ONE WORLD ○ OUR APPROVAL

Test report

261299-14TRFWL

Date of issue: June 11, 2014

Applicant:

Ericsson WiFi Inc.

Product:

Wi-Fi Access Point

Model:

BelAir20EO-11x

Model variants:

20EO-11A, 20EO-11B, 20EO-11C, 20EO-11D, 20EO-11E

FCC ID:

RAR80005000

IC Registration number:

4674A-40005011

Specifications:

- FCC 47 CFR Part 15 Subpart C, §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

Test location

Company name:	Nemko Canada Inc.
Address:	303 River Road
City:	Ottawa
Province:	Ontario
Postal code:	K1V 1H2
Country:	Canada
Telephone:	+1 613 737 9680
Facsimile:	+1 613 737 9691
Toll free:	+1 800 563 6336
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:	October 24, 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 contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of contents

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)&(4)	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)&(4)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§15.247(b)(3)&(4)	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(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	September 11, 2013
Nemko sample ID number	1

3.2 EUT information

Product name	Wi-Fi Access Point
Model	BelAir20EO-11x
Model variants	Please refer to the table 3.3–1 below for complete list of model variants
Serial number	201352811804

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 %)	13.75 MHz (802.11b); 16.97 MHz (802.11g); 18.03 MHz (802.11n HT20); 36.78 MHz (802.11n HT40)
Emission designator	W7D
Power requirements	48 V_{DC} via PoE at 120 V_{AC}, 60 Hz or direct AC mains connection to 120 V_{AC}, 60 Hz
Antenna information	The EUT is professionally installed. For the antenna variants refer to table 3.3–1 below.

Table 3.3-1: *Product model variants*

Product/Configuration	Powering	Antenna type	Antenna gain, dBi
20EO-11A	AC	Two internal, omnidirectional	4.4
20EO-11B	AC	Two internal, omnidirectional	4.4
20EO-11C	AC	Two internal, directional, cross polarized	8
20EO-11D	AC	Two external, directional, cross polarized	8
20EO-11E	AC	Two internal, directional, cross polarized	12

Note: cross polarized antennas are such as one of the transmitter outputs is a 90-degree phase-shifted replica of the other and the phase centers of the two antennas are co-located.

3.4 Product description and theory of operation

The EUT is a 2×2 MIMO combo Wi-Fi module designed to operate in the 2.4–2.4835 GHz band, and 5 GHz ISM and UNII bands.
There are two independent radio units. This report covers only the 2.4 GHz 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

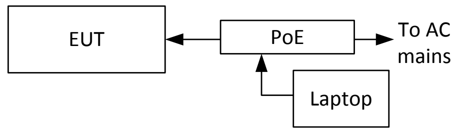


Figure 3.6-1: *Setup diagram*

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
PoE adapter	Cincon Electronics Co., Ltd.	TRG60A-POE-L	RD Sample 4 1127

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 ±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 source	California Instruments	3001i	FA001021	1 year	June 04/14
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Feb. 28/14
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Jan. 10/14
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Feb. 21/14
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Feb. 21/14
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 21/14

Note: NCR - no calibration required

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 μH/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 μH line impedance stabilization network (LISN).

Table 8.1-1: *Conducted emissions limit*

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

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

8.1.2 Test summary

Test date	June 19, 2013	Temperature	24 °C
Test engineer	Andrey Adelberg	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	30 %

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.

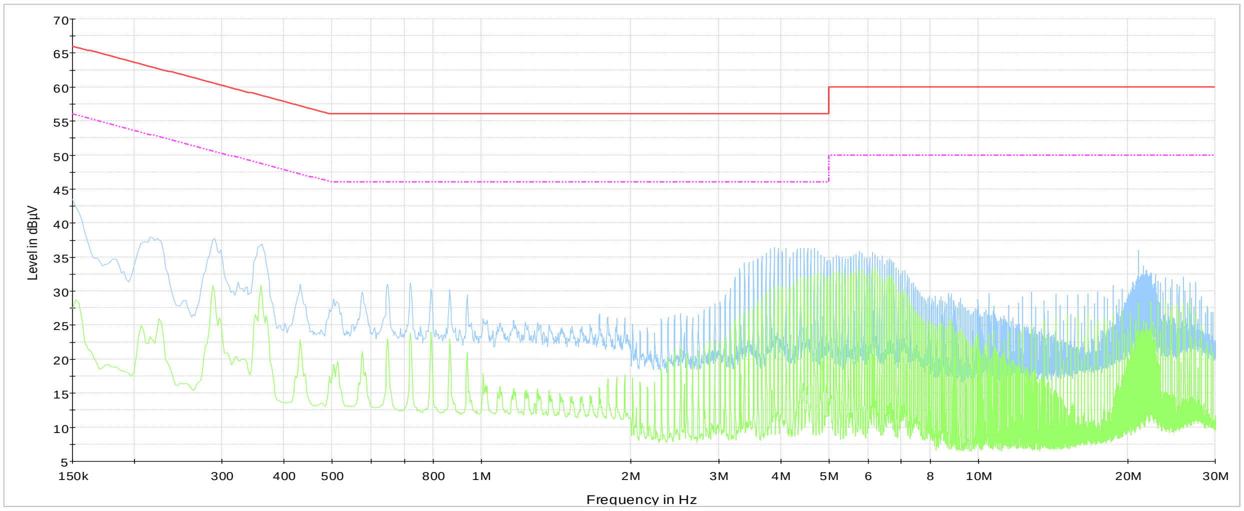
Receiver settings for preview measurements:

Resolution bandwidth:	9 kHz
Video bandwidth:	30 kHz
Detector mode:	Peak and Average
Trace mode:	Max Hold
Measurement time:	1000 ms

Receiver settings for final measurements:

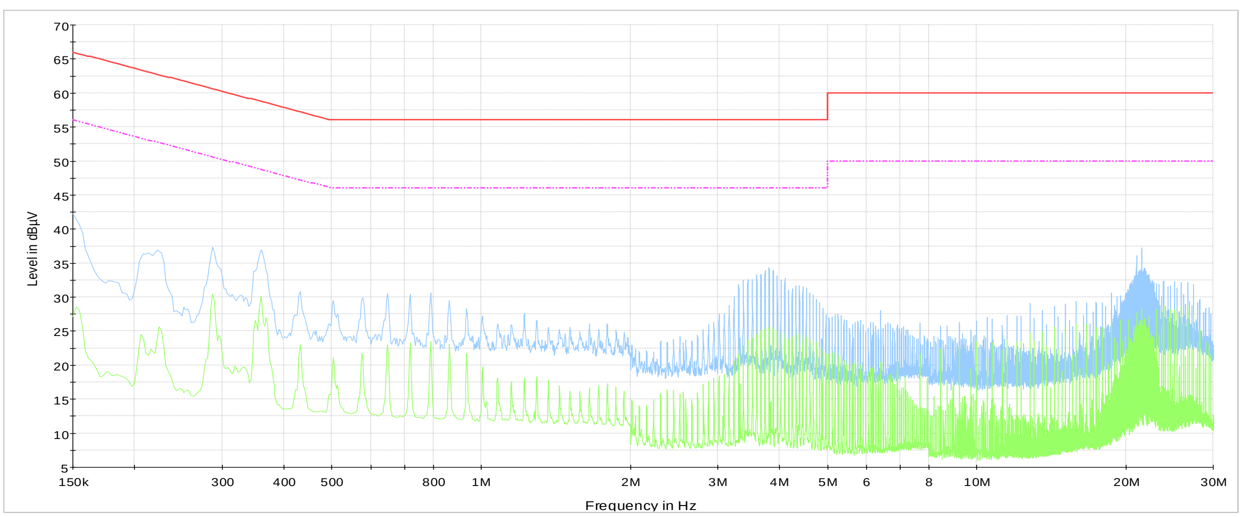
Resolution bandwidth:	9 kHz
Video bandwidth:	30 kHz
Detector mode:	Quasi-Peak and Average
Trace mode:	Max Hold
Measurement time:	1000 ms

8.1.4 Test data



Conducted emissions on phase line
CISPR 22 Mains QP Class B
CISPR 22 Mains AV Class B
Preview Result 1-PK+
Preview Result 2-AVG

Plot 8.1-1: *Conducted emissions on phase line*



Conducted emissions on neutral line
CISPR 22 Mains QP Class B
CISPR 22 Mains AV Class B
Preview Result 1-PK+
Preview Result 2-AVG

Plot 8.1-2: *Conducted emissions on neutral line*

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:	June 20, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1003 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 ch0*

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11b	2412	**11.04**	**0.50**	**10.54**
	2437	**10.64**	**0.50**	**10.14**
	2462	**10.90**	**0.50**	**10.40**
802.11g	2412	**16.63**	**0.50**	**16.13**
	2437	**16.55**	**0.50**	**16.05**
	2462	**16.53**	**0.50**	**16.03**
802.11n HT20	2412	**17.83**	**0.50**	**17.33**
	2437	**17.80**	**0.50**	**17.30**
	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	**36.56**	**0.50**	**36.06**

Note: Margin = 6 dB bandwidth result – Minimum limit

8.2.4 Test data, continued

Table 8.2-2: *6 dB bandwidth results for ch1*

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11b	2412	**10.87**	**0.50**	**10.37**
	2437	**10.56**	**0.50**	**10.06**
	2462	**11.00**	**0.50**	**10.50**
802.11g	2412	**16.59**	**0.50**	**16.09**
	2437	**16.58**	**0.50**	**16.08**
	2462	**16.58**	**0.50**	**16.08**
802.11n HT20	2412	**17.84**	**0.50**	**17.34**
	2437	**17.78**	**0.50**	**17.28**
	2462	**17.78**	**0.50**	**17.28**
802.11n HT40	2422	**36.55**	**0.50**	**36.05**
	2437	**36.78**	**0.50**	**36.28**
	2457	**36.79**	**0.50**	**36.29**

Note: Margin = 6 dB bandwidth result – Minimum limit

8.2.4 Test data, continued

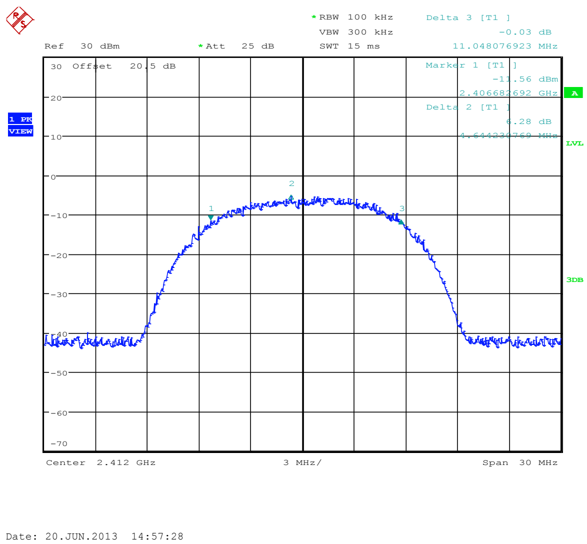


Figure 8.2-1: *6 dB bandwidth on 802.11b, sample plot*

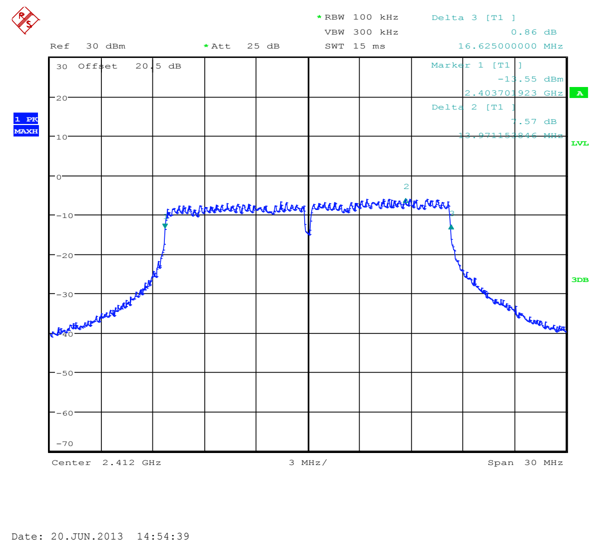


Figure 8.2-2: *6 dB bandwidth on 802.11g, sample plot*

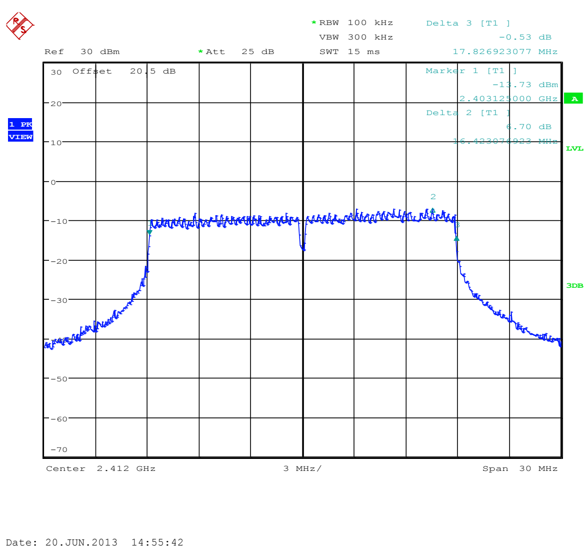


Figure 8.2-3: *6 dB bandwidth on 802.11n HT20, sample plot*

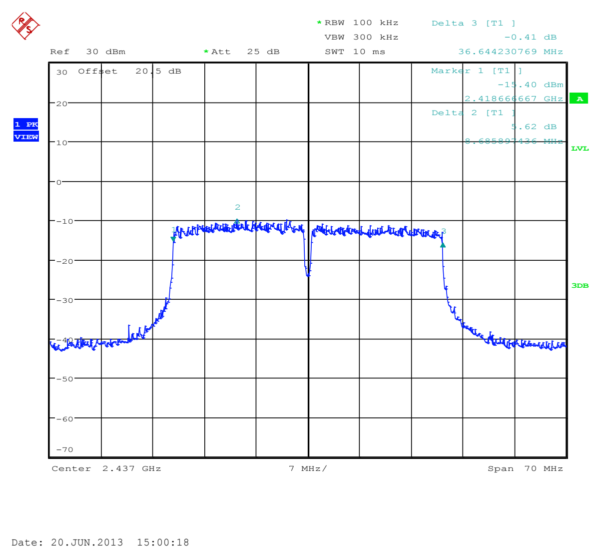


Figure 8.2-4: *6 dB bandwidth on 802.11n HT40, sample plot*

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:	June 20, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

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	**13.75**
802.11g	**16.97**
802.11n HT20	**18.03**
802.11n HT40	**36.78**

8.3.4 Test data, continued

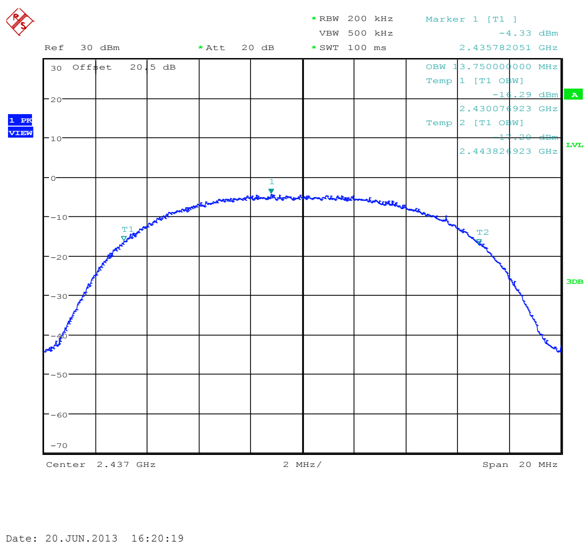


Figure 8.3-1: *99 % bandwidth on 802.11b, sample plot*

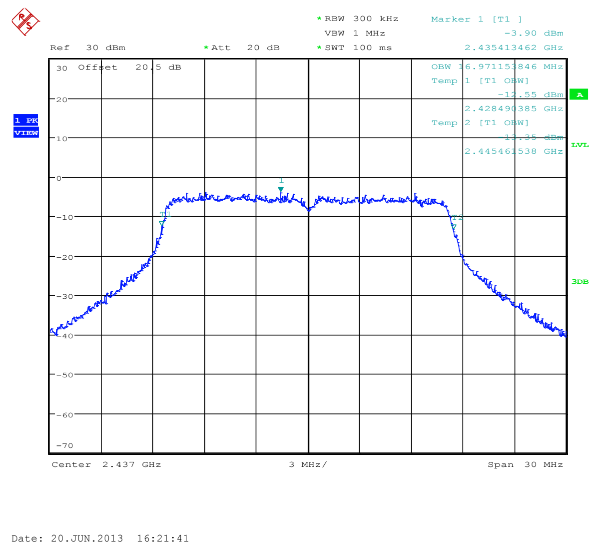


Figure 8.3-2: *99 % bandwidth on 802.11g, sample plot*

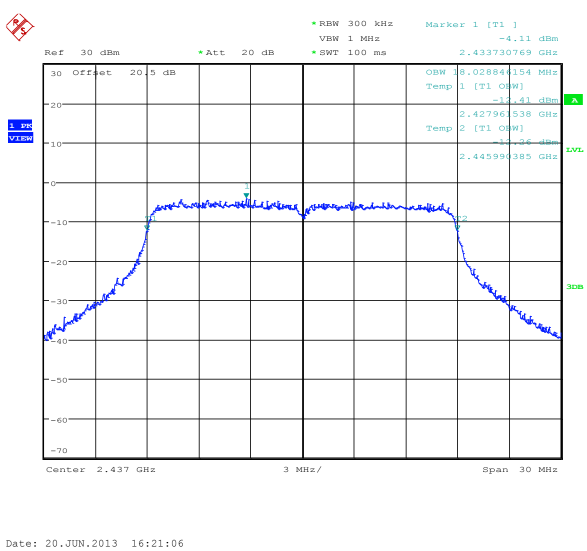


Figure 8.3-3: *99 % bandwidth on 802.11n HT20, sample plot*

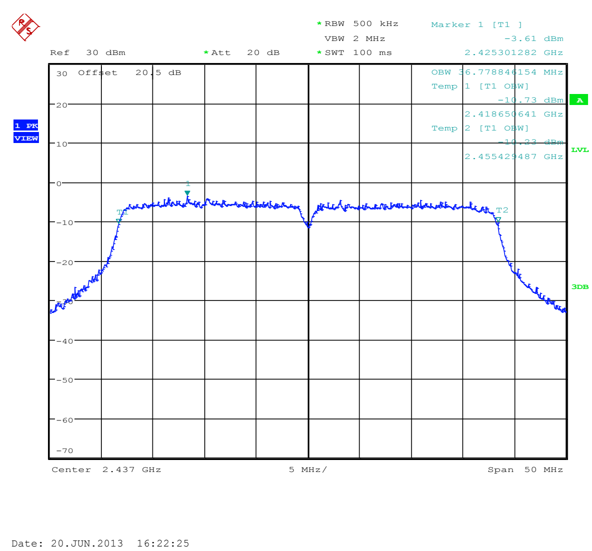


Figure 8.3-4: *99 % bandwidth on 802.11n HT40, sample plot*

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:

<u>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</u>

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:	September 11, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	33 %

8.4.3 Observations, settings and special notes

The test was performed according to DTS guidelines section 9.2.2.2, method AVGSA-1: maximum conducted (average) output power with trace averaging.
The EUT was set to transmit with 100% duty cycle.
Spectrum analyzer settings were as follows:

Span:	1.5 times the OBW
Resolution bandwidth:	1–5 % of the OBW, not to exceed 1 MHz
Video bandwidth:	≥3 × RBW
Detector mode:	RMS
Trace mode:	Power averaging over 100 traces

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

Directional gain for MIMO Correlated 2 × 2 (CDD/TXBF) = 4.4 dBi + 10 × $\log_{10}$ (N) dB = 4.4 dBi + 3 dB = 7.4 dBi, where “N” is number of antennae.
Output power limit was calculated as follows: 30 – (7.4 – 6) = 28.6 dBm

Directional gain for MIMO Uncorrelated (cross polarized) 2 × 2 = 8 dBi. Output power limit was calculated as follows: 30 – (8 – 6) = 28 dBm

Directional gain for MIMO Uncorrelated (cross polarized) 2 × 2 = 12 dBi. Output power limit was calculated as follows: 30 – (12 – 6) = 24 dBm

8.4.4 Test data

Table 8.4-1: *Output power measurements results for MIMO 2 × 2 with 4.4 dBi antenna configuration*

Modulation	Frequency, MHz	Conducted output power, dBm				Margin, dB	Total antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		on ch0	on ch1	Combined	Limit					
802.11b	2412	22.01	20.89	**24.50**	**28.60**	**4.10**	7.40	**31.90**	**36.00**	**4.10**
	2437	22.68	22.65	**25.68**	**28.60**	**2.92**	7.40	**33.08**	**36.00**	**2.92**
	2462	21.36	19.33	**23.47**	**28.60**	**5.13**	7.40	**30.87**	**36.00**	**5.13**
802.11g	2412	16.43	15.09	**18.82**	**28.60**	**9.78**	7.40	**26.22**	**36.00**	**9.78**
	2437	22.47	22.53	**25.51**	**28.60**	**3.09**	7.40	**32.91**	**36.00**	**3.09**
	2462	17.60	16.40	**20.05**	**28.60**	**8.55**	7.40	**27.45**	**36.00**	**8.55**
802.11n HT20	2412	17.20	15.87	**19.60**	**28.60**	**9.00**	7.40	**27.00**	**36.00**	**9.00**
	2437	22.42	22.57	**25.51**	**28.60**	**3.09**	7.40	**32.91**	**36.00**	**3.09**
	2462	15.43	14.97	**18.22**	**28.60**	**10.38**	7.40	**25.62**	**36.00**	**10.38**
802.11n HT40	2422	14.50	13.45	**17.02**	**28.60**	**11.58**	7.40	**24.42**	**36.00**	**11.58**
	2437	22.95	22.55	**25.76**	**28.60**	**2.84**	7.40	**33.16**	**36.00**	**2.84**
	2457	16.71	16.63	**19.68**	**28.60**	**8.92**	7.40	**27.08**	**36.00**	**8.92**

Table 8.4-2: *Output power measurements results for MIMO 2 × 2 with 8 dBi antenna configuration*

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	17.24	16.17	**19.75**	**28.00**	**8.25**	8.00	**27.75**	**36.00**	**8.25**
	2437	18.35	18.37	**21.37**	**28.00**	**6.63**	8.00	**29.37**	**36.00**	**6.63**
	2462	15.73	14.64	**18.23**	**28.00**	**9.77**	8.00	**26.23**	**36.00**	**9.77**
802.11g	2412	16.90	15.48	**19.26**	**28.00**	**8.74**	8.00	**27.26**	**36.00**	**8.74**
	2437	18.03	17.80	**20.93**	**28.00**	**7.07**	8.00	**28.93**	**36.00**	**7.07**
	2462	15.41	14.54	**18.01**	**28.00**	**9.99**	8.00	**26.01**	**36.00**	**9.99**
802.11n HT20	2412	18.36	14.86	**19.96**	**28.00**	**8.04**	8.00	**27.96**	**36.00**	**8.04**
	2437	18.06	17.89	**20.99**	**28.00**	**7.01**	8.00	**28.99**	**36.00**	**7.01**
	2462	15.43	14.97	**18.22**	**28.00**	**9.78**	8.00	**26.22**	**36.00**	**9.78**
802.11n HT40	2422	15.05	13.88	**17.51**	**28.00**	**10.49**	8.00	**25.51**	**36.00**	**10.49**
	2437	21.32	20.82	**24.09**	**28.00**	**3.91**	8.00	**32.09**	**36.00**	**3.91**
	2457	13.81	13.80	**16.82**	**28.00**	**11.18**	8.00	**24.82**	**36.00**	**11.18**

8.4.4 Test data, continued

Table 8.4-3: *Output power measurements results for MIMO 2 × 2 with 12 dBi antenna configuration*

Modulation	Frequency, MHz	Conducted output power, dBm on ch0	Conducted output power, dBm on ch1	Conducted output power, dBm Combined	Conducted output power, dBm Limit	Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
802.11b	2412	19.46	17.96	**21.78**	**24.00**	**2.22**	12.00	**33.78**	**36.00**	**2.22**
	2437	20.95	20.79	**23.88**	**24.00**	**0.12**	12.00	**35.88**	**36.00**	**0.12**
	2462	16.77	16.15	**19.48**	**24.00**	**4.52**	12.00	**31.48**	**36.00**	**4.52**
802.11g	2412	20.50	20.50	**23.51**	**24.00**	**0.49**	12.00	**35.51**	**36.00**	**0.49**
	2437	20.91	20.99	**23.96**	**24.00**	**0.04**	12.00	**35.96**	**36.00**	**0.04**
	2462	17.50	17.50	**20.51**	**24.00**	**3.49**	12.00	**32.51**	**36.00**	**3.49**
802.11n HT20	2412	20.50	20.50	**23.51**	**24.00**	**0.49**	12.00	**35.51**	**36.00**	**0.49**
	2437	20.74	20.99	**23.88**	**24.00**	**0.12**	12.00	**35.88**	**36.00**	**0.12**
	2462	17.50	17.50	**20.51**	**24.00**	**3.49**	12.00	**32.51**	**36.00**	**3.49**
802.11n HT40	2422	19.50	19.50	**22.51**	**24.00**	**1.49**	12.00	**34.51**	**36.00**	**1.49**
	2437	20.93	20.82	**23.89**	**24.00**	**0.11**	12.00	**35.89**	**36.00**	**0.11**
	2457	19.50	19.50	**22.51**	**24.00**	**1.49**	12.00	**34.51**	**36.00**	**1.49**

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	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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 emissions 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: *FCC and IC (combined) restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677-5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

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 the standard.

8.5.2 Test summary

Test date:	June 21, 2013	Temperature:	21 °C
Test engineer:	Andrey Adelberg	Air pressure:	1005 mbar
Verdict:	Pass	Relative humidity:	37 %

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 outside restricted bands limit is −30 dBc/100 kHz
Peak conducted spurious emissions limit for frequencies that fall within restricted bands is 20 dB greater than the average limits shown above.

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 **radiated** measurements **within restricted bands** above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz (peak); 10 Hz (average)
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for **conducted** spurious emissions measurements **outside restricted bands**:

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

Spectrum analyser settings for peak **conducted** spurious emissions measurements **within restricted bands**:

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

Spectrum analyser settings for average **conducted** spurious emissions measurements **within restricted bands**:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Detector mode:	RMS
Trace mode:	Power averaging over 100 sweeps

8.5.4 Test data

Table 8.5-3: *Radiated field strength measurement results for 802.11b for 12 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	59.54	74.00	14.46	48.46	54.00	5.54
Low	4824	65.72	74.00	8.28	53.15	54.00	0.85
Mid	4874	66.40	74.00	7.60	53.82	54.00	0.18
High	2483.5	60.27	74.00	13.73	48.51	54.00	5.49
High	4925	66.79	74.00	7.21	53.82	54.00	0.18

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

Table 8.5-4: *Radiated field strength measurement results for 802.11g for 12 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	68.65	74.00	5.35	50.78	54.00	3.22
Low	4824	68.24	74.00	5.76	54.00	54.00	0.00
Mid	4874	68.00	74.00	6.00	53.55	54.00	0.45
High	2483.5	59.41	74.00	14.59	48.61	54.00	5.39
High	4925	70.02	74.00	3.98	53.70	54.00	0.30

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 802.11n HT20 for 12 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	69.25	74.00	4.75	52.53	54.00	1.47
Low	4824	68.66	74.00	5.34	53.82	54.00	0.18
Mid	4874	68.78	74.00	5.22	53.46	54.00	0.54
High	2483.5	62.19	74.00	11.81	48.60	54.00	5.40
High	4925	70.17	74.00	3.83	53.54	54.00	0.46

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 HT40 for 12 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	69.56	74.00	4.44	53.84	54.00	0.16
Low	4840	67.22	74.00	6.78	53.51	54.00	0.49
Mid	4874	69.15	74.00	4.85	53.88	54.00	0.12
High	2483.5	72.08	74.00	1.92	52.80	54.00	1.20
High	4915	69.55	74.00	4.45	53.57	54.00	0.43

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

8.5.4 Test data, continued

Table 8.5-7: *Radiated field strength measurement results for 802.11b for 8 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	61.56	74.00	12.44	48.75	54.00	5.25
Low	4824	65.66	74.00	8.34	53.33	54.00	0.67
Mid	4874	66.61	74.00	7.39	53.54	54.00	0.46
High	2483.5	59.31	74.00	14.69	47.87	54.00	6.13
High	4925	66.57	74.00	7.43	53.62	54.00	0.38

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

Table 8.5-8: *Radiated field strength measurement results for 802.11g for 8 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	72.24	74.00	1.76	53.70	54.00	0.30
Low	4824	69.89	74.00	4.11	53.69	54.00	0.31
Mid	4874	68.81	74.00	5.19	53.73	54.00	0.27
High	2483.5	66.34	74.00	7.66	49.74	54.00	4.26
High	4925	69.89	74.00	4.11	53.50	54.00	0.50

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

Table 8.5-9: *Radiated field strength measurement results for 802.11n HT20 for 8 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	69.86	74.00	4.14	53.20	54.00	0.80
Low	4824	69.94	74.00	4.06	53.36	54.00	0.64
Mid	4874	69.41	74.00	4.59	53.71	54.00	0.29
High	2483.5	69.57	74.00	4.43	51.61	54.00	2.39
High	4925	71.23	74.00	2.77	53.75	54.00	0.25

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

Table 8.5-10: *Radiated field strength measurement results for 802.11n HT40 for 8 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB	Average Field strength, dBµV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	69.92	74.00	4.08	53.66	54.00	0.34
Low	4840	67.51	74.00	6.49	53.65	54.00	0.35
Mid	4874	67.65	74.00	6.35	53.61	54.00	0.39
High	2483.5	66.27	74.00	7.73	53.74	54.00	0.26
High	4915	69.34	74.00	4.66	52.86	54.00	1.14

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

8.5.4 Test data, continued

Table 8.5-11: *Radiated field strength measurement results for 802.11b for 4.4 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	65.32	74.00	8.68	53.26	54.00	0.74
Low	4824	66.28	74.00	7.72	53.34	54.00	0.66
Mid	4874	64.21	74.00	9.79	51.98	54.00	2.02
High	2483.5	64.81	74.00	9.19	53.33	54.00	0.67
High	4925	67.61	74.00	6.39	53.82	54.00	0.18

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

Table 8.5-12: *Radiated field strength measurement results for 802.11g for 4.4 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	70.69	74.00	3.31	53.97	54.00	0.03
Low	4824	60.94	74.00	13.06	45.75	54.00	8.25
Mid	4874	67.33	74.00	6.67	53.66	54.00	0.34
High	2483.5	66.72	74.00	7.28	53.00	54.00	1.00
High	4925	67.85	74.00	6.15	52.48	54.00	1.52

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

Table 8.5-13: *Radiated field strength measurement results for 802.11n HT20 for 4.4 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	71.32	74.00	2.68	52.71	54.00	1.29
Low	4824	60.74	74.00	13.26	45.74	54.00	8.26
Mid	4874	66.35	74.00	7.65	52.13	54.00	1.87
High	2483.5	66.18	74.00	7.82	51.97	54.00	2.03
High	4925	66.25	74.00	7.75	47.39	54.00	6.61

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

Table 8.5-14: *Radiated field strength measurement results for 802.11n HT40 for 4.4 dBi antenna*

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2390	73.56	74.00	0.44	52.07	54.00	1.93
Low	4840	52.61	74.00	21.39	39.81	54.00	14.19
Mid	4874	64.54	74.00	9.46	49.67	54.00	4.33
High	2483.5	64.48	74.00	9.52	53.88	54.00	0.12
High	4915	63.08	74.00	10.92	48.05	54.00	5.95

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

8.5.4 Test data, continued

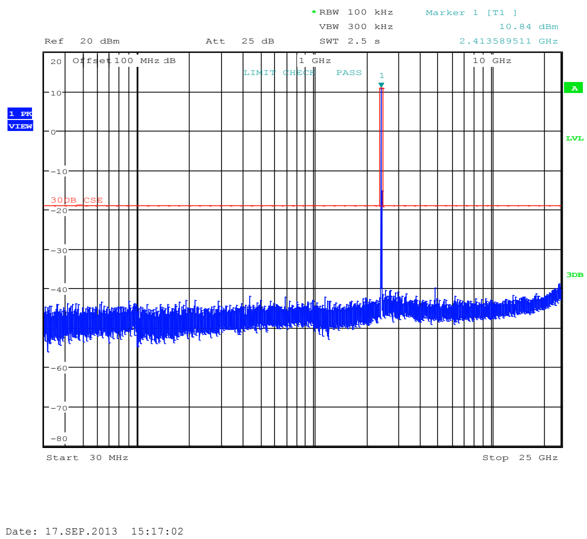


Figure 8.5-1: *Conducted spurious emissions for 802.11b, ch0, low channel*

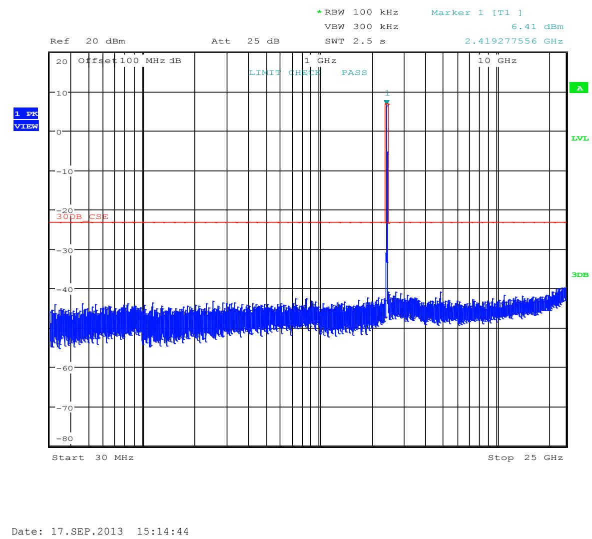


Figure 8.5-2: *Conducted spurious emissions for 802.11g, ch0, low channel*

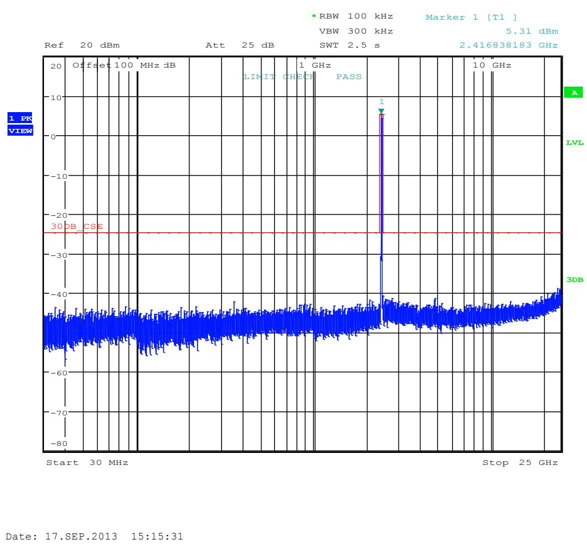


Figure 8.5-3: *Conducted spurious emissions for 802.11n HT20, ch0, low channel*

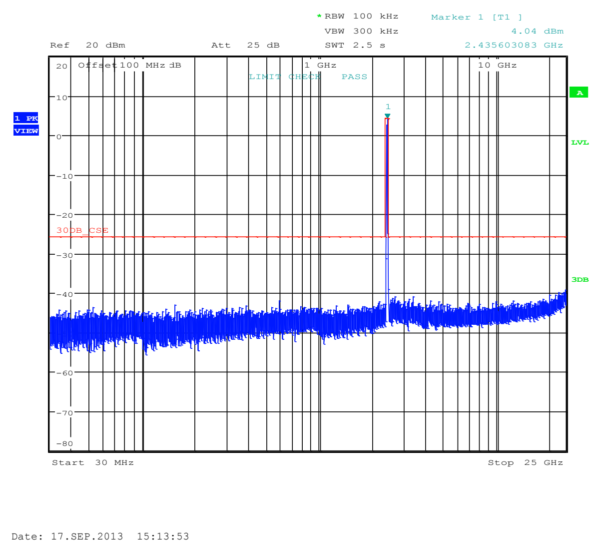


Figure 8.5-4: *Conducted spurious emissions for 802.11n HT40, ch0, low channel*

8.5.4 Test data, continued

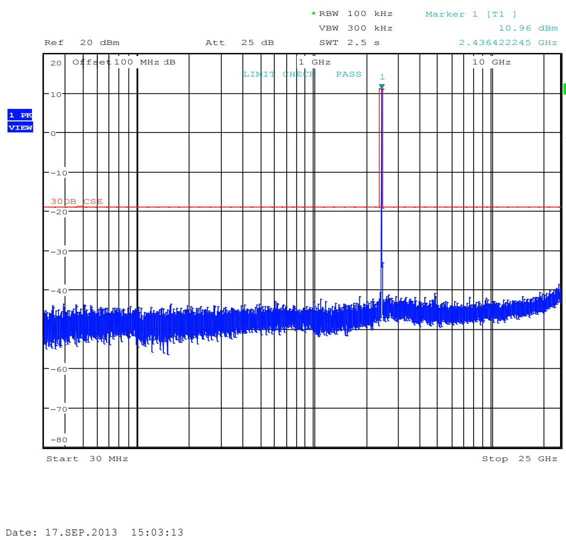


Figure 8.5-5: *Conducted spurious emissions for 802.11b, ch0, mid channel*

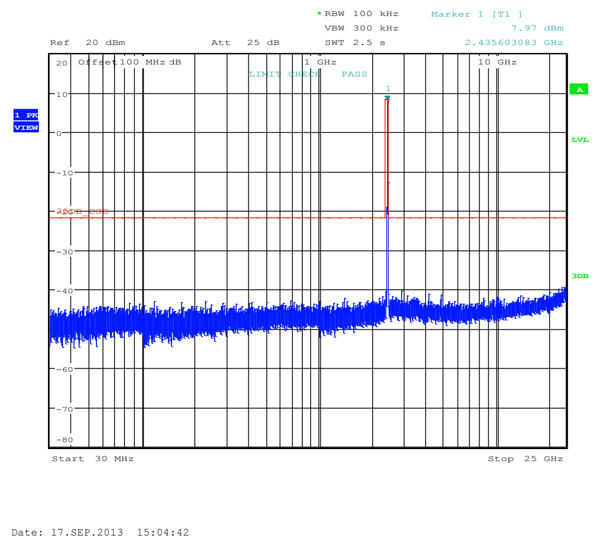


Figure 8.5-6: *Conducted spurious emissions for 802.11g, ch0, mid channel*

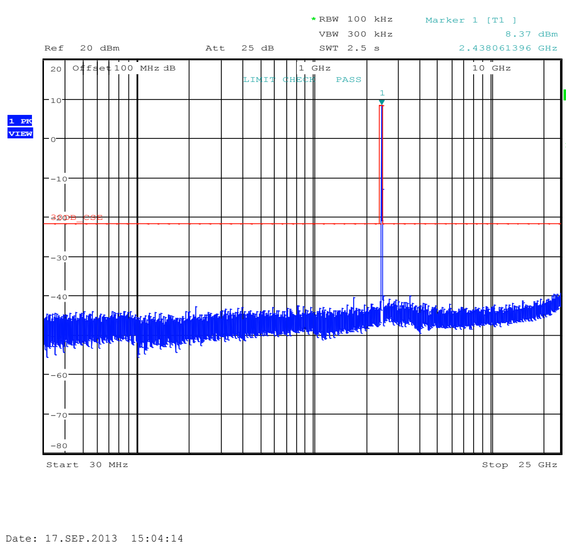


Figure 8.5-7: *Conducted spurious emissions for 802.11n HT20, ch0, mid channel*

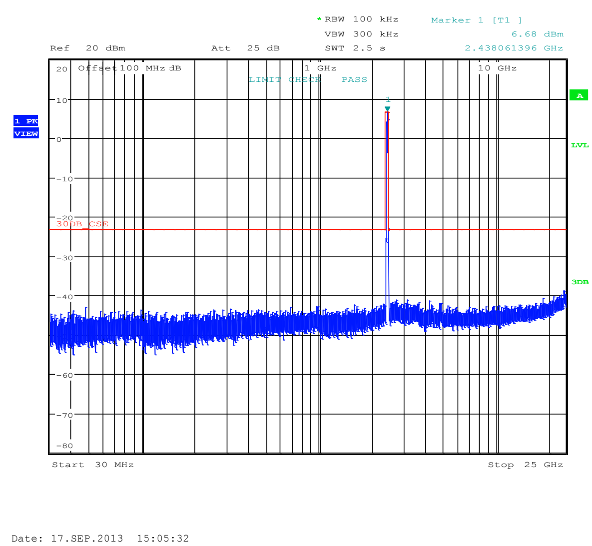


Figure 8.5-8: *Conducted spurious emissions for 802.11n HT40, ch0, mid channel*

8.5.4 Test data, continued

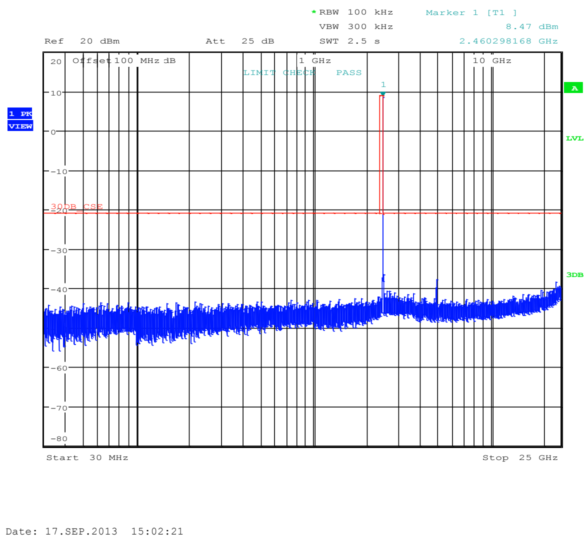


Figure 8.5-9: *Conducted spurious emissions for 802.11b, ch0, high channel*

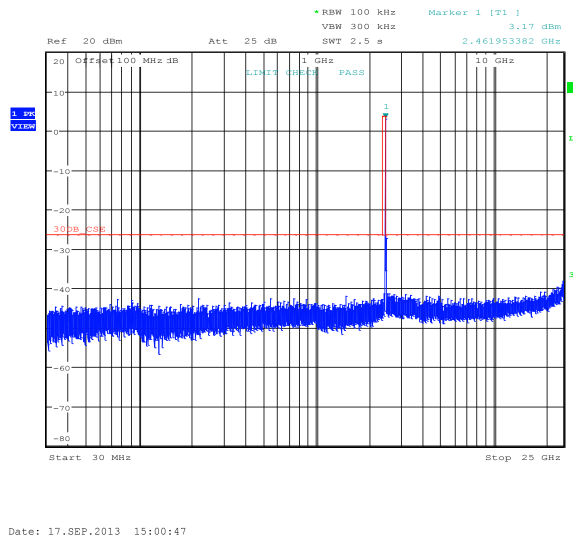


Figure 8.5-10: *Conducted spurious emissions for 802.11g, ch0, high channel*

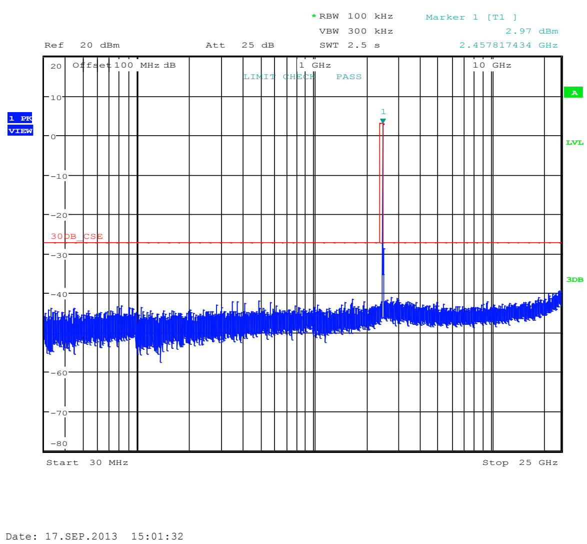


Figure 8.5-11: *Conducted spurious emissions for 802.11n HT20, ch0, high channel*

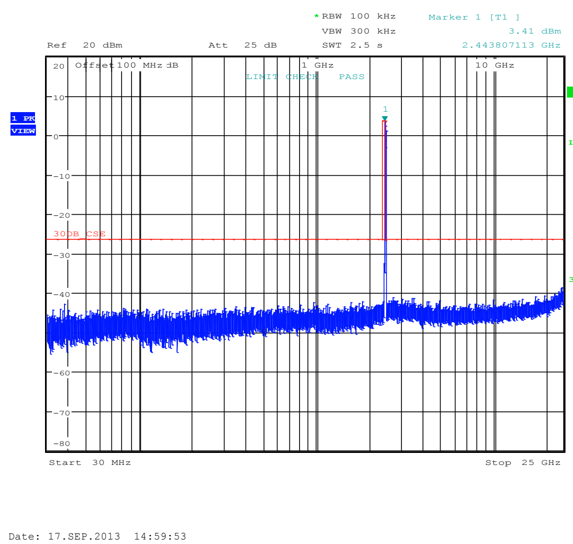


Figure 8.5-12: *Conducted spurious emissions for 802.11n HT40, ch0, high channel*

8.5.4 Test data, continued

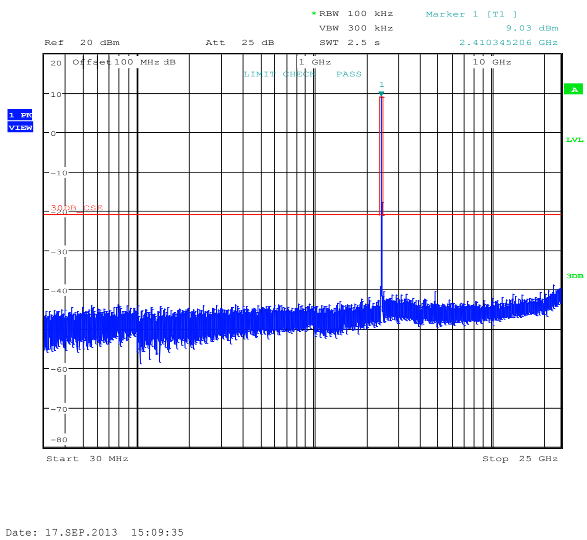


Figure 8.5-13: *Conducted spurious emissions for 802.11b, ch1, low channel*

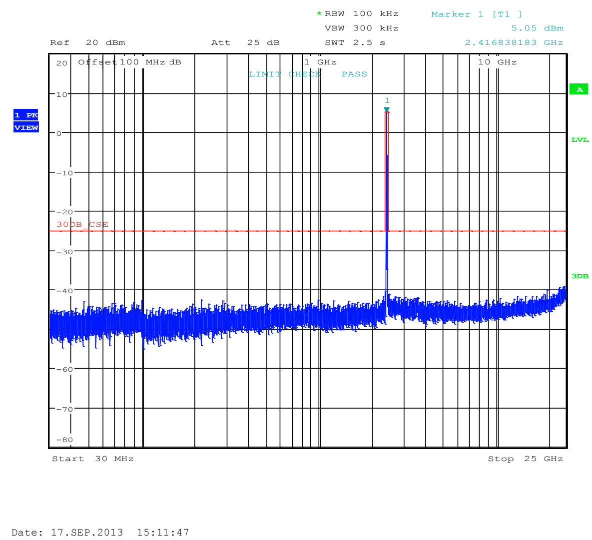


Figure 8.5-14: *Conducted spurious emissions for 802.11g, ch1, low channel*

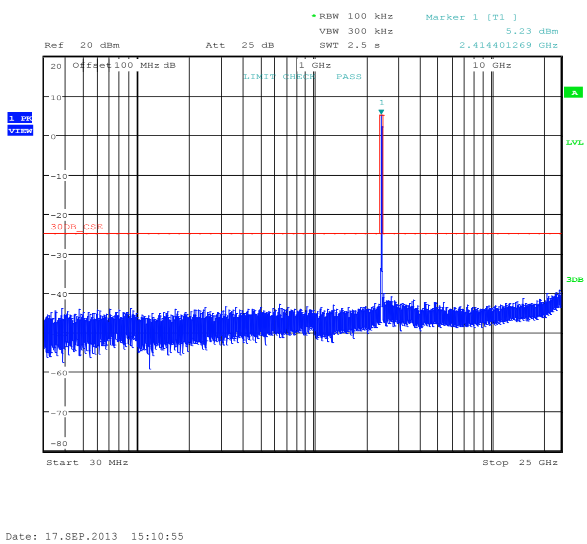


Figure 8.5-15: *Conducted spurious emissions for 802.11n HT20, ch1, low channel*

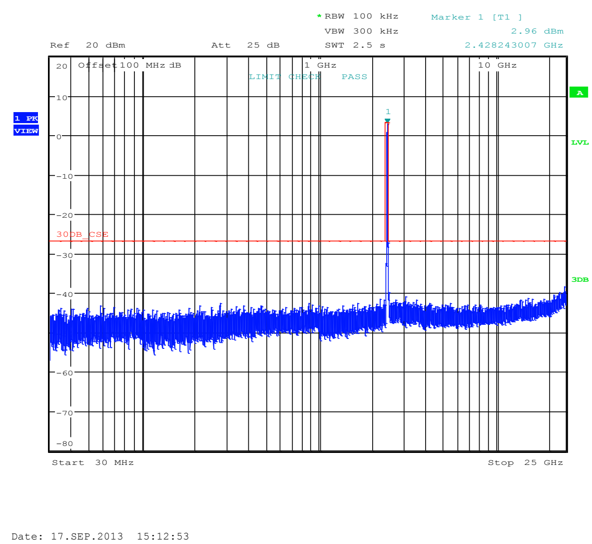


Figure 8.5-16: *Conducted spurious emissions for 802.11n HT40, ch1, low channel*

8.5.4 Test data, continued

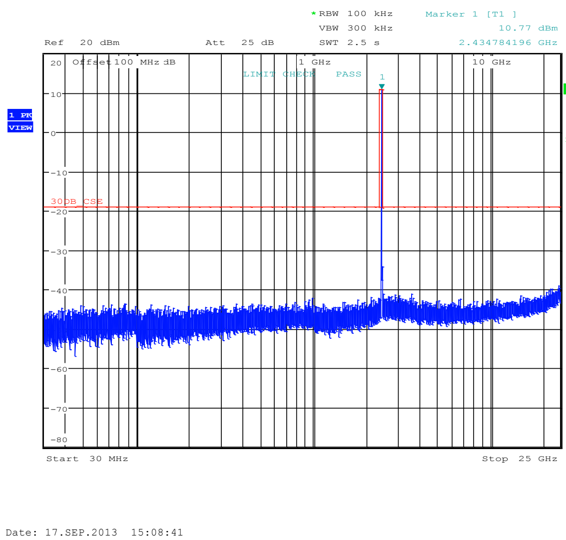


Figure 8.5-17: *Conducted spurious emissions for 802.11b, ch1, mid channel*

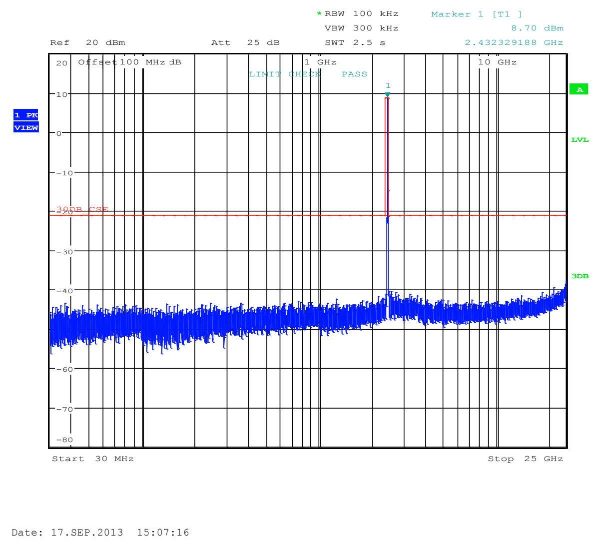


Figure 8.5-18: *Conducted spurious emissions for 802.11g, ch1, mid channel*

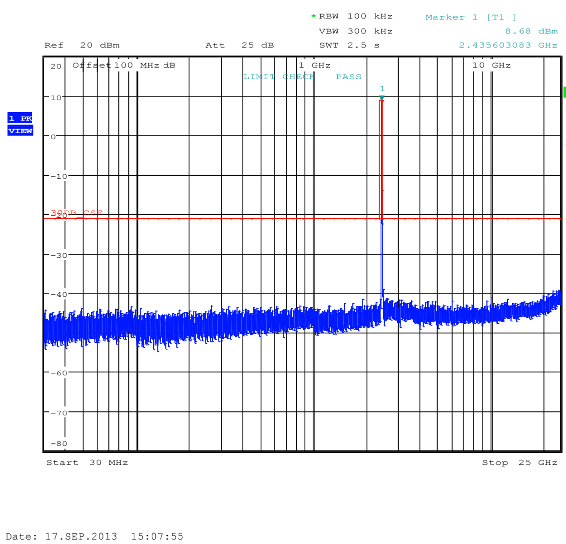


Figure 8.5-19: *Conducted spurious emissions for 802.11n HT20, ch1, mid channel*

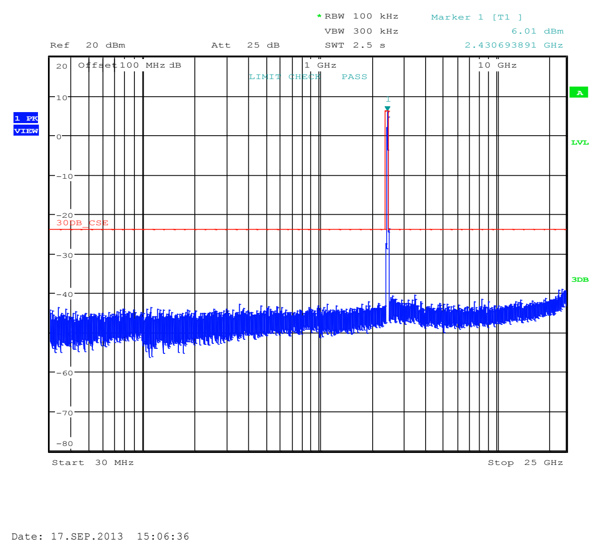


Figure 8.5-20: *Conducted spurious emissions for 802.11n HT40, ch1, mid channel*

8.5.4 Test data, continued

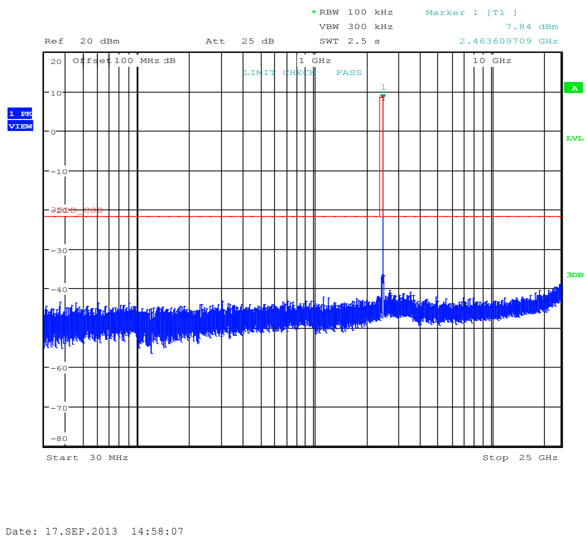


Figure 8.5-21: *Conducted spurious emissions for 802.11b, ch1, high channel*

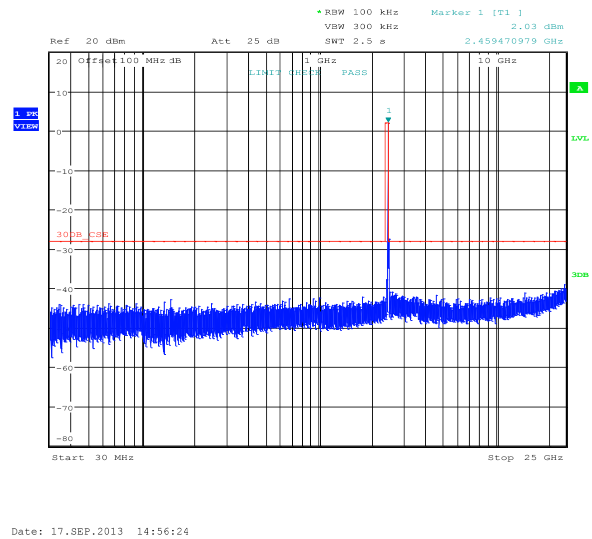


Figure 8.5-22: *Conducted spurious emissions for 802.11g, ch1, high channel*

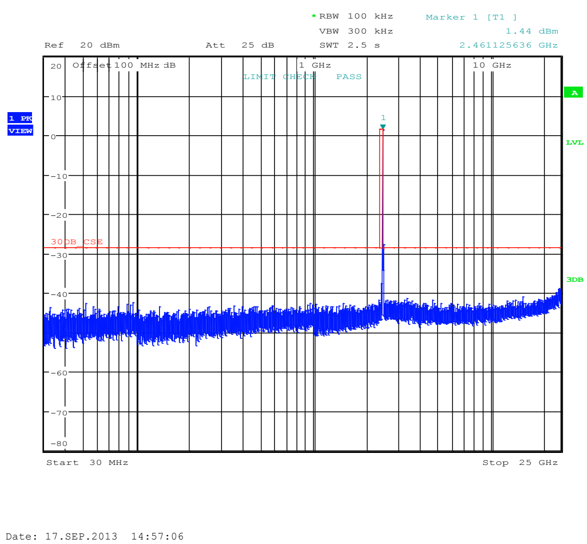


Figure 8.5-23: *Conducted spurious emissions for 802.11n HT20, ch1, high channel*

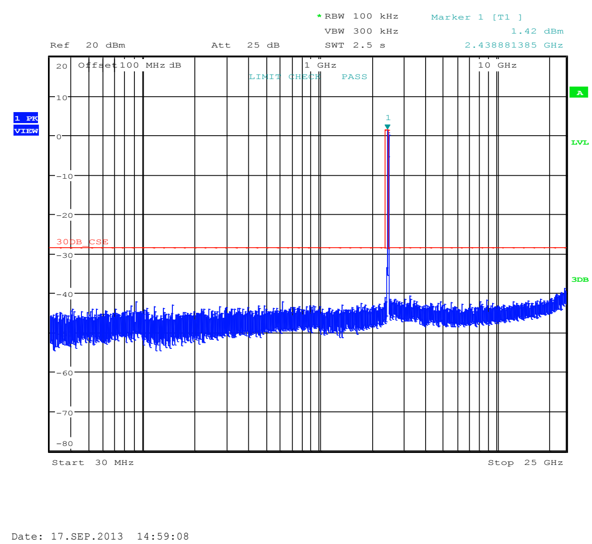


Figure 8.5-24: *Conducted spurious emissions for 802.11n HT40, ch1, high channel*

8.5.4 Test data, continued

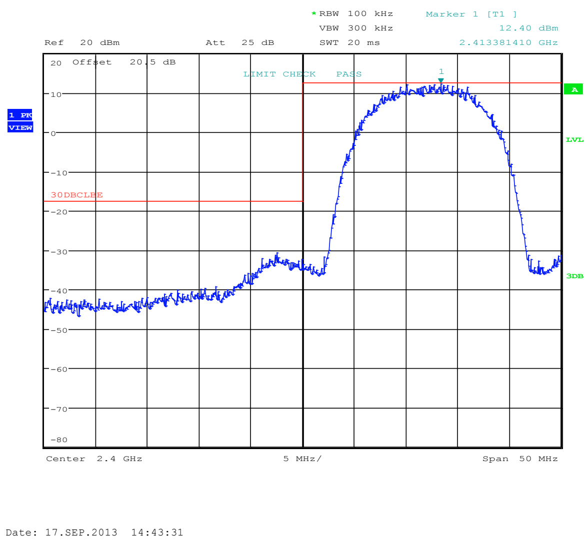


Figure 8.5-25: *Conducted lower band edge for 802.11b, ch0*

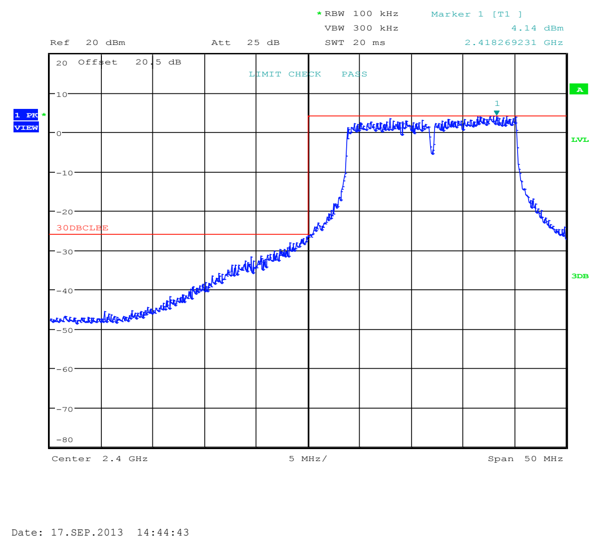


Figure 8.5-26: *Conducted lower band edge for 802.11g, ch0*

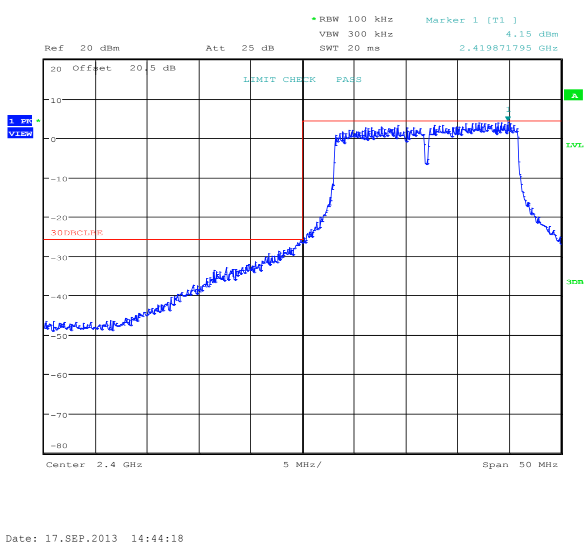


Figure 8.5-27: *Conducted lower band edge for 802.11n HT20, ch0*

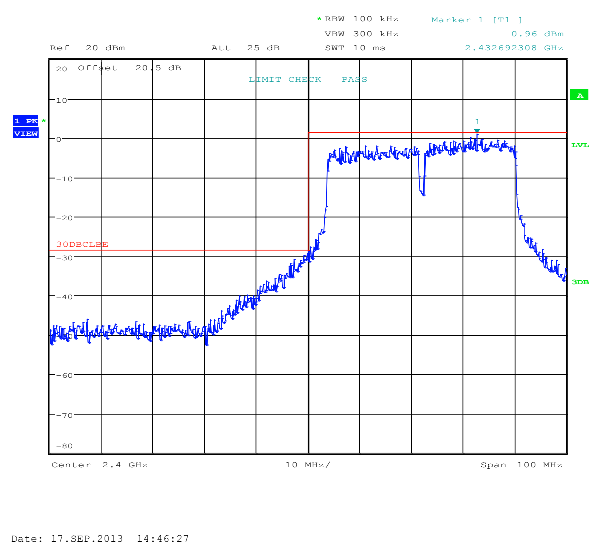


Figure 8.5-28: *Conducted lower band edge for 802.11n HT40, ch0*

8.5.4 Test data, continued

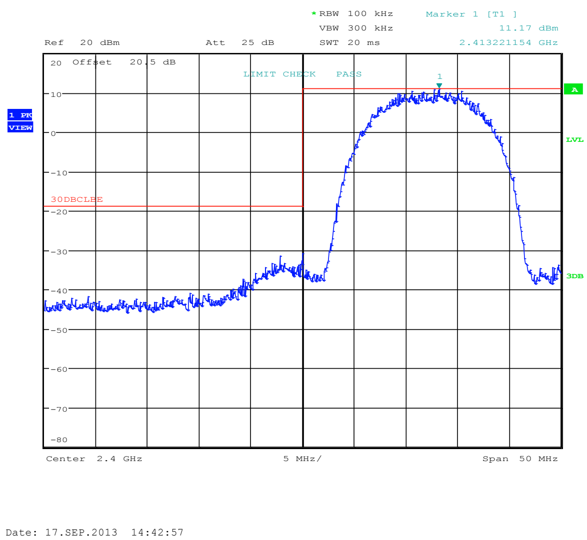


Figure 8.5-29: *Conducted lower band edge for 802.11b, ch1*

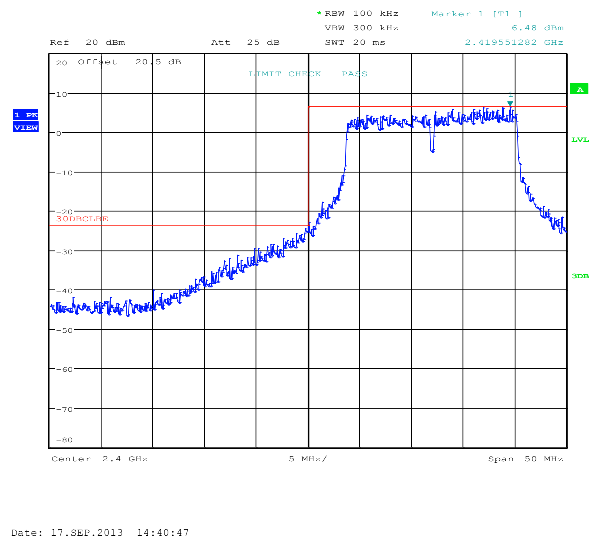


Figure 8.5-30: *Conducted lower band edge for 802.11g, ch1*

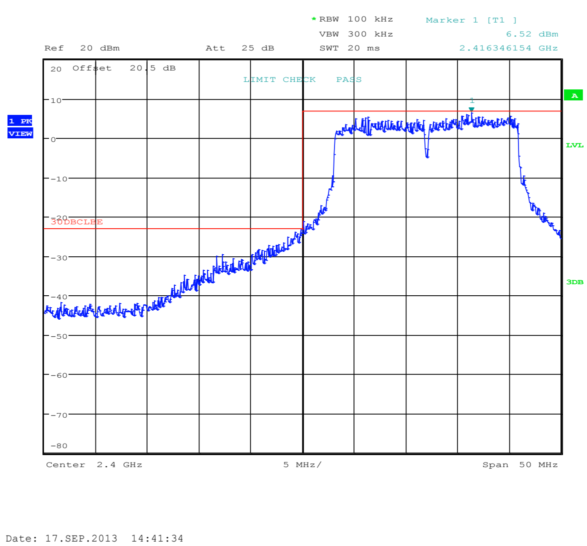


Figure 8.5-31: *Conducted lower band edge for 802.11n HT20, ch1*

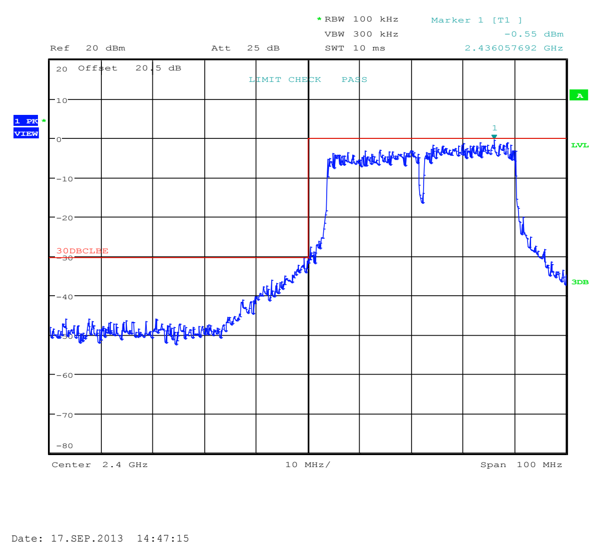


Figure 8.5-32: *Conducted lower band edge for 802.11n HT40, ch1*

8.5.4 Test data, continued

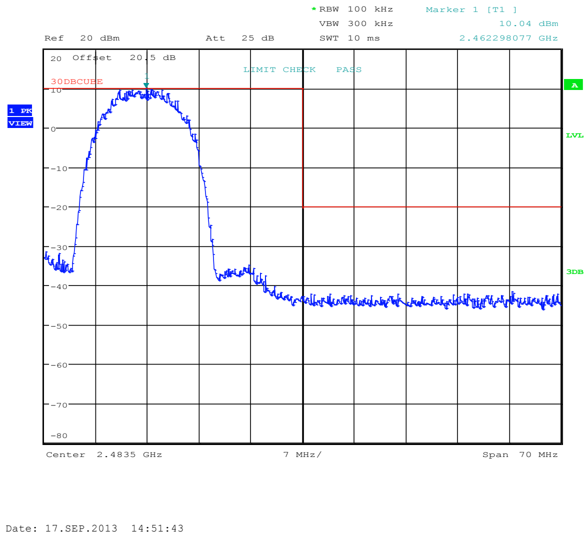


Figure 8.5-33: *Conducted upper band edge for 802.11b, ch0*

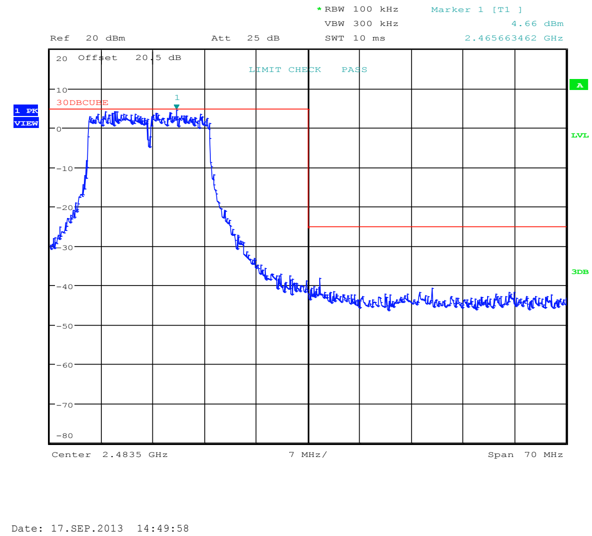


Figure 8.5-34: *Conducted upper band edge for 802.11g, ch0*

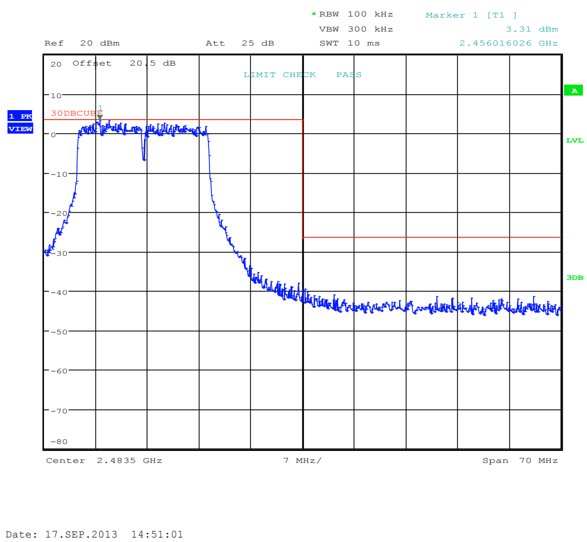


Figure 8.5-35: *Conducted upper band edge for 802.11n HT20, ch0*

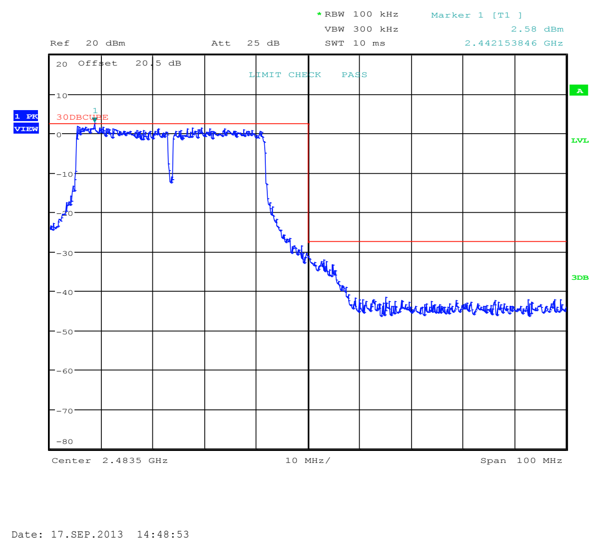


Figure 8.5-36: *Conducted upper band edge for 802.11n HT40, ch0*

8.5.4 Test data, continued

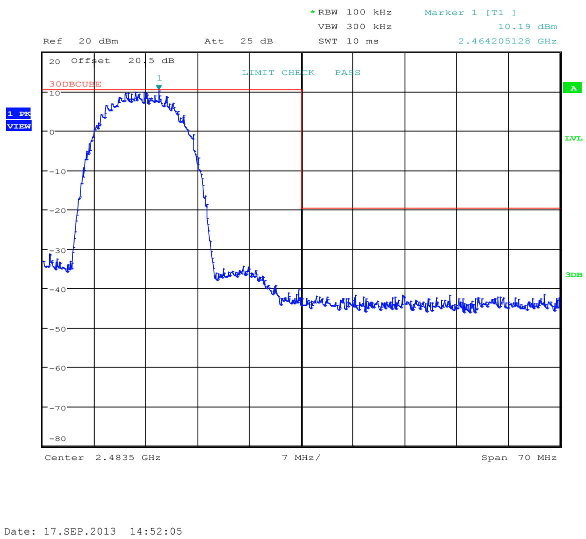


Figure 8.5-37: *Conducted upper band edge for 802.11b, ch1*

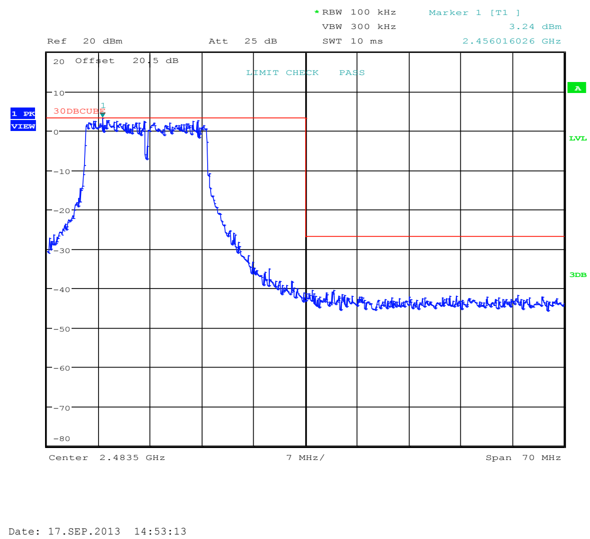


Figure 8.5-38: *Conducted upper band edge for 802.11g, ch1*

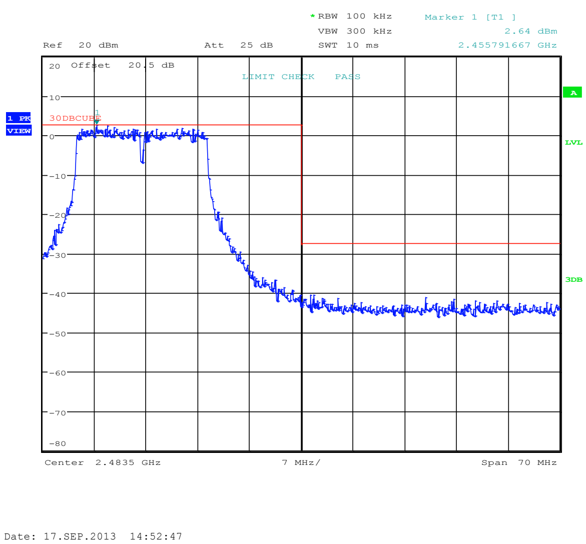


Figure 8.5-39: *Conducted upper band edge for 802.11n HT20, ch1*

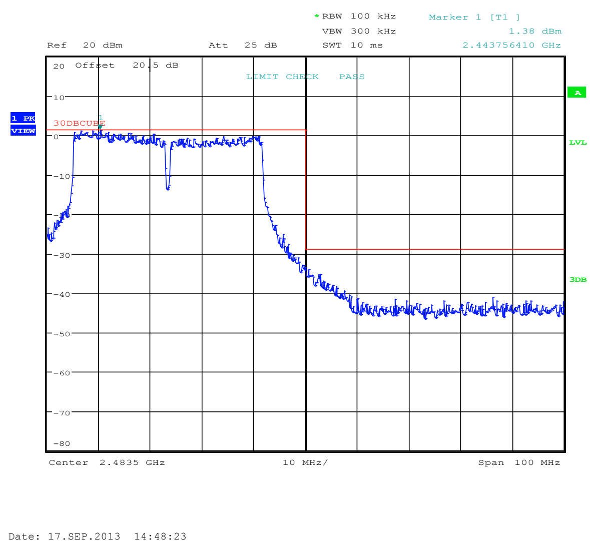


Figure 8.5-40: *Conducted upper band edge for 802.11n HT40, ch1*

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:	September 17, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1003 mbar
Verdict:	Pass	Relative humidity:	36 %

8.6.3 Observations, settings and special notes

The test was performed using method described in section 10.3 AVGPSD-1 of the 558074 D01 DTS Meas Guidance v03r01.
Spectrum analyser settings were set as follows:

Resolution bandwidth:	3–100 kHz
Video bandwidth:	1 MHz
Frequency span:	16 MHz (1.5 × DTS channel BW for 802.11b), 26 MHz (1.5 × DTS channel BW for 802.11g and 802.11n HT20) and to 55 MHz (1.5 × DTS channel BW for 802.11n HT40)
Detector mode:	RMS
Trace mode:	Power averaging over 100 sweeps

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

8.6.4 Test data

Table 8.6-1: *PSD measurements results for MIMO 2 × 2 with 4.4 dBi antenna configuration*

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	-1.43	-2.56	**1.05**	**8.00**	**6.95**
	2437	-0.47	-0.04	**2.76**	**8.00**	**5.24**
	2462	-2.51	-3.65	**-0.03**	**8.00**	**8.03**
802.11g	2412	-2.72	-4.04	**-0.32**	**8.00**	**8.32**
	2437	-1.98	-2.01	**1.02**	**8.00**	**6.98**
	2462	-5.05	-5.13	**-2.08**	**8.00**	**10.08**
802.11n HT20	2412	-3.52	-4.67	**-1.05**	**8.00**	**9.05**
	2437	-2.41	-2.55	**0.53**	**8.00**	**7.47**
	2462	-4.76	-4.94	**-1.84**	**8.00**	**9.84**
802.11n HT40	2422	-7.73	-8.76	**-5.20**	**8.00**	**13.20**
	2437	-2.38	-3.03	**0.32**	**8.00**	**7.68**
	2457	-9.38	-9.49	**-6.42**	**8.00**	**14.42**

Table 8.6-2: *PSD measurements results for MIMO 2 × 2 with 8 dBi antenna configuration*

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	3.24	2.49	**5.89**	**8.00**	**2.11**
	2437	3.97	4.50	**7.25**	**8.00**	**0.75**
	2462	2.34	0.95	**4.71**	**8.00**	**3.29**
802.11g	2412	-2.91	-4.22	**-0.51**	**8.00**	**8.51**
	2437	2.48	2.53	**5.52**	**8.00**	**2.48**
	2462	-2.76	-3.48	**-0.09**	**8.00**	**8.09**
802.11n HT20	2412	-2.49	-3.87	**-0.12**	**8.00**	**8.12**
	2437	2.13	2.30	**5.23**	**8.00**	**2.77**
	2462	-4.76	-4.94	**-1.84**	**8.00**	**9.84**
802.11n HT40	2422	-8.67	-8.94	**-5.79**	**8.00**	**13.79**
	2437	-0.66	-1.06	**2.15**	**8.00**	**5.85**
	2457	-6.12	-6.63	**-3.36**	**8.00**	**11.36**

Table 8.6-3: *PSD measurements results for MIMO 2 × 2 with 12 dBi antenna configuration*

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	1.23	-0.36	**3.52**	**8.00**	**4.48**
	2437	1.58	2.02	**4.82**	**8.00**	**3.18**
	2462	-0.89	-1.34	**1.90**	**8.00**	**6.10**
802.11g	2412	0.33	-0.55	**2.92**	**8.00**	**5.08**
	2437	0.11	0.74	**3.45**	**8.00**	**4.55**
	2462	-3.43	-3.64	**-0.52**	**8.00**	**8.52**
802.11n HT20	2412	0.08	-1.08	**2.55**	**8.00**	**5.45**
	2437	-0.18	0.42	**3.14**	**8.00**	**4.86**
	2462	-3.81	-4.11	**-0.95**	**8.00**	**8.95**
802.11n HT40	2422	-2.66	-2.86	**0.25**	**8.00**	**7.75**
	2437	-2.45	-2.93	**0.33**	**8.00**	**7.67**
	2457	-4.66	-4.88	**-1.76**	**8.00**	**9.76**

8.6.4 Test data, continued

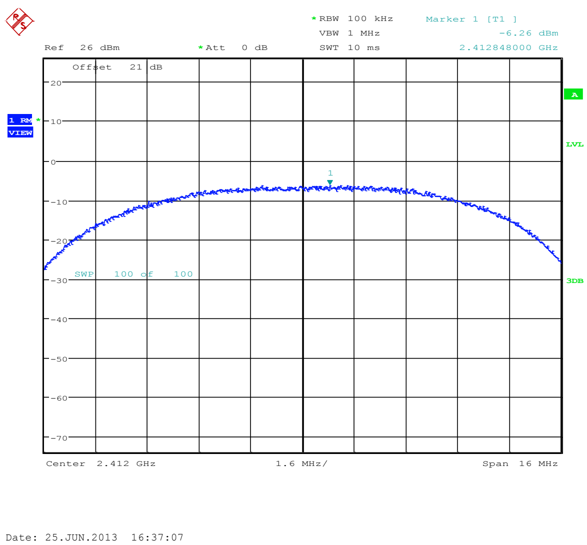


Figure 8.6-1: *Output power and PSD on 802.11b, sample plot*

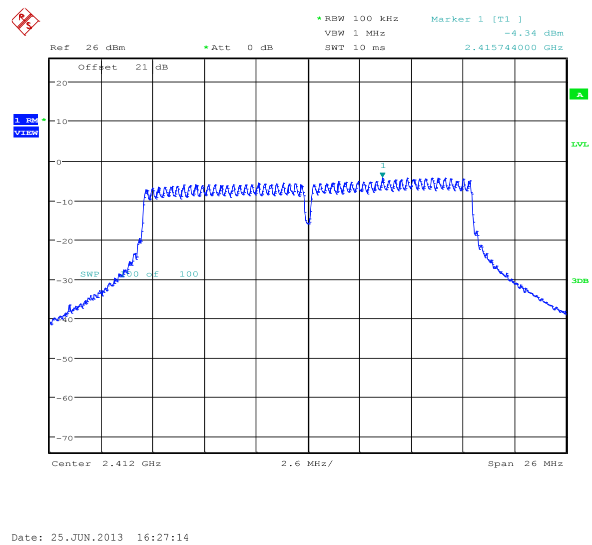


Figure 8.6-2: *Output power and PSD on 802.11g, sample plot*

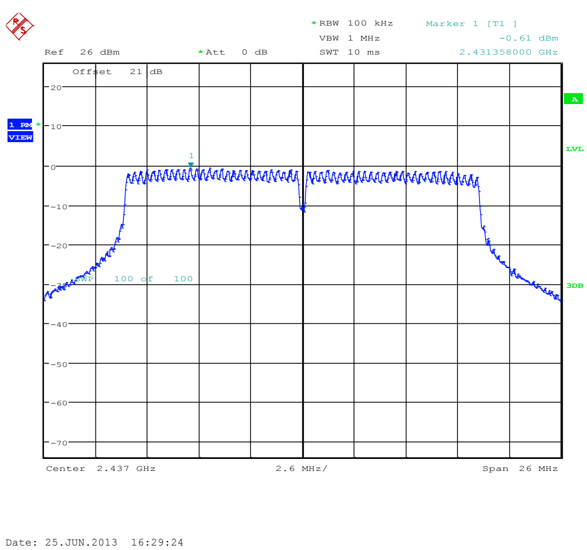


Figure 8.6-3: *Output power and PSD on 802.11n HT20, sample plot*

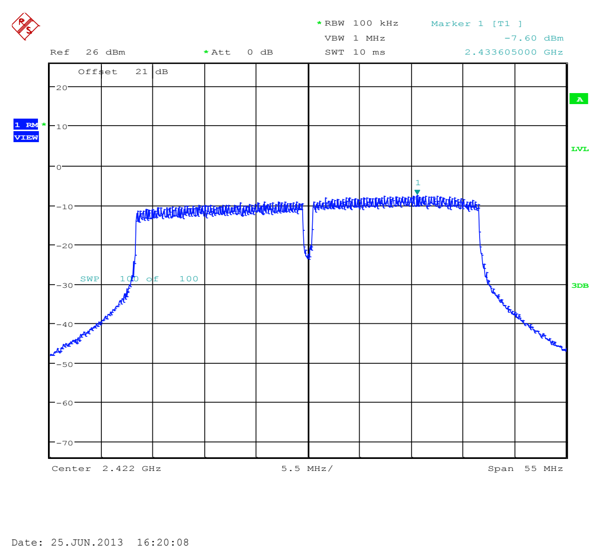
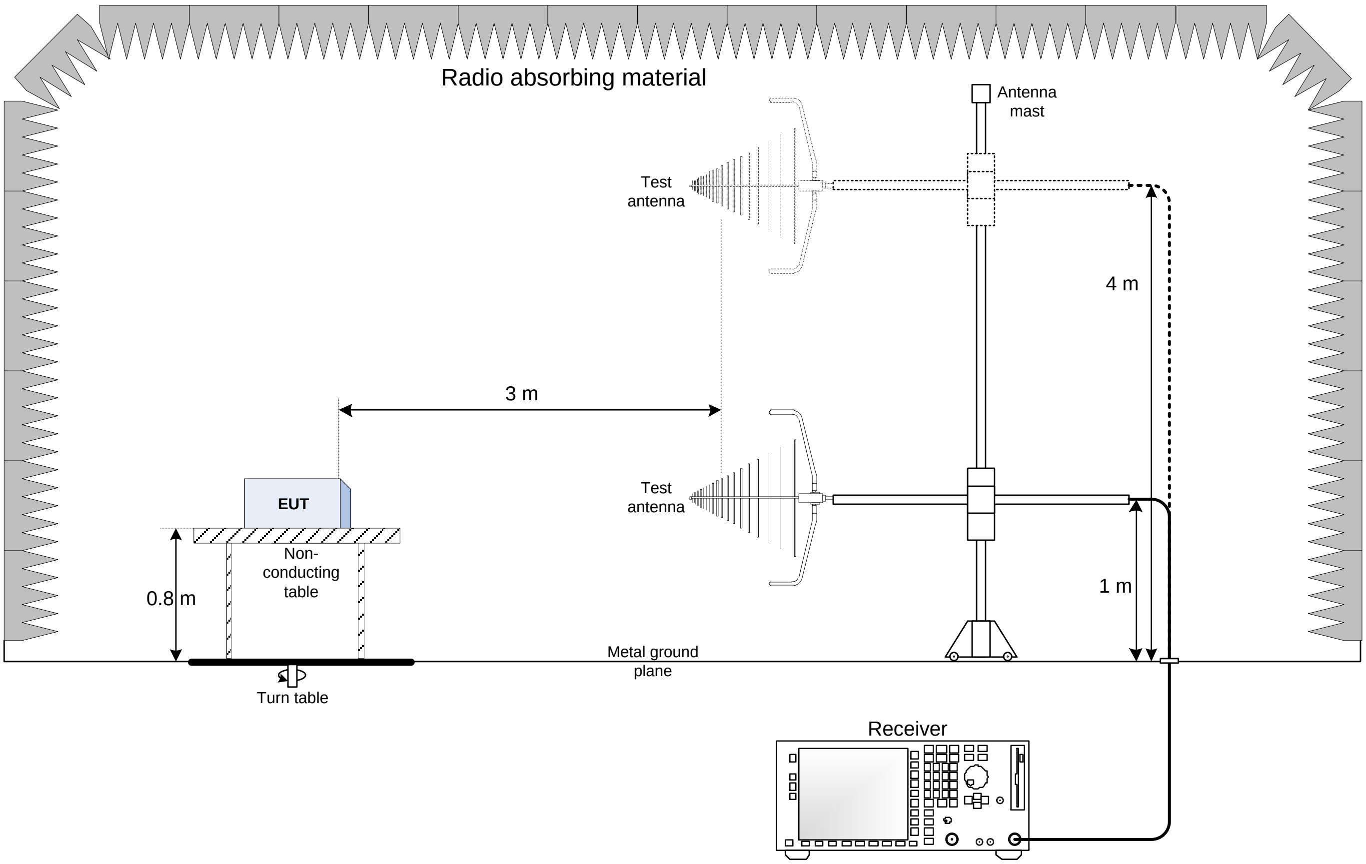


Figure 8.6-4: *Output power and PSD on 802.11n HT40, sample plot*

Note: plots provided above are only for information about test equipment settings and are not representing final results of the testing.

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up