Extron Electronics
INTERFACING, SWITCHING AND CONTROL

FCC AND IC RF TEST REPORT

Product Tested
Wi-Fi Transceiver Module

Report Number
1947-1

Prepared for:
Extron Electronics
1025 E. Ball Road
Anaheim, CA 92805
714.491.1500

Prepared by:
Extron Electronics – Compliance Lab

ACCREDITED
Testing Cert # 3429.01

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REVISION PAGE

Issue Date	Revision	Changes	By
8/3/2015	A	Initial Release	Boni Baniqued
10/12/2015	B	Updated report (extracted appendices and converted to separate exhibit files)	Boni Baniqued
10/23/2015	C	Updated page 6 section 1.4, and page 59	Boni Baniqued

CERTIFICATION

PRODUCT NAME:	Transceiver module with support for IEEE 802.11 a/b/g/n
BRAND NAME:	Extron
MODEL NUMBER:	20-2052-01LF
FCC ID:	2AE3WEXT2052CB
IC:	10862A-EXT2052CB
APPLICANT NAME:	Extron Electronics, 1025 E, Ball Road, Anaheim, CA 92805
DATE OF TESTING:	April 1-7, 2015, May 1-29, 2015
STANDARDS:	FCC Part 15 Subpart C (Section 15.247)
	IC RSS-247 Issue 1 (Digital Transmission Systems)
	IC RSS-GEN Issue 4
OPERATING BAND:	2400 MHz – 2483.5 MHz

The above equipment was found to be in compliance with the limits and levels of the standards listed in this report based on the testing results. Unless otherwise stated, the results of this report relate only to the items tested as described in the General Information section of this test report. If any significant changes are made to the EUT, the changes shall be evaluated and a retest may be required.

Test reports shall not be reproduced except in full, without the written approval of the Extron Director of Compliance Engineering, or his designee.

Approved & Released for
Extron Electronics Compliance Engineering By:

Digitally signed by Homi Ahmadi
Date: 2015.10.23 19:16:47 -07'00'

Homi Ahmadi
Director of Compliance Engineering
Extron Electronics

Tested By:

Digitally signed by Boni Baniqued
DN: cn=Boni Baniqued, o=Extron Electronics, ou=Compliance Engineering, email=bbaniqued@extron.com, c=US
Date: 2015.10.23 13:58:27 -07'00'

Boni Baniqued
Regulatory Compliance Engineer
Extron Electronics

1 GENERAL INFORMATION

1.1 Applicant Information

Extron Electronics, 1025 E. Ball Road, Anaheim, CA 92805, USA

1.2 Objective

The objective is to request a Class II Permissive Change (Reassessment) under the new FCC DTS Rules and IC DTS certification requirements to a single modular certified transceiver module (FCC ID: TFB-TIWI501, IC: 5969A-TIWI501) with additional antenna, carrier board (20-2052-00LF), and disabled Bluetooth 2.1+EDR and Bluetooth LE functions.

1.3 Related Submittal(s)/Grant(s)

- FCC Identifier: TFB-TIWI501; Name of Grantee: LS Research, LLC
- IC Certification Number: 5969A-TIWI501; Issued to: LS Research, LLC
- Test Report #: 311362 A

1.4 Test Methodology

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 DTS Measurement Guidance v03r03, IC RSS-GEN Issue 4, and IC RSS-247 Issue 1.

Note: The EUT is considered an Information Technology Equipment (ITE) peripheral, because the connection to an ITE host is necessary for typical use, it has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC) and IC ICES-003 Issue 5. The test report has been issued separately.

1.5 Test Facilities and Accreditations

- All testing was performed at Extron Electronics – Compliance Laboratory, 1001 E. Ball Road, Anaheim, CA 92805, USA
- American Association for Laboratory Accreditation: 3429.01, Valid Through June 30, 2017
- FCC Designation Number: US1143, Valid Through 06/30/2016
- VCCI Registration Number: A-0186, Valid Through 06/30/2017
- Industry Canada Site Number: 10862A-1, Valid Through 07/15/2016

NOTE

This report cannot be used to claim product endorsement by any of the agencies listed above.

NOTE

The Extron Electronics – Compliance Laboratory operates as an independent test lab within Extron Electronics with no organizational or financial relationship.

1.6 Measurement Uncertainty

Measurement uncertainty is used to reflect the accuracy of the measured result as compared with its "true" or theoretically correct value. Our measurement data meets or exceeds the measurement uncertainty requirements of CISPR 16-4-2. In the case of transient tests our test equipment has been demonstrated by calibration to provide at least a 95% confidence that it complies with the test specification requirements. The measurement uncertainty for any test is available upon request.

Radiated Emissions

Test Method	Lab	Uncertainty	Units
Radiated Emissions 30-1000MHz (Vertical Polarity)	B	±4.88	dB
Radiated Emissions 30-1000MHz (Horizontal Polarity)	B	±4.88	dB
Radiated Emissions 1-18GHz	B	±5.01	dB
Radiated Emissions 18-40GHz	B	±5.02	dB

Conducted Emissions

Test Method	Lab	Uncertainty	Units
Conducted Emissions with LISN	E	±3.79	dB
Conducted Emissions with T-ISN	E	±3.75	dB

2 PRODUCT INFORMATION

2.1 Description of the EUT

The Equipment Under Test (EUT) is the Extron transceiver module (P/N: 20-2052-01LF) with support for 2.4/5.5 GHz IEEE 802.11 a/b/g/n.

** The test data gathered are from Production sample, serial number A11XLLA, received from the manufacturer on April 1, 2015.*

2.2 Description of the Antenna

WLAN Embedded Antenna

Model	Manufacturer	Type	Peak Gain (dBi)		
			2.39 - 2.49 GHz	5.15 - 5.35 GHz	5.7 - 5.9 GHz
1000418	Ethertronics	Isolated Magnetic Dipole (iMD)	1.5 - 2.5	2 - 3.5	2 - 3.5

2.3 Description of Test Setup

Support Equipment List

Description	Manufacturer	Model/Part Number	Serial Number	Quantity
Laptop PC	Dell	D630	N/A	1
12VDC Desktop Power Supply	Extron	28-071-57LF	A0K80EJ	1
Control Board	Extron	20-1847-01LF	A0YL2DF	1
10/100 HUB	Bay Networks	BayStack 253	H418A00535	1

I/O Cable List

Description	Manufacturer	Model/Part Number	Serial Number	Quantity
CAT-5e UTP 10’ cable	Extron Electronics	26-640-10	N/A	2
CAT-5e STP 50’ cable	Extron Electronics	26-669-50	N/A	1

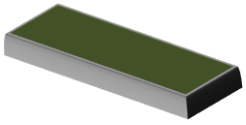
2.4 Worst Test Modes and Channel Details

Test Condition	Test Item	Modulation Mode	Data Rate (Mbps / MCS)	Test Frequency (MHz)
RF Conducted	6dB EBW and 99% OBW Maximum Conducted Output Power Power Spectral Density Emissions in non-restricted frequency bands	802.11b	1 Mbps	2412 / 2437 / 2462
			11 Mbps	2412 / 2437 / 2462
		802.11g	6 Mbps	2412 / 2437 / 2462
		802.11n (HT20)	MCS0	2412 / 2437 / 2462
	Authorized Band-edge	802.11b	1 Mbps	2412 / 2462
			11 Mbps	2412 / 2462
		802.11g	6 Mbps	2412 / 2462
		802.11n (HT20)	MCS0	2412 / 2462
Radiated	Radiated Emissions < 1GHz	802.11b	1 Mbps	2462
	Radiated Spurious Emissions > 1GHz	802.11b	1 Mbps	2412 / 2437 / 2462
	Restricted-band band-edge	802.11b	1 Mbps	2412 / 2462
			11 Mbps	2412 / 2462
		802.11g	6 Mbps	2412 / 2462
		802.11n (HT20)	MCS0	2412 / 2462
Line Conducted	AC Power-line Conducted Emissions	802.11b	1 Mbps	2462

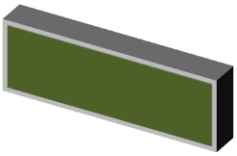
NOTE:

The fundamental frequency of the EUT was investigated in three orthogonal orientations of the antenna, vertical (V), horizontal 1 (H1), and horizontal 2 (H2) as shown below. It was determined that the vertical antenna orientation was the worst-case orientation; therefore, final radiated emissions testing was performed with the antenna in the vertical orientation.

Vertical (V)



2. Horizontal 1 (H1)



3. Horizontal 2 (H2)

2.5 Equipment Modifications

None

2.6 Testing Condition

Test Item	Test Site	Environmental Condition			Tested By
		Temperature	Relative Humidity	Atmospheric Pressure	
RF Conducted Emissions	Lab A	22-25°C	40-60%	1002-1012mbar	Boni Baniqued
Radiated Spurious Emissions	Lab B	22-25°C	40-60%	1002-1012mbar	Boni Baniqued
AC Power-Line Conducted Emissions	Lab E	23°C	48%	1010mbar	Boni Baniqued

2.7 Software

• Tera Term V4.83 [SVN#5602] – for Wi-Fi Module control
• R&S EMC32 V8.53 - AC power line conducted emissions and radiated spurious emissions measurements
• R&S RSCommander V1.5.9 – for Spectrum Analyzer /Receiver plot capture

3 TEST AND MEASUREMENT EQUIPMENT

Equipment Type	Manufacturer	Model Number	Asset/Serial Number	Calibration Due Date
EMI Receiver, 40 GHz	Rohde & Schwarz	ESU40	100161	8/18/2015
EMI Receiver, 26 GHz	Rohde & Schwarz	ESU26	100189	11/18/2015
Antenna – Bilog, 30MHz-1GHz	ETS-Lingren	3142D	14010	2/18/2016
Antenna – Bilog, 30MHz-1GHz	ETS-Lingren	3142D	13988	04/13/2016
Antenna, Horn, 1-18 GHz	ETS	3117	14041	02/18/2016
Antenna, Horn, 18- 40 GHz	ATM	180-442-KF/CAL	L488008-01	02/18/2016
Pre-Amplifier, 1-18 GHz	A.H. Systems, Inc	PAM-0118	274	02/17/2016
Pre-Amplifier, 1-18 GHz	Rohde & Schwarz	TS-PR18	100066	04/01/2016
Pre-Amplifier, 18-40 GHz	Rohde & Schwarz	TS-PR18-40	10001	02/18/2016
RF Cable, 0.30-18 GHz	SEMFLEX	N130SFBN10360	N/A	8/25/2015
RF Cable, 1-18 GHz	Pasternack	PE302-12	274	02/17/2016
RF Cable, 1-18 GHz	Huber-Suhner	Sucoflex 104E	232648 003	04/01/2016
RF Cable, 1-40 GHz	SEMFLEX	60637-59957	N/A	02/05/2016
Notch Filter, 2400-2500 MHz	Micro-Tronics	BRM50702-02	019	04/20/2016
Notch Filter, 5150-5880 MHz	Micro-Tronics	BRM50716-02	005	05/11/2016
Attenuator, 10dB	Bracke	BM10060.10	N/A	CNR

Note: CNR – Calibration Not Required

4 TEST RESULTS SUMMARY

FCC Rule Section	IC RSS Rule Section	Test Item Description		Test Limit	Test Conditions	Test Result
§ 15.247 (a)(2)	247 § 5.2 (1) Gen § 6.6	6dB Bandwidth and 99% OBW		≥ 500 kHz	Conducted	PASS
§ 15.247 (b)(3)	247 § 5.4 (4)	Maximum Conducted Output Power		< 1Watt (30 dBm) / 36 dBm (e.i.r.p.)		PASS
§ 15.247 (e)	247 § 5.2 (2)	Power Spectral Density		< 8dBm / 3kHz		PASS
§ 15.247 (d)	247 § 5.5	Unwanted Emissions /Band-edge		> 30dBc		PASS
§ 15.205 § 15.209 § 15.247 (d)	247 § 5.5 GEN § 8.10	Unwanted Emissions	Restricted Band-edge	FCC 15.209(a) Gen § 8.9 Table 4	Radiated	PASS
			Restricted Band	FCC 15.209(a) Gen § 8.9 Table 4		PASS
§ 15.207 (a)	Gen § 8.8	AC Power-Line Conducted Emissions		FCC 15.207(a) Gen § 8.8 Table 3	Line Conducted	PASS
§ 1.1307 § 1.1310 § 15.247 (i)	102 (4)	RF Exposure Requirements		FCC 1.1310 (e) 102 (4) Table 4	Conducted	PASS

5 DUTY CYCLE

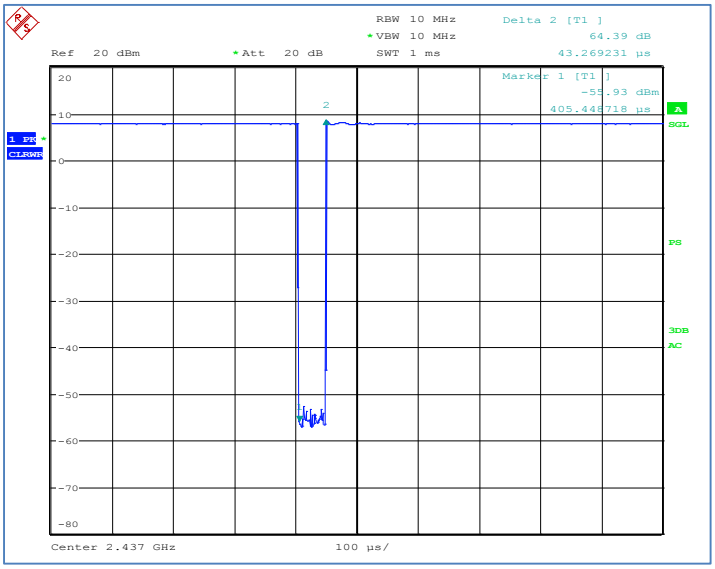
The duty cycles for all modes were determined based on measurements per KDB 558074 D01 v03r03 section 6.0 b) using spectrum analyzer in zero-span mode with RBW = 10 MHz, VBW = 10 MHz, and detector = Peak. The RBW and VBW are > than 50/T and the number of sweep points across duration T exceeds 100.

802.11 Mode	Data Rates	T_{OFF} (usec)	T_{ON} (usec)	Duty Cycle [DC]	Duty Cycle (%)	DC Factor (dB)
b	1 Mbps	43.27	16778.85	0.997	99.7	None
	11 Mbps	43.27	1706.73	0.975	97.5	0.11
g	6 Mbps	49.49	5533.65	0.991	99.1	None
802.11n (HT20)	MCS0	49.49	5113.59	0.990	99.0	None

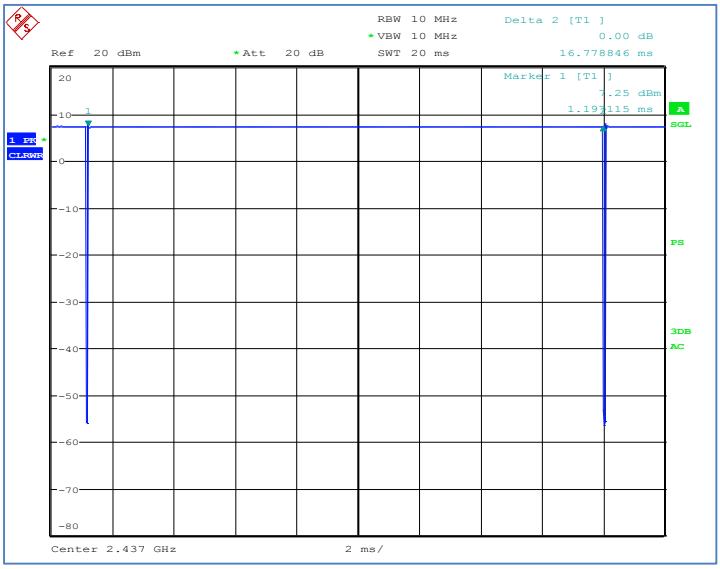
Note:
- No DC factor if the duty cycle is > 98%
- T_{OFF} – Transmission OFF time
- T_{ON} – Transmission ON time

DUTY CYCLE PLOTS

802.11b: 1 Mbps

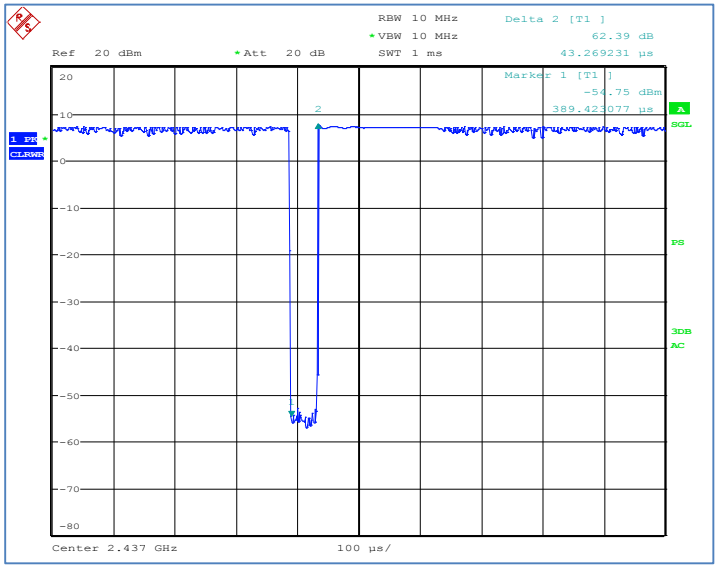


OFF Time = 43.27 us

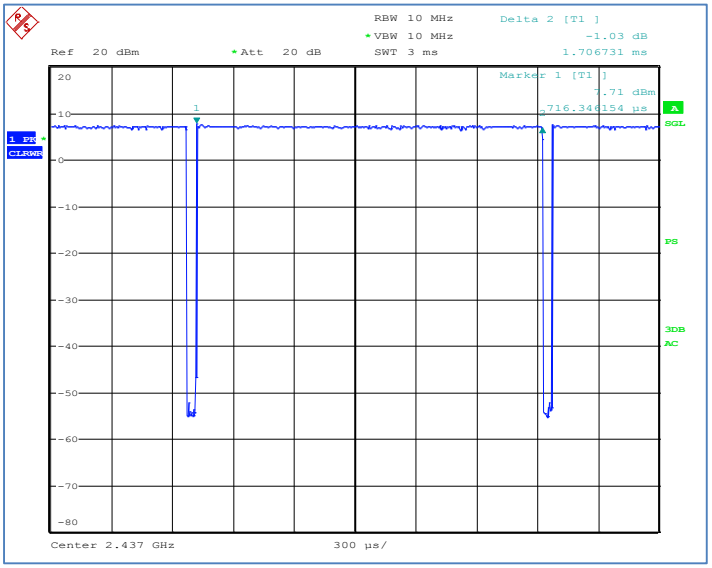


ON Time = 16778.85 us

802.11b: 11 Mbps

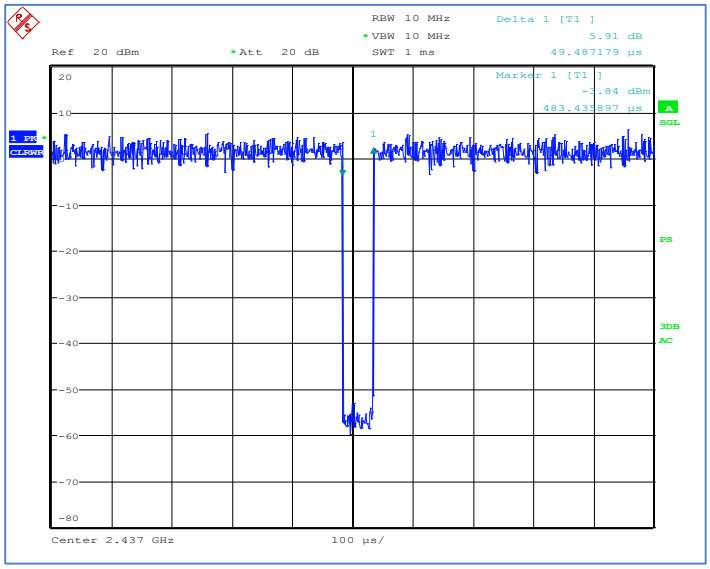


OFF Time = 43.27 us

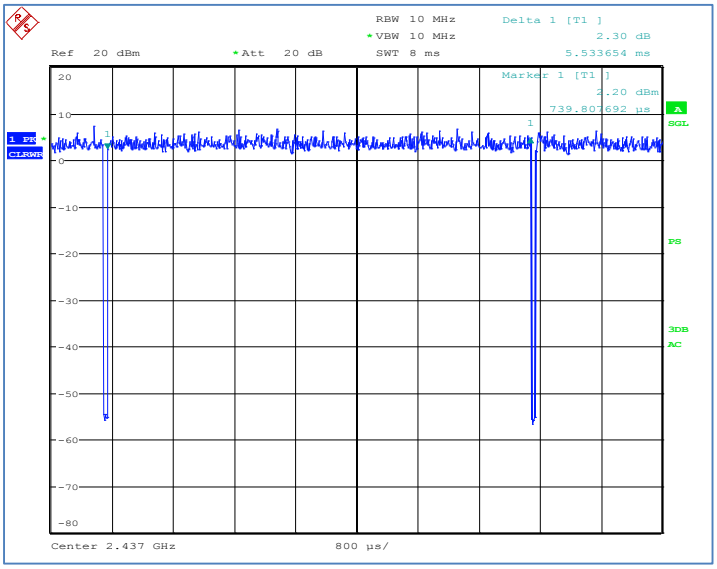


ON Time = 1706.73 us

802.11g: 6 Mbps

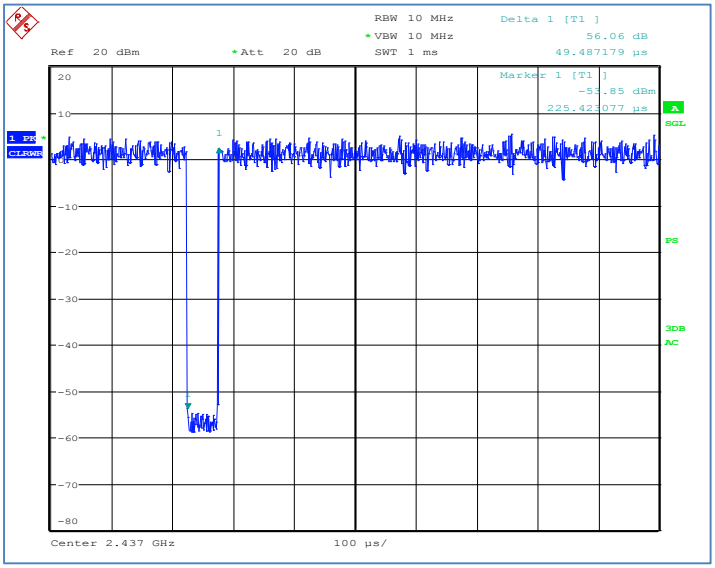


OFF Time = 49.49 us

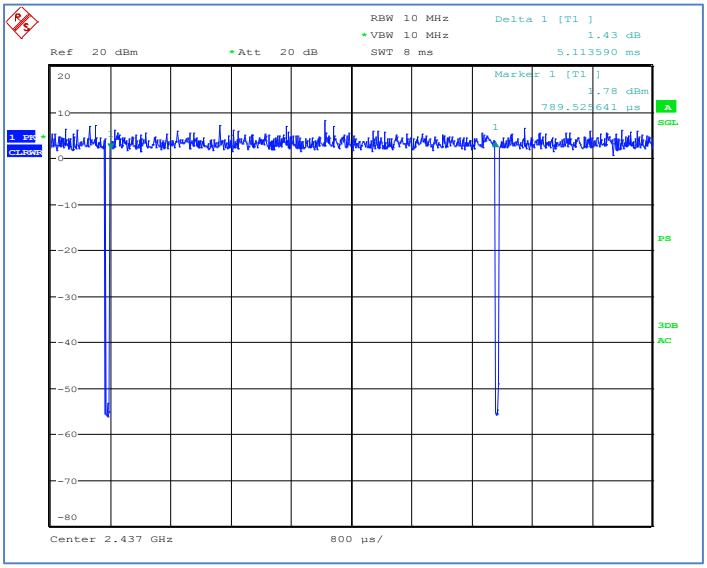


ON Time = 5533.65 us

802.11n (HT20): MCS0



OFF Time = 49.49 us



ON Time = 5113.59 us

6 TEST RESULTS

6.1 6dB DTS Bandwidth and 99% Occupied Bandwidth

Limits

FCC Part 15 Subpart C §15.247 (a) (2) and Industry Canada RSS-247 § 5.2 (1) and RSS-GEN § 6.6

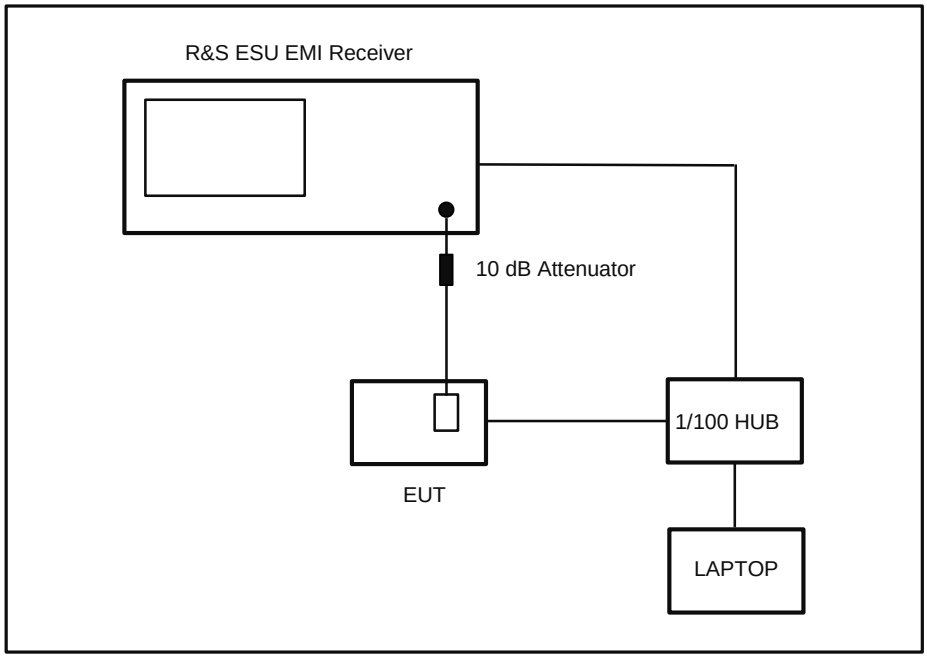
The minimum 6 dB bandwidth shall be at least 500 kHz

Test Procedures

ANSI C63.10-2013 § 11.8.1 Option 1
KDB 558074 D01 v03r03 § 8.1 Option 1

Note: EMI Receiver (Spectrum Analyzer) Reference Level Offset = 10.4 dB (10 dB Attenuator Pad + 0.4 cable loss)

Test Setup

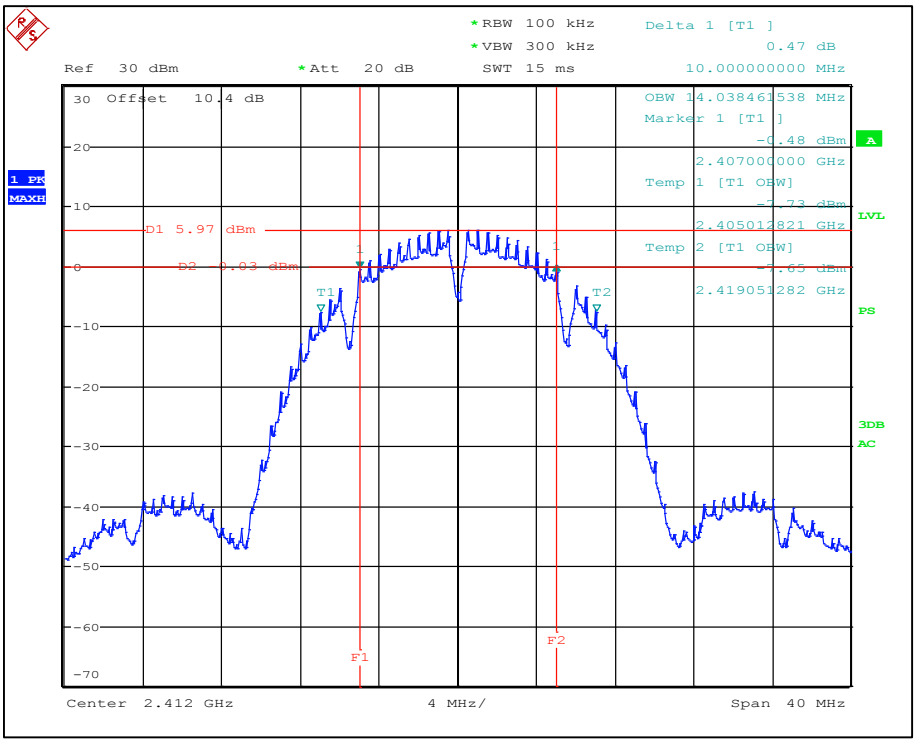


Test Results

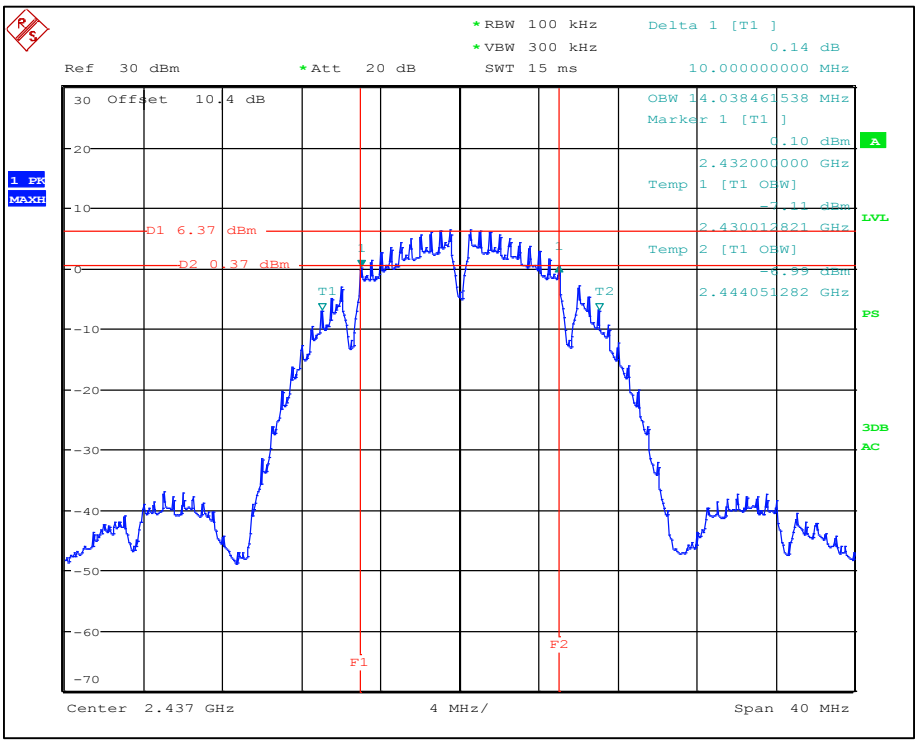
6.1.1 6dB DTS Bandwidth and 99% Occupied Bandwidth

Data Rate		Channel	Frequency (MHz)	6dB EBW (MHz)	99% OBW (MHz)	6dB EBW Limit (kHz)
802.11b	1 Mbps	1	2412	10.0	14.0	> 500
		6	2437	10.0	14.0	> 500
		11	2462	10.0	14.0	> 500
	11 Mbps	1	2412	10.1	14.4	> 500
		6	2437	10.1	14.5	> 500
		11	2462	10.1	14.5	> 500
802.11g	6 Mbps	1	2412	16.4	16.4	> 500
		6	2437	16.4	16.4	> 500
		11	2462	16.4	16.4	> 500
802.11n HT20	MCS0	1	2412	17.6	17.6	> 500
		6	2437	17.6	17.6	> 500
		11	2462	17.6	17.6	> 500

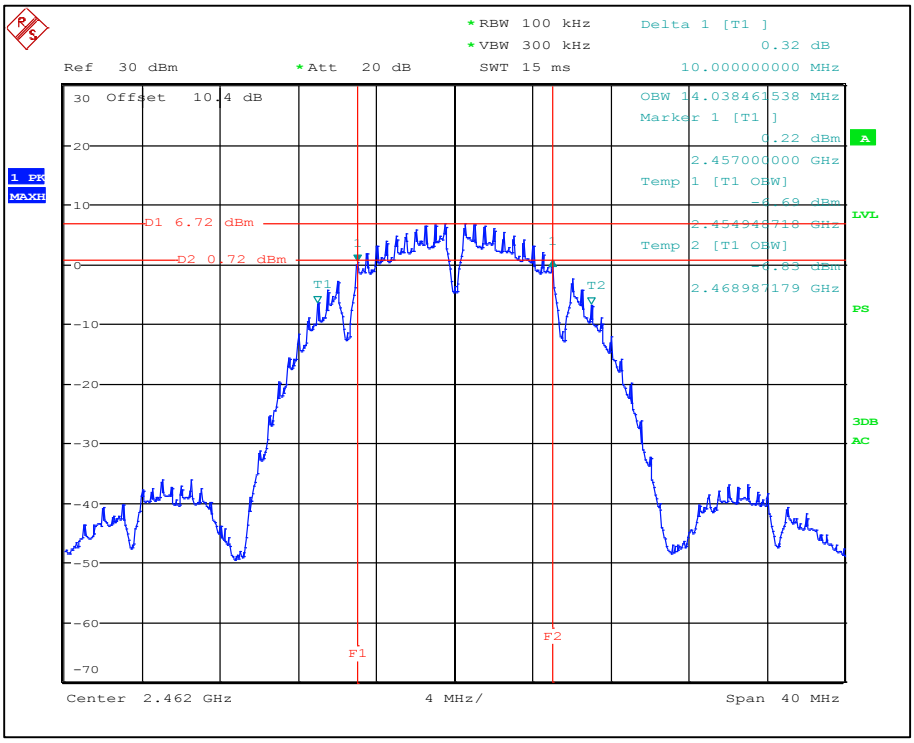
Refer to the following plots



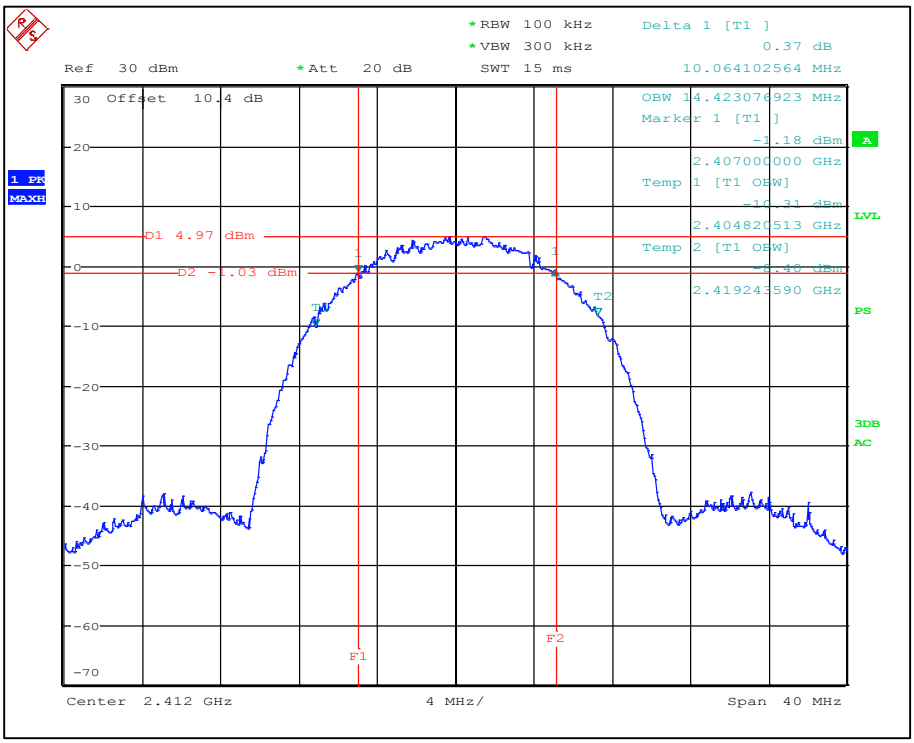
802.11b: 1Mbps – Channel 1 (2412 MHz) 6dB DTS BW and 99% OBW



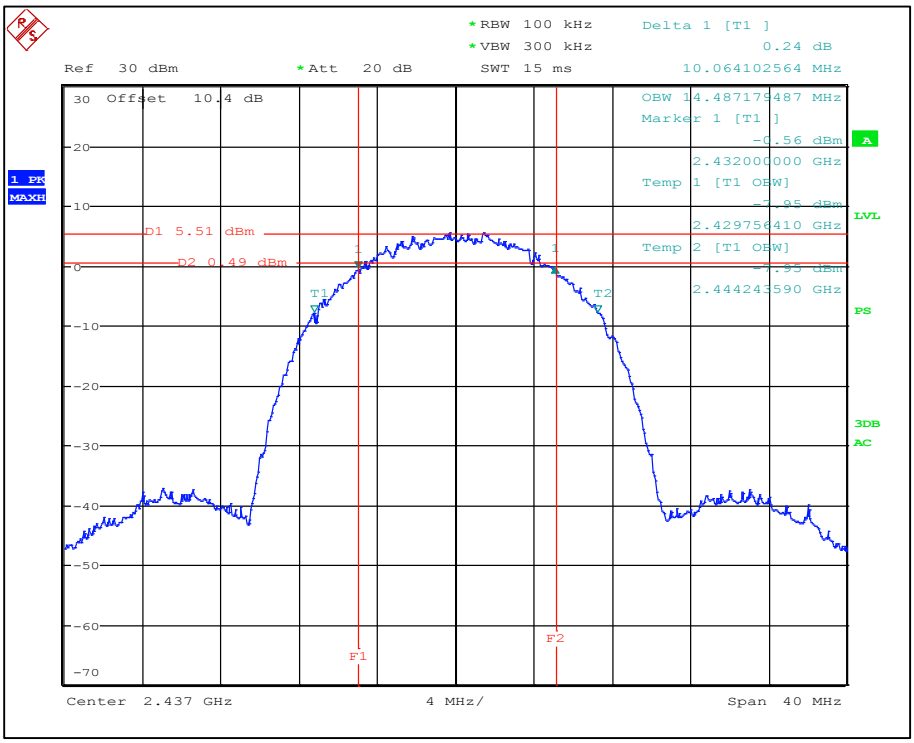
802.11b: 1Mbps – Channel 6 (2437 MHz) 6dB DTS BW and 99% OBW



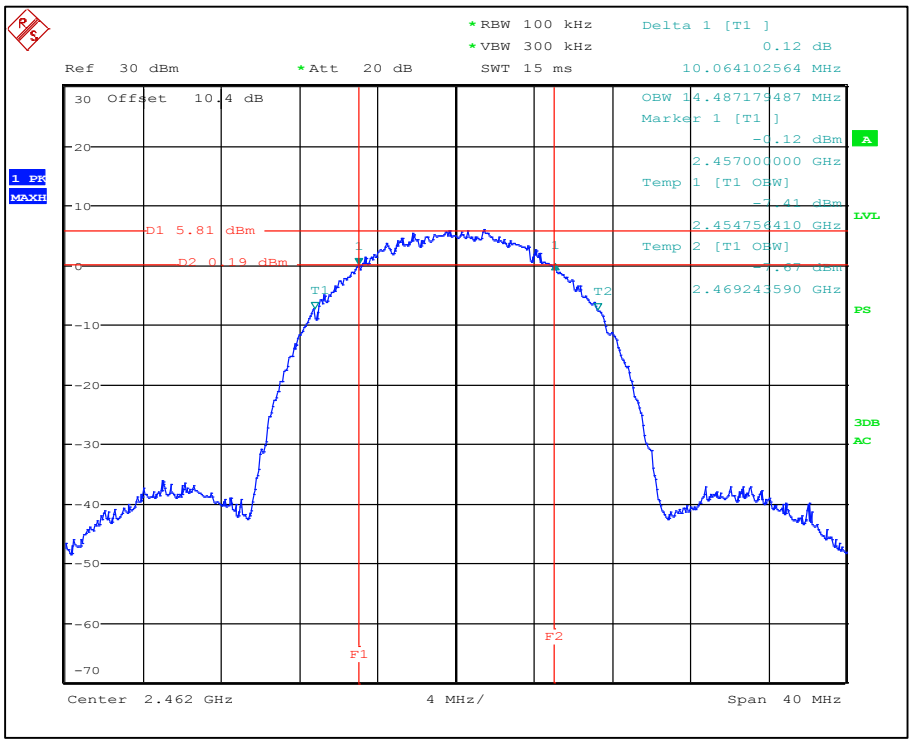
802.11b: 1Mbps – Channel 11 (2462 MHz) 6dB DTS BW and 99% OBW



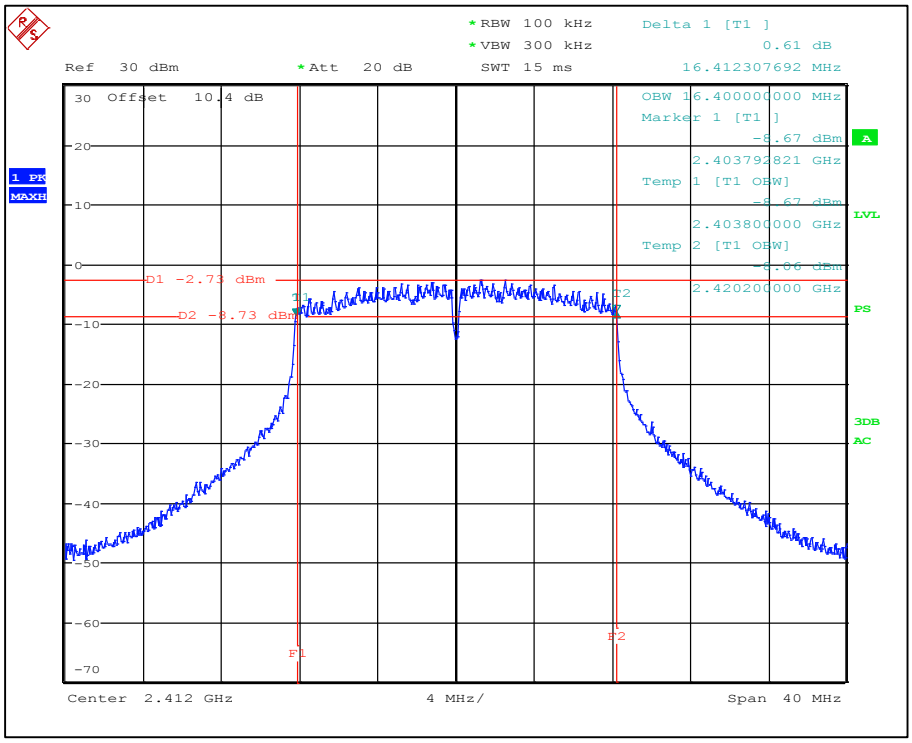
802.11b: 11Mbps – Channel 1 (2412 MHz) 6dB DTS BW and 99% OBW



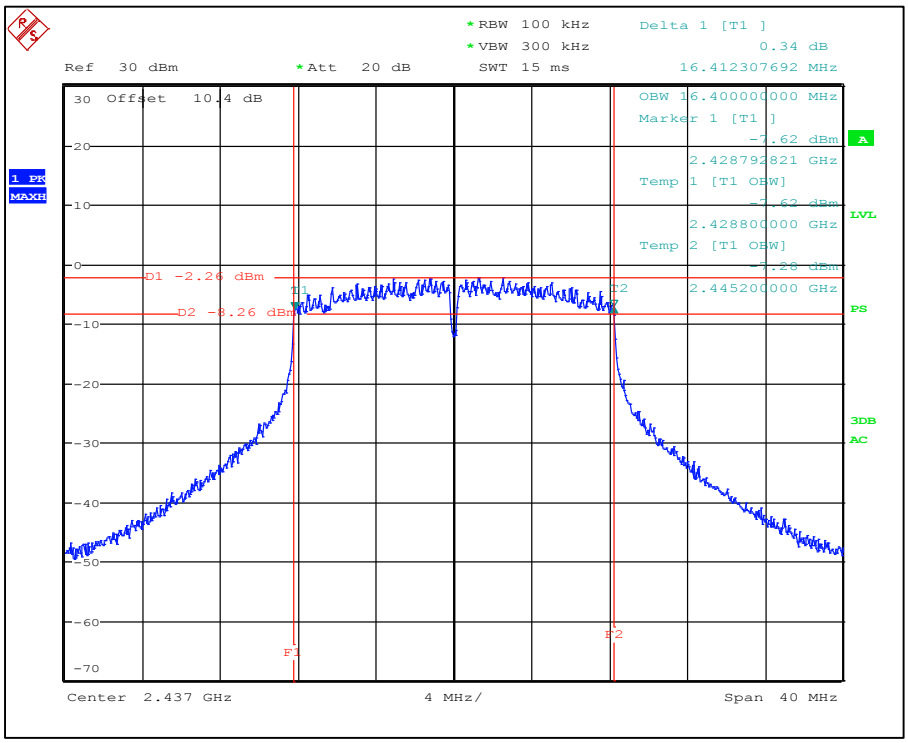
802.11b: 11Mbps – Channel 6 (2437 MHz) 6dB DTS BW and 99% OBW



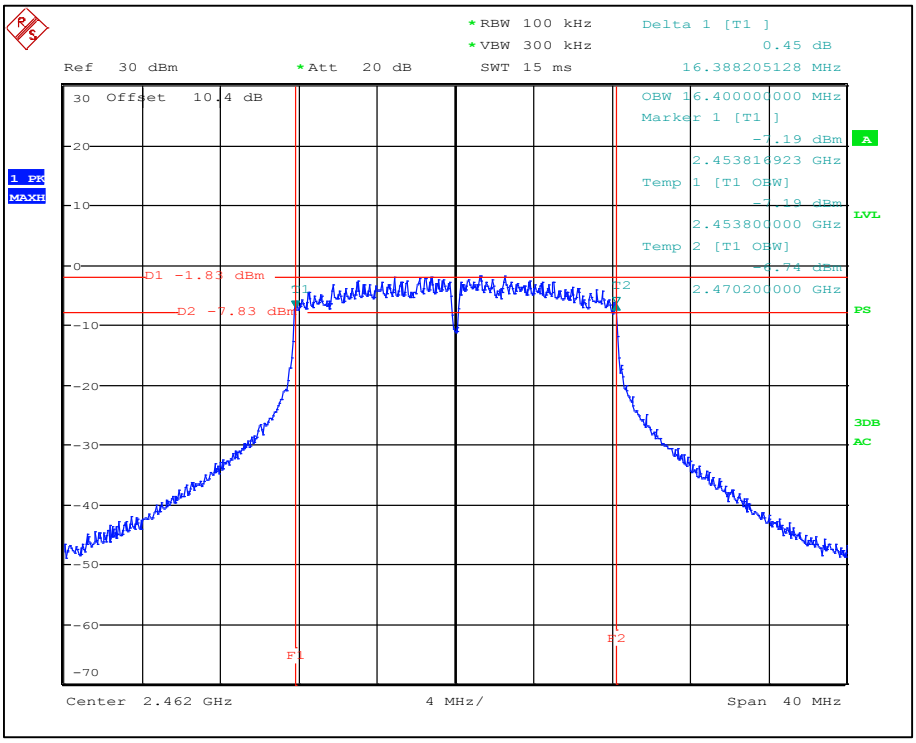
802.11b: 11Mbps – Channel 11 (2462 MHz) 6dB DTS BW and 99% OBW



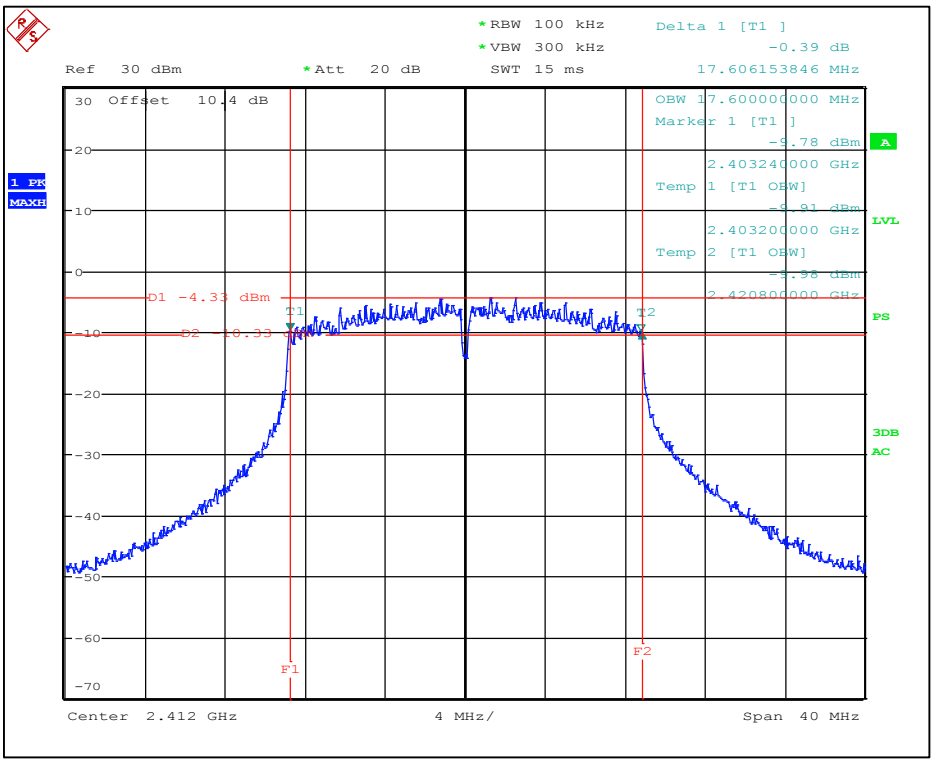
802.11g: 6 Mbps – Channel 1 (2412 MHz) 6dB DTS BW and 99% OBW



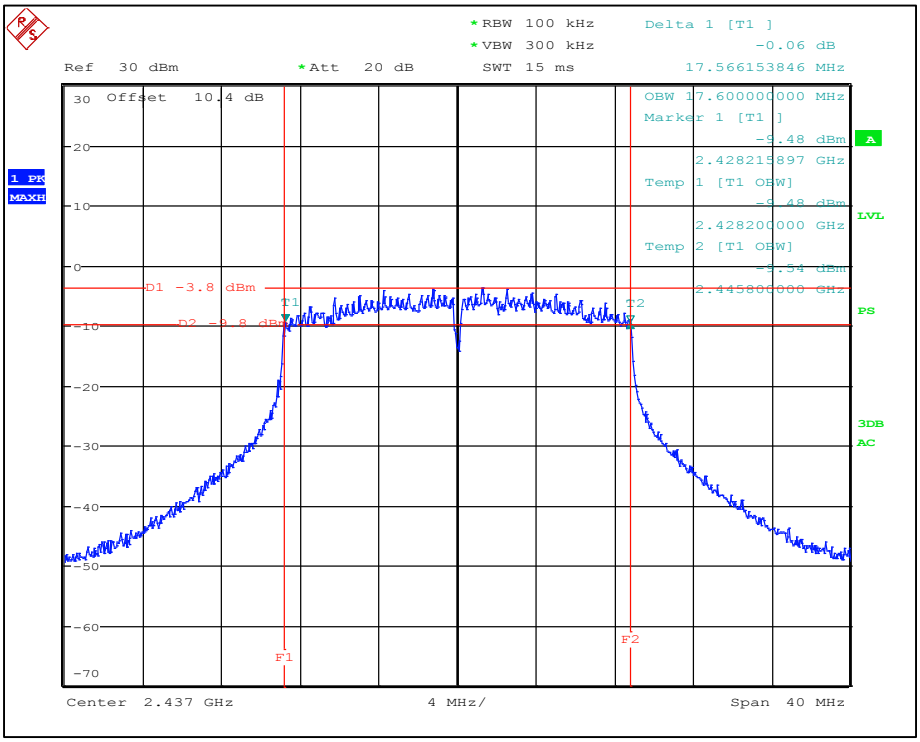
802.11g: 6 Mbps – Channel 6 (2437 MHz) 6dB DTS BW and 99% OBW



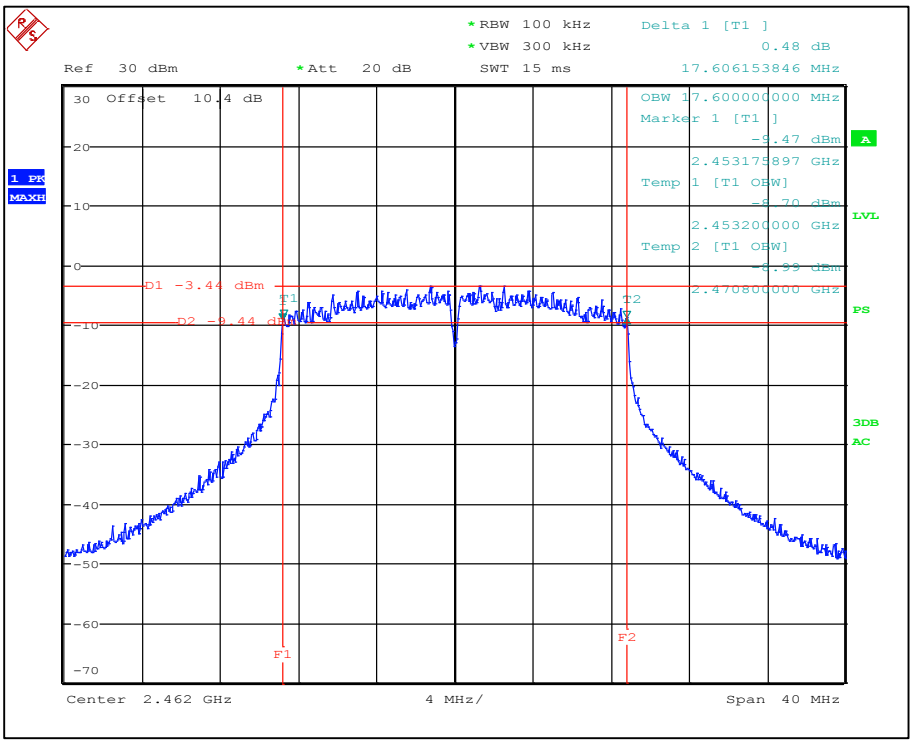
802.11g: 6 Mbps – Channel 11 (2462 MHz) 6dB DTS BW and 99% OBW



802.11n: MCS0 – Channel 1 (2412 MHz) 6dB DTS BW and 99% OBW



802.11n: MCS0 – Channel 6 (2437 MHz) 6dB DTS BW and 99% OBW



802.11n: MCS0 – Channel 11 (2462 MHz) 6dB DTS BW and 99% OBW

6.2 Maximum Conducted Output Power and e.i.r.p.

Limits

FCC Part 15 Subpart C §15.247 (b) (3)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level..

Industry Canada RSS-247 Issue 1 §5.4 (4)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

Test Procedures

For transmit duty cycle ≥ 98%
-ANSI C63.10-2013 § 11.9.2.2.2 Method AVGSA-1
-KDB 558074 D01 v03r03 § 9.2.2.2 Method AVGSA-1

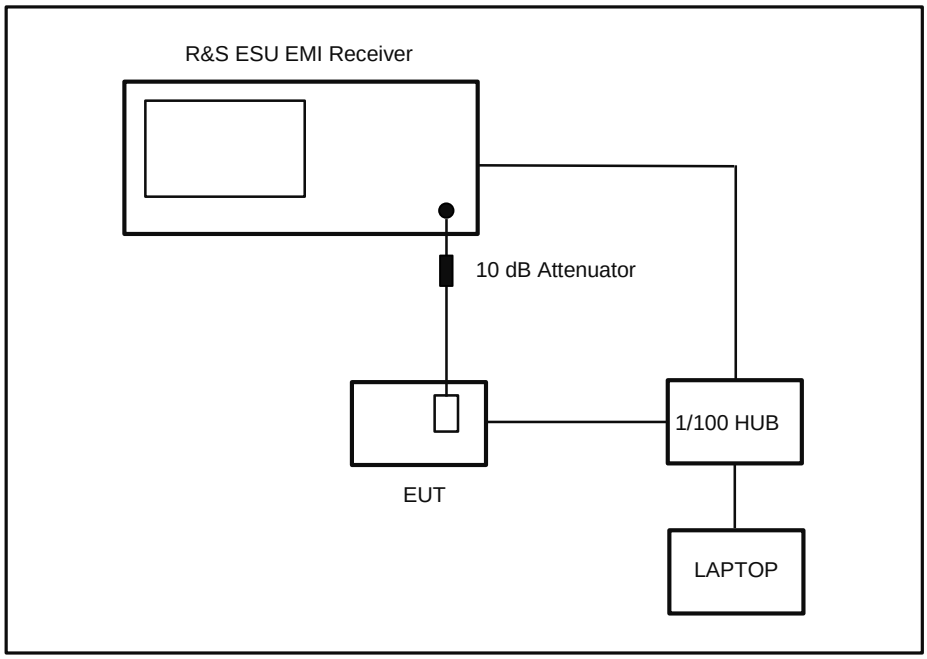
For transmit duty cycle ≤ 98%
-ANSI C63.10-2013 § 11.9.2.2.4 Method AVGSA-2
-KDB 558074 D01 v03r03 § 9.2.2.4 Method AVGSA-2

Note:

Spectrum Analyzer Offset level Calculation:

OFFSET (dB) = 10.4 dB (10 dB Attenuator Pad + 0.4 dB cable loss) [for 1Mbps, 6Mbps, & MCS0 data rates]
OFFSET (dB) = 10.5 dB (10 dB Attenuator Pad + 0.4 dB cable loss + 0.11 Duty Cycle Factor) [for 11Mbps data rate]

Test Setup

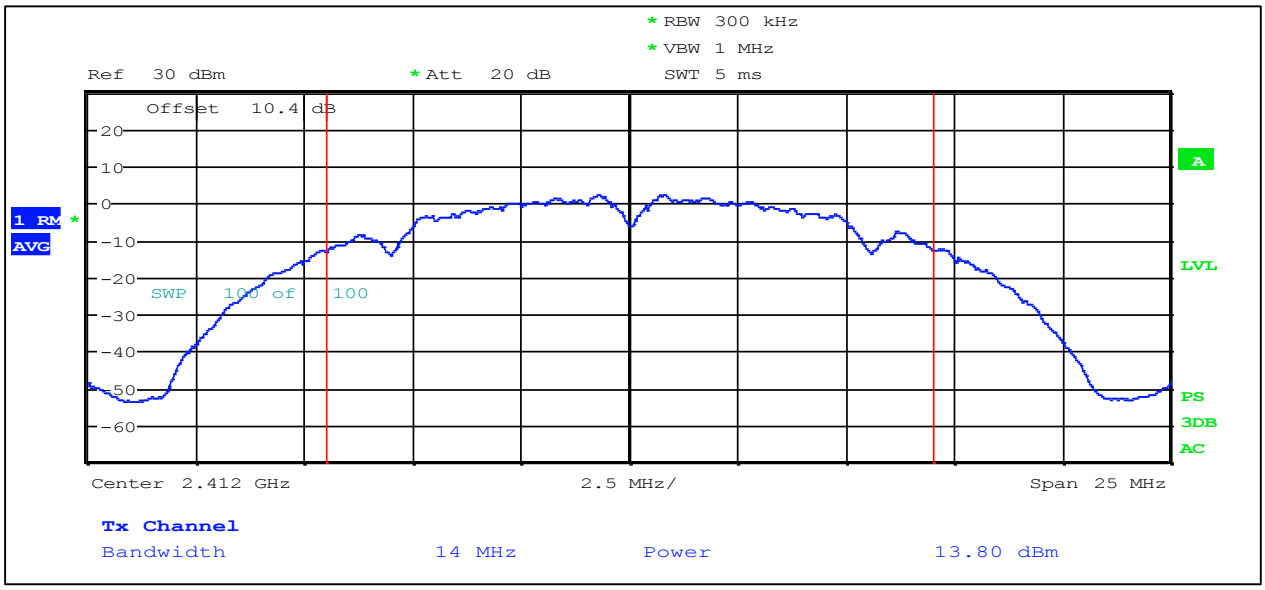


Test Results

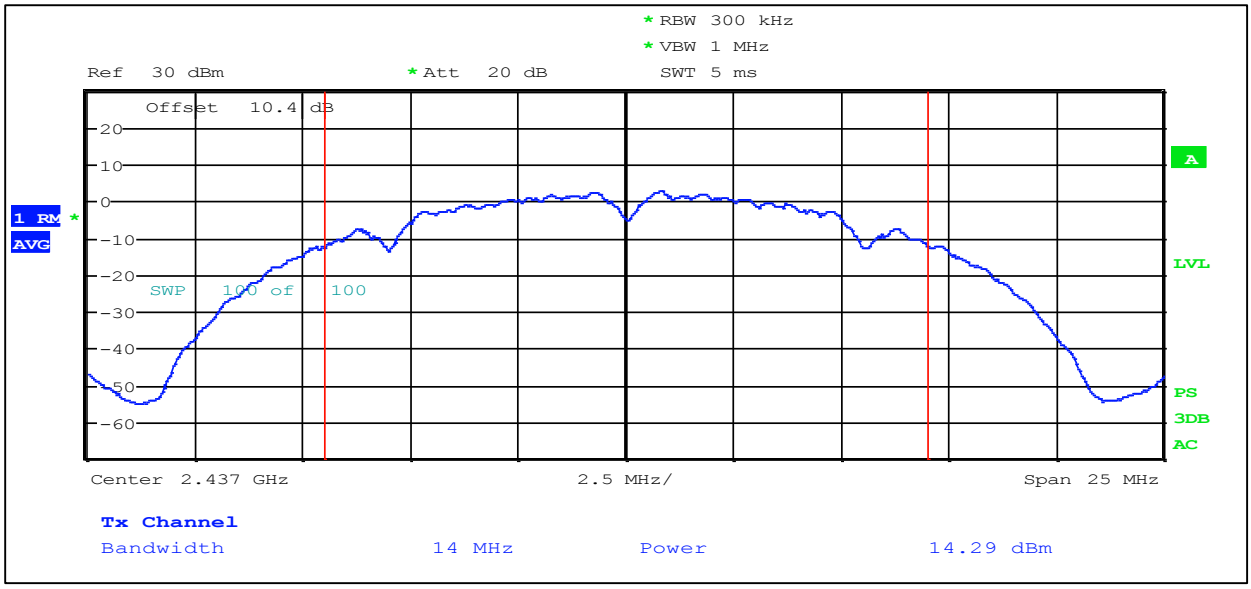
6.2.1 Maximum Conducted Output Power and e.i.r.p

802.11 Mode	Data Rate	Channel	Frequency (MHz)	Maximum Conducted Output Power			e.i.r.p.			
				Result (dBm)	Limit (dBm)	Margin (dB)	Directional Gain (dBi)	Result (dBm)	Limit (dBm)	Margin (dB)
b	1 Mbps	1	2412	13.8	30.0	-16.2	2.5	16.3	36.0	-19.7
		6	2437	14.3	30.0	-15.7	2.5	16.8	36.0	-19.2
		11	2462	14.9	30.0	-15.1	2.5	17.4	36.0	-18.6
	11 Mbps	1	2412	13.0	30.0	-17.0	2.5	15.5	36.0	-20.5
		6	2437	13.6	30.0	-16.4	2.5	16.1	36.0	-19.9
		11	2462	13.9	30.0	-16.1	2.5	16.4	36.0	-19.6
g	6 Mbps	1	2412	8.9	30.0	-21.1	2.5	11.4	36.0	-24.6
		6	2437	9.5	30.0	-20.5	2.5	12.0	36.0	-24.0
		11	2462	9.9	30.0	-20.1	2.5	12.4	36.0	-23.6
n (20 MHz)	MCS0	1	2412	8.9	30.0	-21.1	2.5	11.4	36.0	-24.6
		6	2437	9.5	30.0	-20.5	2.5	12.0	36.0	-24.0
		11	2462	9.8	30.0	-20.2	2.5	12.3	36.0	-23.7

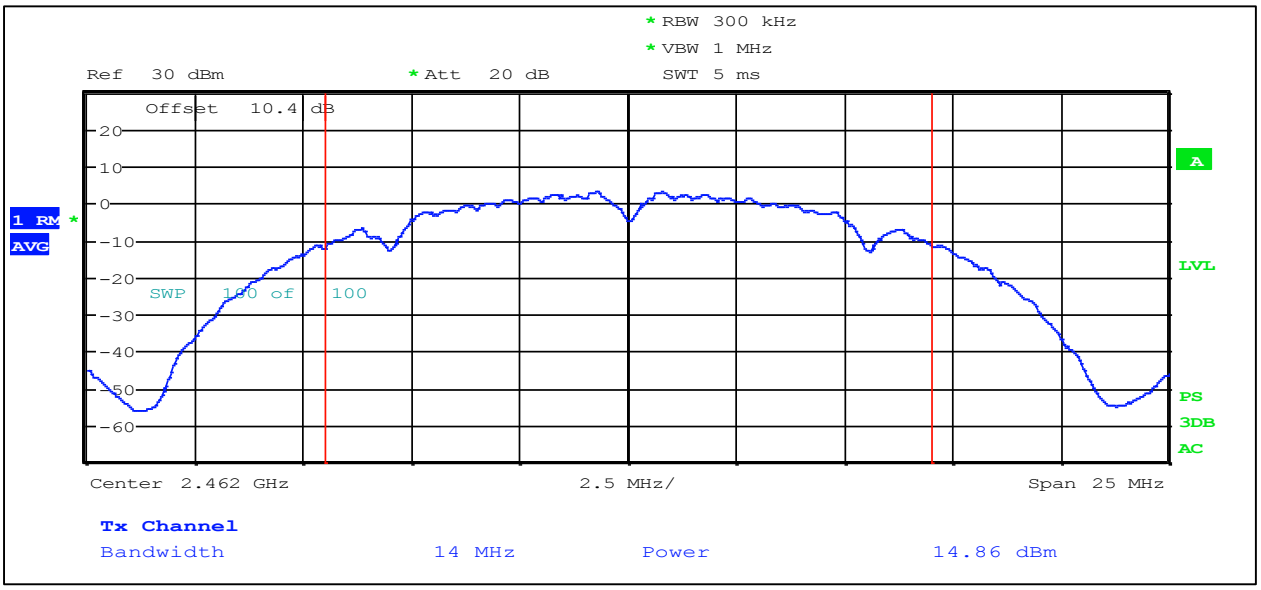
Refer to the following plots



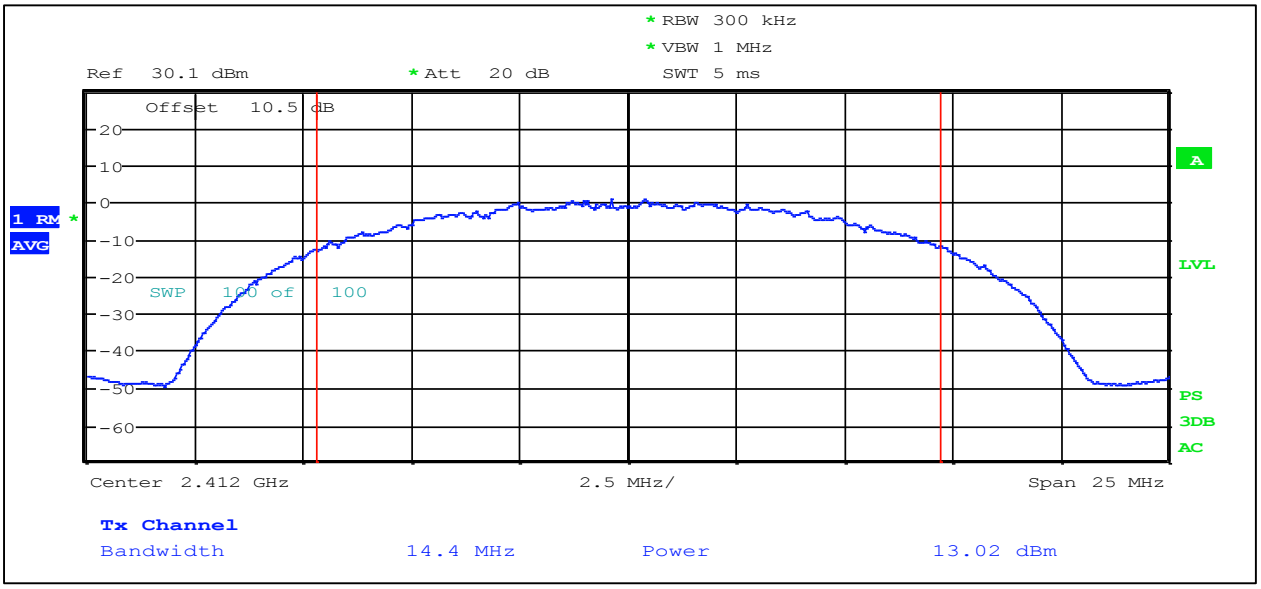
802.11b: 1 Mbps – Channel 1 (2412 MHz) Maximum Conducted Output Power



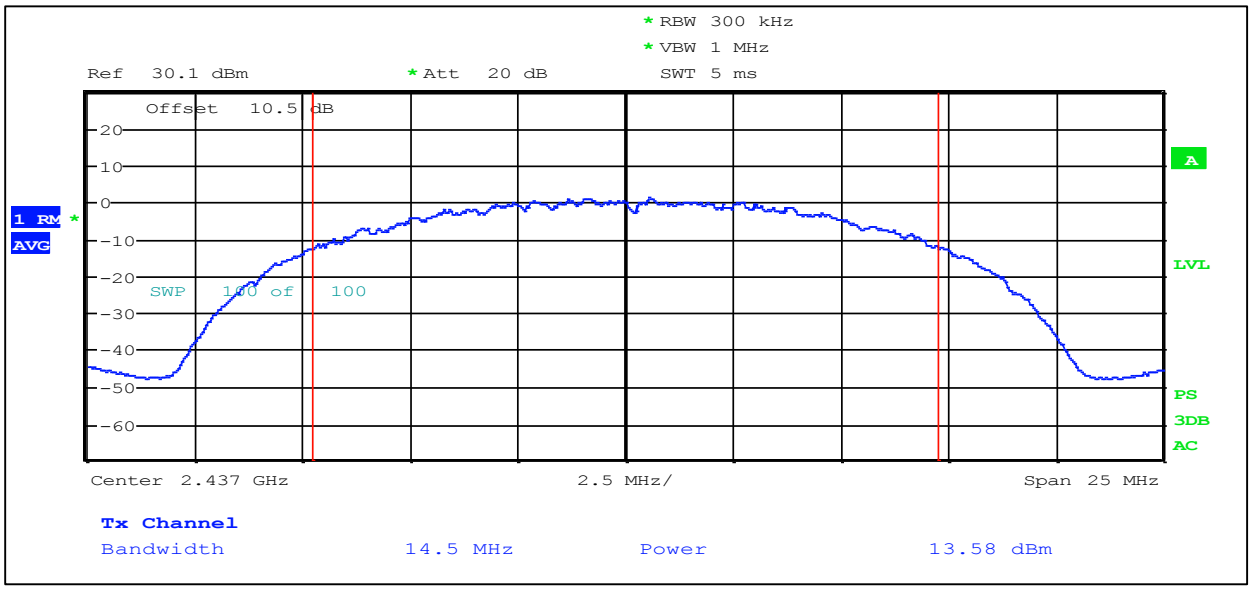
802.11b: 1 Mbps – Channel 6 (2437 MHz) Maximum Conducted Output Power



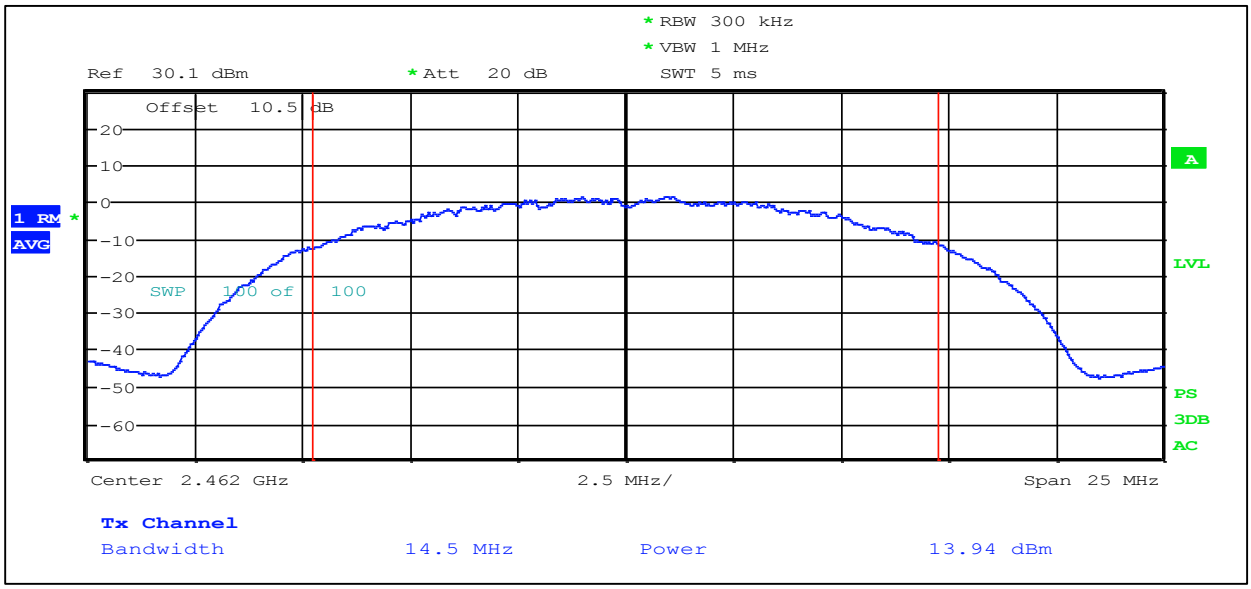
802.11b: 1 Mbps – Channel 11 (2462 MHz) Maximum Conducted Output Power



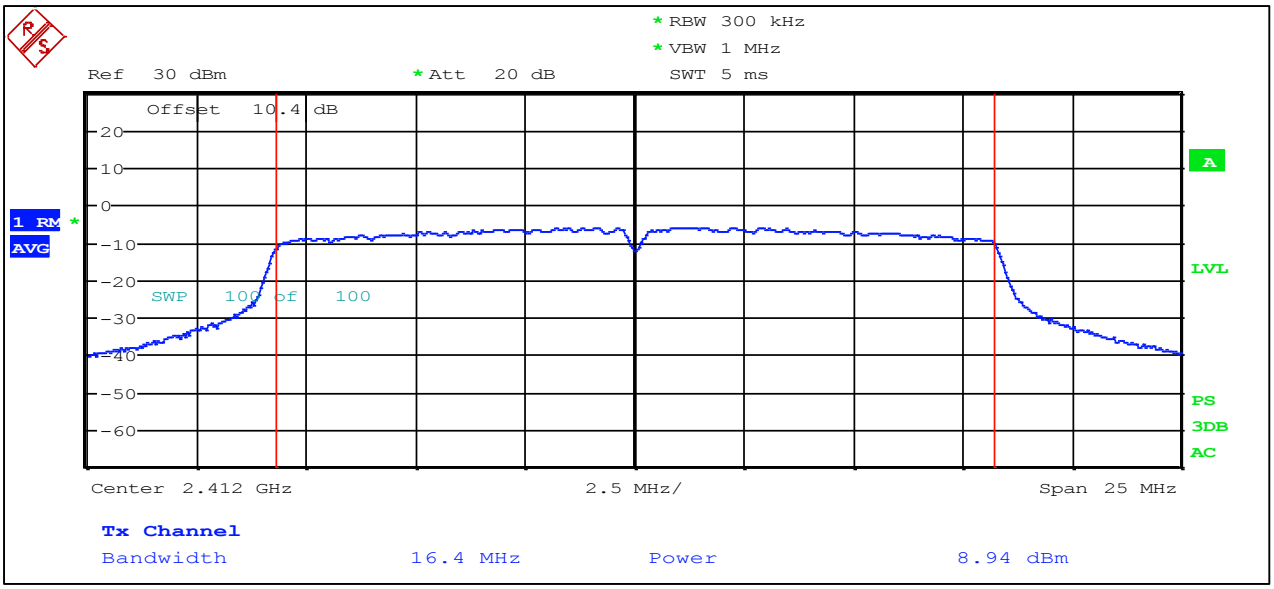
802.11b: 11 Mbps – Channel 1 (2412 MHz) Maximum Conducted Output Power



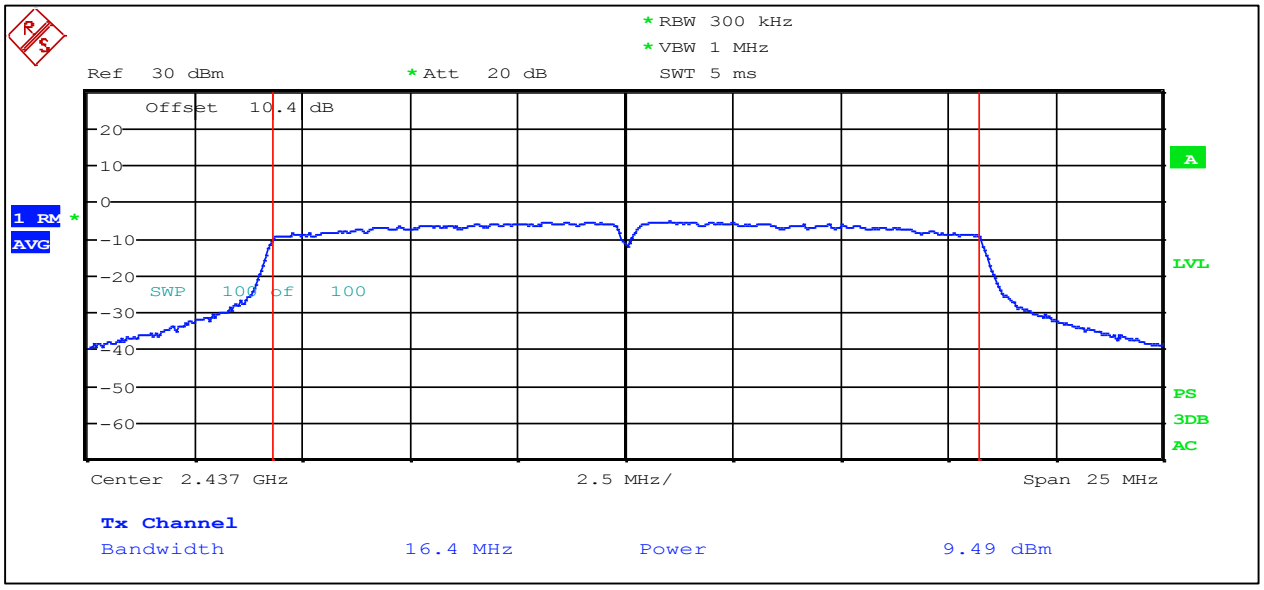
802.11b: 11 Mbps – Channel 6 (2437 MHz) Maximum Conducted Output Power



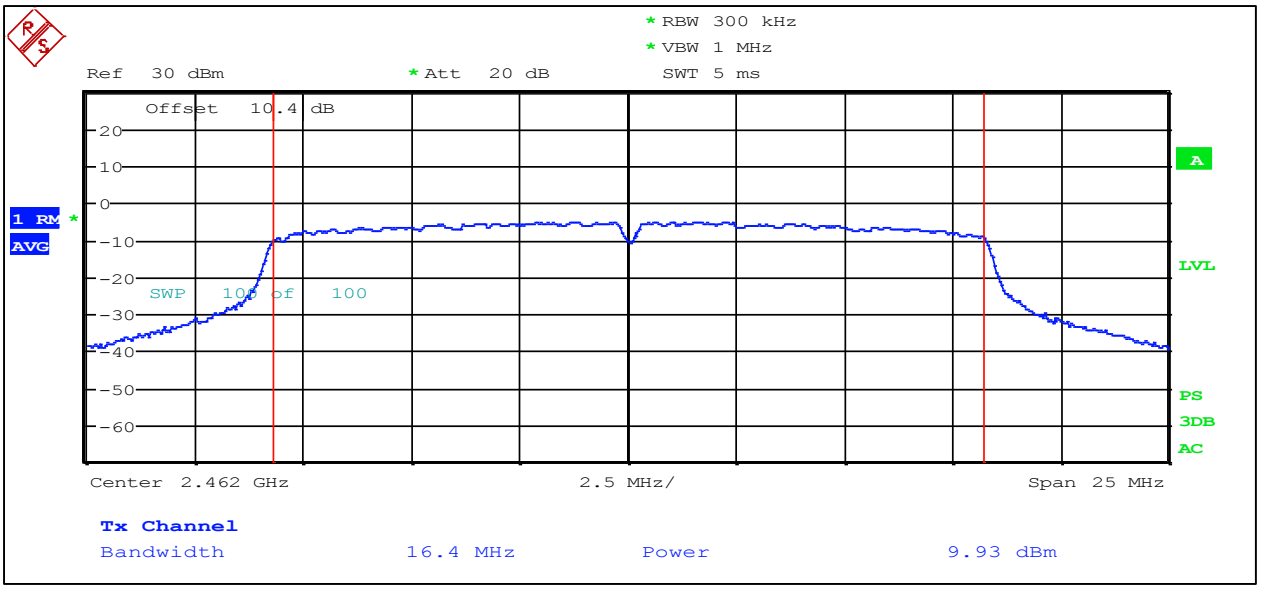
802.11b: 11 Mbps – Channel 11 (2462 MHz) Maximum Conducted Output Power



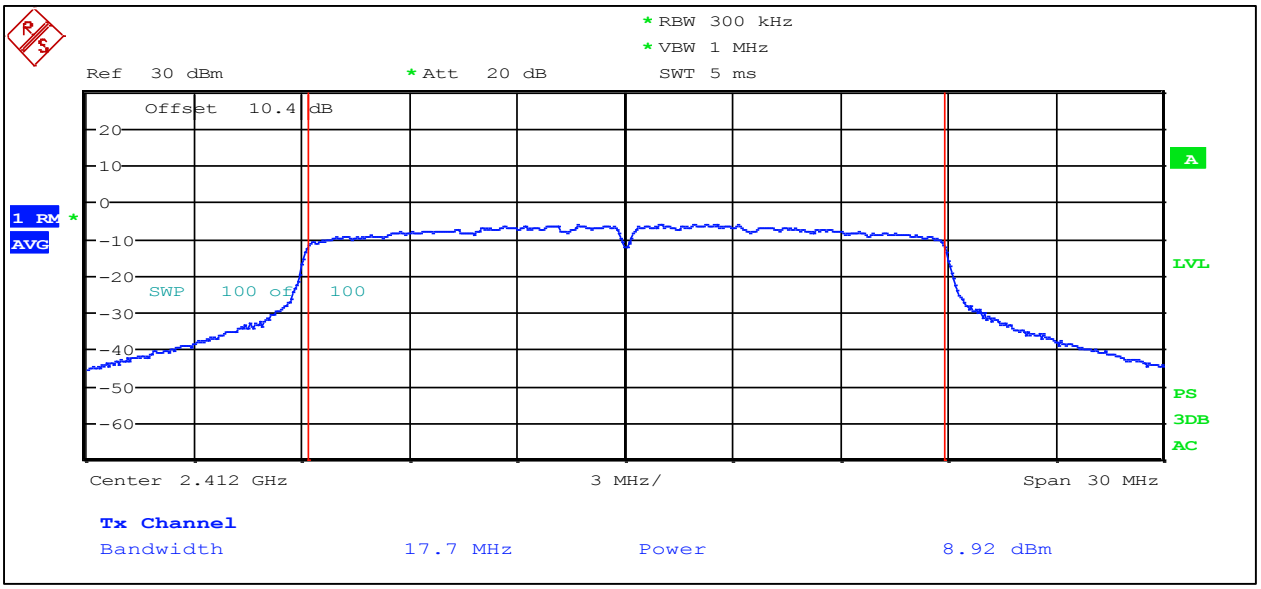
802.11g: 6 Mbps – Channel 1 (2412 MHz) Maximum Conducted Output Power



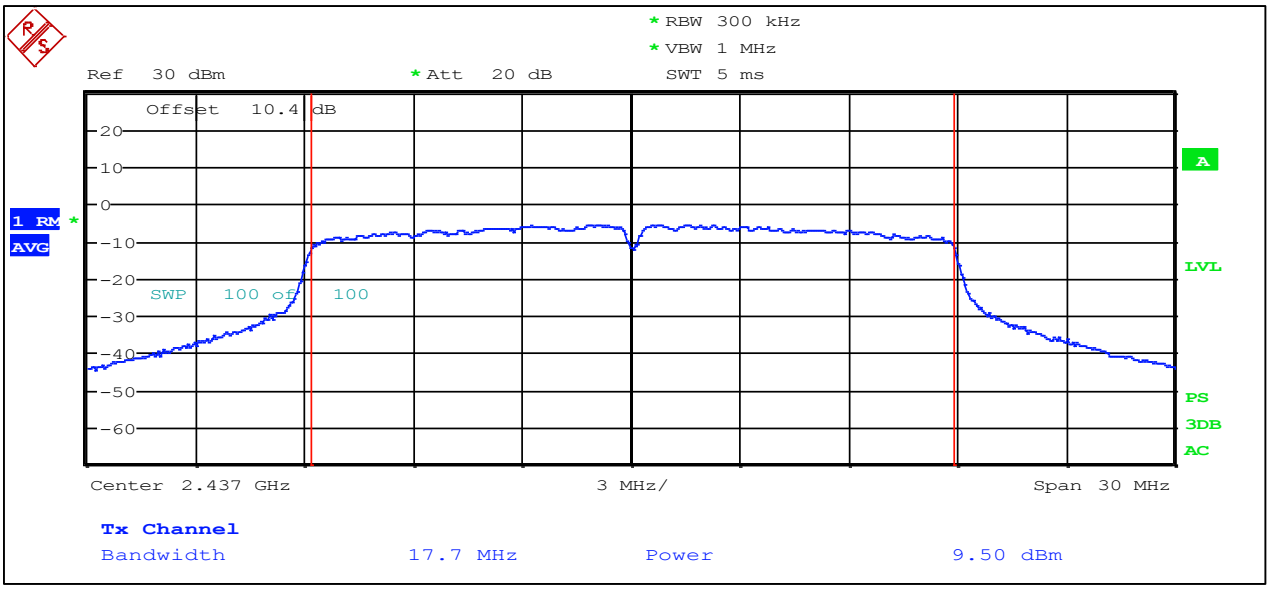
802.11g: 6 Mbps – Channel 6 (2437 MHz) Maximum Conducted Output Power



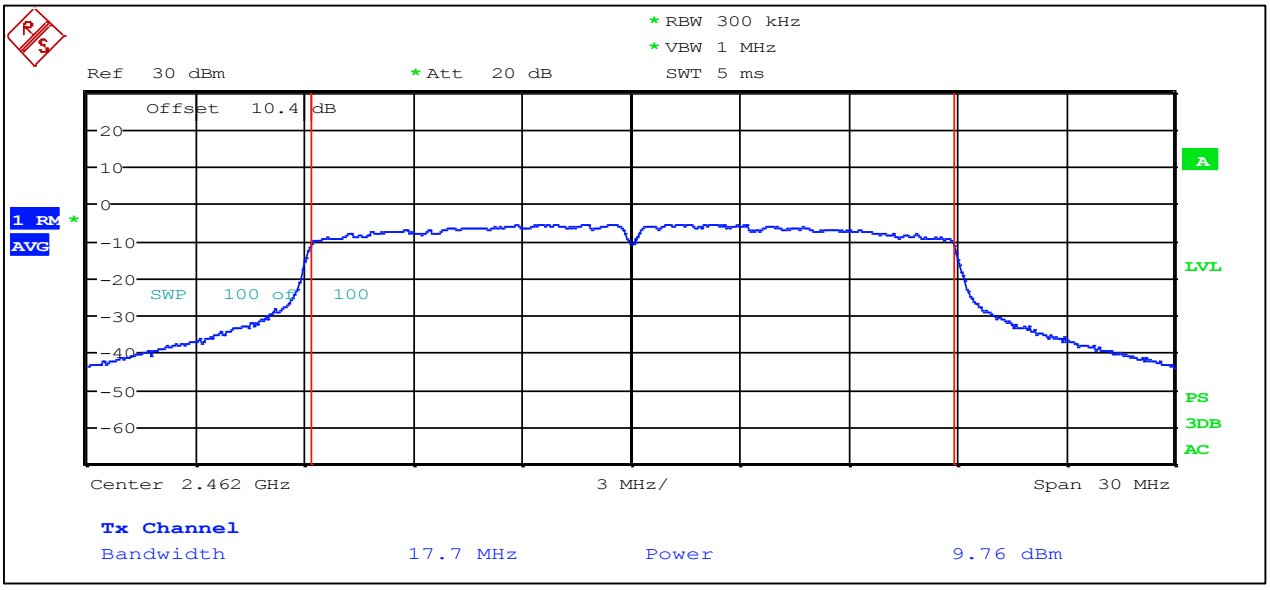
802.11g: 6 Mbps – Channel 11 (2462 MHz) Maximum Conducted Output Power



802.11n: MCS0 – Channel 1 (2412 MHz) Maximum Conducted Output Power



802.11n: MCS0 – Channel 6 (2437 MHz) Maximum Conducted Output Power



802.11n: MCS0 – Channel 11 (2462 MHz) Maximum Conducted Output Power

6.3 Maximum Power Spectral Density

Limits

FCC Part 15 Subpart C §15.247 (e)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Industry Canada RSS-247 Issue §5.2 (2)

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4 (4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Procedures

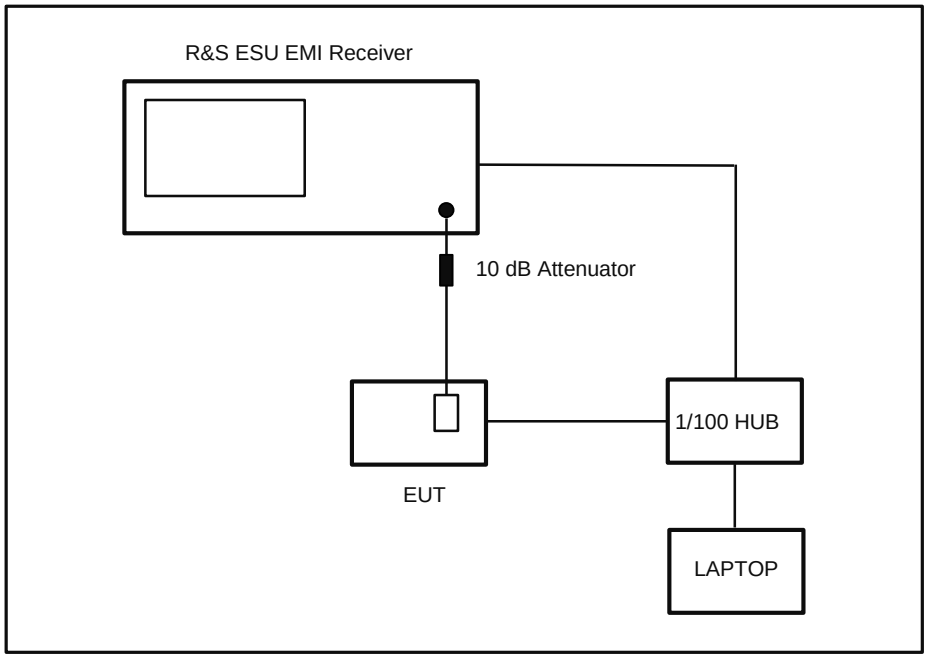
ANSI C63.10-2013 § 11.10.3 Method AVGPSD-1
KDB558074 D01 v03R03 § 10.3 Method AVGPSD-1

Note:

Spectrum Analyzer Offset level Calculation:

OFFSET (dB) = 10.4 dB (10 dB Attenuator Pad + 0.4 dB cable loss) [for 1Mbps, 6Mbps, & MCS0 data rates]
OFFSET (dB) = 10.5 dB (10 dB Attenuator Pad + 0.4 dB cable loss + 0.11 Duty Cycle Factor) [for 11Mbps data rate]

Test Setup

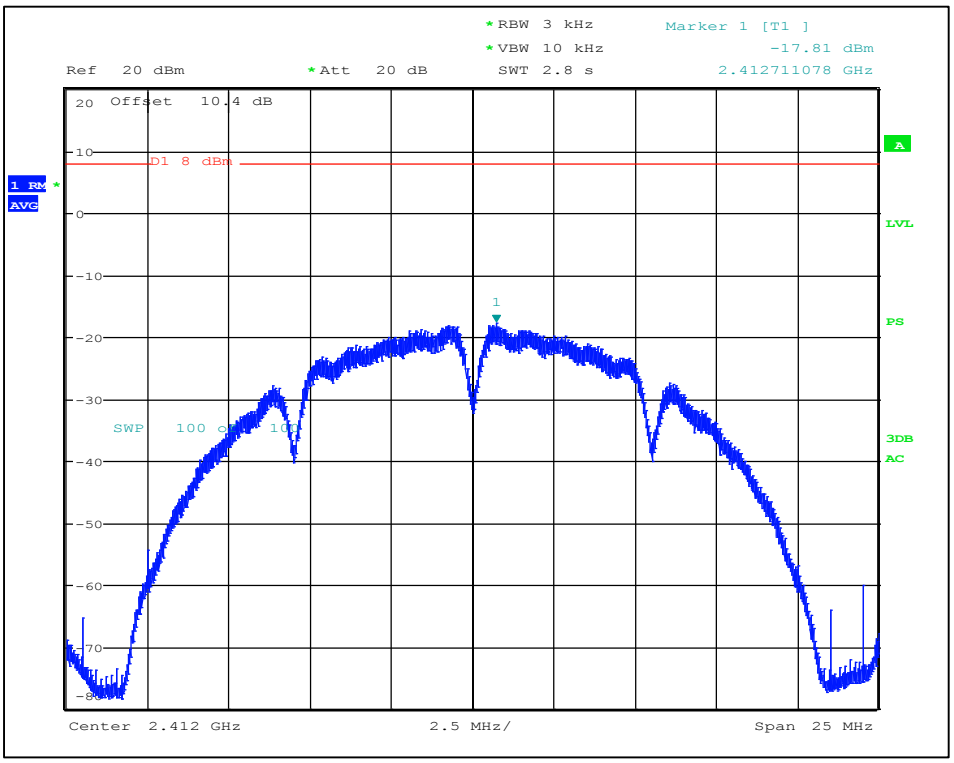


Test Results

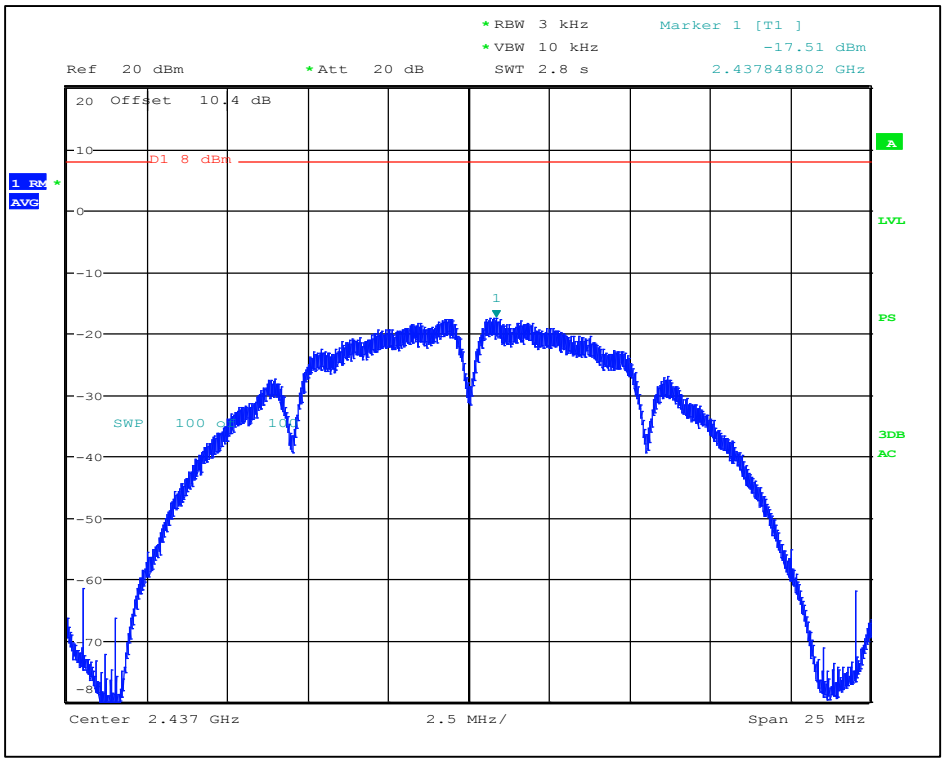
6.3.1 Maximum Power Spectral Density

802.11 Mode	Data Rate	Channel	Frequency (MHz)	Maximum PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
b	1 Mbps	1	2412	-17.8	8	-25.8
		6	2437	-17.5	8	-25.5
		11	2462	-16.4	8	-24.4
	11 Mbps	1	2412	-16.1	8	-24.1
		6	2437	-15.9	8	-23.9
		11	2462	-15.4	8	-23.4
g	6 Mbps	1	2412	-25.4	8	-33.4
		6	2437	-24.7	8	-32.7
		11	2462	-24.1	8	-32.1
802.11n HT20	MCS0	1	2412	-25.6	8	-33.6
		6	2437	-25.0	8	-33.0
		11	2462	-24.6	8	-32.6

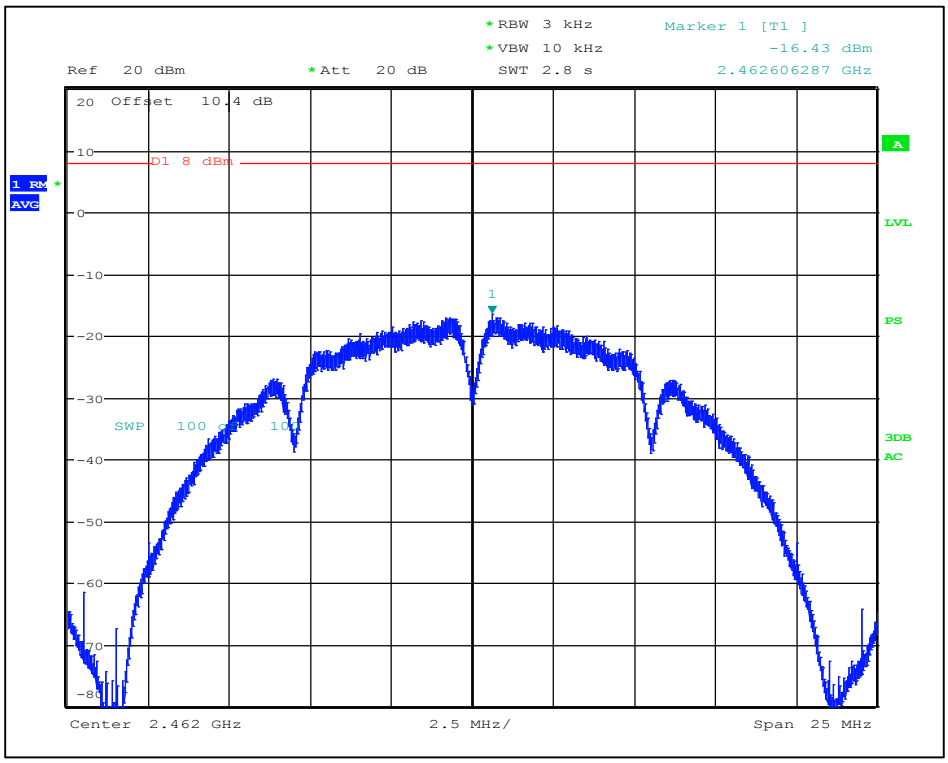
Refer to the following plots



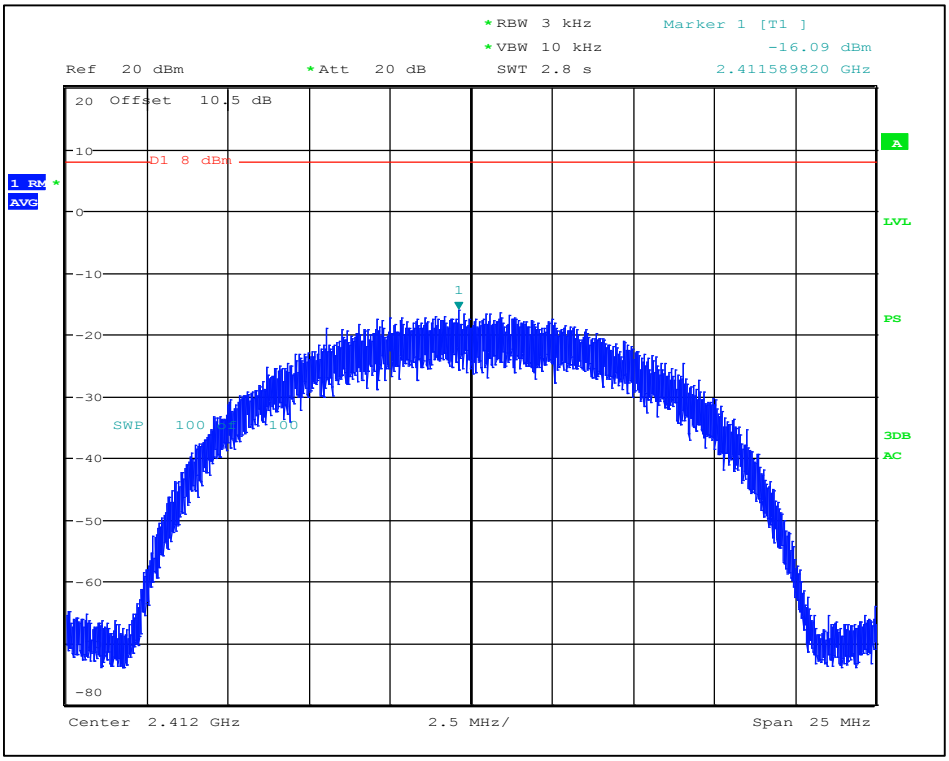
802.11b: 1 Mbps - Channel 1 (2412 MHz) Maximum PSD



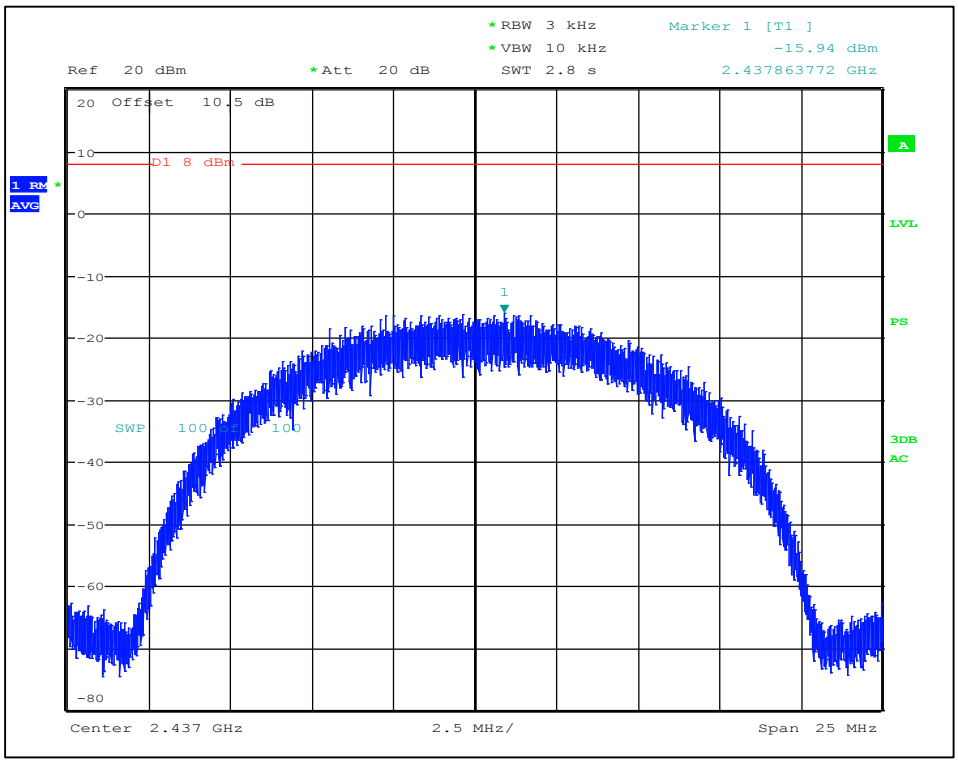
802.11b: 1 Mbps - Channel 6 (2437 MHz) Maximum PSD



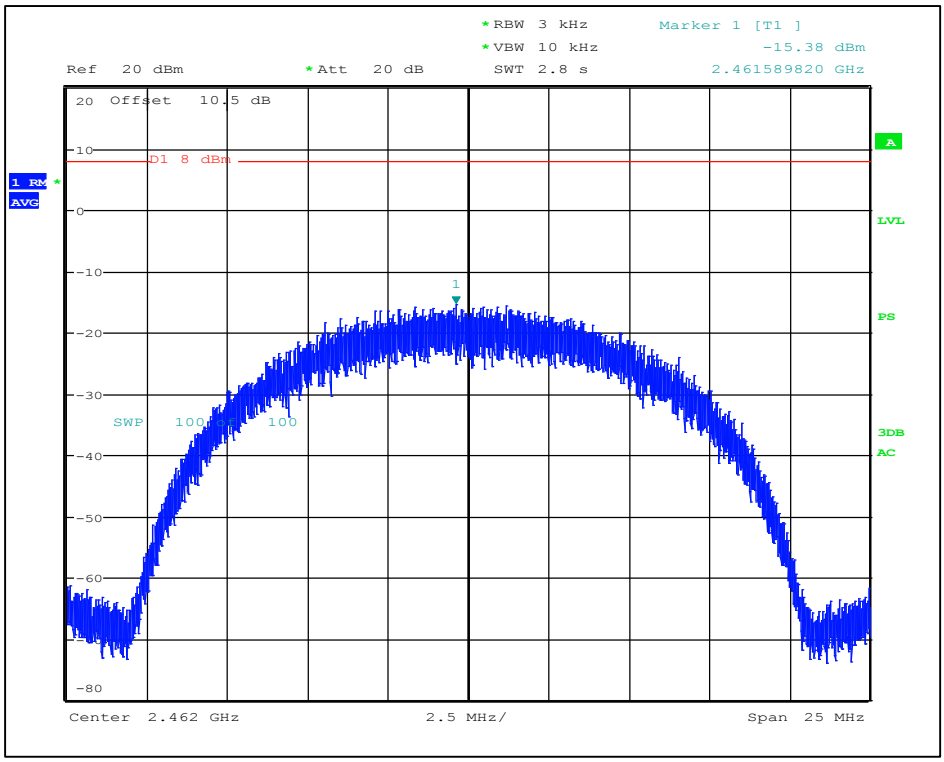
802.11b: 1 Mbps - Channel 11 (2462 MHz) Maximum PSD



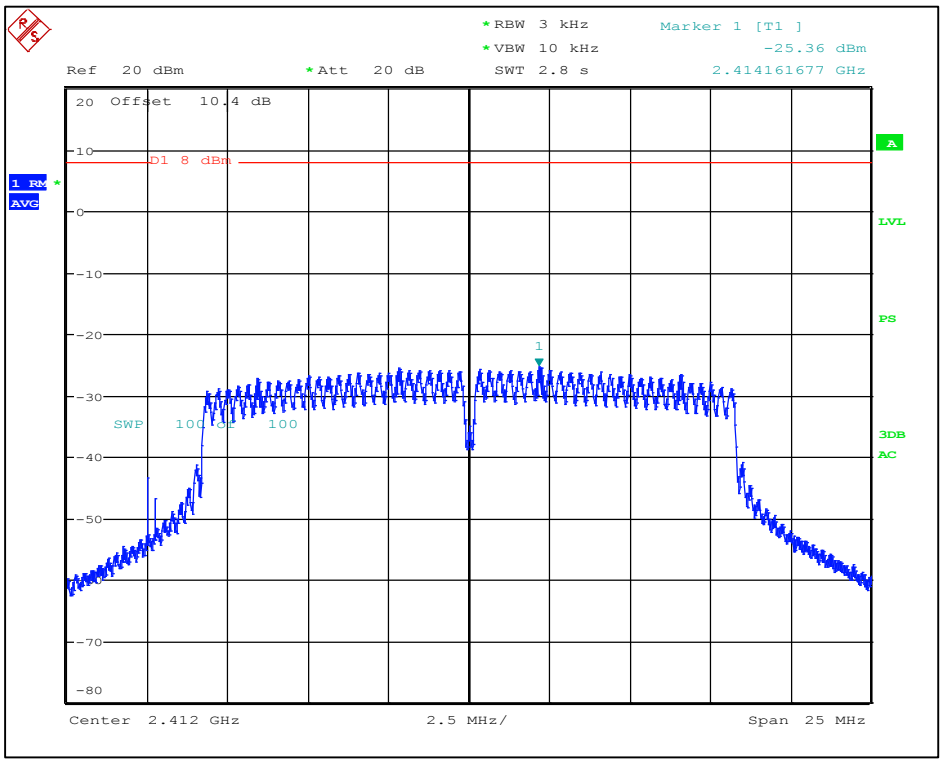
802.11b: 11 Mbps - Channel 1 (2412 MHz) Maximum PSD



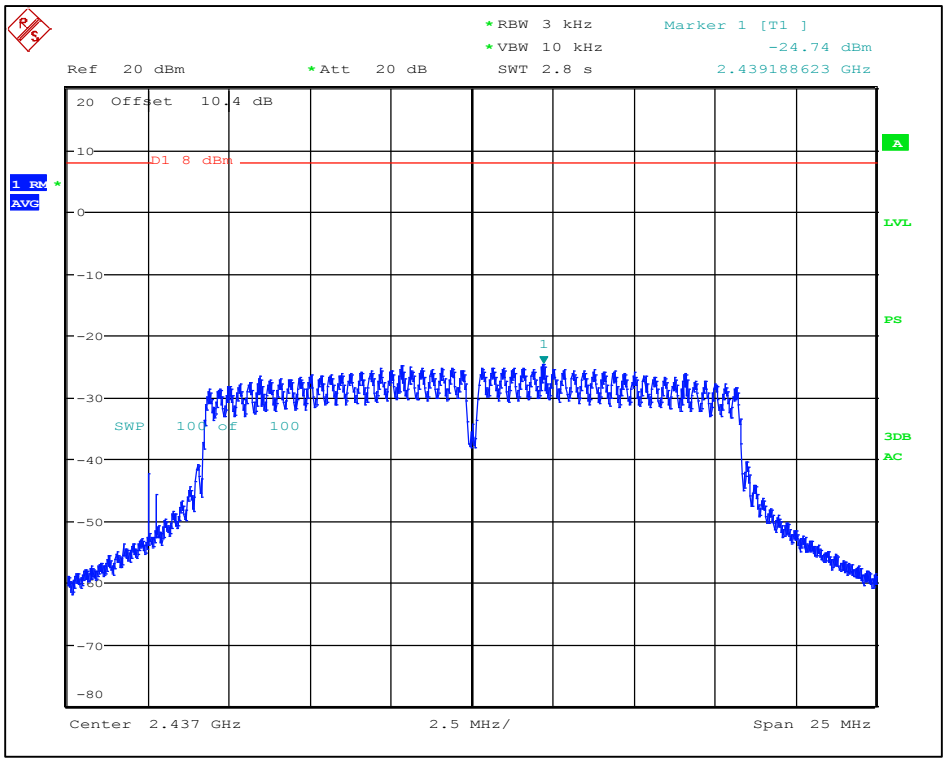
802.11b: 11 Mbps - Channel 6 (2437 MHz) Maximum PSD



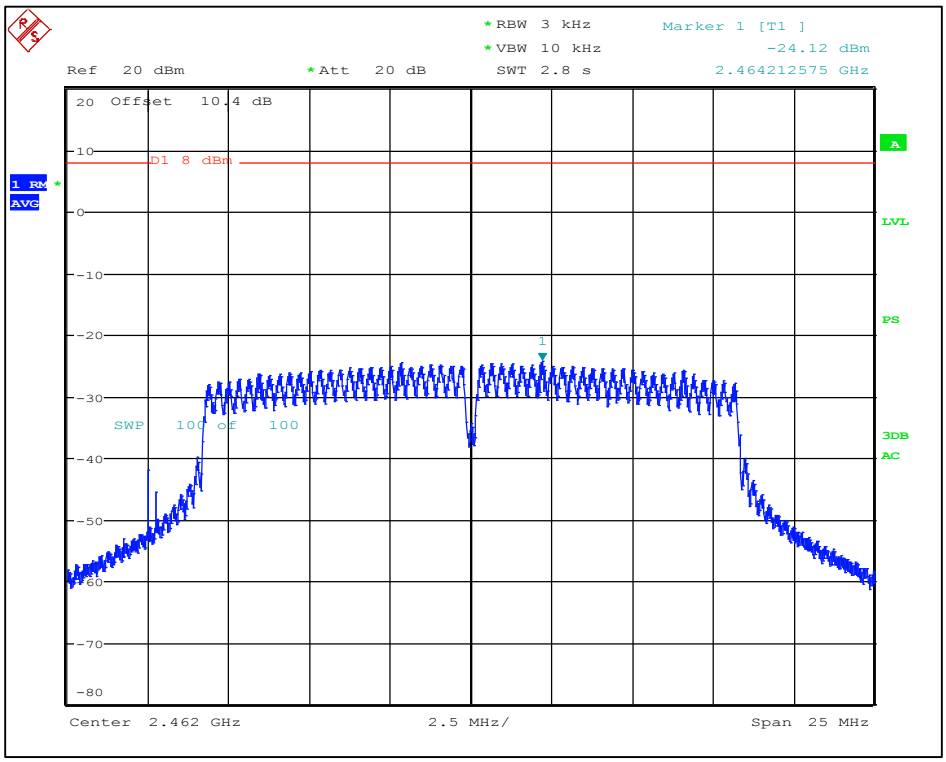
802.11b: 11 Mbps - Channel 11 (2462 MHz) Maximum PSD



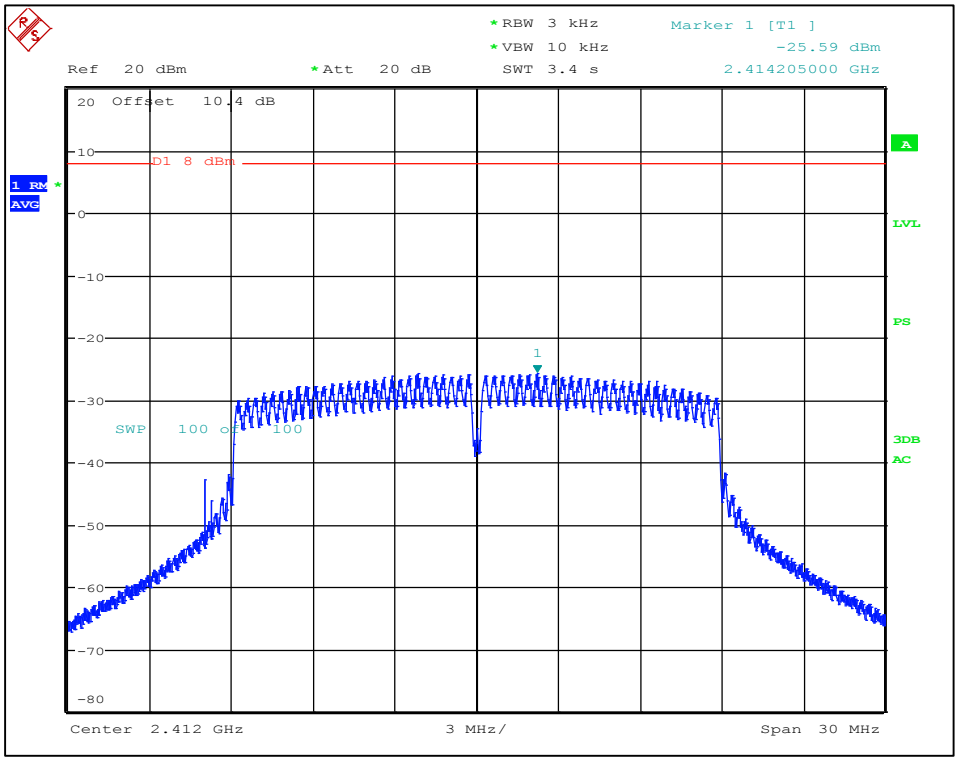
802.11g: 6 Mbps - Channel 1 (2412 MHz) Maximum PSD



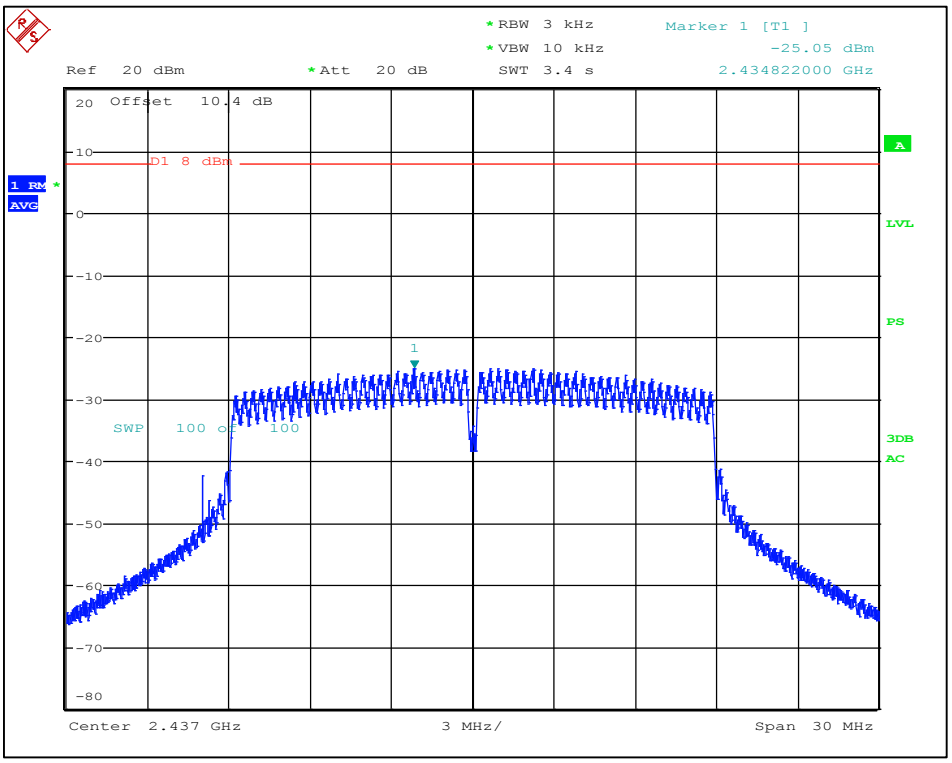
802.11g: 6 Mbps - Channel 6 (2437 MHz) Maximum PSD



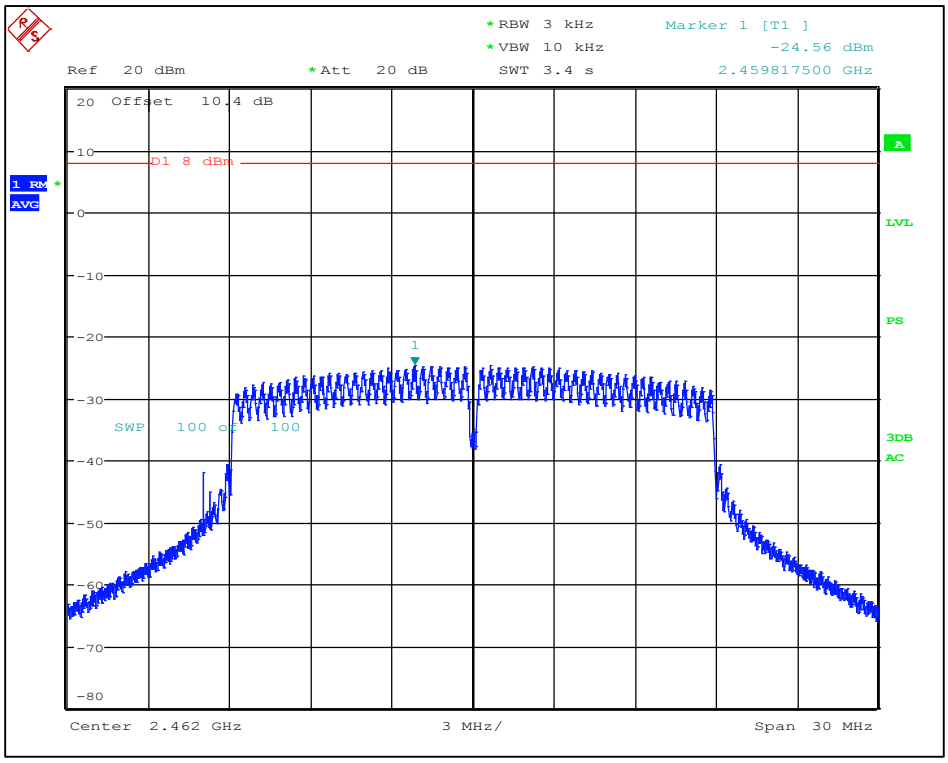
802.11g: 6 Mbps - Channel 11 (2462 MHz) Maximum PSD



802.11n: MCS0 - Channel 1 (2412 MHz) Maximum PSD



802.11n: MCS0 - Channel 6 (2437 MHz) Maximum PSD



802.11n: MCS0 - Channel 11 (2462 MHz) Maximum PSD

6.4 Unwanted Emissions: Conducted Spurious Emissions at Antenna Port

Limits

FCC Part 15 Subpart C §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Industry Canada RSS-247 Issue 1 §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

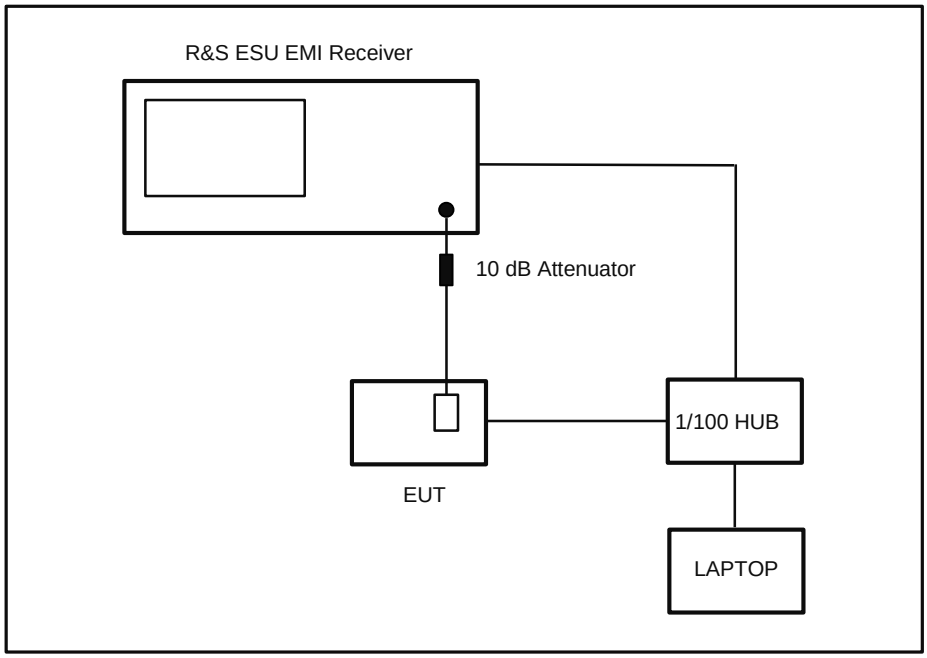
Test Procedures

ANSI C63.10-2013 § 6.10.4 – Authorized band-edge measurements
KDB 558074 v03r03 §11.0– Emissions in the non-restricted frequency bands

Note:
Authorized band-edge measurements and In-band reference level:
• *EMI Receiver (Spectrum Analyzer) Reference Level Offset = 10.4 dB (10 dB Attenuator Pad + 0.4 cable loss)*

Conducted spurious emissions measurements up to 25 GHz:
• *EMI Receiver (Spectrum Analyzer) Reference Level Offset = 10 dB (10 dB Attenuator Pad); with transducer factor (cable loss) in the 30 MHz to 25 GHz.*

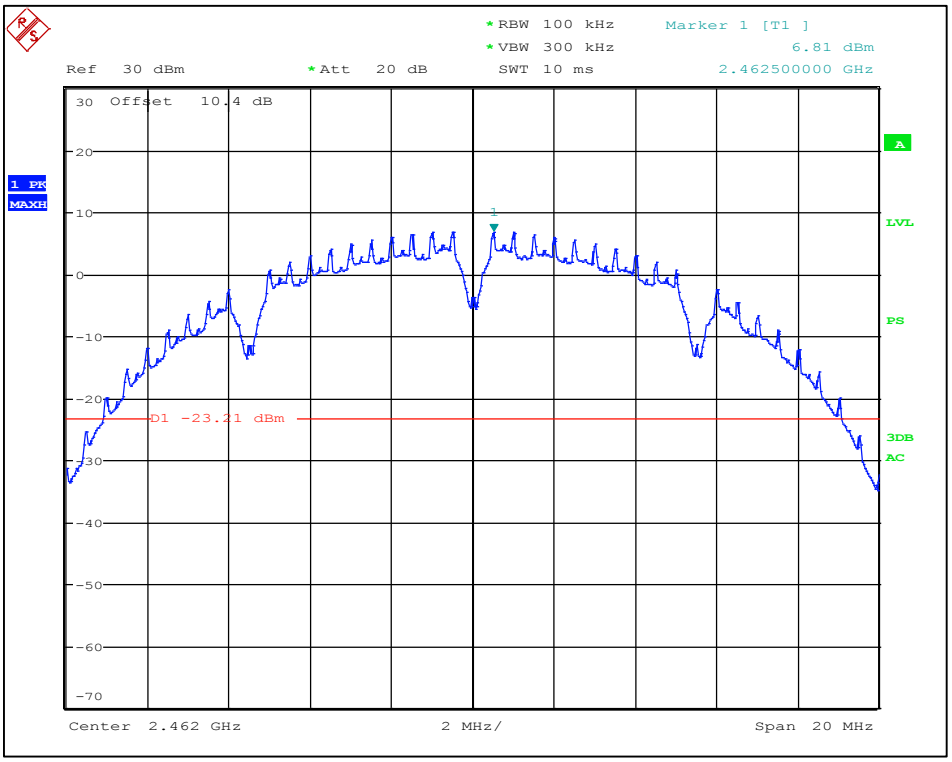
Test Setup



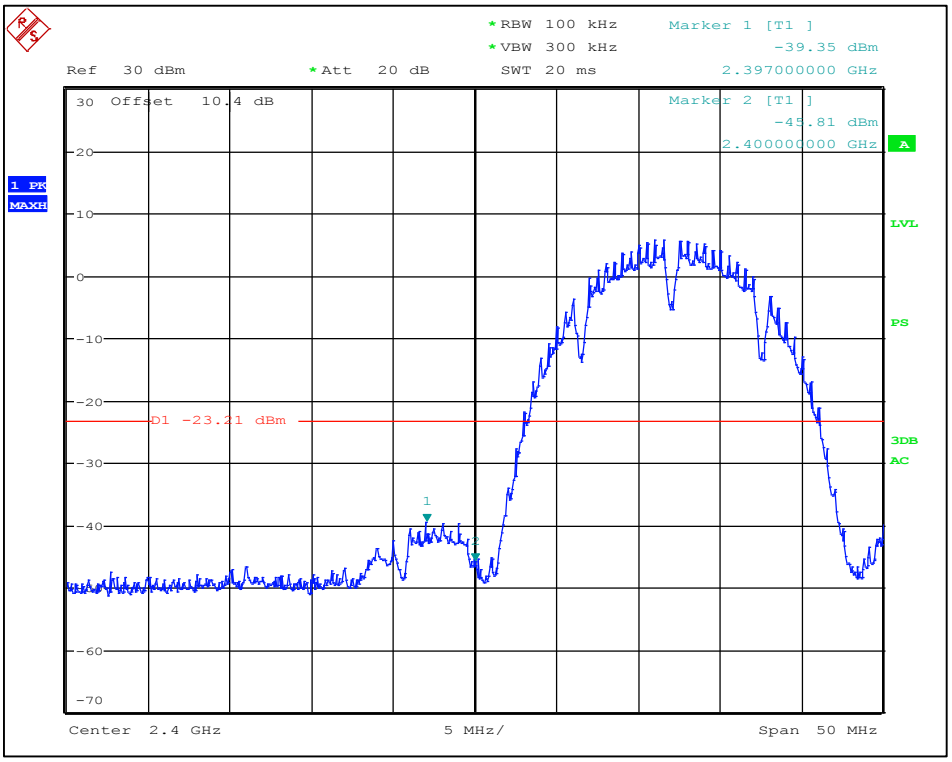
Test Results

6.4.1 Conducted Spurious Emissions at the authorized-band band-edge

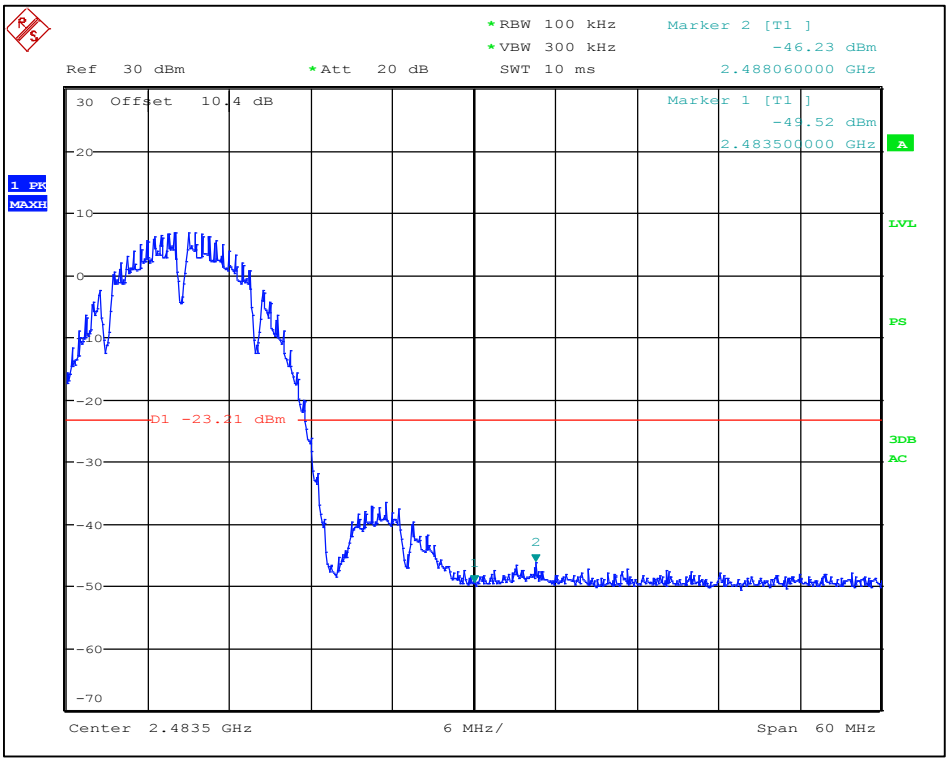
802.11b, 1 Mbps



In-band reference level (802.11b at 1Mbps- CH 11)

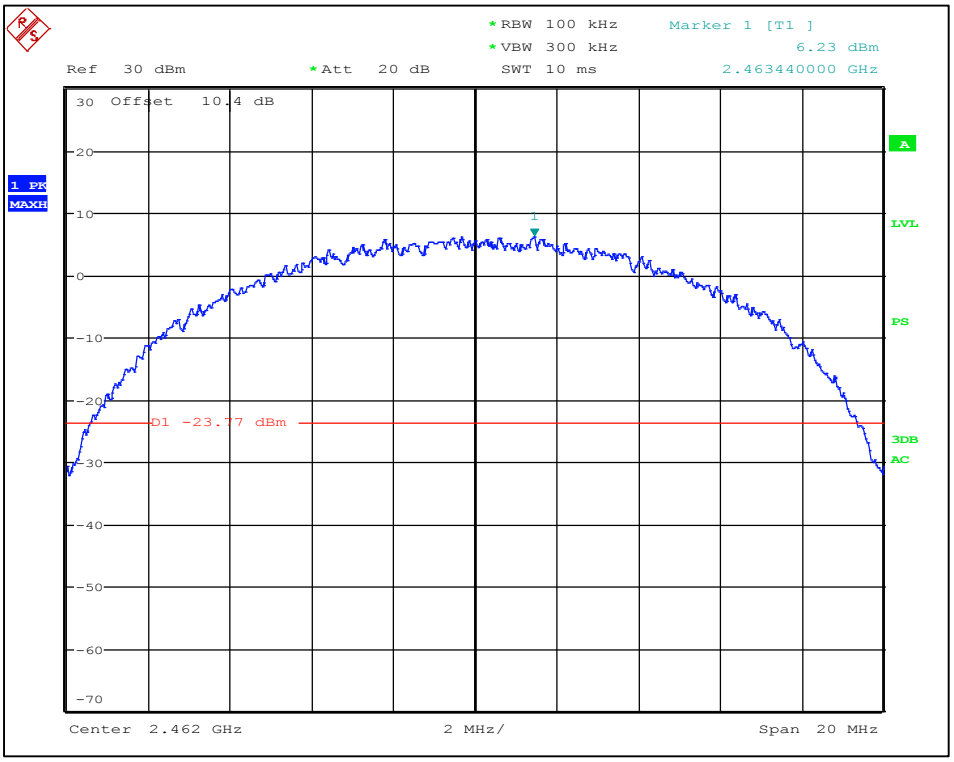


802.11b at 1Mbps – Conducted Spurious Emissions at the 2400 MHz Band Edge

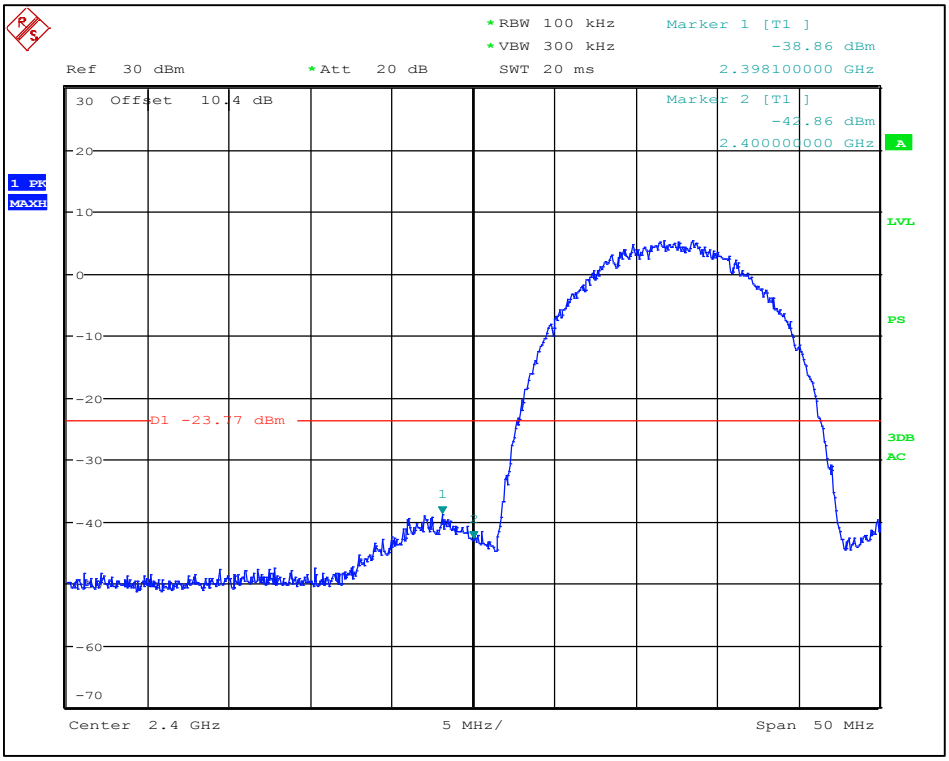


802.11b at 1Mbps - Conducted Spurious Emissions at the 2483.5 MHz Band Edge

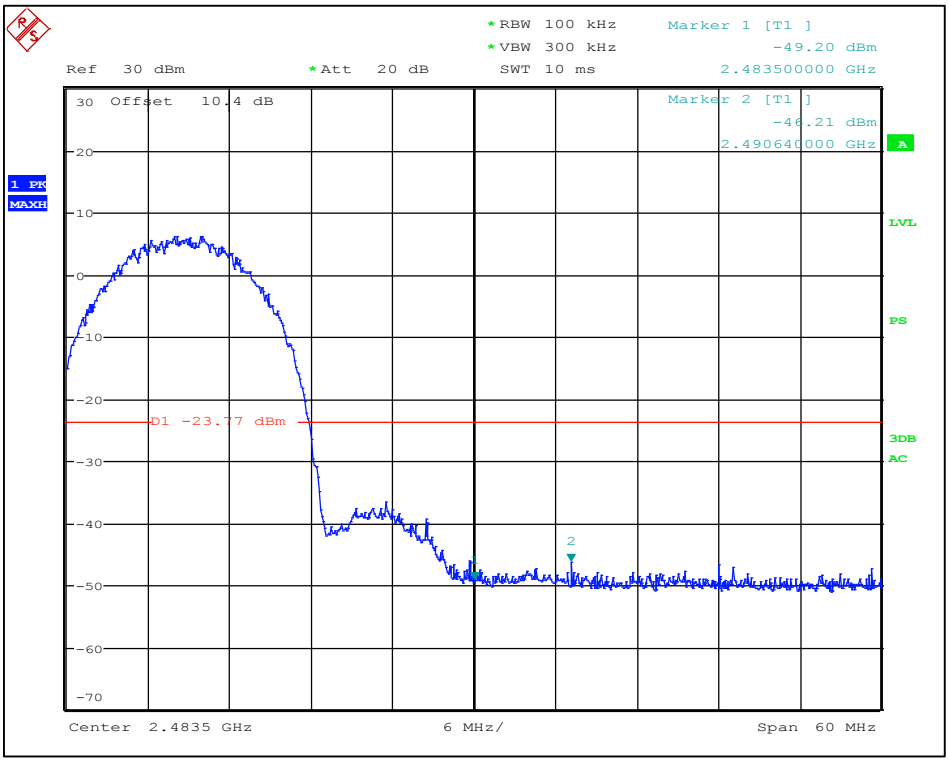
802.11b, 11 Mbps



In-band reference level (802.11b at 11Mbps- CH 11)

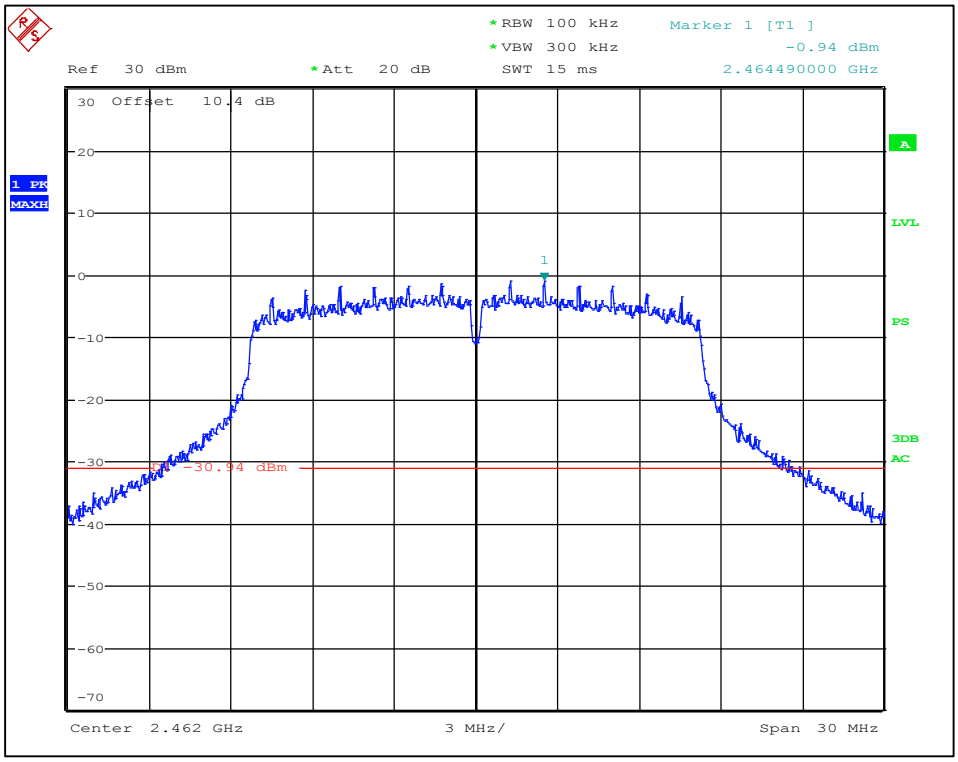


802.11b at 11Mbps – Conducted Spurious Emissions at the 2400 MHz Band Edge

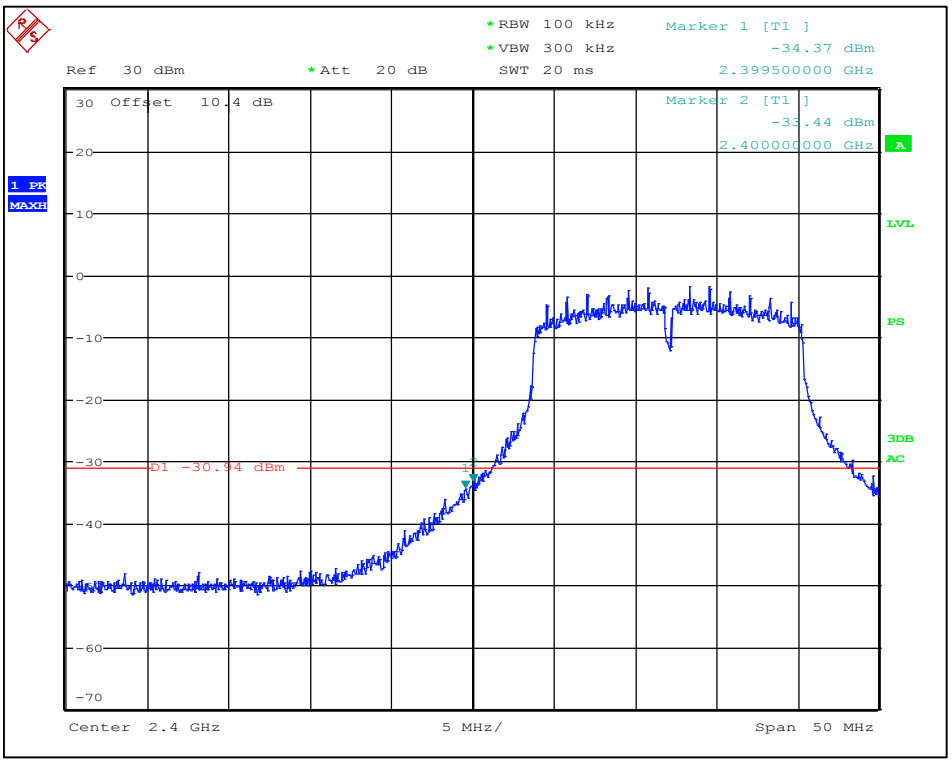


802.11b at 11Mbps - Conducted Spurious Emissions at the 2483.5 MHz Band Edge

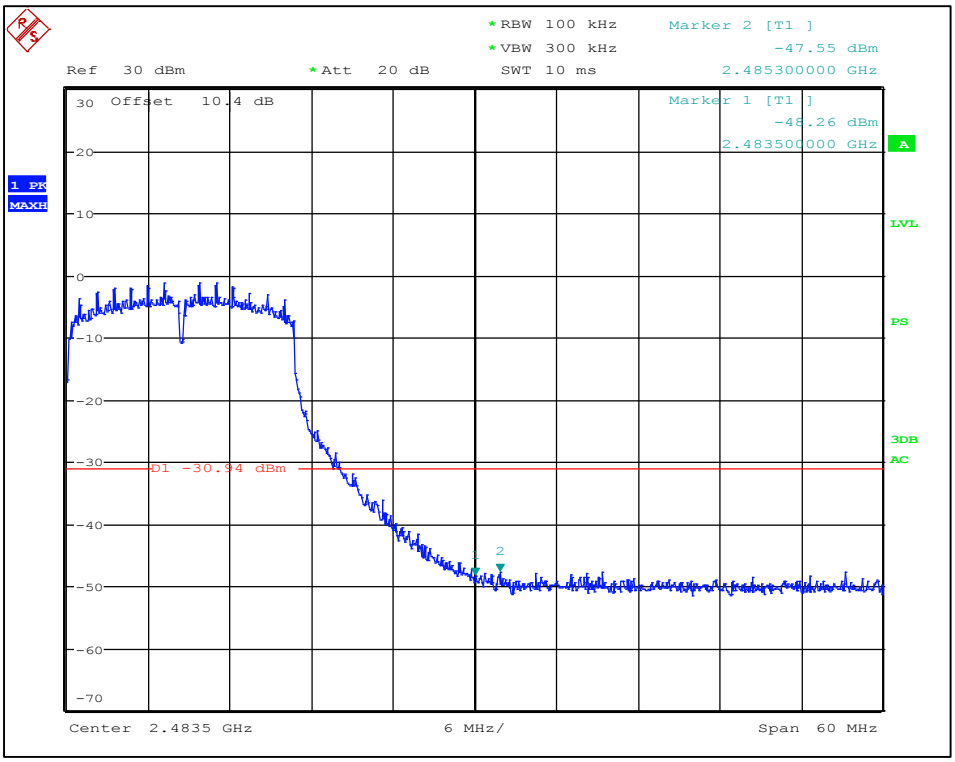
802.11g, 6 Mbps



In-band reference level (802.11g at 6Mbps- CH 11)

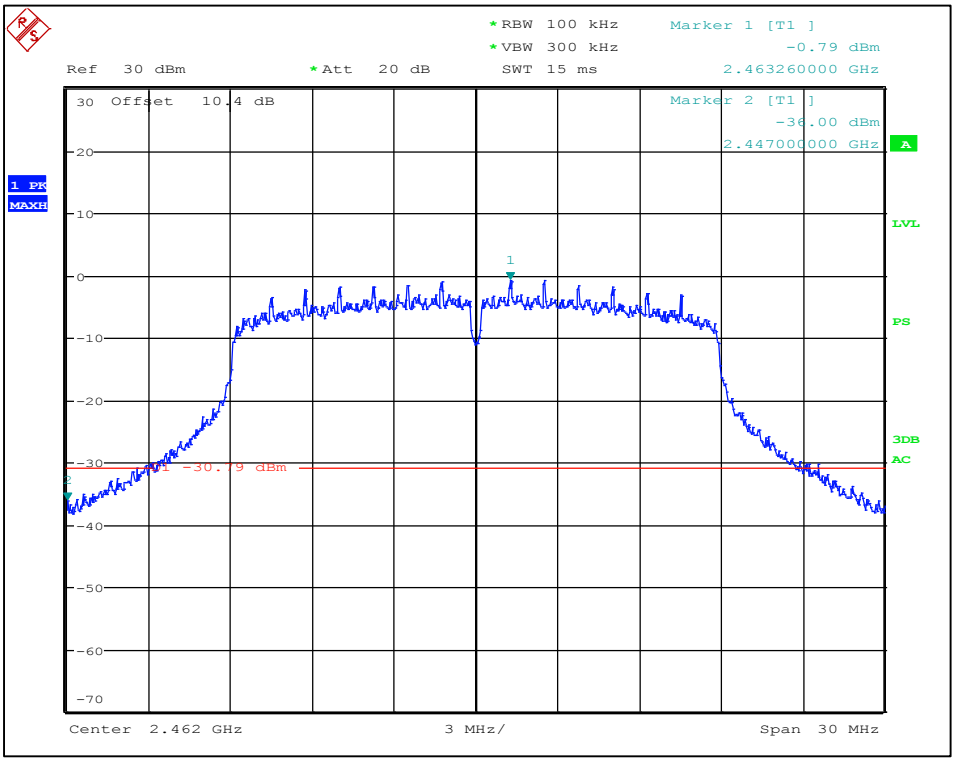


802.11g at 6 Mbps – Conducted Spurious Emissions at the 2400 MHz Band Edge

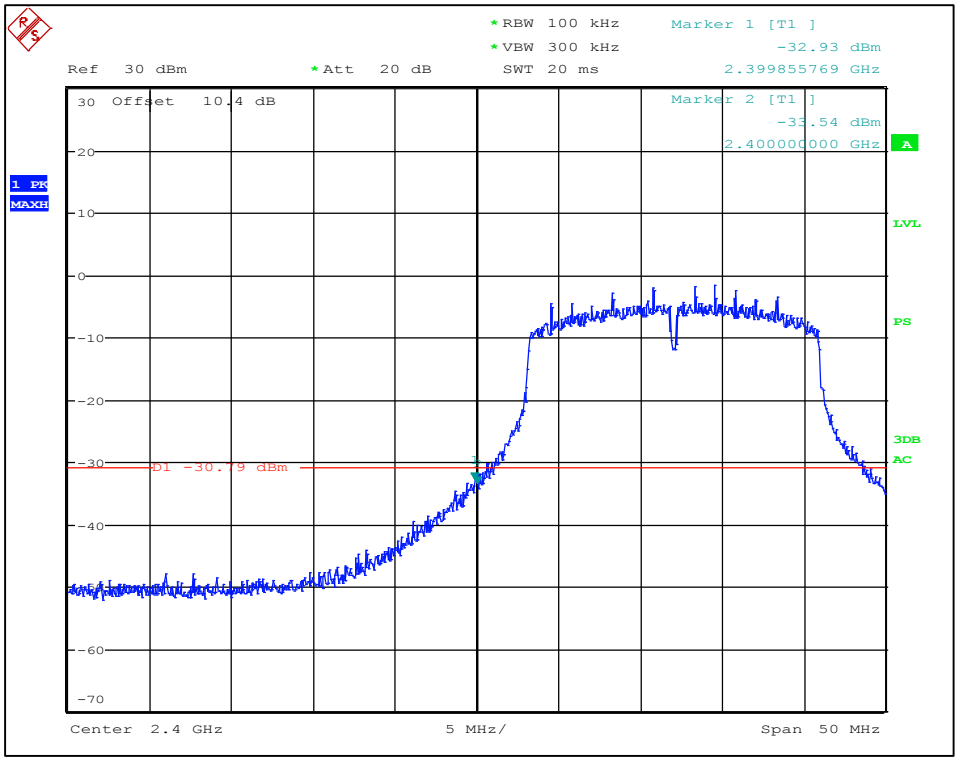


802.11g at 6 Mbps - Conducted Spurious Emissions at the 2483.5 MHz Band Edge

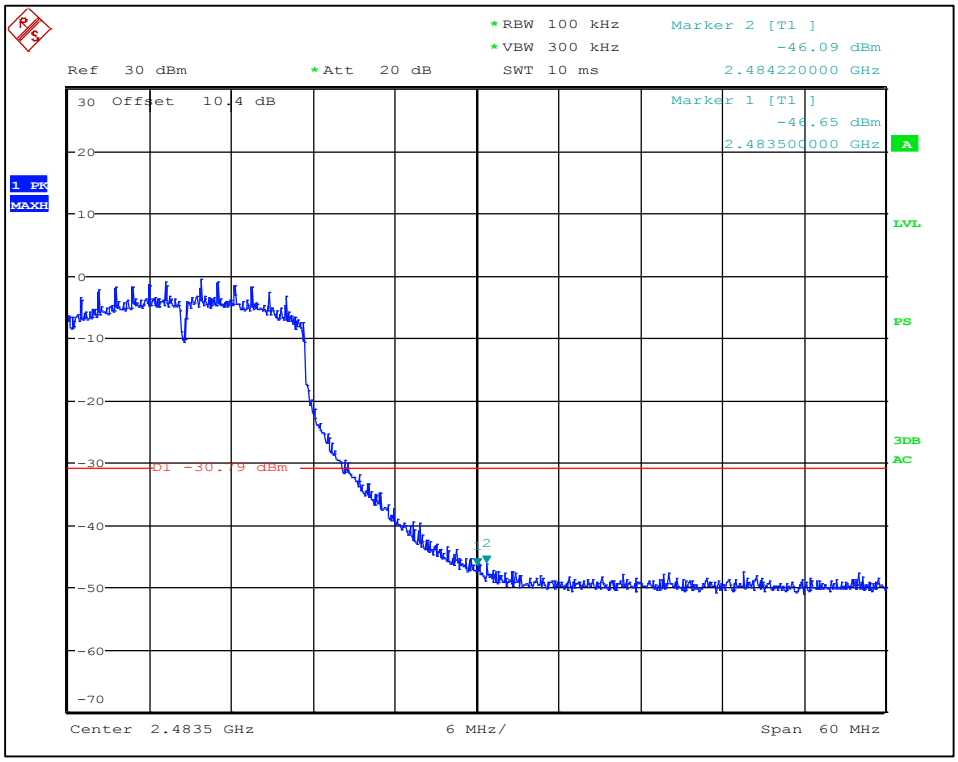
802.11n, MCS0



In-band reference level (802.11n at MCS0 - CH 11)



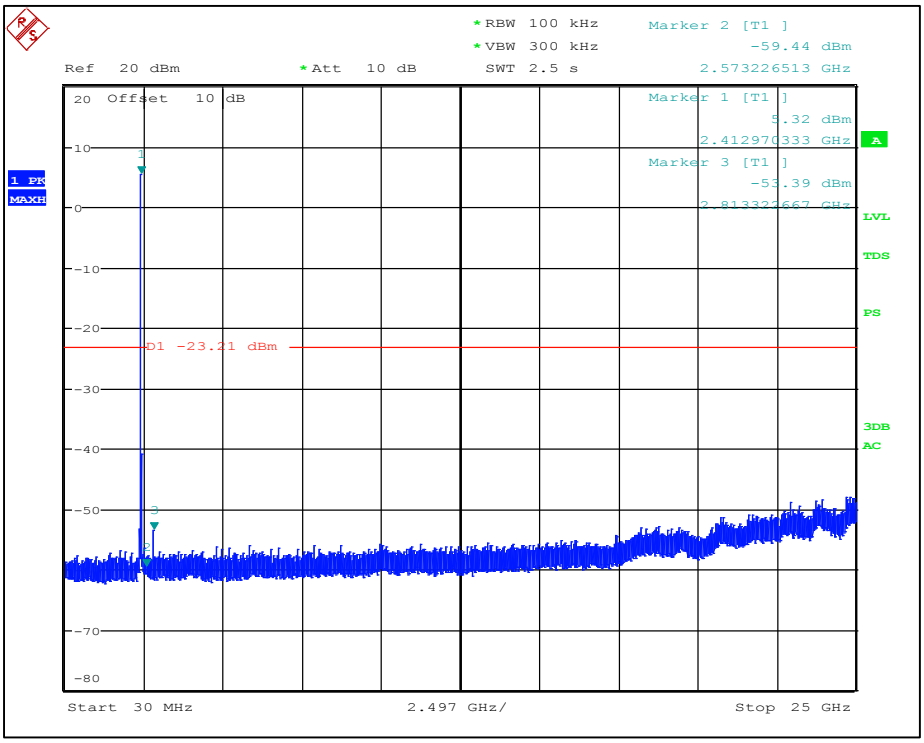
802.11n at MCS0 – Conducted Spurious Emissions at the 2400 MHz Band Edge



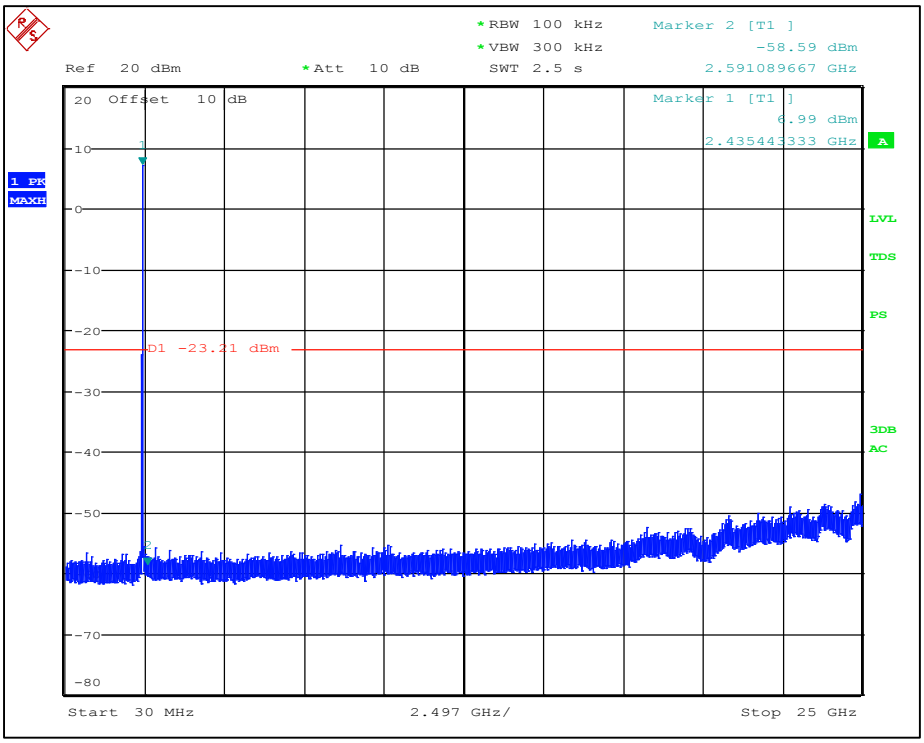
802.11n at MCS0 - Conducted Spurious Emissions at the 2483.5 MHz Band Edge

6.4.2 Conducted Spurious Emissions in non-restricted frequency bands

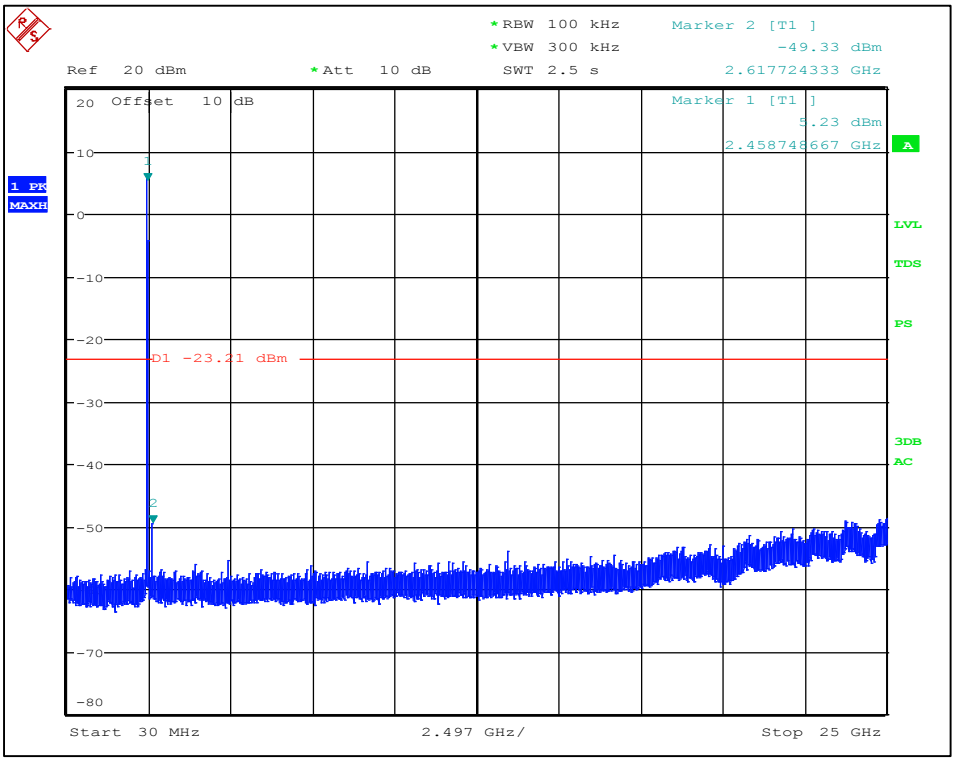
802.11b, 1 Mbps



Conducted Spurious Emissions Plot (802.11b at 1Mbps - CH1)

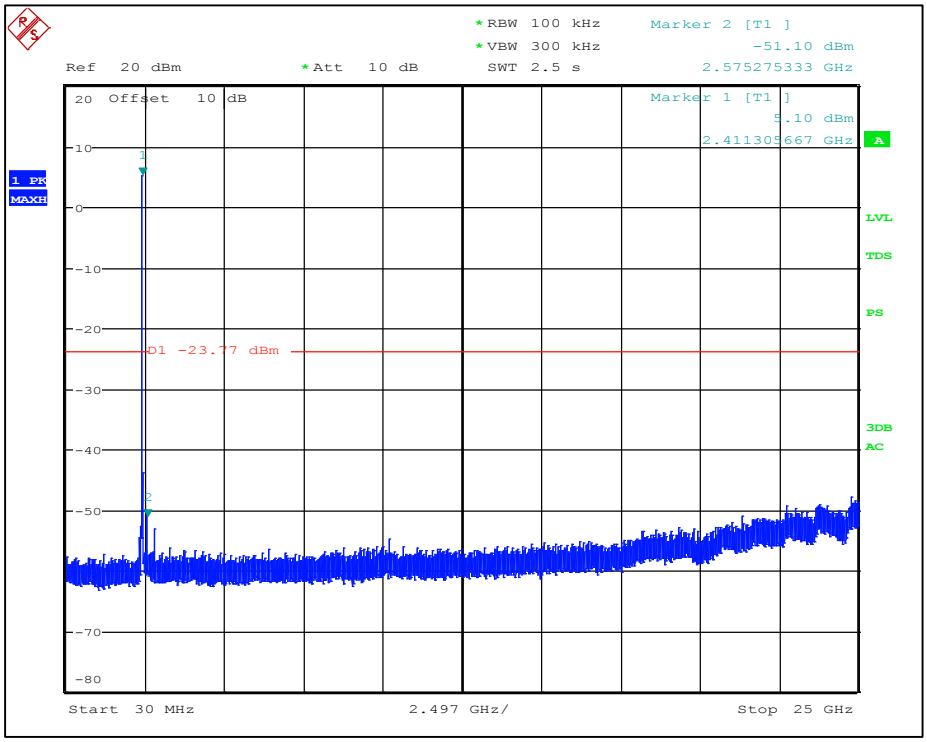


Conducted Spurious Emissions Plot (802.11b at 1Mbps - CH 6)

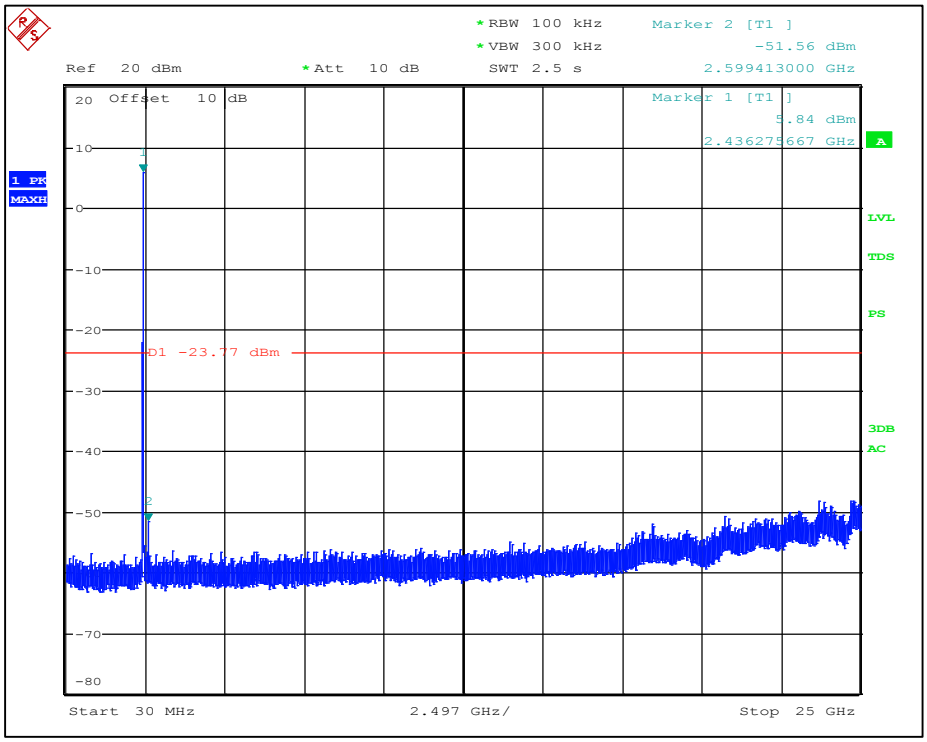


Conducted Spurious Emissions Plot (802.11b at 1Mbps - CH 11)

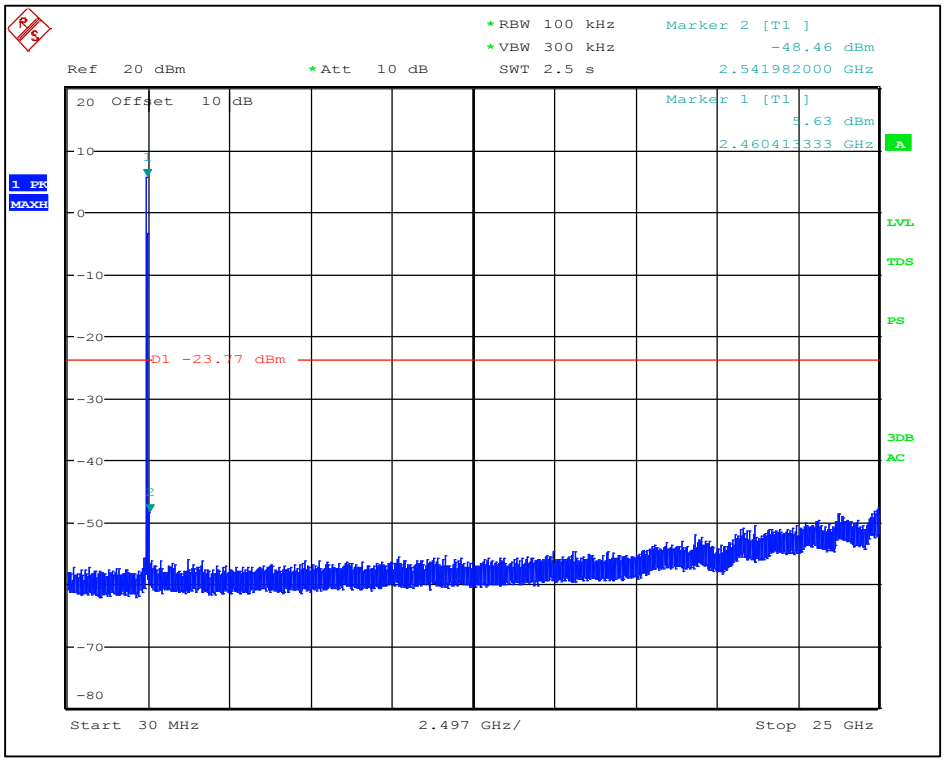
802.11b, 11 Mbps



Conducted Spurious Emissions Plot (802.11b at 11Mbps - CH1)

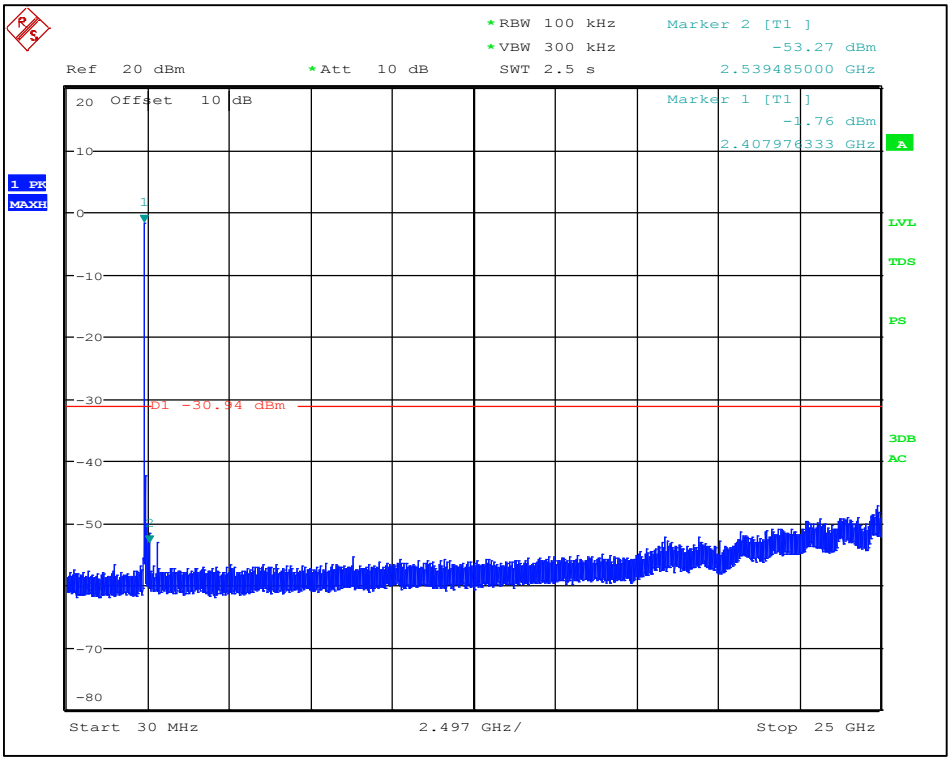


Conducted Spurious Emissions Plot (802.11b at 11Mbps - CH 6)

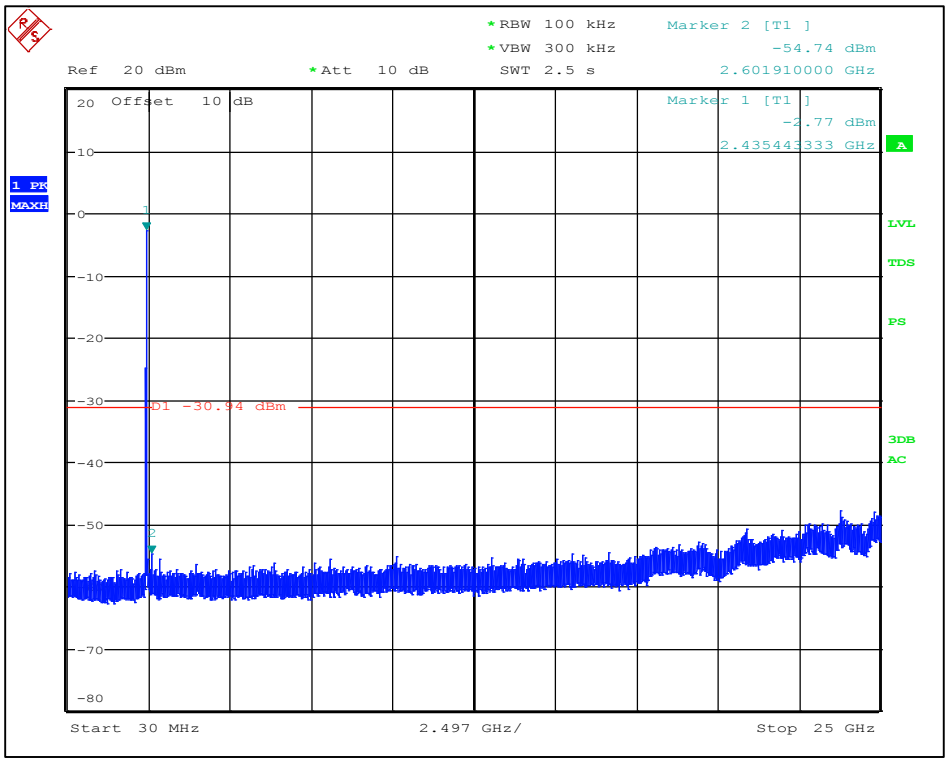


Conducted Spurious Emissions Plot (802.11b at 11Mbps - CH 11)

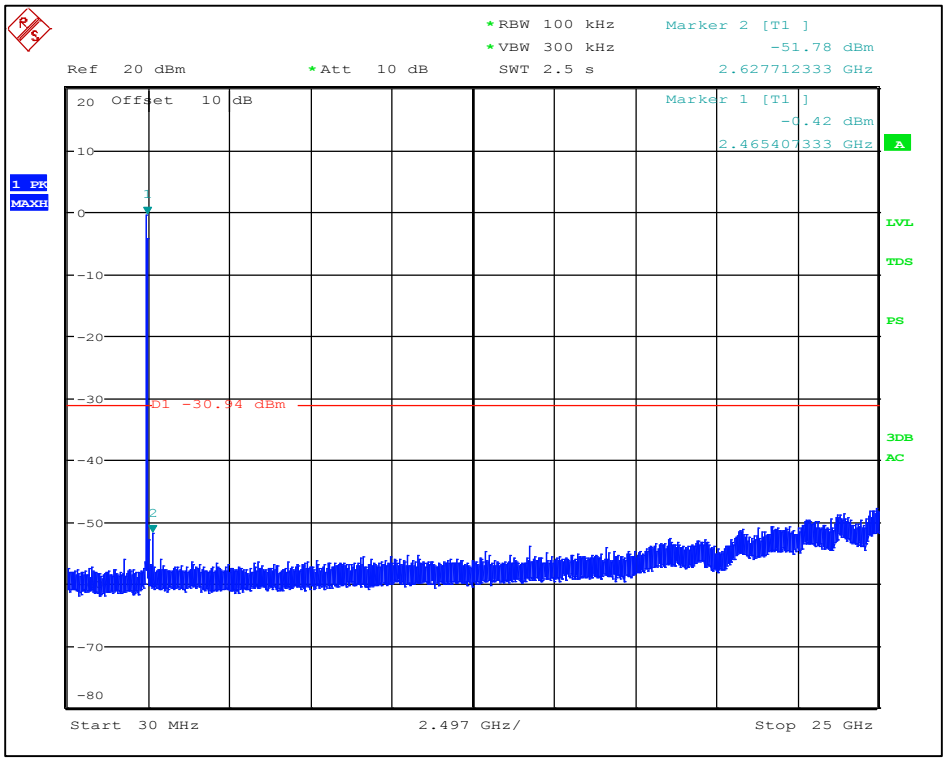
802.11g, 6 Mbps



Conducted Spurious Emissions Plot (802.11g at 6Mbps - CH1)

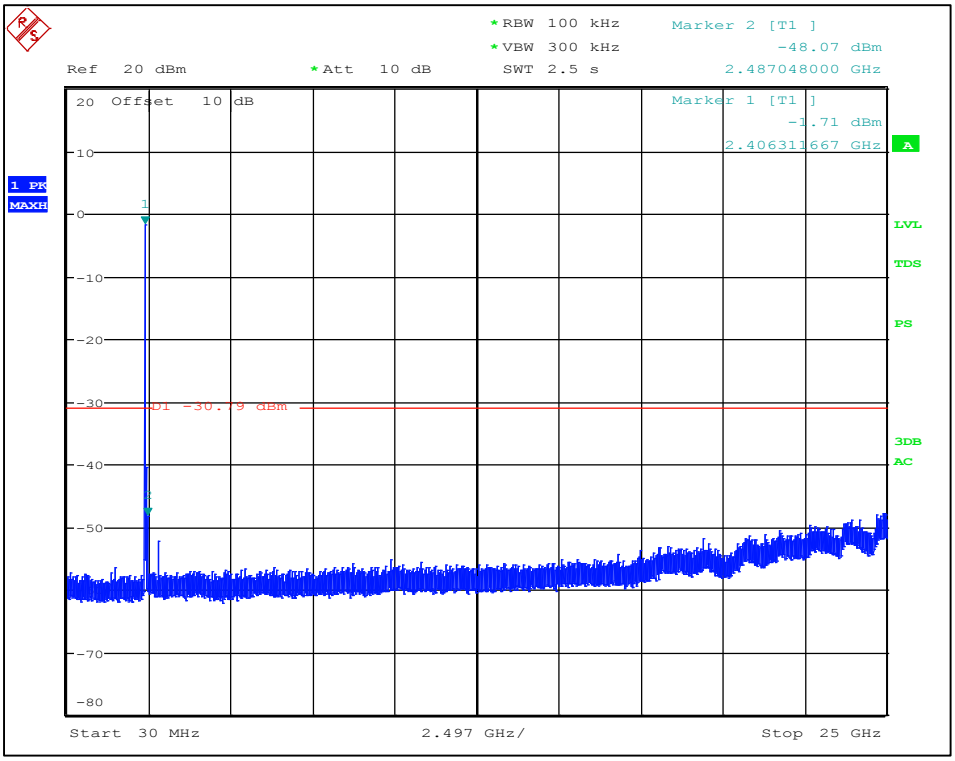


Conducted Spurious Emissions Plot (802.11g at 6Mbps - CH 6)

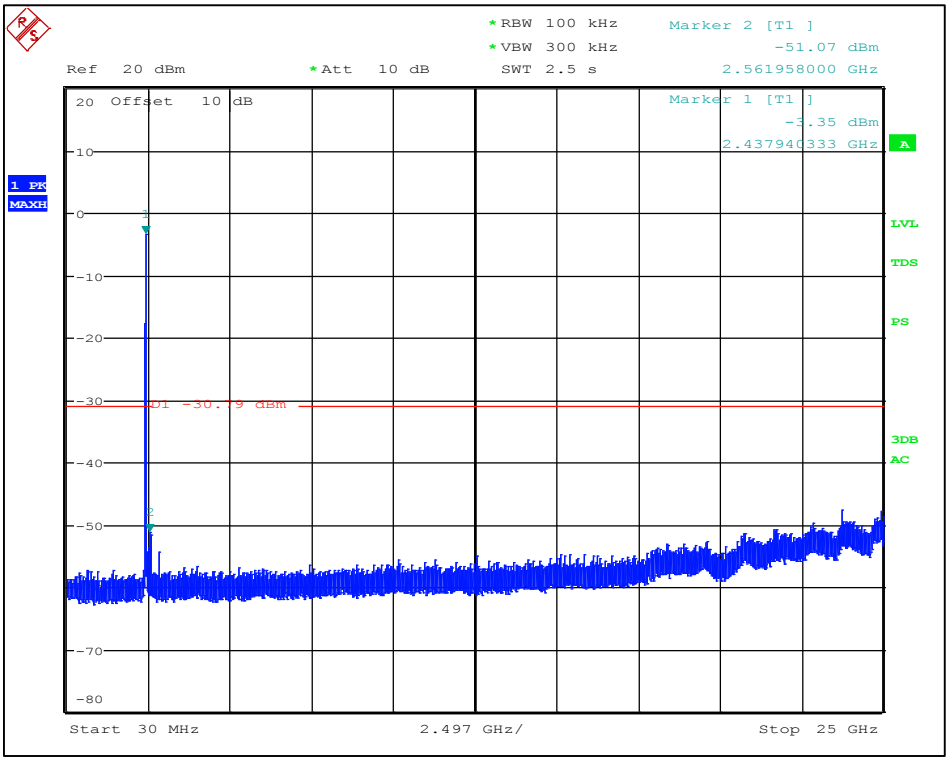


Conducted Spurious Emissions Plot (802.11g at 6Mbps - CH 11)

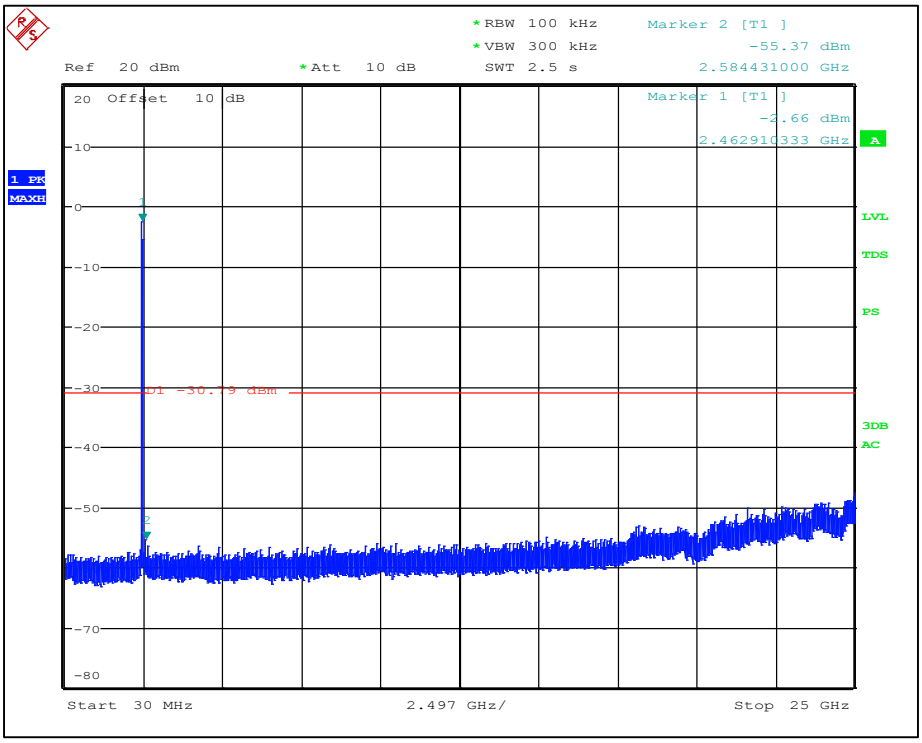
802.11n, MCS0



Conducted Spurious Emissions Plot (802.11n at MCS0 - CH1)



Conducted Spurious Emissions Plot (802.11n at MCS0 - CH 6)



Conducted Spurious Emissions Plot (802.11n at MCS0 - CH 11)

6.5 Unwanted Emissions: Transmitter Radiated Spurious Emissions

Limits

FCC Part 15 Subpart C §15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

FCC Part 15 Subpart C §15.209 (a)

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

IC RSS-247 Issue 1 §5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

IC RSS-GEN Issue 4 §8.10 Restricted Frequency Bands

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

(a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
(b) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
(c) Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

IC RSS-GEN §8.9 Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at frequencies above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960	500

Test Procedure used

ANSI C63.10-2013 §11.11 and KDB 558074 D01 v03r03 §11.0: for emissions in non-restricted frequency bands
ANSI C63.10-2013 §11.12.1 and KDB 558074 D01 v03r03 §12.1, §12.2.7: for emissions in restricted frequency bands

Sample Calculations

For Radiated Restricted Band Band-edge Measurement

- Corrected Level $_{(dB\mu V/m)}$ = Spectrum Analyzer (SA) Reading $_{(dB\mu V/m)}$ + Duty Cycle Factor $_{(dB)}$
- Spectrum Analyzer (SA) Reading $_{(dB\mu V/m)}$ = Amplitude (Raw) $_{(dB\mu V/m)}$ + Transducer Factor $_{(dB/m)}$ + Offset $_{(dB)}$
- Transducer Factor $_{(dB/m)}$ = Antenna Factor $_{(dB/m)}$ + Cable Loss $_{(dB)}$ – Pre-amplifier Gain $_{(dB)}$
- Offset $_{(dB)}$ = 10 dB Attenuator
- Margin $_{(dB)}$ = Corrected Level $_{(dB\mu V/m)}$ – Limit $_{(dB\mu V/m)}$

For Spurious Emissions Levels above 1GHz

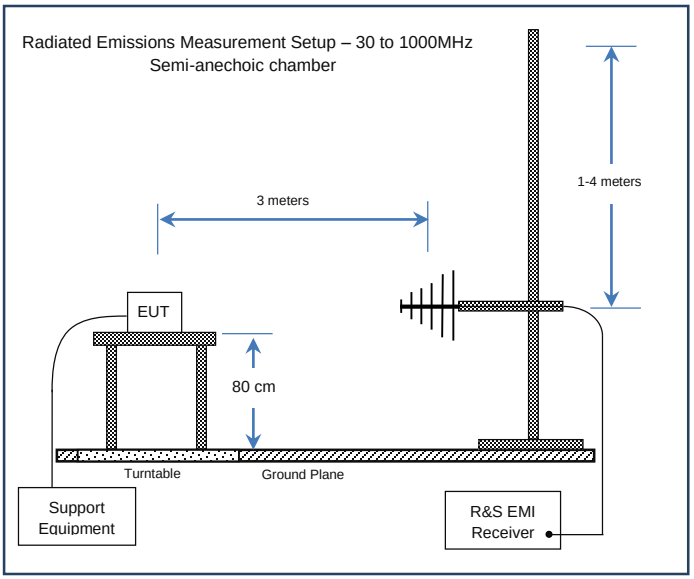
- Corrected Level $_{(dB\mu V/m)}$ = Spectrum Analyzer (SA) Reading $_{(dB\mu V/m)}$ + Correction Factor $_{(dB)}$ + Duty Cycle Factor $_{(dB)}$
- Correction Factor $_{(dB)}$ = Antenna Factor $_{(dB/m)}$ + Cable Loss $_{(dB)}$ + Filter Insertion Loss $_{(dB)}$
- Margin $_{(dB)}$ = Corrected Level $_{(dB\mu V/m)}$ – Limit $_{(dB\mu V/m)}$

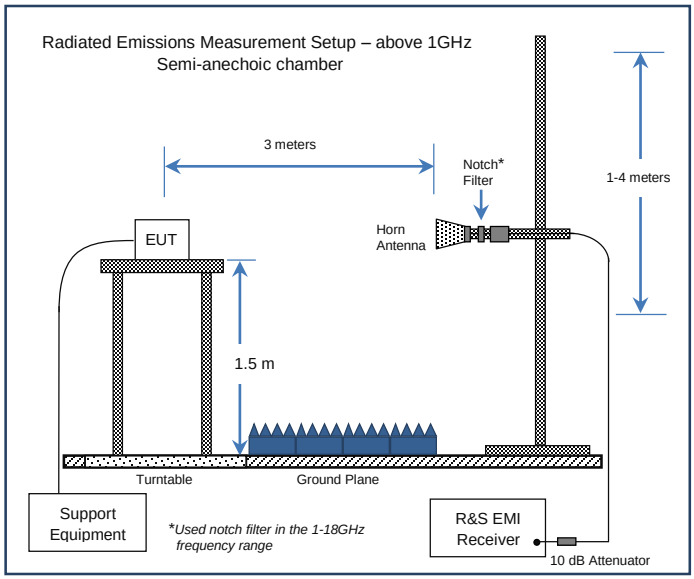
For Spurious Emissions Levels below 1GHz

- Amplitude $_{(dB\mu V/m)}$ = Receiver Reading $_{(dB\mu V/m)}$ + Correction Factor $_{(dB)}$ + Duty Cycle Factor $_{(dB)}$
- Correction Factor $_{(dB)}$ = Antenna Factor $_{(dB/m)}$ + Cable Loss $_{(dB)}$
- Margin $_{(dB)}$ = Amplitude $_{(dB\mu V/m)}$ – Limit $_{(dB\mu V/m)}$

Note: The general radiated emission limits above 30 MHz obtained from Title 47 CFR, Part 15.209 were applied to any signals found in the 15.205 restricted bands radiated measurements. These limits correspond to those limits listed in IC RSS-GEN.

Test Setup





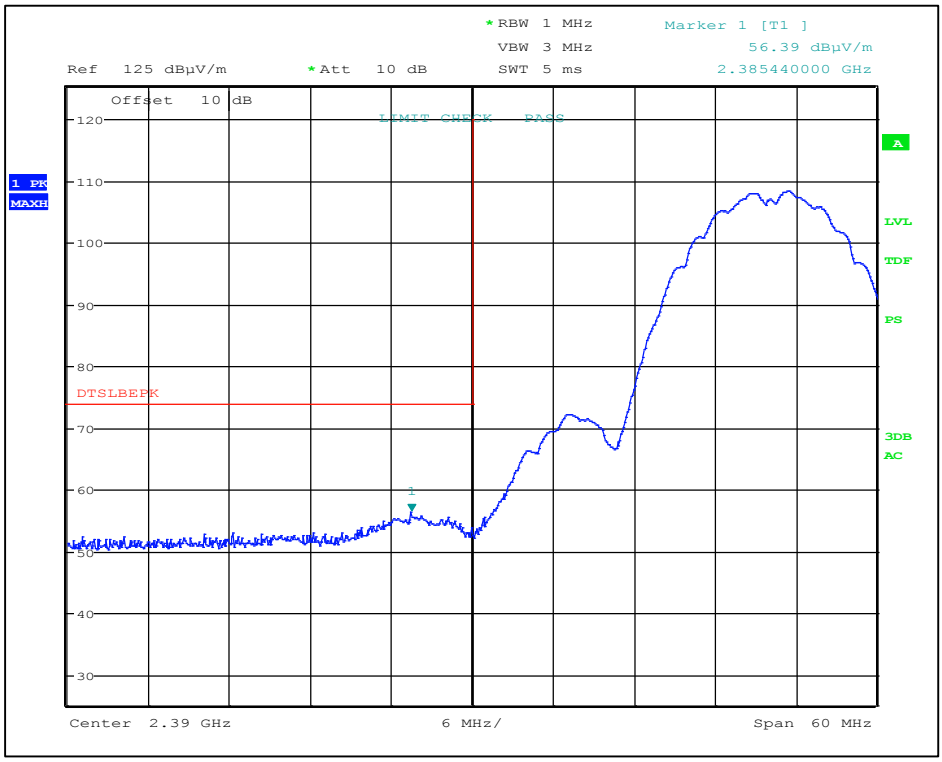
Test Results

6.5.1 Radiated Restricted-band band-edge measurements at 2390 MHz (802.11b, 1Mbps)

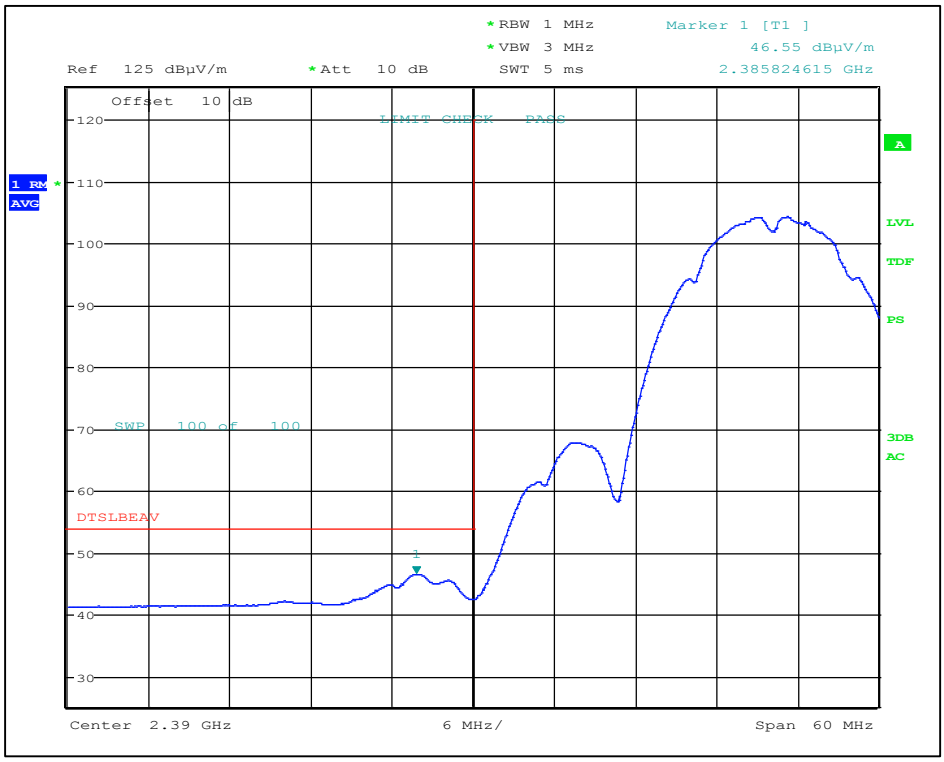
802.11b: 1 Mbps, Channel 1 (2412 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2385.4	56.4	PK	150	V	30	V	0.00	-2.0	56.4	74.0	-17.6
2385.8	46.6	AV	150	V	30	V	0.00	-2.0	46.6	54.0	-7.4
2389.6	52.3	PK	180	H	40	H1	0.00	-2.2	52.3	74.0	-21.7
2386.3	41.5	AV	180	H	40	H1	0.00	-2.2	41.5	54.0	-12.5

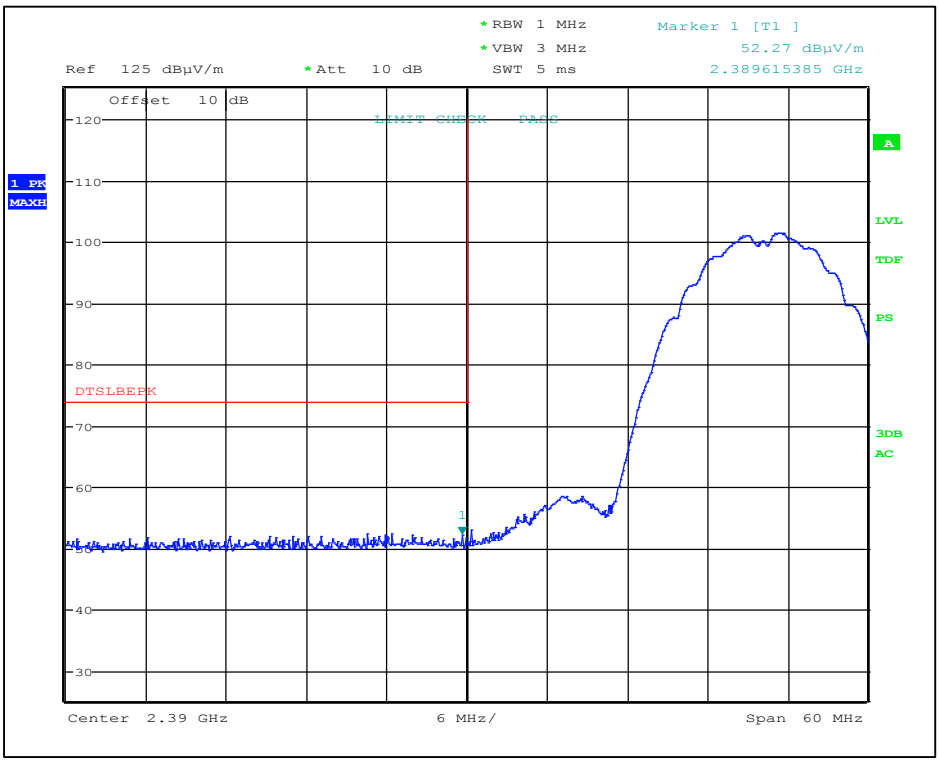
Refer to the following Plots



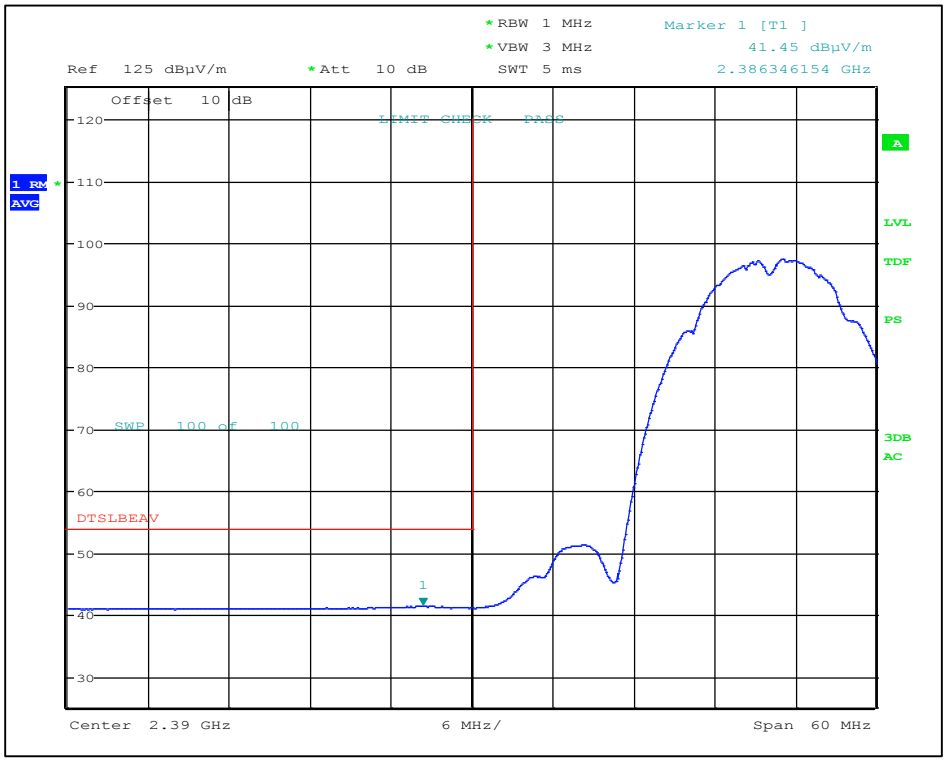
802.11b at 1Mbps – Restricted-band band-edge at low channel (Vertical Peak)



802.11b at 1Mbps - Restricted-band band-edge at low channel (Vertical Average)



802.11b at 1Mbps - Restricted-band band-edge at low channel (Horizontal Peak)



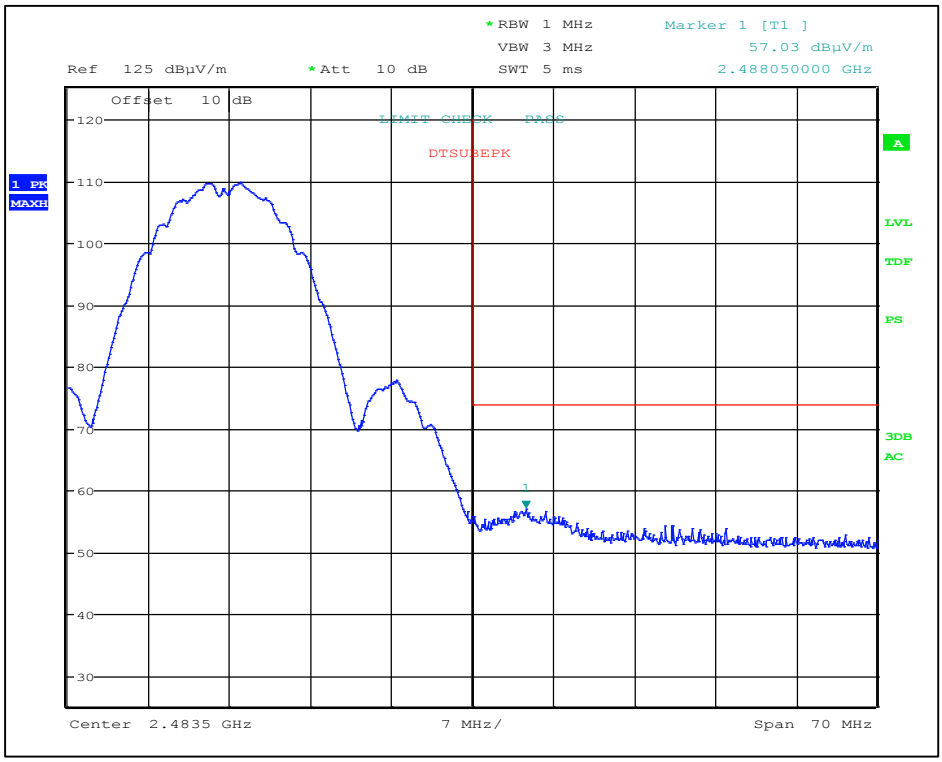
802.11b at 1Mbps - Restricted-band band-edge at low channel (Horizontal Average)

6.5.2 Radiated Restricted-band band-edge at 2483.5 MHz (802.11b, 1Mbps)

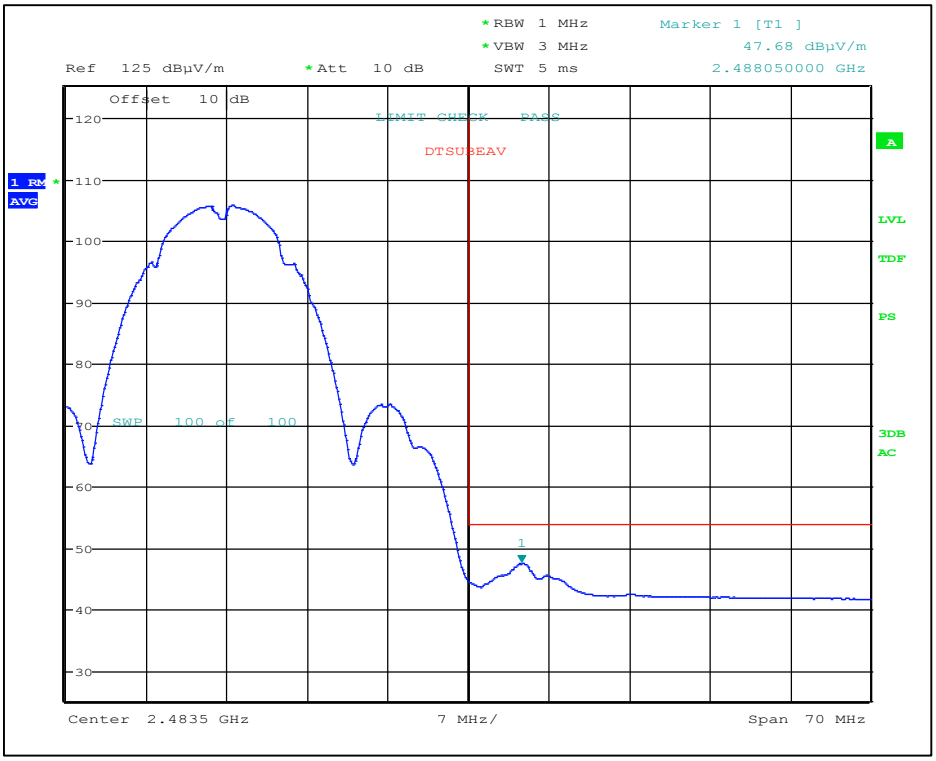
802.11b: 1Mbps, Channel 11 (2462 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2488.1	57.0	PK	150	V	25	V	0.00	-1.5	57.0	74.0	-17.0
2488.1	47.7	AV	150	V	25	V	0.00	-1.5	47.7	54.0	-6.3
2487.5	55.6	PK	165	H	0	H1	0.00	-1.8	55.6	74.0	-18.4
2487.5	45.6	AV	165	H	0	H1	0.00	-1.8	45.6	54.0	-8.4

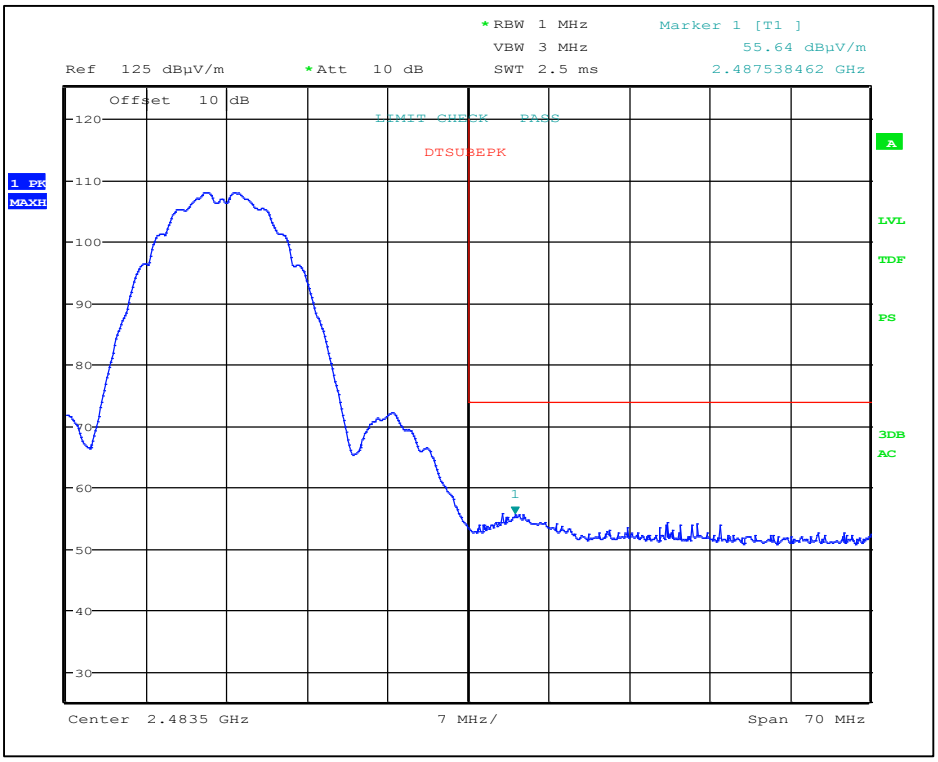
Refer to the following Plots



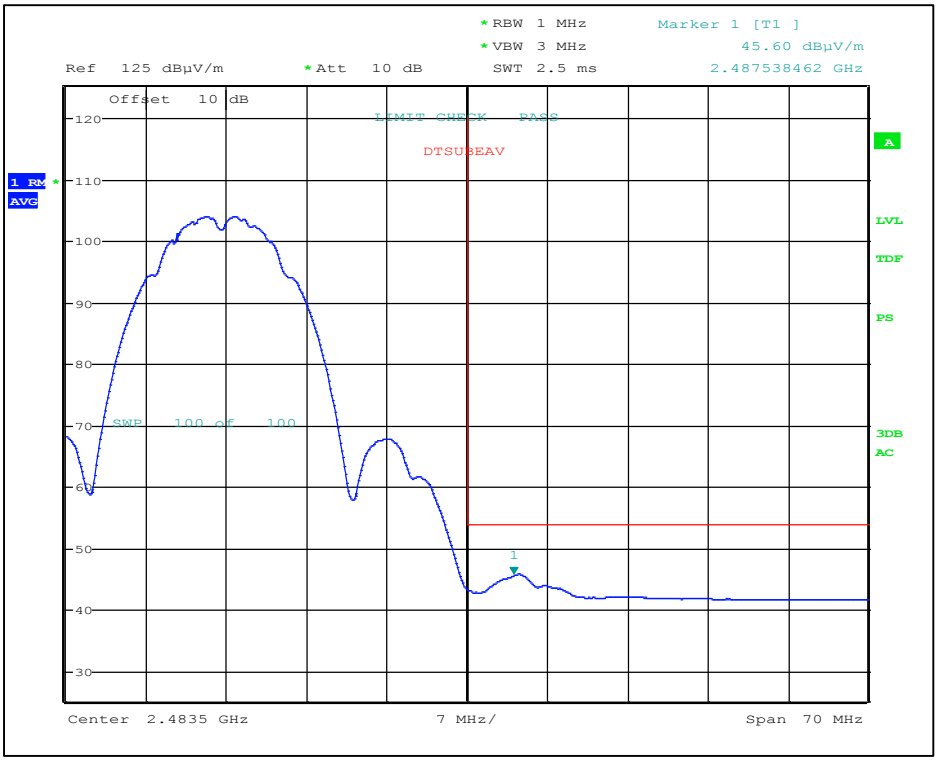
802.11b at 1Mbps - Restricted-band band-edge at high channel (Vertical Peak)



802.11b at 1Mbps - Restricted-band band-edge at high channel (Vertical Average)



802.11b at 1Mbps - Restricted-band band-edge at high channel (Horizontal Peak)



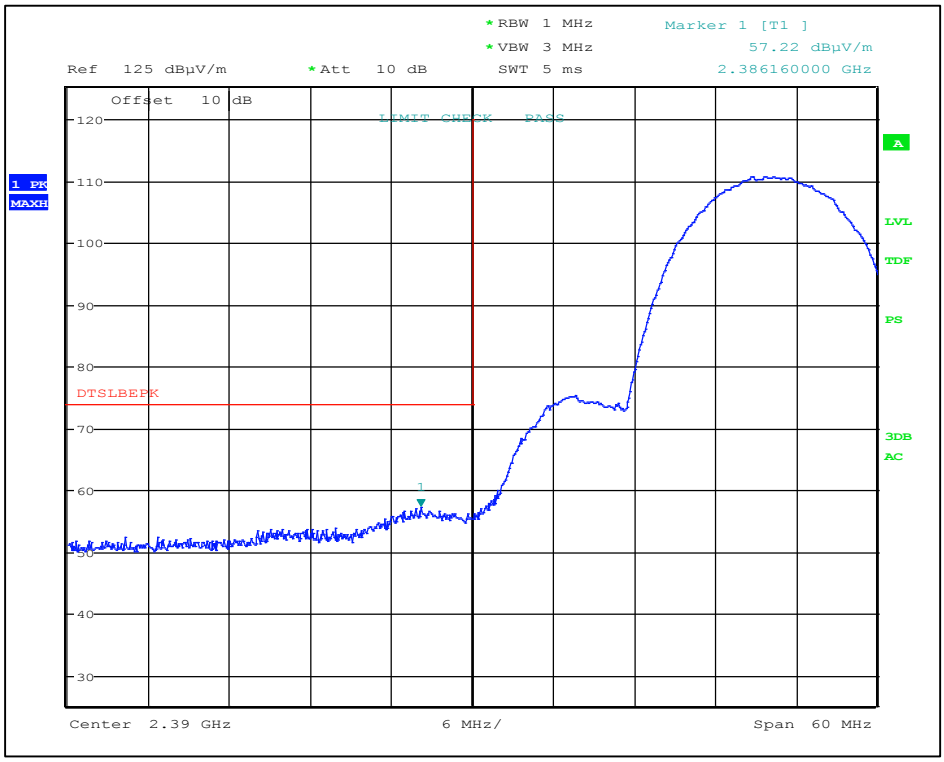
802.11b at 1Mbps - Restricted-band band-edge at high channel (Horizontal Average)

6.5.3 Radiated Restricted-band band-edge measurements at 2390 MHz (802.11b, 11Mbps)

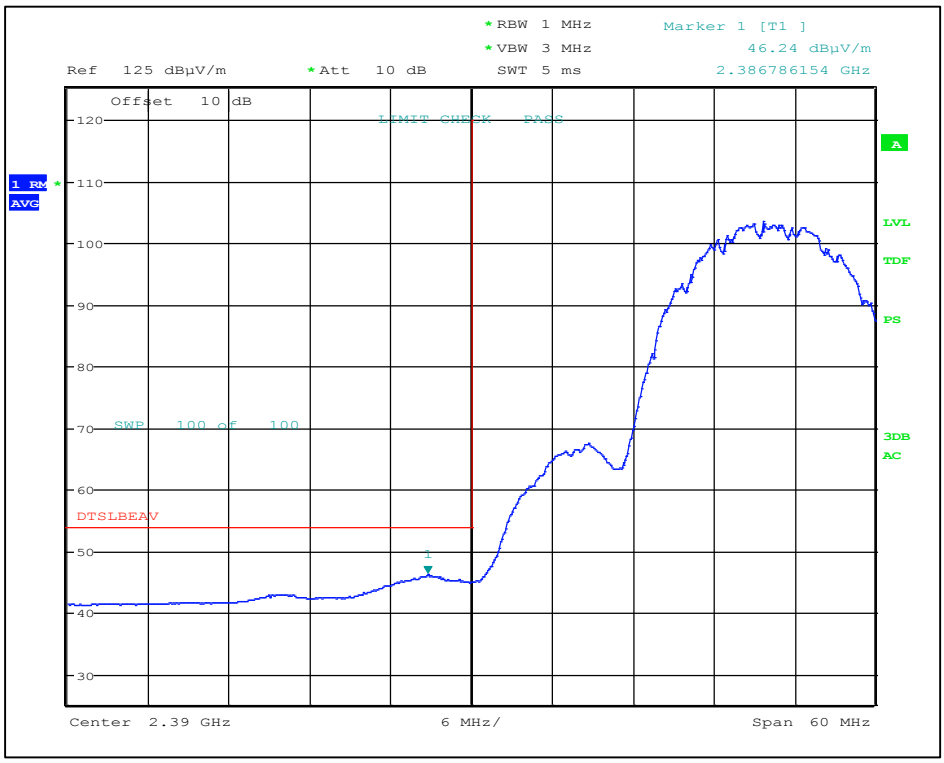
802.11b: 11 Mbps, Channel 1 (2412 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2386.2	57.2	PK	150	V	30	V	0.00	-2.0	57.2	74.0	-16.8
2386.8	46.2	AV	150	V	30	V	0.11	-2.0	46.3	54.0	-7.7
2387.0	52.7	PK	180	H	40	H1	0.00	-2.2	52.7	74.0	-21.3
2387.0	41.5	AV	180	H	40	H1	0.11	-2.2	41.6	54.0	-12.4

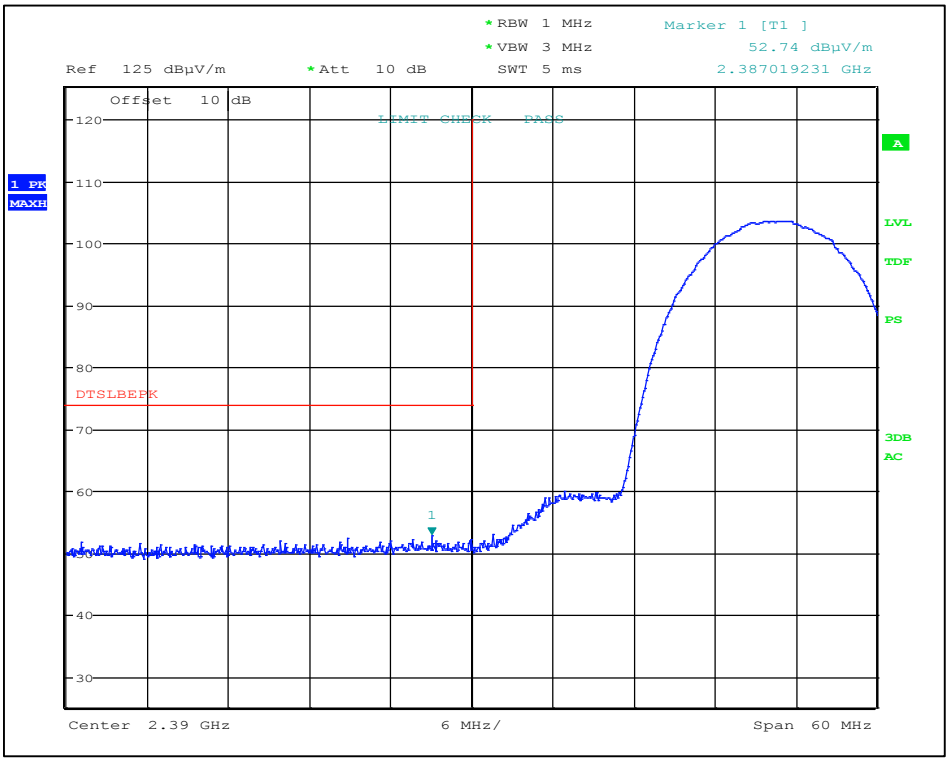
Refer to the following Plots



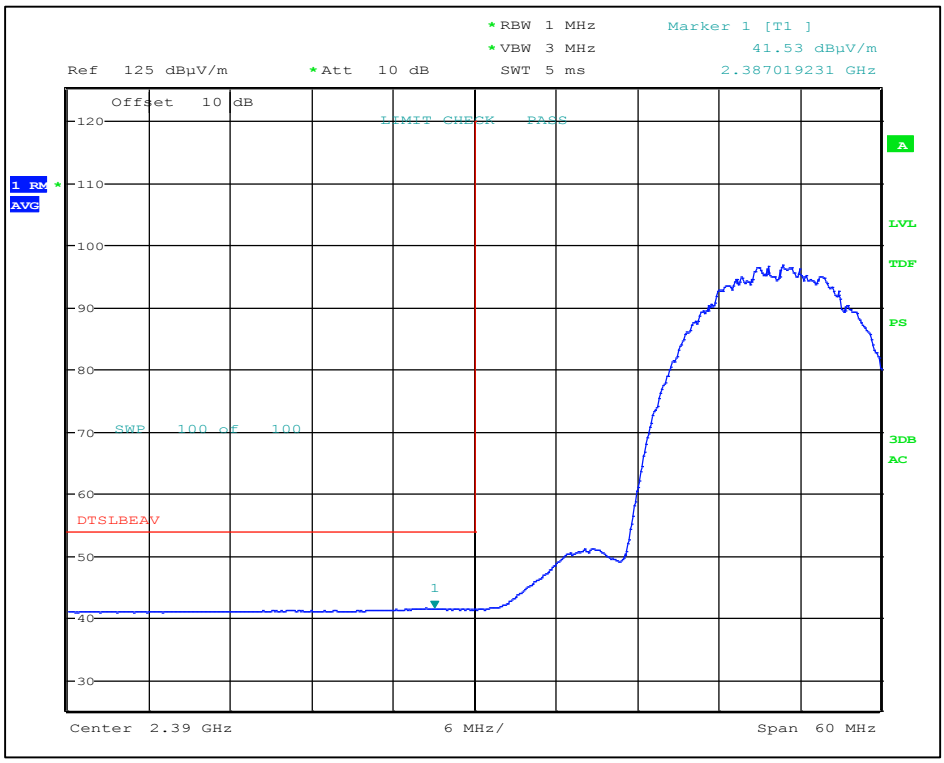
802.11b at 11Mbps - Restricted-band band-edge at low channel (Vertical Peak)



802.11b at 11Mbps - Restricted-band band-edge at low channel (Vertical Average)



802.11b at 11Mbps - Restricted-band band-edge at low channel (Horizontal Peak)



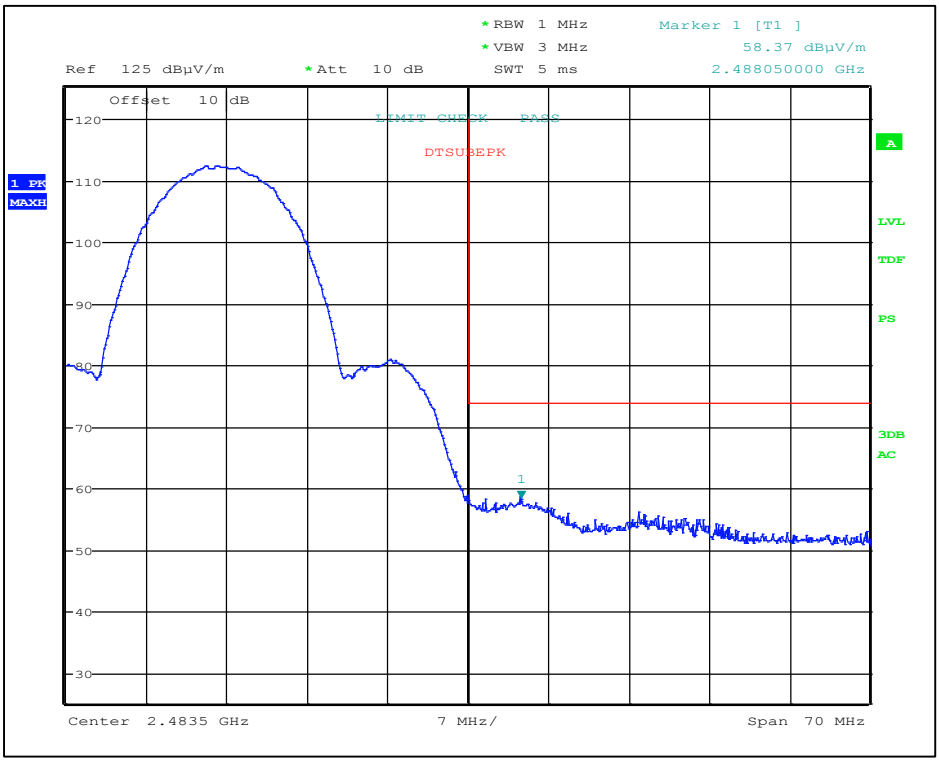
802.11b at 11Mbps - Restricted-band band-edge at low channel (Horizontal Average)

6.5.4 Radiated Restricted-band band-edge at 2483.5 MHz (802.11b, 11Mbps)

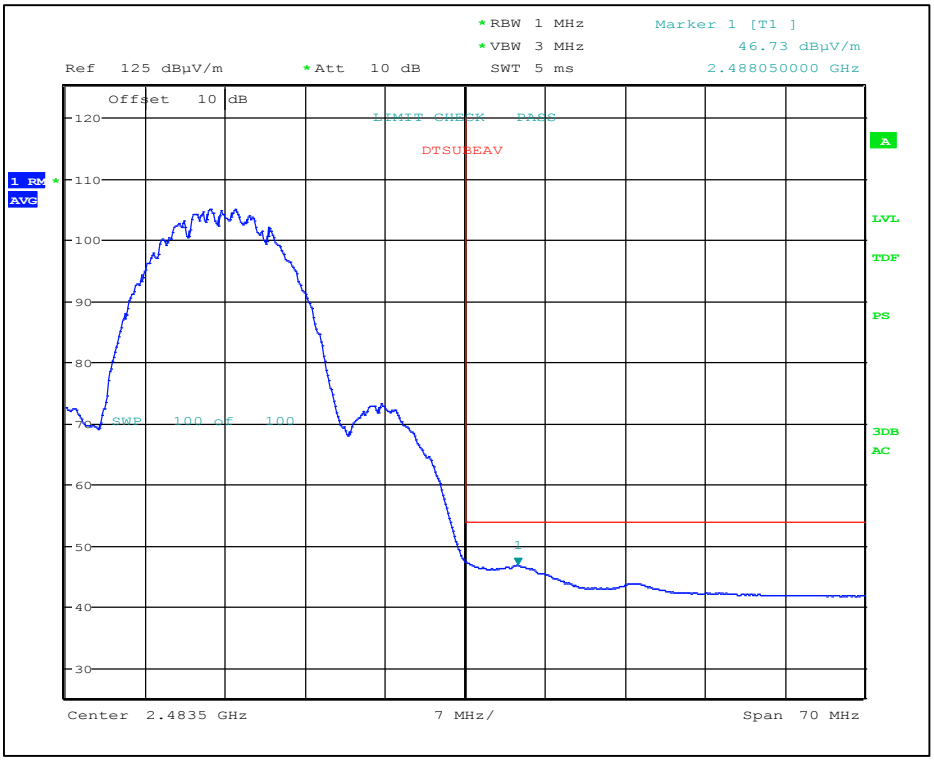
802.11b: 11Mbps, Channel 11 (2462 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2488.1	58.4	PK	150	V	25	V	0.00	-1.5	58.4	74.0	-15.6
2488.1	46.7	AV	150	V	25	V	0.11	-1.5	46.8	54.0	-7.2
2487.2	57.2	PK	165	H	0	H1	0.00	-1.8	57.2	74.0	-16.8
2487.5	45.8	AV	165	H	0	H1	0.11	-1.8	45.9	54.0	-8.1

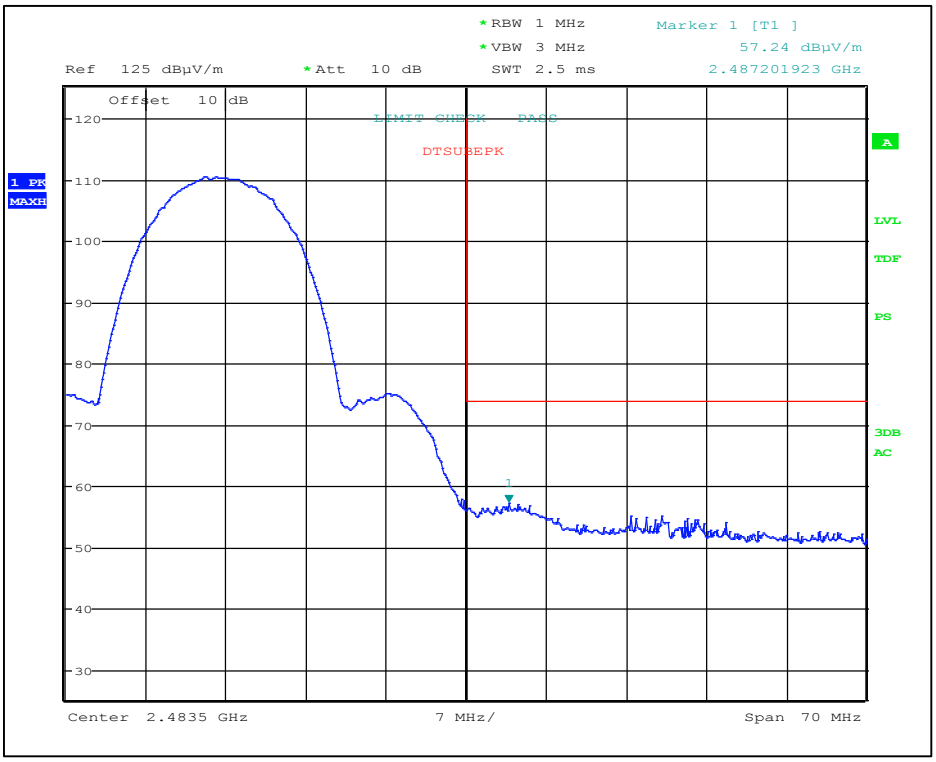
Refer to the following Plots



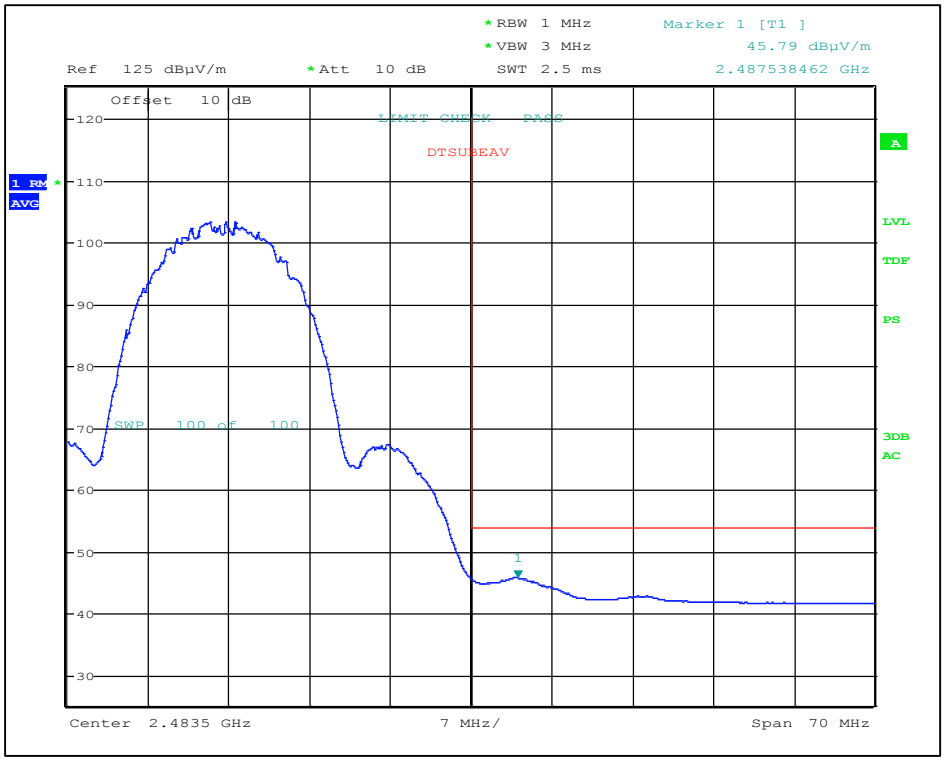
802.11b: 11Mbps - Restricted-band band-edge at high channel (Vertical Peak)



802.11b: 11Mbps - Restricted-band band-edge at high channel (Vertical Average)



802.11b: 11Mbps - Restricted-band band-edge at high channel (Horizontal Peak)



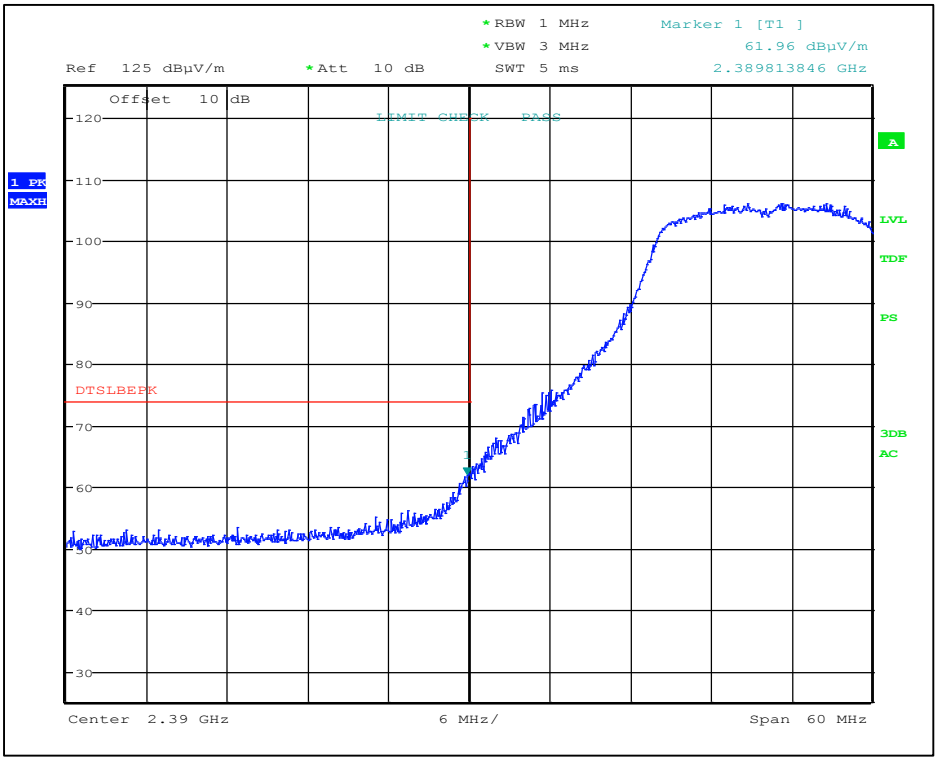
802.11b: 11Mbps - Restricted-band band-edge at high channel (Horizontal Average)

6.5.5 Radiated Restricted-band band-edge measurements at 2390 MHz (802.11g, 6Mbps)

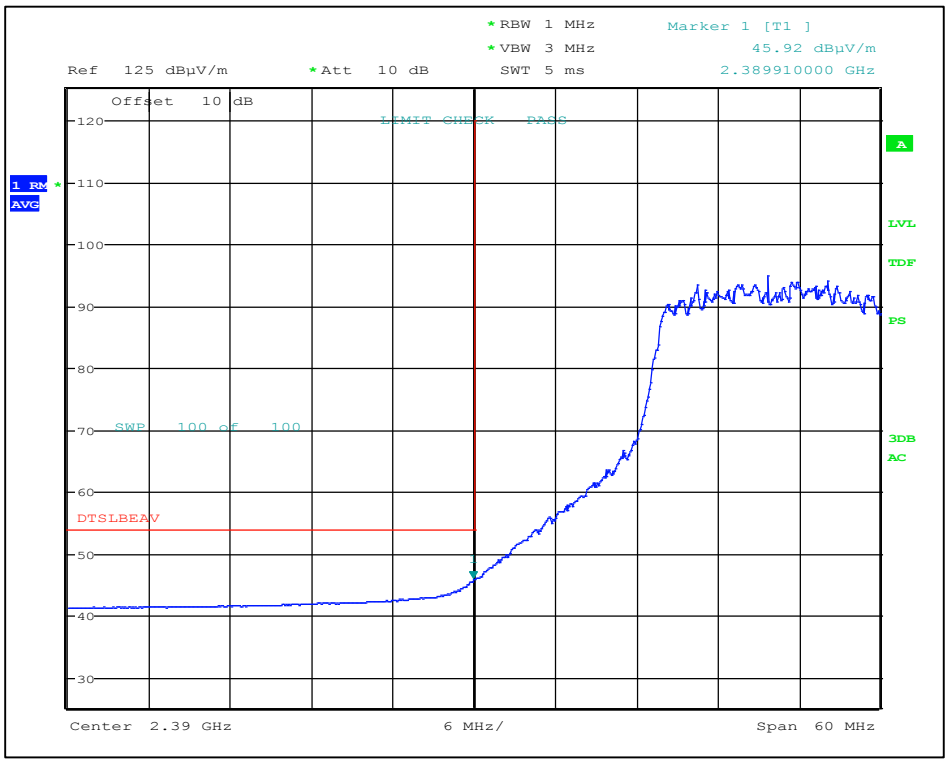
802.11g: 6 Mbps, Channel 1 (2412 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2389.8	62.0	PK	150	V	30	V	0.00	-2.0	62.0	74.0	-12.0
2389.9	45.9	AV	150	V	30	V	0.00	-2.0	45.9	54.0	-8.1
2388.8	52.0	PK	180	H	40	H1	0.00	-2.2	52.0	74.0	-22.0
2390.0	41.4	AV	180	H	40	H1	0.00	-2.2	41.4	54.0	-12.6

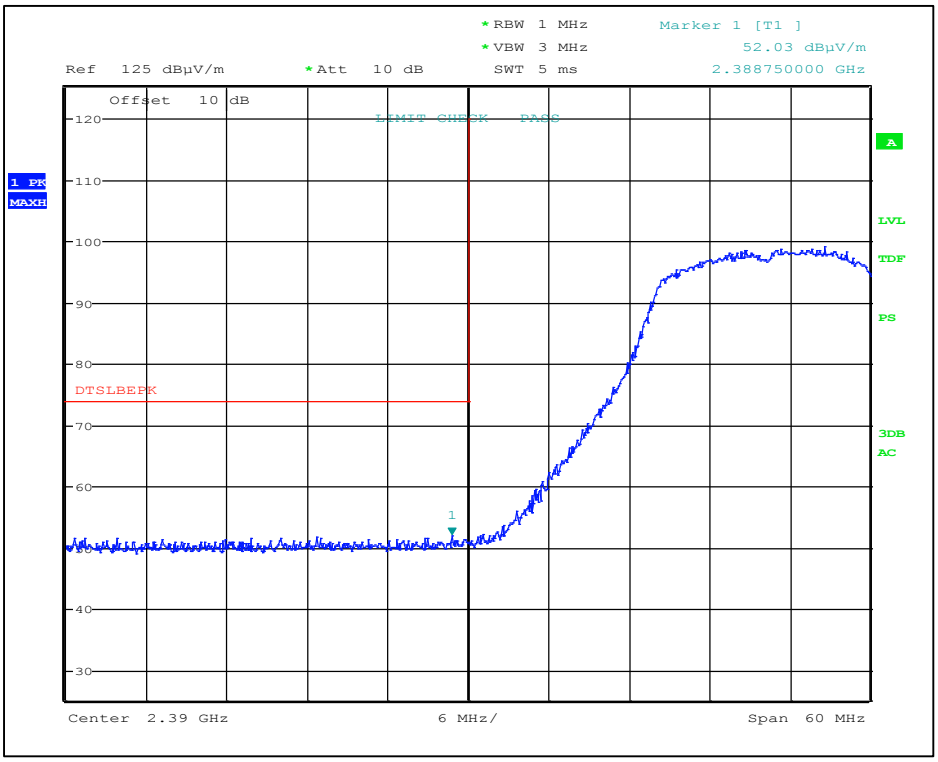
Refer to the following Plots



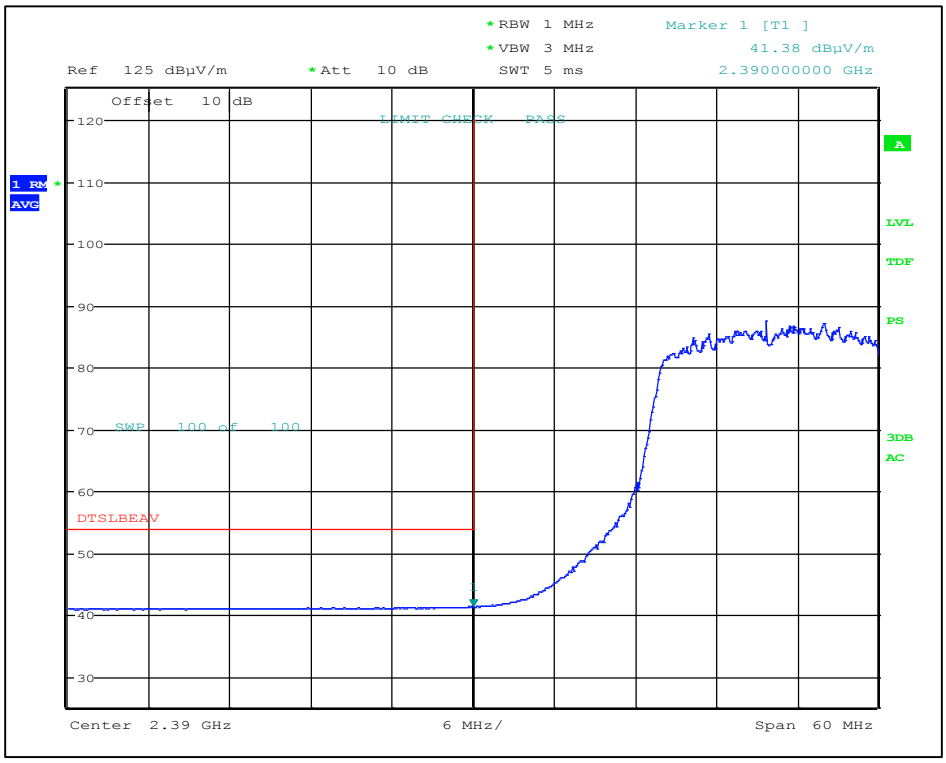
802.11g at 6Mbps - Restricted-band band-edge at low channel (Vertical Peak)



802.11g at 6Mbps - Restricted-band band-edge at low channel (Vertical Average)



802.11g at 6Mbps - Restricted-band band-edge at low channel (Horizontal Peak)



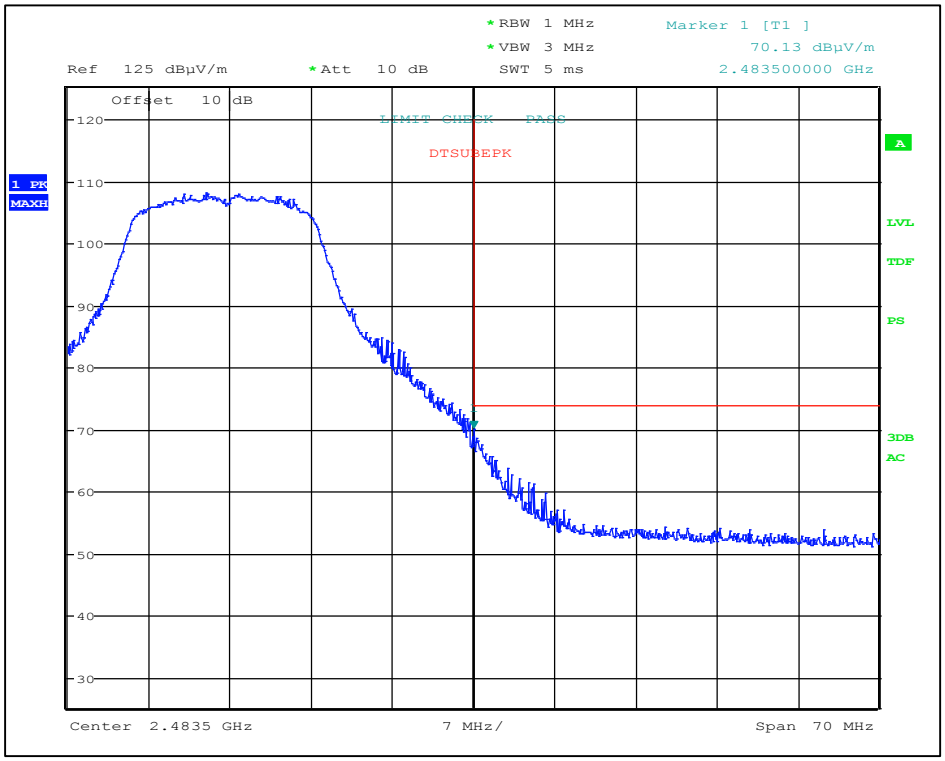
802.11g at 6Mbps - Restricted-band band-edge at low channel (Horizontal Average)

6.5.6 Radiated Restricted-band band-edge at 2483.5 MHz (802.11g, 6Mbps)

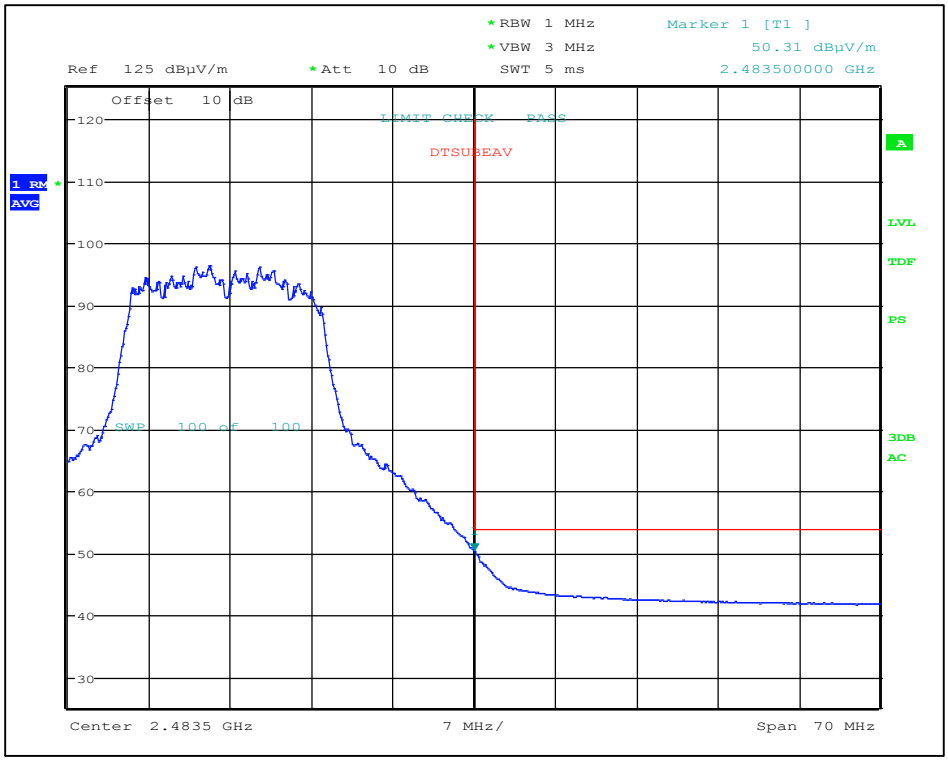
802.11g: 6Mbps, Channel 11 (2462 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2483.5	70.1	PK	150	V	25	V	0.00	-1.5	70.1	74.0	-3.9
2483.5	50.3	AV	150	V	25	V	0.00	-1.5	50.3	54.0	-3.7
2484.0	63.6	PK	165	H	0	H1	0.00	-1.8	63.6	74.0	-10.4
2483.5	46.7	AV	165	H	0	H1	0.00	-1.8	46.7	54.0	-7.3

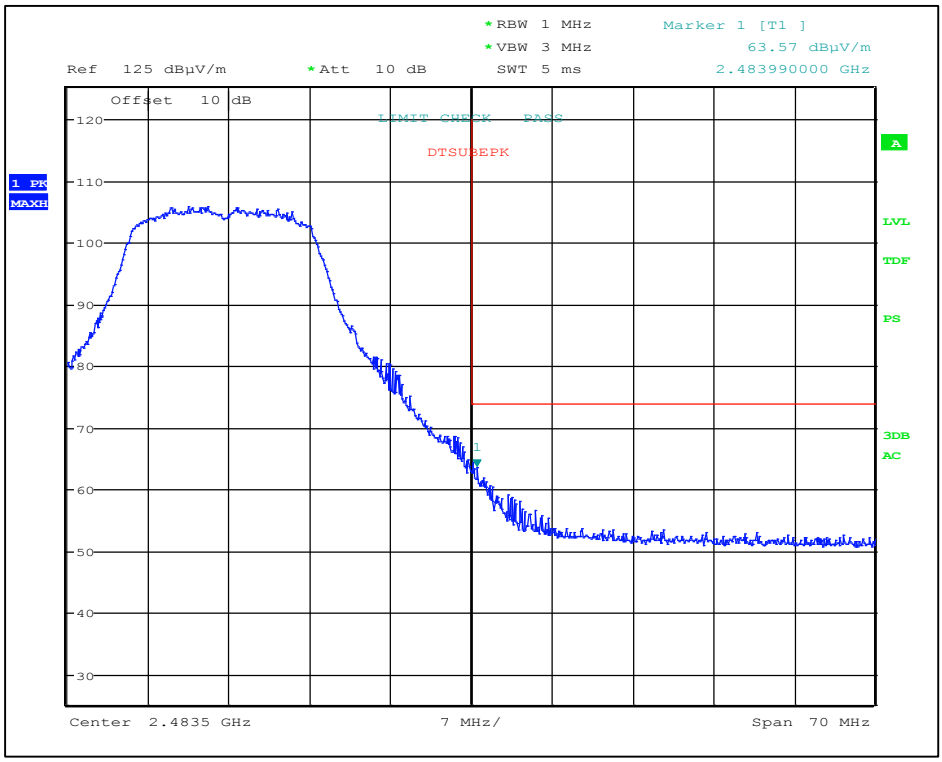
Refer to the following Plots



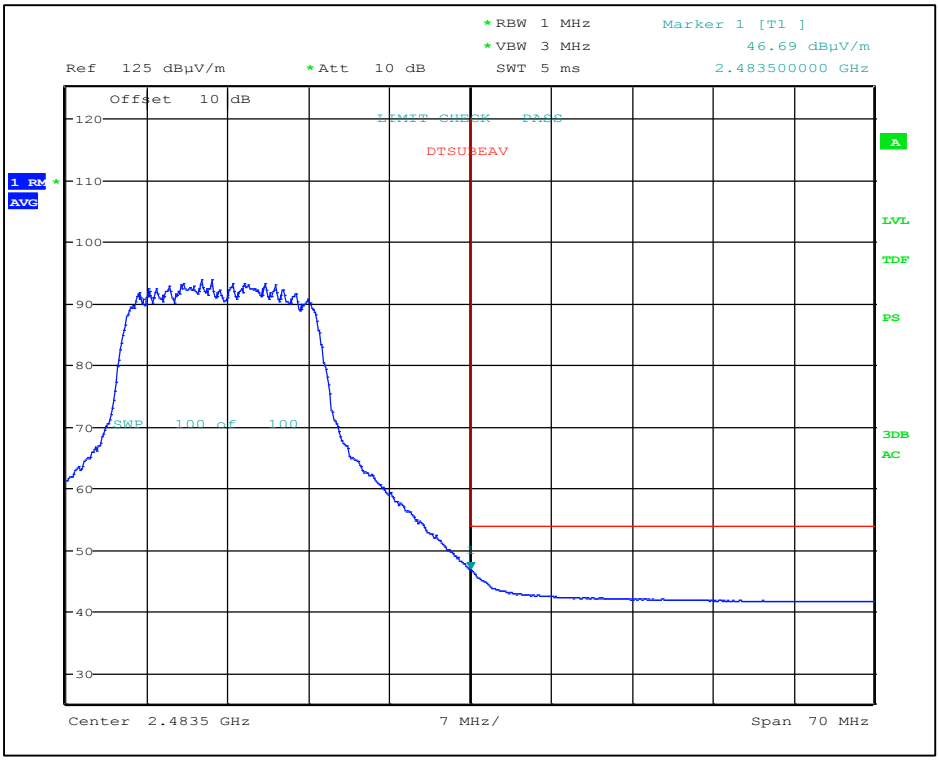
802.11g: 6Mbps - Restricted-band band-edge at high channel (Vertical Peak)



802.11g: 6Mbps - Restricted-band band-edge at high channel (Vertical Average)



802.11g: 6Mbps - Restricted-band band-edge at high channel (Horizontal Peak)



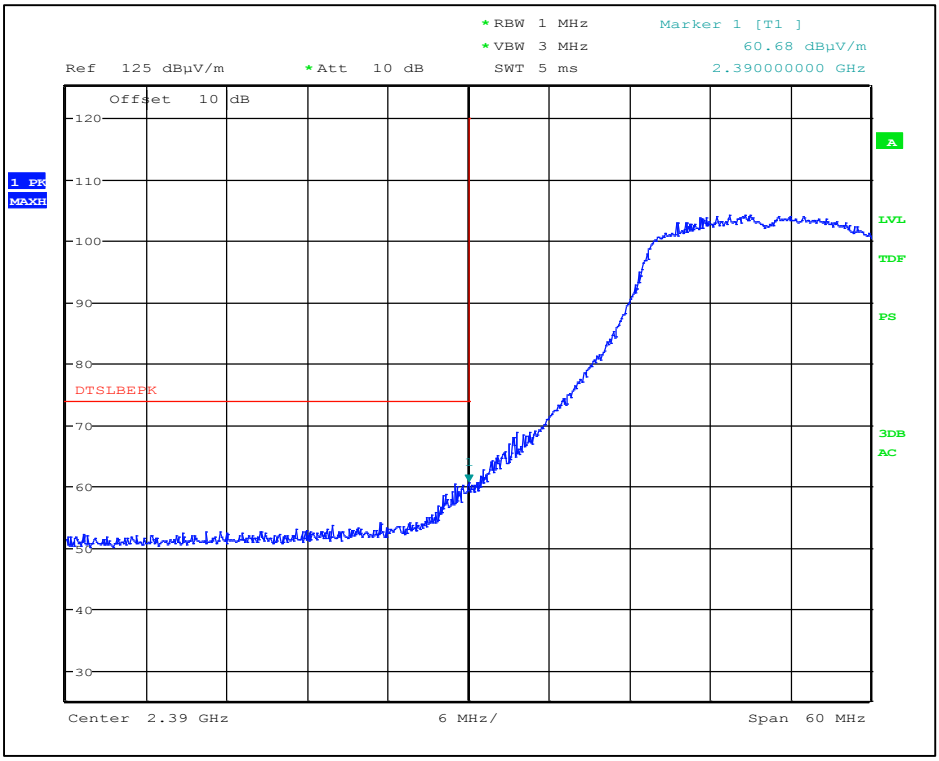
802.11g: 6Mbps - Restricted-band band-edge at high channel (Horizontal Average)

6.5.7 Radiated Restricted-band band-edge measurements at 2390 MHz (802.11n, MCS0)

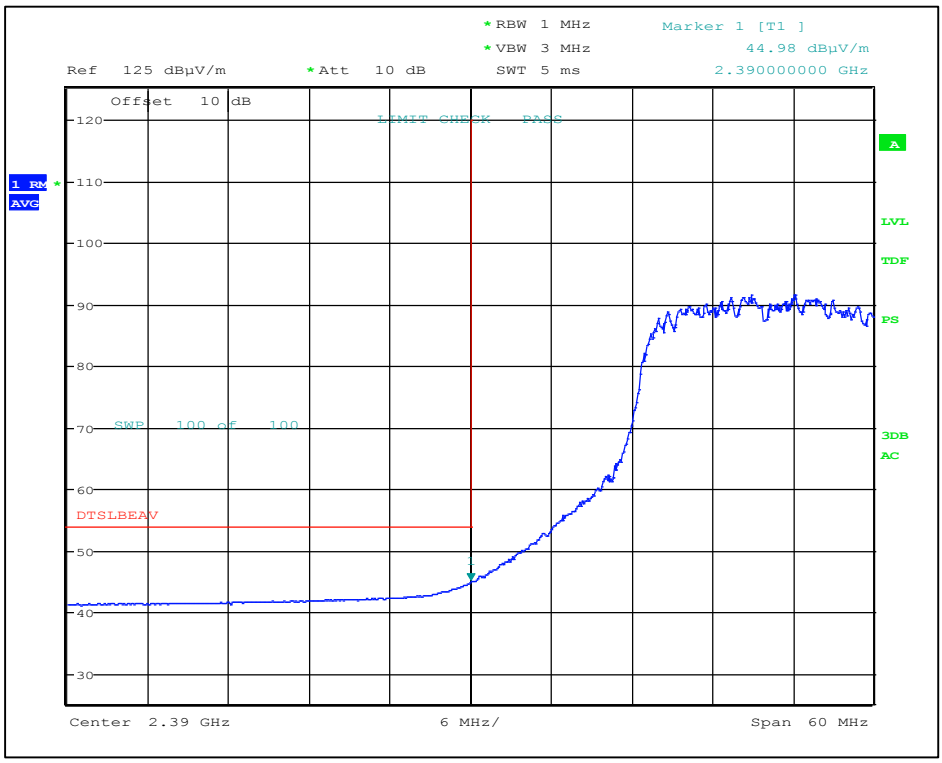
802.11n: MCS0, Channel 1 (2412 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2390.0	60.7	PK	150	V	30	V	0.00	-2.0	60.7	74.0	-13.3
2390.0	45.0	AV	150	V	30	V	0.00	-2.0	45.0	54.0	-9.0
2389.6	52.4	PK	180	H	40	H1	0.00	-2.2	52.4	74.0	-21.6
2390.0	41.3	AV	180	H	40	H1	0.00	-2.2	41.3	54.0	-12.7

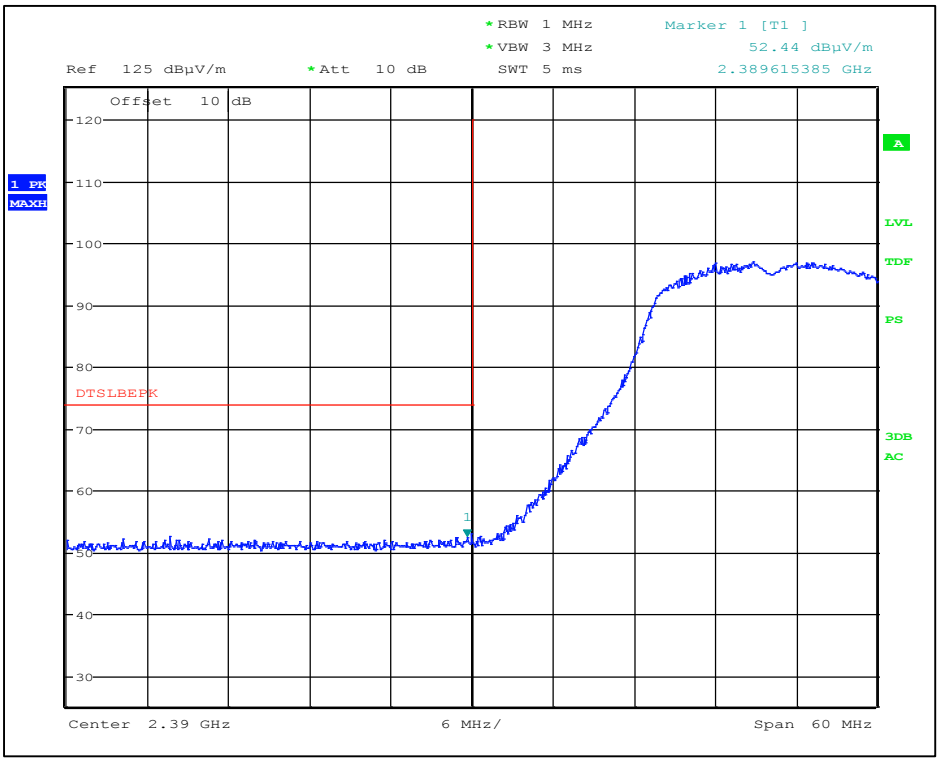
Refer to the following Plots



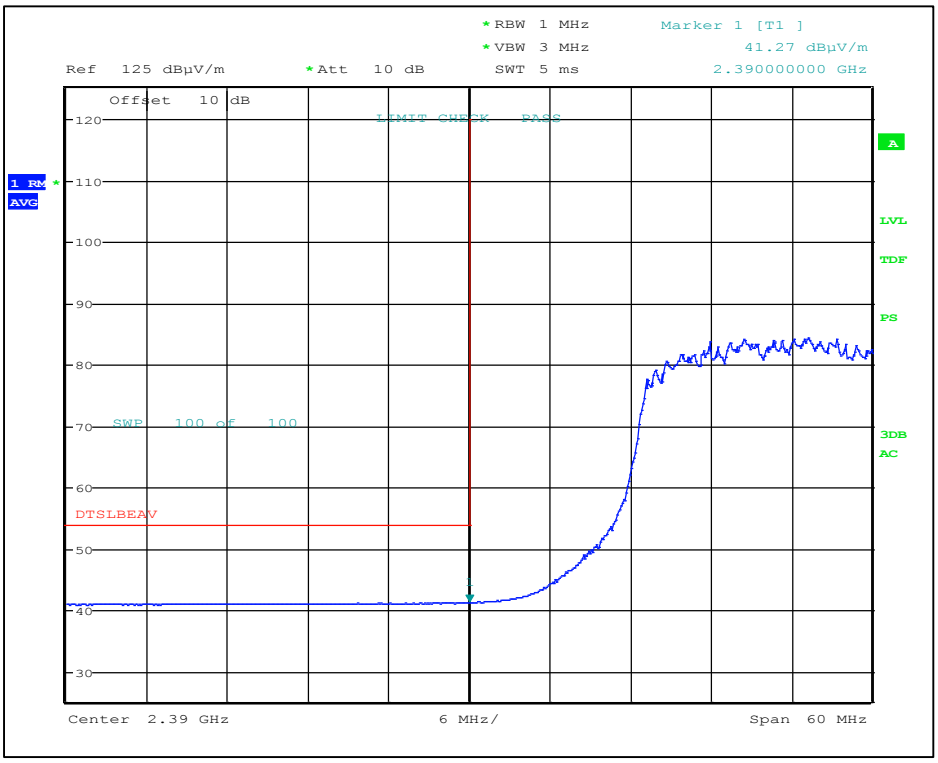
802.11n at MCS0 - Restricted-band band-edge at low channel (Vertical Peak)



802.11n at MCS0 - Restricted-band band-edge at low channel (Vertical Average)



802.11n at MCS0 - Restricted-band band-edge at low channel (Horizontal Peak)



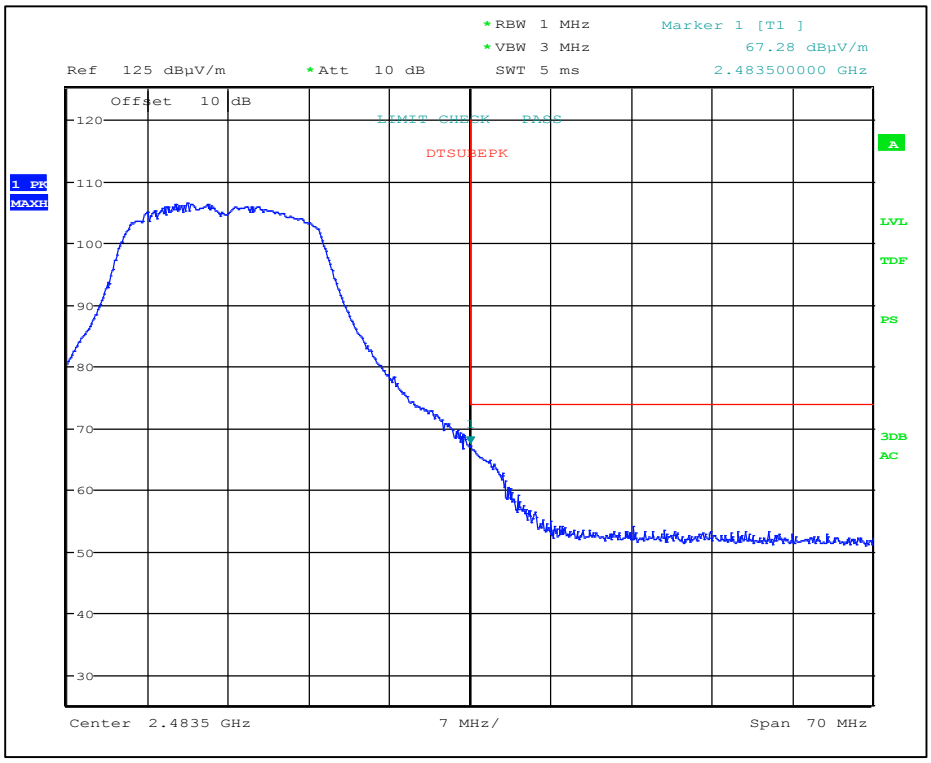
802.11n at MCS0 - Restricted-band band-edge at low channel (Horizontal Average)

6.5.8 Radiated Restricted-band band-edge at 2483.5 MHz (802.11n, MCS0)

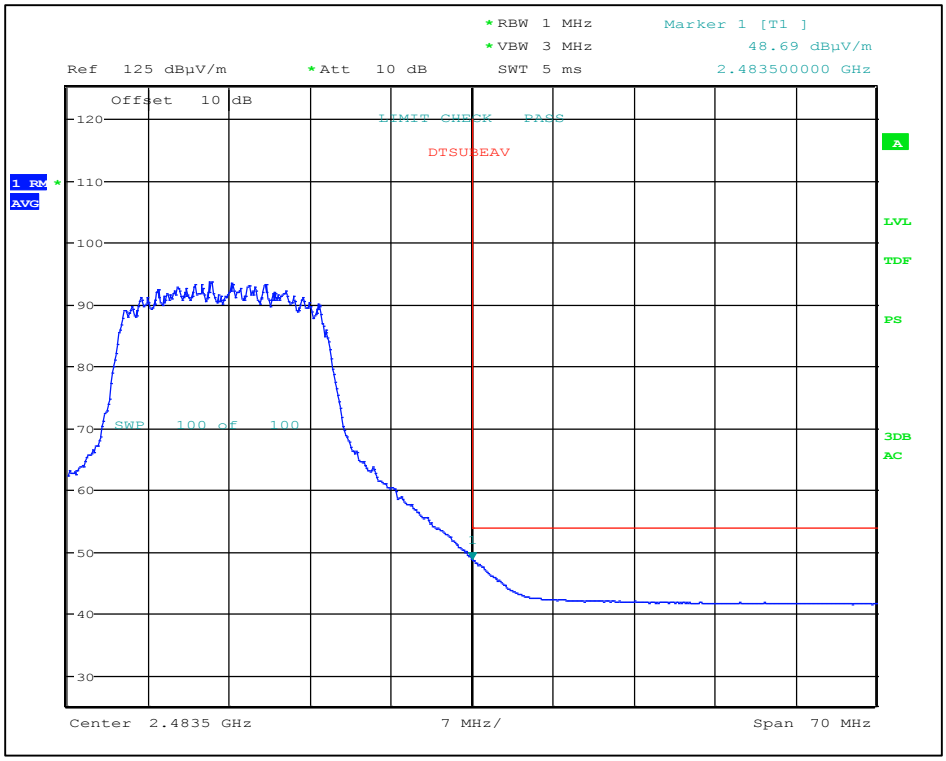
802.11n: MCS0, Channel 11 (2462 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Transducer Factor (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
2483.5	67.3	PK	150	V	25	V	0.00	-1.5	67.3	74.0	-6.7
2483.5	48.7	AV	150	V	25	V	0.00	-1.5	48.7	54.0	-5.3
2483.5	62.5	PK	165	H	0	H1	0.00	-1.8	62.5	74.0	-11.5
2483.5	45.5	AV	165	H	0	H1	0.00	-1.8	45.5	54.0	-8.5

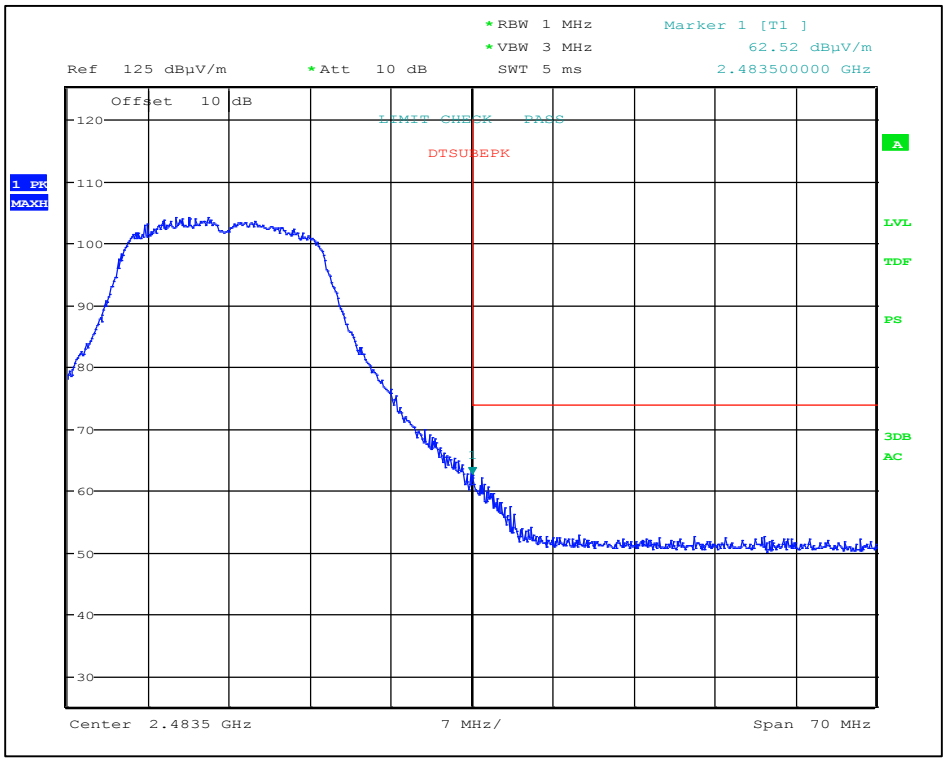
Refer to the following Plots



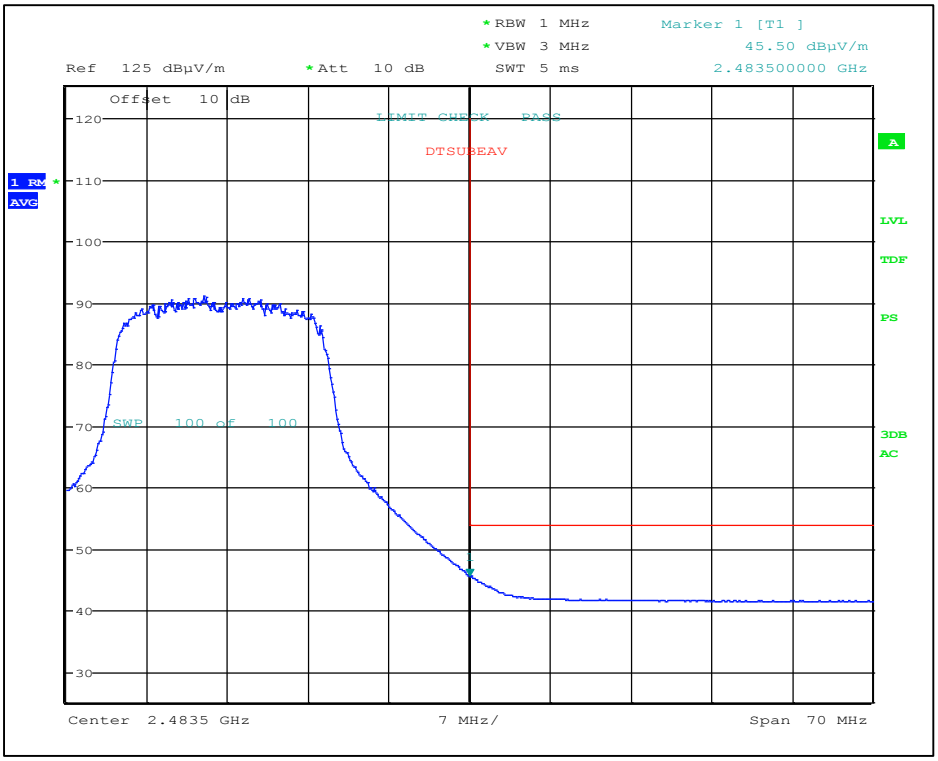
802.11n: MCS0 - Restricted-band band-edge at high channel (Vertical Peak)



802.11n: MCS0 - Restricted-band band-edge at high channel (Vertical Average)



802.11n: MCS0 - Restricted-band band-edge at high channel (Horizontal Peak)



802.11n: MCS0 - Restricted-band band-edge at high channel (Horizontal Average)

6.5.9 Transmitter Radiated Emissions above 1 GHz

Worst Case Mode:	802.11b
Data Rate:	1 Mbps
Measurement Distance:	3 meters
Operating Mode:	Continuous Transmit
Frequency Range:	1000 MHz – 25000 MHz
Note: The pre-scan plots do not show the maximized amplitude, only included for the purpose of identifying spurious emissions requiring final measurements.	

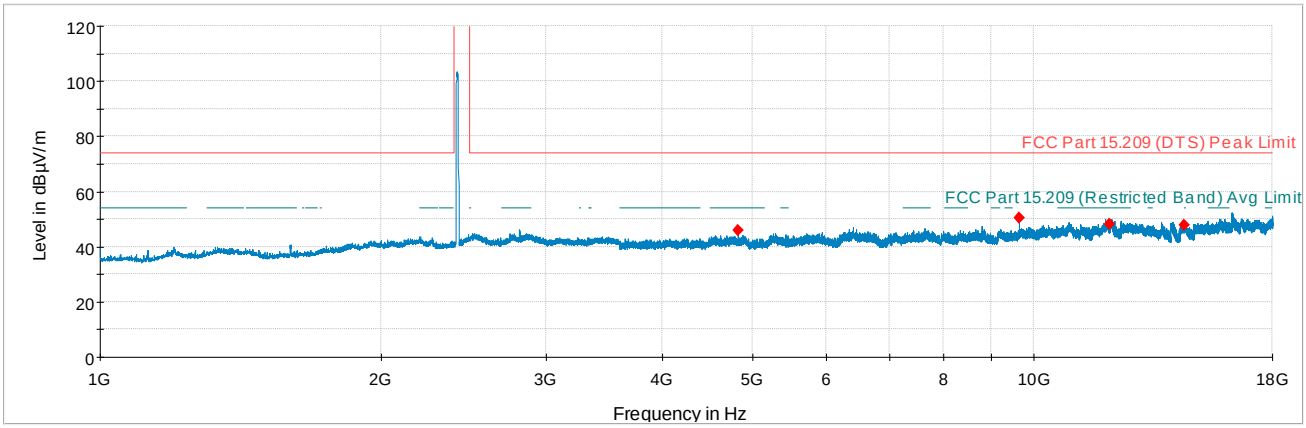
Channel 1 (2412 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Correction Factor (dB)	Corrected Level (dBuV/m)	Limit [RB] (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
*4824.0	44.0	PK	246.0	V	90.0	V	0.0	3.5	47.5	74.0	-26.5
*4824.0	33.6	AV	246.0	V	90.0	V	0.0	3.5	37.1	54.0	-16.9
*12060.0	42.2	PK	191.0	V	90.0	V	0.0	11.0	53.2	74.0	-20.8
*12060.0	30.5	AV	191.0	V	90.0	V	0.0	11.0	41.5	54.0	-12.5

*Note: * - indicates frequency in FCC §15.205 Restricted bands of operation; RB - Restricted Band*

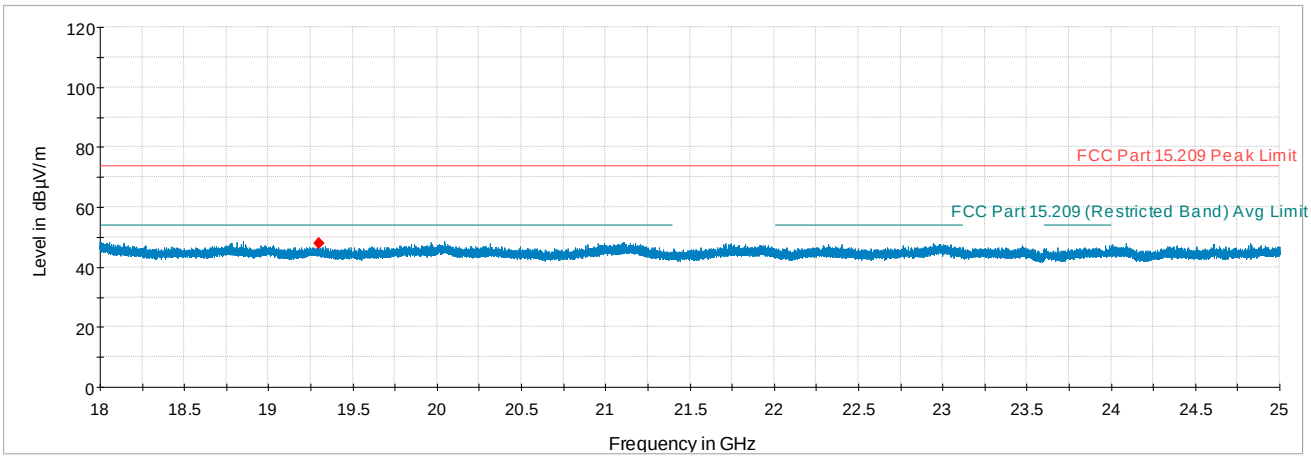
Radiated Spurious Emissions Pre-scan Vertical and Horizontal Plots

Channel 1 (2412 MHz) 1000-18000 MHz Vertical Plot



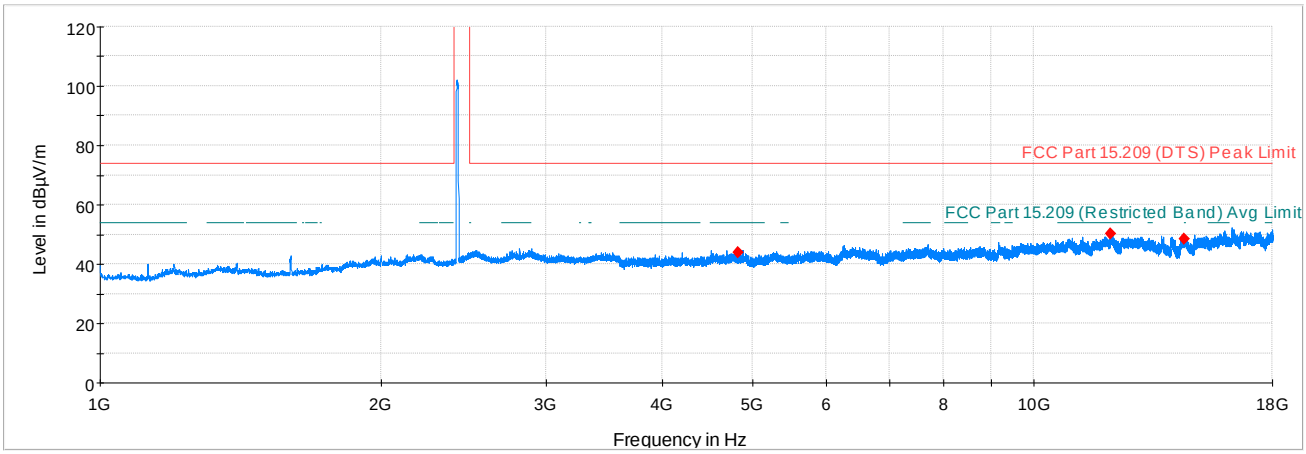
802.11b: 1Mbps - Radiated Emissions 1-18 GHz at Channel 1 (Vertical)

Channel 1 (2412 MHz) 18000-25000 MHz Vertical Plot



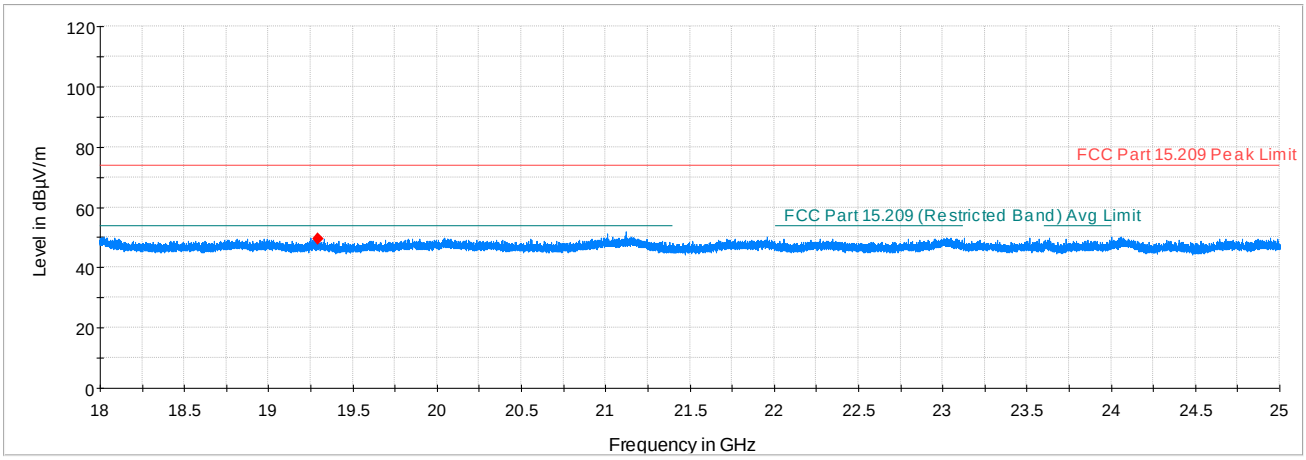
802.11b: 1Mbps - Radiated Emissions 18-25 GHz at Channel 1 (Vertical)

Channel 1 (2412 MHz) 1000-18000 MHz Horizontal Plot



802.11b: 1Mbps - Radiated Emissions 1-18 GHz at Channel 1 (Horizontal)

Channel 1 (2412 MHz) 18000-25000 MHz Horizontal Plot



802.11b: 1Mbps - Radiated Emissions 18-25 GHz at Channel 1 (Horizontal)

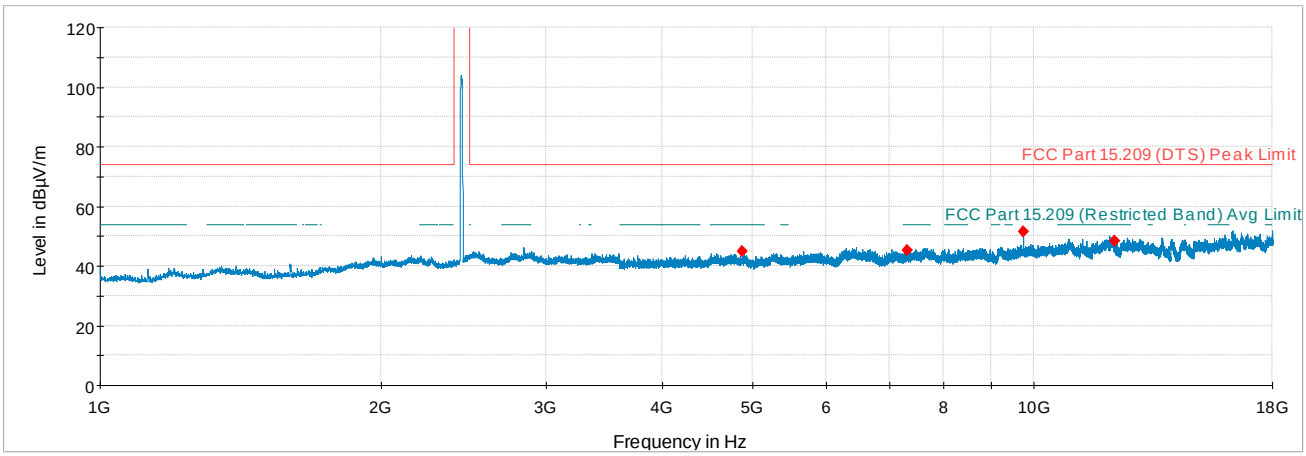
Channel 6 (2437 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Correction Factor (dB)	Corrected Level (dBuV/m))	Limit [RB] (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
*4874.0	44.2	PK	246.0	V	90.0	V	0.0	3.9	48.1	74.0	-25.9
*4874.0	33.4	AV	246.0	V	90.0	V	0.0	3.9	37.3	54.0	-16.7
*7311.0	43.5	PK	230.0	V	90.0	V	0.0	5.6	49.1	74.0	-24.9
*7311.0	32.0	AV	230.0	V	90.0	V	0.0	5.6	37.6	54.0	-16.4
*12185.0	41.2	PK	190.0	V	90.0	V	0.0	11.2	52.4	74.0	-21.6
*12185.0	29.4	AV	190.0	V	90.0	V	0.0	11.2	40.6	54.0	-13.4

*Note: * - indicates frequency in FCC §15.205 Restricted bands of operation; RB - Restricted Band*

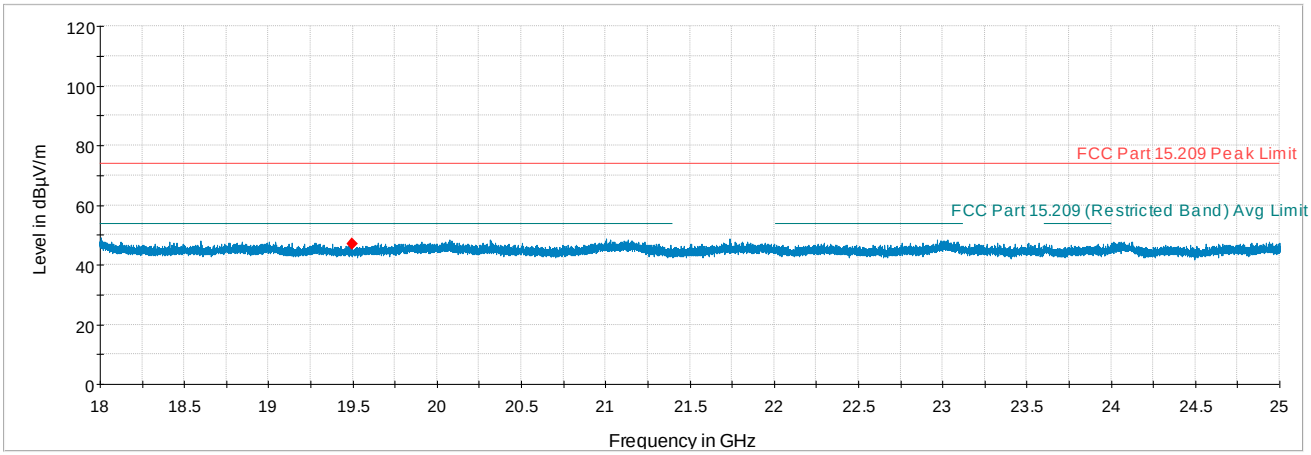
Radiated Spurious Emissions Pre-scan Vertical and Horizontal Plots

Channel 6 (2437 MHz): 1000-18000 MHz Vertical Plot



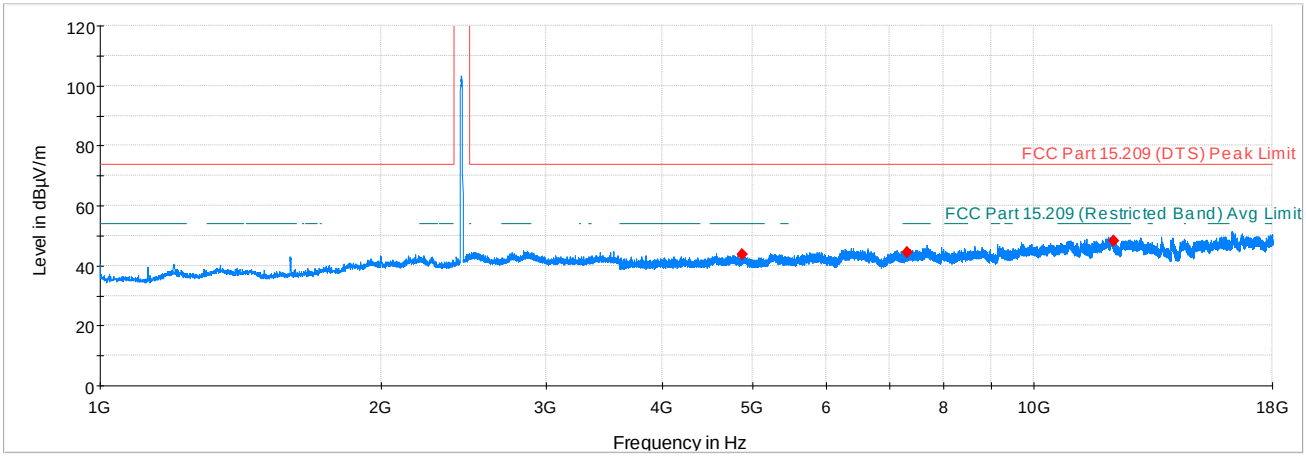
802.11b: 1Mbps - Radiated Emissions 1-18 GHz at Channel 6 (Vertical)

Channel 6 (2437 MHz): 18000-25000 MHz Vertical Plot



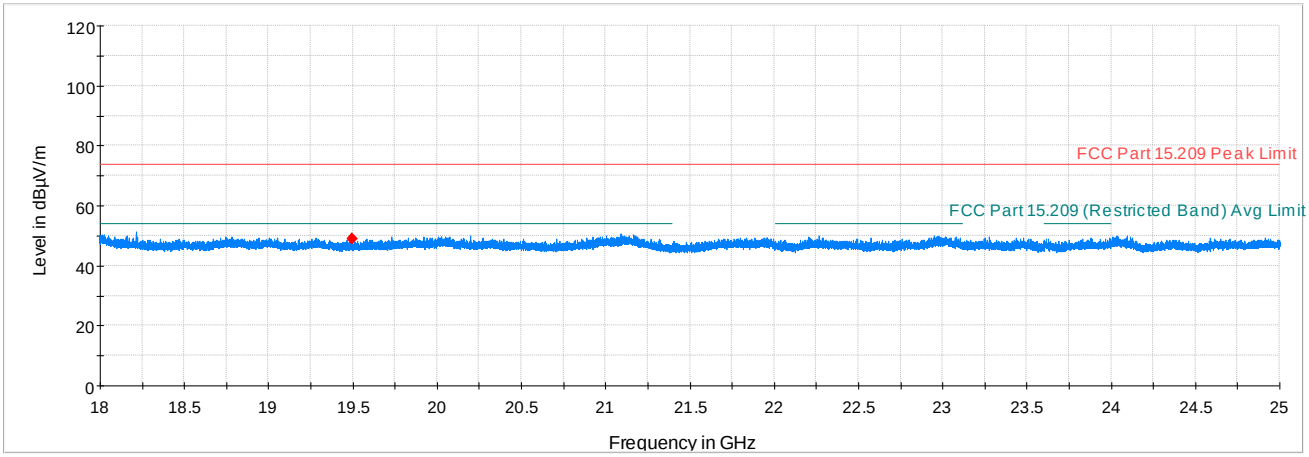
802.11b: 1Mbps - Radiated Emissions 18-25 GHz at Channel 6 (Vertical)

Channel 6 (2437 MHz): 1000-18000 MHz Horizontal Plot



802.11b: 1Mbps - Radiated Emissions 1-18 GHz at Channel 6 (Horizontal)

Channel 6 (2437 MHz): 18000-25000 MHz Horizontal Plot



802.11b: 1Mbps - Radiated Emissions 18-25 GHz at Channel 6 (Horizontal)

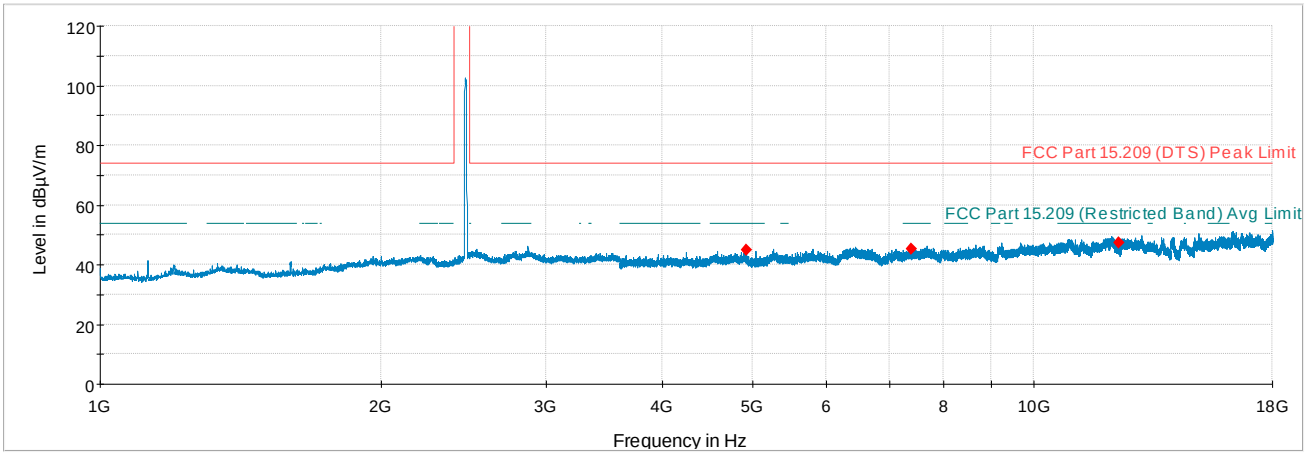
Channel 11 (2462 MHz)

Frequency (MHz)	SA Reading (dBuV/m)	Detector PK/AV	Antenna			EUT Antenna Polarity (V/H1/H2)	DC Factor (dB)	Correction Factor (dB)	Corrected Level (dBuV/m)	Limit [RB] (dBuV/m)	Margin (dB)
			Height (cm)	Polarity (V/H)	Azimuth (Deg)						
*4924.0	41.9	PK	230.0	V	220.0	V	0.0	4.1	46.0	74.0	-28.0
*4924.0	31.5	AV	230.0	V	220.0	V	0.0	4.1	35.6	54.0	-18.4
*7386.0	41.5	PK	230.0	V	90.0	V	0.0	5.7	47.2	74.0	-26.8
*7386.0	30.6	AV	230.0	V	90.0	V	0.0	5.7	36.3	54.0	-17.7
*19696.0	56.5	PK	160.0	V	89.0	V	0.0	-5.0	51.5	74.0	-22.5
*19696.0	48.2	AV	160.0	V	89.0	V	0.0	-5.0	43.2	54.0	-10.8

*Note: * - indicates frequency in FCC §15.205 Restricted bands of operation; RB - Restricted Band*

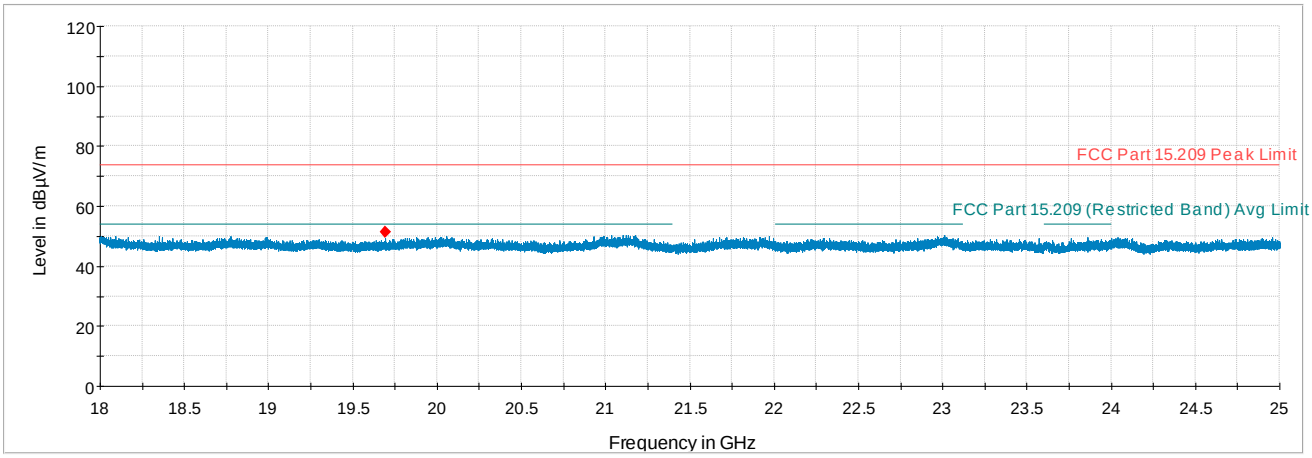
Radiated Spurious Emissions Pre-scan Vertical and Horizontal Plots

Channel 11 (2462 MHz): 1000-18000 MHz Vertical Plot



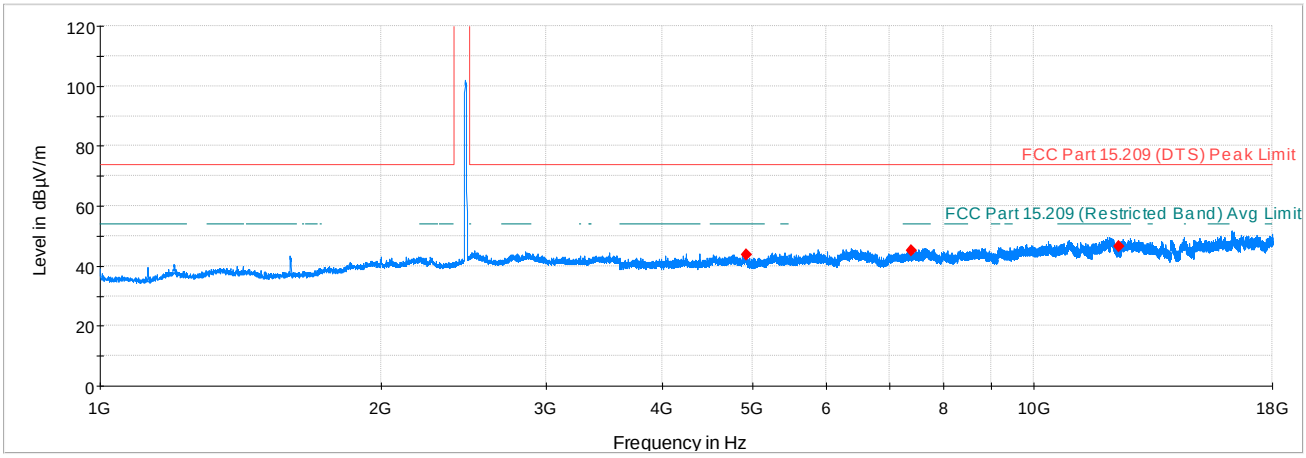
802.11b: 1Mbps - Radiated Emissions 1-18 GHz at Channel 11 (Vertical)

Channel 11 (2462 MHz): 18000-25000 MHz Vertical Plot



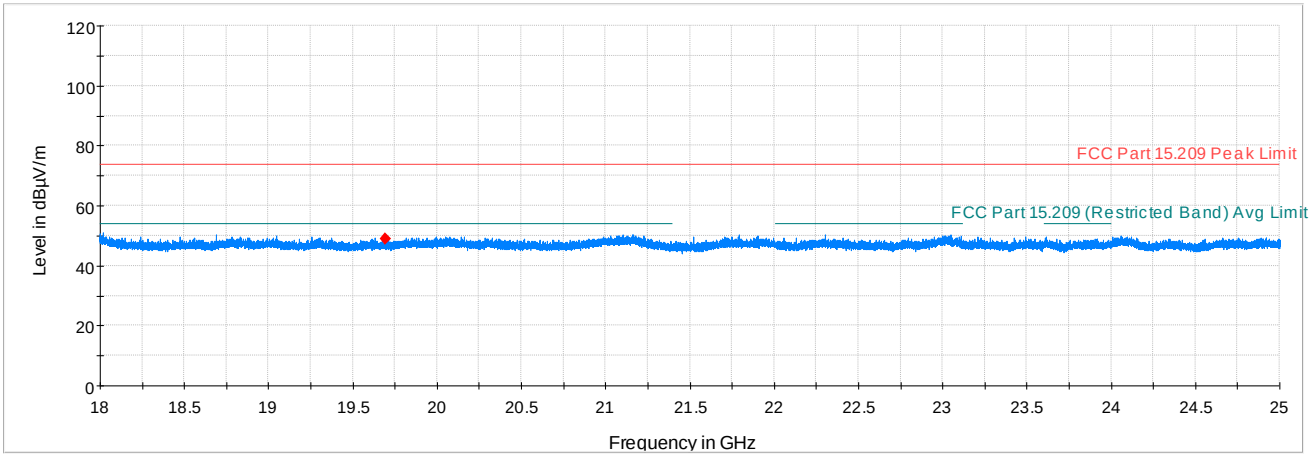
802.11b: 1Mbps - Radiated Emissions 18-25 GHz at Channel 11 (Vertical)

Channel 11 (2462 MHz): 1000-18000 MHz Horizontal Plot



802.11b: 1Mbps - Radiated Emissions 1-18 GHz at Channel 11 (Horizontal)

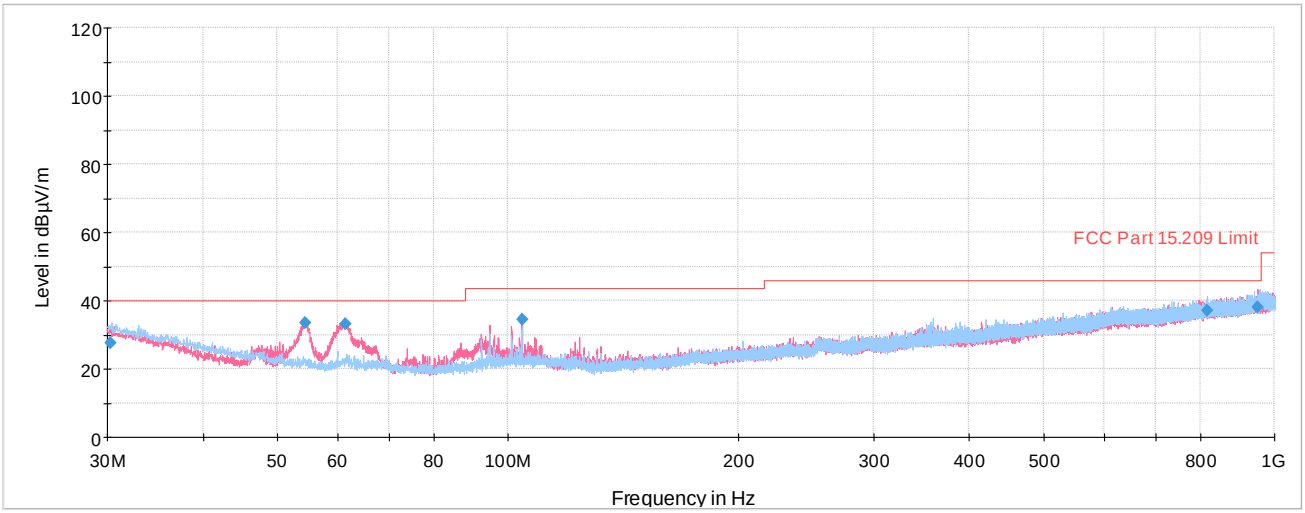
Channel 11 (2462 MHz): 18000-25000 MHz Horizontal Plot



802.11b: 1Mbps - Radiated Emissions 18-25 GHz at Channel 11 (Horizontal)

6.5.10 Transmitter Radiated Emissions in the 30MHz to 1000MHz

Worst Case Mode:	802.11b
Data Rate:	1 Mbps
Measurement Distance:	3 meters
Operating Frequency:	2462 MHz
Test Channel:	11



FCC Part 15B QP Class B Limit
Preview Result 1V-PK+
Preview Result 1H-PK+
Final Result 1-QPK

EUT: 20-2052-01LF (Wi-Fi Module); S/N: #1
Operating @ DTS Channel 11, 1Mbps Data Rate
2015-05-29

Frequency (MHz)	Amplitude (dBµV)	Height (cm)	Antenna Polarization (H/V)	Azimuth (deg)	Correction Factor (dB)	Margin (dB)	Limit (dBµV/m)	Detector (QP/PK/AV)
54.379	33.5	100.0	V	0.0	8.6	-6.5	40.0	QP
61.323	33.0	100.0	V	22.0	8.9	-7.9	40.0	QP
952.080	38.0	200.0	V	0.0	26.4	-8.0	46.0	QP
104.342	34.5	389.0	V	18.0	10.9	-9.0	43.5	QP
818.090	37.0	100.0	H	156.0	24.8	-9.0	46.0	QP
30.296	27.6	100.0	V	127.0	16.6	-12.4	40.0	QP

6.6 AC Power-line Conducted Emissions

Limits

FCC § 15.207 (a)

Frequency of emissions (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*

RSS-Gen Issue 4 Section 8.8

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emissions Limits

Frequency of emissions (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

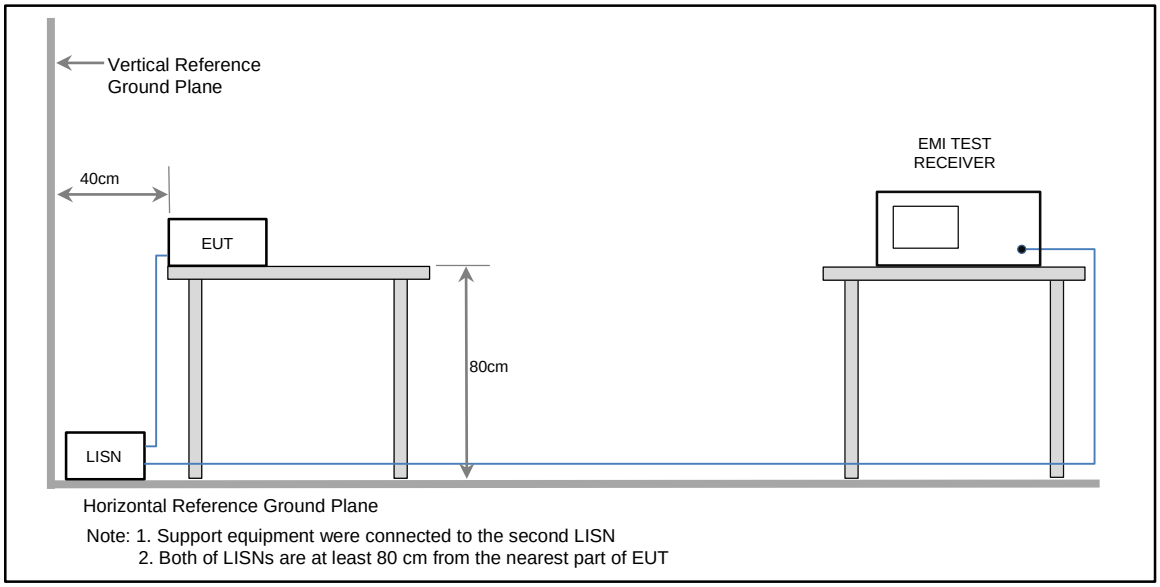
** Decreases with the logarithm of the frequency, ** A linear average detector is required*

Conducted Emissions Test Setup and Procedure

The EUT power cord was connected to a LISN and folded back and forth forming a bundle 30 to 40 cm long. All support equipment power cords were connected to an auxiliary LISN via a multiple outlet strip. The EUT LISN was kept at a distance 80 cm from the closest part of the EUT.
Using the test software, an initial PEAK pre-scan was taken. After the pre-scan was complete, a minimum of 6 highest frequencies were chosen. Quasi-Peak and Average measurements were taken at these frequencies selected. If the test software measured any signal within 3 dB of the limit, then the same signal was re-measured manually using the front keys of the EMI receiver to make sure of the software accuracy. This was performed for both “Line 1” and “Neutral” leads of the EUT power cord.

Example of Calculations:

Amplitude [QP/AV] $_{(dBuV)}$ *= Receiver Level* $_{(dB\mu V)}$ *+ Correction Factor* $_{(dB)}$
Correction Factor $_{(dB)}$ *= Cable Loss* $_{(dB)}$ *+ LISN Insertion Loss* $_{(dB)}$ *+ 10 dB Attenuator*
Margin $_{(dB)}$ *= Amplitude [QP/AV]* $_{(dBuV)}$ *– Limit [QP/AV]* $_{(dBuV)}$

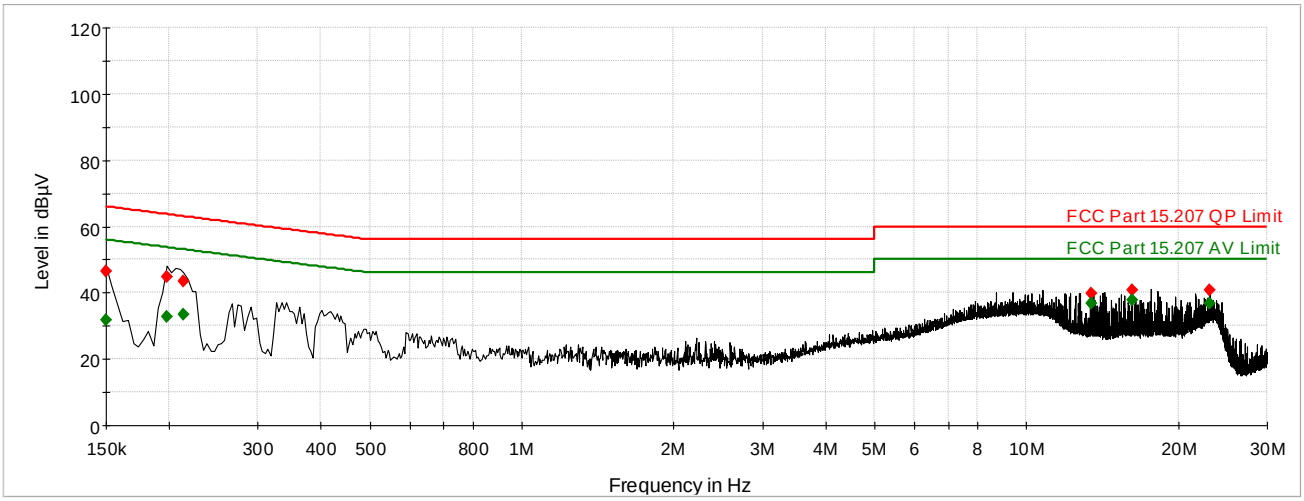


Note: 1. Support equipment were connected to the second LISN
2. Both of LISNs are at least 80 cm from the nearest part of EUT

Test Results

Worst Case Mode:	802.11b
Data Rate:	1Mbps
Test Voltage/Frequency:	120V/60Hz
Operating Frequency:	2462 MHz
Test Channel:	11

LINE1 (L1) Plot



FCC Part 15.207 QP Limit
FCC Part 15.207 AV Limit
Preview Result 1-PK+
Final Result 1-QPK
Final Result 2-AVG

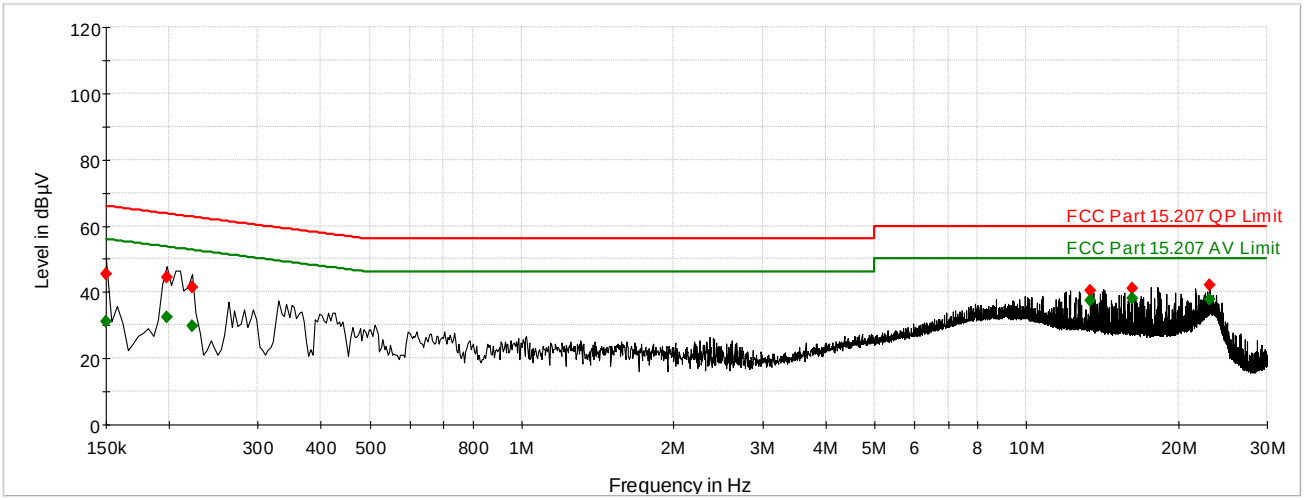
EUT: 20-2052-01LF (Wi-Fi Module); S/N: #1
Operating @ Channel 11, 1Mbps Data Rate
120VAC Input Voltage; LINE
2015-05-29

LINE1 (L1) Results

Frequency (MHz)	Amplitude (dBµV)	Line (L1/N)	Correction Factor (dB)	Margin (dB)	Limit (dBµV)	Detector (QP/AV)
0.198	44.9	L1	19.9	-18.8	63.7	QP
23.130	40.9	L1	20.2	-19.1	60.0	QP
16.230	40.7	L1	19.8	-19.3	60.0	QP
0.150	46.5	L1	19.9	-19.5	66.0	QP
0.214	43.5	L1	19.9	-19.6	63.0	QP
13.418	39.7	L1	19.9	-20.3	60.0	QP

Frequency (MHz)	Amplitude (dBµV)	Line (L1/N)	Correction Factor (dB)	Margin (dB)	Limit (dBµV)	Detector (QP/AV)
16.230	37.7	L1	19.8	-12.3	50.0	AV
13.418	36.8	L1	19.9	-13.2	50.0	AV
23.130	36.8	L1	20.2	-13.2	50.0	AV
0.214	33.4	L1	19.9	-19.7	53.0	AV
0.198	32.7	L1	19.9	-21.0	53.7	AV
0.150	31.8	L1	19.9	-24.2	56.0	AV

NEUTRAL Line (N) Plot



FCC Part 15.207 QP Limit
FCC Part 15.207 AV Limit
Preview Result 1-PK+
Final Result 1-QPK
Final Result 2-AVG

EUT: 20-2052-01LF (Wi-Fi Module); S/N: #1
Operating @ Channel 11, 1Mbps Data Rate
120VAC Input Voltage; NEUTRAL
2015-05-29

NEUTRAL Line (N) Results

Frequency (MHz)	Amplitude (dBµV)	Line (L1/N)	Correction Factor (dB)	Margin (dB)	Limit (dBµV)	Detector (QP/AV)
23.130	42.0	N	20.4	-18.0	60.0	QP
16.230	41.3	N	19.9	-18.7	60.0	QP
0.198	44.3	N	19.8	-19.4	63.7	QP
13.358	40.5	N	20.1	-19.5	60.0	QP
0.150	45.6	N	19.8	-20.4	66.0	QP
0.222	41.3	N	19.8	-21.4	62.7	QP

Frequency (MHz)	Amplitude (dBµV)	Line (L1/N)	Correction Factor (dB)	Margin (dB)	Limit (dBµV)	Detector (QP/AV)
16.230	38.2	N	19.9	-11.8	50.0	AV
23.130	37.8	N	20.4	-12.2	50.0	AV
13.358	37.4	N	20.1	-12.6	50.0	AV
0.198	32.6	N	19.8	-21.1	53.7	AV
0.222	29.8	N	19.8	-22.9	52.7	AV
0.150	31.2	N	19.8	-24.8	56.0	AV

END OF REPORT