

Test report

292515-1TRFWL

Date of issue: September 14, 2015

Applicant:

Ericsson Canada

Product:

DRUE 5.8 GHz radio

Model:

B5CH118AA

FCC ID:

RAR50005001


Specifications:

- ◆ **FCC 47 CFR Part 15 Subpart E, §15.407**

Unlicensed National Information Infrastructure Devices

Test location

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Website	www.nemko.com
Site number	FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Review date	September 14, 2015
Reviewer 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.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Ericsson Canada Inc.
Address	349 Terry Fox Drive
City	Ottawa
Province/State	ON
Postal/Zip code	K2K 2V6
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart E, Clause 15.407	Unlicensed National Information Infrastructure Devices
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1.3 Test methods

789033 D02 General UNII Test Procedures New Rules v01 (June 6, 2014)	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013)	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
662911 D02 MIMO with Cross Polarized Antenna v01 (October 25, 2011)	Emissions testing of transmitters with multiple outputs in the same band (MIMO) with Cross Polarized Antenna
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

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
§15.31(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)	Power and density limits within 5.15–5.25 GHz band	Not applicable
§15.407(a)(2)	Power and density limits within 5.25–5.35 GHz and 5.47–5.725 GHz bands	Not applicable
§15.407(a)(3)	Power and density limits within 5.725–5.85 GHz band	Pass
§15.407(b)(1)	Undesirable emission limits for 5.15–5.25 GHz band	Not applicable
§15.407(b)(2)	Undesirable emission limits for 5.25–5.35 GHz band	Not applicable
§15.407(b)(3)	Undesirable emission limits for 5.47–5.725 GHz bands	Not applicable
§15.407(b)(4)	Undesirable emission limits for 5.725–5.85 GHz band	Pass
§15.407(b)(6)	Conducted limits for U-NII devices using an AC power line	Pass
§15.407(e)	Minimum 6 dB bandwidth of U-NII devices within the 5.725-5.85 GHz band	Pass
§15.407(g)	Frequency stability	Pass
§15.407(h)(1) ¹	Transmit power control (TPC)	Not applicable
§15.407(h)(2) ¹	Dynamic Frequency Selection (DFS)	Not applicable

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

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 17, 2015
Nemko sample ID number	1

3.2 EUT information

Product name	DRUE 5.8 GHz radio
Model	B5CH118AA
Serial number	M1817E0018

3.3 Technical information

Frequency band	5725–5850 MHz
Operational frequency ranges	For 20 MHz channels: 5740–5825 MHz For 40 MHz channels: 5755–5815 MHz
Type of modulation	802.11a, 802.11n HT20 and 802.11n HT40
Emission classification (F1D, G1D, D1D)	W7D
Power requirements	120 V _{AC} , 60 Hz
Antenna information	Non-detachable, Omni-directional 3 × 3 array of antennas MN: BMAG00291-A, 6.5 dBi gain and 0.5 dB cable loss.

3.4 Product description and theory of operation

The EUT is a 3×3 MIMO combo Wi-Fi module designed to operate in the 2.4 GHz and 5 GHz bands. There are two independent radio units. This report covers only the 5 GHz radio UNII band.

3.5 EUT setup diagram

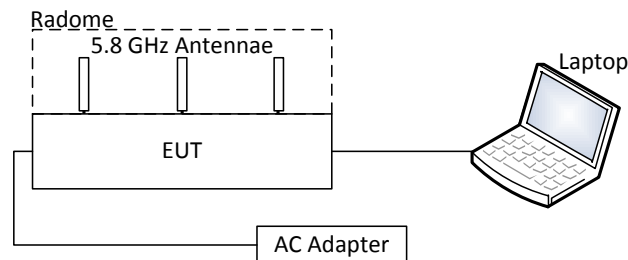


Figure 3.5-1: Setup diagram

3.6 EUT exercise details

The EUT was controlled to transmit at selected frequencies and modulations from laptop using Art GUI software and telnet session with the following maximum power settings:

Table 3.6-1: Power settings at 20 MHz channels for various uncorrelated MIMO applications

Modulation	Chain	5740 MHz	5745 MHz	5785 MHz	5825 MHz
802.11a	ch0	12.5	16.0	18.0	16.0
802.11a	ch1	12.5	16.5	18.0	17.5
802.11a	ch2	12.5	17.0	18.0	17.5
802.11n HT20	ch0	12.5	16.0	18.0	16.0
802.11n HT20	ch1	12.5	16.5	18.0	17.5
802.11n HT20	ch2	12.5	16.5	18.0	17.5

Table 3.6-2: Power settings at 40 MHz channels for various uncorrelated MIMO applications

Modulation	Chain	5755 MHz	5795 MHz	5815 MHz
802.11n HT40	ch0	13.0	18.0	15.5
802.11n HT40	ch1	13.5	18.0	15.5
802.11n HT40	ch2	14.0	18.0	16.0

Table 3.6-3: Power settings at 20 MHz channels for correlated MIMO 3 × 3 applications

Modulation	Chain	5740 MHz	5745 MHz	5785 MHz	5825 MHz
802.11a	ch0	12.5	16.0	15.0	16.0
802.11a	ch1	12.5	16.5	15.5	17.5
802.11a	ch2	12.5	16.0	15.0	16.5
802.11n HT20	ch0	12.5	16.0	15.5	16.0
802.11n HT20	ch1	12.5	16.0	15.5	16.5
802.11n HT20	ch2	12.5	16.5	15.0	17.5

Table 3.6-4: Power settings at 40 MHz channels for correlated MIMO 3 × 3 applications

Modulation	Chain	5755 MHz	5795 MHz	5815 MHz
802.11n HT40	ch0	13.0	16.0	15.5
802.11n HT40	ch1	13.5	16.0	15.5
802.11n HT40	ch2	14.0	15.5	16.0

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

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

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	Feb. 25/16
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Power source	California Instruments	5001ix	FA002494	1 year	Jan. 22 /16
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Jan. 07/16
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Apr. 12/16
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Apr. 01/16
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	Jan. 09/16
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	May 05/16
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU
LISN	Rohde & Schwarz	ENV216	FA002023	1 year	Jan. 09/16
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR

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

Section 8. Testing data

8.1 FCC 15.403(i) Emission bandwidth

8.1.1 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.

8.1.2 Test summary

Test date	August 18, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	35 %

8.1.3 Observations, settings and special notes

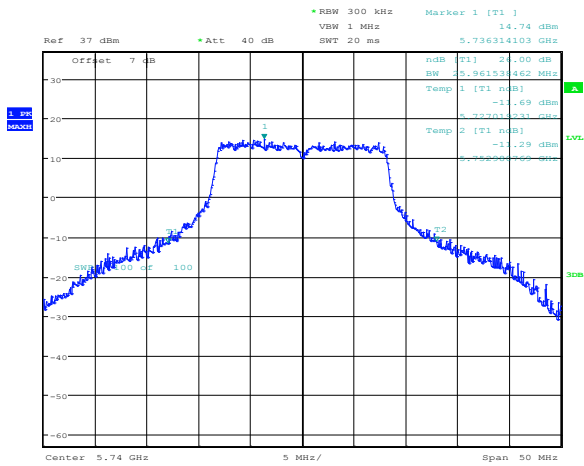
Spectrum analyser settings:

Resolution bandwidth	300 kHz for 20 MHz channels and 500 kHz for 40 MHz channels
Video bandwidth	> RBW
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

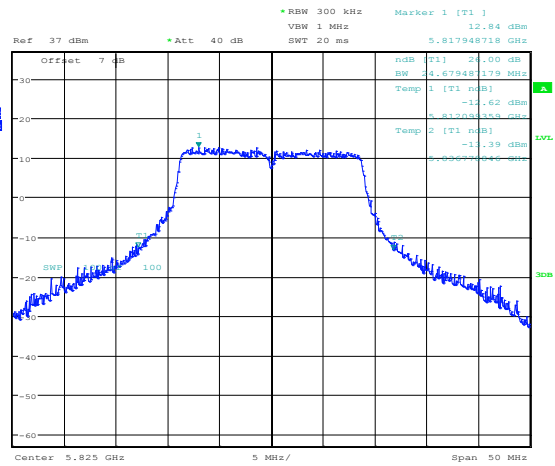
Table 8.1-1: 26 dB bandwidth results

Modulation	Frequency, MHz	26 dB bandwidth on ch0,	26 dB bandwidth on ch1,	26 dB bandwidth on ch2,
		MHz	MHz	MHz
802.11a	5740	25.48	25.96	25.00
	5745	23.47	23.64	24.28
	5785	23.99	23.80	23.99
	5825	24.04	24.04	23.88
802.11n HT20	5740	25.64	25.96	26.84
	5745	24.43	24.6	24.84
	5785	24.90	24.62	25.08
	5825	24.86	25.16	24.68
802.11n HT40	5755	47.88	48.37	48.94
	5795	48.33	48.40	47.98
	5815	49.13	46.92	48.94



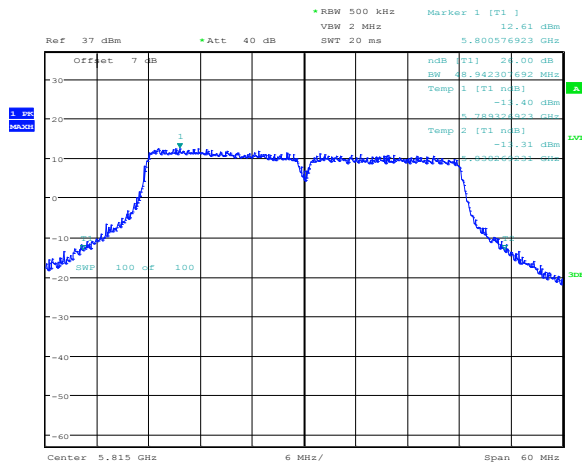
Date: 18.AUG.2015 15:38:59

Figure 8.1-1: 26 dB bandwidth on 802.11a, sample plot



Date: 18.AUG.2015 15:46:19

Figure 8.1-2: 26 dB bandwidth on 802.11n HT20, sample plot



Date: 18.AUG.2015 15:32:40

Figure 8.1-3: 26 dB bandwidth on 802.11n HT40, sample plot

8.2 FCC 15.407(e) Minimum 6 dB bandwidth

8.2.1 Definitions and limits

For equipment operating in the band 5725–5850 MHz, the minimum 6 dB bandwidth shall be at least 500 kHz.

8.2.2 Test summary

Test date	August 18, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	35 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	≥3 × RBW
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: 6 dB bandwidth results for cho

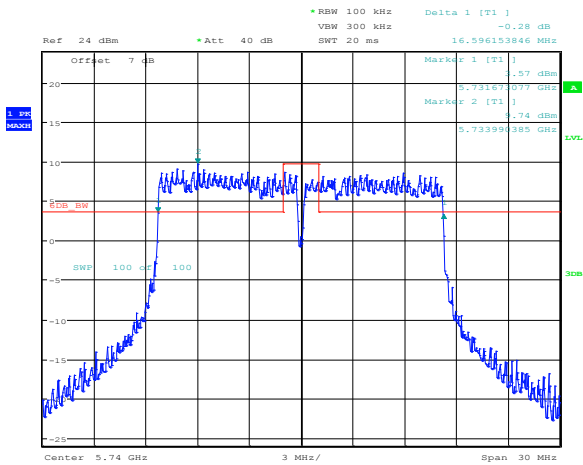
Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11a	5740	16.60	0.50	16.10
	5745	16.61	0.50	16.11
	5785	16.60	0.50	16.10
	5825	16.61	0.50	16.11
802.11n HT20	5740	17.85	0.50	17.35
	5745	17.86	0.50	17.36
	5785	17.85	0.50	17.35
	5825	17.86	0.50	17.36
802.11n HT40	5755	36.68	0.50	36.18
	5795	36.71	0.50	36.21
	5815	36.71	0.50	36.21

Table 8.2-2: 6 dB bandwidth results for ch1

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11a	5740	16.60	0.50	16.10
	5745	16.65	0.50	16.15
	5785	16.55	0.50	16.05
	5825	16.65	0.50	16.15
802.11n HT20	5740	17.89	0.50	17.39
	5745	17.86	0.50	17.36
	5785	17.86	0.50	17.36
	5825	17.86	0.50	17.36
802.11n HT40	5755	36.68	0.50	36.18
	5795	36.69	0.50	36.19
	5815	36.71	0.50	36.21

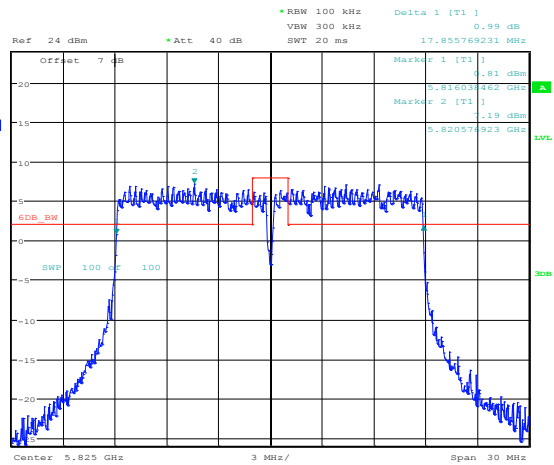
Table 8.2-3: 6 dB bandwidth results for ch2

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11a	5740	16.60	0.50	16.10
	5745	16.60	0.50	16.10
	5785	16.54	0.50	16.04
	5825	16.61	0.50	16.11
802.11n HT20	5740	17.85	0.50	17.35
	5745	17.86	0.50	17.36
	5785	17.84	0.50	17.34
	5825	17.86	0.50	17.36
802.11n HT40	5755	36.78	0.50	36.28
	5795	36.65	0.50	36.15
	5815	36.71	0.50	36.21



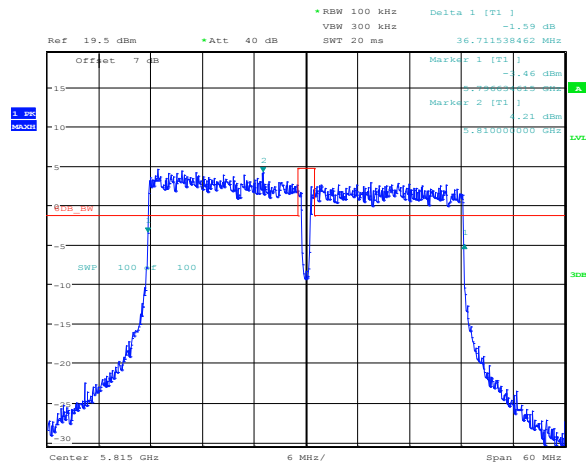
Date: 18.AUG.2015 16:06:11

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



Date: 18.AUG.2015 15:57:10

Figure 8.2-2: 6 dB bandwidth on 802.11n HT20, sample plot



Date: 18.AUG.2015 16:13:26

Figure 8.2-3: 6 dB bandwidth on 802.11n HT40, sample plot

8.3 FCC 15.407(a)(3) 5.725–5.85 GHz band output power and spectral density limits

8.3.1 Definitions and limits

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum 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 greater than 6 dBi without any corresponding reduction in transmitter conducted power. 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.

8.3.2 Test summary

Test date	August 18, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	35 %

8.3.3 Observations, settings and special notes

Output power was tested according to section II.E.2.b, method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep).

Power spectral density was tested according to section II.F

Combined average output power was calculated as follows:

$$P_{combined_{MIMO\ 2 \times 2}} = 10 \times \log_{10} \left((10^{P_{cho}/10}) + (10^{P_{ch1}/10}) \right)$$

$$P_{combined_{MIMO\ 3 \times 3}} = 10 \times \log_{10} \left((10^{P_{cho}/10}) + (10^{P_{ch1}/10}) + (10^{P_{ch2}/10}) \right)$$

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

Combined PPSD was calculated as follows:

$$PSD_{combined_{MIMO\ 2 \times 2}} = 10 \times \log_{10} \left((10^{PSD_{cho}/10}) + (10^{PSD_{ch1}/10}) \right)$$

$$PSD_{combined_{MIMO\ 3 \times 3}} = 10 \times \log_{10} \left((10^{PSD_{cho}/10}) + (10^{PSD_{ch1}/10}) + (10^{PSD_{ch2}/10}) \right)$$

Directional gain for correlated MIMO 3 × 3 is 6.5 dBi + 10 × Log₁₀ (3) = 11.27 dBi, or 10.77 dBi with 0.5 dB cable loss.

Directional gain for correlated MIMO 2 × 2 and 2 × 3 is 6.5 dBi + 10 × Log₁₀ (2) = 9.5 dBi, or 9 dBi with 0.5 dB cable loss.

The EUT is also a fixed point-to-point device; therefore it may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

For antennas with the directional gain greater than 6 dBi, the maximum output power limit was calculated as follows:

30 dBm – (Maximum antenna gain – 6 dBi)

Limit_{MIMO 2 × 2} = 30 dBm – (9 dBi – 6 dBi) = 27.00 dBm

Limit_{MIMO 3 × 3} = 30 dBm – (10.77 dBi – 6 dBi) = 25.23 dBm

For antennas with the directional gain greater than 6 dBi, the maximum power spectral density limit was calculated as follows:

30 dBm/500 kHz – (Maximum antenna gain – 6 dBi)

Limit_{MIMO 2 × 2} = 30 dBm/500 kHz – (9 dBi – 6 dBi) = 27.00 dBm/500 kHz

Limit_{MIMO 3 × 3} = 30 dBm/500 kHz – (10.77 dBi – 6 dBi) = 25.23 dBm/500 kHz

8.3.4 Test data

Table 8.3-1: Output power measurements results for correlated 3×3 MIMO (CDD/TXBF), 802.11a

Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Output power at ch2, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
5740	18.21	18.20	18.31	23.01	25.23	2.22
5745	19.53	20.82	20.55	25.11	25.23	0.12
5785	20.08	20.27	20.13	24.93	25.23	0.30
5825	19.93	20.95	20.44	25.23	25.23	0.00

Table 8.3-2: Output power measurements results for correlated 3×3 MIMO (CDD/TXBF), 802.11n

Channel BW, MHz	Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Output power at ch2, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
20	5740	18.06	18.16	18.29	22.94	25.23	2.29
20	5745	19.48	20.76	20.68	25.12	25.23	0.11
20	5785	20.12	20.25	20.14	24.94	25.23	0.29
20	5825	19.94	20.94	20.43	25.23	25.23	0.00
40	5755	17.05	17.71	18.52	22.57	25.23	2.66
40	5795	20.22	20.38	20.12	25.01	25.23	0.22
40	5815	19.32	19.14	19.69	24.16	25.23	1.07

Table 8.3-3: Output power measurements results for correlated $2 \times 3, 2 \times 2$ MIMO (CDD/TXBF), 802.11a

Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
5740	18.21	18.2	21.22	27.00	5.78
5745	19.53	20.82	23.23	27.00	3.77
5785	22.21	22.14	25.19	27.00	1.81
5825	19.93	20.95	23.48	27.00	3.52

Table 8.3-4: Output power measurements results for correlated $2 \times 3, 2 \times 2$ MIMO (CDD/TXBF), 802.11n

Channel BW, MHz	Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
20	5740	18.06	18.16	21.12	27.00	5.88
20	5745	19.48	20.76	23.18	27.00	3.82
20	5785	22.28	22.14	25.22	27.00	1.78
20	5825	19.94	20.94	23.48	27.00	3.52
40	5755	17.05	17.71	20.40	27.00	6.60
40	5795	22.03	21.95	25.00	27.00	2.00
40	5815	19.32	19.14	22.24	27.00	4.76

Table 8.3-5: Output power measurements results for correlated $1 \times 3, 1 \times 2, 1 \times 1$ MISO (CDD/TXBF) and uncorrelated, 802.11a

Frequency, MHz	Output power at ch0, dBm	Limit, dBm	Margin, dB
5740	18.21	30.00	11.79
5745	19.53	30.00	10.47
5785	22.21	30.00	7.79
5825	19.93	30.00	10.07

Table 8.3-6: Output power measurements results for correlated 1×3 , 1×2 , 1×1 MISO (CDD/TXBF) and uncorrelated, 802.11n

Channel BW, MHz	Frequency, MHz	Output power at ch0, dBm	Limit, dBm	Margin, dB
20	5740	18.06	30.00	11.94
20	5745	19.48	30.00	10.52
20	5785	22.28	30.00	7.72
20	5825	19.94	30.00	10.06
40	5755	17.05	30.00	12.95
40	5795	22.03	30.00	7.97
40	5815	19.32	30.00	10.68

Table 8.3-7: Output power measurements results for uncorrelated 3×3 MIMO (STBC/STC), 802.11a

Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Output power at ch2, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
5740	18.21	18.20	18.31	23.01	30.00	6.99
5745	19.53	20.82	21.55	25.48	30.00	4.52
5785	22.21	22.14	22.46	27.04	30.00	2.96
5825	19.93	20.95	21.44	25.59	30.00	4.41

Table 8.3-8: Output power measurements results for uncorrelated 3×3 MIMO (STBC/STC), 802.11n

Channel BW, MHz	Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Output power at ch2, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
20	5740	18.06	18.16	18.29	22.94	30.00	7.06
20	5745	19.48	20.76	21.18	25.30	30.00	4.70
20	5785	22.28	22.14	22.45	27.06	30.00	2.94
20	5825	19.94	20.94	21.43	25.58	30.00	4.42
40	5755	17.05	17.71	18.52	22.57	30.00	7.43
40	5795	22.03	21.95	22.12	26.81	30.00	3.19
40	5815	19.32	19.14	19.69	24.16	30.00	5.84

Table 8.3-9: Output power measurements results for uncorrelated 2×3 , 2×2 MIMO (STBC/STC), 802.11a

Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
5740	18.21	18.20	21.22	30.00	8.78
5745	19.53	20.82	23.23	30.00	6.77
5785	22.21	22.14	25.19	30.00	4.81
5825	19.93	20.95	23.48	30.00	6.52

Table 8.3-10: Output power measurements results for uncorrelated 2×3 , 2×2 MIMO (STBC/STC), 802.11n

Channel BW, MHz	Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
20	5740	18.06	18.16	21.12	30.00	8.88
20	5745	19.48	20.76	23.18	30.00	6.82
20	5785	22.28	22.14	25.22	30.00	4.78
20	5825	19.94	20.94	23.48	30.00	6.52
40	5755	17.05	17.71	20.40	30.00	9.60
40	5795	22.03	21.95	25.00	30.00	5.00
40	5815	19.32	19.14	22.24	30.00	7.76



Table 8.3-11: Output power measurements results for correlated Point-to-Point 3 × 3 MIMO (TXBF), 802.11a

Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Output power at ch2, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
5740	18.21	18.20	18.31	21.27	30.00	8.73
5745	19.53	20.82	21.55	24.21	30.00	5.79
5785	22.21	22.14	22.46	25.31	30.00	4.69
5825	19.93	20.95	21.44	24.21	30.00	5.79

Table 8.3-12: Output power measurements results for correlated Point-to-Point 3 × 3 MIMO (TXBF), 802.11n

Channel BW, MHz	Frequency, MHz	Output power at ch0, dBm	Output power at ch1, dBm	Output power at ch2, dBm	Combined output power, dBm	Limit, dBm	Margin, dB
20	5740	18.06	18.16	18.29	22.94	30.00	7.06
20	5745	19.48	20.76	21.18	25.30	30.00	4.70
20	5785	22.28	22.14	22.45	27.06	30.00	2.94
20	5825	19.94	20.94	21.43	25.58	30.00	4.42
40	5755	17.05	17.71	18.52	22.57	30.00	7.43
40	5795	22.03	21.95	22.12	26.81	30.00	3.19
40	5815	19.32	19.14	19.69	24.16	30.00	5.84

Table 8.3-13: PSD measurements results for correlated 3 × 3 MIMO (CDD/TXBF), 802.11a

Frequency, MHz	PSD at ch0, dBm/500 kHz	PSD at ch1, dBm/500 kHz	PSD at ch2, dBm/500 kHz	Combined PSD, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
5740	4.06	4.08	4.14	8.86	25.23	16.37
5745	5.42	6.74	7.40	11.37	25.23	13.86
5785	5.86	6.18	6.14	10.83	25.23	14.40
5825	5.45	6.86	7.43	11.43	25.23	13.80

Table 8.3-14: PSD measurements results for correlated 3 × 3 MIMO (CDD/TXBF), 802.11n

Channel BW, MHz	Frequency, MHz	PSD at ch0, dBm/500 kHz	PSD at ch1, dBm/500 kHz	PSD at ch2, dBm/500 kHz	Combined PSD, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
20	5740	3.50	3.79	3.86	8.49	25.23	16.74
20	5745	5.09	6.49	6.59	10.88	25.23	14.35
20	5785	5.49	5.87	5.83	10.50	25.23	14.73
20	5825	5.16	6.53	7.13	11.12	25.23	14.11
40	5755	0.03	0.78	1.43	5.56	25.23	19.67
40	5795	3.04	3.31	3.79	8.16	25.23	17.07
40	5815	1.91	2.22	3.20	7.25	25.23	17.98

Table 8.3-15: PSD measurements results for correlated 2 × 3, 2 × 2 MIMO (CDD/TXBF), 802.11a

Frequency, MHz	PSD at ch0, dBm/500 kHz	PSD at ch1, dBm/500 kHz	Combined PSD, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
5740	4.06	4.08	7.08	27.00	19.92
5745	5.42	6.74	9.14	27.00	17.86
5785	8.03	8.03	11.04	27.00	15.96
5825	5.45	6.86	9.22	27.00	17.78

Table 8.3-16: PSD measurements results for correlated 2 × 3, 2 × 2 MIMO (CDD/TXBF), 802.11n

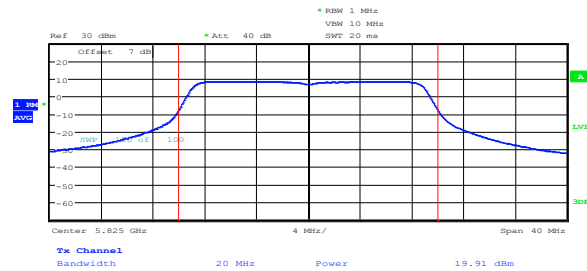
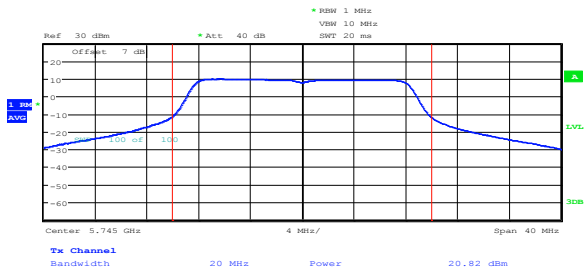
Channel BW, MHz	Frequency, MHz	PSD at ch0, dBm/500 kHz	PSD at ch1, dBm/500 kHz	Combined PSD, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
20	5740	3.50	3.79	6.66	27.00	20.34
20	5745	5.09	6.49	8.86	27.00	18.14
20	5785	7.68	7.72	10.71	27.00	16.29
20	5825	5.16	6.53	8.91	27.00	18.09
40	5755	0.03	0.78	3.43	27.00	23.57
40	5795	4.80	4.89	7.86	27.00	19.14
40	5815	1.91	2.22	5.08	27.00	21.92

Table 8.3-17: PSD measurements results for correlated 1 × 3, 1 × 2, 1 × 1 MISO (CDD/TXBF) and uncorrelated, 802.11a

Frequency, MHz	PSD at ch0, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
5740	4.06	30.00	25.94
5745	5.42	30.00	24.58
5785	8.03	30.00	21.97
5825	5.45	30.00	24.55

Table 8.3-18: PSD measurements results for correlated 1 × 3, 1 × 2, 1 × 1 MISO (CDD/TXBF) and uncorrelated, 802.11n

Channel BW, MHz	Frequency, MHz	PSD at ch0, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
20	5740	3.50	30.00	26.50
20	5745	5.09	30.00	24.91
20	5785	7.68	30.00	22.32
20	5825	5.16	30.00	24.84
40	5755	0.03	30.00	29.97
40	5795	7.72	30.00	22.28
40	5815	1.91	30.00	28.09



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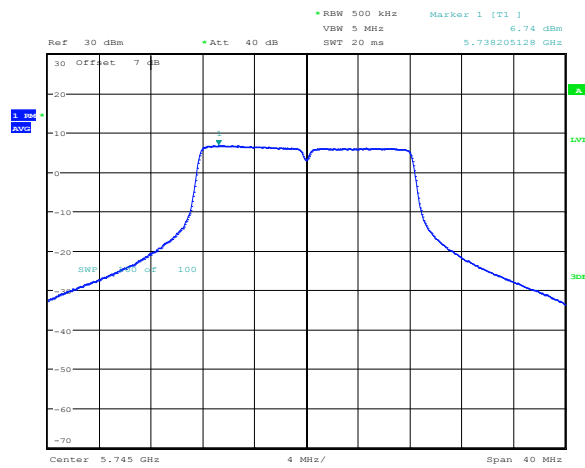
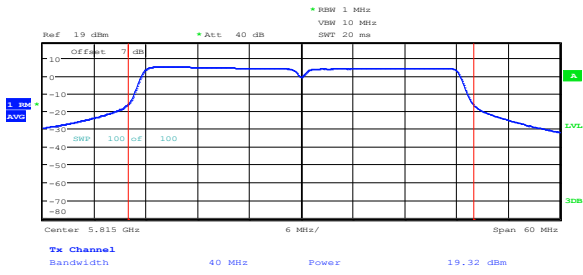
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Figure 8.3-1: Sample plot for output power for 802.11a

Figure 8.3-2: Sample plot for output power for 802.11n HT20

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 FCC 15.407(a)(3) 5.725–5.85 GHz band output power and spectral density limits
 FCC Part 15 Subpart E

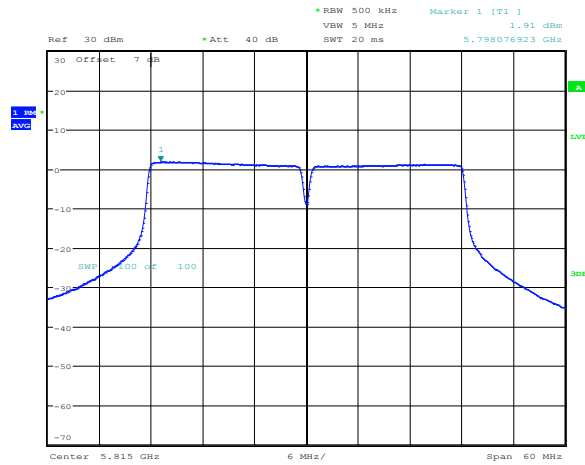
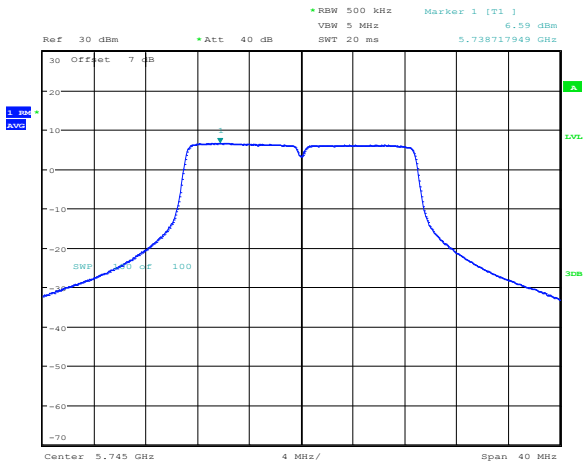


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Figure 8.3-3: Sample plot for output power for 802.11n HT40

Figure 8.3-4: Sample plot for PSD for 802.11a



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Figure 8.3-5: Sample plot for PSD for 802.11n HT20

Figure 8.3-6: Sample plot for PSD for 802.11n HT40

8.4 FCC 15.407(b) Spurious (out-of-band) emissions

8.4.1 Definitions and limits

(4) For transmitters operating in the 5.725–5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of –17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. 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.

(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.

Table 8.4-1: FCC §15.209 – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

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

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

Table 8.4-2: 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			

8.4.2 Test summary

Test date	August 19, 2015	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	34 %

8.4.3 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 all MIMO chains simultaneously. Radiated emissions were performed while all 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

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

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

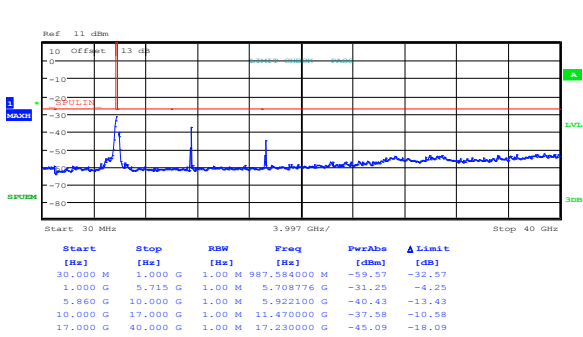
Resolution bandwidth:	1 MHz
Video bandwidth:	10 MHz
Detector mode:	RMS
Trace mode:	Power average
Number of averaging traces:	100

Spectrum analyser for peak conducted measurements outside restricted bands:

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

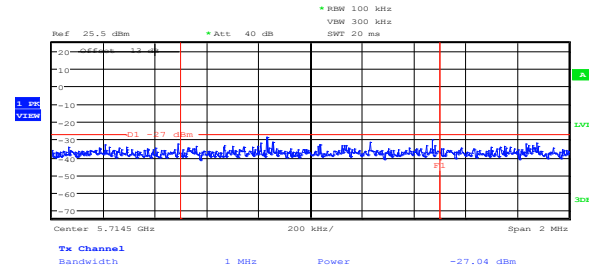
Conducted emissions measurements outside restricted bands were performed on each individual MIMO chain.

8.4.4 Test data



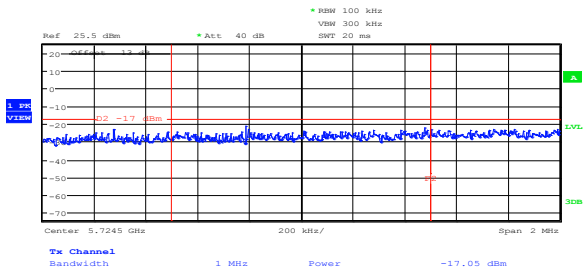
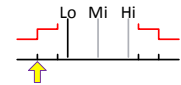
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Figure 8.4-1: Conducted spurious emissions outside restricted bands, 802.11a, 5740 MHz, cho



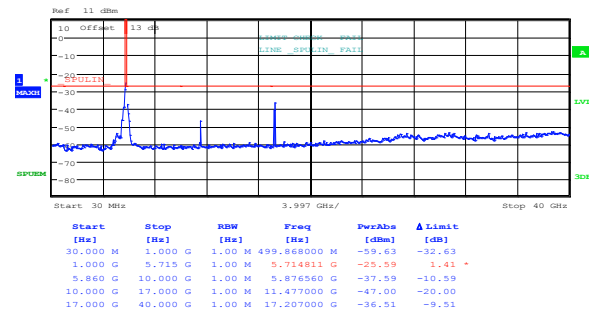
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Figure 8.4-2: Lower band edge emissions at 5715 MHz, 802.11a, 5740 MHz, cho



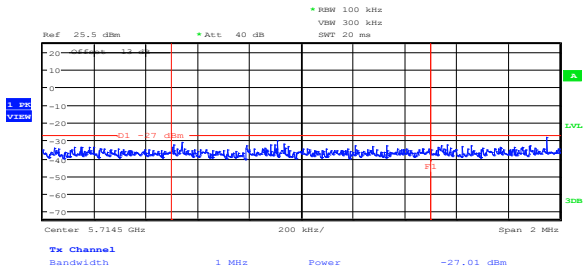
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Figure 8.4-3: Lower band edge emissions at 5725 MHz, 802.11a, 5740 MHz, cho



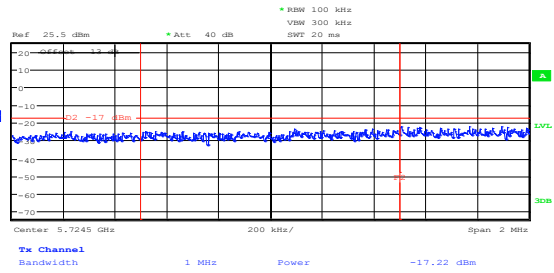
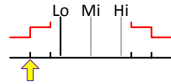
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Figure 8.4-4: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5740 MHz, cho



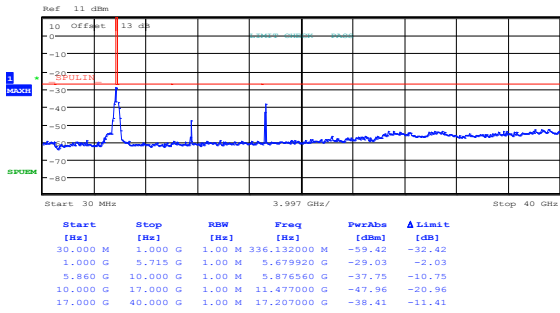
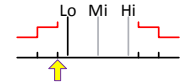
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Figure 8.4-5: Lower band edge emissions at 5715 MHz, 802.11n HT20, 5740 MHz, cho



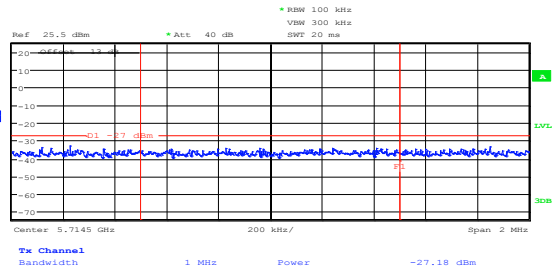
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Figure 8.4-6: Lower band edge emissions at 5725 MHz, 802.11n HT20, 5740 MHz, cho



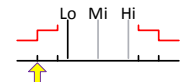
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Figure 8.4-7: Conducted spurious emissions outside restricted bands, 802.11a, 5740 MHz, ch1



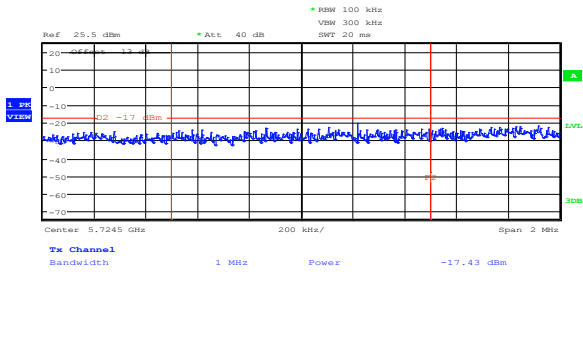
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Figure 8.4-8: Upper band edge emissions at 5715 MHz, 802.11a, 5740 MHz, ch1



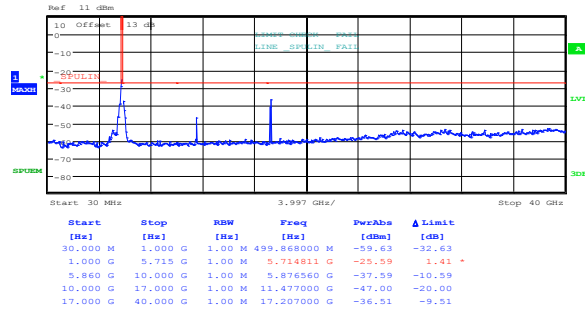
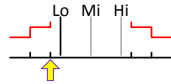
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 FCC 15.407(b) Spurious (out-of-band) emissions
 FCC Part 15 Subpart E



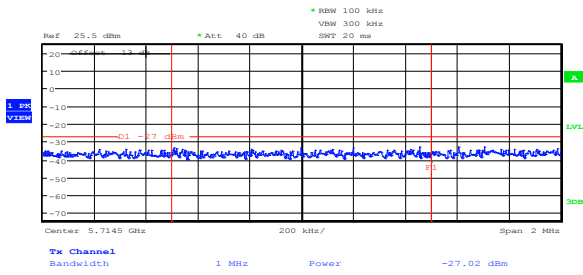
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Figure 8.4-9: Upper band edge emissions at 5725 MHz, 802.11a, 5740 MHz, ch1



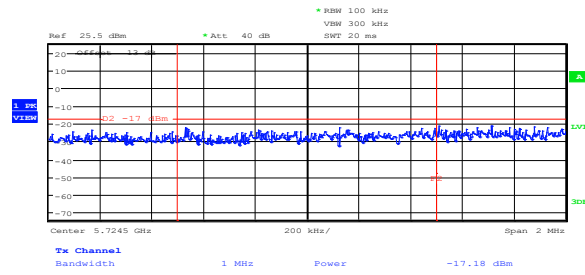
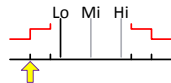
Date: 19.AUG.2015 15:12:52

Figure 8.4-10: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5740 MHz, ch1



Date: 19.AUG.2015 10:33:34

Figure 8.4-11: Lower band edge emissions at 5715 MHz, 802.11n HT20, 5740 MHz, ch1



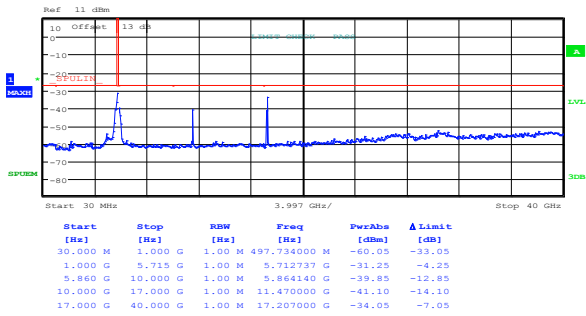
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Figure 8.4-12: Lower band edge emissions at 5725 MHz, 802.11n HT20, 5740 MHz, ch1



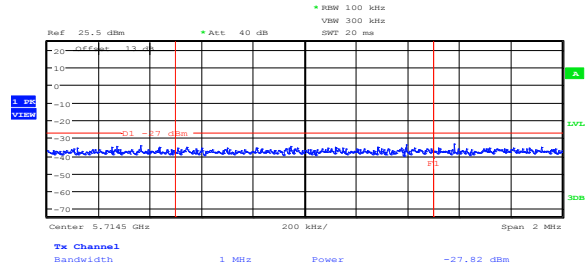
Section 8
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Specification

Testing data
 FCC 15.407(b) Spurious (out-of-band) emissions
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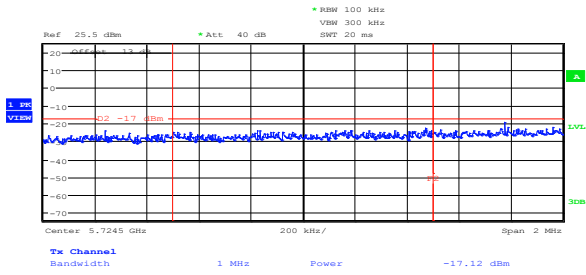
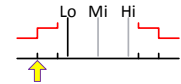
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Figure 8.4-13: Conducted spurious emissions outside restricted bands, 802.11a, 5740 MHz, ch2



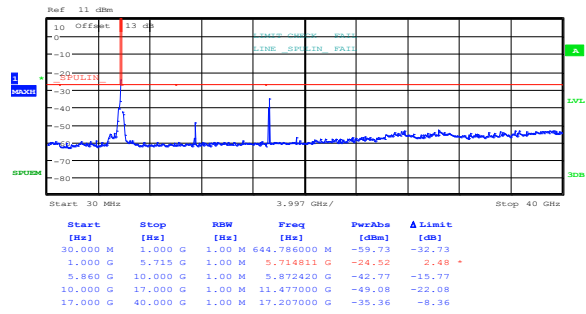
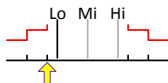
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Figure 8.4-14: Lower band edge emissions at 5715 MHz, 802.11a, 5740 MHz, ch2



Date: 19.AUG.2015 10:38:34

Figure 8.4-15: Lower band edge emissions at 5725 MHz, 802.11a, 5740 MHz, ch2

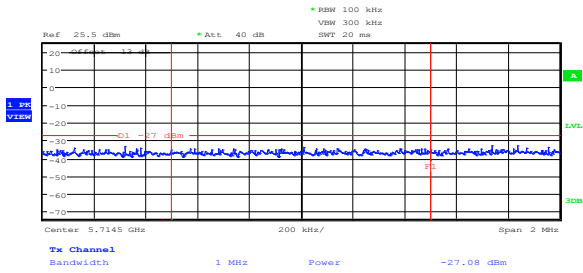


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Figure 8.4-16: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5740 MHz, ch2

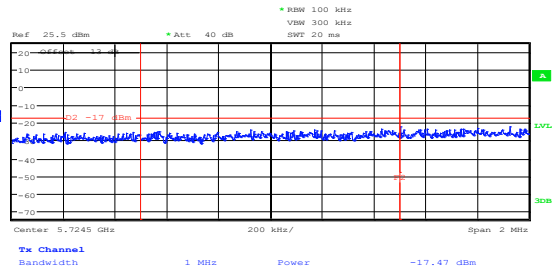
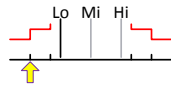
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 FCC 15.407(b) Spurious (out-of-band) emissions
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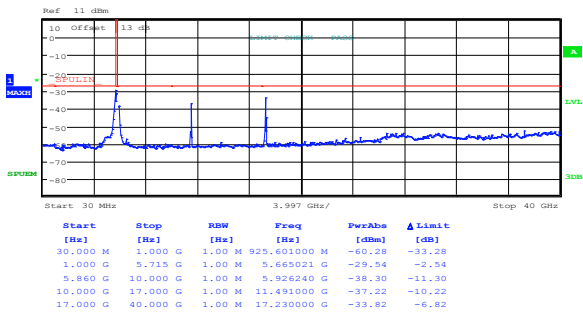
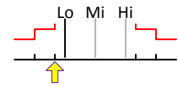
Date: 19.AUG.2015 10:39:56

Figure 8.4-17: Upper band edge emissions at 5715 MHz, 802.11n HT20, 5740 MHz, ch2



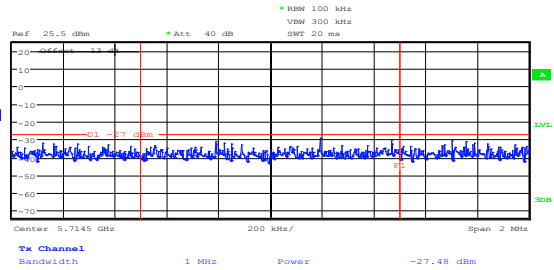
Date: 19.AUG.2015 10:40:31

Figure 8.4-18: Upper band edge emissions at 5725 MHz, 802.11n HT20, 5740 MHz, ch2



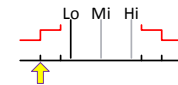
Date: 19.AUG.2015 15:04:55

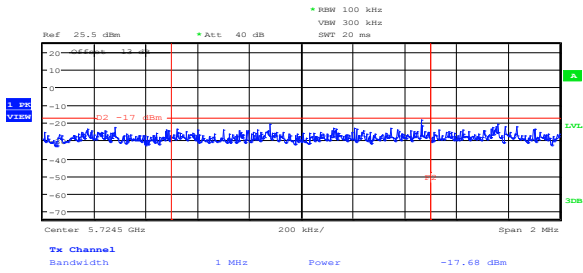
Figure 8.4-19: Conducted spurious emissions outside restricted bands, 802.11a, 5745 MHz, cho



Date: 19.AUG.2015 11:05:07

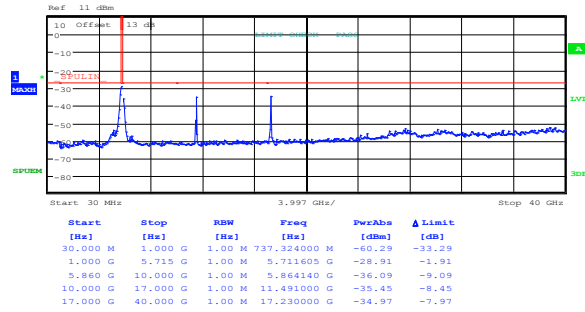
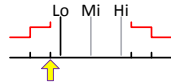
Figure 8.4-20: Lower band edge emissions at 5715 MHz, 802.11a, 5745 MHz, cho





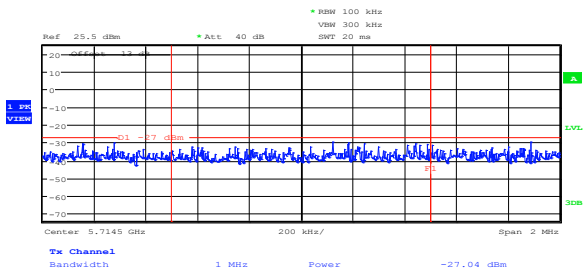
Date: 19.AUG.2015 11:05:39

Figure 8.4-21: Lower band edge emissions at 5725 MHz, 802.11a, 5745 MHz, cho



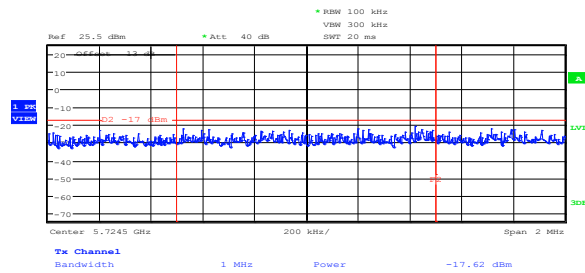
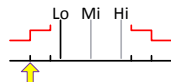
Date: 19.AUG.2015 15:03:58

Figure 8.4-22: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5745 MHz, cho



Date: 19.AUG.2015 11:03:18

Figure 8.4-23: Lower band edge emissions at 5715 MHz, 802.11n HT20, 5745 MHz, cho



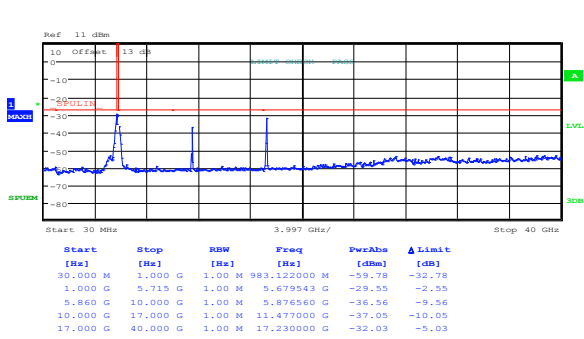
Date: 19.AUG.2015 11:04:00

Figure 8.4-24: Lower band edge emissions at 5725 MHz, 802.11n HT20, 5745 MHz, cho



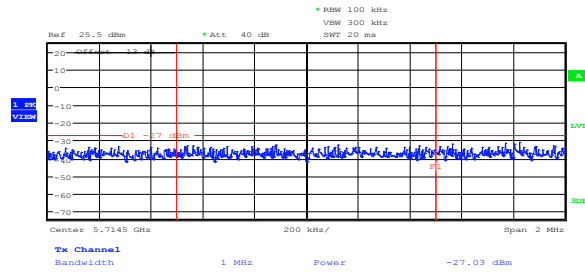
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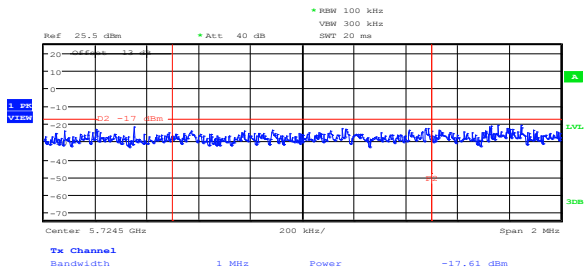
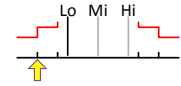
Date: 19.AUG.2015 15:11:32

Figure 8.4-25: Conducted spurious emissions outside restricted bands, 802.11a, 5745 MHz, ch1



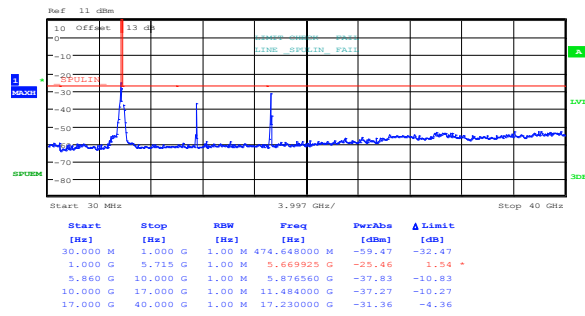
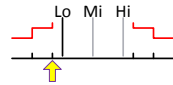
Date: 19.AUG.2015 11:00:00

Figure 8.4-26: Upper band edge emissions at 5715 MHz, 802.11a, 5745 MHz, ch1



Date: 19.AUG.2015 10:59:26

Figure 8.4-27: Upper band edge emissions at 5725 MHz, 802.11a, 5745 MHz, ch1

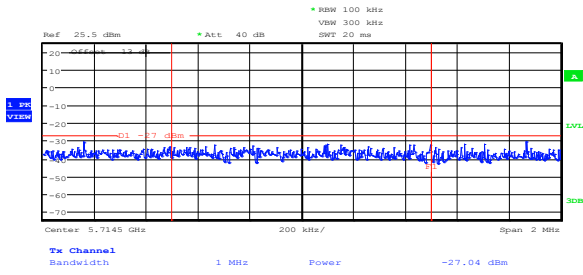


Date: 19.AUG.2015 15:12:04

Figure 8.4-28: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5745 MHz, ch1

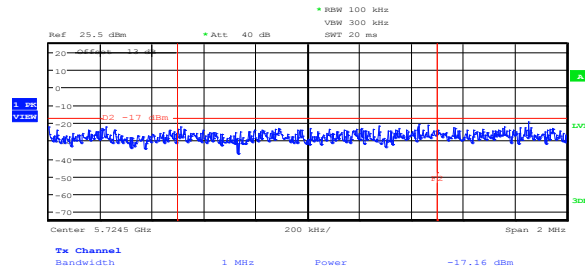
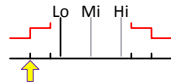
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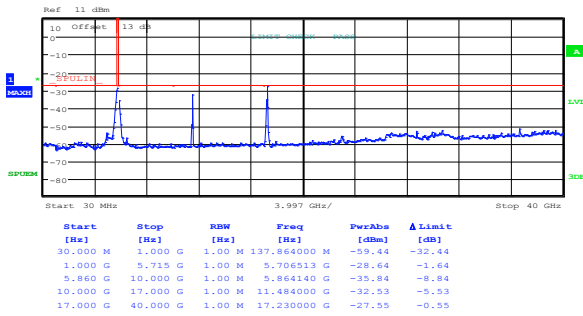
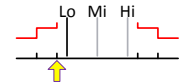
Date: 19.AUG.2015 11:00:46

Figure 8.4-29: Lower band edge emissions at 5715 MHz, 802.11n HT20, 5745 MHz, ch1



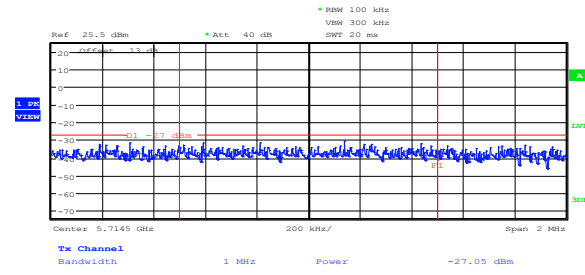
Date: 19.AUG.2015 11:01:23

Figure 8.4-30: Lower band edge emissions at 5725 MHz, 802.11n HT20, 5745 MHz, ch1



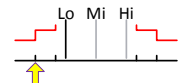
Date: 19.AUG.2015 15:17:05

Figure 8.4-31: Conducted spurious emissions outside restricted bands, 802.11a, 5745 MHz, ch2



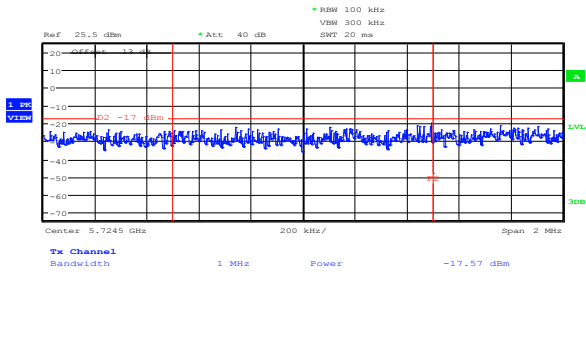
Date: 19.AUG.2015 10:44:07

Figure 8.4-32: Lower band edge emissions at 5715 MHz, 802.11a, 5745 MHz, ch2



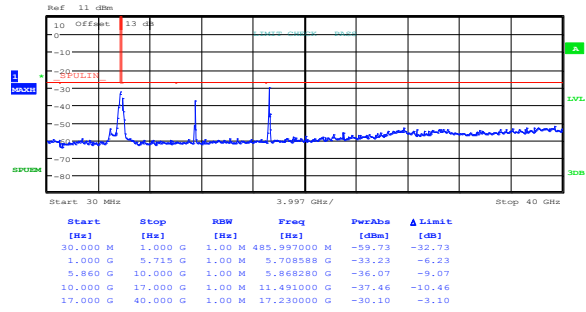
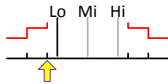
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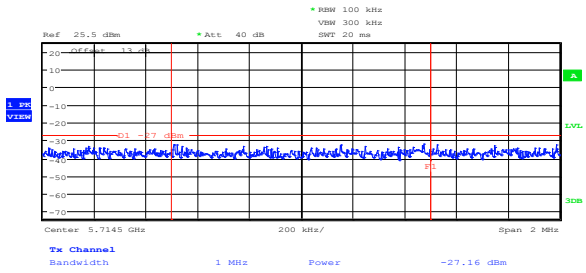
Date: 19.AUG.2015 10:44:55

Figure 8.4-33: Lower band edge emissions at 5725 MHz, 802.11a, 5745 MHz, ch2



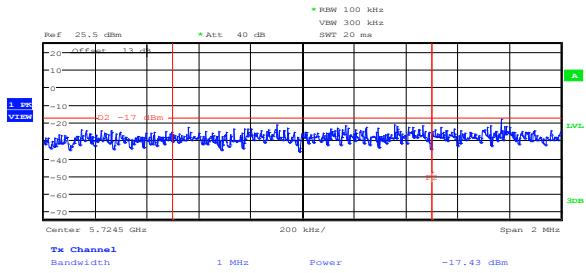
Date: 19.AUG.2015 15:17:33

Figure 8.4-34: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5745 MHz, ch2



Date: 19.AUG.2015 10:43:08

Figure 8.4-35: Upper band edge emissions at 5715 MHz, 802.11n HT20, 5745 MHz, ch2



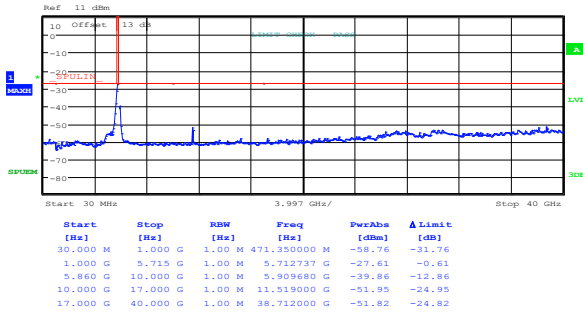
Date: 19.AUG.2015 10:42:29

Figure 8.4-36: Upper band edge emissions at 5725 MHz, 802.11n HT20, 5745 MHz, ch2



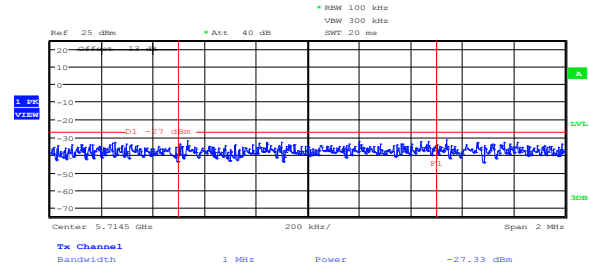
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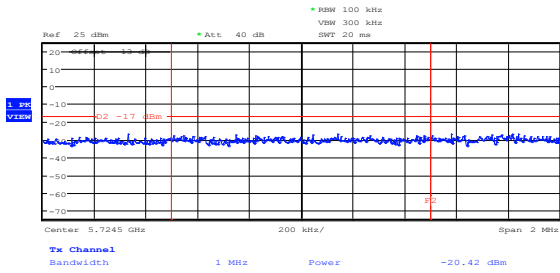
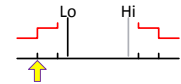
Date: 19.AUG.2015 14:58:54

Figure 8.4-37: Conducted spurious emissions outside restricted bands, 802.11n HT40, 5755 MHz, cho



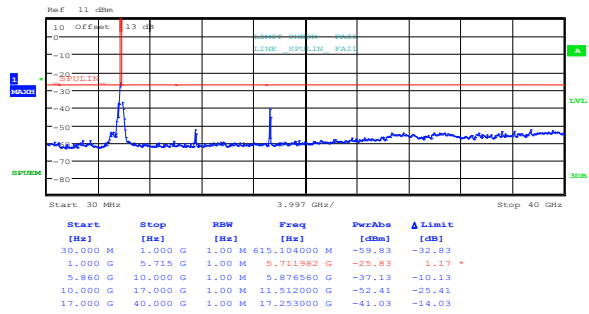
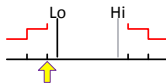
Date: 19.AUG.2015 14:08:46

Figure 8.4-38: Lower band edge emissions at 5715 MHz, 802.11n HT40, 5755 MHz, cho



Date: 19.AUG.2015 14:09:17

Figure 8.4-39: Lower band edge emissions at 5725 MHz, 802.11n HT40, 5755 MHz, cho

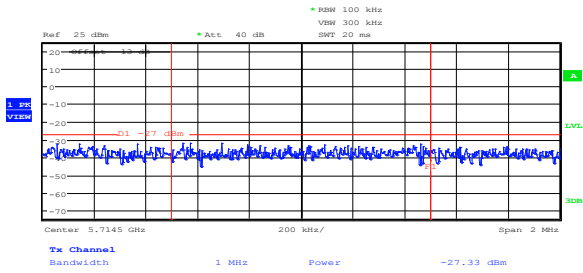


Date: 19.AUG.2015 15:14:30

Figure 8.4-40: Conducted spurious emissions outside restricted bands, 802.11n HT40, 5755 MHz, ch1

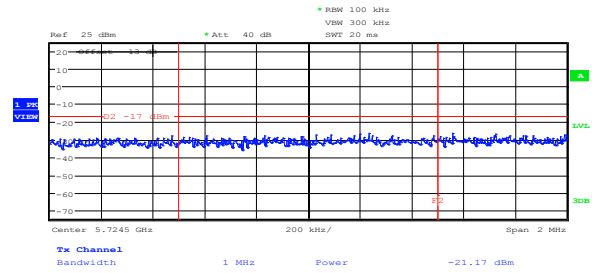
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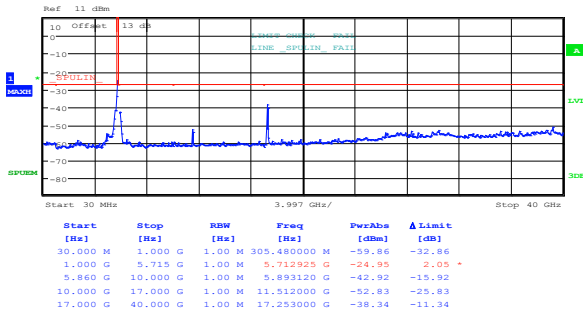
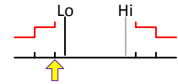
Date: 19.AUG.2015 14:07:16

Figure 8.4-41: Upper band edge emissions at 5715 MHz, 802.11n HT40, 5755 MHz, ch1



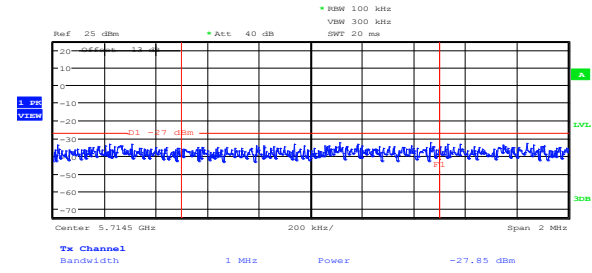
Date: 19.AUG.2015 14:07:49

Figure 8.4-42: Upper band edge emissions at 5725 MHz, 802.11n HT40, 5755 MHz, ch1



Date: 19.AUG.2015 15:16:11

Figure 8.4-43: Conducted spurious emissions outside restricted bands, 802.11n HT40, 5755 MHz, ch2



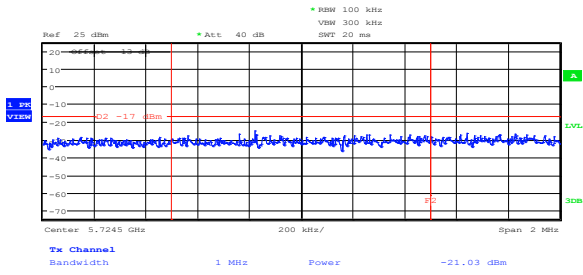
Date: 19.AUG.2015 14:05:11

Figure 8.4-44: Lower band edge emissions at 5715 MHz, 802.11n HT40, 5755 MHz, ch2



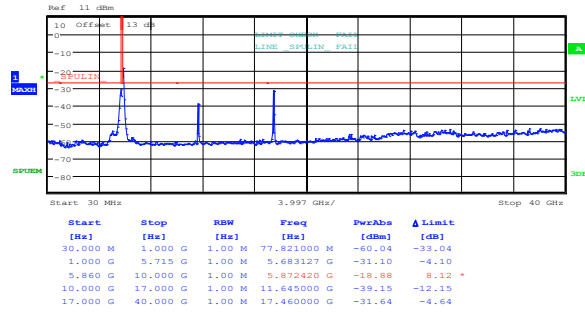
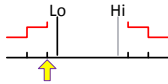
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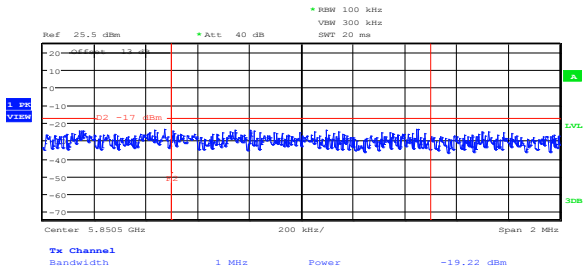
Date: 19.AUG.2015 14:05:52

Figure 8.4-45: Lower band edge emissions at 5725 MHz, 802.11n HT40, 5755 MHz, ch2



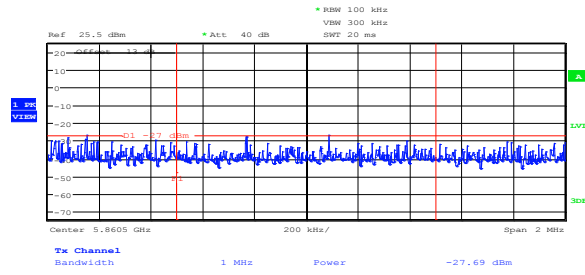
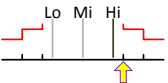
Date: 19.AUG.2015 15:06:04

Figure 8.4-46: Conducted spurious emissions outside restricted bands, 802.11a, 5825 MHz, ch0



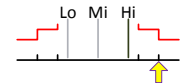
Date: 19.AUG.2015 11:09:04

Figure 8.4-47: Upper band edge emissions at 5850 MHz, 802.11a, 5825 MHz, ch1



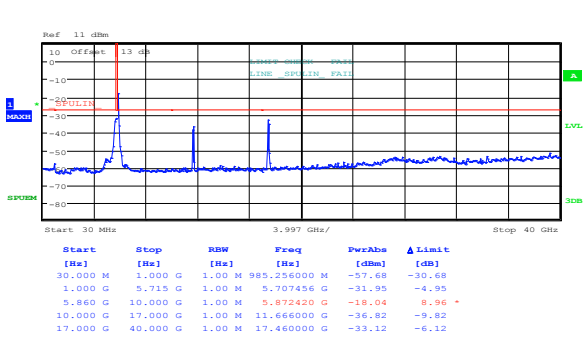
Date: 19.AUG.2015 11:08:21

Figure 8.4-48: Upper band edge emissions at 5860 MHz, 802.11a, 5825 MHz, ch1



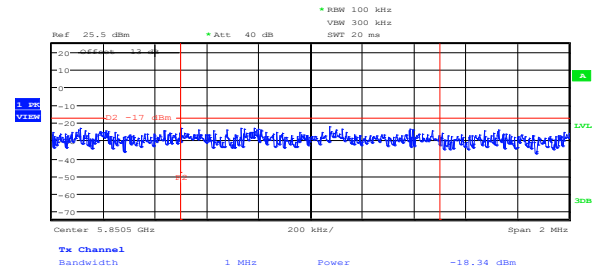
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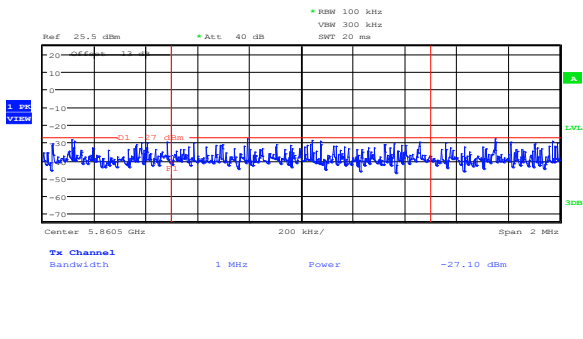
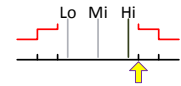
Date: 19.AUG.2015 15:06:37

Figure 8.4-49: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5825 MHz, cho



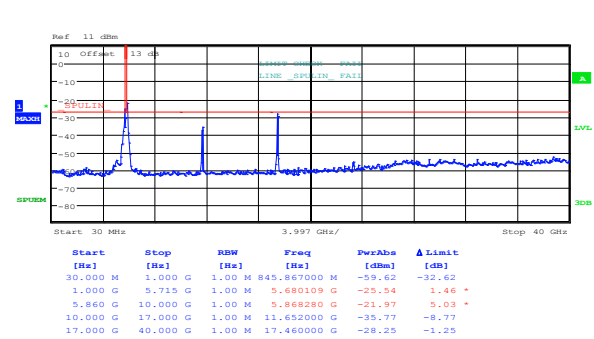
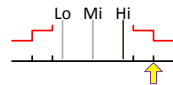
Date: 19.AUG.2015 11:11:20

Figure 8.4-50: Upper band edge emissions at 5850 MHz, 802.11n HT20, 5825 MHz, cho



Date: 19.AUG.2015 11:10:24

Figure 8.4-51: Upper band edge emissions at 5860 MHz, 802.11n HT20, 5825 MHz, cho

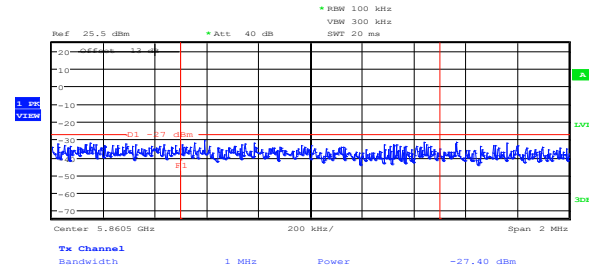
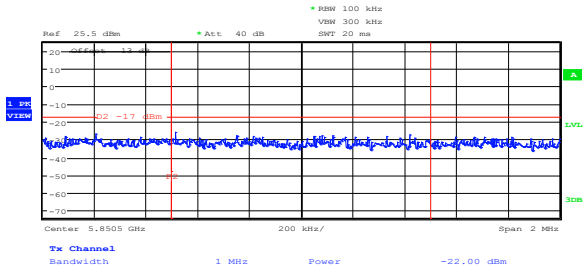


Date: 19.AUG.2015 15:10:32

Figure 8.4-52: Conducted spurious emissions outside restricted bands, 802.11a, 5825 MHz, ch1

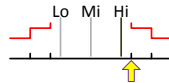
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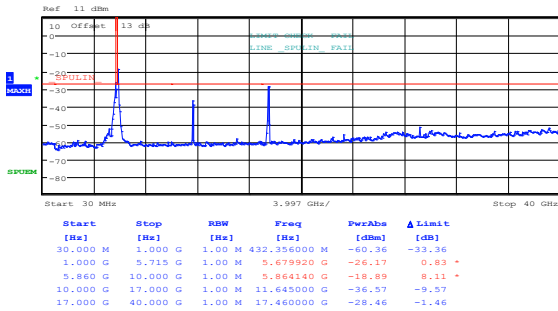
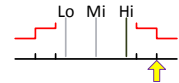
Date: 19.AUG.2015 11:16:23

Figure 8.4-53: Upper band edge emissions at 5850 MHz, 802.11a, 5825 MHz, ch1



Date: 19.AUG.2015 11:15:40

Figure 8.4-54: Upper band edge emissions at 5860 MHz, 802.11a, 5825 MHz, ch1

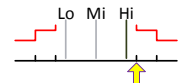


Date: 19.AUG.2015 15:09:59

Figure 8.4-55: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5825 MHz, ch1

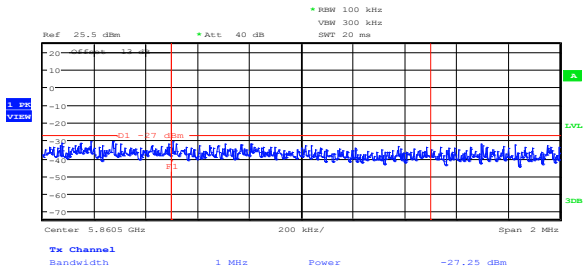
Date: 19.AUG.2015 11:14:46

Figure 8.4-56: Upper band edge emissions at 5850 MHz, 802.11n HT20, 5825 MHz, ch1



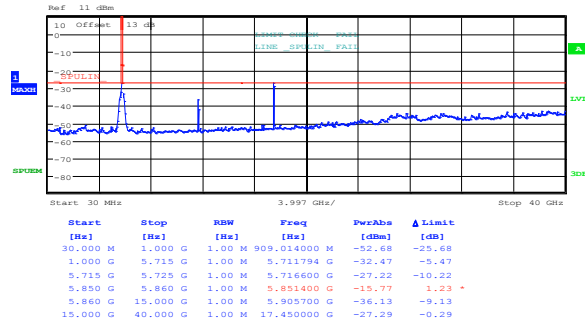
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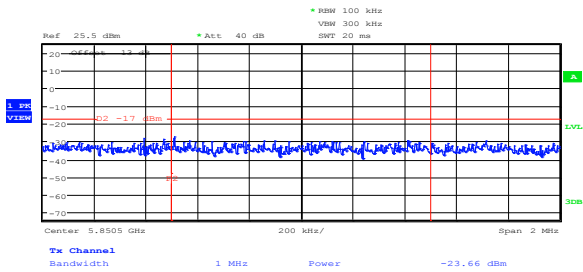
Date: 19.AUG.2015 11:14:09

Figure 8.4-57: Upper band edge emissions at 5860 MHz, 802.11n HT20, 5725 MHz, ch1



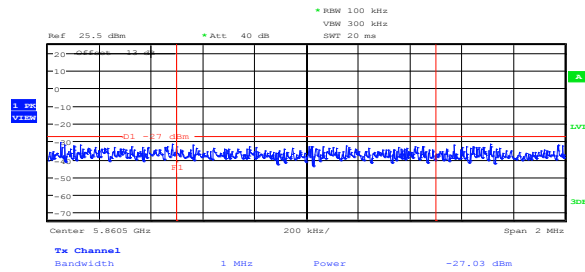
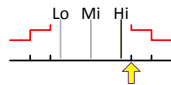
Date: 9.SEP.2015 10:45:06

Figure 8.4-58: Conducted spurious emissions outside restricted bands, 802.11a, 5825 MHz, ch2



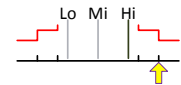
Date: 19.AUG.2015 11:18:13

Figure 8.4-59: Upper band edge emissions at 5850 MHz, 802.11a, 5825 MHz, ch2



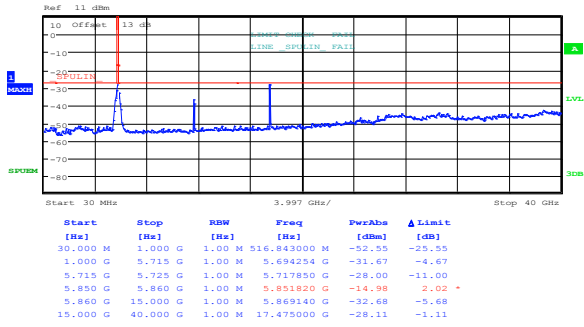
Date: 19.AUG.2015 11:17:32

Figure 8.4-60: Upper band edge emissions at 5860 MHz, 802.11a, 5825 MHz, ch2



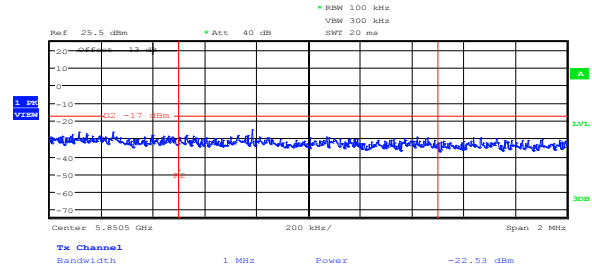
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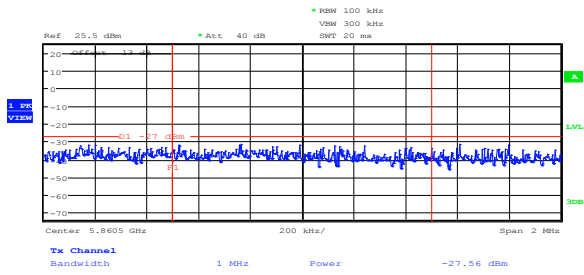
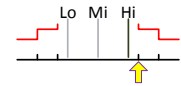
Date: 9.SEP.2015 10:44:43

Figure 8.4-61: Conducted spurious emissions outside restricted bands, 802.11n HT20, 5825 MHz, ch2



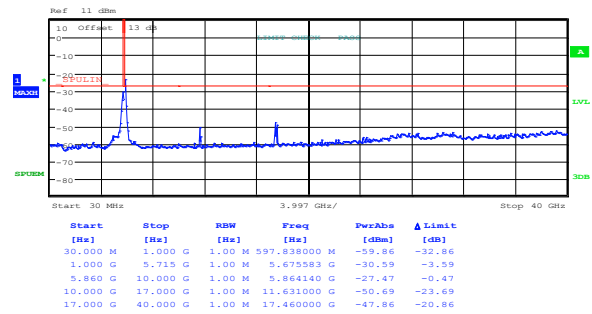
Date: 19.AUG.2015 11:19:59

Figure 8.4-62: Upper band edge emissions at 5850 MHz, 802.11n HT20, 5825 MHz, ch2



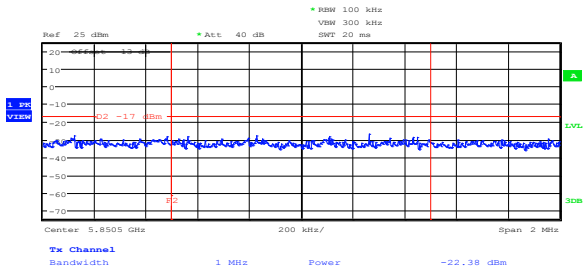
Date: 19.AUG.2015 11:19:30

Figure 8.4-63: Upper band edge emissions at 5860 MHz, 802.11n HT20, 5825 MHz, ch2



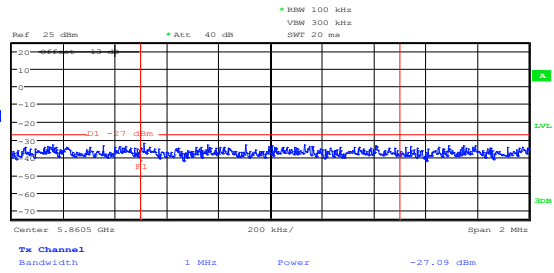
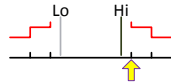
Date: 19.AUG.2015 15:00:31

Figure 8.4-64: Conducted spurious emissions outside restricted bands, 802.11n HT40, 5815 MHz, cho



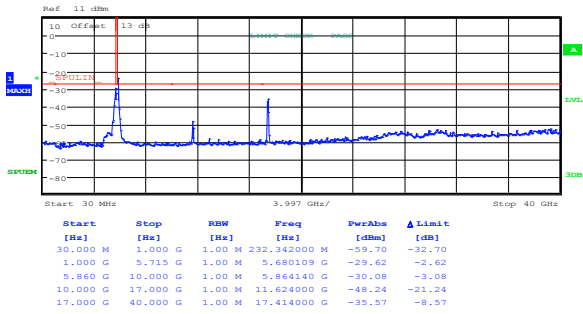
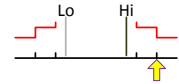
Date: 19.AUG.2015 13:47:20

Figure 8.4-65: Upper band edge emissions at 5850 MHz, 802.11n HT40, 5815 MHz, cho



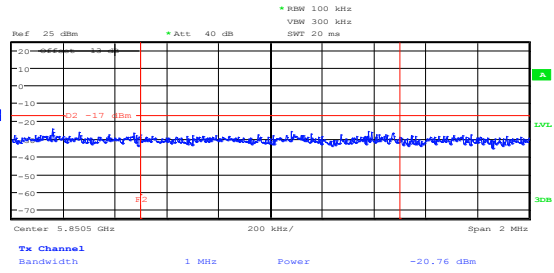
Date: 19.AUG.2015 13:47:57

Figure 8.4-66: Upper band edge emissions at 5860 MHz, 802.11n HT40, 5815 MHz, cho



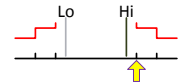
Date: 19.AUG.2015 15:15:00

Figure 8.4-67: Conducted spurious emissions outside restricted bands, 802.11n HT40, 5815 MHz, ch1



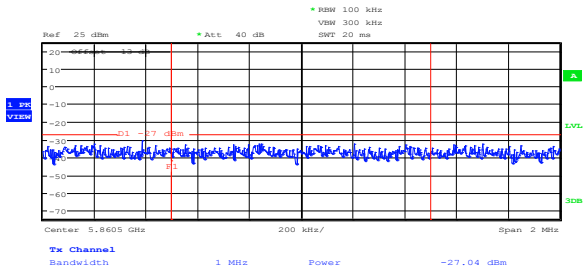
Date: 19.AUG.2015 13:59:56

Figure 8.4-68: Upper band edge emissions at 5850 MHz, 802.11n HT40, 5815 MHz, ch1



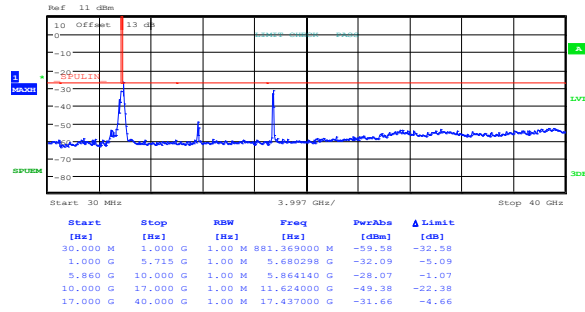
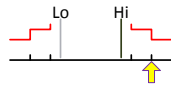
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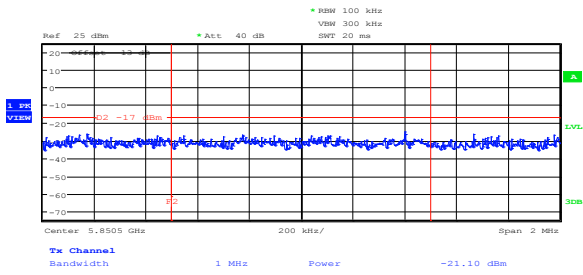
Date: 19.AUG.2015 13:59:22

Figure 8.4-69: Upper band edge emissions at 5860 MHz, 802.11n HT40, 5815 MHz, ch1



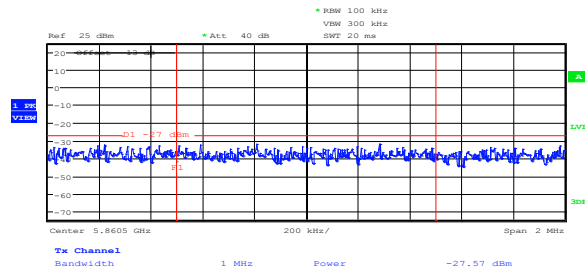
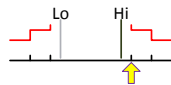
Date: 19.AUG.2015 15:15:35

Figure 8.4-70: Conducted spurious emissions outside restricted bands, 802.11n HT40, 5815 MHz, ch2



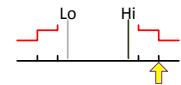
Date: 19.AUG.2015 14:00:24

Figure 8.4-71: Upper band edge emissions at 5850 MHz, 802.11n HT40, 5815 MHz, ch2



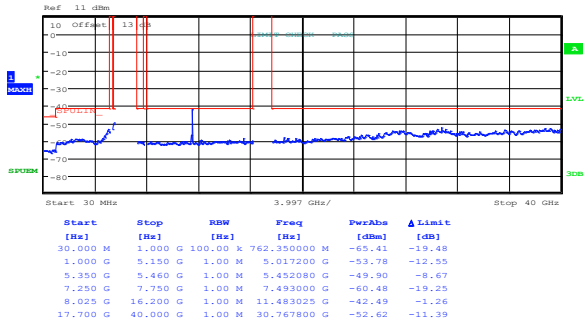
Date: 19.AUG.2015 14:01:03

Figure 8.4-72: Upper band edge emissions at 5860 MHz, 802.11n HT40, 5815 MHz, ch2



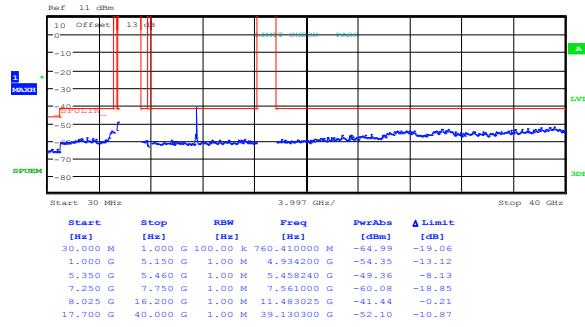
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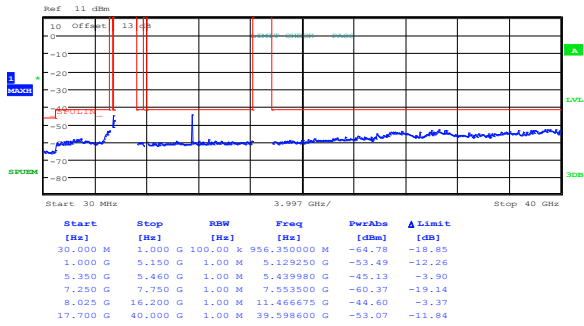
Date: 19.AUG.2015 16:14:09

Figure 8.4-73: Conducted spurious emissions within restricted bands, 802.11a, 5740 MHz, cho



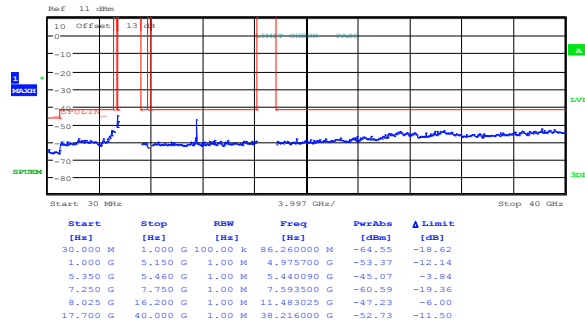
Date: 19.AUG.2015 16:14:30

Figure 8.4-74: Conducted spurious emissions within restricted bands, 802.11n HT20, 5740 MHz, cho



Date: 19.AUG.2015 16:08:42

Figure 8.4-75: Conducted spurious emissions within restricted bands, 802.11a, 5740 MHz, ch1

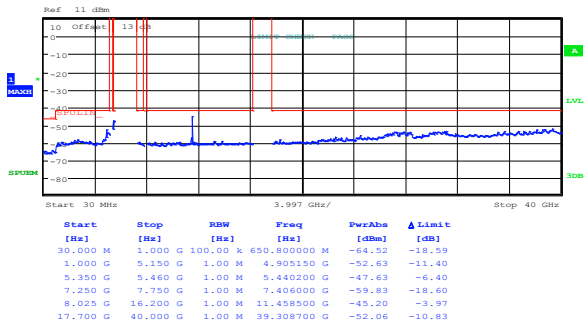


Date: 19.AUG.2015 16:08:13

Figure 8.4-76: Conducted spurious emissions within restricted bands, 802.11n HT20, 5740 MHz, ch1

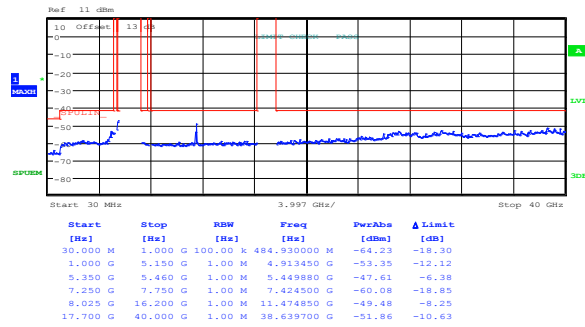
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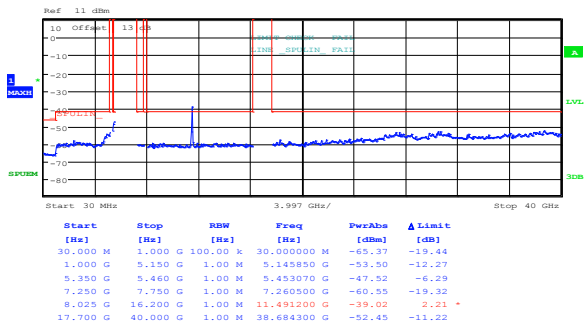
Date: 19.AUG.2015 15:55:56

Figure 8.4-77: Conducted spurious emissions within restricted bands, 802.11a, 5740 MHz, ch2



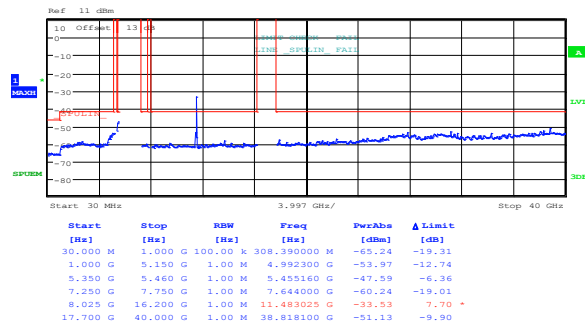
Date: 19.AUG.2015 15:56:47

Figure 8.4-78: Conducted spurious emissions within restricted bands, 802.11n HT20, 5740 MHz, ch2



Date: 19.AUG.2015 16:11:43

Figure 8.4-79: Conducted spurious emissions within restricted bands, 802.11a, 5745 MHz, cho



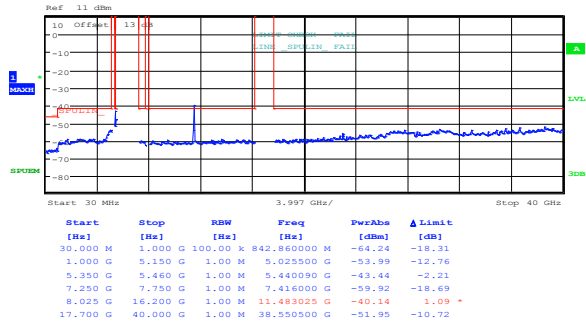
Date: 19.AUG.2015 16:12:19

Figure 8.4-80: Conducted spurious emissions within restricted bands, 802.11n HT20, 5745 MHz, cho

Note: Where second harmonic's peak level exceeded the average limit, through measurement of harmonic's peak and average levels was performed. Please refer to the plots below.

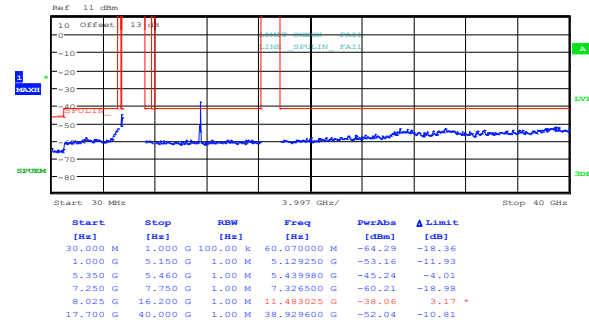
Section 8
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Testing data
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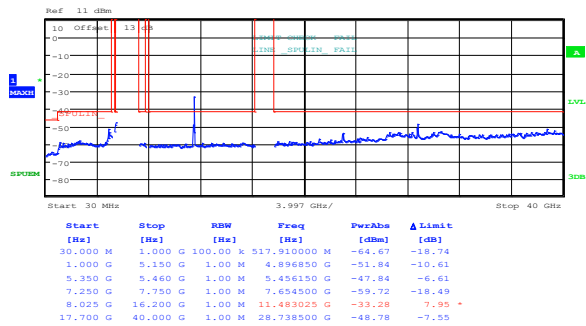
Date: 19.AUG.2015 16:07:03

Figure 8.4-81: Conducted spurious emissions within restricted bands, 802.11a, 5745 MHz, ch1



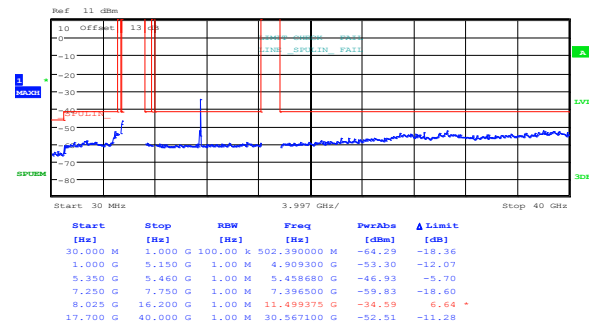
Date: 19.AUG.2015 16:07:41

Figure 8.4-82: Conducted spurious emissions within restricted bands, 802.11n HT20, 5745 MHz, ch1



Date: 19.AUG.2015 15:58:31

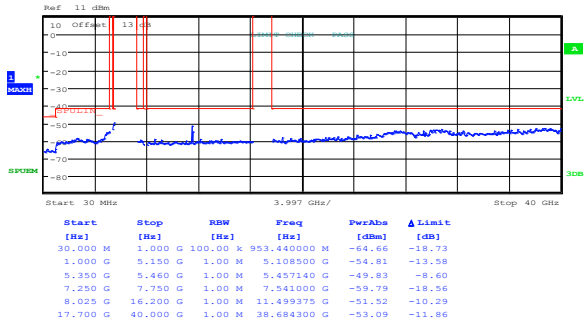
Figure 8.4-83: Conducted spurious emissions within restricted bands, 802.11a, 5745 MHz, ch2



Date: 19.AUG.2015 15:57:36

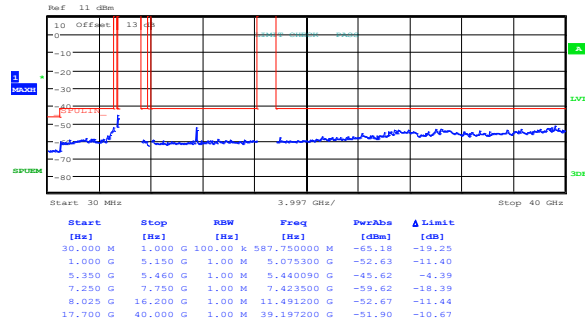
Figure 8.4-84: Conducted spurious emissions within restricted bands, 802.11n HT20, 5745 MHz, ch2

Note: Where second harmonic's peak level exceeded the average limit, through measurement of harmonic's peak and average levels was performed. Please refer to the plots below.



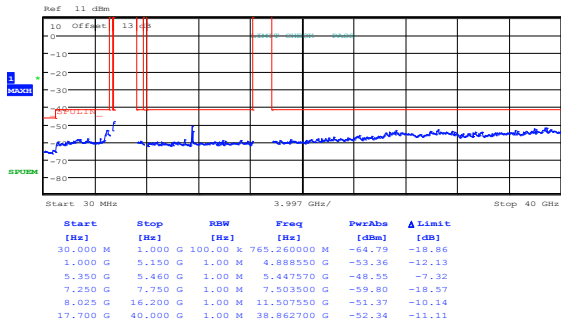
Date: 19.AUG.2015 16:11:05

Figure 8.4-85: Conducted spurious emissions within restricted bands, 802.11n HT40, 5755 MHz, cho



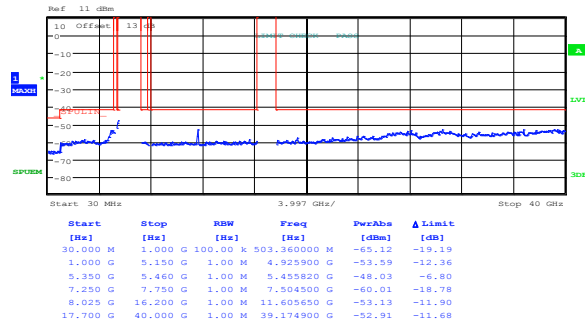
Date: 19.AUG.2015 16:09:19

Figure 8.4-86: Conducted spurious emissions within restricted bands, 802.11n HT40, 5755 MHz, ch1



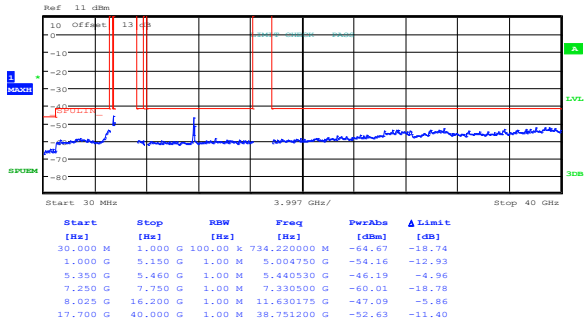
Date: 19.AUG.2015 15:59:19

Figure 8.4-87: Conducted spurious emissions within restricted bands, 802.11n HT20, 5755 MHz, ch2



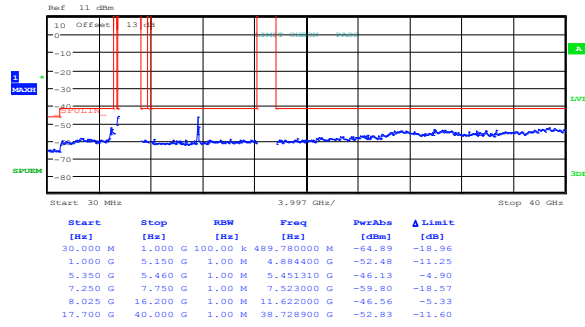
Date: 19.AUG.2015 16:10:35

Figure 8.4-88: Conducted spurious emissions within restricted bands, 802.11n HT40, 5815 MHz, cho



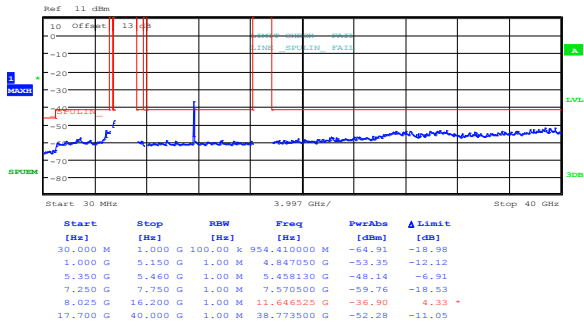
Date: 19.AUG.2015 16:09:57

Figure 8.4-89: Conducted spurious emissions within restricted bands, 802.11n HT40, 5815 MHz, ch1



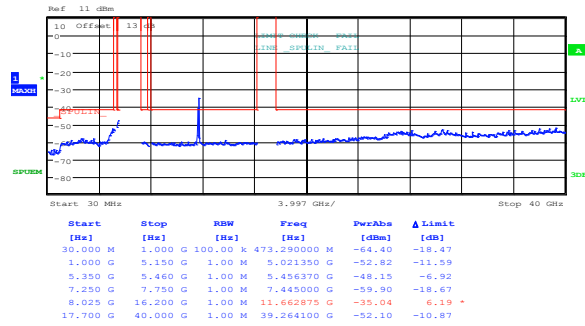
Date: 19.AUG.2015 15:59:57

Figure 8.4-90: Conducted spurious emissions within restricted bands, 802.11n HT40, 5815 MHz, ch2



Date: 19.AUG.2015 16:13:29

Figure 8.4-91: Conducted spurious emissions within restricted bands, 802.11a, 5825 MHz, cho



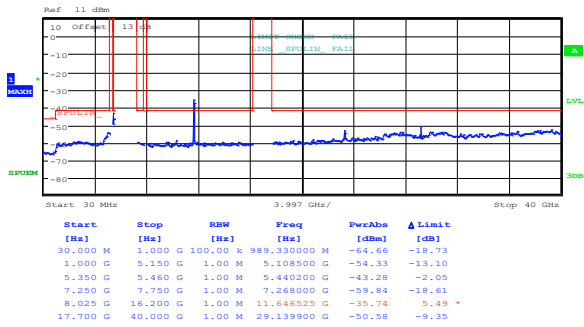
Date: 19.AUG.2015 16:12:56

Figure 8.4-92: Conducted spurious emissions within restricted bands, 802.11n HT20, 5825 MHz, cho

Note: Where second harmonic's peak level exceeded the average limit, through measurement of harmonic's peak and average levels was performed. Please refer to the plots below.

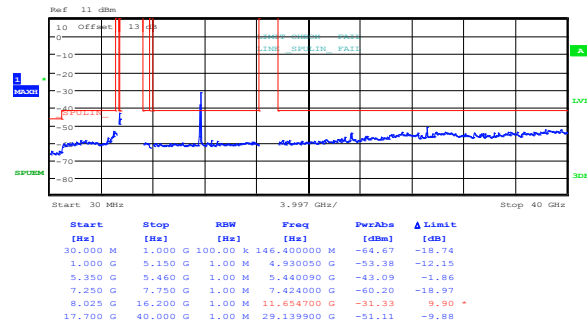
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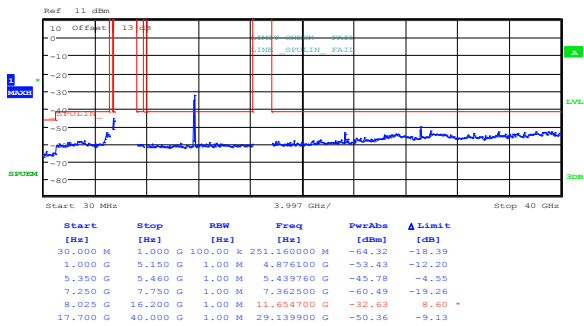
Date: 19.AUG.2015 16:04:12

Figure 8.4-93: Conducted spurious emissions within restricted bands, 802.11a, 5825 MHz, ch1



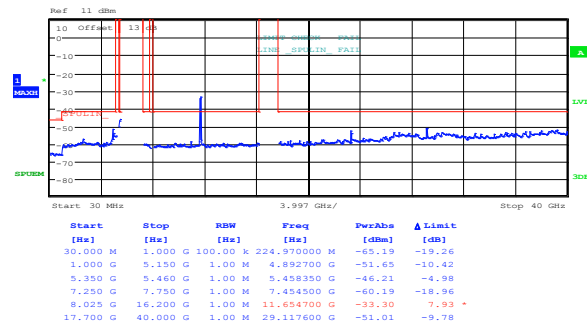
Date: 19.AUG.2015 16:03:43

Figure 8.4-94: Conducted spurious emissions within restricted bands, 802.11n HT20, 5825 MHz, ch1



Date: 19.AUG.2015 16:00:40

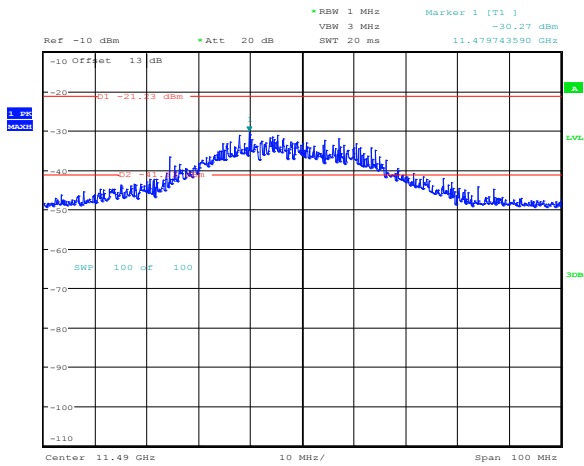
Figure 8.4-95: Conducted spurious emissions within restricted bands, 802.11a, 5825 MHz, ch2



Date: 19.AUG.2015 16:02:15

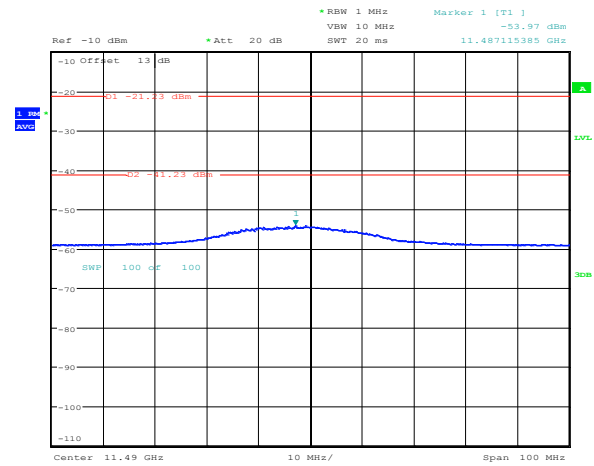
Figure 8.4-96: Conducted spurious emissions within restricted bands, 802.11n HT20, 5825 MHz, ch2

Note: Where second harmonic's peak level exceeded the average limit, through measurement of harmonic's peak and average levels was performed. Please refer to the plots below.



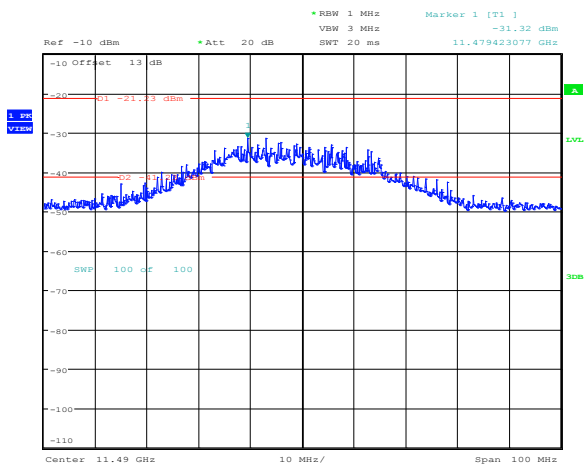
Date: 19.AUG.2015 16:20:08

Figure 8.4-97: Conducted peak spurious emissions at 2nd harmonic, 802.11a, 5745 MHz, cho



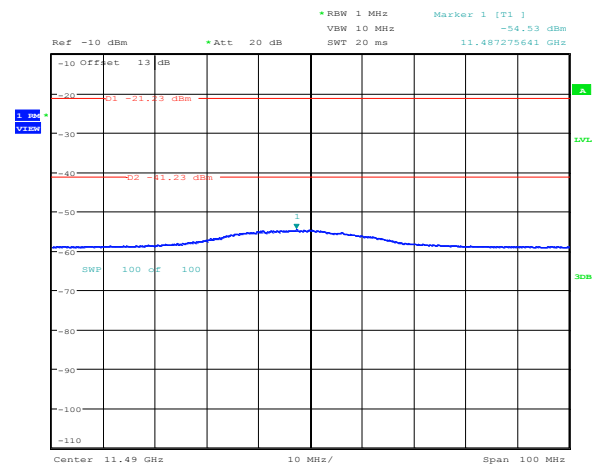
Date: 19.AUG.2015 16:19:50

Figure 8.4-98: Conducted average spurious emissions at 2nd harmonic, 802.11a, 5745 MHz, cho



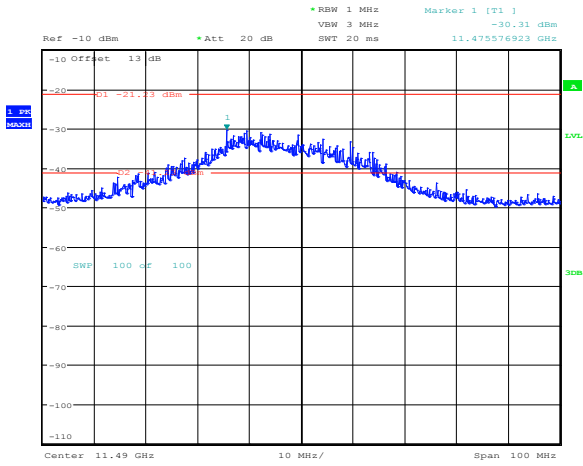
Date: 19.AUG.2015 16:18:47

Figure 8.4-99: Conducted peak spurious emissions at 2nd harmonic, 802.11n HT20, 5745 MHz, cho



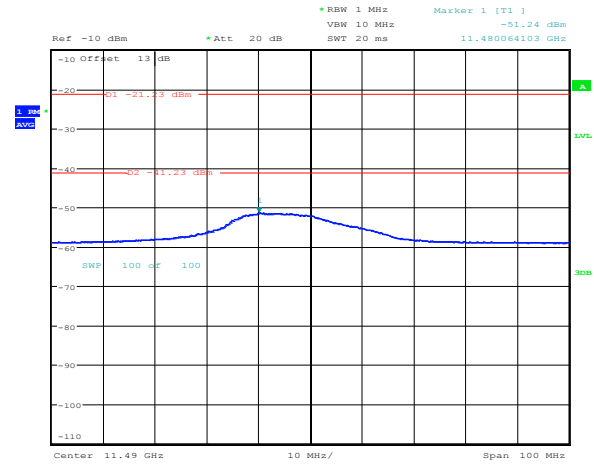
Date: 19.AUG.2015 16:19:19

Figure 8.4-100: Conducted average spurious emissions at 2nd harmonic, 802.11n HT20, 5745 MHz, cho



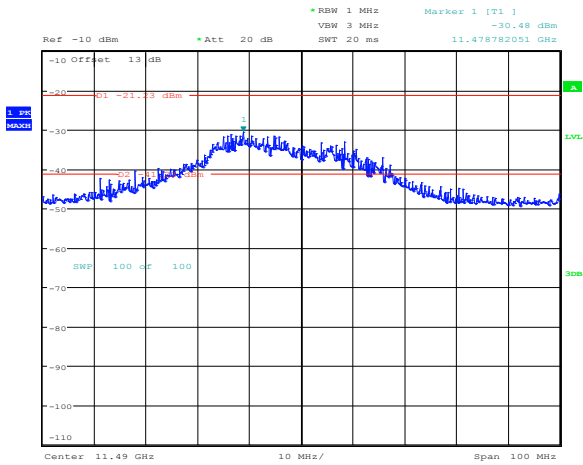
Date: 19.AUG.2015 16:20:44

Figure 8.4-101: Conducted peak spurious emissions at 2nd harmonic, 802.11a, 5745 MHz, ch1



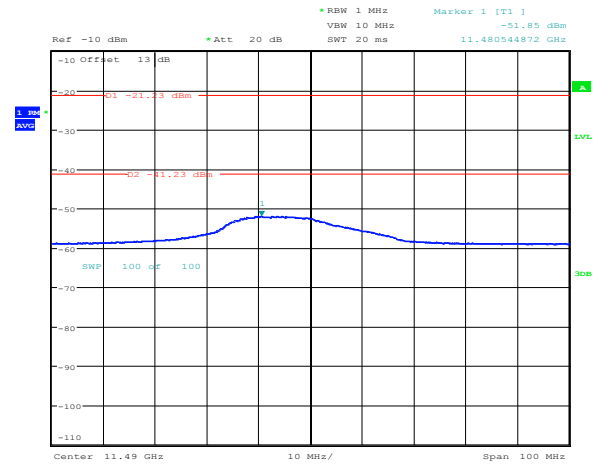
Date: 19.AUG.2015 16:21:04

Figure 8.4-102: Conducted average spurious emissions at 2nd harmonic, 802.11a, 5745 MHz, ch1



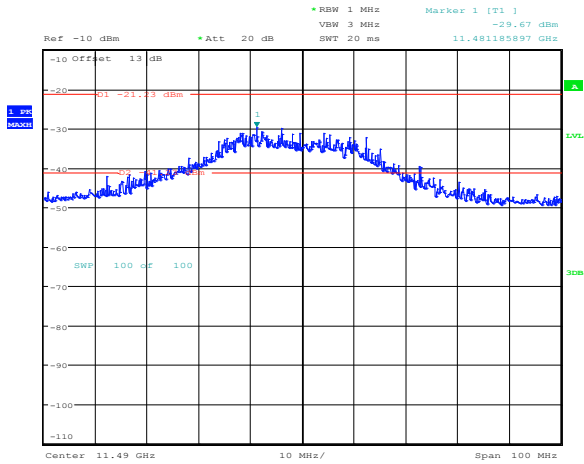
Date: 19.AUG.2015 16:22:34

Figure 8.4-103: Conducted peak spurious emissions at 2nd harmonic, 802.11n HT20, 5745 MHz, ch1



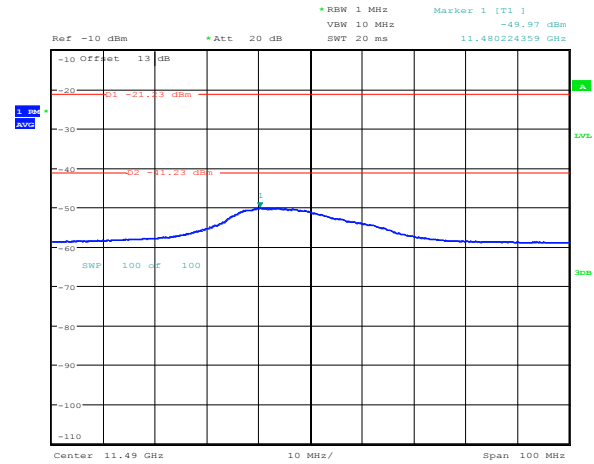
Date: 19.AUG.2015 16:23:30

Figure 8.4-104: Conducted average spurious emissions at 2nd harmonic, 802.11n HT20, 5745 MHz, ch1



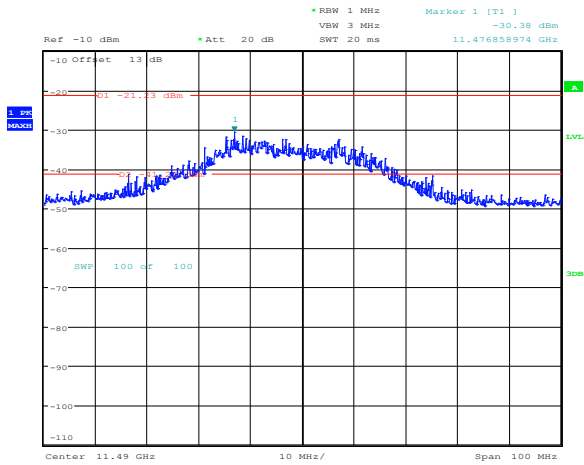
Date: 19.AUG.2015 16:25:08

Figure 8.4-105: Conducted peak spurious emissions at 2nd harmonic, 802.11a, 5745 MHz, ch2



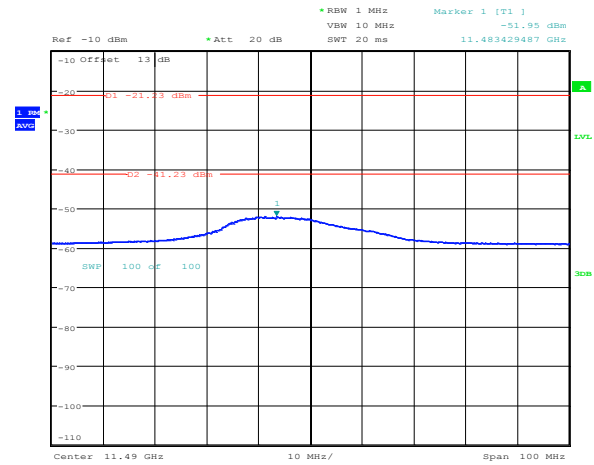
Date: 19.AUG.2015 16:25:34

Figure 8.4-106: Conducted average spurious emissions at 2nd harmonic, 802.11a, 5745 MHz, ch2



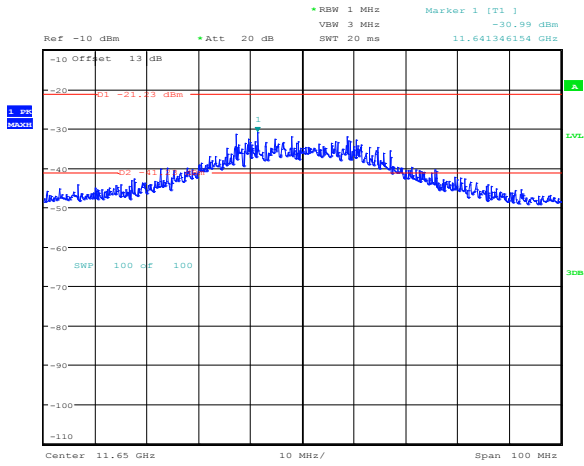
Date: 19.AUG.2015 16:24:43

Figure 8.4-107: Conducted peak spurious emissions at 2nd harmonic, 802.11n HT20, 5745 MHz, ch2



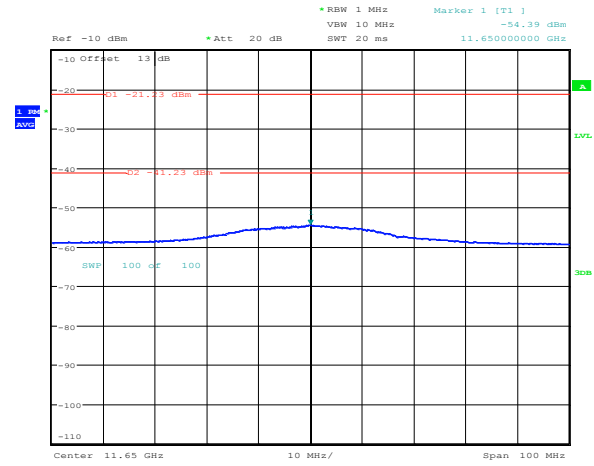
Date: 19.AUG.2015 16:24:25

Figure 8.4-108: Conducted average spurious emissions at 2nd harmonic, 802.11n HT20, 5745 MHz, ch2



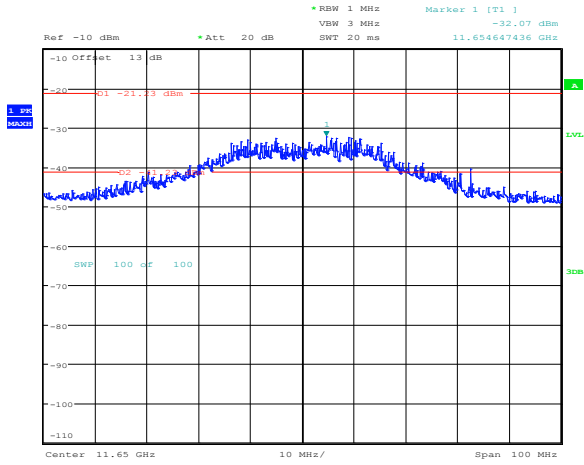
Date: 19.AUG.2015 16:31:34

Figure 8.4-109: Conducted peak spurious emissions at 2nd harmonic, 802.11a, 5825 MHz, cho



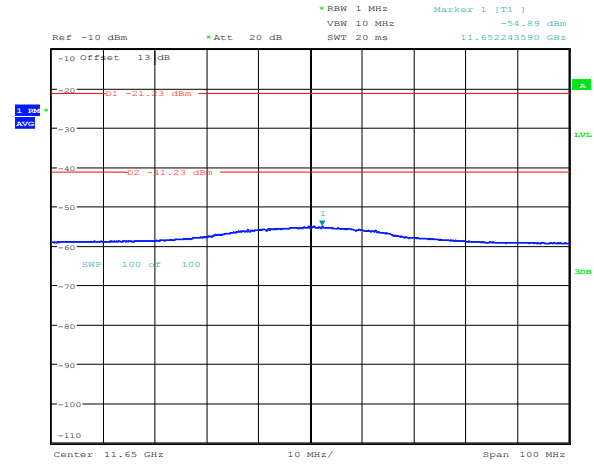
Date: 19.AUG.2015 16:31:13

Figure 8.4-110: Conducted average spurious emissions at 2nd harmonic, 802.11a, 5825 MHz, cho



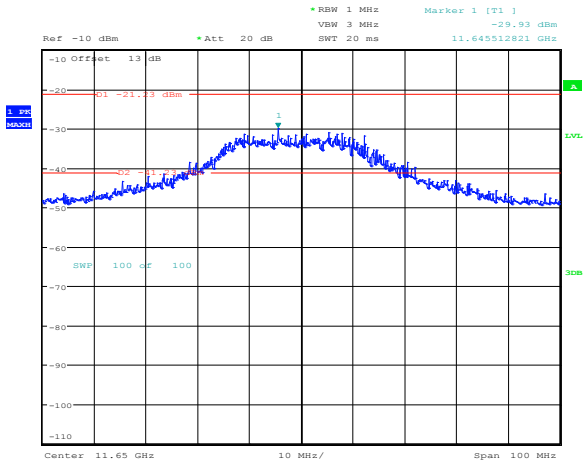
Date: 19.AUG.2015 16:32:10

Figure 8.4-111: Conducted peak spurious emissions at 2nd harmonic, 802.11n HT20, 5825 MHz, cho



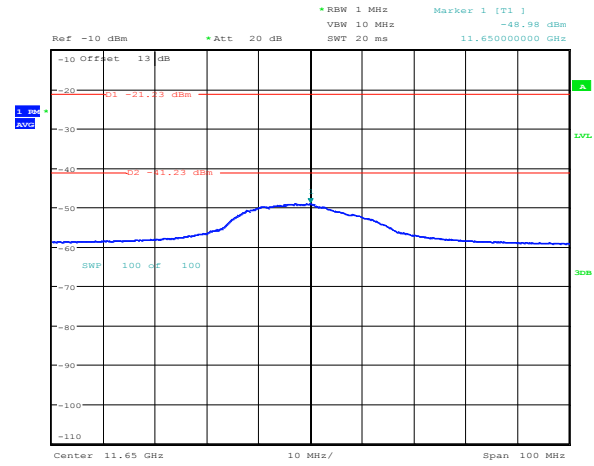
Date: 19.AUG.2015 16:32:29

Figure 8.4-112: Conducted average spurious emissions at 2nd harmonic, 802.11n HT20, 5825 MHz, cho



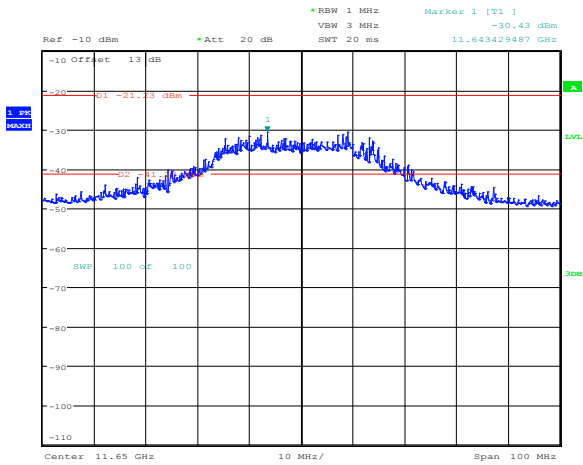
Date: 19.AUG.2015 16:30:00

Figure 8.4-113: Conducted peak spurious emissions at 2nd harmonic, 802.11a, 5825 MHz, ch1



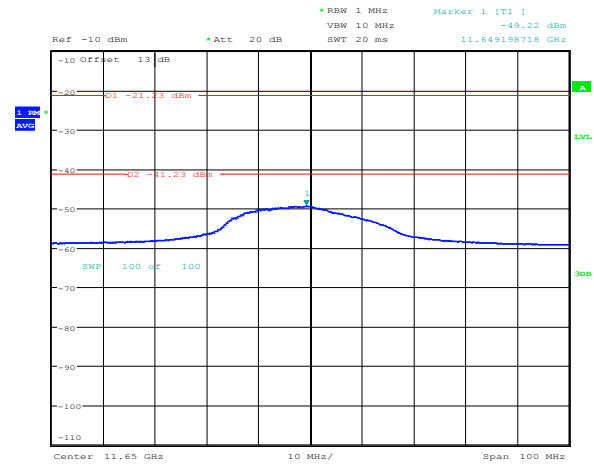
Date: 19.AUG.2015 16:30:17

Figure 8.4-114: Conducted average spurious emissions at 2nd harmonic, 802.11a, 5825 MHz, ch1



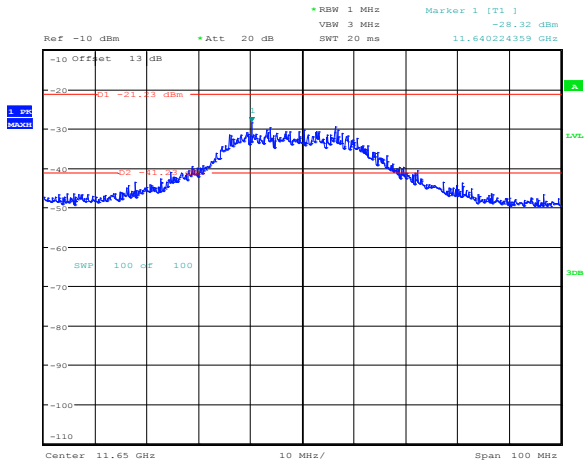
Date: 19.AUG.2015 16:29:21

Figure 8.4-115: Conducted peak spurious emissions at 2nd harmonic, 802.11n HT20, 5825 MHz, ch1



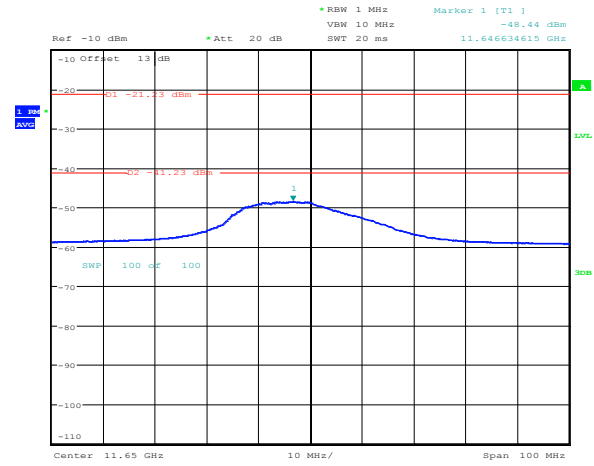
Date: 19.AUG.2015 16:28:58

Figure 8.4-116: Conducted average spurious emissions at 2nd harmonic, 802.11n HT20, 5825 MHz, ch1



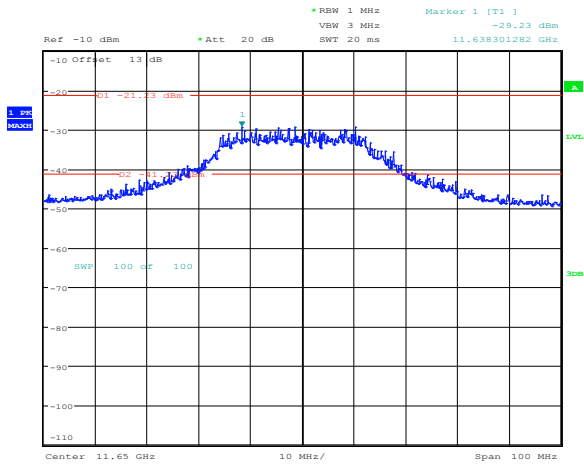
Date: 19.AUG.2015 16:27:00

Figure 8.4-117: Conducted peak spurious emissions at 2nd harmonic, 802.11a, 5825 MHz, ch2



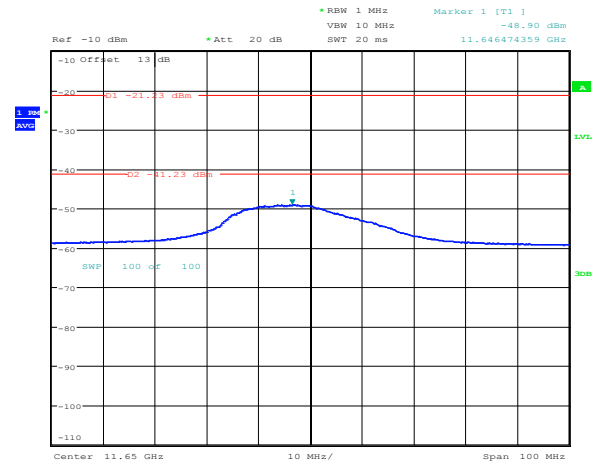
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Figure 8.4-118: Conducted average spurious emissions at 2nd harmonic, 802.11a, 5825 MHz, ch2



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Figure 8.4-119: Conducted peak spurious emissions at 2nd harmonic, 802.11n HT20, 5825 MHz, ch2



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Figure 8.4-120: Conducted average spurious emissions at 2nd harmonic, 802.11n HT20, 5825 MHz, ch2

8.5 FCC 15.207(a) AC power line conducted emissions limits

8.5.1 Definitions and limits

FCC §15.407(6)(b):

Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207

FCC §15.207(a):

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.

Table 8.5-1: 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: * - The level decreases linearly with the logarithm of the frequency.

** - A linear average detector is required.

8.5.2 Test summary

Test date	August 5, 2011	Temperature	25 °C
Test engineer	Andrey Adelberg	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	45 %

8.5.3 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.

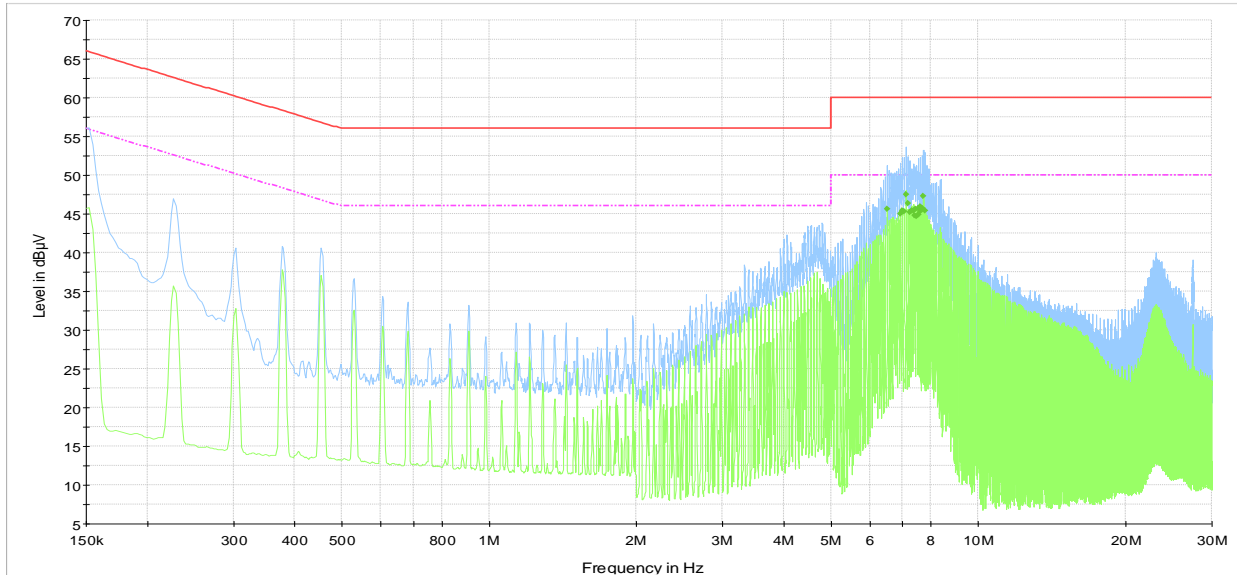
Receiver settings for preview measurements:

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

8.5.4 Test data



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

Plot 8.5-1: Conducted emissions on phase line

Table 8.5-2: Average conducted emissions results on phase line

Frequency, MHz	Average result, dBµV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBµV
7.480500	44.7	100.0	9	On	10.2	5.3	50.0
7.419750	44.8	100.0	9	On	10.2	5.2	50.0
7.541250	44.9	100.0	9	On	10.2	5.1	50.0
6.931500	45.0	100.0	9	On	10.2	5.0	50.0
7.248750	45.2	100.0	9	On	10.2	4.8	50.0
7.602000	45.3	100.0	9	On	10.2	4.7	50.0
6.992250	45.4	100.0	9	On	10.2	4.6	50.0
7.053000	45.4	100.0	9	On	10.2	4.6	50.0
7.316250	45.4	100.0	9	On	10.2	4.6	50.0
7.383750	45.4	100.0	9	On	10.2	4.6	50.0
7.791000	45.4	100.0	9	On	10.2	4.6	50.0

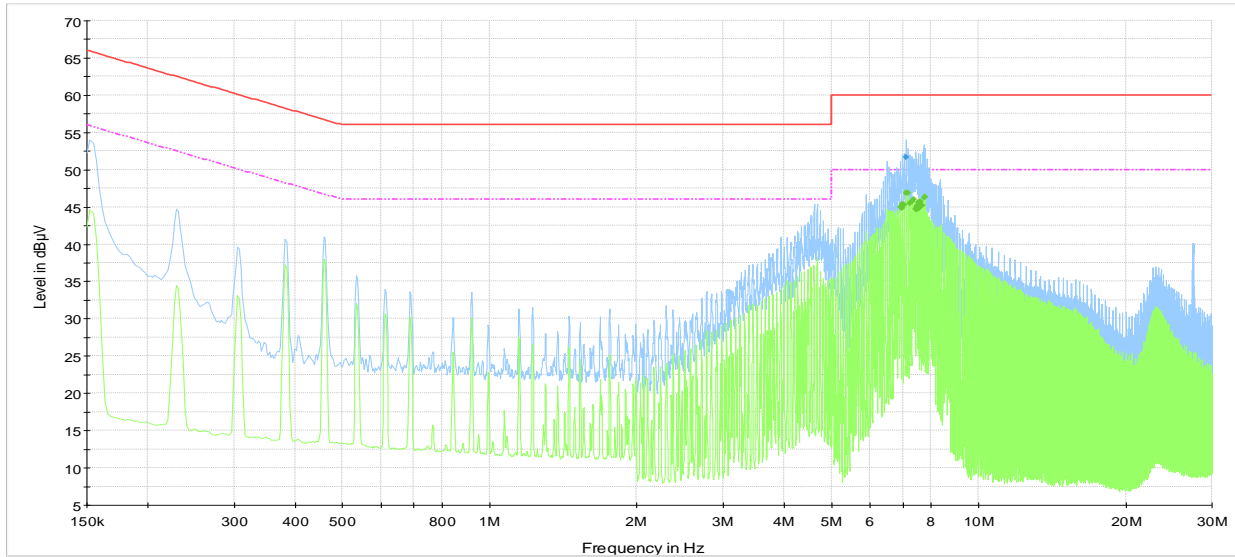
Sample calculation:

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)



Conducted emissions on neutral line
 — CISPR 22 Mains OP Class B.LimitLine
 - - - CISPR 22 Mains AV Class B.LimitLine
 Preview Result 1-PK+
 Preview Result 2-AVG
 Final Result 1-QPK
 Final Result 2-AVG

Plot 8.5-2: Conducted emissions on neutral line

Table 8.5-3: 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
7.113750	51.6	100.0	9	On	10.2	8.4	60.0

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

Table 8.5-4: Average conducted emissions results on neutral line

Frequency, MHz	Average result, dBµV	Meas. Time, ms	Bandwidth, kHz	Filter	Correction, dB	Margin, dB	Limit, dBµV
7.480500	44.6	100.0	9	On	10.2	5.4	50.0
7.541250	44.7	100.0	9	On	10.2	5.3	50.0
7.419750	44.8	100.0	9	On	10.2	5.2	50.0
6.976500	44.9	100.0	9	On	10.2	5.1	50.0
6.931500	45.0	100.0	9	On	10.2	5.0	50.0
7.451250	45.1	100.0	9	On	10.2	4.9	50.0
7.602000	45.1	100.0	9	On	10.2	4.9	50.0
7.653750	45.2	100.0	9	On	10.2	4.8	50.0
7.053000	45.3	100.0	9	On	10.2	4.7	50.0
6.992250	45.4	100.0	9	On	10.2	4.6	50.0
7.246500	45.5	100.0	9	On	10.2	4.5	50.0

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)

8.6 FCC 15.407(g) Frequency stability

8.6.1 Definitions and limits

Manufacturers of U-NII (IC: LE-LAN) 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	August 24, 2015	Temperature	24 °C
Test engineer	Andrey Adelberg	Air pressure	1008 mbar
Verdict	Pass	Relative humidity	40 %

8.6.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 Hz
Video bandwidth:	300 Hz
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	5784951883	-40
+40 °C, Nominal	5784951948	25
+30 °C, Nominal	5784951923	0
+20 °C, +15 %	5784951930	7
+20 °C, Nominal	5784951923	<i>Reference</i>
+20 °C, -15 %	5784951933	10
+10 °C, Nominal	5784951931	8
0 °C, Nominal	5784951977	54
-10 °C, Nominal	5784951982	59
-20 °C, Nominal	5784952025	102
-30 °C, Nominal	5784952018	95



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	5.727019231	40	5.727019191	5.725	2.019191
802.11n HT20	5.726618590	40	5.726618550	5.725	1.618550
802.11n HT40	5.729711538	40	5.729711498	5.725	4.711498

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

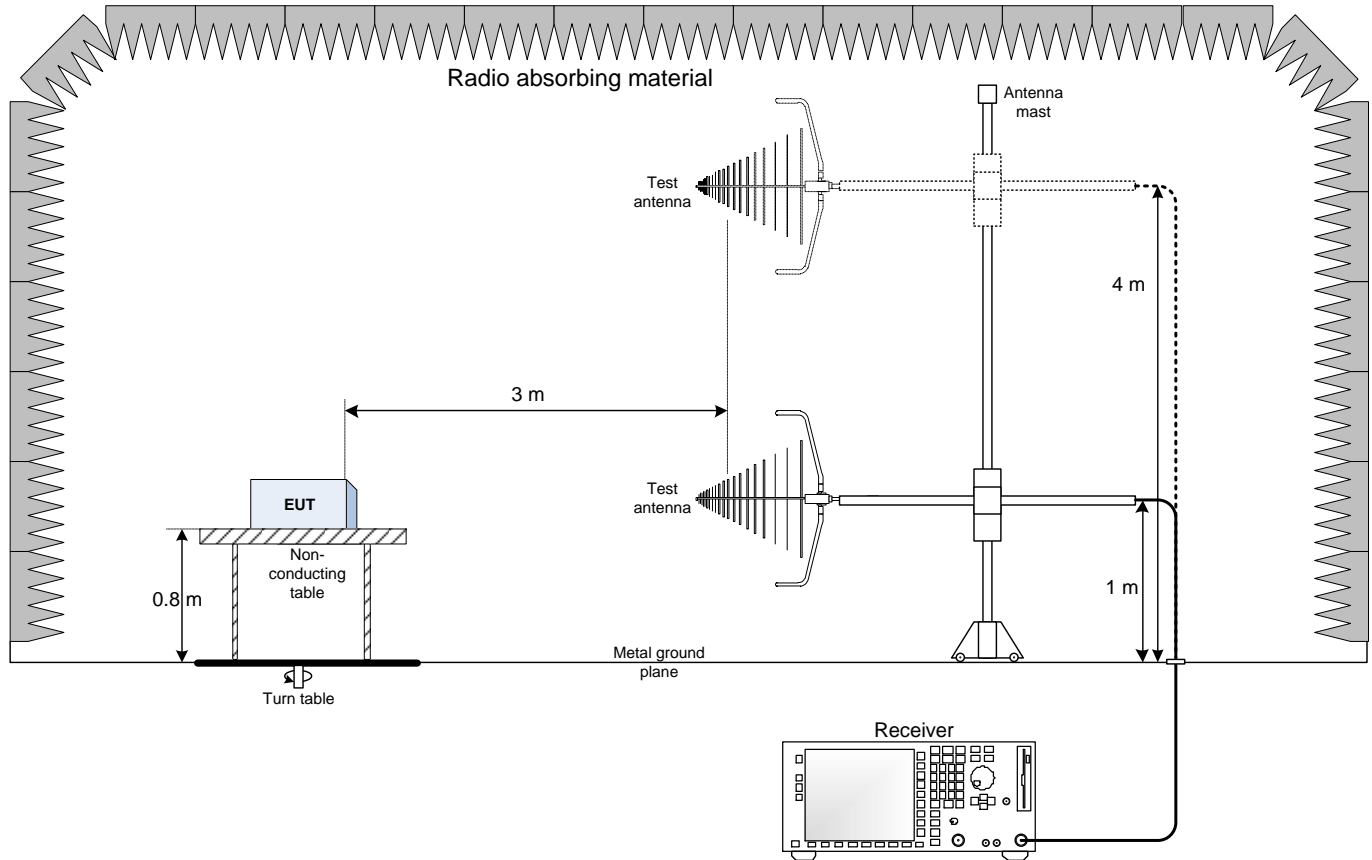
Table 8.6-3: Upper band edge drift calculation

Modulation	-26 dBc upper cross point, GHz	Max positive drift, Hz	Drifted upper cross point, GHz	Band edge, GHz	Margin, MHz
802.11a	5.837019231	102	5.837019333	5.850	12.980667
802.11n HT20	5.837668256	102	5.837668358	5.850	12.331642
802.11n HT40	5.839038462	102	5.839038564	5.850	10.961436

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

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up

