

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

Product name : Hable One
Applicant : Hable One BV
FCC ID : 2A7AZ-HABLE1
IC : 28649-HABLE1

Test report No. : P000133072 004 v3.00

Laboratory information

Accreditation

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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	25-08-2022	First draft	RvB
v1.00	05-09-2022	Release version	RvB
v2.00	01-12-2022	Added Rf output power measurement	RvB
v3.00	11-04-2023	Implemented assessor comments	RvB

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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	3.2	Pass
15.247 (b)	RSS-247 5.4 (d)	RF output power	3.1	Pass
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.2	Pass
15.207 (c)	RSS-Gen 7.2	AC mains conducted emission	3.3	Pass

1 General Description

1.1 Applicant

Client name:	Hable One BV
Address	Torenallee, 20 Eindhoven, The Netherlands
Zip code:	5671 BC
Telephone:	+31 687595573
E-mail:	ayushman@iamhable.com
Contact name:	Mr. T. Ayushman

1.2 Manufacturer

Manufacturer name:	Hable One BV
Address:	Torenallee, 20 Eindhoven, The Netherlands
Zip code:	5671 BC
Telephone:	+31 687595573
E-mail:	ayushman@iamhable.com
Contact name:	Mr. T. Ayushman

1.3 Tested Equipment Under Test (EUT)

Product name:	Hable One
Brand name:	Hable
Product type:	Wireless phone keyboard
Variant model(s):	--
Software version:	--
Hardware version:	--
Date of receipt	27-07-2022
Tests started:	17-08-2022
Testing ended:	17-08-2022

1.4 Product specifications of Equipment under test

TX Frequency range (MHz):	BLE: 2400 – 2483.5 MHz
RX frequency range (MHz):	BLE: 2400 – 2483.5 MHz
Antenna type:	Chip
Antenna gain:	0 dBi
Type of modulation:	According Bluetooth spec.

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

1.5 Environmental conditions

Test date	01-08-2022	02-08-2022	17-08-2022
Ambient temperature	23.9°C	24.2°C	23.7°C
Humidity	59.5%	56.9%	64.2%

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 §15.207
- FCC Part 15 Subpart C §15.247
- RSS-Gen Issue 5
- RSS-247 Issue 2

1.8 Observation and remarks

The EUT is charged with a USB-C cable. This provided cable is maximum 15 cm in length.

No AC/DC adapter is supplied with the EUT. The AC power line conducted emission test is performed with a Samsung AC/DC adapter, model: EP-TA200. The contains a recertified module with the FCC id: SQGBL654

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. R. van Barneveld

Review of test methods and report by:

Name : P. van Wanrooij, BASc

The above conclusions have been verified by the following signatory:

Date : 11-04-2023

Name : P. van Wanrooij

Signature :

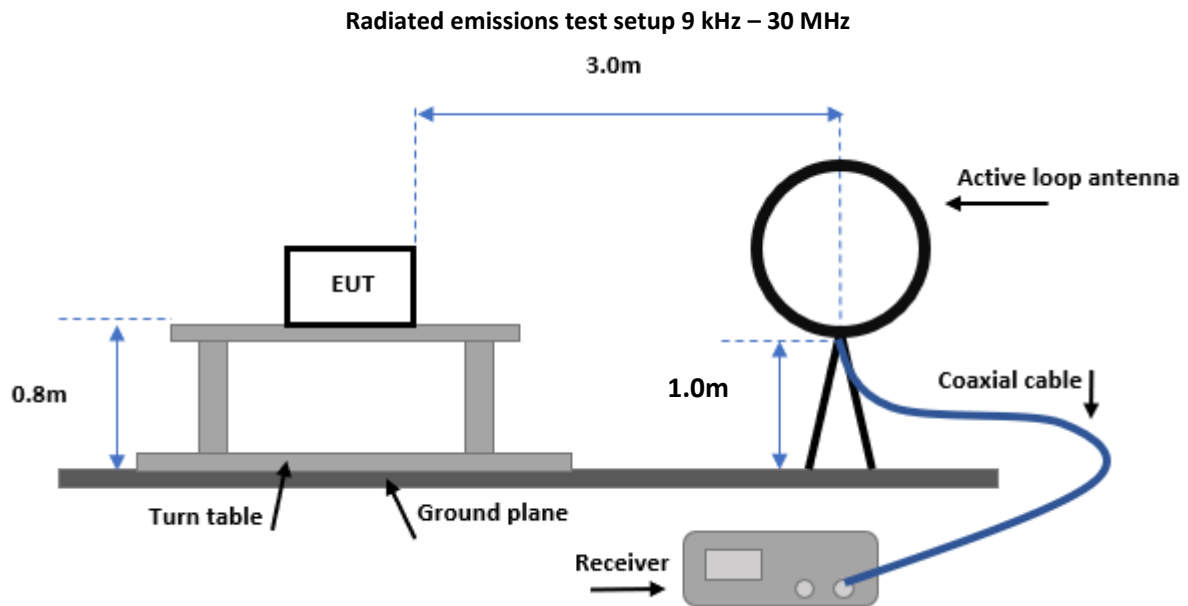
A handwritten signature in black ink, appearing to be "P. van Wanrooij".

2 Test configuration of the Equipment Under Test

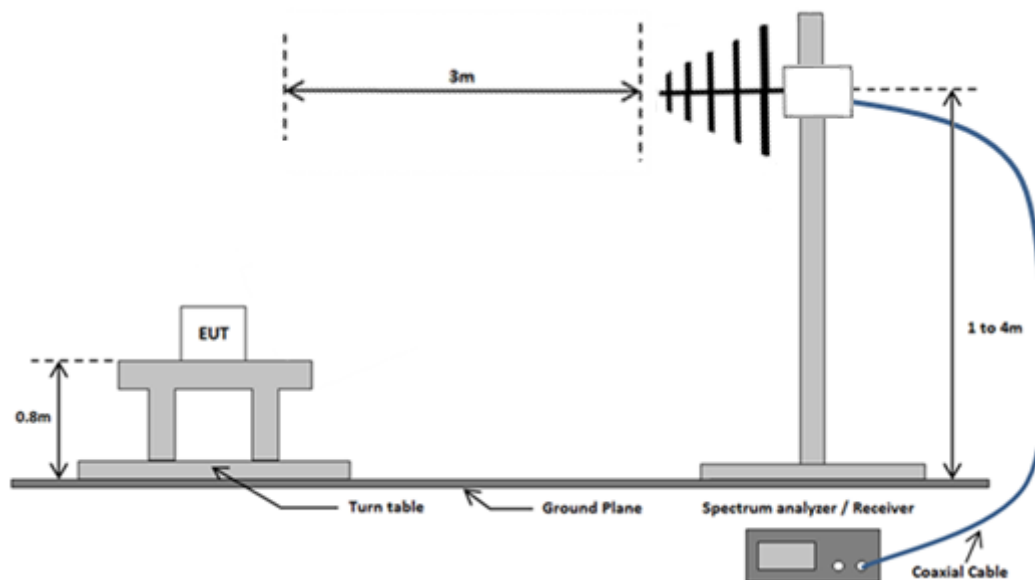
2.1 Test mode

The applicant provided test mode firmware for the EUT, in which it was possible to configure the EUT into different test channels. The RF output power set to software setting "0 dBm".

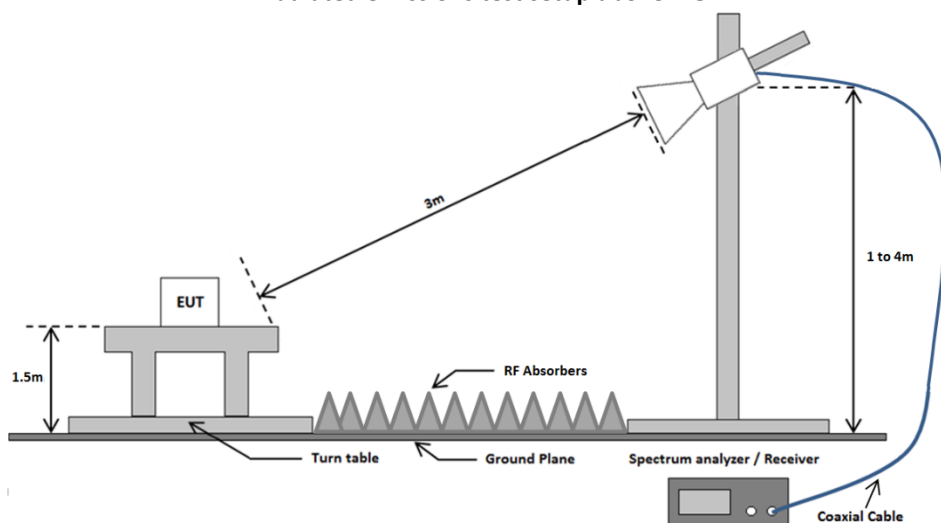
2.2 Test setups



Radiated emissions test setup 30 MHz - 1 GHz

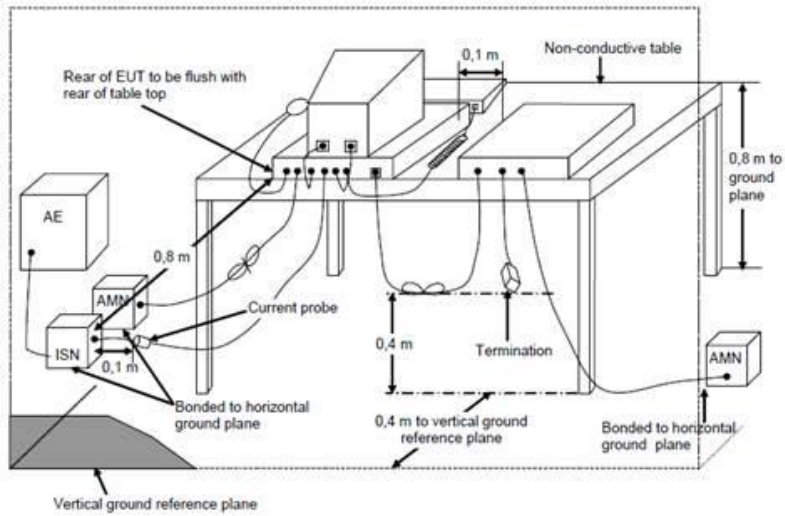


Radiated emissions test setup above 1 GHz



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	ESCI	114161	02-2022	02-2023	3.3
EMI Receiver	Rohde & Schwarz	ESR7	114534	01-2022	01-2023	3.2
Spectrum analyzer	Rohde & Schwarz	FSP40	TE11125	03-2022	03-2023	3.1; 3.2
3.0 GHz HPF	Wainwright	WHK3.0/18G-10EF	114682	07-2021	07-2024	3.2
Active loop antenna	EMCO	6502	114515	01-2022	01-2024	3.2
Biconical antenna + 6dB attenuator	Schwarzbeck + HP	VHA9103 + 8491A	114436 + 114254	03-2021	03-2024	3.2
Logperiodic antenna	EMCO	3147	114385	03-2021	03-2024	3.2
Horn antenna	EMCO	3115	114607	01-2021	01-2024	3.1; 3.2
Horn antenna	FLANN-MICROWAVE	20240-25	114518	NA*	NA*	3.2
Preamplifier 1-18 GHz	µComp Nordic	MCNA-40-0010800-25-10P	114690	01-2022	01-2023	3.1; 3.2
Preamplifier 18-40 GHz	Miteq	JS4-18004000-33-8P	114693	01-2022	01-2023	3.2
Test software	Raditeq	Radimation Version 2021.1.9	TE 02008	--	--	3.2/3.3
Two line V-network	Rohde & Schwarz	ENV 216	114379	07-2021	07-2023	3.3

*Note: Standard gain horn antennas do not need calibration

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 Output Power Measurement

3.1.1 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.

3.1.2 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

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

IRN 014 - RF power (W) - Method 6

3.1.5 Test results of Output Power Measurement

Peak method				
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy	1	2402	1 Mbps	-11.2
	18	2440	1 Mbps	-1.2
	39	2480	1 Mbps	-1.8
Uncertainty	±5.7 dB			

Note: radiated output power (dBm) – antenna gain (dBi) = Peak output power (dBm)

3.2 Radiated spurious emissions

3.2.1 Limit

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Field strength ($\text{dB}\mu\text{V/m}$)	Measurement distance(m)
0.009 – 0.490	$2400/F(\text{kHz})$	$20*\{\log[2400]-\log[F(\text{kHz})]\}$	300*
0.490 – 1.705	$24000/F(\text{kHz})$	$20*\{\log[24000]-\log[F(\text{kHz})]\}$	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: Measured values in the plots 9 kHz to 30 MHz corrected to 3m measurement distance according to the method described in ANSI C63.10-2013, clause 6.4

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

Prior to running the measurements, the EUT has been investigated in the X, Y and Z dimensions to determine the worst case configuration for spurious emissions.

9 kHz – 30 MHz: According to ANSI C63.10

30 MHz to 26.5 GHz: According to ANSI C63.10

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

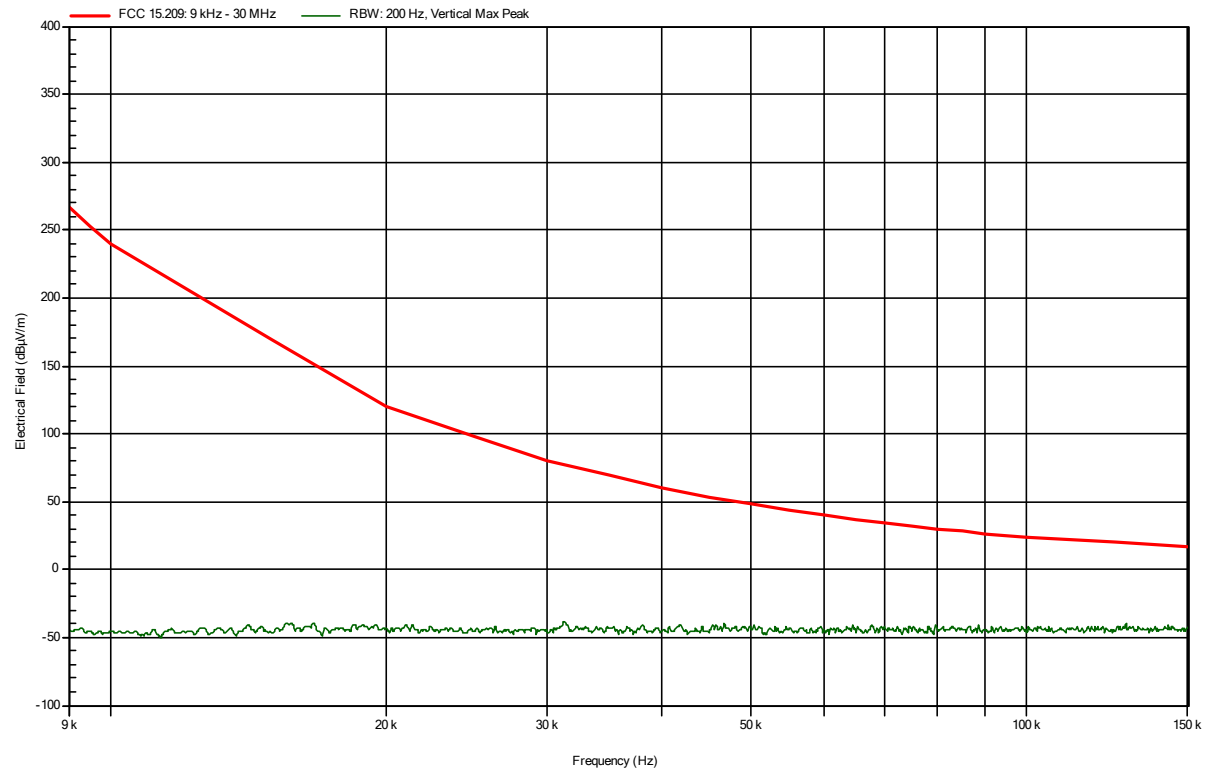
18 to 26.5 GHz: IRN 026 – Method 3

3.2.5 Measurement Uncertainty

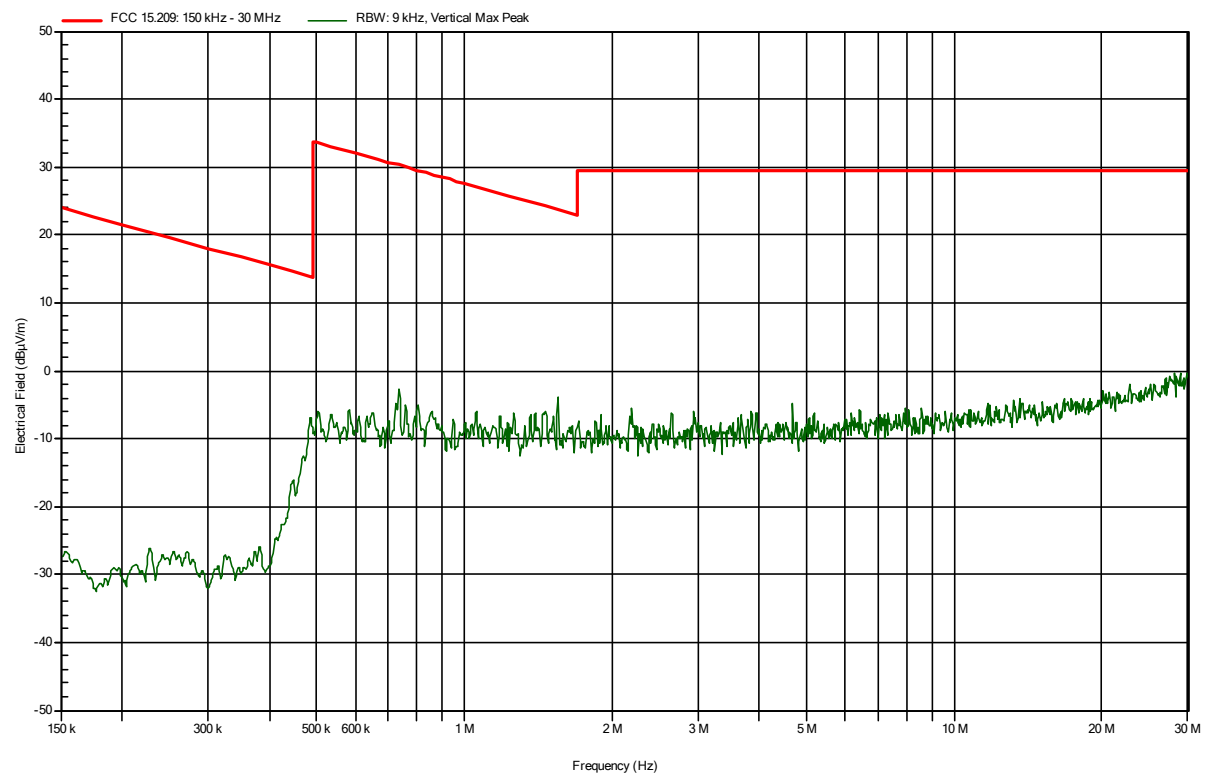
Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	± 1.6 dB
30 – 200 MHz	Horizontal	± 4.5 dB
	Vertical	± 5.4 dB
200 -1000 MHz	Horizontal	± 3.6 dB
	Vertical	± 4.6 dB
1 – 18 GHz	Horizontal	± 5.7 dB
	Vertical	± 5.7 dB
18 – 26.5 GHz	Horizontal	± 4.9 dB
	Vertical	± 4.9 dB

3.2.6 Plots of the Radiated Spurious Emissions Measurement

9 – 150 kHz

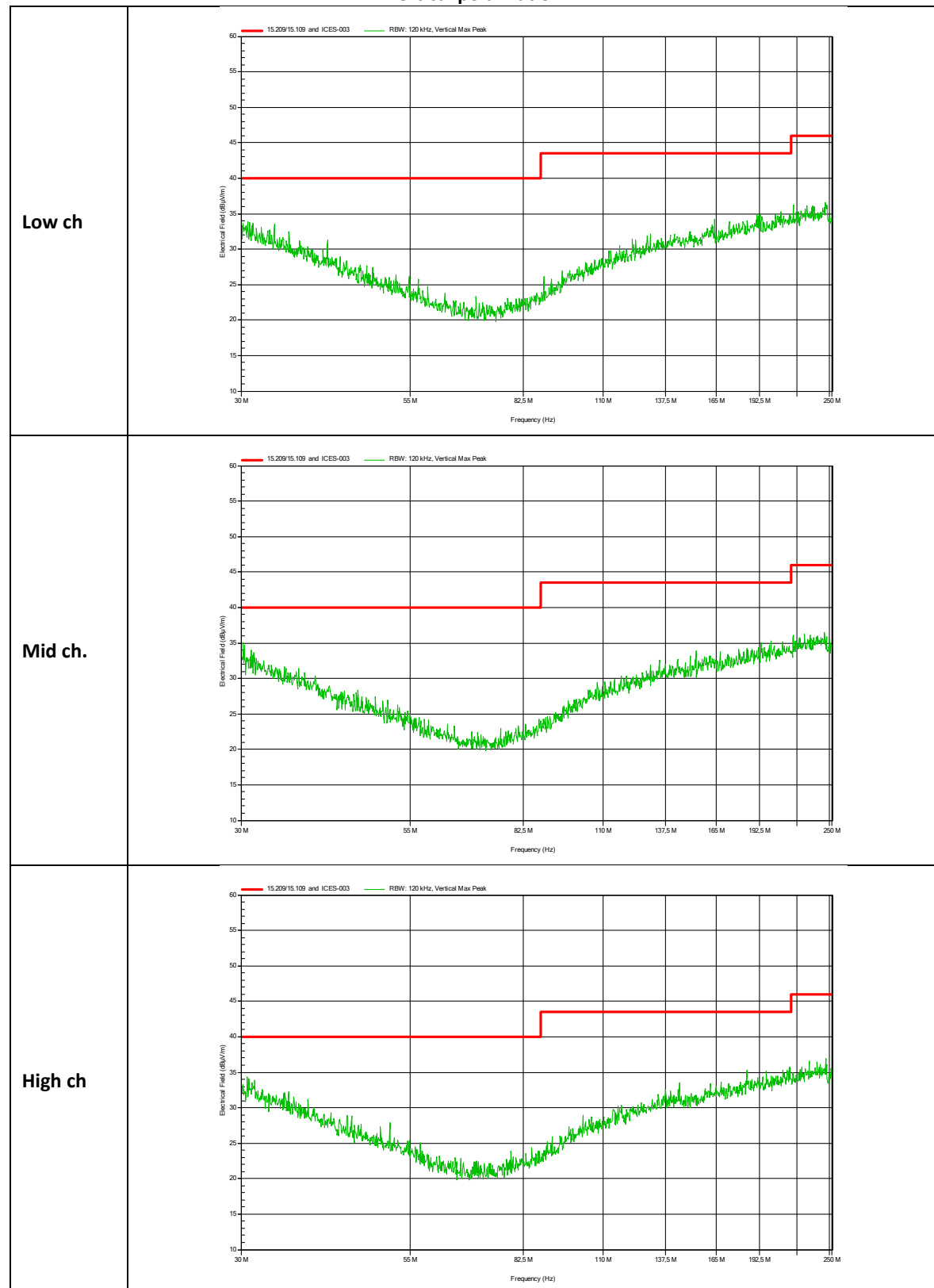


150 kHz – 30 MHz



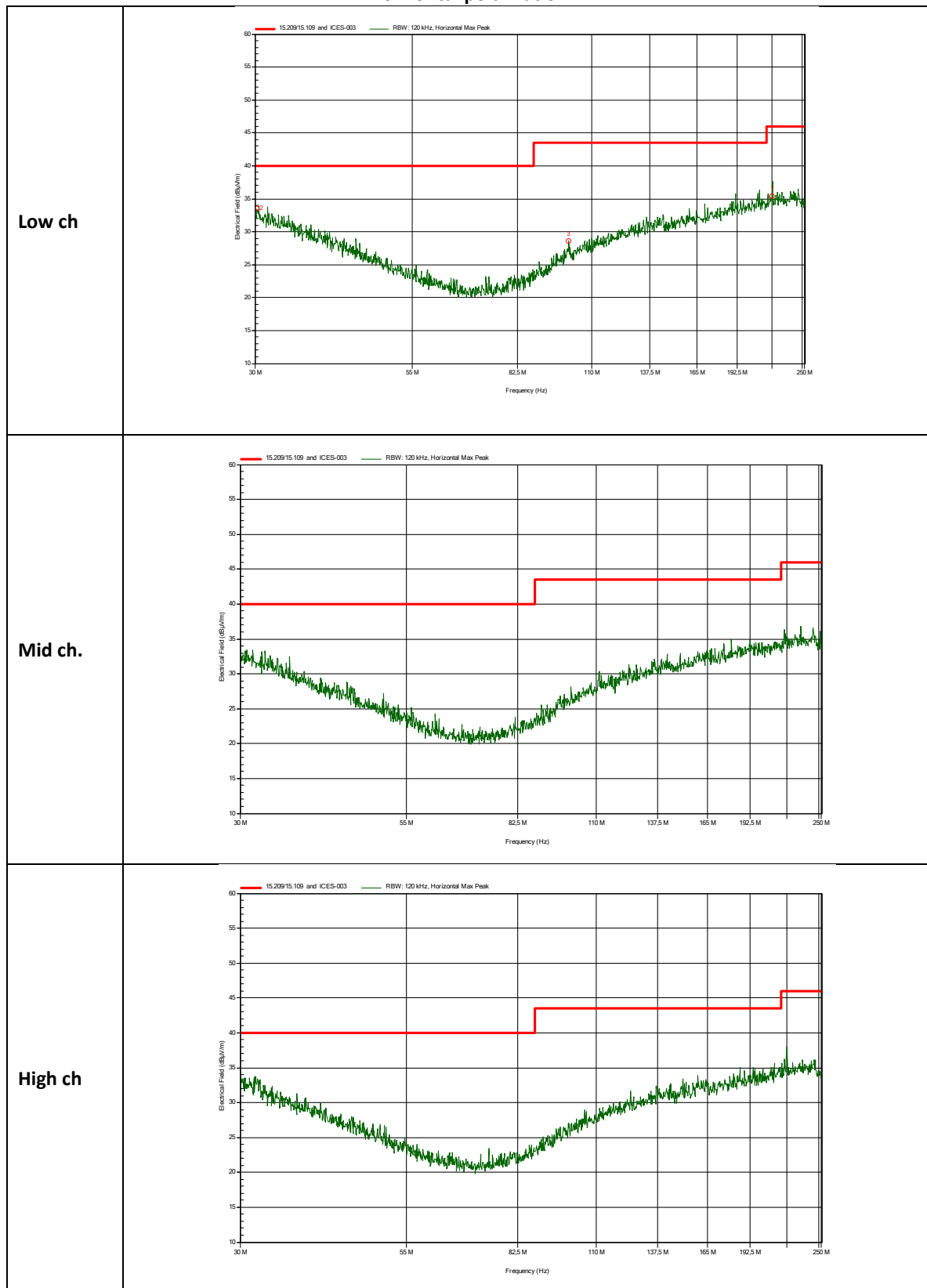
30 MHz to 250 MHz

Vertical polarization



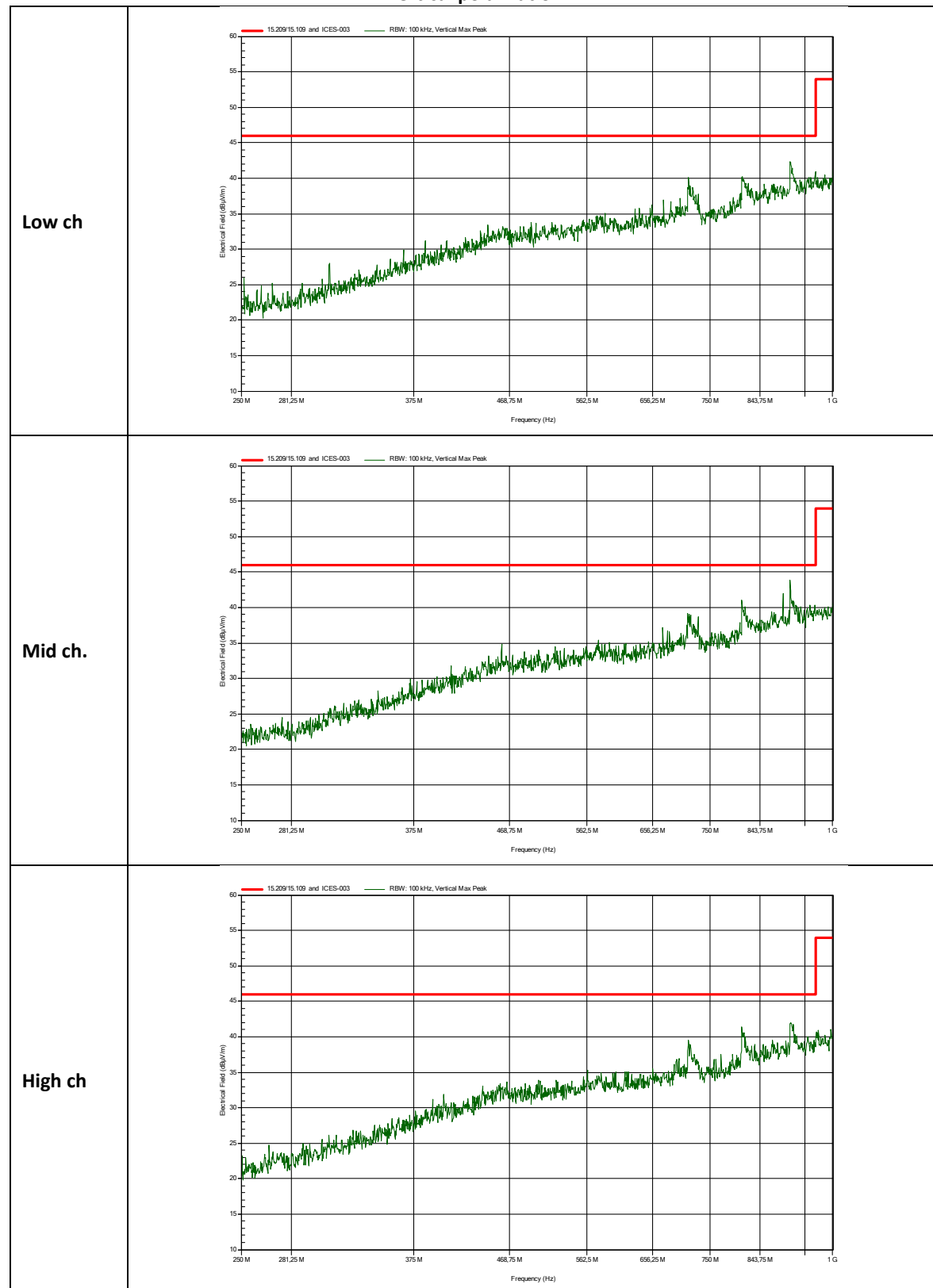
30 MHz to 250 MHz

Horizontal polarization



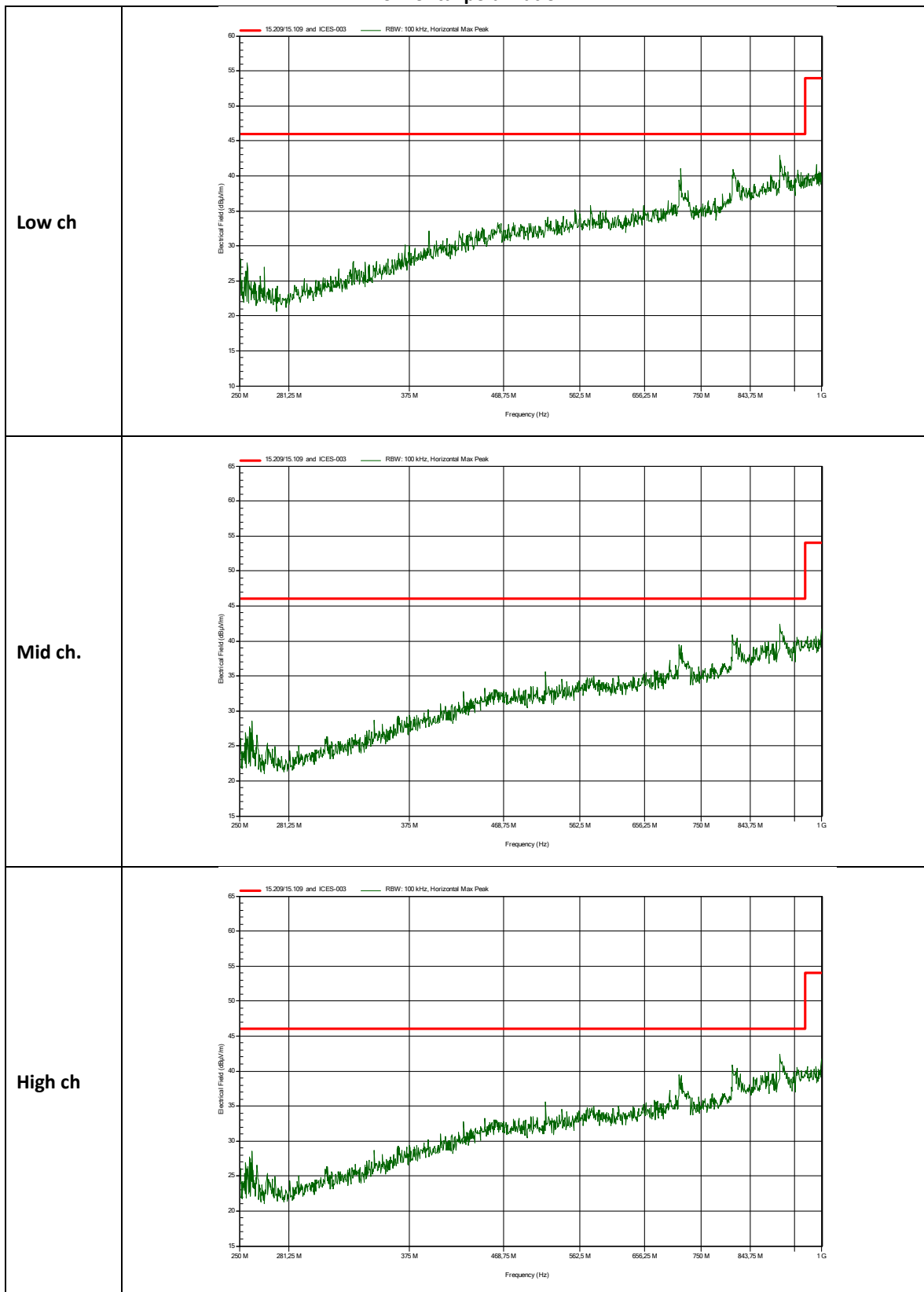
250 MHz to 1 GHz

Vertical polarization



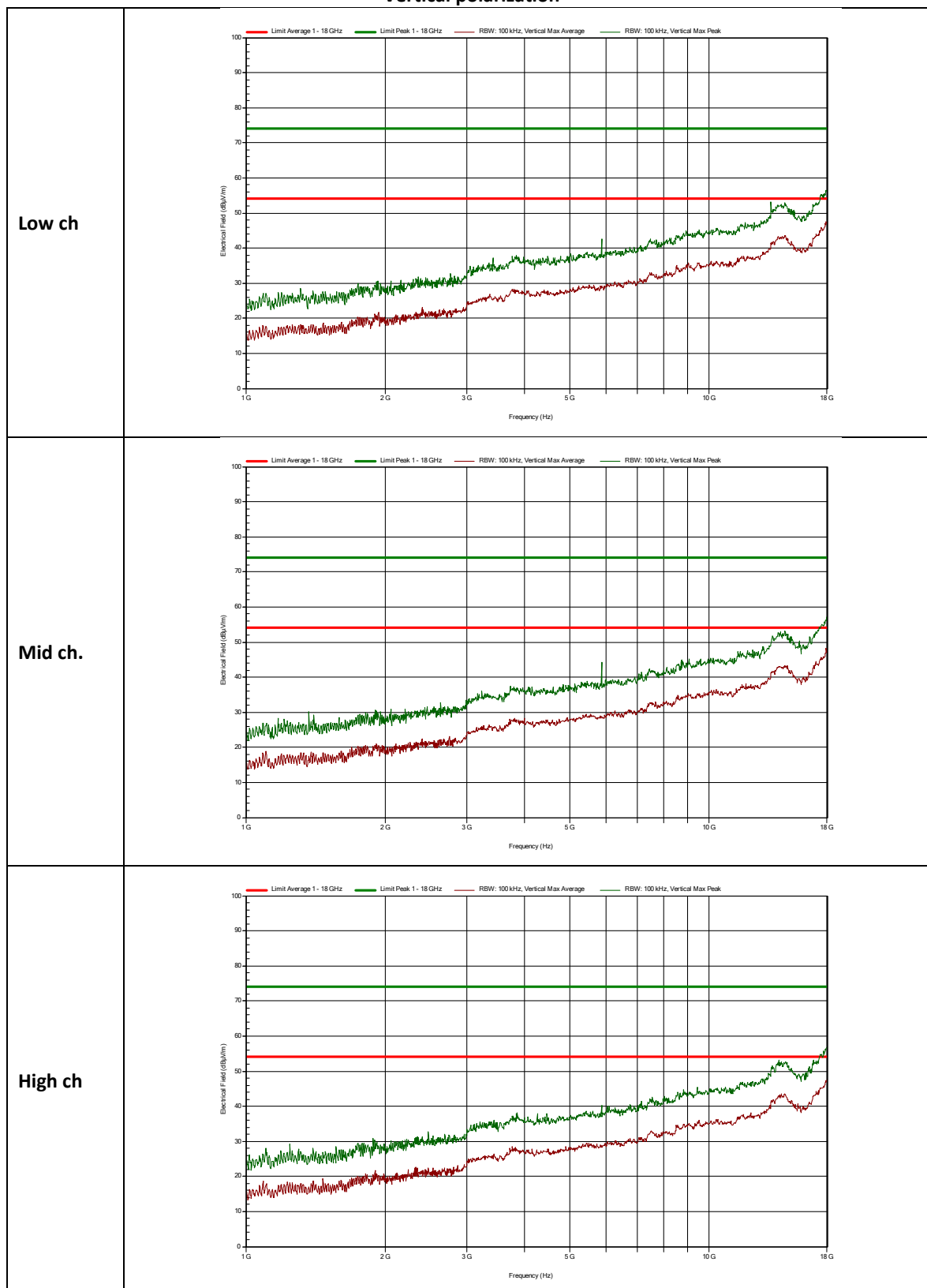
250 MHz to 1 GHz

Horizontal polarization



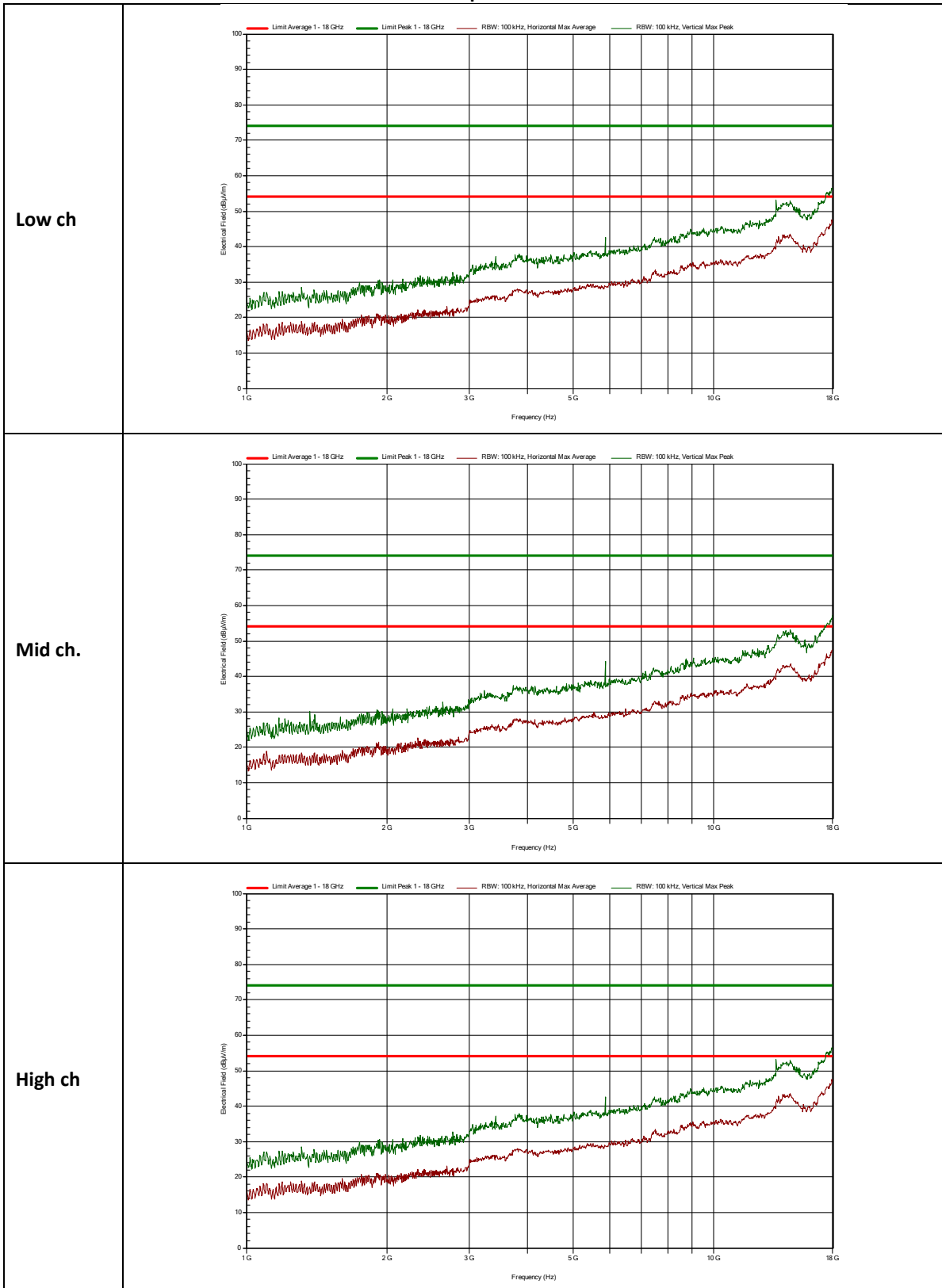
1 GHz to 18 GHz

Vertical polarization



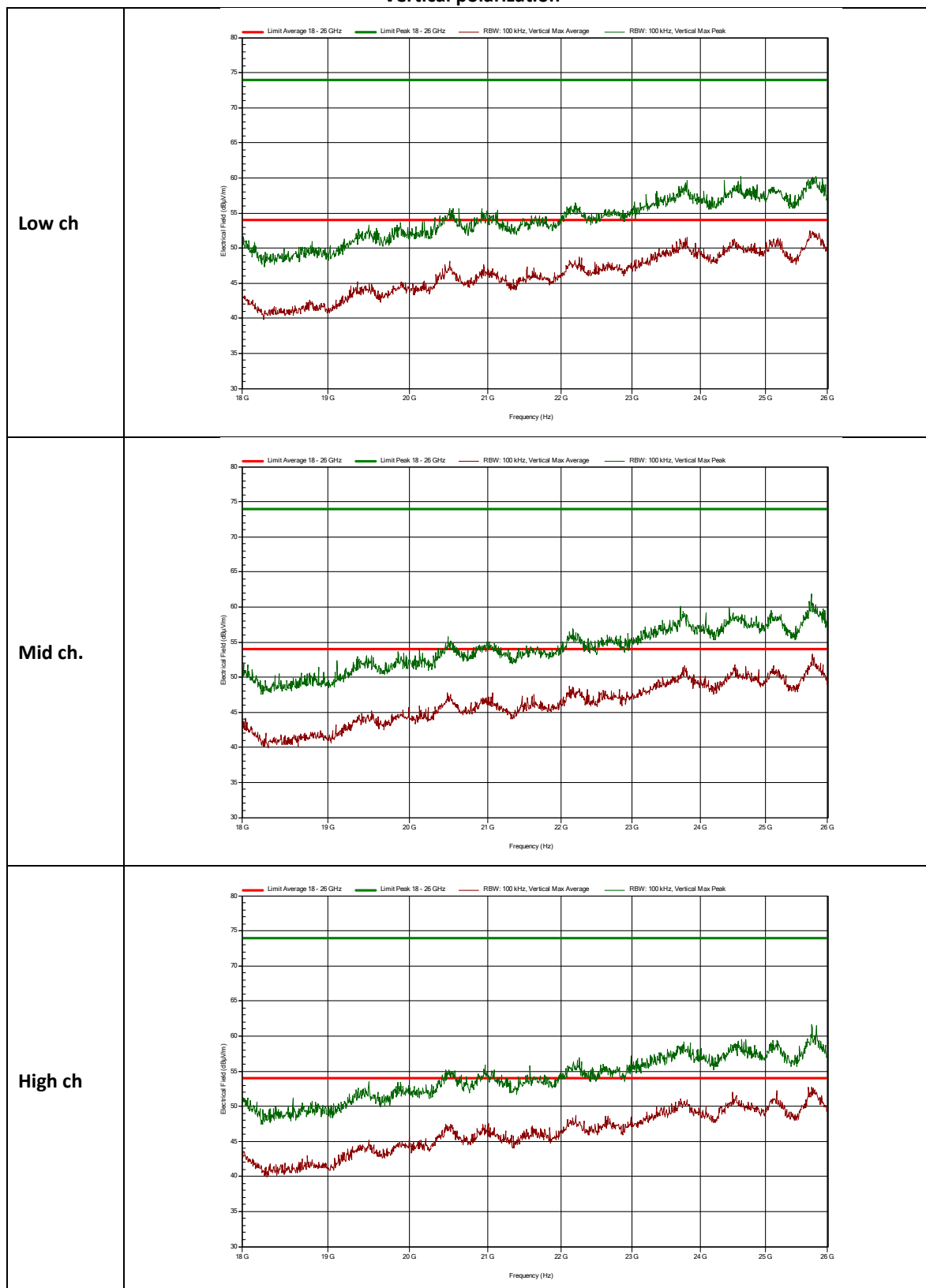
1 GHz to 18 GHz

Horizontal polarization



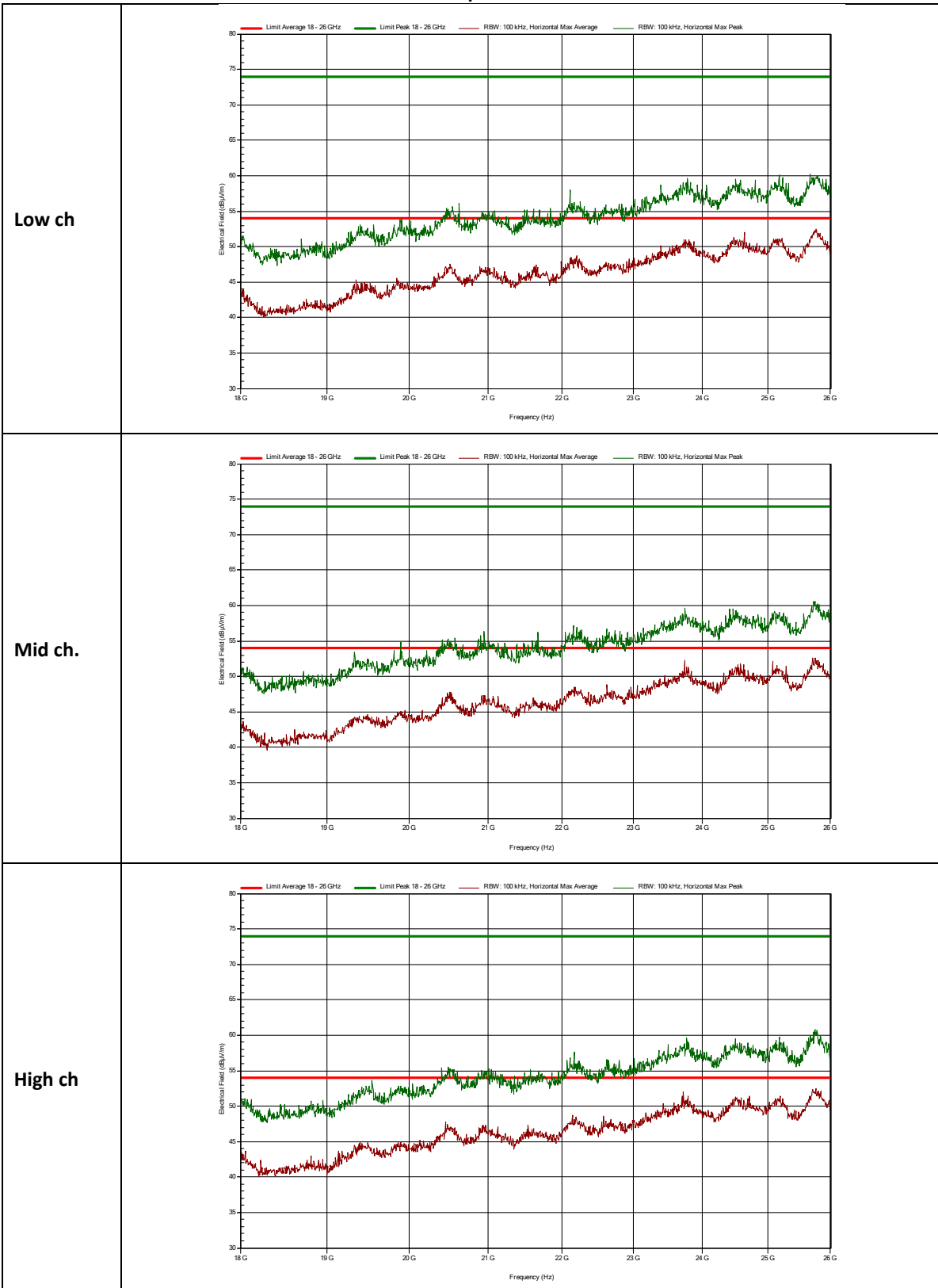
18 GHz to 26 GHz

Vertical polarization



18 GHz to 26 GHz

Horizontal polarization



3.2.7 Peak Table

Frequency	Peak	Peak Limit	Status	Angle	Height	Polarization
220,3 MHz	35,5 dB μ V/m	46 dB μ V/m	Pass	211 degrees	2 m	Horizontal
30,193 MHz	33,5 dB μ V/m	40 dB μ V/m	Pass	220 degrees	2,5 m	Horizontal
100,455 MHz	28,6 dB μ V/m	43,5 dB μ V/m	Pass	0 degrees	1,5 m	Horizontal
904,75 MHz	41,9 dB μ V/m	46 dB μ V/m	Pass	242 degrees	2 m	Vertical
808,469 MHz	40,3 dB μ V/m	46 dB μ V/m	Pass	325 degrees	4 m	Vertical
712,938 MHz	40 dB μ V/m	46 dB μ V/m	Pass	95 degrees	1 m	Vertical

3.3 AC power line conducted emissions

3.3.1 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.

3.3.2 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

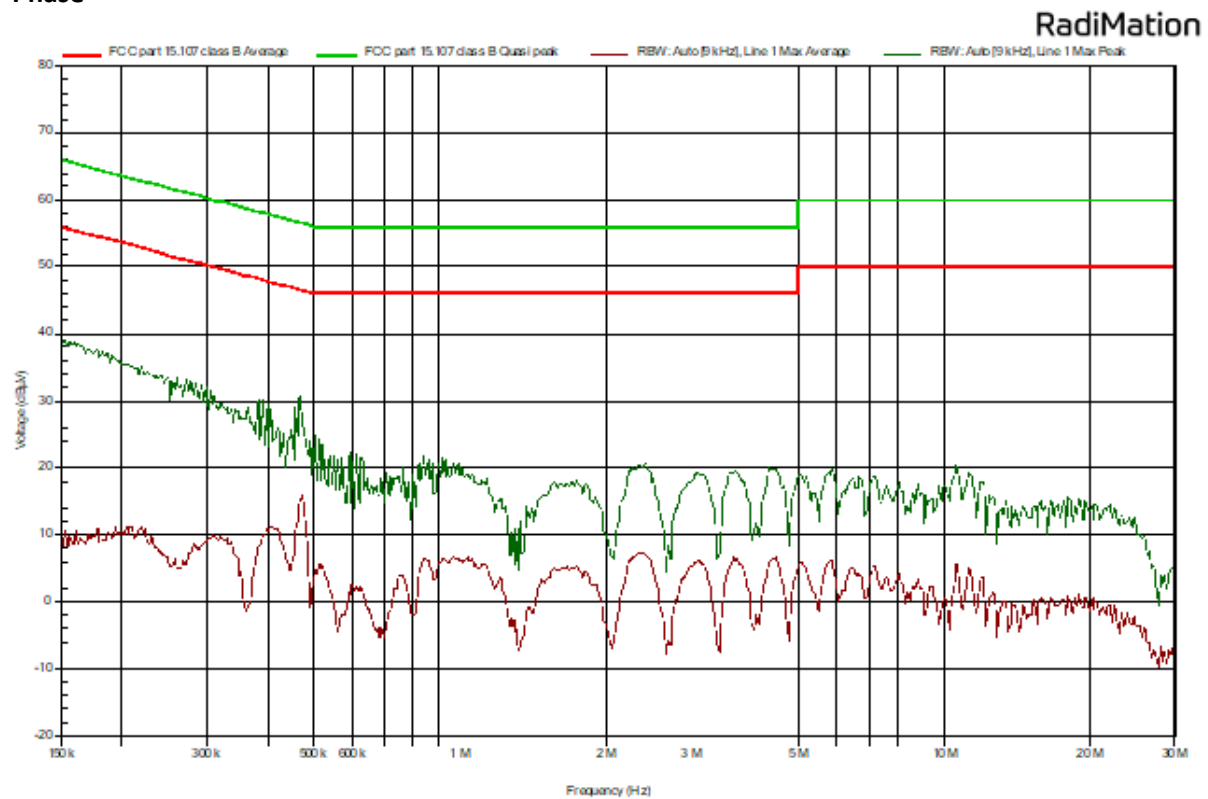
According to ANSI C63.10: 2014
IRN 029 – Method 1

3.3.5 Measurement uncertainty

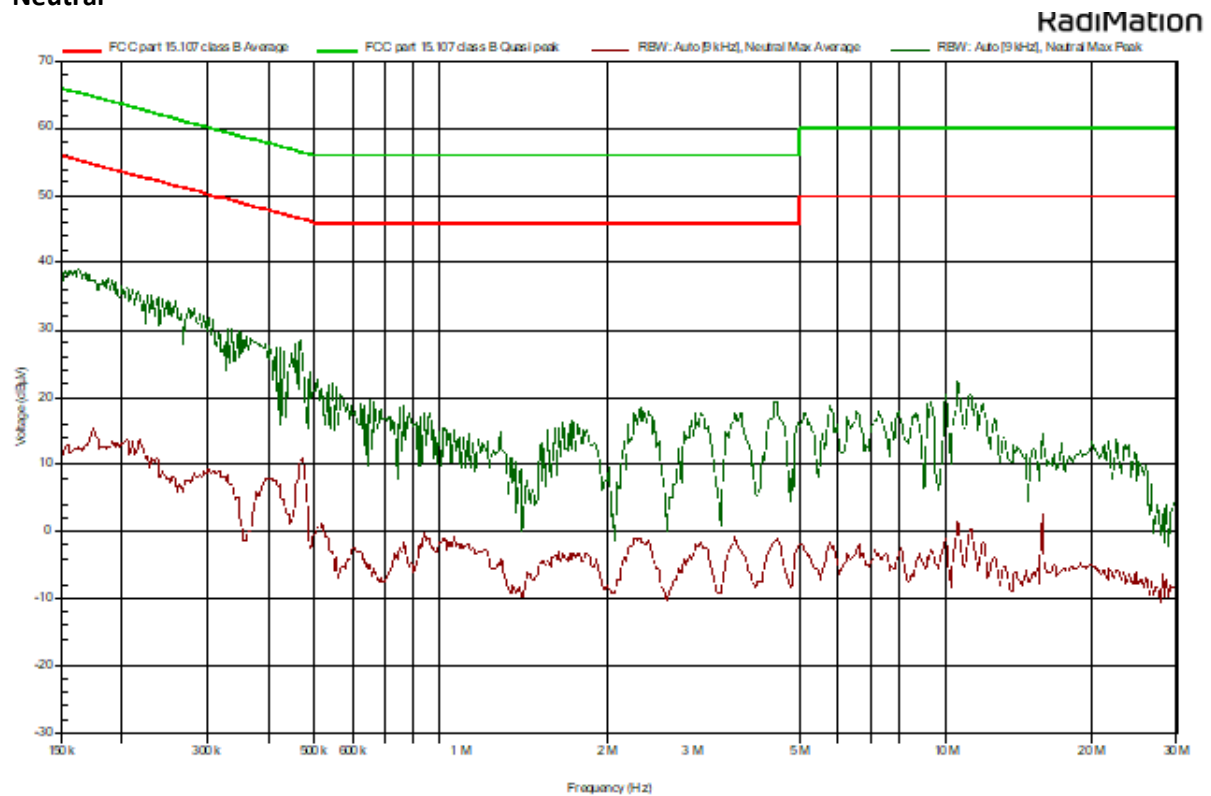
+/- 3.6 dB

3.3.6 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)	Cable loss (dB)	Corr. (dB)
	114379 Rohde & Schwarz ENV216	TE 11134	
0,15	9.6	0,02	9.62
0,3	9.6	0,03	9.63
0,5	9.6	0,08	9.68
0,7	9.7	0,25	9.95
1	9.6	0,11	9.71
3	9.6	0,21	9.81
5	9.6	0,21	9.81
7	9.7	0,25	9.95
10	9.7	0,29	9.99
15	9.7	0,34	10.04
20	9.8	0,37	10.17
22	9.6	0,39	9.99
24	9.6	0,43	10.03
30	9.6	0,45	10.05

Magnetic field strength measurement:

$$H \left[dB \left(\mu \frac{A}{m} \right) \right] = V[dB(\mu V)] + L_c[dB] + AF^H \left[\frac{dB}{\Omega m} \right]$$

Where:

H is the magnetic field strength (to be compared to the limit)

V is the voltage level measured by the receiver or spectrum analyzer

L_c is the cable loss

AF^H is the magnetic antenna factor

Frequency (MHz)	AF (dB/Ωm)	CL (dB)	Corr. (dB)
	114515 EMCO 6505 S/N:9112-2710	SAR cable	
0,009	-32,35	0,7	-31,65
0,01	-33,16	0,05	-33,11
0,02	-37,56	0,07	-37,49
0,03	-39,29	0,1	-39,19
0,04	-40,11	0,1	-40,01
0,1	-41,27	0,1	-41,17
0,2	-41,48	0,1	-41,38
0,5	-41,58	0,1	-41,48
1	-41,62	0,2	-41,42
3	-41,6	0,2	-41,4
5	-41,65	0,3	-41,35
10	-42,11	0,6	-41,51
15	-42,88	0,9	-41,98
20	-43,78	1	-42,78
25	-44,85	0,7	-44,15
27	-45,36	1,2	-44,16
30	-46,25	1	-45,25

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)
	Id: 114436 Schwarzbeck VHA9103+BBA9106 SN: 9856	Id: SAR cable	
30	18,64	0,68	19,32
100	10,43	1,15	11,58
150	14,76	1,41	16,17
200	16,04	1,63	17,67
250	16,89	1,93	18,82

Frequency (Mhz)	AF (dB/m)	Cable loss (dB)	Corr. (dB)
	Id: 114385 EMCO 3147 SN: 9104-1031	Id: SAR cable	
250	11,8	1,93	13,73
300	13	2,12	15,12
350	14,2	2,2	16,4
400	15,6	2,29	17,89
450	17,1	2,53	19,63
500	17,3	2,67	19,97
550	17,7	2,9	20,6
600	18,4	3,02	21,42
650	19,2	3,09	22,29
700	19,7	3,22	22,92
750	20,3	3,56	23,86
800	21,4	3,69	25,09
900	22,1	3,81	25,91
950	22,6	3,91	26,51
1000	22,5	4,3	26,8

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 00818 Flann 20240-25 SN: 163703	TE 11131 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

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