

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

Product name : SC 358 E3 Connect
Applicant : Lukas Hydraulik GmbH
FCC ID : 2A3RJ-E3CS
IC : 27976-E3CS

Test report No. : 210300633 001 Ver 3.00

Laboratory information

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Documentation

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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
v0.50	18-06-2021	First draft	R.T
v1.00	08-10-2021	Final version	R.T
V2.00	22-12-2021	Updated FCC + ISED ID	R.T
V3.00	22-03-2022	Updated : Updated standards on clause 1.6 and 3.1.4 Updated antenna gain clause 1.4 Updated observations on clause 1.8 Added RF output measurement	R.T

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247(d) 15.109(a) 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: Lukas Hydraulik GmbH
Address: Weinstrasse 39, 91058 Erlangen, Germany
Telephone: +49 9131 / 698 - 274
E-mail: tlittwin@idexcorp.com
Contact name: Thomas Littwin

1.2 Manufacturer

Manufacturer name: Hurst Jaws of Life INC
Address: 711 North Post Road, 28150, NC, Shelby, USA
Telephone: +1 800 537 3645
E-mail: thorne@idexcorp.com
Contact name: Tammy Horne

1.3 Tested Equipment Under Test (EUT)

Product name: SC 358 E3 Connect
Brand name: HURST Jaws of Life
FCC ID: 2A3RJ-E3CS
IC: 27976-E3CS
Product type: Hydraulic Rescue Tool
Model(s): See next page
Batch and/or serial No. See next page
Software version: -
Hardware version: -
Date of receipt 08-06-2021
Tests started: 14-06-2021
Testing ended: 17-06-2021

Overview of variant models

Model overview

OEM/Variant	Description	Trademark	Type Designation
Variant	Hydraulic Rescue Tool	HURST	S 378 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	S 789 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	S 799 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	SC 258 E3 Connect
OEM	Hydraulic Rescue Tool	HURST	SC 358 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	SC 758 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	SP 333 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	SP 555 E3 Connect
Variant	Hydraulic Rescue Tool	HURST	SP 777 E3 Connect

1.4 Product specifications of Equipment under test

Tx Frequency:	2400 -2483,5 MHz
Rx frequency:	2400 -2483,5 MHz, 1575.42 MHz
Antenna type:	Meandering PCB
Antenna gain:	3.7 dBi
Type of modulation:	GFSK,QPSK
Emission designator	BT:1M15F1D WiFi :1M53G1D,16M5D1D, 17M7D1D, 36M3D1D

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

1.5 Environmental conditions

Test date	14-06-2021
Ambient temperature	21°C
Humidity	48 %

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 §15.109
- 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 manufacturer provided test mode firmware to set the EUT to transmit or receive continuously. The EUTs are battery powered and the manufacturer declared that the batteries are pre certified. Radio testing of the 2,4 GHz WiFi, BT, and GPS radio module based on pre certified radio, so verification testing only. Therefore only radiated spurious emission were tested. The RF output power has been tested in the worst case scenario.

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, MSc under supervision of P. van Wanrooij, BASc

Review of test methods and report by:

Name : ing. R. van Barneveld

The above conclusions have been verified by the following signatory:

Date : 23-05-2022

Name : Koray Korcum, MSc

Function : Test engineer

Signature :

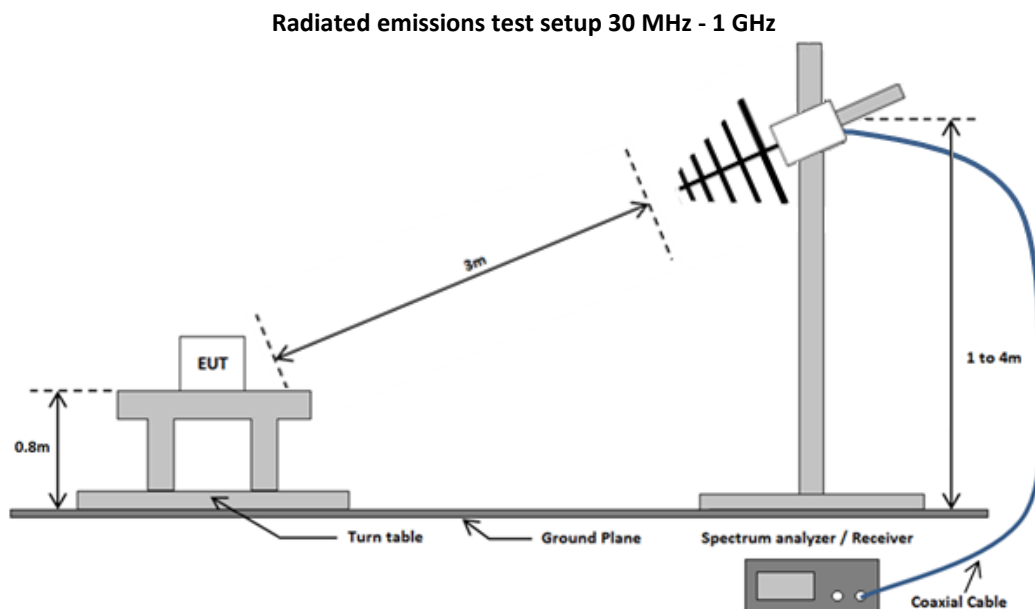
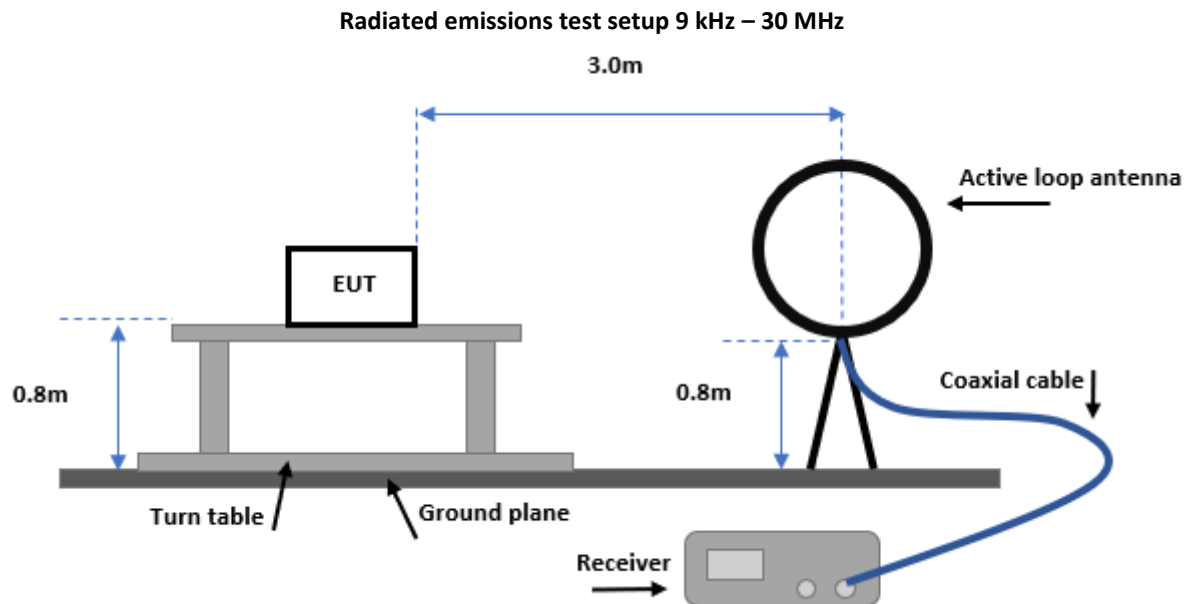
A handwritten signature in blue ink, appearing to read "K. Korcum", enclosed within a blue circular stamp.

2 Test configuration of the Equipment Under Test

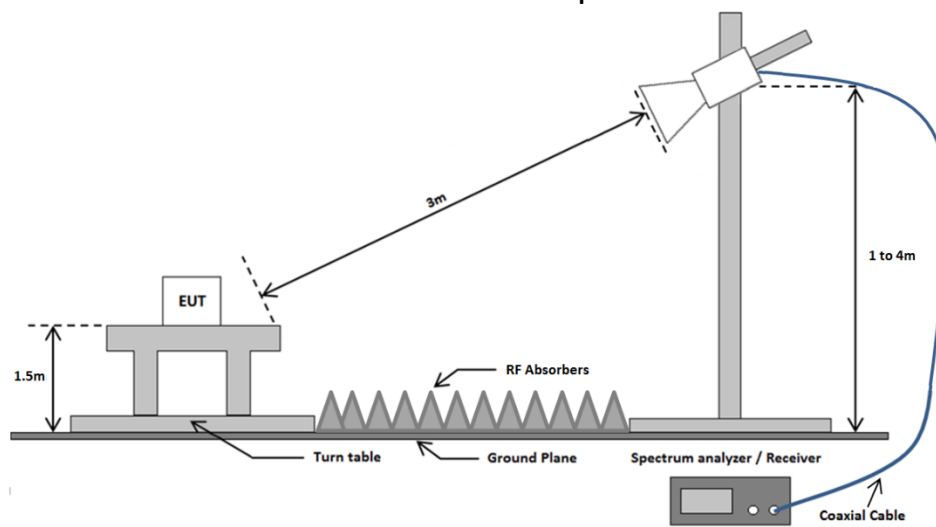
2.1 Test mode

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

2.2 Test setups



Radiated emissions test setup above 1 GHz



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.	Due date	Cal date
EMI Receiver	Rohde & Schwarz	ESCI	TE11128	3.1	Feb 2022	Feb 2021
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	3.1	Mar 2022	Mar 2020
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	TE01140	3.1	N.A	N.A
Active loop antenna	EMCO	6502	TE11171	3.1	Jan 2024	Jan 2022
Biconilog antenna	Chase	CBL6112A	TE00967	3.1	Mar 2023	Mar 2021
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	TE11175	3.1	Feb 2022	Jan 2022
Horn antenna	FLANN-MICROWAVE	20240-25	TE 00818	3.1	N.A [*]	N.A [*]
Preamplifier 18-26 GHz	Miteq	JS4-18004000-33-8P	TE 11131	3.1	Feb 2022	Jan 2022

* 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 ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	$20*\{\log[2400]-\log[F(\text{kHz})]\}$	300*
0.490 – 1.705	24000/F(kHz)	$20*\{\log[24000]-\log[F(\text{kHz})]\}$	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 C63.10-2013, 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

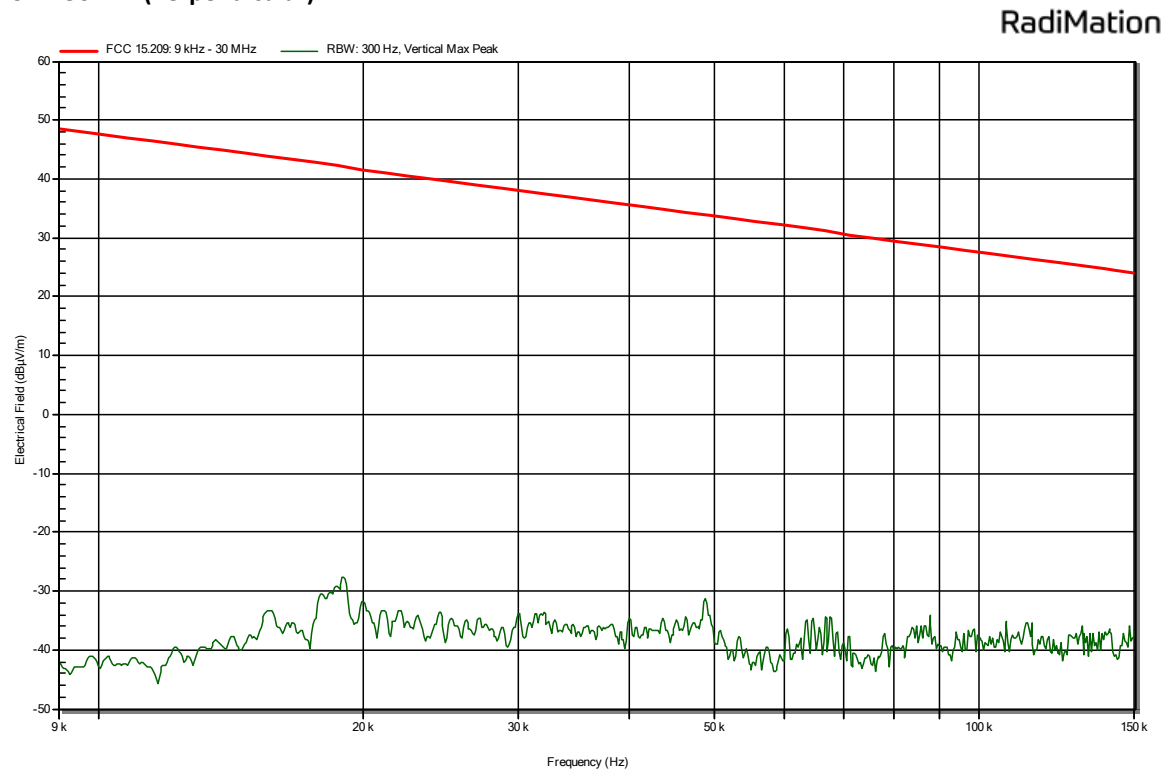
18 to 26.5 GHz: IRN 026 – Method 3

3.1.5 Measurement Uncertainty

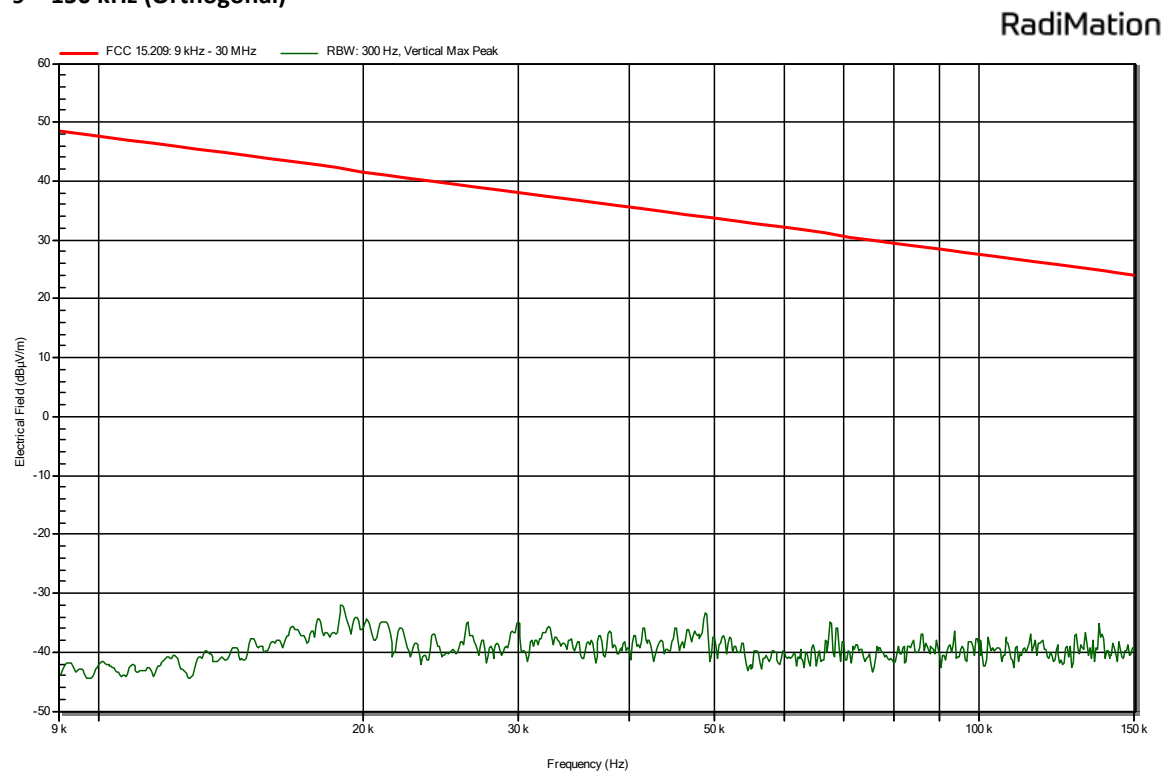
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	± 1.6 dB
30 – 200 MHz	Horizontal	± 4.5 dB
	Vertical	± 5.4 dB
200 -1000 MHz	Horizontal	± 3.6 dB
	Vertical	± 4.6 dB
1 – 18 GHz	Horizontal	± 5.7 dB
	Vertical	± 5.7 dB
18 – 26.5 GHz	Horizontal	± 4.9 dB
	Vertical	± 4.9 dB

3.1.6 Plots of the Radiated Spurious Emissions Measurement (WIFI B)

9 – 150 kHz (Perpendicular)

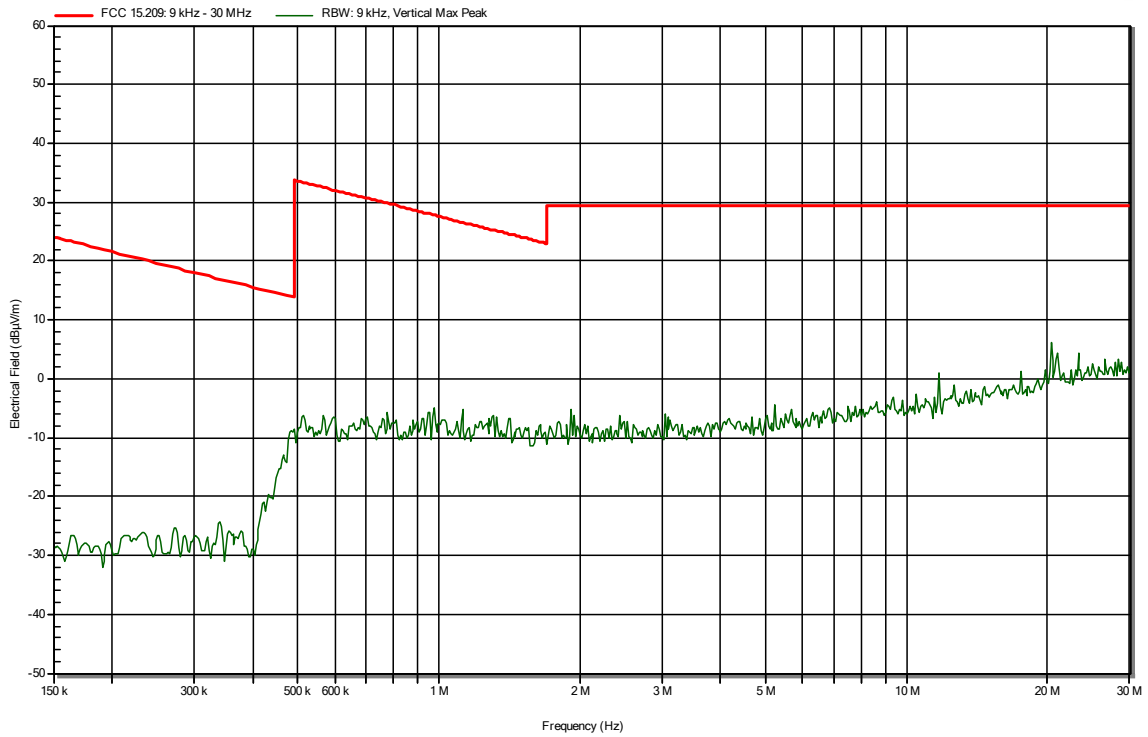


9 – 150 kHz (Orthogonal)



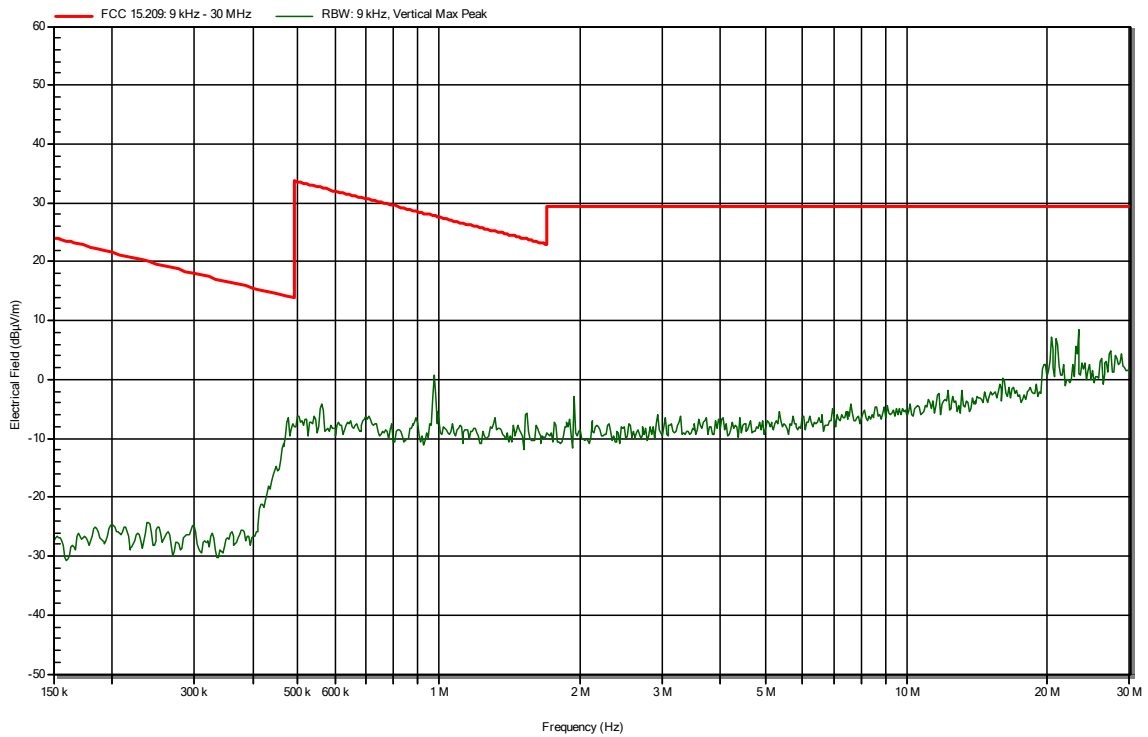
150 kHz – 30 MHz (Perpendicular)

RadiMation



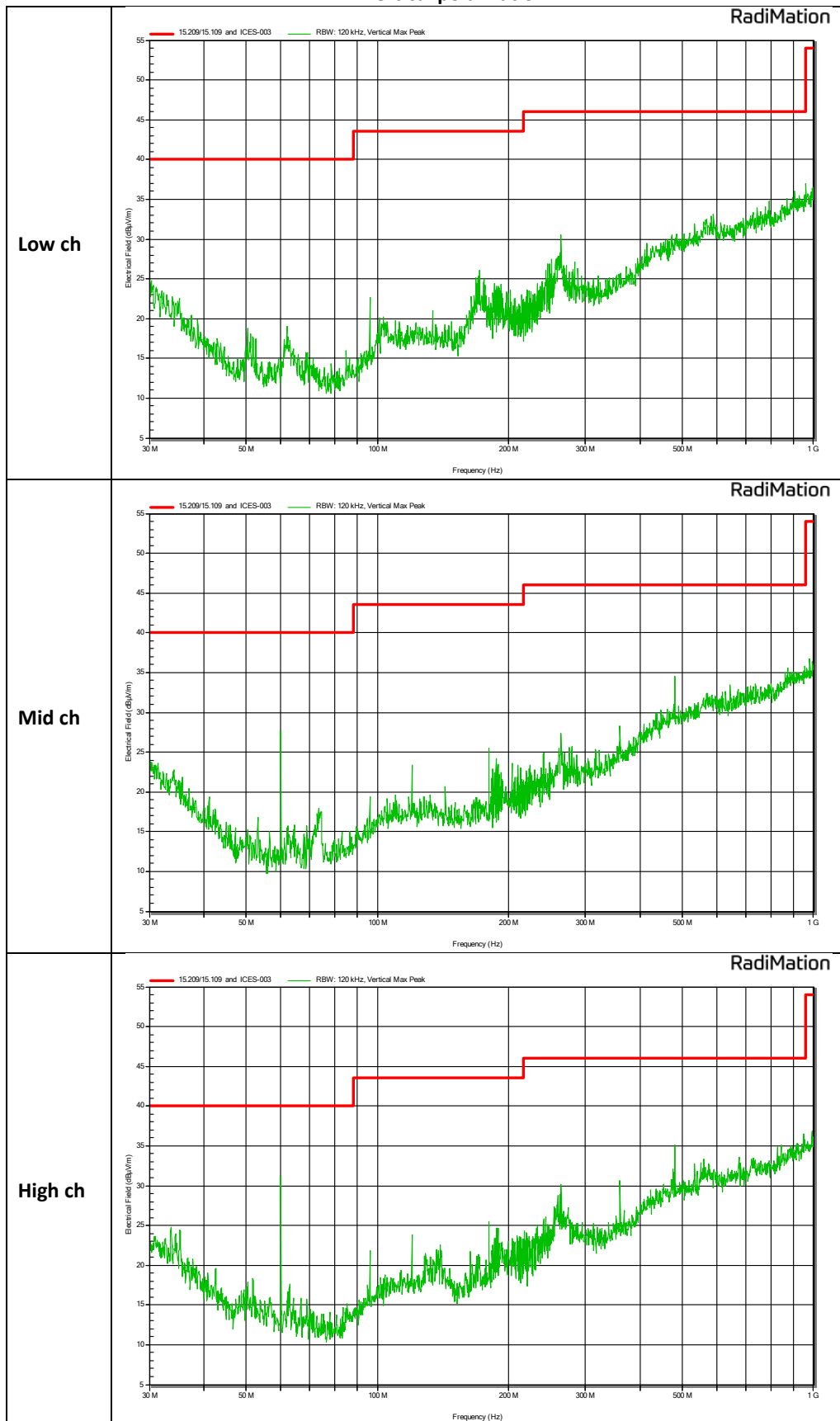
150 kHz – 30 MHz (Orthogonal)

RadiMation



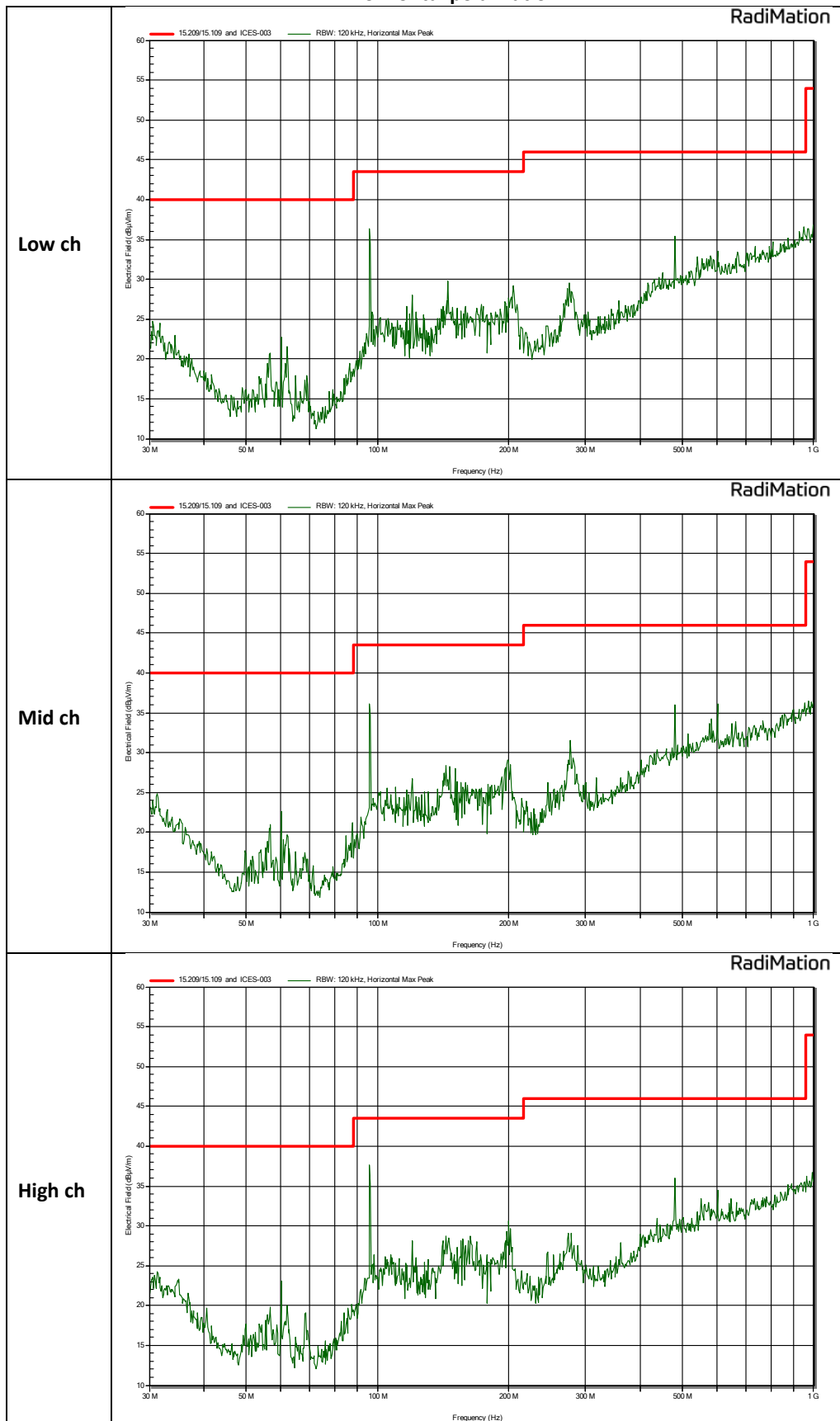
30 -1000 MHz

Vertical polarization



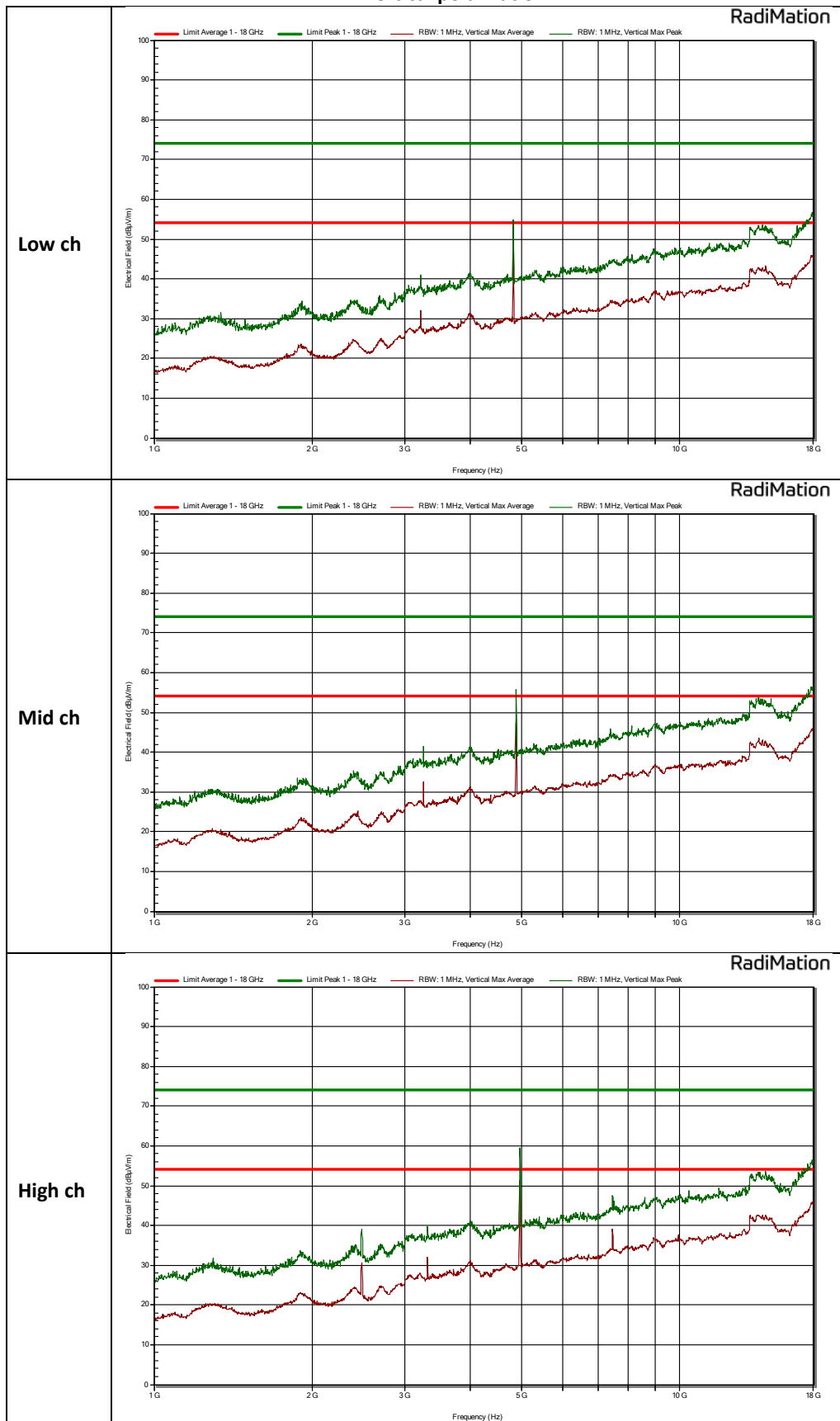
30 MHz to 1 GHz

Horizontal polarization



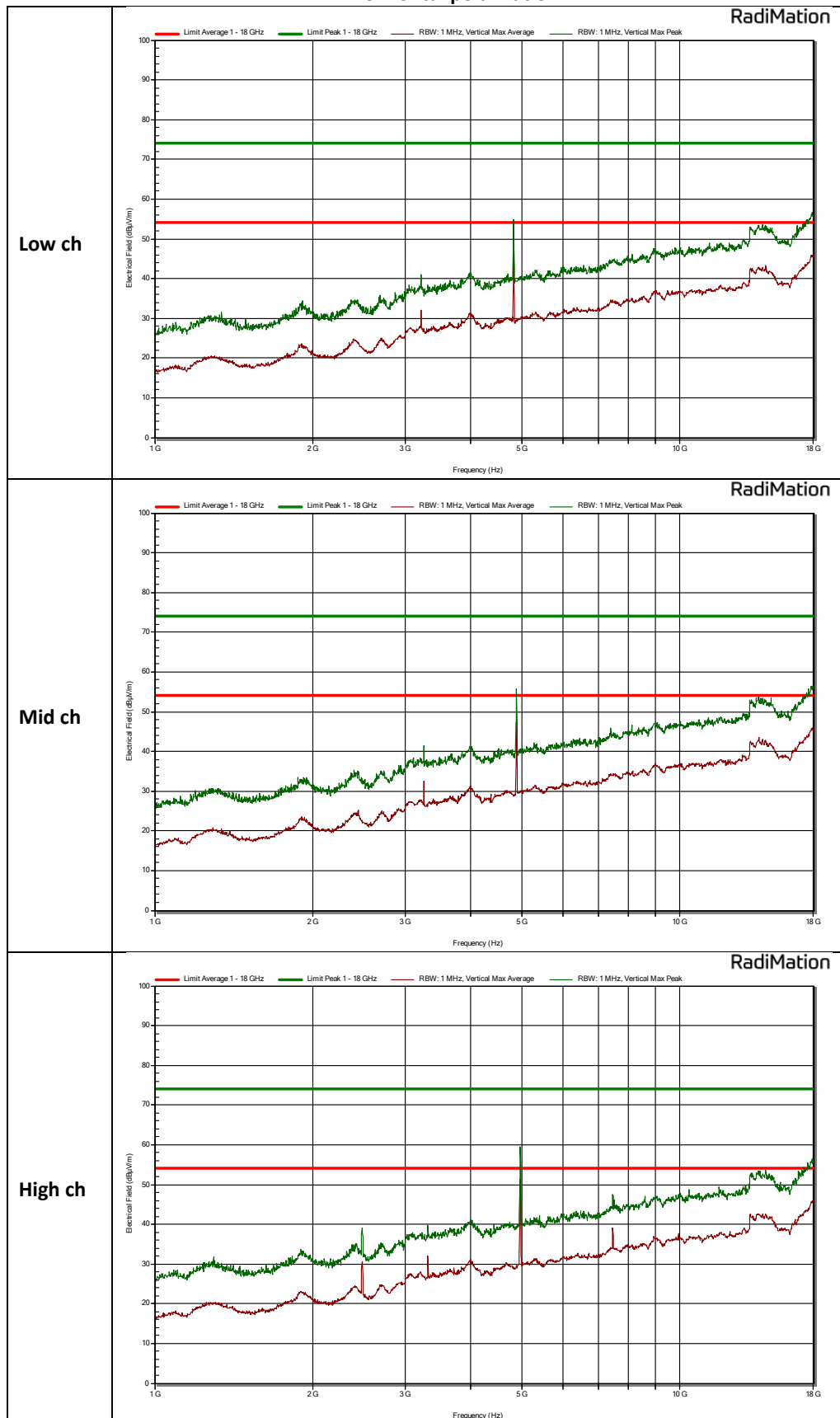
1 GHz to 18 GHz

Vertical polarization



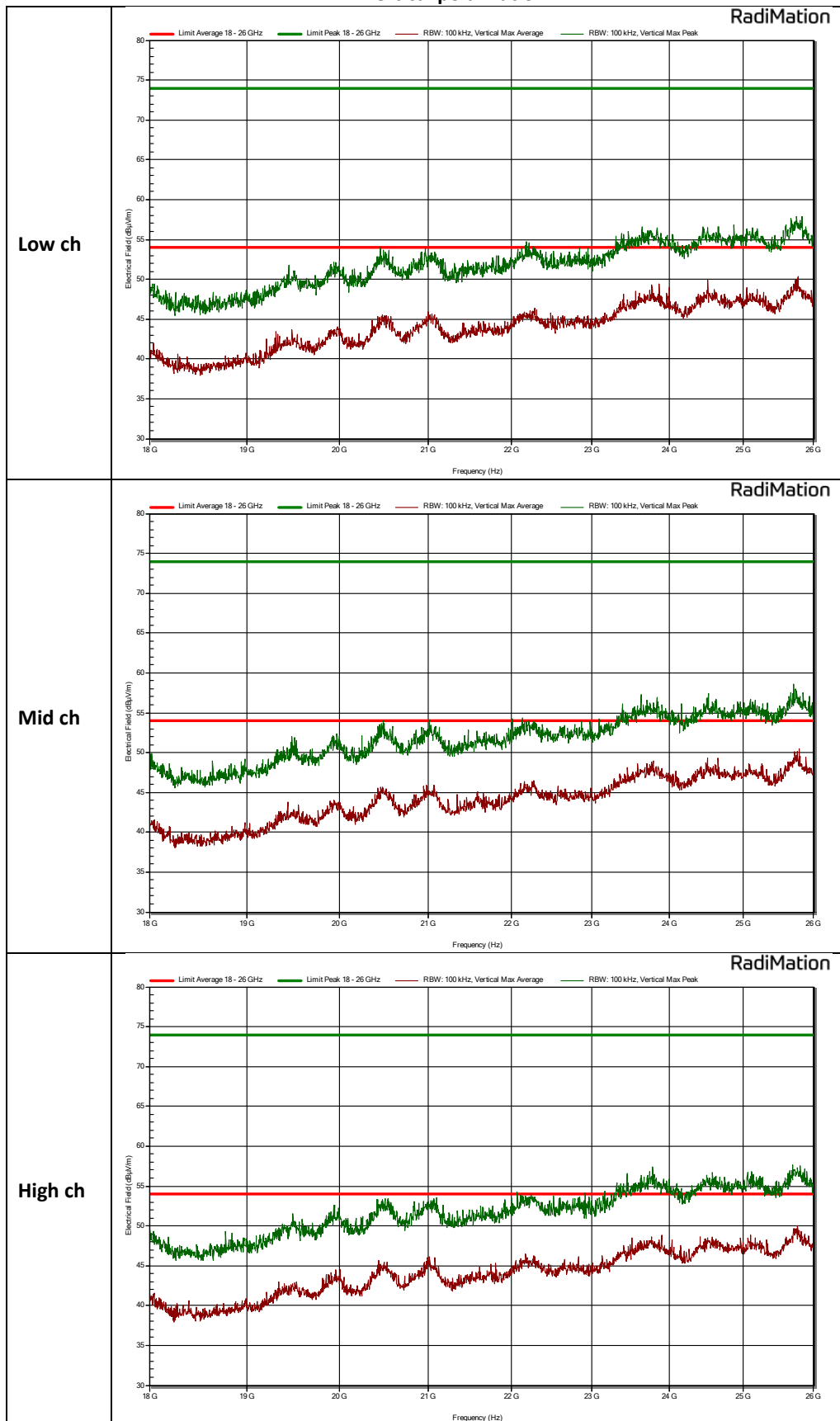
1 GHz to 18 GHz

Horizontal polarization



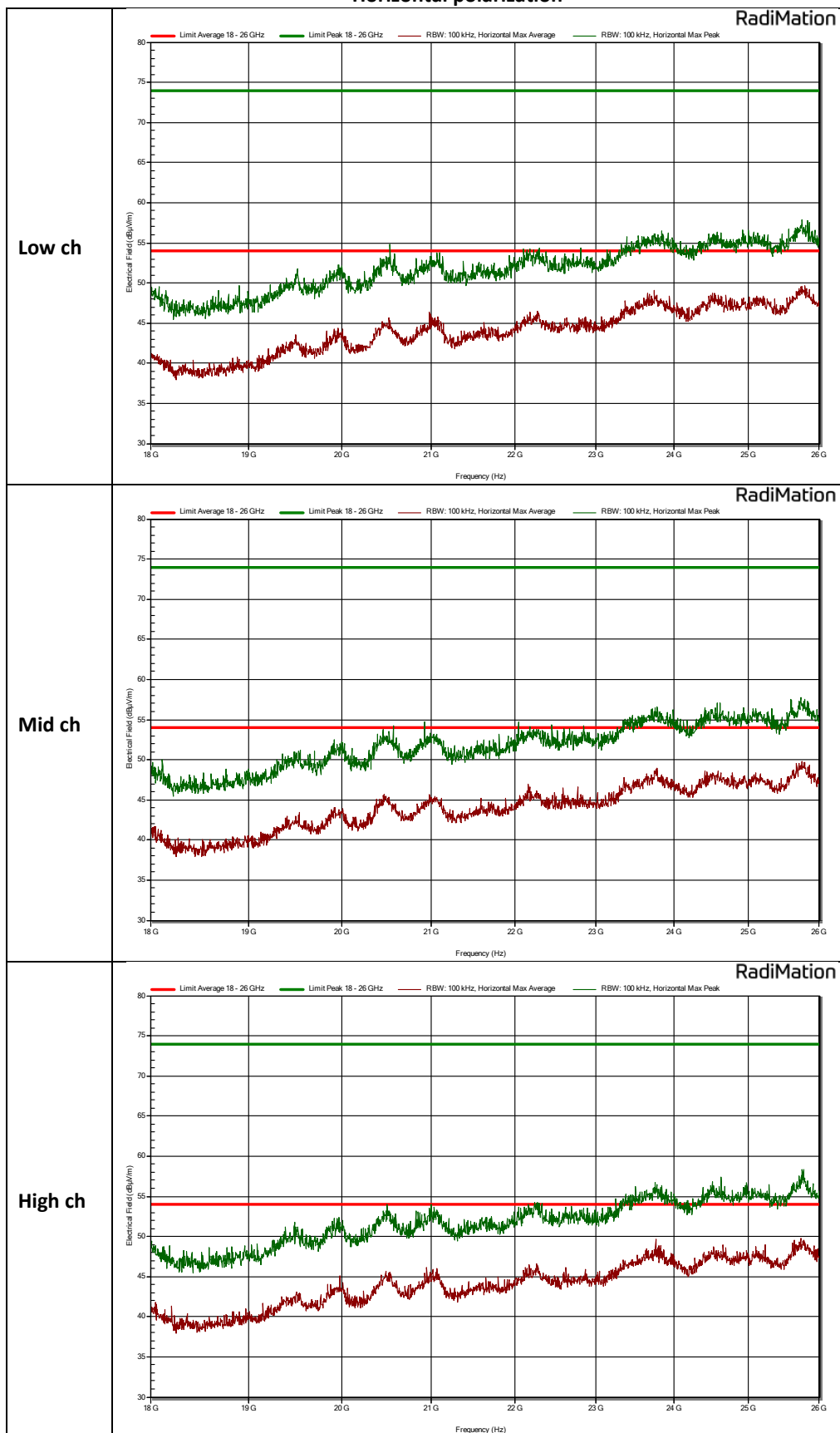
18 GHz to 26 GHz

Vertical polarization



18 GHz to 26 GHz

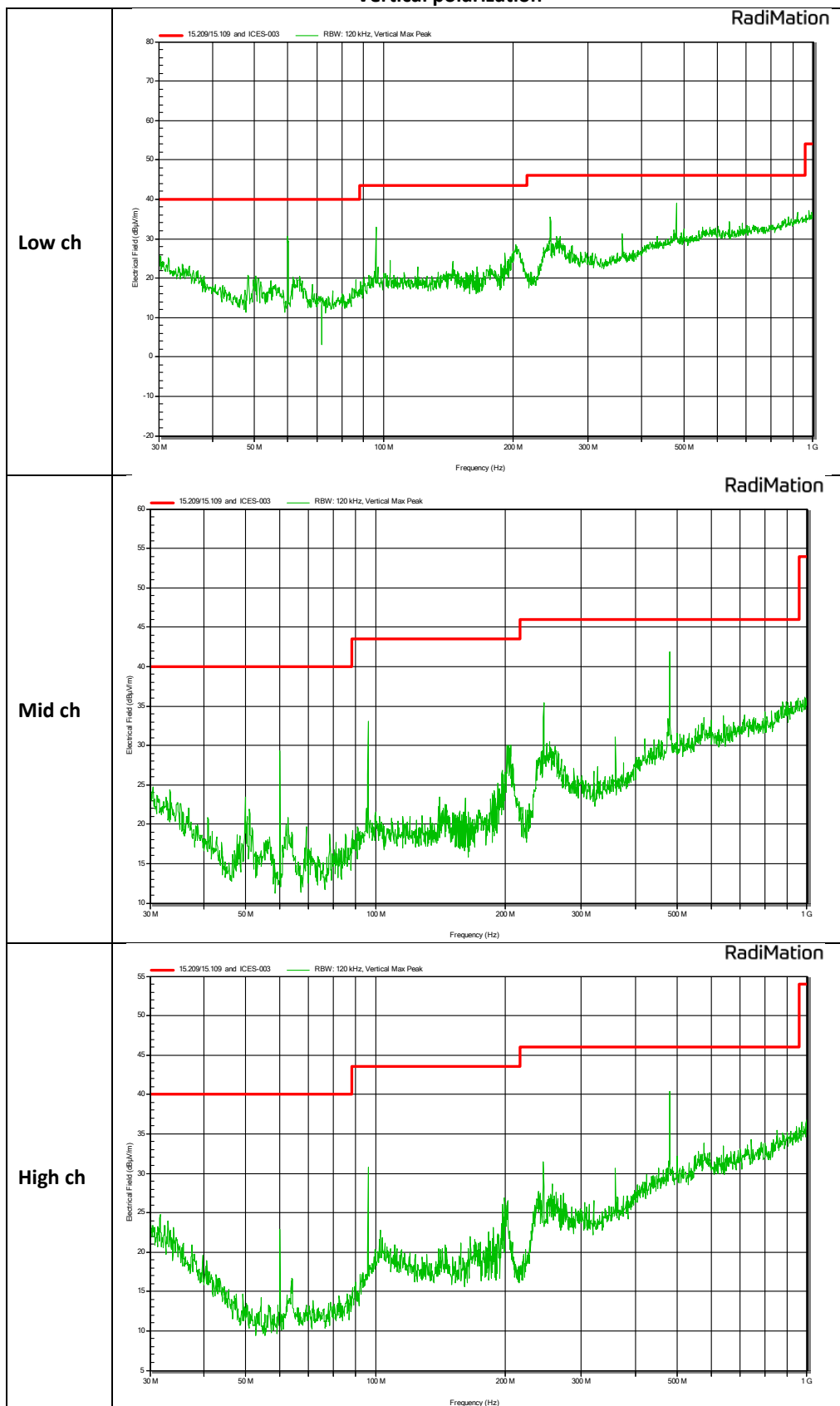
Horizontal polarization



3.1.7 Plots of the Radiated Spurious Emissions Measurement (WIFI N)

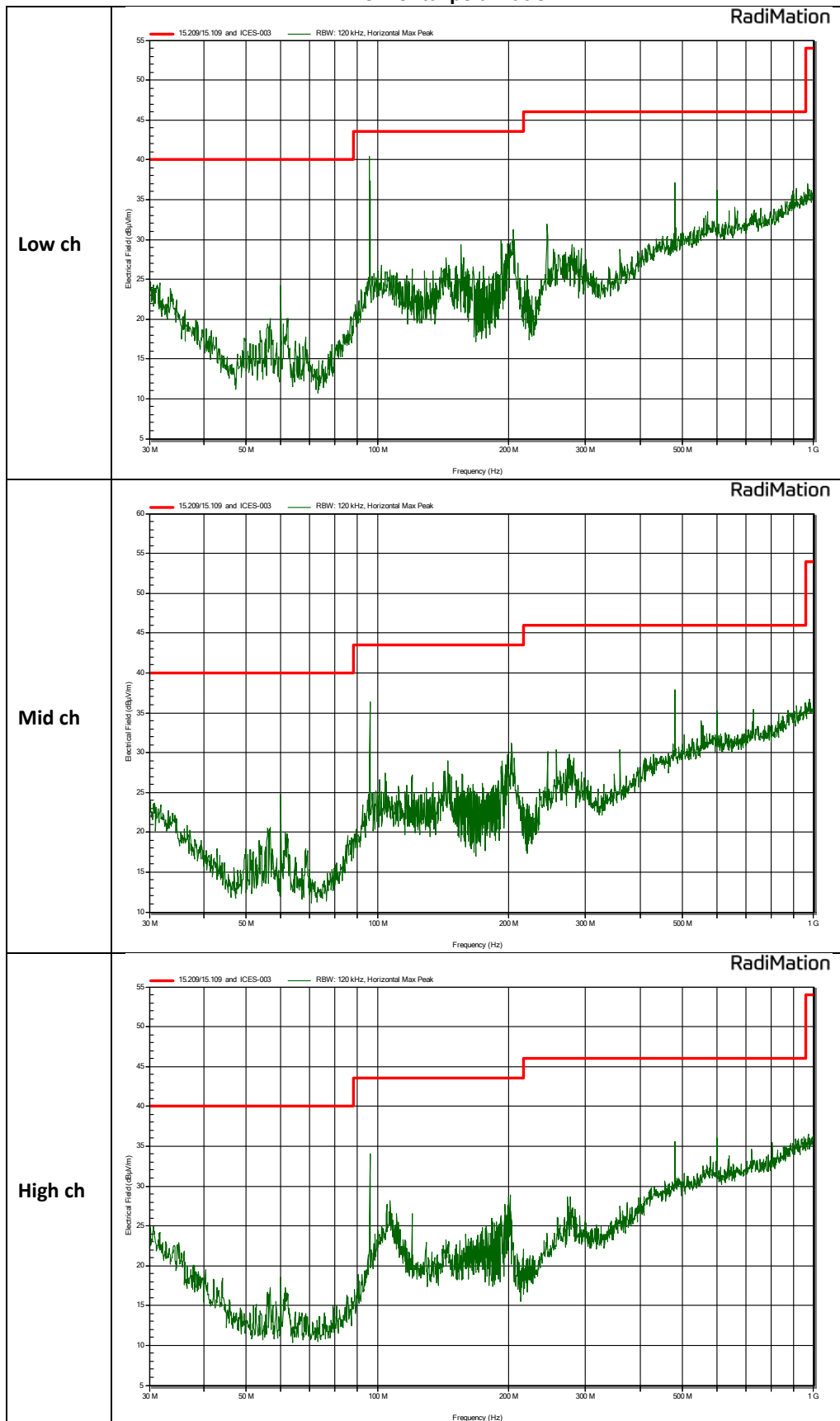
30 MHz to 1 GHz

Vertical polarization



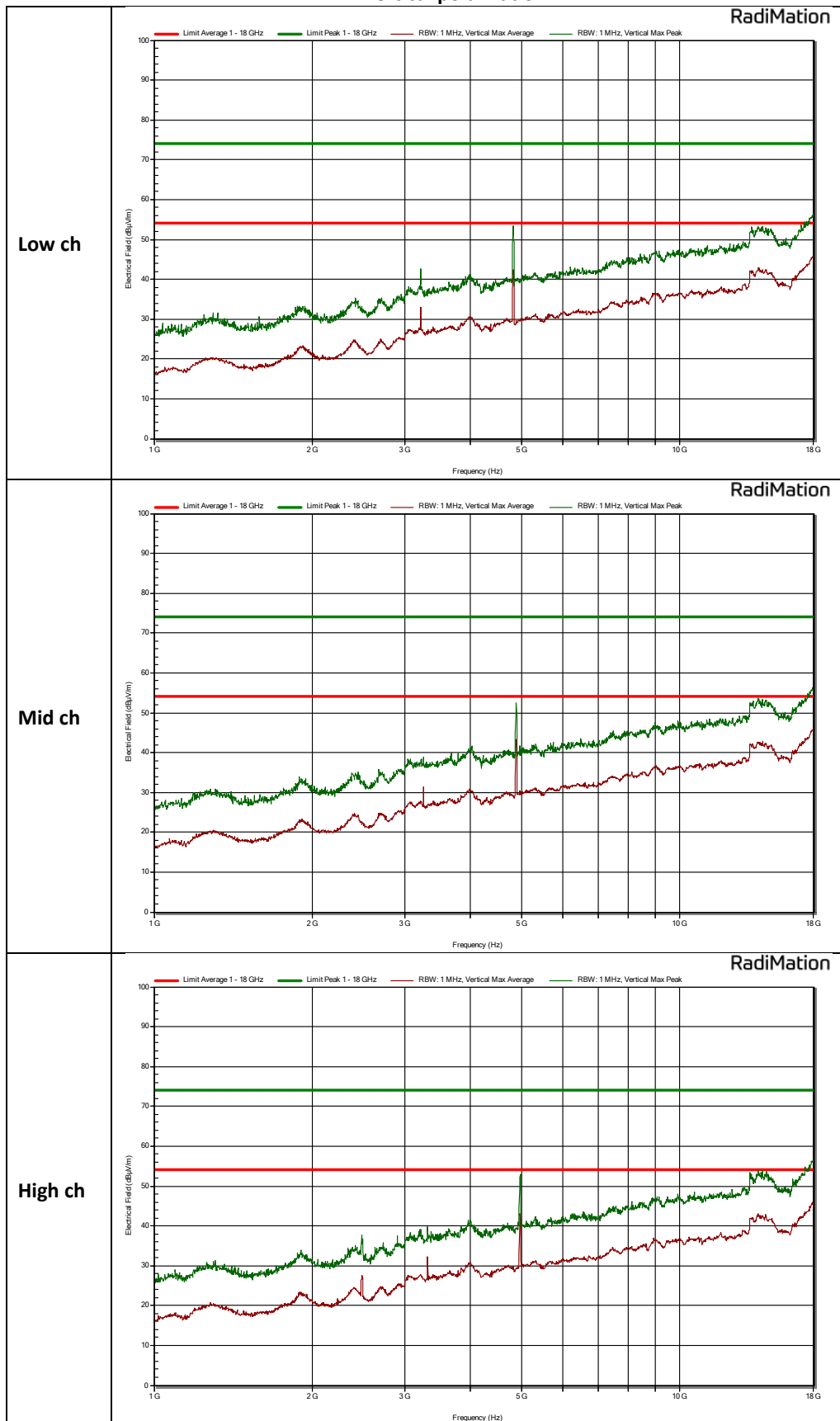
30 MHz to 1 GHz

Horizontal polarization



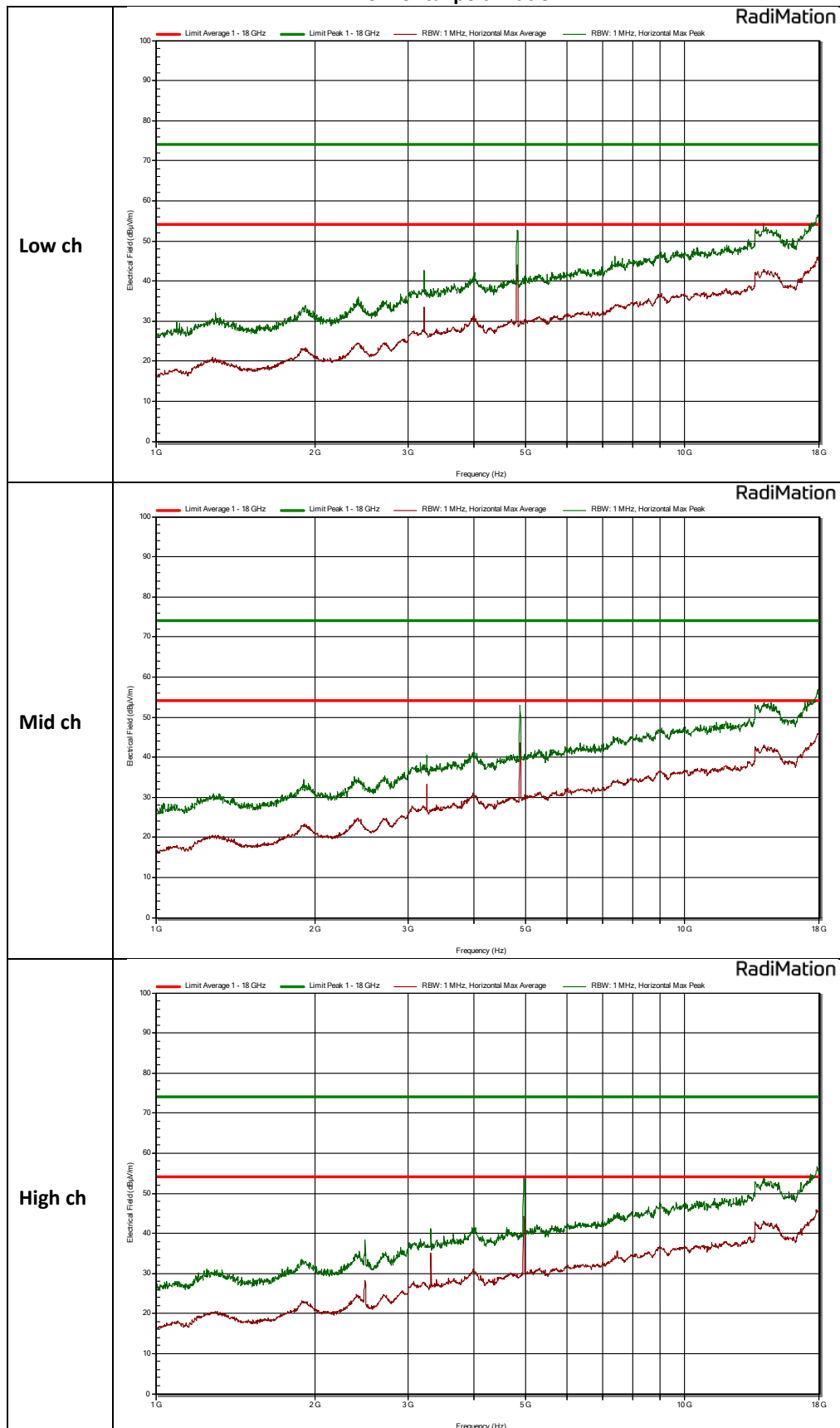
1 GHz to 18 GHz

Vertical polarization



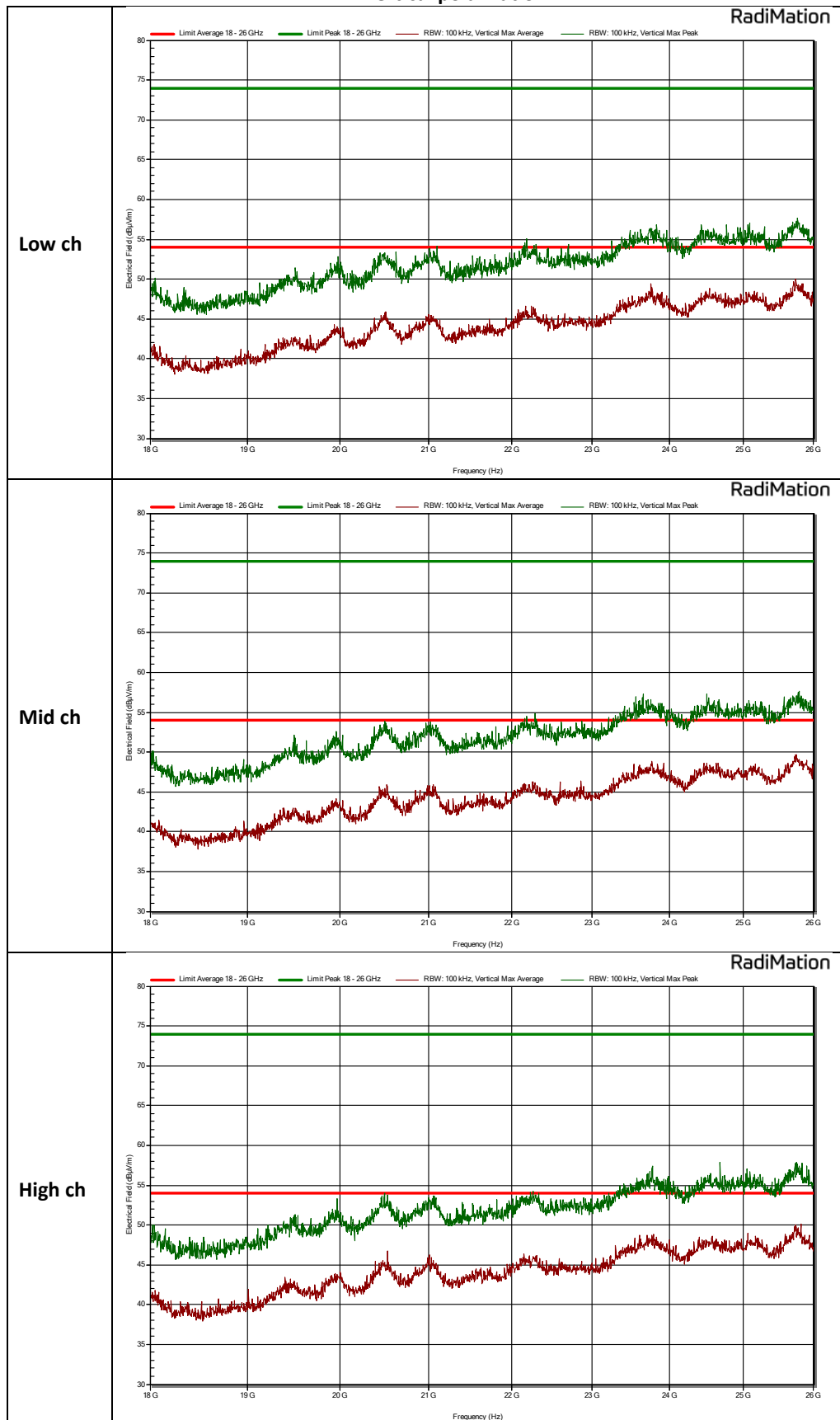
1 GHz to 18 GHz

Horizontal polarization



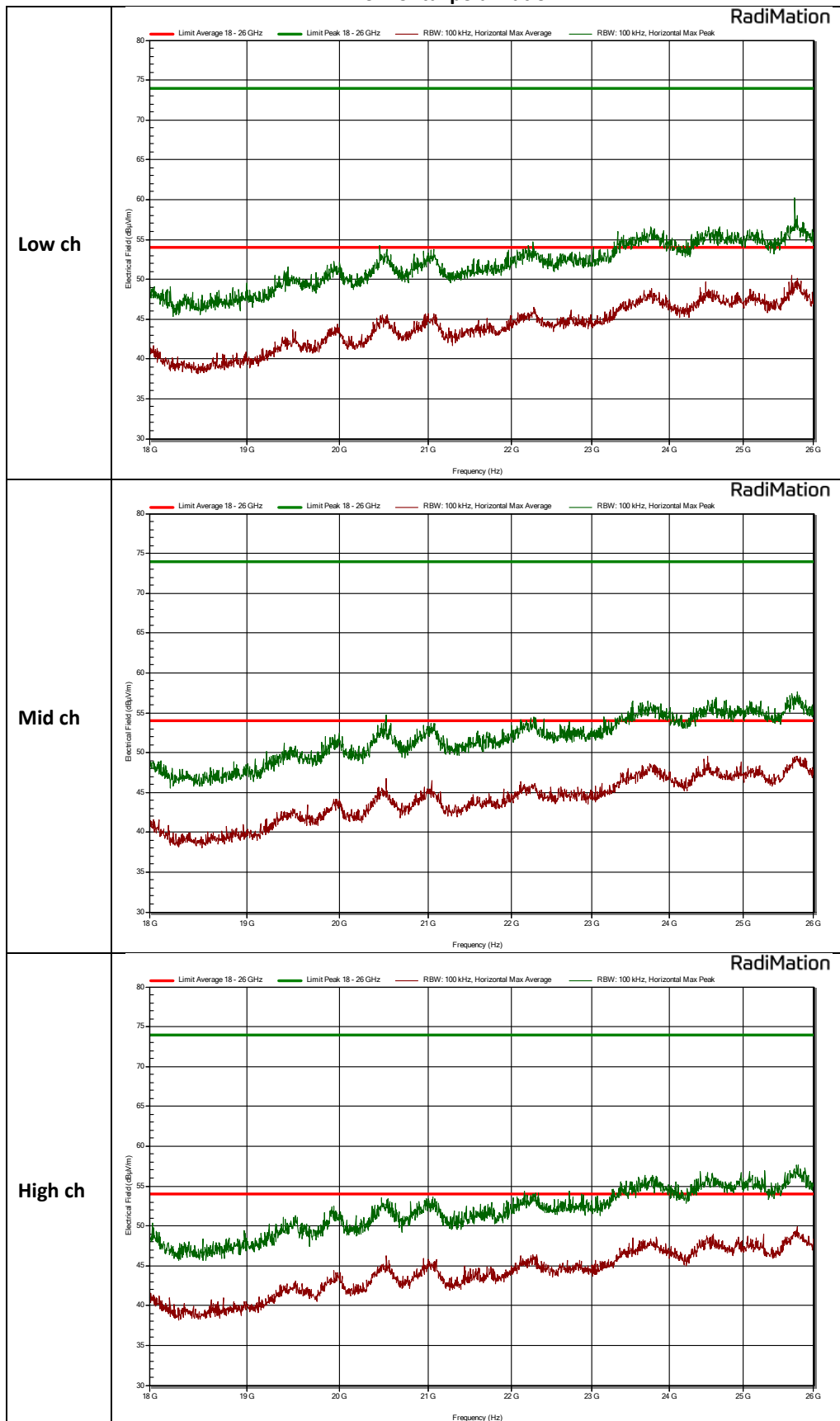
18 GHz to 26 GHz

Vertical polarization



18 GHz to 26 GHz

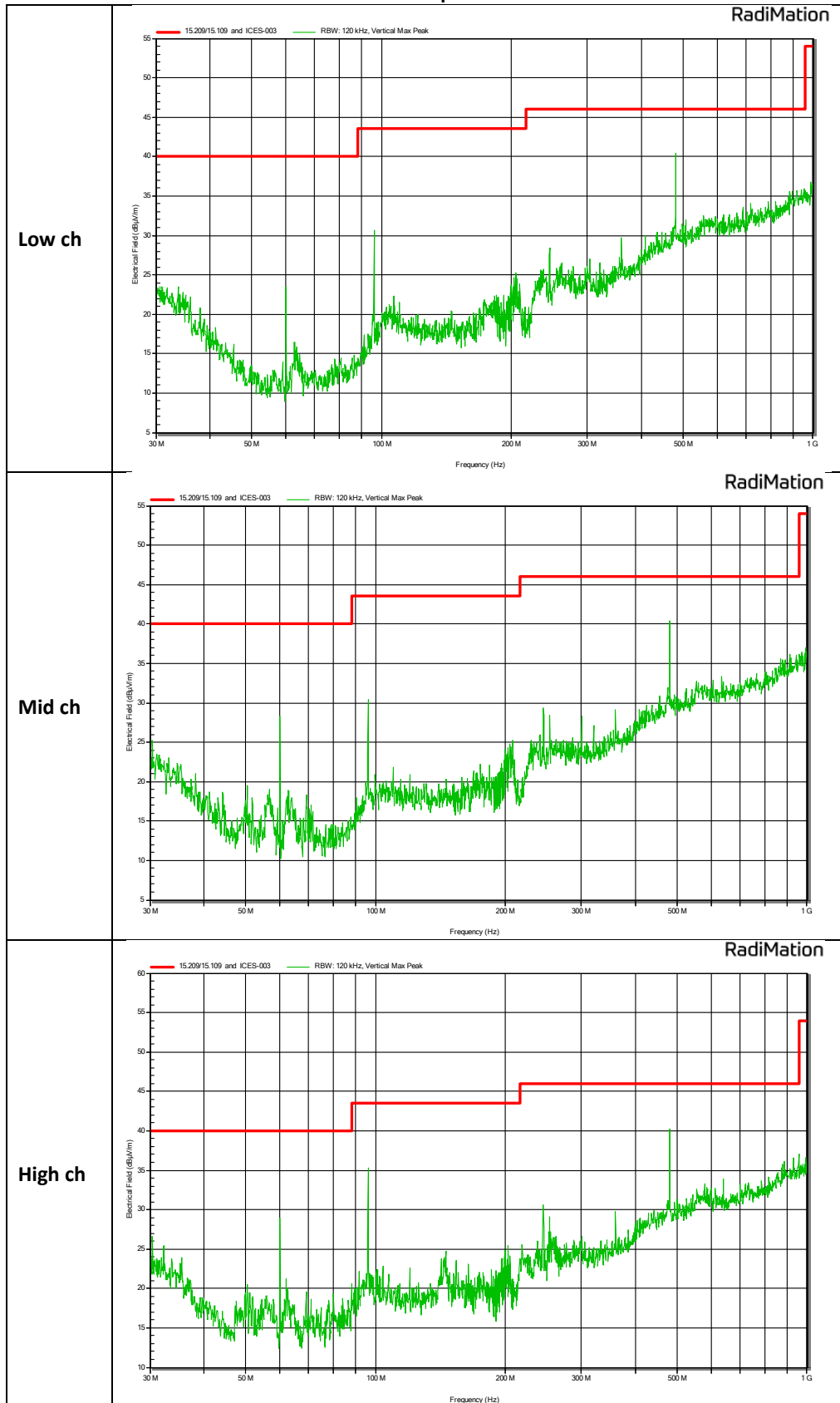
Horizontal polarization



3.1.8 Plots of the Radiated Spurious Emissions Measurement(BT)

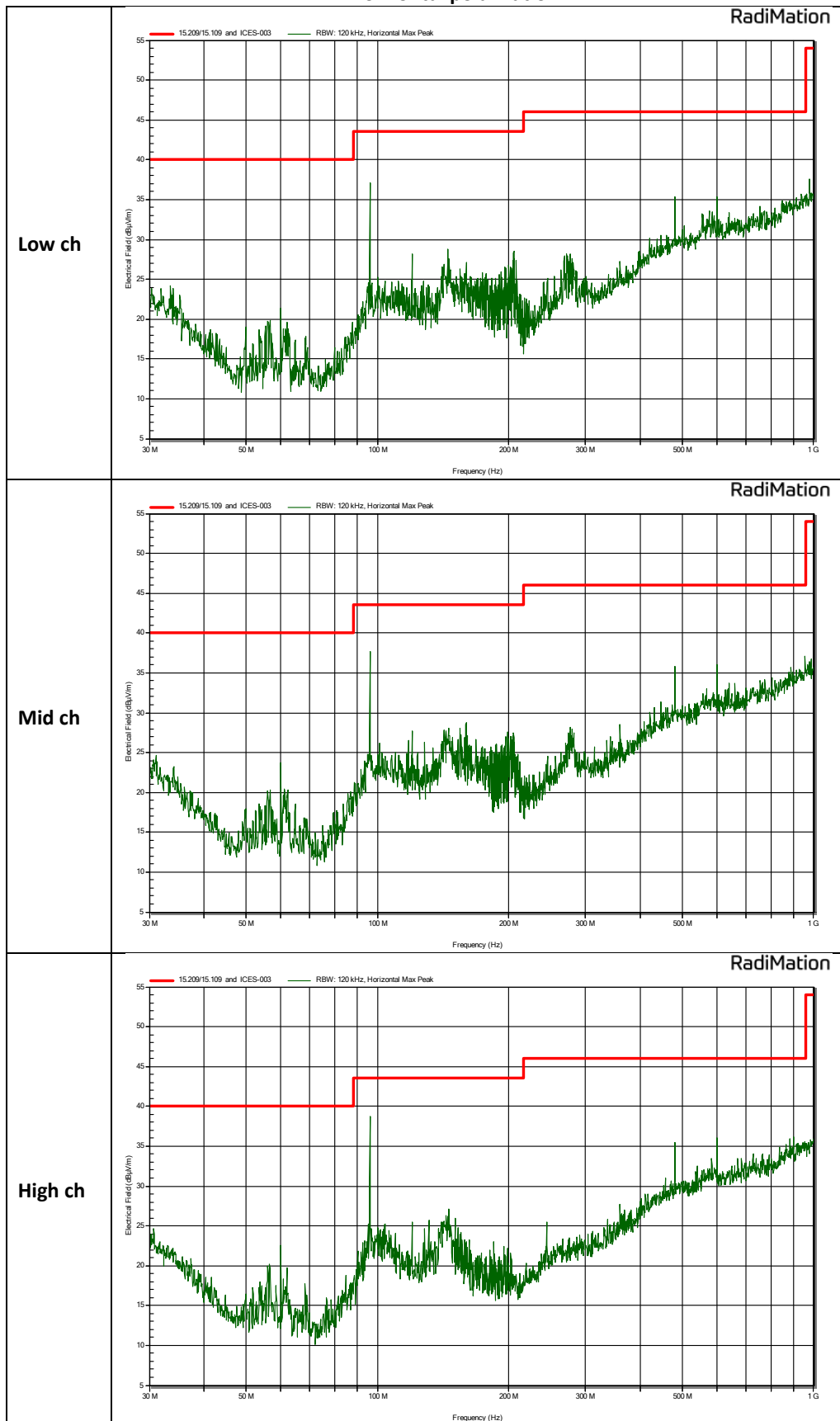
30 -1000 MHz

Vertical polarization



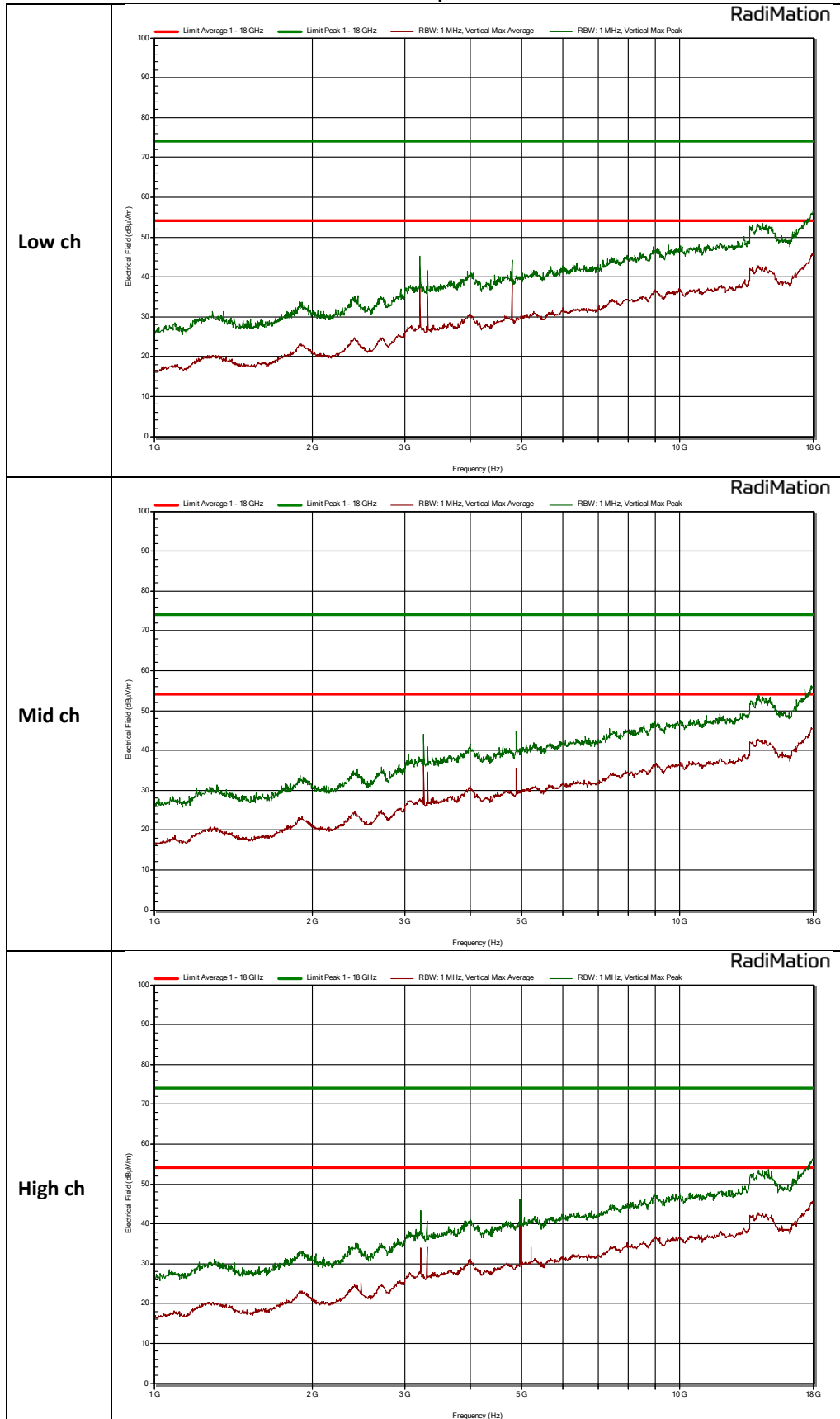
30 MHz to 1 GHz

Horizontal polarization



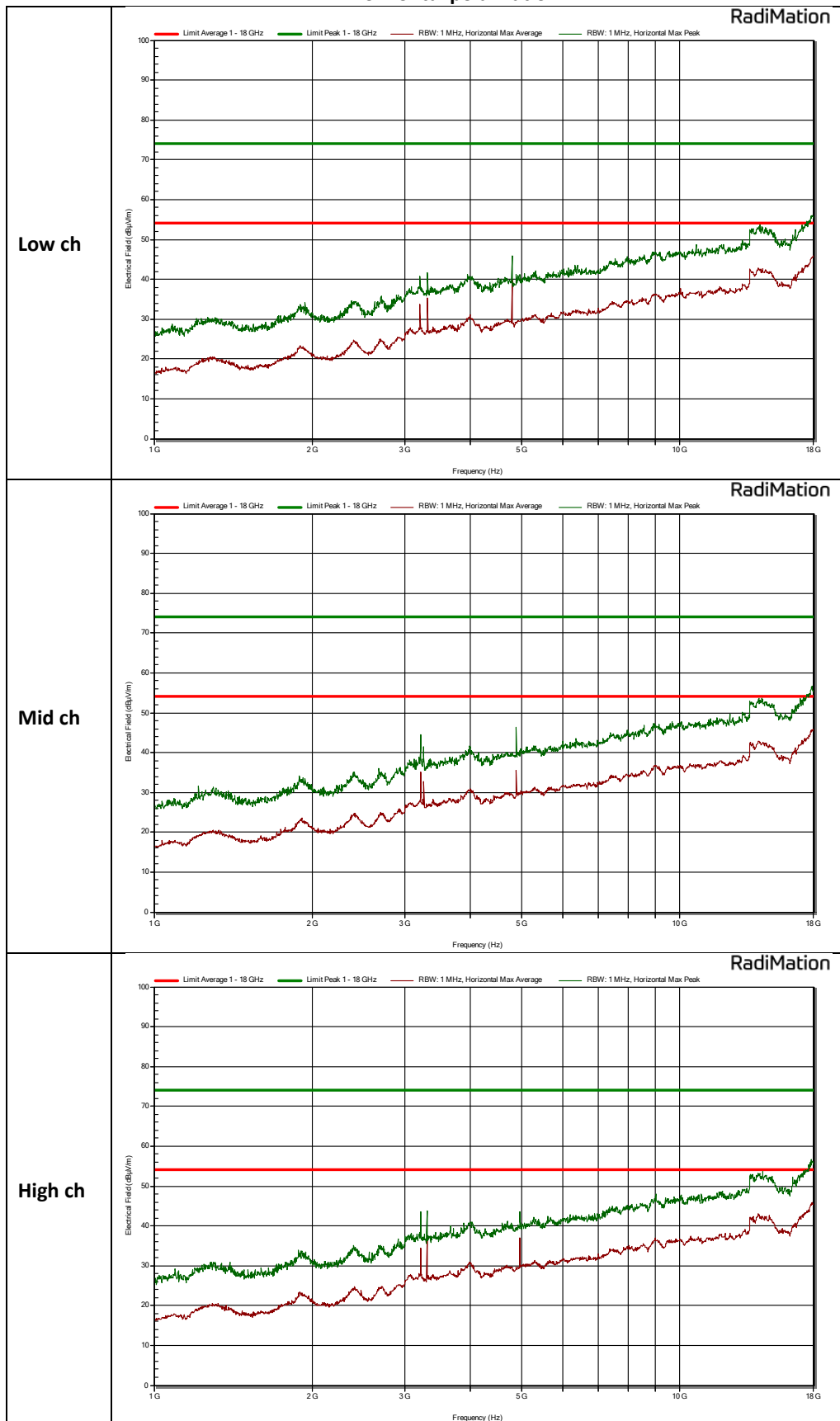
1 GHz to 18 GHz

Vertical polarization



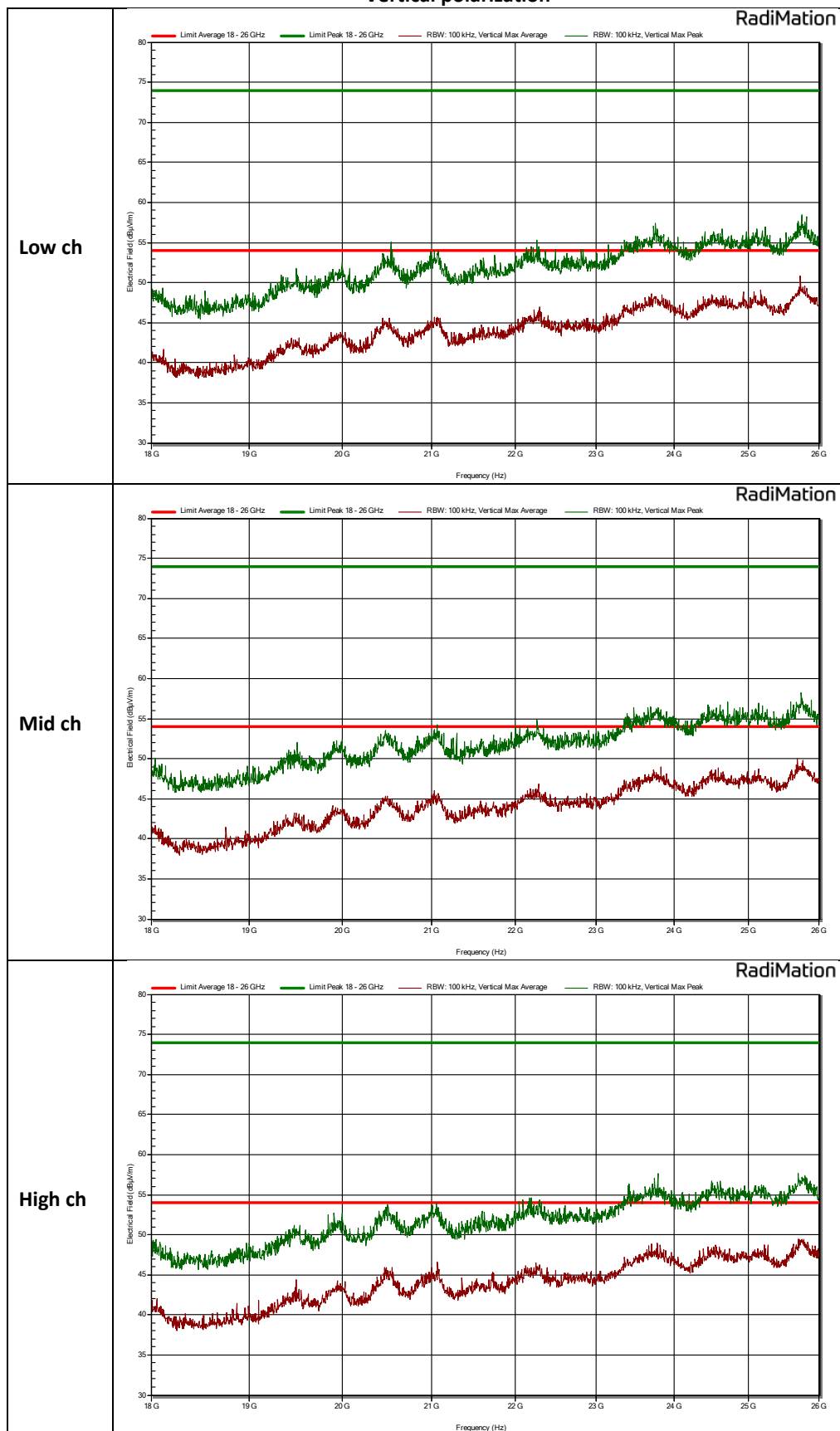
1 GHz to 18 GHz

Horizontal polarization



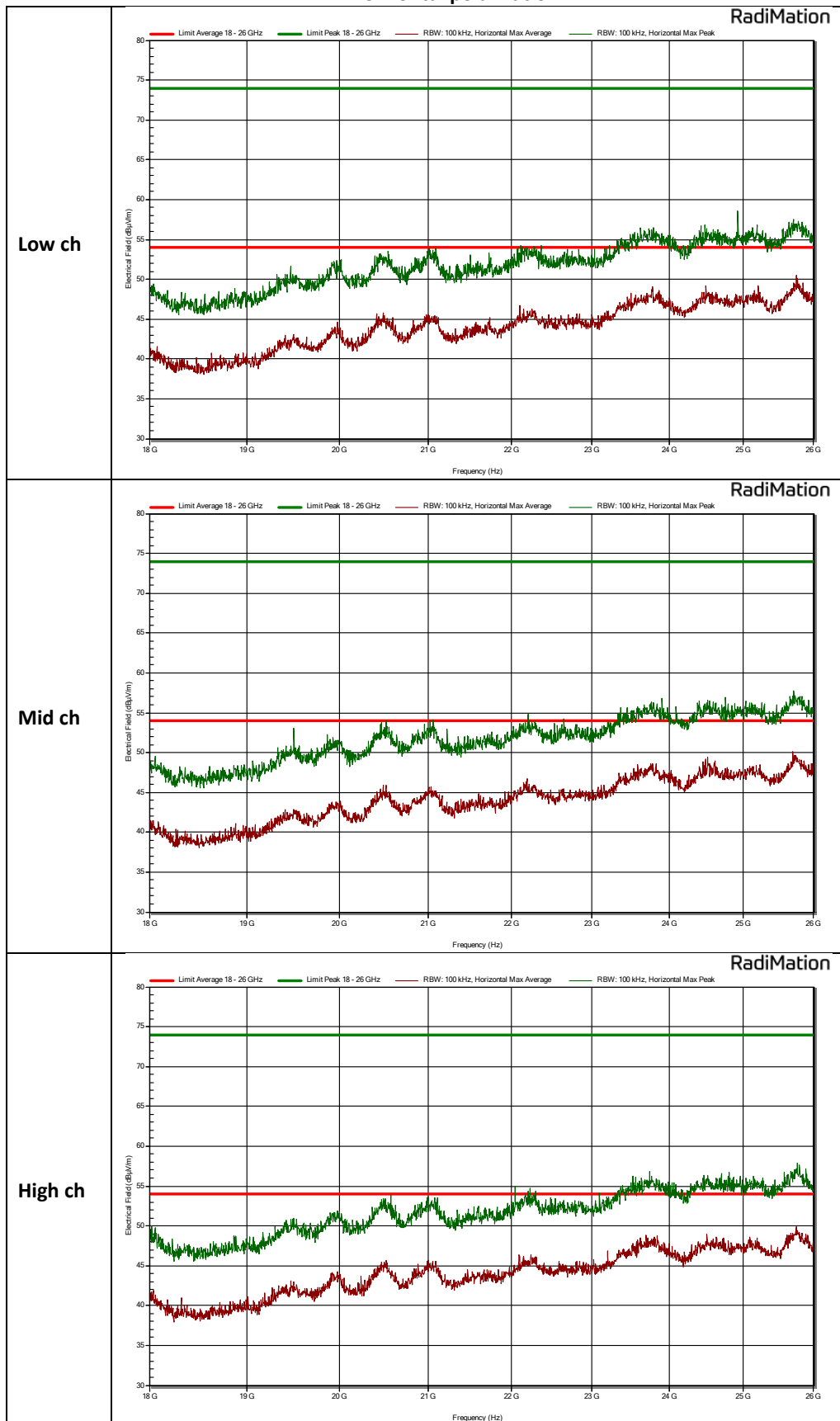
18 GHz to 26 GHz

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 6

3.2.5 Test results of Output Power Measurement

Technology Std.	Channel	Peak method		Peak output power (dBm)
		Frequency (MHz)	Data rate	
WIFI 802.11b	1	2412	54 Mbps	18.5
12Uncertainty	±0.71 dB			

Note: The output power has been measured in the worst case scenario which is WIFI 802.11b.

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