ENGINEERING TEST REPORT

Connex WiFi Controller
Model: 6700530100
FCC ID: Z49-00007

Applicant:

Dimplex North America Limited
1367 Industrial Road
Cambridge, Ontario
Canada N1R 7G8

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Systems (DTS) Operating in 2400 – 2483.5 MHz Band

UltraTech's File No.: 15DIEX022_FCC15C247DTS

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: November 10, 2015	
Report Prepared by: Dan Huynh Issued Date: November 10, 2015	Tested by: Hung Trinh Test Dates: August 4 – 10, 2015

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
Purpose of Test:	Equipment Certification for Digital Modulation Systems (DTS) Transmitter Operating in the Frequency Band 2400-2483.5 MHz.
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC KDB Publication No. 558074 D01 DTS Meas Guidance v03r03
Environmental Classification:	[ ] Commercial, industrial or business environment [x] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2015	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CISPR 22 & EN 55022	2008-09, Edition 6.0 2006	Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC, KDB Publication No. 558074 D01 DTS Meas Guidance v03r03	2015	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
FCC, KDB Publication No. 662911 D01 Multiple Transmitter Output v02r01	2013	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Dimplex North America Limited
Address:	1367 Industrial Road Cambridge, Ontario Canada N1R 7G8
Contact Person:	Mr. Kelly Stinson Phone #: 519-650-3630 Fax #: 519-650-3651 Email Address: kstinson@dimplex.com

MANUFACTURER	
Name:	Dimplex North America Limited
Address:	1367 Industrial Road Cambridge, Ontario Canada N1R 7G8
Contact Person:	Mr. Kelly Stinson Phone #: 519-650-3630 Fax #: 519-650-3651 Email Address: kstinson@dimplex.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The applicant supplied the following information.

Brand Name:	Dimplex North America Limited
Product Name:	Connex WiFi Controller
Model Name or Number:	6700530100
Serial Number:	Test Sample
Type of Equipment:	Digital Transmission System (DTS)
Input Power Supply Type:	5V, 1A
Primary User Functions of EUT:	Electrical resistance heating control interface. Wireless connection to LAN using 802.11b/g/n and a single channel control signal.

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Residential environment
Power Supply Requirement:	5V, 1A
RF Output Power Rating:	16.17 dBm (41.40 mW) Peak
Operating Frequency Range:	2412 - 2462 MHz
RF Output Impedance:	50 Ω
Modulation Type:	802.11bgn
Antenna Connector Type:	Integral

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Antenna Type	Maximum Gain (dBi)
Chip Antenna	3

2.5. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	USB	1	USB	Shielded cable

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	USB AC Adapter
Brand name:	Dongguan Guanjin Electronics Technology Co., Ltd.
Model Name or Number:	K05S050100U 1527
Connected to EUT's Port:	USB

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 ^{o}C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	5V, 1A via AC adapter

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Special software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	2412 - 2462 MHz
Frequency(ies) Tested:	2412 MHz, 2437 MHz, 2462 MHz
RF Power Output: (measured maximum output power at antenna terminals)	16.17 dBm (41.40 mW) Peak
Normal Test Modulation:	DSSS/OFDM
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3). Expiry Date: 2017-04-02.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	Yes
15.247(b)(3)	Peak Conducted Output Power - DTS	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	Yes
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. TEST DATA

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

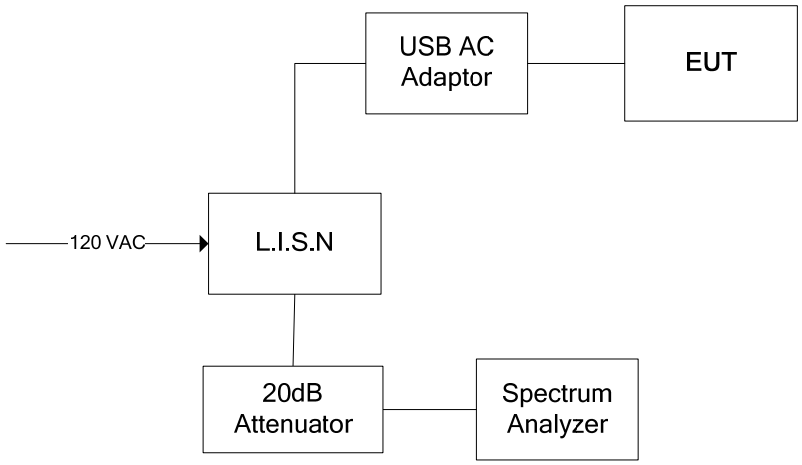
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..	60 ...……..	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4-2009

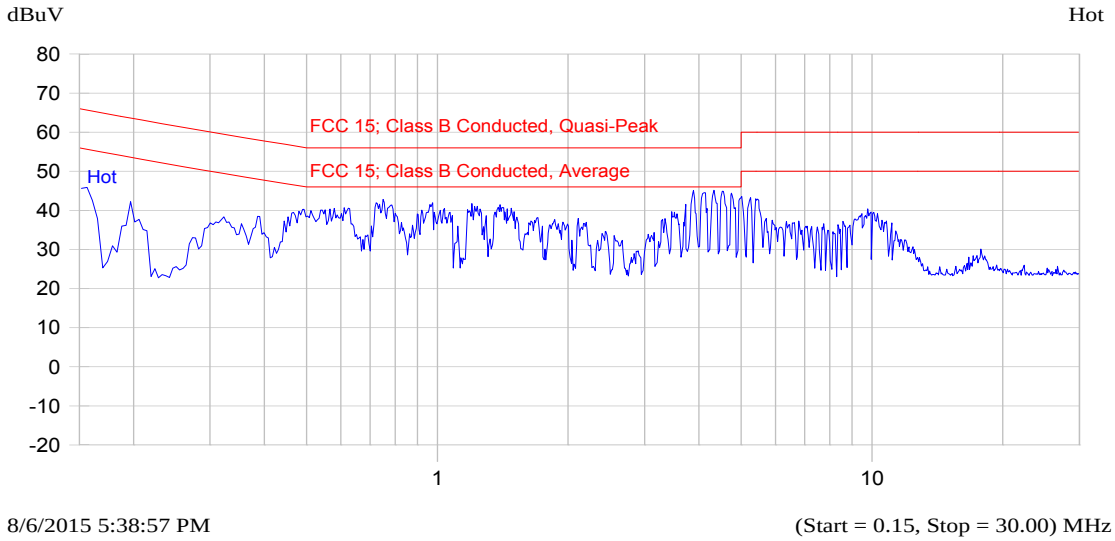
5.1.3. Test Arrangement



5.1.4. Test Data

Plot 5.1.4.1. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Hot

Current Graph

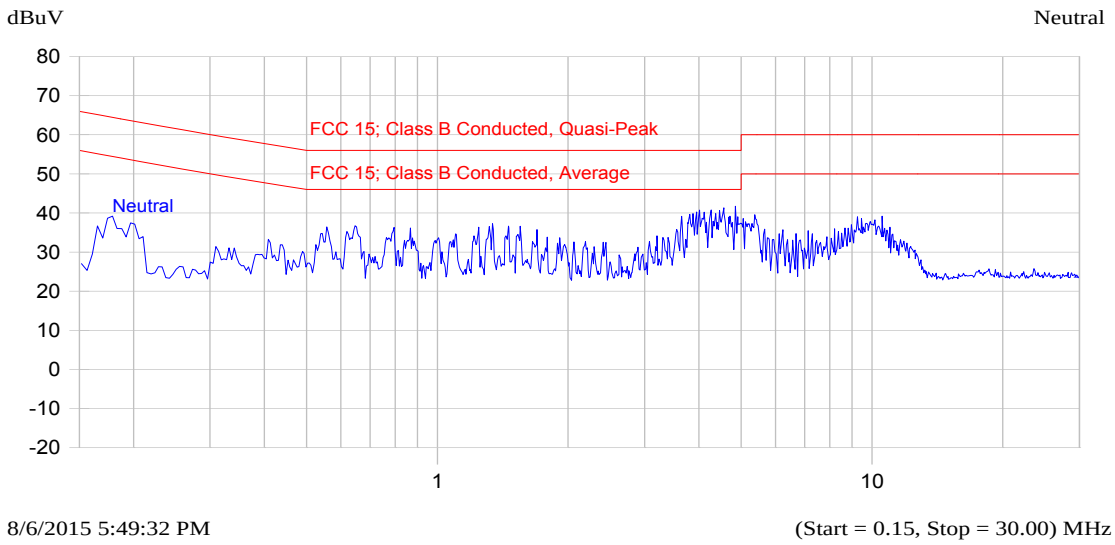


Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.193	41.3	36.8	-27.1	28.1	-25.8	Hot
0.753	44.2	39.0	-17.0	29.9	-16.1	Hot
3.892	46.3	41.2	-14.8	31.5	-14.5	Hot
4.333	46.3	41.6	-14.4	31.1	-14.9	Hot
9.788	40.7	36.5	-23.5	26.9	-23.1	Hot

Plot 5.1.4.2. Power Line Conducted Emissions; Line Voltage120 VAC; Line Tested: Neutral

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.176	42.7	36.8	-27.9	29.1	-25.6	Neutral
0.646	37.9	33.1	-22.9	25.6	-20.4	Neutral
1.333	40.0	32.8	-23.2	25.3	-20.7	Neutral
4.865	42.0	35.6	-20.4	26.5	-19.5	Neutral
10.554	38.7	31.8	-28.2	23.5	-26.5	Neutral

5.2. OCCUPIED BANDWIDTH [§ 15.247(a)(2)]

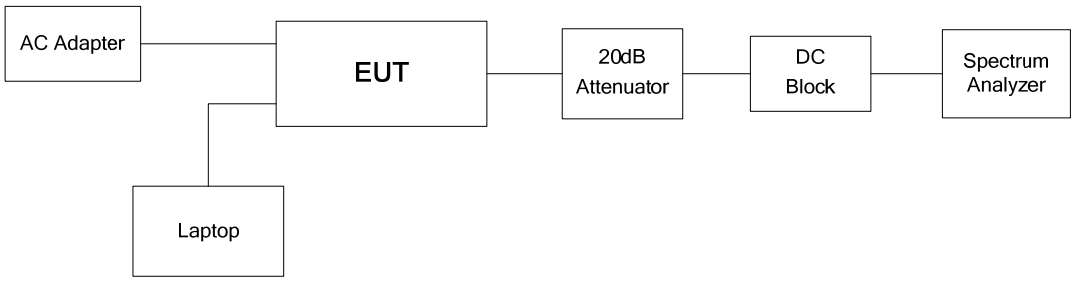
5.2.1. Limit(s)

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

5.2.2. Method of Measurements

KDB Publication No. 558074 D01 DTS Meas Guidance V03r03, Section 8.1 Option 1

5.2.3. Test Arrangement



5.2.4. Test Data

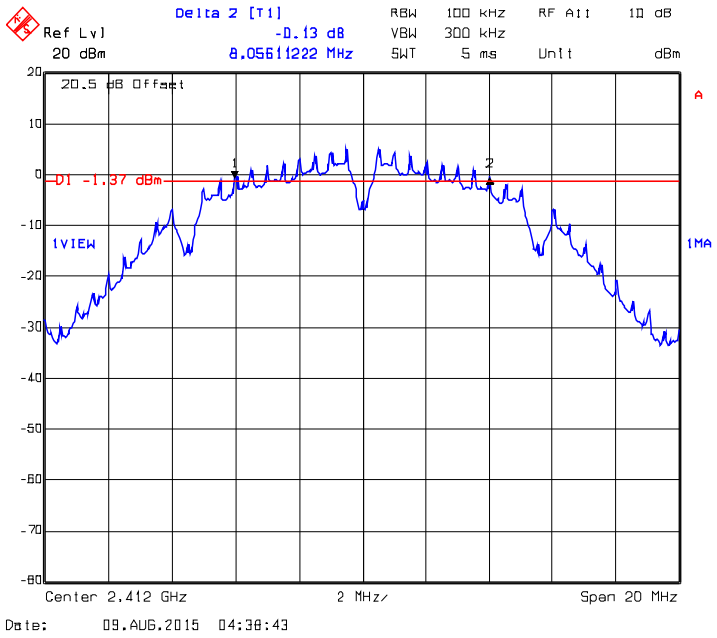
802.11b, Output Power Setting 18					
Modulation	Data Rate (Mbps)	Channel Number	Frequency (MHz)	6dB BW (MHz)	Min. Limit (kHz)
DBPSK	1	1	2412	8.06	500
		6	2437	8.54	500
		11	2462	8.02	500
DQPSK	2	1	2412	8.10	500
		6	2437	8.10	500
		11	2462	8.02	500
CCK	11	1	2412	8.22	500
		6	2437	8.14	500
		11	2462	7.98	500

802.11g, Output Power Setting 11					
Modulation	Data Rate (Mbps)	Channel Number	Frequency (MHz)	6dB BW (MHz)	Min. Limit (kHz)
BPSK	9	1	2412	15.64	500
		6	2437	15.71	500
		11	2462	15.57	500
QPSK	18	1	2412	15.22	500
		6	2437	15.36	500
		11	2462	15.29	500
16-QAM	36	1	2412	16.06	500
		6	2437	16.48	500
		11	2462	16.13	500
64-QAM	54	1	2412	16.13	500
		6	2437	16.27	500
		11	2462	16.13	500

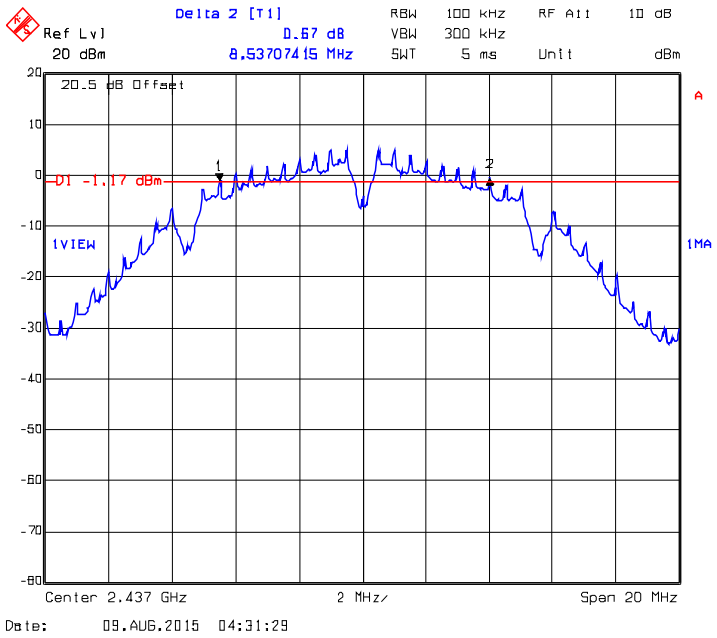
802.11n HT20, Output Power Setting 11						
MCS Index	Modulation	Data Rate (Mbps)	Channel Number	Frequency (MHz)	6dB BW (MHz)	Min. Limit (kHz)
0	BPSK 1/2	6.5	1	2412	16.48	500
			6	2437	16.13	500
			11	2462	16.20	500
2	QPSK 3/4	19.5	1	2412	15.43	500
			6	2437	15.78	500
			11	2462	16.13	500
4	16-QAM 3/4	39	1	2412	17.75	500
			6	2437	17.75	500
			11	2462	17.68	500
7	64-QAM 5/6	65	1	2412	17.68	500
			6	2437	17.68	500
			11	2462	17.68	500

See the following plots for detailed measurements.

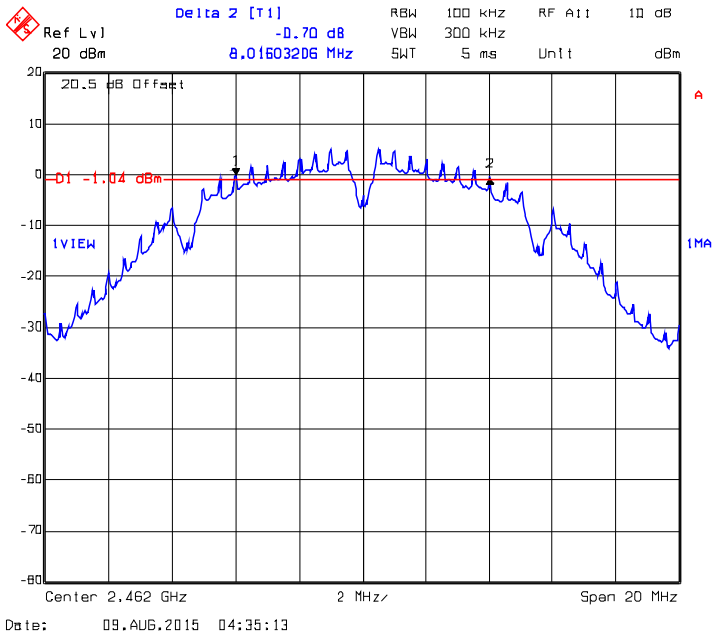
Plot 5.2.4.1. 6 dB Bandwidth, 802.11b, Ch 1, 2412 MHz, DBPSK 1 Mbps, Output Power Setting 18



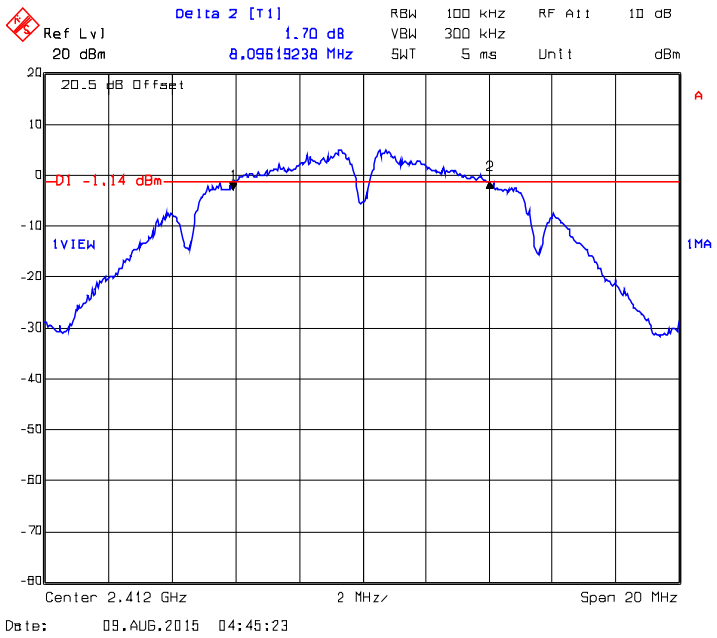
Plot 5.2.4.2. 6 dB Bandwidth, 802.11b, Ch 6, 2437 MHz, DBPSK 1 Mbps, Output Power Setting 18



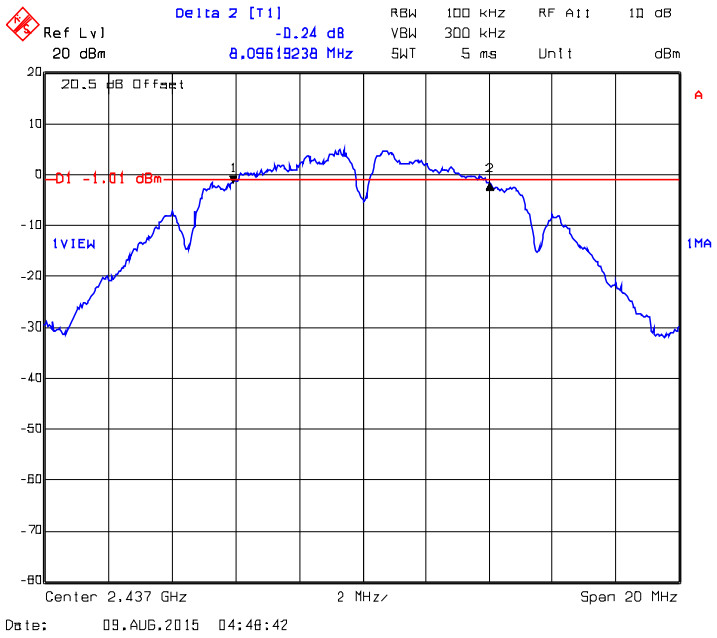
Plot 5.2.4.3. 6 dB Bandwidth, 802.11b, Ch 11, 2462 MHz, DBPSK 1 Mbps, Output Power Setting 18



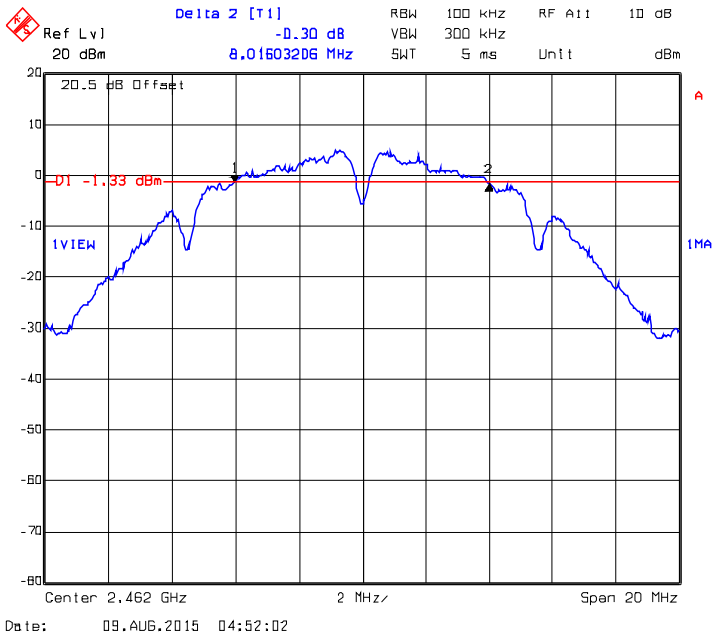
Plot 5.2.4.4. 6 dB Bandwidth, 802.11b, Ch 1, 2412 MHz, DQPSK 2 Mbps, Output Power Setting 18



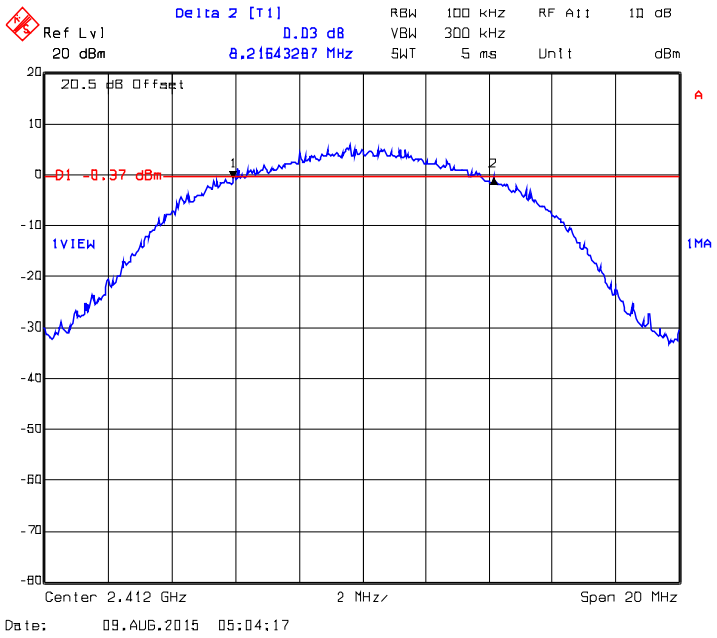
Plot 5.2.4.5. 6 dB Bandwidth, 802.11b, Ch 6, 2437 MHz, DQPSK 2 Mbps, Output Power Setting 18



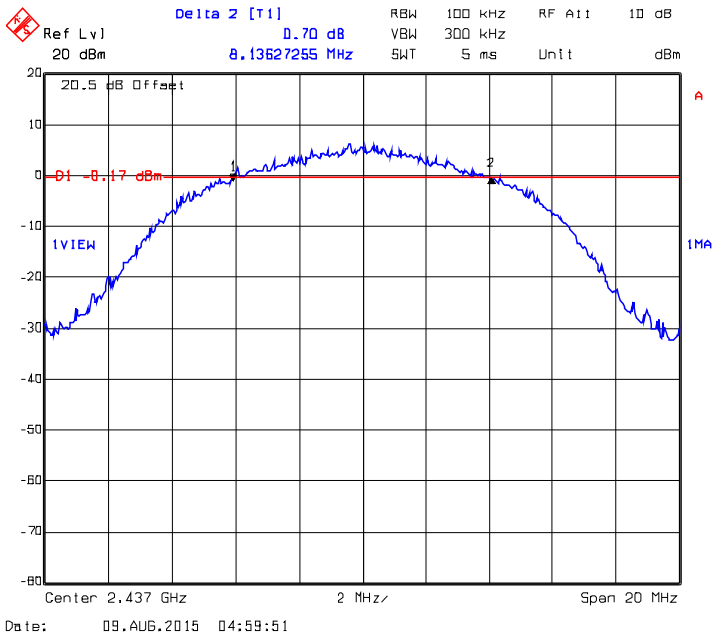
Plot 5.2.4.6. 6 dB Bandwidth, 802.11b, Ch 11, 2462 MHz, DQPSK 2 Mbps, Output Power Setting 18



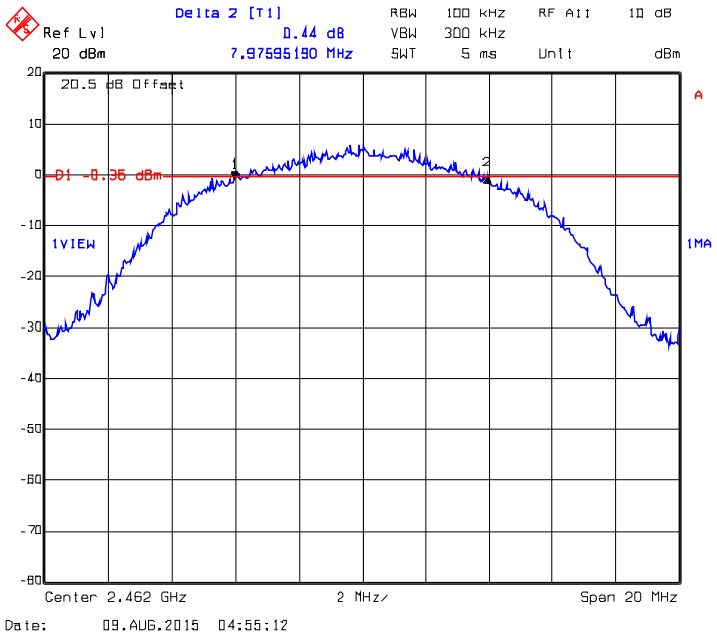
Plot 5.2.4.7. 6 dB Bandwidth, 802.11b, Ch 1, 2412 MHz, CCK 11 Mbps, Output Power Setting 18



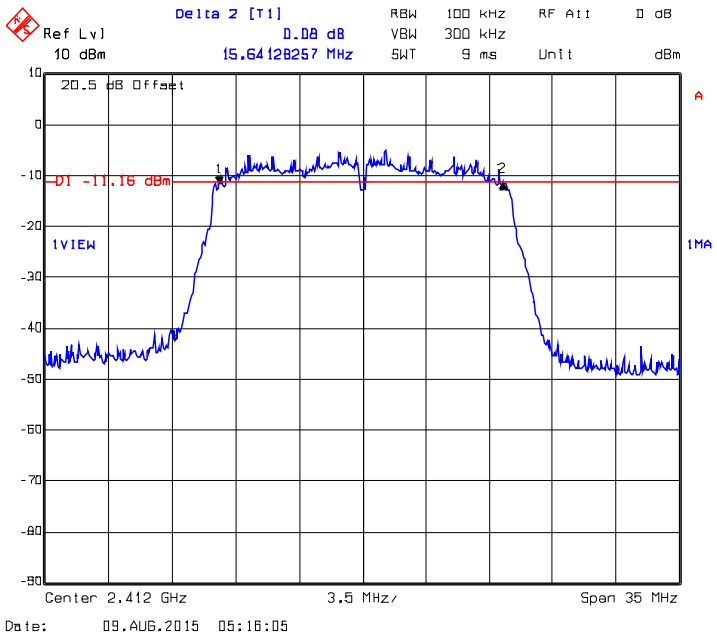
Plot 5.2.4.8. 6 dB Bandwidth, 802.11b, Ch 6, 2437 MHz, CCK 11 Mbps, Output Power Setting 18



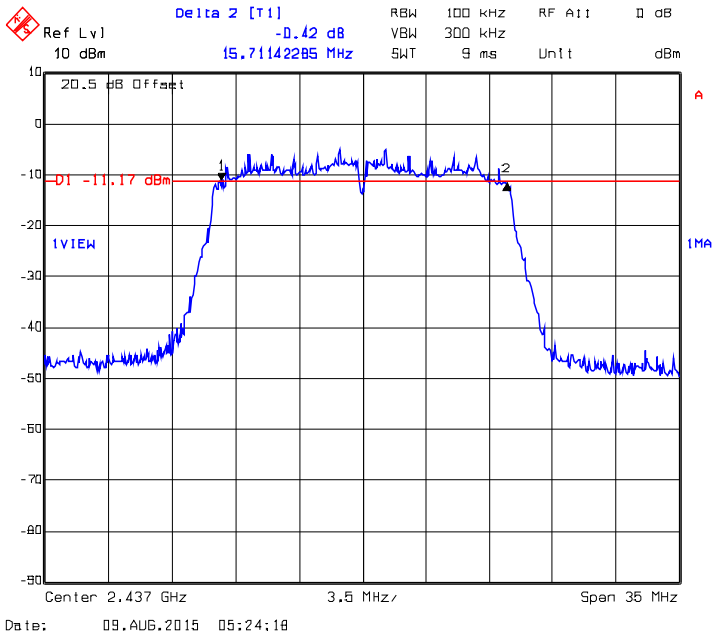
Plot 5.2.4.9. 6 dB Bandwidth, 802.11b, Ch 11, 2462 MHz, CCK 11 Mbps, Output Power Setting 18



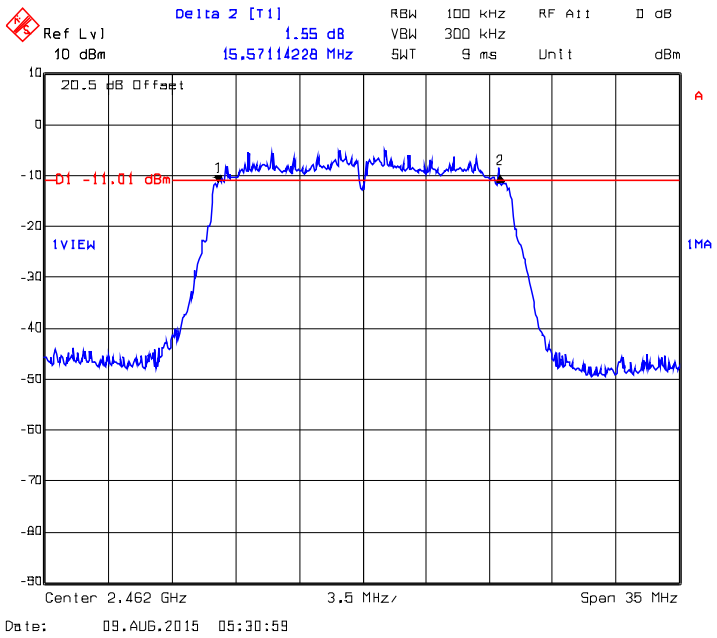
Plot 5.2.4.10. 6 dB Bandwidth, 802.11g, Ch 1, 2412 MHz, BPSK 9 Mbps, Output Power Setting 11



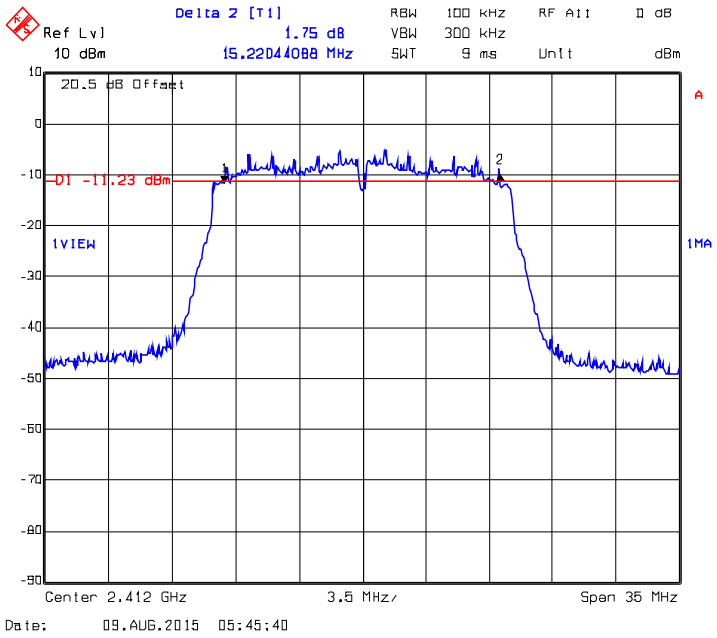
Plot 5.2.4.11. 6 dB Bandwidth, 802.11g, Ch 6, 2437 MHz, BPSK 9 Mbps, Output Power Setting 11



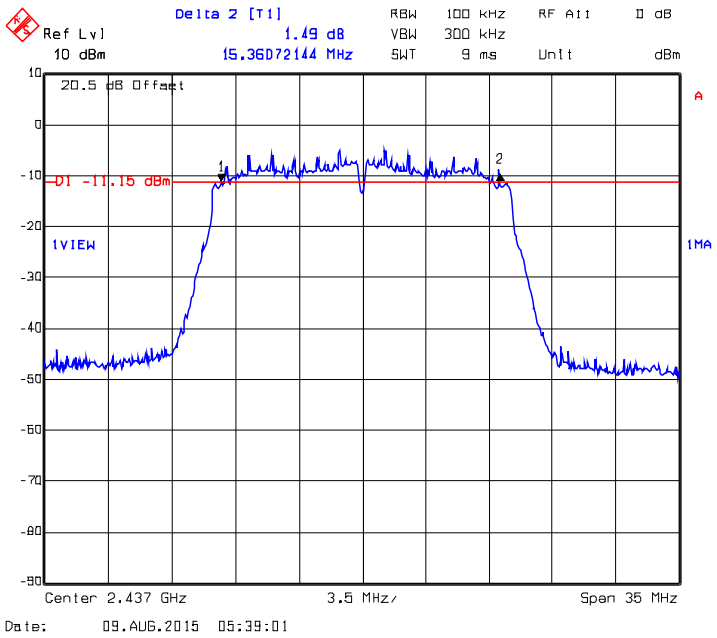
Plot 5.2.4.12. 6 dB Bandwidth, 802.11g, Ch 11, 2462 MHz, BPSK 9 Mbps, Output Power Setting 11



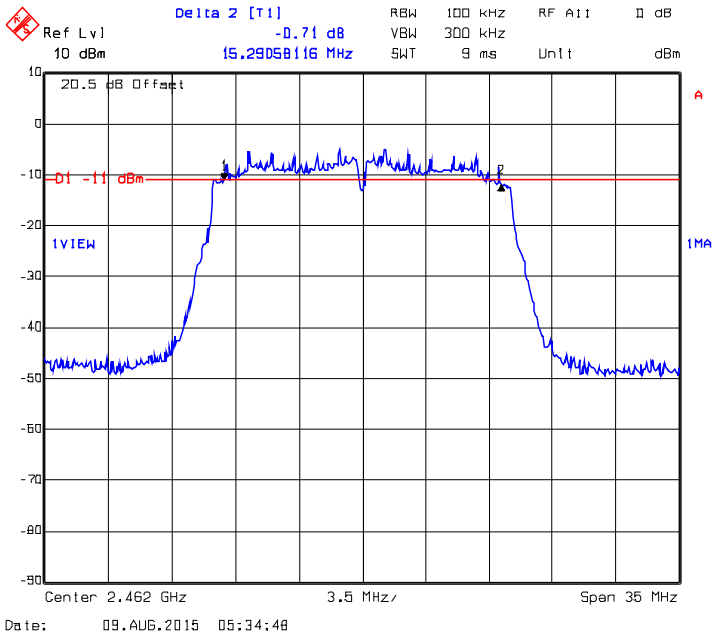
Plot 5.2.4.13. 6 dB Bandwidth, 802.11g, Ch 1, 2412 MHz, QPSK 18 Mbps, Output Power Setting 11



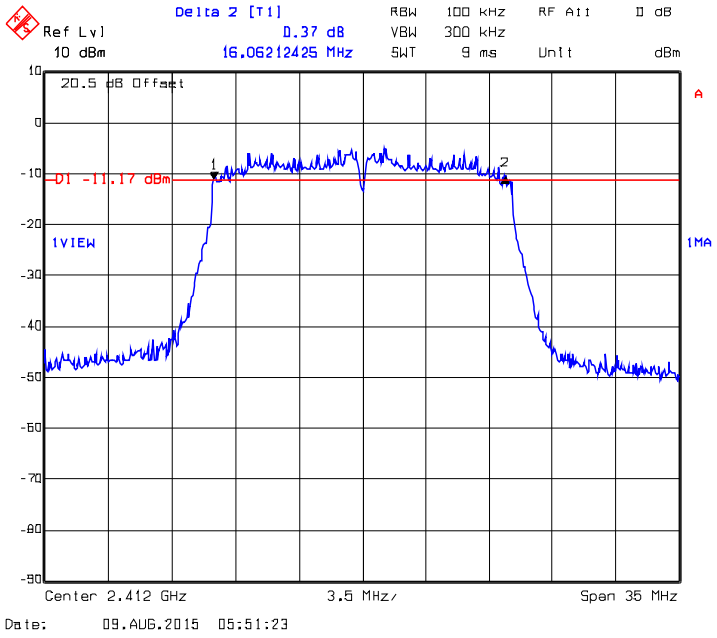
Plot 5.2.4.14. 6 dB Bandwidth, 802.11g, Ch 6, 2437 MHz, QPSK 18 Mbps, Output Power Setting 11



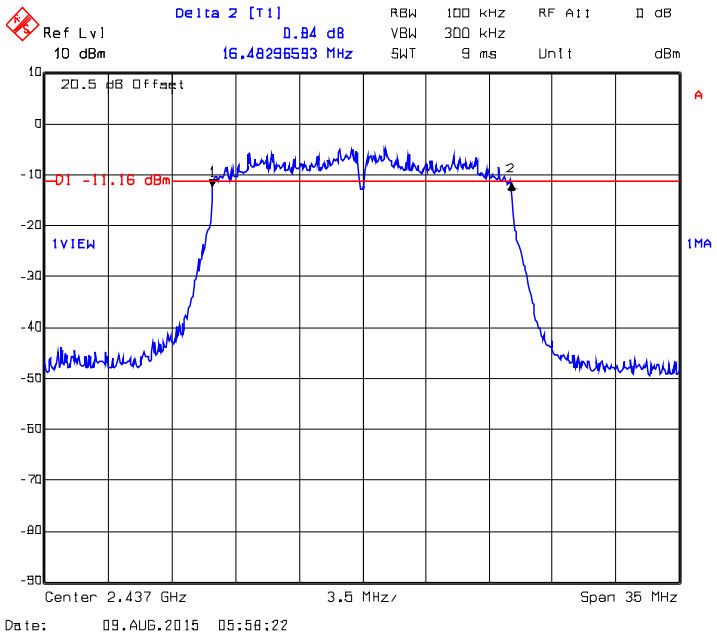
Plot 5.2.4.15. 6 dB Bandwidth, 802.11g, Ch 11, 2462 MHz, QPSK 18 Mbps, Output Power Setting 11



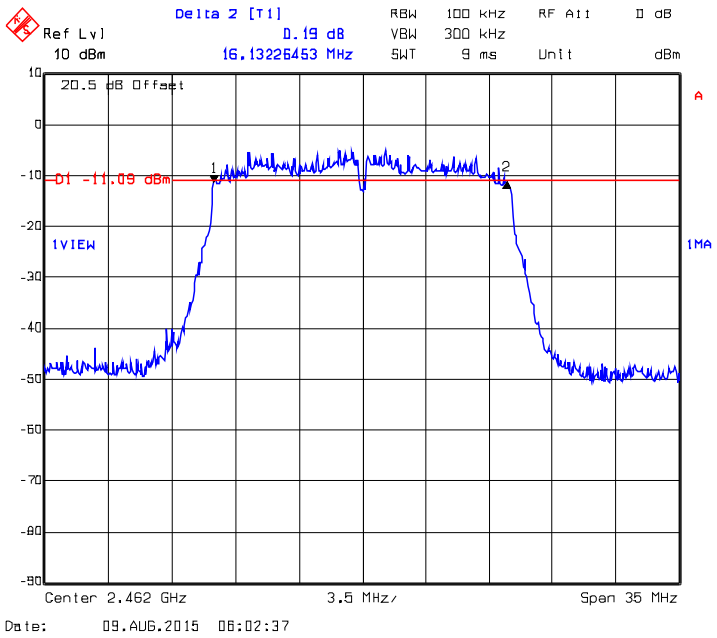
Plot 5.2.4.16. 6 dB Bandwidth, 802.11g, Ch 1, 2412 MHz, 16-QAM 36 Mbps, Output Power Setting 11



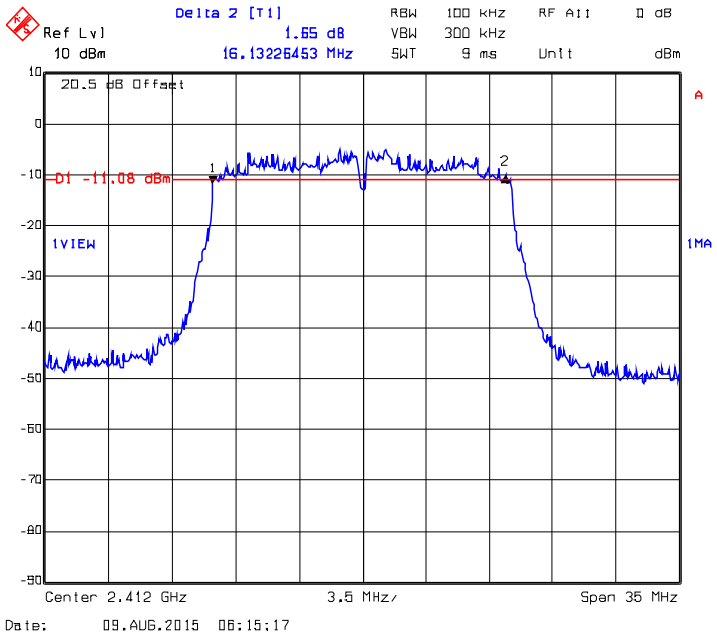
Plot 5.2.4.17. 6 dB Bandwidth, 802.11g, Ch 6, 2437 MHz, 16-QAM 36 Mbps, Output Power Setting 11



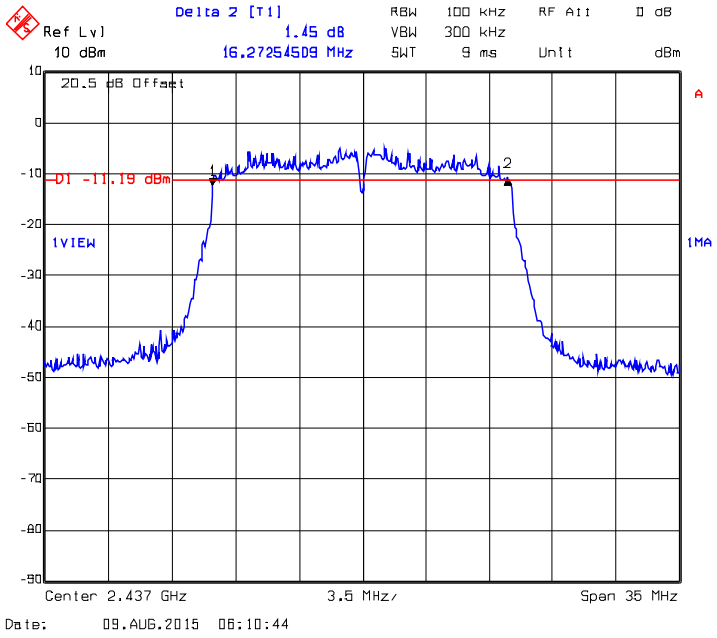
Plot 5.2.4.18. 6 dB Bandwidth, 802.11g, Ch 11, 2462 MHz, 16-QAM 36 Mbps, Output Power Setting 11



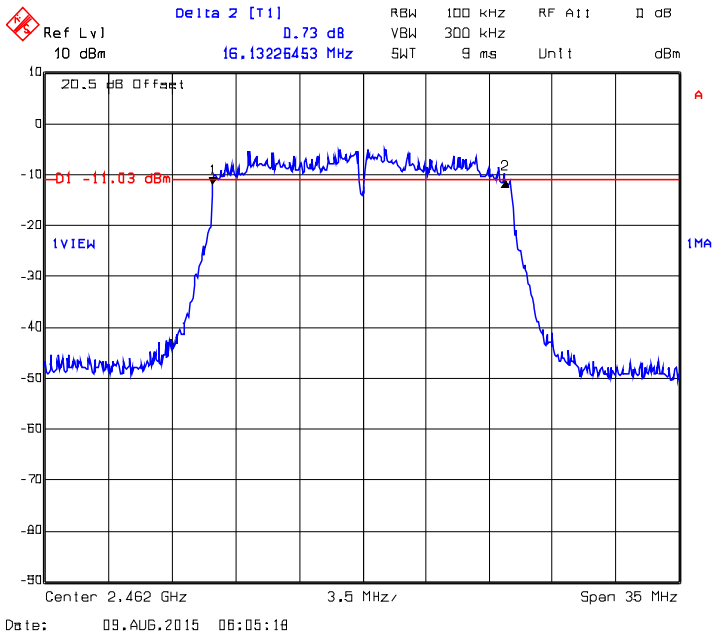
Plot 5.2.4.19. 6 dB Bandwidth, 802.11g, Ch 1, 2412 MHz, 64-QAM 54 Mbps, Output Power Setting 11



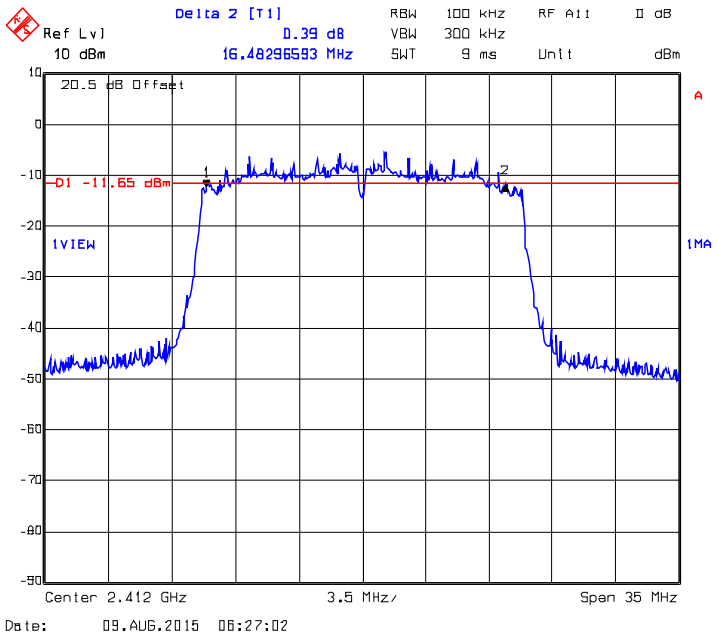
Plot 5.2.4.20. 6 dB Bandwidth, 802.11g, Ch 6, 2437 MHz, 64-QAM 54 Mbps, Output Power Setting 11



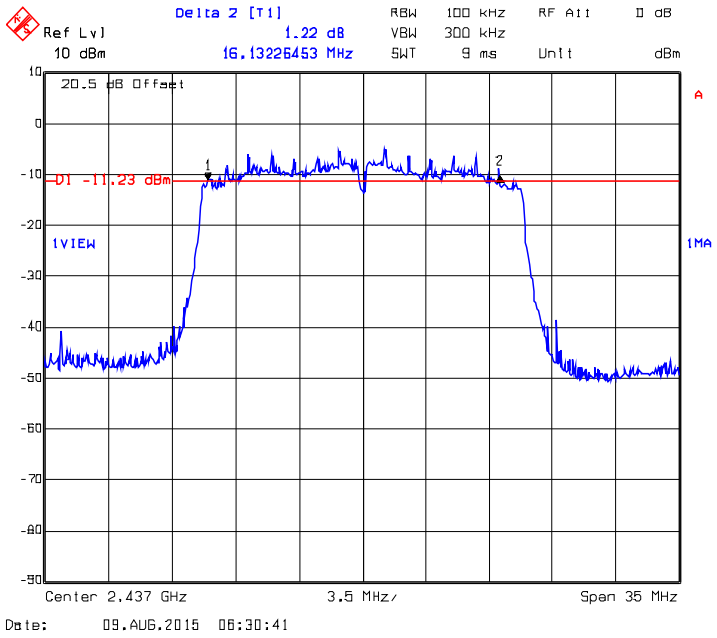
Plot 5.2.4.21. 6 dB Bandwidth, 802.11g, Ch 11, 2462 MHz, 64-QAM 54 Mbps, Output Power Setting 11



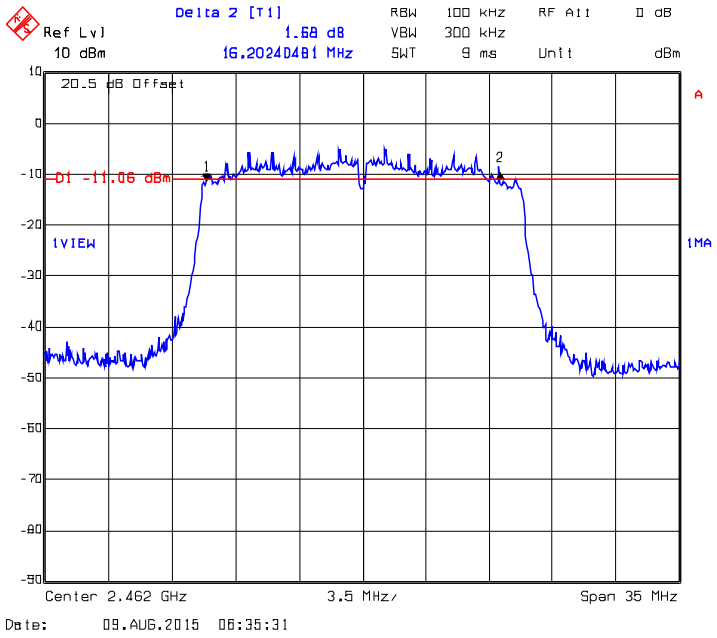
Plot 5.2.4.22. 6 dB Bandwidth, 802.11n HT20, Ch 1, 2412 MHz, MCS 0, BPSK 1/2 6.5 Mbps, Output Power Setting 11



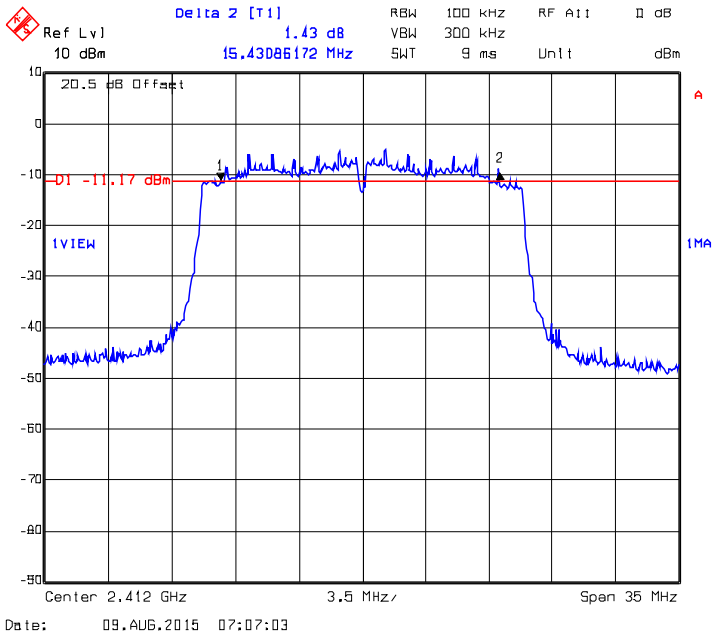
Plot 5.2.4.23. 6 dB Bandwidth, 802.11n HT20, Ch 6, 2437 MHz, MCS 0, BPSK 1/2 6.5 Mbps, Output Power Setting 11



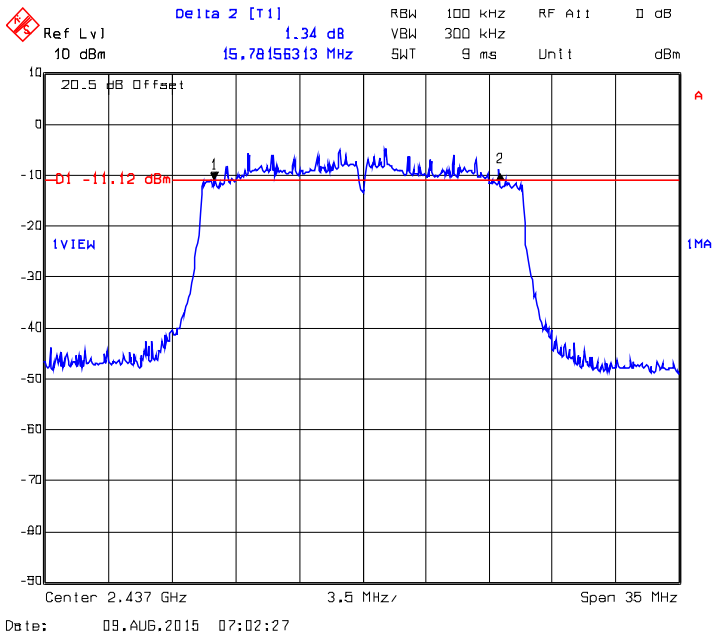
Plot 5.2.4.24. 6 dB Bandwidth, 802.11n HT20, Ch 11, 2462 MHz, MCS 0, BPSK 1/2 6.5 Mbps, Output Power Setting 11



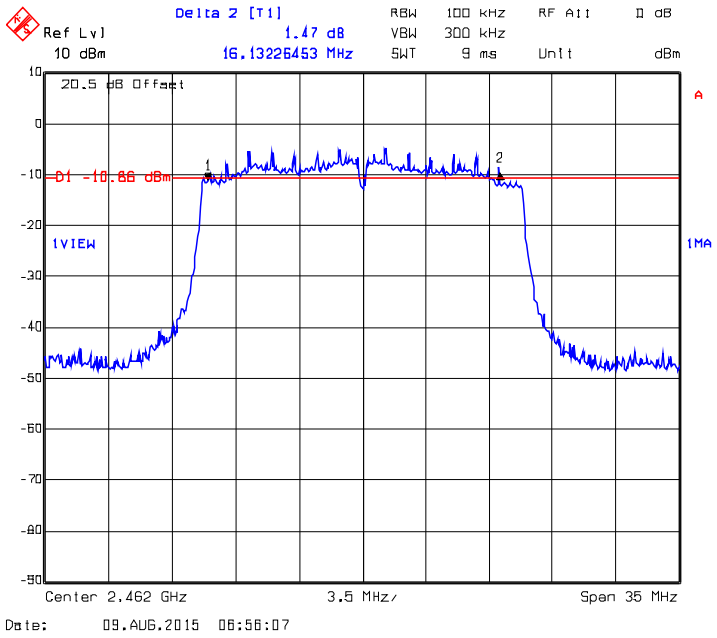
Plot 5.2.4.25. 6 dB Bandwidth, 802.11n HT20, Ch 1, 2412 MHz, MCS 2, QPSK 3/4 19.5 Mbps, Output Power Setting 11



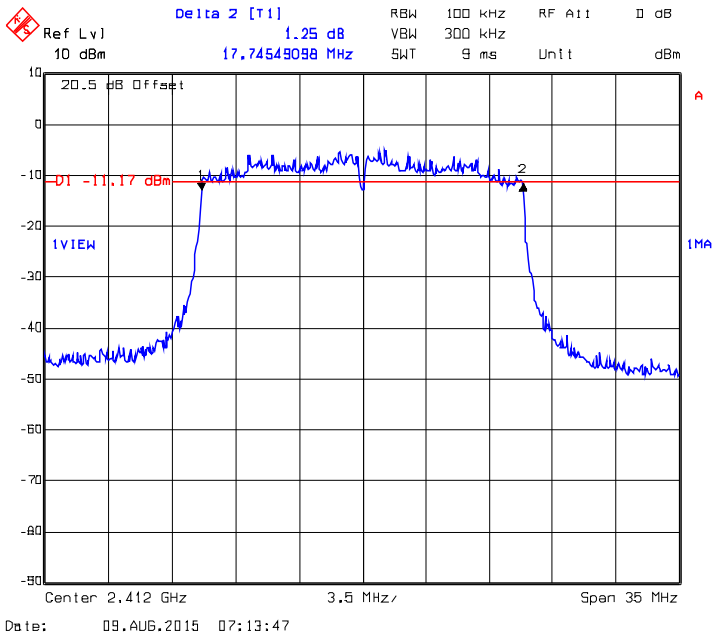
Plot 5.2.4.26. 6 dB Bandwidth, 802.11n HT20, Ch 6, 2437 MHz, MCS 2, QPSK 3/4 19.5 Mbps, Output Power Setting 11



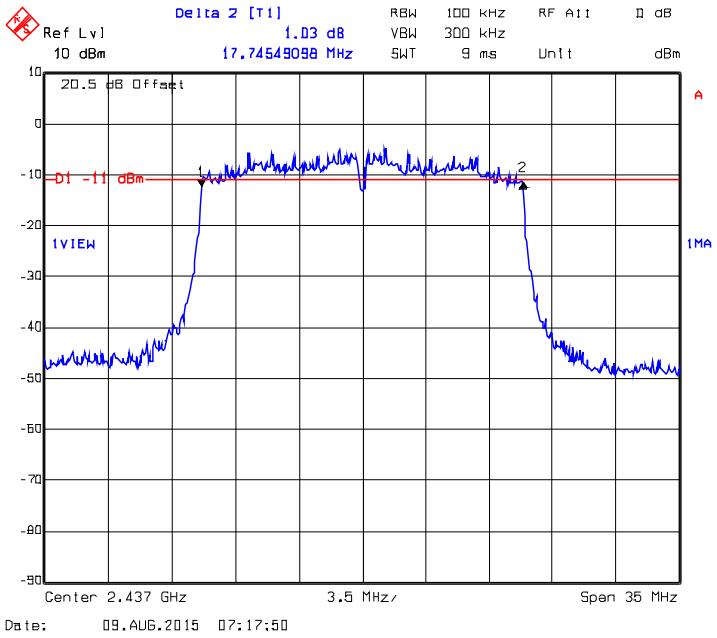
Plot 5.2.4.27. 6 dB Bandwidth, 802.11n HT20, Ch 11, 2462 MHz, MCS 2, QPSK 3/4 19.5 Mbps, Output Power Setting 11



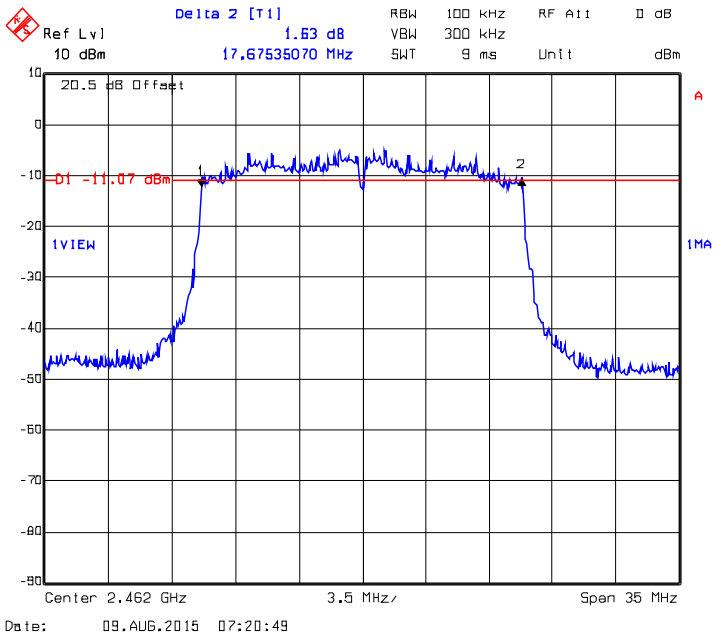
Plot 5.2.4.28. 6 dB Bandwidth, 802.11n HT20, Ch 1, 2412 MHz, MCS 4, 16-QAM 3/4 39 Mbps, Output Power Setting 11



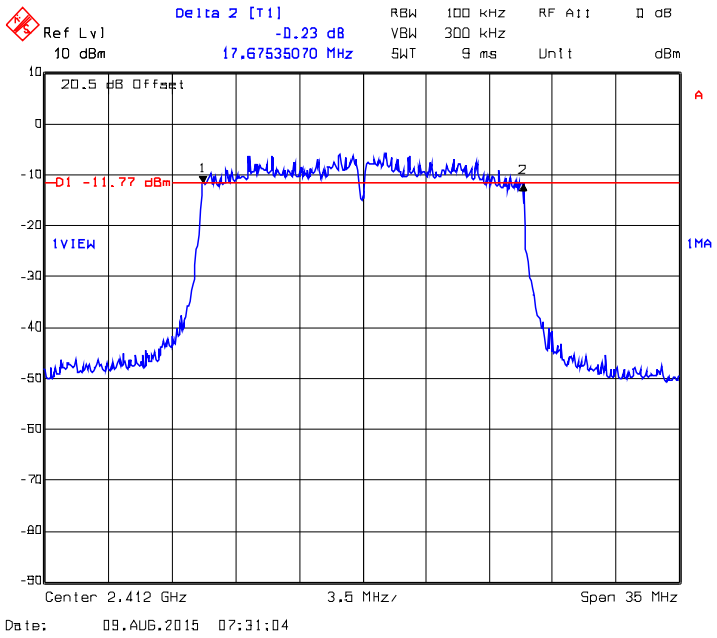
Plot 5.2.4.29. 6 dB Bandwidth, 802.11n HT20, Ch 6, 2437 MHz, MCS 4, 16-QAM 3/4 39 Mbps, Output Power Setting 11



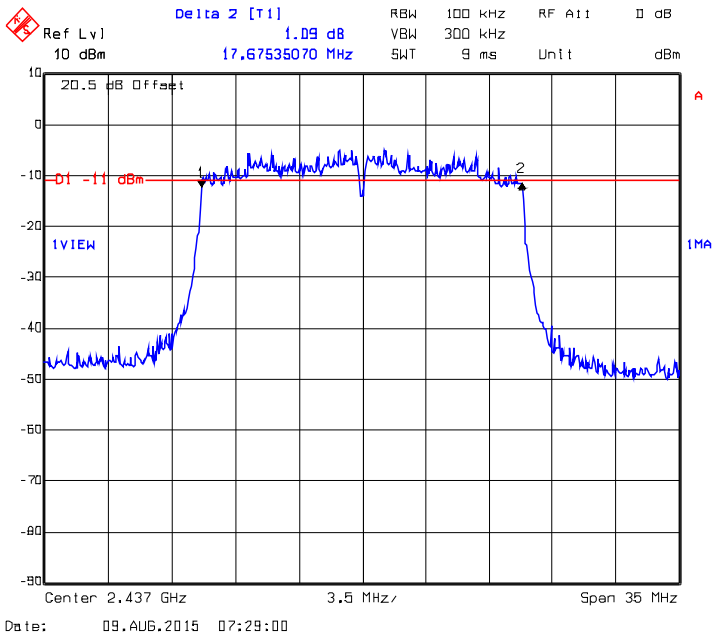
Plot 5.2.4.30. 6 dB Bandwidth, 802.11n HT20, Ch 11, 2462 MHz, MCS 4, 16-QAM 3/4 39 Mbps, Output Power Setting 11



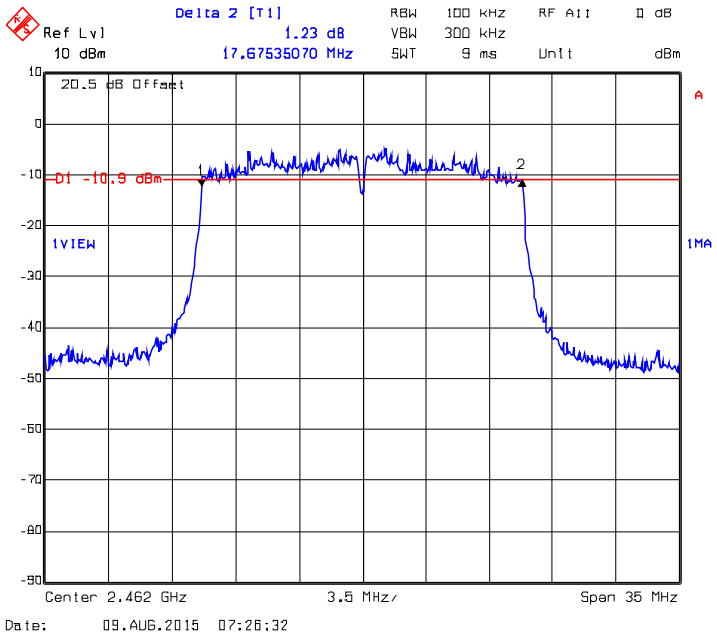
Plot 5.2.4.31. 6 dB Bandwidth, 802.11n HT20, Ch 1, 2412 MHz, MCS 7, 64-QAM 5/6 65 Mbps, Output Power Setting 11



Plot 5.2.4.32. 6 dB Bandwidth, 802.11n HT20, Ch 6, 2437 MHz, MCS 7, 64-QAM 5/6 65 Mbps, Output Power Setting 11



Plot 5.2.4.33. 6 dB Bandwidth, 802.11n HT20, Ch 11, 2462 MHz, MCS 7, 64-QAM 5/6 65 Mbps, Output Power Setting 11



5.3. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

5.3.1. Limit(s)

§ 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. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§ 15.247(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, *i.e.*, the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph

(b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

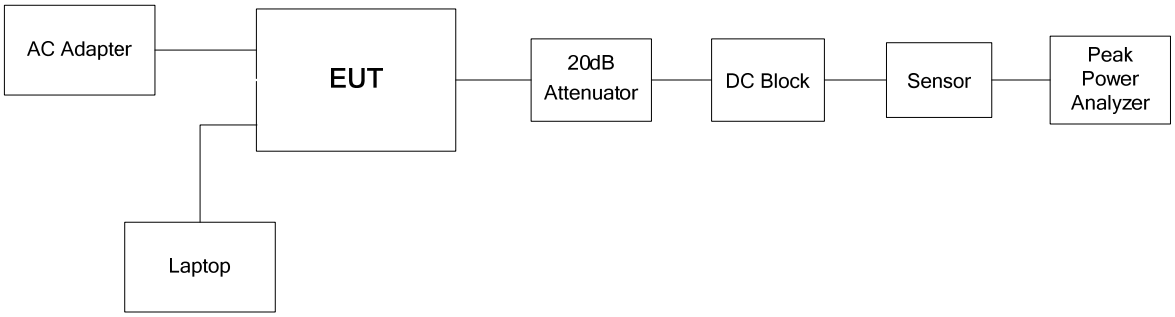
(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

5.3.2. Method of Measurements

KDB Publication No. 558074 D01 DTS Meas Guidance V03r03, Section 9.1.2 PKPM1 Peak power meter method.

5.3.3. Test Arrangement



5.3.4. Test Data

Operating Mode	Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power Limit (dBm)	Margin (dBm)
802.11b (Output Power Setting 18)	DBPSK	1	1	2412	16.15	30	-13.85
			6	2437	16.09	30	-13.91
			11	2462	16.09	30	-13.91
	DQPSK	2	1	2412	15.86	30	-14.14
			6	2437	16.03	30	-13.97
			11	2462	16.05	30	-13.95
	CCK	11	1	2412	15.99	30	-14.01
			6	2437	15.99	30	-14.01
			11	2462	16.17	30	-13.83

Operating Mode	Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power Limit (dBm)	Margin (dBm)
802.11g (Output Power Setting 11)	BPSK	9	1	2412	16.10	30	-13.90
			6	2437	15.80	30	-14.20
			11	2462	16.00	30	-14.00
	QPSK	18	1	2412	15.87	30	-14.13
			6	2437	15.87	30	-14.13
			11	2462	15.61	30	-14.39
	16-QAM	36	1	2412	16.12	30	-13.88
			6	2437	15.36	30	-14.64
			11	2462	15.74	30	-14.26
	64-QAM	54	1	2412	15.42	30	-14.58
			6	2437	15.87	30	-14.13
			11	2462	16.06	30	-13.94

Operating Mode	MCS Index	Modulation	Data Rate (Mbps)	Channel	Frequency (MHz)	Peak Power (dBm)	Peak Power Limit (dBm)	Margin (dBm)
802.11n, HT20 (Output Power Setting 11)	MCS0	BPSK 1/2	6.5	1	2412	15.74	30	-14.26
				6	2437	15.80	30	-14.20
				11	2462	15.48	30	-14.52
	MCS2	QPSK 3/4	19.5	1	2412	15.61	30	-14.39
				6	2437	15.36	30	-14.64
				11	2462	15.55	30	-14.45
	MCS4	16-QAM 3/4	39	1	2412	15.23	30	-14.77
				6	2437	15.42	30	-14.58
				11	2462	15.66	30	-14.34
	MCS7	64-QAM 5/6	65	1	2412	15.55	30	-14.45
				6	2437	15.36	30	-14.64
				11	2462	15.74	30	-14.26

5.4. TRANSMITTER BAND-EDGE & SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.4.1. Limit(s)

§ 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

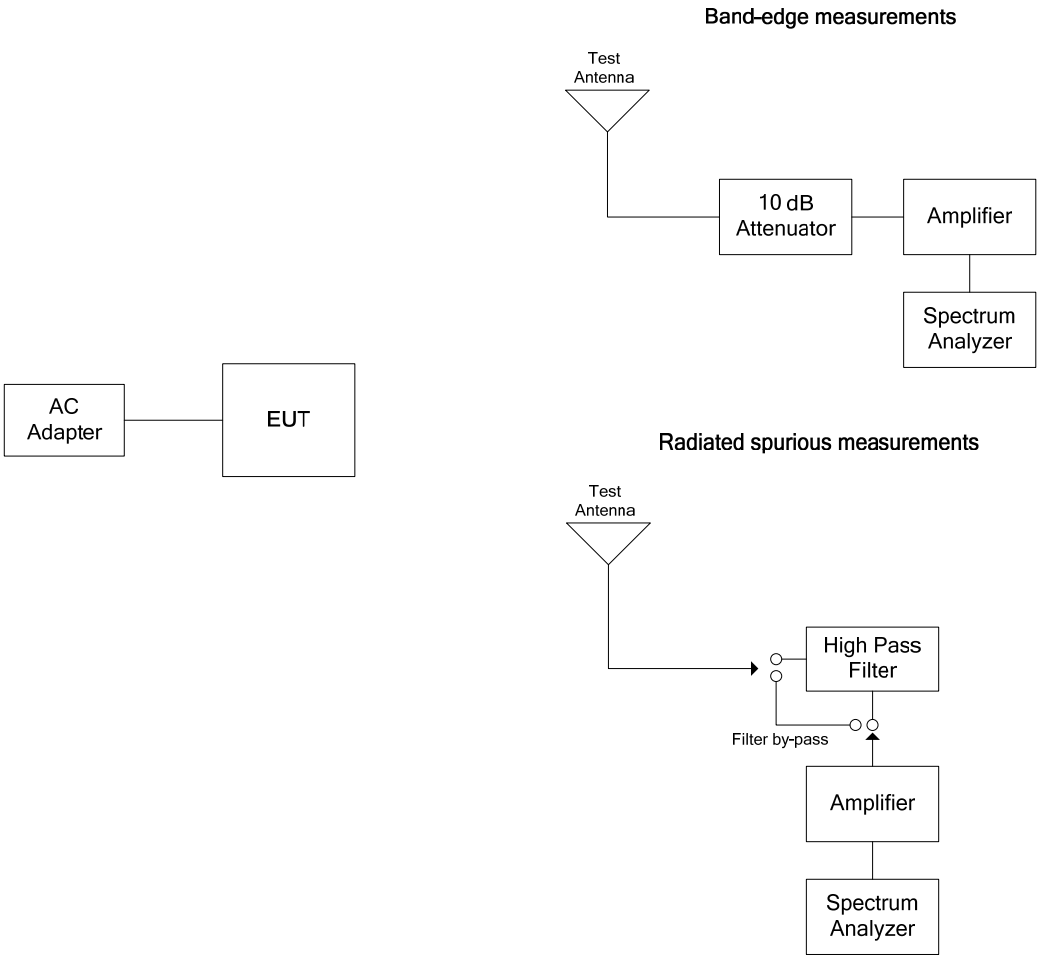
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / 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

5.4.2. Method of Measurements

FCC KDB Publication No. 558074 D01 DTS Meas Guidance V03r03, Sections 11, 12 and 13.

5.4.3. Test Arrangement

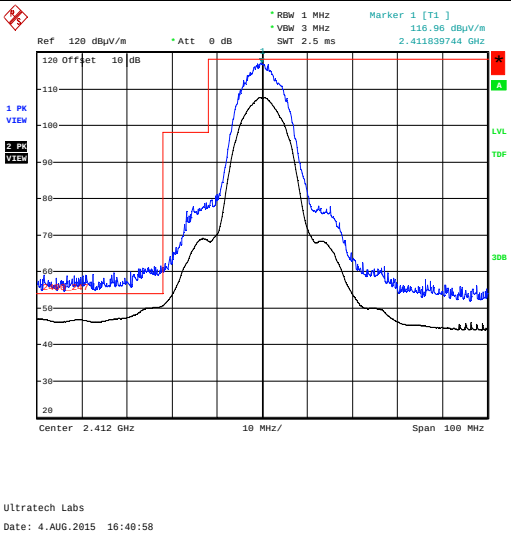


5.4.4. Test Data

5.4.4.1. Band-Edge Radiated Emissions

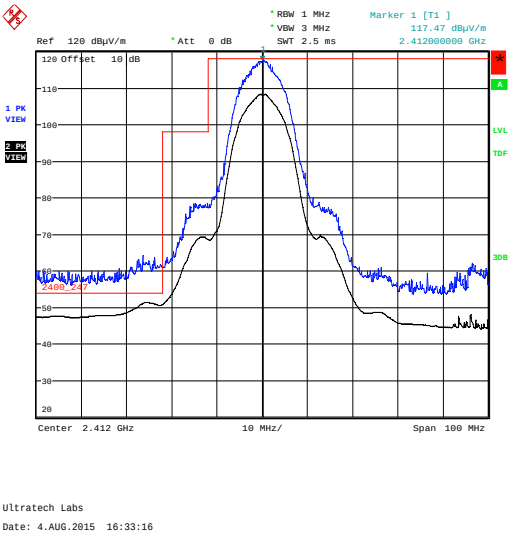
Remark(s): Exploratory tests performed to determined worst-case test configurations, the following test results represent the worst-case.

Plot 5.4.4.1.1. Band-Edge Radiated Emissions, 802.11b, DBPSK 1 Mbps, Output Power Setting 18
Receiver Antenna Orientation: Horizontal



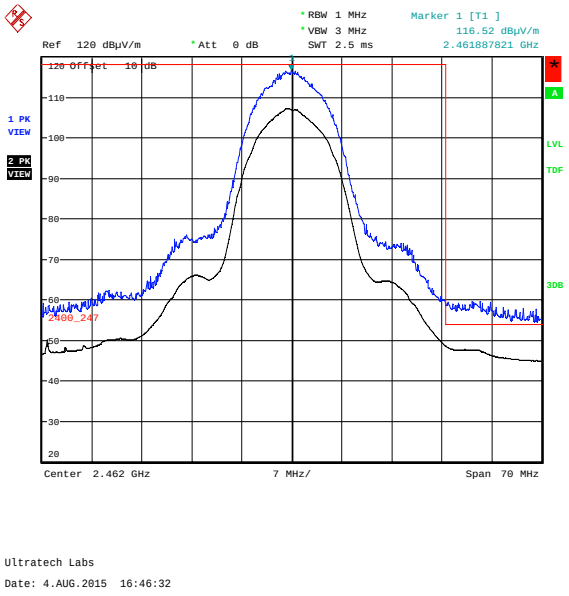
Trace 1: RBW= 1 MHz, VBW= 3 MHz (Peak); Trace 2: RBW= 1 MHz, VBW= 10 Hz (Average)

Plot 5.4.4.1.2. Band-Edge Radiated Emissions, 802.11b, DBPSK 1 Mbps, Output Power Setting 18
Receiver Antenna Orientation: Vertical



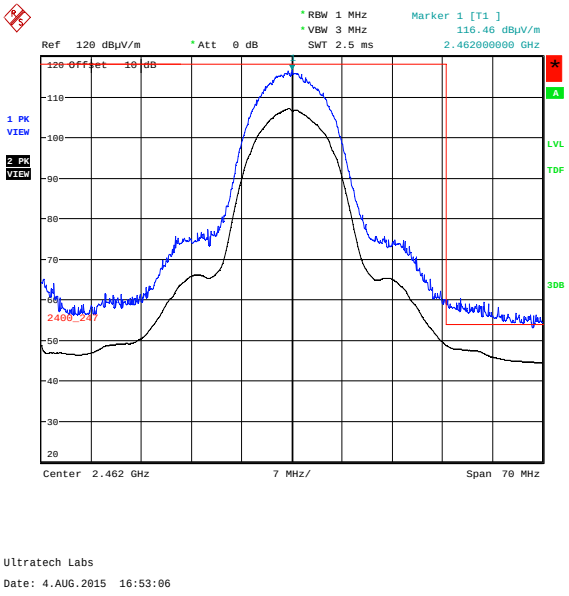
Trace 1: RBW= 1 MHz, VBW= 3 MHz (Peak); Trace 2: RBW= 1 MHz, VBW= 10 Hz (Average)

Plot 5.4.4.1.3. Band-Edge Radiated Emissions, 802.11b, DBPSK 1 Mbps, Output Power Setting 18
Receiver Antenna Orientation: Horizontal



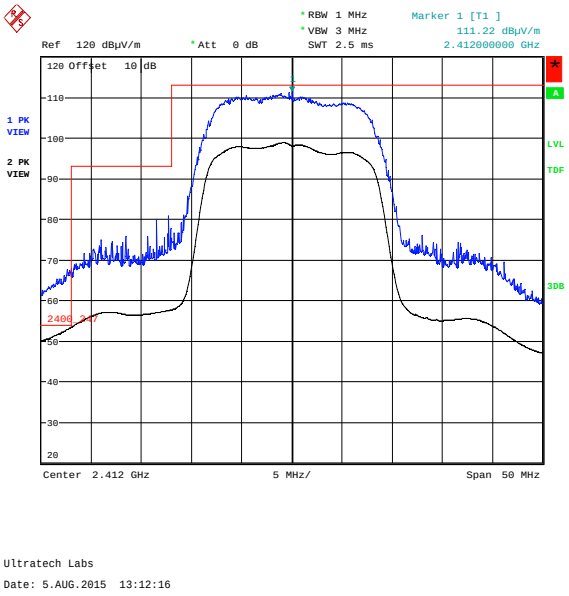
Trace 1: RBW= 1 MHz, VBW= 3 MHz (Peak); Trace 2: RBW= 1 MHz, VBW= 10 Hz (Average)

Plot 5.4.4.1.4. Band-Edge Radiated Emissions, 802.11b, DBPSK 1 Mbps, Output Power Setting 18
Receiver Antenna Orientation: Vertical



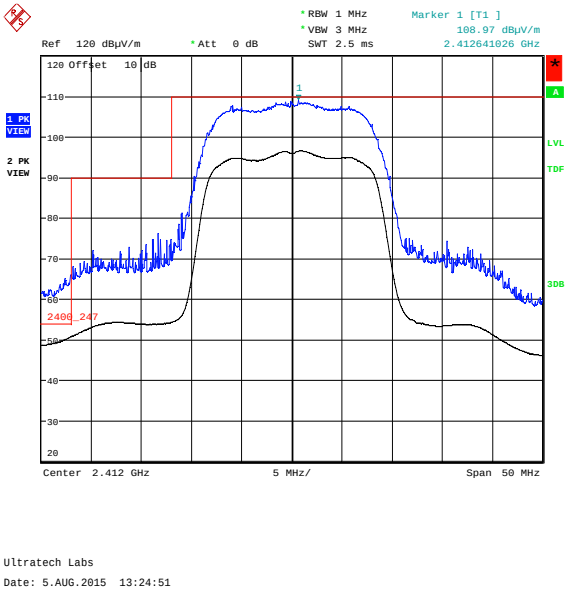
Trace 1: RBW= 1 MHz, VBW= 3 MHz (Peak); Trace 2: RBW= 1 MHz, VBW= 10 Hz (Average)

Plot 5.4.4.1.5. Band-Edge Radiated Emissions, 802.11g, 2412 MHz, BPSK 9 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Horizontal



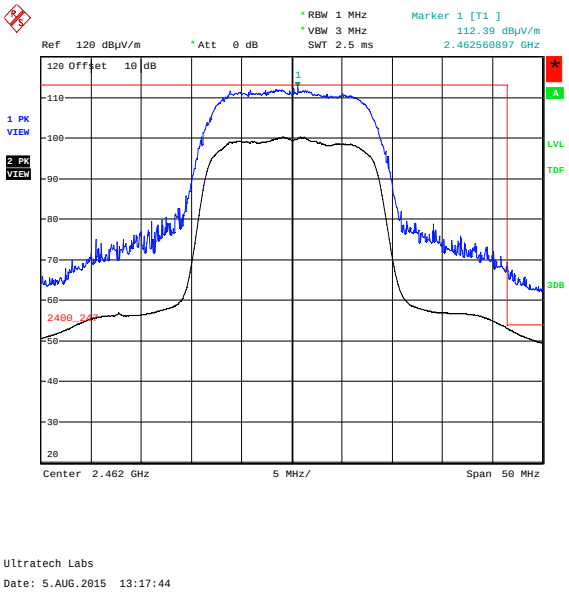
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2390 MHz: 53.47 dBµV/m

Plot 5.4.4.1.6. Band-Edge Radiated Emissions, 802.11g, 2412 MHz, BPSK 9 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Vertical



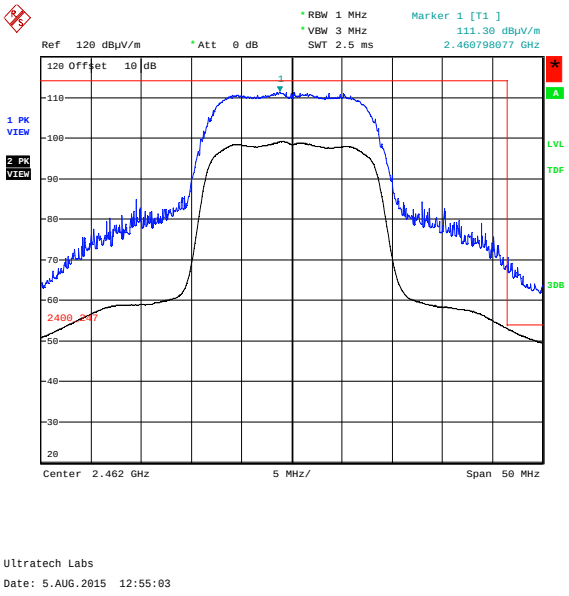
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2390 MHz: 50.71 dBµV/m

Plot 5.4.4.1.7. Band-Edge Radiated Emissions, 802.11g, 2462 MHz, BPSK 9 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Horizontal



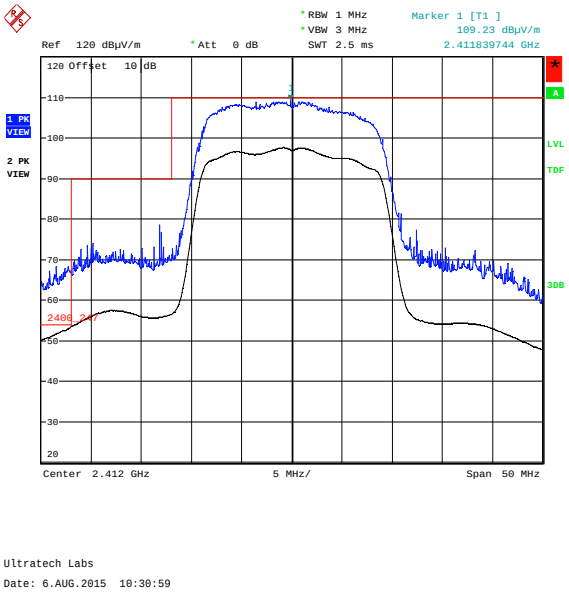
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2483.5 MHz: 52.86 dBµV/m

Plot 5.4.4.1.8. Band-Edge Radiated Emissions, 802.11g, 2462 MHz, BPSK 9 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Vertical



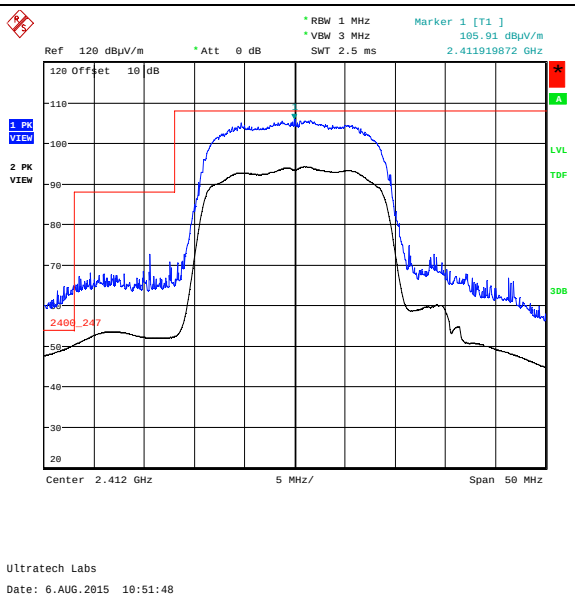
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2483.5 MHz: 53.04 dBµV/m

Plot 5.4.4.1.9. Band-Edge Radiated Emissions, 802.11n HT20, 2412 MHz, BPSK ½ 6.5 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Horizontal



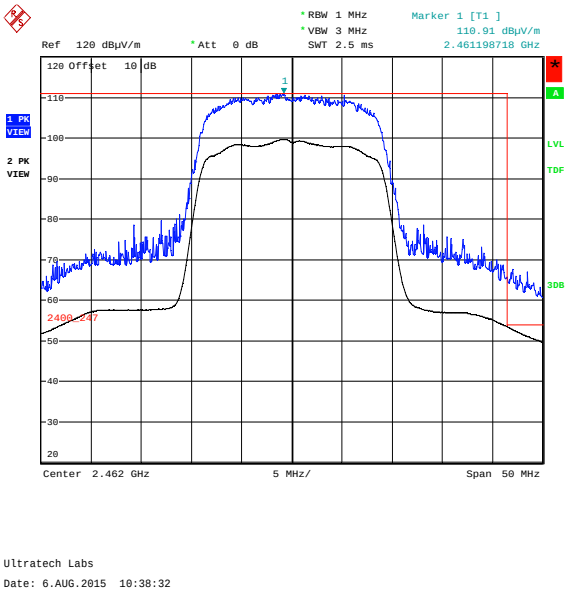
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2390 MHz: 53.43 dBµV/m

Plot 5.4.4.1.10. Band-Edge Radiated Emissions, 802.11n HT20, 2412 MHz, BPSK ½ 6.5 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Vertical



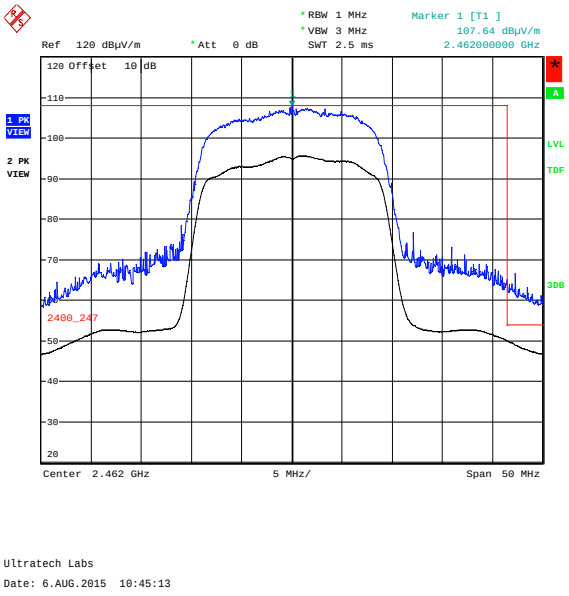
Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2390 MHz: 50.77 dBµV/m

Plot 5.4.4.1.11. Band-Edge Radiated Emissions, 802.11n HT20, 2462 MHz, BPSK ½ 6.5 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Horizontal



Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2483.5 MHz: 53.49 dBµV/m

Plot 5.4.4.1.12. Band-Edge Radiated Emissions, 802.11n HT20, 2462 MHz, BPSK ½ 6.5 Mbps, Output Power Setting 11
Receiver Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz; Trace 2: RBW = 1 MHz, VBW = 10 Hz; Average at 2483.5 MHz: 50.02 dBµV/m

5.4.4.2. Radiated Spurious Emissions

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- Exploratory tests performed to determined worst-case test configurations, the following test results represent the worst-case.

5.4.4.2.1. 802.11b DBPSK 1 Mbps, Output Power Setting 18

Fundamental Frequency:	2412 MHz						
Frequency Test Range	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2412	117.47	--	V	--	--	--	--
2412	116.96	--	H	--	--	--	--
4824	53.19	46.68	V	54.0	97.5	-7.3	Pass*
4824	52.74	43.75	H	54.0	97.5	-10.3	Pass*
*Emission within the restricted bands, limits in section 15.209 applied.							

Fundamental Frequency:	2437 MHz						
Frequency Test Range	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2437	117.32	--	V	--	--	--	--
2437	116.67	--	H	--	--	--	--
4874	51.76	44.05	V	54.0	97.3	-10.0	Pass*
7311	54.55	42.10	V	54.0	97.3	-11.9	Pass*
4874	51.26	43.45	H	54.0	97.3	-10.6	Pass*
7311	54.22	41.45	H	54.0	97.3	-12.6	Pass*
*Emission within the restricted bands, limits in section 15.209 applied.							

Fundamental Frequency:	2462 MHz						
Frequency Test Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2462	116.46	--	V	--	--	--	--
2462	116.52	--	H	--	--	--	--
7386	54.34	41.75	V	54.0	96.5	-12.3	Pass*
7386	54.13	41.27	H	54.0	96.5	-12.7	Pass*
*Emission within the restricted bands, limits in section 15.209 applied.							

5.4.4.2.2. 802.11g BPSK 9 Mbps, Output Power Setting 11

Fundamental Frequency:	2412 MHz						
Frequency Test Range	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2412	108.97	--	V	--	--	--	--
2412	111.22	--	H	--	--	--	--
All emissions were greater than 20 dB below the limit.							

Fundamental Frequency:	2437 MHz						
Frequency Test Range	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2437	110.87	--	V	--	--	--	--
2437	111.95	--	H	--	--	--	--
All emissions were greater than 20 dB below the limit.							

Fundamental Frequency:	2462 MHz						
Frequency Test Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2462	111.30	--	V	--	--	--	--
2462	112.39	--	H	--	--	--	--
All emissions were greater than 20 dB below the limit.							

5.4.4.2.3. 802.11n HT20 BPSK ½ 6.5 Mbps, Output Power Setting 11

Fundamental Frequency:	2412 MHz						
Frequency Test Range	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2412	105.91	--	V	--	--	--	--
2412	109.23	--	H	--	--	--	--
All emissions were greater than 20 dB below the limit.							

Fundamental Frequency:	2437 MHz						
Frequency Test Range	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2437	106.45	--	V	--	--	--	--
2437	110.04	--	H	--	--	--	--
All emissions were greater than 20 dB below the limit.							

Fundamental Frequency:	2462 MHz						
Frequency Test Range:	30 MHz – 25 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
2462	107.64	--	V	--	--	--	--
2462	110.91	--	H	--	--	--	--
All emissions were greater than 20 dB below the limit.							

5.5. POWER SPECTRAL DENSITY [§ 15.247(e)]

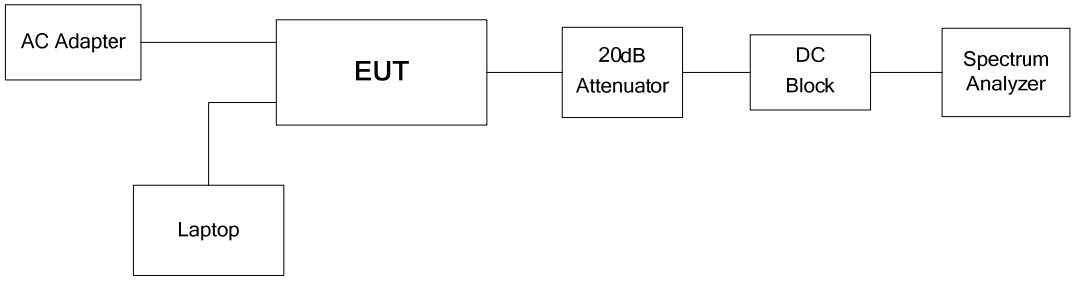
5.5.1. Limit(s)

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.

5.5.2. Method of Measurements

Publication No. KDB Publication No. 558074 D01 DTS Meas Guidance V03r03, Section 10.2 Method PKPSD

5.5.3. Test Arrangement



5.5.4. Test Data

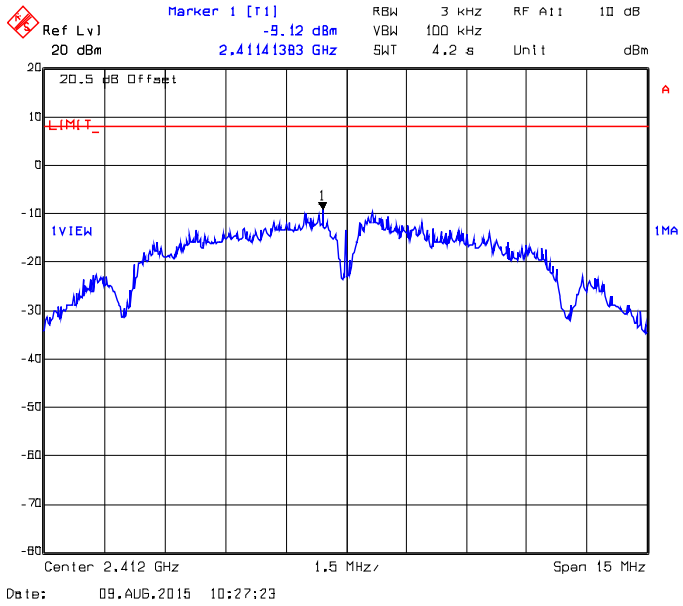
802.11b					
Modulation	Data Rate (Mbps)	Channel Number	Frequency (MHz)	PSD (dBm)	Limit (dBm)
DBPSK	1	1	2412	-9.12	8
		6	2437	-9.63	8
		11	2462	-8.85	8
DQPSK	2	1	2412	-9.30	8
		6	2437	-8.44	8
		11	2462	-9.00	8
CCK	11	1	2412	-10.13	8
		6	2437	-9.36	8
		11	2462	-9.01	8

802.11g					
Modulation	Data Rate (Mbps)	Channel Number	Frequency (MHz)	PSD (dBm)	Limit (dBm)
BPSK	9	1	2412	-20.05	8
		6	2437	-17.24	8
		11	2462	-17.50	8
QPSK	18	1	2412	-18.79	8
		6	2437	-19.15	8
		11	2462	-17.91	8
16-QAM	36	1	2412	-19.75	8
		6	2437	-19.73	8
		11	2462	-19.32	8
64-QAM	54	1	2412	-19.12	8
		6	2437	-18.56	8
		11	2462	-18.85	8

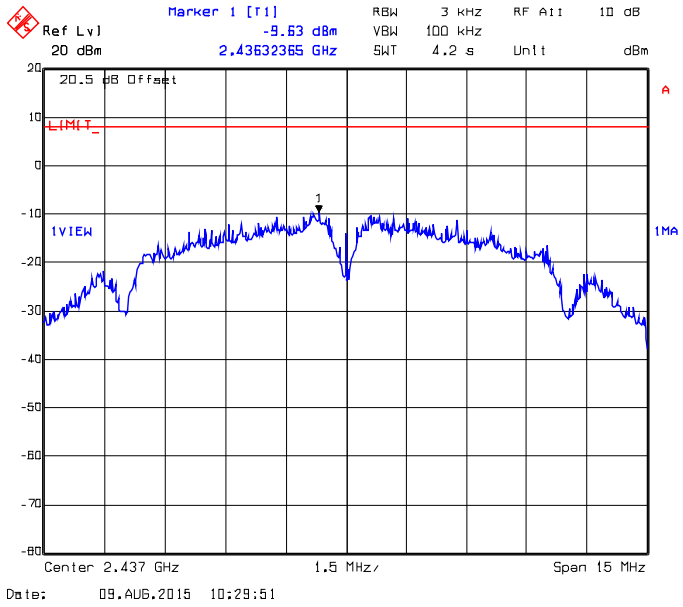
802.11n HT20						
MCS Index	Modulation	Data Rate (Mbps)	Channel Number	Frequency (MHz)	PSD (dBm)	Limit (dBm)
0	BPSK 1/2	6.5	1	2412	-18.67	8
			6	2437	-18.37	8
			11	2462	-19.85	8
2	QPSK 3/4	19.5	1	2412	-20.71	8
			6	2437	-18.66	8
			11	2462	-17.47	8
4	16-QAM 3/4	39	1	2412	-19.89	8
			6	2437	-18.64	8
			11	2462	-20.70	8
7	64-QAM 5/6	65	1	2412	-18.70	8
			6	2437	-20.26	8
			11	2462	-18.94	8

See the following plots for measurement details.

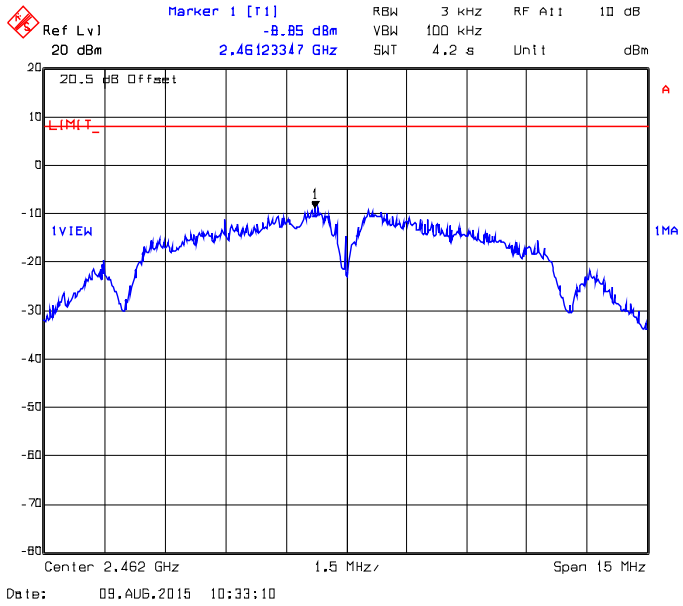
Plot 5.5.4.1. Power Spectral Density
802.11b, Ch 1, 2412 MHz, DBPSK 1 Mbps, Output Power Setting 18



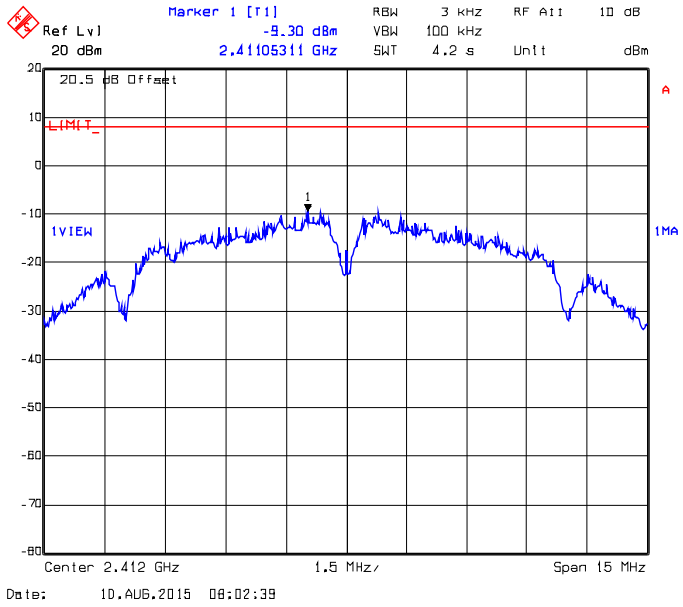
Plot 5.5.4.2. Power Spectral Density
802.11b, Ch 6, 2437 MHz, DBPSK 1 Mbps, Output Power Setting 18



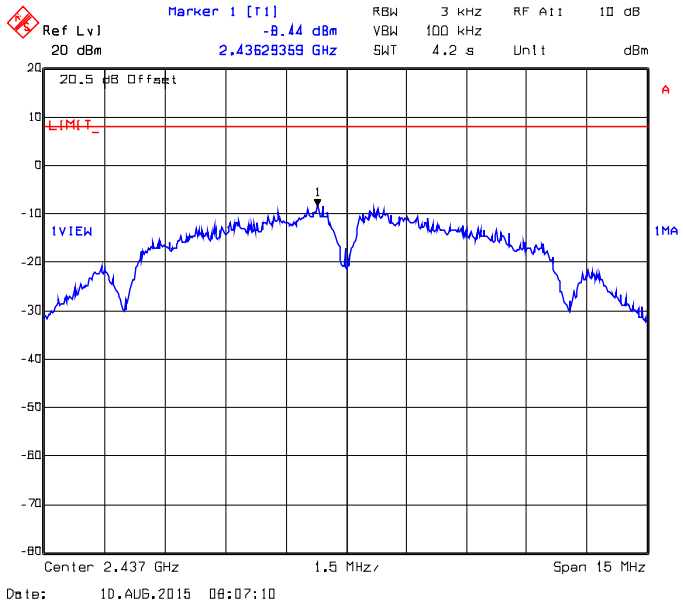
Plot 5.5.4.3. Power Spectral Density
802.11b, Ch 11, 2462 MHz, DBPSK 1 Mbps, Output Power Setting 18



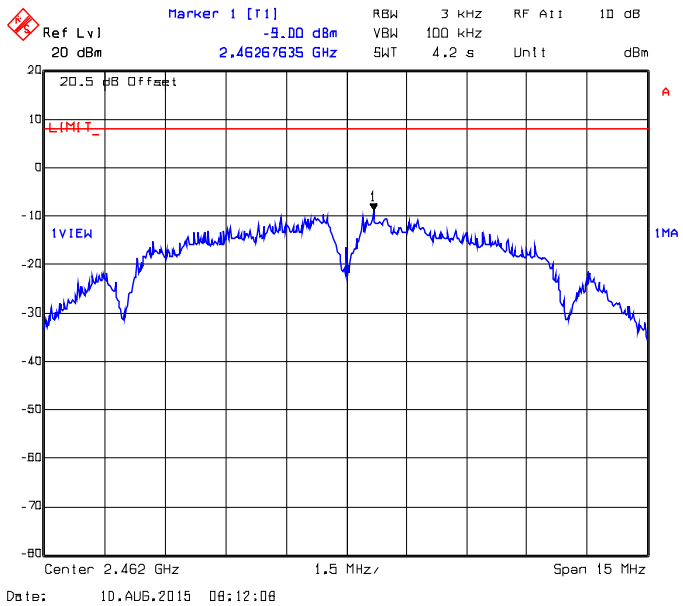
Plot 5.5.4.4. Power Spectral Density
802.11b, Ch 1, 2412 MHz, DQPSK 2 Mbps, Output Power Setting 18



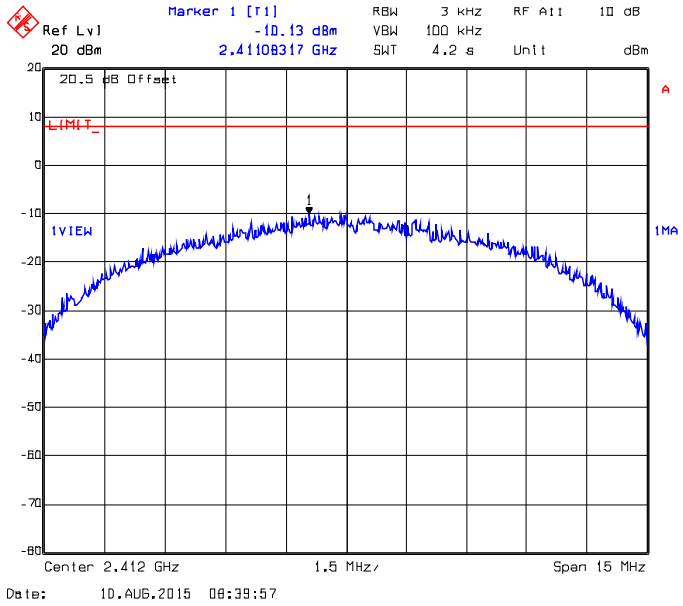
Plot 5.5.4.5. Power Spectral Density
802.11b, Ch 6, 2437 MHz, DQPSK 2 Mbps, Output Power Setting 18



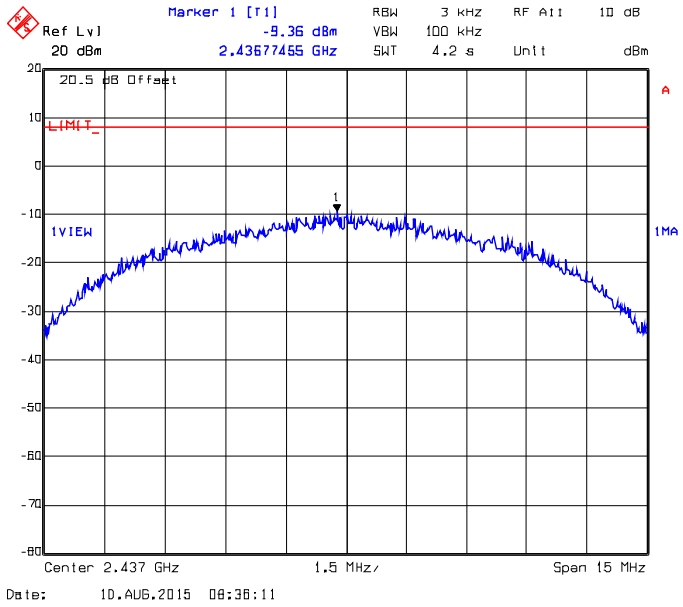
Plot 5.5.4.6. Power Spectral Density
802.11b, Ch 11, 2462 MHz, DQPSK 2 Mbps, Output Power Setting 18



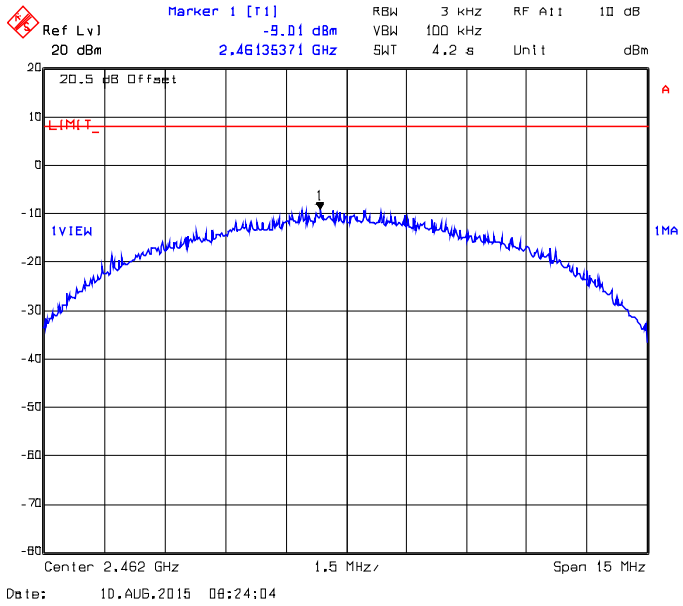
Plot 5.5.4.7. Power Spectral Density
802.11b, Ch 1, 2412 MHz, CCK 11 Mbps, Output Power Setting 18



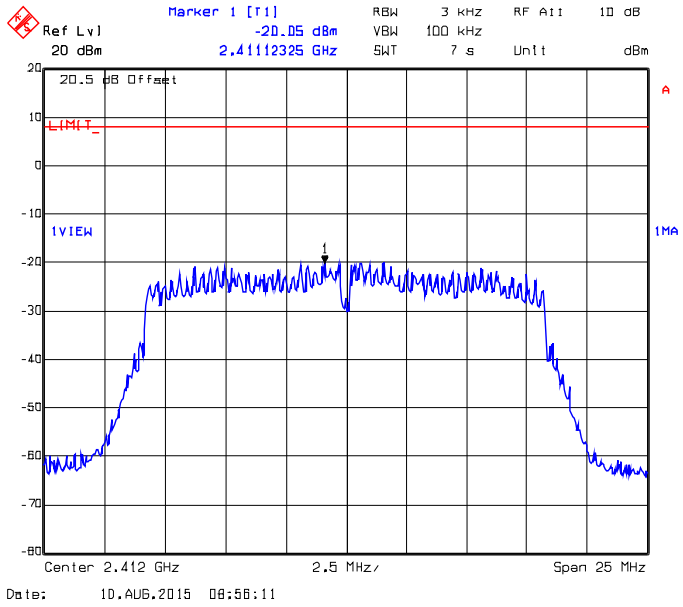
Plot 5.5.4.8. Power Spectral Density
802.11b, Ch 6, 2437 MHz, CCK 11 Mbps, Output Power Setting 18



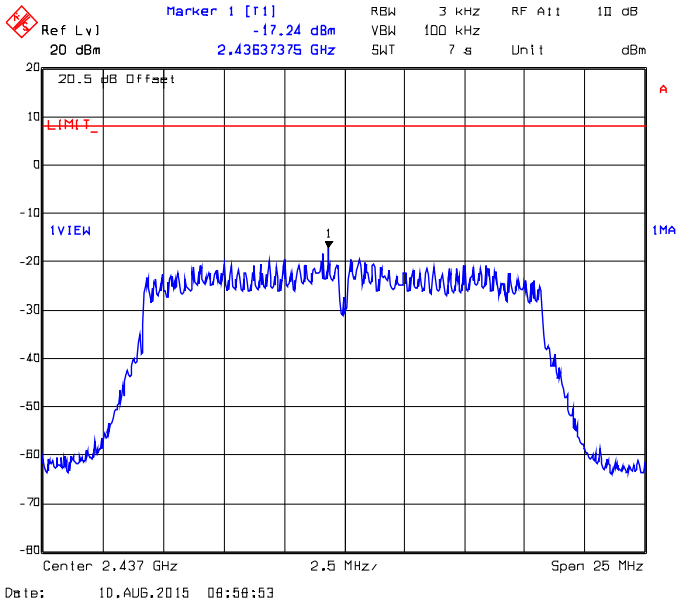
Plot 5.5.4.9. Power Spectral Density
802.11b, Ch 11, 2462 MHz, CCK 11 Mbps, Output Power Setting 18



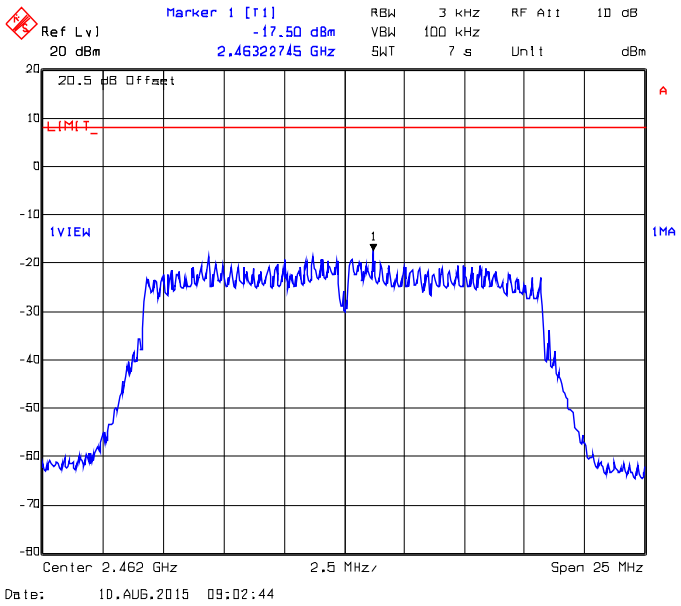
Plot 5.5.4.10. Power Spectral Density
802.11g, Ch 1, 2412 MHz, BPSK 9 Mbps, Output Power Setting 11



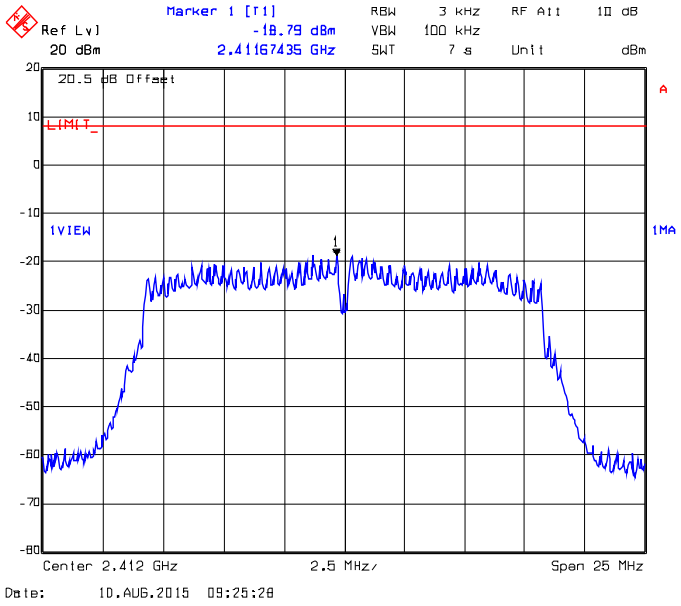
Plot 5.5.4.11. Power Spectral Density
802.11g, Ch 6, 2437 MHz, BPSK 9 Mbps, Output Power Setting 11



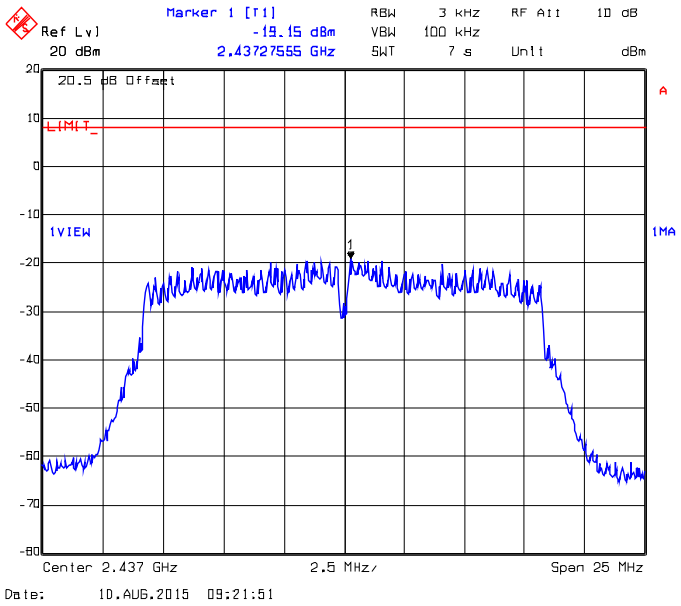
Plot 5.5.4.12. Power Spectral Density
802.11g, Ch 11, 2462 MHz, BPSK 9 Mbps, Output Power Setting 11



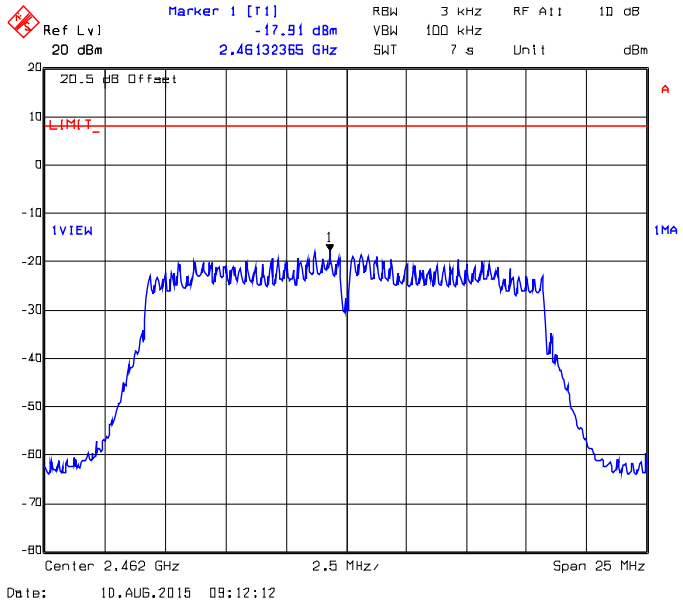
Plot 5.5.4.13. Power Spectral Density
802.11g, Ch 1, 2412 MHz, QPSK 18 Mbps, Output Power Setting 11



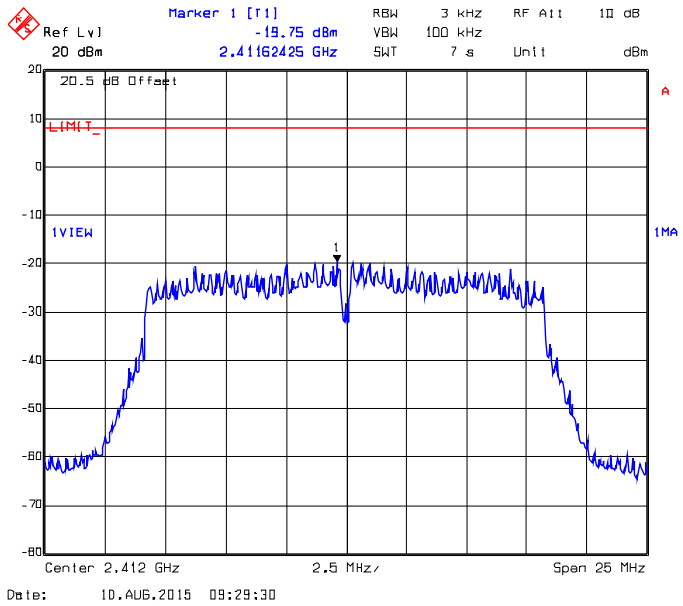
Plot 5.5.4.14. Power Spectral Density
802.11g, Ch 6, 2437 MHz, QPSK 18 Mbps, Output Power Setting 11



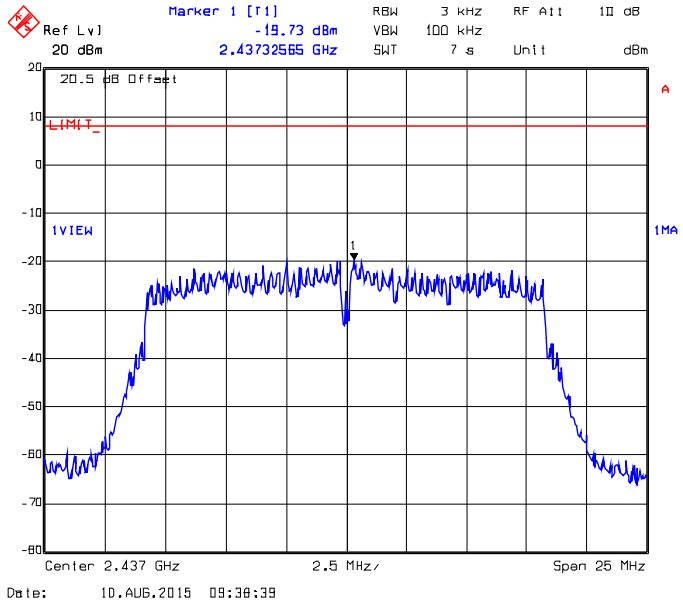
Plot 5.5.4.15. Power Spectral Density
802.11g, Ch 11, 2462 MHz, QPSK 18 Mbps, Output Power Setting 11



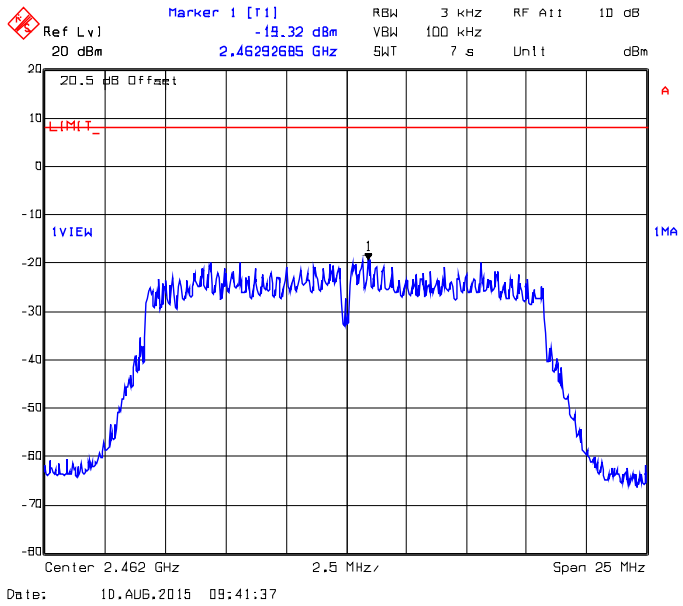
Plot 5.5.4.16. Power Spectral Density
802.11g, Ch 1, 2412 MHz, 16-QAM 36 Mbps, Output Power Setting 11



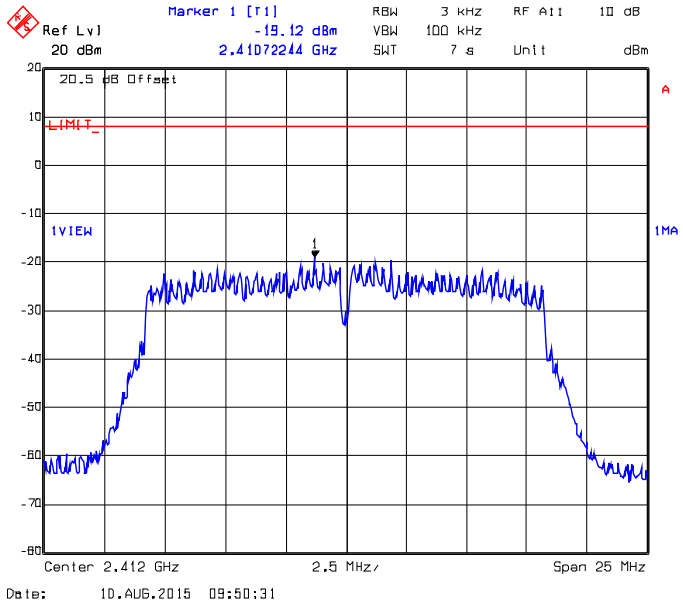
Plot 5.5.4.17. Power Spectral Density
802.11g, Ch 6, 2437 MHz, 16-QAM 36 Mbps, Output Power Setting 11



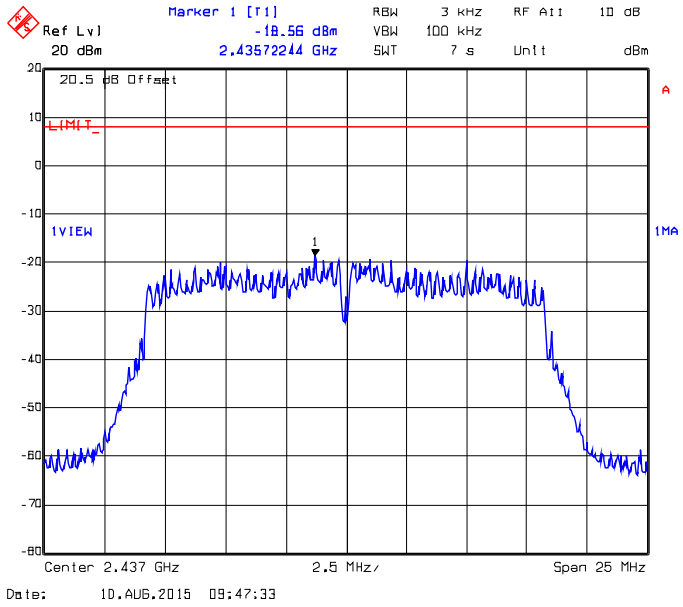
Plot 5.5.4.18. Power Spectral Density
802.11g, Ch 11, 2462 MHz, 16-QAM 36 Mbps, Output Power Setting 11



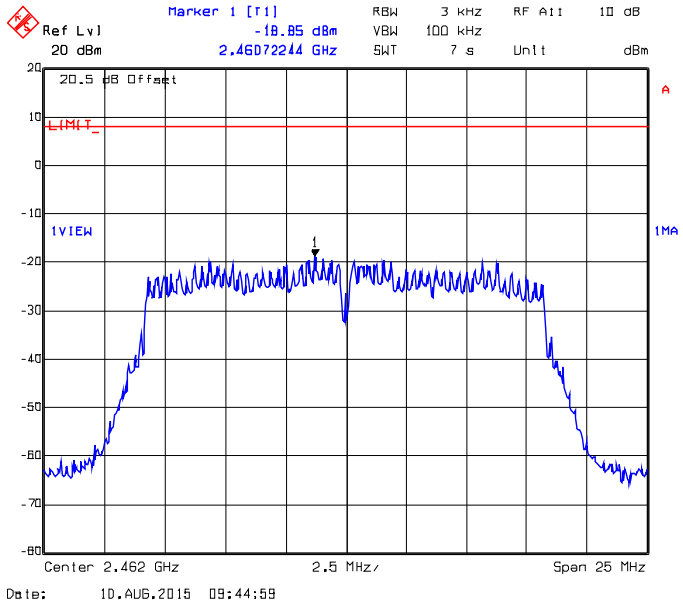
Plot 5.5.4.19. Power Spectral Density
802.11g, Ch 1, 2412 MHz, 64-QAM 54 Mbps, Output Power Setting 11



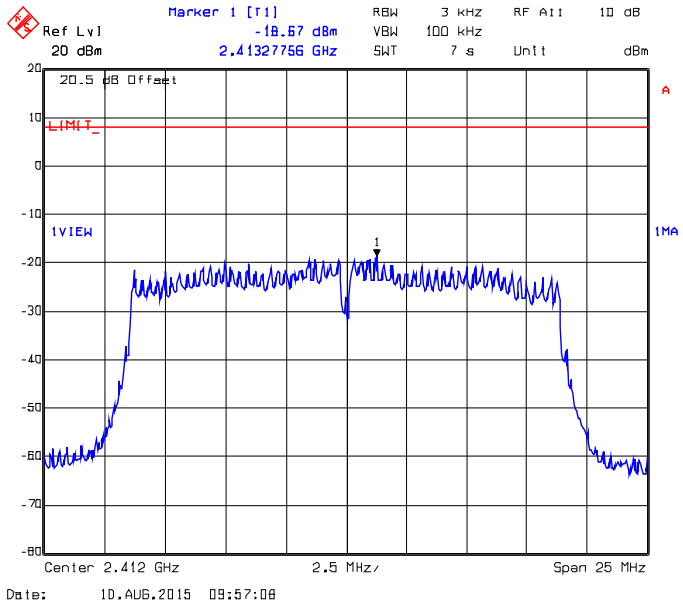
Plot 5.5.4.20. Power Spectral Density
802.11g, Ch 6, 2437 MHz, 64-QAM 54 Mbps, Output Power Setting 11



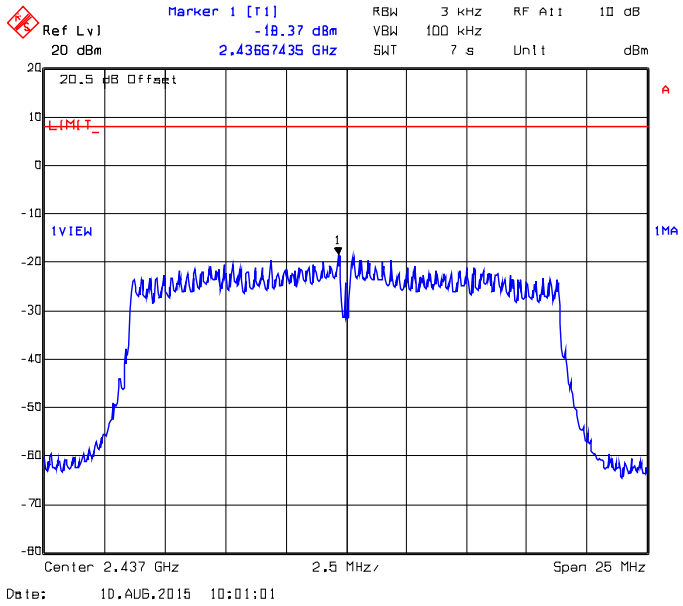
Plot 5.5.4.21. Power Spectral Density
802.11g, Ch 11, 2462 MHz, 64-QAM 54 Mbps, Output Power Setting 11



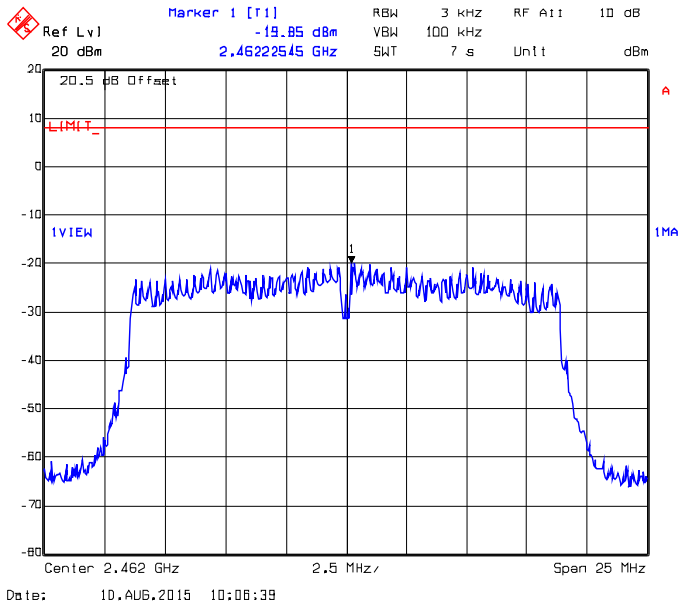
Plot 5.5.4.22. Power Spectral Density
802.11n HT20, Ch 1, 2412 MHz, MCS 0, BPSK 1/2 6.5 Mbps, Output Power Setting 11



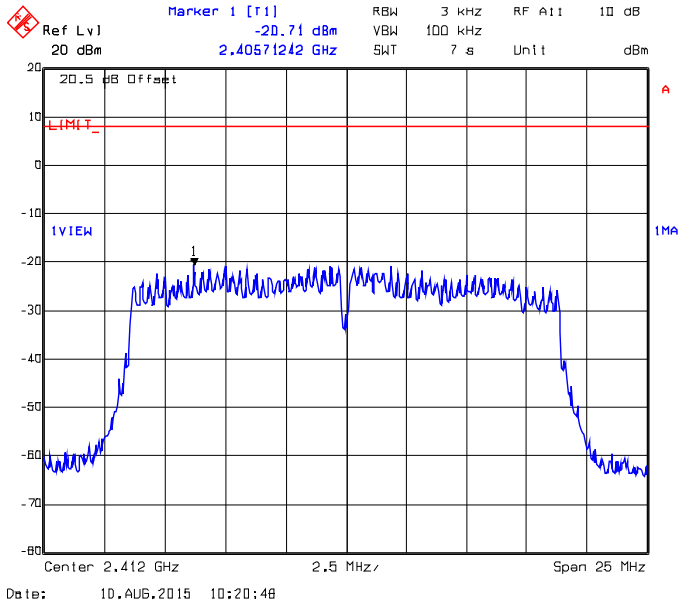
Plot 5.5.4.23. Power Spectral Density
802.11n HT20, Ch 6, 2437 MHz, MCS 0, BPSK 1/2 6.5 Mbps, Output Power Setting 11



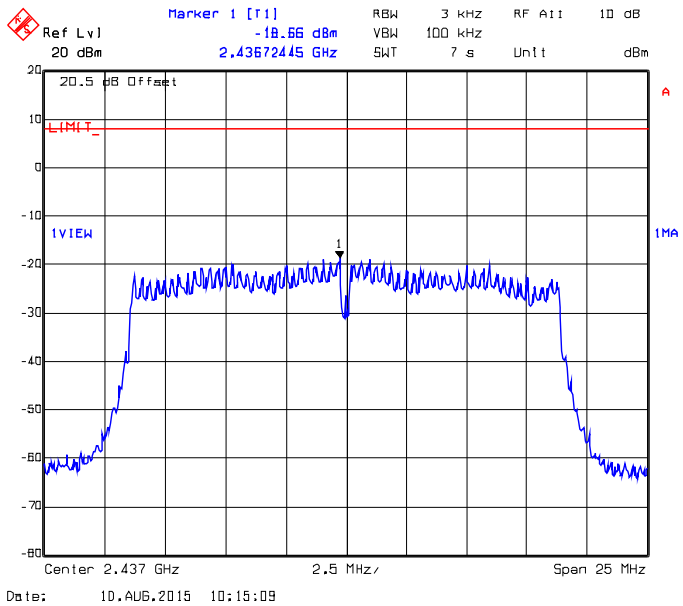
Plot 5.5.4.24. Power Spectral Density
802.11n HT20, Ch 11, 2462 MHz, MCS 0, BPSK 1/2 6.5 Mbps, Output Power Setting 11



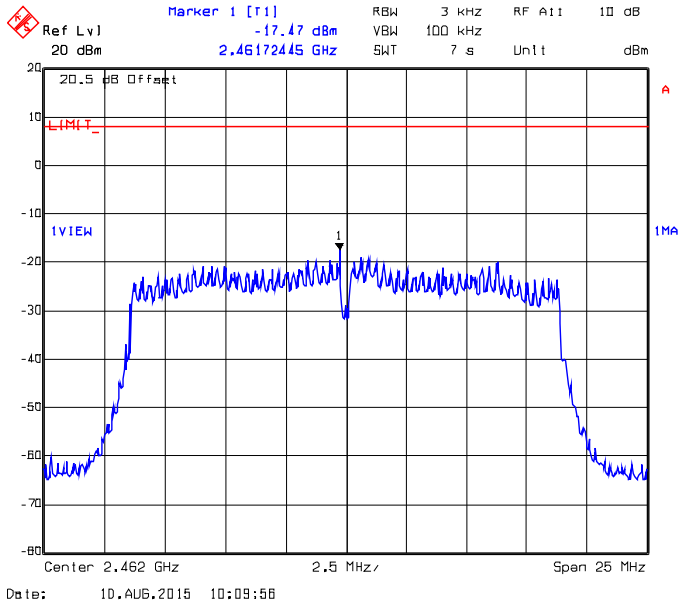
Plot 5.5.4.25. Power Spectral Density
802.11n HT20, Ch 1, 2412 MHz, MCS 2, QPSK 3/4 19.5 Mbps, Output Power Setting 11



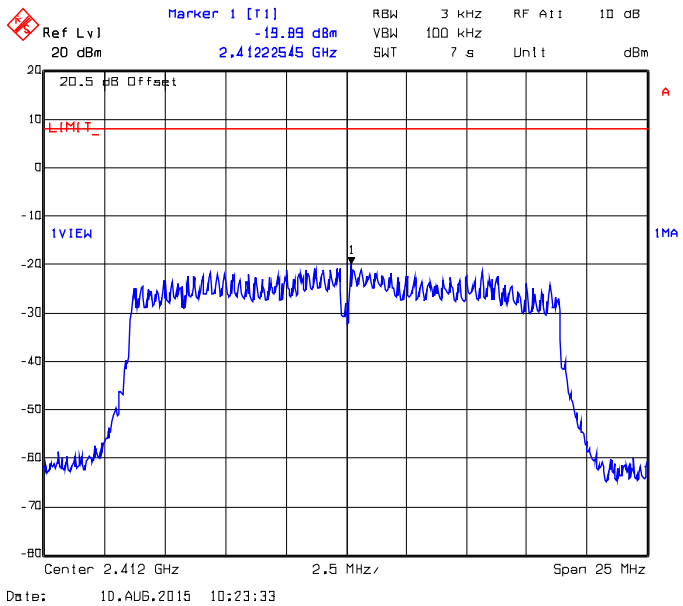
Plot 5.5.4.26. Power Spectral Density
802.11n HT20, Ch 6, 2437 MHz, MCS 2, QPSK 3/4 19.5 Mbps, Output Power Setting 11



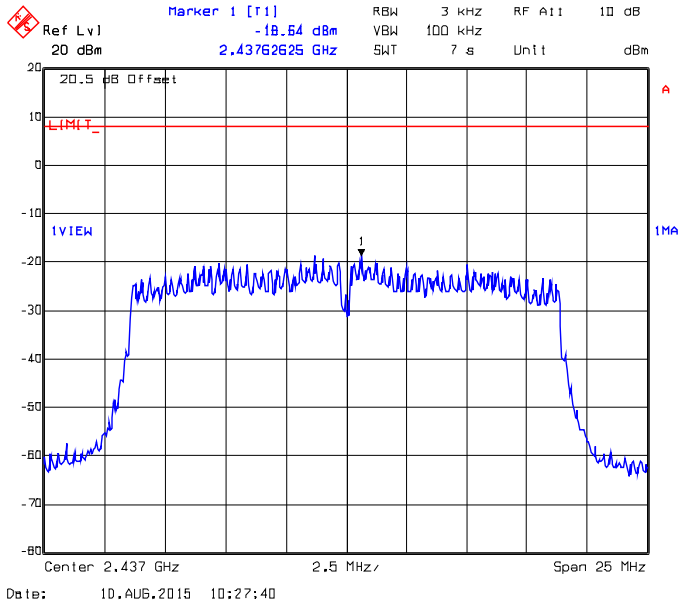
Plot 5.5.4.27. Power Spectral Density
802.11n HT20, Ch 11, 2462 MHz, MCS 2, QPSK 3/4 19.5 Mbps, Output Power Setting 11



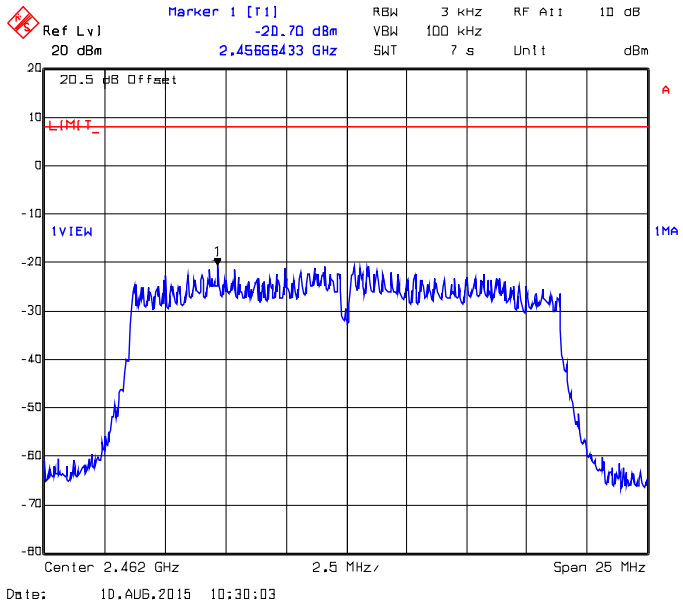
Plot 5.5.4.28. Power Spectral Density
802.11n HT20, Ch 1, 2412 MHz, MCS 4, 16-QAM 3/4 39 Mbps, Output Power Setting 11



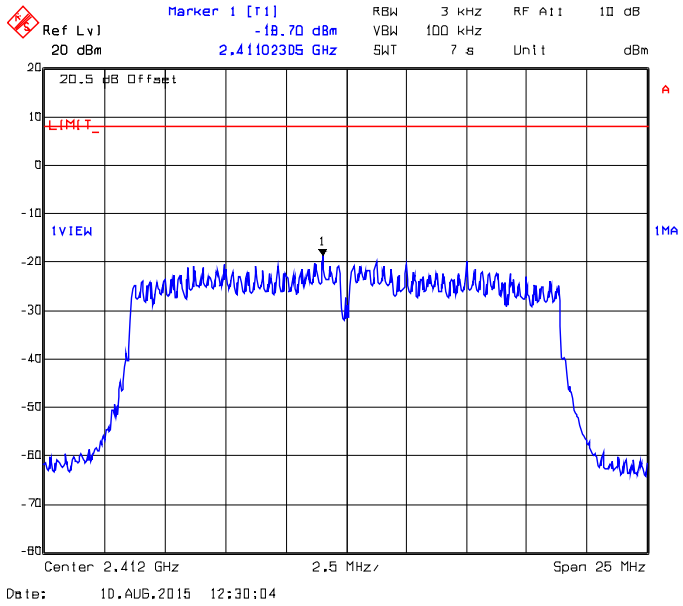
Plot 5.5.4.29. Power Spectral Density
802.11n HT20, Ch 6, 2437 MHz, MCS 4, 16-QAM 3/4 39 Mbps, Output Power Setting 11



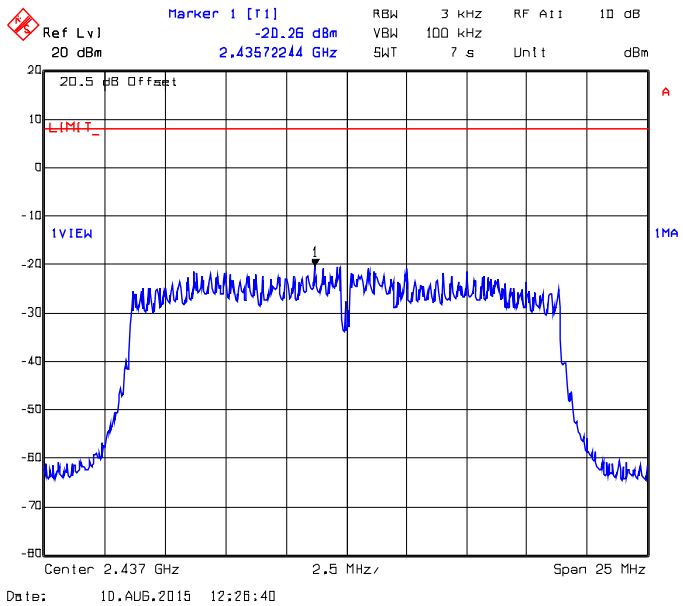
Plot 5.5.4.30. Power Spectral Density
802.11n HT20, Ch 11, 2462 MHz, MCS 4, 16-QAM 3/4 39 Mbps, Output Power Setting 11



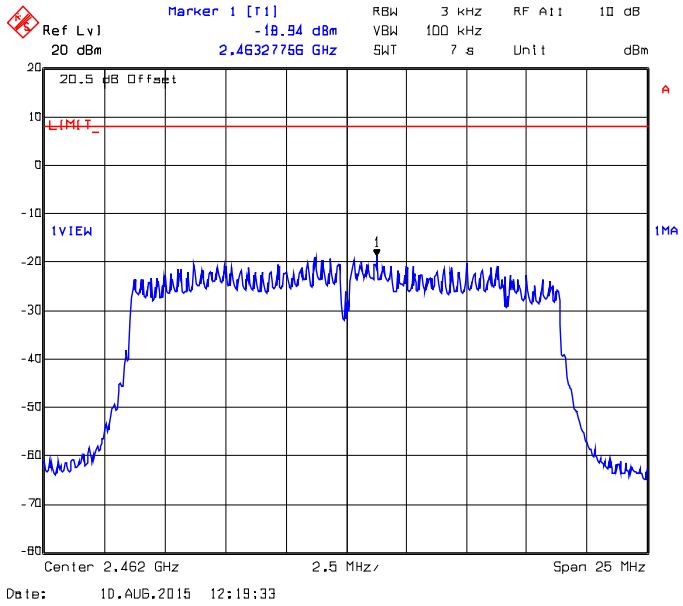
Plot 5.5.4.31. Power Spectral Density
802.11n HT20, Ch 1, 2412 MHz, MCS 7, 64-QAM 5/6 65 Mbps, Output Power Setting 11



Plot 5.5.4.32. Power Spectral Density
802.11n HT20, Ch 6, 2437 MHz, MCS 7, 64-QAM 5/6 65 Mbps, Output Power Setting 11



Plot 5.5.4.33. Power Spectral Density
802.11n HT20, Ch 11, 2462 MHz, MCS 7, 64-QAM 5/6 65 Mbps, Output Power Setting 11



5.6. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

5.6.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.6.2. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$$r = \sqrt{\frac{PG}{4\pi \cdot S}} = \sqrt{\frac{EIRP}{4\pi \cdot S}}$$

5.6.3. RF Evaluation

*Maximum EIRP, **P_{EIRP}[dBm]**:	19.17
MPE Limit for General Population/Uncontrolled Exposure, **$S_{uncontrolled}$[mW/cm^2]**	1.0
Calculated RF Safety Distance for General Population/Uncontrolled Exposure, **$r_{safety\_uncontrolled}$[cm]**	2.6
*Maximum EIRP = Max. Conducted Output Power (16.17 dBm) + Max. Antenna Assembly Gain (3 dBi)	

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412A00103	9 kHz–26.5 GHz	Aug. 09, 2017
Attenuator	Pasternack	PE7010-20	-	DC–2 GHz	Jan. 03, 2016
L.I.S.N	Schwarzbeck	NSLK8127	8127276	0.10 -30 MHz	Apr. 28, 2016
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	Nov. 21, 2015
Attenuator	Pasternack	7024-20	6	DC–26.5 GHz	Cal on use
DC Block	Picosecond Pulse Labs	5501A	4678	0.7 kHz–26 GHz	Cal on use
Peak Power Analyzer	Hewlett Packard	8991A	3342A00657	0.5 - 40 GHz	Jul. 15, 2016
Peak Power Sensor	Hewlett Packard	84814A	3205A00175	0.5 - 40 GHz	Nov. 13, 2015
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	Jul. 14, 2016
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	Feb. 4, 2016
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	Sep. 11, 2015
Attenuator	Pasternack	7024-10	4	DC–26.5 GHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	May 8, 2017
RF Amplifier	Com-Power	PAM-118A	551016	0.5 – 18 GHz	Jan. 6, 2016
Biconilog Antenna	EMCO	3142C	26873	26-3000 MHz	Apr. 14, 2016
Horn Antenna	EMCO	3155	5955	1 – 18 GHz	Mar. 26, 2016
Horn Antenna	EMCO	3160-09	118385	18 – 26.5 GHz	Aug. 4, 2016
High Pass Filter	K & L	11SH10-4000/T12000	4	Cut off 2400 MHz	Cal on use

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.44**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 2.89**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.79**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**