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The Netherlands
Chamber of Commerce
51565536
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telefication

FCC and IC Test Report for Parts 15.247, 15.207 and RSS-247, RSS Gen (Zigbee)

Product name	: Gateway
Applicant	: Velux A/S
FCC ID	: XSG 832160
IC ID	: 8642A-832160

Test report No. : 160601659 004 Ver 3.00

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

The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

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
v0.50	13-09-2016	First draft	RvB
v1.00	15-09-2016	Release version	RvB
v2.00	15-12-2016	Changed chapter observations and remarks	RvB
V3.00	09-06-2017	Added measurement software identification	KR

Table of Contents

Summary of Test results

FCC	IC	Description	Section in report	Verdict
15.247(a)	RSS-247 5.2 (1)	6dB Bandwidth	3.1	Pass
--	RSS-GEN 6.6	99% Bandwidth	3.2	Pass
15.247(b)(c)	RSS-247 5.1 (2)	RF output power	3.3	Pass
15.247(e)	RSS-247 5.2 (2)	Power spectral density	3.4	Pass
15.247(d)	RSS-247 5.5	Conducted Spurious emissions	3.5	Pass
15.209 (a)	RSS-247 5.4	Radiated Spurious emissions	3.6	Pass
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.6	Pass
15.207 (a)	RSS-Gen 8.8	Conducted spurious on AC mains	3.7	Pass

1 General Description

1.1 Applicant

Client name:	Velux A/S
Address	Baekgaerdsvej 40
Zip code:	6900, Skjern
Telephone:	+45 3058 1588
E-mail:	j.a.m.thomsen@velux.com
Contact name:	Mr. J.A.M. Thomsen

1.2 Manufacturer

Manufacturer name:	Velux A/S
Address:	Baekgaerdsvej 40
Zip code:	6900, Skjern
Telephone:	+45 3058 1588
E-mail:	j.a.m.thomsen@velux.com
Contact name:	Mr. J.A.M. Thomsen

1.3 Tested Equipment Under Test (EUT)

Product name:	Gateway
Brand name:	VELUX
Product type:	io- homecontrol
FCC ID:	XSG 832160
IC ID	8642A-832160
Model(s):	BE-RC010-01
Software version:	--
Hardware version:	--
Date of receipt	18-04-2016
Tests started:	01-07-2016
Testing ended:	13-09-2016

1.4 Product specifications of Equipment under test

Tx Frequency range (MHz):	Zigbee: 2425 - 2475 Wlan: 2400 – 2483.5
Rx frequency range (MHz):	Zigbee: 2425 - 2475 Wlan: 2400 – 2483.5
Maximum output power to antenna(dBm):	Zigbee:10 Wlan: 20.5
Antenna type :	Zigbee/Wlan: PCB Antenna (PIFA)
Antenna gain(dBi):	Zigbee: 1 Wlan: 0.36
Type of modulation:	Zigbee: Acc. to IEEE 802.15.4(Zigbee) Wlan: Acc. to IEEE 802.11 b/g/n
Emission designator 802.11b:	12M5G1D
Emission designator 802.11g:	16M5G1D
Emission designator 802.11n:	17M5G1D
Emission designator 802.15.4:	2M50G1D

1.5 Modification of the Equipment Under Test (EUT)

None.

1.6 Observations and remarks

The EUT contains 1 Zigbee and 1 WiFi radio.
See Telefication test report no. 161001057 01 for the Wlan results.

Two samples were provided by the client. One test sample was modified to include an conducted antenna connector. A second sample, used for the radiated spurious test, was unmodified.

1.7 Environmental conditions

Test date	01-07-2016	13-09-2016
Ambient temperature	23.8°C	26.7°C
Humidity	43.5%	48.1%

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 C §15.247, §15.207
- RSS-247 Issue 1, RSS-GEN Issue 4.

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 R. van Barneveld

Review of test methods and report by:

Name : ing P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 09-06-2017

Name : ing K.A. Roes

Function : Coordinator Radio laboratory

Signature :

2 Test configuration of the Equipment Under Test

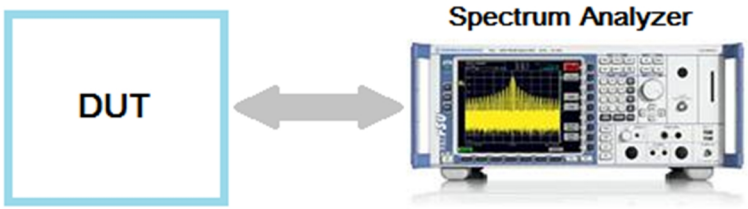
2.1 Test mode

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

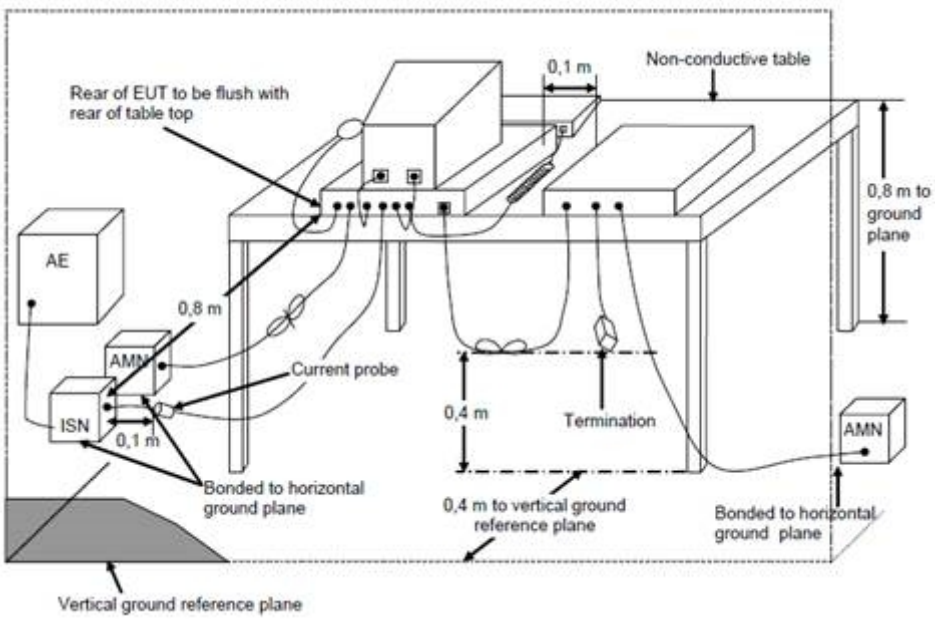
2.2 Tested channels and Data rates

Technology	Channels	Data rate	Frequency (MHz)
IEEE 802.15.4	15	250 kbps	2425
	20	250 kbps	2450
	25	250 kbps	2475

2.3 Conducted Test setup

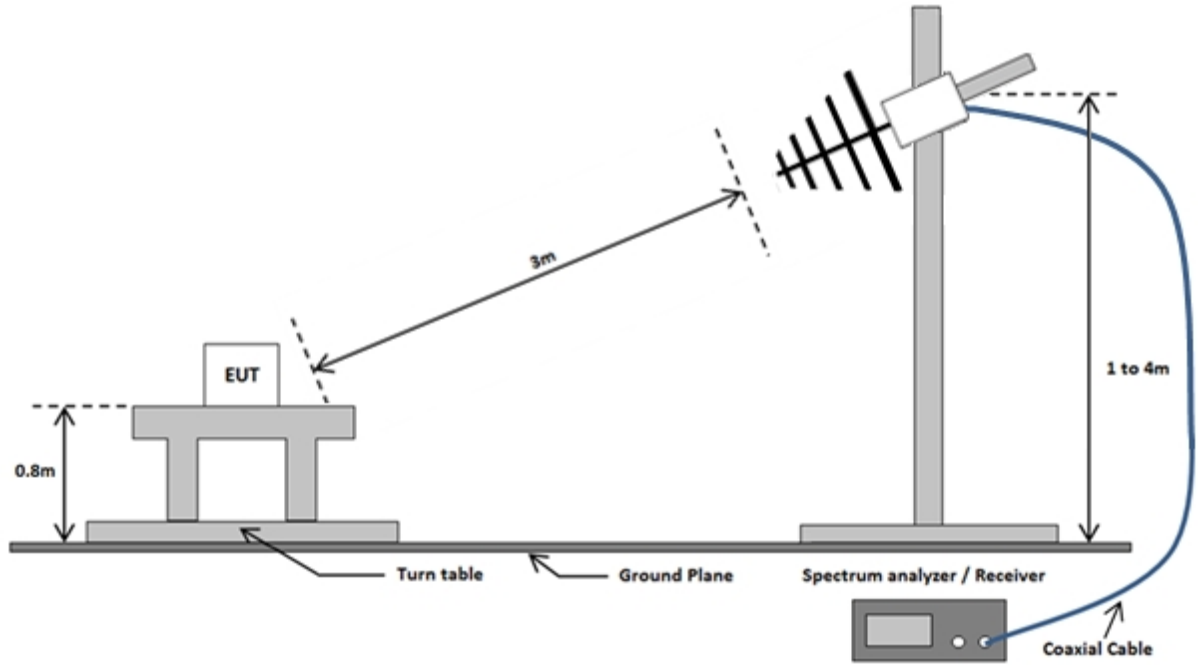


Conducted emission test setup

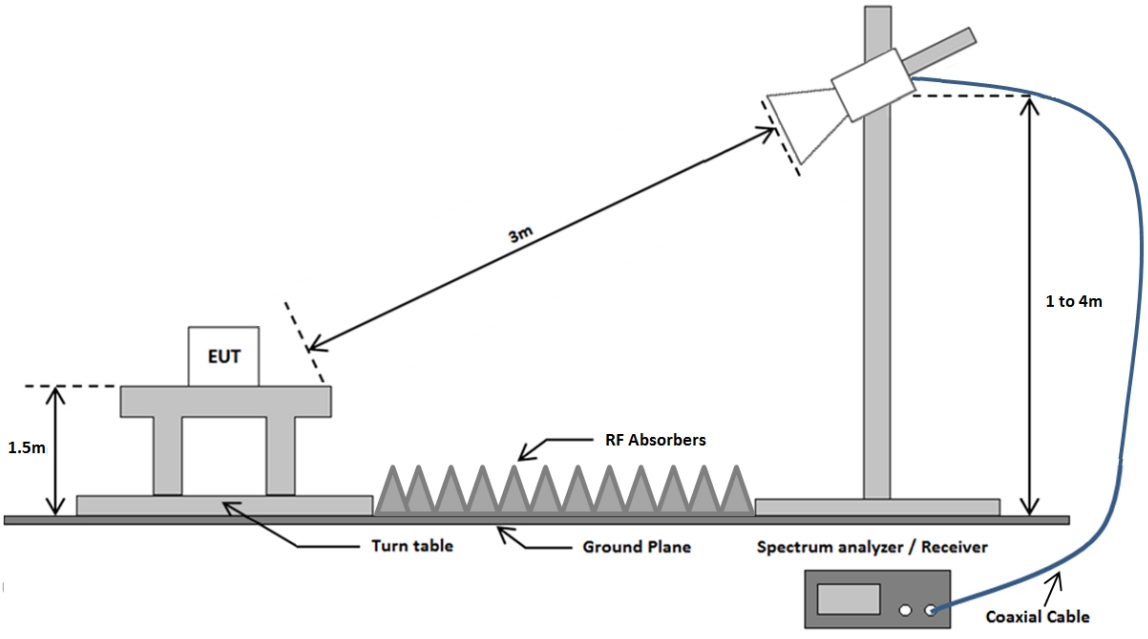


2.4 Radiated Test setup

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.
Signal Generator	Hewlett Packard	83650B	TE00487	3.1 to 3.5
Spectrum Analyzer	Rohde & Schwarz	FSV	TE01269	3.1 to 3.5
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.6
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.6, 3.7
10 MHz distribution Amplifier	Stanford Research Systems	FS735/1	TE01278	3.1 to 3.5
USB to GPIB adapter	National Instruments	GPIB-USB-HS+	TE01283	3.1 to 3.5
Biconilog Antenna	Chase	CBL6112A	TE00967	3.6
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.6
SAC Chamber	Comtest Engineering BV	-	TE00861	3.6
Artificial Mains Network (AMN)	Rohde & Schwarz	ESH3-Z5	TE00208	3.7
Pulse limiter	Rohde & Schwarz	ESH3-Z2	TE00756	3.7
High pass filter	Wainwright instruments	WHK3.0/18G-10EF	TE01140	3.6
Pre-amplifier	Miteq	JF4-18004000-30-8P-A1	TE11131	3.6
Measurement software	DARE!! RadiMation®	Ver. 2016.	--	3.6
Measurement software	Rebase systems	2.0	--	3.1 to 3.5

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 calculations

Field Strength Measurement example:

Frequency (GHz)	Polarization	Height(m)	Peak (dBµV/m)
4.85	Vertical	1.5	45.1

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

(45.1 = 44.82 + 33 - 38.42 + 5.7)

3 Test results

3.1 6dB bandwidth Measurement

3.1.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

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 2.3 of this report.

3.1.4 Test procedure

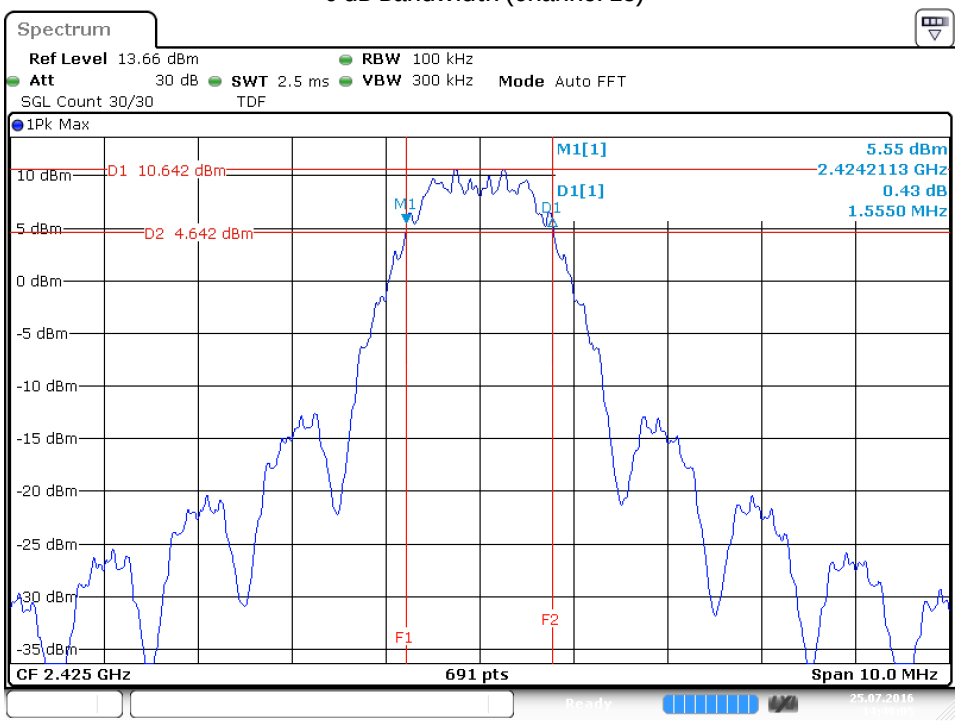
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.

3.1.5 Test Results of the 6 dB bandwidth Measurement

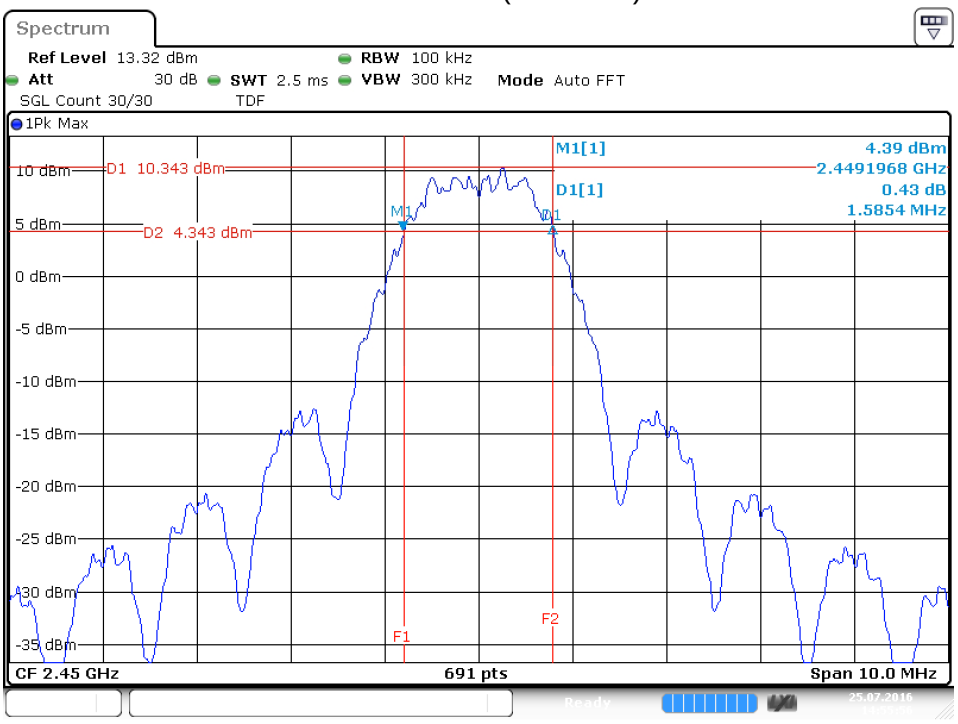
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (MHz)
IEEE 802.15.4	15	2425	250 kb/s	1.555
	20	2450	250 kb/s	1.585
	25	2475	250 kb/s	1.585
Uncertainty	±707 kHz			

3.1.6 Plots of the 6 dB bandwidth Measurement

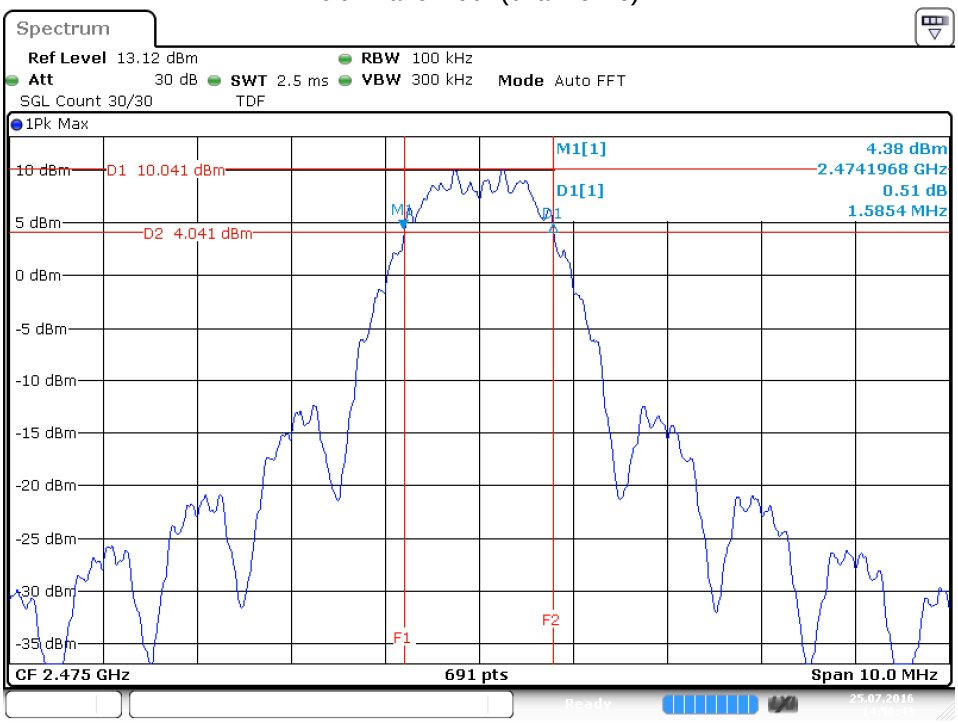
6 dB Bandwidth (Channel 15)



6 dB Bandwidth (Channel 20)



6 dB Bandwidth (Channel 25)



3.2 99% Occupied Bandwidth

3.2.1 Limit

According to RSS-Gen 6.6.

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 2.3 of this report.

3.2.4 Test procedure

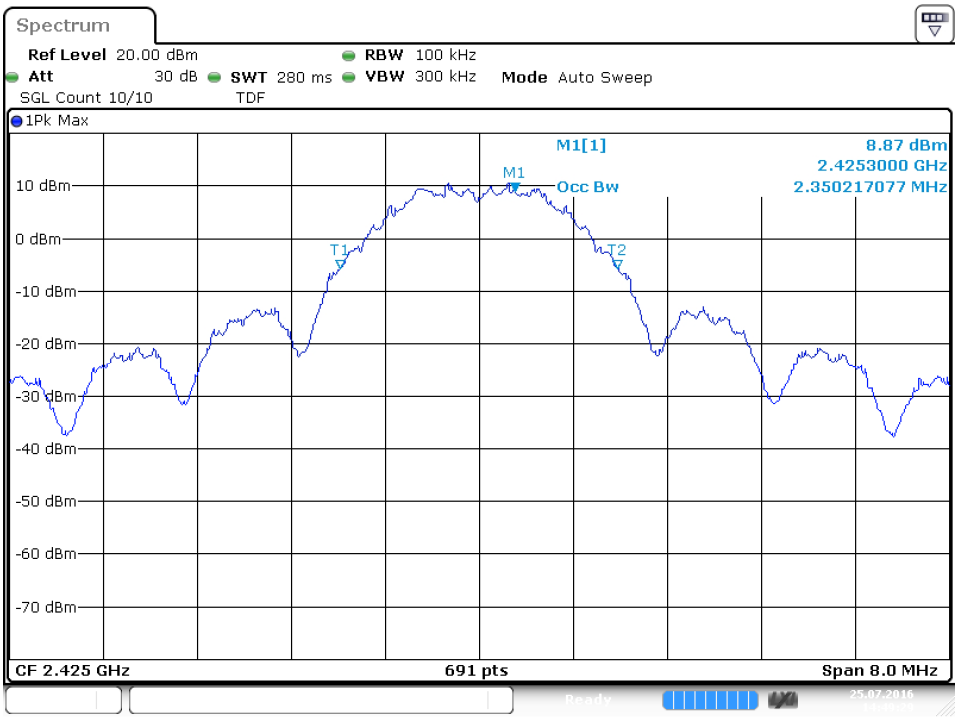
1 Set the centre frequency to the nominal EUT channel centre frequency.
2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
3 Set VBW ≥ 3 x RBW.
4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until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

3.2.5 Test results of the 99% Occupied Bandwidth Measurement

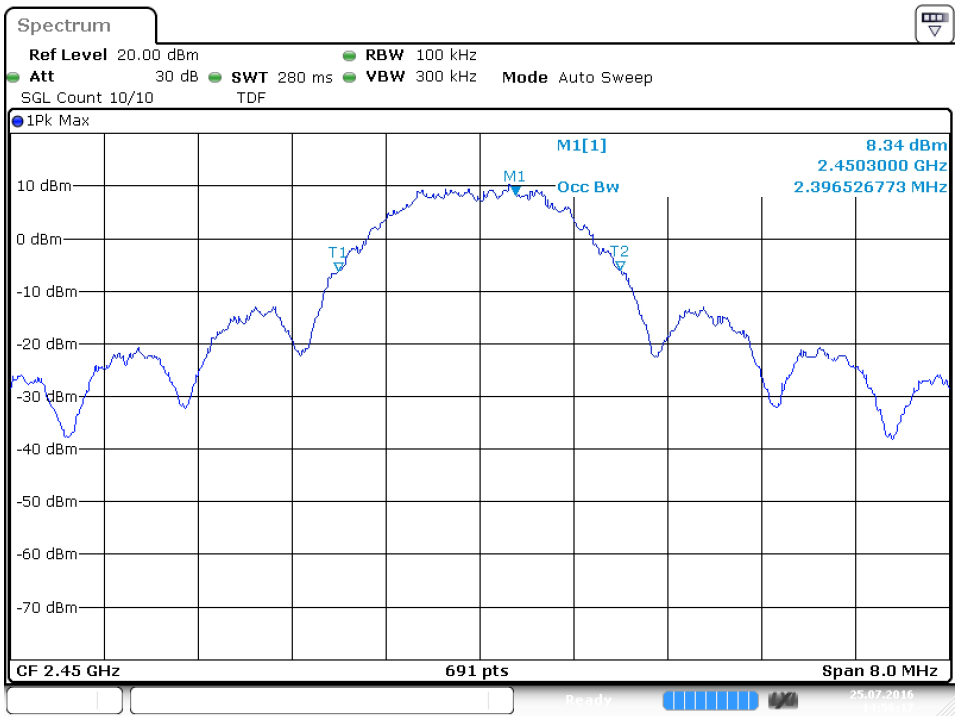
Technology Std.	Channels	Frequency (MHz)	Data rate	99% Occupied Bandwidth (MHz)
IEEE 802.15.4	15	2425	250 kb/s	2.350
	20	2450	250 kb/s	2.396
	25	2475	250 kb/s	2.442
Uncertainty	±707kHz			

3.2.6 Plots of the 99% Occupied Bandwidth Measurement

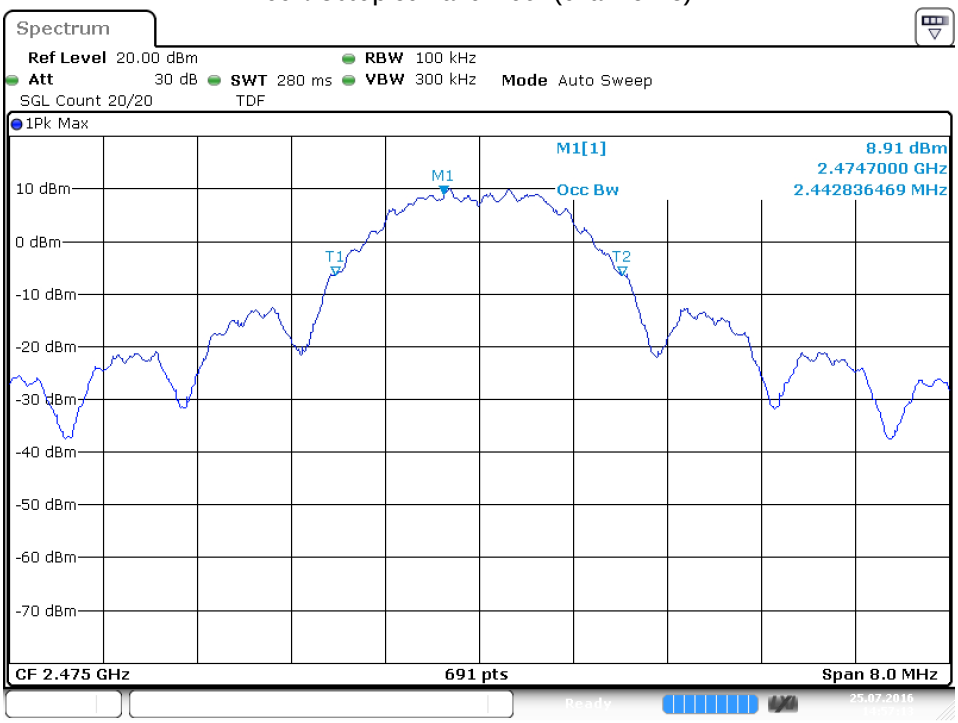
99% Occupied Bandwidth (Channel 15)



99% Occupied Bandwidth (Channel 20)



99% Occupied Bandwidth (Channel 25)



3.3 Output Power Measurement

3.3.1 Limit

For systems using digital modulation in the 2400-2483.5 MHz, 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.

3.3.2 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 2.3 of this report.

3.3.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.

3.3.5 Test results of Output Power Measurement

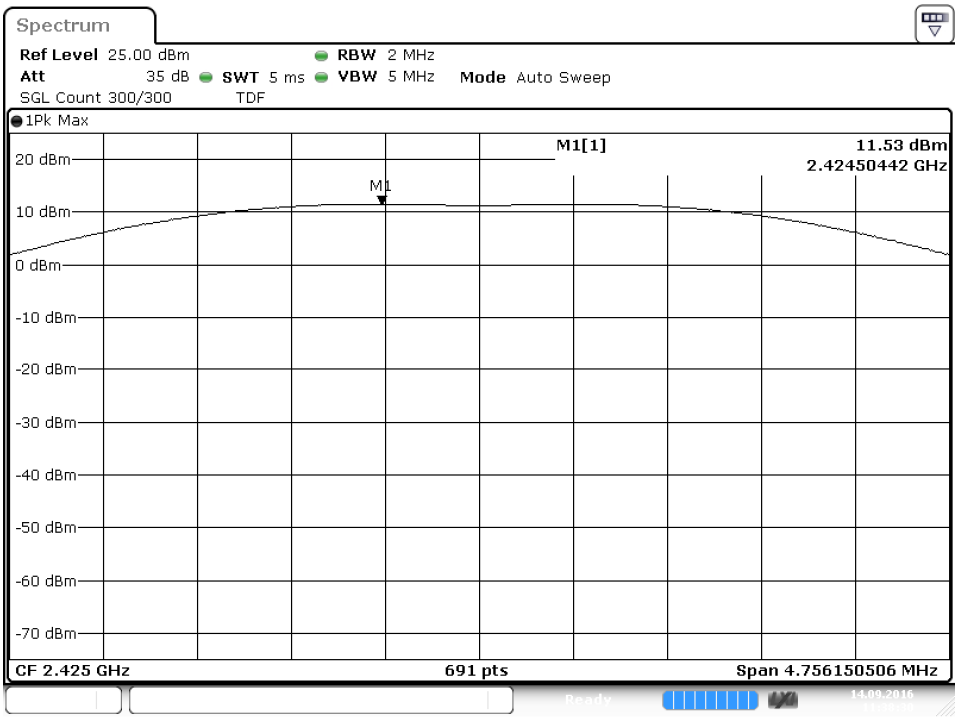
Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
IEEE 802.15.4	15	2425	250 kb/s	12.53
	20	2450	250 kb/s	12.53
	25	2475	250 kb/s	12.12
Uncertainty	±1.78 dB			

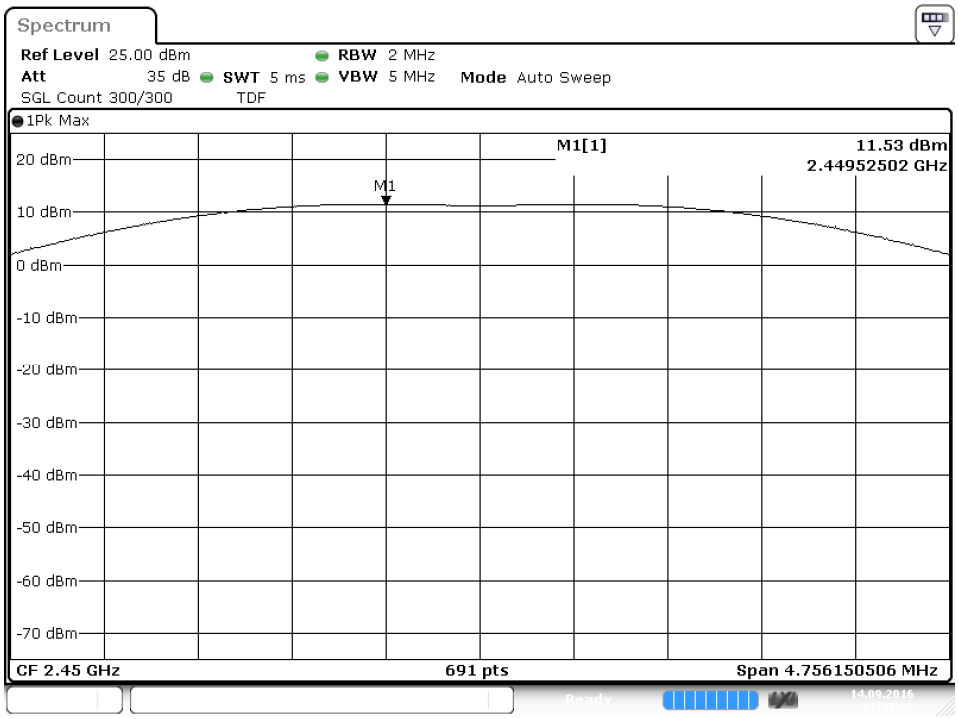
Note: Peak output power = Measured value + Antenna gain

3.3.6 Plots of Peak Output Power Measurement

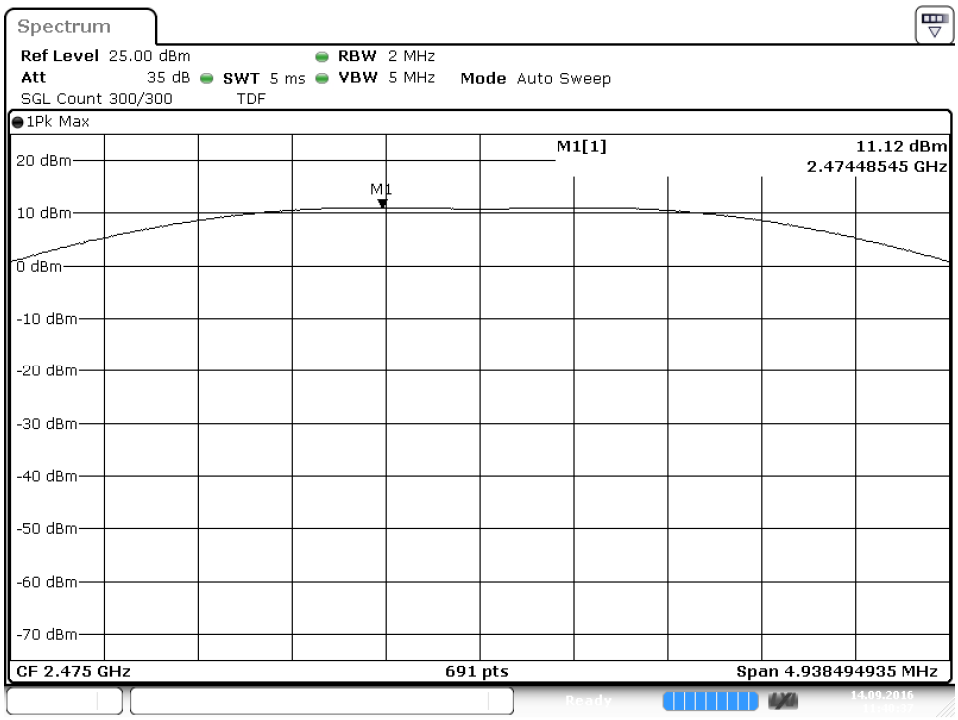
Peak Output Power (Channel 15)



Peak Output Power (Channel 20)



Peak Output Power (Channel 25)



3.4 Power Spectral Density

3.4.1 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.

3.4.2 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 2.3 of this report.

3.4.4 Test procedure

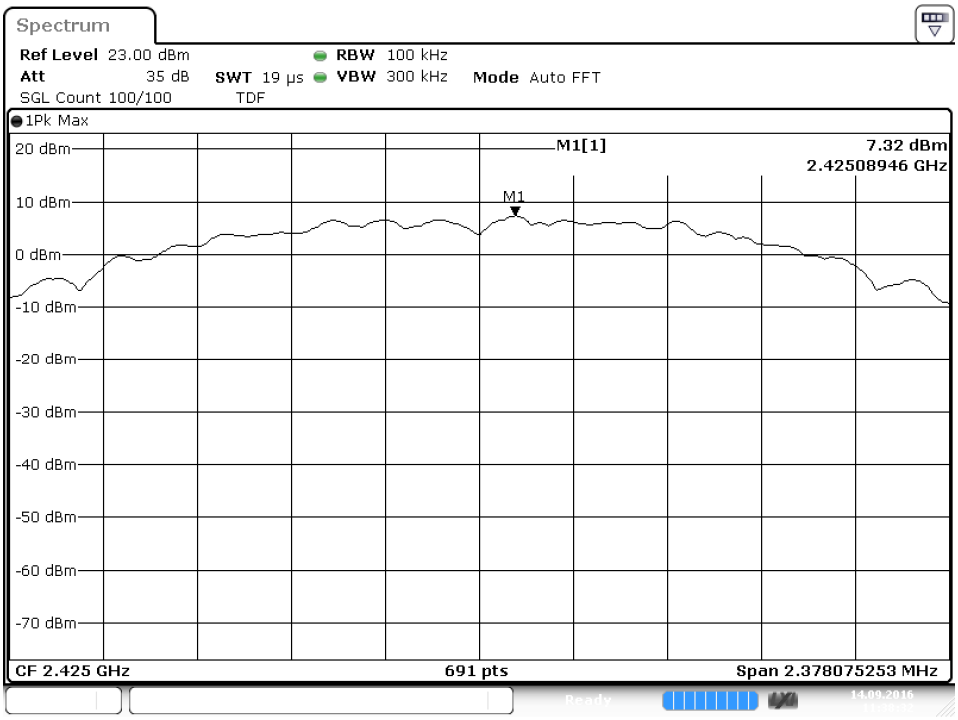
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.

3.4.5 Test results of Power Spectral Density Measurement

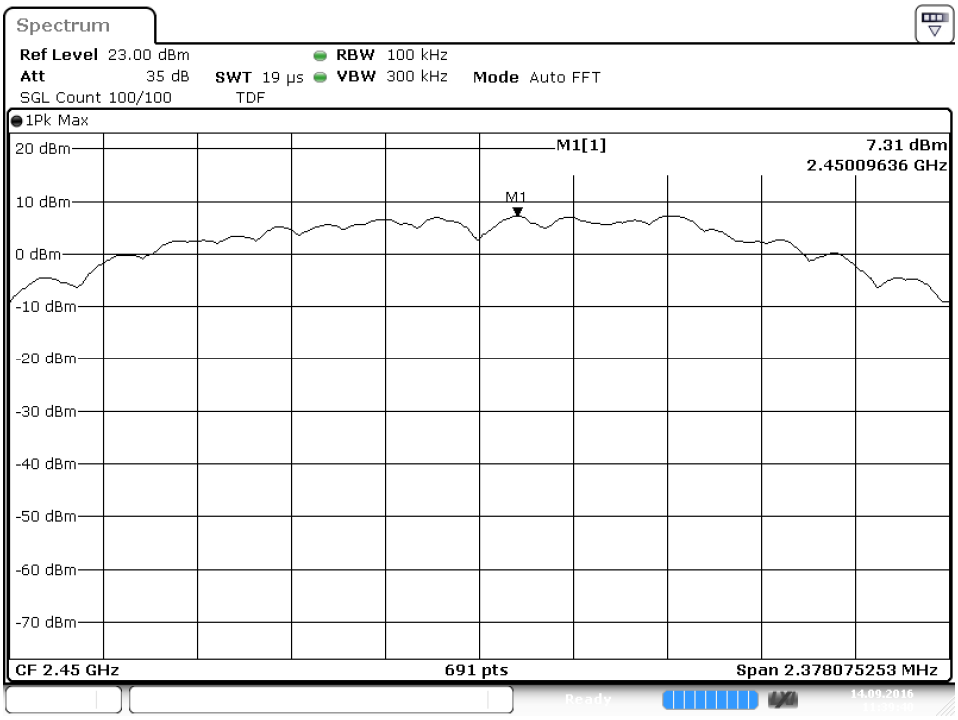
Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/100 kHz (dBm)
IEEE 802.15.4	15	2425	250 kb/s	7.32
	20	2450	250 kb/s	7.31
	25	2475	250 kb/s	6.94
Uncertainty	±0.63 dB			

3.4.6 Plots of the Power Spectral Density Measurements

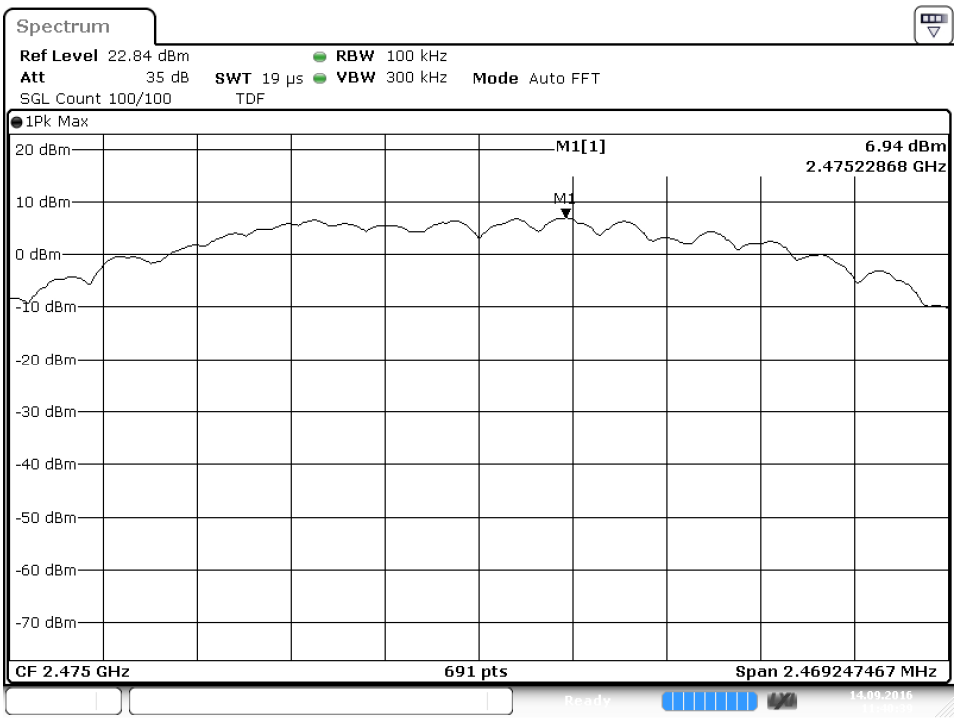
Power Spectral Density 100 kHz (channel 15)



Power Spectral Density 100 kHz (channel 20)



Power Spectral Density 100 kHz (channel 25)



3.5 Conducted Spurious Emissions Measurement

3.5.1 Limit

Spurious Emission:
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.

3.5.2 Measurement instruments

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

3.5.3 Test setup

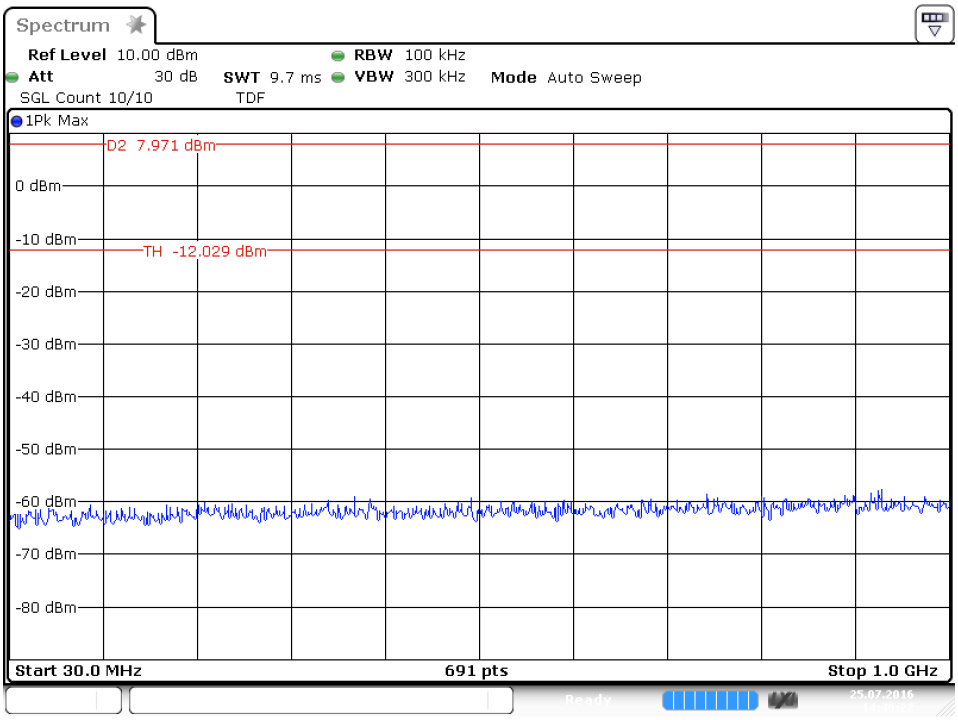
The test setup is as shown in chapter 2.3 of this report.

3.5.4 Test procedure

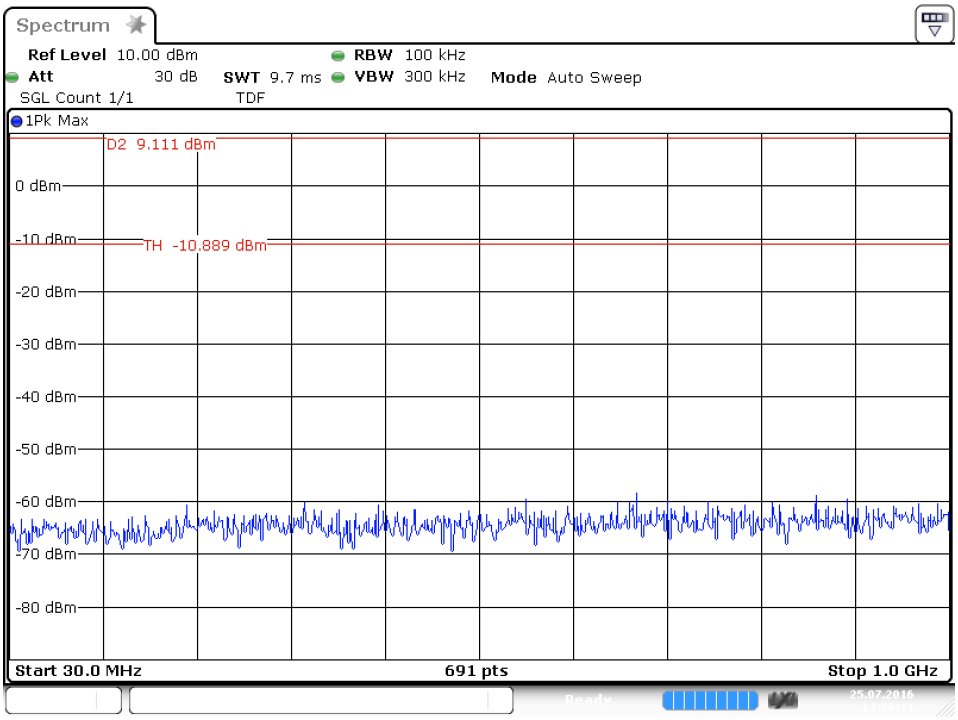
According to KDB Publication 558074 V02r05, sections 11.3 and 12.1

3.5.5 Plots of the Conducted Spurious Measurements

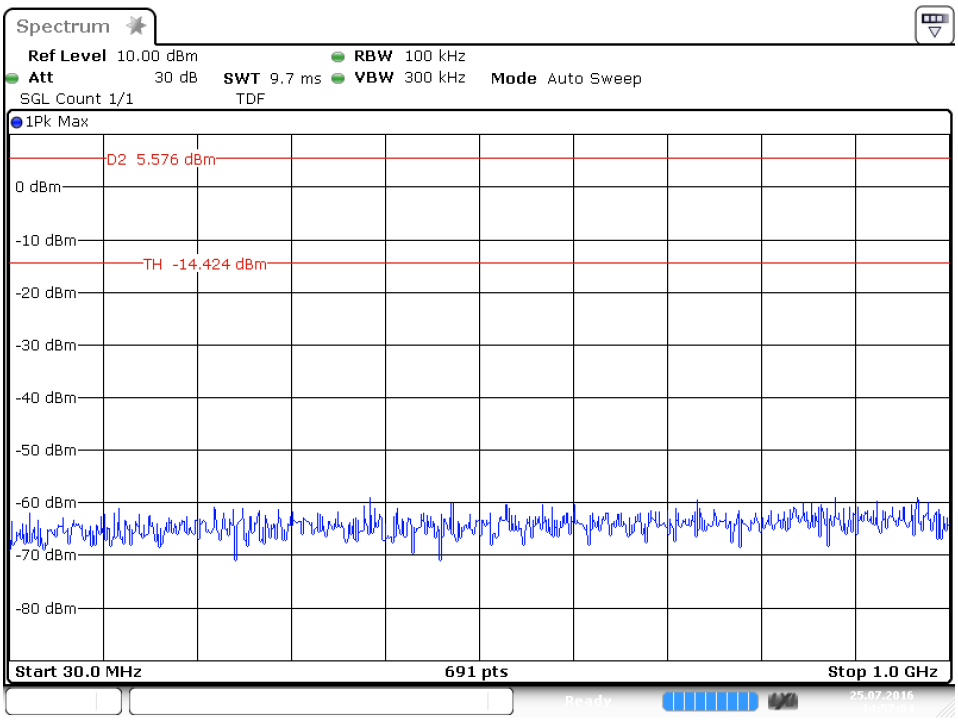
Conducted Spurious Emissions 30 -1000 MHz (Channel 15)



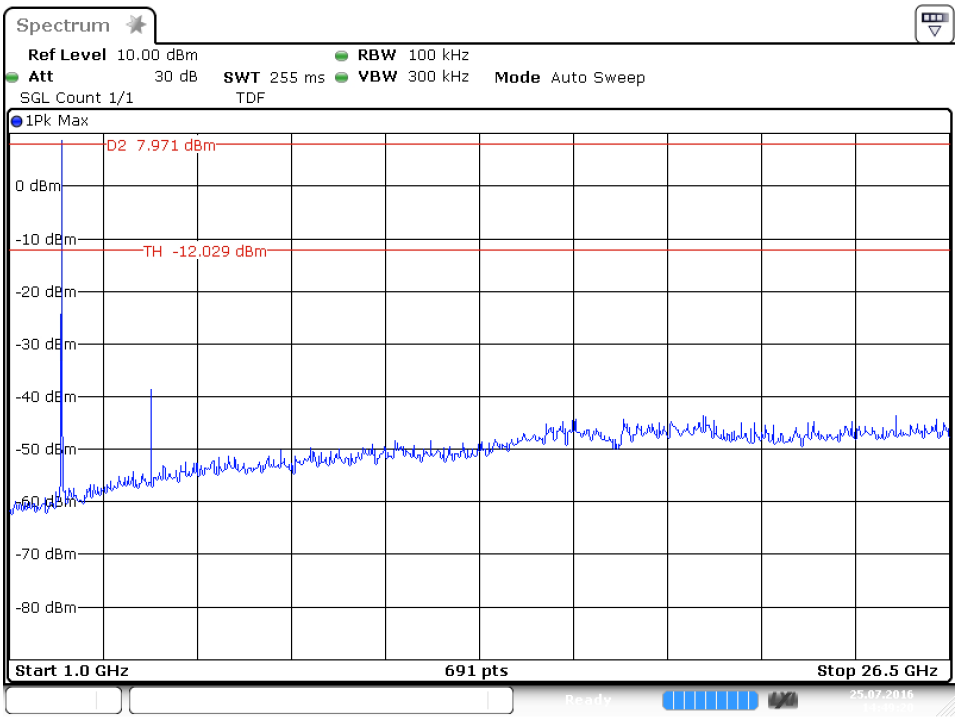
Conducted Spurious Emissions 30 -1000 MHz (Channel 20)



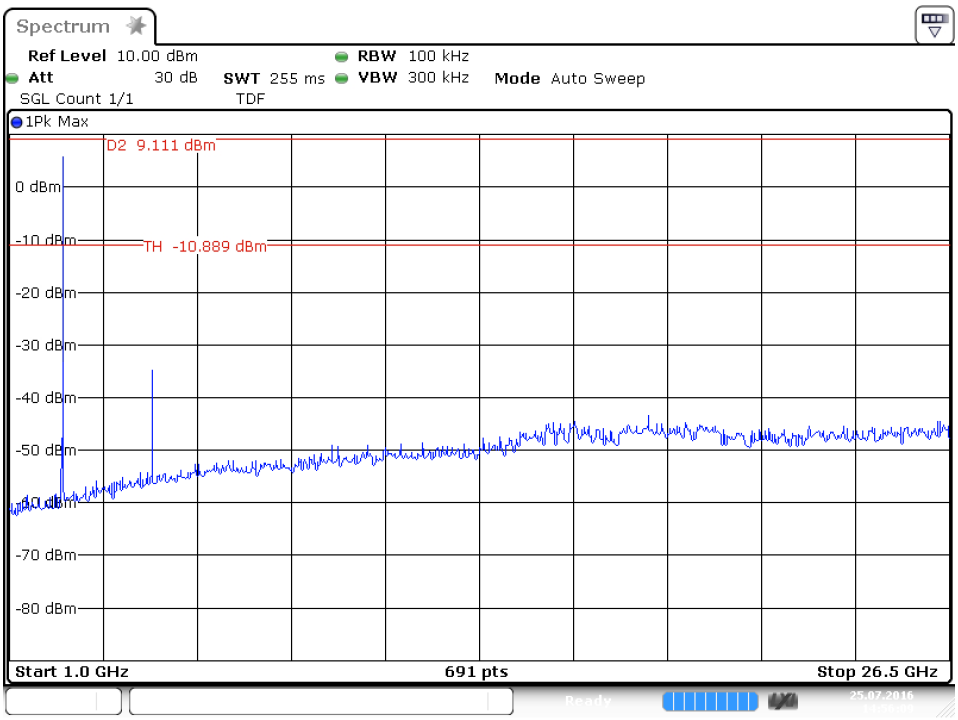
Conducted Spurious Emissions 30 -1000 MHz (Channel 25)



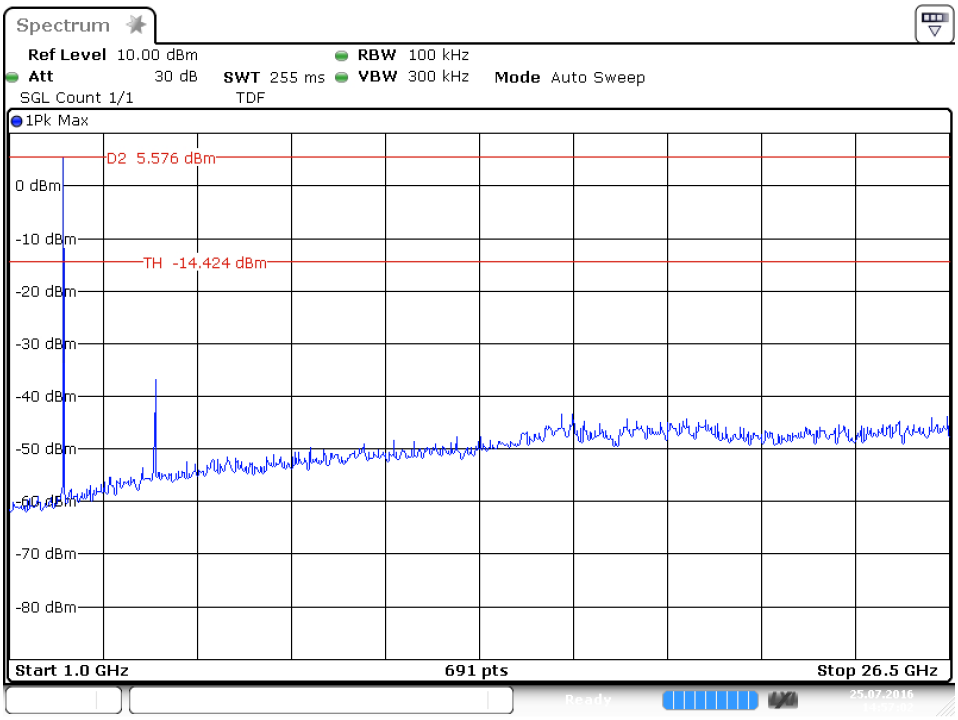
Conducted Spurious Emissions 1 – 26.5 GHz (Channel 15)



Conducted Spurious Emissions 1 – 26.5 GHz (Channel 20)



Conducted Spurious Emissions 1 – 26.5 GHz (Channel 25)



Uncertainty	±0.63 dB

3.6 Radiated Spurious Emissions Measurement

3.6.1 Limit

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

Frequency (MHz)	Field strength (µV/m)	Measurement distance(m)
0.009 - 0490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 - 30	30	30
30 -88	100	3
88 - 216	150	3
216-960	200	3
Above 960	500	3

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 2.4 of this report.

3.6.4 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.

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

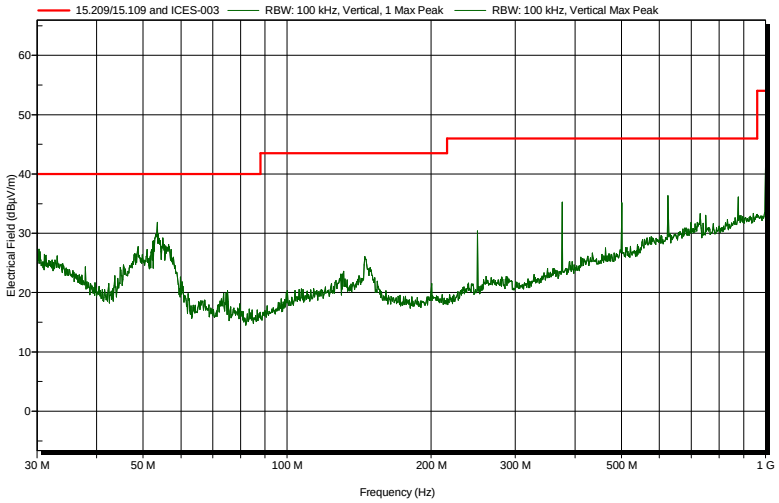
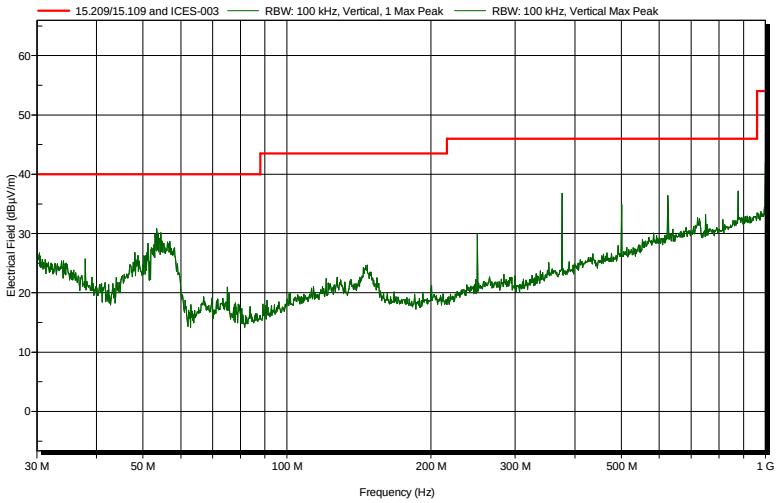
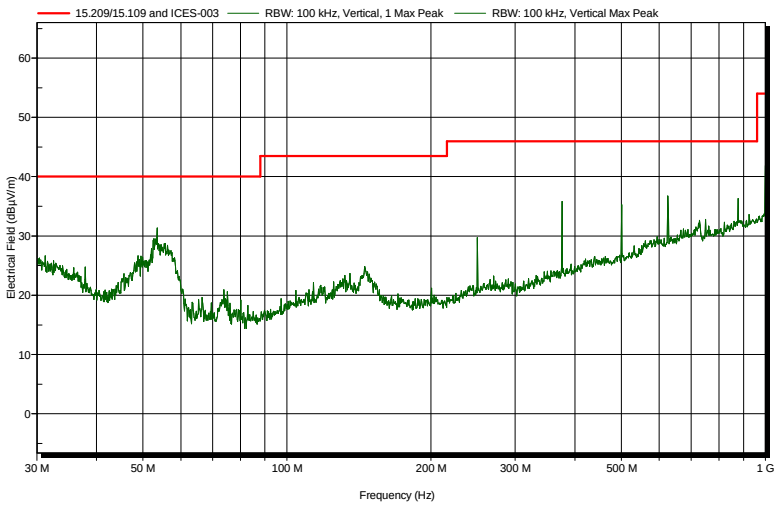
3.6.5 Notes

- 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

3.6.6 Plots of the Radiated Spurious Emissions Measurement

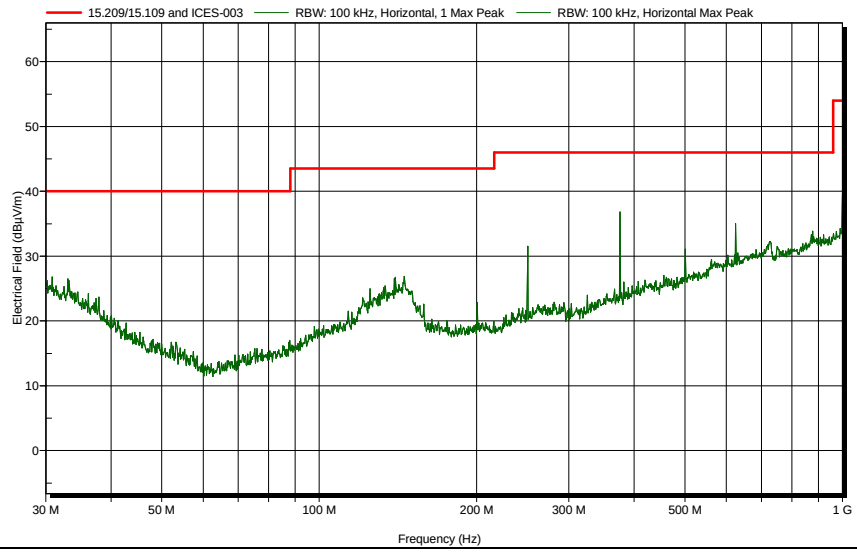
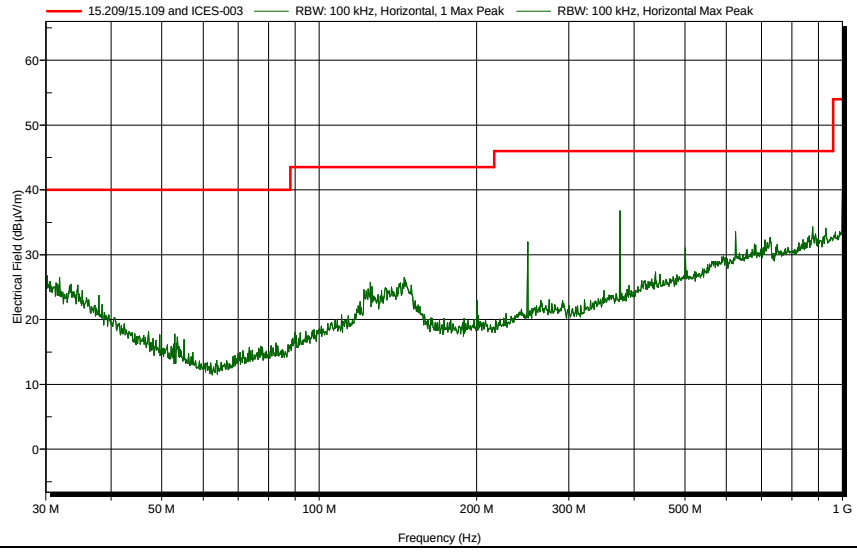
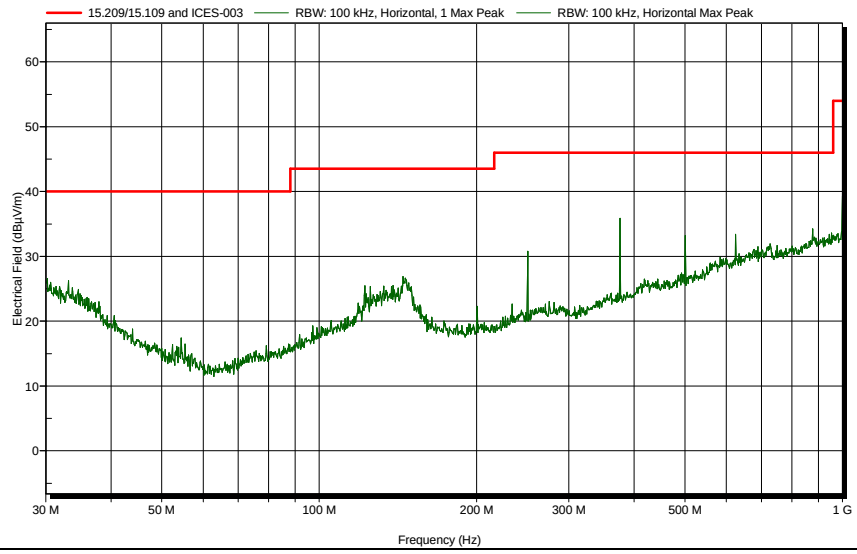
30 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

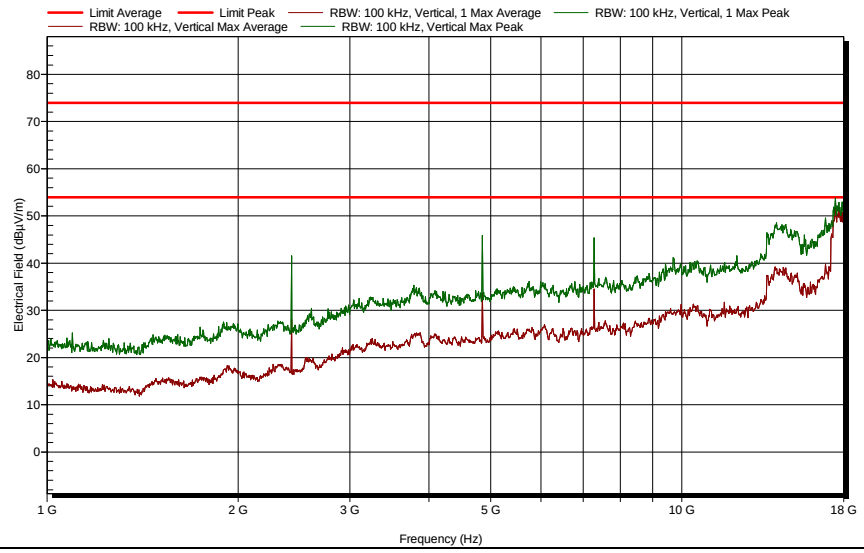
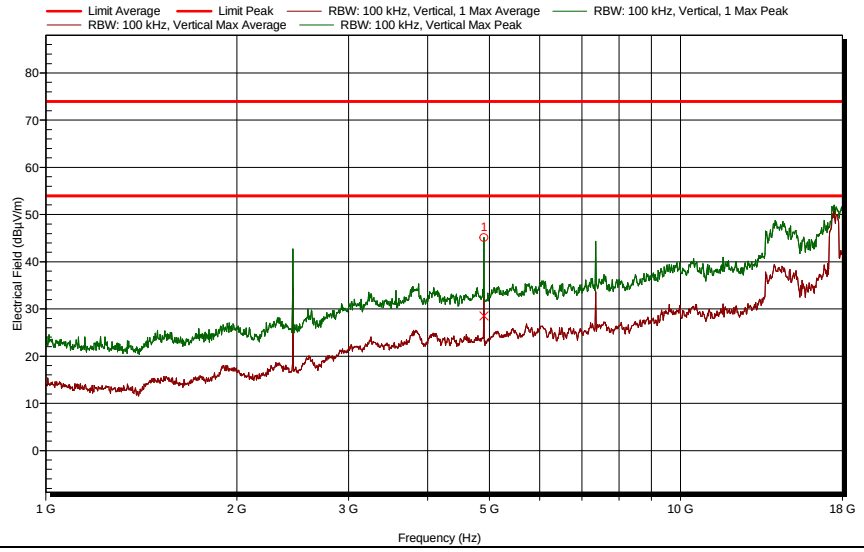
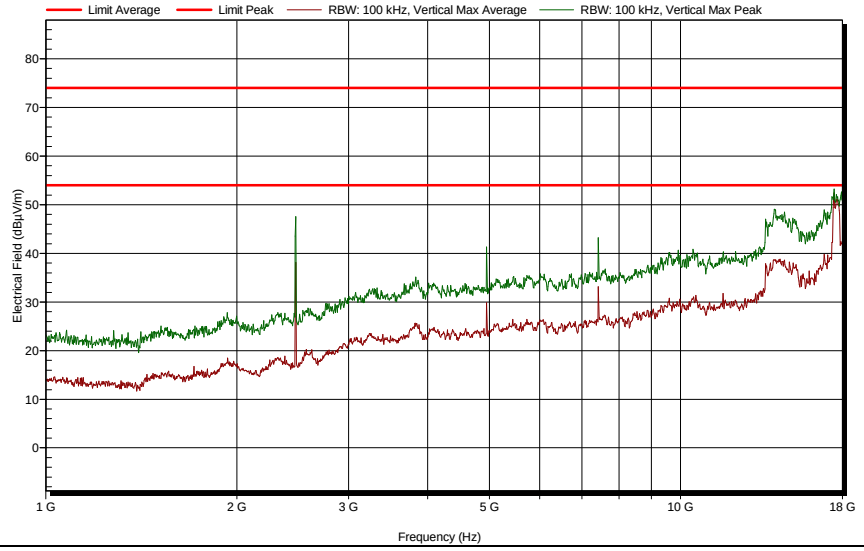
30 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

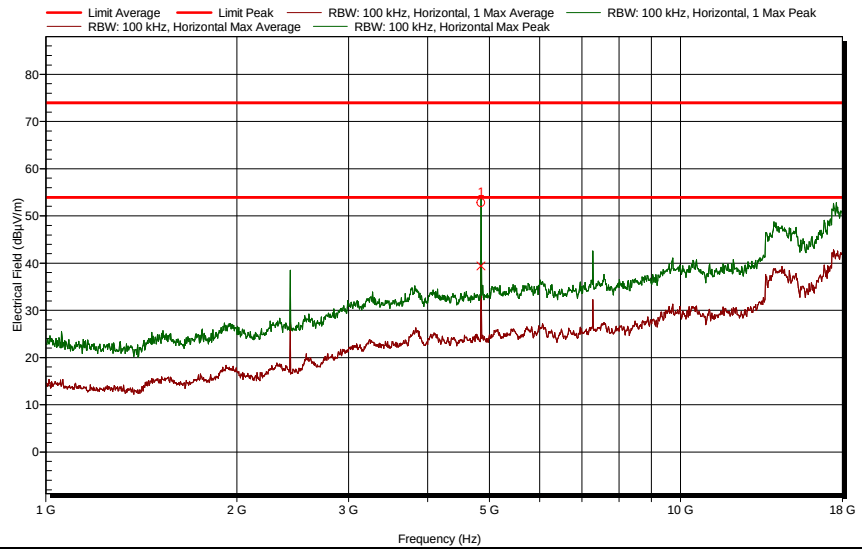
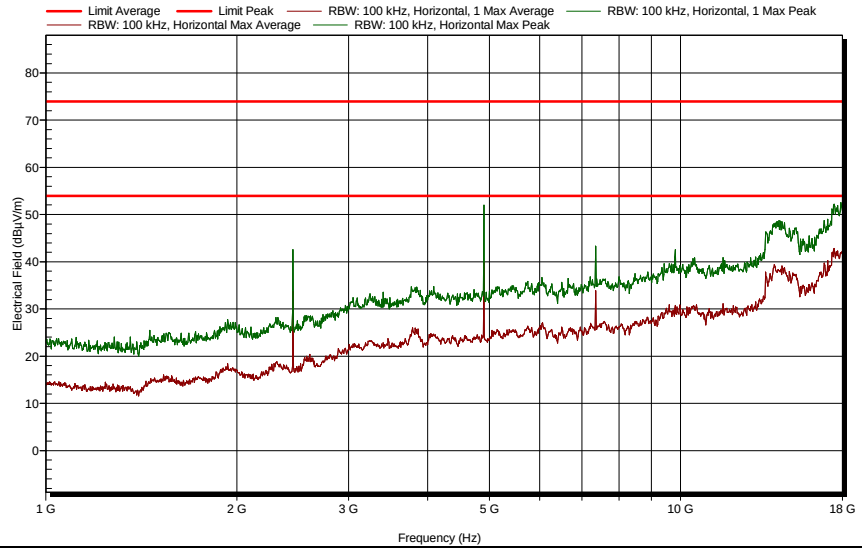
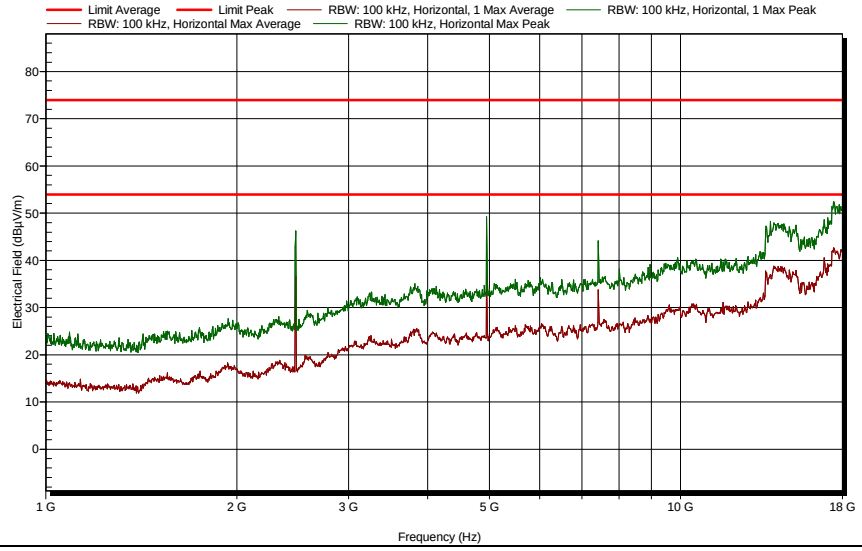
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26.5 GHz

A conducted pre-scan was performed to see if any emission are found in the frequency range from 18 to 26.5 GHz. See chapter 3.5 (no emissions above the noise floor were found)

3.6.7 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 above 1 GHz

1000- 18000 MHZ	+ 5.7/- 5.7dB

3.7 Conducted spurious measurement at AC mains

3.7.1 Limit

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.

3.7.2 Measurement equipment

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

3.7.3 Test set up

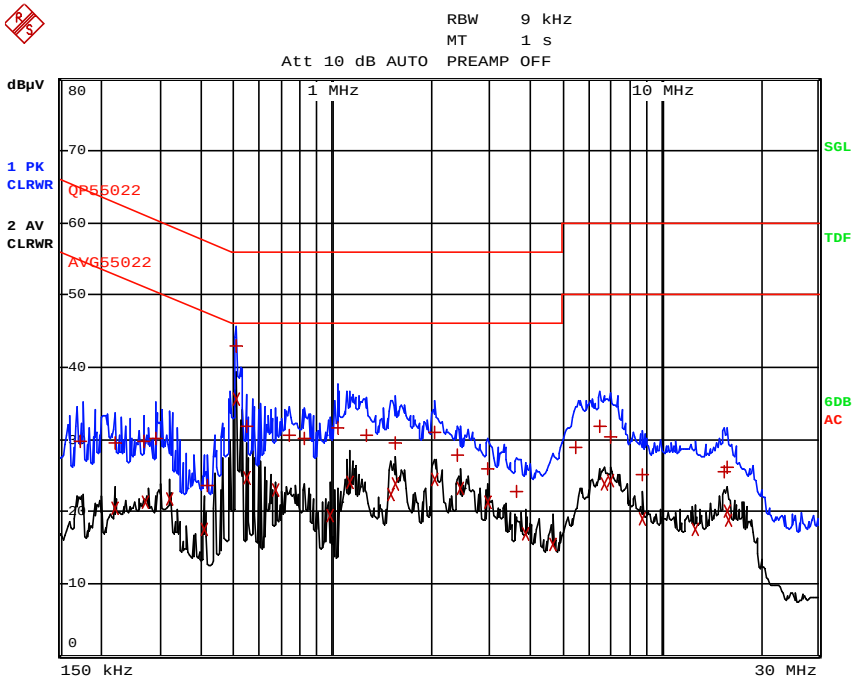
The test setup is as shown in chapter 2.3 of this report.

3.7.4 Test procedure

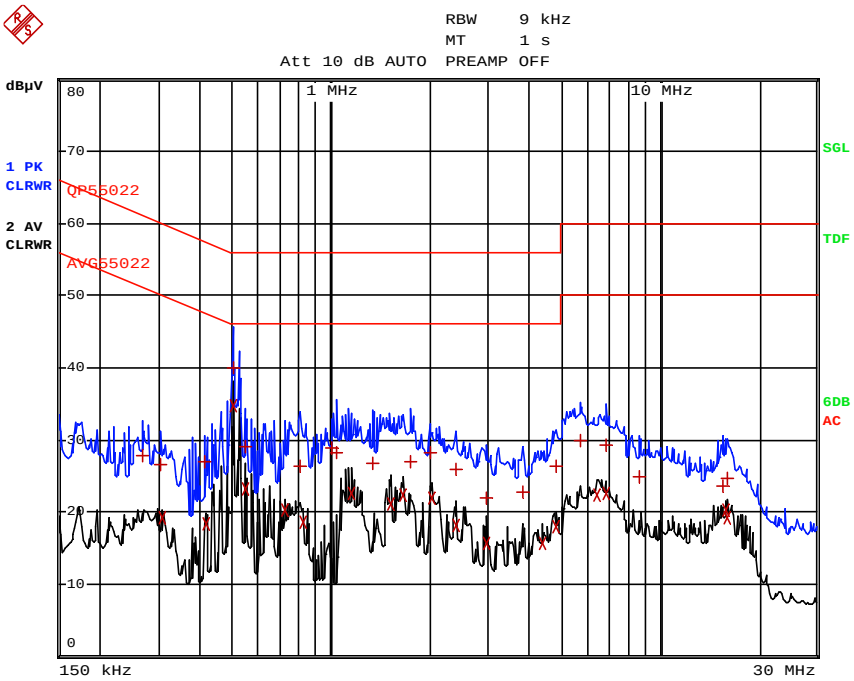
According to ANSI C63.4: 2014, section 13.3.

3.7.5 Plots of the AC conducted spurious measurement

Phase



Neutral



3.7.6 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.