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FCC and IC Test report for parts 15.209, 15.247, RSS-247, RSS-Gen

Product name	: Dräger Bluetooth module 17x10
Applicant	: Dräger Safety AG & Co. KGaA
FCC ID	: X6O-BT02
IC	: 5895F-BT02

Test report No. : 210500464 004 Ver 3.00

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).

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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

Revision History

Version	Date	Remarks	By
v0.50	12-08-2021	First draft	R.T
v1.00	27-09-2021	Final version	R.T
v2.00	14-01-2022	Revised FCC+IC	R.T
v3.00	20-04-2022	Revised Updated emissions designator in clause 1.4 Added calibration data in clause 2.3 Changed procedure in clause 3.1.4	R.T

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
15.247 (b)	RSS-247 5.4 (d)	RF output power	3.2	Pass

1 General Description

1.1 Applicant

Client name:	Dräger Safety AG & Co. KGaA
Address	Revalstr. 1 23560 Lübeck Germany
Telephone:	+49 (0)4501 882 1623
E-mail:	Lutz.rueffert@draeger.com
Contact name:	Lutz Rüffert

1.2 Manufacturer

Manufacturer name:	Dräger Safety AG & Co. KGaA
Address:	Revalstr. 1 23560 Lübeck Germany
Telephone:	+49 (0)4501 882 1623
E-mail:	Lutz.rueffert@draeger.com
Contact name:	Lutz Rüffert

1.3 Tested Equipment Under Test (EUT)

Product name:	Dräger Bluetooth module 17x10
Brand name:	Dräger Safety
FCC ID:	X6O-BT02
IC :	5895F-BT02
Model(s):	BT02
Software version:	Zephyr OS 2.2,1
Hardware version:	3709318-03
Date of receipt	09-08-2021
Tests started:	10-08-2021
Testing ended:	11-08-2021

1.4 Product specifications of Equipment under test

Tx Frequency:	BLE: 2400 – 2483.5 MHz
Rx frequency:	BLE: 2400 – 2483.5 MHz
Antenna type/ gain	Chip antenna / -2dBi
Type of modulation:	BLE: GFSK
Emission designator	12K5F1D (125Kbps) 2M00F1D (2Mbps)

Note: The antenna gain is declared by the manufacturer

1.5 Environmental conditions

Test date	10-08-2021
Ambient temperature	21.1°C
Humidity	58 %

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 §15.209
- FCC Part 15 Subpart C §15.247
- RSS-Gen Issue 5
- RSS-247 Issue 2

1.8 Observation and remarks

Only radiated testing will be performed due to the modification from BT 01 to BT 02 having no effect on the conducted radio measurements. The radio conducted measurements can be found in the 201100701 004 Ver 1.00.

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 : Raoul Tolud under supervision of Roy van Barneveld, BASc

Review of test methods and report by:

Name : P. van Wanrooij, BASc

The above conclusions have been verified by the following signatory:

Date : 21-04-2022

Name : Koray Korcum, MSc

Function : Test Engineer

Signature :

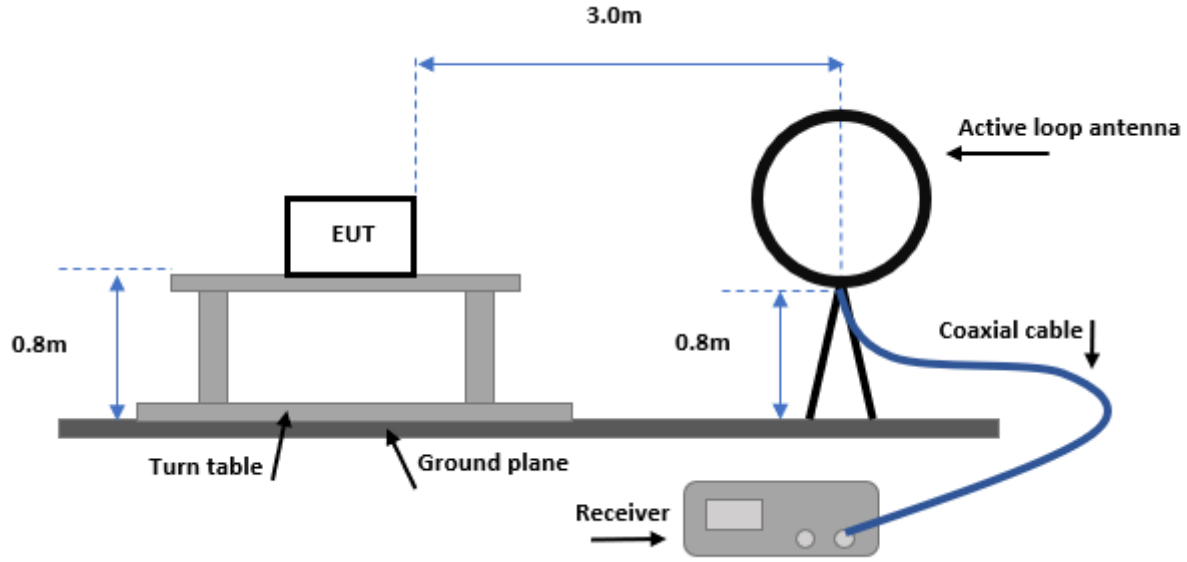
2 Test configuration of the Equipment Under Test

2.1 Test mode

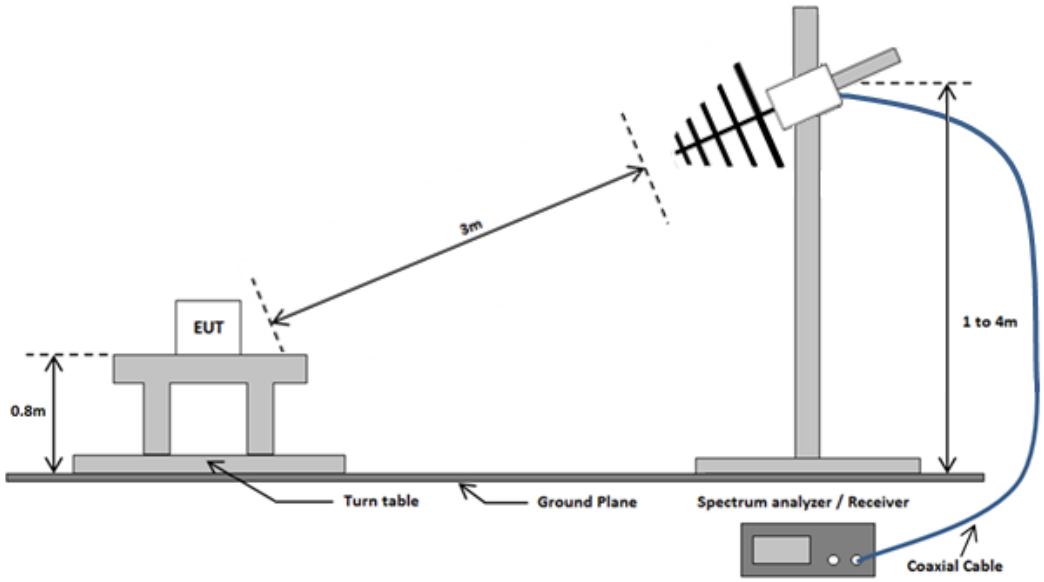
The applicant provided test mode firmware for the BLE radio, in which it was possible to configure the radio to transmit continuously.

2.2 Test setups

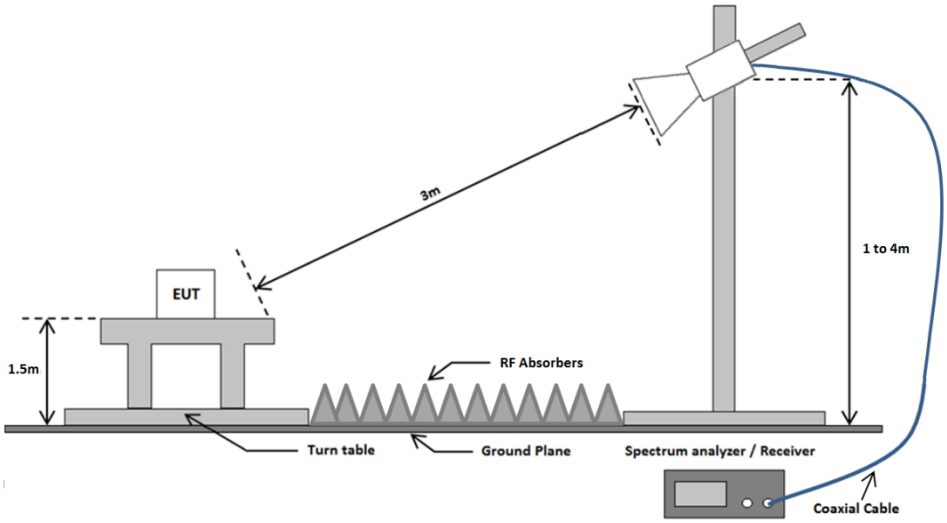
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.	Cal date	Due date
EMI Receiver	Rohde & Schwarz	ESR7	TE01220	3.1	Feb 2022	Feb 2023
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1/3.2	Mar 2020	Mar 2022
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	TE01140	3.1	Sep 2021	Sep 2024
Active loop antenna	EMCO	6502	TE11171	3.1	Jan 2022	Jan 2024
Biconilog antenna	Chase	CBL6112A	TE00967	3.1	Mar 2021	Mar 2023
Horn antenna	EMCO	3115	TE00531	3.1	N.A*	N.A*
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	TE11175	3.1	Jan 2022	Feb 2022
Preamplifier 18-26 GHz	Miteq	JS4-18004000-33-8P	TE 11131	3.1	Jan 2022	Feb 2022
Test software	Raditeq	Radimation 2020.2.8	--	3.1	-	-

*Standard gain horn does not need to get calibrated.

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: Limit lines in the plots 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

9 kHz – 30 MHz: According to ANSI C63.10-2013, section 5.4.2 and 8.2.3
30 MHz to 26.5 GHz: According to ANSI C63.10-2013, section 8.3

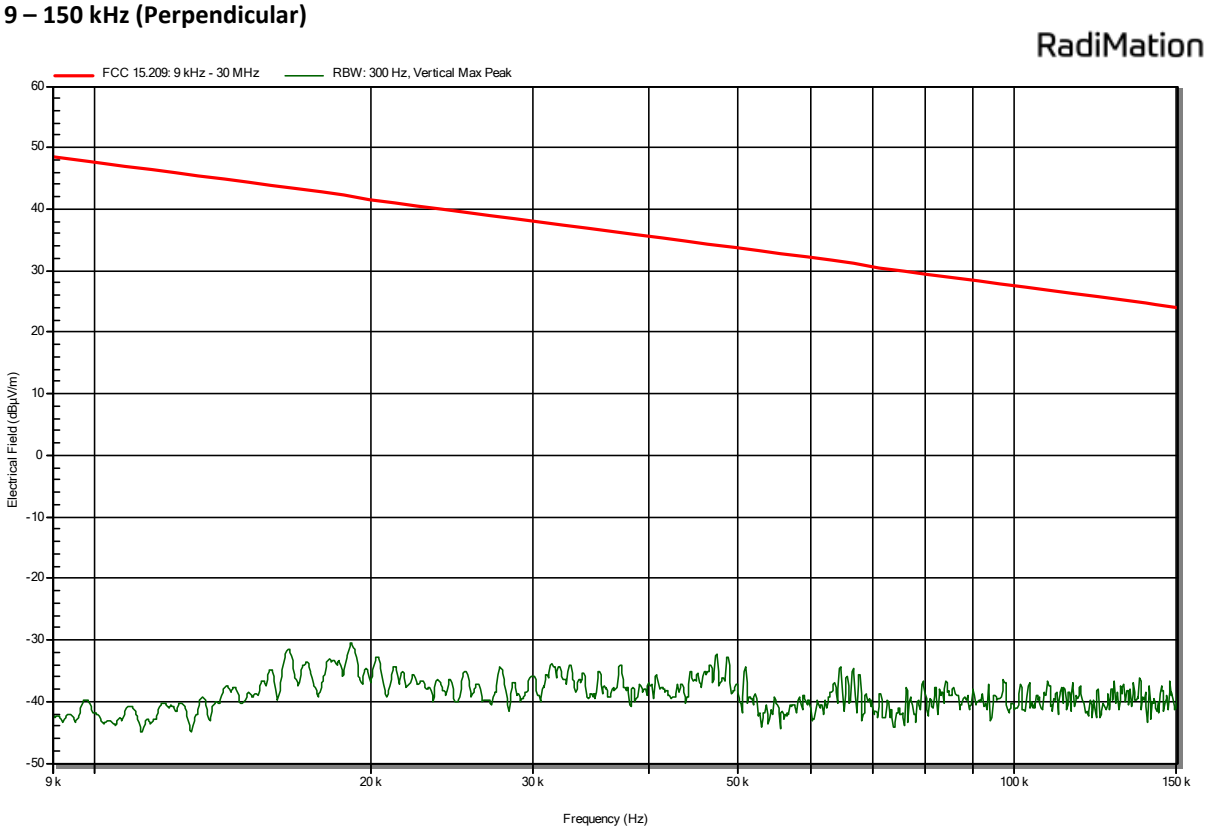
9 kHz to 30 MHz: IRN 026 – Method 10
30 MHz to 1 GHz: IRN 026 – Method 1
1 GHz to 18 GHz: IRN 026 – Method 2
18 to 26.5 GHz: IRN 026 – Method 3

3.1.5 Measurement Uncertainty

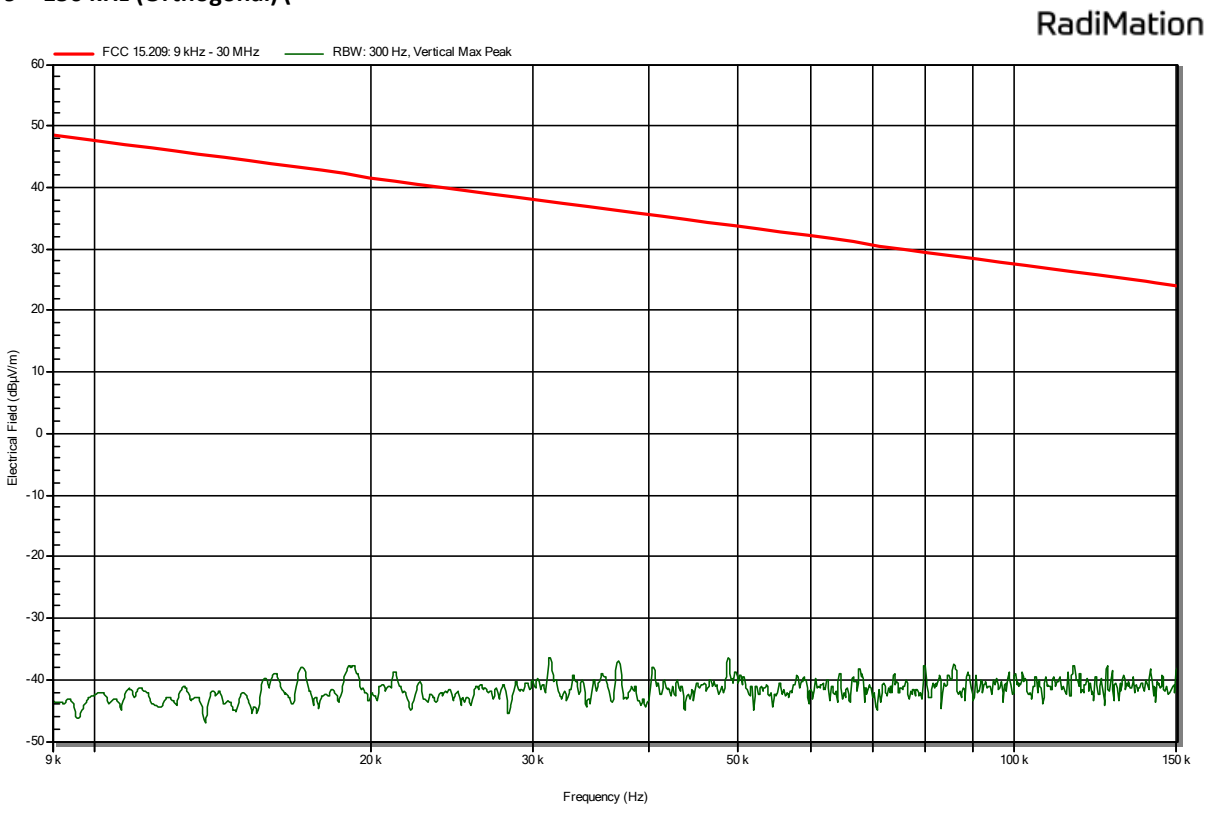
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB
18 – 26.5 GHz	Horizontal	±4.9 dB
	Vertical	±4.9 dB

3.1.6 Plots of the Radiated Spurious Emissions Measurement

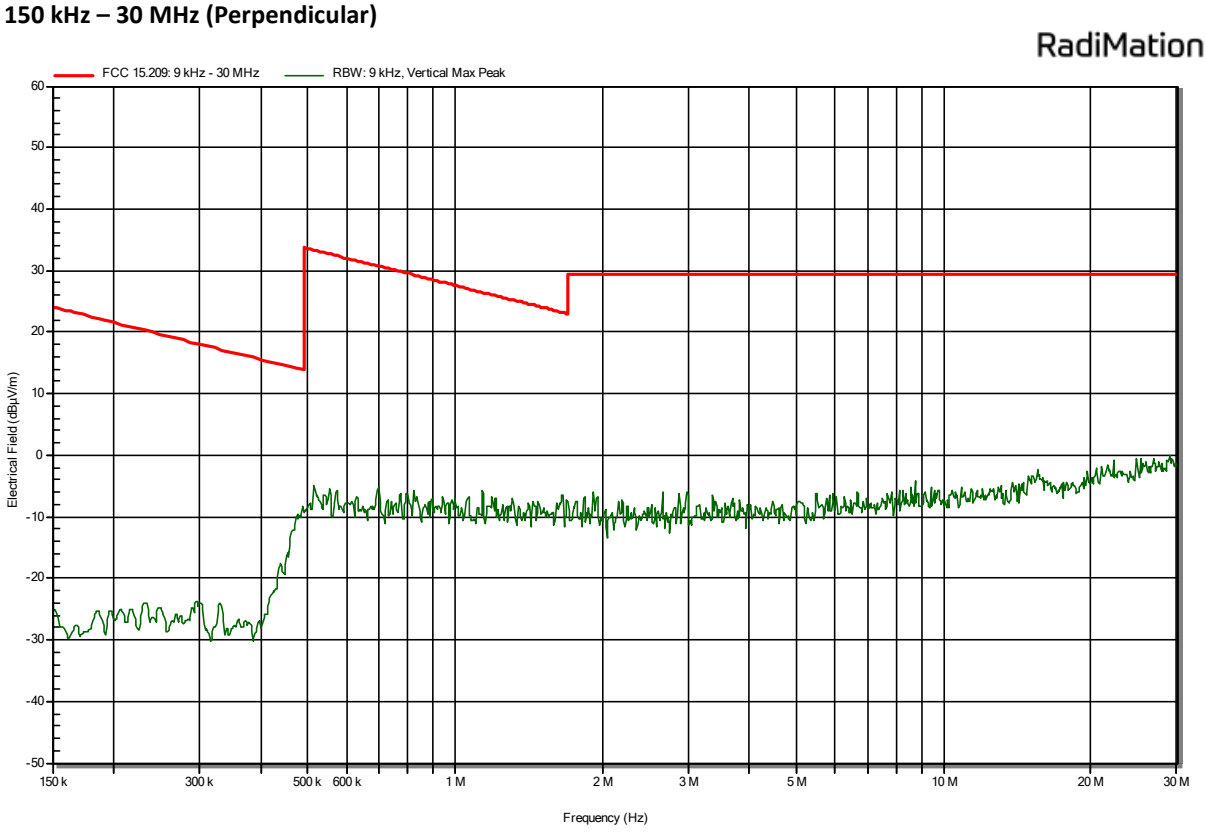
9 – 150 kHz (Perpendicular)



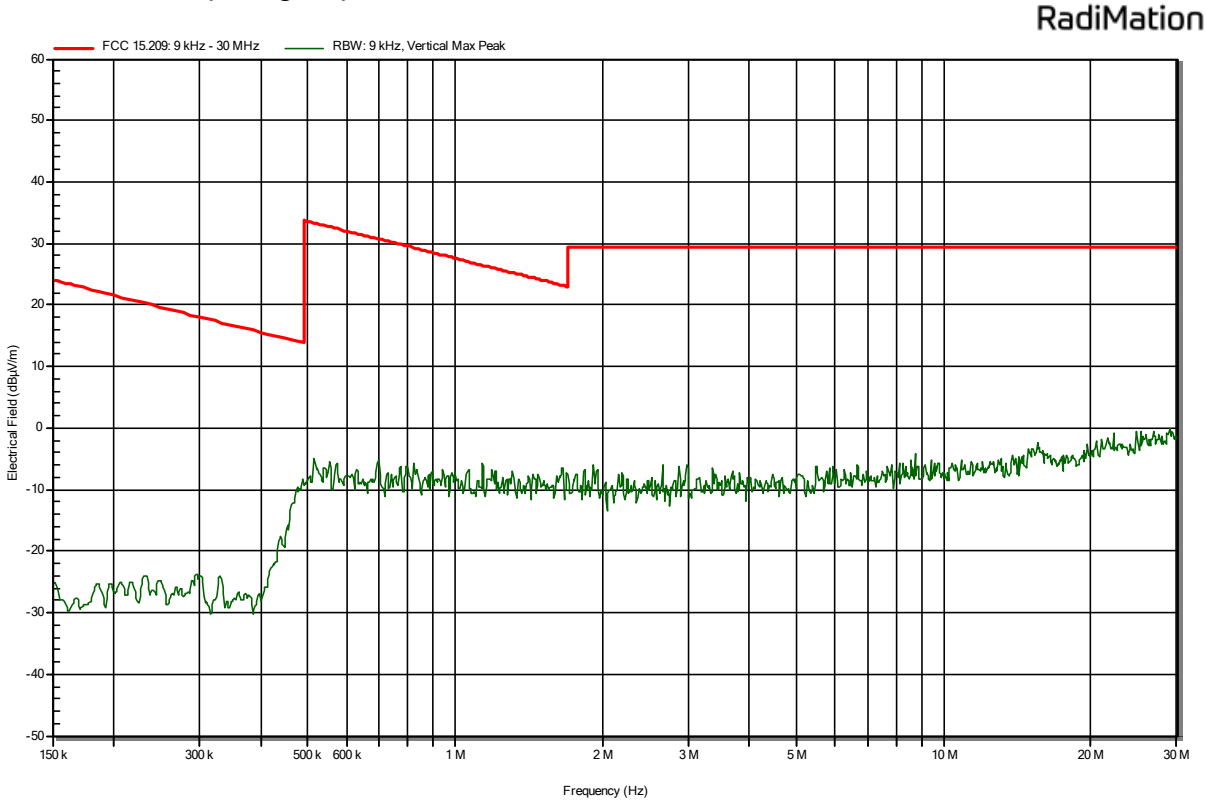
9 – 150 kHz (Orthogonal)



150 kHz – 30 MHz (Perpendicular)

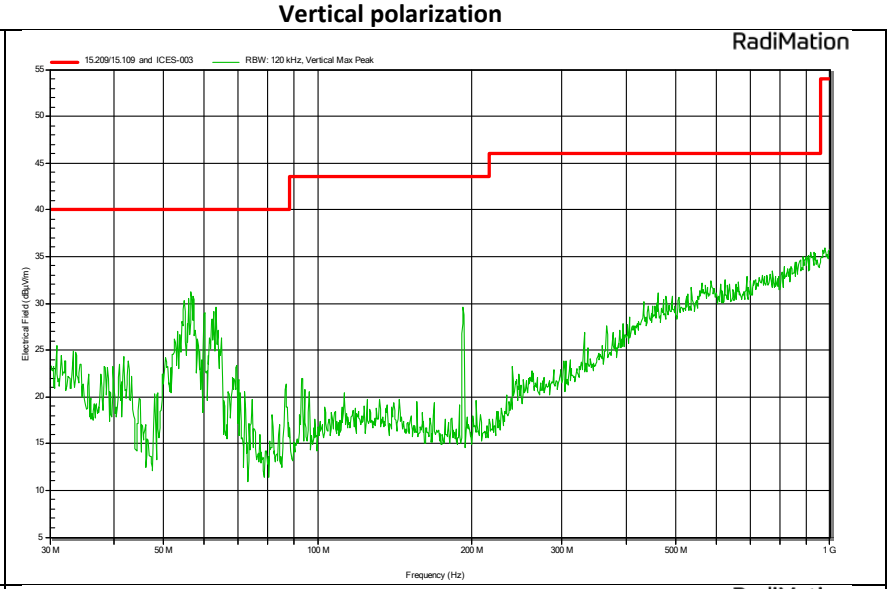
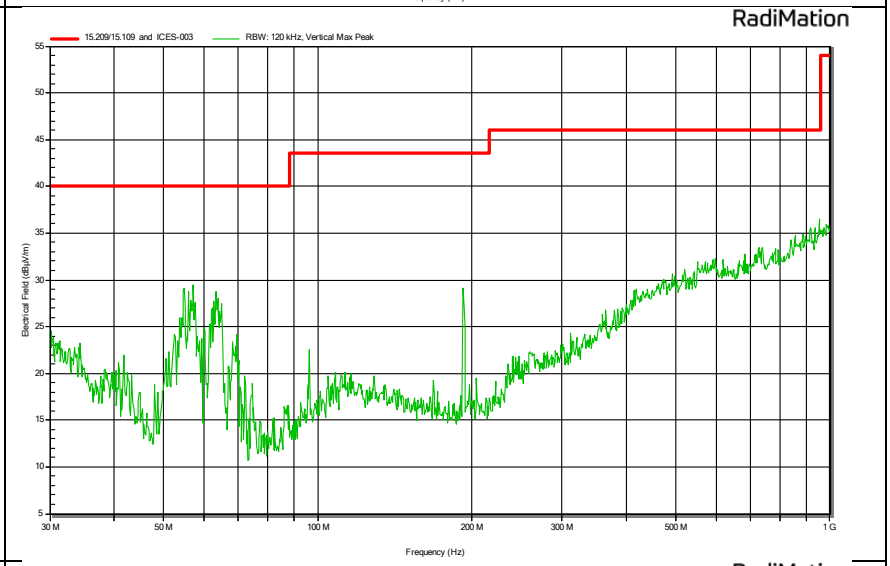
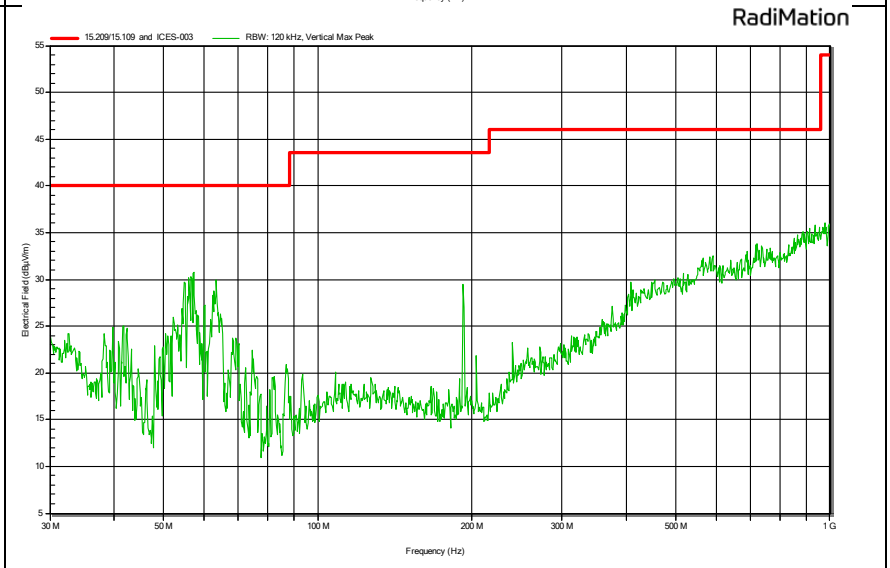


150 kHz – 30 MHz (Orthogonal)



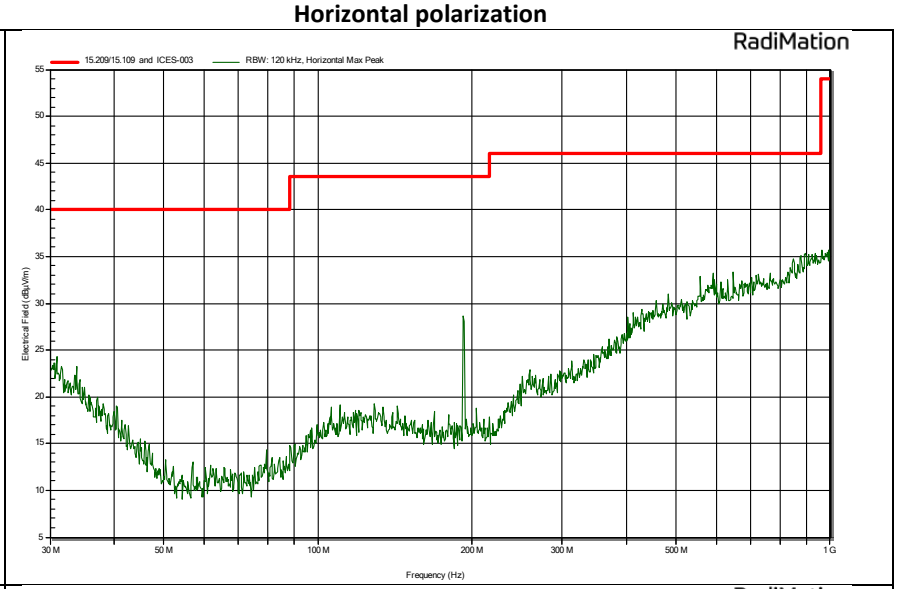
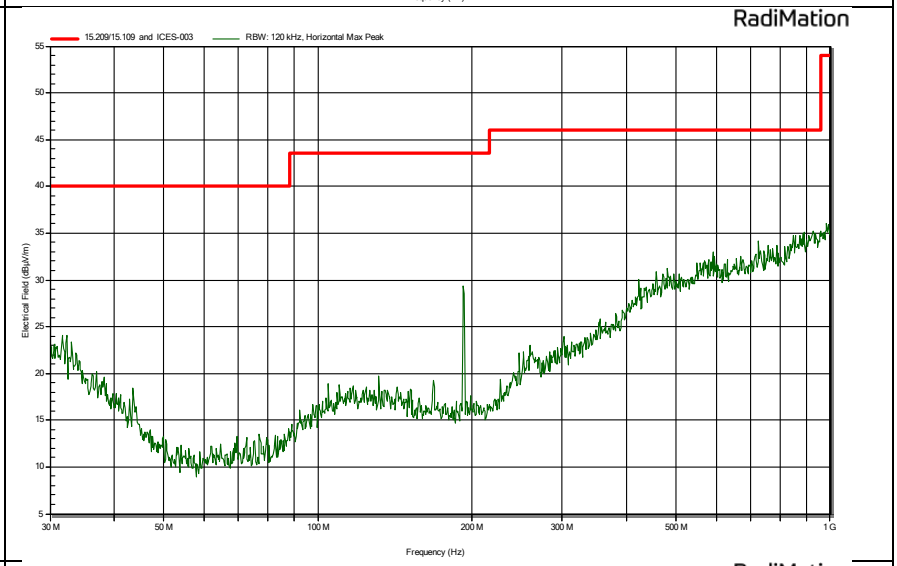
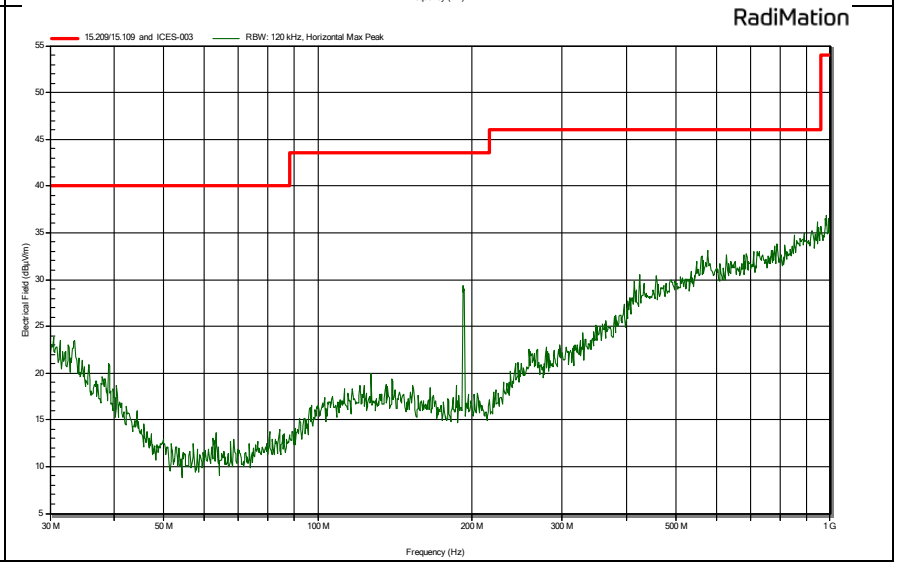
30 -1000 MHz

Vertical polarization

Low ch	
Mid ch	
High ch	

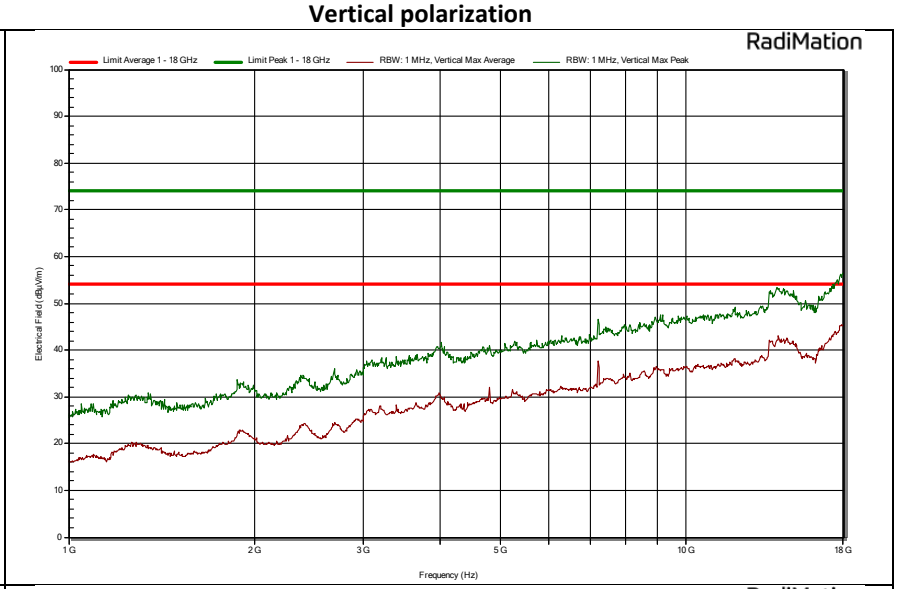
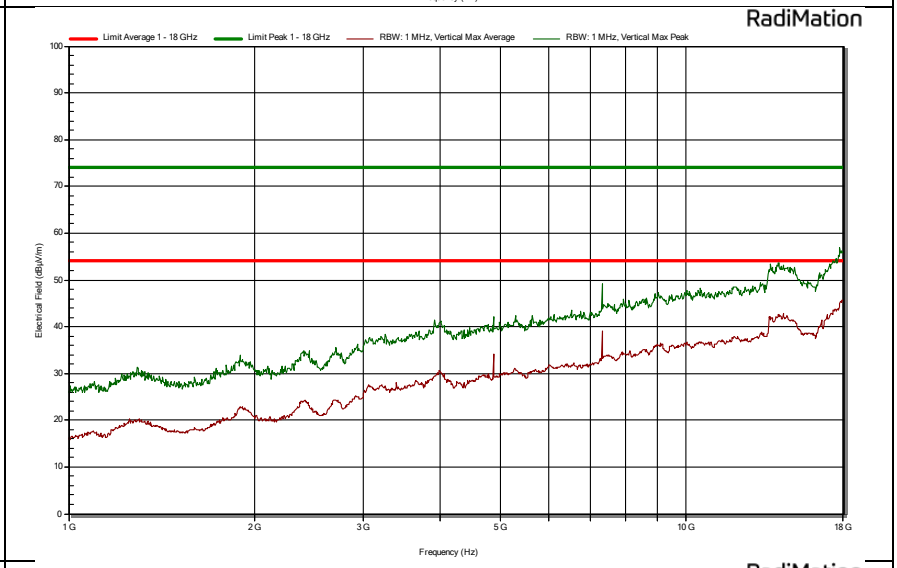
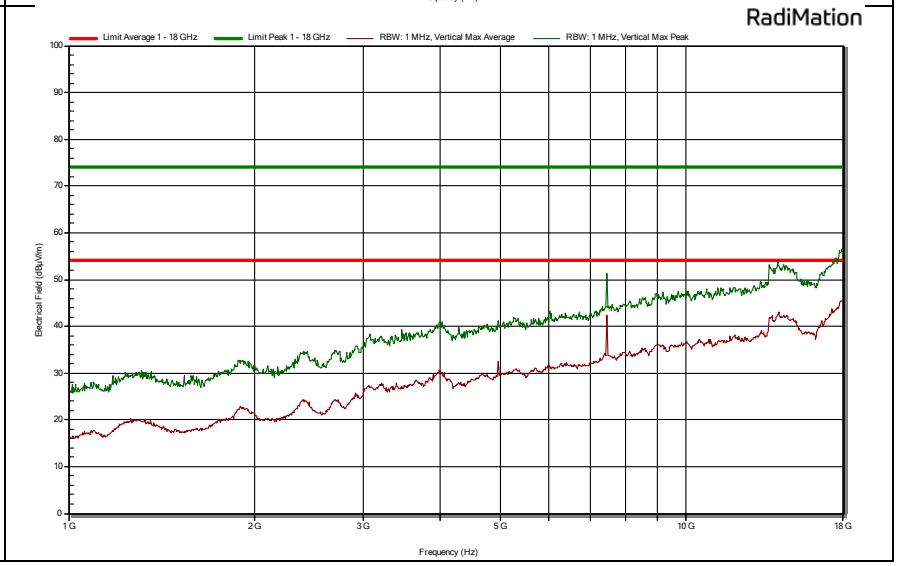
30 MHz to 1 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

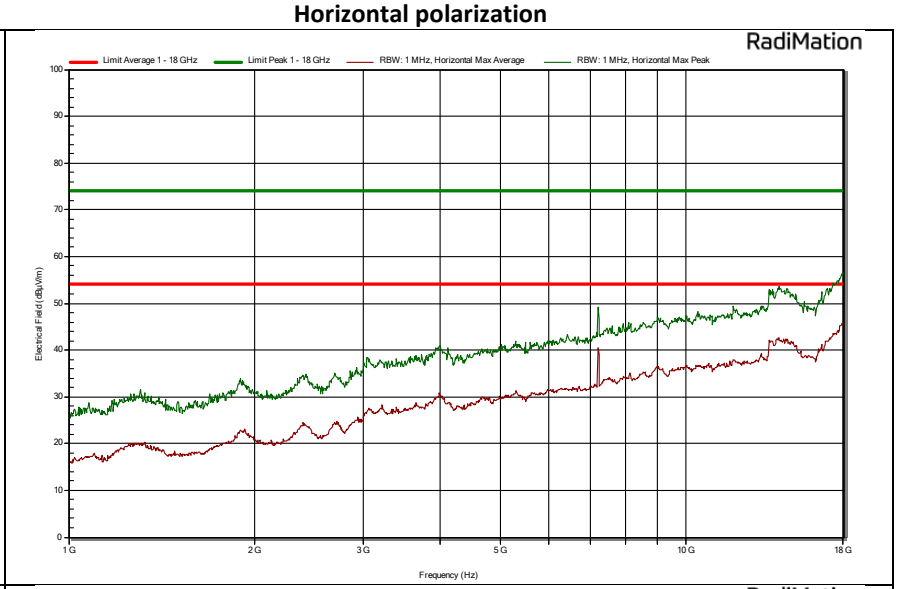
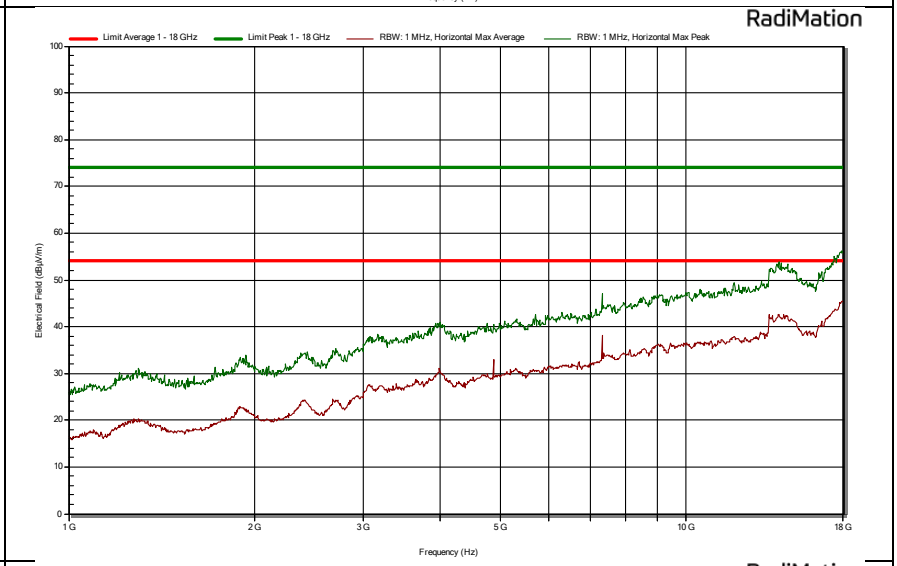
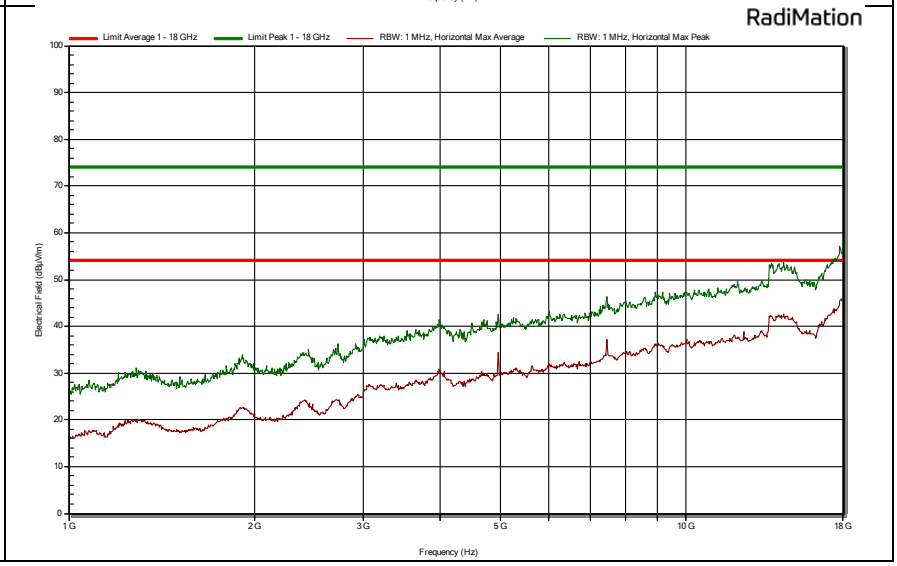
1 GHz to 18 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

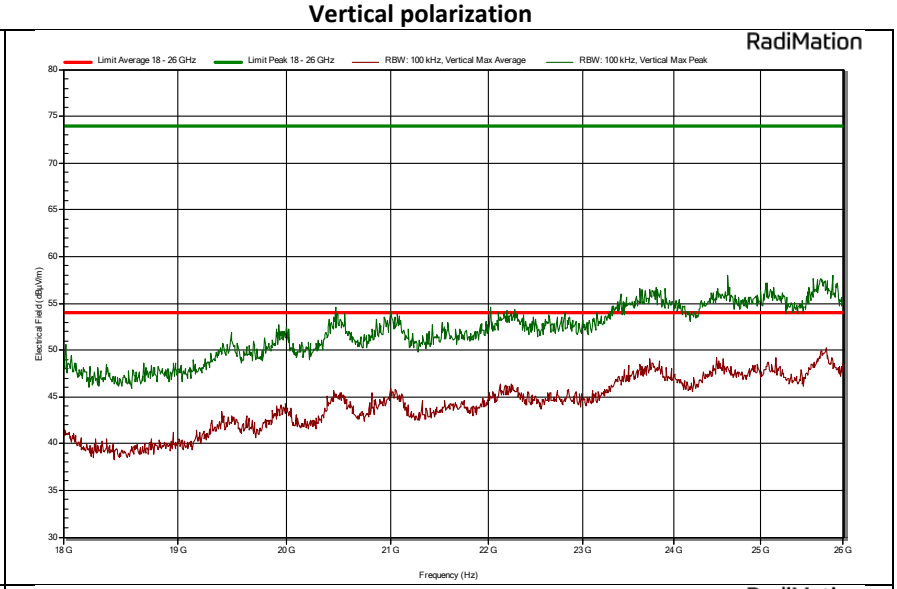
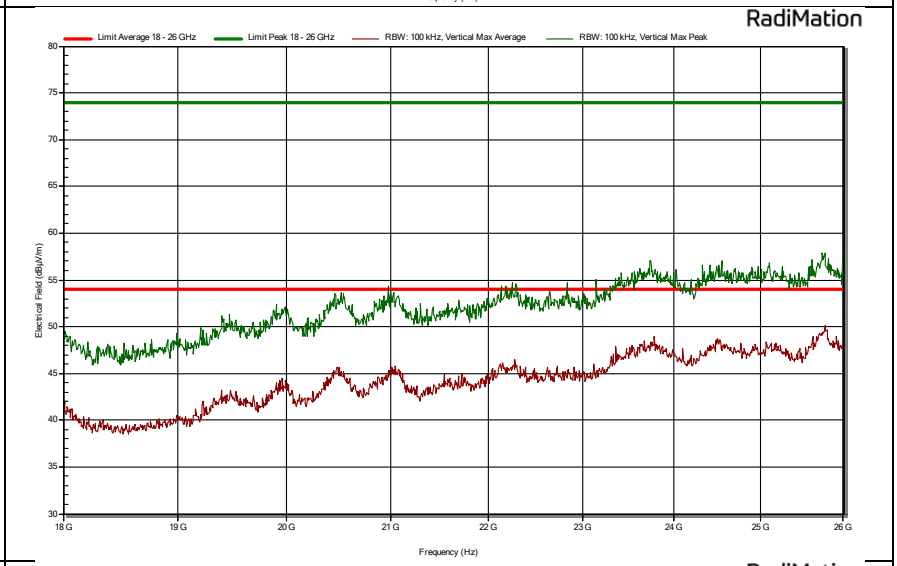
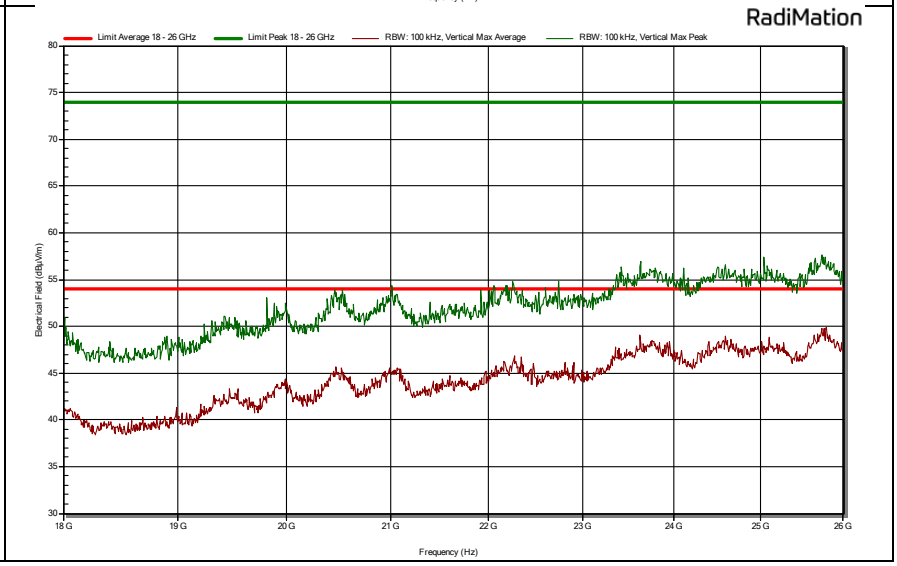
1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

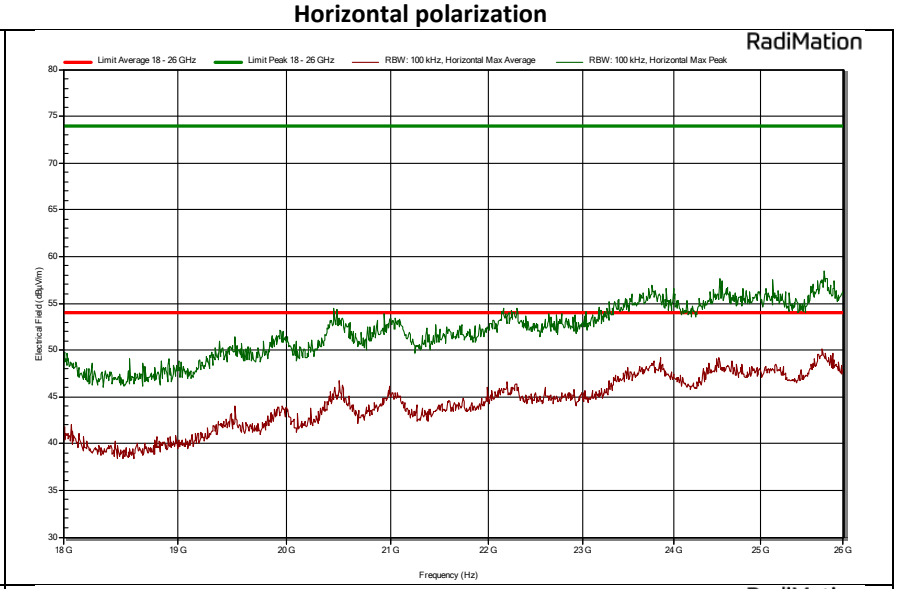
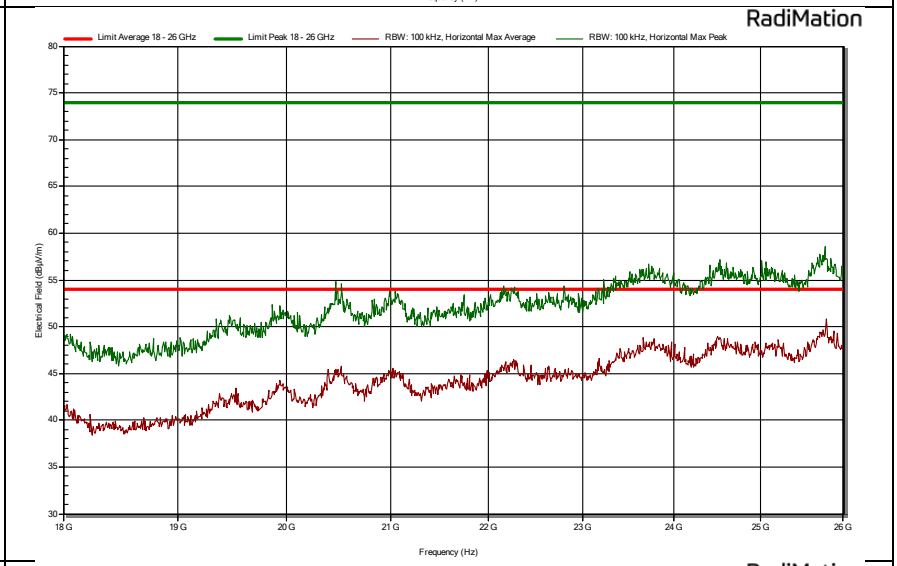
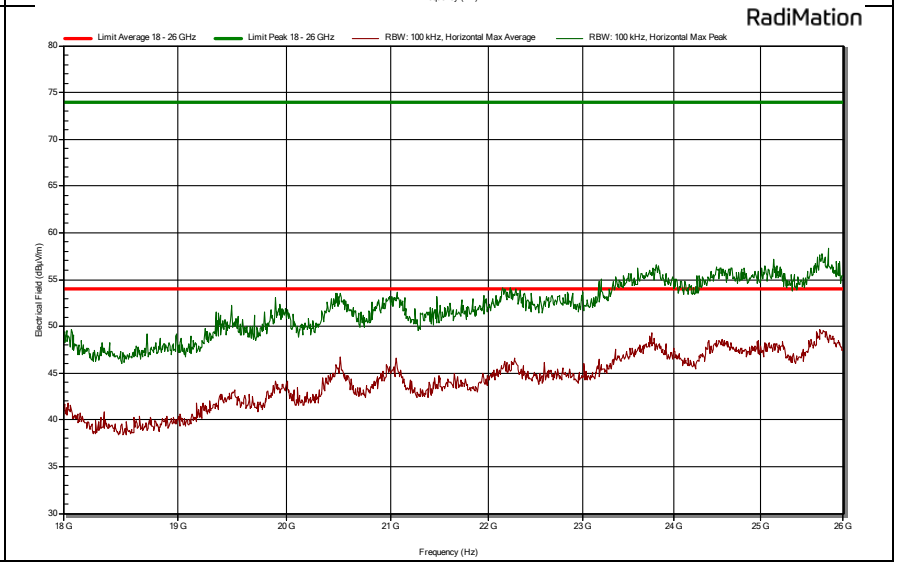
18 GHz to 26 GHz

Vertical polarization

Low ch	
Mid ch	
High ch	

18 GHz to 26 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

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 2.3 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

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05.

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

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	37	2402	2 Mbps	6.77
	19	2440	2 Mbps	6.59
	39	2480	2 Mbps	6.44
Uncertainty	±0.9 dB			

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy	37	2402	125 Kbps	6.76
	19	2440	125 Kbps	6.56
	39	2480	125 Kbps	6.52
Uncertainty	±0.9 dB			

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)**	**Insertion Loss Pulse limiter (dB)**	**Cable loss (dB)**	**Corr. (dB)**
	TE 00208 SN: 892785/004 Rohde & Schwarz ESH3-Z5	**TE 00756 SN: 5SM03153 Rohde & Schwarz ESH3-Z2**	**TE 11134**	
0,15	0,09	9,87	0,02	9,98
0,2	0,1	9,87	0,03	10
0,3	0,1	9,87	0,03	10
0,5	0,1	9,87	0,08	10,05
0,7	0,12	9,87	0,25	10,24
0,8	0,12	9,87	0,25	10,24
1	0,13	9,87	0,11	10,11
2	0,16	9,87	0,15	10,18
3	0,19	9,87	0,21	10,27
5	0,26	9,88	0,21	10,35
7	0,36	9,89	0,25	10,5
8	0,39	9,89	0,25	10,53
10	0,46	9,91	0,29	10,66
15	0,77	9,93	0,34	11,04
20	0,95	9,96	0,37	11,28
25	1,12	9,99	0,43	11,54
30	1,1	10,04	0,45	11,59

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)** **TE 00967** **Chase CBL6112A** **SN: 2308**	**Cable loss (dB)** **Id: SAR cable**	**Corr. (dB)**
30	18,6	0,68	19,28
100	10,7	1,15	11,85
150	10,6	1,41	12,01
200	9,3	1,63	10,93
250	12,6	1,93	14,53
300	13,3	2,12	15,42
350	14,6	2,2	16,8
400	15,5	2,29	17,79
450	16,9	2,53	19,43
500	17,5	2,67	20,17
550	18,4	2,9	21,3
600	18,8	3,02	21,82
650	19,2	3,09	22,29
700	19	3,22	22,22
750	19,8	3,56	23,36
800	19,7	3,69	23,39
900	20,4	3,81	24,21
950	20,8	3,91	24,71
1000	21,2	4,3	25,5

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 00531 Emco 3115 SN: 9412-4377	Gain (dB) TE 11132 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