

FCC and IC Test report for parts
15.107, 15.109, 15.207, 15.209, 15.247
RSS-247, RSS-Gen

Product name : Chirp 2/Chirp+ 2/ECHO+
Applicant : Deeper, UAB
FCC ID : 2AHKO-CRP
IC ID : 21307-CRP

Test report No. : 201200772 001 Ver 1.0

Laboratory information

Accreditation

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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	17-05-2021	First draft	PvW
v1.00	16-07-2021	Initial release	PvW

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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
15.207 (c)	RSS-Gen 8.8	Conducted spurious emissions on AC mains	3.7	Pass

1 General Description

1.1 Applicant

Client name: Deeper, UAB
Address: Antakalnio g. 17; 10312 Vilnius, Lithuania
Telephone: --
E-mail: Mindaugas.spelveris@deeper.eu
Contact name: Mindaugas Špelveris

1.2 Manufacturer

Manufacturer name: Deeper, UAB
Address: Antakalnio str. Vilnius, Lithuania
Telephone: +37066261439
E-mail: Mindaugas.spelveris@deeper.eu
Contact name: Mindaugas Špelveris

1.3 Tested Equipment Under Test (EUT)

Product name: Chirp+ 2
Brand name: Deeper
FCC ID: 2AHKO-CRP
ISED ID: 21307-CRP
Product type: Wireless sonar with GNSS and temperature sensor
Model(s): Chirp+ 2 (GNSS and temperature sensor)
Chirp+ 2 (GNSS, no temperature sensor)
Chirp 2 (no GNSS, only temperature sensor)
Chirp 2 (no GNSS, no temperature sensor)
ECHO+
Model number(s): DP4H10S10
DP4H20S10
DP4H30S10
DP4H40S10
DP4H30S20
Batch and/or serial No. --
Software version: --
Hardware version: --
Date of receipt: 08-03-2021
Tests started: 09-03-2021
Testing ended: 12-05-2021

1.4 Product specifications of Equipment under test

Tx Frequency:	802.11b/g/n: 2400 – 2483.5 MHz
Rx frequency:	GPS: 1575 MHz 802.11b/g/n: 2400 – 2483.5 MHz
Antenna type and gain:	802.11b/g/n: Spiral monopole antenna (-2.3 dBi) GPS: Chip antenna
Type of modulation:	802.11b/g/n: GFSK and OFDM
Emission designator	802.11b: 11M4G1D 802.11g: 17M1G1D 802.11n: 18M3G1D

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

1.5 Environmental conditions

Test date	09-03-2021	19-03-2021	12-05-2021	17-05-2021
Ambient temperature	20.1°C	19.3°C	19.7°C	20.7°C
Humidity	41.3%	42.2%	48.3%	51.6%

1.6 Measurement standards

- ANSI C63.4:2014
- 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 §15.107
- FCC Part 15 Subpart C §15.109
- 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-247 Issue 2

1.8 Observation and remarks

The EUT only uses 802.11b/g/n channel 1 (2412 MHz centre frequency) for communication. Other channels are not used by the device and the user is not able to change the channel.

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 : ing. P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 22-07-2021

Name : ing P.A. Suringa

Function : Senior test engineer

Signature :

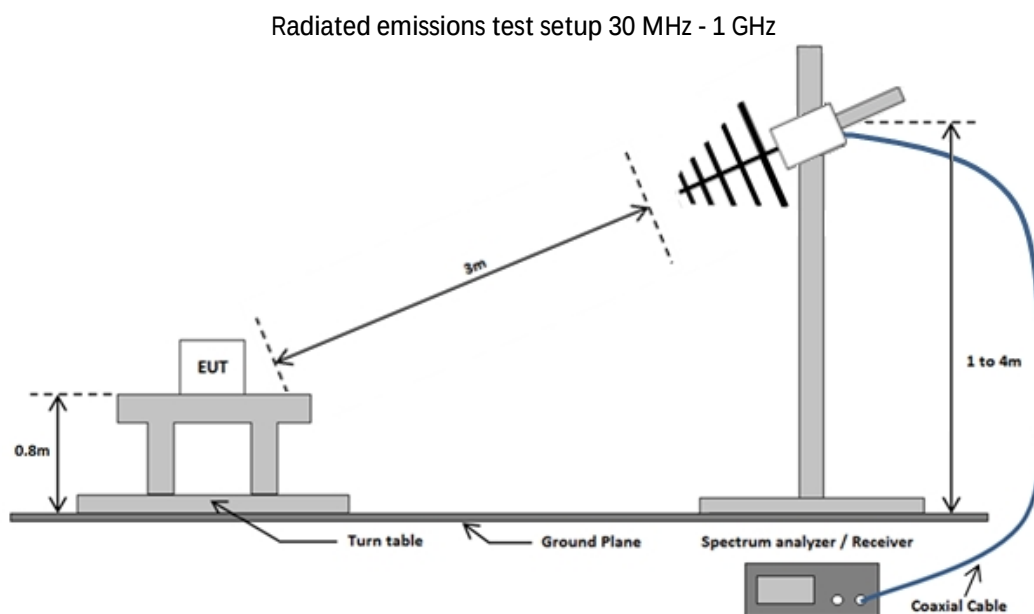
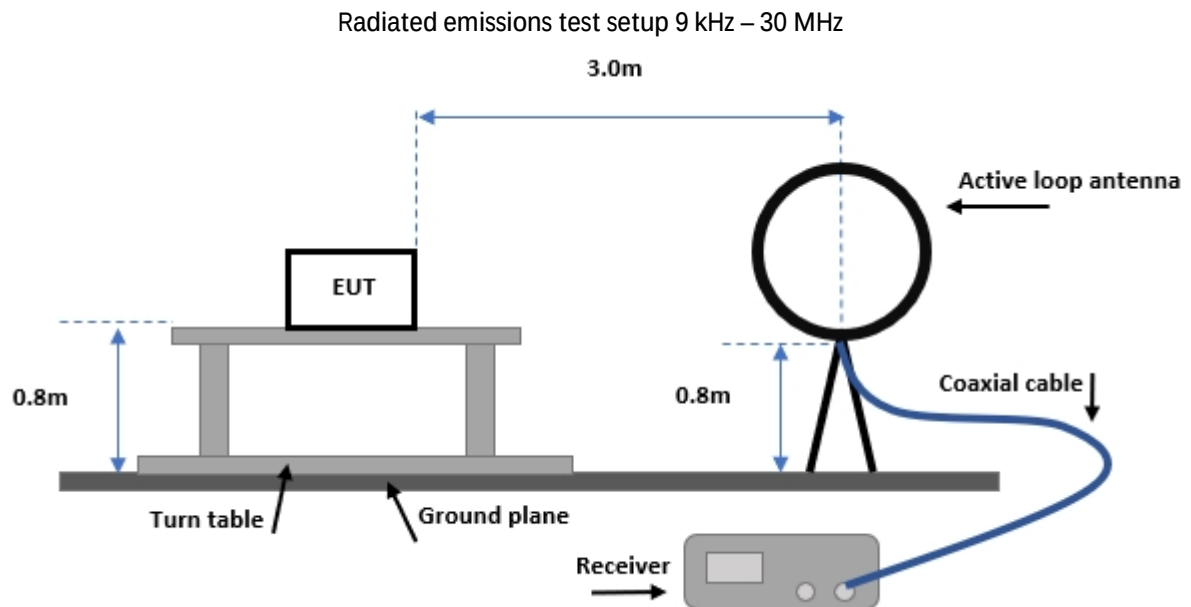


2 Test configuration of the Equipment Under Test

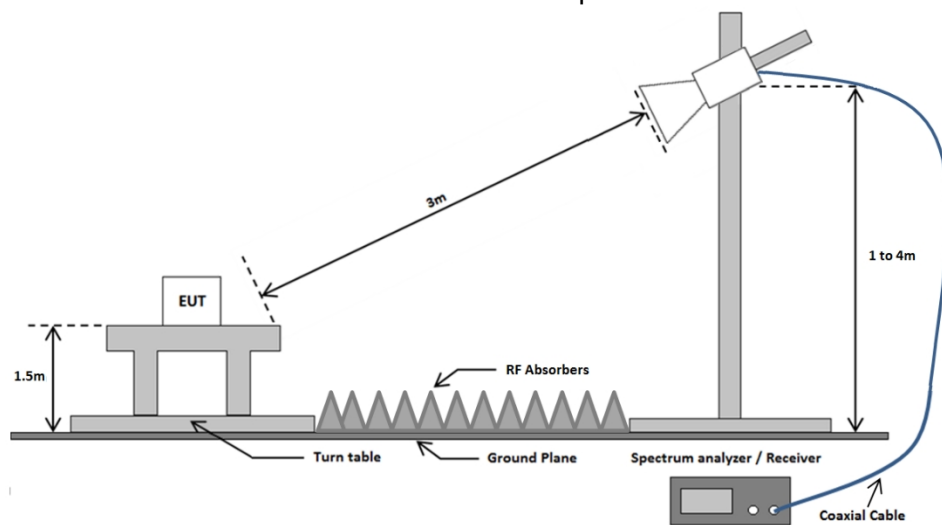
2.1 Test mode

The applicant provided test mode firmware to set the device to continuous Tx and Rx modes.

2.2 Test setups

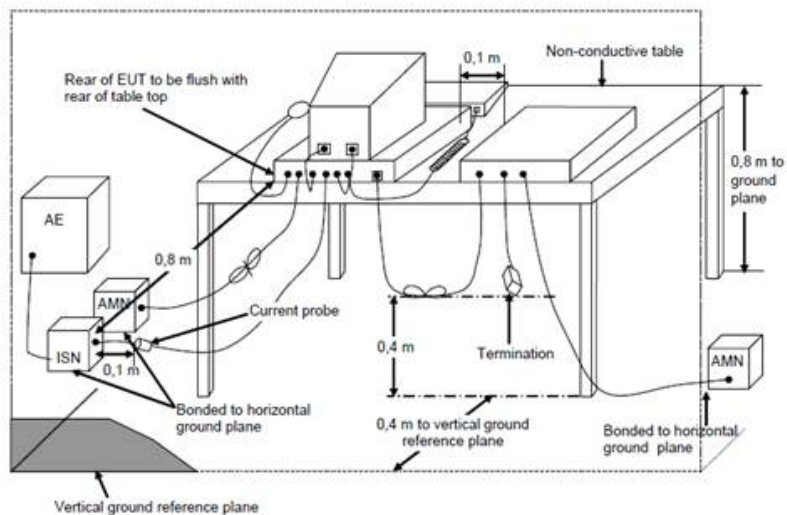


Radiated emissions test setup above 1 GHz



Conducted emissions test setup

Emissions test at AC mains



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
EMI Receiver	Rohde & Schwarz	ESCI	TE11128	3.1
EMI Receiver	Rohde & Schwarz	ESR7	TE01220	3.7
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
Spectrum Analyzer	Rohde & Schwarz	FSV40	TE01269	3.2 – 3.6
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	TE01140	3.1
Active loop antenna	EMCO	6502	TE11171	3.1
Biconilog antenna	Chase	CBL6112A	TE00967	3.1
Horn antenna	EMCO	3115	TE00531	3.1
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800- 25-10P	TE11175	3.1
Horn antenna	FLANN-MICROWAVE	20240-25	TE 00818	3.1
Preamplifier 18-26 GHz	Miteq	JS4-18004000-33- 8P	TE 11131	3.1
LISN	Rohde&Schwarz	ENV216	TE11176	3.7

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)	$20 \cdot \{\log[2400] - \log[F(\text{kHz})]\}$	300*
0.490 – 1.705	24000/F(kHz)	$20 \cdot \{\log[24000] - \log[F(\text{kHz})]\}$	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 C63.4-2014, section 5.4.2 and 8.2.3

30 MHz to 26.5 GHz: According to ANSI C63.4-2014, 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 Peaks of the radiated spurious emissions measurement

Measured peaks Vertical 30 – 1000 MHz 802.11g

Frequency	Polarization	Height	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference
86,788 MHz	Vertical	1,2 m	7 dB μ V/m	40 dB μ V/m	-33,0 dB

Measured peaks Vertical 30 – 1000 MHz 802.11n

Frequency	Polarization	Height	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference
119,703 MHz	Vertical	1,2 m	10,7 dB μ V/m	43,5 dB μ V/m	-32,8 dB

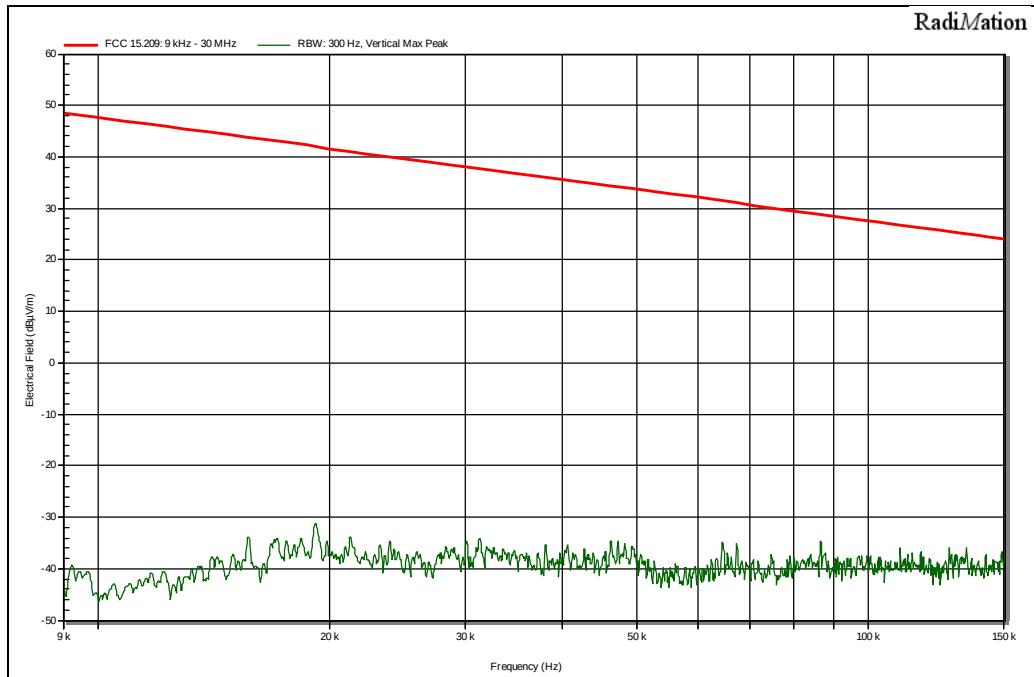
Measured peaks Vertical 1 – 18 GHz 802.11b

Peak Number	Frequency	Peak	Peak Limit	Average	Average Limit	Status
1	4,823 GHz	59,3 dB μ V/m	74 dB μ V/m	50,3 dB μ V/m	54 dB μ V/m	Pass
2	9,649 GHz	55,1 dB μ V/m	74 dB μ V/m	47,5 dB μ V/m	54 dB μ V/m	Pass

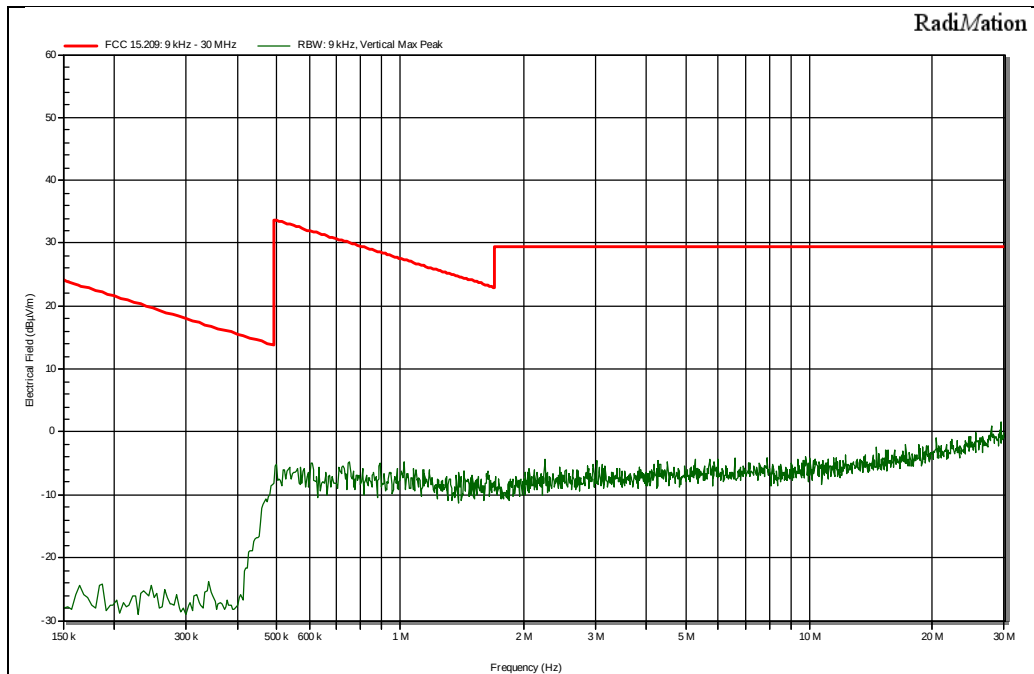
3.1.7 Plots of the Radiated Spurious Emissions

9 kHz to 150 kHz

Parallel

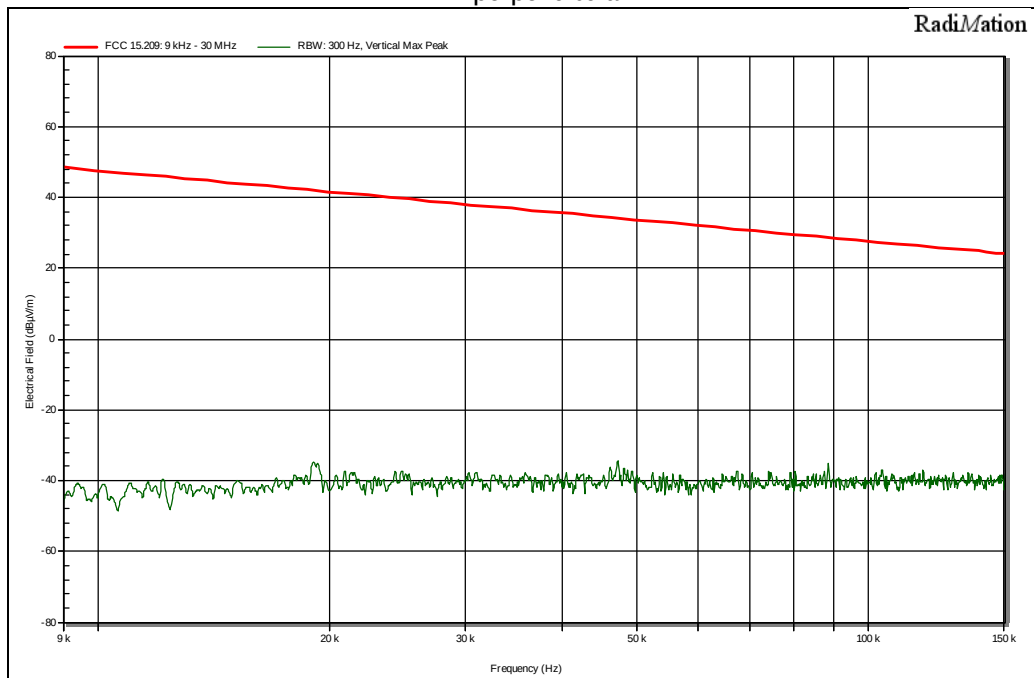


150 kHz to 30 MHz

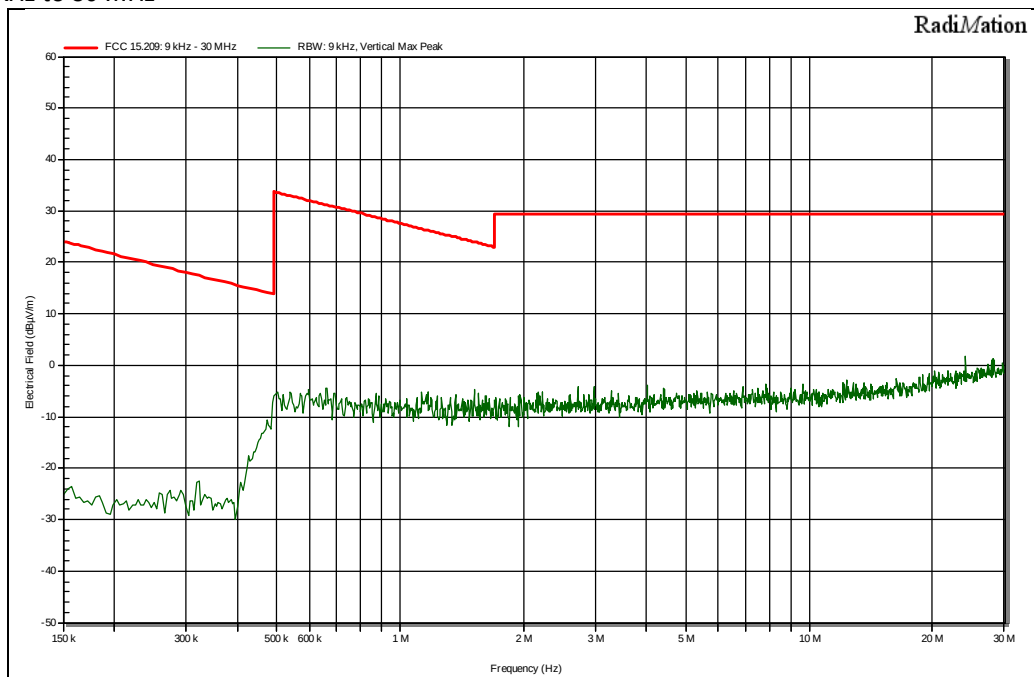


9 kHz to 150 kHz

perpendicular

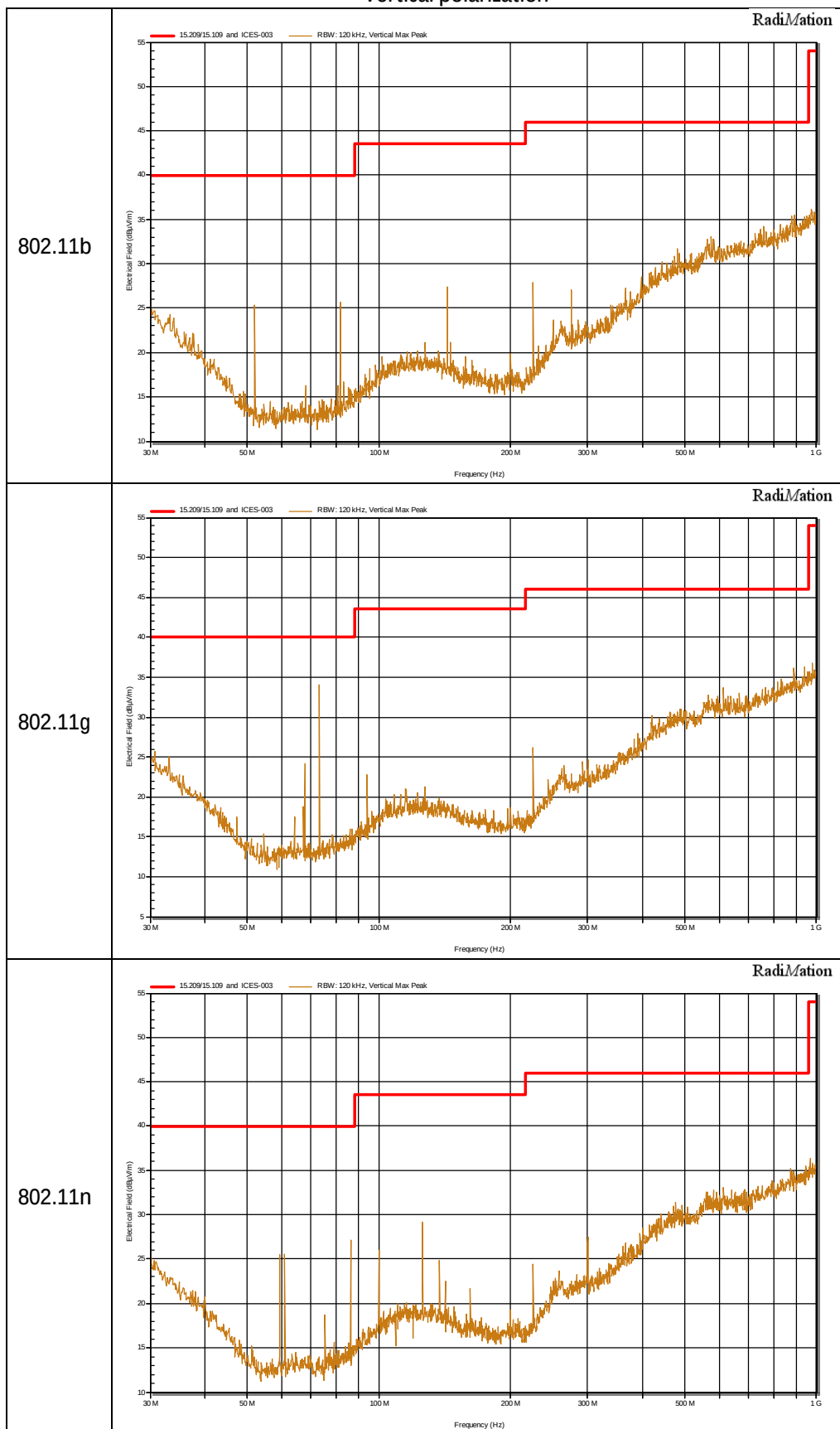


150 kHz to 30 MHz



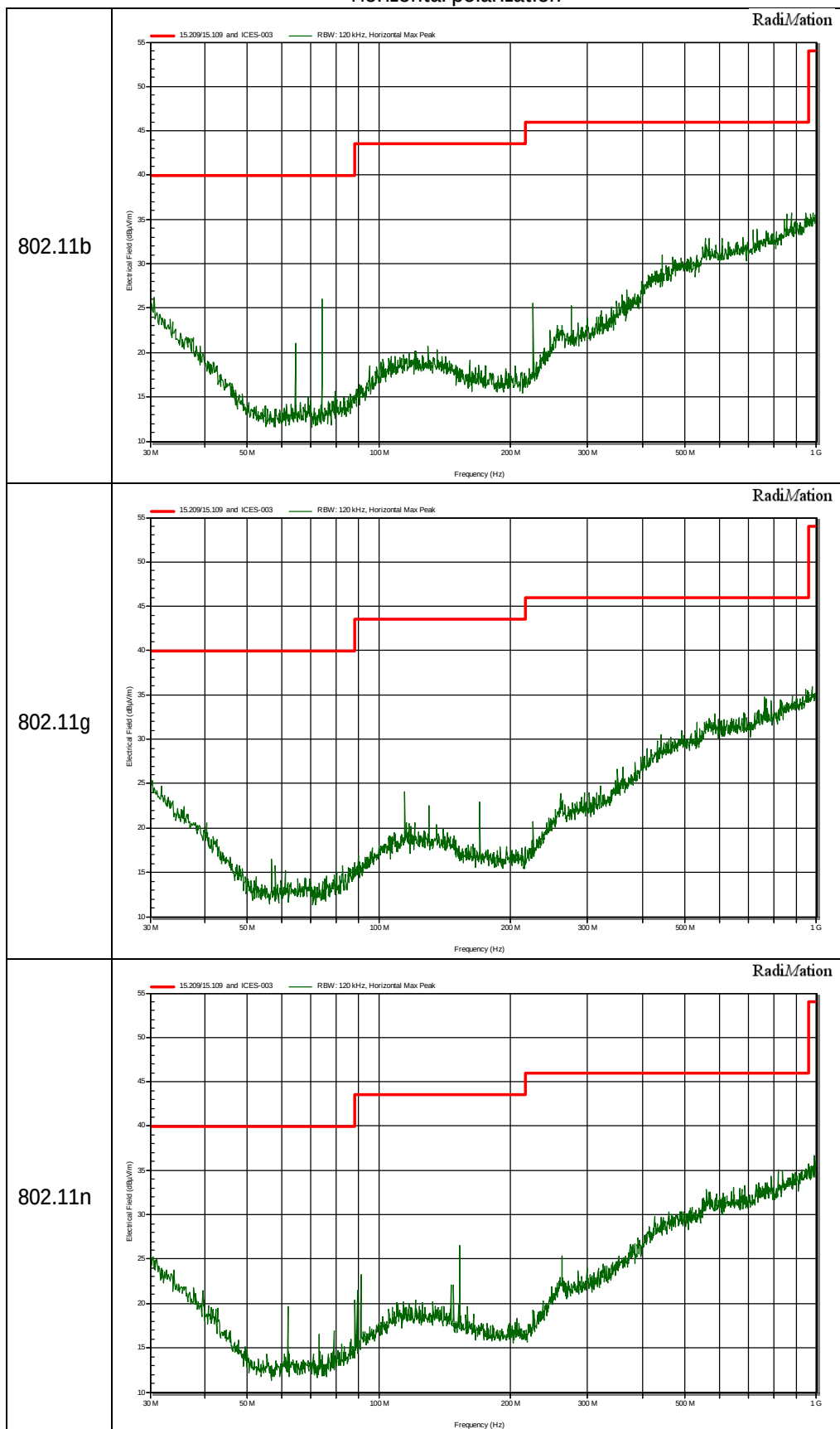
30 MHz to 1 GHz

Vertical polarization



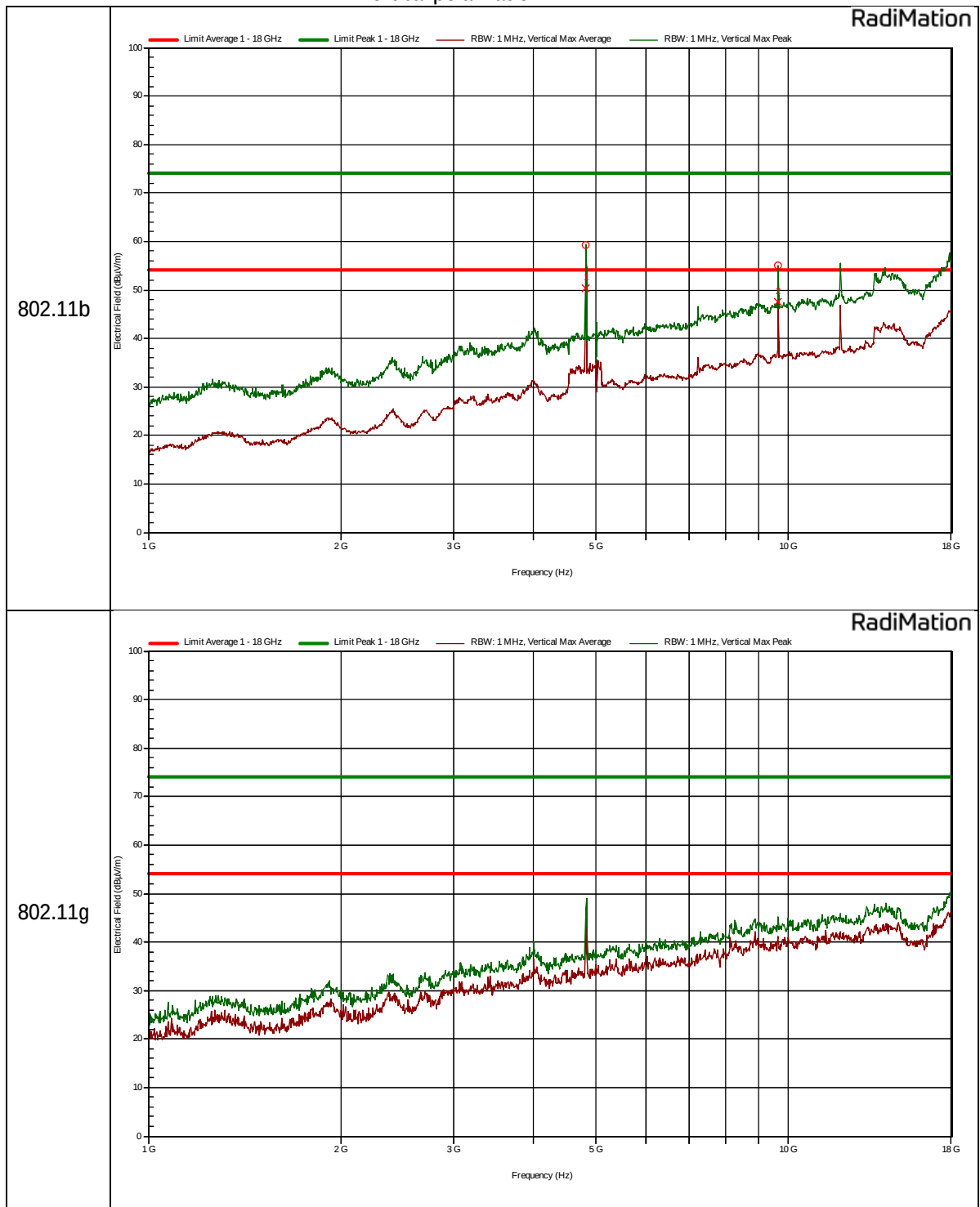
30 MHz to 1 GHz

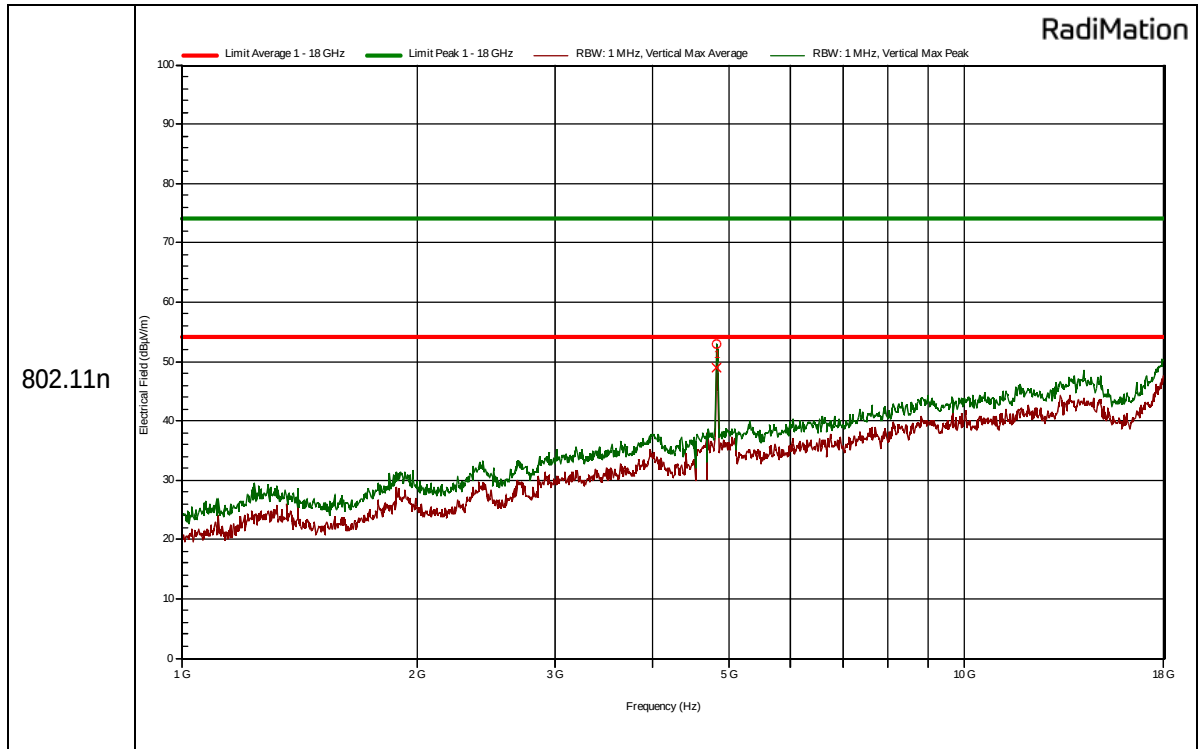
Horizontal polarization



1 GHz to 18 GHz

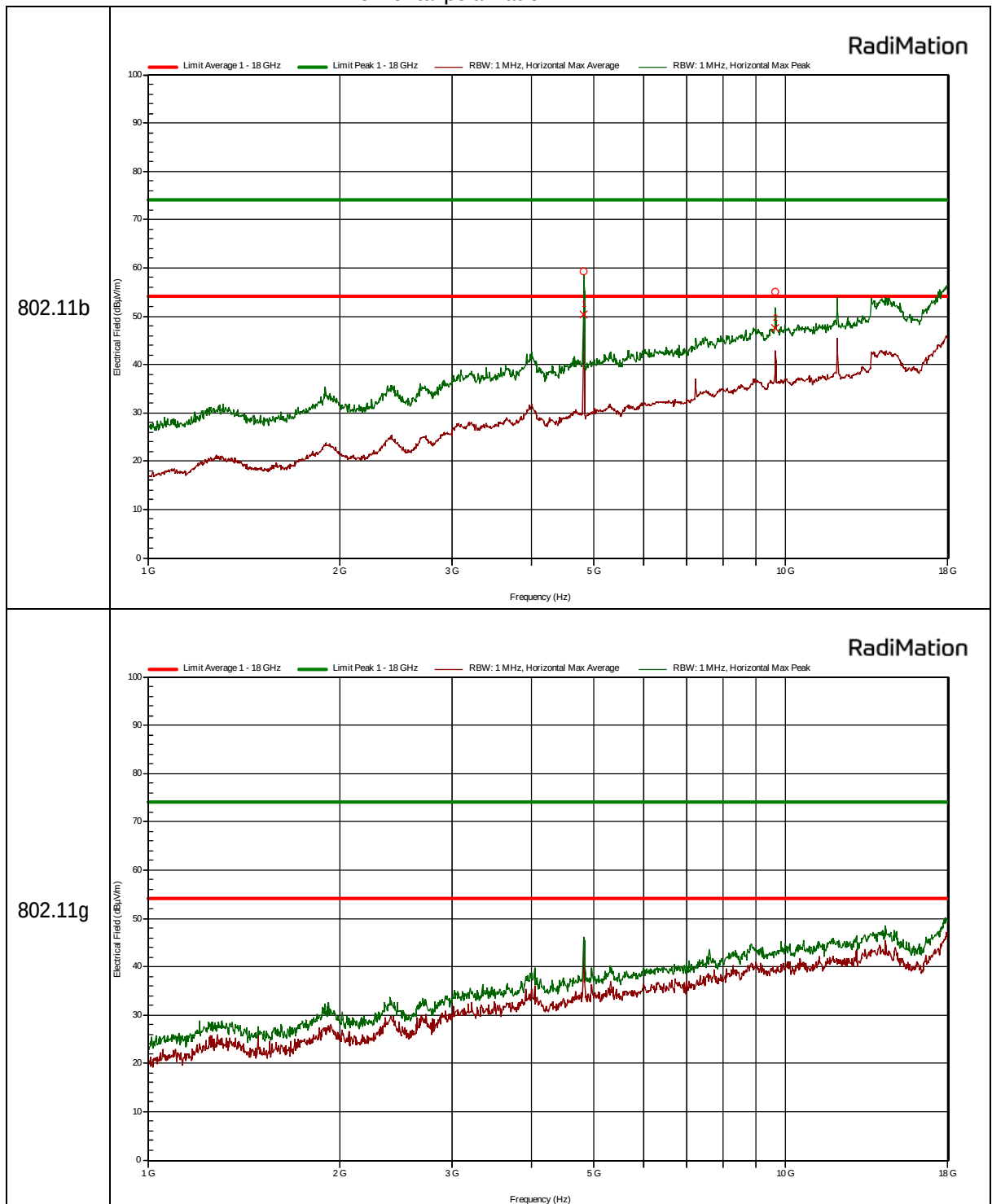
Vertical polarization

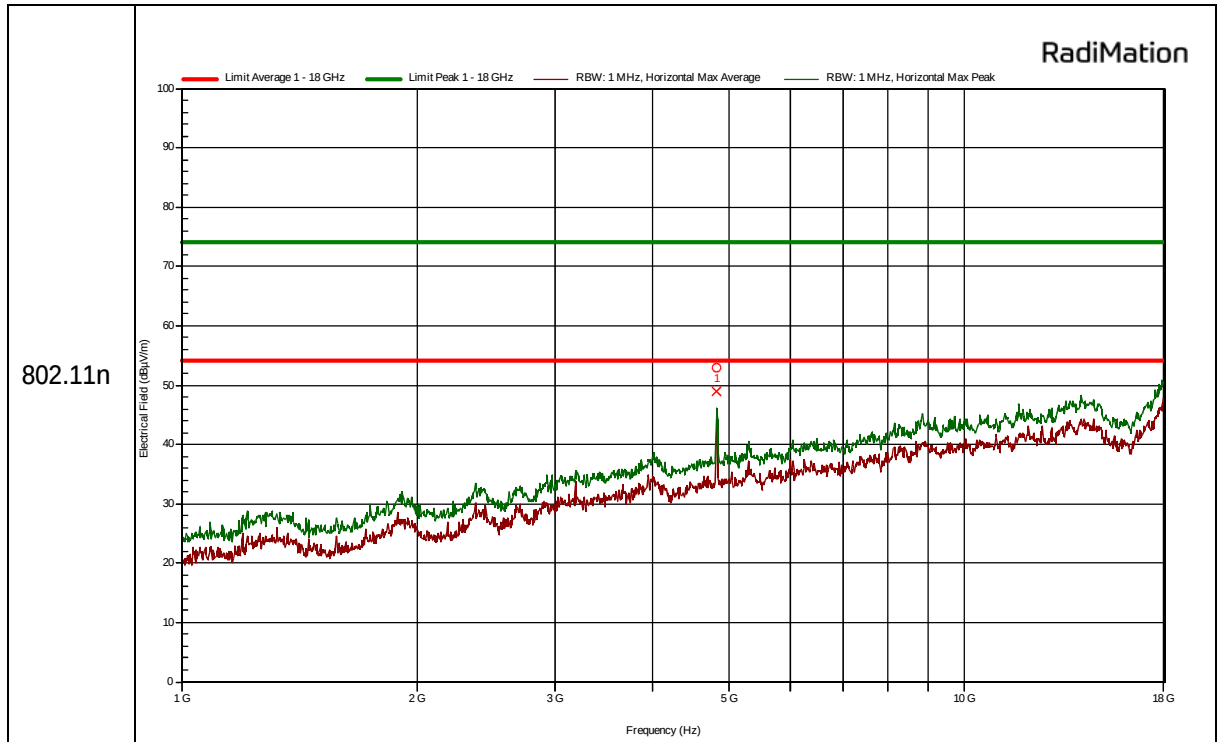




1 GHz to 18 GHz

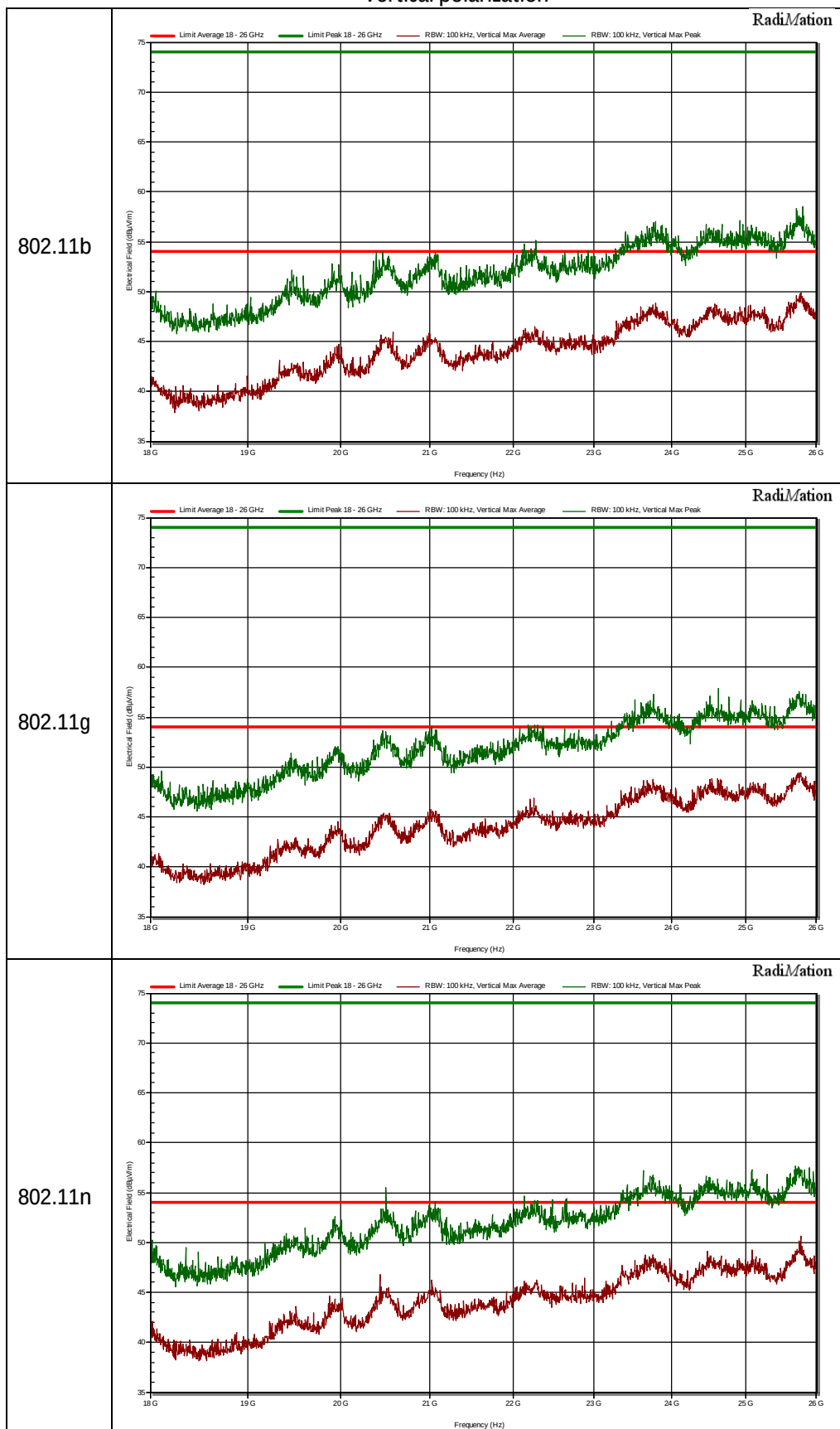
Horizontal polarization





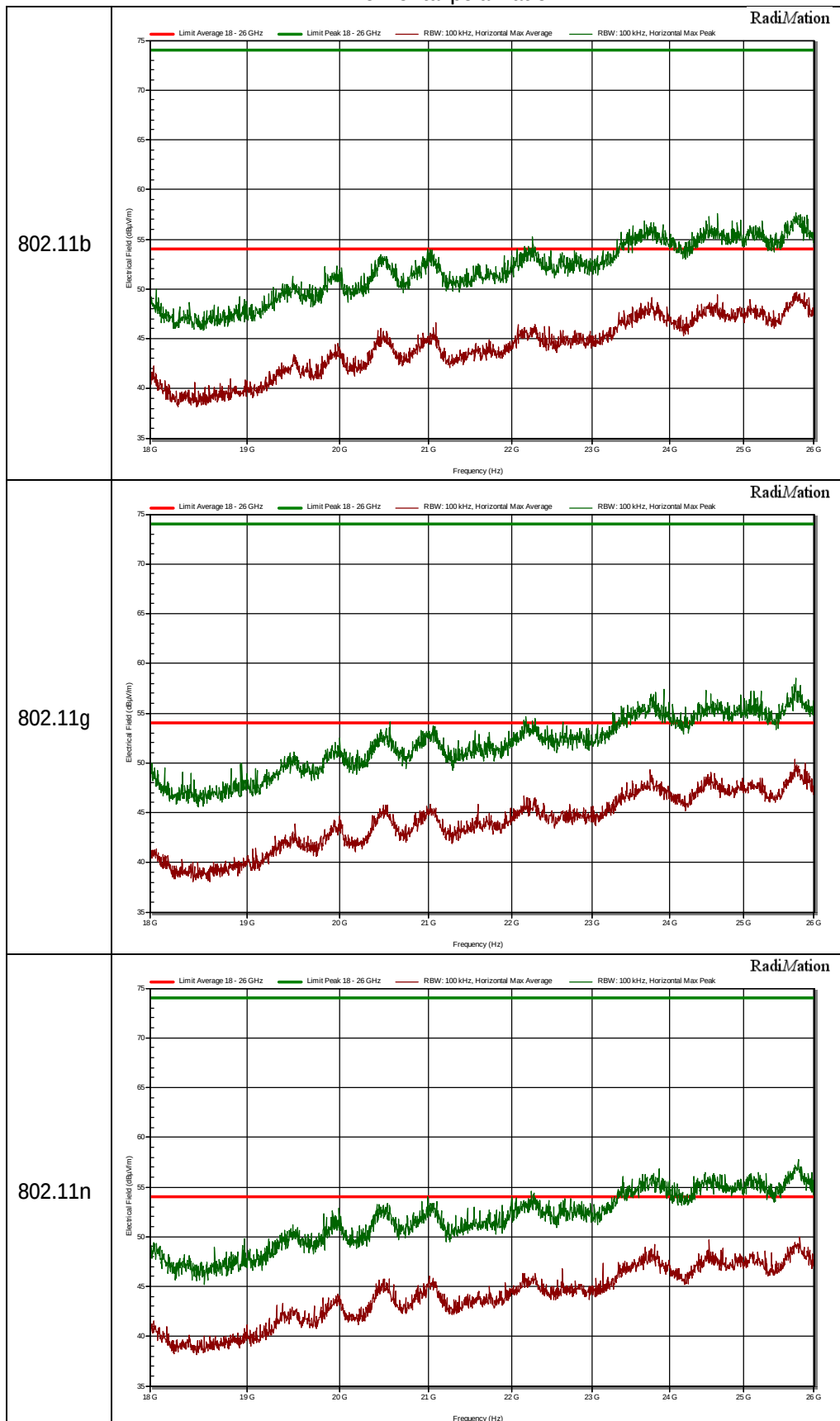
18 GHz to 26 GHz

Vertical polarization



18 GHz to 26 GHz

Horizontal polarization



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.

3.2.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
802.11b	1	2412	1 Mbps	8446
802.11g	1	2412	6.5 Mbps	16192
802.11n	1	2412	11 Mbps	17747
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

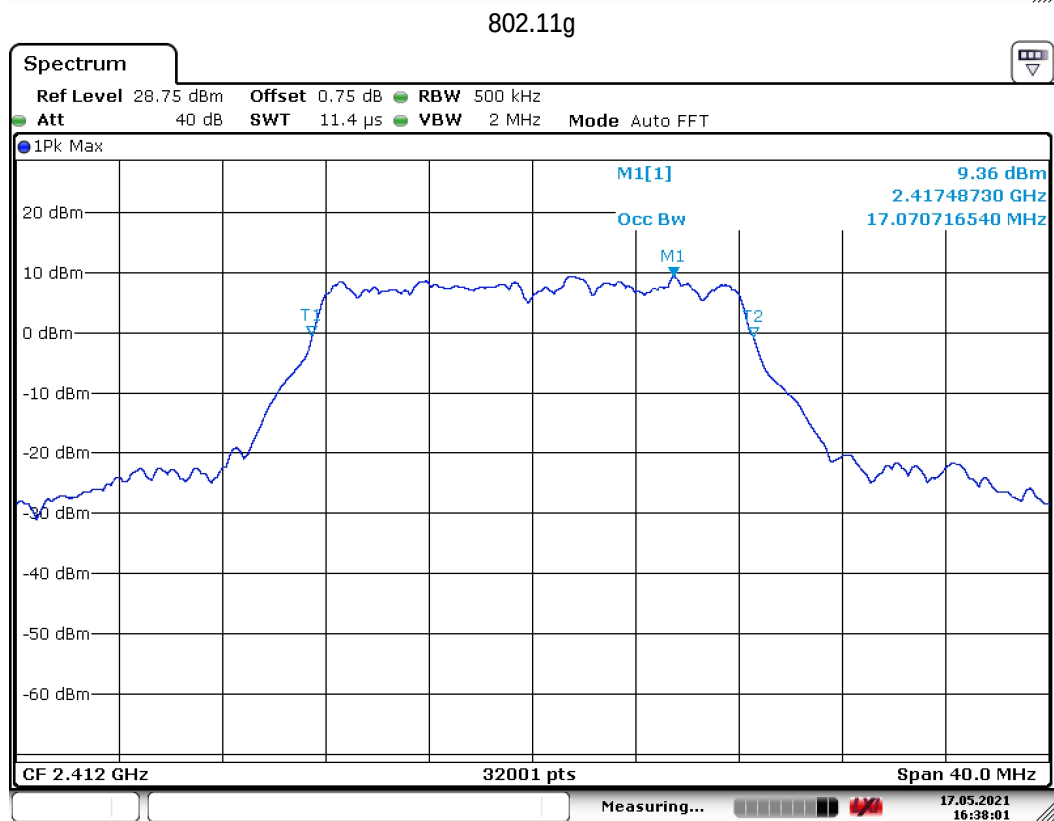
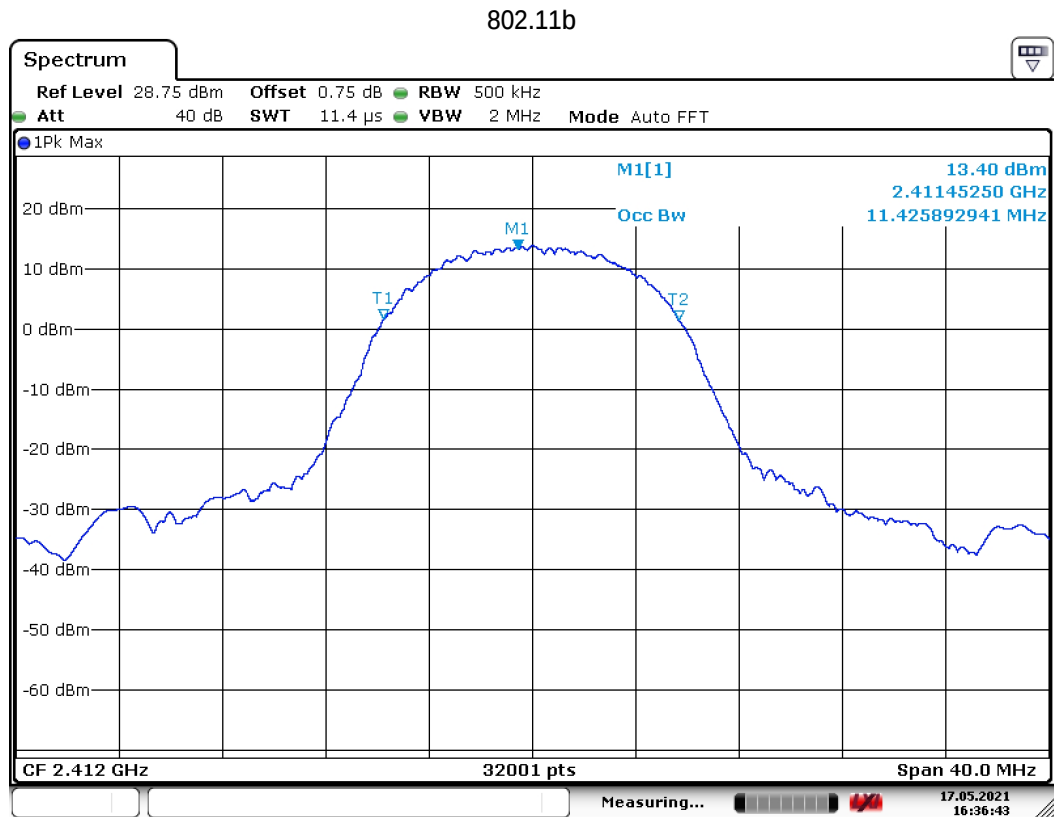
IRN 017 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

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 $\geq$ 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.

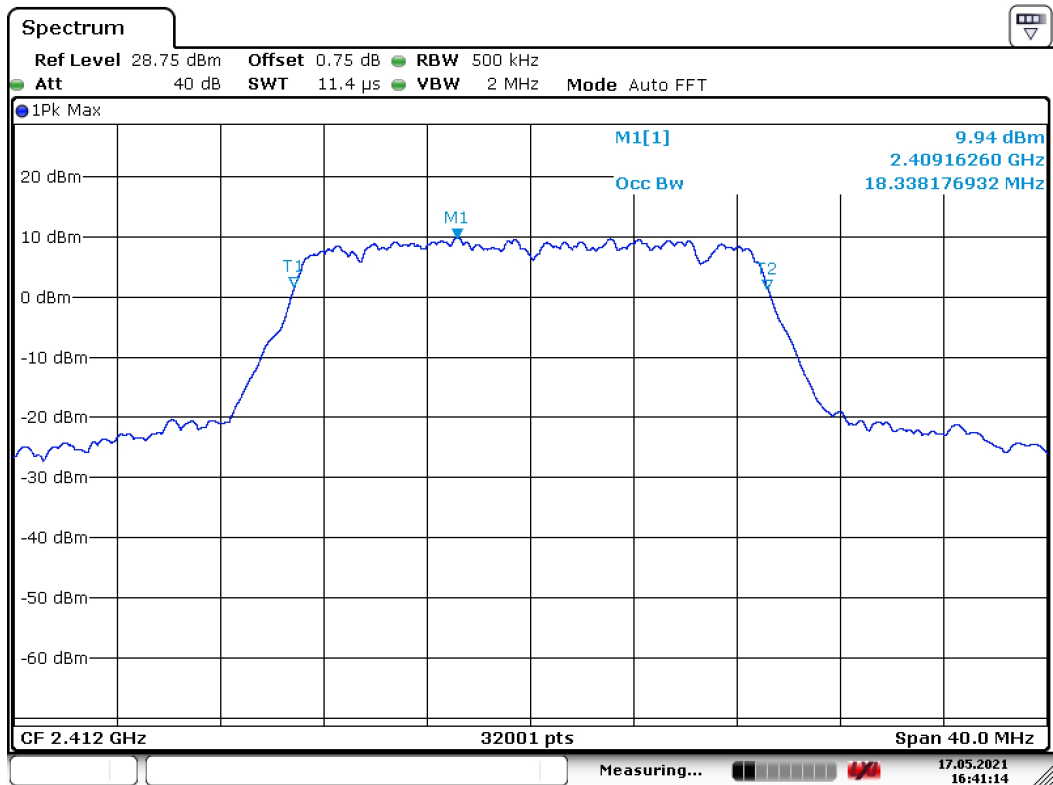
3.3.5 Test results of the 99% occupied bandwidth measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
802.11b	1	2412	1 Mbps	11426
802.11g	1	2412	6.5 Mbps	17071
802.11n	1	2412	11 Mbps	18338
Uncertainty	± 12 kHz			

3.3.6 Plots of the 99% occupied bandwidth measurement



802.11n



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 1 – AVGSA (DTS) according to ANSI C63.10.

3.4.5 Test results of Output Power Measurement

Peak method				
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
802.11b	1	2412	1 Mbps	23.9
802.11g	1	2412	6.5 Mbps	23.3
802.11n	1	2412	11 Mbps	23.5
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)

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)
802.11b	1	2412	1 Mbps	-3.92
802.11g	1	2412	6.5 Mbps	-10.59
802.11n	1	2412	11 Mbps	-8.10
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.

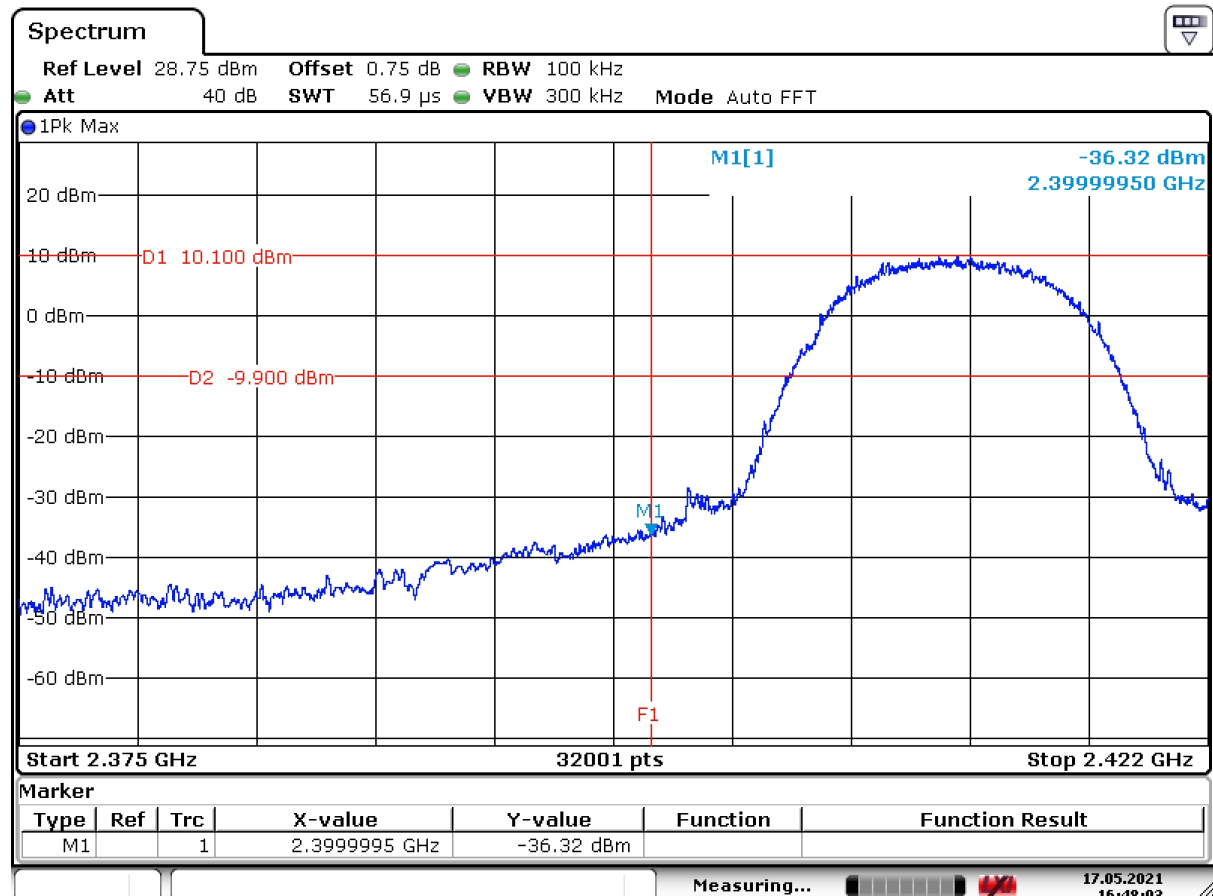
3.6.5 Measurement Uncertainty

± 0.93 dB.

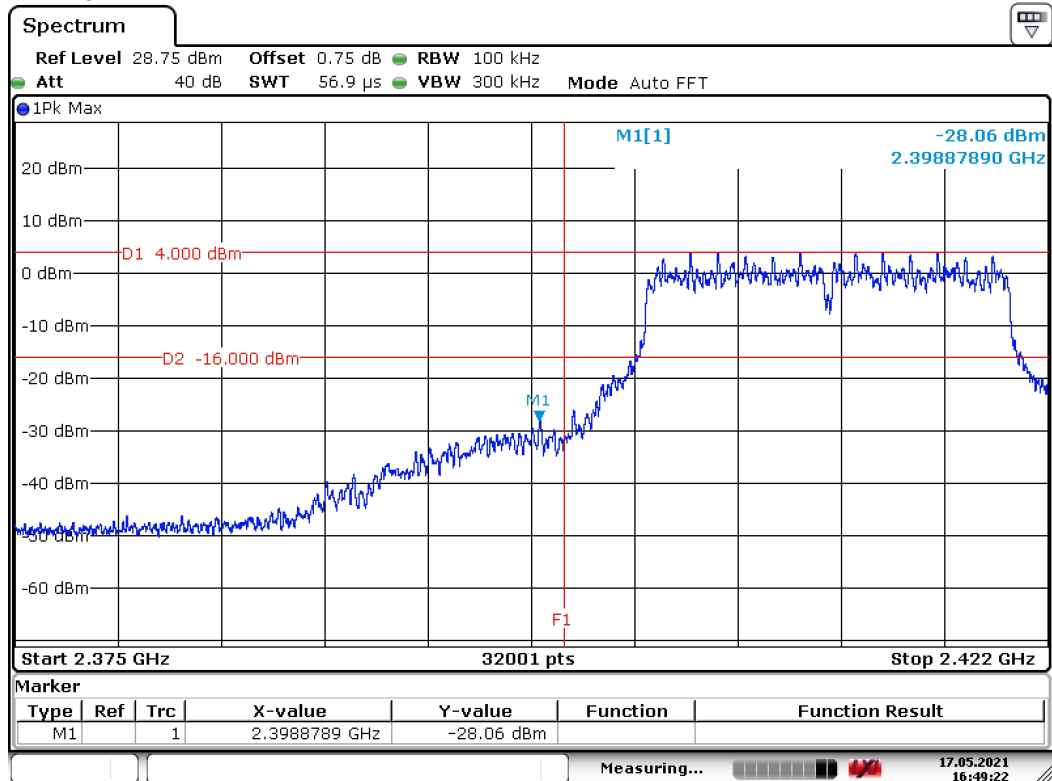
3.6.6 Plots of the Band edge Measurements

Note: Since the EUT only uses channel 1 (2412 MHz) for each 802.11 technology, only the lower band edge has been measured since the frequency of the upper band edge is much farther away from the transmission frequency than the lower band edge.

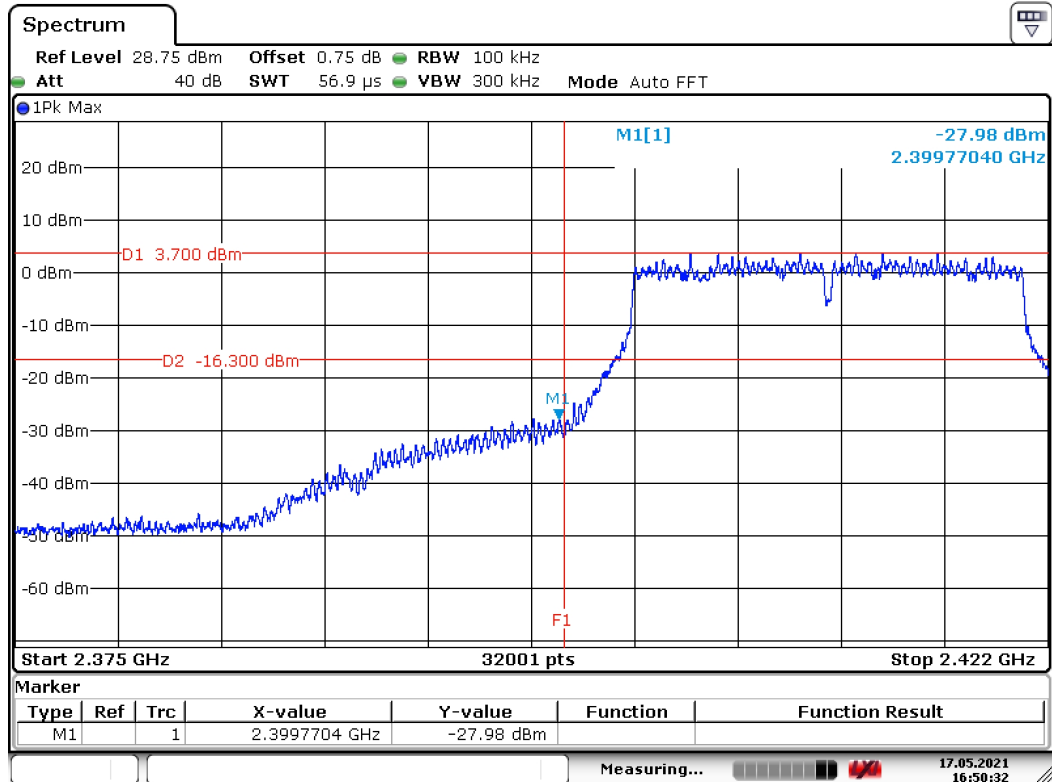
802.11b



802.11g



802.11n



3.7 Conducted emissions

3.7.1 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 (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

3.7.2 Measurement instruments

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

3.7.3 Test setup

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

3.7.4 Test procedure

According to ANSI C63.4: 2014, section 13.3

IRN 029 – Method 1

3.7.5 Test results and plots of the AC mains conducted measurement

See next page.

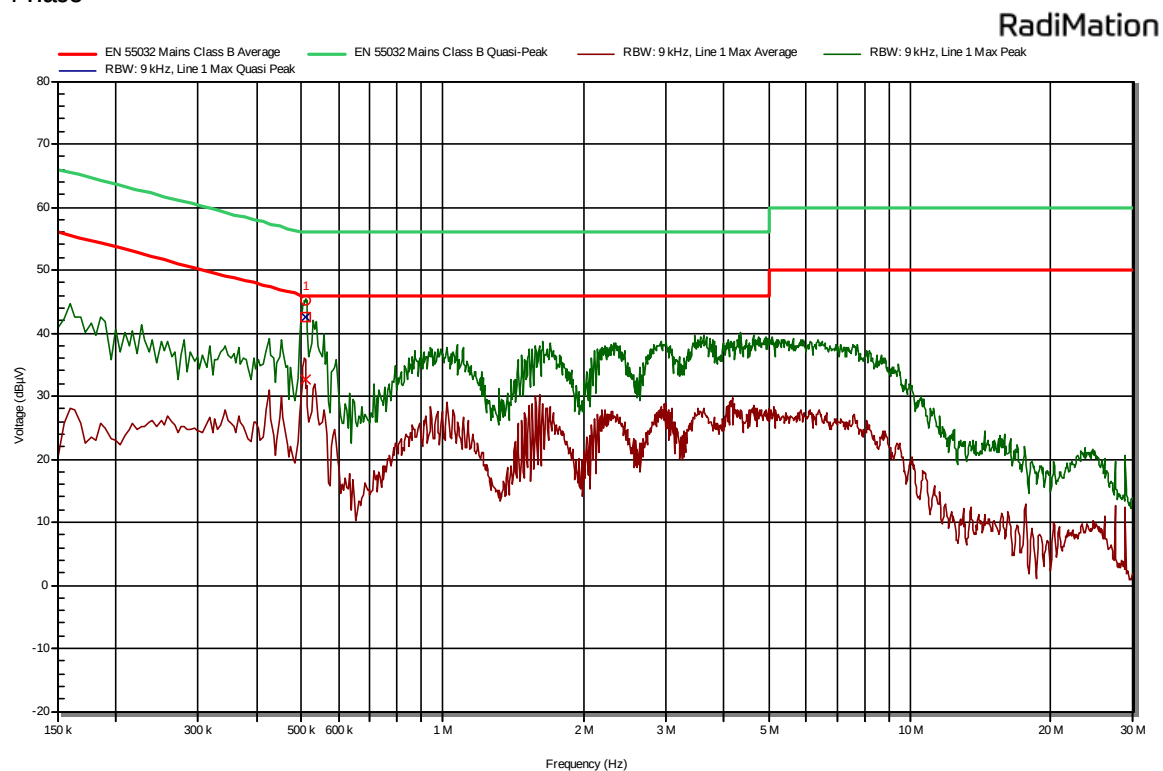
Note: AC mains conducted emissions are measured on a dedicated AC/DC adapter

3.7.6 Measurement uncertainty

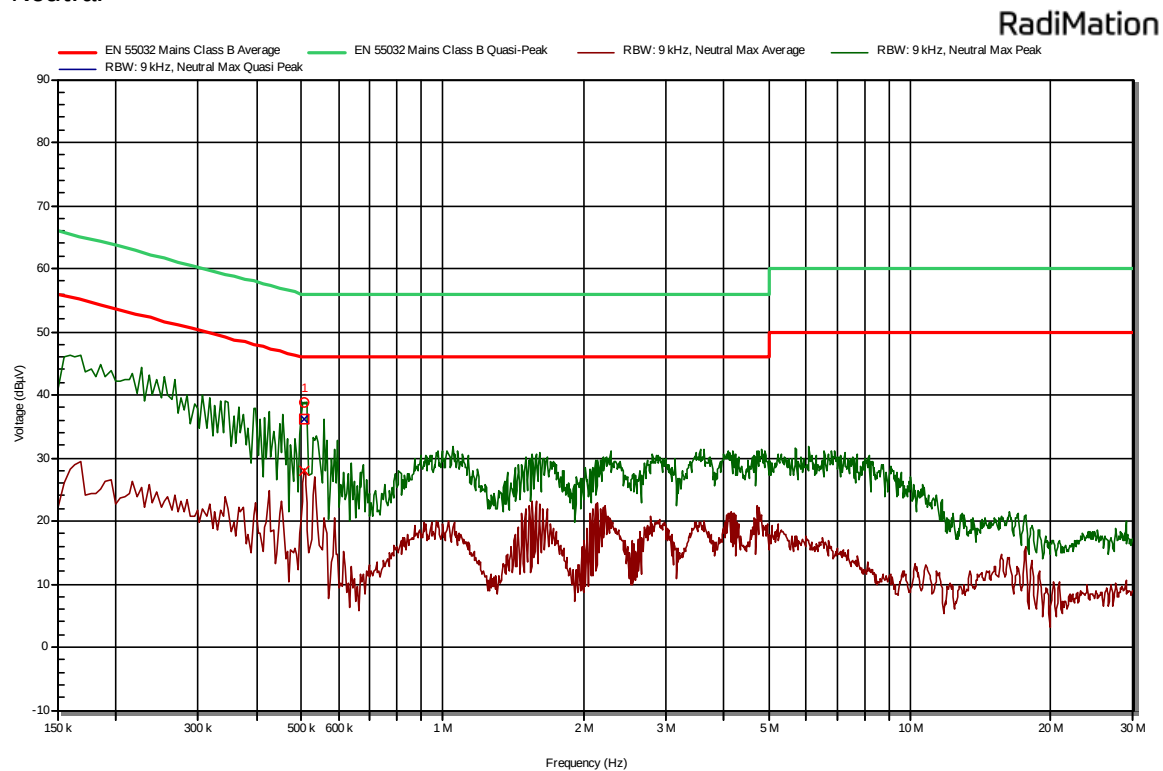
+/- 3.6 dB

3.7.7 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:

$$U_{\text{lisn}} (\text{dB}\mu\text{V}) = U (\text{dB}\mu\text{V}) + \text{Corr. (dB)}$$

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:

$$E \text{ (dB}\mu\text{V/m)} = U \text{ (dB}\mu\text{V)} + AF \text{ (dB/m)} + \text{Corr. (dB)}$$

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)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	TE 00531 Emco 3115 SN: 9412-4377	TE 11132 Miteq JS4-18004000-30-8P-A1	TE 01315	
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)	Gain (dB)	Cable loss (dB)	Corr. (dB)
	TE 00531 Emco 3115 SN: 9412-4377	TE 11132 Miteq JS4-18004000-30-8P-A1	TE 01315	
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