

FCC and ISED Test Report for Parts 15.209, 15.247, RSS-GEN and RSS-247

Main type designation : Easycontrol White, CT200
Applicant : Bosch Thermotechnik GmbH
FCC ID : 2AODDCT200
ISED ID : 23386-CT200

Test report No. : 170601858 04 Ver 1.00

Laboratory information

Accreditation

Telefication 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

The Industry Canada registration number for the 3 meter test chamber of Telefication is: 4173A-1.

Documentation

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. 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 L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

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Testing Location

Test Site	Telefication BV
Test Site location	Edisonstraat 12a 6902 PK Zevenaar The Netherlands Tel. +31889983600 Fax. +31316583189
Test Site FCC	NL0001

Revision History

Version	Date	Remarks	By
v0.50	1-09-2017	First draft	RvB
v1.00	27-11-2017	Release version	RvB

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Summary of Test results

FCC	IC	Description	Section in report	Verdict
15.247(a)	RSS-247 5.2 (1)	6dB Bandwidth	3.1	Pass
--	RSS-GEN 6.6	99% Bandwidth	3.2	Pass
15.247(b)	RSS-247 5.1 (2)	RF output power	3.3	Pass
15.247(e)	RSS-247 5.2 (2)	Power spectral density	3.4	Pass
15.247(d)	RSS-247 5.5	Conducted Spurious emissions	3.5	Pass
15.209 (a)	RSS-247 5.4	Radiated Spurious emissions	3.6	Pass
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	3.6	Pass

1 General Description

1.1 Applicant

Client name: Bosch Thermotechnik GmbH
Address Junkersstrasse 20-24
Zip code: D-73249 Wernau, Germany
Contact name: Andreas Kirchner-Gellert
E-mail: Andreas.Kirchner-Gellert@de.bosch.com

1.2 Manufacturer

Manufacturer name: Bosch Thermotechnik GmbH
Address: Junkersstrasse 20-24
Zip code: D-73249 Wernau, Germany
Contact name: Andreas Kirchner-Gellert
E-mail: Andreas.Kirchner-Gellert@de.bosch.com

1.3 Tested Equipment Under Test (EUT)

Product description: Control device
Main trademark: Bosch
Main type designation: Easycontrol White, CT200
FCC ID: 2AODDCT200
ISED ID 23386-CT200
Variant: Easycontrol Black, CT200B
Software version: RRCNG 00.08.01
Hardware version: 9
Date of receipt 25-07-2017
Tests started: 25-07-2017
Testing ended: 30-08-2017

1.4 Product specifications of Equipment under test

TX Frequency range (MHz):	WLAN (802.11b/g): 2400 – 2472 IEEE 802.15.4: 2400 – 2480
Rx frequency range (MHz):	WLAN (802.11b/g): 2400 – 2472 IEEE 802.15.4: 2400 - 2480
Maximum output power to antenna (dBm):	IEEE 802.11b: 13.8 IEEE 802.11g: 10.9 IEEE 802.15.4: 11.4
Antenna type :	WLAN (802.11b/g): PCB antenna IEEE 802.15.4: PCB antenna
Antenna gain (dBi):	WLAN (802.11b/g): 3.2 IEEE 802.15.4: 3.2
Type of modulation:	WLAN: Acc. to IEEE 802.11 b/g acc. to IEEE 802.15.4
Emission designator 802.11b:	16M6G1D
Emission designator 802.11g:	14M6G1D
Emission designator 802.15.4:	2M58G1D

1.5 Modification of the Equipment Under Test (EUT)

None.

1.6 Observations and remarks

The EUT has two radios embedded, an Wlan radio and an IEEE 802.15.4. This report covers the Wlan and IEEE 802.15.4 radios.

1.7 Environmental conditions

Test date	25-07-2017	30-08-2017
Ambient temperature	24.8 °C	24.8 °C
Humidity	53.2 %	57.3 %

1.8 Measurement Standards

- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V03r05
- ANSI C63.10:2013

1.9 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 §15.247, §15.207
- RSS-247 Issue 1, RSS-GEN Issue 4

1.10 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specifications stated in paragraph 1.9 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 1.9 "*Applicable standards*".

All tests are performed by:

Name : ing. R. van Barneveld

Review of test methods and report by:

Name : ing P.A. Suringa

The above conclusions have been verified by the following signatory:

Date : 28-11-2017

Name : ing. K.A. Roes

Function : Coordinator Radio Laboratory

Signature :



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.

2.2 Tested channels and Data rates

Technology	Channels	Data rate	Frequency (MHz)
IEEE 802.11b	1	11 Mbps	2412
	6	11 Mbps	2437
	11	11 Mbps	2462
IEEE 802.11g	1	54 Mbps	2412
	6	54 Mbps	2437
	11	54 Mbps	2462
IEEE 802.15.4	11	250 kbps	2405
	19	250 kbps	2445
	26	250 kbps	2480

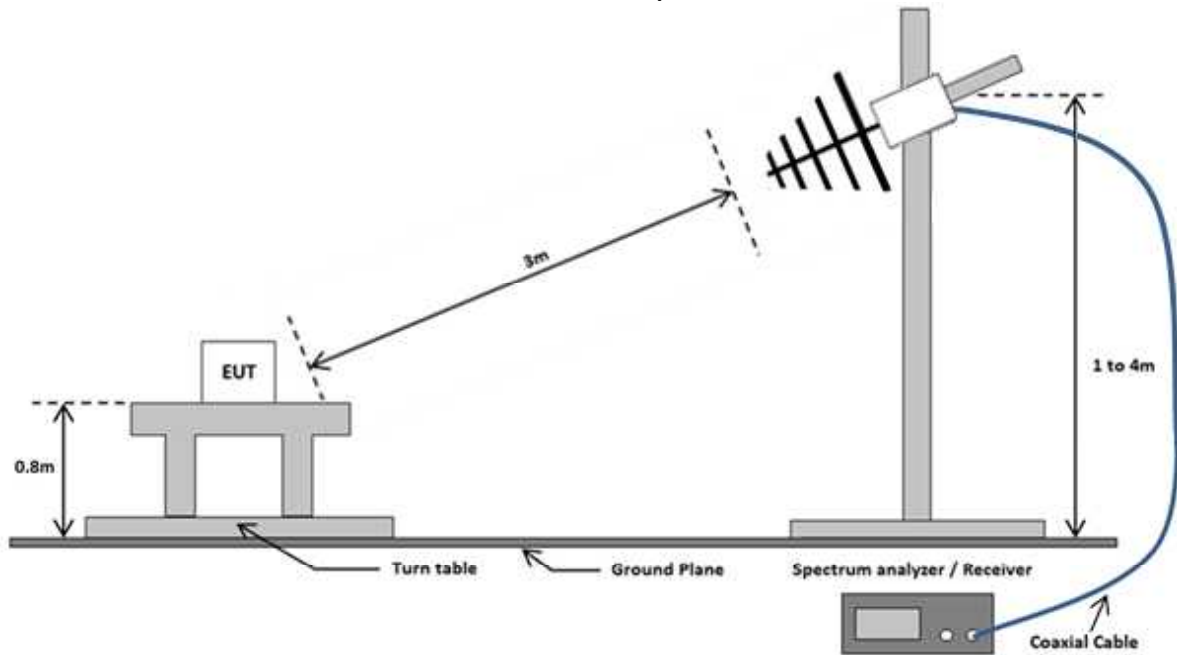
2.3 Conducted Test setup

RF tests at antenna connector

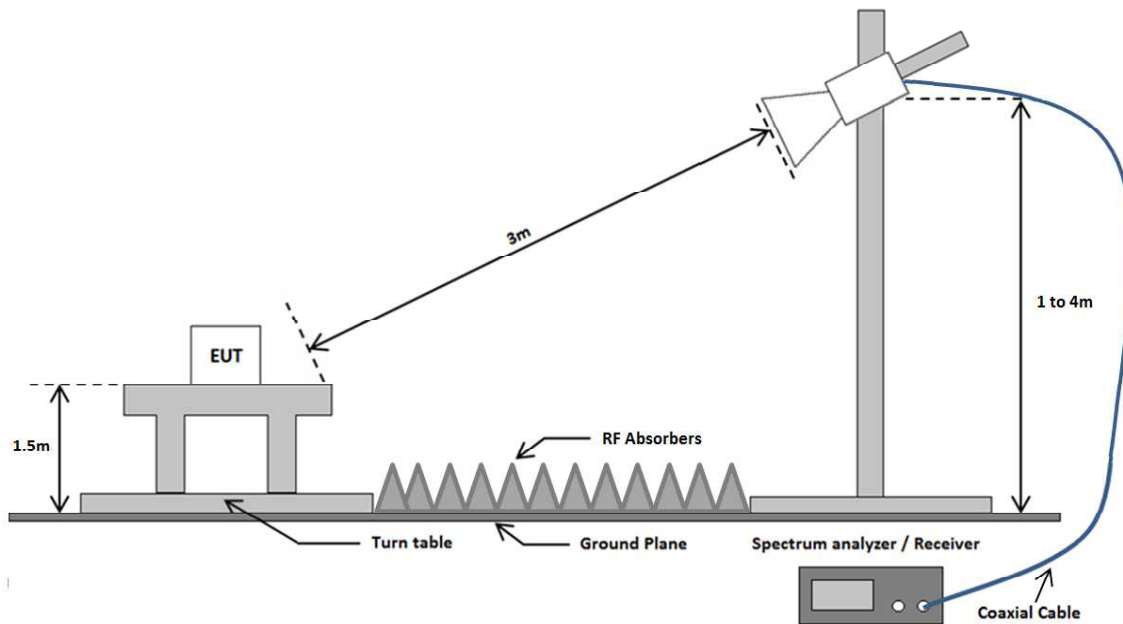


2.4 Radiated Test setup

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.5 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Signal Generator	Hewlett Packard	83650B	TE00487	3.1 to 3.5
Spectrum Analyzer	Rohde & Schwarz	FSV	TE01269	3.1 to 3.5
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.6
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.6, 3.7
10 MHz distribution Amplifier	Stanford Research Systems	FS735/1	TE01278	3.1 to 3.5
USB to GPIB adapter	National Instruments	GPIB-USB-HS+	TE01283	3.1 to 3.5
Biconilog Antenna	Chase	CBL6112A	TE00967	3.6
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.6
SAC Chamber	Comtest Engineering BV	-	TE00861	3.6
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE11132	3.6
Pre-amplifier	Miteq	JS4-18004000-30-8P-A1	TE11131	3.6
High pass filter	Wainwright instruments	WHK3.0/18G-10EF	TE01140	3.6
Horn antenna	Flann Microwave	20240-25	TE00818	3.6
Measurement software	DARE!!	RadiMation® Ver. 2016	--	3.6

2.6 Explanation of the Measurement results for all conducted test items

The path loss between the EUT and the spectrum analyser for the frequency range of 30 MHz to 40 GHz has been measured and stored in the transducer table of the spectrum analyser. This transducer table is used for level offset of the spectrum analyser. With this level offset the spectrum analysers reading will be exactly the RF output.

2.7 Sample calculation

Field Strength Measurement example:

Frequency (GHz)	Polarization	Height(m)	Peak (dBμV/m)
7,236	Horizontal	2	52.5

The following relation applies:

$$E \text{ (dB}\mu\text{V/m)} = U \text{ (dB}\mu\text{V)} + AF \text{ (dB/m)} - G \text{ (dB)} + CL \text{ (dB)}$$

Where:

E = Electric field strength

U = Measuring receiver voltage

AF = Antenna factor

G = Gain of the pre-amplifier

CL = Cable loss

$$(52.5 = 48.12 + 36.1 - 37.42 + 5.7)$$

3 Test results

3.1 6dB bandwidth Measurement

3.1.1 Limit

The minimum 6 dB Bandwidth shall be at least 500 kHz.

3.1.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.1.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.1.4 Test procedure

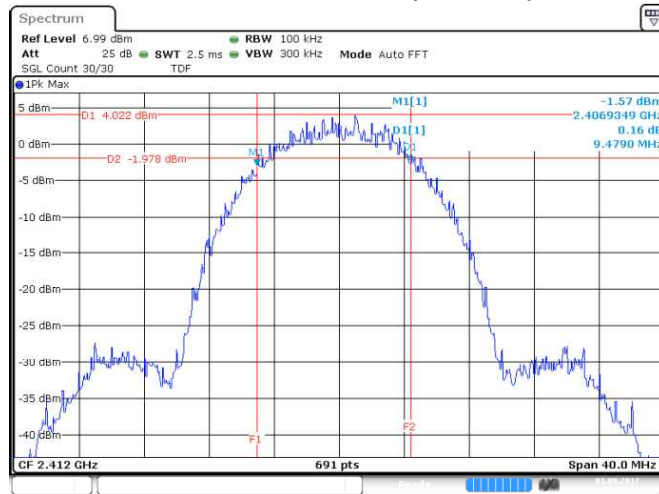
The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.

3.1.5 Test Results of the 6 dB bandwidth Measurement

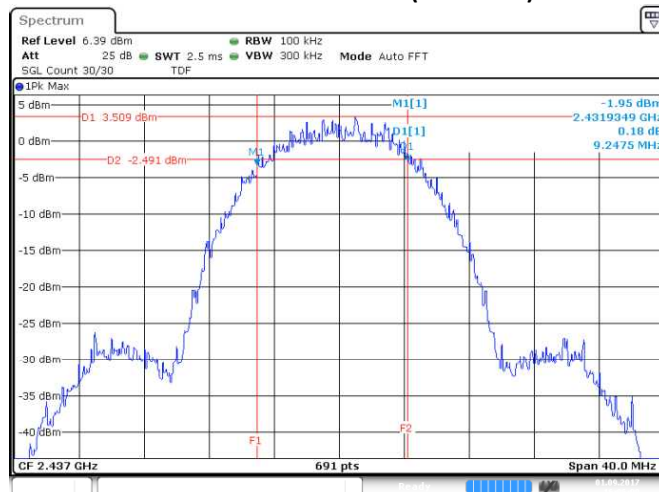
Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (MHz)
IEEE 802.11b	1	2412	11 Mbps	9.479
	6	2437	11 Mbps	9.247
	11	2462	11 Mbps	9.247
IEEE 802.11g	1	2412	54 Mbps	16.396
	6	2437	54 Mbps	16.396
	11	2462	54 Mbps	16.396
IEEE 802.15.4	11	2405	250 kbps	1.630
	19	2445	250 kbps	1.599
	26	2480	250 kbps	1.646
Uncertainty	± 362 kHz			

3.1.6 Plots of the 6 dB bandwidth Measurement

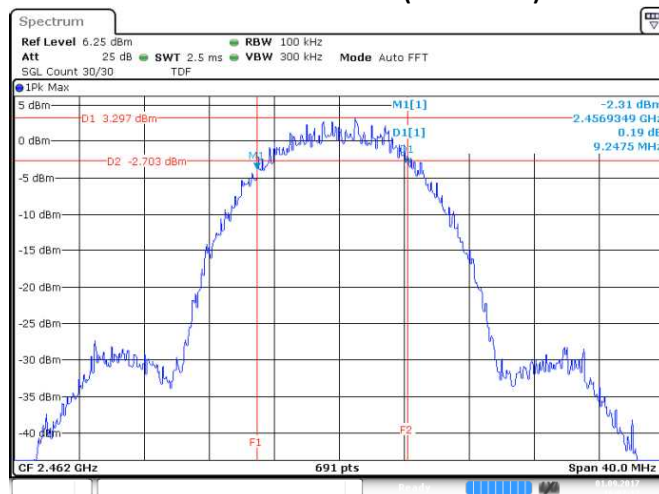
802.11b 6dB Bandwidth (Channel 1)



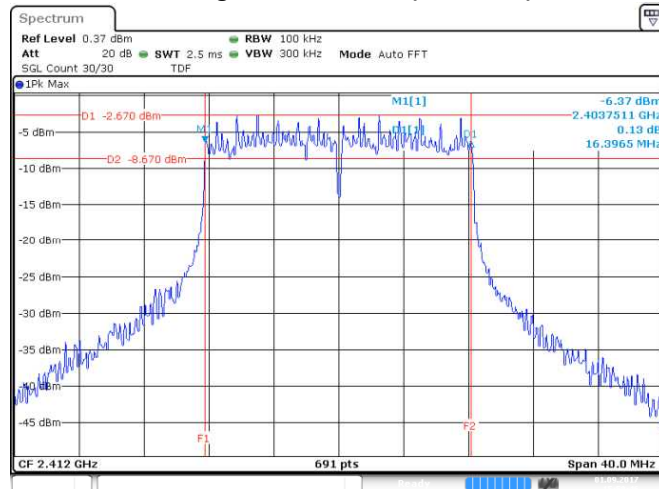
802.11b 6dB Bandwidth (Channel 6)



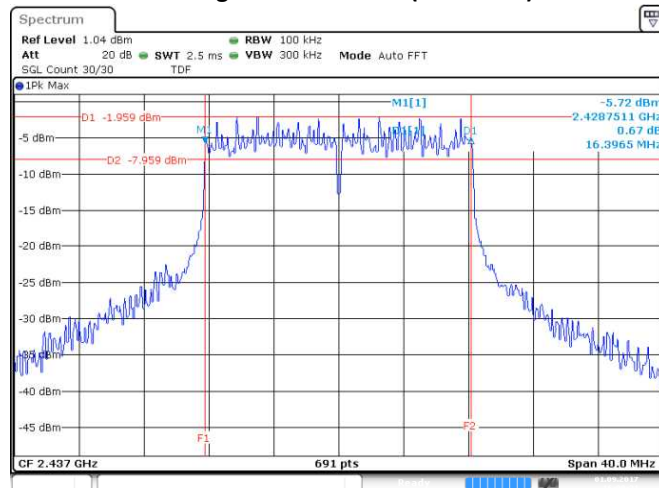
802.11b 6dB Bandwidth (Channel 11)



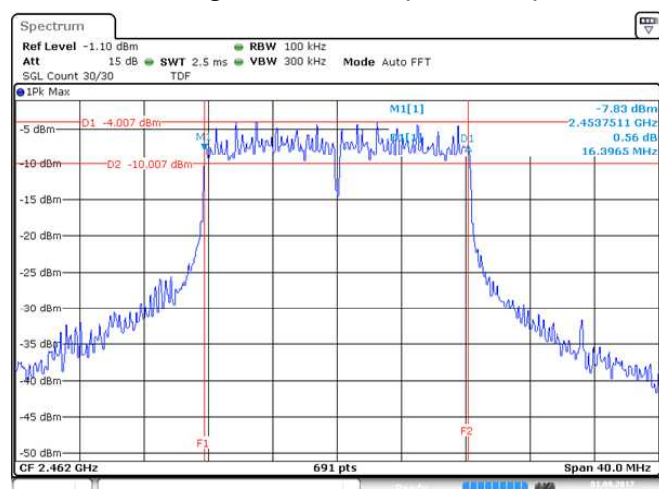
802.11g 6dB Bandwidth (Channel 1)



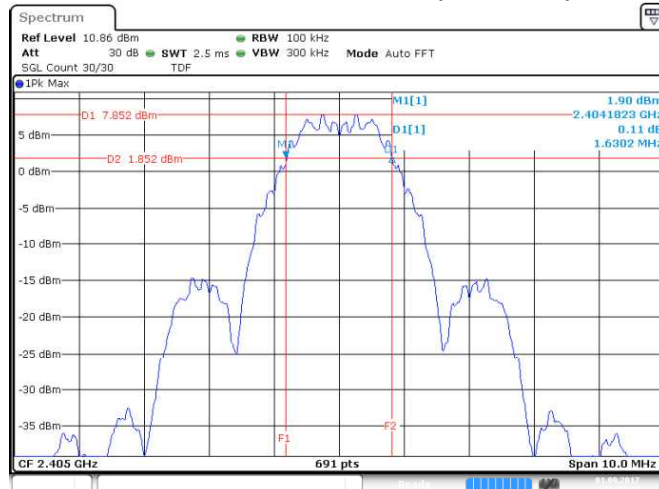
802.11g 6dB Bandwidth (Channel 6)



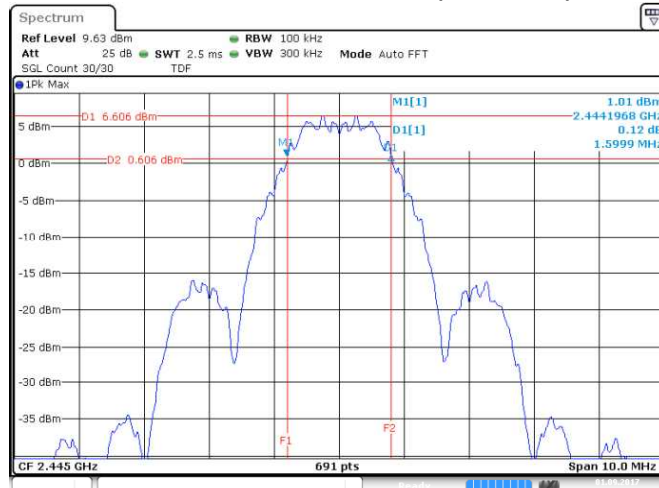
802.11g 6dB Bandwidth (Channel 11)



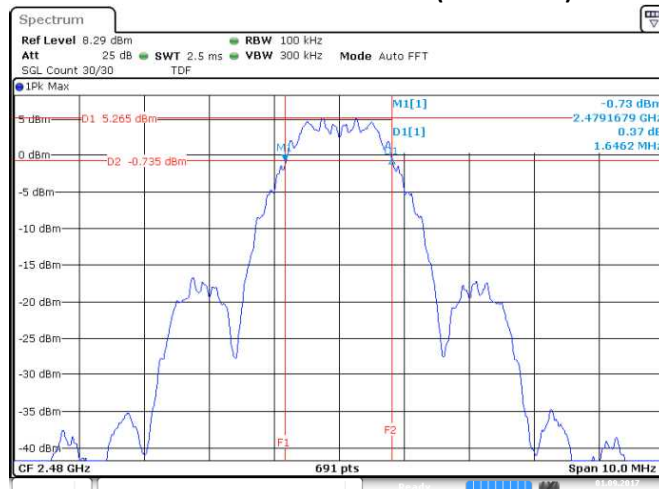
IEEE 802.15.4 6dB Bandwidth (Channel 11)



IEEE 802.15.4 6dB Bandwidth (Channel 19)



IEEE 802.15.4 6dB Bandwidth (Channel 26)



3.2 99% Occupied Bandwidth

3.2.1 Limit

Reporting only

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.2.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.2.4 Test procedure

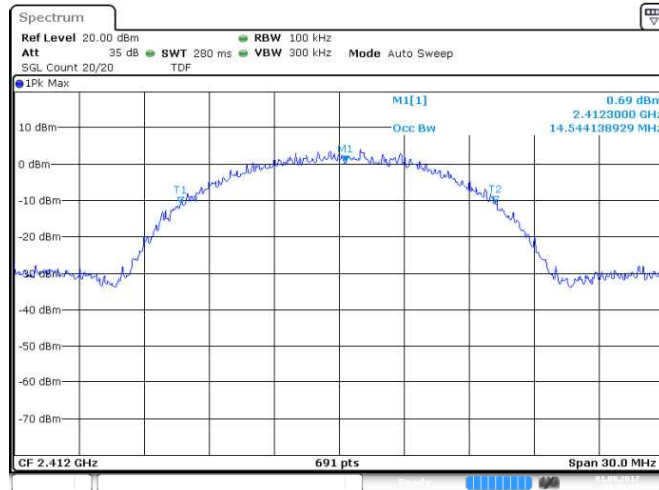
- 1 Set the centre frequency to the nominal EUT channel centre frequency.
- 2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
- 3 Set VBW $\geq 3 \times$ RBW.
- 4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until the trace stabilizes) shall be used.

3.2.5 Test results of the 99% Occupied Bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
IEEE 802.11b	1	2412	11 Mbps	14.544
	6	2437	11 Mbps	14.630
	11	2462	11 Mbps	14.500
IEEE 802.11g	1	2412	54 Mbps	16.497
	6	2437	54 Mbps	16.541
	11	2462	54 Mbps	16.584
IEEE 802.15.4	11	2405	250 kbps	2.570
	19	2445	250 kbps	2.558
	26	2480	250 kbps	2.581
Uncertainty	± 362 kHz			

3.2.6 Plots of the 99% Occupied Bandwidth Measurement

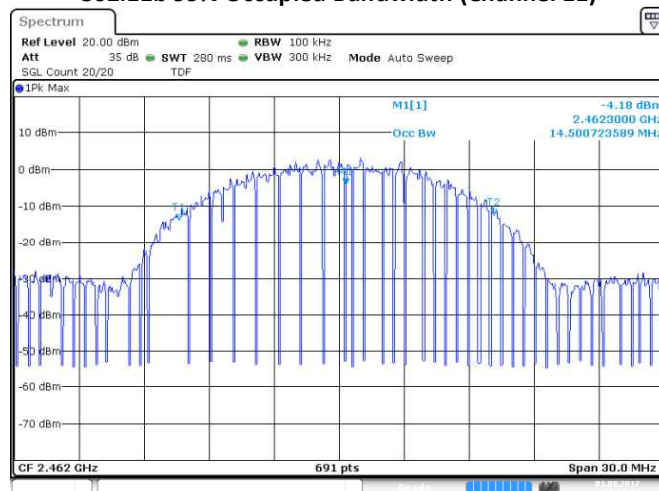
802.11b 99% Occupied Bandwidth (Channel 1)



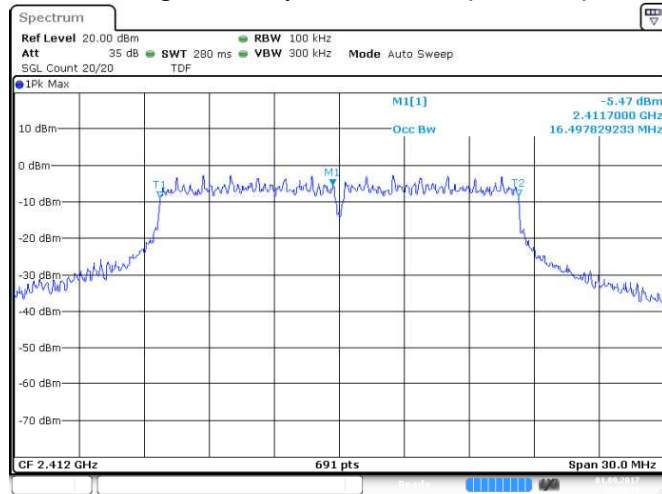
802.11b 99% Occupied Bandwidth (Channel 6)



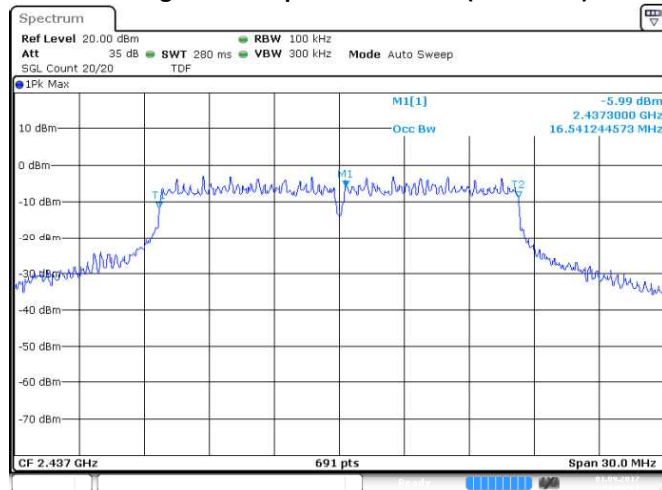
802.11b 99% Occupied Bandwidth (Channel 11)



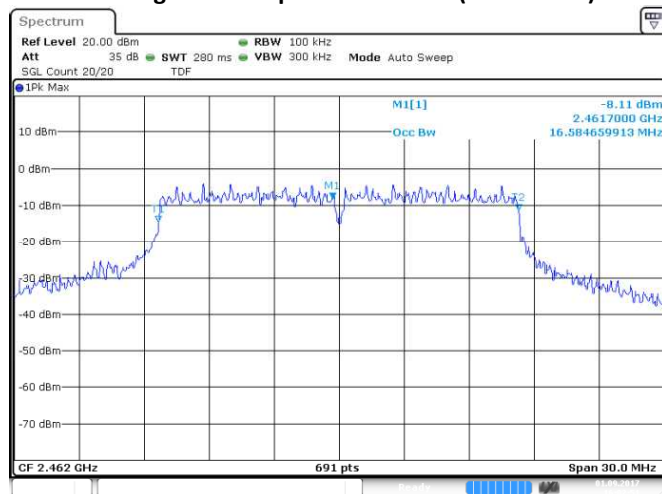
802.11g 99% Occupied Bandwidth (Channel 1)



802.11g 99% Occupied Bandwidth (Channel 6)



802.11g 99% Occupied Bandwidth (Channel 11)



IEEE 802.15.4 99% Occupied Bandwidth (Channel 11)



IEEE 802.15.4 99% Occupied Bandwidth (Channel 19)



IEEE 802.15.4 99% Occupied Bandwidth (Channel 26)



3.3 Output Power Measurement

3.3.1 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.

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.3.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.3.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.

3.3.5 Test results of Output Power Measurement

Duty cycle				
Technology Std.	Channel	Frequency (MHz)	Data rate	Duty cycle (%)
IEEE 802.11b	1	2412	11 Mbps	75
	6	2437	11 Mbps	75
	11	2462	11 Mbps	75
IEEE 802.11g	1	2412	54 Mbps	60
	6	2437	54 Mbps	60
	11	2462	54 Mbps	60
IEEE 802.15.4	11	2405	250 kbps	33
	19	2445	250 kbps	33
	26	2480	250 kbps	33

Peak method				
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
IEEE 802.11b	1	2412	11 Mbps	20.19
	6	2437	11 Mbps	21.19
	11	2462	11 Mbps	19.82
Uncertainty	±0.63 dB			

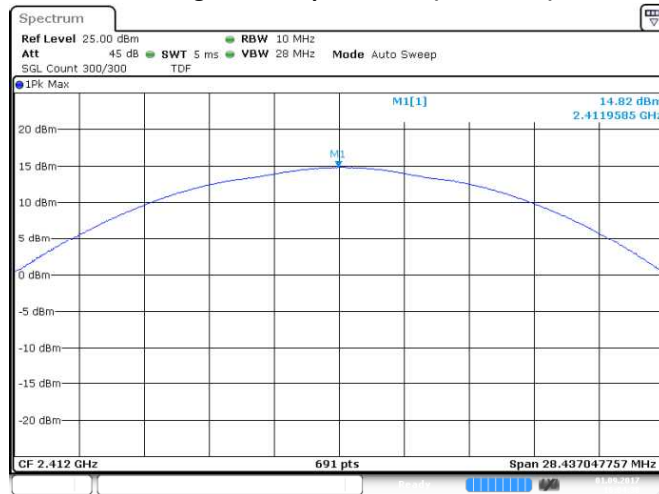
Peak method				
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
IEEE 802.11g	1	2412	54 Mbps	18.02
	6	2437	54 Mbps	17.53
	11	2462	54 Mbps	17.31
Uncertainty	±0.63 dB			

Peak method				
Technology Std.	Channels	Frequency (MHz)	Data rate	Peak output power (dBm)
IEEE 802.15.4	11	2425	250 kbps	14.33
	19	2450	250 kbps	13.05
	26	2475	250 kbps	11.93
Uncertainty	±1.78 dB			

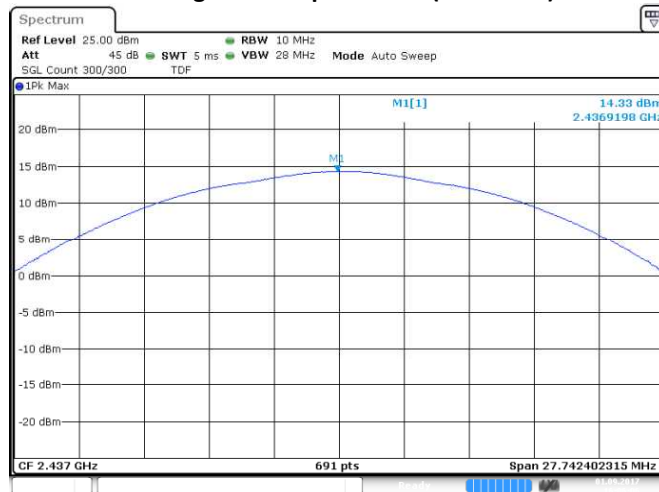
Note: Output power (dBm) =Conducted output power(dBm) + antenna gain (dBi)

3.3.6 Plots of Output Power Measurement

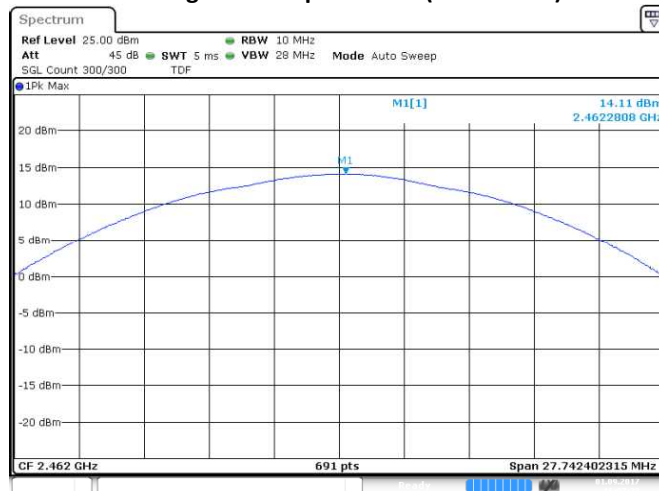
802.11g Peak Output Power (Channel 1)



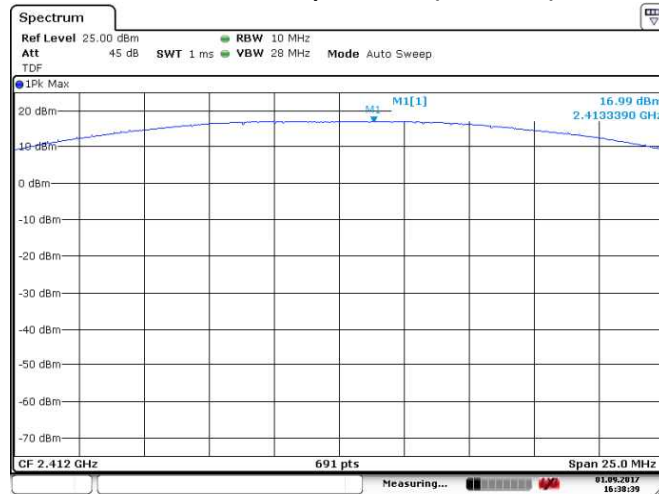
802.11g Peak Output Power (Channel 6)



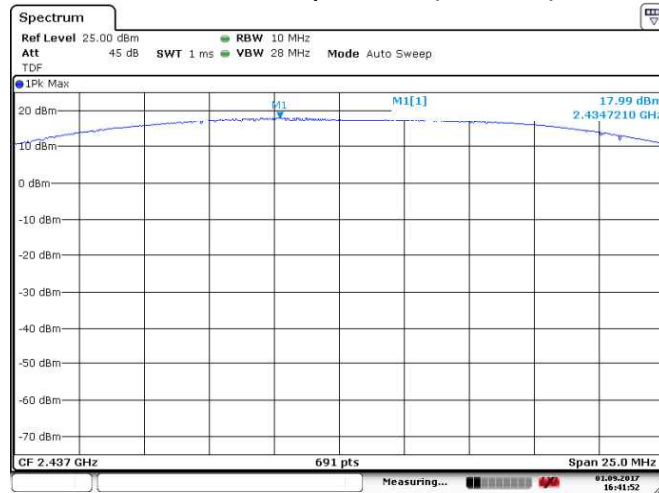
802.11g Peak Output Power (Channel 11)



802.11b Peak Output Power (Channel 1)



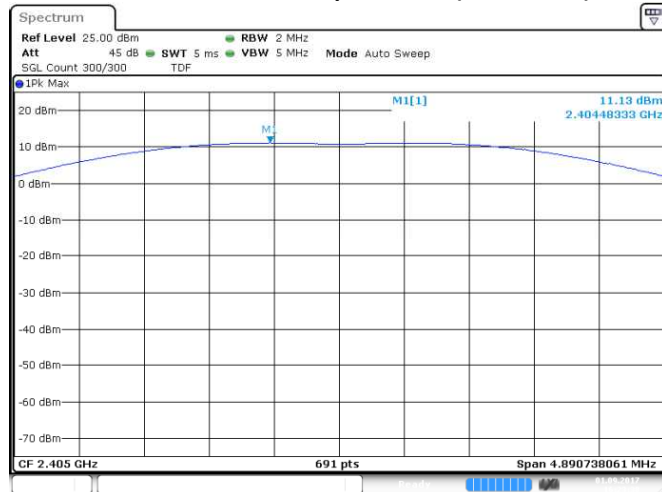
802.11b Peak Output Power (Channel 6)



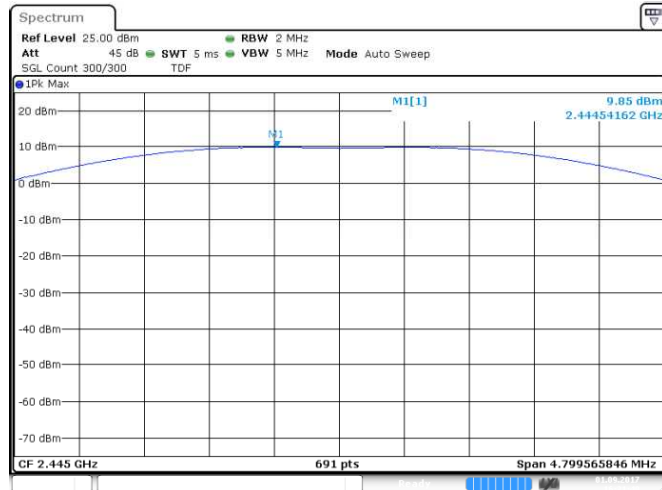
802.11b Peak Output Power (Channel 11)



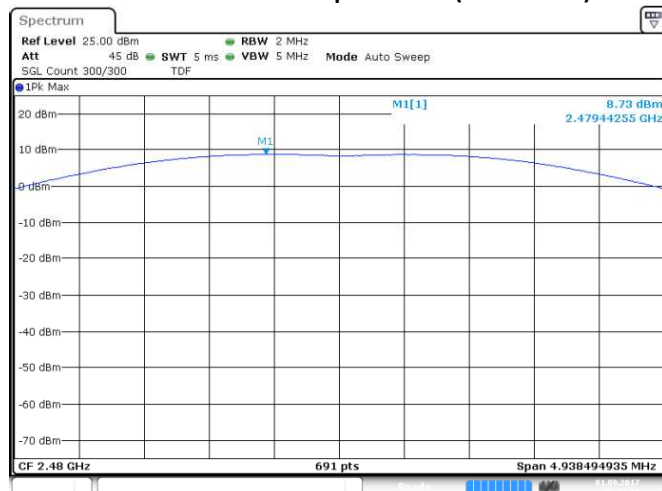
IEEE 802.15.4 Peak Output Power (Channel 11)



IEEE 802.15.4 Peak Output Power (Channel 19)



IEEE 802.15.4 Peak Output Power (Channel 26)



3.4 Power Spectral Density

3.4.1 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.

3.4.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.4.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

3.4.4 Test procedure

The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.

3.4.5 Test results of Power Spectral Density Measurement

Peak Power spectral density

Technology Std.	Channel	Frequency (MHz)	Data rate	PSD/3 kHz (dBm)
IEEE 802.11b	1	2412	11 Mbps	-11.34
	6	2437	11 Mbps	-11.88
	11	2462	11 Mbps	-12.33
Uncertainty	±0.63 dB			

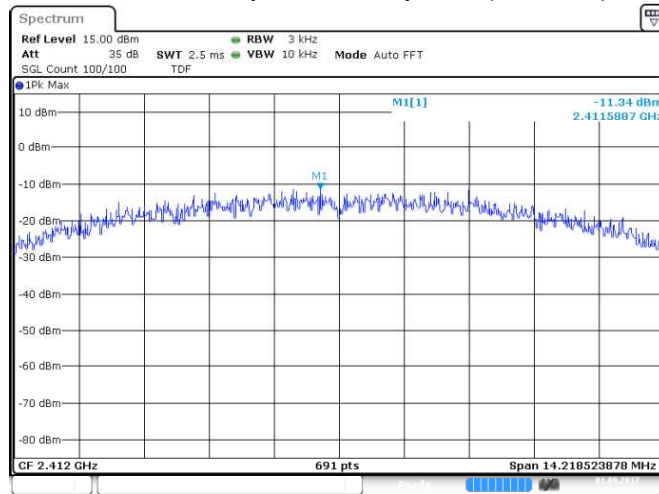
Average Power spectral density

Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/100 kHz (dBm)
IEEE 802.11g	1	2412	54 Mbps	-18.92
	6	2437	54 Mbps	-19.16
	11	2462	54 Mbps	-20.28
Uncertainty	±0.63 dB			

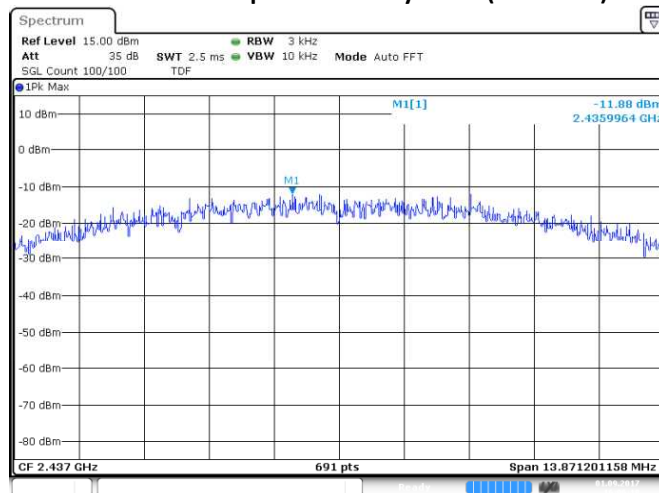
Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/100 kHz (dBm)
IEEE 802.15.4	11	2425	250 kbps	6.20
	19	2450	250 kbps	5.41
	26	2475	250 kbps	4.42
Uncertainty	±0.63 dB			

3.4.6 Plots of the Power Spectral Density Measurements

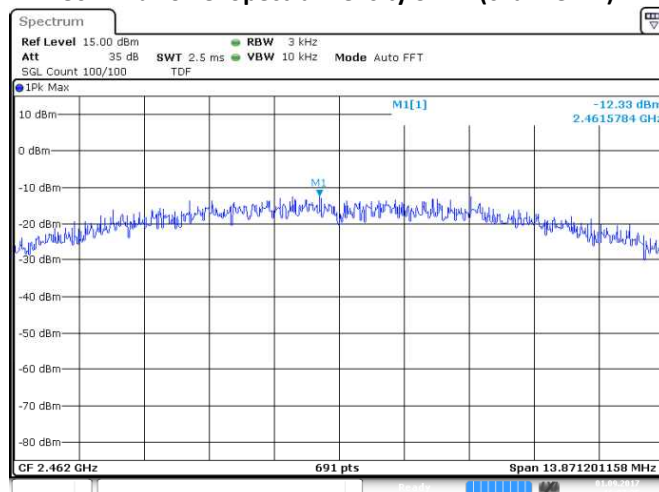
802.11b Power Spectral Density 3 kHz (channel 1)



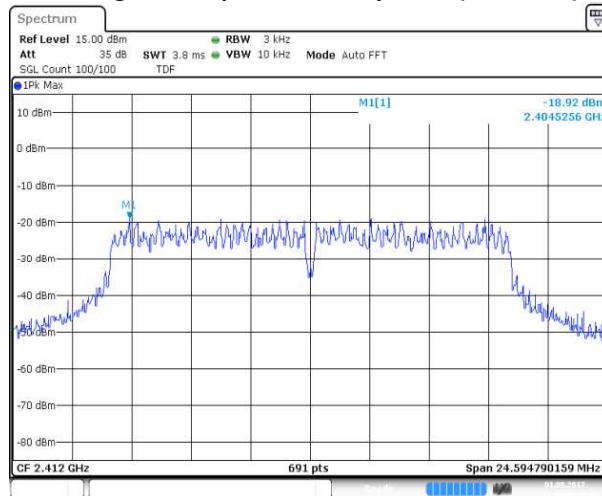
802.11b Power Spectral Density 3 kHz (channel 6)



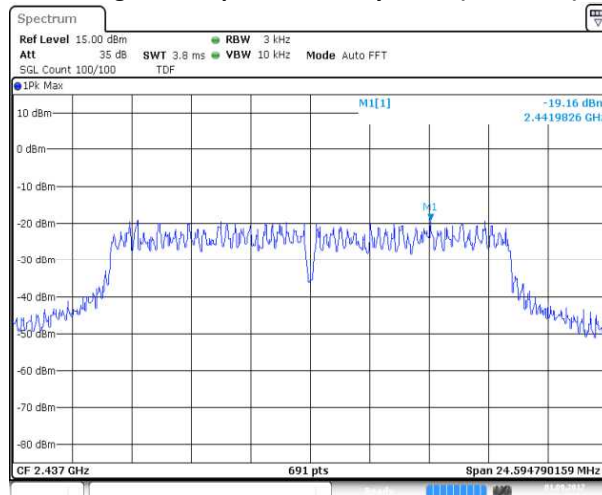
802.11b Power Spectral Density 3 kHz (channel 11)



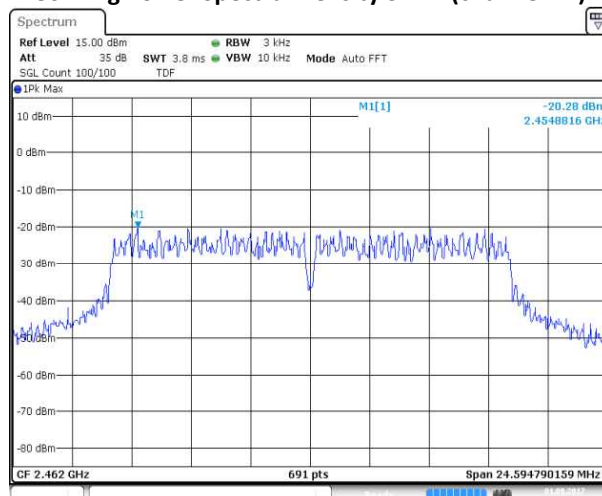
802.11g Power Spectral Density 3 kHz (channel 1)



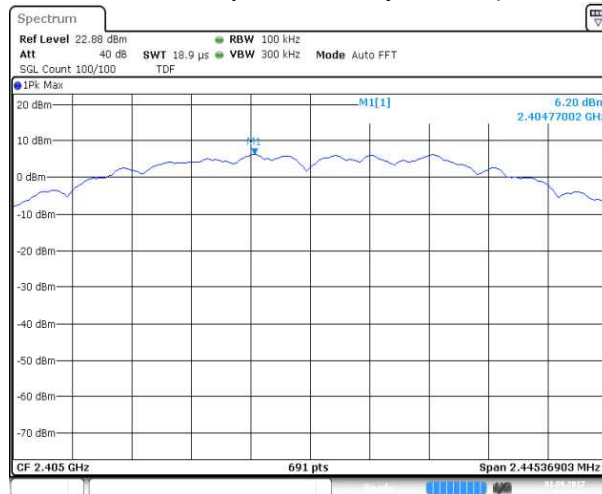
802.11g Power Spectral Density 3 kHz (channel 6)



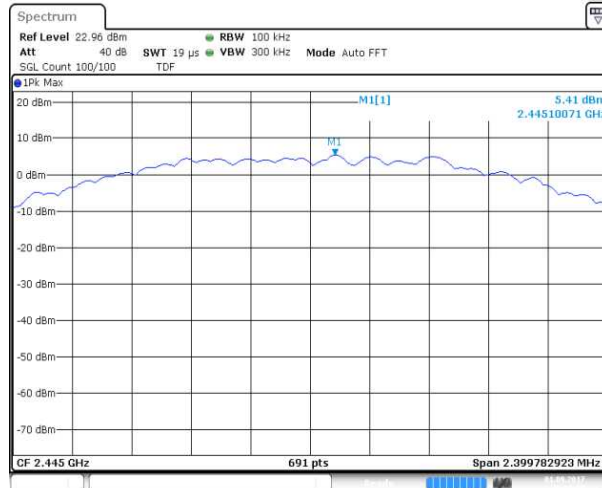
802.11g Power Spectral Density 3 kHz (channel 11)



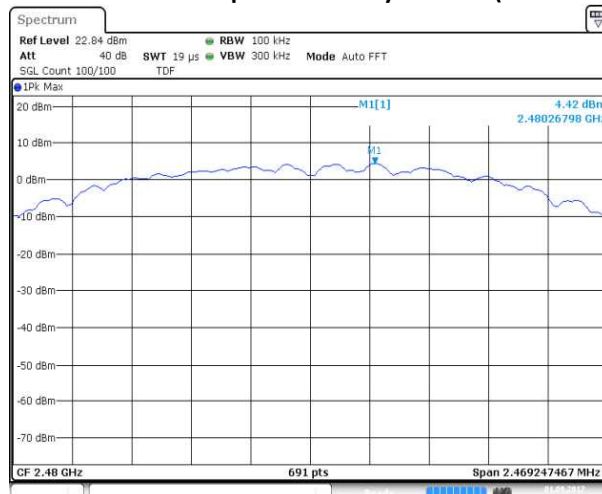
IEEE 802.15.4 Power Spectral Density 100 kHz (channel 11)



IEEE 802.15.4 Power Spectral Density 100 kHz (channel 19)



IEEE 802.15.4 Power Spectral Density 100 kHz (channel 26)



3.5 Conducted Spurious Emissions Measurement

3.5.1 Limit

Spurious Emissions:

In any 100 kHz bandwidth outside the operating frequency band, the RF power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either a RF conducted or a radiated measurement.

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.5.3 Test setup

The test setup is as shown in chapter 2.3 of this report.

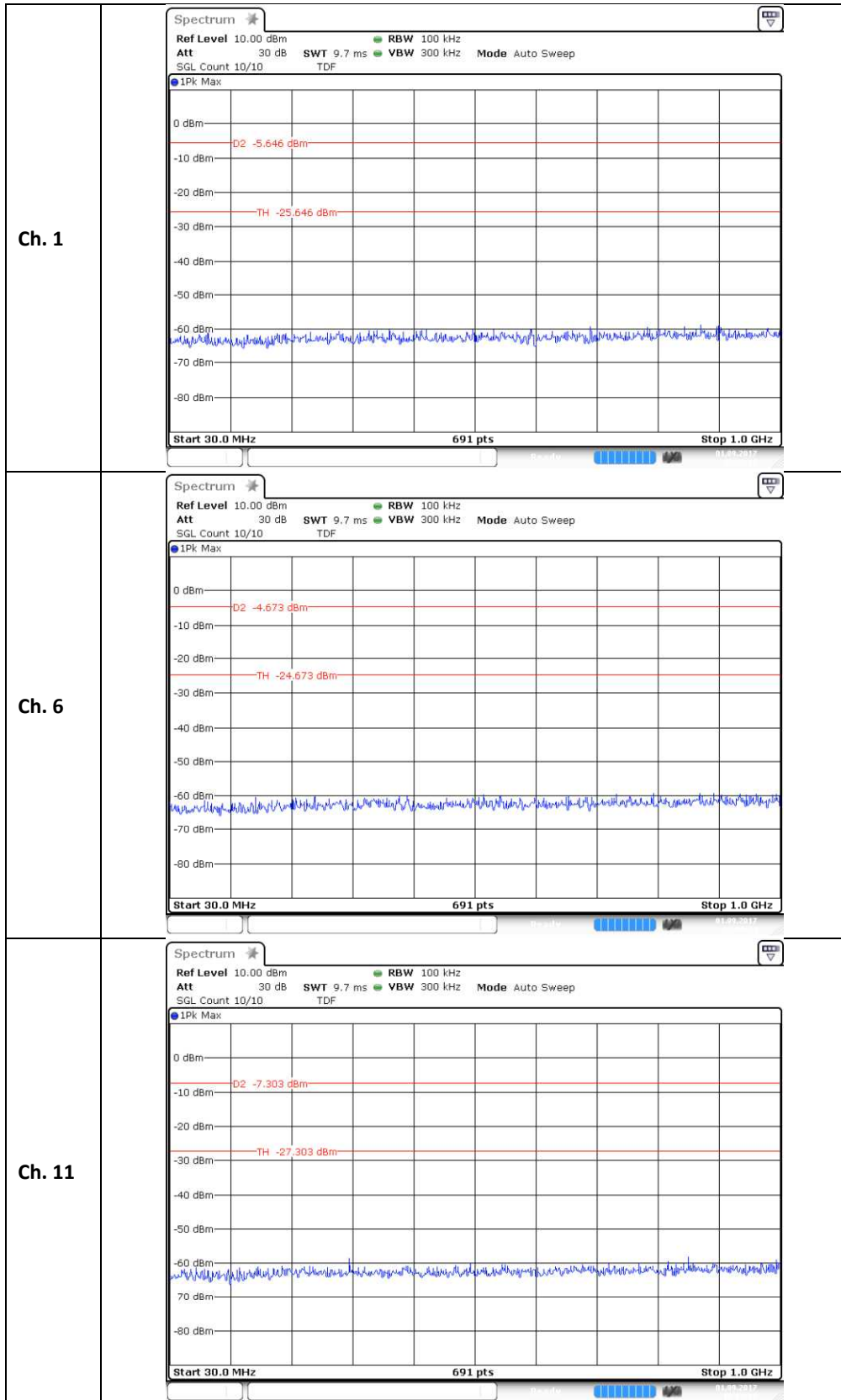
3.5.4 Test procedure

According to KDB Publication 558074 V03r05, sections 11.3 and 12.1

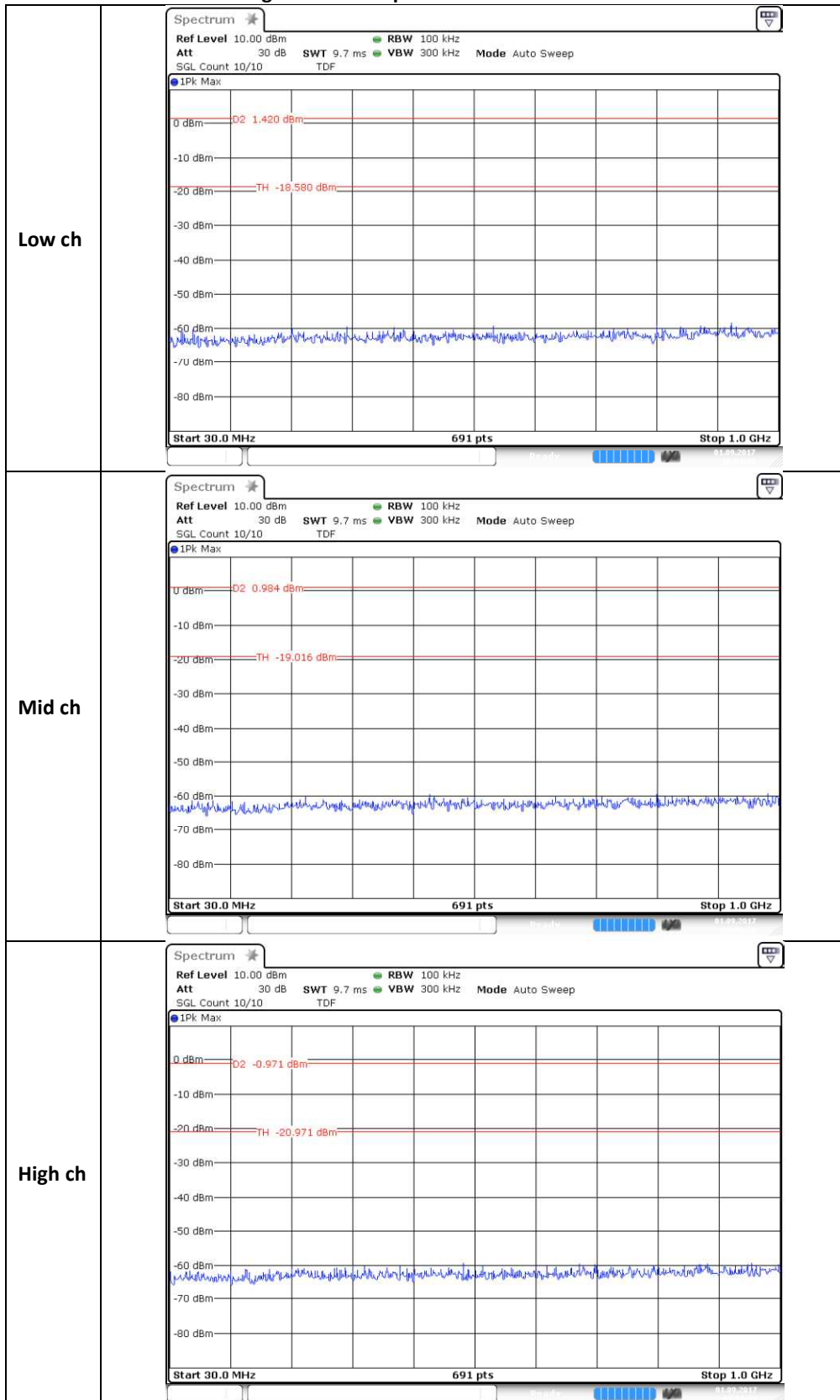
3.5.5 Test results of conducted Spurious Emissions Measurements

See next page

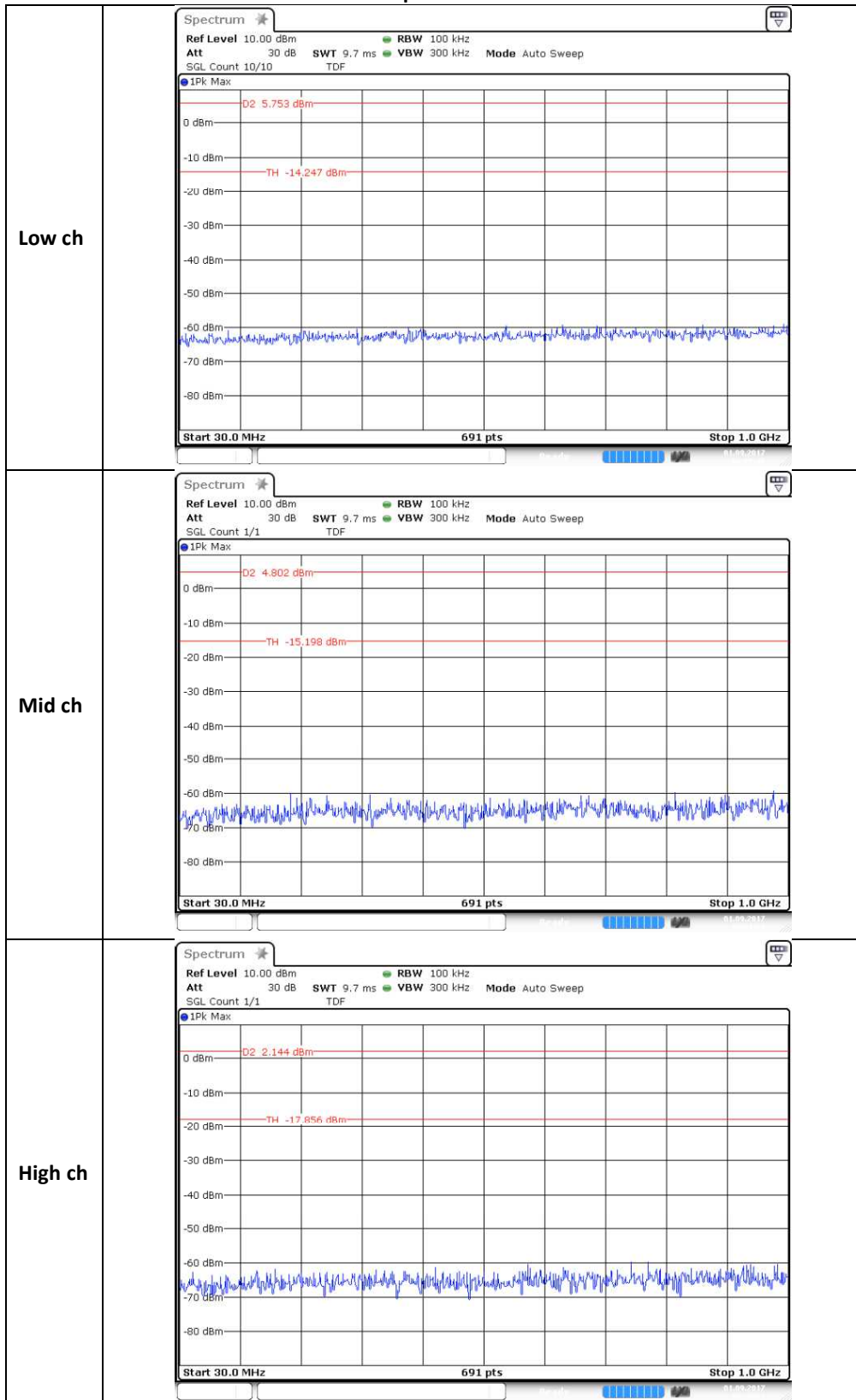
IEEE 802.11b Conducted Spurious Emissions 30 – 1000 MHz



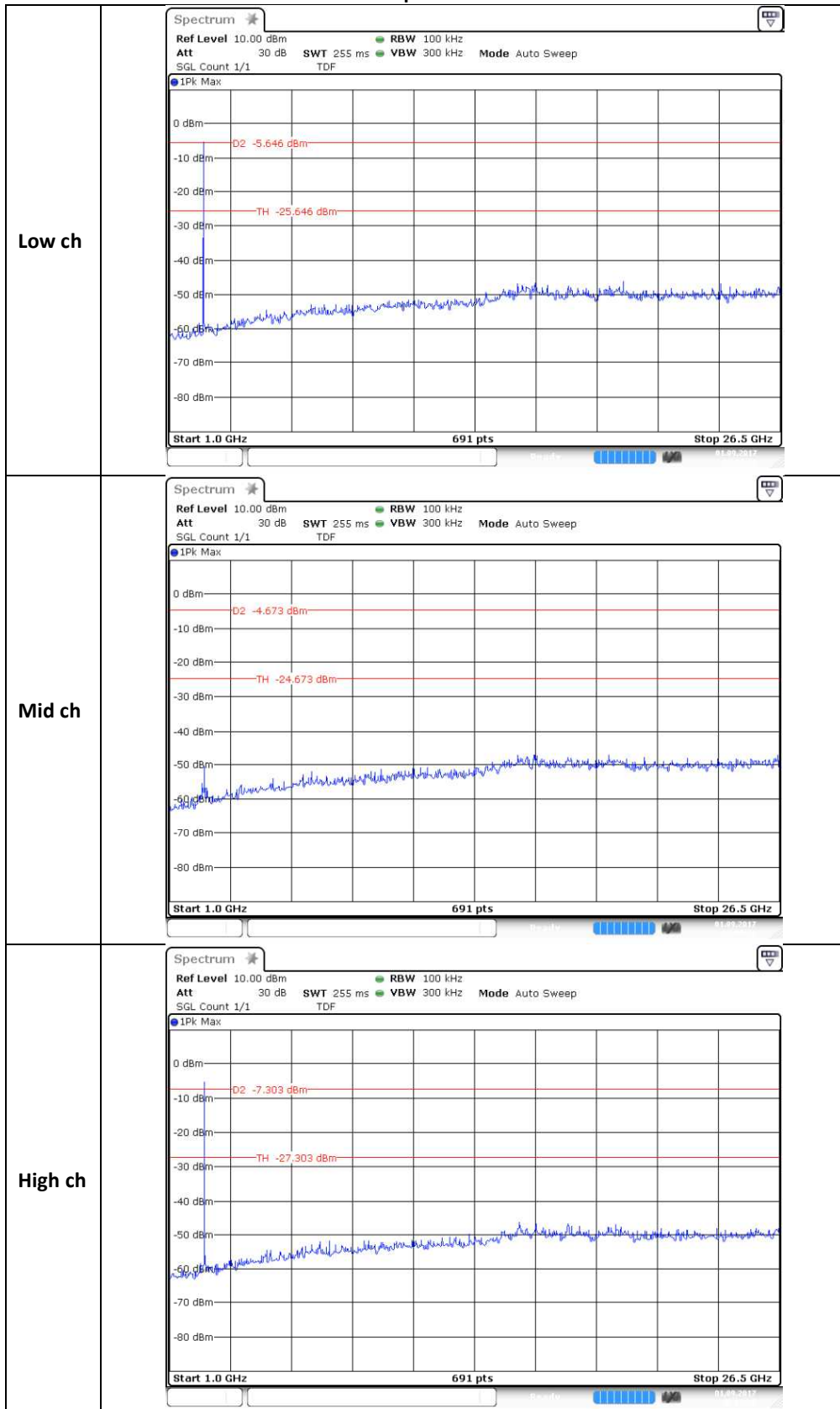
IEEE 802.11g Conducted Spurious Emissions 30 – 1000 MHz



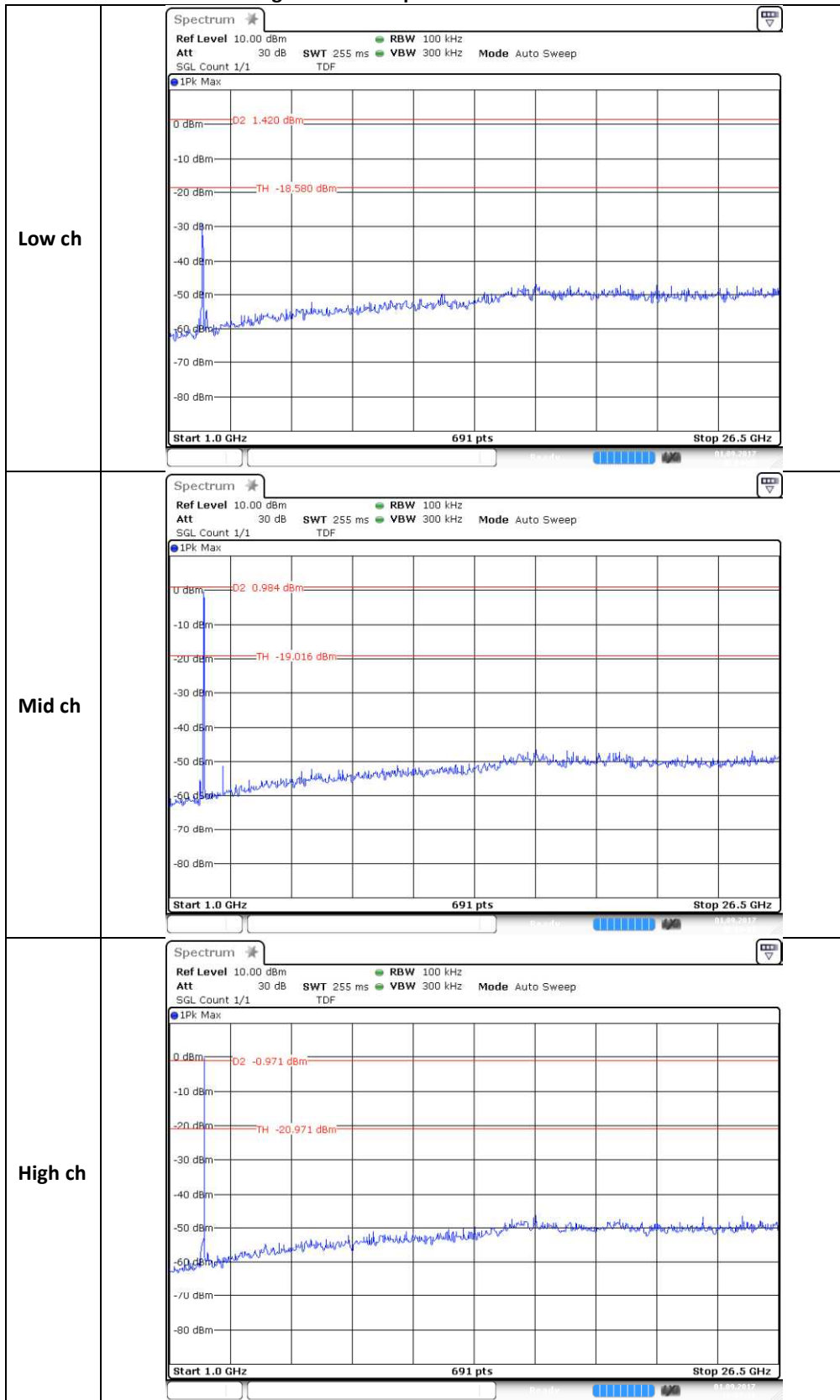
IEEE 802.15.4 Conducted Spurious Emissions 30 – 1000 MHz



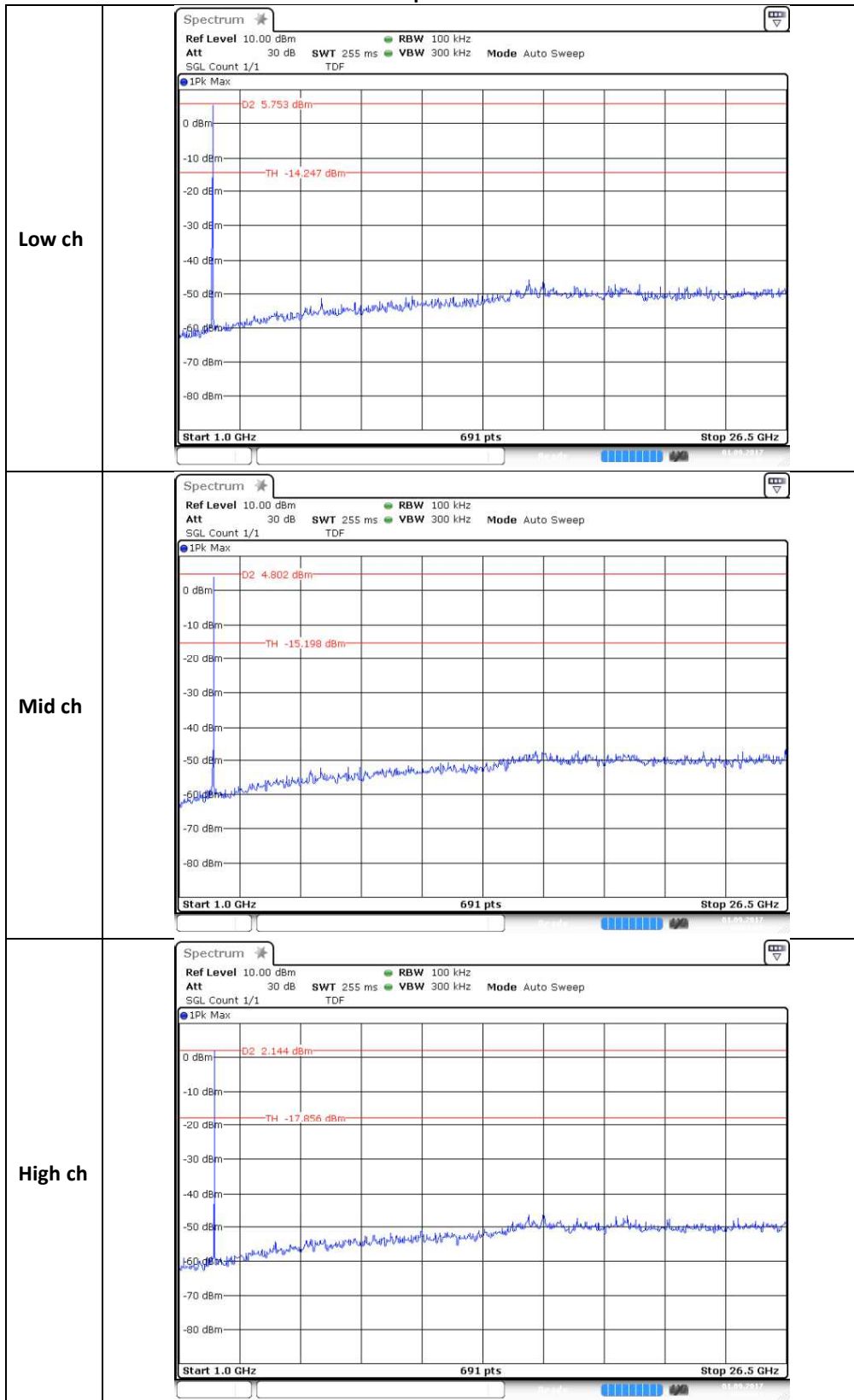
IEEE 802.11b Conducted Spurious Emissions 1 – 26.5 GHz



IEEE 802.11g Conducted Spurious Emissions 1 – 26.5 GHz



IEEE 802.15.4 Conducted Spurious Emissions 1 – 26.5 GHz



3.6 Radiated Spurious Emissions Measurement (incl. Restricted bands)

3.6.1 Limit

The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

15.209

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance(m)
0.009 – 0.490	$2400/F(\text{kHz})$	300
0.490 – 1.705	$24000/F(\text{kHz})$	30
1.705 - 30	30	30
30 -88	100	3
88 - 216	150	3
216-960	200	3
Above 960	500	3

3.6.2 Measurement instruments

The measurement instruments are listed in chapter 2.5 of this report.

3.6.3 Test setup

The test setup is as shown in chapter 2.4 of this report.

3.6.4 Test procedure

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

Other details are according to KDB Publication 558074 V02r05, sections 11.3 and 12.1

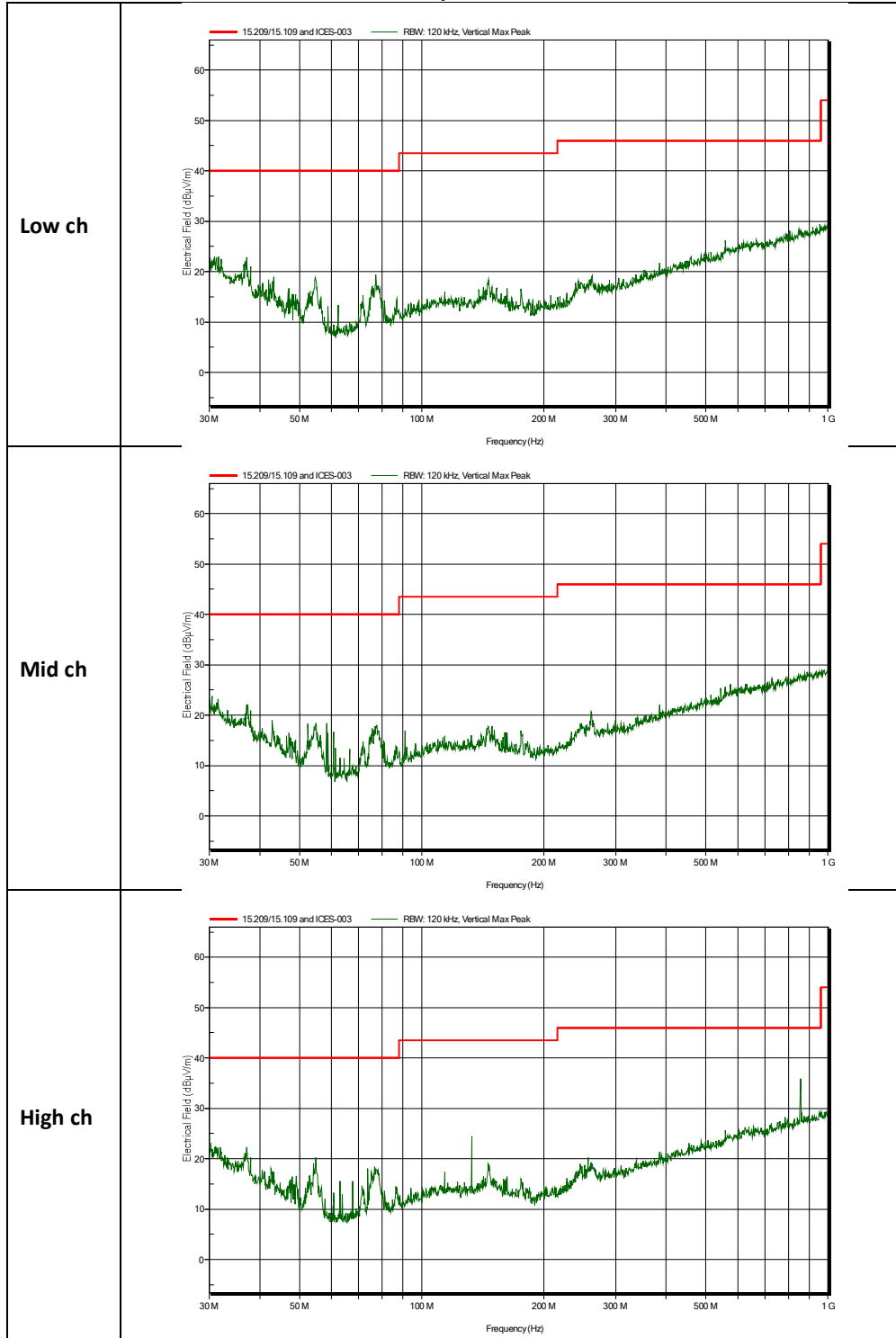
3.6.5 Notes

- In the frequency range of 1 – 18 GHz the green trace is measured using a peak detector and the red trace is measured using an average detector. The top limit line represent the peak limit and the bottom limit represents the average limit

3.6.6 Plots of the Radiated Spurious Emissions Measurement

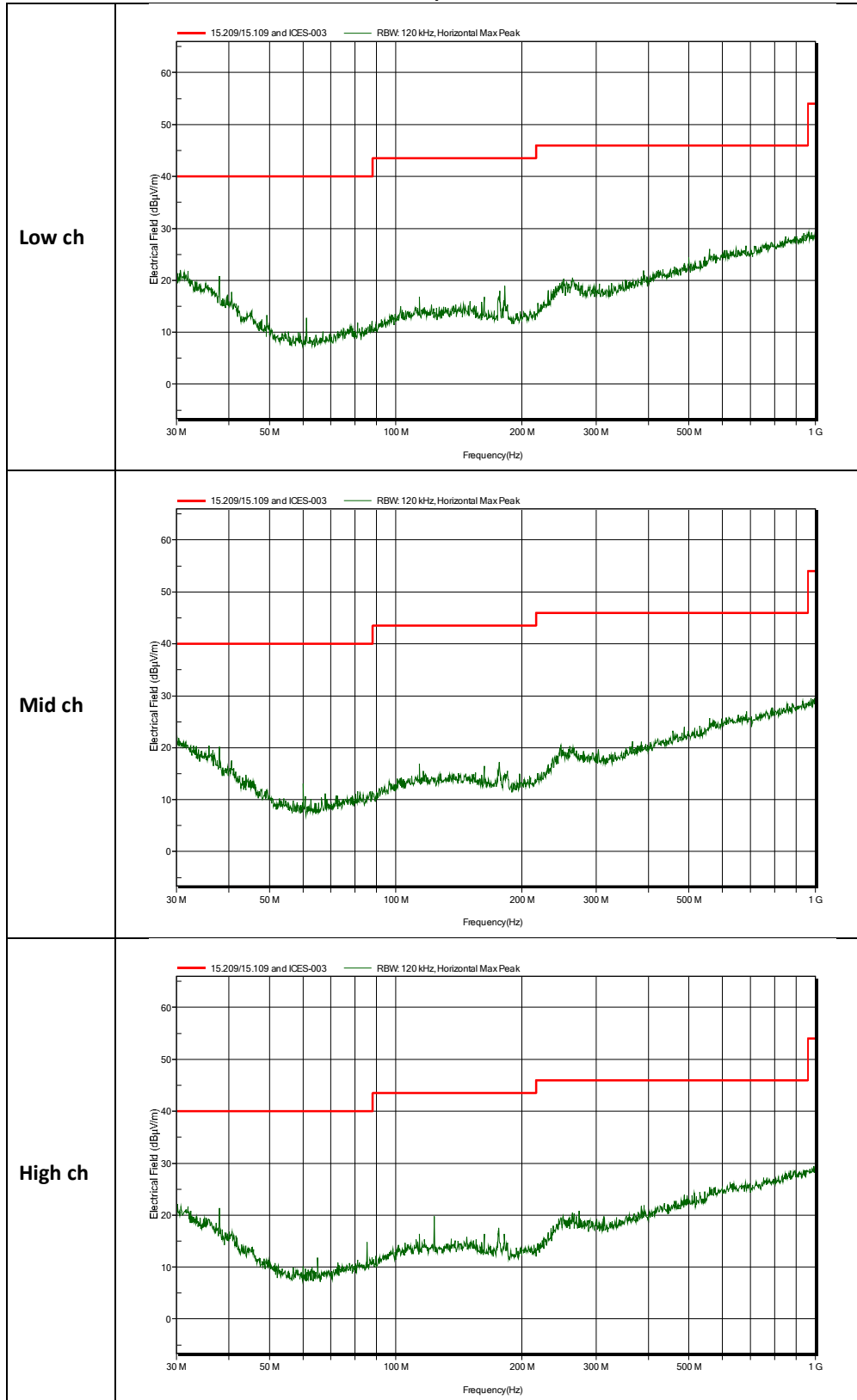
30 MHz to 1 GHz

Vertical polarization, 802.11b



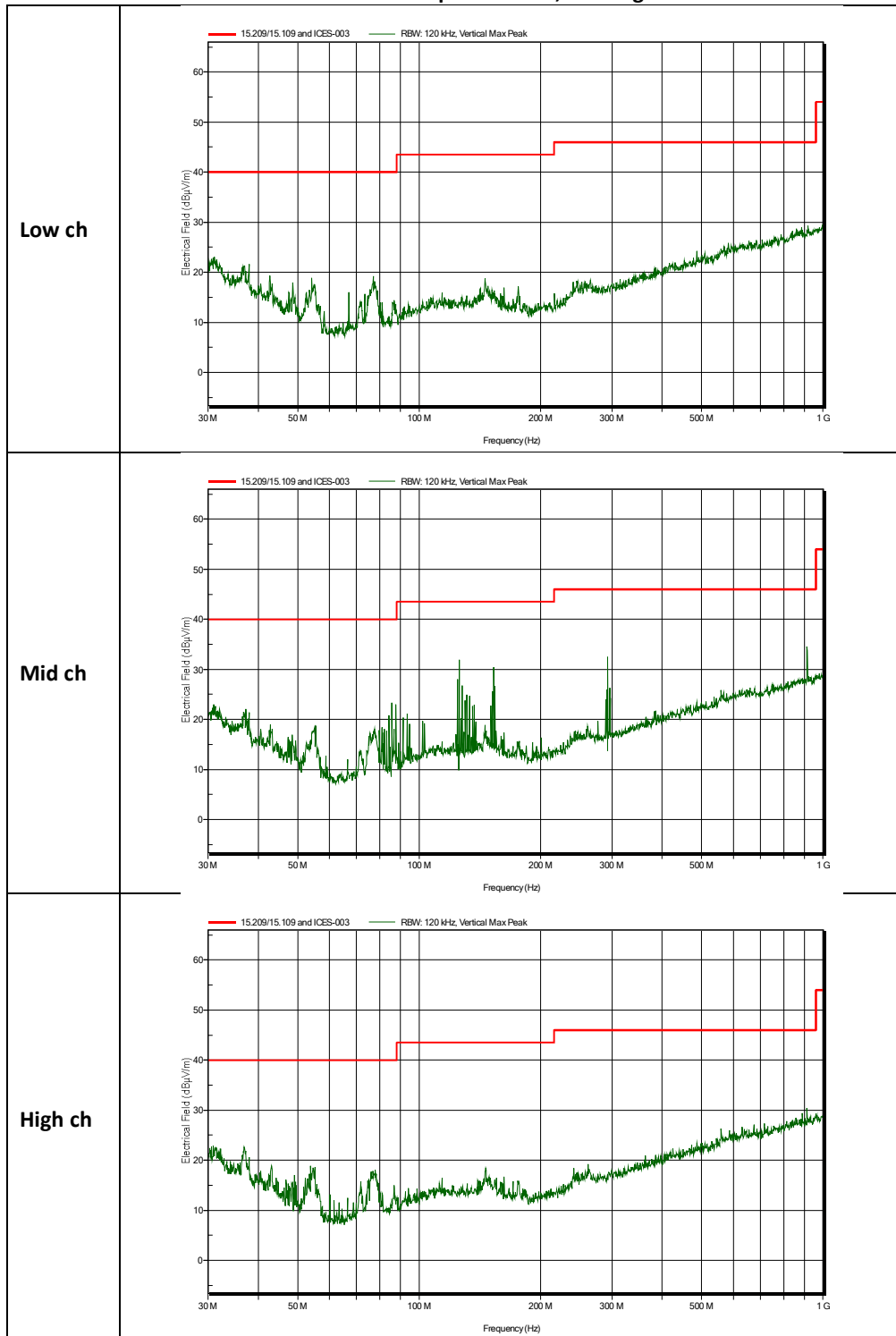
30 MHz to 1 GHz

Horizontal polarization, 802.11b



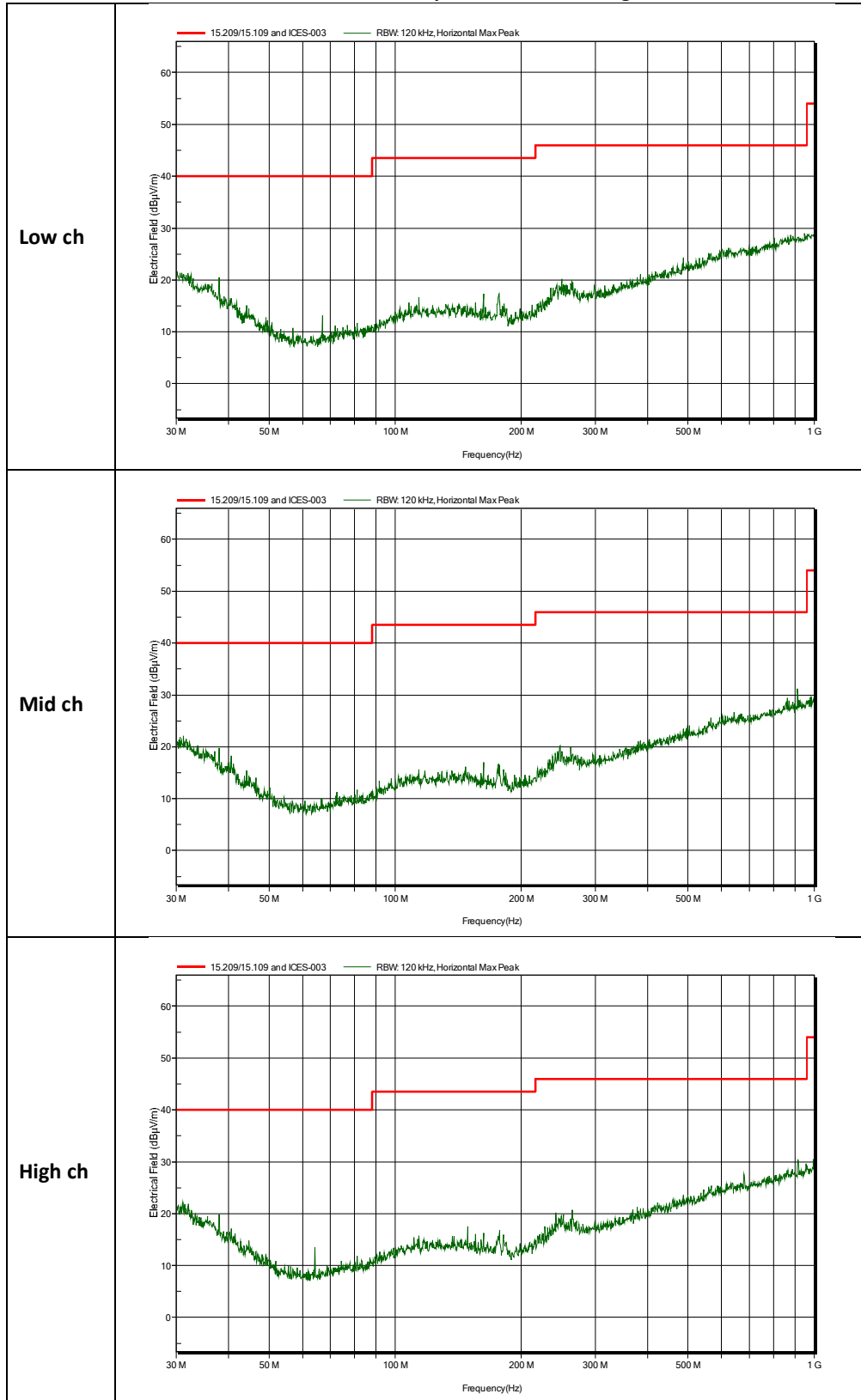
30 MHz to 1 GHz

Vertical polarization, 802.11g



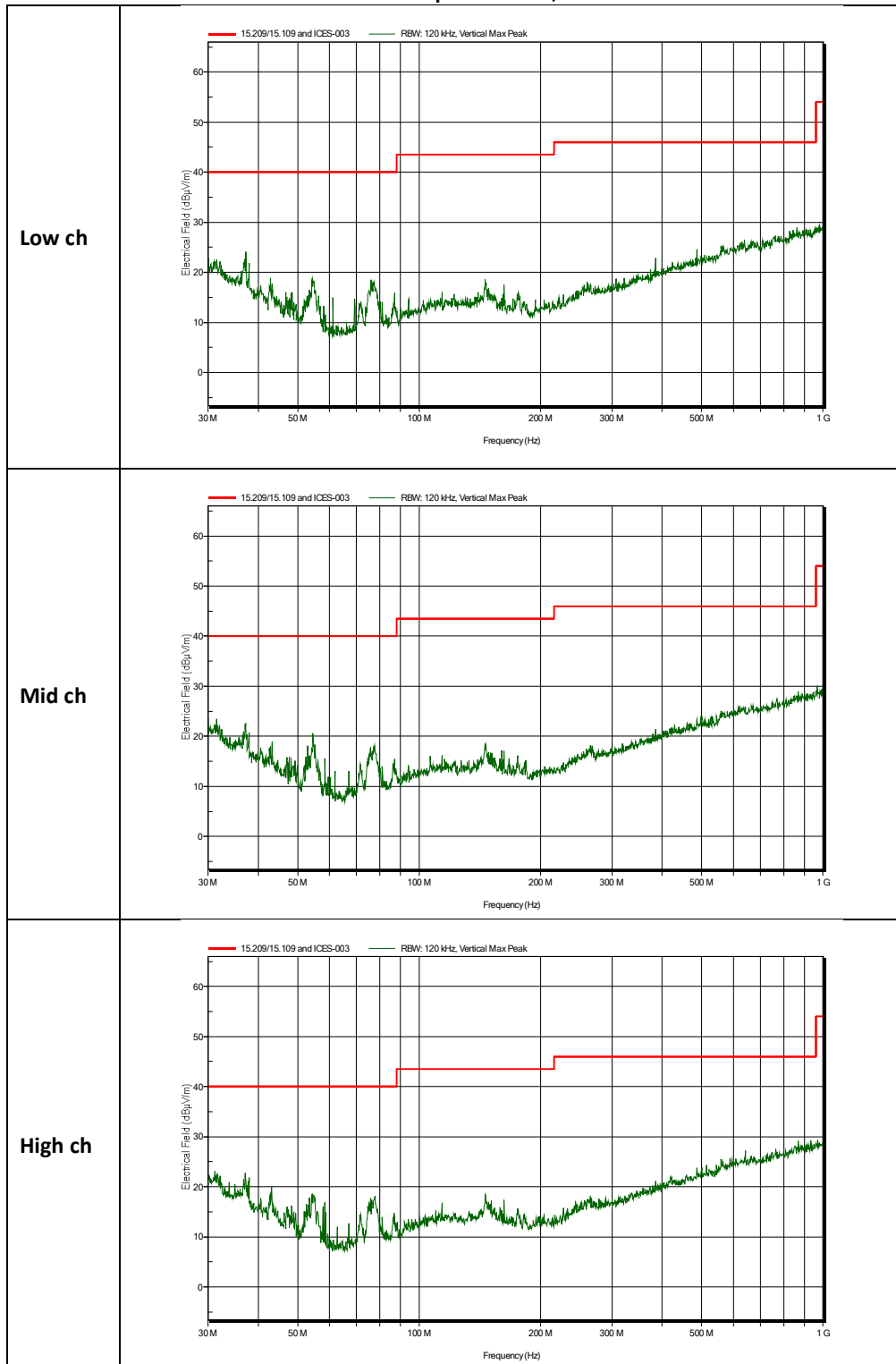
30 MHz to 1 GHz

Horizontal polarization, 802.11g



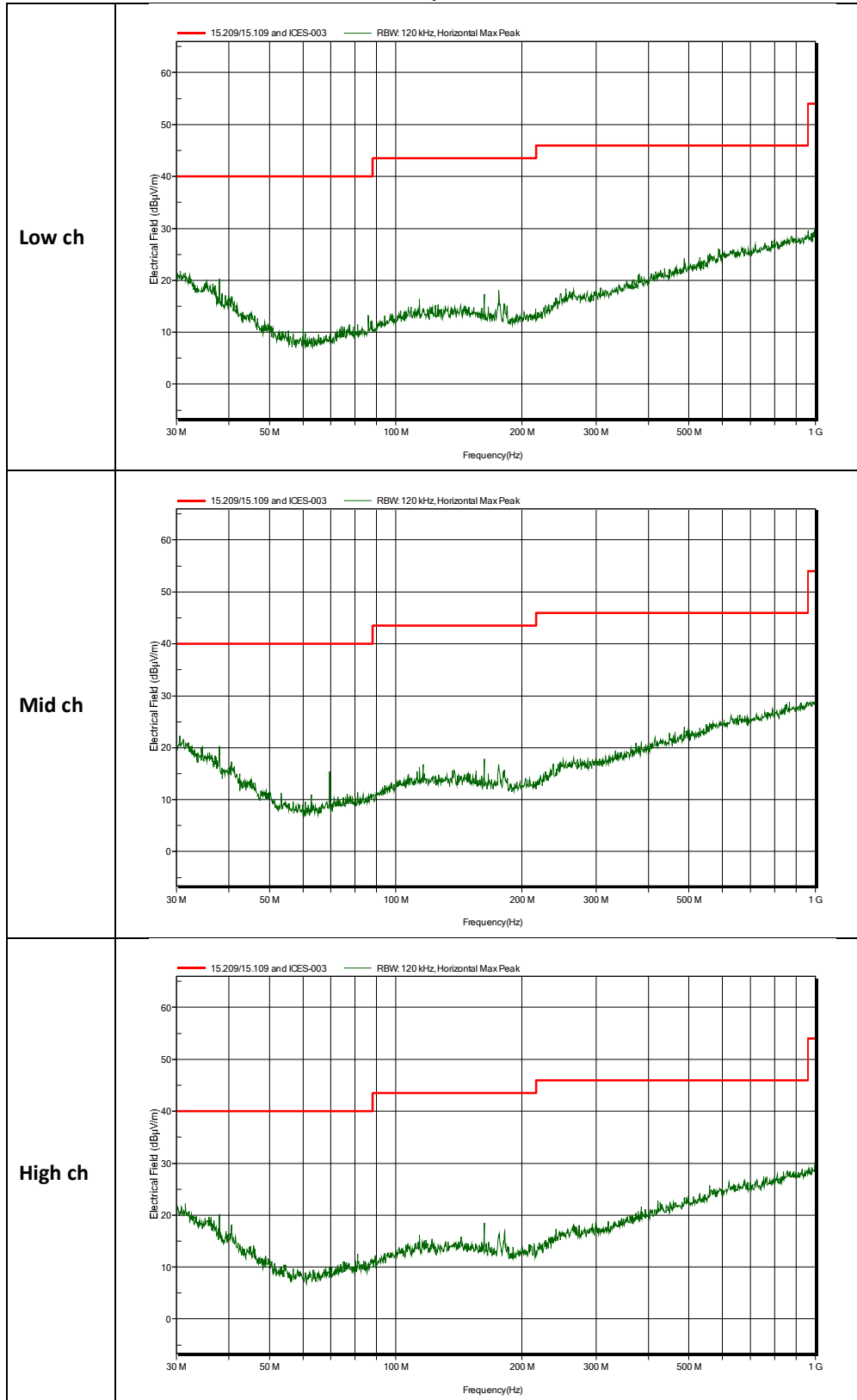
30 MHz to 1 GHz

Vertical polarization, 802.15.4



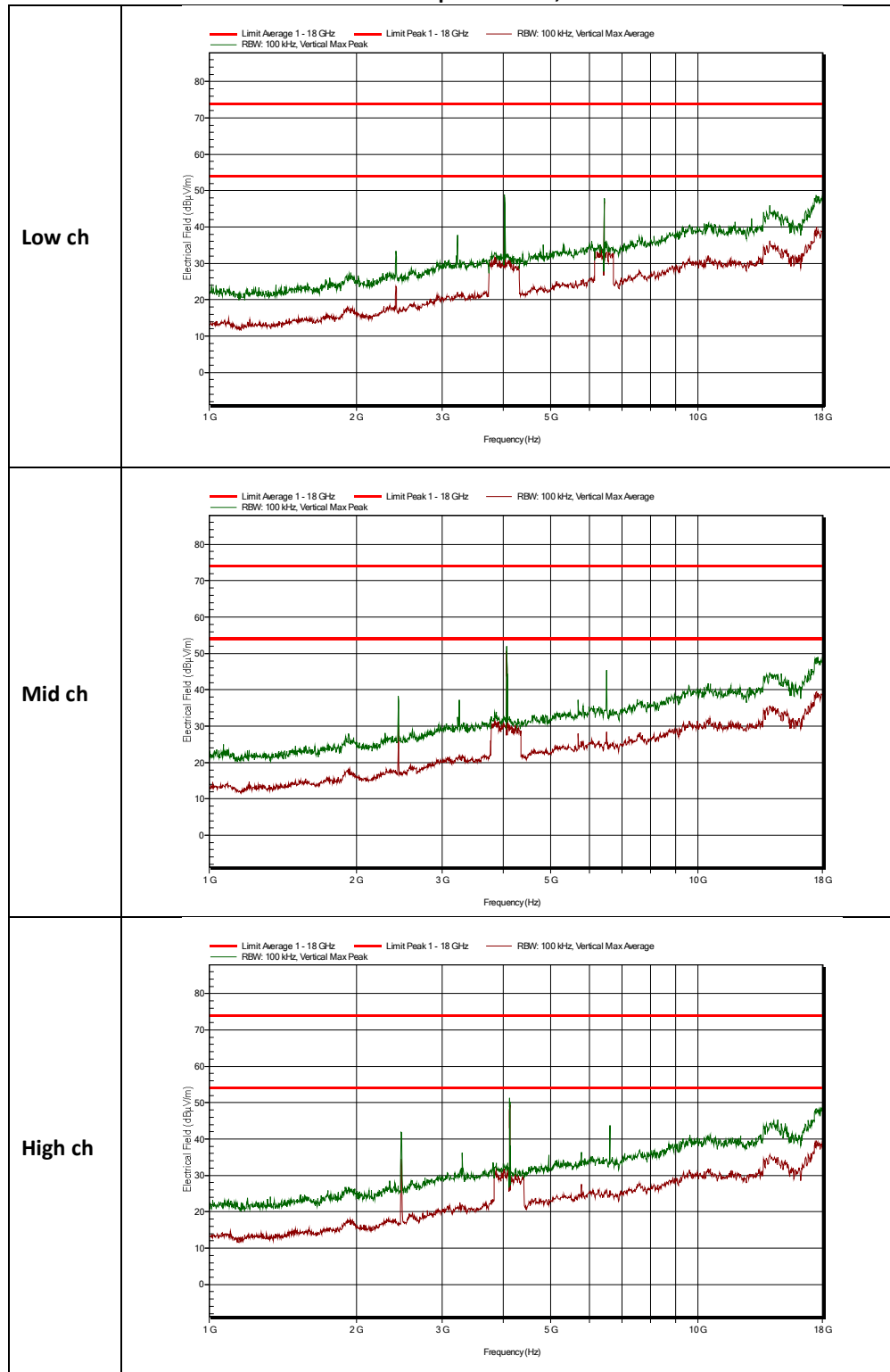
30 MHz to 1 GHz

Horizontal polarization, 802.15.4



1 GHz to 18 GHz

Vertical polarization, 802.11b



Measured peaks Vertical 1 – 18 GHz Low channel

Frequency (GHz)	Pol	Height	Average (dB μ V/m)	Average Limit (dB μ V/m)	Average margin (dB)
4,02	Vert	1 m	40,5	54	-13,5
6,432	Vert	2,5 m	46,5	54	-7,5

Measured peaks Vertical 1 – 18 GHz Middle channel

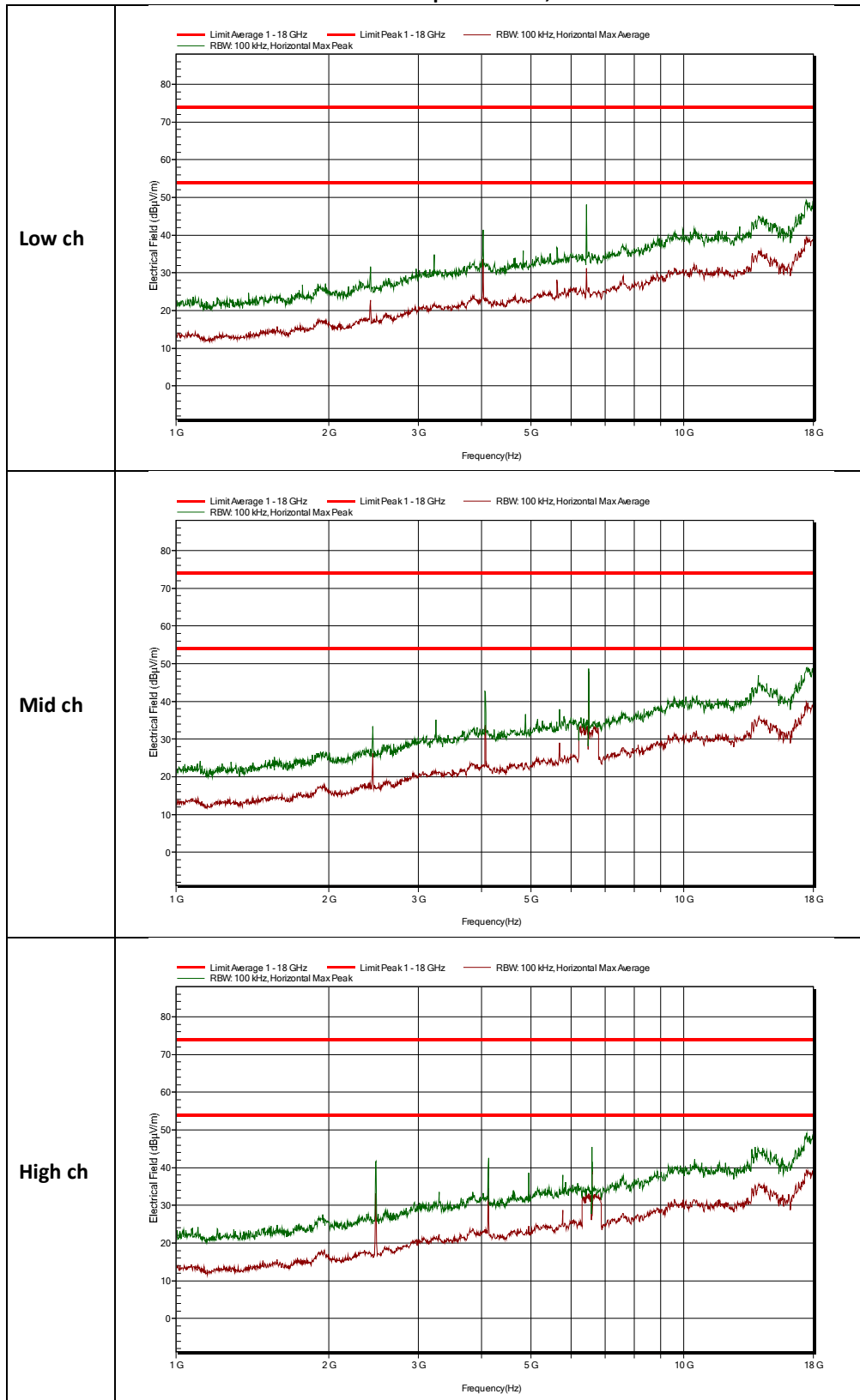
Frequency (GHz)	Pol	Height	Average (dB μ V/m)	Average Limit (dB μ V/m)	Average margin (dB)
4,061	Vert	2,5 m	43,7	54	-10,3

Measured peaks Vertical 1 – 18 GHz High channel

Frequency (GHz)	Pol	Height	Average (dB μ V/m)	Average Limit (dB μ V/m)	Average margin (dB)
4,119	Vert	1,5 m	43	54	-11,0

1 GHz to 18 GHz

Horizontal polarization, 802.11b



Measured peaks Horizontal 1 – 18 GHz Middle channel

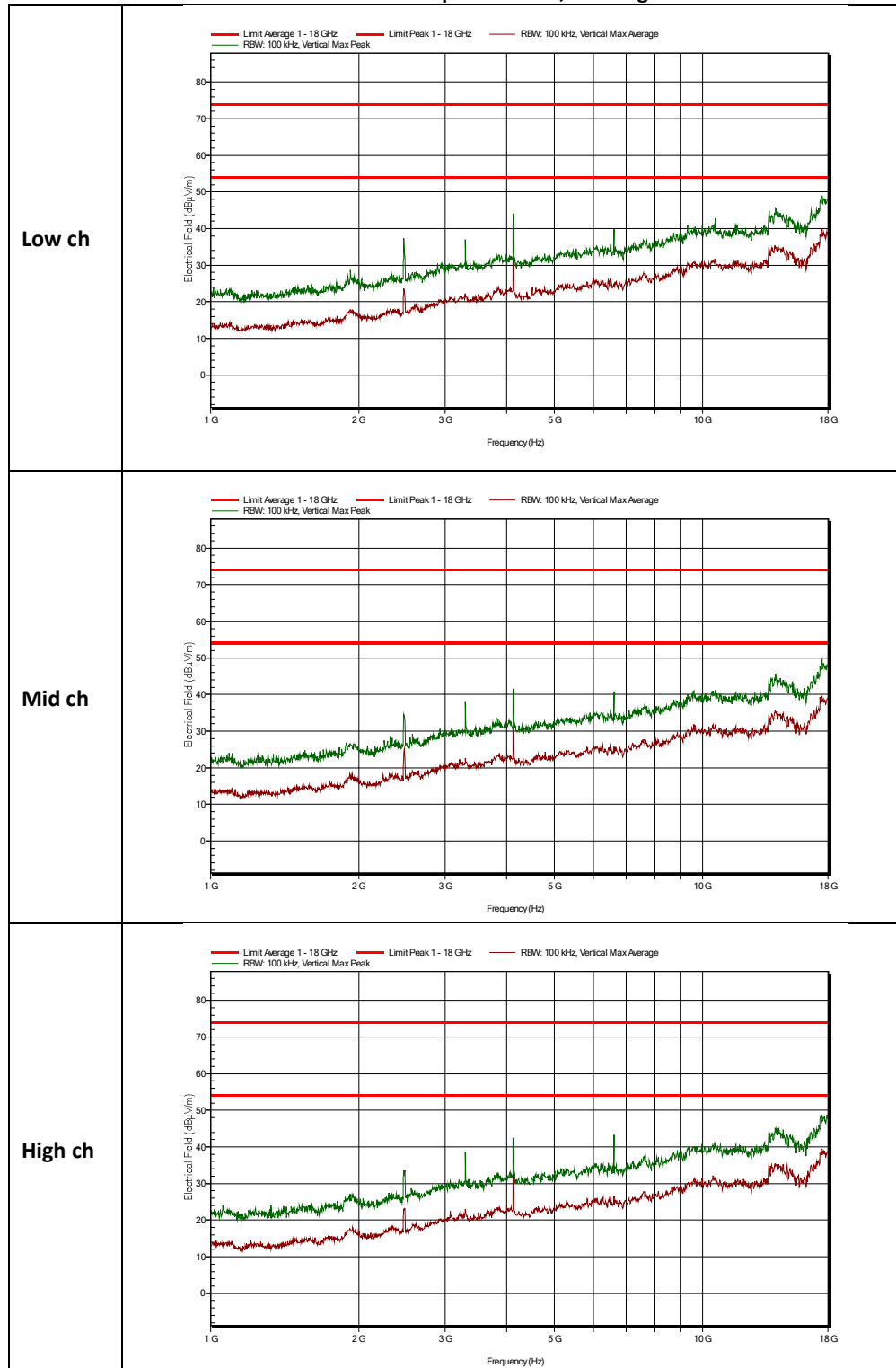
Frequency (GHz)	Pol	Height	Average (dB μ V/m)	Average Limit (dB μ V/m)	Average margin (dB)
6,499	Hor	1,5 m	47	54	-7,0

Measured peaks Horizontal 1 – 18 GHz High channel

Frequency (GHz)	Pol	Height	Average (dB μ V/m)	Average Limit (dB μ V/m)	Average margin (dB)
6,592	Hor	2 m	38,2	54	-15,8

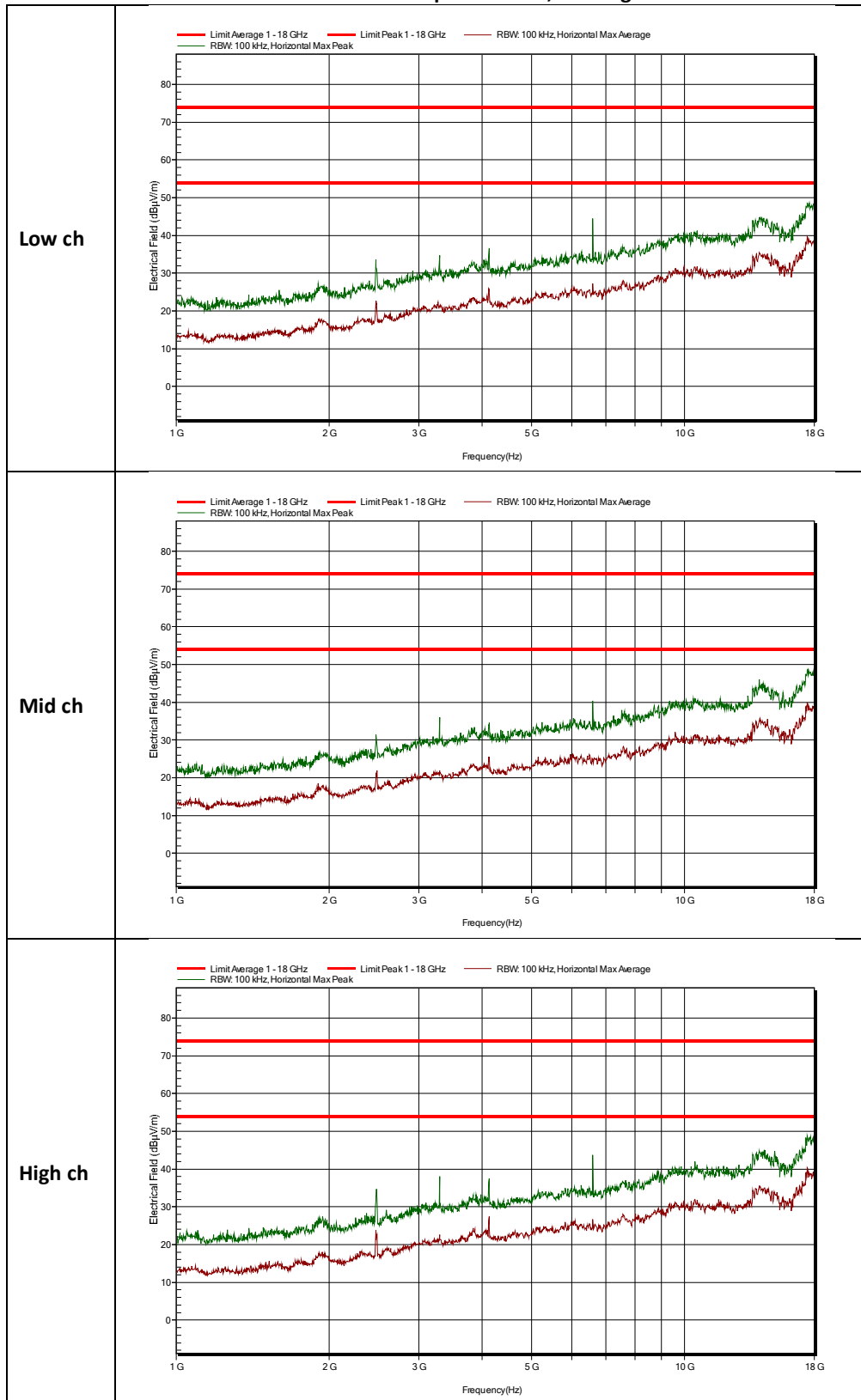
1 GHz to 18 GHz

Vertical polarization, 802.11g



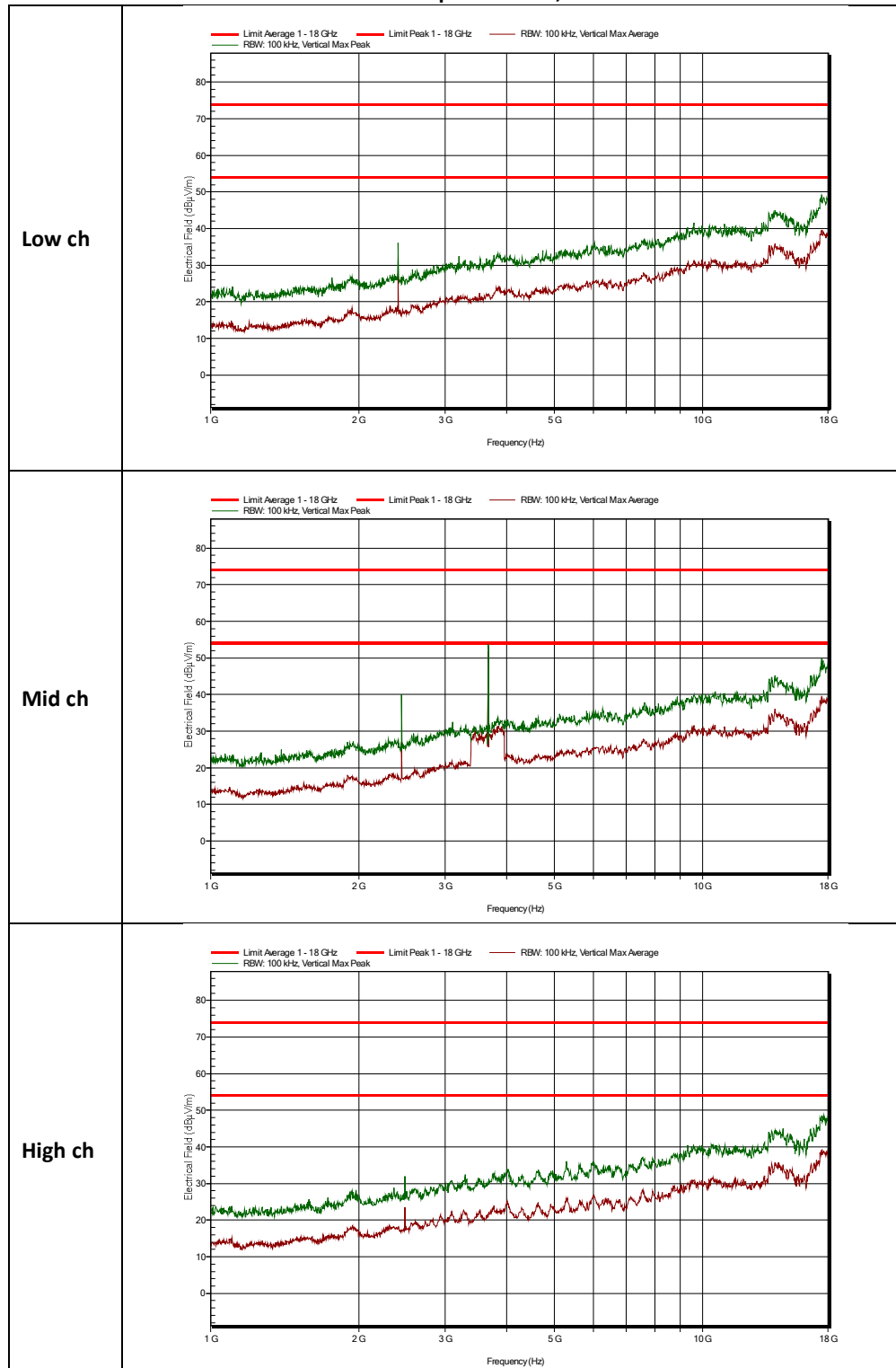
1 GHz to 18 GHz

Horizontal polarization, 802.11g



1 GHz to 18 GHz

Vertical polarization, 802.15.4

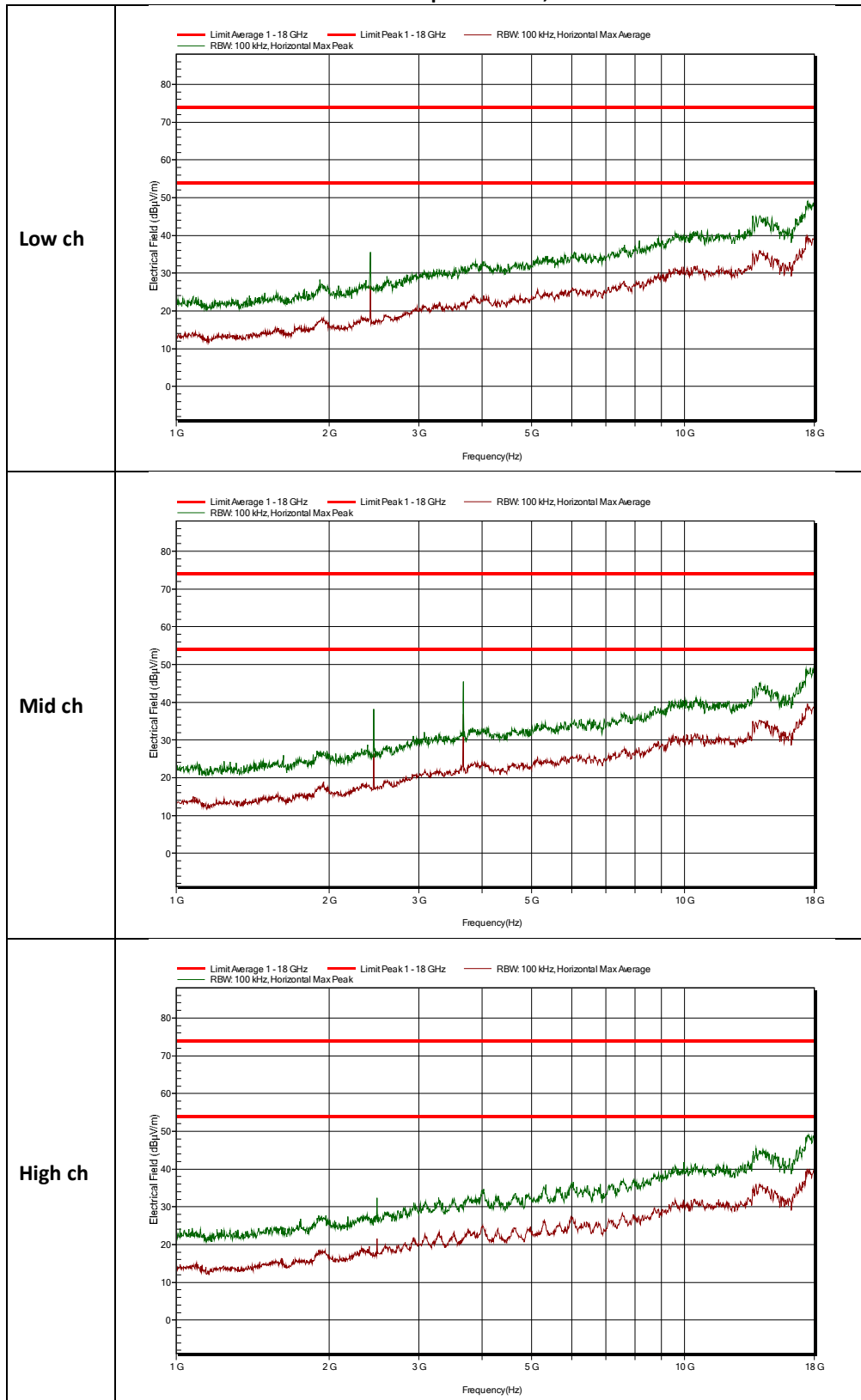


Measured peaks Vertical 1 – 18 GHz Middle channel

Frequency (GHz)	Pol	Height	Average (dBμV/m)	Average Limit (dBμV/m)	Average margin (dB)
3,667	Vert	2 m	48,8	54	-5,2

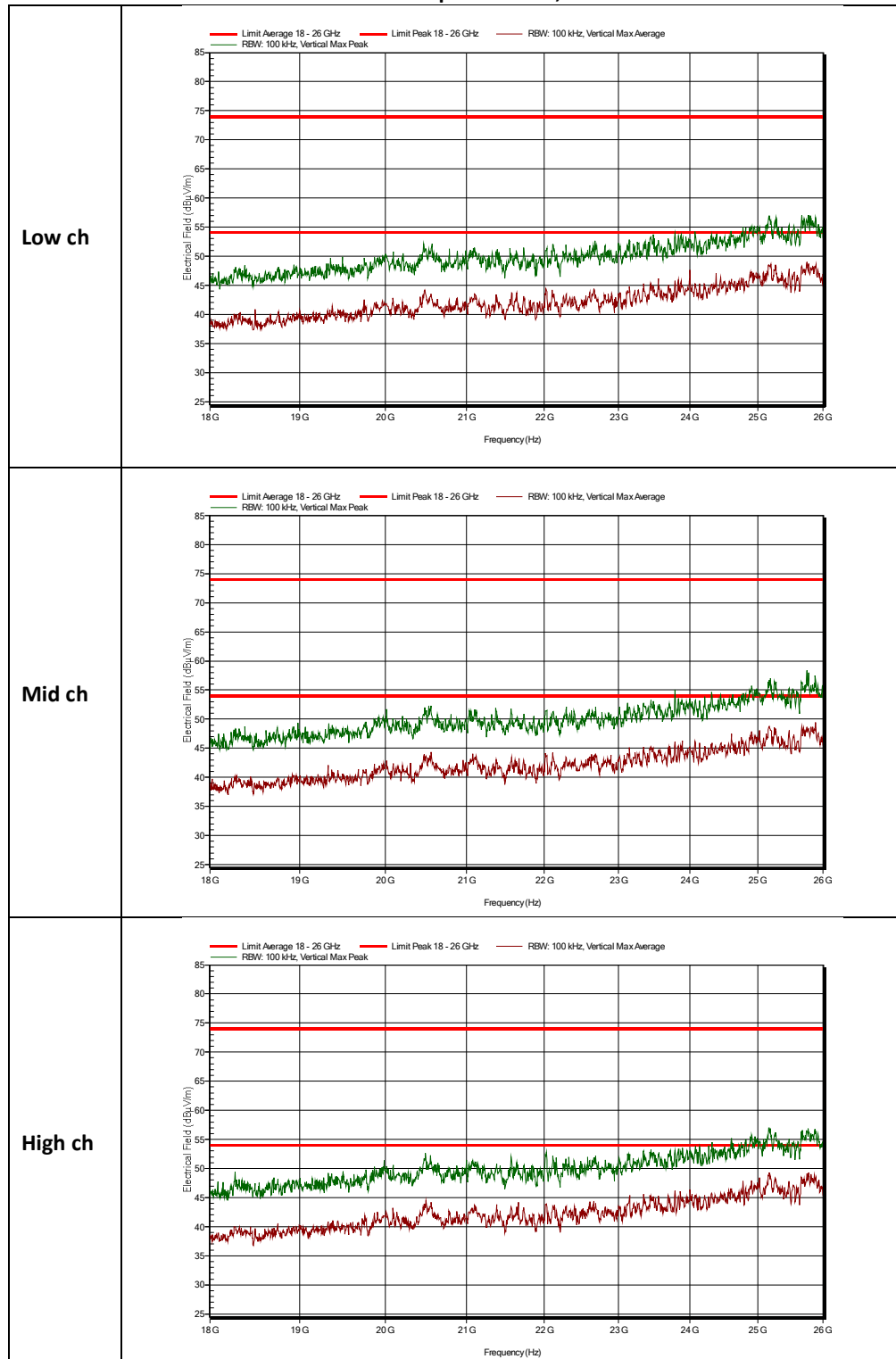
1 GHz to 18 GHz

Horizontal polarization, 802.15.4



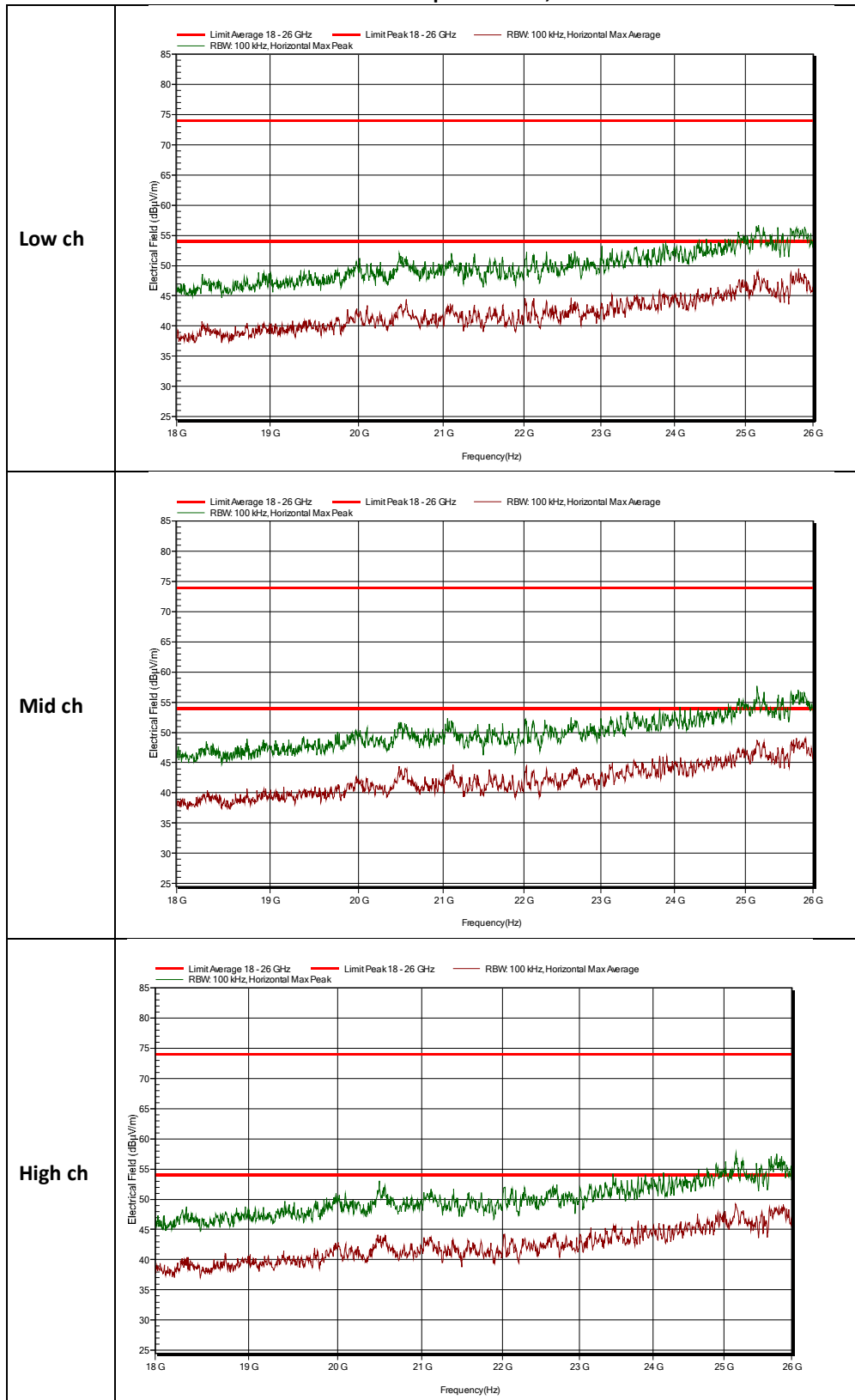
18 GHz to 26 GHz

Vertical polarization, 802.11b



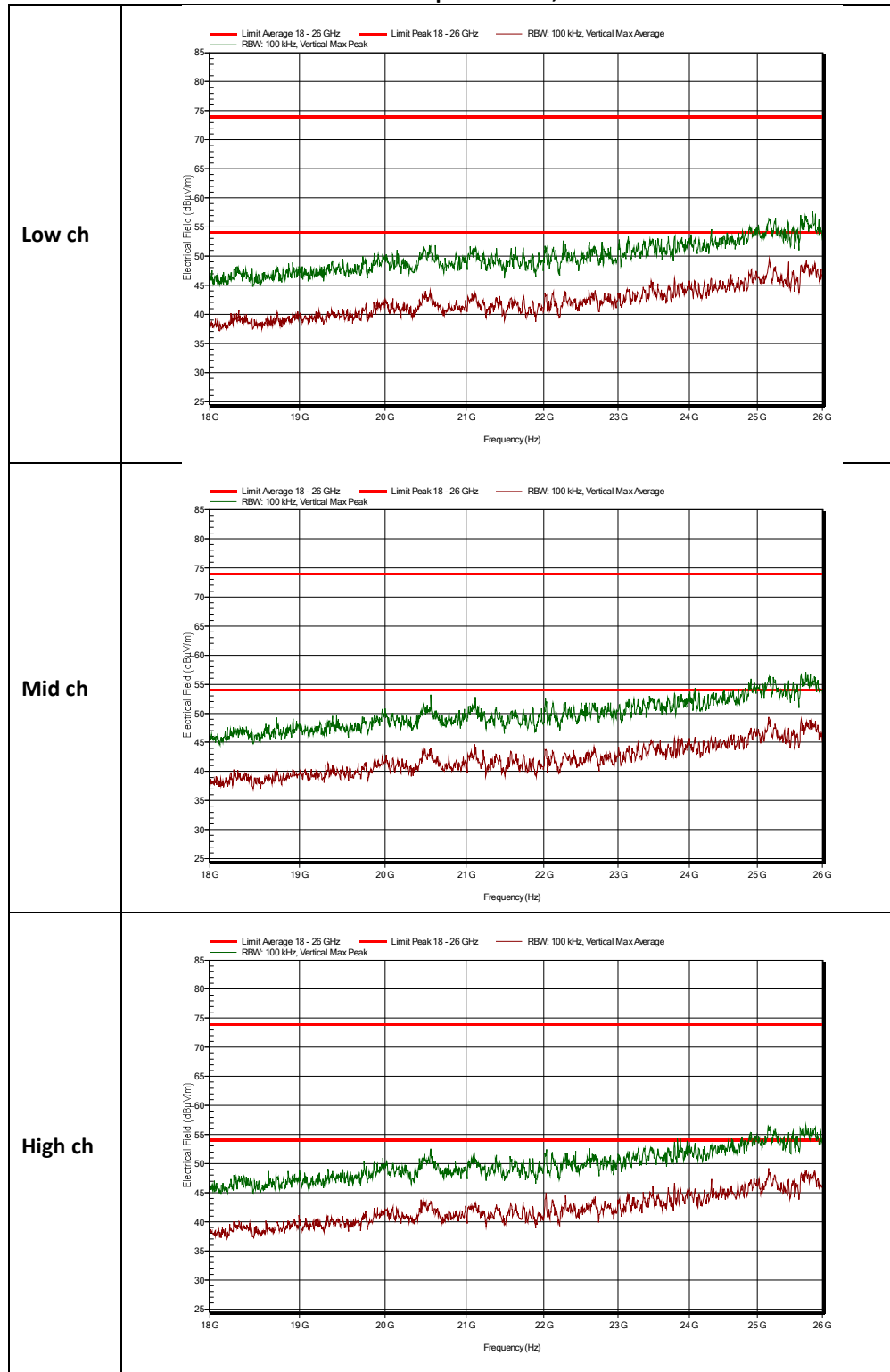
18 GHz to 26 GHz

Horizontal polarization, 802.11b



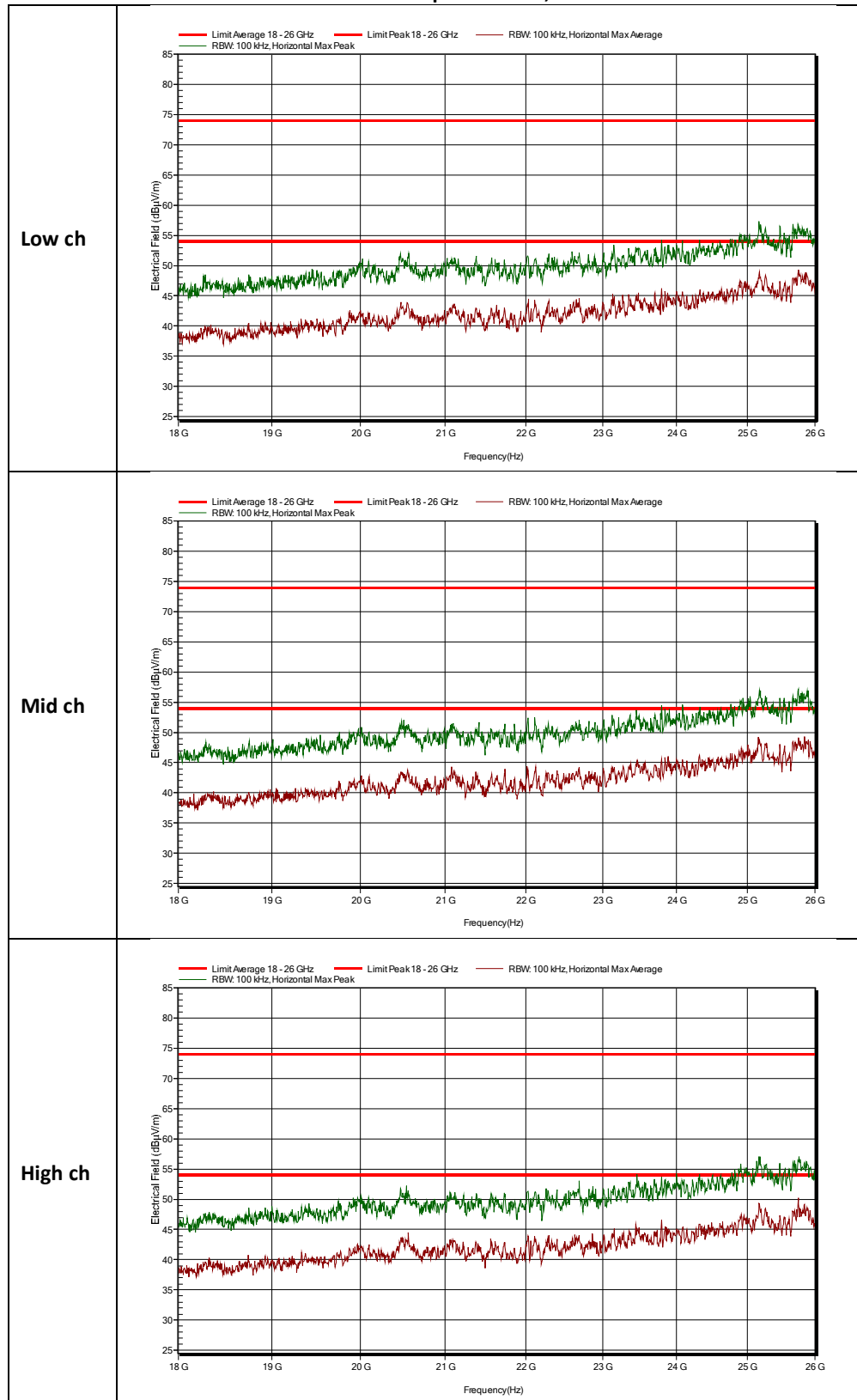
18 GHz to 26 GHz

Vertical polarization, 802.15.4



18 GHz to 26 GHz

Horizontal polarization, 802.15.4



3.6.7 Measurement uncertainty

Measurement uncertainty Radiated emissions below 1 GHz

Horizontal polarization	
30 – 200 MHz	4.5 dB
200 – 1000 MHz	3.6 dB
Vertical polarization	
30 – 200 MHz	5.4 dB
200 – 1000 MHz	4.6 dB

Measurement uncertainty Radiated emissions above 1 GHz

1000- 18000 MHz	5.7 dB
18000 – 26000 MHz	3.9 dB