Test report for

47 CFR Part 15 Subpart B, ICES-003

Test report No. : P000319246 006 Ver 1.00

The RvA is signatory to ILAC - MRA

Product name : Treon Gateway 2

Applicant : Treon

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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Documentation

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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	07-03-2024	First draft	PS
v1.00	27-03-2024	Final release	PS

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.109 (a)	ICES-003 Tables 2, 4	Radiated spurious emissions	3.1	Pass
15.107 (a)	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:	Treon Oy
Address:	Visiokatu 3
Zip code:	33720, Tampere FINLAND
Telephone:	+358505507331
E-mail:	certification@treon.fi
Contact name:	Janne Julkunen

1.2 Manufacturer

Manufacturer name:	Treon Oy
Address:	Visiokatu 3
Zip code:	33720, Tampere FINLAND
Telephone:	+358505507331
E-mail:	certification@treon.fi
Contact name:	Janne Julkunen

1.3 Tested Equipment Under Test (EUT)

Product name:	Treon Gateway 2
Brand name:	Treon
Model or type:	Model 1211,variant WP
Product description:	Wireless IoT Gateway
Variant model(s):	Model 1211, Variant BT
Batch and/or serial No.	--
Software version:	V7
Hardware version:	B5.1
Date of receipt	26-06-2023
Tests started:	11-09-2023
Testing ended:	29-01-2024

Auxiliary items

AUX1

Product name:	Power supply 5 V DC
Brand name:	Globtek
Product type:	AC/DC adapter
Model(s):	GTM-96180-1807-20
Batch and/or serial No.	--
Remarks:	Connects to EUT

AUX2

Product name:	Notebook
Brand name:	HP
Product type:	PC
Model(s):	ProBook
Batch and/or serial No.	--
Remarks:	Connects to EUT Ethernet port, property test lab

1.4 Product specifications of Equipment under test

Wi-Fi	
Tx Frequency:	2.412GHz - 2.462 GHz
Rx frequency:	2.412GHz - 2.462 GHz
Antenna type:	Ceramic chip antenna
Antenna gain:	1.05dBi
Type of modulation:	DSSS
Emission designator:	10M0G7D

BLE	
Tx Frequency:	2.402GHz - 2.480 GHz
Rx frequency:	2.402GHz - 2.480 GHz
Antenna type:	Inverted-F antenna on PCB
Antenna gain:	1.59dBi
Type of modulation:	GFSK
Emission designator	1M00G1D

LTE-M	
Bands 2, 4, 5, 12, 13	1850 - 1910 MHz; 1710 – 1755 MHz; 824 – 849 MHz; 699 – 716 MHz; 777 – 787 MHz
Antenna type:	Monopole antenna
Antenna gain:	2dBi
Type of modulation:	QPSK, QAM
Emission designator	20M0W7D

1.5 Environmental conditions

Test date	28-11-2023	18-10-2023
Ambient temperature	18.8°C	21.3°C
Humidity	33.1%	36.3%

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:

- 47 CFR FCC Part 15 Subpart B
- ICES-003 Issue 7

1.8 Observation and remarks

The EUT is considered as a Class B device.

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".*

Tests are performed by:

Name : I. Cezário, MSc (section 3.2 only)
Name : ing P.A. Suringa (other sections)

Review of test methods and report by:

Name : dr.ir. G. Geers

The above conclusions have been verified by the following signatory:

Date : 10-04-2024

Name : P. van Wanrooij

Function : Test Engineer

Signature :

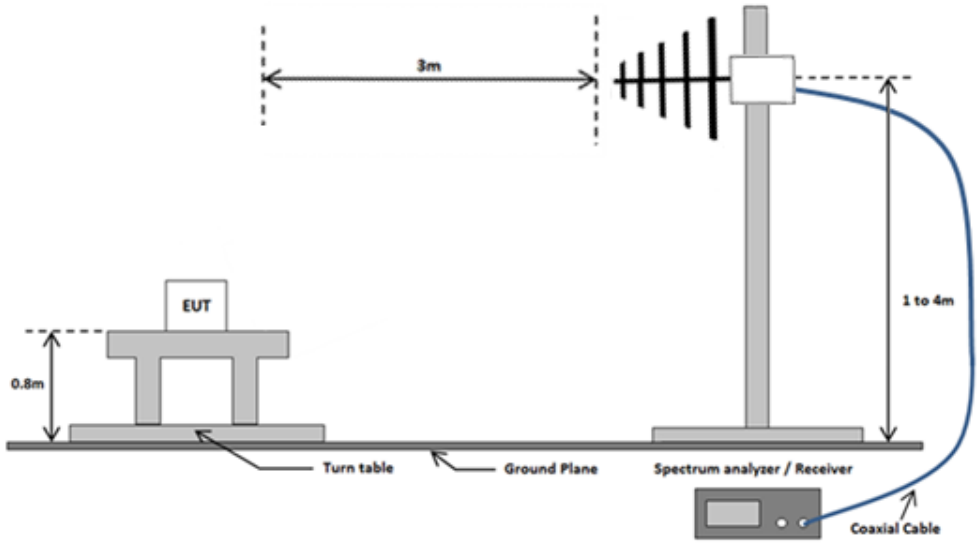
2 Test configuration of the Equipment Under Test

2.1 Test mode

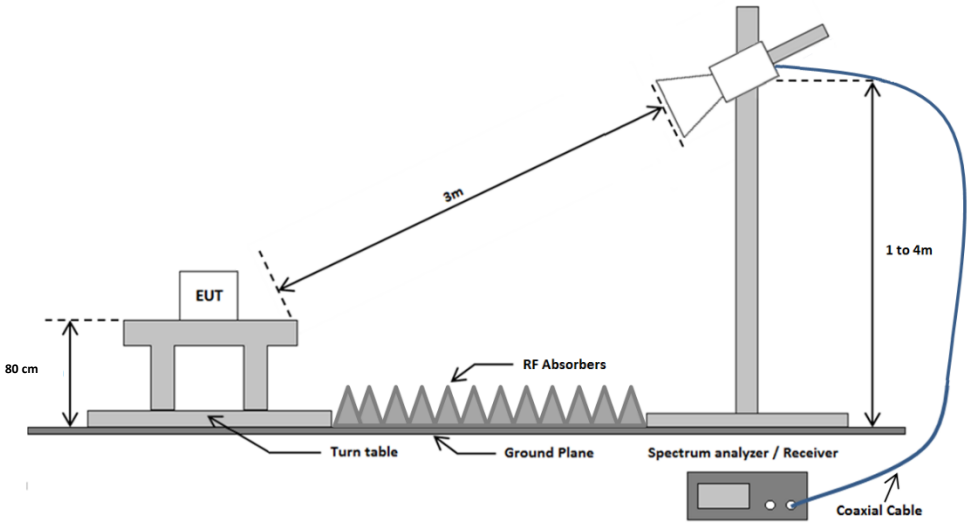
The radios of the EUT are in idle mode (stand by mode) during the tests.
Connection to a notebook computer outside the test premises was established by Ethernet.

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

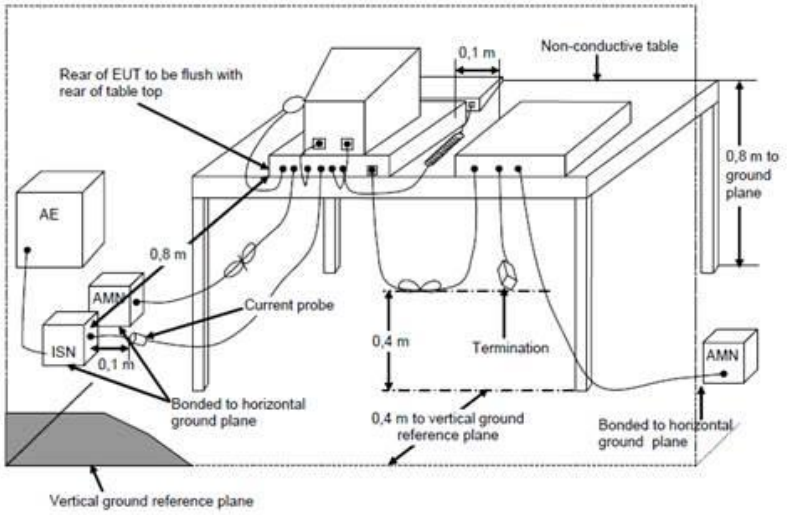


Figure 1. EUT setup

List of used cables					
Number	**Function**	**From**	**To**	**Length**	**Remarks**
1	AC Power	mains 120Vac 60 Hz	EUT	< 3m	-includes AC/DC adapter
2	Ethernet	EUT	Notebook	< 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	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	10-2023	10-2024	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
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114690	01-2023	01-2024	3.1
Test software	Raditeq	Radimation Version 2023.2.3	TE 02008	--	--	3.1, 3.2
LISN /Two line V-network	Rohde & Schwarz	ENV 216	114379	11-2023	11-2026	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.

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
960 - 1000	500	54.0	3

Frequency range (GHz) [i]	Class A [ii, iii, iv] Average dB(µV/m)	Class A [ii, iii, iv] Peak dB(µV/m)	Class B [ii, iii, iv] Average dB(µV/m)	Class B [ii, iii, iv] Peak dB(µV/m)
1 – F_M	60	80	54	74

i. The highest measurement frequency, F_M, in GHz, shall be determined as per table 3.

ii. The measurement bandwidth shall be 1 MHz or greater.

iii. These limit levels apply for a measurement distance of 3 m. If using a different measurement distance, the measured levels shall be extrapolated to the 3 m limit distance using a factor of 20 dB per decade of distance. The measurement distance shall place the measurement antenna in the far field of the ITE or digital apparatus under test.

iv. The test site shall have been validated at the distance used for radiated emission measurements on the ITE or digital apparatus under test.

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.

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
	Vertical	±4.9 dB

3.1.6 Test results

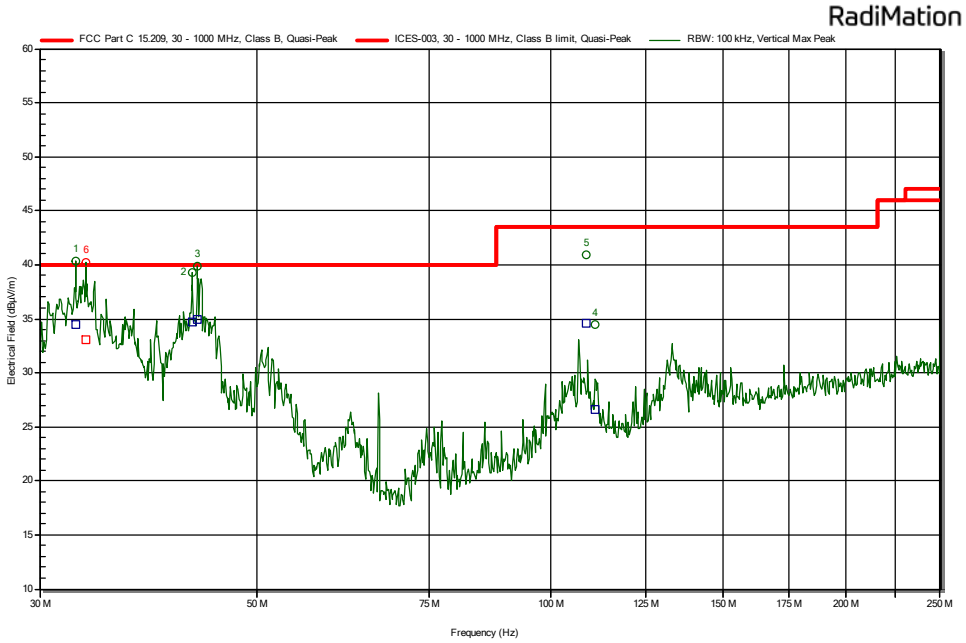
30 – 250 MHz

Peak Number	Frequency	Peak	Quasi-Peak	Quasi-Peak Limit
2	42.94 MHz	39.3 dBµV/m	34.7 dBµV/m	40 dBµV/m
3	43.489 MHz	39.8 dBµV/m	35 dBµV/m	40 dBµV/m
6	33.478 MHz	40.2 dBµV/m	33.1 dBµV/m	40 dBµV/m
4	110.766 MHz	34.5 dBµV/m	26.7 dBµV/m	43.5 dBµV/m
5	108.786 MHz	41 dBµV/m	34.6 dBµV/m	43.5 dBµV/m
1	32.622 MHz	40.3 dBµV/m	34.4 dBµV/m	40 dBµV/m

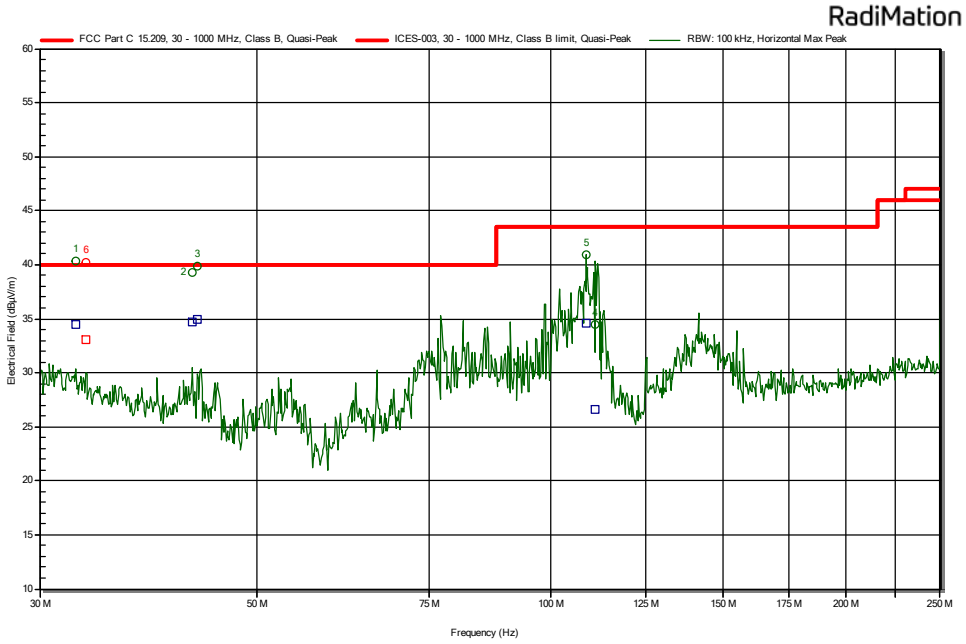
The results of the radiated emission tests are depicted in the table above. A selection of plots is provided on the next pages

3.1.7 Plots of the Radiated Spurious Emissions Measurement

30 – 250 MHz

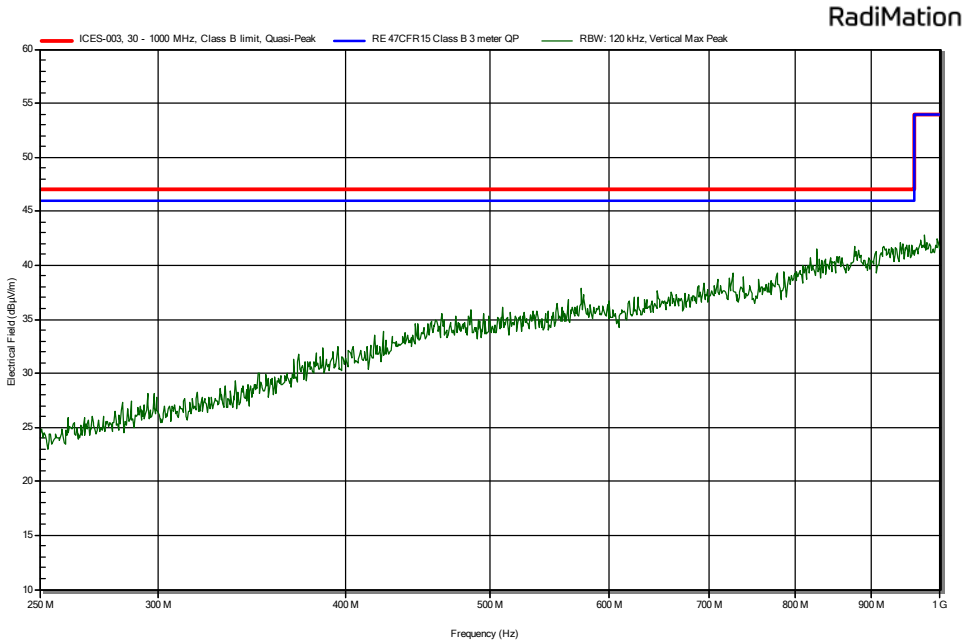


Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz (pre-scan peak values shown)

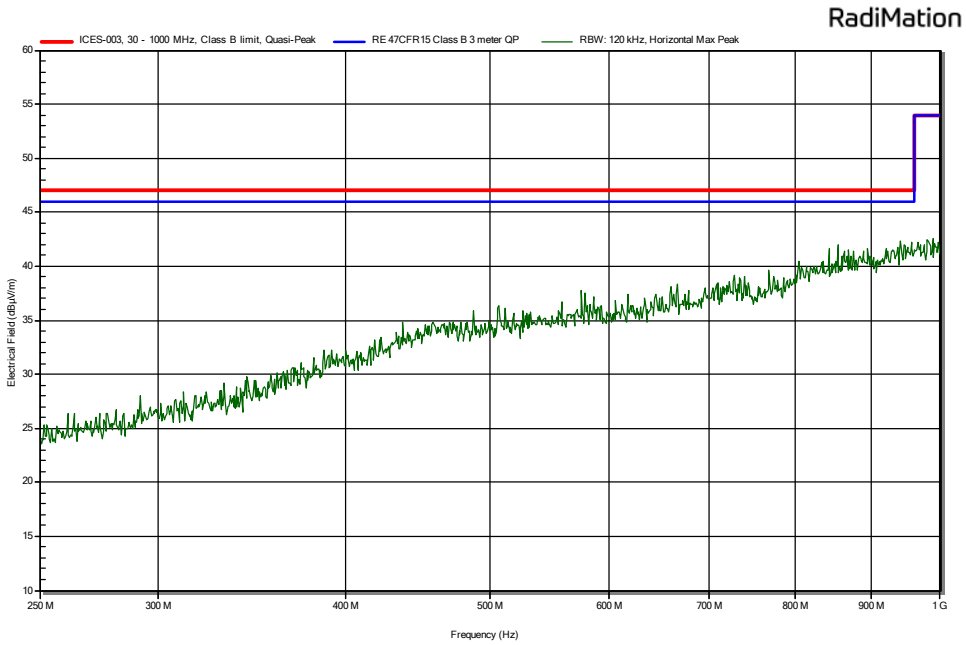


Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz (pre-scan peak values shown)

0.25 – 1 GHz

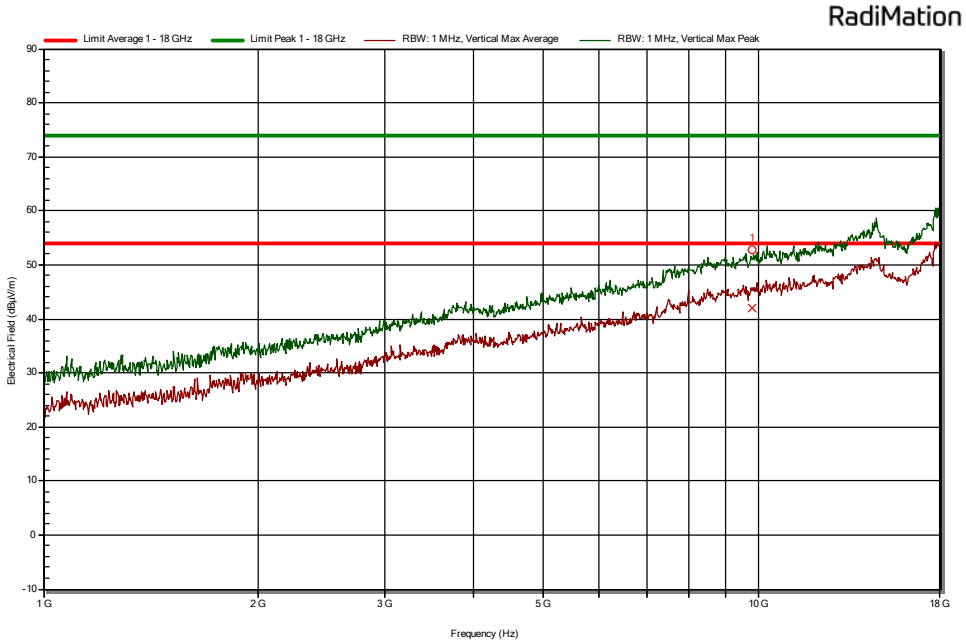


Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz (pre-scan peak values shown)

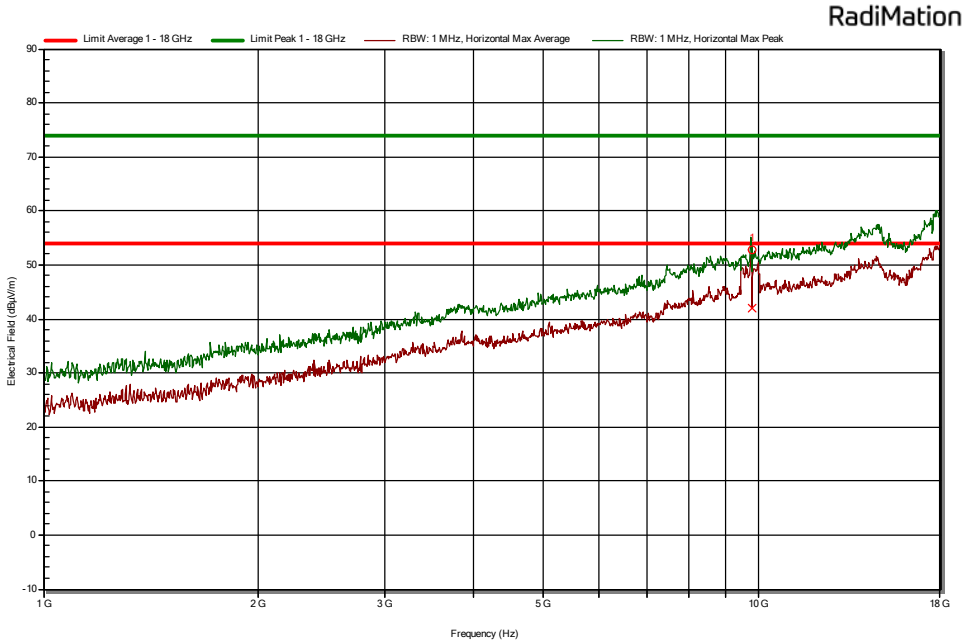


Plot 2b: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz (pre-scan peak values shown)

1 – 18 GHz



Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1-18 GHz (peak and average values shown)



Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1-18 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

3.2.5 Measurement uncertainty

+/- 3.6 dB

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

See next page.

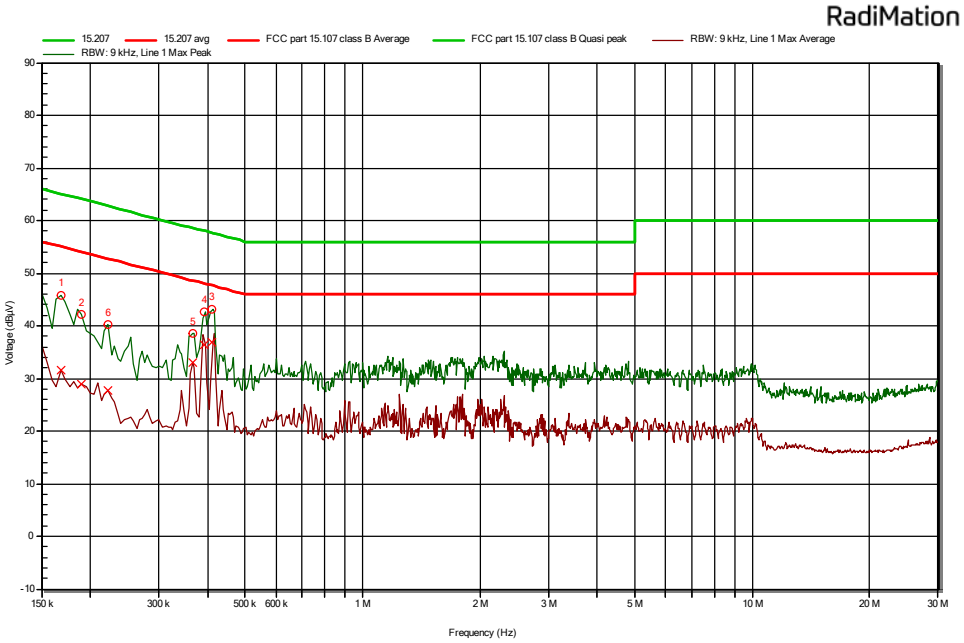
Neutral

Peak Number	Frequency	Peak	Average Limit
6	177 kHz	42.3 dBµV	54.6 dBµV
5	343.5 kHz	36.2 dBµV	49.1 dBµV
4	438 kHz	37 dBµV	47.1 dBµV
3	366 kHz	39.7 dBµV	48.6 dBµV
1	411 kHz	43.1 dBµV	47.6 dBµV
2	393 kHz	42.7 dBµV	48 dBµV

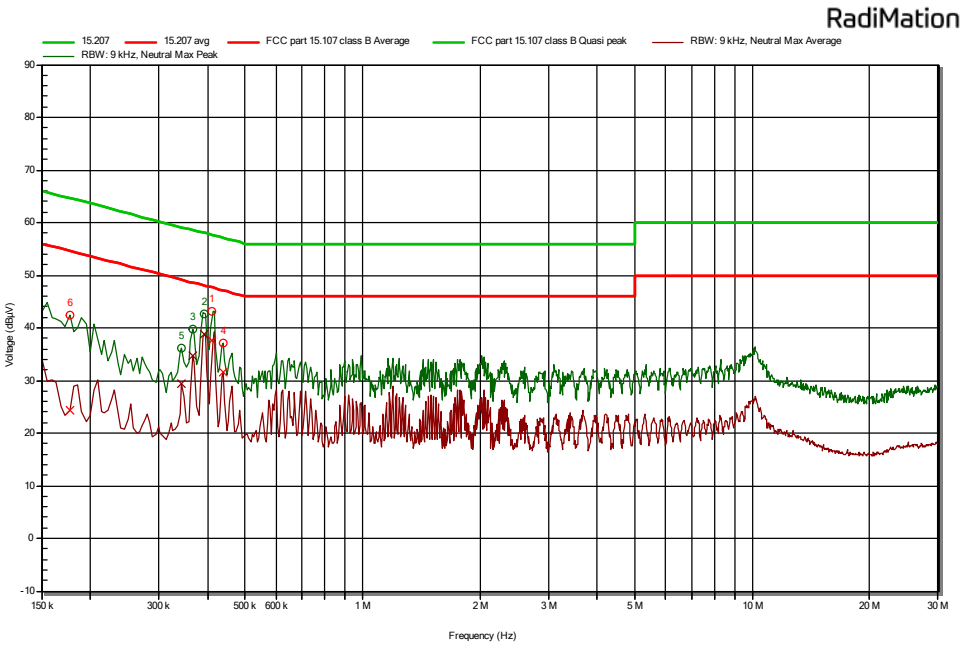
Line

Peak Number	Frequency	Peak	Average Limit
6	222 kHz	40.2 dBµV	52.7 dBµV
2	190.5 kHz	42.3 dBµV	54 dBµV
1	168 kHz	45.8 dBµV	55.1 dBµV
5	366 kHz	38.4 dBµV	48.6 dBµV
4	393 kHz	42.7 dBµV	48 dBµV
3	411 kHz	43 dBµV	47.6 dBµV

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) + CL (dB) – G (dB)

E (dBµV/m) = U(dBµV) + Corr (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss
G = pre-amplifier gain

Corr. = sum of single correction factors of used cable, antenna factor 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)**	**Cable loss (dB)**	**Corr. (dB)**
	ID: 114436 VHA 9103 + BBA 9106 SN: 9856	**Id: SAR cable**	
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)**	**Cable loss (dB)**	**Corr. (dB)**
	ID: 114385 EMCO LPDA SN: 9856	**Id: SAR cable**	
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)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	Kiwa ID: 114607 Emco 3115 SN: 9412-4377	Kiwa ID: 114771 µComp MCNA-40-001080	114691	
1000	23,6	40,4	2,0	-14.8
1500	25,1	40,5	2,4	-13.0
2000	27,1	40,5	2,7	-10.7
2500	28,6	40,7	3,2	-8.9
3000	30,5	40,7	3,2	-7.0
3500	31,2	40,7	3,4	-6.1
4000	32,7	40,9	4,9	-3.3
4500	32,4	40,9	4,4	-3.9
5000	33,2	40,7	4,6	-2.9
5500	34,0	40,5	4,5	-2.0
6000	34,6	40,0	5,2	-0.2
6500	34,3	39,4	5,9	-0.8
7000	35,2	38,6	5,7	2.3
7500	36,4	39,2	5,9	3.1
8000	37,0	38,9	6,3	4.4
8500	37,5	38,4	6,4	5.5
9000	38,1	37,4	6,5	7.2
9500	37,8	37,0	7,1	7.9
10000	38,2	36,5	7,3	9.0
10500	38,1	36,7	7,6	9.0
11000	38,3	36,9	8,3	9.7
11500	38,5	37,6	8,1	9.0
12000	39,1	38,3	8,4	9.2
12500	38,7	38,5	8,3	8.5
13000	39,2	38,9	9,2	9.5
13500	40,5	40,2	8,3	8.6
14000	41,1	40,0	8,2	9.3
14500	41,4	40,1	8,2	9.5
15000	40,2	41,4	8,3	7.1
15500	37,9	41,4	8,6	5.1
16000	37,5	42,8	9,2	3.9
16500	38,6	42,3	8,8	5.1
17000	41,1	43,1	9,4	7.4
17500	42,7	43,2	9,4	8.9
18000	44,0	44,2	9,8	9.6

5 Photograph test setup

5.1 Photograph test setup Radiated Emissions

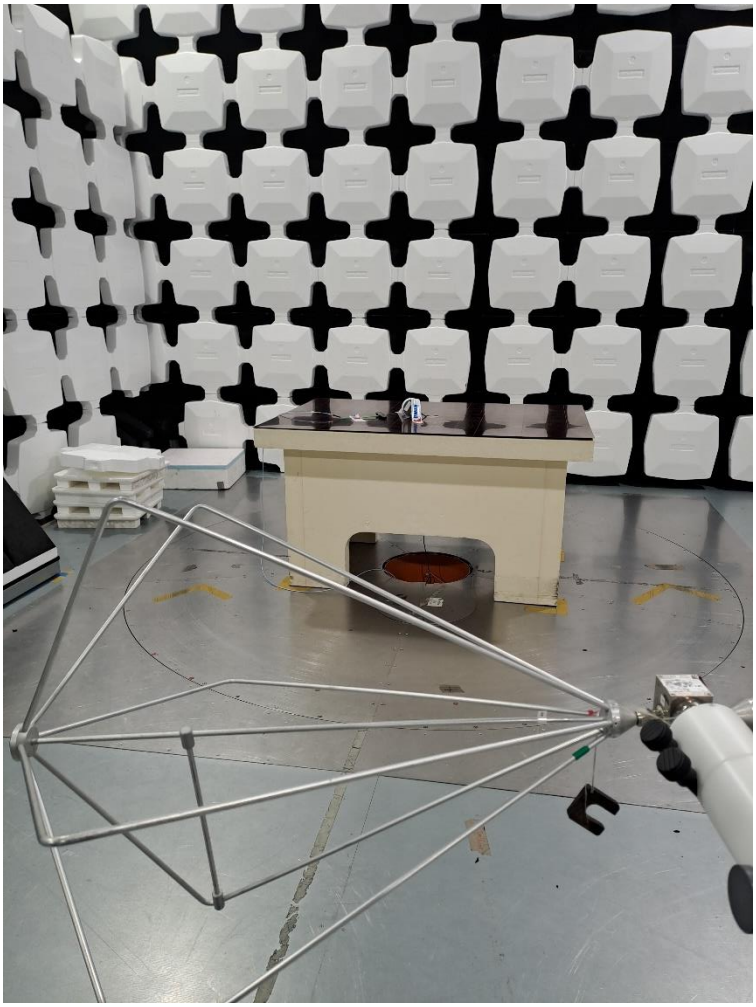


Photo 1 Photograph test setup radiated emissions 30-250 MHz, report section 3.1

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

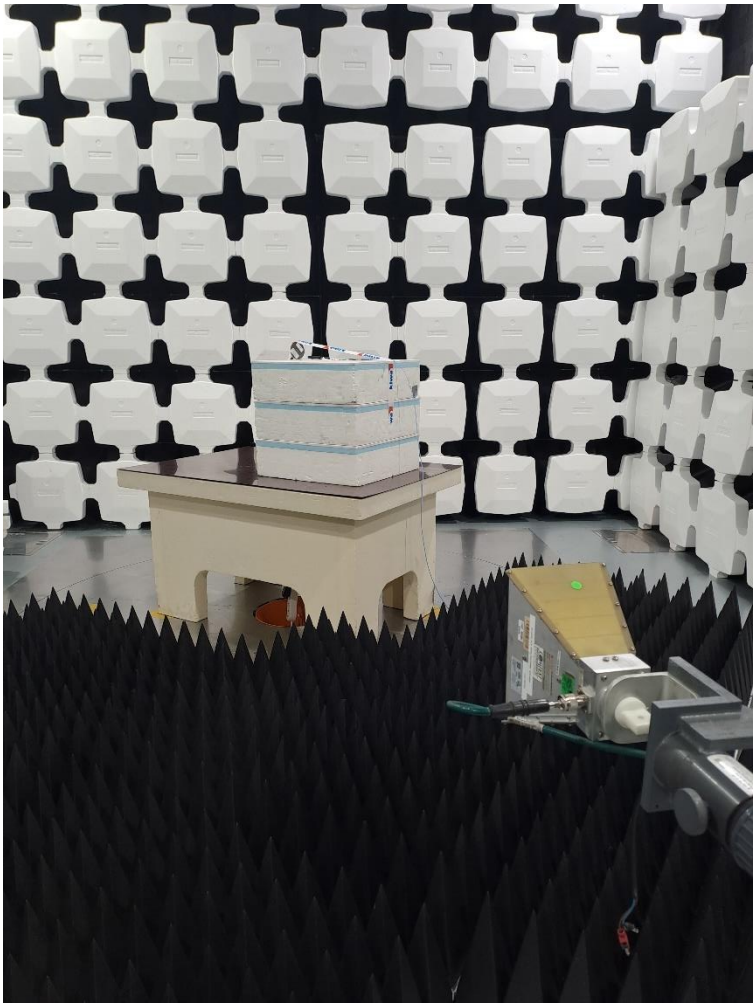


Photo 3 Photograph test setup radiated emissions 1-18 GHz, report section 3.1

5.2 Photograph test setup, AC Power Line Conducted emissions

Photo 4: Photographs AC Power Line conducted emission, report section 3.3

<<END OF REPORT>>