Test report for

47 CFR Part 15 Subpart C

RSS-247, RSS-Gen

The RvA is signatory to ILAC - MRA

Product name	: WIB2000
Applicant	: CowManager
FCC ID	: Y8K-WIB2000
IC	: 22382-WIB2000

Test report No. : P000265432 004 Ver 2.00

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.

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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	30-03-2023	First draft	KK
v1.00	03-05-2023	Final release	KK
v2.00	06-06-2023	Additional statements has been added Measurement setting has been added	KK

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247(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:	CowManager B.V.
Address:	Gerverscop 9, Harmelen, The Netherlands
Zip code:	3481 LT
Telephone:	+31 (0)348443840
E-mail:	certification@cowmanager.com
Contact name:	Mark Peeters

1.2 Manufacturer

Manufacturer name:	CowManager B.V.
Address:	Gerverscop 9, Harmelen, The Netherlands
Zip code:	3481 LT
Telephone:	+31 (0)348443840
E-mail:	certification@cowmanager.com
Contact name:	Mark Peeters

1.3 Tested Equipment Under Test (EUT)

Product name:	WIB2000
Brand name:	CowManager B.V.
FCC ID:	Y8K-WIB2000
IC:	22383-WIB2000
Product description:	Coordinator/Router (CR3)
Variant model(s):	-
Batch and/or serial No.	-
Software version:	V6.2
Hardware version:	20.4
Date of receipt	01-12-2022
Tests started:	06-12-2022
Testing ended:	27-03-2023

1.3.1 Auxiliary items

EUT does use external AC power adapter.

1.4 Product specifications of Equipment under test

Tx Frequency:	Zigbee: 2400 – 2483.5 MHz
Rx frequency:	Zigbee: 2400 – 2483.5 MHz
Occupied channel width:	2375 kHz
Antenna type:	Monopole Antenna
Antenna gain:	5dBi
Type of modulation:	QPSK
Emission designator	2M37F1D

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 %

Test date	08-03-2023
Ambient temperature	21.2 C°
Humidity	26.1 %

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
- RSS-Gen Issue 5
- RSS-247 Issue 2

1.8 Observation and remarks

The EUT has been tested at the worst case orientation for radiated tests. The EUT is a fixed use device with AC power. Customer provided software tool to set the device to continuous transmit mode.

1.9 Modifications to the EUT (Equipment Under Test)

None.

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 : Koray Korcum, MSc

Review of test methods and report by:

Name : Paul van Wanrooij, BSc

The above conclusions have been verified by the following signatory:

Date : 03-07-2023

Name : P. van Wanrooij

Function : Test Engineer

Signature :

2 Test configuration of the Equipment Under Test

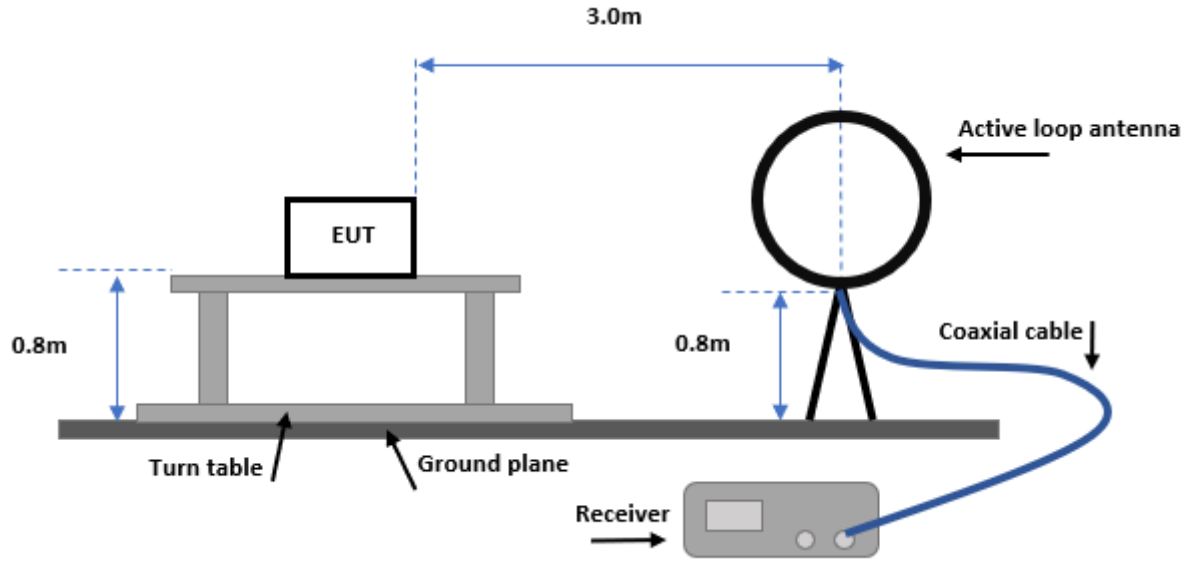
2.1 Test mode

The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels. During the test 0 level setting as a power level has been used as a recommended setting from customer.

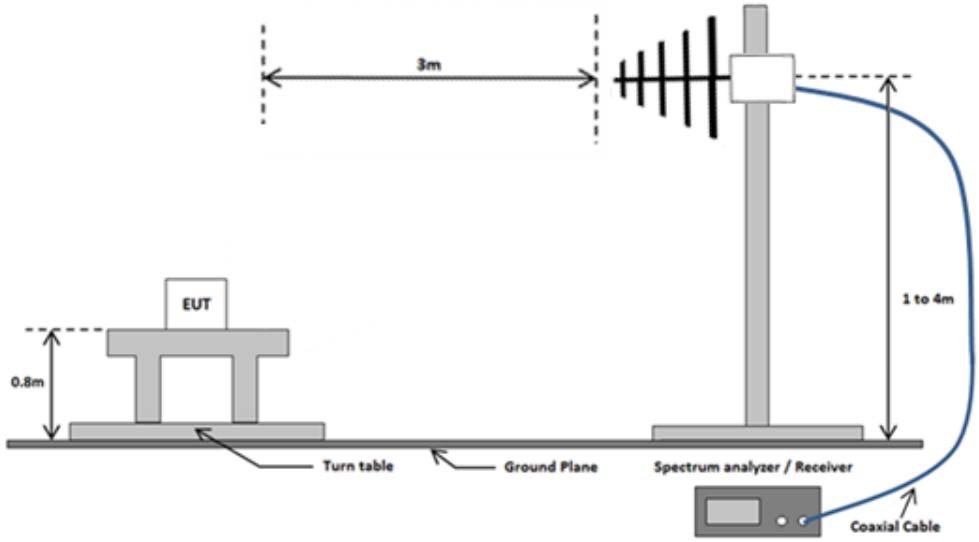
Technology	Channels	Data rate	Frequency (MHz)
Zigbee	11	250 Kbps	2405
	18	250 Kbps	2440
	26	250 Kbps	2480

2.2 Test setups

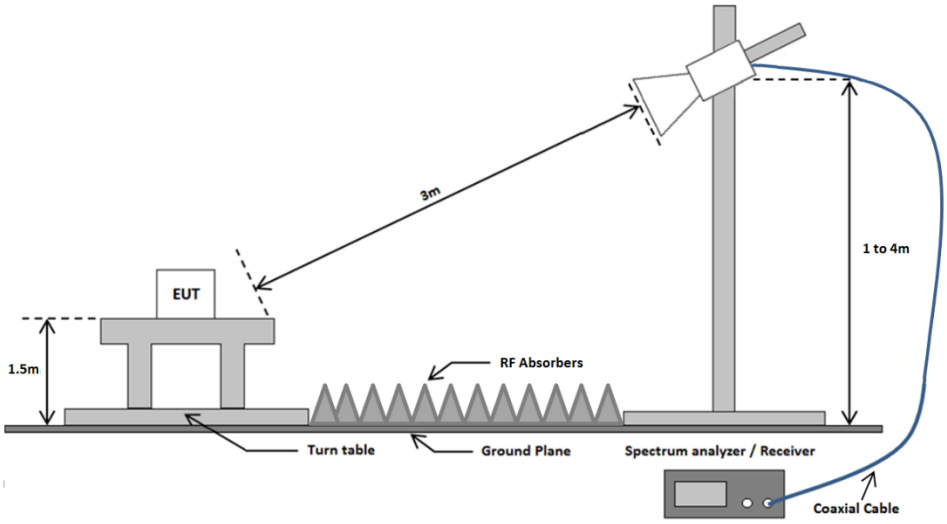
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz

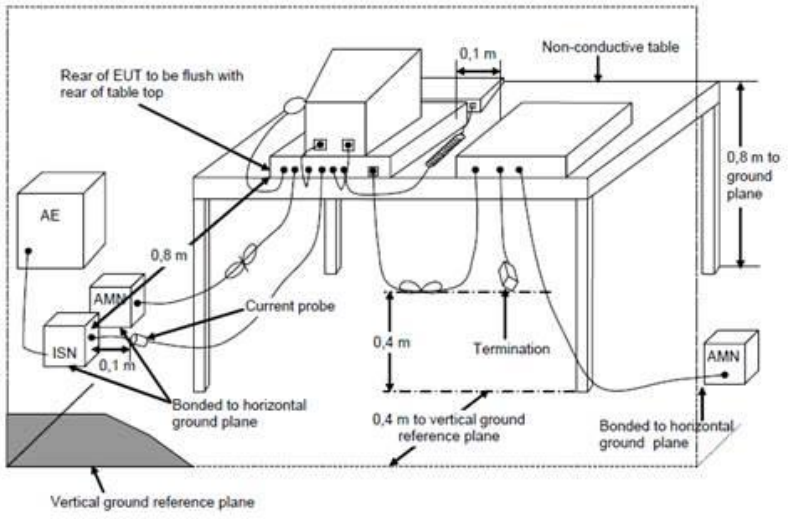


Radiated emissions test setup above 1 GHz

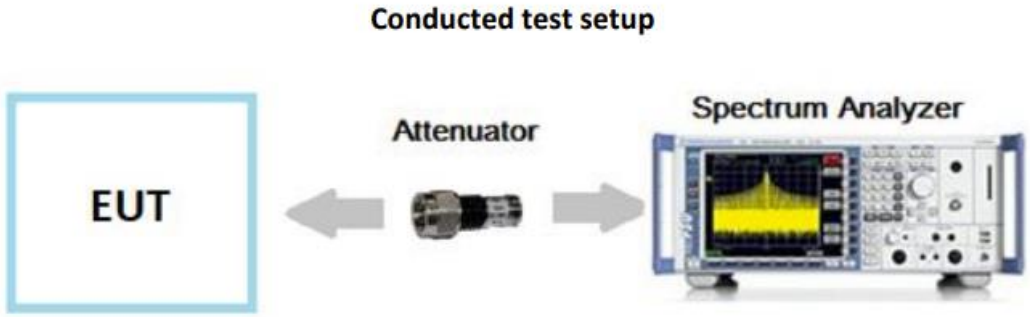


AC Power line conducted emissions test setup

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	< 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	ESCI	114161	01-2023	01-2024	3.7
EMI Receiver	Rohde & Schwarz	ESR7	114534	09-2022	09-2023	3.1
Spectrum analyzer	Rohde & Schwarz	FSP40	114792	03-2023	03-2024	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV40	114527	01-2023	01-2024	3.2-3.6
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
Horn antenna	Scientific atlanta	12A-26	11487	NA*	NA*	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114690	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	--	--	--	-
LISN /Two line V-network	Rohde & Schwarz	ENV 216	114379	07-2021	07-2023	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

15.209(a) / RSS-Gen 8.9
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 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

Frequency	Peak	Quasi-Peak limit	Status	Angle	Height	Polarization
99,575 MHz	25 dBµV/m	44 dBµV/m	Pass	258 degrees	2 m	Horizontal
84,918 MHz	20,5 dBµV/m	44 dBµV/m	Pass	0 degrees	2 m	Horizontal
97,458 MHz	24,2 dBµV/m	44 dBµV/m	Pass	160 degrees	2 m	Vertical

Frequency	Peak	Peak Limit	Average	Average Limit	Status	Angle	Height	Polarization
4,810 GHz	50,6 dBµV/m	74 dBµV/m	40,5 dBµV/m	54 dBµV/m	Pass	360 degrees	1 m	Horizontal
4,886 GHz	47,8 dBµV/m	74 dBµV/m	35,7 dBµV/m	54 dBµV/m	Pass	0 degrees	1,2 m	Horizontal
4,829 GHz	47,3 dBµV/m	74 dBµV/m	35,6 dBµV/m	54 dBµV/m	Pass	0 degrees	1,5 m	Vertical

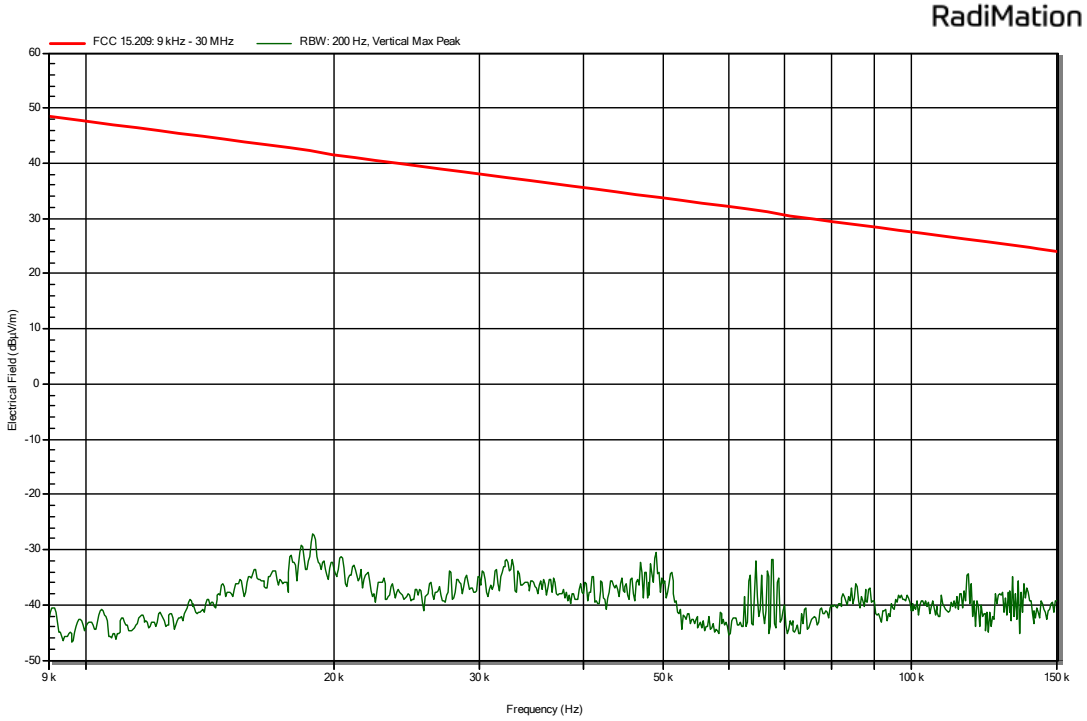
The results of the radiated emission tests are depicted in the table above. A selection of plots are provided on the next pages.

Note: radiated emission plots has been numbered as follows:

Plot 1 (9-150 kHz – a:perpendicular b:paralel)
Plot 2 (0.15-30 MHz - a:perpendicular b:paralel)
Plot 3 (30 – 250 MHz - low channel a:horizontal b: vertical)
Plot 4 (30 – 250 MHz - mid channel a:horizontal b: vertical)
Plot 5 (30 – 250 MHz - high channel a:horizontal b: vertical)
Plot 6 (250 – 1000 MHz - low channel a:horizontal b: vertical)
Plot 7 (250 – 1000 MHz - mid channel a:horizontal b: vertical)
Plot 8 (250 – 1000 MHz - high channel a:horizontal b: vertical)
Plot 9 (1 – 18 GHz - low channel a:horizontal b: vertical)
Plot 10 (1 – 18 GHz - mid channel a:horizontal b: vertical)
Plot 11 (1 – 18 GHz - high channel a:horizontal b: vertical)
Plot 12 (18 – 26 GHz - low channel a:horizontal b: vertical)
Plot 13 (18 – 26 GHz - mid channel a:horizontal b: vertical)
Plot 14 (18 – 26 GHz - high channel a:horizontal b: vertical)

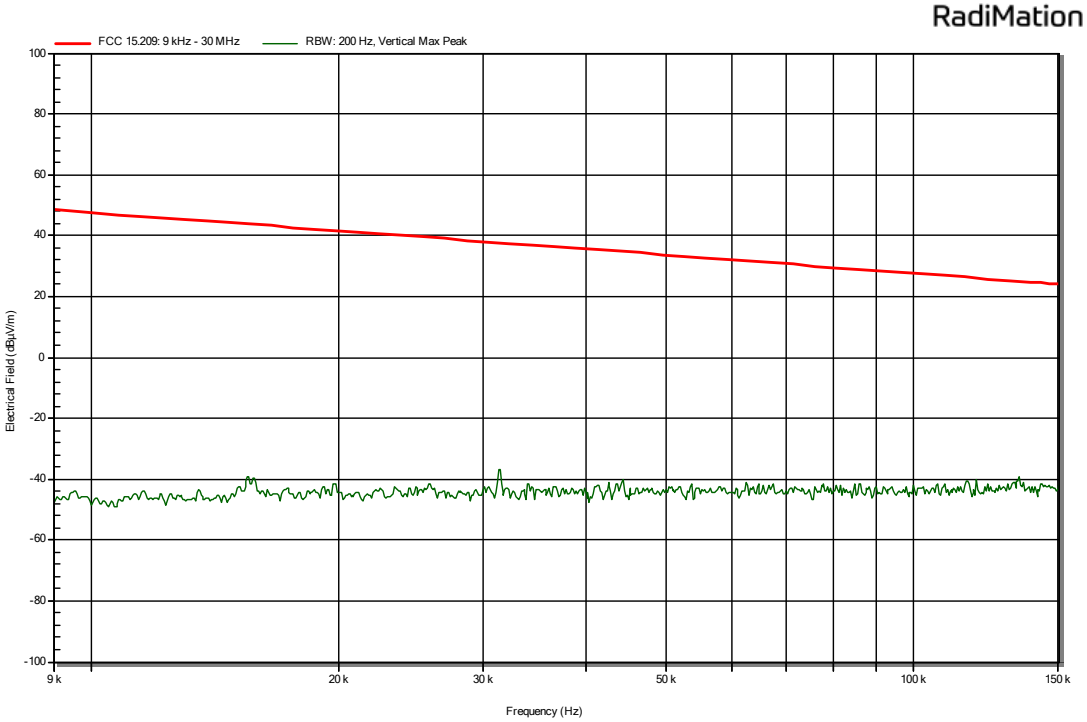
3.1.7 Plots of the Radiated Spurious Emissions Measurement

9 – 150 kHz (Perpendicular)



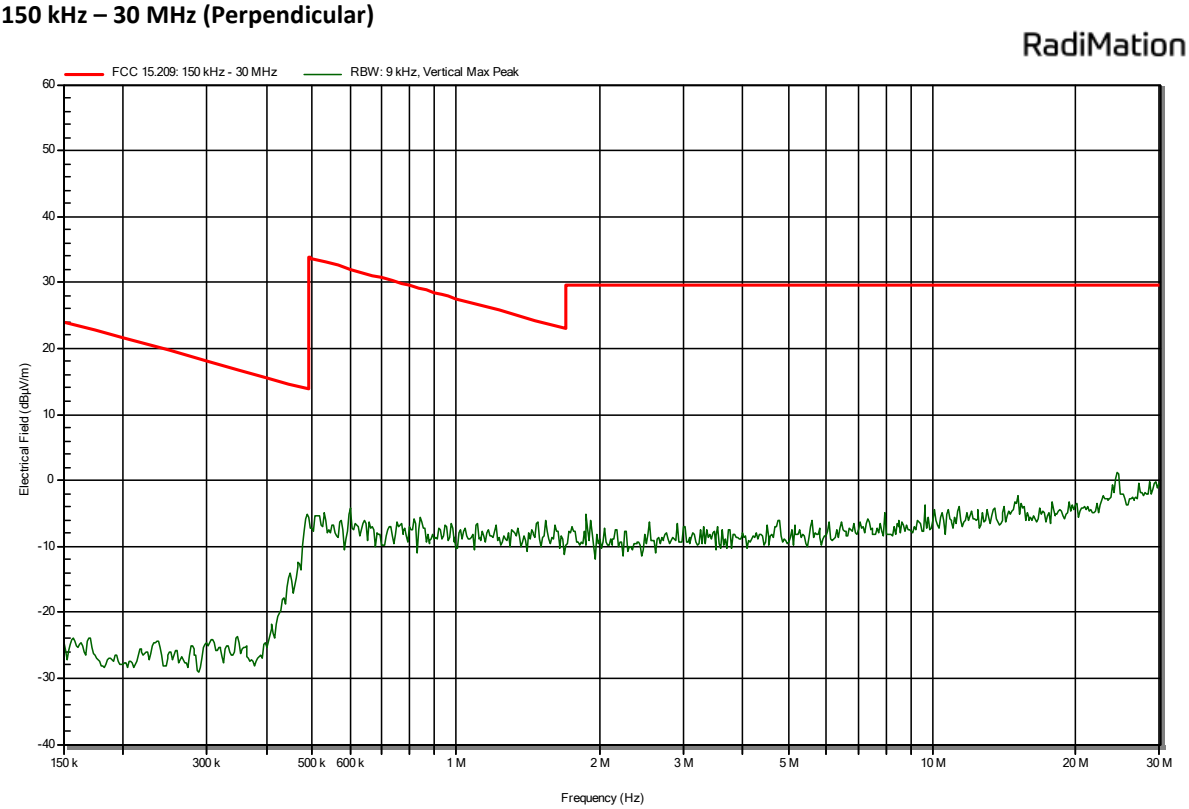
Plot 1a: radiated emissions of the EUT, Antenna perpendicular, in the range 9 – 150 kHz (pre-scan peak values shown).

9 – 150 kHz (Parallel)



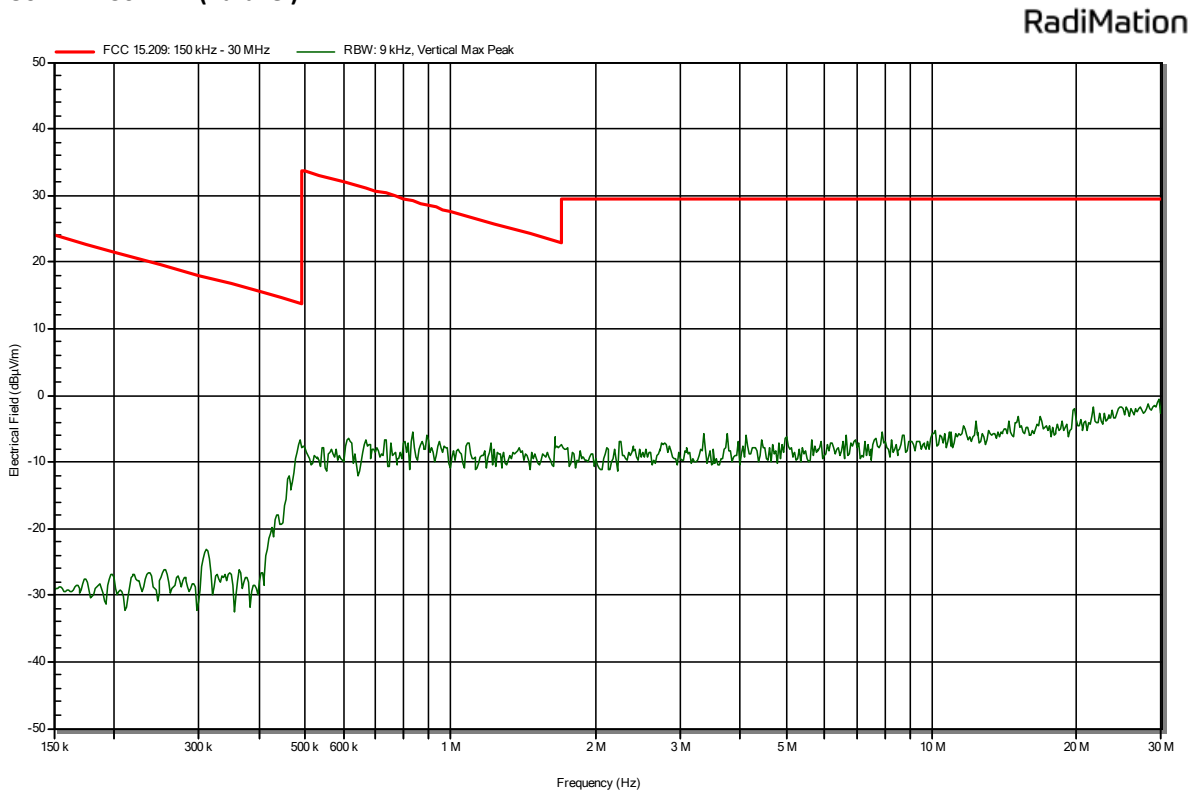
Plot 1b: radiated emissions of the EUT, Antenna parallel, in the range 9 – 150 kHz (pre-scan peak values shown).

150 kHz – 30 MHz (Perpendicular)



Plot 2a: radiated emissions of the EUT, Antenna perpendicular, in the range 150 kHz – 30 MHz (pre-scan peak values shown).

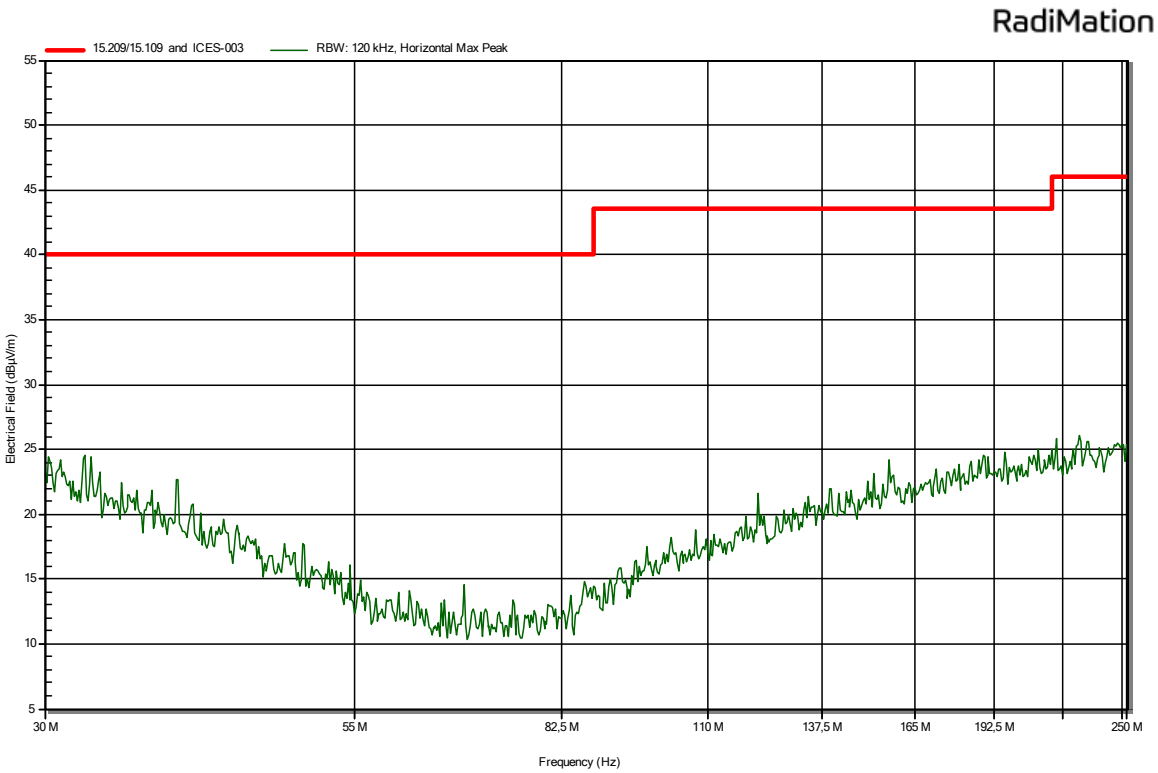
150 kHz – 30 MHz (Parallel)



Plot 2b: radiated emissions of the EUT, Antenna parallel, in the range 150 kHz – 30 MHz (pre-scan peak values shown).

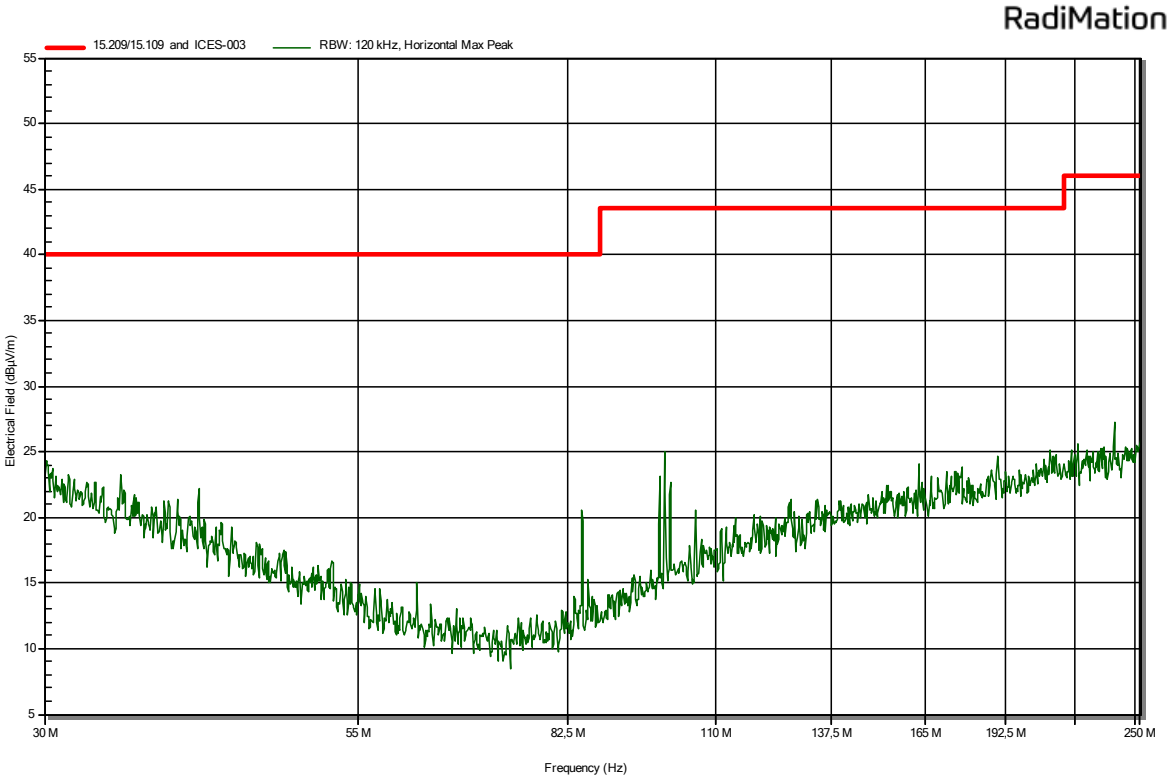
30 – 250 MHz

Low channel



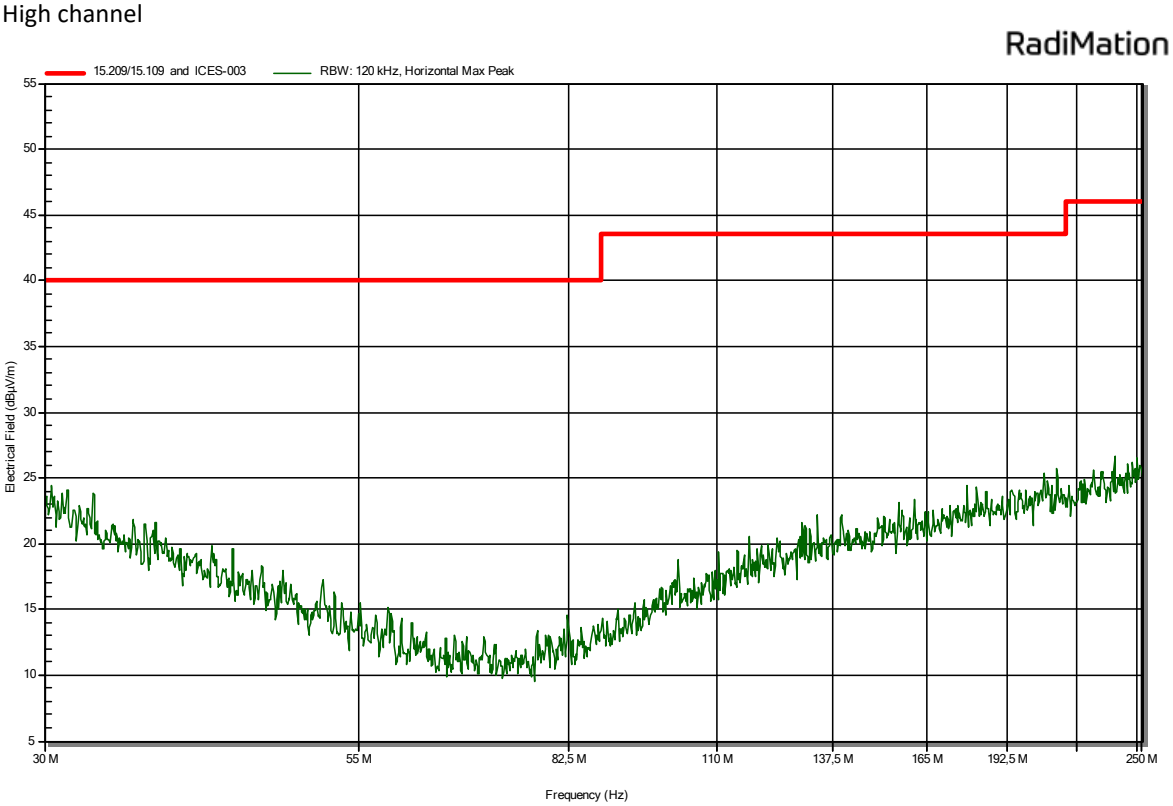
Plot 3a: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown).

Mid channel



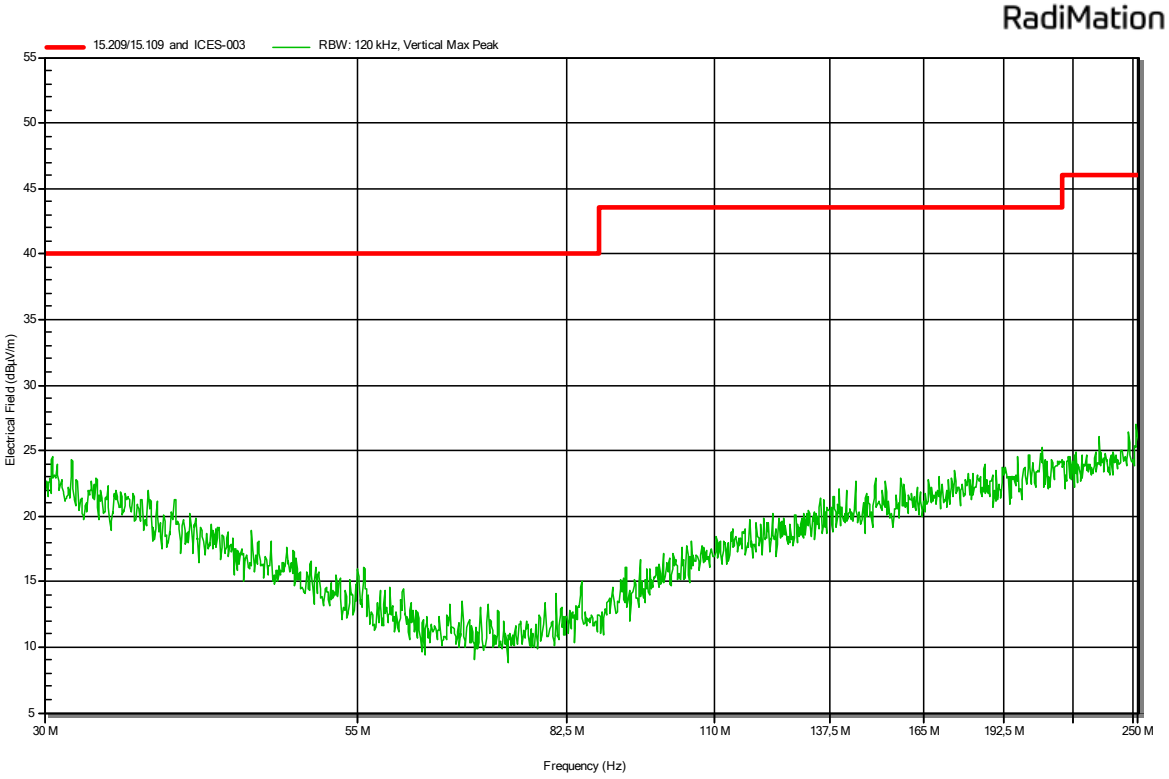
Plot 4a: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown).

High channel



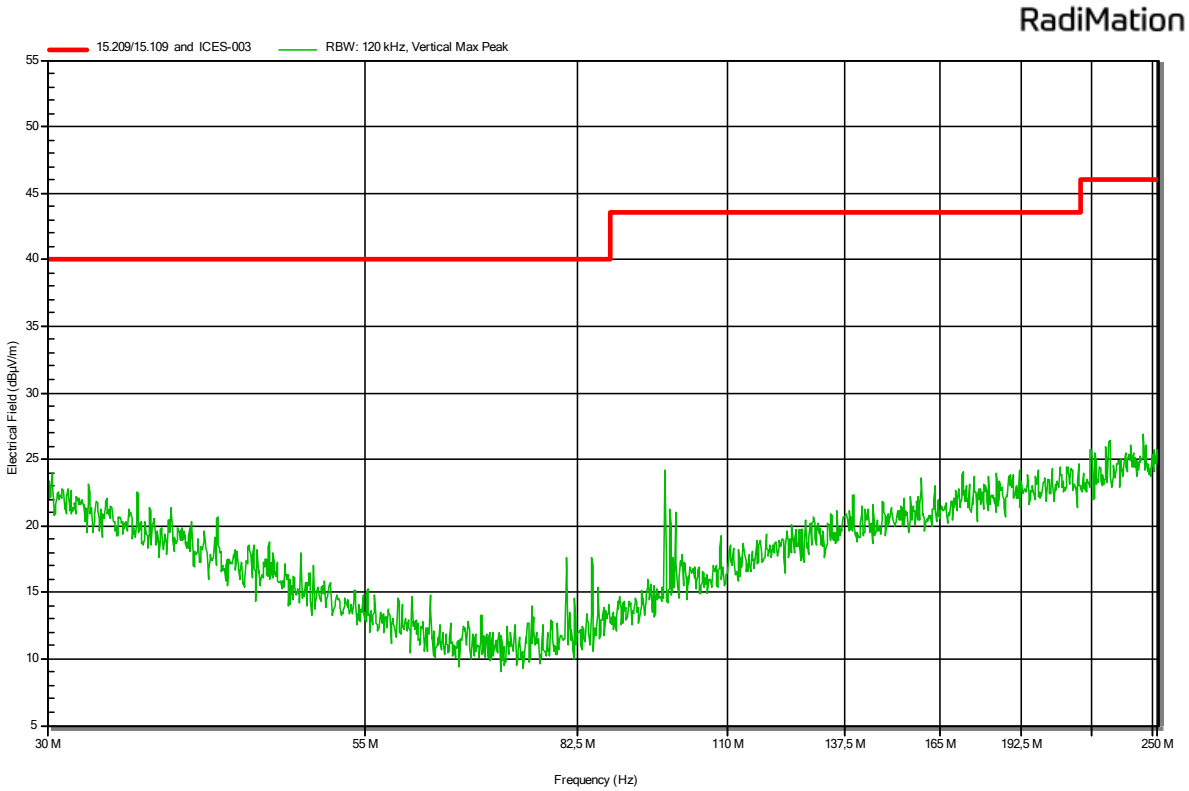
Plot 5a: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown).

Low channel



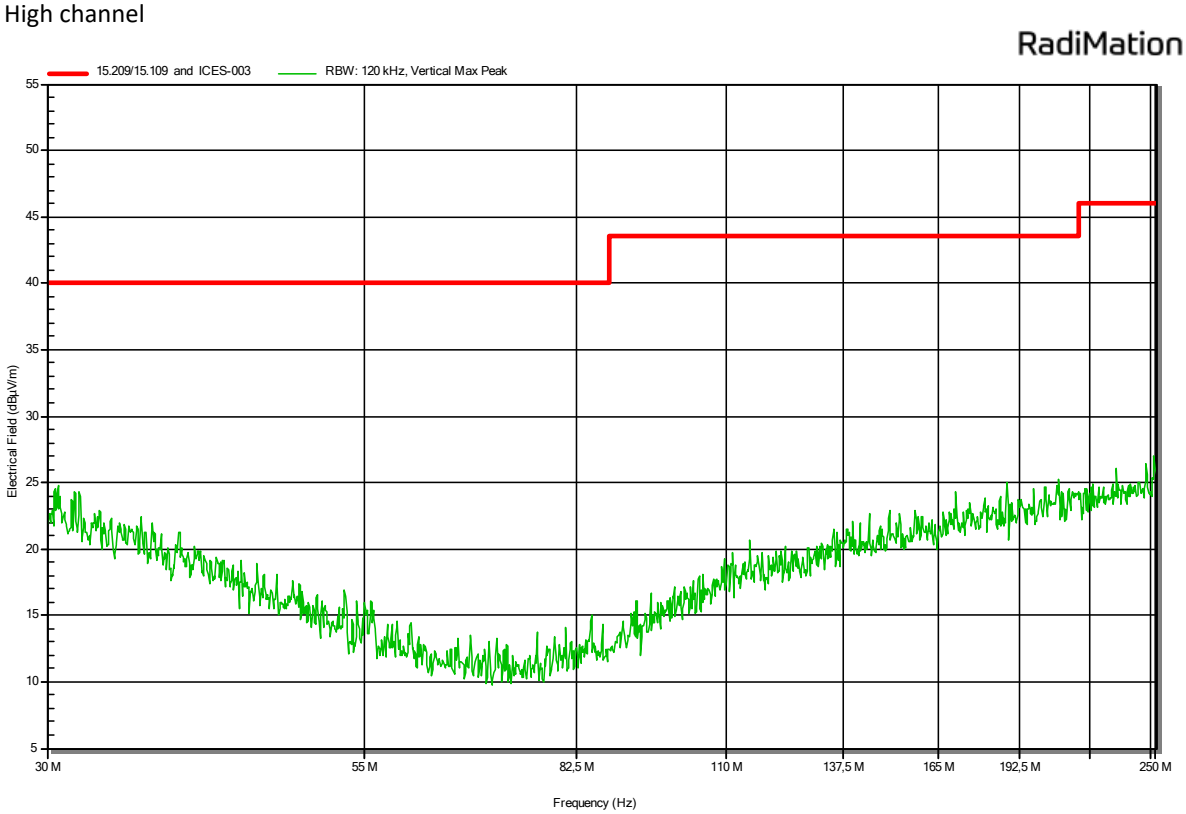
Plot 3b: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown).

Mid channel



Plot 4b: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown).

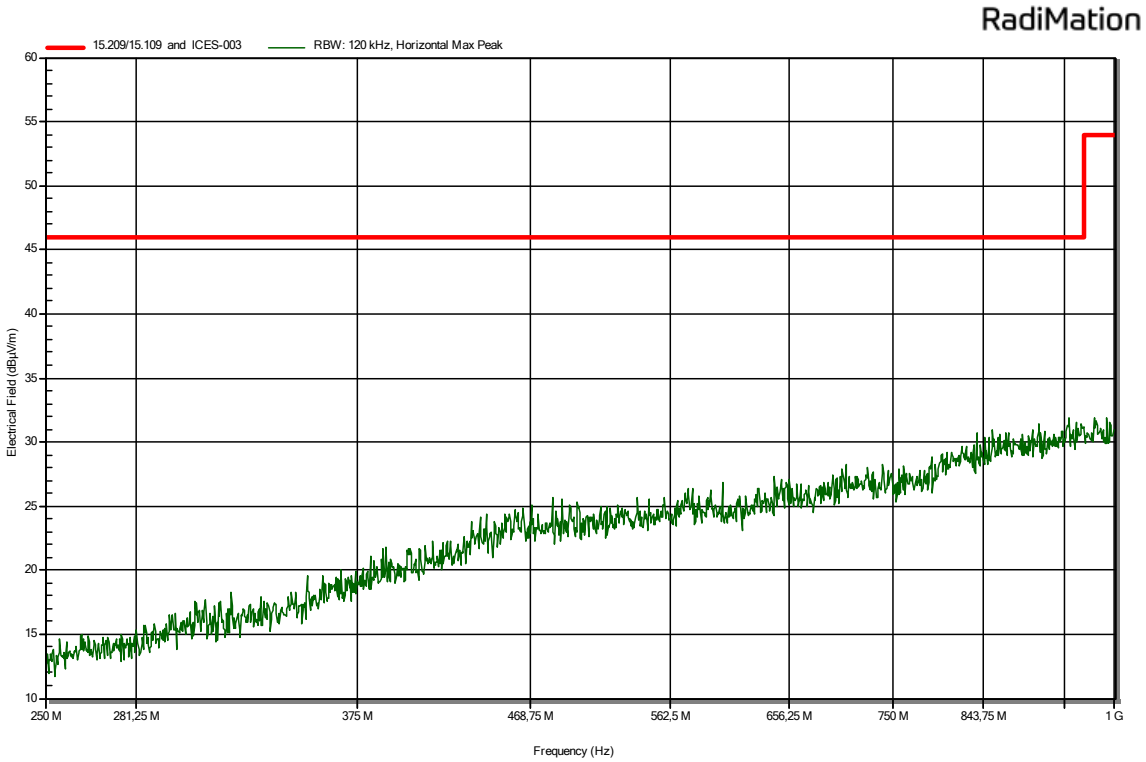
High channel



Plot 5b: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown).

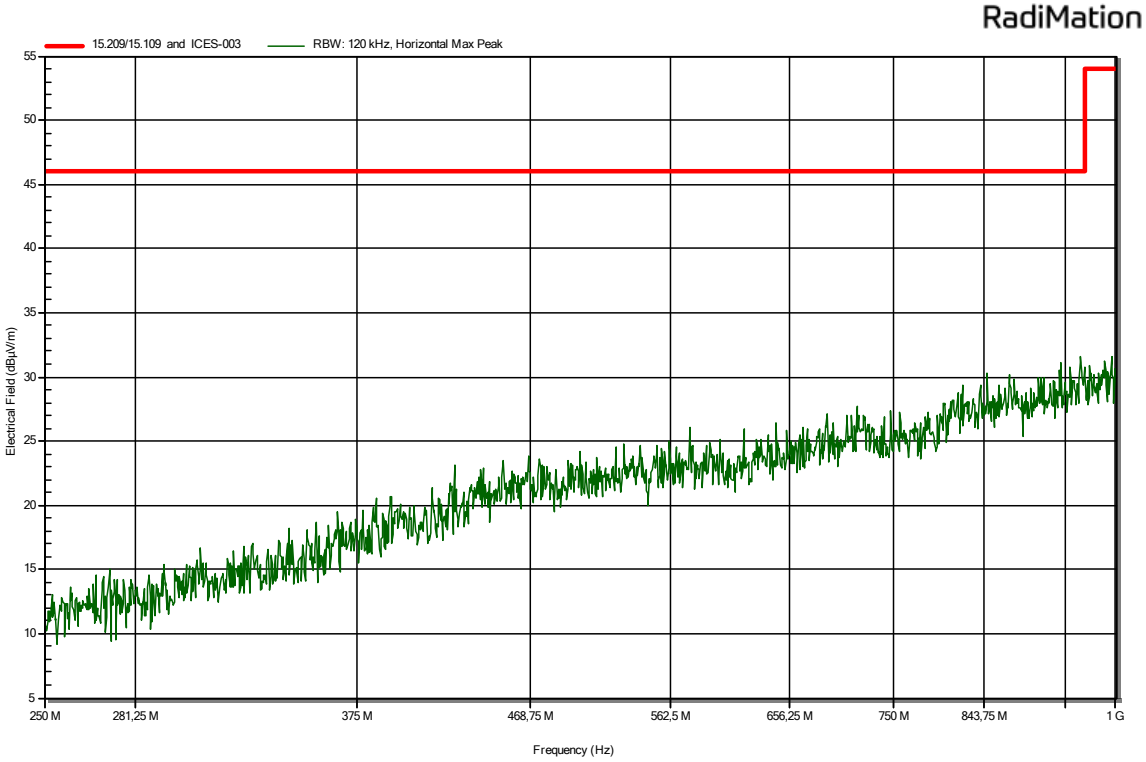
250 – 1000 MHz

Low channel



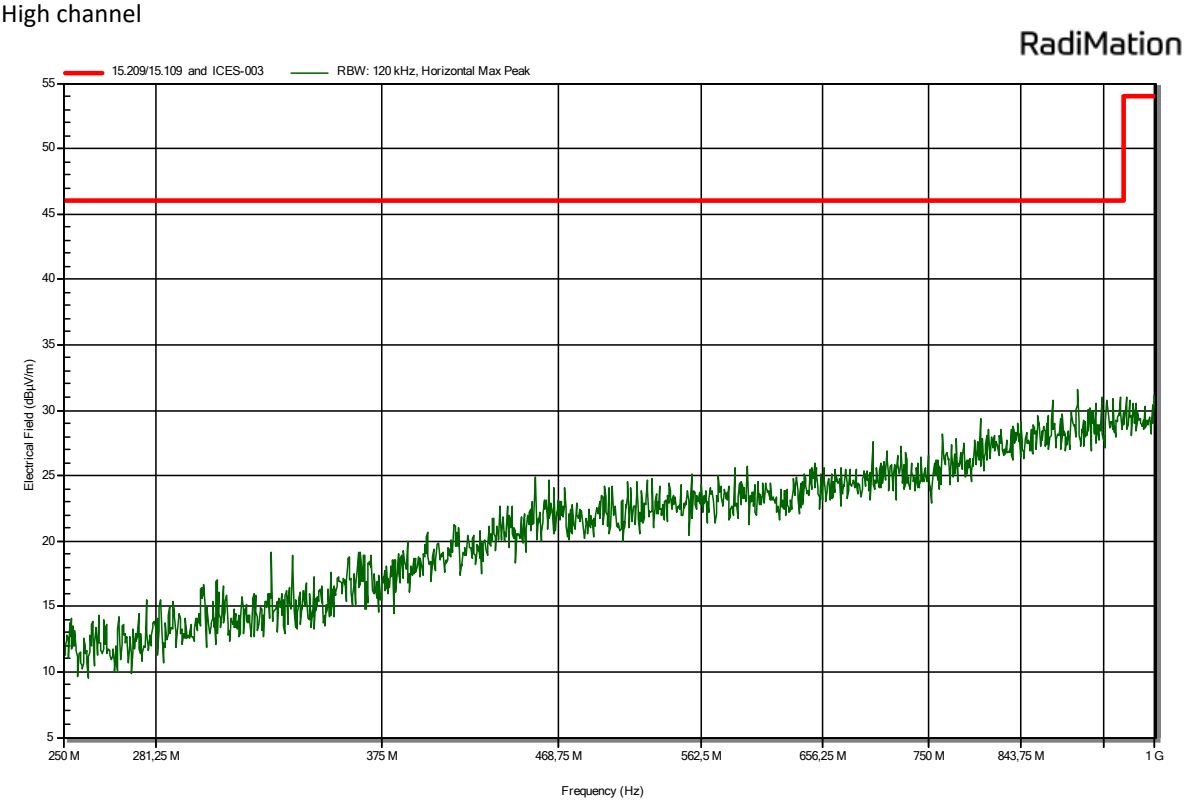
Plot 6a: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz (pre-scan peak values shown).

Mid channel



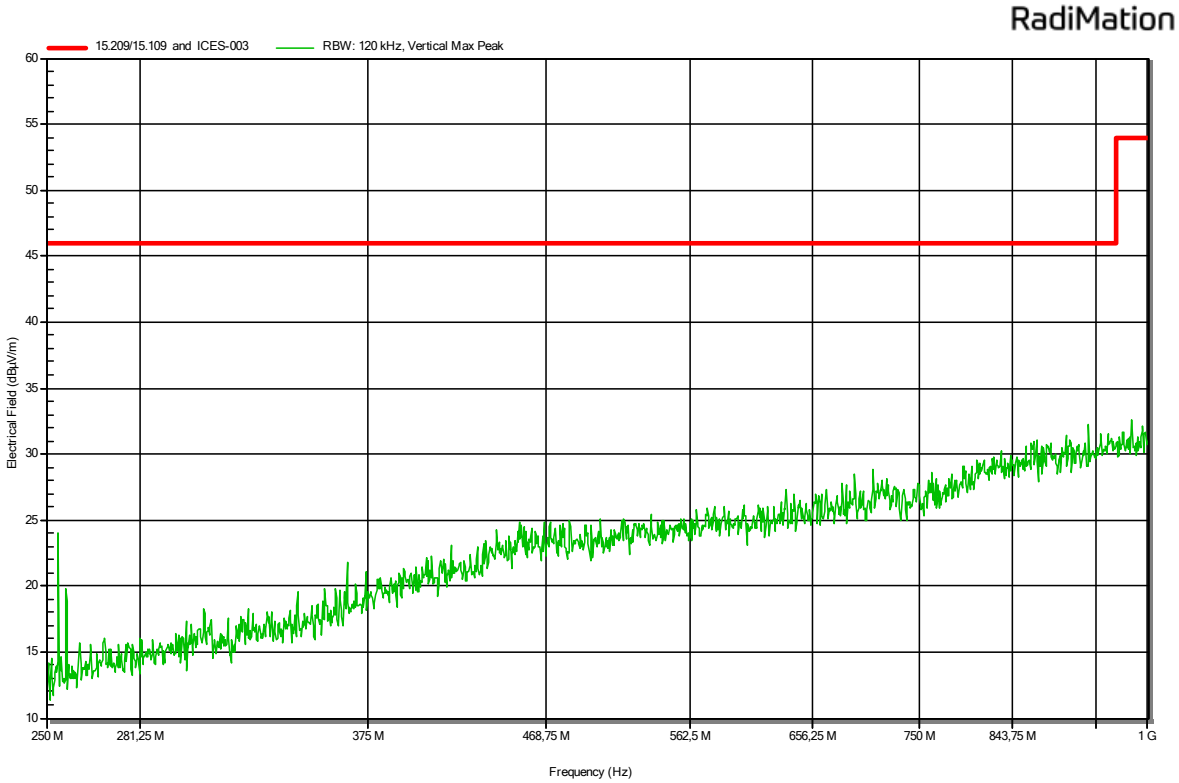
Plot 7a: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz (pre-scan peak values shown).

High channel



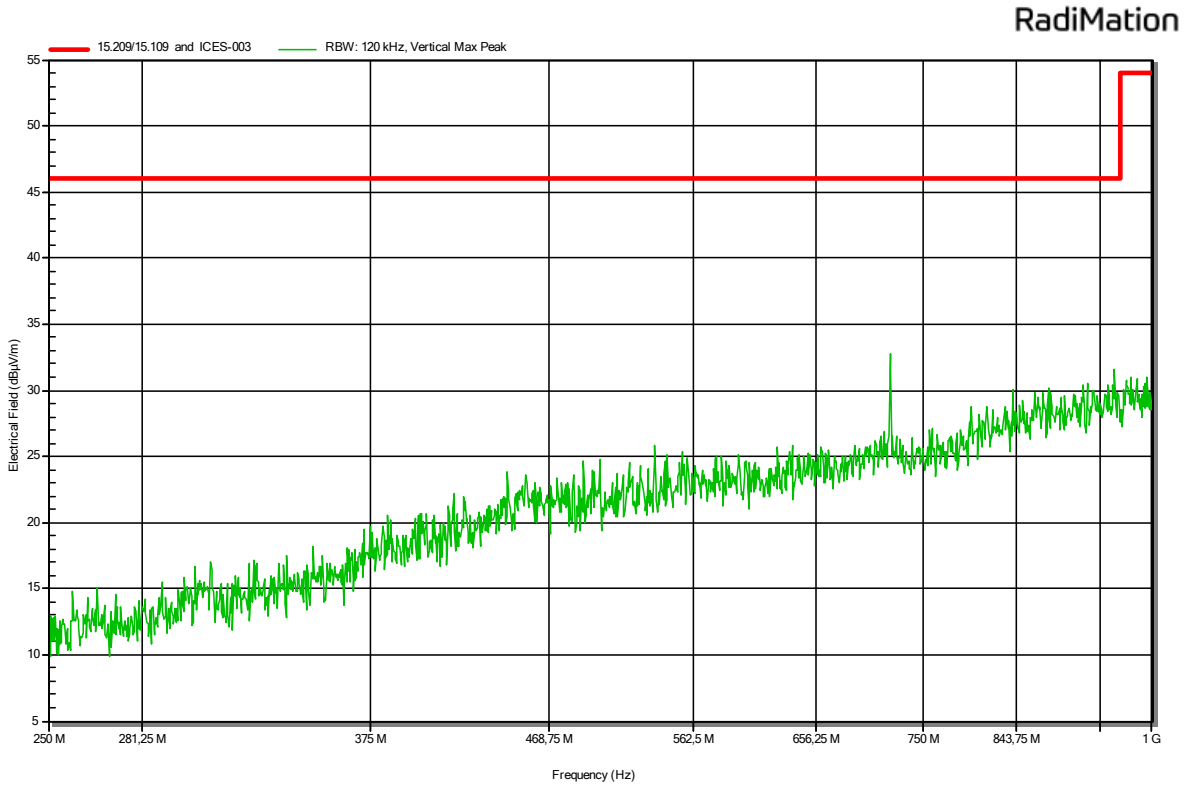
Plot 8a: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz (pre-scan peak values shown).

Low channel



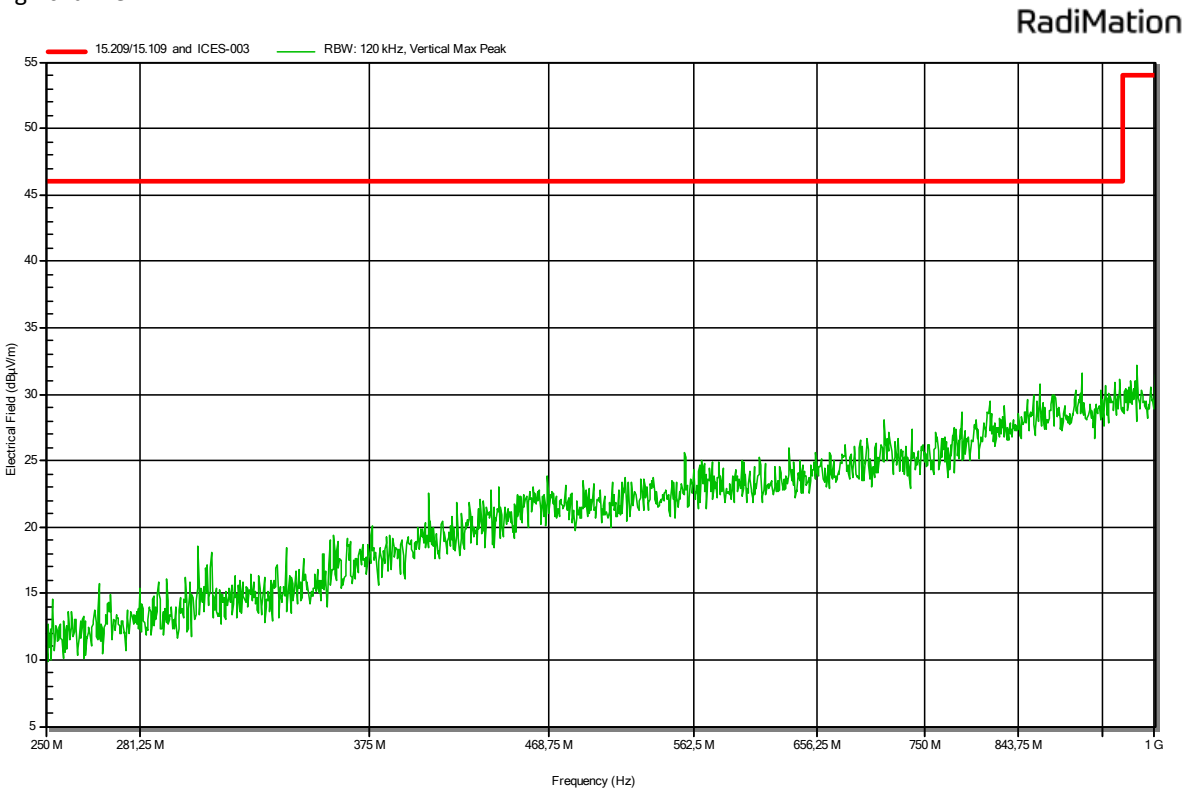
Plot 6b: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz (pre-scan peak values shown).

Mid channel



Plot 7b: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz (pre-scan peak values shown).

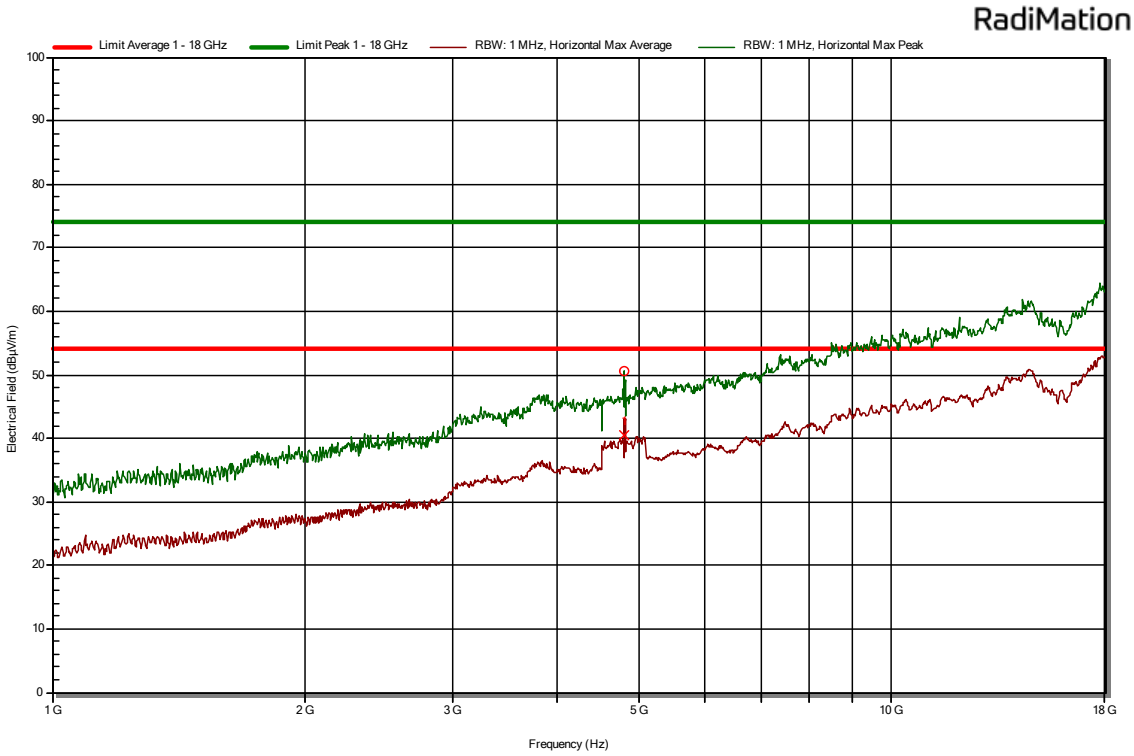
High channel



Plot 8b: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz (pre-scan peak values shown).

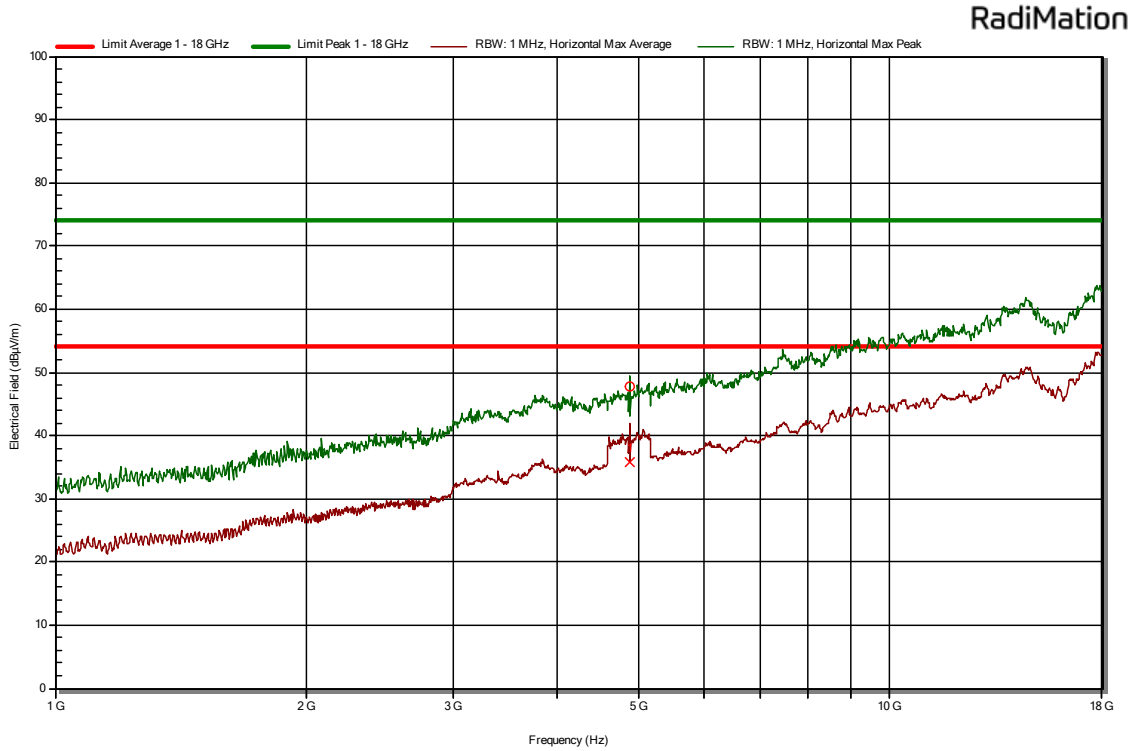
1 – 18 GHz

Low channel



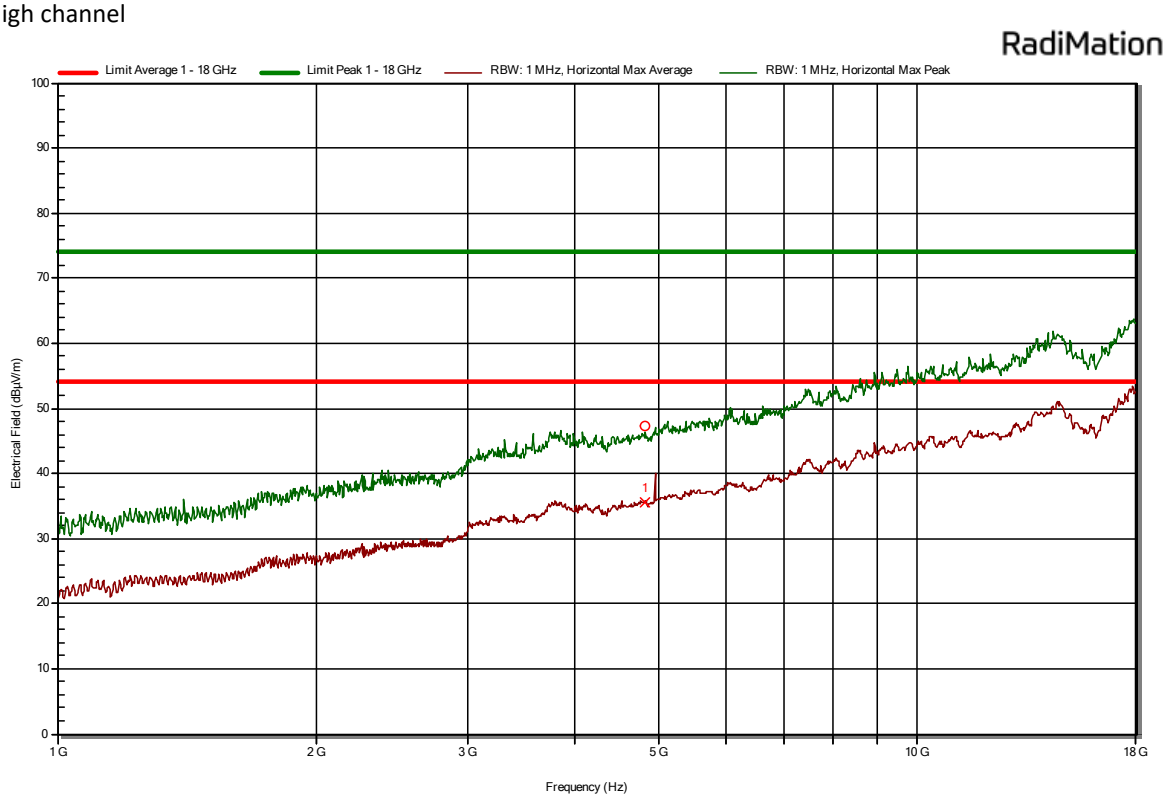
Plot 9a: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz (pre-scan peak values shown).

Mid channel



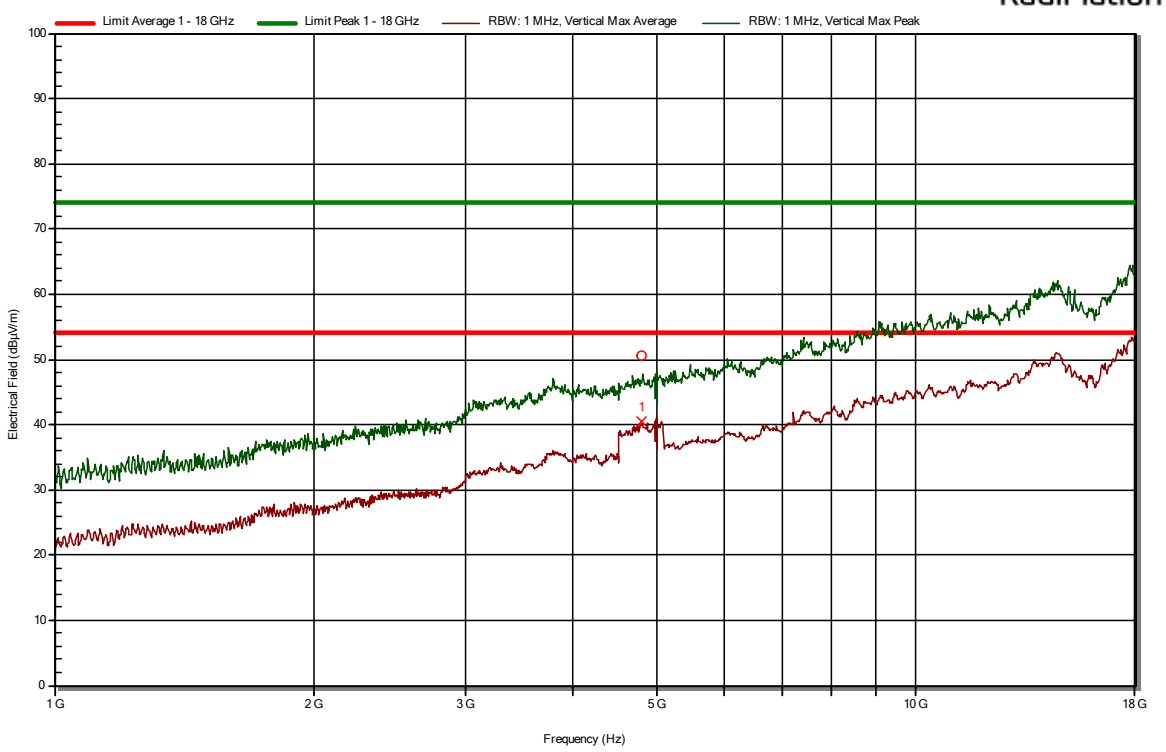
Plot 10a: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz (pre-scan peak values shown).

High channel



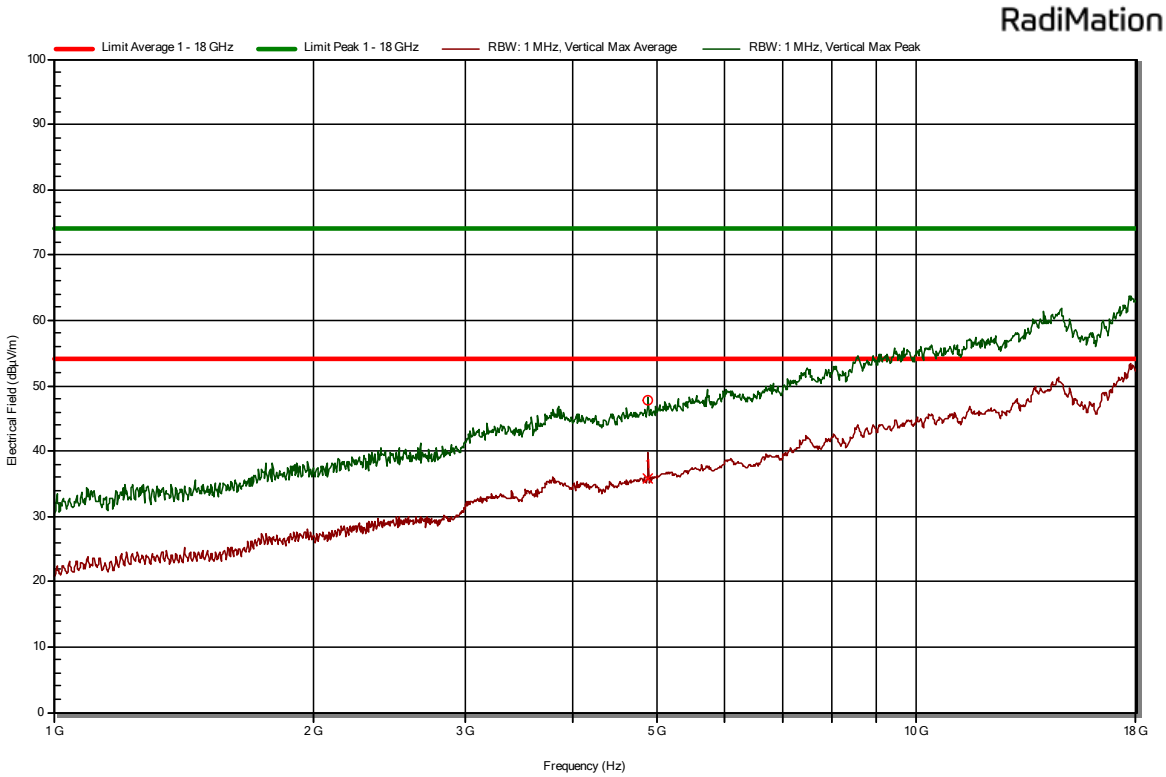
Plot 11a: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz (pre-scan peak values shown).

Low channel



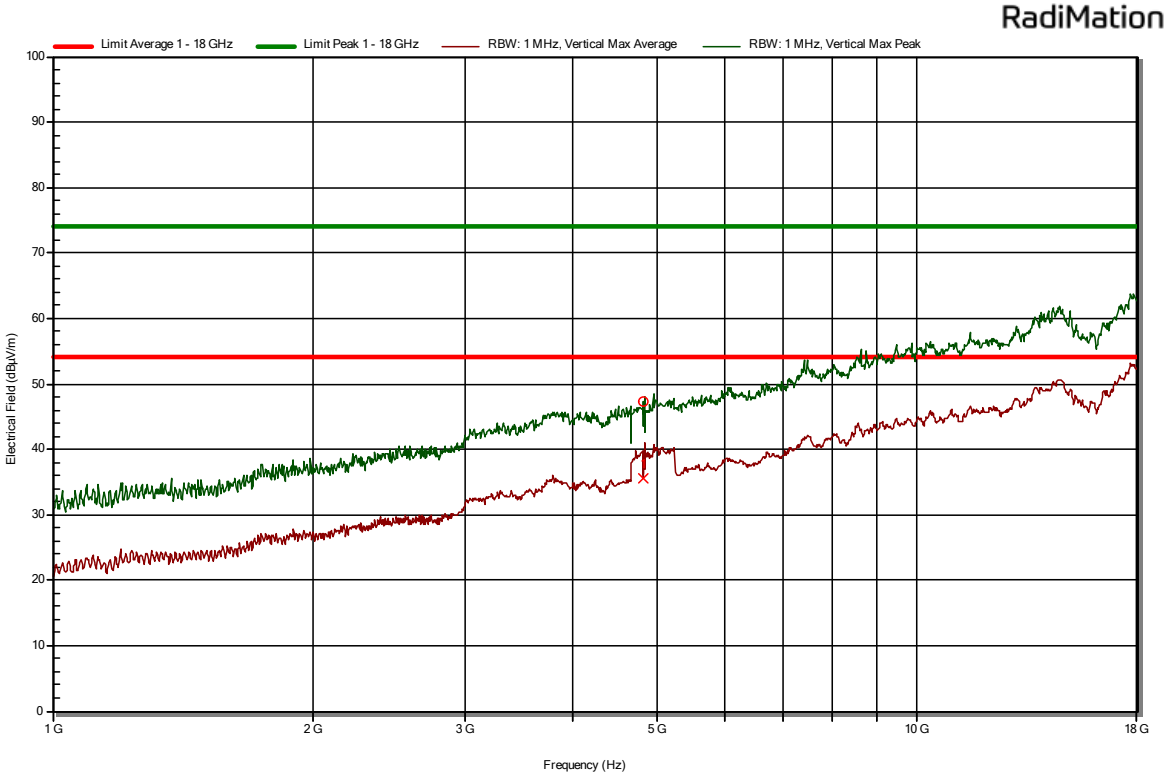
Plot 9b: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz (pre-scan peak values shown).

Mid channel



Plot 10b: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz (pre-scan peak values shown).

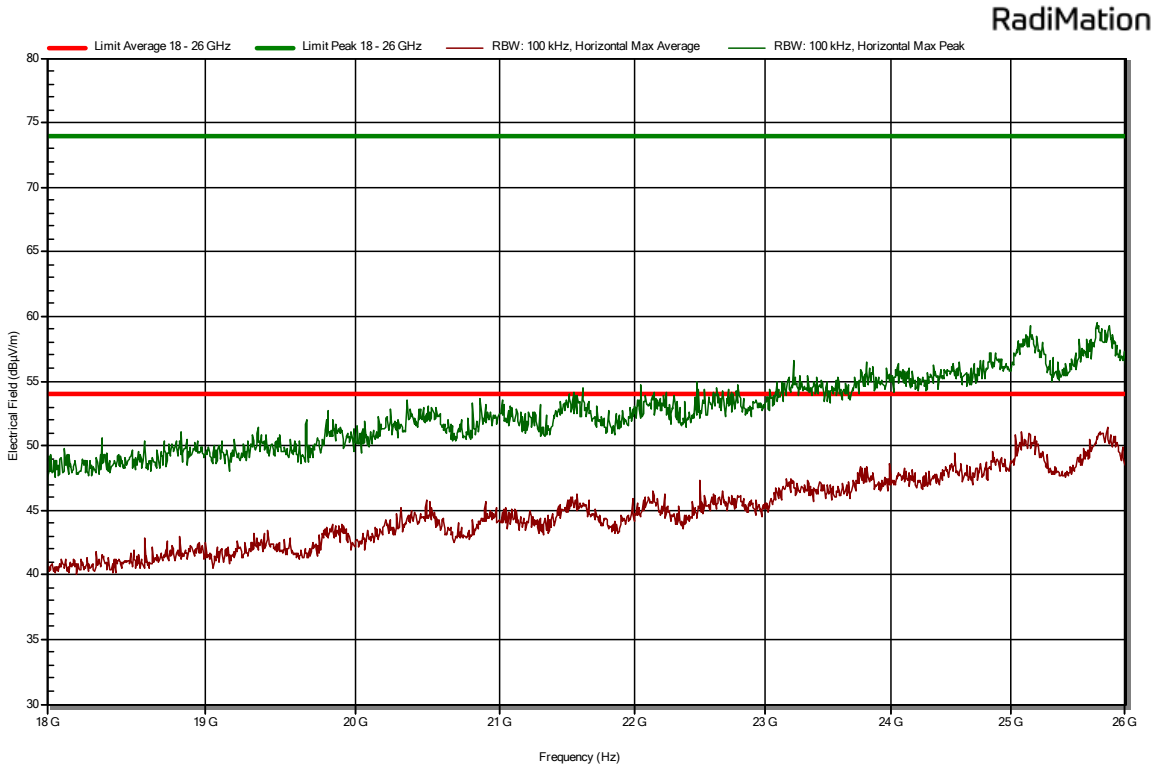
High channel



Plot 11b: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz (pre-scan peak values shown).

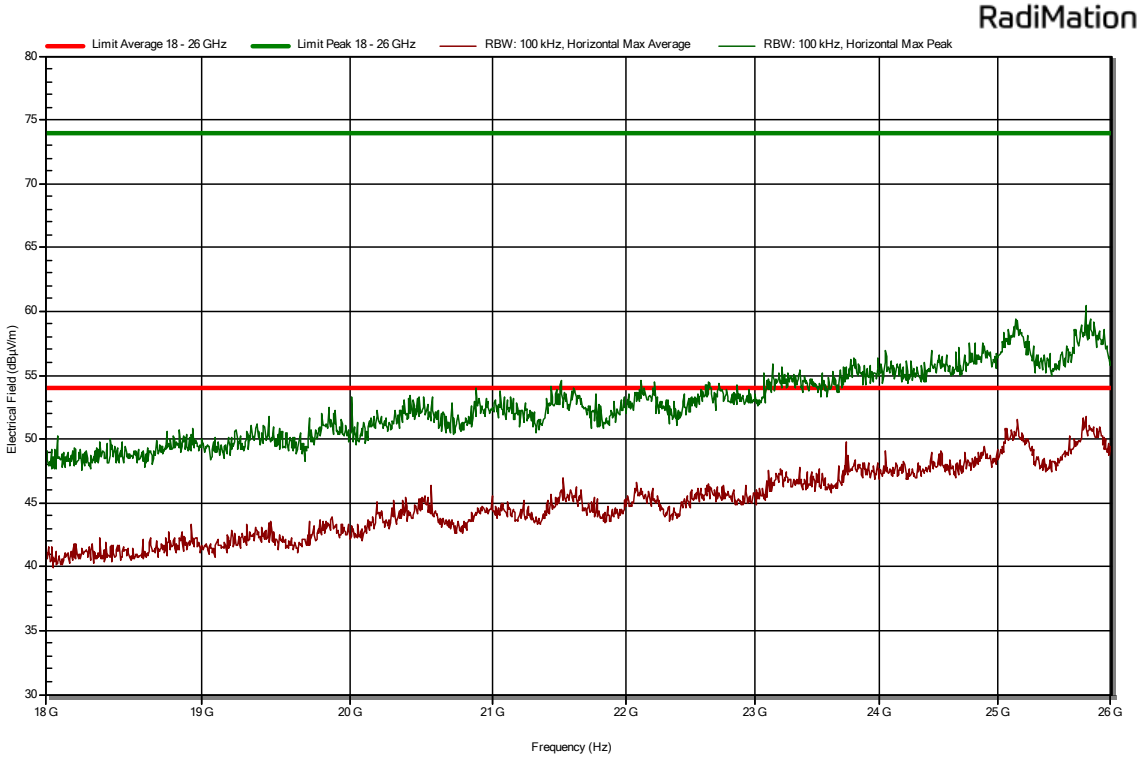
18 – 26 GHz

Low channel



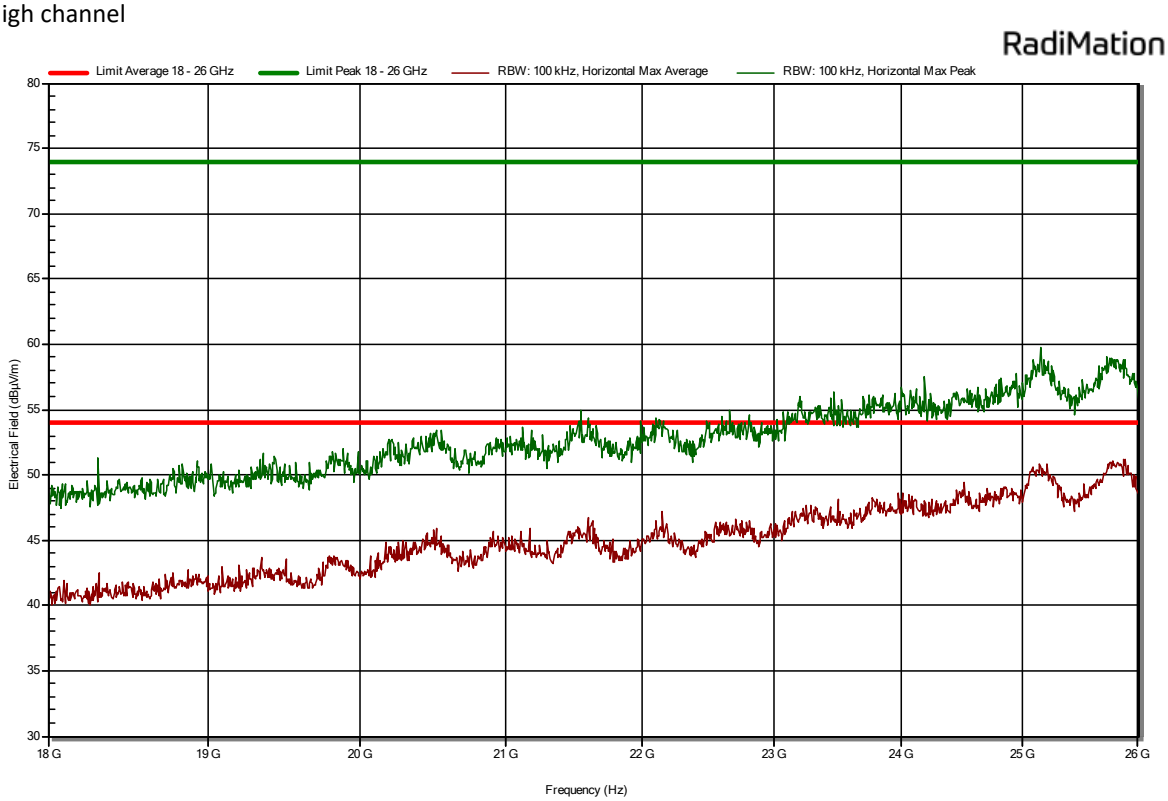
Plot 12a: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz (pre-scan peak values shown).

Mid channel



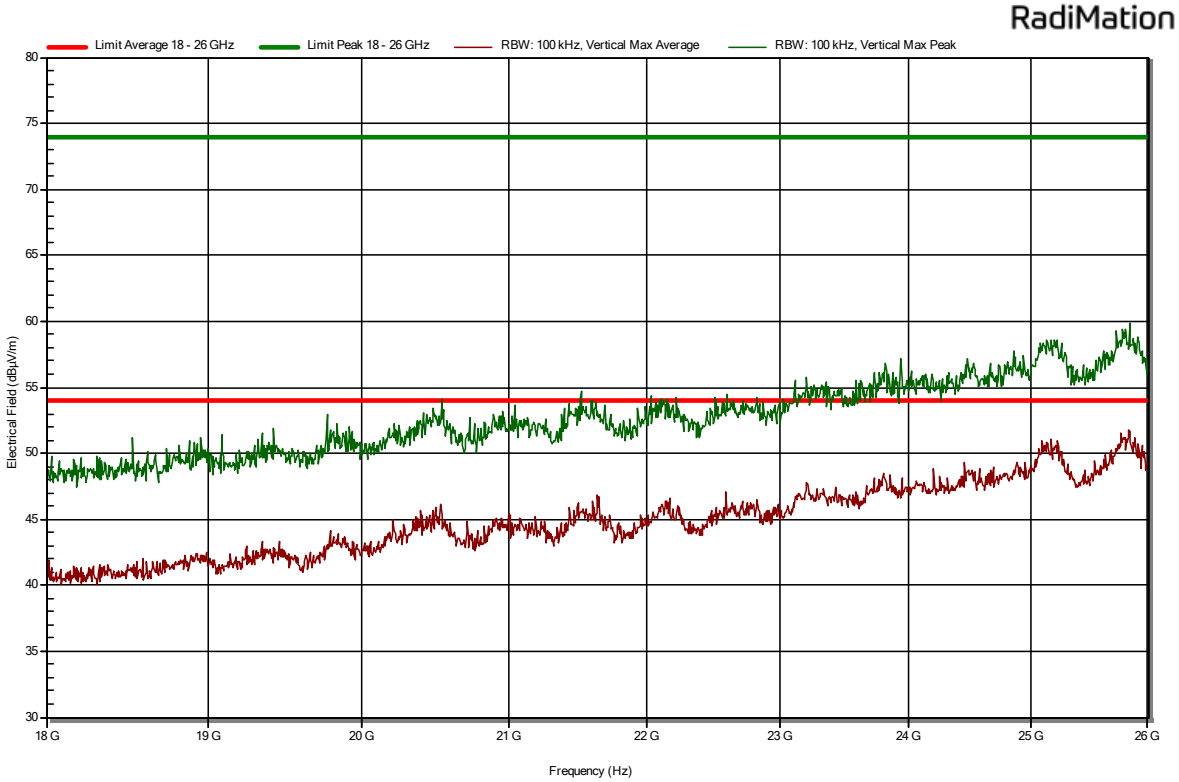
Plot 13a: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz (pre-scan peak values shown).

High channel



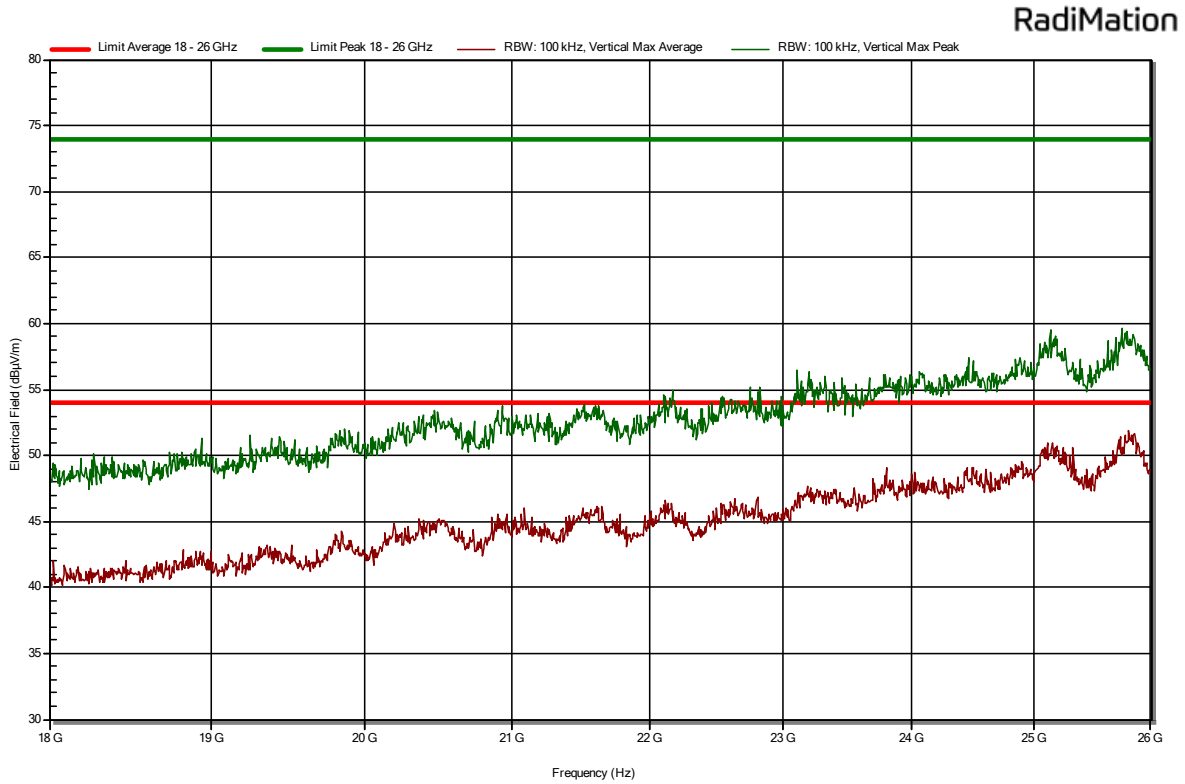
Plot 14a: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz (pre-scan peak values shown).

Low channel



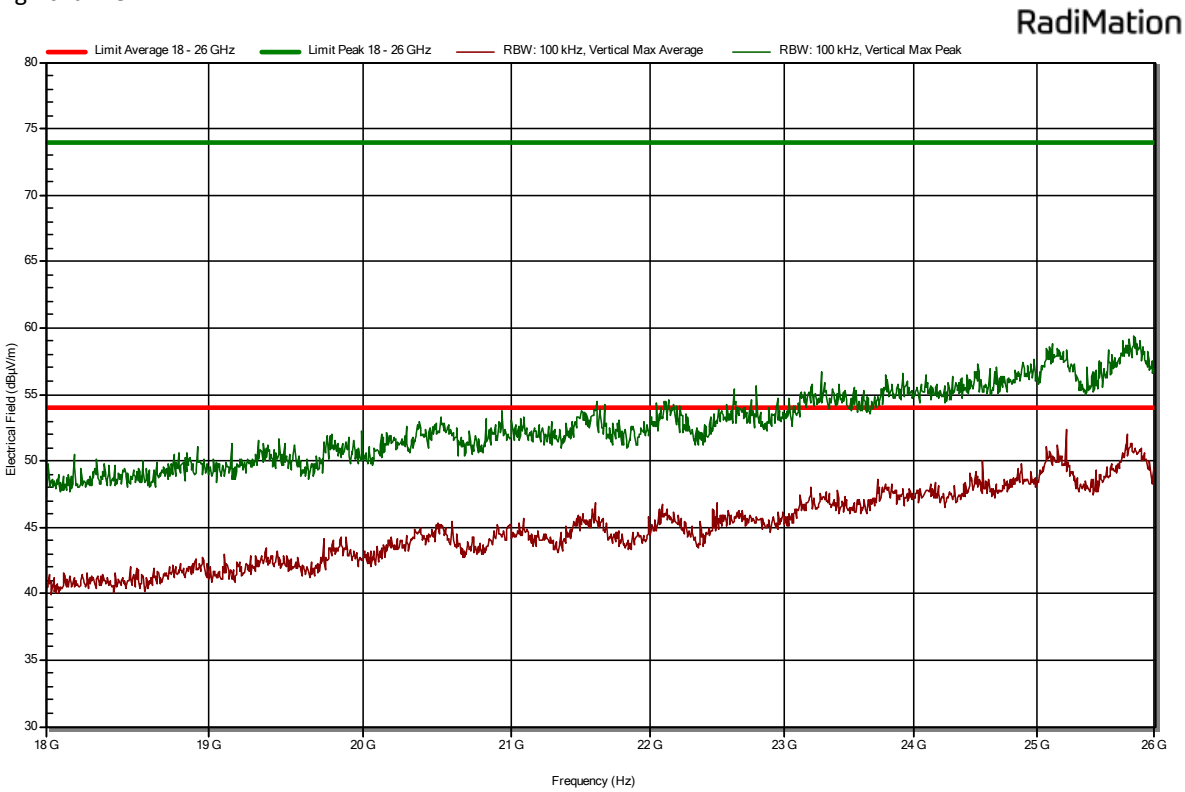
Plot 12b: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz (pre-scan peak values shown).

Mid channel



Plot 13b: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz (pre-scan peak values shown).

High channel



Plot 14b: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz (pre-scan peak values shown).

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
IRN 404 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

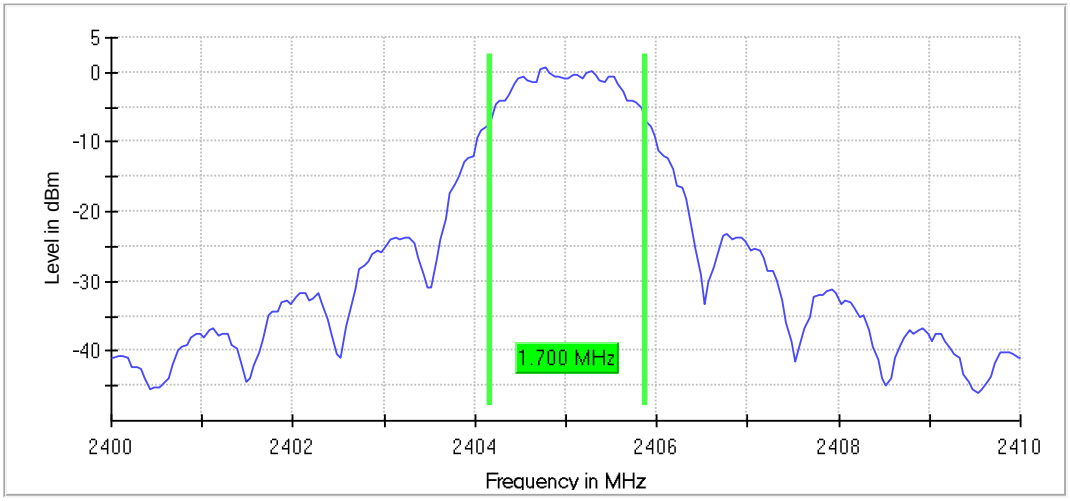
3.2.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Zigbee	11	2405	250 Kbps	1700
	18	2440	250 Kbps	1700
	26	2480	250 Kbps	1700
Uncertainty	± 36.2 kHz			

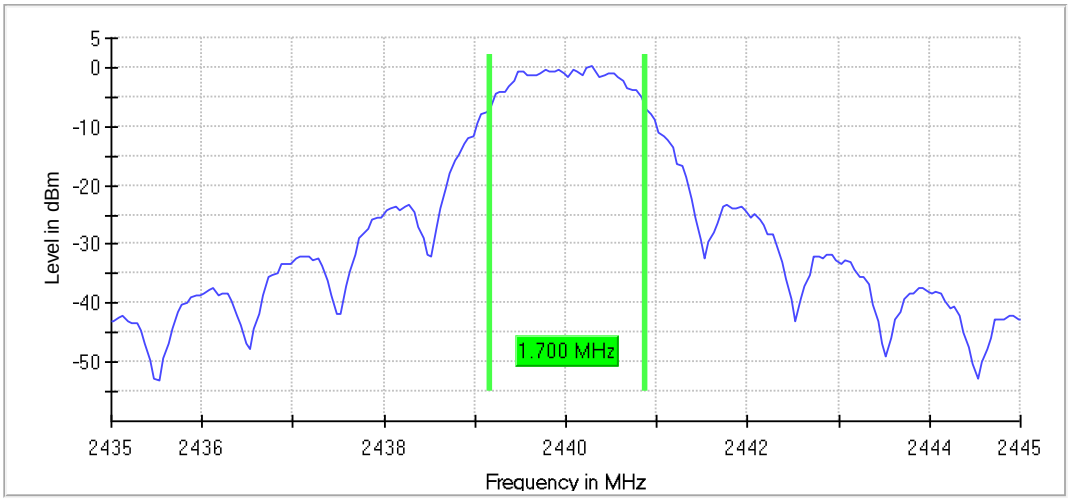
Note: plots are provided on the next page.

3.2.6 Plots of the 6 dB bandwidth

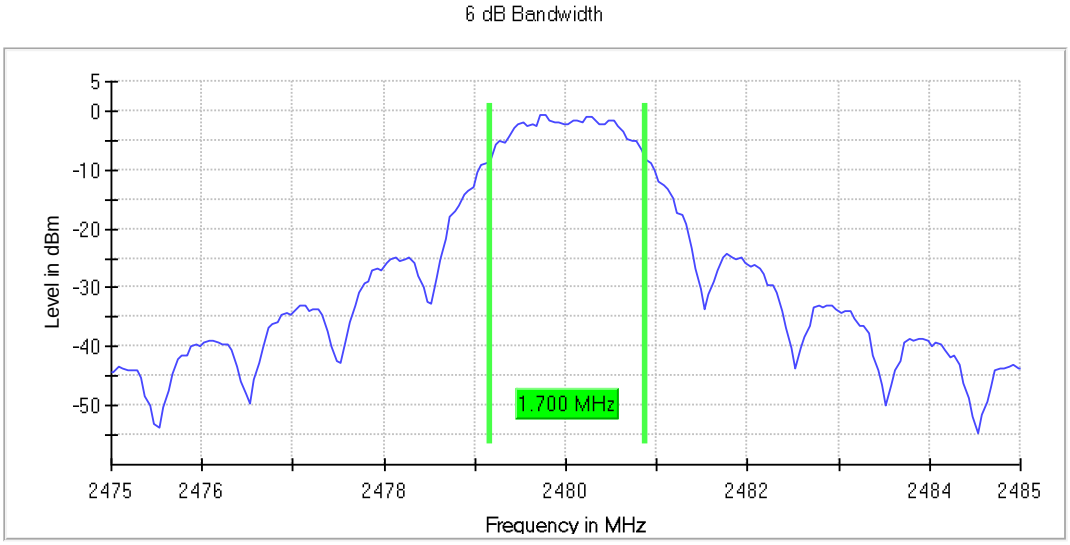
Channel 11



Channel 18



Channel 26



3.2.7 Measurement settings

Setting	Instrument Value	Target Value
Span	10.000 MHz	10.000 MHz
RBW	100.000 kHz	~ 100.000 kHz
VBW	300.000 kHz	~ 300.000 kHz
SweepPoints	200	~ 200
Sweeptime	1.000 ms	AUTO
Reference Level	20.000 dBm	20.000 dBm
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	24 / max. 150	max. 150
Stable	5 / 5	5
Max Stable Difference	0.43 dB	0.50 dB

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.

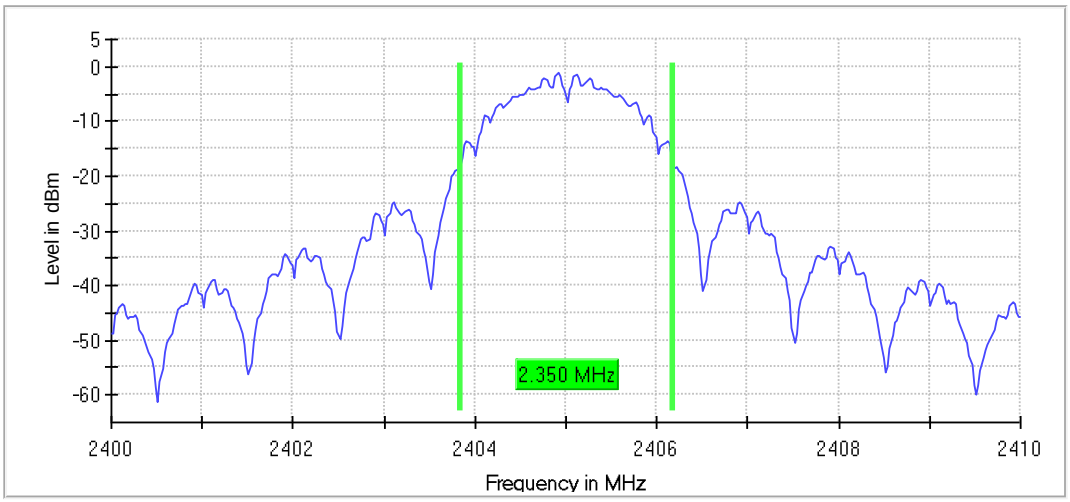
3.3.5 Test results of the 99% occupied bandwidth measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Zigbee	11	2405	250 Kbps	2350
	18	2440	250 Kbps	2350
	26	2480	250 Kbps	2375
Uncertainty	± 12 kHz			

3.3.6 Plots of the 99% occupied bandwidth measurement

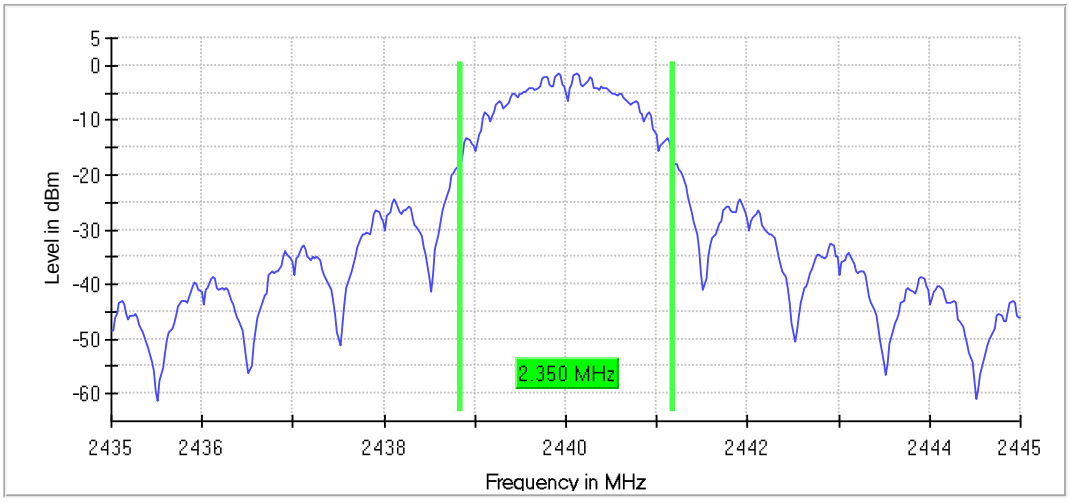
Channel 11

99 % Bandwidth



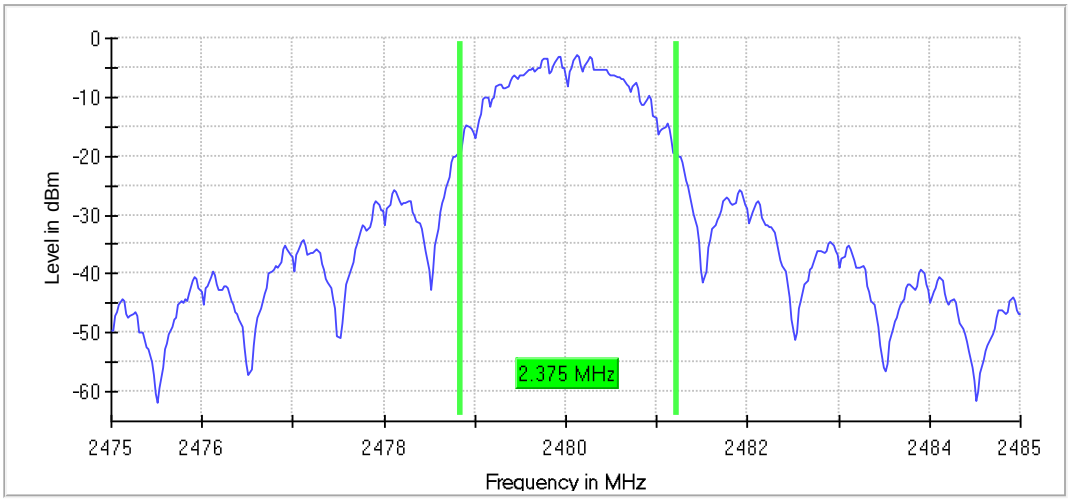
Channel 18

99 % Bandwidth



Channel 26

99 % Bandwidth



3.3.7 Measurement settings

Setting	Instrument Value	Target Value
Span	10.000 MHz	10.000 MHz
RBW	50.000 kHz	>= 50.000 kHz
VBW	200.000 kHz	>= 150.000 kHz
SweepPoints	400	~ 400
Sweeptime	1.000 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Stablemode	Trace	Trace
Stablevalue	0.30 dB	0.30 dB
Run	16 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.19 dB	0.30 dB

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 12 – Output power using a spectrum analyser (peak method).

3.4.5 Test results of Output Power Measurement

Peak method

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output conducted power (dBm)
Zigbee	11	2405	250 Kbps	3.22
	18	2440	250 Kbps	3.25
	26	2480	250 Kbps	2.02
Uncertainty	±0.71 dB			

Note: plots are provided on the next page

3.4.6 Plots of the Output power

Channel 11

Channel 18

Channel 26

3.4.7 Measurement settings

Setting	Instrument Value	Target Value
Measurement Time	1.000 s	1.000 s
Points	1000000	1000000
Time resolution	1.000 µs	1.000 µs
Span	Zero span	Zero span
RBW	5.000 MHz	>= 100.000 kHz
VBW	20.000 MHz	>= 250.000 kHz

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)

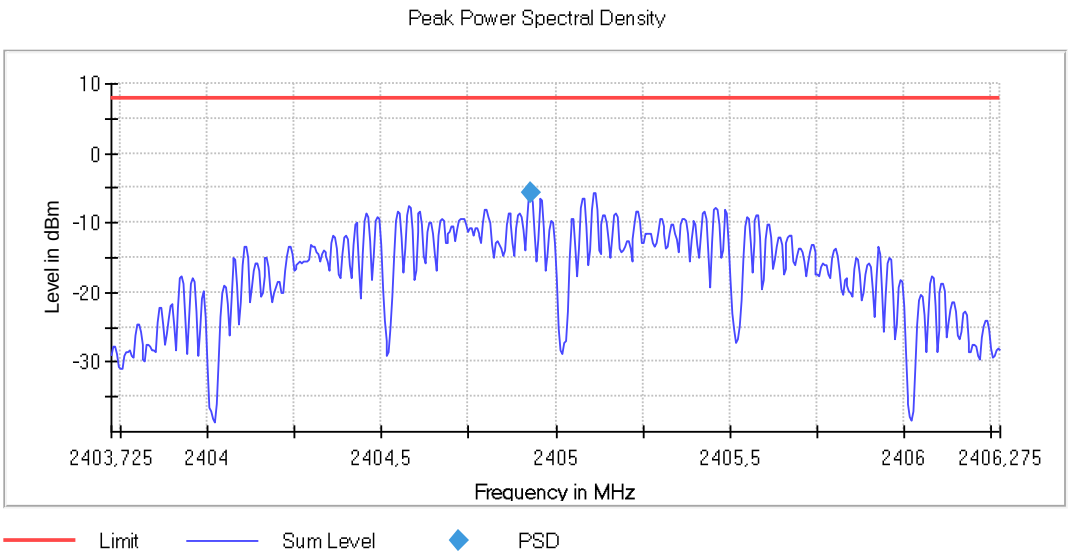
3.5.5 Test results of Power Spectral Density Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD conducted (dBm/3 kHz)	Limit (conducted) (dBm/3kHz)
Zigbee	11	2405	250 Kbps	-5.58	8
	18	2440	250 Kbps	-5.63	8
	26	2480	250 Kbps	-6.97	8
Uncertainty	±2 dB				

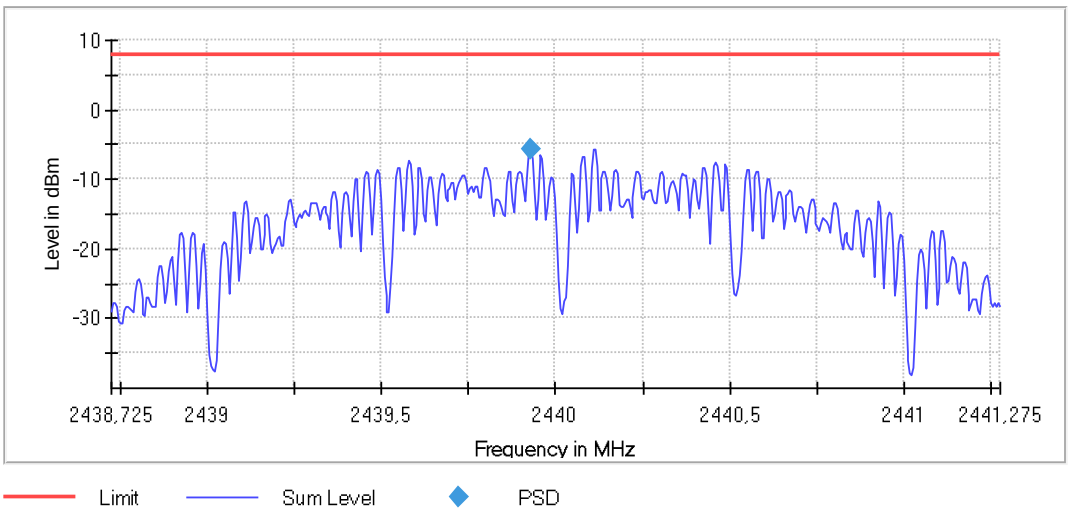
Note: plots are provided on the next page

3.5.6 Plots of the Power Spectral Density

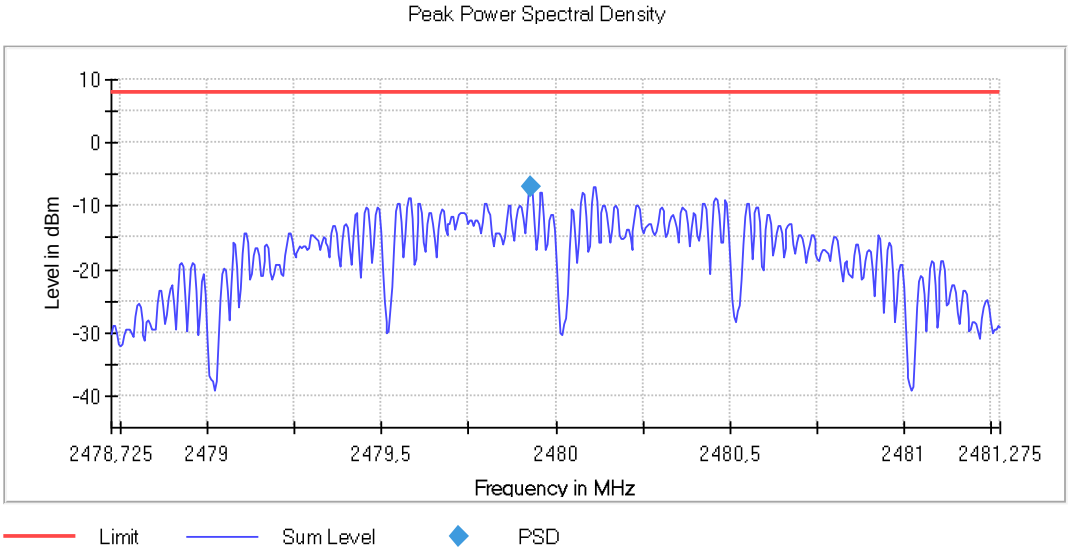
Channel 11



Channel 18



Channel 26



3.5.7 Measurement settings

Setting	Instrument Value	Target Value
Span	2.550 MHz	2.550 MHz
RBW	10.000 kHz	<= 10.000 kHz
VBW	30.000 kHz	>= 30.000 kHz
SweepPoints	510	~ 510
Sweeptime	2.550 ms	AUTO
Reference Level	-10.000 dBm	-10.000 dBm
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	Sweep
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	7 / max. 150	max. 150
Stable	2 / 2	2
Max Stable Difference	0.34 dB	0.50 dB

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.

3.6.4 Test procedure

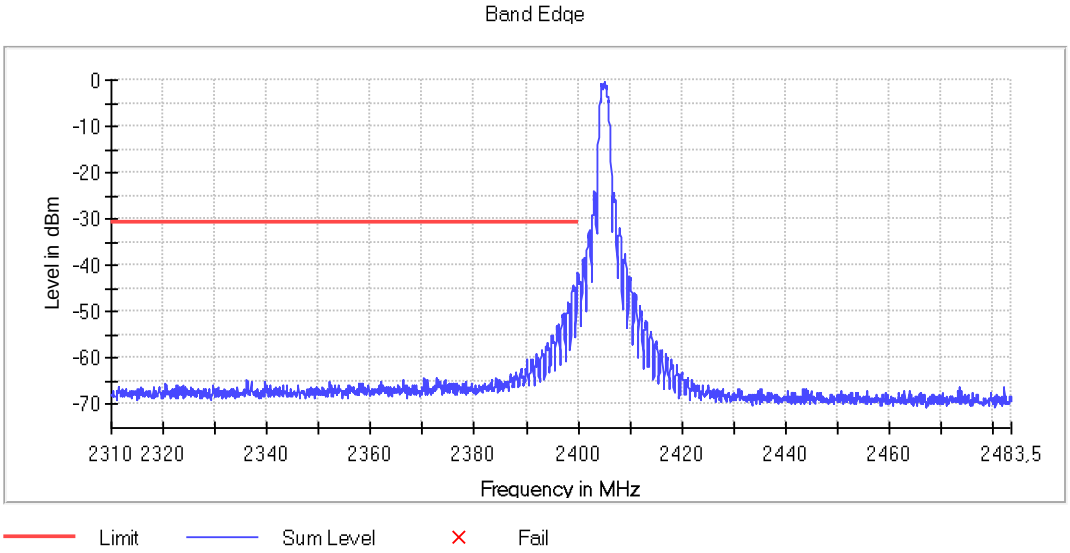
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02, section 8.7.
IRN 441 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.

3.6.5 Measurement Uncertainty

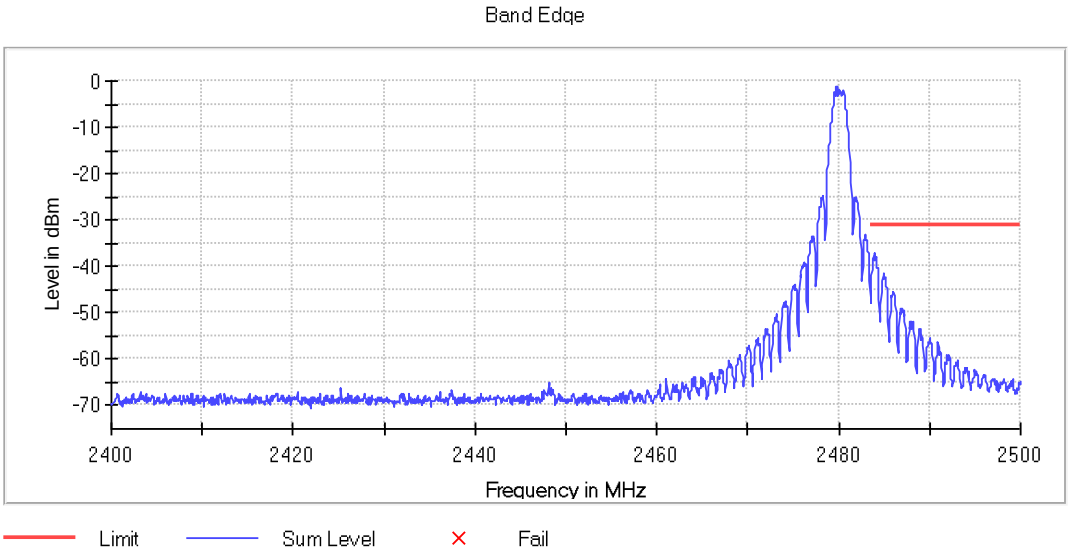
± 0.8 dB.

3.6.6 Plots of the Band edge Measurements

Zigbee Lower band edge (Channel 11)



Zigbee Upper band edge (Channel 26)



3.6.7 Measurement settings

Setting	Instrument Value	Target Value
Start Frequency	2.40000 GHz	2.40000 GHz
Stop Frequency	2.48350 GHz	2.48350 GHz
Span	83.500 MHz	83.500 MHz
RBW	100.000 kHz	<= 100.000 kHz
VBW	300.000 kHz	>= 300.000 kHz
SweepPoints	1670	~ 1670
Sweeptime	1.670 ms	AUTO
Reference Level	10.000 dBm	10.000 dBm
Attenuation	20.000 dB	AUTO
Detector	MaxPeak	MaxPeak
SweepCount	100	100
Filter	3 dB	3 dB
Trace Mode	Max Hold	Max Hold
Sweeptype	Sweep	AUTO
Preamp	off	off
Stablemode	Trace	Trace
Stablevalue	0.50 dB	0.50 dB
Run	9 / max. 150	max. 150
Stable	3 / 3	3
Max Stable Difference	0.34 dB	0.50 dB

3.7 AC Power-line conducted emissions

3.7.1 Limit

According to 15.207 (a), (c) / RSS-Gen 8.8

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.

3.7.2 Measurement instruments

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

3.7.3 Test setup

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

3.7.4 Test procedure

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

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

See next page.

3.7.6 Measurement uncertainty

+/- 3.6 dB

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

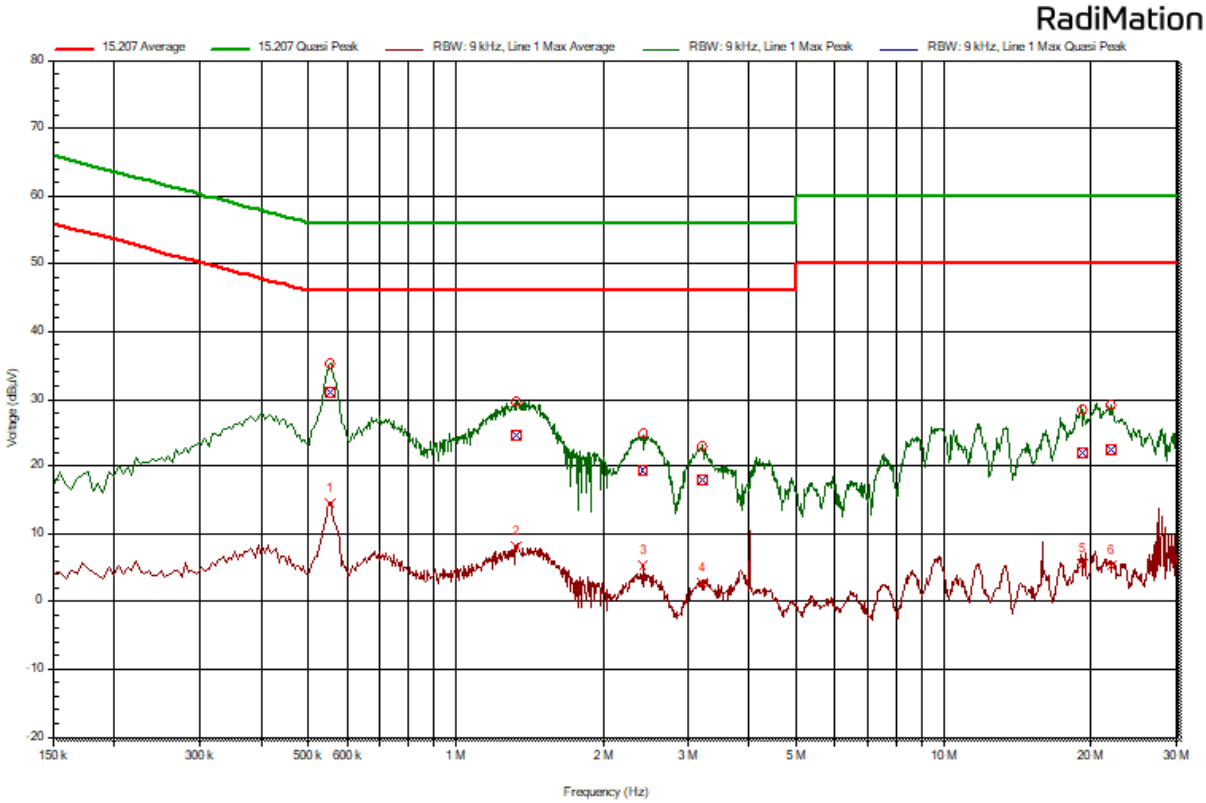
Final measurements of AC Power-line Conducted emissions on **Phase**

Frequency	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	Status	LISN
551,85 kHz	6,3 dBµV	46 dBµV	24,4 dBµV	56 dBµV	Pass	Neutral
29,171 MHz	8,2 dBµV	50 dBµV	23,3 dBµV	60 dBµV	Pass	Neutral
21,984 MHz	1 dBµV	50 dBµV	19,2 dBµV	60 dBµV	Pass	Neutral
13,351 MHz	0,1 dBµV	50 dBµV	16,8 dBµV	60 dBµV	Pass	Neutral
10,014 MHz	-0,7 dBµV	50 dBµV	14,6 dBµV	60 dBµV	Pass	Neutral
11,811 MHz	0,2 dBµV	50 dBµV	16,8 dBµV	60 dBµV	Pass	Neutral

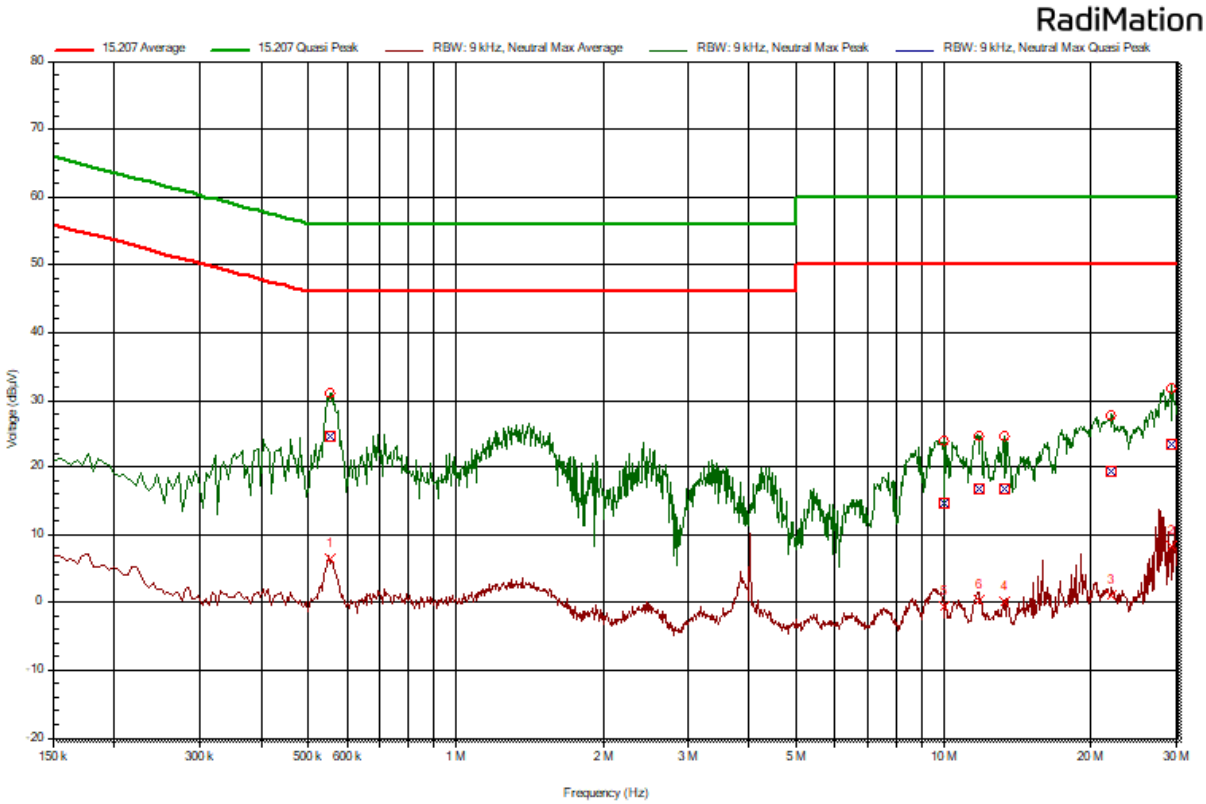
Final measurements of AC Power-line Conducted emissions on **Neutral**

Frequency	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	Status	LISN
553,2 kHz	14,3 dBµV	46 dBµV	31 dBµV	56 dBµV	Pass	Line 1
1,333 MHz	8,1 dBµV	46 dBµV	24,6 dBµV	56 dBµV	Pass	Line 1
2,413 MHz	5,3 dBµV	46 dBµV	19,4 dBµV	56 dBµV	Pass	Line 1
3,215 MHz	2,6 dBµV	46 dBµV	17,9 dBµV	56 dBµV	Pass	Line 1
19,208 MHz	5,6 dBµV	50 dBµV	22 dBµV	60 dBµV	Pass	Line 1
21,939 MHz	5,2 dBµV	50 dBµV	22,3 dBµV	60 dBµV	Pass	Line 1

3.7.8 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

< End of report >