

FCC Test Report for Parts 15.247, 15.207 and 15.209 (DTS)

Product name : The Dash
Applicant : DashTag
FCC ID : 2A0FF A001

Test report No. : 171000318 03 Ver 2.00

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	05-01-2018	First draft	RvB
v1.00	10-01-2018	Initial release	RvB
v2.00	20-03-2018	Updated following items: • Changed KDB Publication No. 558074 D01DTS Meas. Guidance V0305 to v04 • Changed measurement uncertainty in chapters 3.2, 3.3	RvB

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 Test setups.....	10
2.4 Equipment used in the test configuration.....	11
2.5 Sample calculation.....	11
3 Test results	12
3.1 6dB bandwidth Measurement.....	12
3.1.1 Limit.....	12
3.1.2 Measurement instruments	12
3.1.3 Test setup.....	12
3.1.4 Test procedure	12
3.1.5 Test Results of the 6 dB bandwidth Measurement.....	12
3.1.6 Plots of the 6 dB bandwidth Measurement	13
3.2 Output Power Measurement	14
3.2.1 Limit.....	14
3.2.2 Measurement instruments	14
3.2.3 Test setup.....	14
3.2.4 Test procedure	14
3.2.5 Test results of Output Power Measurement.....	14
3.2.6 Plots of Output Power Measurement	15
3.3 Power Spectral Density.....	16
3.3.1 Limit.....	16
3.3.2 Measurement instruments	16

3.3.3	Test setup.....	16
3.3.4	Test procedure	16
3.3.5	Test results of Power Spectral Density Measurement	16
3.3.6	Plots of the Power Spectral Density Measurements.....	17
3.4	Band edge Measurement	18
3.4.1	Limit.....	18
3.4.2	Measurement instruments	18
3.4.3	Test setup.....	18
3.4.4	Test procedure	18
3.4.5	Measurement Uncertainty.....	18
3.4.6	Plots of the Band edge Measurements.....	19
3.5	Radiated Spurious Emissions Measurement	20
3.5.1	Limit.....	20
3.5.2	Measurement instruments	20
3.5.3	Test setup.....	20
3.5.4	Test procedure	20
3.5.5	Notes	20
3.5.6	Plots of the Radiated Spurious Emissions Measurement.....	21
3.5.7	Measurement Uncertainty.....	27
3.6	AC conducted mains measurement	28
3.6.1	Limit.....	28
3.6.2	Measurement instruments	28
3.6.3	Test setup.....	28
3.6.4	Test procedure	28
3.6.5	Test results and plots of the AC conducted mains measurement	28
3.6.6	Measurement uncertainty	28
3.6.7	Plots of the AC conducted spurious measurement.....	29

Summary of Test results

FCC	Description	Section in report	Verdict
15.247 (a)	6dB Bandwidth	3.1	Pass
15.247 (b)	RF output power	3.2	Pass
15.247 (e)	Power spectral density	3.3	Pass
15.247 (d)	Band edge	3.4	Pass
15.209 (a)	Radiated Spurious emissions	3.5	Pass
15.205 (a)	Spurious emissions in the restricted bands	3.5	Pass
15.207 (c)	Conducted limits	3.6	Pass

1 General Description

1.1 Applicant

Client name: DashTag
Address: Stationsplein 45 A4.004, Rotterdam, The Netherlands
Zip code: 3013 AK
Telephone: +31622137002
E-mail: epco@getdashtag.com
Contact name: Epco Berger

1.2 Manufacturer

Manufacturer name: DashTag
Address: Stationsplein 45 A4.004, Rotterdam, The Netherlands
Zip code: 3013 AK
Telephone: +31622137002
E-mail: epco@getdashtag.com
Contact name: Epco Berger

1.3 Tested Equipment Under Test (EUT)

Product name: The Dash
Brand name: DashTag
Product type: A001
FCC ID: 2A0FF A001
Model(s): --
Software version: A
Hardware version: A
Date of receipt: 20-11-2017
Tests started: 08-12-2017
Testing ended: 11-12-2017

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)	-11.8
Antenna type	Ceramic chip antenna
Antenna gain(dBi)	0.5
Type of modulation	BT: Acc. to Bluetooth core spec
Emission designator BLE	1M10F1D

1.5 Modification of the Equipment Under Test (EUT)

None.

1.6 Observations and remarks

--

1.7 Environmental conditions

Test date	08-12-2017	10-01-2018
Ambient temperature	21.1 °C	20.4 °C
Humidity	39.7 %	37.6 %

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

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 : 20-03-2018

Name : ing. K.A. Roes

Function : Coordinator Radio Laboratory

Signature :



2 Test configuration of the Equipment Under Test

2.1 Test mode

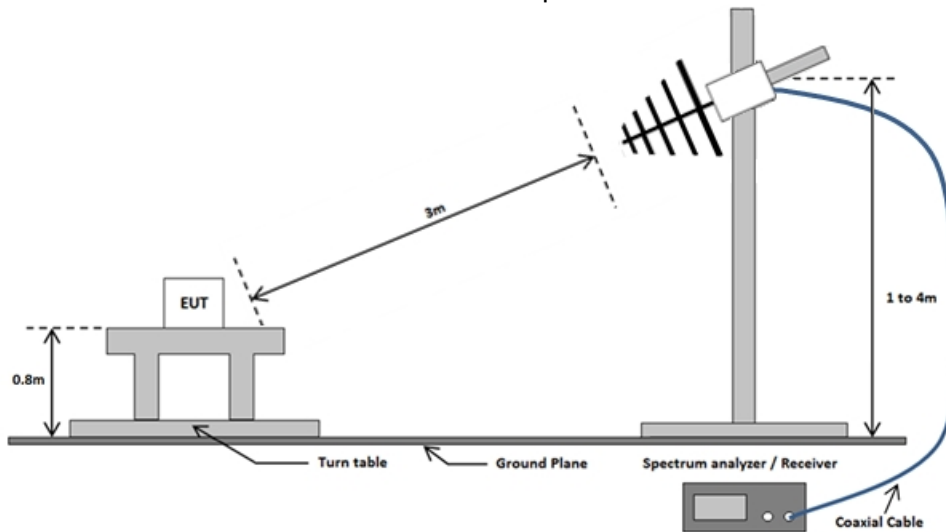
The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

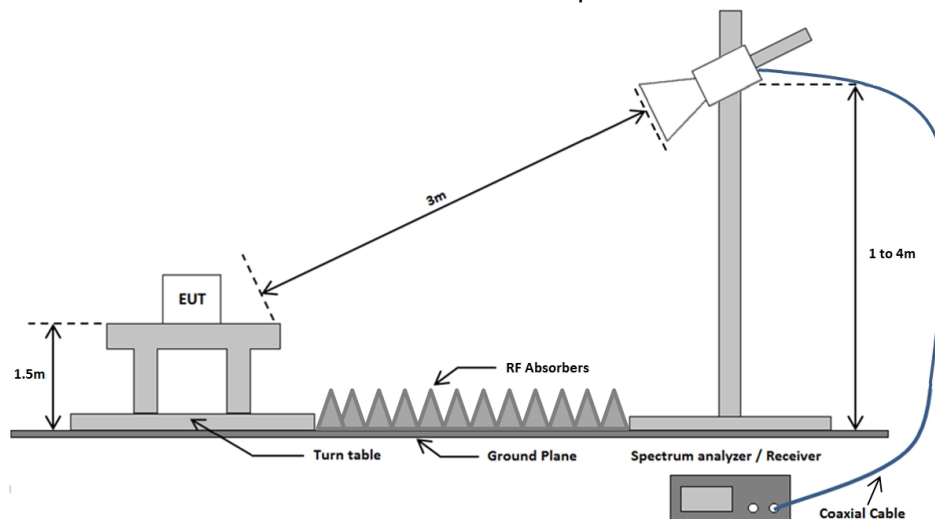
Technology	Channels	Data rate	Frequency (MHz)
Bluetooth Low Energy	1	1 Mbps	2402
	17	1 Mbps	2442
	39	1 Mbps	2408

2.3 Test setups

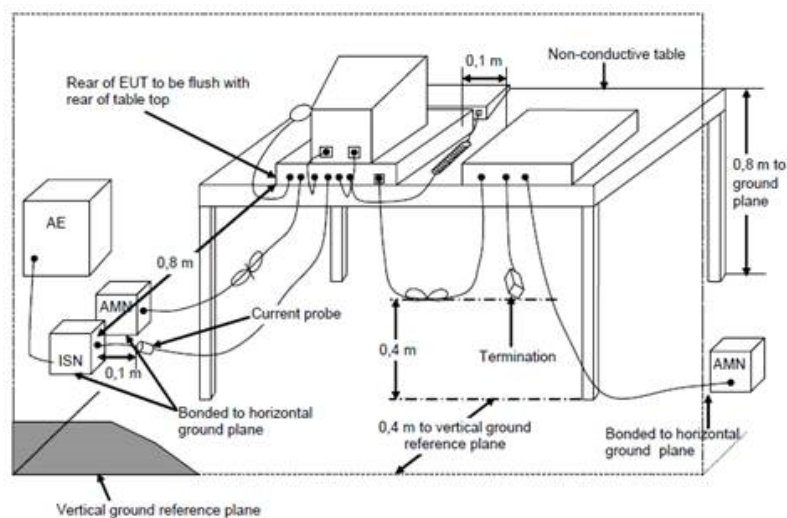
Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



Emissions test at 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	3.2 – 3.3, 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	D.A.R.E Instruments	Radimation 2016.2.8	--	3.1 - 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:

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

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 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

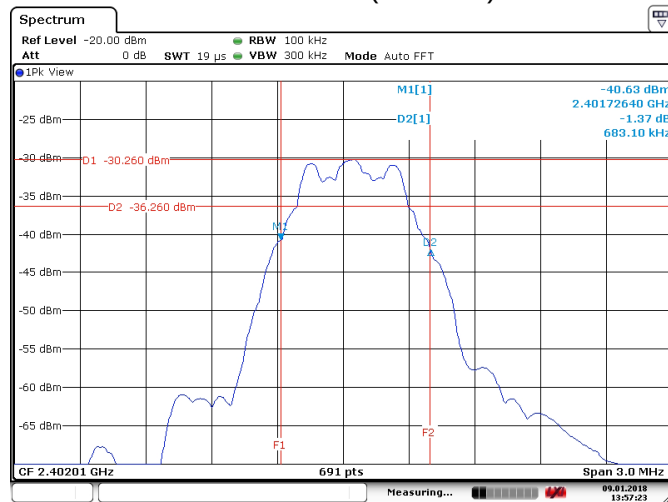
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.

3.1.5 Test Results of the 6 dB bandwidth Measurement

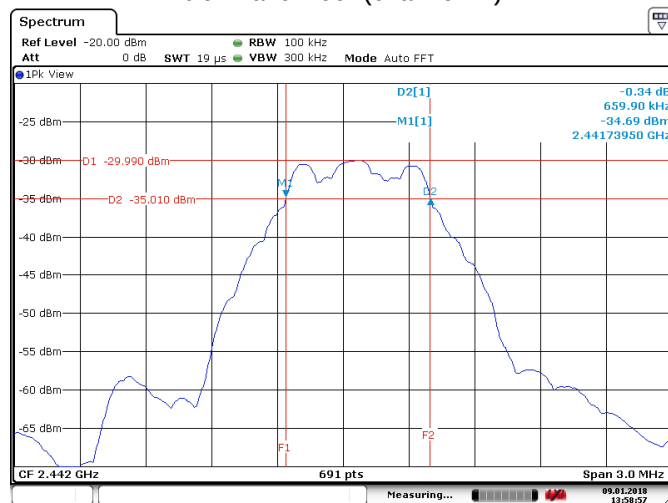
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low energy	1	2404	1 Mbps	683.1
	17	2440	1 Mbps	659.9
	39	2480	1 Mbps	659.9
Uncertainty	± 36.2 kHz			

3.1.6 Plots of the 6 dB bandwidth Measurement

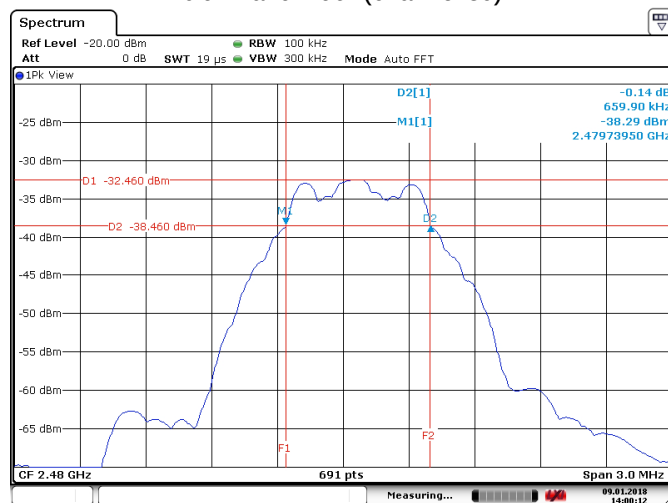
6 dB Bandwidth (Channel 1)



6 dB Bandwidth (Channel 17)



6 dB Bandwidth (Channel 39)



3.2 Output Power Measurement

3.2.1 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.

3.2.2 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

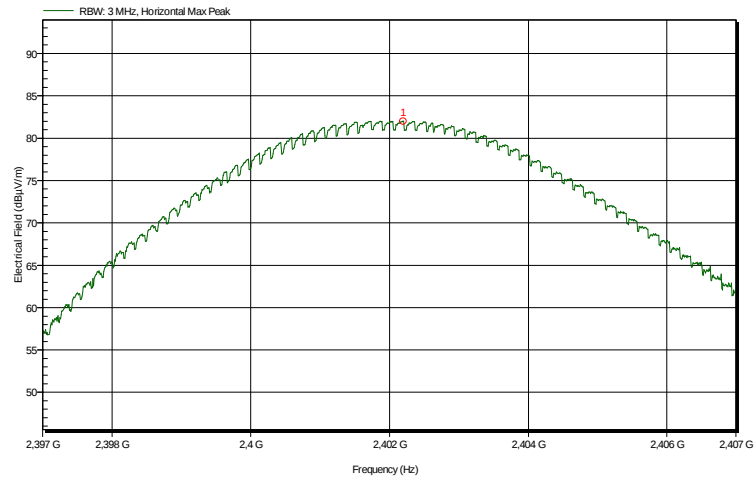
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04

3.2.5 Test results of Output Power Measurement

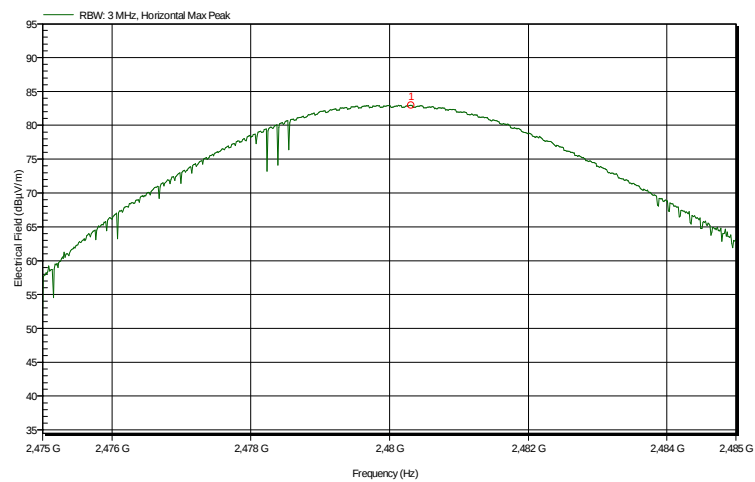
Peak method				
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy	1	2404	1 Mbps	-13.2
	17	2440	1 Mbps	-13.8
	39	2480	1 Mbps	-12.3
Uncertainty	±4.91 dB			

3.2.6 Plots of Output Power Measurement

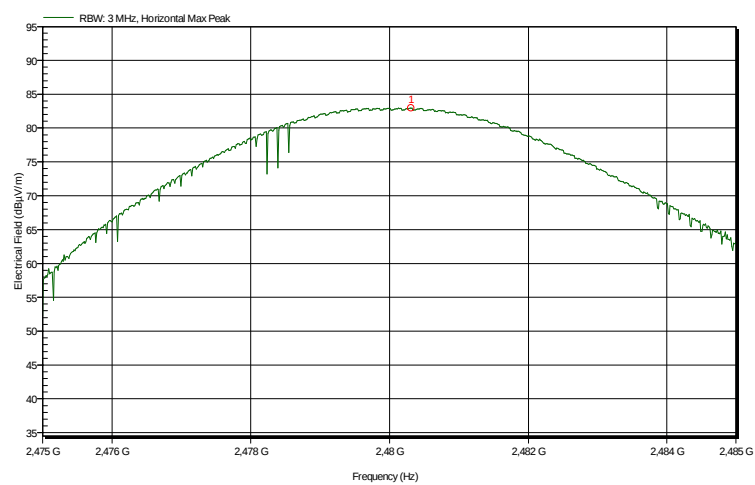
Peak Output Power (Channel 1)



Peak Output Power (Channel 17)



Peak Output Power (Channel 39)



Note: dB μ V/m - 95.2 = dBm

3.3 Power Spectral Density

3.3.1 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.

3.3.2 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

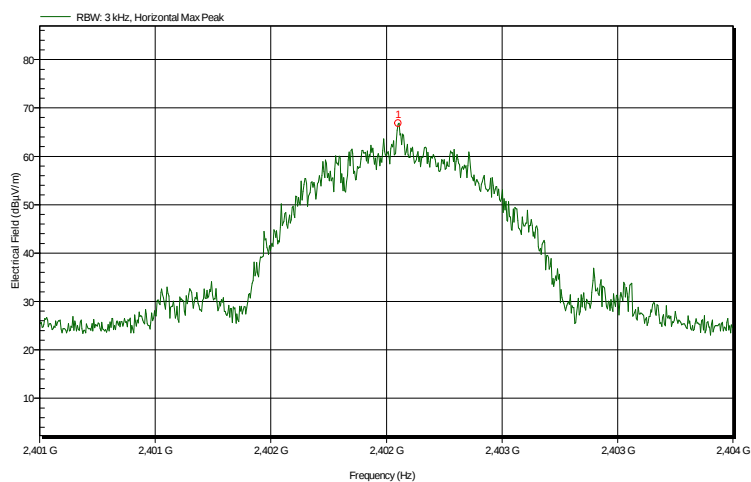
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04

3.3.5 Test results of Power Spectral Density Measurement

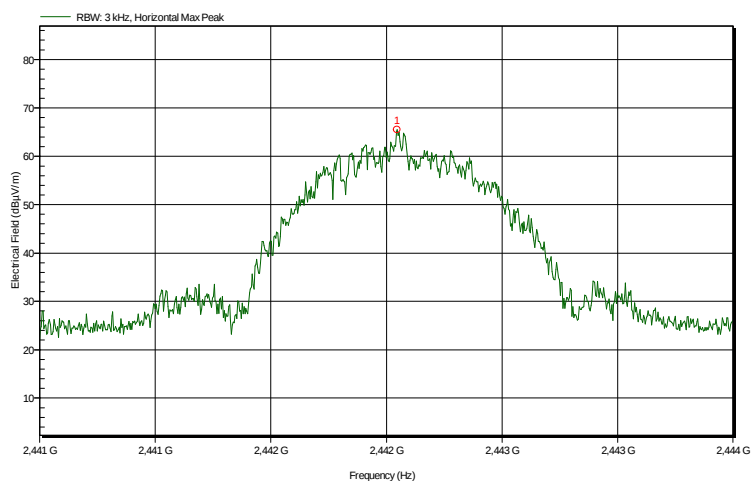
Peak Power spectral density				
Technology Std.	Channel	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth Low Energy	1	2404	1 Mbps	-28.4
	17	2440	1 Mbps	-29.7
	39	2480	1 Mbps	-27.7
Uncertainty	±4.91 dB			

3.3.6 Plots of the Power Spectral Density Measurements

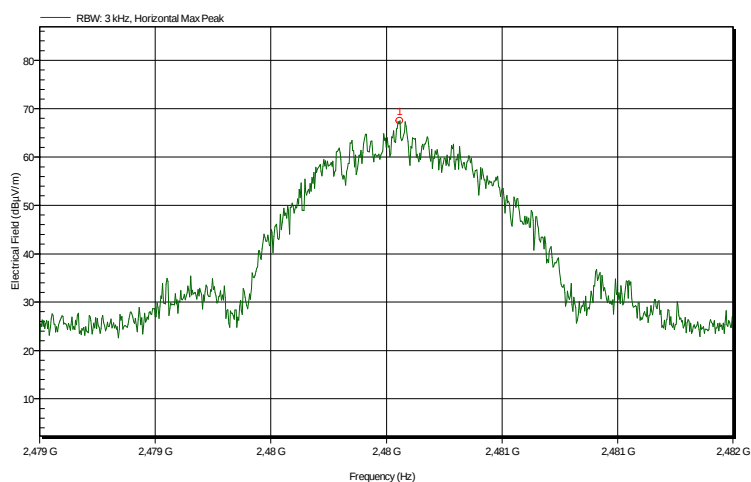
Power Spectral Density 3 kHz (channel 1)



Power Spectral Density 3 kHz (channel 17)



Power Spectral Density 3 kHz (channel 39)



Note: dBμV/m - 95.2 = dBm

3.4 Band edge Measurement

3.4.1 Limit

Band edge:

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

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

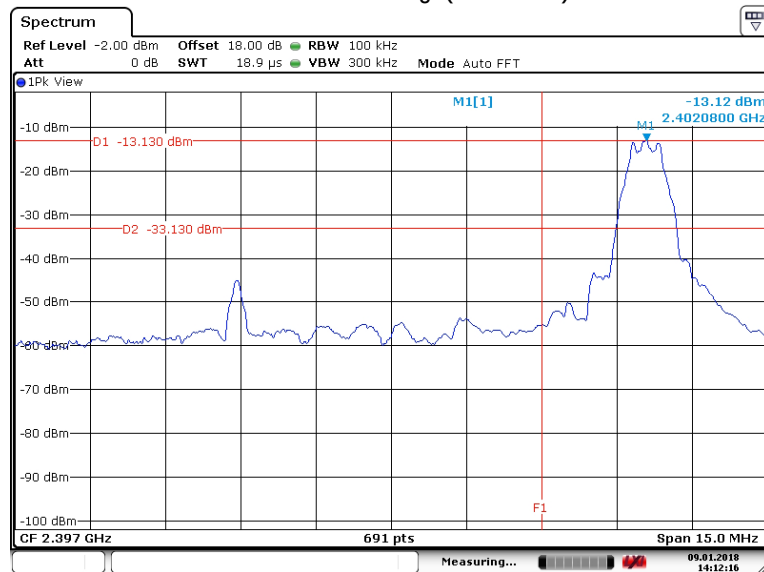
According to KDB Publication 558074 V04, section 13

3.4.5 Measurement Uncertainty

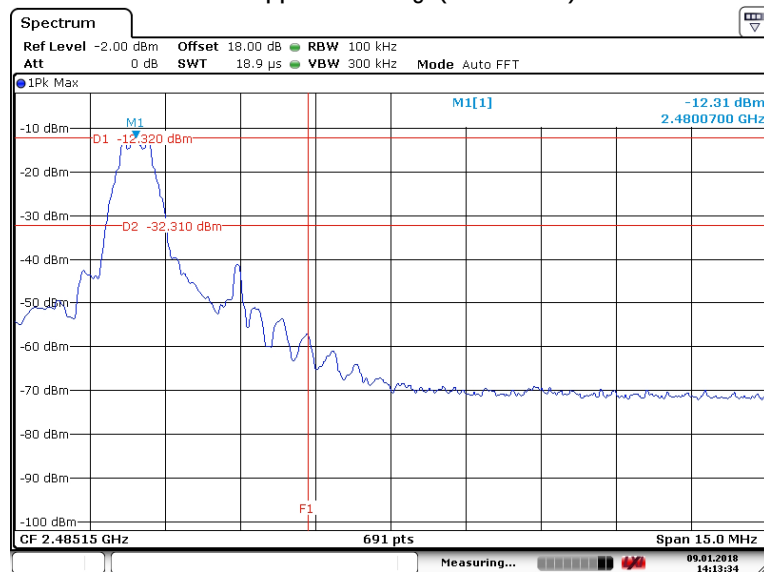
± 5.7 dB.

3.4.6 Plots of the Band edge Measurements

BLE Lower band edge(Channel 1)



BLE Upper band edge(Channel 39)



3.5 Radiated Spurious Emissions Measurement

3.5.1 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 ($\mu\text{V/m}$)	Measurement distance(m)
0.009 – 0.490	$2400/F(\text{kHz})$	300
0.490 – 1.705	$24000/F(\text{kHz})$	30
1.705 - 30	30	30
30 -88	100	3
88 - 216	150	3
216-960	200	3
Above 960	500	3

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

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

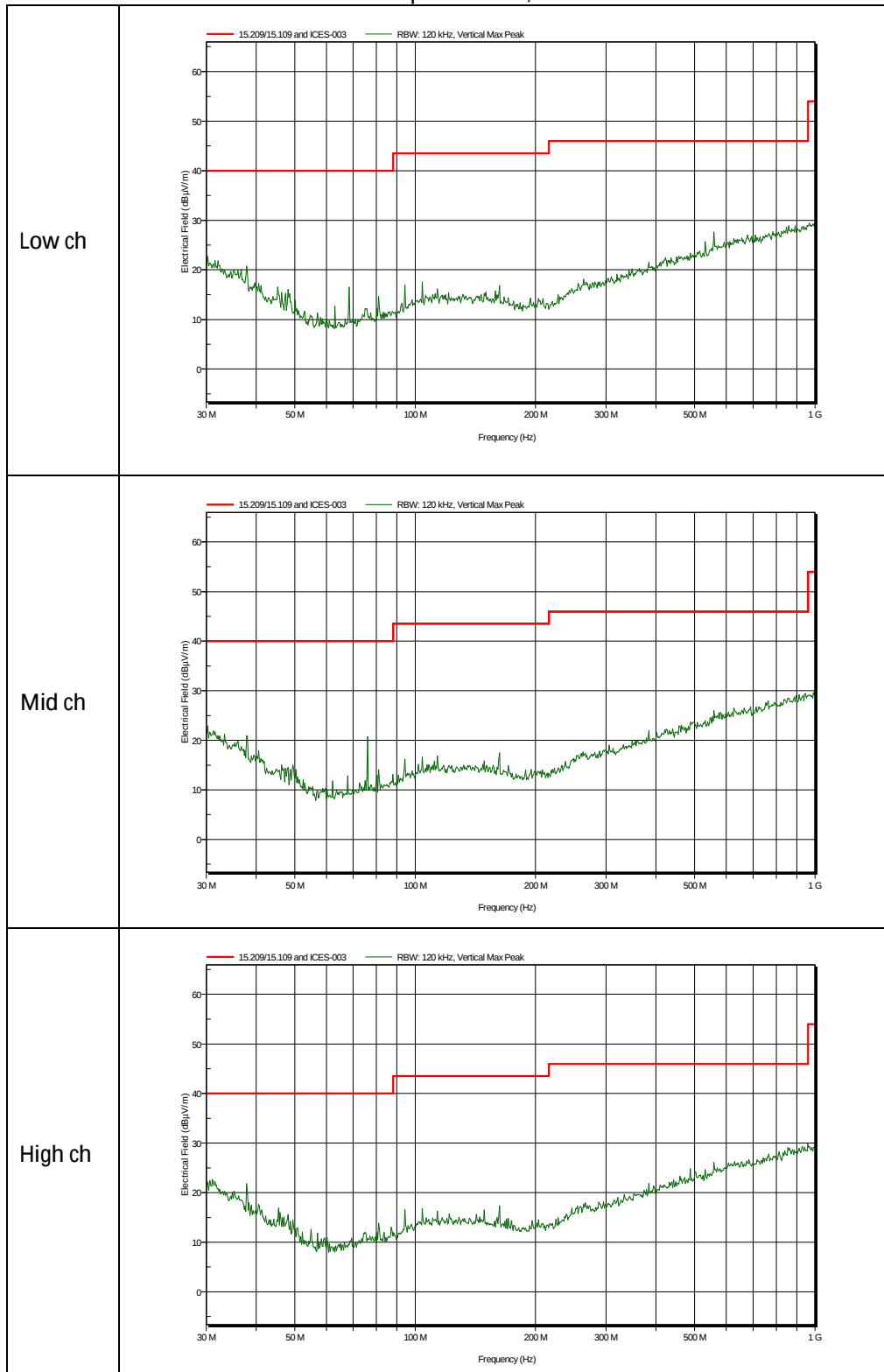
3.5.5 Notes

- 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

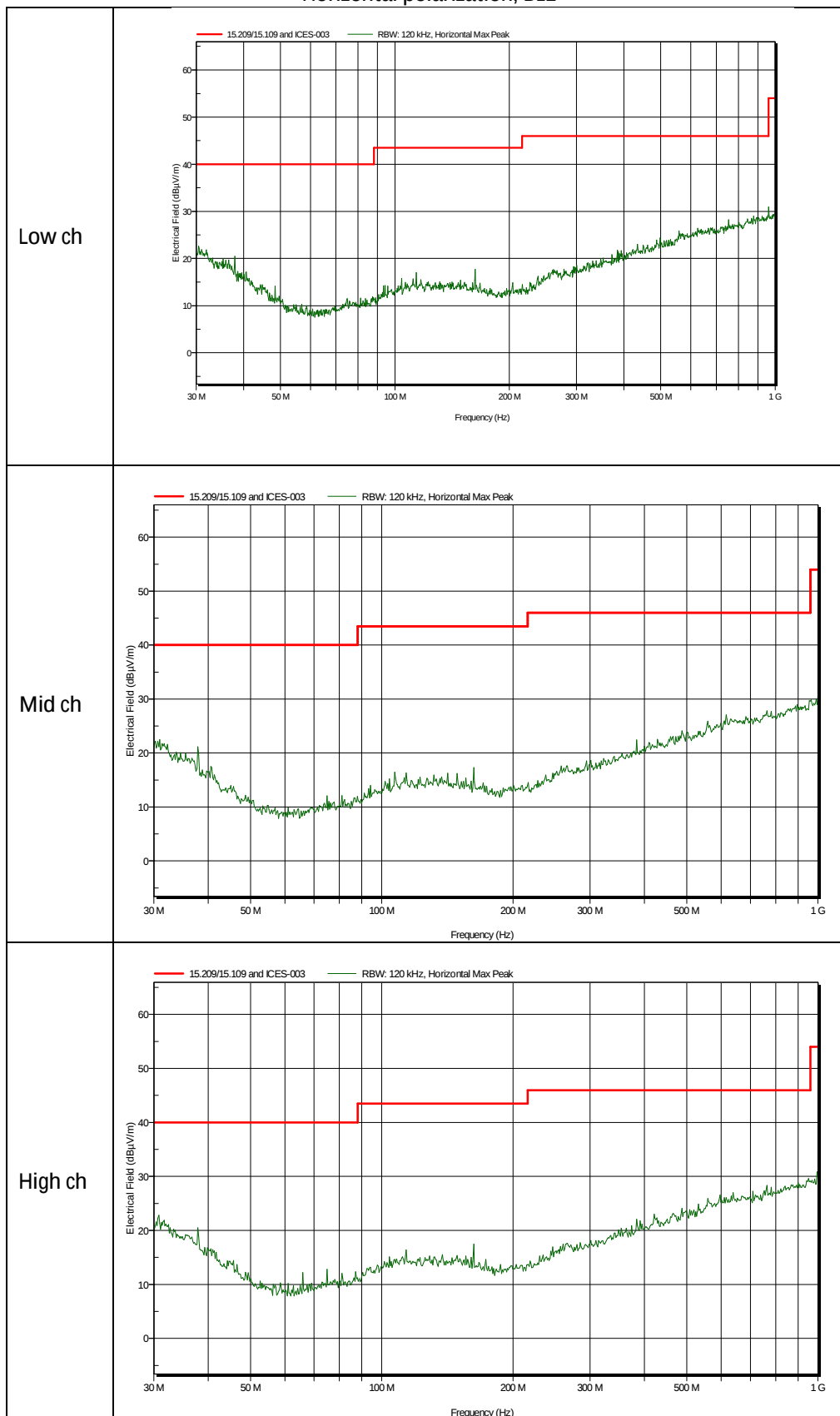
3.5.6 Plots of the Radiated Spurious Emissions Measurement

30 – 1000 MHz

Vertical polarization, BLE

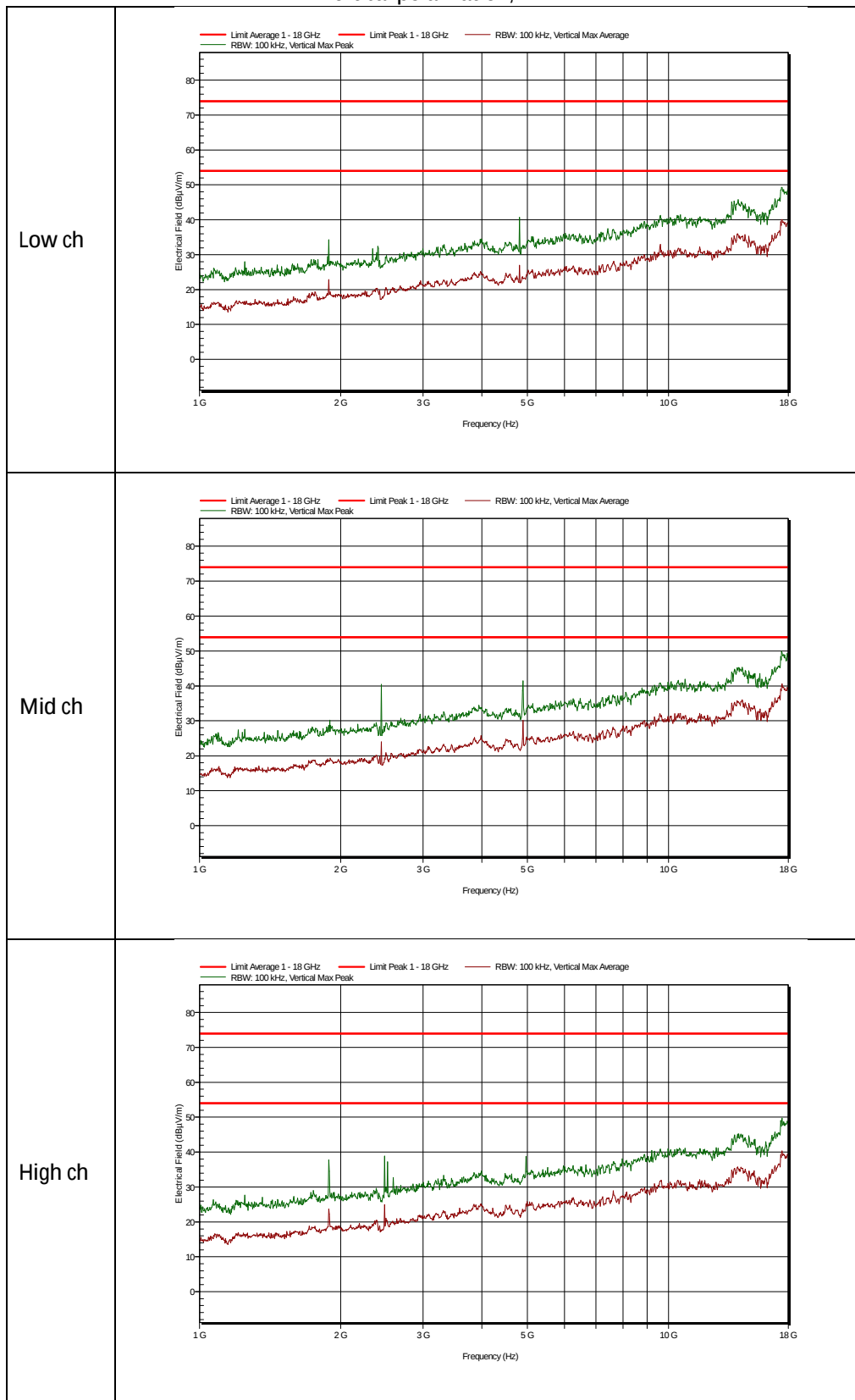


Horizontal polarization, BLE

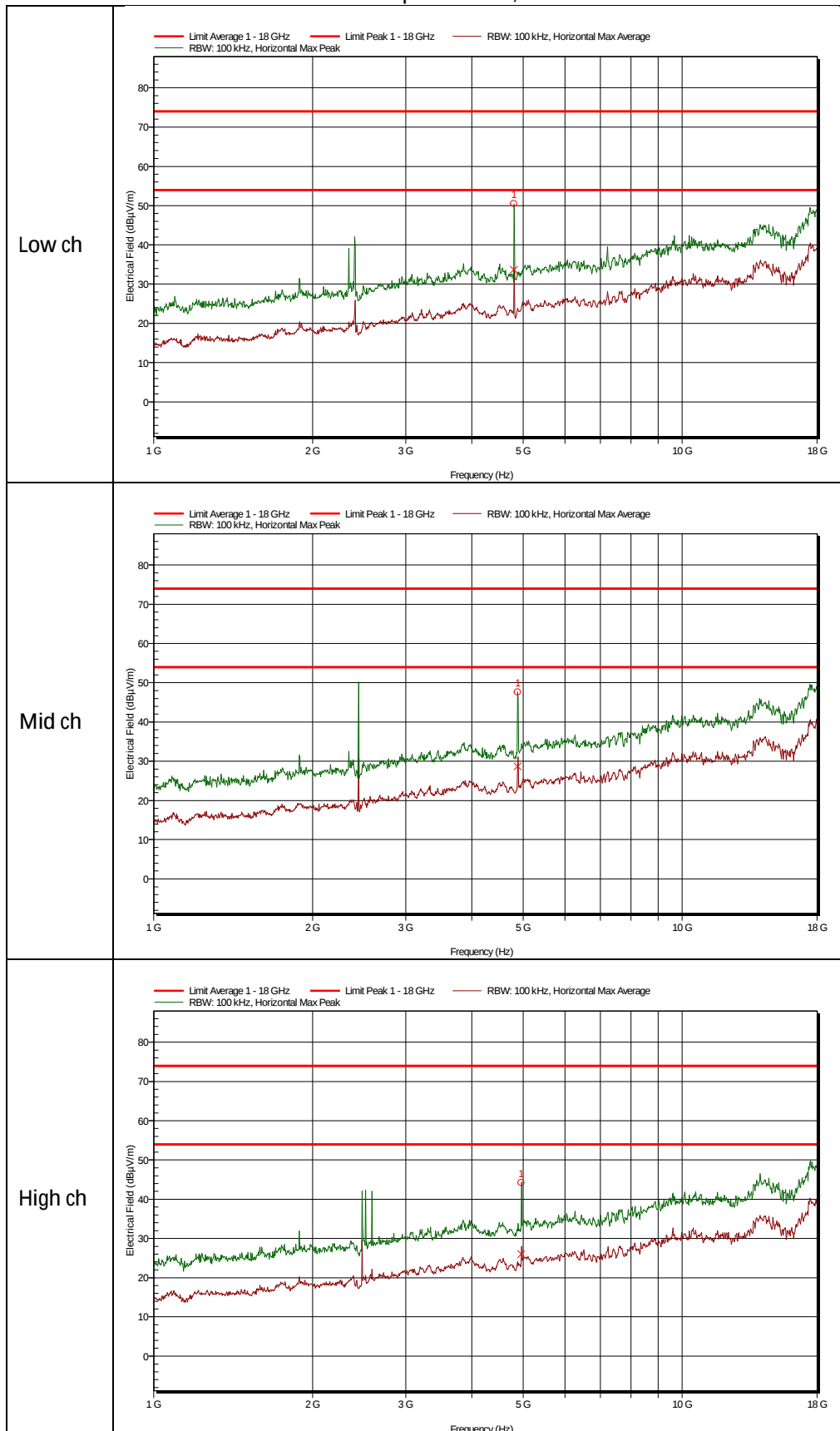


1 – 18 GHz

Vertical polarization, BLE



Horizontal polarization, BLE



Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency (GHz)	Height	Peak (dB μ V/m)	Average (dB μ V/m)	Peak Limit (dB μ V/m)	Average Limit (dB μ V/m)	Peak Margin(dB)	Average Margin(dB)
4,804	1 m	50,5	33,7	74	54	-23,5	-20,3

Measured peaks Horizontal 1 – 18 GHz Middle channel

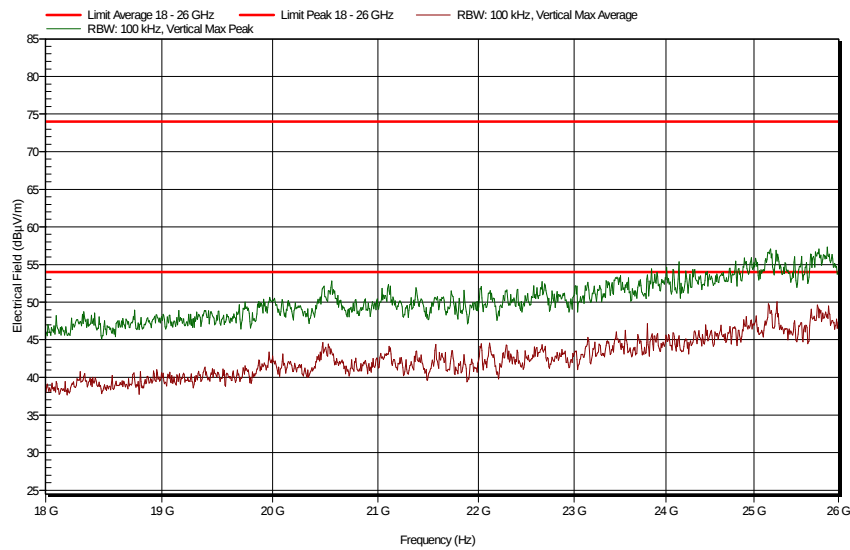
Frequency (GHz)	Height	Peak (dB μ V/m)	Average (dB μ V/m)	Peak Limit (dB μ V/m)	Average Limit (dB μ V/m)	Peak Margin(dB)	Average Margin(dB)
4,882	1 m	47,6	28,7	74	54	-26,4	-25,3

Measured peaks Horizontal 1 – 18 GHz High channel

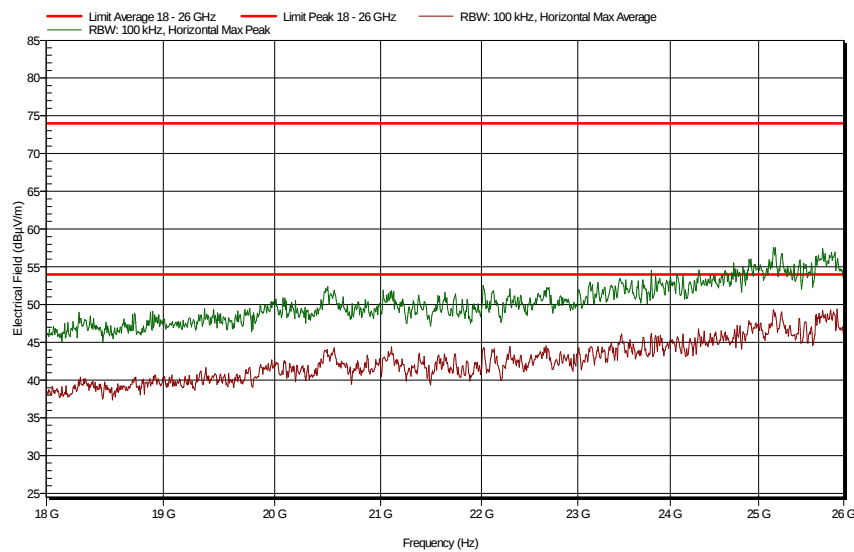
Frequency (GHz)	Height	Peak (dB μ V/m)	Average (dB μ V/m)	Peak Limit (dB μ V/m)	Average Limit (dB μ V/m)	Peak Margin(dB)	Average Margin(dB)
4,961	1 m	44,2	26	74	54	-29,8	-28,0

18 GHz to 26.5 GHz

Vertical polarization (High channel)



Horizontal polarization (High channel)



Note: Only the worst case channel is tested in the 18 to 26 GHz range

3.5.7 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

3.6 AC conducted mains measurement

3.6.1 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 (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.

3.6.2 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

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

3.6.5 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.

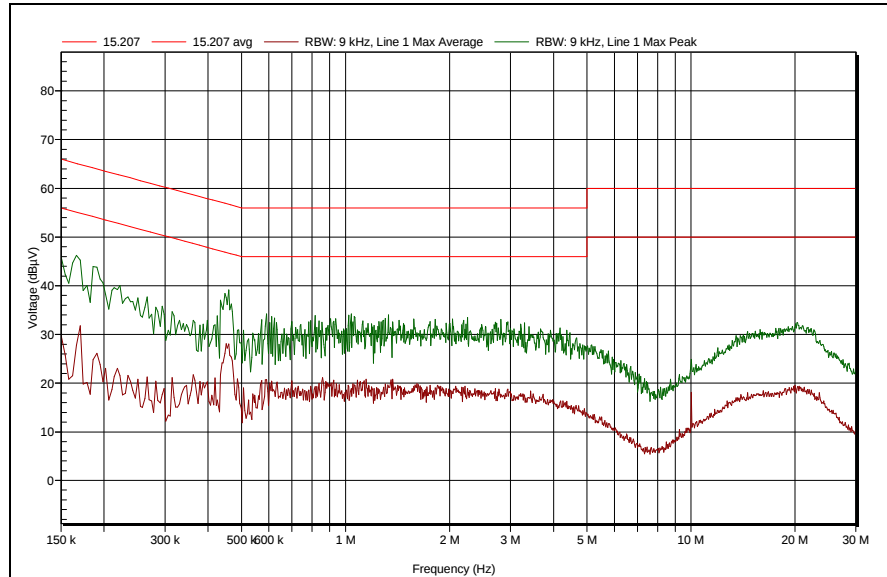
The test results can be found on the next page.

3.6.6 Measurement uncertainty

+/- 3.6 dB.

3.6.7 Plots of the AC conducted spurious measurement

Phase



Neutral

