Test report for

47 CFR Part 15 Subpart C

RSS-247, RSS-Gen

The RvA is signatory to ILAC - MRA

Product name	: TACX Stelvio
Applicant	: TACX/Garmin
FCC ID	: IPH-0S4355
IC	: 1792A-0S4355

Test report No. : P000309942 004 Ver 2.0

Laboratory information

Accreditation

Kiwa Nederland B.V. 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 L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Kiwa Nederland B.V. 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.

Kiwa Nederland B.V. is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.
The Industry Canada company number for Kiwa Nederland B.V. is: 4173A. The CABID 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 Kiwa Nederland B.V.

Testing Location

Test Site	Kiwa Nederland B.V.
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001
CABID	NL0001

Revision History

Version	Date	Remarks	By
v0.50	26-07-2023	First draft	MK
v1.00	22-11-2023	Final release	IC
V2.0	23-01-2024	comments on EUT height	MK

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247(d) 15.225(d) 15.209 (a)	RSS-Gen 8.9	Radiated spurious emissions	3.1	Pass
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.1	Pass
15.247 (a)	RSS-247 5.2(a)	6 dB bandwidth	3.2	Pass
--	RSS-Gen 6.7	99% bandwidth	3.3	Pass
15.247 (b)	RSS-247 5.4 (d)	RF output power	3.4	Pass
15.247 (e)	RSS-247 5.2 (b)	Power spectral density	3.5	Pass
15.247 (d)	RSS-247 5.5	Band edge	3.6	Pass
15.207 (c)	RSS-Gen 8.8	AC power-line conducted emissions	3.7	Pass

Decision rule: Pass/Fail decisions are based on measurement results without taking into account measurement uncertainty.

1 General Description

1.1 Applicant

Client name:	Tacx B.V.
Address:	De Boeg 2 , Oegstgeest
Zip code:	2343 HK
Telephone:	0031 71 799 9292
E-mail:	richard@tacx.nl
Contact name:	Richard Kockelkoren

1.2 Manufacturer

Manufacturer name:	Tacx B.V.
Address:	De Boeg 2 , Oegstgeest
Zip code:	2343 HK
Telephone:	0031 71 799 9292
E-mail:	richard@tacx.nl
Contact name:	Richard Kockelkoren

1.3 Tested Equipment Under Test (EUT)

Product name:	TACX NEO 3M
Brand name:	Garmin
FCC ID:	IPH-0S4355
IC:	1792A-0S4355
Product description:	Indoor bicycle trainer
Batch and/or serial No.	A0S4355
Software version:	006-B4355-00
Hardware version:	011-06120-00-5
Date of receipt	18-06-2023
Tests started:	19-06-2023
Testing ended:	10-07-2023

1.3.1 Auxiliary items

AUX1

Product name:	Programming interface box
Product type:	--
Remarks:	Connects to EUT

AUX2

Product name:	Notebook
Product type:	--
Remarks:	Connects to EUT via AUX1

1.4 Product specifications of Equipment under test

Tx Frequency:	2.402 –2.480 GHz
Rx frequency:	2402 – 2.480 GHz
Occupied channel width:	20Mhz – BLE 1Mbps /2Mbps
Antenna type:	Integrated PCB trace antenna
Antenna gain:	3.25dBi
Type of modulation:	CCK, OFDM, BPSK, QPSK, 16-QAM, 64-QAM
Receiver category:	2

Disclaimer: The operating frequency bands are declared by the applicant

1.5 Environmental conditions

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %

1.6 Measurement standards

- ANSI C63.10:2013
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02

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 §15.207
- FCC Part 15 Subpart C §15.209
- FCC Part 15 Subpart C §15.247
- RSS-Gen Issue 5
- RSS-247 Issue 2

1.8 Observation and remarks

The EUT is considered floor standing. However, to evaluate the worse case for radio emissions the EUT was place on a table to bring up to the antenna boresight.

1.9 Modifications to the EUT (Equipment Under Test)

No modification have been made to the test samples supplied by client.

1.10 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. Kiwa Nederland B.V. 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 tests are performed by:

Name : ing. Maaz H Khan

Review of test methods and report by:

Name : Roy van Barneveld

The above conclusions have been verified by the following signatory:

Date : 26-01-2024

Name : ing. R. van Barneveld

Function : Test Engineer

Signature :

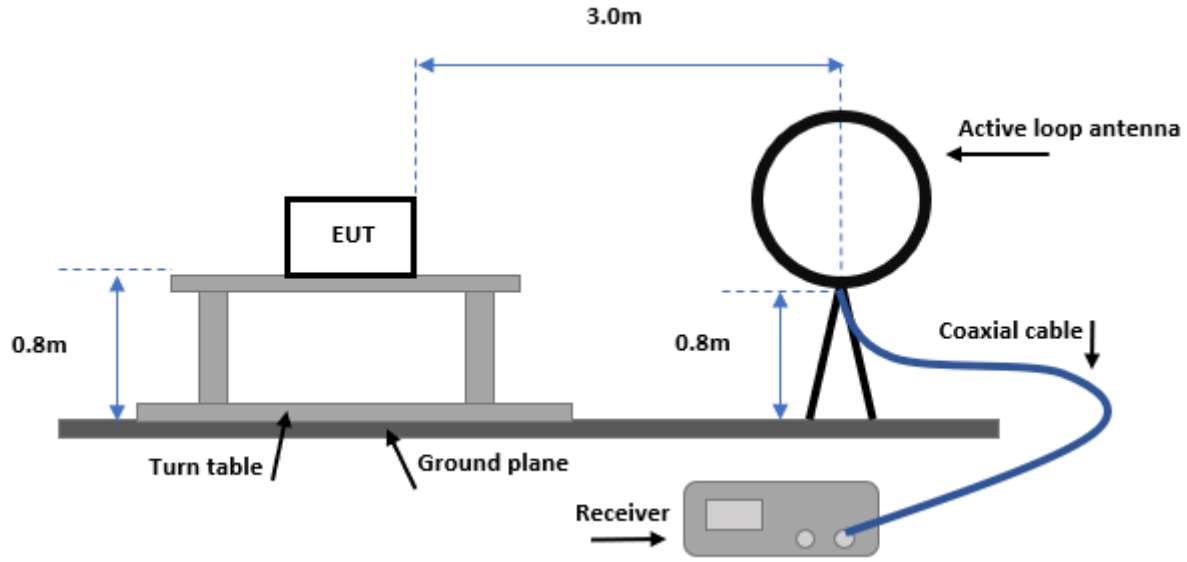
2 Test configuration of the Equipment Under Test

2.1 Test mode

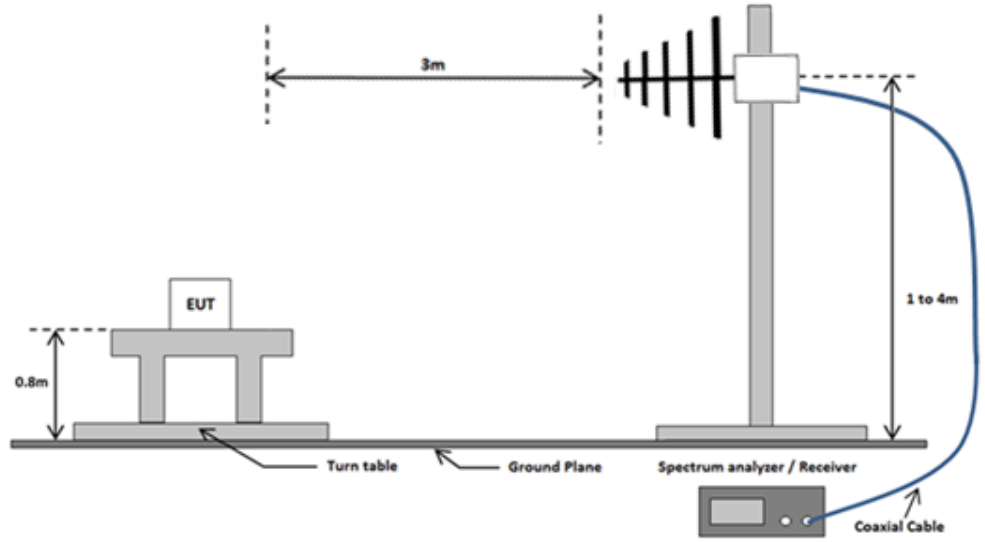
The EUT has only one mode Radio testing mode.

2.2 Test setups

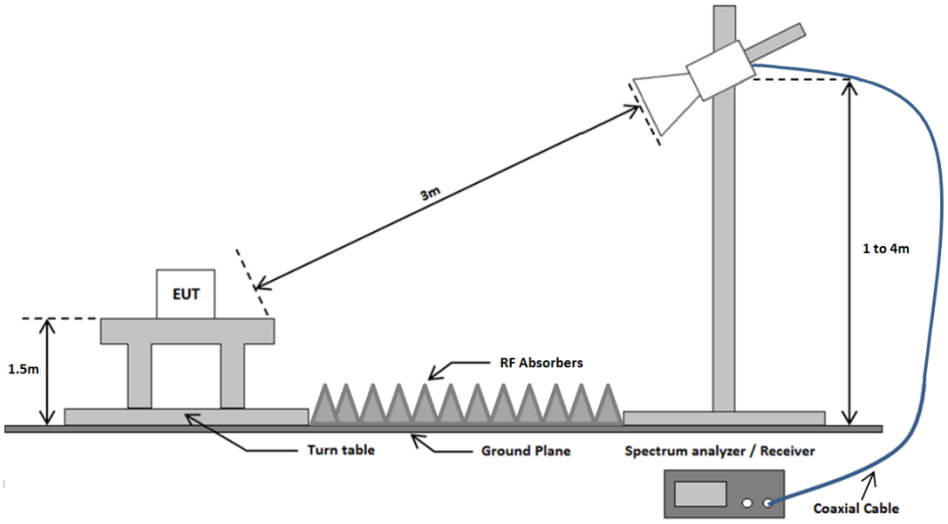
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz

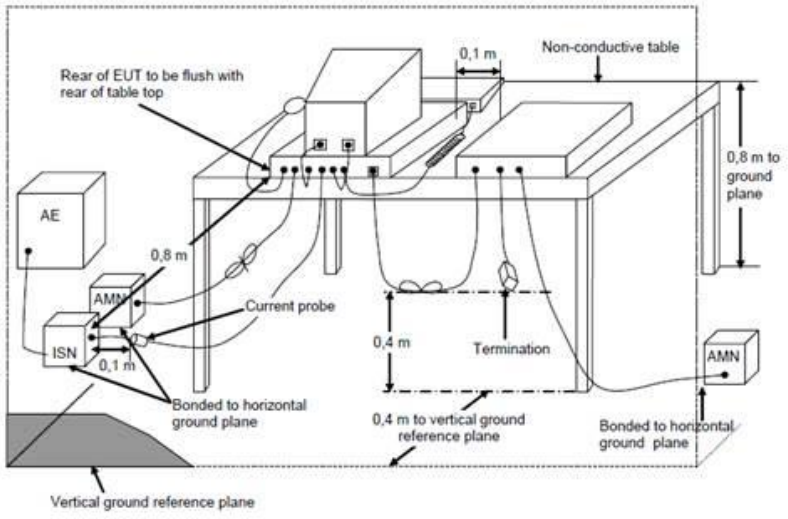


Radiated emissions test setup above 1 GHz

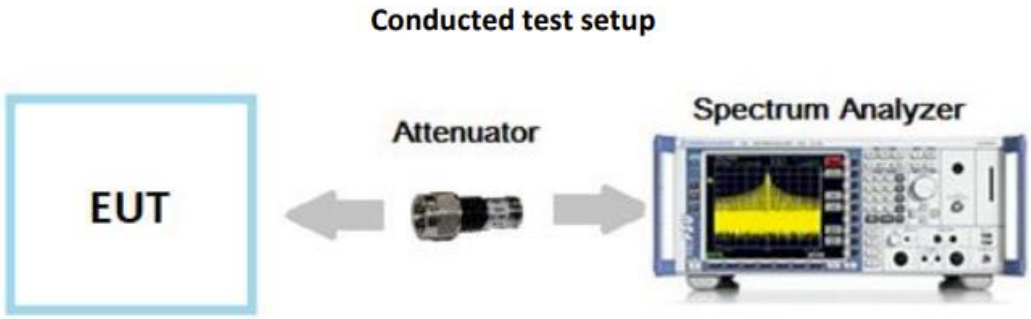


AC Power line conducted emissions test setup

Emissions test at AC mains



Antenna port conducted tests



List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	AC Power	mains 120Vac 60 Hz	AUX1 & AUX2	< 3m	**-**
2	x Vdc power	AUX1	EUT	< 3m	-
3	Ethernet	EUT	AUX2	<3m	**-**

2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Cal. Done date	Cal. due date	Used at Par.
EMI Receiver	Rohde & Schwarz	ESR7	114534	04-2023	04-2024	3.1, 3.7
Spectrum Analyzer	Rohde & Schwarz	FSV40	114527	11-2023	11-2024	3.1, 3.2, 3.3, 3.4, 3.5, 3.6
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	114682	07-2021	07-2024	3.1
Active loop antenna	EMCO	6502	114515	01-2022	01-2024	3.1
Biconical antenna + 6dB attenuator	Schwarzbeck + HP	VHA9103 + 8491A	114436 + 114254	03-2021	03-2024	3.1
Logperiodic antenna	EMCO	3147	114385	03-2021	03-2024	3.1
Horn antenna	EMCO	3115	114607	01-2021	01-2024	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	114518	NA*	NA*	3.1
Preamplifier 1-18 GHz	Schwarzbeck	BBV 9718D	114874	01-2023	01-2024	3.1
Preamplifier 18-40 GHz	Miteq	JS4-18004000-33-8P	114693	01-2023	01-2024	3.1
Test software	Raditeq	Radimation Version 2021.1.9	TE 02008	--	--	3.1

*Note: Standard gain horn antennas do not need calibration
NA= Not Applicable

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

15.209(a)
The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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: Measured values in the plots 9 kHz to 30 MHz corrected to 30m or 300m limit distance according to the method described in ANSI C63.10-2013, clause 6.4

RSS-GEN (section 7.3 table)
The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	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 C63.10-2013, section 6.4
30 MHz to 26.5 GHz: According to ANSI C63.10-2013, section 6.5 and 6.6

9 kHz to 30 MHz: IRN 441 – Method 10
30 MHz to 1 GHz: IRN 441 – Method 1
1 GHz to 18 GHz: IRN 441– Method 2
18 to 26.5 GHz: IRN 441– Method 3

In case of handheld and/or body-worn equipment, the EUT's orientation (X, Y, Z) was varied in order to ensure that maximum emission amplitudes were attained. In all other cases the associated cabling and the EUT orientation was varied for maximum emissions.

The spectrum was examined from 0.009 MHz to 10 times X GHz, not more than the 10th harmonic of the highest intentional generated frequency (X GHz). Final radiated emission measurements were made at 3m distance.

The 6 highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

3.1.5 Measurement Uncertainty

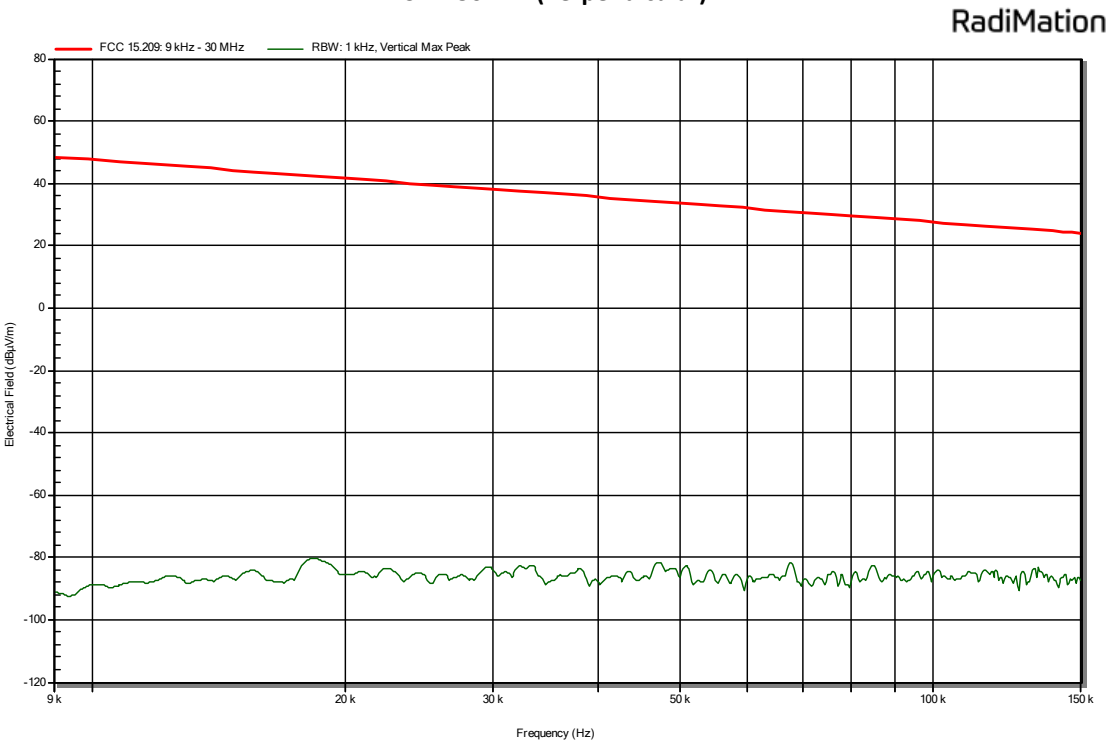
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB
18 – 26.5 GHz	Horizontal	±4.9 dB
	Vertical	±4.9 dB

3.1.6 Test results

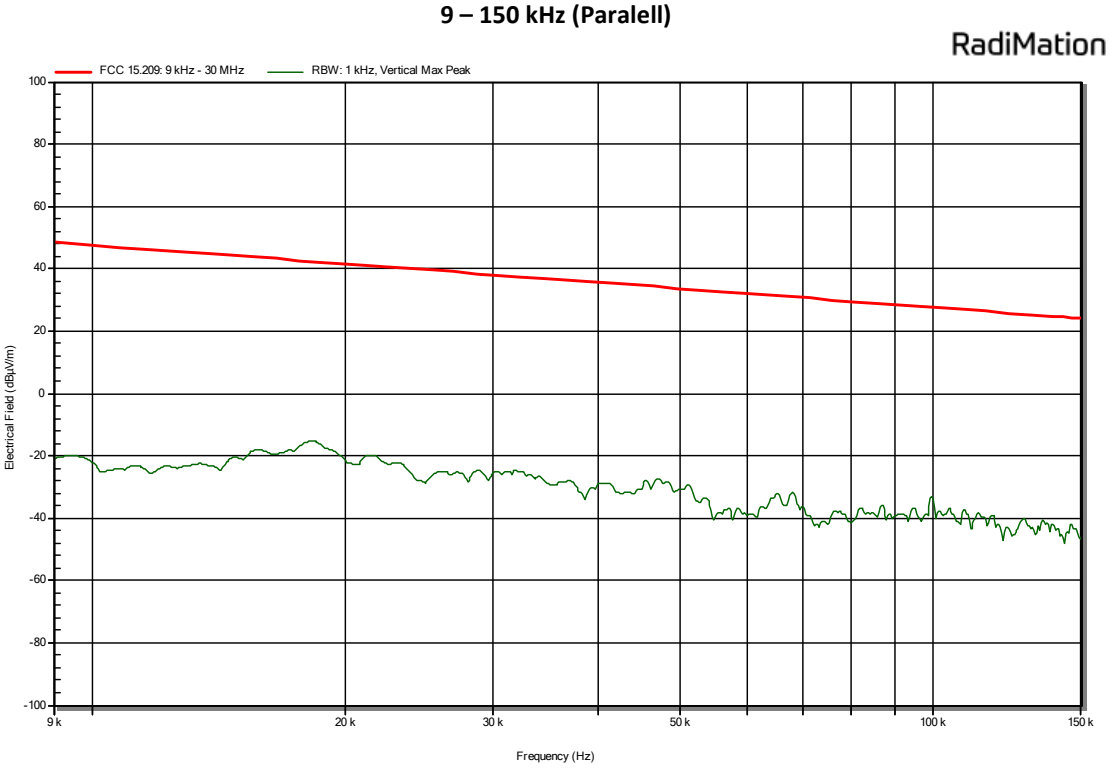
3.1.7 Plots of the Radiated Spurious Emissions Measurement

BLE Low Chan 1mbps

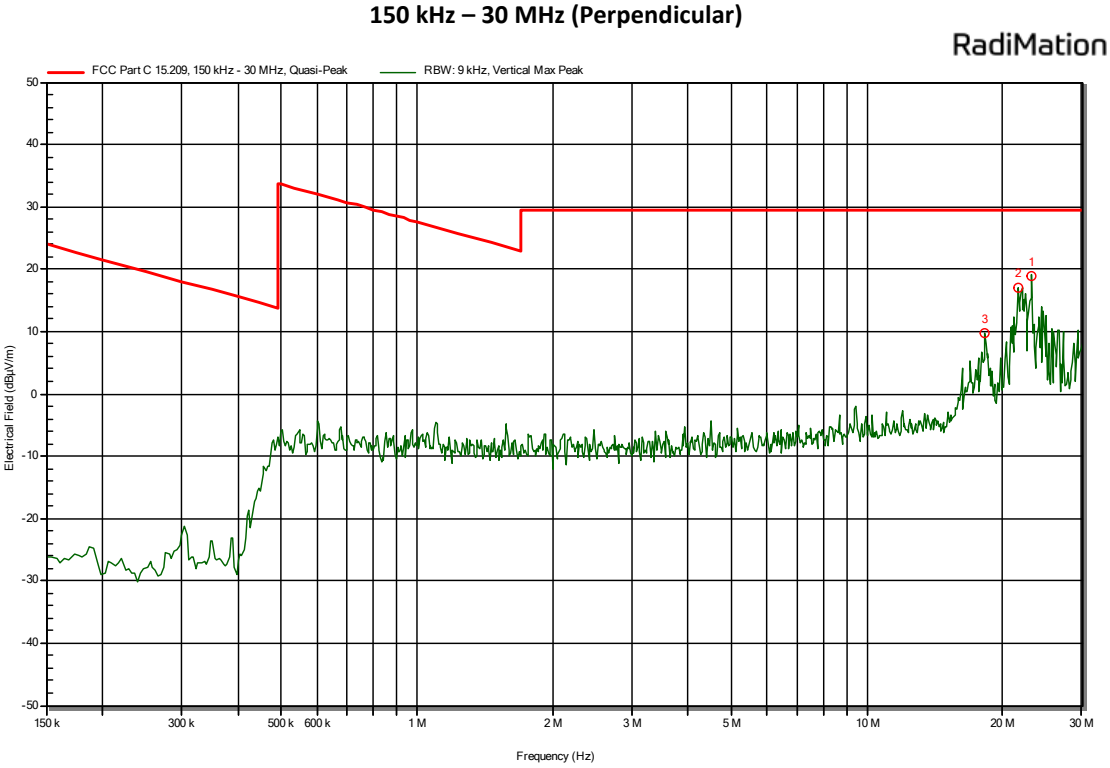
9 – 150 kHz (Perpendicular)



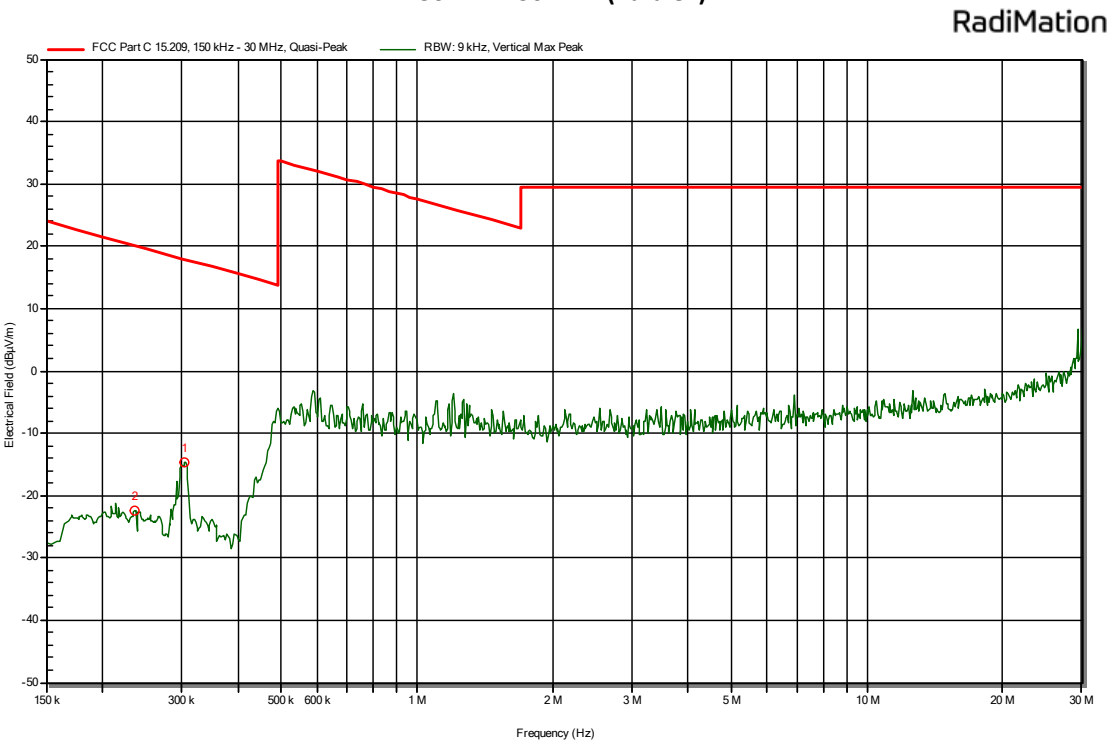
9 – 150 kHz (Paralell)



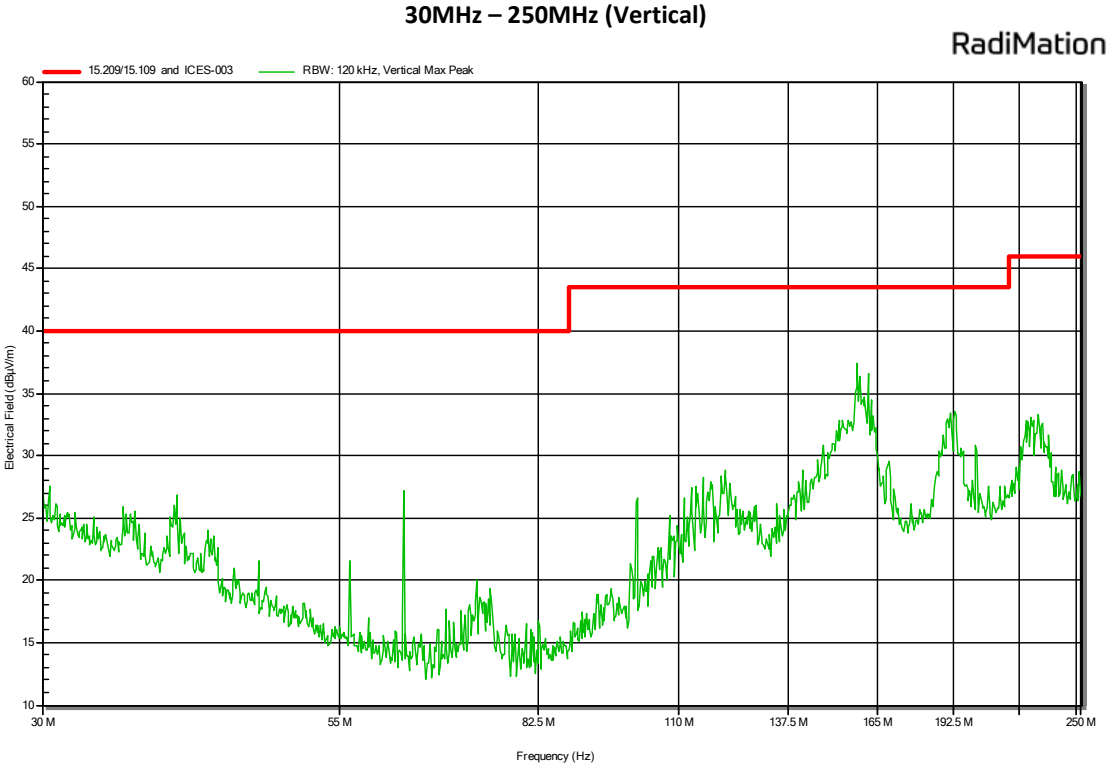
150 kHz – 30 MHz (Perpendicular)



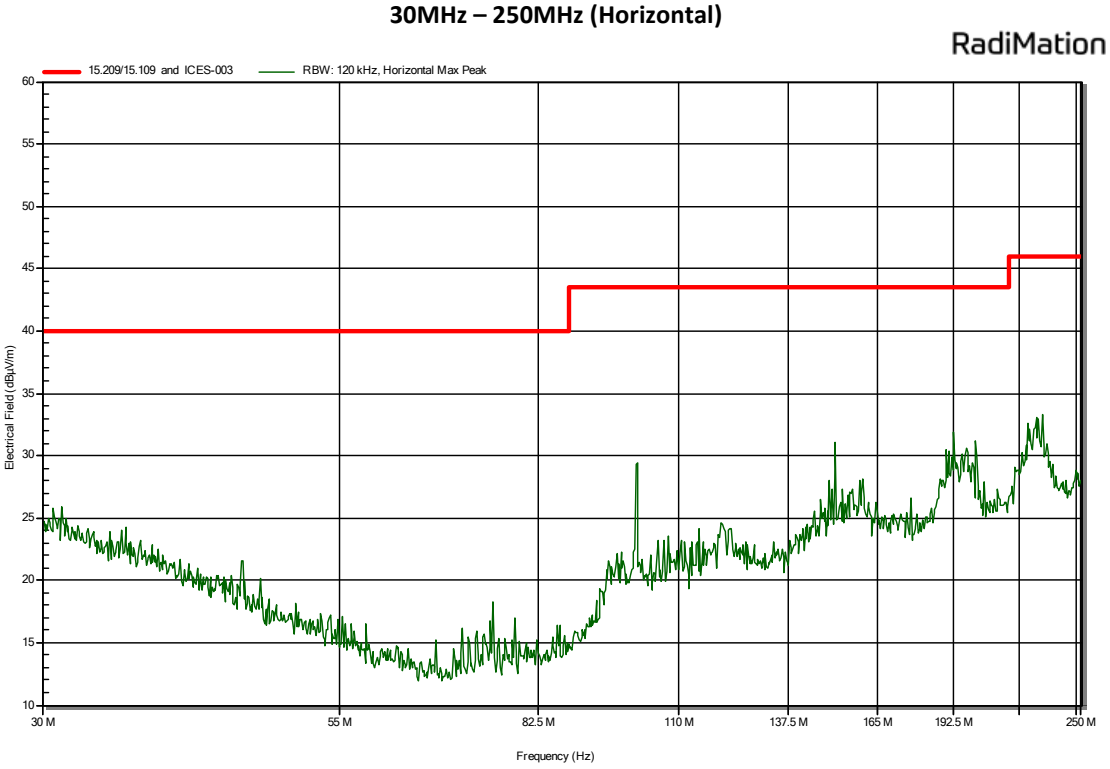
150 kHz – 30 MHz (Paralell)



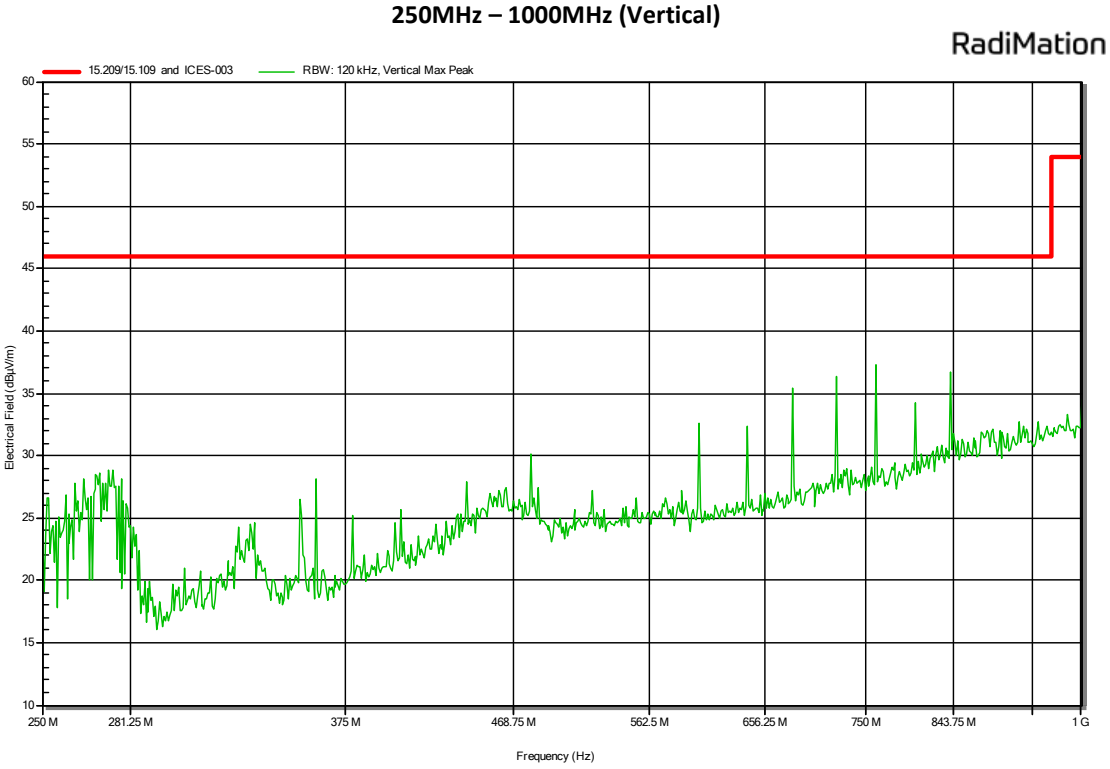
30MHz – 250MHz (Vertical)



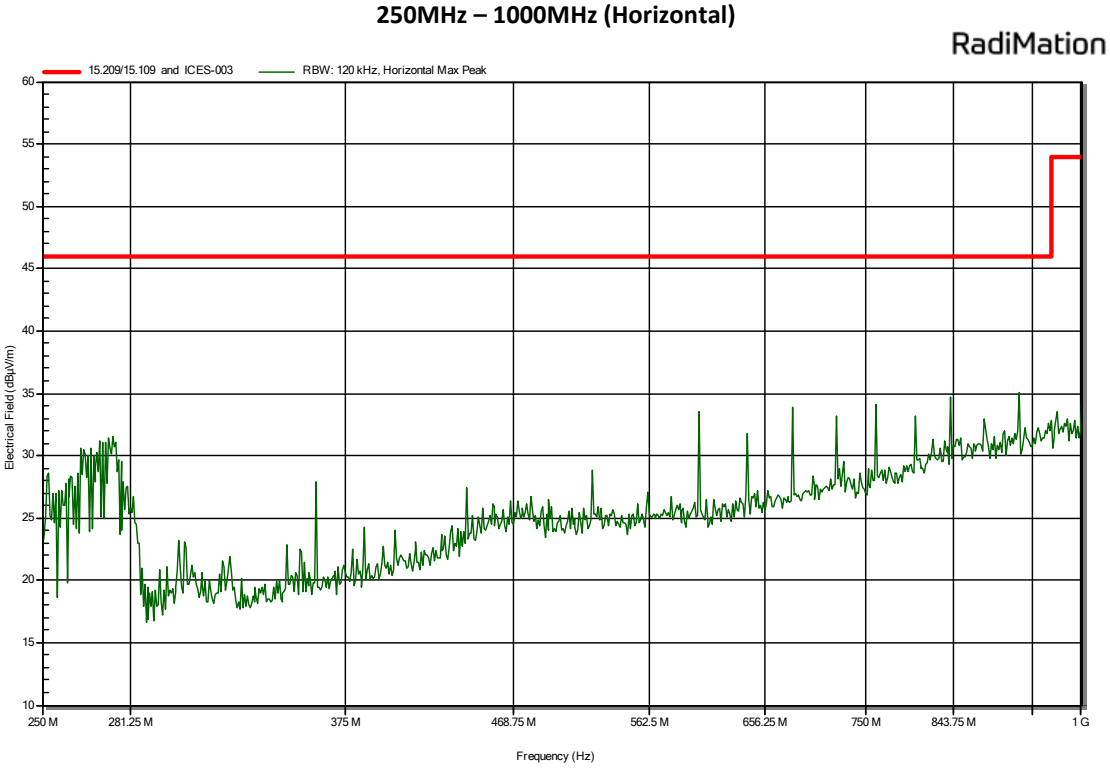
30MHz – 250MHz (Horizontal)



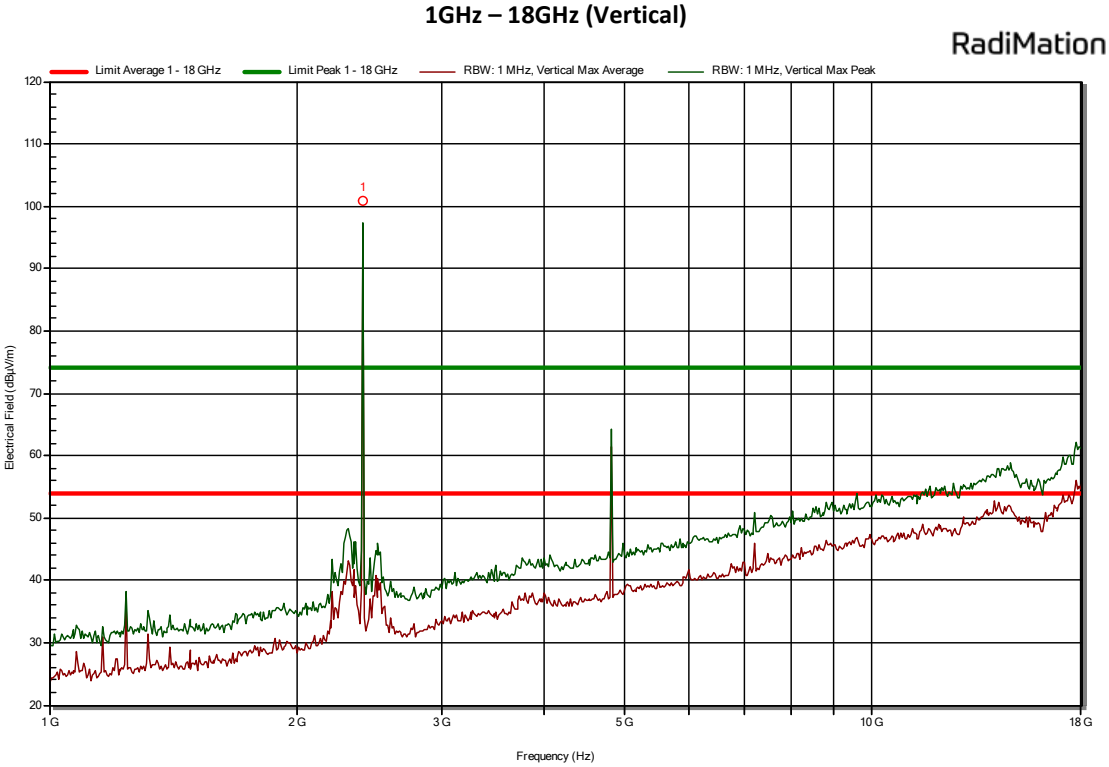
250MHz – 1000MHz (Vertical)



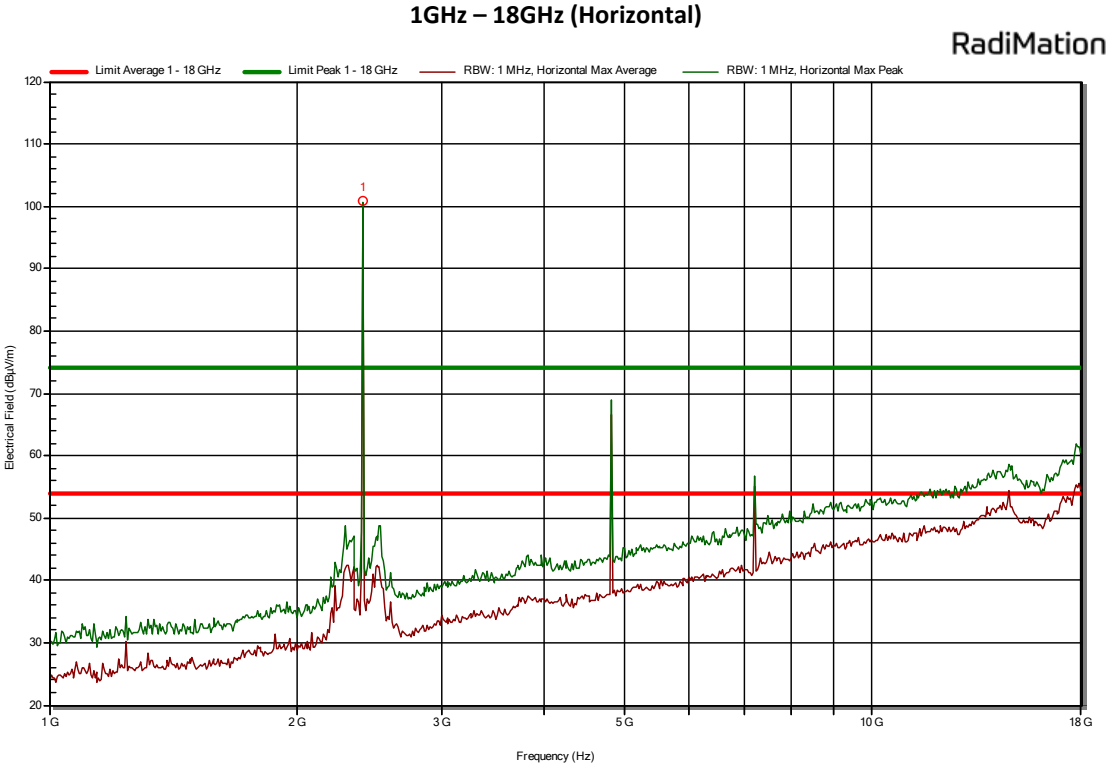
250MHz – 1000MHz (Horizontal)



1GHz – 18GHz (Vertical)

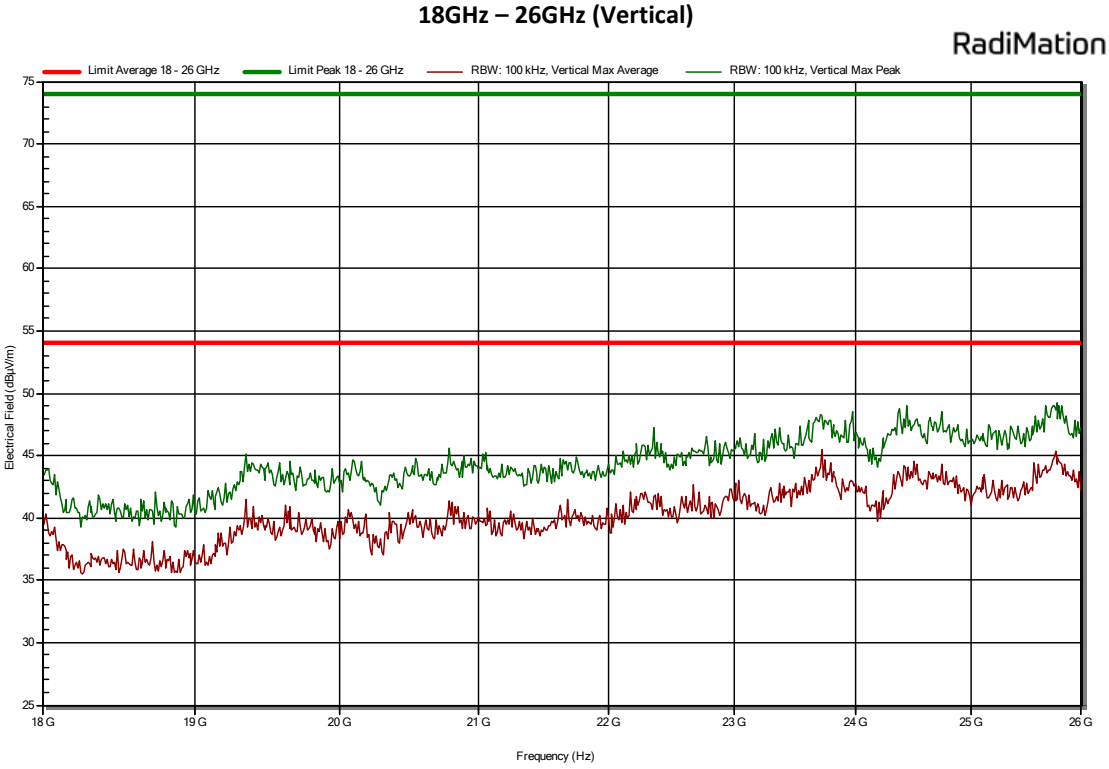


1GHz – 18GHz (Horizontal)

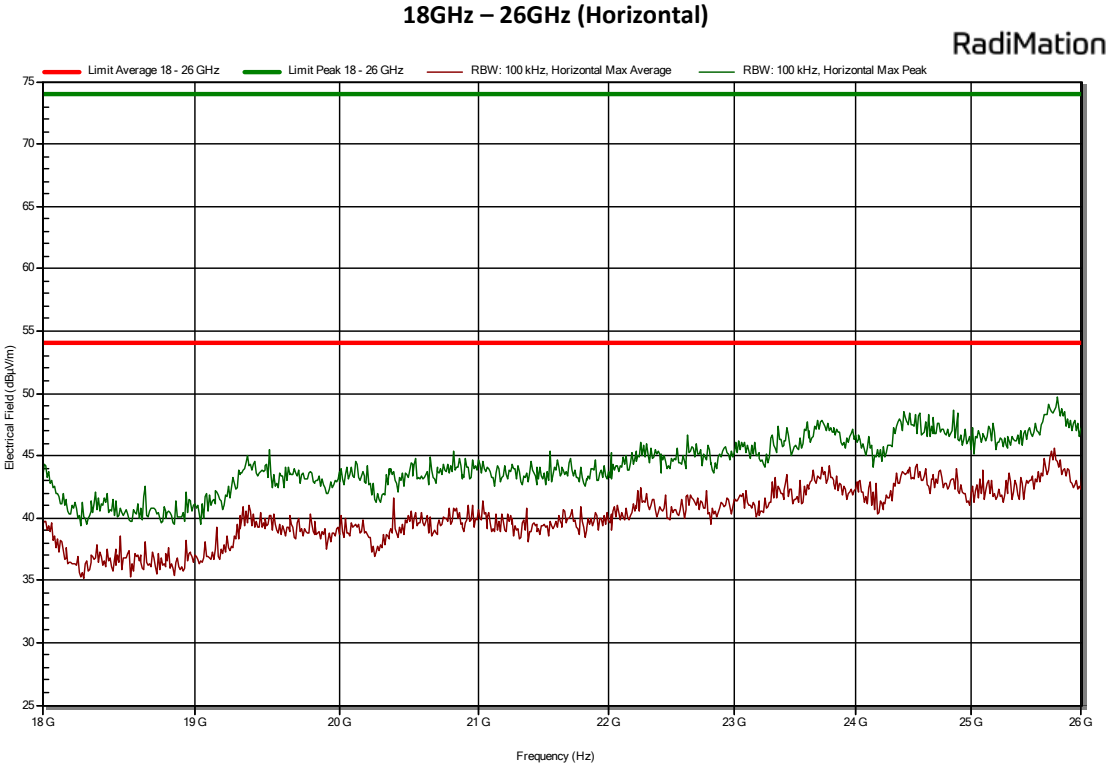


Note: The peaks between 2402 and 2480 Mhz are in the frequency range of transmission, the transmissions peaks are not subject to the limit. For subsequent measurements a high pass filter was used.

18GHz – 26GHz (Vertical)



18GHz – 26GHz (Horizontal)



BLE Mid Chan 1mbps

9 – 150 kHz (Perpendicular)*

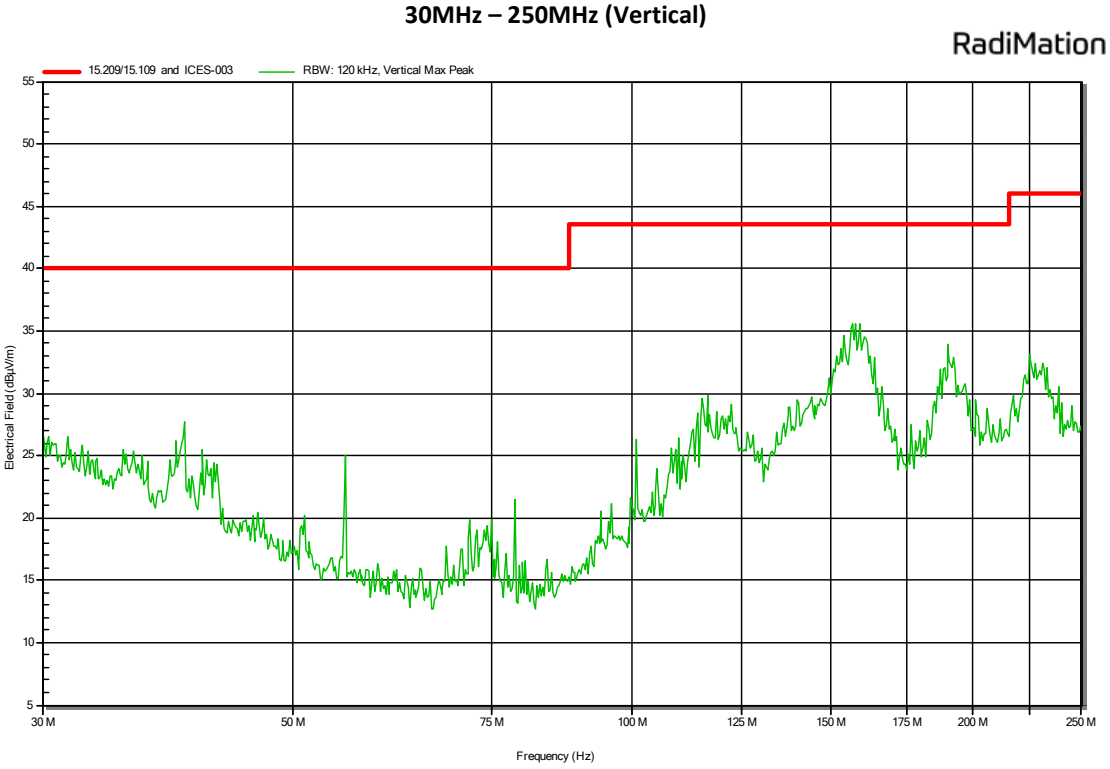
9 – 150 kHz (Paralell)*

150 kHz – 30 MHz (Perpendicular)*

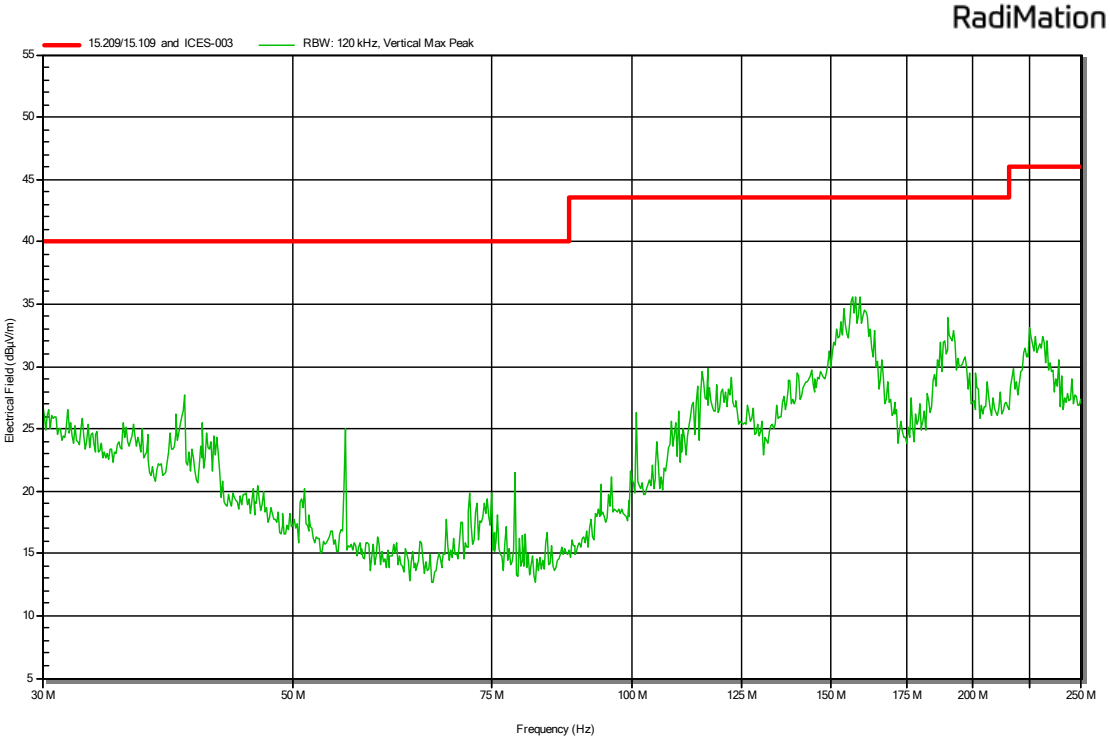
150 kHz – 30 MHz (Paralell)*

Note*: Due to no apparent changes between channels low, mid and high when measuring the frequencies ranges 9 – 150kHz and 150kHz-30MHz, measurements were not made.

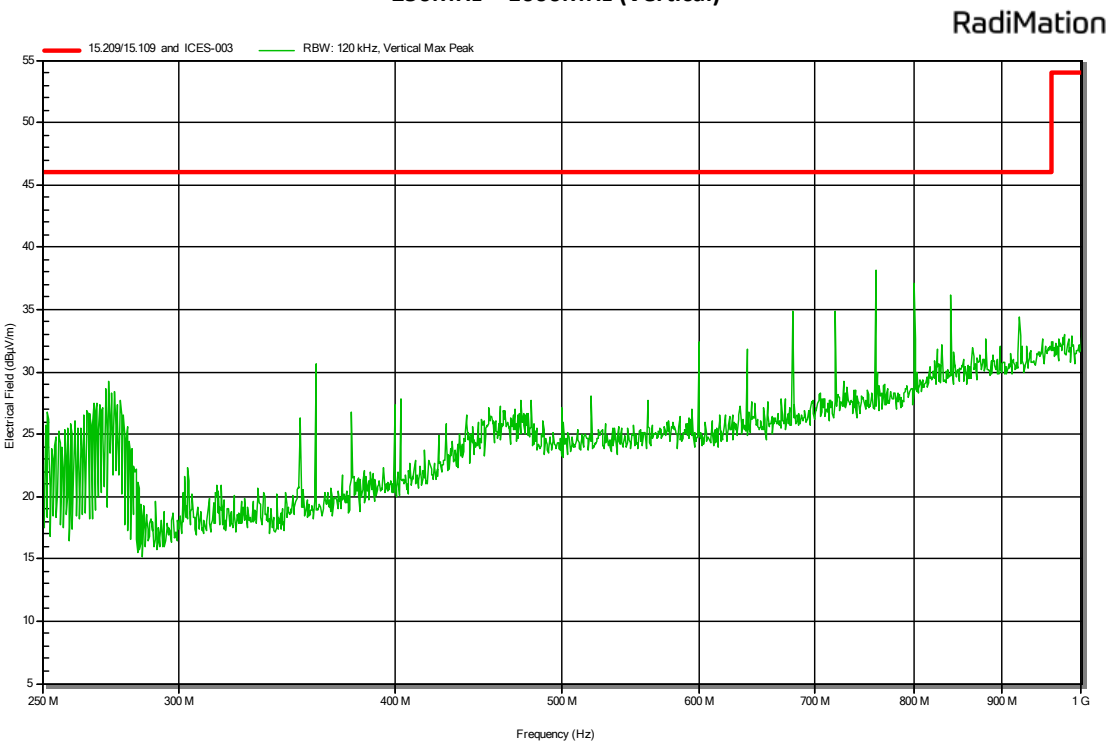
30MHz – 250MHz (Vertical)



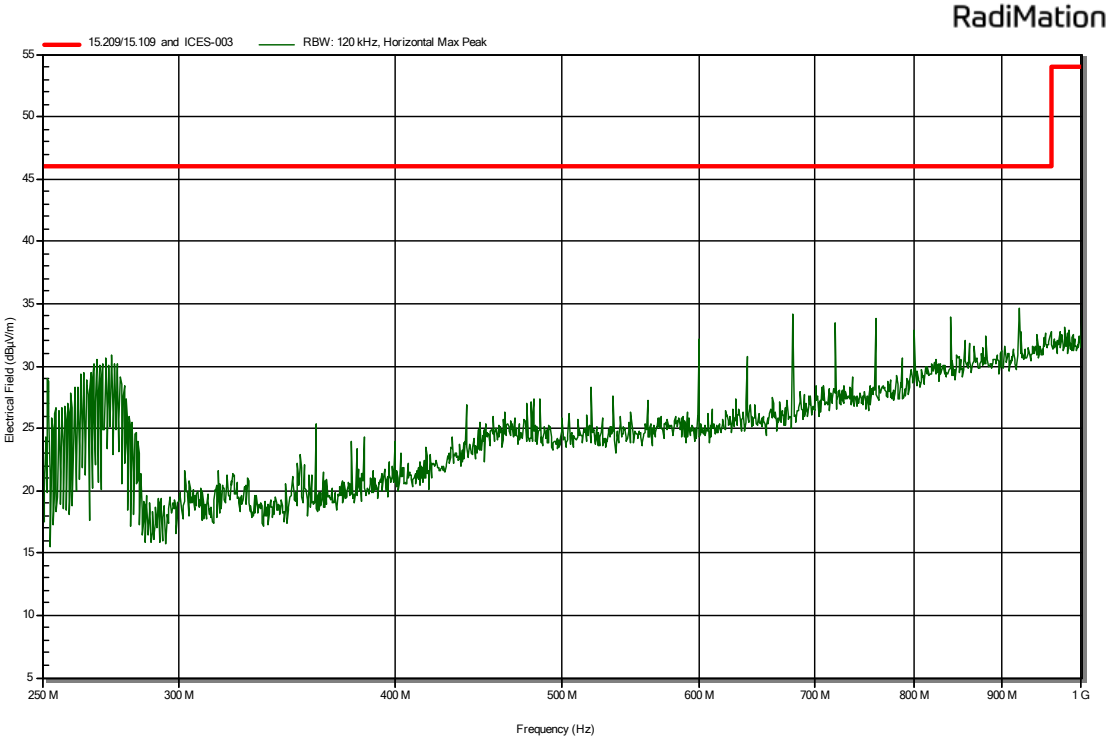
30MHz – 250MHz (Horizontal)



250MHz – 1000MHz (Vertical)

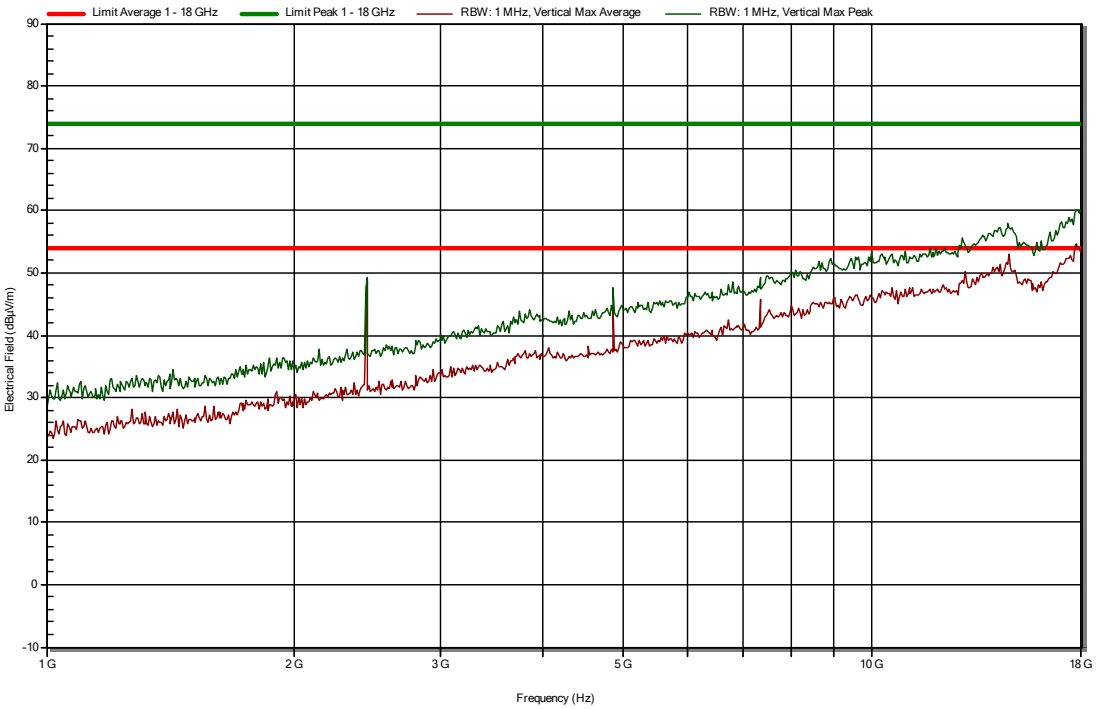


250MHz – 1000MHz (Horizontal)



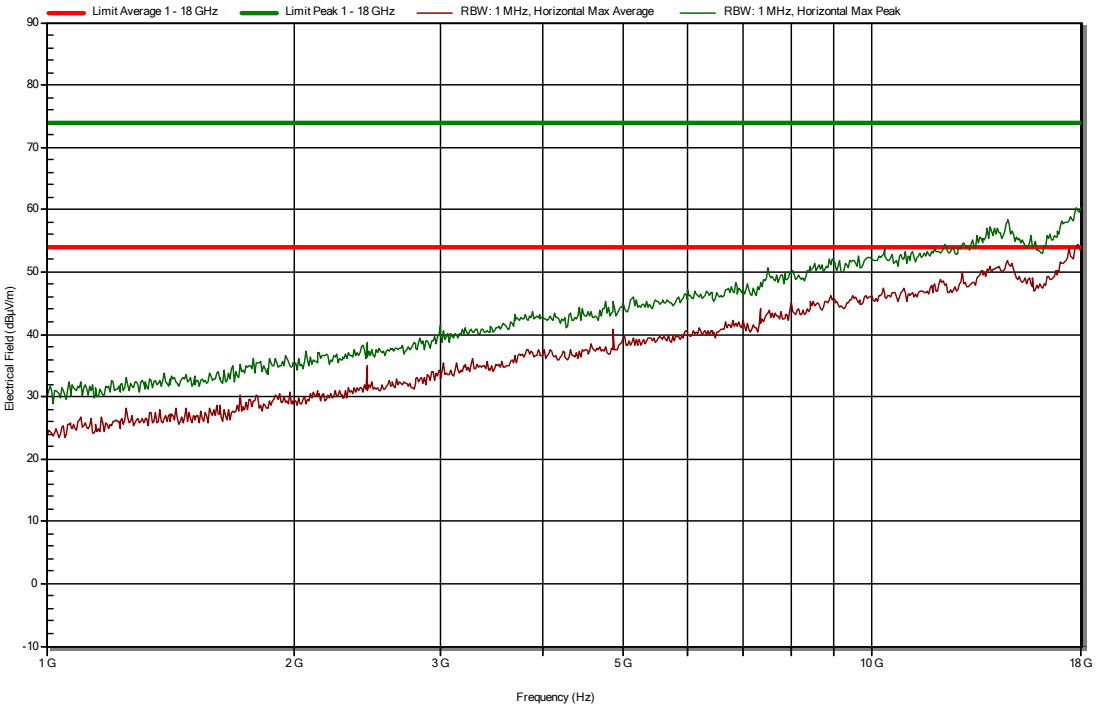
1GHz – 18GHz (Vertical)

RadiMation

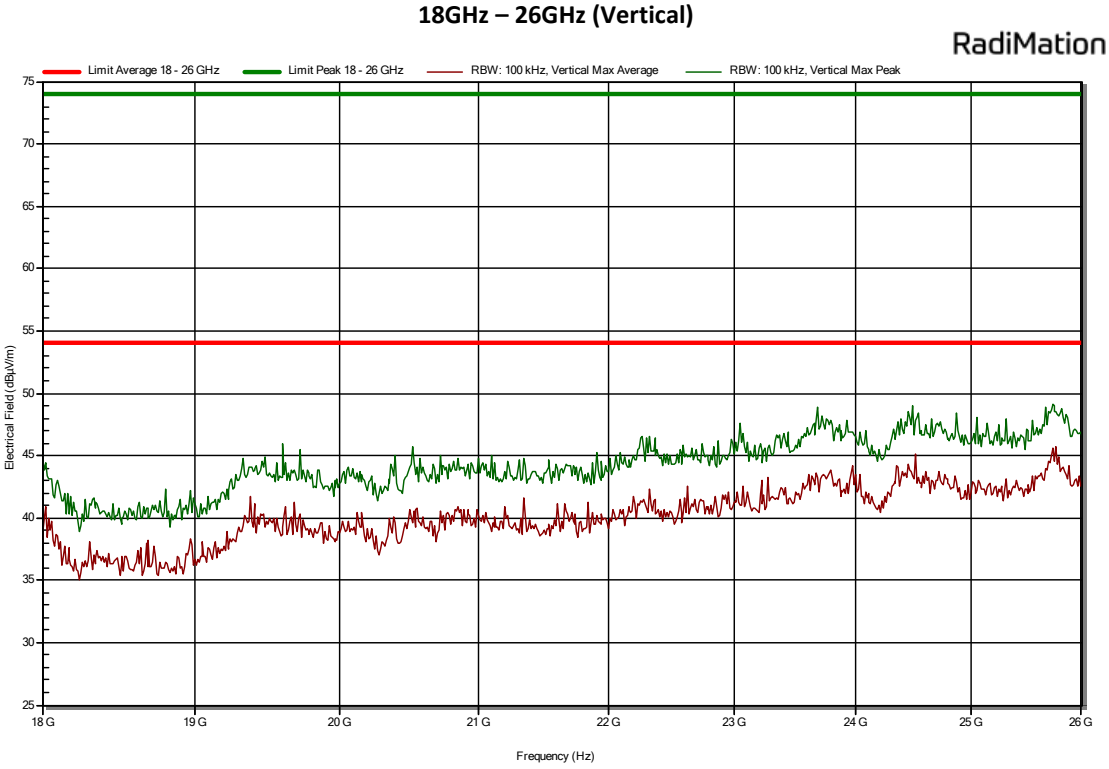


1GHz – 18GHz (Horizontal)

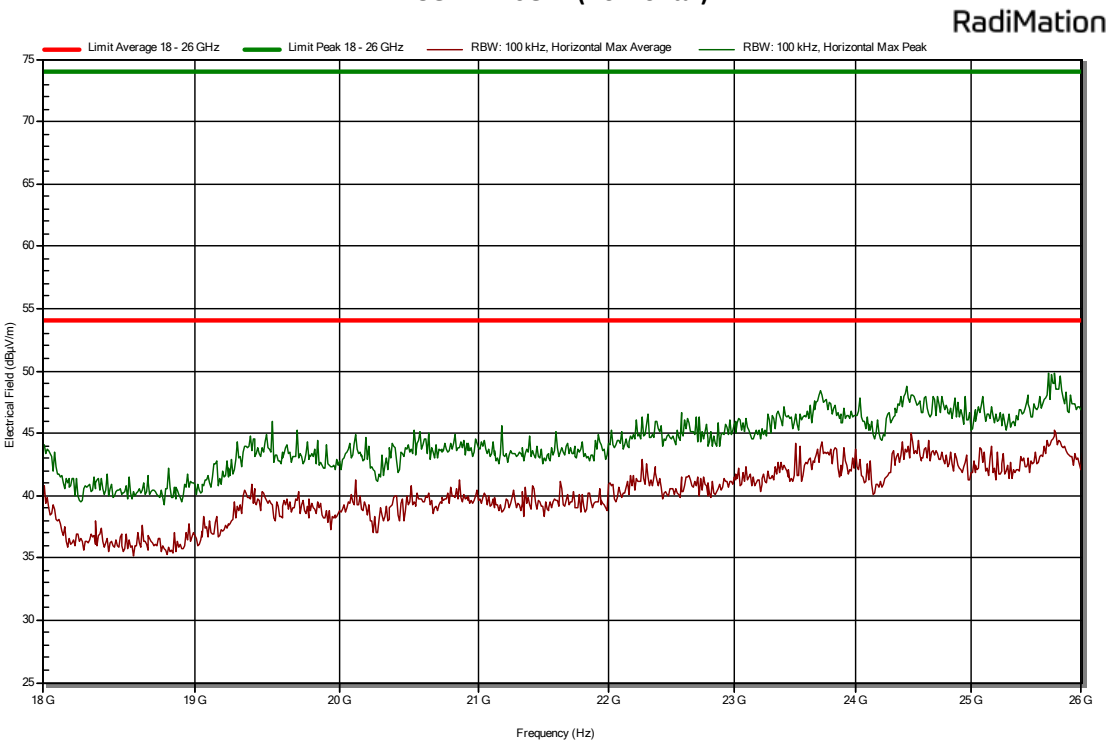
RadiMation



18GHz – 26GHz (Vertical)



18GHz – 26GHz (Horizontal)



Note: Plots shown in the sections 18-26GHz are pre scans and where performed with a RBW of 100KHz.

BLE High Chan 1mbps

9 – 150 kHz (Perpendicular)*

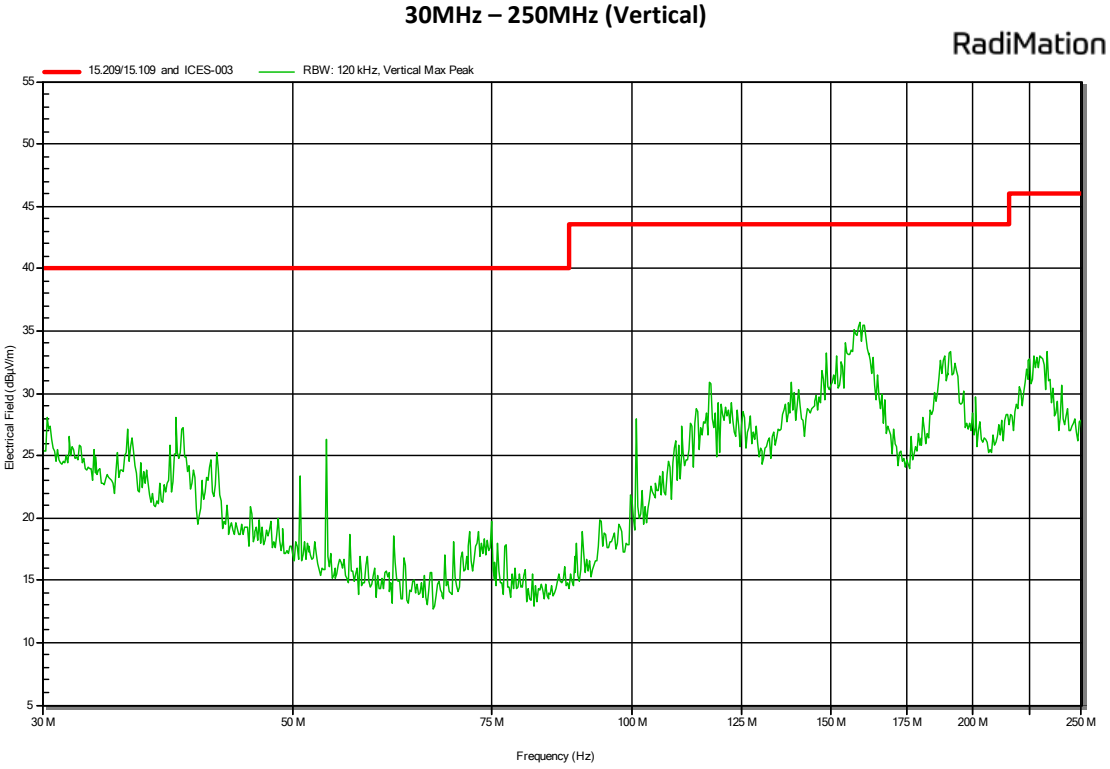
9 – 150 kHz (Paralell)*

150 kHz – 30 MHz (Perpendicular)*

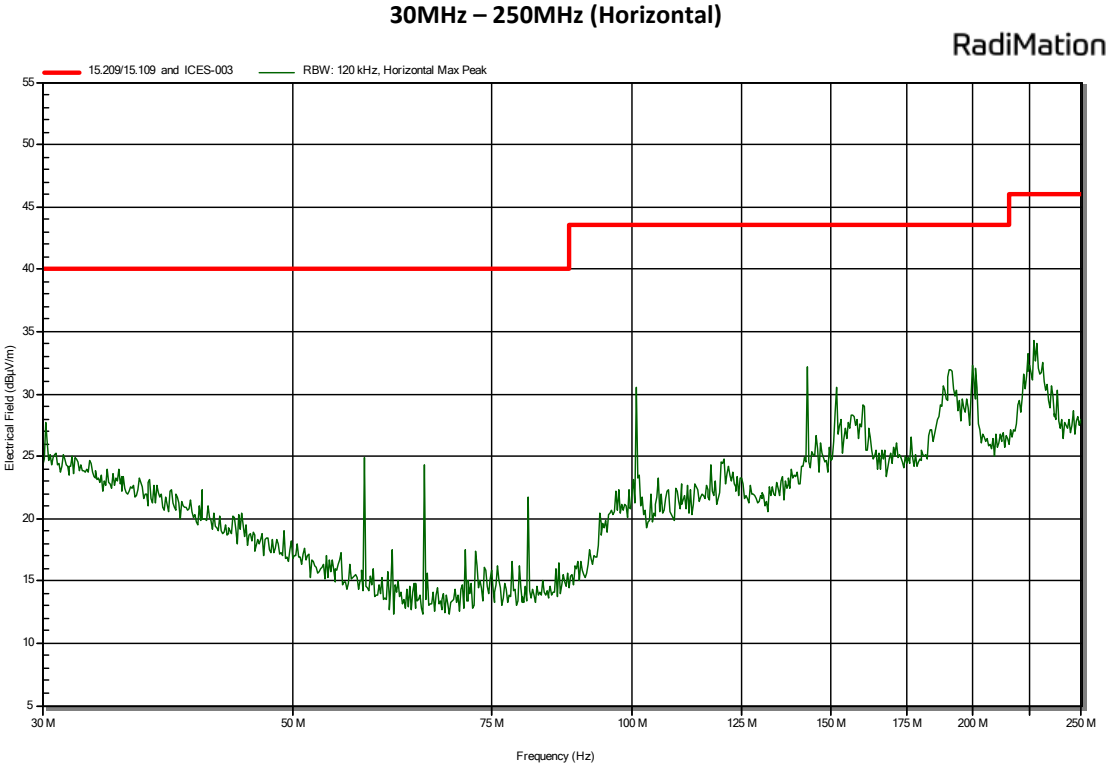
150 kHz – 30 MHz (Paralell)*

Note*: Due to no apparent changes between channels low, mid and high when measuring the frequencies ranges 9 – 150kHz and 150kHz-30MHz, measurements were not made.

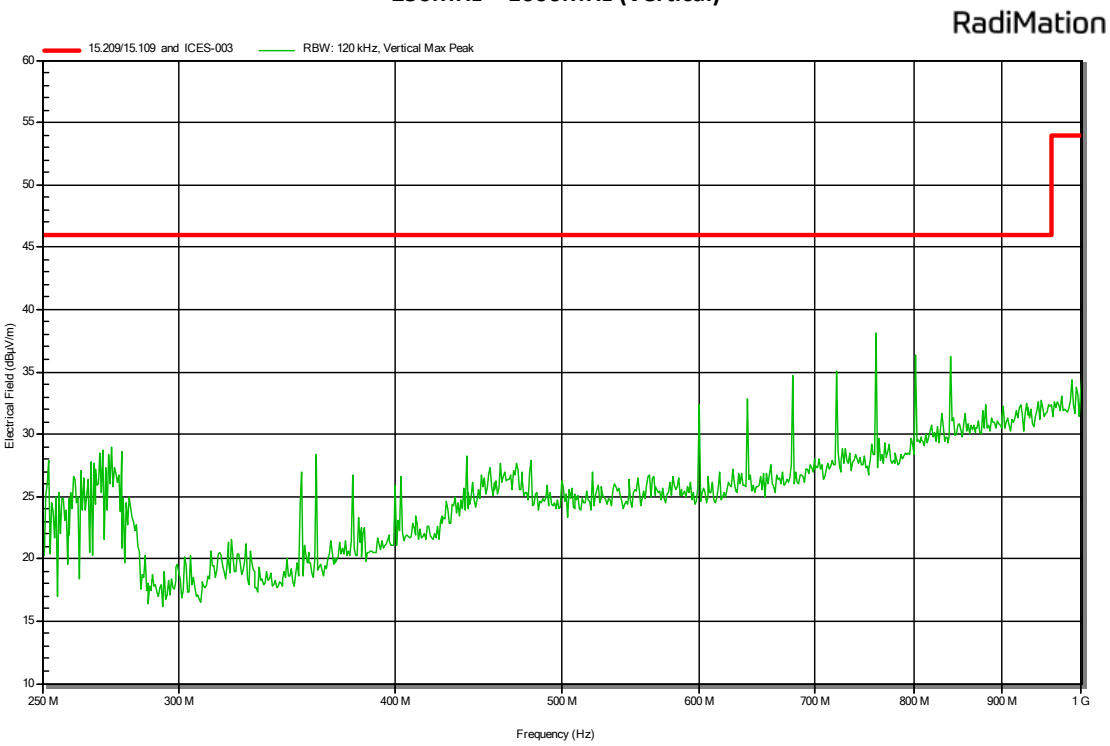
30MHz – 250MHz (Vertical)



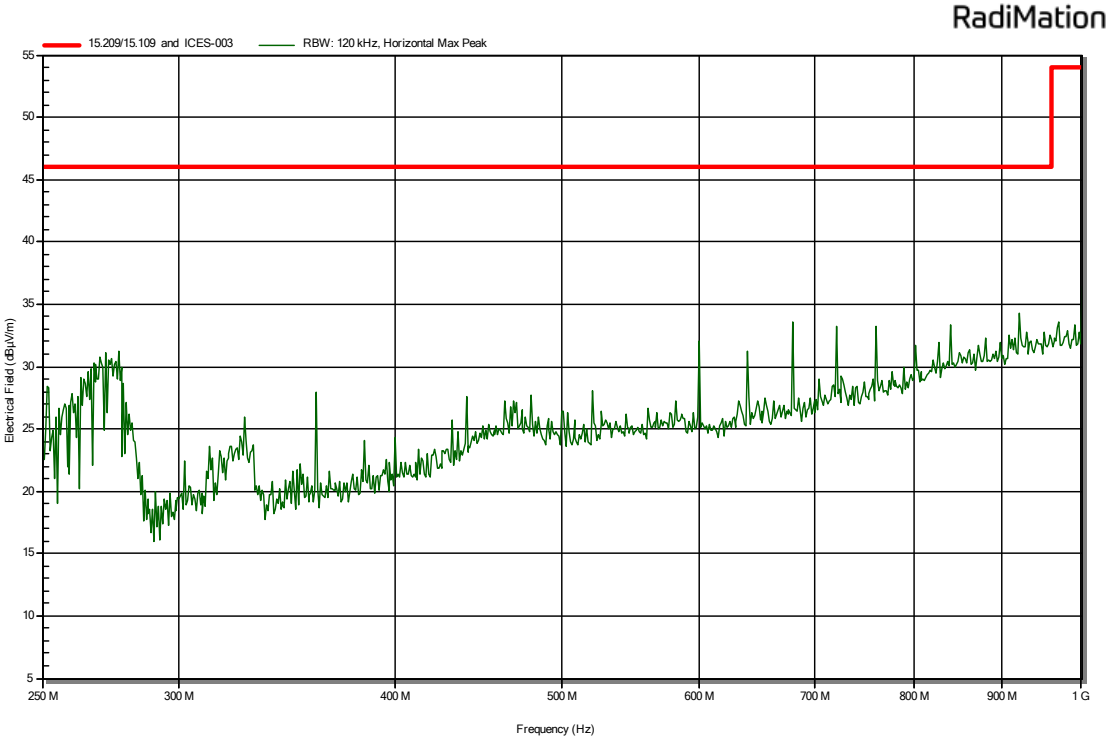
30MHz – 250MHz (Horizontal)



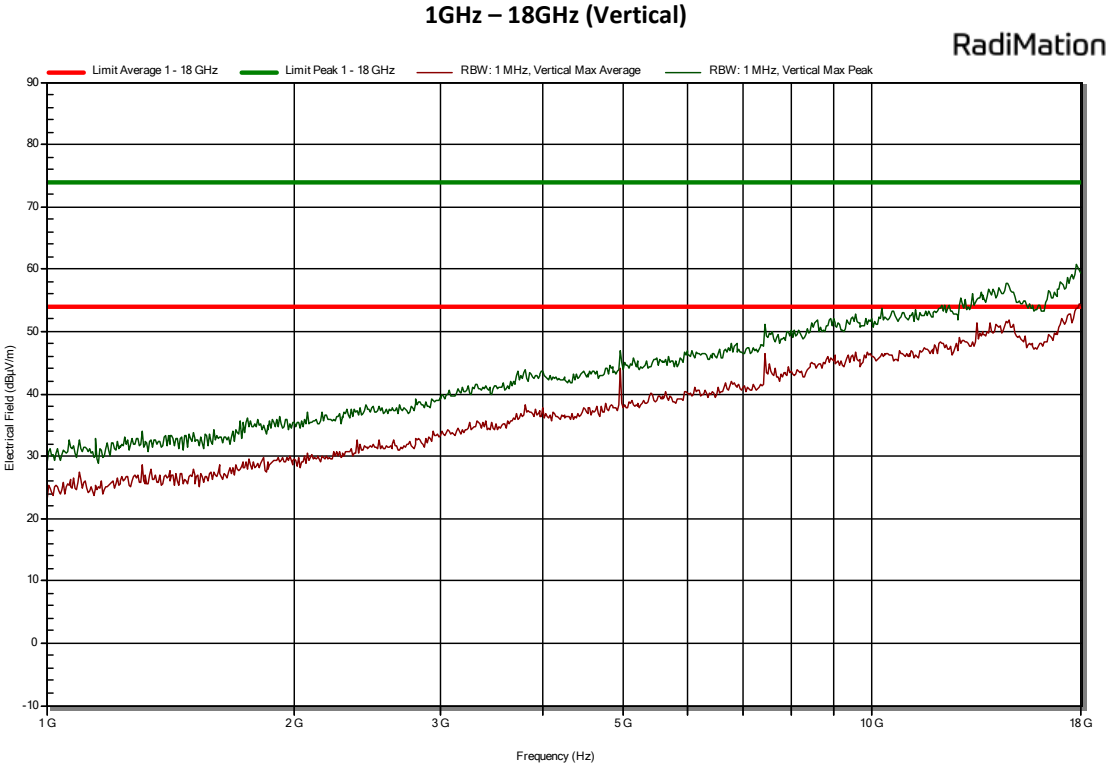
250MHz – 1000MHz (Vertical)



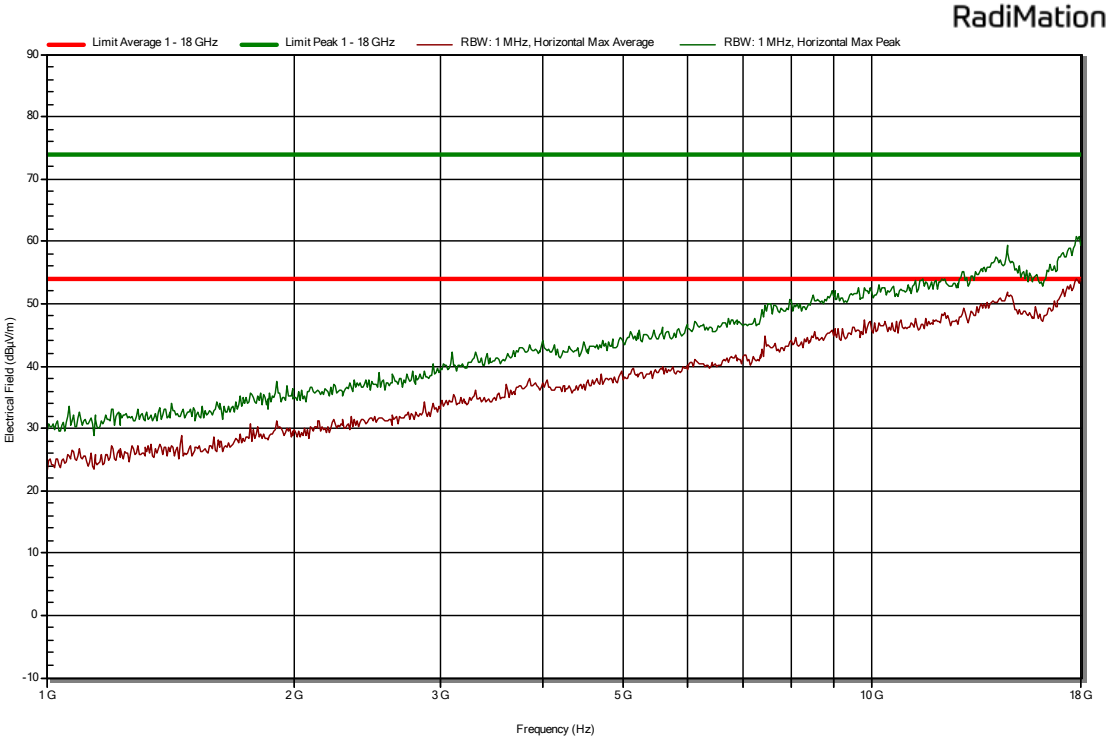
250MHz – 1000MHz (Horizontal)



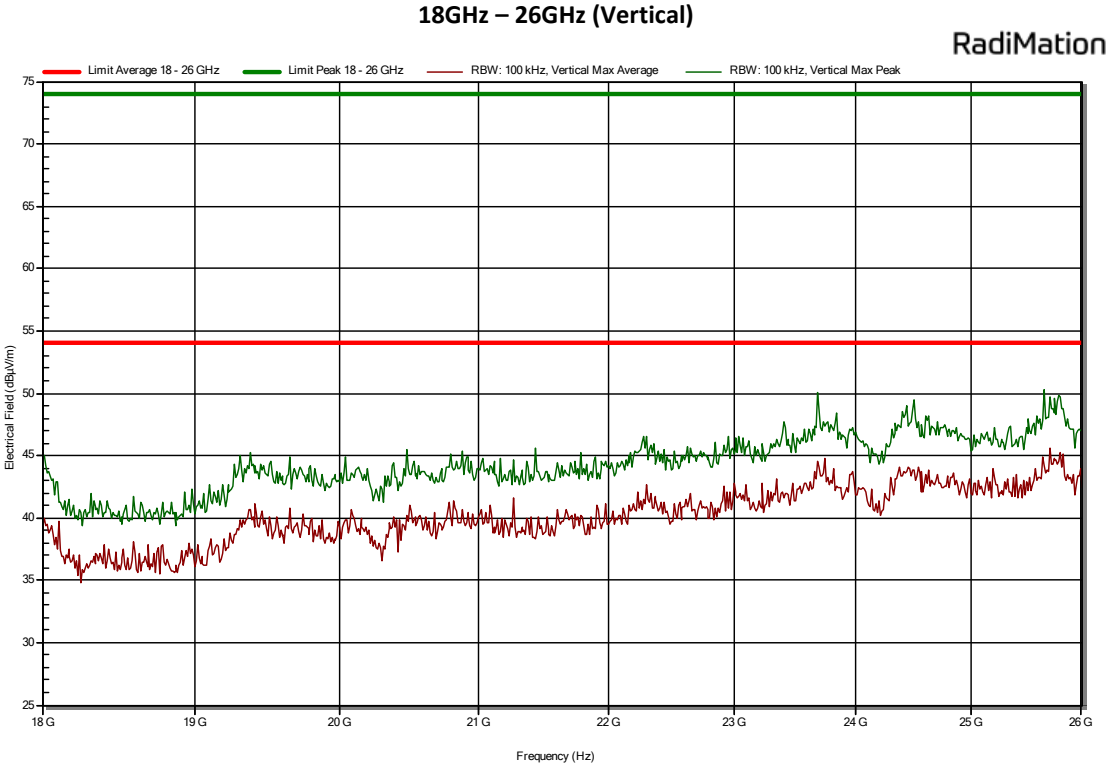
1GHz – 18GHz (Vertical)



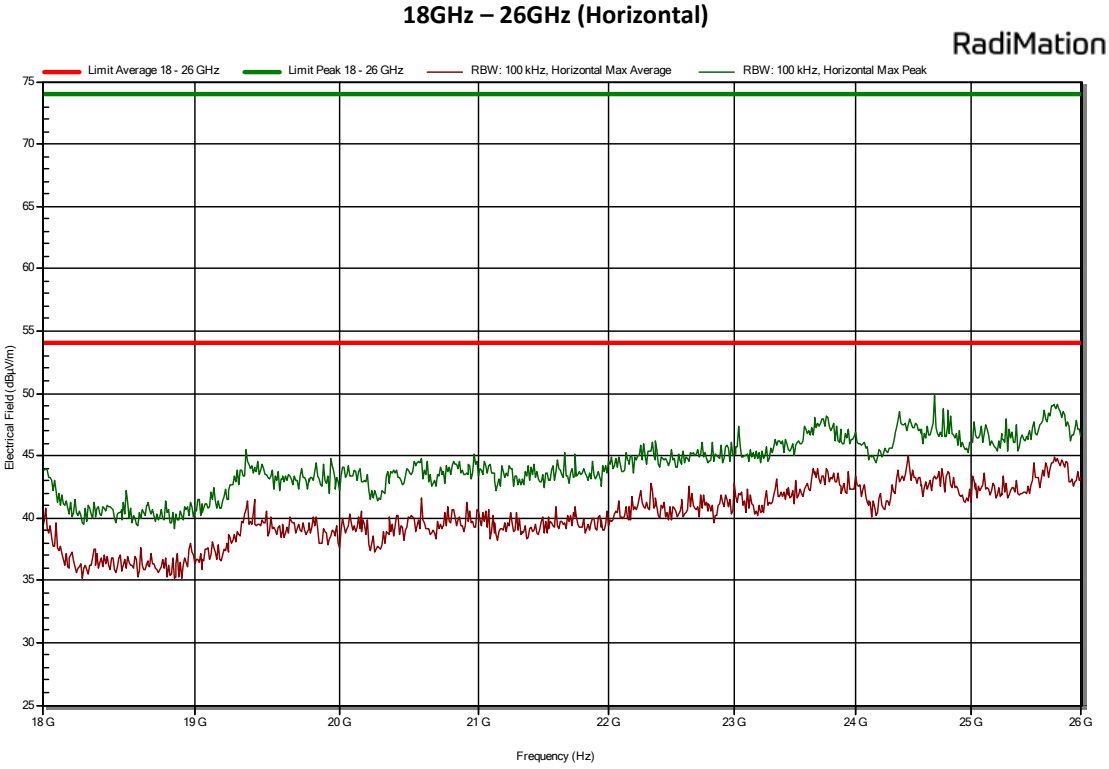
1GHz – 18GHz (Horizontal)



18GHz – 26GHz (Vertical)

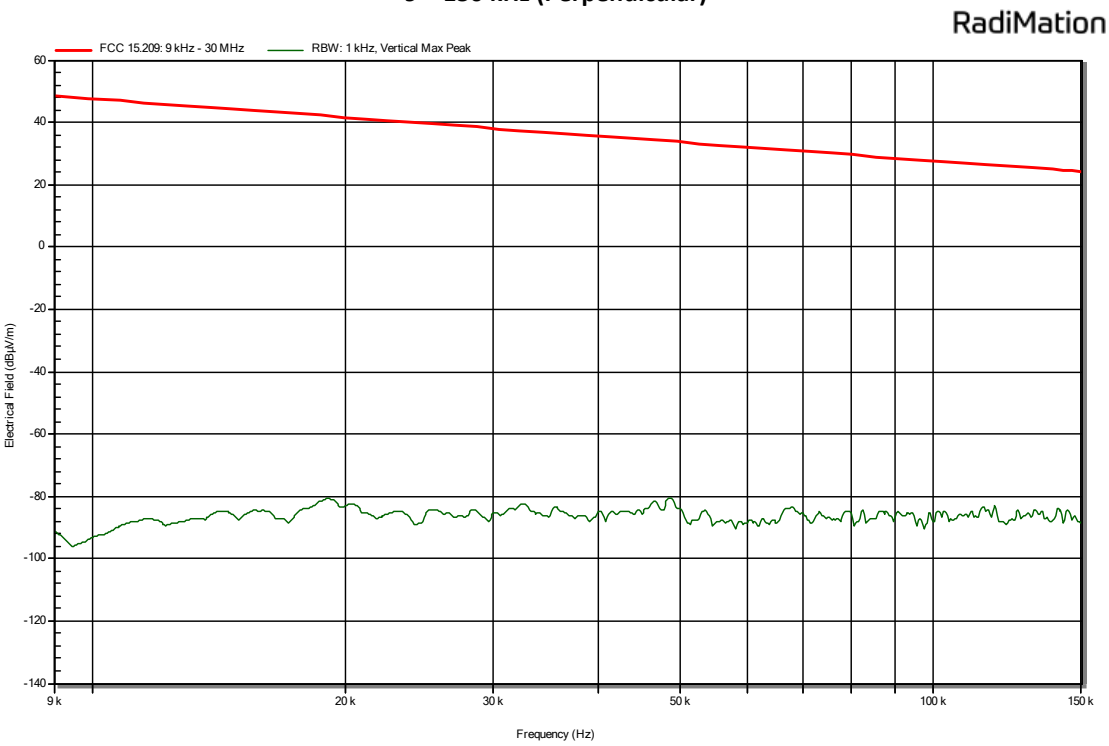


18GHz – 26GHz (Horizontal)

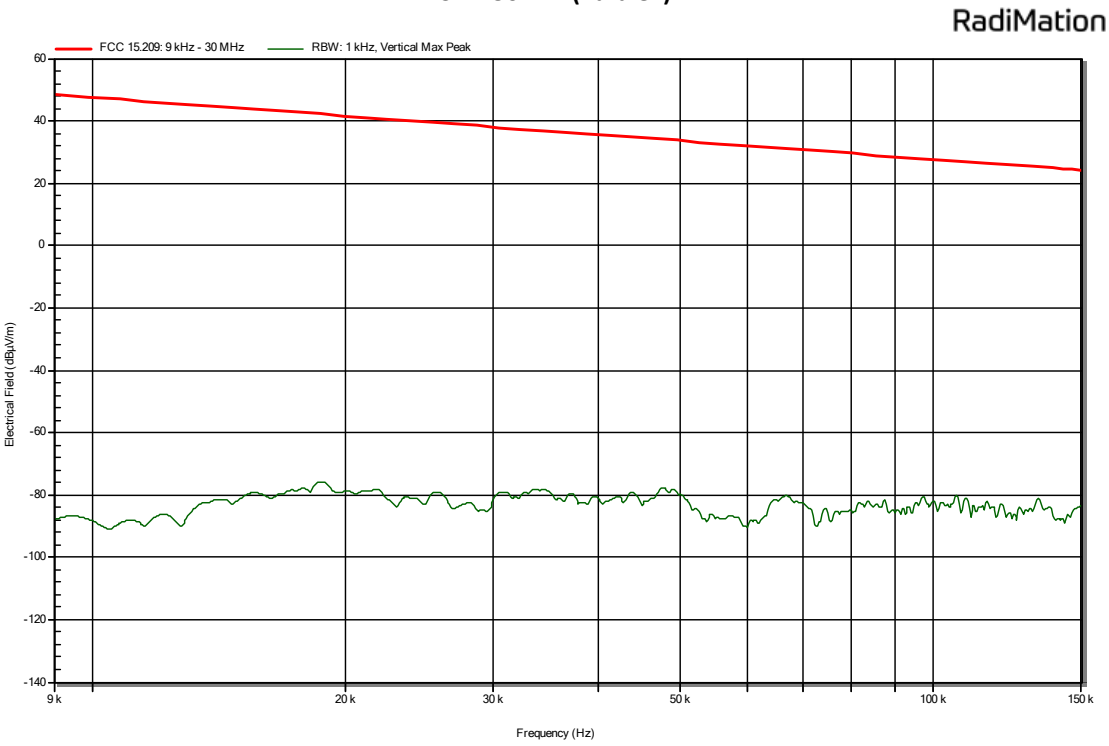


BLE Low Chan 2mbps

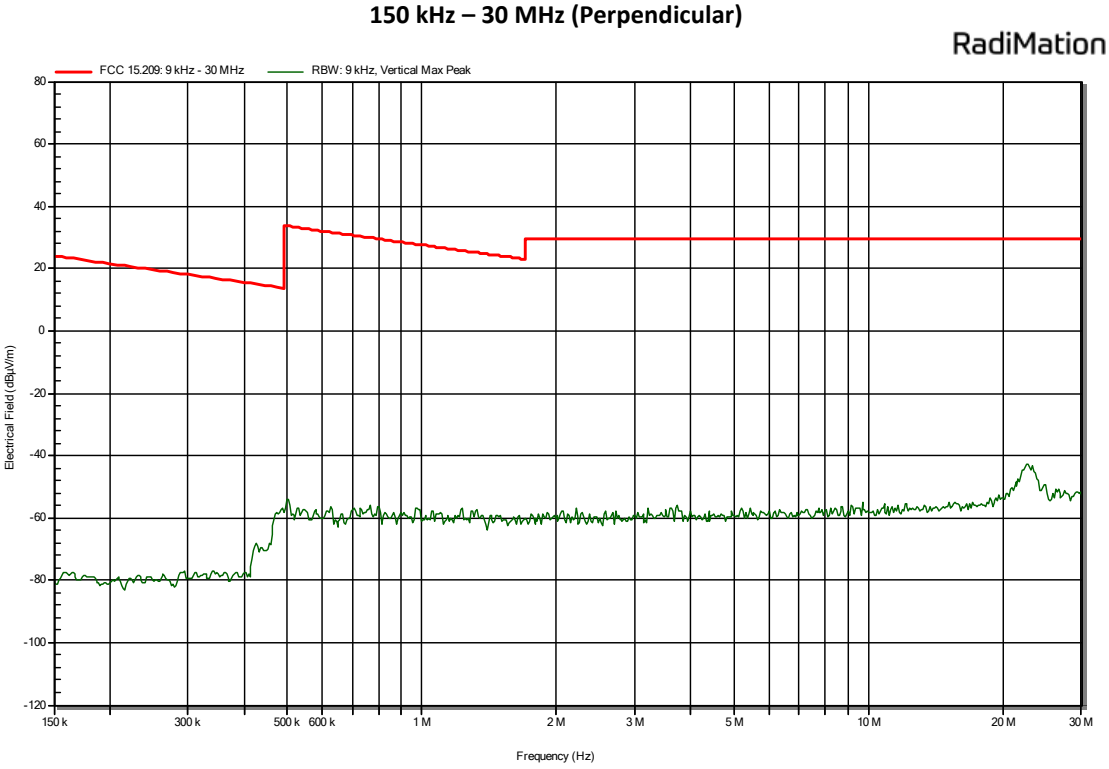
9 – 150 kHz (Perpendicular)



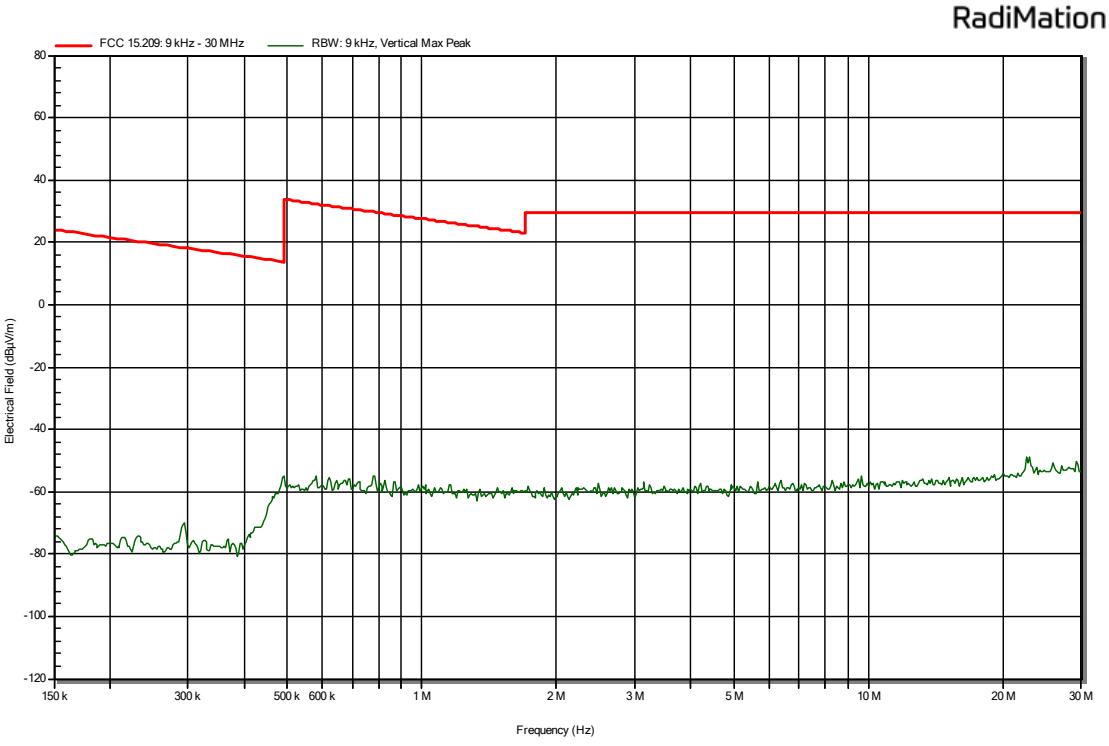
9 – 150 kHz (Paralell)



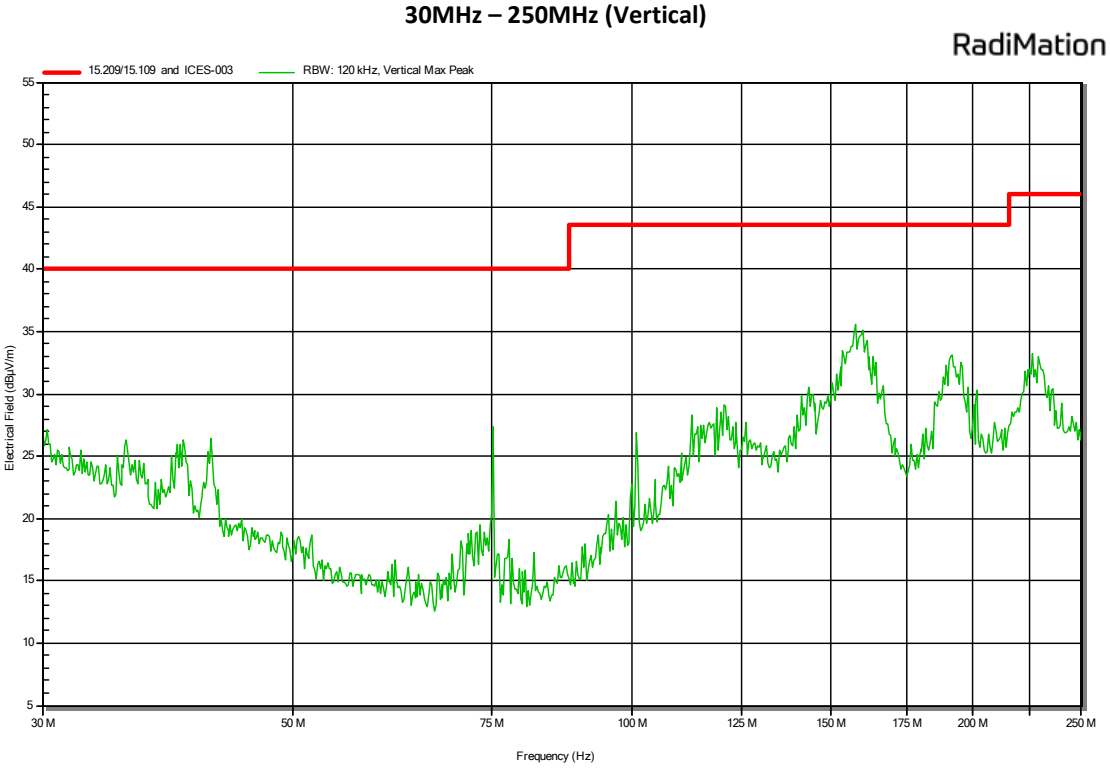
150 kHz – 30 MHz (Perpendicular)



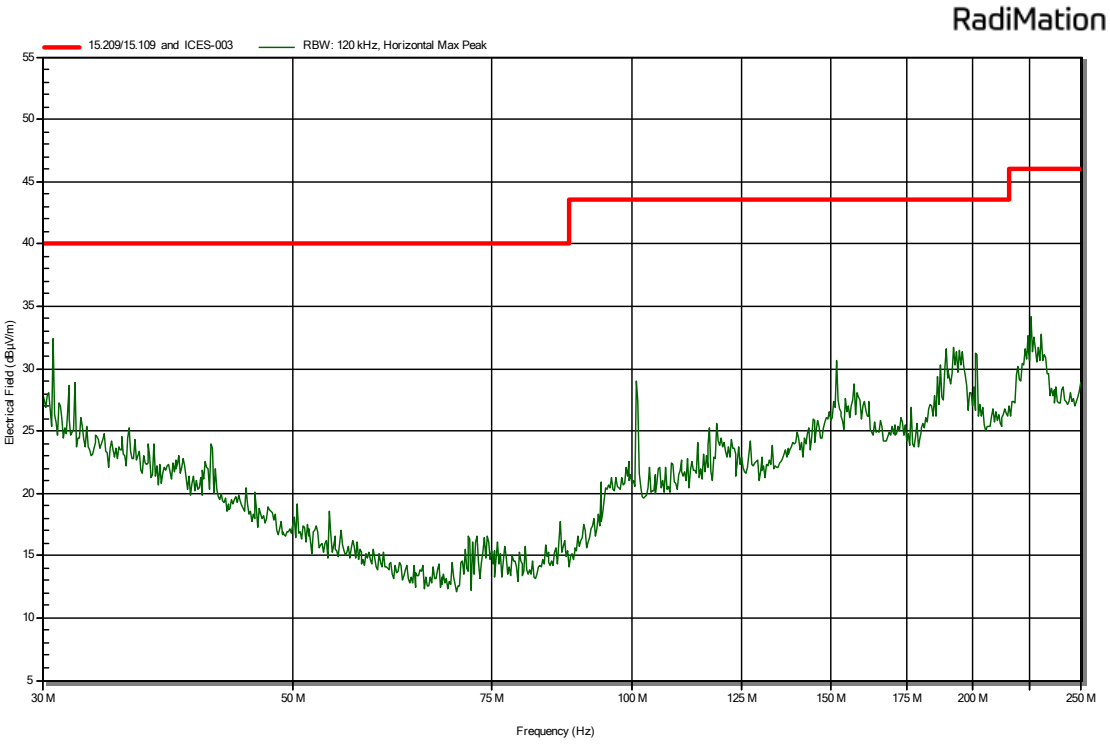
150 kHz – 30 MHz (Paralell)



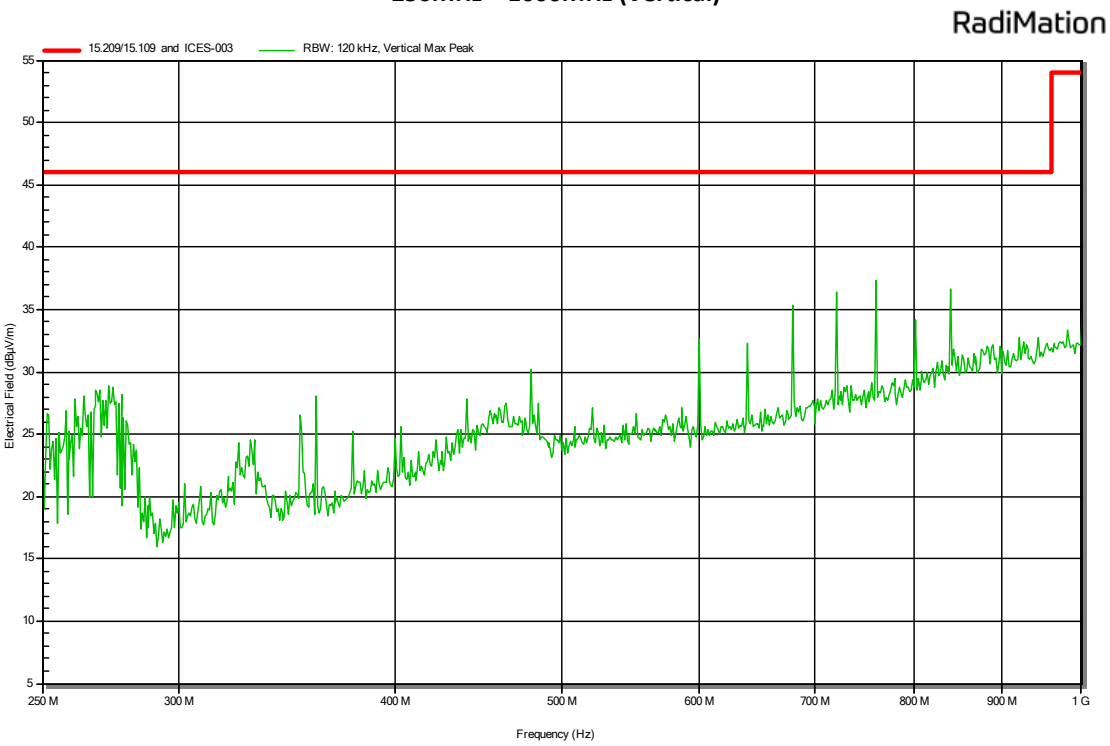
30MHz – 250MHz (Vertical)



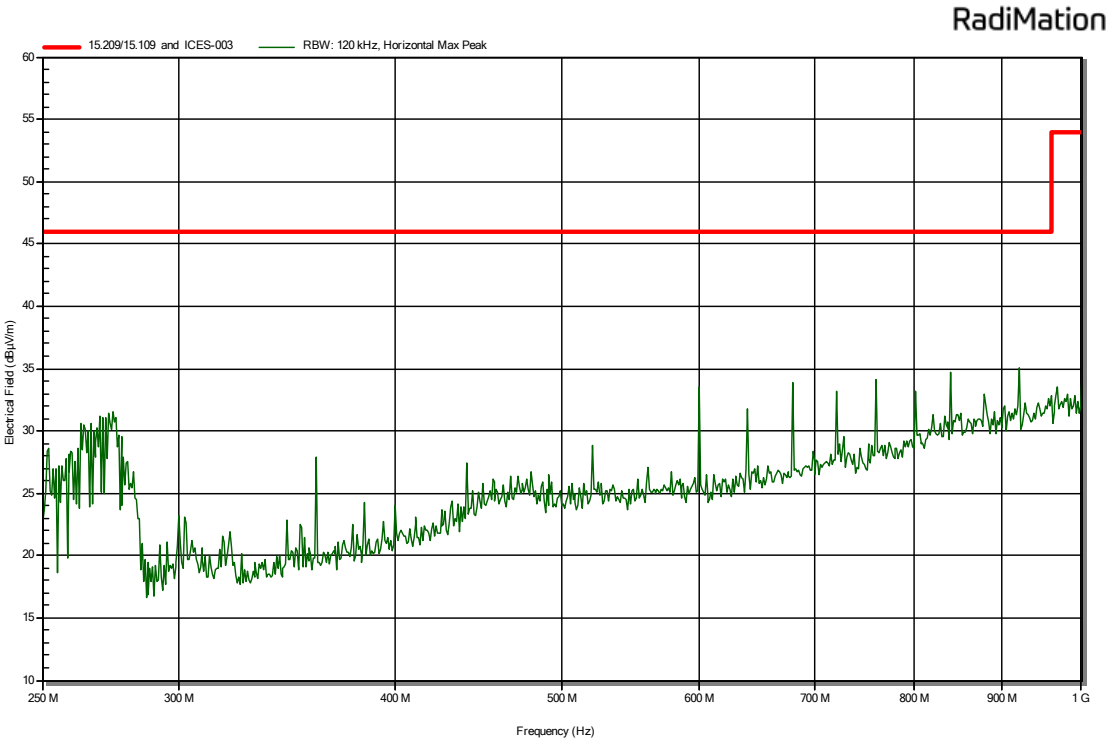
30MHz – 250MHz (Horizontal)



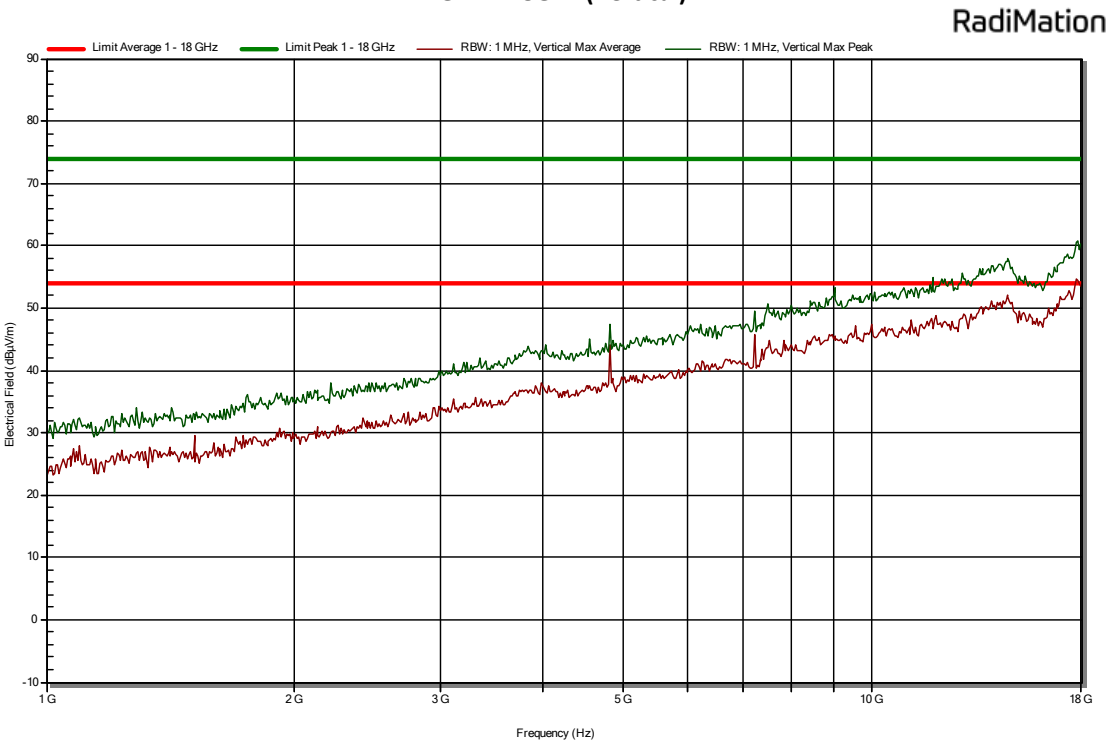
250MHz – 1000MHz (Vertical)



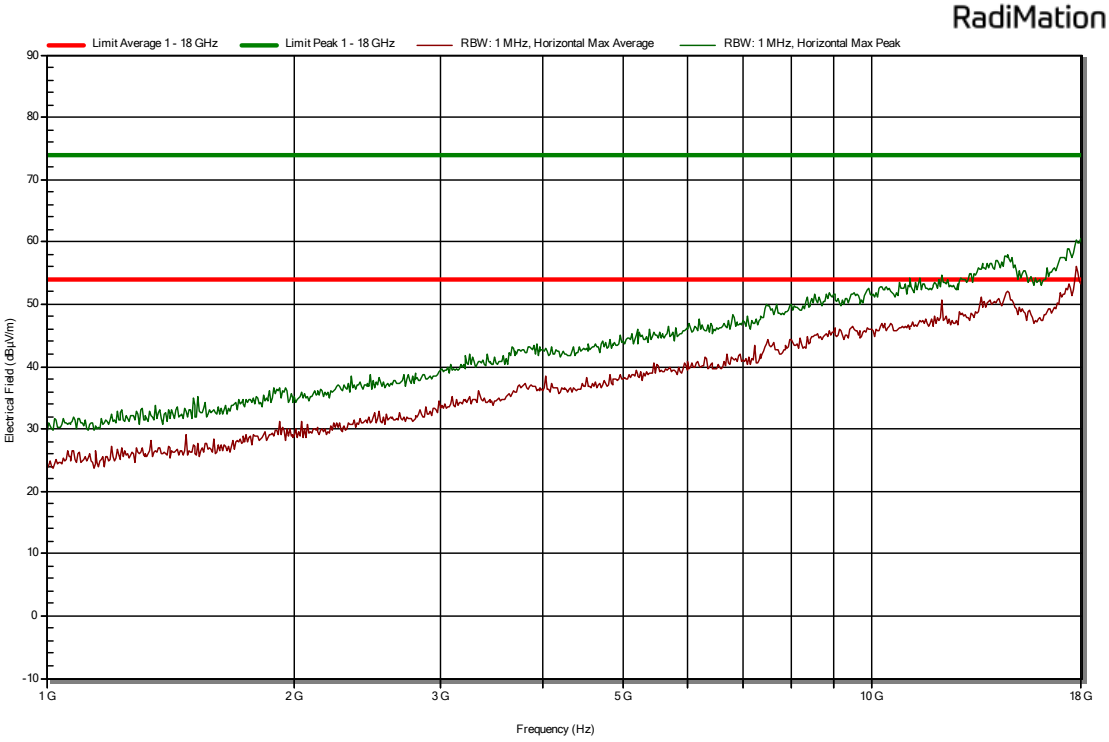
250MHz – 1000MHz (Horizontal)



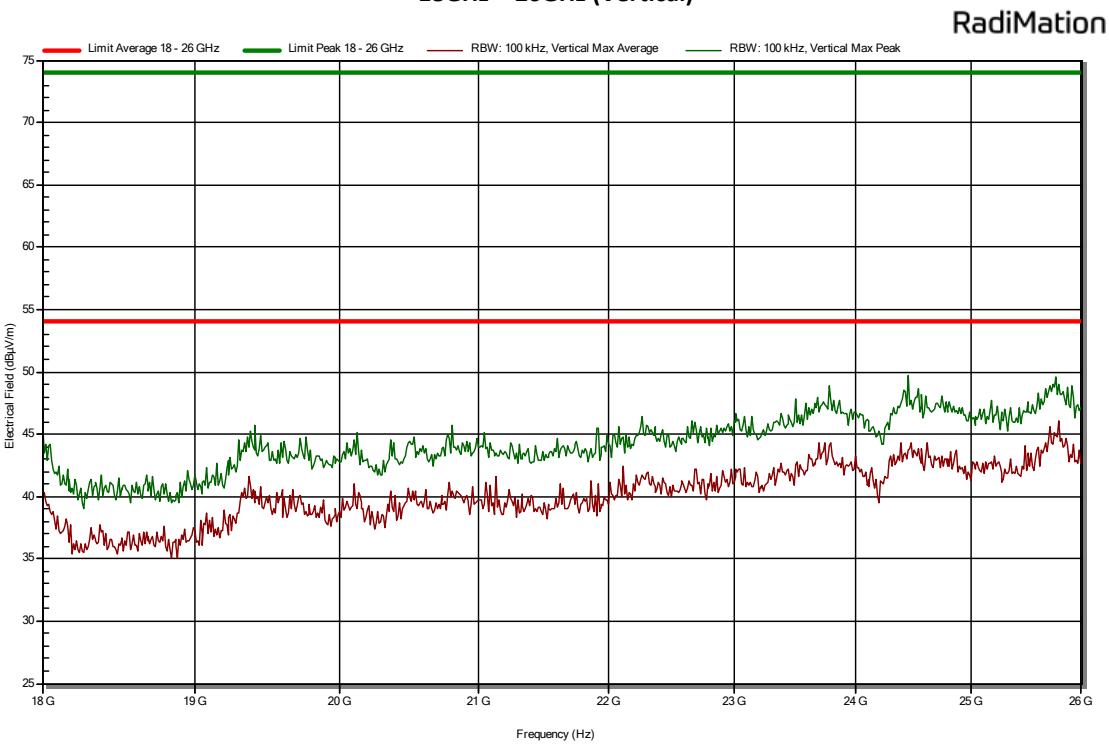
1GHz – 18GHz (Vertical)



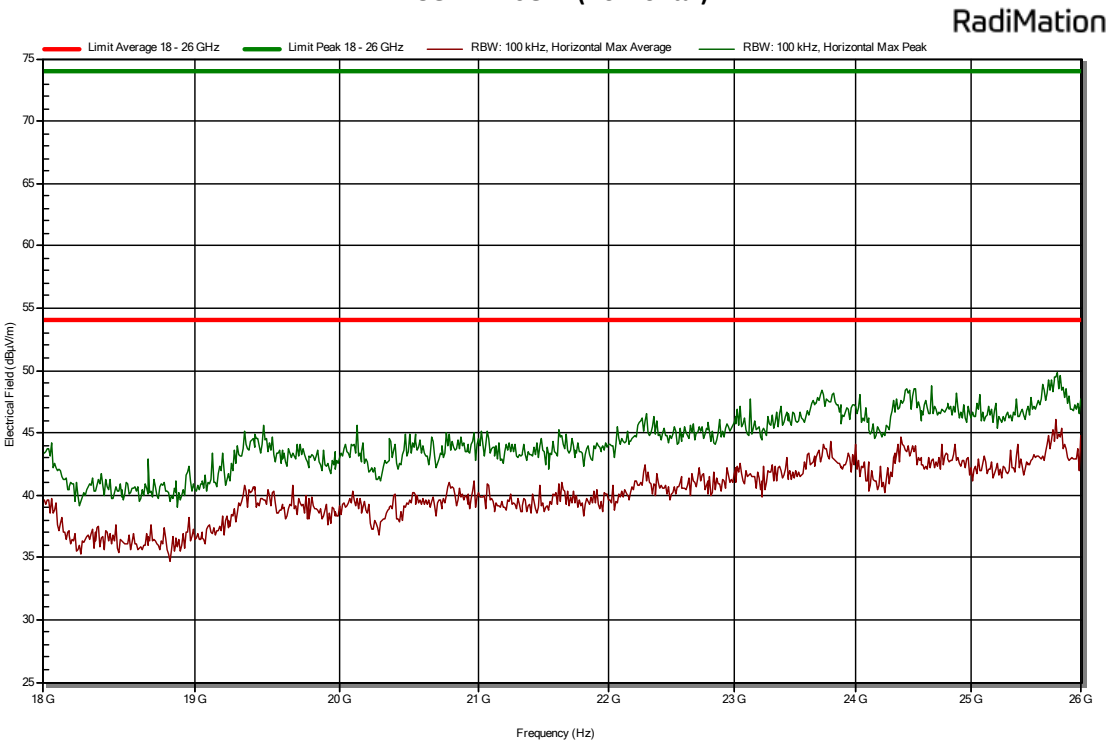
1GHz – 18GHz (Horizontal)



18GHz – 26GHz (Vertical)



18GHz – 26GHz (Horizontal)



BLE Mid Chan 2mbps

9 – 150 kHz (Perpendicular)*

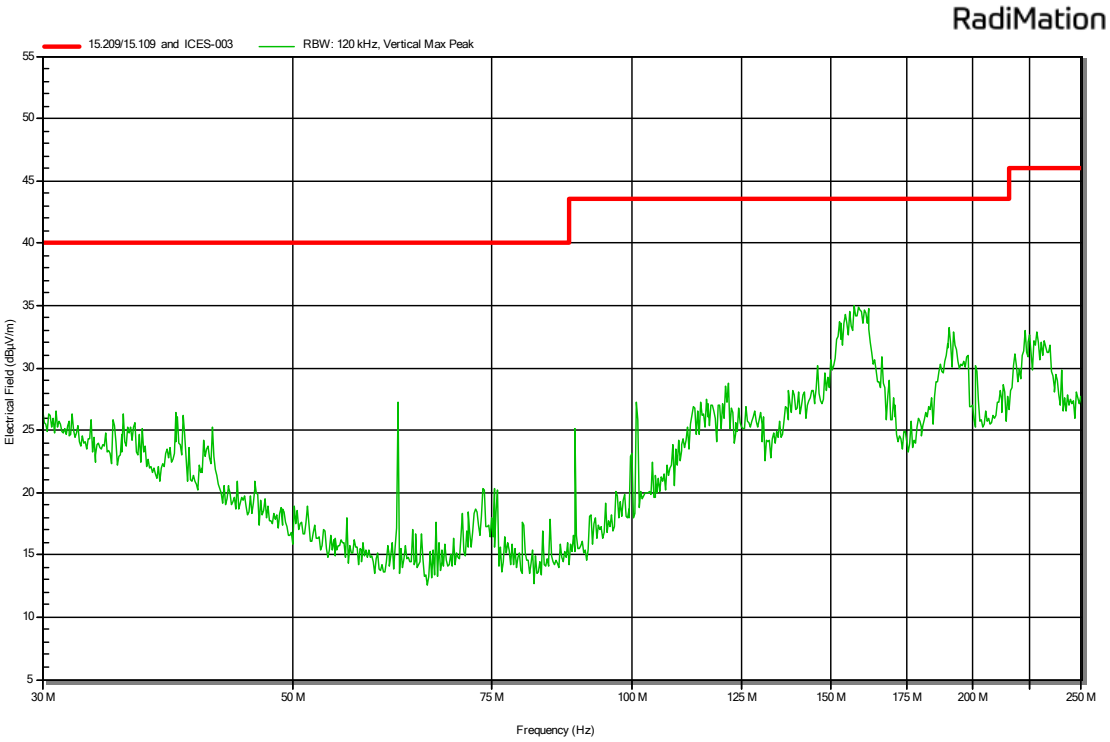
9 – 150 kHz (Paralell)*

150 kHz – 30 MHz (Perpendicular)*

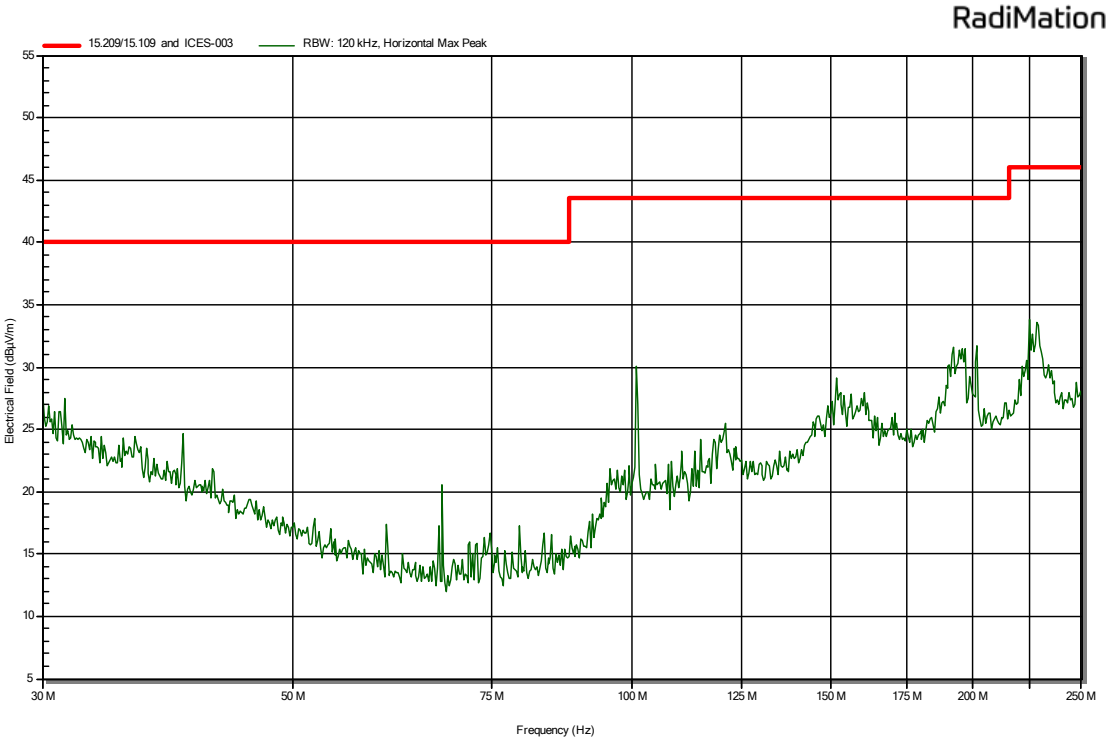
150 kHz – 30 MHz (Paralell)*

Note*: Due to no apparent changes between channels low, mid and high when measuring the frequencies ranges 9 – 150kHz and 150kHz-30MHz, measurements were not made.

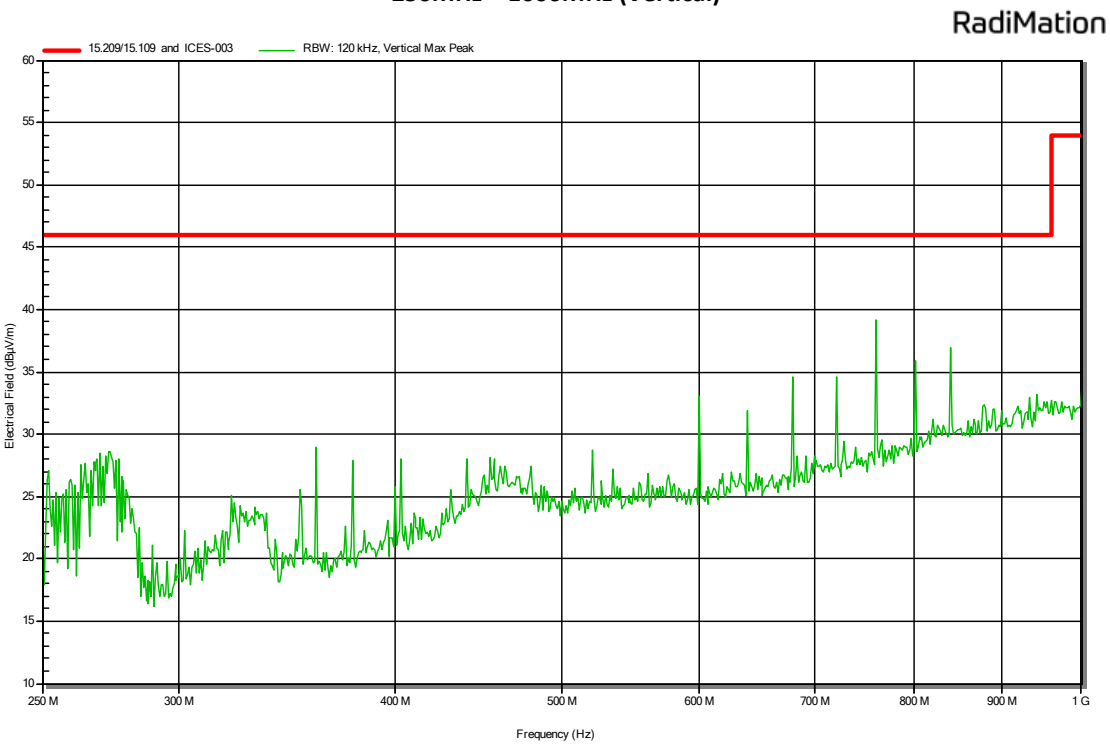
30MHz – 250MHz (Vertical)



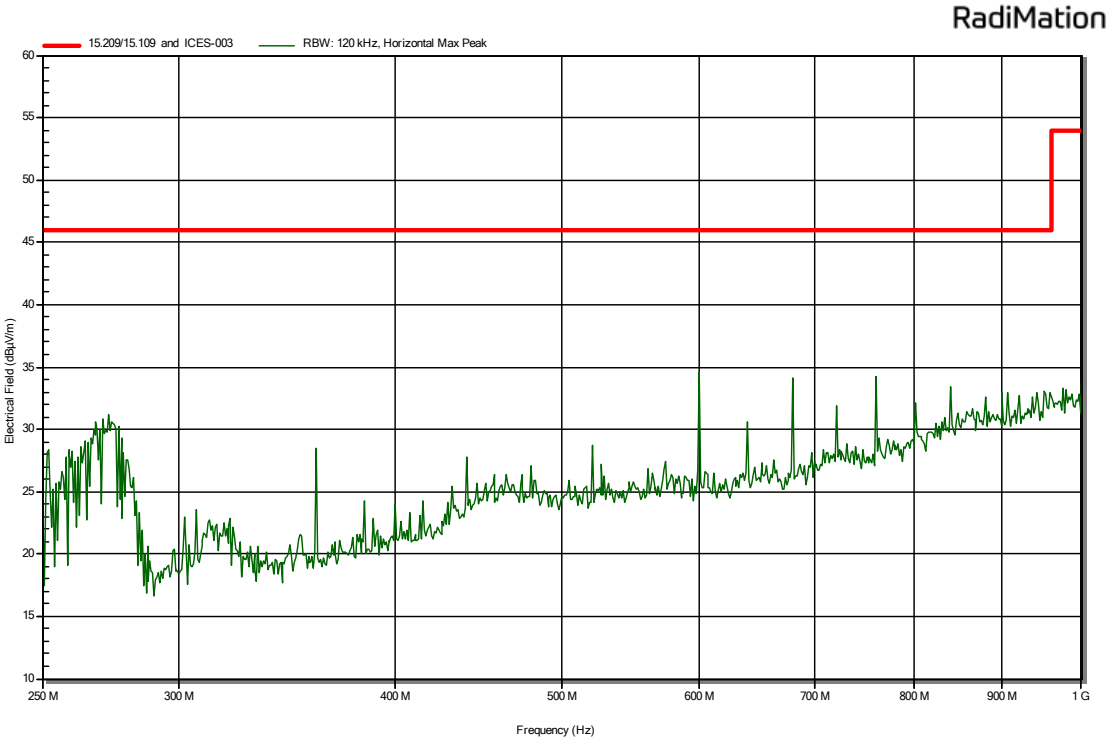
30MHz – 250MHz (Horizontal)



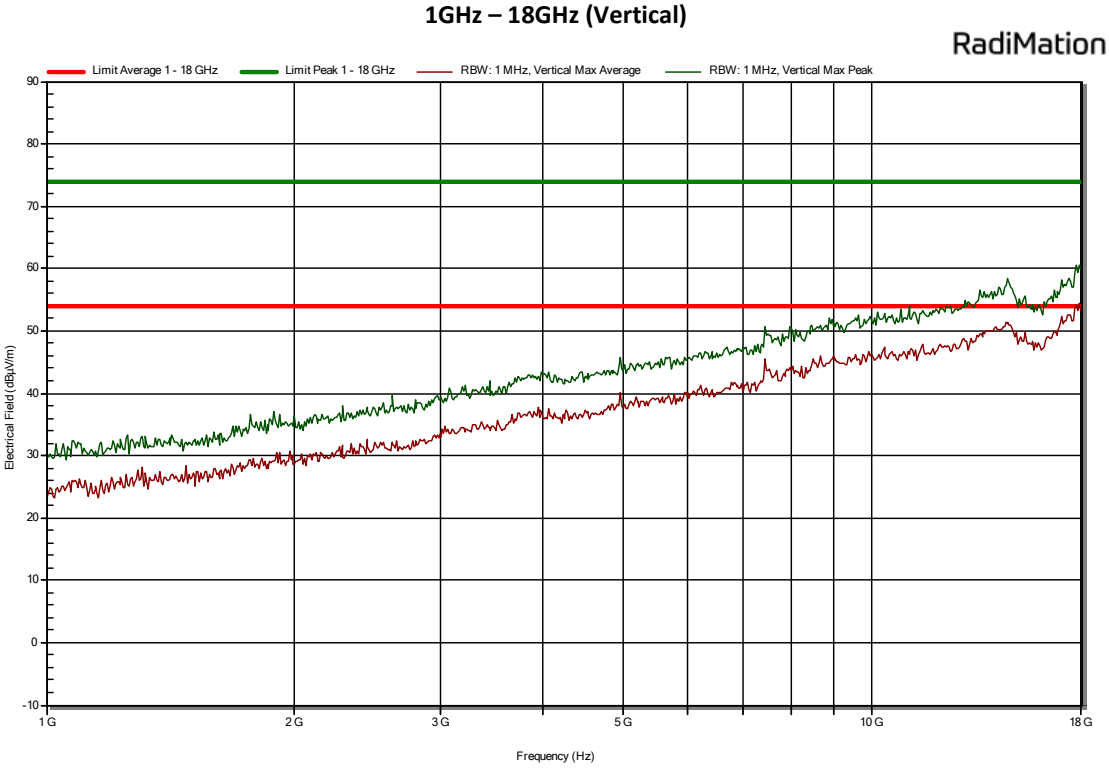
250MHz – 1000MHz (Vertical)



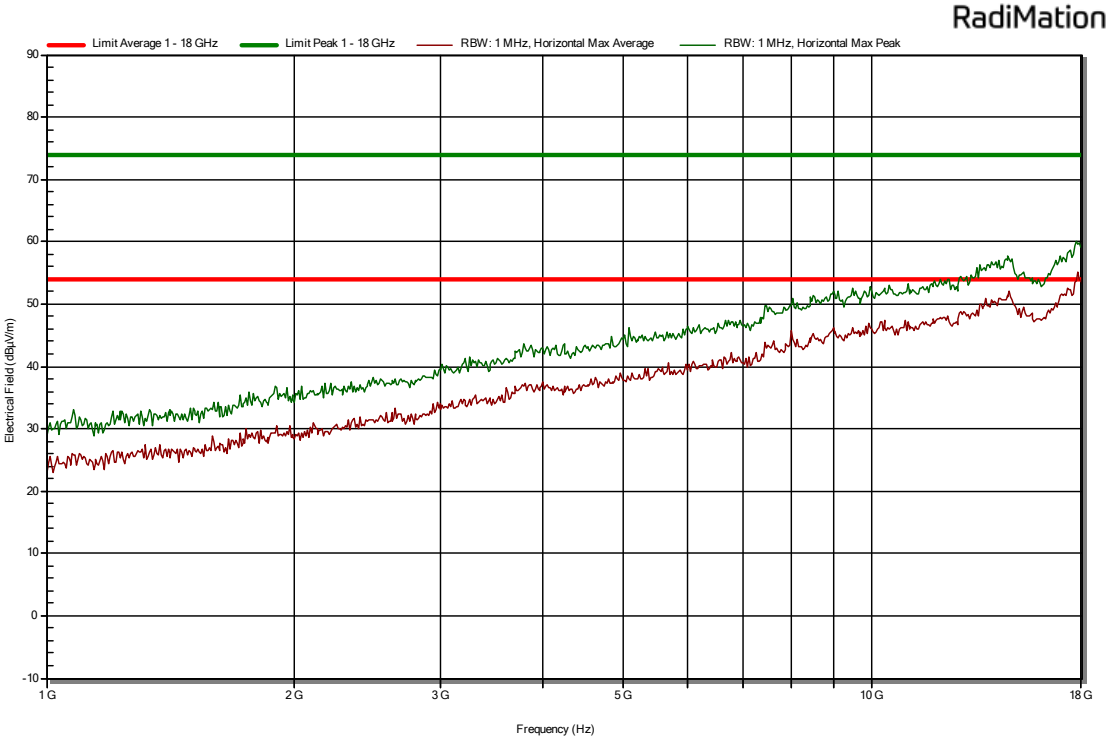
250MHz – 1000MHz (Horizontal)



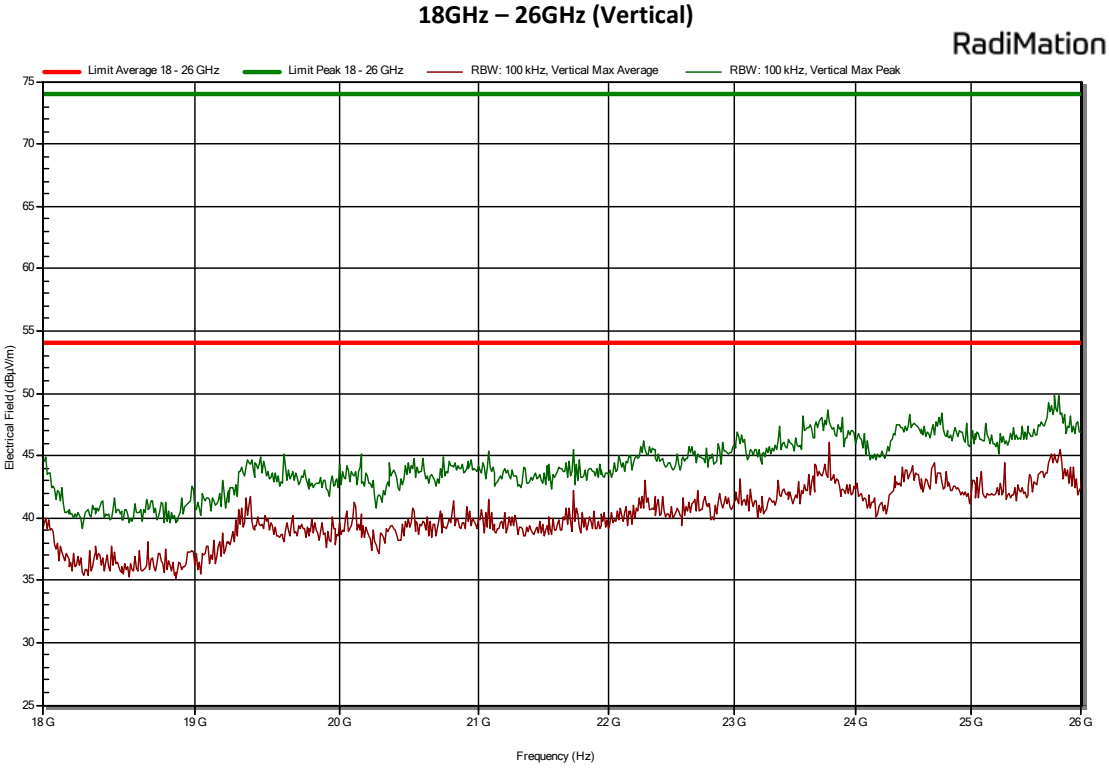
1GHz – 18GHz (Vertical)



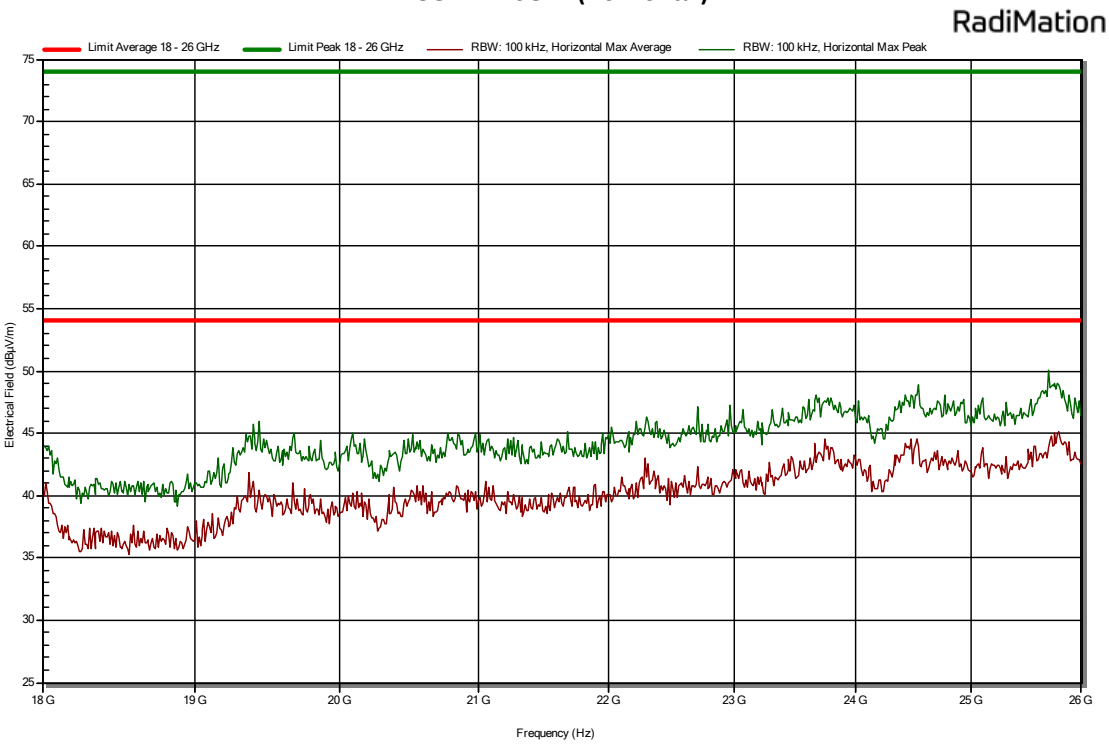
1GHz – 18GHz (Horizontal)



18GHz – 26GHz (Vertical)



18GHz – 26GHz (Horizontal)



BLE High Chan 2mbps

9 – 150 kHz (Perpendicular)*

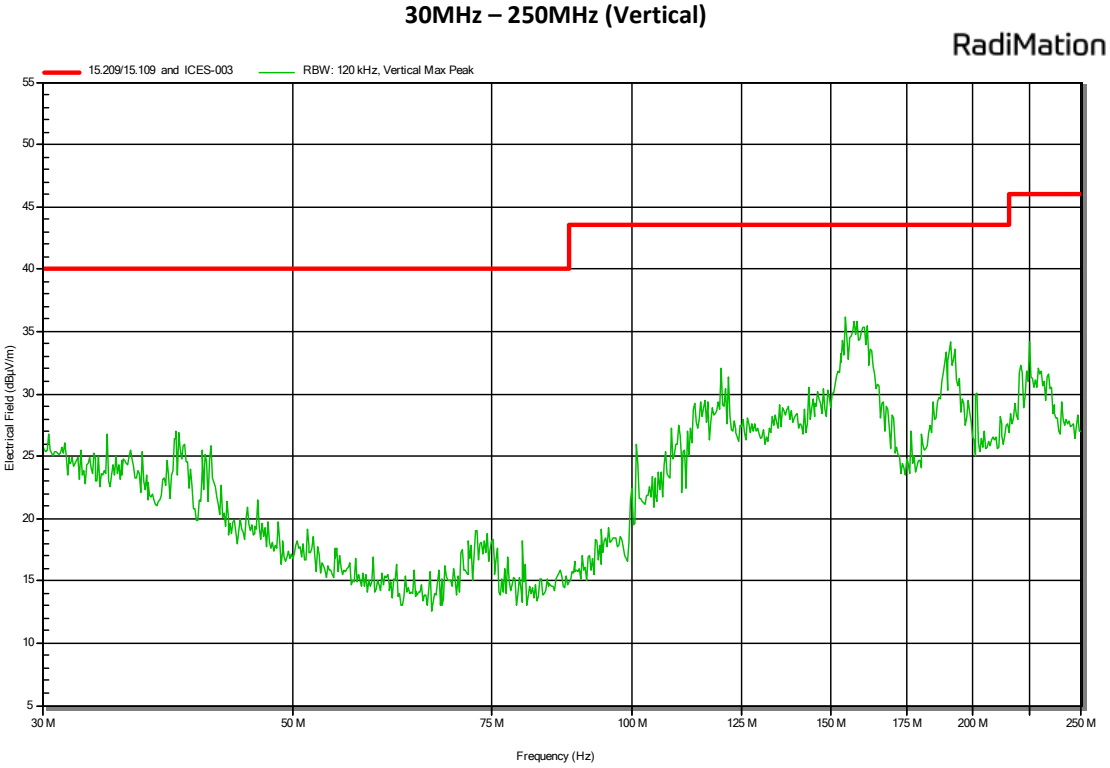
9 – 150 kHz (Paralell)*

150 kHz – 30 MHz (Perpendicular)*

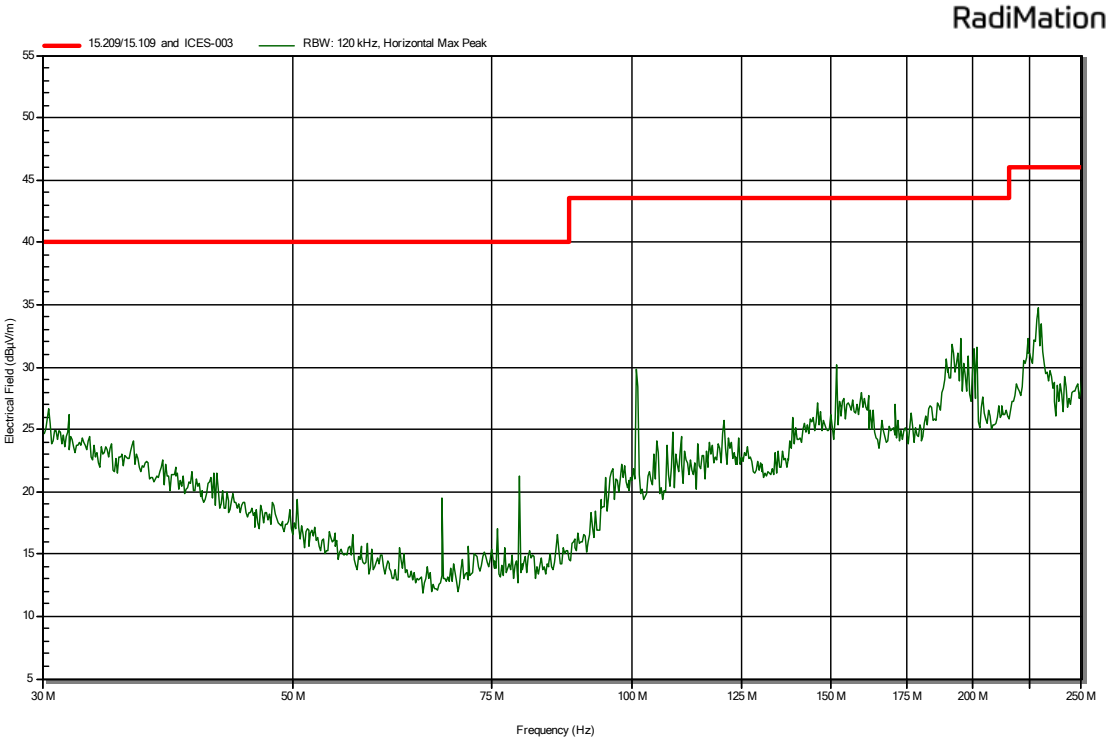
150 kHz – 30 MHz (Paralell)*

Note*: Due to no apparent changes between channels low, mid and high when measuring the frequencies ranges 9 – 150kHz and 150kHz-30MHz, measurements were not made.

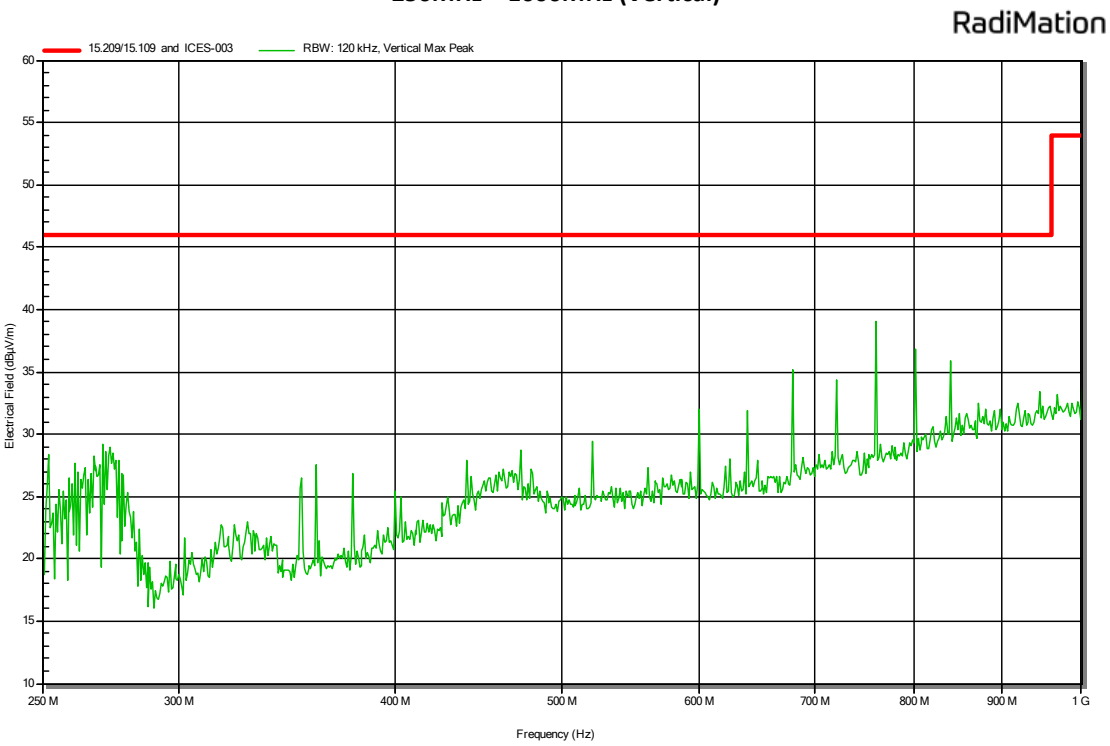
30MHz – 250MHz (Vertical)



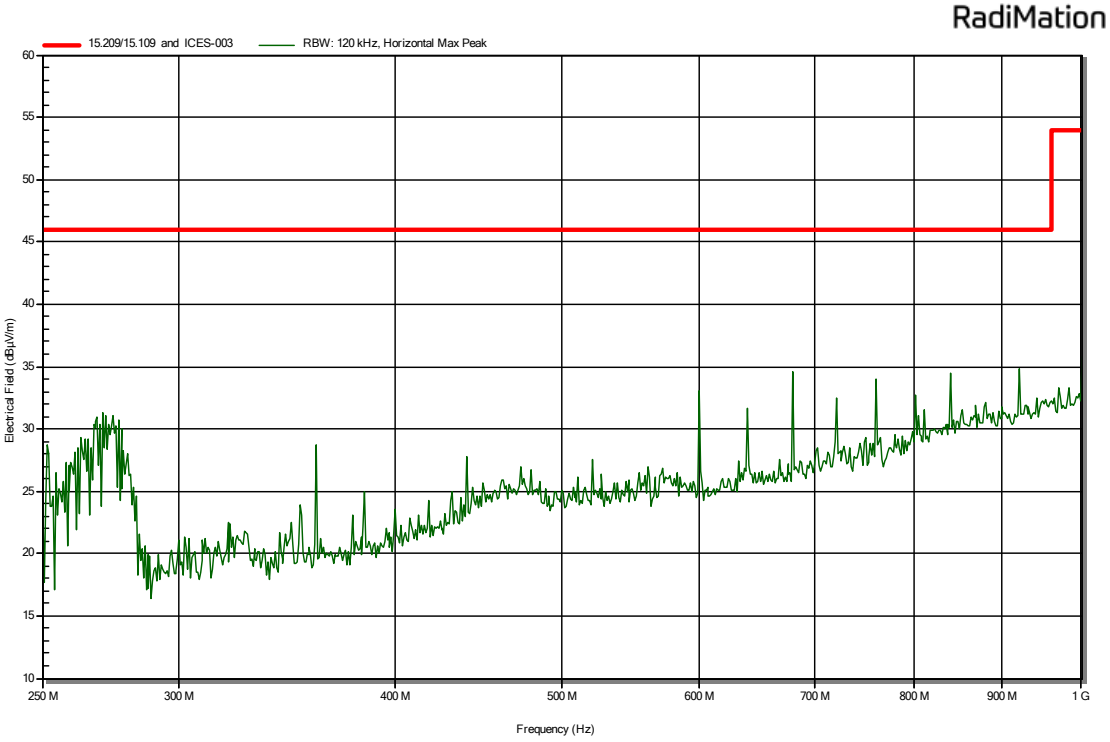
30MHz – 250MHz (Horizontal)



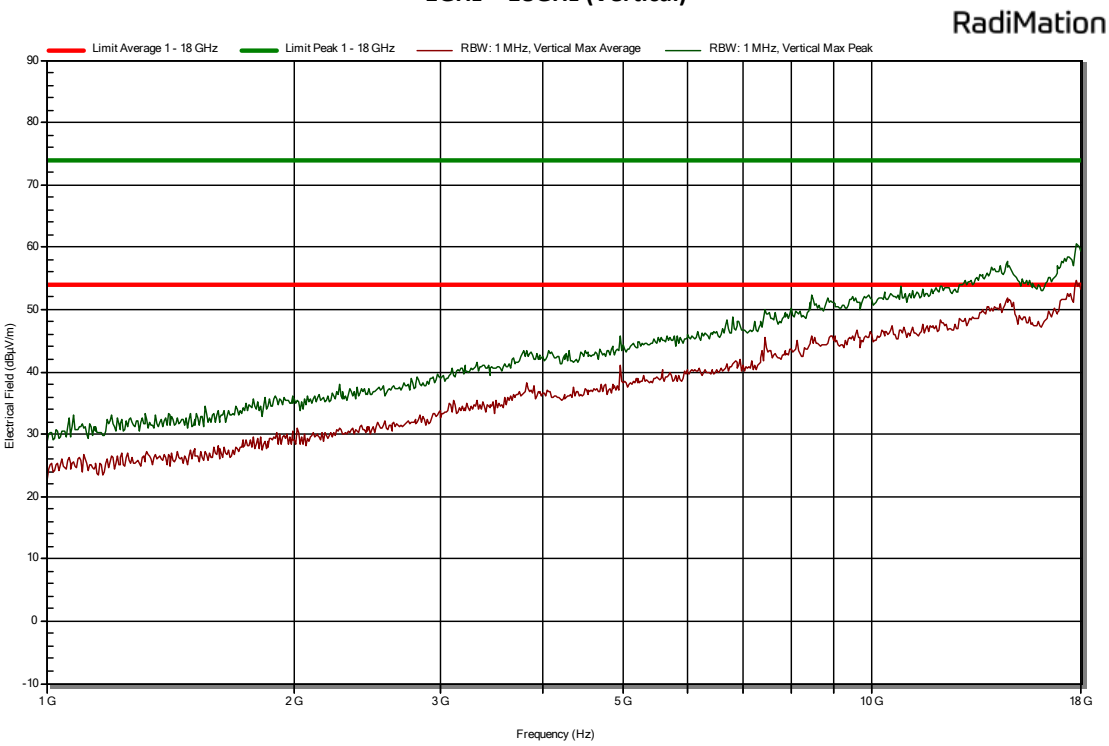
250MHz – 1000MHz (Vertical)



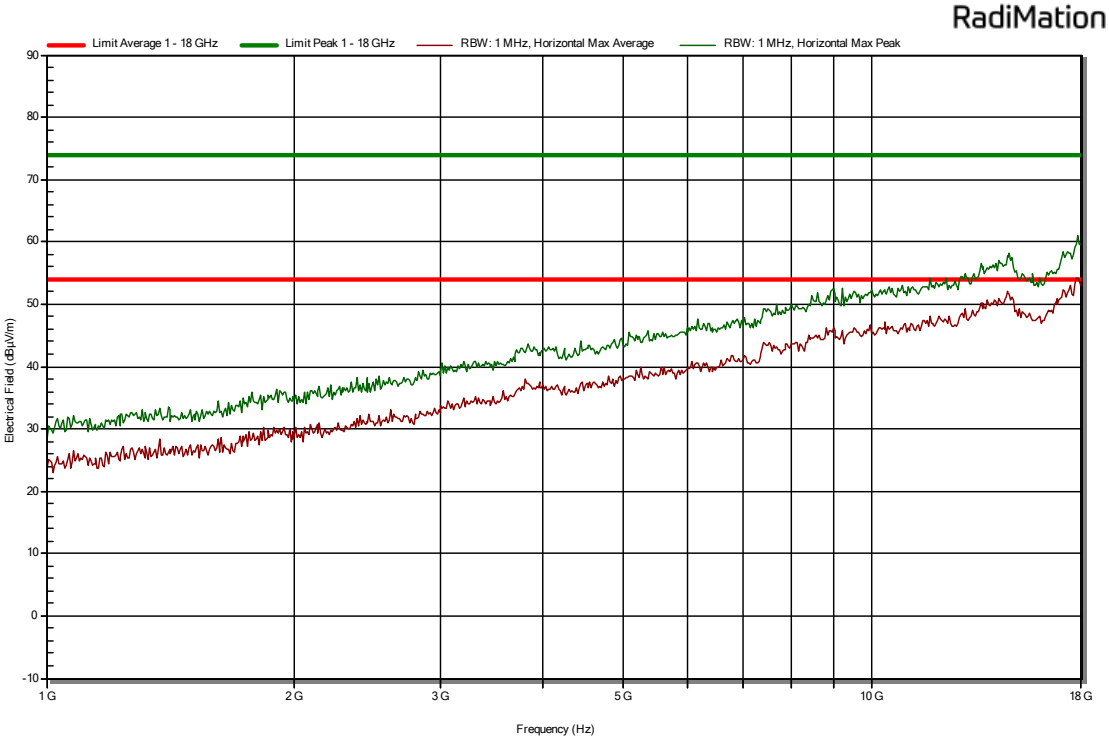
250MHz – 1000MHz (Horizontal)



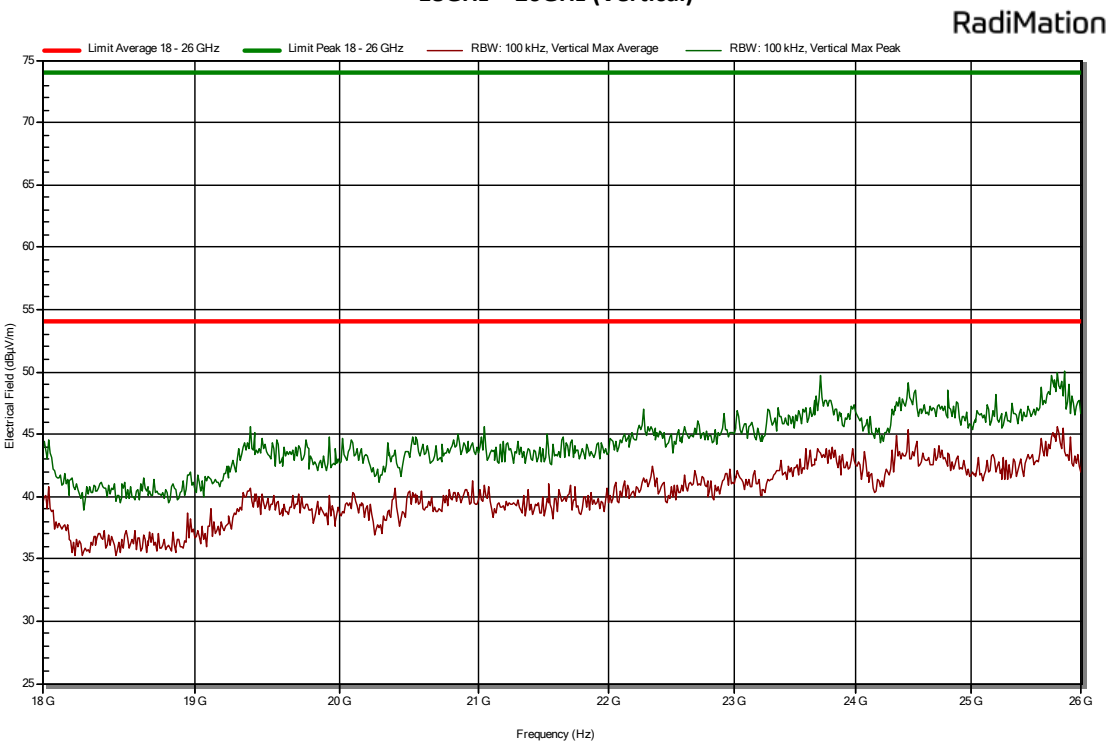
1GHz – 18GHz (Vertical)



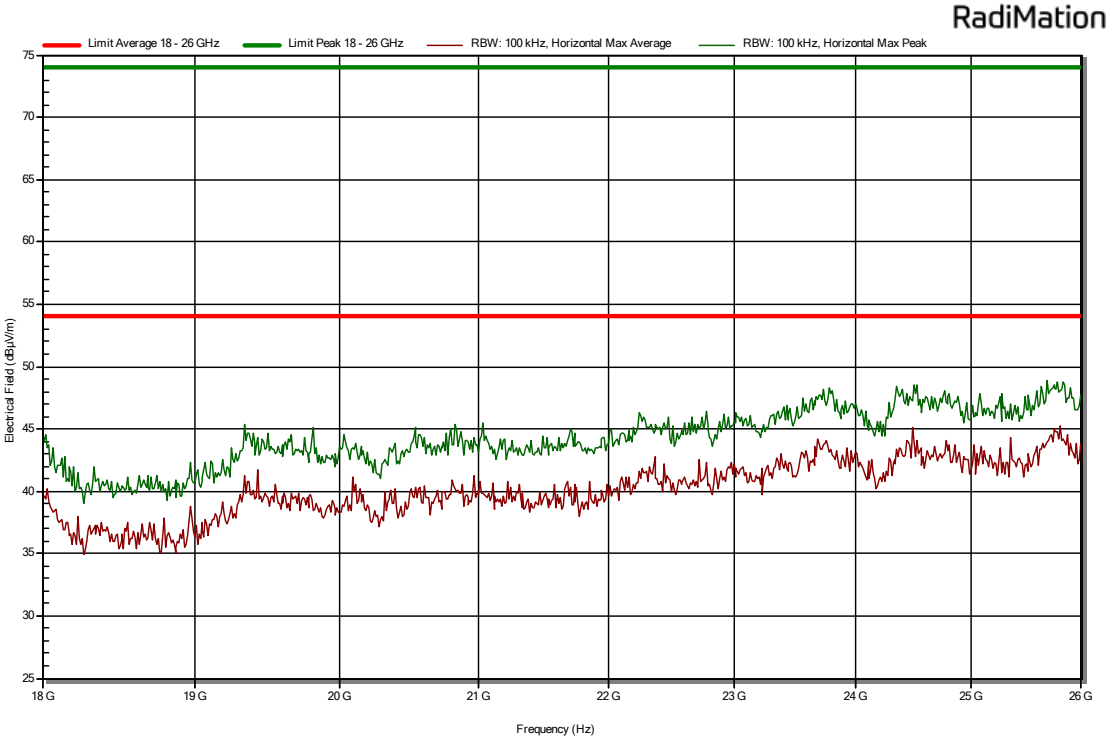
1GHz – 18GHz (Horizontal)



18GHz – 26GHz (Vertical)

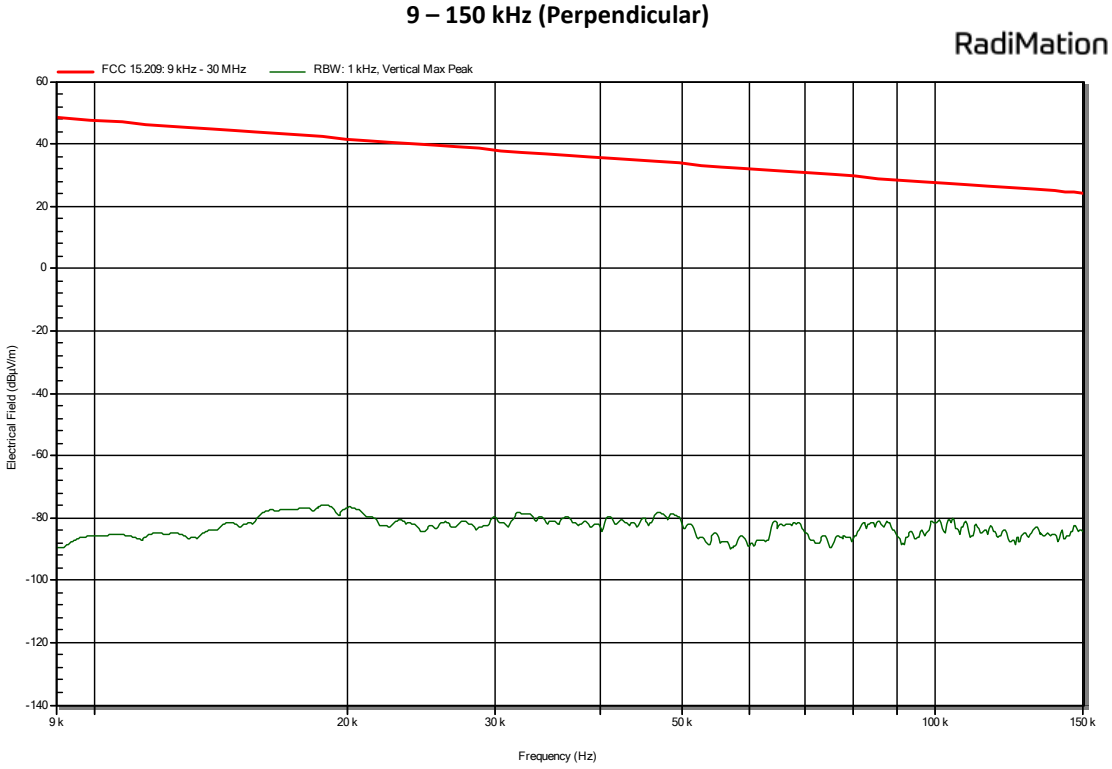


18GHz – 26GHz (Horizontal)

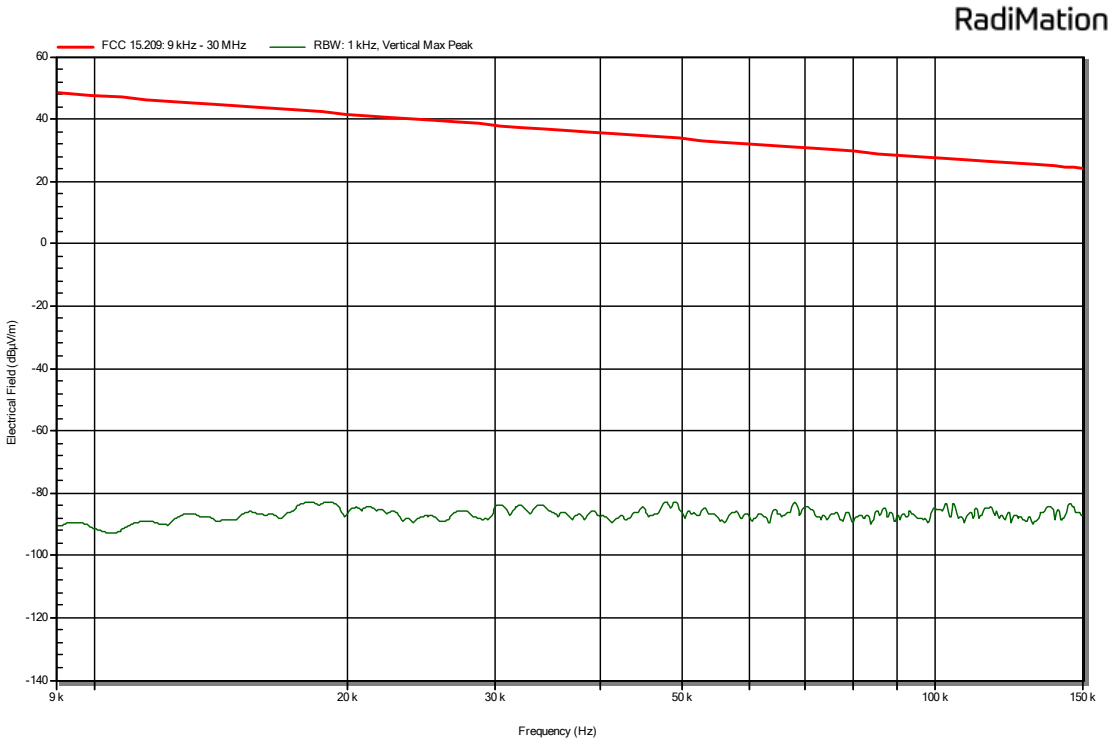


ANT +

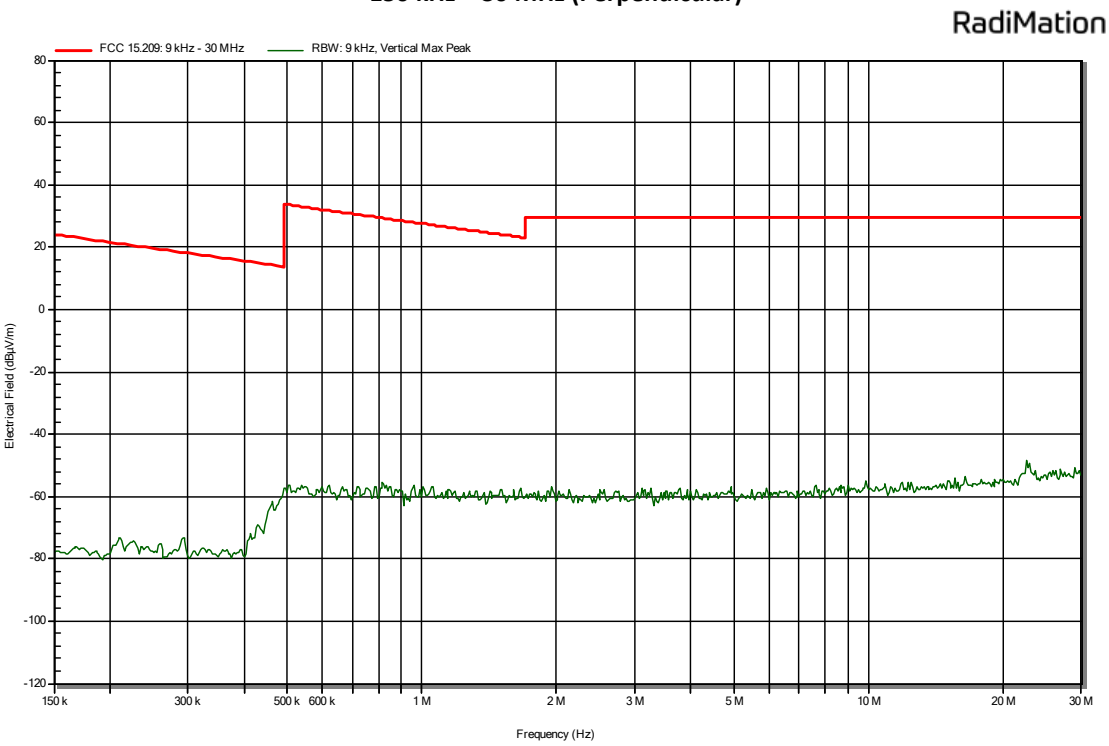
9 – 150 kHz (Perpendicular)



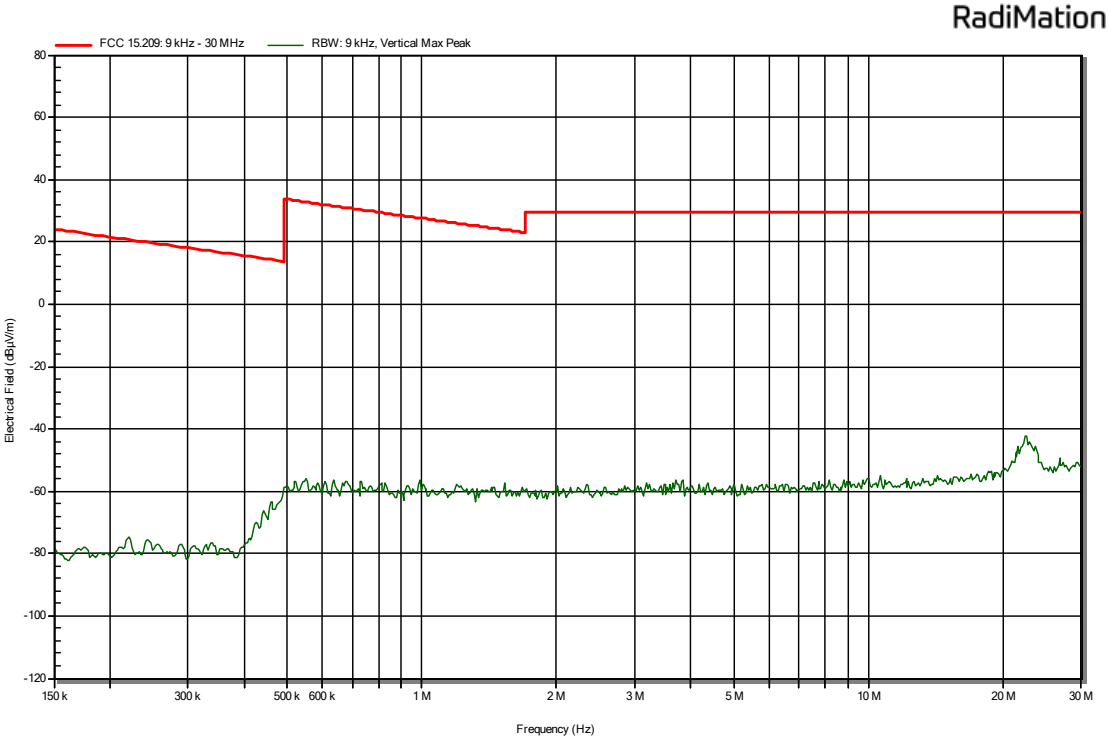
9 – 150 kHz (Paralell)



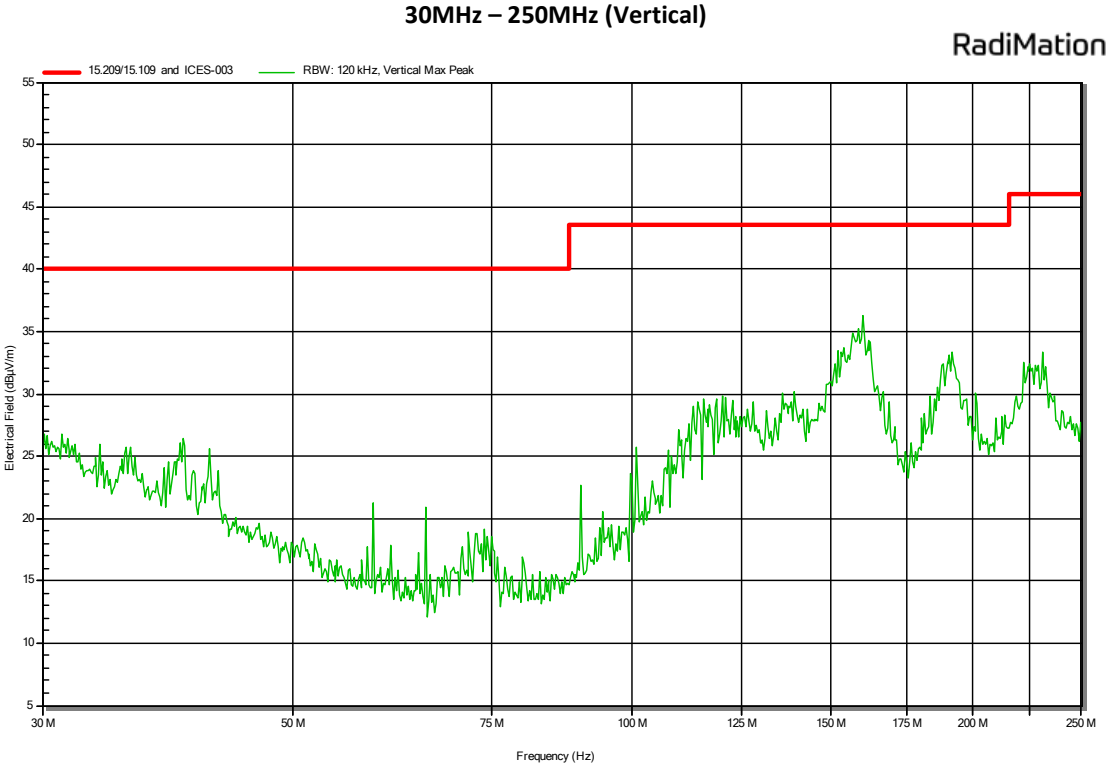
150 kHz – 30 MHz (Perpendicular)



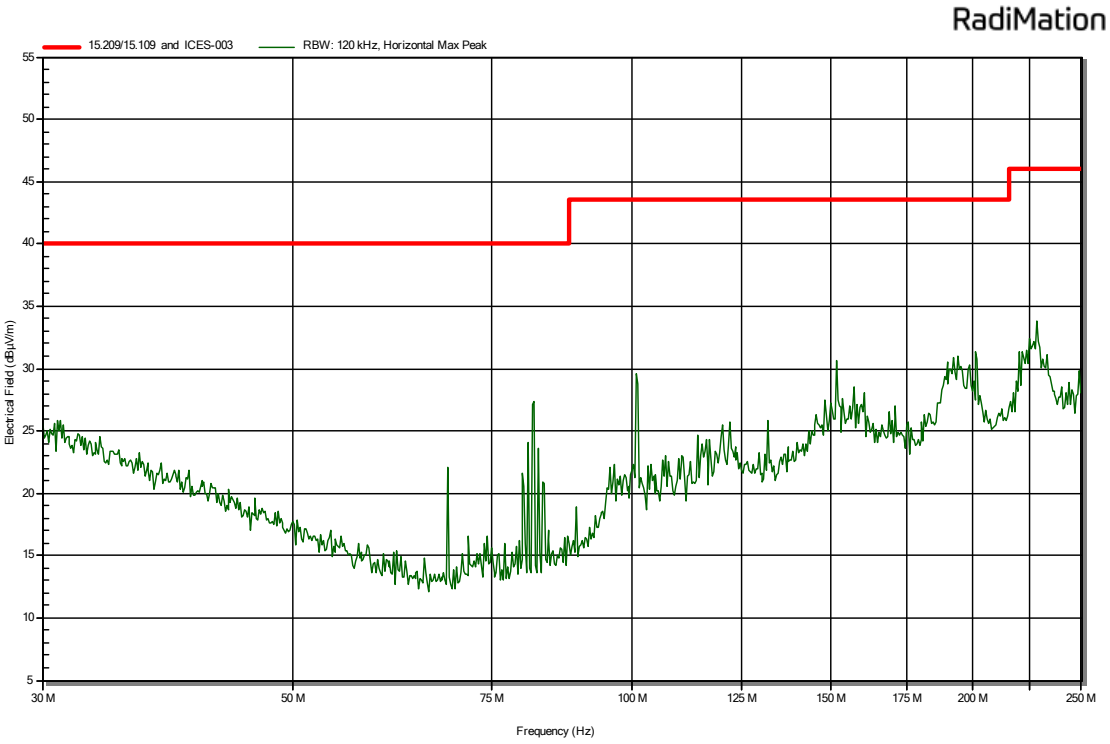
150 kHz – 30 MHz (Paralell)



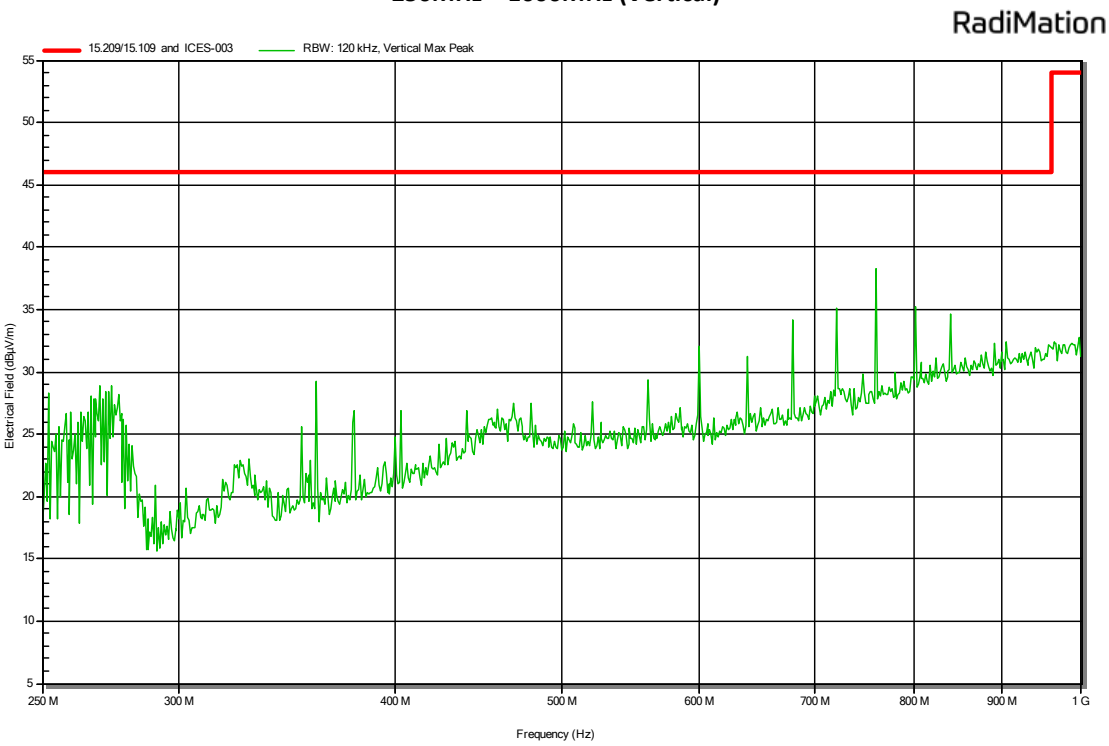
30MHz – 250MHz (Vertical)



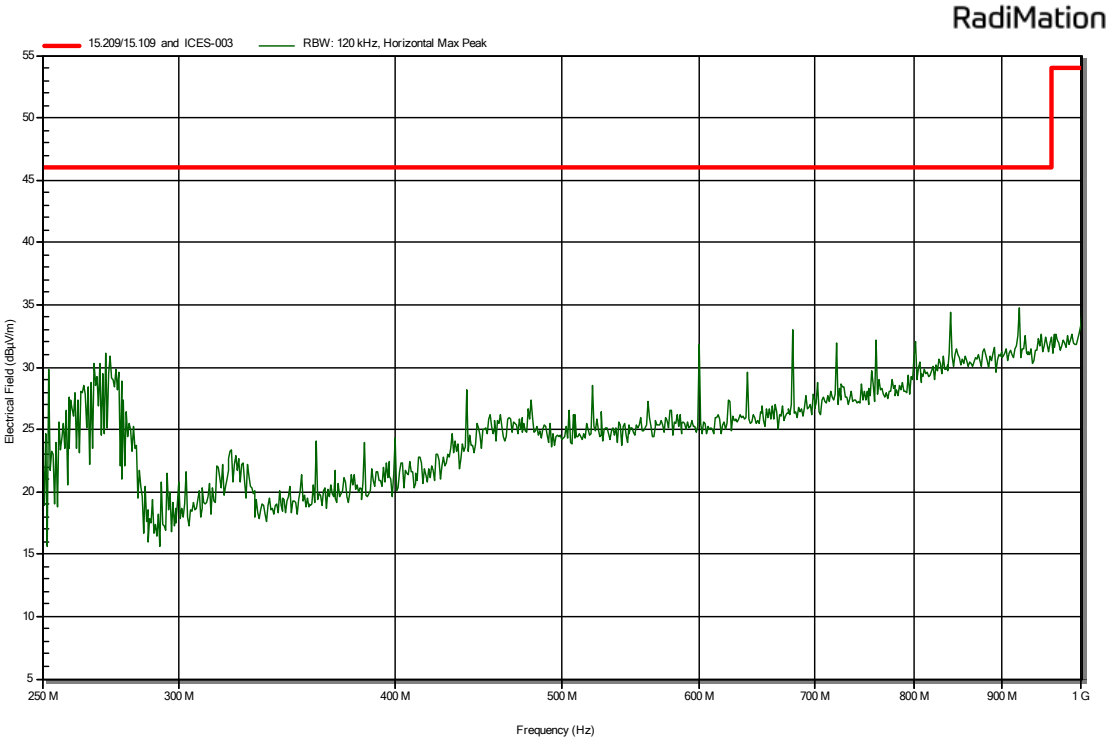
30MHz – 250MHz (Horizontal)



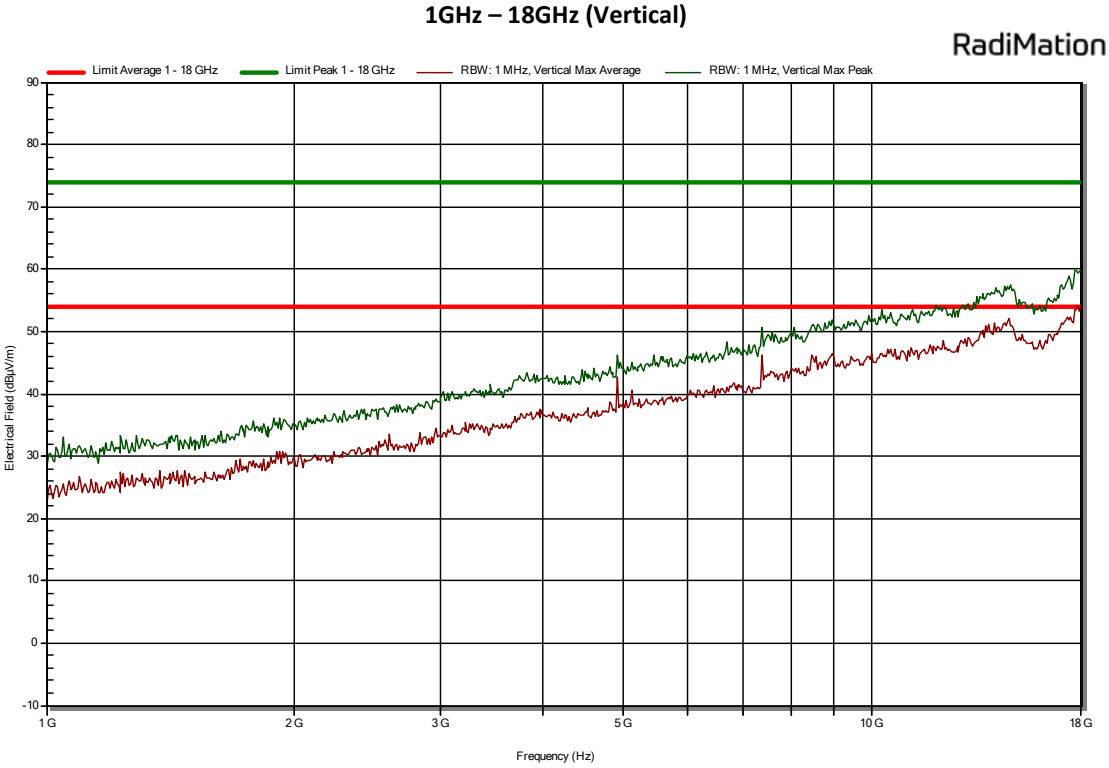
250MHz – 1000MHz (Vertical)



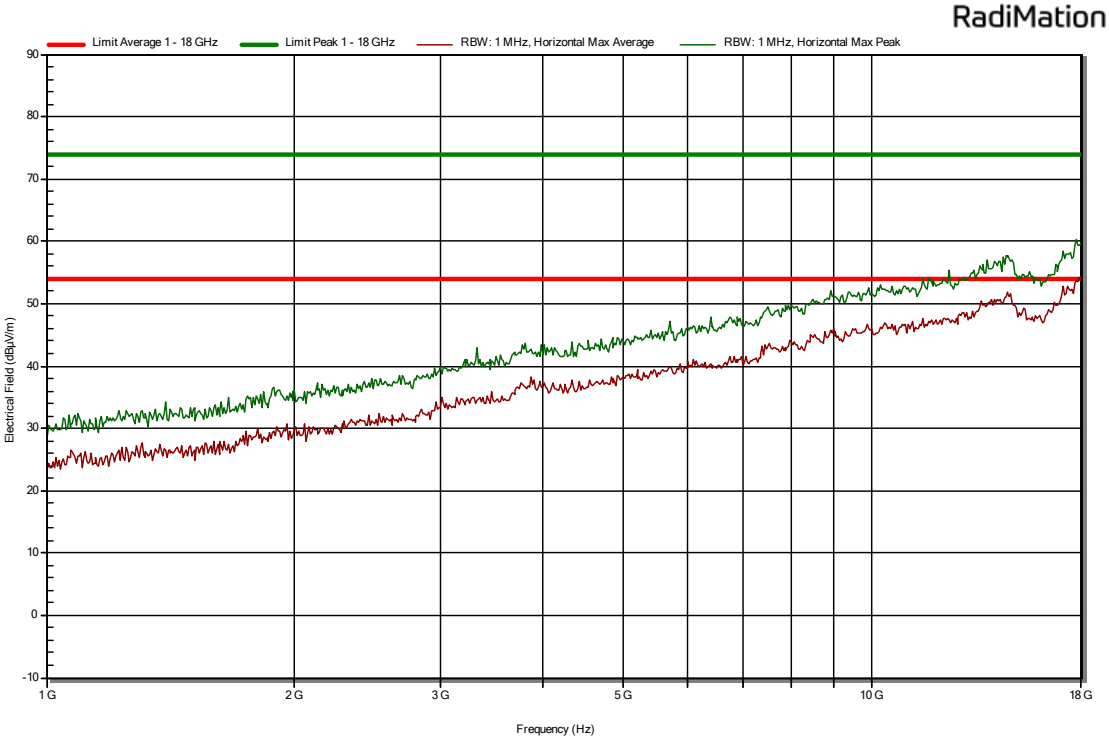
250MHz – 1000MHz (Horizontal)



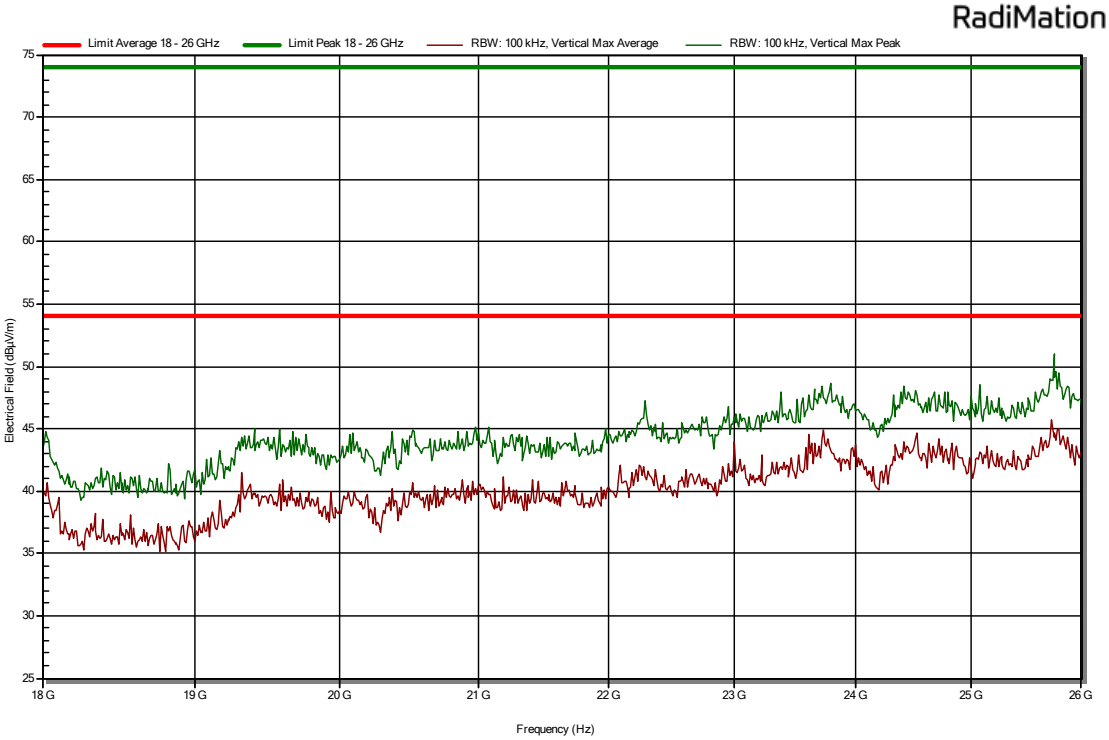
1GHz – 18GHz (Vertical)



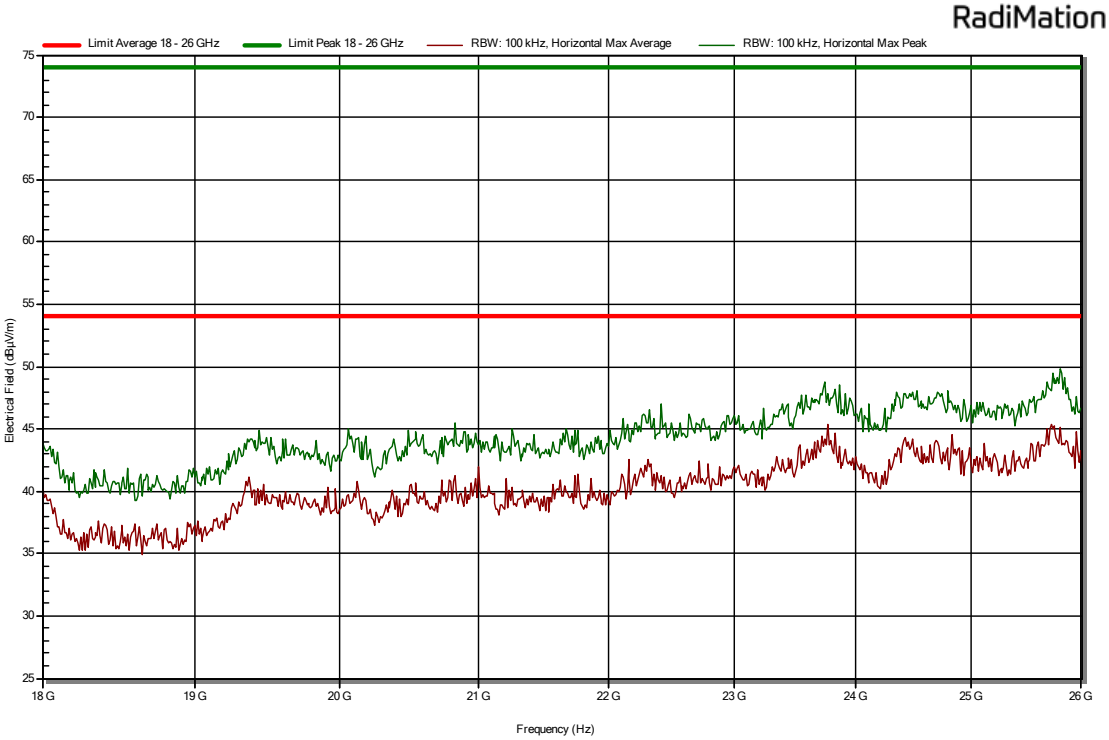
1GHz – 18GHz (Horizontal)



18GHz – 26GHz (Vertical)



18GHz – 26GHz (Horizontal)

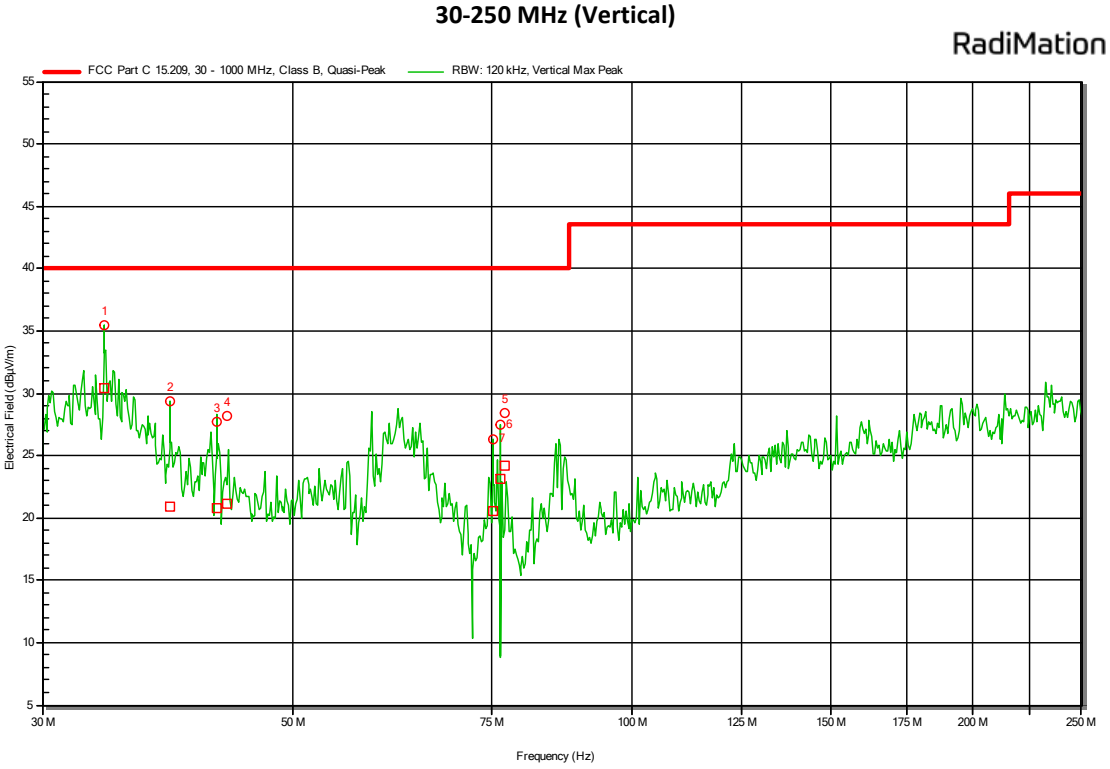


Co-location plots WIFI and BLE set to 2440 MHz

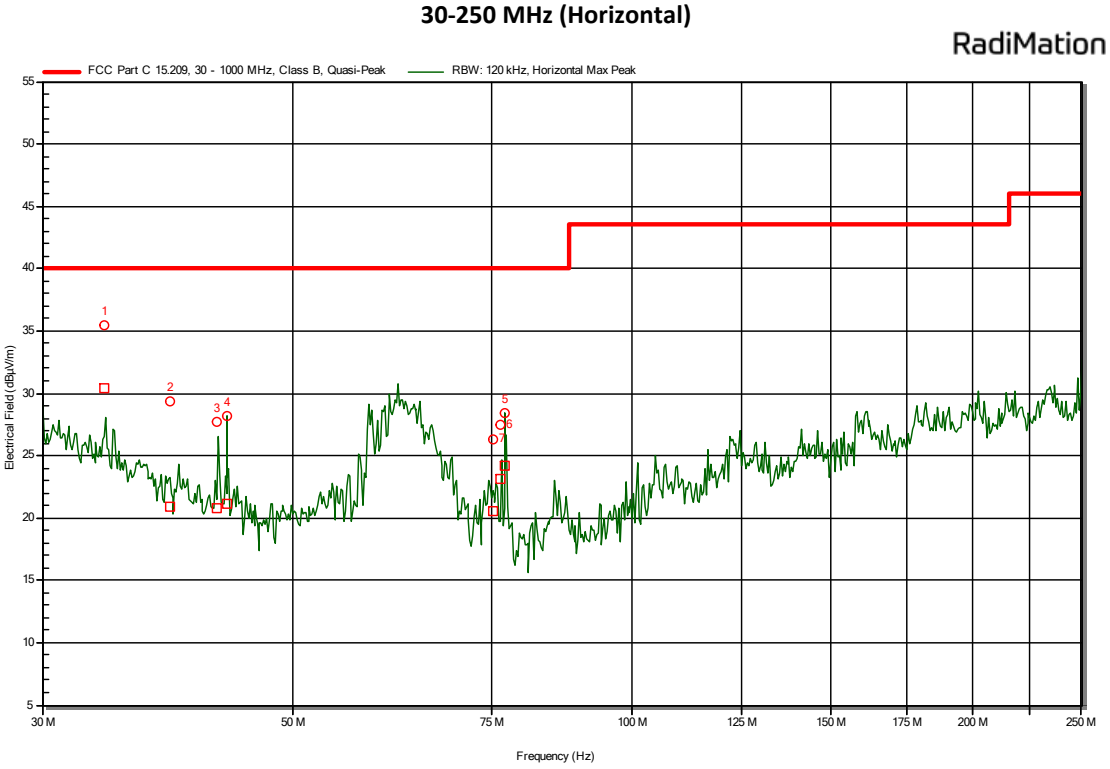
Result table

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit		Angle	Polarization	Status
34.09 MHz	35.5 dBµV/m	30.4 dBµV/m	40 dBµV/m		269 degrees	Vertical	Pass
38.957 MHz	29.3 dBµV/m	20.8 dBµV/m	40 dBµV/m		159 degrees	Vertical	Pass
Frequency	**Peak**	**Quasi-Peak**	**Quasi-Peak Limit**		**Angle**	**Polarization**	**Status**
875.06 MHz	49.2 dBµV/m	44.3 dBµV/m	46 dBµV/m		356 degrees	Horizontal	Pass
625.049 MHz	44.5 dBµV/m	39.9 dBµV/m	46 dBµV/m		355 degrees	Horizontal	Pass
Frequency	**Peak**	**Peak Limit**	**Average**	**Average Limit**	**Angle**	**Polarization**	**Peak Status**
4.872 GHz	48.8 dBµV/m	74 dBµV/m	49.3 dBµV/m	54 dBµV/m	173 degrees	Vertical	Pass
4.872 GHz	49.5 dBµV/m	74 dBµV/m	49 dBµV/m	54 dBµV/m	173 degrees	Vertical	Pass
4.872 GHz	49 dBµV/m	74 dBµV/m	49.1 dBµV/m	54 dBµV/m	173 degrees	Vertical	Pass
Frequency	**Peak**	**Peak Limit**	**Average**	**Average Limit**	**Angle**	**Polarization**	**Status**
23.282 GHz	43.5 dBµV/m	74 dBµV/m	29 dBµV/m	54 dBµV/m	287 degrees	Vertical	Pass
18.179 GHz	35.4 dBµV/m	74 dBµV/m	23.1 dBµV/m	54 dBµV/m	140 degrees	Vertical	Pass
19.308 GHz	39.5 dBµV/m	74 dBµV/m	28.1 dBµV/m	54 dBµV/m	90 degrees	Horizontal	Pass
23.782 GHz	42.7 dBµV/m	74 dBµV/m	30.7 dBµV/m	54 dBµV/m	148 degrees	Horizontal	Pass

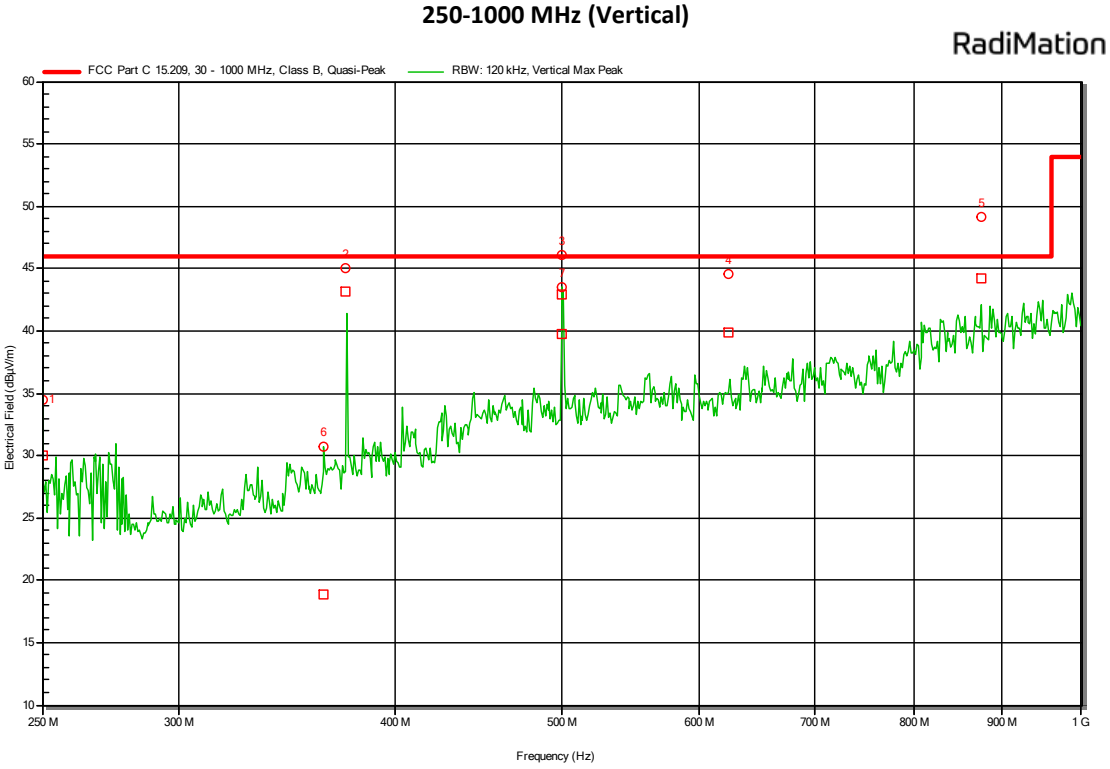
30-250 MHz (Vertical)



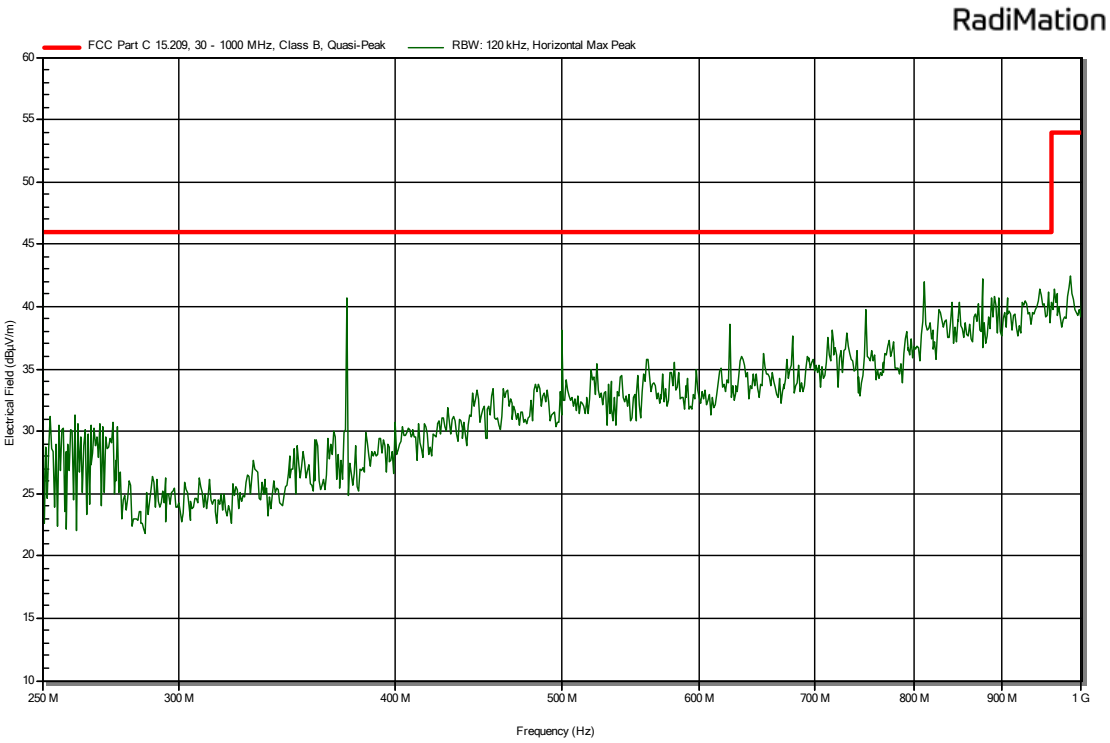
30-250 MHz (Horizontal)



250-1000 MHz (Vertical)

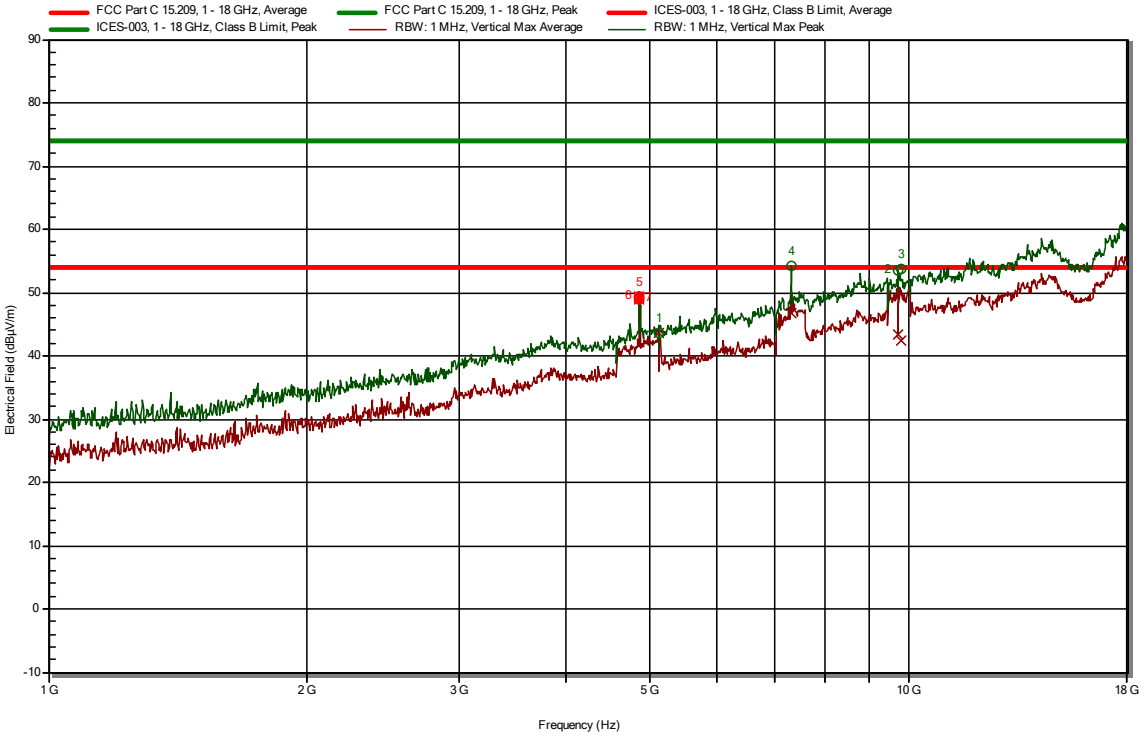


250-1000 MHz (Horizontal)



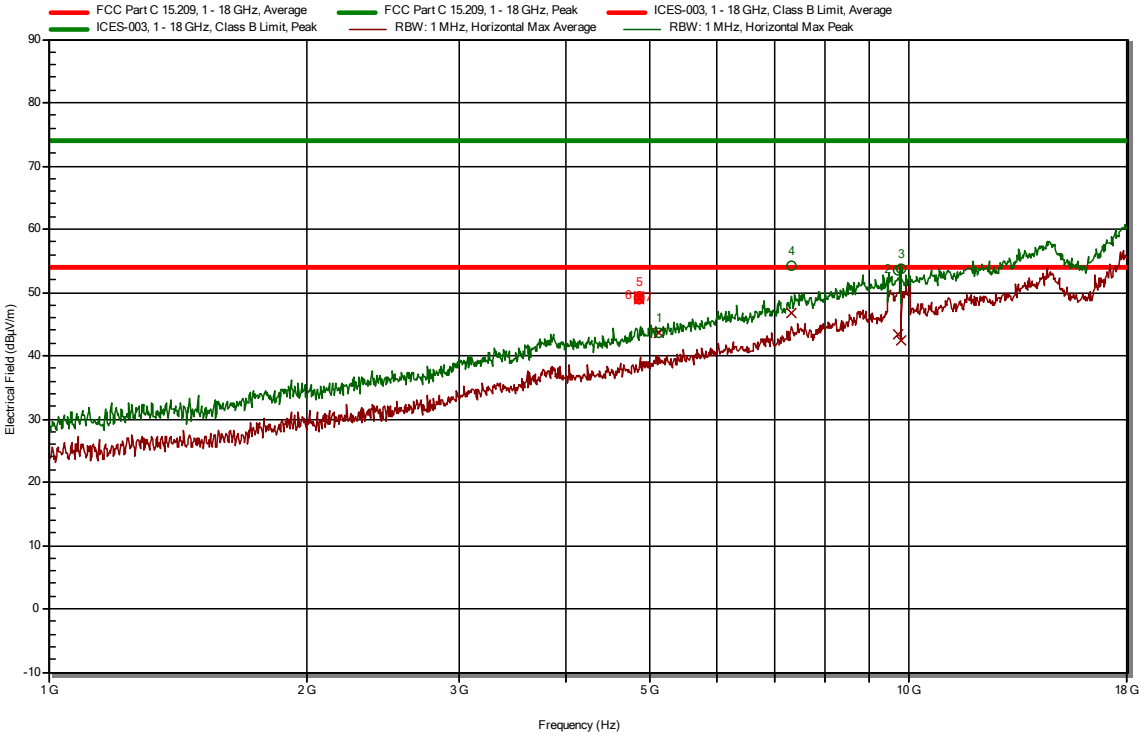
1-18 GHz (Vertical)

RadiMation

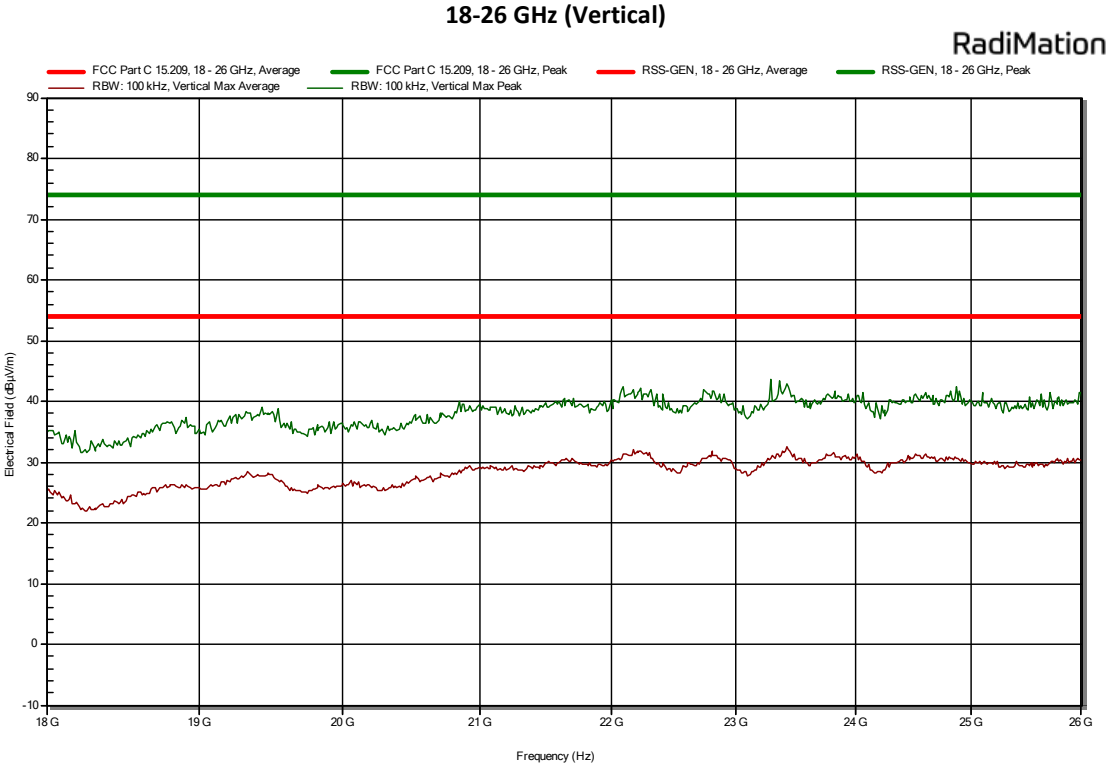


1-18GHz (Horizontal)

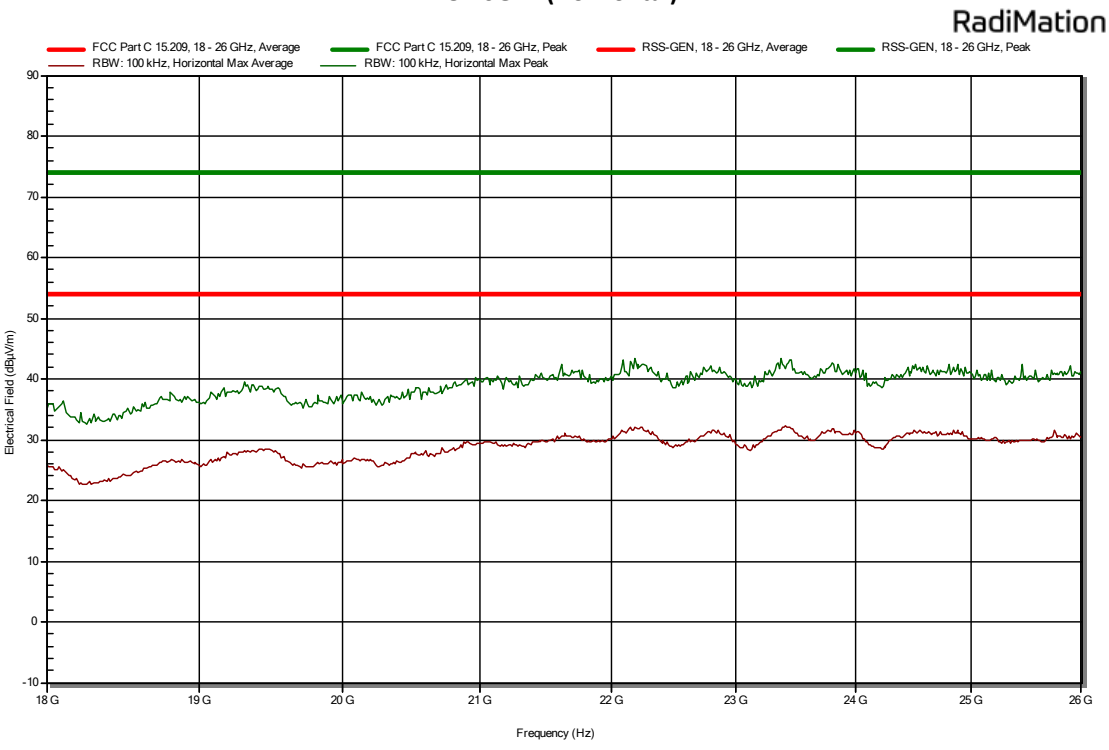
RadiMation



18-26 GHz (Vertical)



18-26GHz (Horizontal)



3.2 6dB bandwidth Measurement

3.2.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

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 C63.10, section 6.9
ANSI C63.10-2013 section 11.8.1
IRN 404 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

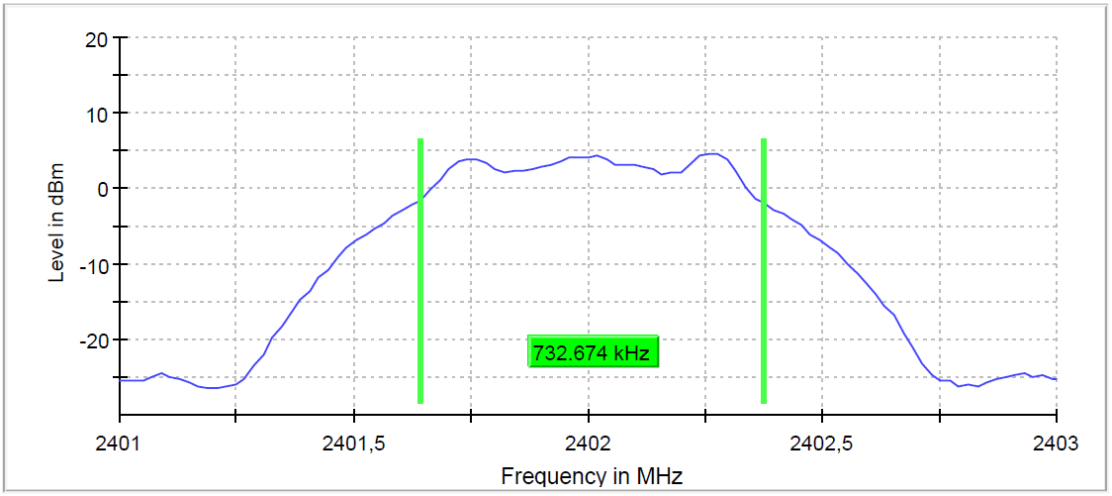
3.2.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low energy	37	2402	1 Mbps	732.7
	15	2436	1 Mbps	732.7
	39	2480	1 Mbps	732.7
	37	2402	2 Mbps	1228
	15	2436	2 Mbps	1228
	39	2480	2 Mbps	1267
ANT+	57	2457	--	514.8
Uncertainty	± 36.2 kHz			

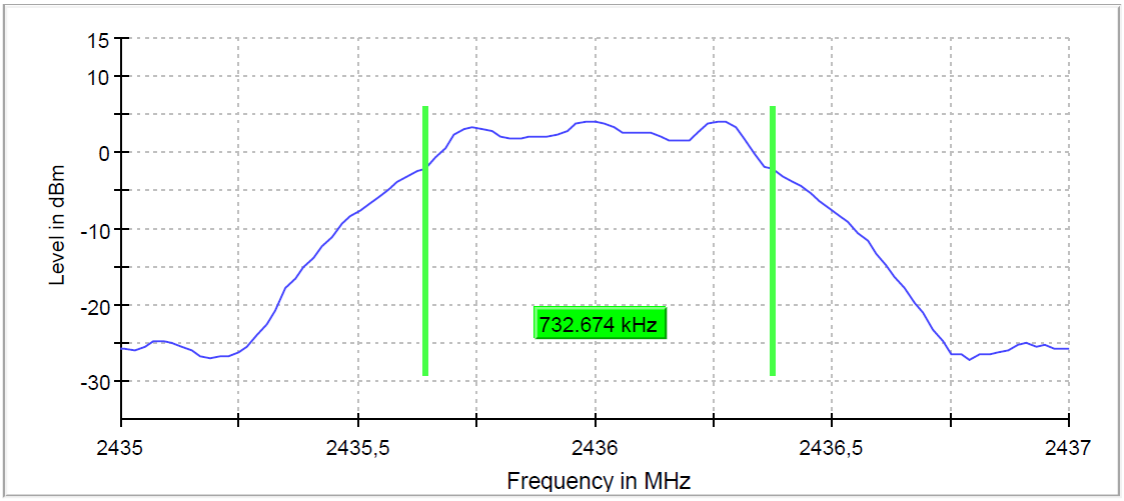
Note: plots are provided on the next page.

3.2.6 Plots of the 6 dB bandwidth

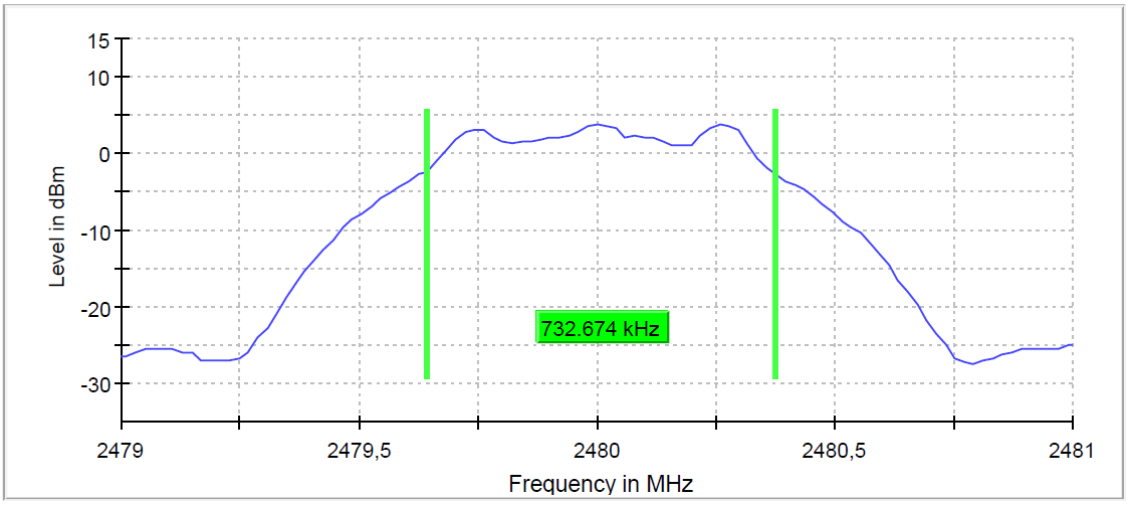
Channel 37 (1Mbps)
6 dB Bandwidth



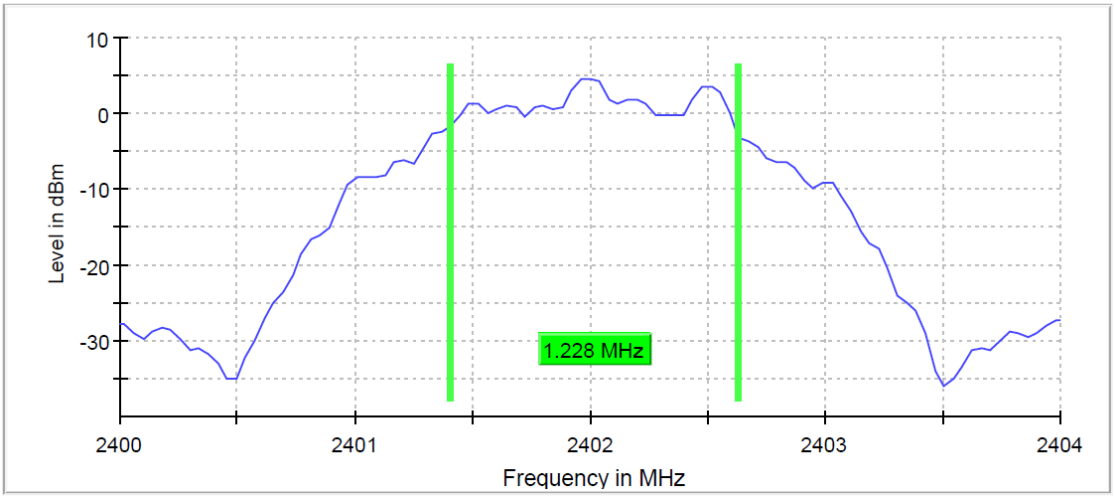
Channel 15 (1Mbps)
6 dB Bandwidth



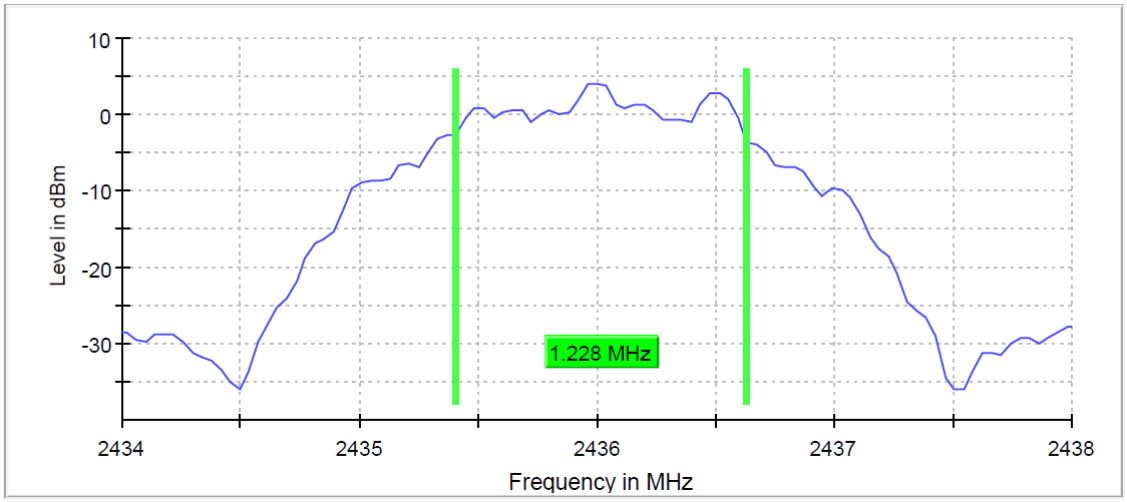
Channel 39 (1Mbps)
6 dB Bandwidth



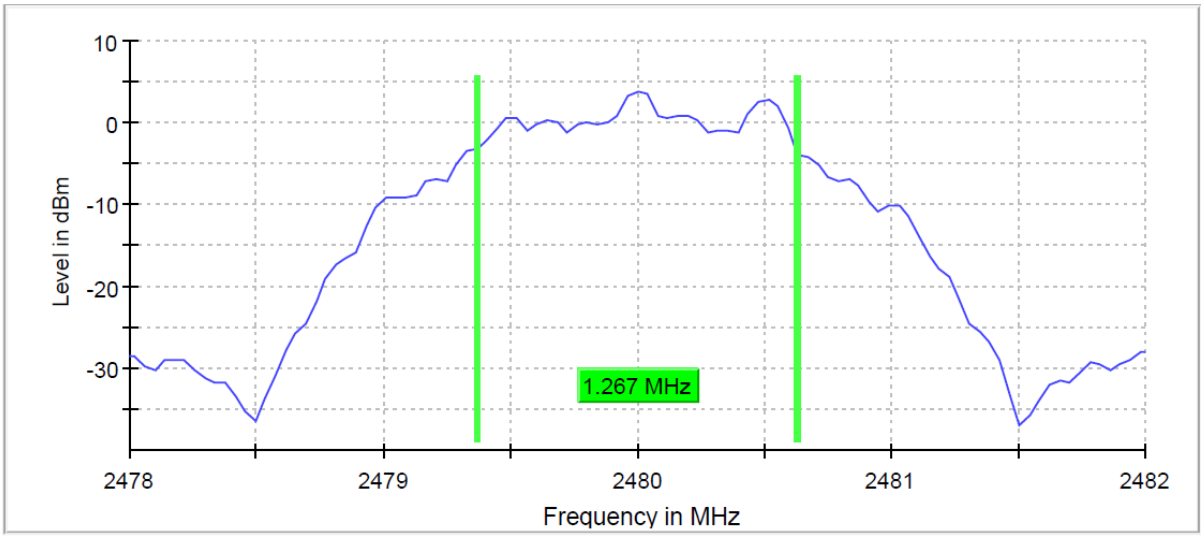
Channel 37 (2Mbps)
6 dB Bandwidth



Channel 15 (2Mbps)
6 dB Bandwidth

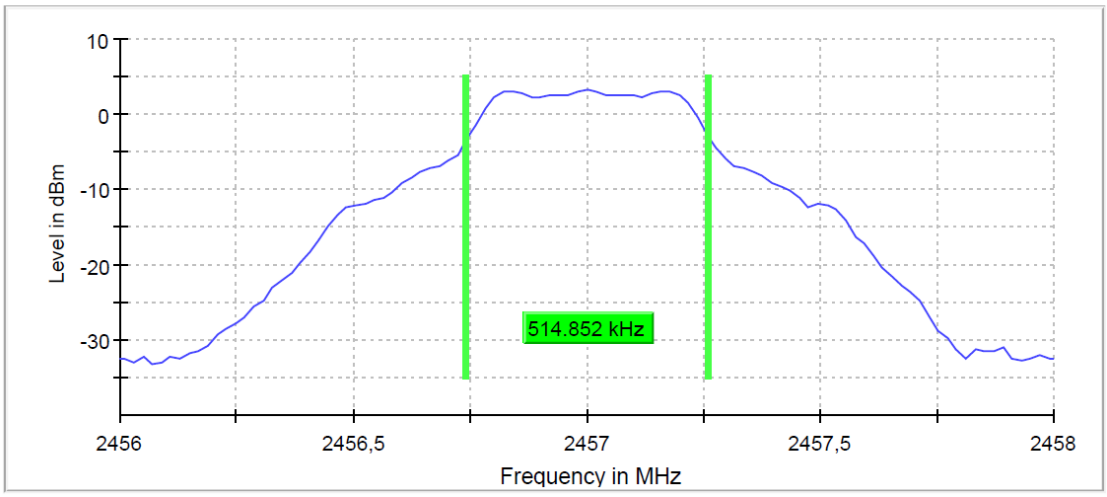


Channel 39 (2Mbps)
6 dB Bandwidth



ANT+

6 dB Bandwidth



3.3 99% Occupied Bandwidth

3.3.1 Limit

According to RSS-Gen 6.7

3.3.2 Measurement instruments

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

3.3.3 Test setup

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

3.3.4 Test procedure

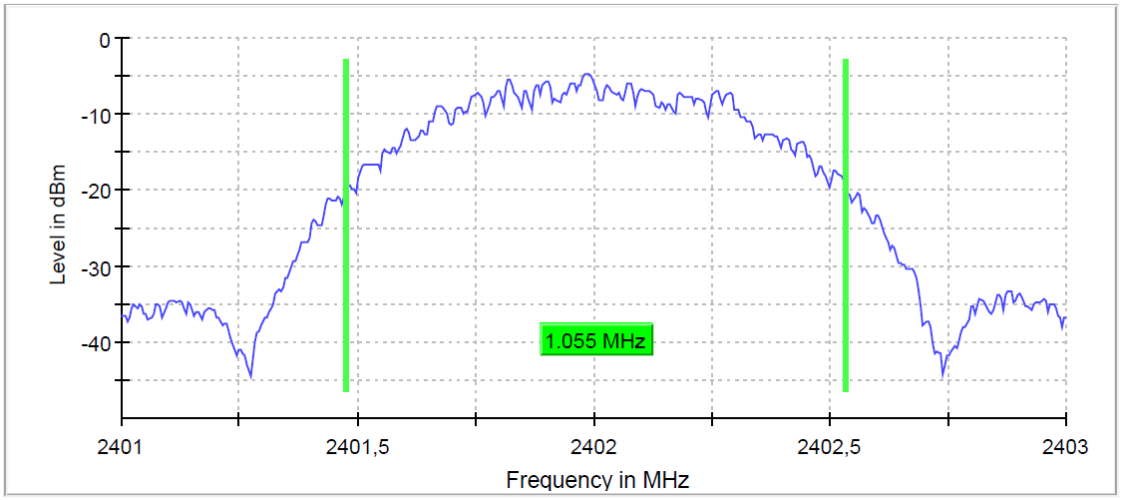
According to ANSI C63.10, section 6.9
IRN 404 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

3.3.5 Test results of the 99% occupied bandwidth measurement

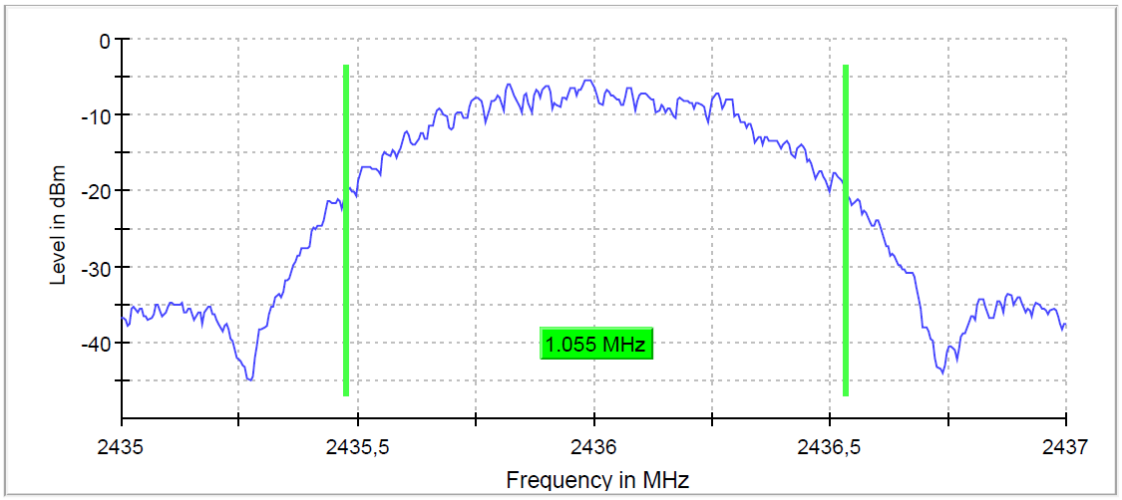
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Bluetooth Low energy	37	2402	1 Mbps	1.055
	15	2436	1 Mbps	1.055
	39	2480	1 Mbps	1.06
	37	2402	2 Mbps	2.02
	15	2436	2 Mbps	2.03
	39	2480	2 Mbps	2.03
ANT+	--	2457	1mbps	0.995
Uncertainty	± 12 kHz			

3.3.6 Plots of the 99% occupied bandwidth measurement

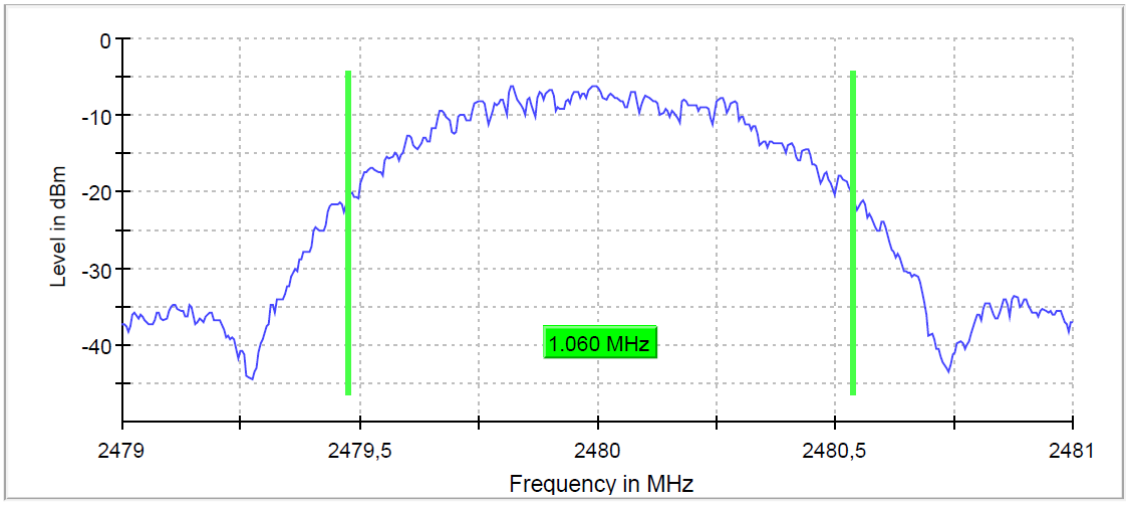
Channel 37 (1Mbps)
99 % Bandwidth



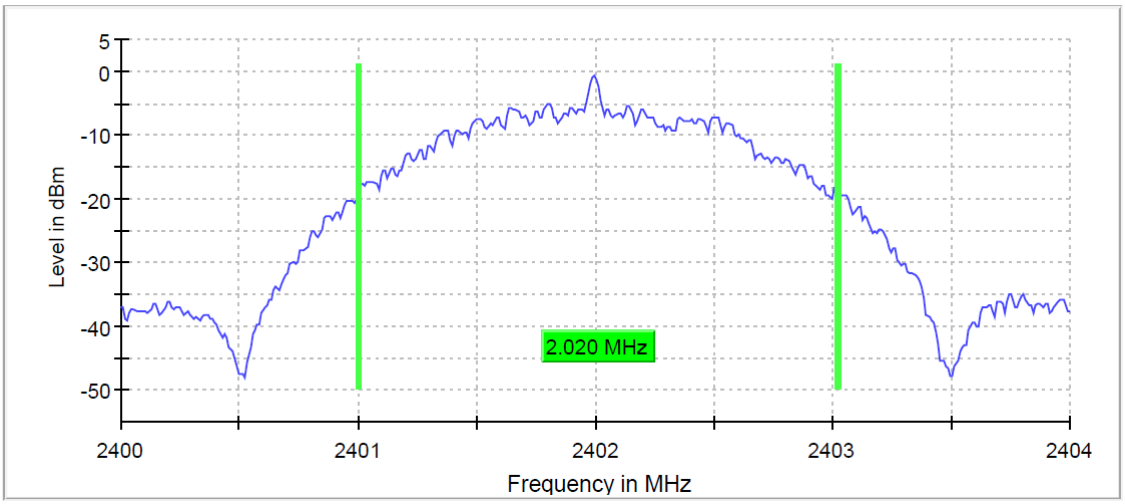
Channel 15 (1Mbps)
99 % Bandwidth



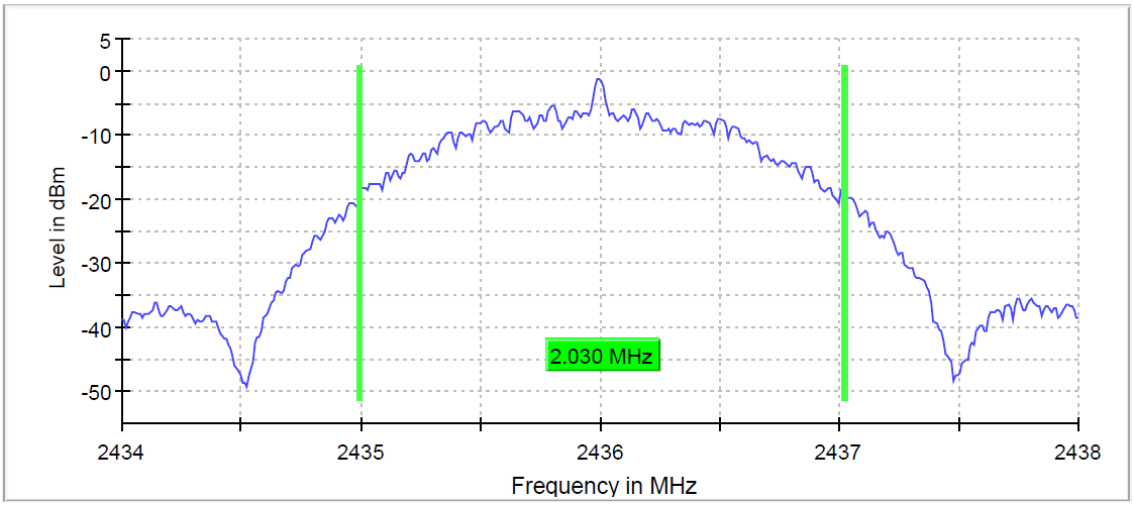
Channel 39 (1Mbps)
99 % Bandwidth



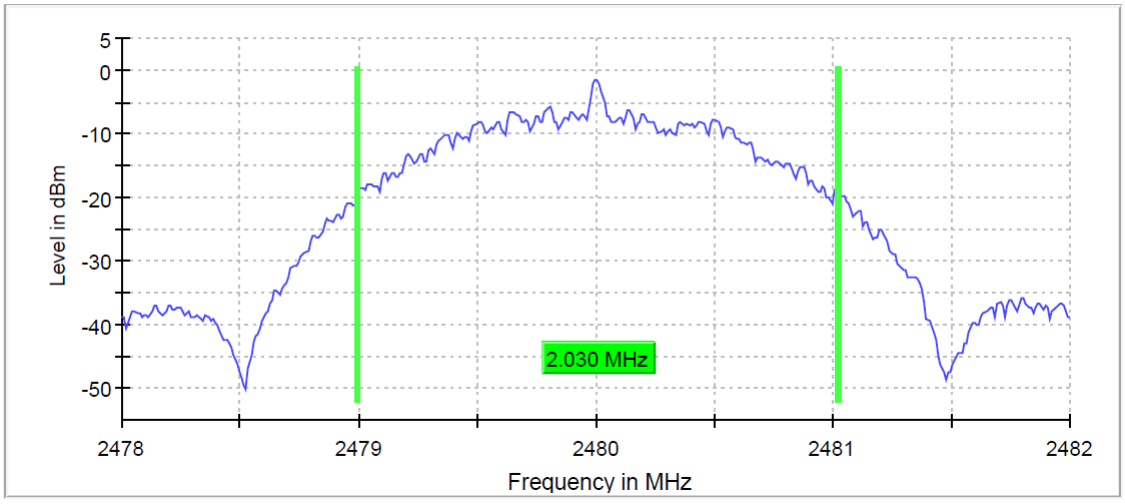
Channel 37 (2Mbps)
99 % Bandwidth



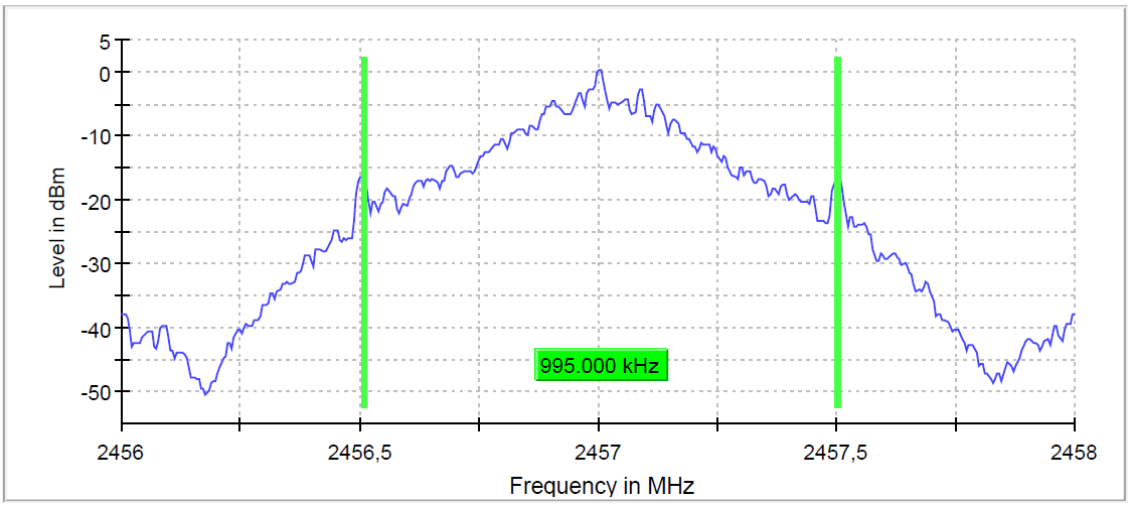
Channel 15 (2Mbps)
99 % Bandwidth



Channel 39 (2Mbps)
99 % Bandwidth



ANT+
99 % Bandwidth



3.4 Output Power Measurement

3.4.1 Limit

For systems using digital modulation in the 2400-2483.5 MHz, the limit for the peak output power is 1W (30 dBm). If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

3.4.2 Measurement instruments

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

3.4.3 Test setup

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

3.4.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.
IRN 402 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

3.4.5 Test results of Output Power Measurement

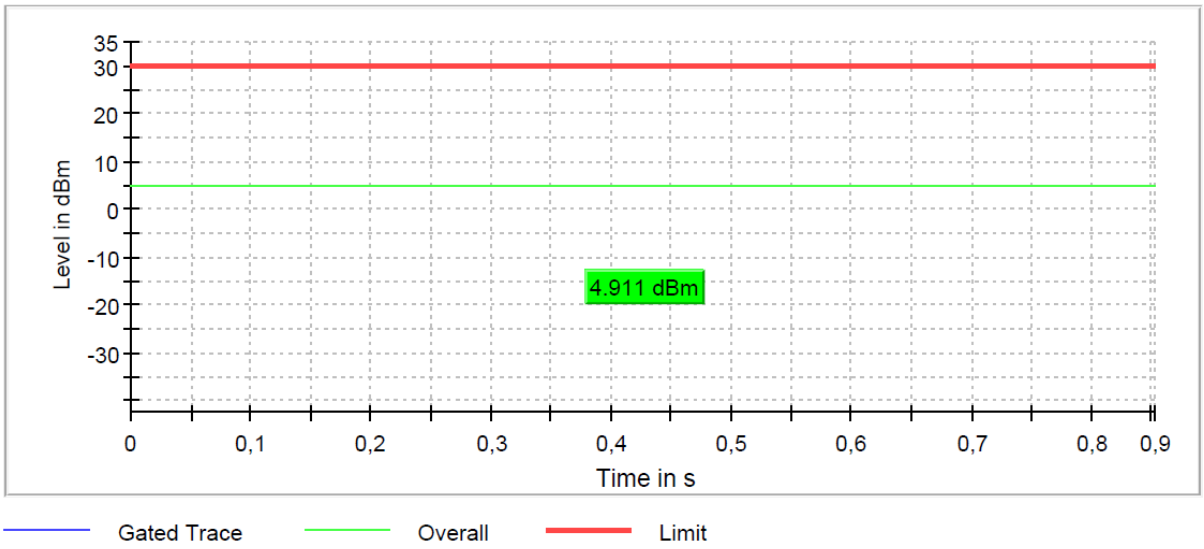
Peak method

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy	37	2402	1 Mbps	4.9
	15	2436	1 Mbps	4.3
	39	2480	1 Mbps	3.9
	37	2402	2 Mbps	4.9
	15	2436	2 Mbps	4.4
	39	2480	2 Mbps	4.0
ANT+	--	2457	1Mbps	3.5
Uncertainty	±0.71 dB/±5.7 *dB			

Note: plots are provided on the next page

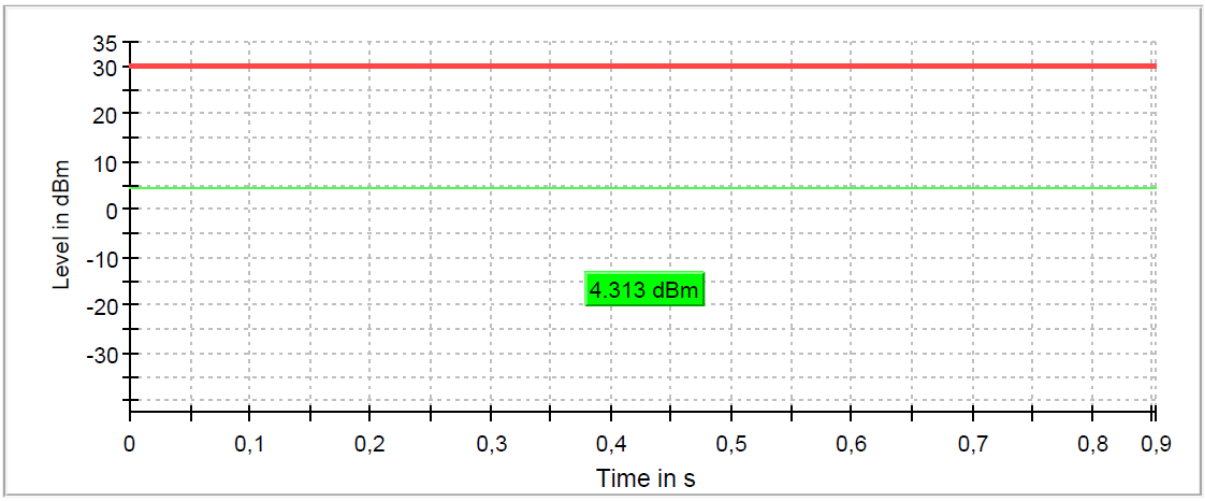
3.4.6 Plots of the Output power

Channel 37 (1Mbps)



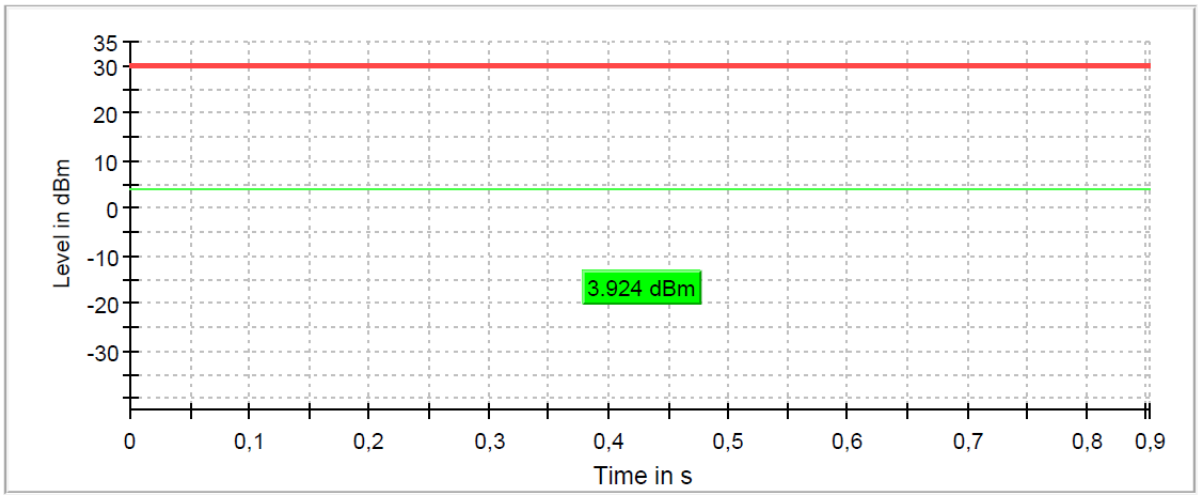
Gated Trace Overall Limit

Channel 15 (1Mbps)



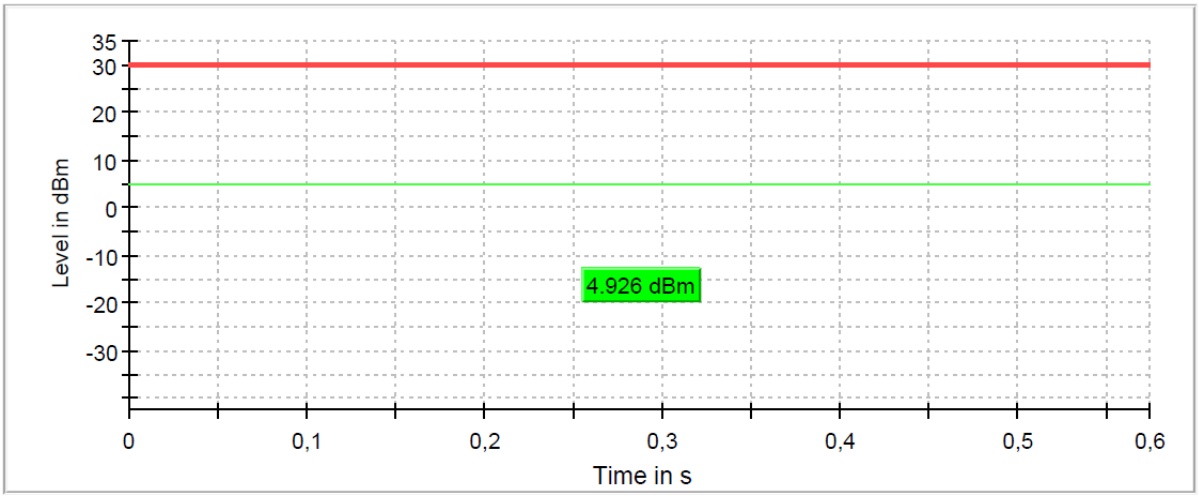
Gated Trace Overall Limit

Channel 39 (1Mbps)



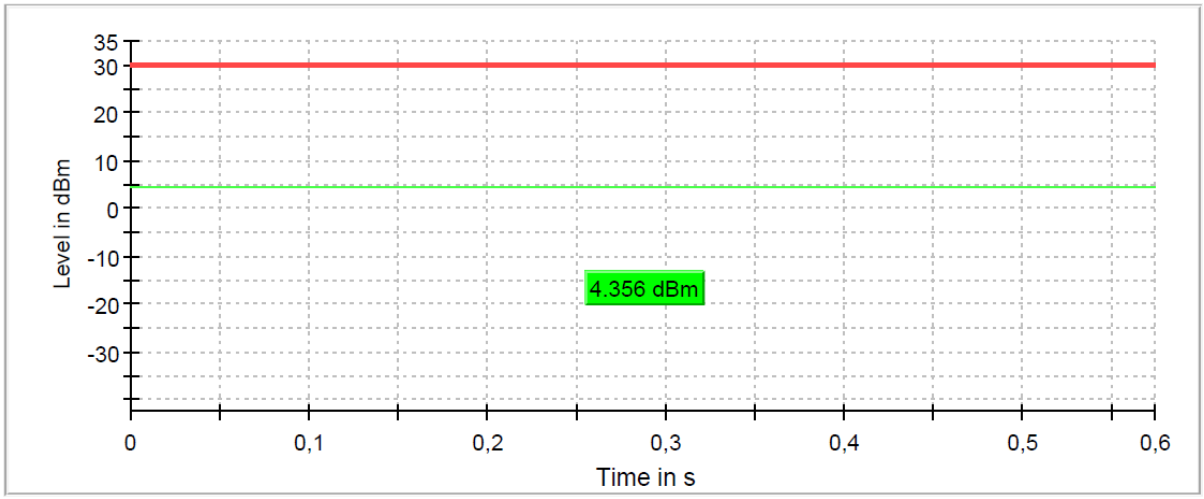
Gated Trace Overall Limit

Channel 37 (2Mbps)



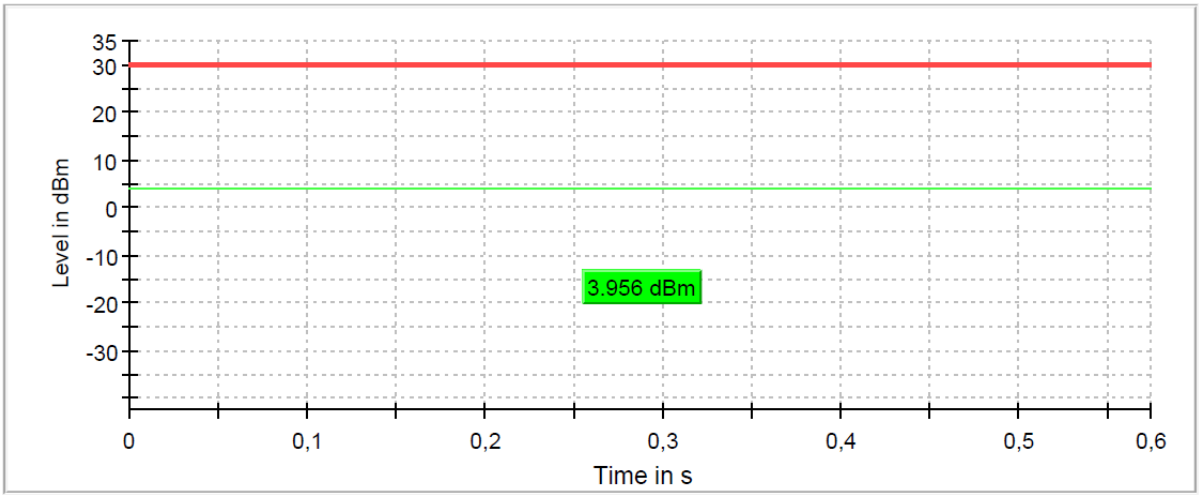
Gated Trace Overall Limit

Channel 15 (2Mbps)



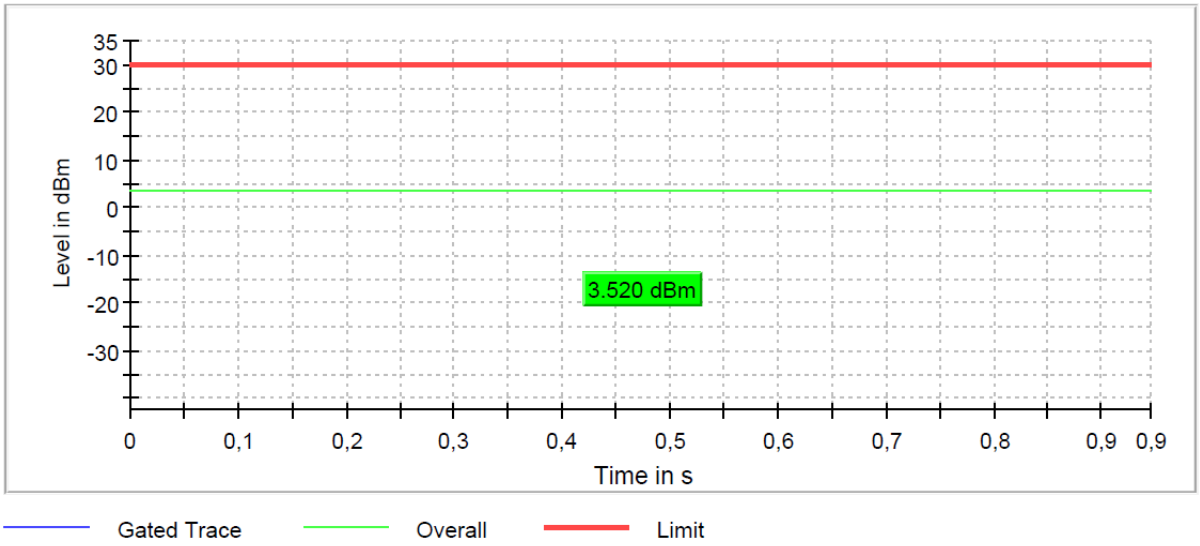
Gated Trace Overall Limit

Channel 39 (2Mbps)



Gated Trace Overall Limit

ANT+


35
30
20
10
0
-10
-20
-30
Level in dBm
3.520 dBm
0
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
0,9
Time in s
Gated Trace
Overall
Limit

3.5 Power Spectral Density

3.5.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.5.2 Measurement instruments

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

3.5.3 Test setup

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

3.5.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.
IRN 412 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band)

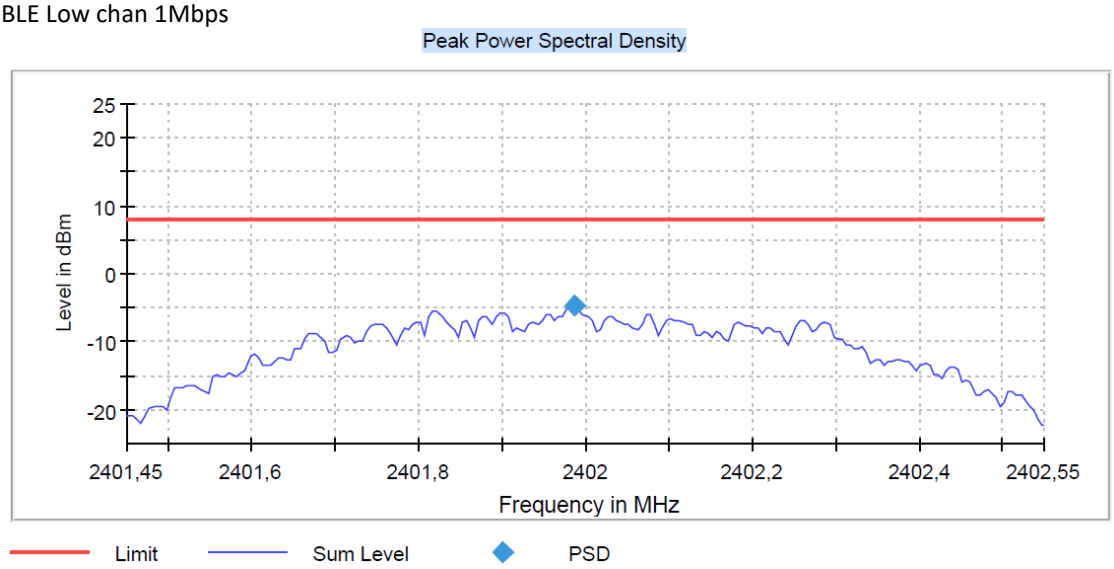
3.5.5 Test results of Power Spectral Density Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD conducted (dBm/3 kHz)	Limit (conducted) (dBm/3kHz)
Bluetooth Low Energy	37	2402	1 Mbps	-4.804	8
	15	2436	1 Mbps	-5.424	8
	39	2480	1 Mbps	-6.243	8
	37	2402	2 Mbps	-5.748	8
	15	2436	2 Mbps	-6.339	8
	39	2480	2 Mbps	-6.606	8
ANT+	--	2457	1Mbps	0.316	8
Uncertainty	±2 dB				

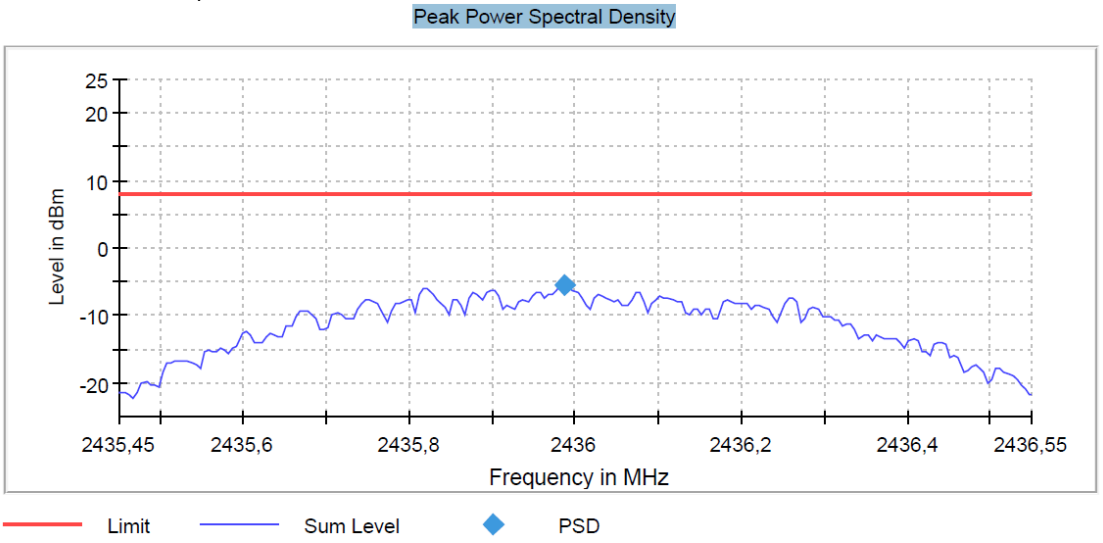
* strikethrough which one is not applicable
Note: plots are provided on the next page

3.5.6 Plots of the Power Spectral Density

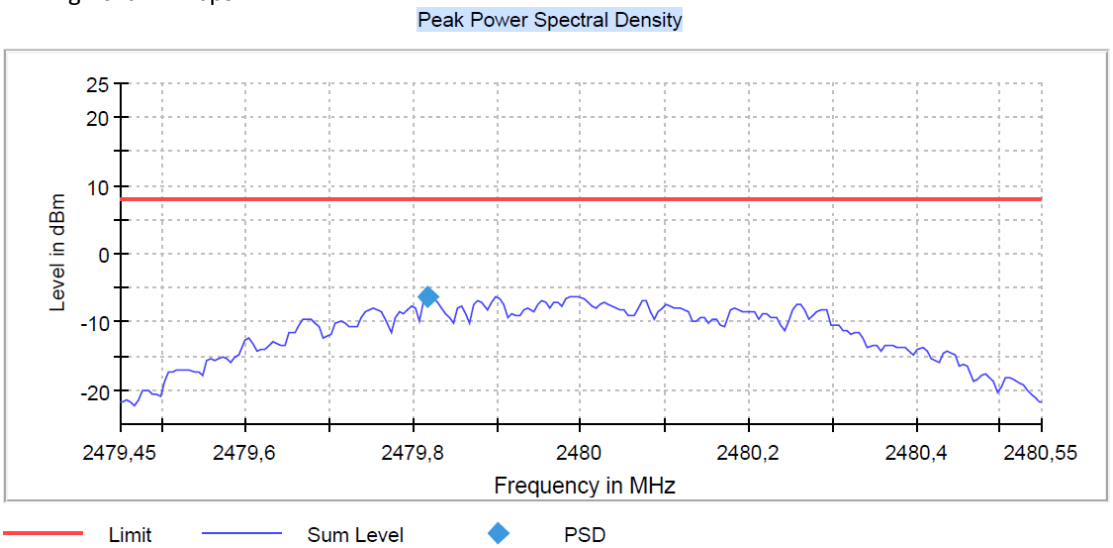
BLE Low chan 1Mbps



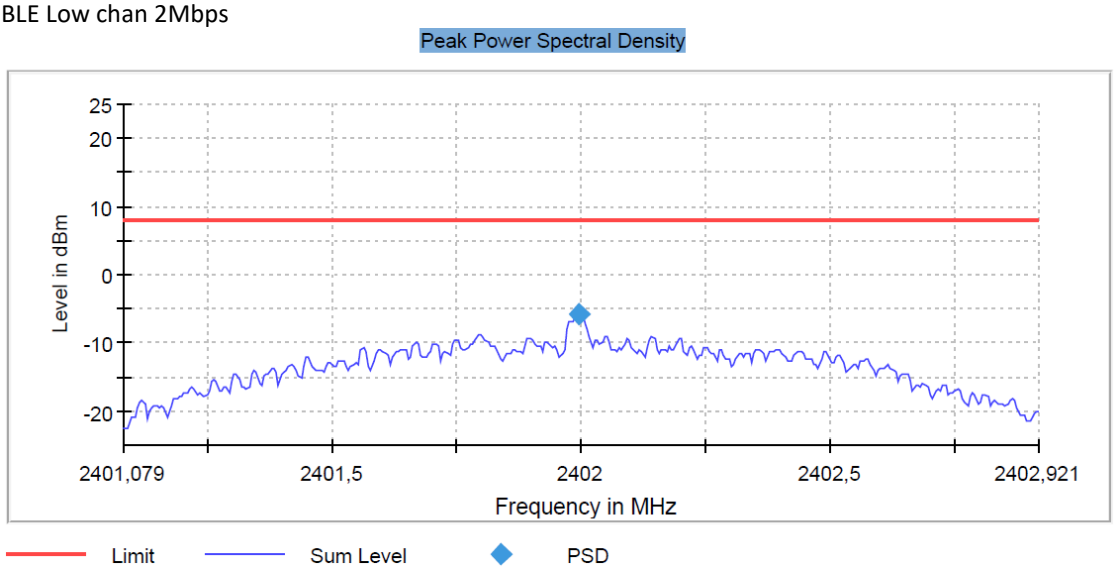
BLE Mid chan 1Mbps



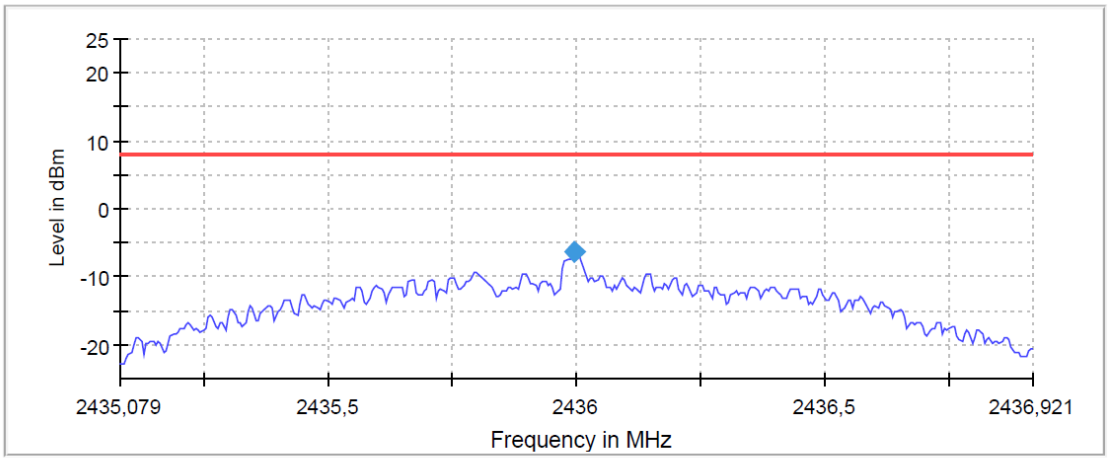
BLE High chan 1Mbps



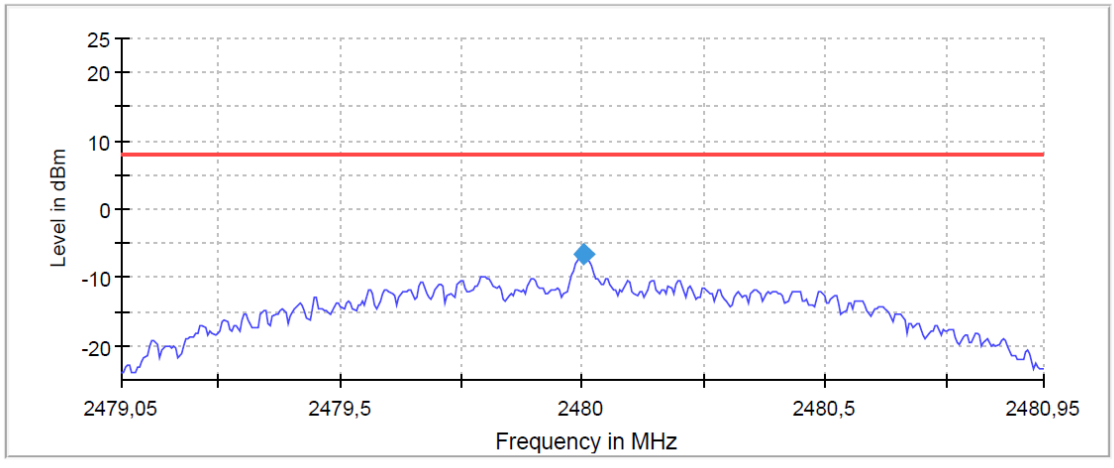
BLE Low chan 2Mbps



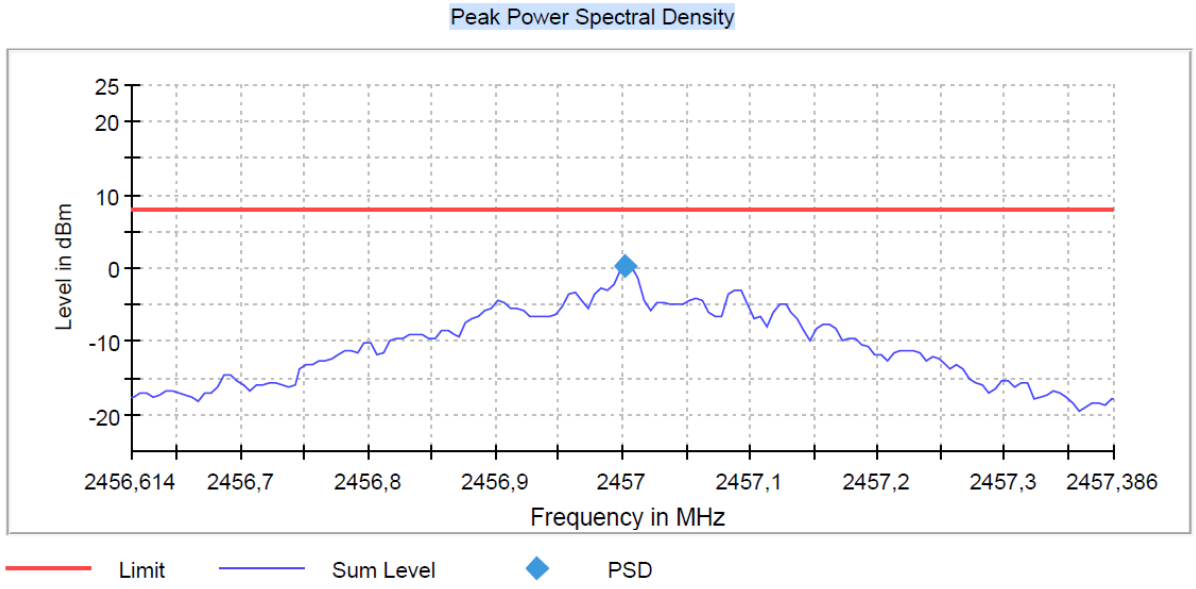
BLE High chan 2Mbps



BLE Mid chan 2Mbps



ANT+


Peak Power Spectral Density
25
20
10
0
-10
-20
Level in dBm
2456,614
2456,7
2456,8
2456,9
2457
2457,1
2457,2
2457,3
2457,386
Frequency in MHz
Limit
Sum Level
PSD

3.6 Band edge Measurement

3.6.1 Limit

Band edge:
At the edge of the authorized band the RF power shall be at least 20 dB down.

3.6.2 Measurement instruments

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

3.6.3 Test setup

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

3.6.4 Test procedure

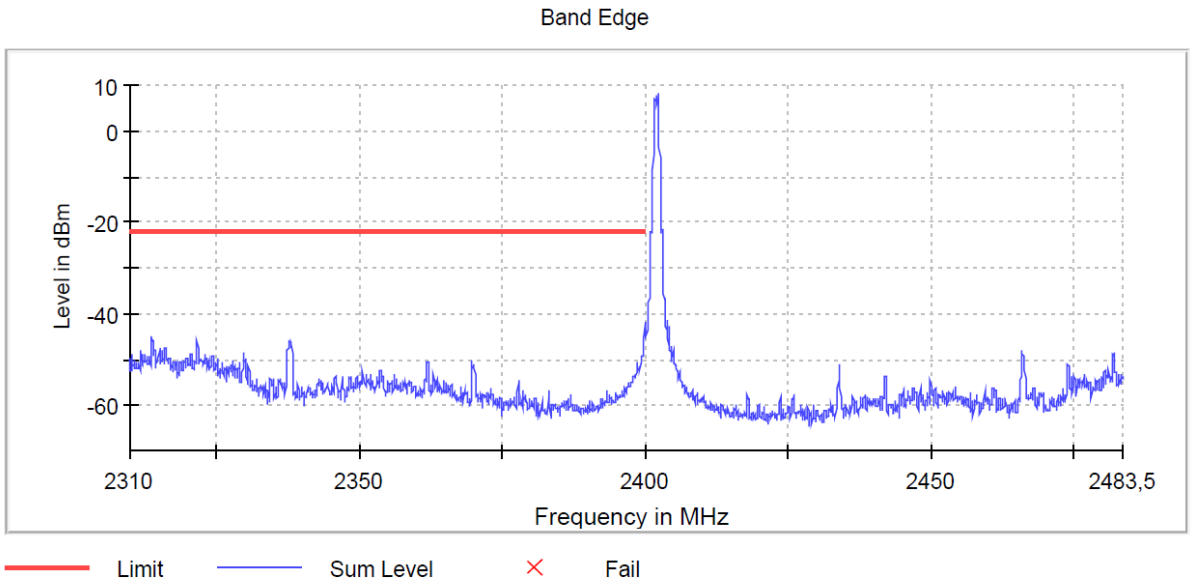
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02, section 8.7.
IRN 441 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.

3.6.5 Measurement Uncertainty

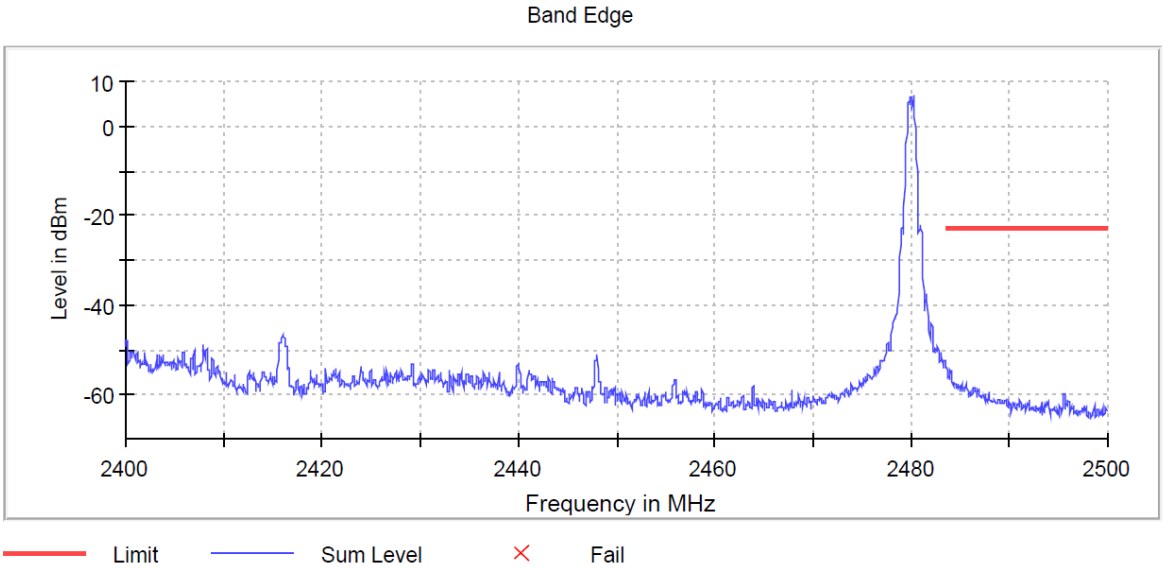
± 5.7 dB.(radiated)

3.6.6 Plots of the Band edge Measurements (1mbps)

BLE Lower band edge (Channel 37)

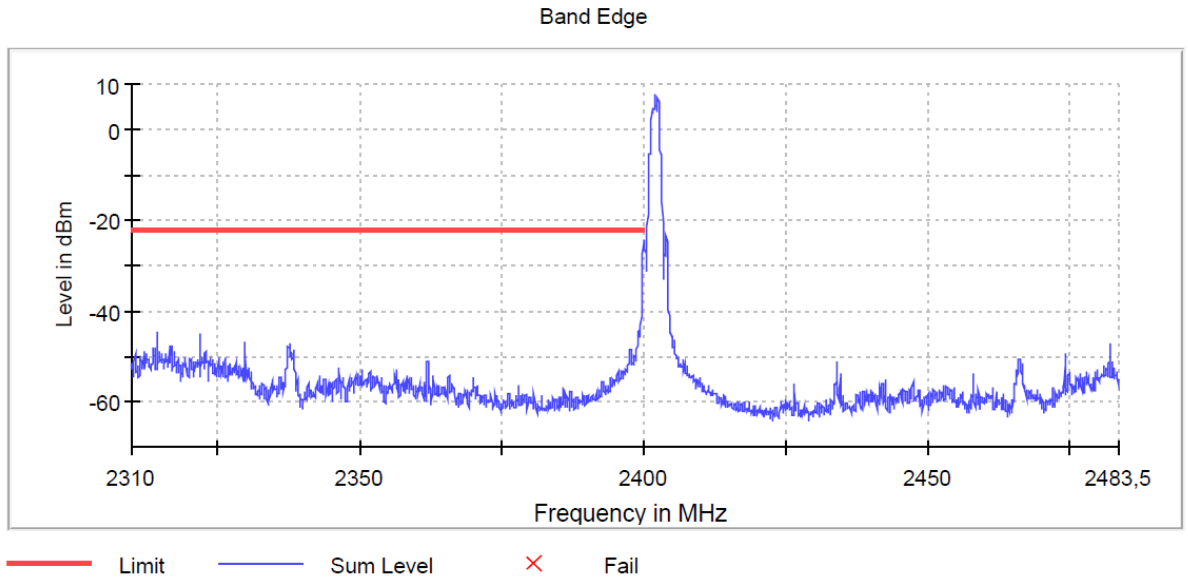


BLE Upper band edge (Channel 39)

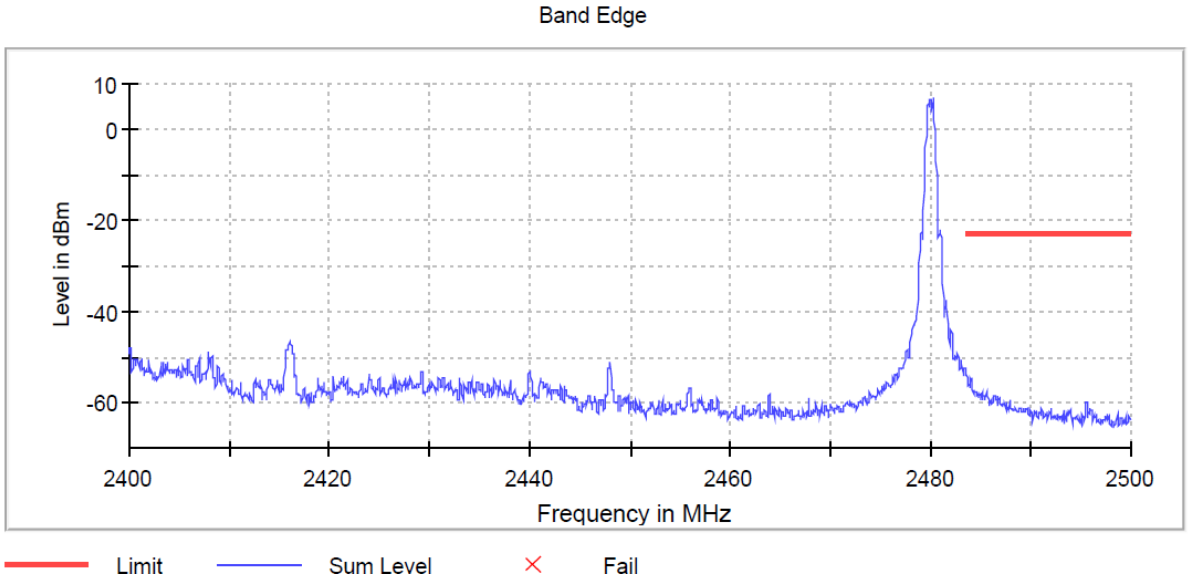


3.6.7 Plots of the Band edge Measurements (2mbps)

BLE Lower band edge (Channel 37)



BLE Upper band edge (Channel 39)



3.8 AC Power-line conducted emissions

3.8.1 Limit

According to 15.207 (a), (c)

An intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN).

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.

3.8.2 Measurement instruments

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

3.8.3 Test setup

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

3.8.4 Test procedure

According to ANSI C63.10-2020 Section 6.2
IRN 439 – Method 1

3.8.5 Test results and plots of the AC power-line conducted measurement

See next page.

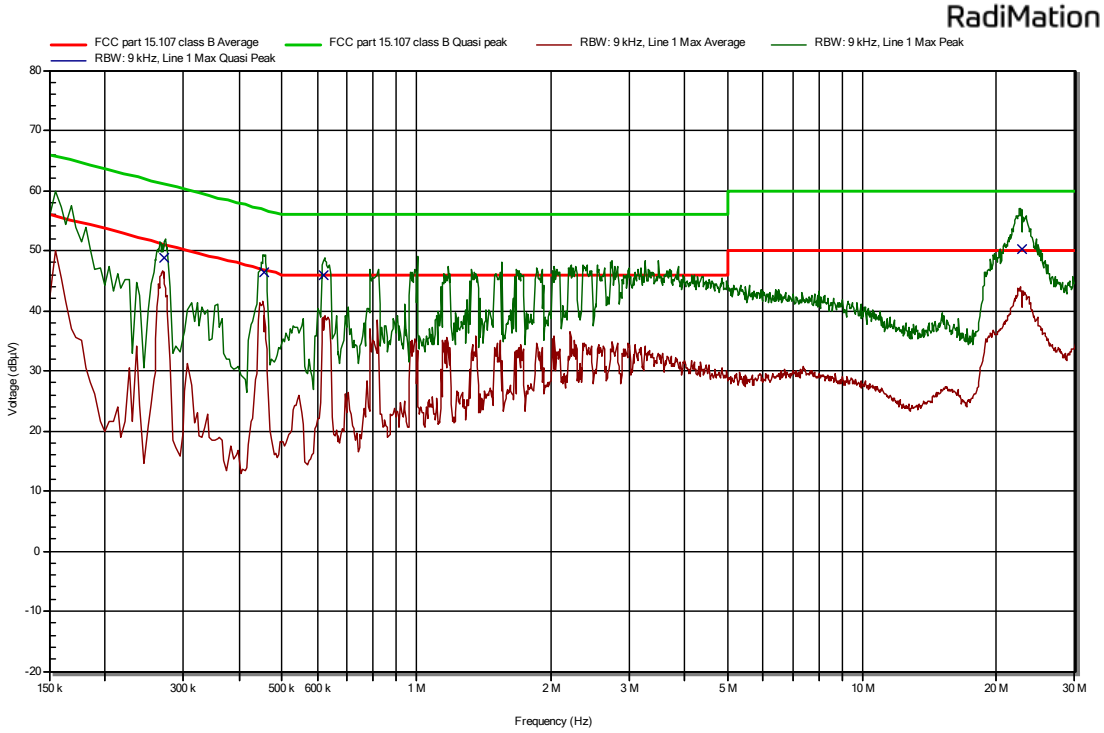
3.8.6 Measurement uncertainty

+/- 3.6 dB

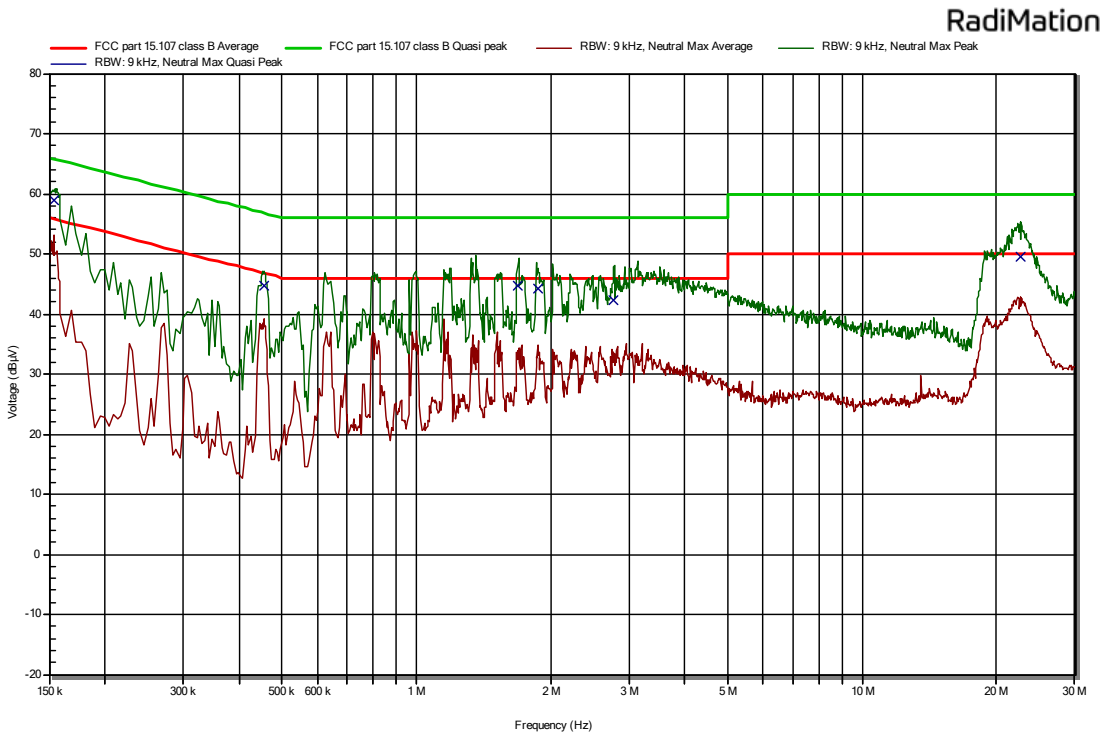
3.8.7 AC Power Line Conducted emission data of the EUT, results

Frequency	Peak	Peak Limit	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	Status	LISN
22.884 MHz	57 dBµV	60 dBµV	42.2 dBµV	50 dBµV	50.4 dBµV	60 dBµV	Pass	L
454.65 kHz	49.2 dBµV	56.8 dBµV	39.3 dBµV	46.8 dBµV	46.3 dBµV	56.8 dBµV	Pass	L
272.85 kHz	52 dBµV	61 dBµV	44.3 dBµV	51 dBµV	48.8 dBµV	61 dBµV	Pass	L
621.15 kHz	48.3 dBµV	56 dBµV	38.3 dBµV	46 dBµV	45.8 dBµV	56 dBµV	Pass	L
154.5 kHz	60.9 dBµV	65.8 dBµV	50.4 dBµV	55.8 dBµV	59 dBµV	65.8 dBµV	Pass	N
1.689 MHz	47.8 dBµV	56 dBµV	33.7 dBµV	46 dBµV	44.7 dBµV	56 dBµV	Pass	N
1.873 MHz	47 dBµV	56 dBµV	33 dBµV	46 dBµV	44.2 dBµV	56 dBµV	Pass	N
2.77 MHz	46.7 dBµV	56 dBµV	32.3 dBµV	46 dBµV	42.3 dBµV	56 dBµV	Pass	N
22.583 MHz	55.4 dBµV	60 dBµV	41.6 dBµV	50 dBµV	49.5 dBµV	60 dBµV	Pass	N
454.2 kHz	46.8 dBµV	56.8 dBµV	37.8 dBµV	46.8 dBµV	44.7 dBµV	56.8 dBµV	Pass	N

3.8.8 Plots of the AC mains conducted spurious measurement



Pre-scan plot with peak detector of the AC Power-line Conducted emissions on **Phase**



Pre-scan plot with peak detector of the AC Power-line Conducted emissions on **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

Magnetic field strength measurement:

$$H\left[dB\left(\mu\frac{A}{m}\right)\right] = V[dB(\mu V)] + L_c[dB] + AF^H[\frac{dB}{\Omega m}]$$

Where:
H is the magnetic field strength (to be compared to the limit)
V is the voltage level measured by the receiver or spectrum analyzer
L_C is the cable loss
AF^H is the magnetic antenna factor

Frequency (MHz)	AF (dB/Ωm) 114515 EMCO 6505 S/N:9112-2710	CL (dB) SAR cable	Corr. (dB)
0,009	-32,35	0,7	-31,65
0,01	-33,16	0,05	-33,11
0,02	-37,56	0,07	-37,49
0,03	-39,29	0,1	-39,19
0,04	-40,11	0,1	-40,01
0,1	-41,27	0,1	-41,17
0,2	-41,48	0,1	-41,38
0,5	-41,58	0,1	-41,48
1	-41,62	0,2	-41,42
3	-41,6	0,2	-41,4
5	-41,65	0,3	-41,35
10	-42,11	0,6	-41,51
15	-42,88	0,9	-41,98
20	-43,78	1	-42,78
25	-44,85	0,7	-44,15
27	-45,36	1,2	-44,16
30	-46,25	1	-45,25

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)** **Id: 109683** **Chase CBL6112B** **SN: 2408**	**Cable loss (dB)** **Id: SAR cable**	**Corr. (dB)**
30	25,4	0,68	26,1
100	16,8	1,15	18,0
150	16,8	1,41	18,2
200	15,3	1,63	16,9
250	19,3	1,93	21,2
300	13,3	2,12	15,4
350	14,6	2,20	16,8
400	22,0	2,29	24,3
450	23,0	2,53	25,5
500	23,8	2,67	26,5
550	25,4	2,90	28,3
600	24,8	3,02	27,8
650	25,2	3,09	28,3
700	25,0	3,22	28,2
750	25,8	3,56	29,4
800	25,8	3,69	29,5
900	26,5	3,81	30,3
950	27,0	3,91	30,9
1000	27,4	4,30	31,7

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 00818 Flann 20240-25 SN: 163703	Gain (dB) TE 11131 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

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