

ENGINEERING TEST REPORT



**160627 Wi-Fi g
Model No.: 160627
FCC ID: T89-160627**

Applicant:

Epson Canada Limited
185 Renfrew Drive
Markham, Ontario
Canada L3R 6G3

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.: EPS-115F15C247

This Test report is Issued under the Authority of
Tri M. Luu, BASc
Vice President of Engineering
UltraTech Group of Labs

Date: June 1, 2011

Report Prepared by: Dan Huynh

Tested by: Mr. Hung Trinh

Issued Date: June 1, 2011

Test Dates: April 12-26, 2011

*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 |
| Purpose of Test: | Equipment Certification for Digital Modulation Systems (DTS) Transmitter Operating in the Frequency Band 2400-2483.5 MHz. |
| Test Procedures: | <ul style="list-style-type: none">▪ ANSI C63.4-2003▪ FCC, KDB Publication No. 558074 |
| Environmental Classification: | <input checked="" type="checkbox"/> Commercial, industrial or business environment <input type="checkbox"/> Residential environment |

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

None.

1.3. NORMATIVE REFERENCES

| Publication | Year | Title |
|---------------------------------|------------------------------|---|
| 47 CFR Parts 0-19 | 2010 | Code of Federal Regulations (CFR), Title 47 – Telecommunication |
| ANSI C63.4 | 2003 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 | 2009 | American National Standard for Testing 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 | 2005 | Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) |

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

| APPLICANT | |
|------------------------|--|
| Name: | Epson Canada Limited |
| Address: | 185 Renfrew Drive Markham, Ontario Canada L3R 6G3 |
| Contact Person: | Mr. Dan Lehotsky Phone #: 905-944-3936 Fax #: 905-944-3772 Email Address: Dan_lehotsky@ea.epson.com |

| MANUFACTURER | |
|------------------------|--|
| Name: | Epson Canada Limited |
| Address: | 185 Renfrew Drive Markham, Ontario Canada L3R 6G3 |
| Contact Person: | Mr. William Gugg Phone #: 905-944-3932 Fax #: 905-944-3772 Email Address: William_gugg@ea.epson.com |

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

| | |
|---------------------------------------|-----------------------------------|
| Brand Name: | Epson Canada Limited |
| Product Name: | 160627 Wi/Fi g |
| Model Name or Number: | 160627 |
| Serial Number: | Test Sample |
| Type of Equipment: | Digital Transmission System (DTS) |
| Input Power Supply Type: | 3.3V DC derived from the Printer |
| Primary User Functions of EUT: | Wi/Fi b/g Interface Module |

2.3. EUT'S TECHNICAL SPECIFICATIONS

| TRANSMITTER | |
|--|--|
| Equipment Type: | <ul style="list-style-type: none">• Mobile• Base Station (fixed use) |
| Intended Operating Environment: | Commercial, industrial or business |
| Power Supply Requirement: | 3.3 VDC |
| RF Output Power Rating: | 802.11b: 7.99 dBm (6.30 mW) Peak Conducted 802.11g: 13.42 dBm (21.98 mW) Peak Conducted |
| Operating Frequency Range: | 2412 - 2462 MHz |
| RF Output Impedance: | 50 Ω |
| Channel Spacing: | 5 MHz for 802.11b 20 MHz for 802.11g |
| Duty Cycle: | 100% |
| Modulation Type: | DSSS, OFDM |
| Oscillator Frequencies: | 40 MHz |
| Antenna Connector Types: | Integral |
| Antenna Description: | Manufacturer: Taiyo Yuden Type: Circuit Board Mounted (Chip Antenna) Model No.: AH104F245001-T Freq. Range: 2.412 – 2.462 GHz Gain: 2dBi |

2.4. LIST OF EUT'S PORTS

| Port Number | EUT's Port Description | Number of Identical Ports | Connector Type | Cable Type (Shielded/Non-shielded) |
|-------------|------------------------|---------------------------|----------------|------------------------------------|
| None. | | | | |

2.5. 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: | Printer |
| Brand name: | Epson |
| Model Name or Number: | M244A |
| Serial Number: | MXAF000189 |
| Connected to EUT's Port: | I/O port of interface board |

| Ancillary Equipment # 2 | |
|--------------------------------|--------------------------|
| Description: | AC/DC Power Adapter |
| Brand name: | Epson |
| Model Name or Number: | M159A |
| Serial Number: | CYYZ46626F |
| Connected to EUT's Port: | DC jack of Epson printer |

| Ancillary Equipment # 3 | |
|--------------------------------|--------------------------------|
| Description: | Laptop |
| Brand name: | Dell |
| Model Name or Number: | PPL |
| Serial Number: | 0009321C |
| Connected to EUT's Port: | Serial port of interface board |

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 °C |
| Humidity: | 45 to 58% |
| Pressure: | 102 kPa |
| Power Input Source: | 3.3 Vdc |

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

| | |
|----------------------------------|--|
| Operating Modes: | Each of lowest, middle and highest channel frequencies transmits continuously for emissions measurements. |
| Special Test Software: | Special software and hardware provided by the Applicant to operate the EUT at each channel frequency continuously. For example, the transmitter will be operated at each of the lowest, middle and highest frequencies individually continuously during testing. |
| Special Hardware Used: | The RF Module could be tested outside of the enclosure using Epson interface board Test Jig connected to EUT. |
| 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: (Near lowest, near middle & near highest frequencies in the frequency range of operation.) | 2412, 2437 and 2462 MHz |
| RF Power Output: (measured maximum output power at antenna terminals) | 802.11b: 7.99 dBm (6.30 mW) Peak 802.11g: 13.42 dBm (21.98 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: 2014-04-04.

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 |

* The EUT complies with the requirement; it employs a permanently mounted integral antenna.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4-2003 and FCC KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems.

5.2. MEASUREMENT UNCERTAINTIES

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. Refer to Exhibit 7 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The 160627 is an 802.11b/g radio module that can be used for adding Wi/Fi functionality to Epson products.

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

5.5.1. Limit(s)

The equipment shall meet the limits of the following table:

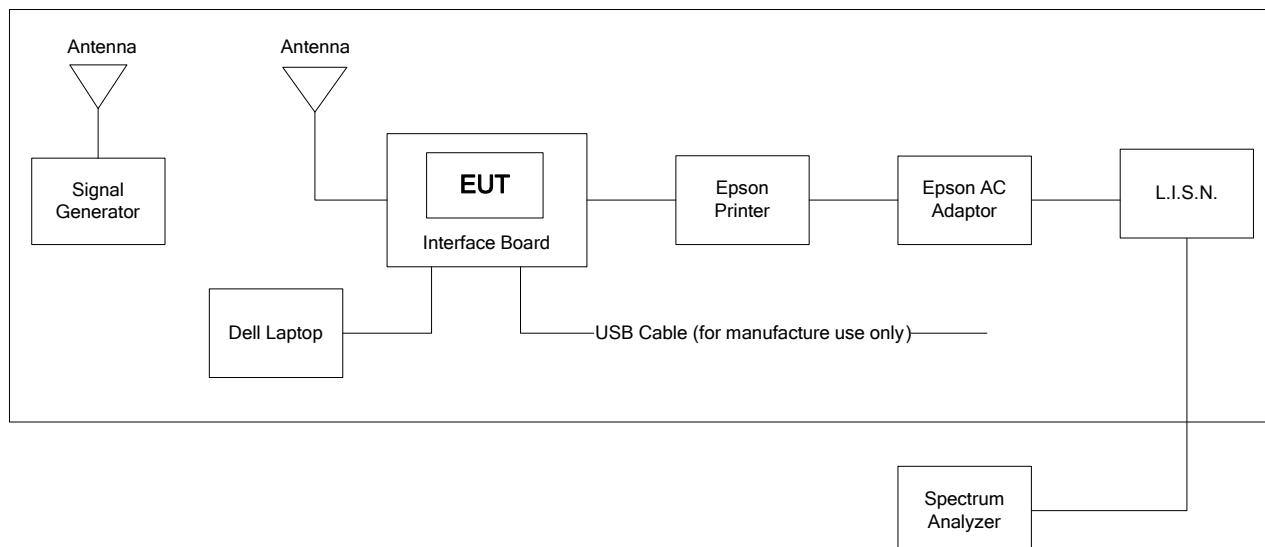
| Frequency of emission (MHz) | Conducted Limits (dB μ V) | |
|--------------------------------|-------------------------------|-----------|
| | Quasi-peak | Average |
| 0.15–0.5 | 66 to 56* | 56 to 46* |
| 0.5–5 | 56 | 46 |
| 5–30 | 60 | 50 |

*Decreases linearly with the logarithm of the frequency

5.5.2. Method of Measurements

ANSI C63.4-2003

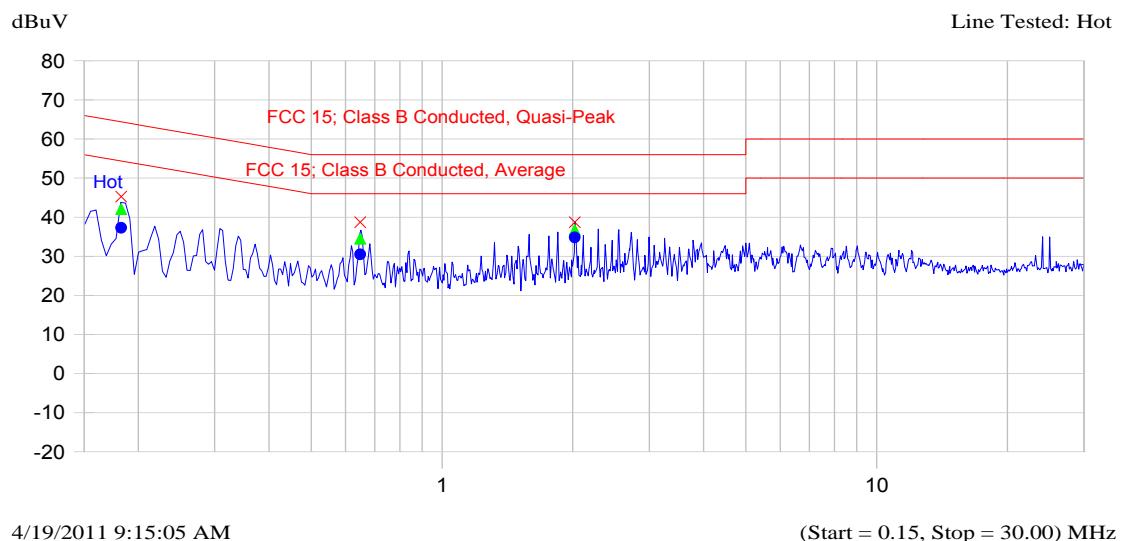
5.5.3. Test Arrangement



5.5.4. Test Data

Plot 5.5.4.1. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 120 VAC 60 Hz
Line Tested: Hot

Current Graph

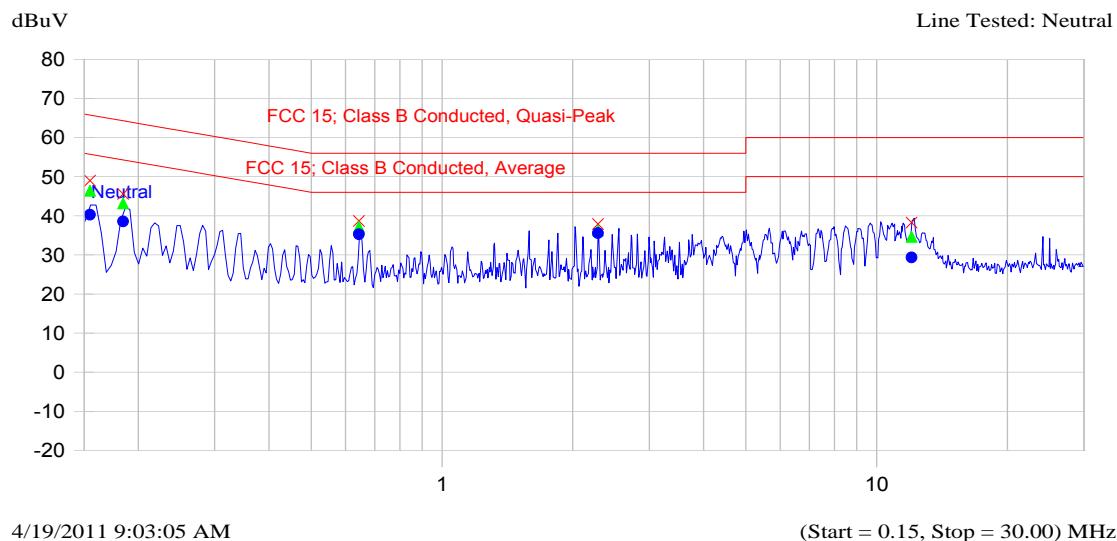


Current List

| Frequency MHz | Peak dBuV | QP dBuV | Delta dBuV | Delta QP-QP Limit dB | Avg dBuV | Delta Avg-Avg Limit dB | Trace Name |
|------------------|--------------|------------|---------------|----------------------------|-------------|---------------------------------|------------|
| 0.183 | 45.2 | 42.1 | -23.0 | 37.3 | -17.8 | | Hot |
| 0.648 | 38.7 | 34.5 | -21.5 | 30.5 | -15.5 | | Hot |
| 2.021 | 38.7 | 36.7 | -19.3 | 34.8 | -11.2 | | Hot |

Plot 5.5.4.2. Power Line Conducted Emissions (Tx Mode)
Line Voltage: 120 VAC 60 Hz
Line Tested: Neutral

Current Graph

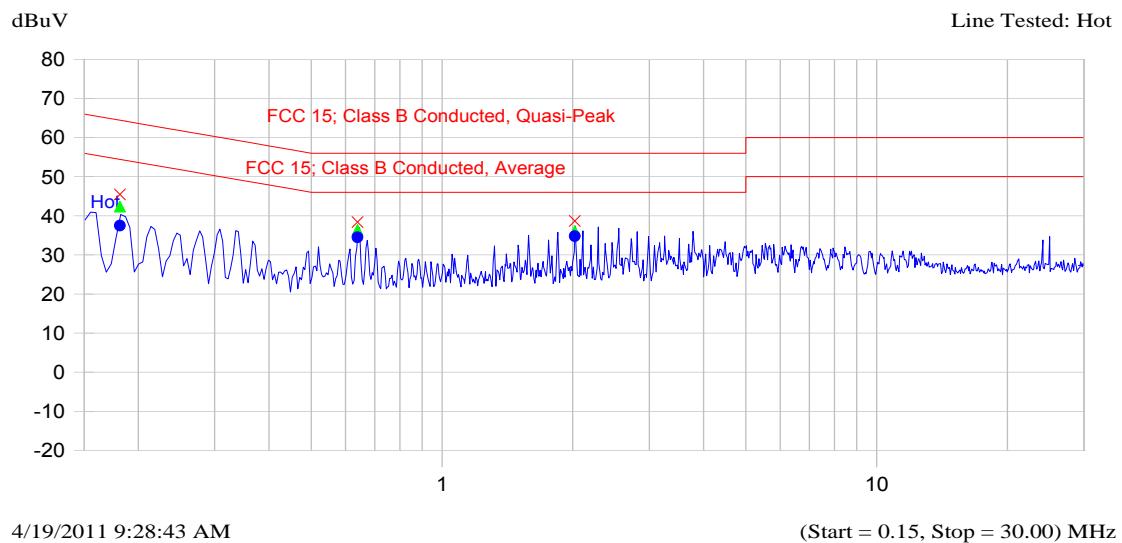


Current List

| Frequency MHz | Peak dBuV | QP dBuV | Delta QP-QP Limit dB | Avg dBuV | Delta Avg-Avg Limit dB | Trace Name |
|------------------|--------------|------------|----------------------------|-------------|------------------------------|------------|
| 0.155 | 49.0 | 46.4 | -19.5 | 40.2 | -15.6 | Neutral |
| 0.185 | 45.6 | 43.2 | -21.8 | 38.5 | -16.5 | Neutral |
| 0.644 | 38.6 | 37.2 | -18.8 | 35.2 | -10.8 | Neutral |
| 2.283 | 37.9 | 36.2 | -19.8 | 35.5 | -10.5 | Neutral |
| 12.035 | 38.2 | 34.6 | -25.4 | 29.3 | -20.7 | Neutral |

Plot 5.5.4.3. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 120 VAC 60 Hz
Line Tested: Hot

Current Graph

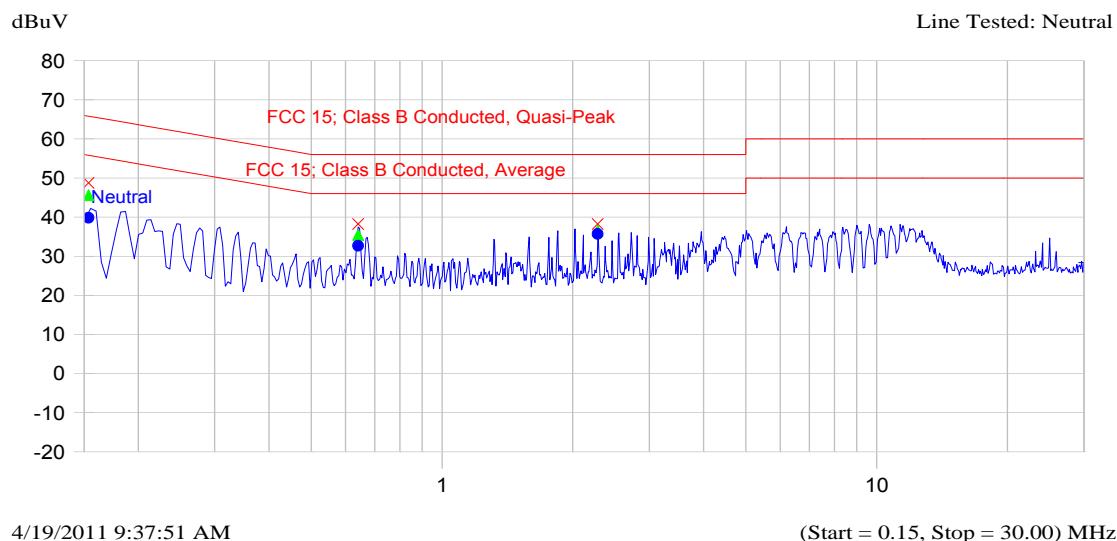


Current List

| Frequency MHz | Peak dBuV | QP dBuV | Delta QP-QP Limit dB | Avg dBuV | Delta Avg-Avg Limit dB | Trace Name |
|------------------|--------------|------------|----------------------------|-------------|------------------------------|------------|
| 0.182 | 45.5 | 42.3 | -22.7 | 37.5 | -17.6 | Hot |
| 0.639 | 38.4 | 36.4 | -19.6 | 34.5 | -11.5 | Hot |
| 2.021 | 38.6 | 36.0 | -20.0 | 34.8 | -11.2 | Hot |

Plot 5.5.4.4. Power Line Conducted Emissions (Rx Mode)
Line Voltage: 120 VAC 60 Hz
Line Tested: Neutral

Current Graph



Current List

| Frequency MHz | Peak dBuV | QP dBuV | Delta QP-QP dB | Avg dBuV | Delta Avg-Avg dB | Trace Name |
|------------------|--------------|------------|-------------------|-------------|---------------------|------------|
| 0.154 | 48.7 | 45.6 | -20.3 | 39.8 | -16.1 | Neutral |
| 0.642 | 38.2 | 35.5 | -20.5 | 32.6 | -13.4 | Neutral |
| 2.282 | 38.3 | 36.5 | -19.5 | 35.7 | -10.3 | Neutral |

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

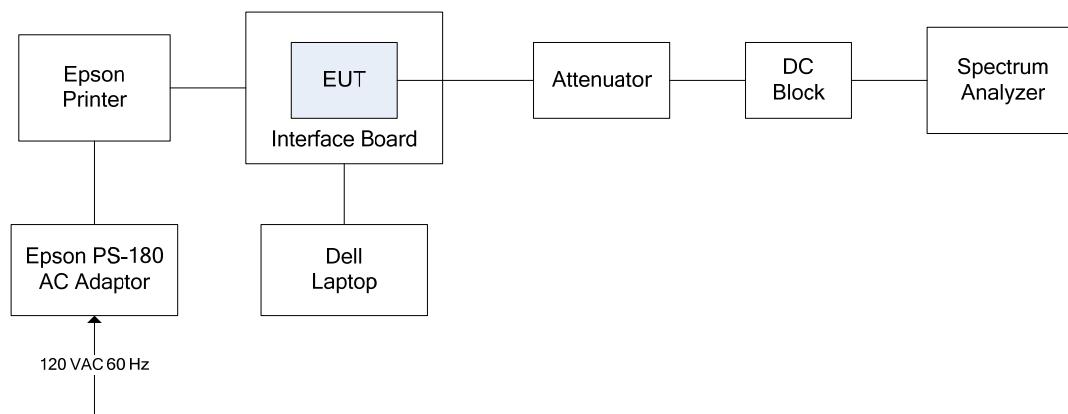
5.6.1. Limit(s)

For a Digital Modulation System, the minimum 6 dB bandwidth shall be at least 500 KHz.

5.6.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) and ANSI C63.4-2003.

5.6.3. Test Arrangement



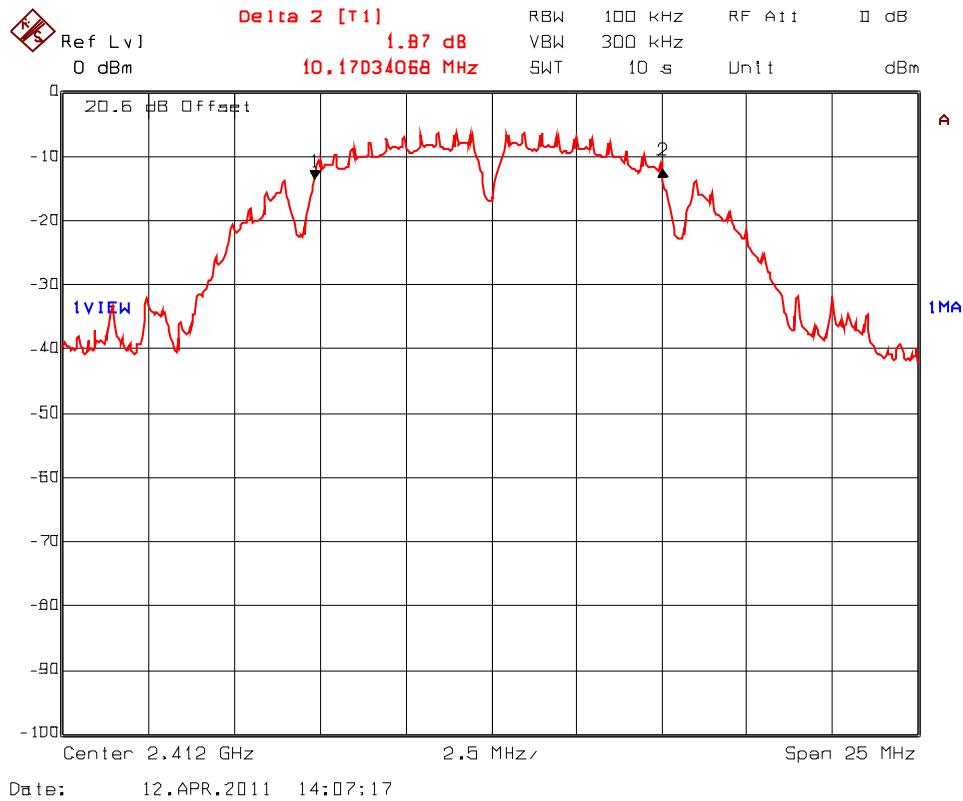
5.6.4. Test Data

| 802.11b Mode | | | | |
|-----------------|------------|------------------|----------------------|------------------------------|
| Frequency (MHz) | Modulation | Data Rate (Mbps) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
| 2412 | DBPSK | 1 | 10.17 | 14.19 |
| | DQPSK | 2 | 10.17 | 14.25 |
| | CCK | 11 | 10.32 | 14.19 |
| 2437 | DBPSK | 1 | 10.22 | 14.19 |
| | DQPSK | 2 | 10.17 | 14.25 |
| | CCK | 11 | 10.37 | 14.13 |
| 2462 | DBPSK | 1 | 10.17 | 14.19 |
| | DQPSK | 2 | 10.17 | 14.19 |
| | CCK | 11 | 10.32 | 14.13 |

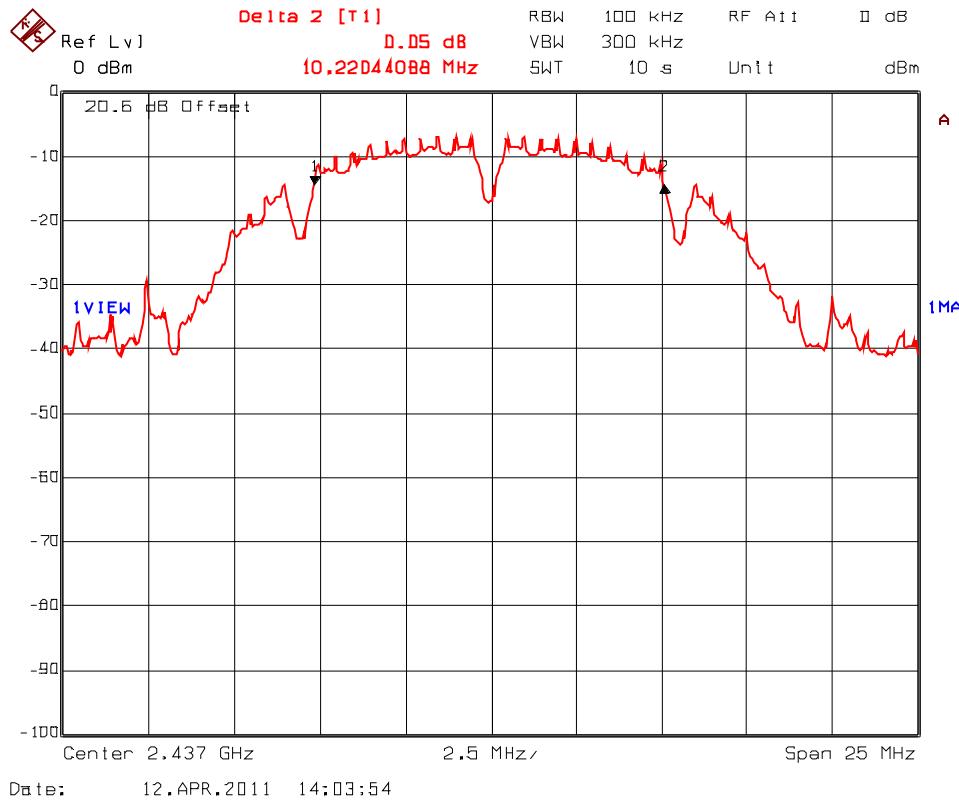
| 802.11g Mode | | | | |
|-----------------|------------|------------------|----------------------|------------------------------|
| Frequency (MHz) | Modulation | Data Rate (Mbps) | 6 dB Bandwidth (MHz) | 99% Occupied Bandwidth (MHz) |
| 2412 | BPSK | 9 | 16.51 | 17.56 |
| | QPSK | 18 | 16.51 | 17.07 |
| | 16-QAM | 36 | 16.59 | 17.00 |
| | 64-QAM | 54 | 16.59 | 17.00 |
| 2437 | BPSK | 9 | 16.51 | 17.64 |
| | QPSK | 18 | 16.59 | 17.07 |
| | 16-QAM | 36 | 16.59 | 17.07 |
| | 64-QAM | 54 | 16.59 | 17.00 |
| 2462 | BPSK | 9 | 16.51 | 17.56 |
| | QPSK | 18 | 16.59 | 17.00 |
| | 16-QAM | 36 | 16.59 | 17.00 |
| | 64-QAM | 54 | 16.59 | 17.07 |

See the following plots for detailed measurements.

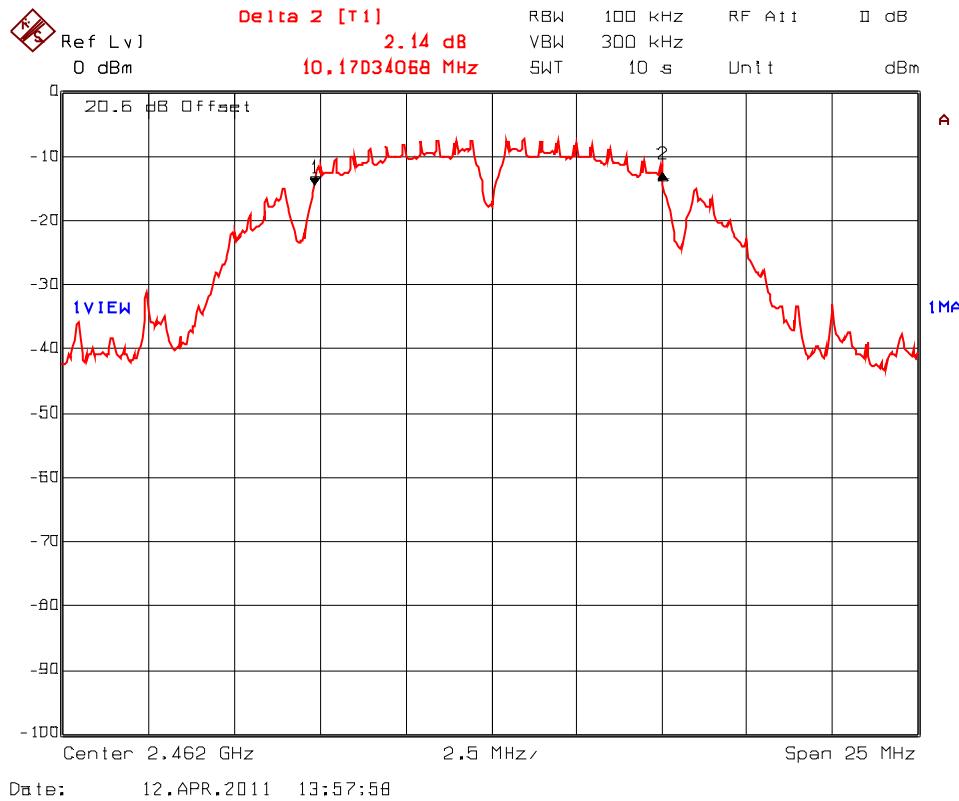
Plot 5.6.4.1. 6 dB Bandwidth, 802.11b, DBPSK 1 Mbps
Test Frequency: 2412 MHz



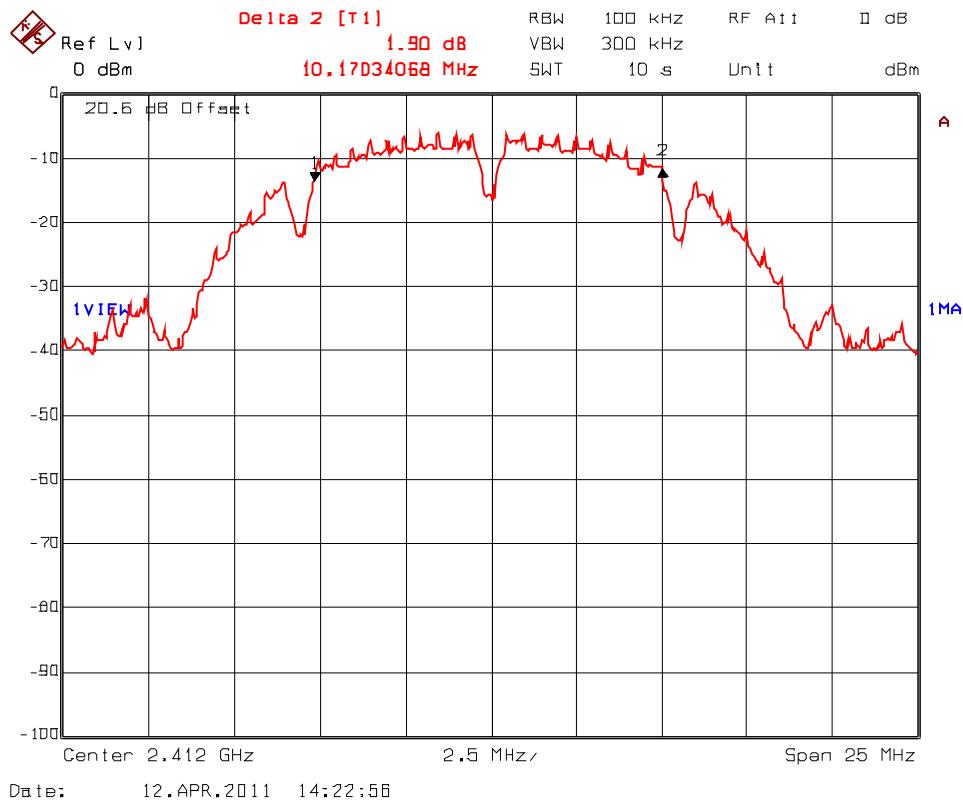
Plot 5.6.4.2. 6 dB Bandwidth, 802.11b, DBPSK 1 Mbps
Test Frequency: 2437 MHz



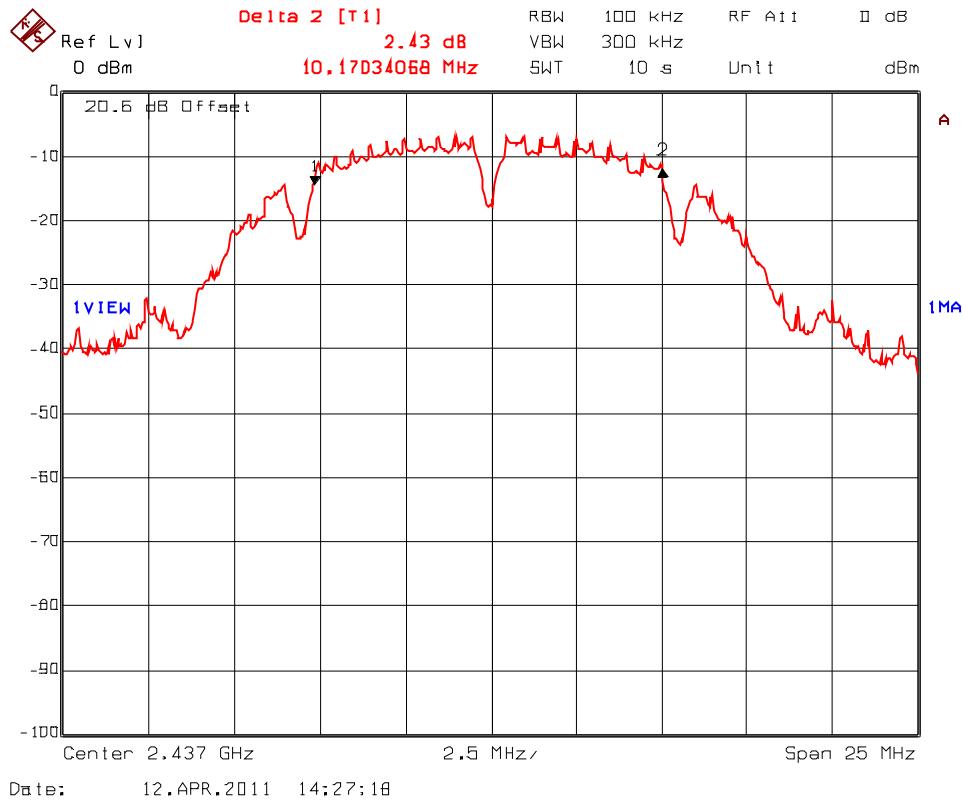
Plot 5.6.4.3. 6 dB Bandwidth, 802.11b, DBPSK 1 Mbps
Test Frequency: 2462 MHz



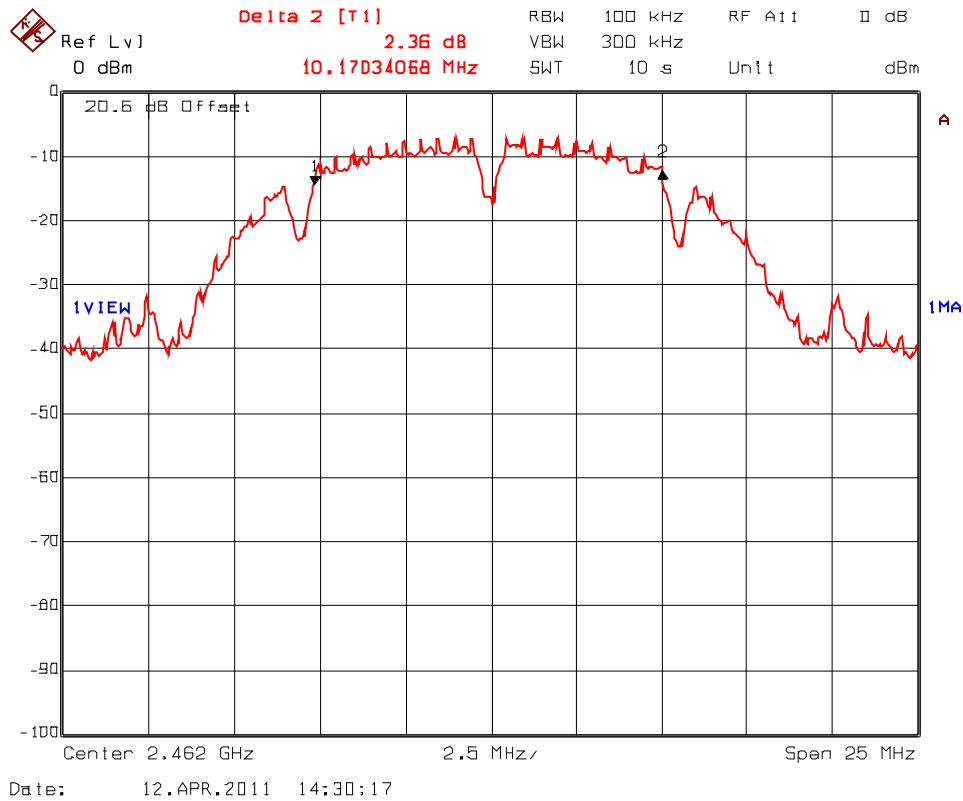
Plot 5.6.4.4. 6 dB Bandwidth, 802.11b, DQPSK 2 Mbps
Test Frequency: 2412 MHz



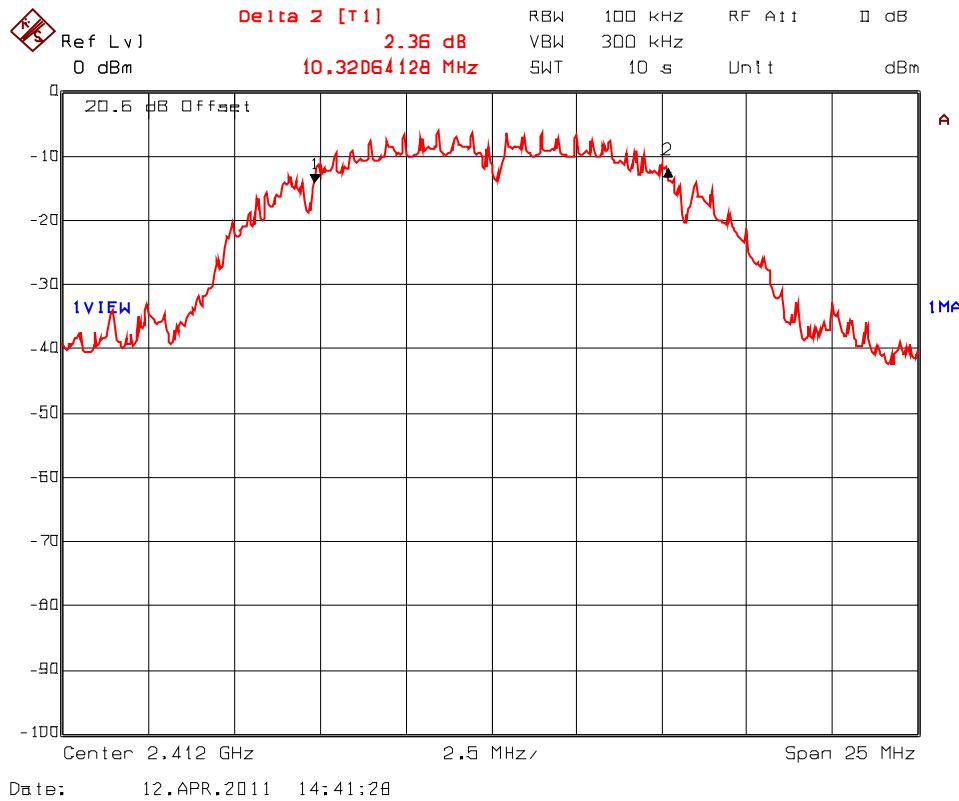
Plot 5.6.4.5. 6 dB Bandwidth, 802.11b, DQPSK 2 Mbps
Test Frequency: 2437 MHz



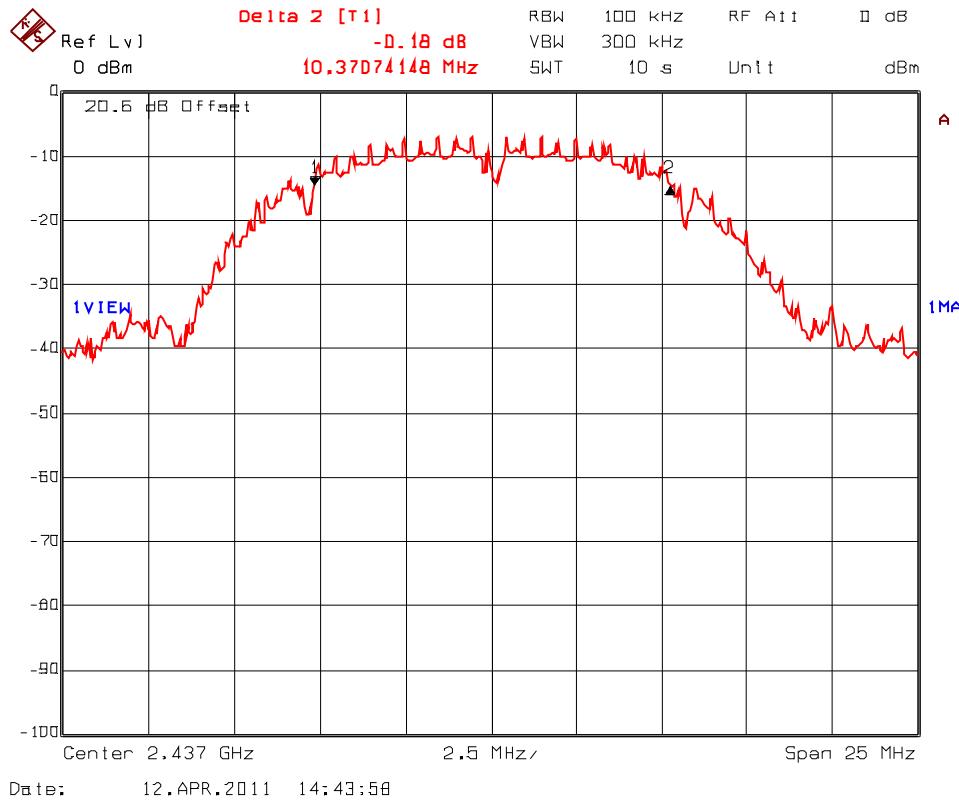
Plot 5.6.4.6. 6 dB Bandwidth, 802.11b, DQPSK 2 Mbps
Test Frequency: 2462 MHz



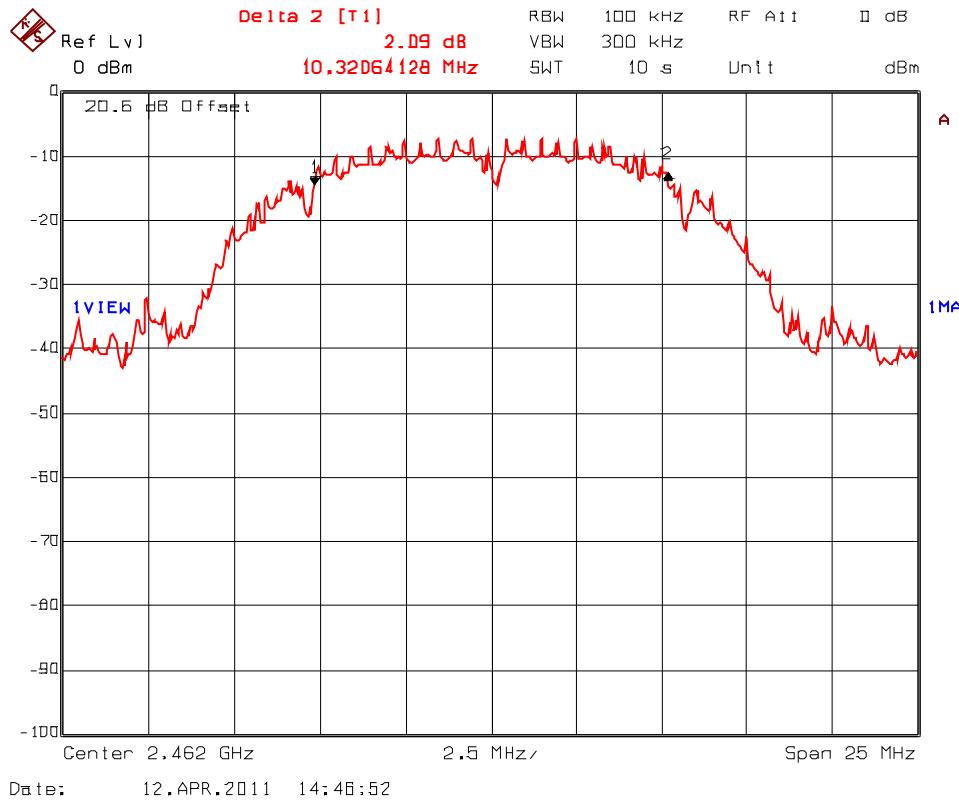
Plot 5.6.4.7. 6 dB Bandwidth, 802.11b, CCK 11 Mbps
Test Frequency: 2412 MHz



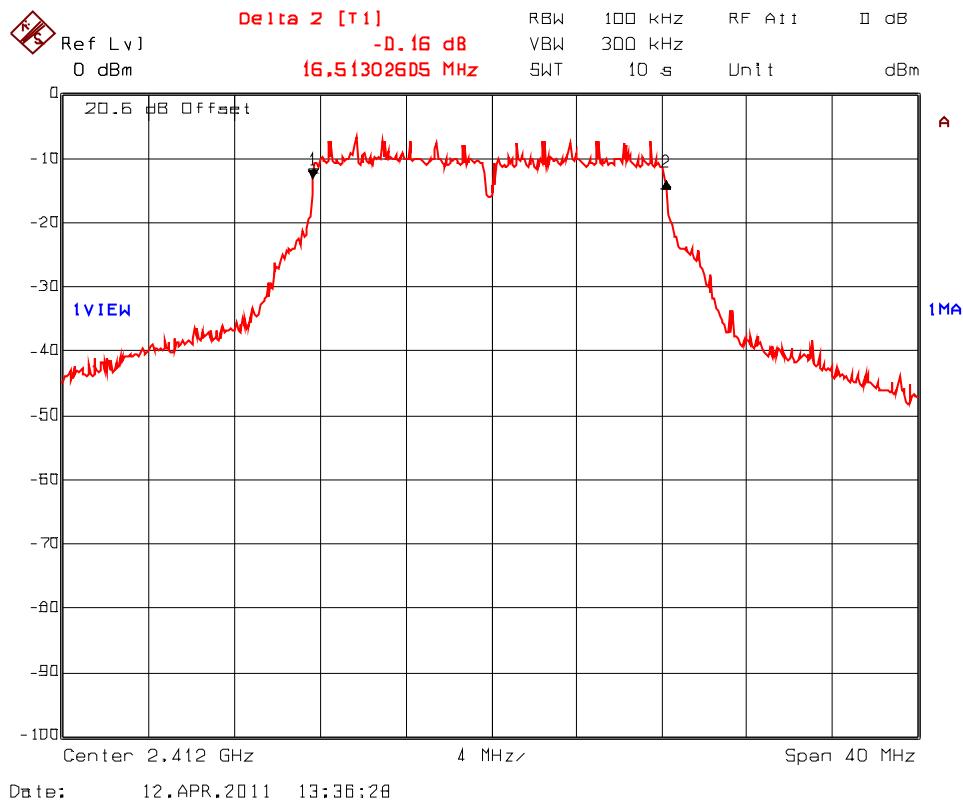
Plot 5.6.4.8. 6 dB Bandwidth, 802.11b, CCK 11 Mbps
Test Frequency: 2437 MHz



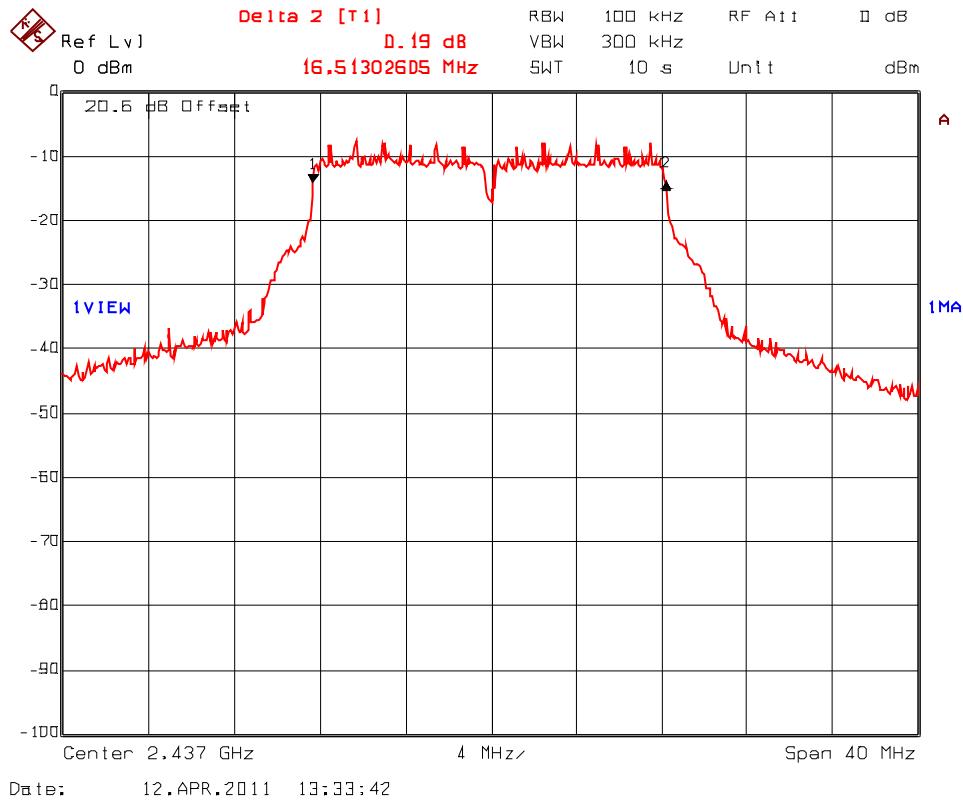
Plot 5.6.4.9. 6 dB Bandwidth, 802.11b, CCK 11 Mbps
Test Frequency: 2462 MHz



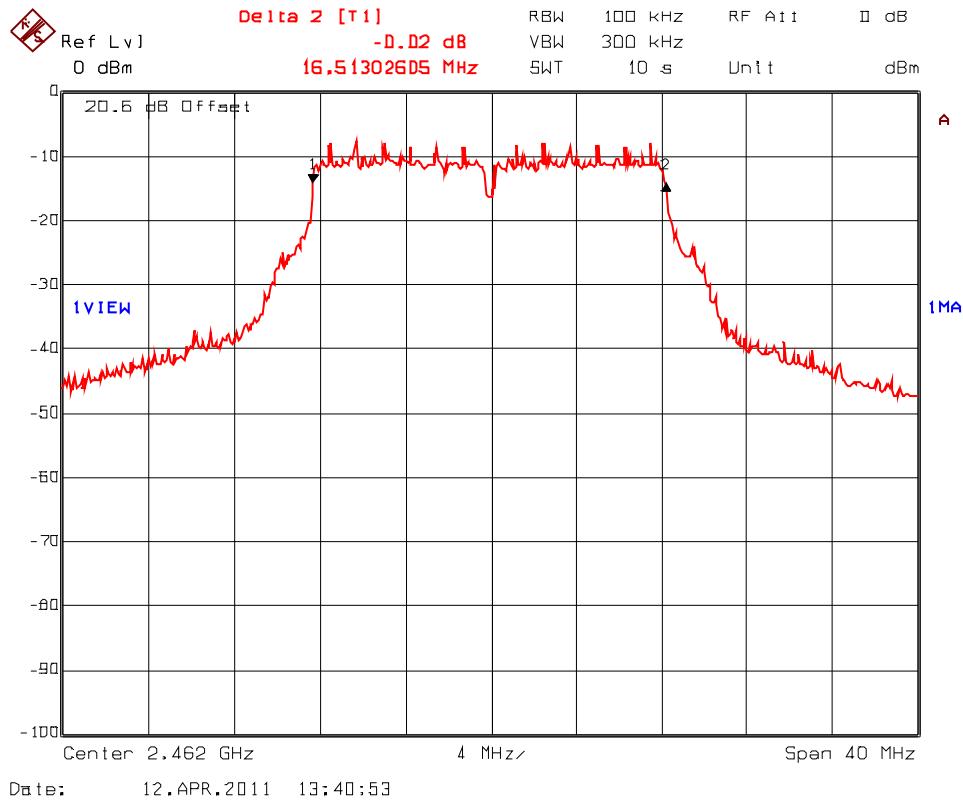
Plot 5.6.4.10. 6 dB Bandwidth, 802.11g, BPSK 9 Mbps
Test Frequency: 2412 MHz



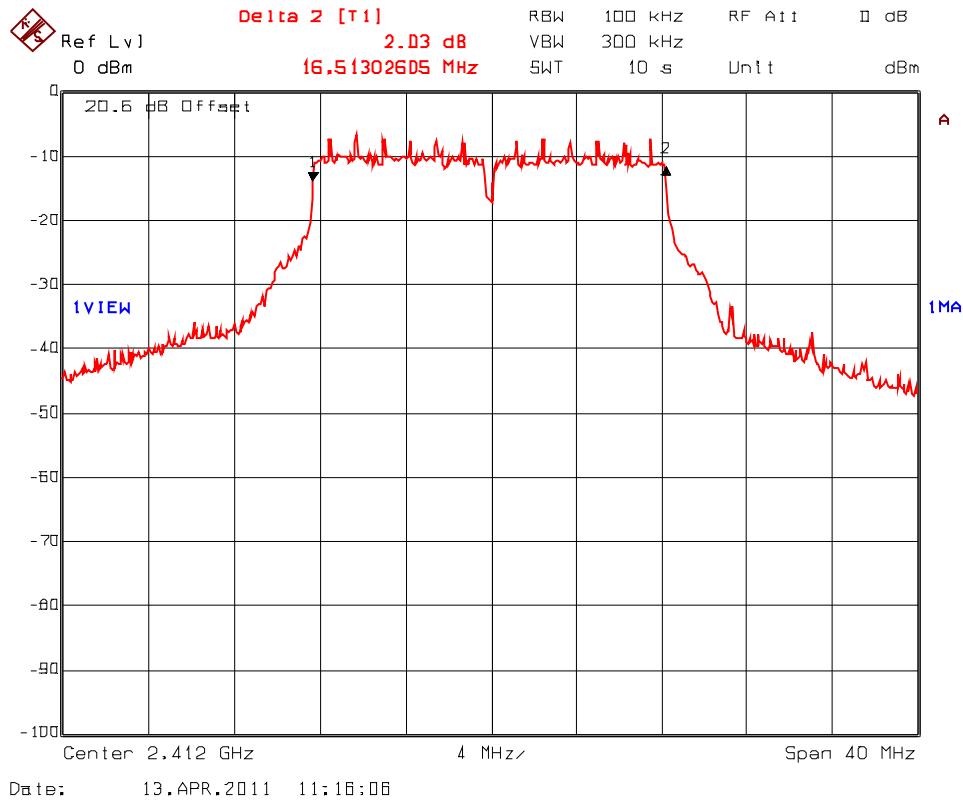
Plot 5.6.4.11. 6 dB Bandwidth, 802.11g, BPSK 9 Mbps
Test Frequency: 2437 MHz



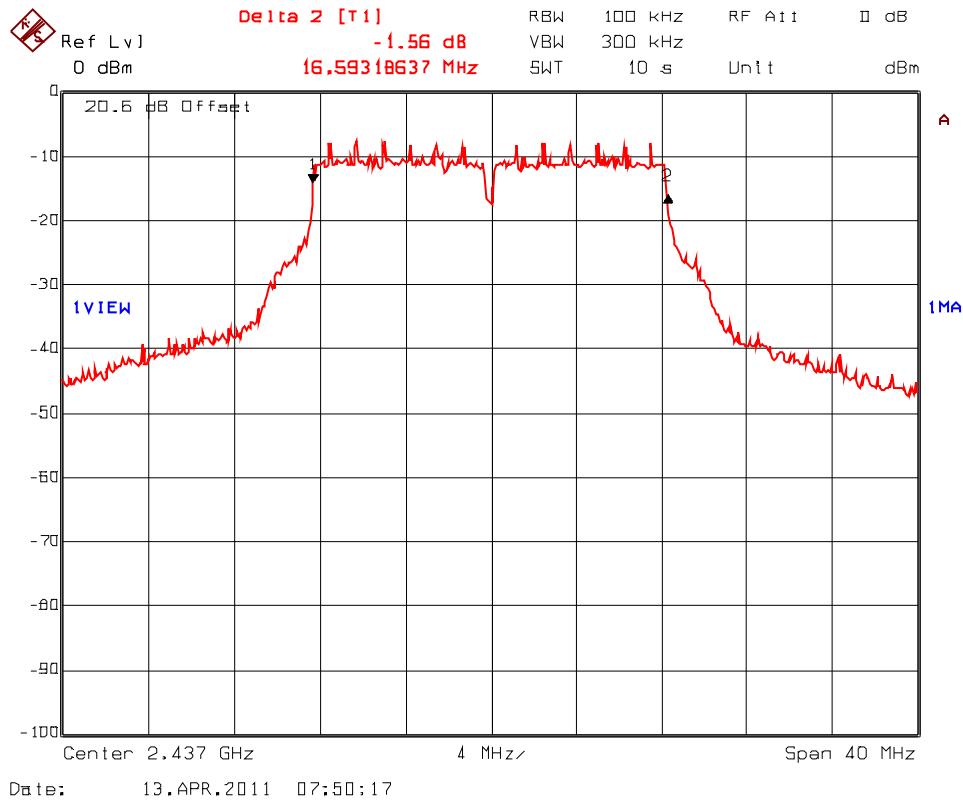
Plot 5.6.4.12. 6 dB Bandwidth, 802.11g, BPSK 9 Mbps
Test Frequency: 2462 MHz



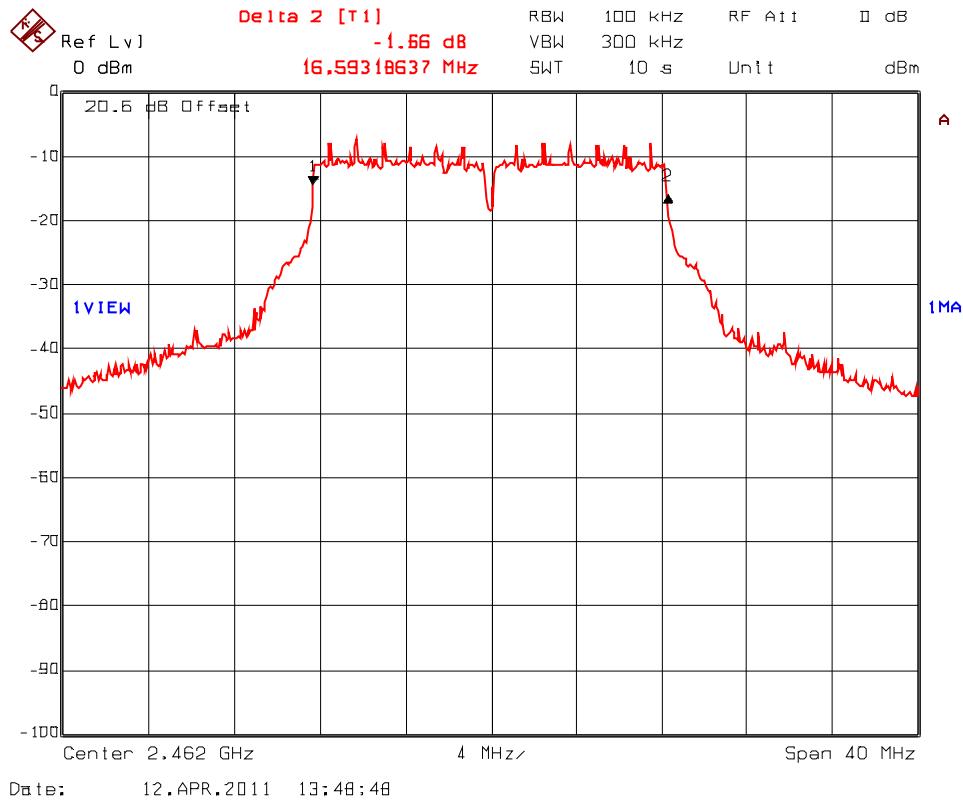
Plot 5.6.4.13. 6 dB Bandwidth, 802.11g, QPSK 18 Mbps
Test Frequency: 2412 MHz



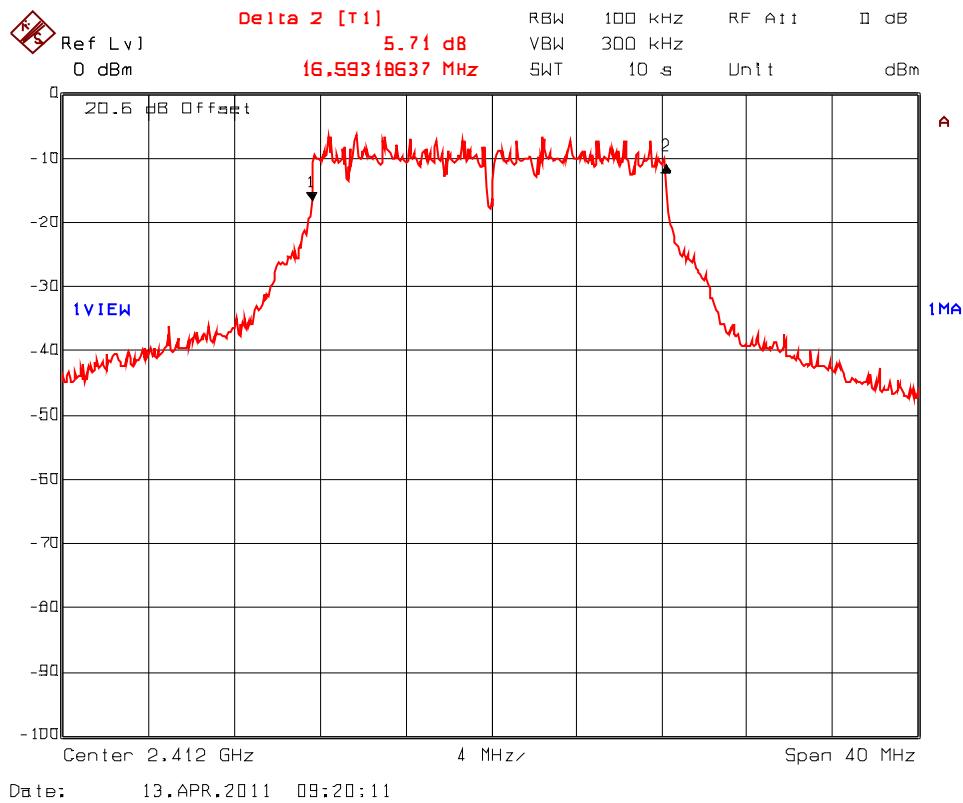
Plot 5.6.4.14. 6 dB Bandwidth, 802.11g, QPSK 18 Mbps
Test Frequency: 2437 MHz



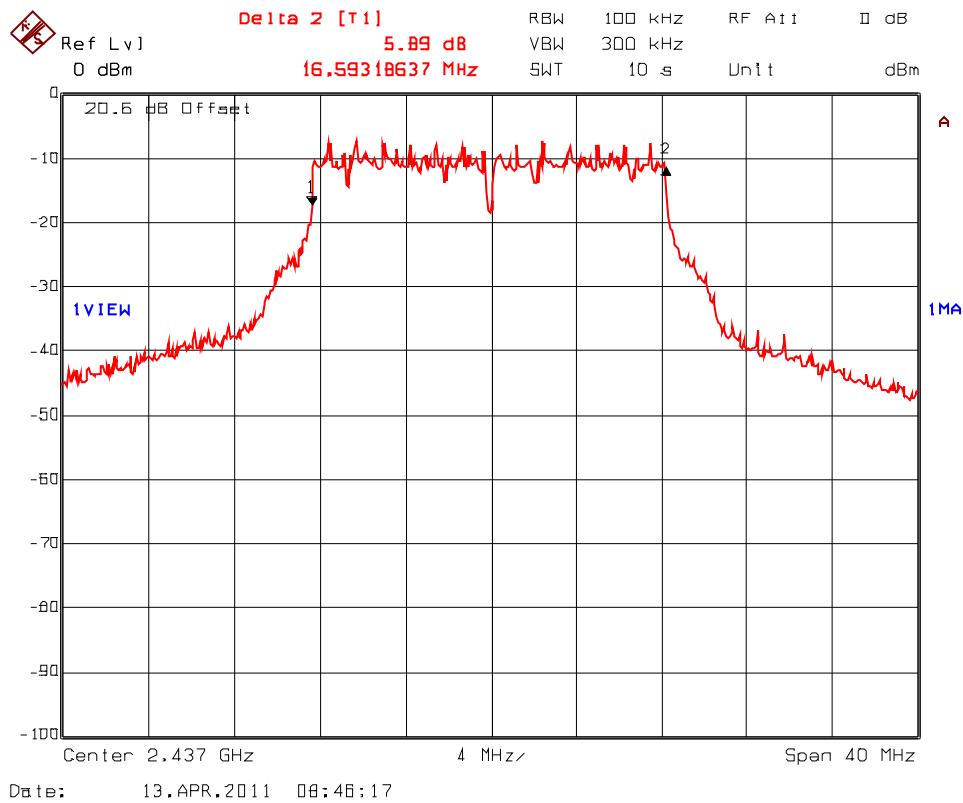
Plot 5.6.4.15. 6 dB Bandwidth, 802.11g, QPSK 18 Mbps
Test Frequency: 2462 MHz



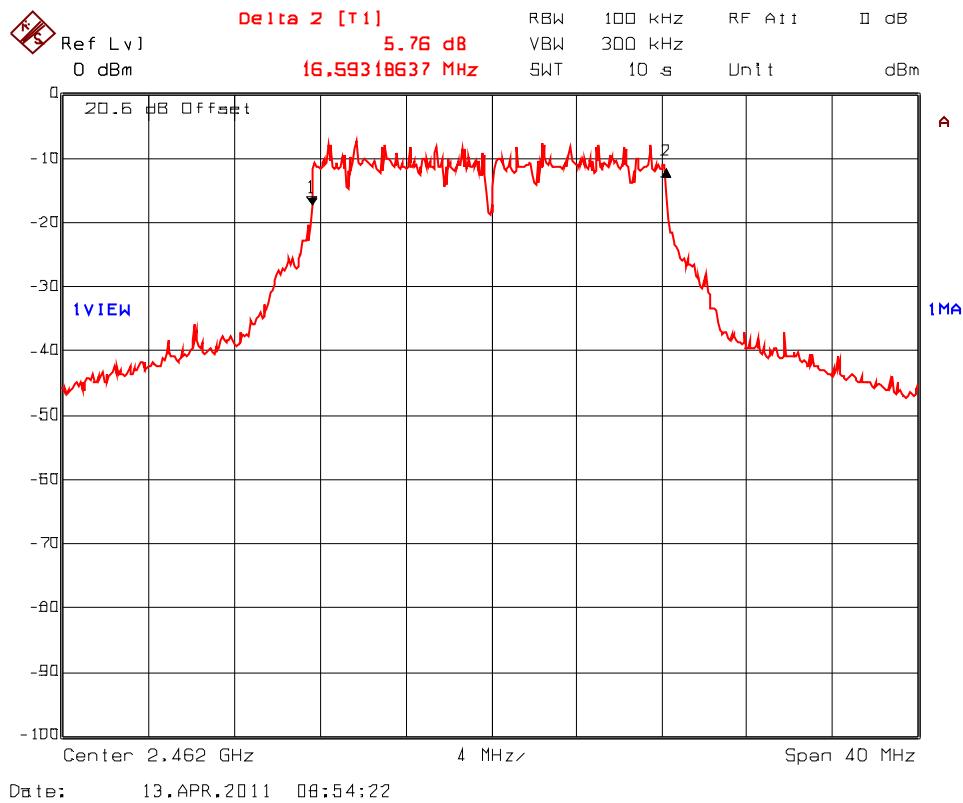
Plot 5.6.4.16. 6 dB Bandwidth, 802.11g, 16-QAM 36 Mbps
Test Frequency: 2412 MHz



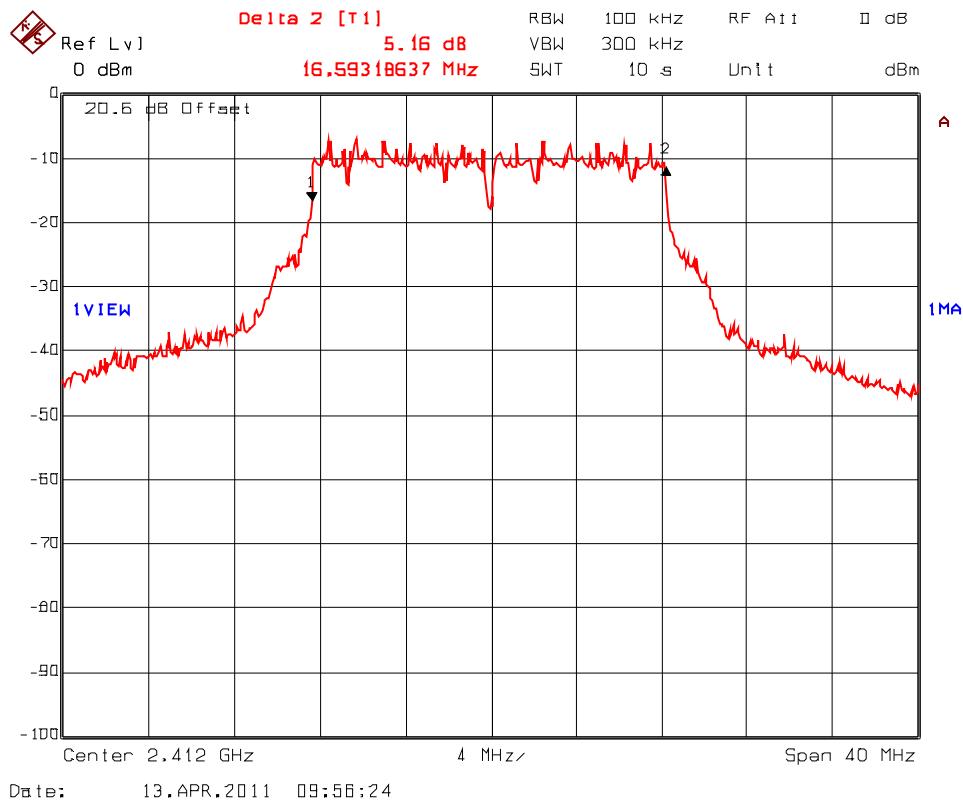
Plot 5.6.4.17. 6 dB Bandwidth, 802.11g, 16-QAM 36 Mbps
Test Frequency: 2437 MHz



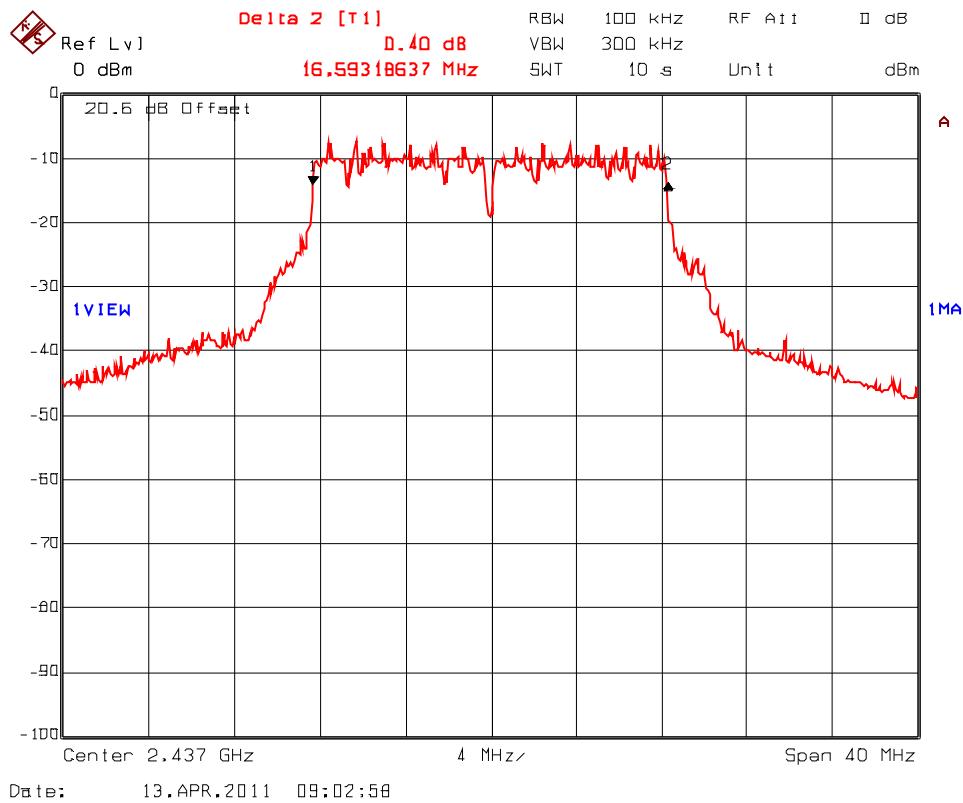
Plot 5.6.4.18. 6 dB Bandwidth, 802.11g, 16-QAM 36 Mbps
Test Frequency: 2462 MHz



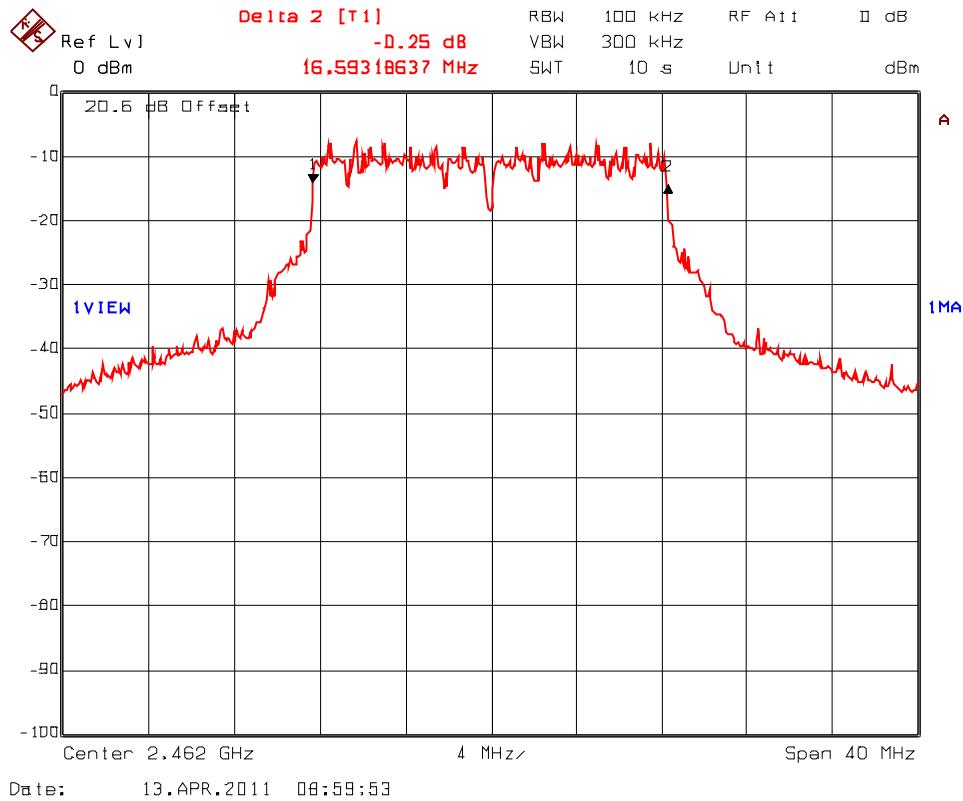
Plot 5.6.4.19. 6 dB Bandwidth, 802.11g, 64-QAM 54 Mbps
Test Frequency: 2412 MHz



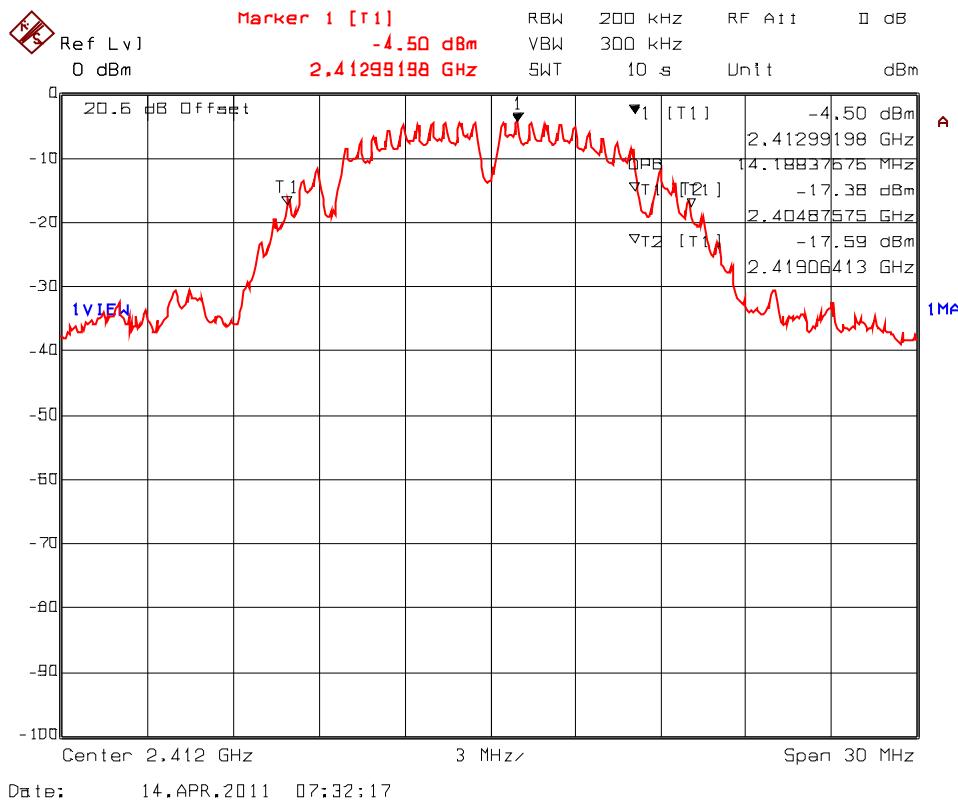
Plot 5.6.4.20. 6 dB Bandwidth, 802.11g, 64-QAM 54 Mbps
Test Frequency: 2437 MHz



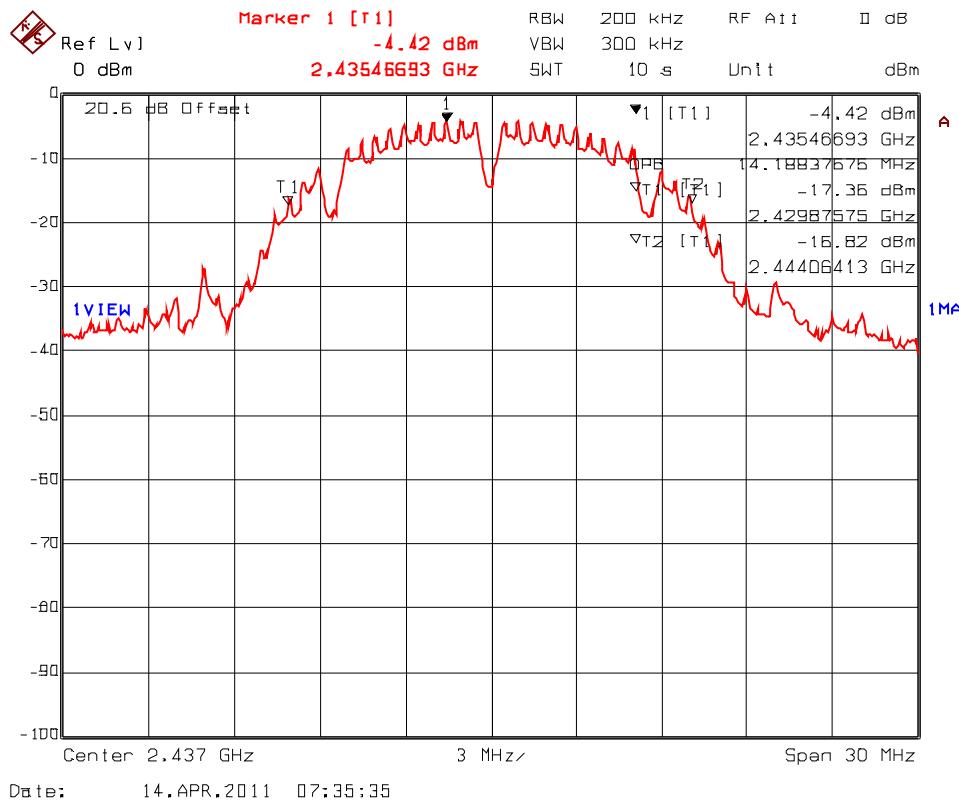
Plot 5.6.4.21. 6 dB Bandwidth, 802.11g, 64-QAM 54 Mbps
Test Frequency: 2462 MHz



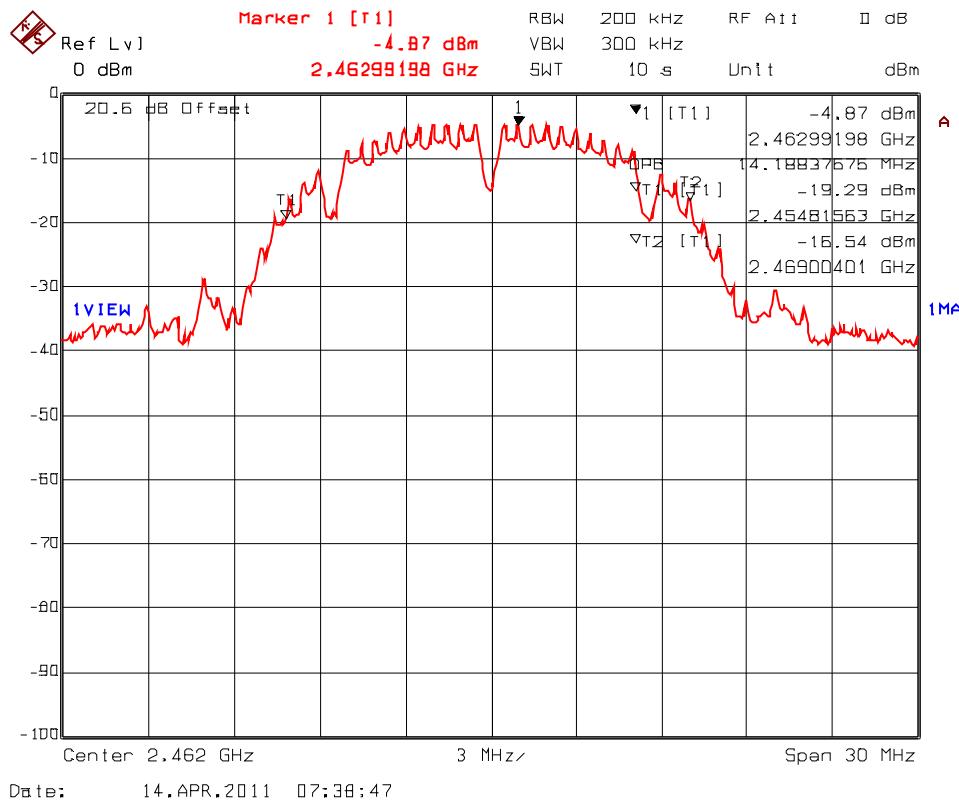
Plot 5.6.4.22. 99% Occupied Bandwidth, 802.11b, DBPSK 1 Mbps
Test Frequency: 2412 MHz



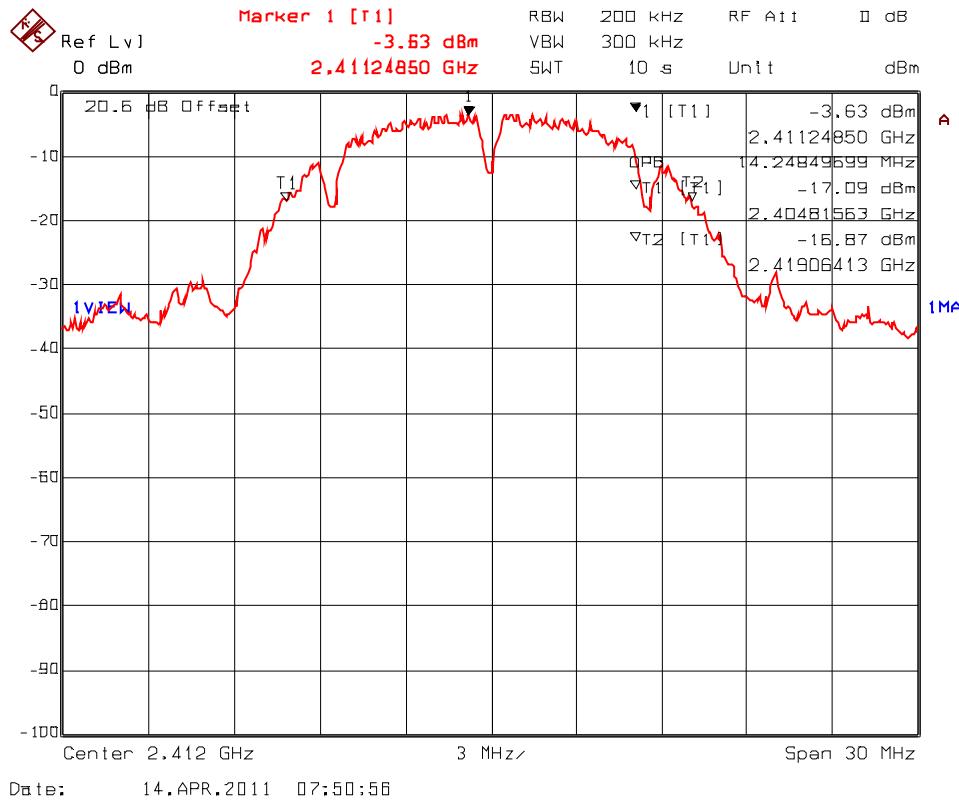
Plot 5.6.4.23. 99% Occupied Bandwidth, 802.11b, DBPSK 1 Mbps
Test Frequency: 2437 MHz



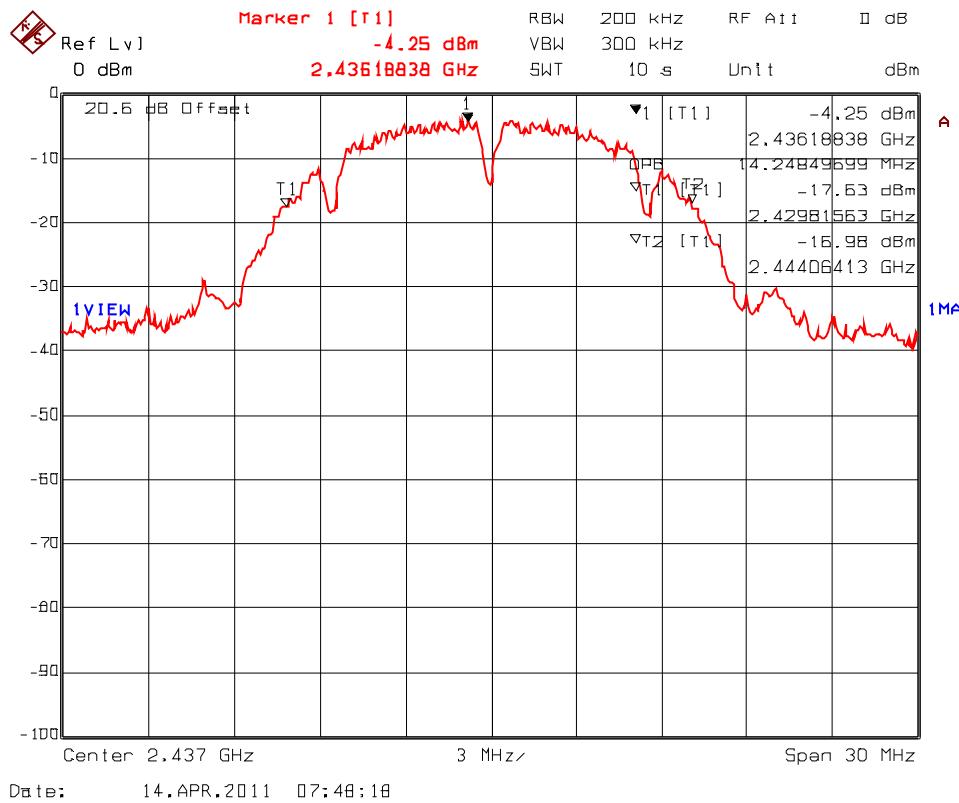
Plot 5.6.4.24. 99% Occupied Bandwidth, 802.11b, DBPSK 1 Mbps
Test Frequency: 2462 MHz



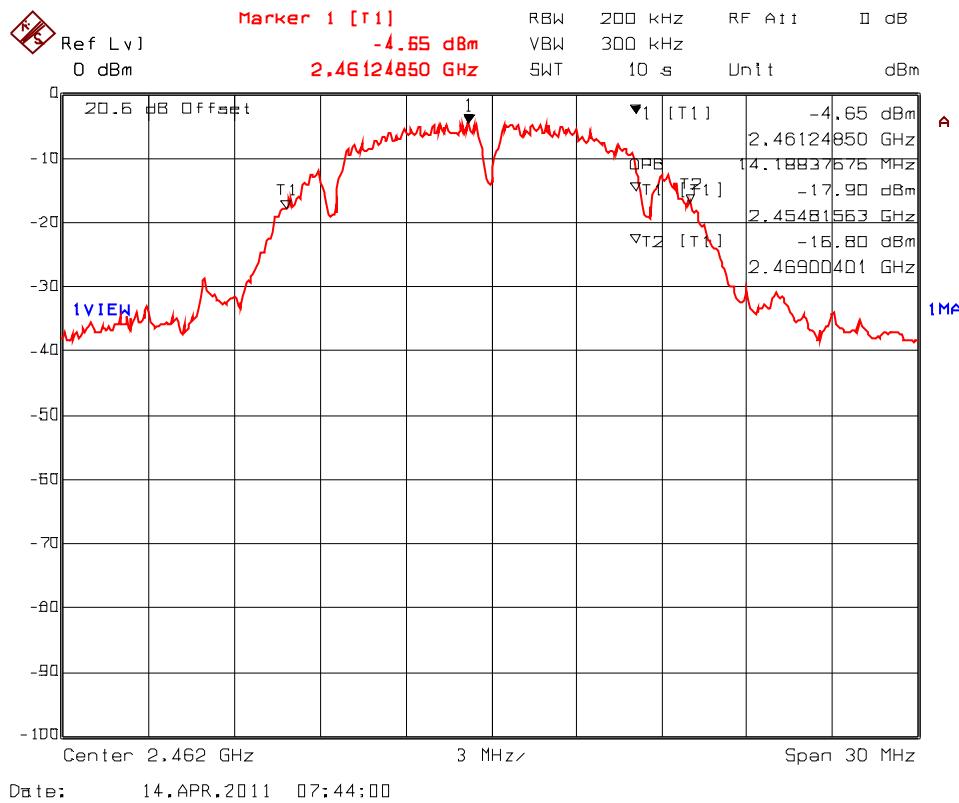
Plot 5.6.4.25. 99% Occupied Bandwidth, 802.11b, DQPSK 2 Mbps
Test Frequency: 2412 MHz



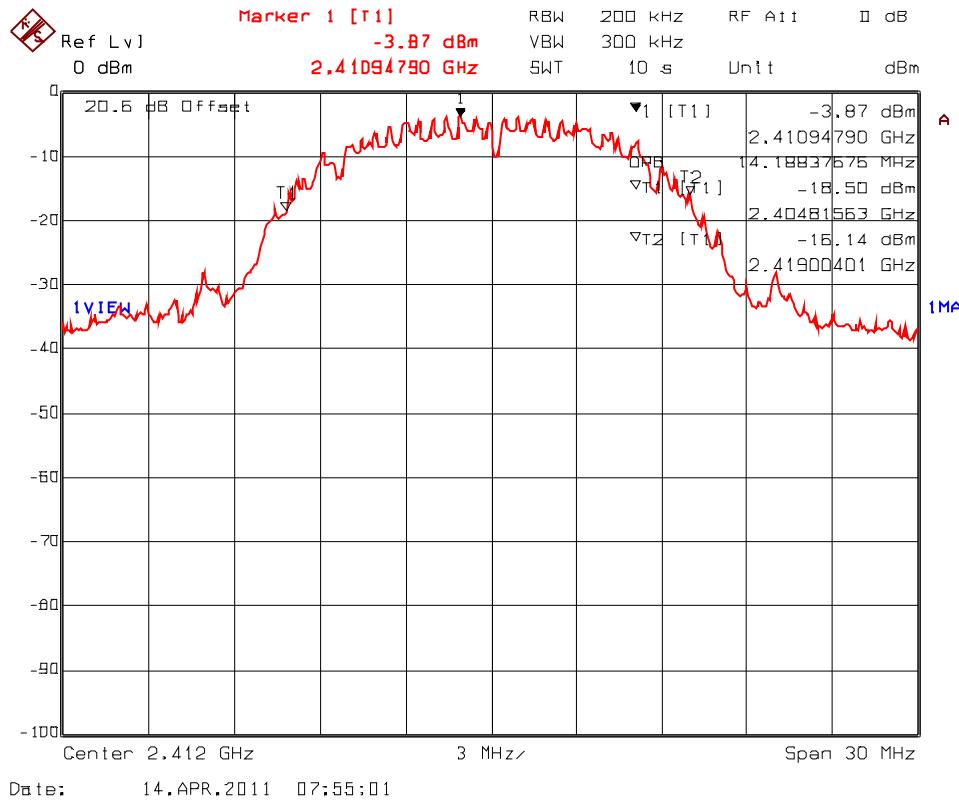
Plot 5.6.4.26. 99% Occupied Bandwidth, 802.11b, DQPSK 2 Mbps
Test Frequency: 2437 MHz



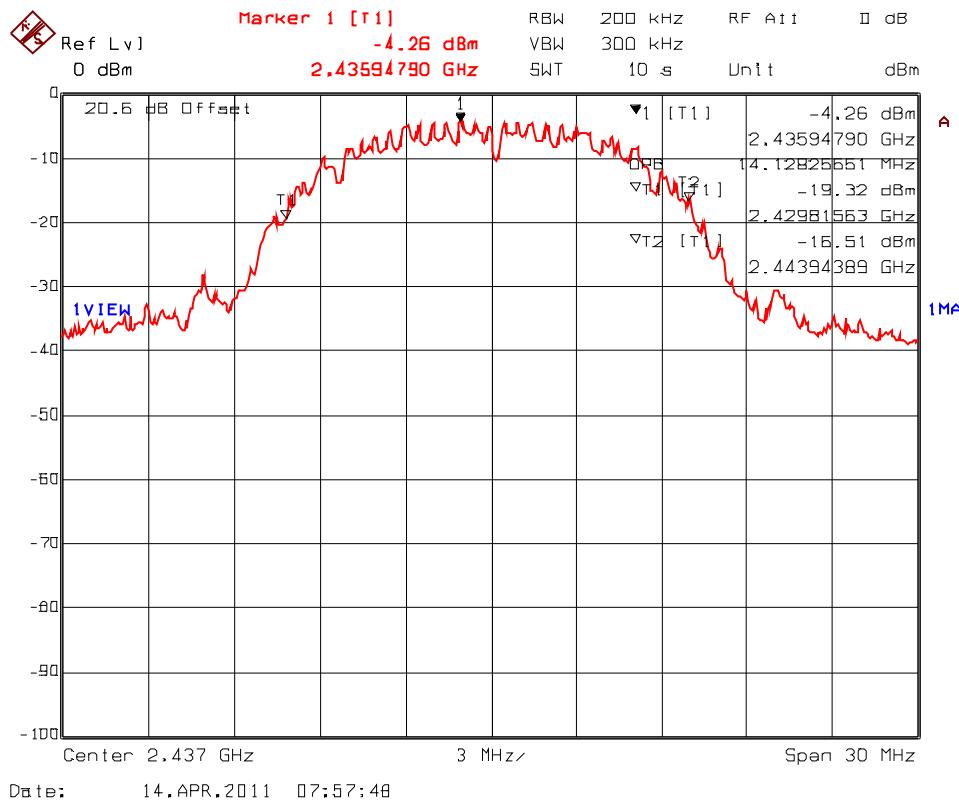
Plot 5.6.4.27. 99% Occupied Bandwidth, 802.11b, DQPSK 2 Mbps
Test Frequency: 2462 MHz



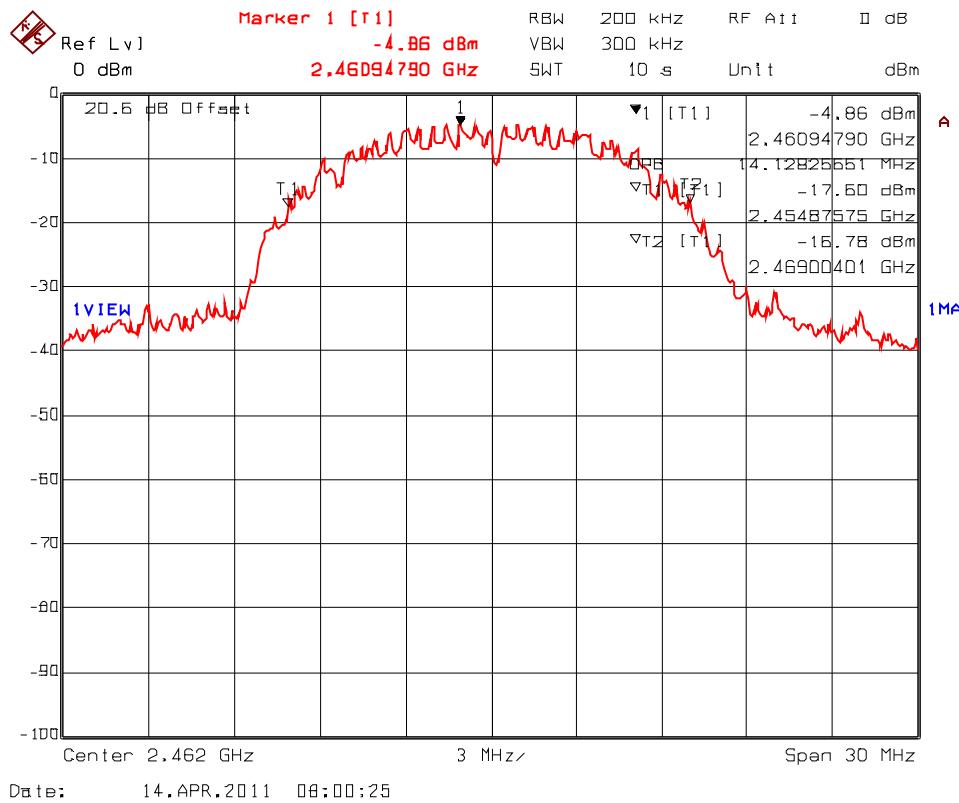
Plot 5.6.4.28. 99% Occupied Bandwidth, 802.11b, CCK 11 Mbps
Test Frequency: 2412 MHz



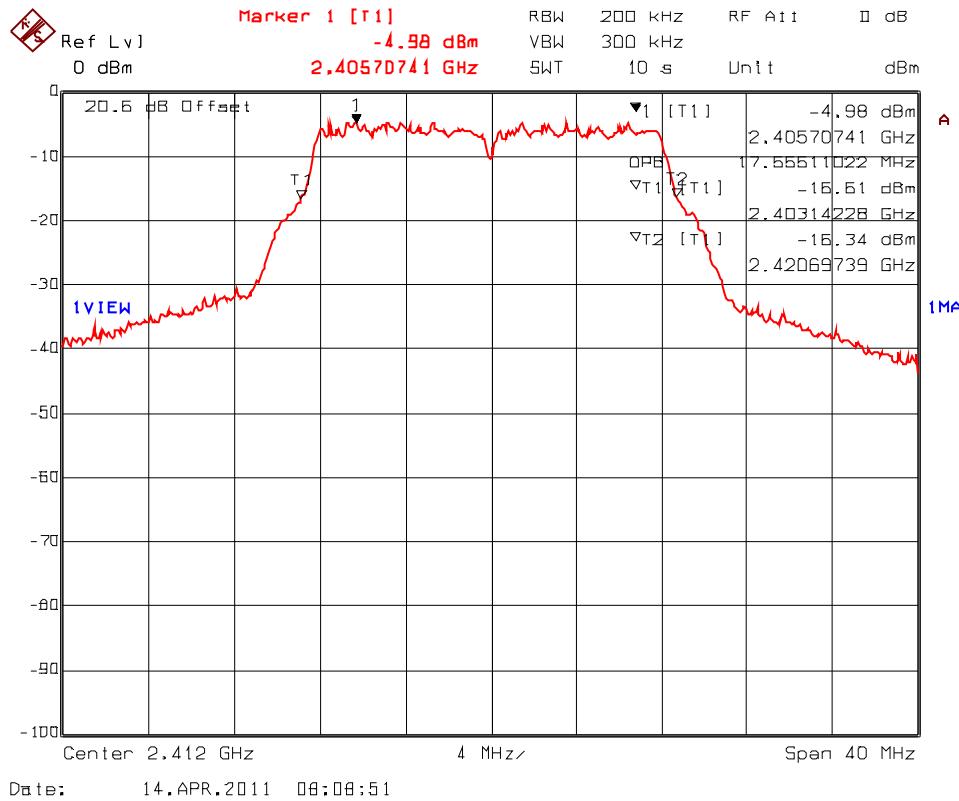
Plot 5.6.4.29. 99% Occupied Bandwidth, 802.11b, CCK 11 Mbps
Test Frequency: 2437 MHz



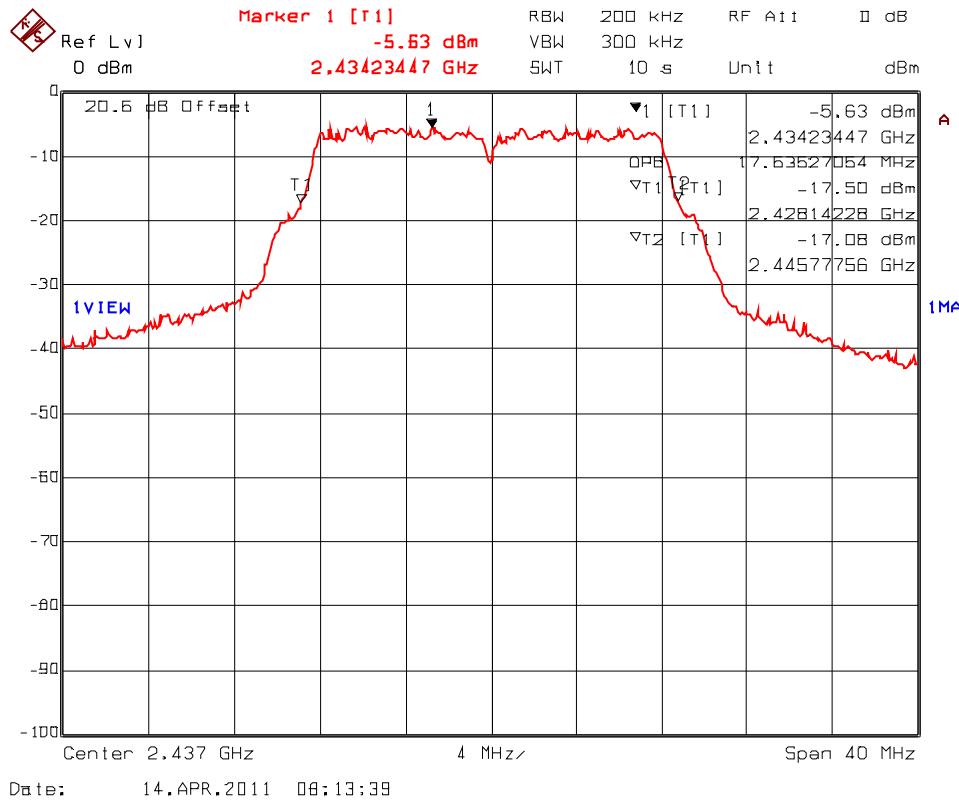
Plot 5.6.4.30. 99% Occupied Bandwidth, 802.11b, CCK 11 Mbps
Test Frequency: 2462 MHz



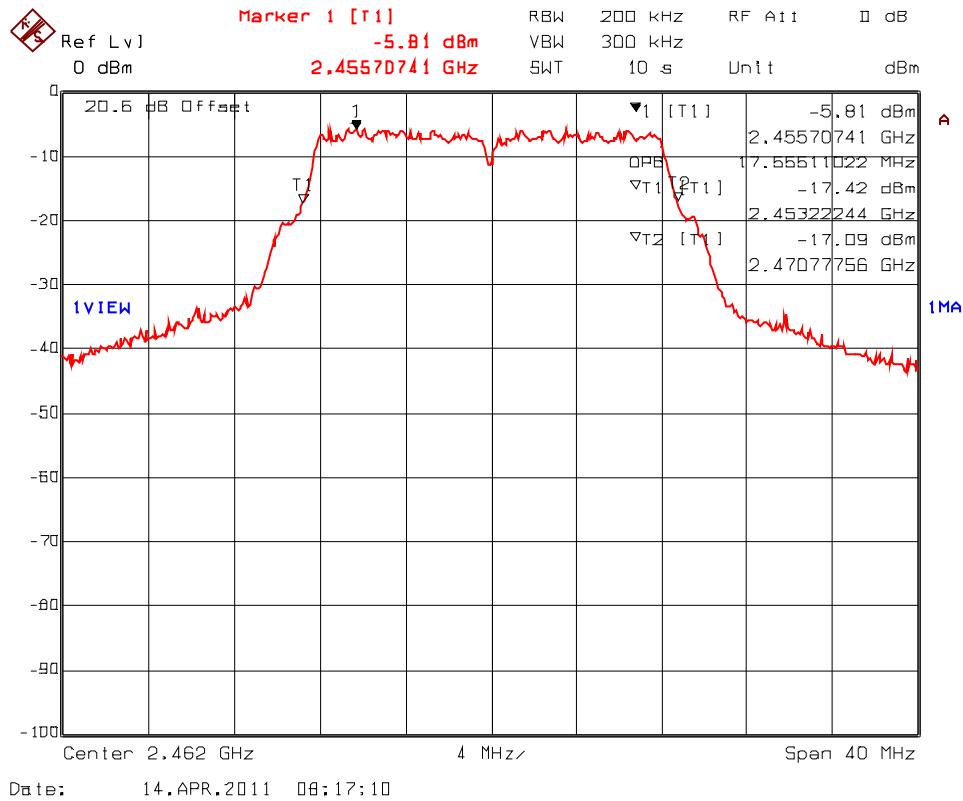
Plot 5.6.4.31. 99% Occupied Bandwidth, 802.11g, BPSK 9 Mbps
Test Frequency: 2412 MHz



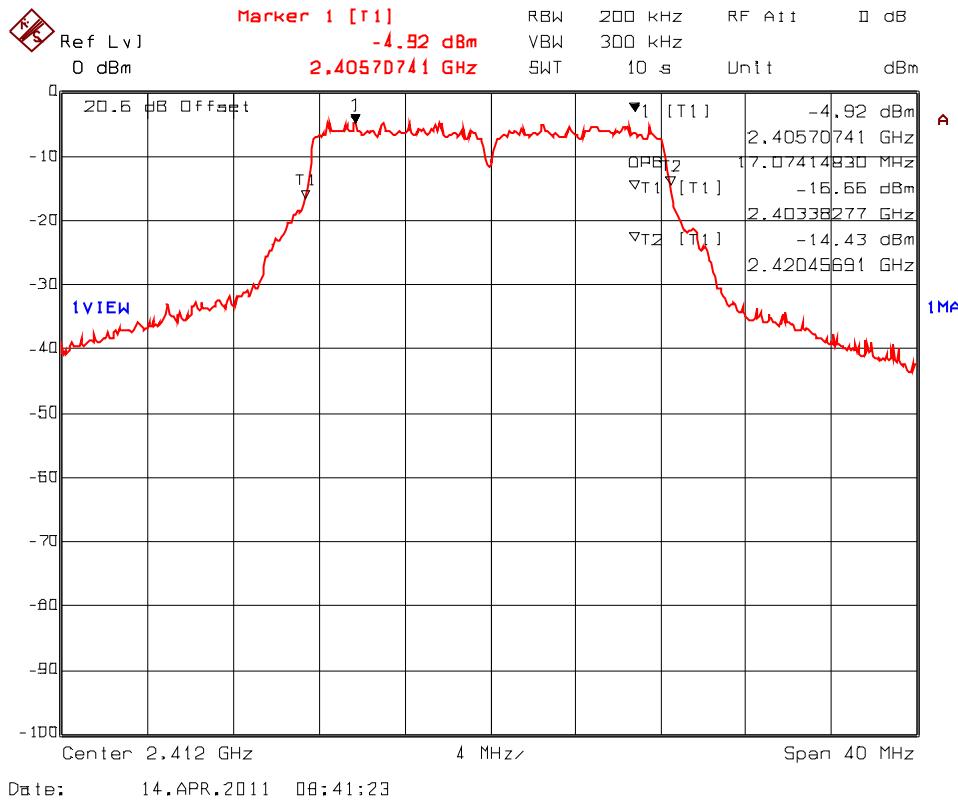
Plot 5.6.4.32. 99% Occupied Bandwidth, 802.11g, BPSK 9 Mbps
Test Frequency: 2437 MHz



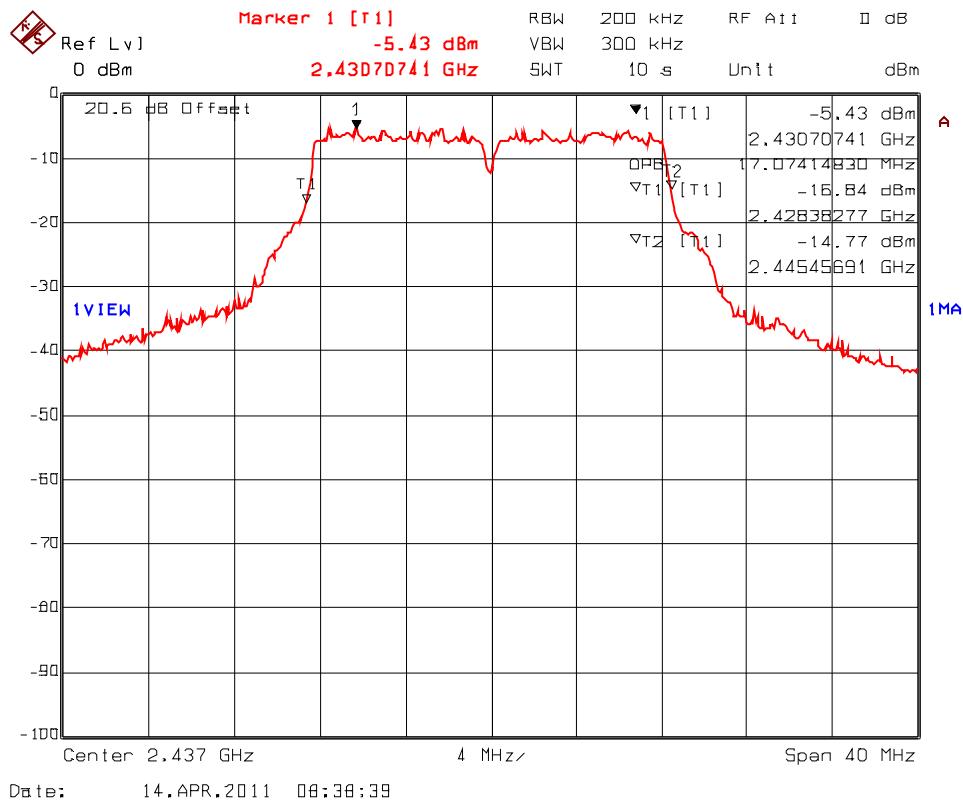
Plot 5.6.4.33. 99% Occupied Bandwidth, 802.11g, BPSK 9 Mbps
Test Frequency: 2462 MHz



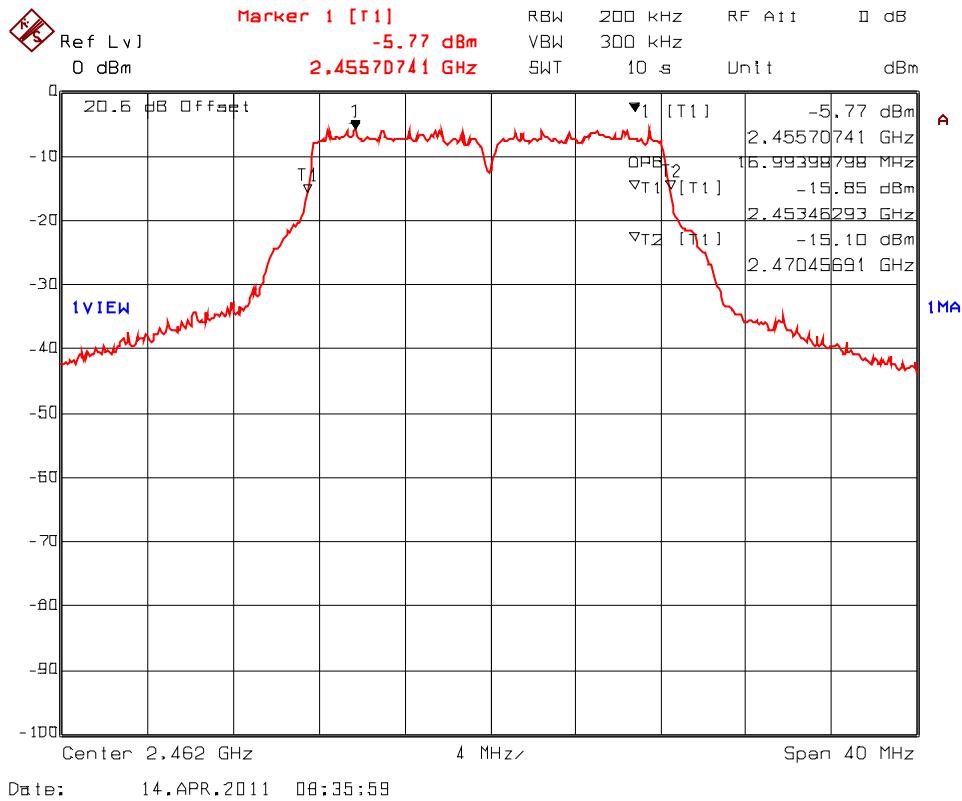
Plot 5.6.4.34. 99% Occupied Bandwidth, 802.11g, QPSK 18 Mbps
Test Frequency: 2412 MHz



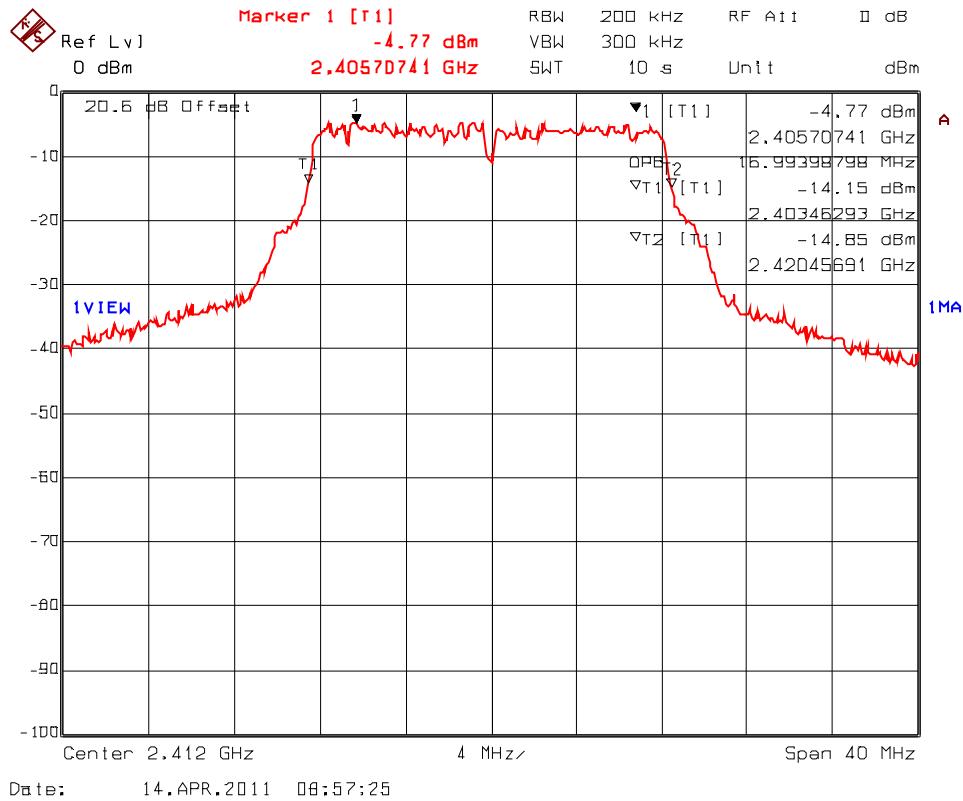
Plot 5.6.4.35. 99% Occupied Bandwidth, 802.11g, QPSK 18 Mbps
Test Frequency: 2437 MHz



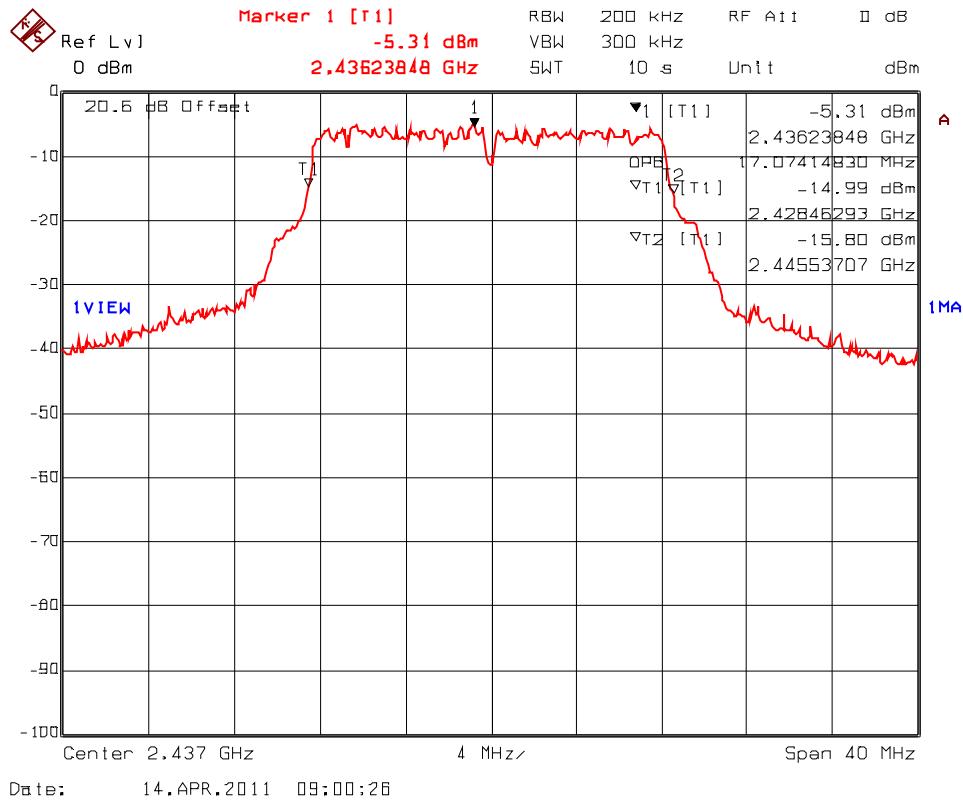
Plot 5.6.4.36. 99% Occupied Bandwidth, 802.11g, QPSK 18 Mbps
Test Frequency: 2462 MHz



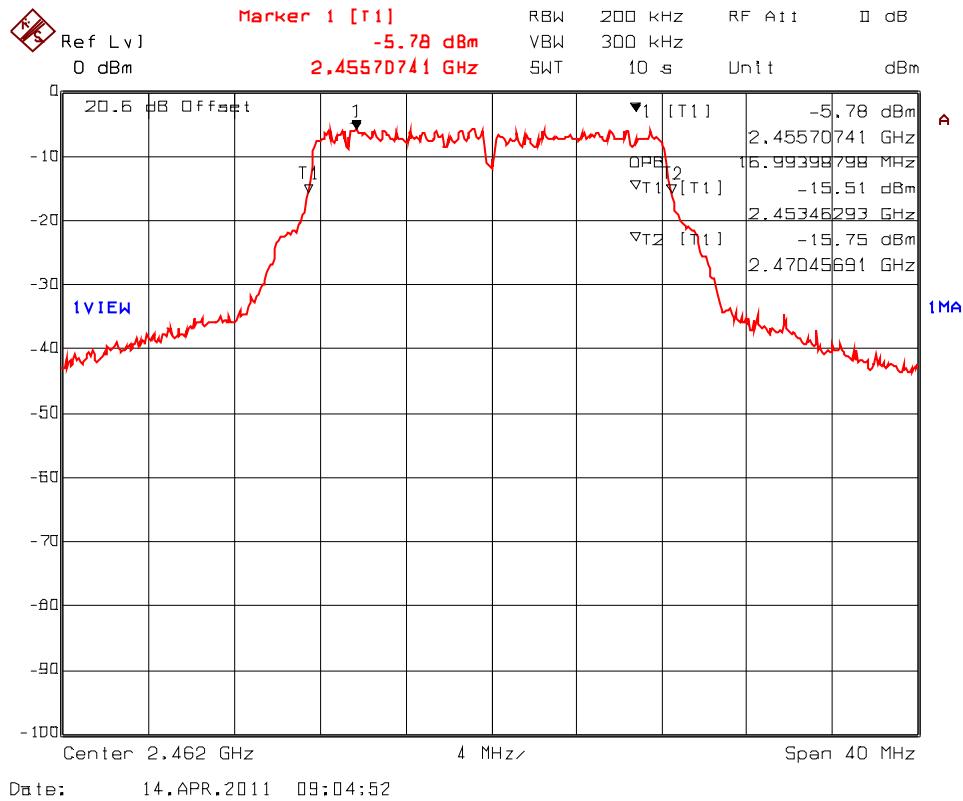
Plot 5.6.4.37. 99% Occupied Bandwidth, 802.11g, 16-QAM 36 Mbps
Test Frequency: 2412 MHz



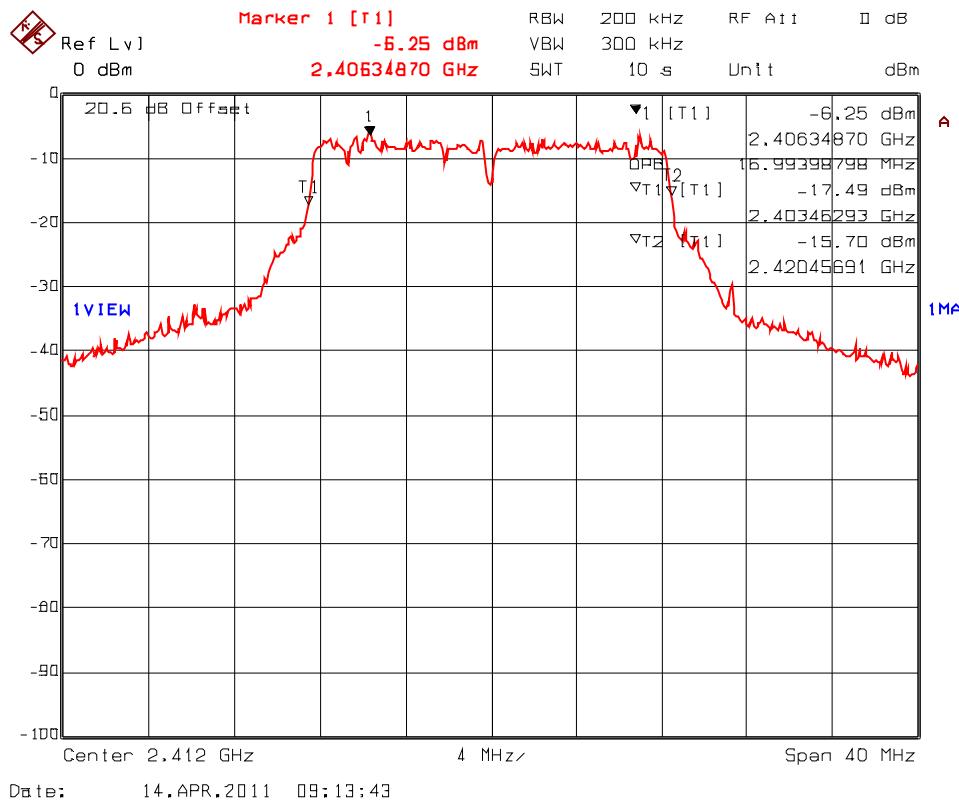
Plot 5.6.4.38. 99% Occupied Bandwidth, 802.11g, 16-QAM 36 Mbps
Test Frequency: 2437 MHz



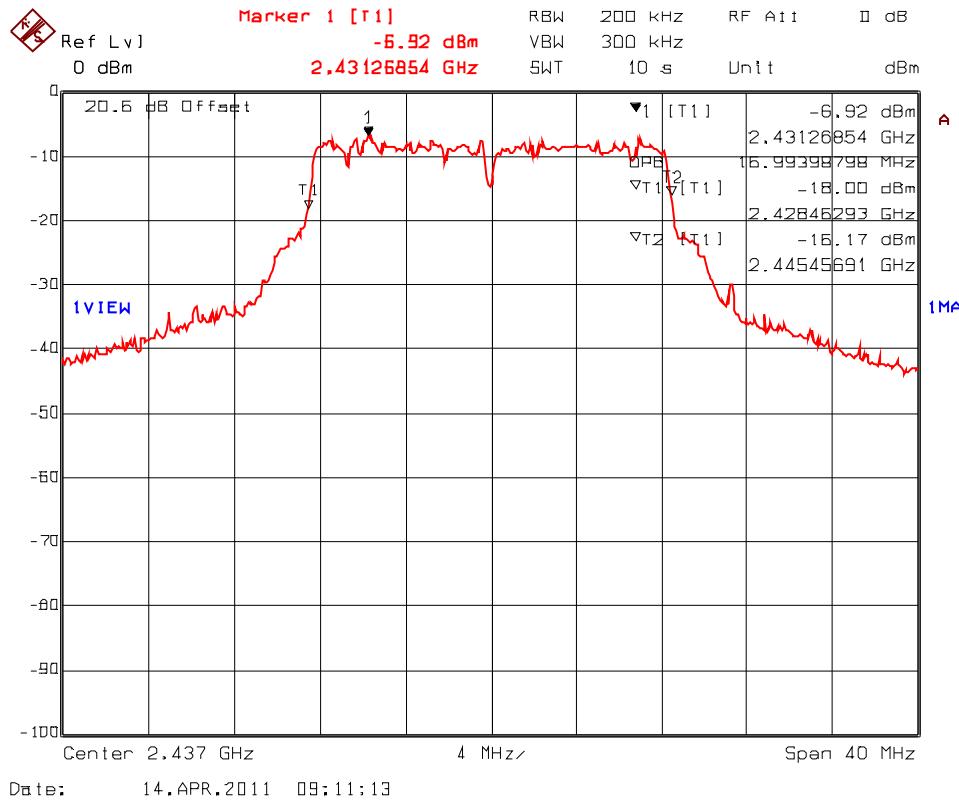
Plot 5.6.4.39. 99% Occupied Bandwidth, 802.11g, 16-QAM 36 Mbps
Test Frequency: 2462 MHz



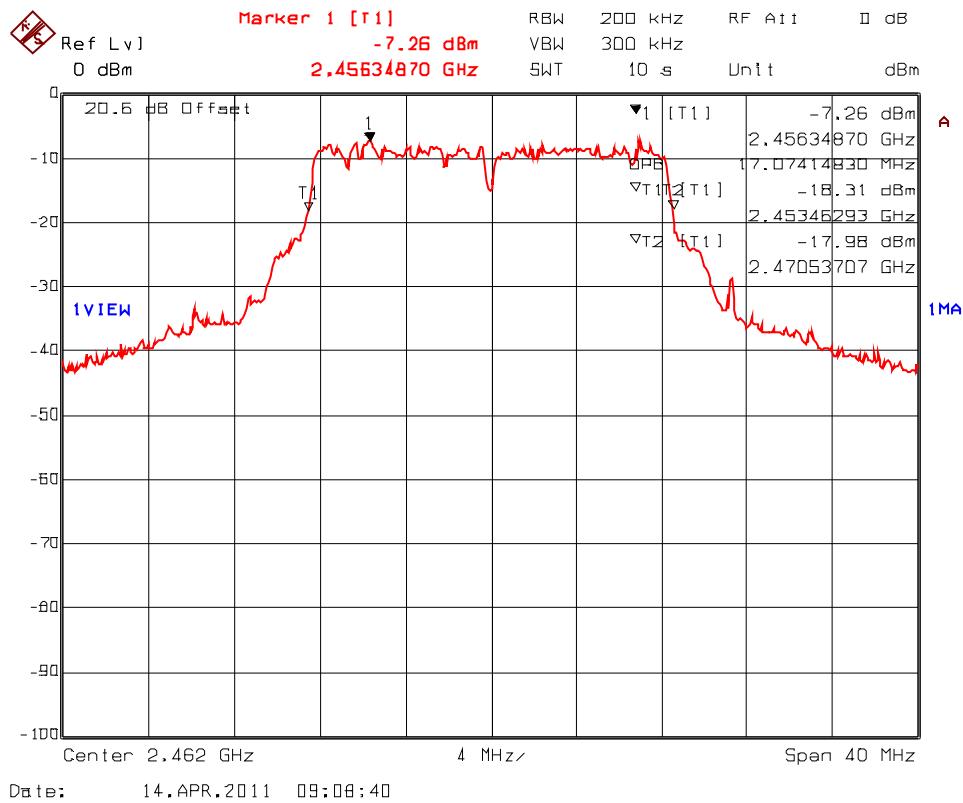
Plot 5.6.4.40. 99% Occupied Bandwidth, 802.11g, 64-QAM 54 Mbps
Test Frequency: 2412 MHz



Plot 5.6.4.41. 99% Occupied Bandwidth, 802.11g, 64-QAM 54 Mbps
Test Frequency: 2437 MHz



Plot 5.6.4.42. 99% Occupied Bandwidth, 802.11g, 64-QAM 54 Mbps
Test Frequency: 2462 MHz



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

5.7.1. Limit(s)

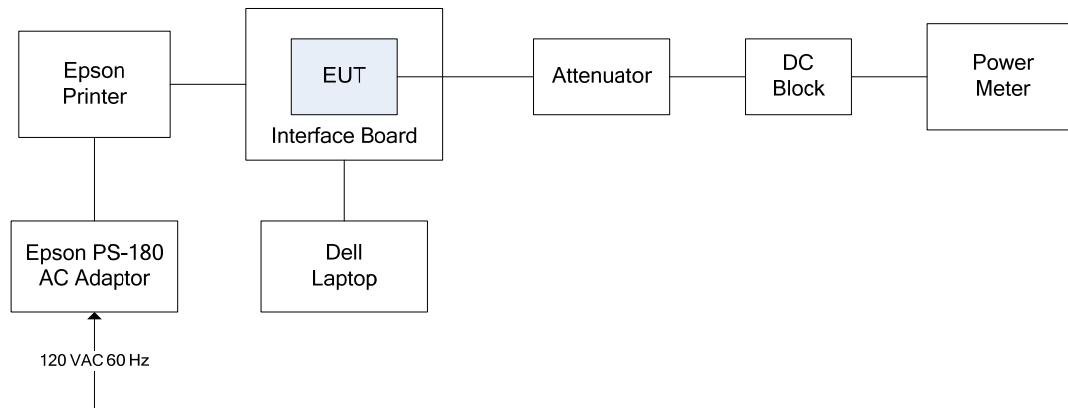
§ 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power 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.

5.7.2. Method of Measurements & Test Arrangement

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247).

5.7.3. Test Arrangement



5.7.4. Test Data

| Remark(s): Test method used: Power output option 1, peak measurement. | | | | | | |
|--|------------|------------------|----------------------------|--|----------------------------------|------------------|
| Frequency (MHz) | Modulation | Data Rate (Mbps) | Peak Conducted Power (dBm) | Peak EIRP ^(Note 1, 2) (dBm) | Peak Conducted Power Limit (dBm) | EIRP Limit (dBm) |
| 802.11b Mode | | | | | | |
| 2412 | DBPSK | 1 | 7.40 | 9.40 | 30 | 36 |
| | DQPSK | 2 | 7.99 | 9.99 | 30 | 36 |
| | CCK | 11 | 7.63 | 9.63 | 30 | 36 |
| 2437 | DBPSK | 1 | 7.32 | 9.32 | 30 | 36 |
| | DQPSK | 2 | 7.85 | 9.85 | 30 | 36 |
| | CCK | 11 | 7.63 | 9.63 | 30 | 36 |
| 2462 | DBPSK | 1 | 7.08 | 9.08 | 30 | 36 |
| | DQPSK | 2 | 7.71 | 9.71 | 30 | 36 |
| | CCK | 11 | 7.40 | 9.40 | 30 | 36 |
| 802.11g Mode | | | | | | |
| 2412 | BPSK | 9 | 13.42 | 15.42 | 30 | 36 |
| | QPSK | 18 | 12.28 | 14.04 | 30 | 36 |
| | 16-QAM | 36 | 12.43 | 14.04 | 30 | 36 |
| | 64-QAM | 54 | 12.99 | 14.81 | 30 | 36 |
| 2437 | BPSK | 9 | 13.03 | 15.03 | 30 | 36 |
| | QPSK | 18 | 12.04 | 14.04 | 30 | 36 |
| | 16-QAM | 36 | 12.04 | 14.04 | 30 | 36 |
| | 64-QAM | 54 | 12.81 | 14.81 | 30 | 36 |
| 2462 | BPSK | 9 | 12.70 | 14.70 | 30 | 36 |
| | QPSK | 18 | 11.61 | 13.61 | 30 | 36 |
| | 16-QAM | 36 | 11.64 | 13.64 | 30 | 36 |
| | 64-QAM | 54 | 12.43 | 14.43 | 30 | 36 |

Note 1: The Peak EIRP is calculated as the sum of Peak Conducted Power in dBm and antenna assembly gain of EUT in dBi (antenna gain – cable loss).

Note 2: The maximum assembly antenna gain: 2 dBi

5.8. TRANSMITTER BAND-EDGE & SPURIOUS CONDUCTED EMISSIONS [§ 15.247(d)]

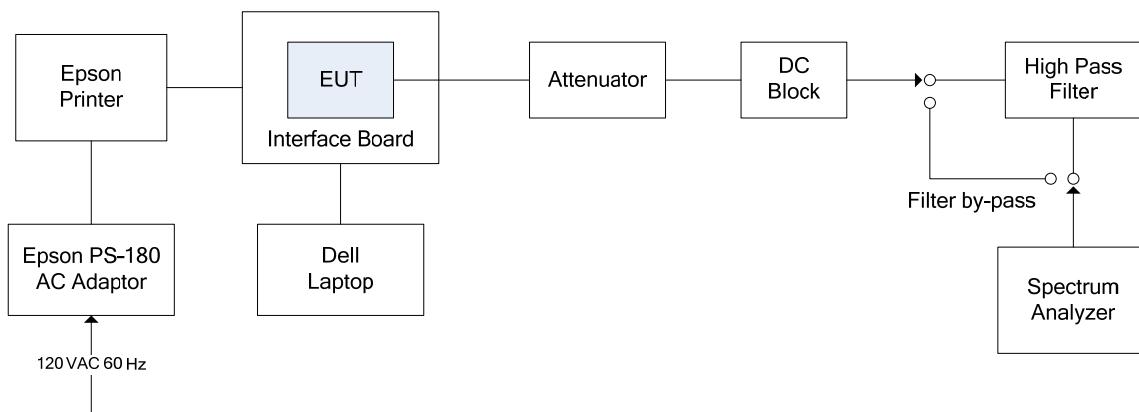
5.8.1. Limit(s)

§ 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.

5.8.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247).

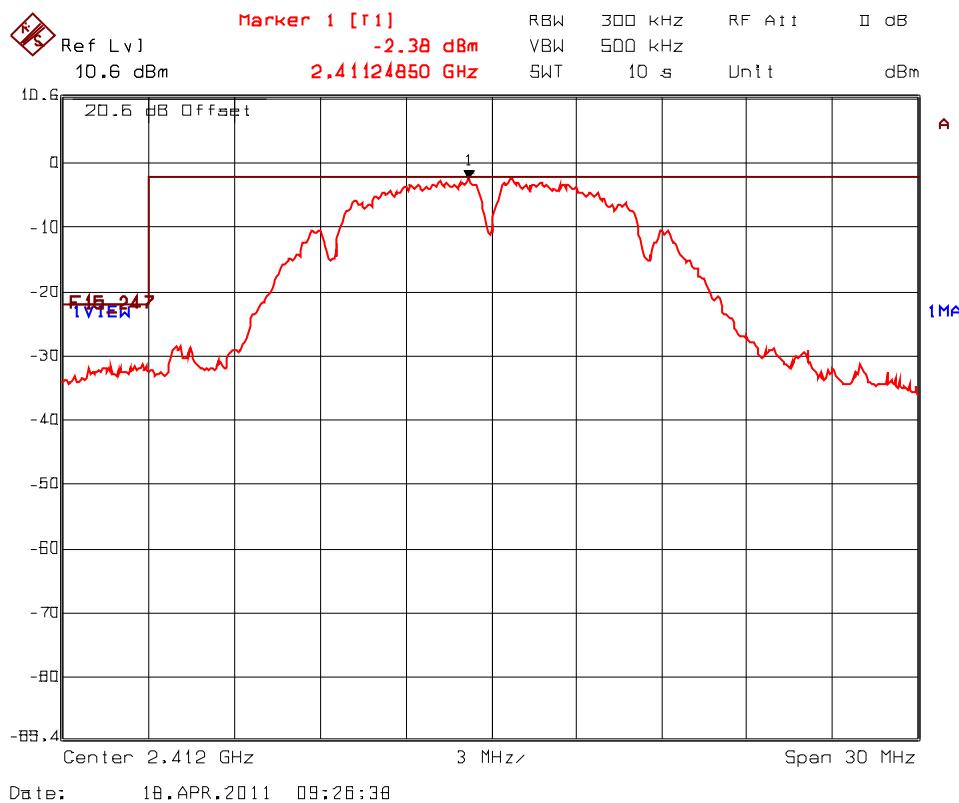
5.8.3. Test Arrangement



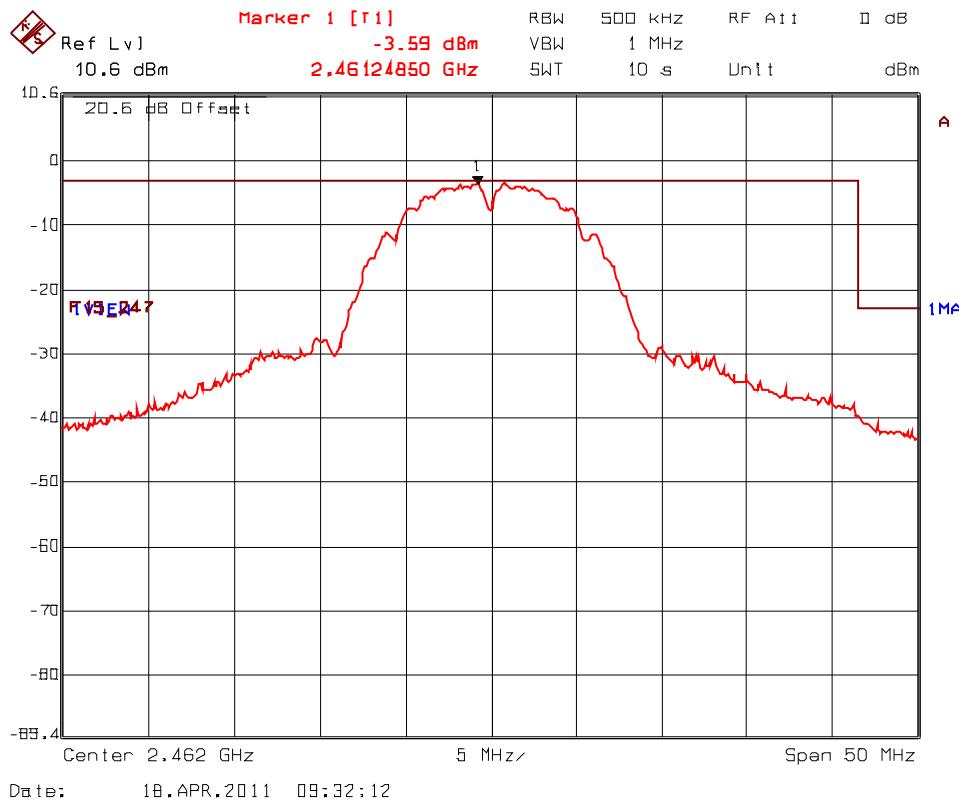
5.8.4. Test Data

5.8.4.1. Band-Edge RF Conducted Emissions

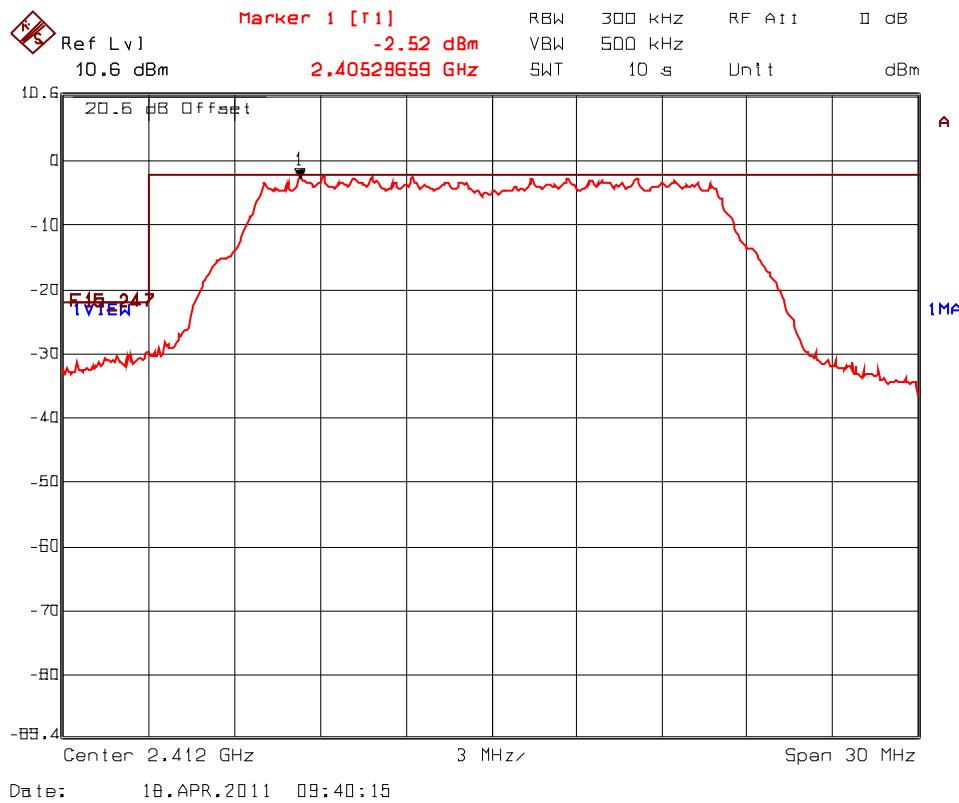
**Plot 5.8.4.1.1. Band-Edge RF Conducted Emissions, 802.11b, CCK 11 Mbps
Low End of Frequency Band (2412 MHz)**



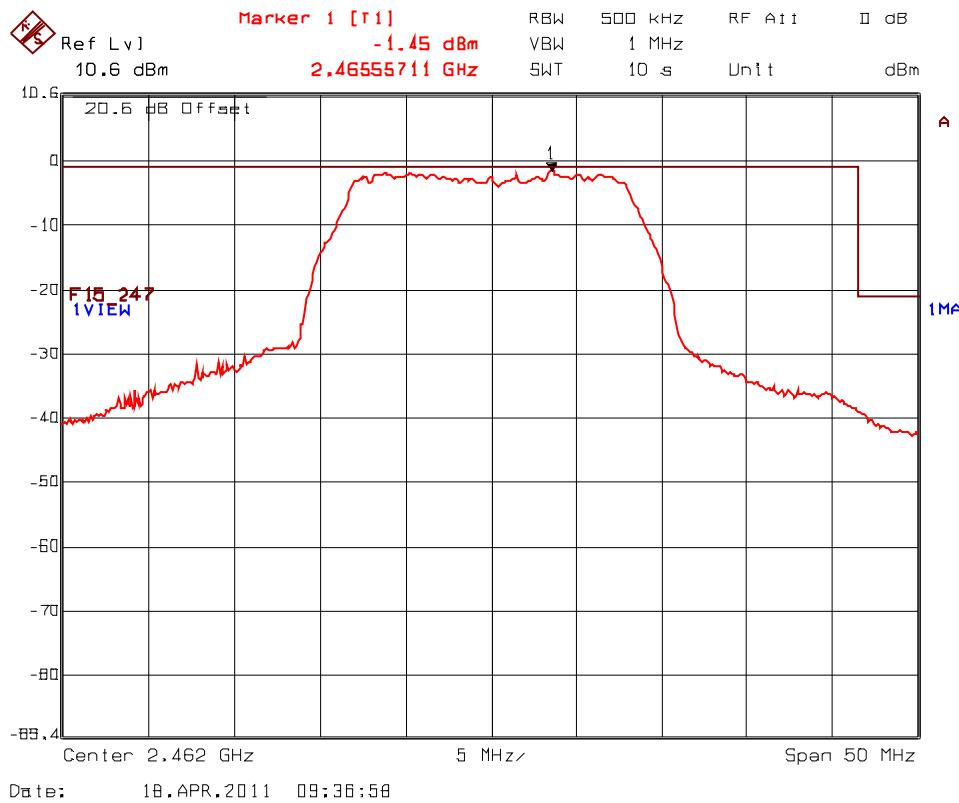
**Plot 5.8.4.1.2. Band-Edge RF Conducted Emissions, 802.11b, CCK 11 Mbps
High End of Frequency Band (2462 MHz)**



**Plot 5.8.4.1.3. Band-Edge RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps
Low End of Frequency Band (2412 MHz)**

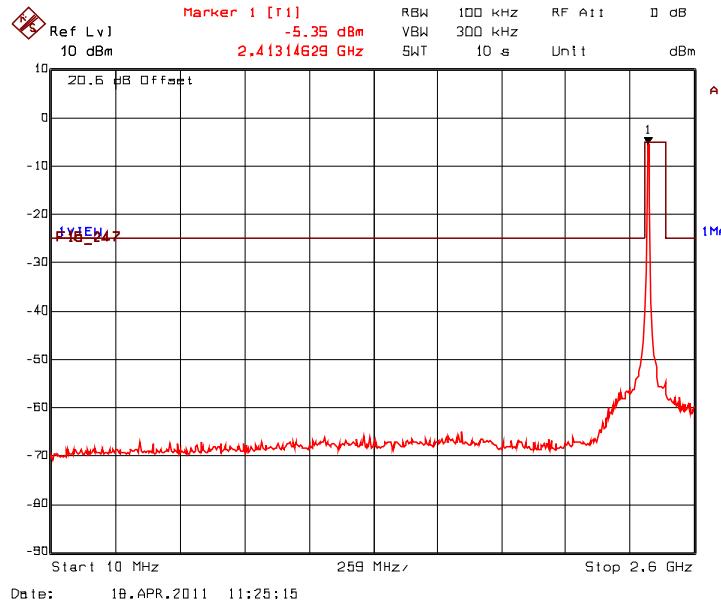


**Plot 5.8.4.1.4. Band-Edge RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps
High End of Frequency Band (2462 MHz)**

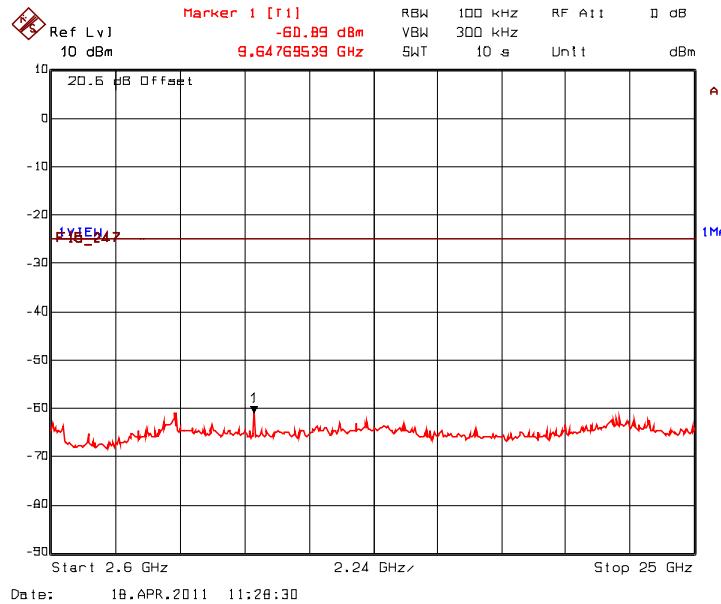


5.8.4.2. Spurious RF Conducted Emissions

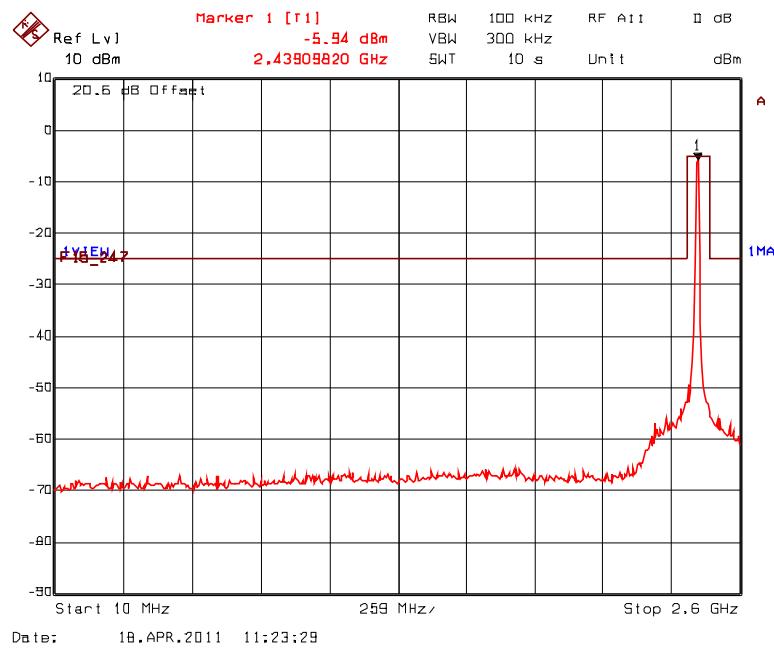
Plot 5.8.4.2.1. Spurious RF Conducted Emissions, 802.11b, CCK 11 Mbps, 10 MHz - 2.6 GHz
Transmitter Frequency: 2412 MHz



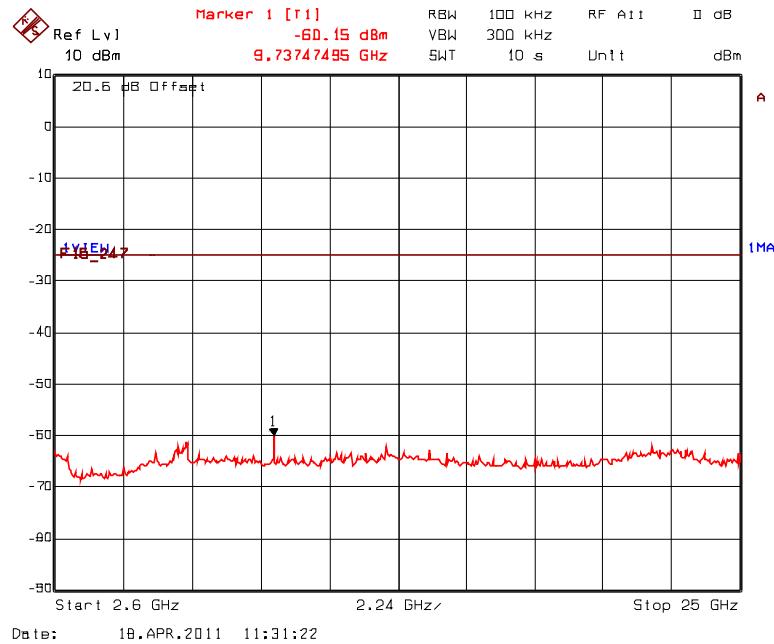
Plot 5.8.4.2.2. Spurious RF Conducted Emissions, 802.11b, CCK 11 Mbps, 2.6 GHz - 25 GHz
Transmitter Frequency: 2412 MHz



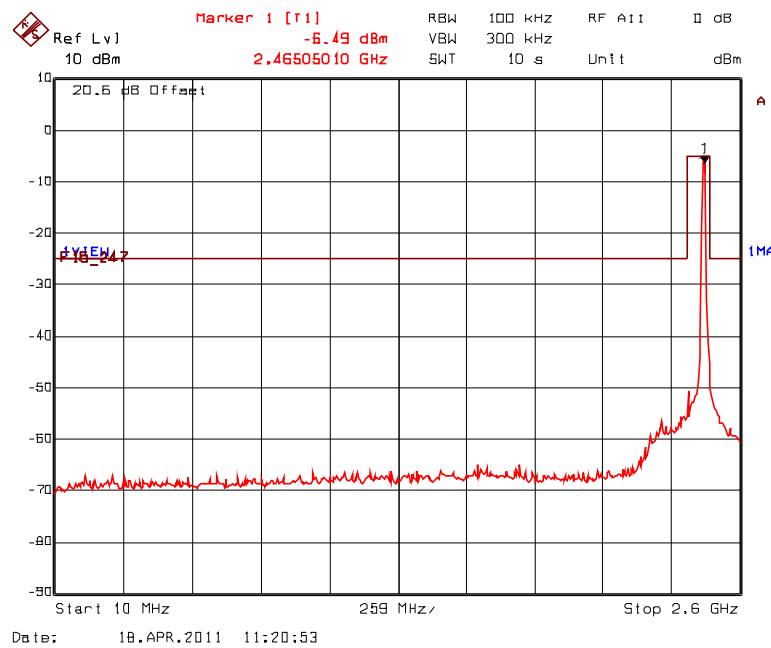
Plot 5.8.4.2.3. Spurious RF Conducted Emissions, 802.11b, CCK 11 Mbps, 10 MHz - 2.6 GHz
Transmitter Frequency: 2437 MHz



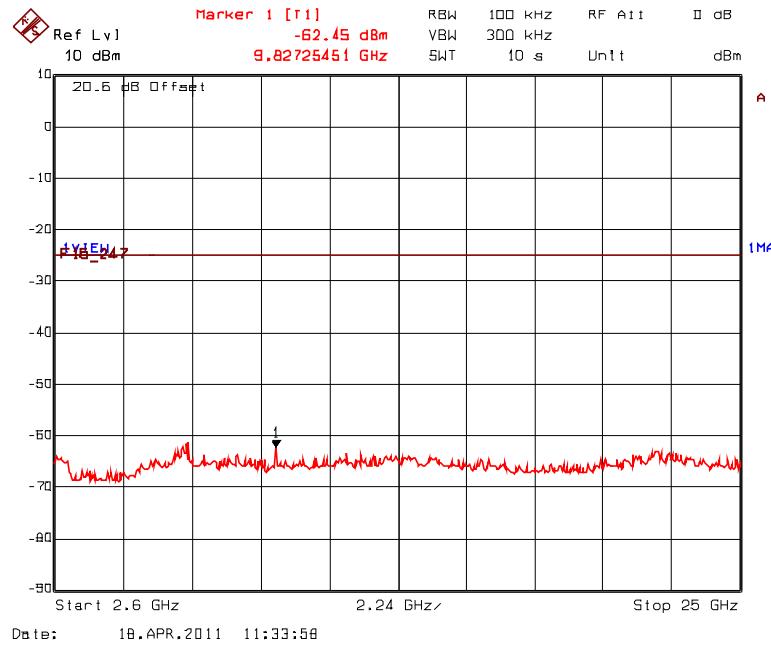
Plot 5.8.4.2.4. Spurious RF Conducted Emissions, 802.11b, CCK 11 Mbps, 2.6 GHz - 25 GHz
Transmitter Frequency: 2437 MHz



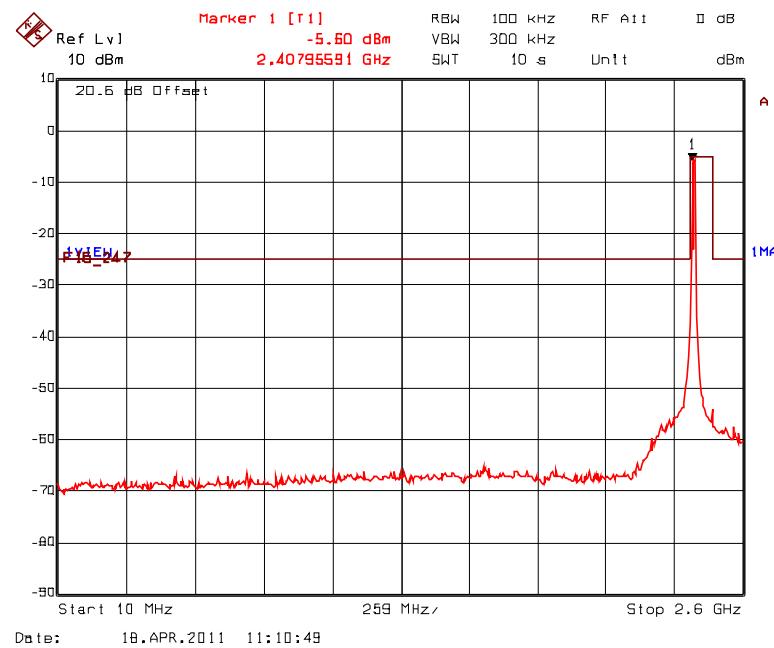
**Plot 5.8.4.2.5. Spurious RF Conducted Emissions, 802.11b, CCK 11 Mbps, 10 MHz - 2.6 GHz
Transmitter Frequency: 2462 MHz**



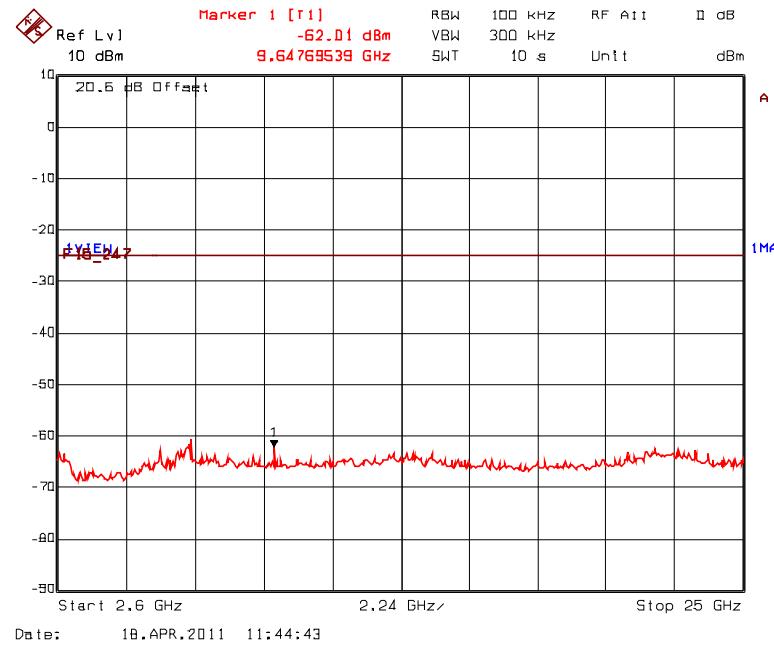
**Plot 5.8.4.2.6. Spurious RF Conducted Emissions, 802.11b, CCK 11 Mbps, 2.6 GHz - 25 GHz
Transmitter Frequency: 2462 MHz**



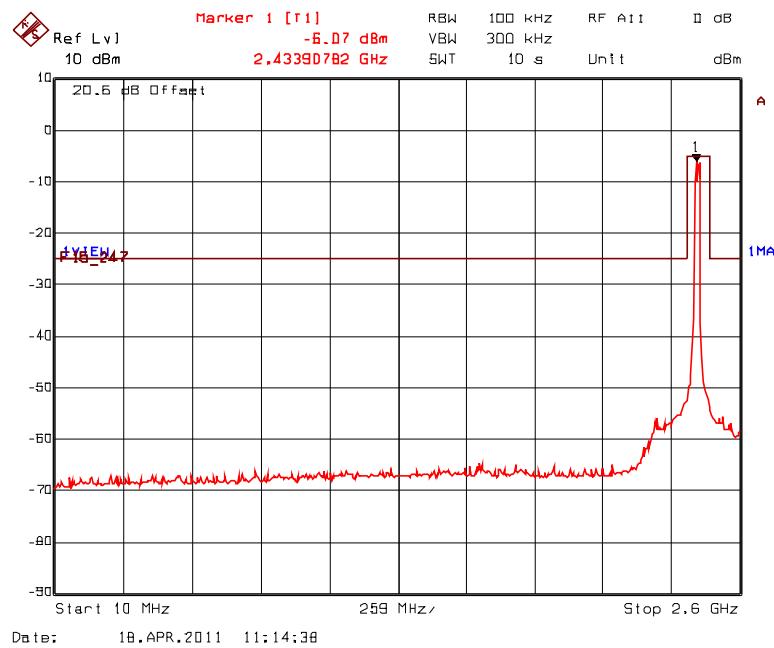
**Plot 5.8.4.2.7. Spurious RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps, 10 MHz - 2.6 GHz
Transmitter Frequency: 2412 MHz**



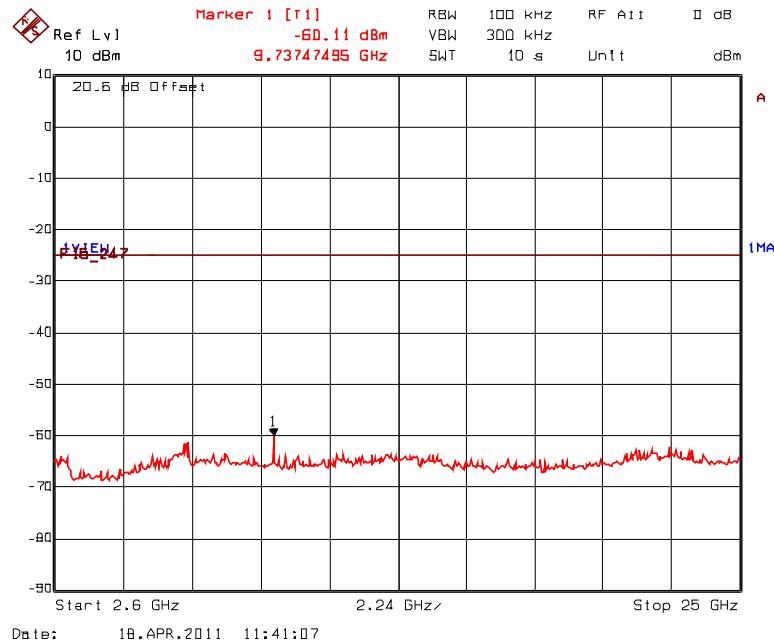
**Plot 5.8.4.2.8. Spurious RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps, 2.6 GHz - 25 GHz
Transmitter Frequency: 2412 MHz**



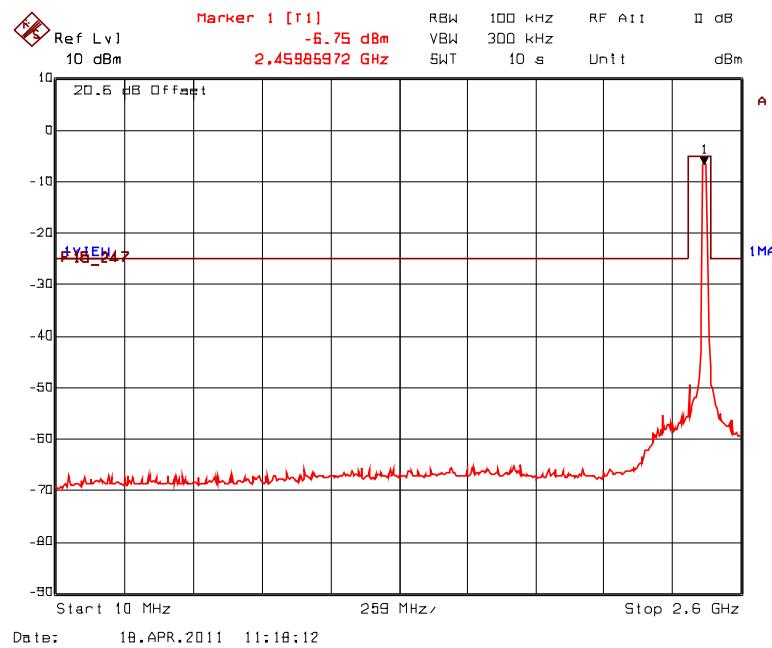
Plot 5.8.4.2.9. Spurious RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps, 10 MHz - 2.6 GHz
Transmitter Frequency: 2437 MHz



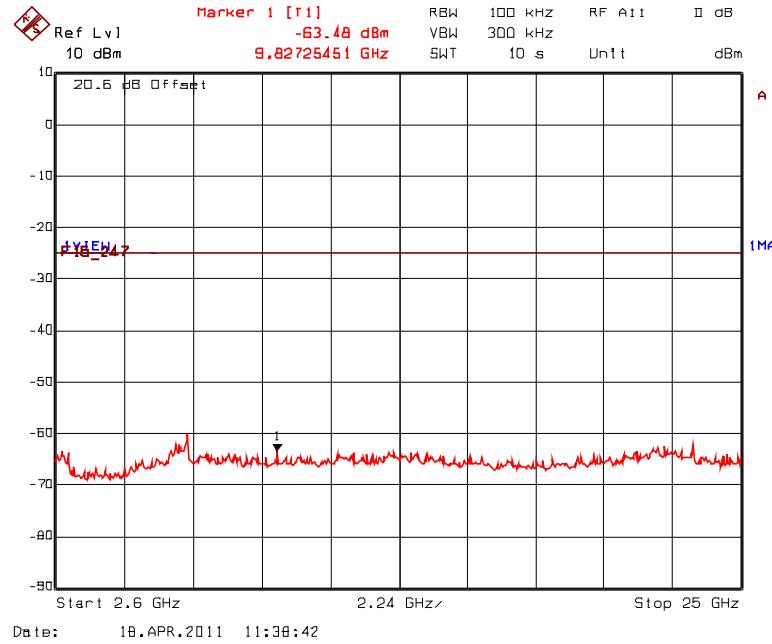
Plot 5.8.4.2.10. Spurious RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps, 2.6 GHz - 25 GHz
Transmitter Frequency: 2437 MHz



Plot 5.8.4.2.11. Spurious RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps, 10 MHz - 2.6 GHz
Transmitter Frequency: 2462 MHz



Plot 5.8.4.2.12. Spurious RF Conducted Emissions, 802.11g, 64-QAM 54 Mbps, 2.6 GHz - 25 GHz
Transmitter Frequency: 2462 MHz



5.9. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.9.1. 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 |
| 1.495–0.505 | 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

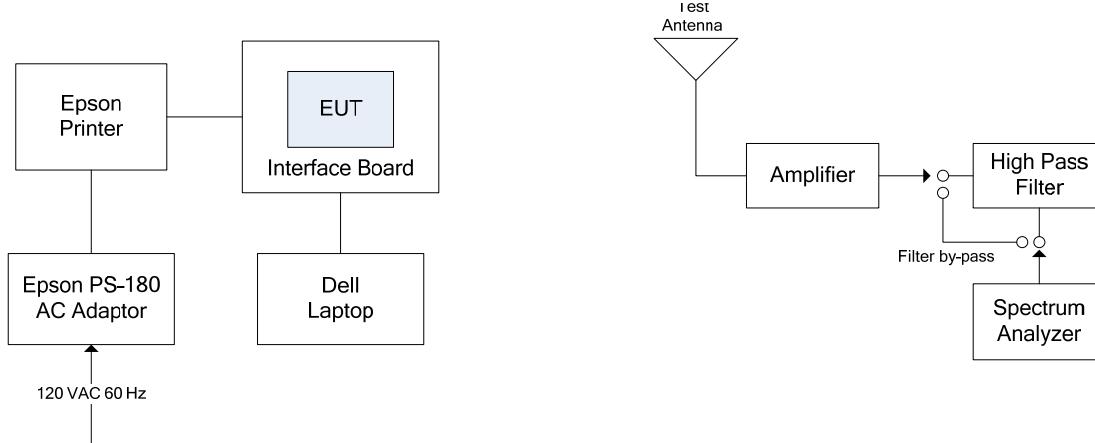
Section 15.209(a) -- Field Strength Limits within Restricted Frequency Bands --

| 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 |

5.9.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247) and ANSI C63.4-2003.

5.9.3. Test Arrangement



5.9.4. Test Data

Remarks:

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- The following test results are the worst-case measurements, with the EUT set to 802.11g mode at 64-QAM 54 Mbps

| Fundamental Frequency: 2412 MHz Test Frequency Range: 30 MHz – 25 GHz | | | | | | | |
|--|------------------------------|-----------------------------|---------------------|-----------------------------|-----------------------------|-------------|-----------|
| Frequency (MHz) | RF Peak Level (dB μ V/m) | RF Avg Level (dB μ V/m) | Antenna Plane (H/V) | Limit 15.209 (dB μ V/m) | Limit 15.247 (dB μ V/m) | Margin (dB) | Pass/Fail |
| 2412 | 100.48 | -- | V | -- | -- | -- | -- |
| 2412 | 100.63 | -- | H | -- | -- | -- | -- |
| 4824 | 54.53 | 49.77 | V | 54.0 | 80.6 | -4.2 | Pass* |
| 4824 | 54.99 | 52.05 | H | 54.0 | 80.6 | -2.0 | Pass* |

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

| Fundamental Frequency: 2437 MHz Test Frequency Range: 30 MHz – 25 GHz | | | | | | | |
|--|------------------------------|-----------------------------|---------------------|-----------------------------|-----------------------------|-------------|-----------|
| Frequency (MHz) | RF Peak Level (dB μ V/m) | RF Avg Level (dB μ V/m) | Antenna Plane (H/V) | Limit 15.209 (dB μ V/m) | Limit 15.247 (dB μ V/m) | Margin (dB) | Pass/Fail |
| 2437 | 99.45 | -- | V | -- | -- | -- | -- |
| 2437 | 99.85 | -- | H | -- | -- | -- | -- |
| 4874 | 53.74 | 49.49 | V | 54.00 | 79.9 | -4.51 | Pass* |
| 4874 | 55.65 | 52.61 | H | 54.00 | 79.9 | -1.39 | Pass* |

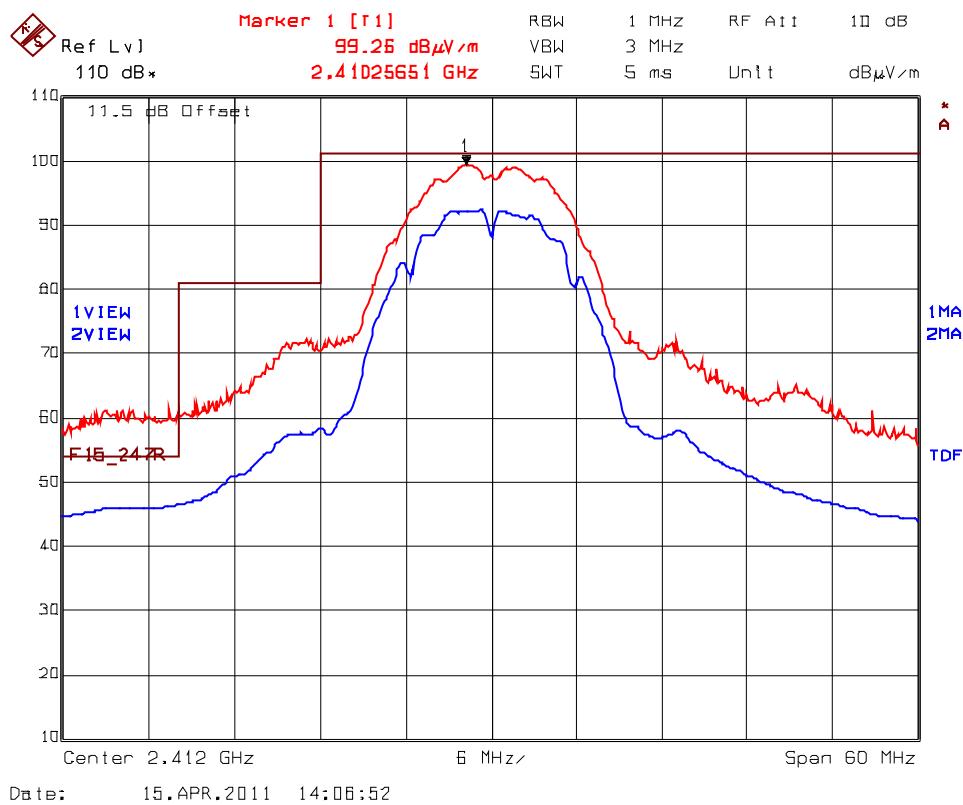
*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

| Fundamental Frequency: 2462 MHz Test Frequency Range: 30 MHz – 25 GHz | | | | | | | |
|--|------------------------------|-----------------------------|---------------------|-----------------------------|-----------------------------|-------------|-----------|
| Frequency (MHz) | RF Peak Level (dB μ V/m) | RF Avg Level (dB μ V/m) | Antenna Plane (H/V) | Limit 15.209 (dB μ V/m) | Limit 15.247 (dB μ V/m) | Margin (dB) | Pass/Fail |
| 2462 | 99.39 | -- | V | -- | -- | -- | -- |
| 2462 | 99.26 | -- | H | -- | -- | -- | -- |
| 4924 | 54.82 | 49.67 | V | 54.0 | 79.4 | -4.3 | Pass* |
| 4924 | 55.30 | 52.85 | H | 54.0 | 79.4 | -1.2 | Pass* |

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

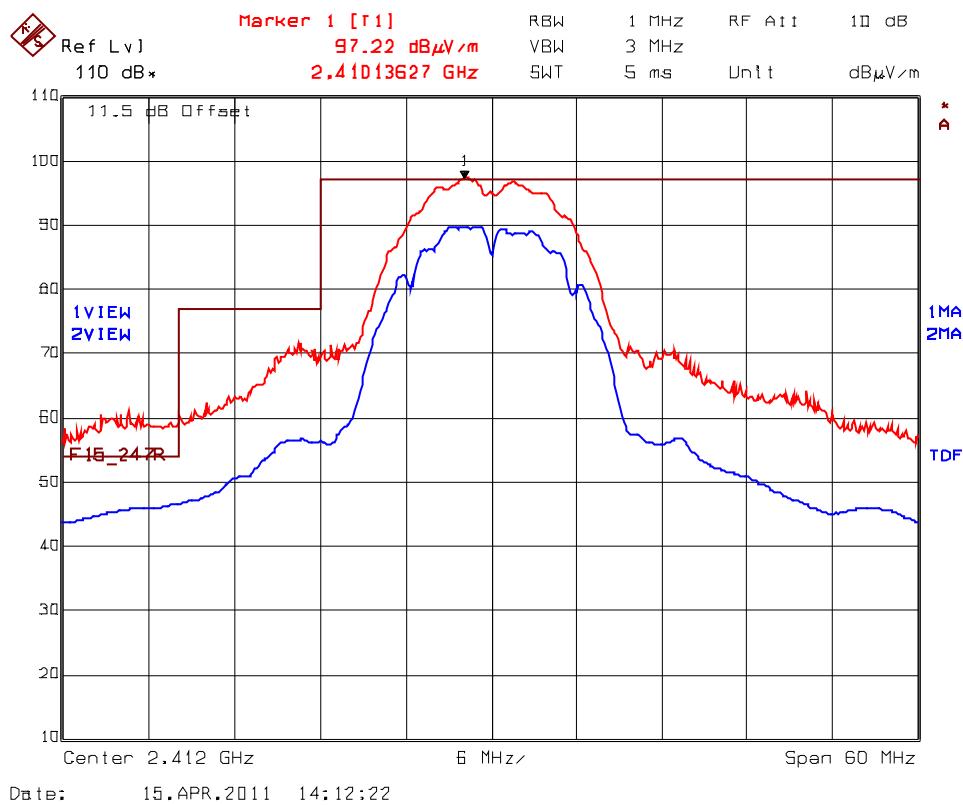
See the following test data plots for band-edge emissions.

Plot 5.9.4.1. Band-Edge RF Radiated Emissions @ 3 m, 802.11b CCK 11 Mbps
Low End of Frequency Band (2412 MHz)
Rx Antenna Orientation: Horizontal

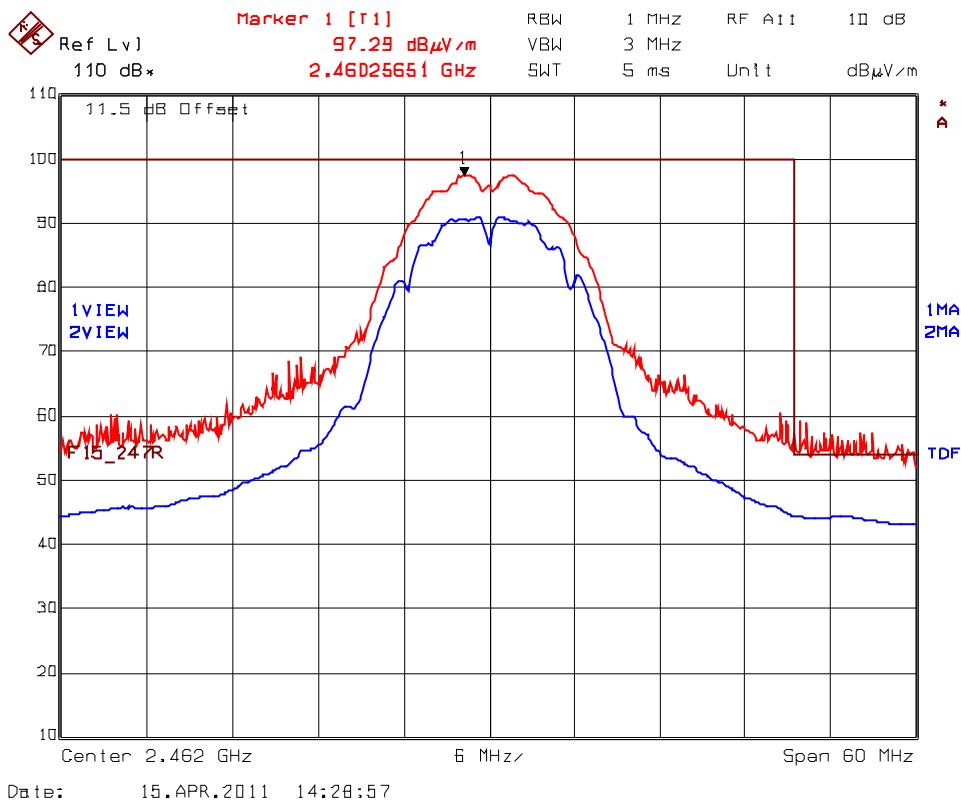


Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

**Plot 5.9.4.2. Band-Edge RF Radiated Emissions @ 3 m, 802.11b CCK 11 Mbps
Low End of Frequency Band, 2412 MHz
Rx Antenna Orientation: Vertical**

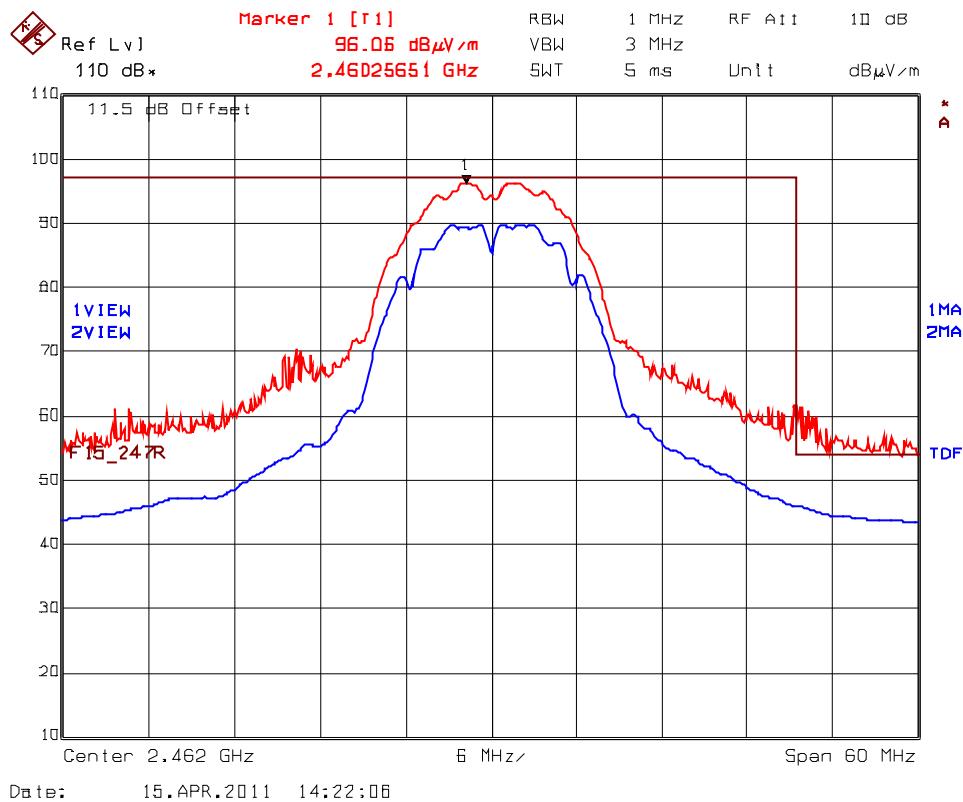


Plot 5.9.4.3. Band-Edge RF Radiated Emissions @ 3 m, 802.11b CCK 11 Mbps
Low End of Frequency Band (2462 MHz)
Rx Antenna Orientation: Horizontal



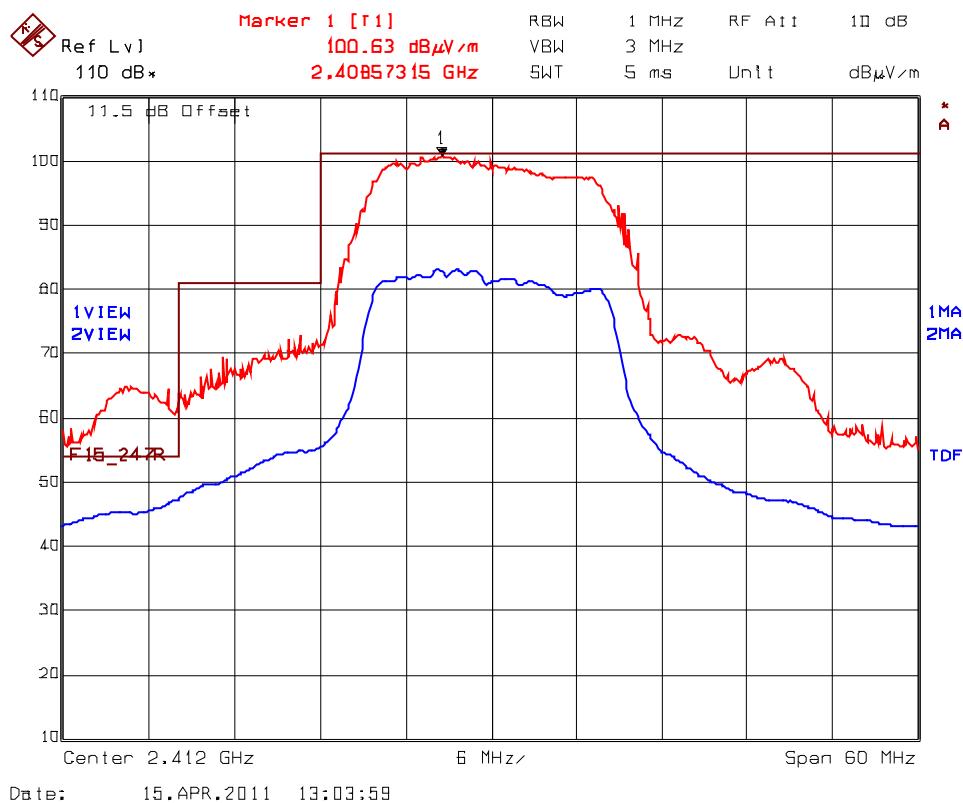
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.9.4.4. Band-Edge RF Radiated Emissions @ 3 m, 802.11b CCK 11 Mbps
Low End of Frequency Band (2462 MHz)
Rx Antenna Orientation: Vertical



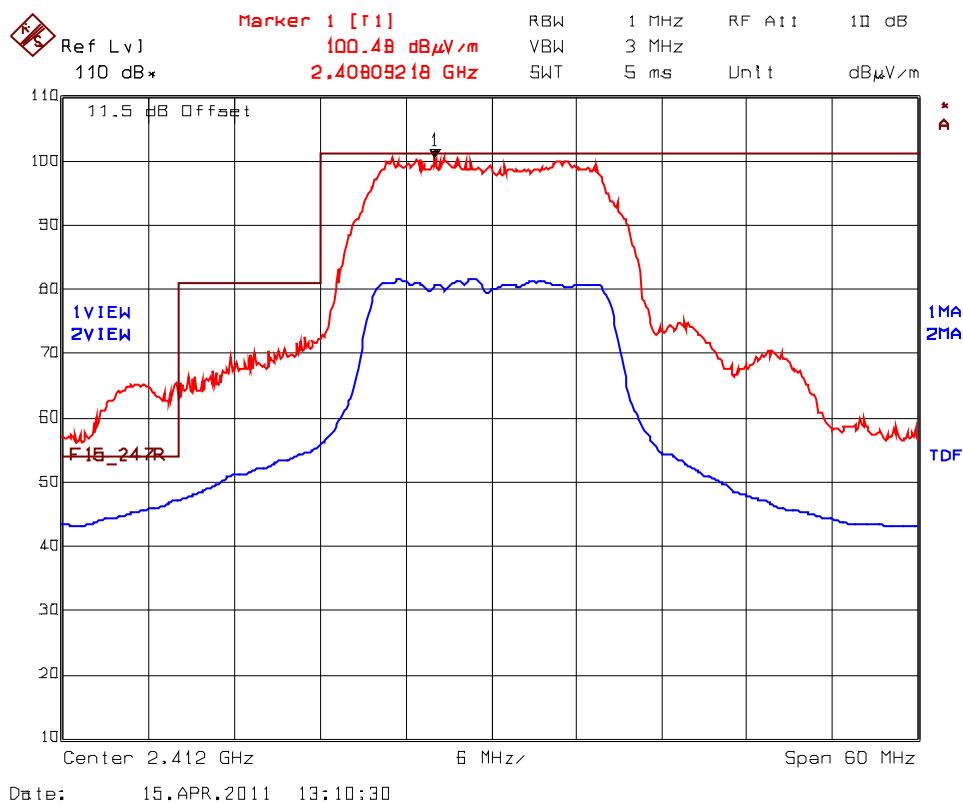
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.9.4.5. Band-Edge RF Radiated Emissions @ 3 m, 802.11g 64-QAM 54 Mbps
Low End of Frequency Band (2412 MHz)
Rx Antenna Orientation: Horizontal



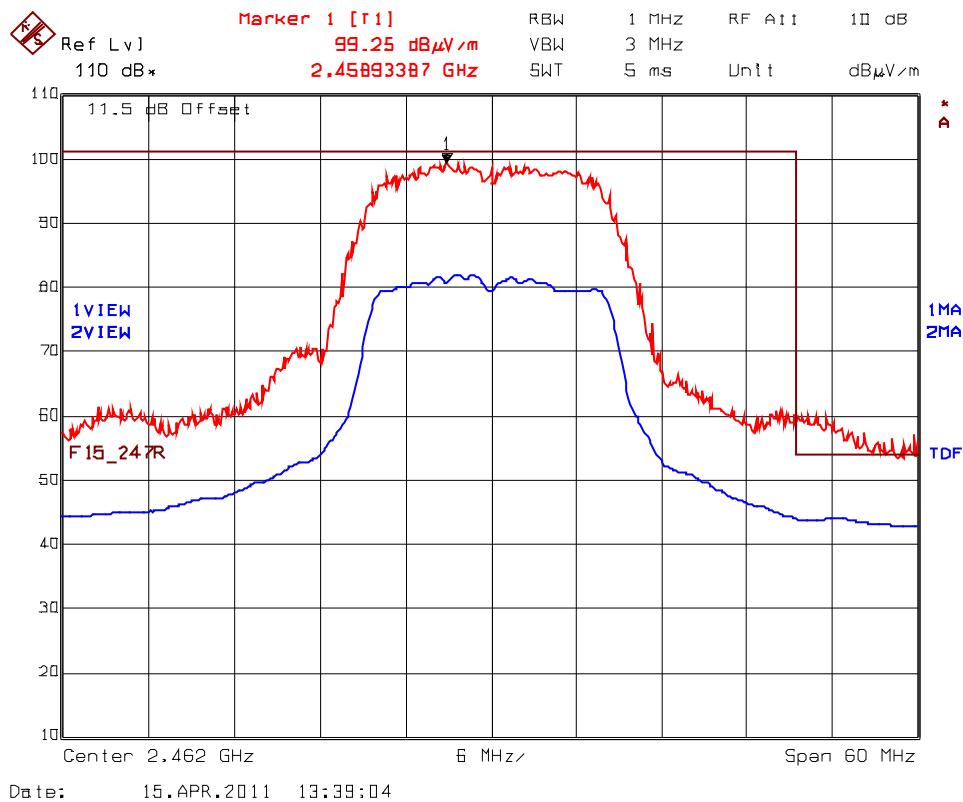
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.9.4.6. Band-Edge RF Radiated Emissions @ 3 m, 802.11g 64-QAM 54 Mbps
Low End of Frequency Band, 2412 MHz
Rx Antenna Orientation: Vertical



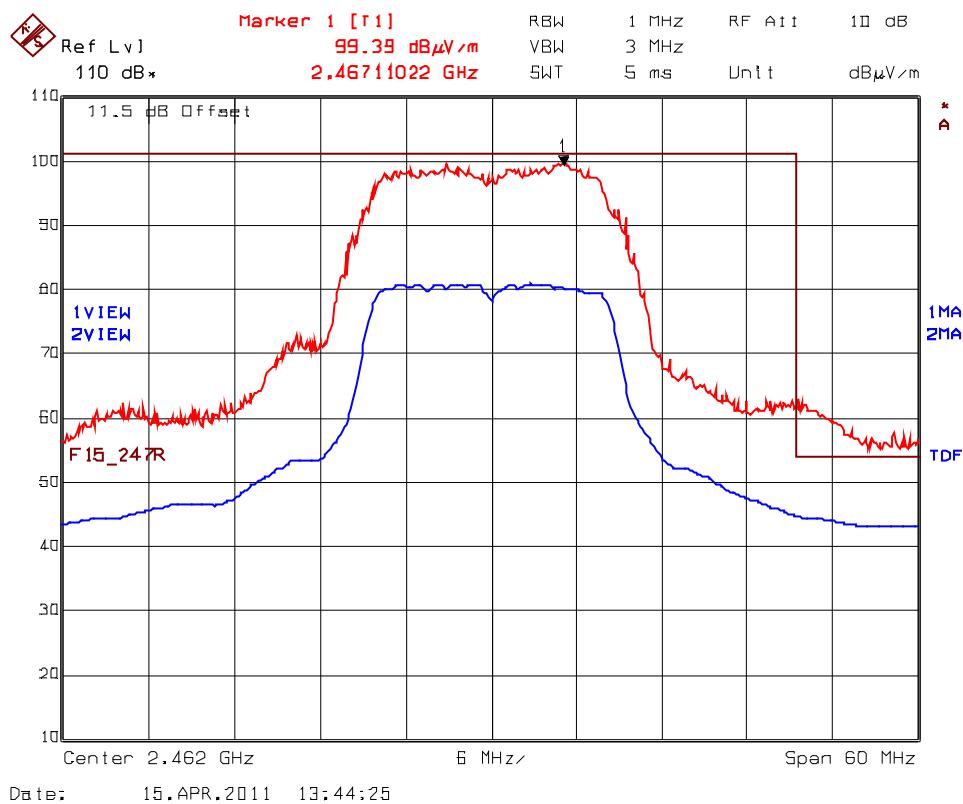
Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.9.4.7. Band-Edge RF Radiated Emissions @ 3 m, 802.11g 64-QAM 54 Mbps
Low End of Frequency Band (2462 MHz)
Rx Antenna Orientation: Horizontal



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

Plot 5.9.4.8. Band-Edge RF Radiated Emissions @ 3 m, 802.11g 64-QAM 54 Mbps
Low End of Frequency Band (2462 MHz)
Rx Antenna Orientation: Vertical



Trace 1: RBW = 1 MHz, VBW = 3 MHz
Trace 2: RBW = 1 MHz, VBW = 10 Hz

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

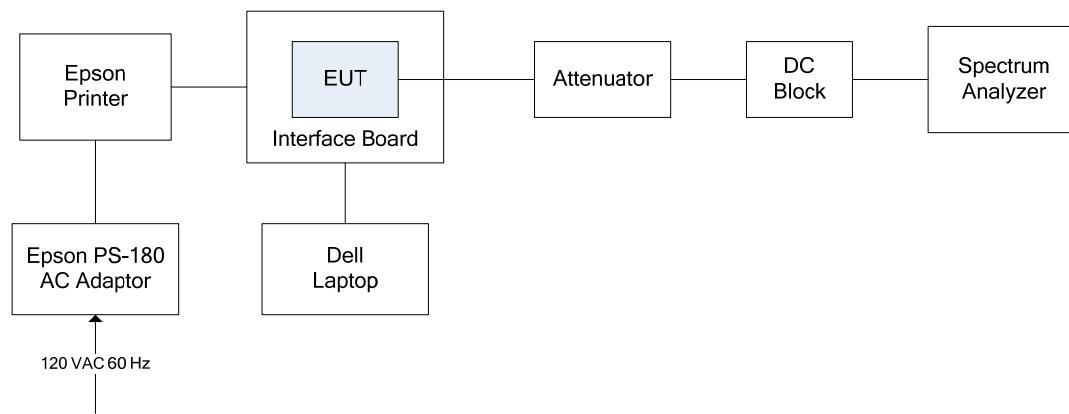
5.10.1. Limit(s)

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.

5.10.2. Method of Measurements

KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247).

5.10.3. Test Arrangement



5.10.4. Test Data

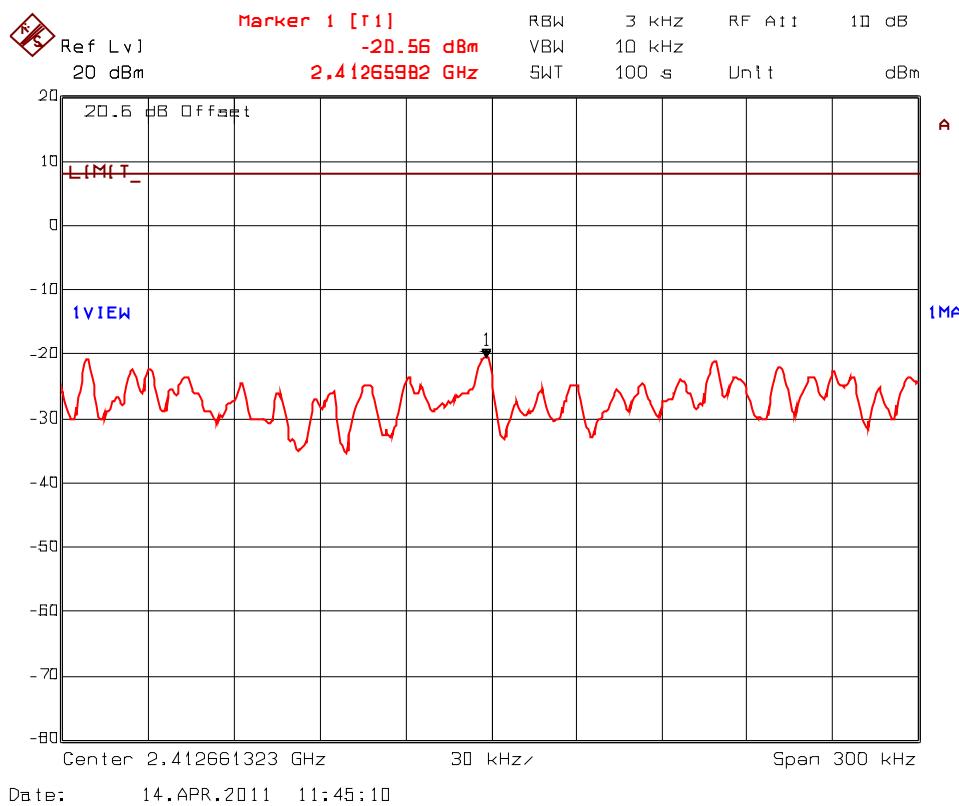
Remarks:

- Measurement method: Power spectral density (PSD) Option 1.
- Investigation of all combinations of modulations and data rates were carried out to determine the worst-case operation and the highest level is recorded in the following table.

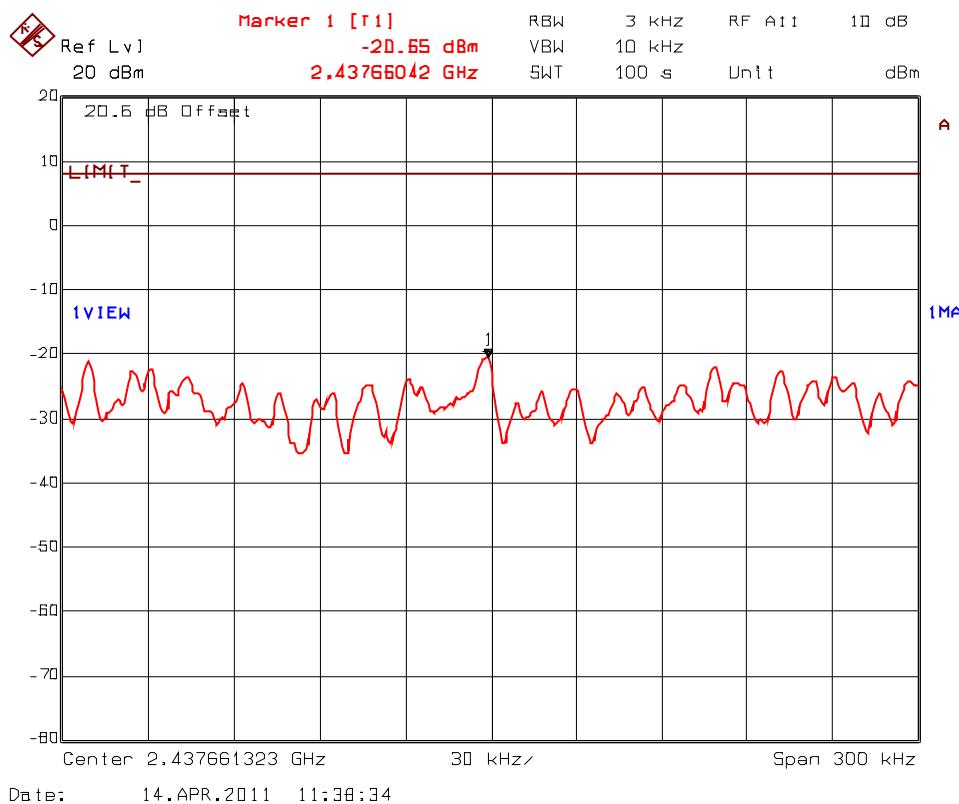
| Frequency (MHz) | Modulation | Data Rate (Mbps) | *PSD in 3 kHz BW (dBm) | Limit (dBm) | Margin (dB) |
|---------------------|------------|------------------|------------------------|-------------|-------------|
| 802.11b Mode | | | | | |
| 2412 | DQPSK | 2 | -20.56 | 8 | -28.56 |
| 2437 | DQPSK | 2 | -20.65 | 8 | -28.65 |
| 2462 | DQPSK | 2 | -20.82 | 8 | -28.82 |
| 802.11g Mode | | | | | |
| 2412 | 16-QAM | 36 | -14.58 | 8 | -22.58 |
| 2437 | 16-QAM | 36 | -14.86 | 8 | -22.86 |
| 2462 | 16-QAM | 36 | -15.25 | 8 | -23.25 |

*See the following plots for measurement details.

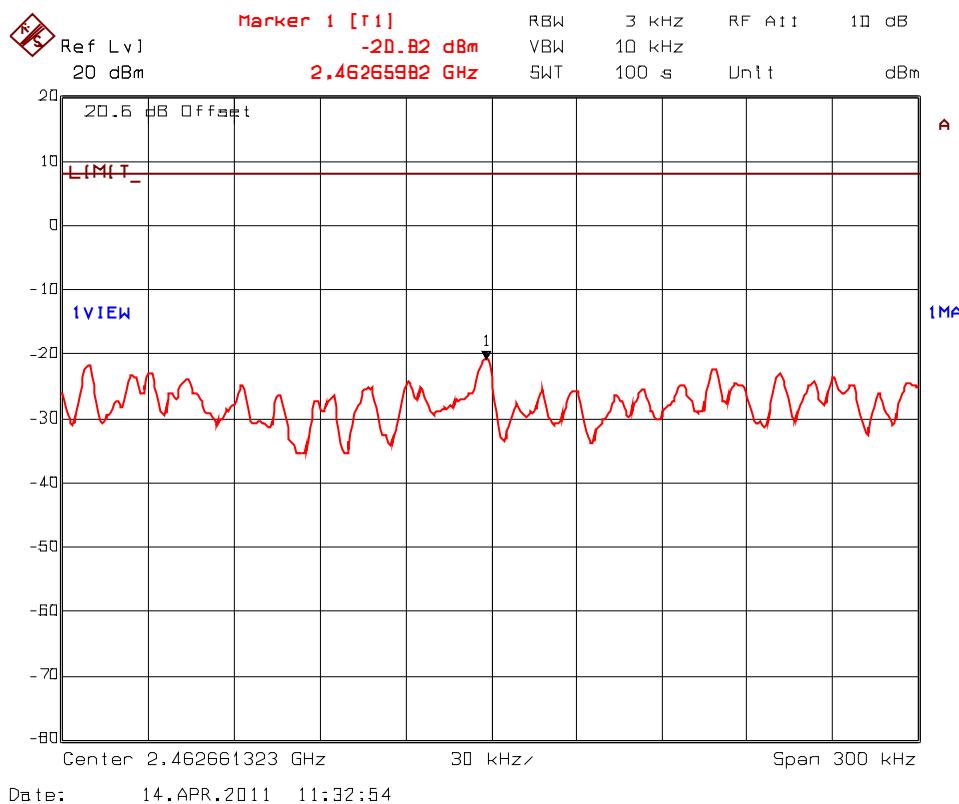
Plot 5.10.4.1. Power Spectral Density, 802.11b DQPSK 2 Mbps
Test Frequency: 2412 MHz



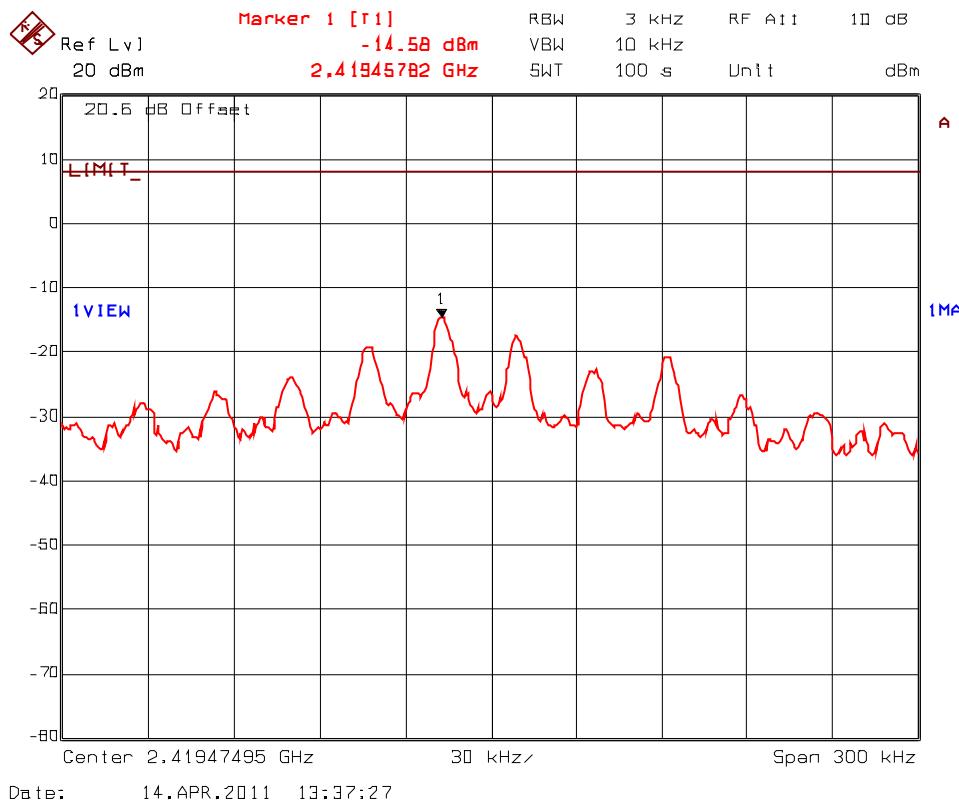
Plot 5.10.4.2. Power Spectral Density, 802.11b DQPSK 2 Mbps
Test Frequency: 2437 MHz



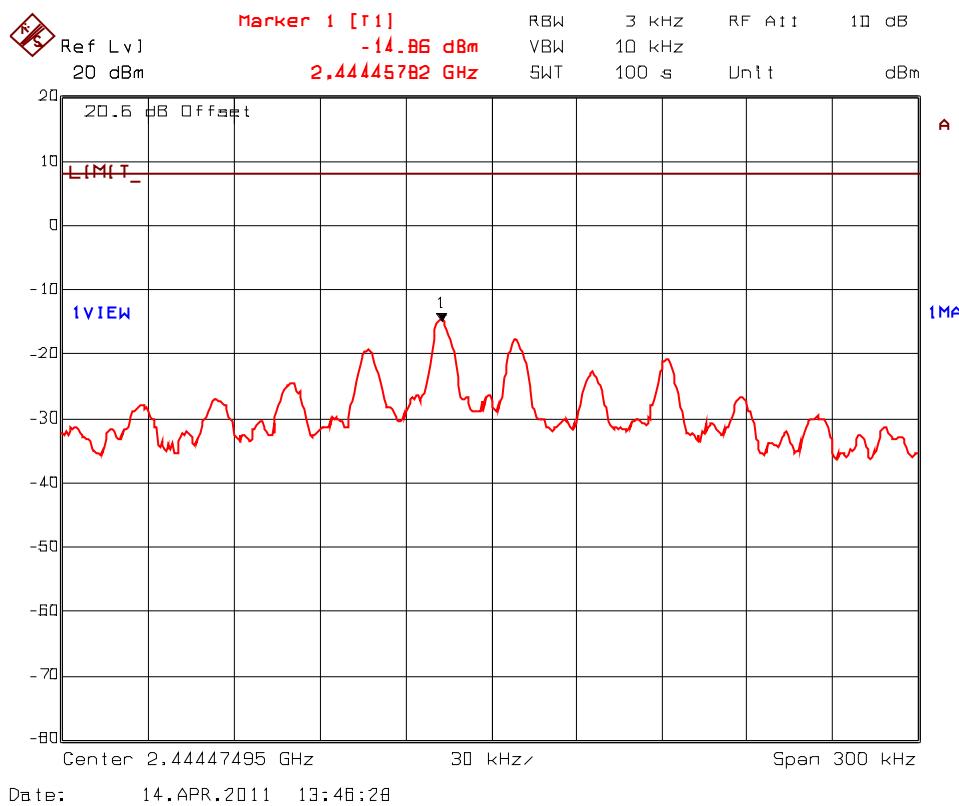
Plot 5.10.4.3. Power Spectral Density, 802.11b DQPSK 2 Mbps
Test Frequency: 2462 MHz



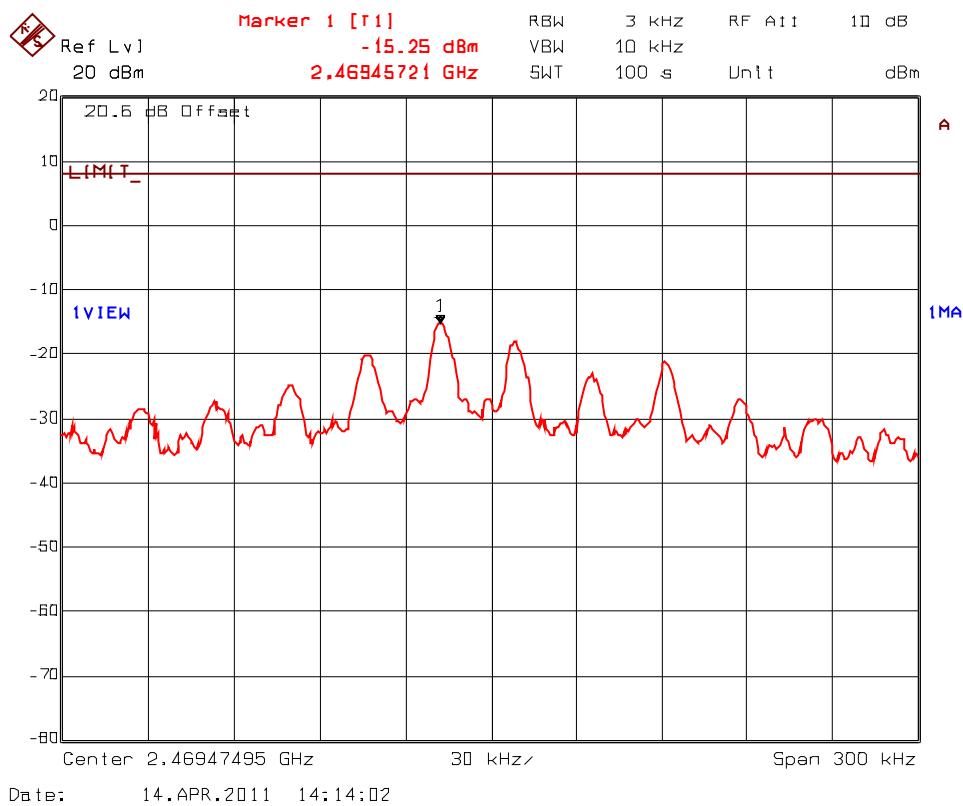
Plot 5.10.4.4. Power Spectral Density, 802.11g 16-QAM 36 Mbps
Test Frequency: 2412 MHz



Plot 5.10.4.5. Power Spectral Density, 802.11g 16-QAM 36 Mbps
Test Frequency: 2437 MHz



Plot 5.10.4.6. Power Spectral Density, 802.11g 16-QAM 36 Mbps
Test Frequency: 2462 MHz



5.11. RF EXPOSURE REQUIREMENTS [§§ 15.247(e)(i), 1.1310 & 2.1091]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—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 TO TABLE 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 TO TABLE 1: 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.

5.11.1. Method of Measurements

Refer to Sections 1.1310, 2.1091

In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

- (1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
- (2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
- (3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
- (4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

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

Where:
P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power
S: power density mW/cm²
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.11.2. RF Evaluation

| Evaluation of RF Exposure Compliance Requirements | |
|--|---|
| RF Exposure Requirements | Compliance with FCC Rules |
| Minimum calculated separation distance between antenna and persons required: *1.7 cm | Manufacturer' instruction for separation distance between antenna and persons required: 20 cm. |
| Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement | Antenna installation and device operating instructions shall be provided to installers to maintain and ensure compliance with RF exposure requirements. |
| Caution statements and/or warning labels that are necessary in order to comply with the exposure limits | Refer to User's Manual for RF Exposure Information. |
| Any other RF exposure related issues that may affect MPE compliance | None. |

*The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

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

S = 1.0 mW/cm²

EIRP = 15.42 dBm = 34.83 mW (Worst Case)

$$(\text{Minimum Safe Distance, } r) = \sqrt{\frac{EIRP}{4 \cdot \pi \cdot S}} = \sqrt{\frac{34.83}{4 \cdot \pi \cdot (1.0)}} \approx 1.7cm$$

EXHIBIT 6. TEST EQUIPMENT LIST

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range | Cal. Due Date |
|--------------------|-----------------|--------------------|------------|--------------------|---------------|
| Spectrum Analyzer | Rohde & Schwarz | FSEK30 | 100077 | 20 Hz – 40 GHz | 14 Aug 2011 |
| Spectrum Analyzer | Rohde & Schwarz | ESU40 | 100037 | 20 Hz – 40 GHz | 15 Mar 2012 |
| RF Amplifier | Hewlett Packard | 84498 | 3008A00769 | 1 – 26.5 GHz | 17 Feb 2012 |
| RF Amplifier | AH System | PAM-0118 | 225 | 20 MHz – 18 GHz | 15 Mar 2012 |
| High Pass Filter | K & L | 11SH10-4000/T12000 | 4 | Cut off 2.4 GHz | Cal. on use |
| Horn Antenna | Emco | 3155 | 6570 | 1 – 18 GHz | 22 Feb 2012 |
| Horn Antenna | Emco | 3155 | 5955 | 1 – 18 GHz | 09 Jan 2012 |
| Biconi-Log Antenna | Emco | 3142C | 00026873 | 26 – 3000 MHz | 26 Apr 2012 |
| Dipole Antenna | Emco | 3121C | 434 | 26 – 1000 MHz | 16 Aug 2011 |
| Signal Generator | Hewlett Packard | 8648C | 3443U00391 | 100 kHz – 3200 MHz | 16 Dec 2011 |
| Power Divider | Mini-Circuits | 15542 | 0235 | DC – 18 GHz | Cal. on use |
| Attenuator | Narda | 4768-20 | - | DC – 40 GHz | Cal. on use |
| DC Block | Hewlett-Packard | 11742A | 12460 | 0.045 – 26.5 GHz | Cal. on use |
| Spectrum Analyzer | Agilent | E7401A | US40240432 | 9 kHz – 1.5 GHz | 10 Jan 2012 |
| LISN | Schwarzbeck | NSLK8127 | 8127276 | 10 kHz – 30 MHz | 07 Apr 2012 |
| Attenuator | Pasternack | PE7010-20 | - | - | 18 Jan 2012 |
| Power Meter | Hewlett Packard | 8900D | 2131A01044 | 01 – 18 GHz | 24 Jun 2011 |
| Power Sensor | Hewlett Packard | 84811A | 2551A01484 | 01 – 18 GHz | 24 Jun 2011 |

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 (150 kHz – 30 MHz): | Measured | Limit |
|-------|--|------------|-----------|
| u_c | Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$ | ± 1.57 | ± 1.8 |
| U | Expanded uncertainty U: $U = 2u_c(y)$ | ± 3.14 | ± 3.6 |

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

| | Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz): | Measured | Limit |
|-------|--|------------|-----------|
| u_c | Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$ | ± 2.15 | ± 2.6 |
| U | Expanded uncertainty U: $U = 2u_c(y)$ | ± 4.30 | ± 5.2 |

| | Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz): | Measured | Limit |
|-------|--|------------|-----------|
| 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 | Limit |
|-------|--|------------|---------------------|
| 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 |