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The Netherlands
Chamber of Commerce
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FCC and IC Test report for parts
15.209, 15.247
RSS-210, RSS-247, RSS-Gen

Product name	: Sentien Audio
Applicant	: Sentien HQ s.r.o.
FCC ID	: 2A5DB-SA11
IC	: 28301-SA11

Test report No. : P00005533 001 Ver 3.0

Laboratory information

Accreditation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. 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 company number for Telefication is: 4173A. The CABID is NL0001.

Telefication is a registered Conformity Assessment body (CAB) under the Japan-EC MRA (Agreement on Mutual Recognition between Japan and the European Community). The registration number is: 201.

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	Kiwa Telefication BV
Test Site location	Wilmersdorf 50 7327 AC Apeldoorn The Netherlands Tel. +31 88998 3393
Test Site FCC	NL0001
CABID	NL0001

Revision History

Version	Date	Remarks	By
v0.5	09-05-2022	First draft	PvW
v1.0	28-07-2022	Initial release	PvW
V2.0	10-08-2022	Updated hardware revision	PvW
V3.0	16-08-2022	Added AC conducted emission results Clarified test method in clause 3.4 and 3.6	PvW

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247(d) 15.209 (a)	RSS-Gen 8.9	Radiated spurious emissions	3.1	Pass
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.1	Pass
15.247 (a)	RSS-247 5.2(a)	6 dB bandwidth	3.2	Pass
--	RSS-Gen 6.7	99% bandwidth	3.3	Pass
15.247 (b)	RSS-247 5.4 (d)	RF output power	3.4	Pass
15.247 (e)	RSS-247 5.2 (b)	Power spectral density	3.5	Pass
15.247 (d)	RSS-247 5.5	Band edge	3.6	Pass
15.247(1)(iii)	RSS-247 5.1 (c)	Average time of occupancy	3.7	Pass
15.247(1)(iii)	RSS-247 5.1(c)	Number of hopping channels	3.8	Pass

1 General Description

1.1 Applicant

Client name:	Sentien HQ s.r.o.
Address:	Jankovcova 1522 / 53; 170 00 Prague; Czech Republic
Telephone:	+420 606 895 278
E-mail:	support@sentienhq.com
Contact name:	Imrich Valach

1.2 Manufacturer

Client name:	Sentien HQ s.r.o.
Address:	Jankovcova 1522 / 53; 170 00 Prague; Czech Republic
Telephone:	+420 606 895 278
E-mail:	support@sentienhq.com
Contact name:	Imrich Valach

1.3 Tested Equipment Under Test (EUT)

Product name:	Sentien Audio
Brand name:	Sentien Audio
FCC ID:	2A5DB-SA11
IC:	28301-SA11
Product type:	Wireless headset
Model(s):	SA-1
Batch and/or serial No.	--
Software version:	1.1
Hardware version:	SA-6
Date of receipt:	03-03-2022
Tests started:	07-03-2022
Testing ended:	06-04-2022

1.4 Product specifications of Equipment under test

Tx Frequency:	2400 – 2483.5 MHz
Rx frequency:	2400 – 2483.5 MHz
Occupied Channel Width:	BLE: 2 MHz BT/BT EDR: 1 MHz
Antenna type:	PCB antenna
Antenna gain:	2.7 dBi
Type of modulation:	BLE: GFSK BT EDR: GFSK and π/4-DQPSK or 8DPSK
Emission designator	BLE 1Mbit: 1M03G1D BLE 2Mbit: 2M06G1D EDR 3DH5: 779KG1D

Disclaimer: The antenna gain, OCW and operating frequency bands are declared by the applicant

1.5 Environmental conditions

Test date	07-03-2022	09-03-2022	10-03-2022	18-03-2022	01-04-2022	06-04-2022	16-08-2022
Ambient temperature	21.8°C	21.4°C	20.7°C	21.2°C	20.2°C	20.2°C	24.8°C
Humidity	22.3%	20.4%	21.1%	31.9%	25.0%	29.7%	58.8%

1.6 Measurement standards

- ANSI C63.10:2013

1.7 Applicable standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.207
- FCC Part 15 Subpart C §15.209
- FCC Part 15 Subpart C §15.247
- RSS-Gen, Issue 5
- RSS-210 Issue 9
- RSS-247 Issue 2

1.8 Observation and remarks

The EUT has a radio chip capable of transmitting either BLE signals or BT classic/EDR signals.
The EUT is battery powered. The design of the EUT does not contain provisions for operation while connected to the AC power lines: the provided charging cable is 1.0m length and the EUT is designed to wear while moving/on the go.

1.9 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.7 of this report.

The results of the test as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any properties of product items in this test report, which are not supported by the tests as specified in paragraph 1.7 *"Applicable standards".*

All conducted tests are performed by:

Name : P. van Wanrooij, BASc

Review of test methods and report by:

Name : R. Tolud

The above conclusions have been verified by the following signatory:

Date : 16-08-2022

Name : Koray Korcum, Msc

Function : Test Engineer

Signature :

2 Test configuration of the Equipment Under Test

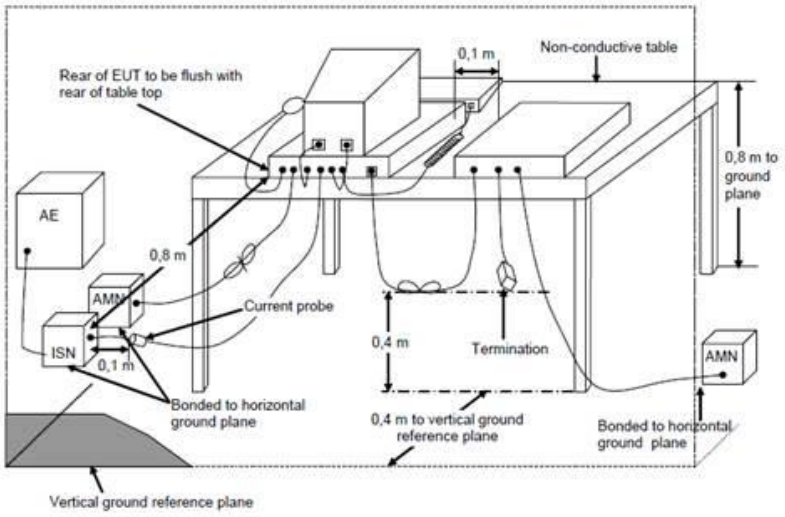
2.1 Test mode

The manufacturer provided test samples which could be programmed to transmit continuously on a fixed channel. BLE is tested on power setting 9. EDR/BR is tested on power setting 10.

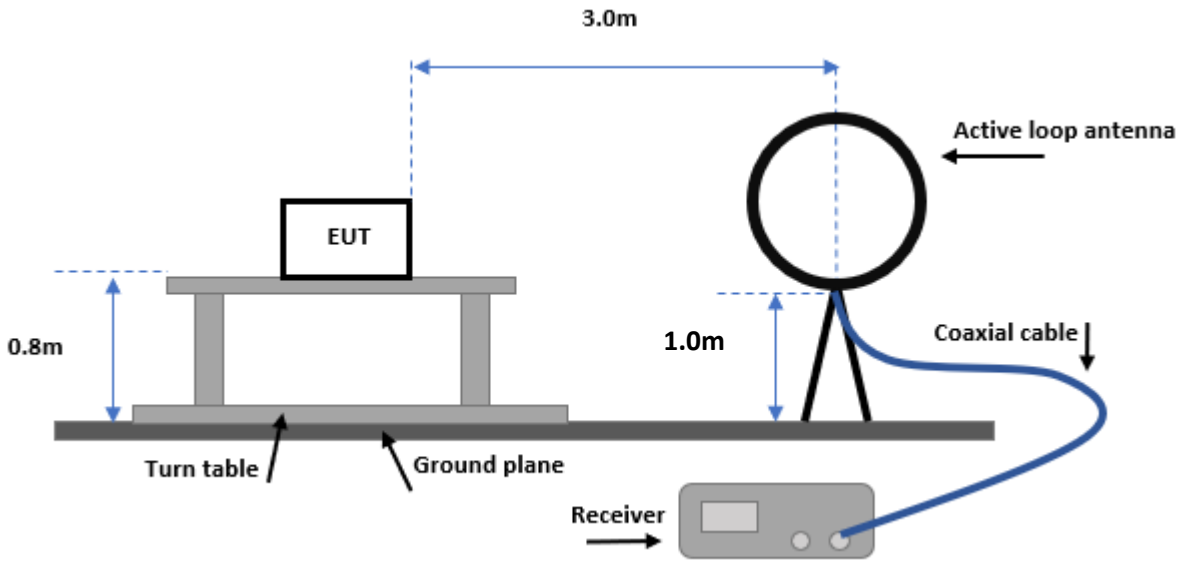
2.2 Test setups

Conducted emissions test setup

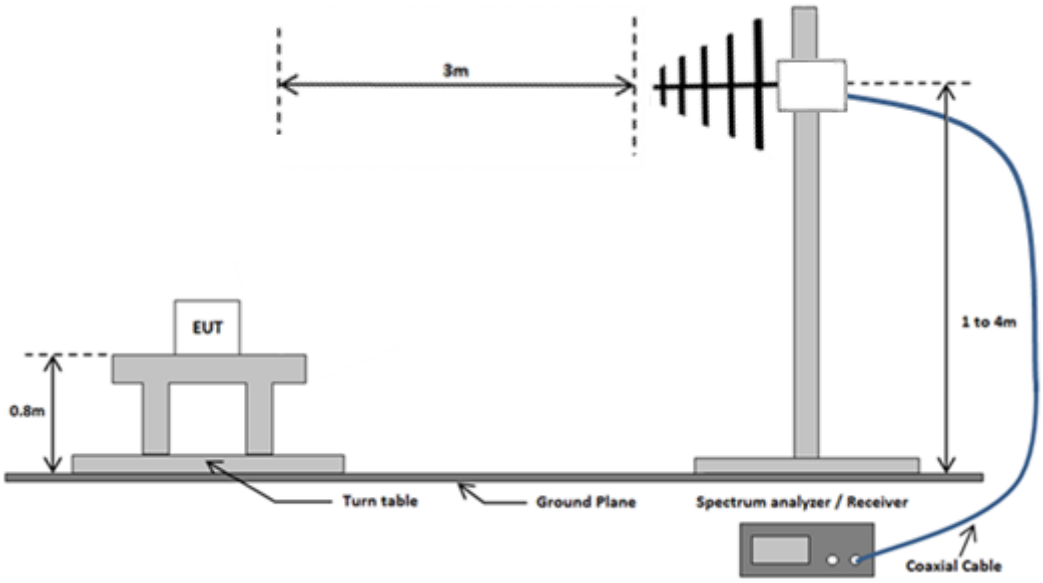
Emissions test at AC mains



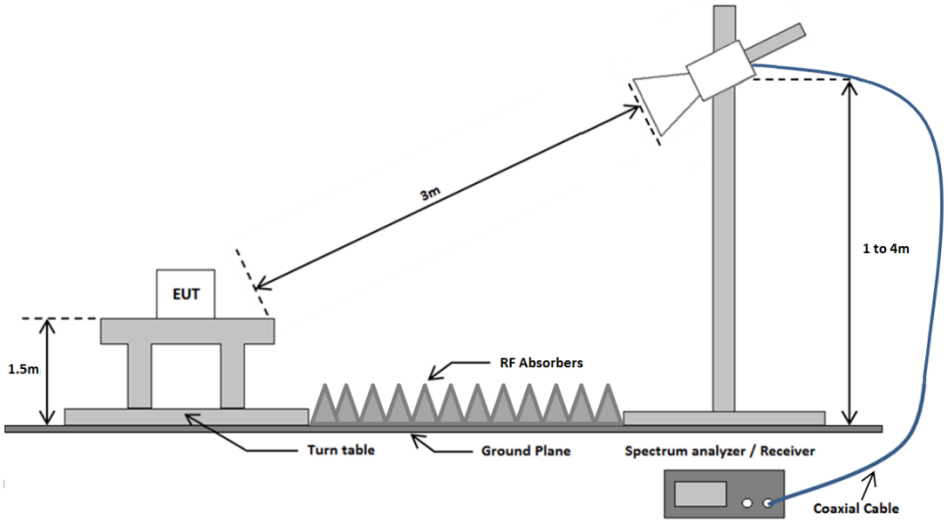
Radiated emissions test setup 9 kHz – 30 MHz



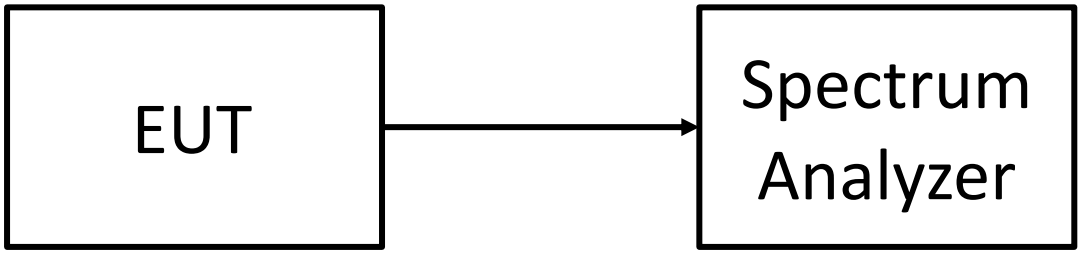
Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



Conducted RF tests



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Cal. Done date	Cal. due date	Used at Par.
EMI Receiver	Rohde & Schwarz	ESCI	114161	02-2022	02-2023	3.1
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	03-2022	04-2022	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV40	114527	01-2021	04-2022	3.2 – 3.7
EMI Receiver	Rohde & Schwarz	ESR7	114534	01-2022	01-2023	3.9
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	114682	09-2021	09-2022	3.1
Active loop antenna	EMCO	6502	114515	01-2022	01-2024	3.1
Biconical antenna + 6dB attenuator	Schwarzbeck + HP	VHA9103 + 8491A	114436 + 114254	03-2021	03-2024	3.1
Logperiodic antenna	EMCO	3147	114385	03-2021	03-2024	3.1
Horn antenna	EMCO	3115	114607	01-2021	01-2024	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	114518	NA*	NA*	3.1
Horn antenna	Scientific atlanta	12A-26	11487	NA*	NA*	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114690	01-2022	01-2023	3.1
Preamplifier 18-40 GHz	Miteq	JS4-18004000-33-8P	114693	01-2022	01-2023	3.1
Test software	Raditeq	Radimation Version 2021.1.9	TE 02008	--	--	3.1
Two line V-network	Rohde & Schwarz	ENV 216	114379	07-2021	07-2023	3.9

*Note: Standard gain horn antennas do not need calibration

2.4 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test results

3.1 Radiated spurious emissions

3.1.1 Limit

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	20*{log[2400]-log[F(kHz)]}	300*
0.490 – 1.705	24000/F(kHz)	20*{log[24000]-log[F(kHz)]}	30*
1.705 – 13.11 14.01 – 30.0	30	29.5	30*
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

*Note: Measured values in the plots 9 kHz to 30 MHz corrected to 3m measurement distance according to the method described in ANSI C63.10-2013, clause 6.4

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.1.4 Test procedure

Prior to running the measurements, the EUT has been investigated in the X, Y and Z dimensions to determine the worst case configuration for spurious emissions. The worst case configuration is with the EUT positioned in normal wearing position.

9 kHz – 30 MHz: According to ANSI C63.10-2013, section 6.4; 11.11 and 11.12
30 MHz to 1 GHz: According to ANSI C63.10-2013, section 6.5; 11.11 and 11.12
Above 1 GHz: According to ANSI C63.10-2013, section 6.6; 11.11 and 11.12

9 kHz to 30 MHz: IRN 026 – Method 10
30 MHz to 1 GHz: IRN 026 – Method 1
1 GHz to 18 GHz: IRN 026 – Method 2
18 to 26.5 GHz: IRN 026 – Method 3

3.1.5 Measurement Uncertainty

Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB
18 – 26.5 GHz	Horizontal	±4.9 dB
	Vertical	±4.9 dB

3.1.6 Peak tables of the radiated spurious emissions measurement (BLE)

Measured peaks 250 - 1000 MHz Low channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
952,343	Horizontal	2,7	30,3	46	Pass

Measured peaks 250 - 1000 MHz Middle channel

Frequency (MHz)	Polarization	Height (m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Status
952,343	Horizontal	2,7	30,3	46	Pass

Measured peaks Horizontal 1 – 18 GHz Low channel

Frequency (MHz)	Polarization	Height (m)	Peak (dBµV/m)	Average (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Result
4804,446	Horizontal	2	52,3	52,1	74	54	Pass
4804,475	Horizontal	2	52,3	52,3	74	54	Pass

Measured peaks Horizontal 1 – 18 GHz Middle channel

Frequency (MHz)	Polarization	Height (m)	Peak (dBµV/m)	Average (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Result
5129,404	Horizontal	4	38,5	38,3	74	54	Pass
4879,608	Vertical	2	49,5	49,5	74	54	Pass
7471,108	Horizontal	1,2	45,8	33,5	74	54	Pass

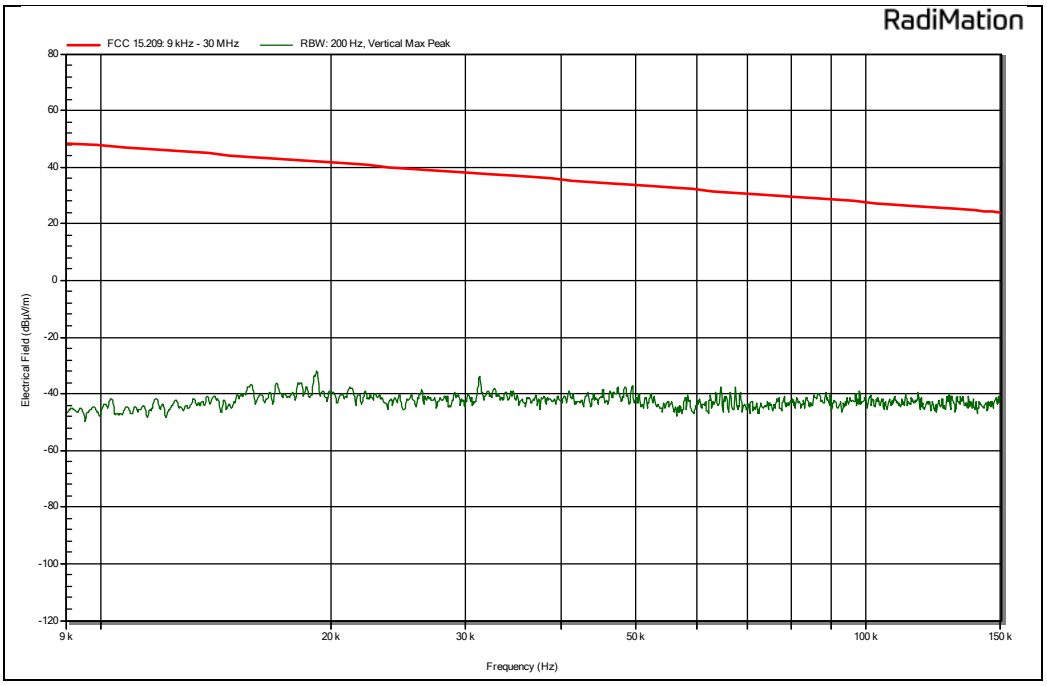
Measured peaks Horizontal 1 – 18 GHz High channel

Frequency (MHz)	Polarization	Height (m)	Peak (dBµV/m)	Average (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Result
4959,484	Horizontal	1,7	52,6	52,6	74	54	Pass
4960,495	Vertical	1	53,9	53,9	74	54	Pass

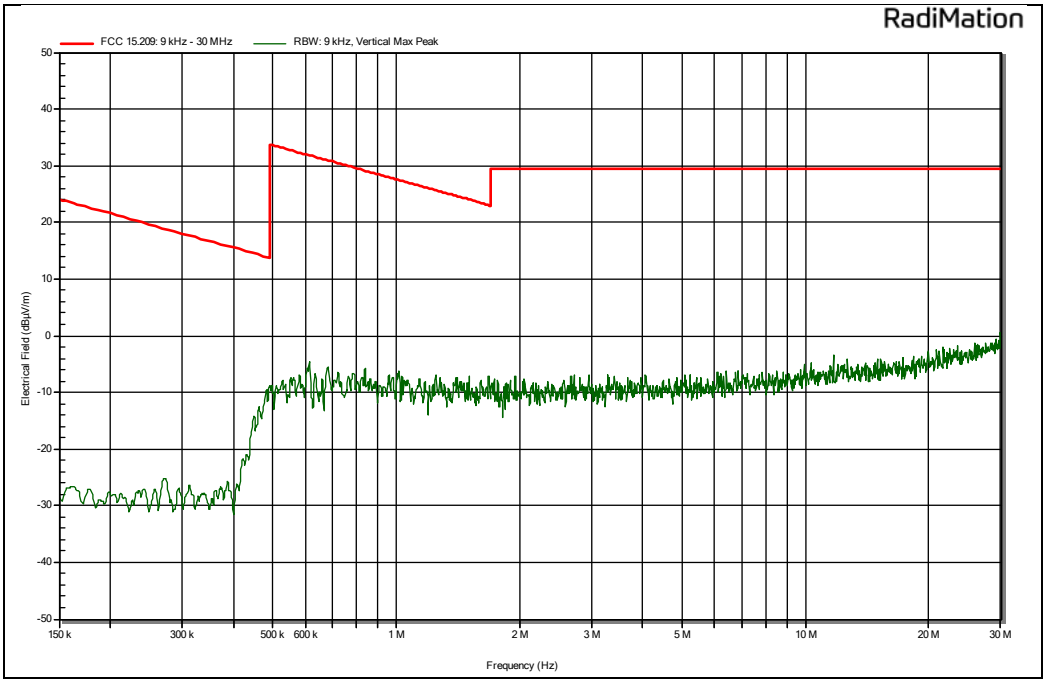
3.1.7 Plots of the Radiated Spurious Emissions Measurement (BLE)

9 kHz to 150 kHz

Parallel

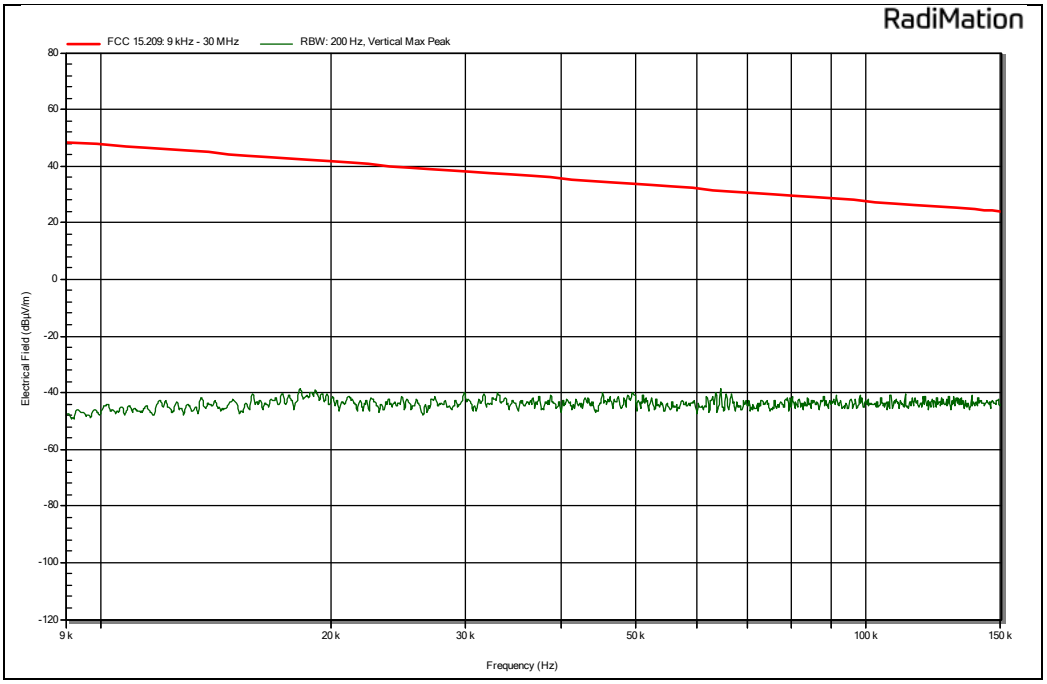


150 kHz to 30 MHz

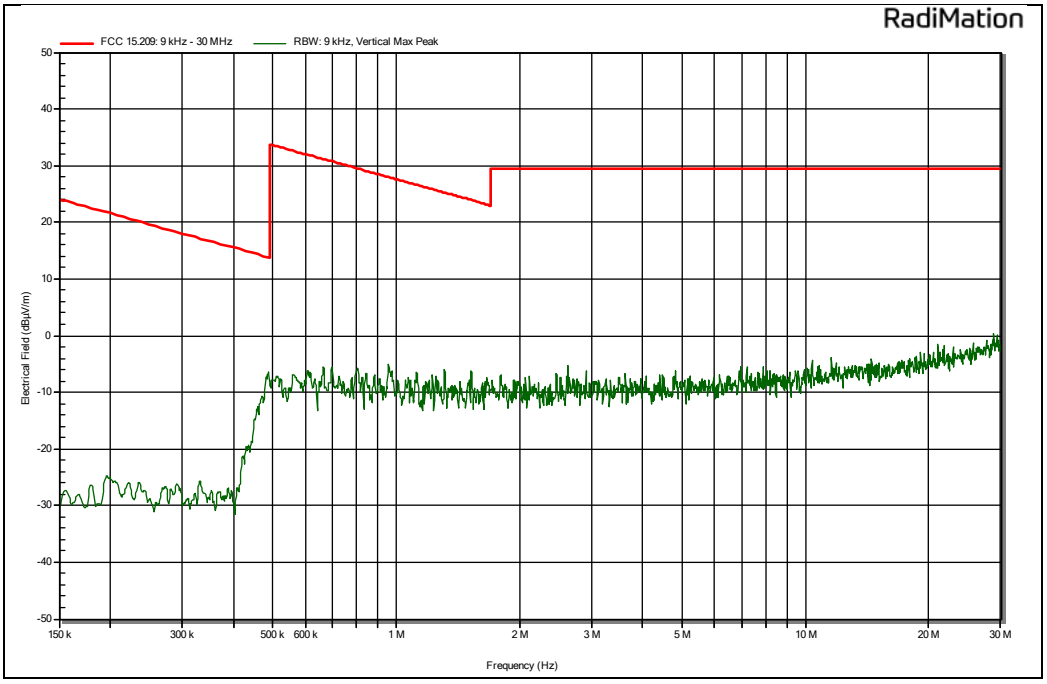


9 kHz to 150 kHz

Parallel

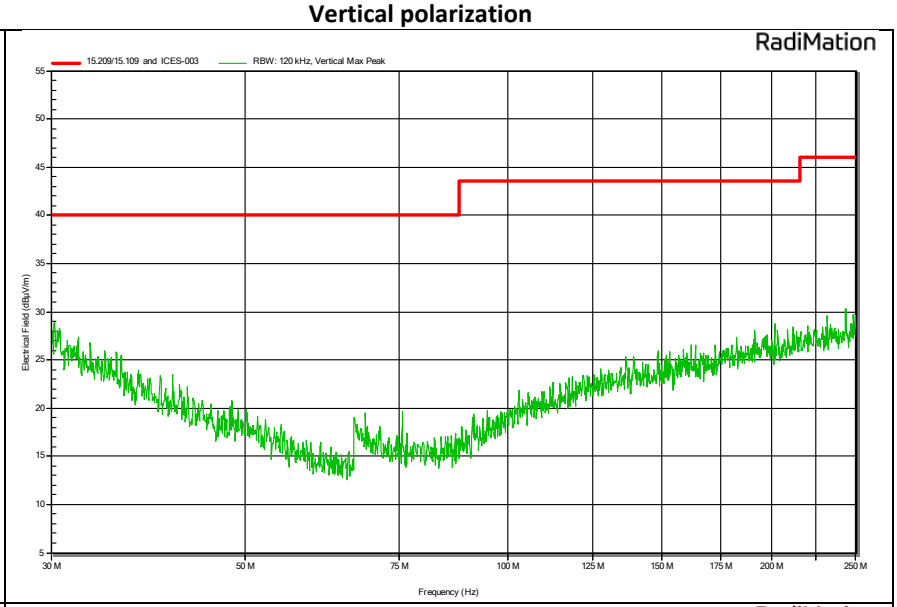
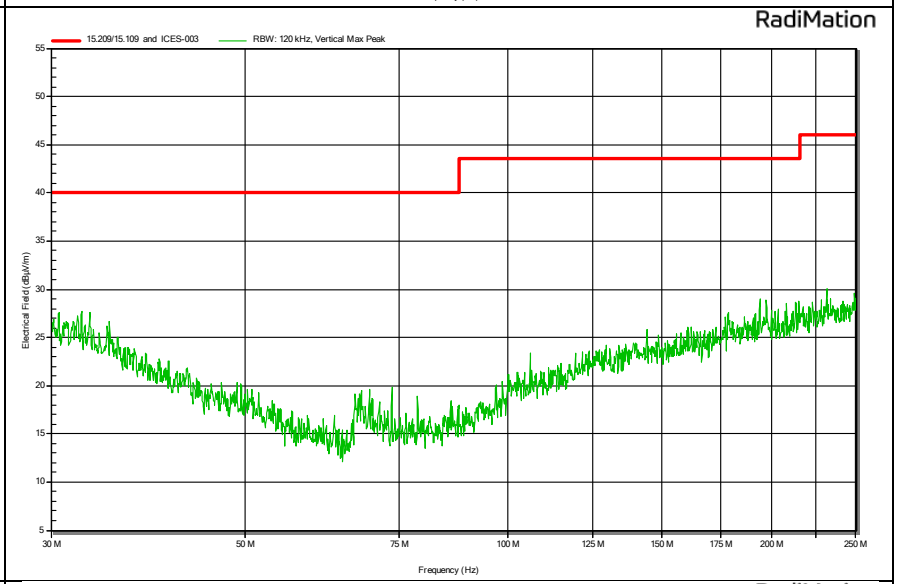
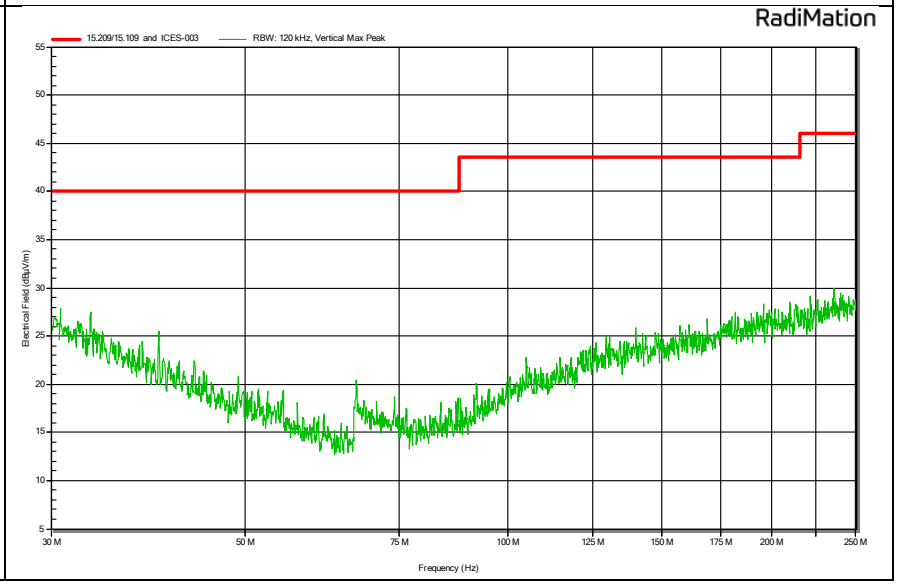


150 kHz to 30 MHz



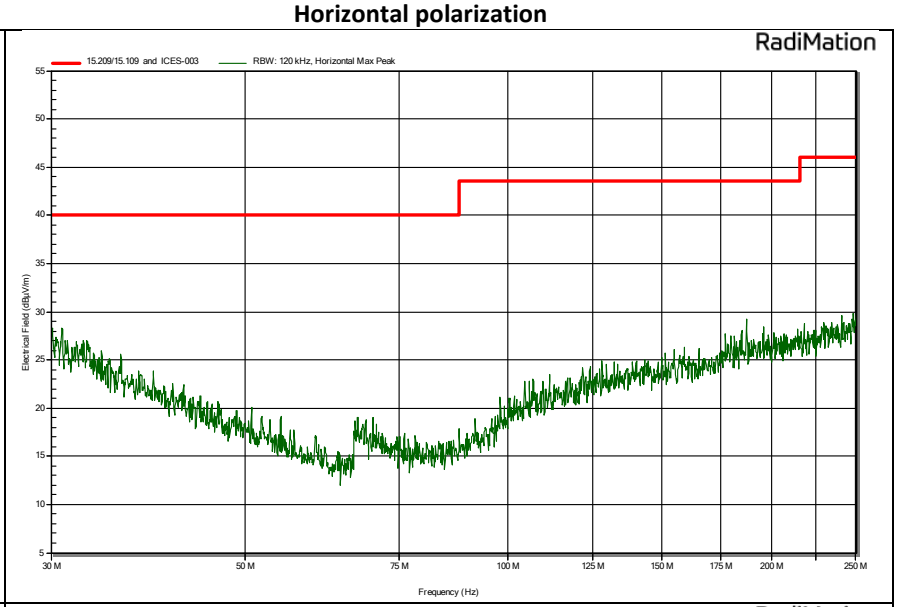
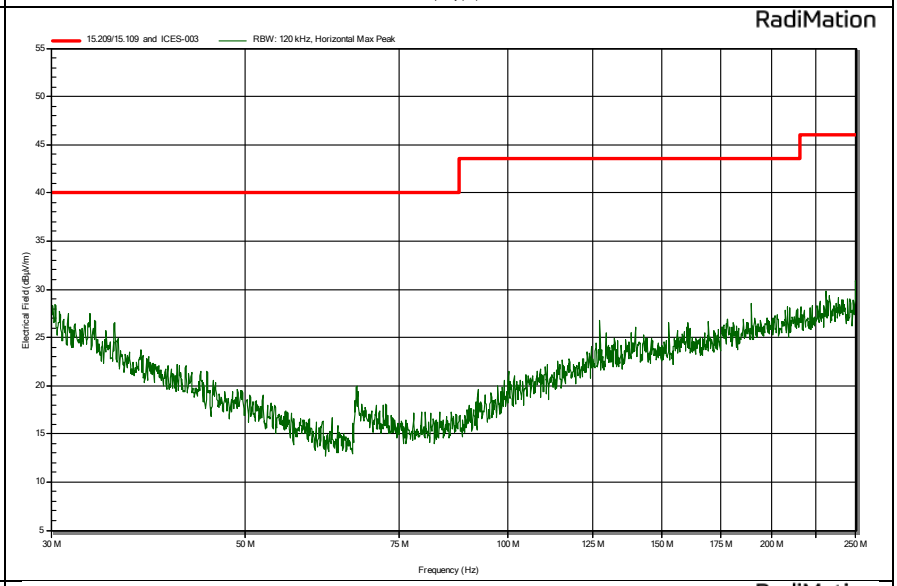
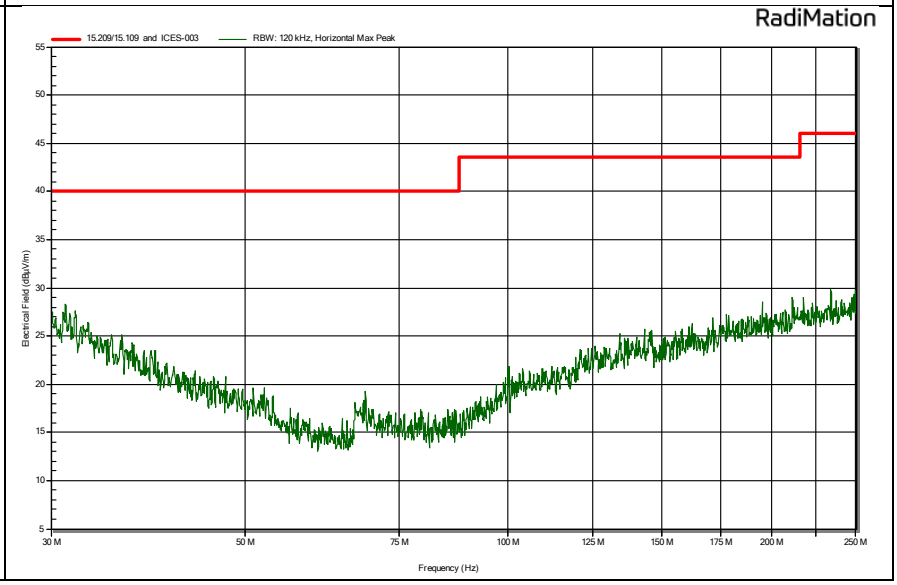
30 MHz to 250 MHz

Vertical polarization

Low ch	
Mid ch	
High ch	

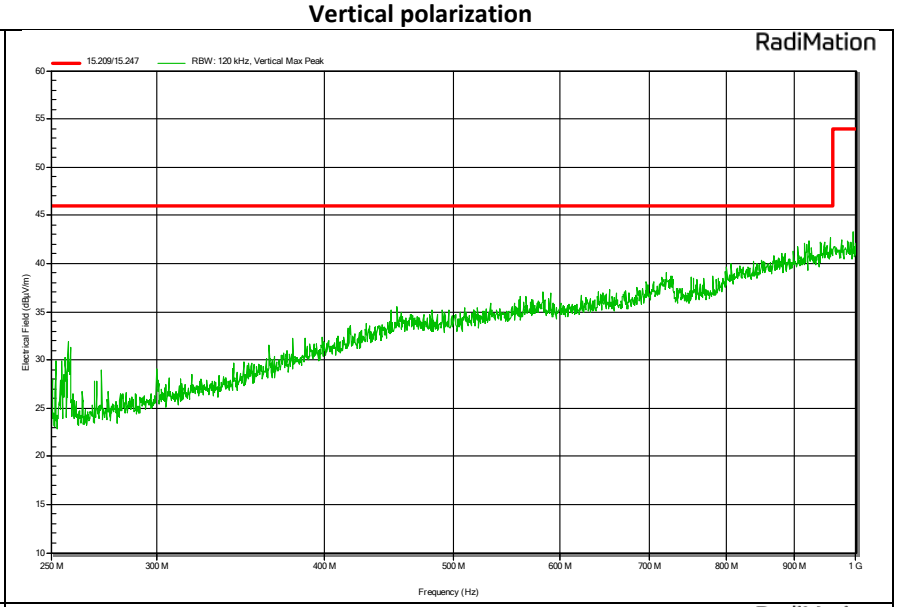
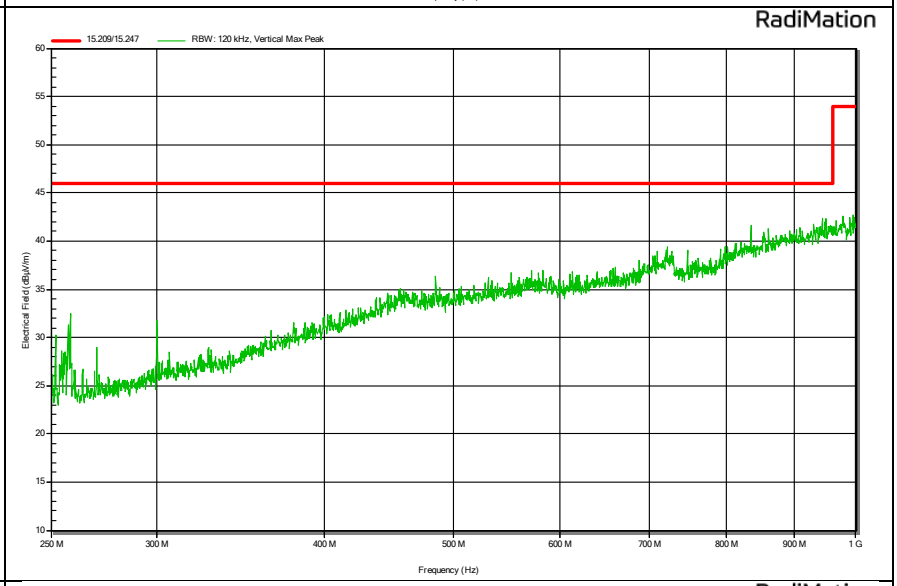
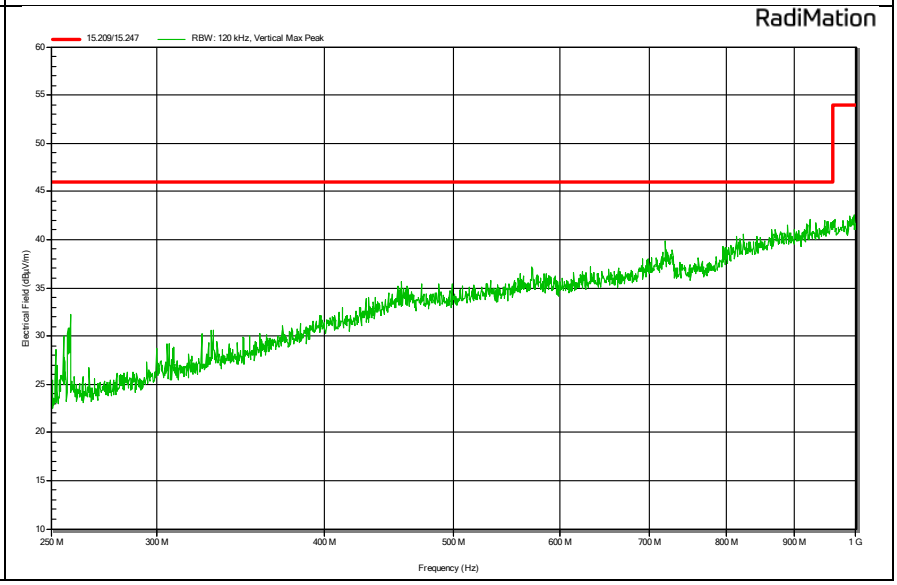
30 MHz to 250 MHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

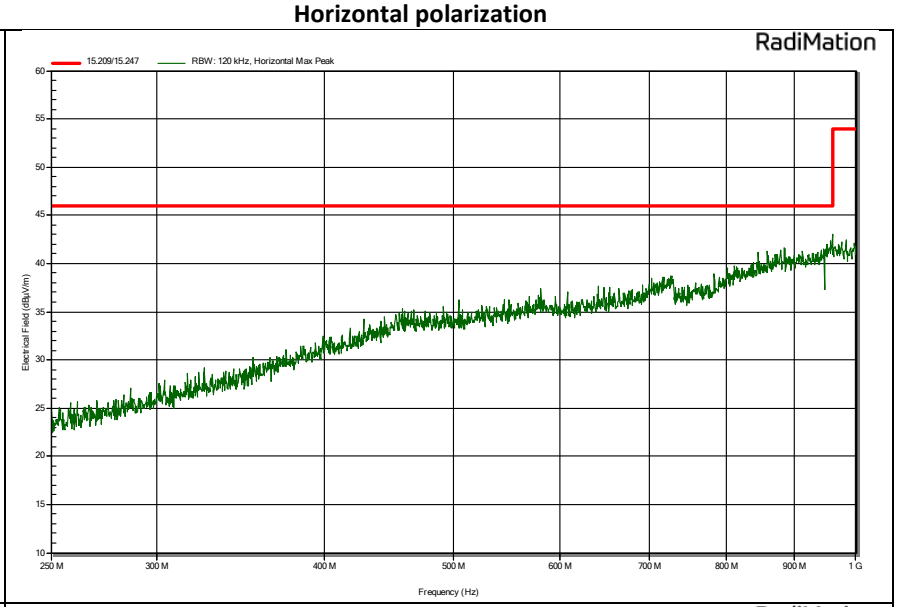
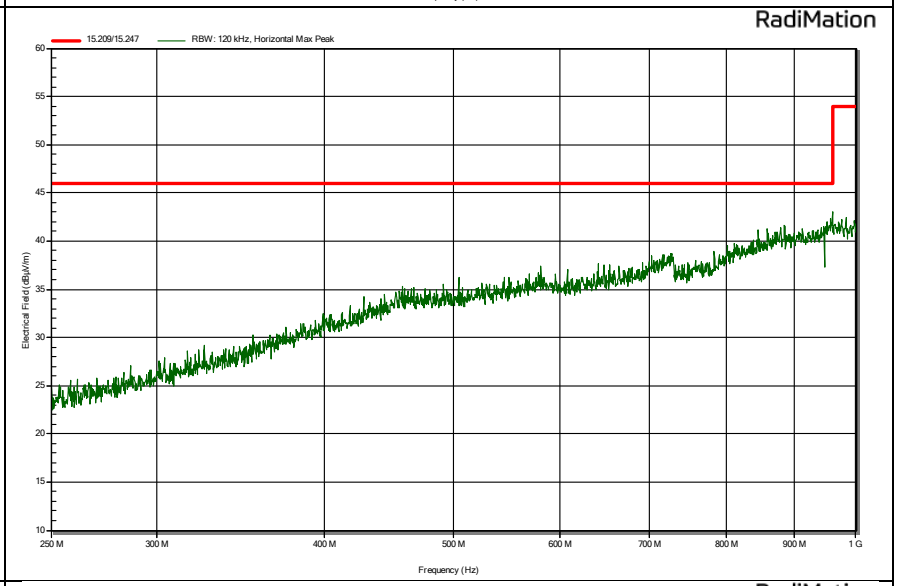
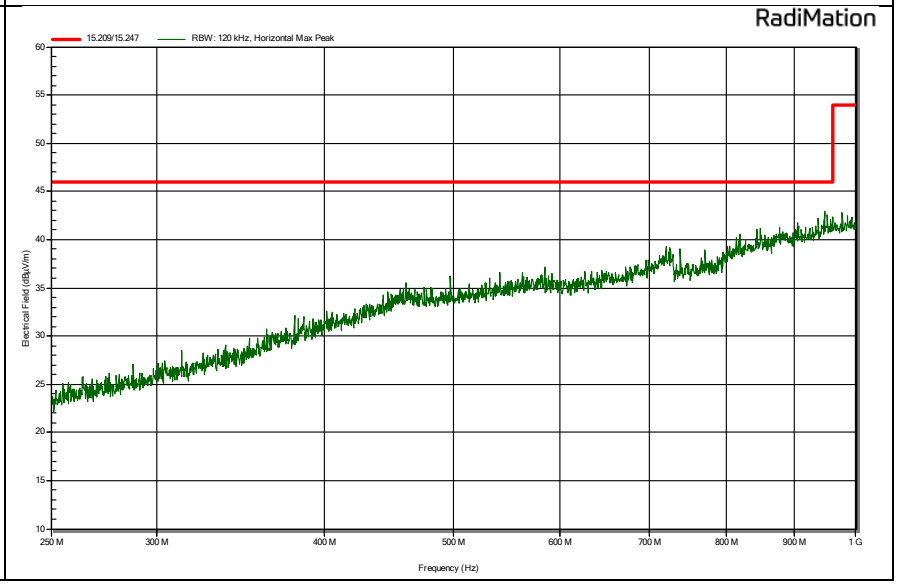
250 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

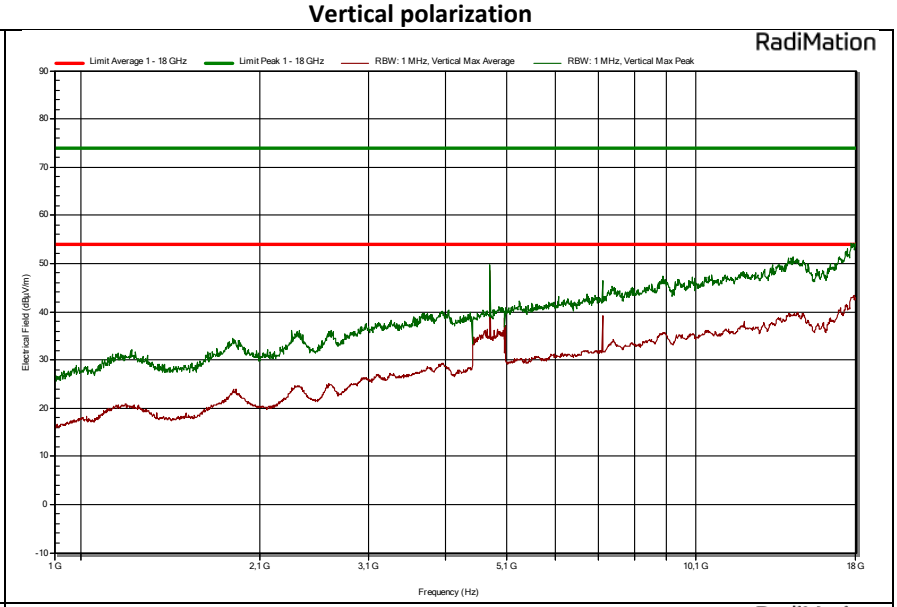
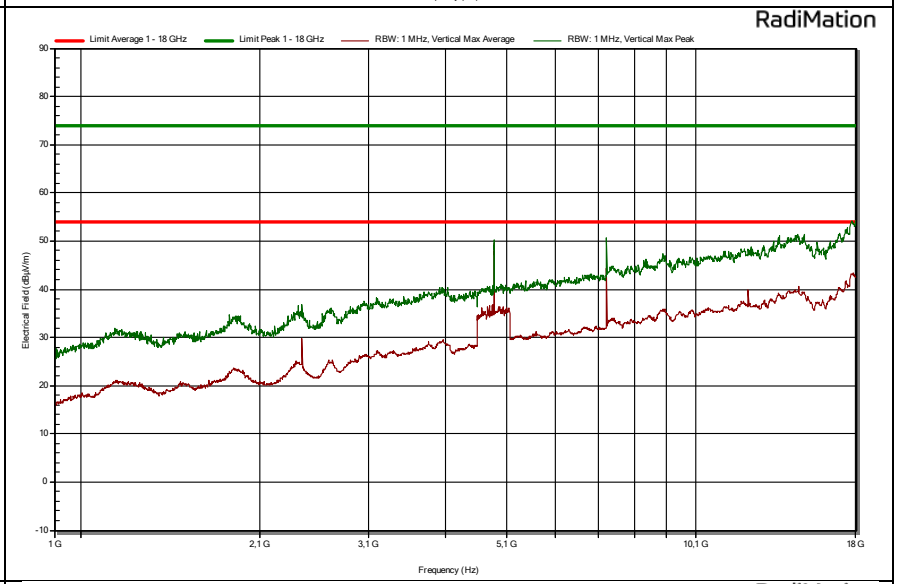
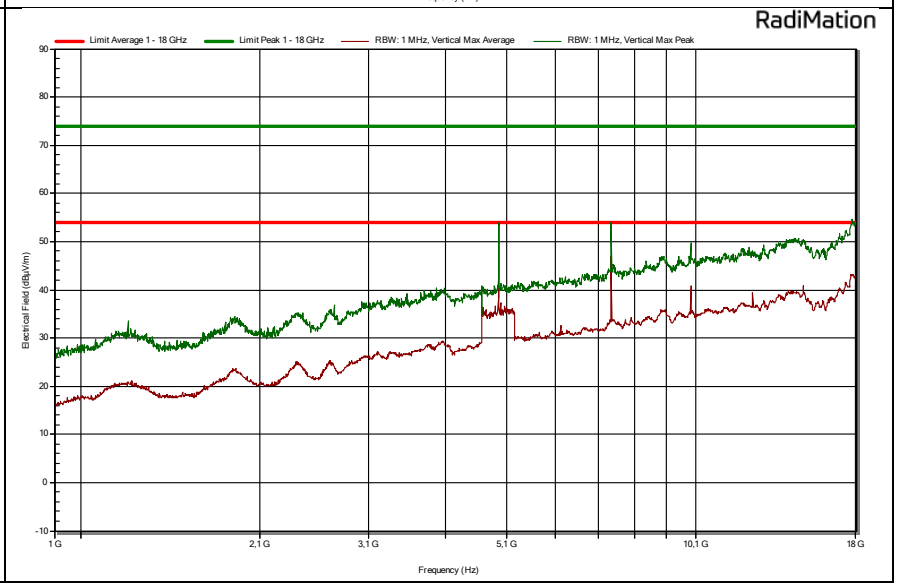
250 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

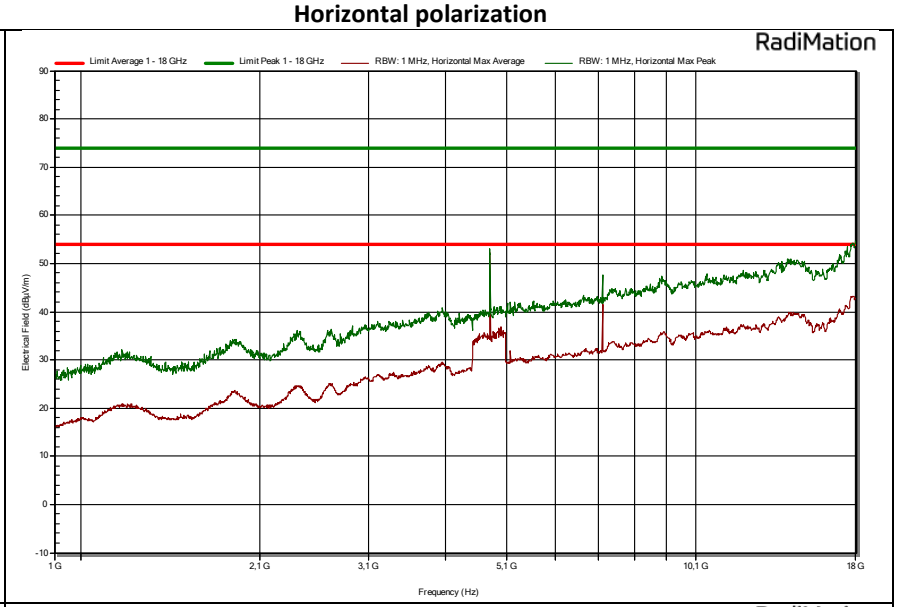
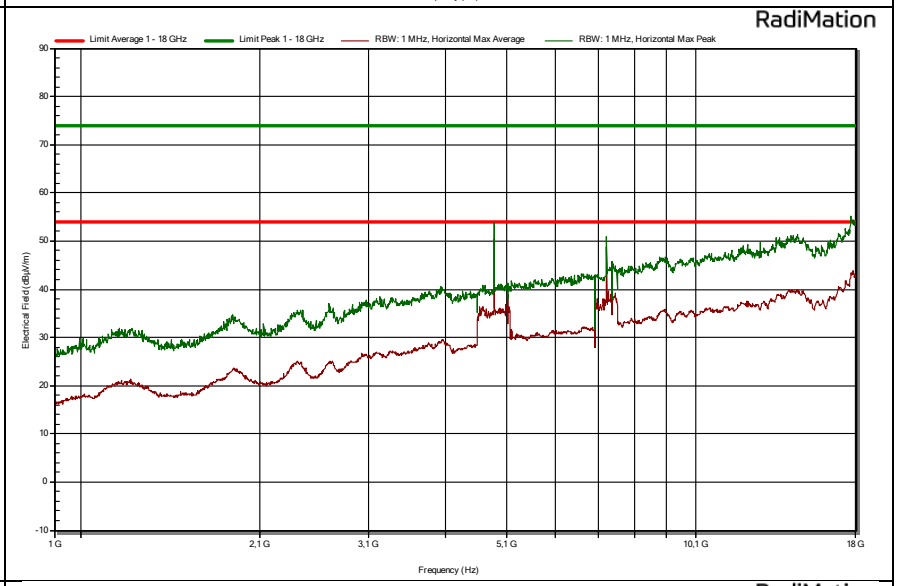
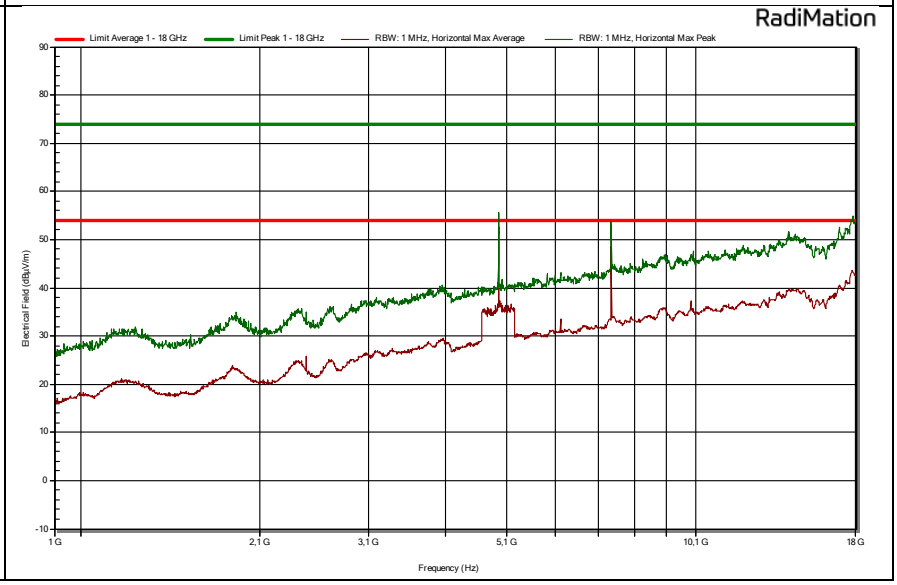
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

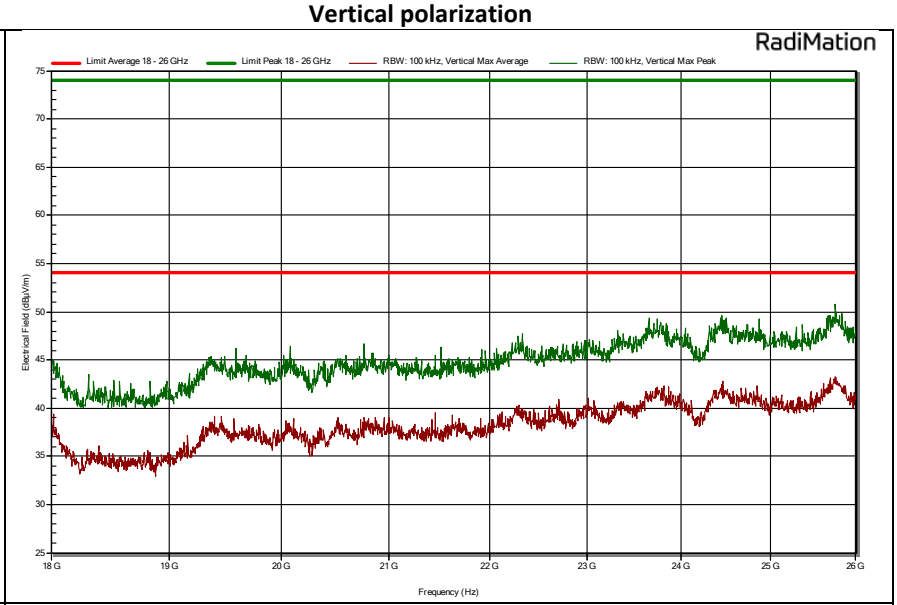
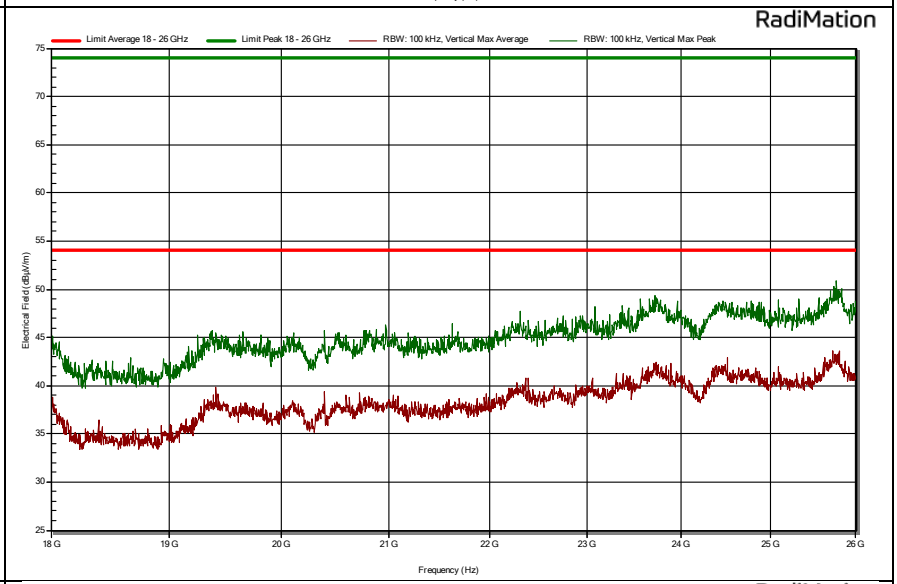
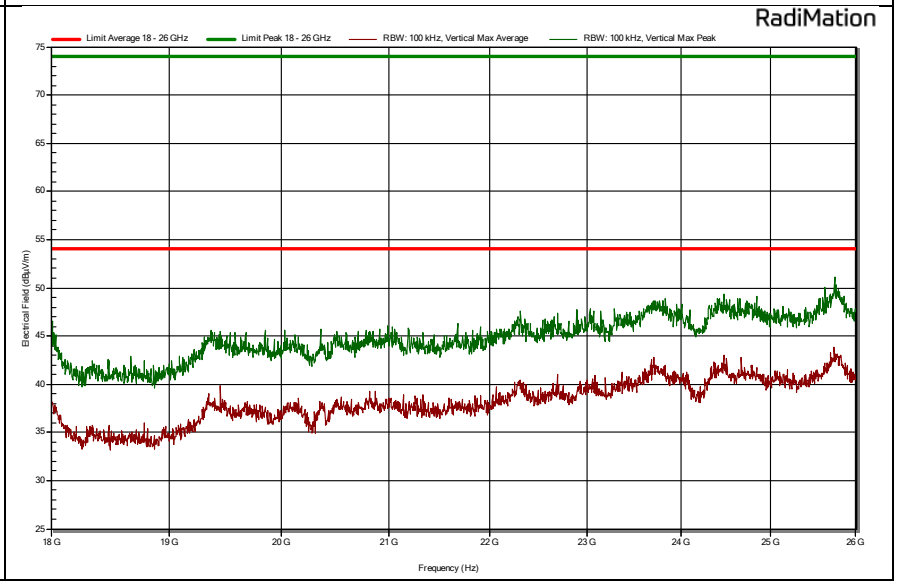
1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

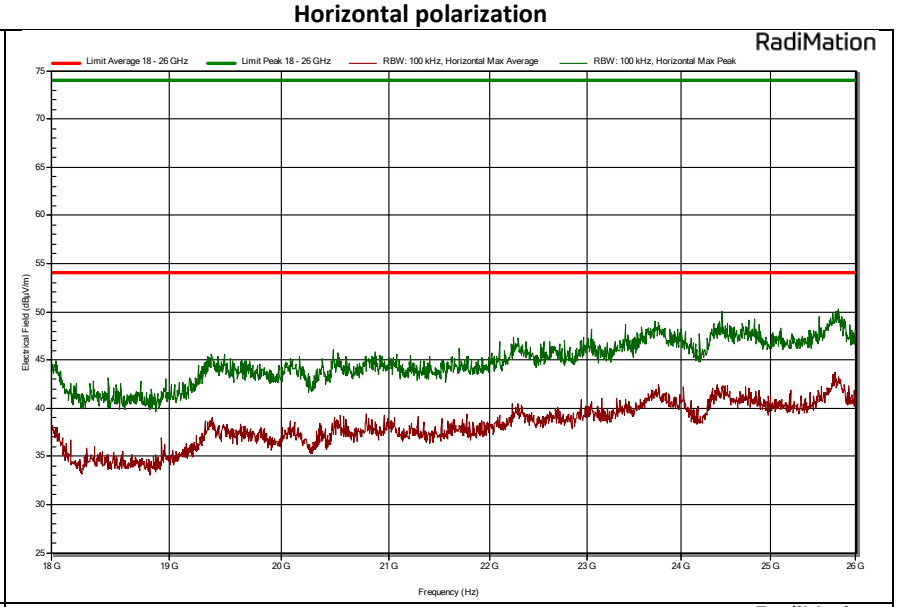
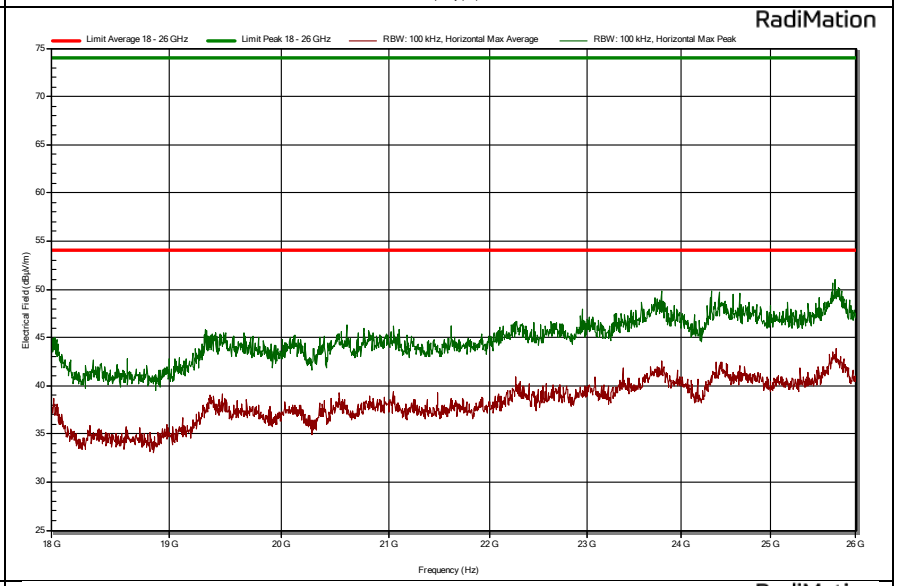
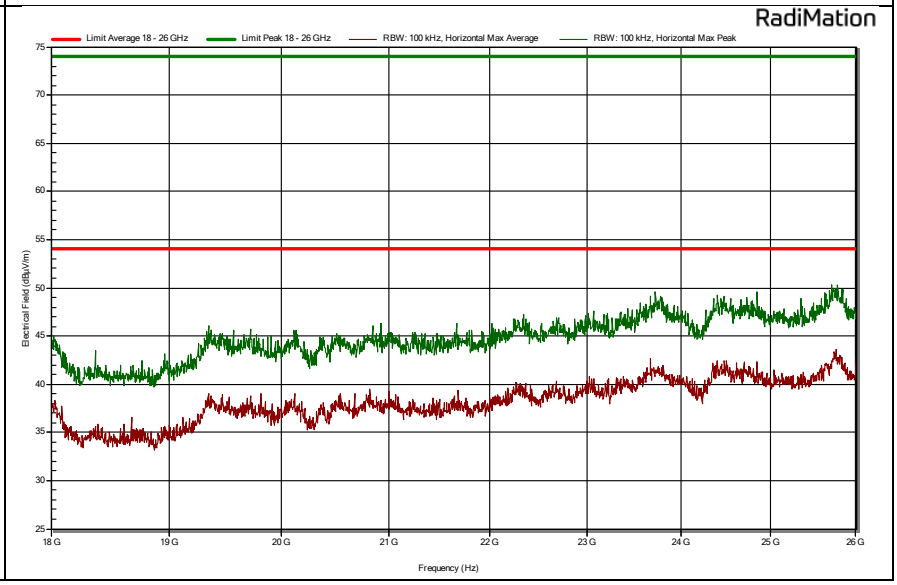
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

3.1.8 Peak tables of the radiated spurious emissions measurement (BT EDR)

Measured peaks 1 – 18 GHz Low channel

Frequency (MHz)	Polarization	Height (m)	Peak (dBµV/m)	Average (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Result
4804,308	Horizontal	2,7	50,9	46,2	74	54	Pass
7205,57	Vertical	1	51,8	44,8	74	54	Pass
4803,726	Vertical	1,2	56,1	53,2	74	54	Pass
9608,501	Vertical	2,7	50,4	40	74	54	Pass
7206,476	Horizontal	1	51	43,2	74	54	Pass
9663,461	Horizontal	1	48,3	34,6	74	54	Pass

Measured peaks 1 – 18 GHz Middle channel

Frequency (MHz)	Polarization	Height (m)	Peak (dBµV/m)	Average (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Result
4879,703	Horizontal	1,5	50,7	46	74	54	Pass
7319,575	Vertical	2,7	53,5	48	74	54	Pass
4880,275	Vertical	3,5	49	43,1	74	54	Pass
7320,297	Horizontal	1	52,4	46,8	74	54	Pass

Measured peaks 1 – 18 GHz High channel

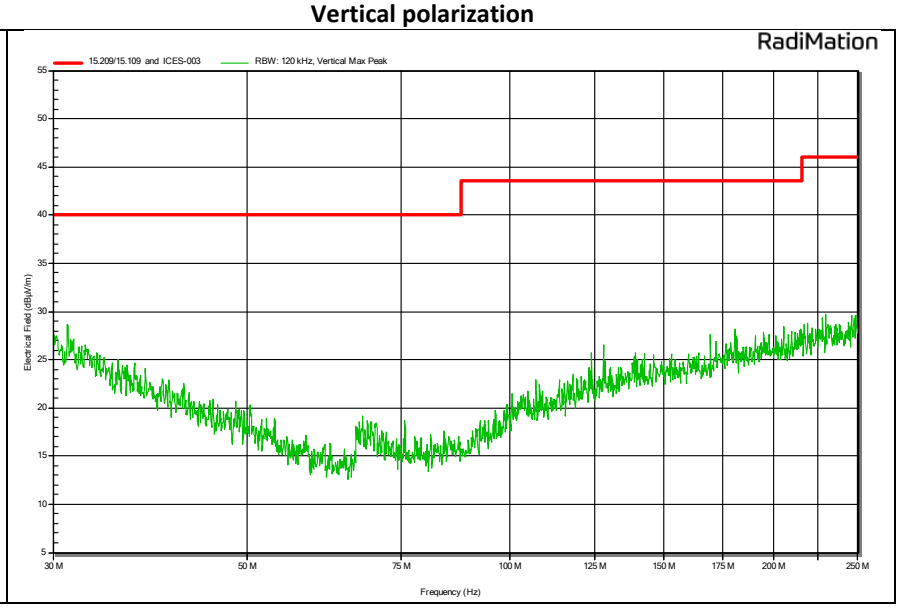
Frequency (MHz)	Polarization	Height (m)	Peak (dBµV/m)	Average (dBµV/m)	Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Result
4959,652	Horizontal	1,2	50,9	46,1	74	54	Pass
7440,582	Vertical	1	54,6	48	74	54	Pass
4960,056	Vertical	1	54	51,3	74	54	Pass

3.1.9 Plots of the Radiated Spurious Emissions Measurement (BT EDR)

Note: Since the transmission type has no influence on the emissions in the 9 kHz – 30 MHz range, no plots are reported for BT EDR. See BLE results.

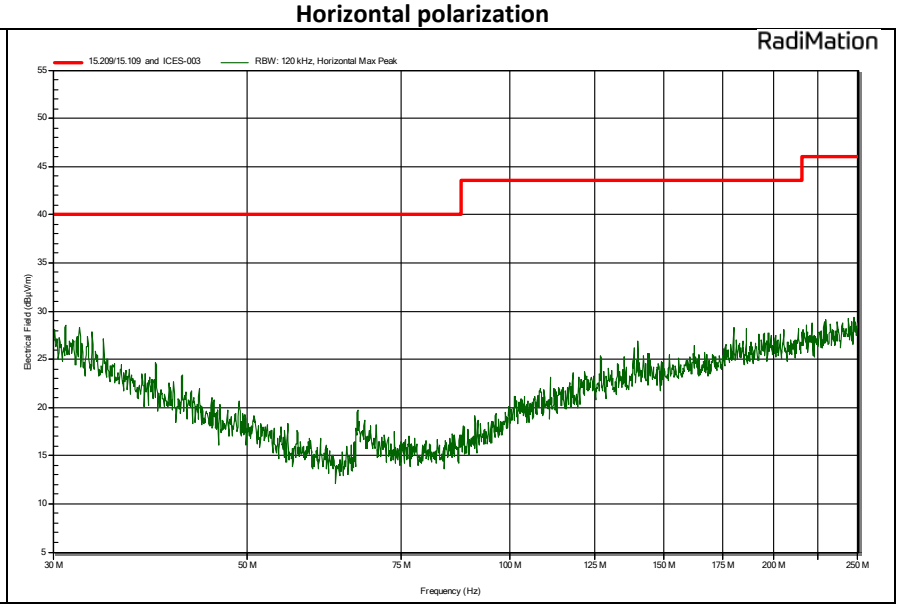
30 MHz to 250 MHz

Vertical polarization

Low ch	

30 MHz to 250 MHz

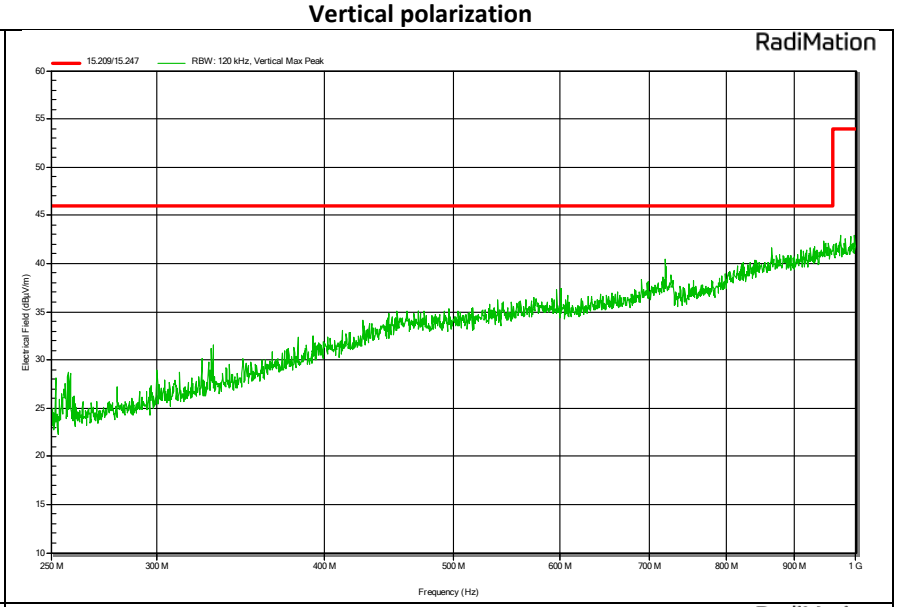
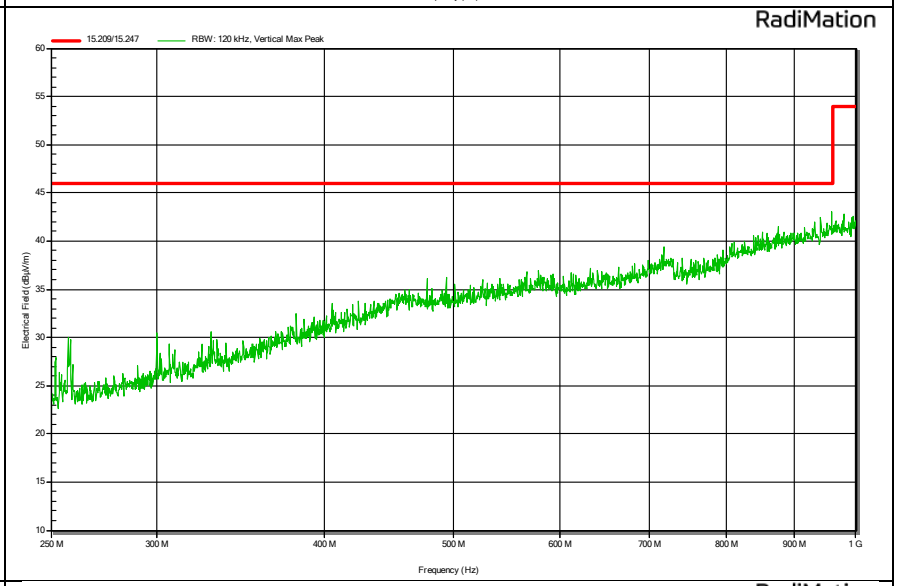
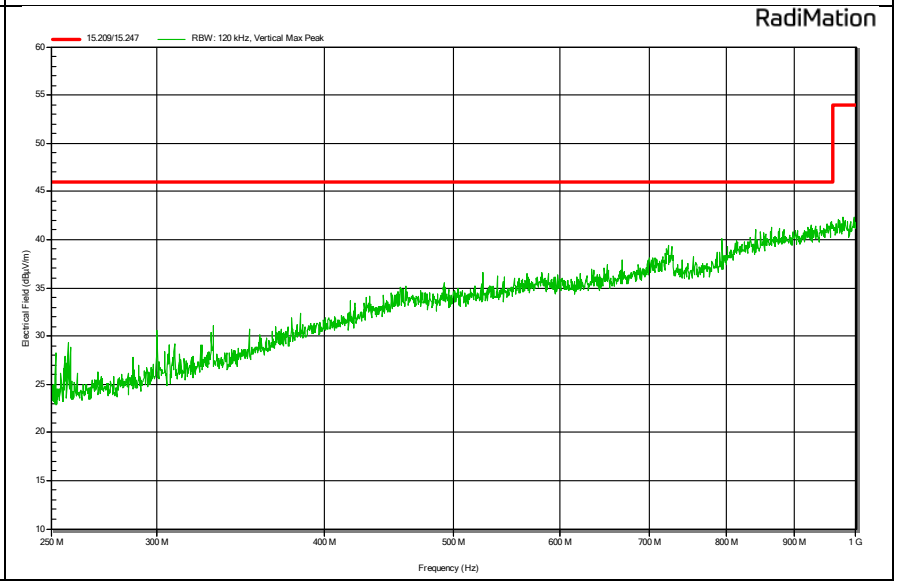
Horizontal polarization

Low ch	

Note: Since there is no difference of emissions in the 30-250 MHz range between the BLE and EDR results, only low channel results are reported for BT EDR.

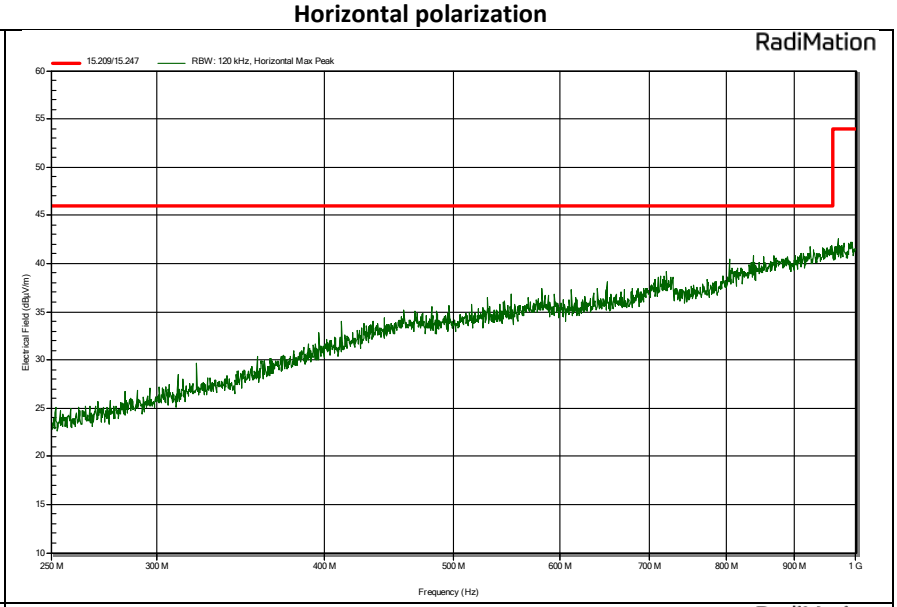
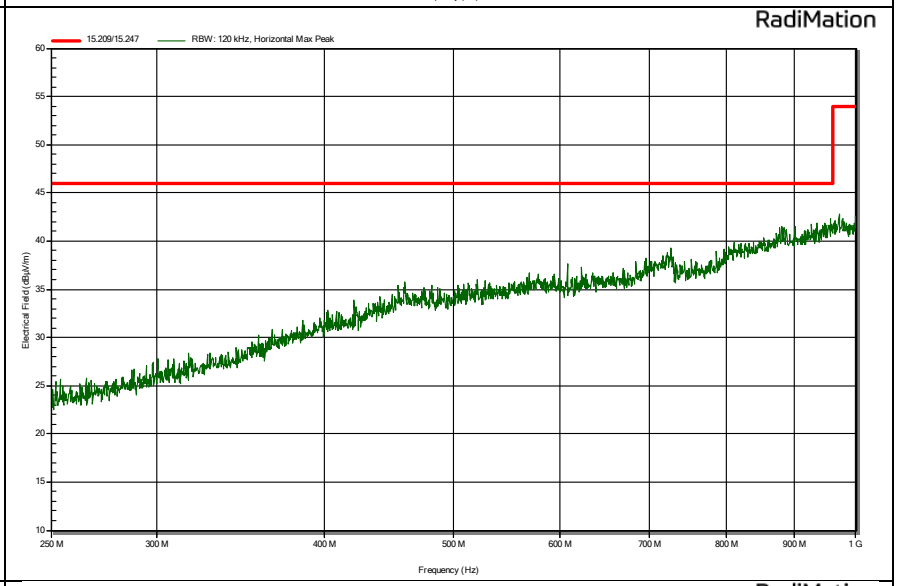
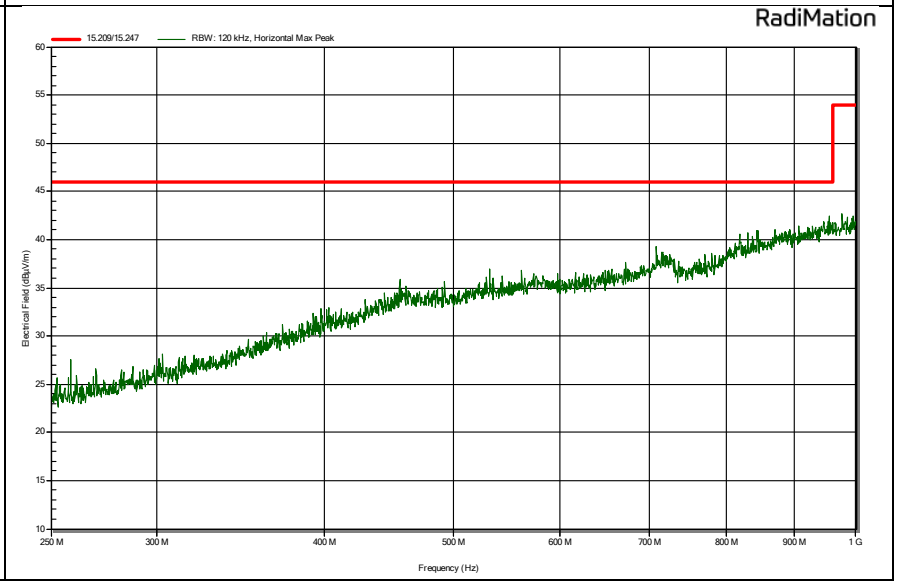
250 MHz to 1 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

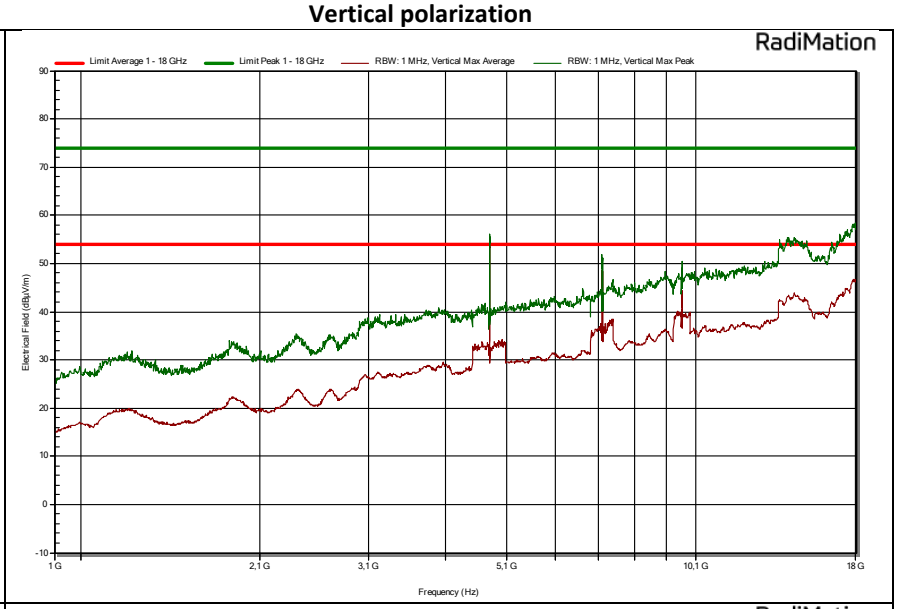
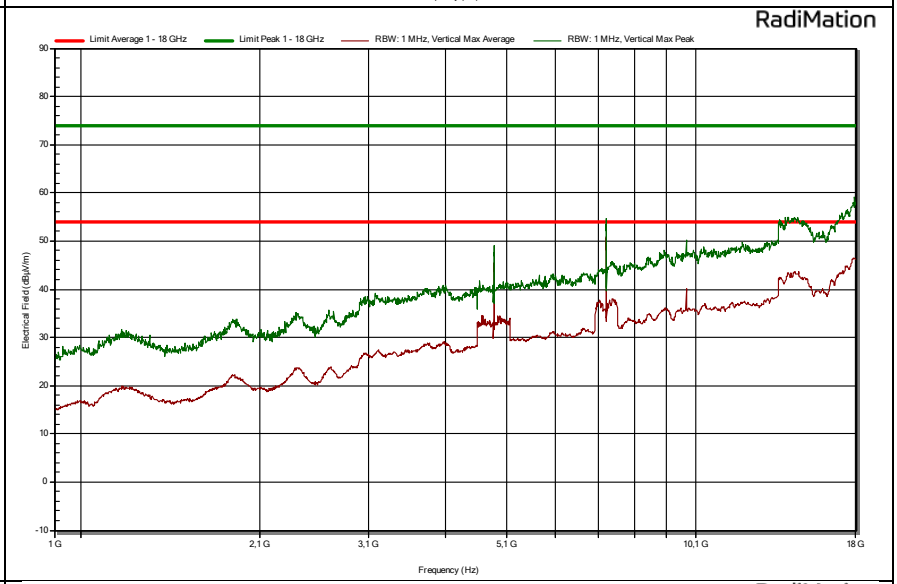
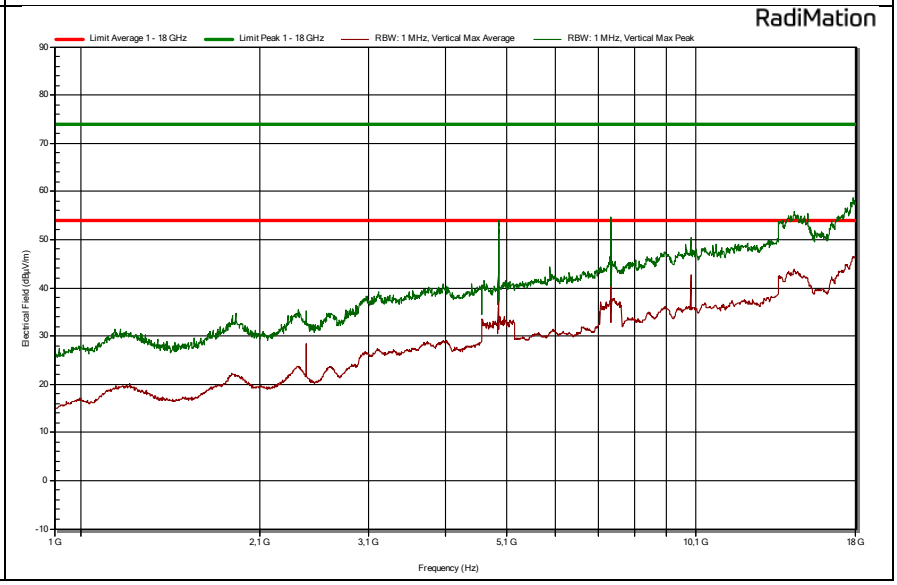
250 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

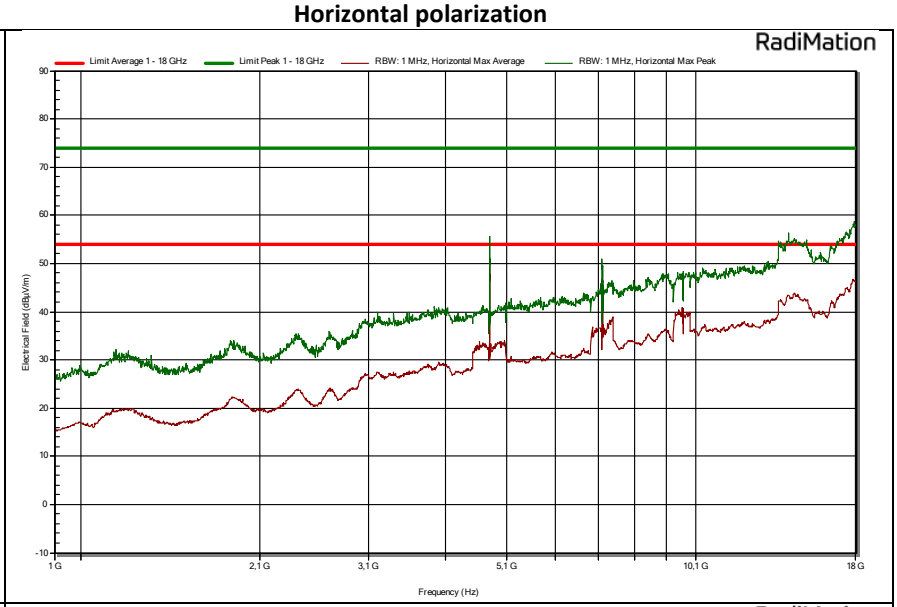
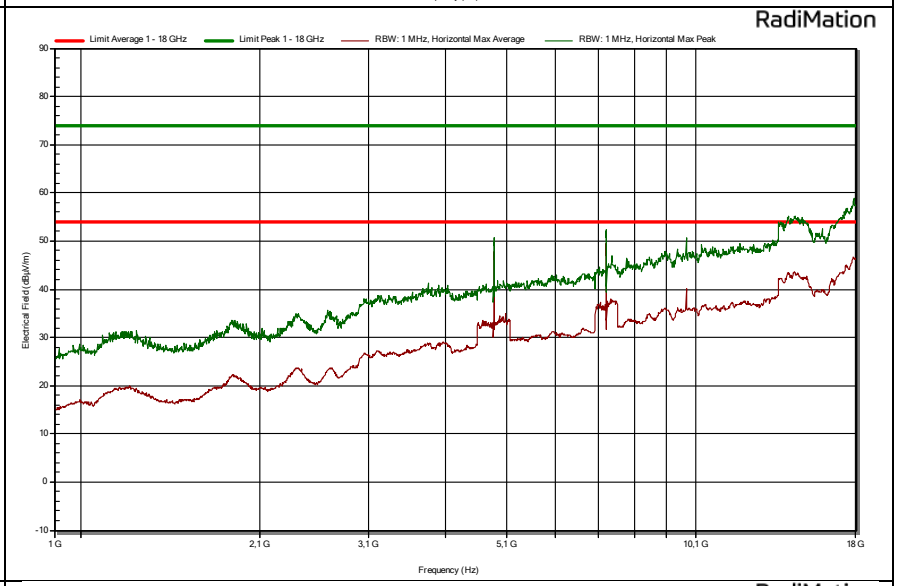
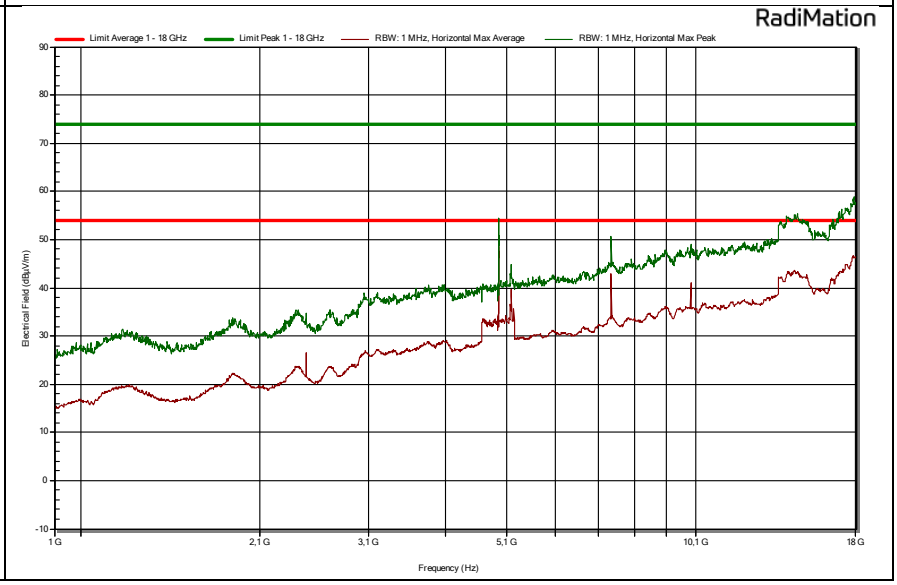
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

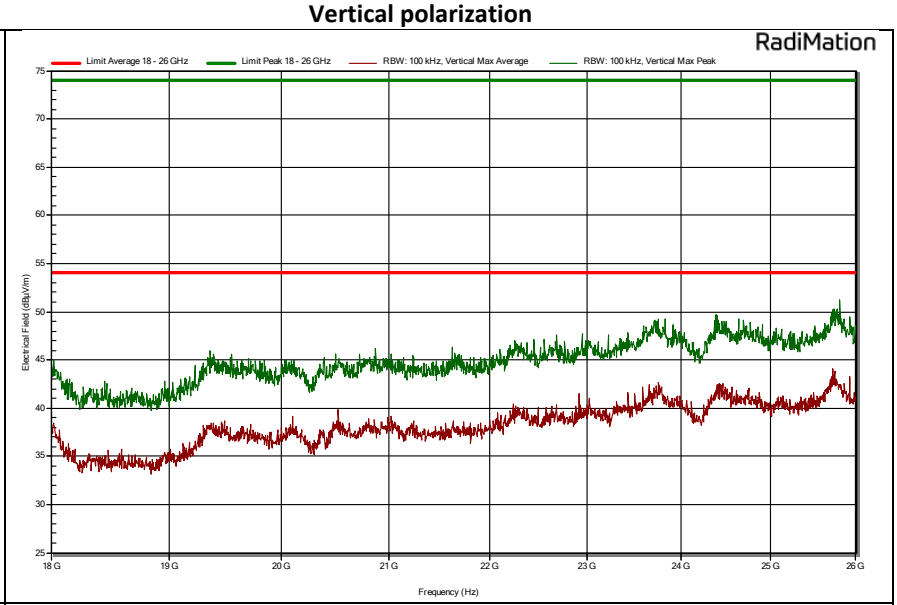
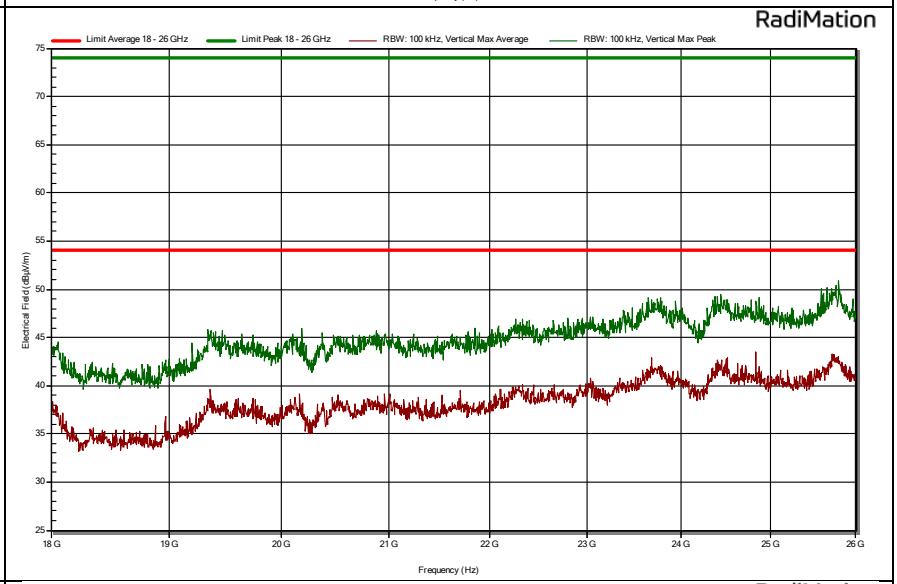
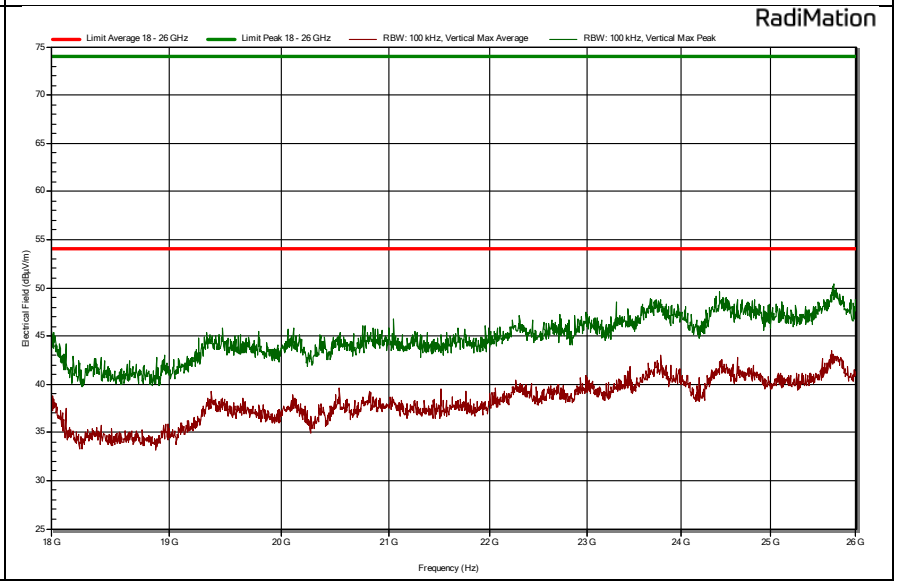
1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

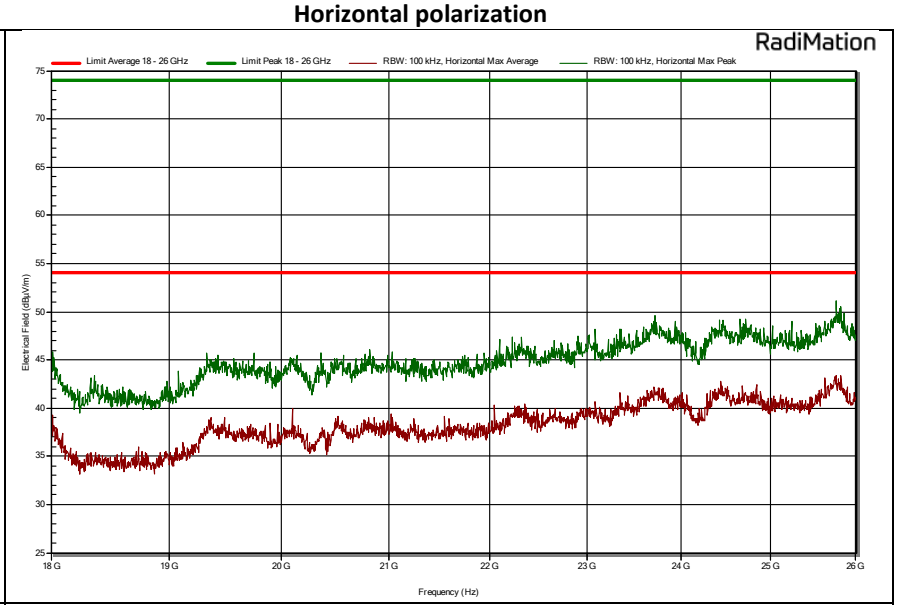
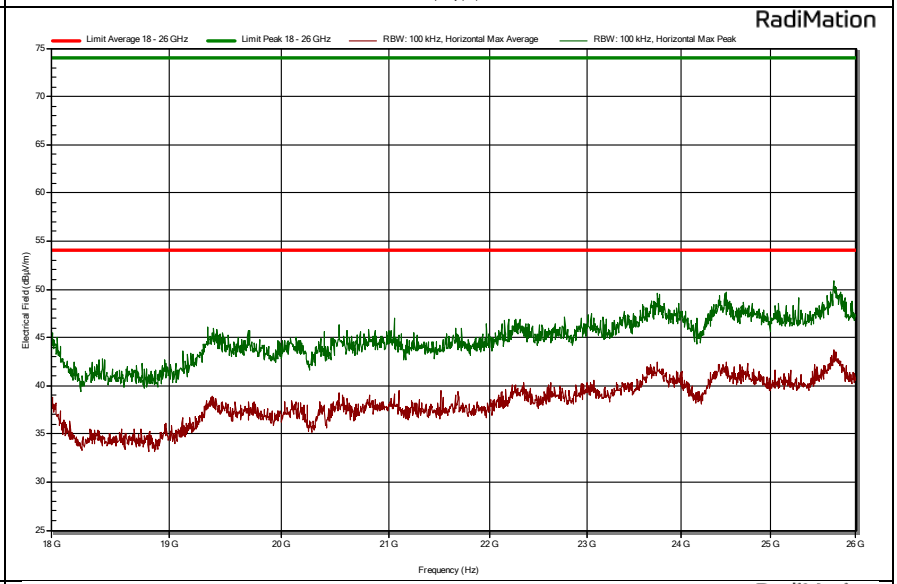
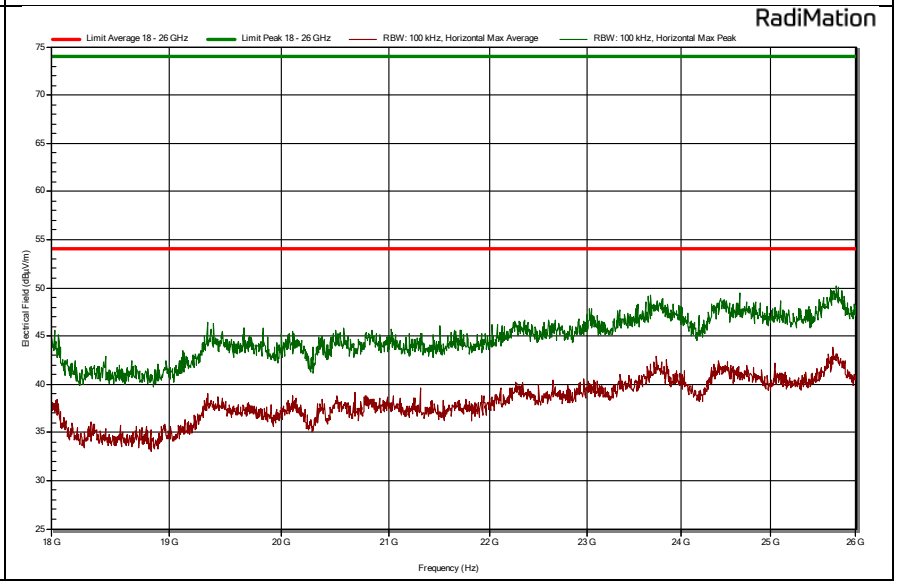
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

3.2 6dB bandwidth Measurement

3.2.1 Limit

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

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.2.4 Test procedure

Tests according to ANSI C63.10
IRN 017 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

Test is only applicable to BLE

3.2.5 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	724.9
	18	2440	1 Mbps	725.4
	39	2480	1 Mbps	716.9
Bluetooth Low energy	1	2402	2 Mbps	1263.7
	18	2440	2 Mbps	1452.8
	39	2480	2 Mbps	1256.4
Uncertainty	± 36.2 kHz			

3.3 99% Occupied Bandwidth

3.3.1 Limit

According to RSS-Gen 6.7

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.3.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.3.4 Test procedure

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

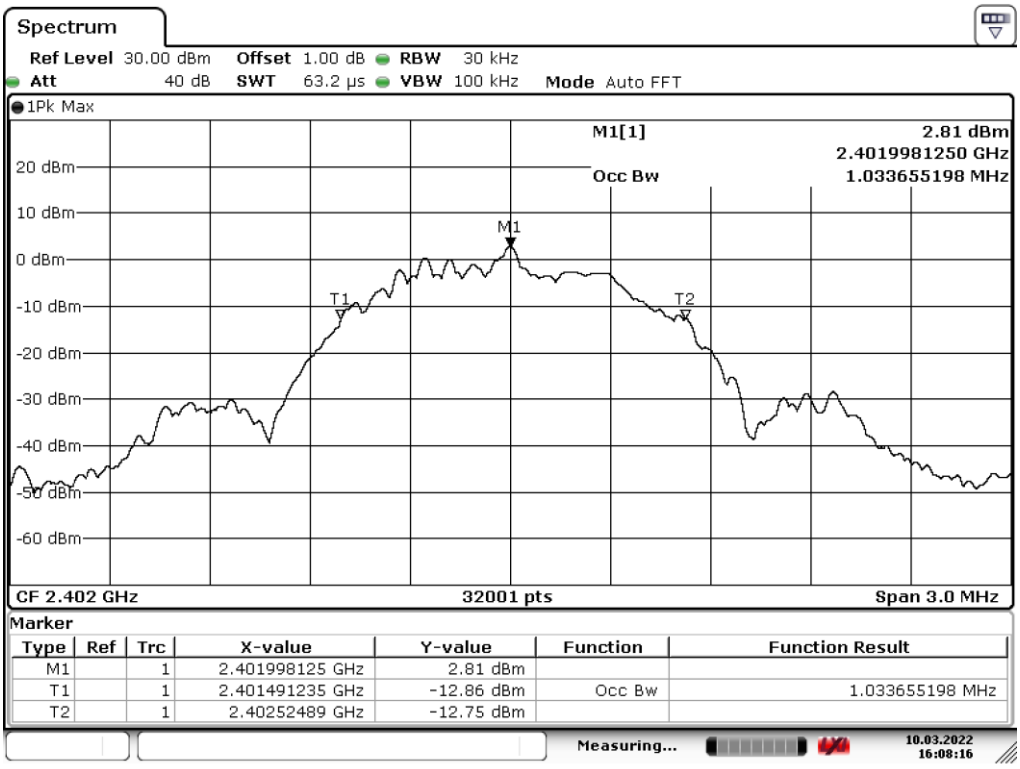
1. Set the centre frequency to the nominal EUT channel centre frequency
2. Set span = 1.5 times to 0.5 times the Occupied Bandwidth
3. Set VBW ≥ 3x RBW
4. Video averaging is not permitted. Where practical, detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until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

3.3.5 Test results of the 99% occupied bandwidth measurement

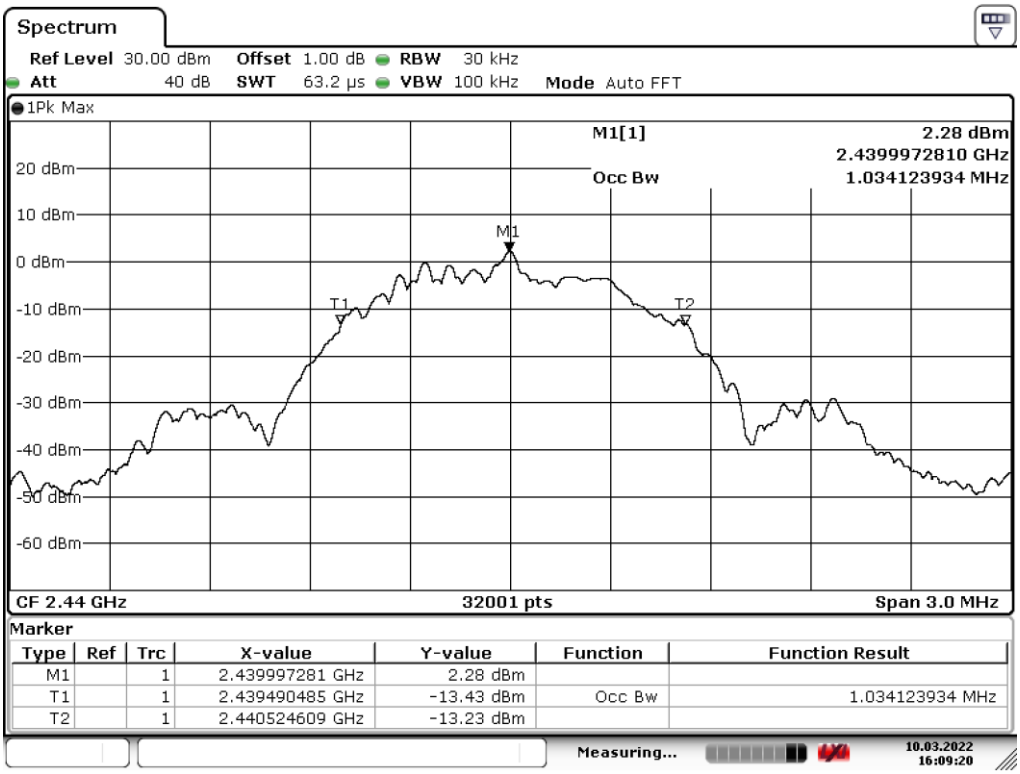
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Bluetooth Low energy	1	2402	1 Mbps	1033.7
	18	2440	1 Mbps	1034.1
	39	2480	1 Mbps	1030.0
Bluetooth Low energy	1	2402	2 Mbps	2058.5
	18	2440	2 Mbps	2057.7
	39	2480	2 Mbps	2056.3
Bluetooth EDR	1	2402	3-DH5	774.4
	39	2440	3-DH5	779.1
	78	2480	3-DH5	778.1
Uncertainty	± 12 kHz			

3.3.6 Plots of the 99% occupied bandwidth measurement (BLE 1 Mbps)

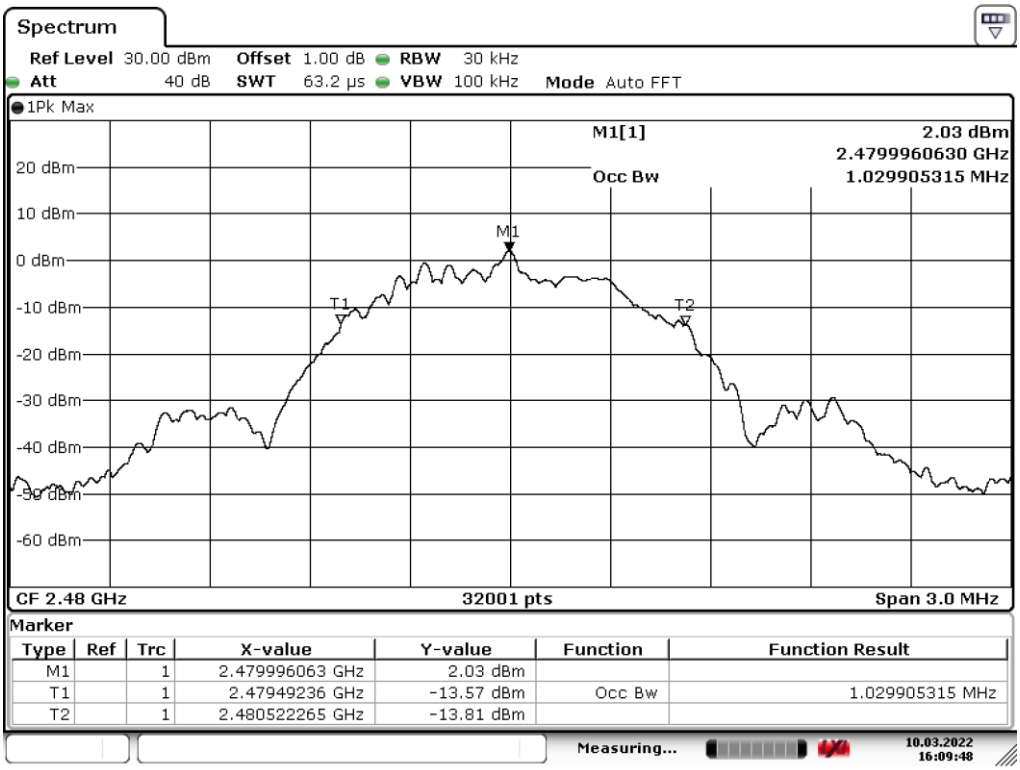
Channel 1



Channel 18

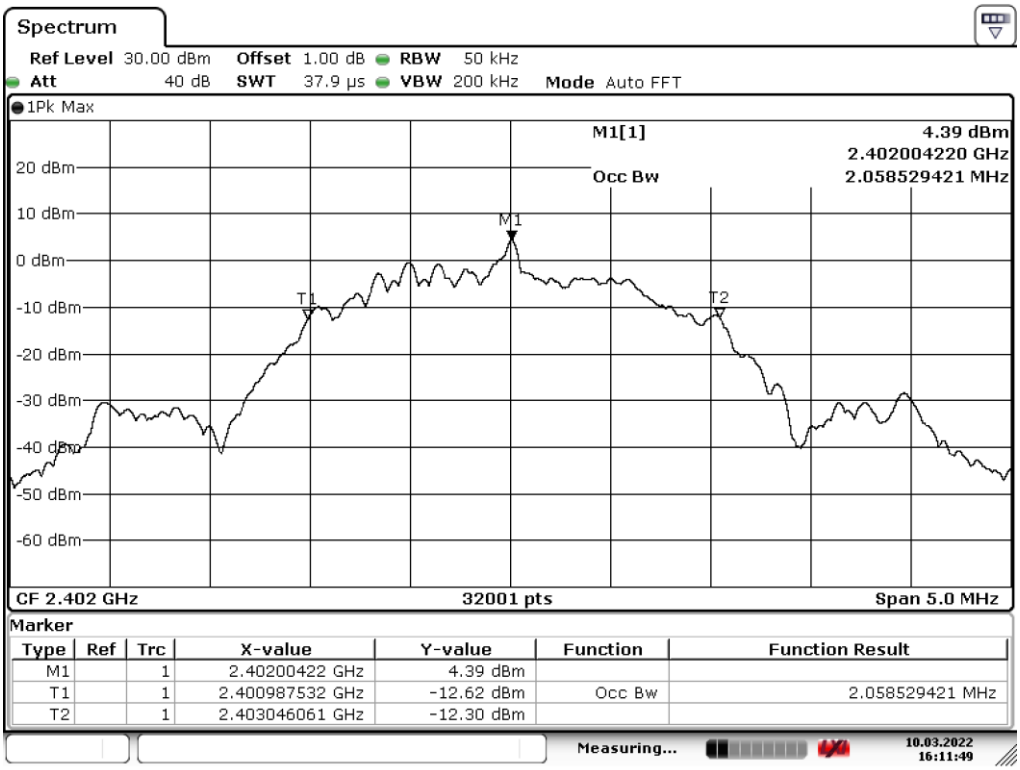


Channel 39

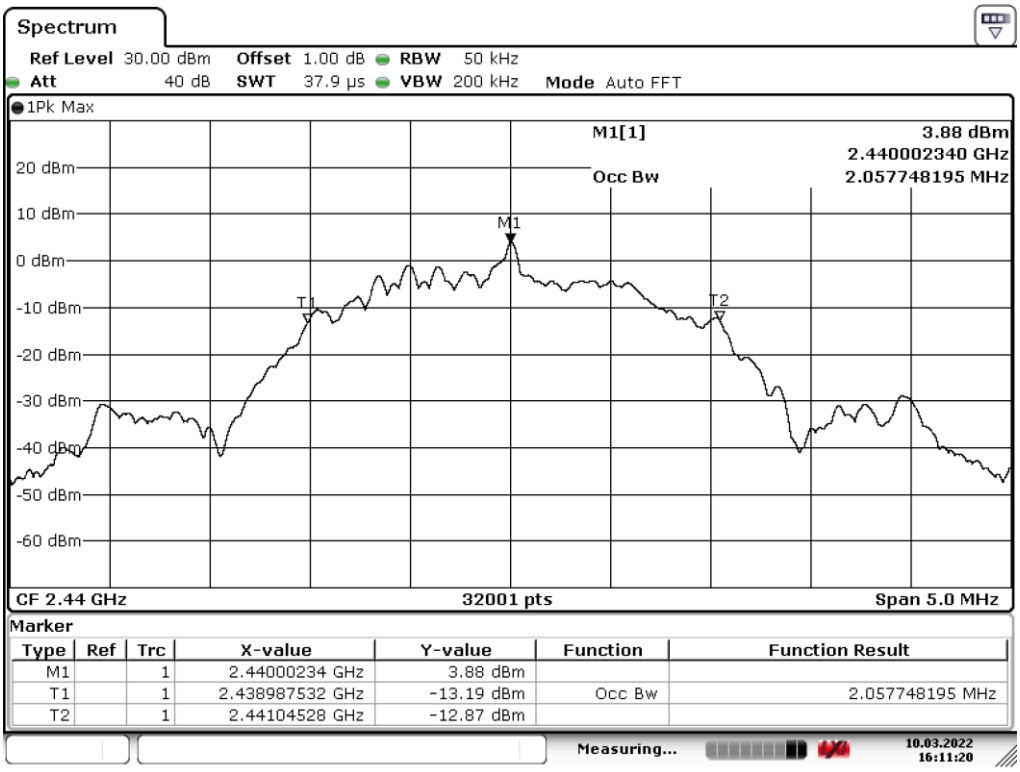


3.3.7 Plots of the 99% occupied bandwidth measurement (BLE 2 Mbps)

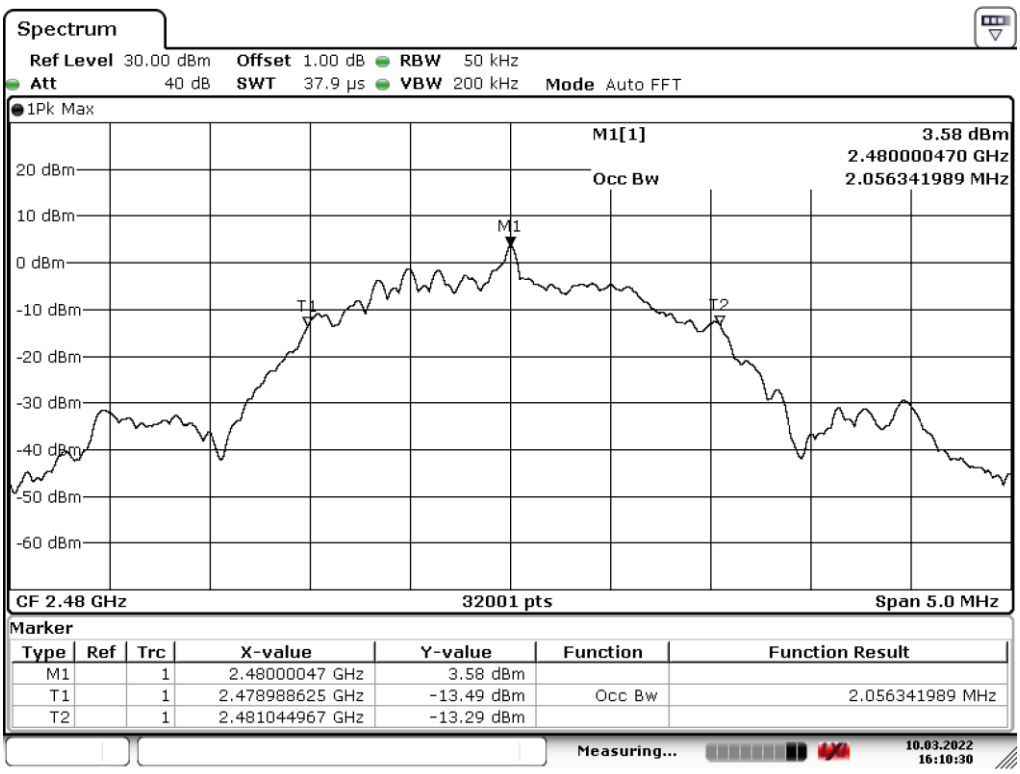
Channel 1



Channel 18

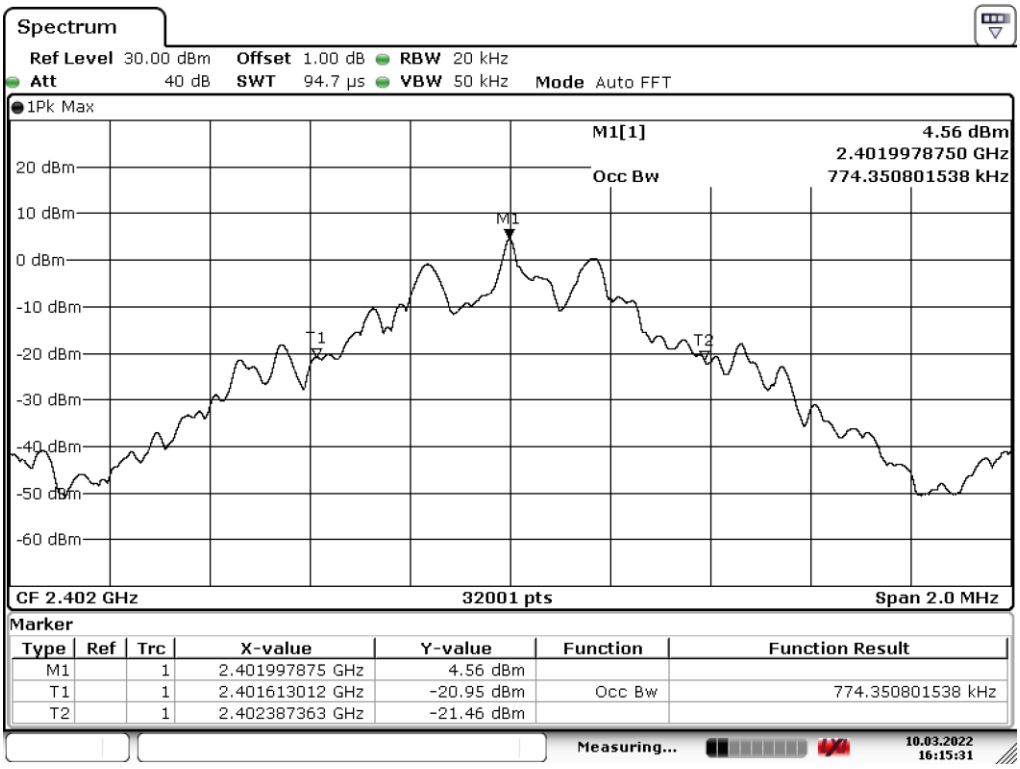


Channel 39

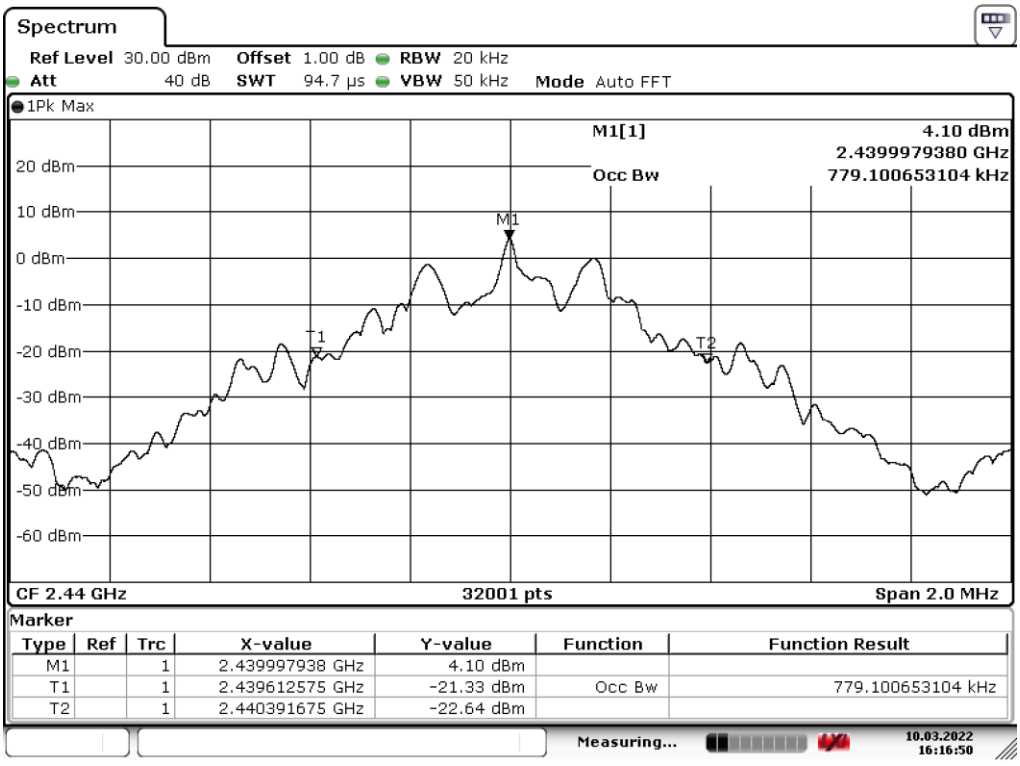


3.3.8 Plots of the 99% occupied bandwidth measurement (BT EDR 3-DH5)

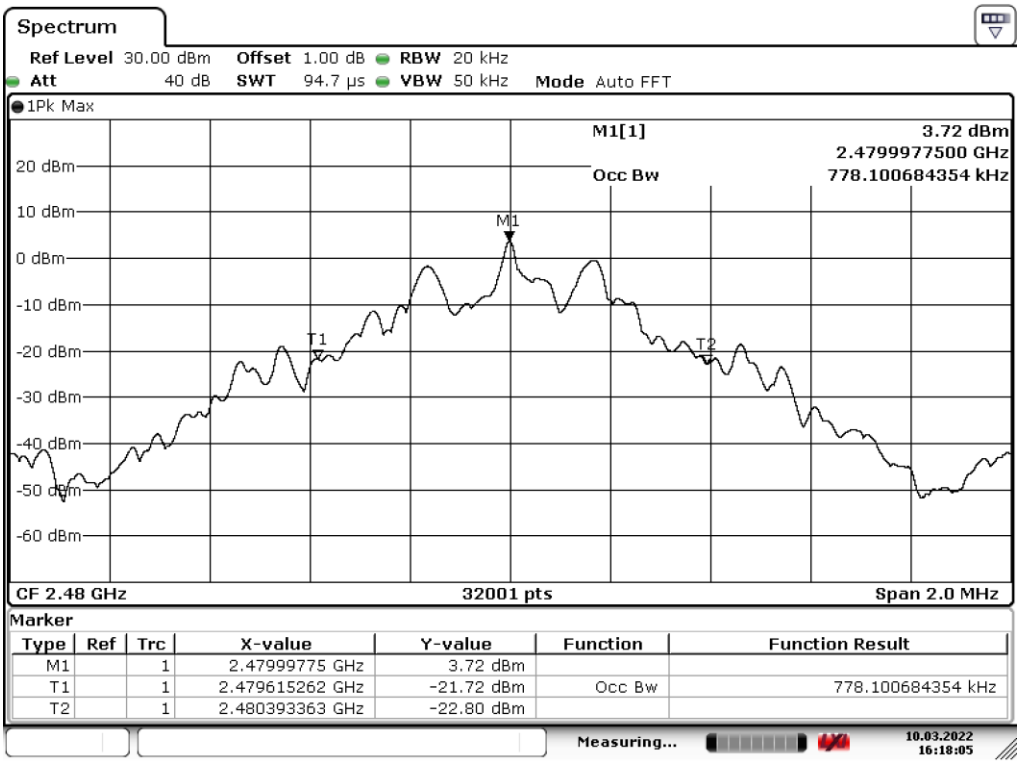
Channel 1



Channel 18



Channel 39


Spectrum
Ref Level 30.00 dBm Offset 1.00 dB RBW 20 kHz
Att 40 dB SWT 94.7 µs VBW 50 kHz Mode Auto FFT
1Pk Max
M1[1] 3.72 dBm
2.4799977500 GHz
Occ Bw 778.100684354 kHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
T1
T2
CF 2.48 GHz
32001 pts
Span 2.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.47999775 GHz 3.72 dBm
T1 1 2.479615262 GHz -21.72 dBm Occ Bw 778.100684354 kHz
T2 1 2.480393363 GHz -22.80 dBm
Measuring...
10.03.2022
16:18:05

3.4 Output Power Measurement

3.4.1 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.

3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.4.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.4.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05.
IRN 014 - RF power (W) - Method 6

Measurement is performed conducted

3.4.5 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	4.78
	18	2440	1 Mbps	4.15
	39	2480	1 Mbps	4.20
Bluetooth BR/EDR	1	2402	3-DH5	7.40
	19	2440	3-DH5	6.99
	79	2480	3-DH5	7.05
Uncertainty	±0.71 dB			

3.5 Power Spectral Density

3.5.1 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.

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.5.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.5.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05.
IRN 030 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band)

Test is only applicable to BLE

3.5.5 Test results of Power Spectral Density Measurement

Peak Power spectral density

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD (dBm/3 kHz)
Bluetooth Low Energy	1	2402	1 Mbps	-9.96
	18	2440	1 Mbps	-10.38
	39	2480	1 Mbps	-10.62
Bluetooth Low Energy	1	2402	2 Mbps	-12.70
	18	2440	2 Mbps	-13.19
	39	2480	2 Mbps	-13.54
Uncertainty	±2 dB			

3.6 Band edge Measurement

3.6.1 Limit

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

3.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.6.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.6.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05, sections 11.3 and 12.1. IRN 026 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.

Measurements are performed conducted

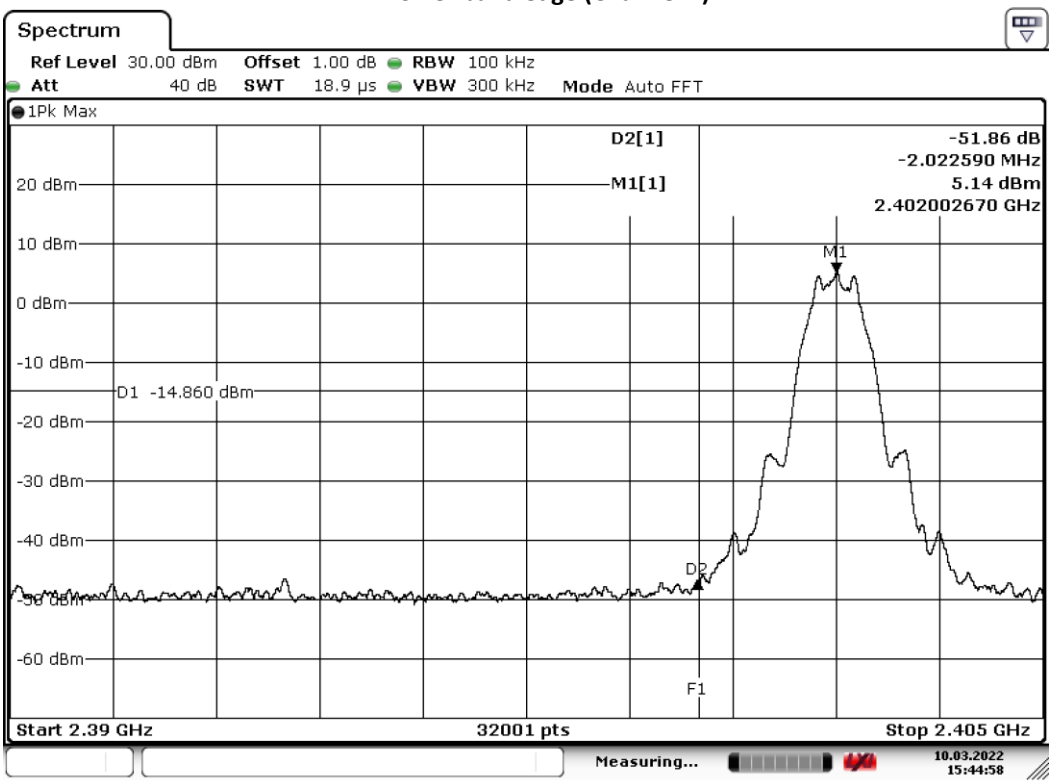
3.6.5 Measurement Uncertainty

± 5.7 dB.

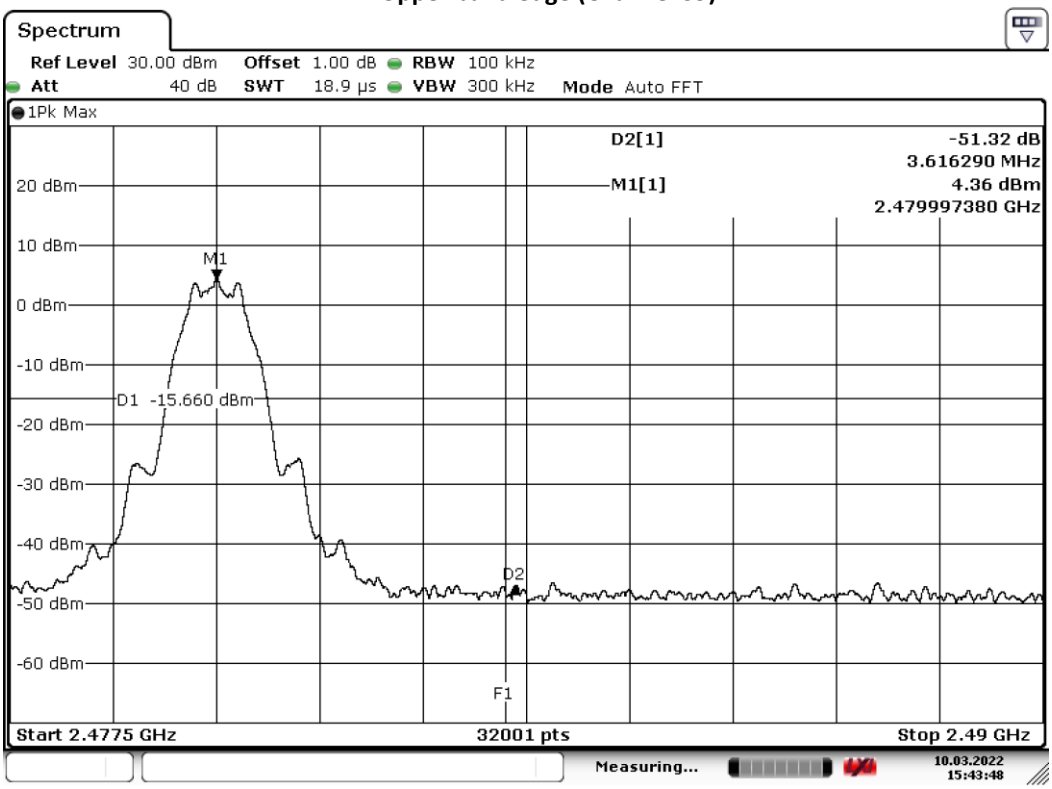
3.6.6 Plots of the Band edge Measurements

See next page

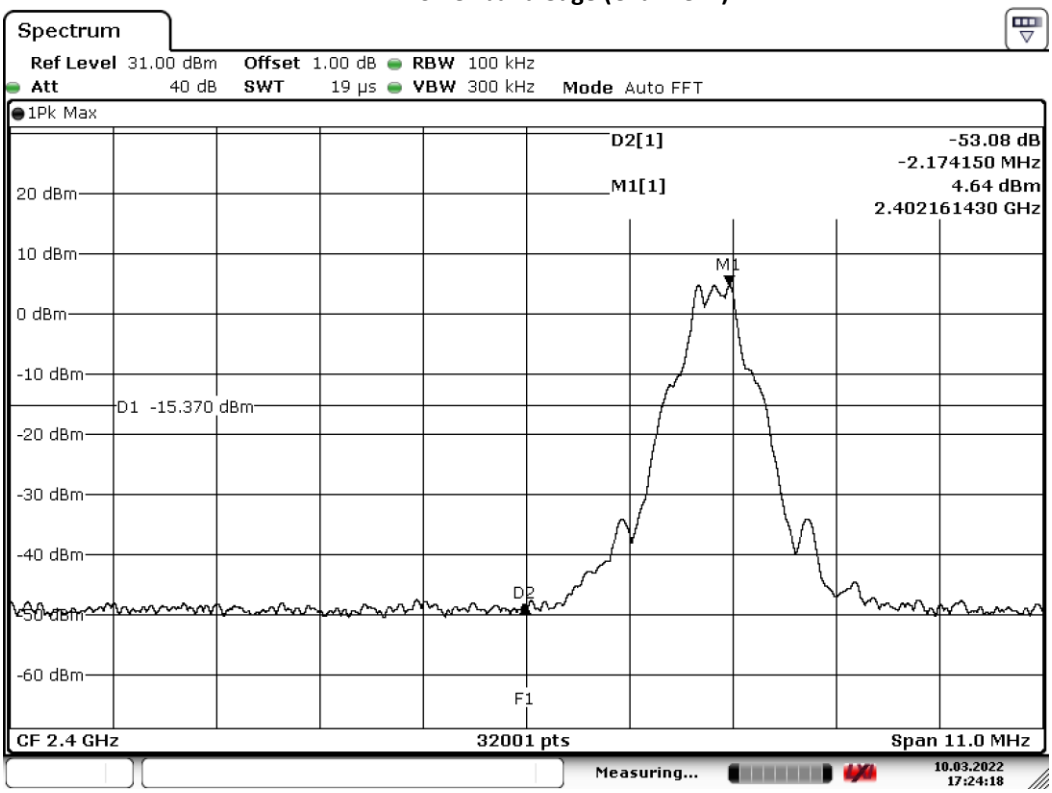
BLE Lower band edge (Channel 1)



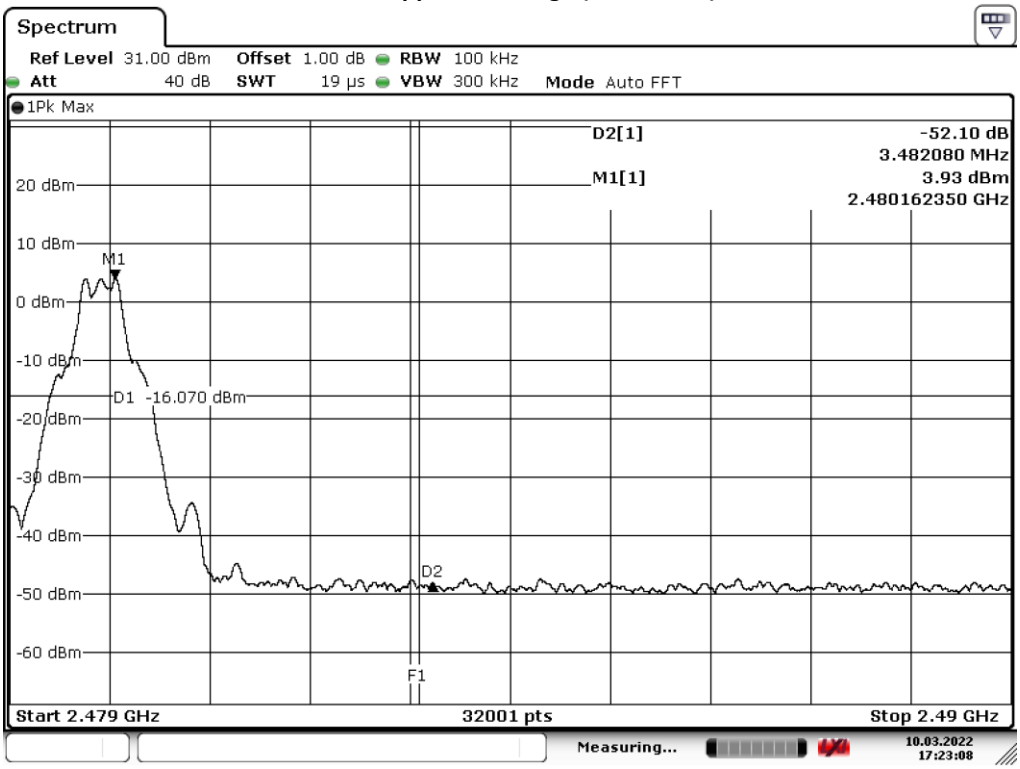
BLE Upper band edge (Channel 39)



BT EDR Lower band edge (Channel 1)



BT EDR upper band edge (channel 78)



3.7 Average time of occupancy

3.7.1 Limit

The average time of occupancy on any frequency shall not exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. 0.4 * 78 = 31.2 seconds
Limit: 0.4 seconds/31.2 seconds

3.7.2 Measurement instruments

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

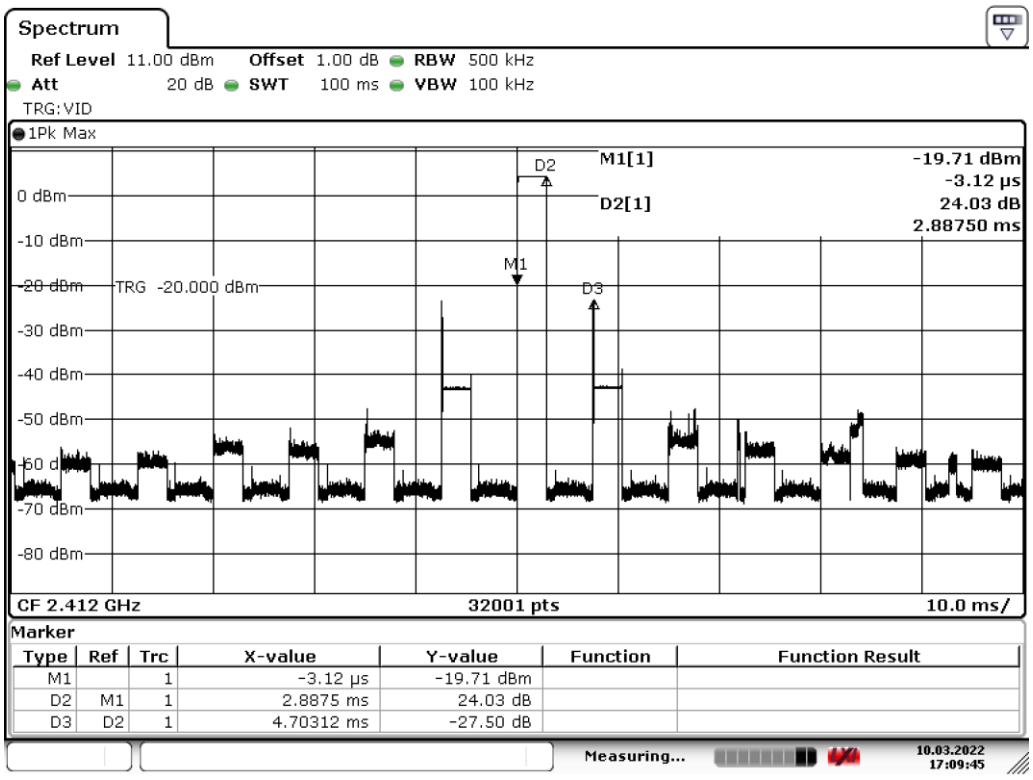
3.7.3 Test setup

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

3.7.4 Test procedure

According to ANSI C63.10: 2013 section 7.8
IRN 013 - Duty cycle (%) - Method 2

3.7.5 Plot of the average time of occupancy measurement.



The maximum occupancy time on a single frequency is 2.89 ms.
The off time between hops is 4.70 ms.
78 channels mean it takes (2.89+4.70)*78 = 592.08 ms to complete one hopping sequency through the operating frequency band.
31.2/0.59208 = 52.7 = 53 transmissions on the same frequency within a 31.2 second period
53 * 2.89 = 153.2 ms ≤ 400 ms
The EUT transmits a maximum of 153.2 ms on any one frequency within a 31.2 second period which is less than the maximum permitted 400 ms.

3.7.6 Measurement uncertainty

± 5.7%

3.8 Number of hopping channels

3.8.1 Limit

For frequency hopping systems operating in the 2400 – 2483.5 MHz band: The system shall use at least 15 channels.

3.8.2 Measurement instruments

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

3.8.3 Test setup

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

3.8.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05.
IRN 005 - Method 2

3.8.5 Results of the hopping channel verification

The EUT follows the standardized BT protocol which uses 79 channels.
79 ≥ 15

3.9 AC power line conducted emissions

3.9.1 Limit

According to 15.207 (c)

Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

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.

3.9.2 Measurement instruments

The measurement instruments are listed in chapter 2.3 of this report.

3.9.3 Test setup

The test setup is as shown in chapter 2.2 of this report.

3.9.4 Test procedure

According to ANSI C63.4: 2014, section 13.3
IRN 029 – Method 1

Note: Since the EUT is not sold with a dedicated AC/DC power adapter, AC power line conducted emissions have been measured on an adapter provided by the laboratory. The adapter is a Samsung, model EP-TA200.

3.9.5 Peak table of the AC power line emission measurement

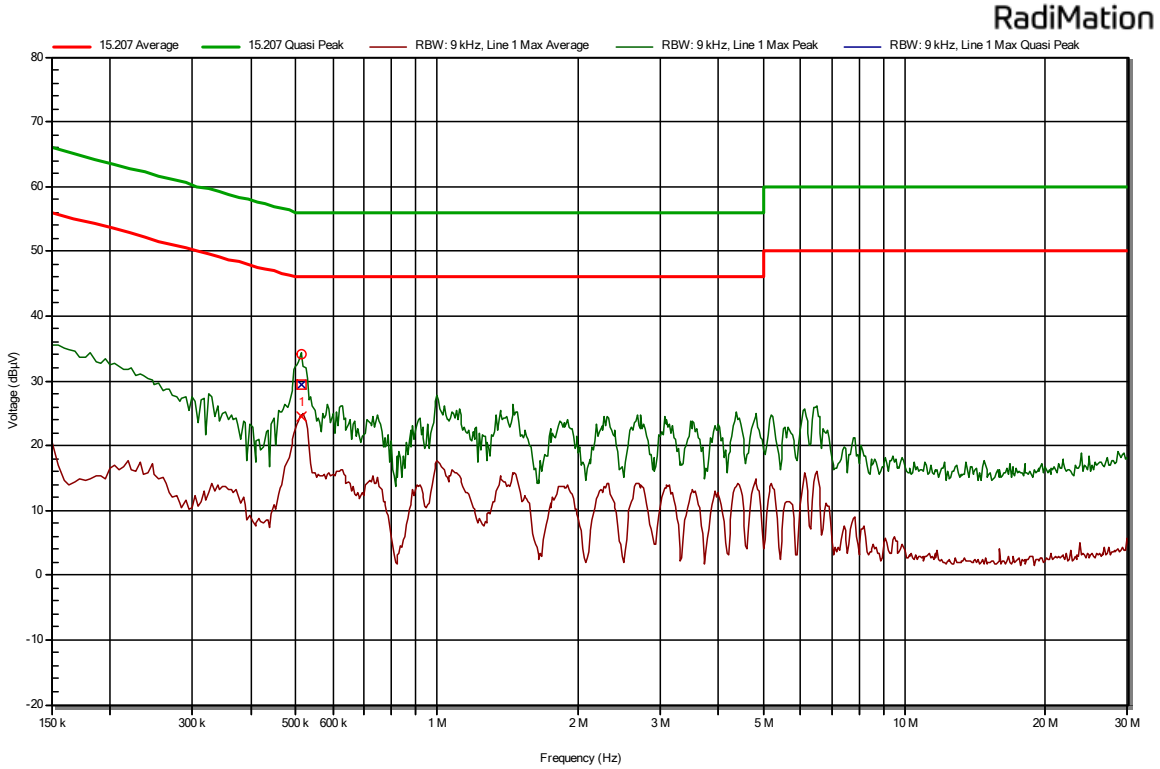
Frequency	Average	Average Limit	Quasi-Peak	Quasi-Peak Limit	Status	LISN
519 kHz	24,7 dBµV	46 dBµV	29,1 dBµV	56 dBµV	Pass	Neutral
514,05 kHz	24,4 dBµV	46 dBµV	29,4 dBµV	56 dBµV	Pass	Line 1

3.9.6 Measurement uncertainty

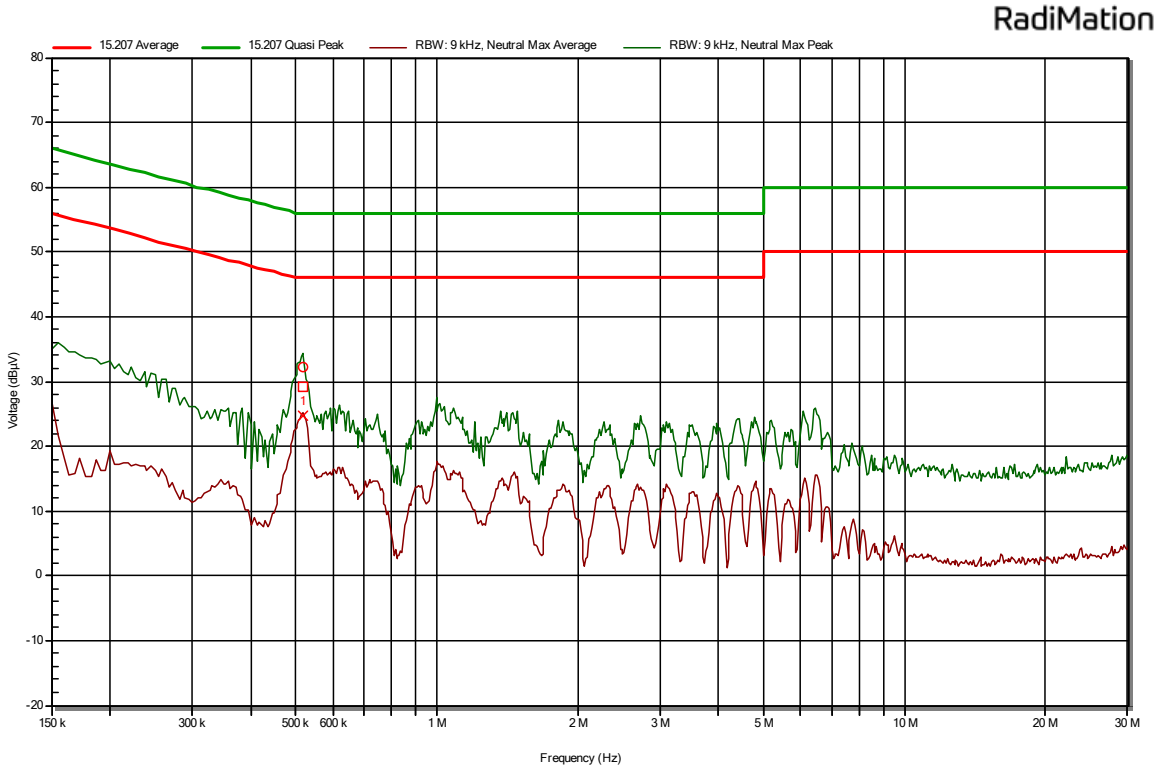
+/- 3.6 dB

3.9.7 Plots of the AC mains conducted spurious measurement

Phase



Neutral



4 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Conducted emission Measurement:

U_{lisn} (dBµV) = U (dBµV) + Corr. (dB)

Where:
U = Measuring receiver voltage
LISN insertion loss = Voltage division factor of LISN
Corr. = sum of single correction factors of used LISN, cables and pulse limiter.
Linear interpolation will be used for frequencies in between the values in the table.

Frequency (MHz)	**Voltage division LISN (db)**	**Cable loss (dB)**	**Corr. (dB)**
	114379 Rohde & Schwarz ENV216	**TE 11134**	
0,15	9.6	0,02	9.62
0,3	9.6	0,03	9.63
0,5	9.6	0,08	9.68
0,7	9.7	0,25	9.95
1	9.6	0,11	9.71
3	9.6	0,21	9.81
5	9.6	0,21	9.81
7	9.7	0,25	9.95
10	9.7	0,29	9.99
15	9.7	0,34	10.04
20	9.8	0,37	10.17
22	9.6	0,39	9.99
24	9.6	0,43	10.03
30	9.6	0,45	10.05

Magnetic field strength measurement:

$$H\left[dB\left(\mu\frac{A}{m}\right)\right] = V[dB(\mu V)] + L_c[dB] + AF^H[\frac{dB}{\Omega m}]$$

Where:
H is the magnetic field strength (to be compared to the limit)
V is the voltage level measured by the receiver or spectrum analyzer
L_C is the cable loss
AF^H is the magnetic antenna factor

Frequency (MHz)	AF (dB/Ωm) 114515 EMCO 6505 S/N:9112-2710	CL (dB) SAR cable	Corr. (dB)
0,009	-32,35	0,7	-31,65
0,01	-33,16	0,05	-33,11
0,02	-37,56	0,07	-37,49
0,03	-39,29	0,1	-39,19
0,04	-40,11	0,1	-40,01
0,1	-41,27	0,1	-41,17
0,2	-41,48	0,1	-41,38
0,5	-41,58	0,1	-41,48
1	-41,62	0,2	-41,42
3	-41,6	0,2	-41,4
5	-41,65	0,3	-41,35
10	-42,11	0,6	-41,51
15	-42,88	0,9	-41,98
20	-43,78	1	-42,78
25	-44,85	0,7	-44,15
27	-45,36	1,2	-44,16
30	-46,25	1	-45,25

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + Corr. (dB)

Where:
E = Electric field strength
U = Measuring receiver voltage
AF = Antenna factor
CL = Cable loss

Corr. = sum of single correction factors of used cable and amplifier (if applicable).
Linear interpolation will be used for frequencies in between the values in the table.
Tables shows an extract of the values.

Frequency (Mhz)	**AF (dB/m)**	**Cable loss (dB)**	**Corr. (dB)**
	Id: 114436 Schwarzbeck VHA9103+BBA9106 SN: 9856	**Id: SAR cable**	
30	18,64	0,68	19,32
100	10,43	1,15	11,58
150	14,76	1,41	16,17
200	16,04	1,63	17,67
250	16,89	1,93	18,82

Frequency (Mhz)	**AF (dB/m)**	**Cable loss (dB)**	**Corr. (dB)**
	Id: 114385 EMCO 3147 SN: 9104-1031	**Id: SAR cable**	
250	11,8	1,93	13,73
300	13	2,12	15,12
350	14,2	2,2	16,4
400	15,6	2,29	17,89
450	17,1	2,53	19,63
500	17,3	2,67	19,97
550	17,7	2,9	20,6
600	18,4	3,02	21,42
650	19,2	3,09	22,29
700	19,7	3,22	22,92
750	20,3	3,56	23,86
800	21,4	3,69	25,09
900	22,1	3,81	25,91
950	22,6	3,91	26,51
1000	22,5	4,3	26,8

Frequency (Mhz)	AF (dB/m) TE 00531 Emco 3115 SN: 9412-4377	Gain (dB) TE 11132 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) TE 01315	Corr. (dB)
1000	23,6	40,4	2,0	66
1500	25,1	40,5	2,4	68
2000	27,1	40,5	2,7	70,3
2500	28,6	40,7	3,2	72,5
3000	30,5	40,7	3,2	74,4
3500	31,2	40,7	3,4	75,3
4000	32,7	40,9	4,9	78,5
4500	32,4	40,9	4,4	77,7
5000	33,2	40,7	4,6	78,5
5500	34,0	40,5	4,5	79
6000	34,6	40,0	5,2	79,8
6500	34,3	39,4	5,9	79,6
7000	35,2	38,6	5,7	79,5
7500	36,4	39,2	5,9	81,5
8000	37,0	38,9	6,3	82,2
8500	37,5	38,4	6,4	82,3
9000	38,1	37,4	6,5	82
9500	37,8	37,0	7,1	81,9
10000	38,2	36,5	7,3	82
10500	38,1	36,7	7,6	82,4
11000	38,3	36,9	8,3	83,5
11500	38,5	37,6	8,1	84,2
12000	39,1	38,3	8,4	85,8
12500	38,7	38,5	8,3	85,5
13000	39,2	38,9	9,2	87,3
13500	40,5	40,2	8,3	89
14000	41,1	40,0	8,2	89,3
14500	41,4	40,1	8,2	89,7
15000	40,2	41,4	8,3	89,9
15500	37,9	41,4	8,6	87,9
16000	37,5	42,8	9,2	89,5
16500	38,6	42,3	8,8	89,7
17000	41,1	43,1	9,4	93,6
17500	42,7	43,2	9,4	95,3
18000	44,0	44,2	9,8	98

Frequency (Mhz)	AF (dB/m) TE 00818 Flann 20240-25 SN: 163703	Gain (dB) TE 11131 Miteq JS4-18004000-30-8P-A1	Cable loss (dB) TE 01315	Corr. (dB)
18000	31,3	26,2	9,8	67,3
19000	31,5	26,1	9,6	67,2
20000	31,7	25,9	11	68,6
21000	31,9	24,3	10,7	66,9
22000	32,1	18,3	10,5	60,9
23000	32,2	18,9	10,8	61,9
24000	32,3	23,6	11,4	67,3
25000	32,4	24,5	11,6	68,5
26000	32,5	25,3	11,7	69,5

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