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FCC and ISED Test Report for Parts 15.247, 15.109, 15.207 (DTS) and RSS-247 and RSS-Gen

Product name	: Water quality detection system
Applicant	: Neways Technologies
FCC ID(1)	: 2AO8D-SENSOR
FCC ID(2)	: 2AO8D-IOT
ISED ID(1)	: 23695-H2OALERTSEN
ISED ID(2)	: 23695-H2OALERTIOT

Test report No.: 171200011 06 Ver 2.00

Laboratory information

Accreditation

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).

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

Telefication is a Wireless Device Testing laboratory recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements. The Designation number is: ISED#: 4173A. The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

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 Telefication Netherlands.

Testing Location

Test Site	Telefication BV
Test Site location	Edisonstraat 12a 6902 PK Zevenaar The Netherlands Tel. +31889983600 Fax. +31316583189
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	27-03-2018	First draft	PS
v1.00	25-07-2018	Final version	PS
v2.00	04-07-2019	Correct typo in the test summary table on line 3. Updated ISED id of sensor on frontpage. Added occupied bandwidth test results.	PS

Table of Contents

Summary of Test results

FCC part 15.247 section	RSS-247 issue 2 section	Description	Section in report	Verdict
15.247(b)	5.1 (20	RF output power	3.1	Pass
15.247(e)	5.2 (2)	Power spectral density	3.3	Pass
15.247 (f)	5.3	Hybrid operation	3.2	Pass
15.247(d)	5.5	TX Radiated Spurious emissions	3.5	Pass
15.109(a)	5.4	RX Radiated Spurious emissions	3.4	Pass
15.207 (a)	RSS Gen 8.8	AC conducted emissions	3.5	Pass
--	RSS-Gen 6.7	99% Bandwidth	3.6	Pass

1 General Description

1.1 Applicant

Client name:	Neways Technologies
Address	Voltaweg 10
Zip code:	6101XK, Echt
Country:	The Netherlands
Telephone:	+31(0) 646287548
E-mail:	Tim.van.der.loo@newayselectronics.com

1.2 Manufacturer

Manufacturer name:	BekoSense
Address:	Hoofdstraat 100
Zip code:	4265HA, Genderen
Country:	The Netherlands
Telephone:	+31 90) 653272390
E-mail:	ekolsteeg@bekosense.com

1.3 Tested Equipment Under Test (EUT)

Product name:	Water quality detection system
Brand name:	H2O-ALERT
Type designation (1)	1003300
Type designation (2)	1003310
FCC ID (1):	2AO8D-SENSOR
FCC ID (2)	2AO8D-IOT
ISED ID(1)	23695-H2OALERTSEN
ISED ID(2)	23695-H2OALERTIOT
Serial number:	--
Software version (1):	1.4.0
Software version (2):	1.4.1
Hardware versions (1 & 2):	Rev1
Date of receipt	7-02-2018
Tests started:	7-02-2018
Testing ended:	8-02-2018

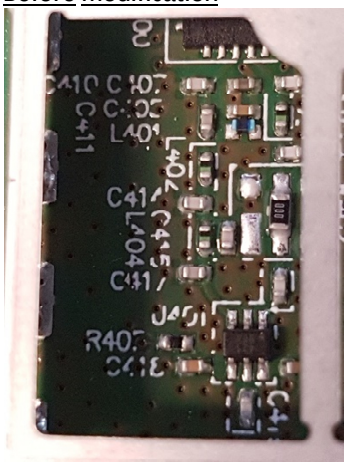
1.4 Product specifications of Equipment under test

TX frequencies (MHz)	915.0; 915.2; 915.4
RX frequencies	915.0; 915.2; 915.4
Maximum output power to antenna	14 dBm
Antenna gain	0.4 dBi
Type of modulation	GFSK
Emission designator	125KF1D
Spreading factor	8

1.5 Modification of the Equipment Under Test (EUT)

The filter between LoRa transceiver module (part number U400A) and antenna connection has been modified for both the sensor and the gateway in order to suppress radiated spurious emissions below the limit.

Before modification



After modification

1.6 Environmental conditions

- Ambient temperature 24 °C
- Humidity 42.2 %

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 C §15.247
- FCC Part 15 Subpart B, § 15.109
- ISED RSS-247
- ISED RSS-Gen

1.8 Measurement guidances:

- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V4.
- ANSI C63.10:2013
- ANSI C63.4: 2014
- FCC KDB Publication No. 453039

1.9 Observations and remarks

The H20alert is a water quality detection system which measures temperature and conductivity changes inside drinking water tanks for cows.
The system has one or more sensors and a gateway.
The sensor measures every minute the temperature and the conductivity of the water. If these values are within the alarm trigger range, an data transfer over the air by use of LORA will happen in the first available timeslot. The Gateway receives this data and will transmit it over GPRS to a webserver which triggers the alarm and inform the end user.

Except for the spurious emission tests (TX and RX) all other tests are common for the sensor and the gateway.

1.10 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. 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 1.7 *"Applicable standards".*

All tests are performed by:

Name : ing. P.A. Suringa

Review of test methods and report by:

Name : ing. R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 05-07-2019

Name : ing. K.A Roes

Function : Coordinator Radio Laboratory

Signature :

2 Test configuration of the Equipment Under Test

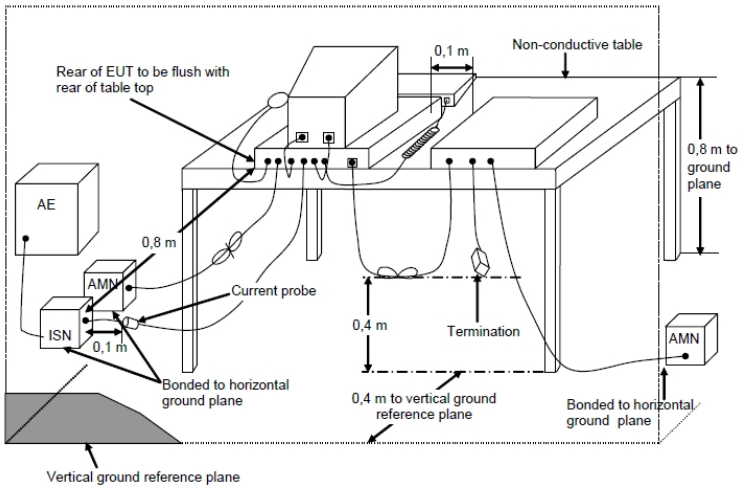
2.1 Test mode

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

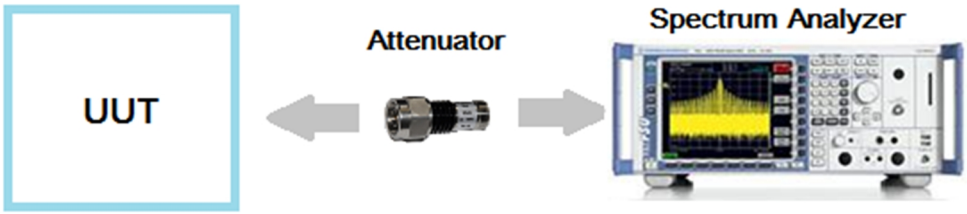
2.2 Tested channels and Data rates

Technology	Channels	Data rate	Frequency (MHz)
Proprietary RF	Low	3 kbps	915

2.3 Conducted Test setup

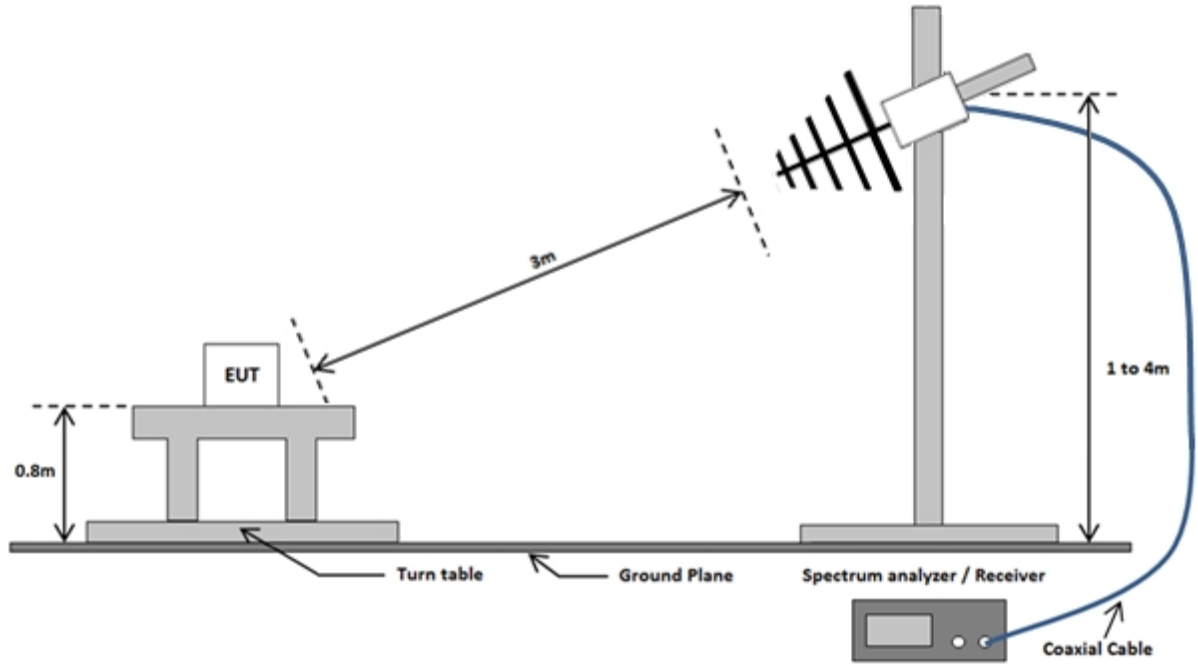


Conducted antenna port test setup

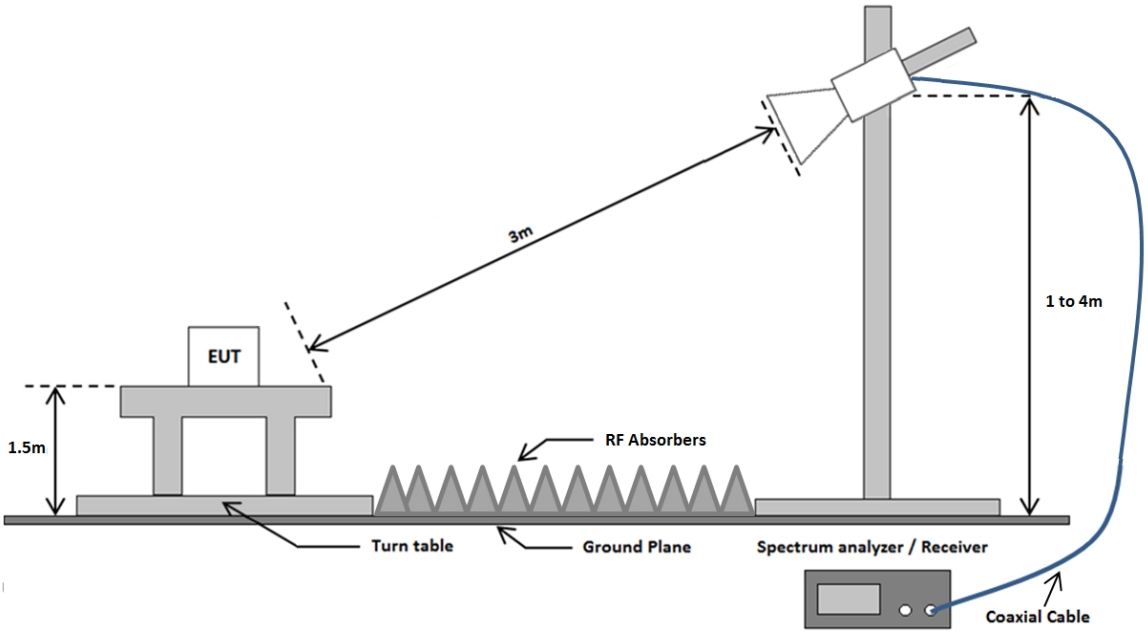


2.4 Radiated Test setup

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.5 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSV	TE01269	3.4, 3.5
EMI receiver	Rohde & Schwarz	ESR7	TE01220	3.1, 3.2, 3.3, 3.4, 3.5, 3.6
Biconilog Antenna	Chase	CBL6112A	TE00967	3.1, 3.2, 3.3, 3.4, 3.5
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.4, 3.5
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE11132	3.4, 3.5
Semi Anechoic Chamber (SAC)	Comtest Engineering BV	-	TE00861	3.1, 3.2, 3.3, 3.4, 3.5
High pass filter	Wainwright instruments	WHK1.1/15G-10EF	TE01139	3.4, 3.5
Measurement software	DARE!! RadiMation®	Ver. 2016.	--	3.1, 3.4, 3.5, 3.6
Artificial Mains network	Rohde & Schwarz	ESH3-Z5	TE00208	3.6

2.6 Sample calculations

Field strength measurement example (ref. § 3.5.5 of this report)

Frequency	Polarization	Height	Peak
7,336 GHz	Vertical	4 m	52,2 dBµV/m

The following relation applies:

E (dBµV/m) = U(dBµV) + AF (dB/m) – G (dB) + CL (dB)

Where:

E = Electric field strength
U = Measuring receiver voltage
AF = Antenna Factor
G = Gain of the pre-amplifier
CL = Cable Loss

(52.2 = 46.22 + 36.4 - 37.62 +7.2)

3 Test results

3.1 Peak Output Power Measurement

3.1.1 Limit

For systems using digital modulation in the 902 - 928 MHz band, the limit for the peak output power is 30 dBm.
If transmitting antenna of directional gain greater than 6 dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point to point operation, the limit has to be reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

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

IRN 014 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v4.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.

3.1.5 Test results of Peak Output Power Measurement

Sensor

Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Proprietary RF	Low	915.00	3 kbps	14.9
Uncertainty	±4.6 dB			

Gateway

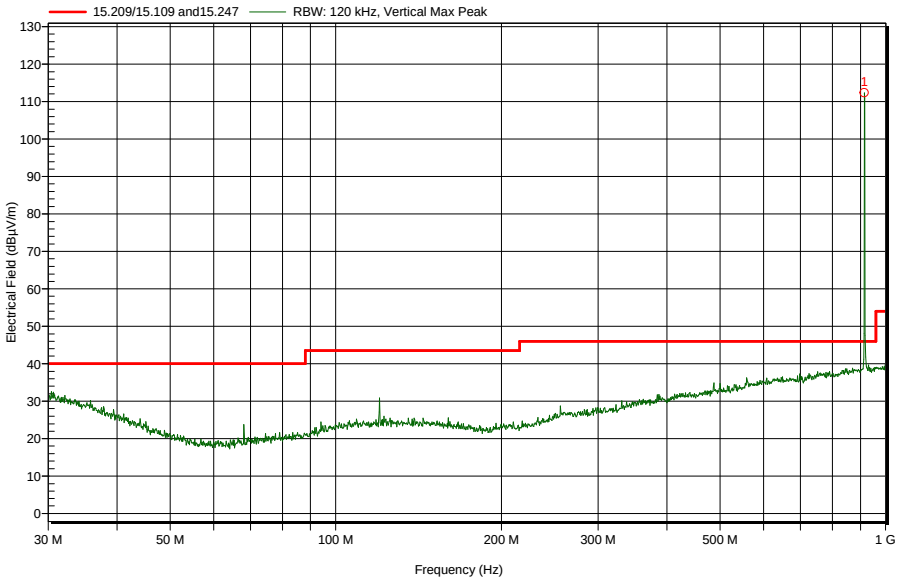
Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Proprietary RF	Low	915.00	3 kbps	12.6
Uncertainty	±4.6 dB			

3.1.6 Plots of Peak Output Power Measurement

Peak Output Power

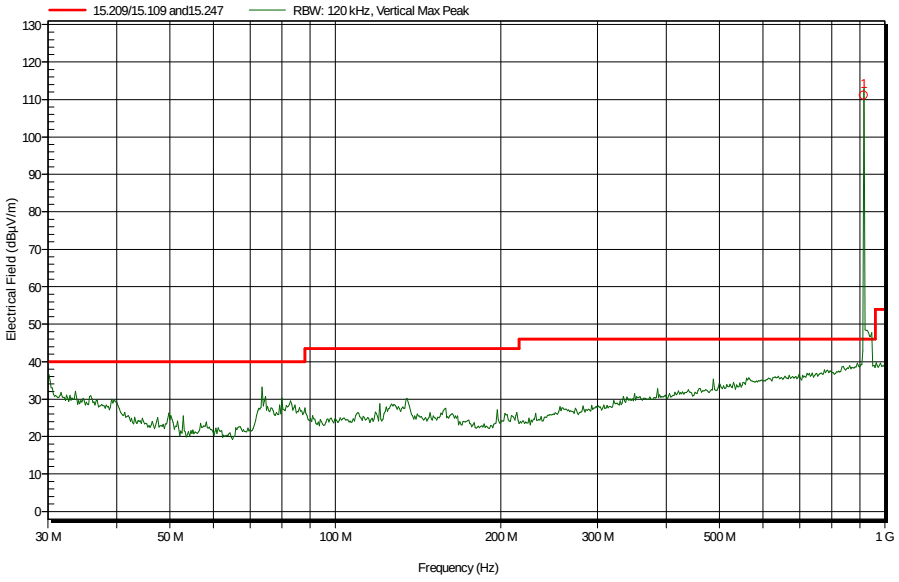
Sensor



Frequency	Peak	Polarization	Height
914,994 MHz	112.3 dBµV/m *)	Vertical	2 m

*) after conversion acc. to ANSI C63.10 Annex G.2, the result is 14.9 dBm.

Gateway



Frequency	Peak	Polarization	Height
914,994 MHz	110 dBµV/m *)	Vertical	2 m

*) after conversion acc. to ANSI C63.10 Annex G.2, the result is 12.6 dBm.

3.2 Hybrid operation

3.2.1 Peak Power density

3.2.1.1 Limit

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.2.1.2 Measurement instruments

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

3.2.1.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.2.1.4 Test procedure

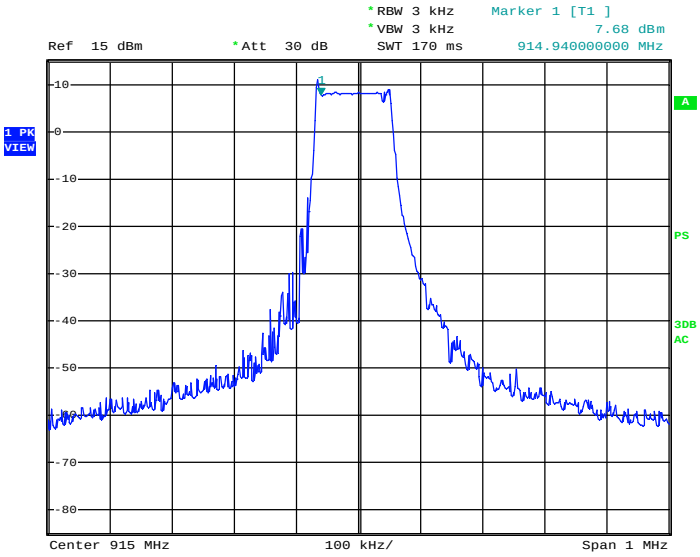
IRN 030 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band).

1. As the transmission pulse (or sequence of pulses) does not remain at maximum transmit power throughout each of the 100 sweeps of averaging, a different approach than that described in ANSI C63.10, § 11.10.3 (Method AVGPSD-1) is followed.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.
4. The procedure as described in method AVGPSD-1 is followed, with the following deviations:
    - trace averaging is disabled,
    - trace mode is set to Max hold

3.2.1.5 Test results of Power Spectral Density Measurement

Technology Std.	Channels	Frequency (MHz)	Data rate	PPSD/3 kHz (dBm)
Proprietary RF	Low	915.0	3 kbps	7.68
	Mid	---	--	--
	High	---	--	--
Uncertainty	±0.63 dB			

3.2.1.6 Plot of the Peak Power Spectral Density Measurement



Date: 8.FEB.2018 09:39:21

3.2.2 Average time of occupancy

3.2.2.1 Limit

The average time of occupancy on any frequency shall not exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4.

3.2.2.2 Measurement instruments

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

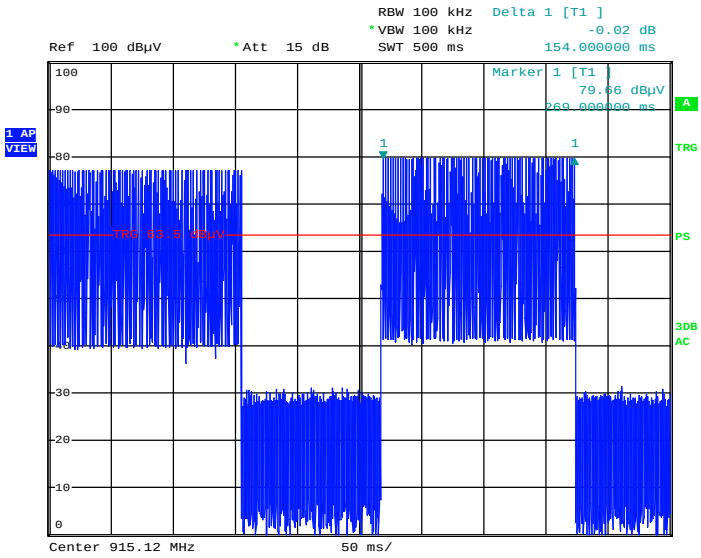
3.2.2.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.2.2.4 Test procedure

According to FCC Public Notice No. DA 00-705.

3.2.2.5 Plot of the average time of occupancy measurement.



Date: 7.FEB.2018 15:46:22

Note: The plot represents the occupancy time of both the sensor and the gateway.
The occupancy time of the sensor is 154 msec.

Measurement uncertainty: ± 5.7%

3.2.3 Hopping function of a hybrid system: channel separation

3.2.3.1 Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

3.2.3.2 Measurement instruments

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

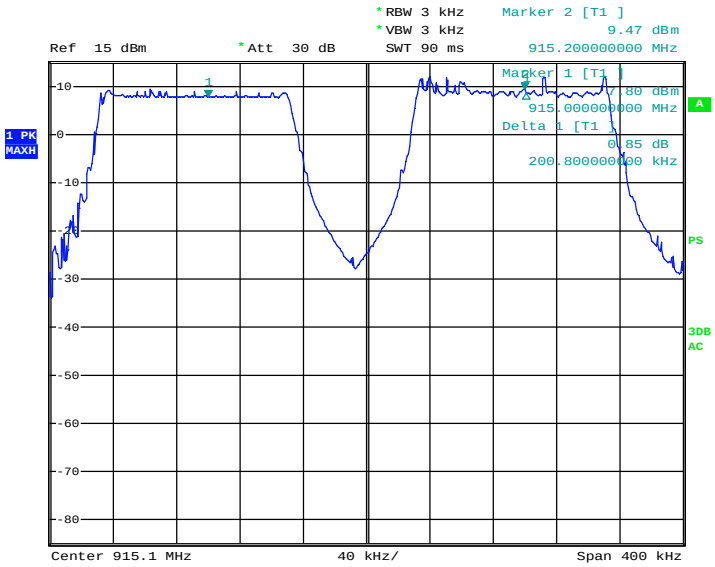
3.2.3.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.2.3.4 Test procedure

According to FCC Public Notice No. DA 00-705.

3.2.3.5 Plot of the channel separation measurement



Date: 8.FEB.2018 09:49:06

The measured channel separation is: 200.8 kHz
Measurement uncertainty: ± 8 kHz

3.3 Tx Radiated Emissions Measurement (incl. restricted bands emissions)

3.3.1 Limit

In any 100 kHz bandwidth outside the operating frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either a RF conducted or a radiated measurement.

Since restricted band emissions are involved, the limits of section 15.209(a) apply.

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

3.3.2 Measurement instruments

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

3.3.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.3.4 Test procedure

According to KDB Publication 558074 V4, sections 11.3 and 12.1.
IRN 026 - Radiated electrical disturbance (V per m) Method 1 – 30 MHz – 1 GHz in SAR.
IRN 026 - Radiated electrical disturbance (V per m) Method 2 – 1 - 18 GHz in SAR.
IRN 026 - Radiated electrical disturbance (V per m) Method 3 – 18 - 26.5 GHz in SAR.

3.3.5 Measurement uncertainty

Frequency range (MHz)	Horizontal polarization	Vertical polarization
30 – 200	4.5 dB	5.4 dB
200 – 1000	3.6 dB	4.6 dB
1000 - 18000	5.7 dB	5.7 dB

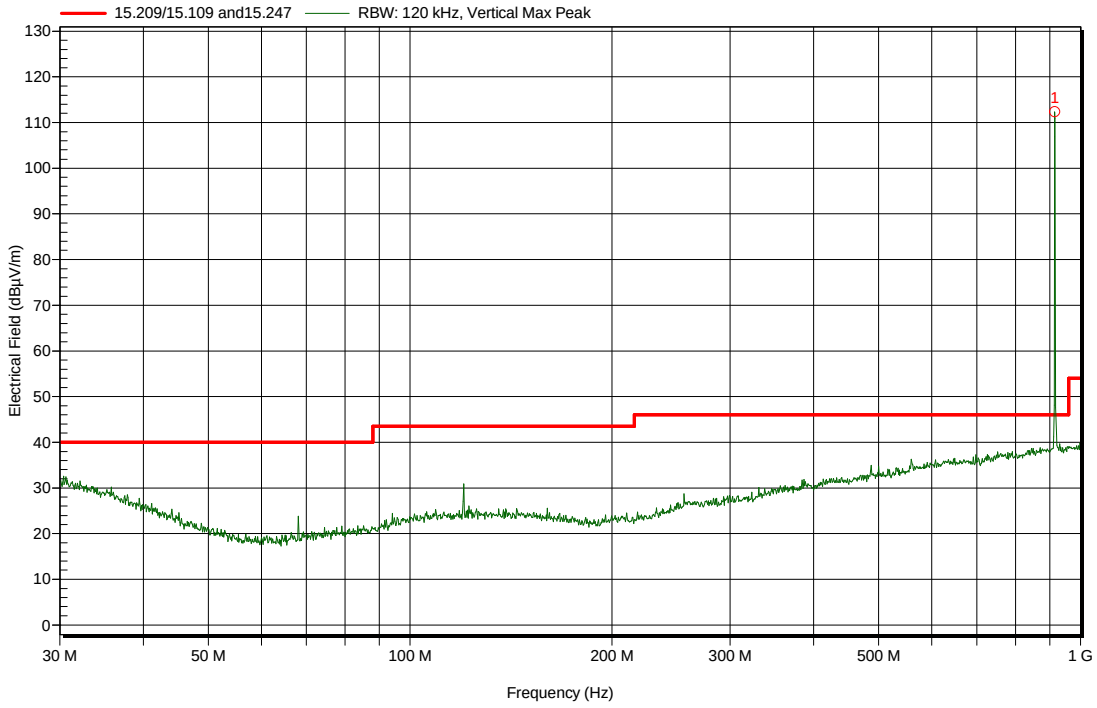
Plots of the Tx Radiated Emissions Measurement (0.03 -10 GHz)

Sensor

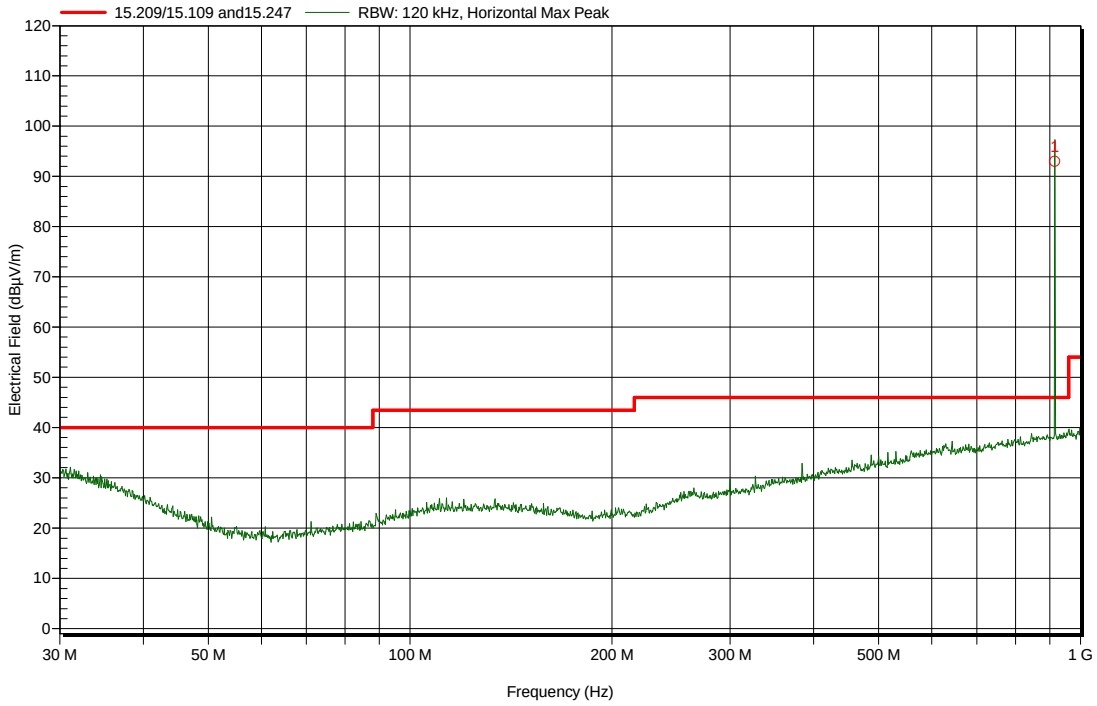
See next page.

0.03 – 1 GHz

Vertical polarization

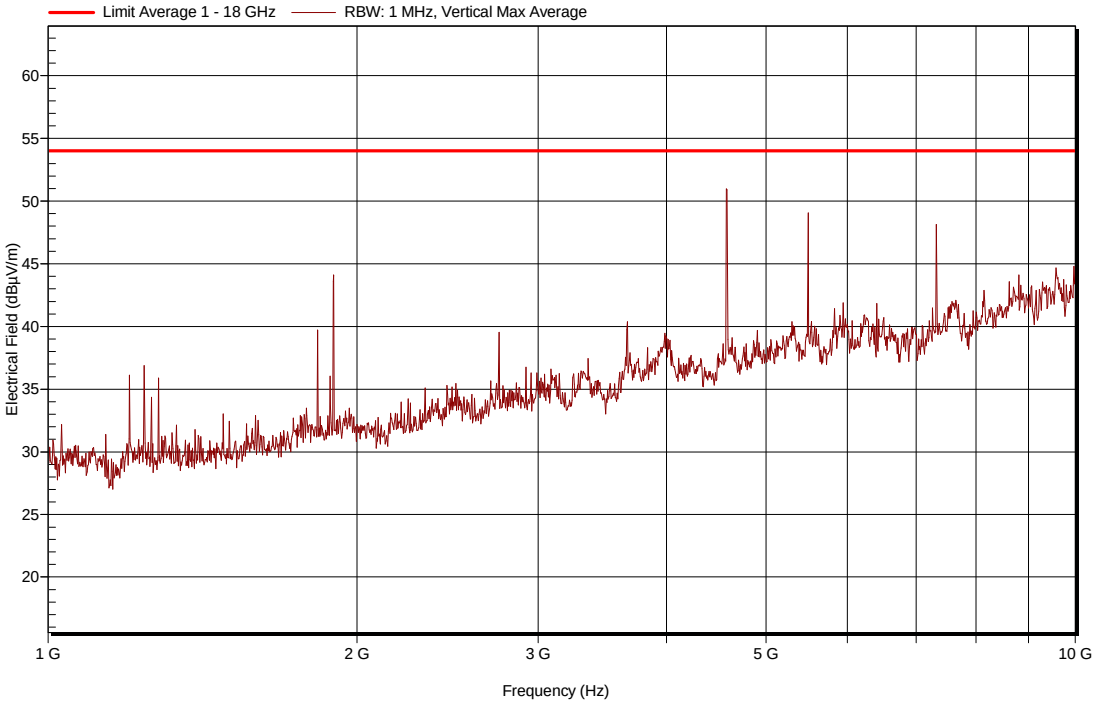


Horizontal polarization

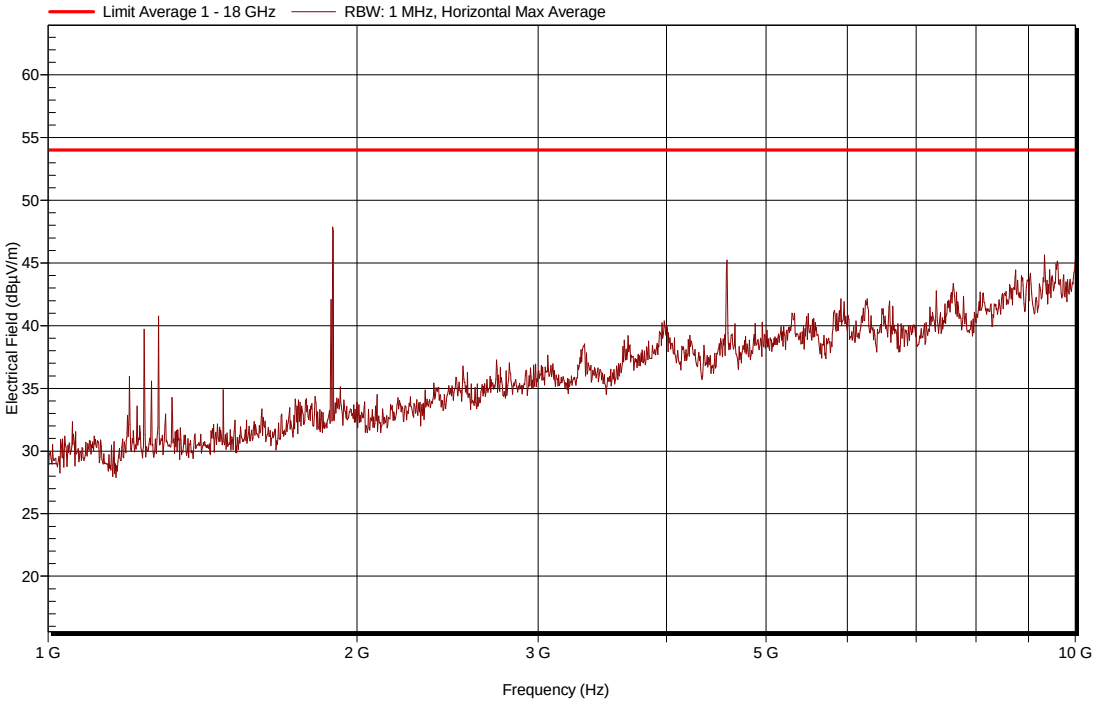


1 - 10 GHz

Vertical polarization



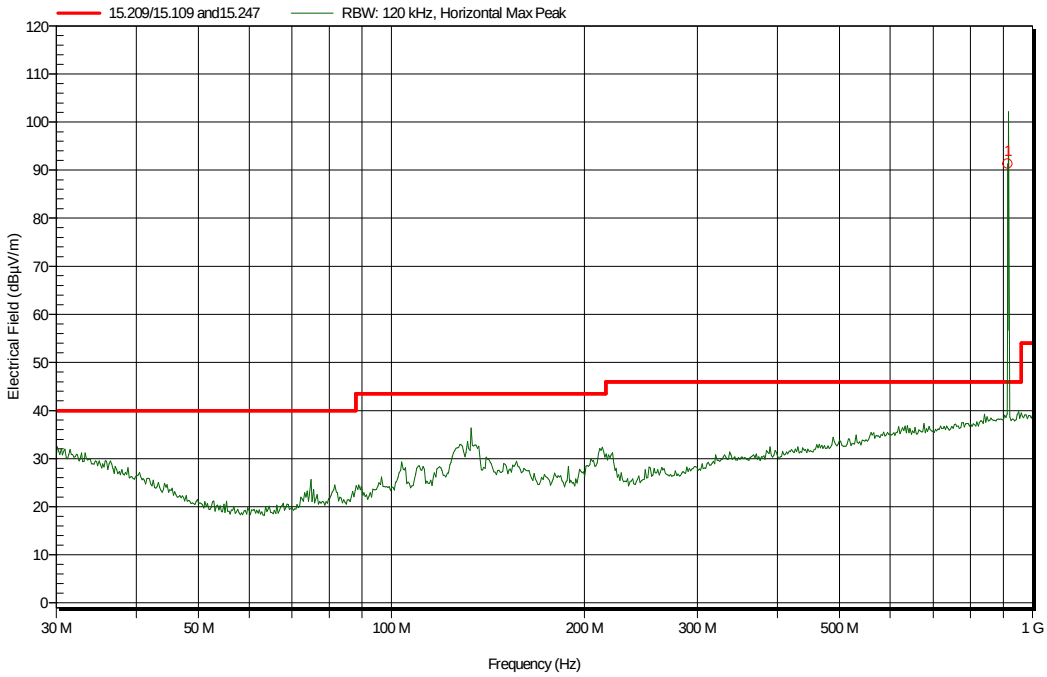
Horizontal polarization



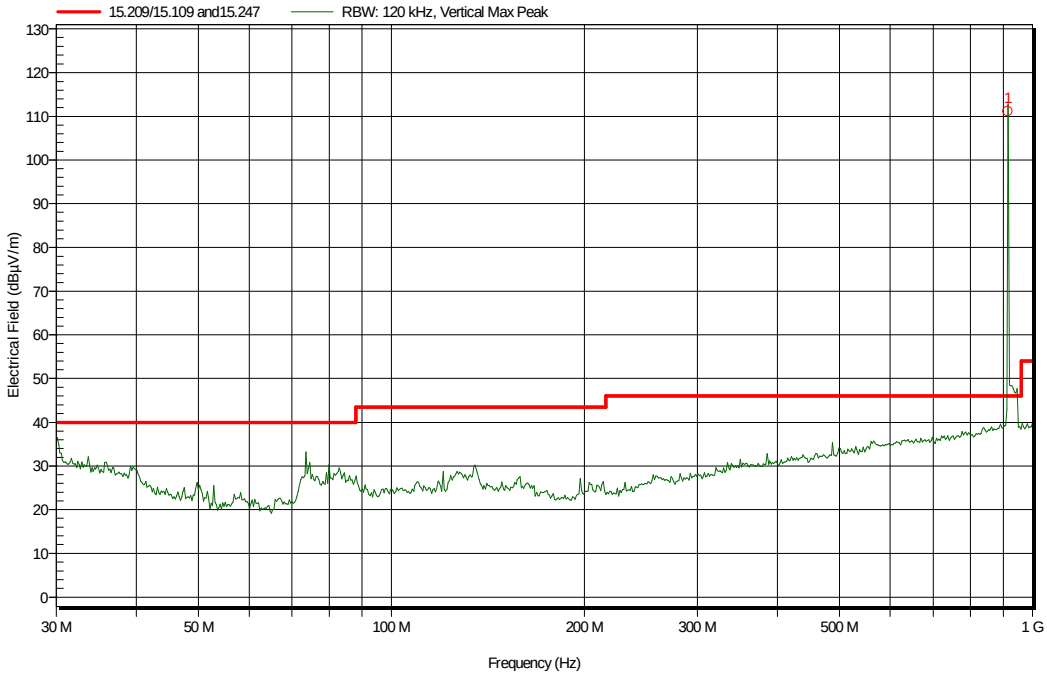
Gateway

0.03 – 1 GHz

Horizontal polarization

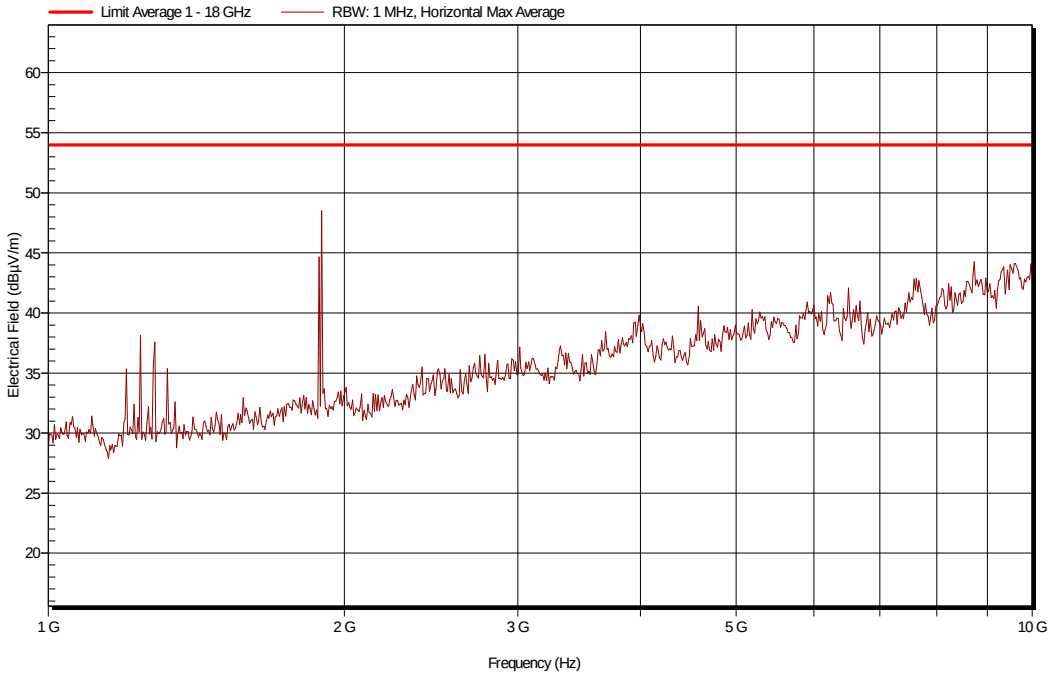


Vertical polarization

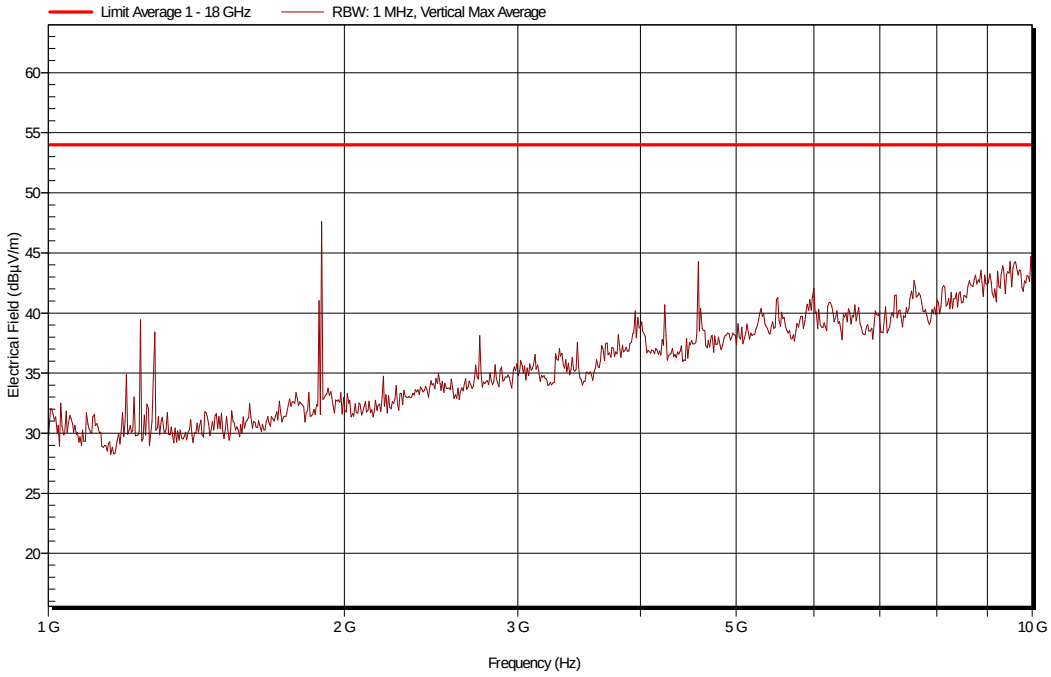


1 - 10 GHz

Horizontal polarization



Vertical polarization



3.4 Rx Radiated Emissions Measurements

3.4.1 Limit

According to FCC part 15.109(a)

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

3.4.2 Measurement instruments

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

3.4.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.4.4 Test procedure

According to ANSI C63.4: 2014, section 8.3.
IRN 026 - Radiated electrical disturbance (V per m) Method 1 – 30 MHz – 1 GHz in SAR.
IRN 026 - Radiated electrical disturbance (V per m) Method 2 – 1 - 18 GHz in SAR.
IRN 026 - Radiated electrical disturbance (V per m) Method 3 – 18 - 26.5 GHz in SAR.

3.4.5 Measurement uncertainty

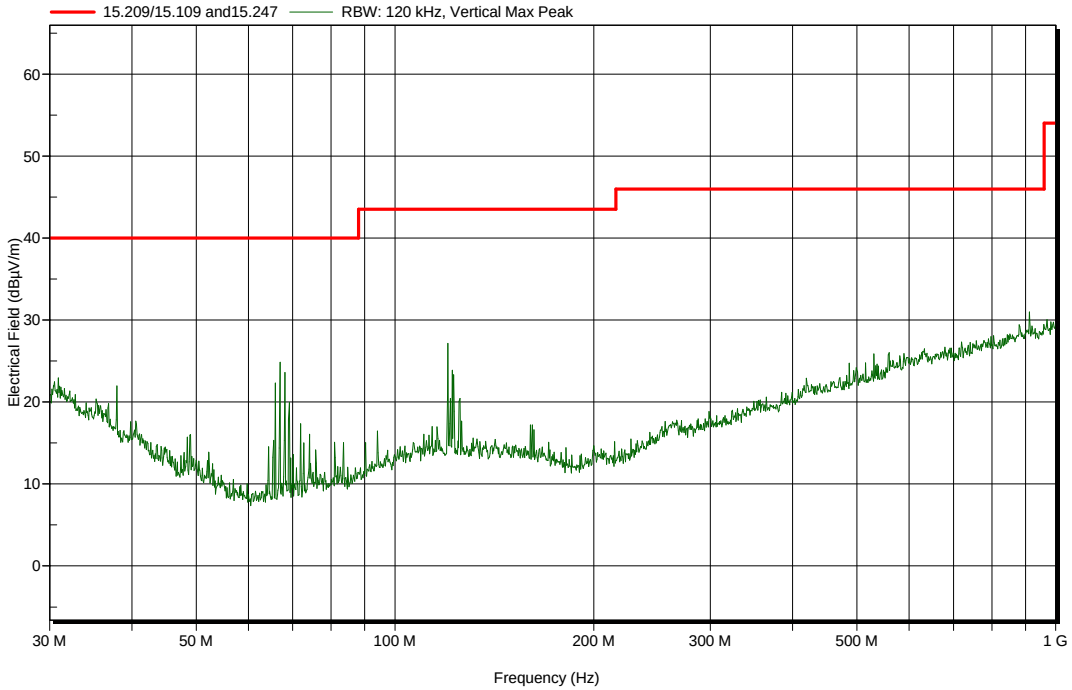
Frequency range (MHz)	Horizontal polarization	Vertical polarization
30 – 200	4.5 dB	5.4 dB
200 – 1000	3.6 dB	4.6 dB
1000 - 18000	5.7 dB	5.7 dB

3.4.6 Plots of the Rx Radiated Emissions Measurement (0.03 -10 GHz)

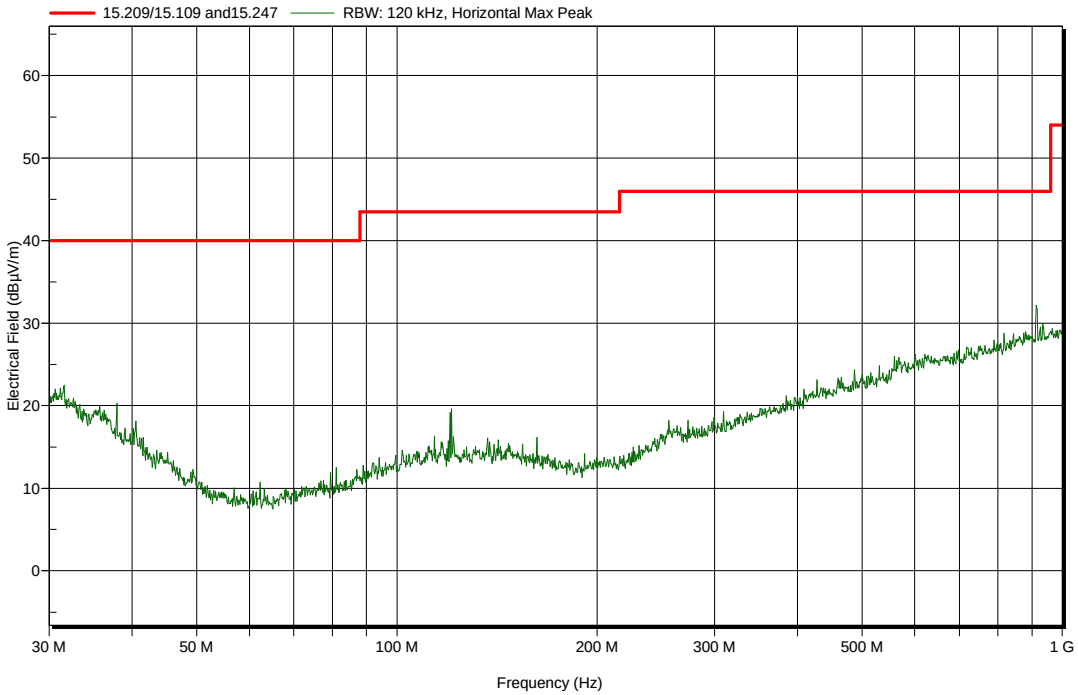
See next page.

Sensor
0.03 - 1 GHz

Vertical polarization

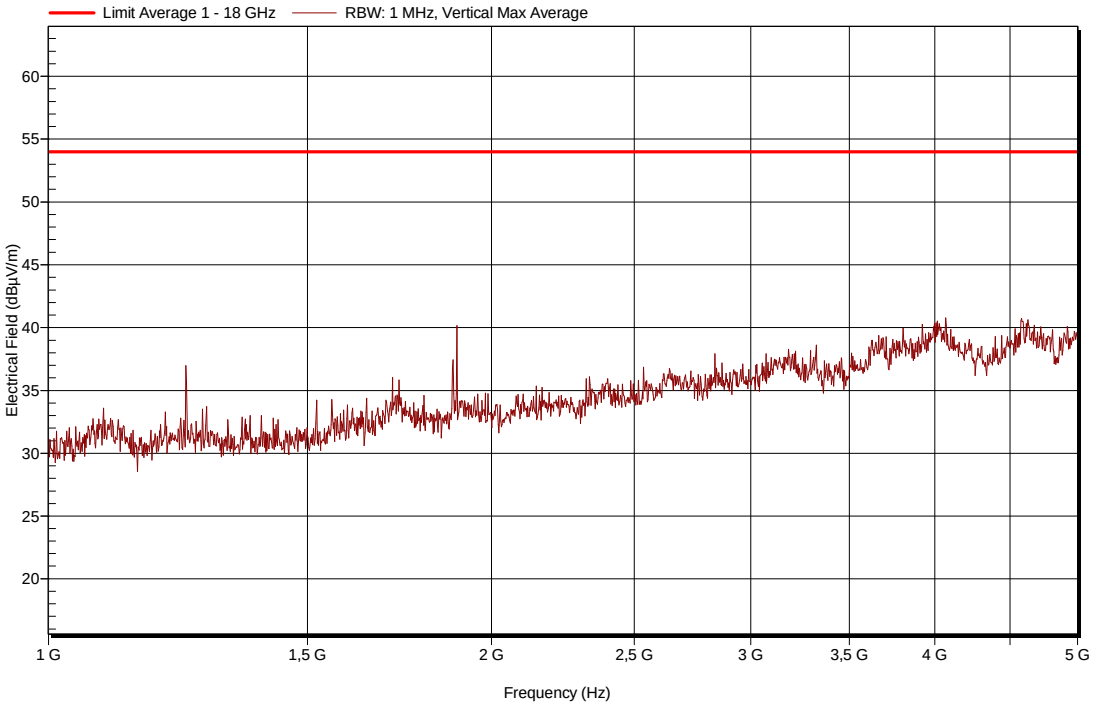


Horizontal polarization

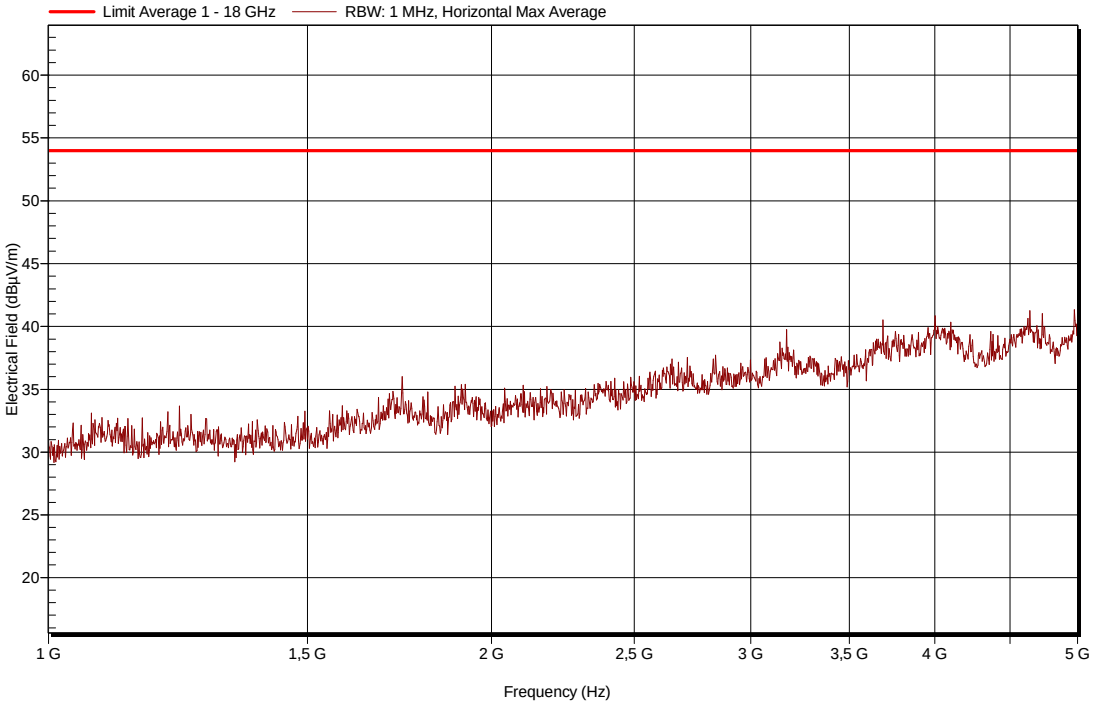


1 – 5 GHz

Vertical polarization



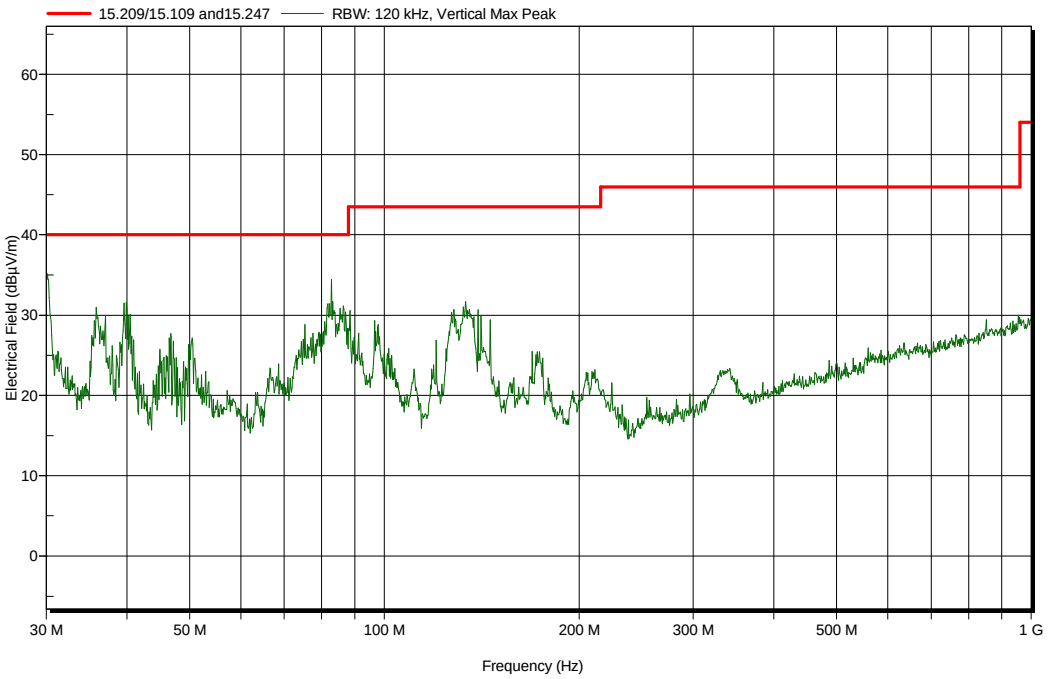
Horizontal polarization



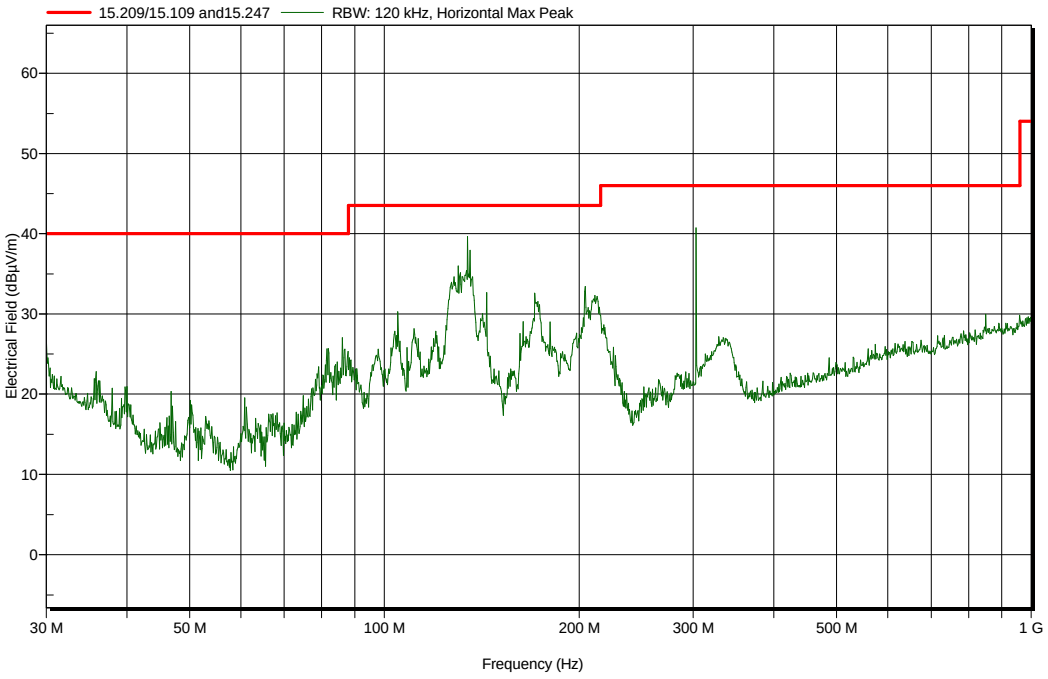
Gateway

0.03 – 1 GHz

Vertical polarization

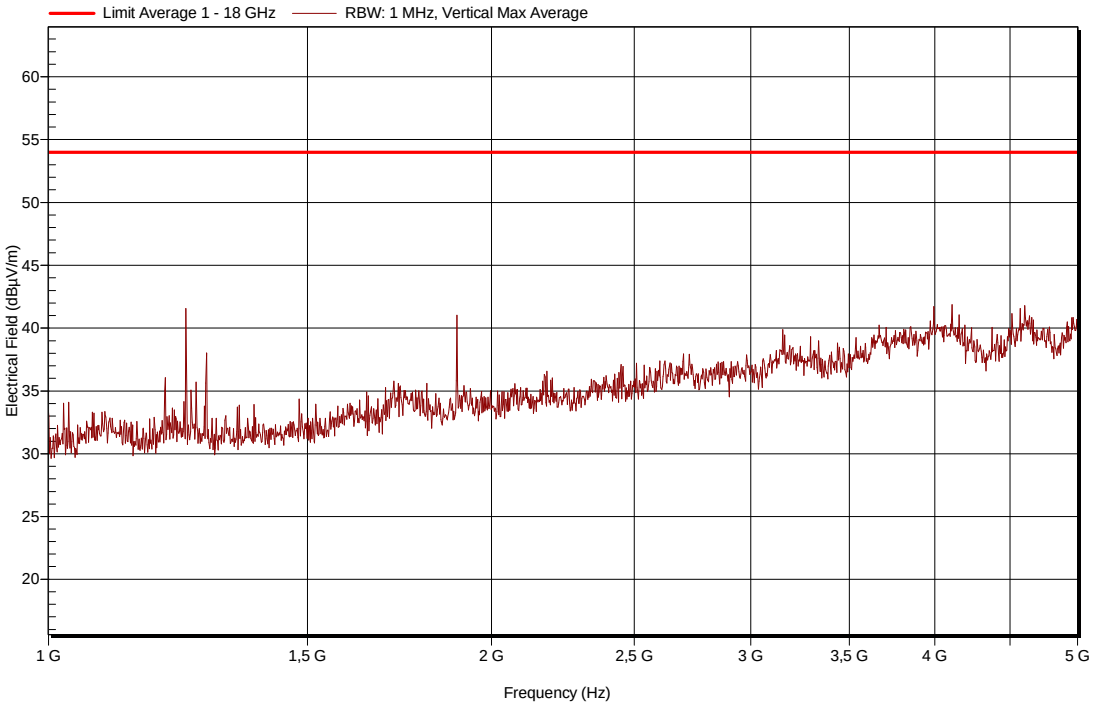


Horizontal polarization

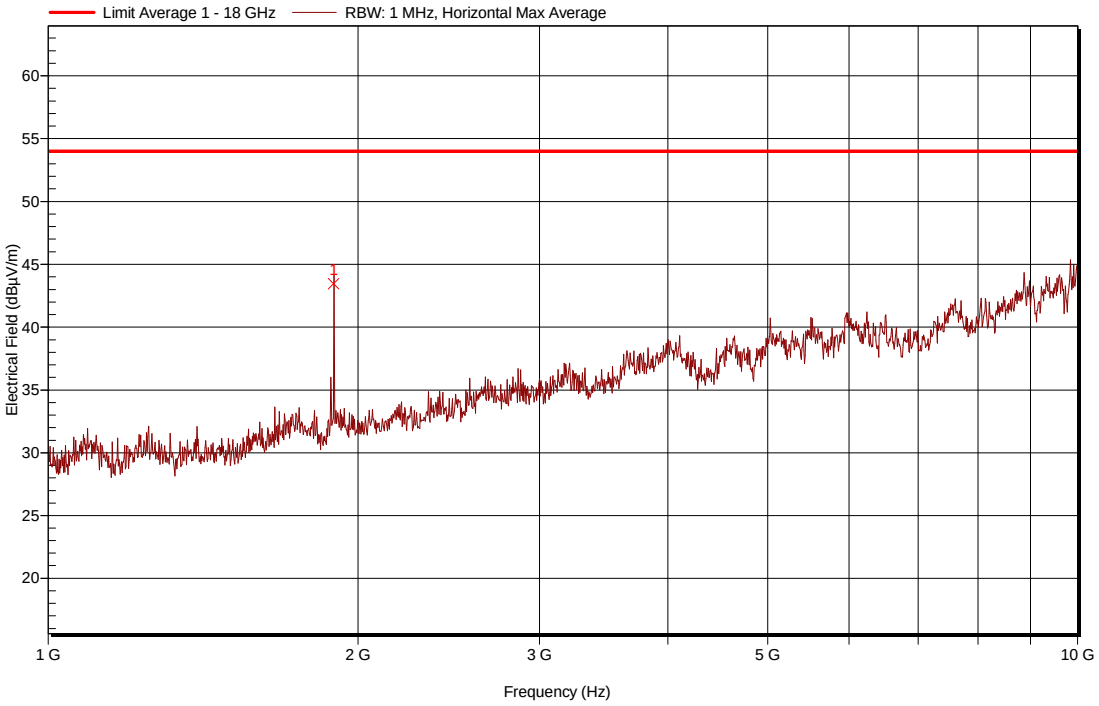


1 – 5 GHz

Vertical polarization



Horizontal polarization



3.5 Conducted emissions

3.5.1 Limit

According to 15.207 (c).

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 (dBµV)	
	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.

3.5.2 Measurement setup

The measurement setup can be found in chapter 2.3 of this report.

3.5.3 Test procedure

According to ANSI C63.10: 2013, clause 6.2.1.
IRN 029 - Conducted disturbance (V) Method 1 – AC mains conducted disturbance.

3.5.4 Test results

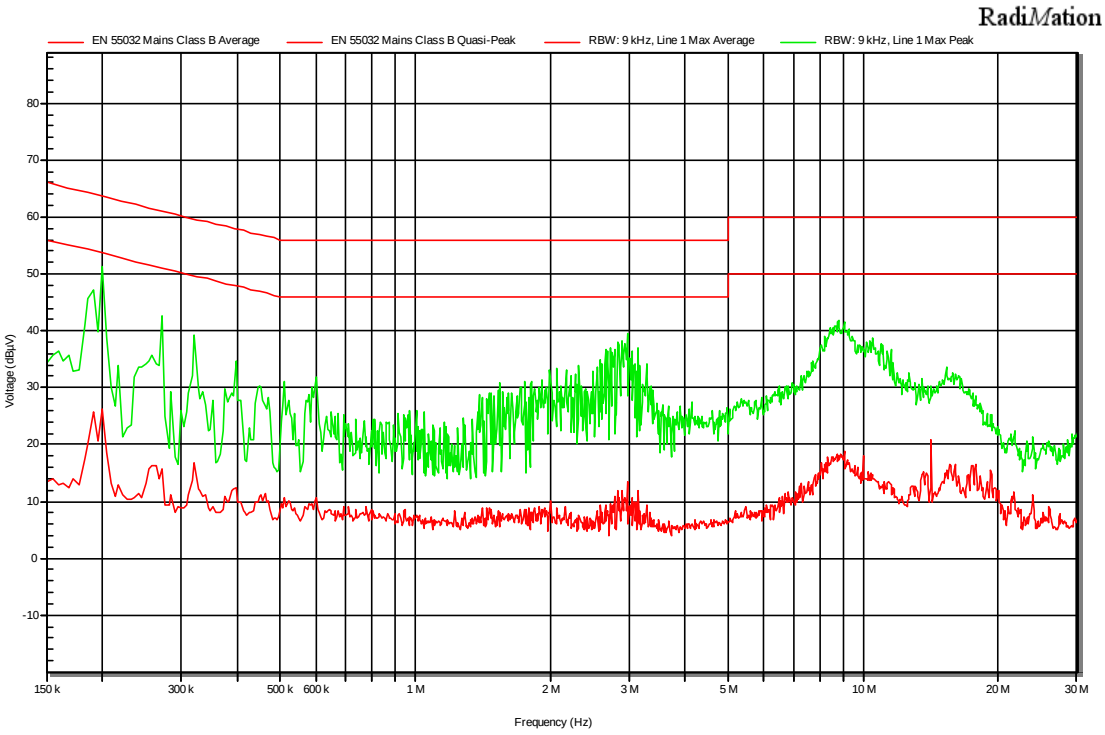
Port	Line	Result
AC power input	Neutral	Pass
AC power input	Live	Pass

3.5.5 Measurement uncertainty

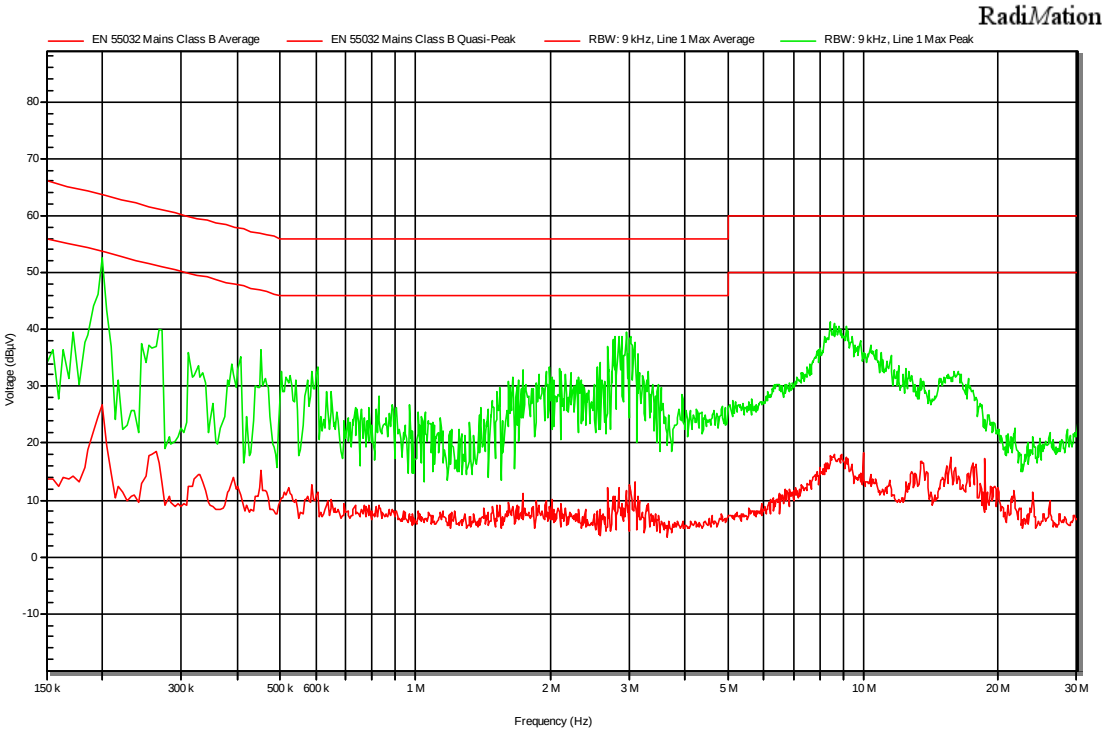
+/- 3.6 dB.

3.5.6 Test result plots

Neutral



Live



3.6 99% Occupied Bandwidth

3.6.1 Limit

According to RSS-Gen 6.7.

3.6.2 Measurement instruments

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

3.6.3 Test setup

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

3.6.4 Test procedure

IRN 017 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

1 Set the centre frequency to the nominal EUT channel centre frequency.
2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
3 Set VBW ≥ 3 x RBW.
4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until the trace stabilizes) shall be used.

3.6.5 Test results of the 99% Occupied Bandwidth Measurement

EUT	Occupied Bandwidth (kHz) Low channel	Occupied Bandwidth (kHz) High channel
Sensor	126.8	126.5
Gateway	126.8	126.5
Uncertainty	± 7.3 kHz	