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Chamber of Commerce
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telefication

FCC Test report for parts 15.109, 15.209, 15.247

Product name : Musca 2S

Applicant : Tyro Products B.V.

FCC ID : SQLRXTX-03

Test report No. : 200900474 001 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.

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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
v0.51	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 (a)	Radiated spurious emissions	3.1	Pass
15.205 (a)	Spurious emissions in the restricted bands	3.1	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:	Musca 2S
Brand name:	Tyro Remotes
FCC ID:	SQLRXTX-03
Product type:	Remote control transmitter
Model(s):	Musca 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	PCB antenna, -9.1 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 §15.109
- 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 spurious emission are included in this report.
The same module used for 191001881 001 testing has been used in this report.
The EUT is battery powered.

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 :

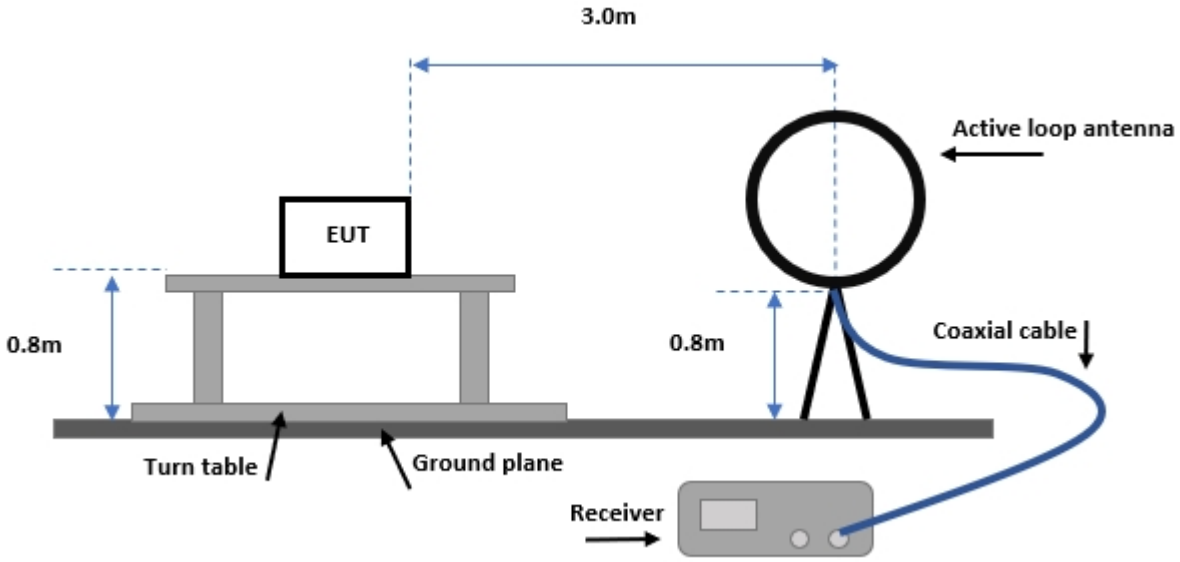
2 Test configuration of the Equipment Under Test

2.1 Test mode

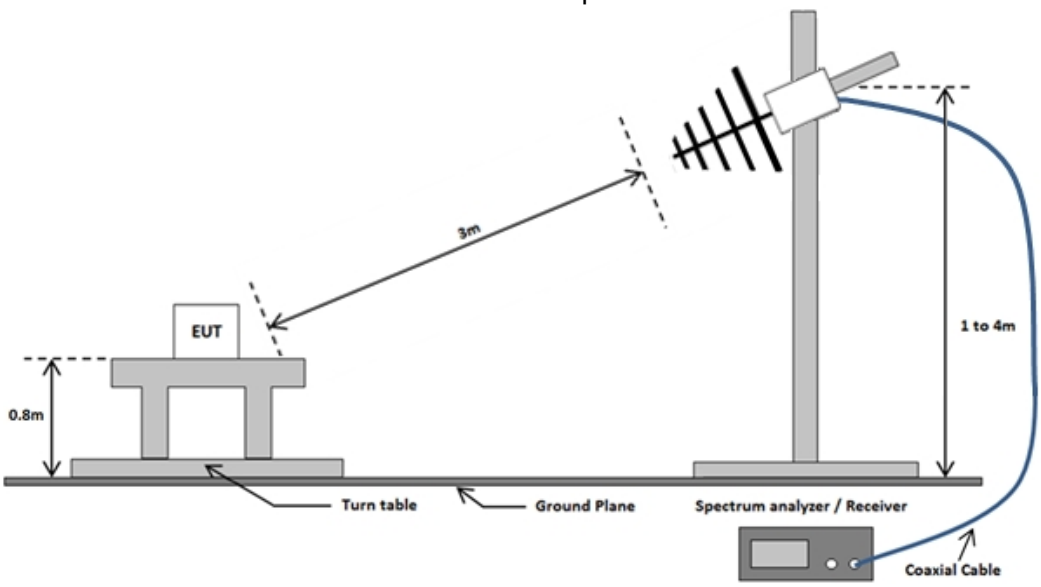
The applicant provided test mode firmware for the radio, in which it was possible to configure the radio to transmit continuously.

2.2 Test setups

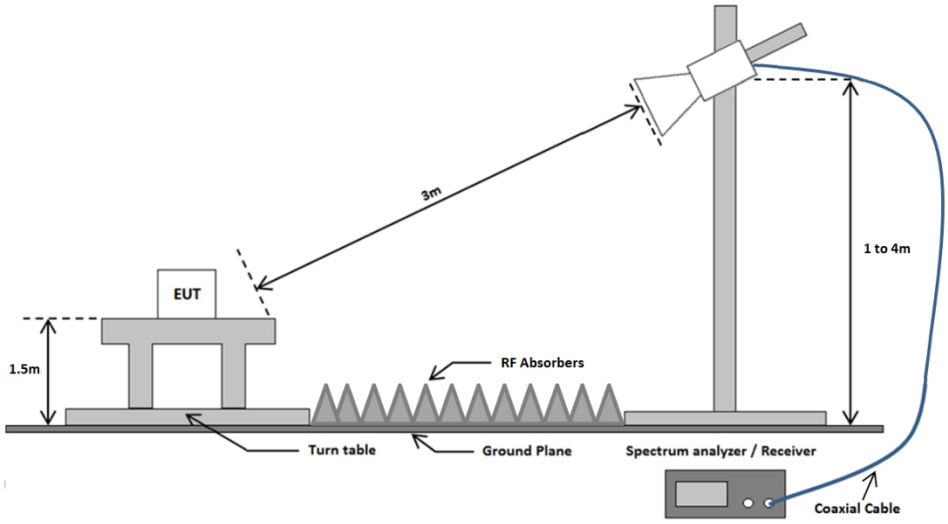
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
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

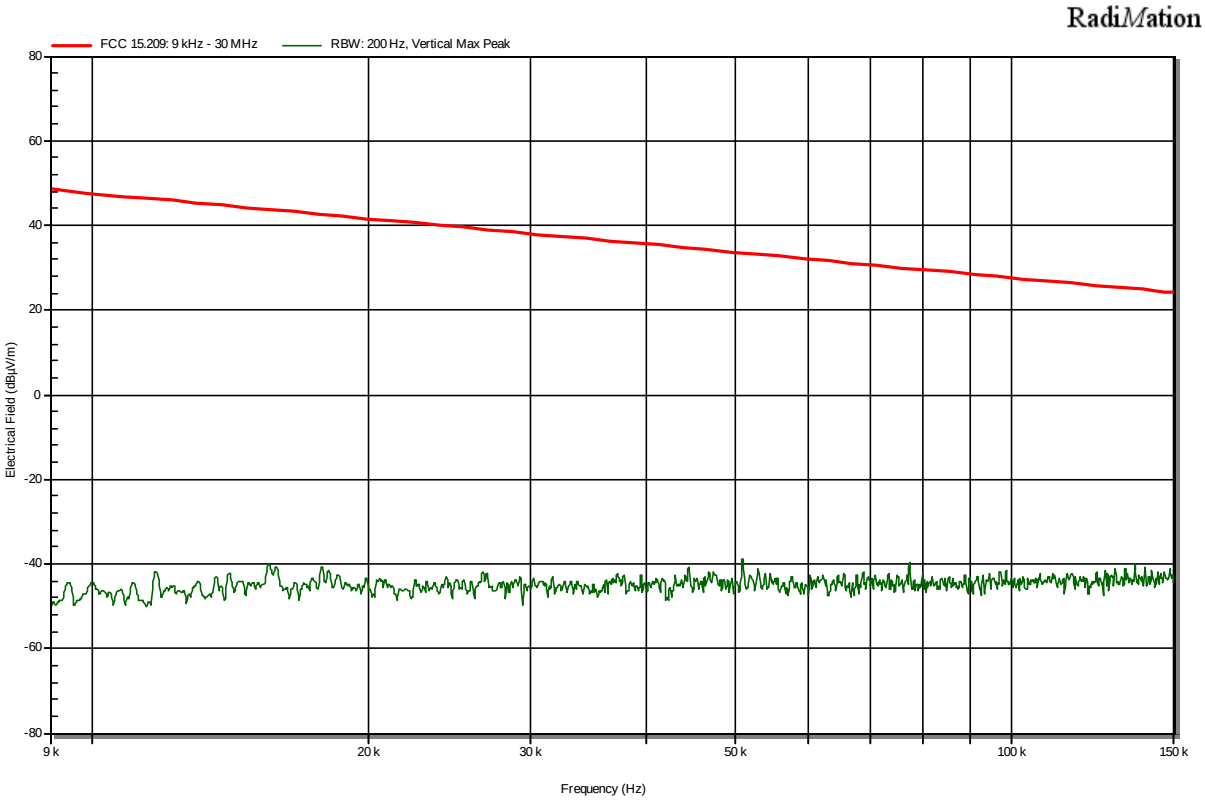
9 kHz to 30 MHz: IRN 026 – Method 10
30 MHz to 1 GHz: IRN 026 – Method 1
1 GHz to 18 GHz: IRN 026 – Method 2

3.1.5 Measurement Uncertainty

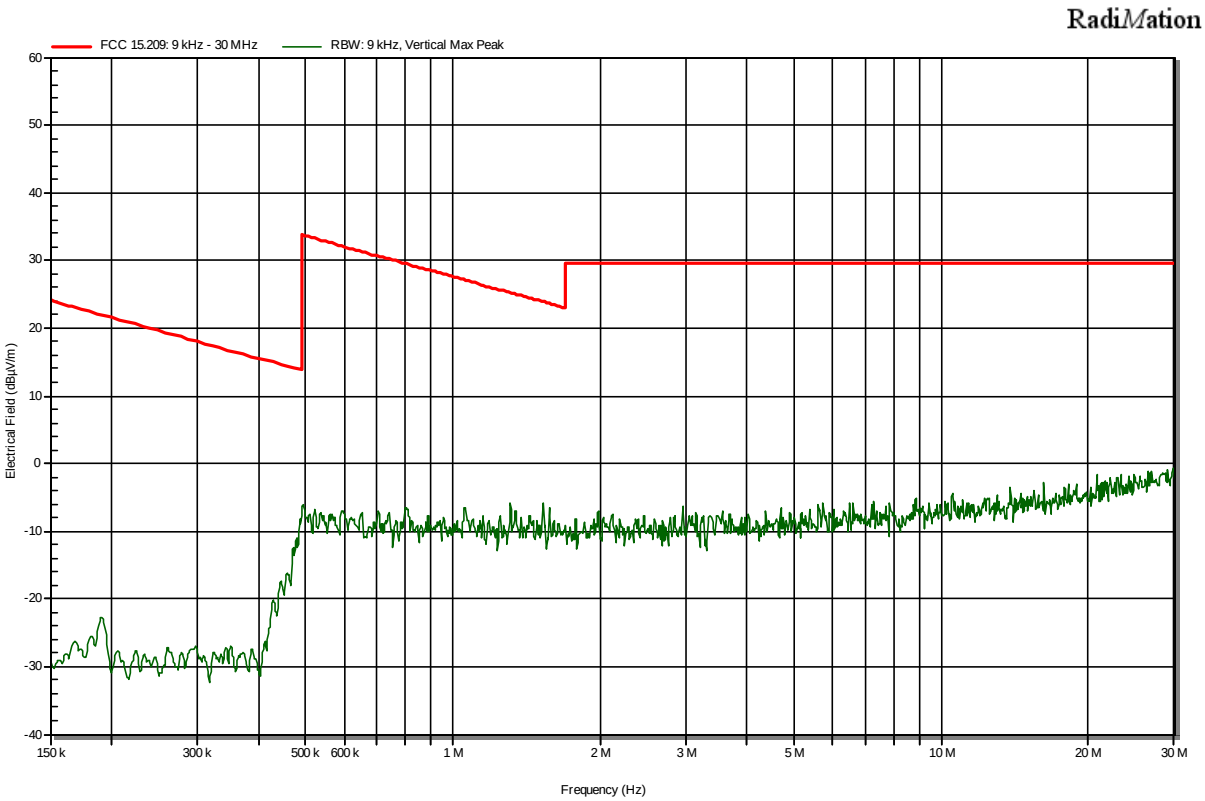
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB

3.1.6 Plots of the Radiated Spurious Emissions Measurement

9 – 150 kHz

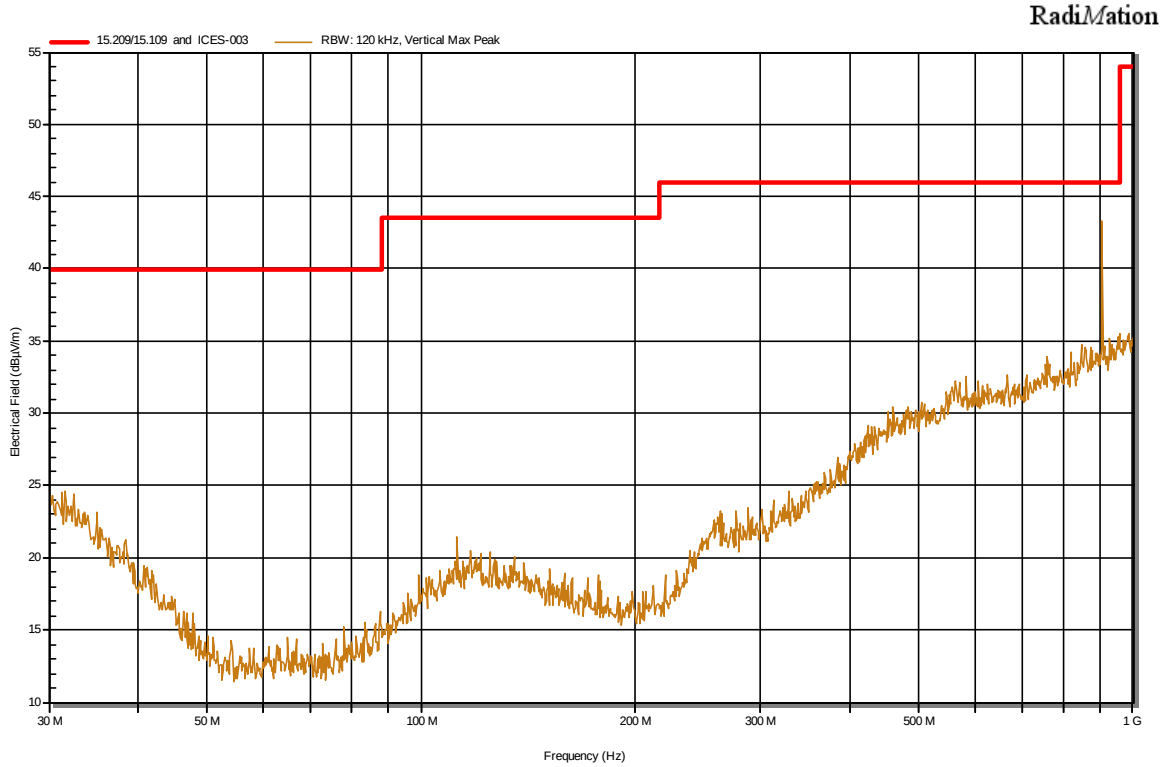


150 kHz – 30 MHz

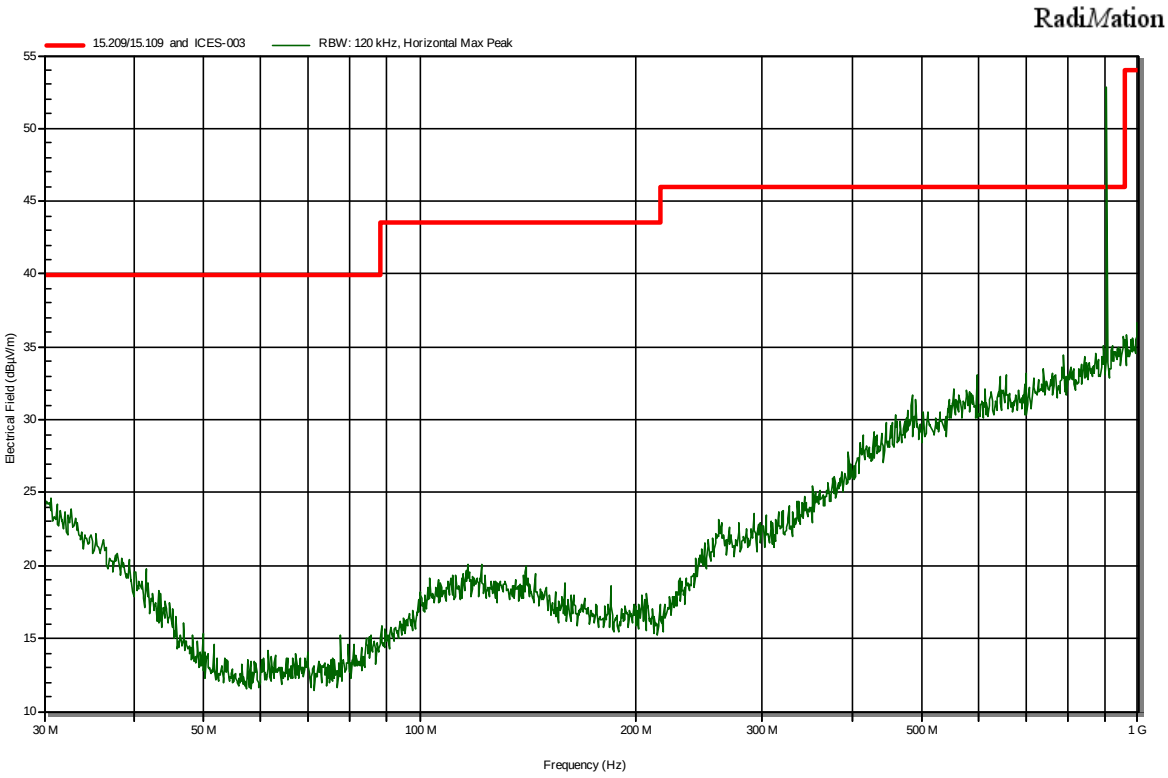


30 -1000 MHz
Low channel

Vertical polarization



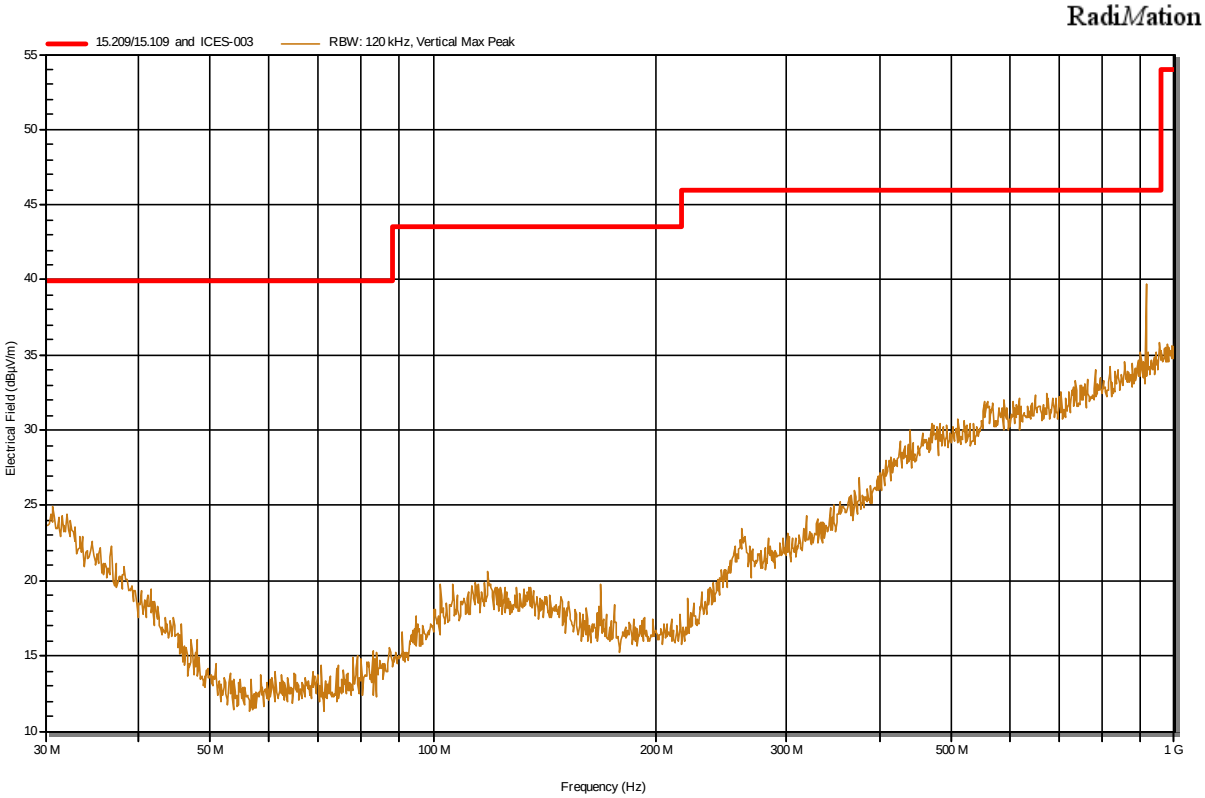
Horizontal polarization



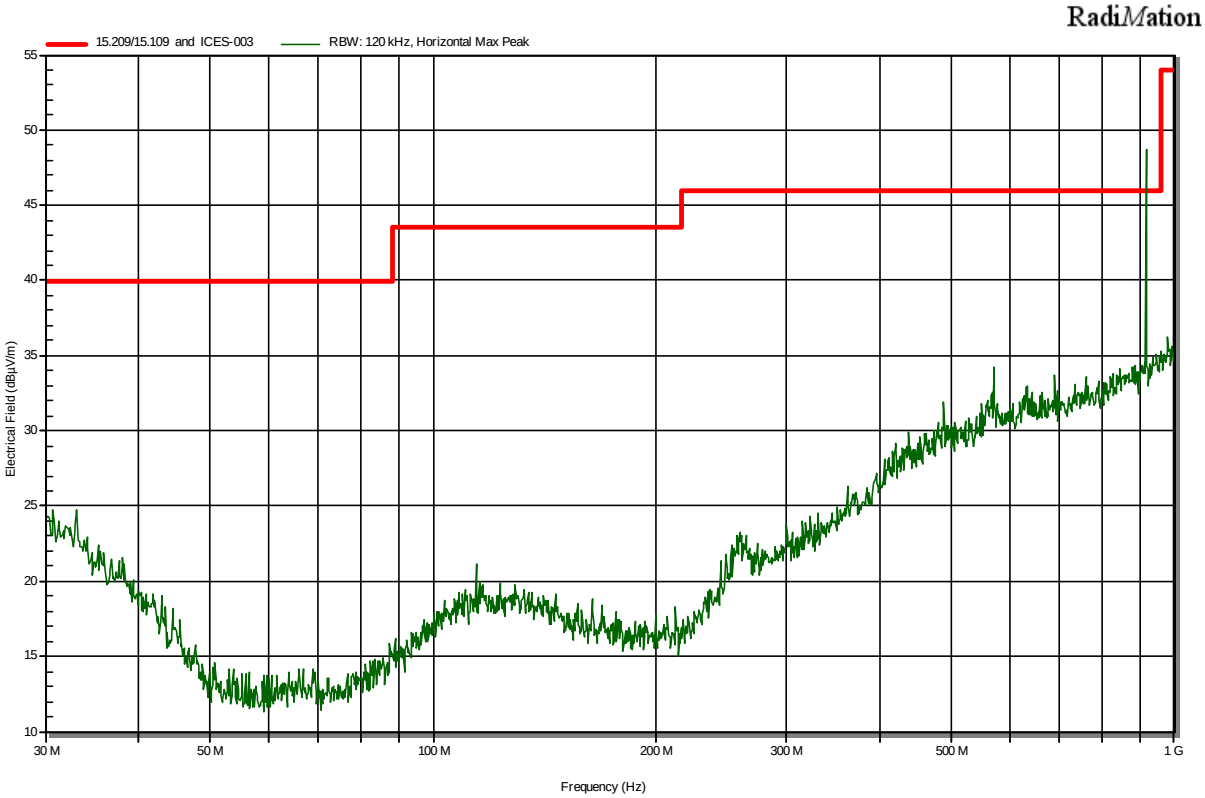
Note: the peak seen in the 900 MHz range is the transmission frequency, and is not subject to the spurious emission limit.

30 -1000 MHz
Middle channel

Vertical polarization



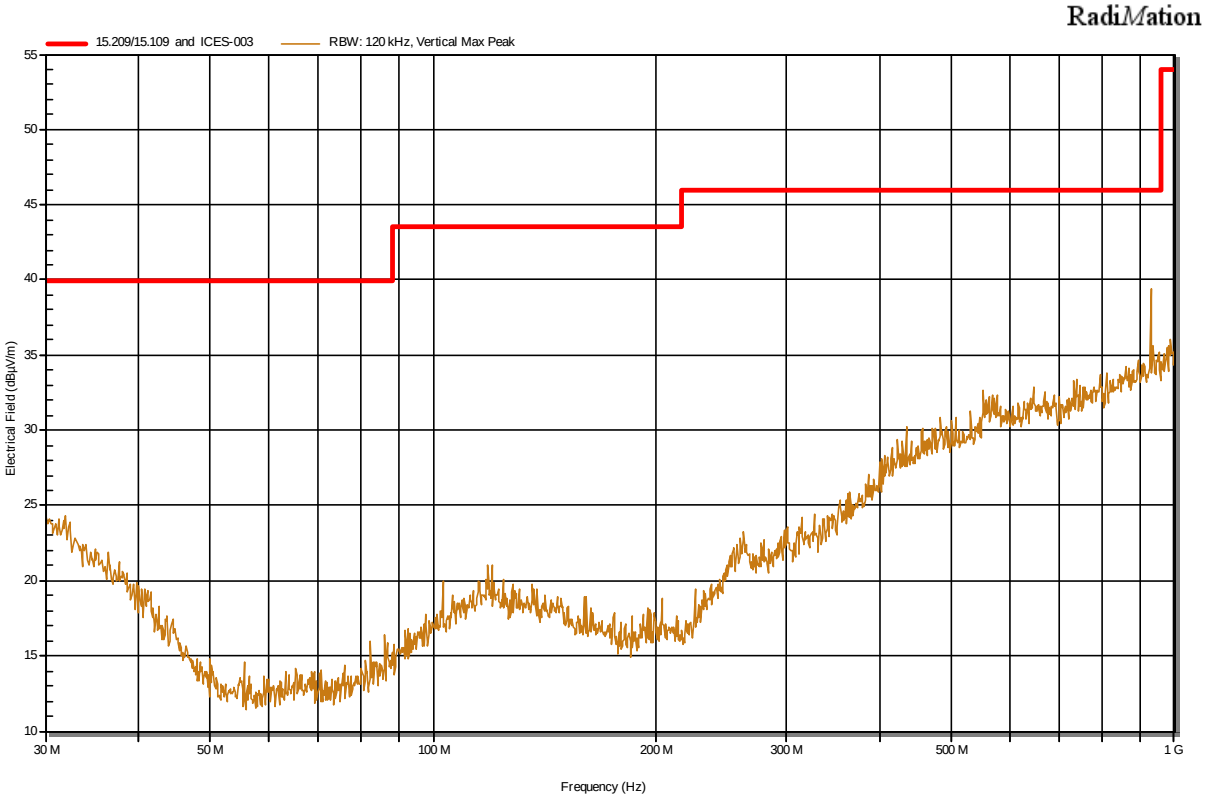
Horizontal polarization



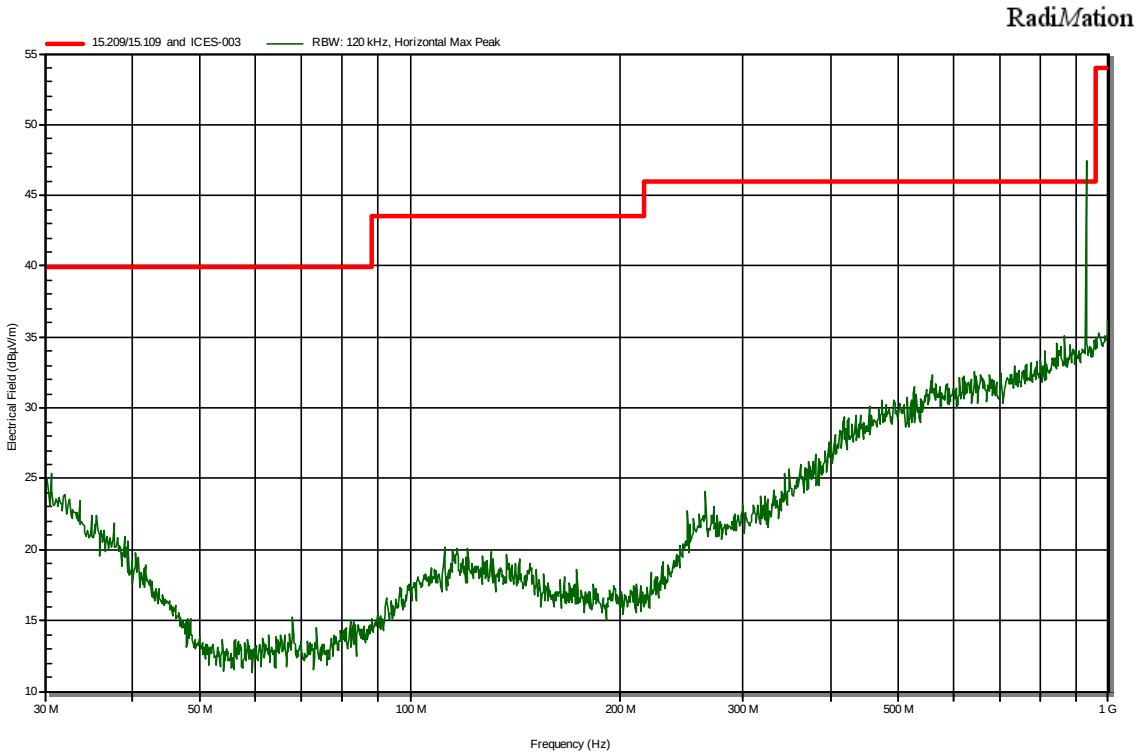
Note: the peak seen in the 900 MHz range is the transmission frequency, and is not subject to the spurious emission limit.

30 -1000 MHz
High channel

Vertical polarization



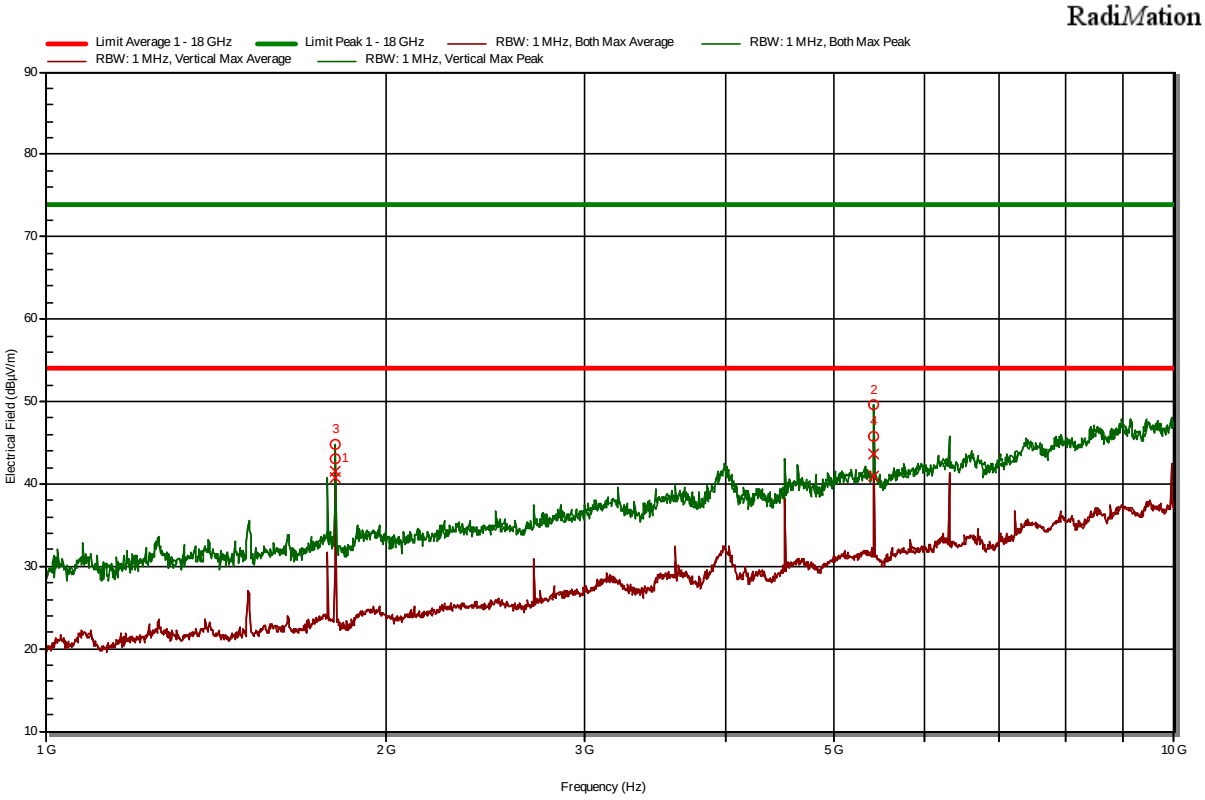
Horizontal polarization



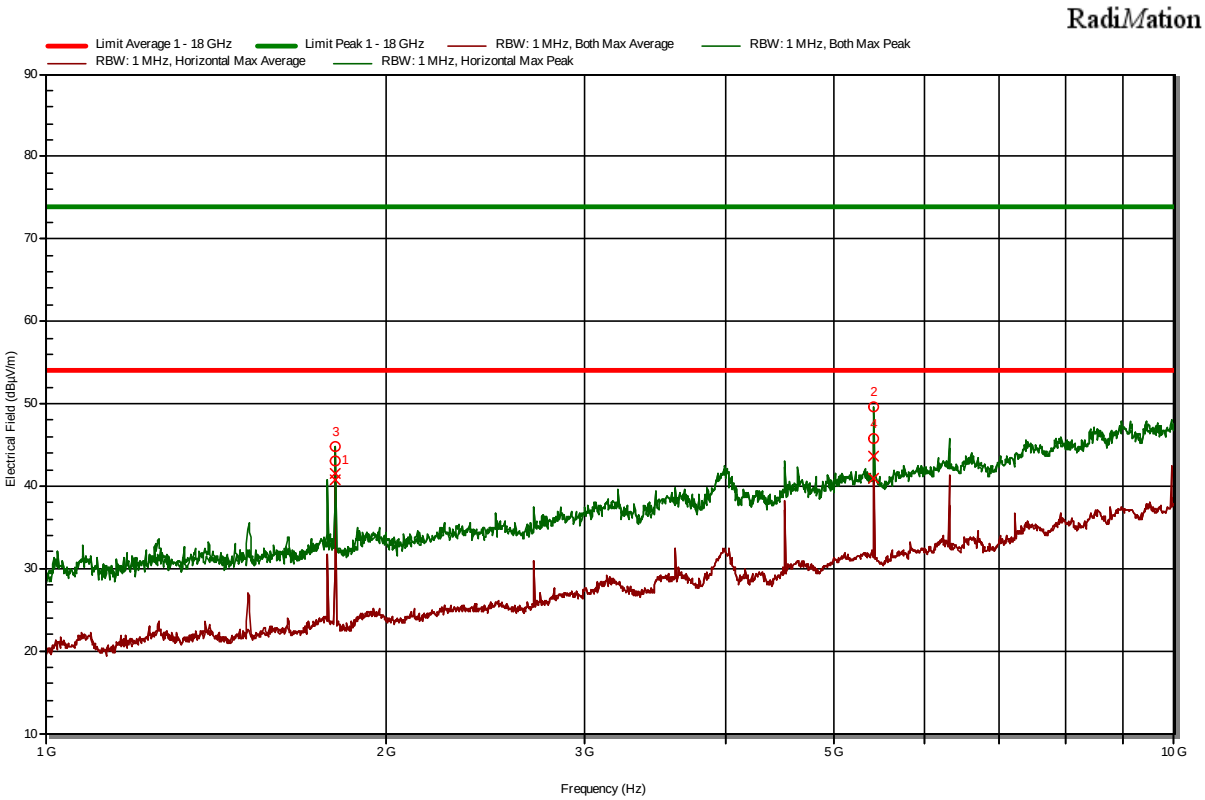
Note: the peak seen in the 900 MHz range is the transmission frequency, and is not subject to the spurious emission limit.

1 - 10 GHz
Low channel

Vertical polarization

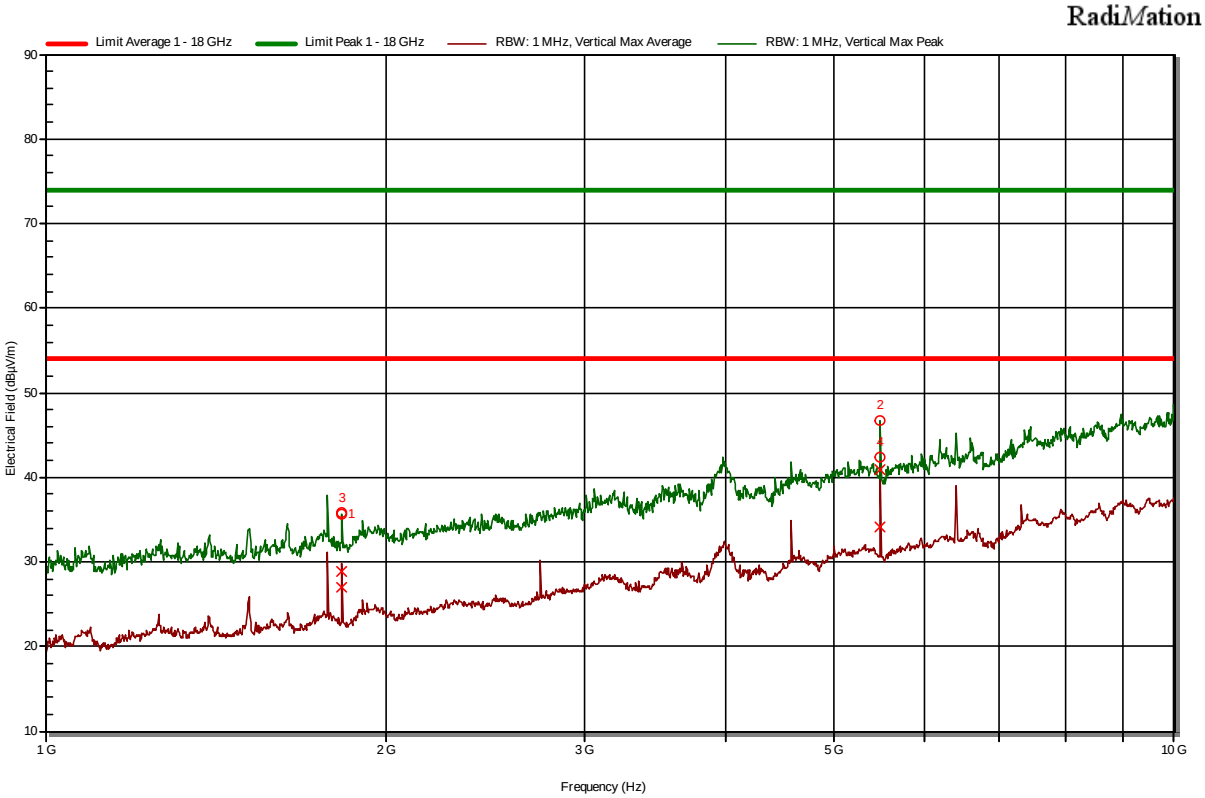


Horizontal polarization

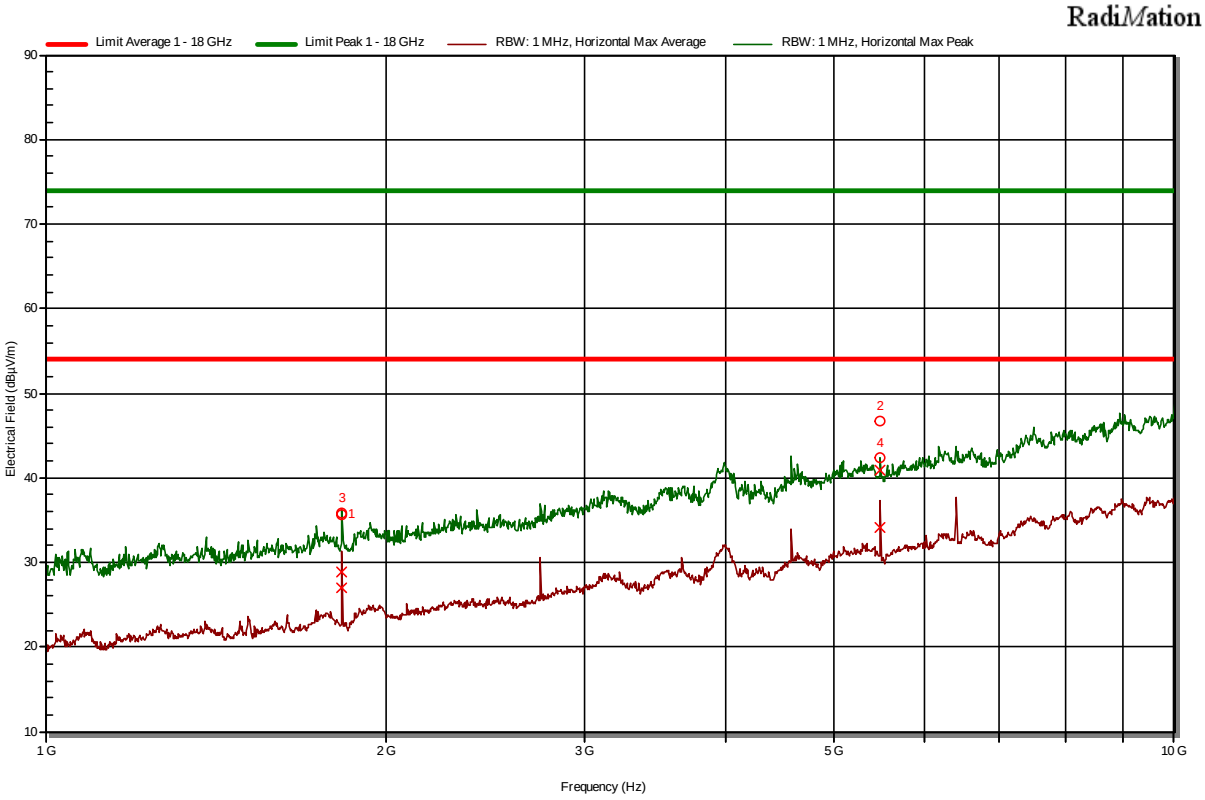


1 - 10 GHz
Middle channel

Vertical polarization

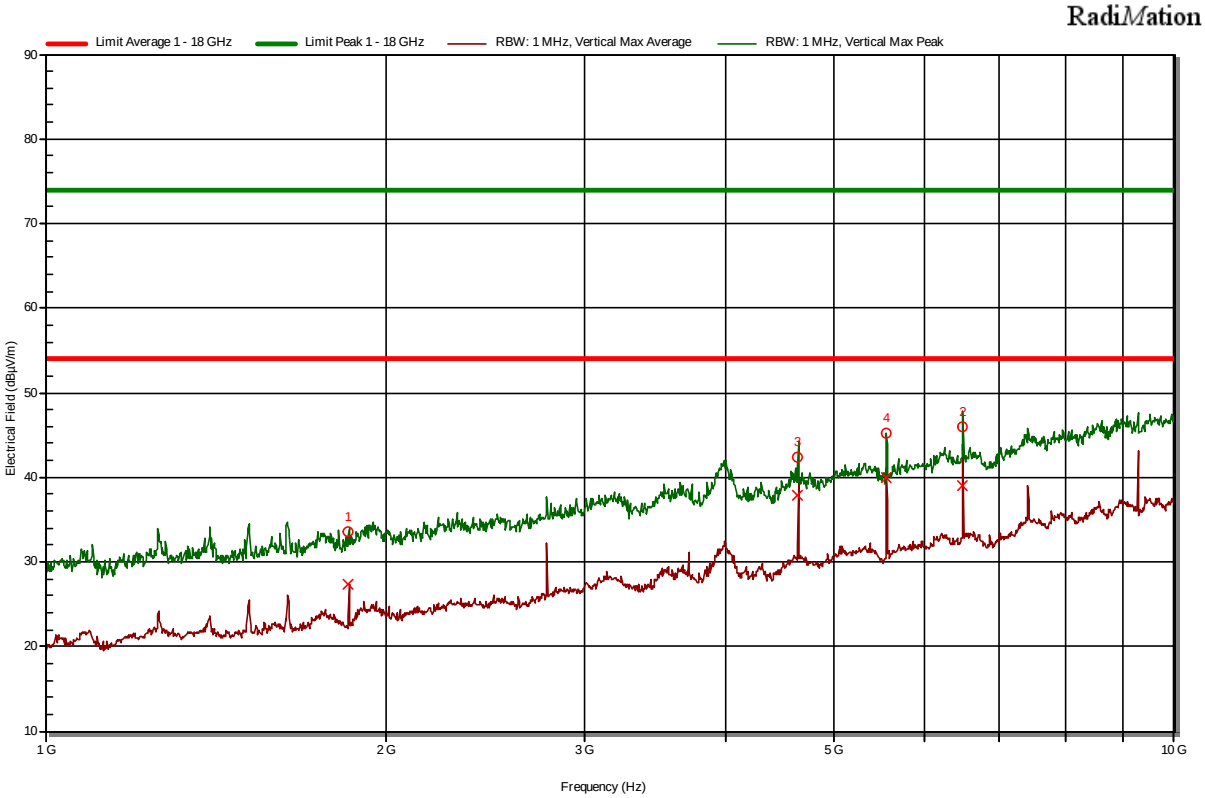


Horizontal polarization

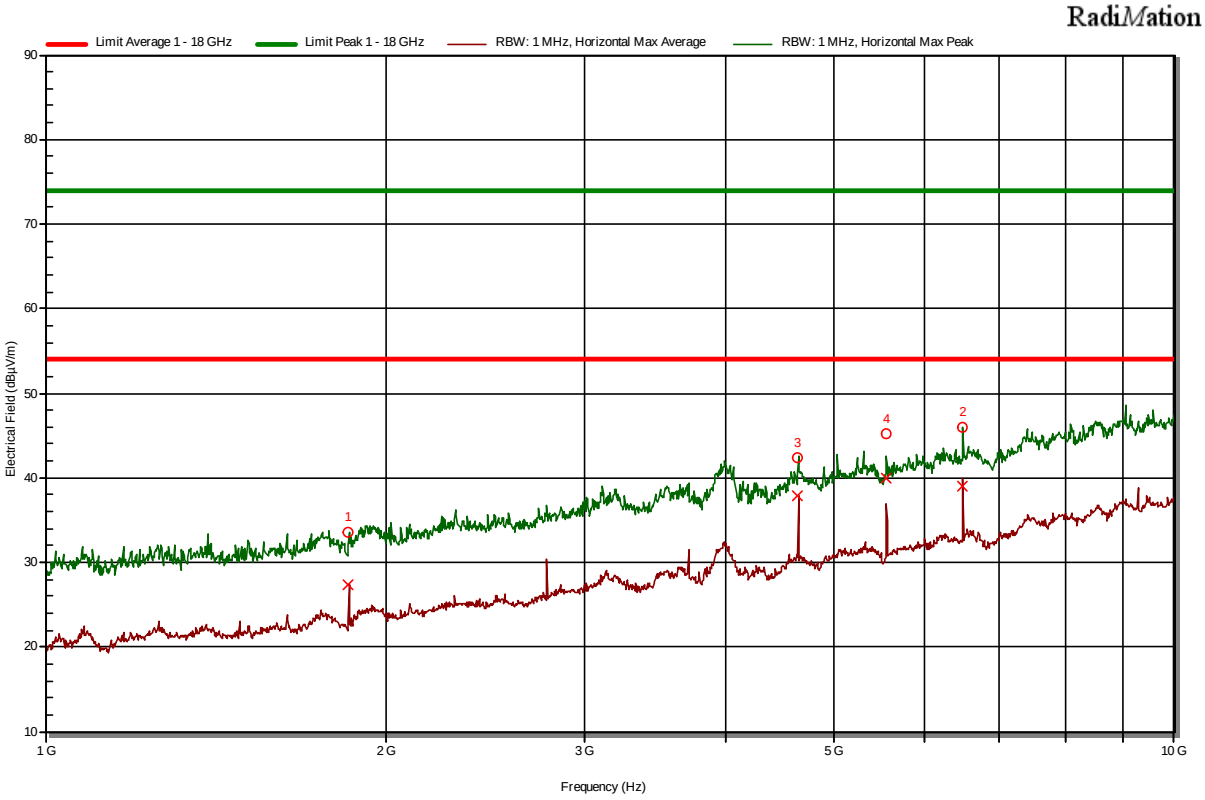


1 - 10 GHz
High channel

Vertical polarization



Horizontal polarization



Measured Peaks

Low Channel

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
1,804 GHz	43,1 dBµV/m	74 dBµV/m	40,7 dBµV/m	54 dBµV/m	Pass	4 degrees	4 m	Vertical
5,415 GHz	49,5 dBµV/m	74 dBµV/m	43,6 dBµV/m	54 dBµV/m	Pass	113 degrees	3,5 m	Vertical
1,804 GHz	44,7 dBµV/m	74 dBµV/m	41,4 dBµV/m	54 dBµV/m	Pass	262 degrees	2,5 m	Horizontal
5,416 GHz	45,7 dBµV/m	74 dBµV/m	40,9 dBµV/m	54 dBµV/m	Pass	328 degrees	2,5 m	Horizontal

Middle Channel

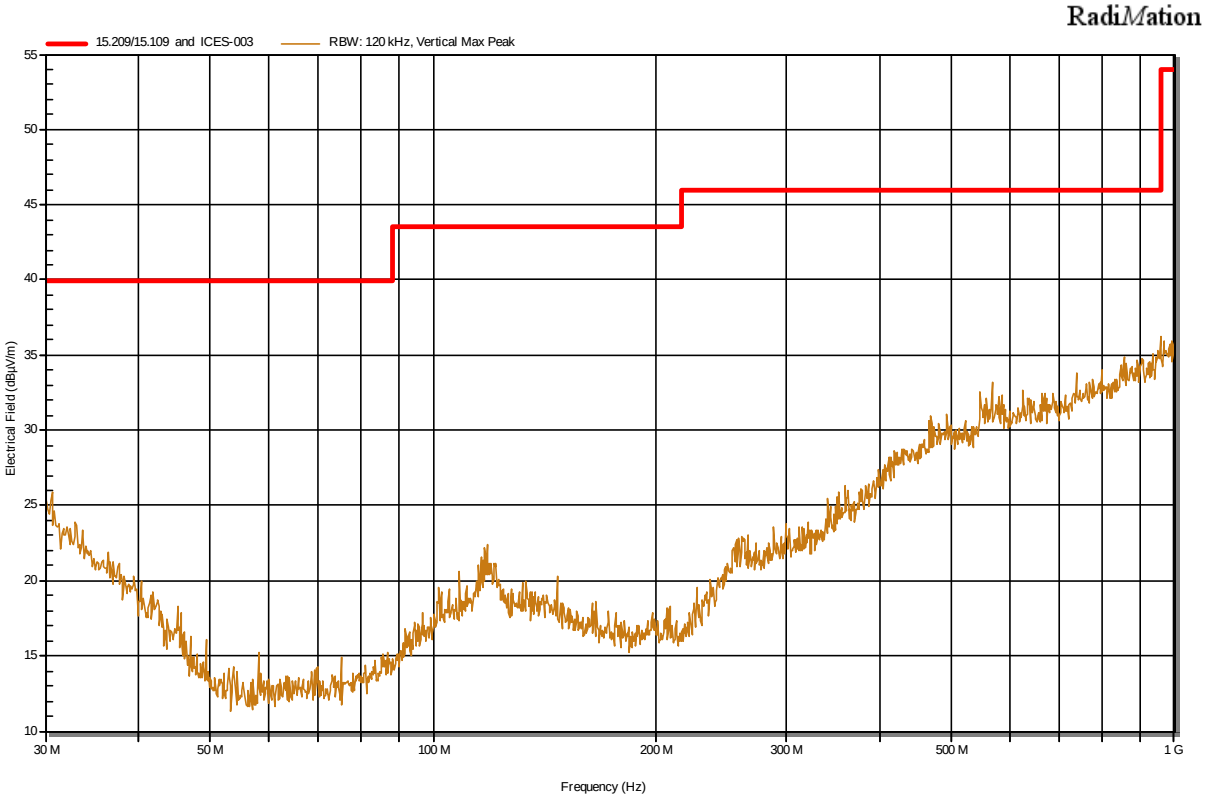
Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
1,828 GHz	35,7 dBµV/m	74 dBµV/m	27 dBµV/m	54 dBµV/m	Pass	358 degrees	2 m	Vertical
5,488 GHz	46,8 dBµV/m	74 dBµV/m	40,8 dBµV/m	54 dBµV/m	Pass	135 degrees	4 m	Vertical
1,829 GHz	35,9 dBµV/m	74 dBµV/m	28,8 dBµV/m	54 dBµV/m	Pass	264 degrees	1,5 m	Horizontal
5,488 GHz	42,4 dBµV/m	74 dBµV/m	34,1 dBµV/m	54 dBµV/m	Pass	204 degrees	3 m	Horizontal

High Channel

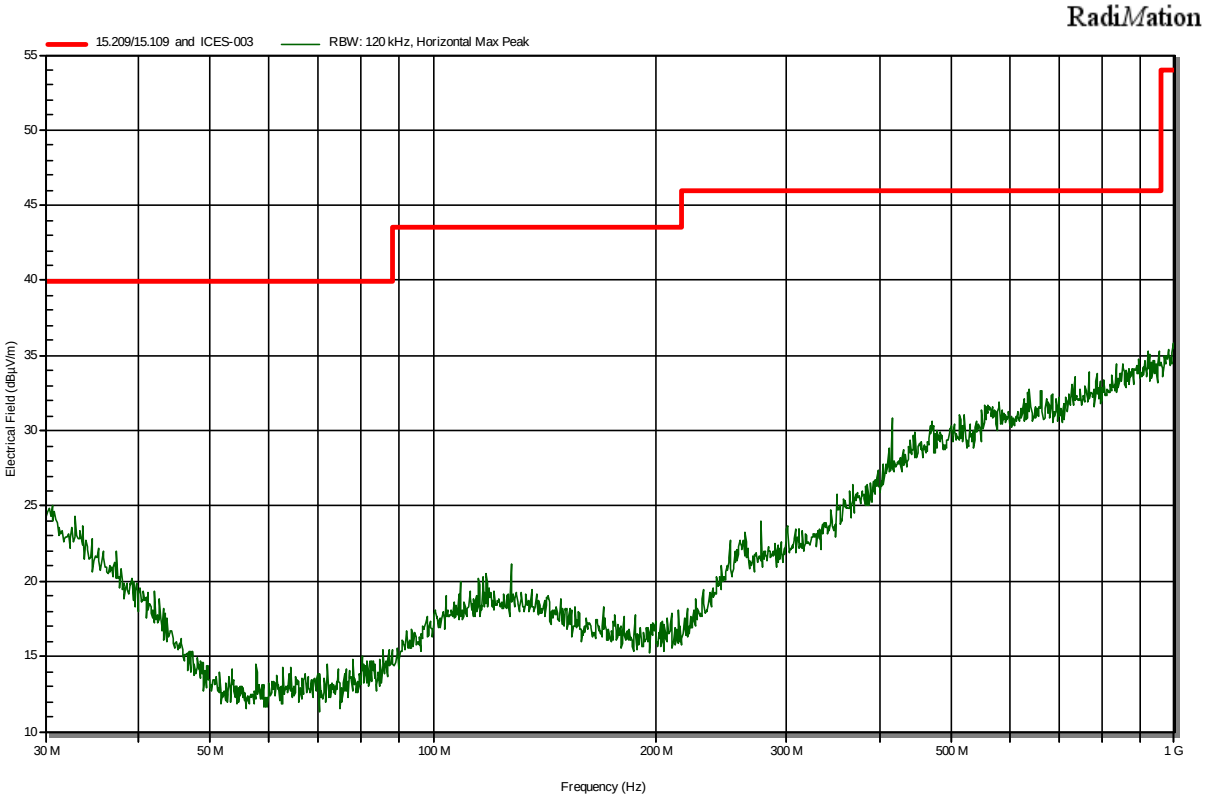
Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
1,854 GHz	33,5 dBµV/m	74 dBµV/m	27,3 dBµV/m	54 dBµV/m	Pass	228 degrees	2 m	Horizontal
6,49 GHz	45,9 dBµV/m	74 dBµV/m	39 dBµV/m	54 dBµV/m	Pass	350 degrees	1 m	Horizontal
4,635 GHz	42,5 dBµV/m	74 dBµV/m	37,9 dBµV/m	54 dBµV/m	Pass	29 degrees	1 m	Horizontal
5,562 GHz	45,1 dBµV/m	74 dBµV/m	39,9 dBµV/m	54 dBµV/m	Pass	309 degrees	2 m	Vertical

30 -1000 MHz (RX)
Low channel

Vertical polarization

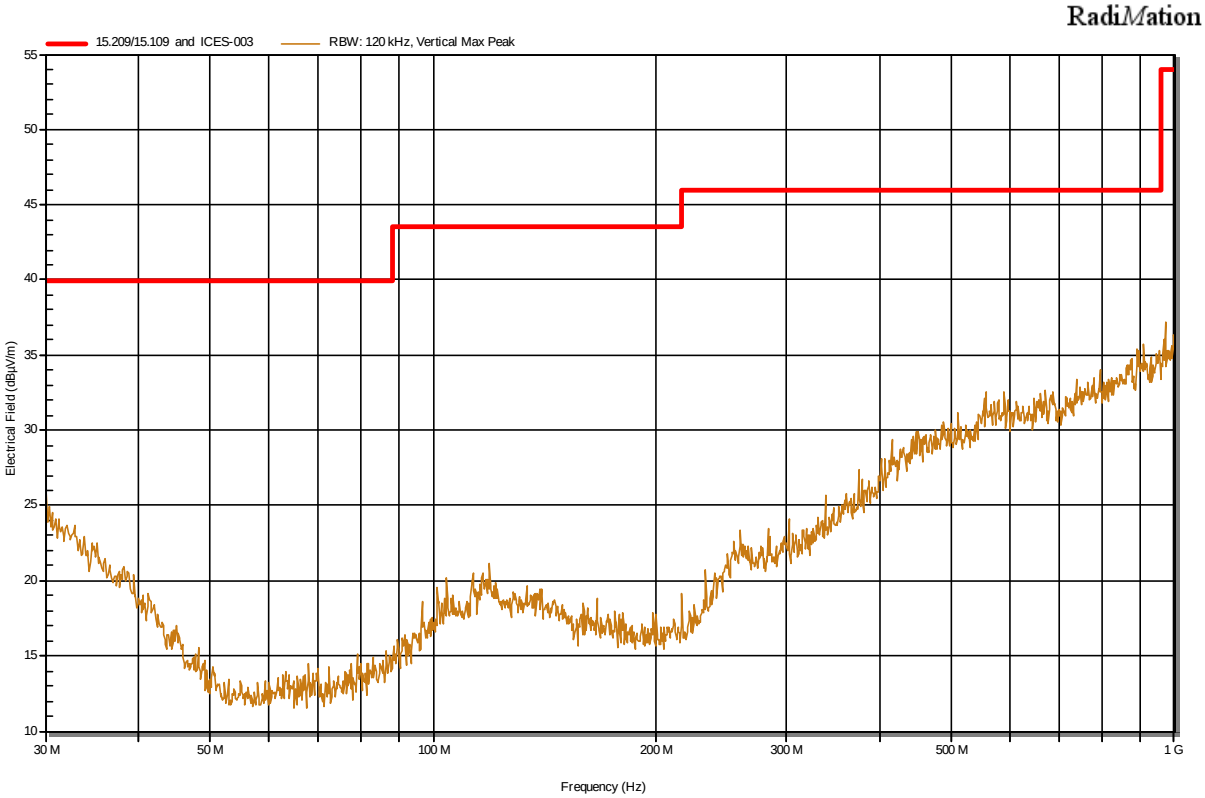


Horizontal polarization

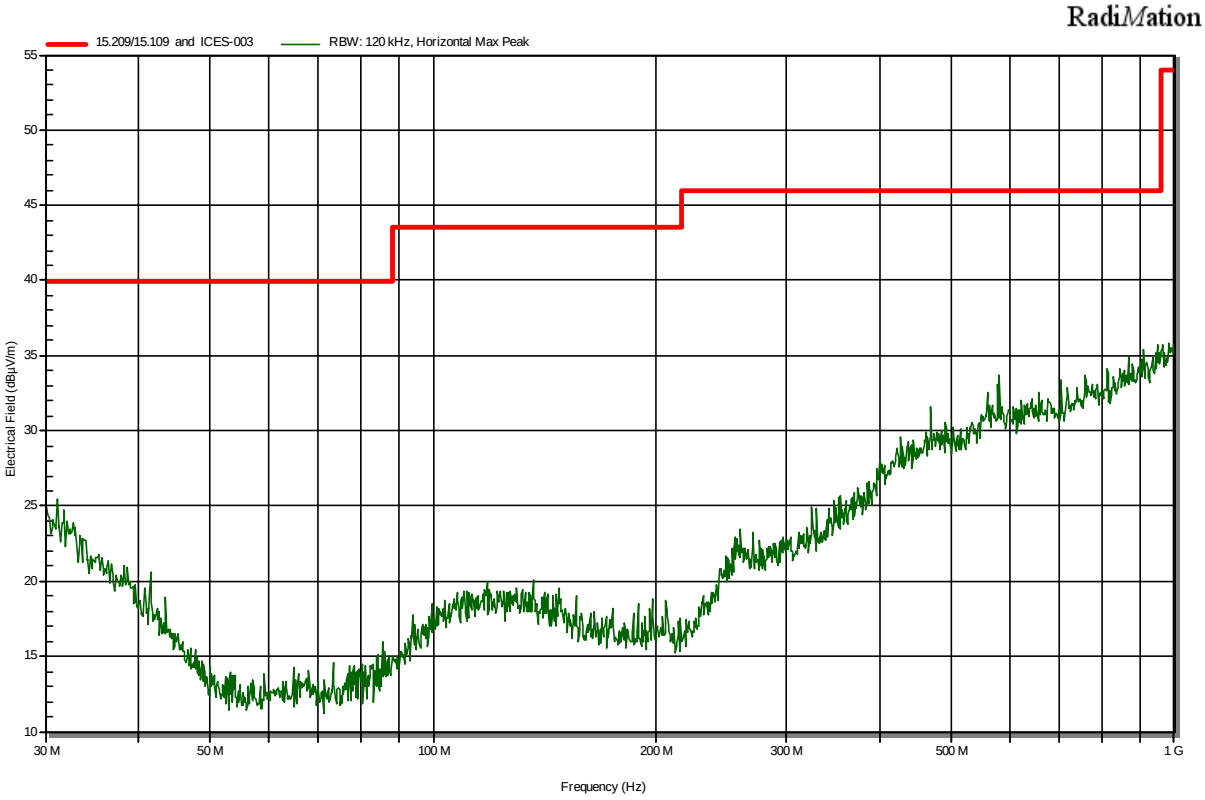


30 -1000 MHz (RX)
Middle channel

Vertical polarization

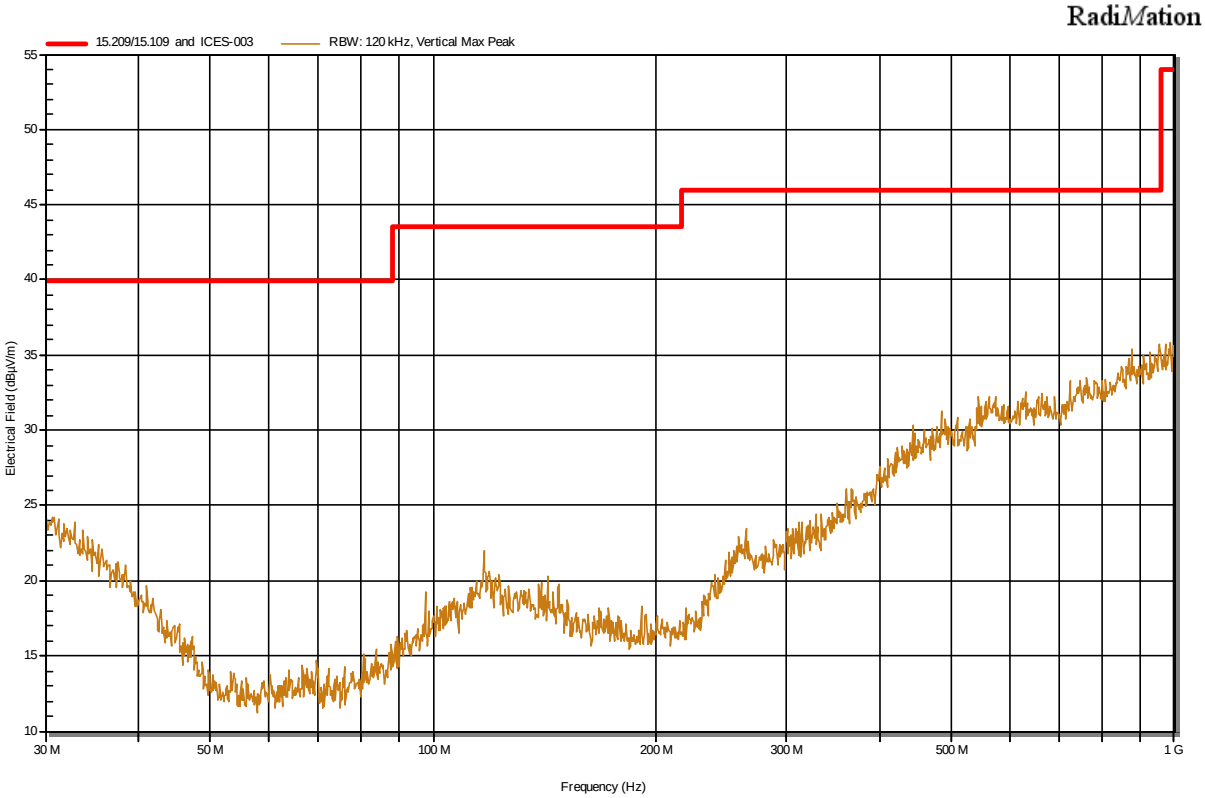


Horizontal polarization

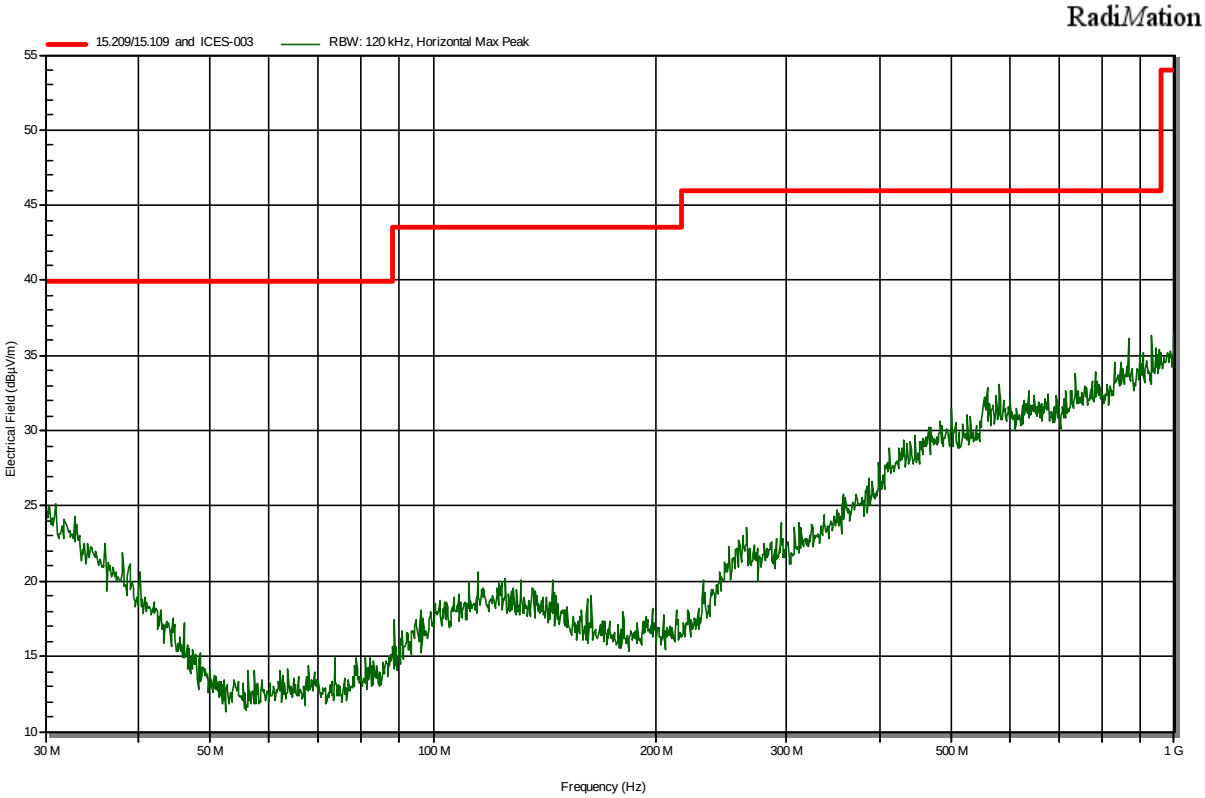


30 -1000 MHz (RX)
High channel

Vertical polarization

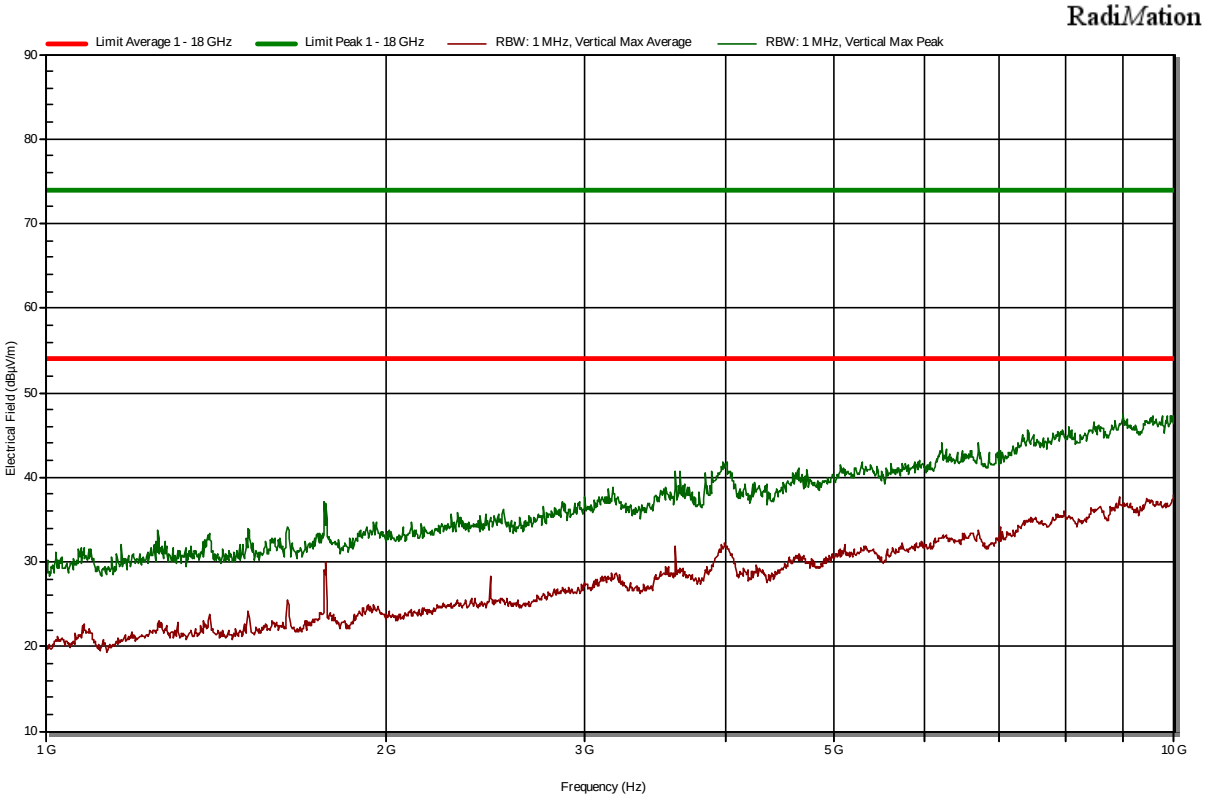


Horizontal polarization

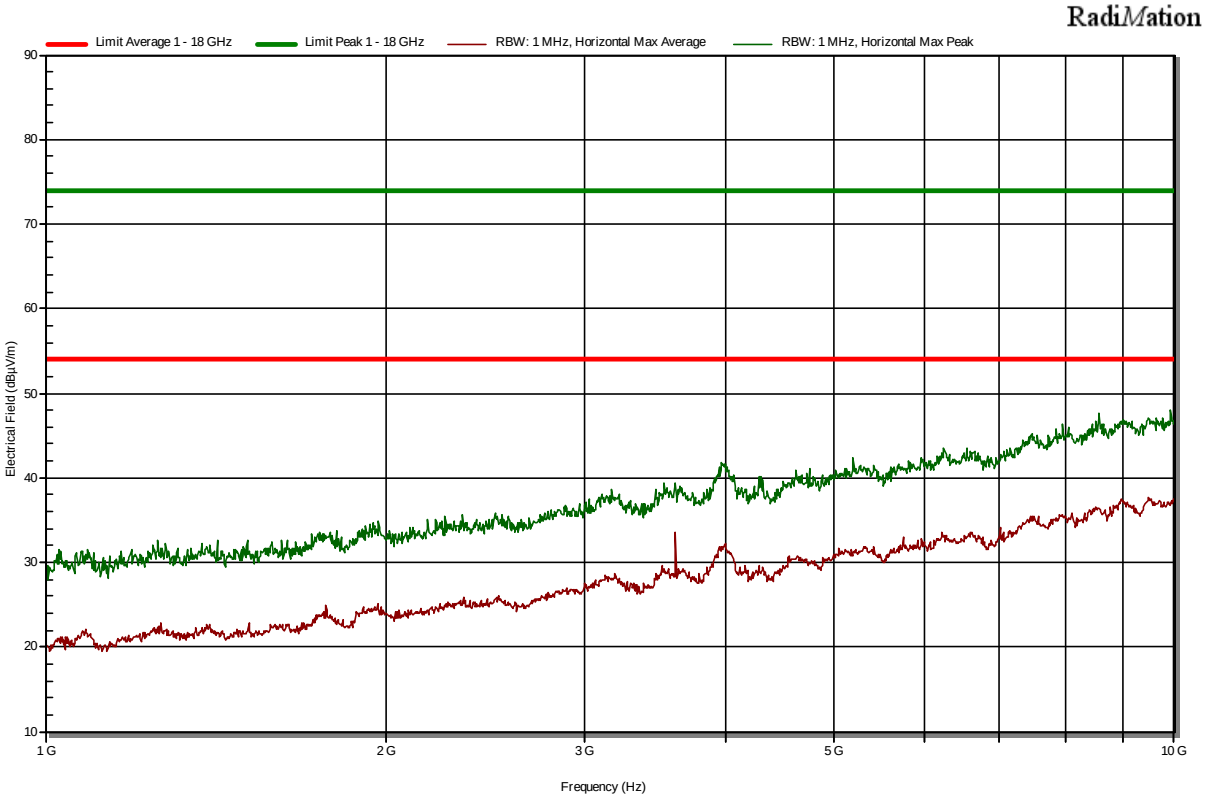


1 -10 GHz (RX)
Low channel

Vertical polarization

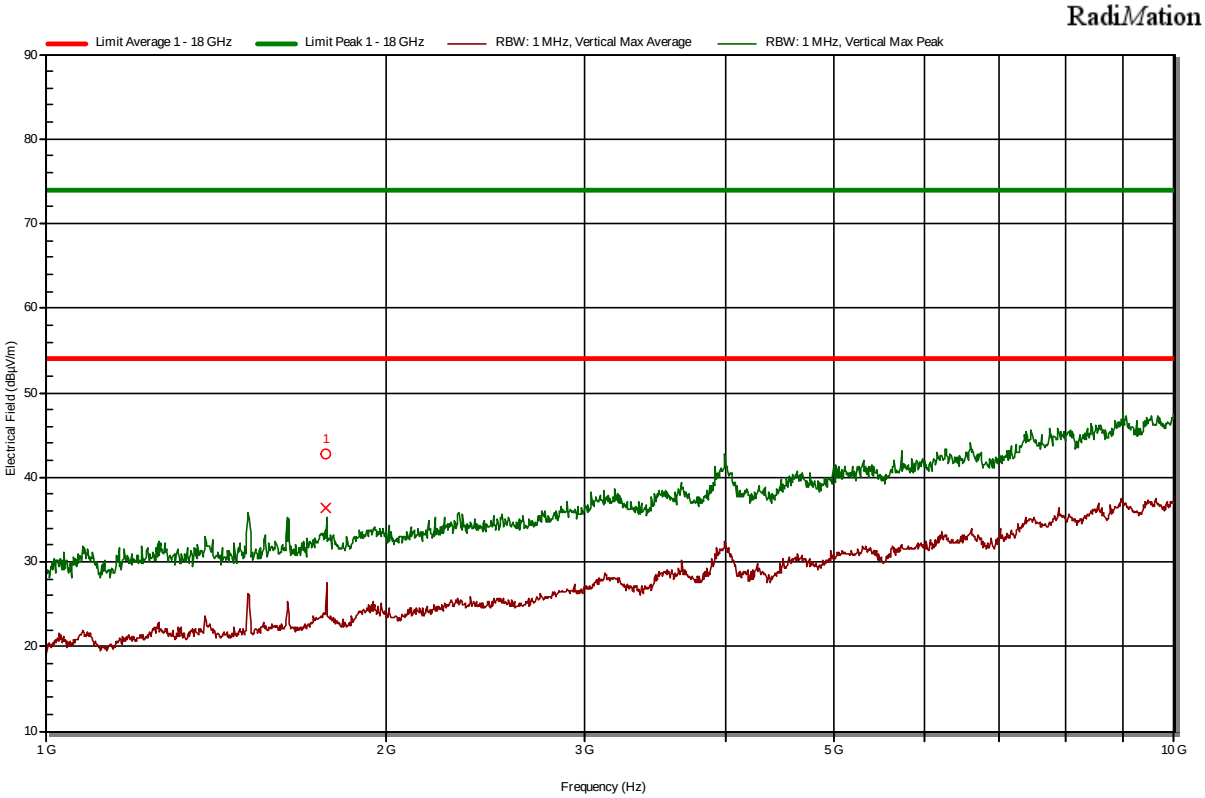


Horizontal polarization

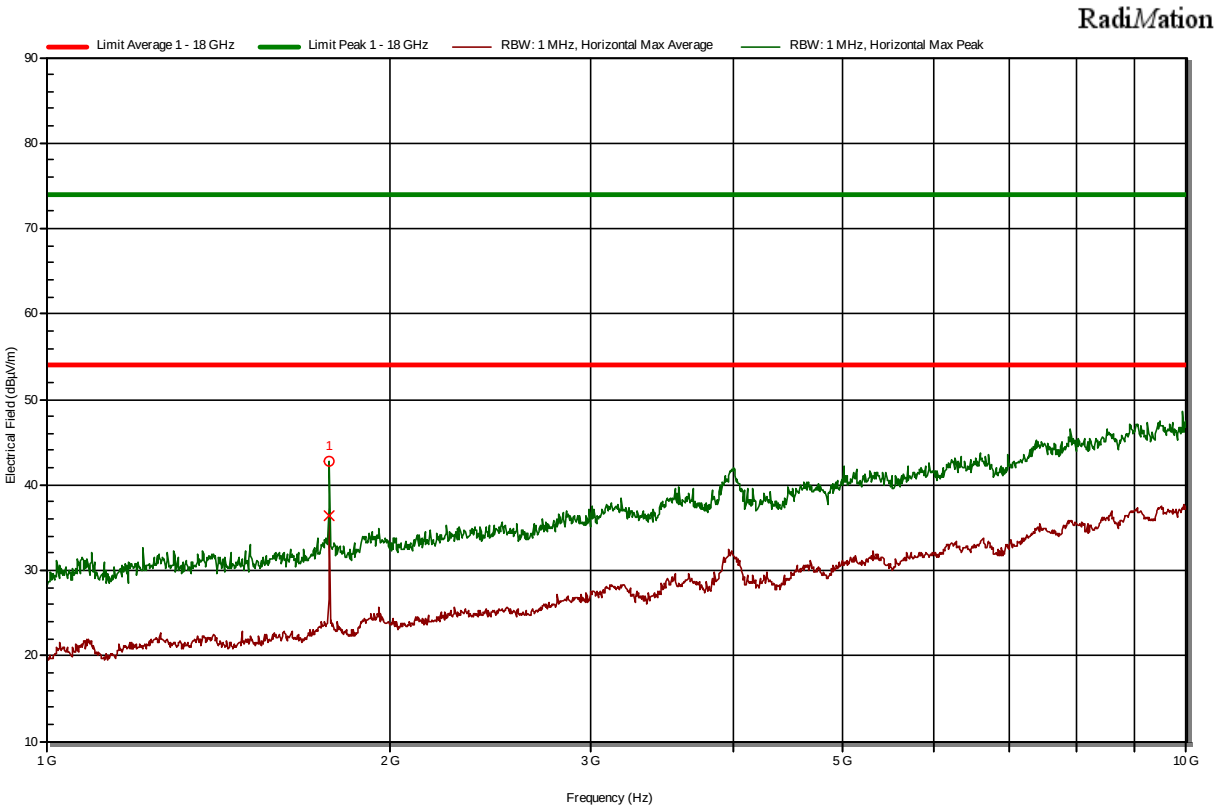


1 -10 GHz (RX)
Middle channel

Vertical polarization

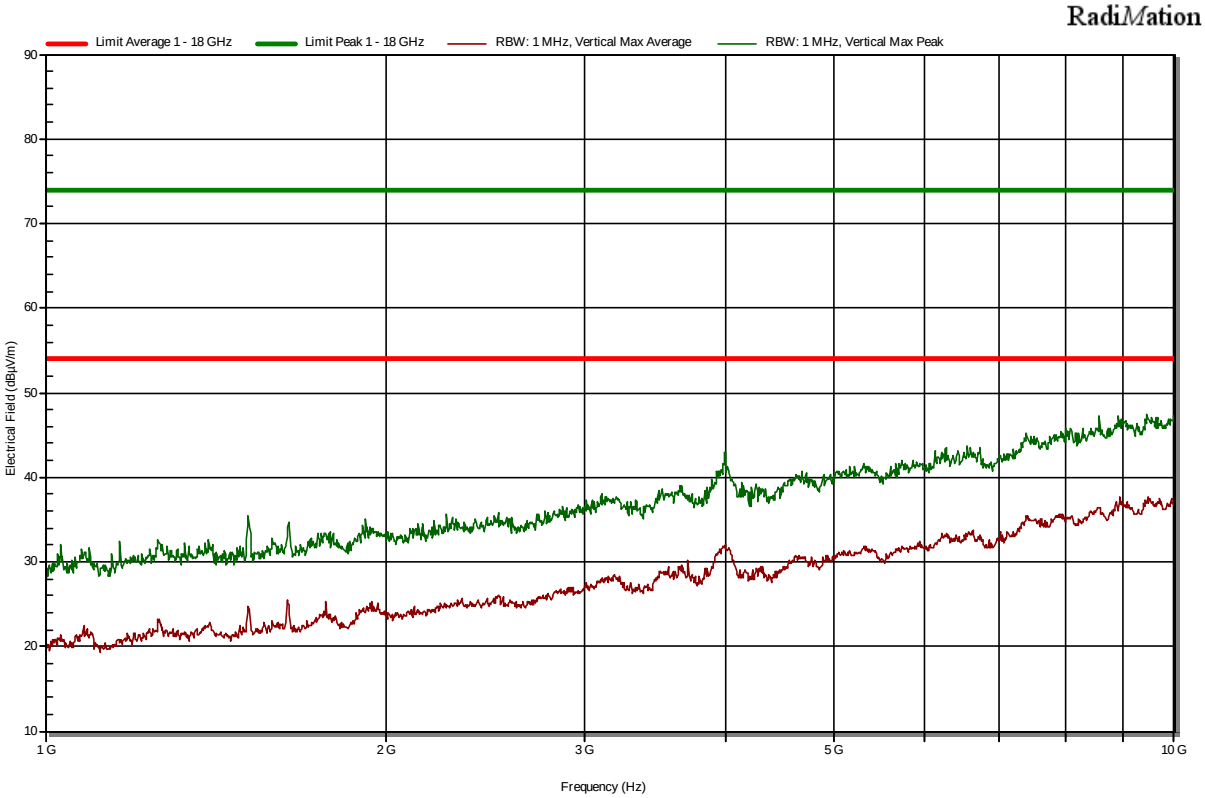


Horizontal polarization

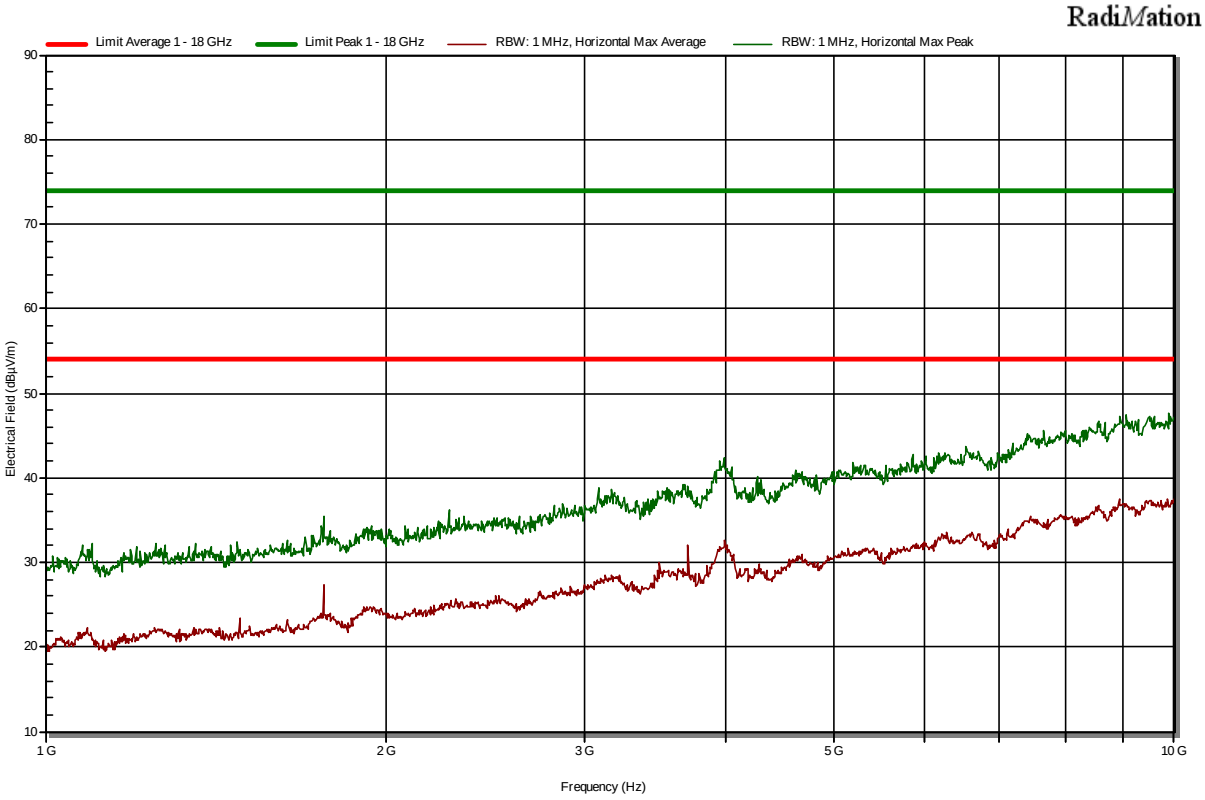


1 -10 GHz (RX)
High channel

Vertical polarization



Horizontal polarization



4 Sample calculations

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

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