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Chamber of Commerce
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telefication

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

Product name	: AXA IN ERL BLE 2
Applicant	: AXA Stenman Nederland B.V
FCC ID	: 2AIQH-AXA-IN-ERL-2
ISED ID	: 21586-AXAINERL2

Test report No. : 190100025 005 v2.00

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 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	05-02-2019	First draft	RvB
v1.00	14-02-2019	Initial release	RvB
v2.00	18-03-2019	Updated FCC and ISED id	RvB

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.203	--	Antenna requirement	1.4	Pass
15.247 (a)	RSS-247 5.2(a)	6dB Bandwidth	3.1	Pass
--	RSS-Gen 6.7	99% Bandwidth	3.2	Pass
15.247 (b)	RSS-247 5.4 (d)	RF output power	3.3	Pass
15.247 (e)	RSS-247 5.2 (b)	Power spectral density	3.4	Pass
15.247 (d)	RSS-247 5.5	Conducted Spurious emissions	3.5	Pass
15.247 (d)	RSS-247 5.5	Conducted Band edge	3.6	Pass
15.209 (a)	RSS-247 5.5	Radiated Spurious emissions	3.7	Pass
15.205 (a)/ 15.247 (d)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.7	Pass

1 General Description

1.1 Applicant

Client name:	AXA Stenman Nederland B.V
Address	Energiestraat 2, Veenendaal, Utrecht, The Netherlands
Zip code:	3903 AV
Telephone:	+31 318 536 111
E-mail:	Gerbrand.hutten@allegion.com
Contact name:	Mr. G. Hutten

1.2 Manufacturer

Manufacturer name:	AXA Stenman Nederland B.V
Address:	Energiestraat 2, Veenendaal, Utrecht, The Netherlands
Zip code:	3903 AV
Telephone:	+31 318 536 111
E-mail:	Gerbrand.hutten@allegion.com
Contact name:	Mr. G. Hutten

1.3 Tested Equipment Under Test (EUT)

Product name:	AXA IN ERL BLE2
Brand name:	AXA
Product Description:	Electronic bicycle lock with BLE
FCC ID:	2AIQH-AXA-IN-ERL-2
ISED ID:	21586-AXAINERL2
Software version:	--
Hardware version:	--
Date of receipt	22-01-2019
Tests started:	22-01-2019
Testing ended:	30-01-2019

1.4 Product specifications of Equipment under test

TX Frequency range :	BLE:2400 – 2483.5 MHz RFID: 125 kHz
RX frequency range :	BLE:2400 – 2483.5 MHz RFID: 125 kHz NFC: 13.56 MHz
Antenna type:	BLE: PCB Antenna RFID: loop antenna NFC: PCB loop antenna
Antenna gain :	BLE: - 2 dBi
Emission designators	BLE: 831KF1D

1.5 Modification of the Equipment Under Test (EUT)

None.

1.6 Observations and remarks

The EUT is an Electronic bicycle lock with BLE, RFID and NFC.
With the BLE function the lock can be locked and unlocked. RFID is used to detect a RFID tag embedded inside a chain and the NFC function is used during programming in the factory.
The manufacturer provided both a radiated sample and conducted sample for radio testing.

The NFC radio is in listening mode only. It doesn't transmit a 13.56 MHz carrier. So it was tested with a host device. (Samsung Galaxy A3 (2016))

1.7 Environmental conditions

Test date	28-01-2019	30-01-2019
Ambient temperature	20.5 °C	19.4 °C
Humidity	35.1 %	31.2 %

1.8 Measurement Standards

- ANSI C63.10:2013
- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05

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, §15.209
- RSS-247 Issue 2, RSS-Gen Issue 5

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 : 09-04-2019

Name : ing K.A. Roes

Function : Coordinator Radio Laboratory

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

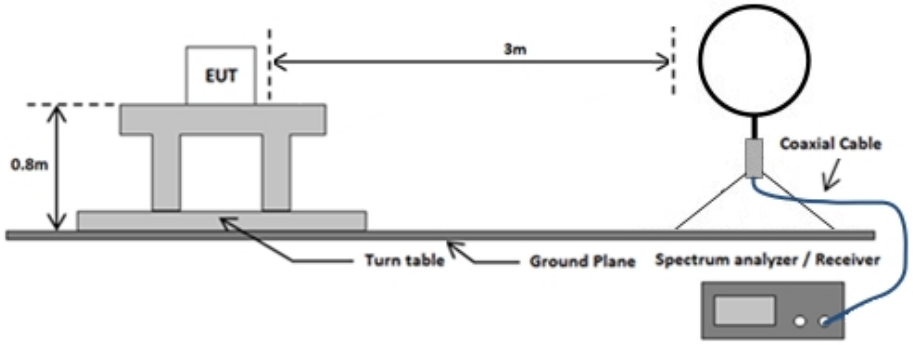
The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels.

2.2 Tested channels and Data rates

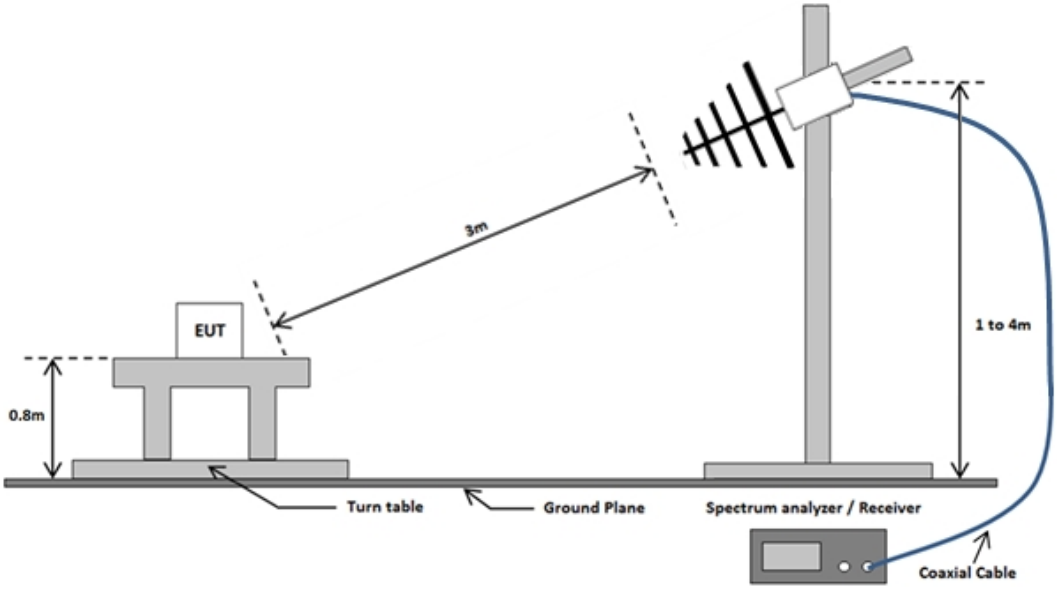
Technology	Channels	Data rate	Frequency (MHz)
Bluetooth Low Energy	37 (Low)	1 Mbps	2402
	38 (Mid)	1 Mbps	2426
	39 (High)	1 Mbps	2480

2.3 Test setups

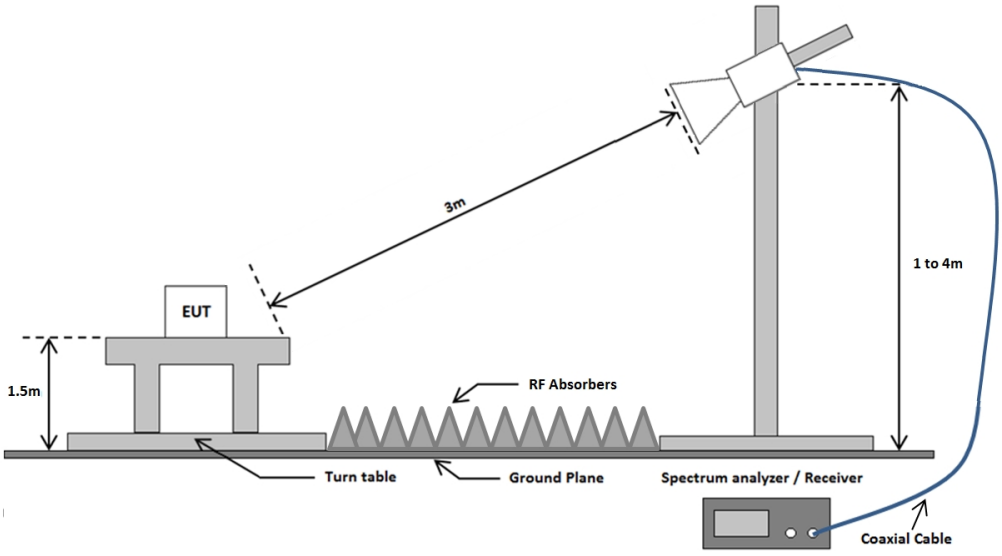
Radiated emissions test setup 9 kHz - 30 MHz



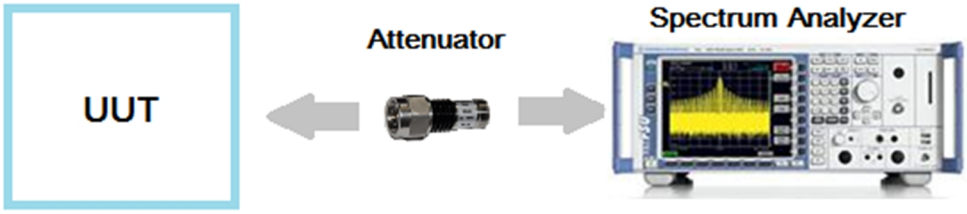
Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



Conducted antenna port test setup



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	3.7
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.5 -3.7
Biconilog Antenna	Chase	CBL6112A	TE00967	3.7
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.7
Horn Antenna	Flann Microwave	20240-25	TE00818	3.7
SAC Chamber	Comtest Engineering BV	-	TE00861	3.7
High pass filter	Wainwright	WHK10-2520-3000-18000-40EF	TE11146	3.7
Pre-amplifier	Miteq	Js4-18004000-30-8P-A1	TE11131	3.7
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE00092	3.7
Software	DARE Instruments	Radimation 2016.2.8	--	3.7

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 ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

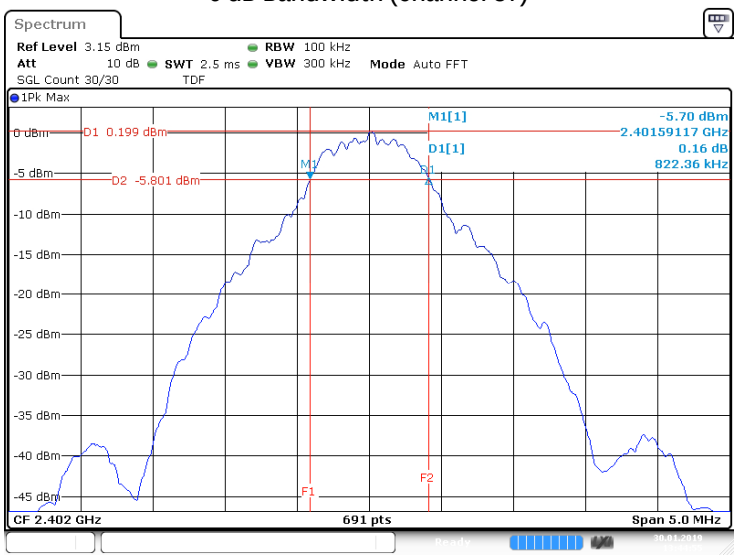
IRN 017 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

3.1.5 Test Results of the 6 dB bandwidth Measurement

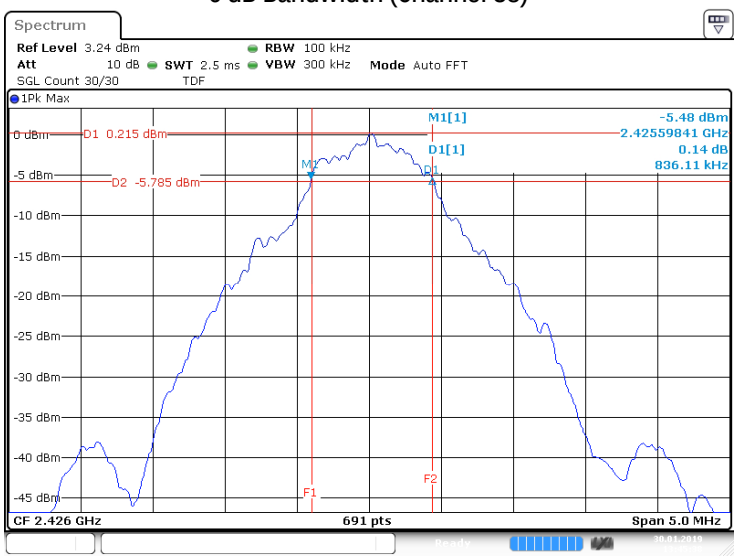
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low Energy	37	2402	1 Mbps	822.36
	38	2426	1 Mbps	831.11
	39	2480	1 Mbps	760.85
Uncertainty	± 39 kHz			

3.1.6 Plots of the 6 dB bandwidth Measurement

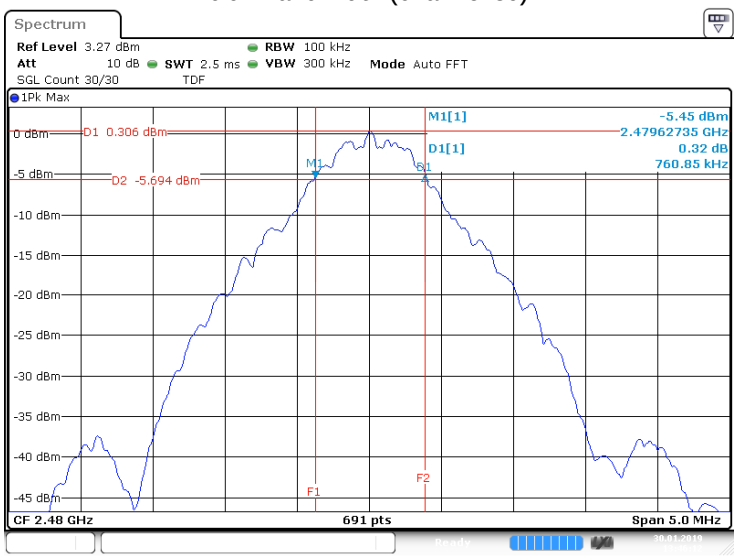
6 dB Bandwidth (Channel 37)



6 dB Bandwidth (Channel 38)



6 dB Bandwidth (Channel 39)



3.2 99% Occupied Bandwidth

3.2.1 Limit

Reporting only.

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

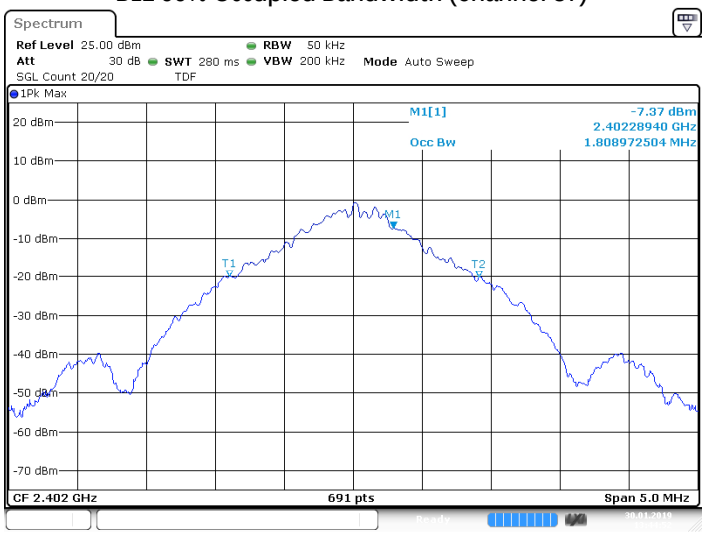
1 Set the centre frequency to the nominal EUT channel centre frequency.
2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
3 Set VBW ≥ 3 x RBW.
4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until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

3.2.5 Test results of the 99% Occupied Bandwidth Measurement

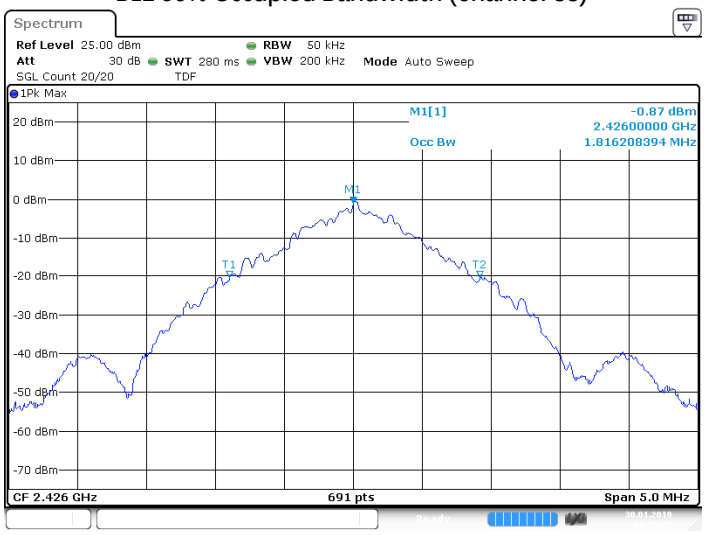
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
Bluetooth Low Energy	37	2402	1 Mbps	1.809
	38	2426	1 Mbps	1.816
	39	2480	1 Mbps	1.802
Uncertainty	±39 kHz			

3.2.6 Plots of the 99% Occupied Bandwidth Measurement

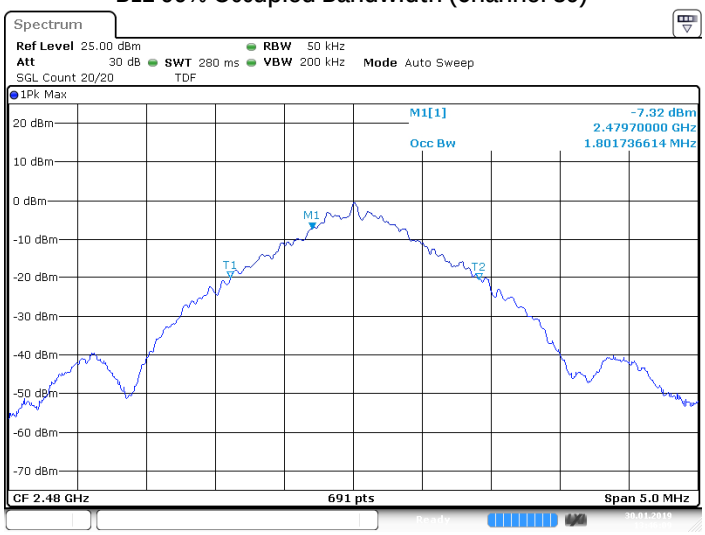
BLE 99% Occupied Bandwidth (Channel 37)



BLE 99% Occupied Bandwidth (Channel 38)



BLE 99% Occupied Bandwidth (Channel 39)



3.3 Output Power Measurement

3.3.1 Limit

15.247(b)

For systems using digital modulation in the 2400-2483.5 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.

RSS 247 section 5.4(d)

The EIRP shall not exceed 4W (36 dBm).

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 ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

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

3.3.5 Test results of Output Power Measurement

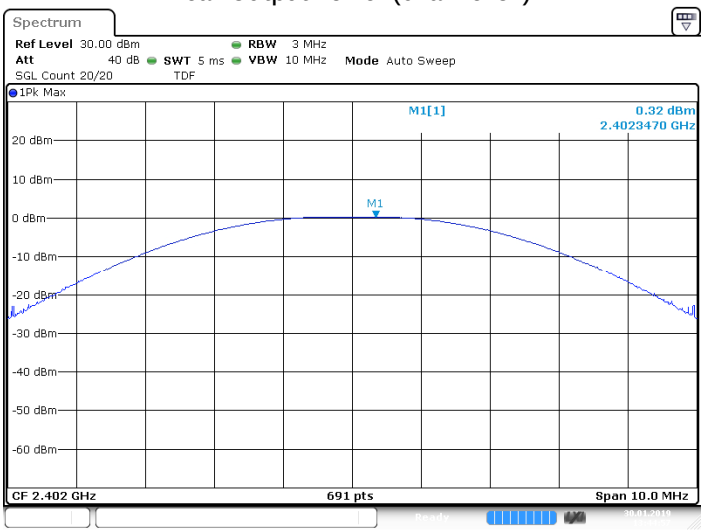
Peak method

Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy	37	2402	1 Mbps	-1.68
	38	2426	1 Mbps	-1.57
	39	2480	1 Mbps	-1.55
Uncertainty	± 0.71 dB			

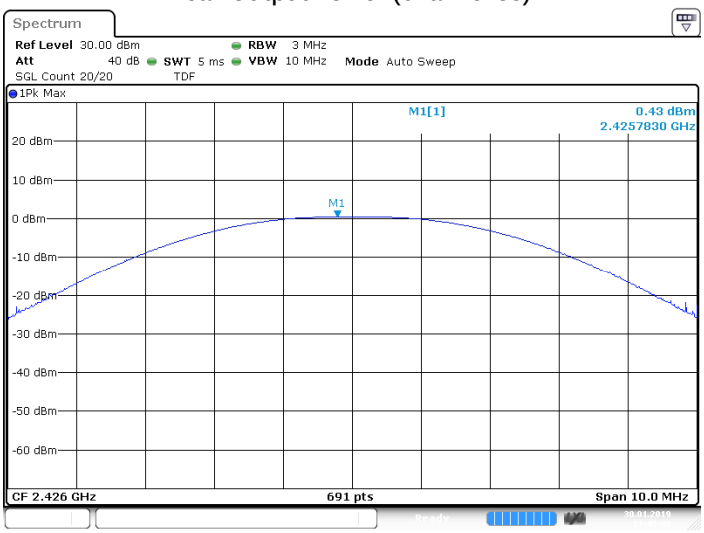
Note : Output power (dBm) = Conducted output power (dBm) + Antenna Gain (dBi)

3.3.6 Plots of Peak Output Power Measurement

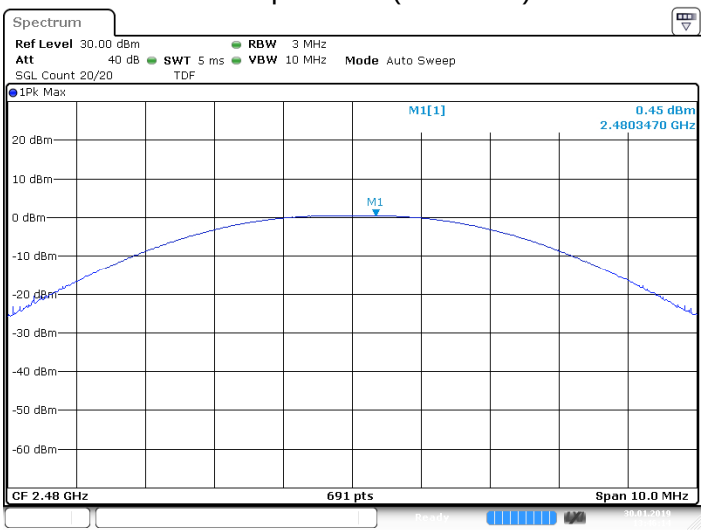
Peak Output Power (Channel 37)



Peak Output Power (Channel 38)



Peak Output Power (Channel 39)



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 ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.
IRN 030 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band).

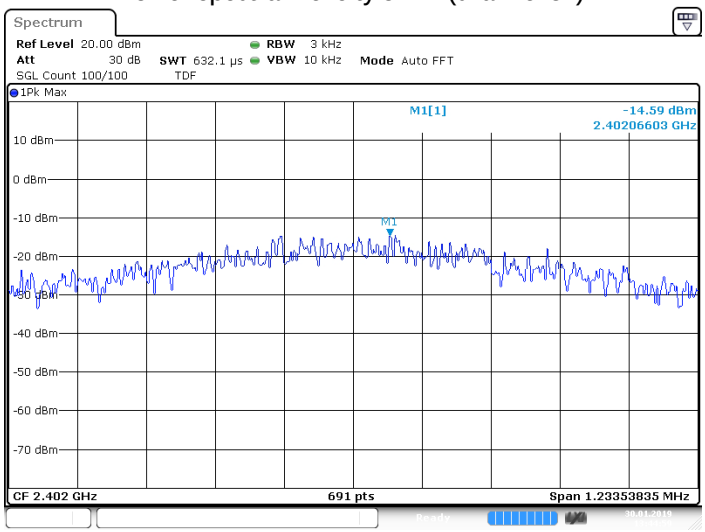
3.4.5 Test results of Power Spectral Density Measurement

Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
Bluetooth Low Energy	37	2402	1 Mbps	-16.59
	38	2426	1 Mbps	-15.54
	39	2480	1 Mbps	-15.45
Uncertainty	±0.71 dB			

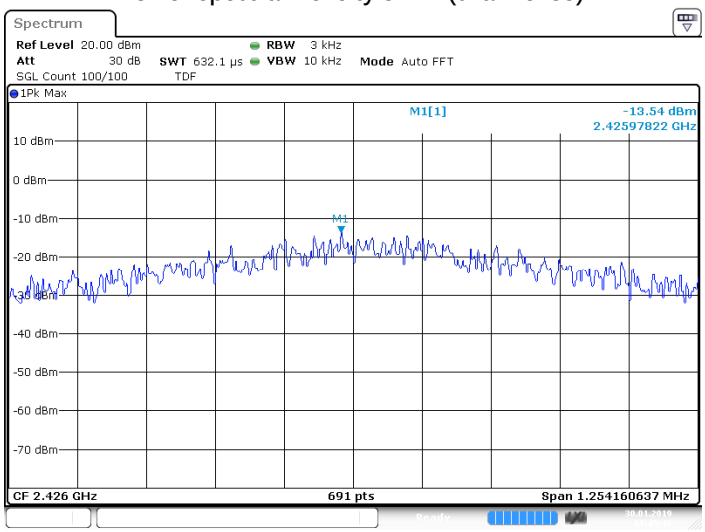
Note : Power Spectral Density (dBm) = Conducted Power Spectral Density (dBm) + Antenna Gain (dBi)

3.4.6 Plots of the Power Spectral Density Measurements

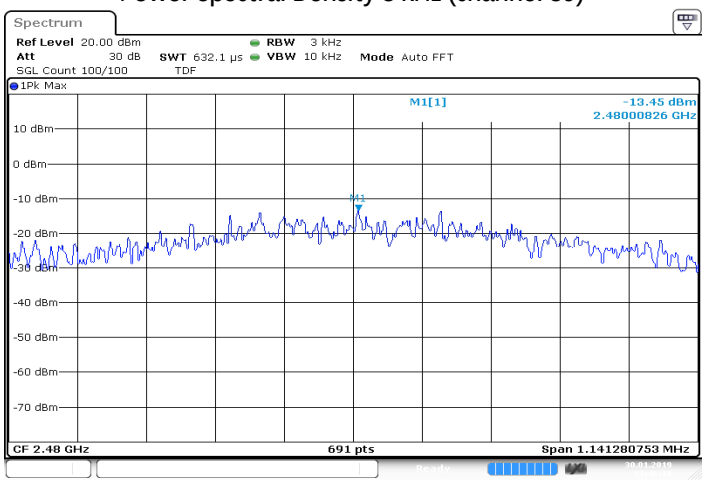
Power Spectral Density 3 kHz (channel 37)



Power Spectral Density 3 kHz (channel 38)



Power Spectral Density 3 kHz (channel 39)



3.5 Conducted Spurious Emissions Measurement

3.5.1 Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, 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 desired power.

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 testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

IRN 016 – Spurious emission (W) - Method 1/2/3.

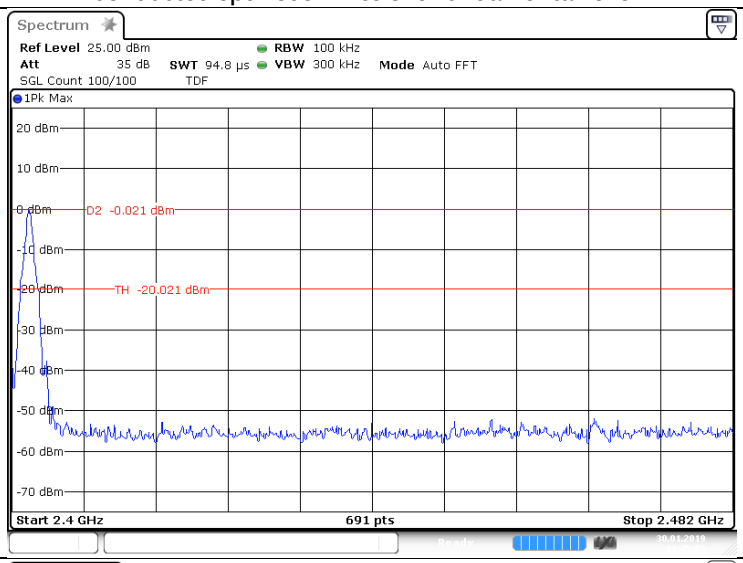
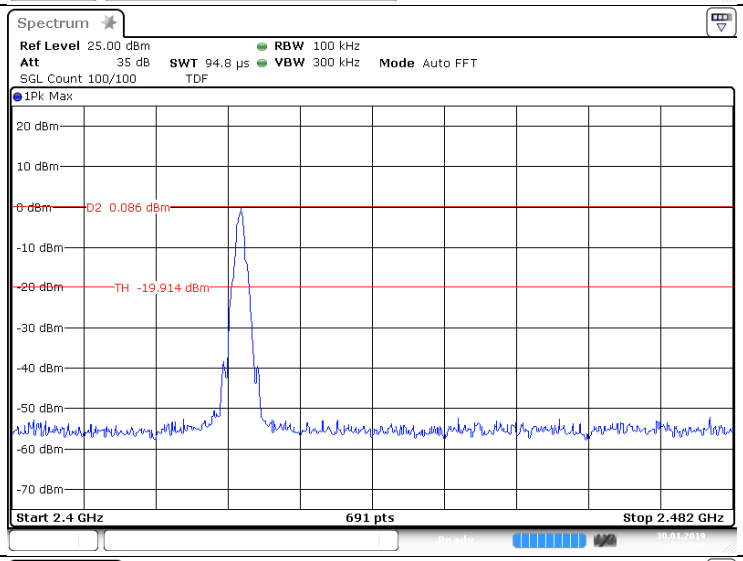
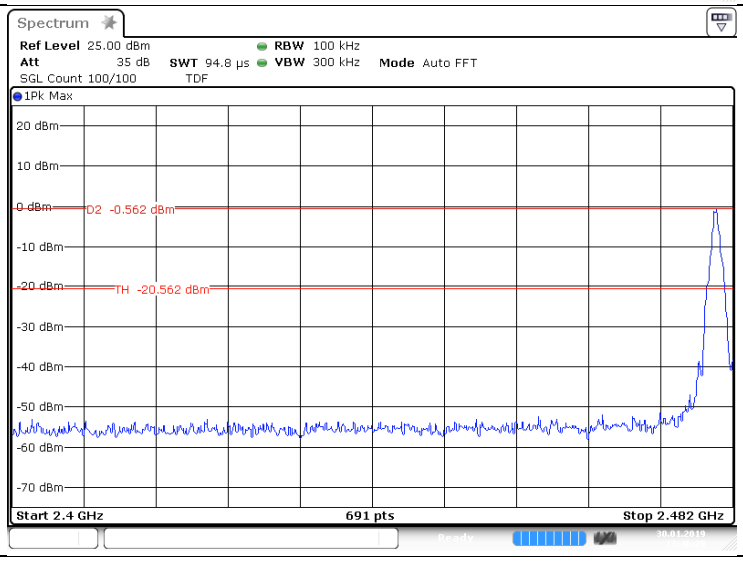
3.5.5 Plots of the Conducted Spurious Emissions Measurement

See next page.

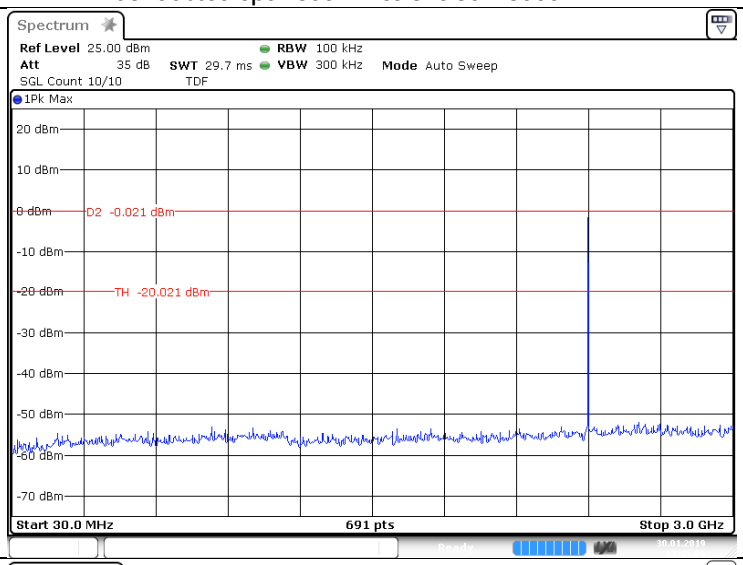
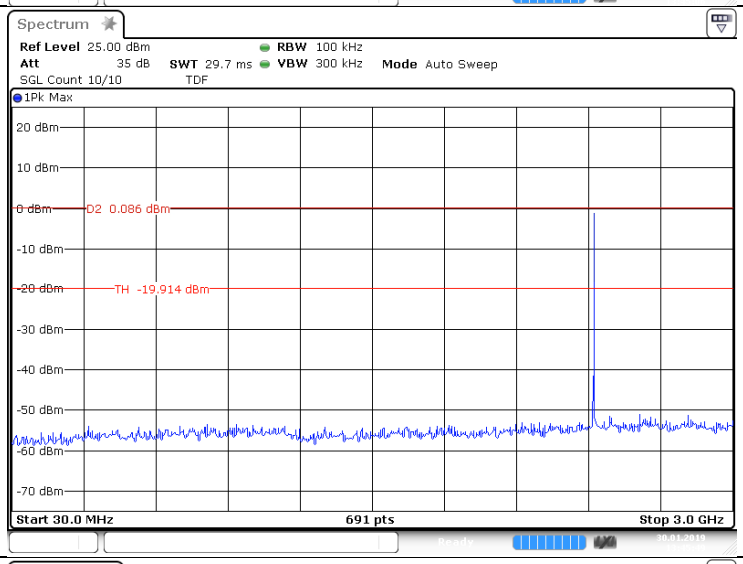
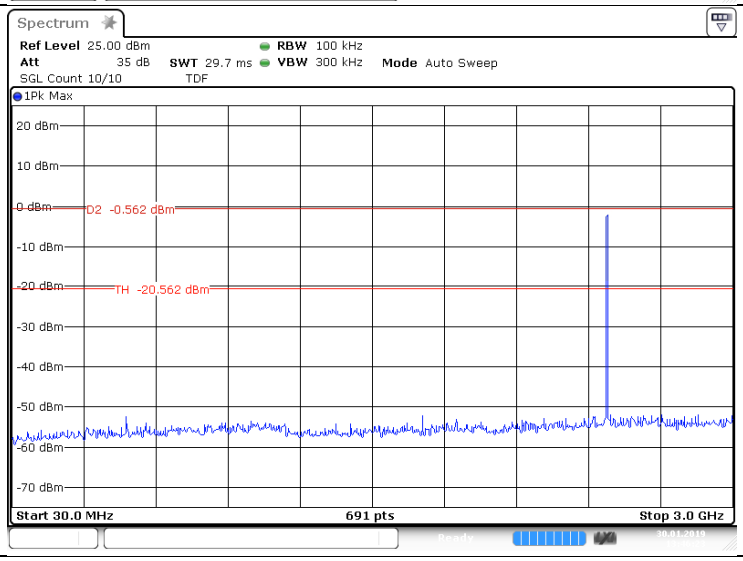
3.5.6 Measurement Uncertainty

< 1 GHz	±1.1 dB
≥ 1 GHz	±1.1 dB

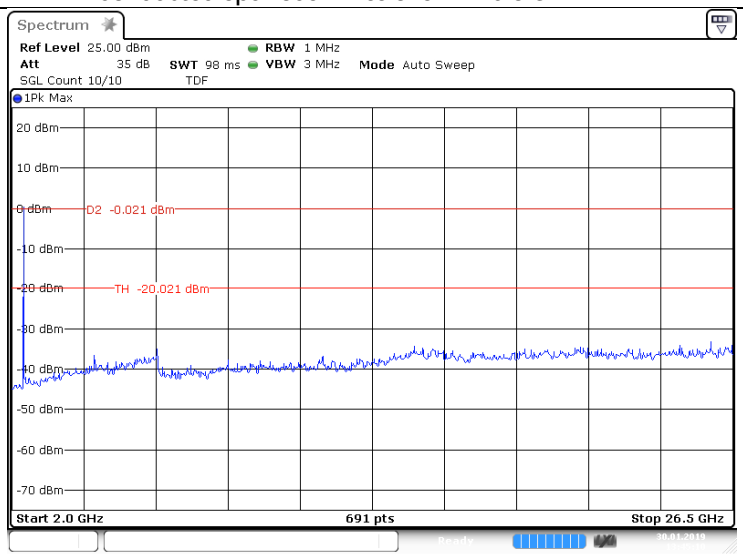
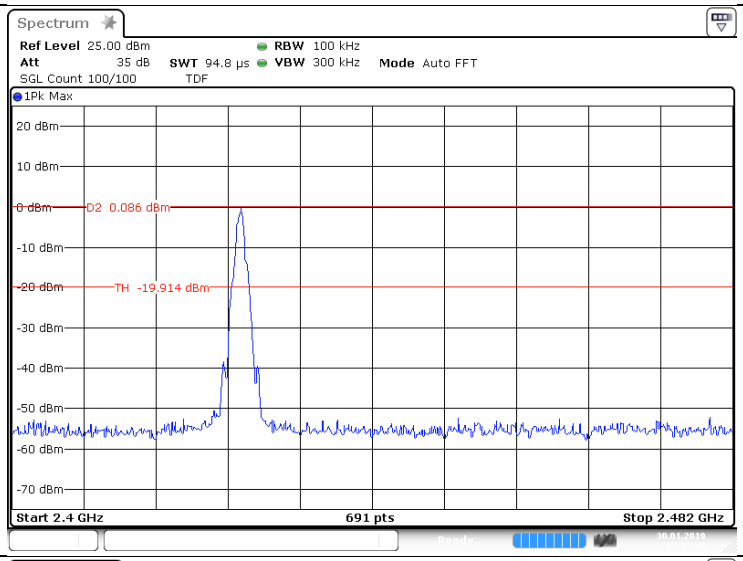
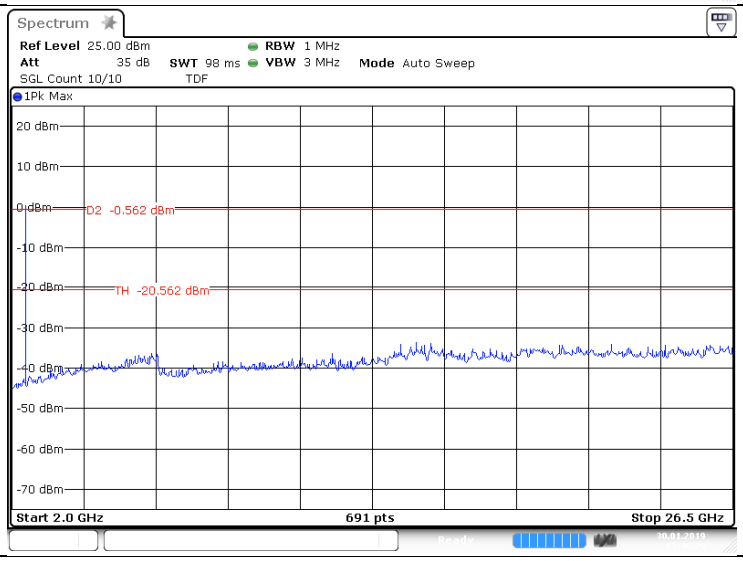
BLE Conducted Spurious Emissions Fundamental level

Low ch	
Mid ch	
High ch	

BLE Conducted Spurious Emissions 30 – 3000 MHz

Low ch	
Mid ch	
High ch	

BLE Conducted Spurious Emissions 1 – 26.5 GHz

Ch. 1	
Ch. 6	
Ch. 11	

3.6 Band edge emissions in the authorized band

3.6.1 Limit

At least 20 dB attenuation in a 100 kHz bandwidth relative to the highest fundamental channel power spectral density in 100 kHz.

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 testing follows ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

IRN 026 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.
IRN 026 - Radiated electrical disturbance (V per m) Method 7 – Radiated electrical disturbance at the Restricted band edge.

3.6.5 Test results of band edge measurements

Peak method

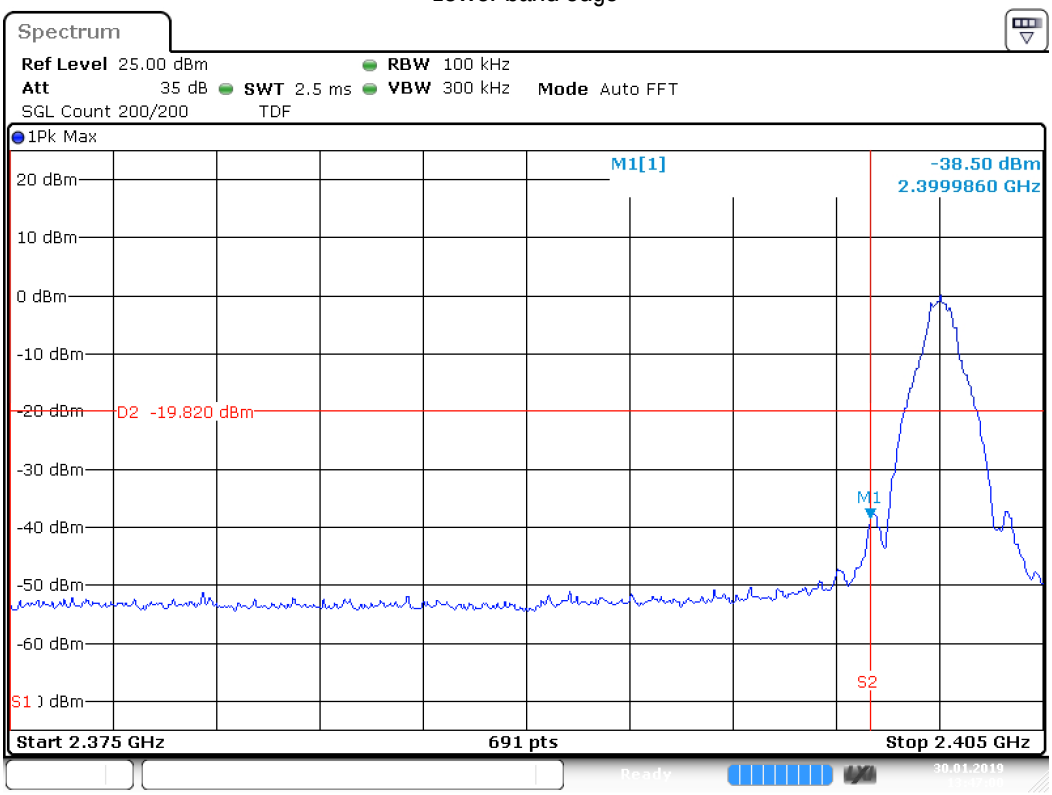
Technology Std.	Channels	Frequency (MHz)	Data rate	Attenuation (dB)
Bluetooth Low Energy	37	2402	1 Mbps	-38.50
	39	2480	1 Mbps	-48.95

3.6.6 Measurement Uncertainty

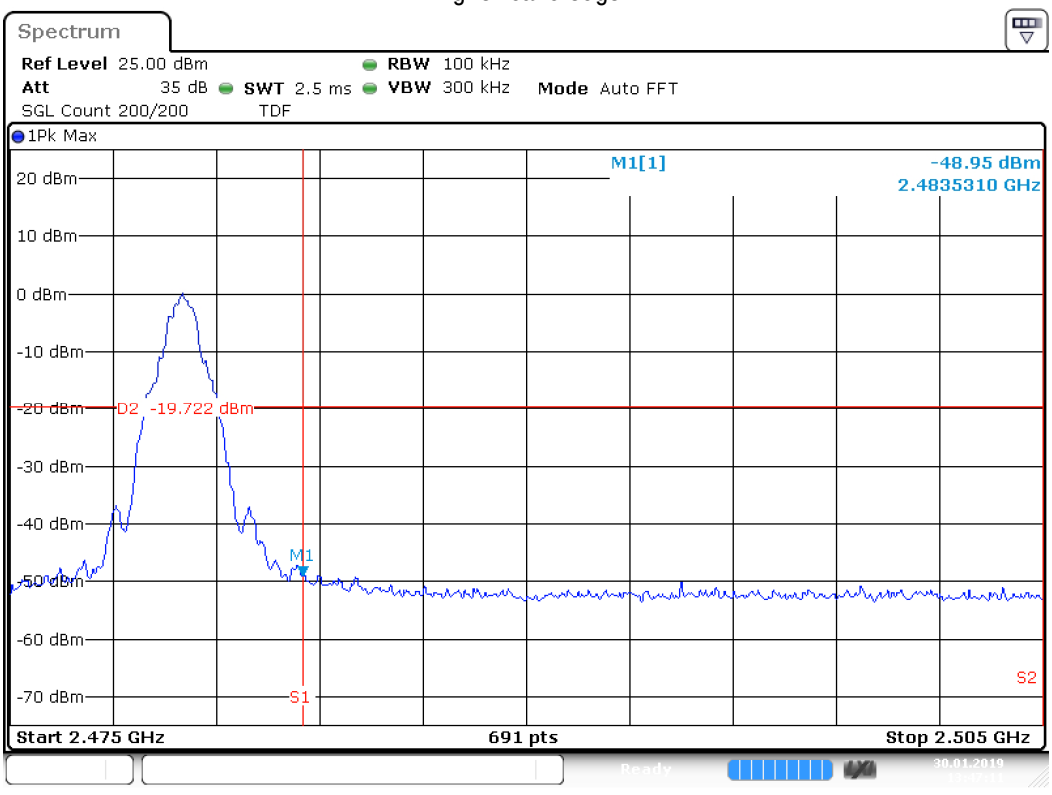
≥ 1 GHz	±1.7 dB

3.6.7 Plots of the band edge measurements

Lower band edge



Higher band edge



3.7 Radiated Spurious Emissions Measurement

3.7.1 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

3.7.2 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

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 ANSI C63.10 in conjunction with FCC KDB Publication No. 558074 D01DTS Meas. Guidance V05.

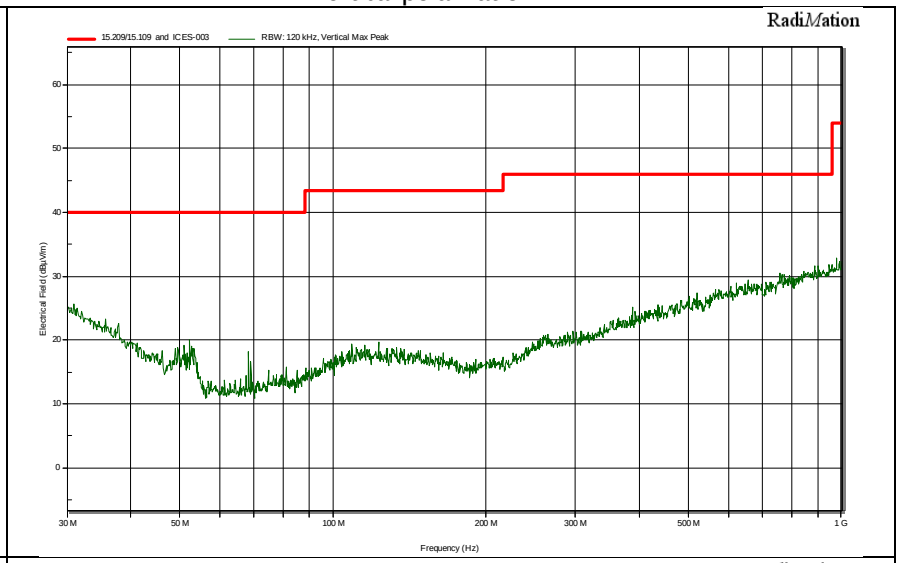
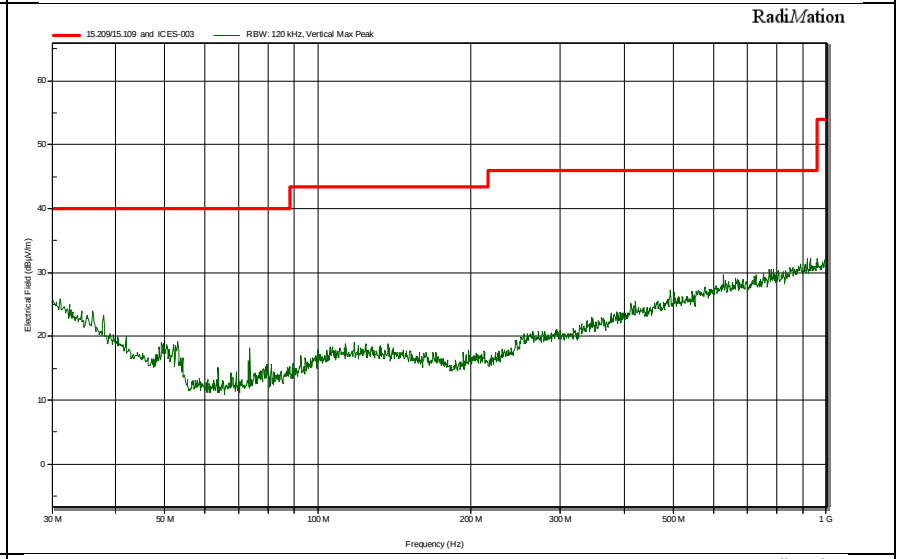
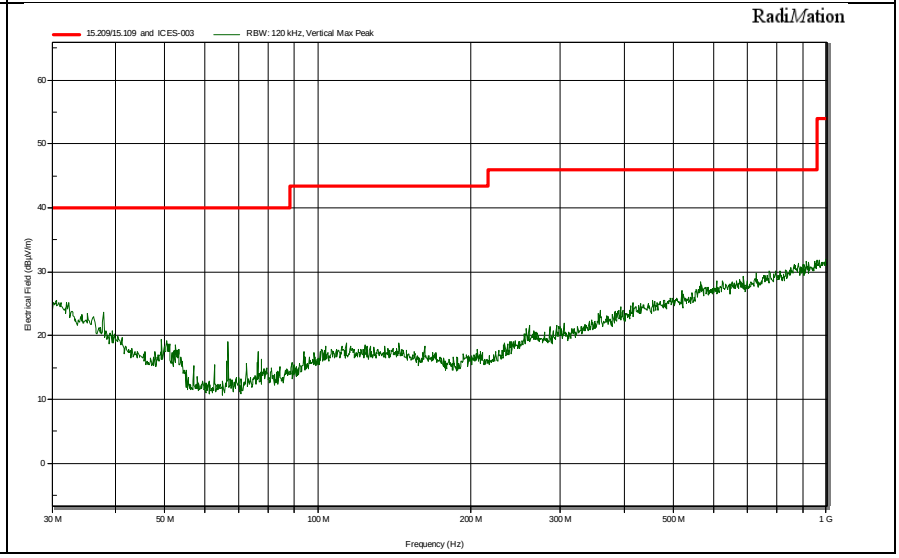
3.7.5 Notes

- 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.
- For the frequency range 1 -18 GHz a high pass filter was used see chapter 2.4.
- All spurious emissions in the 9 kHz to 30 MHz range are 20 dB below the limit and are there for not reported in this report. For 9 kHz to 30 MHz results see Telefication report 190100025 004.
- In the frequency range 30 MHz – 1 GHz a peak detector is used.

3.7.6 Plots of the Radiated Spurious Emissions

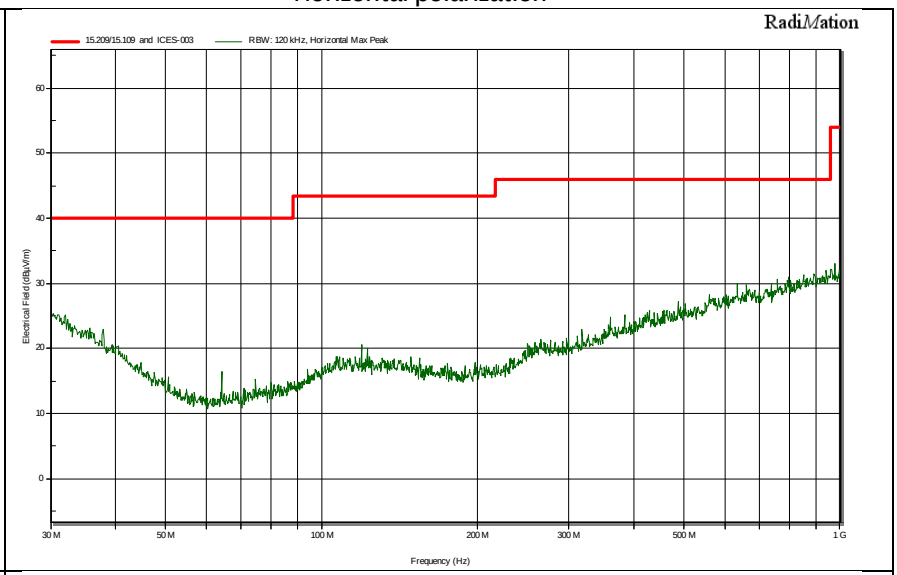
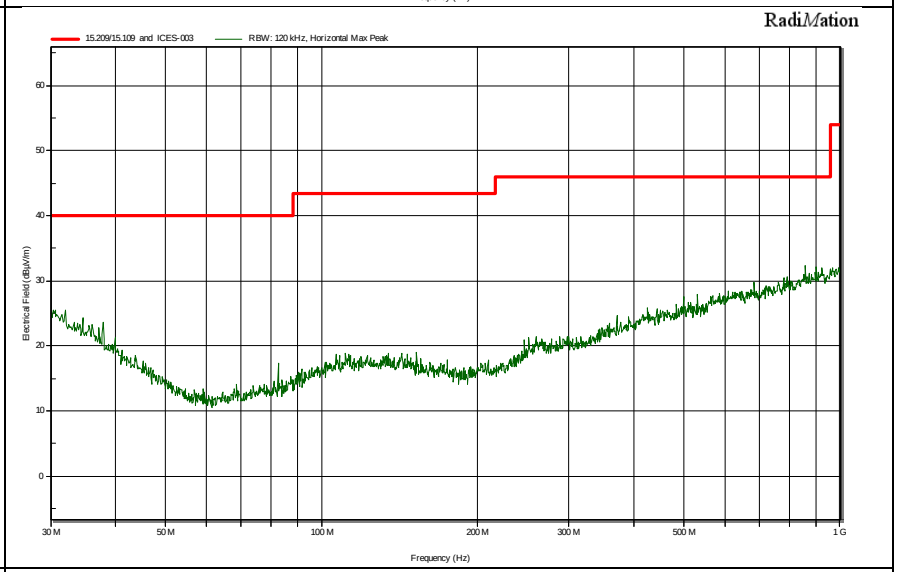
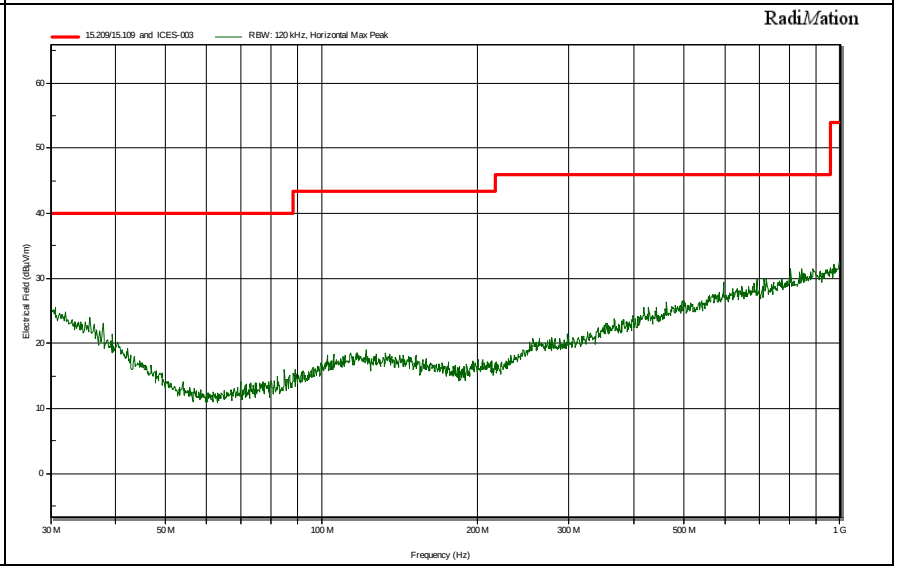
30 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

30 MHz to 1 GHz

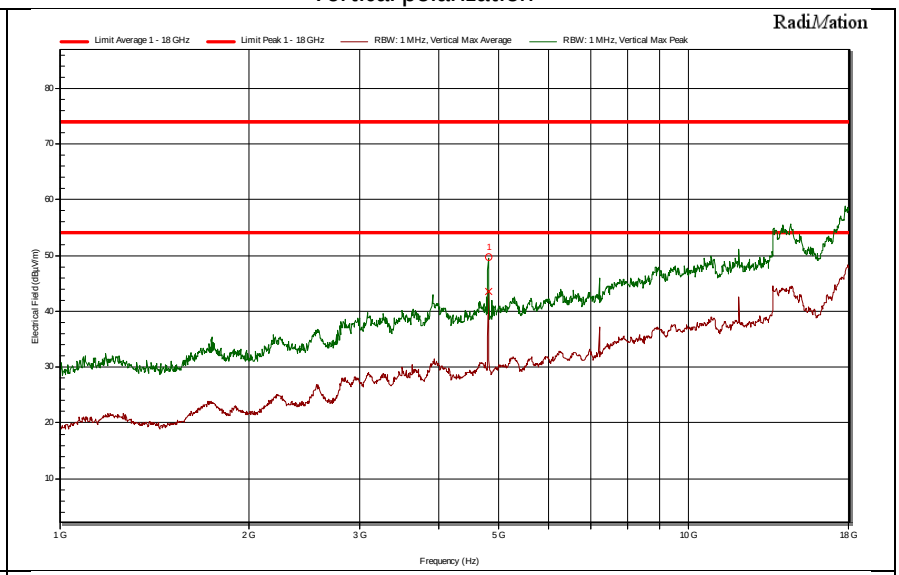
Horizontal polarization

Low ch	
Mid ch	
High ch	

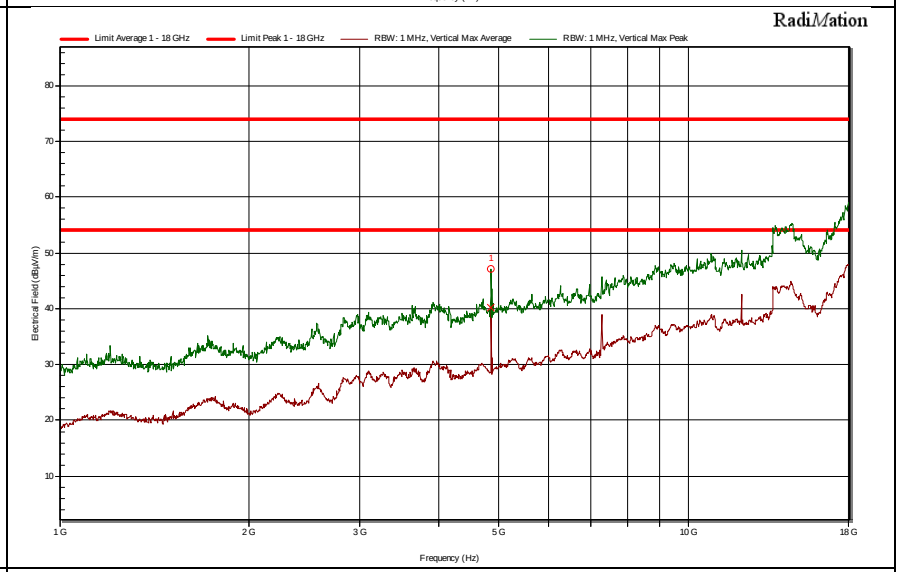
1 GHz to 18 GHz

Vertical polarization

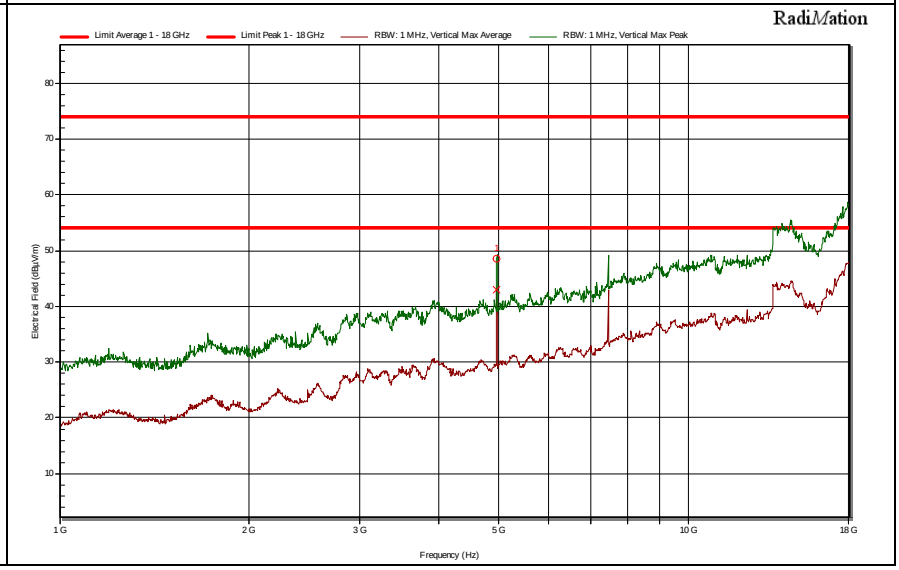
Low ch



Mid ch



High ch



Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,804 GHz	Vertical	1 m	49,6 dBµV/m	43,6 dBµV/m	74 dBµV/m	54 dBµV/m	-24,4 dB	-10,4 dB

Measured peaks Vertical 1 – 18 GHz Middle channel

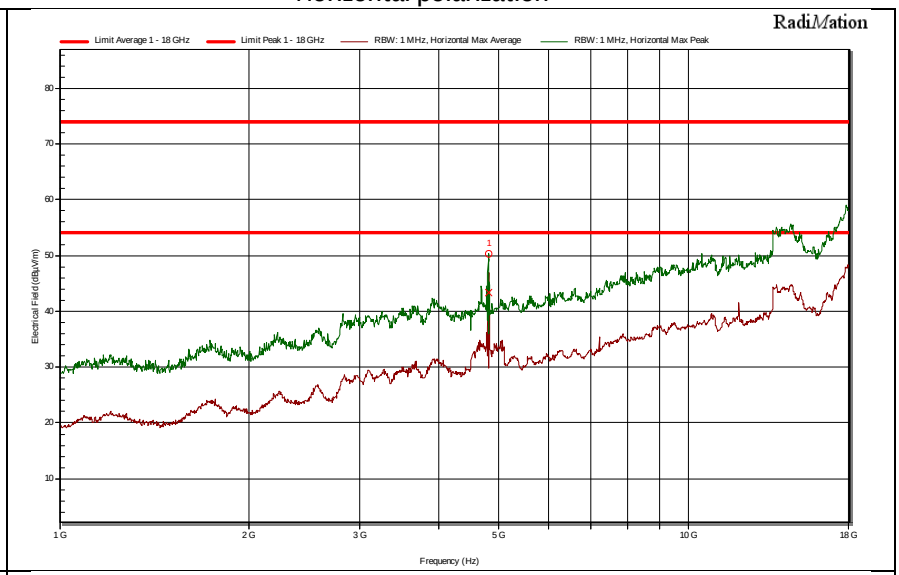
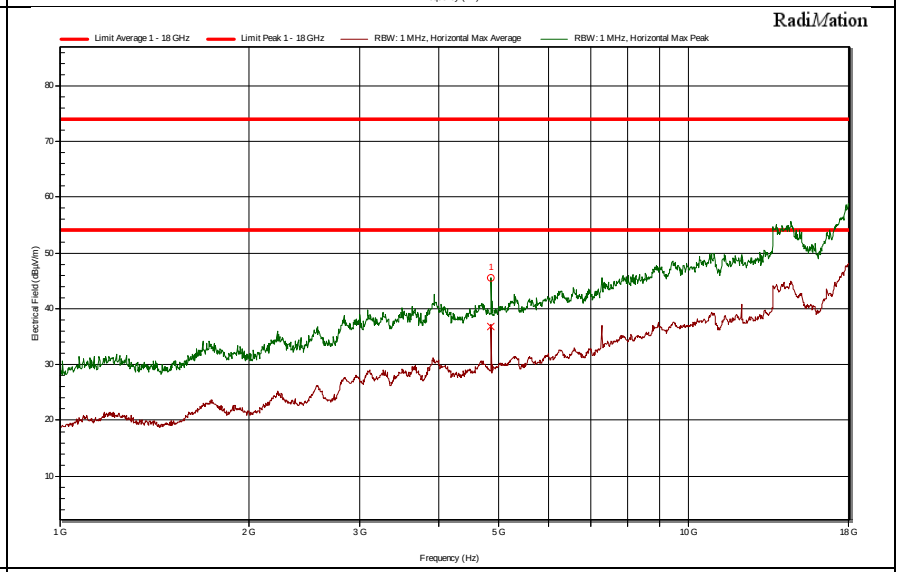
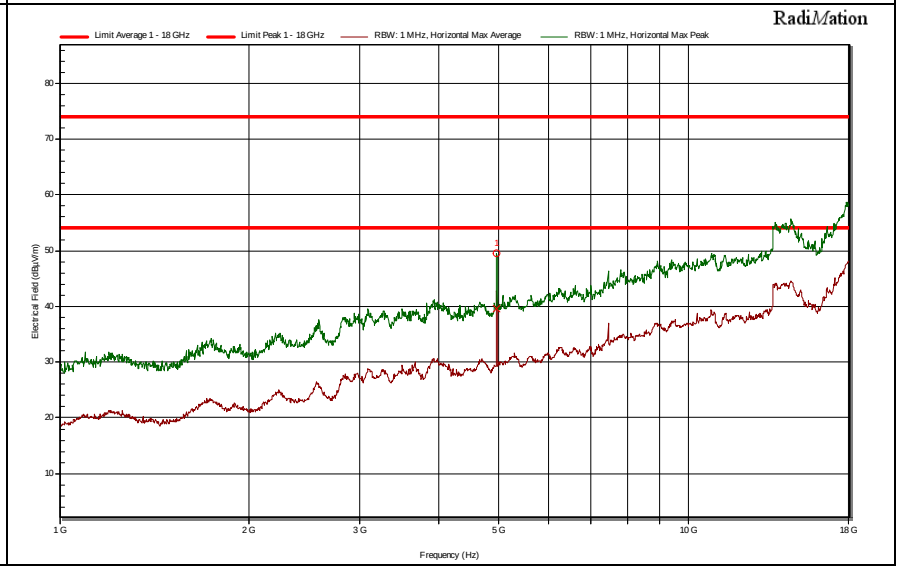
Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,853 GHz	Vertical	2 m	47,2 dBµV/m	40,1 dBµV/m	74 dBµV/m	54 dBµV/m	-26,8 dB	-13,9 dB

Measured peaks Vertical 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,959 GHz	Vertical	3 m	48,5 dBµV/m	43 dBµV/m	74 dBµV/m	54 dBµV/m	-25,5 dB	-11,0 dB

1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,803 GHz	Horizontal	1,5 m	50,3 dBµV/m	43,5 dBµV/m	74 dBµV/m	54 dBµV/m	-23,7 dB	-10,5 dB

Measured peaks Horizontal 1 – 18 GHz Middle channel

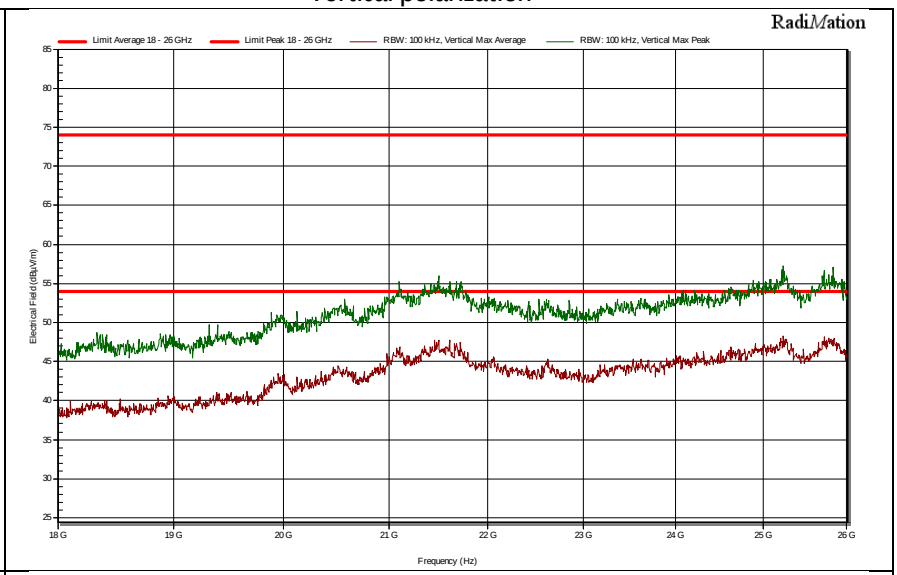
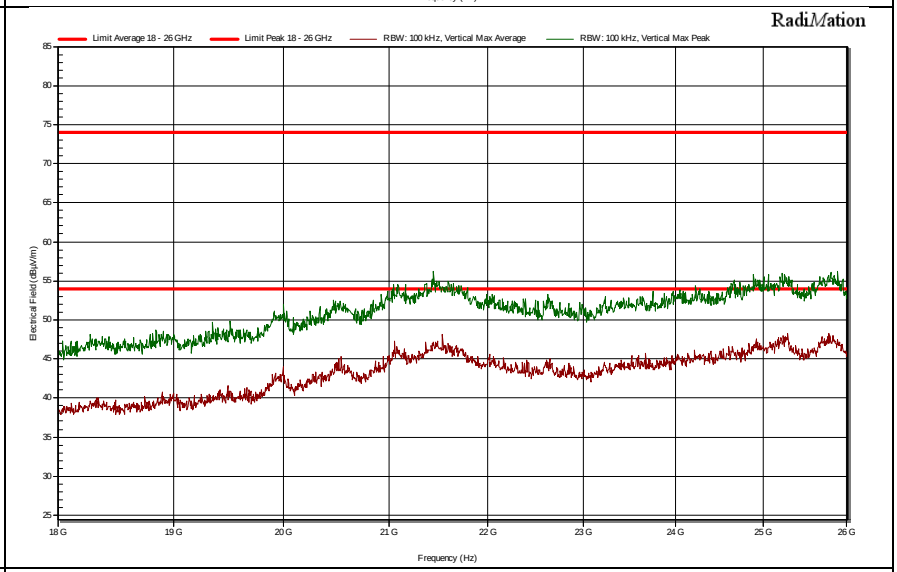
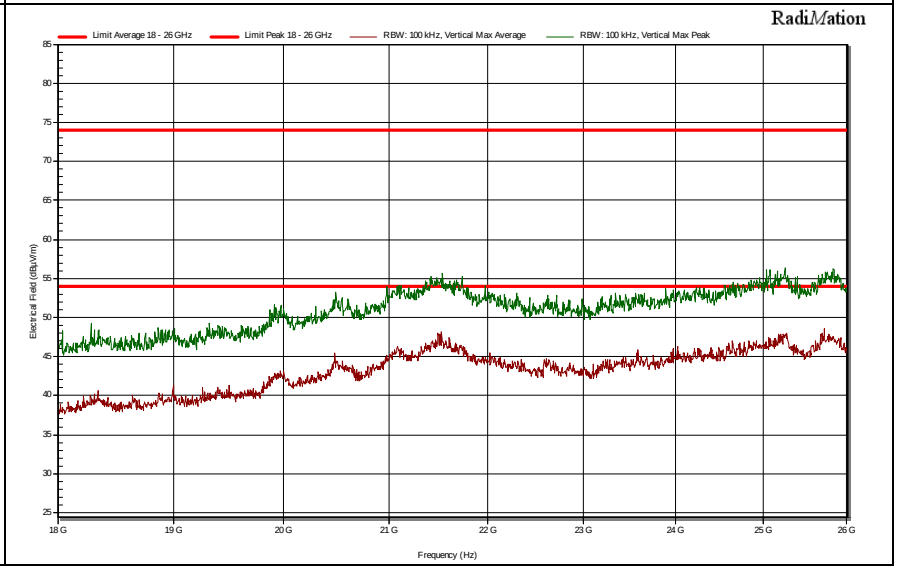
Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,851 GHz	Horizontal	3 m	45,5 dBµV/m	36,9 dBµV/m	74 dBµV/m	54 dBµV/m	-28,5 dB	-17,1 dB

Measured peaks Horizontal 1 – 18 GHz High channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,959 GHz	Horizontal	3 m	49,5 dBµV/m	39,7 dBµV/m	74 dBµV/m	54 dBµV/m	-24,5 dB	-14,3 dB

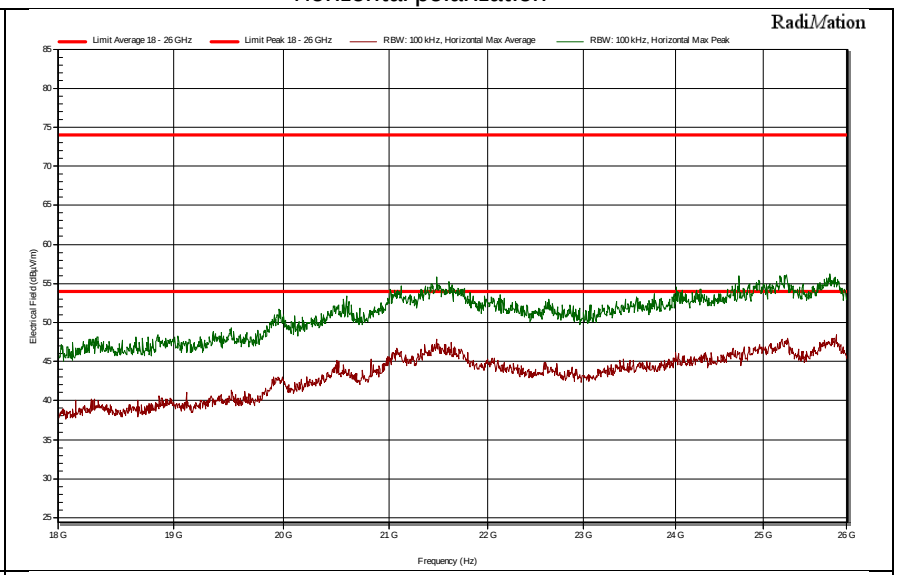
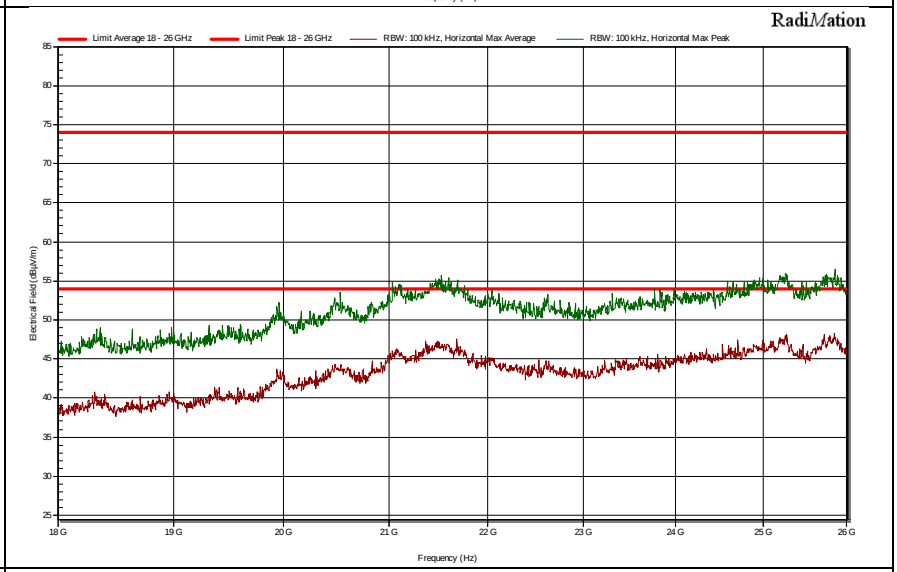
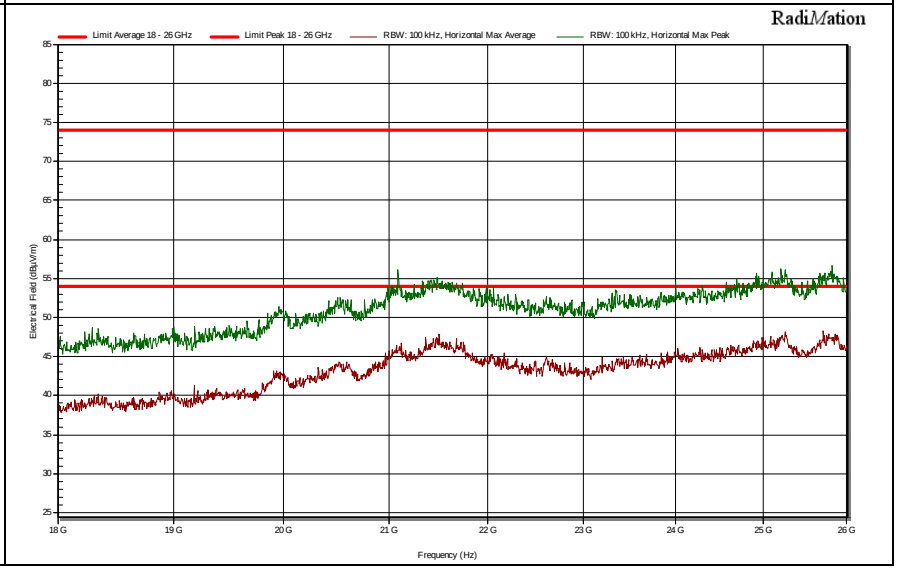
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

3.7.7 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	4.9 dB