# Test report for

# 47 CFR Part 15 Subpart B

# ICES-003

The RvA is signatory to ILAC - MRA

| | |
|---|---|
| Product name | : RC-01-0202 |
| Applicant | : Antennex B.V. |
| FCC ID | : 2BEY8-RC010202 |
| IC | : Not applicable |

Test report No. : P000426897 001 Ver 2.00

# Laboratory information

## Accreditation

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

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

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.

Kiwa Nederland B.V. is a registered Conformity Assessment body (CAB) under the Japan-EC MRA (Agreement on Mutual Recognition between Japan and the European Community). The registration number is: 201.

## 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<br>7327 AC Apeldoorn<br>The Netherlands<br>Tel. +31 88998 3393 |
| **Test Site FCC** | NL0001 |
| **CABID** | NL0001 |

## Revision History

| Version | Date | Remarks | By |
|---|---|---|---|
| v0.50 | 21-11-2024 | First draft | MHK |
| v1.00 | 04-12-2024 | Final release | AWM |
| v2.00 | 11-12-2024 | Updated 1.4 | AWM |

# Table of Contents

## Summary of Test results

| FCC | ISED | Description | Section in report | Verdict |
|---|---|---|---|---|
| 15.109 (b) | ICES-003 Table 2 | Radiated spurious emissions < 1GHz | 3.1 | Pass |
| 15.109 (b) | ICES-003 Table 4 | Radiated spurious emissions > 1GHz | 3.1 | Pass |
| 15.107 (b) | 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:** | ANTENNEX B.V. |
| **Address:** | Het Eeuwsel 57 |
| **Zip code:** | 5612 AS Eindhoven |
| **Telephone:** | +31 6 839 837 79 |
| **E-mail:** | Tim.stek@antennex.tech |
| **Contact name:** | Tim Stek |

## 1.2 Manufacturer

| | |
|---|---|
| **Manufacturer name:** | ANTENNEX B.V. |
| **Address:** | Het Eeuwsel 57 |
| **Zip code:** | 5612 AS Eindhoven |
| **Telephone:** | +31 6 839 837 79 |
| **E-mail:** | Tim.stek@antennex.tech |
| **Contact name:** | Tim Stek |

## 1.3 Tested Equipment Under Test (EUT)

| | |
|---|---|
| **Product name:** | The Wireless Connector |
| **Brand name:** | Antennex B.V. |
| **FCC ID:** | 2BEY8-RC010202 |
| **IC:** | - |
| **Product type:** | Reverberation Chamber |
| **Model(s):** | RC-01-0202 |
| **Batch and/or serial No.** | RC010202-0001 |
| **Software version:** | EMC Software Release |
| **Hardware version:** | EMC Prototype |
| **Date of receipt** | 11/11/2024 |
| **Tests started:** | 11/11/2024 |
| **Testing ended:** | 11/11/2024 |

## 1.4 Product specifications of Equipment under test

The ANTENNEX Reverberation Chamber is a test chamber developed for mmWave (millimeterwave) applications. This test chamber enables the measurement and validation of radio performance, including Total Radiated Power (TRP) measurements. The chamber is equipped with features, such as a built-in calibration module and an intuitive touchscreen control system, making it a suitable tool for research, development, and quality control in mmWave applications.

UPDATE: The chamber has been updated to be able to measure up to 140 GHz, this has changed from 90 GHz in the previous version of the EUT.

Disclaimer: above info is declared by the applicant

The EUT is considered as a Class A device.

## 1.5 Environmental conditions

| | |
|---|---|
| **Test date** | 11-11-2024 |
| **Ambient temperature** | 19.9C |
| **Humidity** | 48.2% |

## 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

## 1.8 Observation and remarks

During the test the EUT is performing a “calibration sweep from 20 – 140 GHz”.

## 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 : ing. A. W. Mostert (report by ing. M.H.Khan)

Review of test methods and report by:

Name : ing P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 13-01-2025

Name : ing. R. van Barneveld

Function : Test Engineer

Signature :

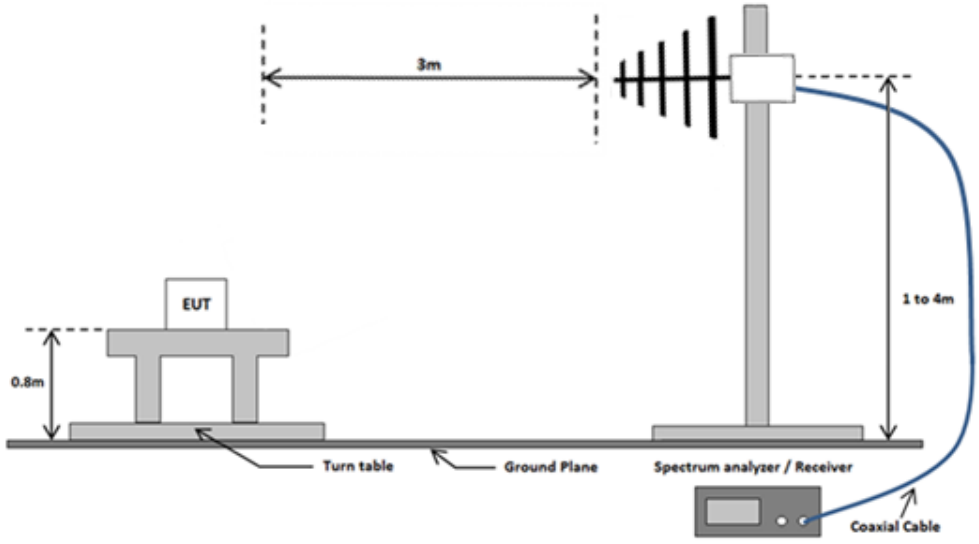
# 2 Test configuration of the Equipment Under Test

## 2.1 Test mode

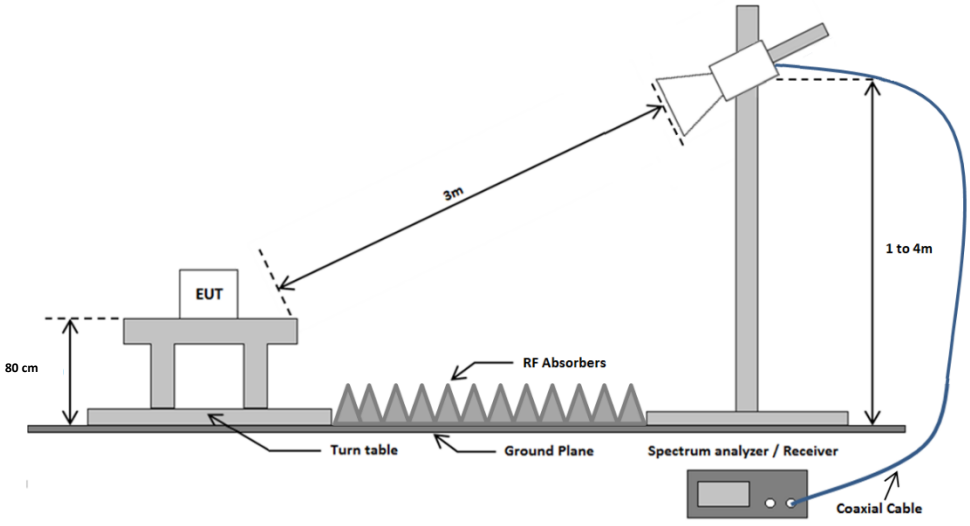
Calibration sweep from 50-90 GHz

## 2.2 Test setups

### 2.2.1 Radiated emissions test setup 30 MHz – 1 GHz

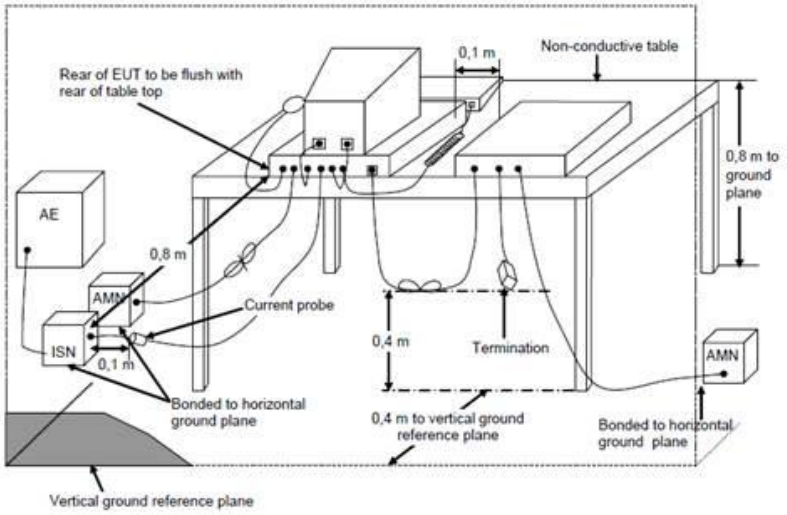



### 2.2.2 Radiated emissions test setup above 1 GHz



### 2.2.3 AC Power line conducted emissions test setup

*Emissions test at AC mains*



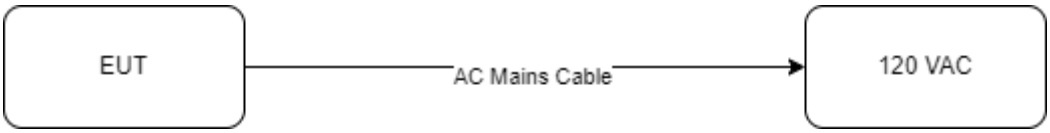




Figure 1. EUT and auxiliary setup

| List of used cables | | | | | |
|---|---|---|---|---|---|
| **Number** | **Function** | **From** | **To** | **Length** | **Remarks** |
| 1 | AC Power | mains 120Vac 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. 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 | 114870 | 11-2024 | 11-2025 | 3.1/3.2 |
| Spectrum Analyzer | Rohde & Schwarz | FSV3044 | 114923 | 10-2023 | 10-2025 | 3.1 |
| Biconical antenna + 6dB attenuator | EMCO | 3109 | 107818 | 06-2022 | 06-2025 | 3.1 |
| Logperiodic antenna | EMCO | 3147 | 114385 | 02-2021 | 02-2026 | 3.1 |
| Horn antenna | EMCO | 3115 | 114607 | 01-2021 | 01-2025 | 3.1 |
| Horn antenna | FLANN-MICROWAVE | 20240-25 | 114518 | NA* | NA* | 3.1 |
| Horn antenna | Scientific atlanta | 12A-26 | 114487 | NA* | NA* | 3.1 |
| Preamplifier 1-18 GHz | µComp Nordic | MCNA-40-0010800-25-10P | 114771 | 08-2024 | 08-2025 | 3.1 |
| Preamplifier 18-40 GHz | Schwarzbeck | BBV-9721 | 115434 | 06-2024 | 06-2025 | 3.1 |
| Semi-Anechoic Chamber | ETS Lindgren | SAR | 114624 | 03-2023 | 03-2026 | 3.1 |
| Test software | Raditeq | Radimation Version 2023.2.3 | -- | -- | -- | 3.1/3.2 |
| LISN /Two line V-network | Rohde & Schwarz | ENV 216 | 114379 | 11-2023 | 11-2025 | 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

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(b)

| Frequency (MHz) | Field strength (µV/meter) | Field strength (dBµV/m) | Measurement distance (meters) |
|---|---|---|---|
| 30-88 | 90 | 39.0 | 10 |
| 88-216 | 150 | 43.5 | 10 |
| 216-960 | 210 | 46.4 | 10 |
| Above 960 | 300 | 49.5 | 10 |

ICES-003 tables 2, 4 Class A

| Frequency (MHz) | Field strength (µV/meter) | Field strength (dBµV/m) | Measurement distance (meters) |
|---|---|---|---|
| 30-88 | 100 | 40.0 | 10 |
| 88-216 | 150 | 43.5 | 10 |
| 216-230 | 200 | 46.4 | 10 |
| 230-960 | 224 | 47.0 | 10 |
| 960-1000 | 300 | 49.5 | 10 |
| 1000 – $F_{M\ Average}$ | 300 | 49.5 | 10 |
| 1000 – $F_{M\ Peak}$ | 2985 | 69.5 | 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 40 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
26.5 – 40 GHz: IRN 441– Method 4
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 |
| 26.5 – 40 GHz | Horizontal | ±4.5 dB |
| | Vertical | ±4.5 dB |

### 3.1.6 Test results

Test results 30 MHz – 1 GHz Class A @10m

| Frequency | Peak | Quasi-Peak | Quasi-Peak Limit | Status | Angle | Height | Polarization |
|---|---|---|---|---|---|---|---|
| 233.363 MHz | 41.3 dBµV/m | 39.3 dBµV/m | 47 dBµV/m | Pass | 331 degrees | 1 m | Vertical |
| 742.518 MHz | 43.1 dBµV/m | 37.7 dBµV/m | 47 dBµV/m | Pass | 223 degrees | 1.3 m | Horizontal |
| 594.004 MHz | 41.6 dBµV/m | 39.4 dBµV/m | 47 dBµV/m | Pass | 170 degrees | 1 m | Vertical |

Test results 1 GHz – 40 GHz ICES Class A @3m

| Frequency | Peak | Peak Limit | Average | Average Limit | Status | Angle | Height | Polarization |
|---|---|---|---|---|---|---|---|---|
| 9.729 GHz | 55 dBµV/m | 80 dBµV/m | 42.5 dBµV/m | 60 dBµV/m | Pass | 11 degrees | 1.7 m | Horizontal |
| 8.486 GHz | 54.2 dBµV/m | 80 dBµV/m | 41.8 dBµV/m | 60 dBµV/m | Pass | 98 degrees | 1.2 m | Vertical |
| 13.408 GHz | 57.9 dBµV/m | 80 dBµV/m | 45.5 dBµV/m | 60 dBµV/m | Pass | 149 degrees | 1 m | Horizontal |
| 13.107 GHz | 57.9 dBµV/m | 80 dBµV/m | 45.4 dBµV/m | 60 dBµV/m | Pass | 260 degrees | 3.7 m | Vertical |
| 1.485 GHz | 59 dBµV/m | 80 dBµV/m | 52 dBµV/m | 60 dBµV/m | Pass | 276 degrees | 3.5 m | Vertical |
| 1.485 GHz | 56.7 dBµV/m | 80 dBµV/m | 47.1 dBµV/m | 60 dBµV/m | Pass | 308 degrees | 2.5 m | Horizontal |
| 14.761 GHz | 60.6 dBµV/m | 80 dBµV/m | 47.7 dBµV/m | 60 dBµV/m | Pass | 345 degrees | 1.2 m | Horizontal |
| 13.375 GHz | 62.1 dBµV/m | 80 dBµV/m | 45.8 dBµV/m | 60 dBµV/m | Pass | 355 degrees | 3.3 m | Vertical |
| 23.012 GHz | 54.1 dBµV/m | 80 dBµV/m | 42.1 dBµV/m | 60 dBµV/m | Pass | 61 degrees | 2.2 m | Vertical |
| 22.931 GHz | 55.1 dBµV/m | 80 dBµV/m | 42.8 dBµV/m | 60 dBµV/m | Pass | 92 degrees | 1.7 m | Horizontal |
| 24.816 GHz | 54.3 dBµV/m | 80 dBµV/m | 42.1 dBµV/m | 60 dBµV/m | Pass | 16 degrees | 1.2 m | Horizontal |
| 24.61 GHz | 54.7 dBµV/m | 80 dBµV/m | 42.3 dBµV/m | 60 dBµV/m | Pass | 160 degrees | 2 m | Vertical |
| 23.818 GHz | 54.6 dBµV/m | 80 dBµV/m | 42.7 dBµV/m | 60 dBµV/m | Pass | 111 degrees | 2.2 m | Vertical |
| 23.155 GHz | 54.3 dBµV/m | 80 dBµV/m | 41.8 dBµV/m | 60 dBµV/m | Pass | 78 degrees | 2.2 m | Vertical |
| 25.671 GHz | 54.6 dBµV/m | 80 dBµV/m | 42.7 dBµV/m | 60 dBµV/m | Pass | 74 degrees | 1.2 m | Horizontal |
| 25.244 GHz | 67.5 dBµV/m | 80 dBµV/m | 52.3 dBµV/m | 60 dBµV/m | Pass | 58 degrees | 1.2 m | Horizontal |
| 25.099 GHz | 54.5 dBµV/m | 80 dBµV/m | 42.6 dBµV/m | 60 dBµV/m | Pass | 44 degrees | 1.2 m | Horizontal |
| 28.875 GHz | 67.1 dBµV/m | 80 dBµV/m | 39.8 dBµV/m | 60 dBµV/m | Pass | 47 degrees | 1.15 m | Horizontal |
| 31.161 GHz | 50.8 dBµV/m | 80 dBµV/m | 41.4 dBµV/m | 60 dBµV/m | Pass | 202 degrees | 1.5 m | Horizontal |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 29.854 GHz | 48.6 dBµV/m | 80 dBµV/m | 39.9 dBµV/m | 60 dBµV/m | Pass | 102 degrees | 1.5 m | Horizontal |
| 29.43 GHz | 48.4 dBµV/m | 80 dBµV/m | 39.4 dBµV/m | 60 dBµV/m | Pass | 83 degrees | 1.3 m | Horizontal |
| 37.423 GHz | 60.4 dBµV/m | 80 dBµV/m | 46.4 dBµV/m | 60 dBµV/m | Pass | 0 degrees | 1.5 m | Horizontal |
| 38.677 GHz | 55 dBµV/m | 80 dBµV/m | 45.7 dBµV/m | 60 dBµV/m | Pass | 47 degrees | 1.5 m | Horizontal |
| 37.952 GHz | 57.3 dBµV/m | 80 dBµV/m | 47.6 dBµV/m | 60 dBµV/m | Pass | 26 degrees | 1.35 m | Horizontal |
| 39.104 GHz | 55.1 dBµV/m | 80 dBµV/m | 46.4 dBµV/m | 60 dBµV/m | Pass | 62 degrees | 1.5 m | Horizontal |
| 38.558 GHz | 55.1 dBµV/m | 80 dBµV/m | 45.9 dBµV/m | 60 dBµV/m | Pass | 46 degrees | 1.3 m | Horizontal |
| 38.508 GHz | 54.4 dBµV/m | 80 dBµV/m | 45.3 dBµV/m | 60 dBµV/m | Pass | 47 degrees | 1.4 m | Horizontal |

Test results 1 GHz – 40 GHz FCC 15.109 Class A @10m

| **Frequency** | **Peak** | **Peak Limit** | **Average** | **Average Limit** | **Status** | **Angle** | **Height** | **Polarization** |
|---|---|---|---|---|---|---|---|---|
| 9.729 GHz | 44.54 dBµV/m | 69.5 dBµV/m | 32.04 dBµV/m | 49.5 dBµV/m | Pass | 11 degrees | 1.7 m | Horizontal |
| 8.486 GHz | 43.74 dBµV/m | 69.5 dBµV/m | 31.34 dBµV/m | 49.5 dBµV/m | Pass | 98 degrees | 1.2 m | Vertical |
| 13.408 GHz | 47.44 dBµV/m | 69.5 dBµV/m | 35.04 dBµV/m | 49.5 dBµV/m | Pass | 149 degrees | 1 m | Horizontal |
| 13.107 GHz | 47.44 dBµV/m | 69.5 dBµV/m | 34.94 dBµV/m | 49.5 dBµV/m | Pass | 260 degrees | 3.7 m | Vertical |
| 1.485 GHz | 48.54 dBµV/m | 69.5 dBµV/m | 41.54 dBµV/m | 49.5 dBµV/m | Pass | 276 degrees | 3.5 m | Vertical |
| 1.485 GHz | 46.24 dBµV/m | 69.5 dBµV/m | 36.64 dBµV/m | 49.5 dBµV/m | Pass | 308 degrees | 2.5 m | Horizontal |
| 14.761 GHz | 50.14 dBµV/m | 69.5 dBµV/m | 37.24 dBµV/m | 49.5 dBµV/m | Pass | 345 degrees | 1.2 m | Horizontal |
| 13.375 GHz | 51.64 dBµV/m | 69.5 dBµV/m | 35.34 dBµV/m | 49.5 dBµV/m | Pass | 355 degrees | 3.3 m | Vertical |
| 23.012 GHz | 43.64 dBµV/m | 69.5 dBµV/m | 31.64 dBµV/m | 49.5 dBµV/m | Pass | 61 degrees | 2.2 m | Vertical |
| 22.931 GHz | 44.64 dBµV/m | 69.5 dBµV/m | 32.34 dBµV/m | 49.5 dBµV/m | Pass | 92 degrees | 1.7 m | Horizontal |
| 24.816 GHz | 43.84 dBµV/m | 69.5 dBµV/m | 31.64 dBµV/m | 49.5 dBµV/m | Pass | 16 degrees | 1.2 m | Horizontal |
| 24.61 GHz | 44.24 dBµV/m | 69.5 dBµV/m | 31.84 dBµV/m | 49.5 dBµV/m | Pass | 160 degrees | 2 m | Vertical |
| 23.818 GHz | 44.14 dBµV/m | 69.5 dBµV/m | 32.24 dBµV/m | 49.5 dBµV/m | Pass | 111 degrees | 2.2 m | Vertical |
| 23.155 GHz | 43.84 dBµV/m | 69.5 dBµV/m | 31.34 dBµV/m | 49.5 dBµV/m | Pass | 78 degrees | 2.2 m | Vertical |
| 25.671 GHz | 44.14 dBµV/m | 69.5 dBµV/m | 32.24 dBµV/m | 49.5 dBµV/m | Pass | 74 degrees | 1.2 m | Horizontal |
| 25.244 GHz | 57.04 dBµV/m | 69.5 dBµV/m | 41.84 dBµV/m | 49.5 dBµV/m | Pass | 58 degrees | 1.2 m | Horizontal |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 25.099 GHz | 44.04 dBµV/m | 69.5 dBµV/m | 32.14 dBµV/m | 49.5 dBµV/m | Pass | 44 degrees | 1.2 m | Horizontal |
| 28.875 GHz | 56.64 dBµV/m | 69.5 dBµV/m | 29.34 dBµV/m | 49.5 dBµV/m | Pass | 47 degrees | 1.15 m | Horizontal |
| 31.161 GHz | 40.34 dBµV/m | 69.5 dBµV/m | 30.94 dBµV/m | 49.5 dBµV/m | Pass | 202 degrees | 1.5 m | Horizontal |
| 29.854 GHz | 38.14 dBµV/m | 69.5 dBµV/m | 29.44 dBµV/m | 49.5 dBµV/m | Pass | 102 degrees | 1.5 m | Horizontal |
| 29.43 GHz | 37.94 dBµV/m | 69.5 dBµV/m | 28.94 dBµV/m | 49.5 dBµV/m | Pass | 83 degrees | 1.3 m | Horizontal |
| 37.423 GHz | 49.94 dBµV/m | 69.5 dBµV/m | 35.94 dBµV/m | 49.5 dBµV/m | Pass | 0 degrees | 1.5 m | Horizontal |
| 38.677 GHz | 44.54 dBµV/m | 69.5 dBµV/m | 35.24 dBµV/m | 49.5 dBµV/m | Pass | 47 degrees | 1.5 m | Horizontal |
| 37.952 GHz | 46.84 dBµV/m | 69.5 dBµV/m | 37.14 dBµV/m | 49.5 dBµV/m | Pass | 26 degrees | 1.35 m | Horizontal |
| 39.104 GHz | 44.64 dBµV/m | 69.5 dBµV/m | 35.94 dBµV/m | 49.5 dBµV/m | Pass | 62 degrees | 1.5 m | Horizontal |
| 38.558 GHz | 44.64 dBµV/m | 69.5 dBµV/m | 35.44 dBµV/m | 49.5 dBµV/m | Pass | 46 degrees | 1.3 m | Horizontal |
| 38.508 GHz | 43.94 dBµV/m | 69.5 dBµV/m | 34.84 dBµV/m | 49.5 dBµV/m | Pass | 47 degrees | 1.4 m | Horizontal |

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

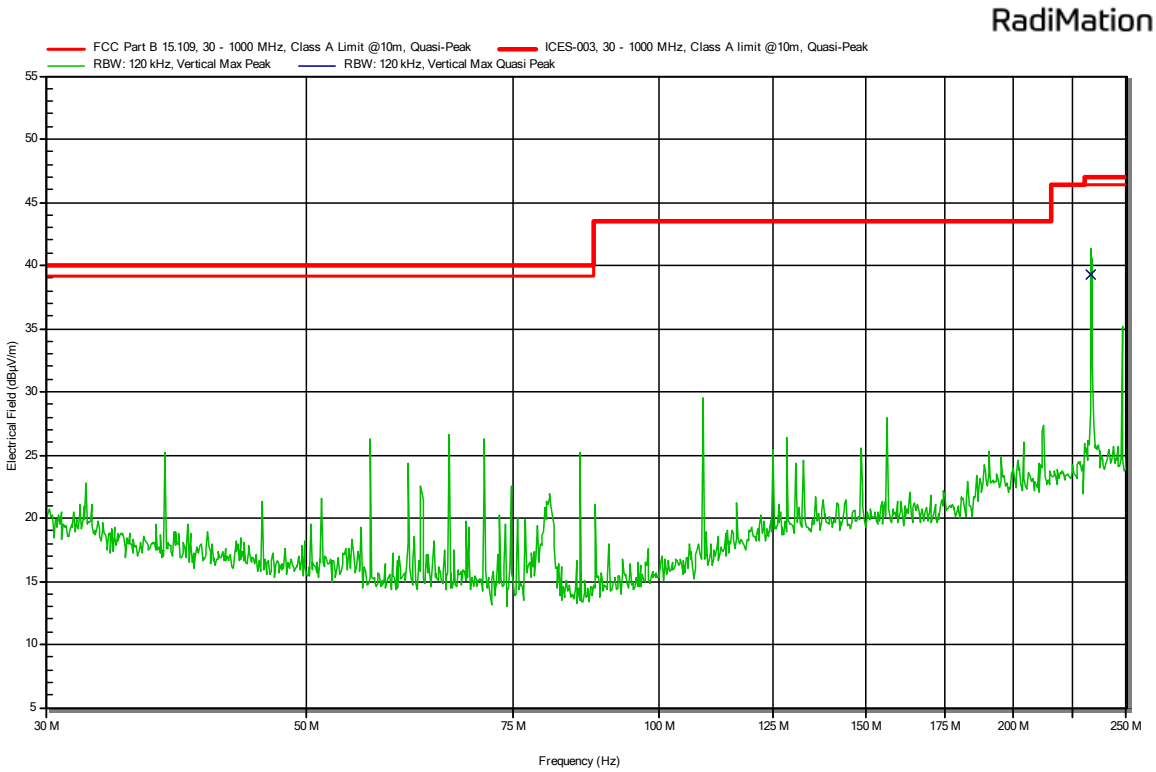
**NOTE:** The measurements from 1 – 40 GHz, were performed at a measurement distance of 3 meters. For FCC 15.109, these values were converted from 3 meters to 10 meters.

Converting from 3 meters to 10 meters:

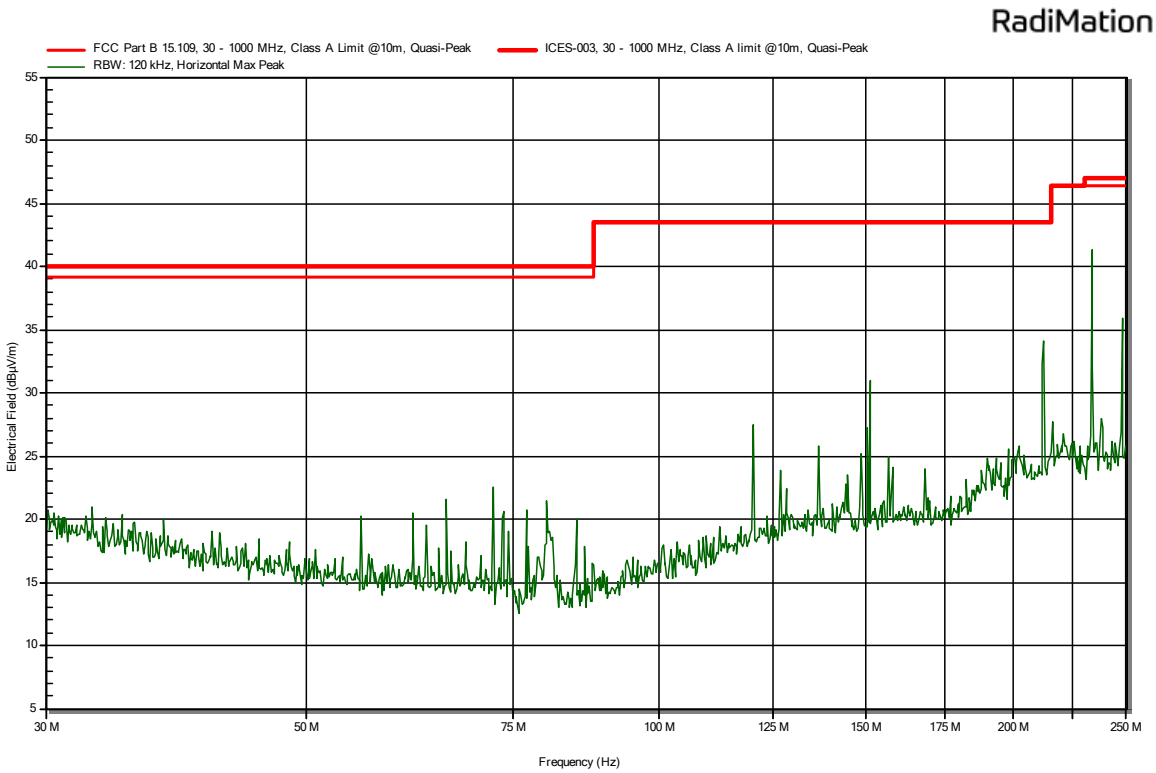
$\Delta dB = 20 * \log_{10}(10/3)$
$\Delta dB = 20 * \log_{10}(3.333)$
$\Delta dB = 10.46$ dB

Therefore to go from 3 meter to 10 meter the values will decrease by 10.46 dB.

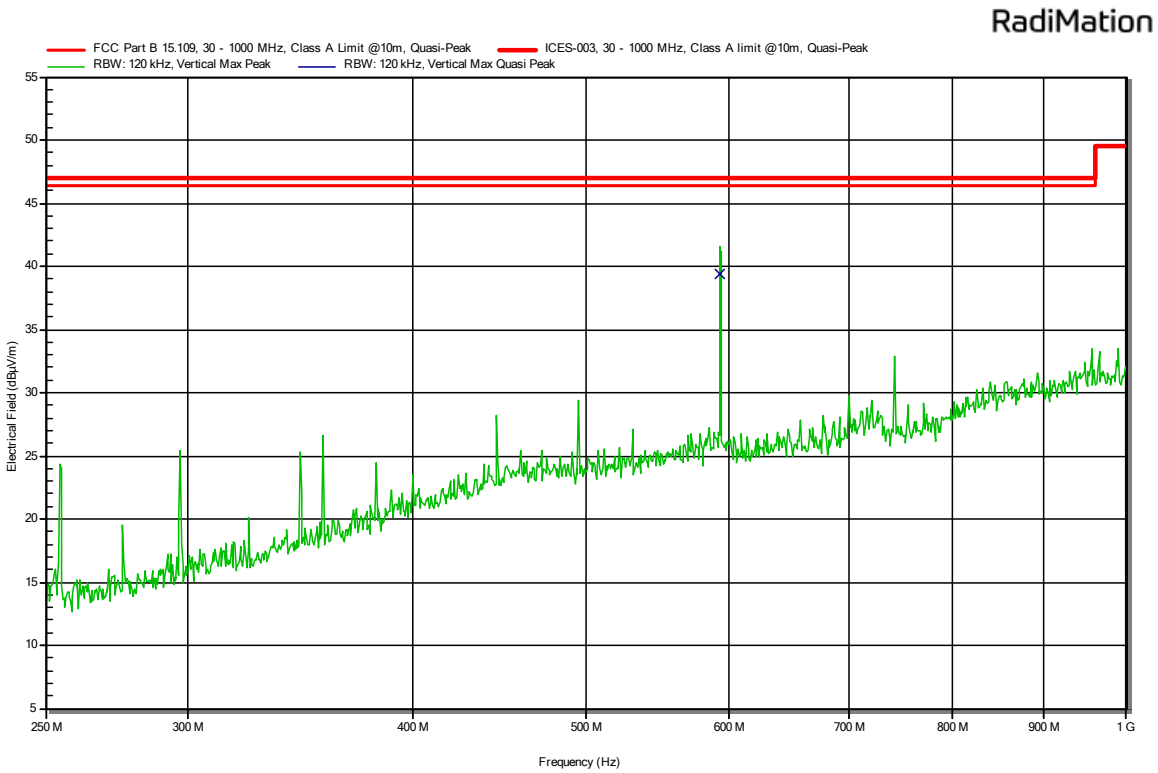
### 3.1.7 Plots of the Radiated Spurious Emissions Measurement



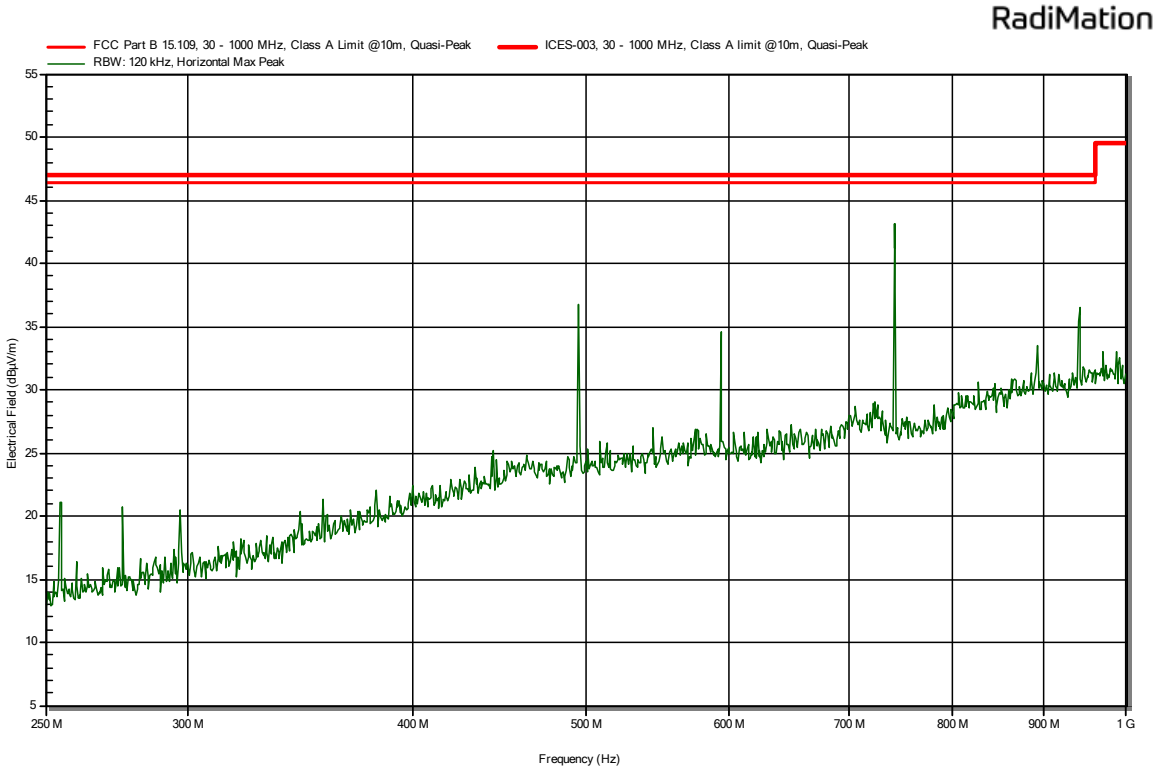

Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)



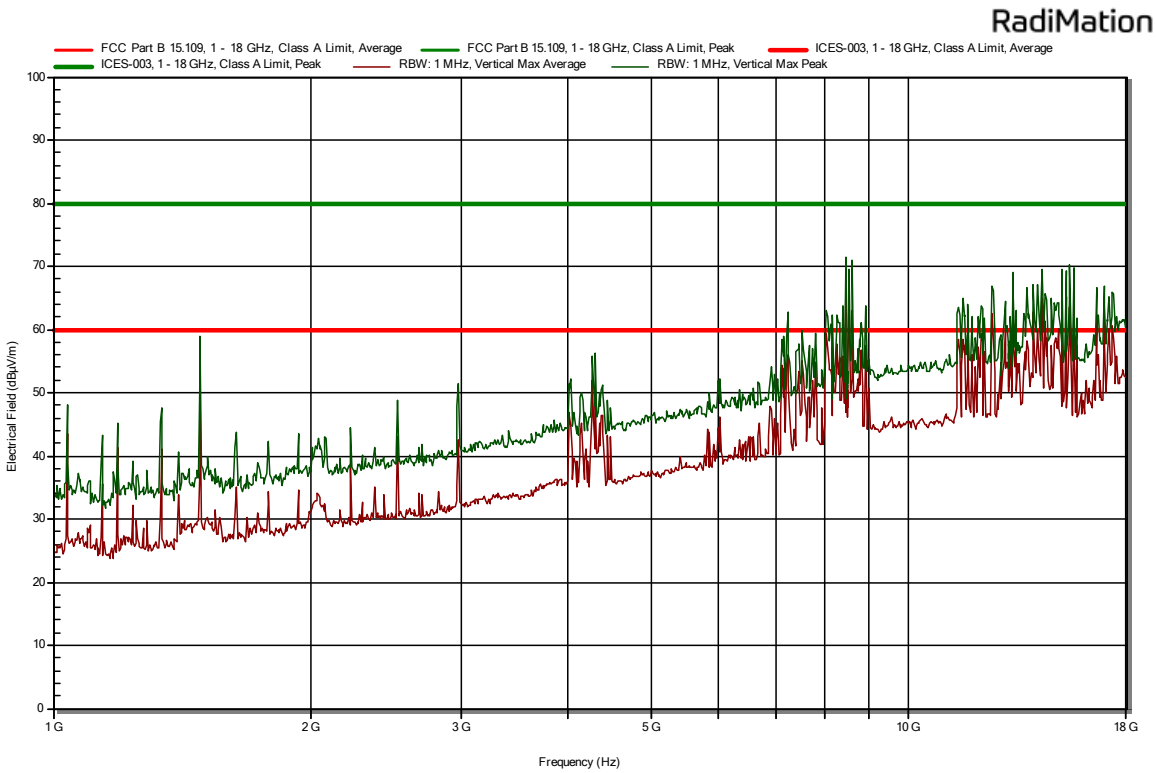

Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)



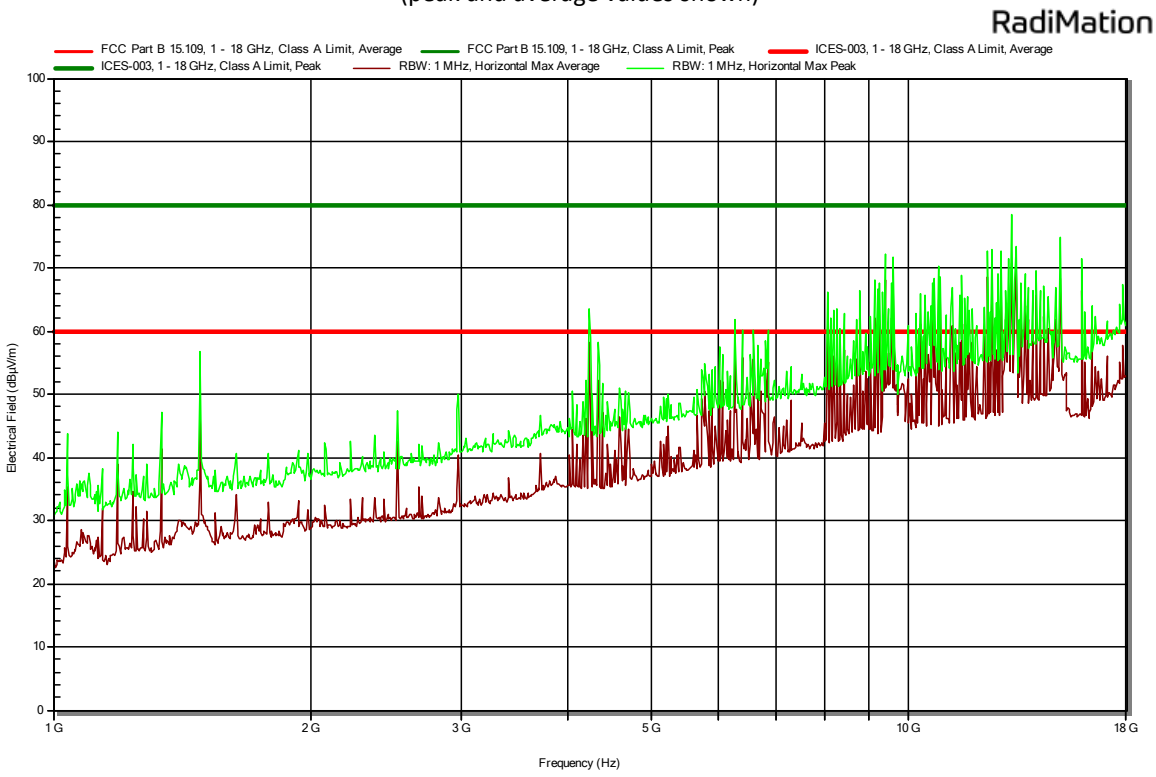

Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250-1000 MHz
(pre-scan peak values shown)



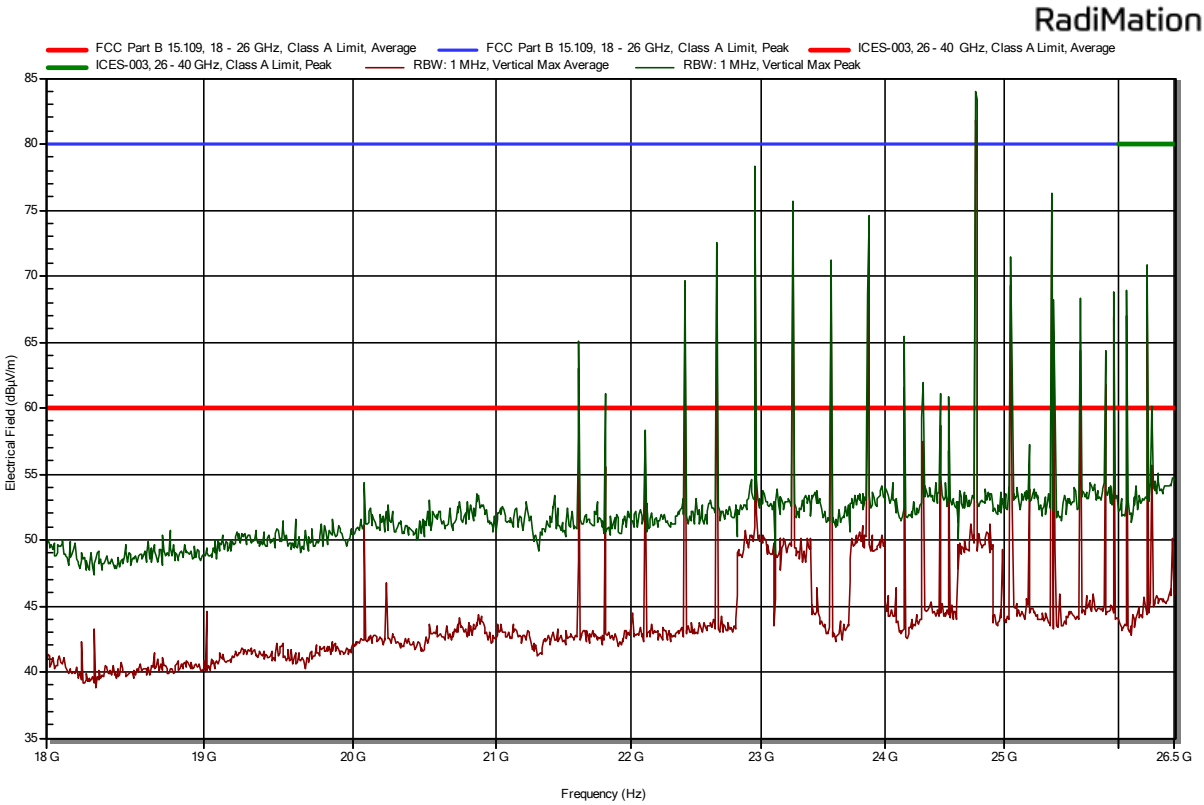

Plot 2b: radiated emissions of the EUT, Antenna horizontal, in the range 250-1000 MHz
(pre-scan peak values shown)



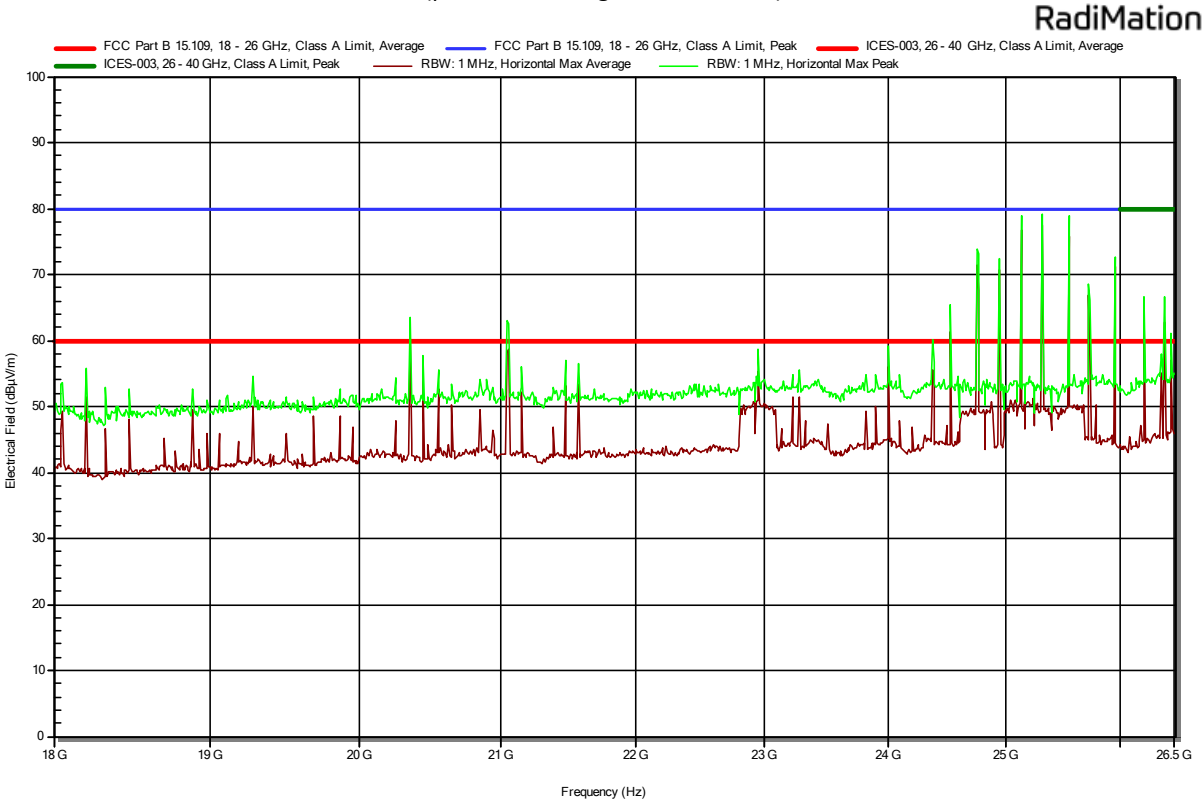

Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1-18 GHz
(peak and average values shown)



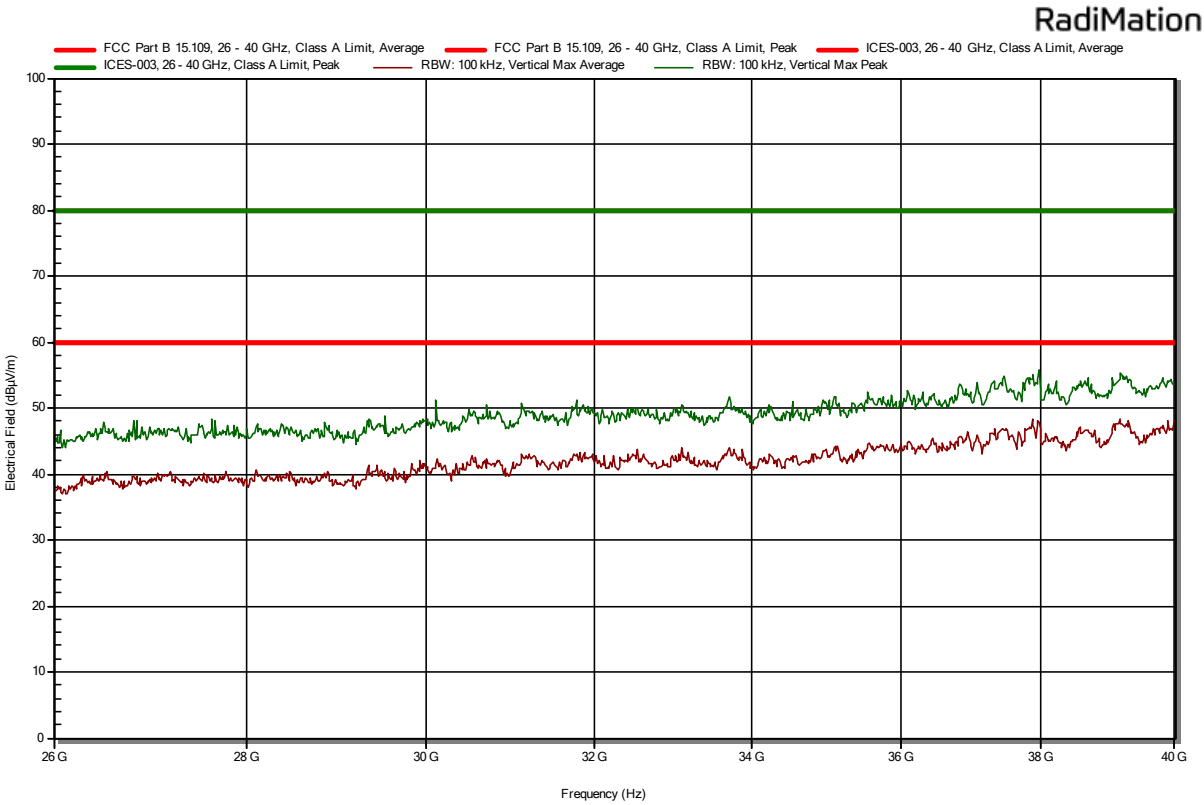

Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1-18GHz
(peak and average values shown)



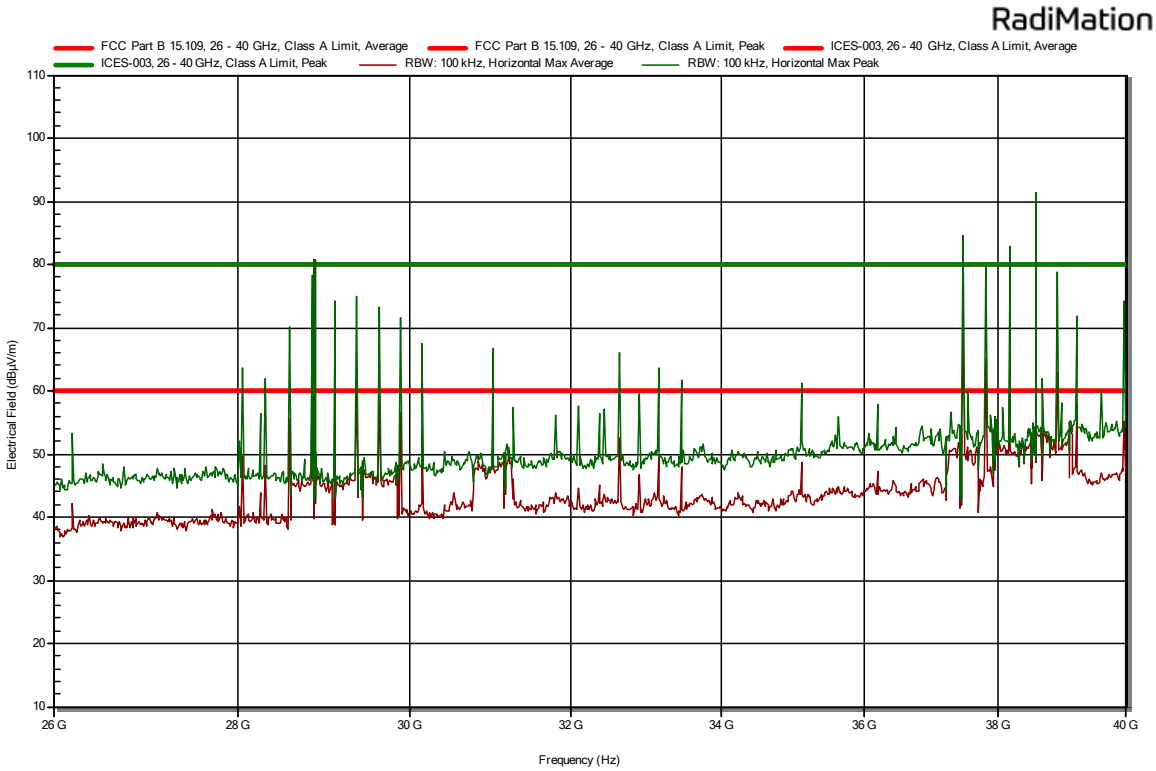

Plot 4a: radiated emissions of the EUT, Antenna vertical, in the range 18-26 GHz
(peak and average values shown)




Plot 4b: radiated emissions of the EUT, Antenna horizontal, in the range 18-26 GHz
(peak and average values shown)




Plot 5a: radiated emissions of the EUT, Antenna vertical, in the range 26-40 GHz
(peak and average values shown)




Plot 5b: radiated emissions of the EUT, Antenna horizontal, in the range 26-40 GHz
(peak and average values shown)

## 3.2 AC Power-line conducted emissions

### 3.2.1 Limit

§ 15.107 (b)
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.

Class A 15.107/ICES-003

| 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

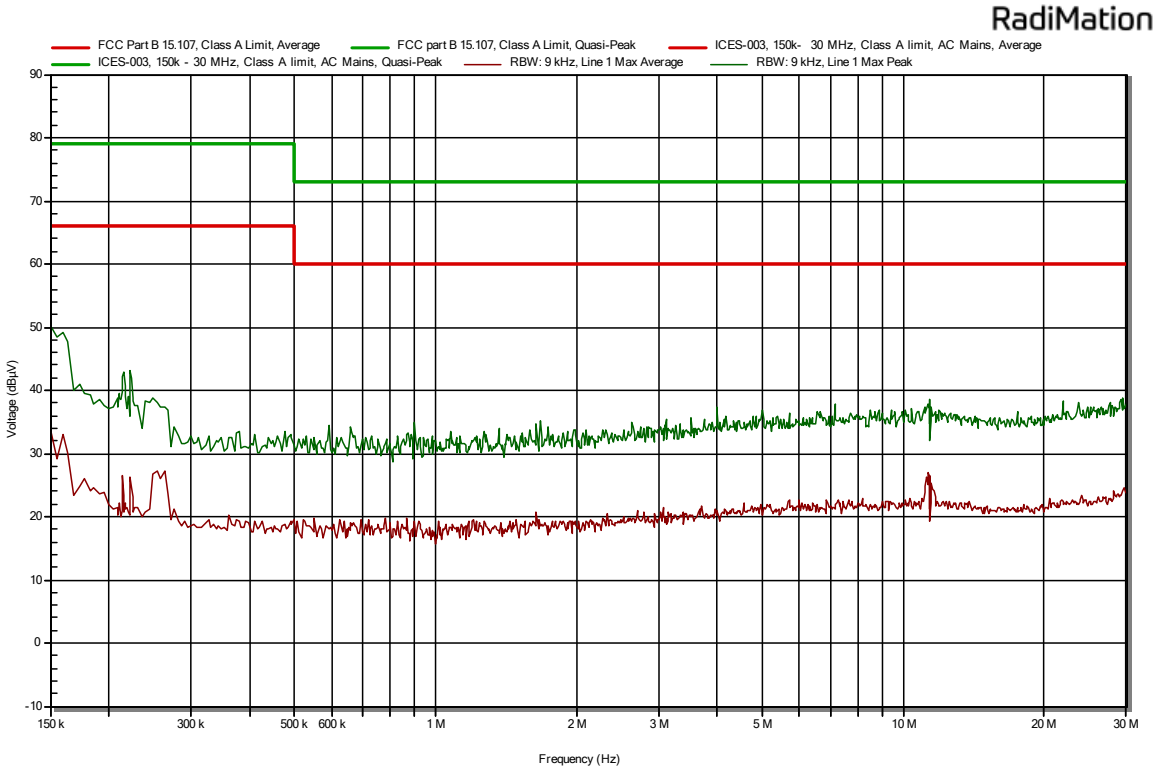
### 3.2.5 Measurement uncertainty

+/- 3.6 dB

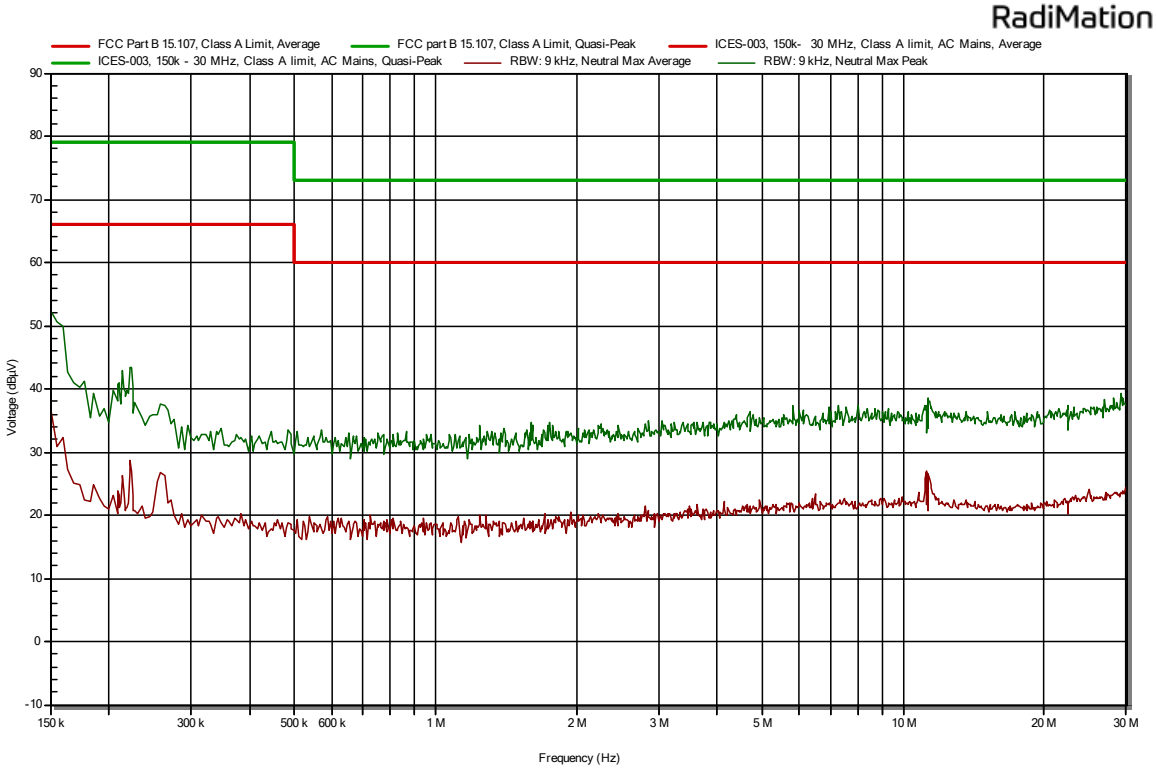
### 3.2.6 AC Power Line Conducted emission data of the EUT, results

| Frequency | Peak | Peak Limit | Average | Average Limit | Quasi-Peak | Quasi-Peak Limit | Status | LISN |
|---|---|---|---|---|---|---|---|---|
| 222.9 kHz | 43.5 dBµV | 62.7 dBµV | 24.2 dBµV | 52.7 dBµV | 37.3 dBµV | 62.7 dBµV | Pass | Neutral |
| 1.608 MHz | 35.1 dBµV | 56 dBµV | 17.9 dBµV | 46 dBµV | 23.4 dBµV | 56 dBµV | Pass | Neutral |
| 11.252 MHz | 38 dBµV | 60 dBµV | 26 dBµV | 50 dBµV | 32.1 dBµV | 60 dBµV | Pass | Neutral |
| 22.466 MHz | 38.4 dBµV | 60 dBµV | 20.5 dBµV | 50 dBµV | 26 dBµV | 60 dBµV | Pass | Neutral |
| 214.8 kHz | 42.8 dBµV | 63 dBµV | 23.2 dBµV | 53 dBµV | 35.7 dBµV | 63 dBµV | Pass | Line 1 |
| 663 kHz | 35.5 dBµV | 56 dBµV | 18.1 dBµV | 46 dBµV | 23.4 dBµV | 56 dBµV | Pass | Line 1 |
| 3.107 MHz | 37.3 dBµV | 56 dBµV | 19.1 dBµV | 46 dBµV | 24.3 dBµV | 56 dBµV | Pass | Line 1 |
| 11.401 MHz | 38.4 dBµV | 60 dBµV | 25.6 dBµV | 50 dBµV | 31.7 dBµV | 60 dBµV | Pass | Line 1 |

### 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)**<br>**ID: 107818**<br>**EMCO 3109** | **Cable loss (dB)**<br>**Id: 114928** | **Attenuator**<br>**ID:114525**<br>**Hewlett Packard** | **Corr. (dB)** |
|---|---|---|---|---|
| 30 | 13.5 | 1.8 | 6 | 21.3 |
| 100 | 9.2 | 2.7 | 6 | 17.9 |
| 150 | 12.6 | 3.2 | 6 | 21.8 |
| 200 | 13.6 | 3.6 | 6 | 23.2 |
| 250 | 15.2 | 4.3 | 6 | 25.5 |

| **Frequency (MHz)** | **AF (dB/m)**<br>**ID: 114385**<br>**EMCO LPDA** | **Cable loss (dB)**<br>**Id: 114928** | **Corr. (dB)** |
|---|---|---|---|
| 250 | 11.8 | 4.3 | 16.1 |
| 300 | 13 | 5.1 | 18.1 |
| 350 | 14.2 | 5.8 | 20.0 |
| 400 | 15.6 | 7.3 | 22.9 |
| 450 | 17.1 | 7.9 | 25.0 |
| 500 | 17.3 | 8.0 | 25.3 |
| 550 | 17.7 | 8.0 | 25.7 |
| 600 | 18.4 | 7.7 | 26.1 |
| 650 | 19.2 | 7.5 | 26.7 |
| 700 | 19.7 | 7.7 | 27.4 |
| 750 | 20.3 | 7.9 | 28.2 |
| 800 | 21.4 | 8.2 | 29.6 |
| 850 | 22.0 | 8.7 | 30.7 |
| 900 | 22.1 | 8.9 | 31.0 |
| 950 | 22.6 | 9.2 | 31.8 |
| 1000 | 22.5 | 9.6 | 32.1 |

| Frequency (MHz) | AF (dB/m)<br>114607<br>Emco 3115<br>SN: 9412-4377 | Gain (dB)<br>114690<br>µComp Nordic<br>MCNA-40-0010800-25-10P | Cable loss (dB)<br>114691 | Corr. (dB) |
|---|---|---|---|---|
| 1000 | 23.6 | 45.1 | 2.1 | -19.4 |
| 2000 | 27.1 | 44.7 | 3.3 | -14.3 |
| 3000 | 30.5 | 44.2 | 4.2 | -9.5 |
| 4000 | 32.7 | 43.5 | 4.9 | -5.9 |
| 5000 | 33.2 | 43.1 | 5.6 | -4.3 |
| 6000 | 34.6 | 43.0 | 6.3 | -2.1 |
| 7000 | 35.2 | 42.9 | 6.4 | -1.3 |
| 8000 | 37.0 | 43.3 | 7.2 | 0.9 |
| 9000 | 38.1 | 43.3 | 7.9 | 2.7 |
| 10000 | 38.2 | 43.0 | 8.2 | 3.4 |
| 11000 | 38.3 | 42.9 | 8.7 | 4.1 |
| 12000 | 39.1 | 42.6 | 9.0 | 5.5 |
| 13000 | 39.2 | 43.6 | 9.8 | 5.4 |
| 14000 | 41.1 | 44.3 | 9.7 | 6.5 |
| 15000 | 40.2 | 44.4 | 10.4 | 6.2 |
| 16000 | 37.5 | 44.3 | 10.8 | 4.0 |
| 17000 | 41.1 | 44.5 | 11.4 | 8.0 |
| 18000 | 44.0 | 44.9 | 11.4 | 10.5 |

| Frequency (MHz) | AF (dB/m)<br>Kiwa ID: 114518<br>Flann 20240-25<br>SN: 163703 | Gain (dB)<br>Kiwa ID:<br>Schwarzbeck<br>BBV 9721 | Cable loss (dB)<br>114691 | Corr. (dB) |
|---|---|---|---|---|
| 18000 | 31.3 | 34.5 | 11.4 | 8.2 |
| 19000 | 31.5 | 34.9 | 11.2 | 7.8 |
| 20000 | 31.7 | 34.1 | 11.6 | 9.2 |
| 21000 | 31.9 | 33.6 | 12.1 | 10.4 |
| 22000 | 32.1 | 33.6 | 12.4 | 10.9 |
| 23000 | 32.2 | 33.3 | 13.6 | 12.5 |
| 24000 | 32.3 | 32.3 | 13.5 | 13.5 |
| 25000 | 32.4 | 33.0 | 13.4 | 12.8 |
| 26000 | 32.5 | 32.9 | 13.7 | 13.3 |

| Frequency (MHz) | AF (dB/m)<br>Kiwa ID: 114487<br>Scientific Atlanta | Gain (dB)<br>Kiwa ID:<br>Schwarzbeck<br>BBV 9721 | Cable loss (dB)<br>114691 | Corr. (dB) |
|---|---|---|---|---|
| 26000 | 35.3 | 32.9 | 13.7 | 16.1 |
| 27000 | 35.4 | 32.6 | 14.9 | 17.7 |
| 28000 | 35.6 | 32.6 | 14.4 | 17.4 |
| 29000 | 35.9 | 32.9 | 14.6 | 17.6 |
| 30000 | 36.2 | 32.7 | 15.2 | 18.7 |
| 31000 | 36.1 | 32.9 | 14.9 | 18.1 |
| 32000 | 36.0 | 33.8 | 16.7 | 18.9 |
| 33000 | 36.2 | 34.8 | 16.8 | 18.2 |
| 34000 | 36.3 | 35.5 | 15.9 | 16.7 |
| 35000 | 36.4 | 35.5 | 17.5 | 18.4 |
| 36000 | 36.5 | 34.6 | 17.9 | 19.8 |
| 37000 | 36.6 | 33.6 | 18.2 | 21.2 |
| 38000 | 36.8 | 32.5 | 17.7 | 22.0 |
| 39000 | 37.0 | 32.1 | 17.7 | 22.6 |
| 40000 | 37.2 | 29.9 | 19.0 | 26.3 |

# 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*

*Photo 4  Photograph test setup  radiated emissions 18-26 GHz, report section 3.1*


*Photo 5  Photograph test setup  radiated emissions 26-40 GHz, report section 3.1*

## 5.2 Photograph test setup, AC Power Line Conducted emissions

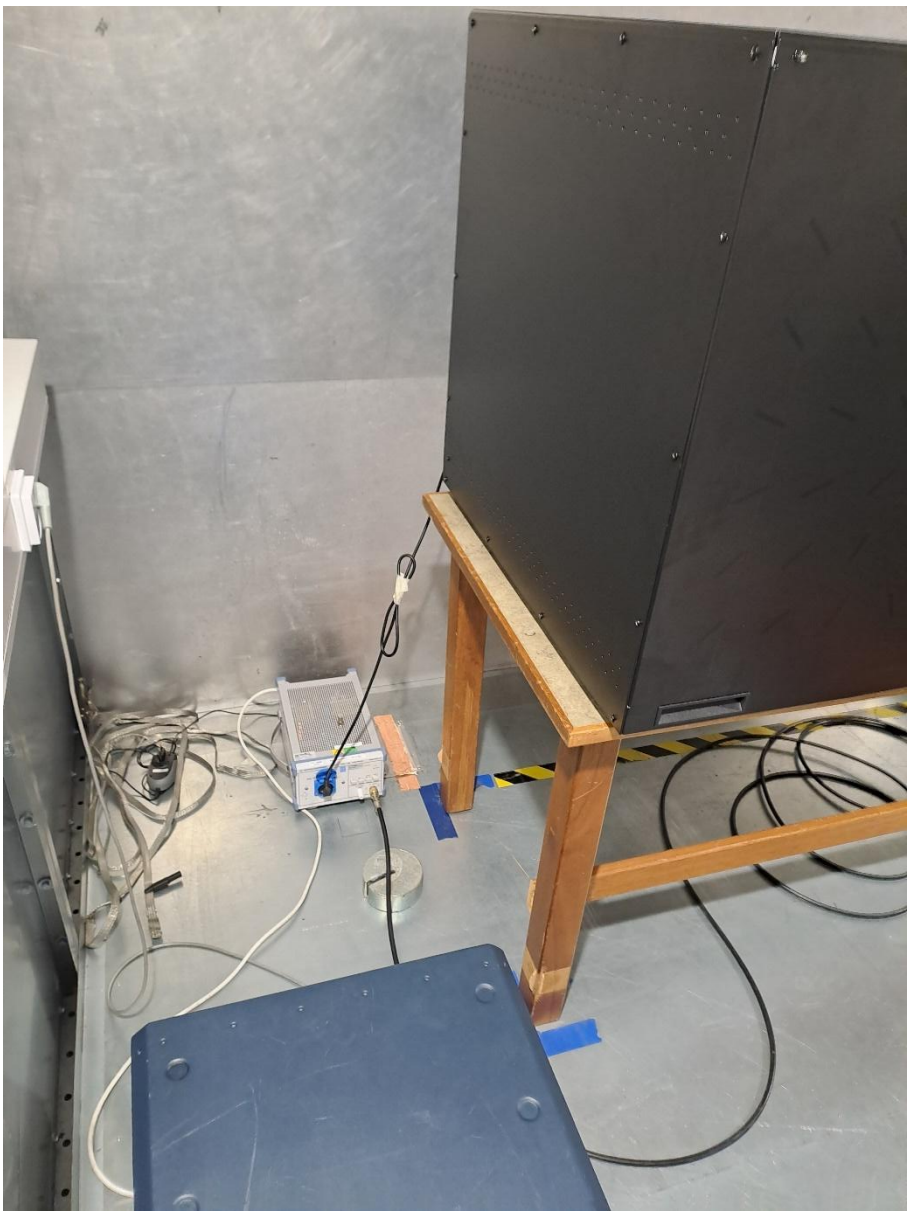


*Photo 6: Photographs AC Power Line conducted emission, report section 3.3*

<<END OF REPORT>>