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FCC and IC Test Report for Parts 15.247, 15.207 and 15.209 (DTS) and RSS-247, RSS Gen

Product name	: Onyx-PCB
Applicant	: Feel Robotics
FCC ID	: 2AO5N-ONXD18
IC ID	: 23801-ONXD18

Test report No. : 180201427 002 v3.00

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. +31889983600 Fax. +31316583189
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	23-04-2018	First draft	PvW
v1.00	03-05-2018	Initial release	PvW
v2.00	24-05-2018	Updated emission designator on page 7	KR
v3.00	04-06-2018	Updated channel 1 frequency type error on page 12, 13, 16 and 17	KR

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247 (a)	--	6dB Bandwidth	3.1	Pass
--	RSS-Gen 6.6	99% Bandwidth	3.2	Pass
15.247 (b)	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	Band edge	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 (c)	RSS-Gen 8.8	Conducted spurious emissions on AC mains	3.7	Pass

1 General Description

1.1 Applicant

Client name:	Feel Robotics B.V.
Address	Amstelplein 62, 30th Floor, Amsterdam, the Netherlands
Zip code:	1096 BC
Telephone:	(0)20 737 1194
E-mail:	maurice@kiiroo.com
Contact name:	Maurice op de Beek

1.2 Manufacturer

Manufacturer name:	Feel Robotics B.V.
Address:	Amstelplein 62, 30th Floor, Amsterdam, the Netherlands
Zip code:	1096 BC
Telephone:	(0)20 737 1194
E-mail:	maurice@kiiroo.com
Contact name:	Maurice op de Beek

1.3 Tested Equipment Under Test (EUT)

Product name:	Massager
Brand name:	Kiiroo
Product type:	Onyx 3
FCC ID:	2AO5N-ONXD18
IC ID	23801-ONXD18
Software version:	--
Hardware version:	B
Date of receipt	26-02-2018
Tests started:	26-02-2018
Testing ended:	09-03-2018

1.4 Product specifications of Equipment under test

TX Frequency range (MHz)	2400 – 2483.5
RX frequency range (MHz)	2400 – 2483.5
Maximum output power to antenna (dBm)	-0.16
Antenna type	PCB antenna
Antenna gain (dBi)	2.0
Type of modulation	GFSK
Emission designator BLE	1M01G1D

1.5 Modification of the Equipment Under Test (EUT)

The manufacturer provided both a radiated sample and a conducted sample for radio testing.

1.6 Observations and remarks

None.

1.7 Environmental conditions

Test date	26-02-2018	27-02-2018	09-03-2018
Ambient temperature	20.9 °C	20.4 °C	21.4 °C
Humidity	27.5 %	26.6 %	31.2 %

1.8 Measurement Standards

- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V04
- 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, §15.209
- 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 : 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 : 04-06-2018

Name : ing. K.A. Roes

Function : Coordinator Radio Laboratory

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

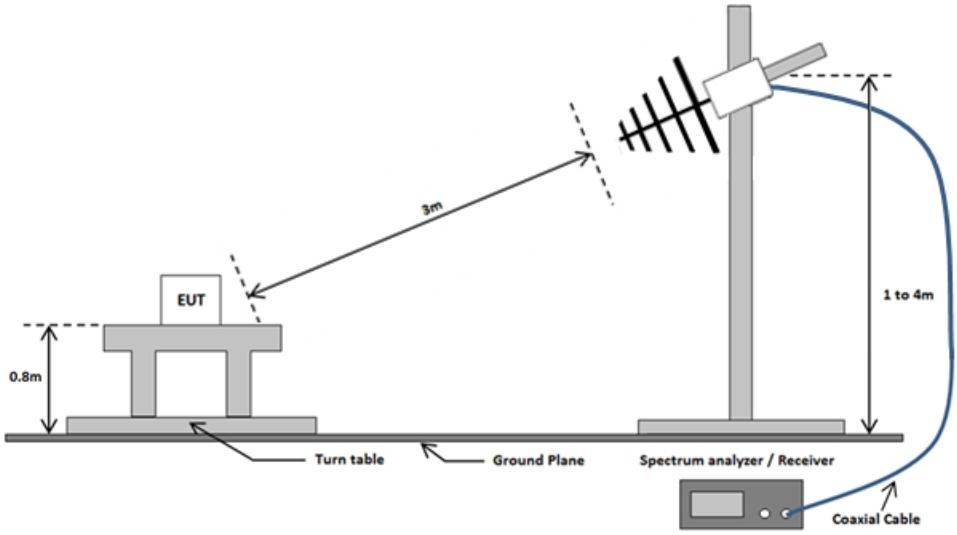
The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

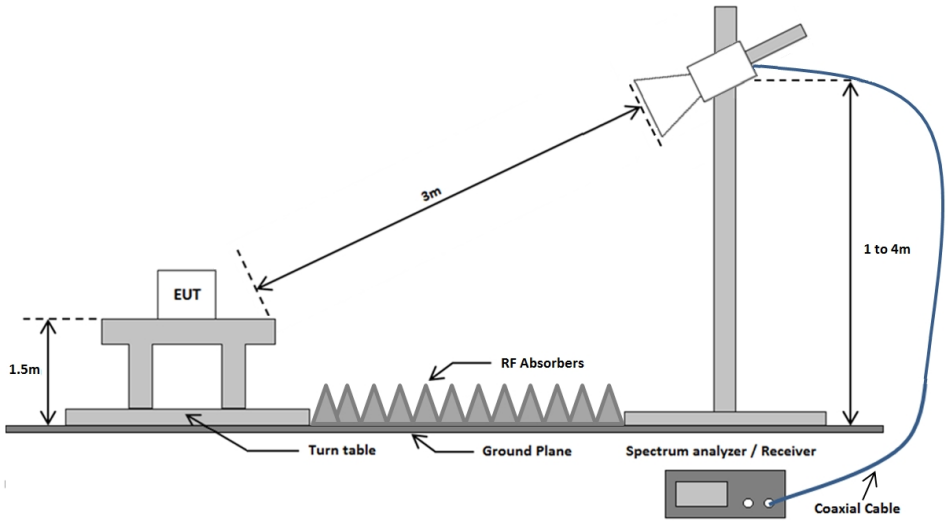
Technology	Channels	Data rate	Frequency (MHz)
Bluetooth Low Energy	1 (Low)	1 Mbps	2402
	18 (Mid)	1 Mbps	2440
	39 (High)	1 Mbps	2480

2.3 Test setups

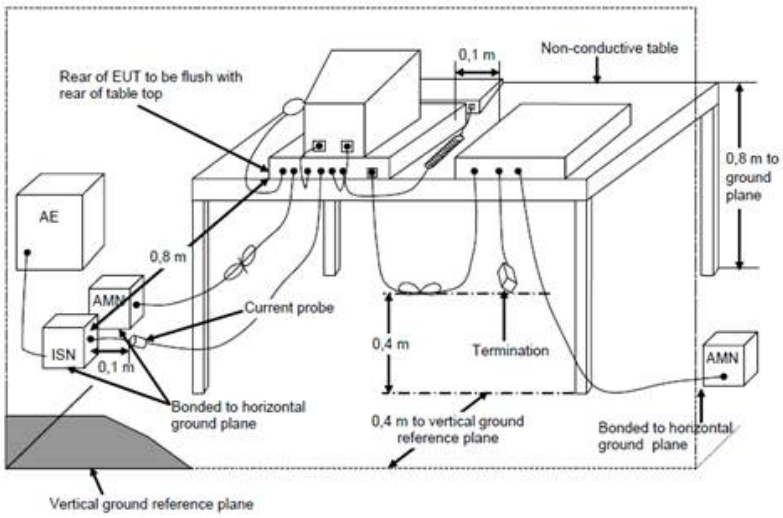
Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



Emissions test AC mains



2.4 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSV40	TE01269	3.1, 3.4
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.5
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.5 -3.6
Biconilog Antenna	Chase	CBL6112A	TE00967	3.5
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.5
Horn Antenna	Flann Microwave	20240-25	TE00818	3.5
SAC Chamber	Comtest Engineering BV	-	TE00861	3.5
Band reject filter	5N45-2441/T83-0/0	WHK3.0/18G-10EF	TE00932	3.5
Pre-amplifier	Miteq	Js4-18004000-30-8P-A1	TE11131	3.5
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE00092	3.6
Software	DARE Instruments	Radimation 2016.2.8	--	3.5
Software	DARE Instruments	Radimation 2017.2.5	--	3.6
Artificial Mains Network (AMN)	Rohde & Schwarz	ESH3-Z5	TE00208	3.6
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	TE00756	3.6

2.5 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 (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

(52.5 = 48.12 + 36.1 - 37.42 + 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 2.4 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 v04.
IRN 017 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

3.1.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low energy	1	2402	1 Mbps	651.6
	18	2440	1 Mbps	652.0
	39	2480	1 Mbps	651.0
Uncertainty	± 36.2 kHz			

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 2.4 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

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

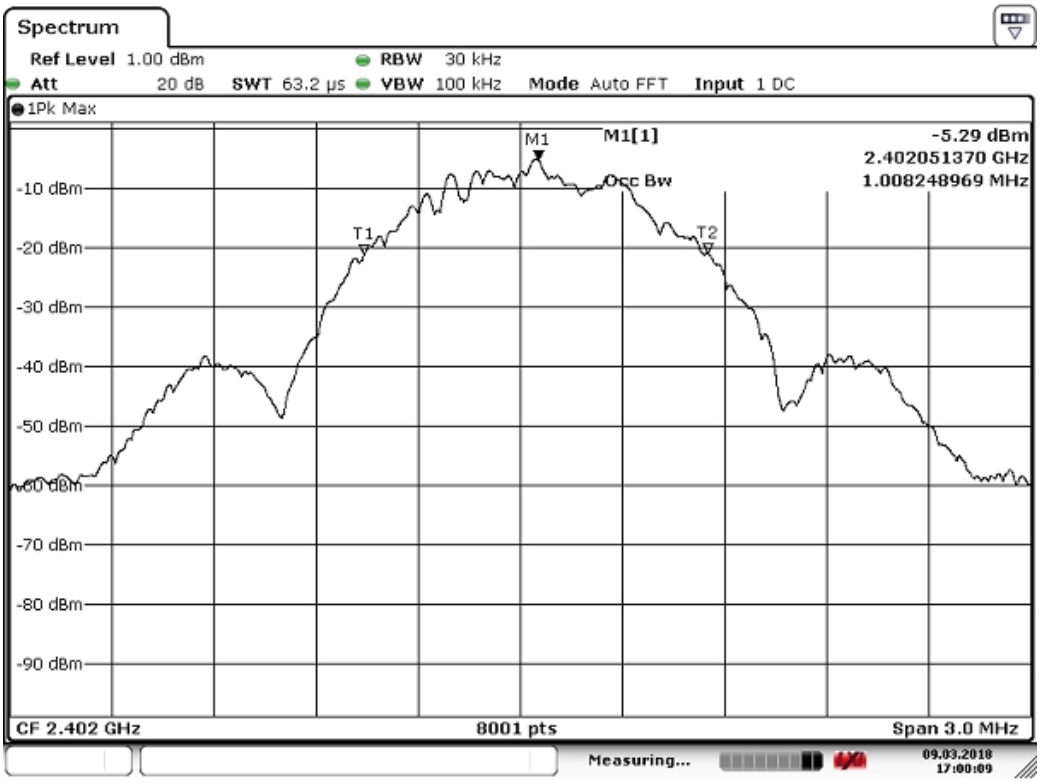
1. Set the centre frequency to the nominal EUT channel centre frequency
2. Set span = 1.5 times to 0.5 times the Occupied Bandwidth
3. Set VBW ≥ 3x RBW
4. Video averaging is not permitted. Where practical, detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until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

3.2.5 Test results of the 99% occupied bandwidth measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Bluetooth Low energy	1	2402	1 Mbps	1008
	18	2440	1 Mbps	1012
	39	2480	1 Mbps	1008
Uncertainty	± 12 kHz			

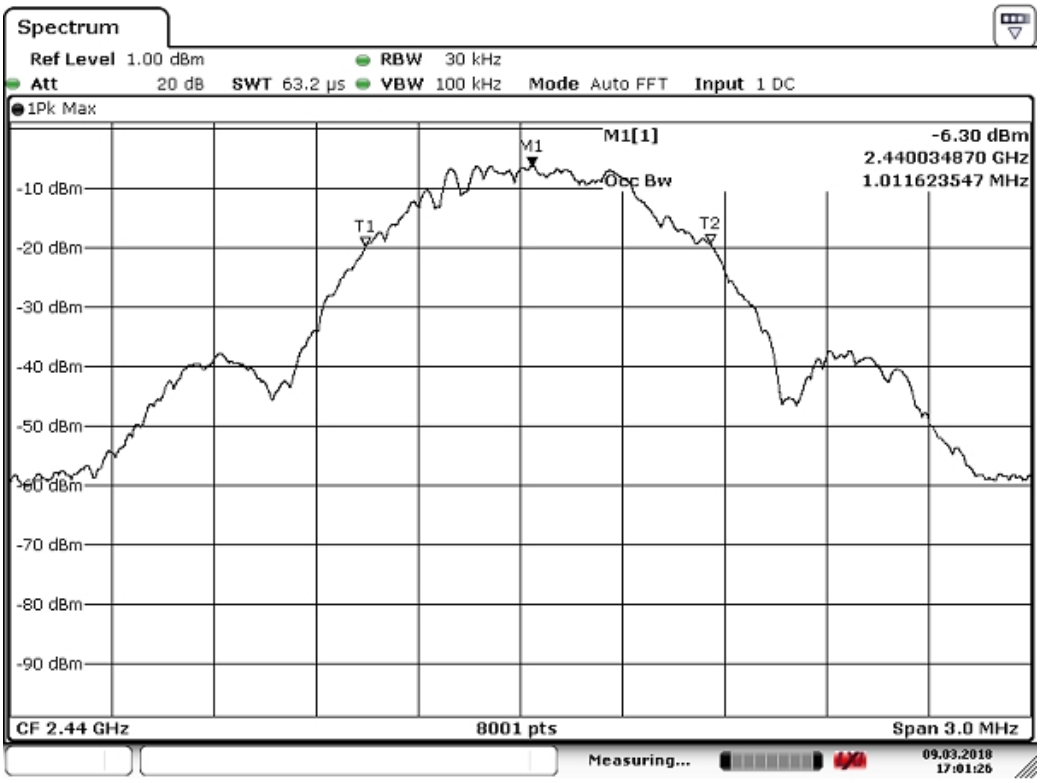
3.2.6 Plots of the 99% occupied bandwidth measurement

Channel 1



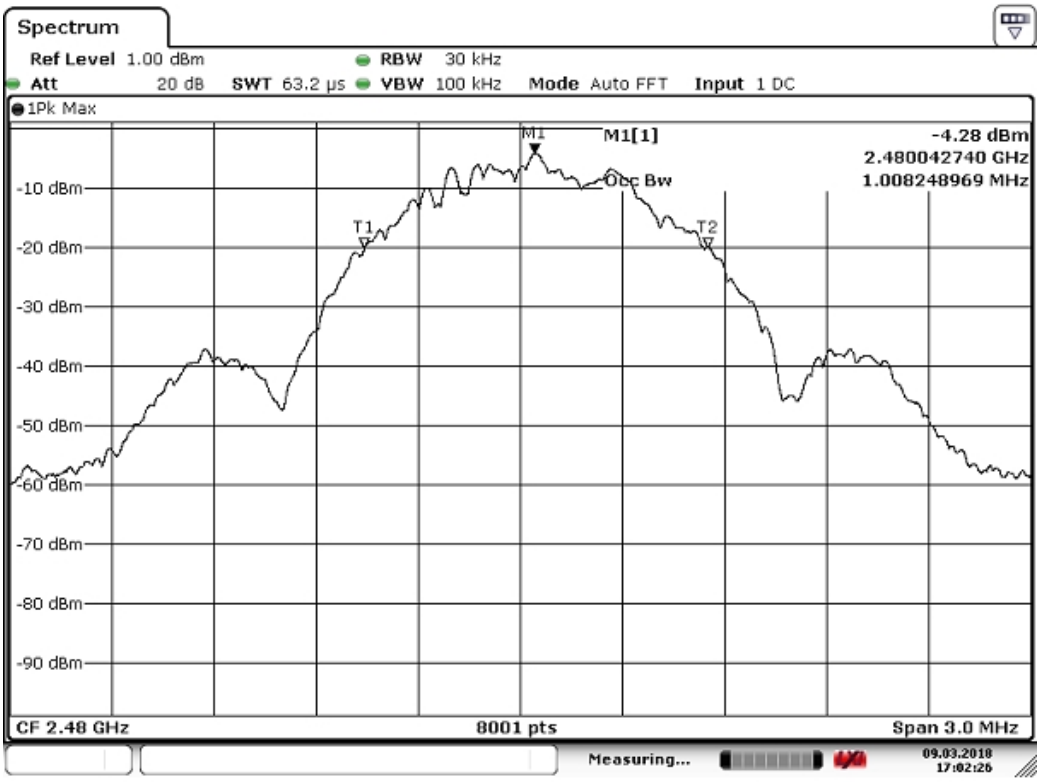
Date: 9.MAR.2018 17:00:09

Channel 18



Date: 9.MAR.2018 17:01:26

Channel 39



Date: 9.MAR.2018 17:02:27

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 2.4 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 v04.
IRN 014 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

3.3.5 Test results of Output Power Measurement

Peak method

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy	1	2402	1 Mbps	-1.47
	18	2440	1 Mbps	-0.53
	39	2480	1 Mbps	-0.16
Uncertainty	±0.71 dB			

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 2.4 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 v04.

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

3.4.5 Test results of Power Spectral Density Measurement

Peak Power spectral density

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth Low Energy	1	2402	1 Mbps	-17.69
	18	2440	1 Mbps	-16.61
	39	2480	1 Mbps	-16.61
Uncertainty	±2 dB			

3.5 Band edge Measurement

3.5.1 Limit

Band edge:
At the edge of the authorized band the RF power shall be at least 20 dB down.

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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 V04, sections 11.3 and 12.1.
IRN 026 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.

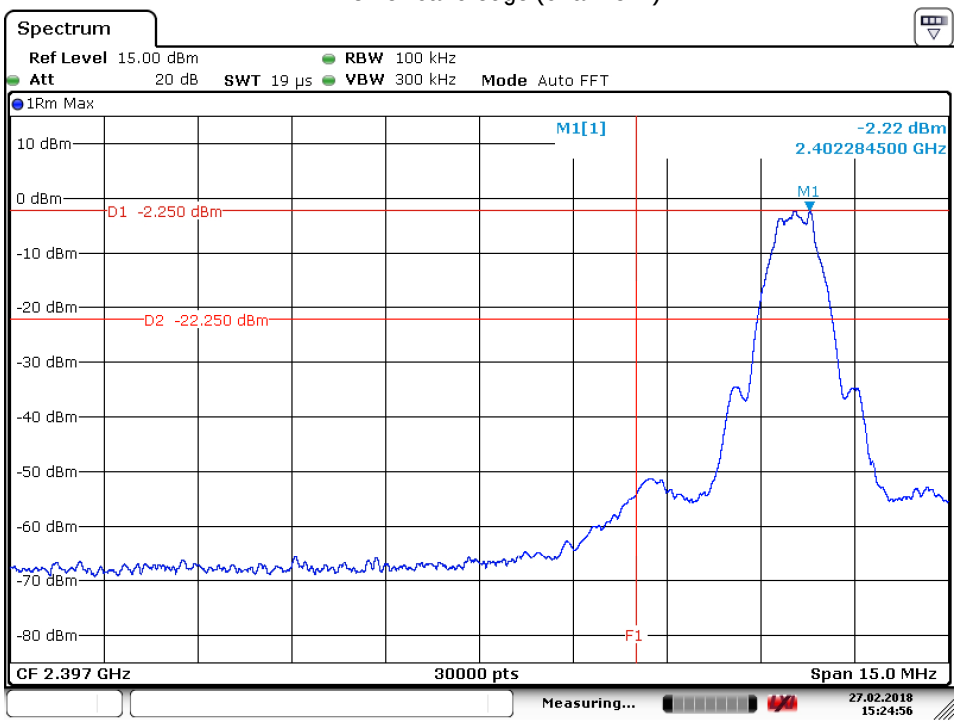
3.5.5 Measurement Uncertainty

± 5.7 dB.

3.5.6 Plots of the Band edge Measurements

See next page

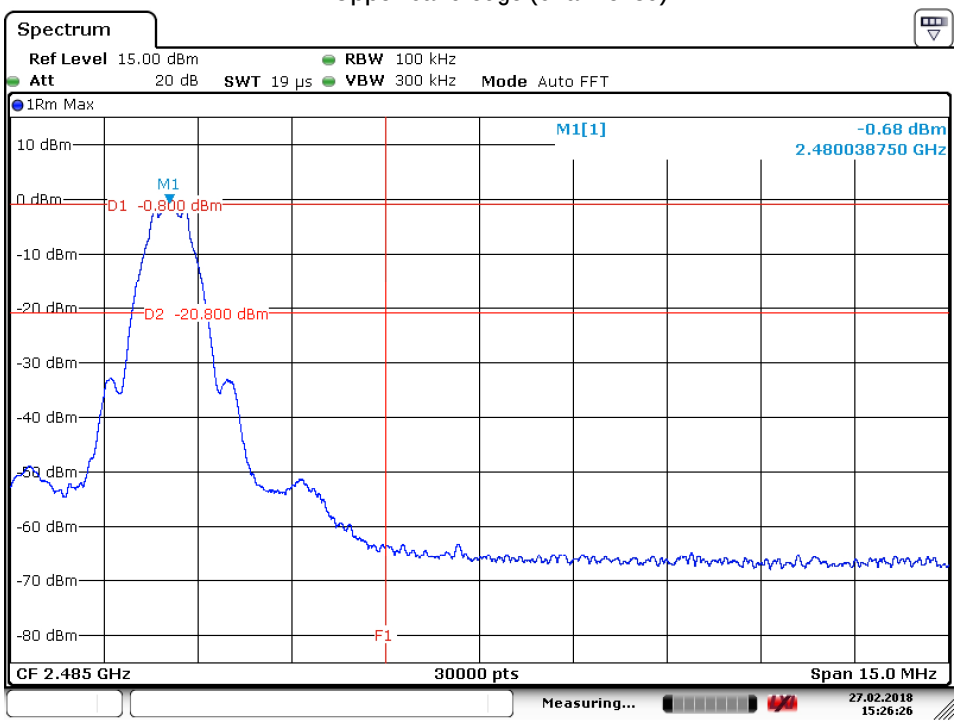
BLE Lower band edge (Channel 1)



IEEE802_11b, channel: 13 : Measure RX Spurious Emission 1 - 12.5 GHz

Date: 27.FEB.2018 15:24:57

BLE Upper band edge (Channel 39)



IEEE802_11b, channel: 13 : Measure RX Spurious Emission 1 - 12.5 GHz

Date: 27.FEB.2018 15:26:26

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:

15.209

Frequency (MHz)	Field strength (µV/m)	Measurement distance(m)
0.009 – 0.490	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 2.4 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

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 V04, 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.

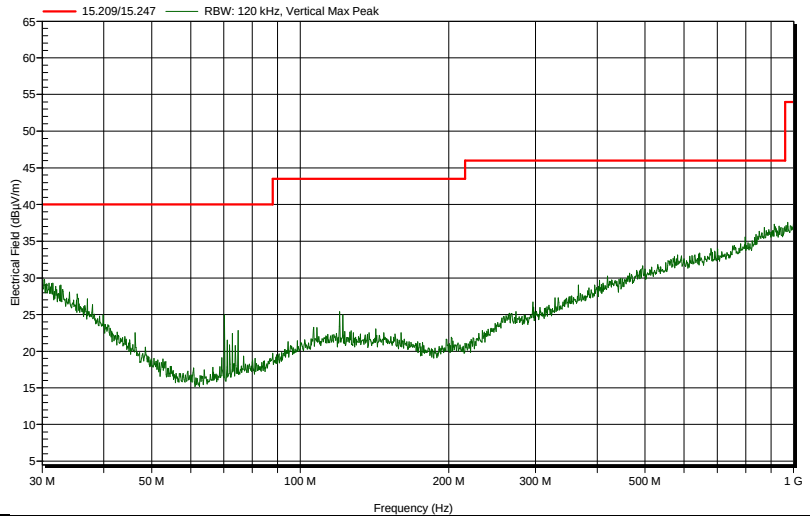
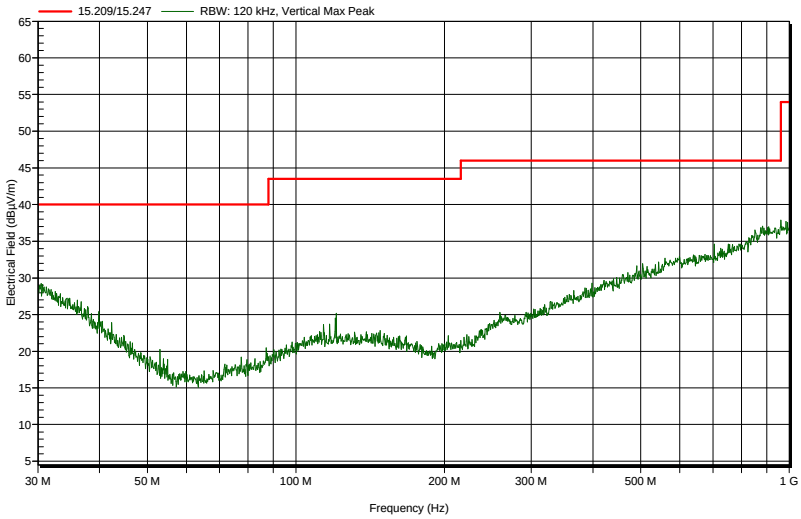
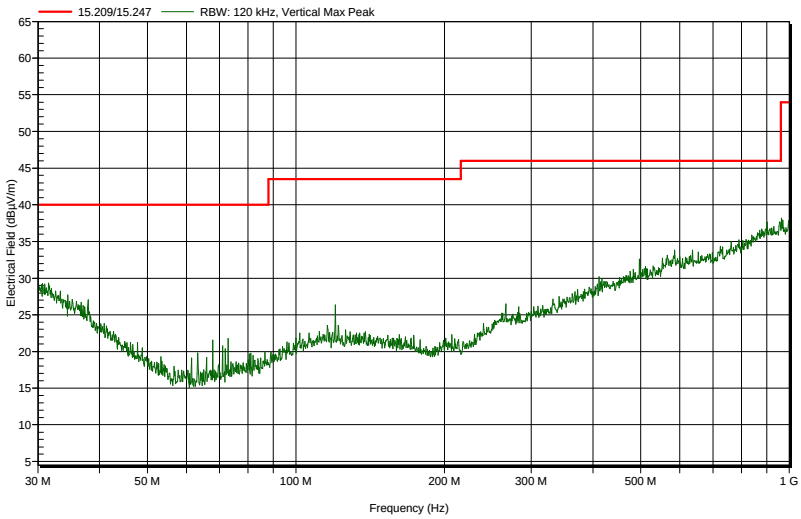
3.6.5 Notes

- In the frequency range of 1 – 26 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
- The peak exceeding the spurious limits at 2.4 GHz in the 1-18 GHz plots is the transmission frequency, and therefore not subject to the limit.

3.6.6 Plots of the Radiated Spurious Emissions

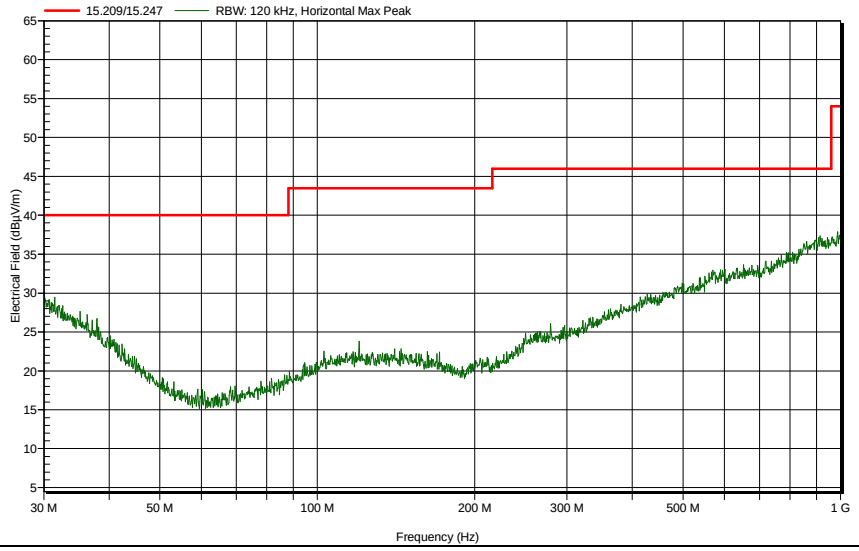
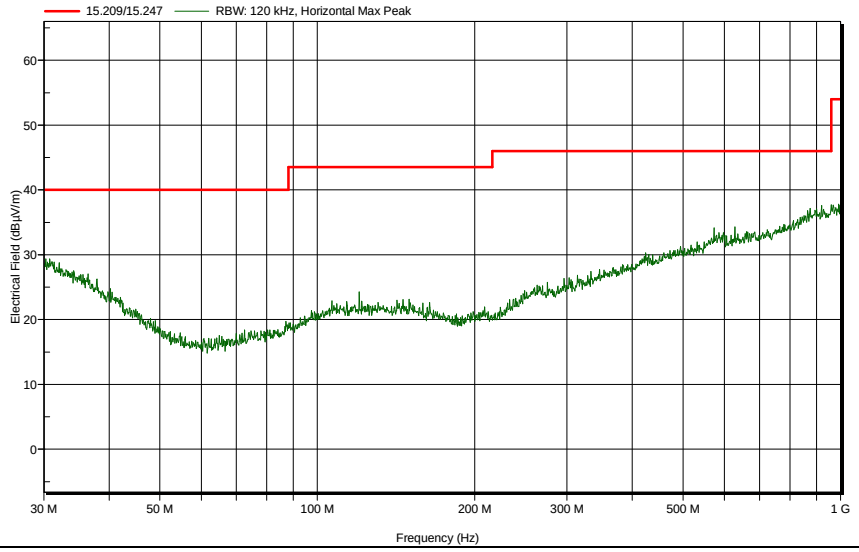
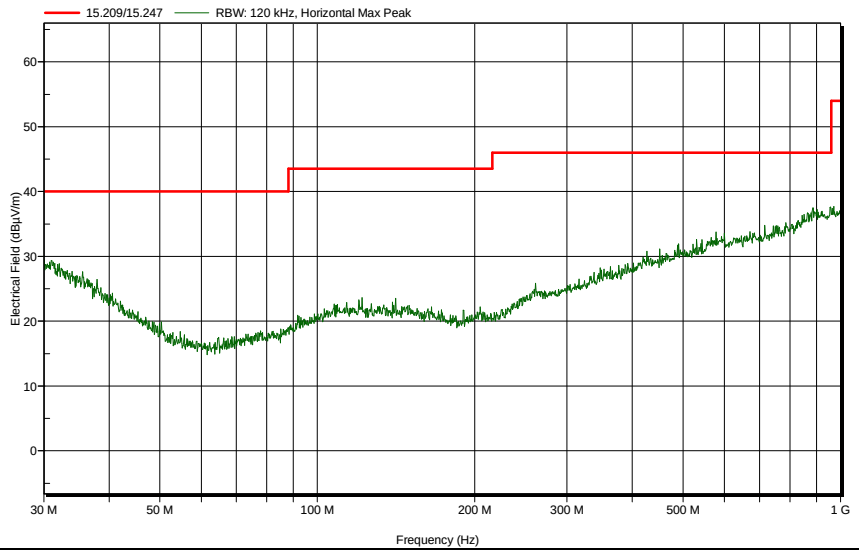
30 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

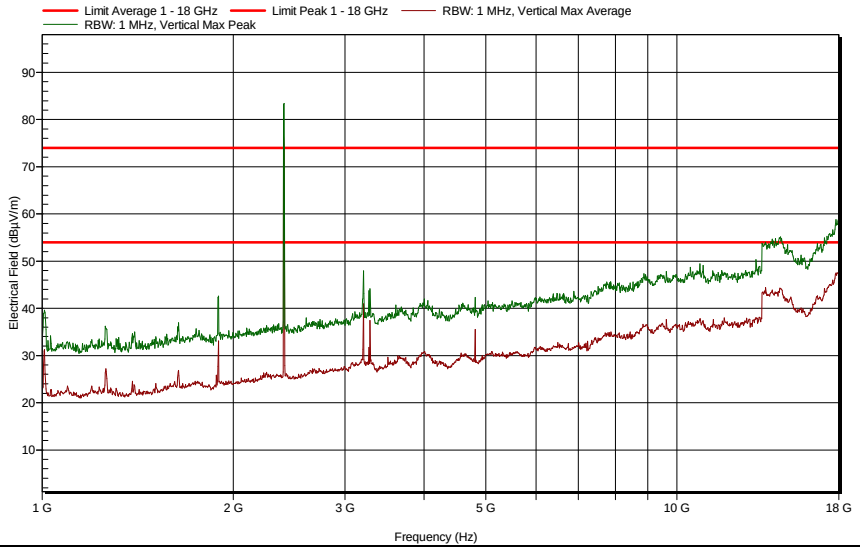
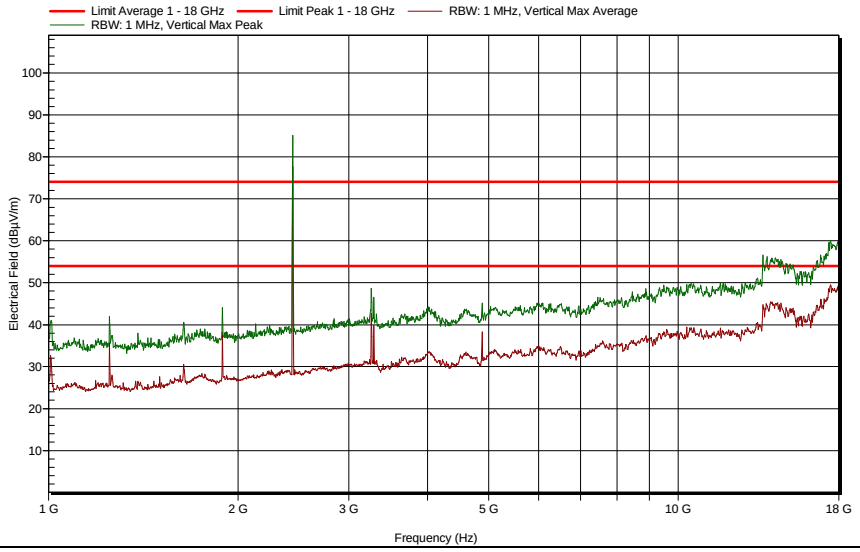
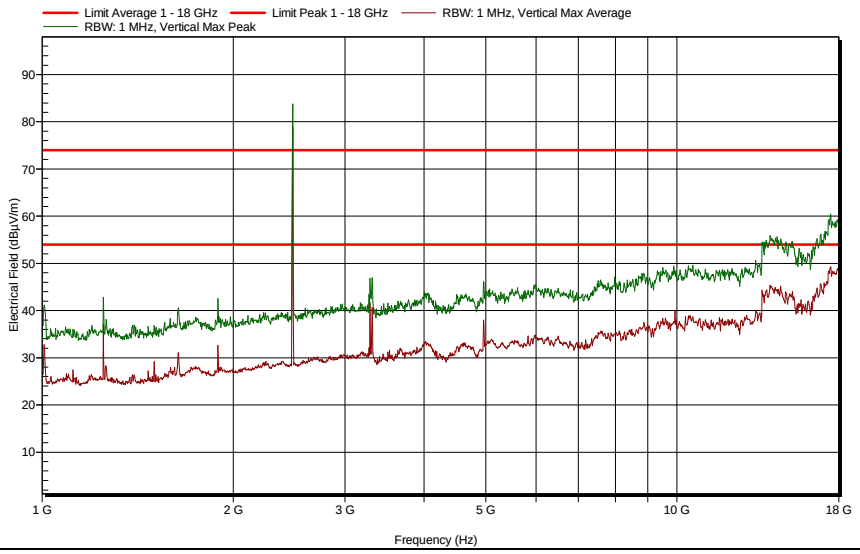
30 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

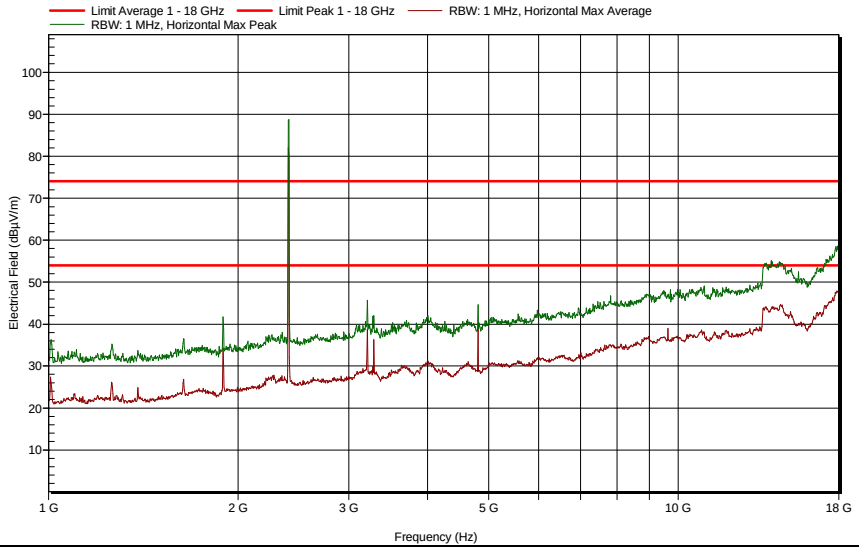
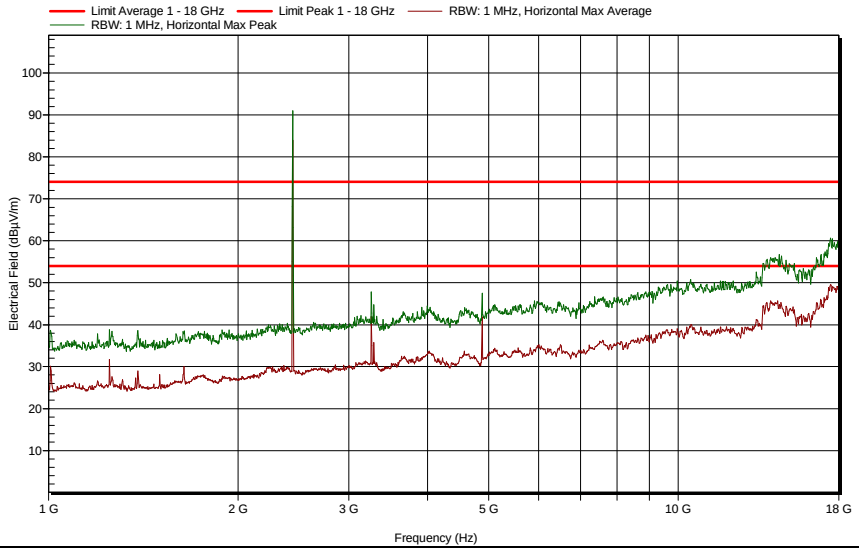
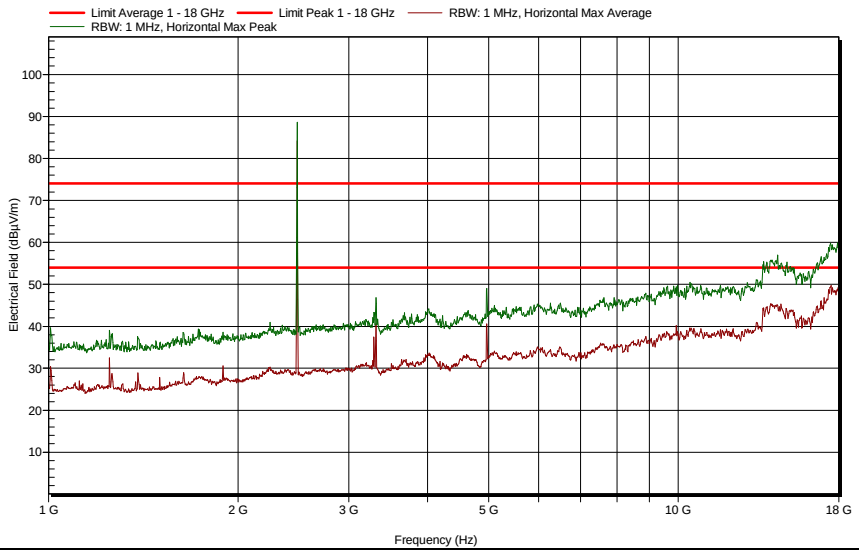
1 GHz to 18 GHz

Vertical polarization

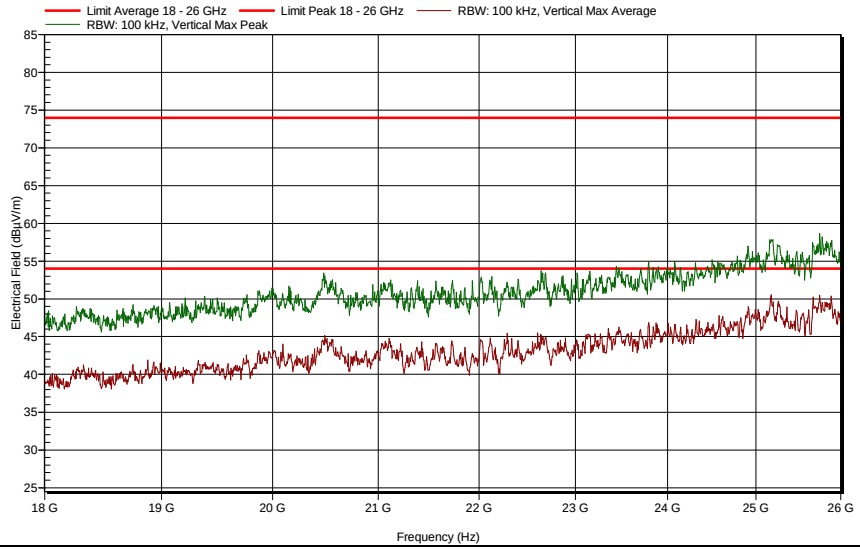
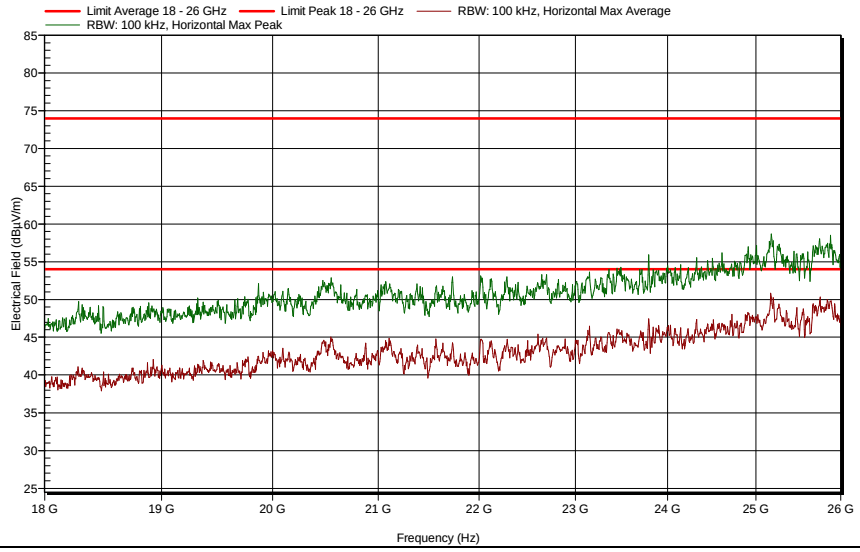
Low ch	
Mid ch	
High ch	

1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Vertical polarization Mid ch	
Horizontal polarization Mid ch	

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 dB
18000 – 26000 MHZ	3.9 dB

3.7 AC conducted mains measurement

3.7.1 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.

3.7.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 of this report.

3.7.3 Test setup

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.
IRN 029 - Conducted disturbance (V) Method 1 – AC mains conducted disturbance.

3.7.5 Test results and plots of the AC conducted mains measurement

The EUT normally receives power from another device that in turn connects to the public-utility ac power lines, therefore the measurements are made with a representative charger with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.

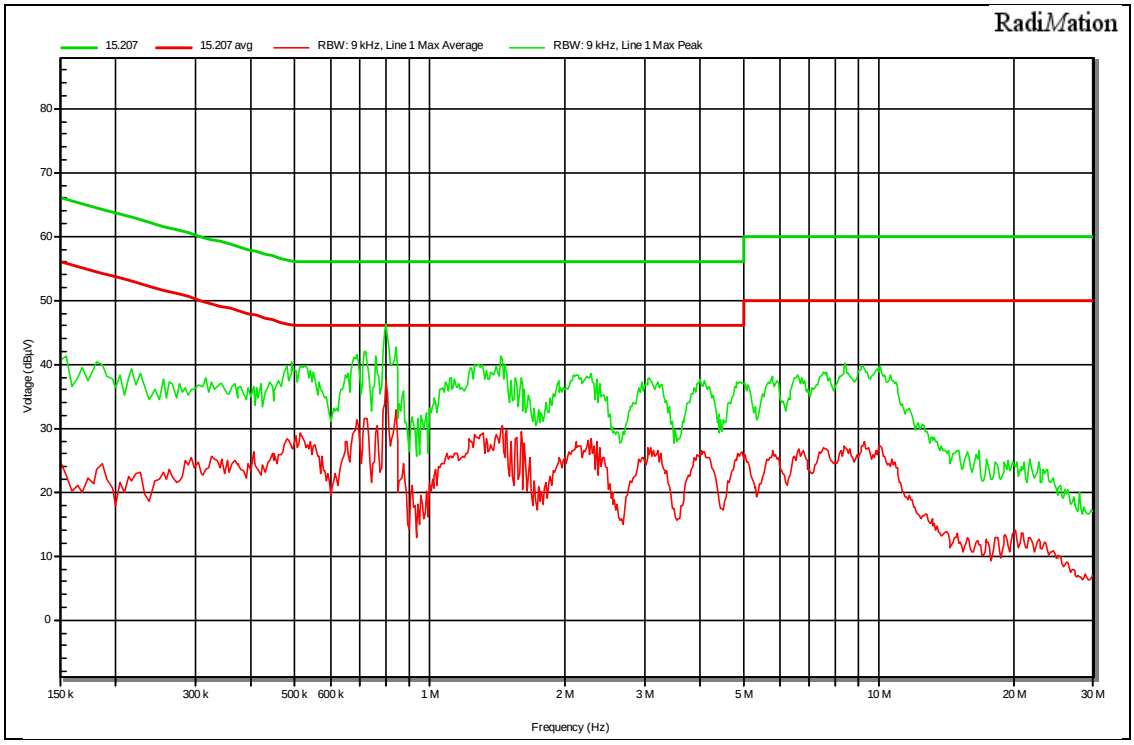
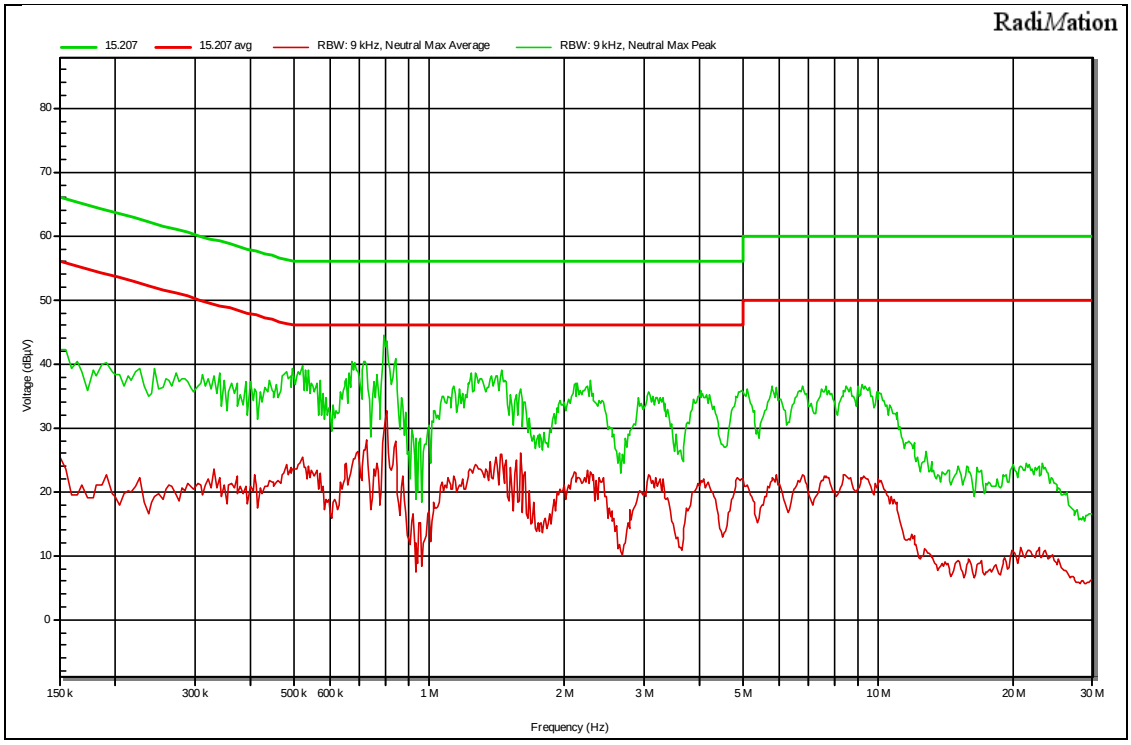
The test results can be found on the next page.

3.7.6 Measurement uncertainty

+/- 3.6 dB.

3.7.7 Plots of the AC conducted spurious measurement

Phase



Neutral