

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

Product name : WISR LR
Applicant : Orlaco
FCC ID : 2ADBX-PR1U
IC ID : 12390A-PR1U

Test report No. : 201001090 001 Ver 1.0

Laboratory information

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Documentation

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Testing Location

Test Site	Kiwa NV
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	02-12-2020	First draft	PvW
v1.00	11-01-2021	Initial release version	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 (b)	RSS-247 5.4 (d)	RF output power	3.2	Pass
15.247 (e)	RSS-247 5.2 (b)	Power spectral density	3.3	Pass
15.247 (d)	RSS-247 5.5	Band edge	3.4	Pass

1 General Description

1.1 Applicant

Client name:	Orlaco Products B.V.
Address:	Postbus 193, Barneveld, the Netherlands
Zip code:	3770 AD
Telephone:	0342 404 555
E-mail:	info@orlaco.nl
Contact name:	Mr. A. Canrinus

1.2 Manufacturer

Manufacturer name:	Orlaco Products B.V.
Address:	Postbus 193, Barneveld, the Netherlands
Zip code:	3770 AD
Telephone:	0342 404 555
E-mail:	compliance@orlaco.com
Contact name:	--

1.3 Tested Equipment Under Test (EUT)

Product name:	WISR LR
Brand name:	Orlaco
FCC ID:	2ADBX-PR1U
IC ID:	12390A-PR1U
Product type:	Wireless Send Receive Long Range
Model(s):	--
Batch and/or serial No.	--
Software version:	V1.1.2.8
Hardware version:	PR1UXXXXX
Date of receipt:	30-11-2020
Tests started:	30-11-2020
Testing ended:	30-11-2020

1.4 Product specifications of Equipment under test

Tx Frequency:	802.11n: 2400 – 2483.5 MHz
Rx frequency:	802.11n: 2400 – 2483.5 MHz
Antenna type	2x2 MIMO Patch antenna
Antenna gain	+6.5 dBiC = +3.5 dBi
Type of modulation:	OFDM
Emission designator	20M0F1D

1.5 Environmental conditions

Test date	30-11-2020
Ambient temperature	19.9°C
Humidity	30.5%

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 §15.109
- 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 equipment uses a pre-certified module 'Rambutan' with FCC ID Z9W-RMB.

The equipment is a modified version of the WISR, tested previously at Telefication as project no. 190501396

The manufacturer has changed the antennas to model: Pulse W3229.

This version of the WISR only uses IEEE 802.11n 20 MHz for communication.

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 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 : 11-01-2021

Name : ing P.A. Suringa

Function : Senior Test Engineer

Signature :



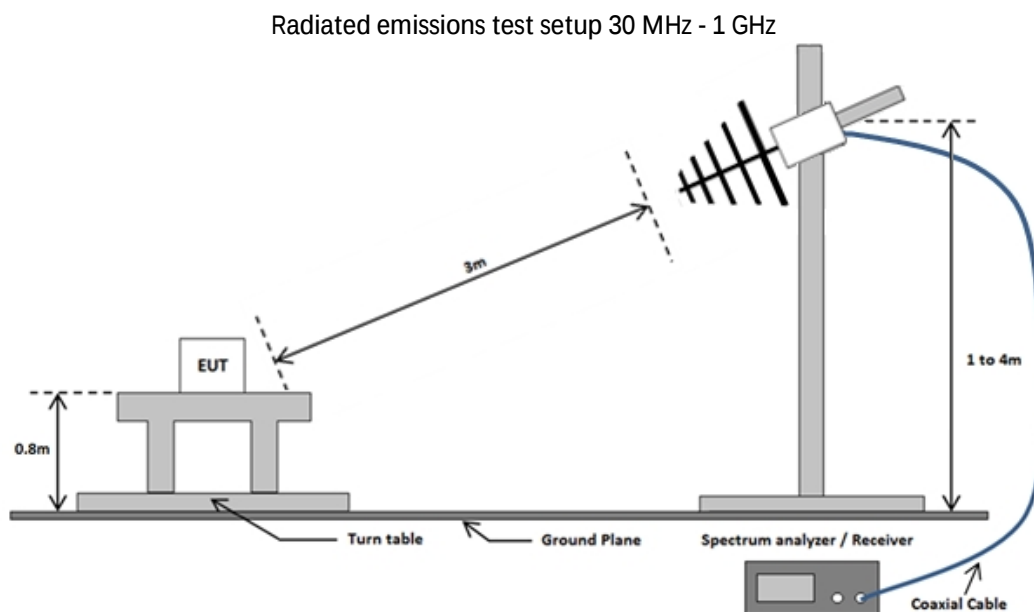
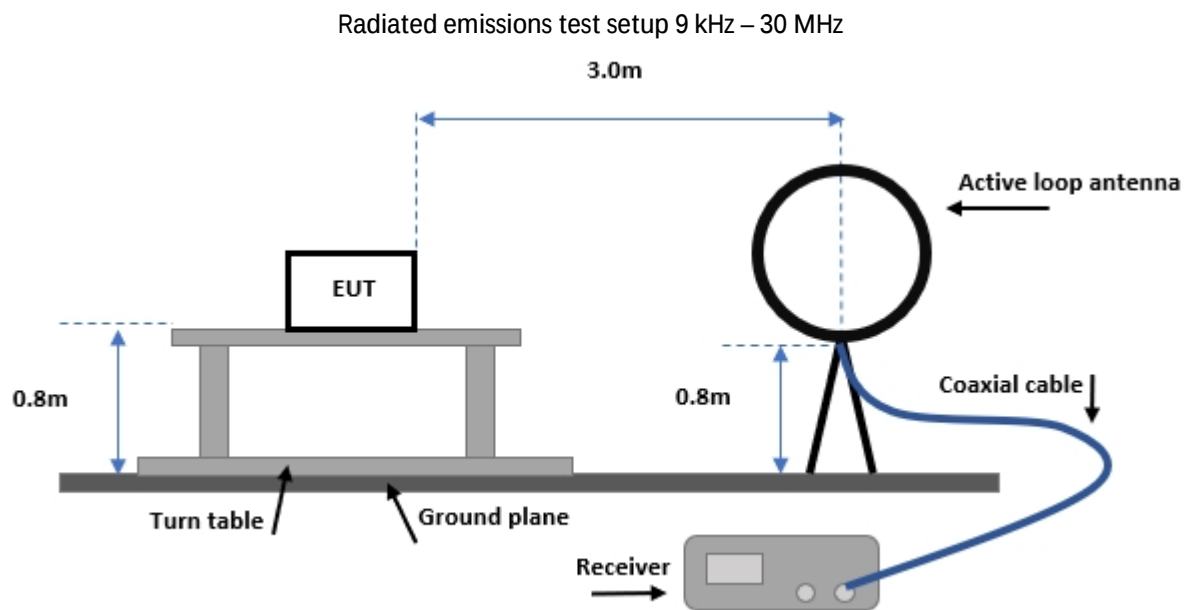
2 Test configuration of the Equipment Under Test

2.1 Test mode

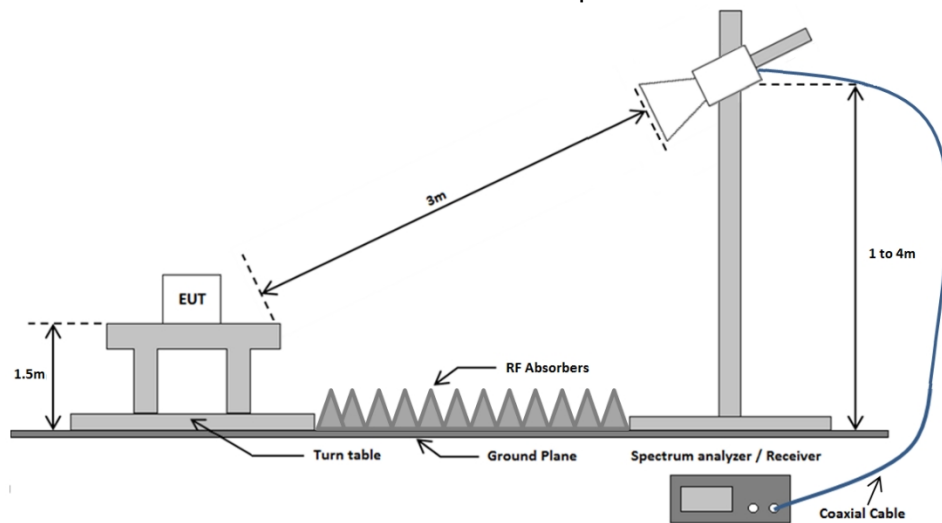
The manufacturer provided software with which it was possible to set the EUT to transmit at different operating channels. A camera streaming video was connected to the video input port, making sure the port was active during spurious emissions testing.

The software (Photoview) running on the tablet connected to the EUT had software version V.1.2.2.4-test.

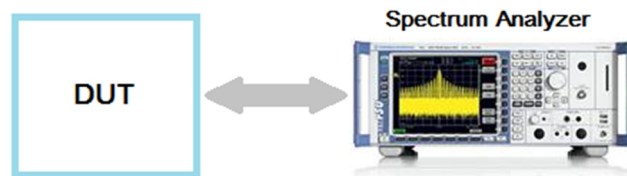
2.2 Test setups



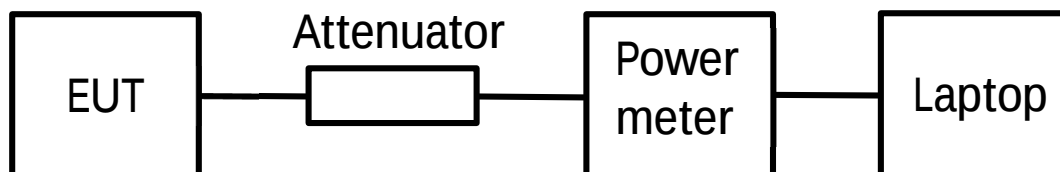
Radiated emissions test setup above 1 GHz



Band edge and PSD measurement



RF output power measurement



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
EMI Receiver	Rohde & Schwarz	ESR7	TE01220	3.1, 3.3, 3.4
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
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, 3.2
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800- 25-10P	TE11175	3.1
Preamplifier 18-26 GHz	Miteq	Js4-18004000-30- 8P-8SS	TE11131	3.1
Signal generator	Rohde & Schwarz	SMB100a		3.2
RF power meter	DARE instruments	RPR3006W	TE11140	3.2

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 Results of the radiated spurious emissions measurement

Measured peaks Vertical 30 – 1000 MHz Low channel

Frequency	Polarization	Height	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference
45,745 MHz	Vertical	1 m	27,6 dB μ V/m	40 dB μ V/m	-12,4 dB

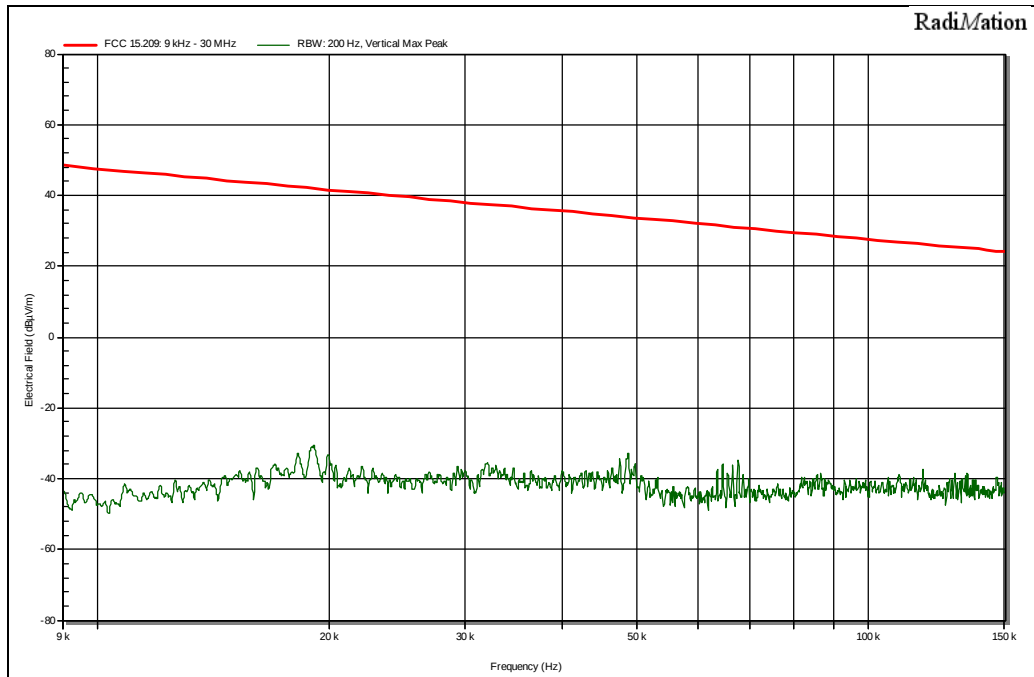
Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
4,828 GHz	Vertical	3,5 m	49,3 dB μ V/m	32,9 dB μ V/m	74 dB μ V/m	54 dB μ V/m	-24,7 dB	-21,1 dB

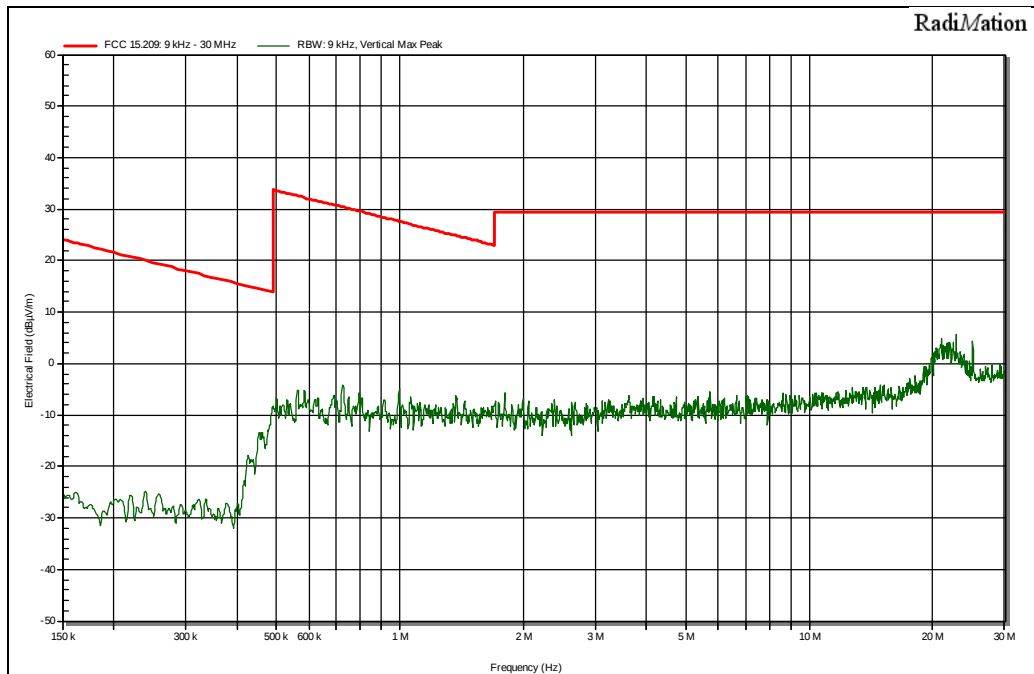
3.1.7 Plots of the Radiated Spurious Emissions Measurement

9 kHz to 150 kHz

Parallel

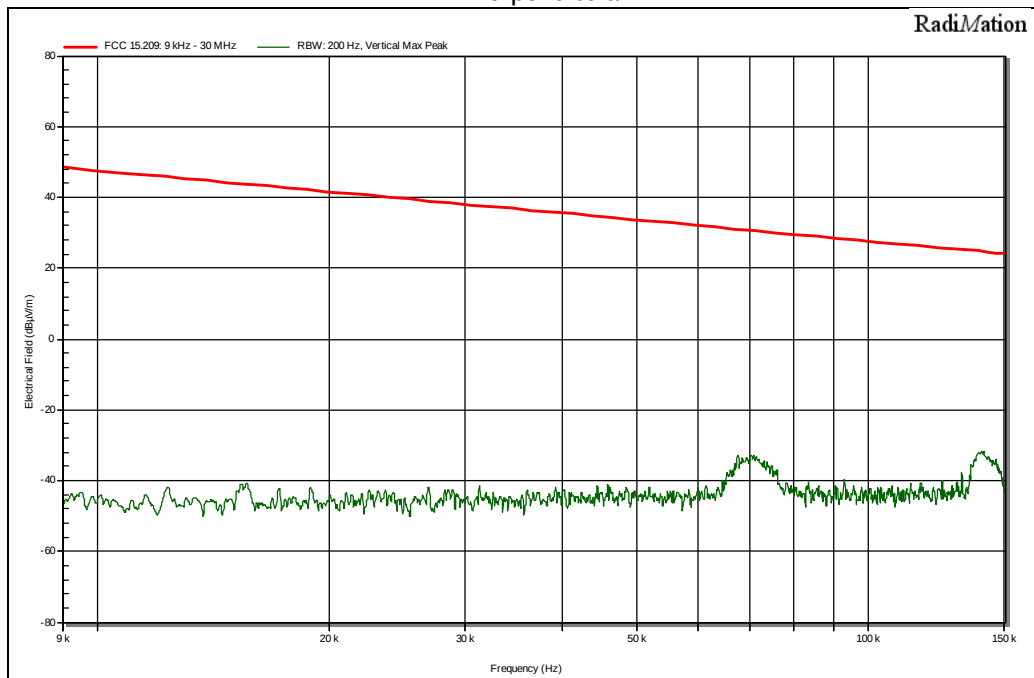


150 kHz to 30 MHz

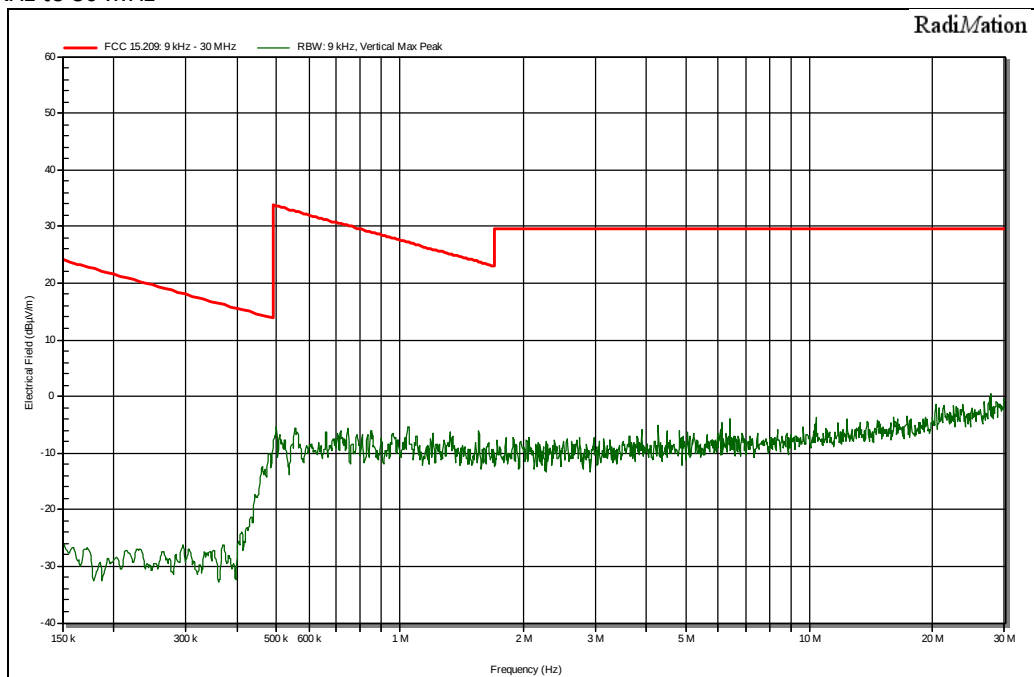


9 kHz to 150 kHz

Perpendicular

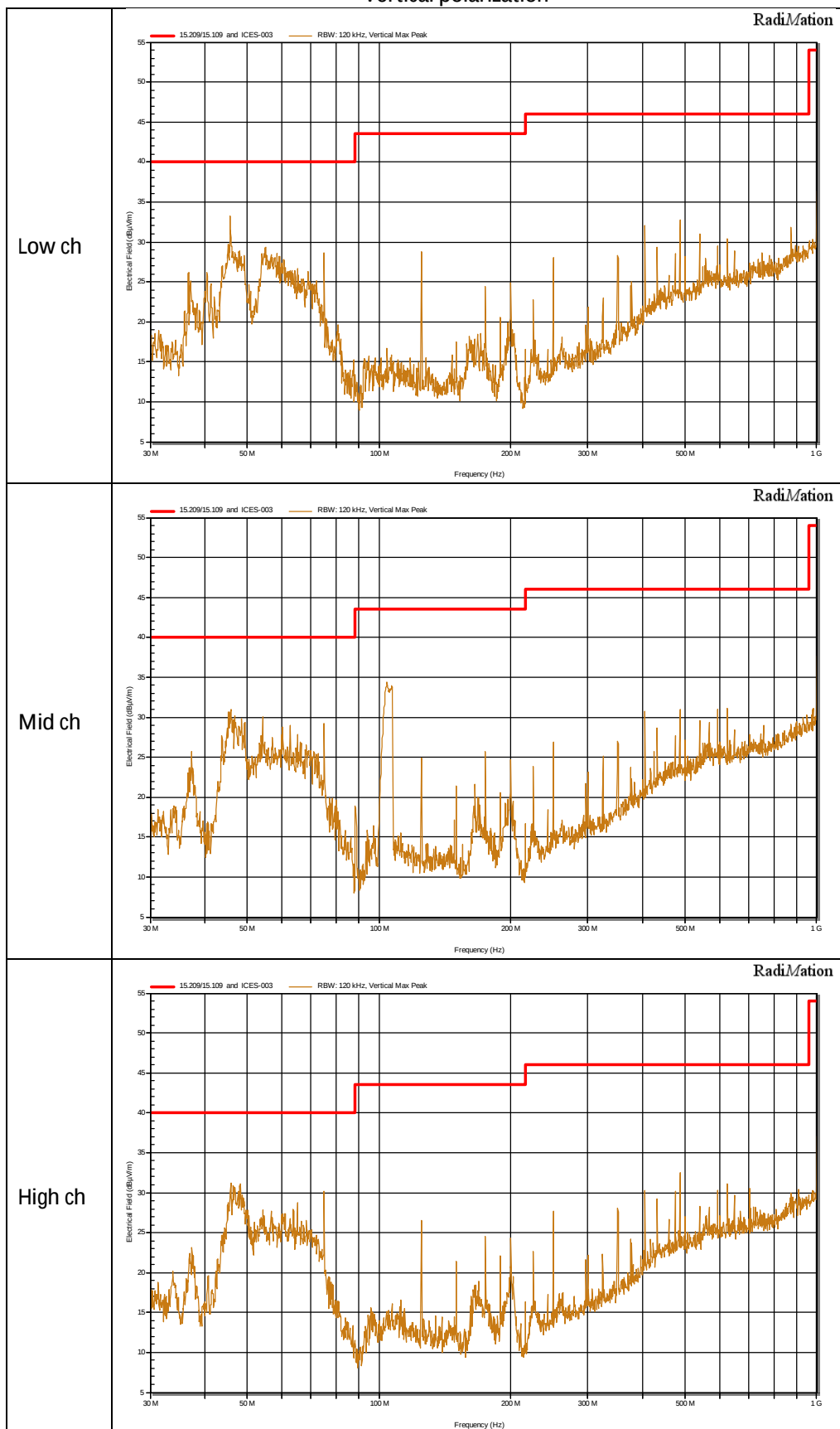


150 kHz to 30 MHz



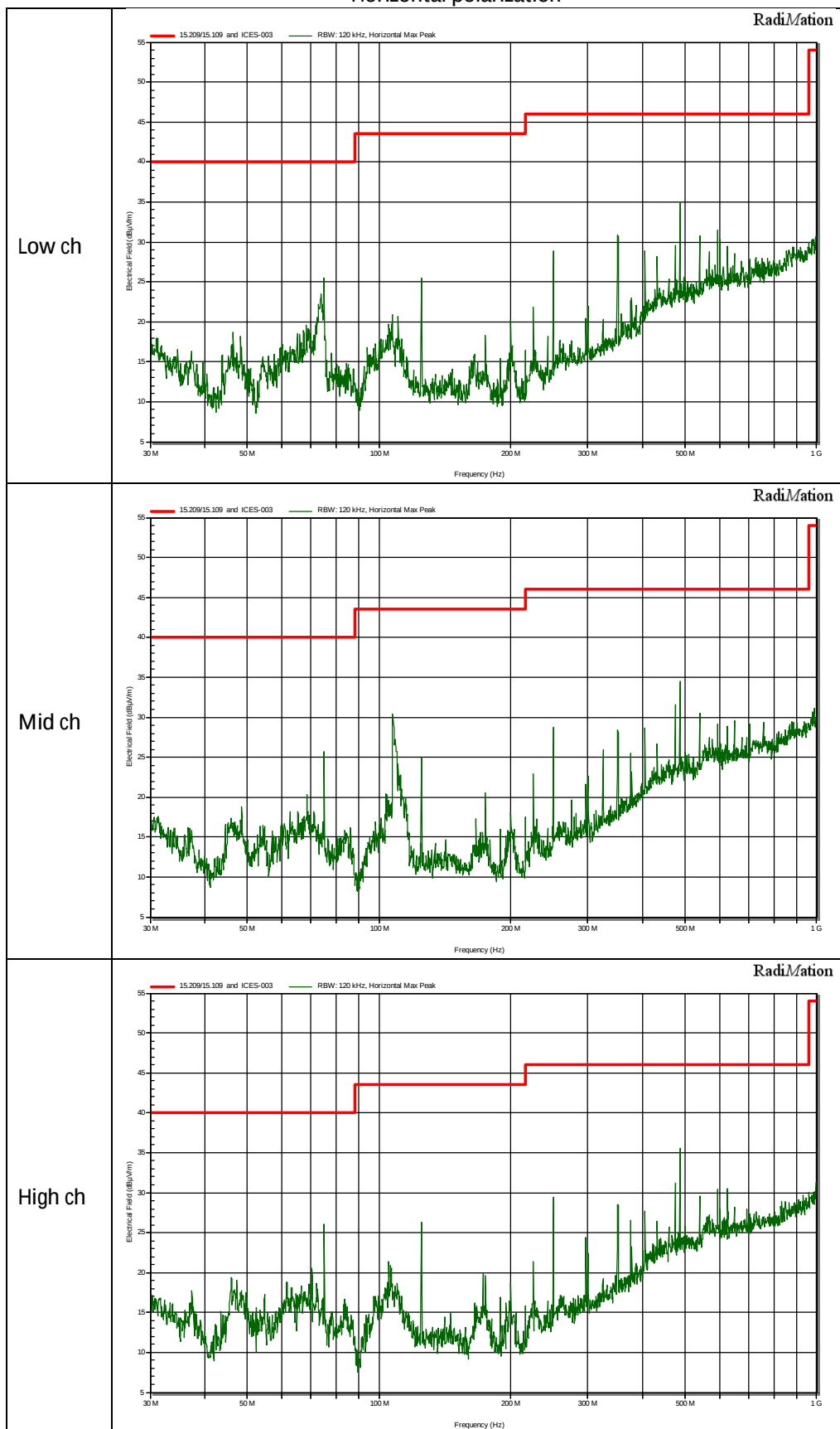
30 MHz to 1 GHz

Vertical polarization



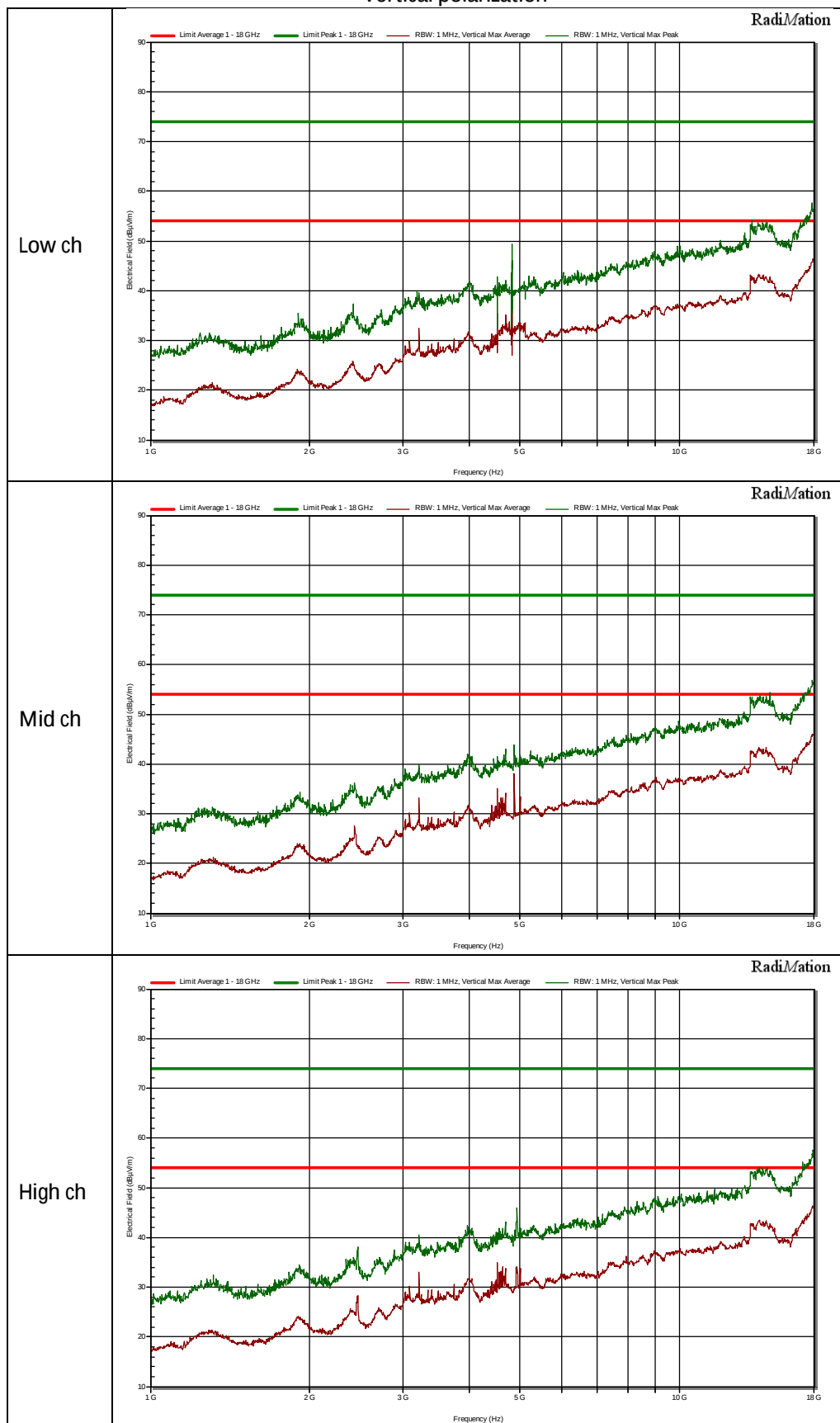
30 MHz to 1 GHz

Horizontal polarization



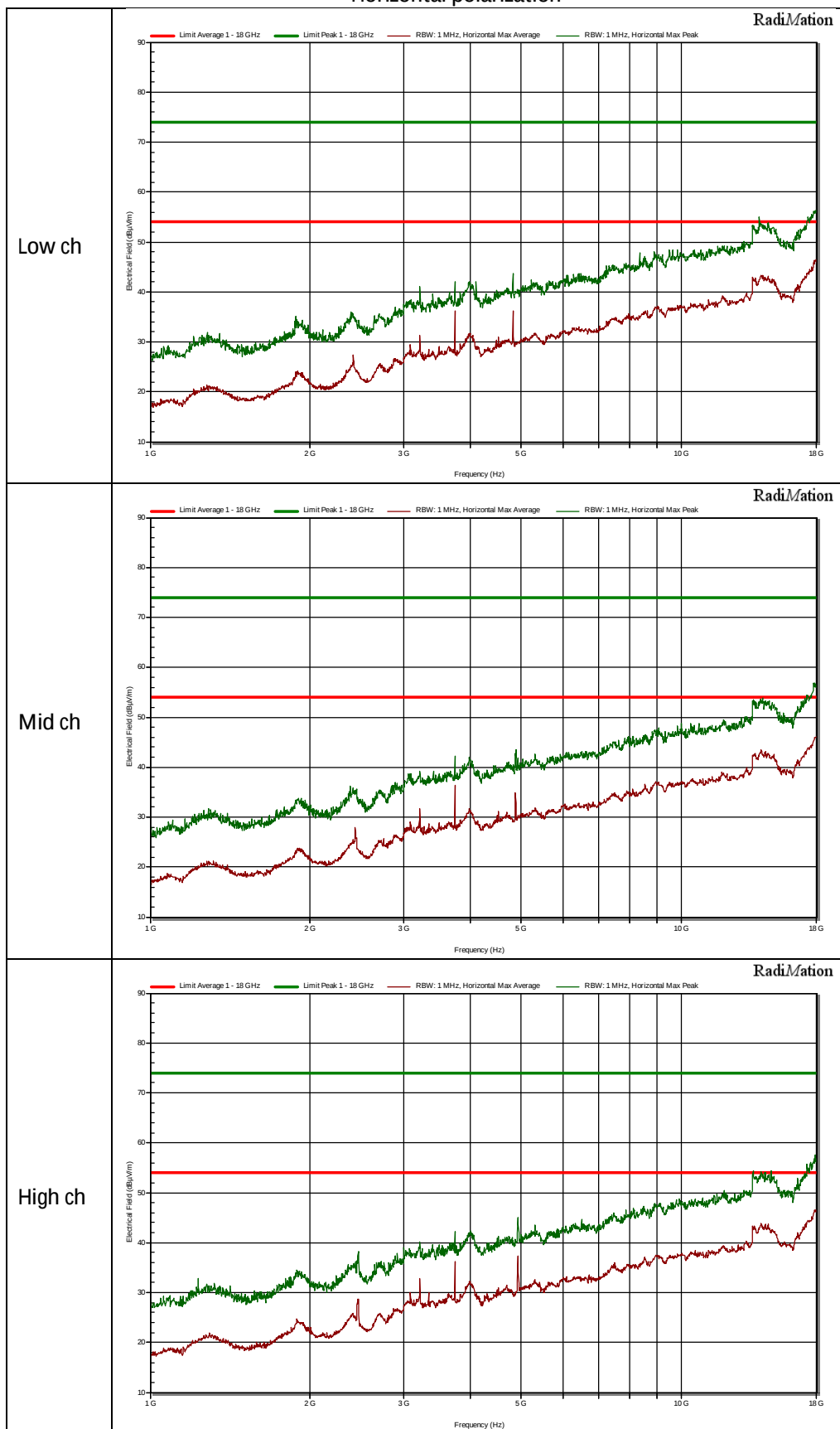
1 GHz to 18 GHz

Vertical polarization



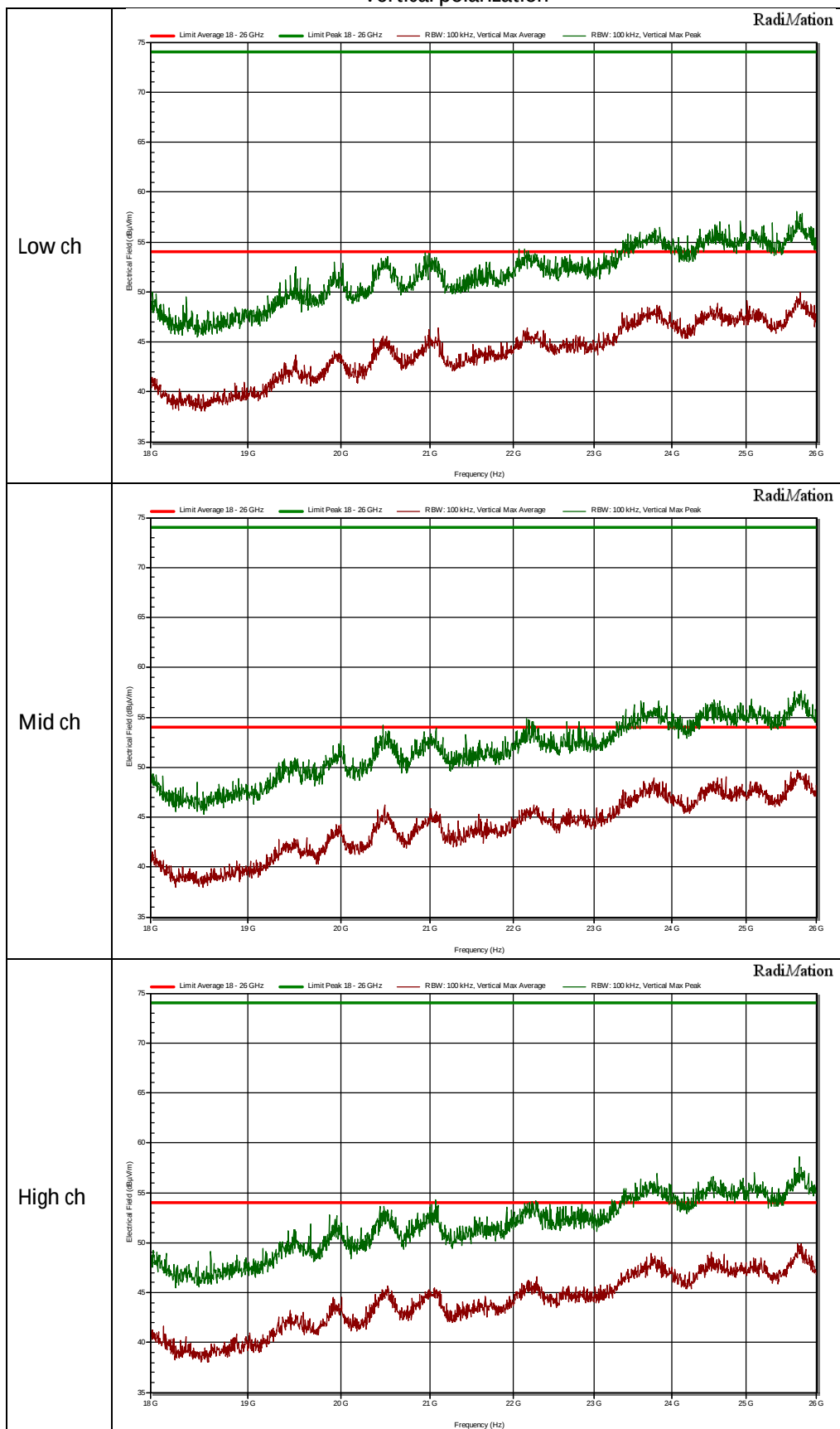
1 GHz to 18 GHz

Horizontal polarization



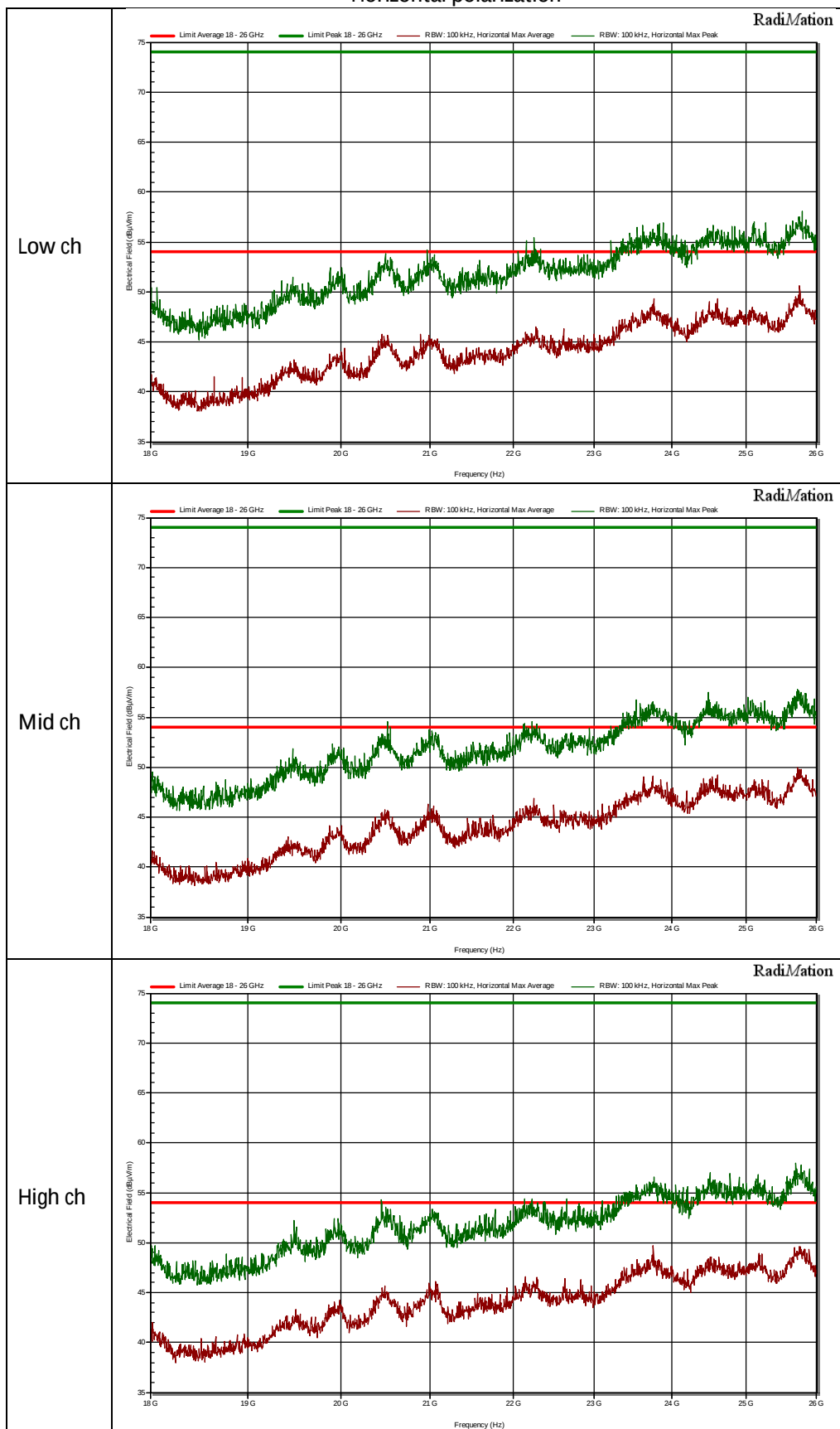
18 GHz to 26 GHz

Vertical polarization



18 GHz to 26 GHz

Horizontal polarization



3.2 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

3.2.5 Test results of Output Power Measurement

Peak method

Antenna port 1

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
802.11n	1	2412	Up to 150 Mbps	17.3
	6	2437	Up to 150 Mbps	17.0
	11	2462	Up to 150 Mbps	17.2
Uncertainty	±0.71 dB			

Antenna port 2

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
802.11n	1	2412	Up to 150 Mbps	19.0
	6	2437	Up to 150 Mbps	18.3
	11	2462	Up to 150 Mbps	18.1
Uncertainty	±0.71 dB			

Total output power

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
802.11n	1	2412	Up to 150 Mbps	21.2
	6	2437	Up to 150 Mbps	20.7
	11	2462	Up to 150 Mbps	20.7
Uncertainty	±0.71 dB			

Note: the total output power is calculated by summing the peak output power of the antenna ports in linear units (mW) and converting the resulting power back to logarithmic values (dBm) using the equation below.

$$P_{tot}(dBm) = 10 * \log_{10} \left[10^{\frac{P_{ant1}(dBm)}{10}} + 10^{\frac{P_{ant2}(dBm)}{10}} \right]$$

P_{tot} is the total output power

P_{antX} is the output power of each antenna port

3.2.6 Total output power E.I.R.P.

By customer request the total radiated output power has been measured in addition to the conducted output power.

The measurement has been performed using the substitution method in ANSI C63.10-2013, clause G5.3

Total output power

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power E.I.R.P. (dBm)
802.11n	1	2412	Up to 150 Mbps	19.0
	6	2437	Up to 150 Mbps	20.6
	11	2462	Up to 150 Mbps	18.6
Uncertainty	± 3.8 dB			

3.3 Power Spectral Density

3.3.1 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.

3.3.2 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

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)

3.3.5 Test results of Power Spectral Density Measurement

Antenna port 1

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak PSD (dBm/3 kHz)
802.11n	1	2412	Up to 150 Mbps	-7.9
	6	2437	Up to 150 Mbps	-9.2
	11	2462	Up to 150 Mbps	-7.7
Uncertainty	±2.0 dB			

Antenna port 2

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak PSD (dBm/3 kHz)
802.11n	1	2412	Up to 150 Mbps	-5.2
	6	2437	Up to 150 Mbps	-6.7
	11	2462	Up to 150 Mbps	-7.8
Uncertainty	±2.0 dB			

Total PSD

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak PSD (dBm/3 kHz)
802.11n	1	2412	Up to 150 Mbps	-3.3
	6	2437	Up to 150 Mbps	-4.8
	11	2462	Up to 150 Mbps	-4.8
Uncertainty	±2.0 dB			

Note: the total PSD is calculated by summing the peak PSD of the antenna ports in linear units (mW/3 kHz) and converting the resulting power back to logarithmic values (dBm/3 kHz) using the equation below.

$$P_{tot}(dBm) = 10 * \log_{10} \left[10^{\frac{P_{ant1}(\frac{dBm}{3 kHz})}{10}} + 10^{\frac{P_{ant2}(\frac{dBm}{3 kHz})}{10}} \right]$$

3.4 Band edge Measurement

3.4.1 Limit

Band edge:

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

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, sections 11.3 and 12.1.
IRN 026 - Radiated electrical disturbance (V per m) Method 6 – Radiated electrical disturbance at the Authorized band edge.

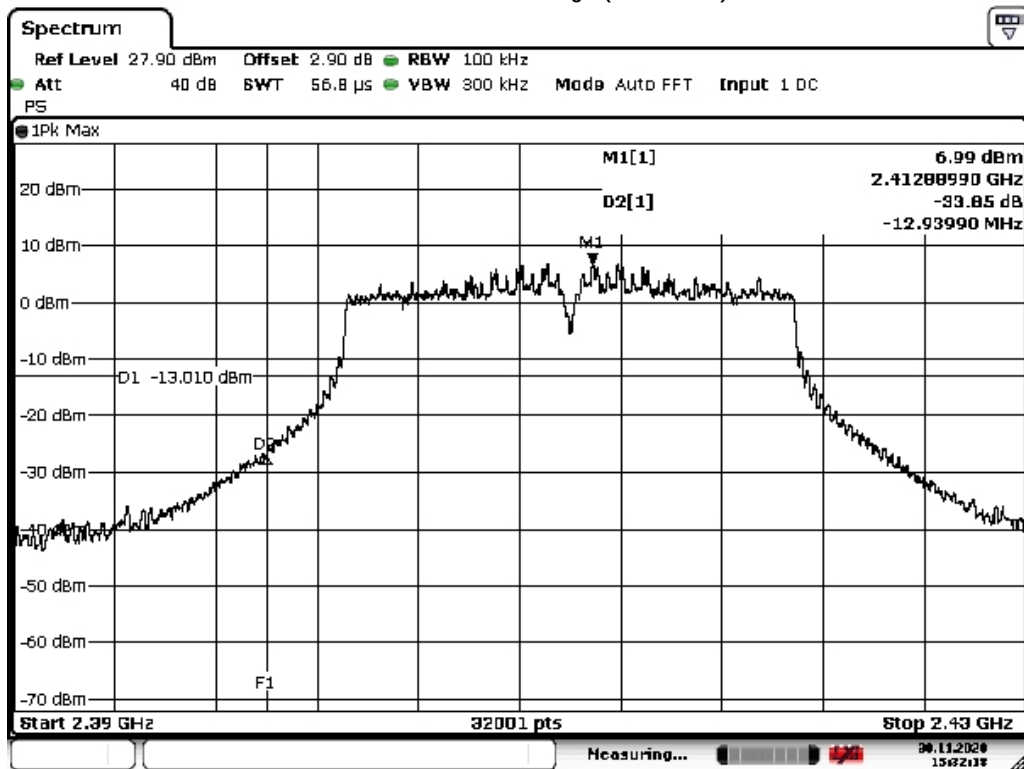
3.4.5 Measurement Uncertainty

± 5.7 dB.

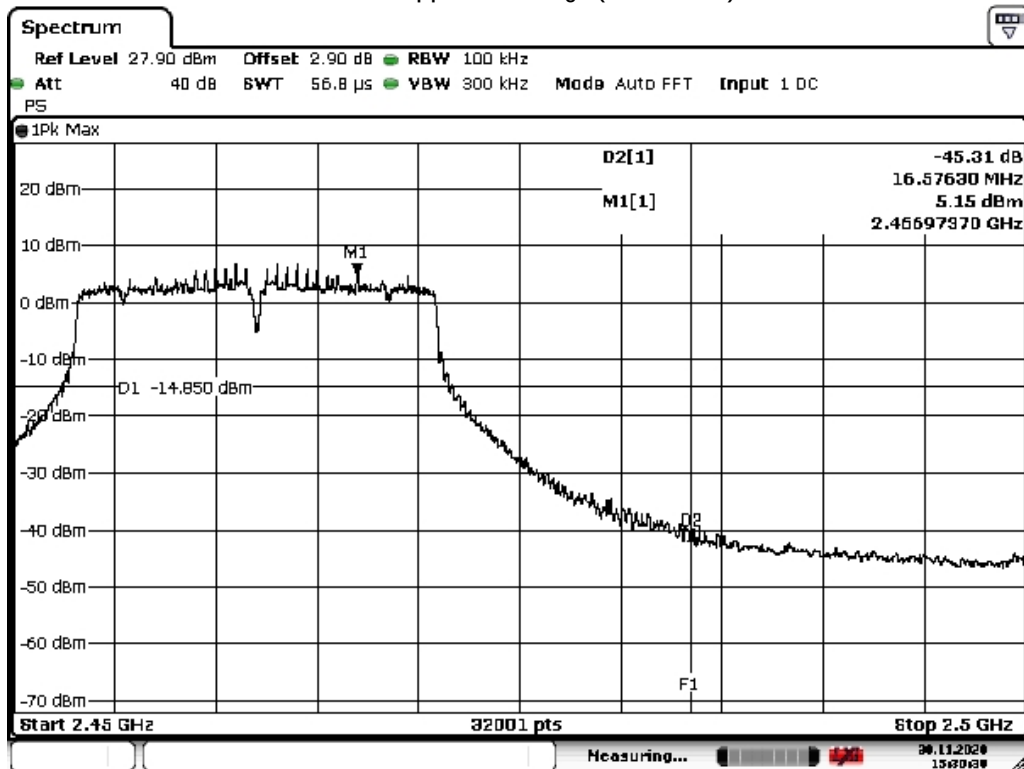
3.4.6 Plots of the Band edge Measurements

See next page

Antenna 1 802.11n Lower band edge (Channel 1)

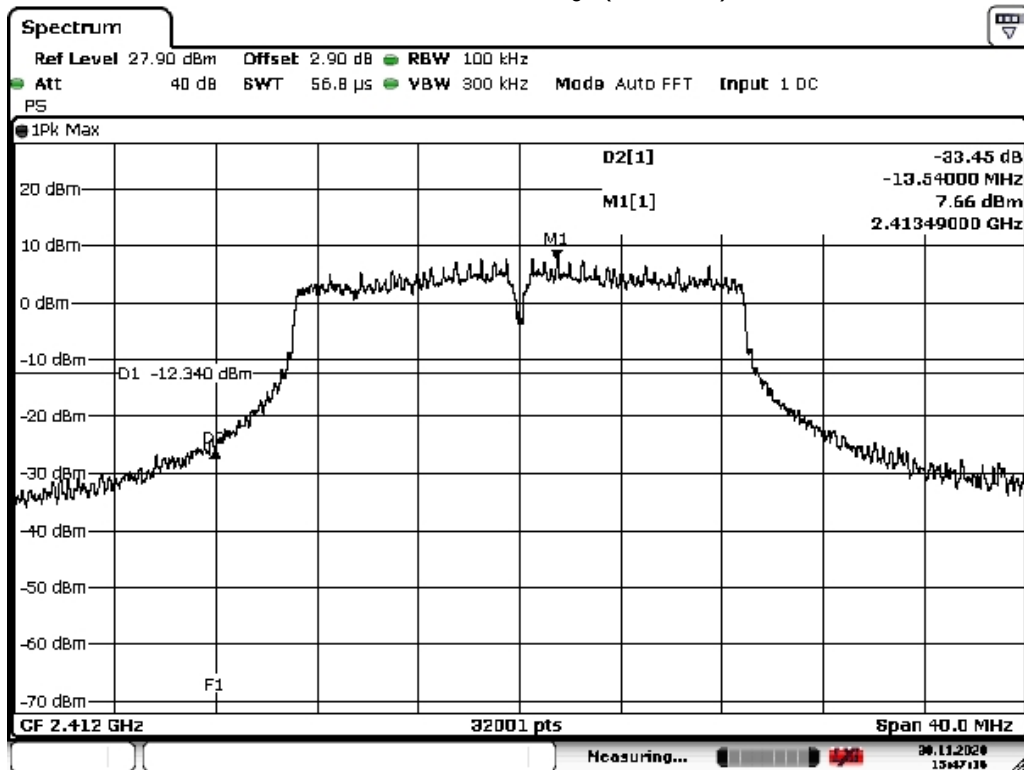


802.11n Upper band edge (Channel 11)

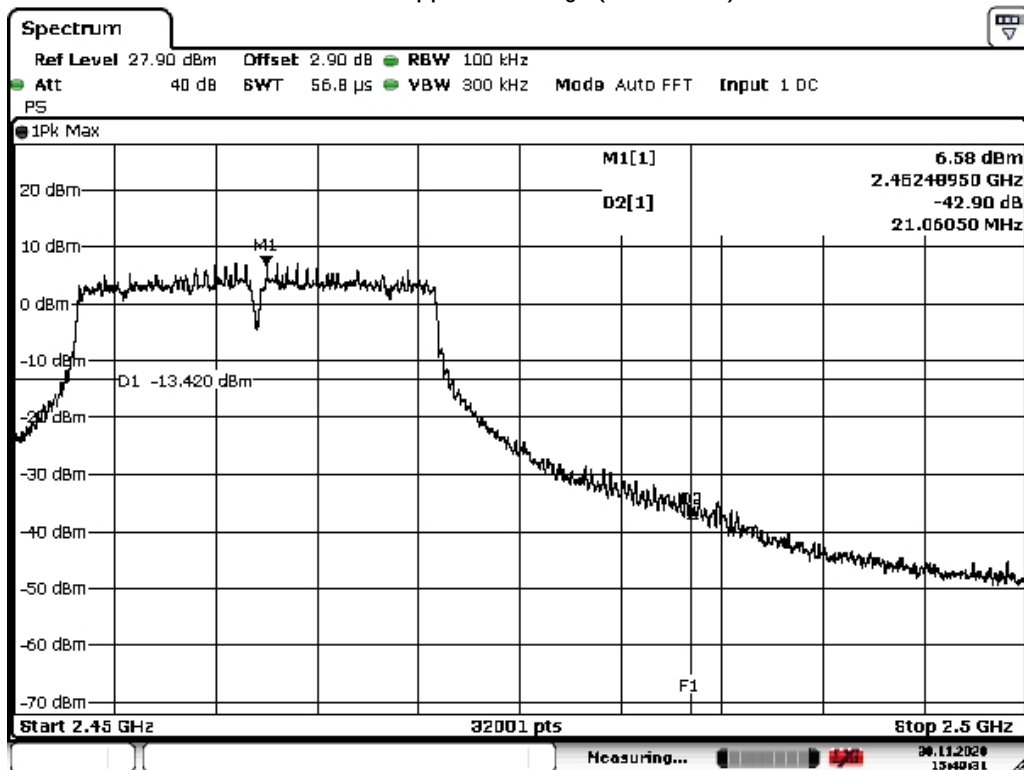


Antenna 2

802.11n Lower band edge (Channel 1)



802.11n Upper band edge (Channel 11)



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)	Cable loss (dB)	Corr. (dB)
	TE 00967 Chase CBL6112A SN: 2308	Id: SAR cable	
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