

FCC Test Report for Parts 15.109, 15.207 and 15.209

Product name : Lightport
Applicant : Invisua Lighting B.V.
FCC ID : XVV-MEGA23M12

Test report No. : 161201223 001 V1.0

Laboratory information

Accreditation

Telefication 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

Documentation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. 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 L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

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 Telefication Netherlands

Testing Location

| | |
|--------------------|---|
| Test Site | Telefication BV |
| Test Site location | Edisonstraat 12a 6902 PK Zevenaar The Netherlands Tel. +31316583180 Fax. +31316583189 |
| Test Site FCC | NL0001 |

Revision History

| Version | Date | Remarks | By |
|---------|------------|---------------|-----|
| 0.50 | 14-12-2016 | First draft | PvW |
| 1.0 | 20-04-2017 | Final version | PvW |
| | | | |
| | | | |
| | | | |

Table of Contents

| | |
|---|----|
| Revision History | 2 |
| Summary of Test results..... | 5 |
| 1 General Description..... | 6 |
| 1.1 Applicant..... | 6 |
| 1.2 Manufacturer | 6 |
| 1.3 Tested Equipment Under Test (EUT) | 6 |
| 1.4 Product specifications of Equipment under test | 7 |
| 1.5 Modification of the Equipment Under Test (EUT)..... | 7 |
| 1.6 Observations and remarks..... | 7 |
| 1.7 Environmental conditions..... | 7 |
| 1.8 Measurement Standards | 7 |
| 1.9 Applicable Standards | 7 |
| 1.10 Conclusions..... | 8 |
| 2 Test configuration of the Equipment Under Test | 9 |
| 2.1 Test mode | 9 |
| 2.2 Tested channels and Data rates | 9 |
| 2.3 Conducted Test setup..... | 9 |
| 2.4 Radiated Test setup | 10 |
| 2.5 Equipment used in the test configuration..... | 12 |
| 2.6 Explanation of the Measurement results for all conducted test items | 12 |
| 2.7 Sample calculation..... | 12 |
| 3 Test results | 13 |
| 3.1 Radiated Magnetic Disturbance 9 kHz to 30 MHz..... | 13 |
| 3.1.1 Limit..... | 13 |
| 3.1.2 Measurement instruments | 13 |
| 3.1.3 Test setup..... | 13 |
| 3.1.4 Test procedure | 13 |
| 3.1.5 Notes | 13 |
| 3.1.6 Measurement uncertainty | 13 |
| 3.1.7 Plot of the Radiated Magnetic Disturbance 9kHz to 30MHz..... | 14 |
| 3.2 Radiated Spurious Emissions 30MHz to 26GHz Measurement | 15 |
| 3.2.1 Limit..... | 15 |
| 3.2.2 Measurement instruments | 15 |
| 3.2.3 Test setup..... | 15 |
| 3.2.4 Test procedure | 15 |
| 3.2.5 Notes | 15 |
| 3.2.6 Plots of the Radiated Spurious Emissions Measurement..... | 16 |
| 3.2.7 Measurement Uncertainty..... | 24 |

| | | |
|-------|---|----|
| 3.3 | Conducted spurious measurement at AC mains | 25 |
| 3.3.1 | Limit..... | 25 |
| 3.3.2 | Measurement equipment | 25 |
| 3.3.3 | Test set up | 25 |
| 3.3.4 | Test procedure | 25 |
| 3.3.5 | Plots of the AC conducted spurious measurement..... | 26 |
| 3.3.6 | Measurement uncertainty | 26 |

Summary of Test results

| FCC | Description | Section in report | Verdict |
|------------|---------------------------------|-------------------|---------|
| 15.209 (a) | Radiated Magnetic Disturbance | 3.1 | Pass |
| 15.209 (a) | Radiated Spurious emissions | 3.2 | Pass |
| 15.207 (a) | Conducted emissions on AC mains | 3.3 | Pass |

1 General Description

1.1 Applicant

| | |
|---------------|--|
| Client name: | Invisua Lighting B.V. |
| Address | Nuenenseweg 167-B23, Geldrop, The Netherlands |
| Zip code: | 5667 KP |
| Telephone: | +31 407370190 |
| E-mail: | Loek.janssen@invisua.com |
| Contact name: | L. Janssen |

1.2 Manufacturer

| | |
|--------------------|--|
| Manufacturer name: | Invisua Lighting B.V. |
| Address: | Nuenenseweg 167-B23, Geldrop, The Netherlands |
| Zip code: | 5667 KP |
| Telephone: | +31 407370190 |
| E-mail: | Loek.janssen@invisua.com |
| Contact name: | L. Janssen |

1.3 Tested Equipment Under Test (EUT)

| | |
|-------------------|------------------------------|
| Product name: | Lightport |
| Brand name: | Invisua |
| Product type: | FR controller (for LED spot) |
| FCC ID: | XVV-MEGA23M12 |
| Model(s): | - |
| Software version: | - |
| Hardware version: | BOM version 01 |
| Date of receipt | 12-12-2016 |
| Tests started: | 12-12-2016 |
| Testing ended: | 13-12-2016 |

1.4 Product specifications of Equipment under test

| | |
|--|--------------------------|
| Tx Frequency range (MHz): | 2405.0-2480.0 |
| Rx frequency range (MHz): | 2405.0-2480.0 |
| Maximum output power to antenna (dBm): | 11.8 |
| Antenna type : | Half wave dipole antenna |
| Antenna gain(dBi): | 2.1 dBi |
| Type of modulation: | O-QPSK |
| Emission designator: | 2M24G1D |

1.5 Modification of the Equipment Under Test (EUT)

None.

1.6 Observations and remarks

The EUT contains FCC ID: XVV-MEGA23M12, a 802.15.4 (Zigbee) radio module by Dresden elektronik.

1.7 Environmental conditions

| | | |
|---------------------|------------|------------|
| Test date | 12-12-2016 | 13-12-2016 |
| Ambient temperature | 22.5°C | 22.5°C |
| Humidity | 35.9% | 33.4% |

1.8 Measurement Standards

- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V03r05
- ANSI C63.10:2013

1.9 Applicable Standards

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

- FCC Part 15 Subpart §15.109, §15.207, §15.209

1.10 Conclusions

The sample of the product showed NO NON-COMPLIANCES to the specifications stated in paragraph 1.9 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. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.9 "*Applicable standards*".

All tests are performed by:

Name : ing P. Suringa and 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 : 12-05-2017

Name : ing. K.A. Roes

Function : Coordinator Radio Laboratory

Signature :



2 Test configuration of the Equipment Under Test

2.1 Test mode

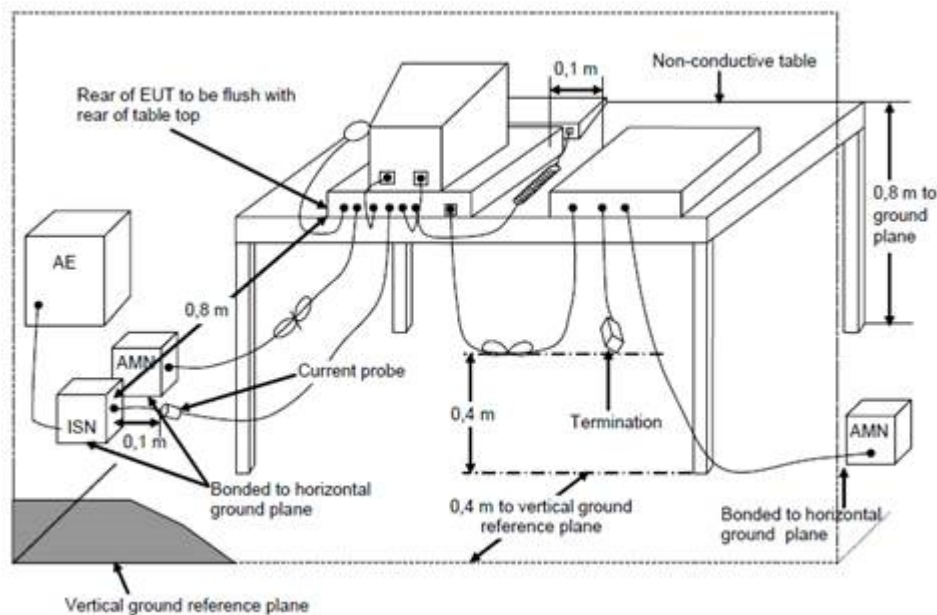
The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

| Technology | Channels | Data rate | Frequency (MHz) |
|------------|----------|-----------|-----------------|
| 802.15.4 | 11 | 250 kbps | 2404.5 |
| | 18 | 250 kbps | 2439.5 |
| | 26 | 250 kbps | 279.5 |

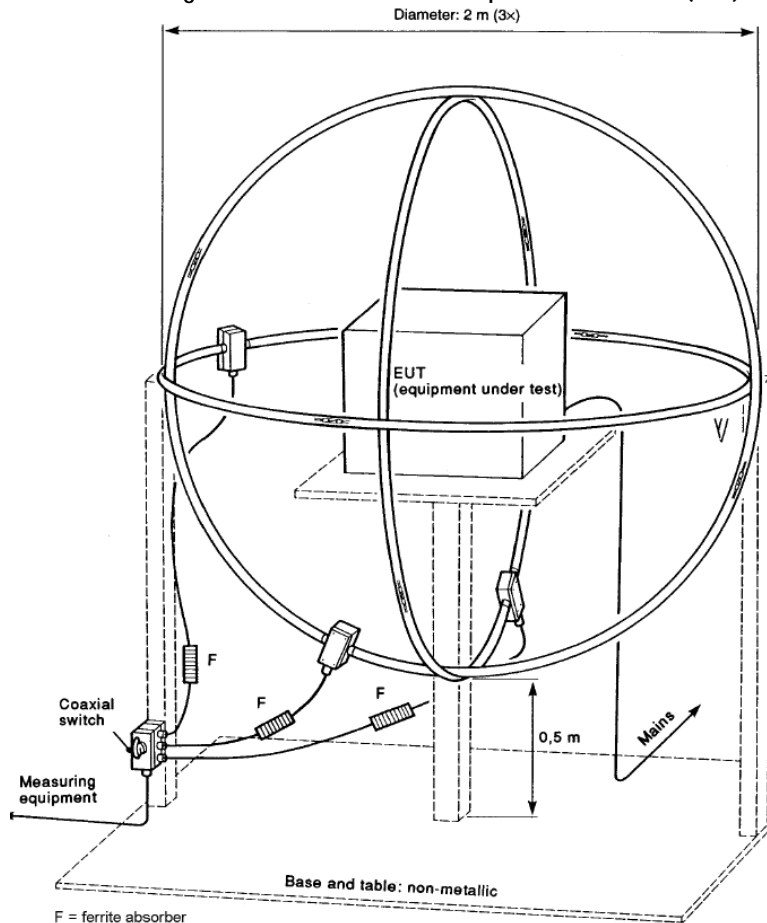
2.3 Conducted Test setup

Emissions test at AC mains

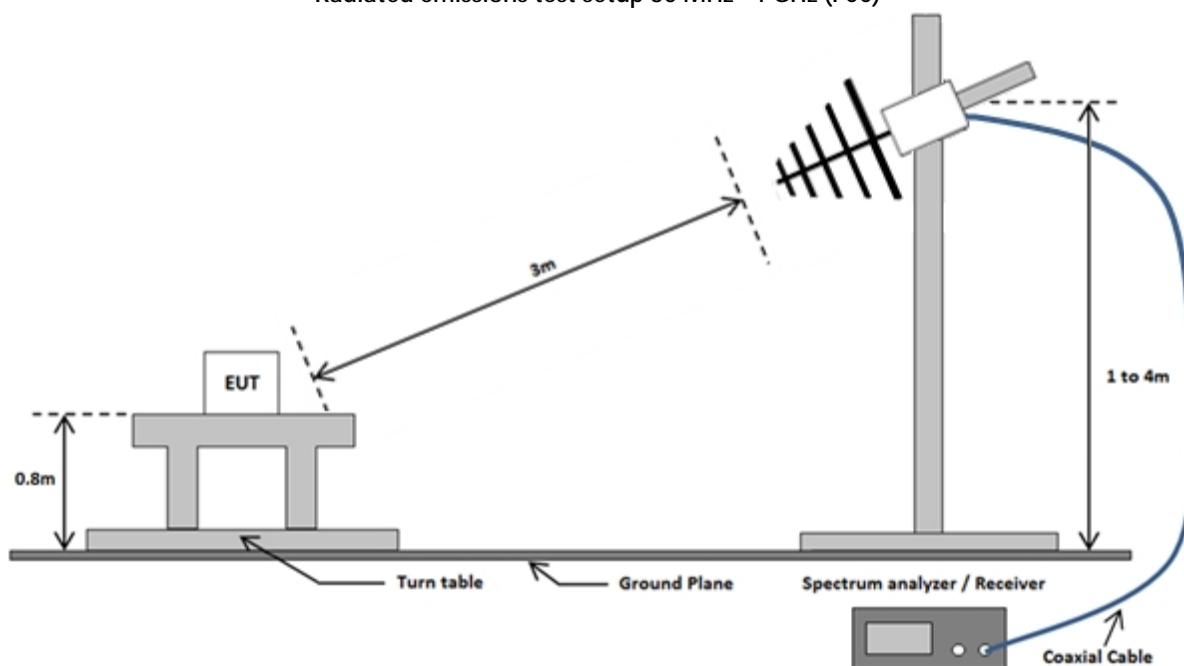


2.4 Radiated Test setup

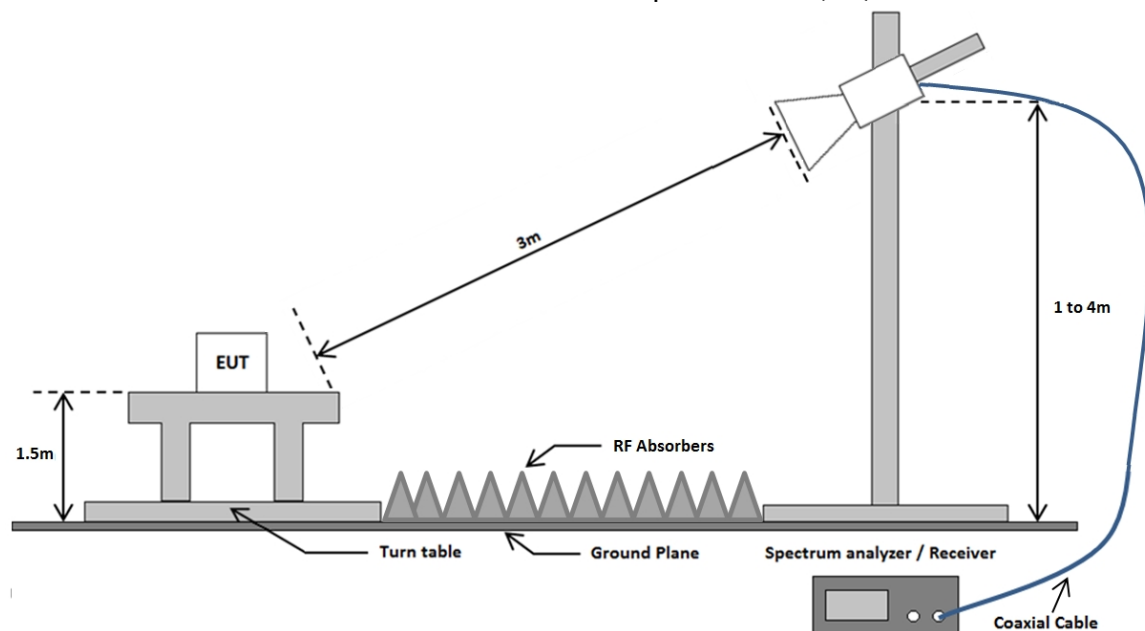
Radiated magnetic disturbance test setup 0.009 – 30 MHz (FCC)



Radiated emissions test setup 30 MHz - 1 GHz (FCC)



Radiated emissions test setup above 1 GHz (FCC)



2.5 Equipment used in the test configuration

| Description | Manufacturer | Model | ID | Used at Par. |
|--------------------------------|---------------------------------|---------------------------|----------|--------------|
| Spectrum Analyzer | Rohde & Schwarz | ESR7 | TE01220 | 3.1, 3.2 |
| Spectrum Analyzer | Rhode & Schwarz | ESCI | TE11128 | 3.3 |
| Spectrum Analyzer | Rhode & Schwarz | FSV | | 3.2 |
| Biconilog Antenna | Chase | CBL6112A | TE00967 | 3.2 |
| Horn Antenna | EMCO The Electro – Mechanics Co | 3115 | TE00531 | 3.2 |
| Horn Antenna | FM LT.D | - | TE00818 | 3.2 |
| SAC Chamber | Comtest Engineering BV | - | TE00861 | 3.2 |
| Artificial Mains Network (AMN) | Rohde & Schwarz | ESH3-Z5 | TE00208 | 3.3 |
| High pass filter | Wainwright instruments | WHK3.0/18G-10EF | TE01140 | 3.2 |
| Pre-amplifier 1-18GHz | Hewlett Packard | 8449B | TE00092 | 3.2 |
| Pre-amplifier 18-26GHz | Miteq | JS4 | TE11131 | 3.2 |
| Triple loop antenna | Schwarzbeck | HXY29170 | TE01311 | 3.1 |
| Pulse limiter | Rhode & Schwarz | ESH3-Z2 | TE 00756 | 3.3 |
| Measurement software | DARE!! | RadiMation® Ver. 2016.2.8 | -- | 3.2, 3.3 |

2.6 Explanation of the Measurement results for all conducted test items

The path loss between the EUT and the spectrum analyser for the frequency range of 30 MHz to 40 GHz has been measured and stored in the transducer table of the spectrum analyser. This transducer table is used for level offset of the spectrum analyser. With this level offset the spectrum analysers reading will be exactly the RF output.

2.7 Sample calculation

Field Strength Measurement example:

| Frequency (GHz) | Polarization | Height(m) | Peak (dBμV/m) |
|-----------------|--------------|-----------|---------------|
| 7,236 | Horizontal | 2 | 52.5 |

The following relation applies:

$$E \text{ (dB}\mu\text{V/m)} = U \text{ (dB}\mu\text{V)} + AF \text{ (dB/m)} - G \text{ (dB)} + CL \text{ (dB)}$$

Where:

E = Electric field strength

U = Measuring receiver voltage

AF = Antenna factor

G = Gain of the pre-amplifier

CL = Cable loss

$$(52.5 = 48.12 + 36.1 - 37.42 + 5.7)$$

3 Test results

3.1 Radiated Magnetic Disturbance 9 kHz to 30 MHz

3.1.1 Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field strength ($\mu\text{V/m}$) | Measurement distance(m) |
|-----------------|------------------------------------|-------------------------|
| 0.009 - 0490 | $2400/F(\text{kHz})$ | 300 |
| 0.490 – 1.705 | $24000/F(\text{kHz})$ | 30 |
| 1.705 - 30 | 30 | 30 |

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 2.4 of this report.

3.1.4 Test procedure

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

3.1.5 Notes

None.

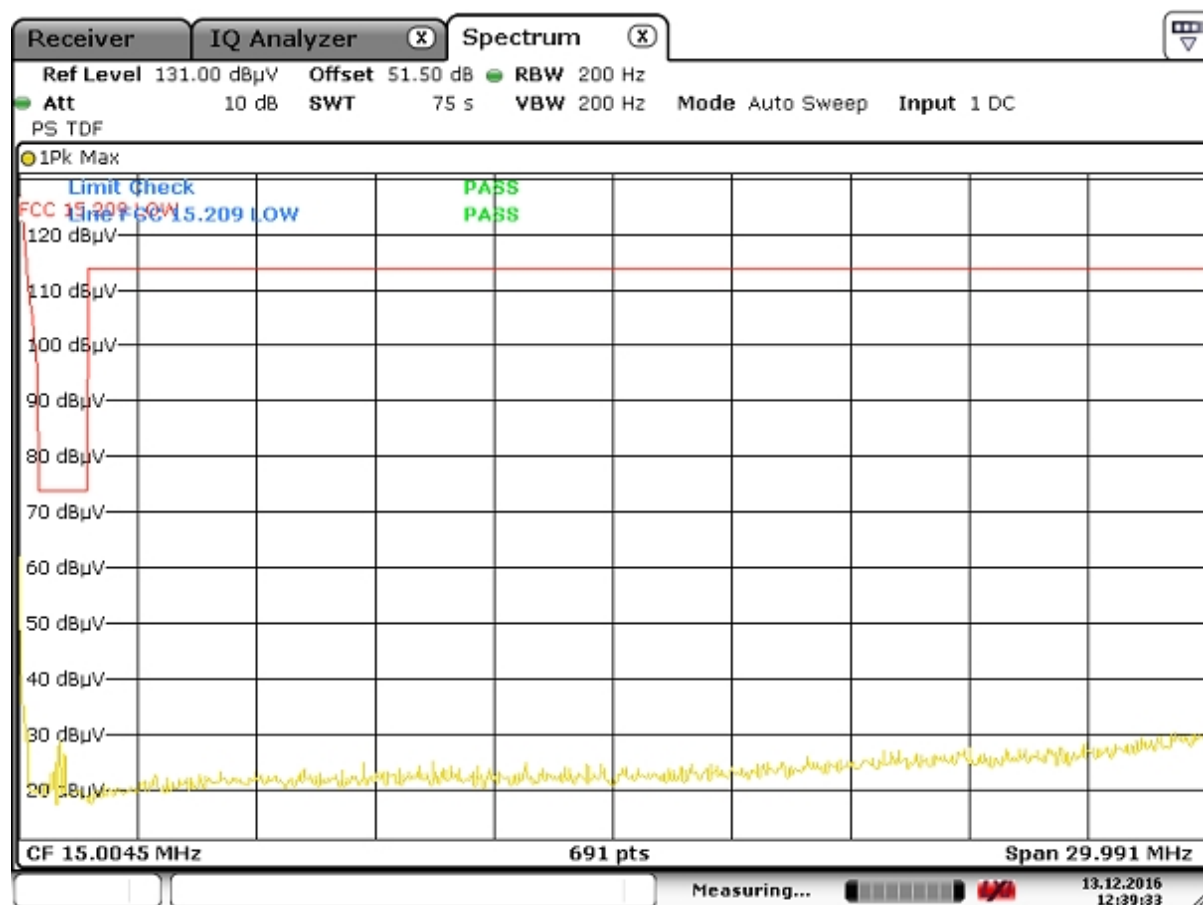
3.1.6 Measurement uncertainty

+/- 3.0 dB

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=1.96$, providing a level of confidence of 95%.

Report number: 161201223 001 V1.0

3.1.7 Plot of the Radiated Magnetic Disturbance 9kHz to 30MHz



3.2 Radiated Spurious Emissions 30MHz to 26GHz Measurement

3.2.1 Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field strength ($\mu\text{V/m}$) | Measurement distance(m) |
|-----------------|------------------------------------|-------------------------|
| 30 -88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216-960 | 200 | 3 |
| Above 960 | 500 | 3 |

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 2.4 of this report.

3.2.4 Test procedure

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands above 1000 MHz.

Radiated emission limits in these three bands are based on measurements employing an average detector.

Other details are according to KDB Publication 558074 V02r05, sections 11.3 and 12.1

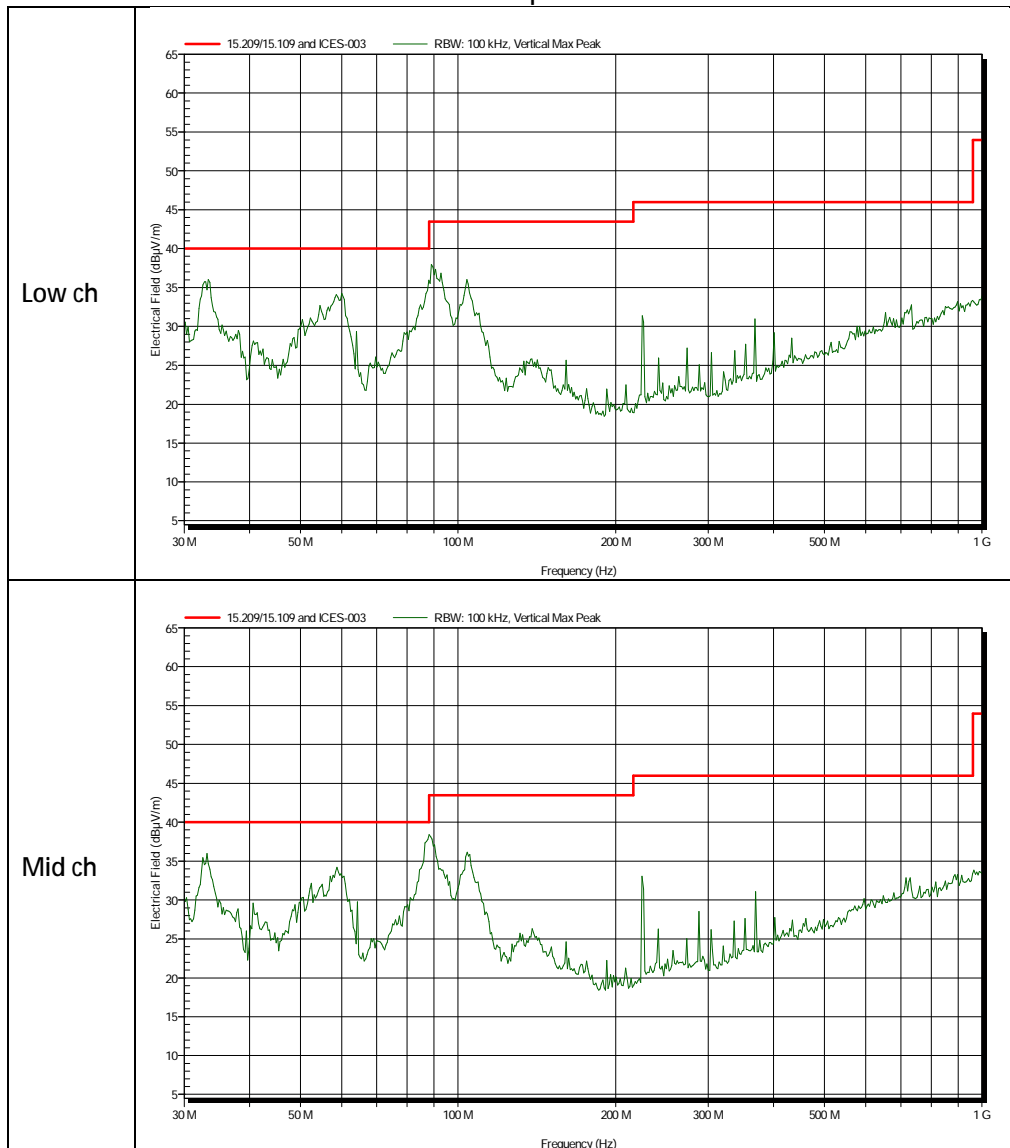
3.2.5 Notes

- In the frequency range of 1 – 18 GHz the green trace is measured using a peak detector and the red trace is measured using an average detector. The top limit line represent the peak limit and the bottom limit represents the average limit

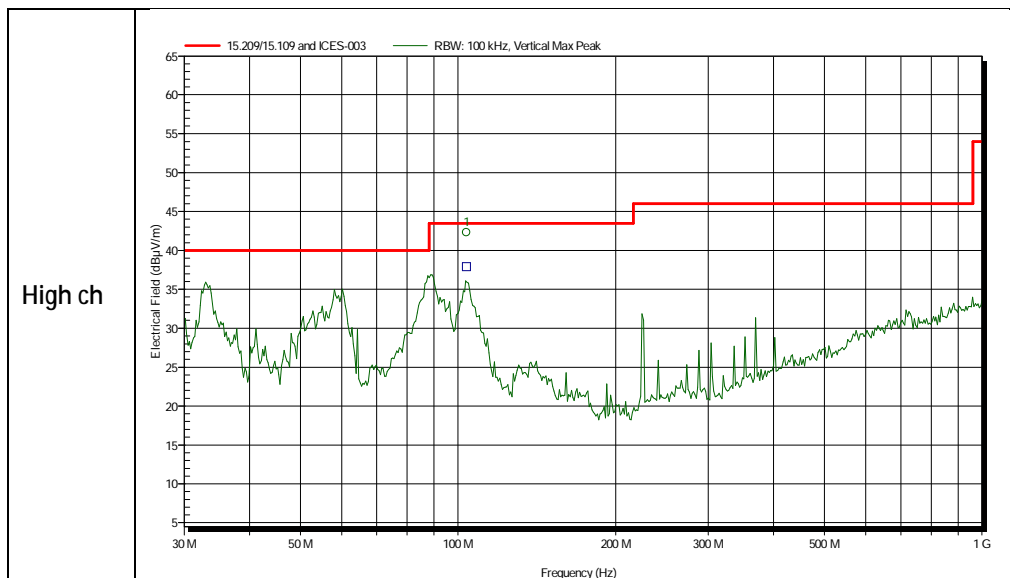
3.2.6 Plots of the Radiated Spurious Emissions Measurement

30 MHz to 1 GHz

Vertical polarization

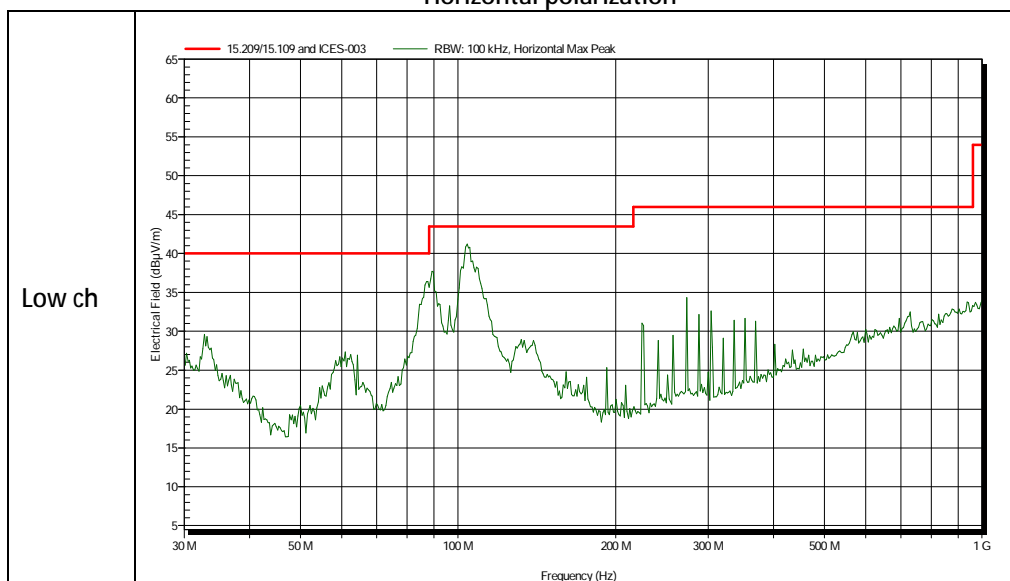


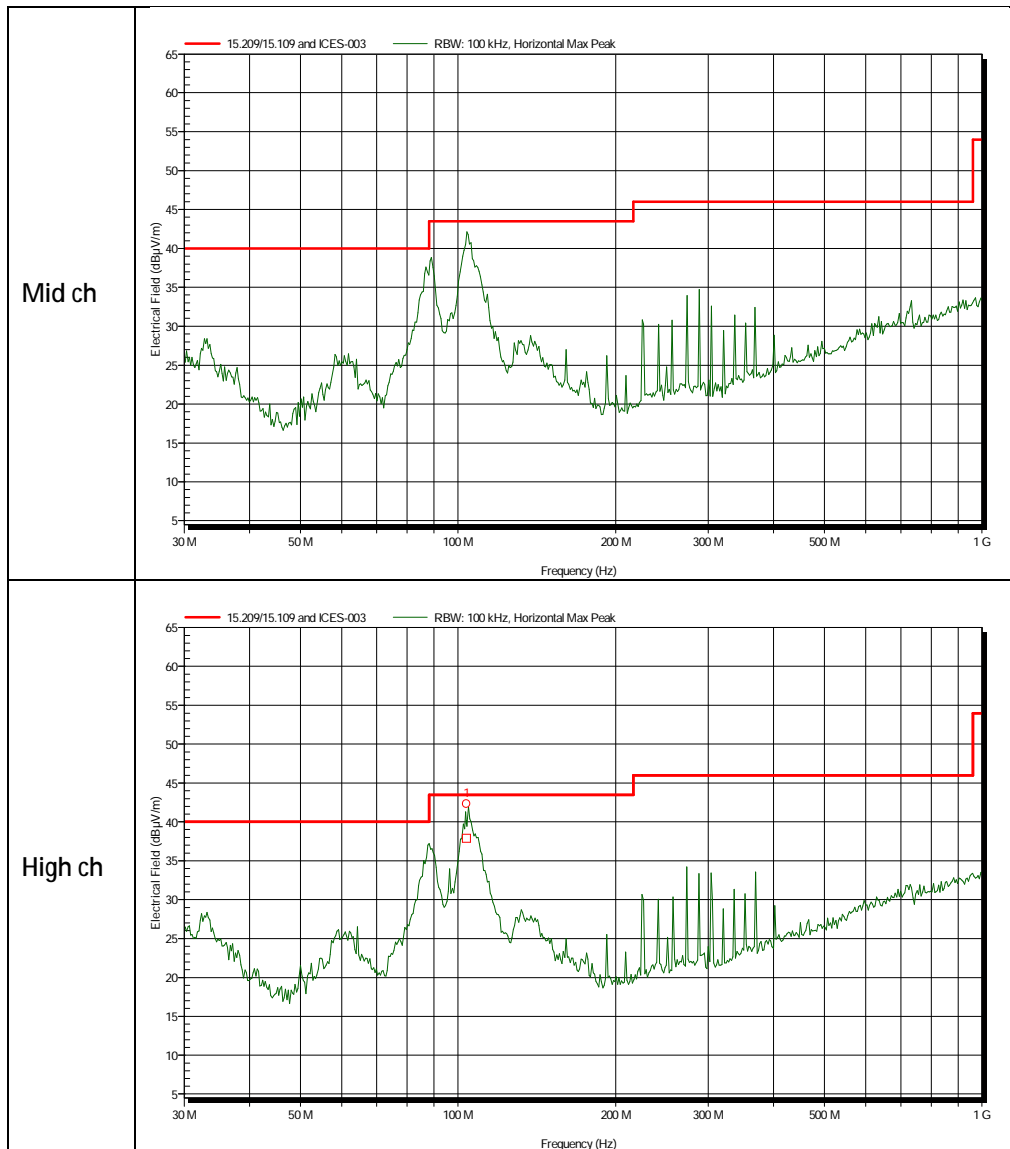
Report number: 161201223 001 V1.0



30 MHz to 1 GHz

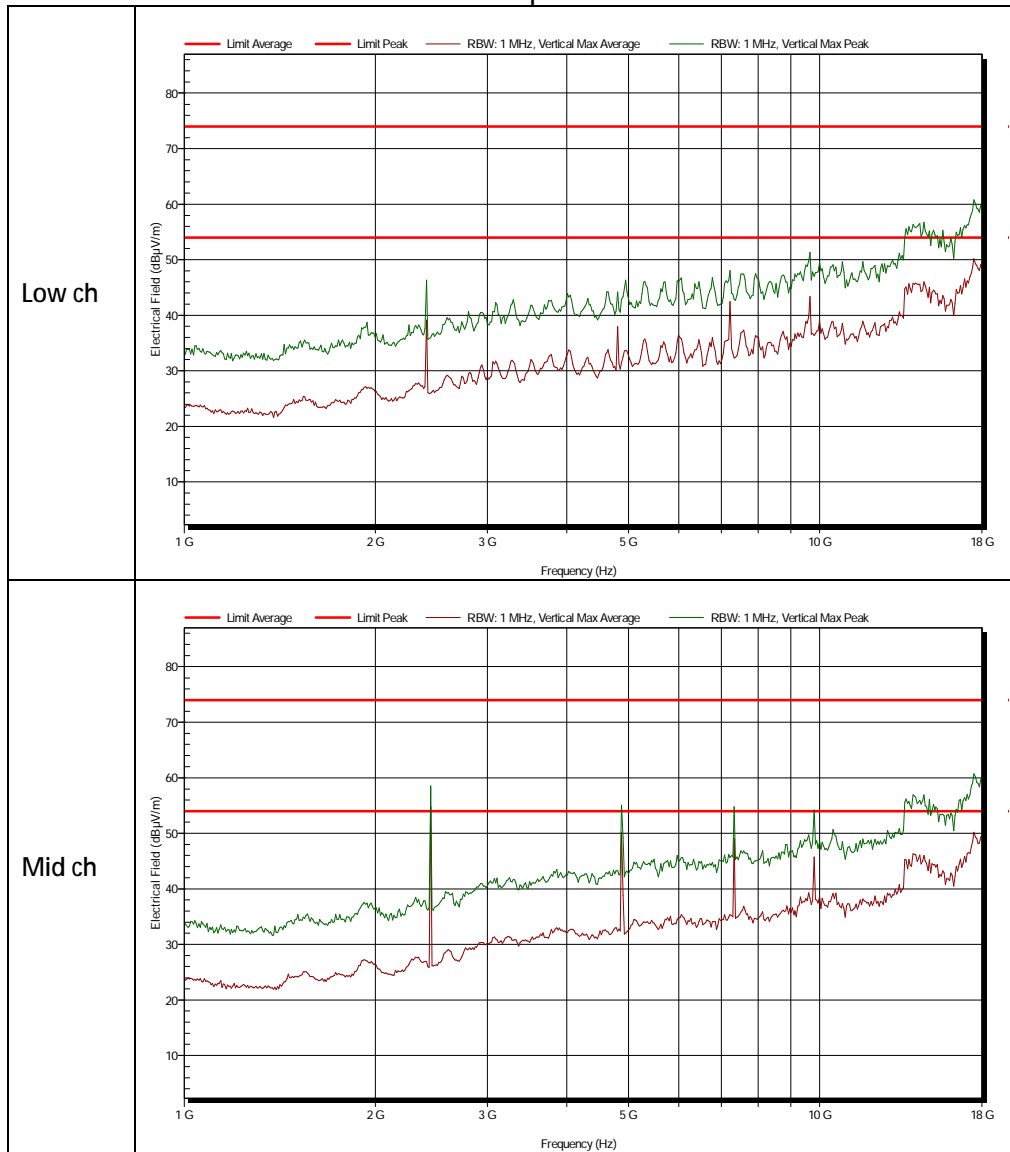
Horizontal polarization



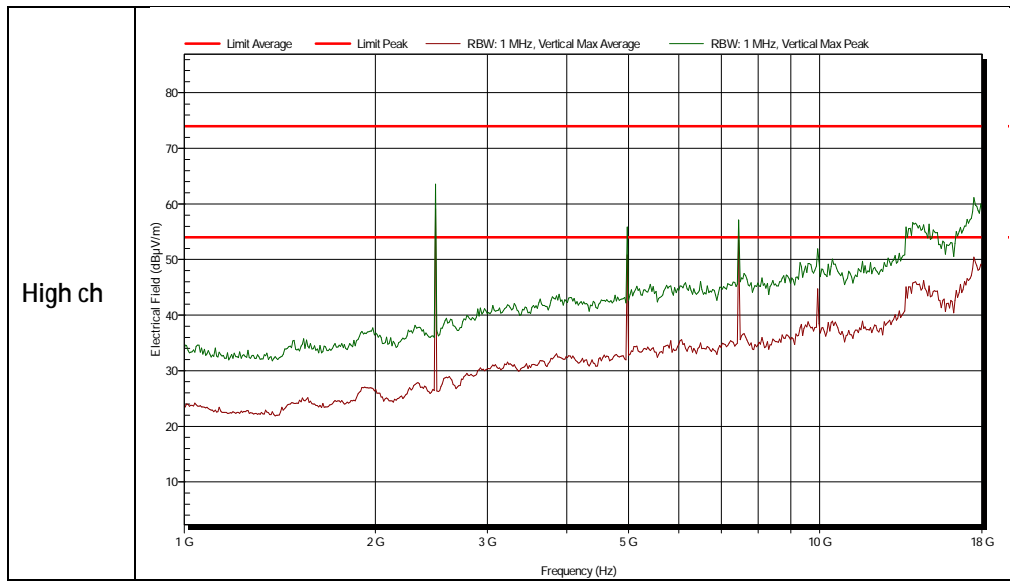


1 GHz to 18 GHz

Vertical polarization



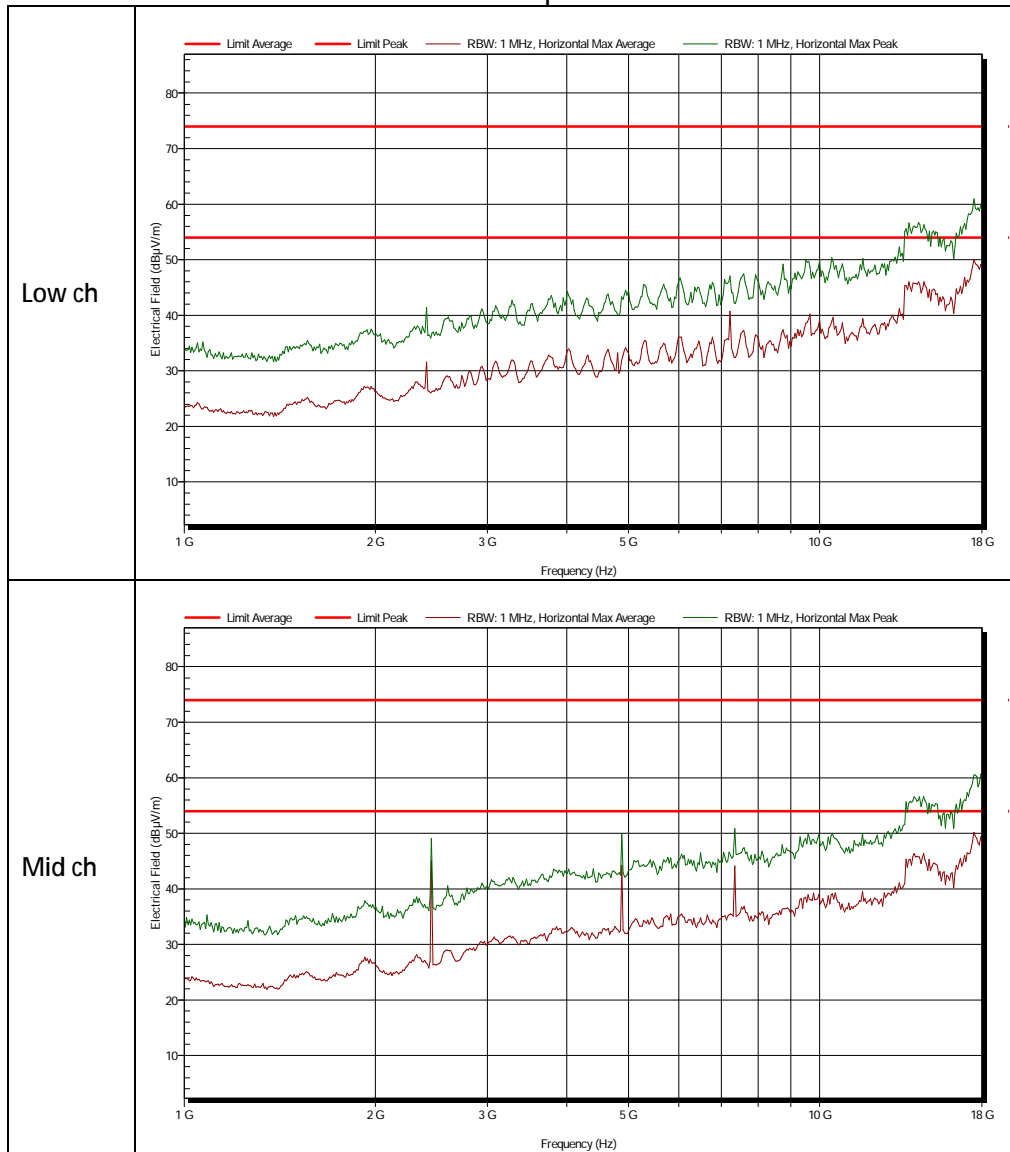
Note: The peaks at 2,4; 4,8; 7,2 and 9,6 GHz are the transmission frequency and its harmonics

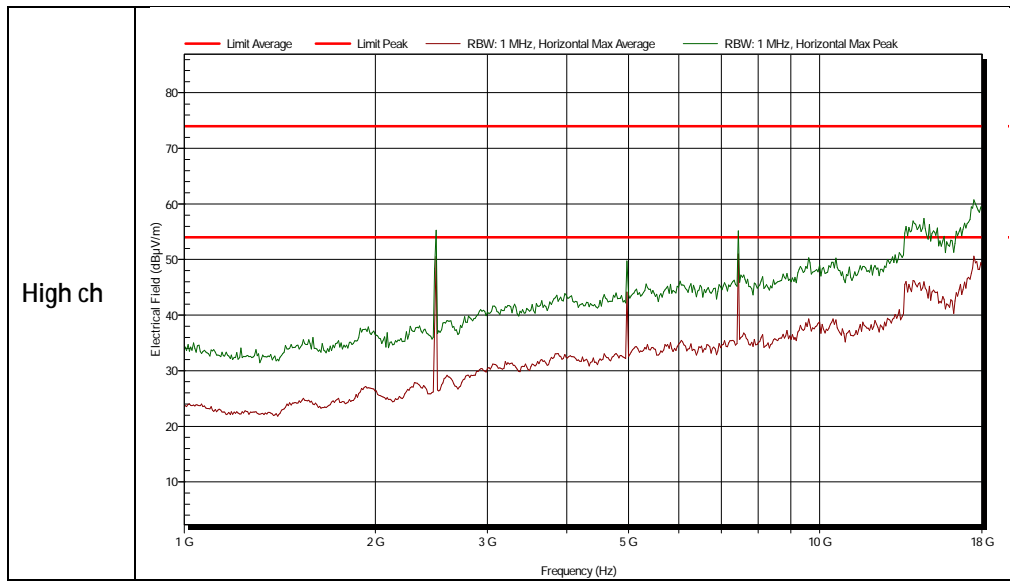


Report number: 161201223 001 V1.0

1 GHz to 18 GHz

Horizontal polarization





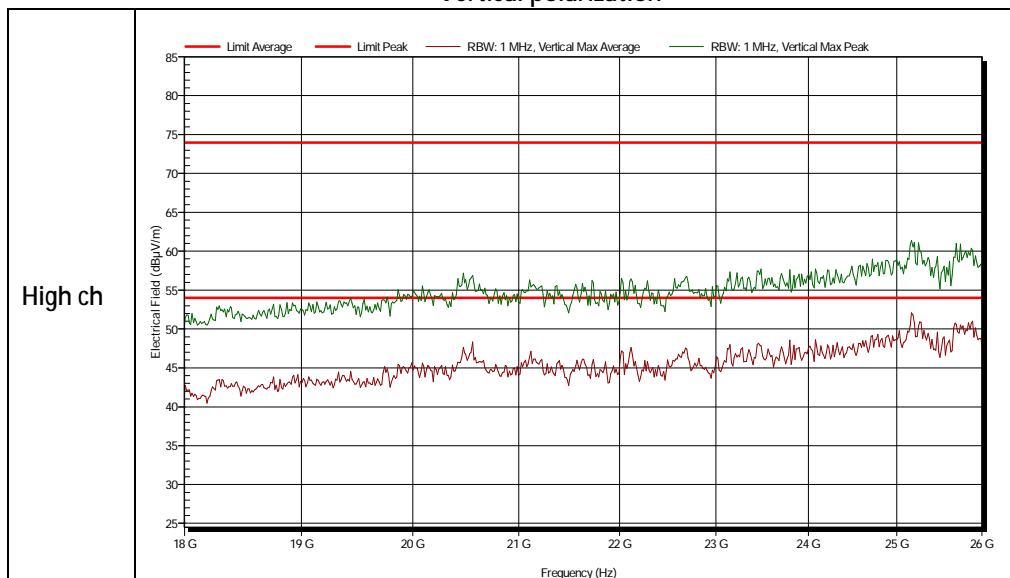
Report number: 161201223 001 V1.0

18 GHz to 26 GHz

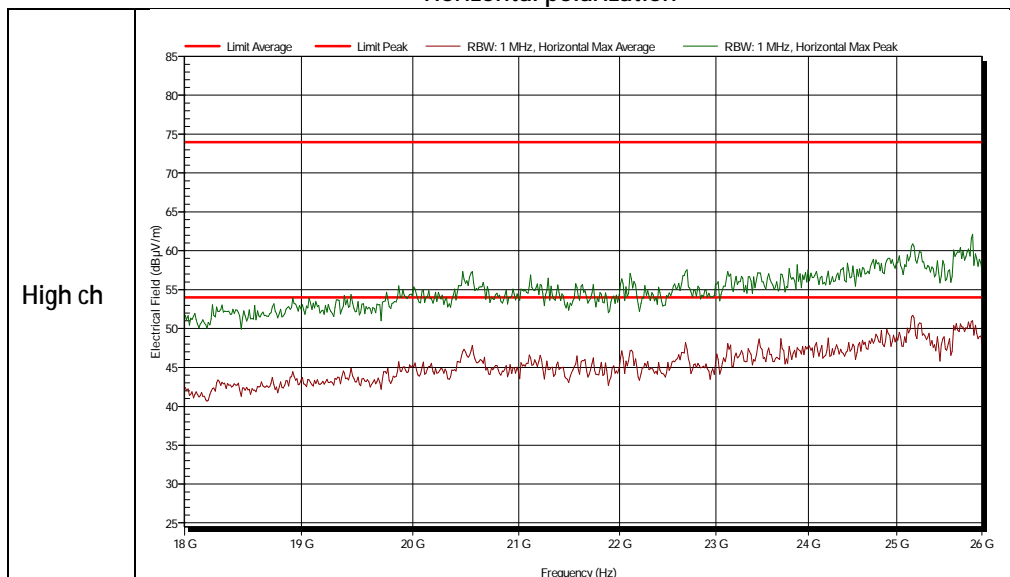
From the 1 to 18 GHz results the high channel was selected to be representative for the emissions in the 18 to 26 GHz band for all channels.

No emissions above measurement system noise floors are measured. (See below)

Vertical polarization



Horizontal polarization



3.2.7 Measurement Uncertainty

Measurement uncertainty Radiated emissions below 1 GHz

| | |
|-------------------------|--------|
| Horizontal polarization | |
| 30 – 200 MHz | 4.5 dB |
| 200 – 1000 MHz | 3.6 dB |
| Vertical polarization | |
| 30 – 200 MHz | 5.4 dB |
| 200 – 1000 MHz | 4.6 dB |

Measurement uncertainty Radiated emissions between 1-18 GHz

| | |
|-----------------|---------------|
| 1000- 18000 MHz | + 5.7/- 5.7dB |
|-----------------|---------------|

Measurement uncertainty radiated emissions between 18-26 GHz

| | |
|-----------------|---------------|
| 18000-26000 MHz | + 3.9/- 3.9dB |
|-----------------|---------------|

3.3 Conducted spurious measurement at AC mains

3.3.1 Limit

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

| Frequency of emission (MHz) | Conducted limit (dB μ V) | |
|-----------------------------|------------------------------|-----------|
| | Quasi-peak | Average |
| 0.15–0.5 | 66 to 56* | 56 to 46* |
| 0.5–5 | 56 | 46 |
| 5–30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

3.3.2 Measurement equipment

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

3.3.3 Test set up

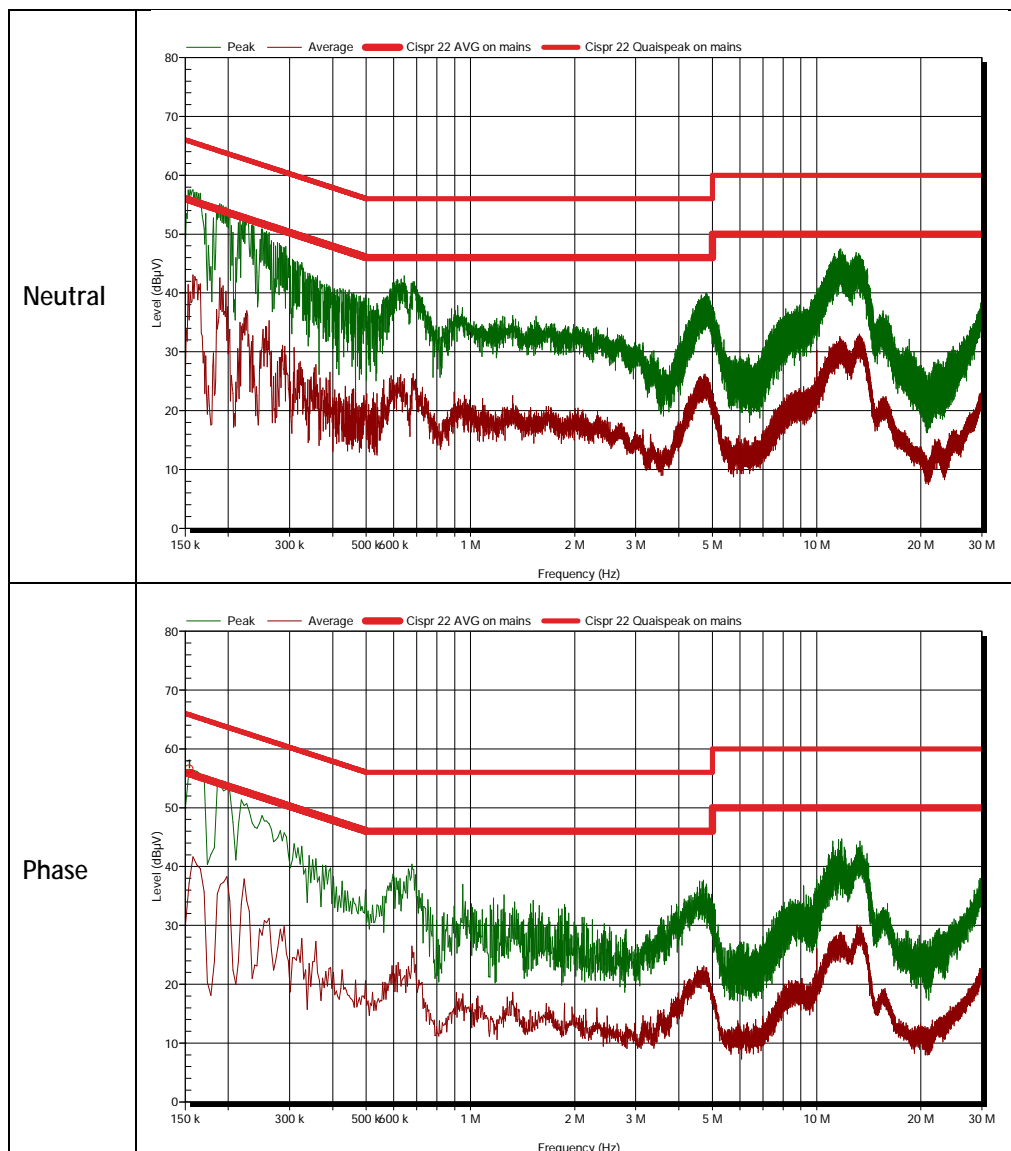
The test setup is as shown in chapter 2.3 of this report.

3.3.4 Test procedure

According to ANSI C63.4: 2014, section 13.3.

3.3.5 Plots of the AC conducted spurious measurement

150 kHz to 30 MHz



3.3.6 Measurement uncertainty

+/- 3.6 dB

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approx. 95%, but excluding the effect of measurement system repeatability.