Test report for

47 CFR Part 15 Subpart B

Test report No. : P000311130 001 Ver 1.0

The RvA is signatory to ILAC - MRA

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

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
v0.5	11-08-2023	First draft	PvW
v1.0	27-09-2023	Final release	PvW

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Summary of Test results

FCC	Description	Section in report	Verdict
15.109 (a)	Radiated spurious emissions < 1GHz	3.1	Pass
15.109 (a)	Radiated spurious emissions > 1GHz	3.1	Pass
15.107 (c)	AC power-line conducted emissions	3.2	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:	Hella Gutmann Solution GmbH
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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:	07-08-2023

Auxiliary items:

None

1.4 Product specifications of Equipment under test

Tx Frequency range (MHz)	WLAN: 2400 – 2483.5
Rx Frequency range (MHz)	WLAN: 2400 – 2483.5
Antenna type	Patch antenna

Disclaimer: above info is declared by the applicant

The EUT is considered as a Class A device.

1.5 Environmental conditions

Test date	07-08-2023	08-08-2023	09-08-2023
Ambient temperature	21.3°C	21.6°C	22.3°C
Humidity	62.9%	50.3%	44.8%

1.6 Measurement standards

- ANSI C63.4:2014

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart B

1.8 Observation and remarks

The EUT is tested in the upright position, with the power cord hanging straight down to the ground. The controls are height adjustable, the were positioned at a normal operating height for a 1.80 m long person. The EUT has a USB port at the back, this port is intended for a flash drive during updating/maintenance of the device.

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.8 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 1.8 *"Applicable standards".*

All tests are performed by:

Name : P. van Wanrooij, BASc

Review of test methods and report by:

Name : ing. R. 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 :

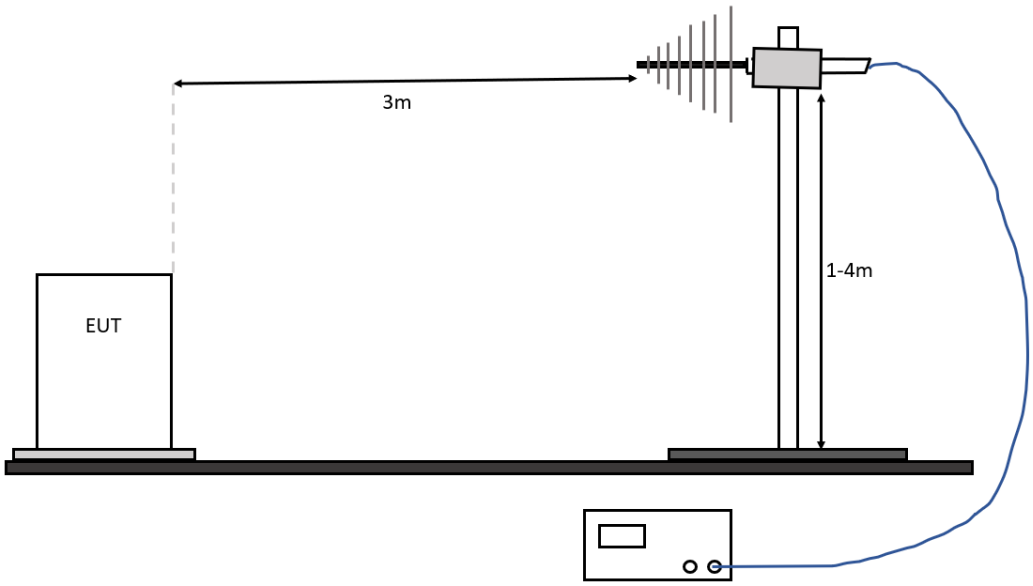
2 Test configuration of the Equipment Under Test

2.1 Test mode

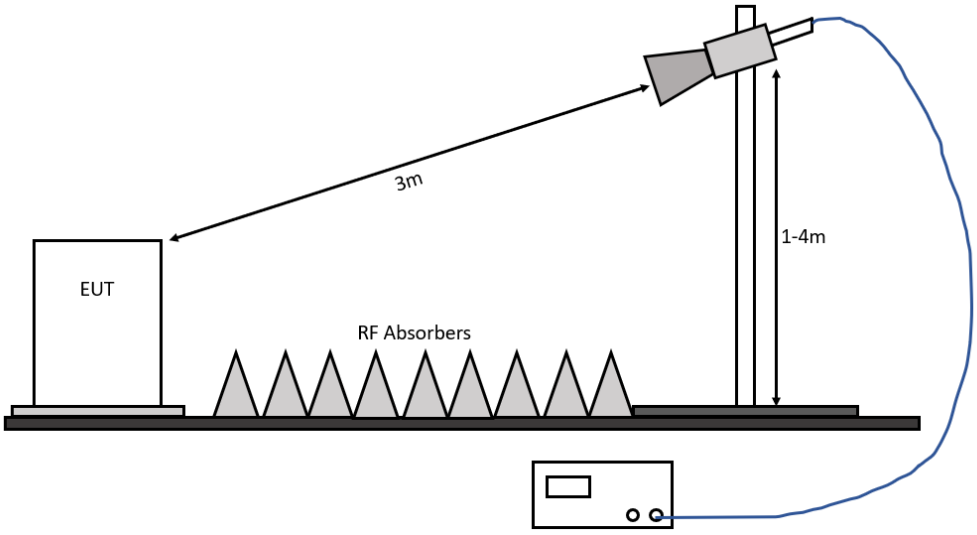
The equipment is tested in normal operating mode. The laser was switched on during emission testing.
The EUT is floor-standing equipment

2.2 Test setups

2.2.1 Radiated emissions test setup 30 MHz - 1 GHz

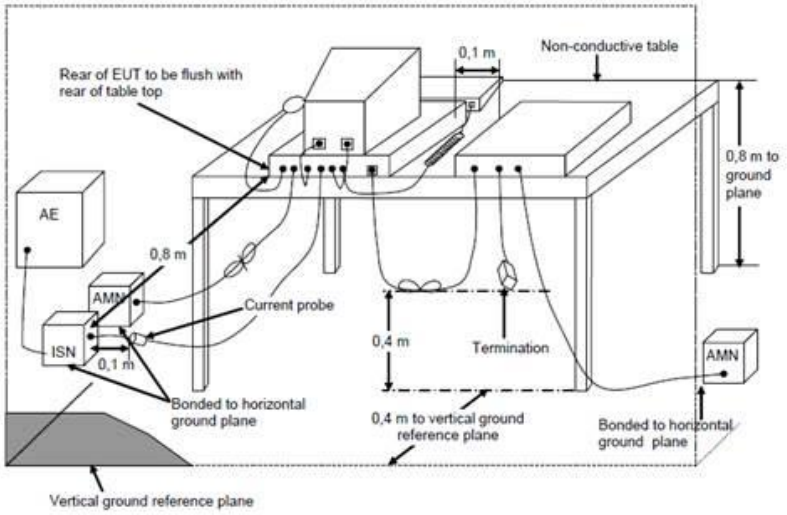


2.2.2 Radiated emissions test setup above 1 GHz



2.2.3 AC Power line conducted emissions test setup

Emissions test at AC mains



List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	AC Power	mains 110Vac 60 Hz	AUX1 & AUX2	< 3m	-

2.3 Test methodology

The test methodology used is based on the requirements of 47 CFR Part 15, sections 15.31, 15.107 and 15.109, ICES-003 and ICES-Gen. The test methods, which have been used, are based on ANSI C63.4-2014.

2.4 Equipment modifications.

No modifications have been made to the equipment.

2.5 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Cal. Done date	Cal. due date	Used at Par.
EMI Receiver	Rohde & Schwarz	ESR7	114534	04-2023	04-2024	3.1
EMI Receiver	Rohde & Schwarz	ESCI	114161	01-2023	01-2024	
Spectrum Analyzer	Rohde & Schwarz	FSV40	114527	11-2023	11-2024	3.1
Biconical antenna + 6dB attenuator	Schwarzbeck + HP	VHA9103 + 8491A	114436 + 114254	03-2021	03-2024	3.1
Logperiodic antenna	EMCO	3147	114385	03-2021	03-2024	3.1
Horn antenna	EMCO	3115	114607	01-2021	01-2024	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	114518	NA*	NA*	3.1
Preamplifier 1-18 GHz	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		--	--	3.1; 3.2
LISN /Two line V-network	Rohde & Schwarz	ENV 216	114379	07-2021	31-08-2023	3.2
AC source	Chroma	61601	114363	03-2023	03-2024	3.1; 3.2

*Note: Standard gain horn antennas do not need calibration
Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2017 has been confirmed before testing.
NA= Not Applicable

2.6 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

The field strength of radiated emissions from a Class A digital device from an unintentional radiator shall not exceed the field strength levels specified in the following tables.
On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified.
Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function.
When average radiated emission measurements are specified in this part, there is also a limit on the peak level of the emissions. Unless otherwise specified, the limit on peak emissions is 20 dB above the average limit.
The product under test shall comply with both the average and the peak limits.

FCC 15.109(a)

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	90	39.1	10
88-216	150	43.5	10
216-960	210	46.4	10
Above 960	300	49.5	10

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2.1 and 2.2.2 of this report.

3.1.4 Test procedure

30 MHz to 26.5 GHz: According to ANSI C63.4-2014, section 8.3

30 MHz to 1 GHz: IRN 441 – Method 1
1 GHz to 18 GHz: IRN 441 – Method 2
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 30MHz to the highest measurement frequency according to the table below. Final radiated emission measurements were made at 3m distance.

The field strength is measured at 3 meter distance and is converted to a measurement distance of 10 meter:

$$FS@10m\ \left(dB\mu\frac{V}{m}\right) = FS@3m\left(dB\mu\frac{V}{m}\right) - 10.46\ dB$$

Highest internal frequency (F_X) [i]	Highest measurement frequency (F_M)
$F_X \leq 108$ MHz	1 GHz
108 MHz < $F_X \leq 500$ MHz	2 GHz
500 MHz < $F_X \leq 1$ GHz	5 GHz
$F_X > 1$ GHz	5 x F_X up to a maximum of 40 GHz
i. F_X is the highest fundamental frequency generated and/or used in the ITE or digital apparatus under test.	

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
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB

3.1.6 Test results

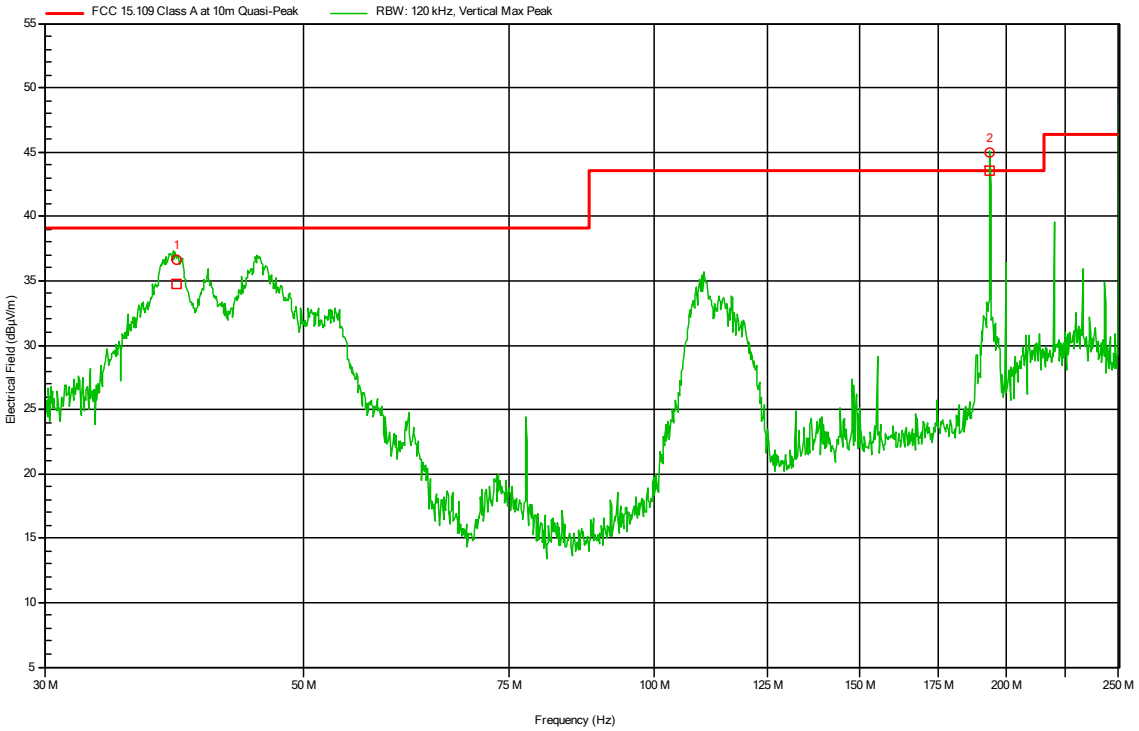
Frequency	Peak	Quasi-Peak @3m	Quasi-Peak @10m	Quasi-Peak Limit @10m	Polarization	Height	Quasi-Peak Status
38,925 MHz	36,6 dBµV/m	34,8 dBµV/m	24,3 dBµV/m	39,1 dBµV/m	Vertical	1 m	Pass
193,948 MHz	45 dBµV/m	43,6 dBµV/m	33,1 dBµV/m	43,5 dBµV/m	Vertical	2 m	Pass
300,001 MHz	54,8 dBµV/m	54,4 dBµV/m	43,9 dBµV/m	46,4 dBµV/m	Vertical	1,5 m	Pass
599,994 MHz	51,2 dBµV/m	50,5 dBµV/m	40,0 dBµV/m	46,4 dBµV/m	Vertical	1,5 m	Pass
499,992 MHz	52,7 dBµV/m	52,1 dBµV/m	41,6 dBµV/m	46,4 dBµV/m	Horizontal	1,3 m	Pass
599,981 MHz	51,3 dBµV/m	50,7 dBµV/m	40,2 dBµV/m	46,4 dBµV/m	Horizontal	1 m	Pass

Frequency	Average @3m	Average @10m	Average Limit @10m	Peak @3m	Peak @10m	Peak Limit @10m	Polarization	Height	Status
1,012 GHz	47,9 dBµV/m	37,4 dBµV/m	49,5 dBµV/m	45,8 dBµV/m	35,3 dBµV/m	69,5 dBµV/m	Vertical	2 m	Pass
1,056 GHz	45,4 dBµV/m	34,5 dBµV/m	49,5 dBµV/m	46,7 dBµV/m	36,2 dBµV/m	69,5 dBµV/m	Vertical	3,3 m	Pass
2,095 GHz	27,8 dBµV/m	17,3 dBµV/m	49,5 dBµV/m	38,3 dBµV/m	27.8 dBµV/m	69,5 dBµV/m	Horizontal	3,5 m	Pass
1,973 GHz	40,3 dBµV/m	29,8 dBµV/m	49,5 dBµV/m	47 dBµV/m	36,5 dBµV/m	69,5 dBµV/m	Horizontal	3,5 m	Pass

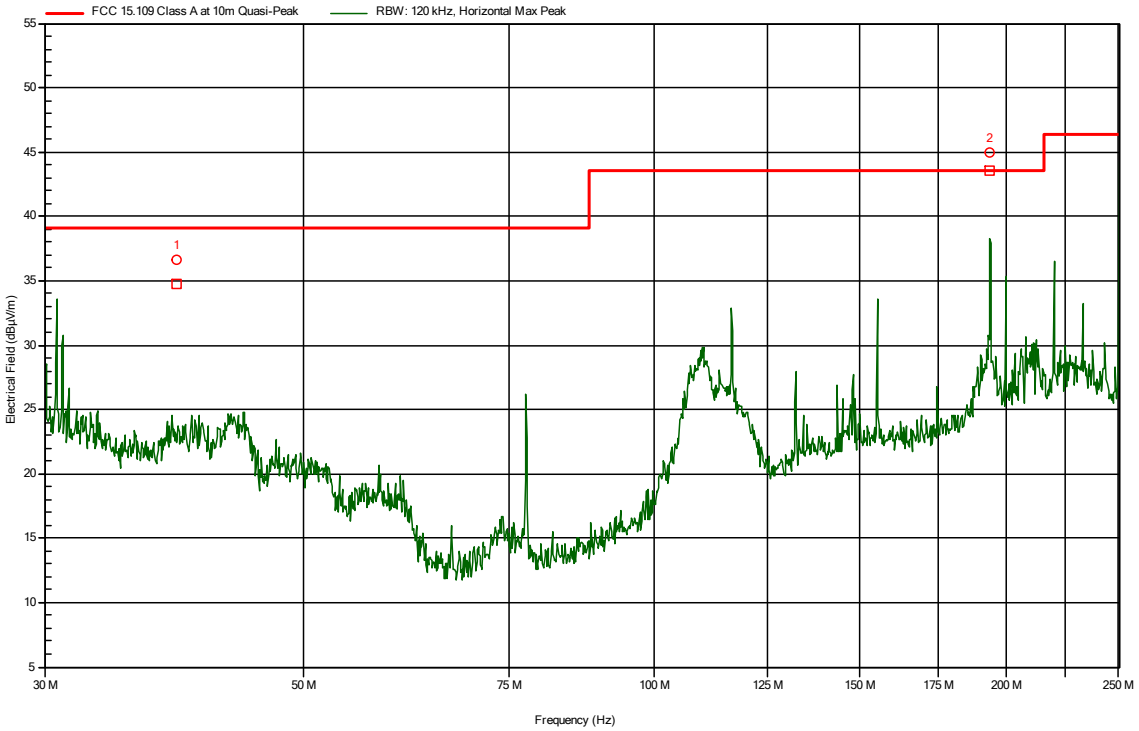
The results of the radiated emission tests are depicted in the table above. A selection of plots is provided on the next pages

Note: The graphs show measurement values at 3m, while the shown limit lines are defined at 10m. Final measurement values are converted to 10m distance with the equation in clause 3.1.4

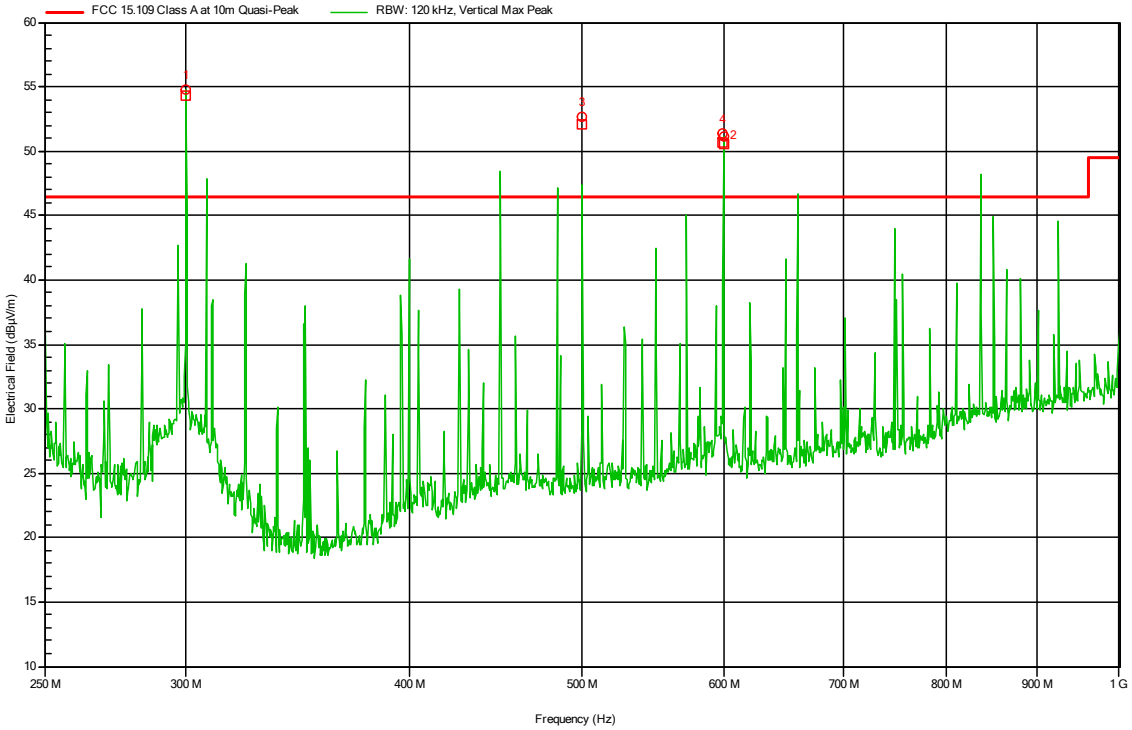
3.1.7 Plots of the Radiated Spurious Emissions Measurement



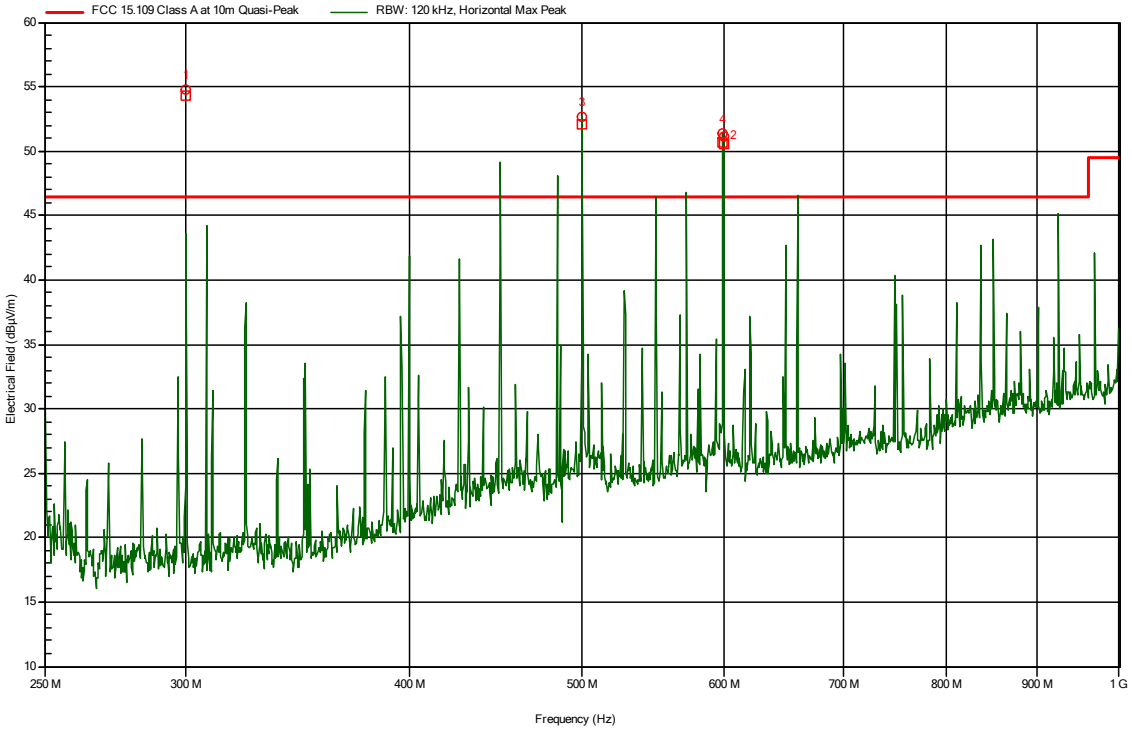
Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown).



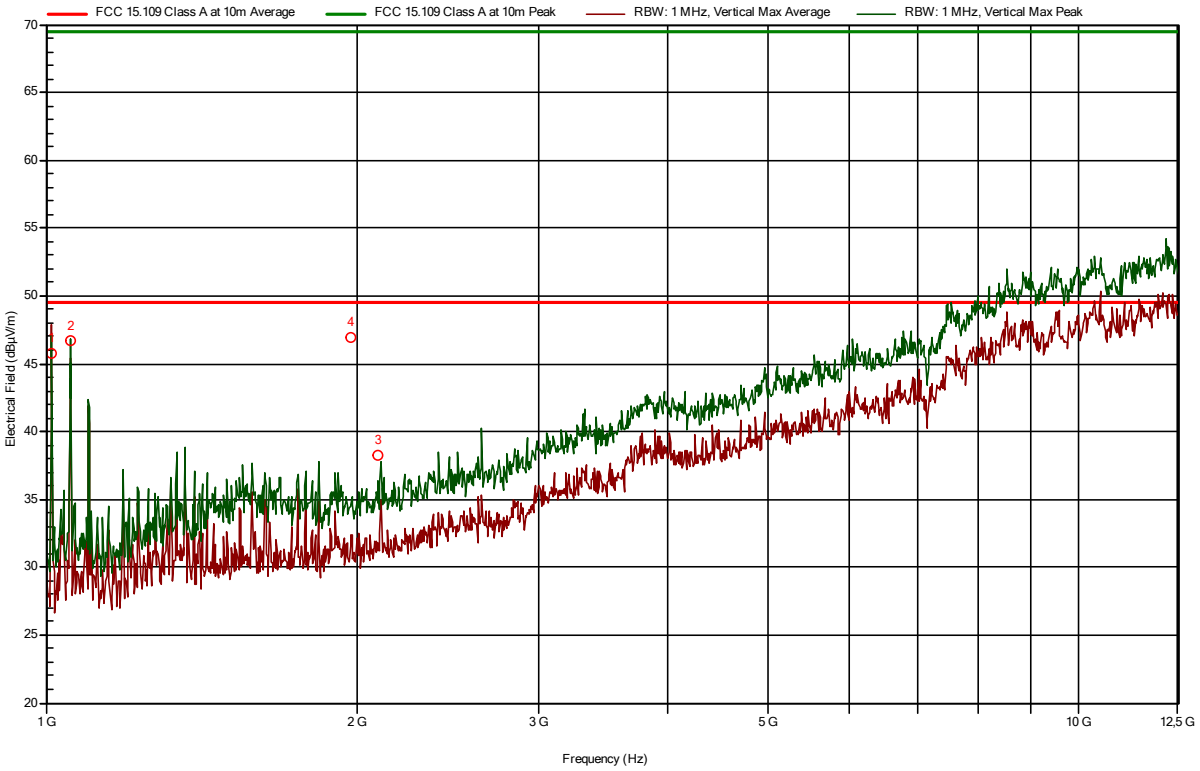
Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown).



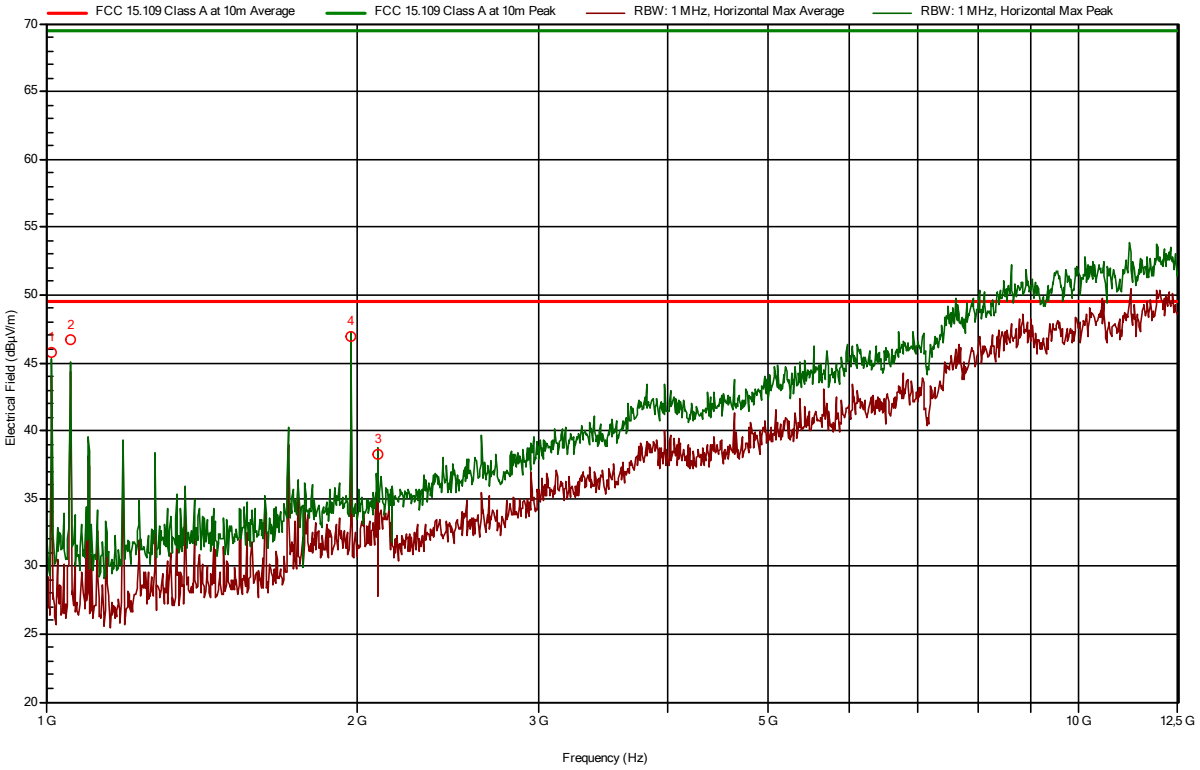
Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz (pre-scan peak values shown).



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



Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1 – 12.5 GHz (pre-scan peak values shown).



Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 12.5 GHz (pre-scan peak values shown).

3.2 AC Power-line conducted emissions

3.2.1 Limit

15.107 (b) For a Class A digital device 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 LISN. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBµV) Quasi-Peak	Conducted Limit (dBµV) Average
0.15 – 0.5	79	66
0.5 - 30	73	60

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.2.3 of this report.

3.2.4 Test procedure

According to ANSI C63.4: 2014, section 13.3

IRN 439 – Method 1

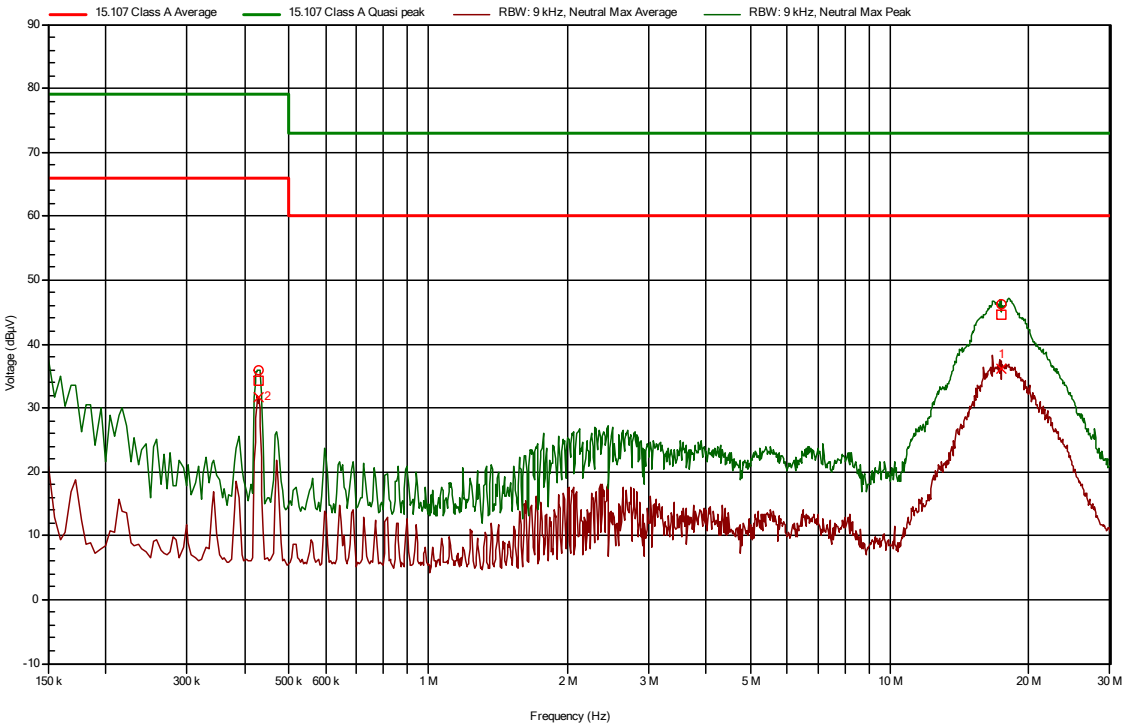
3.2.5 Measurement uncertainty

+/- 3.6 dB

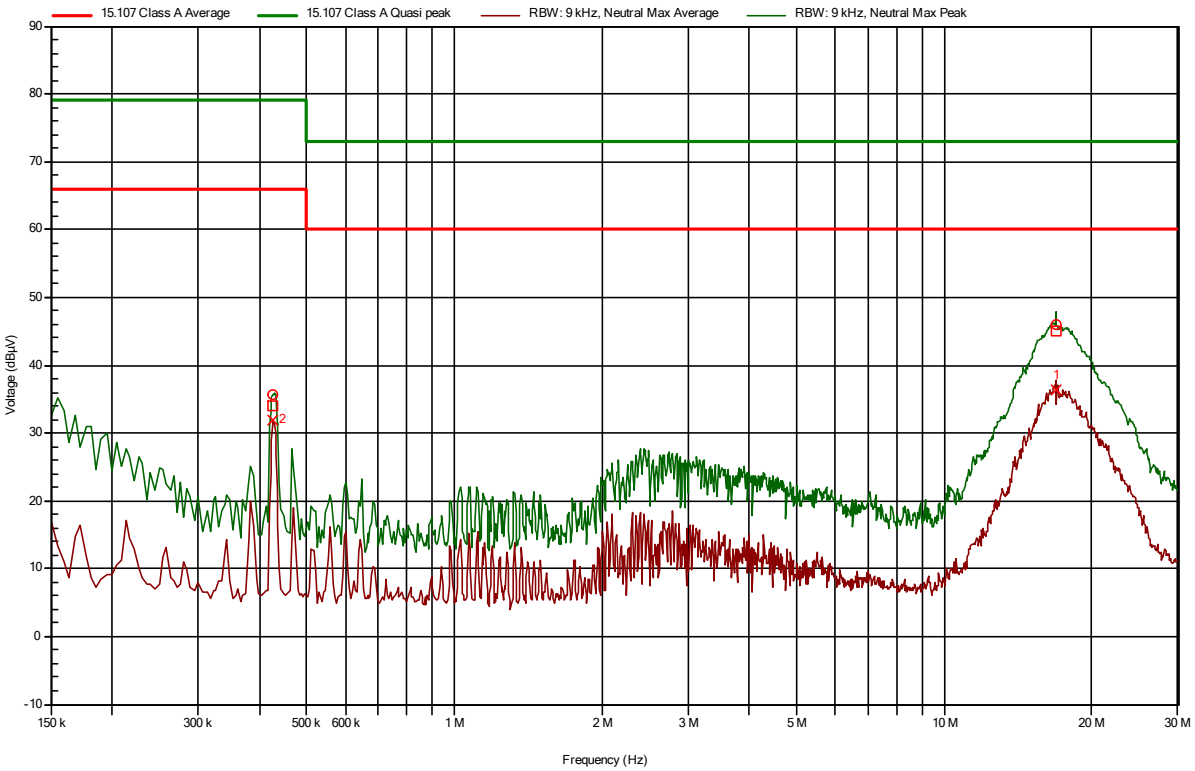
3.2.6 AC Power Line Conducted emission data of the EUT, results

Frequency	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	LISN	Status
16,94 MHz	36,3 dBµV	60 dBµV	45,2 dBµV	73 dBµV	Neutral	Pass
426,75 kHz	32 dBµV	66 dBµV	34 dBµV	79 dBµV	Neutral	Pass
17,381 MHz	36,2 dBµV	60 dBµV	44,5 dBµV	73 dBµV	Line	Pass
428,1 kHz	31,6 dBµV	66 dBµV	34,3 dBµV	79 dBµV	Line	Pass

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**

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

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

5 Photograph test setup

5.1 Photograph test setup Radiated Emissions

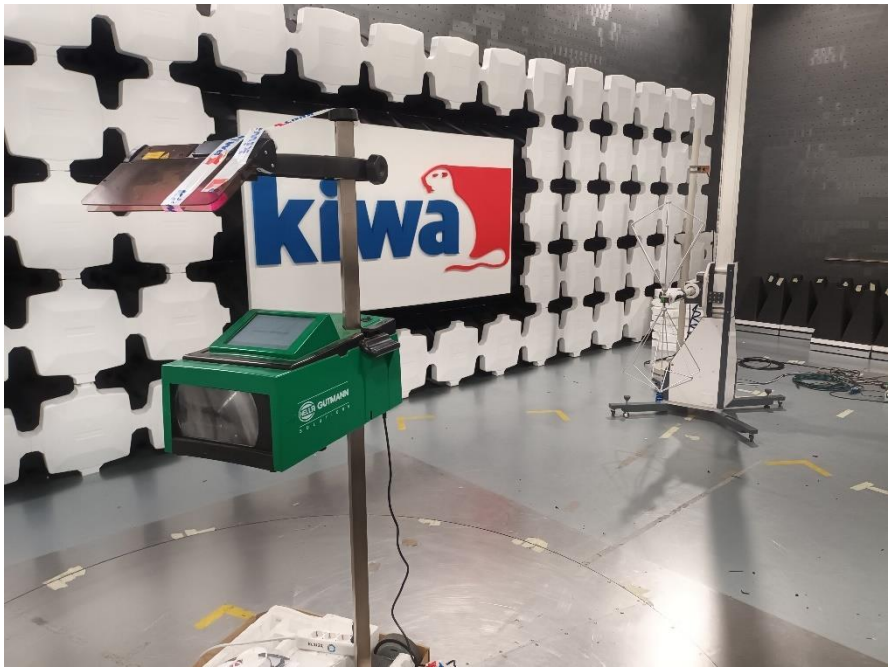


Photo 1 Photograph test setup radiated emissions 30-250 MHz, report section 3.1

Photo 2 Photograph test setup radiated emissions 250-1000 MHz, report section 3.1

Photo 3 Photograph test setup radiated emissions 1-12.5 GHz, report section 3.1

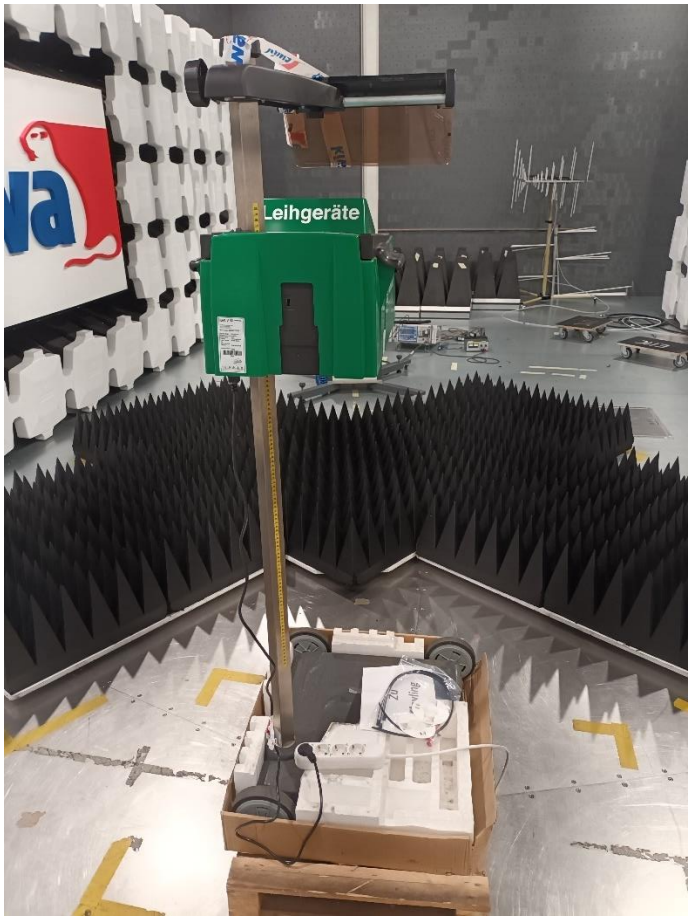


Photo 4 Photograph Cable position

5.2 Photograph test setup, AC Power Line Conducted emissions

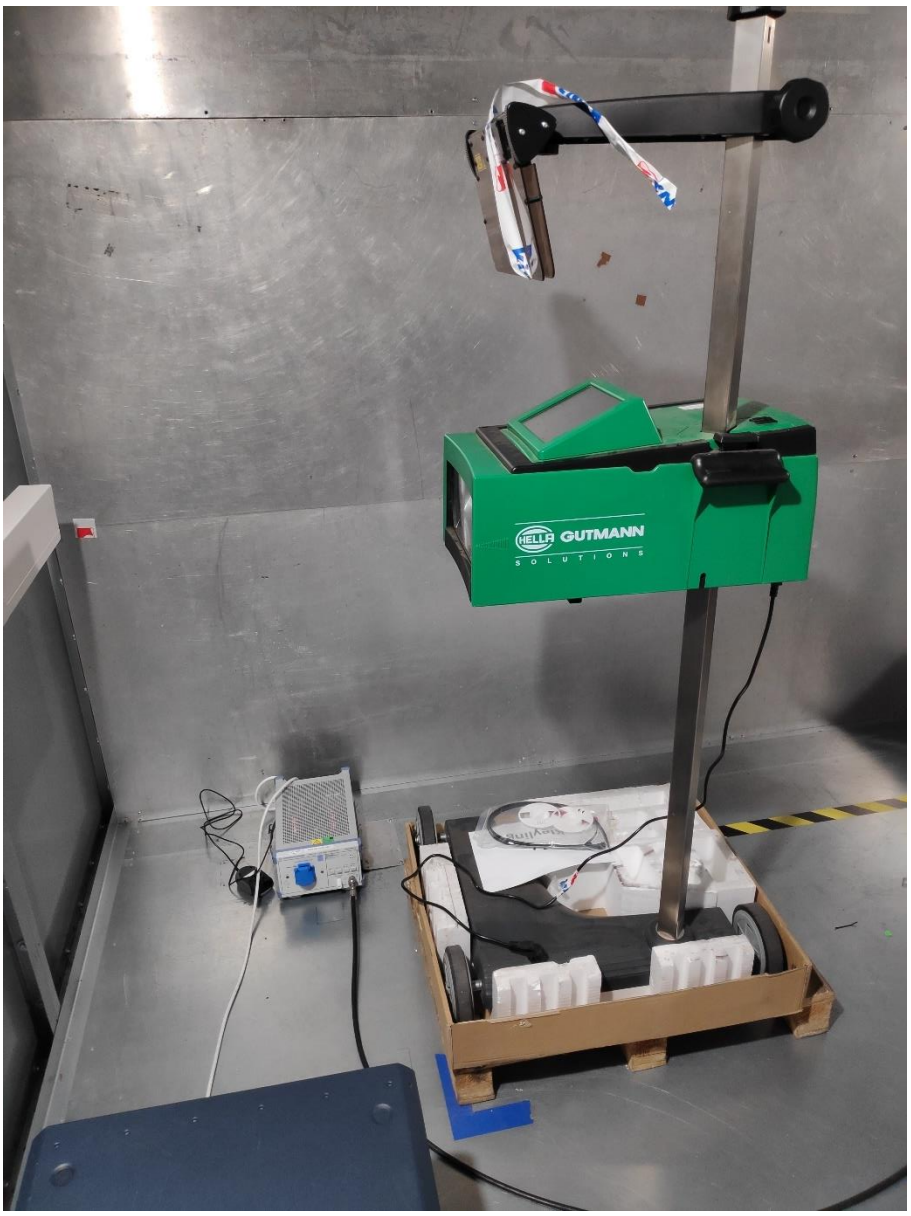


Photo 5: Photographs AC Power Line conducted emission, report section 3.2

<<END OF REPORT>>