Test report for

47 CFR Part 15 Subpart C

RSS-210, RSS-247, RSS-Gen

The RvA is signatory to ILAC - MRA

Product name	: FullCloud Controller
Applicant	: 4Suites Cloud B.V.
FCC ID	: 2A225-FC2922
IC	: 29825-FC2922

Test report No. : P000270309 002 Ver2.0

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	12/02/2023	First draft	MK
v1.00	13/02/2023	Final release	MK
V2.0	02/06/2023	Name update	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
15.225 (a),(b),(c)	RSS-210 B.6	Field strength of emissions	3.8	Pass
15.225(e)	RSS-210 B.6	Frequency Stability	3.9	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:	4Suites Cloud B.V.
Address:	Laan van de Maagd 103, Apeldoorn, Netherlands
Zip code:	7324 BT
Telephone:	--
E-mail:	marijn@pinvaccess.com
Contact name:	Mr. Marijn Achterkamp

1.2 Manufacturer

Manufacturer name:	4Suites Cloud B.V.
Address:	Laan van de Maagd 103, Apeldoorn, Netherlands
Zip code:	7324 BT
Telephone:	--
E-mail:	marijn@pinvaccess.com
Contact name:	Mr. Marijn Achterkamp

1.3 Tested Equipment Under Test (EUT)

Product name:	FullCloud Controller
Brand name:	4Suites Cloud B.V.
FCC ID:	2A225-FC2922
IC:	29825-FC2922
Product type:	IoT Cloud Controller
Model(s):	--
Batch and/or serial No.	--
Software version:	--
Hardware version:	--
Date of receipt	25/01/2023
Tests started:	06/02/2023
Testing ended:	10/02/2023

1.3.1 Auxiliary items

AUX1

Product name:	NFC Tag
Product type:	--
Remarks:	Connects to EUT

1.4 Product specifications of Equipment under test

Tx Frequency:	NFC: 13.56 MHz BLE: 2400 – 2483.5 MHz Proprietary: 902 – 928 MHz
Rx frequency:	NFC: 13.56 MHz BLE: 2400 – 2483.5 MHz Proprietary: 902 – 928 MHz
Occupied channel width:	BLE: 2 MHz Proprietary: 700 kHz
Antenna type:	NFC: Loop Antenna BLE: Ceramic Chip Antenna Proprietary: Ceramic Chip Antenna
Antenna gain:	Proprietary: -2.6 dBi BLE: 0.5 dBi
Type of modulation:	NFC: ASK BLE: GFSK Proprietary: DSSS
Emission designator	NFC: 423KA1D BLE: 713KF1D Proprietary: 696KF1D

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 §15.225
- FCC Part 15 Subpart C §15.247
- RSS-Gen Issue 5
- RSS-210 Issue 9
- RSS-247 Issue 2

1.8 Observation and remarks

Proprietary modulation use wideband DSSS modulation under IEEE 802.15.4 protocol, It advertise in 902.6 - 927.4 MHz band with 200 kHz channel width. Co-location test has been performed to observe the possible interference between the NFC and Proprietary. Also to note BLE and Proprietary cannot transmit simultaneously.

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. 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 : Maaz Harris Khan, BEng under supervision of Paul van Wanrooij, BASc

Review of test methods and report by:

Name : Raoul Tolud, Msc

The above conclusions have been verified by the following signatory:

Date : 15-06-2023

Name : Koray Korcum, MSc

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

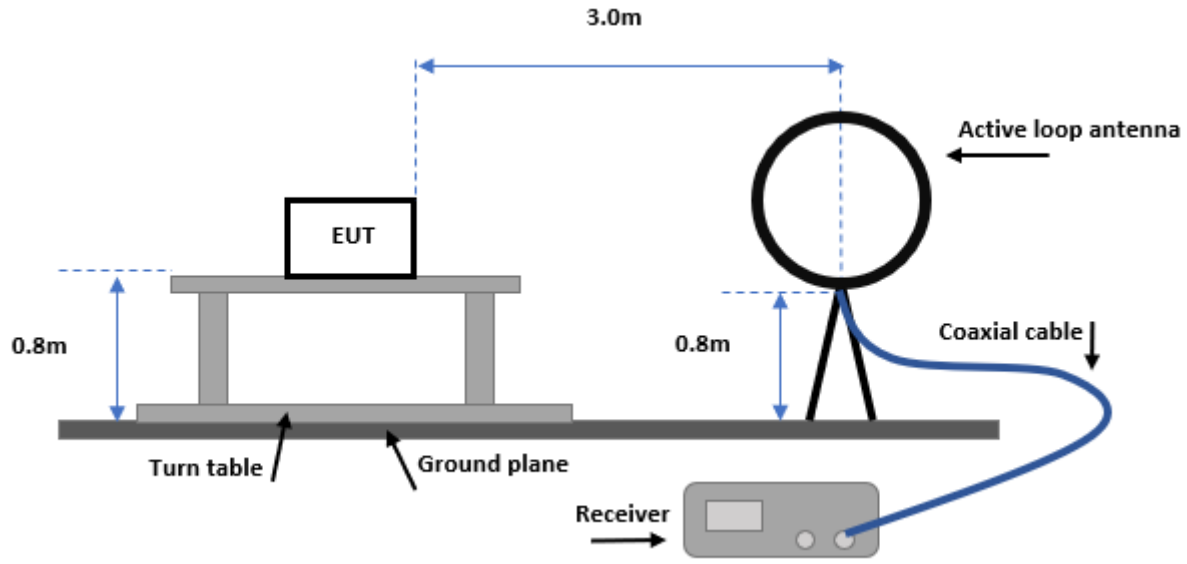
The client provided the means to set the EUT in the different test mode required for all the test cases. The technology as well as frequency was changed using a Texas Instruments flash tool.

Tested channels and data rates

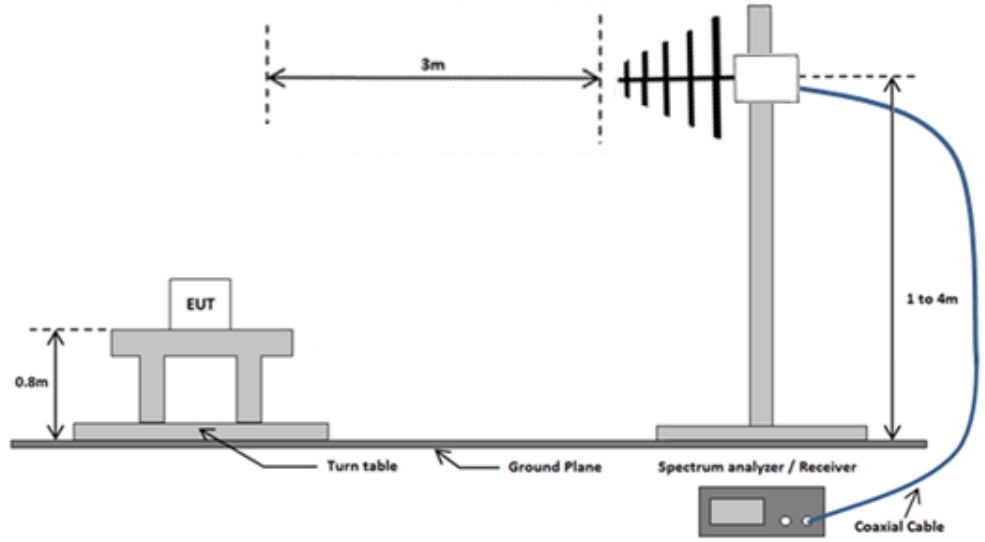
Technology	Channel	Data Rate	Frequency
NFC	--	424 kbps	13.56 MHz
BLE	Channel 37	1 & 2 Mbps	2402 MHz
BLE	Channel 17	1 & 2 Mbps	2440 MHz
BLE	Channel 39	1 & 2 Mbps	2480 MHz
Proprietary	Low	50 kbps	902.6 MHz
Proprietary	Mid	50 kbps	915.0 MHz
Proprietary	High	50 kbps	927.4 MHz

2.2 Test setups

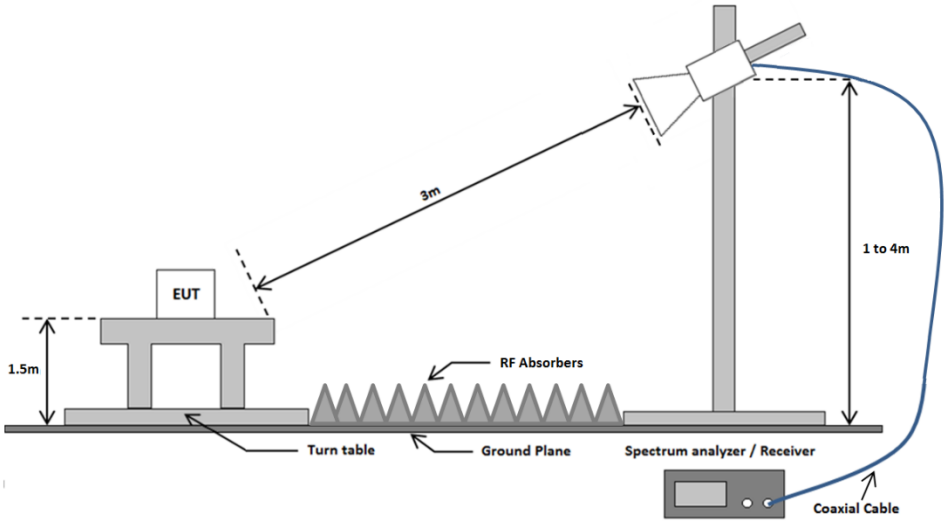
Radiated emissions test setup 9 kHz – 30 MHz



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	Cal. Done date	Cal. due date	Used at Par.
EMI Receiver	Rohde & Schwarz	ESCI	114161	01-2023	01-2024	3.1 – 3.8
EMI Receiver	Rohde & Schwarz	ESR7	114534	02-2023	02-2025	3.1 – 3.8
Spectrum Analyzer	Rohde & Schwarz	FSP40	114792	03-2022	03-2023	3.1 – 3.8
Spectrum Analyzer	Rohde & Schwarz	FSV40	114527	05-2022	05-2023	3.1 – 3.8
1.1 GHz HPF	Wainwright	WHK1.1/15G-10EF	114682	09-2021	09-2024	3.1
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
Log periodic 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	µComp Nordic	MCNA-40-0010800-25-10P	114690	01-2022	01-2023	3.1
Preamplifier 18-40 GHz	Miteq	JS4-18004000-33-8P	114693	01-2022	01-2023	3.1
Test software	Raditeq	Radimation Version 2021.1.9	--	--	--	3.1 – 3.7

*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

15.225(d)
The field strength of any emissions appearing outside of the 13.110 -14.010 MHz band shall not exceed the general radiated emission limits in part 15.209. (remove this if you did not test against 15.225)

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 C63.10-2020, 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 C63.10-2020, section 6.4
30 MHz to 26.5 GHz: According to ANSI C63.10-2020, section 6.5 and 6.6

9 kHz to 30 MHz: IRN 441 – Method 9
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

30MHz – 250MHz NFC read mode

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Pol
67.812 MHz	31.1 dBµV/m	30.1 dBµV/m	40 dBµV/m	Pass	1.7 m	Ver
40.686 MHz	38 dBµV/m	36.7 dBµV/m	40 dBµV/m	Pass	1 m	Ver

30MHz – 250MHz BLE low channel

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Pol
112.473 MHz	49.7 dBµV/m	17.1 dBµV/m	40 dBµV/m	Pass	1 m	Ver

30MHz – 250MHz BLE high channel

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Pol
70.883 MHz	17.4 dBµV/m	11.1 dBµV/m	40 dBµV/m	Pass	3.2 m	Ver

30MHz – 250MHz Proprietary 915MHz low channel

Frequency	Peak	Quasi-Peak	Quasi-Peak Limit	Status	Height	Pol
60.476 MHz	19.2 dBµV/m	12.9 dBµV/m	40 dBµV/m	Pass	2 m	Ver

1GHz – 18GHz Proprietary 915MHz low channel

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
1.805 GHz	51.9 dBµV/m	74 dBµV/m	47.3 dBµV/m	54 dBµV/m	Pass	2 m	Ver
2.708 GHz	58.2 dBµV/m	74 dBµV/m	53.2 dBµV/m	54 dBµV/m	Pass	1.5 m	Hor
2.709 GHz	58.6 dBµV/m	74 dBµV/m	53.7 dBµV/m	54 dBµV/m	Pass	4.2 m	Ver

1GHz – 18GHz Proprietary 915MHz mid channel

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
2.745 GHz	52.4 dBµV/m	74 dBµV/m	46 dBµV/m	54 dBµV/m	Pass	1.5 m	Hor
2.746 GHz	52.7 dBµV/m	74 dBµV/m	46 dBµV/m	54 dBµV/m	Pass	1.7 m	Hor

1GHz – 18GHz Proprietary 915MHz high channel

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
1.773 GHz	41 dBµV/m	74 dBµV/m	28.6 dBµV/m	54 dBµV/m	Pass	1 m	Hor
2.784 GHz	48.7 dBµV/m	74 dBµV/m	40.9 dBµV/m	54 dBµV/m	Pass	2 m	Hor
1.855 GHz	47 dBµV/m	74 dBµV/m	41 dBµV/m	54 dBµV/m	Pass	1.2 m	Hor

1GHz – 18GHz BLE low channel (no tag)

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
4.806 GHz	53.3 dBµV/m	74 dBµV/m	45.9 dBµV/m	54 dBµV/m	Pass	3 m	Ver
9.41 GHz	56.6 dBµV/m	74 dBµV/m	44.9 dBµV/m	54 dBµV/m	Pass	3 m	Hor

1GHz – 18GHz BLE mid channel (no tag)

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
4.886 GHz	51.6 dBµV/m	74 dBµV/m	41.4 dBµV/m	54 dBµV/m	Pass	1.2 m	Ver

1GHz – 18GHz BLE high channel (no tag)

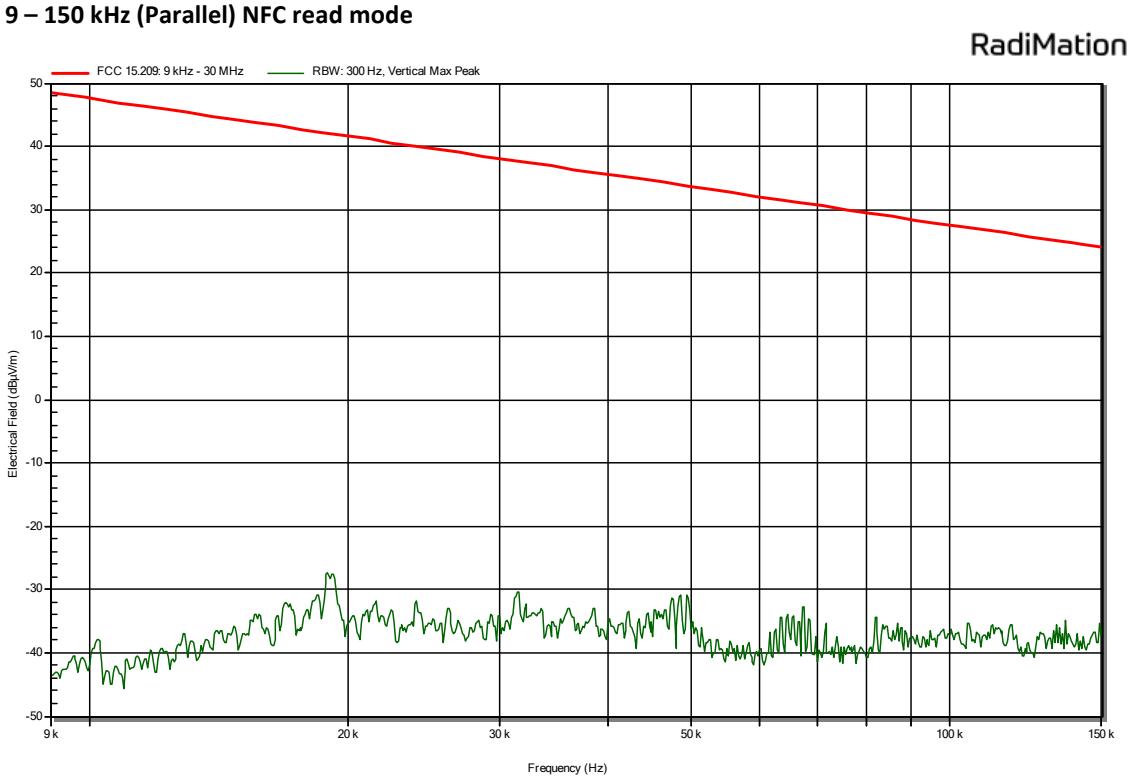
Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
4.876 GHz	49.1 dBµV/m	74 dBµV/m	37.2 dBµV/m	54 dBµV/m	Pass	1.5 m	Hor

10GHz – 18GHz BLE low channel (no tag)

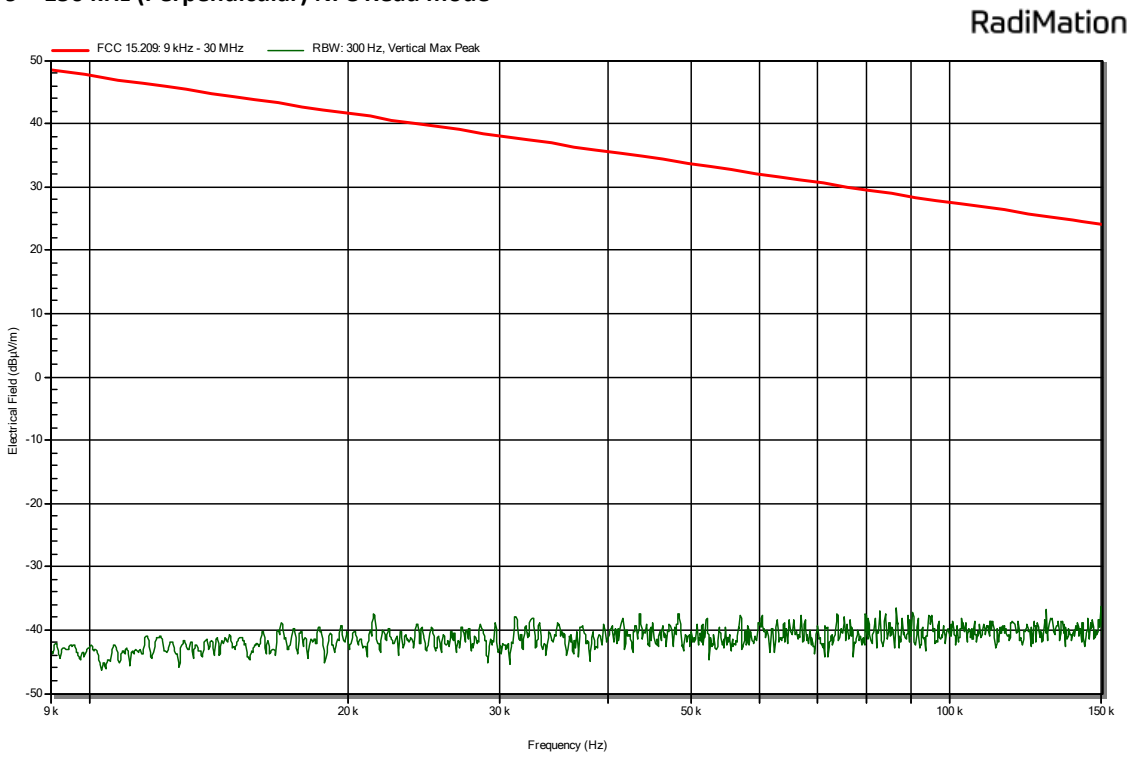
Frequency	Peak	Peak Limit	Average	Average Limit	Status	Height	Pol
25.214 GHz	59.4 dBµV/m	74 dBµV/m	50.7 dBµV/m	54 dBµV/m	Pass	1.6 m	Hor

3.1.7 Plots of the Radiated Spurious Emissions Measurement

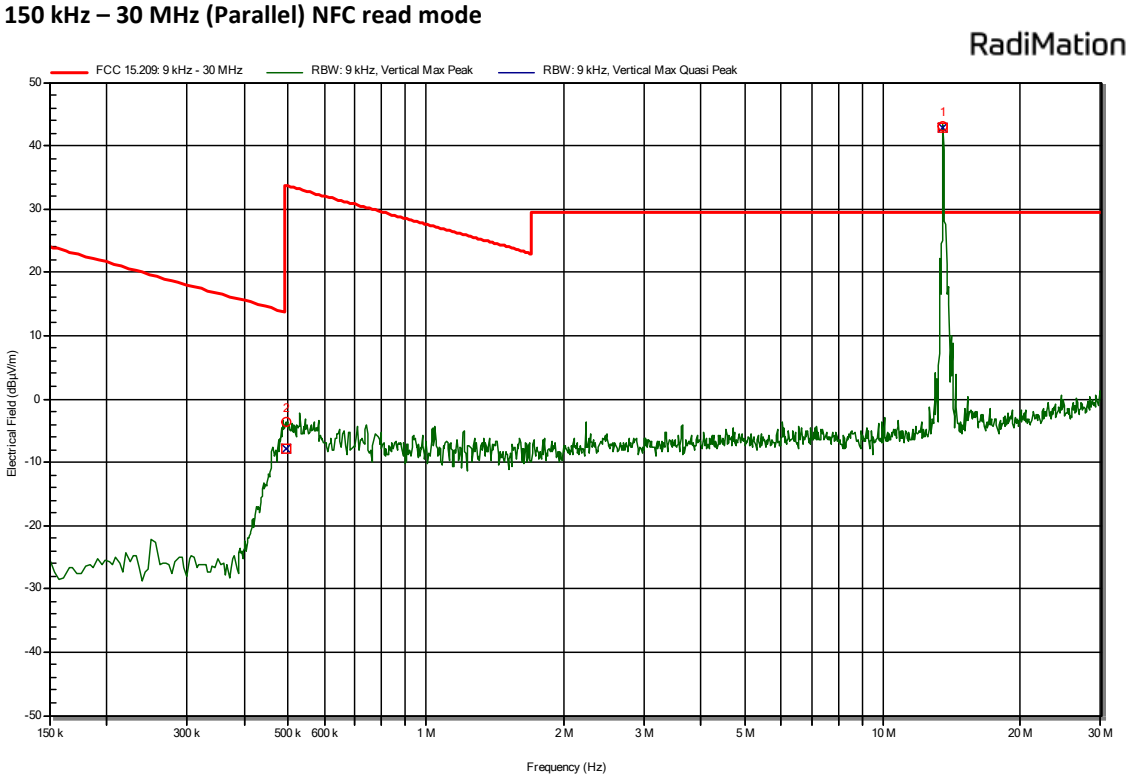
9 – 150 kHz (Parallel) NFC read mode



9 – 150 kHz (Perpendicular) NFC Read mode

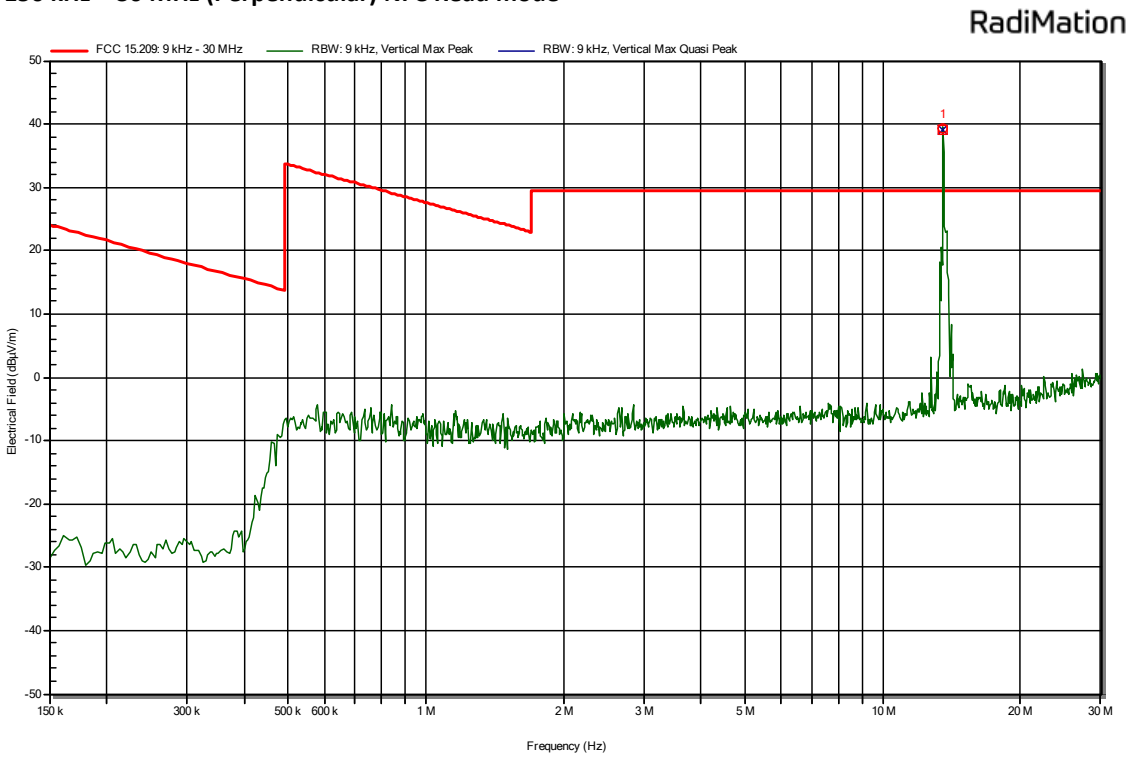


150 kHz – 30 MHz (Parallel) NFC read mode



Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

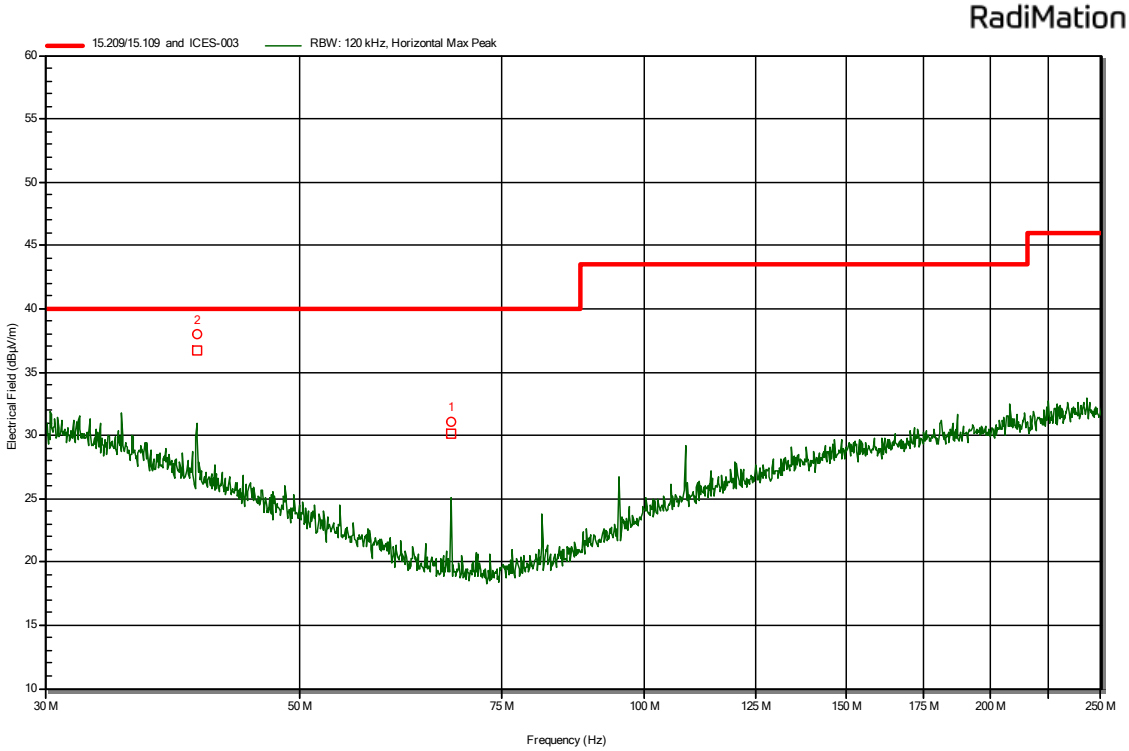
150 kHz – 30 MHz (Perpendicular) NFC Read mode



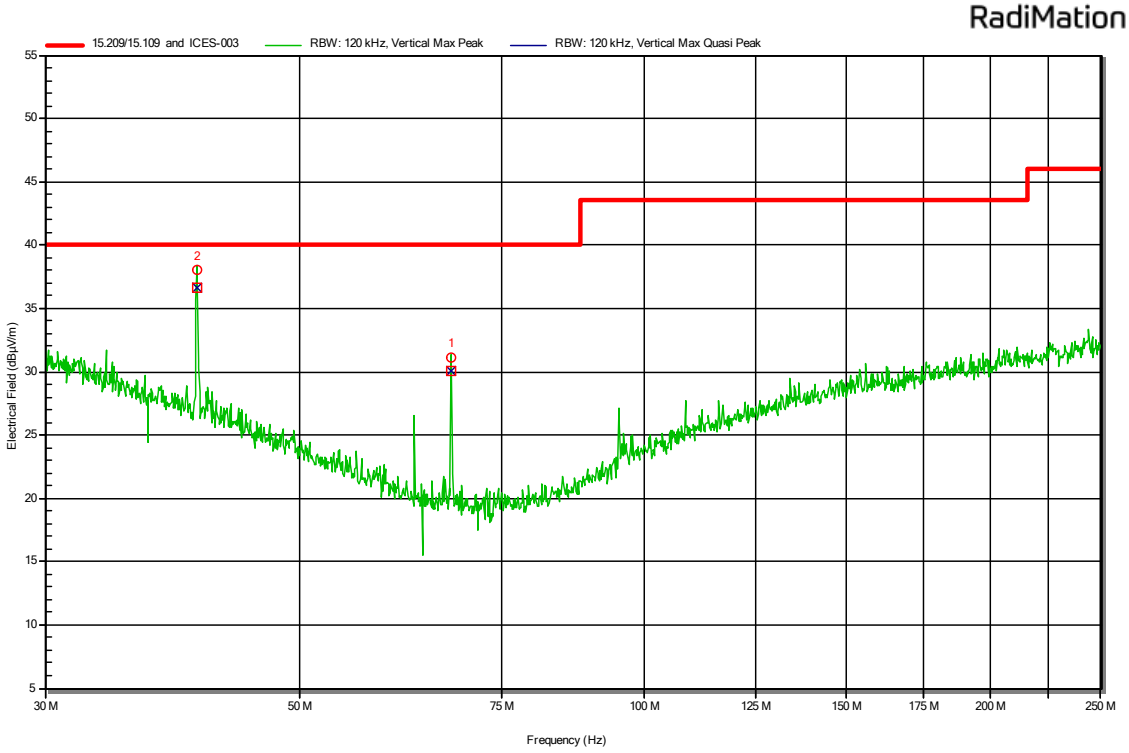
Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

30MHz – 250MHz NFC read mode

Horizontal

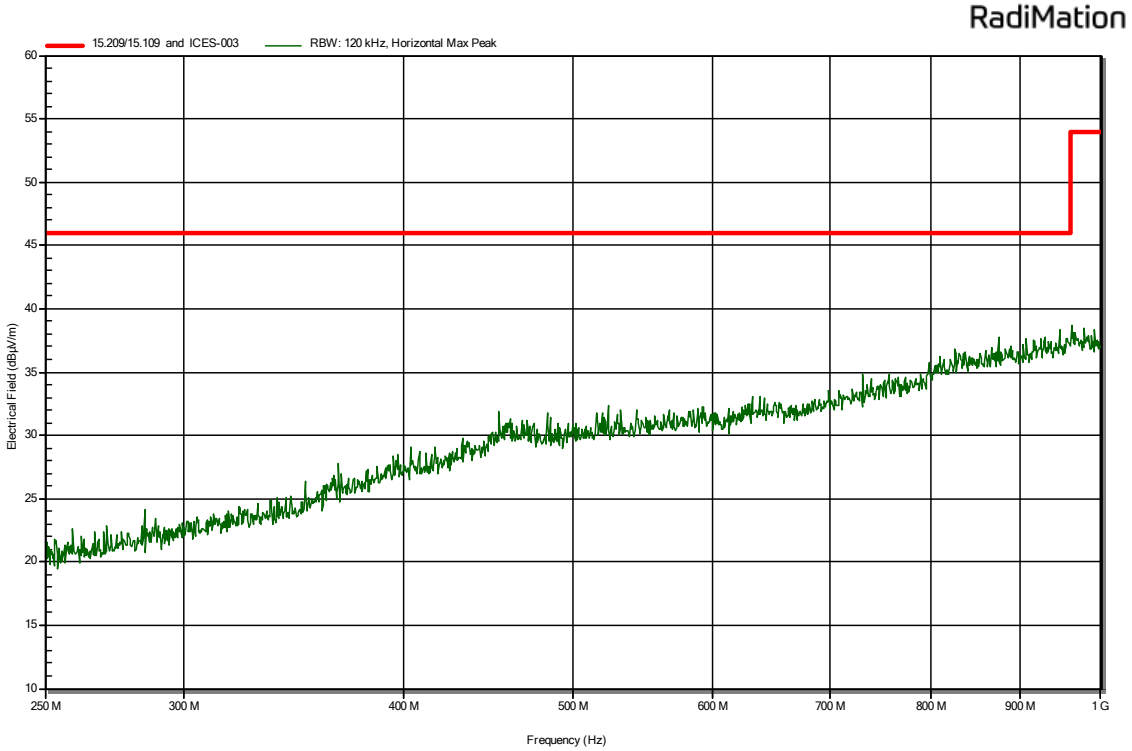


Vertical

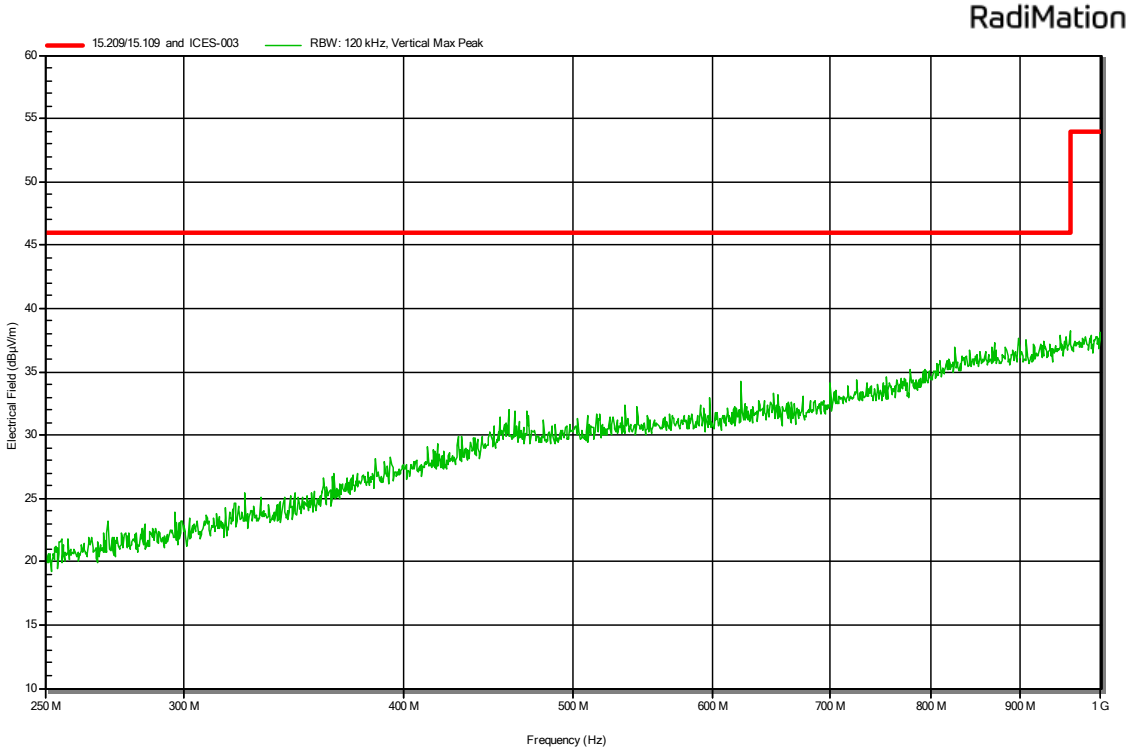


250MHz – 1000MHz NFC read mode

Horizontal

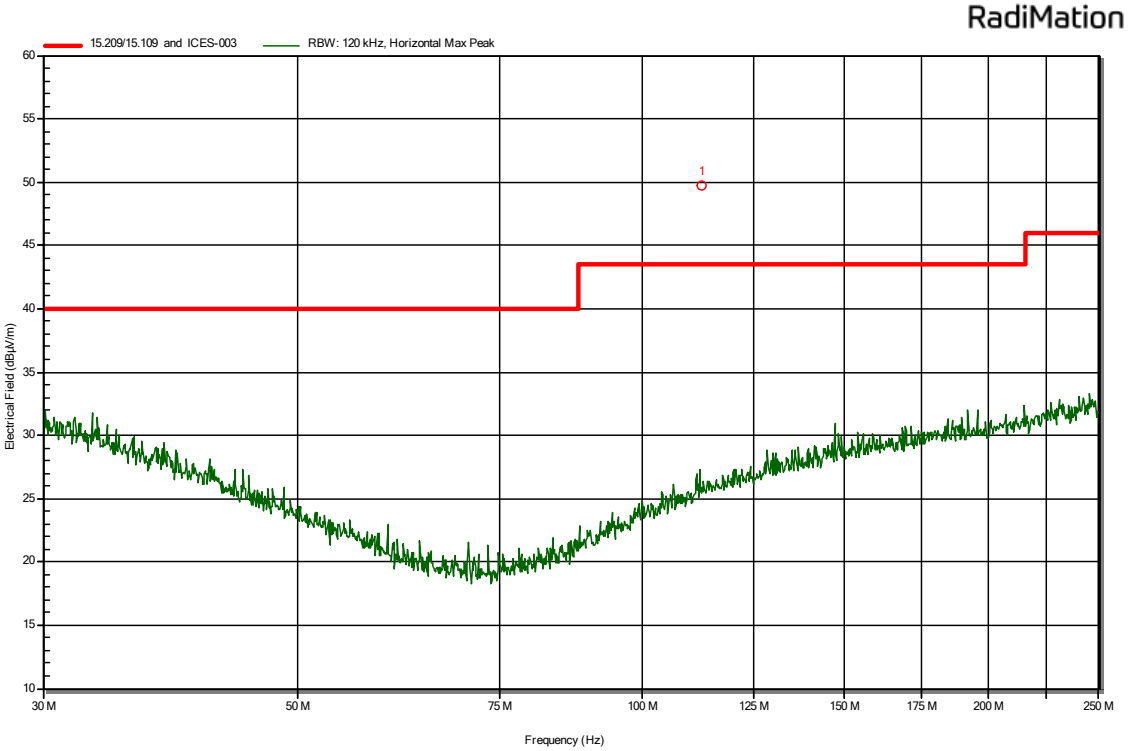


Vertical

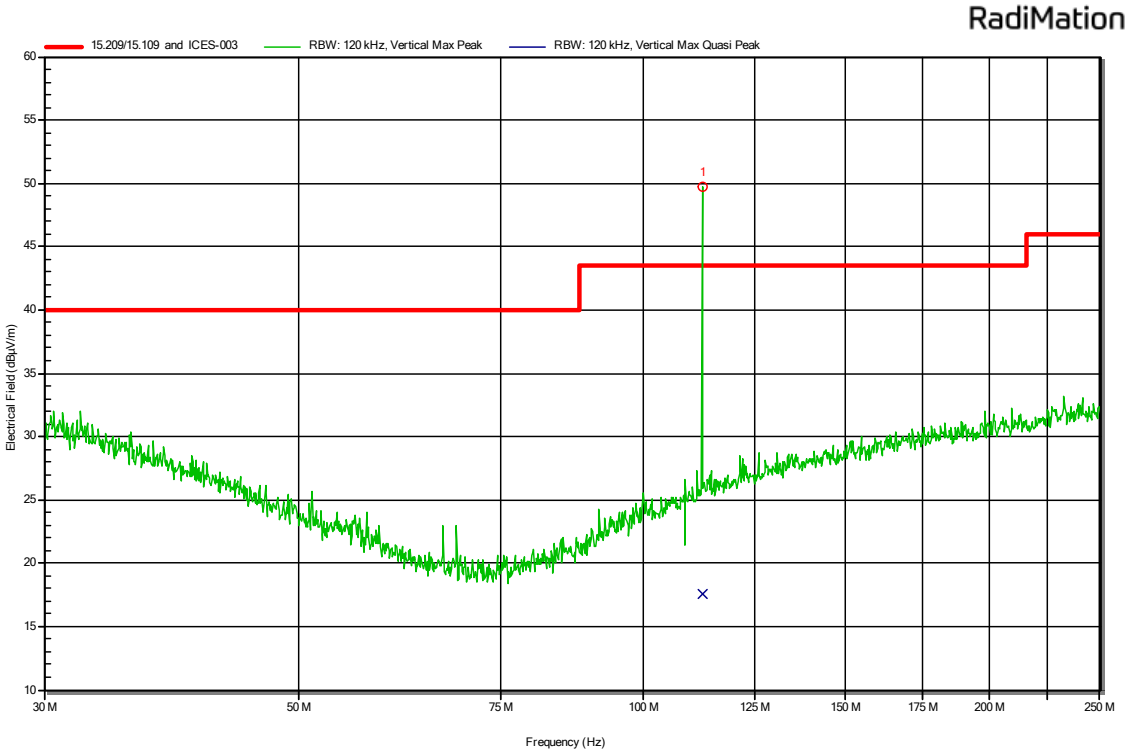


30MHz – 250MHz BLE low channel

Horizontal

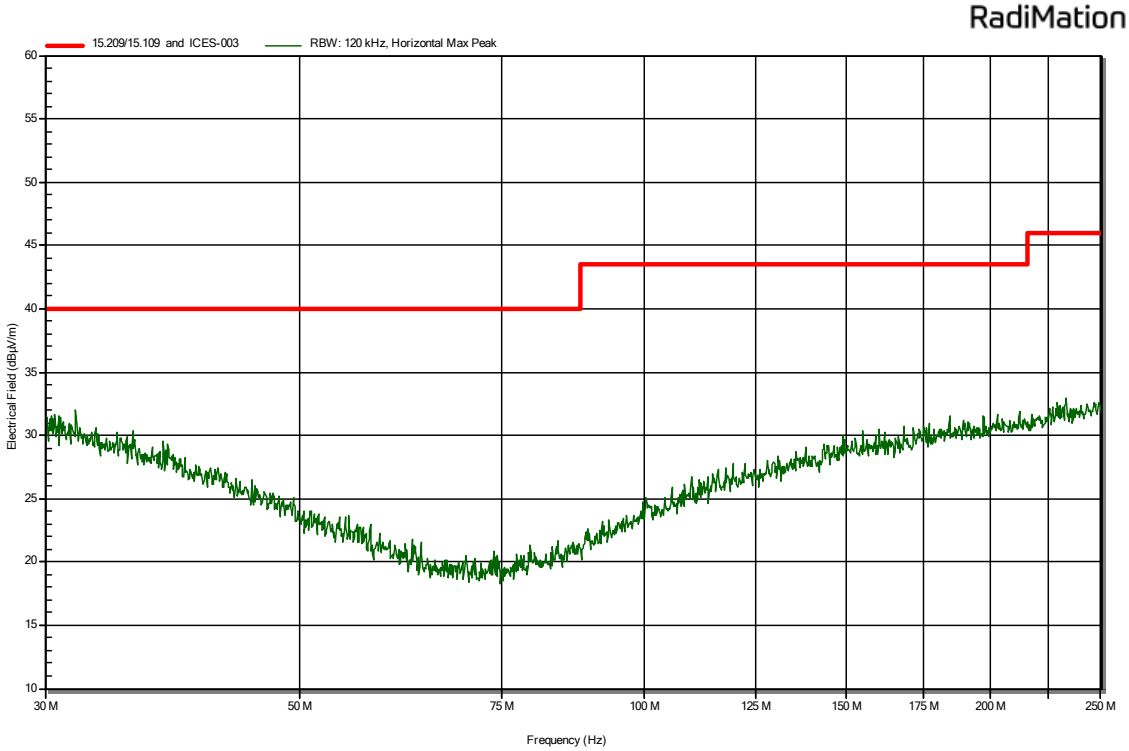


Vertical



30MHz – 250MHz BLE mid channel

Horizontal



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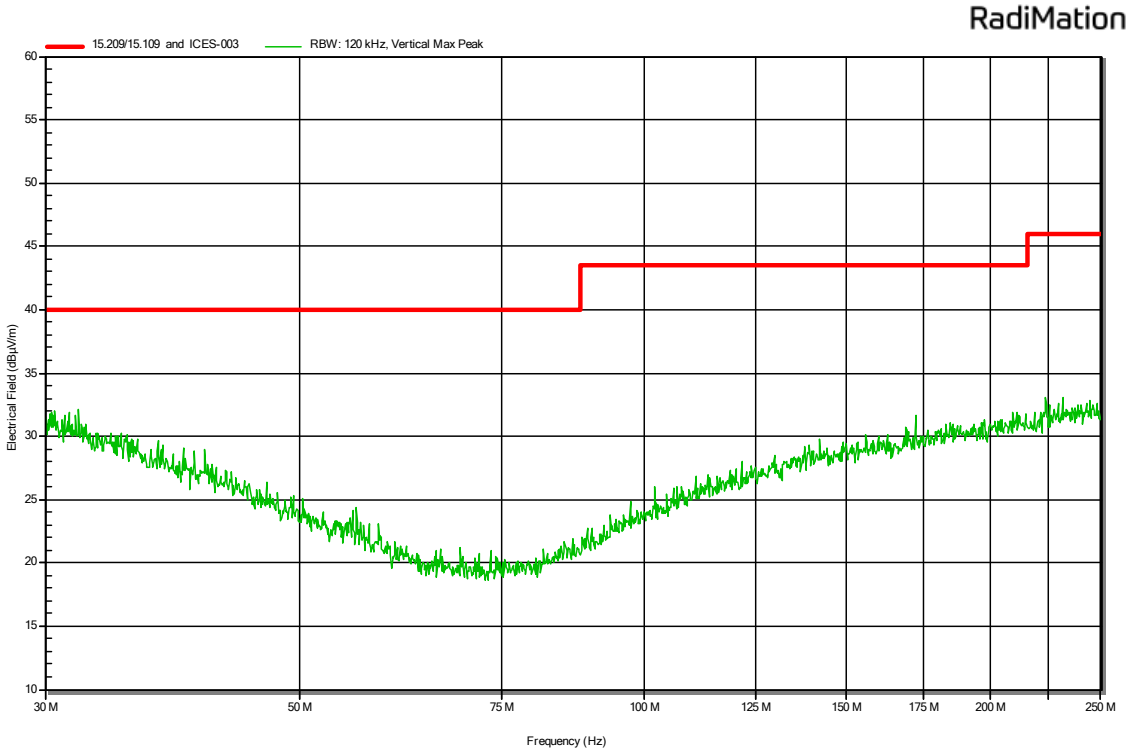
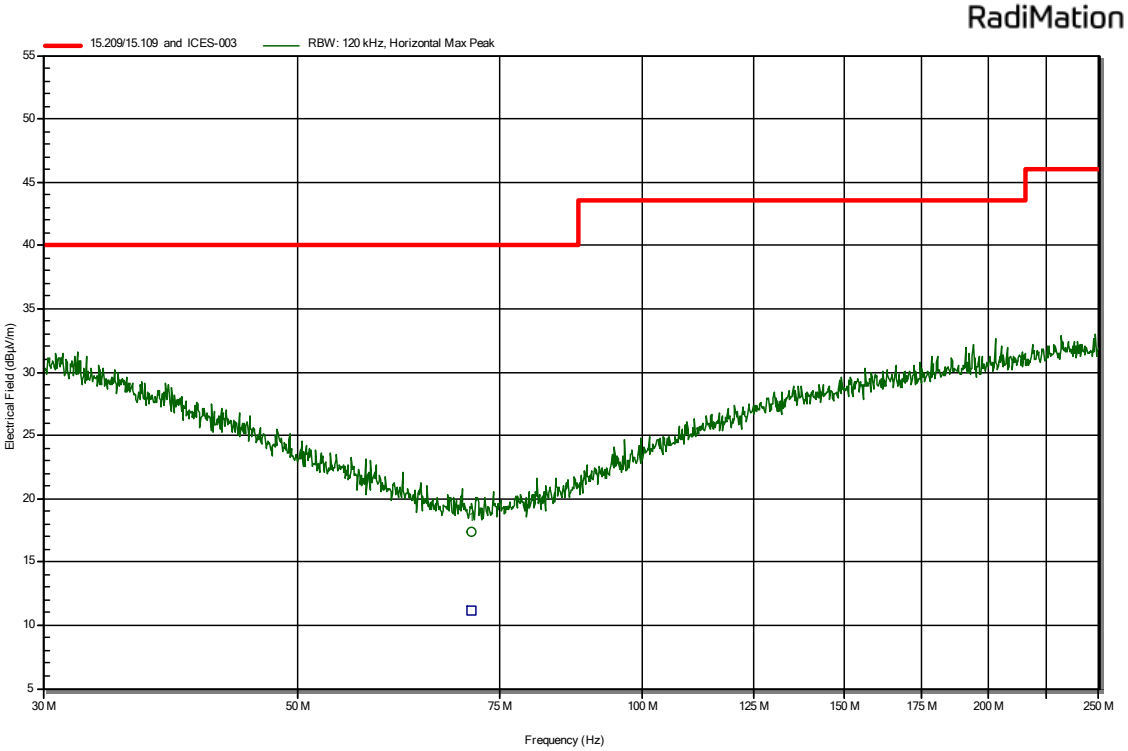
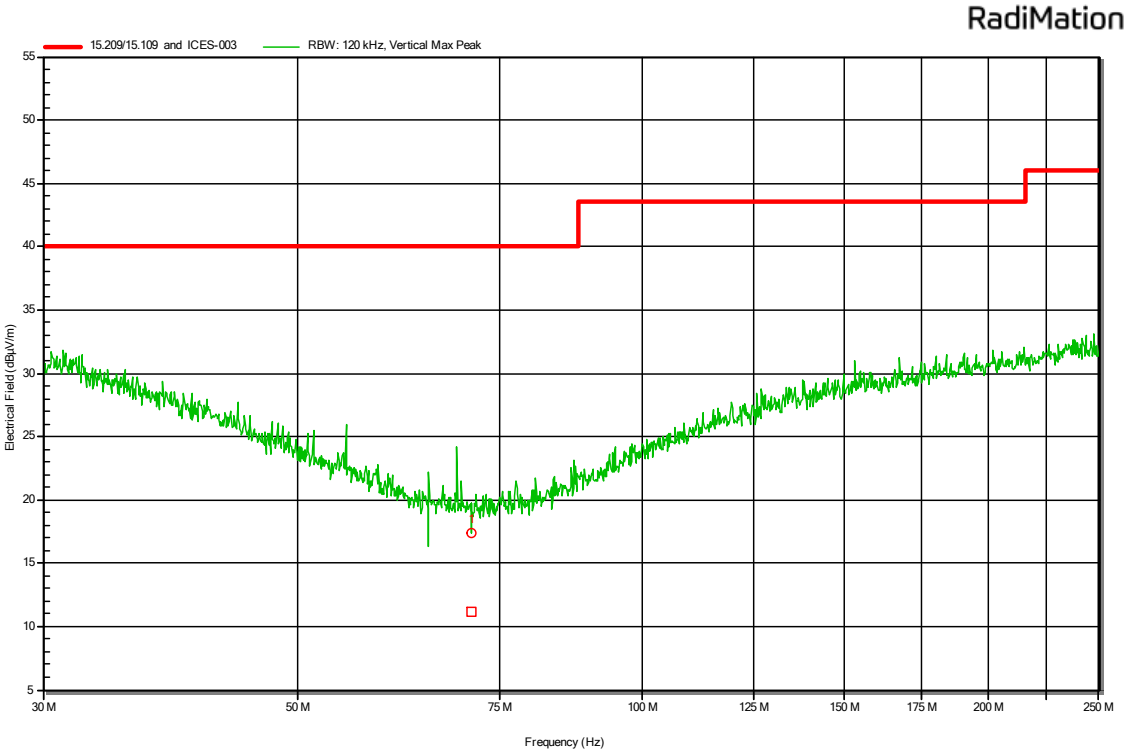


30MHz – 250MHz BLE high channel

Horizontal

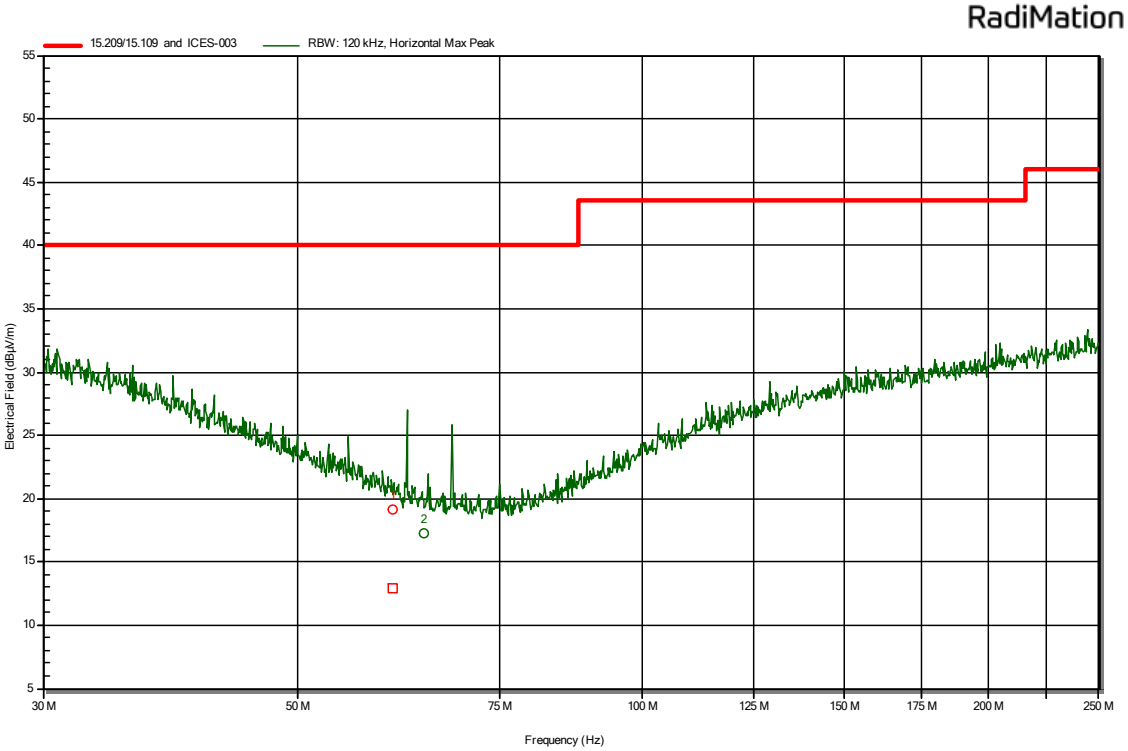


Vertical

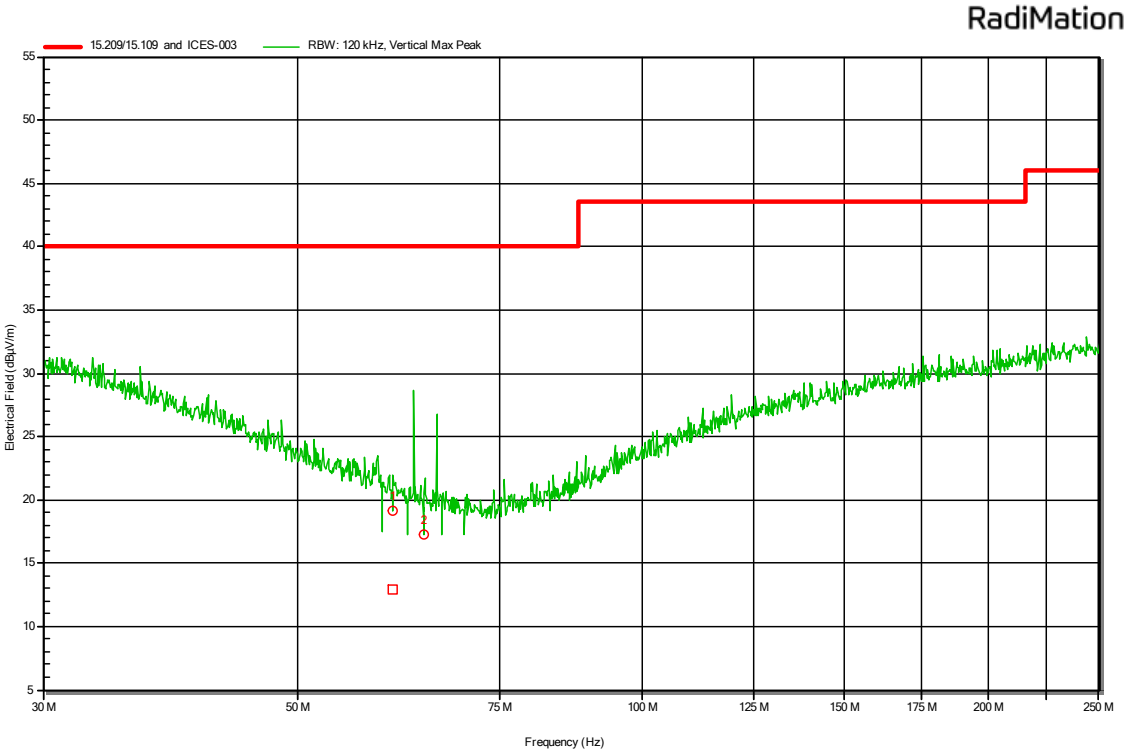


30MHz – 250MHz Proprietary 915MHz low channel

Horizontal

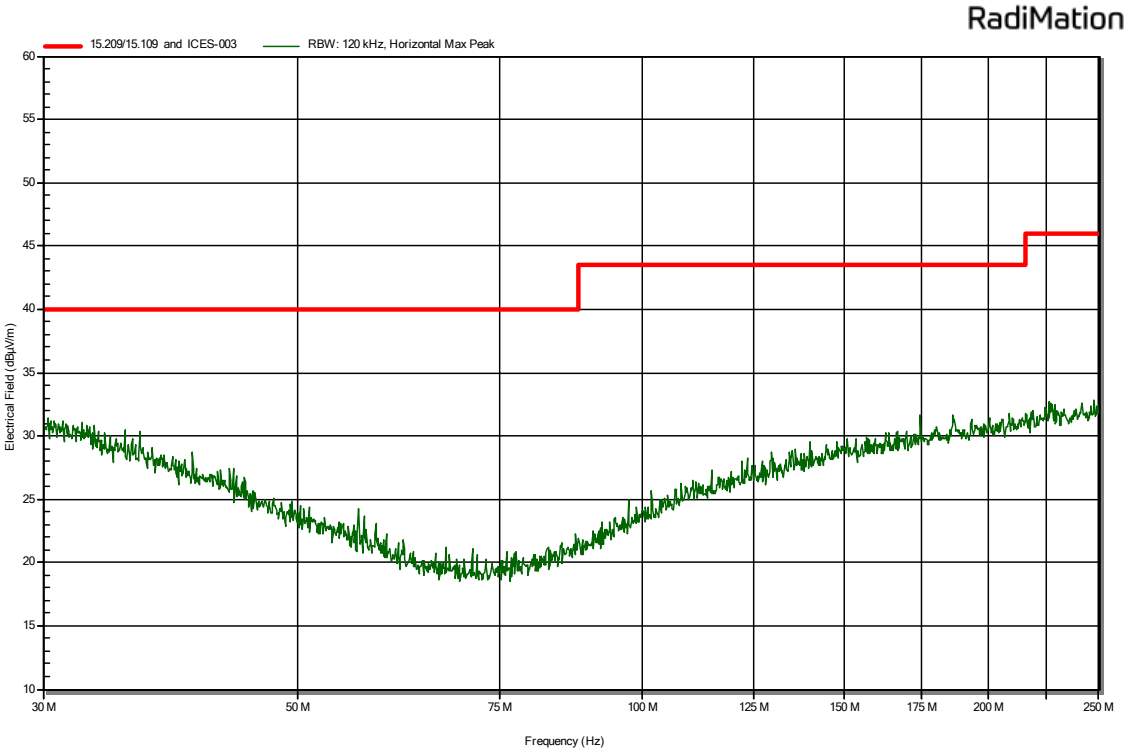


Vertical

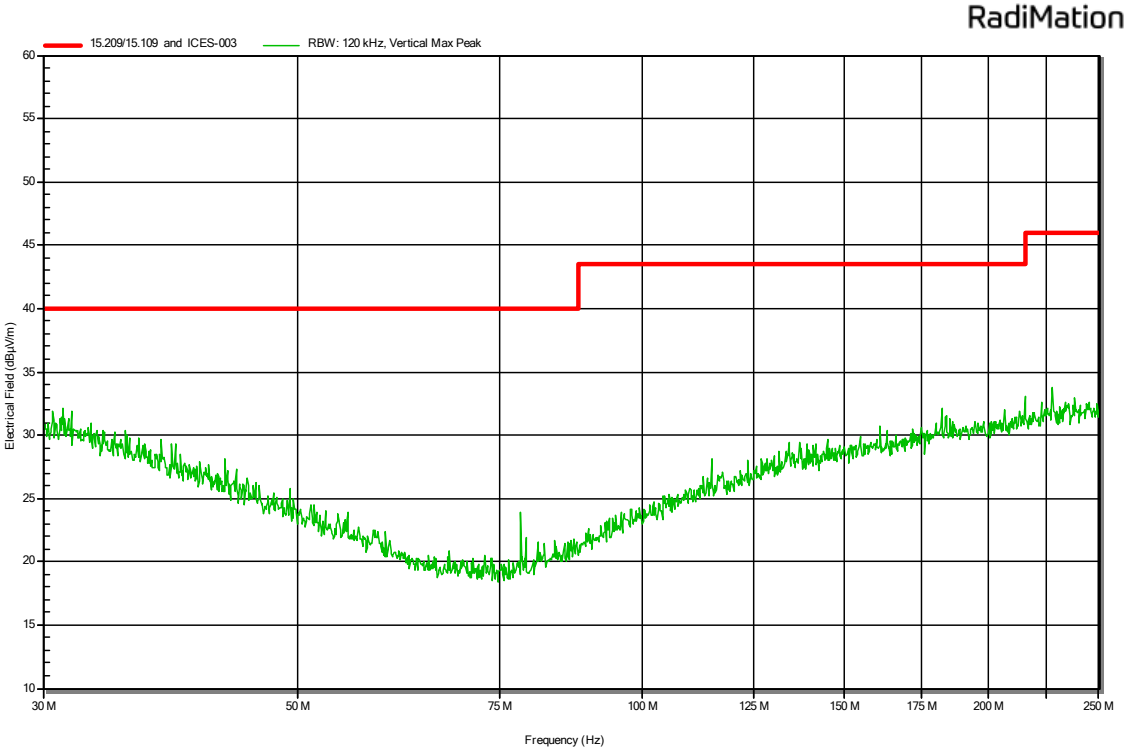


30MHz – 250MHz Proprietary 915MHz mid channel

Horizontal

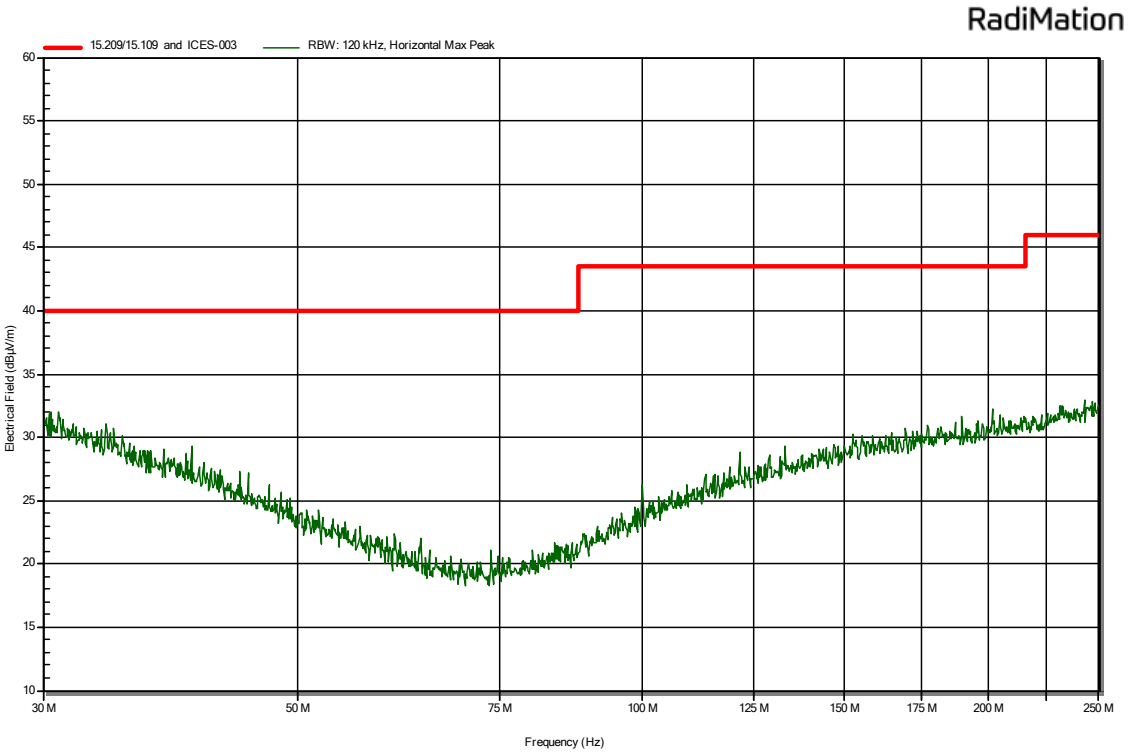


Vertical

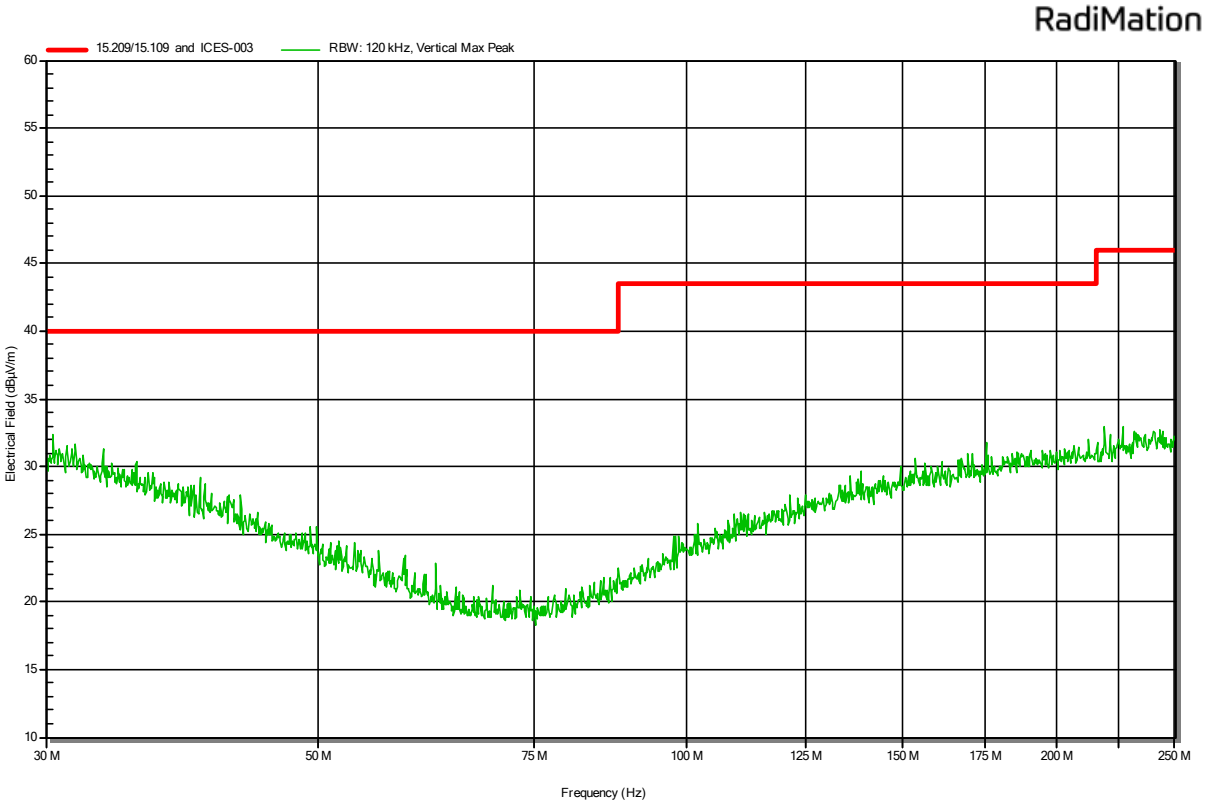


30MHz – 250MHz Proprietary 915MHz high channel

Horizontal

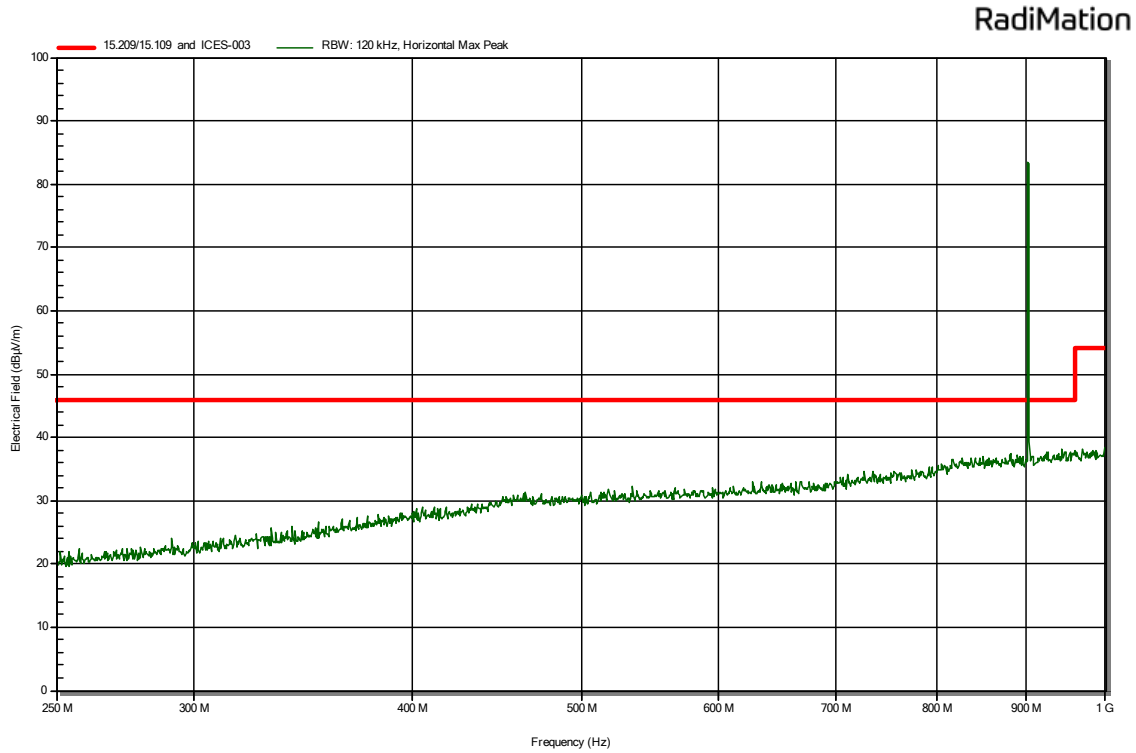


Vertical



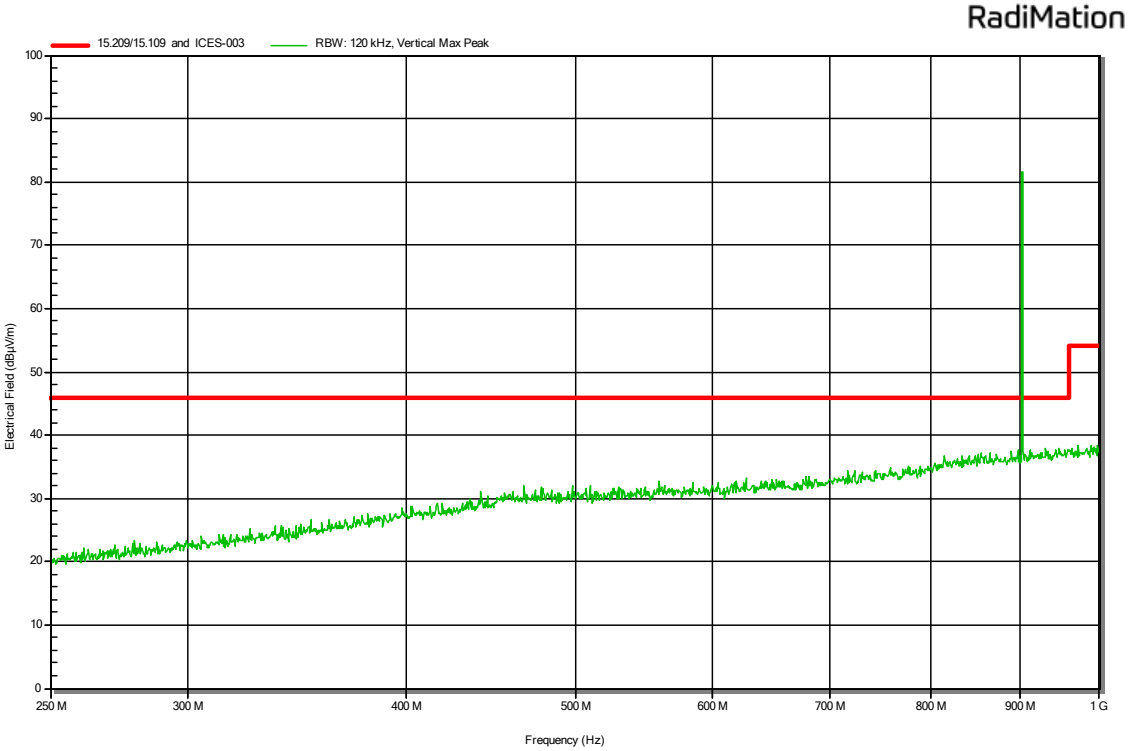
250MHz – 1000MHz Proprietary 915MHz low channel

Horizontal



Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

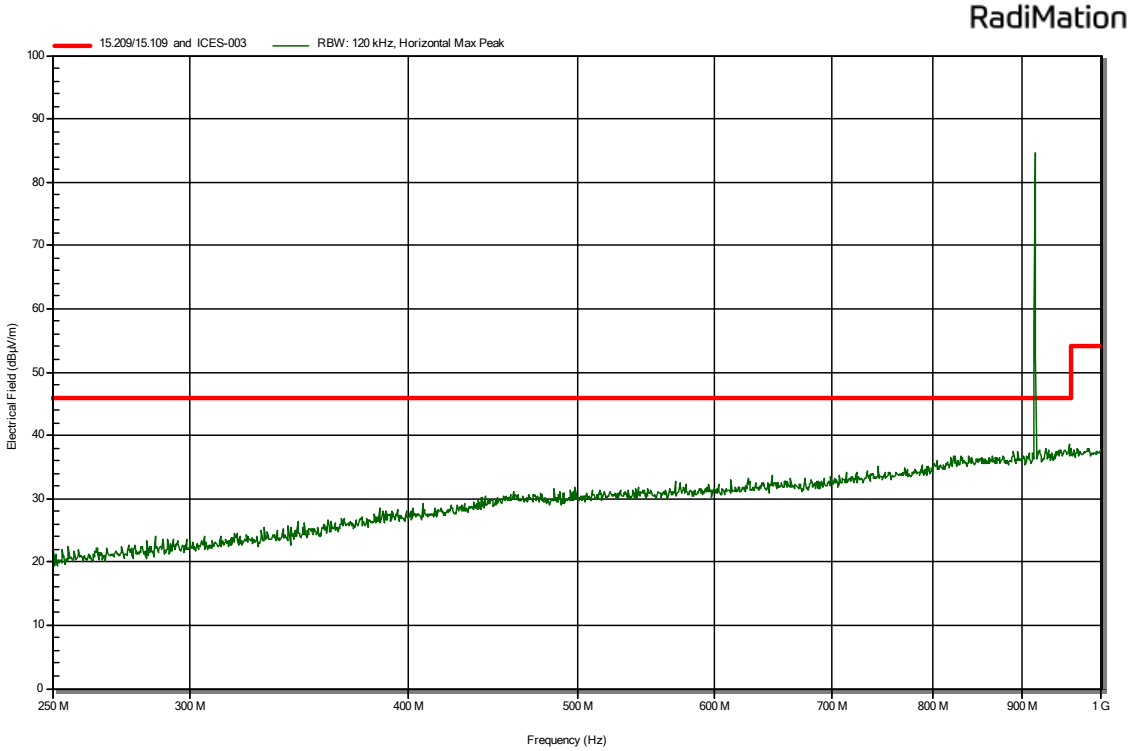
Vertical



Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

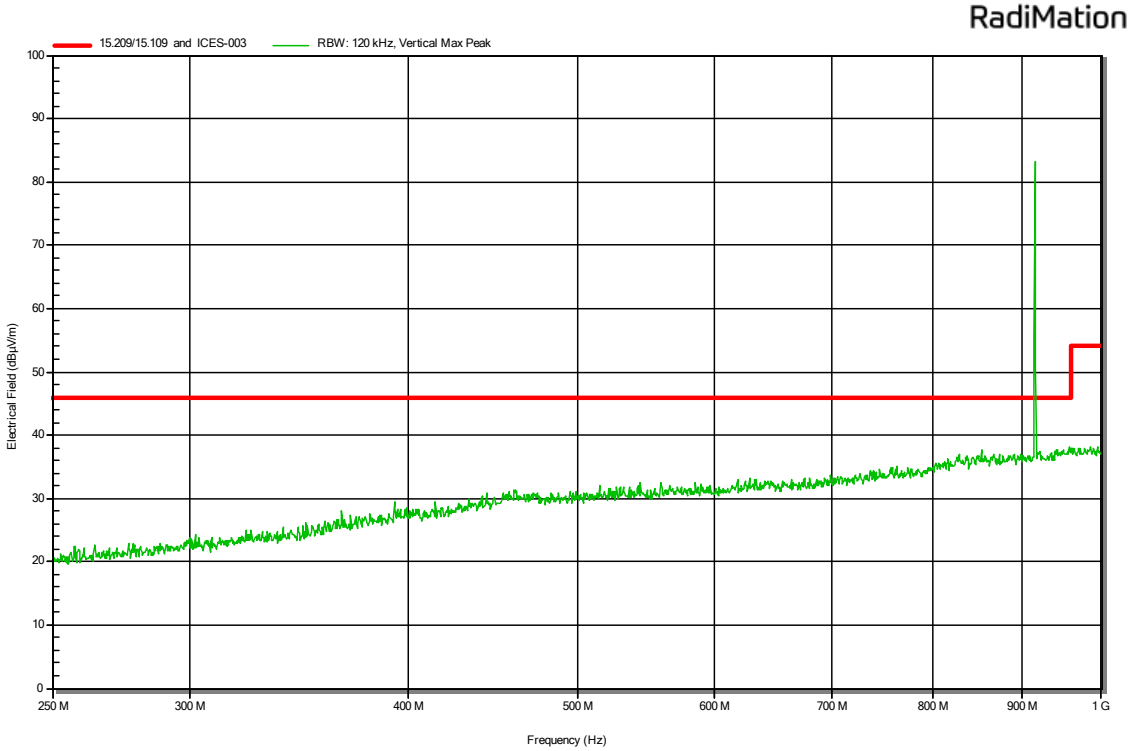
250MHz – 1000MHz Proprietary 915MHz mid channel

Horizontal



Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

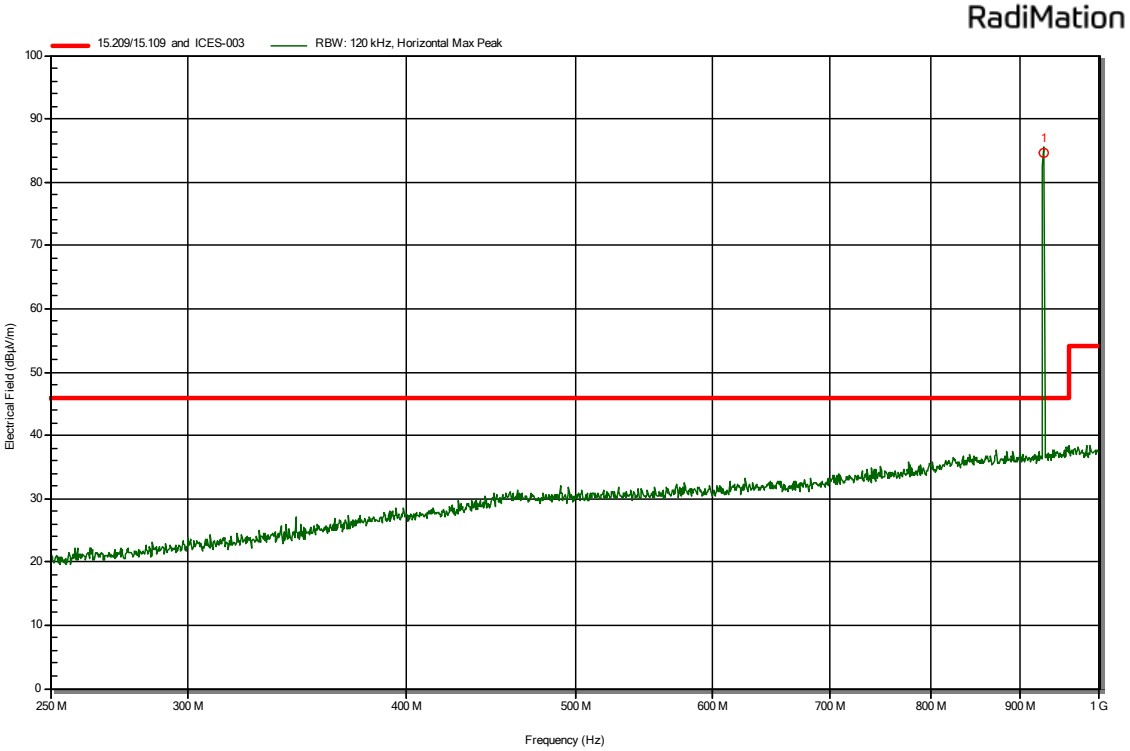
Vertical



Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

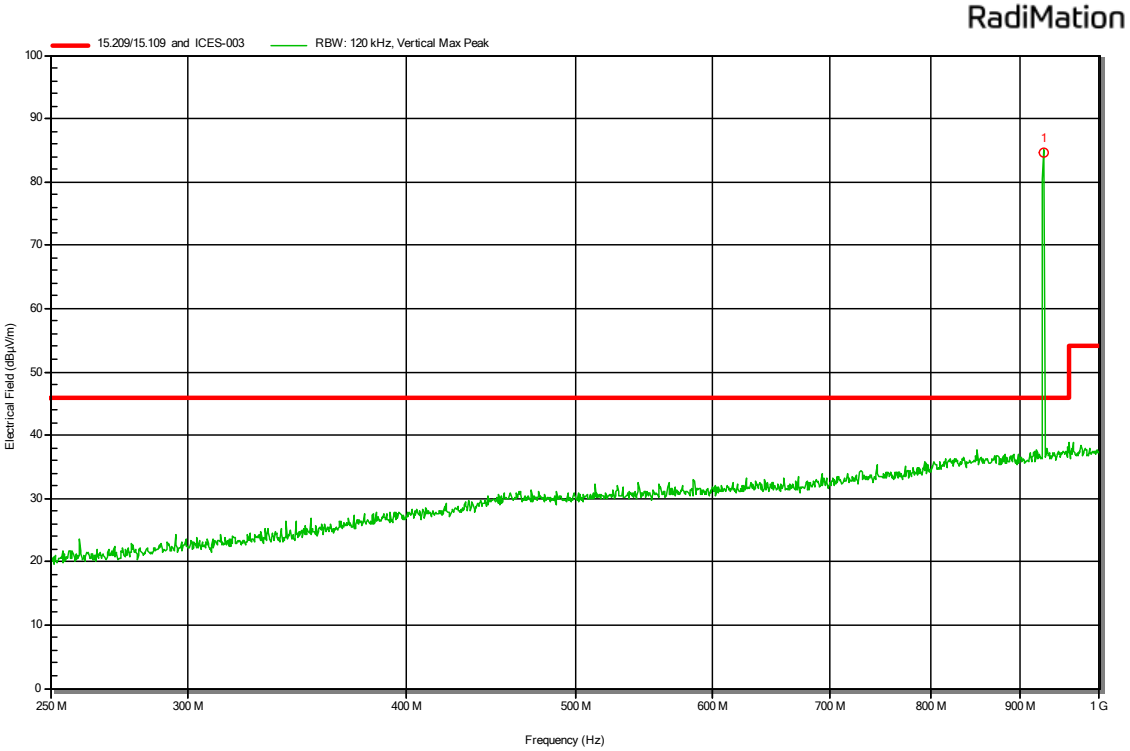
250MHz – 1000MHz Proprietary 915MHz high channel

Horizontal



Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

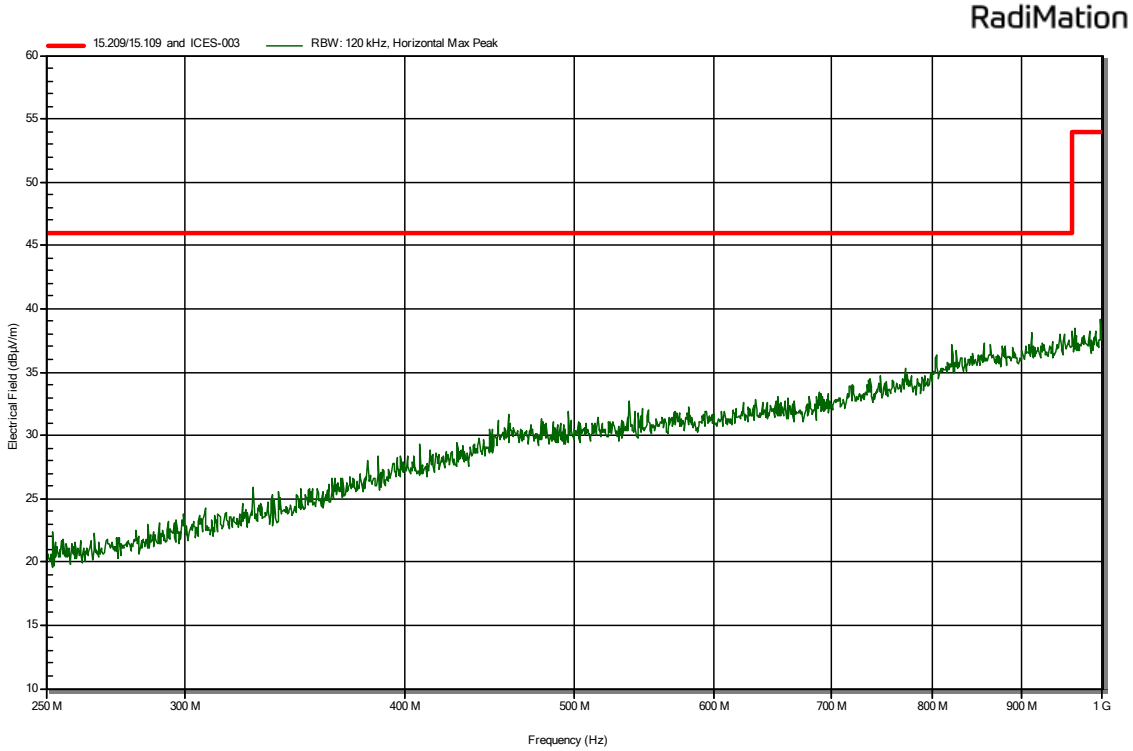
Vertical



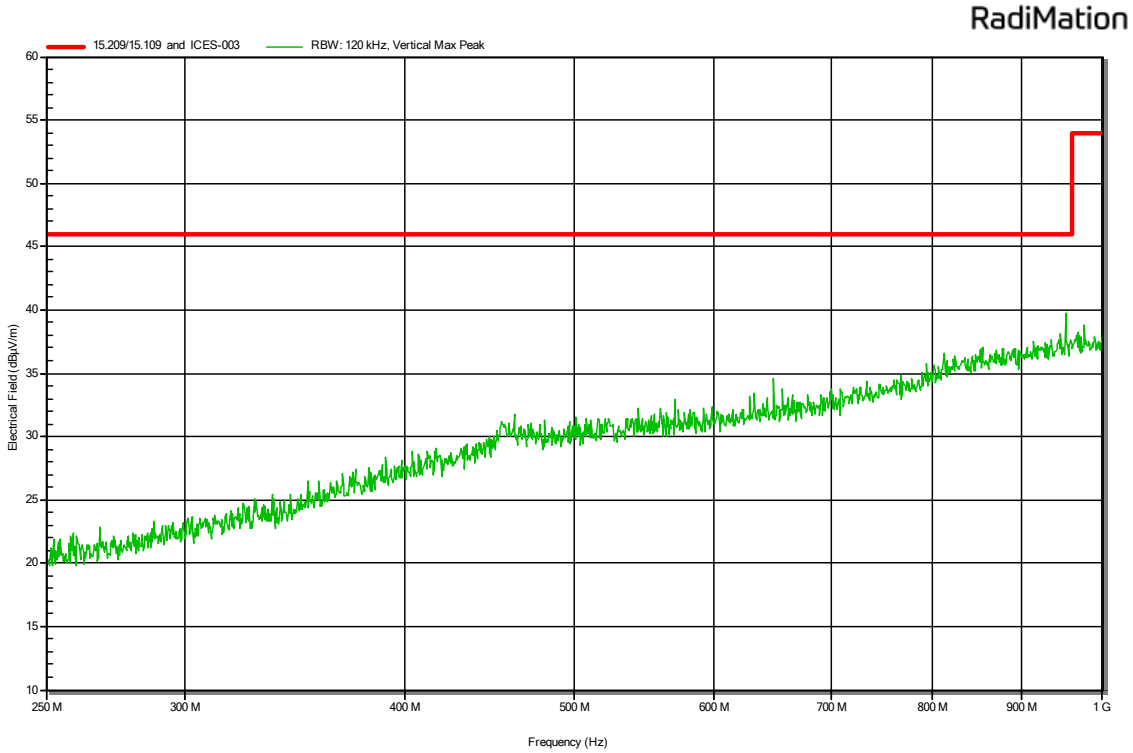
Note: The peak in the above graph is the transmitted signal and is not subject to the limit line.

250MHz – 1000MHz BLE low channel

Horizontal

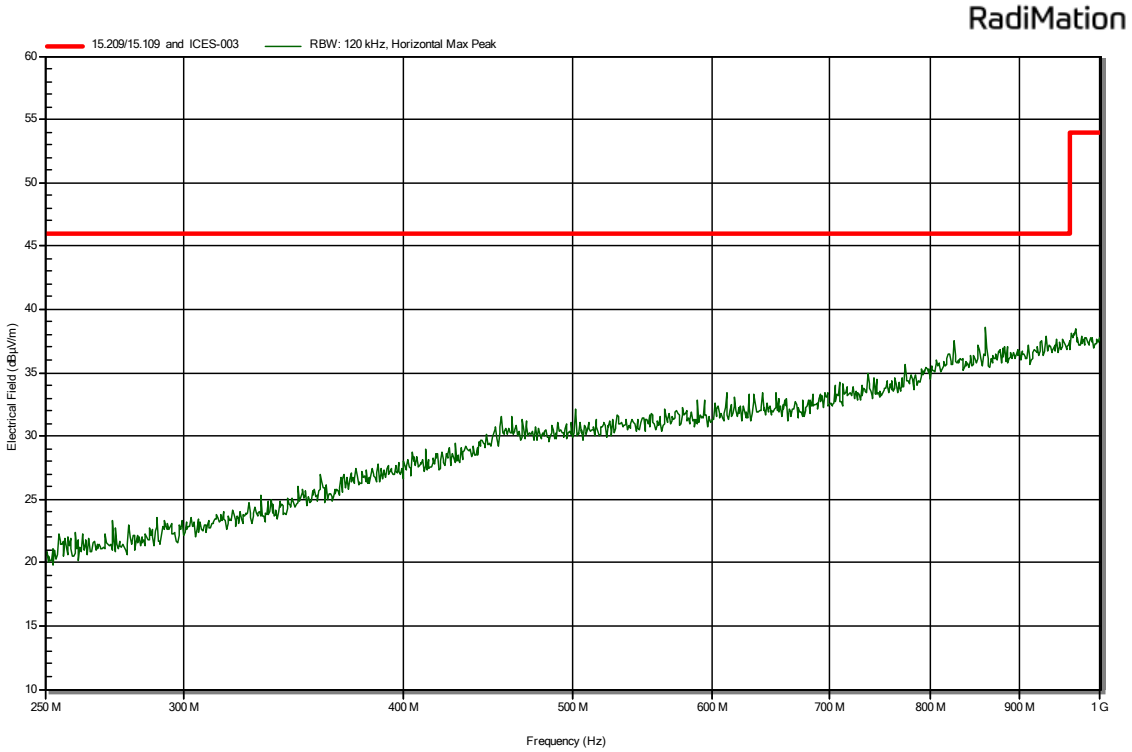


Vertical

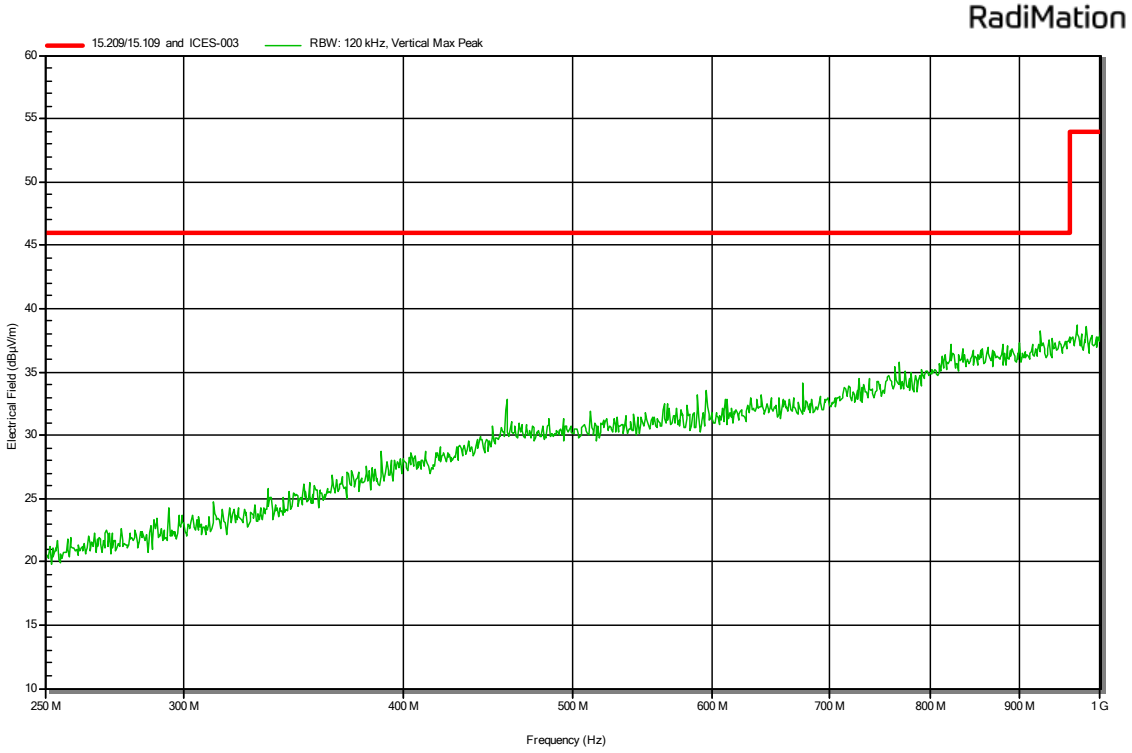


250MHz – 1000MHz BLE mid channel

Horizontal

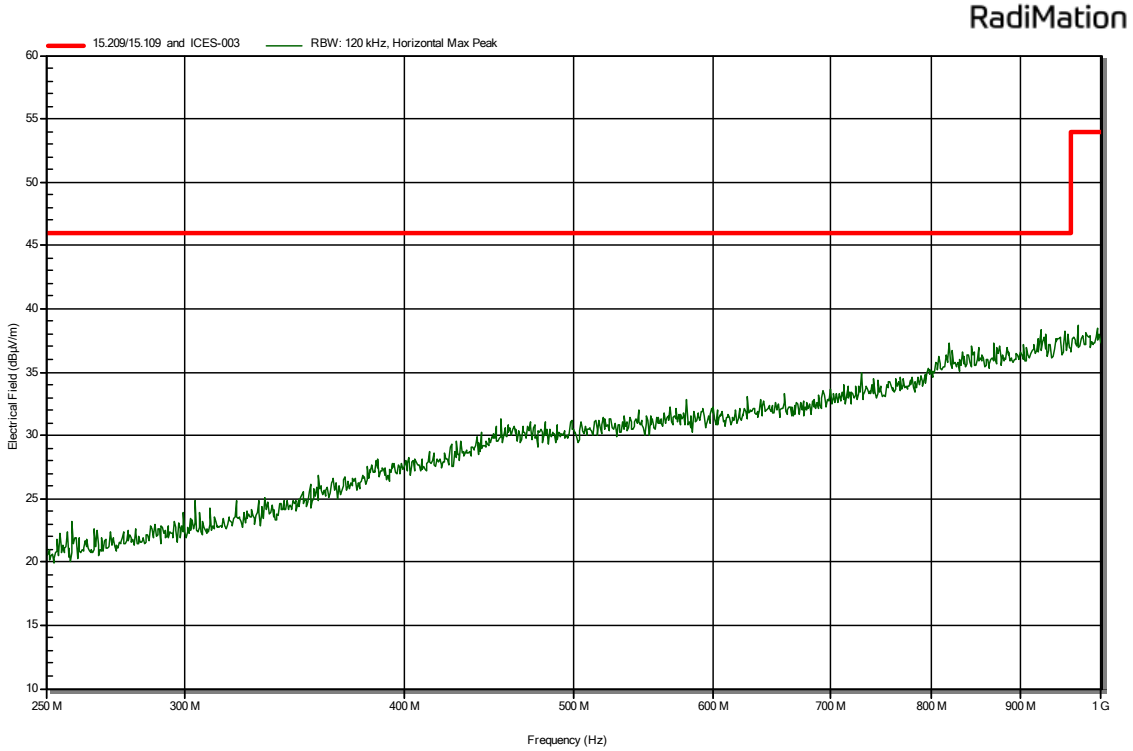


Vertical

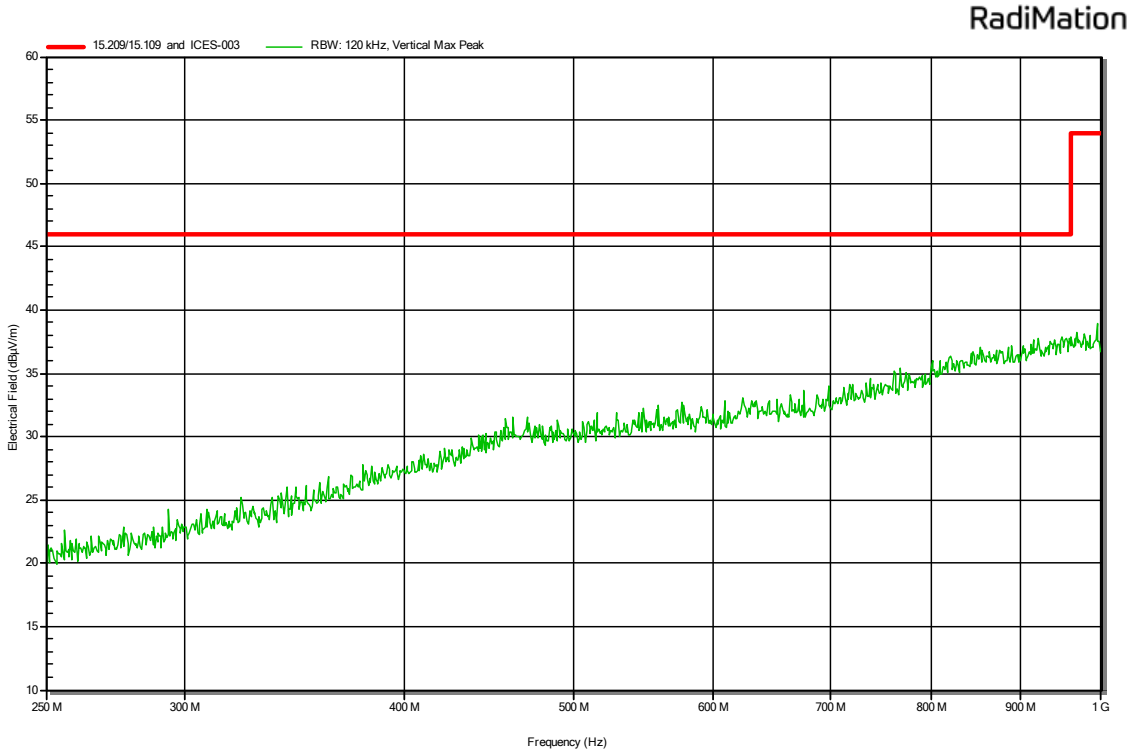


250MHz – 1000MHz BLE high channel

Horizontal

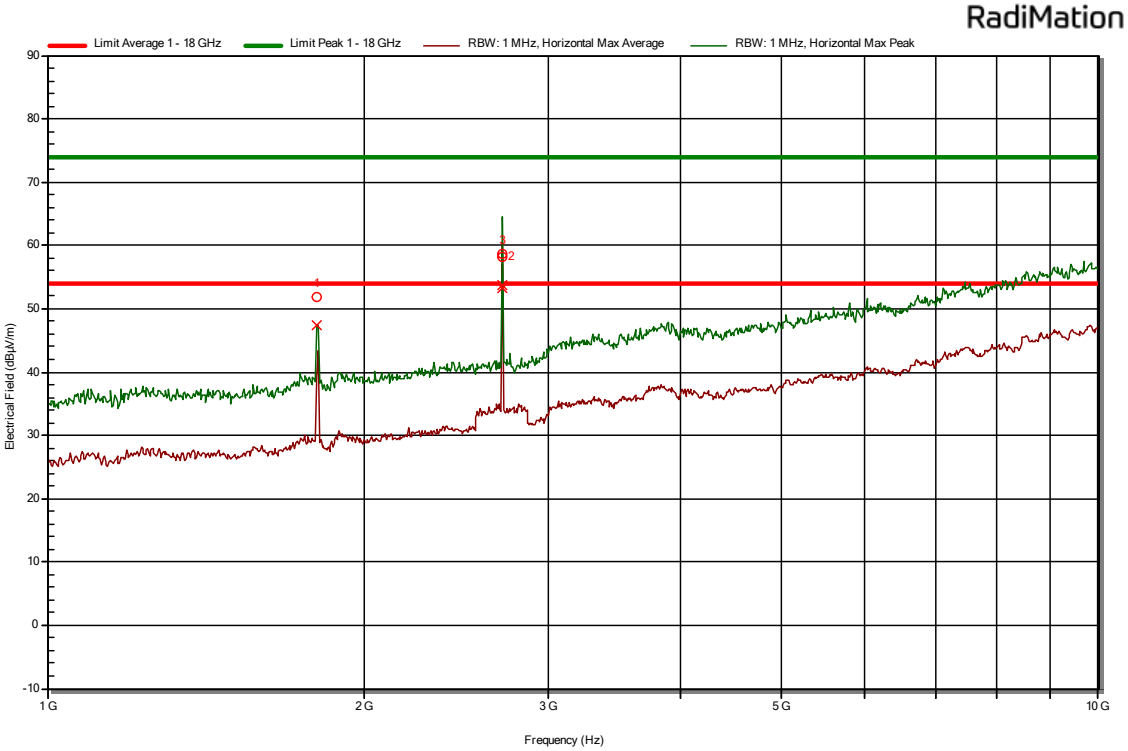


Vertical

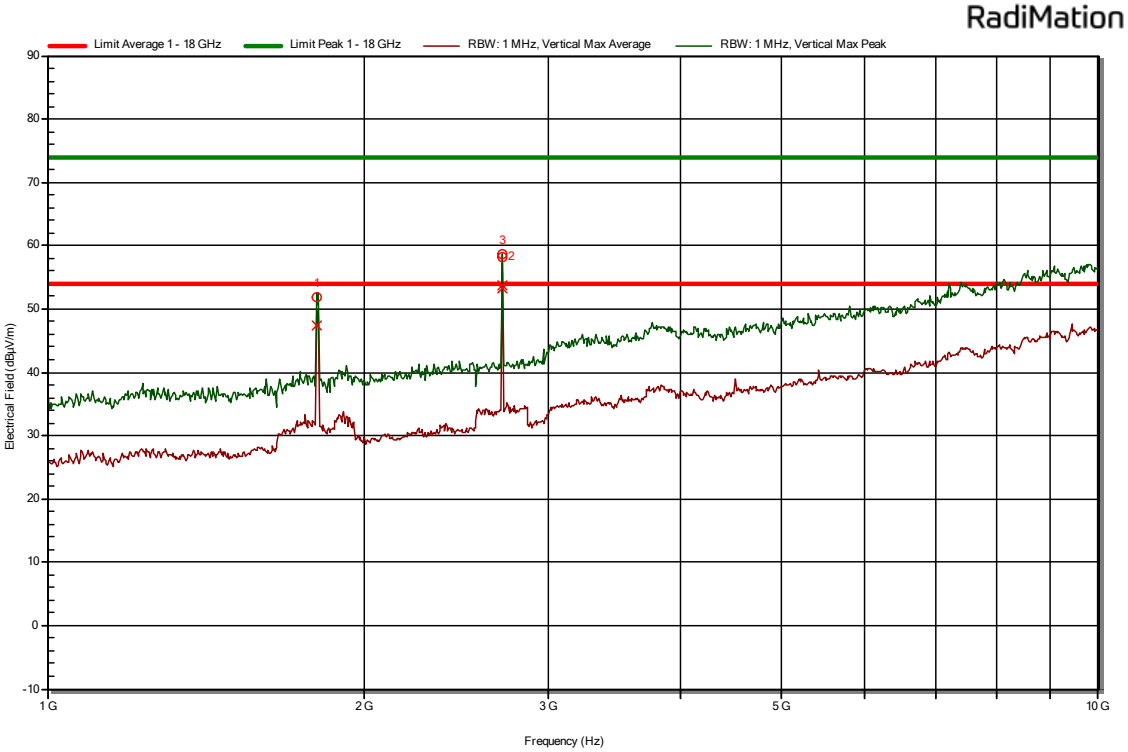


1GHz – 10GHz Proprietary 915MHz low channel

Horizontal

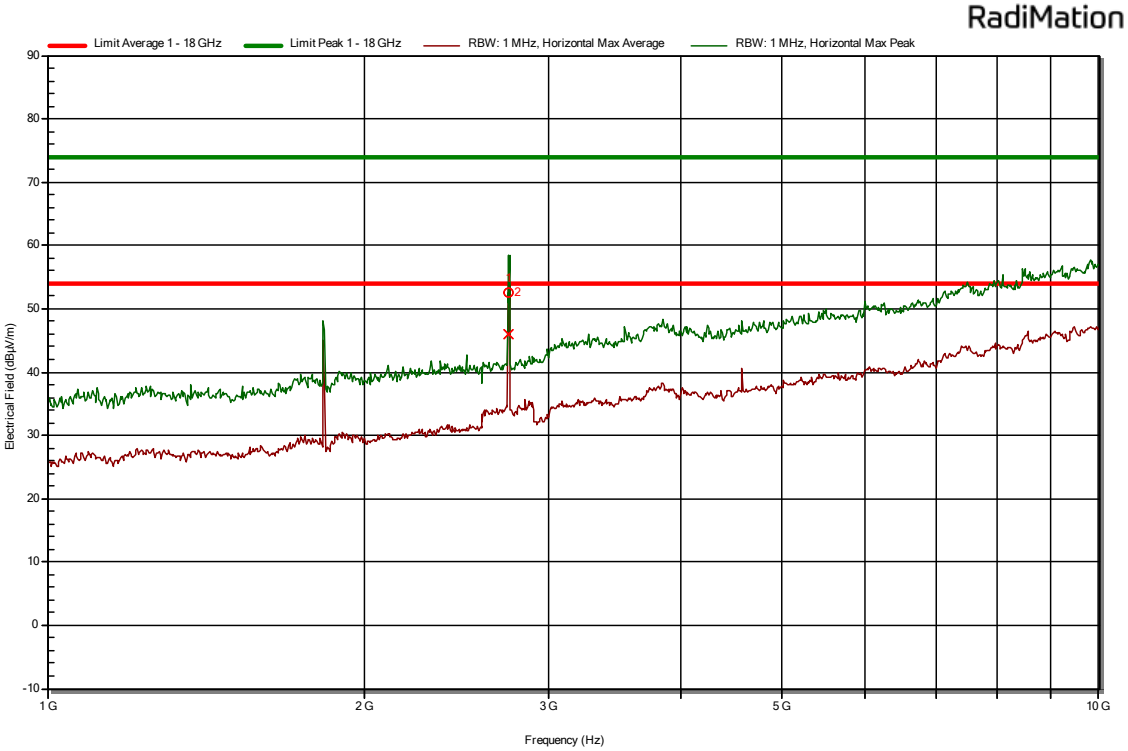


Vertical

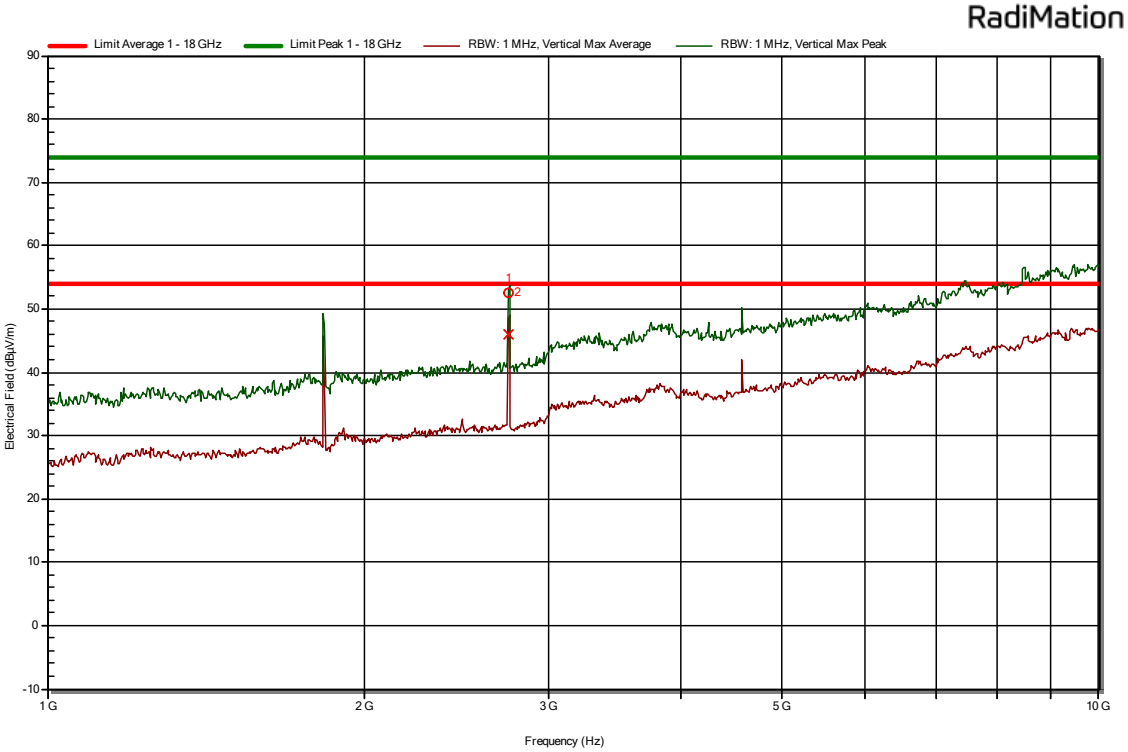


1GHz – 10GHz Proprietary 915MHz mid channel

Horizontal

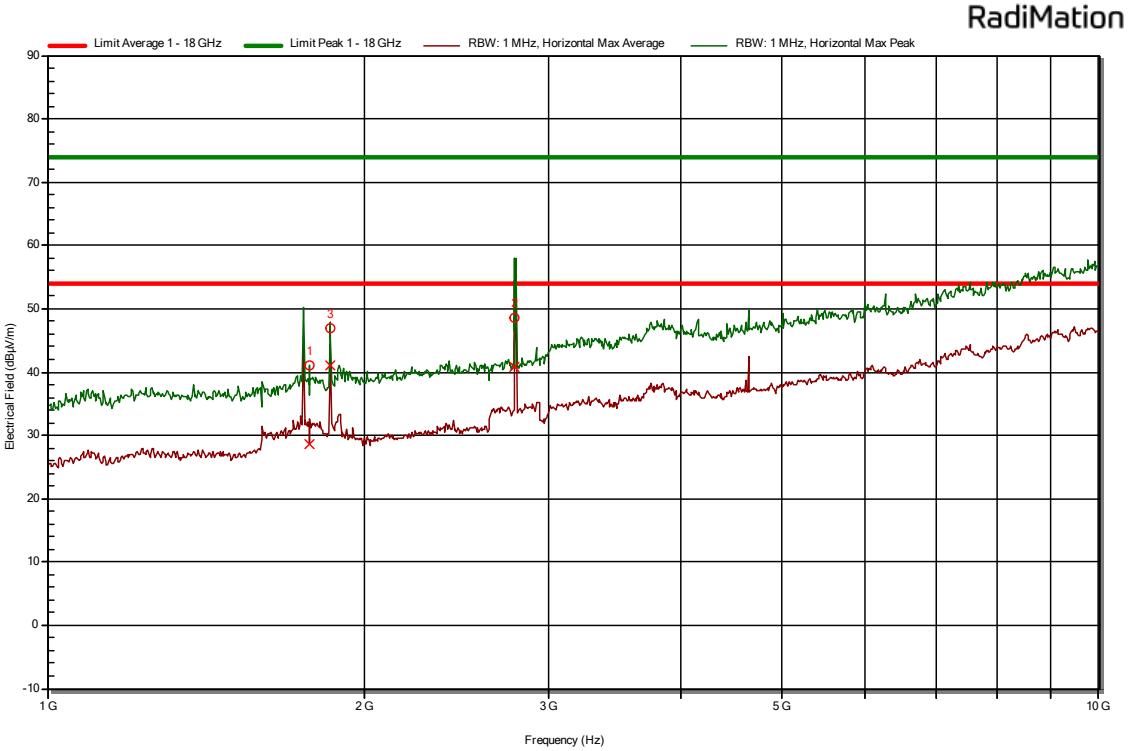


Vertical

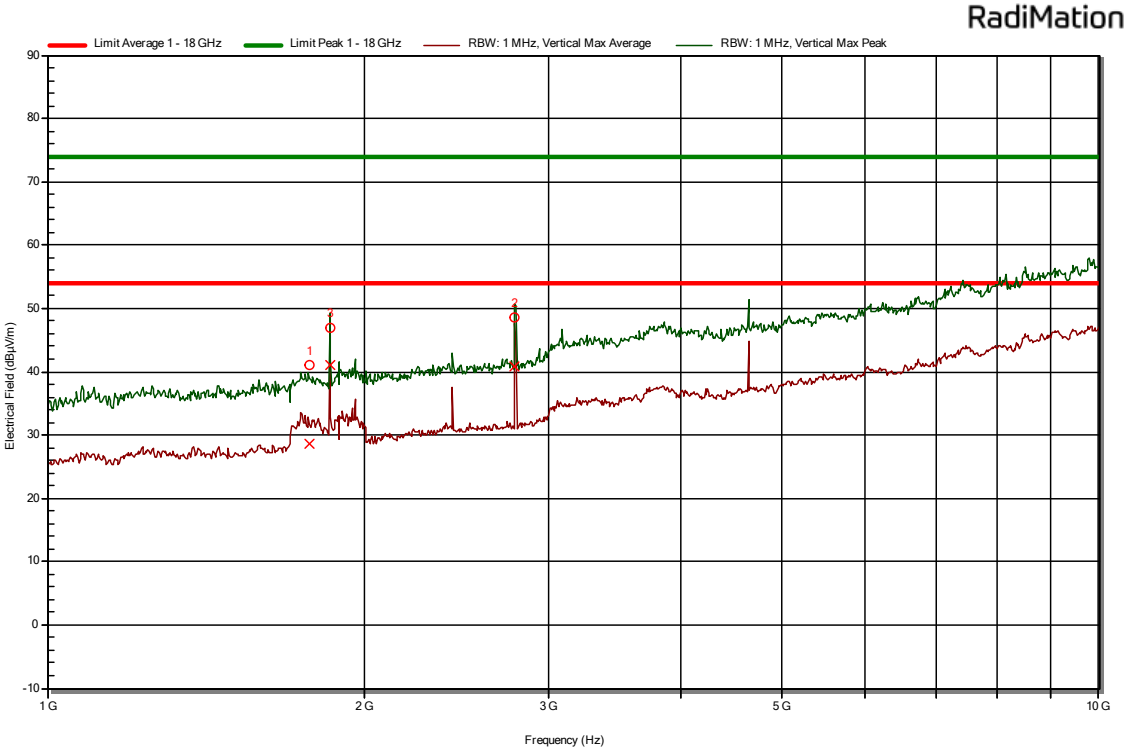


1GHz – 10GHz Proprietary 915MHz high channel

Horizontal

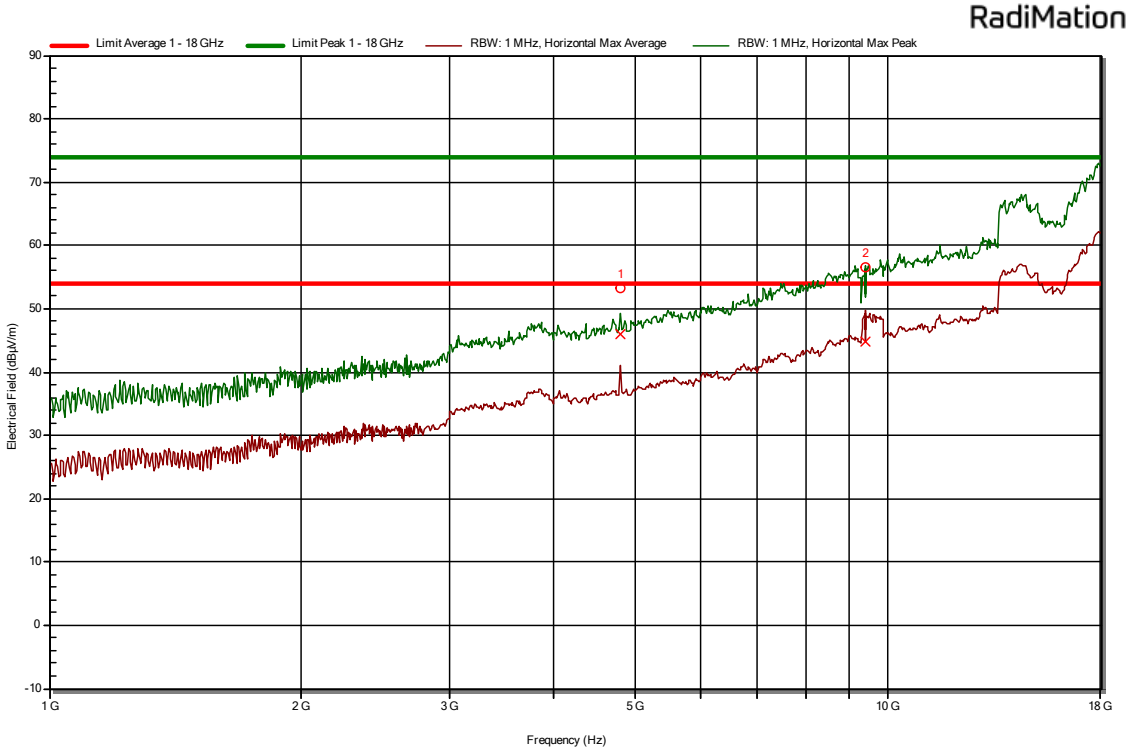


Vertical

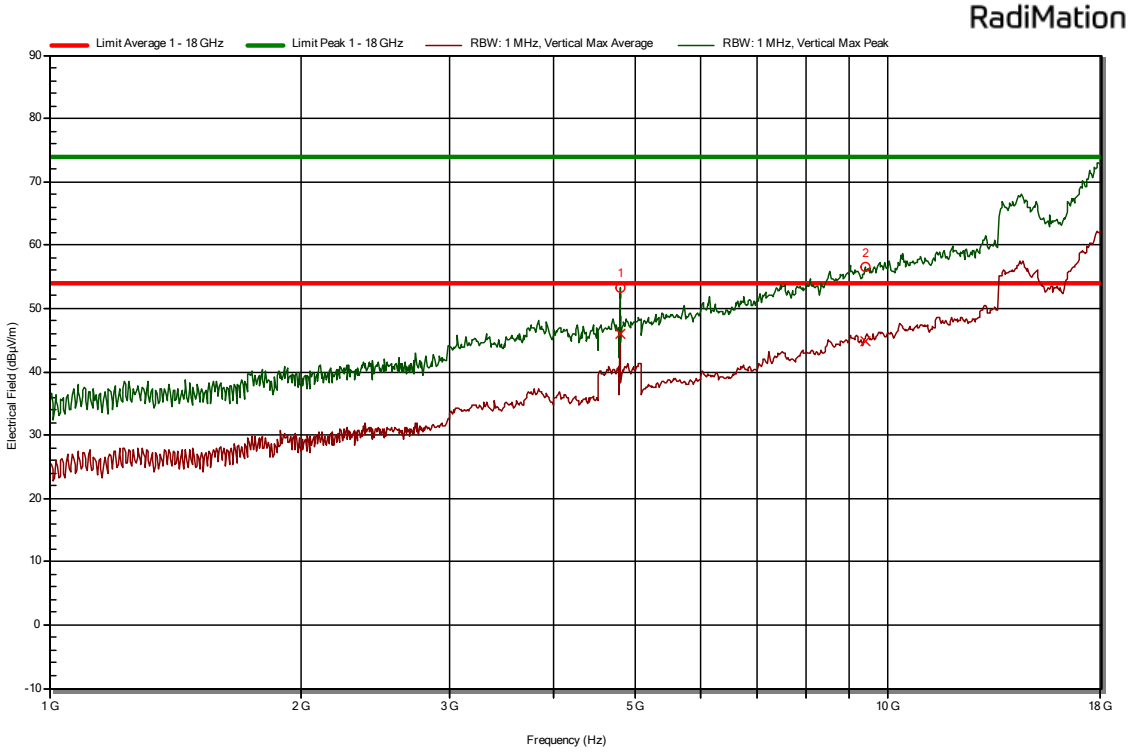


1GHz – 18GHz BLE low channel (no tag)

Horizontal

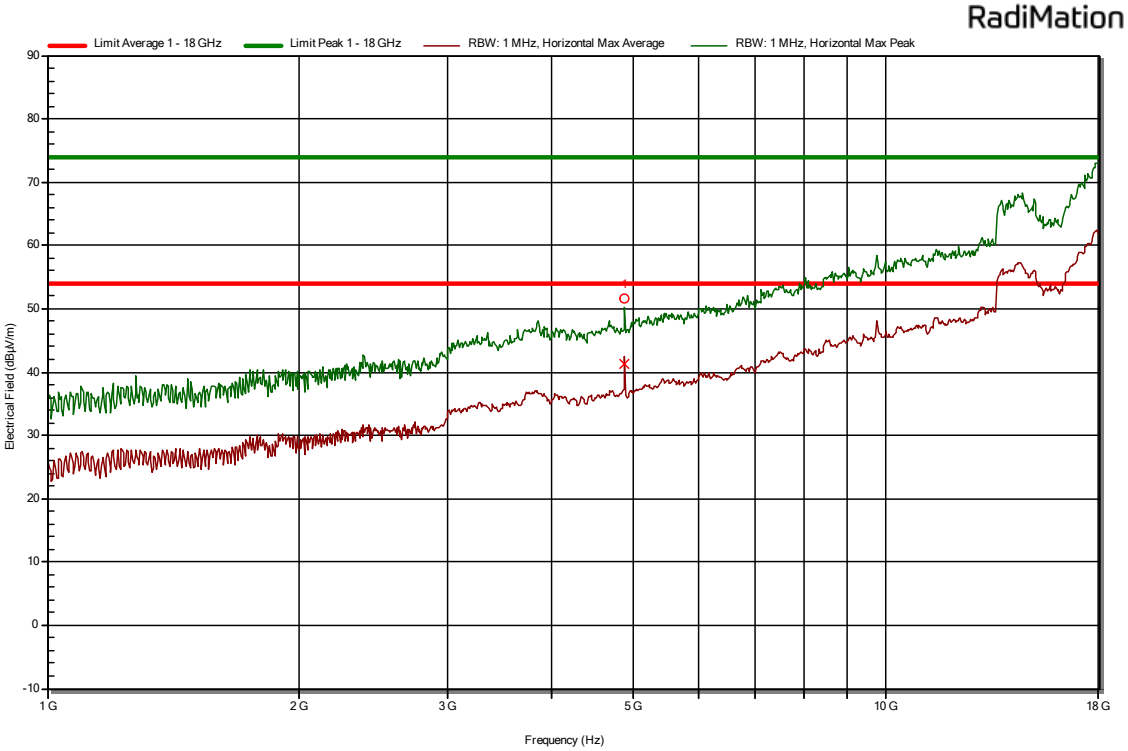


Vertical

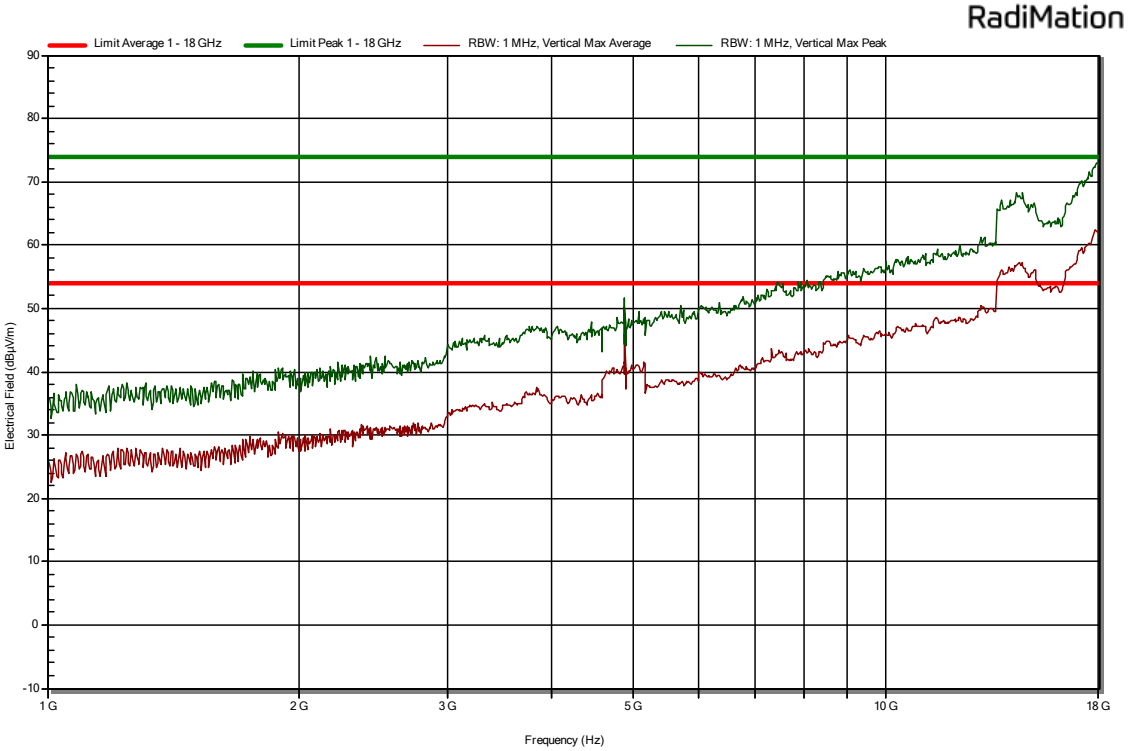


1GHz – 18GHz BLE mid channel (no tag)

Horizontal



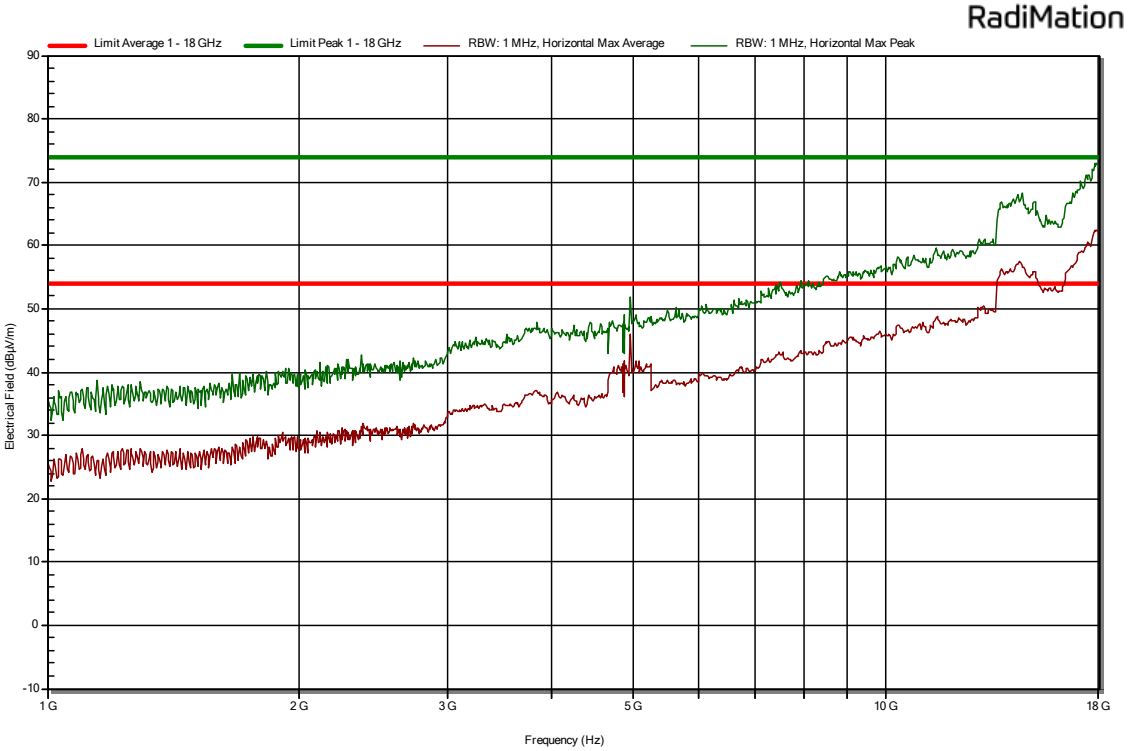
Vertical



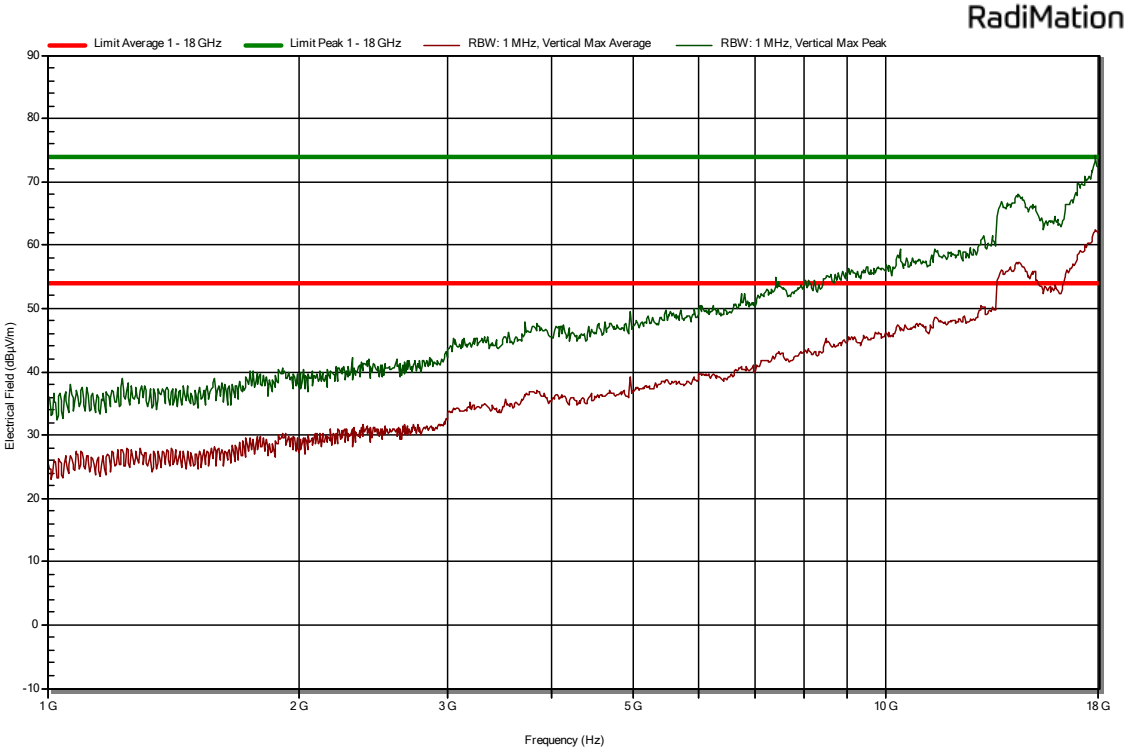
Note on graphs 1-18 GHz:
The noise floor of the average measurement exceeds the average limit, this is caused by the measurement equipment, not by the EUT. The plots on the next pages measured with 120 kHz RBW show that no peaks are present in this frequency range.

1GHz – 18GHz BLE high channel (no tag)

Horizontal

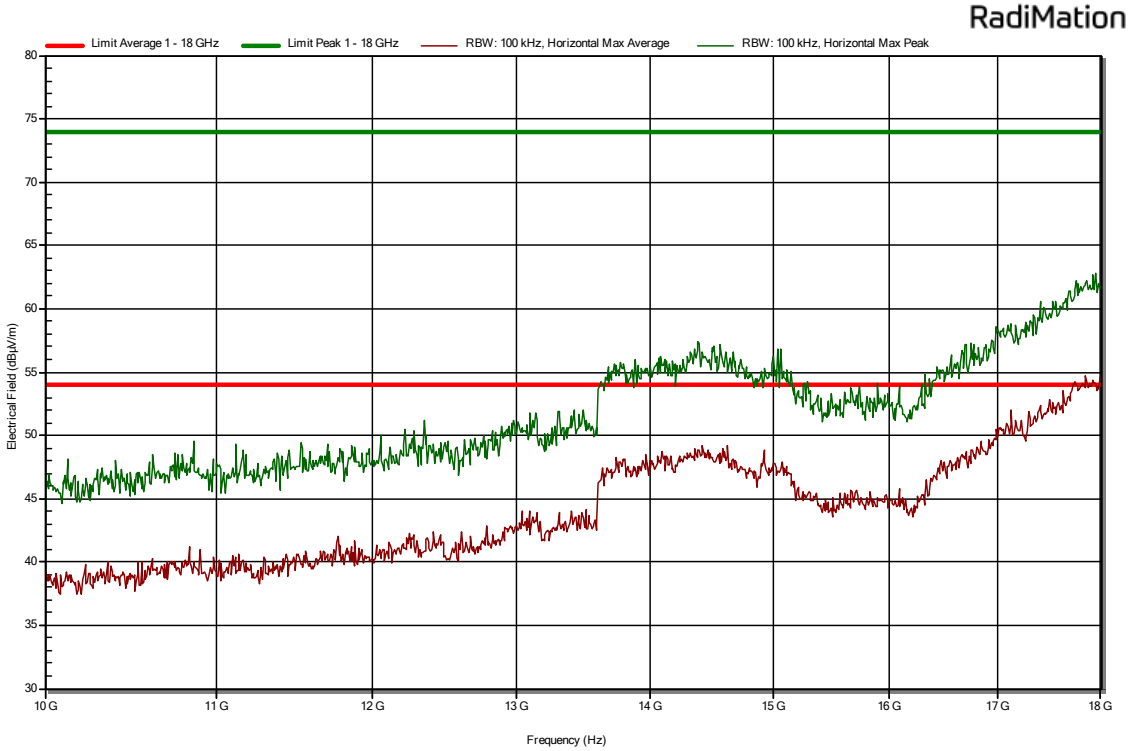


Vertical

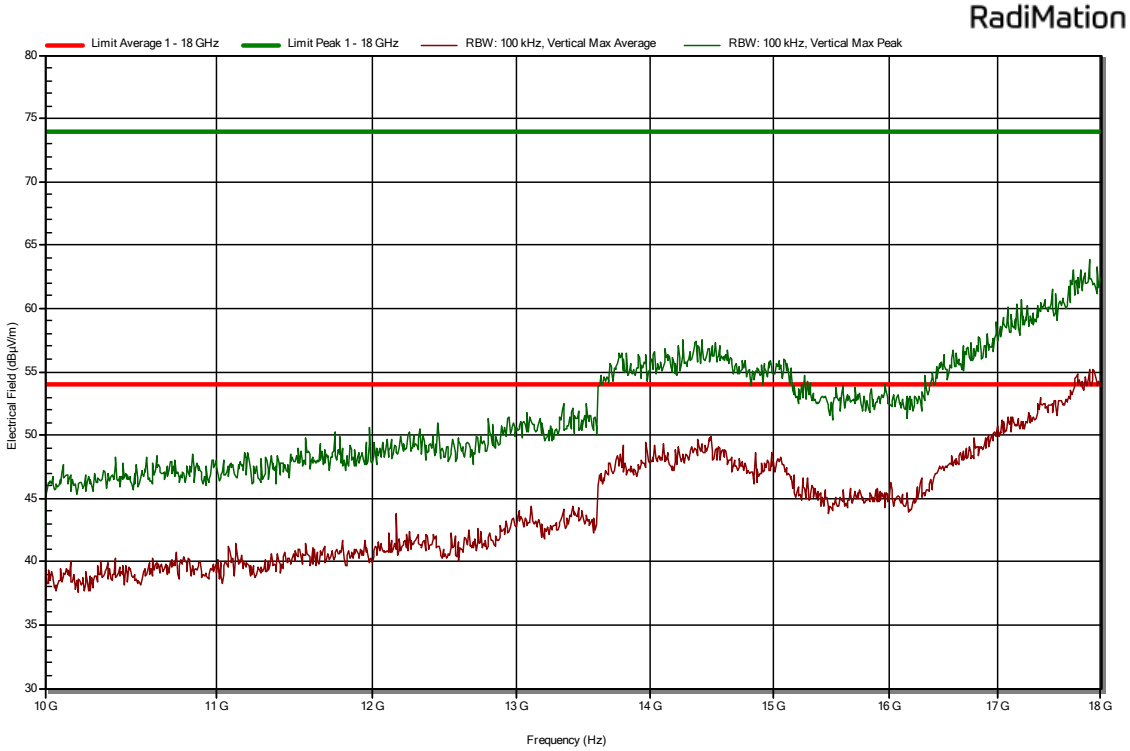


10GHz – 18GHz BLE low channel (no tag)

Horizontal

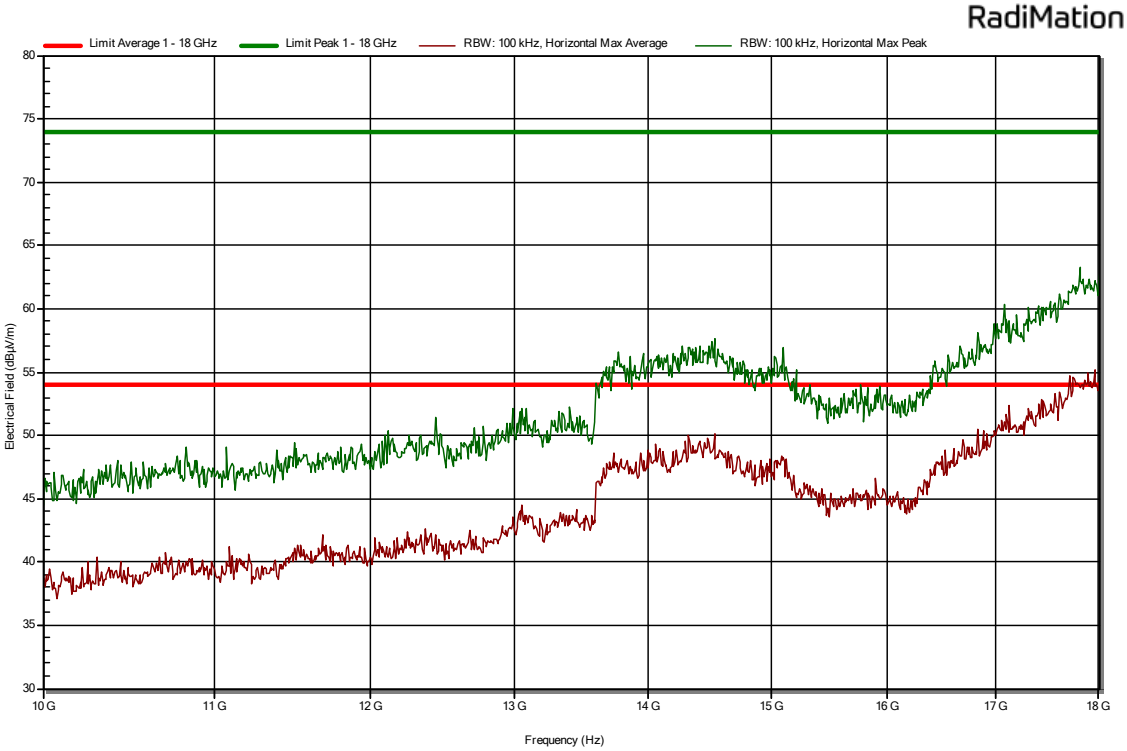


Vertical

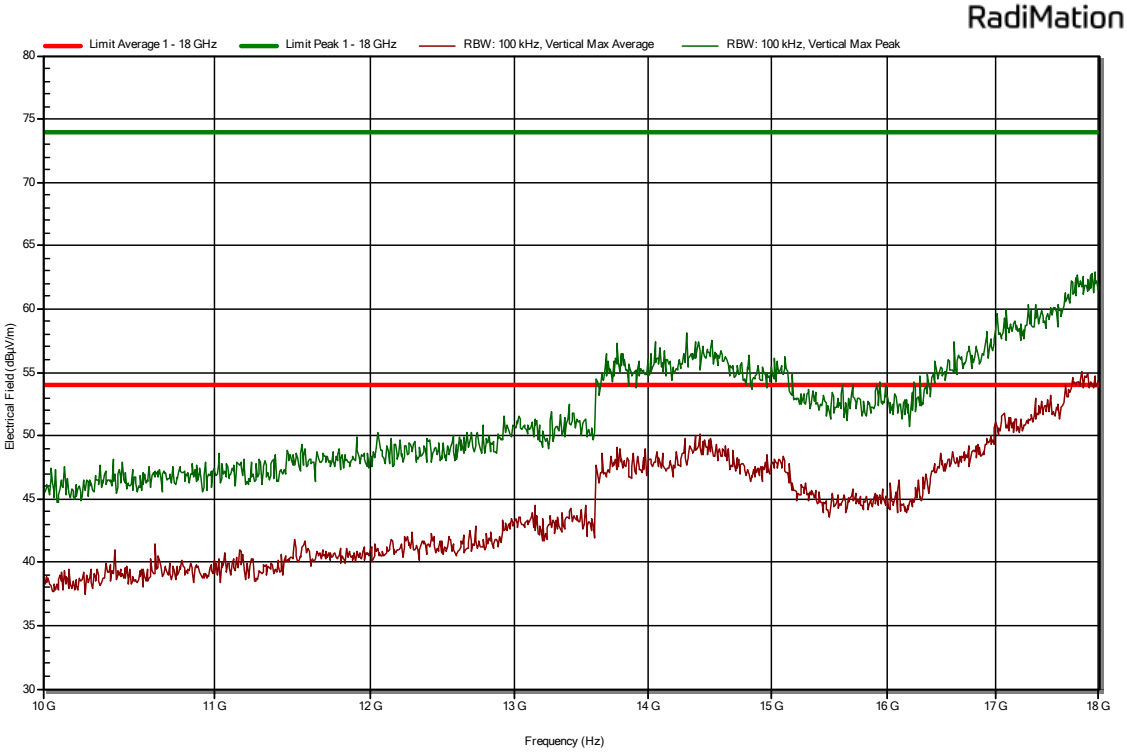


10GHz – 18GHz BLE mid channel (no tag)

Horizontal

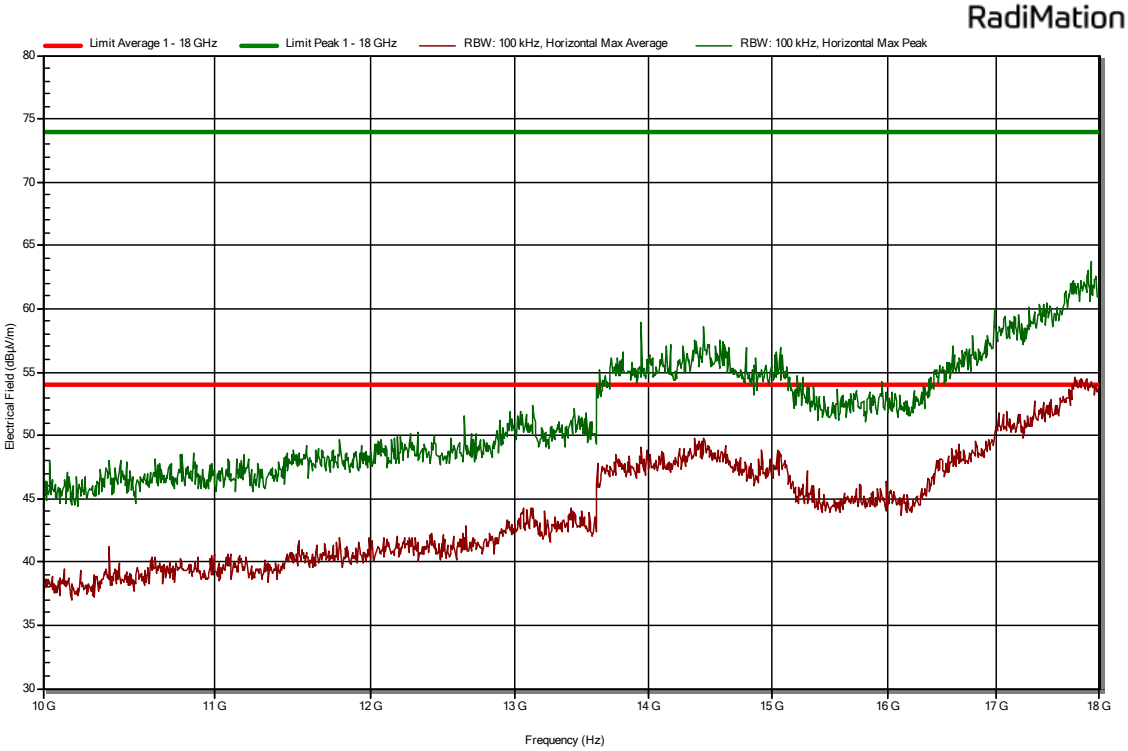


Vertical

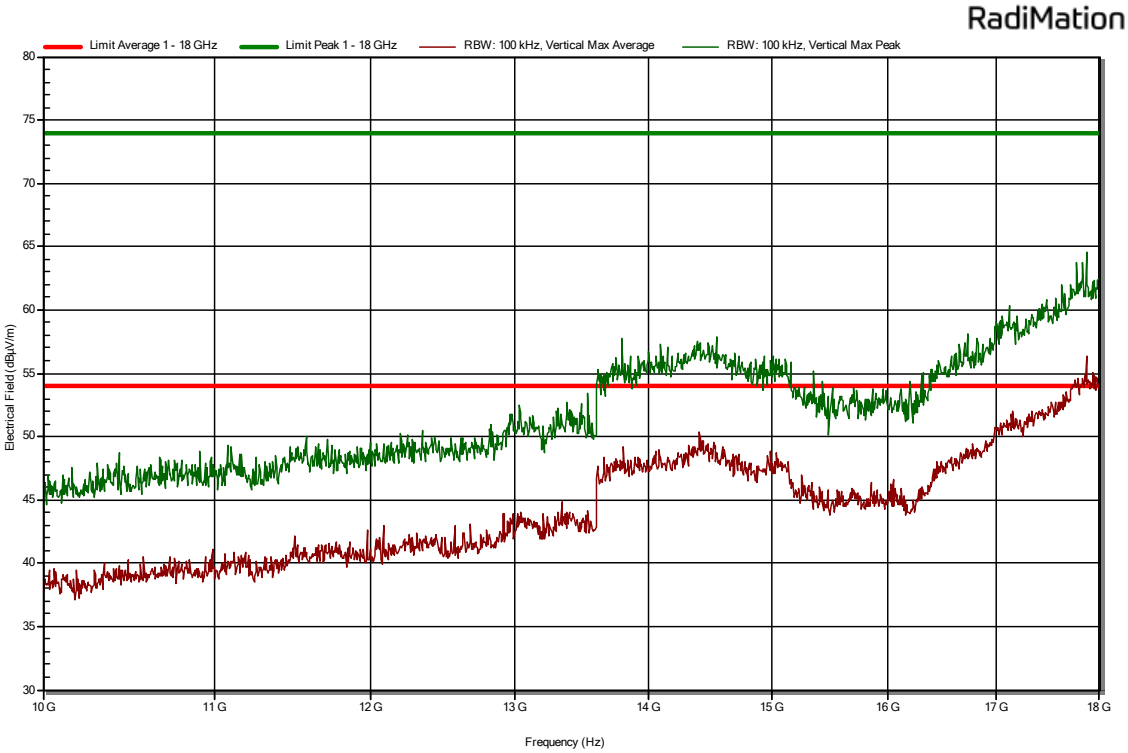


10GHz – 18GHz BLE high channel (no tag)

Horizontal

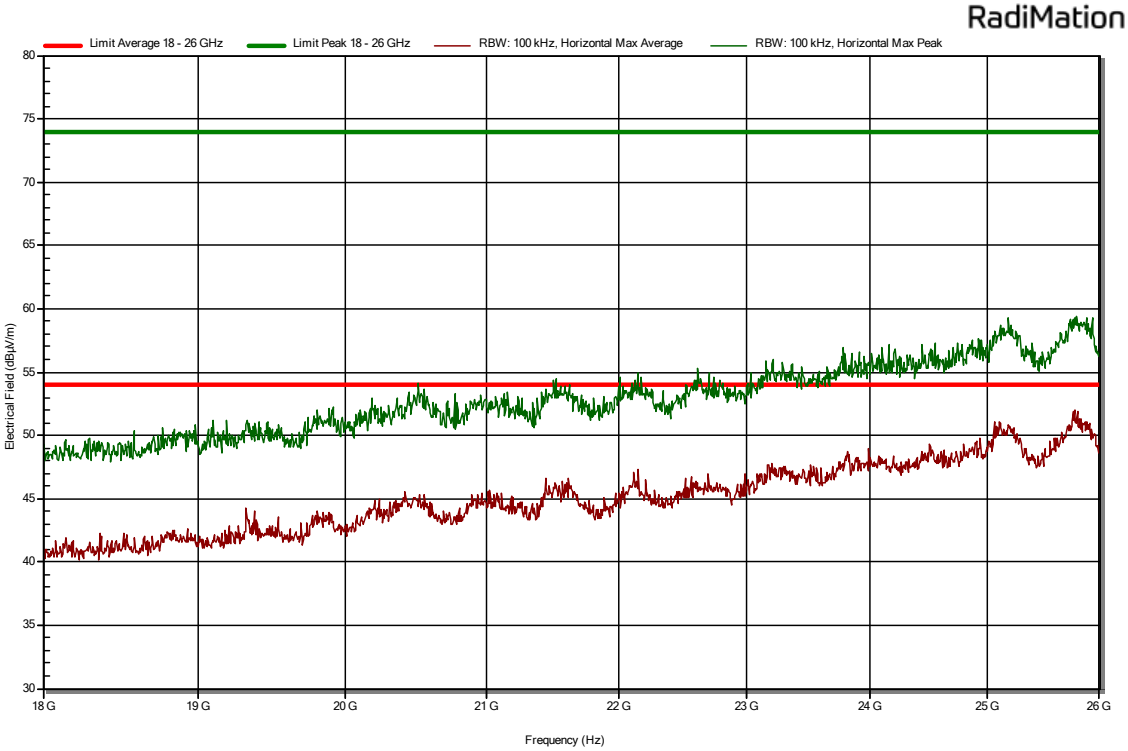


Vertical

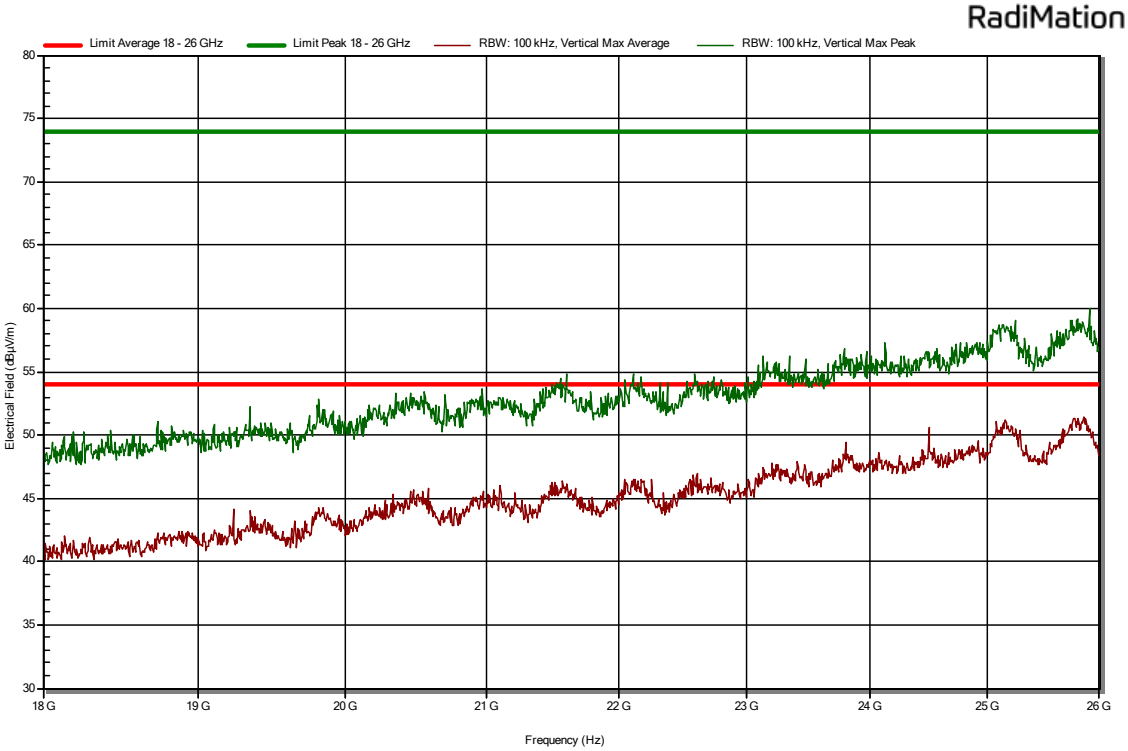


18GHz – 26GHz BLE low channel (no tag)

Horizontal

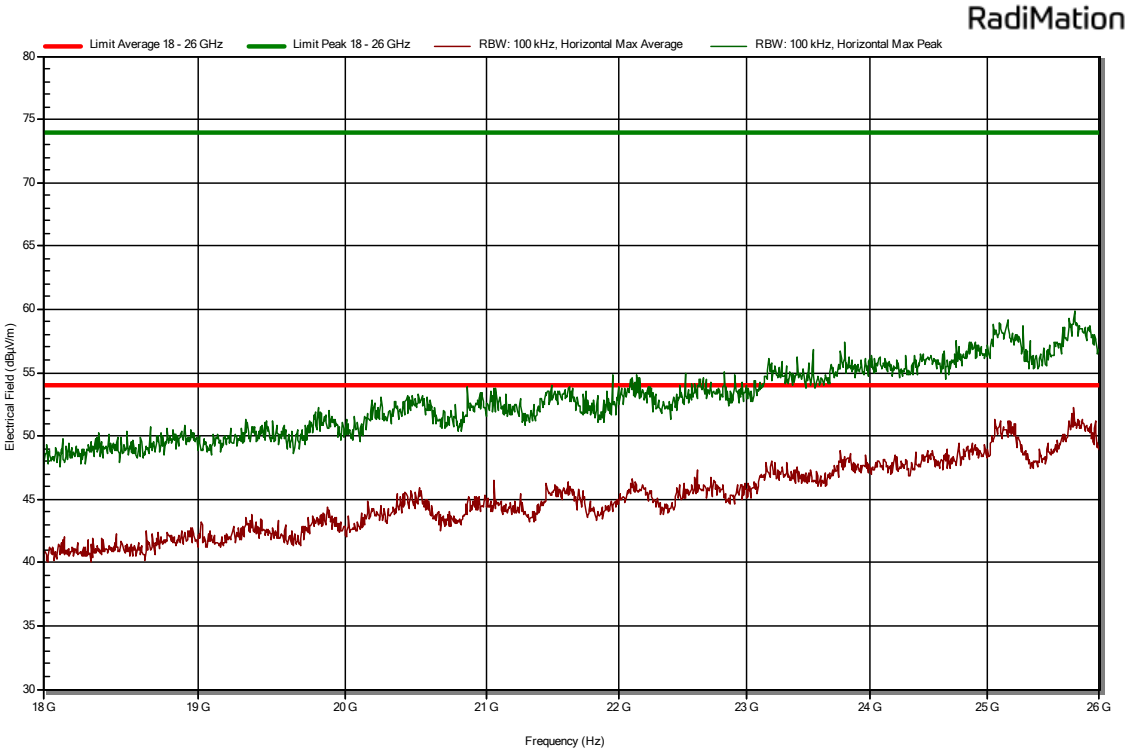


Vertical

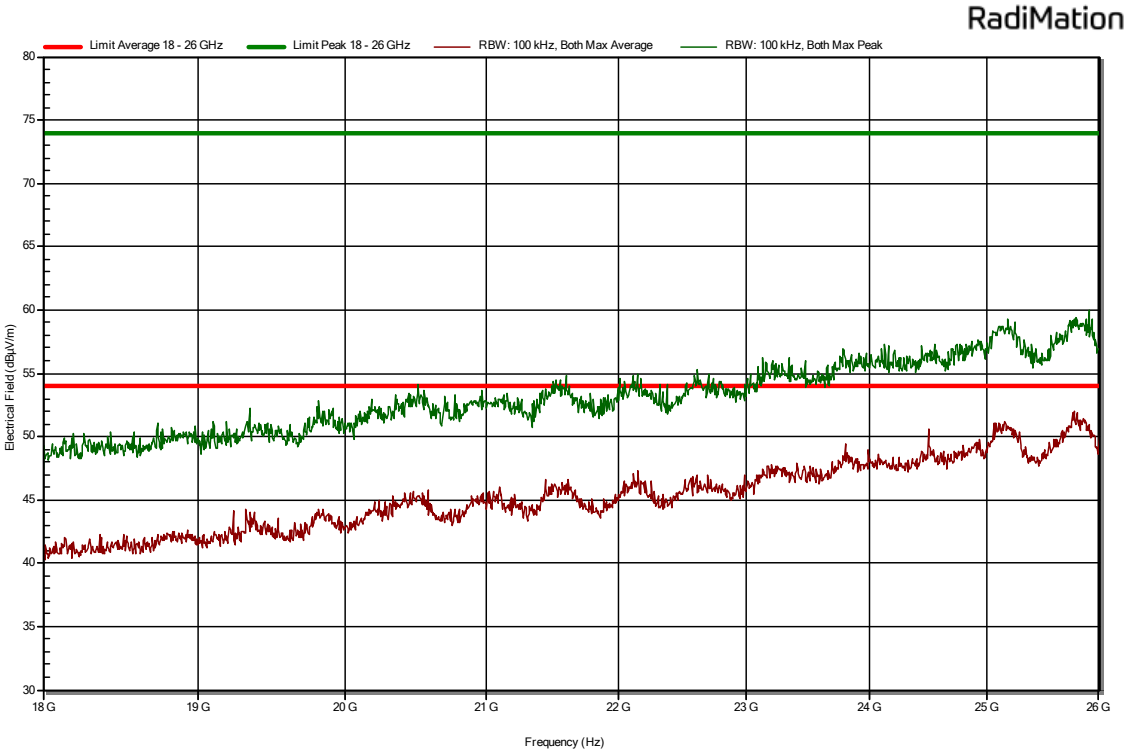


18GHz – 26GHz BLE mid channel (no tag)

Horizontal

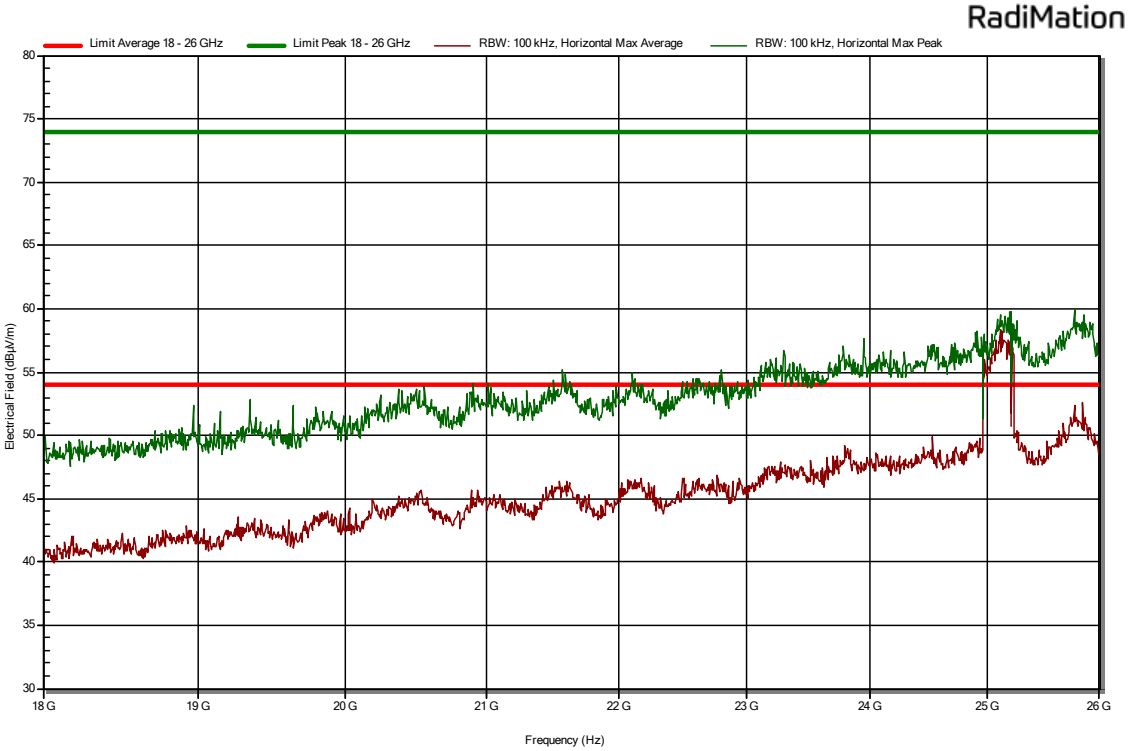


Vertical

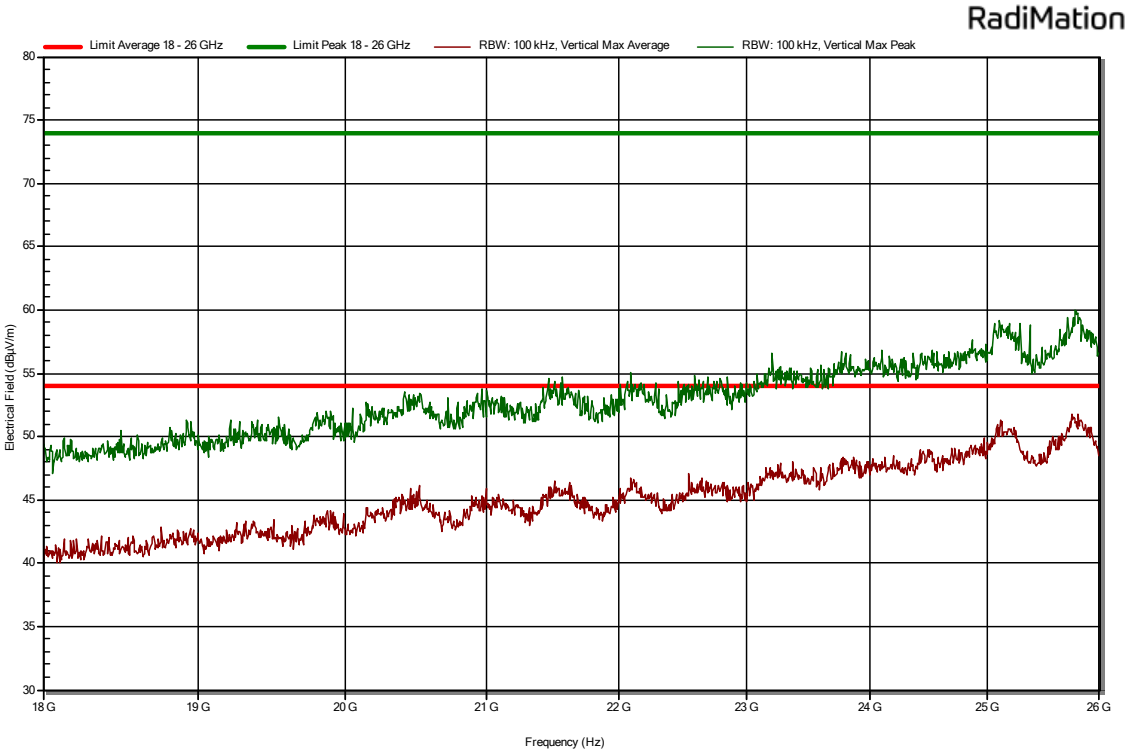


18GHz – 26GHz BLE high channel (no tag)

Horizontal



Vertical



3.2 N-dB 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
IRN 017 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

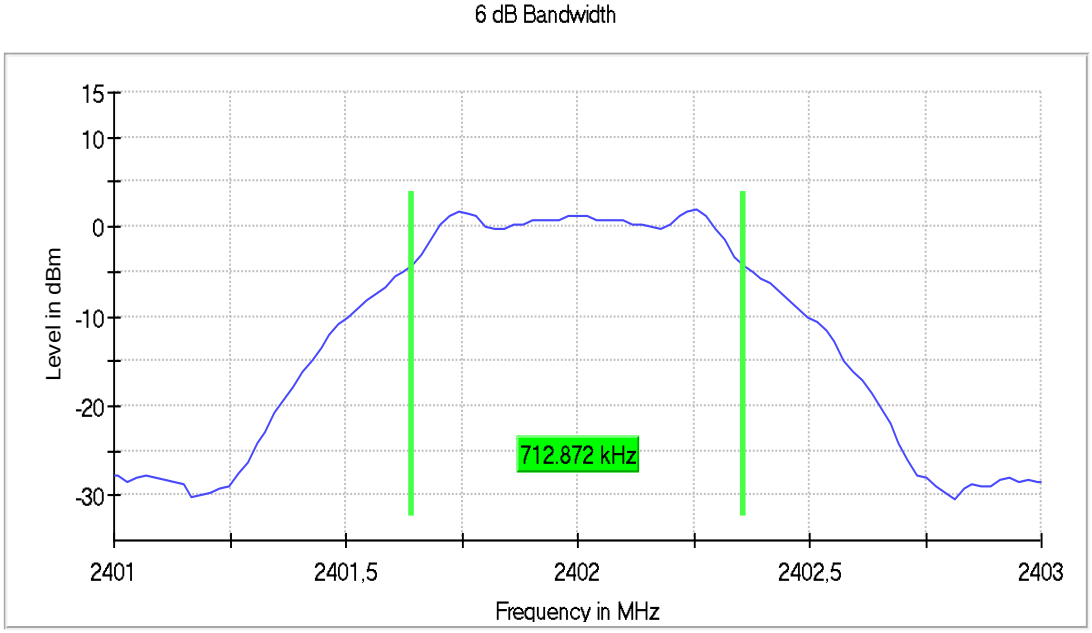
3.2.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)	20 dB bandwidth (kHz)
Bluetooth Low energy	37	2402	1 Mbps	712.872	--
	17	2440	1 Mbps	732.647	--
	39	2480	1 Mbps	712.872	--
915 Proprietary	low	902.6	50 Kbps	576.86	--
	mid	915	50 Kbps	544.1	--
	high	927.4	50 Kbps	572.33	--
NFC	--	13.56	--	--	64.95450
Uncertainty	± 36.2 kHz				

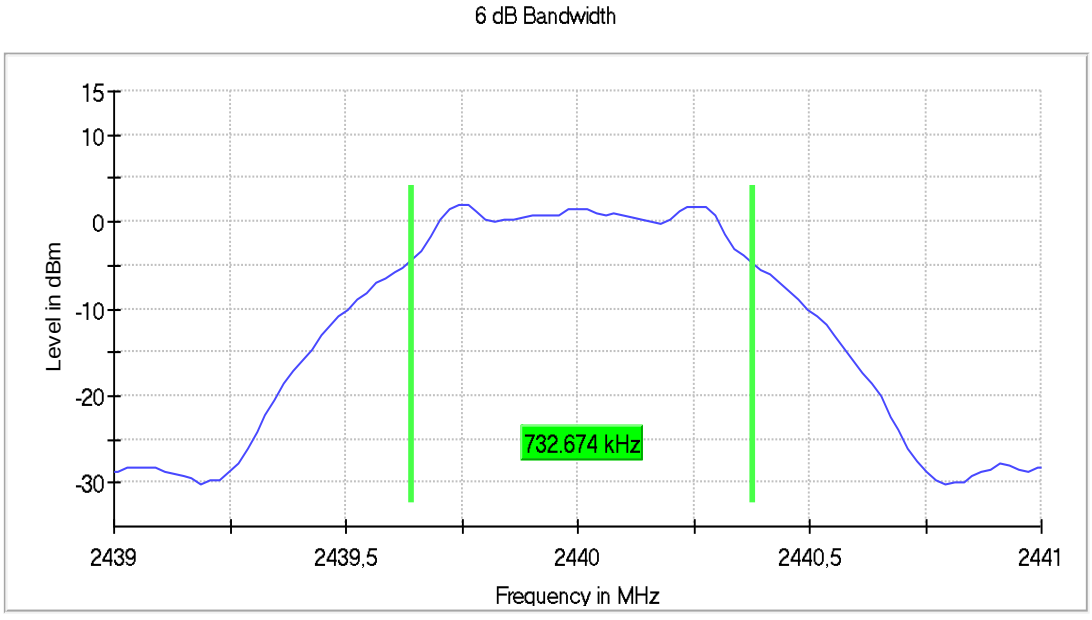
Note: plots are provided on the next page.

3.2.6 Plots of the 6 dB bandwidth

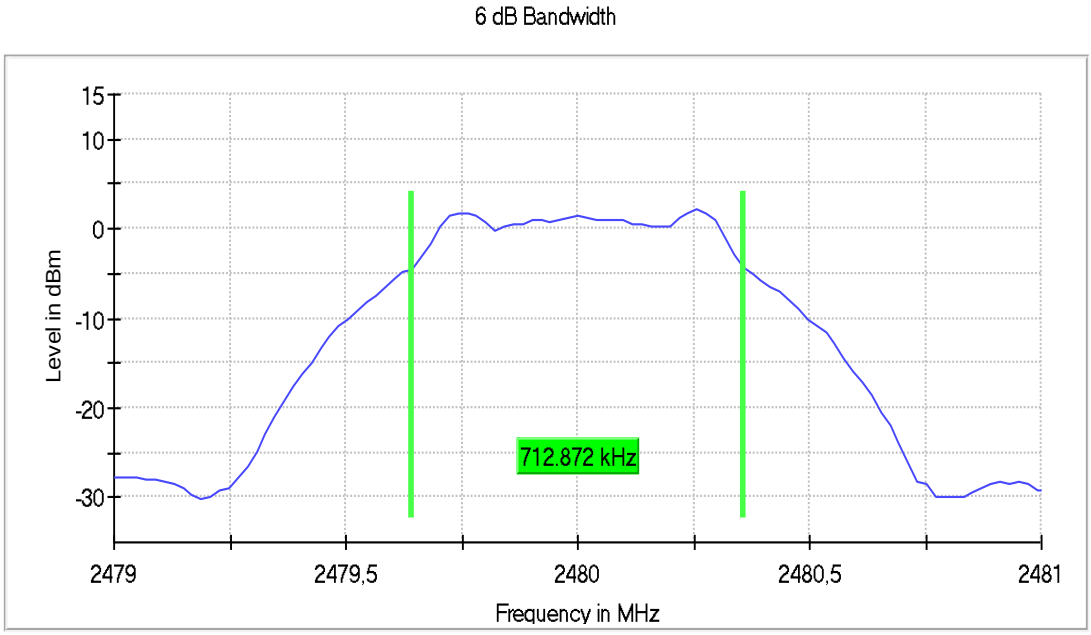
BLE low channel



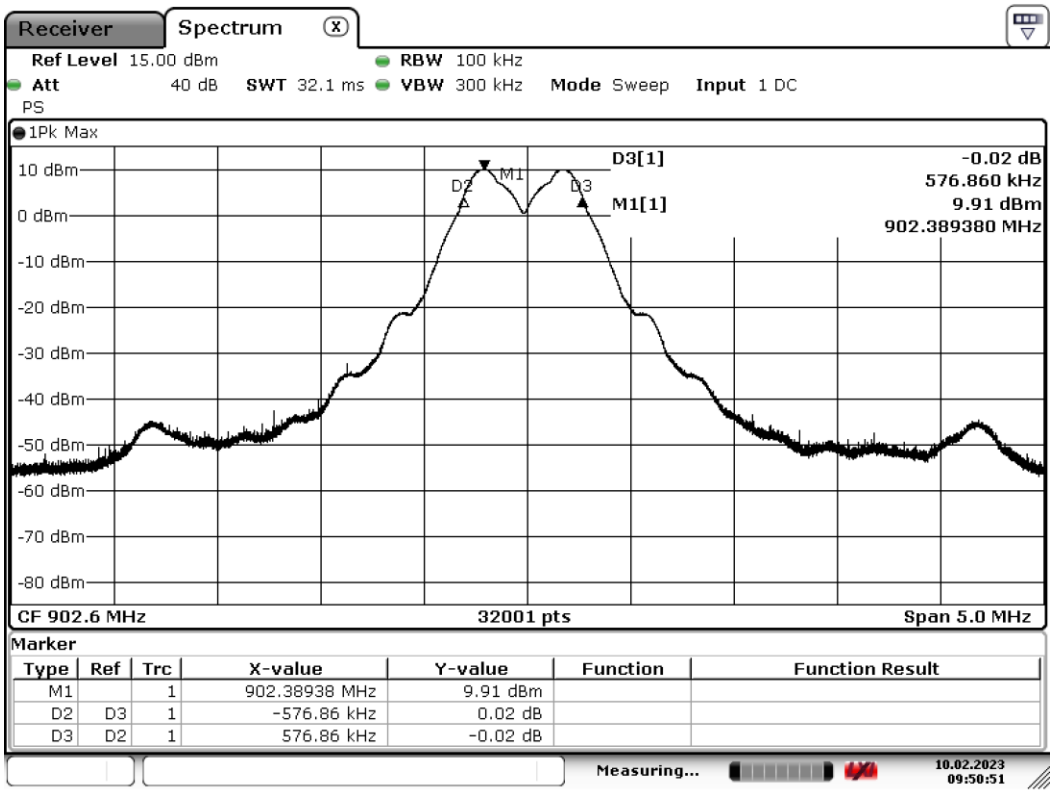
BLE mid channel



BLE high channel

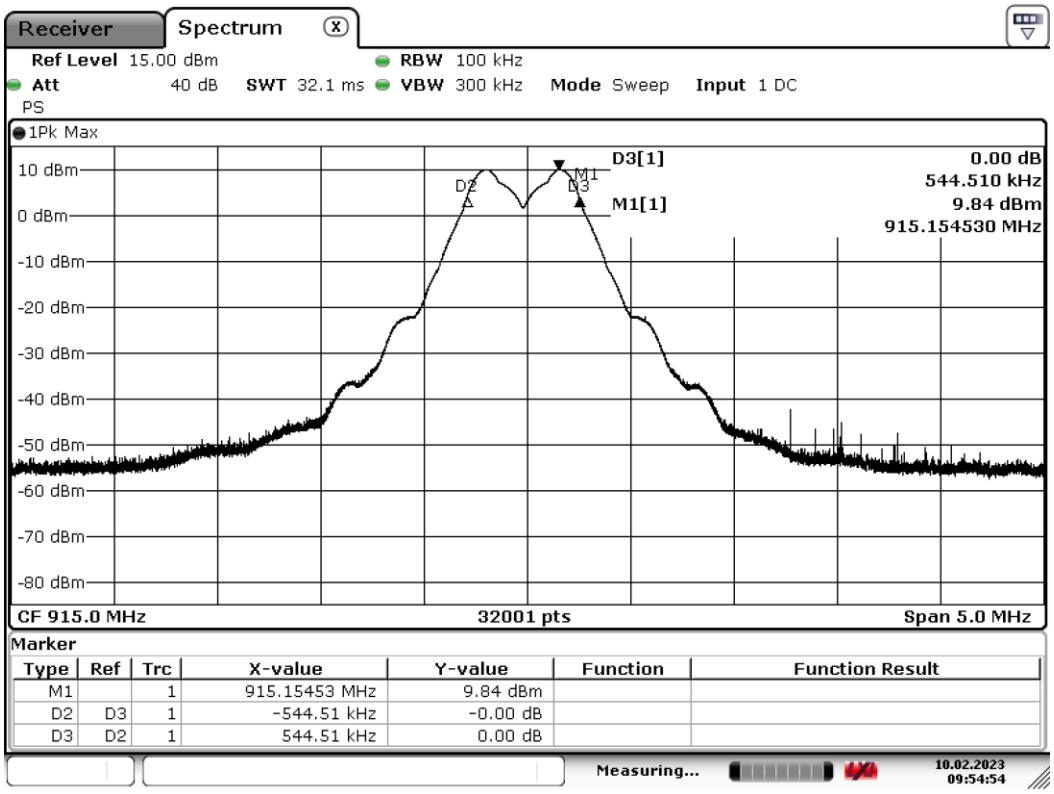


915 low channel



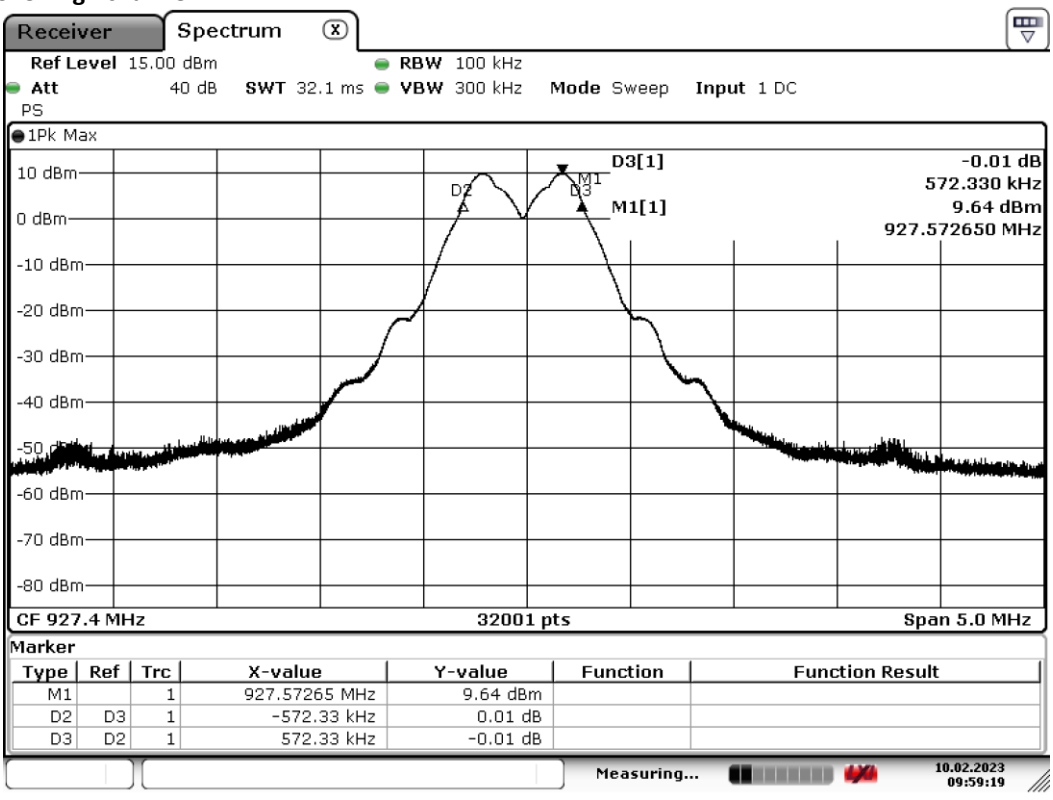
Date: 10.FEB.2023 09:50:51

915 Mid channel



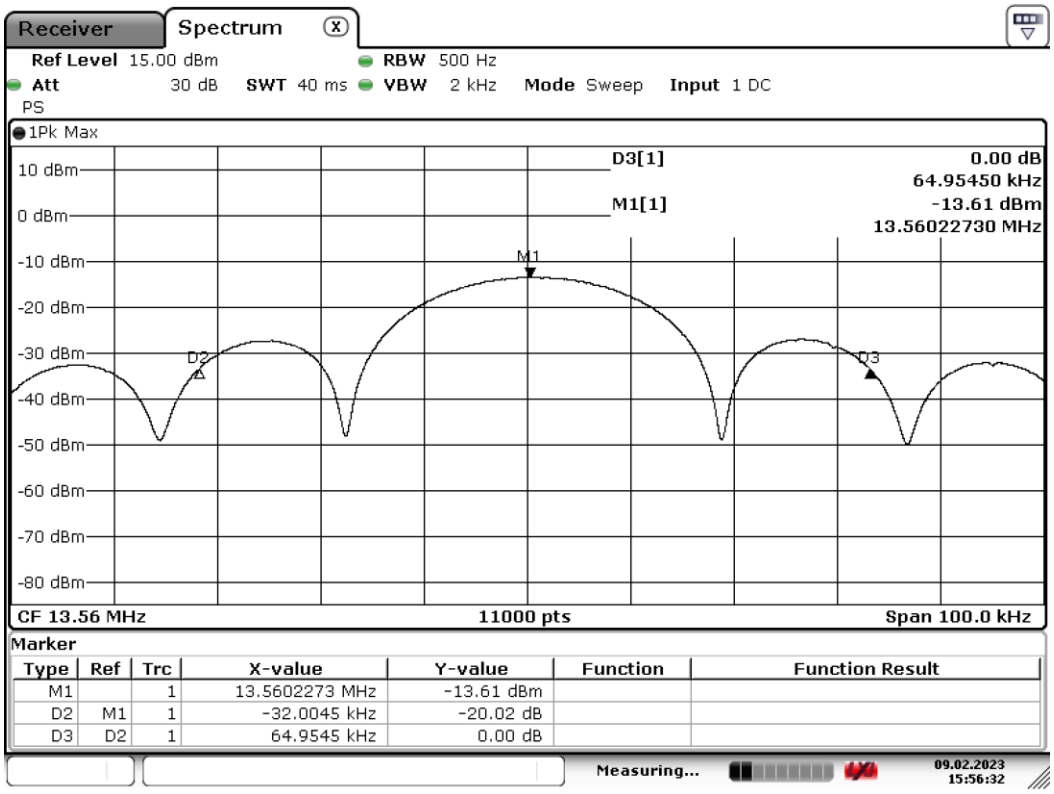
Date: 10.FEB.2023 09:54:54

915 High channel



Date: 10.FEB.2023 09:59:20

NFC 20dB bandwidth



Date: 9.FEB.2023 15:56:33

99% Occupied Bandwidth

3.2.7 Limit

According to RSS-Gen 6.7

3.2.8 Measurement instruments

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

3.2.9 Test setup

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

3.2.10 Test procedure

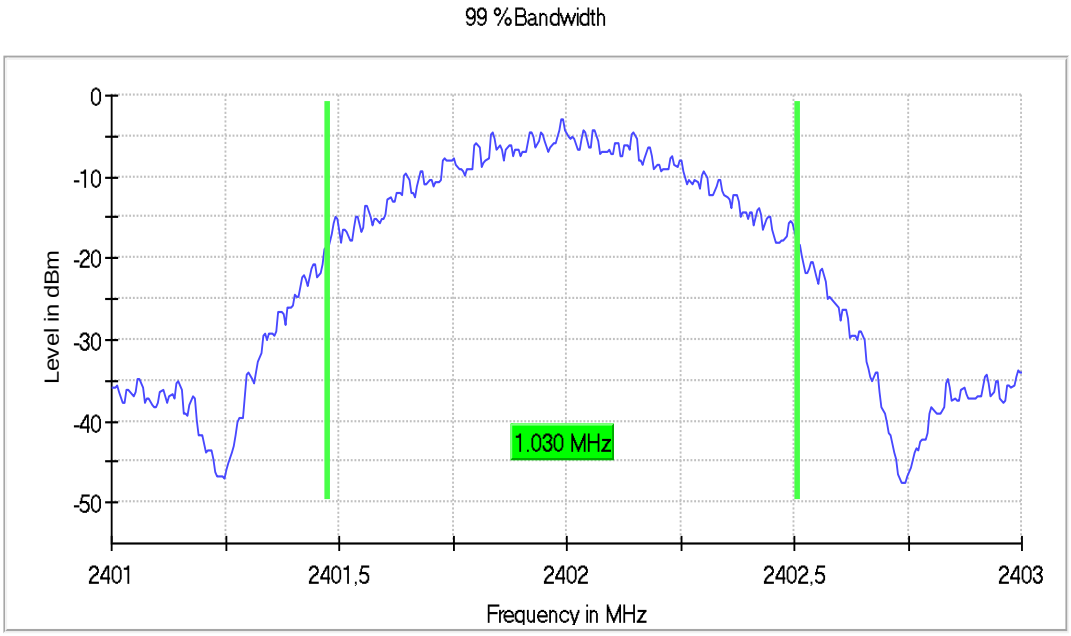
According to ANSI C63.10, section 6.9
IRN 017 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

3.2.11 Test results of the 99% occupied bandwidth measurement

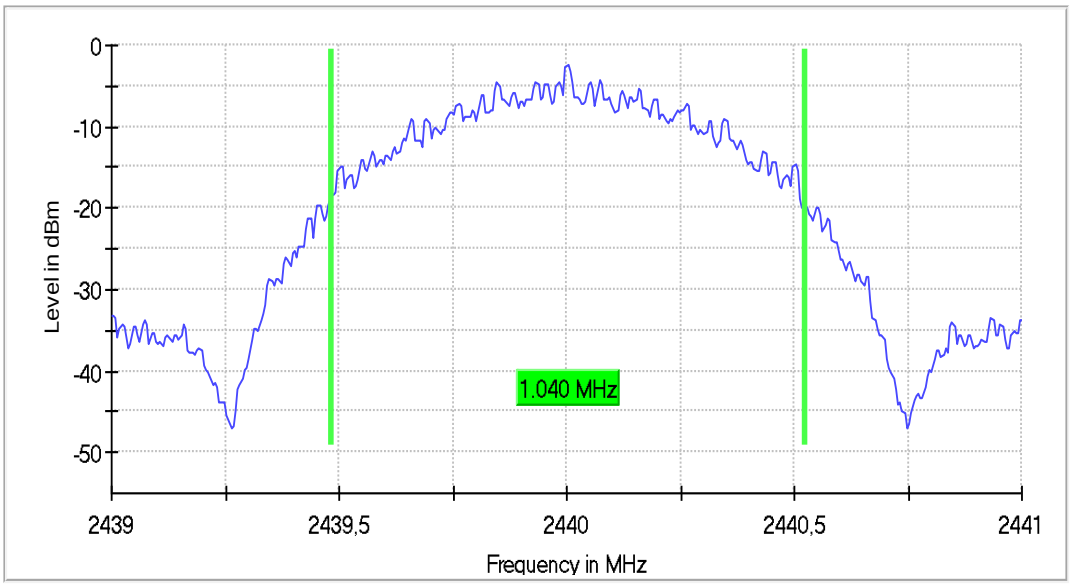
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Bluetooth Low energy	37	2402	1 Mbps	1030
	17	2440	1 Mbps	1040
	39	2480	1 Mbps	1040
RFID	--	13.56	--	64.9545
915 Proprietary	Low	902.6	50 Kbps	701.61
	Mid	915	50 Kbps	696.23
	High	927.4	50 Kbps	718.30
Uncertainty	± 12 kHz			

3.2.12 Plots of the 99% occupied bandwidth measurement

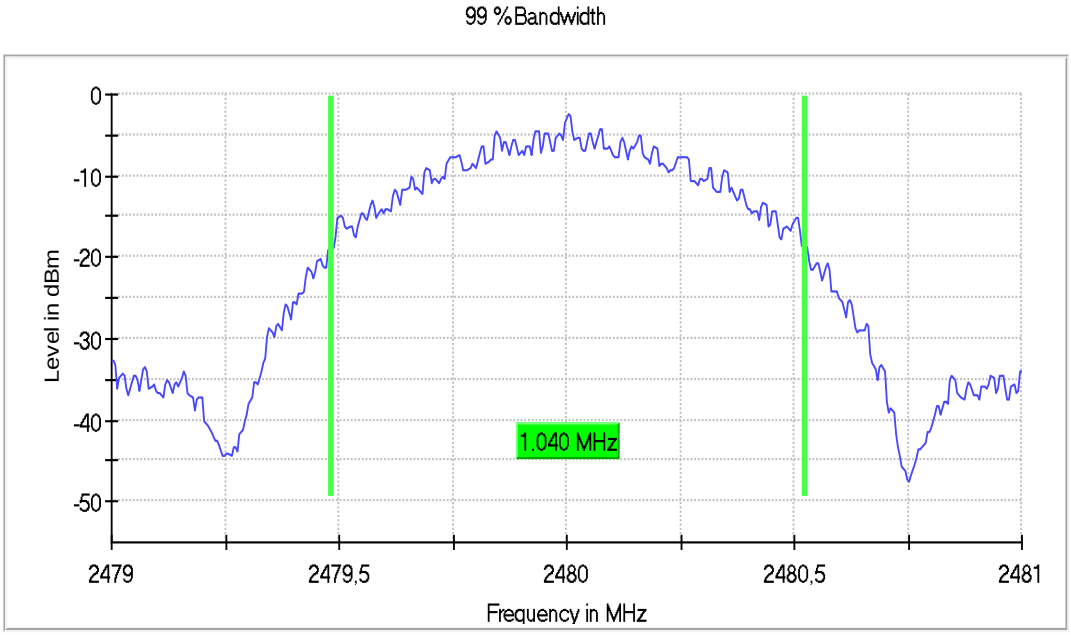
BLE Low Channel



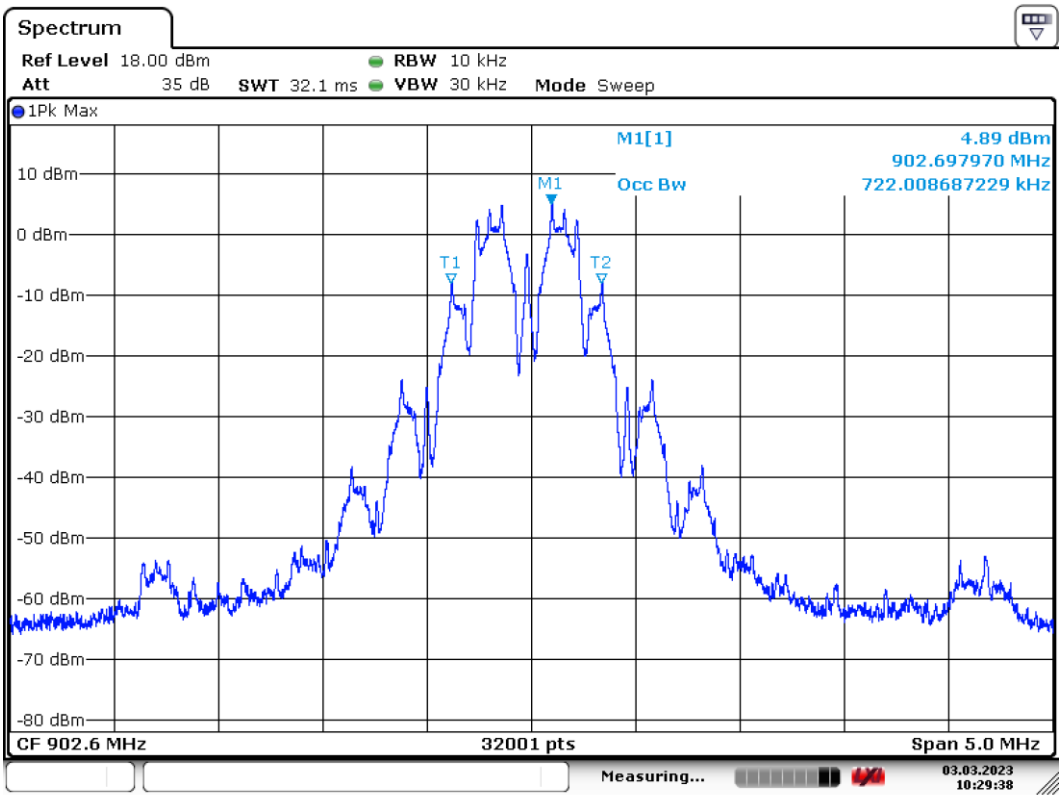
BLE Mid Channel



BLE High Channel



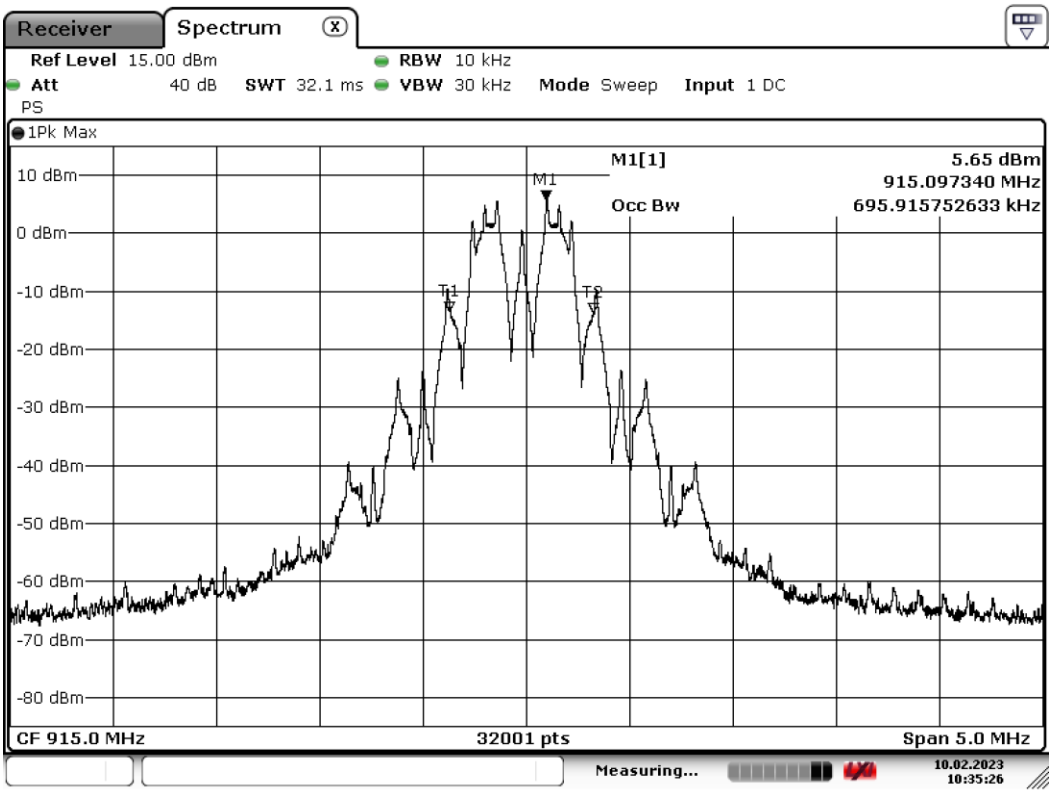
915 Low Channel



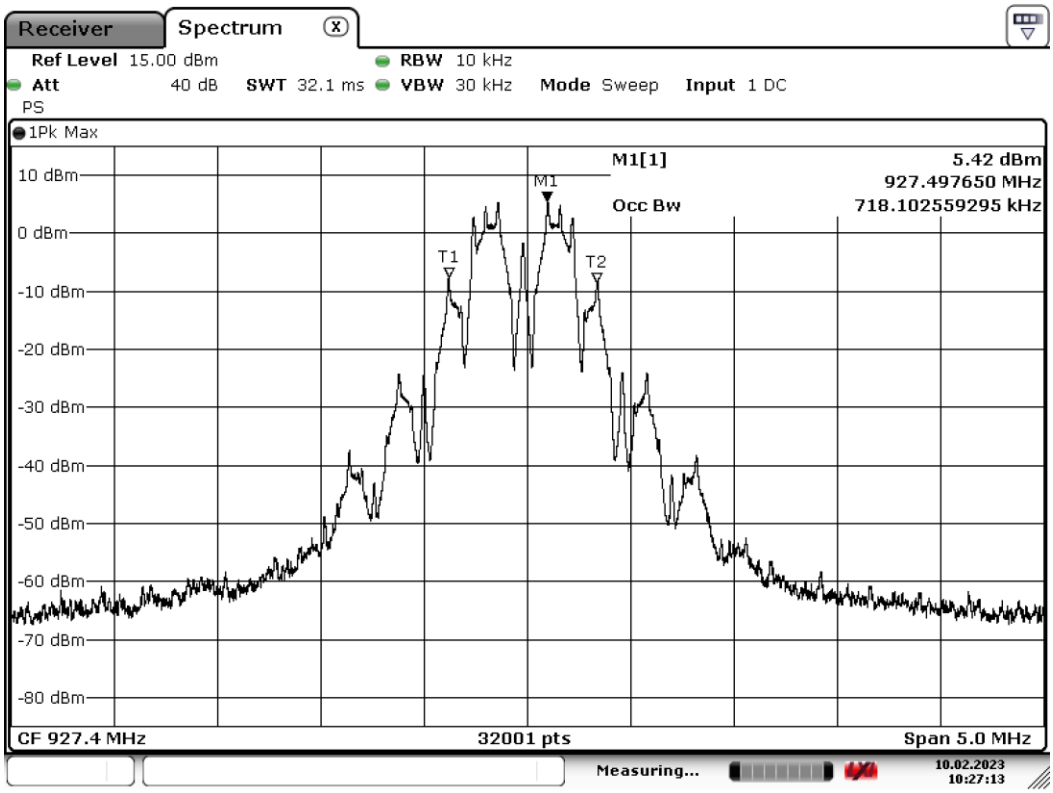
Ble, channel: 39 : Measure RX Spurious Emission 1 - 12.5 GHz

Date: 3.MAR.2023 10:29:38

915 Mid Channel



915 High Channel



Date: 10.FEB.2023 10:27:13

3.3 Output Power Measurement

3.3.1 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.

3.3.2 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

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02.
IRN 014 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

3.3.5 Test results of Output Power Measurement

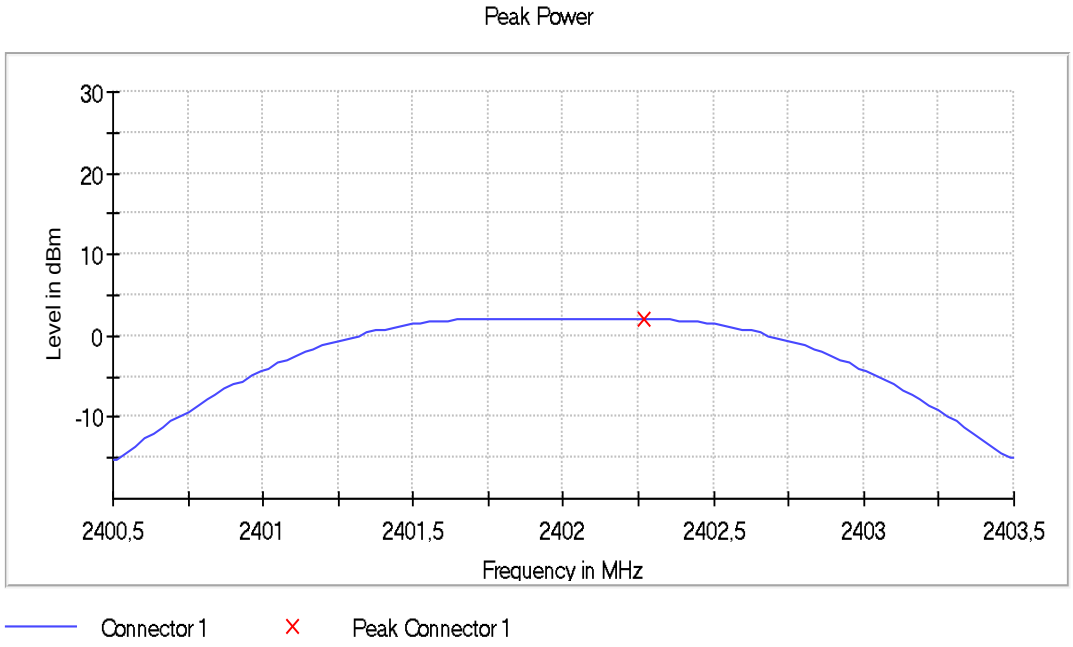
Peak method

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power conducted*(dBm)
Bluetooth Low Energy	37	2402	1 Mbps	2.1
	17	2440	1 Mbps	2.2
	39	2480	1 Mbps	2.3
915 Proprietary	--	902.6	50 kbps	10.72*
	--	915	50 kbps	10.58*
	--	927.4	50 kbps	10.45*
Uncertainty	±0.71 dB			

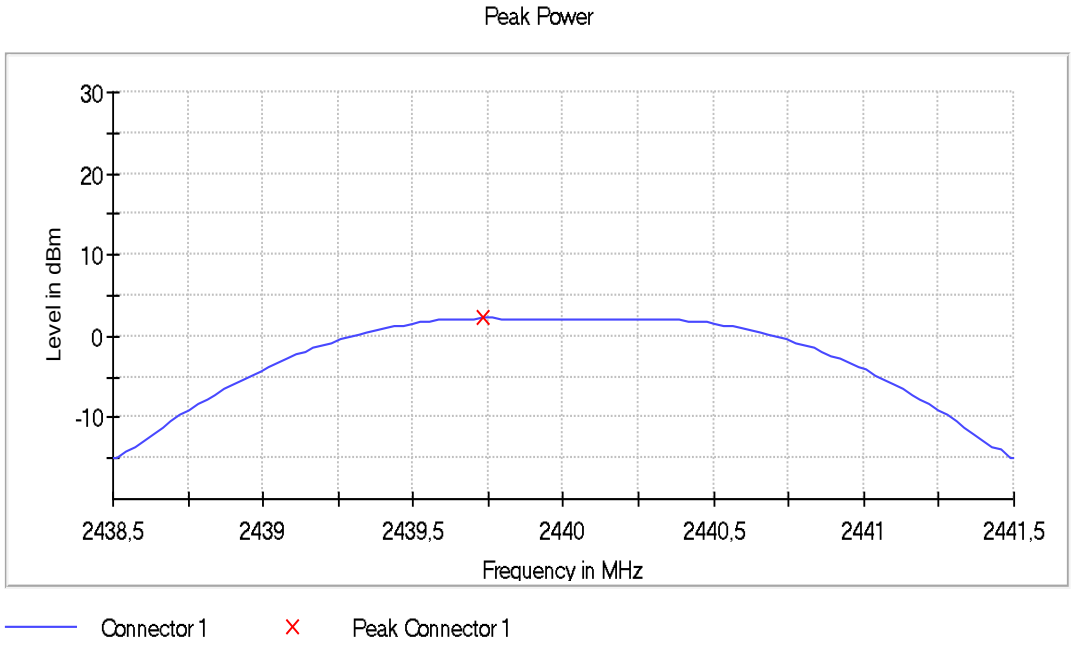
Note: plots are provided on the next page
*The resultant power is corrected for cable losses.

3.3.6 Plots of the Output power

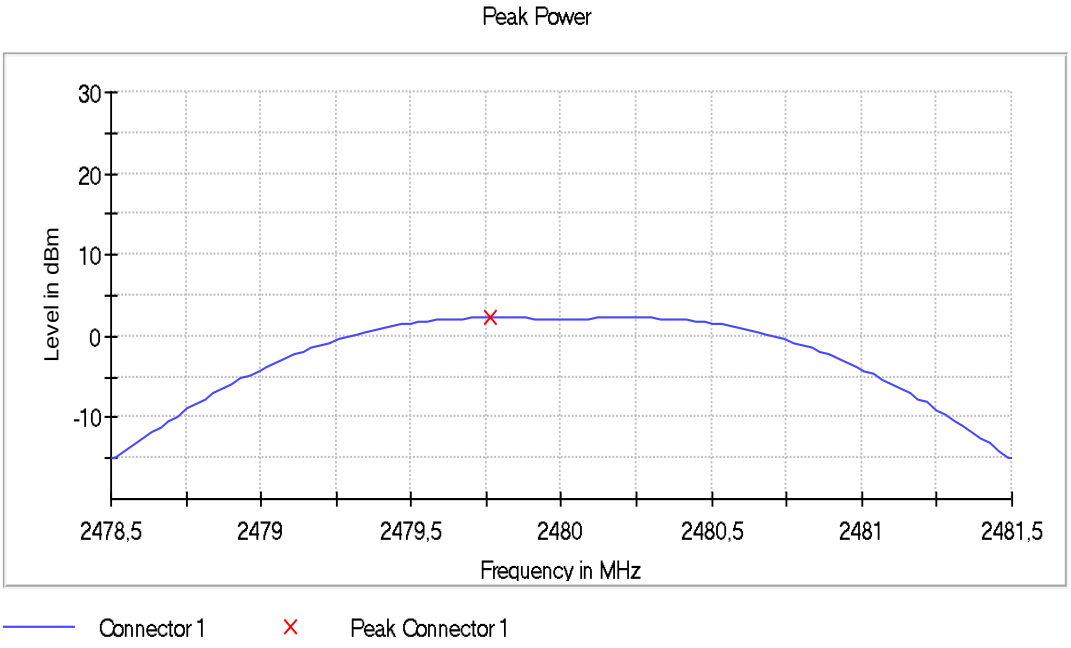
BLE Low Channel



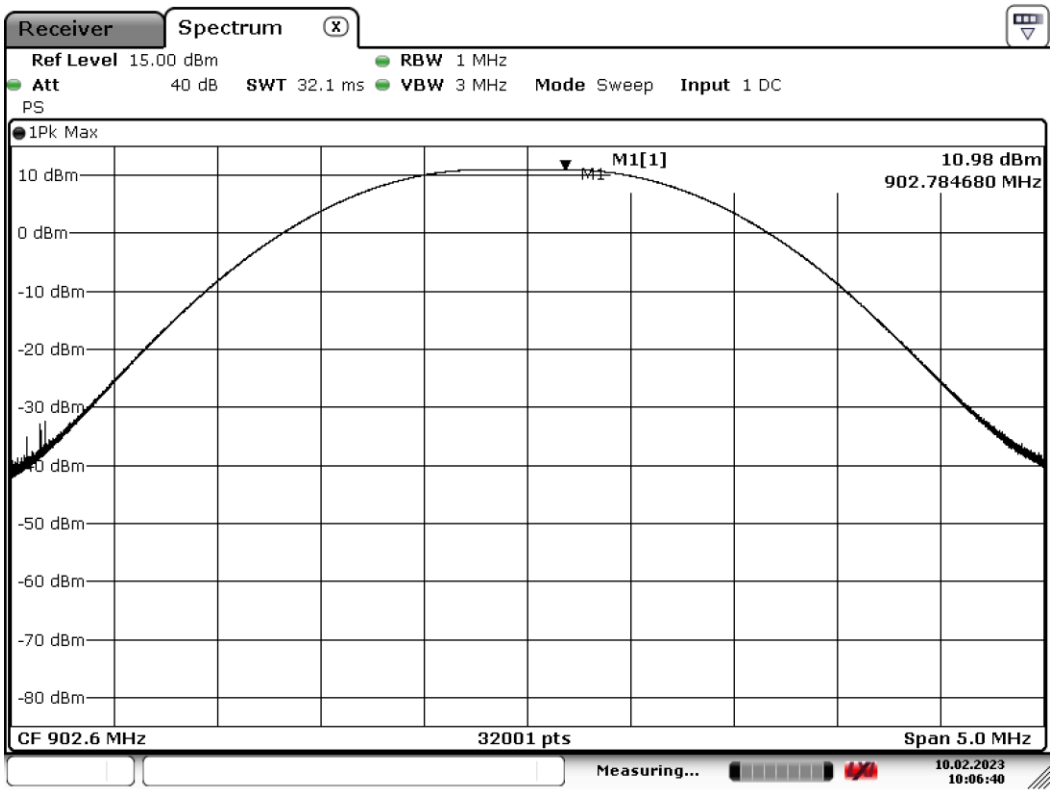
BLE Mid Channel



BLE High Channel

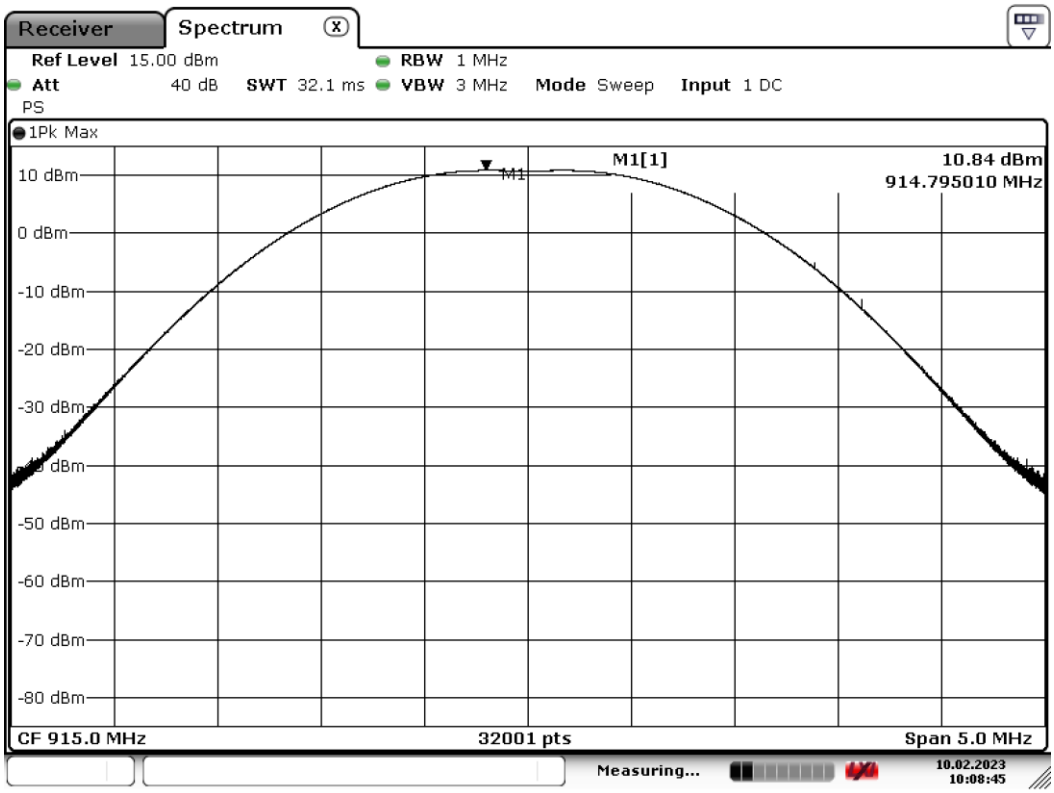


915 Low Channel



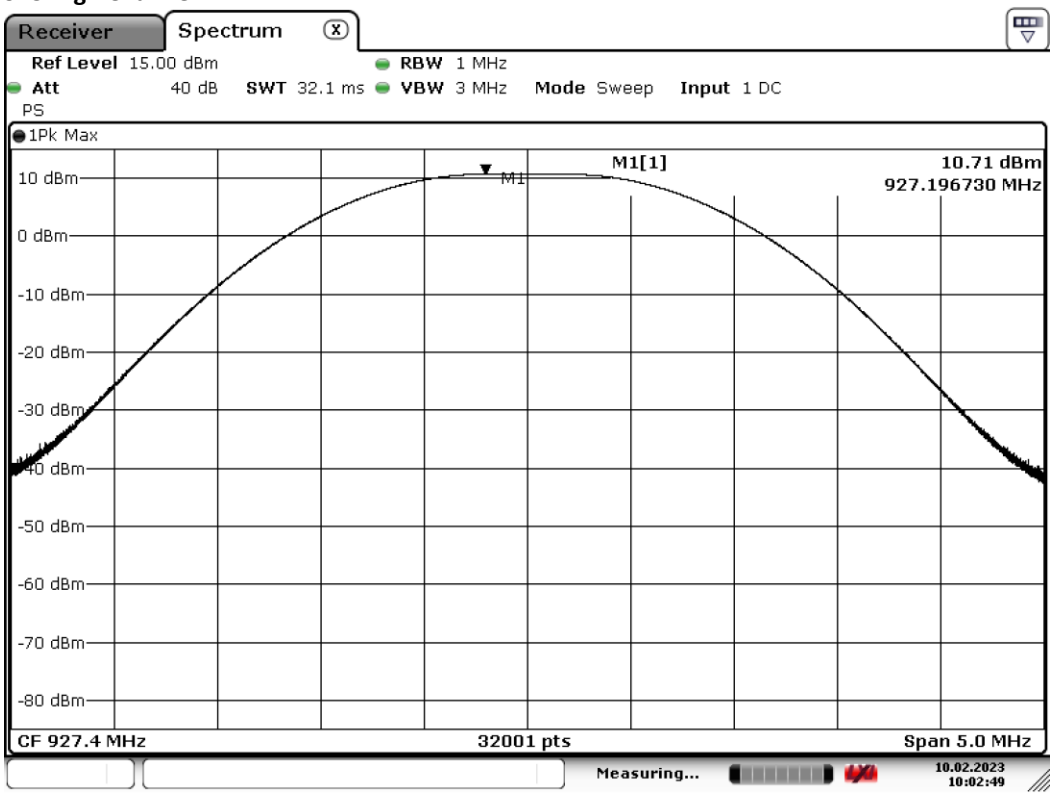
Date: 10.FEB.2023 10:06:40

915 Mid Channel



Date: 10.FEB.2023 10:08:46

915 High Channel



3.4 Power Spectral Density

3.4.1 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.

3.4.2 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 030 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band)

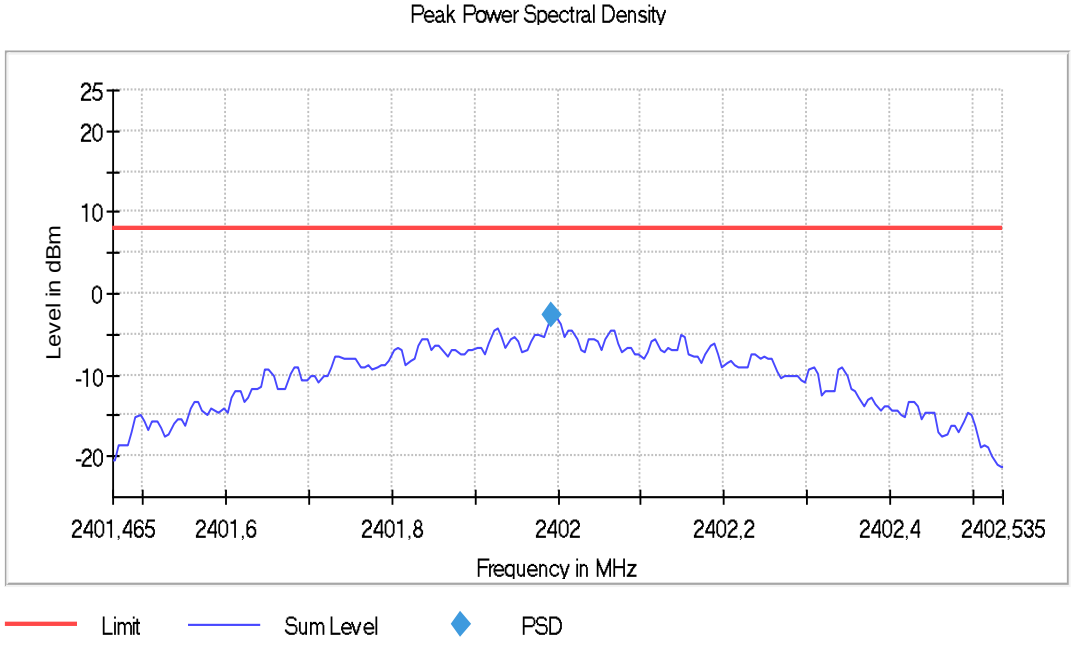
3.4.5 Test results of Power Spectral Density Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD conducted (dBm/3 kHz)	Limit (conducted) (dBm/3kHz)
Bluetooth Low Energy	1	2402	1 Mbps	-2.649	8
	18	2440	1 Mbps	-2.539	8
	39	2480	1 Mbps	-2.369	8
915 Proprietary	Low	902.6	50 kbps	3.7	--
	Mid	915	50 kbps	3.85	--
	high	927.4	50 kbps	2.94	--
Uncertainty	±2 dB				

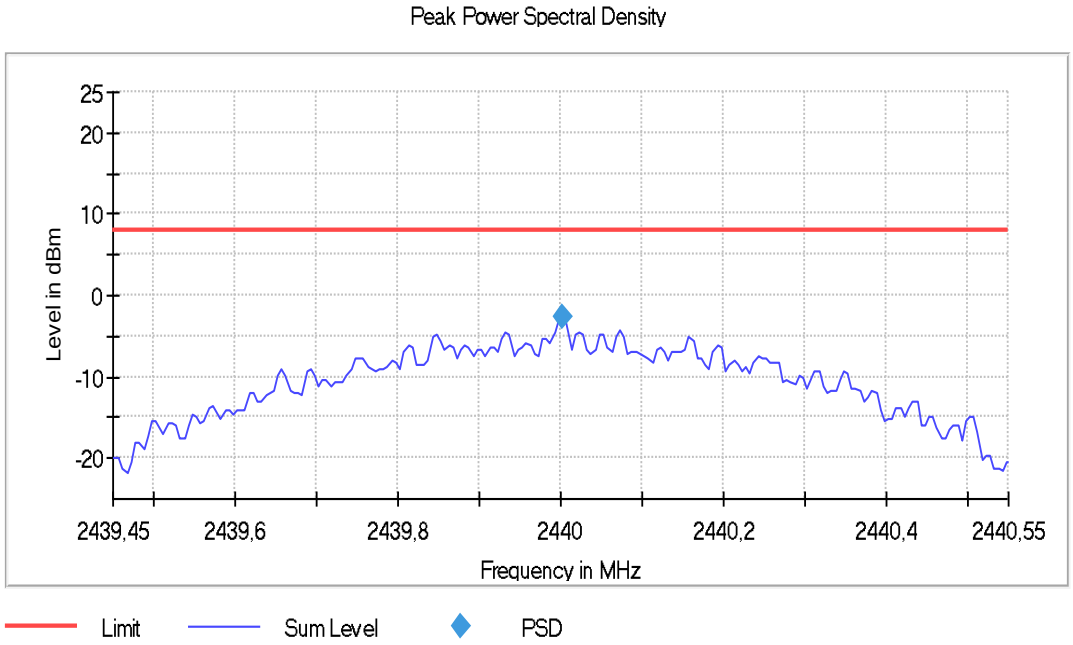
Note: plots are provided on the next page

3.4.6 Plots of the Power Spectral Density

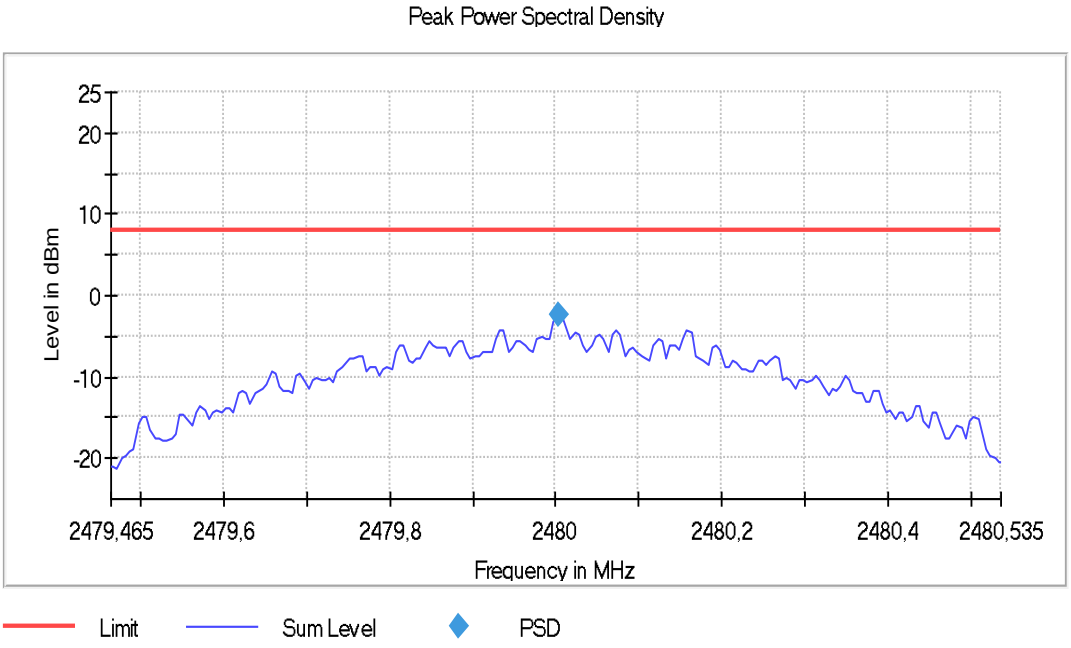
BLE Low Channel



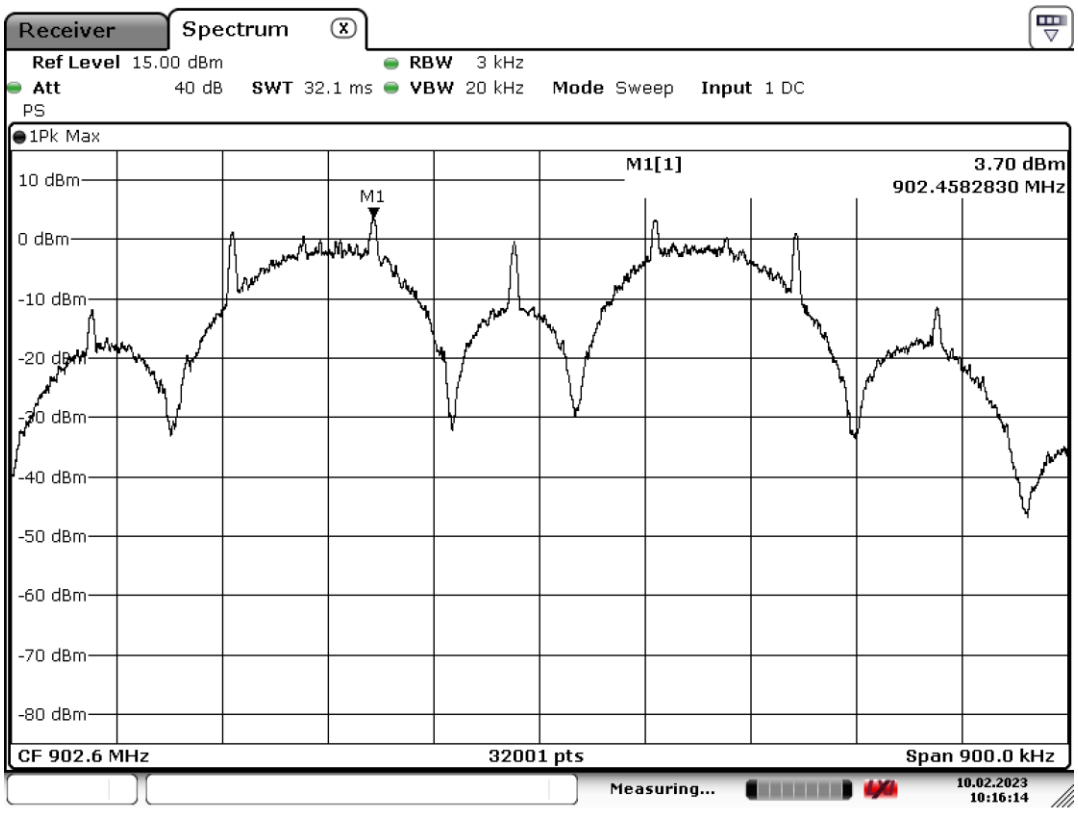
BLE Mid Channel



BLE High Channel



915 Low Channel



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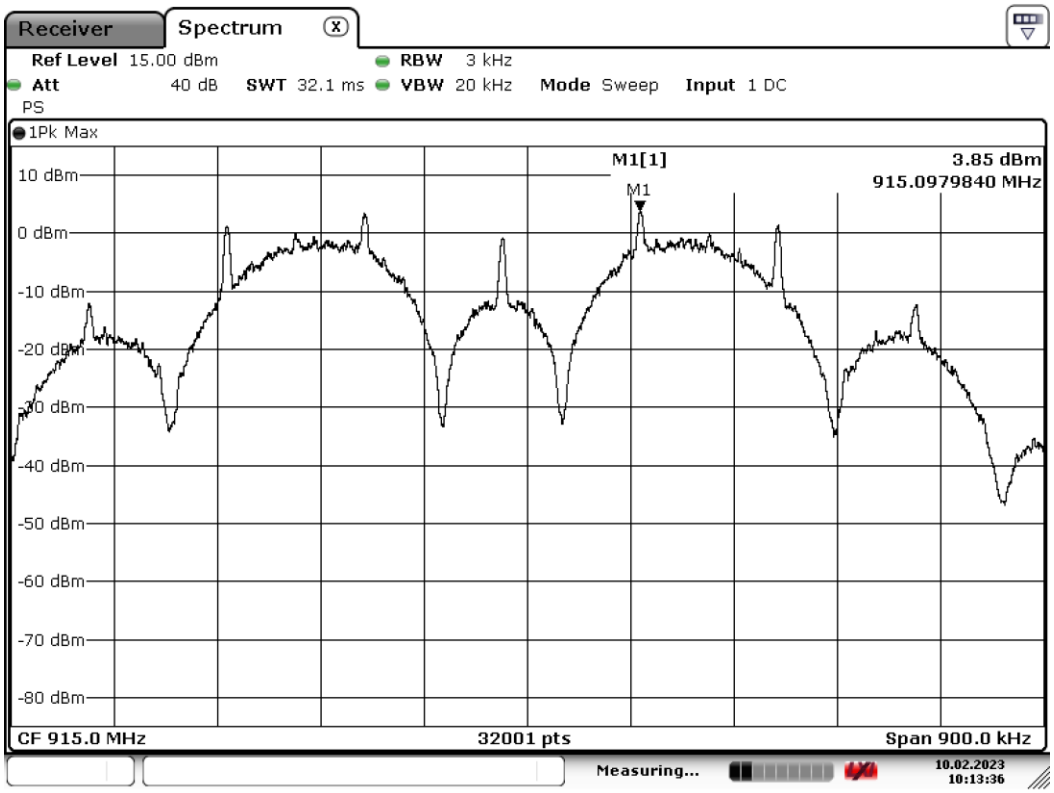
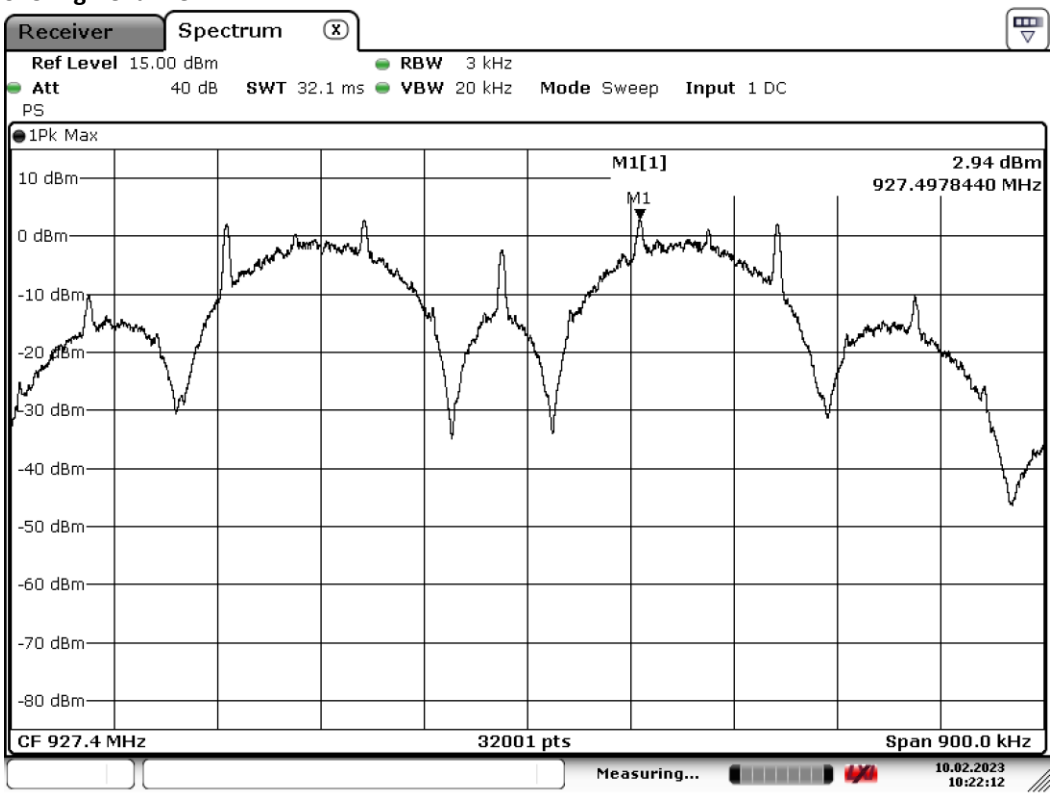
915 Mid Channel



Date: 10.FEB.2023 10:13:36

915 High Channel



Date: 10.FEB.2023 10:22:13

3.5 Band edge Measurement

3.5.1 Limit

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

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. Antenna port conducted.

3.5.4 Test procedure

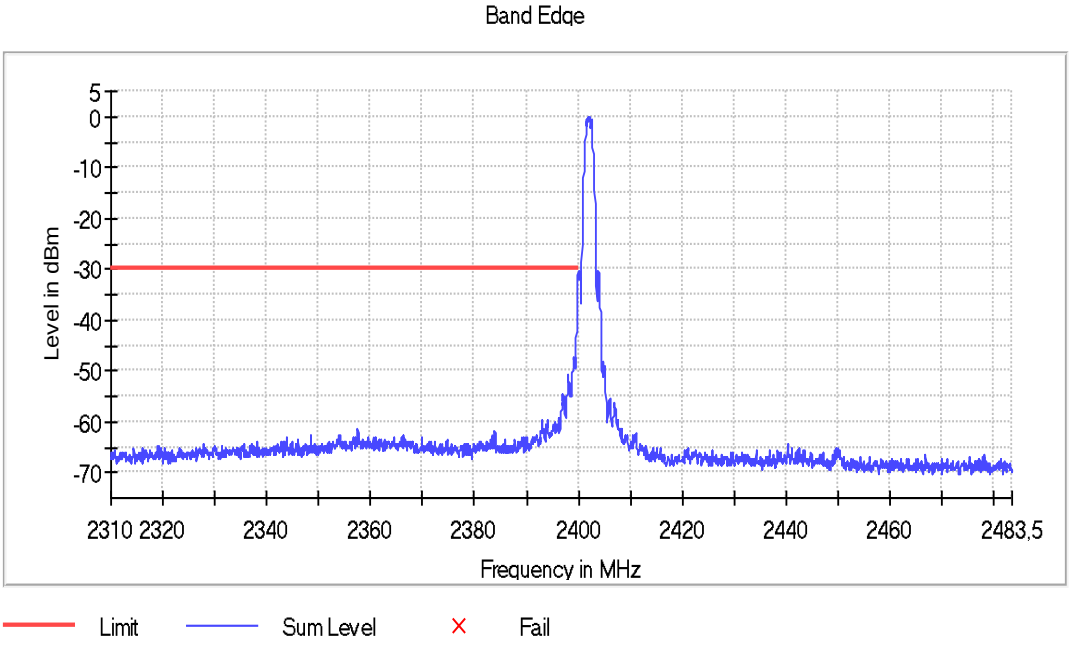
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02, section 8.7.
IRN 026 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.

3.5.5 Measurement Uncertainty

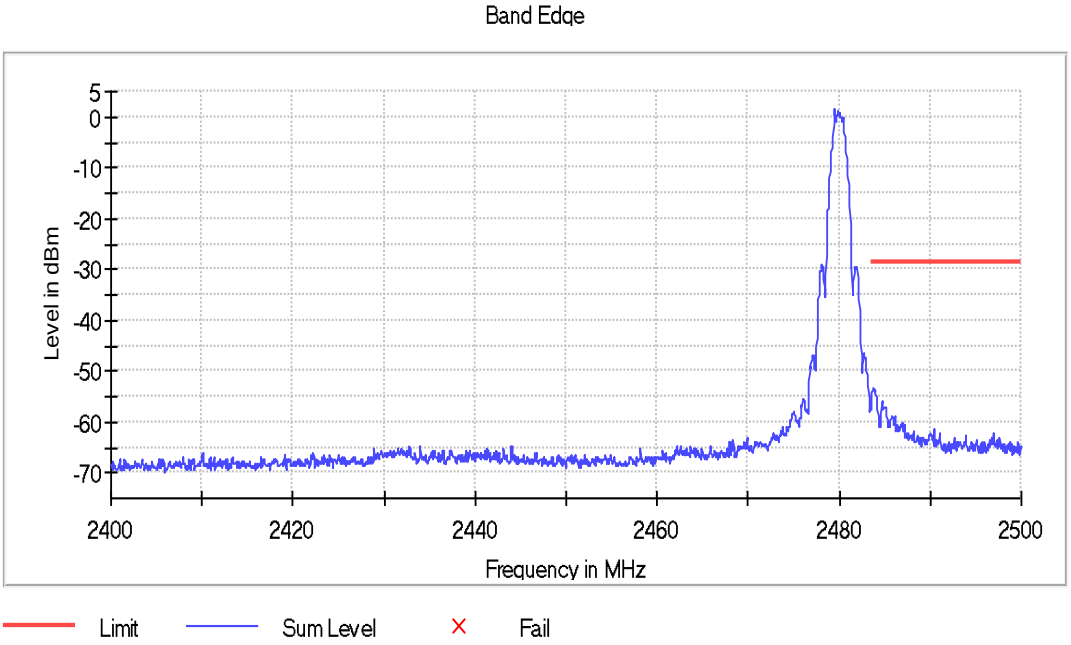
± 5.7 dB.(radiated)

3.5.6 Plots of the Band edge Measurements

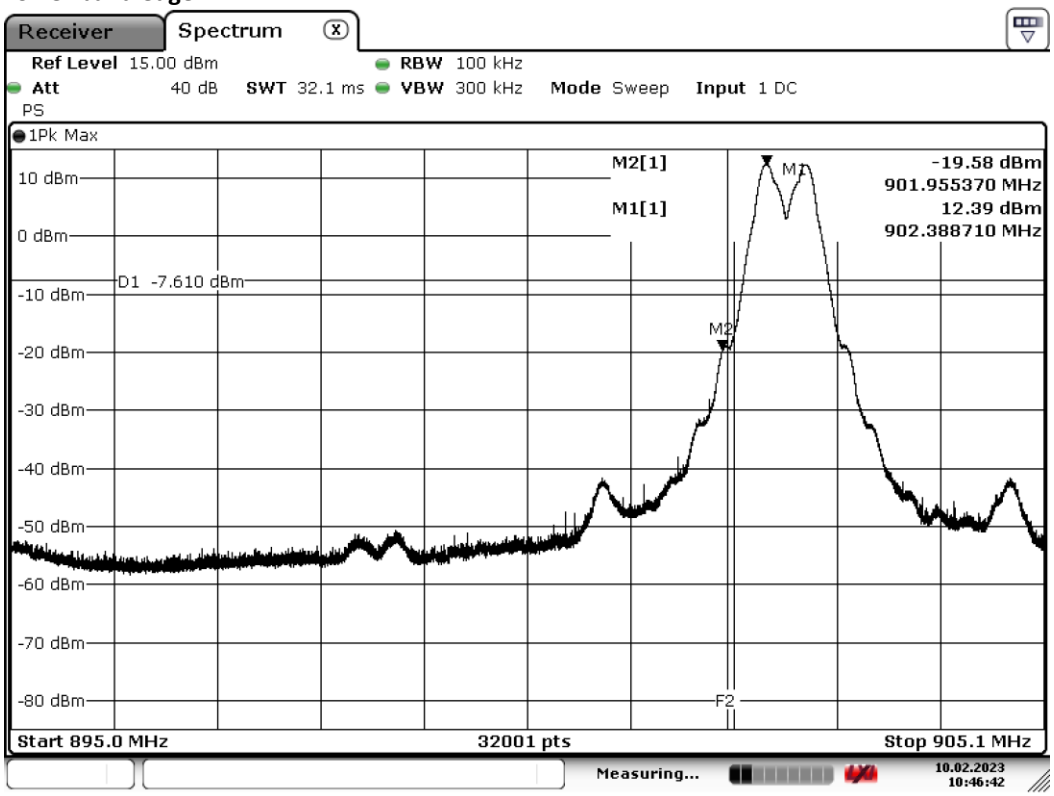
BLE Lower band edge (Channel 1)



BLE Upper band edge (Channel 39)

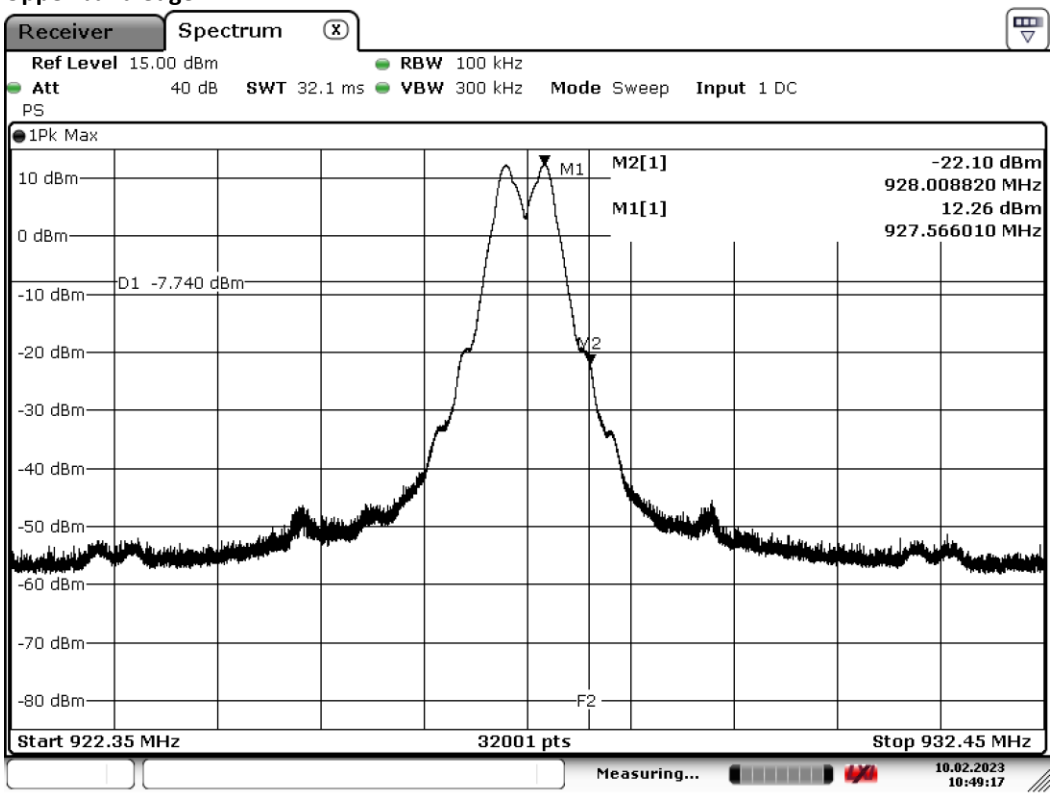


Lower band edge



Date: 10.FEB.2023 10:46:43

Upper band edge



Date: 10.FEB.2023 10:49:18

3.6 Field strength of emissions

3.6.1 Limit

15.225 (a) (b) (c)

Frequency (MHz)	µV/m at 30 meter	dBµV/m at 30 meter
13.553 – 13.567	15,848	84
13.410 – 13.553 and 13.567 – 13.710	334	50.5
13.110 – 13.410 and 13.710 - 14.010	106	40.5

15.225(d)

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
0.009 - 0.490	2400/F(kHz)	67.6-20 log(F(kHz))	300
0.490 – 1.705	24000/F(kHz)	87.6-20 log(F(kHz))	30
14.010 - 30	30	29.5	30

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.

3.6.4 Test procedure

According to ANSI C63.10-2020, section 6.4.4.2
IRN 026 – Method 10

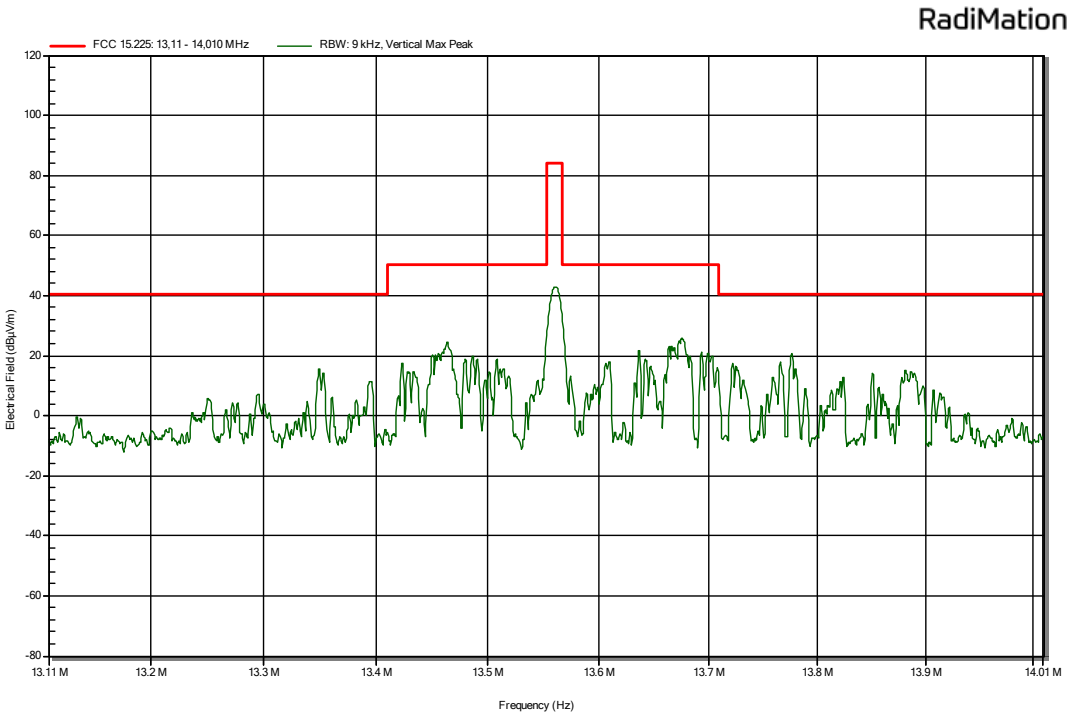
3.6.5 Test results of Field strength of emissions

Frequency (MHz)	Max Field strength at 30m (dBµV/m) (Perpendicular to site axis)	Max Field strength at 30m (dBµV/m) (Parallel to site axis)	Limit (dBµV/m) at 30m distance
13.56	42.9	42.6	84
Uncertainty	+3.0 / -2.5 dB		

3.6.6 Plots of Field strength of emissions Measurement

Loop antenna perpendicular to site axis

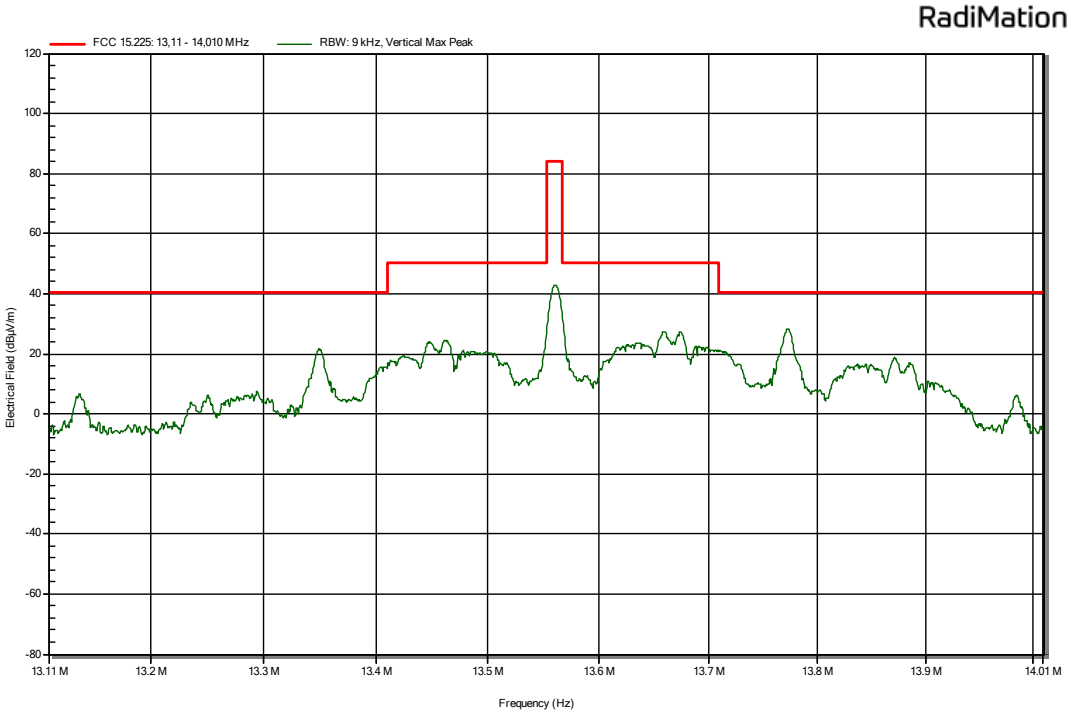
13.11 MHz to 14.01 MHz



Note: in the plots above a distance factor of - 40 dB/decade to convert to 3 m distance has been used (ref. 47 CFR part 15, §15.31 f (2)).

Loop antenna parallel to site axis

13.11 MHz to 14.01 MHz



3.7 Frequency Stability

3.7.1 Limit

The frequency stability of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

The measured frequency for the 13.56 MHz radio should fall within the limits 13558.644 kHz ≤ f ≤ 13561.356 kHz.

3.7.2 Measurement instruments

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

3.7.3 Test setup

The test has been performed in a climatic chamber using a test fixture

3.7.4 Test procedure

According to ANSI C63.10-2013, section 6.8
IRN 005 – Method 2

3.7.5 Test results of Frequency Stability Measurements

Temperature variation:

	Time after power on	2 minutes	Pass/fail	5 minutes	Pass/fail	10 minutes	Pass/fail
Temperature							
50°C		13.560587	Pass	13.560588	Pass	13.560588	Pass
40°C		13.560591	Pass	13.560591	Pass	13.560591	Pass
30°C		13.560607	Pass	13.560606	Pass	13.560606	Pass
20°C		13.560623	Pass	13.560616	Pass	13.560616	Pass
10°C		13.560655	Pass	13.560654	Pass	13.560654	Pass
0°C		13.560666	Pass	13.560666	Pass	13.560667	Pass
-10°C		13.560667	Pass	13.560667	Pass	13.560668	Pass
-20°C		13.560650	Pass	13.560655	Pass	13.560655	Pass

Voltage variation:

Voltage	Frequency (MHz)	Deviation (%)*)	Limit (%)
5.10	13.560618	0.00456	0.01
6.90	13.560617	0.00455	0.01

*) w.r.t. nominal frequency of 13.56 MHz

3.7.6 Measurement Uncertainty

Measurement uncertainty = + /- 10 Hz

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