

FCC and IC Test Report for Parts 15.247, 15.249, 15.209 and RSS-247, RSS Gen, RSS-210

Product name : T2030
Applicant : Tacx
FCC ID : 2AAMI-T2030
IC ID : 11353A-T2030

Test report No. : 180801587 003 Ver 3.00

Laboratory information

Accreditation

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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Documentation

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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	11-12-2018	First draft	PvW
v1.00	15-02-2019	Initial release	PvW
v2.00	01-03-2019	Added field strength of fundamental to ANT/ANT+ in clause 3.3.5	PVW
v3.00	06-03-2019	Updated emission designator for ANT+ from 1M00F7D to 1M00F1D	PVW

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Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.247 (a)	RSS-247 5.2(a)	6dB Bandwidth	3.1	Pass
--	RSS-Gen 6.7	99% Bandwidth	3.2	Pass
15.247 (b)	RSS-247 5.1 (b)	RF output power	3.3	Pass
15.247 (e)	RSS-247 5.2 (b)	Power spectral density	3.4	Pass
15.247 (d)	RSS-247 5.5	Band edge	3.5	Pass
15.209 (a)	RSS-247 5.4 RSS-Gen 8.9 RSS-210 B.10	Radiated emissions	3.6	Pass
15.205 (a)	RSS-Gen 8.10 RSS-210 B.10	Spurious emissions in the restricted bands	3.6	Pass

1 General Description

1.1 Applicant

Client name:	Tacx b.v.
Address	Rijksstraatweg 52, Wassenaar, the Netherlands
Zip code:	2241BW
Telephone:	+31 (0)705119259
E-mail:	martin@tacx.nl
Contact name:	Martin Smits

1.2 Manufacturer

Manufacturer name:	Tacx b.v.
Address:	Rijksstraatweg 52, Wassenaar, the Netherlands
Zip code:	2241BW
Telephone:	+31 (0)705119259
E-mail:	martin@tacx.nl
Contact name:	Martin Smits

1.3 Tested Equipment Under Test (EUT)

Product name:	T2030
Brand name:	Tacx
Product type:	Power meter
FCC ID:	2AAMI-T2030
IC ID	11353A-T2030
Software version:	--
Hardware version:	V08
Date of receipt	15-10-2018
Tests started:	15-10-2018
Testing ended:	14-02-2019

1.4 Product specifications of Equipment under test

TX Frequency range (MHz)	BLE V5.0: 2400 – 2483.5 ANT: 2400 – 2483.5 ANT+: 2450 and 2457 MHz ¹
RX frequency range (MHz)	BLE V5.0: 2400 – 2483.5 ANT: 2400 – 2483.5 ANT+: 2450 and 2457 MHz ¹
Maximum output power to antenna (dBm)	-0.68
Antenna type	Ceramic chip antenna
Antenna gain (dBi)	-2.0
Type of modulation	ANT; ANT+: GFSK BLE V5.0: GFSK
Emission designator BLE (V5.0)	2M21F7D
Emission designator ANT+	1M00F1D

Note 1: ANT+ uses the same modulation techniques and transmission power as ANT. Measurements on ANT are considered representative for all ANT+ frequencies. See clause 3.2.8 for a comparison of the signals.

1.5 Modification of the Equipment Under Test (EUT)

The manufacturer provided both a radiated sample and a conducted sample for radio testing.

1.6 Observations and remarks

For the ANT radio, only RF power, 99% occupied bandwidth and radiated spurious emissions tests are applicable.

Measurements of the ANT technology are considered representative for all frequencies of the ANT+ technology because ANT+ uses the same modulation techniques and transmission power as ANT.

The EUT uses ANT+ when possible, but switches to ANT when communicating with a non-ANT+ device.

For the BLE V5.0 radio, all tests in this test report are applicable.

Spurious emissions in the 9 kHz – 30 MHz range are not reported as these emissions are more than 20 dB below the transmission level.

1.7 Environmental conditions

Test date	31-10-2018	01-11-2018	14-02-2019
Ambient temperature	19.2 °C	20.3 °C	20.3 °C
Humidity	42.8 %	41.8 %	39.7 %

1.8 Measurement Standards

- 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, §15.249, §15.209
- RSS-247 Issue 2, RSS-Gen Issue 5, RSS-210 Issue 9

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 : 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 : 06-03-2019

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

2 Mbps BLE V5.0 has not been tested because the RF chip of the EUT only supports 1 Mbps BLE V5.0.

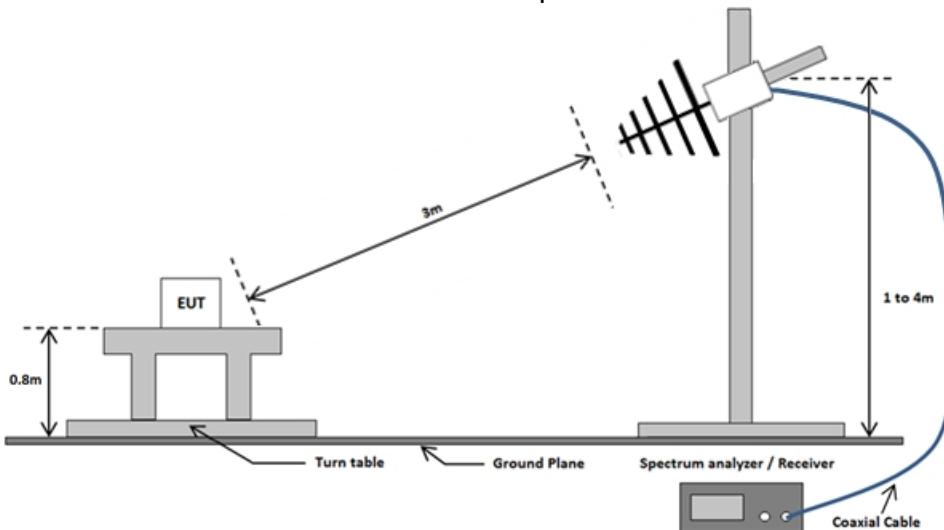
Technology	Channels	Data rate	Frequency (MHz)
Bluetooth Low Energy V5.0	1 (Low)	1 Mbps	2402
	18 (Mid)	1 Mbps	2440
	39 (High)	1 Mbps	2480

Technology	Channels	Data rate	Frequency (MHz)
ANT	1 (Low)	1 Mbps	2402
	39 (Mid)	1 Mbps	2440
	78 (High)	1 Mbps	2480

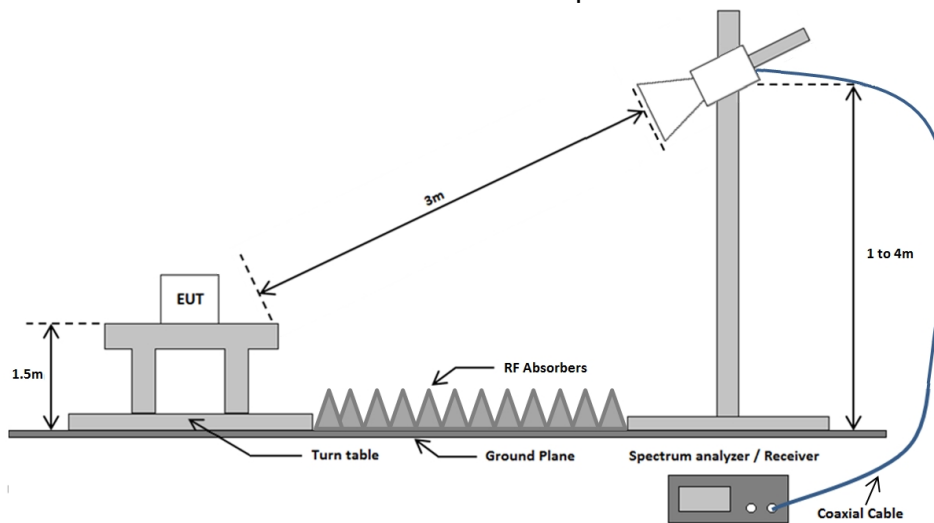
Technology	Channels	Data rate	Frequency (MHz)
ANT+	--	1 Mbps	2457

2.3 Test setups

Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2.4 Equipment used in the test configuration

Description	Test setup number	Used at paragraphs
Radiated emission measurement system	TS 00004	3.6
Conducted emission radio equipment	TS 00008	3.1 – 3.5

Description	Manufacturer	Model	Equipment ID	Used at paragraphs
Spectrum analyser	Rohde & Schwarz	FSV40	TE 11160	3.1 – 3.5
High pass filter	Wainwright	WHK10-2520-30	TE 11146	3.6
Software	DARE Instruments	Radimation 2018.1.5	--	3.6

2.5 Sample calculation

Field Strength Measurement example:

Frequency (GHz)	Polarization	Height(m)	Peak (dB μ V/m)
7,32	Horizontal	2	47.9

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 2.4 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

Tests according to ANSI C63.10.

IRN 017 - Occupied bandwidth (Hz) Method 4 – DTS Bandwidth.

3.1.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
Bluetooth Low energy V5.0	1	2402	1 Mbps	1133.8
	18	2440	1 Mbps	1129.5
	39	2480	1 Mbps	1133.8
Uncertainty	± 36.2 kHz			

3.2 99% Occupied Bandwidth

3.2.1 Limit

According to RSS-Gen 6.7.

3.2.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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

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.

3.2.5 Test results of the 99% occupied bandwidth measurement

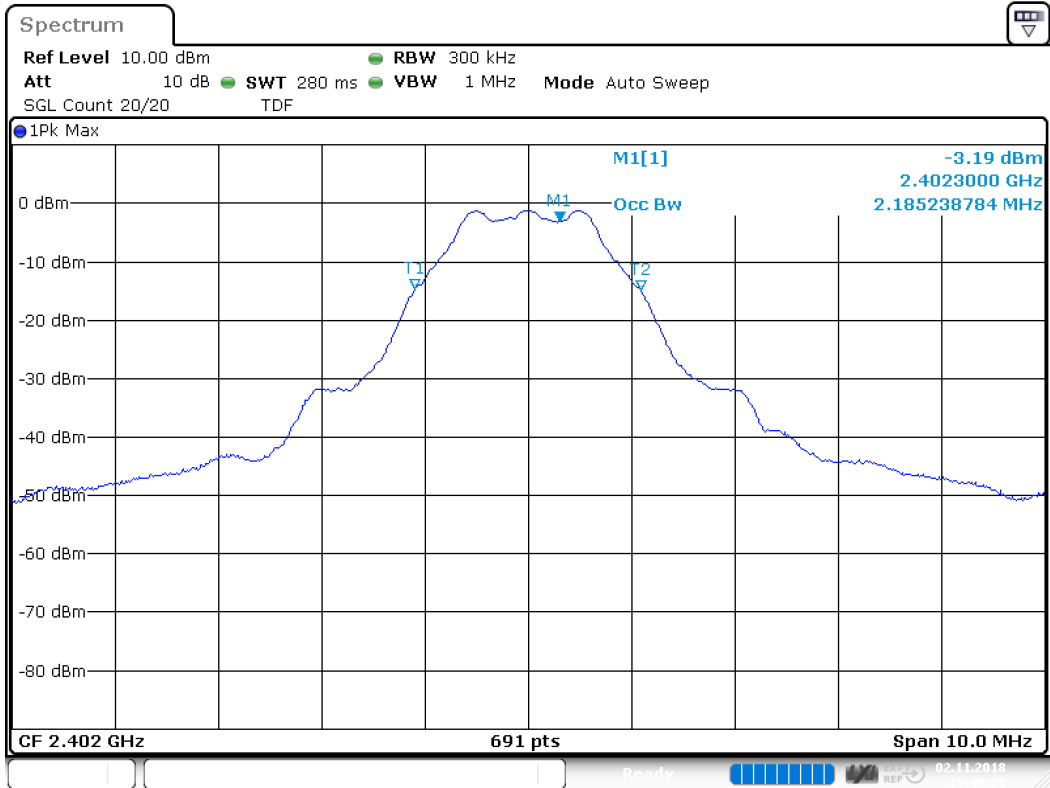
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
Bluetooth Low energy V5.0	1	2402	1 Mbps	2185
	18	2440	1 Mbps	2200
	39	2480	1 Mbps	2214
Uncertainty	± 12 kHz			

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
ANT	1	2402	1 Mbps	1187
	39	2440	1 Mbps	1187
	78	2480	1 Mbps	1187
Uncertainty	± 12 kHz			

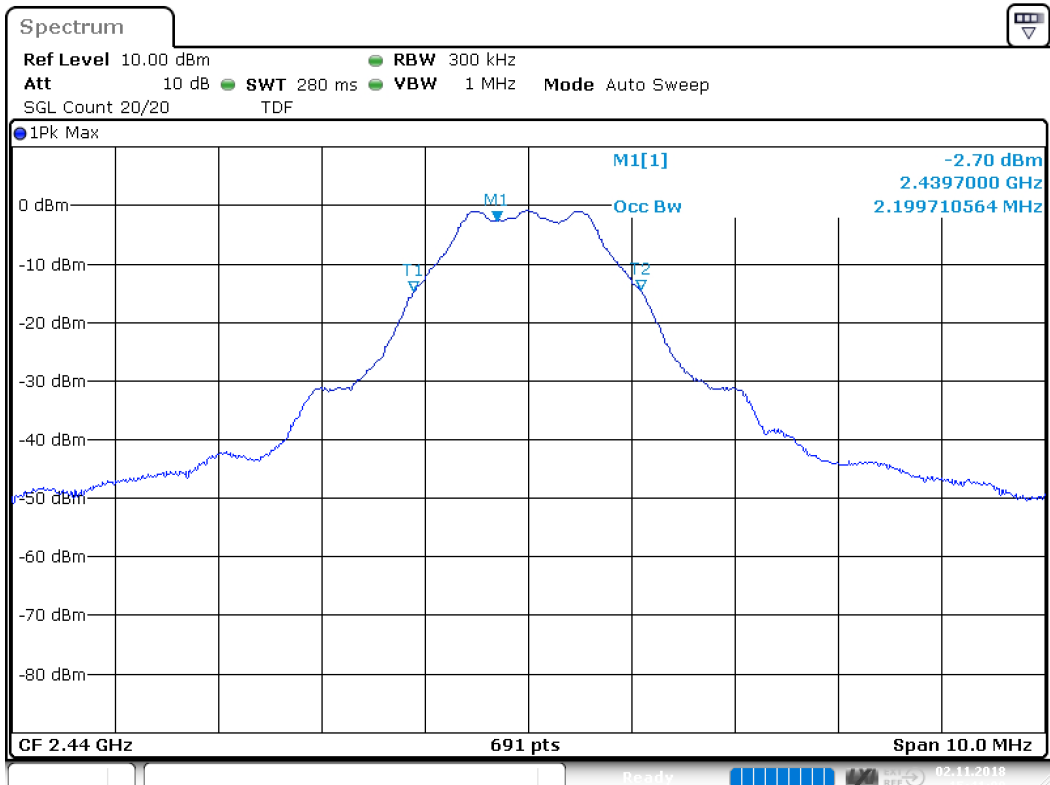
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (kHz)
ANT+	--	2457	1 Mbps	1187
Uncertainty	± 12 kHz			

3.2.6 Plots of the BLE V5.0 99% occupied bandwidth measurement

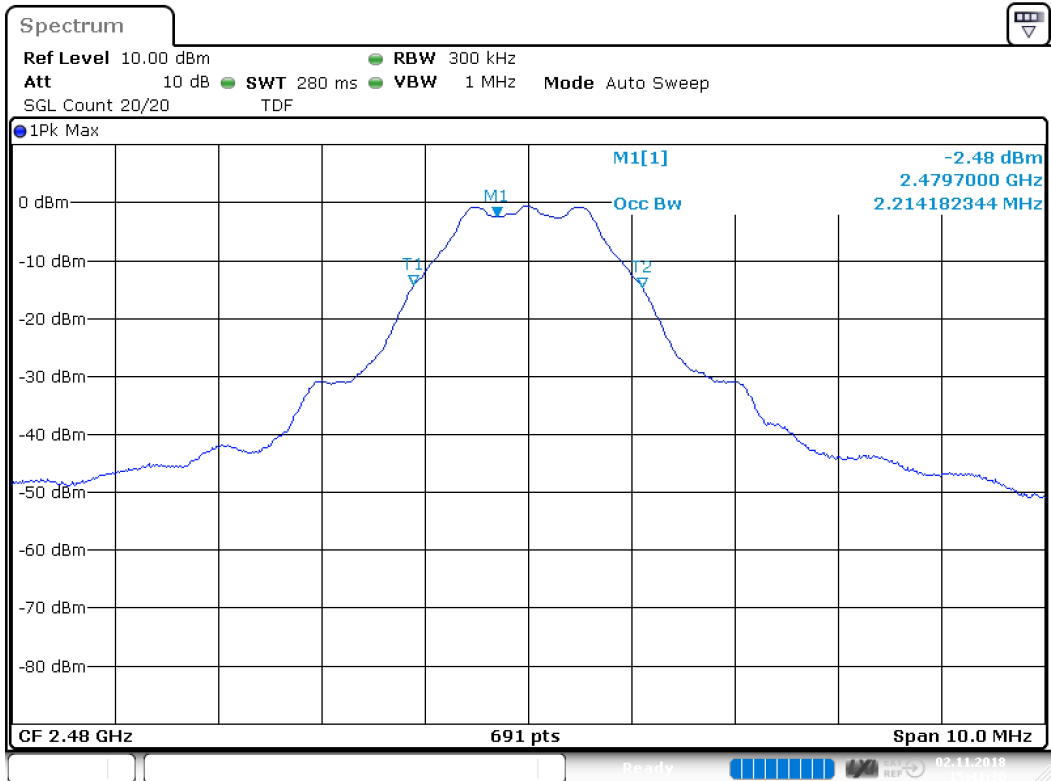
Channel 1



Channel 18

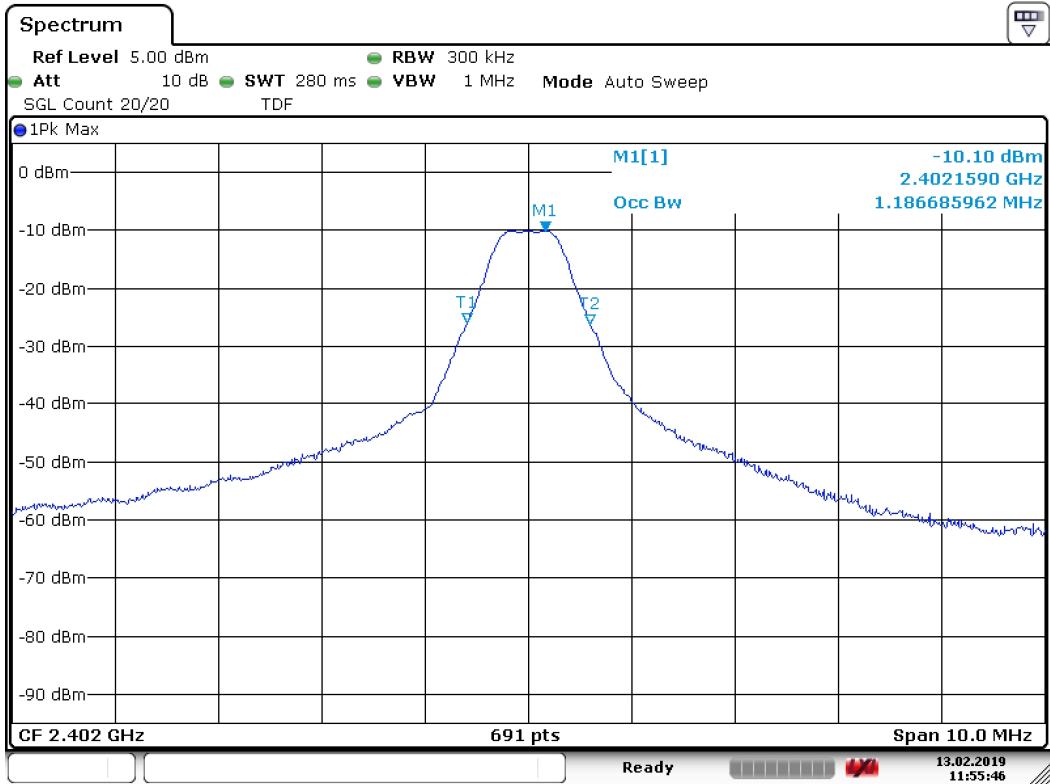


Channel 39

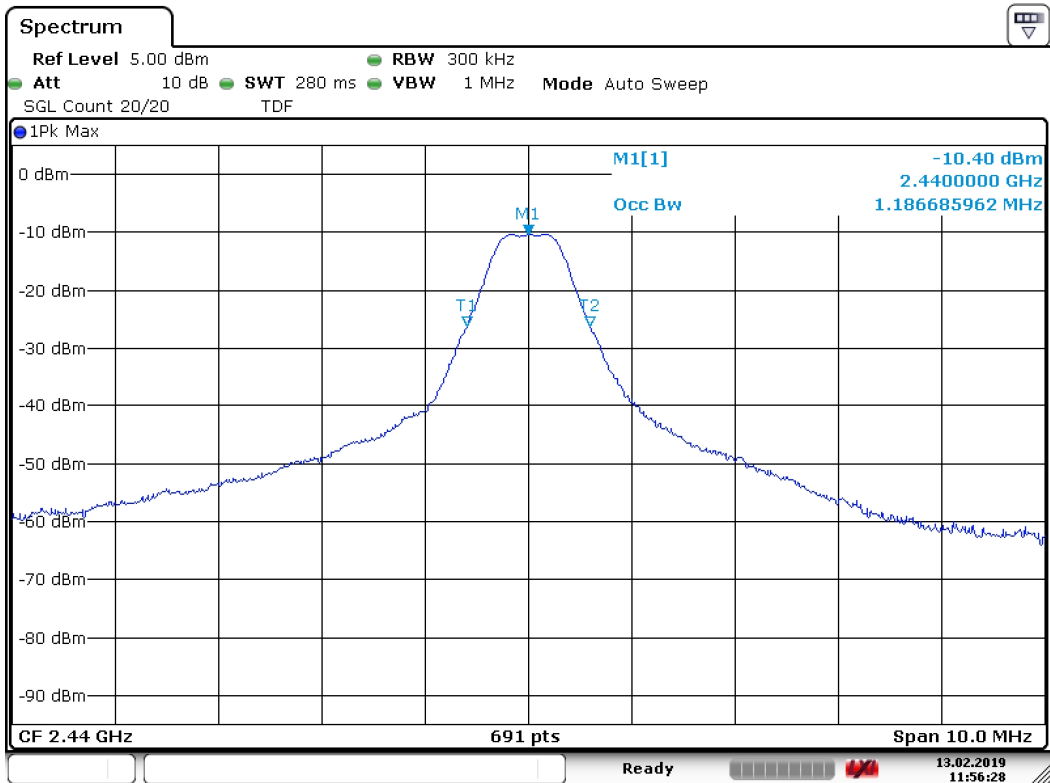


3.2.7 Plots of the ANT 99% Occupied bandwidth measurement

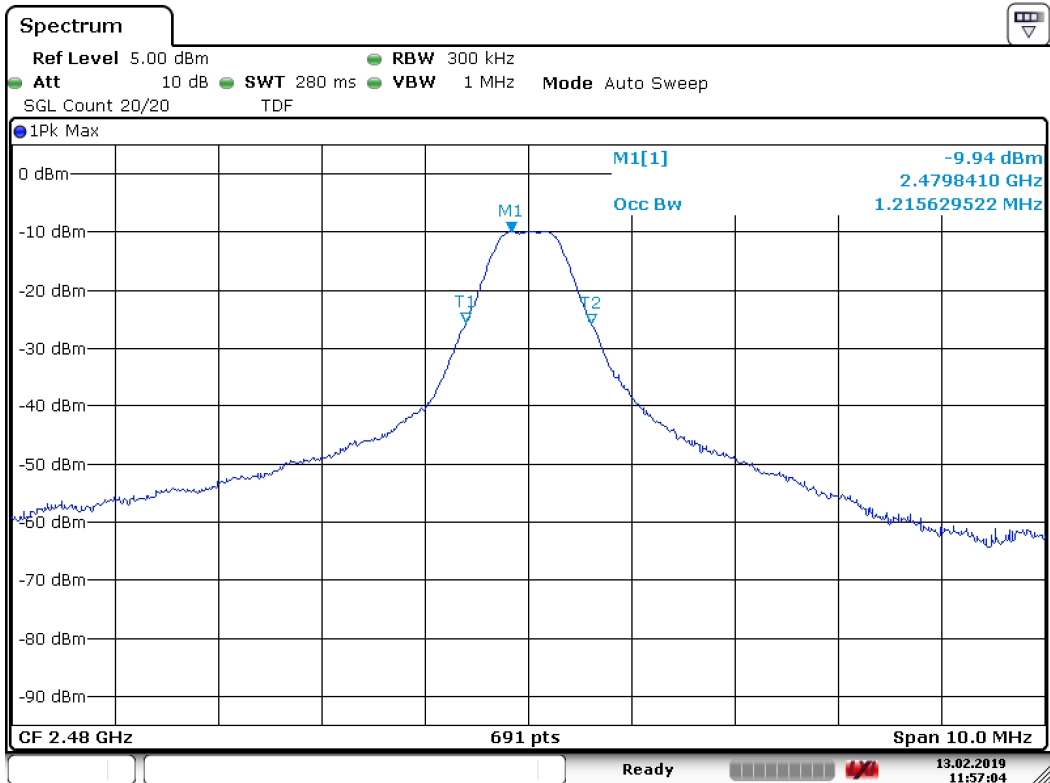
Channel 1



Channel 39

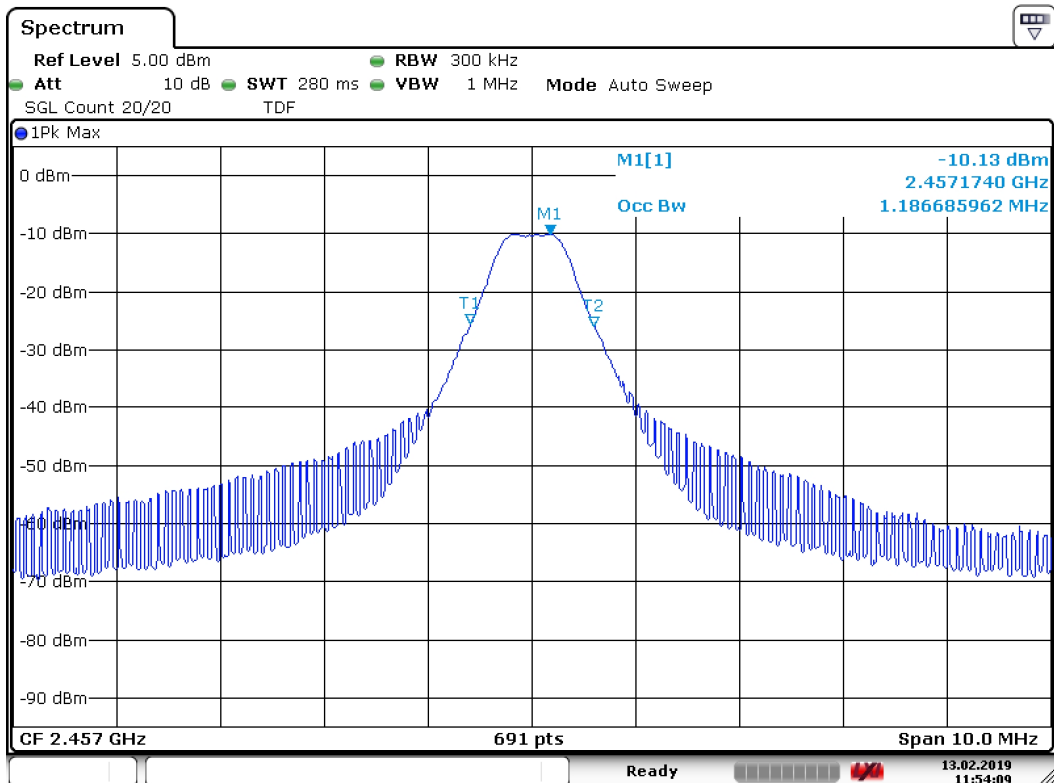


Channel 78



3.2.8 Plot of the ANT+ 99% occupied bandwidth measurement

2457 MHz



3.3 Output Power Measurement

3.3.1 Limit

BLE V5.0: 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.

ANT/ANT+: Field strength of fundamental: 50 mV/m @ 3m.

3.3.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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 ANSI C63.10.

IRN 014 - RF power (W) - Method 1 – AVGSA (DTS) according to ANSI C63.10.

3.3.5 Test results of Output Power Measurement

Peak method

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
Bluetooth Low Energy V5.0	1	2402	1 Mbps	-1.31
	18	2440	1 Mbps	-0.93
	39	2480	1 Mbps	-0.68
Uncertainty	±0.71 dB			

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)	Field strength of fundamental (mV/m @ 3m)
ANT	1	2402	1 Mbps	-10.10	0.018
	39	2440	1 Mbps	-10.40	0.017
	78	2480	1 Mbps	-9.94	0.18
Uncertainty	±0.71 dB				

Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)	Field strength of fundamental (mV/m @ 3m)
ANT+	--	2457	1 Mbps	-10.13	0.018
Uncertainty	±0.71 dB				

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 2.4 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 ANSI C63.10.

IRN 030 - Spectral power density (W per n.Hz) - Method 5 – Peak method PKPSD (PSD in 3 kHz band).

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)
Bluetooth Low Energy V5.0	1	2402	1 Mbps	-19.2
	18	2440	1 Mbps	-18.8
	39	2480	1 Mbps	-18.7
Uncertainty	±2.0 dB			

3.5 Band edge Measurement

3.5.1 Limit

Band edge:

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

3.5.2 Measurement instruments

The measurement instruments are listed in chapter 2.4 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 ANSI C63.10.

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

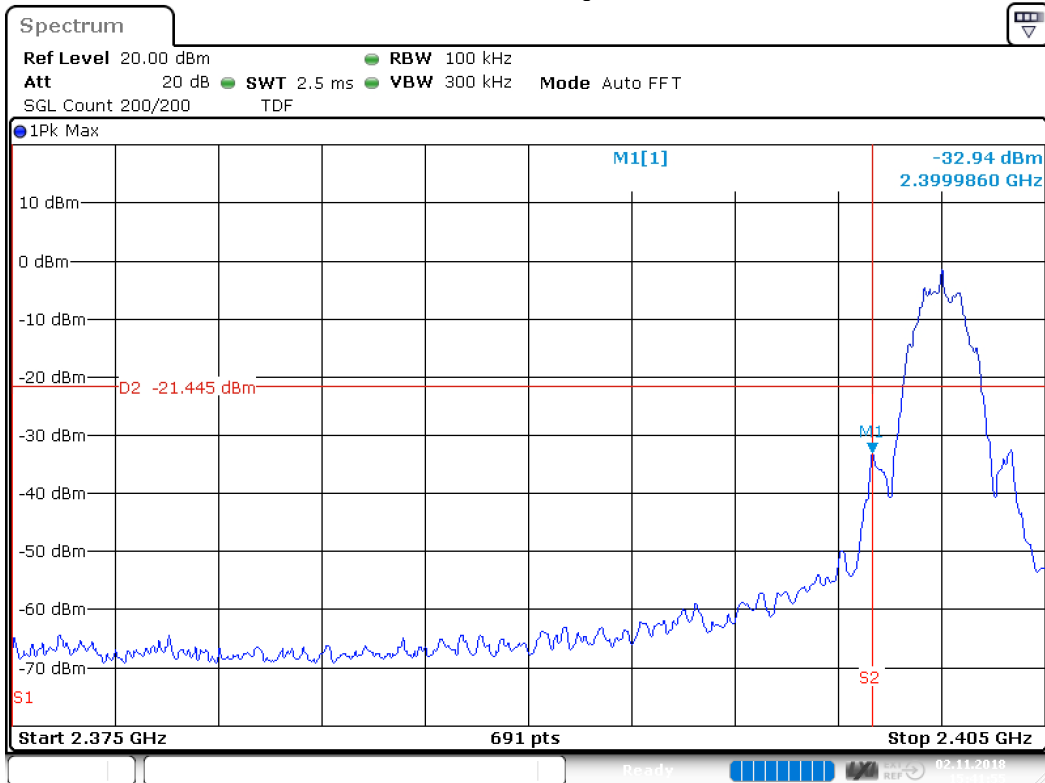
3.5.5 Measurement Uncertainty

± 5.7 dB.

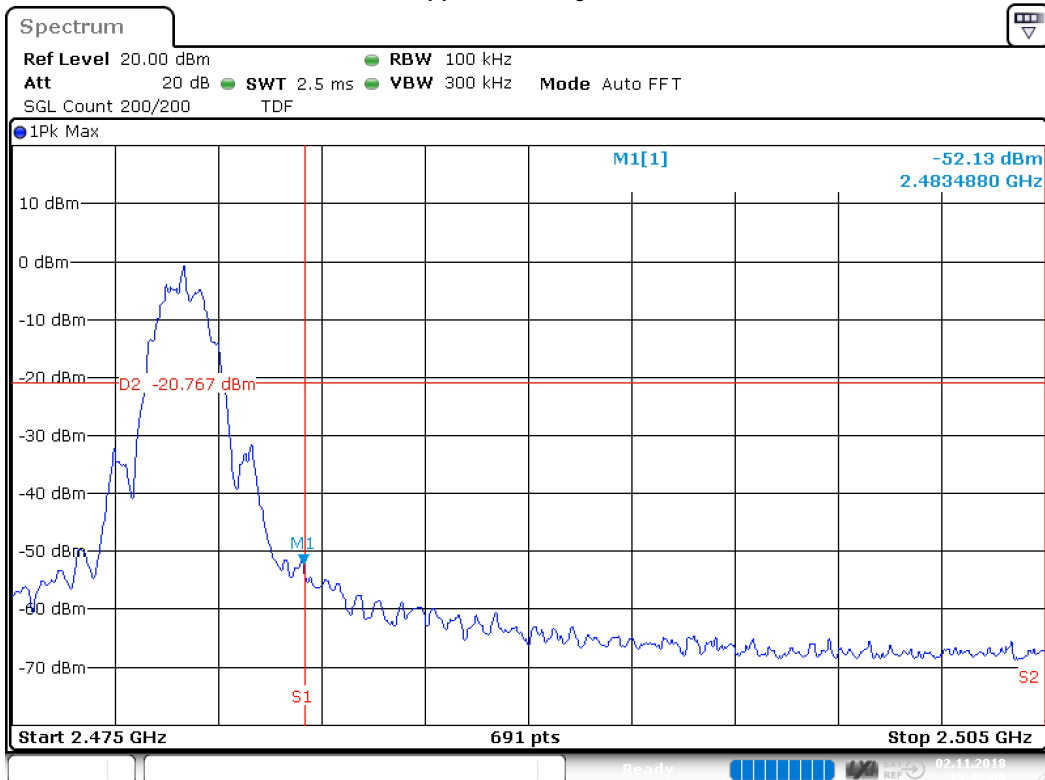
3.5.6 Plots of the Band edge Measurements

See next page.

BLE V5.0 Lower band edge (Channel 1)



BLE V5.0 Upper band edge (Channel 39)



3.6 Radiated Spurious Emissions Measurement

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(kHz)	300
0.490 – 1.705	24000/F(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 2.4 of this report.

3.6.3 Test setup

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

3.6.4 Test procedure

Spurious emissions in the 9 kHz – 30 MHz range are not reported as these emissions are more than 20 dB below the transmission level.

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 ANSI C63.10.

IRN 026 - Radiated electrical disturbance (V per m) Method 1 – 30 MHz – 1 GHz in SAR.

IRN 026 - Radiated electrical disturbance (V per m) Method 2 – 1 - 18 GHz in SAR.

IRN 026 - Radiated electrical disturbance (V per m) Method 3 – 18 - 26.5 GHz in SAR.

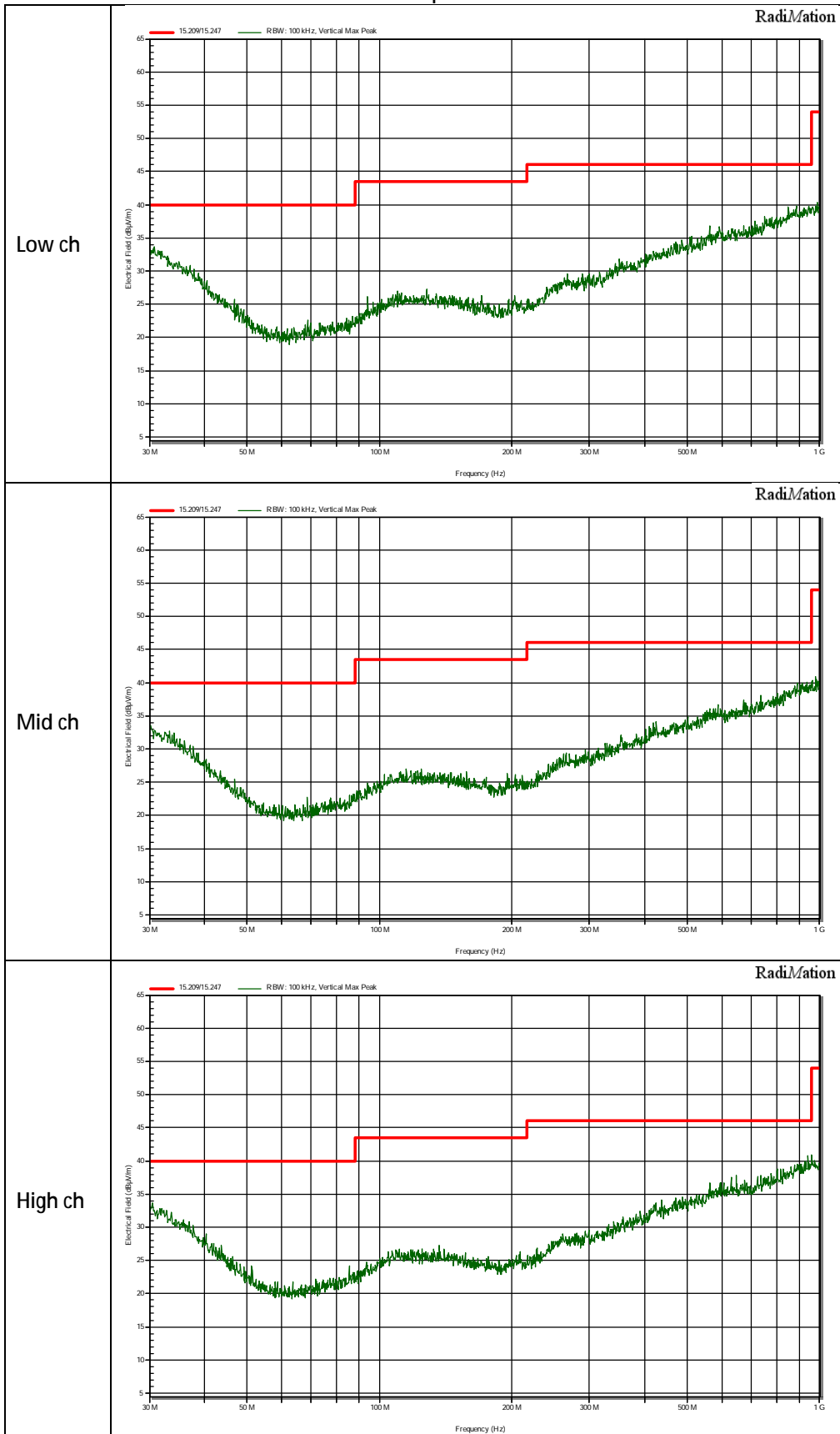
3.6.5 Notes

- In the frequency range of 1 – 26 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 (BLE V5.0)

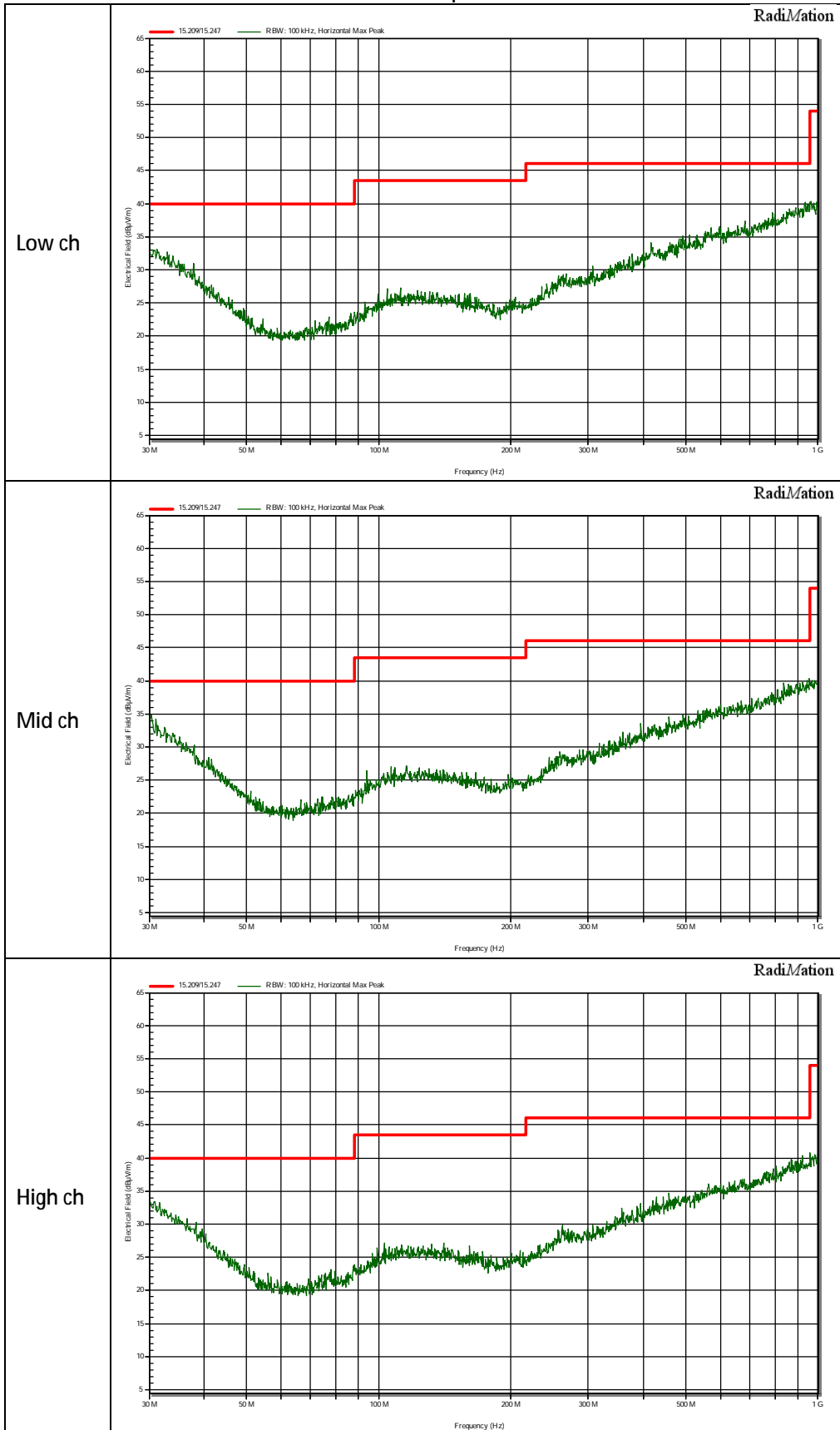
30 MHz to 1 GHz

Vertical polarization



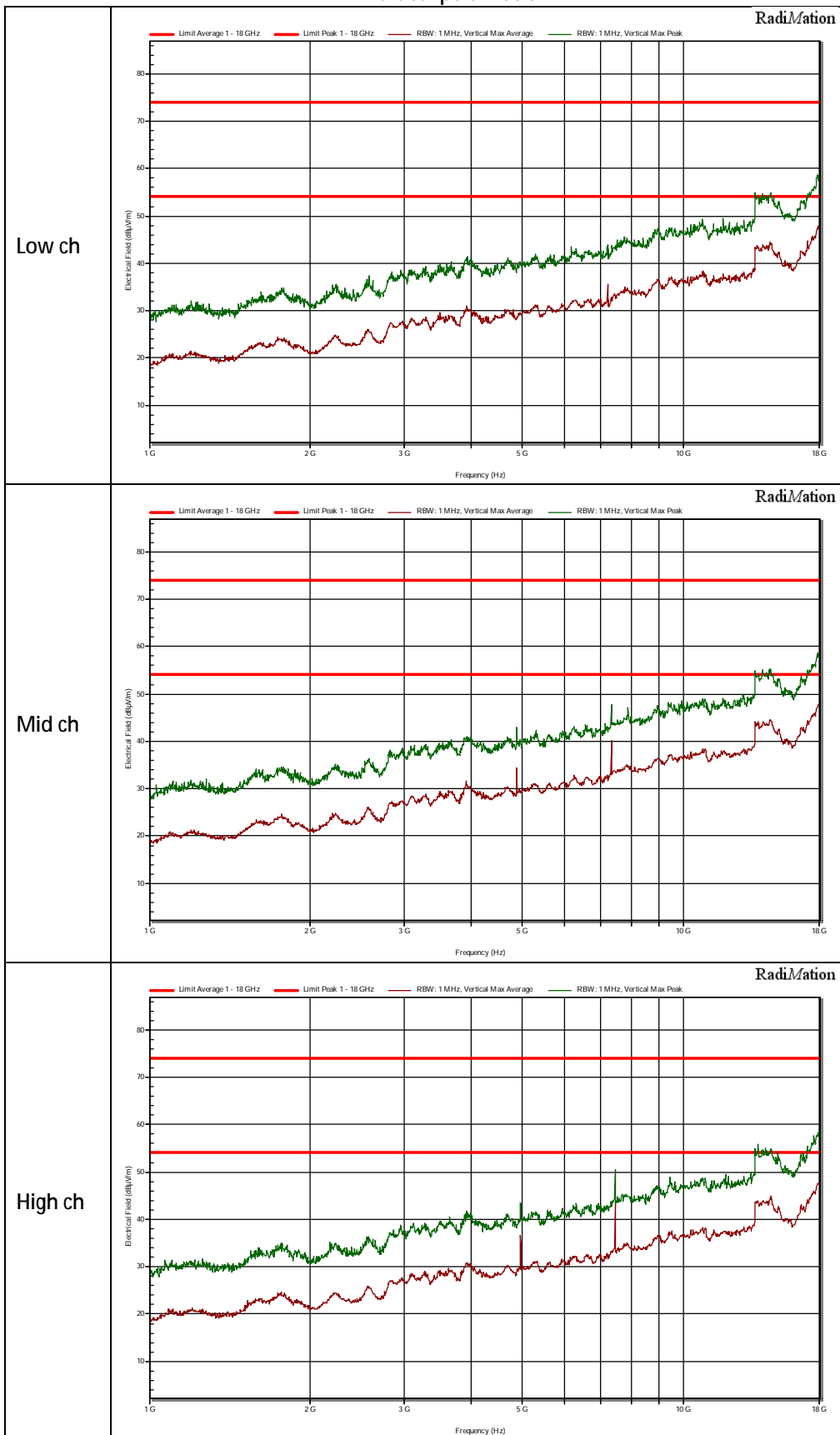
30 MHz to 1 GHz

Horizontal polarization



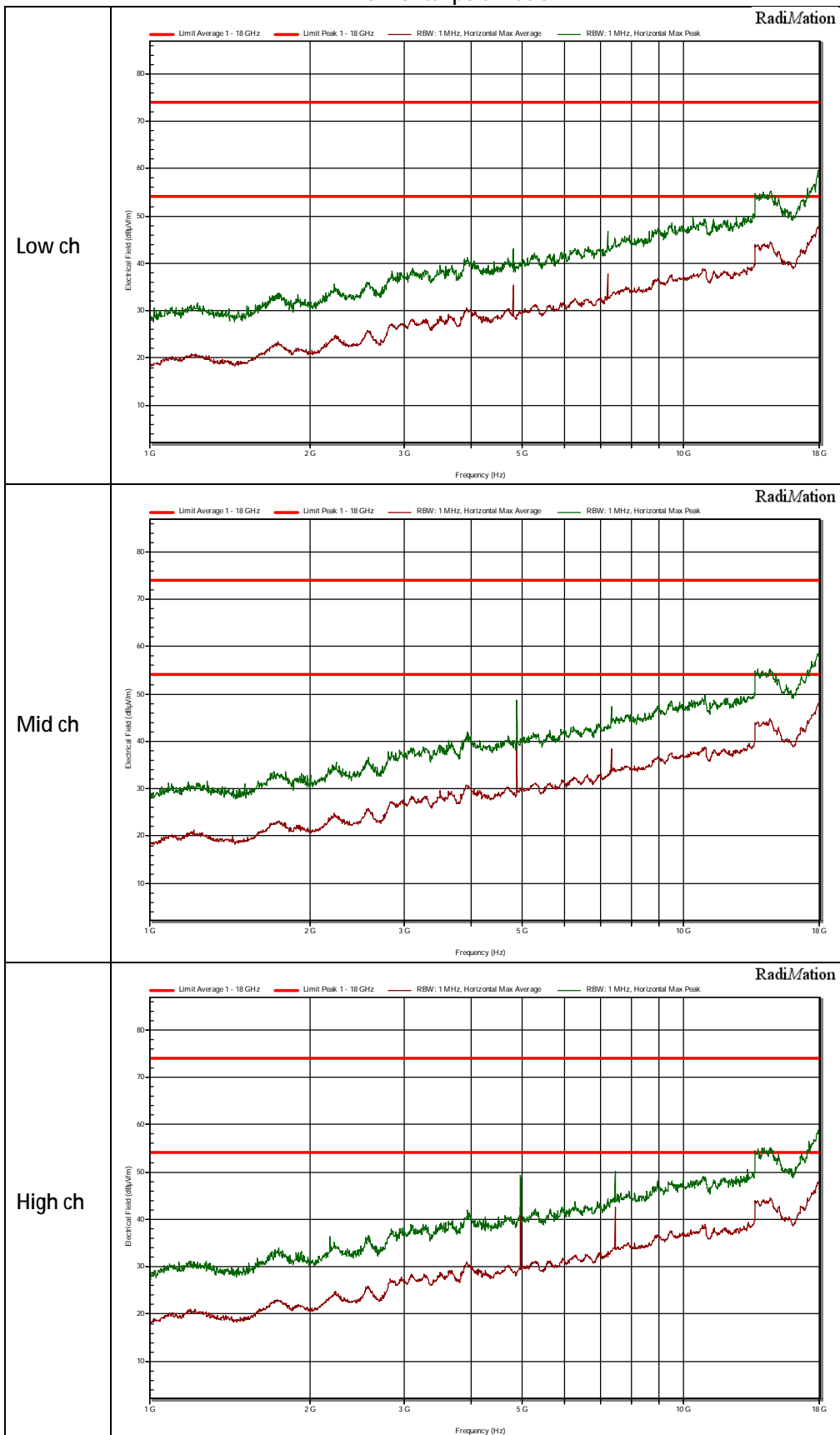
1 GHz to 18 GHz

Vertical polarization



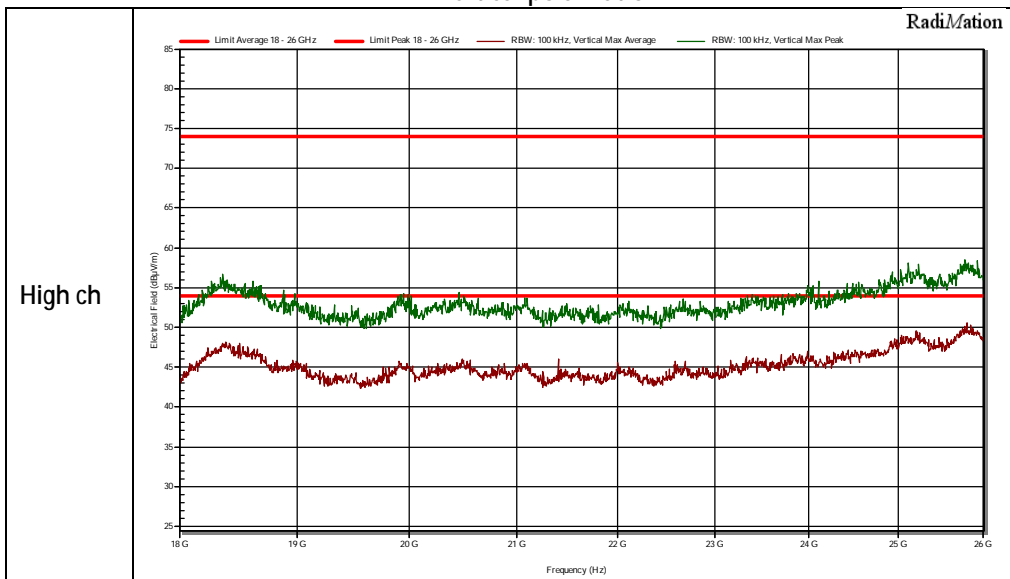
1 GHz to 18 GHz

Horizontal polarization

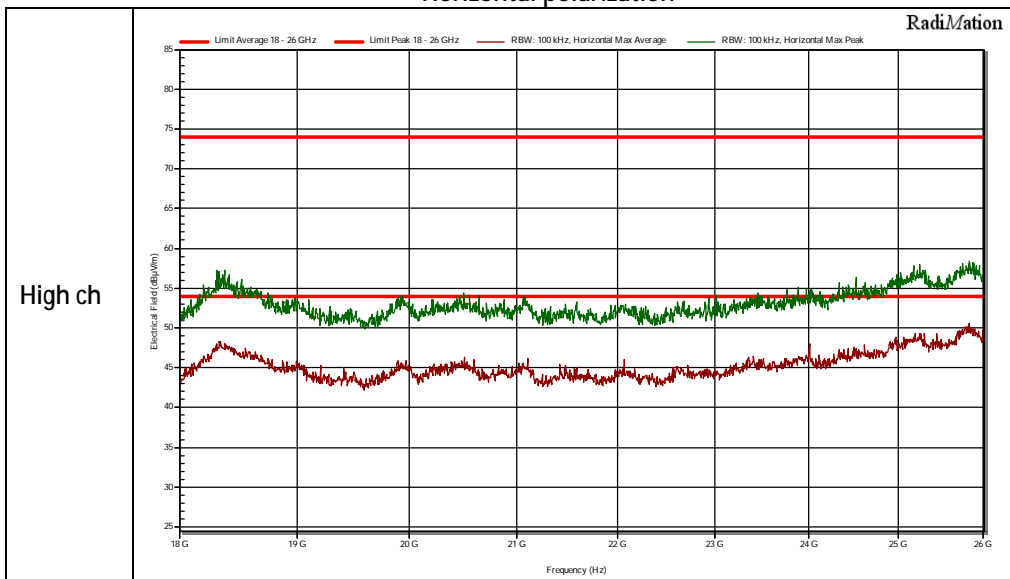


18 GHz to 26 GHz

Vertical polarization



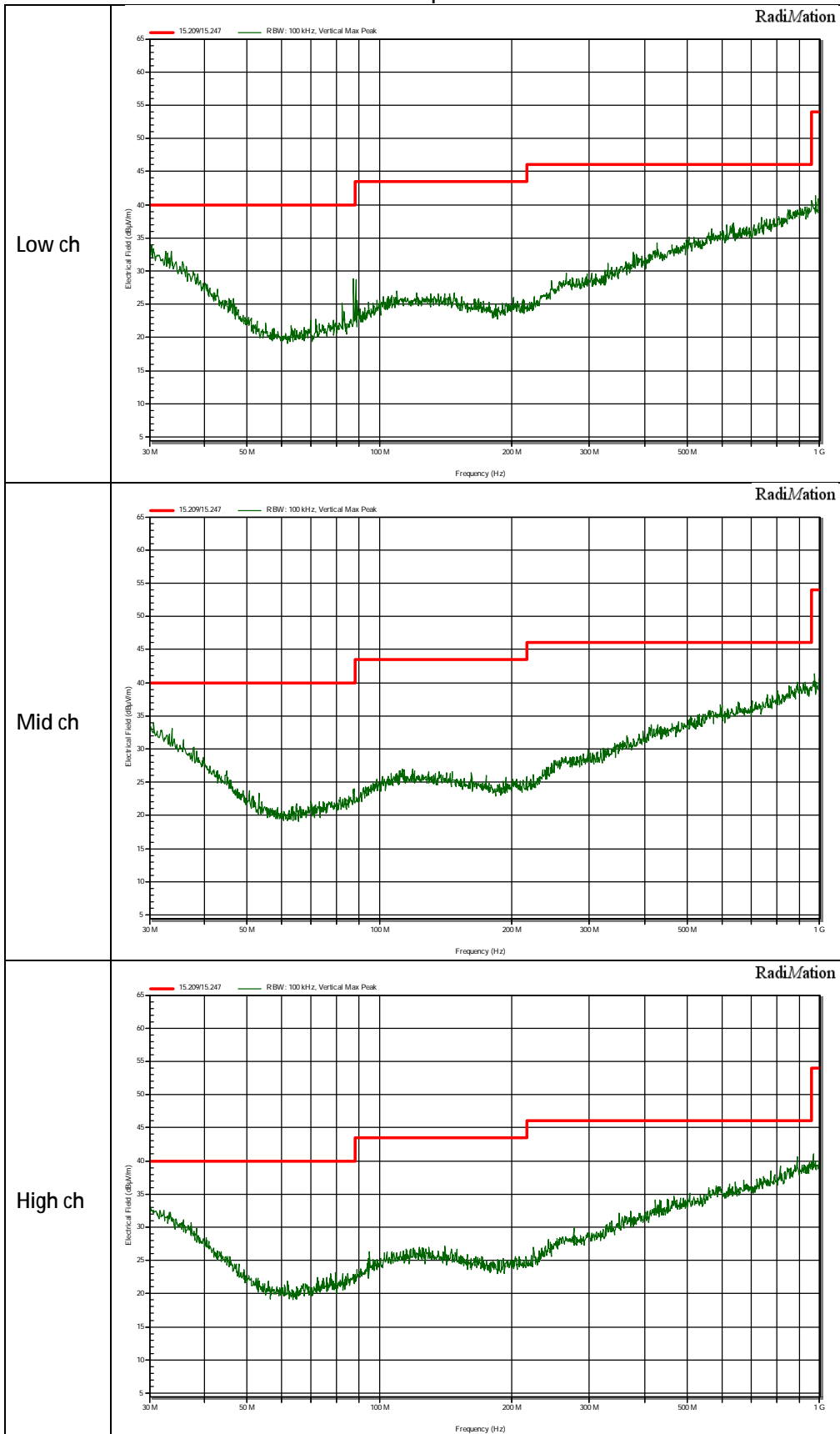
Horizontal polarization



3.6.7 Plots of the Radiated Spurious Emissions (ANT)

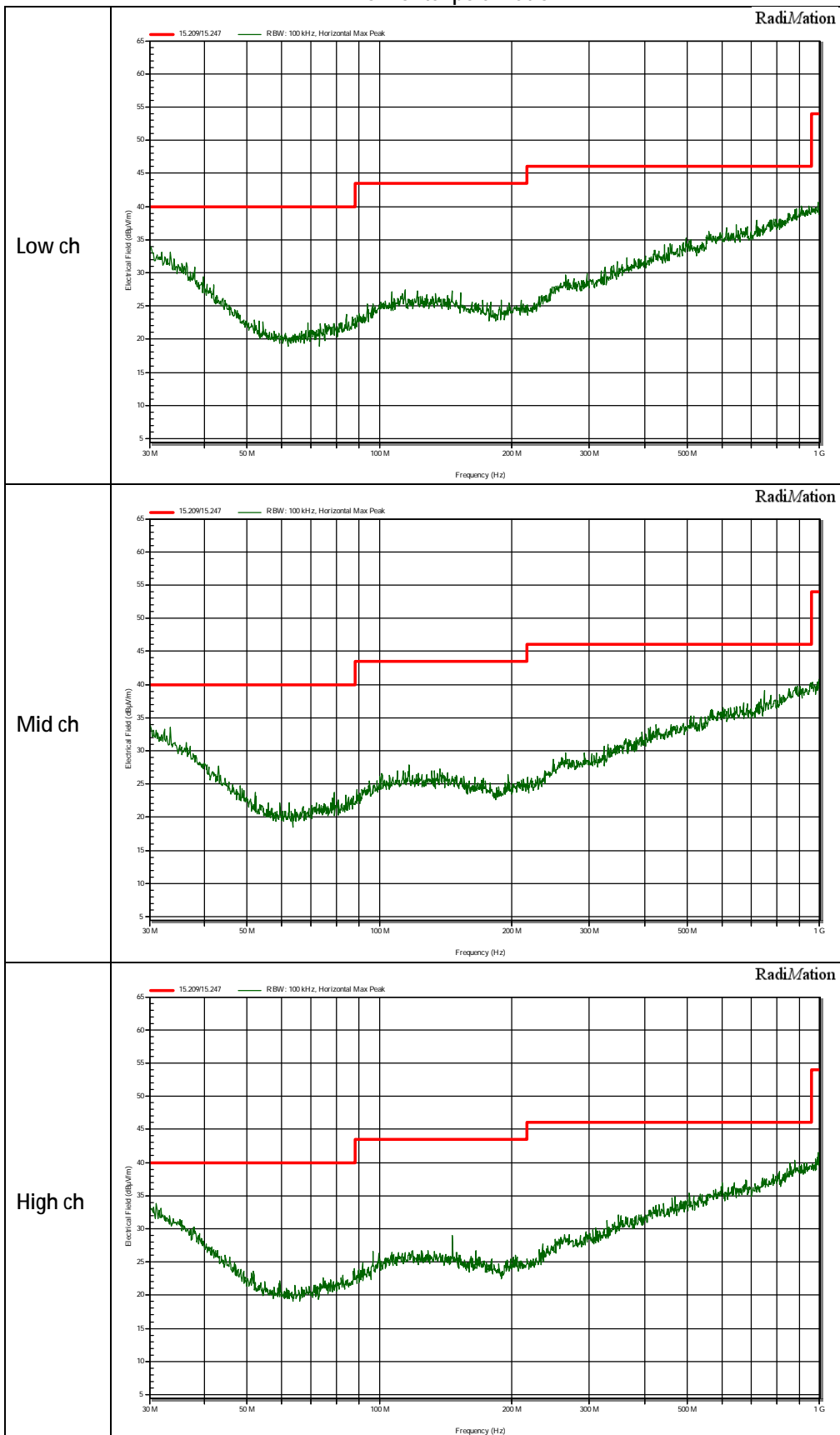
30 MHz to 1 GHz

Vertical polarization



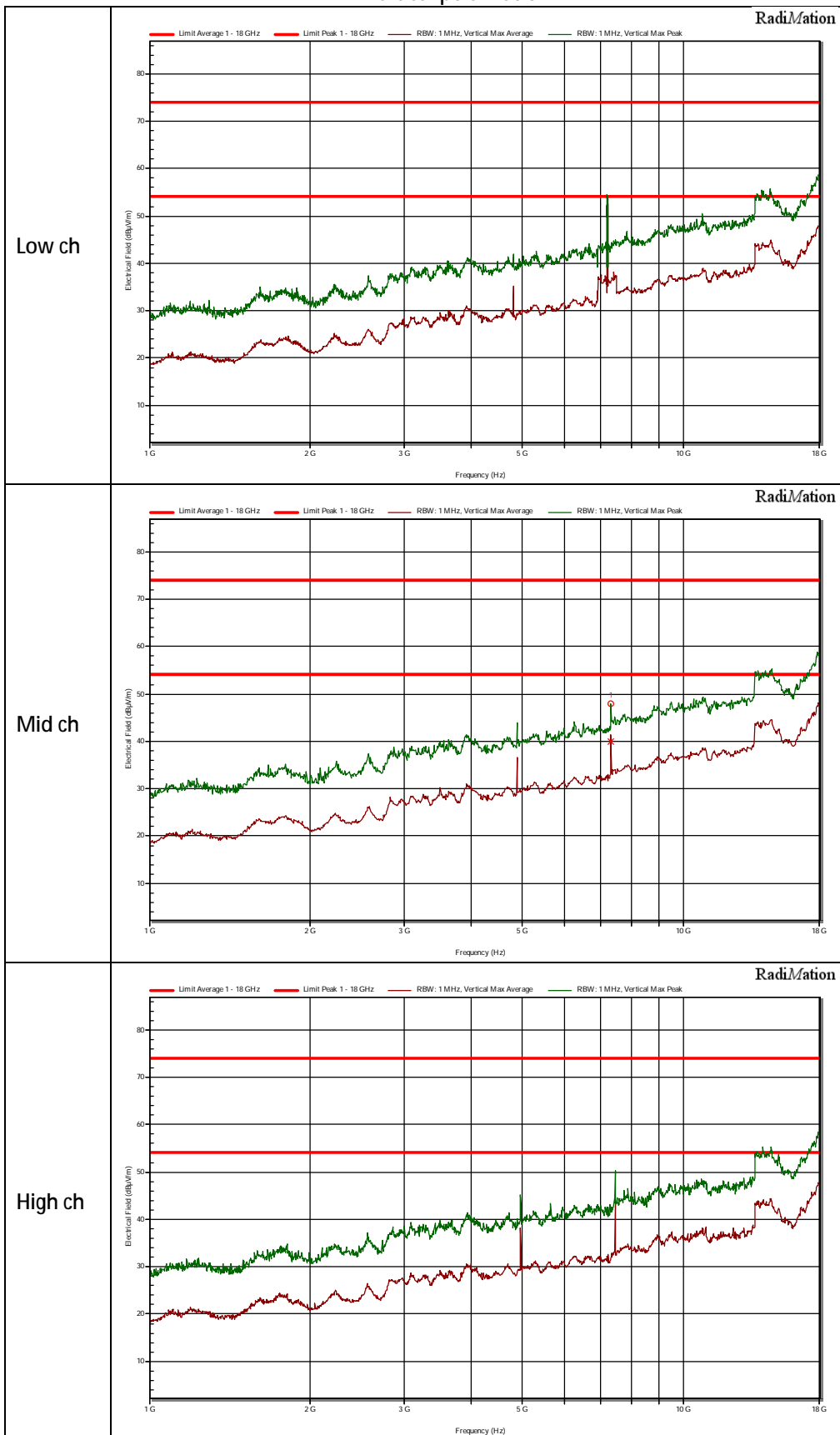
30 MHz to 1 GHz

Horizontal polarization



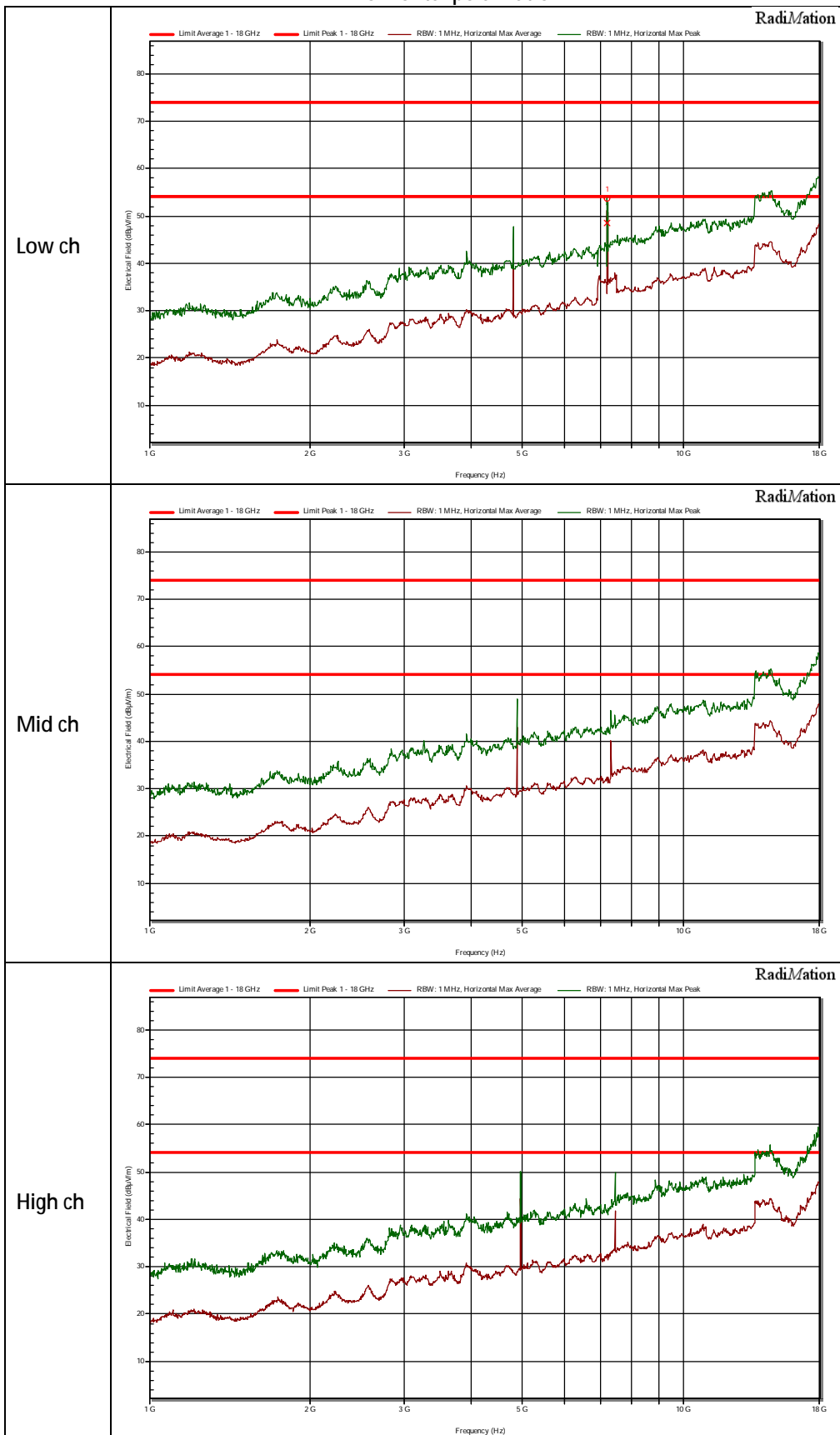
1 GHz to 18 GHz

Vertical polarization



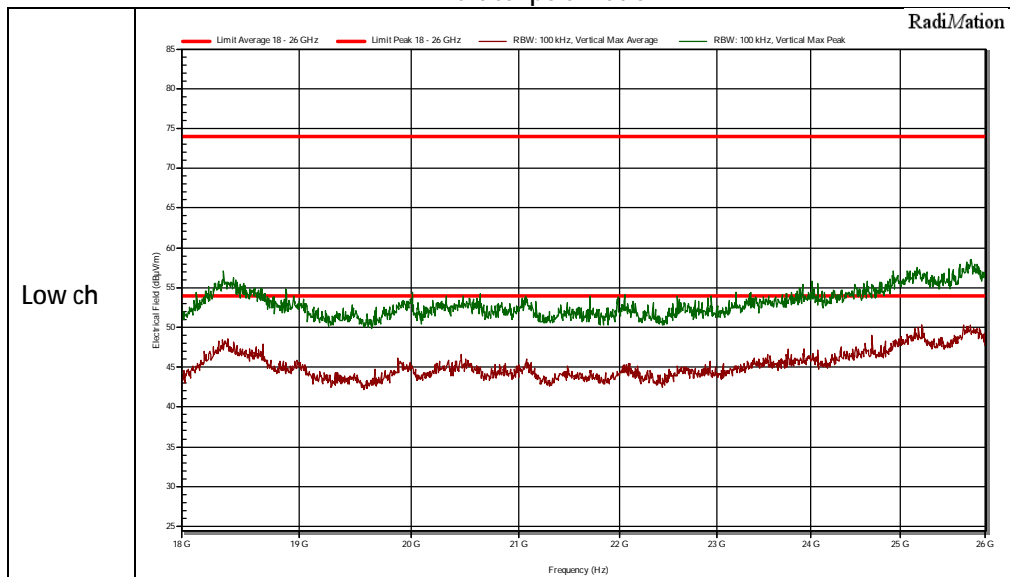
1 GHz to 18 GHz

Horizontal polarization



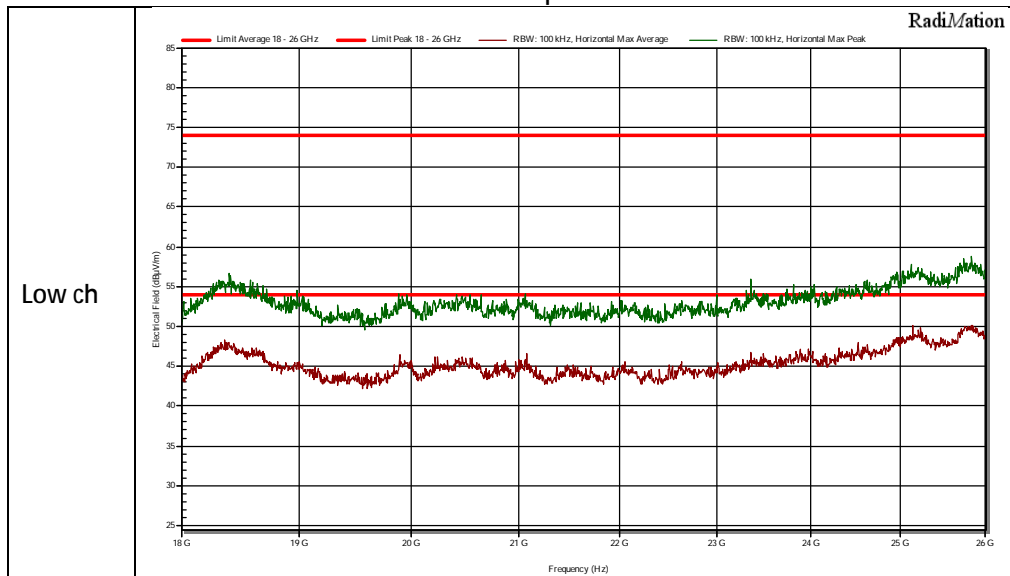
18 GHz to 26 GHz

Vertical polarization



18 GHz to 26 GHz

Horizontal polarization



ANT Measured peaks Vertical 1 – 18 GHz Low channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
7,206 GHz	Vertical	3 m	54,5 dBµV/m	49,6 dBµV/m	74 dBµV/m	54 dBµV/m	-19,5 dB	-4,4 dB

ANT Measured peaks Horizontal 1 – 18 GHz Middle channel

Frequency	Polarization	Height	Peak	Average	Peak Limit	Average Limit	Peak Difference	Average Difference
7,32 GHz	Vertical	1,5 m	47,9 dBµV/m	40,1 dBµV/m	74 dBµV/m	54 dBµV/m	-26,1 dB	-13,9 dB

3.6.8 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