Test report for

47 CFR Part 15 Subpart B

ICES-Gen, ICES-003

Test report No. : P000309928 004 Ver 1.0

The RvA is signatory to ILAC - MRA

Product name	: Smart Network Adapter (WLAN / LAN for bicycle trainer)
Applicant	: Tacx bv. (a Garmin Company)
FCC ID	: IPH-0S4443
IC	: 1792A-0S4443

Laboratory information

Accreditation

Kiwa Nederland B.V. complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Kiwa Nederland B.V. is designated by the FCC as an Accredited Test Firm for compliance testing of equipment subject to Certification under Parts 15 & 18. The Designation number is: NL0001.

Kiwa Nederland B.V. is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements.
The Industry Canada company number for Kiwa Nederland B.V. is: 4173A. The CABID is NL0001.

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Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Kiwa Nederland B.V.

Testing Location

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

Revision History

Version	Date	Remarks	By
v0.50	17-08-2023	First draft	PvW
v1.00	10-01-2024	Final release	PvW

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.109 (a)	ICES-003 Table 2	Radiated spurious emissions < 1GHz	3.1	Pass
15.109 (a)	ICES-003 Table 4	Radiated spurious emissions > 1GHz	3.1	Pass
15.107 (c)	ICES-003 Table 1	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:	Tacx bv. (a Garmin Company)
Address:	De Boeg 2, 2343 HK, Oegstgeest, the Netherlands
Telephone:	+31 (0)71 7999292
E-mail:	richard@tacx.nl
Contact name:	Richard Kockelkoren

1.2 Manufacturer

Client name:	Garmin International
Address:	1200 E. 151st, 66062, Olathe, Kansas, USA
Telephone:	(913) 440-1946
E-mail:	Ben.karsak@garmin.com
Contact name:	Mr. Ben Karsak

1.3 Tested Equipment Under Test (EUT)

Product name:	Smart Network Adapter (WLAN / LAN for bicycle trainer)
Brand name:	GARMIN
FCC ID:	IPH-0S4443
IC:	1792A-0S4443
Product type:	LAN/WLAN Accessory
Model(s):	A0S4443
Batch and/or serial No.	P220536V04
Software version:	006-B4443-00
Hardware version:	013-01104-20
Date of receipt:	26-06-2023
Tests started:	05-07-2023
Testing ended:	05-07-2023

Auxiliary items

AUX1

Product name:	300Mbps Wireless N Nano Router
Brand name:	TP-Link
Product type:	Acces point
Model(s):	TL-WR802N
Batch and/or serial No.	22242P8003440
Remarks:	Connects to EUT

AUX2

Product name:	Notebook
Brand name:	DELL
Product type:	Laptop
Model(s):	Latitude 7490
Batch and/or serial No.	9XY13X2
Remarks:	Connects to EUT Ethernet port

AUX3

Product name:	DC supply
Brand name:	Delta Elektronik
Product type:	DC supply
Model(s):	E030-3
Batch and/or serial No.	2494
Remarks:	EUT power supply, property test lab

AUX4

Product name:	Stelvio Trainer
Brand name:	Tacx
Product type:	Trainer
Model(s):	Stelvio
Batch and/or serial No.	Prototype, no SN
Remarks:	Connects to EUT signal and control port, provides power under normal operation. Gateway is intended for use with this trainer.

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:	20/40 MHz
Antenna type:	Meandering Inverted-F PCB antenna
Antenna gain:	-0.3 dBi
Type of modulation:	DSS-CCK, OFDM, MCS0-7

Disclaimer: above info is declared by the applicant

The EUT is considered as a Class B device.

1.5 Environmental conditions

Test date	05-07-2023
Ambient temperature	20.8
Humidity	55.7%

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
- ICES-003 Issue 7
- ICES-Gen Issue 2

1.8 Observation and remarks

The EUT is investigated in the X, Y and Z dimensions for the worst case position. The worst case position is determined to be flat on the test table, as pictured below:

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Kiwa Nederland B.V. accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards".*

All tests are performed by:

Name : P. van Wanrooij, BASc

Review of test methods and report by:

Name : ing. P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 11-01-2024

Name : ing P.A. Suringa

Signature :

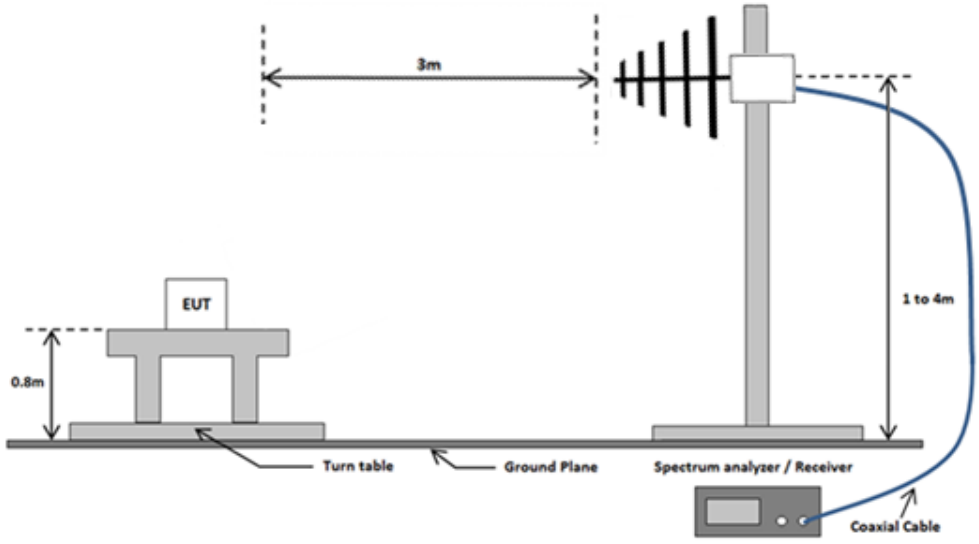
2 Test configuration of the Equipment Under Test

2.1 Test mode

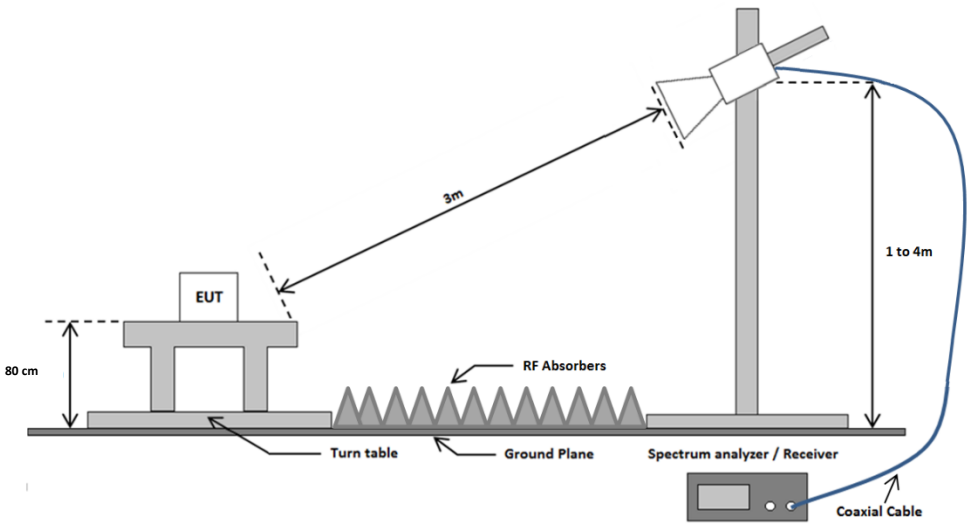
The EUT is tested in normal operating mode, connected to an access point (AP) outside of the test chamber. A loopback test is setup with a laptop connected to the AP in order to keep the ethernet port active. Power is supplied to the EUT from a DC power supply outside of the test chamber.

2.2 Test setups

2.2.1 Radiated emissions test setup 30 MHz - 1 GHz

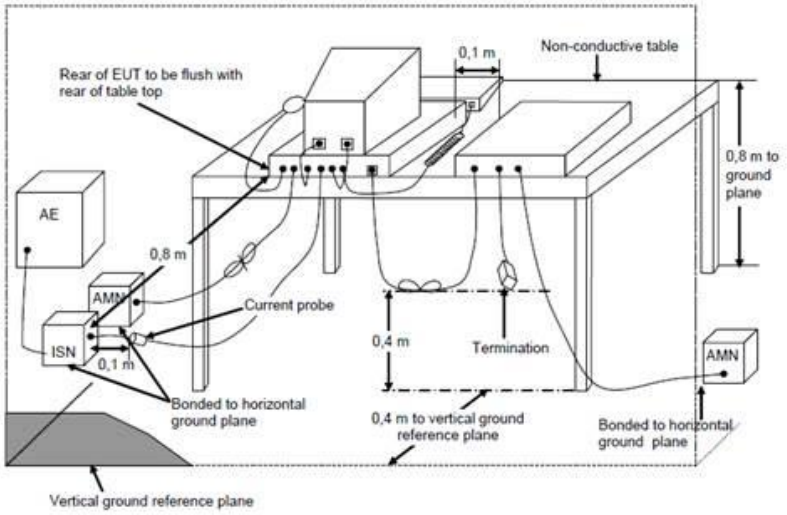


2.2.2 Radiated emissions test setup above 1 GHz



2.2.3 AC Power line conducted emissions test setup

Emissions test at AC mains



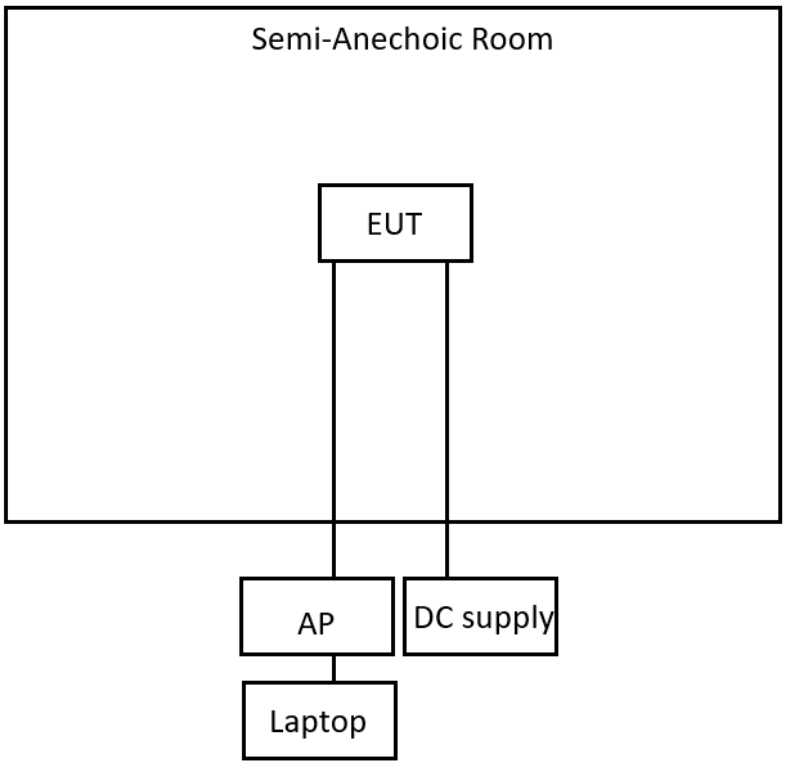


Figure 1. EUT and auxiliary setup

List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	DC power	AUX4	EUT	< 3m	-
2	LAN	AUX1	EUT	< 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.

In order to pass conducted spurious emissions on the unshielded LAN port, the L1 CM choke was removed and pads L5 and L6 were bridged with wires.

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	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	11-2022	11-2023	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
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114690	01-2023	01-2024	3.1
Test software	Raditeq	Radimation Version 2021.1.9	TE 02008	--	--	3.1; 3.2
LISN /Two line V-network	Rohde & Schwarz	ENV 216	114379	07-2021	31-07-2023	3.2

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

Except for Class A digital devices, the field strength of radiated emissions 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.

ICES-003 Issue 7 section 3.2.2
The quasi-peak limits for the electric component of the radiated field strength emitted from ITE or digital apparatus, within 30 MHz to 1 GHz, for a measurement distance of 3m are presented in table below.
At and above 1 GHz, except for outdoor units of home satellite receiving systems, the ITE or digital apparatus shall comply with the limits specified in table below up to the frequency F_M, which shall be determined. 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	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

ICES-003 tables 2, 4

Frequency (MHz)	Field strength (µV/meter)	Field strength (dBµV/m)	Measurement distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-230	200	46.0	3
230 -960	224	47.0	3
Above 960	500	54.0	3

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
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 30MHz to the highest measurement frequency according to the table below. Final radiated emission measurements were made at 3m distance.

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
18 – 26.5 GHz	Horizontal	±4.9 dB
	Vertical	±4.9 dB

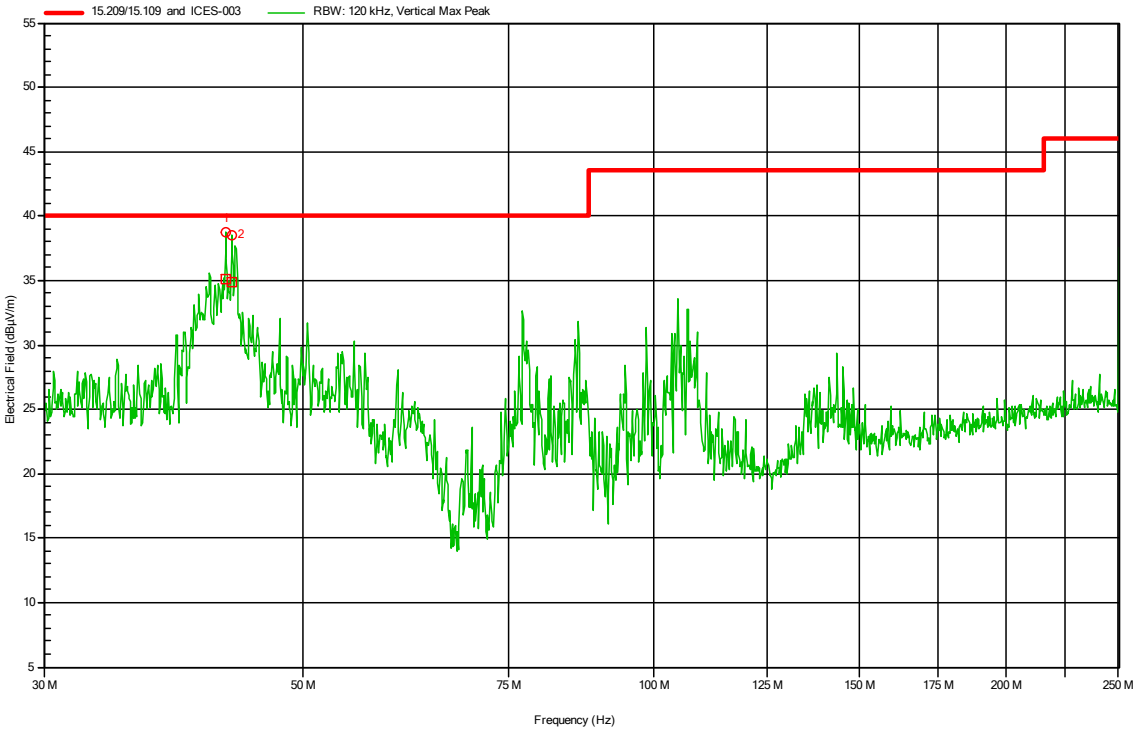
3.1.6 Test results

Frequency	Quasi-Peak	Quasi-Peak Limit	Angle	Height	Polarization	Status
42,921 MHz	35,1 dBµV/m	40 dBµV/m	357 degrees	1 m	Vertical	Pass
43,496 MHz	34,8 dBµV/m	40 dBµV/m	358 degrees	1 m	Vertical	Pass
500,034 MHz	45,1 dBµV/m	46 dBµV/m	336 degrees	1,7 m	Horizontal	Pass
375,017 MHz	33,1 dBµV/m	46 dBµV/m	4 degrees	1 m	Horizontal	Pass
875,055 MHz	38,1 dBµV/m	46 dBµV/m	337 degrees	1,5 m	Horizontal	Pass
625,04 MHz	38,9 dBµV/m	46 dBµV/m	9 degrees	1,3 m	Horizontal	Pass

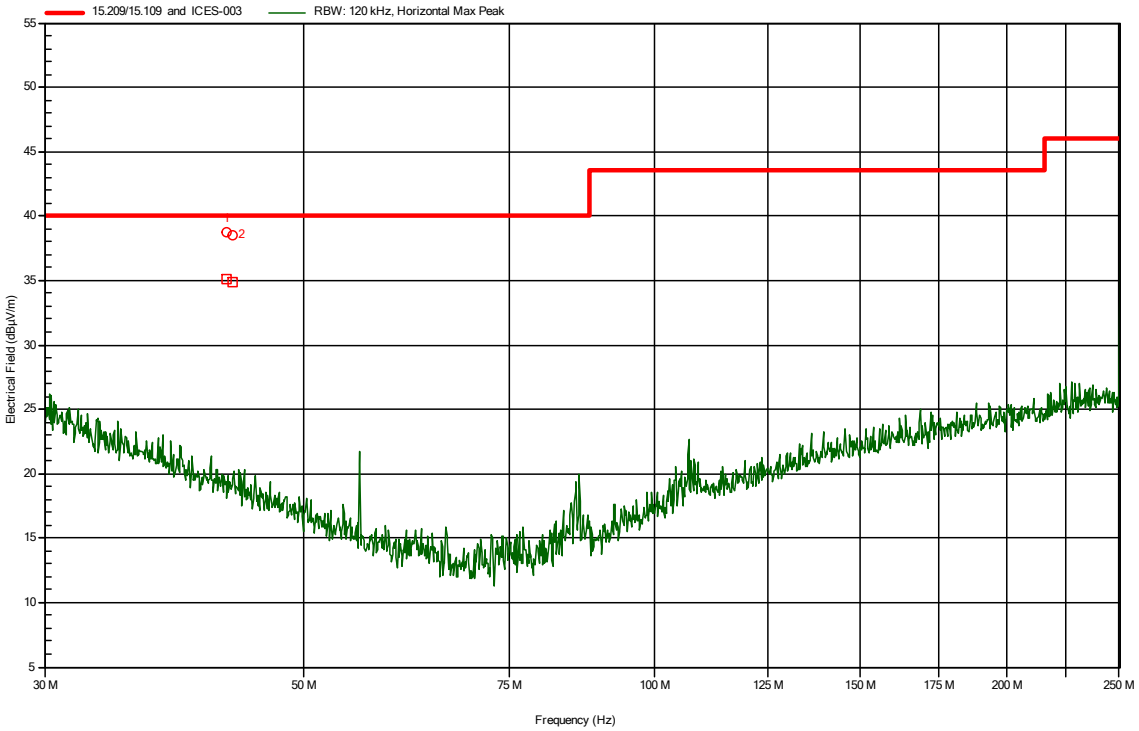
Frequency	Average	Average Limit	Peak	Peak Limit	Angle	Height	Polarization	Status
1,955 GHz	38,3 dBµV/m	54 dBµV/m	42,8 dBµV/m	74 dBµV/m	223 degrees	1,5 m	Horizontal	Pass

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

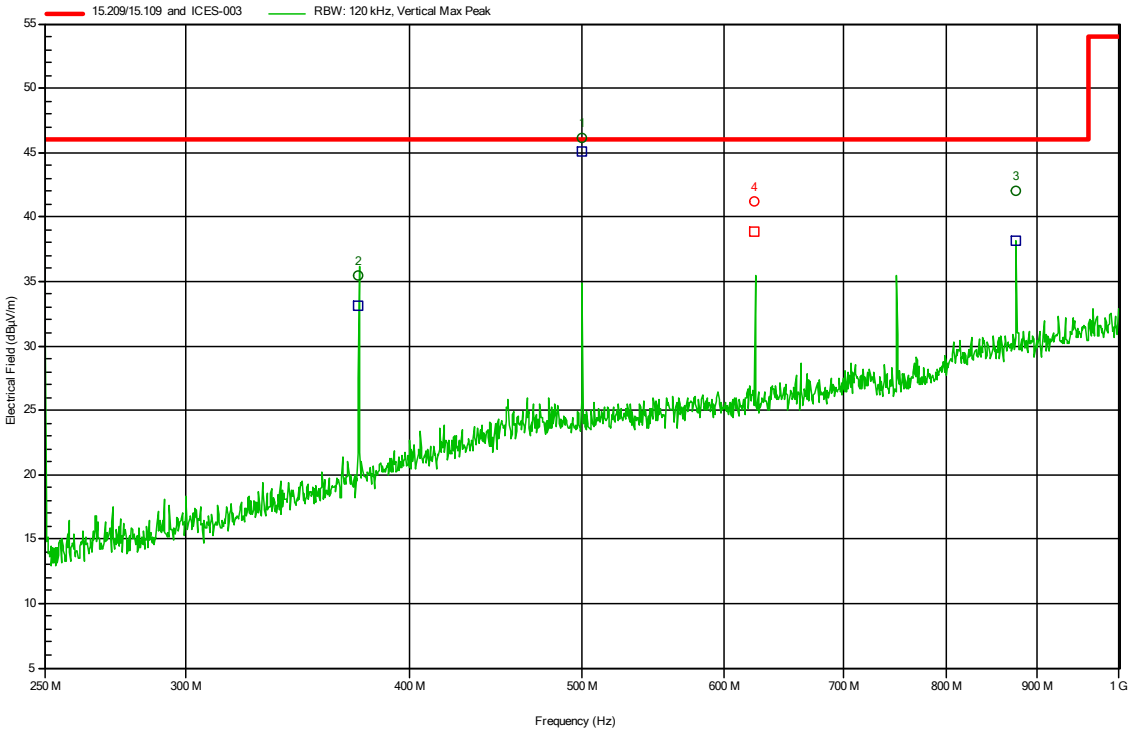
3.1.7 Plots of the Radiated Spurious Emissions Measurement



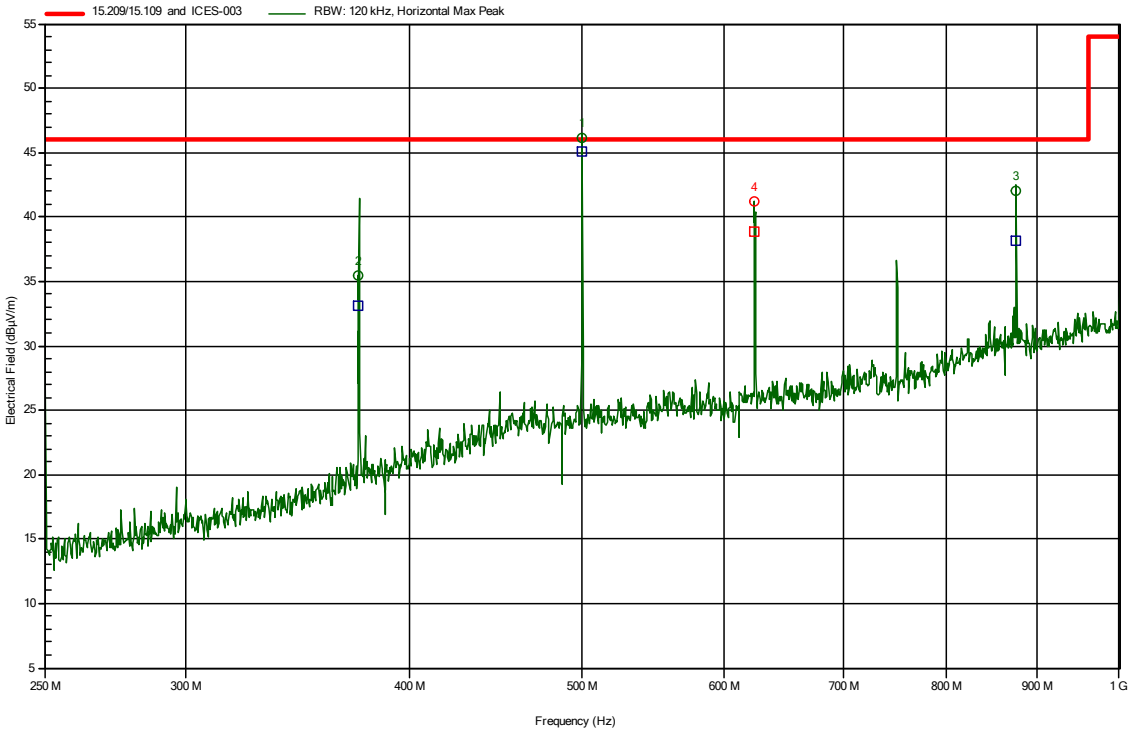
Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)



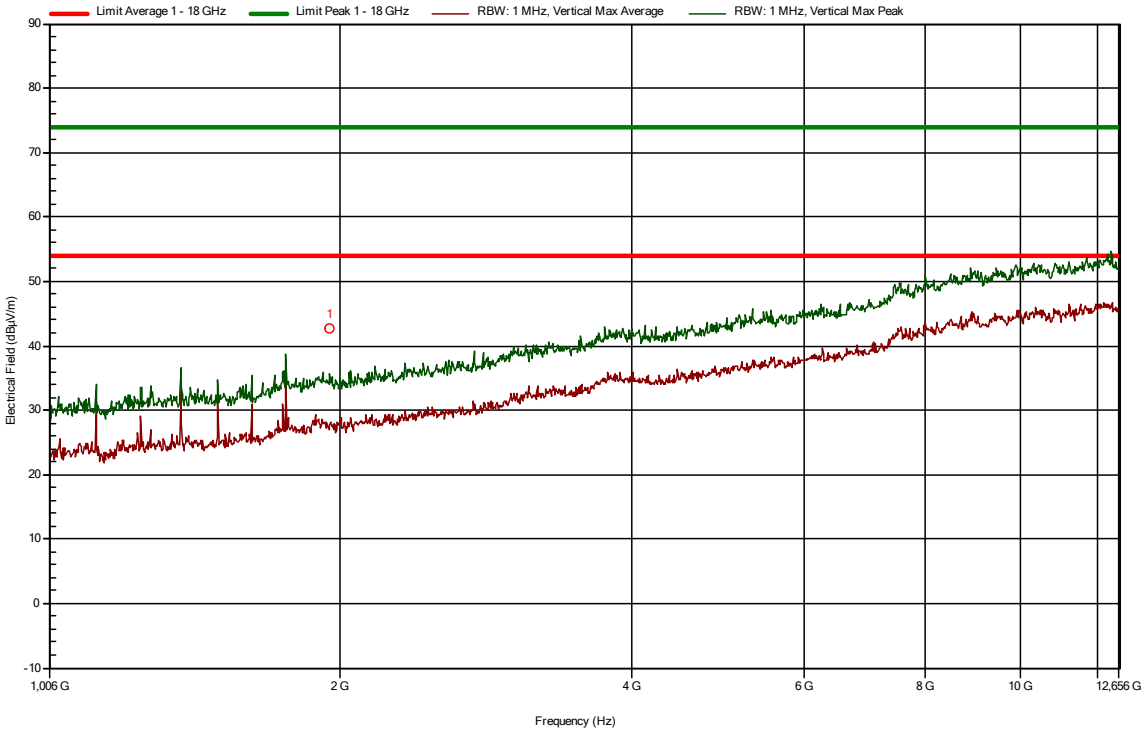
Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)



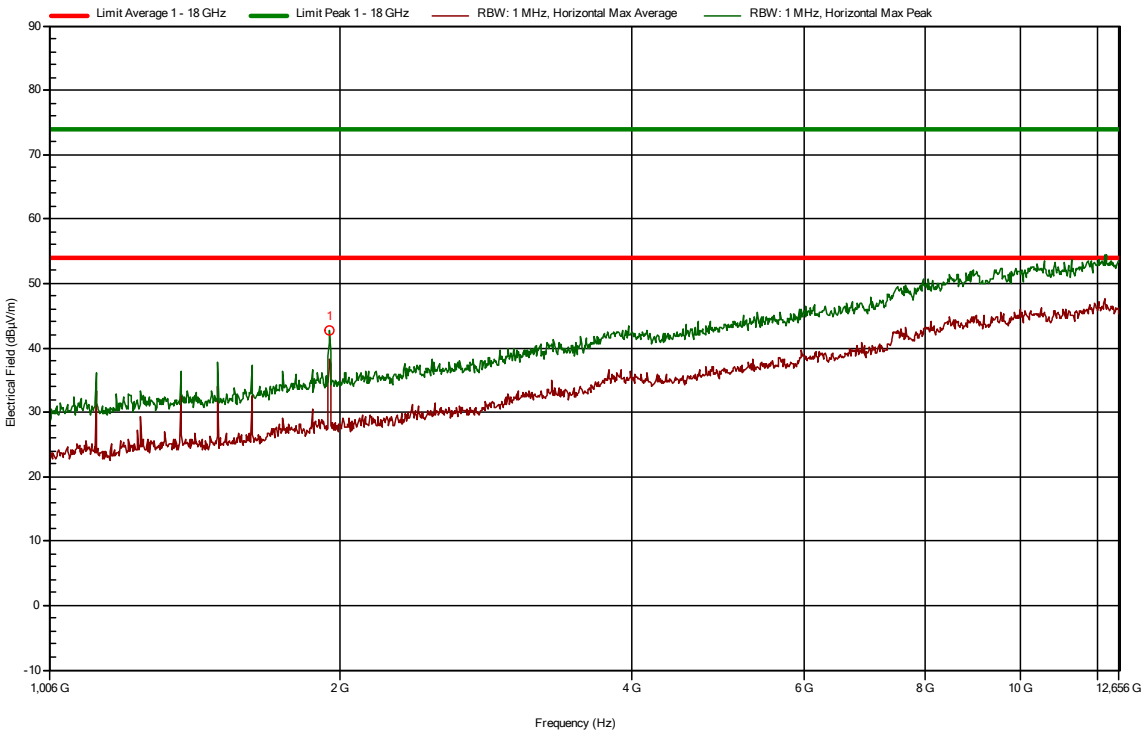
Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz
(pre-scan peak values shown)



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 (peak and average values shown)



Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1-12.5 GHz (peak and average values shown)

3.2 AC Power-line conducted emissions

3.2.1 Limit

§ 15.107 (a)
Except for Class A digital devices, for equipment 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).

ICES-003 Issue 7 section 3.2.1

The ITE or digital apparatus shall comply with the conducted emission limits specified in table below at its AC mains power terminals. The product under test shall comply with both the quasi-peak and the average limits.

Where the product under test is powered through an external device (for example, through an external power supply, or by means of a device providing power over Ethernet to the product under test), the conducted emission limits apply at the AC mains power terminals of the external device, while this is powering the product under test: see ICES-Gen.

Frequency of Emission (MHz)	Conducted Limit (dBµV) Quasi-Peak	Conducted Limit (dBµV) Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	46	50

*Decreases with the logarithm of the frequency.

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
Measurements performed on the AC side of AUX4

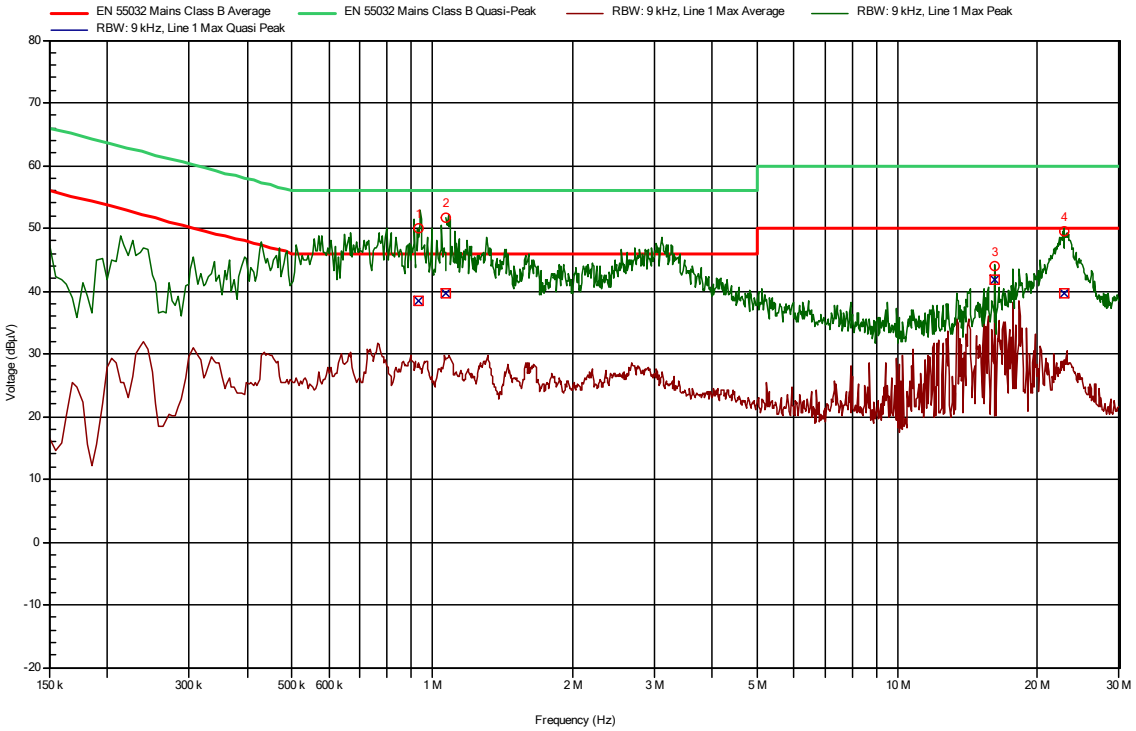
3.2.5 Measurement uncertainty

+/- 3.6 dB

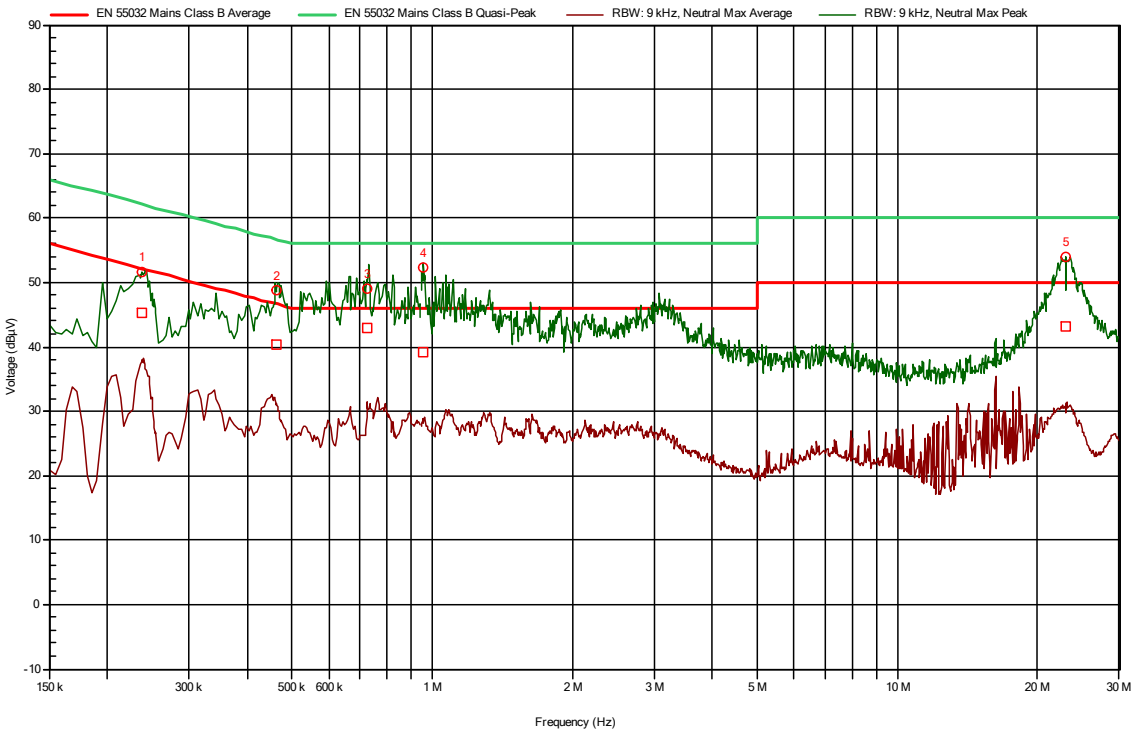
3.2.6 AC Power Line Conducted emission data of the EUT, results

Frequency	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	LISN	Status
932,1 kHz	28,3 dBµV	46 dBµV	38,4 dBµV	56 dBµV	Line 1	Pass
1,072 MHz	29,3 dBµV	46 dBµV	39,6 dBµV	56 dBµV	Line 1	Pass
16,228 MHz	40,8 dBµV	50 dBµV	41,8 dBµV	60 dBµV	Line 1	Pass
22,772 MHz	27,6 dBµV	50 dBµV	39,6 dBµV	60 dBµV	Line 1	Pass
726,9 kHz	31,5 dBµV	46 dBµV	43 dBµV	56 dBµV	Pass	Neutral
958,2 kHz	28,7 dBµV	46 dBµV	39,2 dBµV	56 dBµV	Pass	Neutral
463,2 kHz	31,2 dBµV	46,6 dBµV	40,3 dBµV	56,6 dBµV	Pass	Neutral
23,019 MHz	30,2 dBµV	50 dBµV	43,2 dBµV	60 dBµV	Pass	Neutral
238,2 kHz	38 dBµV	52,2 dBµV	45,3 dBµV	62,2 dBµV	Pass	Neutral

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)**	**Cable loss (dB)**	**Corr. (dB)**
	114379 SN: 230000813 Rohde & Schwarz ENV 216	**TE 11134**	
0,15	9.7	0.02	9.72
0,2	9.68	0.03	9.71
0,3	9.68	0.03	9.71
0,5	9.69	0.08	9.77
0,7	9.69	0.25	9.94
0,8	9.69	0.25	9.94
1	9.68	0.11	9.79
2	9.7	0.15	9.85
3	9.71	0.21	9.92
5	9.72	0.21	9.93
7	9.76	0.25	10.01
8	9.77	0.25	10.02
10	9.77	0.29	10.06
15	9.84	0.34	10.18
20	9.88	0.37	10.25
25	9.97	0.43	10.4
30	10.08	0.45	10.53

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: 114436** **VHA 9103 + BBA 9106** **SN: 9856**	**Cable loss (dB)** **Id: SAR cable**	**Corr. (dB)**
30	18.6	0.68	19.28
100	10.4	1.15	11.55
150	14.8	1.41	16.21
200	16.0	1.63	17.63
250	16.9	1.93	18.83

Frequency (MHz)	**Gain (dBi)** **ID: 114385** **EMCO LPDA** **SN: 9856**	**Cable loss (dB)** **Id: SAR cable**	**Corr. (dB)**
250	11.8	1.93	13.73
300	13	2.12	15.12
350	15.6	2.2	17.8
400	17.1	2.29	19.39
450	17.3	2.53	19.83
500	17.7	2.67	20.37
550	18.4	2.9	21.3
600	19.2	3.02	22.22
650	19.7	3.09	22.79
700	20.3	3.22	23.52
750	21.4	3.56	24.96
800	22	3.69	25.69
900	22.1	3.81	25.91
950	22.6	3.91	26.51
1000	22.5	4.3	26.8

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

5.2 Photograph test setup, AC Power Line Conducted emissions

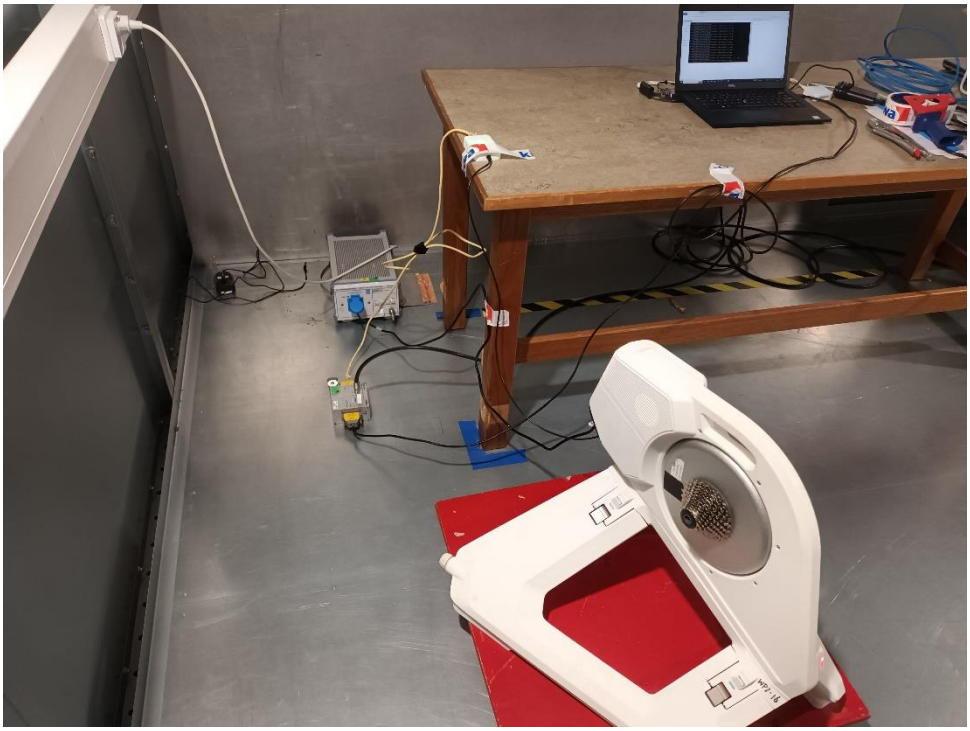


Photo 4: Photographs AC Power Line conducted emission, report section 3.2

<<END OF REPORT>>