

Test report

231485-3TRFWL

Date of issue: July 12, 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, §15.407**
Unlicensed National Information Infrastructure Devices
- ◆ **RSS-210, Issue 8, December 2010, Annex 9**
Local Area Network Devices

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:	July 12, 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

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
© Nemko Canada Inc.

Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Test methods	4
1.4 Statement of compliance	4
1.5 Exclusions	4
1.6 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Part 15 Subpart C, general requirements test results	5
2.2 FCC Part 15 Subpart E, test results	5
2.3 RSS-Gen, Issue 3, test results	5
2.4 IC RSS-210, Issue 8, test results	6
Section 3. Equipment under test (EUT) details	7
3.1 Sample information	7
3.2 EUT information	7
3.3 Technical information	7
3.4 Product description and theory of operation	7
3.5 EUT exercise details	7
3.6 EUT setup diagram	8
3.7 EUT sub assemblies	8
Section 4. Engineering considerations	9
4.1 Modifications incorporated in the EUT	9
4.2 Technical judgment	9
4.3 Deviations from laboratory tests procedures	9
Section 5. Test conditions	10
5.1 Atmospheric conditions	10
5.2 Power supply range	10
Section 6. Measurement uncertainty	11
6.1 Uncertainty of measurement	11
Section 7. Test equipment	12
7.1 Test equipment list	12
Section 8. Testing data	13
8.1 FCC 15.207(a) and RSS-Gen 7.2.4 AC power line conducted emissions limits	13
8.2 FCC 15.403(i) Emission bandwidth	17
8.3 RSS-Gen 4.6.1 Occupied bandwidth	19
8.4 FCC 15.407(a)(3) and RSS-210 A9.2(4) 5.725–5.825 GHz band output power, EIRP and spectral density limits	21
8.5 FCC 15.407(b) and RSS-210 A9.2(4) Spurious (out-of-band) emissions	24
8.6 FCC 15.407(g) Frequency stability	44
8.7 FCC 15.407(a)(6) and RSS-210 A9.4(2) Peak excursion and PSD-to-average ratio	46
Section 9. Block diagrams of test set-ups	48
9.1 Radiated emissions set-up	48
9.2 Conducted emissions set-up	48

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 E, Clause 15.407	Unlicensed National Information Infrastructure Devices
RSS-210, Issue 8, December 2010, Annex 9	Local Area Network Devices

1.3 Test methods

Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E	789033 D01 General UNII Test Procedures v01r03 (April 8, 2013)
Emissions testing of transmitters with multiple outputs in the same band (MIMO)	662911 D01 Multiple Transmitter Output v02 (May 28, 2013)
Emissions testing of transmitters with multiple outputs in the same band (MIMO) with Cross Polarized Antenna	662911 D02 MIMO with Cross Polarized Antenna v01
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: ¹Measurements 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

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

2.2 FCC Part 15 Subpart E, test results

Part	Test description	Verdict
§15.403(i)	Emission bandwidth	Not applicable
§15.407(a)(1)	5.15–5.25 GHz band power and density limits ¹	Not applicable
§15.407(a)(2)	5.25–5.35 GHz and 5.47–5.725 GHz bands power and density limits	Not applicable
§15.407(a)(3)	5.725–5.825 GHz band power and density limits	Pass
§15.407(a)(6)	Peak excursion	Not applicable
§15.407(b)(1)	5.15–5.25 GHz band undesired emission limits	Not applicable
§15.407(b)(2)	5.25–5.35 GHz band undesired emission limits	Not applicable
§15.407(b)(3)	5.47–5.725 GHz band undesired emission limits	Not applicable
§15.407(b)(4)	5.725–5.825 GHz band undesired emission limits	Pass
§15.407(b)(6)	Unwanted emissions below 1 GHz	Pass
§15.407(b)(7)	Radiated emissions within restricted bands	Pass
§15.407(e)	5.15–5.25 GHz band operational restriction	Not applicable
§15.407(g)	Frequency stability	Pass
§15.407(h)(1)	Transmit power control (TPC)	Not applicable ¹
§15.407(h)(2)	Dynamic Frequency Selection (DFS)	Not applicable ¹

Notes: ¹DFS and TPC requirements are only applicable to 5.25–5.35 GHz and 5.47–5.725 GHz bands

2.3 RSS-Gen, Issue 3, test results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
4.7	Transmitter frequency stability	Pass
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: ¹According 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
A9.2	Transmitter power, e.i.r.p., TPC ¹ and spectral power density limits	
A9.2 (1)	5150–5250 MHz band	Not applicable
A9.2 (2)	5250–5350 MHz band	Not applicable
A9.2 (3)	5470–5600 MHz and 5650–5725 MHz bands	Not applicable
A9.2 (4)	5725–5825 MHz band	Pass
A9.2	Out-of-band emission limits	
A9.2 (1)	5150–5250 MHz band	Not applicable
A9.2 (2)	5250–5350 MHz band	Not applicable
A9.2 (3)	5470–5600 MHz and 5650–5725 MHz bands	Not applicable
A9.2 (4)	5725–5825 MHz band	Pass
A9.3	Dynamic Frequency Selection (DFS) for devices operating in the bands 5250–5350 MHz, 5470–5600 MHz and 5650–5725 MHz	Not applicable
A9.4	Other Requirements for all bands	
A9.4 (1)	Digital modulation	Pass ²
A9.4 (2)	PSD to average power ratio	Pass
A9.4 (3)	Test frequencies	Pass
A9.4 (4)	Discontinuation of transmission	Not tested ³

Notes: ¹ Transmit Power Control (TPC) requirement is applicable only for 5250–5350 MHz, 5470–5600 MHz and 5650–5725 MHz bands

² The EUT uses digital modulations, such as: 802.11a, 802.11n HT20 and 802.11n HT40

³ It is up to applicant to fulfill the requirement of discontinuation of the transmission in case of absence of information to transmit

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	5725–5825 MHz
Operating frequency	5745–5805 MHz (20 MHz channel) and 5755–5795 MHz (40 MHz channel)
Modulation type	802.11a/n
Occupied bandwidth (99 %)	16.83 MHz (802.11a); 17.93 MHz (802.11n HT20); 36.62 MHz (802.11n HT40)
Emission designator	W7D
Power requirements	48 V _{DC}
Antenna information	2 internal 7.2 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 device designed to operate in the 2.4 GHz band, and 5 GHz 2×2 MIMO ISM and UNII bands. There are two independent radio units. This report covers only the 5.8 GHz UNII 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

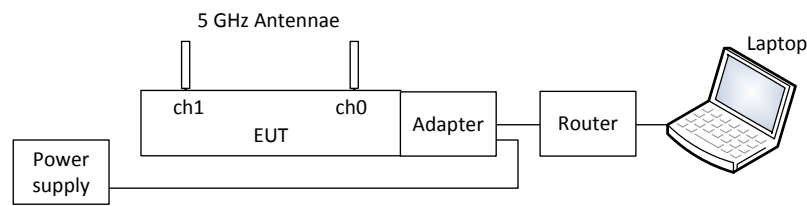


Figure 3.6-1: Setup diagram

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
Power meter	Agilent	N1911A	FA001946	1 year	Feb. 13/14
Power sensor	Agilent	N1922A	FA001947	1 year	Feb. 13/14
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Horn antenna 18–40 GHz	EMCO	3116	FA001847	1 year	Sept. 06/13
26–40 GHz pre-amplifier	Narda	DBL-2640N610	FA001556	—	VOU
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)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

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.

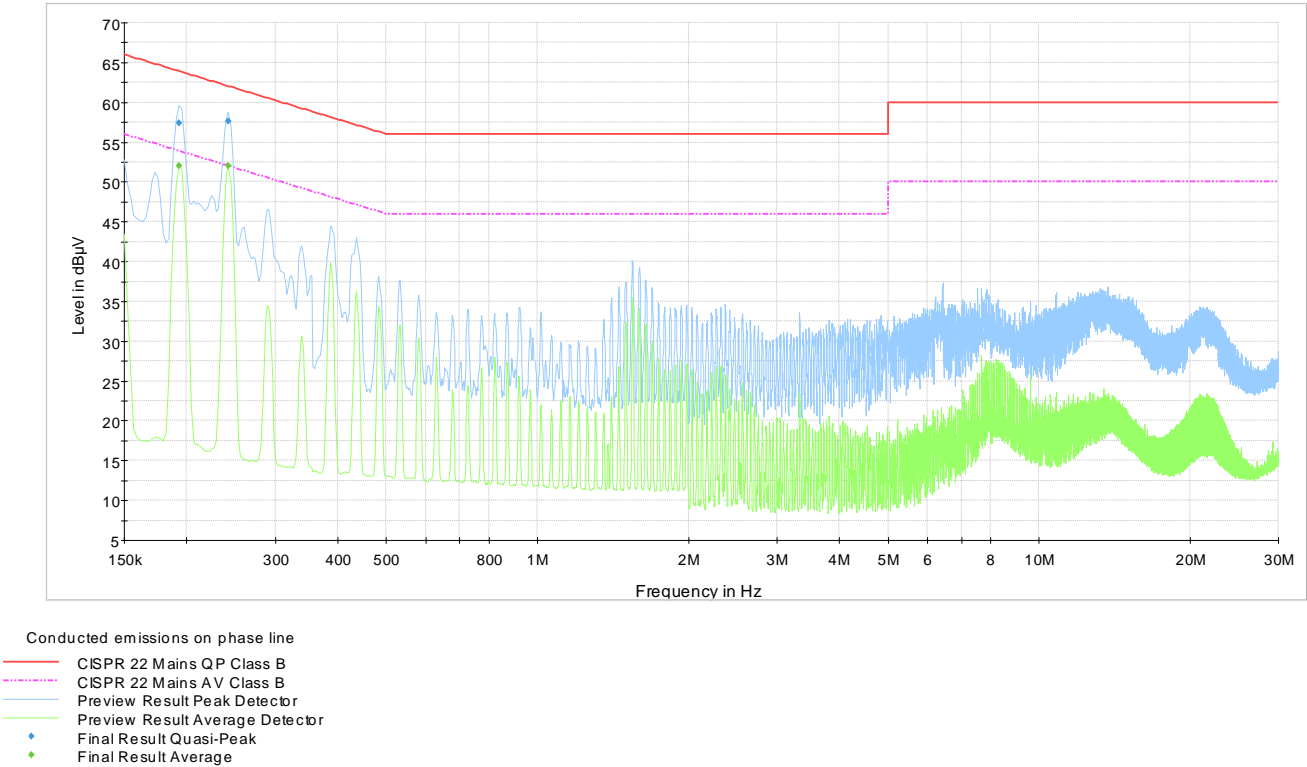
Receiver settings for preview measurements:

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, dBµV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBµV
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 dBµV = 23.2 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

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

Frequency, MHz	Average result, dBµV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBµV
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 (dBµV) = XX dBµV (reading from receiver) + XX dB (Correction factor)

Example:

43.5 dBµV = 23.2 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

8.1.4 Test data, continued

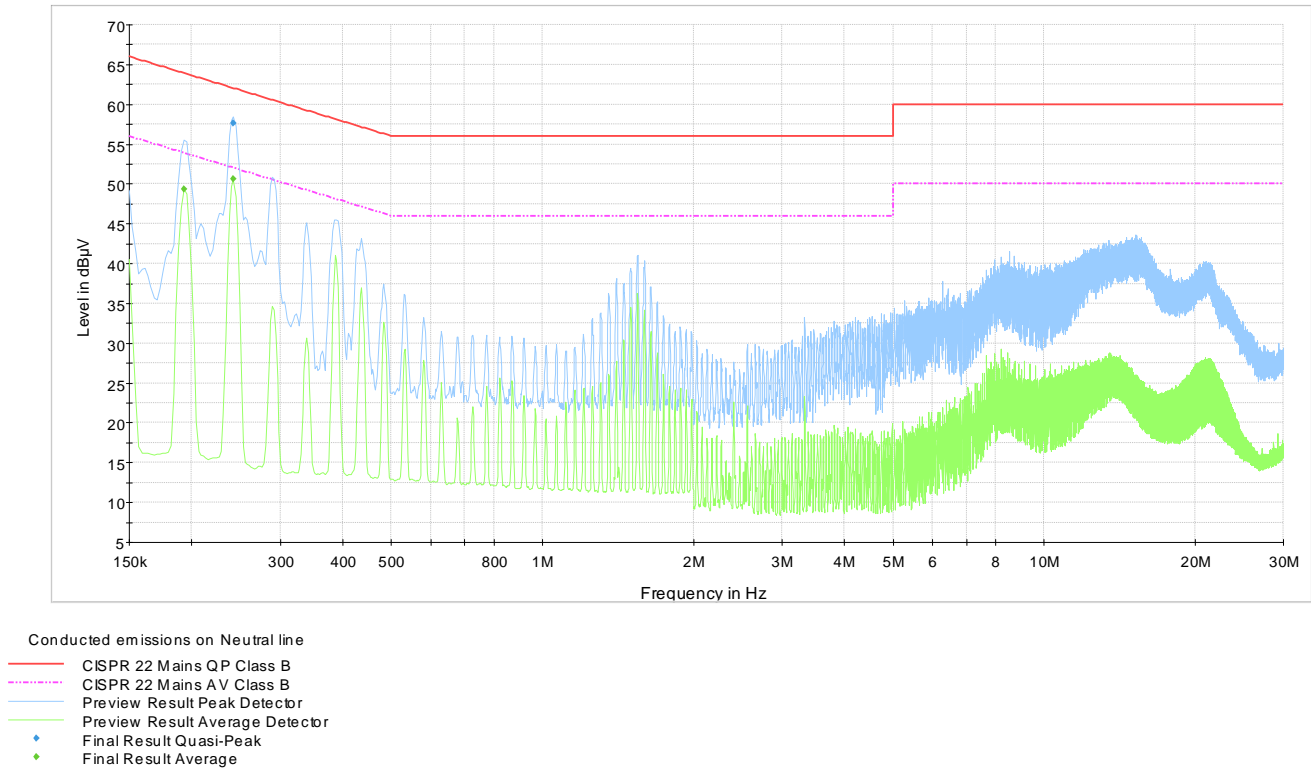


Figure 8.1-2: Conducted emissions on neutral line

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

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

Note: 43.5 dBµV = 23.2 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

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

Frequency, MHz	Average result, dBµV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBµV
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 (dBµV) = XX dBµV (reading from receiver) + XX dB (Correction factor)

Example:

43.5 dBµV = 23.2 dBµV (receiver reading) + 10.1 dB (LISN factor IL) + 0.2 dB (cable loss) + 10 dB (attenuator)

8.2 FCC 15.403(i) Emission bandwidth

8.2.1 Definitions and limits

For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

8.2.2 Test summary

Test date:	April 17, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	32 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

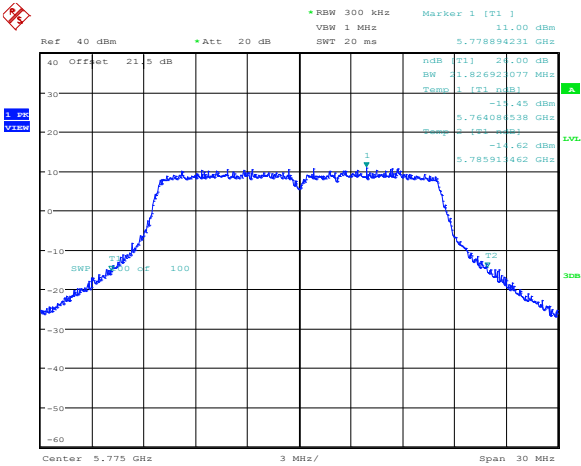
Resolution bandwidth:	≥ 1 % of emission BW
Video bandwidth:	≥ 3 × RBW
Frequency span:	30 MHz for 20 MHz channel; 50 MHz for 40 MHz channel
Detector mode:	Peak
Trace mode:	Max Hold

8.2.4 Test data

Table 8.2-1: 26 dB bandwidth results

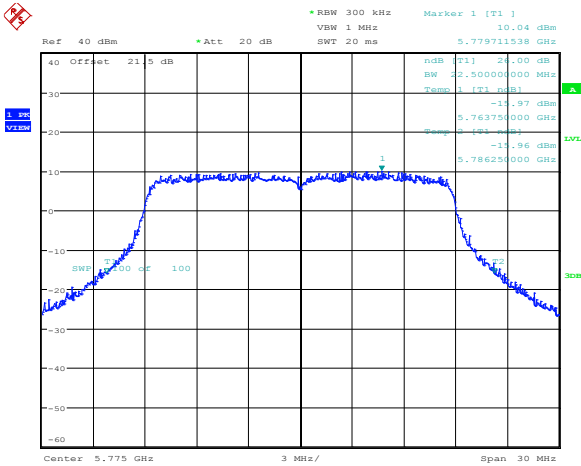
Antenna chain	Modulation	Frequency, MHz	26 dB bandwidth, MHz
ch0	802.11a	5745	22.02
		5775	21.83
		5805	21.68
	802.11n HT20	5745	22.50
		5775	22.50
		5805	22.50
	802.11n HT40	5755	45.11
		5795	45.03
		5745	21.64
ch1	802.11a	5775	21.25
		5805	21.83
		5745	22.36
	802.11n HT20	5775	22.40
		5805	21.97
	802.11n HT40	5755	44.63
		5795	45.03

8.2.4 Test data, continued



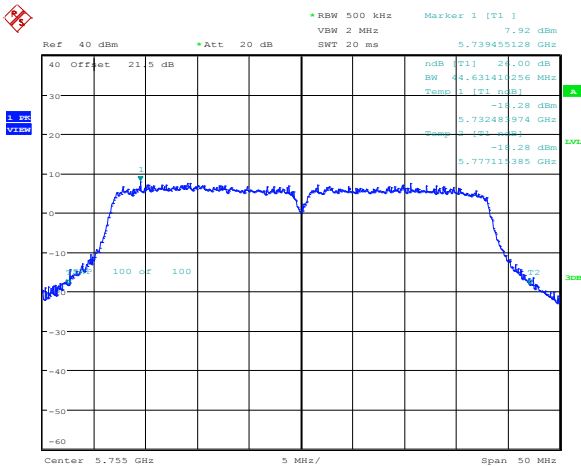
Date: 16.APR.2013 14:32:29

Figure 8.2-1: 26 dB bandwidth on 802.11a, sample plot



Date: 16.APR.2013 14:32:58

Figure 8.2-2: 26 dB bandwidth on 802.11n HT20, sample plot



Date: 16.APR.2013 14:44:50

Figure 8.2-3: 26 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 17, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	32 %

8.3.3 Observations, settings and special notes

Spectrum analyser settings:

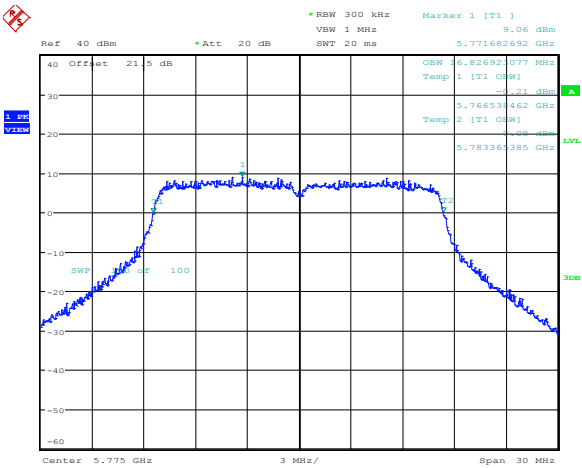
Resolution bandwidth:	≥ 1 % of span
Video bandwidth:	≥ 3 × RBW
Frequency span:	30 MHz for 20 MHz channel; 50 MHz for 40 MHz channel
Detector mode:	Peak
Trace mode:	Max Hold

8.3.4 Test data

Table 8.3-1: 99 % bandwidth results

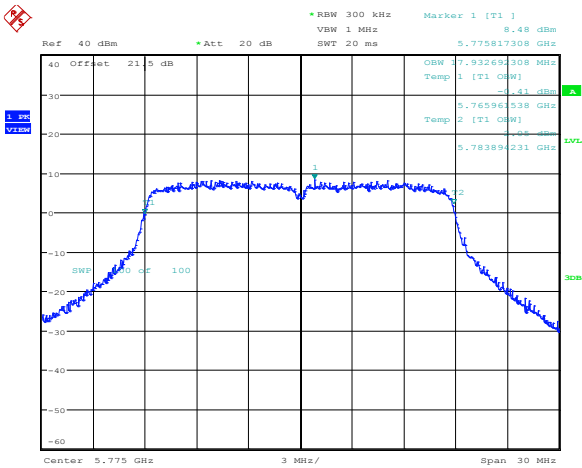
Modulation	99 % bandwidth, MHz
802.11a	16.83
802.11n HT20	17.93
802.11n HT40	36.62

8.3.4 Test data, continued



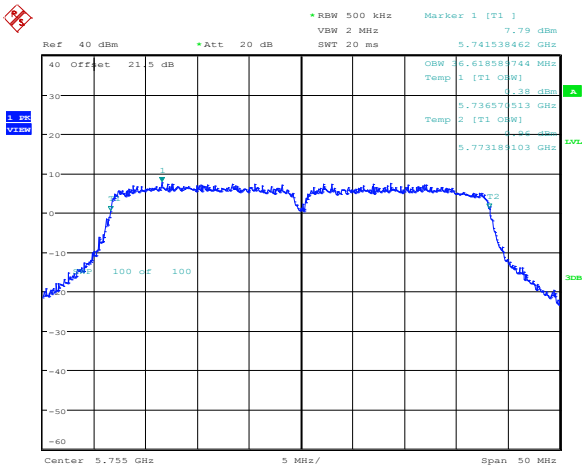
Date: 16.APR.2013 14:43:19

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



Date: 16.APR.2013 14:42:39

Figure 8.3-2: 99 % bandwidth on 802.11n HT20, sample plot



Date: 16.APR.2013 14:44:24

Figure 8.3-3: 99 % bandwidth on 802.11n HT40, sample plot

8.4 FCC 15.407(a)(3) and RSS-210 A9.2(4) 5.725–5.825 GHz band output power, EIRP and spectral density limits

8.4.1 Definitions and limits

FCC:

For the band 5.725–5.825 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 1 W (30 dBm) or 17 dBm + 10 log₁₀ B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 17 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain up to 23 dBi without any corresponding reduction in the transmitter peak output power or peak power spectral density. For fixed, point-to-point U-NII transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in peak transmitter power and peak power spectral density for each 1 dB of antenna gain in excess of 23 dBi would be required. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

IC:

The maximum conducted output power shall not exceed 1 W (30 dBm) or 17 + 10 log₁₀ B, dBm, whichever power is less. The power spectral density shall not exceed 17 dBm in any 1 MHz band. The maximum e.i.r.p. shall not exceed 4 W (36 dBm) or 23 + 10 log₁₀ B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

Fixed point-to-point systems for this band are permitted to have an e.i.r.p. greater than 4 W (36 dBm) provided that the higher e.i.r.p. is achieved by employing higher gain antennas, but not higher transmitter output powers. Point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding 4 W e.i.r.p. However, remote stations of point-to-multipoint systems shall be permitted to operate at greater than 4 W e.i.r.p. under the same conditions as for point-to-point systems.

8.4.2 Test summary

Test date:	April 17, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1003 mbar
Verdict:	Pass	Relative humidity:	32 %

8.4.3 Observations, settings and special notes

The test was performed according to 789033 D01 General UNII Test Procedures section E) 3) a) Method PM: maximum conducted (average) output power using wideband RF average power meter with a thermocouple detector.

Combined average output power was calculated as follows: $P_{combined} = 10 \times \log_{10} \left((10^{P_{cho}/10}) + (10^{P_{ch1}/10}) \right)$

EIRP was calculated as follows: $EIRP = P_{combined} + \text{antenna gain}$

Combined PPSD was calculated as follows: $PPSD_{combined} = 10 \times \log_{10} \left((10^{PSD_{cho}/10}) + (10^{PSD_{ch1}/10}) \right)$

Directional gain for cross-polarized MIMO 2 × 2 is 7.2 dBi. No summation of gain is needed for cross-polarized antennas as per manufacturer's definition of the cross-polarized MIMO type.

The 26 dB measured bandwidth for 802.11a was 22.02 MHz, for 802.11n HT20 was 22.50 MHz and for 802.11n HT40 was 45.11 MHz.

FCC output power limit for 802.11a was calculated as follows: $17 + 10 \times \log_{10} (22.02) - (7.2 - 6) = 29.23 \text{ dBm} > 28.2 \text{ dBm} = 30 - (7.2 - 6)$

FCC output power limit for 802.11n HT20 was calculated as follows: $17 + 10 \times \log_{10} (22.50) - (7.2 - 6) = 29.32 \text{ dBm} < 28.2 \text{ dBm} = 30 - (7.2 - 6)$

FCC output power limit for 802.11n HT40 was calculated as follows: $17 + 10 \times \log_{10} (45.11) - (7.2 - 6) = 32.34 \text{ dBm} > 28.2 \text{ dBm} = 30 - (7.2 - 6)$

FCC PPSD limit was calculated as follows: $17 - (7.2 - 6) = 15.8 \text{ dBm/MHz}$

The 99 % measured occupied bandwidth for 802.11a was 16.83 MHz, for 802.11n HT20 was 17.93 MHz and for 802.11n HT40 was 36.62 MHz.

IC output power limit for 802.11a was calculated as follows: $17 + 10 \times \log_{10} (16.83) = 29.26 \text{ dBm} < 30 \text{ dBm}$

IC output power limit for 802.11n HT20 was calculated as follows: $17 + 10 \times \log_{10} (17.93) = 29.54 \text{ dBm} < 30 \text{ dBm}$

IC output power limit for 802.11n HT40 was calculated as follows: $17 + 10 \times \log_{10} (36.62) = 32.64 \text{ dBm} > 30 \text{ dBm}$, therefore the limit is 30 dBm

EIRP was calculated as conducted output power + 6 dB.

Section 8

Test name

Specification

Testing data

FCC 15.407(a)(3) and RSS-210 A9.2(4) 5.725–5.825 GHz band output power, EIRP and spectral density limits

FCC Part 15 Subpart E and RSS-210 A9, Issue 8



8.4.4 Test data

Table 8.4-1: Output power measurements and EIRP calculations results for FCC

Modulation	Frequency, MHz	Conducted output power, dBm			Power limit, dBm	Margin, dB	Antenna gain, dBi	Equivalent Isotropically Radiated Power, dBm		
		On ch0	On ch1	Combined				Calculated	Limit	Margin*
802.11a	5745	24.27	24.30	27.30	28.20	0.90	7.20	34.50	36.00	1.50
	5775	25.29	24.82	28.07	28.20	0.13	7.20	35.27	36.00	0.73
	5805	25.63	24.65	28.18	28.20	0.02	7.20	35.38	36.00	0.62
802.11n HT20	5745	25.26	24.19	27.77	28.20	0.43	7.20	34.97	36.00	1.03
	5775	25.27	24.50	27.91	28.20	0.29	7.20	35.11	36.00	0.89
	5805	25.51	24.78	28.17	28.20	0.03	7.20	35.37	36.00	0.63
802.11n HT40	5755	25.24	24.31	27.81	28.20	0.39	7.20	35.01	36.00	0.99
	5795	25.16	24.42	27.82	28.20	0.38	7.20	35.02	36.00	0.98

Notes: * - Margin obtained in dB units

Table 8.4-2: PSD measurements results for FCC

Modulation	Frequency, MHz	Measured Peak Power Spectral Density (PPSD), dBm/MHz			PPSD limit, dBm/MHz	Margin, dB
		On ch0	On ch1	Combined		
802.11a	5745	12.53	12.42	15.49	15.80	0.31
	5775	12.84	12.11	15.50	15.80	0.30
	5805	12.65	12.70	15.69	15.80	0.11
802.11n HT20	5745	12.24	11.92	15.09	15.80	0.71
	5775	12.57	12.37	15.48	15.80	0.32
	5805	12.78	12.77	15.79	15.80	0.01
802.11n HT40	5755	9.40	8.77	12.11	15.80	3.69
	5795	10.29	9.68	13.01	15.80	2.79

Table 8.4-3: Output power measurements and EIRP calculations results for IC

Modulation	Frequency, MHz	Conducted output power, dBm			Power limit, dBm	Margin, dB	Antenna gain, dBi	Equivalent Isotropically Radiated Power, dBm		
		On ch0	On ch1	Combined				Calculated	Limit	Margin*
802.11a	5745	24.27	24.30	27.30	29.26	1.96	7.20	34.50	35.26	0.76
	5775	24.80	24.82	27.82	29.26	1.44	7.20	35.02	35.26	0.24
	5805	25.16	24.90	28.04	29.26	1.22	7.20	35.24	35.26	0.02
802.11n HT20	5745	25.26	24.19	27.77	29.54	1.77	7.20	34.97	35.54	0.57
	5775	25.27	24.50	27.91	29.54	1.63	7.20	35.11	35.54	0.43
	5805	25.51	24.78	28.17	29.54	1.37	7.20	35.37	35.54	0.17
802.11n HT40	5755	25.24	24.31	27.81	30.00	2.19	7.20	35.01	36.00	0.99
	5795	25.16	24.42	27.82	30.00	2.18	7.20	35.02	36.00	0.98

Notes: * - Margin obtained in dB units

Table 8.4-4: PSD measurements results for IC

Modulation	Frequency, MHz	Measured Power Spectral Density (PSD), dBm/MHz			PSD limit, dBm/MHz	Margin, dB
		On ch0	On ch1	Combined		
802.11a	5745	12.53	12.42	15.49	17.00	1.51
	5775	12.84	12.83	15.85	17.00	1.15
	5805	13.22	13.01	16.13	17.00	0.87
802.11n HT20	5745	12.24	11.92	15.09	17.00	1.91
	5775	13.01	12.37	15.71	17.00	1.29
	5805	13.64	12.77	16.24	17.00	0.76
802.11n HT40	5755	9.40	8.77	12.11	17.00	4.89
	5795	10.29	9.68	13.01	17.00	3.99

Section 8

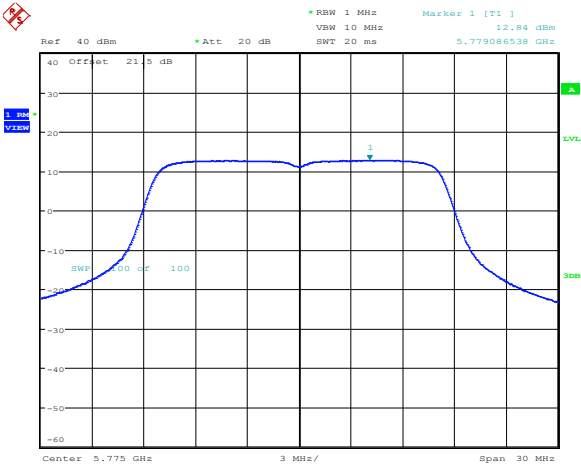
Test name

Specification

Testing data
FCC 15.407(a)(3) and RSS-210 A9.2(4) 5.725–5.825 GHz band output power, EIRP and spectral
density limits
FCC Part 15 Subpart E and RSS-210 A9, Issue 8

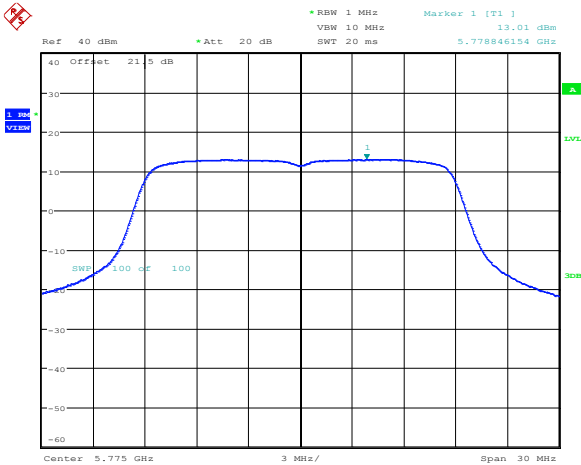


8.4.4 Test data, continued



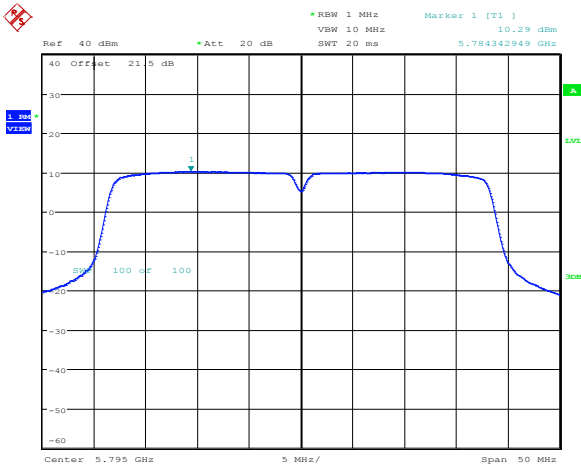
Date: 17.APR.2013 12:26:12

Figure 8.4-1: Sample plot for PPSS on 802.11a



Date: 17.APR.2013 12:27:23

Figure 8.4-2: Sample plot for PPSS on 802.11n HT20



Date: 17.APR.2013 12:12:41

Figure 8.4-3: Sample plot for PPSS on 802.11n HT40

8.5 FCC 15.407(b) and RSS-210 A9.2(4) Spurious (out-of-band) emissions

8.5.1 Definitions and limits

FCC:

(4) For transmitters operating in the 5725–5825 MHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of –17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of –27 dBm/MHz.

(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.

(7) The provisions of § 15.205 apply to intentional radiators operating under this section.

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

IC:

For the band 5725–5825 MHz, emissions within the frequency range from the band edges to 10 MHz above or below the band edges shall not exceed –17 dBm/MHz e.i.r.p. For frequencies more than 10 MHz above or below the band edges, emissions shall not exceed –27 dBm/MHz.

RSS-Gen 7.2.2 Emissions falling within restricted frequency bands

Restricted bands, identified in Table 8.5-2, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- (a) fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of below;
- (b) unwanted emissions falling into restricted bands of below shall comply with the limits specified in RSS-Gen;
- (c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.

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: * - Applicable only to FCC requirements

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

8.5.1 Definitions and limits, continued

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 license-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

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 18, 2013	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	33 %

8.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz.

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. Radiated emissions were performed while both antenna connectors were terminated with 50 Ω load.

Spectrum analyser for peak conducted measurements within restricted bands below 1 GHz:

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

Average limit line was set as follows: 54 dB μ V/m – 95.23 dB – 7.2 dBi – 4.7 dB – 3 dB = –56.13 dBm

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

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

Average limit line was set as follows: 54 dB μ V/m – 95.23 dB – 7.2 dBi – 3 dB = –51.43 dBm/MHz where 3 dB is a multiple antenna ports compensation: $10 \times \log_{10}(2) = 3$ dB

Spectrum analyser for average conducted measurements within restricted bands above 1 GHz for frequencies where peak results were above the average limit:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Detector mode:	RMS
Trace mode:	Power average
Number of averaging traces:	100

Peak limit is 20 dB higher than the average limit: –51.43 dBm/MHz + 20 dB = –31.43 dBm/MHz

Spectrum analyser for peak conducted measurements outside restricted bands:

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

Conducted emissions measurements outside restricted bands were performed on each individual MIMO chain. The limit line was adjusted to include antenna directional gain of 7.2 dBi and a compensation of two antenna ports: –27 dBm/MHz – $10 \times \log_{10}(2)$ – 7.2 dBi = –37.2 dBm/MHz.

In the plots for the band edge measurements the reference level offset of 10.2 dB to include antenna directional gain of 7.2 dBi and a compensation of two antenna ports (3 dB) was added in addition to the general setup offset (in some cases 21.5 dB or 18.5 dB, depends on when the test was performed) In case of 21.5 dB general test equipment offset, the total correction factor is 31.7 dB, and for the 18.5 dB general, the final correction factor was calculated as 28.7 dB. Therefore the band edge limits on the band edge measurement plots are actual limits as per specification: –17 dBm/MHz and –27 dBm/MHz.

8.5.4 Test data

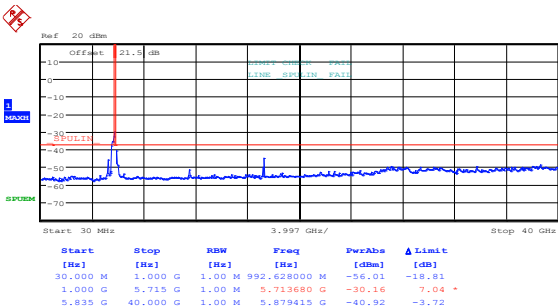


Figure 8.5-1: Conducted spurious emissions outside restricted bands, 802.11a, low channel, cho

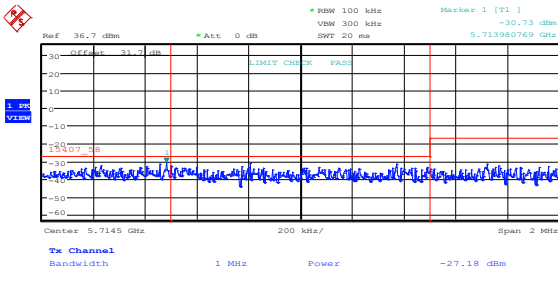


Figure 8.5-2: Lower band edge emissions at 5715 MHz, 802.11a, low channel, cho

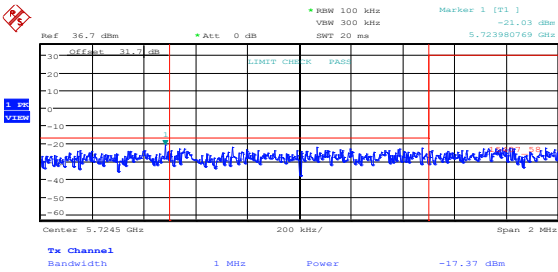
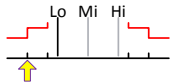


Figure 8.5-3: Lower band edge emissions at 5725 MHz, 802.11a, low channel, cho

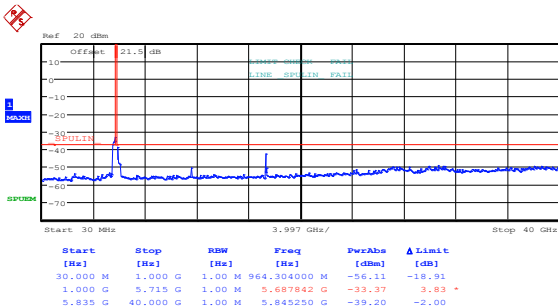


Figure 8.5-4: Conducted spurious emissions outside restricted bands, 802.11a, mid channel, cho

Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued

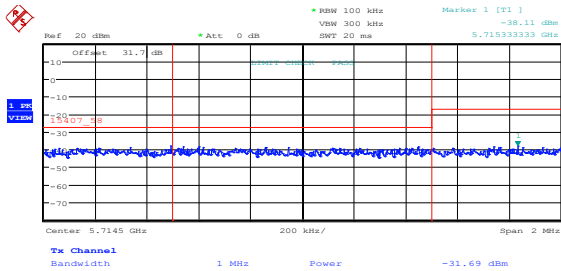


Figure 8.5-5: Lower band edge emissions at 5715 MHz, 802.11a, mid channel, cho

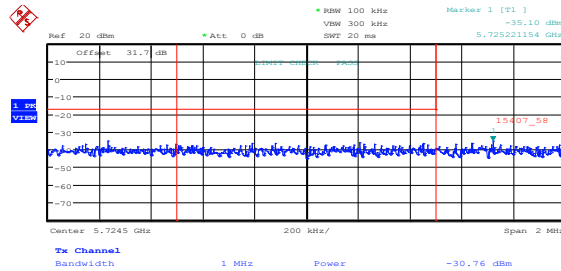


Figure 8.5-6: Lower band edge emissions at 5725 MHz, 802.11a, mid channel, cho

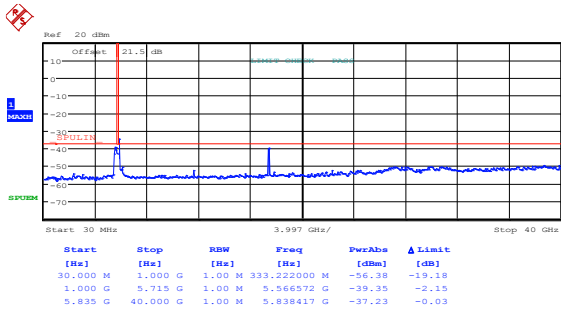
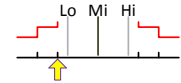


Figure 8.5-7: Conducted spurious emissions outside restricted bands, 802.11a, high channel, cho

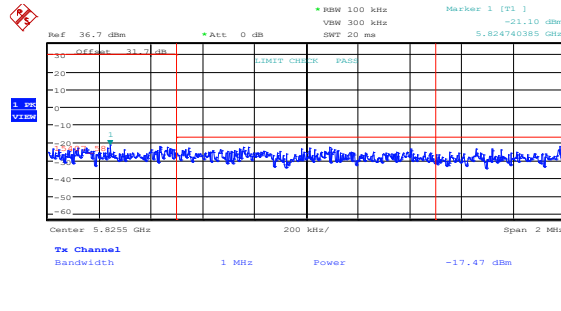


Figure 8.5-8: Upper band edge emissions at 5825 MHz, 802.11a, high channel, cho

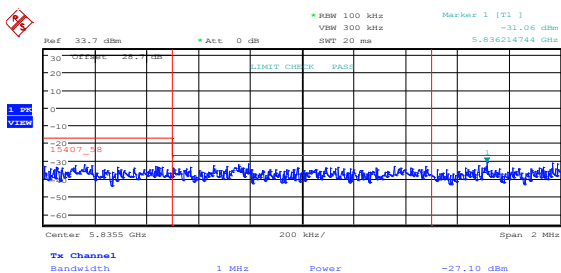
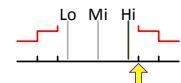


Figure 8.5-9: Upper band edge emissions at 5835 MHz, 802.11a, high channel, cho

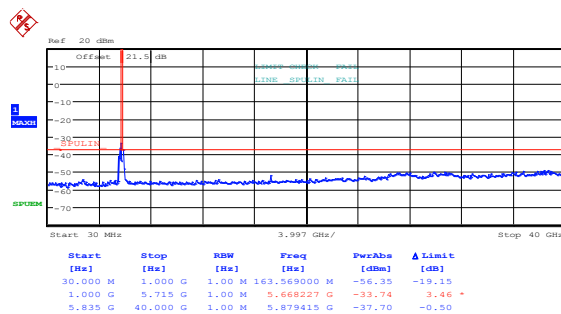


Figure 8.5-10: Conducted spurious emissions outside restricted bands, 802.11a, low channel, ch1

Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued

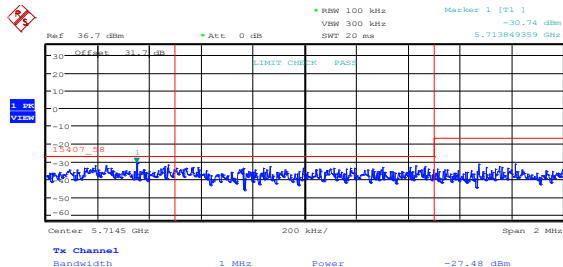


Figure 8.5-11: Lower band edge emissions at 5715 MHz, 802.11a, low channel, ch1

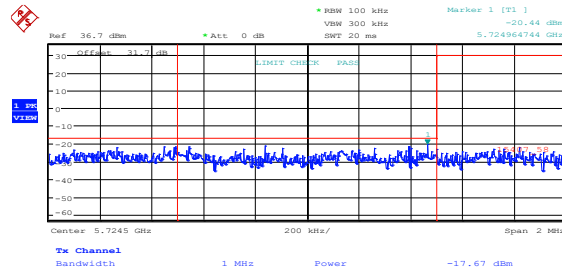
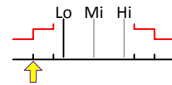


Figure 8.5-12: Lower band edge emissions at 5725 MHz, 802.11a, low channel, ch1

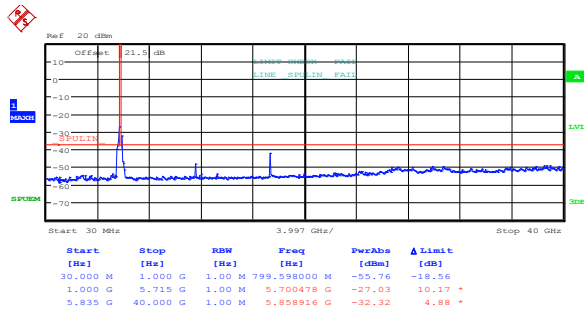
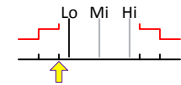


Figure 8.5-13: Conducted spurious emissions outside restricted bands, 802.11a, mid channel, ch1

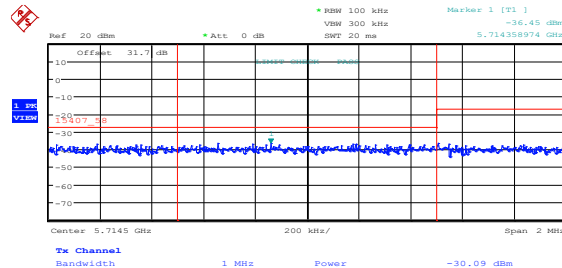


Figure 8.5-14: Lower band edge emissions at 5715 MHz, 802.11a, mid channel, ch1

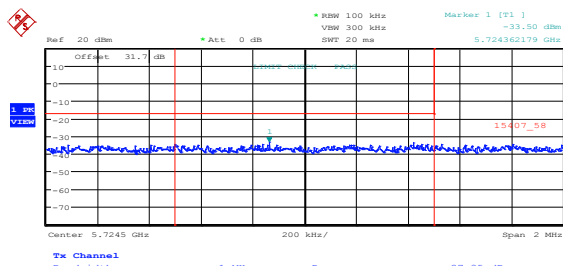
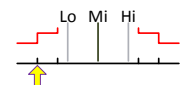


Figure 8.5-15: Lower band edge emissions at 5725 MHz, 802.11a, mid channel, ch1

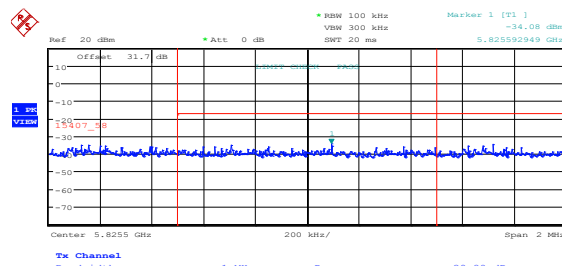
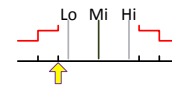
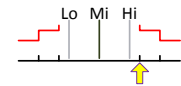


Figure 8.5-16: Upper band edge emissions at 5825 MHz, 802.11a, mid channel, ch1



Note: In the "Conducted spurious emissions outside restricted bands" plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer's band power measurement function.

8.5.4 Test data, continued

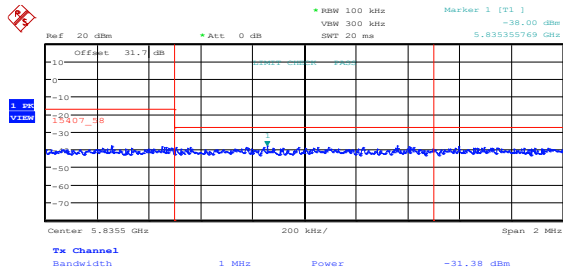


Figure 8.5-17: Upper band edge emissions at 5835 MHz, 802.11a, mid channel, ch1

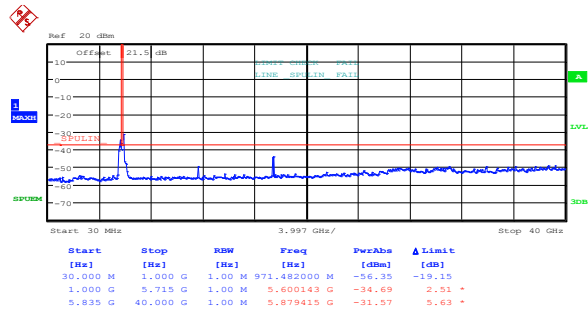


Figure 8.5-18: Conducted spurious emissions outside restricted bands, 802.11a, high channel, ch1

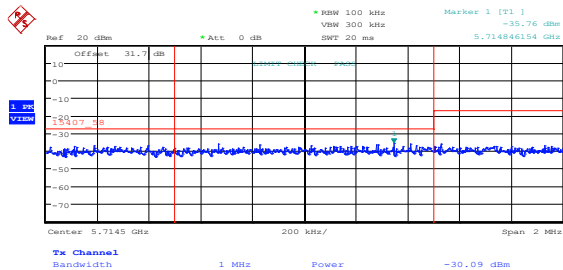


Figure 8.5-19: Lower band edge emissions at 5715 MHz, 802.11a, high channel, ch1

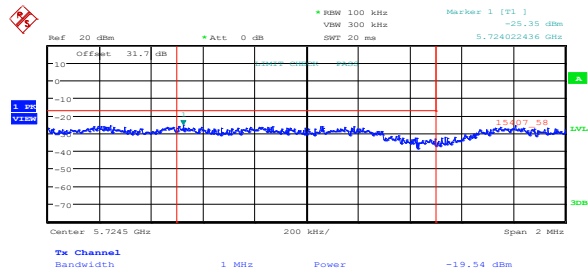


Figure 8.5-20: Lower band edge emissions at 5725 MHz, 802.11a, high channel, ch1

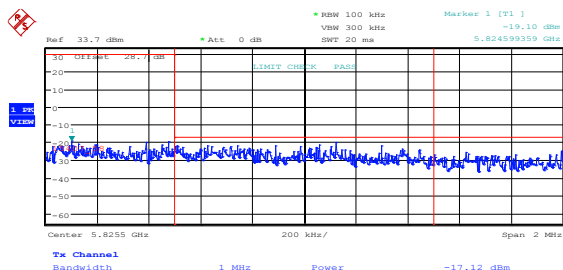
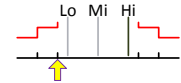


Figure 8.5-21: Upper band edge emissions at 5825 MHz, 802.11a, high channel, ch1

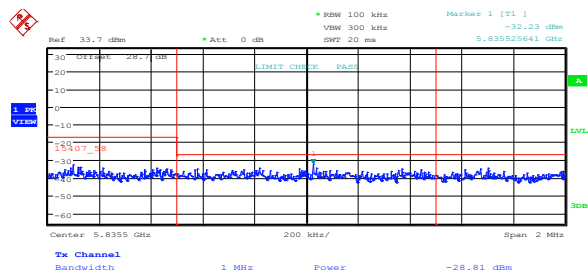
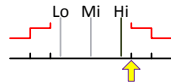
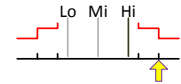


Figure 8.5-22: Upper band edge emissions at 5835 MHz, 802.11a, high channel, ch1



Note: In the "Conducted spurious emissions outside restricted bands" plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer's band power measurement function.

8.5.4 Test data, continued

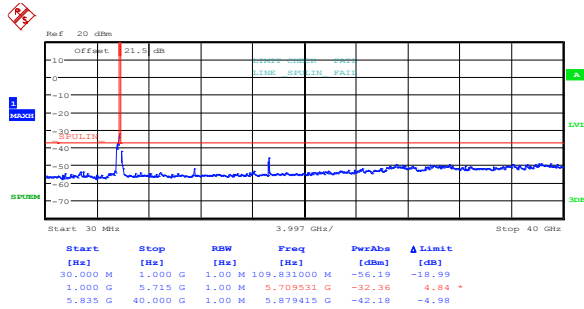


Figure 8.5-23: Conducted spurious emissions outside restricted bands, 802.11n HT20, low channel, cho

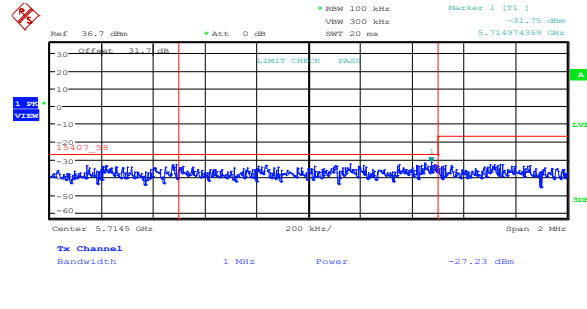


Figure 8.5-24: Lower band edge emissions at 5715 MHz, 802.11n HT20, low channel, cho

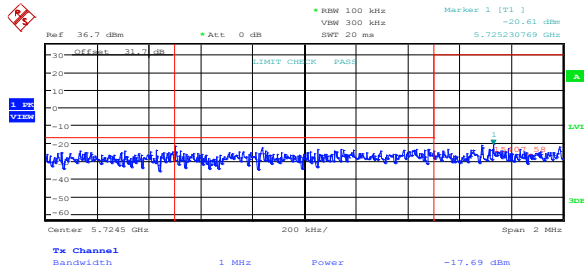
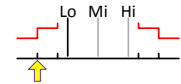


Figure 8.5-25: Lower band edge emissions at 5725 MHz, 802.11n HT20, low channel, cho

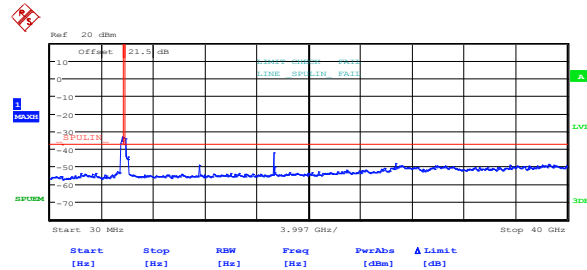
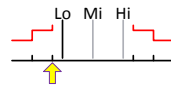


Figure 8.5-26: Conducted spurious emissions outside restricted bands, 802.11n HT20, mid channel, cho

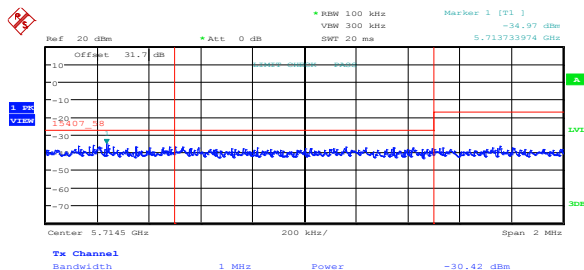


Figure 8.5-27: Lower band edge emissions at 5715 MHz, 802.11n HT20, mid channel, cho

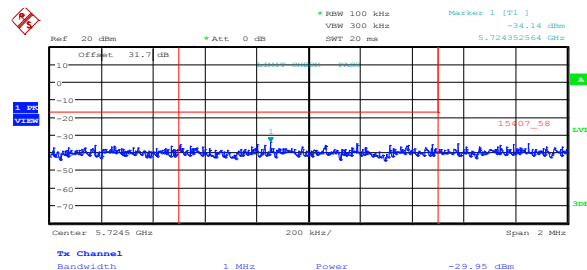
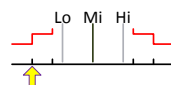
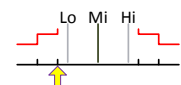


Figure 8.5-28: Lower band edge emissions at 5725 MHz, 802.11n HT20, mid channel, cho



Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued

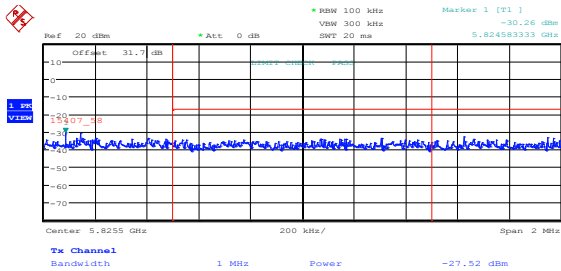


Figure 8.5-29: Upper band edge emissions at 5825 MHz, 802.11n HT20, mid channel, cho

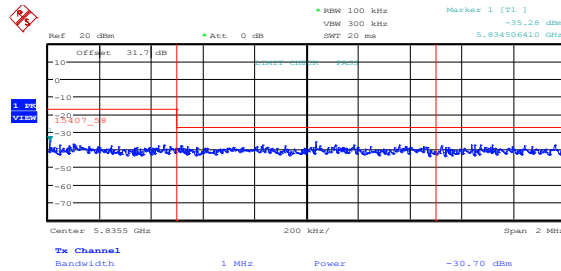


Figure 8.5-30: Upper band edge emissions at 5835 MHz, 802.11n HT20, mid channel, cho

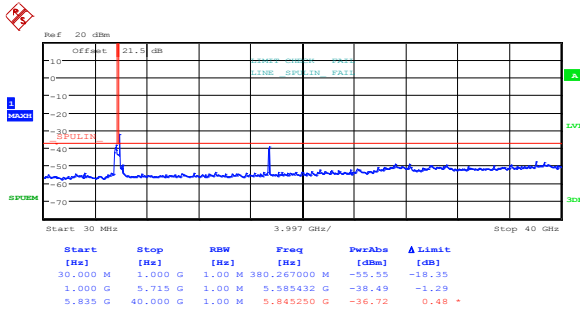


Figure 8.5-31: Conducted spurious emissions outside restricted bands, 802.11n HT20, high channel, cho

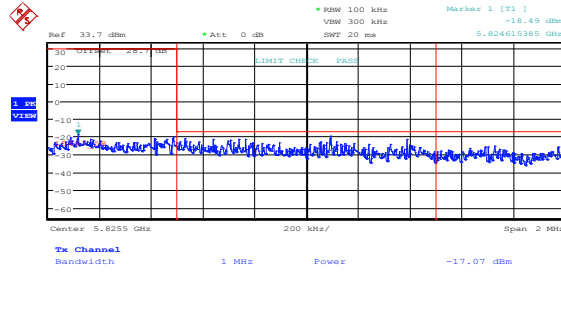


Figure 8.5-32: Upper band edge emissions at 5825 MHz, 802.11n HT20, high channel, cho

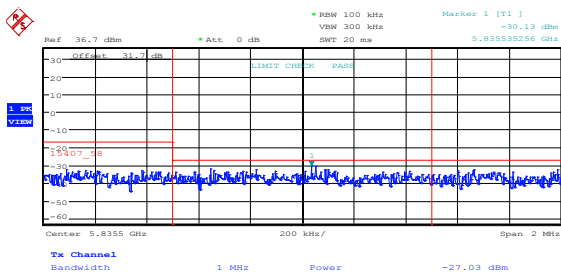


Figure 8.5-33: Upper band edge emissions at 5835 MHz, 802.11n HT20, high channel, cho

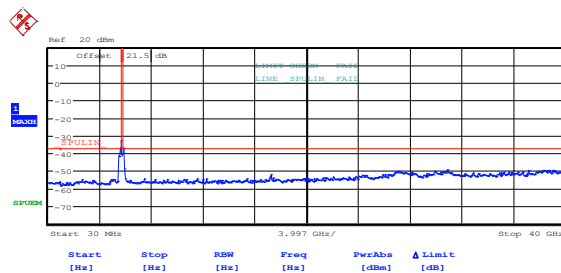


Figure 8.5-34: Conducted spurious emissions outside restricted bands, 802.11n HT20, low channel, ch1

Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued

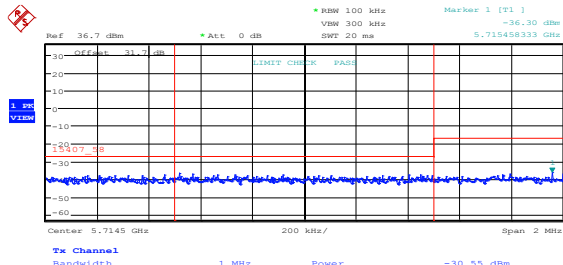


Figure 8.5-35: Lower band edge emissions at 5715 MHz, 802.11n HT20, low channel, ch1

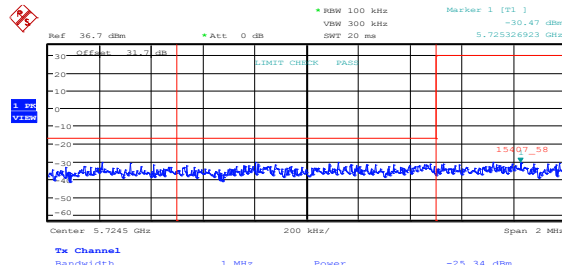


Figure 8.5-36: Lower band edge emissions at 5725 MHz, 802.11n HT20, low channel, ch1

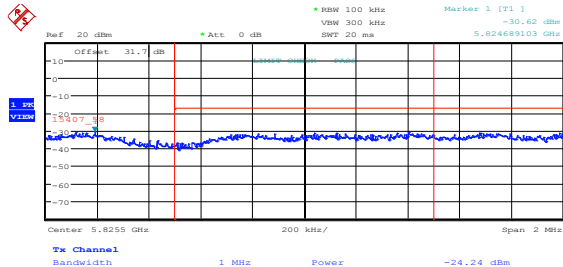
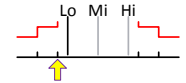


Figure 8.5-37: Upper band edge emissions at 5825 MHz, 802.11n HT20, low channel, ch1

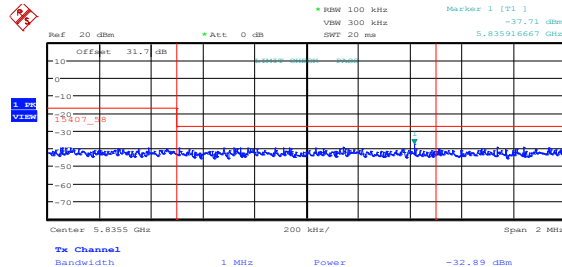
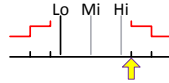


Figure 8.5-38: Upper band edge emissions at 5835 MHz, 802.11n HT20, low channel, ch1

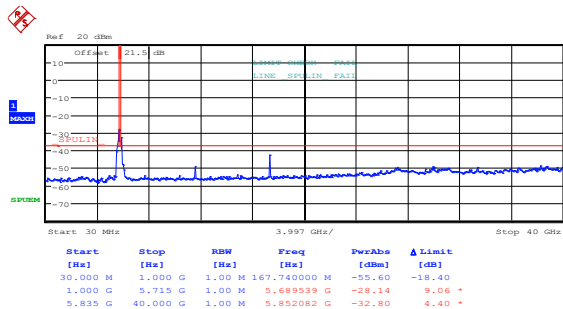


Figure 8.5-39: Conducted spurious emissions outside restricted bands, 802.11n HT20, mid channel, ch1

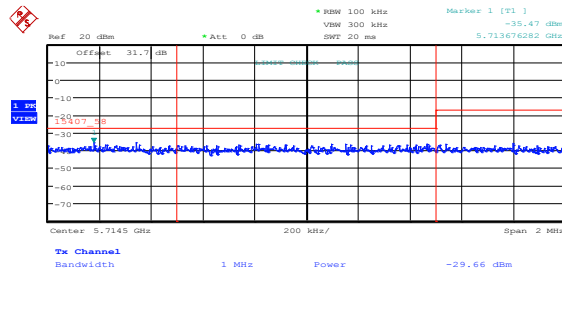
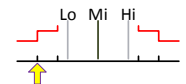


Figure 8.5-40: Lower band edge emissions at 5715 MHz, 802.11n HT20, mid channel, ch1



Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued

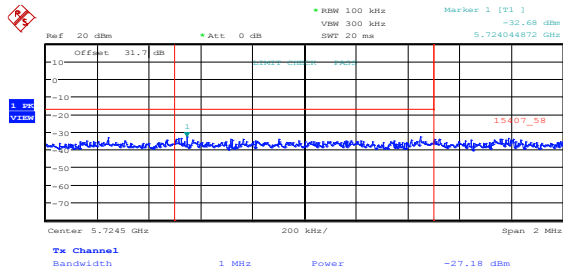


Figure 8.5-41: Lower band edge emissions at 5725 MHz, 802.11n HT20, mid channel, ch1

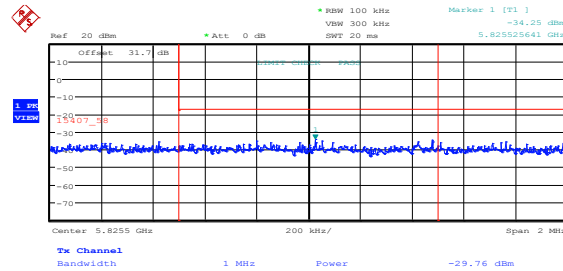
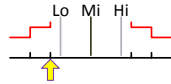


Figure 8.5-42: Upper band edge emissions at 5825 MHz, 802.11n HT20, mid channel, ch1

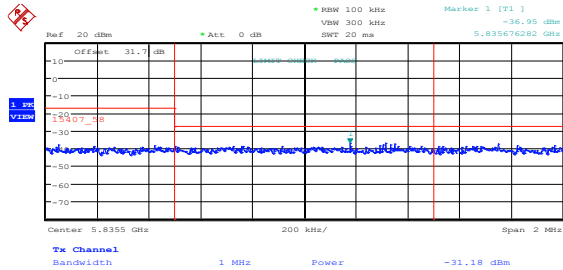
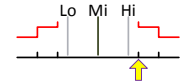


Figure 8.5-43: Upper band edge emissions at 5835 MHz, 802.11n HT20, mid channel, ch1

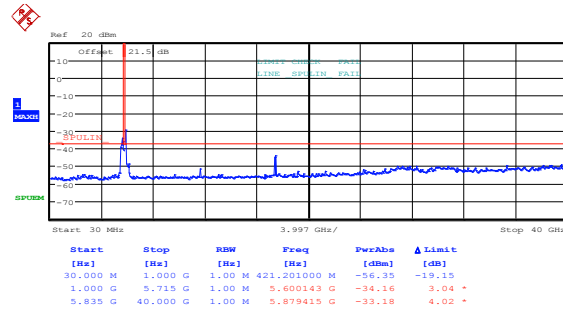
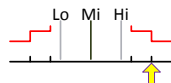


Figure 8.5-44: Conducted spurious emissions outside restricted bands, 802.11n HT20, high channel, ch1

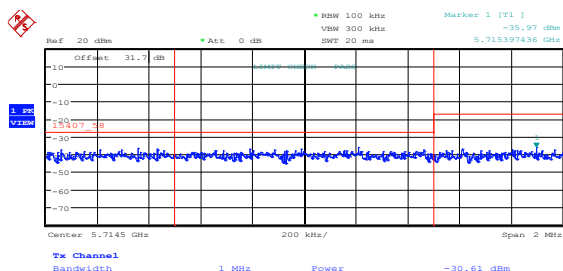


Figure 8.5-45: Lower band edge emissions at 5715 MHz, 802.11n HT20, high channel, ch1

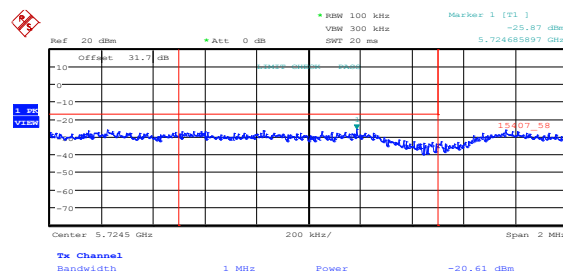
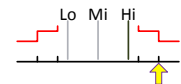
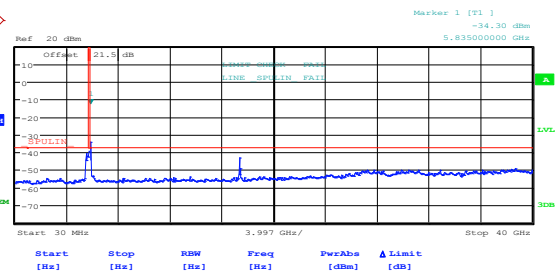
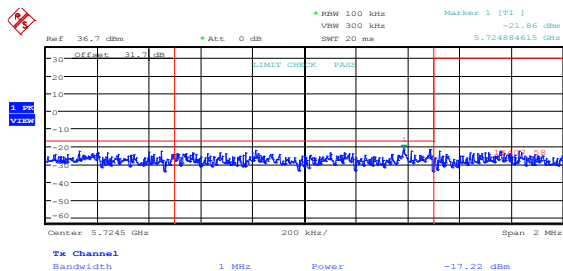
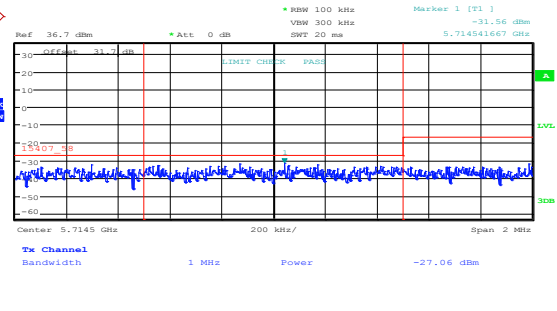
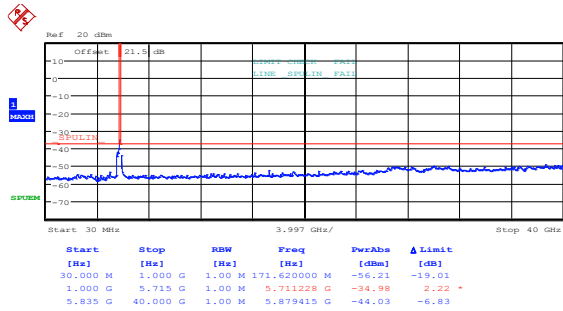
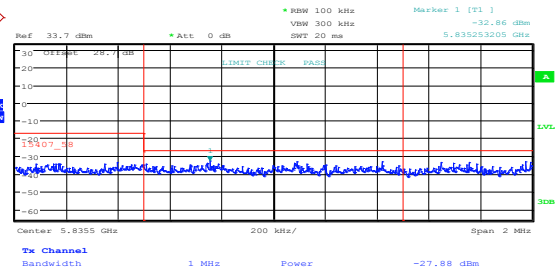
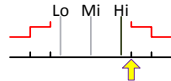
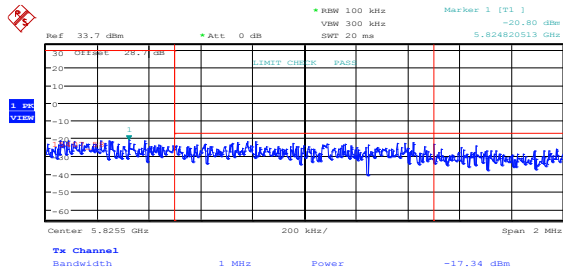


Figure 8.5-46: Lower band edge emissions at 5725 MHz, 802.11n HT20, high channel, ch1



Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued



Note: In the "Conducted spurious emissions outside restricted bands" plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer's band power measurement function.

8.5.4 Test data, continued

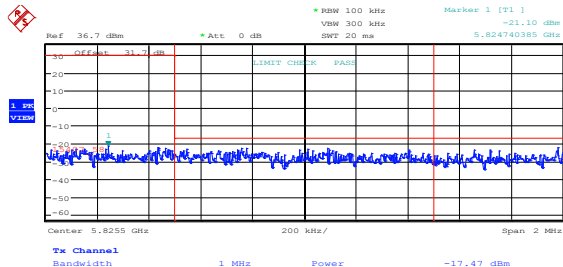


Figure 8.5-53: Upper band edge emissions at 5825 MHz, 802.11n HT40, high channel, cho

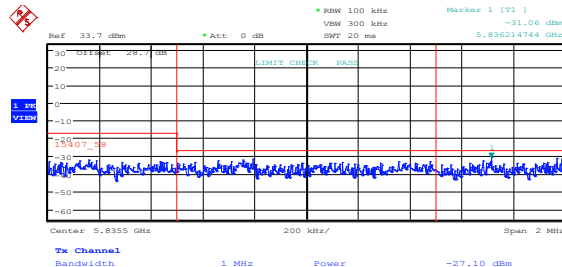
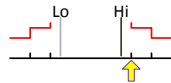


Figure 8.5-54: Upper band edge emissions at 5835 MHz, 802.11n HT40, high channel, cho

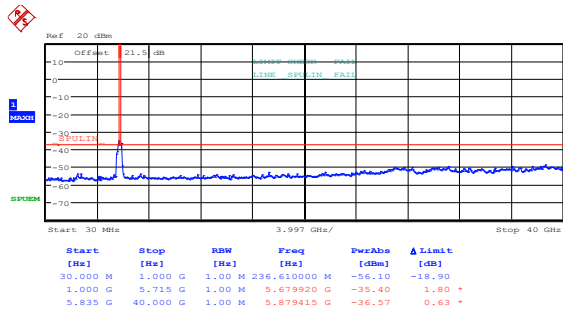


Figure 8.5-55: Conducted spurious emissions outside restricted bands, 802.11n HT40, low channel, ch1

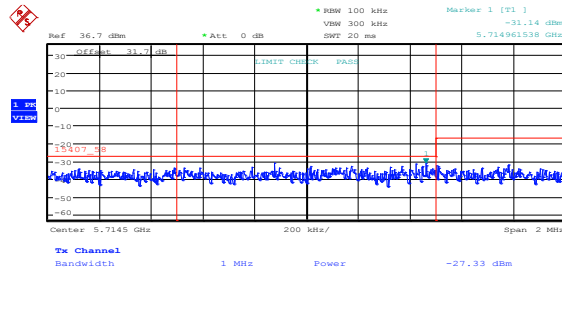


Figure 8.5-56: Lower band edge emissions at 5715 MHz, 802.11n HT40, low channel, ch1

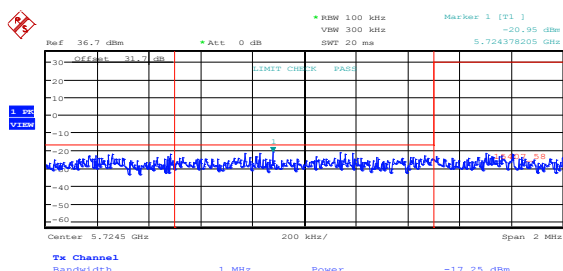
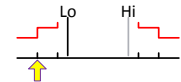


Figure 8.5-57: Lower band edge emissions at 5725 MHz, 802.11n HT40, low channel, ch1

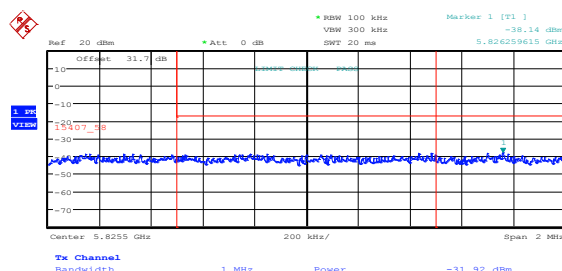
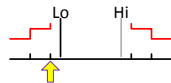
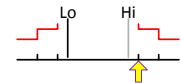


Figure 8.5-58: Upper band edge emissions at 5825 MHz, 802.11n HT40, low channel, ch1



Note: In the "Conducted spurious emissions outside restricted bands" plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer's band power measurement function.

8.5.4 Test data, continued

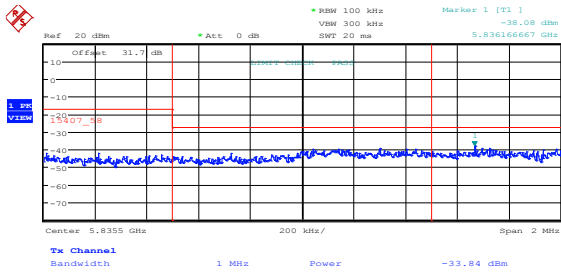


Figure 8.5-59: Upper band edge emissions at 5835 MHz, 802.11n HT40, low channel, ch1

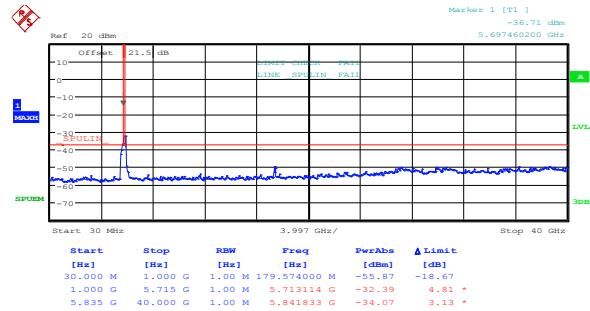
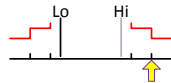


Figure 8.5-60: Conducted spurious emissions outside restricted bands, 802.11n HT40, high channel, ch1

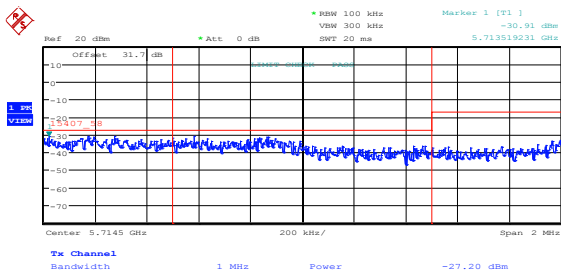


Figure 8.5-61: Lower band edge emissions at 5715 MHz, 802.11n HT40, high channel, ch1

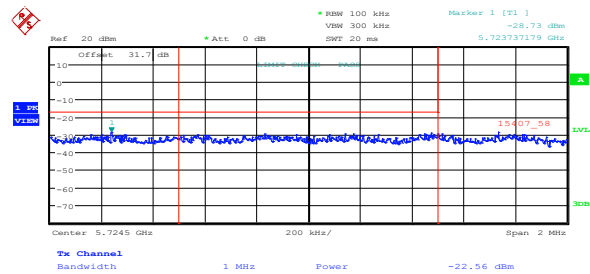
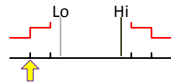


Figure 8.5-62: Lower band edge emissions at 5725 MHz, 802.11n HT40, high channel, ch1

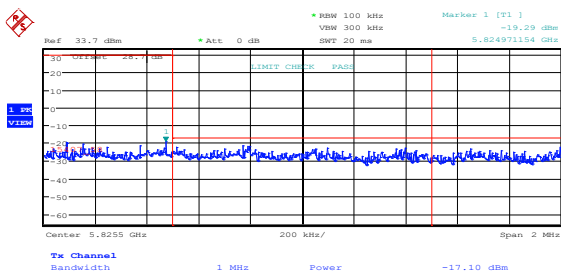


Figure 8.5-63: Upper band edge emissions at 5825 MHz, 802.11n HT40, high channel, ch1

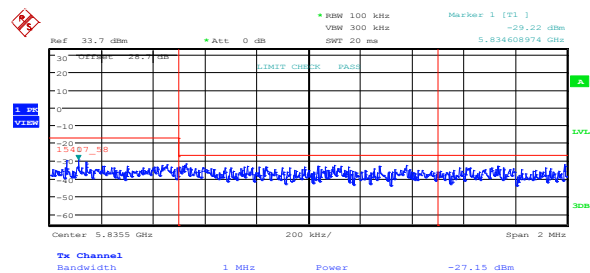
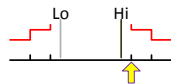
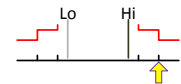
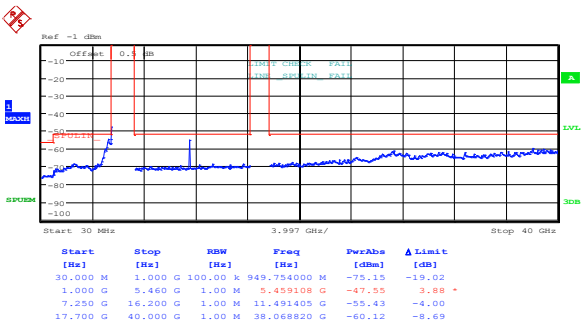


Figure 8.5-64: Upper band edge emissions at 5835 MHz, 802.11n HT40, high channel, ch1



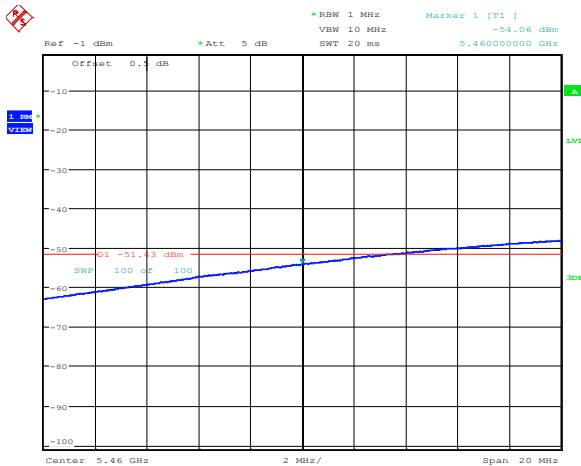
Note: In the “Conducted spurious emissions outside restricted bands” plots above there are two traces present; the red trace indicates the corrected limit as defined in section 8.5.3, the blue trace is a peak detector measurement of the spurious emissions from the EUT with 1 MHz IF BW. Tabular measurements indicate the highest measured peak levels within defined ranges. Any measurements with the 1 MHz IF BW exceeding the limit are re-measured immediately (on the following plots) using a reduced IF BW and the power is computed by integrating the spectrum across 1 MHz using the spectrum analyzer’s band power measurement function.

8.5.4 Test data, continued



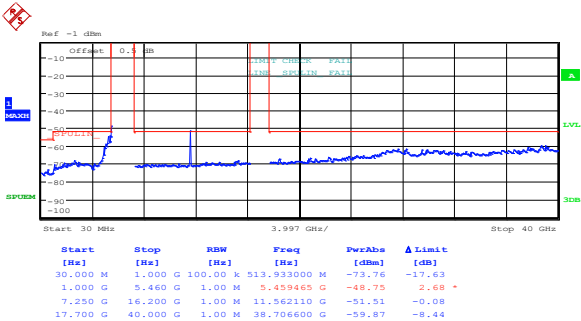
Date: 18.APR.2013 13:56:53

Figure 8.5-65: Conducted peak spurious emissions within restricted bands, 802.11a, low channel, cho



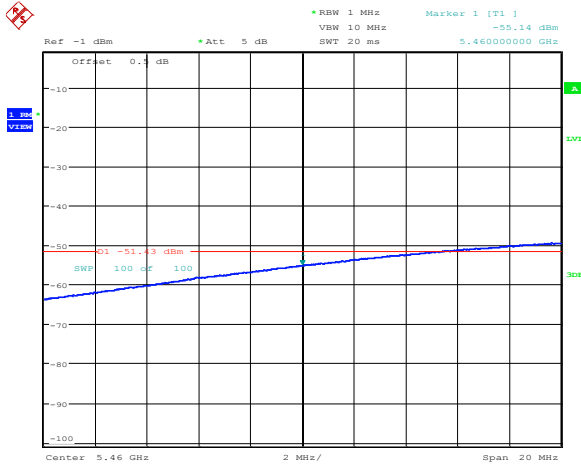
Date: 19.APR.2013 15:29:18

Figure 8.5-66: Conducted average spurious emission at 5.46 GHz, 802.11a, low channel, cho



Date: 18.APR.2013 14:02:03

Figure 8.5-67: Conducted peak spurious emissions within restricted bands, 802.11a, mid channel, cho



Date: 19.APR.2013 15:30:52

Figure 8.5-68: Conducted average spurious emission at 5.46 GHz, 802.11a, mid channel, cho

Note: In the above plots there are two traces present; the red trace indicates the average limit as defined within the specification, the blue trace is a peak detector measurement of the spurious emissions from the EUT. Peak emissions meeting the average limit are deemed to satisfy both the peak and average limits. Tabular measurements above indicate the highest measured peak levels within defined ranges. Any peak measurements exceeding the average limit are re-measured using an average detector (on the following plots); the average measurement results are then compared to the average limit.

8.5.4 Test data, continued

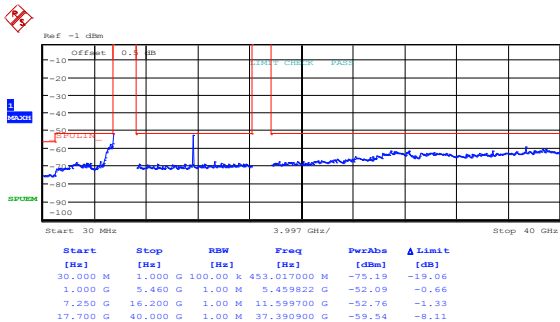


Figure 8.5-69: Conducted peak spurious emissions within restricted bands, 802.11a, high channel, cho

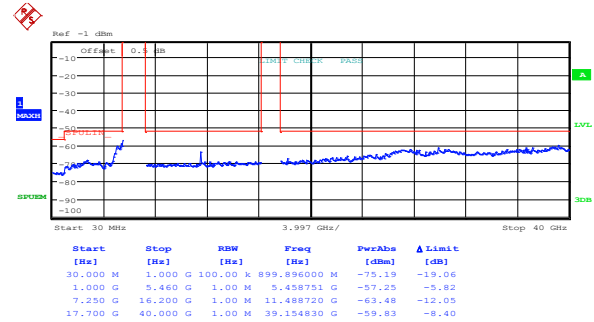
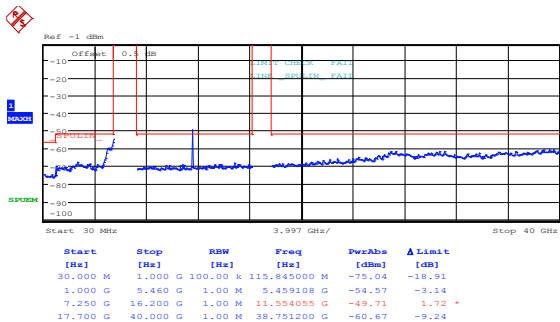
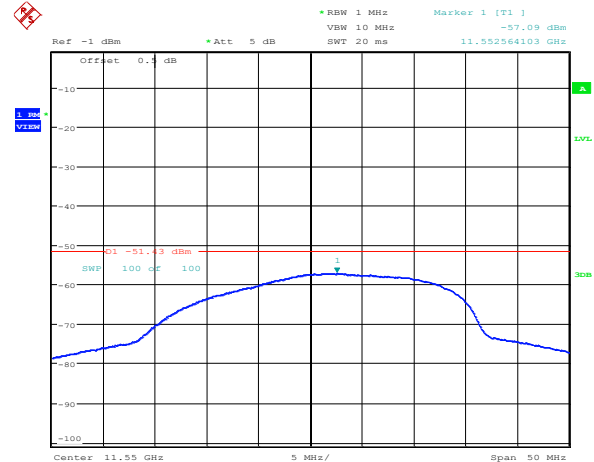


Figure 8.5-70: Conducted peak spurious emissions within restricted bands, 802.11a, low channel, ch1



Date: 18.APR.2013 14:03:36

Figure 8.5-71: Conducted peak spurious emissions within restricted bands, 802.11a, mid channel, ch1

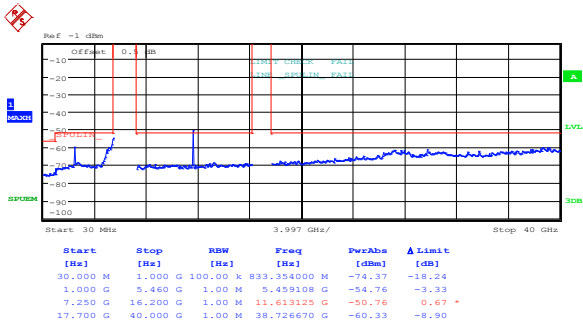


Date: 19.APR.2013 15:24:24

Figure 8.5-72: Conducted average spurious emission at 11.55 GHz, 802.11a, mid channel, ch1

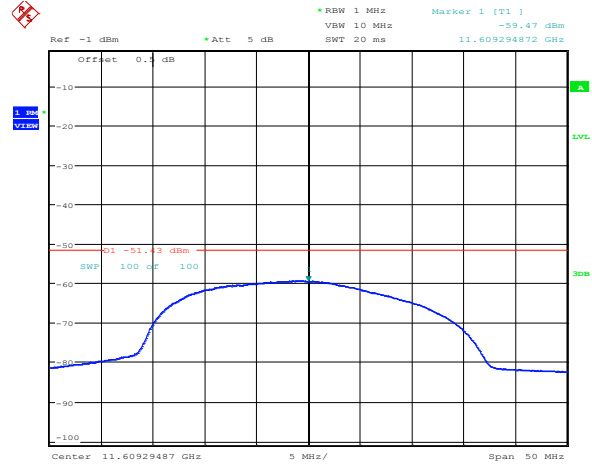
Note: In the above plots there are two traces present; the red trace indicates the average limit as defined within the specification, the blue trace is a peak detector measurement of the spurious emissions from the EUT. Peak emissions meeting the average limit are deemed to satisfy both the peak and average limits. Tabular measurements above indicate the highest measured peak levels within defined ranges. Any peak measurements exceeding the average limit are re-measured using an average detector (on the following plots); the average measurement results are then compared to the average limit.

8.5.4 Test data, continued



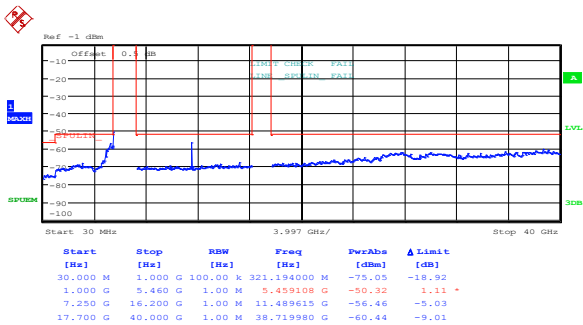
Date: 18.APR.2013 14:07:11

Figure 8.5-73: Conducted peak spurious emissions within restricted bands, 802.11a, high channel, ch1



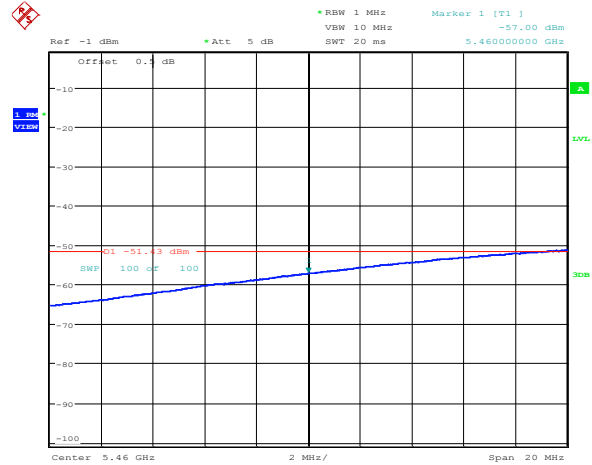
Date: 19.APR.2013 15:25:53

Figure 8.5-74: Conducted average spurious emission at 11.61 GHz, 802.11a, high channel, ch1



Date: 18.APR.2013 13:57:39

Figure 8.5-75: Conducted peak spurious emissions within restricted bands, 802.11n HT20, low channel, cho

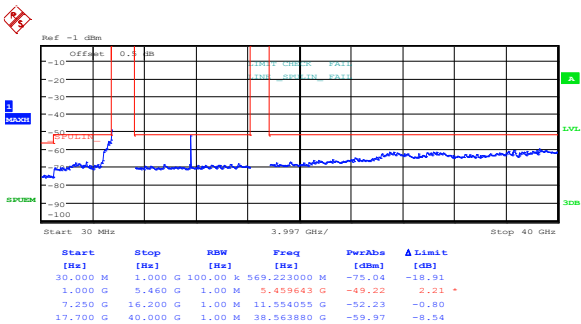


Date: 19.APR.2013 15:28:46

Figure 8.5-76: Conducted average spurious emission at 5.46 GHz, 802.11n HT20, low channel, cho

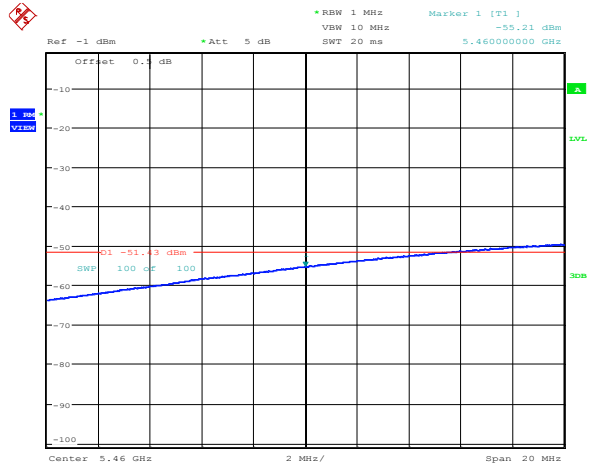
Note: In the above plots there are two traces present; the red trace indicates the average limit as defined within the specification, the blue trace is a peak detector measurement of the spurious emissions from the EUT. Peak emissions meeting the average limit are deemed to satisfy both the peak and average limits. Tabular measurements above indicate the highest measured peak levels within defined ranges. Any peak measurements exceeding the average limit are re-measured using an average detector (on the following plots); the average measurement results are then compared to the average limit.

8.5.4 Test data, continued



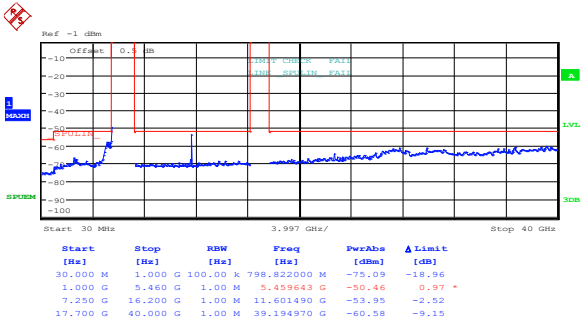
Date: 18.APR.2013 14:01:26

Figure 8.5-77: Conducted peak spurious emissions within restricted bands, 802.11n HT20, mid channel, cho



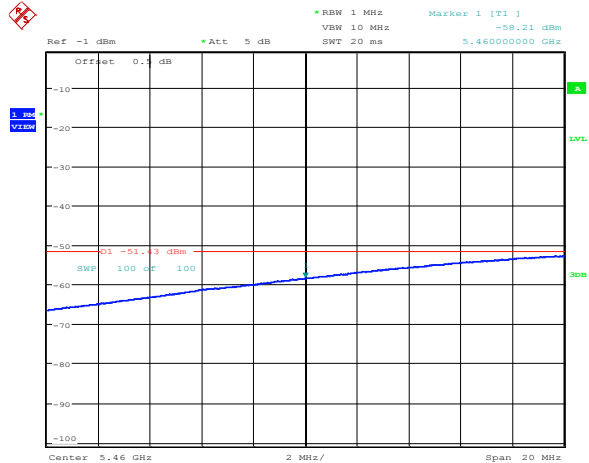
Date: 19.APR.2013 15:31:21

Figure 8.5-78: Conducted average spurious emission at 5.46 GHz, 802.11n HT20, mid channel, cho



Date: 18.APR.2013 14:00:34

Figure 8.5-79: Conducted peak spurious emissions within restricted bands, 802.11n HT20, high channel, cho



Date: 19.APR.2013 15:27:26

Figure 8.5-80: Conducted average spurious emission at 5.46 GHz, 802.11n HT20, high channel, cho

Note: In the above plots there are two traces present; the red trace indicates the average limit as defined within the specification, the blue trace is a peak detector measurement of the spurious emissions from the EUT. Peak emissions meeting the average limit are deemed to satisfy both the peak and average limits. Tabular measurements above indicate the highest measured peak levels within defined ranges. Any peak measurements exceeding the average limit are re-measured using an average detector (on the following plots); the average measurement results are then compared to the average limit.

8.5.4 Test data, continued

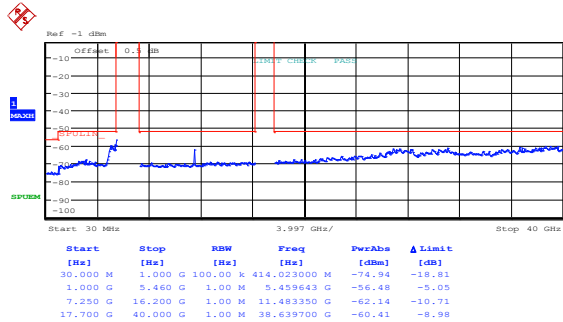


Figure 8.5-81: Conducted peak spurious emissions within restricted bands, 802.11n HT20, low channel, ch1

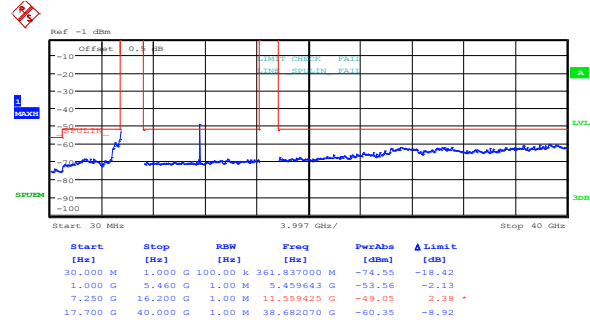
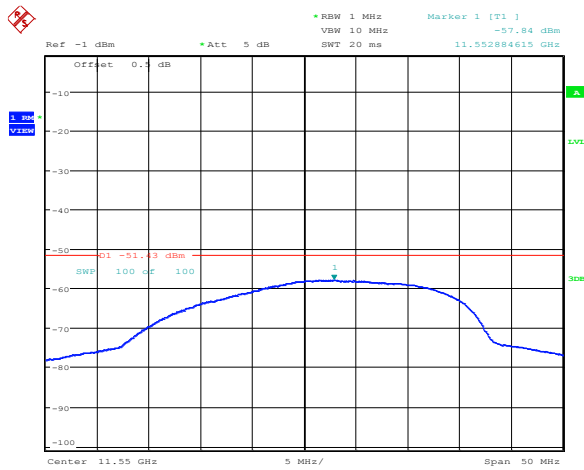
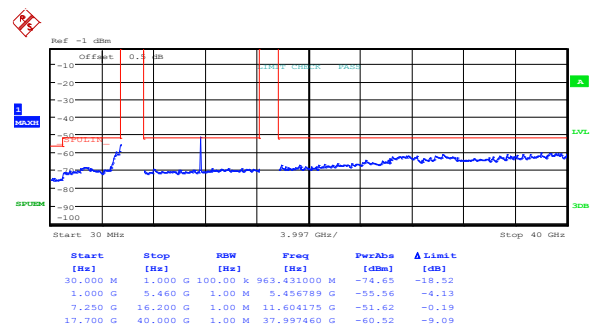


Figure 8.5-82: Conducted peak spurious emissions within restricted bands, 802.11n HT20, mid channel, ch1



Date: 19.APR.2013 15:24:51

Figure 8.5-83: Conducted average spurious emission at 11.55 GHz, 802.11n HT20, mid channel, ch1



Date: 18.APR.2013 14:08:01

Figure 8.5-84: Conducted peak spurious emissions within restricted bands, 802.11n HT20, high channel, ch1

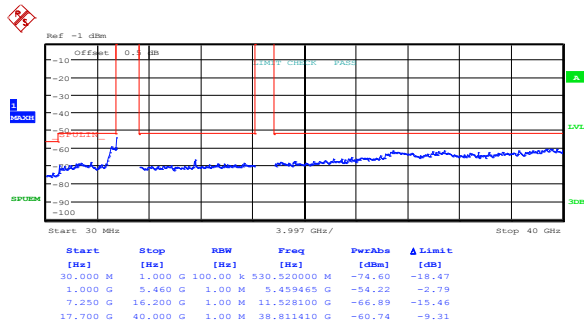


Figure 8.5-85: Conducted peak spurious emissions within restricted bands, 802.11n HT40, low channel, cho

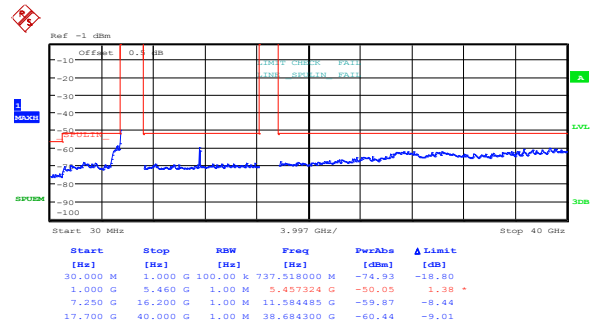
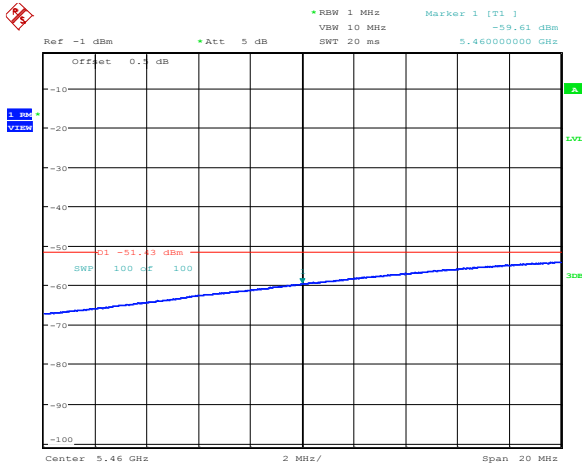


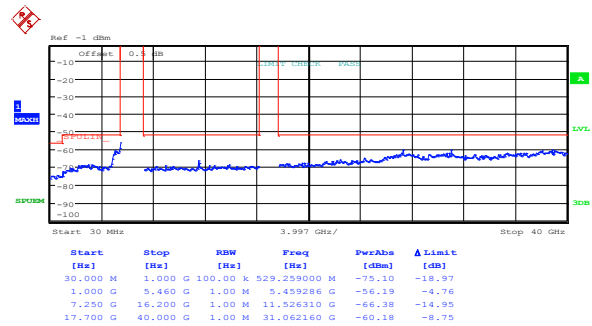
Figure 8.5-86: Conducted peak spurious emissions within restricted bands, 802.11n HT40, high channel, cho

8.5.4 Test data, continued



Date: 19.APR.2013 15:30:06

Figure 8.5-87: Conducted average spurious emission at 5.46 GHz, 802.11n HT40, high channel, cho



Date: 18.APR.2013 14:09:44

Figure 8.5-88: Conducted peak spurious emissions within restricted bands, 802.11n HT420, low channel, ch1

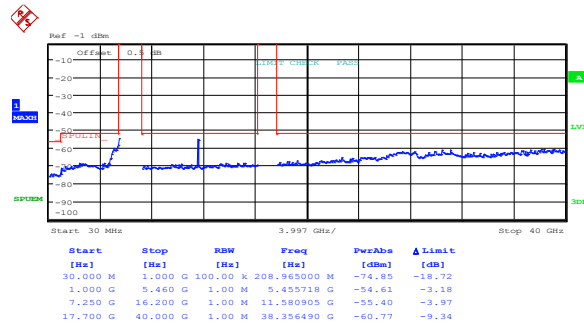


Figure 8.5-89: Conducted peak spurious emissions within restricted bands, 802.11n HT420, high channel, ch1

Note: In the above plots there are two traces present; the red trace indicates the average limit as defined within the specification, the blue trace is a peak detector measurement of the spurious emissions from the EUT. Peak emissions meeting the average limit are deemed to satisfy both the peak and average limits. Tabular measurements above indicate the highest measured peak levels within defined ranges. Any peak measurements exceeding the average limit are re-measured using an average detector (on the following plots); the average measurement results are then compared to the average limit.

Table 8.5-4: Radiated field strength measurement results

Frequency, MHz	Peak Field strength, dBμV/m	Limit, dBμV/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. The spectrum was swept from 30 MHz to 40 GHz. There were no spurious emissions originating from the RF module detected except for those listed in the table above.

8.6 FCC 15.407(g) Frequency stability

8.6.1 Definitions and limits

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

8.6.2 Test summary

Test date:	April 19, 2013	Temperature:	23 °C
Test engineer:	Andrey Adelberg	Air pressure:	1003 mbar
Verdict:	Pass	Relative humidity:	33 %

8.6.3 Observations, settings and special notes

Spectrum analyser settings:

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

8.6.4 Test data

Table 8.6-1: Frequency drift measurement

Test conditions	Frequency, GHz	Drift, Hz
+50 °C, Nominal	5.774937120	-124
+40 °C, Nominal	5.774937317	73
+30 °C, Nominal	5.774937362	118
+20 °C, +15 %	5.774937301	57
+20 °C, Nominal	5.774937244	Reference
+20 °C, -15 %	5.774937175	-69
+10 °C, Nominal	5.774937107	-137
0 °C, Nominal	5.774937207	-37
-10 °C, Nominal	5.774937297	53
-20 °C, Nominal	5.774937326	82
-30 °C, Nominal	5.774937126	-118

8.6.4 Test data, continued

Table 8.6-2: Lower band edge drift calculation

Modulation	-26 dBc lower cross point, GHz	Max negative drift, Hz	Drifted lower cross point, GHz	Band edge, GHz	Margin, MHz
802.11a	5.734743590	137	5.734743453	5.725	9.74
802.11n HT20	5.734342949	137	5.734342812	5.725	9.34
802.11n HT40	5.734262821	137	5.734262684	5.725	9.26

Notes: Drifted lower cross point = -26 dBc lower cross point – max negative drift.

Table 8.6-3: Upper band edge drift calculation

Modulation	-26 dBc upper cross point, GHz	Max positive drift, Hz	Drifted upper cross point, GHz	Band edge, GHz	Margin, MHz
802.11a	5.815102564	118	5.815102682	5.825	9.90
802.11n HT20	5.815423077	118	5.815423195	5.825	9.58
802.11n HT40	5.815352564	118	5.815352682	5.825	9.65

Notes: Drifted upper cross point = -26 dBc upper cross point + max positive drift.

8.7 FCC 15.407(a)(6) and RSS-210 A9.4(2) Peak excursion and PSD-to-average ratio

8.7.1 Definitions and limits

FCC:

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified in Section 8.4 of this document) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

IC:

Within the emission bandwidth, when the peak spectral density per MHz over any continuous transmission exceeds the average ($10 \times \log_{10} (B)$) value by more than 3 dB, the permissible power spectral density shall be reduced by the excess amount.

8.7.2 Test summary

Test date:	April 19, 2013	Temperature:	22 °C
Test engineer:	Andrey Adelberg	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	33 %

8.7.3 Observations, settings and special notes

FCC test was performed using method described in 789033 D01 General UNII Test Procedures v01r03 under sections G.
For PPSD and Average results please refer to Section 8.4 of this document

8.7.4 Test data

Table 8.7-1: FCC peak excursion measurements results

Chain	Modulation	Frequency, MHz	Peak max-hold measurement, dBm	PPSD measurement, dBm/MHz	Peak excursion, dB		
					Ratio	Limit	Margin
ch0	802.11a	5745	21.52	11.51	10.01	13.00	2.99
		5775	22.91	12.84	10.07	13.00	2.93
		5805	20.92	11.02	9.90	13.00	3.10
	802.11n HT20	5745	20.98	10.46	10.52	13.00	2.48
		5775	23.28	12.57	10.71	13.00	2.29
		5805	21.00	10.76	10.24	13.00	2.76
	802.11n HT40	5755	12.86	1.90	10.96	13.00	2.04
		5795	15.43	4.67	10.76	13.00	2.24
	ch1	802.11a	5745	13.97	3.97	10.00	13.00
5775			22.58	12.11	10.47	13.00	2.53
5805			21.71	11.62	10.09	13.00	2.91
802.11n HT20		5745	14.91	3.96	10.95	13.00	2.05
		5775	22.22	12.37	9.85	13.00	3.15
		5805	20.98	10.78	10.20	13.00	2.80
802.11n HT40		5755	9.95	-1.05	11.00	13.00	2.00
		5795	17.99	6.92	11.07	13.00	1.93

Note: Ratio is calculated as follows: Peak max-hold result – PPSD result.



8.7.4 Test data, continued

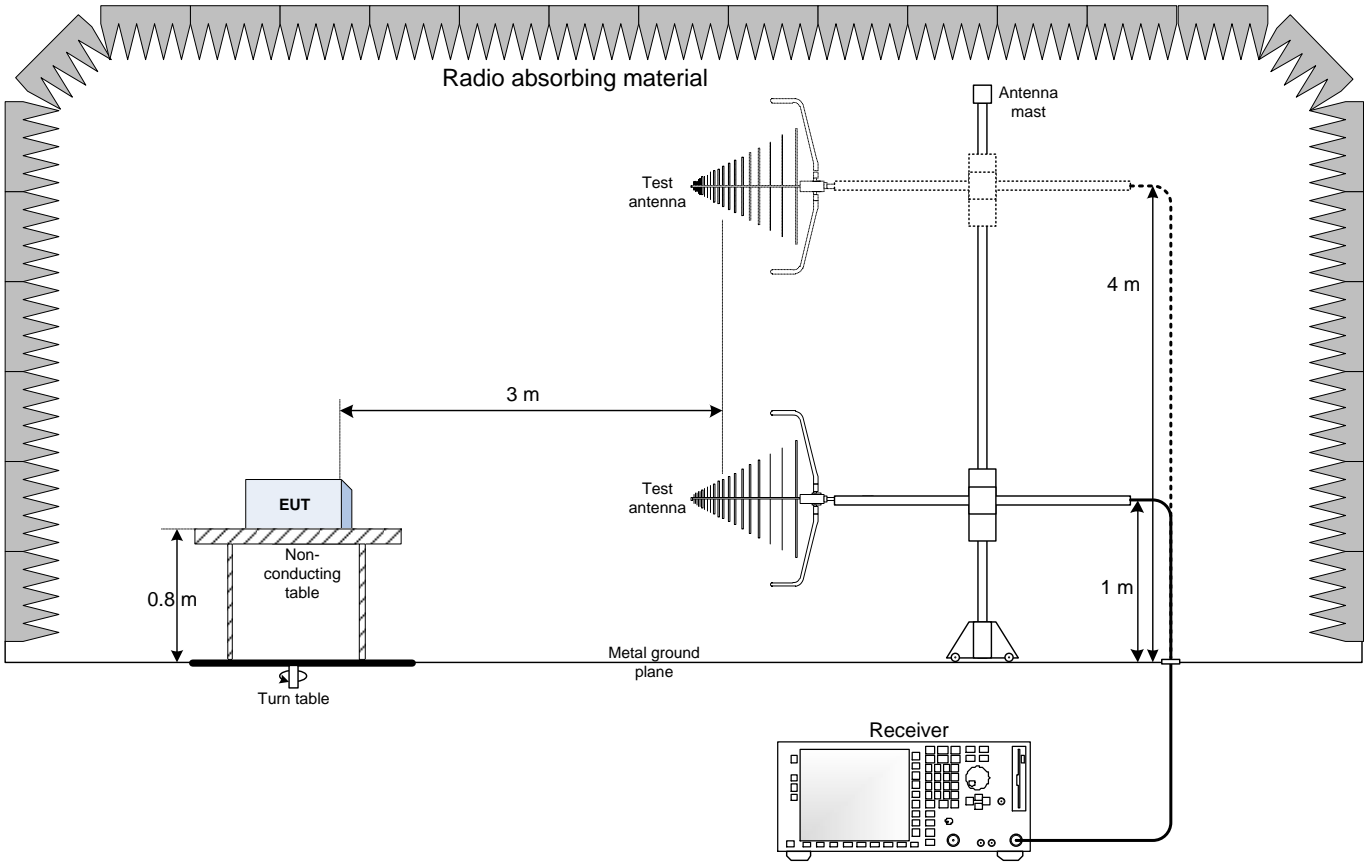
Table 8.7-2: IC PSD-to-average calculations results

Modulation	Frequency, MHz	PSD result, dBm/MHz	Average result, dBm	PSD to average, dB		
				Ratio	Limit	Margin
802.11a	5745	12.21	23.33	-11.11	3.00	14.11
	5785	15.85	27.82	-11.98	3.00	14.98
	5805	14.34	25.38	-11.04	3.00	14.04
802.11n HT20	5755	11.34	22.70	-11.36	3.00	14.36
	5795	15.71	27.91	-12.20	3.00	15.20
	5745	13.78	25.05	-11.27	3.00	14.27
802.11n HT40	5785	3.68	18.04	-14.36	3.00	17.36
	5805	8.95	23.19	-14.25	3.00	17.25

Note: Ratio is calculated as follows: PSD result – Average result.

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up

