Test report for

47 CFR Part 15 Subpart C

The RvA is signatory to ILAC - MRA

Product name	: HEADLIGHT ADJUSTMENT TOOL SEG V
Applicant	: Hella Gutmann Solution GmbH
FCC ID	: 2AEOK-007732401

Test report No. : P000311130 002 Ver 1.0

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).

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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	11-08-2023	First draft	PvW
v1.00	13-11-2023	Final release	PvW

Table of Contents

Summary of Test results

FCC	Description	Section in report	Verdict
15.247(d) 15.209 (a)	Radiated spurious emissions	3.1	Pass
15.205 (a)	Spurious emissions in the restricted bands	3.1	Pass
15.207 (c)	AC power-line conducted emissions	3.2	Pass
15.247(d)	Reference level measurement	3.3	No requirement, reporting purposes only

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

1 General Description

1.1 Applicant

Client name:	Hella Gutmann Solution GmbH
Address:	Am Krebsbach 2, Ihringen, Germany
Zip code:	79241
Telephone:	+49 (7668) 9900 – 1375
E-mail:	Stefan.turnschek@hella-gutmann.com
Contact name:	Stefan Turnschek

1.2 Manufacturer

Manufacturer name:	Hella Gutmann Solution GmbH
Address:	Am Krebsbach 2, Ihringen, Germany
Zip code:	79241
Telephone:	+49 (7668) 9900 – 1375
E-mail:	Stefan.turnschek@hella-gutmann.com
Contact name:	Stefan Turnschek

1.3 Tested Equipment Under Test (EUT)

Product name:	HEADLIGHT ADJUSTMENT TOOL SEG V
Brand name:	Hella Gutmann Solutions
FCC ID:	2AEOK-007732401
IC:	Not applicable
Product type:	Headlight Adjustment Tool
Model(s):	SEG V
Batch and/or serial No.	--
Software version:	--
Hardware version:	--
Date of receipt:	19-10-2022
Tests started:	07-08-2023
Testing ended:	09-08-2023

1.3.1 Auxiliary items

None

1.4 Product specifications of Equipment under test

Tx Frequency:	WLAN: 2400 – 2483.5 MHz
Rx frequency:	WLAN: 2400 – 2483.5 MHz
Occupied channel width:	20 MHz
Antenna type:	Patch antenna
Antenna gain:	4.6dBi
Type of modulation:	BPSK, QPSK, 16-QAM, 64-QAM

Disclaimer: The operating frequency bands are declared by the applicant

1.5 Environmental conditions

Date	Temperature	Humidity
07-08-2023	20.3°C	62.9%
08-08-2023	22.3°C	44.8%
09-08-2023	21.8°C	45.7%

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

1.8 Observation and remarks

The equipment is intended for use in a commercial, industrial or business environment.
The equipment contains a pre-certified U-blox module ELLA-W133, FCC ID: PV7-WIBEAR11N-SF2

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 : P. van Wanrooij, BASc

Review of test methods and report by:

Name : Ing. Roy van Barneveld

The above conclusions have been verified by the following signatory:

Date : 08-12-2023

Name : ing. R. van Barneveld

Function : Test Engineer

Signature :

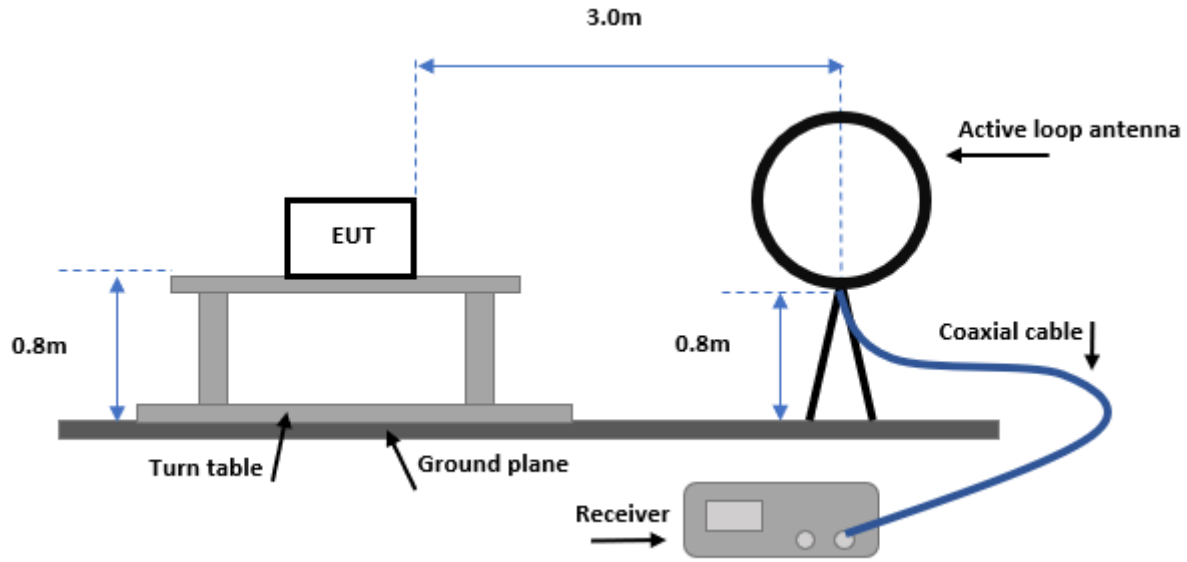
2 Test configuration of the Equipment Under Test

2.1 Test mode

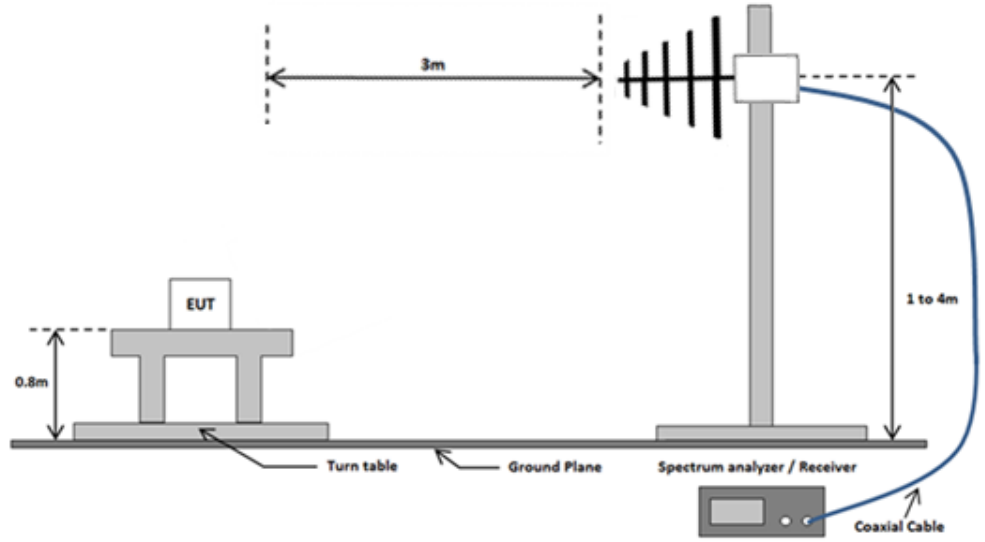
The manufacturer provided test firmware which allowed to set the radio module in continuous transmit mode.

2.2 Test setups

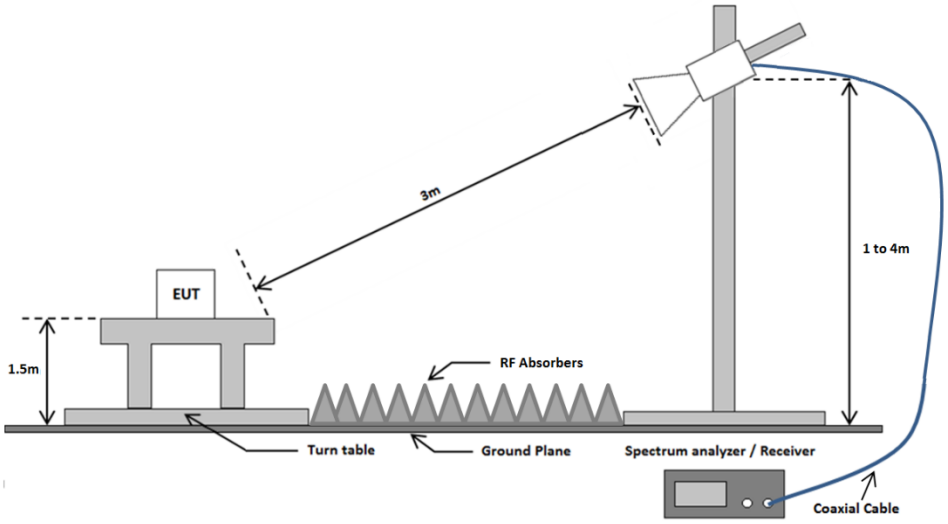
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz

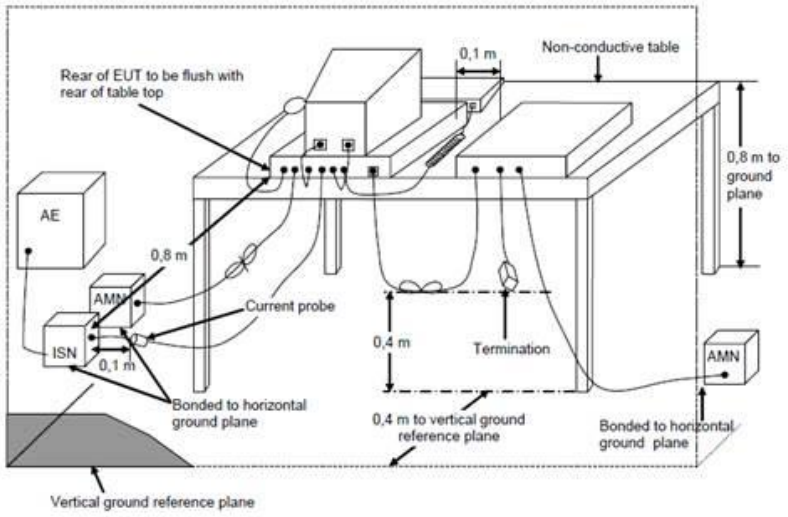


Radiated emissions test setup above 1 GHz



AC Power line conducted emissions test setup

Emissions test at AC mains



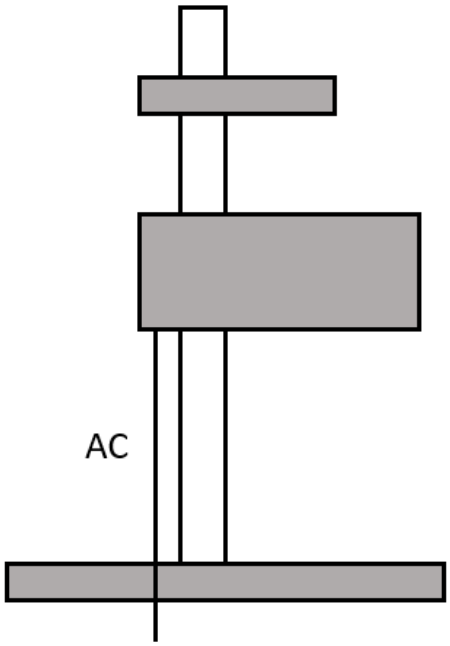


Figure 1. EUT and auxiliary setup

List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	AC Power	mains 110Vac 60 Hz	Power input port	< 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	3.2
EMI Receiver	Rohde & Schwarz	ESR7	114534	04-2023	04-2024	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV40	114527	11-2023	11-2024	3.1; 3.3
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; 3.3
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; 3.3
Preamplifier 18-40 GHz	Miteq	JS4-18004000-33-8P	114693	01-2023	01-2024	3.1
LISN /Two line V-network	Rohde & Schwarz	ENV 216	114379	07-2021	31-08-2023	3.2

*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)[2]	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	20*{log[2400]-log[F(kHz)]}	300[1]
0.490 – 1.705	24000/F(kHz)	20*{log[24000]-log[F(kHz)]}	30[1]
1.705 – 13.11 14.01 – 30.0	30	29.5	30[1]
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

Note 1: 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
Note 2: The limits are only applicable to restricted bands listed in FCC part 15.205(a)

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.
The test setup is as shown in chapter 2.2 of this report.

3.1.3 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

Only spurious emissions are permitted in any of the restricted bands of operation. The frequencies of the restricted bands are listed in clause 15.205(a). As defined in clause 15.247(d), at all other frequencies the emissions produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Clause 3.1.5 shows the maximum field strength of the intentional radiator and the calculated limit.

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.

3.1.4 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

3.1.5 Test results

Frequency (MHz)	Channel	Maximum field strength (dBµV/m) @3m in 100 kHz bandwidth	Spurious emission limit outside of restricted frequency bands
2412	1 (low channel)	100.0	80.0
2442	7 (middle channel)	101.6	81.6
2472	13 (high channel)	100.2	80.2

Measured peaks 30 – 250 MHz Low channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
38,301	Vertical	1	37,5	40	Pass
38,939	Vertical	1	38	40	Pass
41,523	Vertical	1	35,4	40	Pass
46,49	Vertical	1	36,1	40	Pass
193,956	Horizontal	1	40,6	43,5	Pass

Measured peaks 30 – 250 MHz Middle channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
38,773	Vertical	1	37,8	40	Pass
46,482	Vertical	1	36,1	40	Pass
193,953	Vertical	1,5	39,6	43,5	Pass

Measured peaks 30 – 250 MHz High channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
39,011	Vertical	1	36,3	40	Pass
46,224	Vertical	1	35,9	40	Pass
193,96	Vertical	2	37,5	43,5	Pass
219,93	Vertical	1,5	37,8	46	Pass

Measured peaks 250 - 1000 MHz Low channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
299,997	Vertical	1,5	54,1	80	Pass
307,995	Vertical	1,5	47,5	80	Pass
449,994	Vertical	1	48,4	80	Pass
483,99	Vertical	1	47,1	80	Pass
499,689	Vertical	1	29,2	80	Pass
599,991	Vertical	1,7	50,6	80	Pass
659,991	Vertical	1,8	50,1	80	Pass
835,987	Vertical	1	41,9	80	Pass
923,986	Vertical	2,5	44,1	80	Pass
449,982	Horizontal	1,3	49,2	80	Pass
483,948	Horizontal	1,3	46,2	80	Pass
499,992	Horizontal	1,3	52,2	80	Pass
549,994	Horizontal	1	46,4	80	Pass
566,982	Horizontal	1	36,8	80	Pass
600,027	Horizontal	1	48,7	80	Pass
660,018	Horizontal	1	45,3	80	Pass
915,111	Horizontal	1,2	20,9	80	Pass
499,998	Vertical	1	46,8	80	Pass
571,996	Horizontal	1	46,5	80	Pass
923,994	Horizontal	1	44,5	80	Pass

Note: the limit outside of the restricted frequency bands is based on FCC part 15.247 (d); the maximum field strength produced by the intentional radiator within 100 kHz bandwidth within the operating frequency band. (See clause 3.4)

Measured peaks 250 - 1000 MHz Middle channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
299,997	Vertical	1,5	54,3	81.6	Pass
307,998	Vertical	1,2	44,6	81.6	Pass
449,991	Vertical	1	48,5	81.6	Pass
485,989	Vertical	1	33,2	81.6	Pass
499,989	Vertical	1,5	46,2	81.6	Pass
571,993	Vertical	1,5	45,2	81.6	Pass
599,991	Vertical	1,5	50,5	81.6	Pass
659,991	Vertical	1,8	47,7	81.6	Pass
835,983	Vertical	1	48,1	81.6	Pass
849,984	Vertical	1,5	42,9	81.6	Pass
923,976	Vertical	2,5	43,5	81.6	Pass
483,994	Vertical	1	47,4	81.6	Pass
483,948	Horizontal	1,3	46,3	81.6	Pass
500,012	Horizontal	1,3	51,5	81.6	Pass
549,994	Horizontal	1	46,4	81.6	Pass
571,965	Horizontal	1	45,7	81.6	Pass
600,027	Horizontal	1	48,5	81.6	Pass
649,995	Horizontal	1	44,7	81.6	Pass
660,027	Horizontal	2,2	41,5	81.6	Pass
449,978	Horizontal	2,8	49	81.6	Pass

Note: the limit outside of the restricted frequency bands is based on FCC part 15.247 (d); the maximum field strength produced by the intentional radiator within 100 kHz bandwidth within the operating frequency band. (See clause 3.4)

Measured peaks 250 - 1000 MHz High channel

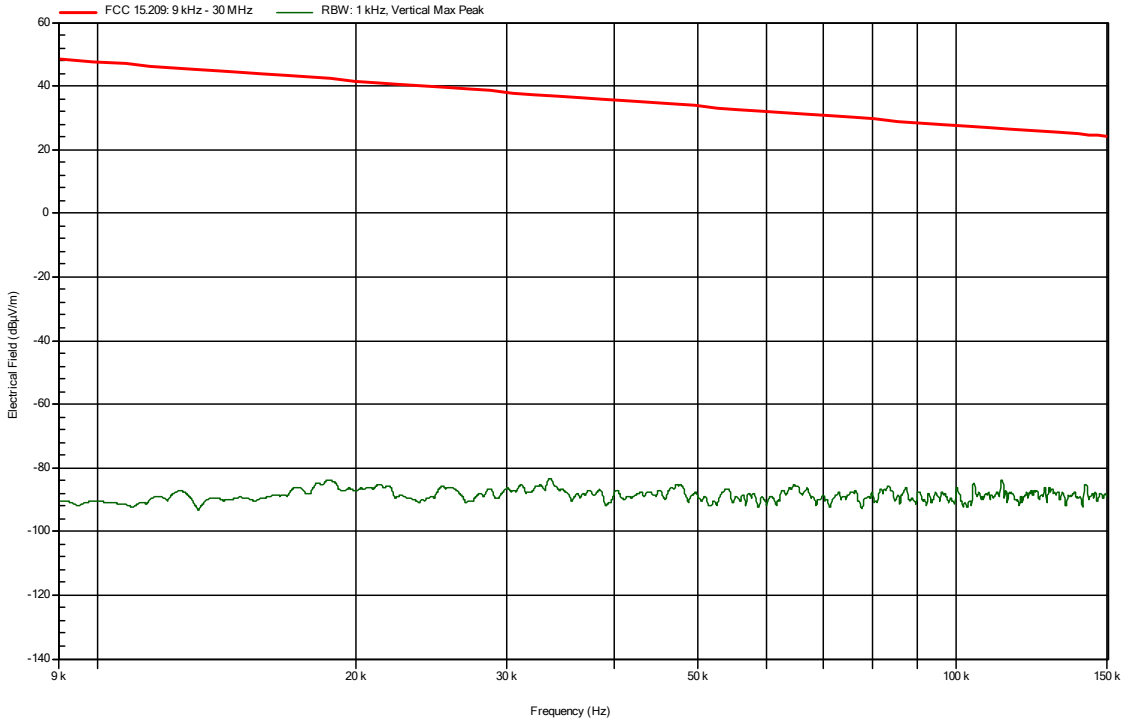
Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
299,997	Vertical	1,3	53,6	80.2	Pass
308,001	Vertical	1,8	42,1	80.2	Pass
599,988	Vertical	2,2	48,6	80.2	Pass
659,988	Vertical	1	48,5	80.2	Pass
449,991	Vertical	1	46,9	80.2	Pass
483,994	Vertical	2,5	47,2	80.2	Pass
918	Vertical	1,5	27,6	80.2	Pass
449,978	Horizontal	2,2	48,6	80.2	Pass
483,998	Horizontal	1	48,7	80.2	Pass
504,288	Horizontal	1,2	34,6	80.2	Pass
549,994	Horizontal	1	45,1	80.2	Pass
599,978	Horizontal	3,5	49,2	80.2	Pass
649,992	Horizontal	2,8	38,5	80.2	Pass
850	Horizontal	1	43,2	80.2	Pass
499,995	Horizontal	1	52,3	80.2	Pass
923,976	Vertical	1,5	47,6	80.2	Pass

Note: the limit outside of the restricted frequency bands is based on FCC part 15.247 (d); the maximum field strength produced by the intentional radiator within 100 kHz bandwidth within the operating frequency band. (See clause 3.4)

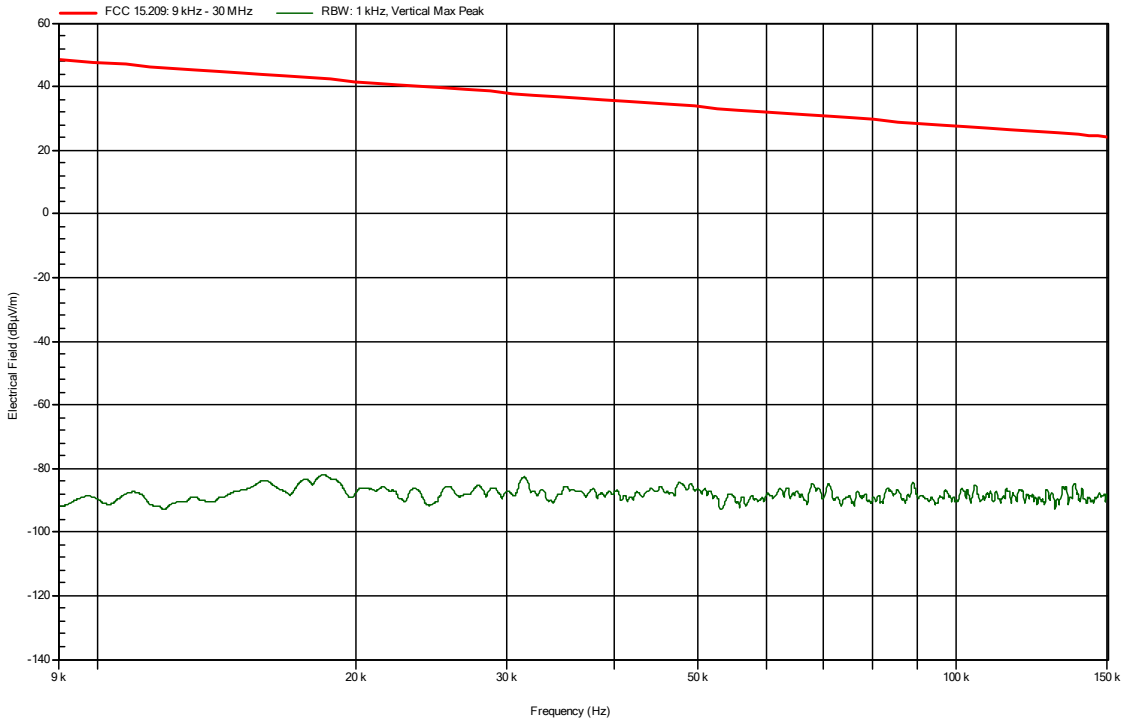
The results of the radiated emission tests are depicted in the tables above. A selection of plots is provided on the next pages

3.1.6 Plots of the Radiated Spurious Emissions Measurement

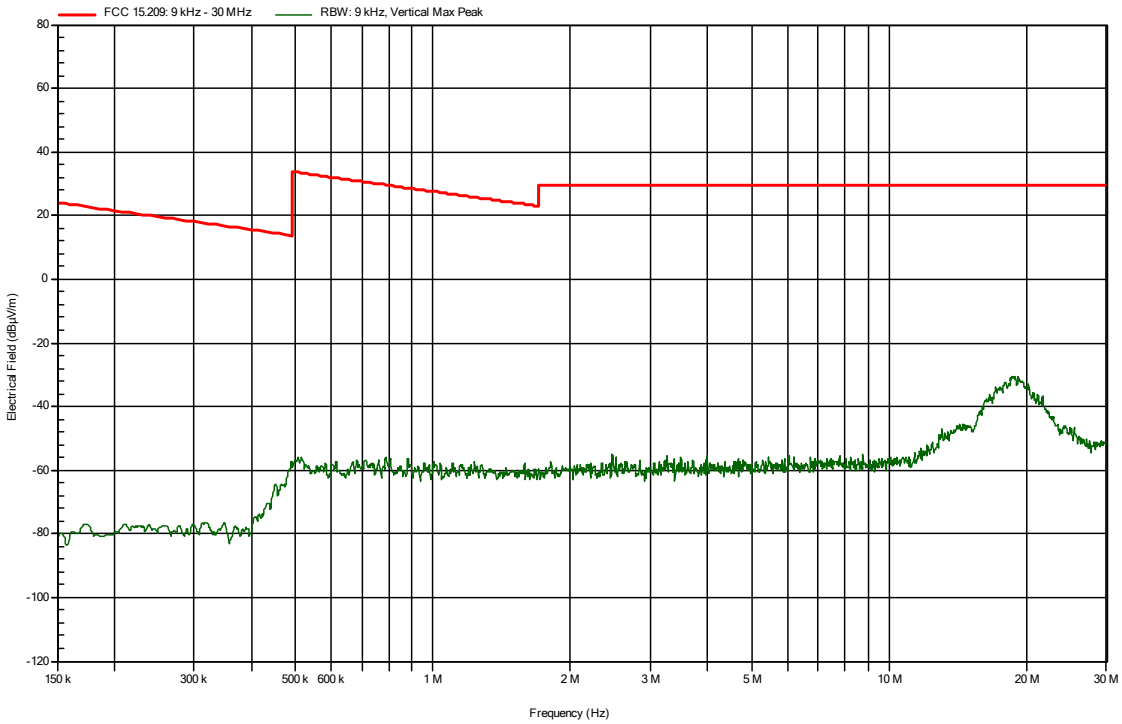
9 – 150 kHz (Perpendicular)



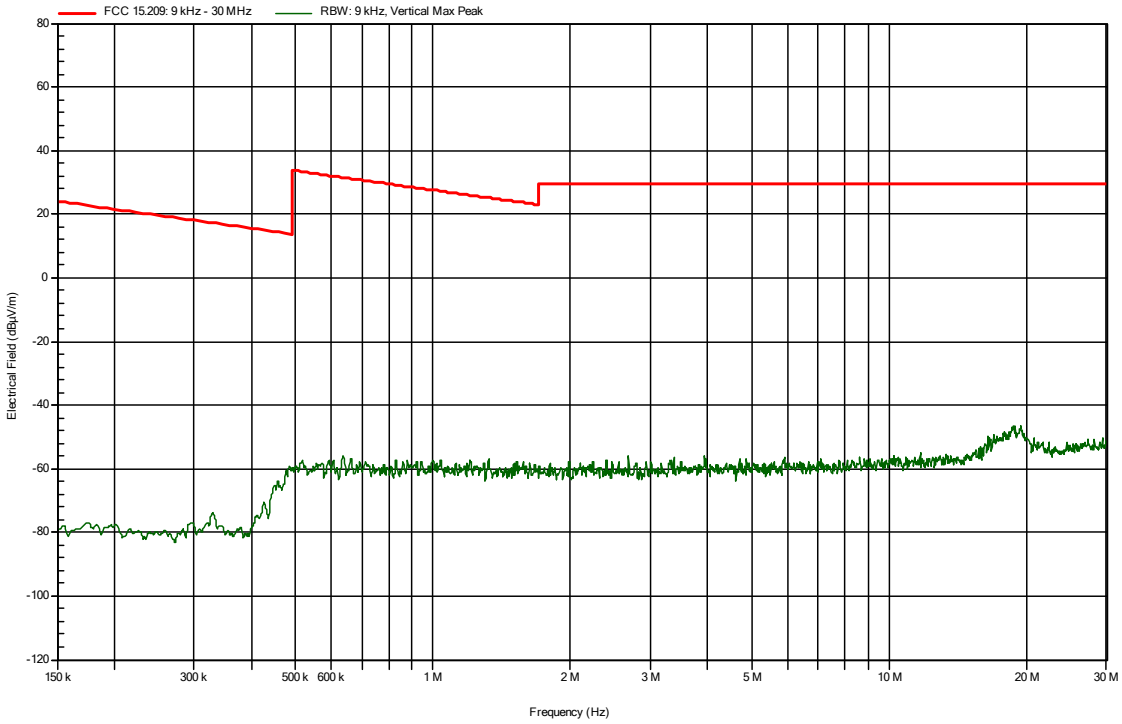
9 – 150 kHz (Orthogonal)

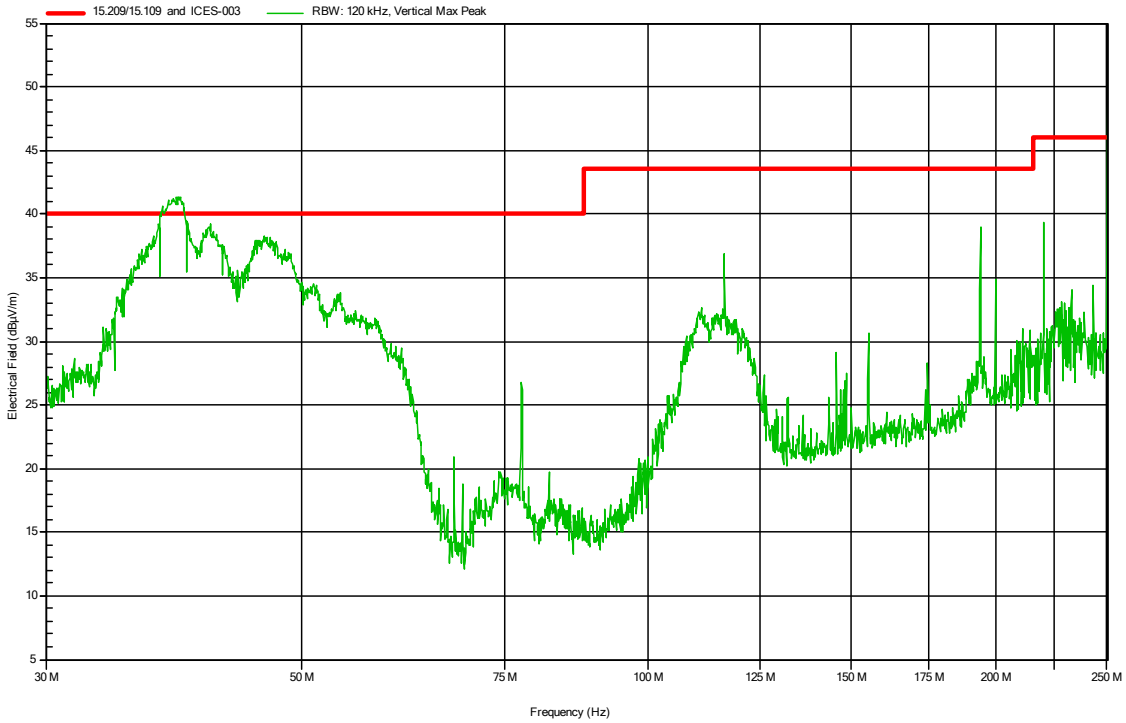


150 kHz – 30 MHz (Perpendicular)

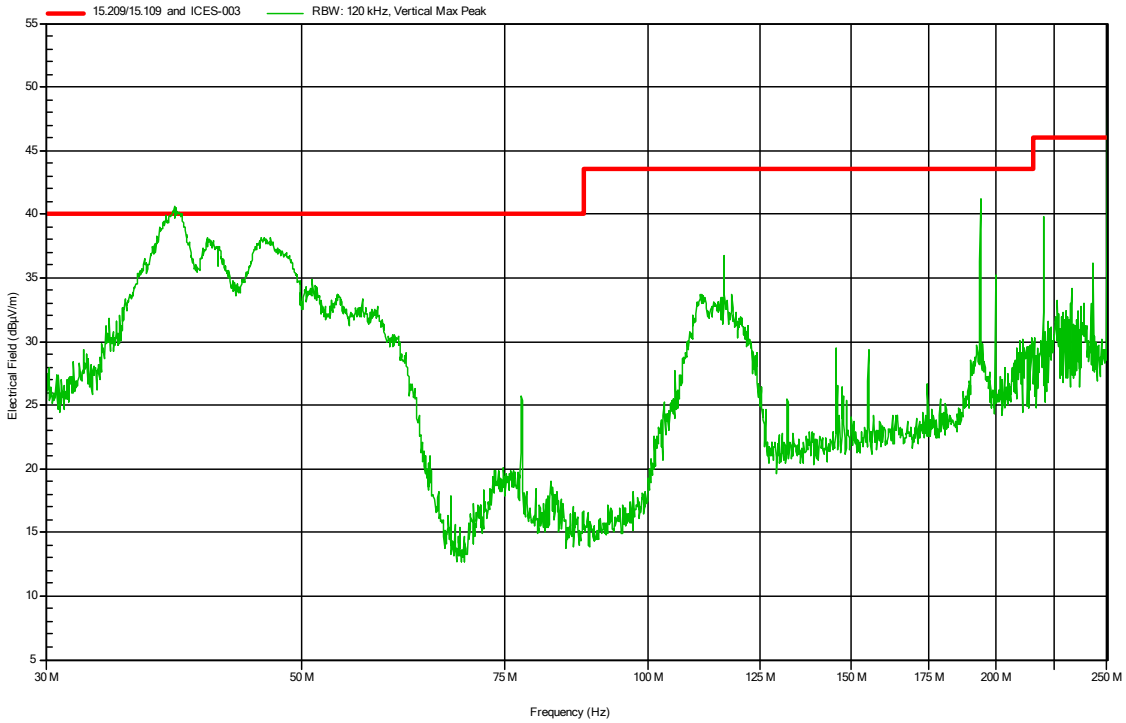


150 kHz – 30 MHz (Orthogonal)



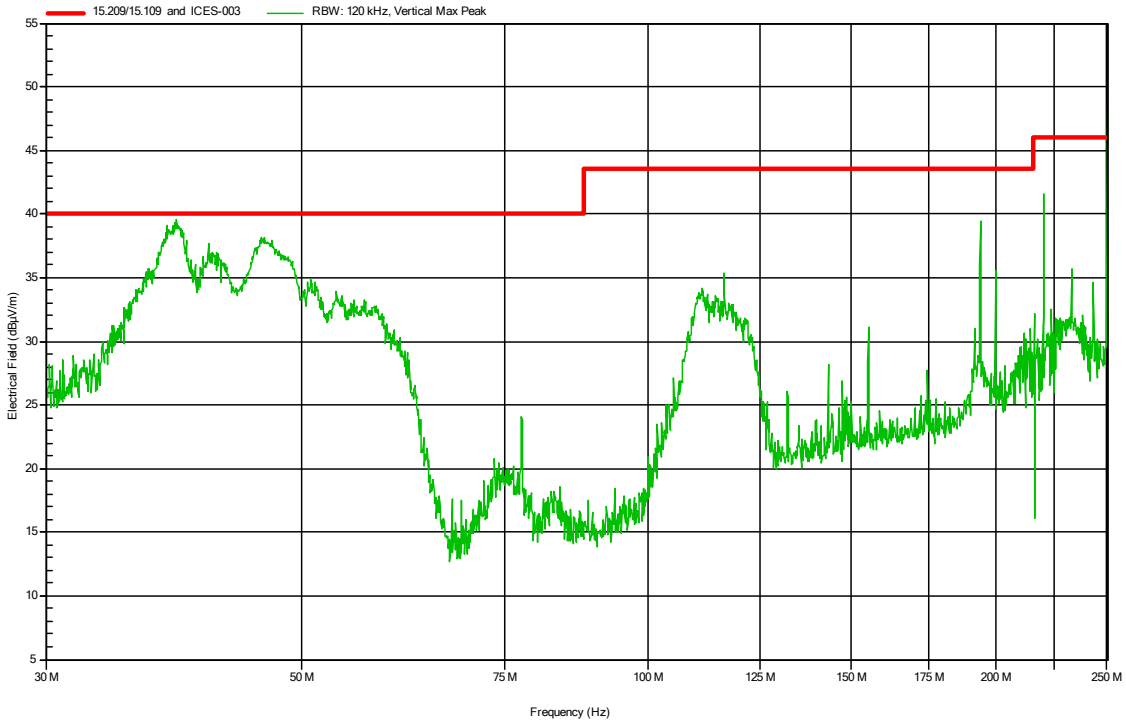


Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown). Channel 1

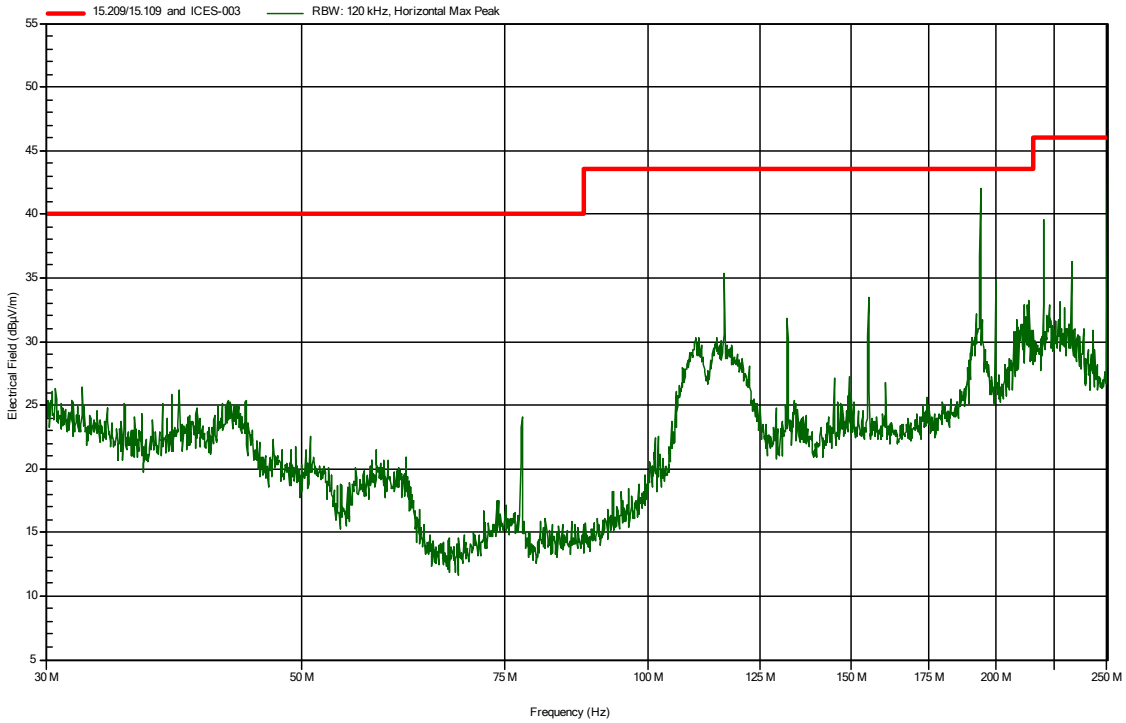


Plot 1b: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown). Channel 7

Note: the limit line in the plots above only shows the restricted band limit. It does not show which frequency bands are restricted bands.

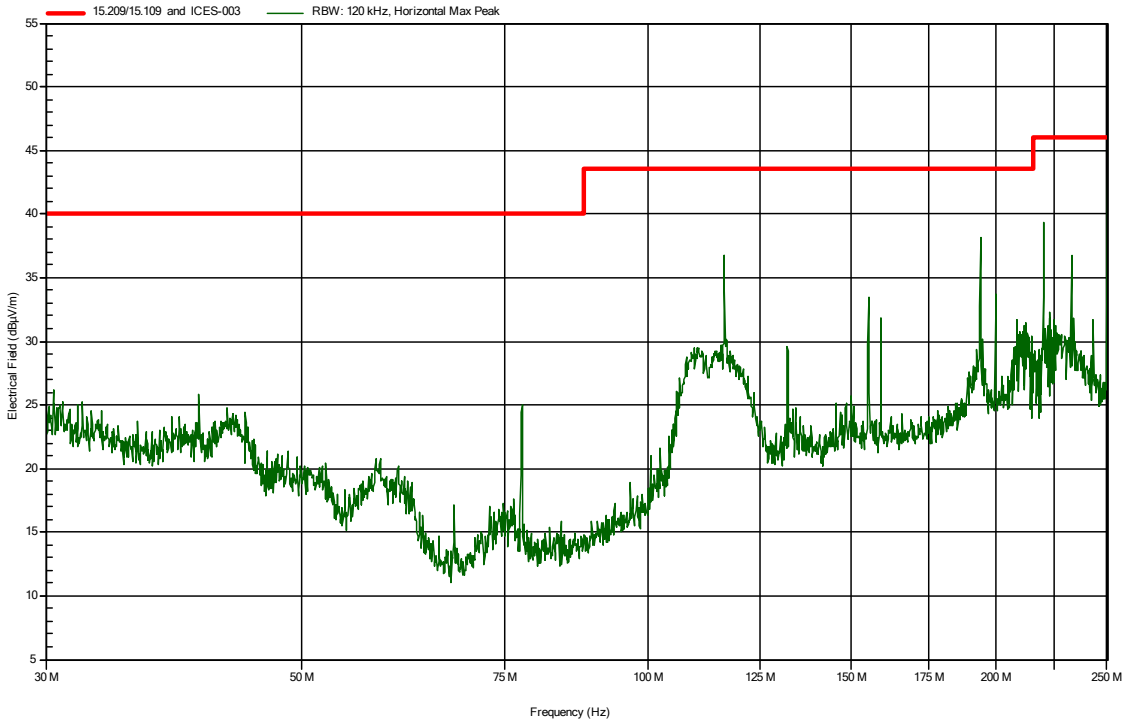


Plot 1c: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown). Channel 13

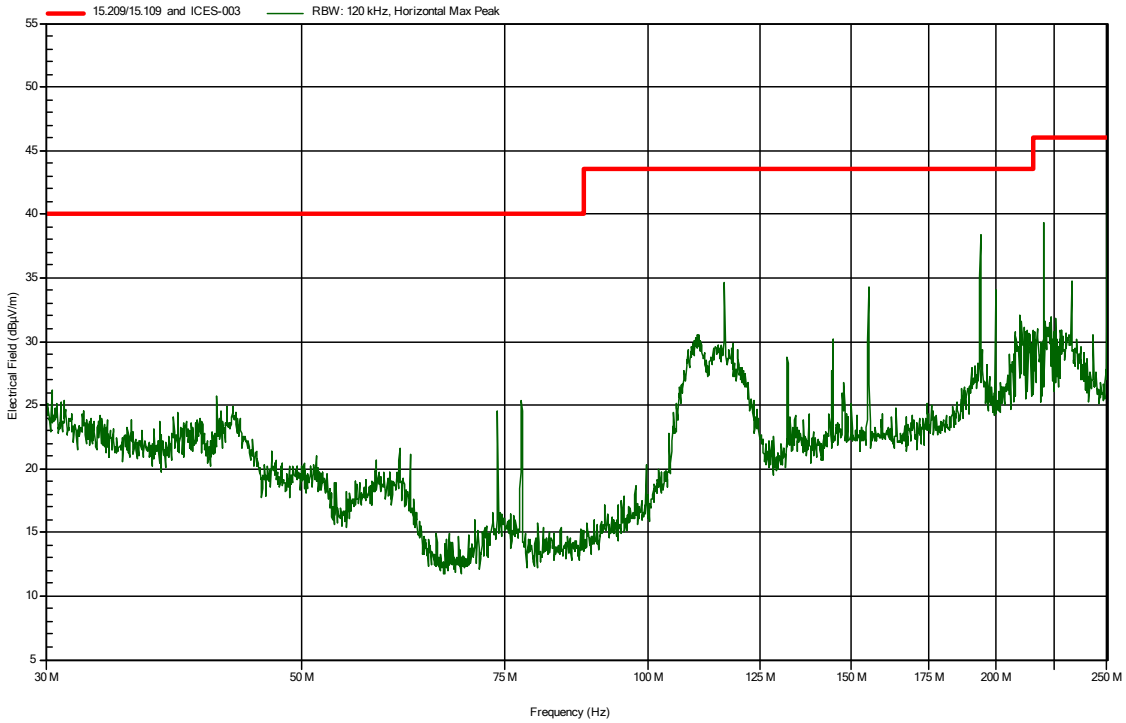


Plot 1d: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown). Channel 1

Note: the limit line in the plots above only shows the restricted band limit. It does not show which frequency bands are restricted bands.

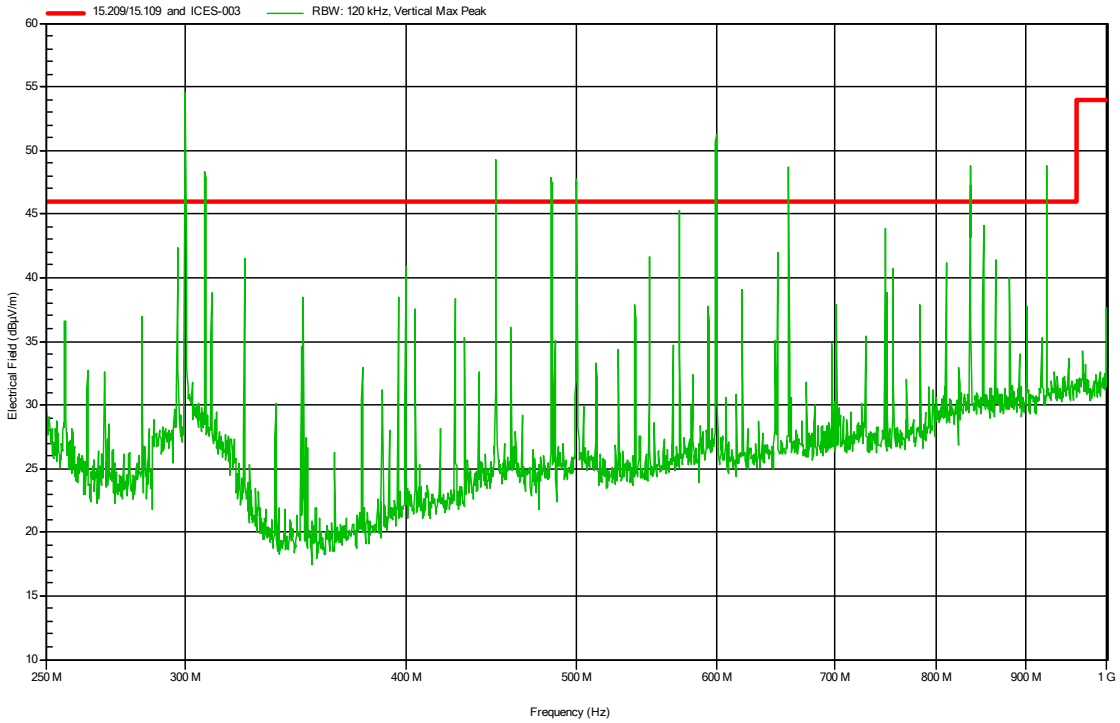


Plot 1e: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown). Channel 7

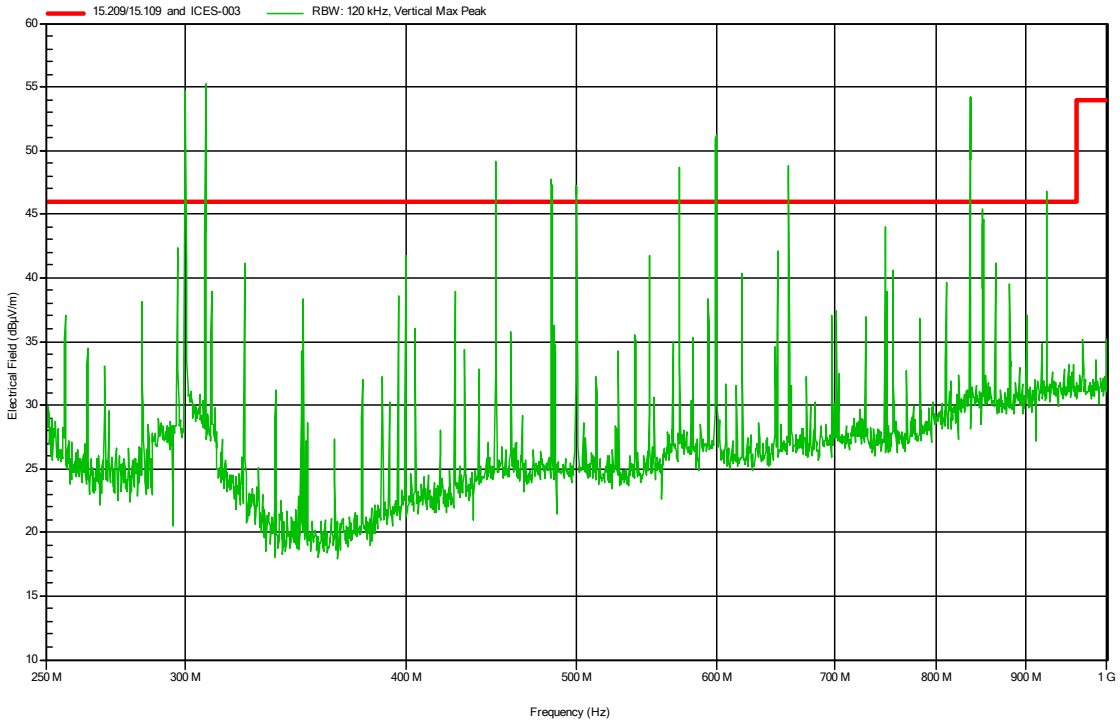


Plot 1f: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown). Channel 13

Note: the limit line in the plots above only shows the restricted band limit. It does not show which frequency bands are restricted bands.

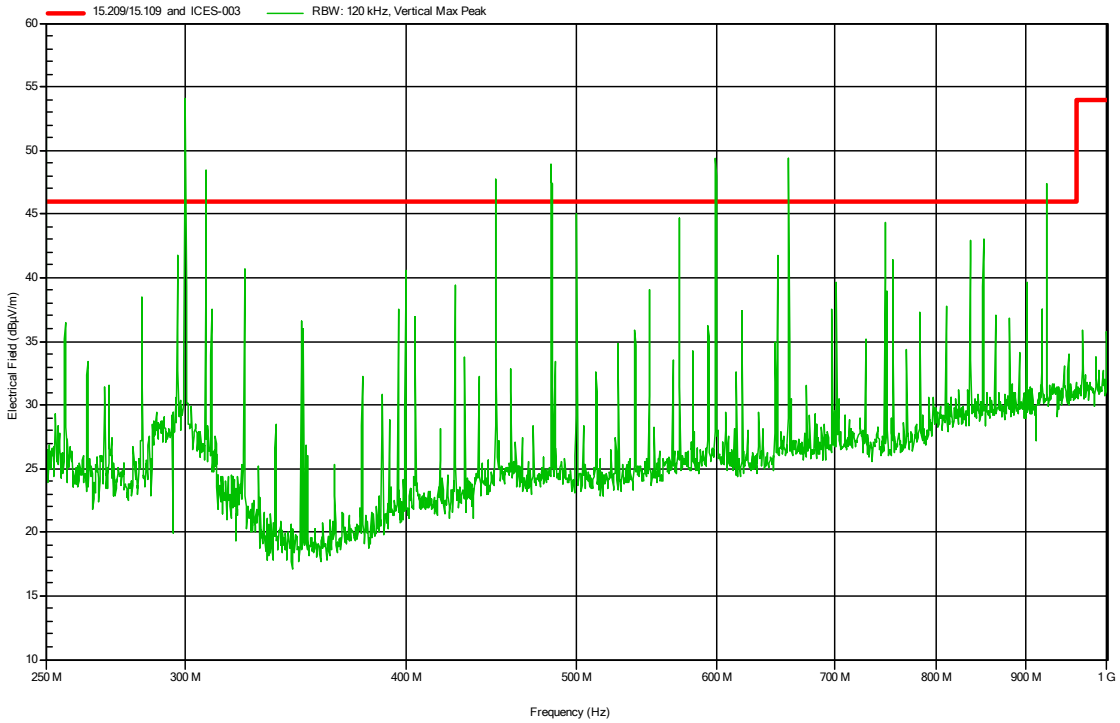


Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz (pre-scan peak values shown). Channel 1

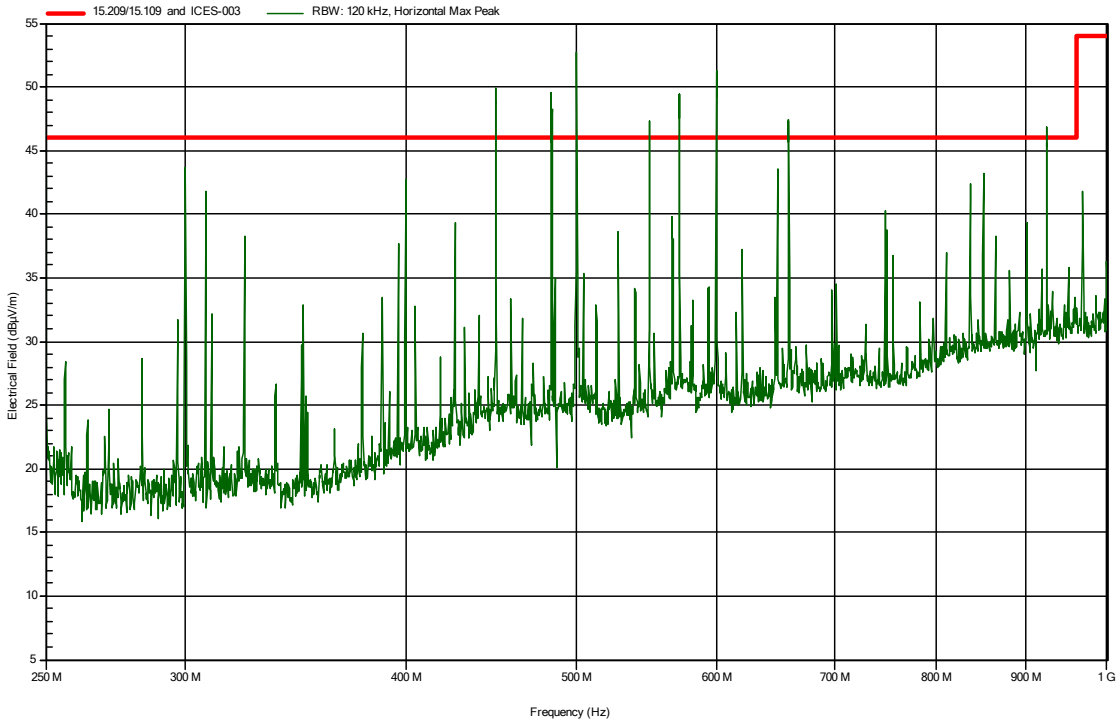


Plot 2b: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz (pre-scan peak values shown). Channel 7

Note: the limit line in the plots above only shows the restricted band limit. It does not show which frequency bands are restricted bands.

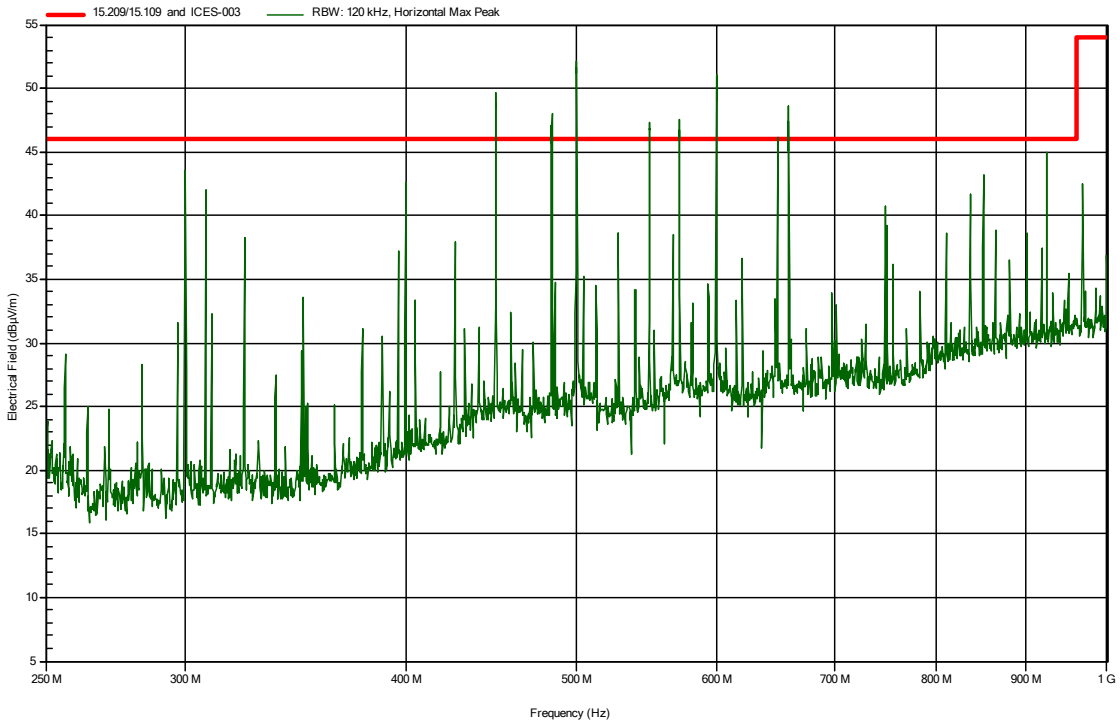


Plot 2c: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz (pre-scan peak values shown). Channel 13

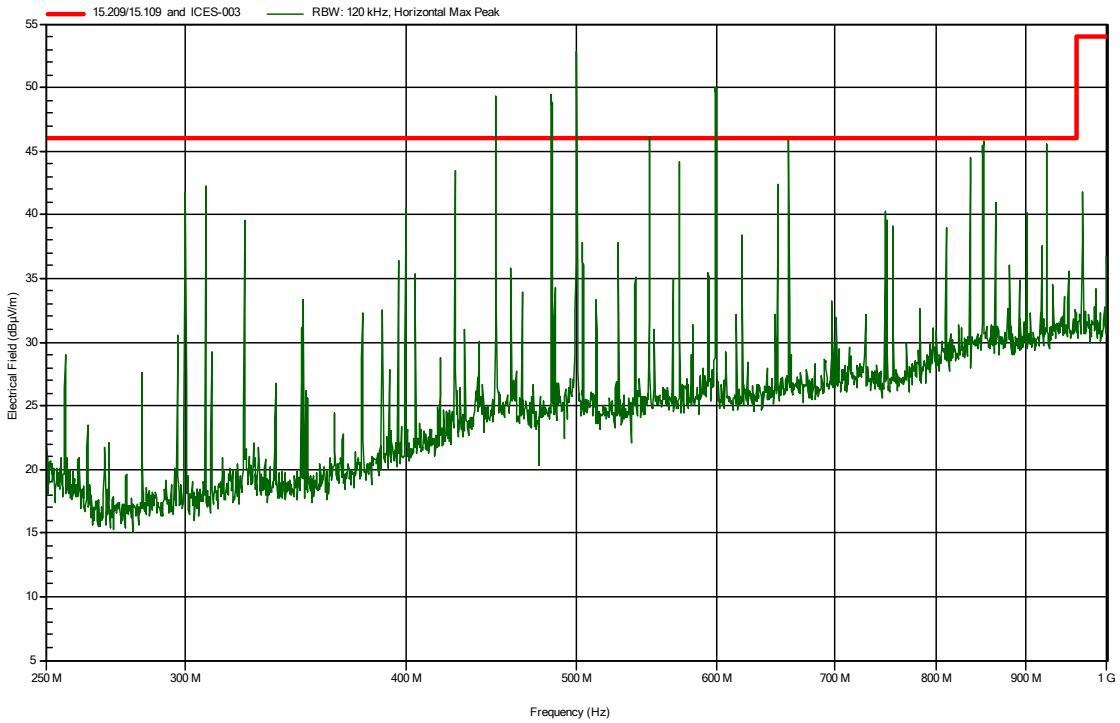


Plot 2d: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz (pre-scan peak values shown). Channel 1

Note: the limit line in the plots above only shows the restricted band limit. It does not show which frequency bands are restricted bands.

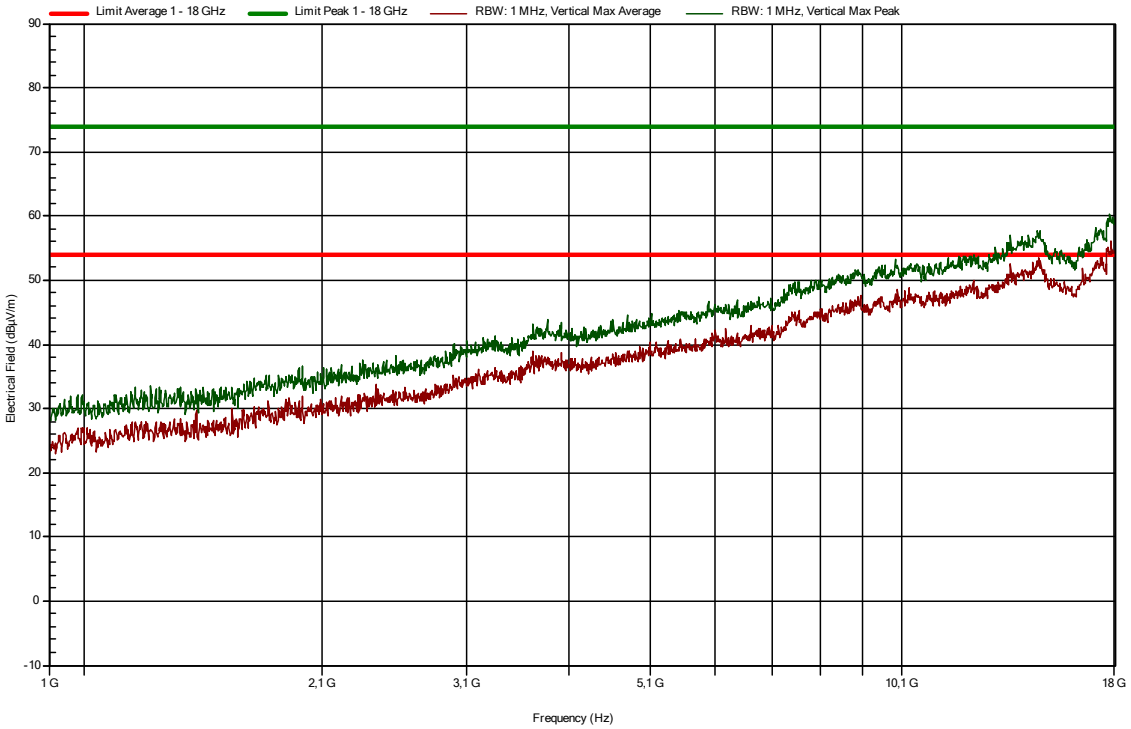


Plot 2e: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz (pre-scan peak values shown). Channel 7



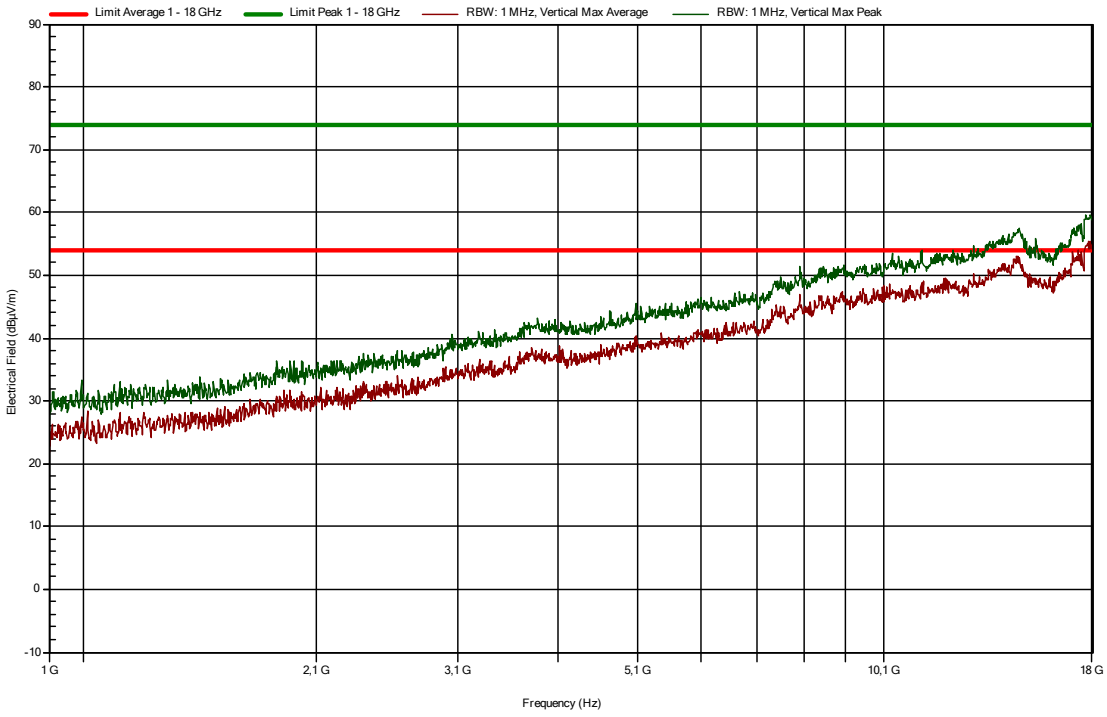
Plot 2f: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz (pre-scan peak values shown). Channel 13

Note: the limit line in the plots above only shows the restricted band limit. It does not show which frequency bands are restricted bands.



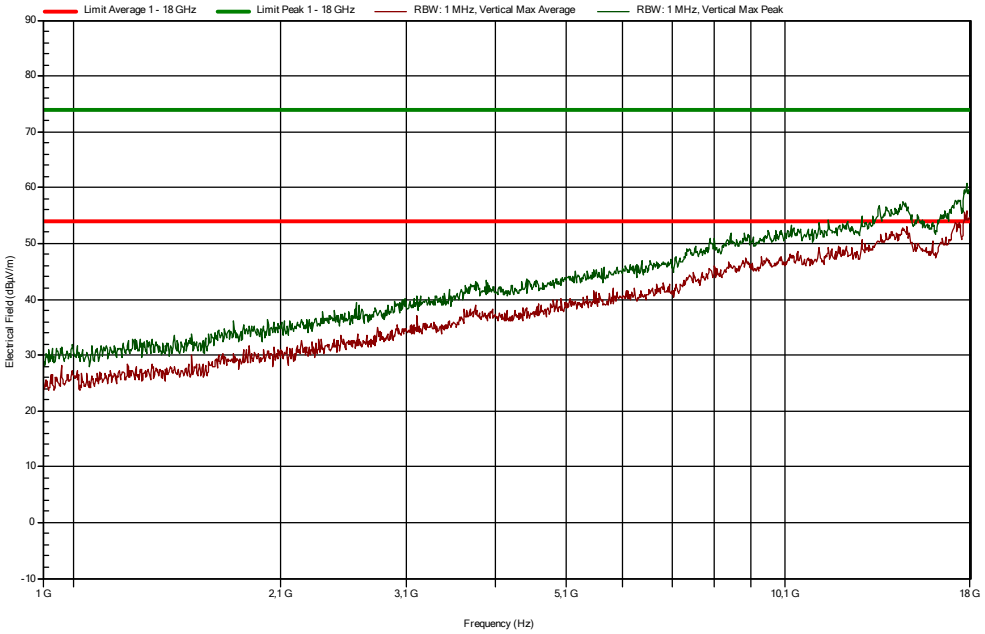
Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1 - 18 GHz (pre-scan peak values shown). Channel 1

Note: the average emission noise floor is close to the limit at 15-18 GHz. This frequency range was investigated with a lower RBW and no peaks emitted by the EUT were detected.



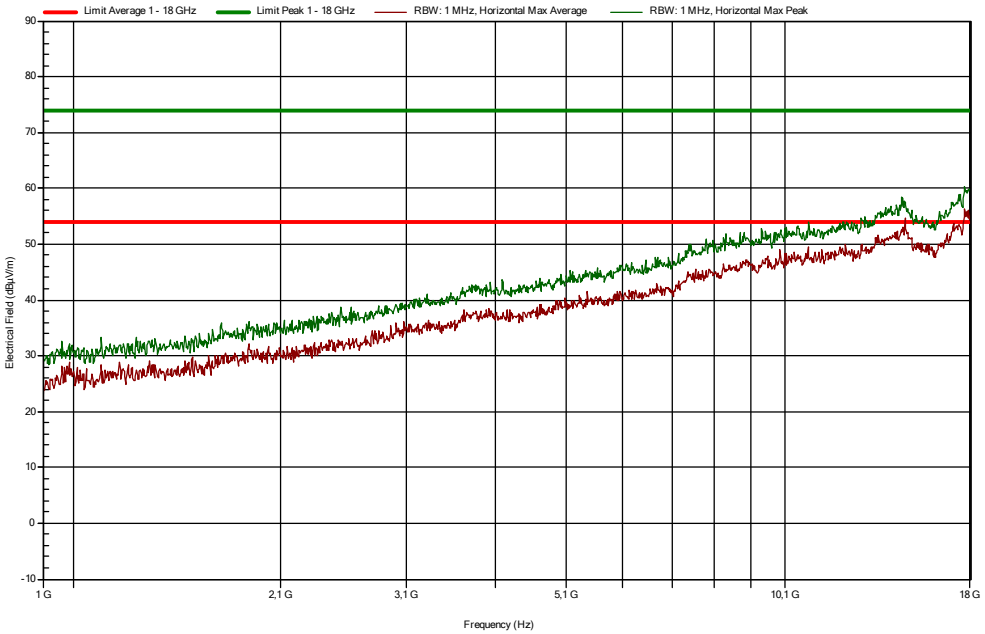
Plot 3b: radiated emissions of the EUT, Antenna vertical, in the range 1 - 18 GHz (pre-scan peak values shown). Channel 7

Note: the average emission noise floor is close to the limit at 15-18 GHz. This frequency range was investigated with a lower RBW and no peaks emitted by the EUT were detected.



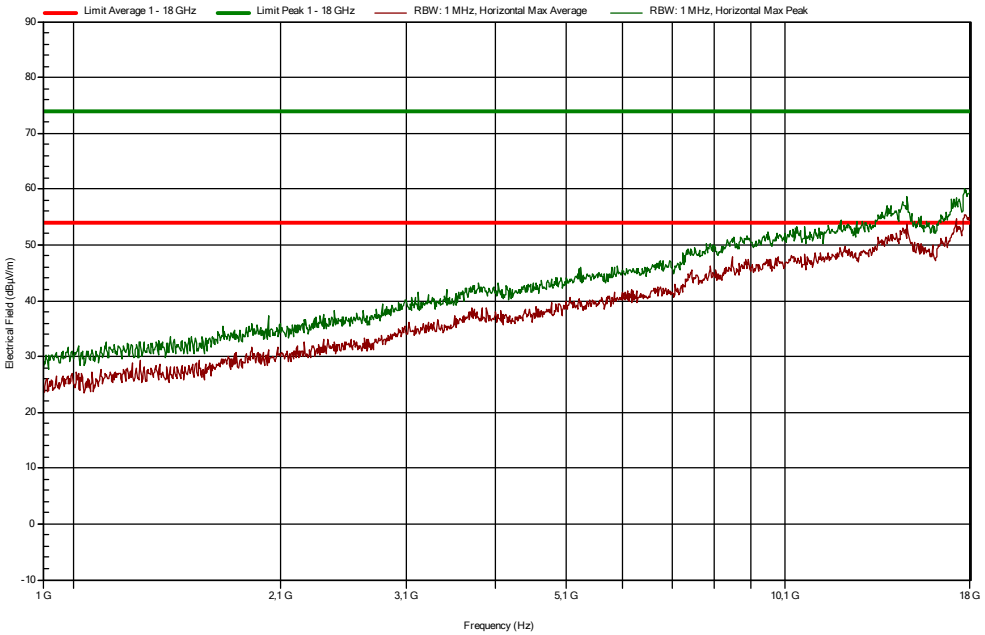
Plot 3c: radiated emissions of the EUT, Antenna vertical, in the range 1 - 18 GHz (pre-scan peak values shown). Channel 13

Note: the average emission noise floor is close to the limit at 15-18 GHz. This frequency range was investigated with a lower RBW and no peaks emitted by the EUT were detected.



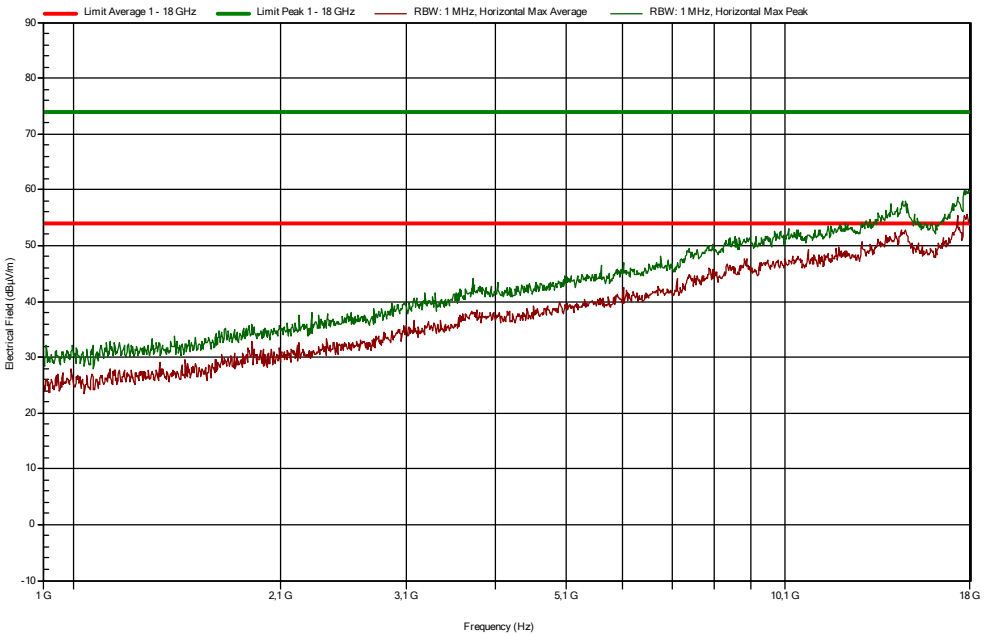
Plot 3d: radiated emissions of the EUT, Antenna horizontal, in the range 1 - 18 GHz (pre-scan peak values shown). Channel 1

Note: the average emission noise floor is close to the limit at 15-18 GHz. This frequency range was investigated with a lower RBW and no peaks emitted by the EUT were detected.



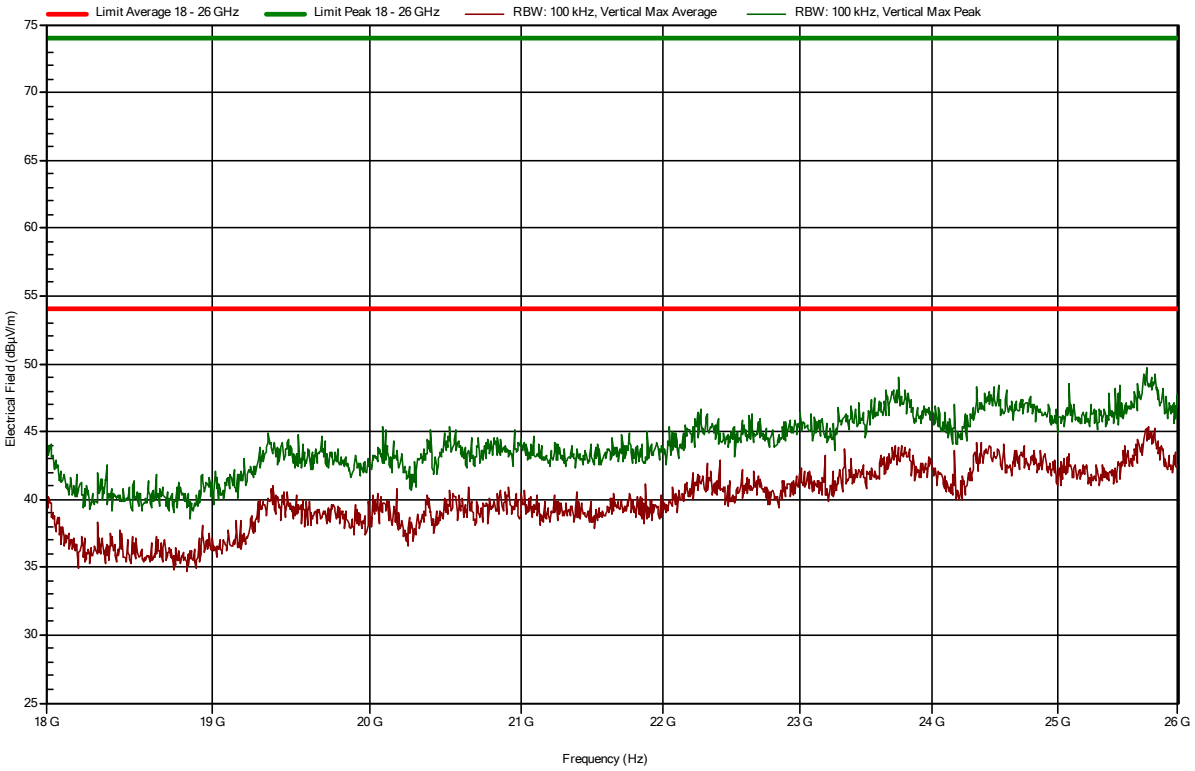
Plot 3e: radiated emissions of the EUT, Antenna horizontal, in the range 1 - 18 GHz (pre-scan peak values shown). Channel 7

Note: the average emission noise floor is close to the limit at 15-18 GHz. This frequency range was investigated with a lower RBW and no peaks emitted by the EUT were detected.

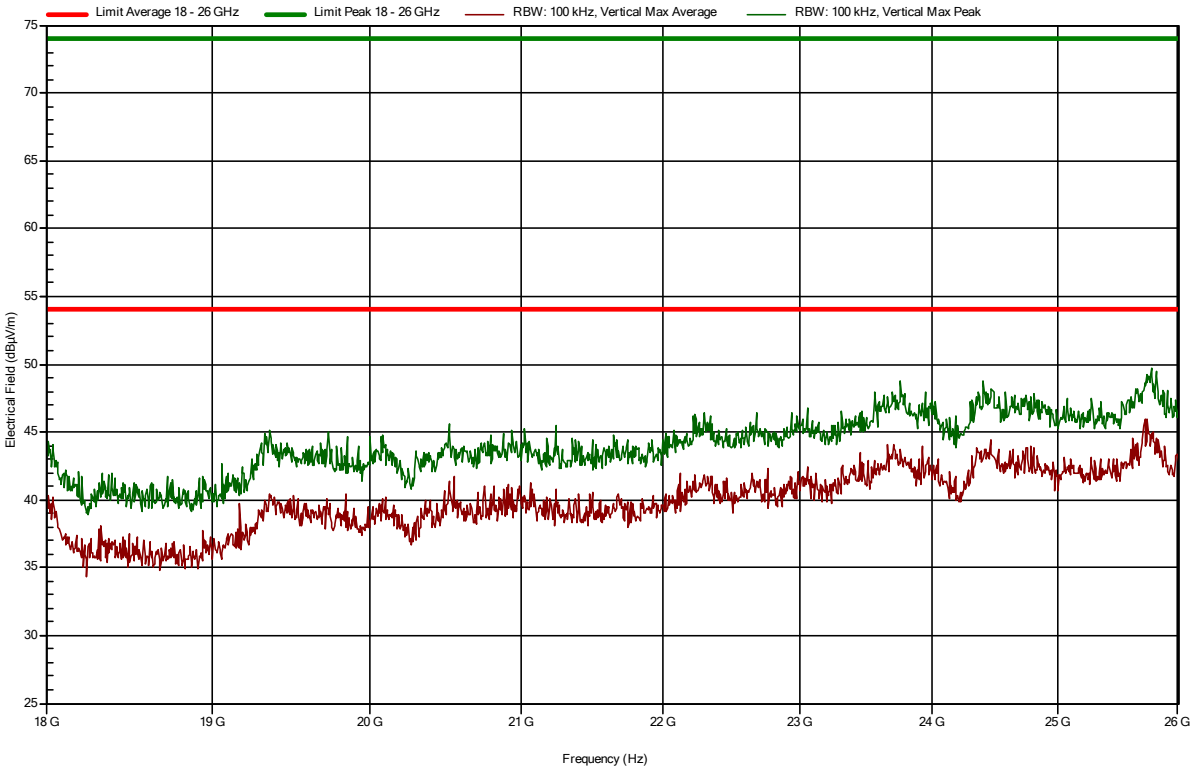


Plot 3f: radiated emissions of the EUT, Antenna horizontal, in the range 1 - 18 GHz (pre-scan peak values shown). Channel 13

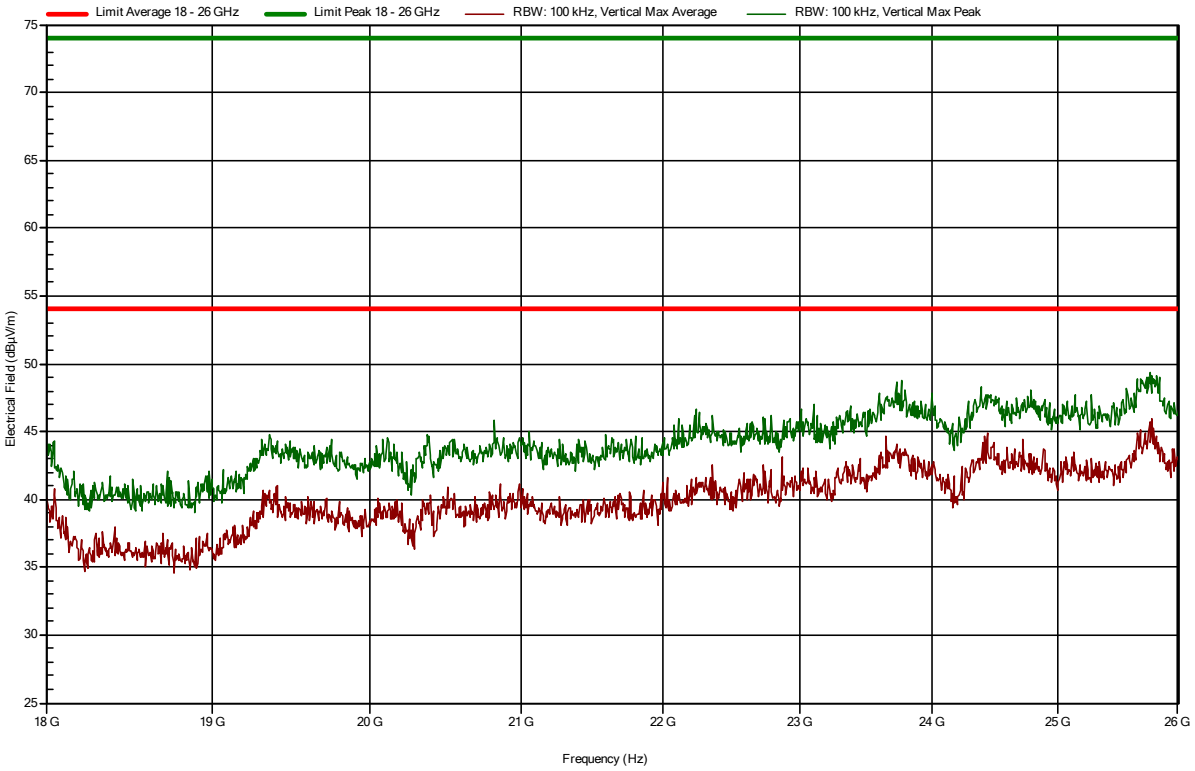
Note: the average emission noise floor is close to the limit at 15-18 GHz. This frequency range was investigated with a lower RBW and no peaks emitted by the EUT were detected.



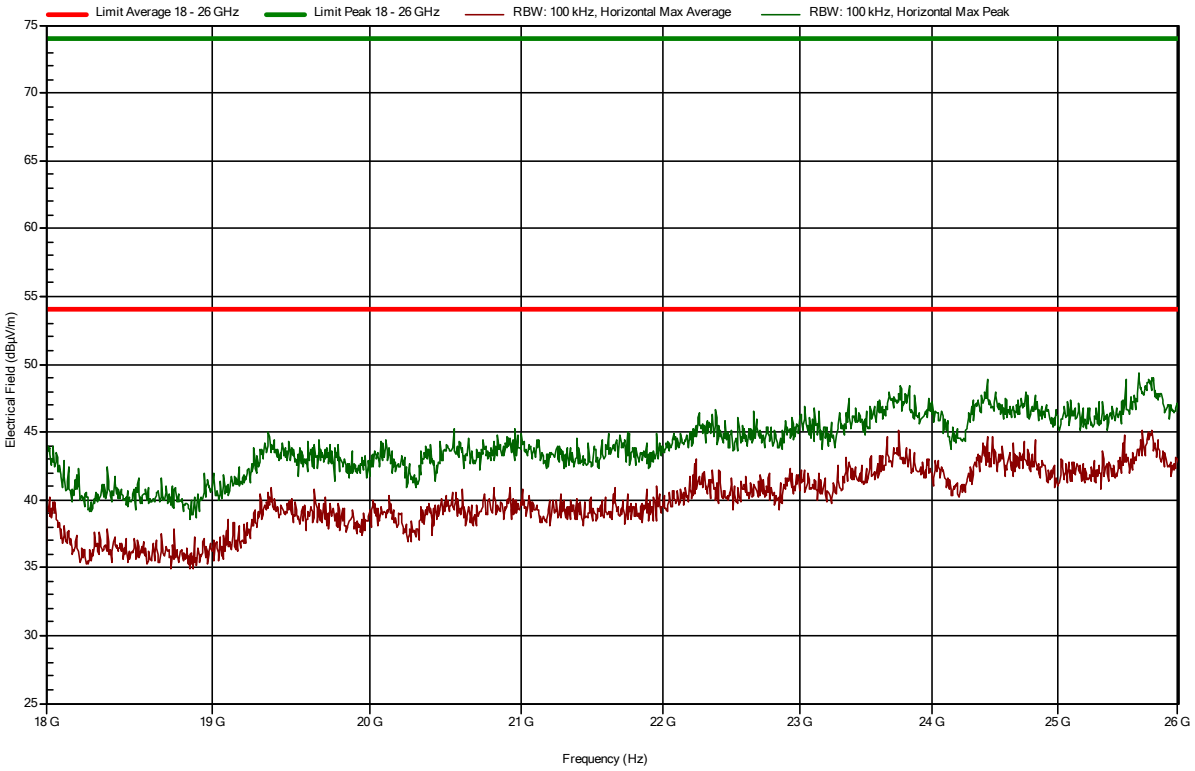
Plot 4a: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz (pre-scan peak values shown). Channel 1



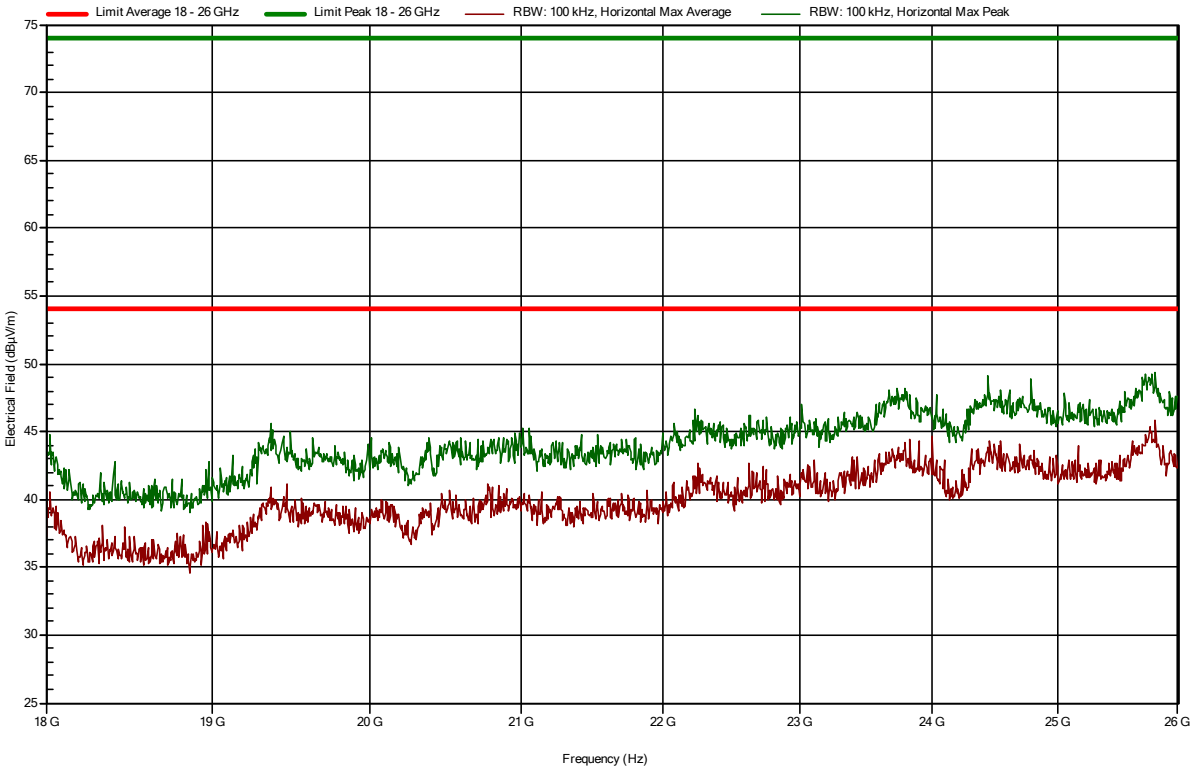
Plot 4b: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz (pre-scan peak values shown). Channel 7



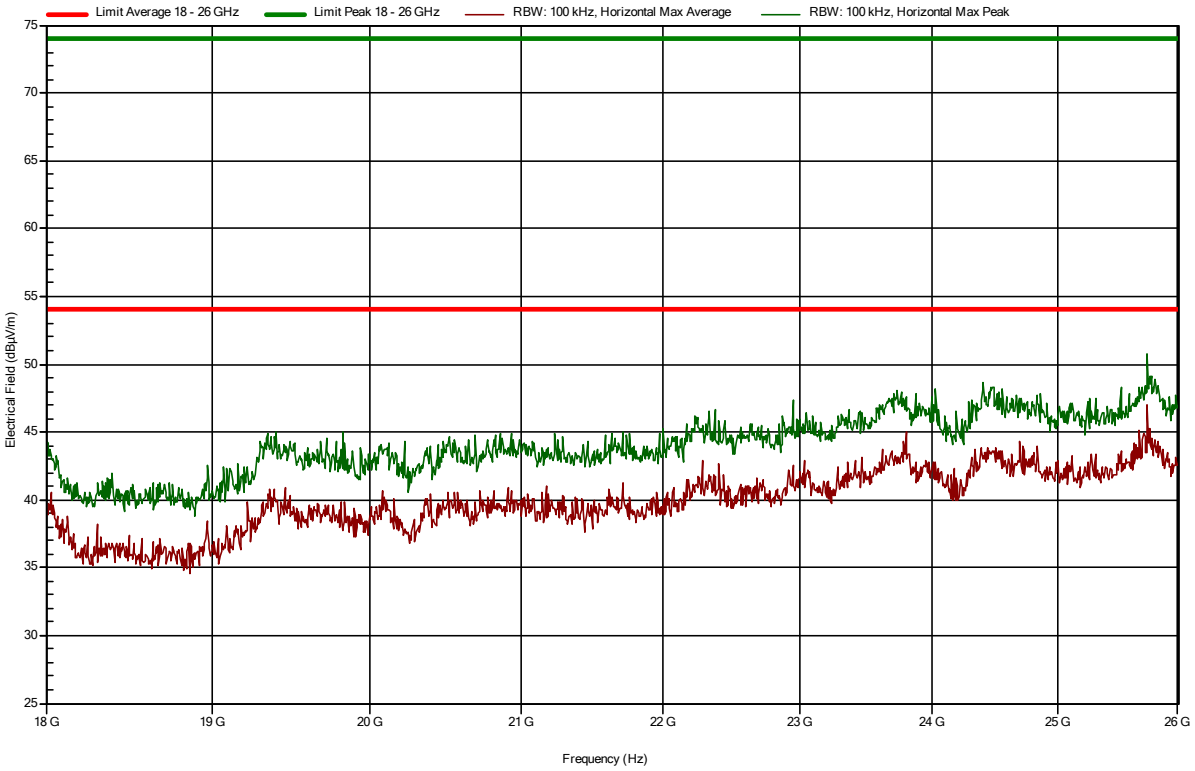
Plot 4c: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26 GHz (pre-scan peak values shown). Channel 13



Plot 4d: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz (pre-scan peak values shown). Channel 1



Plot 4e: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz (pre-scan peak values shown). Channel 7



Plot 4f: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26 GHz (pre-scan peak values shown). Channel 13

3.2 AC Power-line conducted emissions

3.2.1 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.

3.2.2 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 C63.10-2013 Section 6.2
IRN 439 – Method 1

3.2.5 Measurement uncertainty

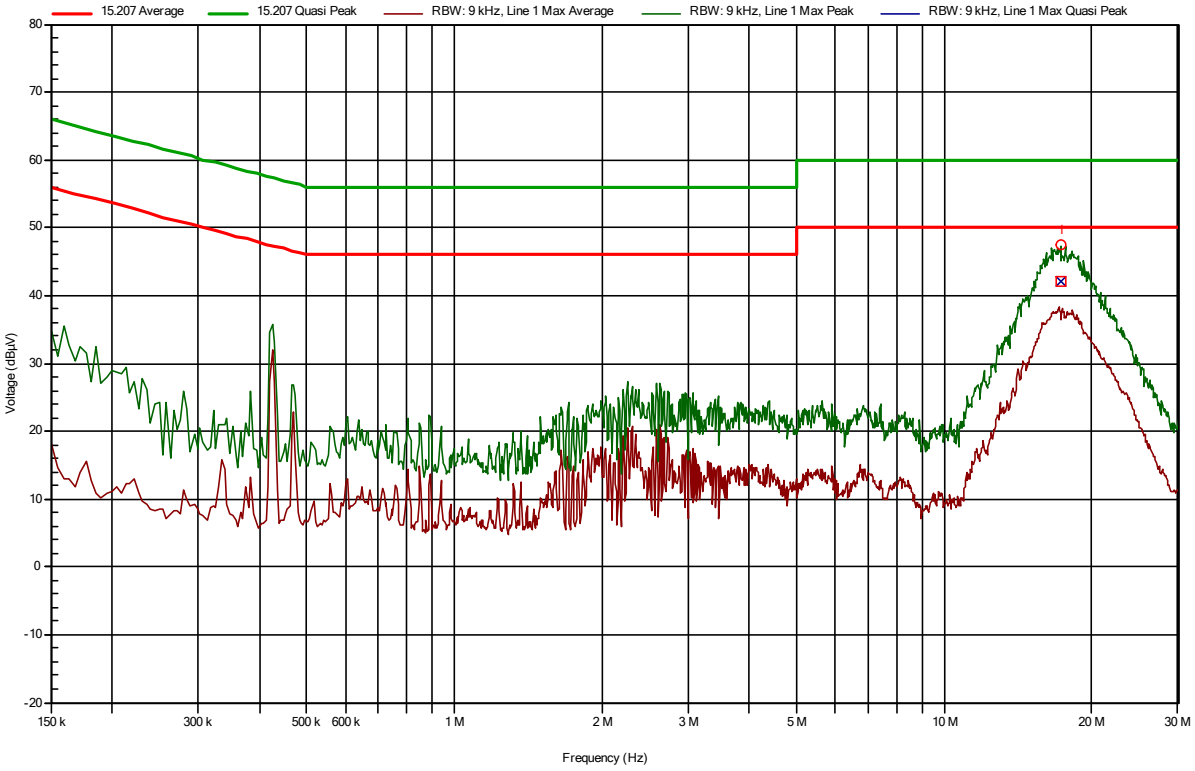
+/- 3.6 dB

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

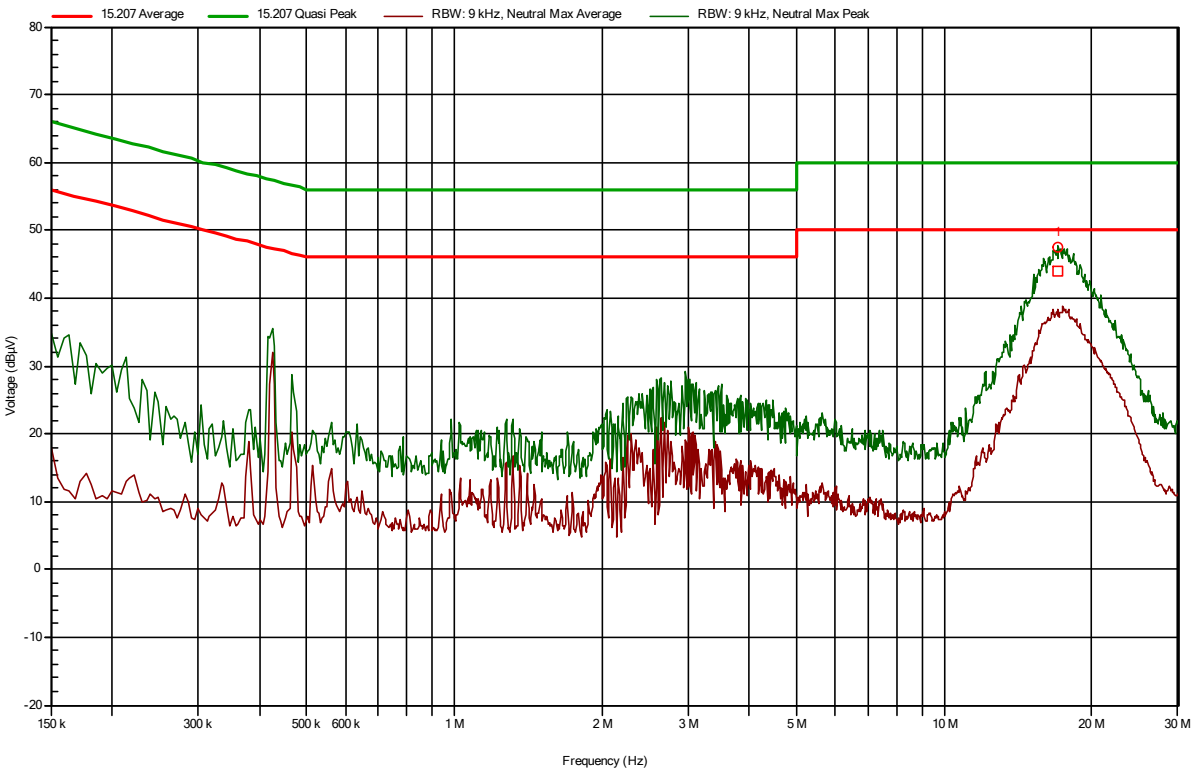
Frequency	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	Status	Line
17,102 MHz	37,8 dBµV	50 dBµV	44,1 dBµV	60 dBµV	Pass	Neutral
17,331 MHz	37,1 dBµV	50 dBµV	42 dBµV	60 dBµV	Pass	Phase

3.2.7 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**



3.3 Field strength of fundamental

3.3.1 Limit

No limit, included for reporting purposes only.

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 C63.10-2013, section 11.11.2
IRN 441 – Method 2

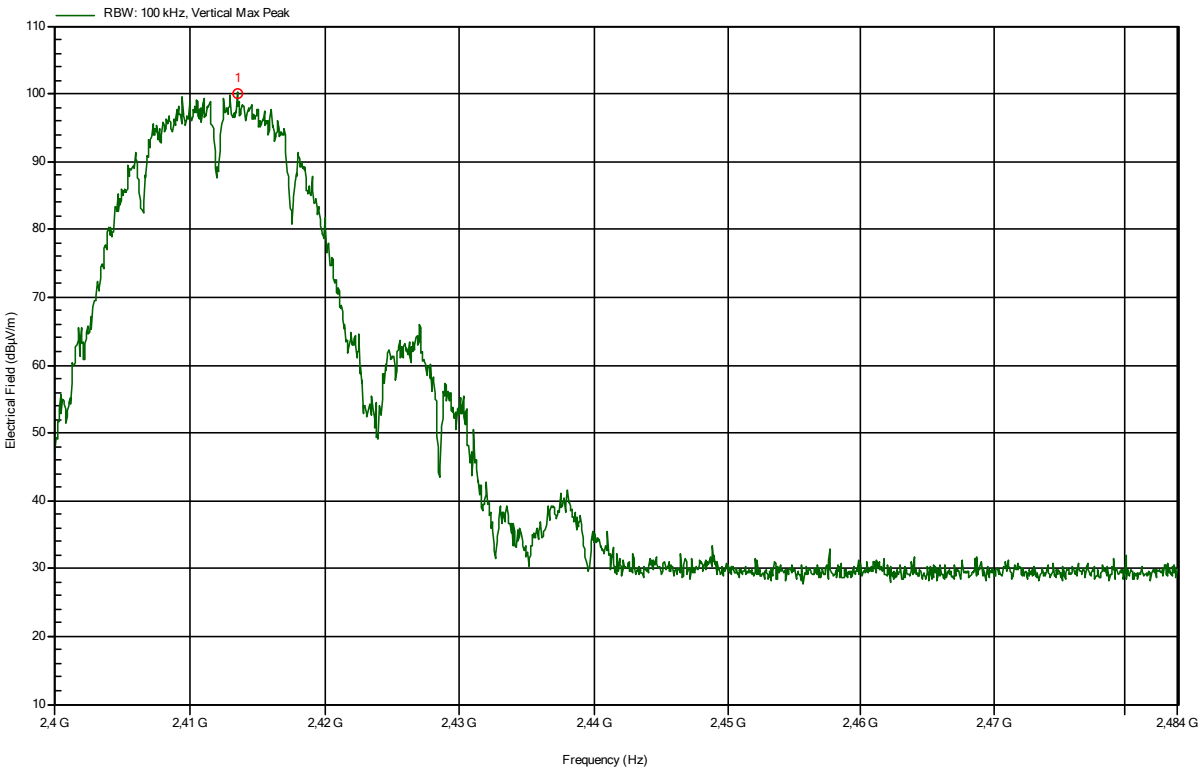
3.3.5 Test results of Field strength of emissions

Frequency (MHz)	Maximum field strength (dBµV/m @3m in 100 kHz RBW)	Maximum emissions in nonrestricted bands (dBµV/m @3m in 100 kHz RBW)
2412	100.0	80.0
2442	101.6	81.6
2472	100.2	80.2

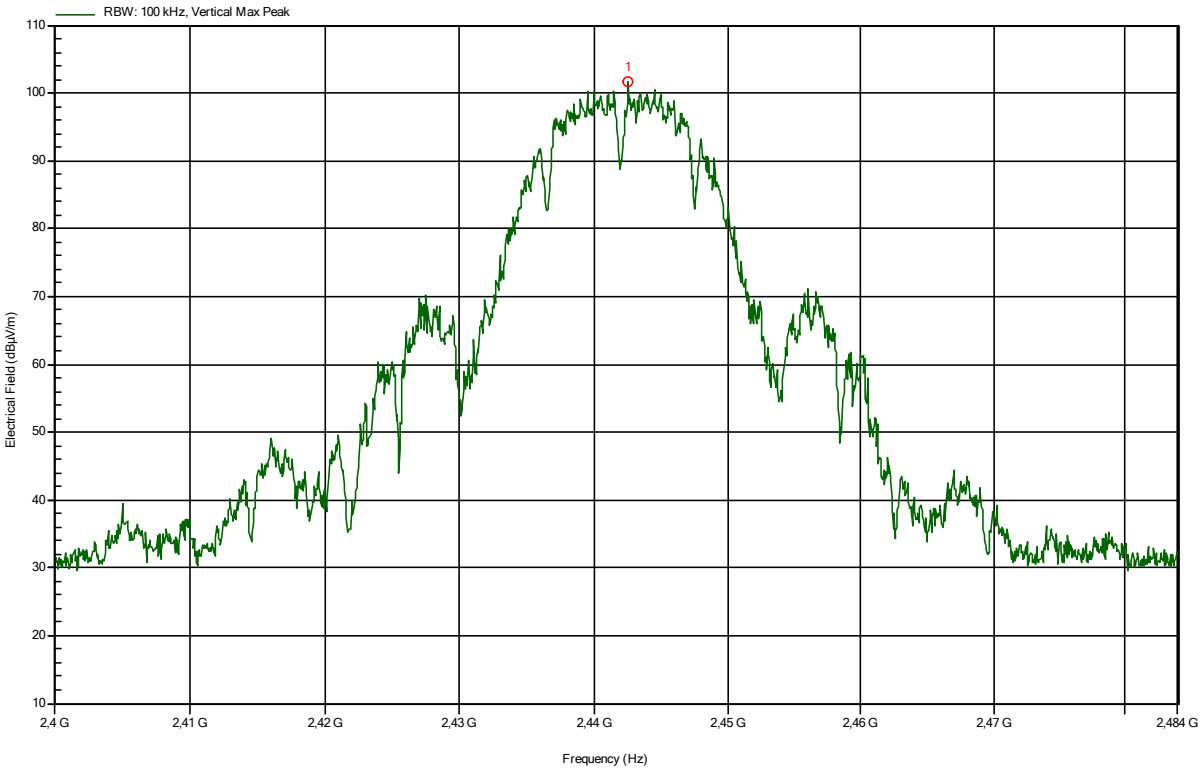
Maximum emissions in nonrestricted bands calculated according to FCC Part 15.247 (d)
Max emissions = Max field strength (dBµV/m @3m in 100 kHz RBW) – 20dB

3.3.6 Plots of Field strength of emissions Measurement

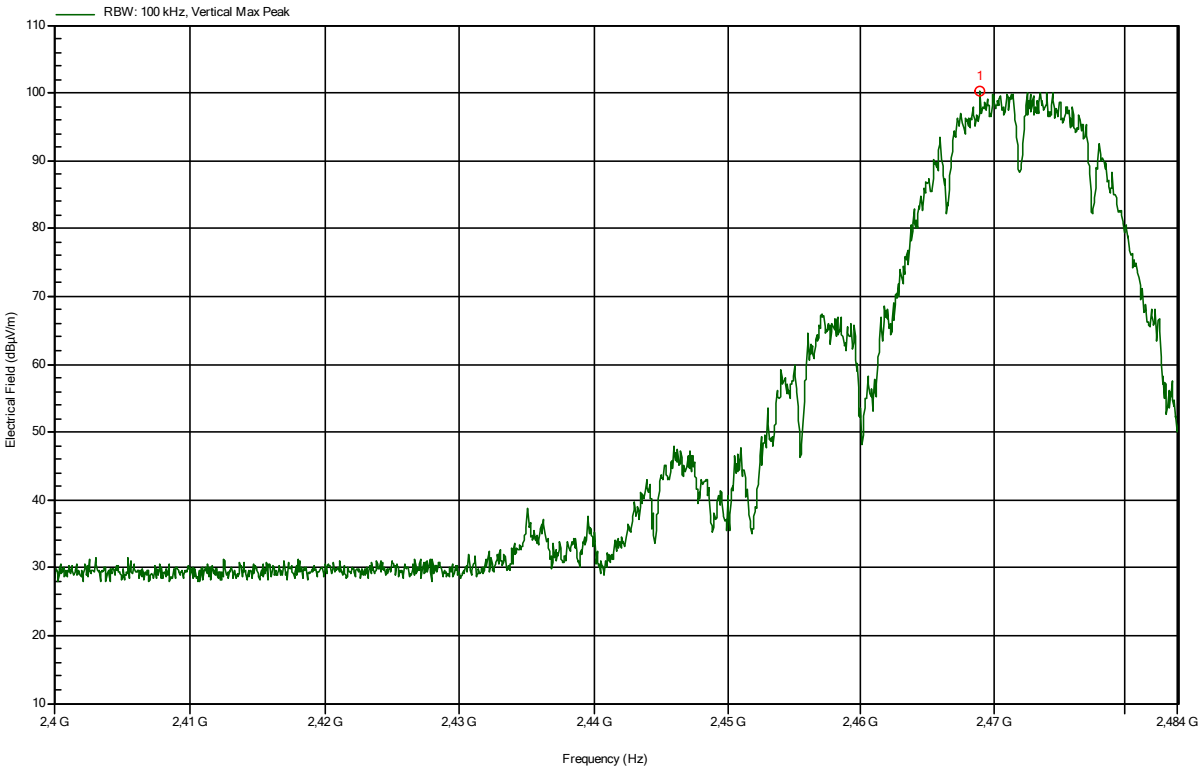
2412 MHz



2442 MHz



2472 MHz



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)**
	Kiwa ID:114159 SN: 892785/004 Rohde & Schwarz ESH3-Z5	**Kiwa ID:114160 SN: 5SM03153 Rohde & Schwarz ESH3-Z2**	-	
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) 114605 Emco 3115 SN: 9412-4377	Gain (dB) 114771 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) 114691	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) 114518 Flann 20240-25 SN: 163703	Gain (dB) 114771 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) 114691	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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