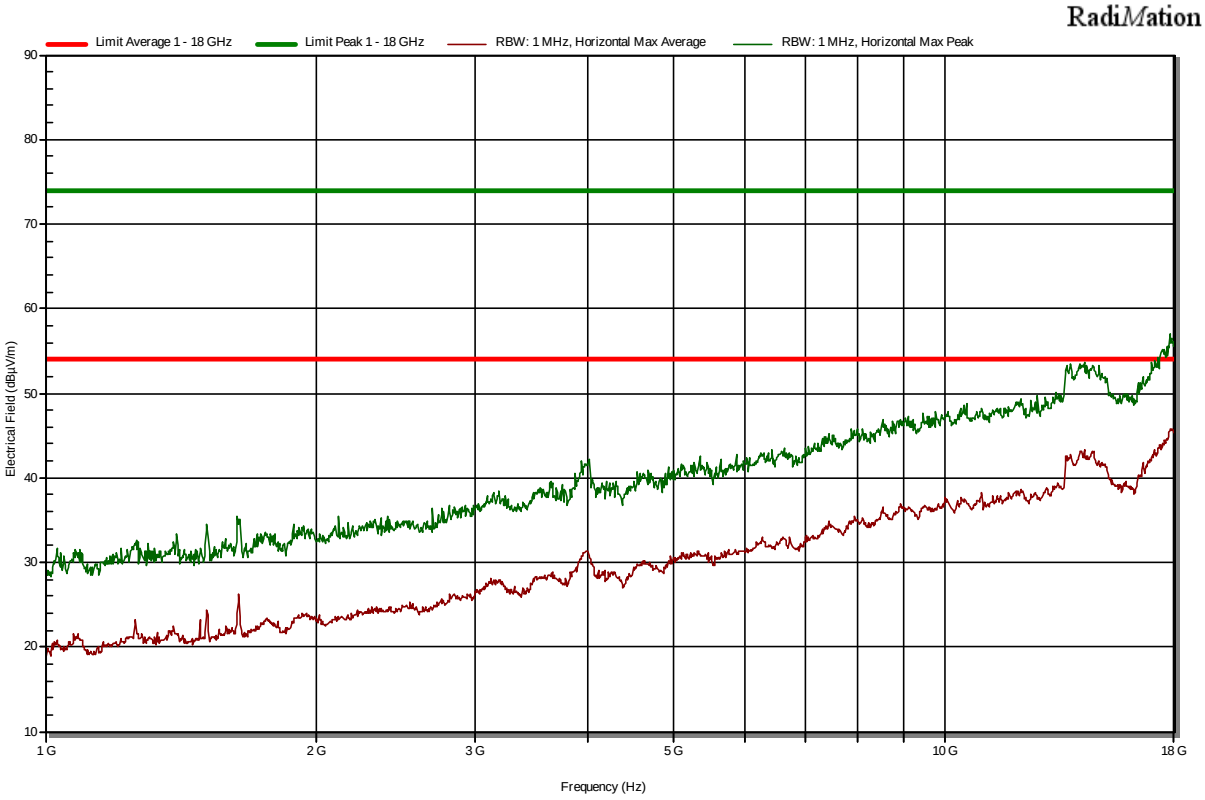


1 -10 GHz (RX)
Middle channel

Vertical polarization

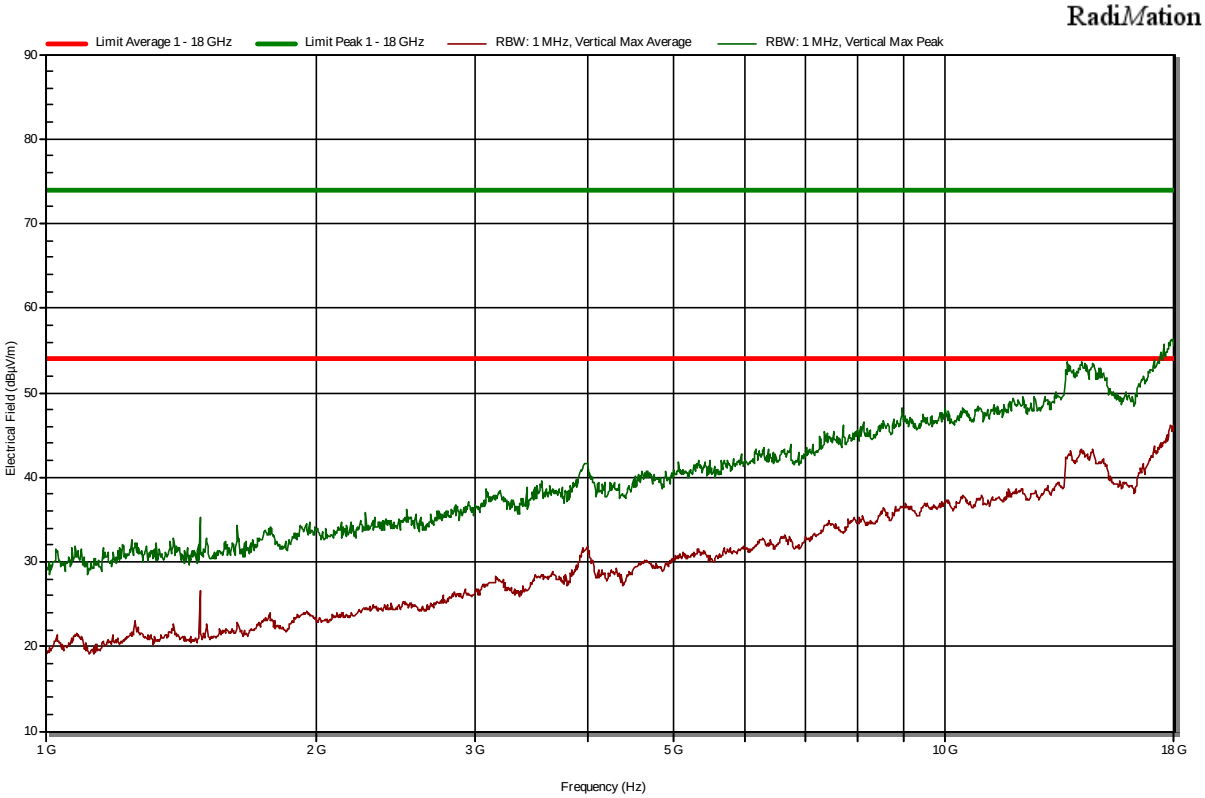


Horizontal polarization

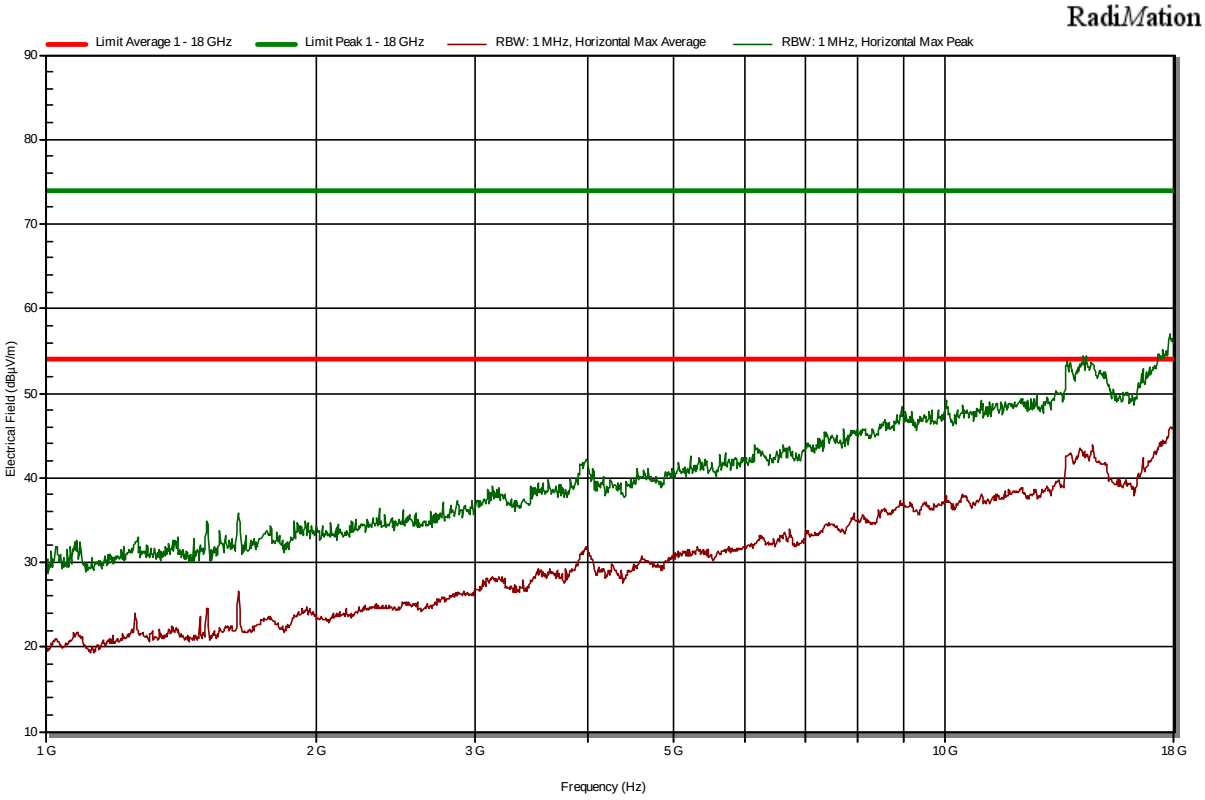


1 -10 GHz (RX)
High channel

Vertical polarization



Horizontal polarization



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 and plots of the AC mains conducted measurement

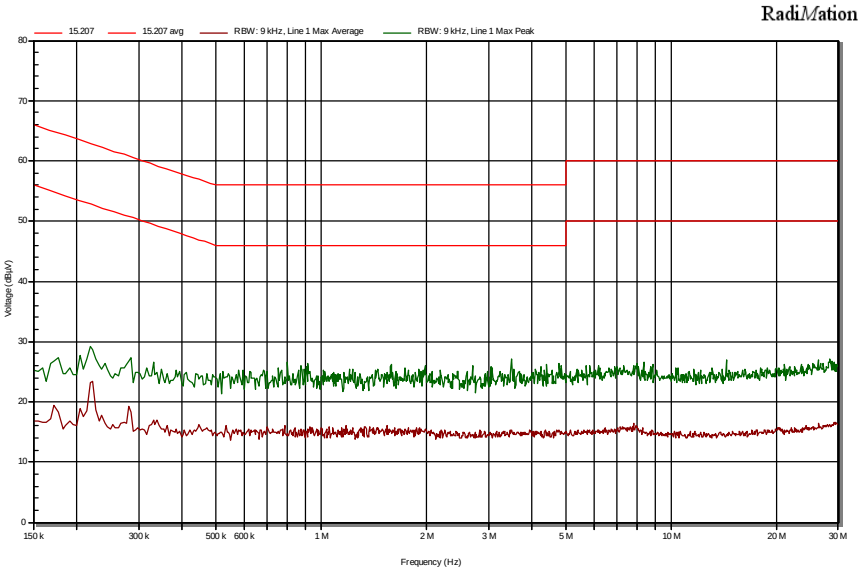
See next page.

3.2.6 Measurement uncertainty

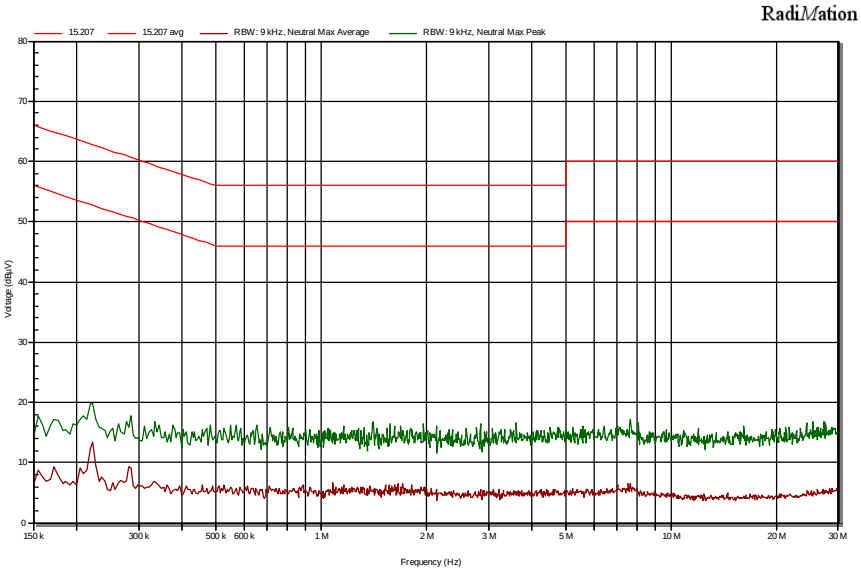
+/- 3.6 dB

3.2.7 Plots of the AC mains conducted spurious measurement

Phase



Neutral



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)	Cable loss (dB)	Corr. (dB)
	TE 00967 Chase CBL6112A SN: 2308	Id: SAR cable	
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)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	TE 00531 Emco 3115 SN: 9412-4377	TE 11132 Miteq JS4-18004000-30-8P-A1	TE 01315	
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)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	TE 00531 Emco 3115 SN: 9412-4377	TE 11132 Miteq JS4-18004000-30-8P-A1	TE 01315	
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