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Test report

231485-1TRFWL

Date of issue: July 5, 2013

Applicant:

Ericsson WiFi Inc.

Product:

AP6401

Model:

KRC 161 393/2

FCC ID:

RAR40025002

IC Registration number:

4674A-40025002

Specifications:

◆ **FCC 47 CFR Part 15 Subpart E, §15.247**

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

◆ **RSS-210, Issue 8, December 2010, Annex 8**

Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

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FCC 15.247 and RSS-210 A8.docx; Date: May 2013



Test location

| | |
|---------------|--|
| Company name: | Nemko Canada Inc. |
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| City: | Ottawa |
| Province: | Ontario |
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| Website: | www.nemko.com |
| Site number: | FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber) |

Tested by: Andrey Adelberg, Senior Wireless/EMC Specialist

Reviewed by: Kevin Rose, Wireless/EMC Specialist

Date: July 5, 2013

Signature:



Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

| | |
|------------------|--------------------|
| Company name: | Ericsson WiFi Inc. |
| Address: | 6300 Legacy Drive |
| City: | Plano |
| Province/State: | TX |
| Postal/Zip code: | 75024 |
| Country: | USA |

1.2 Test specifications

| | |
|--|---|
| FCC 47 CFR Part 15, Subpart C, Clause 15.247 | Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz |
| RSS-210, Issue 8 Annex 8 | Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands |

1.3 Test methods

| | |
|---|--|
| Guidance for compliance measurements on DTS operating under 15.247 | 558074 D01 Meas Guidance v03r01 (April 9, 2013) |
| Emissions testing of transmitters with multiple outputs in the same band (MIMO) | 662911 D01 Multiple Transmitter Output v02 (May 28, 2013) |
| ANSI C64.3 v 2003 | 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 |

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

| Revision # | Details of changes made to test report |
|------------|--|
| TRF | Original report issued |

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

| Part | Test description | Verdict |
|------------|---------------------------|-------------------|
| §15.207(a) | Conducted limits | Pass |
| §15.31(e) | Variation of power source | Pass ¹ |
| §15.203 | Antenna requirement | Pass ² |

Notes: ¹ Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

² The Antennas are located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results

| Part | Test description | Verdict |
|--------------------|--|----------------|
| §15.247(a)(1)(i) | Frequency hopping systems operating in the 902–928 MHz band | Not applicable |
| §15.247(a)(1)(ii) | Frequency hopping systems operating in the 5725–5850 MHz band | Not applicable |
| §15.247(a)(1)(iii) | Frequency hopping systems operating in the 2400–2483.5 MHz band | Not applicable |
| §15.247(a)(2) | Minimum 6 dB bandwidth for systems using digital modulation techniques | Pass |
| §15.247(b)(1) | Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band | Not applicable |
| §15.247(b)(2) | Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band | Not applicable |
| §15.247(b)(3) | Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands | Pass |
| §15.247(b)(4) | Maximum peak output power | Pass |
| §15.247(c)(1) | Fixed point-to-point operation with directional antenna gains greater than 6 dBi | Not applicable |
| §15.247(c)(2) | Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams | Pass |
| §15.247(d) | Spurious emissions | Pass |
| §15.247(e) | Power spectral density for digitally modulated devices | Pass |
| §15.247(f) | Time of occupancy for hybrid systems | Not applicable |

2.3 IC RSS-GEN, Issue 3, test results

| Part | Test description | Verdict |
|-------|--|----------------|
| 4.6.1 | Occupied bandwidth | Pass |
| 4.7 | Transmitter frequency stability | Not applicable |
| 6.1 | Receiver spurious emissions limits (radiated) | Not applicable |
| 6.2 | Receiver spurious emissions limits (antenna conducted) | Not applicable |
| 7.2.4 | AC power lines conducted emission limits | Pass |

Notes: ¹ According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 IC RSS-210, Issue 8, test results

| Part | Test description | Verdict |
|----------|--|----------------|
| A8.1 | Frequency hopping systems | |
| A8.1 (a) | Bandwidth of a frequency hopping channel | Not applicable |
| A8.1 (b) | Minimum channel spacing for frequency hopping systems | Not applicable |
| A8.1 (c) | Frequency hopping systems operating in the 902–928 MHz band | Not applicable |
| A8.1 (d) | Frequency hopping systems operating in the 2400–2483.5 MHz band | Not applicable |
| A8.1 (e) | Frequency hopping systems operating in the 5725–5850 MHz band | Not applicable |
| A8.2 | Digital modulation systems | |
| A8.2 (a) | Minimum 6 dB bandwidth | Pass |
| A8.2 (b) | Maximum power spectral density | Pass |
| A8.3 | Hybrid systems | |
| A8.3 (1) | Digital modulation turned off | Not applicable |
| A8.3 (2) | Frequency hopping turned off | Not applicable |
| A8.4 | Transmitter output power and e.i.r.p. requirements | |
| A8.4 (1) | Frequency hopping systems operating in the 902–928 MHz band | Not applicable |
| A8.4 (2) | Frequency hopping systems operating in the 2400–2483.5 MHz band | Not applicable |
| A8.4 (3) | Frequency hopping systems operating in the 5725–5850 MHz | Not applicable |
| A8.4 (4) | Systems employing digital modulation techniques | Pass |
| A8.4 (5) | Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band | Not applicable |
| A8.4 (6) | Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams | Not applicable |
| A8.5 | Out-of-band emissions | Pass |

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

| | |
|------------------------|---------------|
| Receipt date | April 2, 2013 |
| Nemko sample ID number | 1 |

3.2 EUT information

| | |
|---------------|---------------|
| Product name | AP6401 |
| Model | KRC 161 393/2 |
| Serial number | M1531F0159 |

3.3 Technical information

| | |
|---------------------------|--|
| Operating band | 2400–2483.5 MHz |
| Operating frequency | 2412–2462 MHz (20 MHz channel) and 2422–2457 MHz (40 MHz channel) |
| Modulation type | 802.11b/g/n |
| Occupied bandwidth (99 %) | 13.83 MHz (802.11b); 17.01 MHz (802.11g); 18.09 MHz (802.11n HT20); 36.60 MHz (802.11n HT40) |
| Emission designator | W7D |
| Power requirements | 48 V _{DC} |
| Antenna information | 3 internal 7.7 dBi antennas The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator. |

3.4 Product description and theory of operation

The EUT is a 3x3 MIMO device (can also be utilized as 2x2 MIMO and 1x1 SISO device) designed to operate in the 2.4 GHz band, and 5 GHz bands. There are two independent radio units. This report covers only the 2.4 GHz band radio.

3.5 EUT exercise details

The EUT was controlled to transmit at desired frequency and modulation from laptop using Art GUI software and telnet session.

3.6 EUT setup diagram

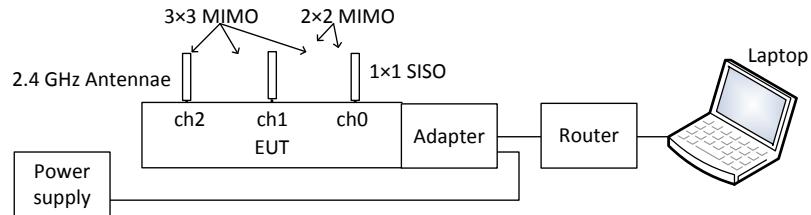


Figure 3.6-1: Setup diagram

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

| Description | Brand name | Model/Part number | Serial number |
|------------------------|-----------------|-------------------|-------------------|
| Laptop | Toshiba | Satellite | Asset number: 441 |
| Switching power supply | Absopulse | PWI 99-P2419 | B7481020 |
| Power adapter | BelAir Networks | B2CG164AA-B | M6431G0075 |
| Router | DLink | DGS-1008G | QB2H1B9002679 |

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

| | |
|-------------------|---------------|
| Temperature | 15–30 °C |
| Relative humidity | 20–75 % |
| Air pressure | 860–1060 mbar |

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

| Equipment | Manufacturer | Model no. | Asset no. | Cal cycle | Next cal. |
|----------------------------|------------------|--------------|-----------|-----------|------------|
| 3 m EMI test chamber | TDK | SAC-3 | FA002047 | 1 year | Mar. 09/14 |
| Flush mount turntable | Sunol | FM2022 | FA002082 | — | NCR |
| Controller | Sunol | SC104V | FA002060 | — | NCR |
| Antenna mast | Sunol | TLT2 | FA002061 | — | NCR |
| Power supply | California Inst. | 3001I | FA001021 | 1 year | Feb 08/14 |
| Receiver/spectrum analyzer | Rohde & Schwarz | ESU 26 | FA002043 | 1 year | May 16/13 |
| Spectrum analyzer | Rohde & Schwarz | FSU | FA001877 | 1 year | Jan. 16/14 |
| Biconical antenna | Sunol | BC2 | FA002078 | 1 year | Jan. 14/14 |
| Log periodic antenna | Sunol | LP5 | FA002077 | 1 year | Jan. 16/14 |
| Horn antenna #1 | EMCO | 3115 | FA000649 | 1 year | Mar. 08/14 |
| 1–18 GHz pre-amplifier | JCA | JCA118-503 | FA002091 | 1 year | July 03/13 |
| Temperature chamber | Thermotron | SM-16C | FA001030 | 1 year | NCR |
| Horn antenna 18–26.5 GHz | Electro-metrics | SH-50/60-1 | FA000479 | — | VOU |
| Power meter | Agilent | N1911A | FA001946 | 1 year | Feb. 13/14 |
| Power sensor | Agilent | N1922A | FA001947 | 1 year | Feb. 13/14 |
| 18–26 GHz pre-amplifier | Narda | BBS-1826N612 | FA001550 | — | VOU |

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 7.2.4 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

IC:

The purpose of this test is to measure unwanted radio frequency currents induced in any AC conductor external to the equipment which could conduct interference to other equipment via the AC electrical network.

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radiocommunication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 2. The tighter limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 Ω /50 μ H line impedance stabilization network (LISN).

Table 8.1-1: Conducted emissions limit

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

Note: * - Decreases with the logarithm of the frequency.

8.1.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | April 10, 2013 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1006 mbar |
| Verdict: | Pass | Relative humidity: | 32 % |

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

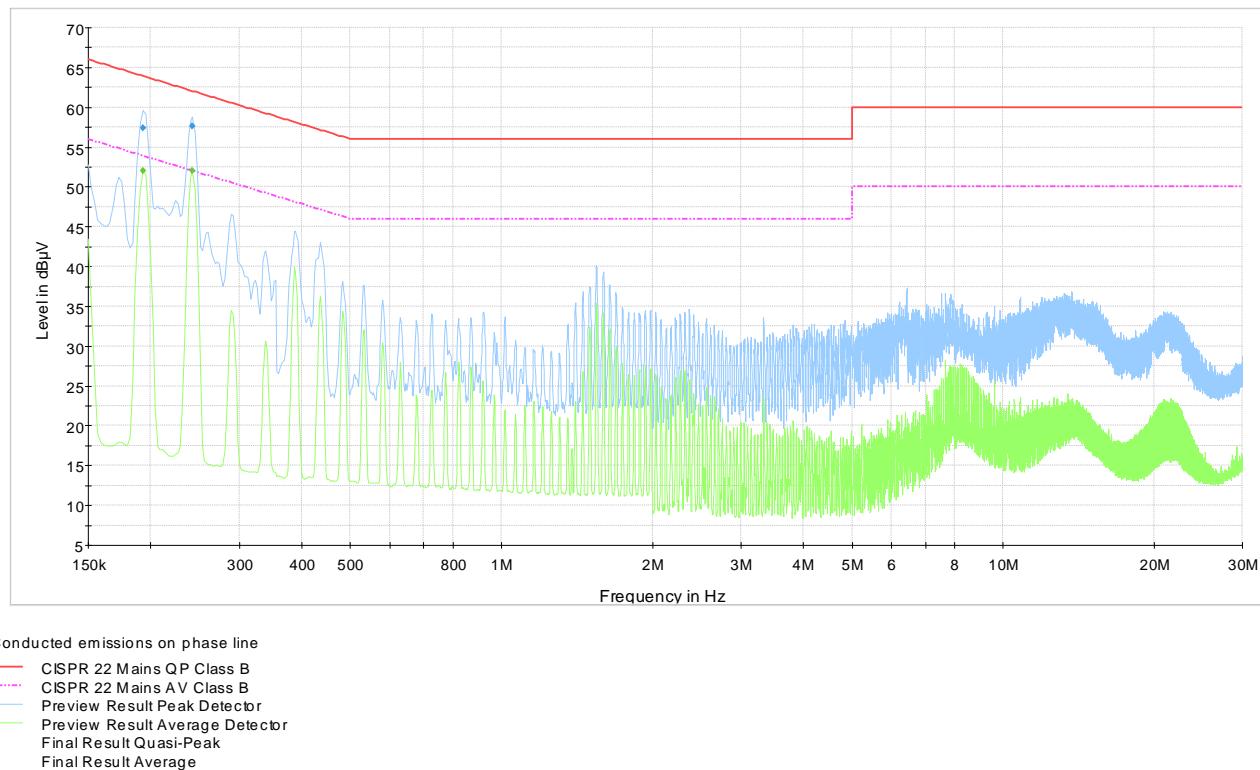
Receiver settings for preview measurements:

| | |
|-----------------------|------------------|
| Resolution bandwidth: | 9 kHz |
| Video bandwidth: | 30 kHz |
| Detector mode: | Peak and Average |
| Trace mode: | Max Hold |
| Measurement time: | 100 ms |

Receiver settings for final measurements:

| | |
|-----------------------|------------------------|
| Resolution bandwidth: | 9 kHz |
| Video bandwidth: | 30 kHz |
| Detector mode: | Quasi-Peak and Average |
| Trace mode: | Max Hold |
| Measurement time: | 100 ms |

8.1.4 Test data



Plot 8.1-1: Conducted emissions on phase line

Table 8.1-2: Quasi-Peak conducted emissions results on phase line

| Frequency, MHz | Q-Peak result, dB μ V | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB | Margin, dB | Limit, dB μ V |
|----------------|---------------------------|----------------|----------------|--------|----------------|------------|-------------------|
| 0.192750 | 57.4 | 100 | 9 | On | 10.0 | 6.5 | 63.9 |
| 0.242250 | 57.6 | 100 | 9 | On | 9.7 | 4.4 | 62.0 |

Note: $43.5 \text{ dB}\mu\text{V} = 23.2 \text{ dB}\mu\text{V} \text{ (receiver reading)} + 10.1 \text{ dB} \text{ (LISN factor IL)} + 0.2 \text{ dB} \text{ (cable loss)} + 10 \text{ dB} \text{ (attenuator)}$

Table 8.1-3: Average conducted emissions results on phase line

| Frequency, MHz | Average result, dB μ V | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB | Margin, dB | Limit, dB μ V |
|----------------|----------------------------|----------------|----------------|--------|----------------|------------|-------------------|
| 0.192750 | 52.1 | 100 | 9 | On | 10.0 | 1.8 | 53.9 |
| 0.242250 | 52.0 | 100 | 9 | On | 9.7 | 0.0 | 52.0 |

Sample calculation:

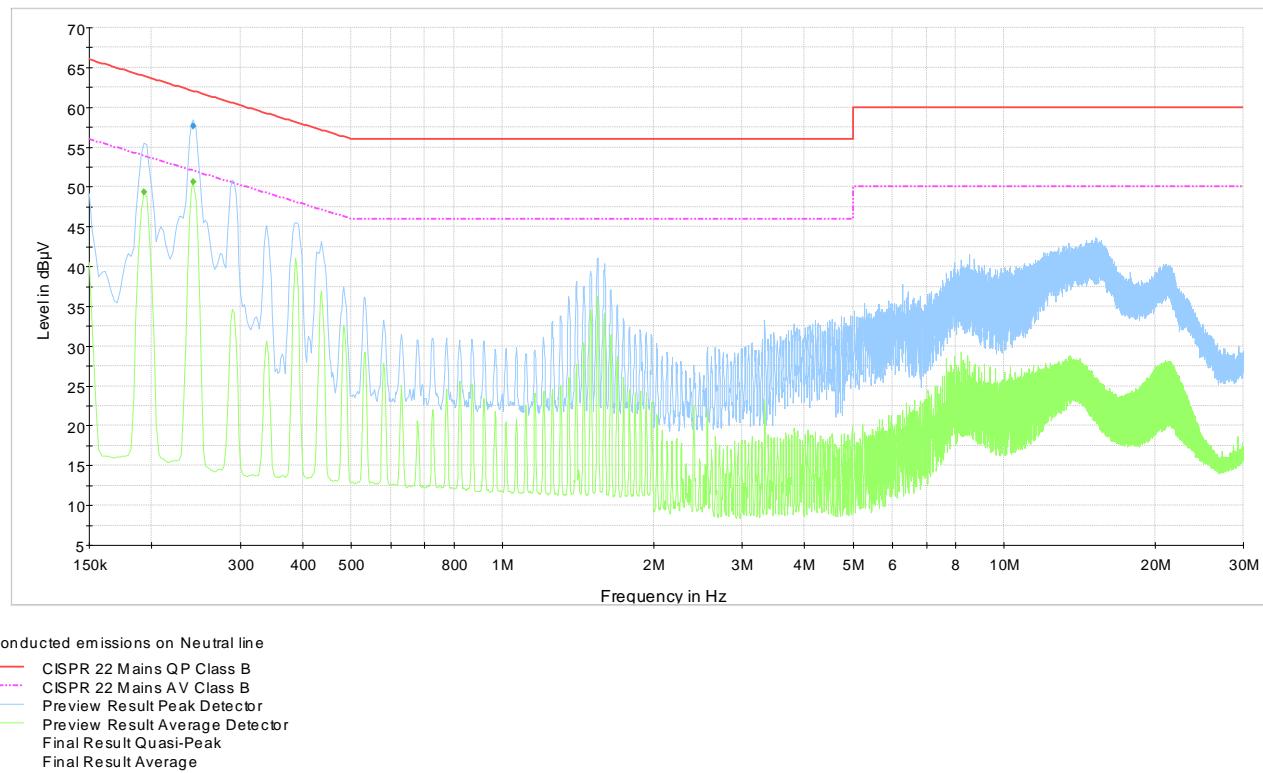
Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

Result (dB μ V) = XX dB μ V (reading from receiver) + XX dB (Correction factor)

Example:

$43.5 \text{ dB}\mu\text{V} = 23.2 \text{ dB}\mu\text{V} \text{ (receiver reading)} + 10.1 \text{ dB} \text{ (LISN factor IL)} + 0.2 \text{ dB} \text{ (cable loss)} + 10 \text{ dB} \text{ (attenuator)}$

8.1.4 Test data, continued



Plot 8.1-2: Conducted emissions on neutral line

Table 8.1-4: Quasi-Peak conducted emissions results on neutral line

| Frequency, MHz | Q-Peak result, dB μ V | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB | Margin, dB | Limit, dB μ V |
|----------------|---------------------------|----------------|----------------|--------|----------------|------------|-------------------|
| 0.242250 | 57.7 | 100 | 9 | On | 9.7 | 4.3 | 62.0 |

Note: $43.5 \text{ dB}\mu\text{V} = 23.2 \text{ dB}\mu\text{V} (\text{receiver reading}) + 10.1 \text{ dB} (\text{LISN factor IL}) + 0.2 \text{ dB} (\text{cable loss}) + 10 \text{ dB} (\text{attenuator})$

Table 8.1-5: Average conducted emissions results on neutral line

| Frequency, MHz | Average result, dB μ V | Meas. Time, ms | Bandwidth, kHz | Filter | Correction, dB | Margin, dB | Limit, dB μ V |
|----------------|----------------------------|----------------|----------------|--------|----------------|------------|-------------------|
| 0.192750 | 49.4 | 100 | 9 | On | 10.0 | 4.5 | 53.9 |
| 0.242250 | 50.6 | 100 | 9 | On | 9.7 | 1.4 | 52.0 |

Sample calculation:

Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

Result (dB μ V) = XX dB μ V (reading from receiver) + XX dB (Correction factor)

Example:

$43.5 \text{ dB}\mu\text{V} = 23.2 \text{ dB}\mu\text{V} (\text{receiver reading}) + 10.1 \text{ dB} (\text{LISN factor IL}) + 0.2 \text{ dB} (\text{cable loss}) + 10 \text{ dB} (\text{attenuator})$

8.2 FCC 15.247(a)(2) and RSS-210 A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.2.1 Definitions and limits

FCC and IC:

- (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
- (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | April 3, 2013 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1004 mbar |
| Verdict: | Pass | Relative humidity: | 33 % |

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

| | |
|-----------------------|--|
| Resolution bandwidth: | 1–5 % of DTS BW (no wider than 100 kHz) |
| Video bandwidth: | ≥3 × RBW |
| Frequency span: | 30 MHz for 20 MHz channel; 70 MHz for 40 MHz channel |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

8.2.4 Test data

Table 8.2-1: 6 dB bandwidth results for cho

| Modulation | Frequency, MHz | 6 dB bandwidth, MHz | Limit, MHz | Margin, MHz |
|--------------|----------------|---------------------|------------|-------------|
| 802.11b | 2412 | 9.12 | 0.50 | 8.62 |
| | 2437 | 9.42 | 0.50 | 8.92 |
| | 2462 | 9.12 | 0.50 | 8.62 |
| 802.11g | 2412 | 16.60 | 0.50 | 16.10 |
| | 2437 | 16.58 | 0.50 | 16.08 |
| | 2462 | 16.46 | 0.50 | 15.96 |
| 802.11n HT20 | 2412 | 17.71 | 0.50 | 17.21 |
| | 2437 | 17.83 | 0.50 | 17.33 |
| | 2462 | 17.78 | 0.50 | 17.28 |
| 802.11n HT40 | 2422 | 36.53 | 0.50 | 36.03 |
| | 2437 | 36.64 | 0.50 | 36.14 |
| | 2457 | 36.61 | 0.50 | 36.11 |

Section 8

Testing data

Test name

FCC 15.247(a)(2) and RSS-210 A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

Specification

FCC 15 Subpart C and RSS-210, Issue 8

**8.2.4** Test data, continued**Table 8.2-2: 6 dB bandwidth results for ch1**

| Modulation | Frequency, MHz | 6 dB bandwidth, MHz | Limit, MHz | Margin, MHz |
|--------------|----------------|---------------------|-------------|--------------|
| 802.11b | 2412 | 9.31 | 0.50 | 8.81 |
| | 2437 | 9.16 | 0.50 | 8.66 |
| | 2462 | 9.31 | 0.50 | 8.81 |
| 802.11g | 2412 | 16.85 | 0.50 | 16.35 |
| | 2437 | 16.61 | 0.50 | 16.11 |
| | 2462 | 16.69 | 0.50 | 16.19 |
| 802.11n HT20 | 2412 | 17.90 | 0.50 | 17.40 |
| | 2437 | 17.65 | 0.50 | 17.15 |
| | 2462 | 17.63 | 0.50 | 17.13 |
| 802.11n HT40 | 2422 | 36.66 | 0.50 | 36.16 |
| | 2437 | 36.81 | 0.50 | 36.31 |
| | 2457 | 36.77 | 0.50 | 36.27 |

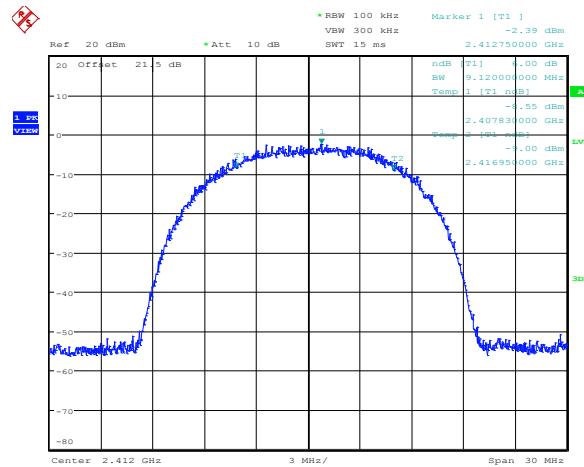
Table 8.2-3: 6 dB bandwidth results for ch2

| Modulation | Frequency, MHz | 6 dB bandwidth, MHz | Limit, MHz | Margin, MHz |
|--------------|----------------|---------------------|-------------|--------------|
| 802.11b | 2412 | 9.45 | 0.50 | 8.95 |
| | 2437 | 9.49 | 0.50 | 8.99 |
| | 2462 | 9.17 | 0.50 | 8.67 |
| 802.11g | 2412 | 16.51 | 0.50 | 16.01 |
| | 2437 | 16.65 | 0.50 | 16.15 |
| | 2462 | 16.57 | 0.50 | 16.07 |
| 802.11n HT20 | 2412 | 17.80 | 0.50 | 17.30 |
| | 2437 | 17.49 | 0.50 | 16.99 |
| | 2462 | 17.80 | 0.50 | 17.30 |
| 802.11n HT40 | 2422 | 36.48 | 0.50 | 35.98 |
| | 2437 | 36.56 | 0.50 | 36.06 |
| | 2457 | 36.76 | 0.50 | 36.26 |

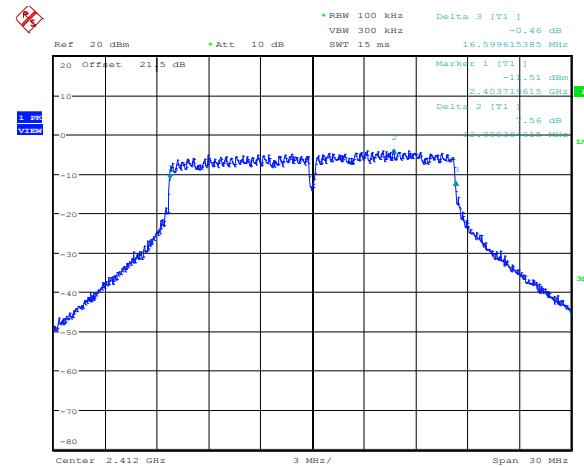
Section 8**Test name****Specification****Testing data**

FCC 15.247(a)(2) and RSS-210 A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

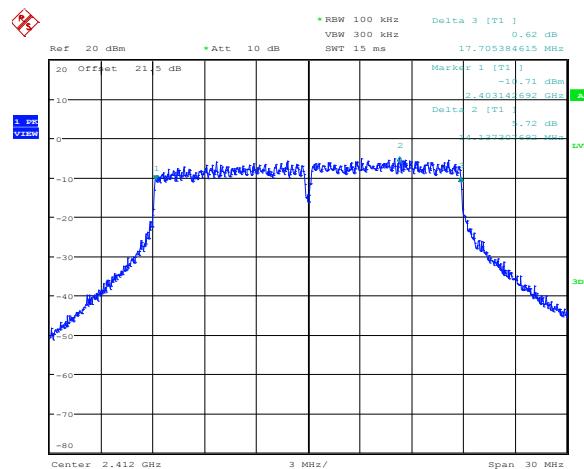
FCC 15 Subpart C and RSS-210, Issue 8

**8.2.4 Test data, continued**

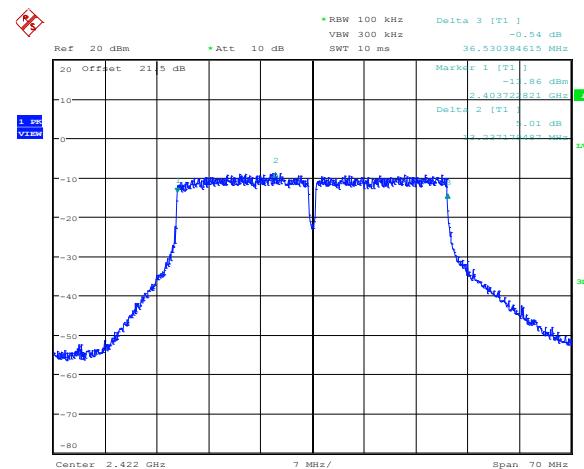
Date: 3.APR.2013 15:59:16

Figure 8.2-1: 6 dB bandwidth on 802.11b, sample plot

Date: 3.APR.2013 15:56:39

Figure 8.2-2: 6 dB bandwidth on 802.11g, sample plot

Date: 3.APR.2013 15:57:38

Figure 8.2-3: 6 dB bandwidth on 802.11n HT20, sample plot

Date: 3.APR.2013 16:06:43

Figure 8.2-4: 6 dB bandwidth on 802.11n HT40, sample plot

8.3 RSS-Gen 4.6.1 Occupied bandwidth

8.3.1 Definitions and limits

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

8.3.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | April 3, 2013 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1004 mbar |
| Verdict: | Pass | Relative humidity: | 33 % |

8.3.3 Observations, settings and special notes

Spectrum analyser settings:

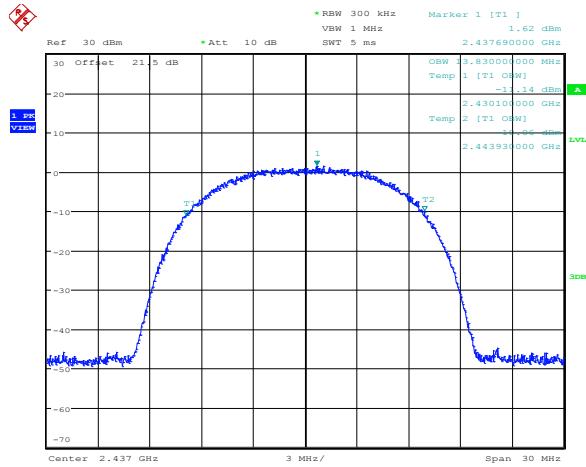
| | |
|-----------------------|--------------|
| Resolution bandwidth: | ≥1 % of span |
| Video bandwidth: | ≥3 × RBW |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

8.3.4 Test data

Table 8.3-1: 99 % bandwidth results

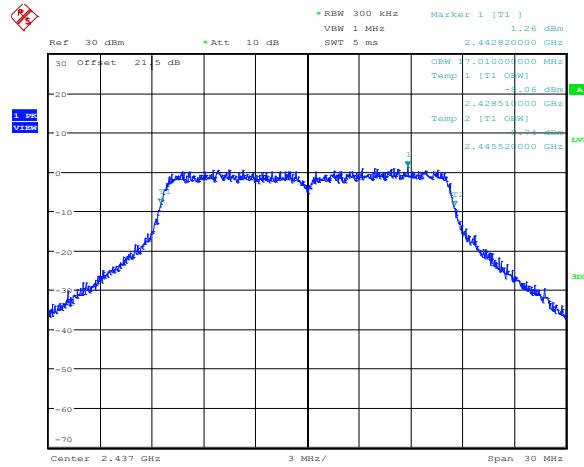
| Modulation | 99 % bandwidth, MHz |
|--------------|---------------------|
| 802.11b | 13.83 |
| 802.11g | 17.01 |
| 802.11n HT20 | 18.09 |
| 802.11n HT40 | 36.60 |

8.3.4 Test data, continued



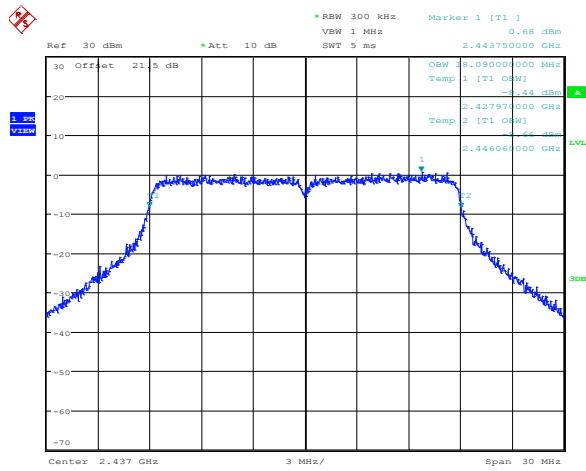
Date: 3.APR.2013 16:13:15

Figure 8.3-1: 99 % bandwidth on 802.11b, sample plot



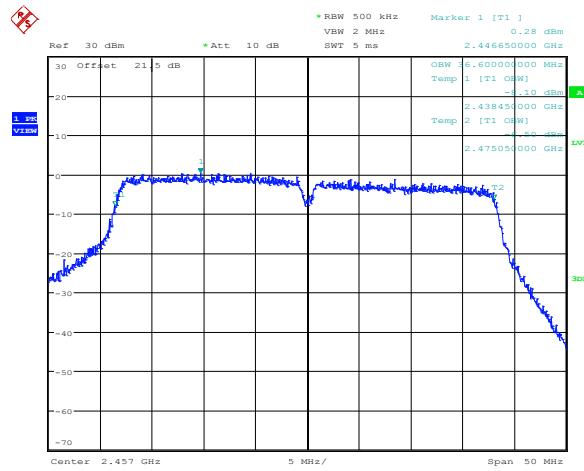
Date: 3.APR.2013 16:12:16

Figure 8.3-2: 99 % bandwidth on 802.11g, sample plot



Date: 3.APR.2013 16:12:48

Figure 8.3-3: 99 % bandwidth on 802.11n HT20, sample plot



Date: 3.APR.2013 16:11:04

Figure 8.3-4: 99 % bandwidth on 802.11n HT40, sample plot

8.4 FCC 15.247(b) and RSS-210 A8.4 (4) Transmitter output power and e.i.r.p. requirements

8.4.1 Definitions and limits

FCC:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). 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.
 - (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.
 - (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 peak 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.

Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(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 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.

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

IC:

A8.4 (4) Transmitter Output Power and e.i.r.p. Requirements for systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands

For systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz, the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section A8.4(5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power (see RSS-Gen).

8.4.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | April 10, 2013 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1005 mbar |
| Verdict: | Pass | Relative humidity: | 36 % |

8.4.3 Observations, settings and special notes

The test was performed according to DTS guidelines section 9.1.3: maximum conducted (average) output power using RF average power meter with a thermocouple detector.

Output power limit for SISO 1 × 1 application was calculated as follows: $30 - (7.7 - 6) = 28.3$ dBm

Combined average output power for MIMO 2 × 2 application was calculated as follows: $P_{combined} = 10 \times \log_{10} \left((10^{P_{ch0}/10}) + (10^{P_{ch1}/10}) \right)$

Directional gain for MIMO Correlated 2 × 2 (CDD/TXBF) = 7.7 dBi + $10 \times \log_{10} (N)$ dB = 7.7 dBi + 3 dB = 10.7 dBi, where "N" is number of antennae.

Output power limit was calculated as follows: $30 - (10.7 - 6) = 25.3$ dBm

Combined average output power for MIMO 3 × 3 application was calculated as follows: $P_{combined} = 10 \times \log_{10} \left((10^{P_{ch0}/10}) + (10^{P_{ch1}/10}) + (10^{P_{ch2}/10}) \right)$

Directional gain for MIMO 3 × 3 (one uncorrelated and two cross polarized antennas) = 7.7 dBi + $10 \times \log_{10} (N)$ dB = 7.7 dBi + 3 dB = 10.7 dBi, where "N" is number of correlated antennas (two).

Output power limit was calculated as follows: $30 - (10.7 - 6) = 25.3$ dBm

8.4.4 Test data

Table 8.4-1: Output power measurements results for SISO 1 × 1 application

| Modulation | Frequency, MHz | Conducted output power, dBm on ch0 | Limit | Margin, dB | Antenna gain, dBi | EIRP, dBm | EIRP limit, dBm | EIRP margin, dB |
|--------------|----------------|---------------------------------------|-------|------------|-------------------|-----------|-----------------|-----------------|
| 802.11b | 2412 | 20.23 | 28.30 | 8.07 | 7.70 | 27.93 | 36.00 | 8.07 |
| | 2437 | 20.72 | 28.30 | 7.58 | 7.70 | 28.42 | 36.00 | 7.58 |
| | 2462 | 20.10 | 28.30 | 8.20 | 7.70 | 27.80 | 36.00 | 8.20 |
| 802.11g | 2412 | 19.55 | 28.30 | 8.75 | 7.70 | 27.25 | 36.00 | 8.75 |
| | 2437 | 21.17 | 28.30 | 7.13 | 7.70 | 28.87 | 36.00 | 7.13 |
| | 2462 | 18.81 | 28.30 | 9.49 | 7.70 | 26.51 | 36.00 | 9.49 |
| 802.11n HT20 | 2412 | 19.51 | 28.30 | 8.79 | 7.70 | 27.21 | 36.00 | 8.79 |
| | 2437 | 21.20 | 28.30 | 7.10 | 7.70 | 28.90 | 36.00 | 7.10 |
| | 2462 | 18.83 | 28.30 | 9.47 | 7.70 | 26.53 | 36.00 | 9.47 |
| 802.11n HT40 | 2422 | 14.20 | 28.30 | 14.10 | 7.70 | 21.90 | 36.00 | 14.10 |
| | 2437 | 21.42 | 28.30 | 6.88 | 7.70 | 29.12 | 36.00 | 6.88 |
| | 2457 | 15.86 | 28.30 | 12.44 | 7.70 | 23.56 | 36.00 | 12.44 |

Table 8.4-2: Output power measurements results for MIMO 2 × 2 application

| Modulation | Frequency, MHz | Conducted output power, dBm | | | Margin, dB | Antenna gain, dBi | EIRP, dBm | EIRP limit, dBm | EIRP margin, dB |
|--------------|----------------|-----------------------------|--------|----------|------------|-------------------|-----------|-----------------|-----------------|
| | | on ch0 | on ch1 | Combined | Limit | | | | |
| 802.11b | 2412 | 20.23 | 20.19 | 23.22 | 25.30 | 2.08 | 10.70 | 33.92 | 36.00 |
| | 2437 | 20.72 | 20.47 | 23.61 | 25.30 | 1.69 | 10.70 | 34.31 | 36.00 |
| | 2462 | 20.10 | 20.33 | 23.23 | 25.30 | 2.07 | 10.70 | 33.93 | 36.00 |
| 802.11g | 2412 | 19.55 | 19.45 | 22.51 | 25.30 | 2.79 | 10.70 | 33.21 | 36.00 |
| | 2437 | 21.17 | 20.39 | 23.81 | 25.30 | 1.49 | 10.70 | 34.51 | 36.00 |
| | 2462 | 18.81 | 18.95 | 21.89 | 25.30 | 3.41 | 10.70 | 32.59 | 36.00 |
| 802.11n HT20 | 2412 | 19.51 | 19.40 | 22.47 | 25.30 | 2.83 | 10.70 | 33.17 | 36.00 |
| | 2437 | 21.20 | 20.39 | 23.82 | 25.30 | 1.48 | 10.70 | 34.52 | 36.00 |
| | 2462 | 18.83 | 18.90 | 21.88 | 25.30 | 3.42 | 10.70 | 32.58 | 36.00 |
| 802.11n HT40 | 2422 | 14.20 | 15.44 | 17.87 | 25.30 | 7.43 | 10.70 | 28.57 | 36.00 |
| | 2437 | 21.42 | 21.06 | 24.25 | 25.30 | 1.05 | 10.70 | 34.95 | 36.00 |
| | 2457 | 15.86 | 14.91 | 18.42 | 25.30 | 6.88 | 10.70 | 29.12 | 36.00 |

8.4.4 Test data, continued

Table 8.4-3: Output power measurements results for MIMO 3 × 3 application

| Modulation | Frequency, MHz | Conducted output power, dBm | | | | Margin, dB | Antenna gain, dBi | EIRP, dBm | EIRP limit, dBm | EIRP margin, dB |
|-----------------|-------------------|-----------------------------|--------|--------|--------------|---------------|----------------------|--------------|-----------------------|-----------------------|
| | | on ch0 | on ch1 | on ch2 | Combined | | | | | |
| 802.11b | 2412 | 20.23 | 20.19 | 20.94 | 25.24 | 25.30 | 0.06 | 10.70 | 35.94 | 36.00 |
| | 2437 | 20.18 | 20.47 | 20.76 | 25.25 | 25.30 | 0.05 | 10.70 | 35.95 | 36.00 |
| | 2462 | 20.10 | 20.33 | 20.53 | 25.09 | 25.30 | 0.21 | 10.70 | 35.79 | 36.00 |
| 802.11g | 2412 | 19.55 | 19.45 | 19.72 | 24.35 | 25.30 | 0.95 | 10.70 | 35.05 | 36.00 |
| | 2437 | 20.37 | 20.39 | 20.61 | 25.23 | 25.30 | 0.07 | 10.70 | 35.93 | 36.00 |
| | 2462 | 18.81 | 18.95 | 19.36 | 23.82 | 25.30 | 1.48 | 10.70 | 34.52 | 36.00 |
| 802.11n HT20 | 2412 | 19.51 | 19.40 | 19.68 | 24.30 | 25.30 | 1.00 | 10.70 | 35.00 | 36.00 |
| | 2437 | 20.33 | 20.39 | 20.59 | 25.21 | 25.30 | 0.09 | 10.70 | 35.91 | 36.00 |
| | 2462 | 18.83 | 18.90 | 19.19 | 23.75 | 25.30 | 1.55 | 10.70 | 34.45 | 36.00 |
| 802.11n HT40 | 2422 | 14.20 | 15.44 | 15.53 | 19.87 | 25.30 | 5.43 | 10.70 | 30.57 | 36.00 |
| | 2437 | 20.35 | 20.32 | 20.73 | 25.24 | 25.30 | 0.06 | 10.70 | 35.94 | 36.00 |
| | 2457 | 15.86 | 14.91 | 15.46 | 20.20 | 25.30 | 5.10 | 10.70 | 30.90 | 36.00 |

8.5 FCC 15.247(d) and RSS-210 A8.5 Spurious (out-of-band) emissions

8.5.1 Definitions and limits

FCC:

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

IC:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided 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 Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

Table 8.5-1: FCC §15.209 and RSS-Gen – Radiated emission limits

| Frequency, MHz | Field strength of emissions | | Measurement distance, m |
|-------------------|-----------------------------|-----------------------------------|-------------------------|
| | µV/m | dBµV/m | |
| 0.009–0.490 | 2400/F | 67.6 – 20 × log ₁₀ (F) | 300 |
| 0.490–1.705 | 24000/F | 87.6 – 20 × log ₁₀ (F) | 30 |
| 1.705–30.0 | 30 | 29.5 | 30 |
| 30–88 | 100 | 40.0 | 3 |
| 88–216 | 150 | 43.5 | 3 |
| 216–960 | 200 | 46.0 | 3 |
| above 960 | 500 | 54.0 | 3 |

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

Table 8.5-2: IC restricted frequency bands

| MHz | MHz | MHz | GHz |
|-----------------|---------------------|---------------|-------------|
| 0.090–0.110 | 12.51975–12.52025 | 399.9–410 | 5.35–5.46 |
| 2.1735–2.1905 | 12.57675–12.57725 | 608–614 | 7.25–7.75 |
| 3.020–3.026 | 13.36–13.41 | 960–1427 | 8.025–8.5 |
| 4.125–4.128 | 16.42–16.423 | 1435–1626.5 | 9.0–9.2 |
| 4.17725–4.17775 | 16.69475–16.69525 | 1645.5–1646.5 | 9.3–9.5 |
| 4.20725–4.20775 | 16.80425–16.80475 | 1660–1710 | 10.6–12.7 |
| 5.677–5.683 | 25.5–25.67 | 1718.8–1722.2 | 13.25–13.4 |
| 6.215–6.218 | 37.5–38.25 | 2200–2300 | 14.47–14.5 |
| 6.26775–6.26825 | 73–74.6 | 2310–2390 | 15.35–16.2 |
| 6.31175–6.31225 | 74.8–75.2 | 2655–2900 | 17.7–21.4 |
| 8.291–8.294 | 108–138 | 3260–3267 | 22.01–23.12 |
| 8.362–8.366 | 156.52475–156.52525 | 3332–3339 | 23.6–24.0 |
| 8.37625–8.38675 | 156.7–156.9 | 3345.8–3358 | 31.2–31.8 |
| 8.41425–8.41475 | 240–285 | 3500–4400 | 36.43–36.5 |
| 12.29–12.293 | 322–335.4 | 4500–5150 | Above 38.6 |

Note: Certain frequency bands listed in Table 8.5-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

8.5.1 Definitions and limits, continued

Table 8.5-3: FCC restricted frequency bands

| MHz | MHz | MHz | GHz |
|-------------------|---------------------|---------------|-------------|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| 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 | 2690–2900 | 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 | Above 38.6 |
| 13.36–13.41 | | | |

8.5.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | April 9, 2013 | Temperature: | 22 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1005 mbar |
| Verdict: | Pass | Relative humidity: | 33 % |

8.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

EUT was set to transmit with 100 % duty cycle.

Radiated measurements were performed at a distance of 3 m, the EUT was transmitting on both MIMO chains simultaneously.

Since fundamental power was tested using average method, the spurious emissions limit is –30 dBc/100 kHz

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

| | |
|-----------------------|----------|
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 300 kHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

| | |
|-----------------------|----------|
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

| | |
|-----------------------|----------|
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 10 Hz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

8.5.3 Observations, settings and special notes, continued

Spectrum analyser settings for conducted spurious emissions measurements:

| | |
|-----------------------|----------|
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 300 kHz |
| Detector mode: | Peak |
| Trace mode: | Max Hold |

8.5.4 Test data

Table 8.5-4: Radiated field strength measurement results for 802.11b

| Channel | Frequency, MHz | Peak Field strength, dB μ V/m | | Margin, dB | Average Field strength, dB μ V/m | | Margin, dB |
|---------|-------------------|-----------------------------------|-------|---------------|--------------------------------------|-------|---------------|
| | | Measured | Limit | | Measured | Limit | |
| Low | 2390.0 | 61.29 | 74.00 | 12.71 | 48.10 | 54.00 | 5.90 |
| Low | 4824.0 | 53.89 | 74.00 | 20.11 | 39.08 | 54.00 | 14.92 |
| Mid | 4874.0 | 53.19 | 74.00 | 20.81 | 39.52 | 54.00 | 14.48 |
| High | 2483.5 | 60.45 | 74.00 | 13.55 | 50.05 | 54.00 | 3.95 |

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.5-5: Radiated field strength measurement results for 802.11g

| Channel | Frequency, MHz | Peak Field strength, dB μ V/m | | Margin, dB | Average Field strength, dB μ V/m | | Margin, dB |
|---------|-------------------|-----------------------------------|-------|---------------|--------------------------------------|-------|---------------|
| | | Measured | Limit | | Measured | Limit | |
| Low | 2390.0 | 71.36 | 74.00 | 2.64 | 50.79 | 54.00 | 3.21 |
| Low | 4824.0 | 57.51 | 74.00 | 16.49 | 42.32 | 54.00 | 11.68 |
| Mid | 4874.0 | 58.27 | 74.00 | 15.73 | 42.71 | 54.00 | 11.29 |
| High | 2483.5 | 71.69 | 74.00 | 2.31 | 53.95 | 54.00 | 0.05 |

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.5-6: Radiated field strength measurement results for 802.11n HT20

| Channel | Frequency, MHz | Peak Field strength, dB μ V/m | | Margin, dB | Average Field strength, dB μ V/m | | Margin, dB |
|---------|-------------------|-----------------------------------|-------|---------------|--------------------------------------|-------|---------------|
| | | Measured | Limit | | Measured | Limit | |
| Low | 2390.0 | 72.09 | 74.00 | 1.91 | 53.01 | 54.00 | 0.99 |
| Low | 4824.0 | 57.17 | 74.00 | 16.83 | 41.69 | 54.00 | 12.31 |
| Mid | 4874.0 | 57.38 | 74.00 | 16.62 | 41.50 | 54.00 | 12.50 |
| High | 2483.5 | 70.33 | 74.00 | 3.67 | 53.92 | 54.00 | 0.08 |

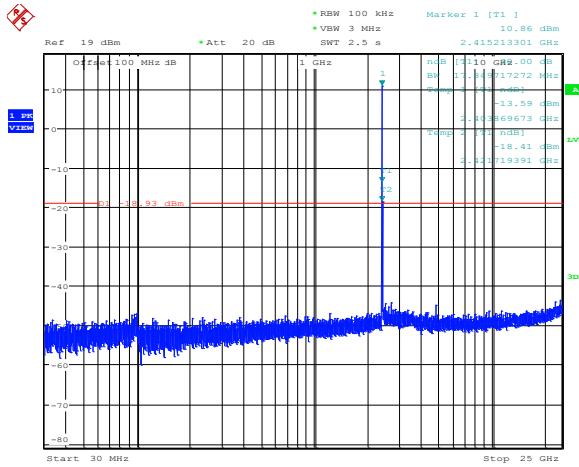
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.5-7: Radiated field strength measurement results for 802.11n HT40

| Channel | Frequency, MHz | Peak Field strength, dB μ V/m | | Margin, dB | Average Field strength, dB μ V/m | | Margin, dB |
|---------|-------------------|-----------------------------------|-------|---------------|--------------------------------------|-------|---------------|
| | | Measured | Limit | | Measured | Limit | |
| Low | 2390.0 | 70.24 | 74.00 | 3.76 | 53.36 | 54.00 | 0.64 |
| Mid | 4874.0 | 54.55 | 74.00 | 19.45 | 40.46 | 54.00 | 13.54 |
| High | 2483.5 | 69.45 | 74.00 | 4.55 | 23.58 | 54.00 | 30.42 |

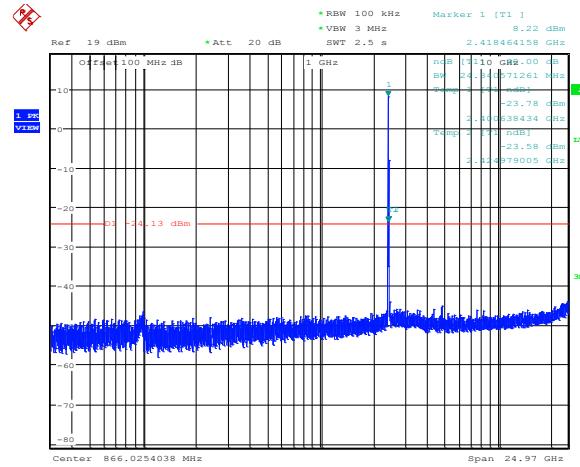
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

8.5.4 Test data, continued



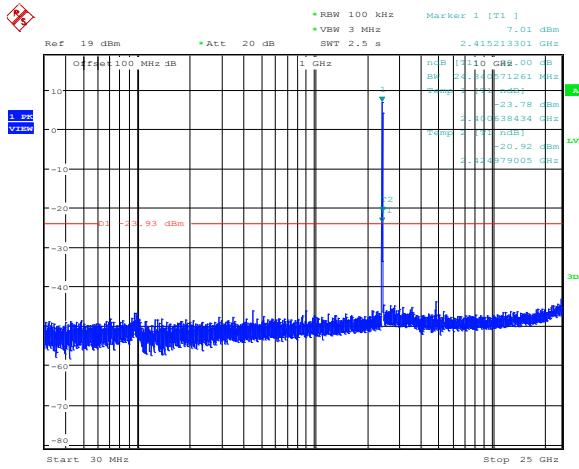
Date: 10.APR.2013 16:21:19

Figure 8.5-1: Conducted spurious emissions for 802.11b, cho, low channel



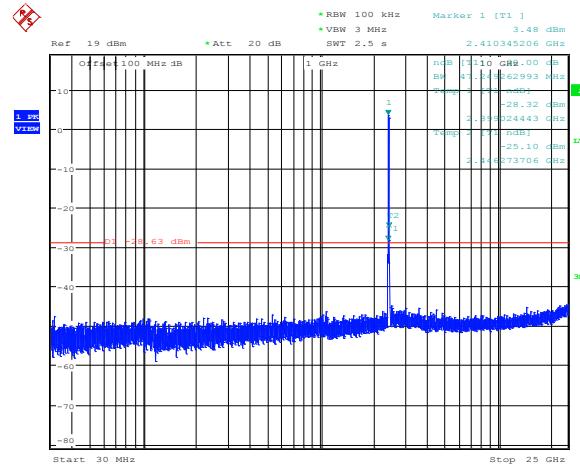
Date: 10.APR.2013 16:17:13

Figure 8.5-2: Conducted spurious emissions for 802.11g, cho, low channel



Date: 10.APR.2013 16:20:42

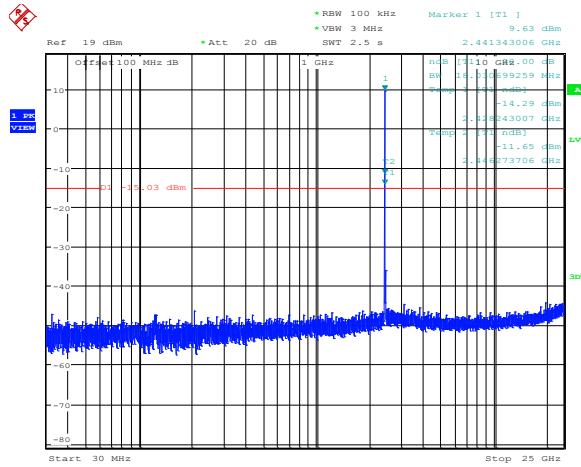
Figure 8.5-3: Conducted spurious emissions for 802.11n HT20, cho, low channel



Date: 10.APR.2013 16:24:29

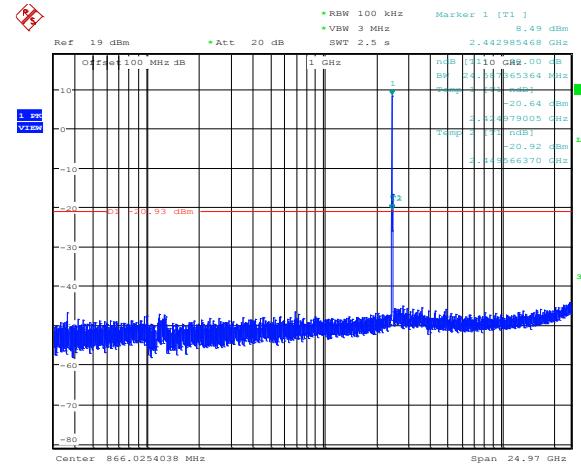
Figure 8.5-4: Conducted spurious emissions for 802.11n HT40, cho, low channel

8.5.4 Test data, continued



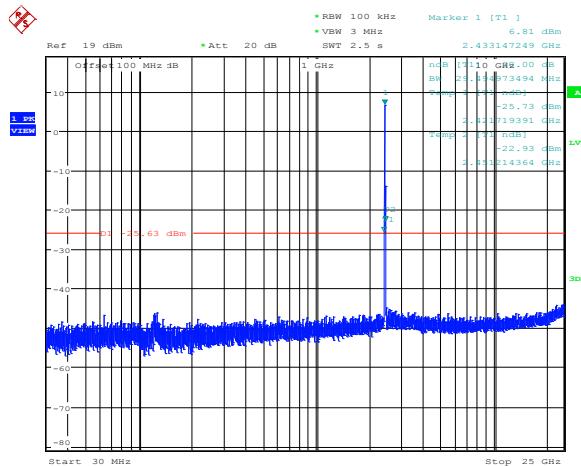
Date: 10.APR.2013 16:21:55

Figure 8.5-5: Conducted spurious emissions for 802.11b, ch0, mid channel



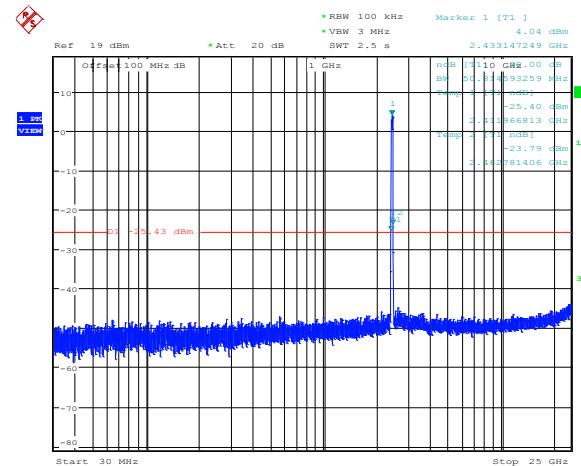
Date: 10.APR.2013 16:18:01

Figure 8.5-6: Conducted spurious emissions for 802.11g, ch0, mid channel



Date: 10.APR.2013 16:20:01

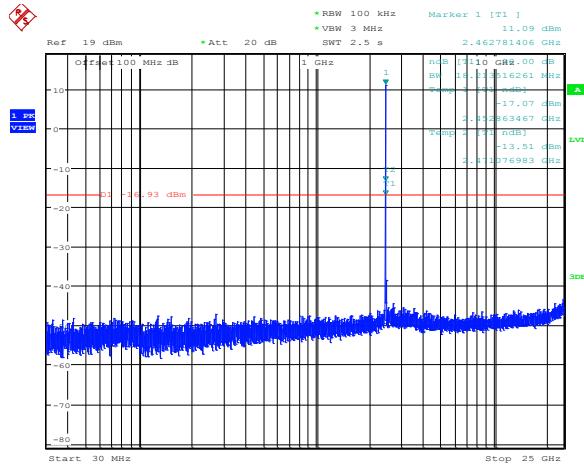
Figure 8.5-7: Conducted spurious emissions for 802.11n HT20, ch0, mid channel



Date: 10.APR.2013 16:23:54

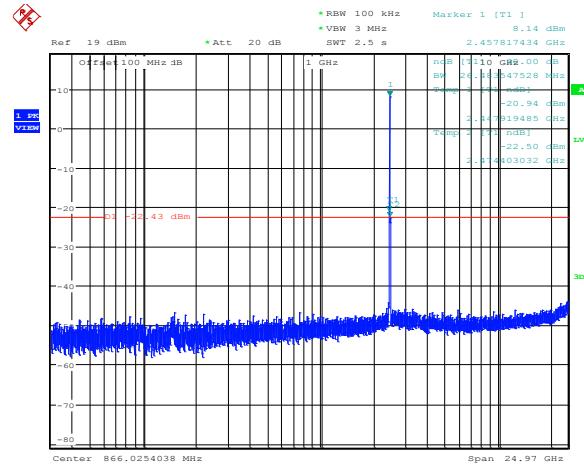
Figure 8.5-8: Conducted spurious emissions for 802.11n HT40, cho, mid channel

8.5.4 Test data, continued



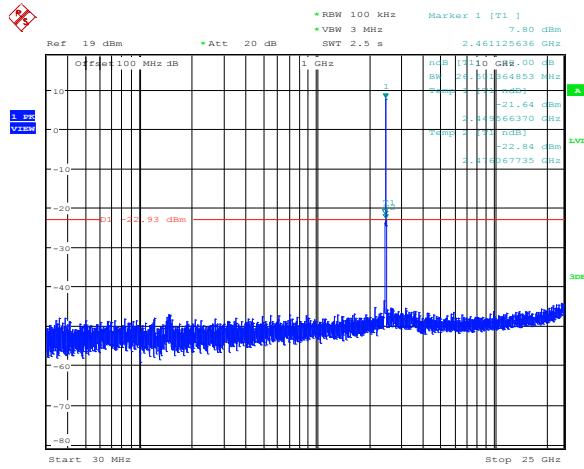
Date: 10.APR.2013 16:22:23

Figure 8.5-9: Conducted spurious emissions for 802.11b, cho, high channel



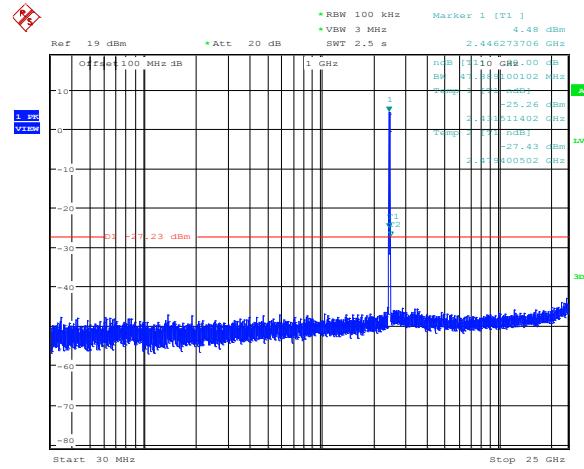
Date: 10.APR.2013 16:18:34

Figure 8.5-10: Conducted spurious emissions for 802.11g, cho, high channel



Date: 10.APR.2013 16:19:23

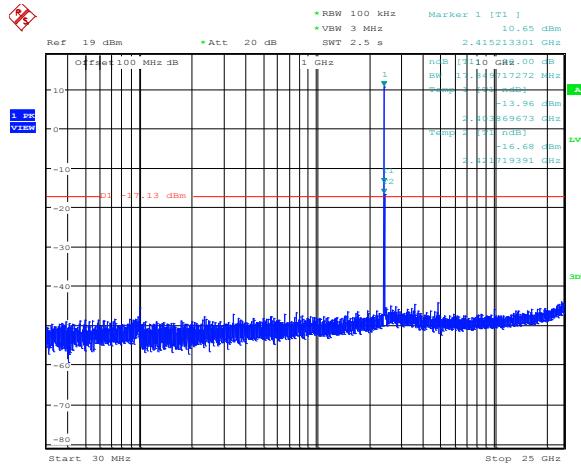
Figure 8.5-11: Conducted spurious emissions for 802.11n HT20, cho, high channel



Date: 10.APR.2013 16:23:19

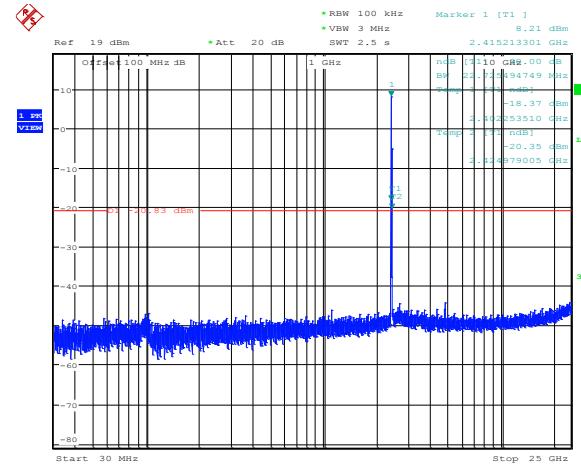
Figure 8.5-12: Conducted spurious emissions for 802.11n HT40, cho, high channel

8.5.4 Test data, continued



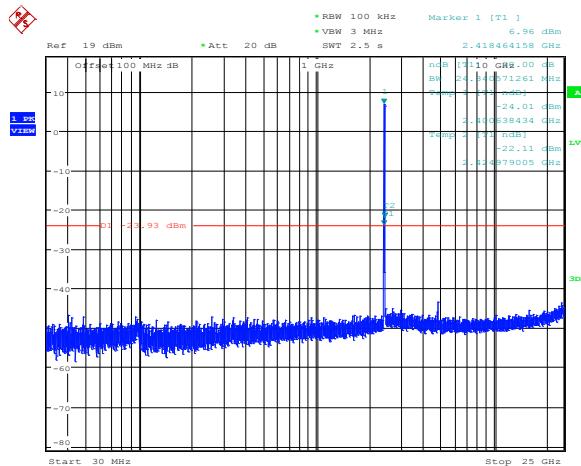
Date: 10.APR.2013 16:44:49

Figure 8.5-13: Conducted spurious emissions for 802.11b, ch1, low channel



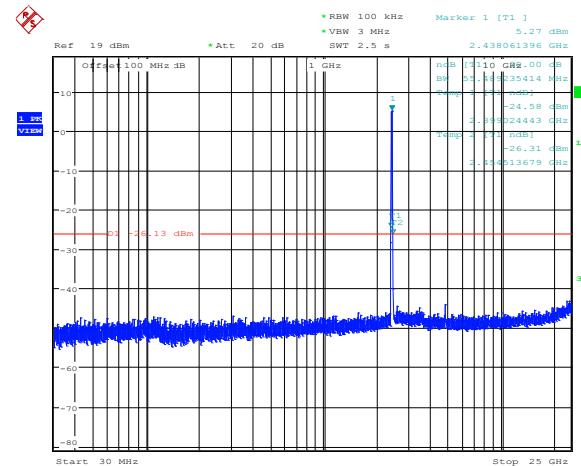
Date: 10.APR.2013 16:35:21

Figure 8.5-14: Conducted spurious emissions for 802.11g, ch1, low channel



Date: 10.APR.2013 16:36:05

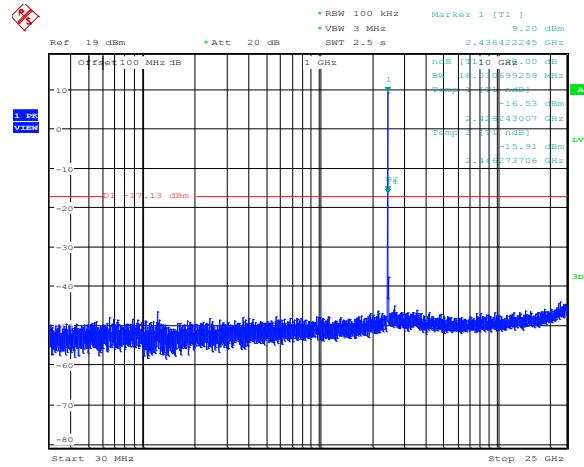
Figure 8.5-15: Conducted spurious emissions for 802.11n HT20, ch1, low channel



Date: 10.APR.2013 16:26:28

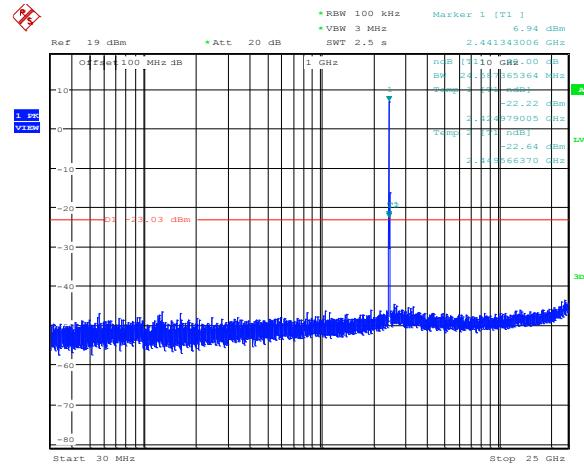
Figure 8.5-16: Conducted spurious emissions for 802.11n HT40, ch1, low channel

8.5.4 Test data, continued



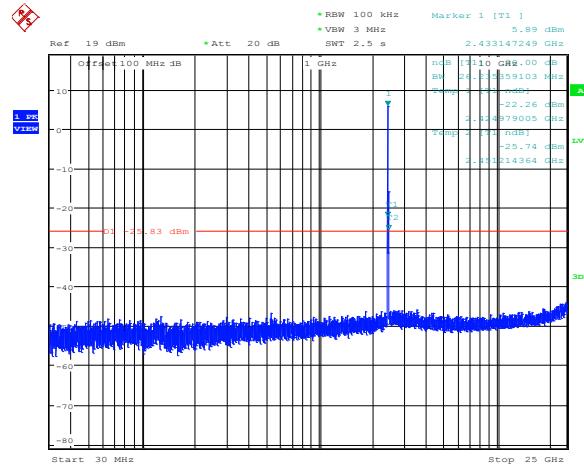
Date: 10.APR.2013 16:41:20

Figure 8.5-17: Conducted spurious emissions for 802.11b, ch1, mid channel



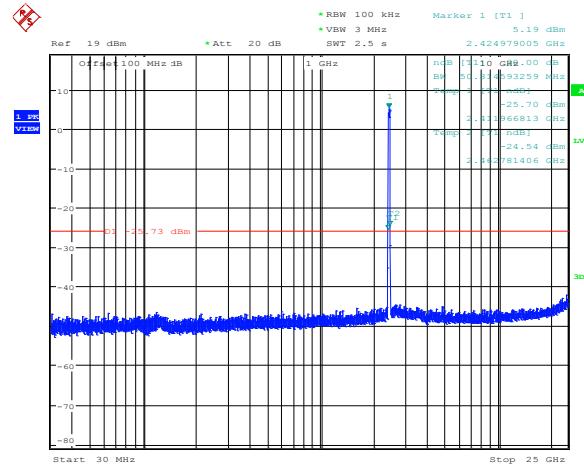
Date: 10.APR.2013 16:34:38

Figure 8.5-18: Conducted spurious emissions for 802.11g, ch1, mid channel



Date: 10.APR.2013 16:36:44

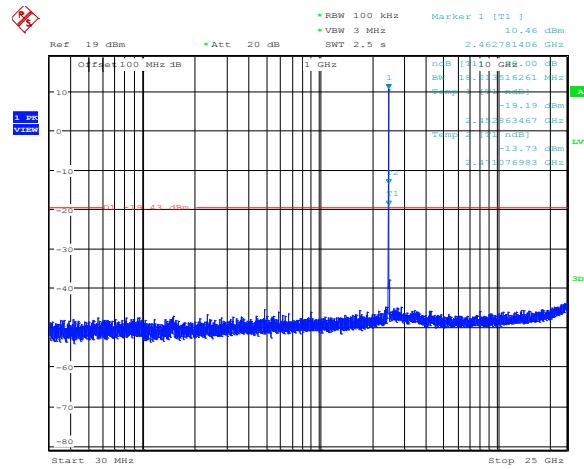
Figure 8.5-19: Conducted spurious emissions for 802.11n HT20, ch1, mid channel



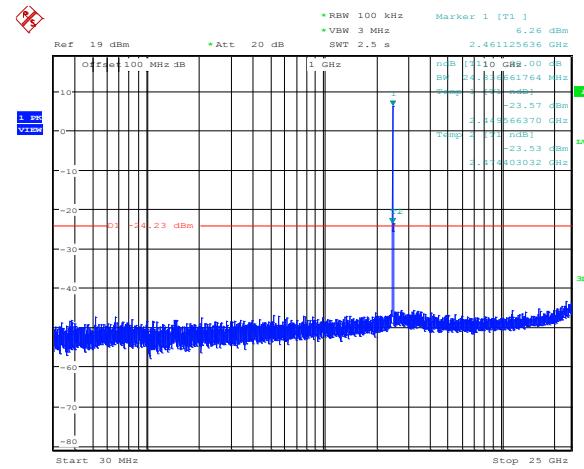
Date: 10.APR.2013 16:32:05

Figure 8.5-20: Conducted spurious emissions for 802.11n HT40, ch1, mid channel

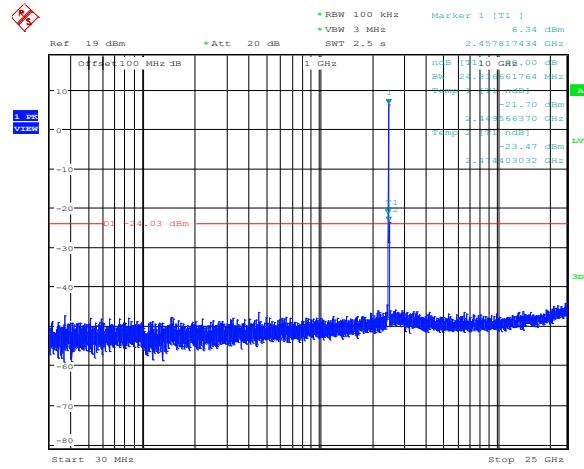
8.5.4 Test data, continued



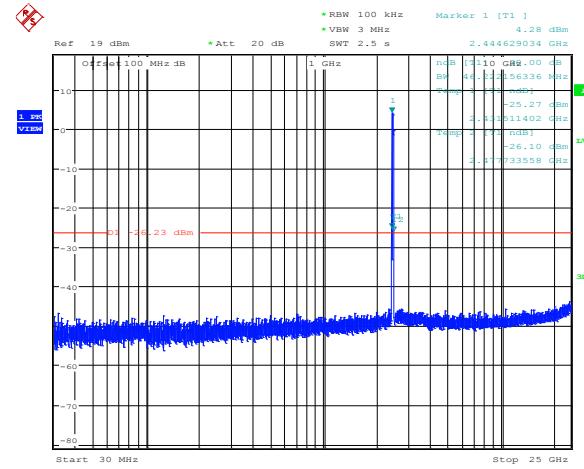
Date: 10.APR.2013 16:39:41



Date: 10.APR.2013 16:33:54

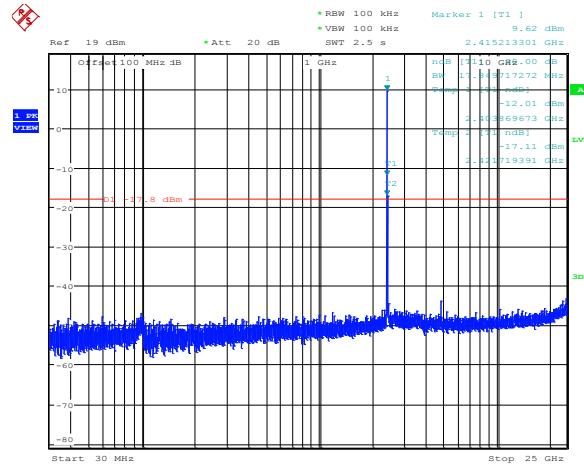


Date: 10.APR.2013 16:37:28



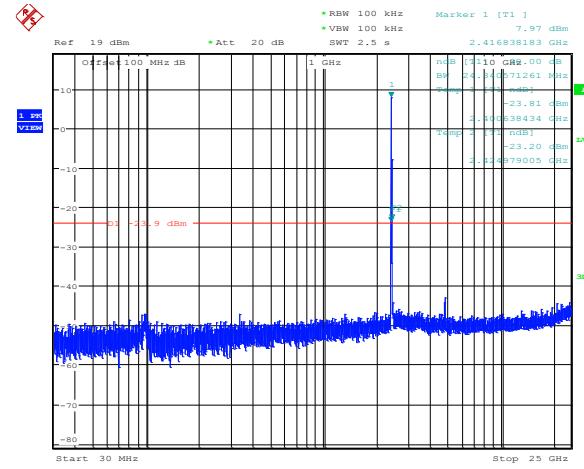
Date: 10.APR.2013 16:33:04

8.5.4 Test data, continued



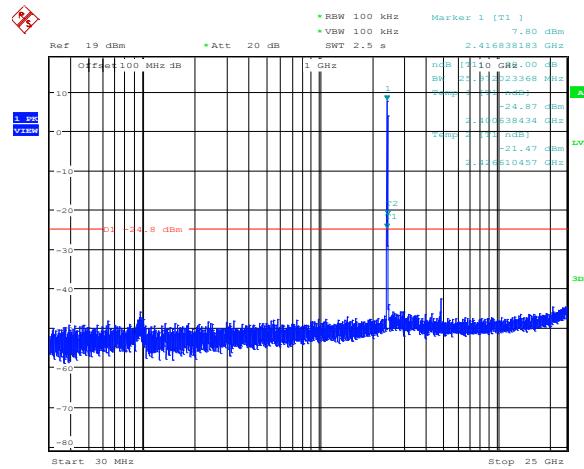
Date: 9.APR.2013 16:49:08

Figure 8.5-25: Conducted spurious emissions for 802.11b, ch2, low channel



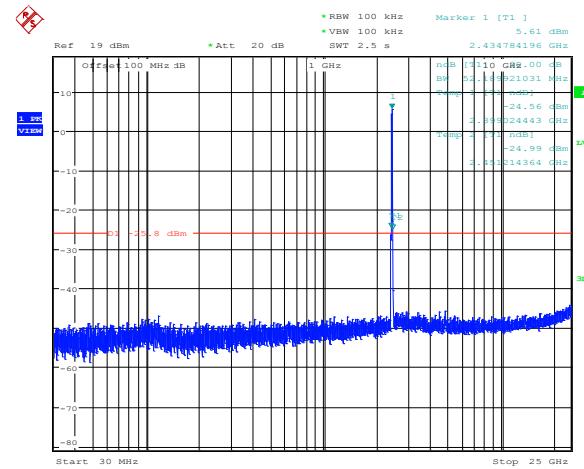
Date: 9.APR.2013 16:45:23

Figure 8.5-26: Conducted spurious emissions for 802.11g, ch2, low channel



Date: 9.APR.2013 16:48:24

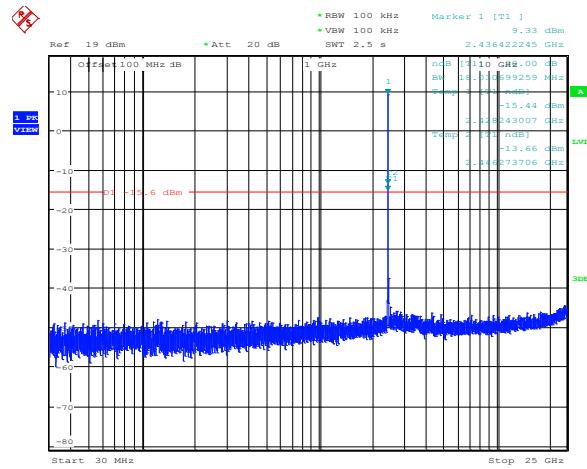
Figure 8.5-27: Conducted spurious emissions for 802.11n HT20, ch2, low channel



Date: 9.APR.2013 16:44:48

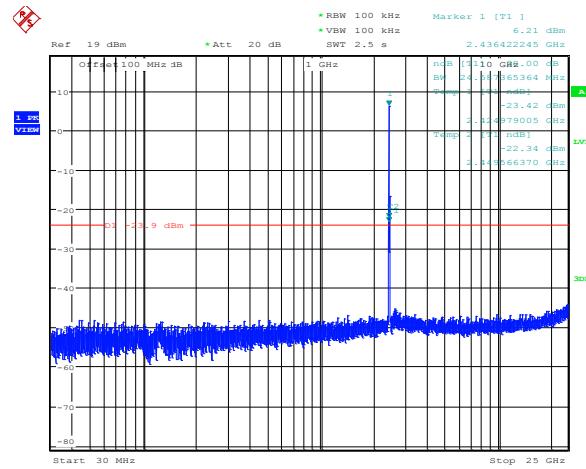
Figure 8.5-28: Conducted spurious emissions for 802.11n HT40, ch2, low channel

8.5.4 Test data, continued



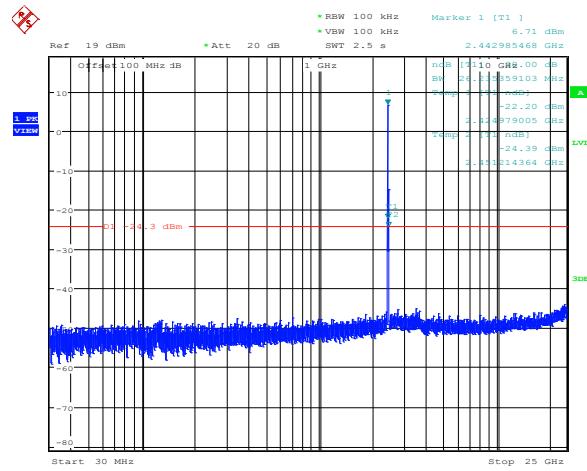
Date: 9.APR.2013 16:49:42

Figure 8.5-29: Conducted spurious emissions for 802.11b, ch2, mid channel



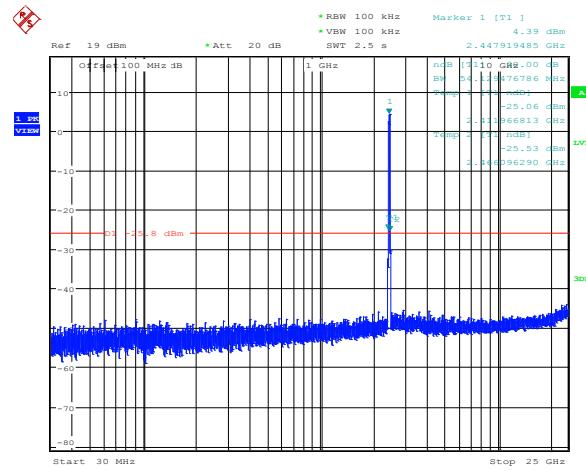
Date: 9.APR.2013 16:45:50

Figure 8.5-30: Conducted spurious emissions for 802.11g, ch2, mid channel



Date: 9.APR.2013 16:47:45

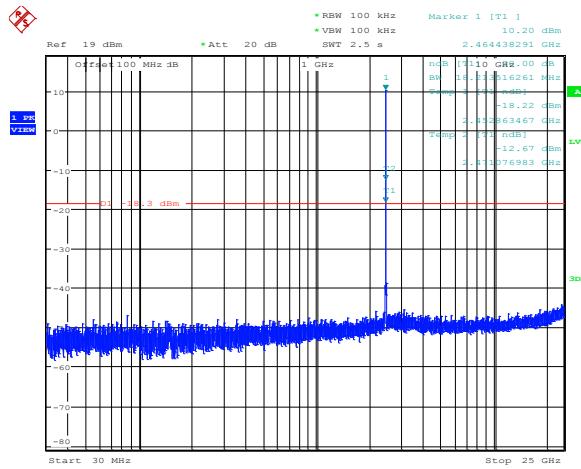
Figure 8.5-31: Conducted spurious emissions for 802.11n HT20, ch2, mid channel



Date: 9.APR.2013 16:44:12

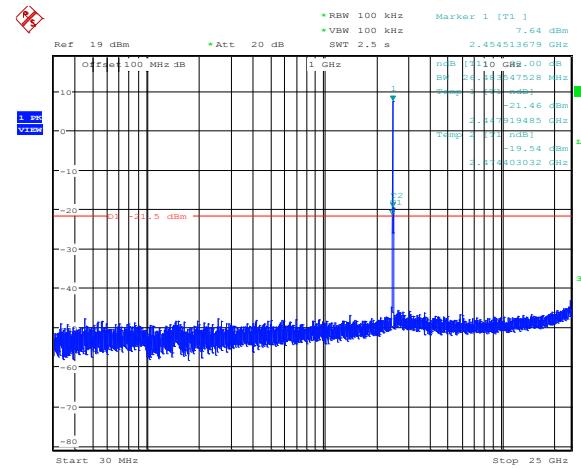
Figure 8.5-32: Conducted spurious emissions for 802.11n HT40, ch2, mid channel

8.5.4 Test data, continued



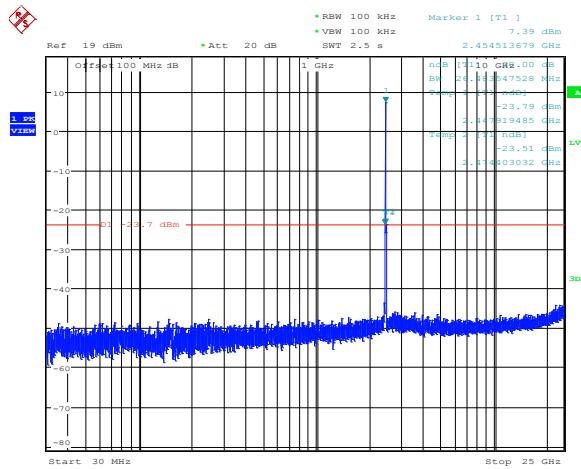
Date: 9.APR.2013 16:50:20

Figure 8.5-33: Conducted spurious emissions for 802.11b, ch2, high channel



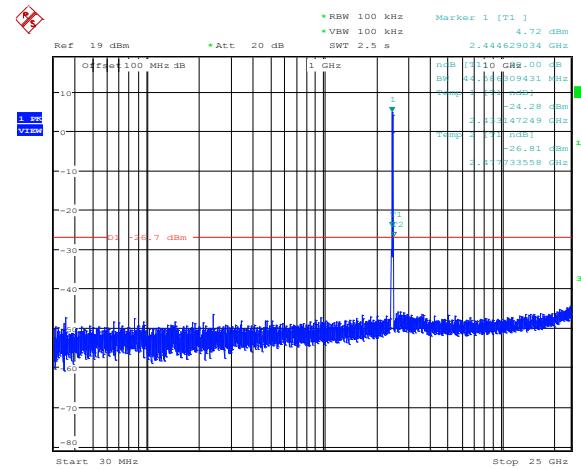
Date: 9.APR.2013 16:46:21

Figure 8.5-34: Conducted spurious emissions for 802.11g, ch2, high channel



Date: 9.APR.2013 16:47:04

Figure 8.5-35: Conducted spurious emissions for 802.11n HT20, ch2, high channel



Date: 9.APR.2013 16:43:21

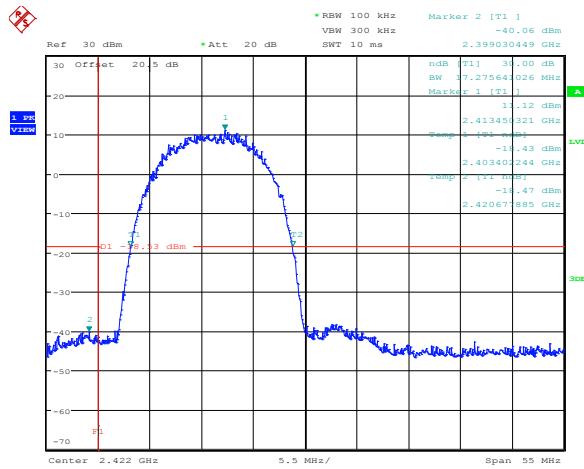
Figure 8.5-36: Conducted spurious emissions for 802.11n HT40, ch2, high channel

Table 8.5-8: Radiated field strength measurement results below 1 GHz

| Frequency, MHz | Peak Field strength, dB μ V/m | Limit, dB μ V/m | Margin, dB |
|-------------------|--------------------------------------|------------------------|---------------|
| 128.47 | 32.93 | 43.50 | 10.57 |
| 169.48 | 33.42 | 43.50 | 10.08 |
| 250.02 | 33.79 | 47.50 | 13.71 |

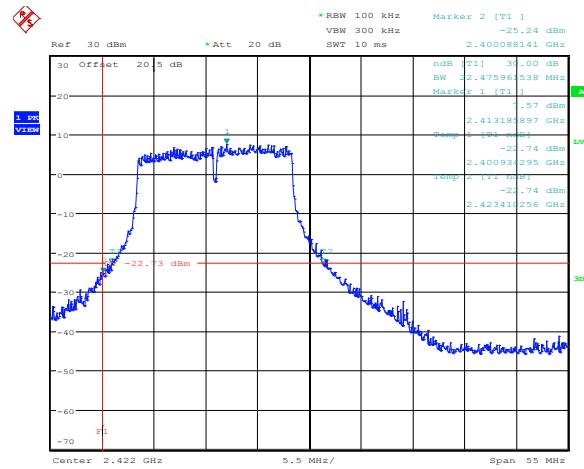
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

8.5.4 Test data, continued



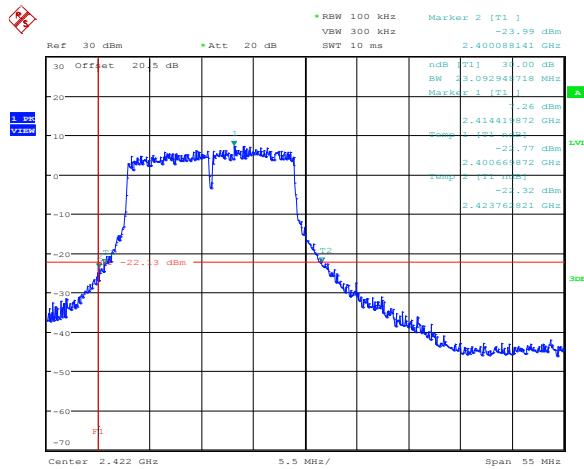
Date: 10.APR.2013 16:57:40

Figure 8.5-37: Conducted lower band edge for 802.11b, cho



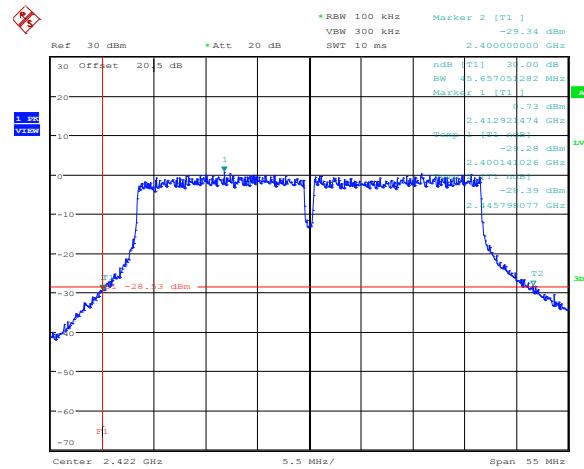
Date: 10.APR.2013 16:59:01

Figure 8.5-38: Conducted lower band edge for 802.11g, cho



Date: 10.APR.2013 16:58:31

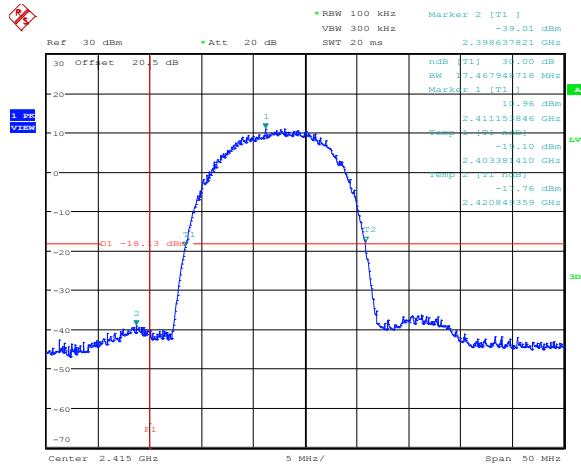
Figure 8.5-39: Conducted lower band edge for 802.11n HT20, cho



Date: 10.APR.2013 16:56:50

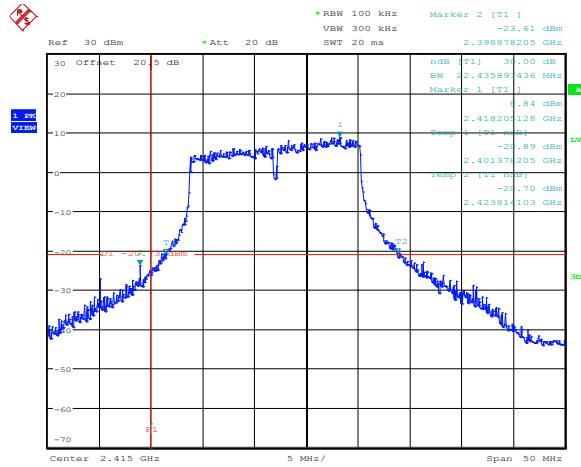
Figure 8.5-40: Conducted lower band edge for 802.11n HT40, cho

8.5.4 Test data, continued



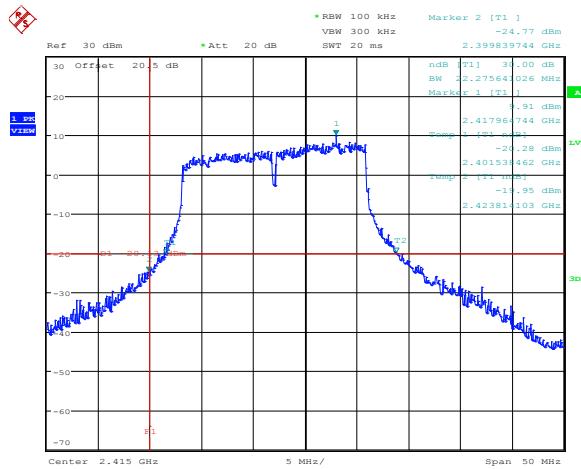
Date: 10.APR.2013 16:48:07

Figure 8.5-41: Conducted lower band edge for 802.11b, ch1



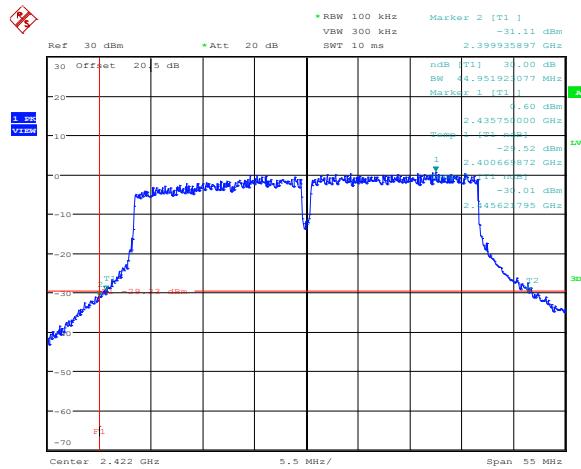
Date: 10.APR.2013 16:49:56

Figure 8.5-42: Conducted lower band edge for 802.11g, ch1



Date: 10.APR.2013 16:48:56

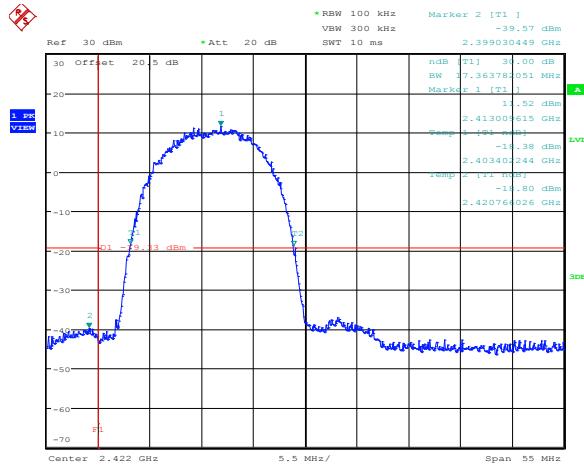
Figure 8.5-43: Conducted lower band edge for 802.11n HT20, ch1



Date: 10.APR.2013 16:52:16

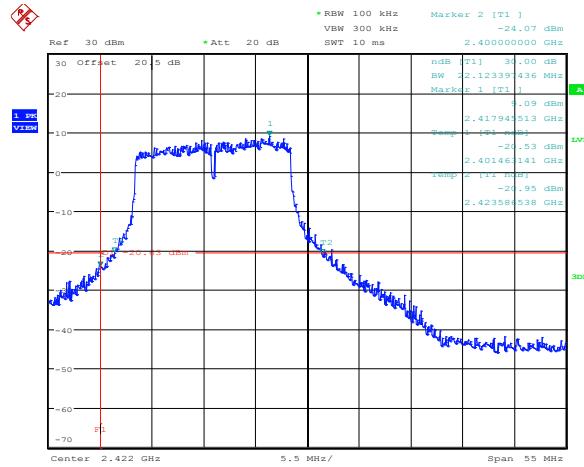
Figure 8.5-44: Conducted lower band edge for 802.11n HT40, ch1

8.5.4 Test data, continued



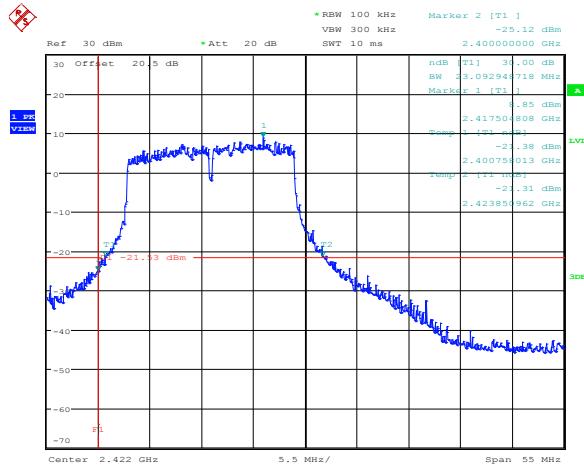
Date: 10.APR.2013 17:01:32

Figure 8.5-45: Conducted lower band edge for 802.11b, ch2



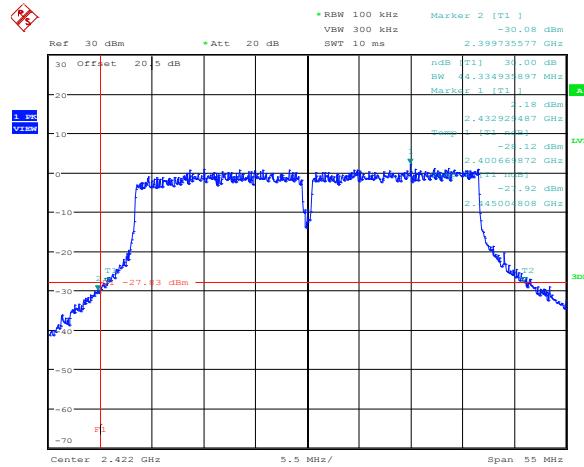
Date: 10.APR.2013 17:00:17

Figure 8.5-46: Conducted lower band edge for 802.11g, ch2



Date: 10.APR.2013 17:00:47

Figure 8.5-47: Conducted lower band edge for 802.11n HT20, ch2



Date: 10.APR.2013 17:02:07

Figure 8.5-48: Conducted lower band edge for 802.11n HT40, ch2

8.6 FCC 15.247(e) and RSS-210 A8.2(b) Power spectral density for digitally modulated devices

8.6.1 Definitions and limits

FCC:

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

IC:

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration. This power spectral density shall be determined in accordance with the provisions of Section A8.4(4); (i.e. the power spectral density shall be determined using the same method for determining the conducted output power).

8.6.2 Test summary

| | | | |
|----------------|-----------------|--------------------|-----------|
| Test date: | April 9, 2013 | Temperature: | 23 °C |
| Test engineer: | Andrey Adelberg | Air pressure: | 1006 mbar |
| Verdict: | Pass | Relative humidity: | 36 % |

8.6.3 Observations, settings and special notes

The test was performed using method described in section 9.2 Option 2 of the 558074 D01 DTS Meas Guidance v03r01.
Spectrum analyser settings:

| | |
|--------------------------|---|
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 1 MHz |
| Frequency span: | 15 MHz (1.5 × DTS channel BW for 802.11b), 30 MHz (1.5 × DTS channel BW for 802.11g and 802.11n HT20) and to 56 MHz (1.5 × DTS channel BW for 802.11n HT40) |
| Detector mode: | RMS |
| Trace mode: | Power average |
| Averaging sweeps number: | 100 |

Combined PSD for MIMO 2 × 2 application was calculated as follows: $PSD_{combined} = 10 \times \log_{10} \left((10^{PSD_{ch0}/10}) + (10^{PSD_{ch1}/10}) \right)$

Combined PSD for MIMO 3 × 3 application was calculated as follows: $PSD_{combined} = 10 \times \log_{10} \left((10^{PSD_{ch0}/10}) + (10^{PSD_{ch1}/10}) + (10^{PSD_{ch2}/10}) \right)$

8.6.4 Test data

Table 8.6-1: PSD measurements results for SISO 1 × 1 application

| Modulation | Frequency, MHz | PSD, dBm/100 kHz | PSD limit, dBm/3 kHz | Margin, dB |
|--------------|----------------|------------------|----------------------|--------------|
| 802.11b | 2412 | 1.19 | 8.00 | 6.81 |
| | 2437 | 1.31 | 8.00 | 6.69 |
| | 2462 | 1.25 | 8.00 | 6.75 |
| 802.11g | 2422 | -0.91 | 8.00 | 8.91 |
| | 2437 | 0.87 | 8.00 | 7.13 |
| | 2457 | -0.23 | 8.00 | 8.23 |
| 802.11n HT20 | 2412 | -1.38 | 8.00 | 9.38 |
| | 2437 | 0.80 | 8.00 | 7.20 |
| | 2462 | -0.66 | 8.00 | 8.66 |
| 802.11n HT40 | 2422 | -9.72 | 8.00 | 17.72 |
| | 2437 | -3.07 | 8.00 | 11.07 |
| | 2457 | -7.49 | 8.00 | 15.49 |

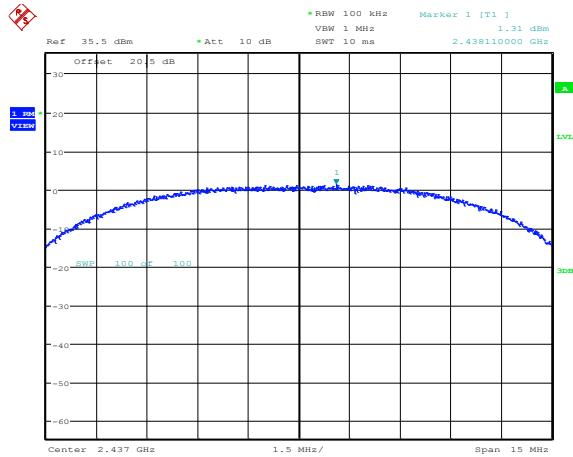
Table 8.6-2: PSD measurements results for MIMO 2 × 2 application

| Modulation | Frequency, MHz | Measured peak spectral density, dBm/100 kHz | | | PSD limit, dBm/3 kHz | Margin, dB |
|--------------|----------------|---|---------|--------------|----------------------|--------------|
| | | On ch0, | On ch1, | Combined | | |
| 802.11b | 2412 | 1.19 | 1.38 | 4.30 | 8.00 | 3.70 |
| | 2437 | 1.31 | 1.21 | 4.27 | 8.00 | 3.73 |
| | 2462 | 1.25 | 1.09 | 4.18 | 8.00 | 3.82 |
| 802.11g | 2422 | -0.91 | -0.01 | 2.57 | 8.00 | 5.43 |
| | 2437 | 0.87 | -0.12 | 3.41 | 8.00 | 4.59 |
| | 2457 | -0.23 | -1.16 | 2.34 | 8.00 | 5.66 |
| 802.11n HT20 | 2412 | -1.38 | -0.31 | 2.20 | 8.00 | 5.80 |
| | 2437 | 0.80 | -0.51 | 3.20 | 8.00 | 4.80 |
| | 2462 | -0.66 | -1.59 | 1.91 | 8.00 | 6.09 |
| 802.11n HT40 | 2422 | -9.72 | -7.98 | -5.75 | 8.00 | 13.75 |
| | 2437 | -3.07 | -2.81 | 0.07 | 8.00 | 7.93 |
| | 2457 | -7.49 | -7.96 | -4.71 | 8.00 | 12.71 |

Table 8.6-3: PSD measurements results for MIMO 3 × 3 application

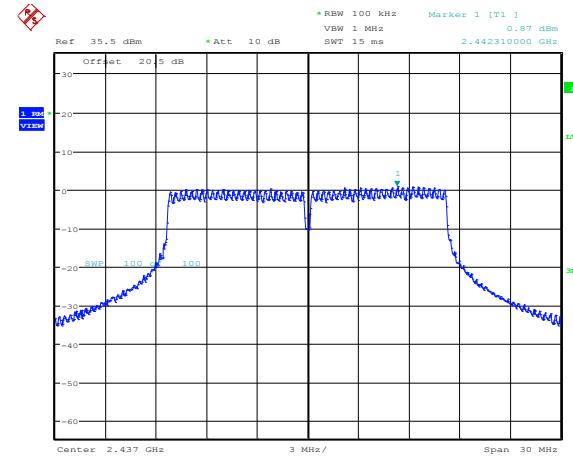
| Modulation | Frequency, MHz | Measured peak spectral density, dBm/100 kHz | | | | PSD limit, dBm/3 kHz | Margin, dB |
|--------------|----------------|---|---------|---------|--------------|----------------------|--------------|
| | | On ch0, | On ch1, | On ch2, | Combined | | |
| 802.11b | 2412 | 1.19 | 1.38 | 1.85 | 6.25 | 8.00 | 1.75 |
| | 2437 | 0.73 | 1.21 | 1.09 | 5.79 | 8.00 | 2.21 |
| | 2462 | 1.25 | 1.09 | 0.95 | 5.87 | 8.00 | 2.13 |
| 802.11g | 2422 | -0.91 | -0.01 | -0.05 | 4.47 | 8.00 | 3.53 |
| | 2437 | -0.05 | -0.12 | -0.11 | 4.68 | 8.00 | 3.32 |
| | 2457 | -0.23 | -1.16 | -0.62 | 4.12 | 8.00 | 3.88 |
| 802.11n HT20 | 2412 | -1.38 | -0.31 | -0.34 | 4.12 | 8.00 | 3.88 |
| | 2437 | -0.02 | -0.51 | -0.56 | 4.41 | 8.00 | 3.59 |
| | 2462 | -0.66 | -1.59 | -1.16 | 3.65 | 8.00 | 4.35 |
| 802.11n HT40 | 2422 | -9.64 | -7.72 | -8.60 | -3.81 | 8.00 | 11.81 |
| | 2437 | -3.47 | -3.44 | -3.82 | 1.20 | 8.00 | 6.80 |
| | 2457 | -7.73 | -7.96 | -7.96 | -3.11 | 8.00 | 11.11 |

8.6.4 Test data, continued



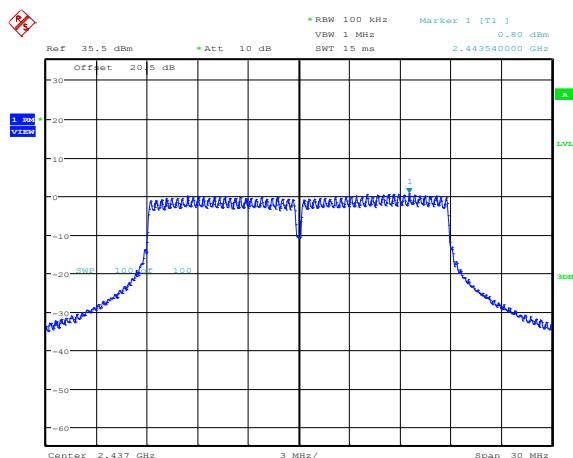
Date: 9.APR.2013 13:42:02

Figure 8.6-1: PSD sample plot on 802.11b



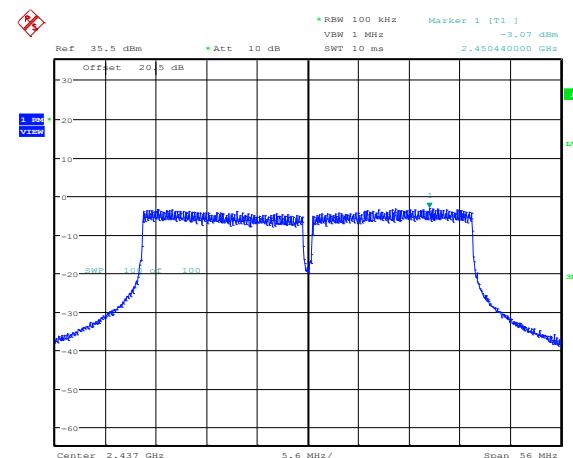
Date: 9.APR.2013 13:40:31

Figure 8.6-2: PSD sample plot on 802.11g



Date: 9.APR.2013 13:41:09

Figure 8.6-3: PSD sample plot on 802.11n HT20

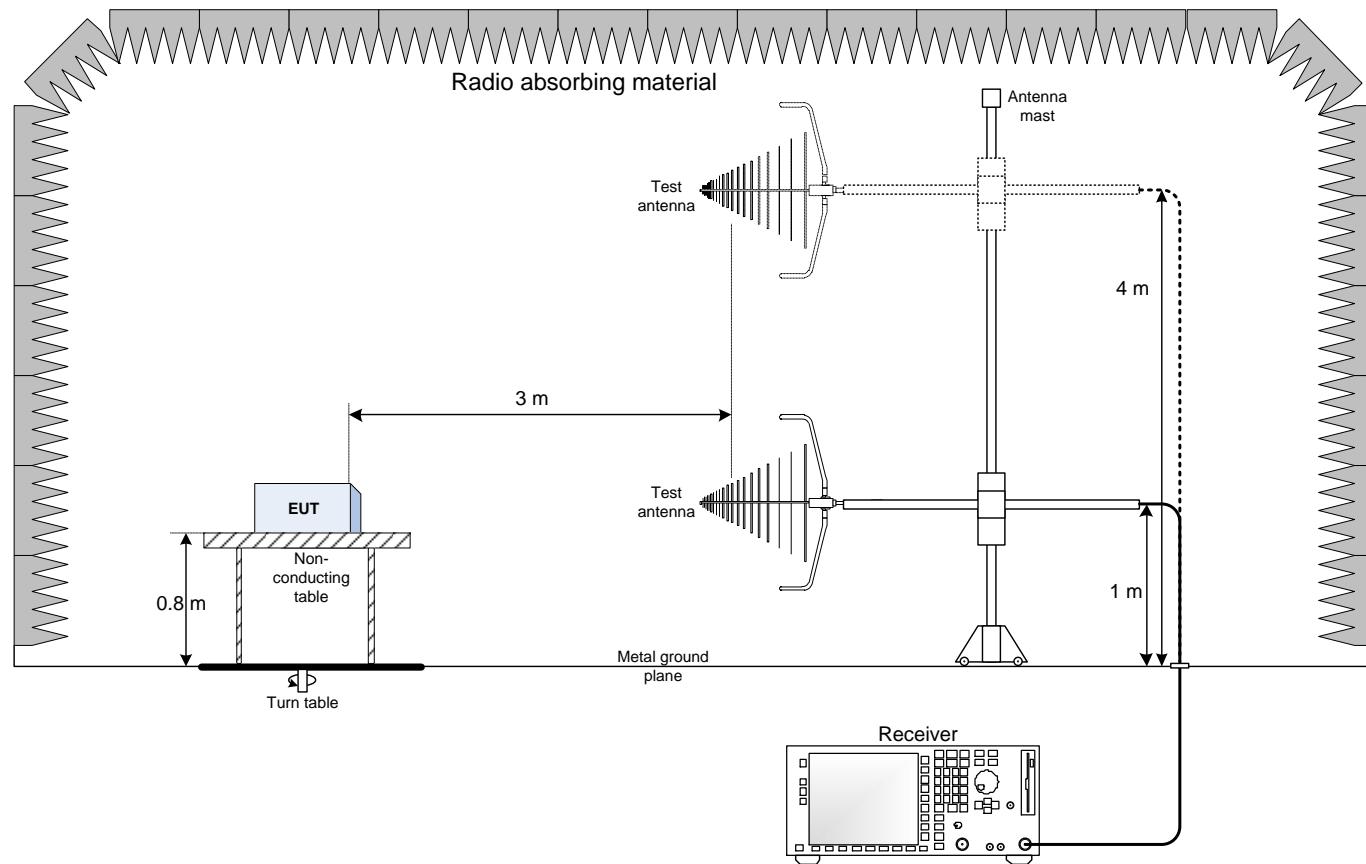


Date: 9.APR.2013 13:44:55

Figure 8.6-4: PSD sample plot on 802.11n HT40

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up

