Test report for

47 CFR Part 15 Subpart C

RSS-247, RSS-Gen

The RvA is signatory to ILAC - MRA

Product name	: Deeper Smart Sonar PRO+
Applicant	: Deeper UAB
FCC ID	: 2AHKO-PRO
IC	: 21307-PRO

Test report No. : P000486402 005 V1.0

Laboratory information

Accreditation

Kiwa Nederland B.V. complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2017. 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 L248 and is granted by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie).

Kiwa Nederland B.V. 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.

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The Industry Canada company number for Kiwa Nederland B.V. is: 4173A. The CABID is NL0001.

Kiwa Nederland B.V. is a registered Conformity Assessment body (CAB) under the Japan-EC MRA (Agreement on Mutual Recognition between Japan and the European Community). The registration number is: 201.

Documentation

The test report must always be reproduced in full; reproduction of an excerpt only is subject to written approval of the testing laboratory. The documentation of the testing performed on the tested devices is archived for 10 years at Kiwa Nederland B.V.

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	14-04-2025	Added test report 160200396 300 and 210600282 005 information in new report template (with new logo's etc.) and added variants without testing in §1.8 on page 9 (only part 15 C)	GG
v1.00	19-05-2025	Initial release	GG

Table of Contents

Summary of Test results

FCC	ISED	Description	Section in report	Verdict
15.209 (a)	RSS-Gen 8.9	Radiated spurious emissions	3.1	Pass
15.207 (c)	RSS-Gen 8.8	Conducted spurious emissions on AC mains	3.2	Pass
--	RSS-Gen 6.7	99% Bandwidth	3.3	Pass

FCC	IC	Description	Section in report	Verdict
15.247(a)	RSS-247 5.2 (1)	6dB Bandwidth	4.1	Pass
--	RSS-GEN 6.7	99% Bandwidth	4.2	Pass
15.247(b)	RSS-247 5.1 (2)	RF output power	4.3	Pass
15.247(e)	RSS-247 5.2 (2)	Power spectral density	4.4	Pass
15.247(d)	RSS-247 5.5	Conducted Spurious emissions	4.5	Pass
15.247(d)	RSS-247 5.5	Conducted Band edge	4.5	Pass
15.247(d)	RSS-247 5.4	Radiated Spurious emissions	4.6	Pass

Decision rule: Pass/Fail decisions are based on measurement results without taking into account measurement uncertainty.

1 General Description

1.1 Applicant

Client name:	Deeper UAB
Address:	Antakalnio str. 17, Vilnius, Lithuania
Zip code:	LT-10312
Telephone:	+37065657151
E-mail:	J. Pileckas
Contact name:	Julius.pileckas@deeper.eu

1.2 Manufacturer

Manufacturer name:	Deeper UAB
Address:	Antakalnio str. 17, Vilnius, Lithuania
Zip code:	LT-10312
Telephone:	+37065657151
E-mail:	J. Pileckas
Contact name:	Julius.pileckas@deeper.eu

1.3 Tested Equipment Under Test (EUT)

Product name:	Deeper Smart Sonar PRO+
Brand name:	Deeper Smart
FCC ID:	2AHKO-PRO
IC:	21307-PRO
Product description:	Wireless Smart Sonar
Variant model(s):	See chapter 1.8 “observations and remarks”
Batch and/or serial No.	--
Software version:	v1.1/ v1.0
Hardware version:	v.3/ H12
Date of receipt:	21-03-2016/ 02-06-2019
Tests started:	31-03-2016/ 16-08-2019
Testing ended:	09-05-2016/19-08-2019

1.3.1 Auxiliary items

AUX1

Product name:	Power supply for EUT
Product type:	AC adapter
Remarks:	Connects to EUT

1.4 Product specifications of Equipment under test

Tx Frequency:	2412 – 2462 MHz
Rx frequency:	2412 – 2462 MHz
Occupied channel width:	According to IEEE 802.11b/g/n
Antenna type:	Omnidirectional Antenna
Antenna gain:	-2.3 dBi at 2.4 GHz
Type of modulation:	Duplex
Power source	Lithium battery
Emission designator	22M0G1D

Disclaimer: The operating frequency bands are declared by the applicant

1.5 Environmental conditions

Test date	31-03-2016	09-05-2016	16-08-2019	19-08-2019
Ambient temperature	20.6°C	23.3°C	24.9 °C	23.8 °C
Humidity	34.7 %	40.1 %	49.6 %	49.8 %

1.6 Measurement standards

- ANSI C63.10:2013
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- FCC KDB Publication No. 558074 D01DTS Meas. Guidance V03r05

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, 15.207
- RSS-Gen Issue 5

- FCC Part 15 Subpart C §15.247.
- RSS-247 issue 3

1.8 Observation and remarks

This is a reissue of the 160200396 300 and 210600282 005 test reports. Because the 210600282 refers to the 160200396 report, these reports are combined within this report, to have one document to reference to.

Observation and remarks of test report no. 210600282 005

The tested (conducted)sample was modified to include an conducted antenna connector

The applicant implemented some changes to the product tested in Telefication test report 160200396 300 (Paragraph 3.4-3.10):

The following changes were made:

- new MCU,
- different battery,
- battery charge IC, connector and inductor,
- boost voltage regulator IC and inductor,
- some components case changed (i.e. 0201 instead of 0402)
- PCB circuit design changed (except for RF part)

As the RF section of the PCB has not changed, only spurious emission tests are performed.

List of Variants:

Main/Variant	Type designation	Trademark	Description	Hardware version	Software version
Main	DP1H10S10	Deeper	Pro+	H12	v.1.0
Variant(tested)	DP3H10S10	Deeper	CHIRP+	v.3	v.1.1
Variant	DP3H20S10	Deeper	CHIRP+	v.3	v.1.1
Variant	DP3H30S10	Deeper	CHIRP	v.3	v.1.1
Variant	DP3H40S10	Deeper	CHIRP	v.3	v.1.1
Variant	DP5H20S10	Deeper	PRO2	v.3	v.0.5
Variant	DP5H10S10	Deeper	PRO+2	v.3	v.0.5
Variant	DP5H10S20	Deeper	PRO+	v.3	v.0.5
Variant	DP5H20S20	Deeper	PRO	v.3	v.0.5
New Variant	DP5H13S10	Deeper	PRO2	--	--
New Variant	DP5H23S10	Deeper	PRO+2	--	--

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. Kiwa Nederland B.V. 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 : ing R. van Barneveld (2016 & 2021)

Review of test methods and report by:

Name : ing P.A. Suringa (2016) & P. van Wanrooij, BASc (2021&2025)

The above conclusions have been verified by the following signatory:

Date : 26-06-2025

Name : P. van Wanrooij

Function : Test Engineer

Signature :

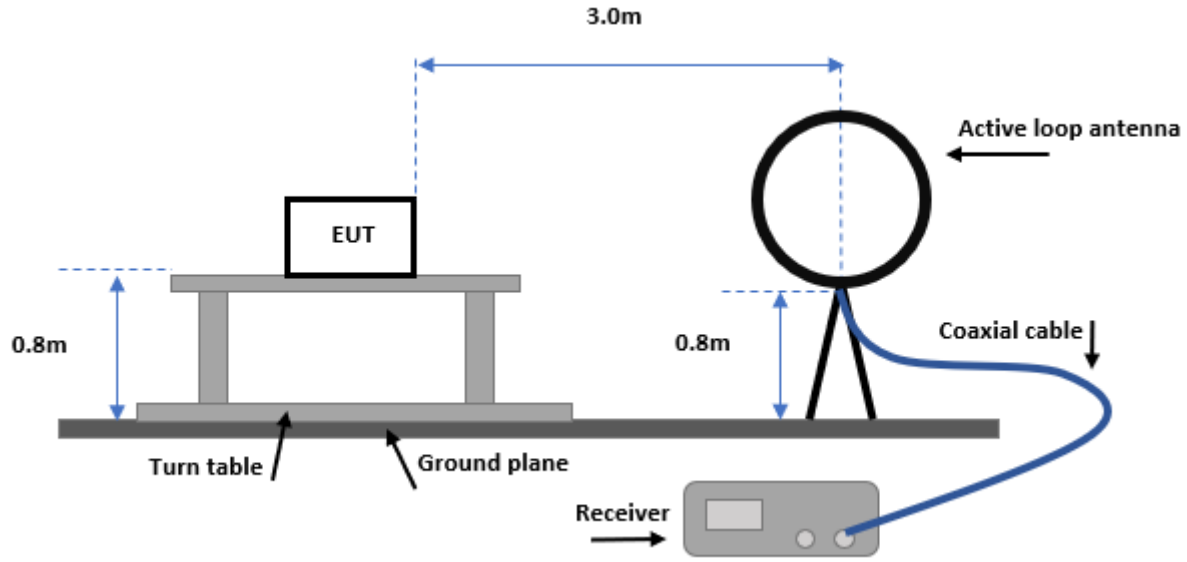
2 Test configuration of the Equipment Under Test

2.1 Test mode

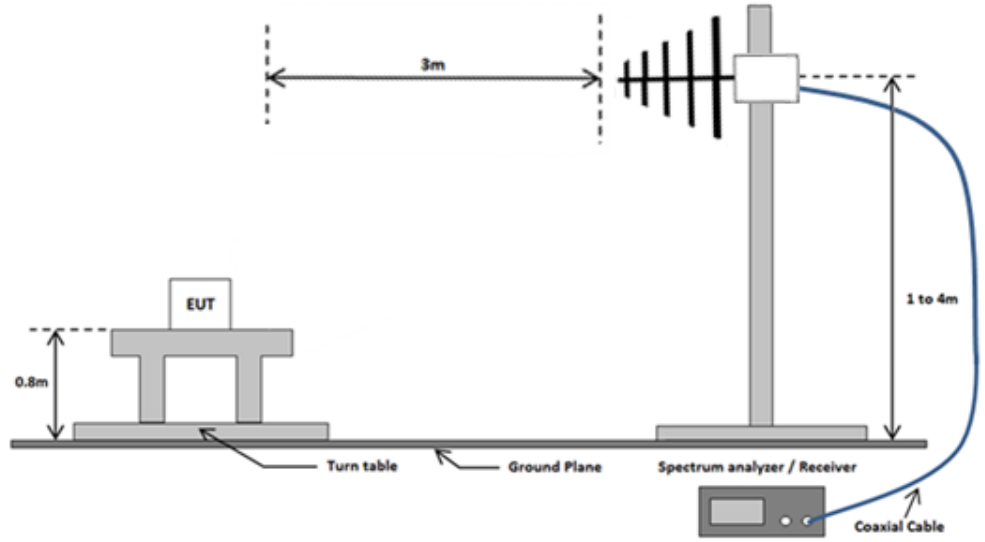
The EUT was transmitting.

2.2 Test setups

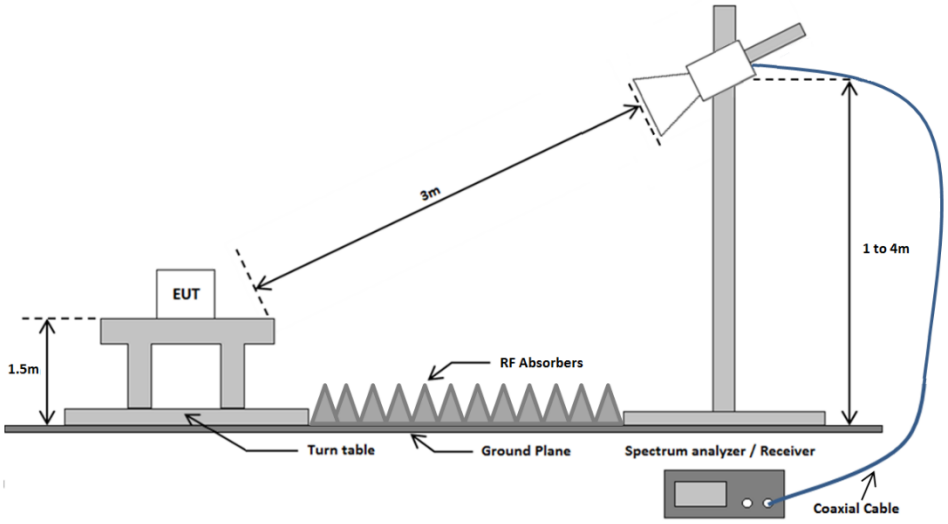
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz

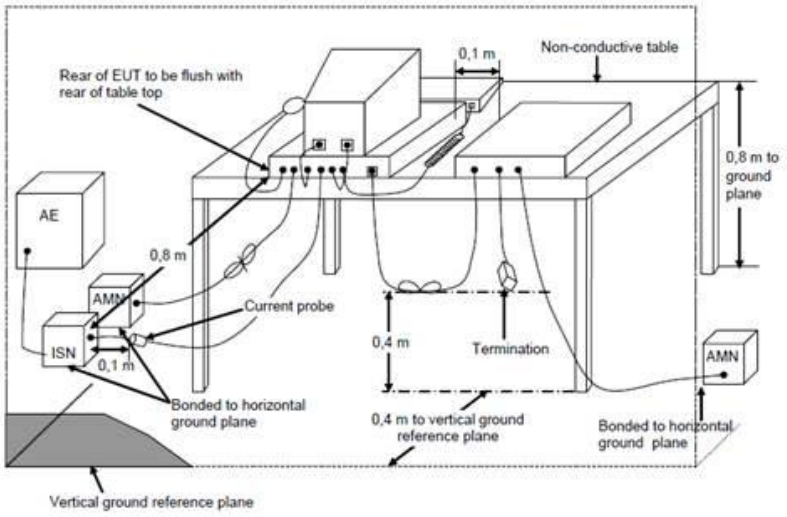


Radiated emissions test setup above 1 GHz



AC Power line conducted emissions test setup

Emissions test at AC mains



2.3 Equipment used in the test configuration

Description	Manufacturer	Model	ID	Used at Par.
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	3.1
Spectrum Analyzer	Rohde & Schwarz	ESR7	TE01220	3.1 – 3.2
Software	D.A.R.E Instruments	Radimation	2019.1.8	3.1
Biconilog Antenna	Chase	CBL6112A	TE00967	3.1
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	3.1
SAC Chamber	Comtest Engineering BV	-	TE00861	3.2
Artificial Mains Network (AMN)	Rohde & Schwarz	ESH3-Z5	TE00208	3.2
Pulse limiter	Rohde & Schwarz	ESH3-Z2	TE00756	3.2
Spectrum Analyzer	Rohde & Schwarz	FSV40	TE01269	3.3

Description	Manufacturer	Model	ID	Used at Par.
Signal Generator	Hewlett Packard	83650B	TE00487	4.1 to 4.5
Spectrum Analyzer	Rohde & Schwarz	FSV	TE01269	4.1 to 4.5
Spectrum Analyzer	Rohde & Schwarz	FSP40	TE11125	4.6-4.7
EMI receiver	Rohde & Schwarz	ESR7	TE01220	4.6-4.7
10 MHz distribution Amplifier	Stanford Research Systems	FS735/1	TE01278	4.1 to 4.5
USB to GPIB adapter	National Instruments	-	TE01283	4.1 to 4.5
Pre-amplifier	Miteq	AFS42-041001800-29-OP-42	TE11132	4.6-4.7
Biconilog Antenna	Chase	CBL6112A	TE00967	4.6-4.7
Horn Antenna	EMCO The Electro – Mechanics Co	3115	TE00531	4.6-4.7
SAC Chamber	Comtest Engineering BV	-	TE00861	4.6-4.7
High pass filter	Wainwright instruments	WHK3.0/18G-10EF	TE01140	4.6

2.4 Sample calculations

All formulas for data conversions and conversion factors are reported in chapter 4 of this test report.

3 Test report

3.1 Radiated spurious emissions

3.1.1 Limit

15.209 (b) and 15.109

Frequency (MHz)	Field strength (µV/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

3.1.2 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 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 V05.

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.
IRN 027 - Radiated magnetic disturbance Method 1 – Loop antenna.

3.1.5 Measurement Uncertainty

Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	+1.5 dB, - 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

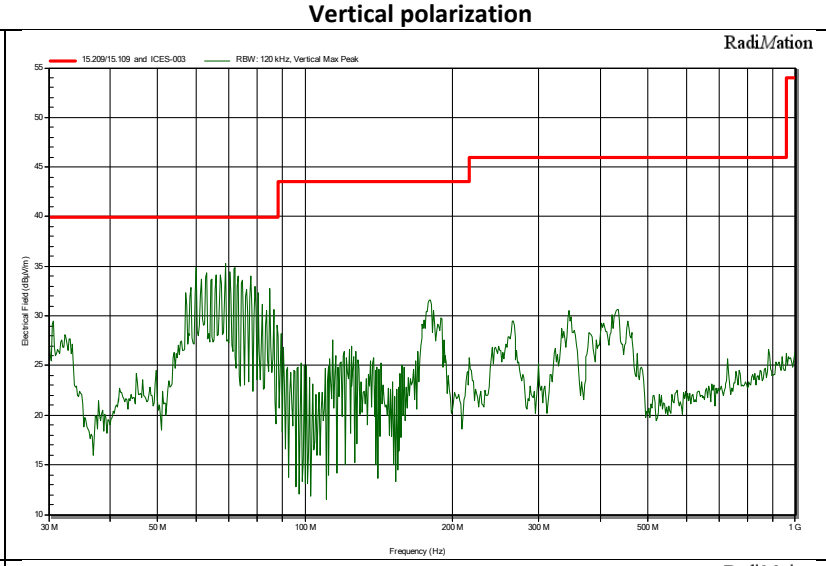
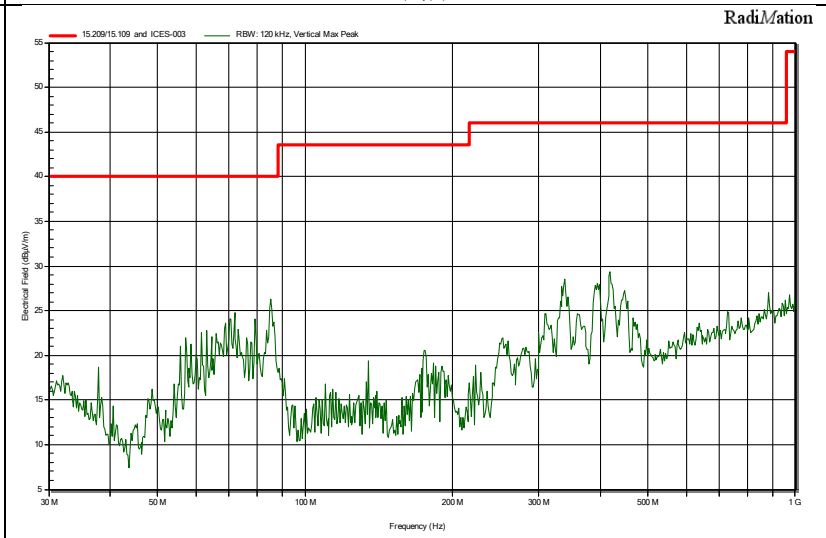
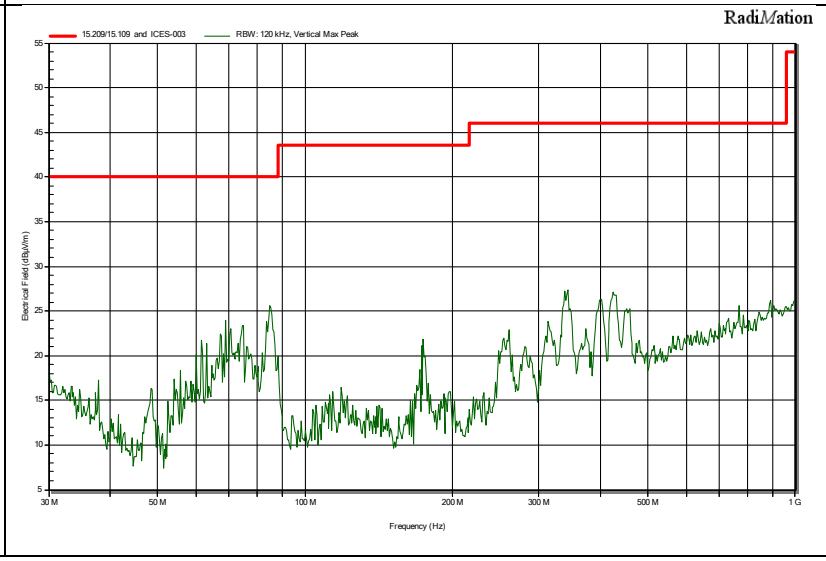
3.1.6 Notes

- 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.
- in the frequency range of 9 kHz to 30 MHz all emissions are 20 dB below the limit and are therefore not reported.
- Tested only on the middle channel.

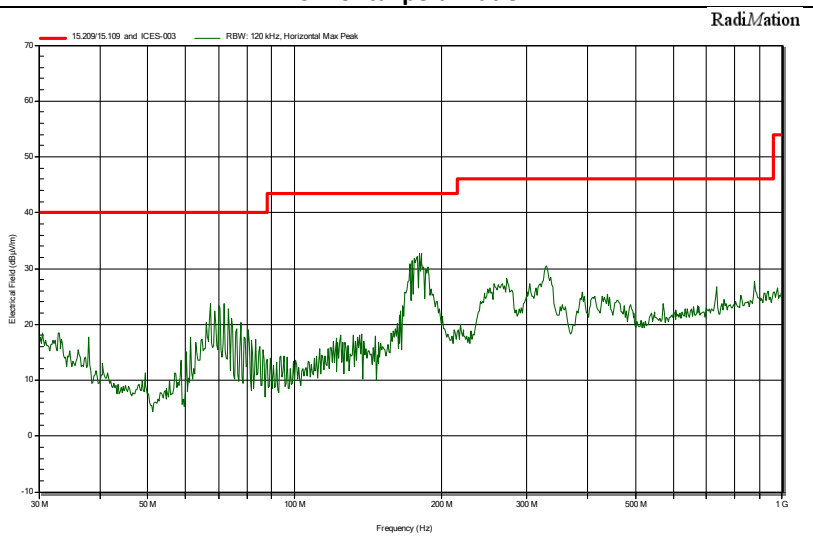
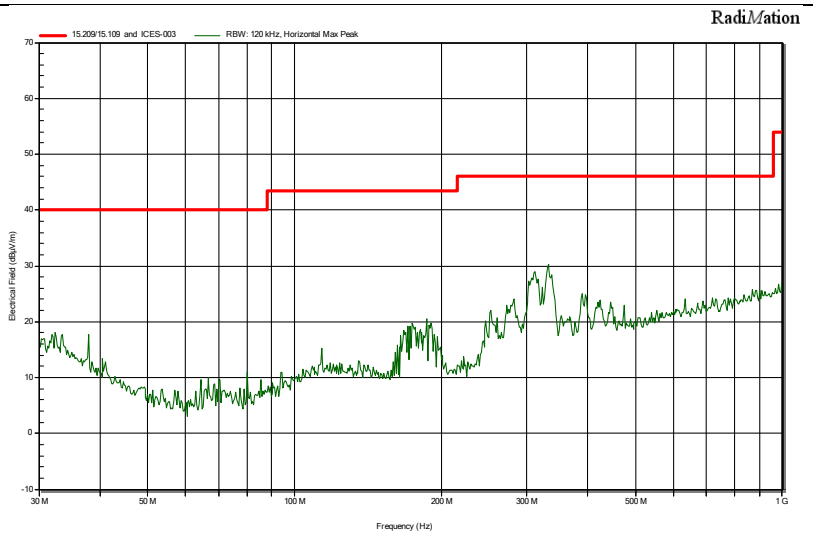
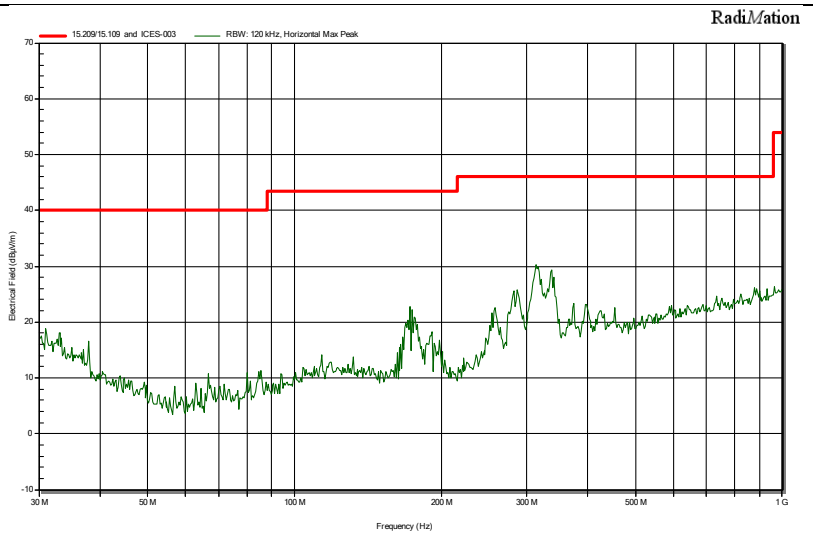
3.1.7 Plots of the Radiated Spurious Emissions Measurement

30 -1000 MHz

Vertical polarization

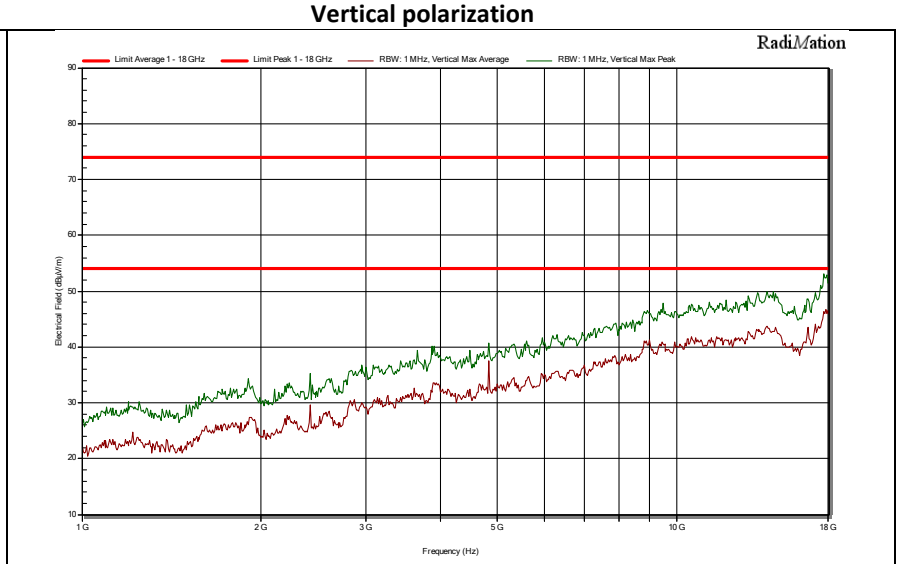
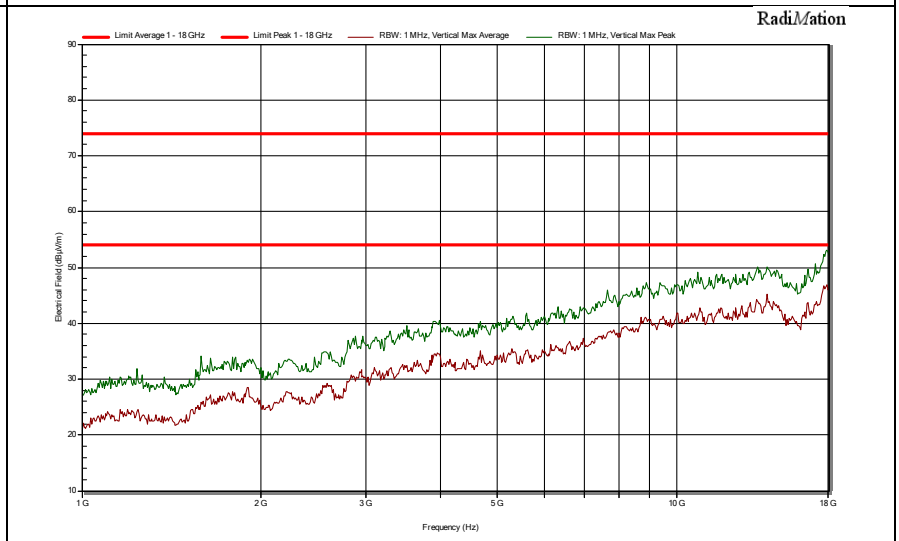
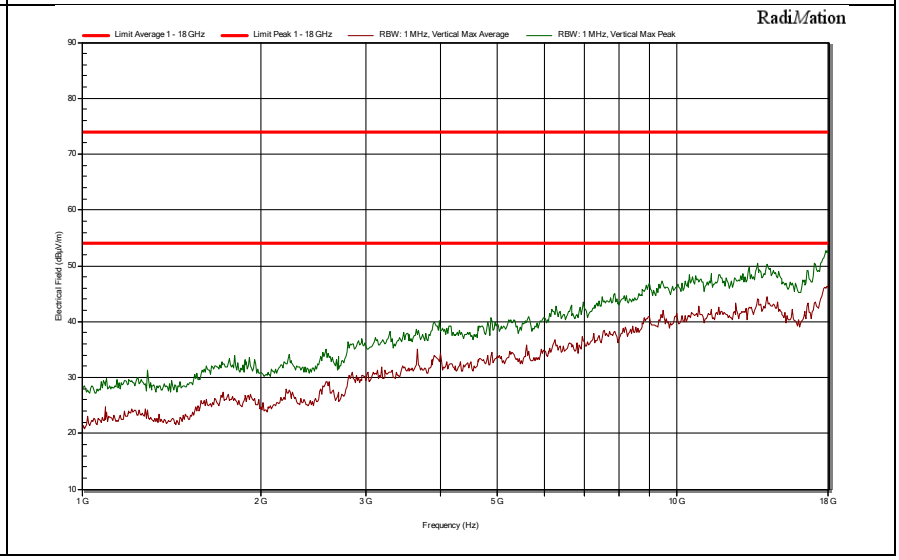
11b	
11g	
11n	

Horizontal polarization

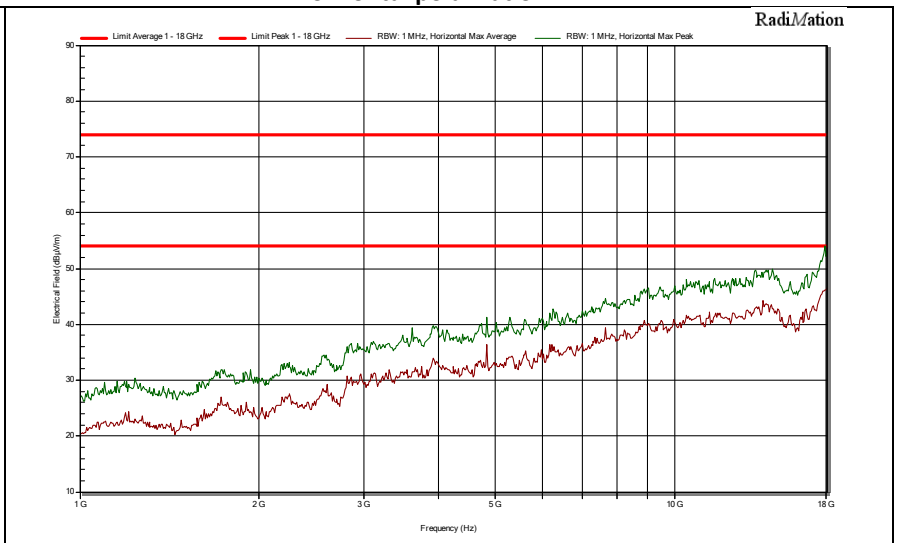
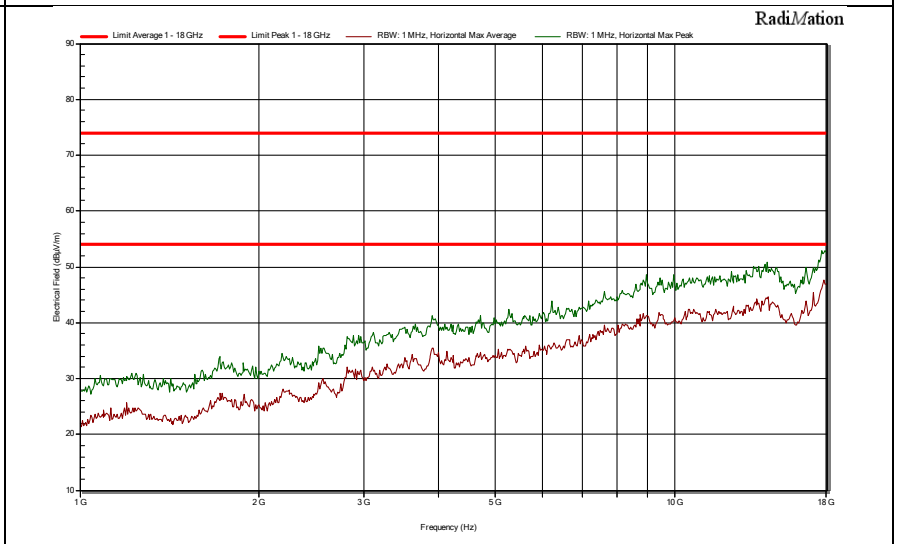
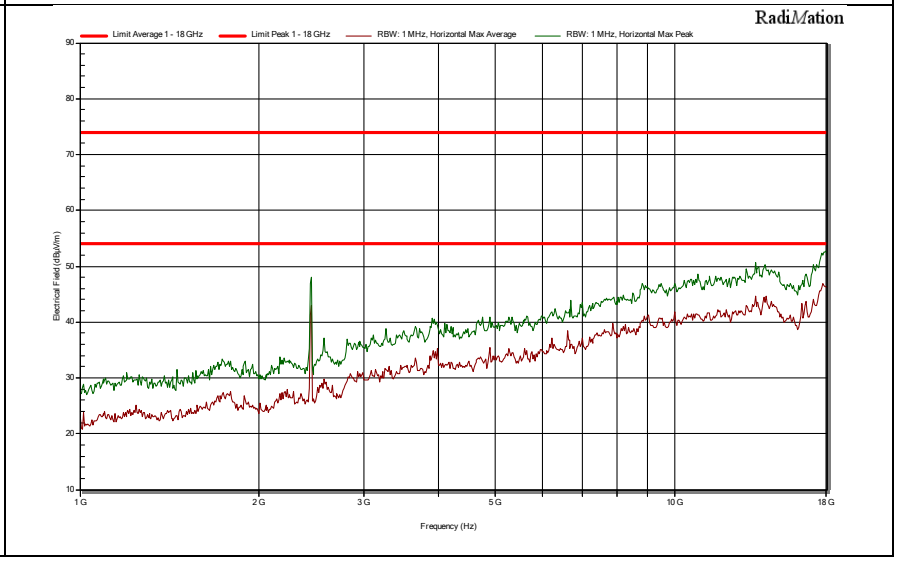
11b	
11g	
11n	

1 – 18 GHz

Vertical polarization

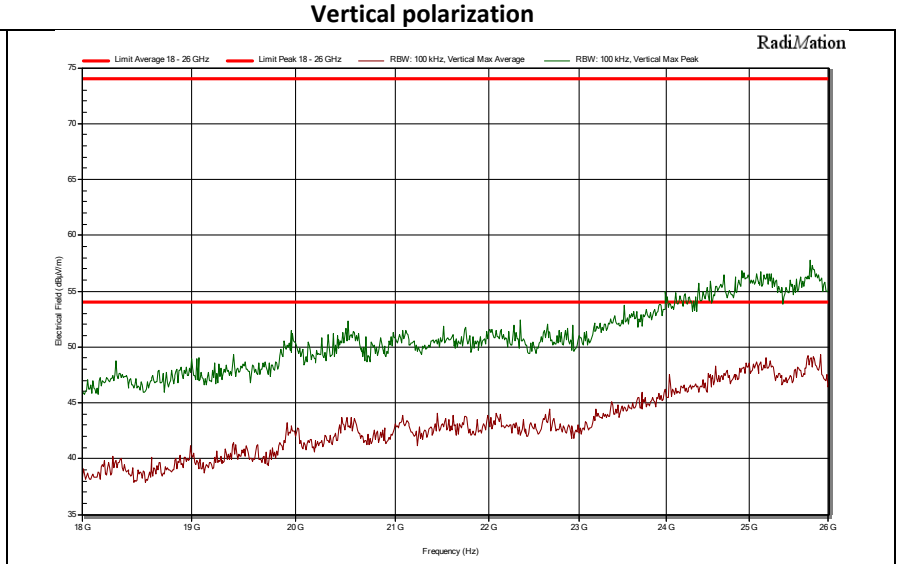
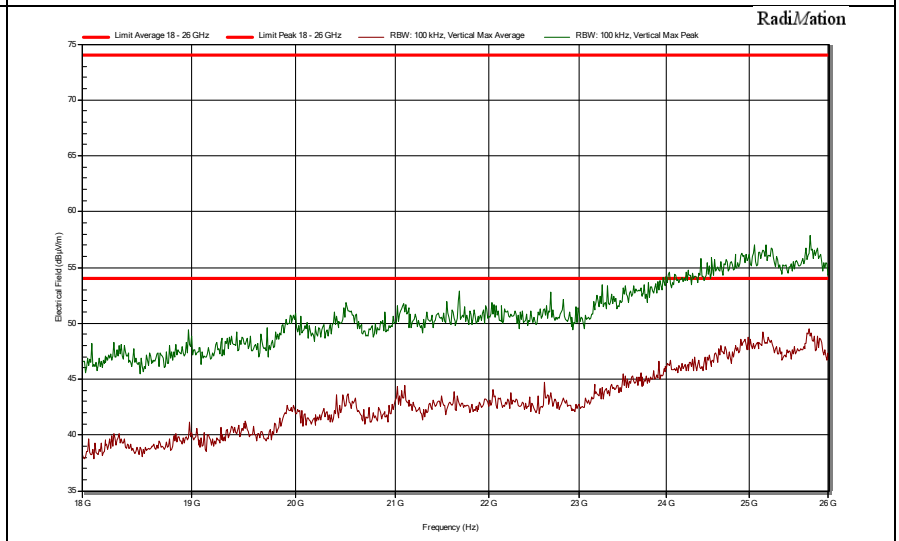
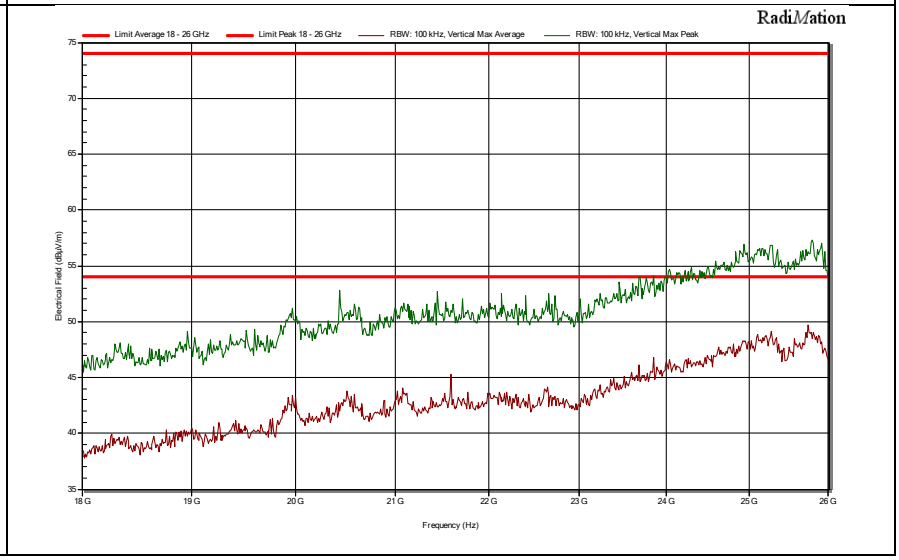
11b	
11g	
11n	

Horizontal polarization

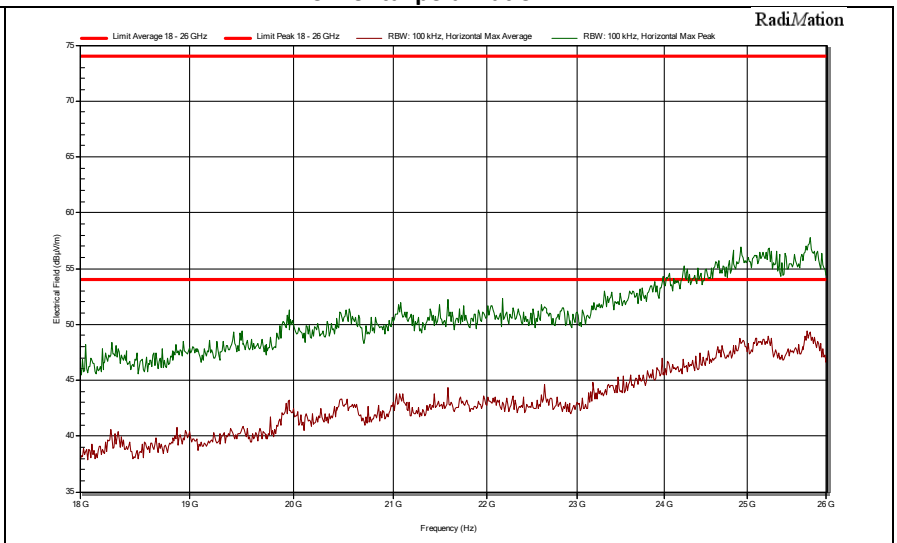
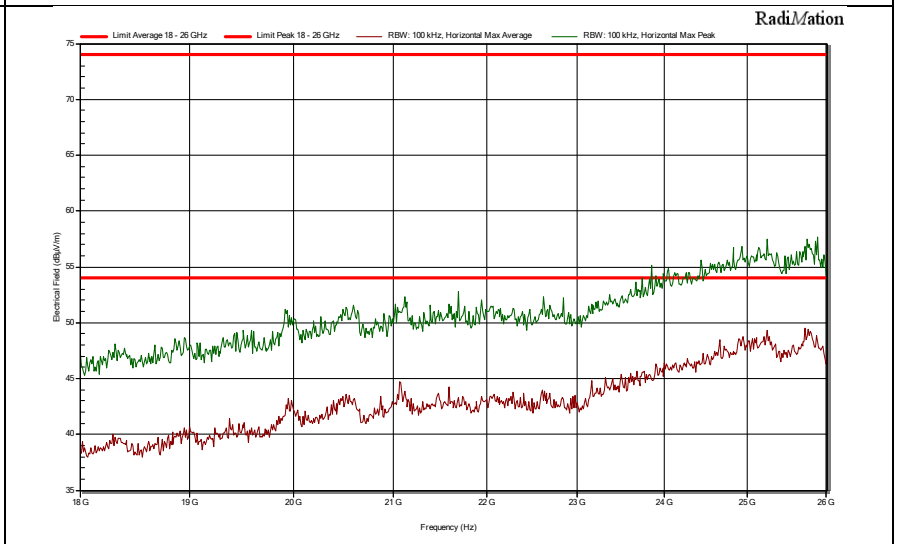
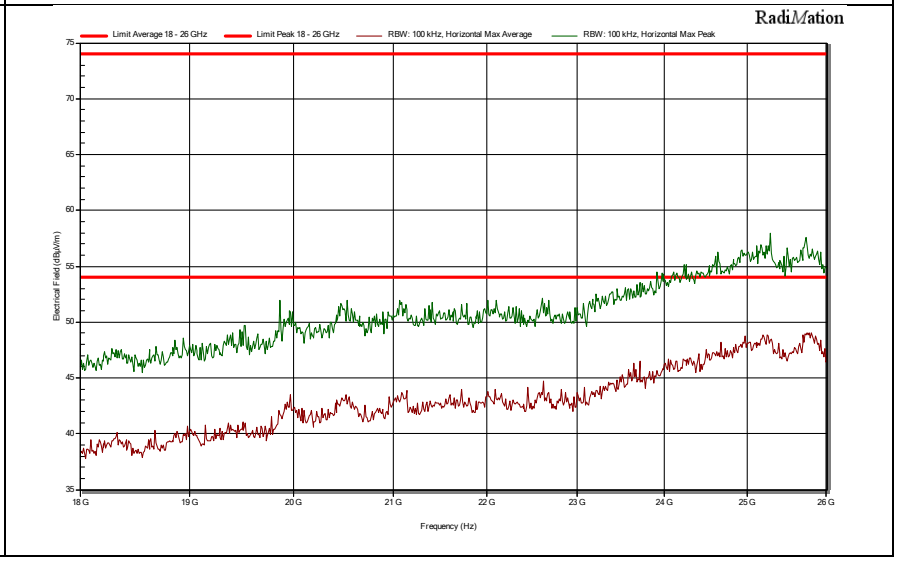
11b	
11g	
11n	

18 – 26.5 GHz

Vertical polarization

11b	
11g	
11n	

Horizontal polarization

11b	
11g	
11n	

3.2 Conducted emissions

3.2.1 Limit

According to 15.207 (c) and 15.107.

an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	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.

3.2.2 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

According to ANSI C63.4: 2014, section 13.3.
IRN 029 – Method 1.

3.2.5 Test results and plots of the AC mains conducted measurement

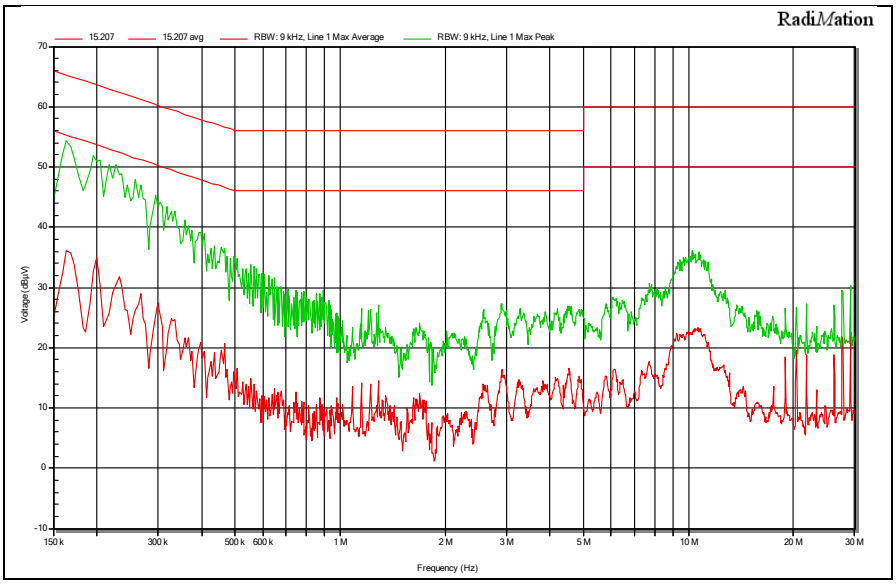
See next page.

3.2.6 Measurement uncertainty

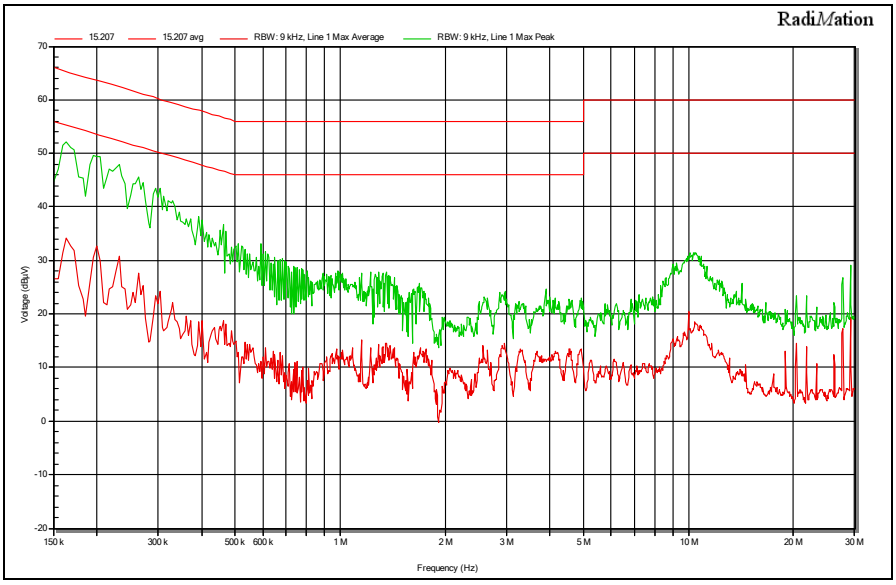
+/- 3.6 dB.

3.2.7 Plots of the AC mains conducted spurious measurement

Phase



Neutral



3.3 99% Occupied Bandwidth

3.3.1 Limit

According to RSS-Gen 6.7

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

IRN 017 - Occupied bandwidth (Hz) Method 1 – XX % power bandwidth.

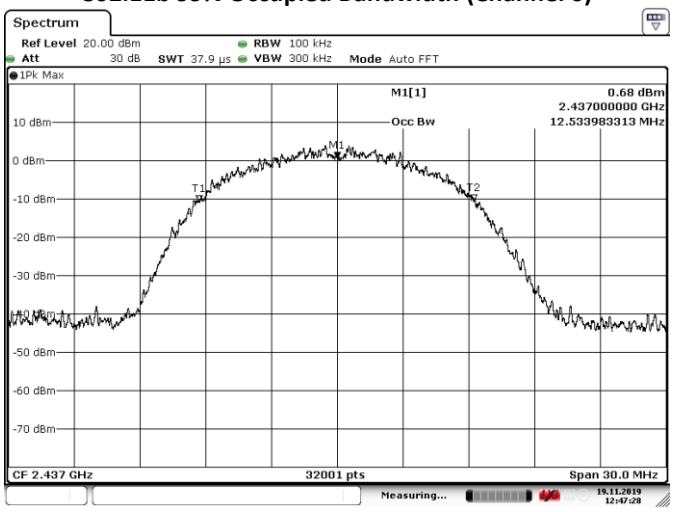
1. Set the centre frequency to the nominal EUT channel centre frequency
2. Set span = 1.5 times to 0.5 times the Occupied Bandwidth
3. Set VBW ≥ 3x RBW
4. Video averaging is not permitted. Where practical, detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until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

3.3.5 Test results of the 99% occupied bandwidth measurement

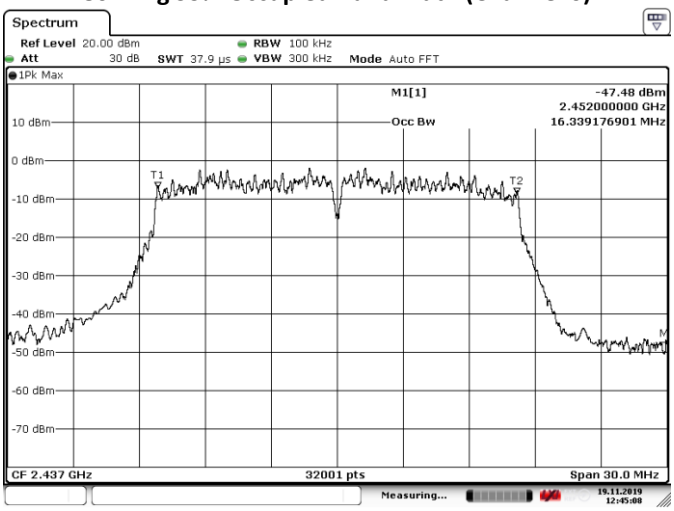
Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
IEEE 802.11b	6(Mid)	2437	11 Mbps	12.55
IEEE 802.11g	6(Mid)	2437	54 Mbps	16.34
IEEE 802.11n	6(Mid)	2437	MCS7	17.49
Uncertainty	±39 kHz			

3.3.6 Plots of the 99% Occupied Bandwidth Measurement

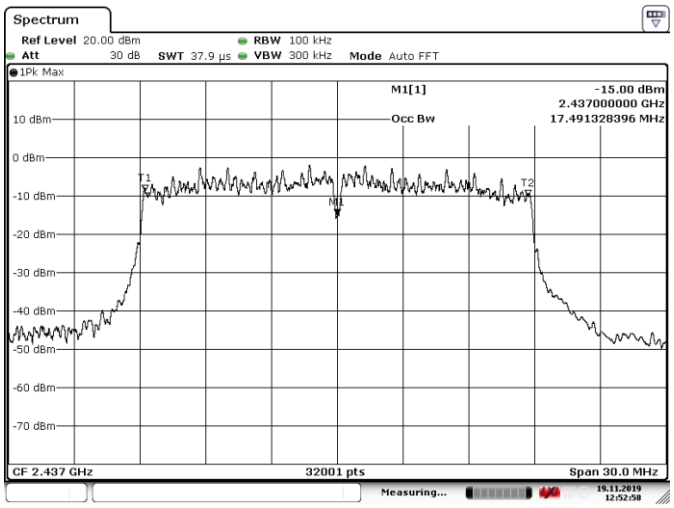
802.11b 99% Occupied Bandwidth (Channel 6)



802.11g 99% Occupied Bandwidth (Channel 6)



802.11n 99% Occupied Bandwidth (Channel 6)



4 Test report 160200396 300

4.1 6dB bandwidth Measurement

4.1.1 Limit

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

4.1.2 Measurement instruments

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

4.1.3 Test setup

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

4.1.4 Test procedure

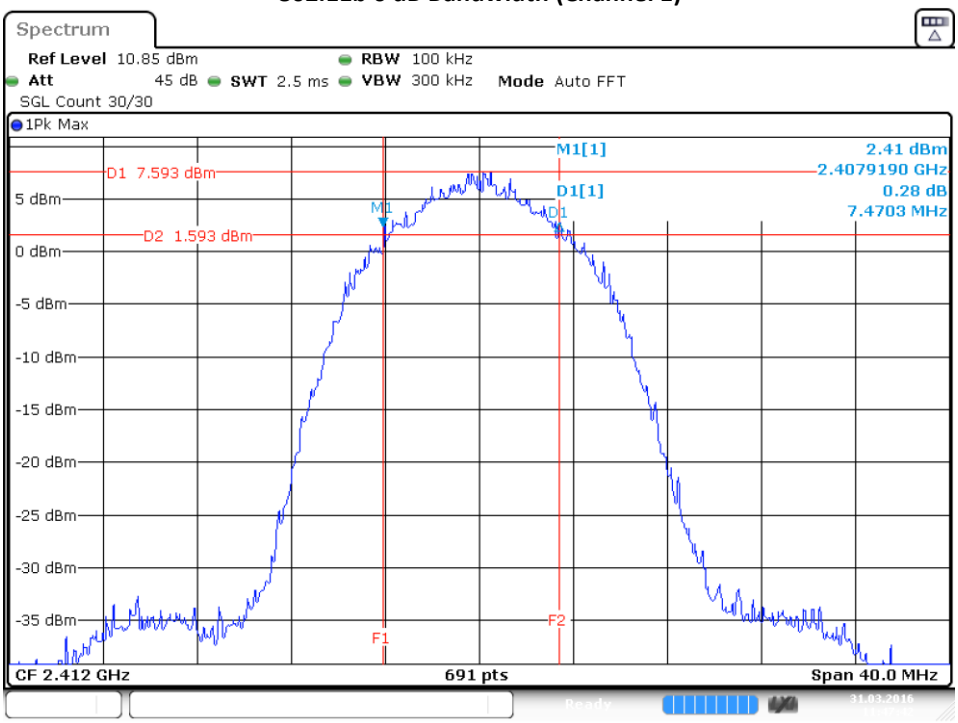
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.

4.1.5 Test Results of the 6 dB bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	6dB bandwidth (kHz)
IEEE 802.11b	1(Low)	2412	11 Mbps	7470.33
	6(Mid)	2437	11 Mbps	6943.56
	11 (High)	2462	11 Mbps	7458.76
IEEE 802.11g	1(Low)	2412	54 Mbps	16274.96
	6(Mid)	2437	54 Mbps	15759.77
	11 (High)	2462	54 Mbps	16049.20
Uncertainty	±707 kHz			

4.1.6 Plots of the 6 dB bandwidth Measurement

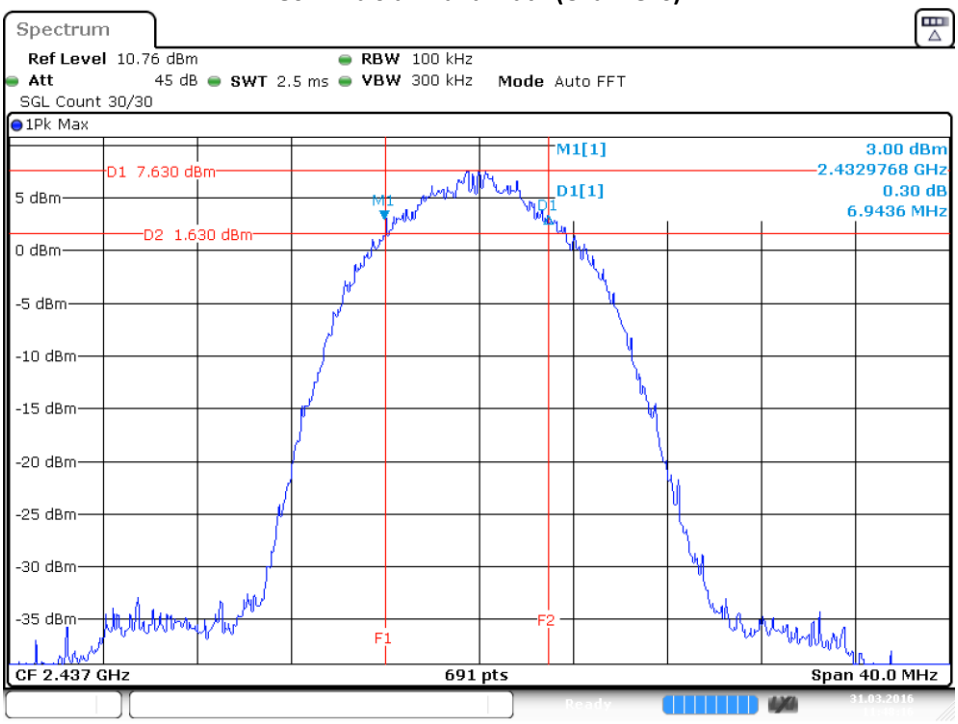
802.11b 6 dB Bandwidth (Channel 1)



IEEE802_11b_QBPSK_11M, channel: 1 : 6dB BW measurement

Date: 31.MAR.2016 11:47:42

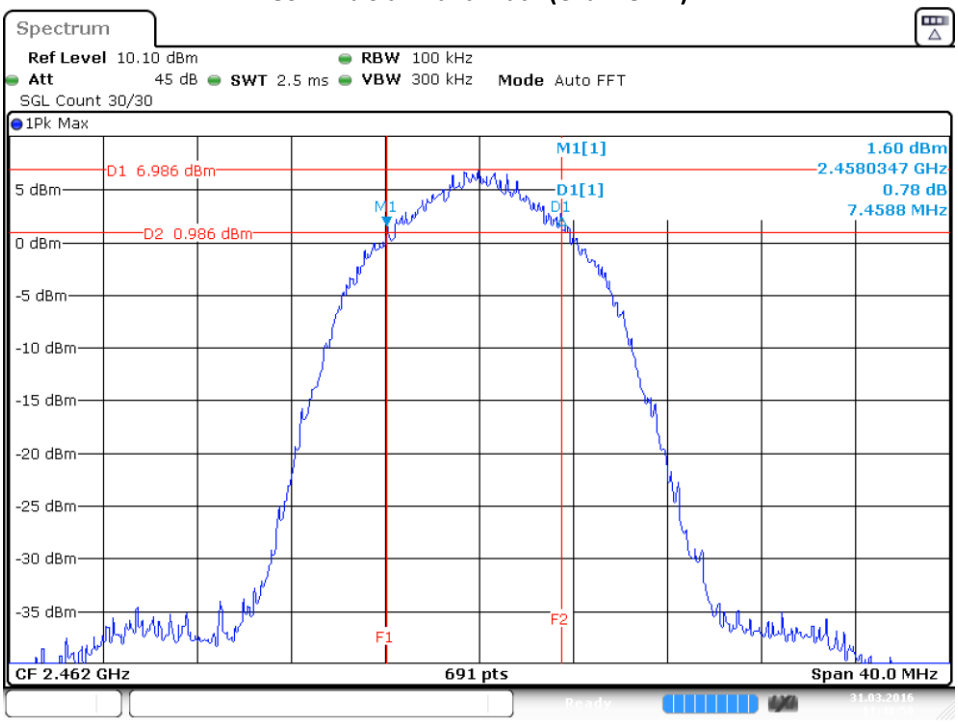
802.11b 6 dB Bandwidth (Channel 6)



IEEE802_11b_QBPSK_11M, channel: 6 : 6dB BW measurement

Date: 31.MAR.2016 11:48:17

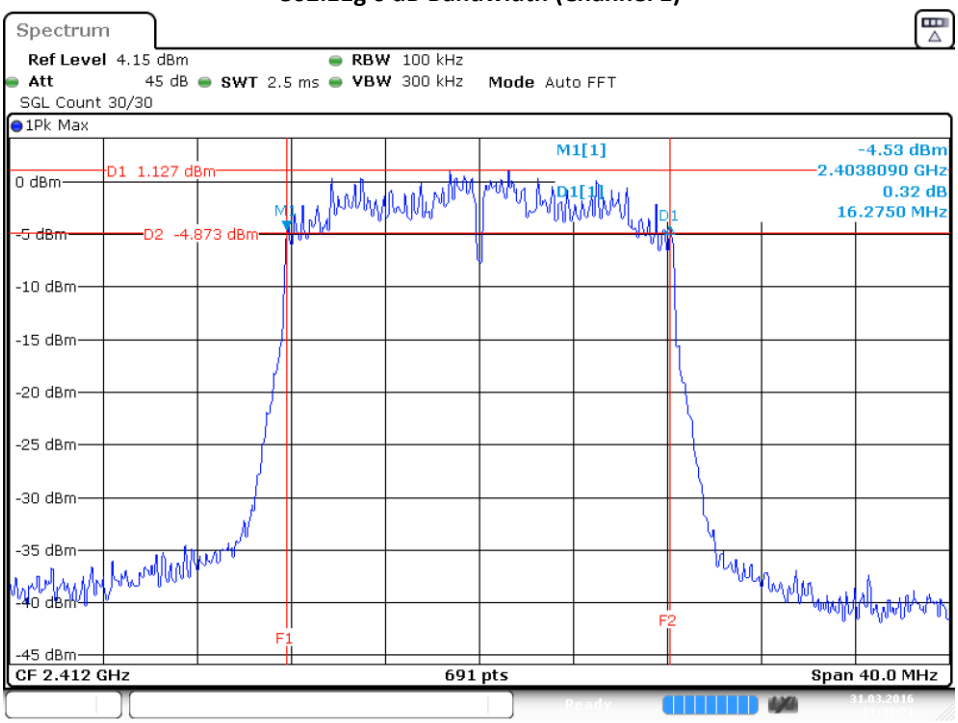
802.11b 6 dB Bandwidth (Channel 11)



IEEE802_11b_QBPSK_11M, channel: 11 : 6dB BW measurement

Date: 31.MAR.2016 11:48:50

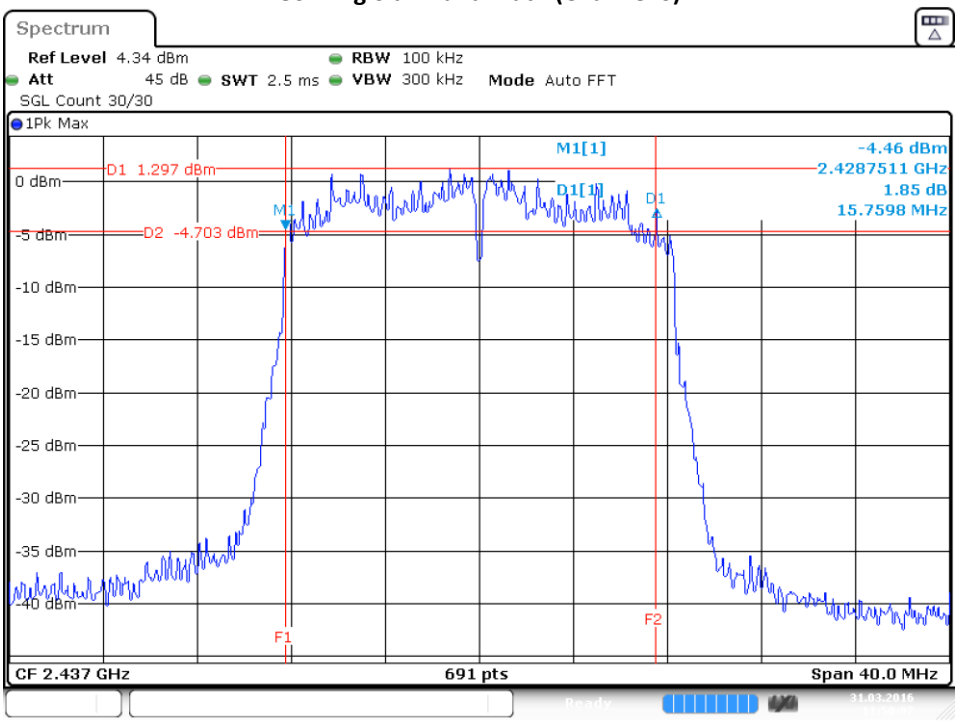
802.11g 6 dB Bandwidth (Channel 1)



IEEE802_11g_OFDM_54M, channel: 1 : 6dB BW measurement

Date: 31.MAR.2016 11:49:21

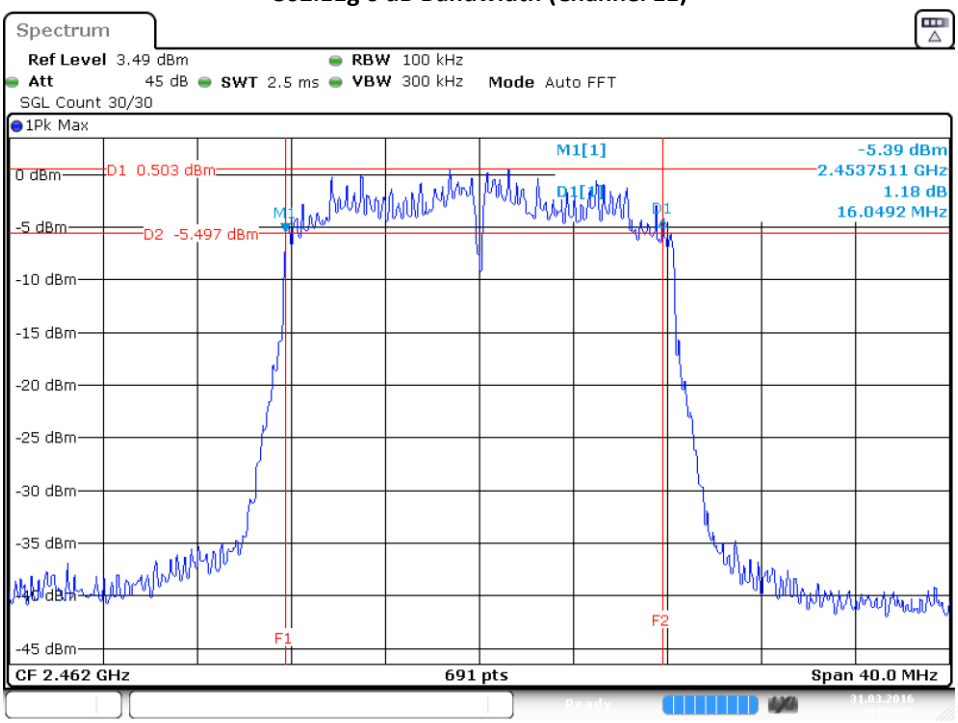
802.11g 6 dB Bandwidth (Channel 6)



IEEE802_11g_OFDM_54M, channel: 6 : 6dB BW measurement

Date: 31.MAR.2016 11:50:07

802.11g 6 dB Bandwidth (Channel 11)



IEEE802_11g_OFDM_54M, channel: 11 : 6dB BW measurement

Date: 31.MAR.2016 11:50:50

4.2 99% Occupied Bandwidth

4.2.1 Limit

According to RSS-Gen 4.6.1.

4.2.2 Measurement instruments

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

4.2.3 Test setup

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

4.2.4 Test procedure

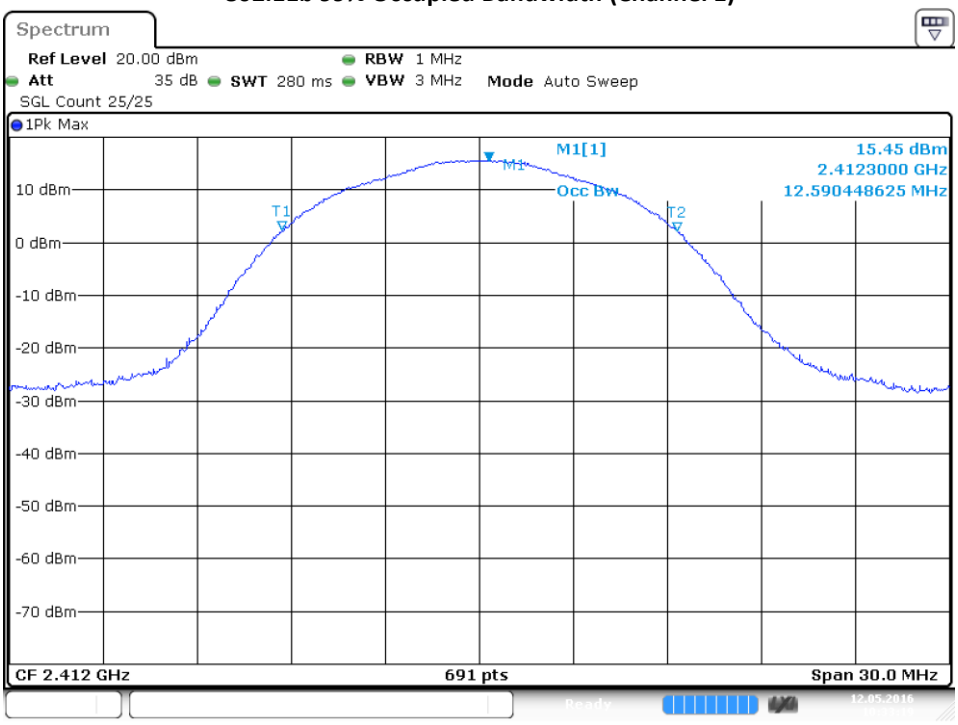
1 Set the centre frequency to the nominal EUT channel centre frequency.
2 Set span = 1.5 times to 0.5 times the Occupied Bandwidth.
3 Set VBW ≥ 3 x RBW.
4 Video averaging is not permitted. Where practical detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode(until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

4.2.5 Test results of the 99% Occupied Bandwidth Measurement

Technology Std.	Channel	Frequency (MHz)	Data rate	99% bandwidth (MHz)
IEEE 802.11b	1(Low)	2412	11 Mbps	12.590
	6(Mid)	2437	11 Mbps	12.590
	11 (High)	2462	11 Mbps	12.590
IEEE 802.11g	1(Low)	2412	54 Mbps	17.106
	6(Mid)	2437	54 Mbps	17.149
	11 (High)	2462	54 Mbps	17.106
Uncertainty	±707 kHz			

4.2.6 Plots of the 99% Occupied Bandwidth Measurement

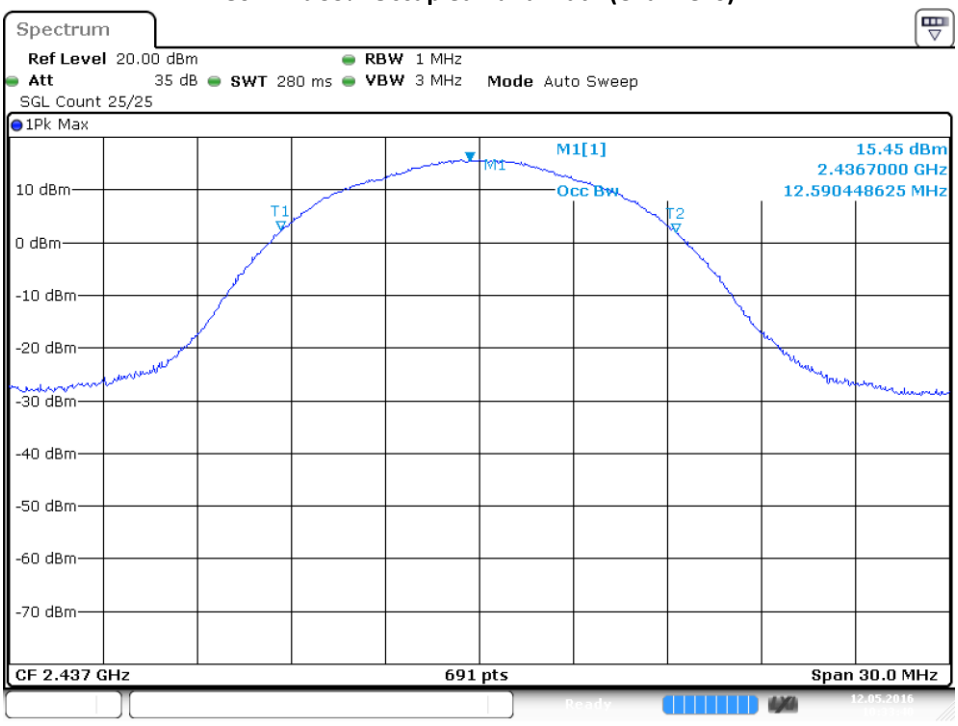
802.11b 99% Occupied Bandwidth (Channel 1)



IEEE802_11 Channel: 1 : Measure Occupied Bandwidth

Date: 12.MAY.2016 10:33:20

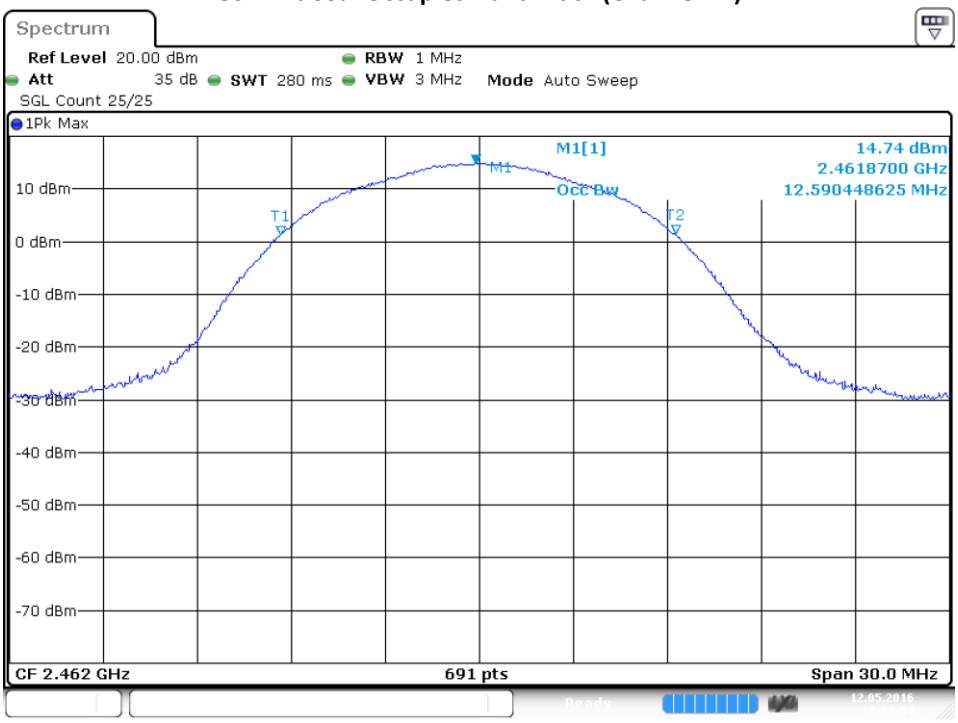
802.11b 99% Occupied Bandwidth (Channel 6)



IEEE802_11 Channel: 6 : Measure Occupied Bandwidth

Date: 12.MAY.2016 10:33:40

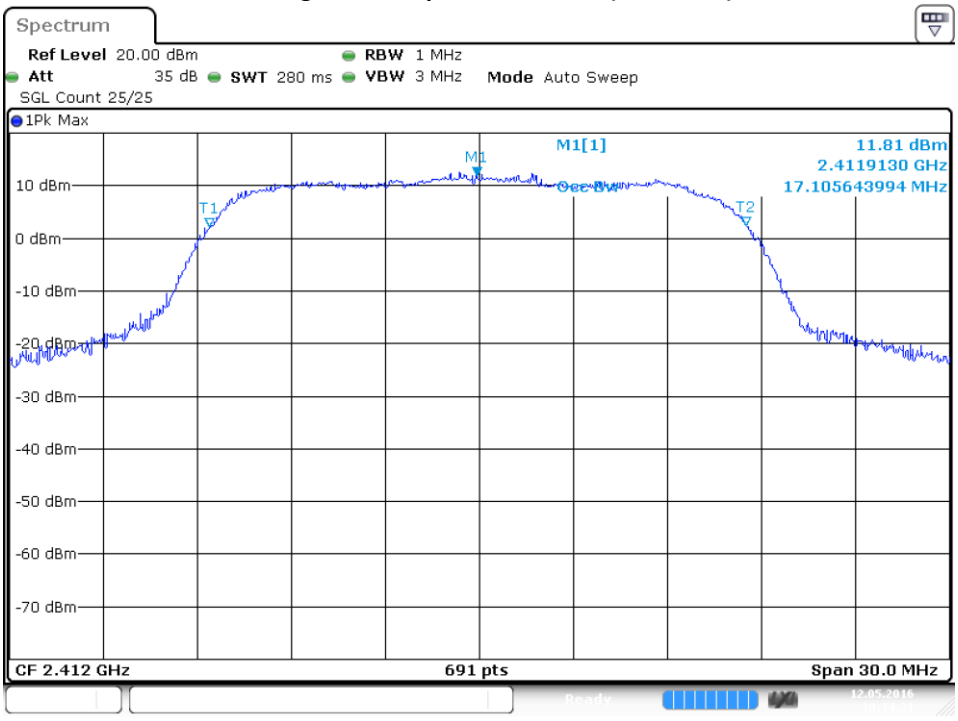
802.11b 99% Occupied Bandwidth (Channel 11)



IEEE802_11 Channel: 11 : Measure Occupied Bandwidth

Date: 12.MAY.2016 10:34:04

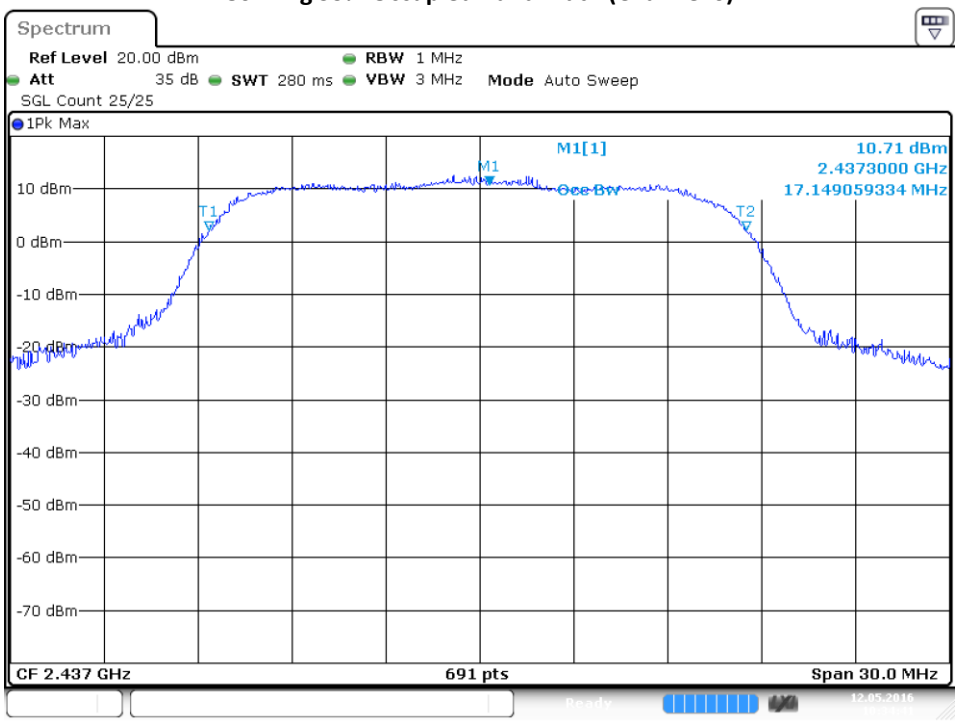
802.11g 99% Occupied Bandwidth (Channel 1)



IEEE802_11 Channel: 1 : Measure Occupied Bandwidth

Date: 12.MAY.2016 10:34:22

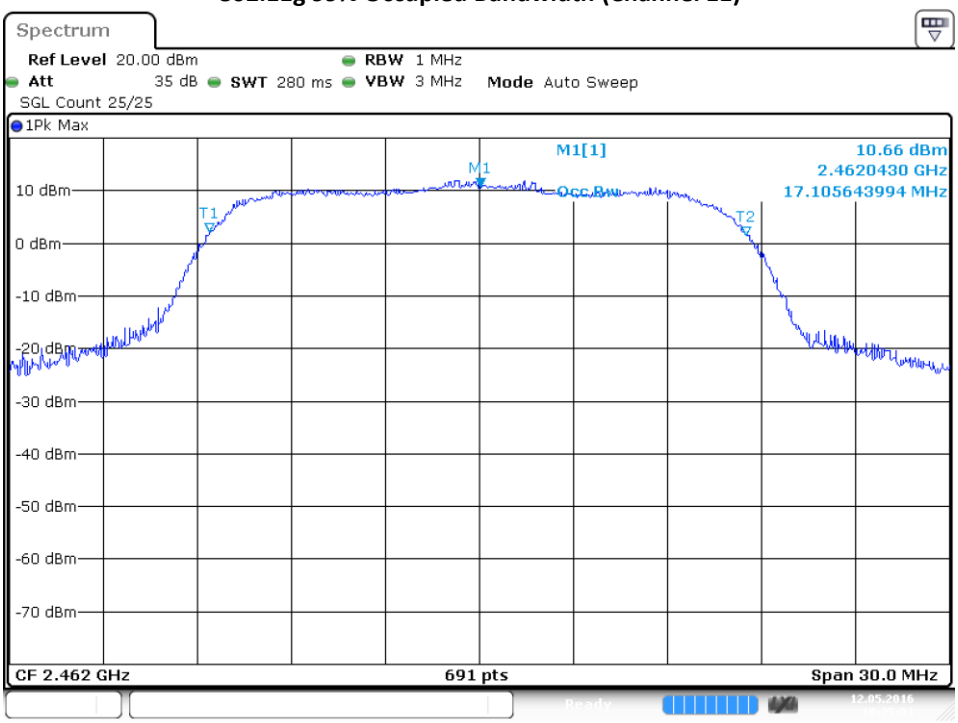
802.11g 99% Occupied Bandwidth (Channel 6)



IEEE802_11 Channel: 6 : Measure Occupied Bandwidth

Date: 12.MAY.2016 10:34:40

802.11g 99% Occupied Bandwidth (Channel 11)



IEEE802_11 Channel: 11 : Measure Occupied Bandwidth

Date: 12.MAY.2016 10:35:03

4.3 Output Power Measurement

4.3.1 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.

4.3.2 Measurement instruments

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

4.3.3 Test setup

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

4.3.4 Test procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.

4.3.5 Test results of Output Power Measurement

Duty cycle

Technology Std.	Channel	Frequency (MHz)	Data rate	Duty cycle (%)
IEEE 802.11b	1(Low)	2412	11 Mbps	98.70
	6(Mid)	2437	11 Mbps	98.70
	11 (High)	2462	11 Mbps	100
IEEE 802.11g	1(Low)	2412	54 Mbps	85.19
	6(Mid)	2437	54 Mbps	85.19
	11 (High)	2462	54 Mbps	85.19

Peak method

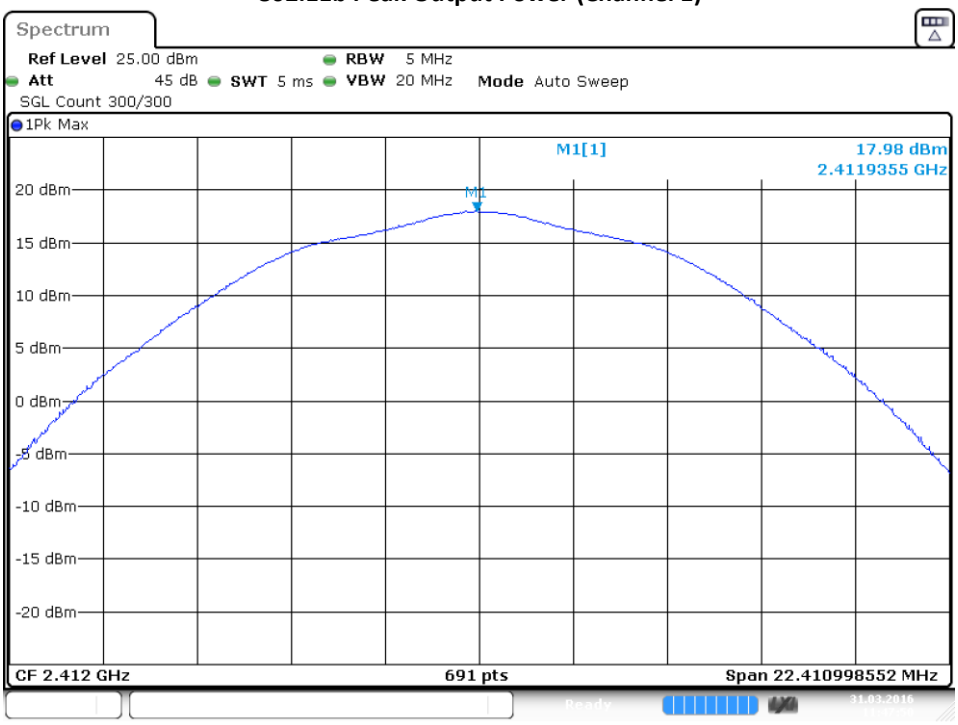
Technology Std.	Channel	Frequency (MHz)	Data rate	Peak output power (dBm)
IEEE 802.11b	1(Low)	2412	11 Mbps	17.98
	6(Mid)	2437	11 Mbps	17.95
	11 (High)	2462	11 Mbps	17.12
Uncertainty	±0.63 dB			

Average method

Technology Std.	Channel	Frequency (MHz)	Data rate	Average output power (dBm)
IEEE 802.11g	1(Low)	2412	54 Mbps	2.33
	6(Mid)	2437	54 Mbps	2.34
	11 (High)	2462	54 Mbps	1.99
Uncertainty	±0.63 dB			

4.3.6 Plots of Output Power Measurement

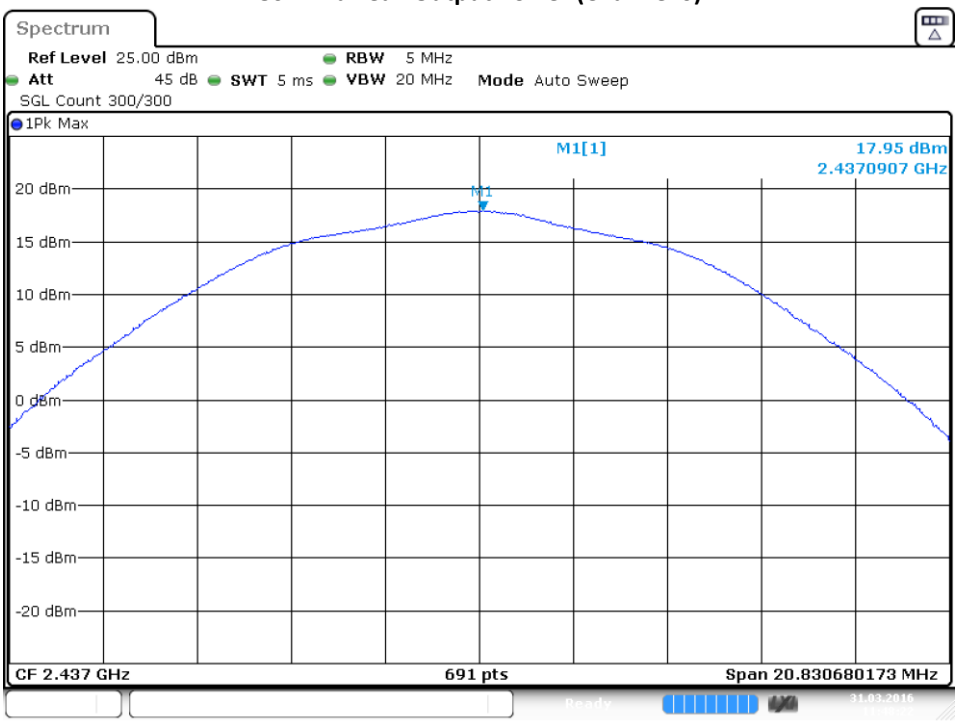
802.11b Peak Output Power (Channel 1)



IEEE802_11b_QBPSK_11M, channel: 1 : Maximum Peak conducted output power

Date: 31.MAR.2016 11:47:51

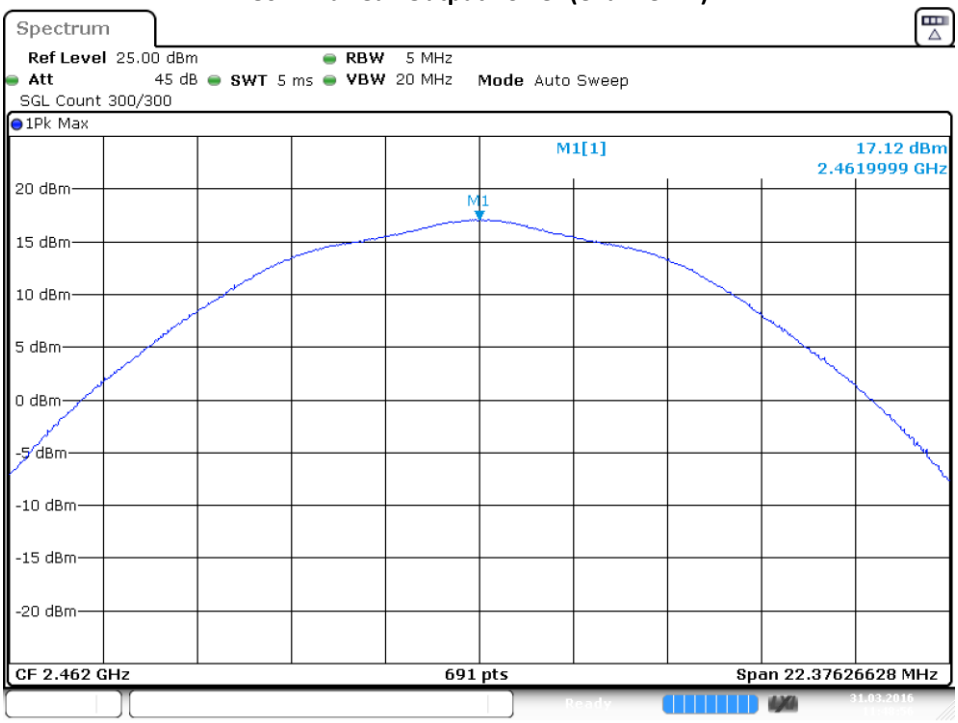
802.11b Peak Output Power (Channel 6)



IEEE802_11b_QBPSK_11M, channel: 6 : Maximum Peak conducted output power

Date: 31.MAR.2016 11:48:23

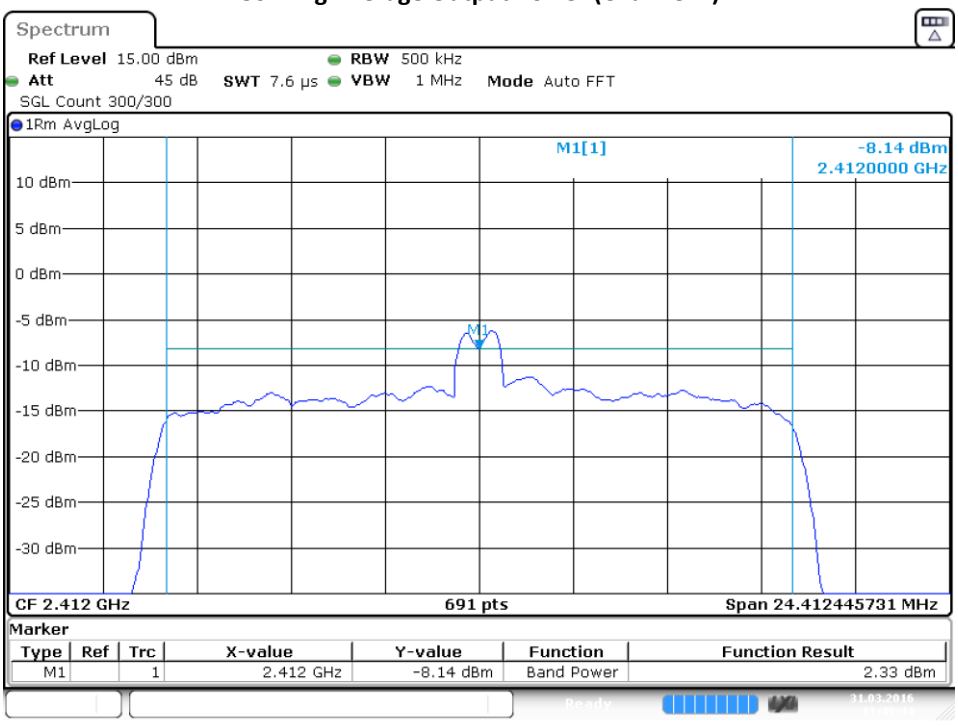
802.11b Peak Output Power (Channel 11)



IEEE802_11b_QBPSK_11M, channel: 11 : Maximum Peak conducted output power

Date: 31.MAR.2016 11:48:56

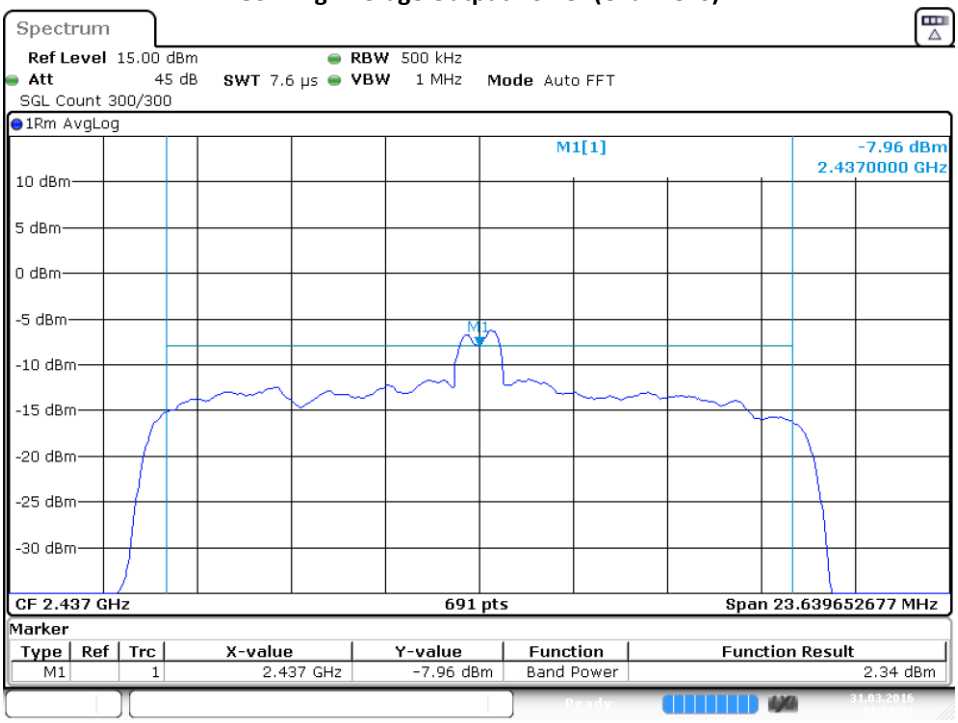
802.11g Average Output Power (Channel 1)



IEEE802_11g_OFDM_54M, channel: 1 : Maximum Peak conducted output power

Date: 31.MAR.2016 11:49:44

802.11g Average Output Power (Channel 6)

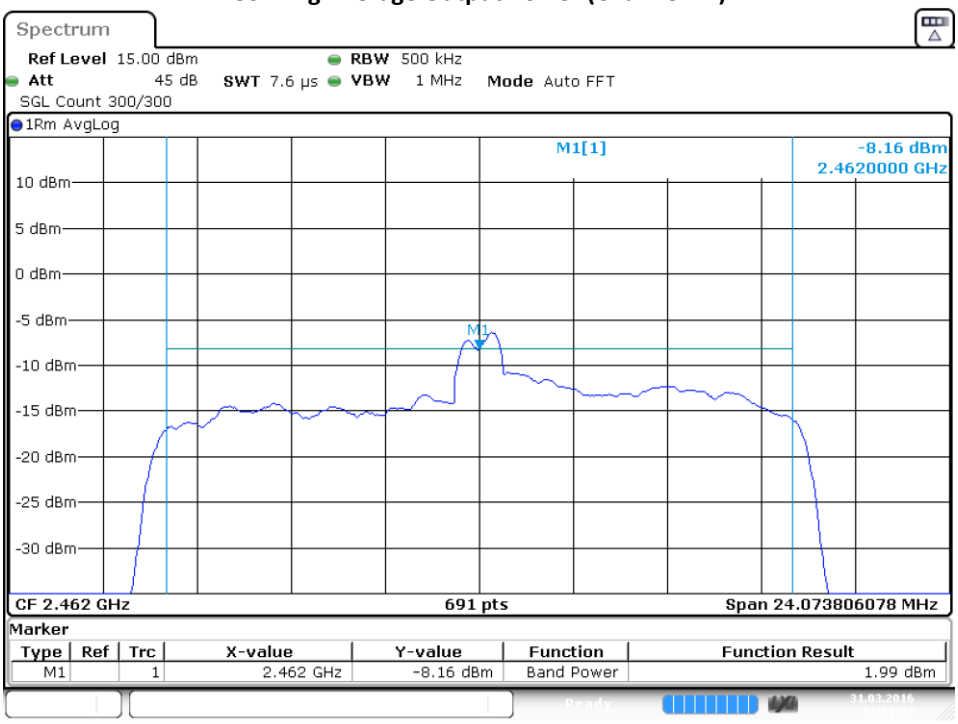


IEEE802_11g_OFDM_54M, channel: 6 : Maximum Peak conducted ou

tput power

Date: 31.MAR.2016 11:50:21

802.11g Average Output Power (Channel 11)



IEEE802_11g_OFDM_54M, channel: 11 : Maximum Peak conducted o

utput power

Date: 31.MAR.2016 11:51:03

4.4 Power Spectral Density

4.4.1 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.

4.4.2 Measurement instruments

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

4.4.3 Test setup

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

4.4.4 Test procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The RF output of EUT was connected to the spectrum analyser by RF cable and attenuator.
3. The path loss was compensated to the results for each measurement. This path loss is stored within the transducer table of the Spectrum analyser.

4.4.5 Test results of Power Spectral Density Measurement

Peak Power spectral density

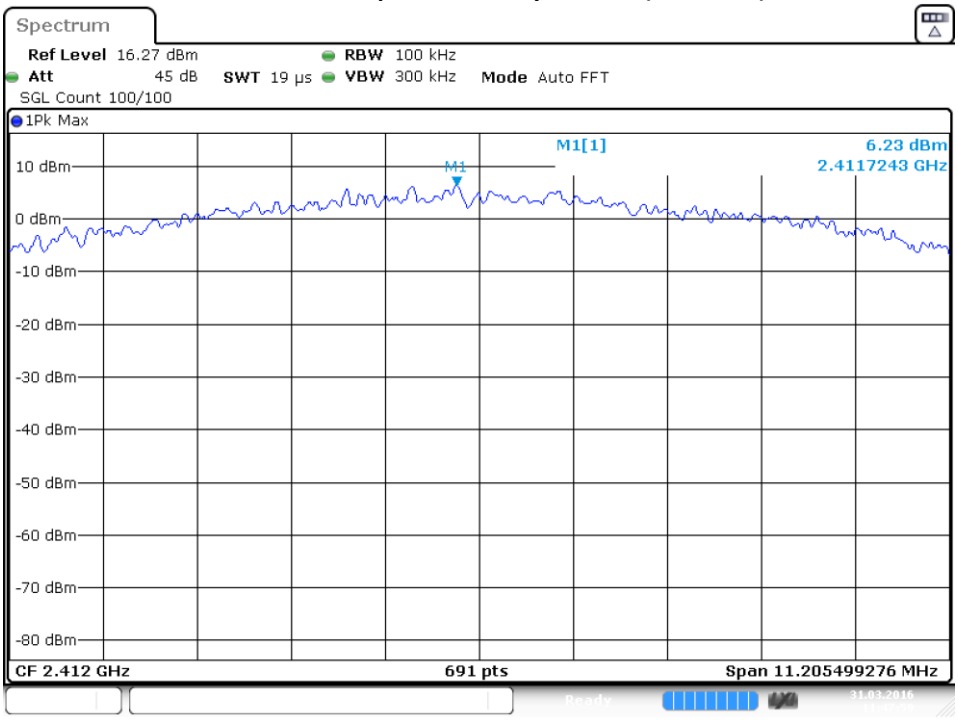
Technology Std.	Channel	Frequency (MHz)	Data rate	PSD/100 kHz (dBm)
IEEE 802.11b	1(Low)	2412	11 Mbps	6,23
	6(Mid)	2437	11 Mbps	6,47
	11 (High)	2462	11 Mbps	5,81
Uncertainty	±0.63 dB			

Average Power spectral density

Technology Std.	Channels	Frequency (MHz)	Data rate	PSD/100 kHz (dBm)
IEEE 802.11g	1(Low)	2412	54 Mbps	-11,09
	6(Mid)	2437	54 Mbps	-11,22
	11 (High)	2462	54 Mbps	-11,26
Uncertainty	±0.63 dB			

4.4.6 Plots of the Power Spectral Density Measurements

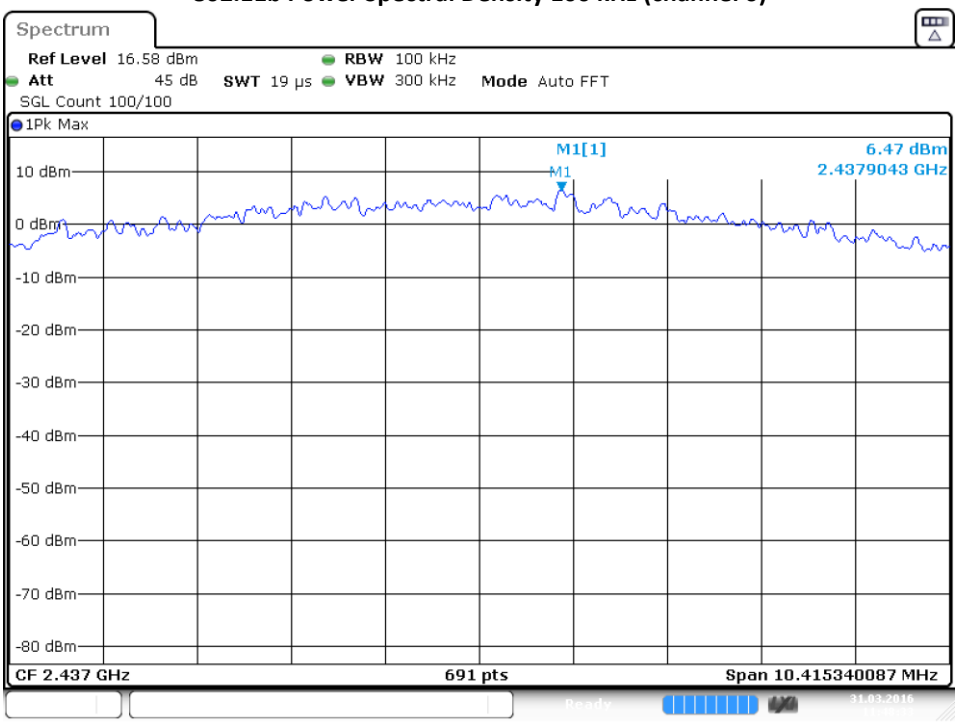
802.11b Power Spectral Density 100 kHz (channel 1)



IEEE802_11b_QBPSK_11M,1 : Power spectral density

Date: 31.MAR.2016 11:48:00

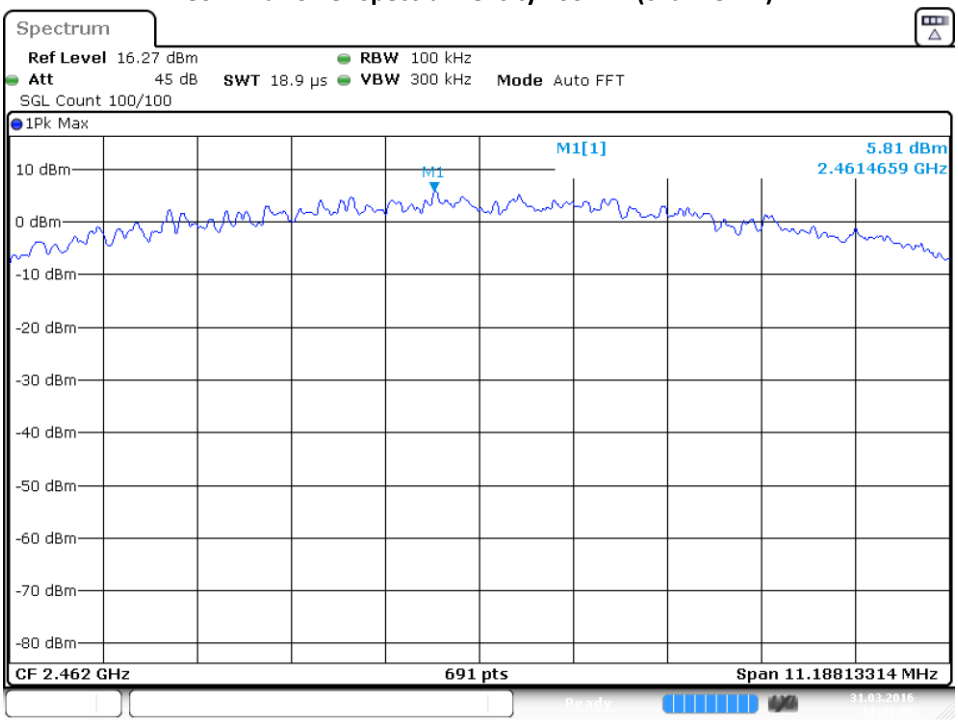
802.11b Power Spectral Density 100 kHz (channel 6)



IEEE802_11b_QBPSK_11M,6 : Power spectral density

Date: 31.MAR.2016 11:48:32

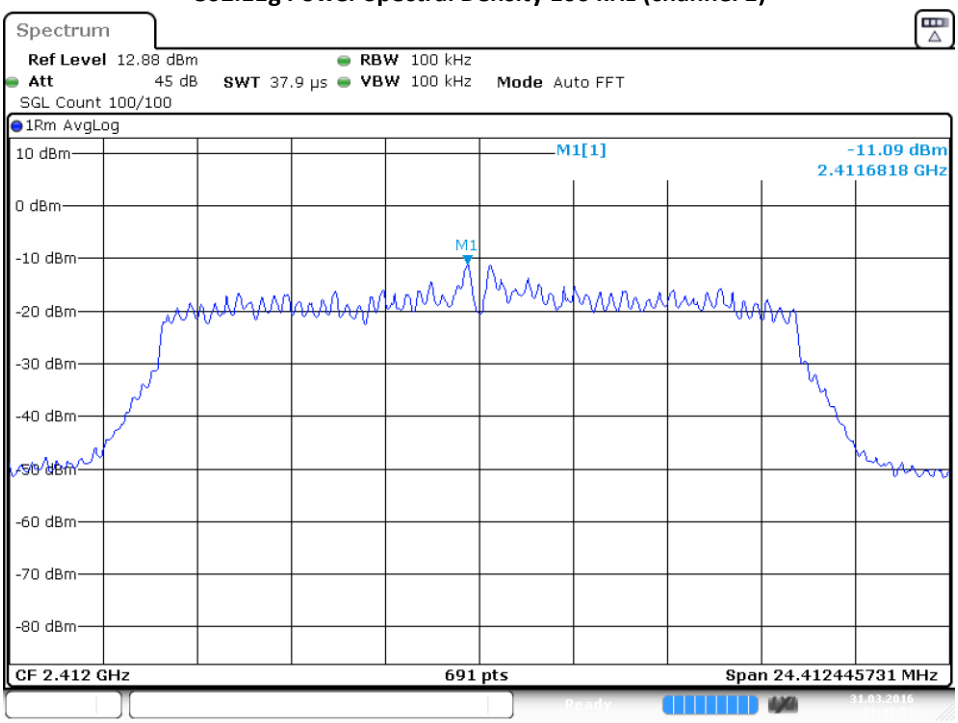
802.11b Power Spectral Density 100 kHz (channel 11)



IEEE802_11b_QBPSK_11M,11 : Power spectral density

Date: 31.MAR.2016 11:49:05

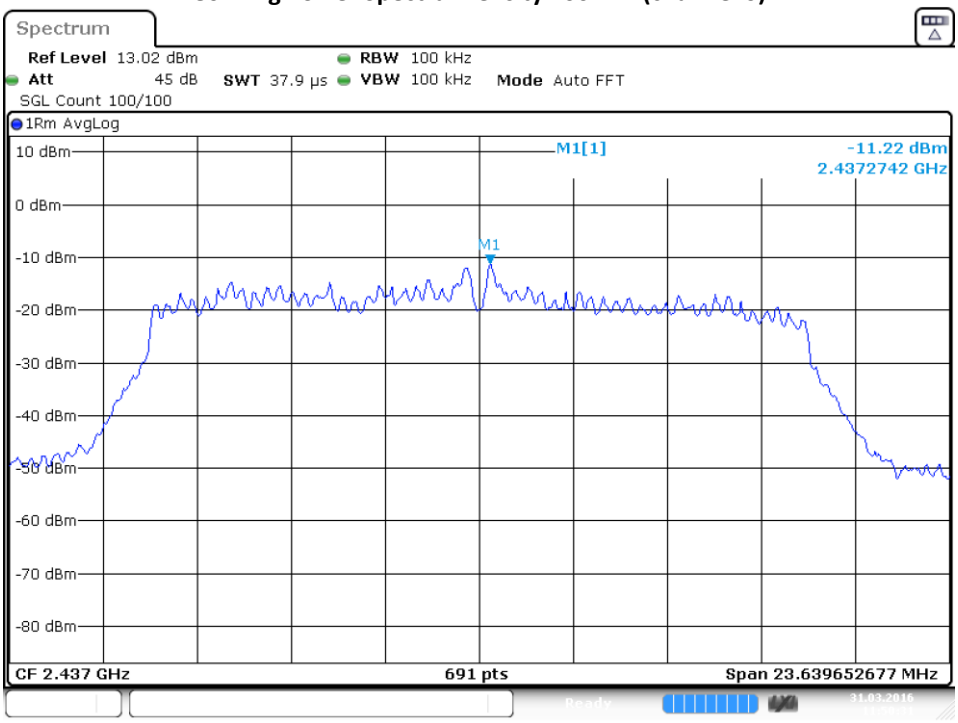
802.11g Power Spectral Density 100 kHz (channel 1)



IEEE802_11g_OFDM_54M, channel: 1 : Power spectral density

Date: 31.MAR.2016 11:49:53

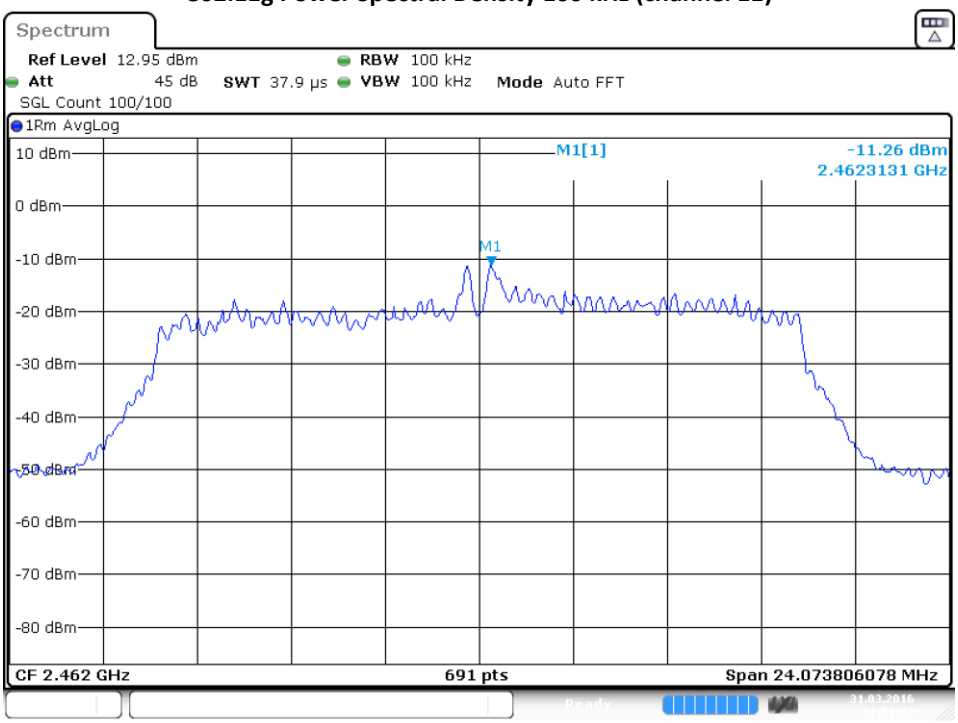
802.11g Power Spectral Density 100 kHz (channel 6)



IEEE802_11g_OFDM_54M, channel: 6 : Power spectral density

Date: 31.MAR.2016 11:50:31

802.11g Power Spectral Density 100 kHz (channel 11)



IEEE802_11g_OFDM_54M, channel: 11 : Power spectral density

Date: 31.MAR.2016 11:51:13

4.5 Conducted Band edge and Spurious Emissions Measurement

4.5.1 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.

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

4.5.2 Measurement instruments

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

4.5.3 Test setup

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

4.5.4 Test procedure

According to KDB Publication 558074 V03r05, sections 11.3 and 12.1

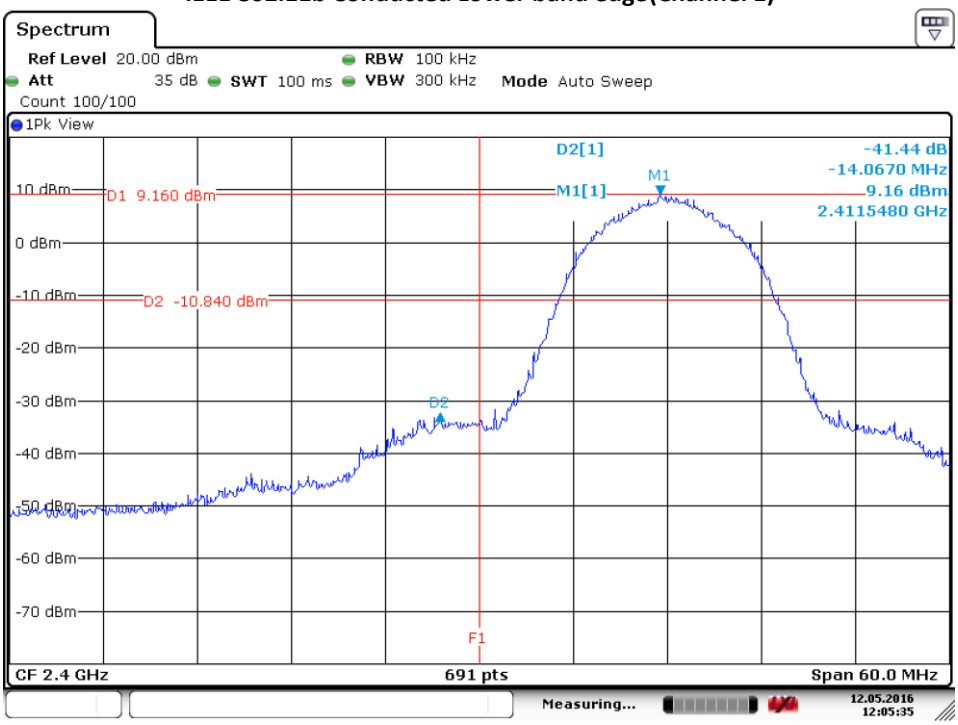
4.5.5 Test results of conducted Band Edge Measurements

Band edge

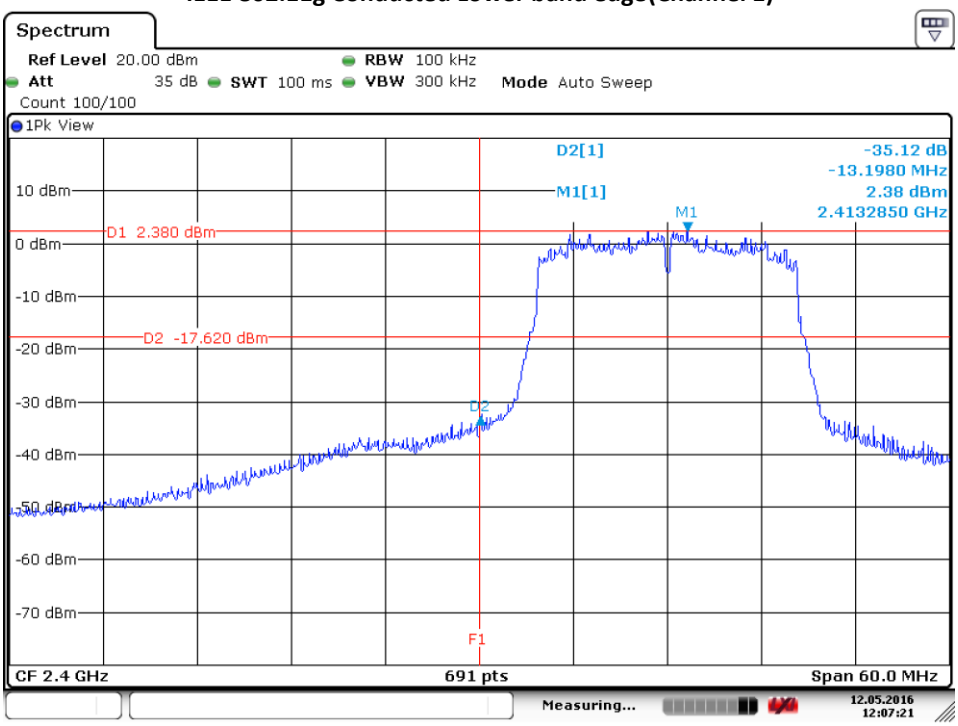
Technology Std.	Channels	Frequency (MHz)	Data rate	Band edge	Limit (dBm)
IEEE 802.11b	1(Low)	2412	11Mbps	-32.74	-10.84
IEEE 802.11g	1(Low)	2412	54 Mbps	-32.28	-17.62
Uncertainty	±0.63 dB				

4.5.6 Plots of the Conducted Spurious an Band edge Measurements

IEEE 802.11b Conducted Lower band edge(Channel 1)



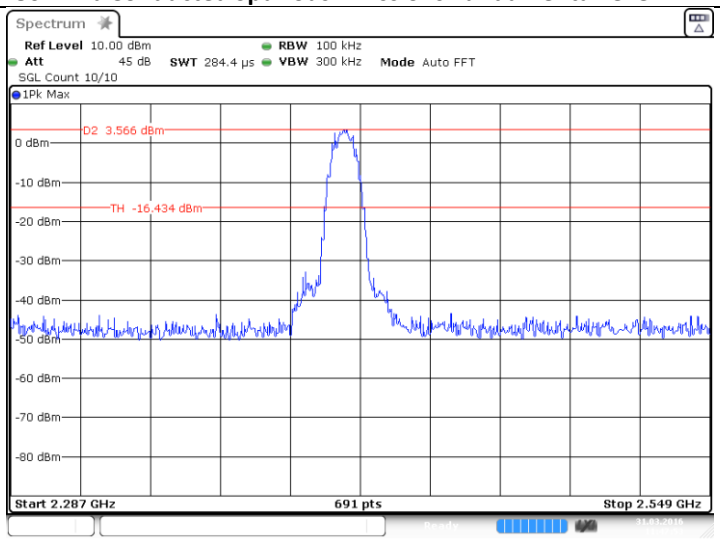
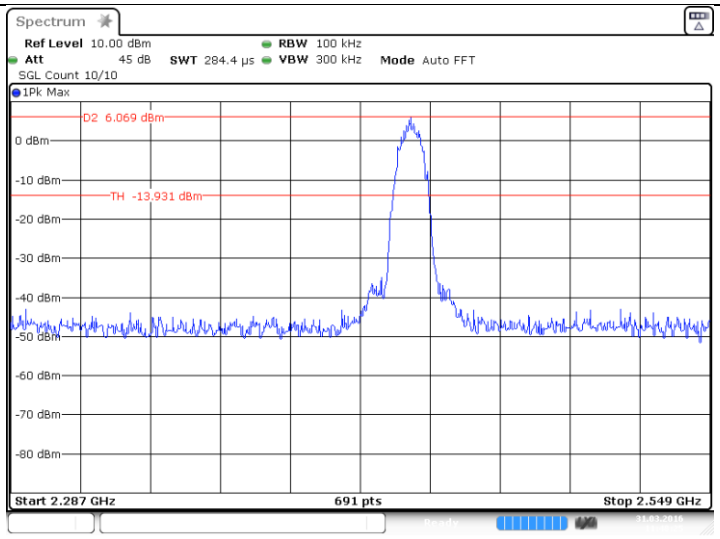
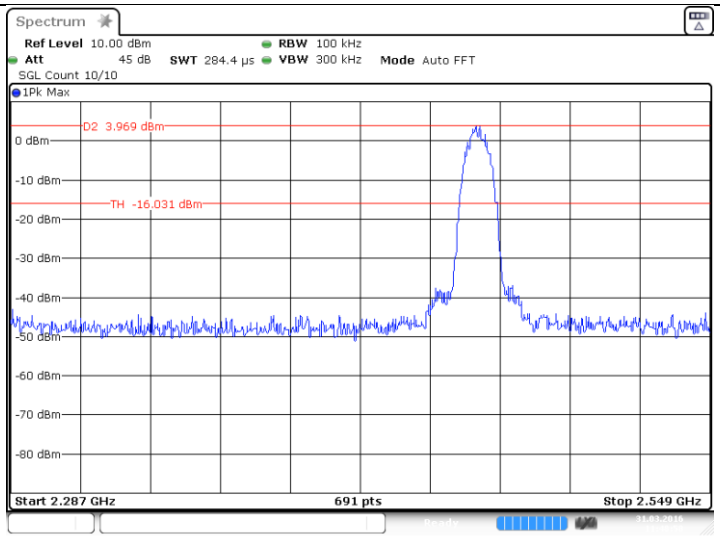
IEEE 802.11g Conducted Lower band edge(Channel 1)



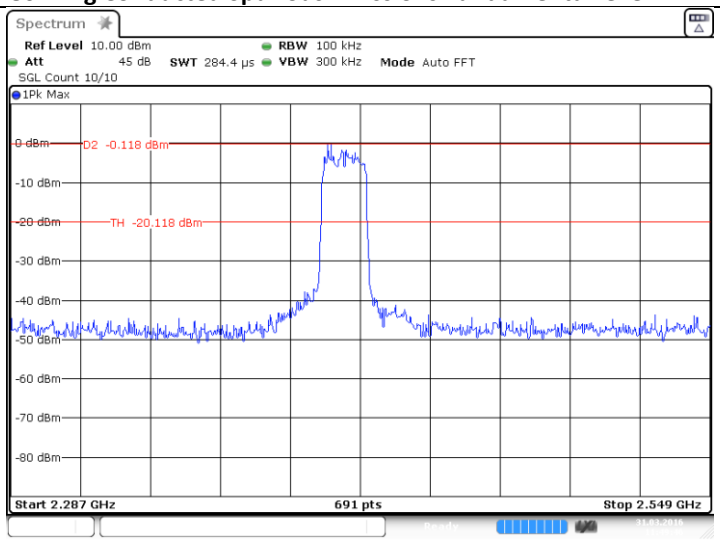
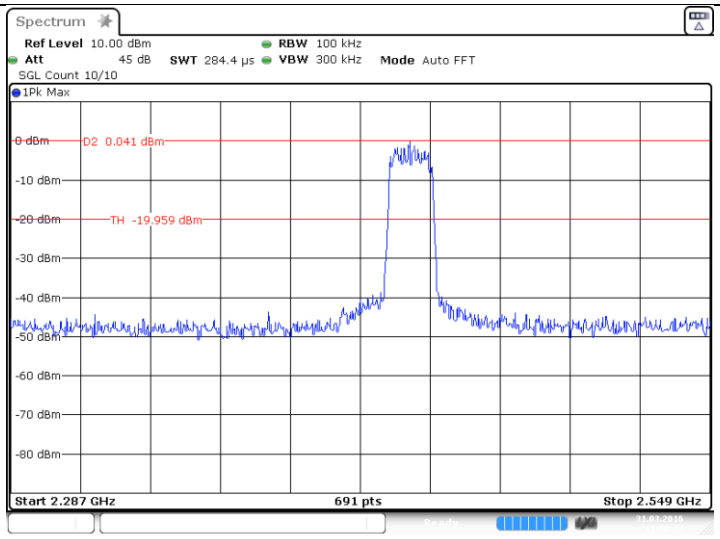
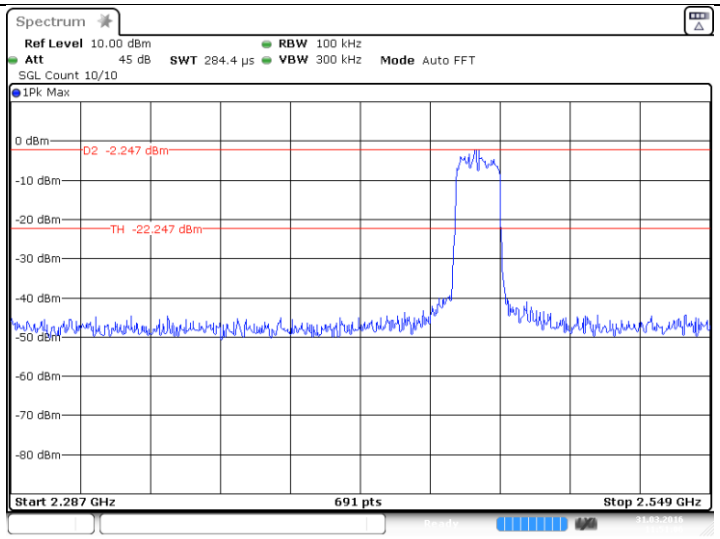
IEEE802_11 Channel: 11 : Measure Occupied Bandwidth
Date: 12.MAY.2016 12:07:21

As channel 11 is more than 20 MHz away from the band edge, no measurements were performed for channel 11

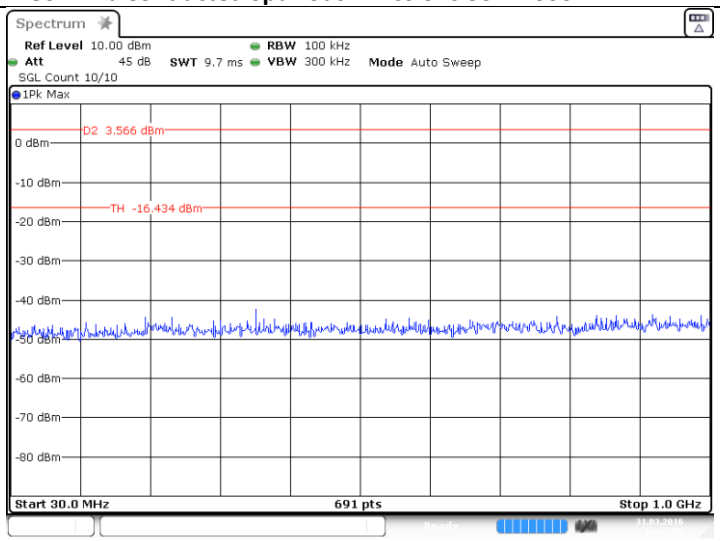
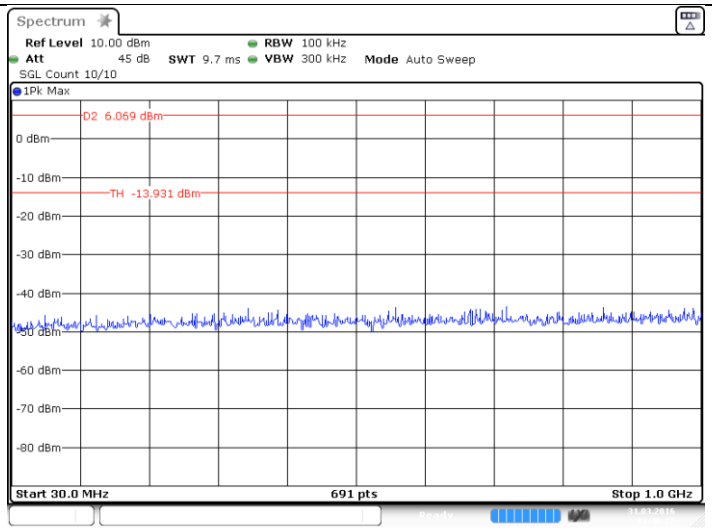
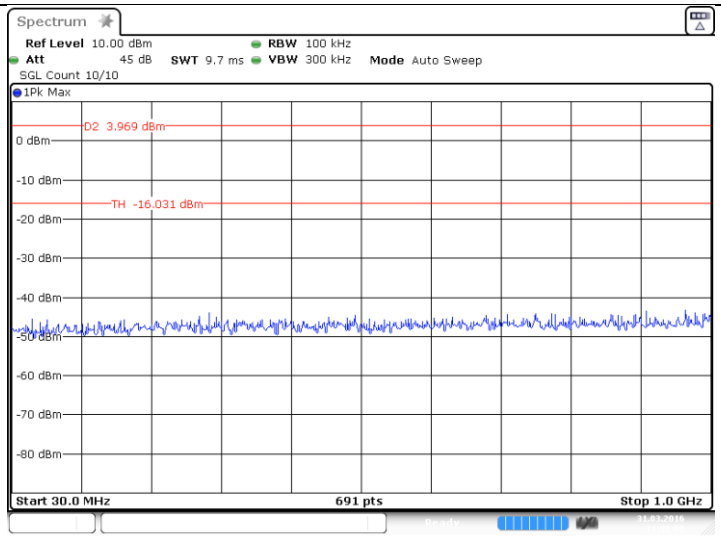
IEEE 802.11b Conducted Spurious Emissions Fundamental level

Ch. 1	
Ch. 6	
Ch. 11	

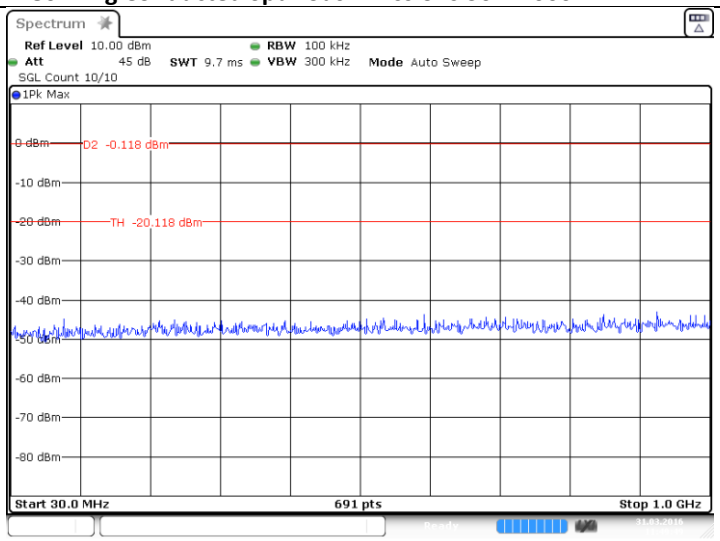
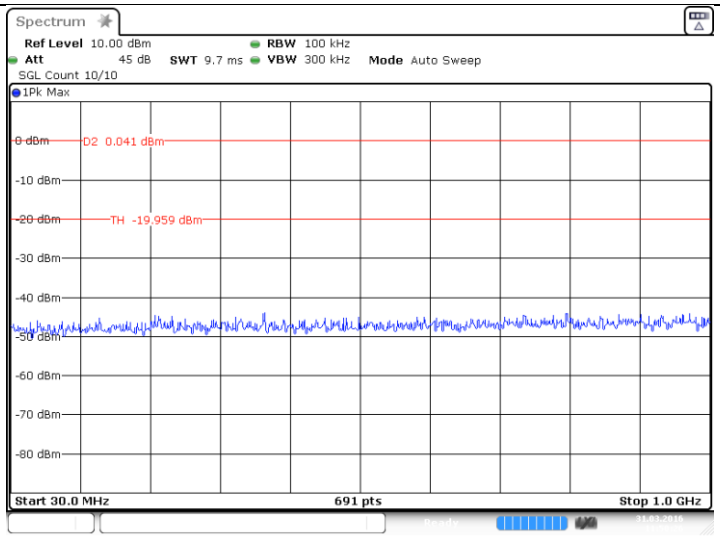
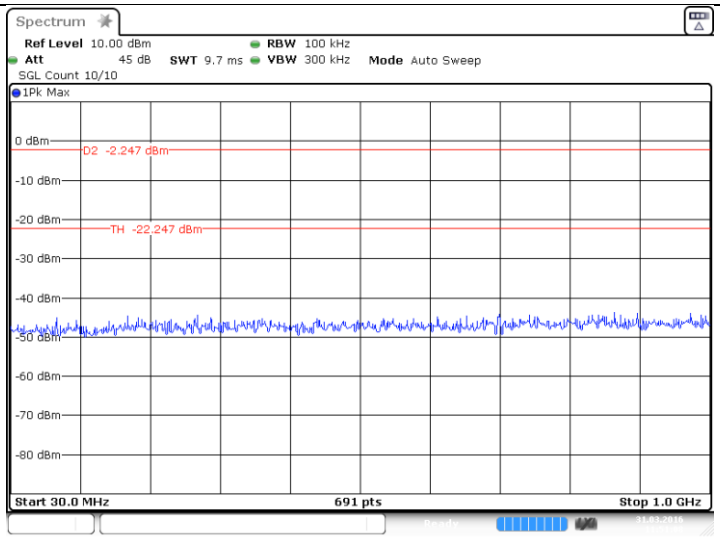
IEEE 802.11g Conducted Spurious Emissions Fundamental level

Ch. 1	
Ch. 6	
Ch. 11	

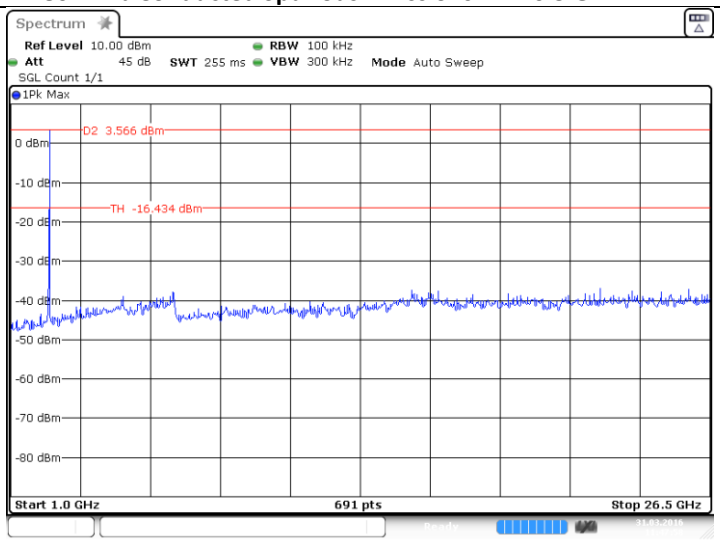
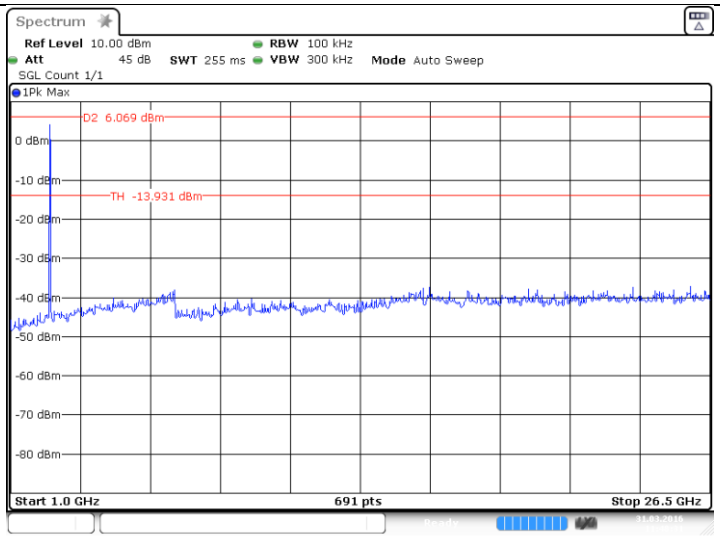
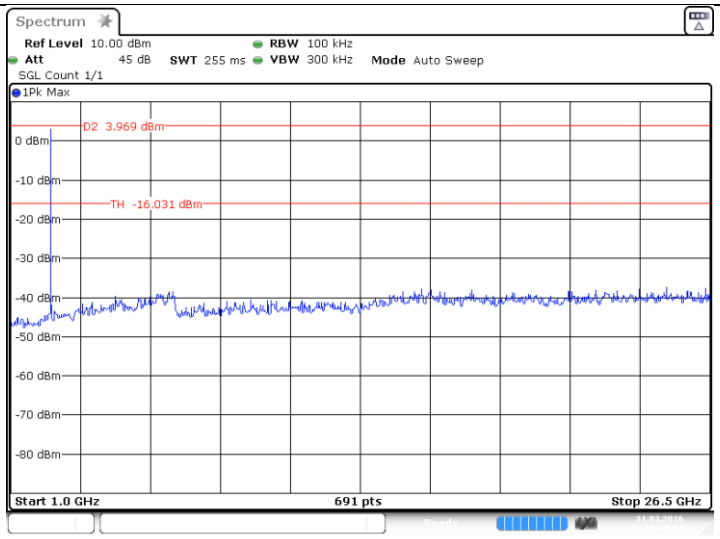
IEEE 802.11b Conducted Spurious Emissions 30 – 1000 MHz

Ch. 1	
Ch. 6	
Ch. 11	

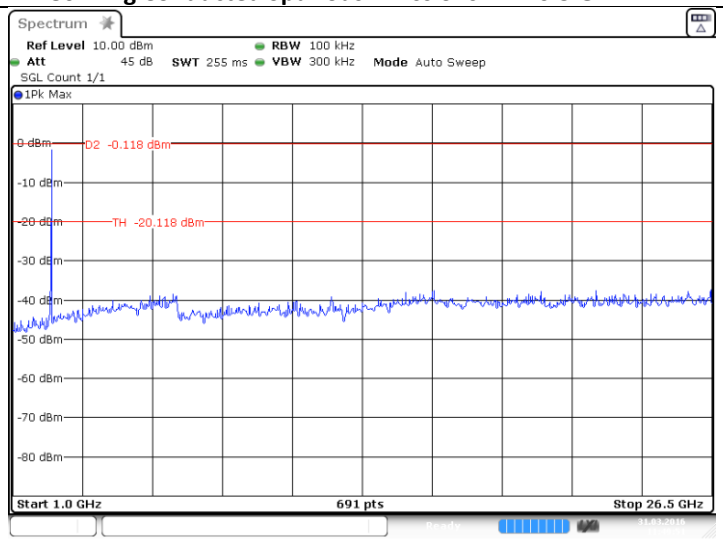
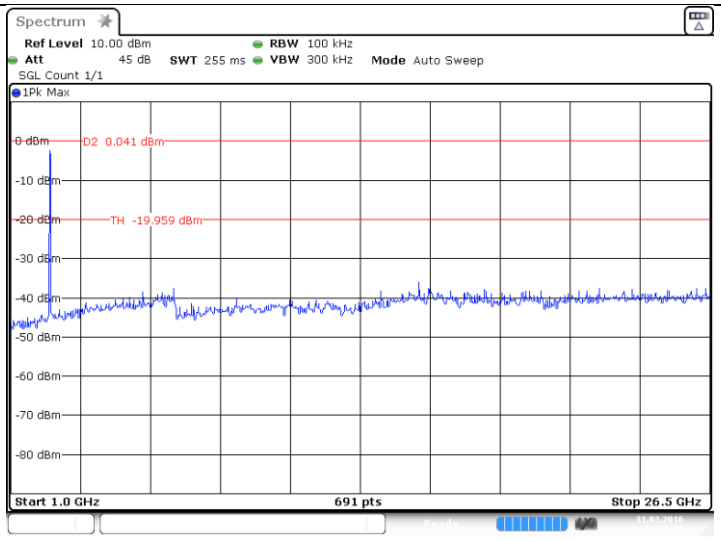
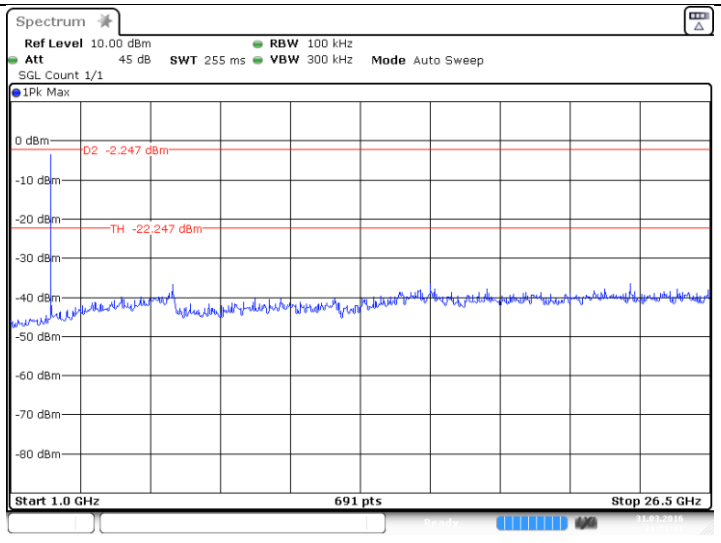
IEEE 802.11g Conducted Spurious Emissions 30 – 1000 MHz

Ch. 1	
Ch. 6	
Ch. 11	

IEEE 802.11b Conducted Spurious Emissions 1 – 26.5 GHz

Ch. 1	
Ch. 6	
Ch. 11	

IEEE 802.11g Conducted Spurious Emissions 1 – 26.5 GHz

Ch. 1	
Ch. 6	
Ch. 11	

4.6 Radiated Spurious Emissions Measurement

4.6.1 Limit

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.

4.6.2 Measurement instruments

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

4.6.3 Test setup

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

4.6.4 Test procedure

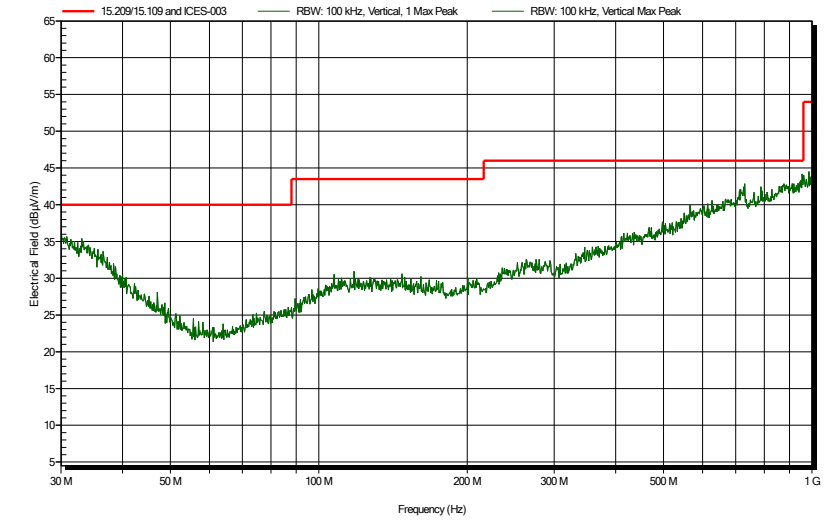
According to KDB Publication 558074 V03r05, sections 11.3 and 12.1

4.6.5 Plots of the Radiated Spurious Emissions Measurement

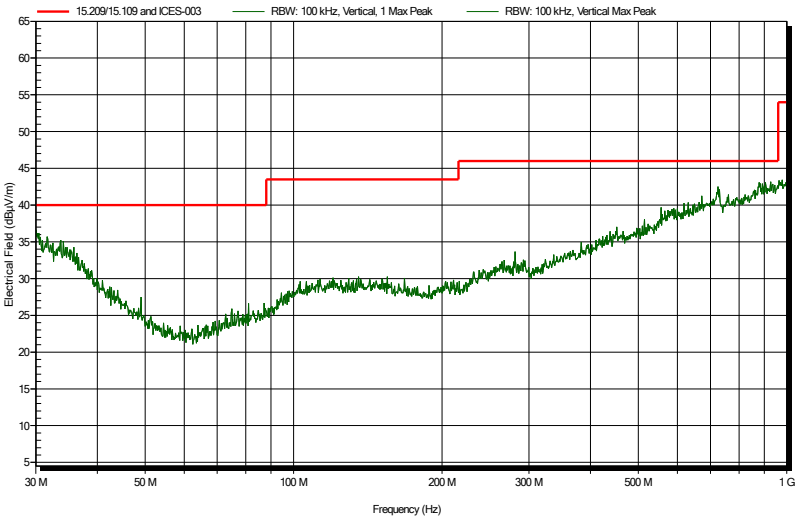
IEEE 802.11b 30 MHz to 1 GHz

Vertical polarization

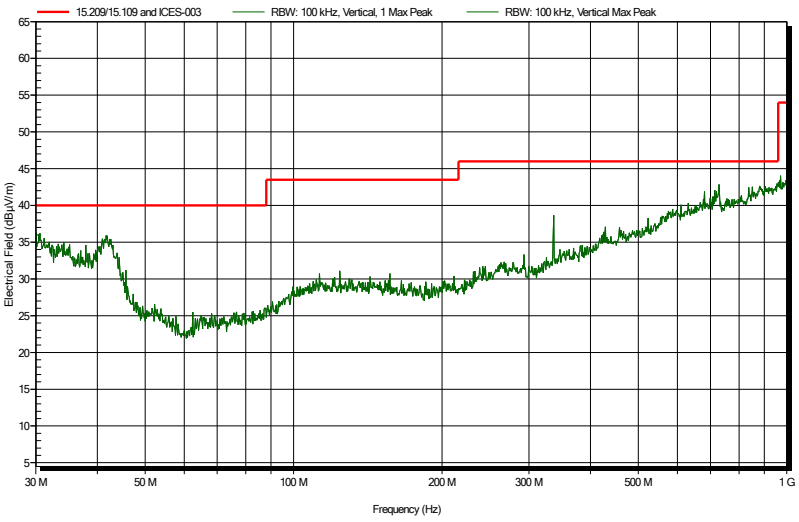
Low ch



Mid ch



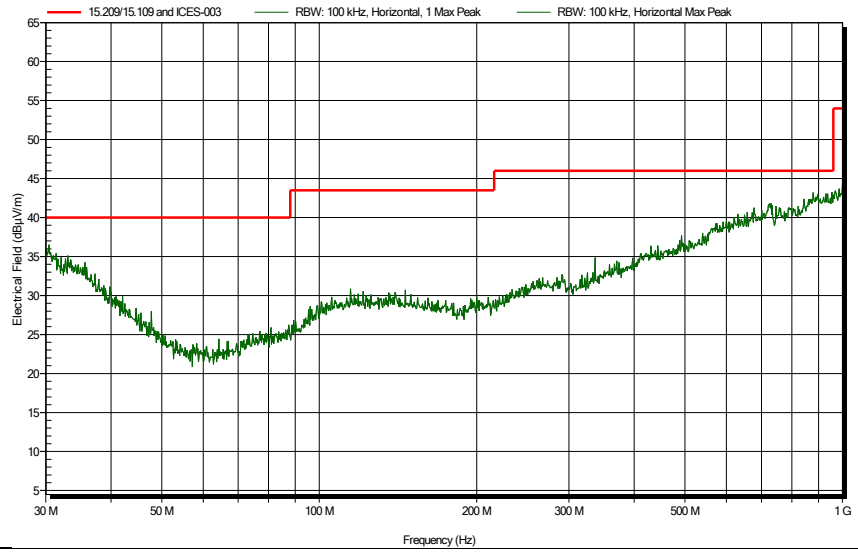
High ch



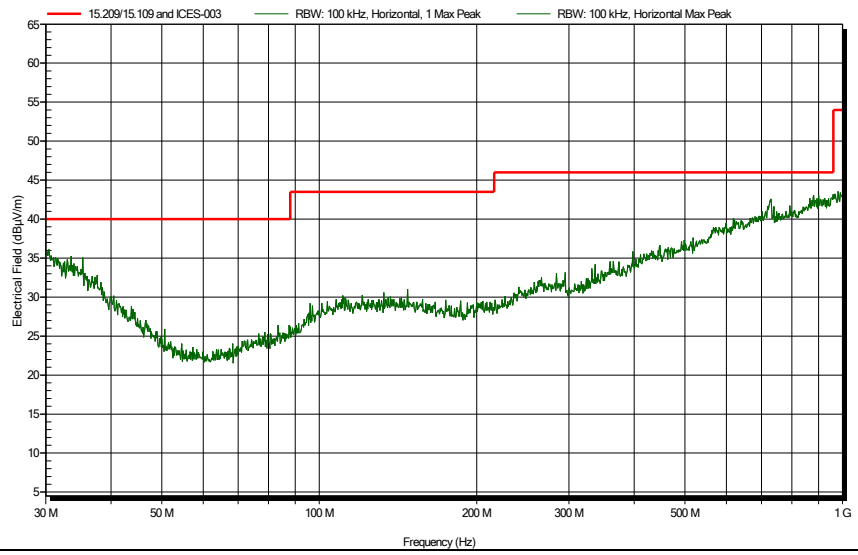
IEEE 802.11b 30 MHz to 1 GHz

Horizontal polarization

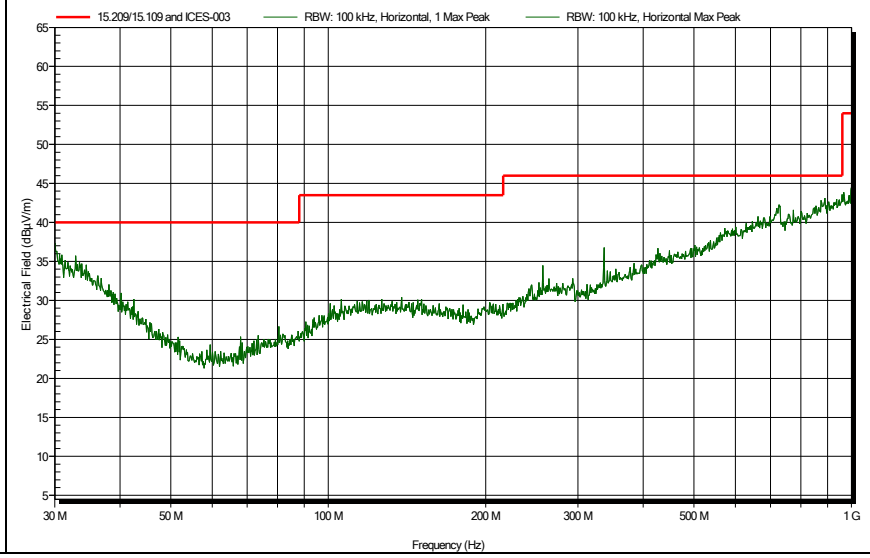
Low ch



Mid ch



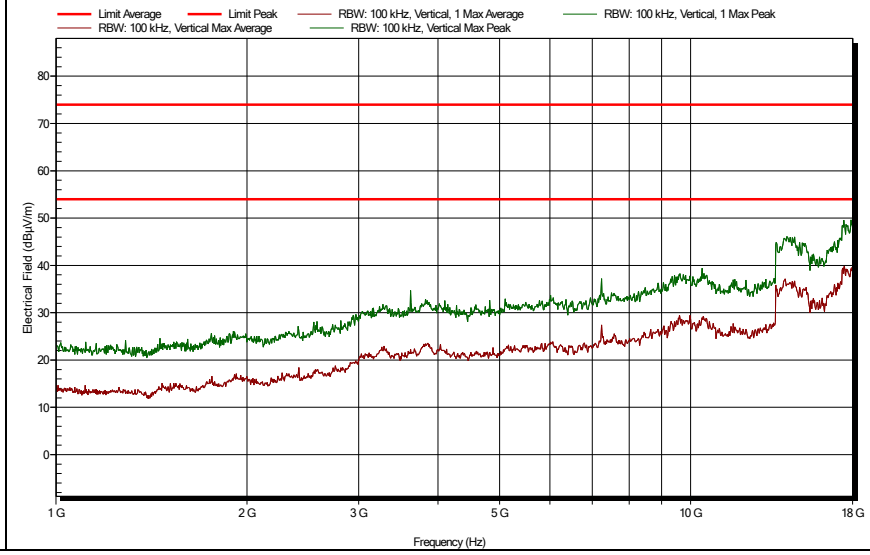
High ch

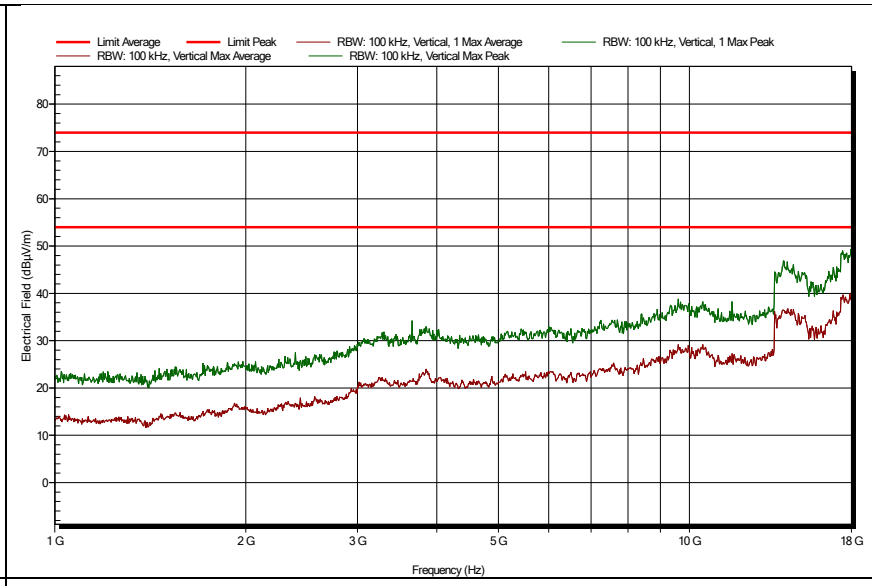
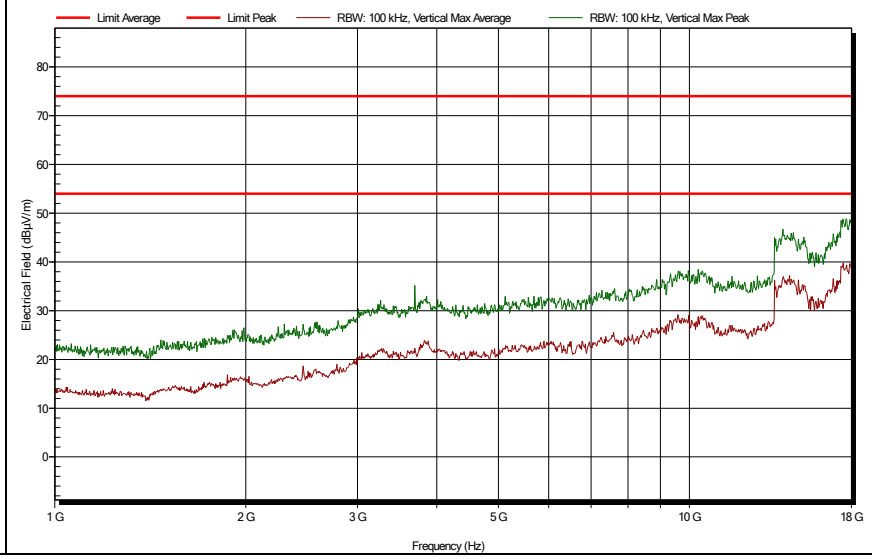


IEEE 802.11b 1 GHz to 18 GHz

Vertical polarization

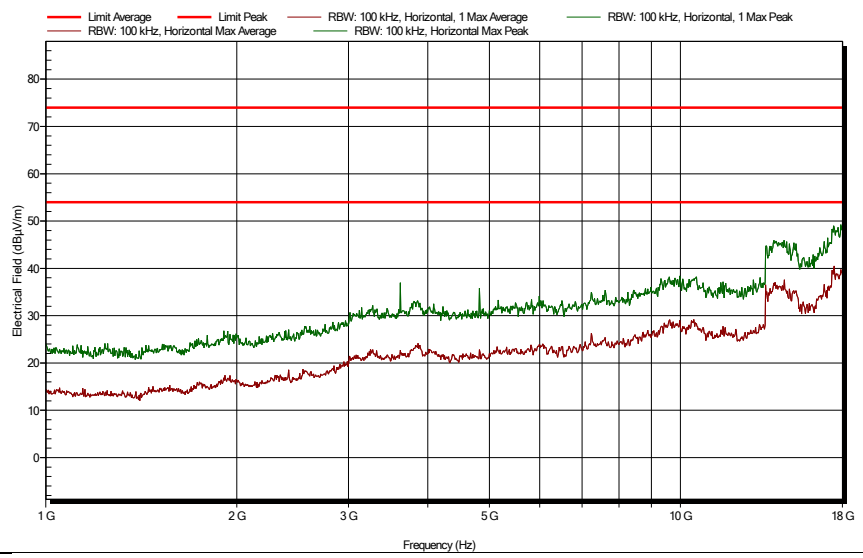
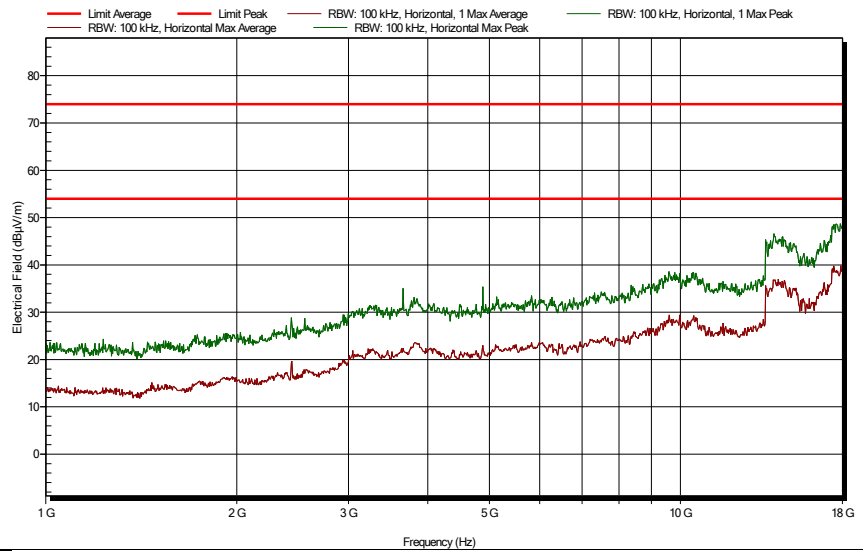
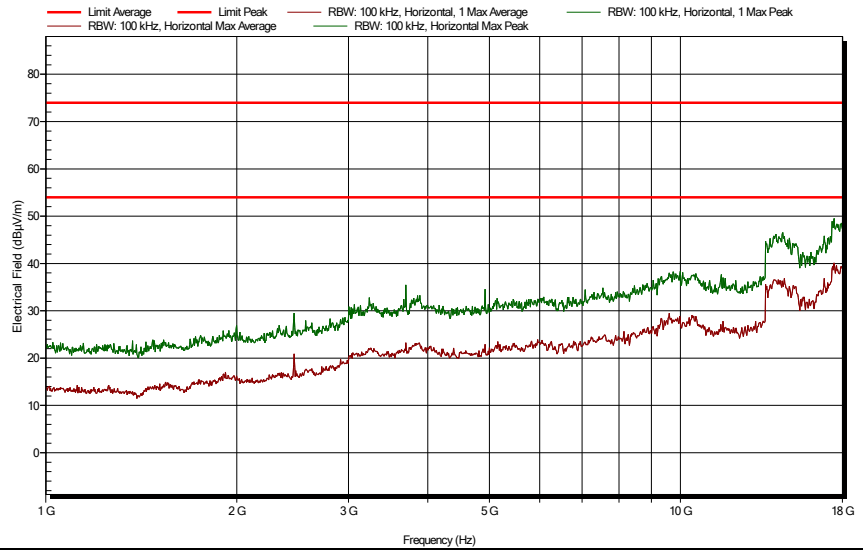
Low ch



Mid ch	
High ch	

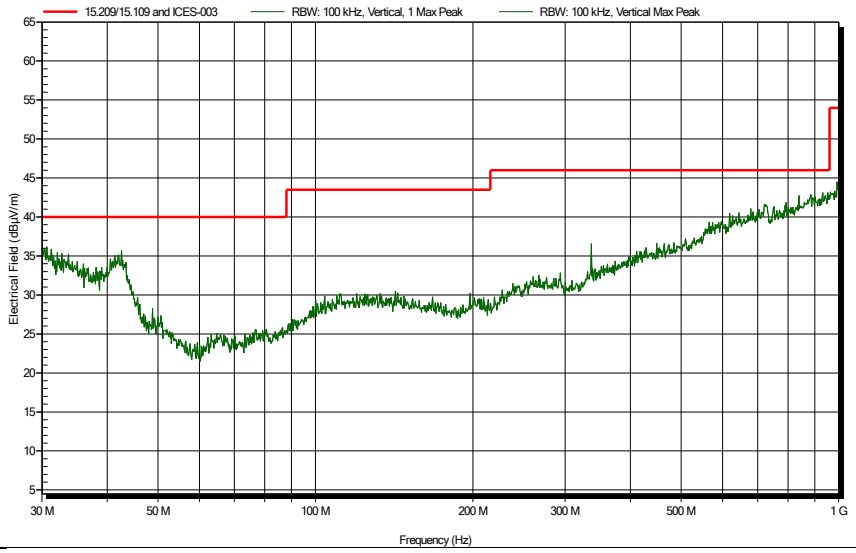
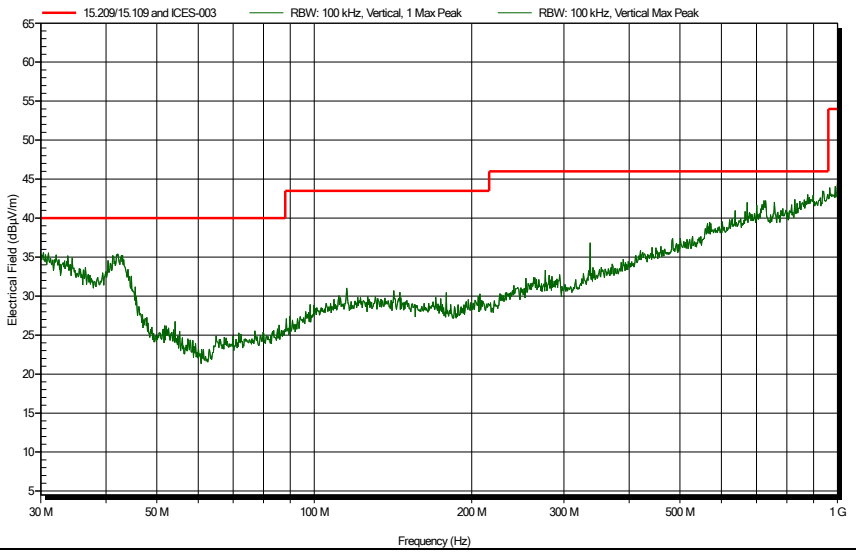
IEEE 802.11b 1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

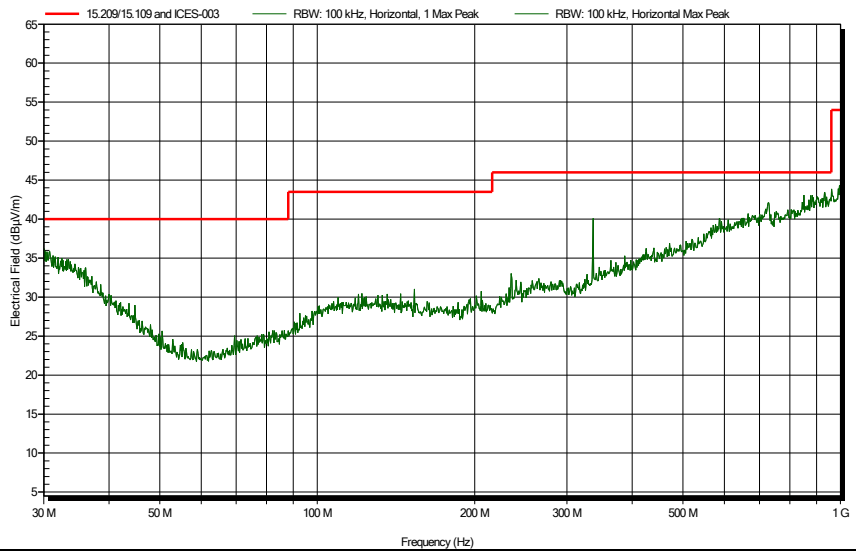
IEEE 802.11g 30 MHz to 1 GHz

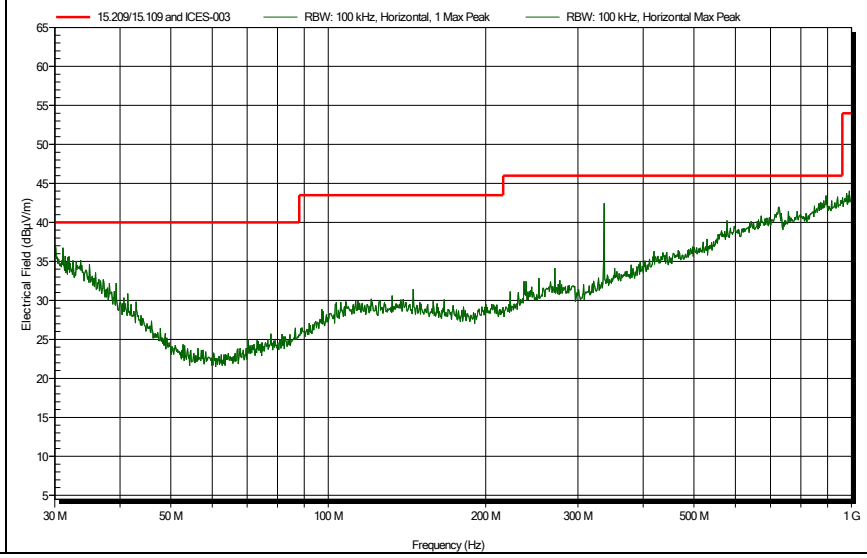
Vertical polarization

Low ch	
Mid ch	
High ch	

IEEE 802.11g 30 MHz to 1 GHz

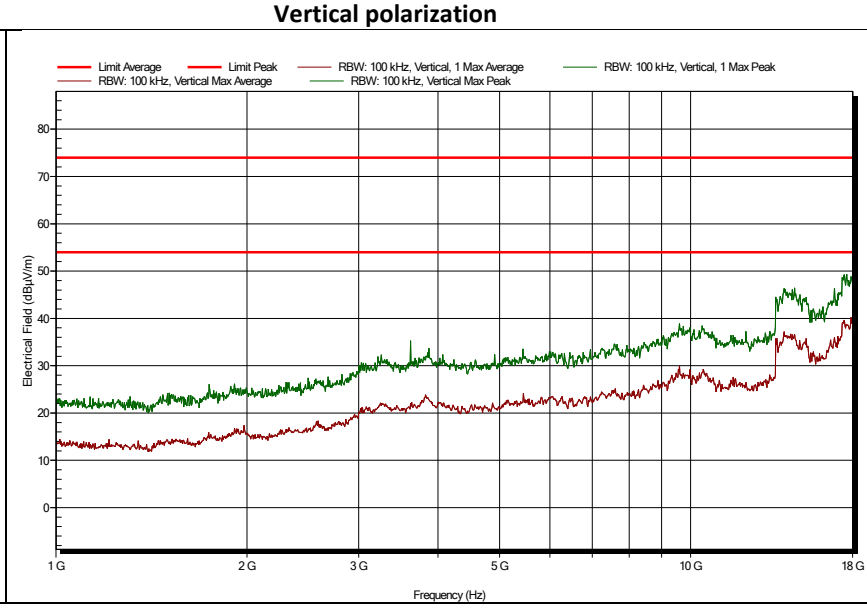
Horizontal polarization

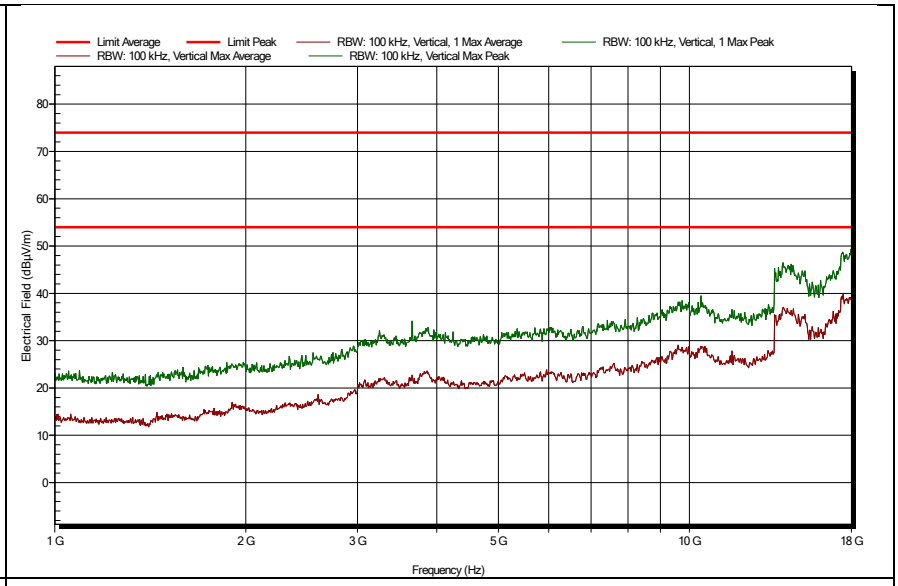
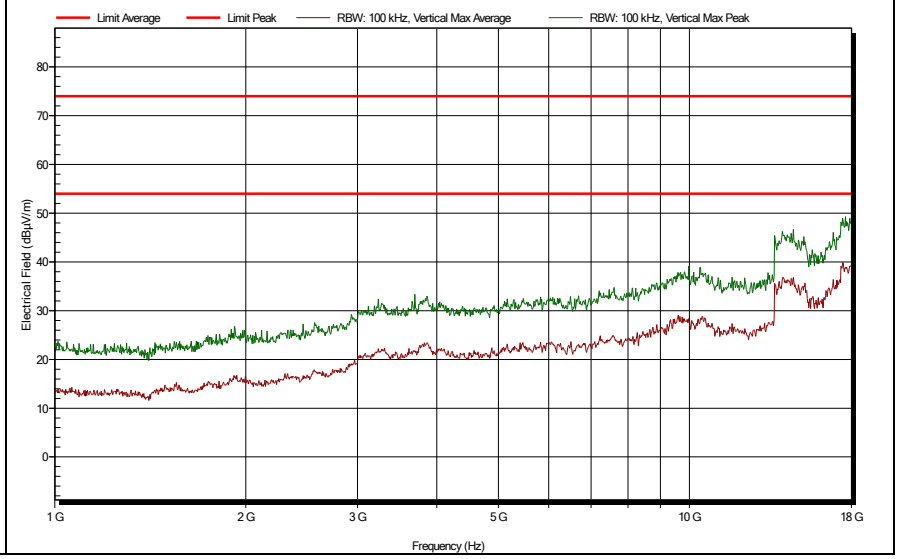
Low ch	
Mid ch	

High ch	

IEEE 802.11g 1 GHz to 18 GHz

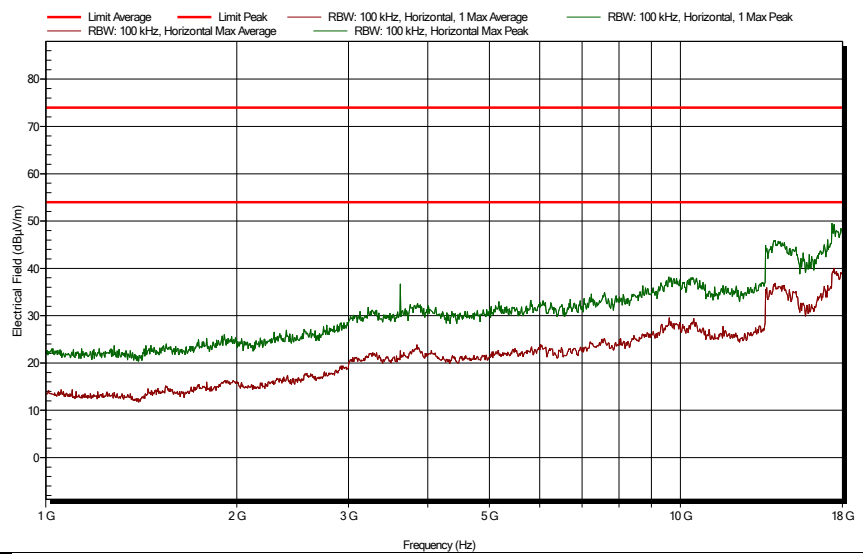
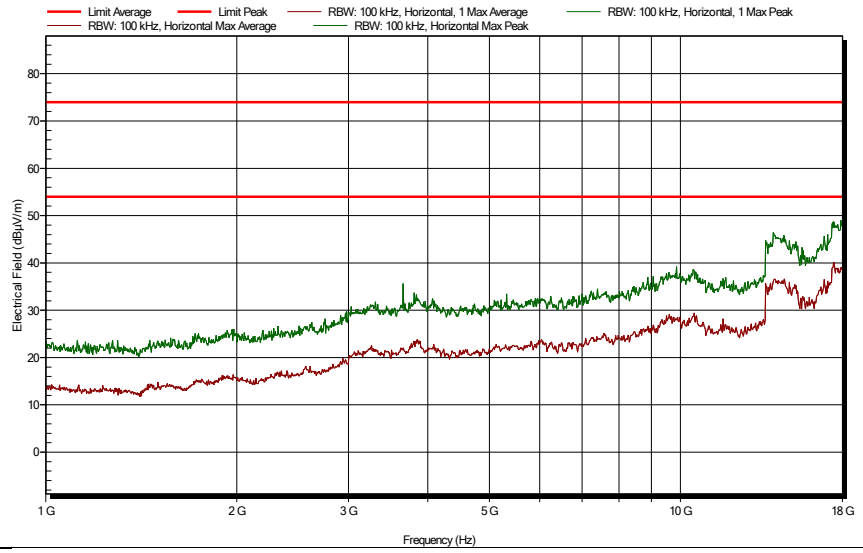
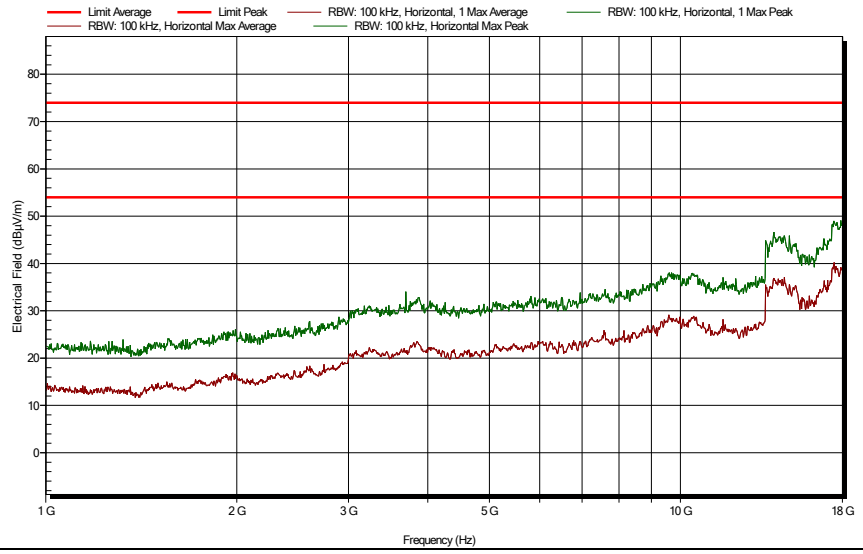
Vertical polarization

Low ch	

Mid ch	
High ch	

IEEE 802.11g 1 GHz to 18 GHz

Horizontal polarization

Low ch	
Mid ch	
High ch	

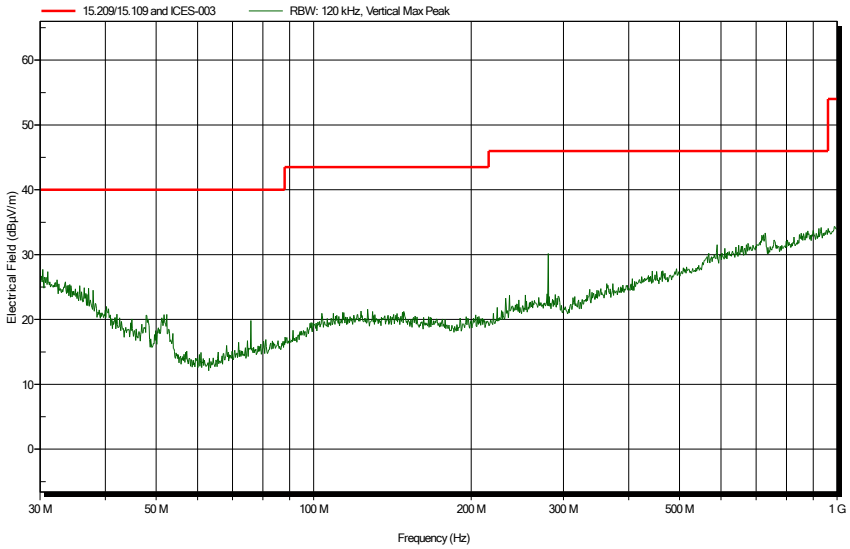
18 GHz to 26 GHz

A conducted pre-scan was performed to see if any emission are found in the frequency range from 18to 26.5 GHz. See chapter 3.5. As no emission were found, no radiated measurements were performed.

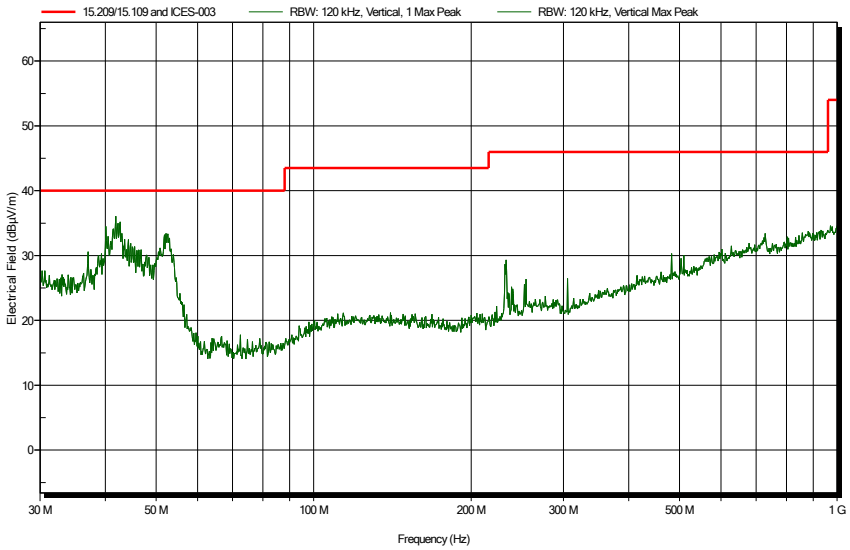
IEEE 802.11b/g 30 MHz to 1 GHz (data communication)

30 MHz to 1 GHz

Vertical polarization

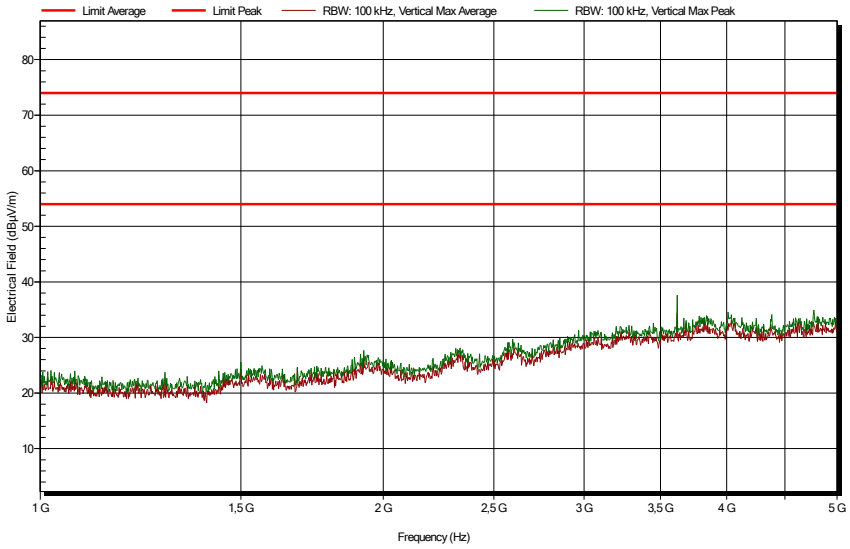


Horizontal polarization

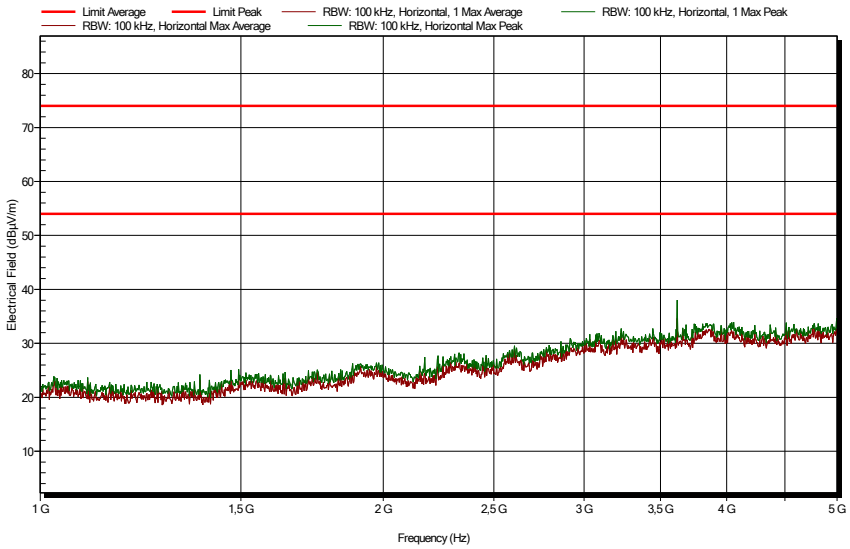


IEEE 802.11b/g 1 GHz to 18 GHz (data communication)

Vertical polarization



Horizontal polarization



4.6.6 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/- 5.7dB

5 Sample calculations

All formulas for data conversions and conversion factors are reported in this chapter.

Conducted emission Measurement:

U_{lisn} (dBµV) = U (dBµV) + 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 SN: 230000813 Rohde & Schwarz ENV 216	**TE 11134**	
0,15	9.7	0.02	9.72
0,2	9.68	0.03	9.71
0,3	9.68	0.03	9.71
0,5	9.69	0.08	9.77
0,7	9.69	0.25	9.94
0,8	9.69	0.25	9.94
1	9.68	0.11	9.79
2	9.7	0.15	9.85
3	9.71	0.21	9.92
5	9.72	0.21	9.93
7	9.76	0.25	10.01
8	9.77	0.25	10.02
10	9.77	0.29	10.06
15	9.84	0.34	10.18
20	9.88	0.37	10.25
25	9.97	0.43	10.4
30	10.08	0.45	10.53

Magnetic field strength measurement:

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

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 114515 EMCO 6505 S/N:9112-2710	300m to 3m and 30m to 3m correction	CL (dB) SAR cable	Corr. (dB)
0.009	18.49	104.956	0.7	-85.8
0.01	17.64	104.041	0.05	-86.4
0.02	13.23	98.02	0.07	-84.7
0.03	11.65	94.498	0.1	-82.7
0.04	10.97	91.999	0.1	-80.9
0.1	10.14	84.041	0.1	-73.8
0.2	10.01	78.02	0.1	-67.9
0.5	9.95	50.061	0.1	-40
1	9.91	44.041	0.2	-33.9
3	9.93	34.498	0.2	-24.4
5	9.93	30.061	0.3	-19.8
10	9.75	24.041	0.6	-13.7
15	9.29	20.519	0.9	-10.3
20	8.57	18.02	1	-8.5
25	7.55	16.082	0.7	-7.8
27	7.01	15.413	1.2	-7.2
30	6.03	14.498	1	-7.5

Field Strength Measurement:

E (dBµV/m) = U(dBµV) + AF (dB/m) + 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) ID: 107818 EMCO 3109	Cable loss (dB) Id: 114928	Attenuator ID:114525 Hewlett Packet	Corr. (dB)
30	13.5	1.8	6	21.3
100	9.2	2.7	6	17.9
150	12.6	3.2	6	21.8
200	13.6	3.6	6	23.2
250	15.2	4.3	6	25.5

Frequency (MHz)	AF (dB/m) ID: 114385 EMCO LPDA	Cable loss (dB) Id: 114928	Corr. (dB)
250	11.8	4.3	16.1
300	13	5.1	18.1
350	14.2	5.8	20.0
400	15.6	7.3	22.9
450	17.1	7.9	25.0
500	17.3	8.0	25.3
550	17.7	8.0	25.7
600	18.4	7.7	26.1
650	19.2	7.5	26.7
700	19.7	7.7	27.4
750	20.3	7.9	28.2
800	21.4	8.2	29.6
850	22.0	8.7	30.7
900	22.1	8.9	31.0
950	22.6	9.2	31.8
1000	22.5	9.6	32.1

Frequency (MHz)	AF (dB/m) 114607 Emco 3115 SN: 9412-4377	Gain (dB) 114690 µComp Nordic MCNA-40-0010800-25-10P	Cable loss (dB) 114691	Corr. (dB)
1000	23.6	45.1	2.1	-19.4
2000	27.1	44.7	3.3	-14.3
3000	30.5	44.2	4.2	-9.5
4000	32.7	43.5	4.9	-5.9
5000	33.2	43.1	5.6	-4.3
6000	34.6	43.0	6.3	-2.1
7000	35.2	42.9	6.4	-1.3
8000	37.0	43.3	7.2	0.9
9000	38.1	43.3	7.9	2.7
10000	38.2	43.0	8.2	3.4
11000	38.3	42.9	8.7	4.1
12000	39.1	42.6	9.0	5.5
13000	39.2	43.6	9.8	5.4
14000	41.1	44.3	9.7	6.5
15000	40.2	44.4	10.4	6.2
16000	37.5	44.3	10.8	4.0
17000	41.1	44.5	11.4	8.0
18000	44.0	44.9	11.4	10.5

Frequency (MHz)	AF (dB/m) Kiwa ID: 114518 Flann 20240-25 SN: 163703	Gain (dB) Kiwa ID: Schwarzbeck BBV 9721	Cable loss (dB) 114691	Corr. (dB)
18000	31.3	34.5	11.4	8.2
19000	31.5	34.9	11.2	7.8
20000	31.7	34.1	11.6	9.2
21000	31.9	33.6	12.1	10.4
22000	32.1	33.6	12.4	10.9
23000	32.2	33.3	13.6	12.5
24000	32.3	32.3	13.5	13.5
25000	32.4	33.0	13.4	12.8
26000	32.5	32.9	13.7	13.3

Frequency (MHz)	AF (dB/m) Kiwa ID: 114487 Scientific Atlanta	Gain (dB) Kiwa ID: Schwarzbeck BBV 9721	Cable loss (dB) 114691	Corr. (dB)
26000	35.3	32.9	13.7	16.1
27000	35.4	32.6	14.9	17.7
28000	35.6	32.6	14.4	17.4
29000	35.9	32.9	14.6	17.6
30000	36.2	32.7	15.2	18.7
31000	36.1	32.9	14.9	18.1
32000	36.0	33.8	16.7	18.9
33000	36.2	34.8	16.8	18.2
34000	36.3	35.5	15.9	16.7
35000	36.4	35.5	17.5	18.4
36000	36.5	34.6	17.9	19.8
37000	36.6	33.6	18.2	21.2
38000	36.8	32.5	17.7	22.0
39000	37.0	32.1	17.7	22.6
40000	37.2	29.9	19.0	26.3

<< END OF REPORT>>