FCC and IC Test report for parts

22.917, 24.238,27.53

RSS-130, RSS-132, RSS-133 RSS-139,

(Transmitter spurious emissions only)

The RvA is signatory to ILAC - MRA

Product name	: TCU V5.5
Applicant	: The Goodyear Tire & Rubber Company
FCC ID	: 2BEXS-TPH55M
IC ID	: 32033-TPH55M

Test report No. : P000334442 011 Ver 1.0

Laboratory information

Accreditation

Kiwa Nederland B.V. 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 L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Kiwa Nederland B.V. 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.

Kiwa Nederland B.V. 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 Kiwa Nederland B.V. is: 4173A. The CABID is NL0001.

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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 Kiwa Nederland B.V.

Testing Location

Test Site	Kiwa Nederland B.V.
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
v0.50	25-10-2024	First draft	MHK
v1.00	11-12-2024	Initial release	MHK

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
22.359 24.238 27.53	RSS-130 RSS-132 RSS-133 RSS-139	Radiated spurious emissions	3.1	Pass

1 General Description

1.1 Applicant

Client name:	The Goodyear Tire & Rubber Company
Address:	200 Innovation Way, OH 44316 Akron, USA
Telephone:	00352691964033
E-mail:	chris_helsel@goodyear.com
Contact name:	Christopher P. Helsel

1.2 Manufacturer

Manufacturer name:	IOSiX, LLC
Address:	1161 Oak Valley Dr, MI 48108 Ann Arbor, USA
Telephone:	0014158002060
E-mail:	info@iosix.com
Contact name:	Robert Vogt

1.3 Tested Equipment Under Test (EUT)

Product name:	TCU V5.5
Brand name:	Goodyear
FCC ID:	2BEXS-TPH55M
IC:	32033-TPH55M
Product description:	IoT gateway for vehicle and tire remote monitoring
Variant model(s):	--
Batch and/or serial No.	--
Software version:	--
Hardware version:	--
Date of receipt	05-04-2024
Tests started:	06-05-2024
Testing ended:	30-10-2024

1.4 Product specifications of Equipment under test

Tx Frequency:	LTE Band 2,4,5,12,13,25,26,66 NB-IoT Band 2,4,5,12,13.17,25, 66
Rx frequency:	LTE Band 2,4,5,12,13,25,26,66 NB-IoT Band 2,4,5,12,13.17,25, 66
Antenna type	Embedded antenna.
Type of modulation:	QPSK, 16 QAM
Emission designator	Band 2: 1M12G7D. Band 5: 1M12G7D. For the rest of the designators, please refer to the Quectel BG951A-GL FCC Certificate.

1.5 Environmental conditions

Test date	07-05-2024	08-05-2024	13-05-2024
Ambient temperature (°C)	22.7	21.1	22.8
Humidity (%)	39.1	43.7	53.4

1.6 Measurement standards

- ANSI C63.26:2015

1.7 Applicable standards

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

- FCC Part 22 Subpart C §22.359
- FCC Part 24 Subpart C §24.238
- FCC Part 27 Subpart C §27.53
- RSS-130 Issue 2
- RSS-132 Issue 3
- RSS-133 Issue 6, A1
- RSS-139 Issue 3

1.8 Observation and remarks

The EUT contains a pre-certified cellular module, so only radiated spurious emissions are tested.
Tests are performed on a representative selection of operating frequency bands.

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 : ing. M.H. Khan.

Review of test methods and report by:

Name : P. van Wanrooij, BASc

The above conclusions have been verified by the following signatory:

Date : 07-01-2025

Name : P. van Wanrooij

Function : Test Engineer

Signature :

2 Test configuration of the Equipment Under Test

2.1 Test mode

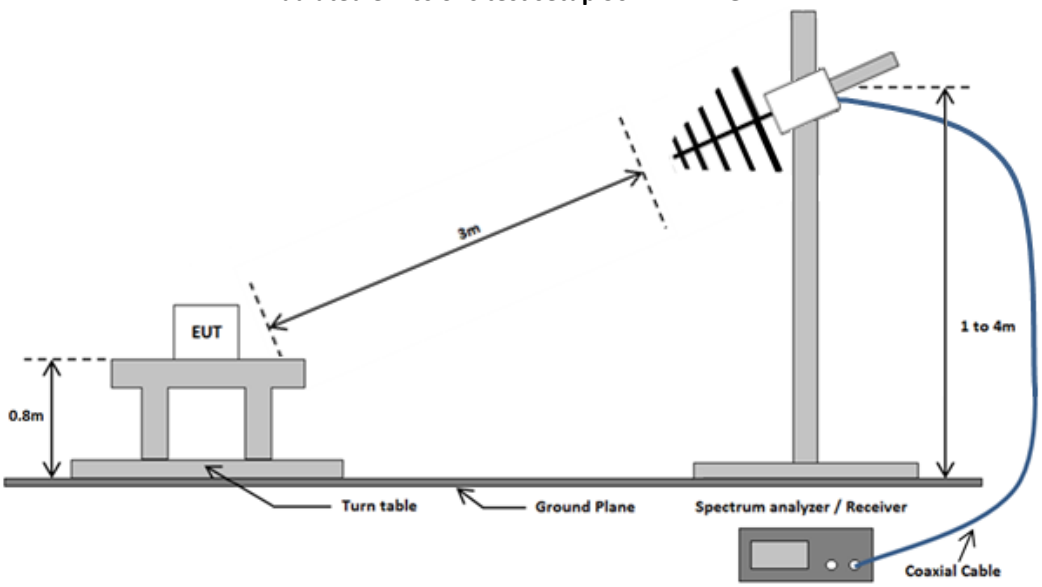
The equipment is configured to connect to a radio communication tester which keeps the transmitter continuously active and transmitting during testing.

Tested channels/bands

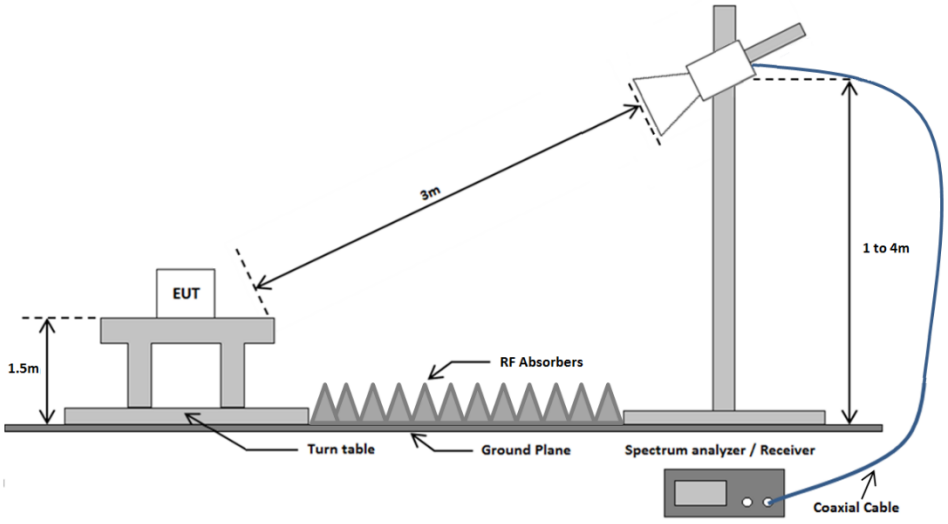
Technology	Band	Uplink Frequency range (MHz)
LTE	2	1850 – 1910
	5	824 – 849

2.2 Test setups

Radiated emissions test setup 30 MHz - 1 GHz

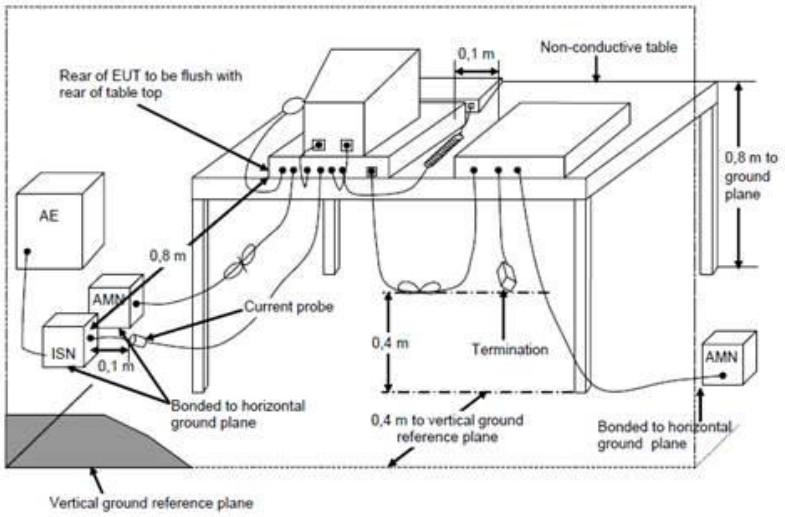


Radiated emissions test setup above 1 GHz



Conducted emissions test setup

Emissions test at AC mains



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	ESR7	114605	11-2024	11-2025	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV3044	114923	10-2023	10-2025	3.1
Biconical antenna + 6dB attenuator	Schwarzbeck + HP	VHA9103 + 8491A	114436 + 114254	08-2024	08-2027	3.1
Logperiodic antenna	EMCO	3147	114385	02-2021	02-2026	3.1
Horn antenna	EMCO	3115	114607	01-2021	01-2025	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	114518	NA*	NA*	3.1
Preamplifier	µComp	MCNA-40-001080	114771	05-2022	05-2024	3.1
Preamplifier 18-40 GHz	Schwarzbeck	BBV 9721	115434	01-2024	01-2025	3.1
Semi-Anechoic room	ETS Lindgren	SAR	114624	03-2023	03-2026	3.1
Radio communication tester	Rohde & Schwarz	CMW-500	TE 01286	--	--	3.1
Radio communication tester	Rohde & Schwarz	CMU-200	TE 01166	--	--	3.1
Test software	Raditeq	Radimation Version 2023.2.3	--	--	--	3.1

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

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10log(P) dB
P = 23 dBm = 0.2 W

$$limit = 23\ dBm - [43 + 10 * \log_{10}(0.2)]dB = -13\ dB$$

The power has been converted to dBuV/m bij adding conversion factor 95.2 dB.

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 3.3 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 3.2 of this report.

3.1.4 Test procedure

30 MHz to 26.5 GHz: According to ANSI C63.26-2015 section 5.5.2

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
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 Results of the radiated spurious emissions measurement

Highest measured peaks are reported

250-1000 MHz Band 5

Frequency (MHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Quasi-Peak (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Height (m)	Polarization
881.821	68.5	82.2	65.3	82.2	1.5	Horizontal
881.526	64	82.2	59.8	82.2	1	Vertical
836.969	110.2	82.2	106.4	82.2	1	Horizontal

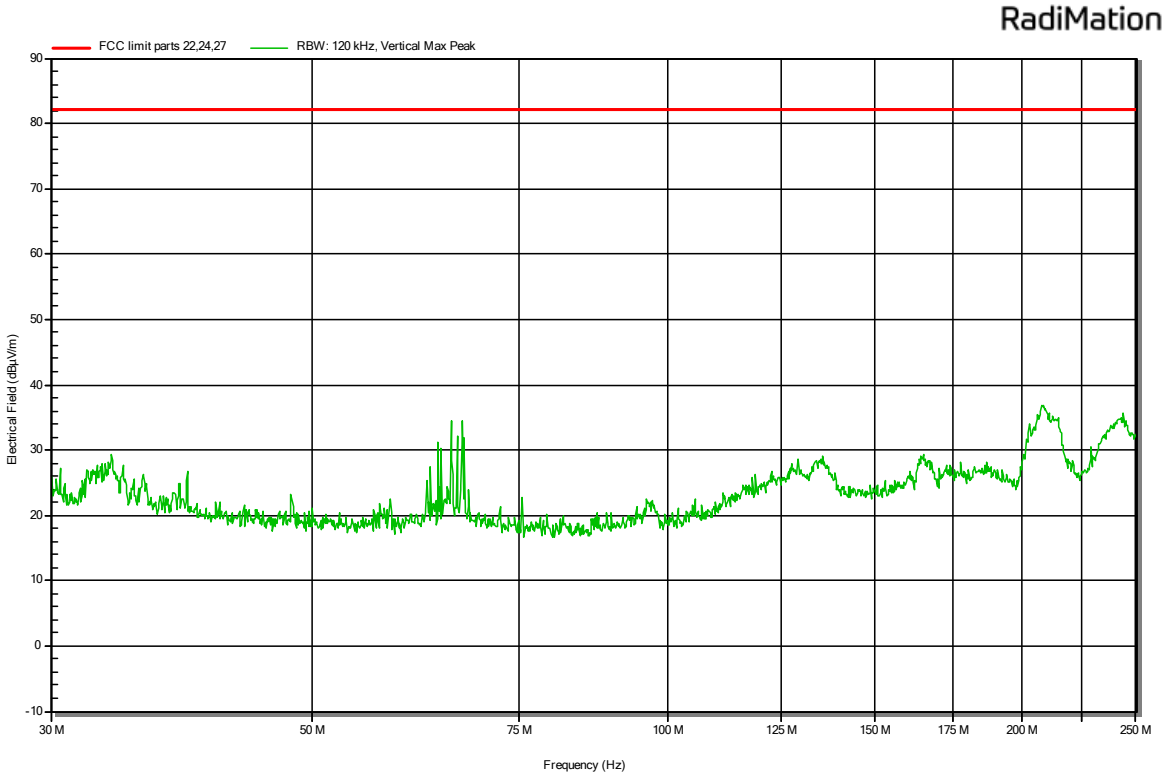
836.969 peak is the transmitting frequency.

1-18 GHz Band 5

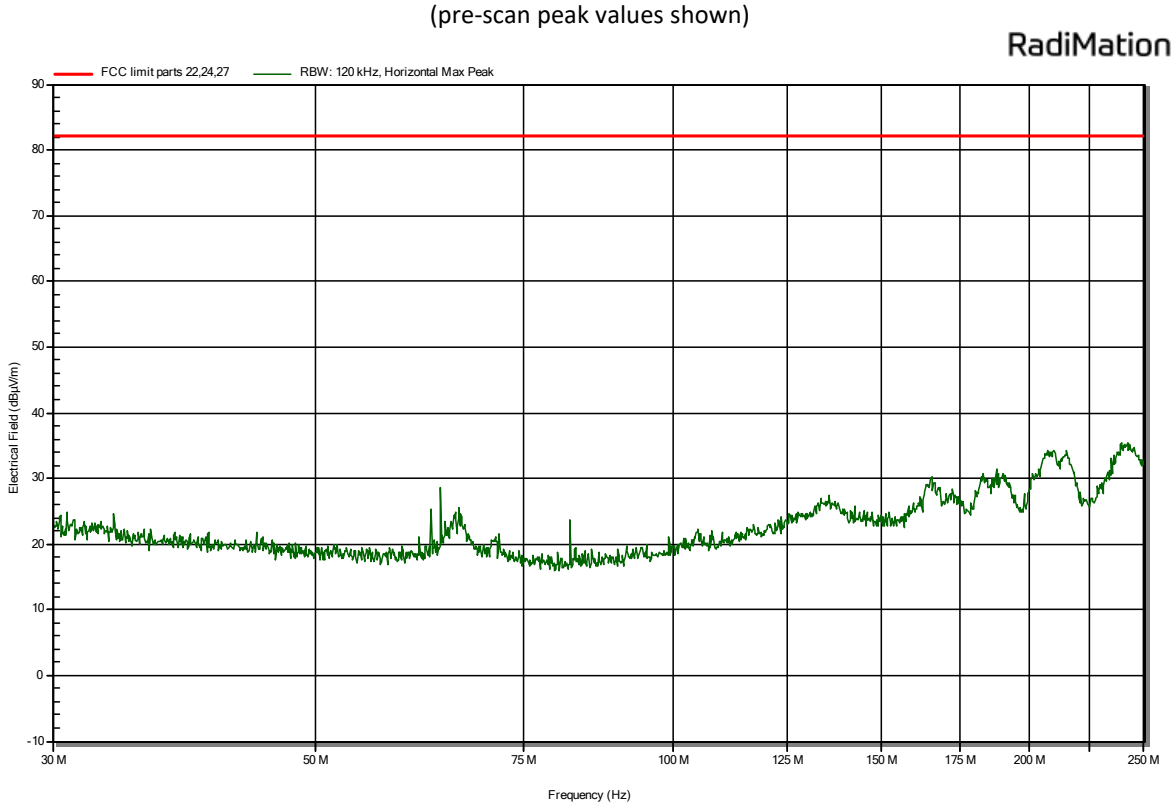
Peak Number	Frequency (GHz)	Peak (dBµV/m)	Peak Limit (dBµV/m)	Average (dBµV/m)	Height (m)	Polarization
1	3.112	44.2	82.2	31	4	Vertical

3.1.7 Plots of the Radiated Spurious Emissions Measurement Band 2

30 – 250 MHz

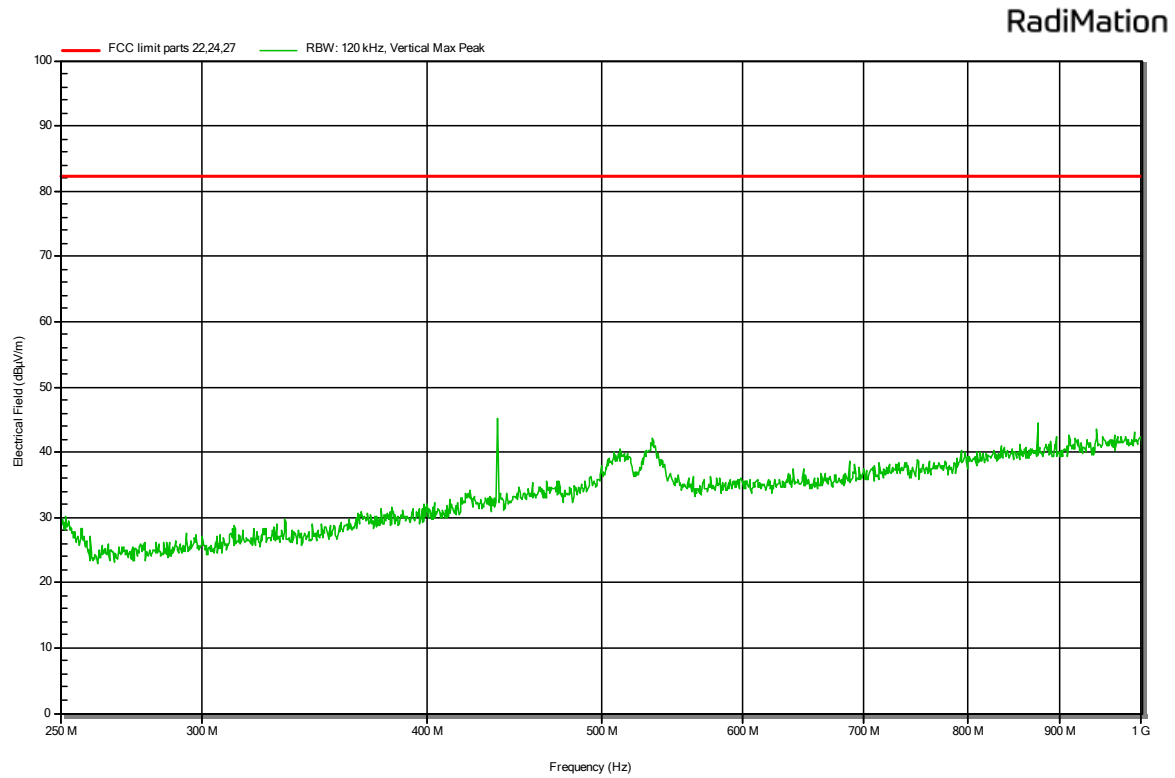


Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)

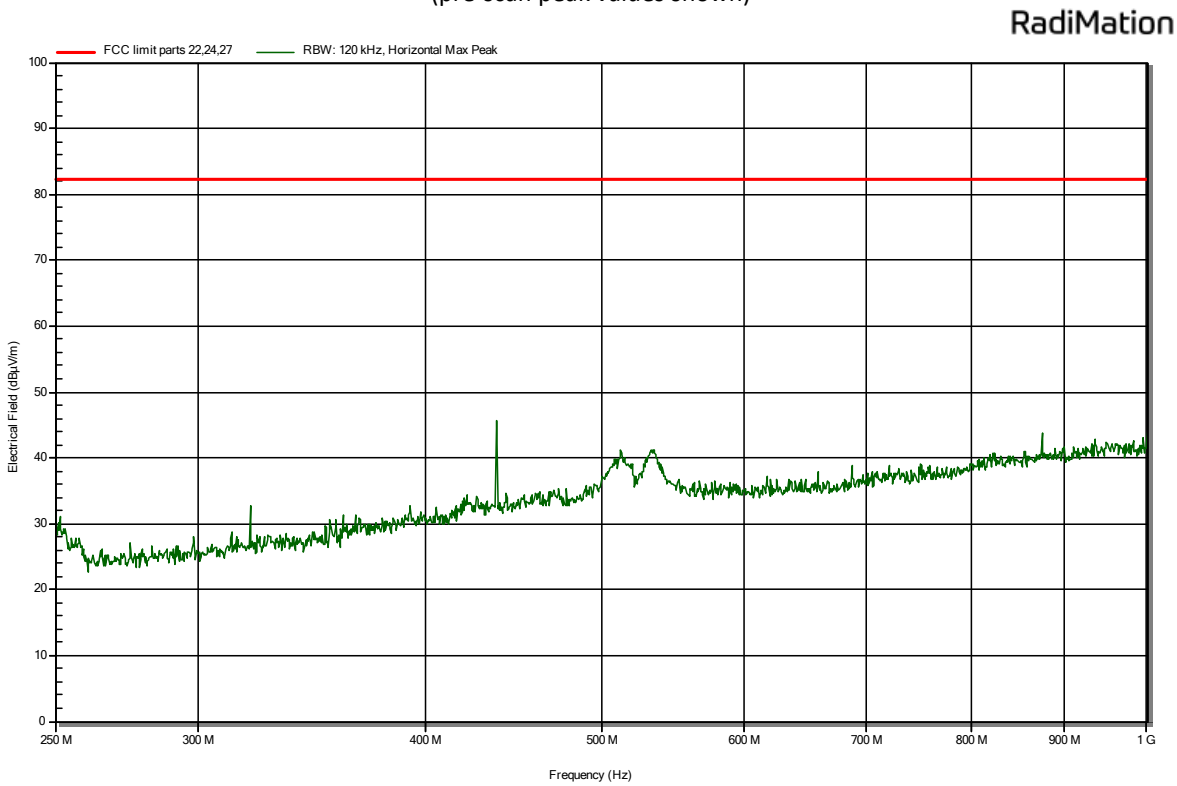


Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)

250 – 1000 MHz

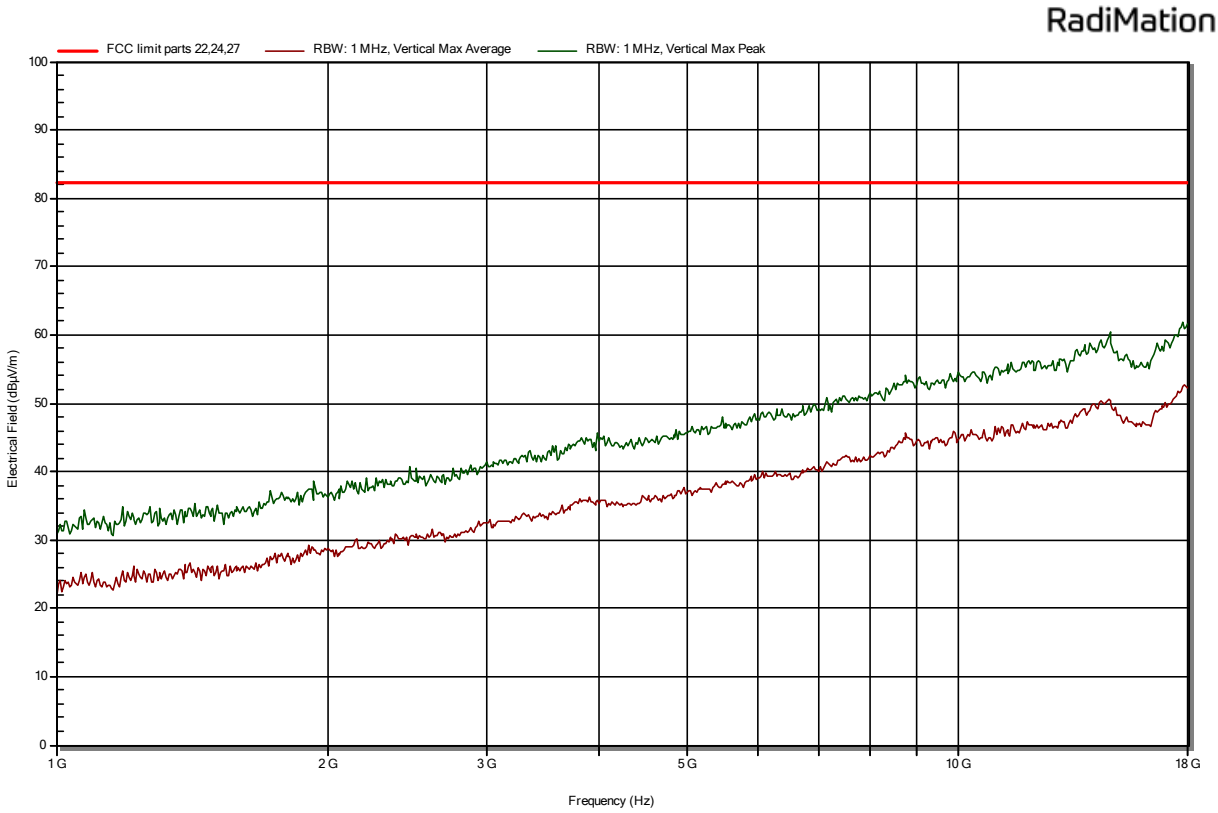


Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz
(pre-scan peak values shown)

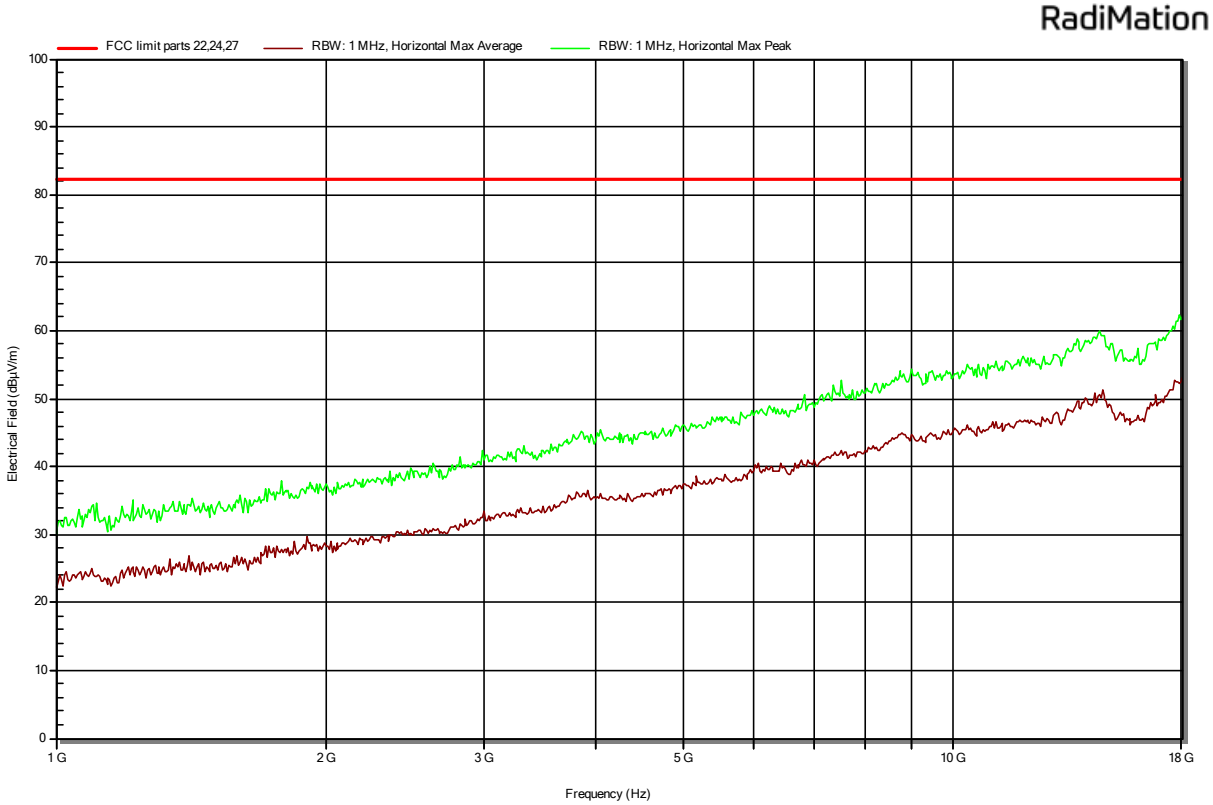


Plot 2b: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz
(pre-scan peak values shown)

1-18 GHz

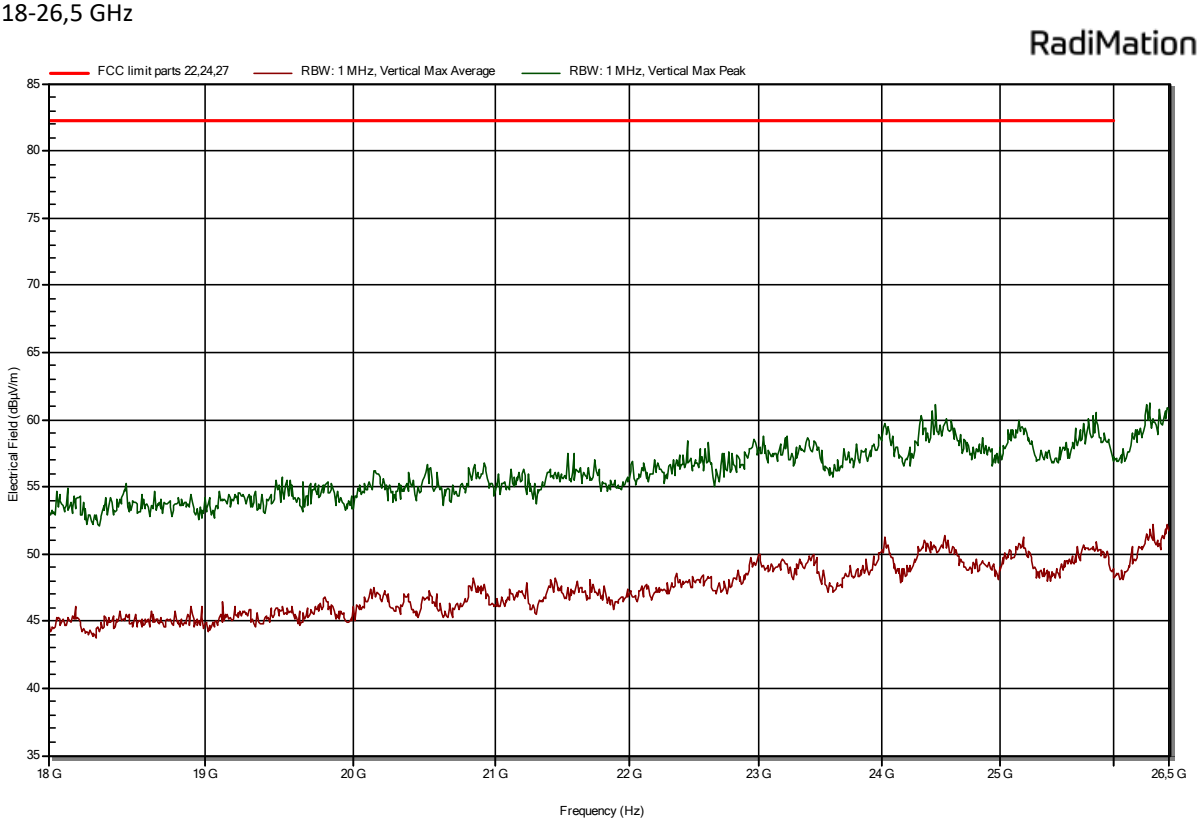


Plot 3a: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz
(pre-scan peak values shown)

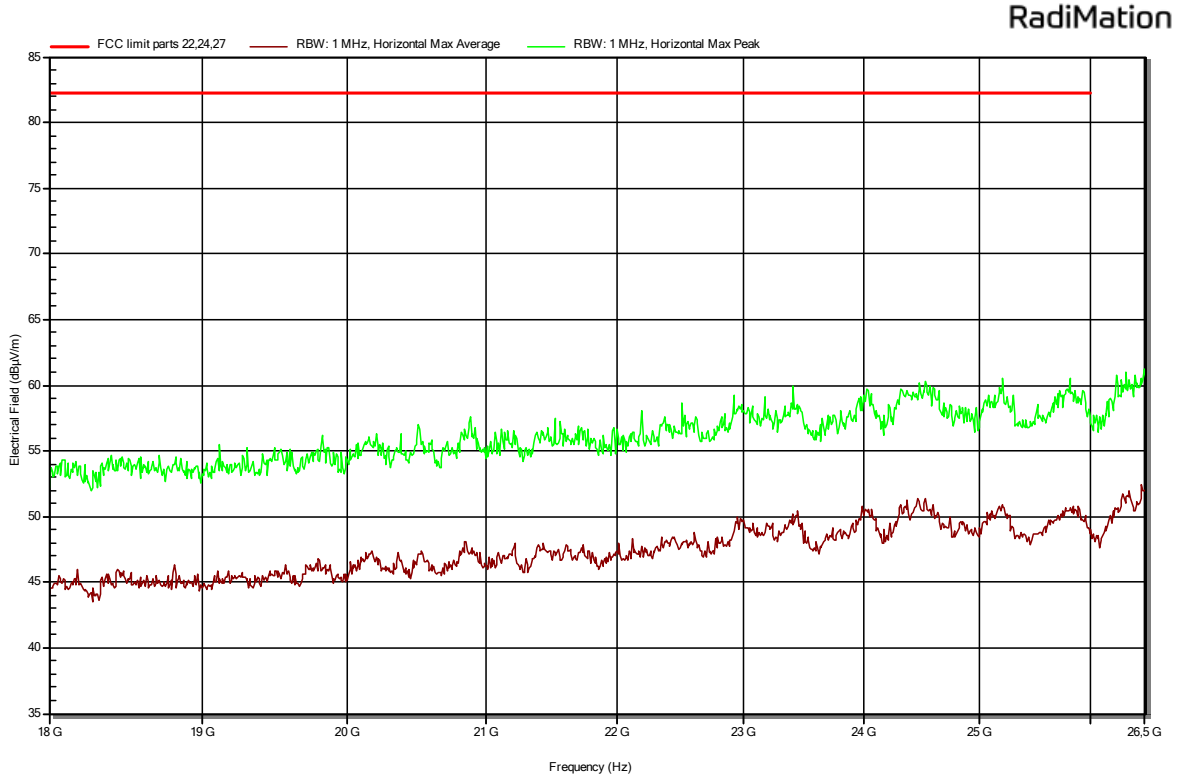


Plot 3b: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz
(pre-scan peak values shown)

18-26,5 GHz



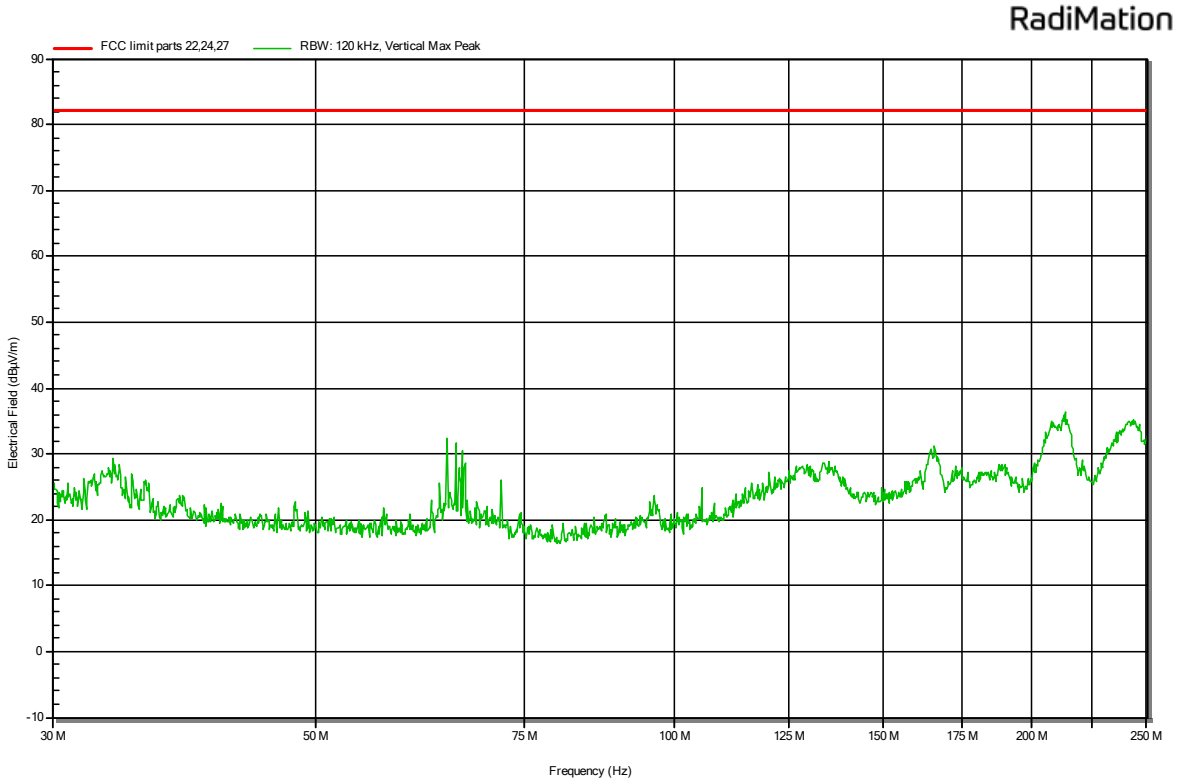
Plot 4a: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26,5 GHz
(pre-scan peak values shown)



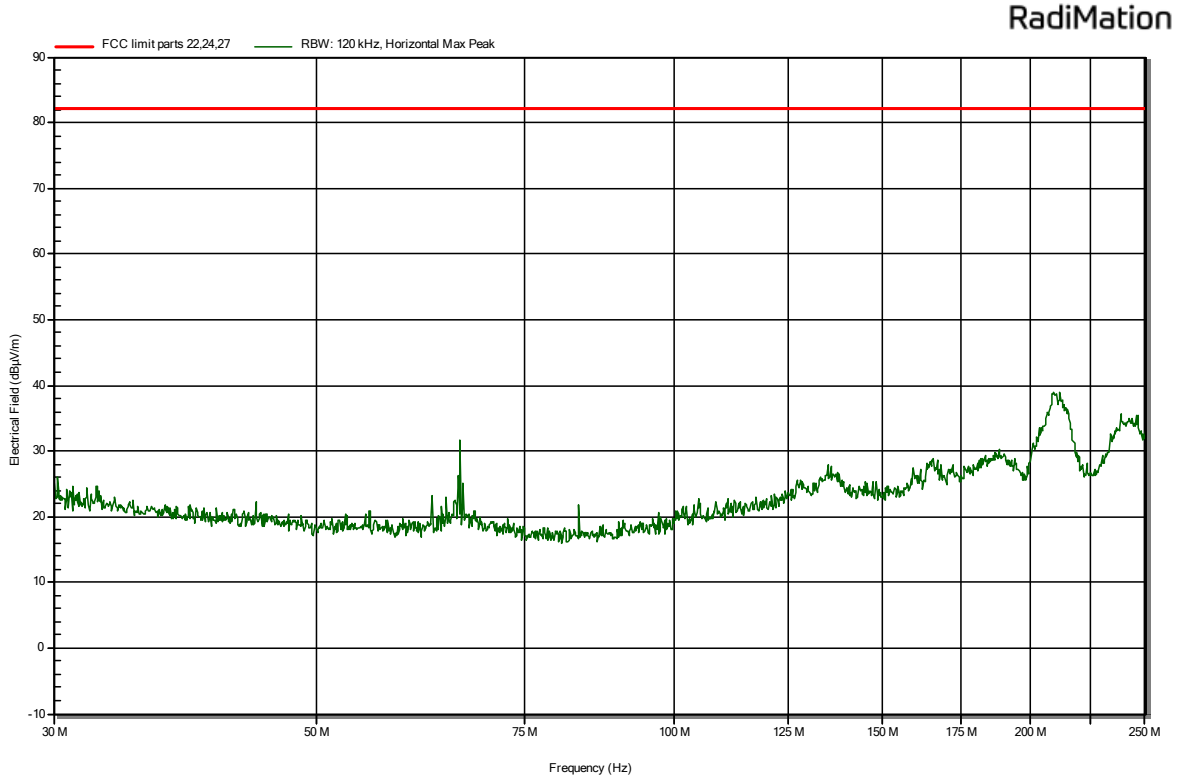
Plot 4b: radiated emissions of the EUT, Antenna horizontal, in the range 18 – 26,5 GHz
(pre-scan peak values shown)

3.1.8 Plots of the Radiated Spurious Emissions Measurement Band 5

30 – 250 MHz

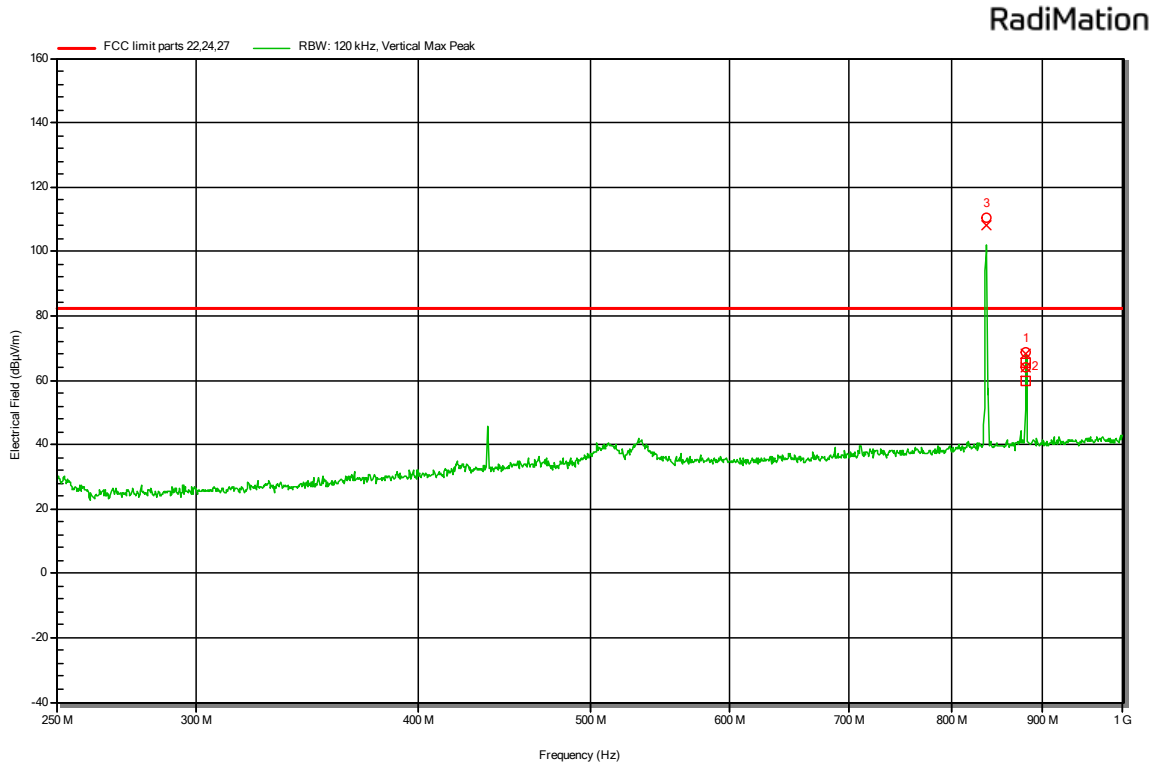


Plot 1a: radiated emissions of the EUT, Antenna vertical, in the range 30 – 250 MHz
(pre-scan peak values shown)

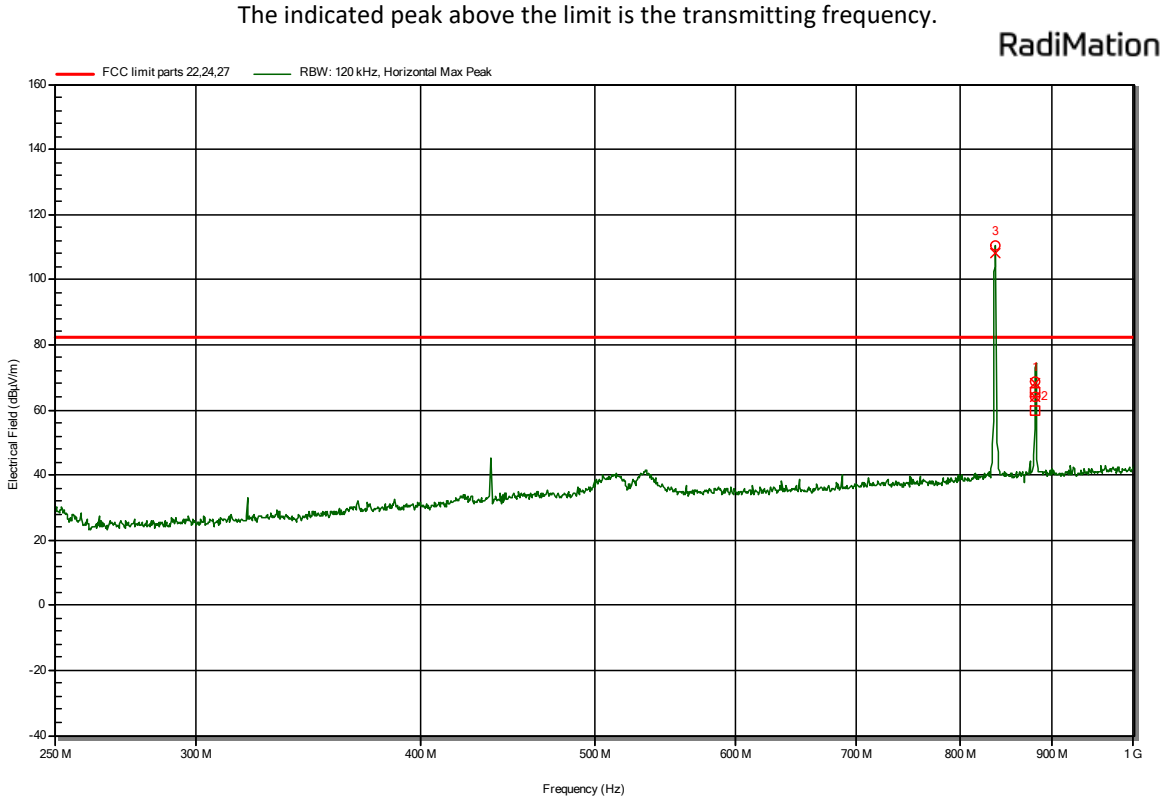


Plot 1b: radiated emissions of the EUT, Antenna horizontal, in the range 30 – 250 MHz
(pre-scan peak values shown)

250 – 1000 MHz

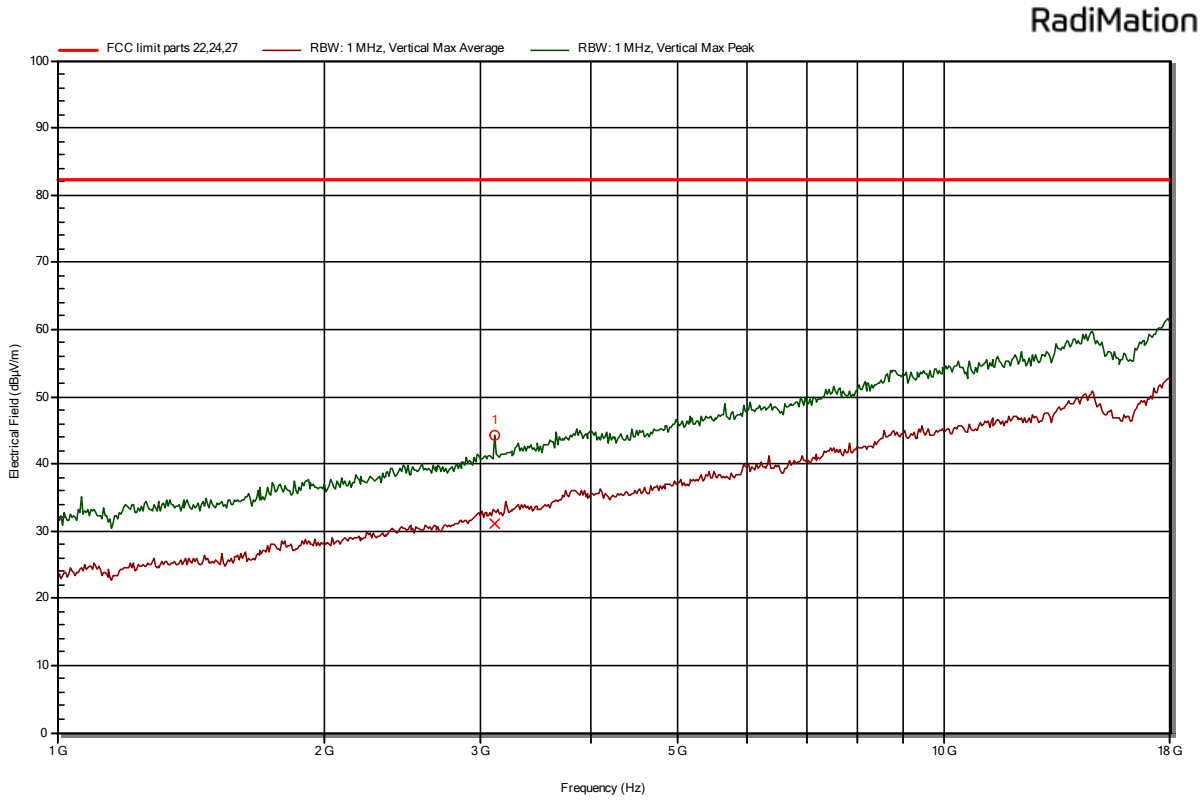


Plot 2a: radiated emissions of the EUT, Antenna vertical, in the range 250 – 1000 MHz
(pre-scan peak values shown)
The indicated peak above the limit is the transmitting frequency.

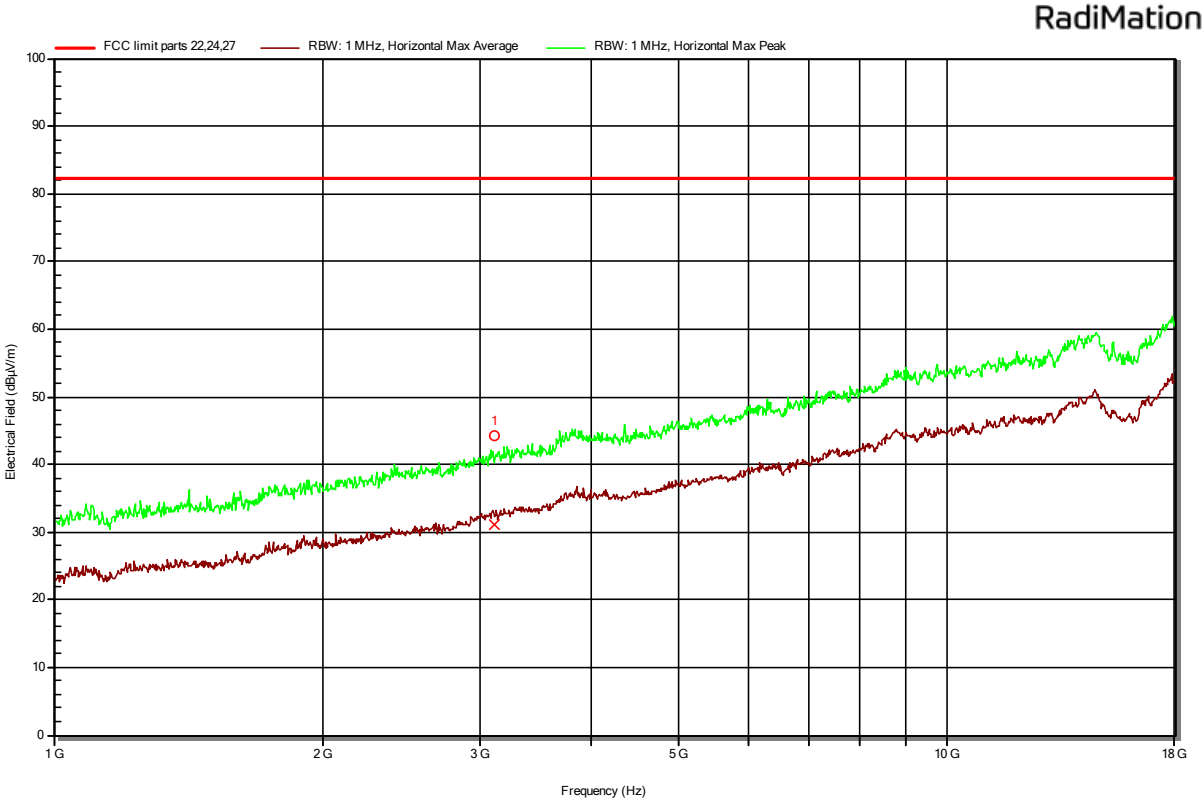


Plot 2b: radiated emissions of the EUT, Antenna horizontal, in the range 250 – 1000 MHz
(pre-scan peak values shown)
The indicated peak above the limit is the transmitting frequency.

1-18 GHz

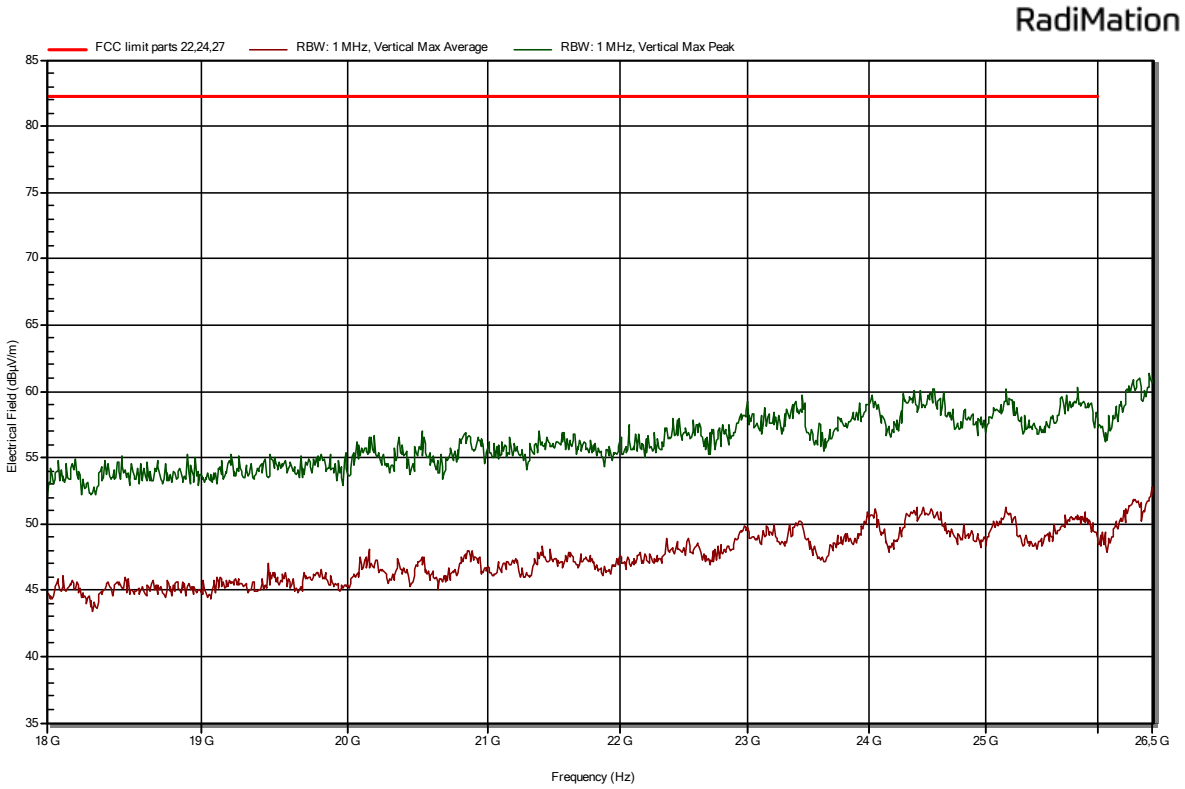


Plot 3c: radiated emissions of the EUT, Antenna vertical, in the range 1 – 18 GHz
(pre-scan peak values shown)

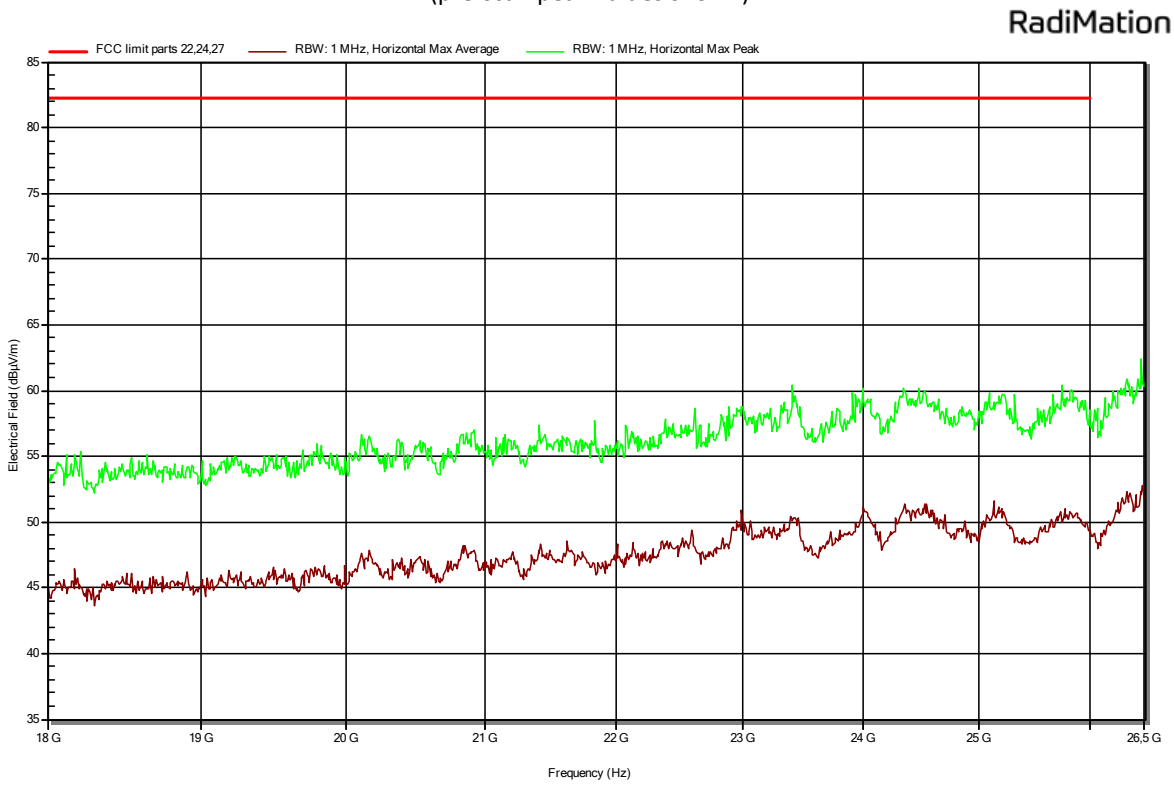


Plot 3d: radiated emissions of the EUT, Antenna horizontal, in the range 1 – 18 GHz
(pre-scan peak values shown)

18-26.5 GHz



Plot 4a: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26,5 GHz
(pre-scan peak values shown)



Plot 4b: radiated emissions of the EUT, Antenna vertical, in the range 18 – 26,5 GHz
(pre-scan peak values shown)

4 Sample calculations

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

Conducted emission Measurement (see chapter 3.9):

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)**
	Kiwa ID 114159 SN: 892785/004 Rohde & Schwarz ESH3-Z5	**Kiwa ID 114160 SN: 5SM03153 Rohde & Schwarz ESH3-Z2**	-	
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 (see chapter 3.3):

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)** **Kiwa ID 114516** **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

<<END OF REPORT>>