

Test report

268950-1TRFWL

Date of issue: March 23, 2015

Applicant:

TableTop Media

Product:

ZIOSK

Model:

Z400

FCC ID:

XOX-Z400

Specification:

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

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

Test location

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Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC ID: 176392 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	March 23, 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	TableTop Media
Address	12404 Park Central Drive Ste 350
City	Dallas
Province/State	TX
Postal/Zip code	75251
Country	United States

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
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1.3 Test methods

Guidance for compliance measurements on DTS operating under 15.247	558074 D01 Meas Guidance v03r02 (June 5, 2014)
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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
§15.207(a)	Conducted limits	Not applicable ³

Notes: ¹ Measurements were performed with fully charged battery

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

³ EUT is battery operated

2.2 FCC Part 15 Subpart C, intentional radiators test results

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

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	September 15, 2014
Nemko sample ID number	1

3.2 EUT information

Product name	ZIOSK
Model	Z400
Serial number	001EC0890C7C

3.3 Technical information

Operating band	2400–2483.5 MHz
Operating frequency	2412–2462 MHz (for 20 MHz channels) and 2422–2452 MHz (for 40 MHz channels)
Modulation type and data rate	802.11b, 1–11 Mbps; 802.11g, 6–54 Mbps; 802.11n HT20, MCS 0–7; 802.11n HT40, MCS 0–7
Occupied bandwidth (99 %)	11.20 MHz (802.11b), 16.59 MHz (802.11g), 17.79 MHz (802.11n HT20), 36.30 MHz (802.11n HT40)
Emission designator	W7D
Power requirements	7.4 V _{DC} Lithium battery
Antenna information	0.83 dBi The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

The Ziosk is a wireless, battery operated touch screen device with a 7" LCD display, used for pay-at-the-table applications in casual dining restaurants. The device can display menu items, specials, entertainment and local area information; it can also process credit card payments and print receipts.

3.5 EUT exercise details

EUT was connected to Laptop via internal (not user accessible) USB connector and Android shell commands were used to control channel, modulation and data rate settings.

3.6 EUT setup diagram

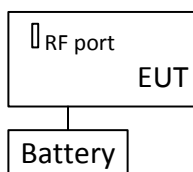


Figure 3.6-1: Setup diagram

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

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

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

5.2 Power supply range

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

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

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

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 18/15
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Oct. 24/14
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Mar. 10/15
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 23/15
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	Jan. 27/15

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.1.1 Definitions and limits

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

8.1.2 Test summary

Test date	September 15, 2014	Temperature	23 °C
Test engineer	Andrey Adelberg	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	32 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Frequency span	30 MHz for 20 MHz channel; 60 MHz for 40 MHz channel
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Table 8.1-1: 6 dB bandwidth results for 802.11b

Frequency, MHz	Data rate	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
2412	1 Mbps	8.07	0.50	7.57
2412	11 Mbps	6.97	0.50	6.47
2437	1 Mbps	8.03	0.50	7.53
2437	11 Mbps	6.63	0.50	6.13
2462	1 Mbps	7.98	0.50	7.48
2462	11 Mbps	7.45	0.50	6.95

Table 8.1-2: 6 dB bandwidth results for 802.11g

Frequency, MHz	Data rate	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
2412	6 Mbps	16.36	0.50	15.86
2412	54 Mbps	16.48	0.50	15.98
2437	6 Mbps	16.40	0.50	15.90
2437	54 Mbps	16.36	0.50	15.86
2462	6 Mbps	16.33	0.50	15.83
2462	54 Mbps	16.50	0.50	16.00

Table 8.1-3: 6 dB bandwidth results for 802.11n HT20

Frequency, MHz	Data rate	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
2412	MCS 0	17.63	0.50	17.13
2412	MCS 7	17.72	0.50	17.22
2437	MCS 0	17.63	0.50	17.13
2437	MCS 7	17.81	0.50	17.31
2462	MCS 0	17.66	0.50	17.16
2462	MCS 7	17.73	0.50	17.23

Table 8.1-4: 6 dB bandwidth results for 802.11n HT40

Frequency, MHz	Data rate	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
2422	MCS 0	36.49	0.50	35.99
2422	MCS 7	36.60	0.50	36.10
2452	MCS 0	36.30	0.50	35.80
2452	MCS 7	36.59	0.50	36.09

Table 8.1-5: 99 % bandwidth results for 802.11b

Frequency, MHz	Data rate	99 % occupied bandwidth, MHz
2412	1 Mbps	10.48
2412	11 Mbps	11.20
2437	1 Mbps	10.53
2437	11 Mbps	11.20
2462	1 Mbps	10.53
2462	11 Mbps	11.20

Table 8.1-6: 99 % bandwidth results for 802.11g

Frequency, MHz	Data rate	99 % occupied bandwidth, MHz
2412	6 Mbps	16.59
2412	54 Mbps	16.49
2437	6 Mbps	16.59
2437	54 Mbps	16.49
2462	6 Mbps	16.59
2462	54 Mbps	16.49

Table 8.1-7: 99 % bandwidth results for 802.11n HT20

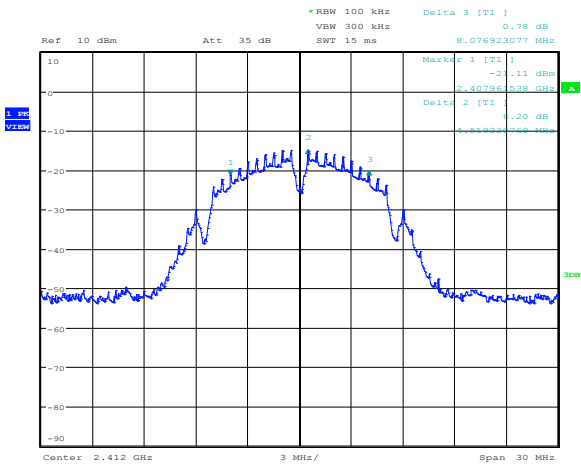
Frequency, MHz	Data rate	99 % occupied bandwidth, MHz
2412	MCS 0	17.74
2412	MCS 7	17.74
2437	MCS 0	17.79
2437	MCS 7	17.74
2462	MCS 0	17.74
2462	MCS 7	17.74

Table 8.1-8: 99 % bandwidth results for 802.11n HT40

Frequency, MHz	Data rate	99 % occupied bandwidth, MHz
2422	MCS 0	36.22
2422	MCS 7	36.30
2452	MCS 0	36.30
2452	MCS 7	36.30

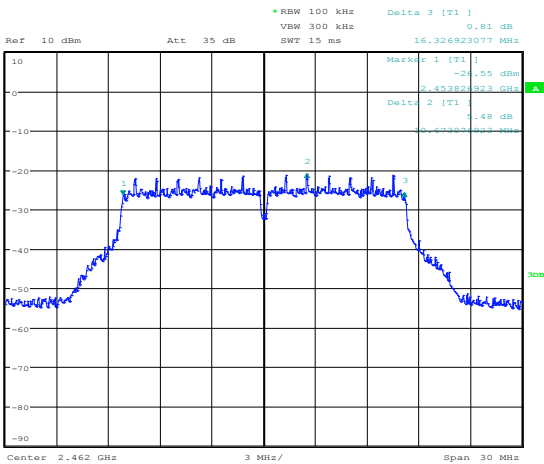
Section 8
Test name
Specification

Testing data
FCC 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques
FCC 15 Subpart C



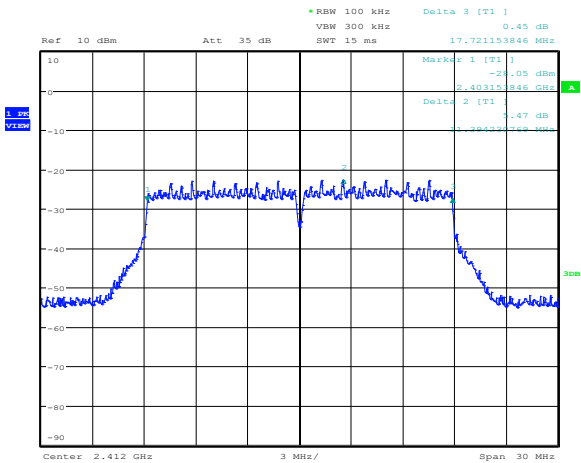
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Figure 8.1-1: 6 dB bandwidth on 802.11b, sample plot



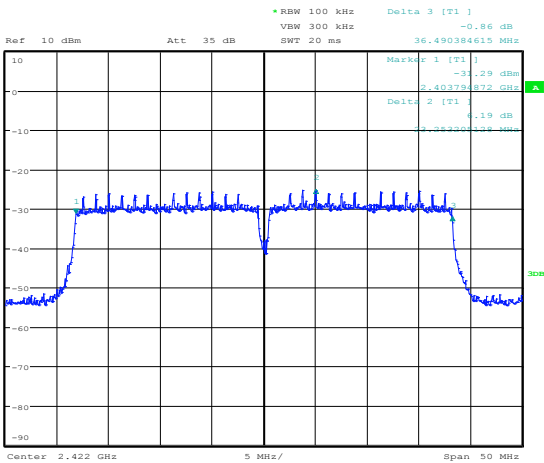
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Figure 8.1-2: 6 dB bandwidth on 802.11g, sample plot



Date: 15.SEP.2014 15:50:30

Figure 8.1-3: 6 dB bandwidth on 802.11n HT20, sample plot

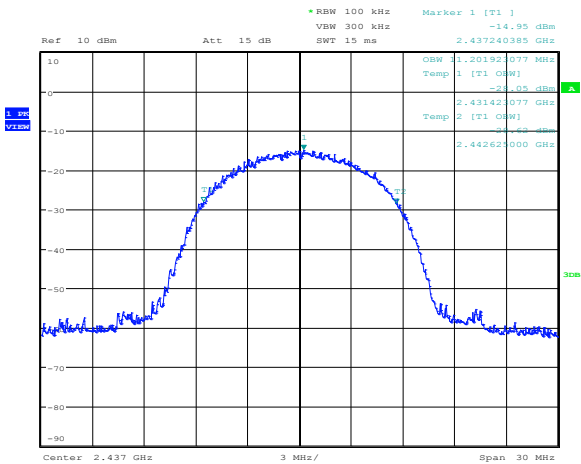


Date: 15.SEP.2014 15:58:54

Figure 8.1-4: 6 dB bandwidth on 802.11n HT40, sample plot

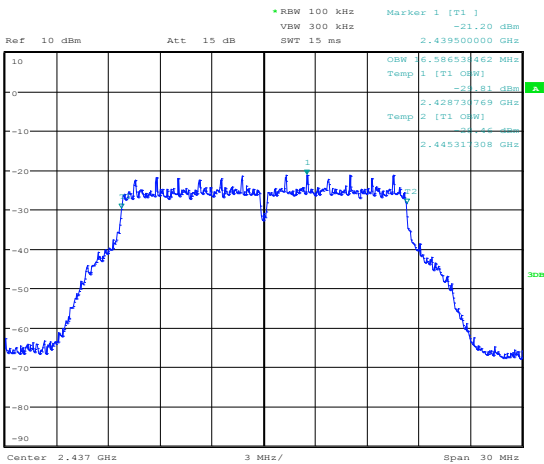
Section 8
Test name
Specification

Testing data
FCC 15.247(a)(2) Minimum 6 dB bandwidth for systems using digital modulation techniques
FCC 15 Subpart C



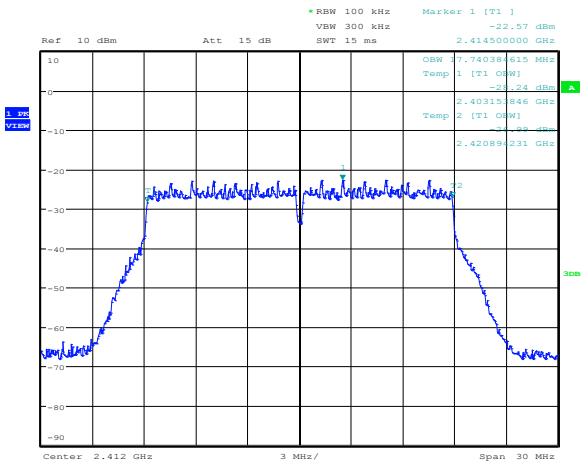
Date: 15.SEP.2014 15:29:54

Figure 8.1-5: 99 % bandwidth on 802.11b, sample plot



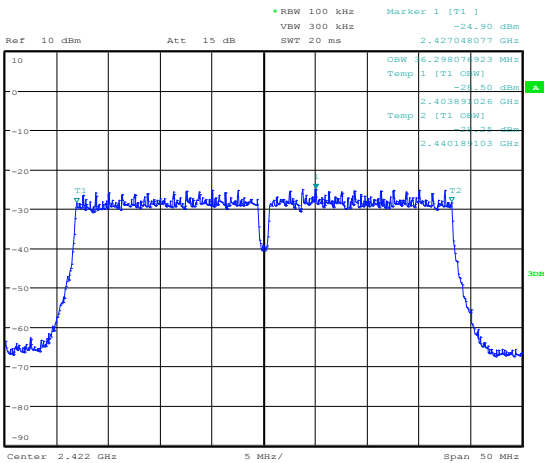
Date: 15.SEP.2014 15:40:56

Figure 8.1-6: 99 % bandwidth on 802.11g, sample plot



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Figure 8.1-7: 99 % bandwidth on 802.11n HT20, sample plot



Date: 15.SEP.2014 16:00:18

Figure 8.1-8: 99 % bandwidth on 802.11n HT40, sample plot

8.2 FCC 15.247(b) Transmitter output power and e.i.r.p. requirements

8.2.1 Definitions and limits

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
 - (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.
 - (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

8.2.2 Test summary

Test date	September 15, 2014	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	31 %

8.2.3 Observations, settings and special notes

The test was performed according to DTS guidelines section 9.2.2.2: Method AVGSA-1 (trace averaging with the EUT transmitting at full power throughout each sweep). Antenna gain is 1.8 dBi; therefore there was no need to reduce the output power limit. Spectrum analyser settings:

Resolution bandwidth	1 MHz
Video bandwidth	10 MHz
Detector mode	RMS
Trace mode	Power averaging over 100 traces
Channel aggregation	20 MHz for (802.11b/g/n HT20) and 40 MHz (for 802.11n HT40)

8.2.4 Test data

Table 8.2-1: Output power measurements results for 802.11b

Frequency, MHz	Data rate	Output power, dBm		Power margin, dB	Antenna gain, dBi	EIRP, dBm		EIRP margin, dB
		Measured	Limit			Calculated	Limit	
2412	1 Mbps	15.08	30.00	14.92	0.83	15.91	36.00	20.09
2412	11 Mbps	15.14	30.00	14.86	0.83	15.97	36.00	20.03
2437	1 Mbps	15.14	30.00	14.86	0.83	15.97	36.00	20.03
2437	11 Mbps	15.19	30.00	14.81	0.83	16.02	36.00	19.98
2462	1 Mbps	15.20	30.00	14.80	0.83	16.03	36.00	19.97
2462	11 Mbps	15.24	30.00	14.76	0.83	16.07	36.00	19.93

Table 8.2-2: Output power measurements results for 802.11g

Frequency, MHz	Data rate	Output power, dBm		Power margin, dB	Antenna gain, dBi	EIRP, dBm		EIRP margin, dB
		Measured	Limit			Calculated	Limit	
2412	6 Mbps	11.73	30.00	18.27	0.83	12.56	36.00	23.44
2412	54 Mbps	11.84	30.00	18.16	0.83	12.67	36.00	23.33
2437	6 Mbps	11.87	30.00	18.13	0.83	12.70	36.00	23.30
2437	54 Mbps	12.10	30.00	17.90	0.83	12.93	36.00	23.07
2462	6 Mbps	11.94	30.00	18.06	0.83	12.77	36.00	23.23
2462	54 Mbps	12.21	30.00	17.79	0.83	13.04	36.00	22.96

Table 8.2-3: Output power measurements results for 802.11n HT20

Frequency, MHz	Data rate	Output power, dBm		Power margin, dB	Antenna gain, dBi	EIRP, dBm		EIRP margin, dB
		Measured	Limit			Calculated	Limit	
2412	MCS 0	10.52	30.00	19.48	0.83	11.35	36.00	24.65
2412	MCS 7	11.05	30.00	18.95	0.83	11.88	36.00	24.12
2437	MCS 0	10.79	30.00	19.21	0.83	11.62	36.00	24.38
2437	MCS 7	11.00	30.00	19.00	0.83	11.83	36.00	24.17
2462	MCS 0	10.84	30.00	19.16	0.83	11.67	36.00	24.33
2462	MCS 7	11.22	30.00	18.78	0.83	12.05	36.00	23.95

Table 8.2-4: Output power measurements results for 802.11n HT40

Frequency, MHz	Data rate	Output power, dBm		Power margin, dB	Antenna gain, dBi	EIRP, dBm		EIRP margin, dB
		Measured	Limit			Calculated	Limit	
2422	MCS 0	11.08	30.00	18.92	0.83	11.91	36.00	24.09
2422	MCS 7	11.17	30.00	18.83	0.83	12.00	36.00	24.00
2452	MCS 0	11.25	30.00	18.75	0.83	12.08	36.00	23.92
2452	MCS 7	11.16	30.00	18.84	0.83	11.99	36.00	24.01

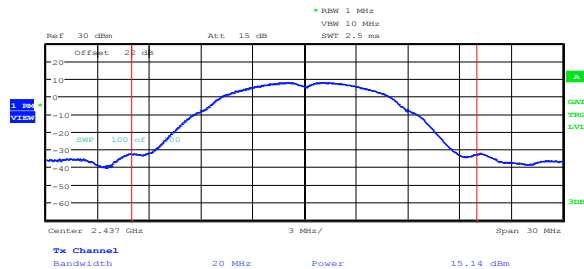


Figure 8.2-1: Output power on 802.11b, sample plot

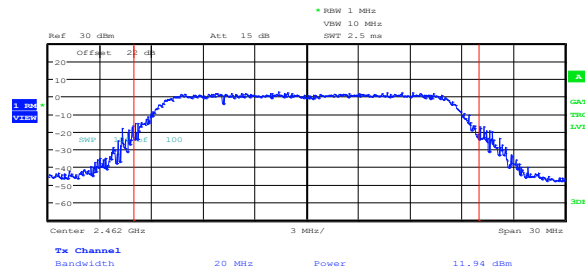


Figure 8.2-2: Output power on 802.11g, sample plot

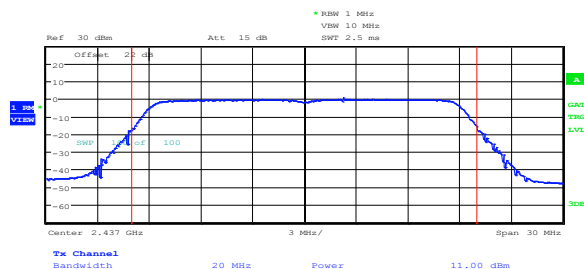


Figure 8.2-3: Output power on 802.11n HT20, sample plot

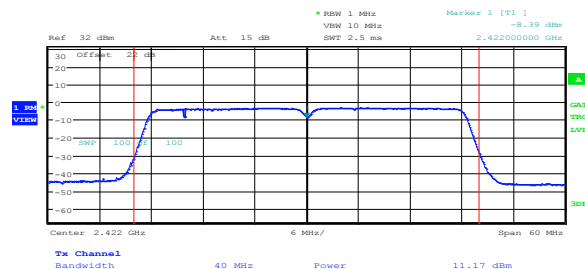


Figure 8.2-4: Output power on 802.11n HT40, sample plot

Output power summary

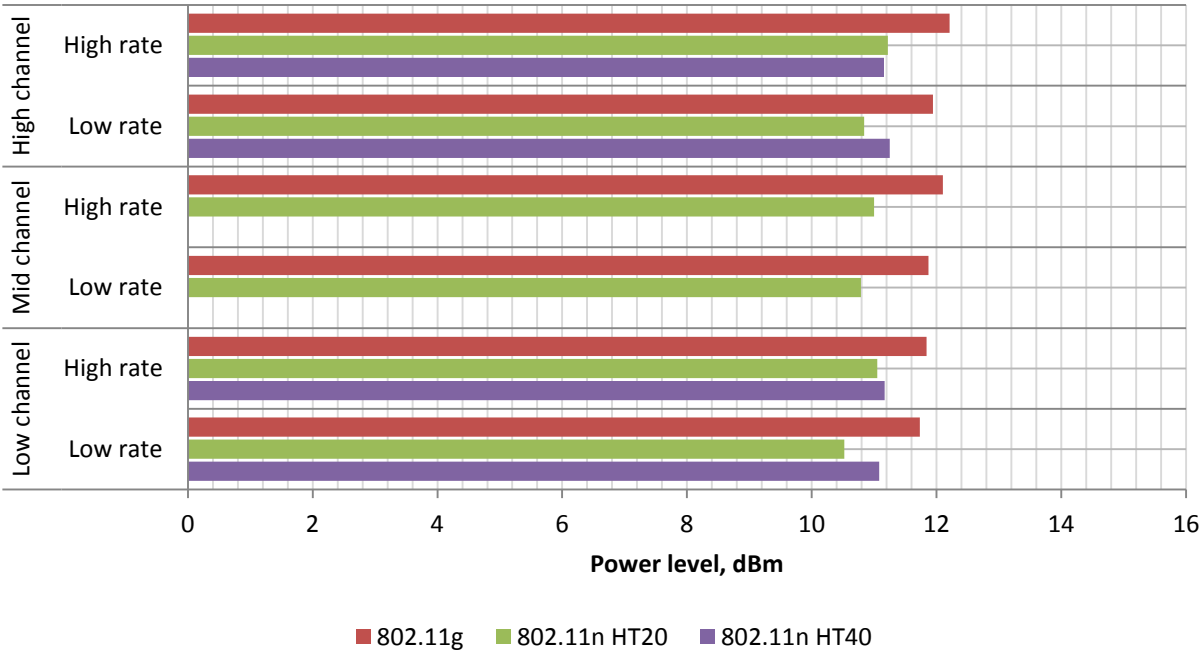


Figure 8.2-5: Output power comparison

8.3 FCC 15.247(d) Spurious (out-of-band) emissions

8.3.1 Definitions and limits

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

Table 8.3-1: FCC §15.209 – Radiated emission limits

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

Notes: In the 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 8.3-2: 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			

8.3.2 Test summary

Test date	September 16, 2014	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	31 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic. Cabinet radiation measurements were performed at a distance of 3 m. No emissions were detected within 20 dB of the specification limit therefore none are reported as per FCC §15.31(o). Band edge data is presented below. Conducted restricted bands average limit was calculated as follows: 54 dBμV/m – 95.23 dB – 0.83 dBi = –42.06 dBm.

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

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

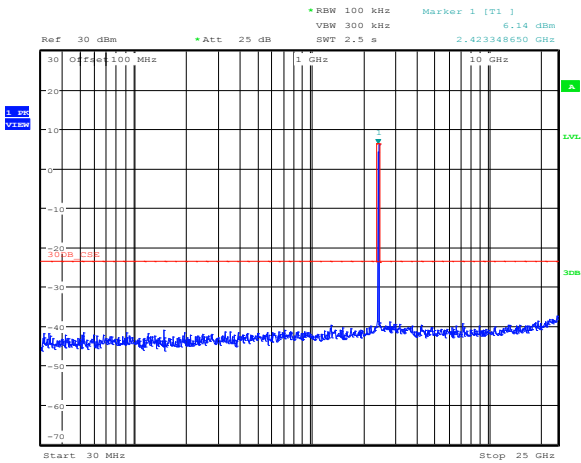
Spectrum analyser settings for peak measurements within restricted bands above 1 GHz:

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

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

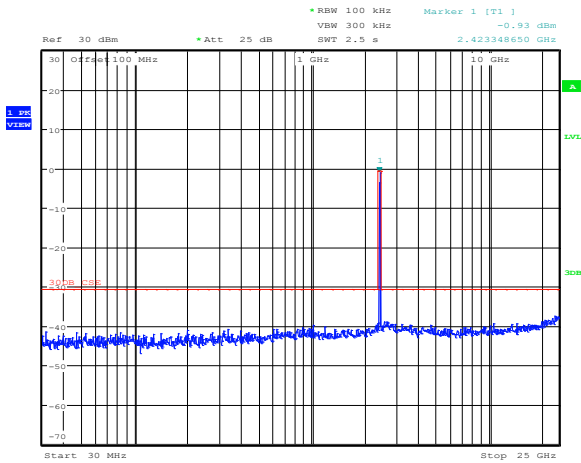
Resolution bandwidth	1 MHz
Video bandwidth	10 Hz
Detector mode	RMS
Trace mode	Power averaging over 100 sweeps

8.3.4 Test data



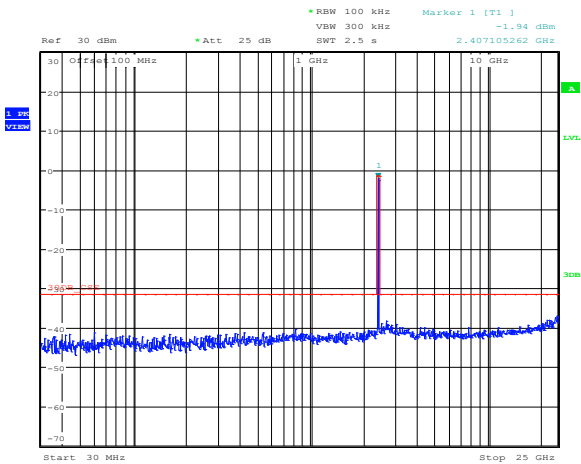
Date: 16.SEP.2014 11:21:45

Figure 8.3-1: Conducted spurious emissions outside restricted bands for 802.11b, 1 Mbps, low channel



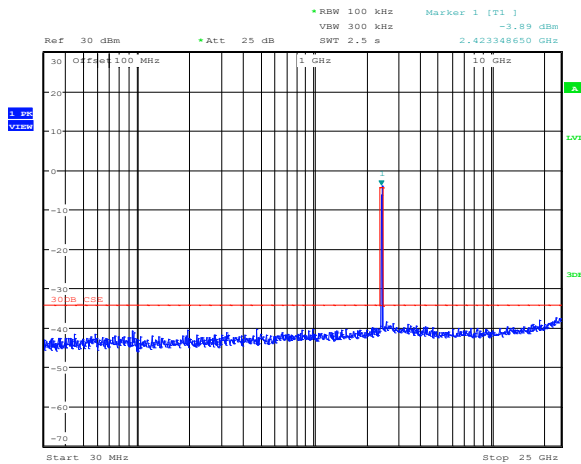
Date: 16.SEP.2014 11:13:48

Figure 8.3-2: Conducted spurious emissions outside restricted bands for 802.11g, 6 Mbps, low channel



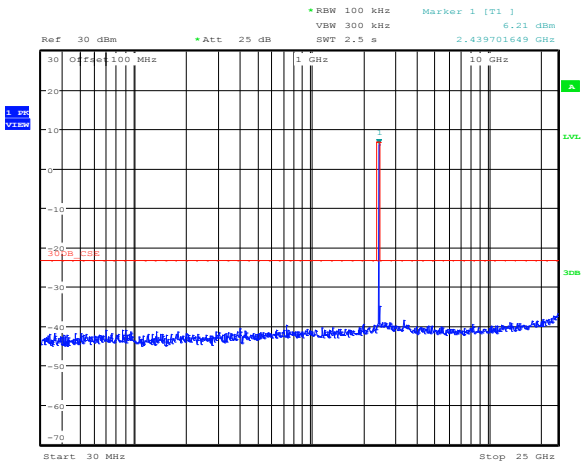
Date: 16.SEP.2014 11:07:01

Figure 8.3-3: Conducted spurious emissions outside restricted bands for 802.11n HT20, MCS 0, low channel



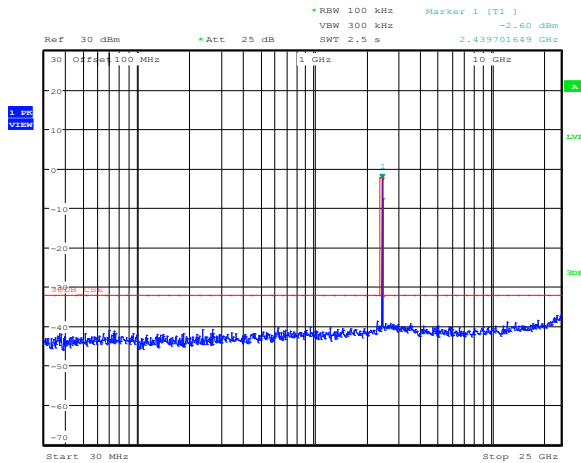
Date: 16.SEP.2014 11:05:38

Figure 8.3-4: Conducted spurious emissions outside restricted bands for 802.11n HT40, MCS 0, low channel



Date: 16.SEP.2014 11:26:36

Figure 8.3-5: Conducted spurious emissions outside restricted bands for 802.11b, 1 Mbps, mid channel



Date: 16.SEP.2014 11:17:08

Figure 8.3-6: Conducted spurious emissions outside restricted bands for 802.11g, 6 Mbps, mid channel

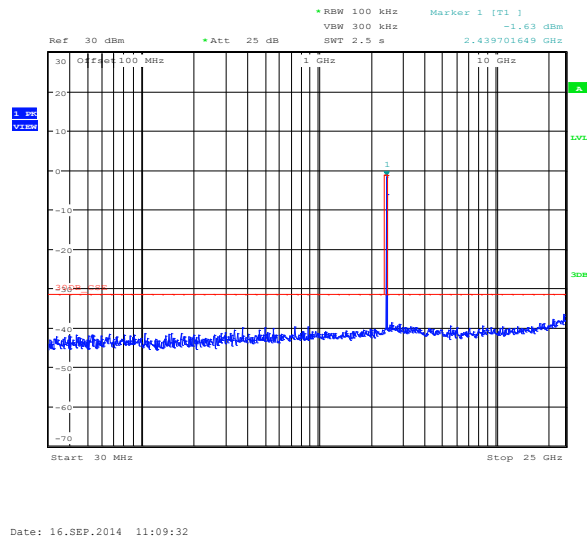


Figure 8.3-7: Conducted spurious emissions outside restricted bands for 802.11n HT20, MCS 0, mid channel

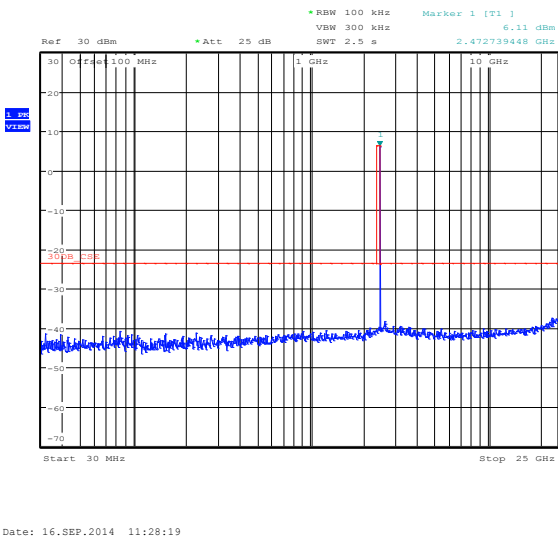


Figure 8.3-8: Conducted spurious emissions outside restricted bands for 802.11b, 1 Mbps, high channel

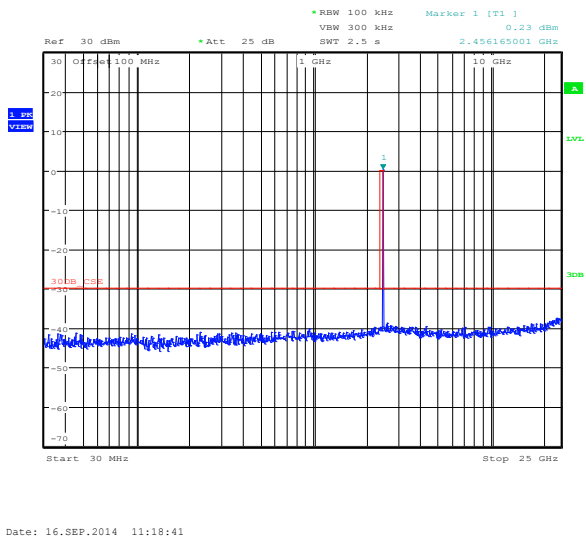
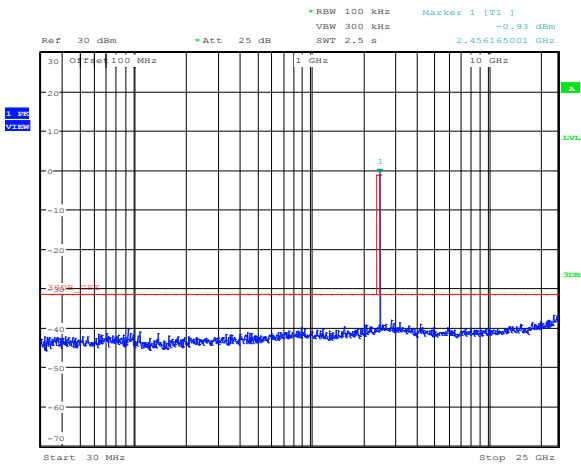
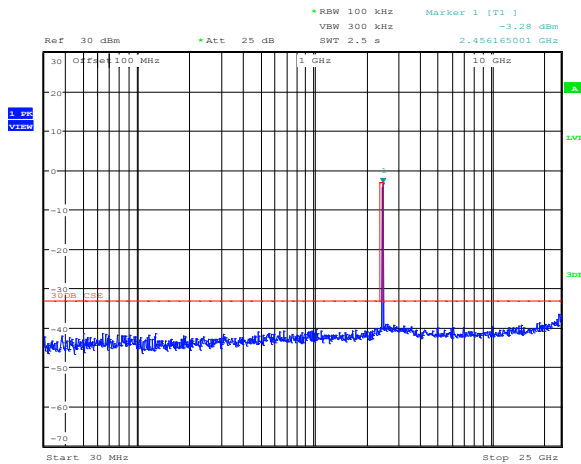


Figure 8.3-9: Conducted spurious emissions outside restricted bands for 802.11g, 6 Mbps, high channel



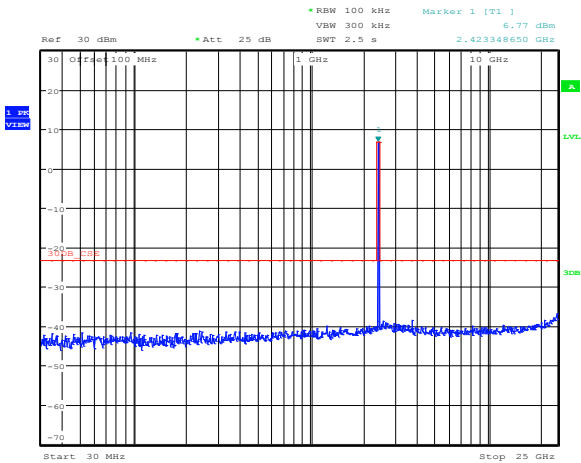
Date: 16.SEP.2014 11:10:31

Figure 8.3-10: Conducted spurious emissions outside restricted bands for 802.11n HT20, MCS 0, high channel



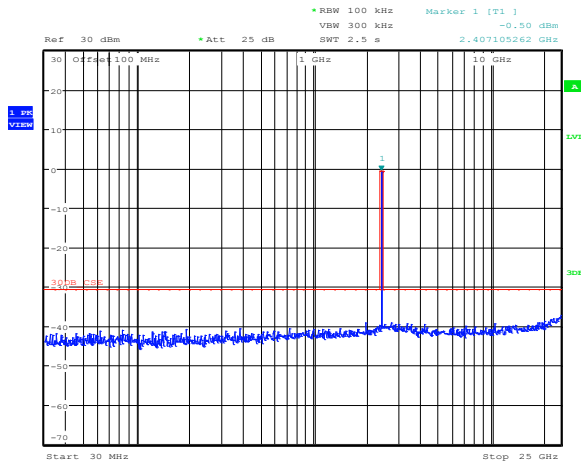
Date: 16.SEP.2014 11:03:07

Figure 8.3-11: Conducted spurious emissions outside restricted bands for 802.11n HT40, MCS 0, high channel



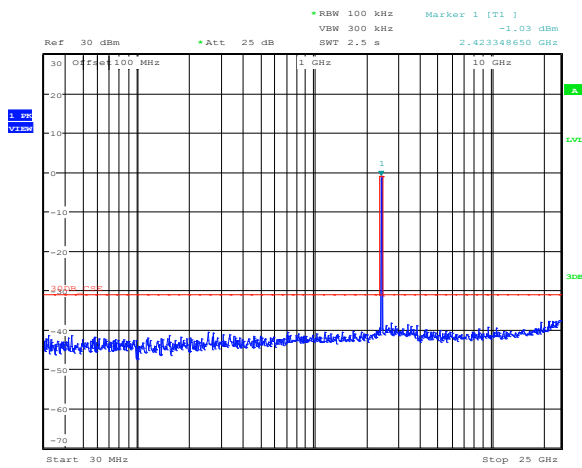
Date: 16.SEP.2014 11:22:39

Figure 8.3-12: Conducted spurious emissions outside restricted bands for 802.11b, 11 Mbps, low channel



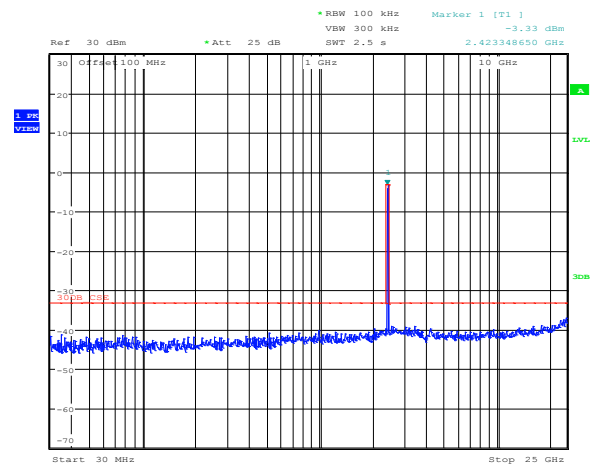
Date: 16.SEP.2014 11:14:38

Figure 8.3-13: Conducted spurious emissions outside restricted bands for 802.11g, 54 Mbps, low channel



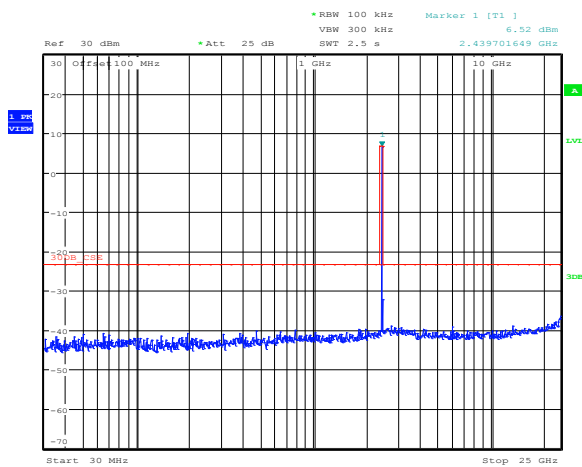
Date: 16.SEP.2014 11:07:42

Figure 8.3-14: Conducted spurious emissions outside restricted bands for 802.11n HT20, MCS 7, low channel



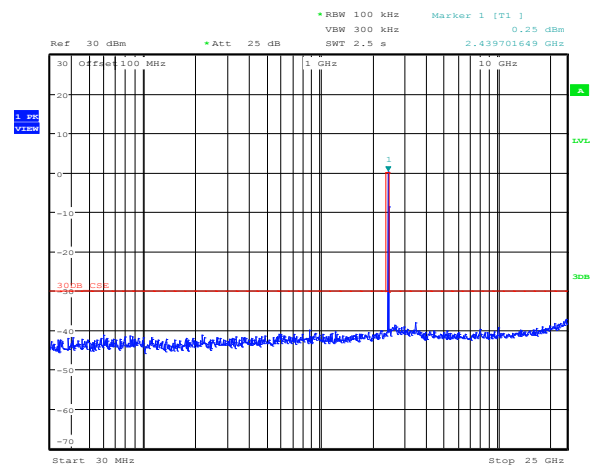
Date: 16.SEP.2014 11:04:52

Figure 8.3-15: Conducted spurious emissions outside restricted bands for 802.11n HT40, MCS 7, low channel



Date: 16.SEP.2014 11:25:17

Figure 8.3-16: Conducted spurious emissions outside restricted bands for 802.11b, 11 Mbps, mid channel



Date: 16.SEP.2014 11:15:47

Figure 8.3-17: Conducted spurious emissions outside restricted bands for 802.11g, 54 Mbps, mid channel

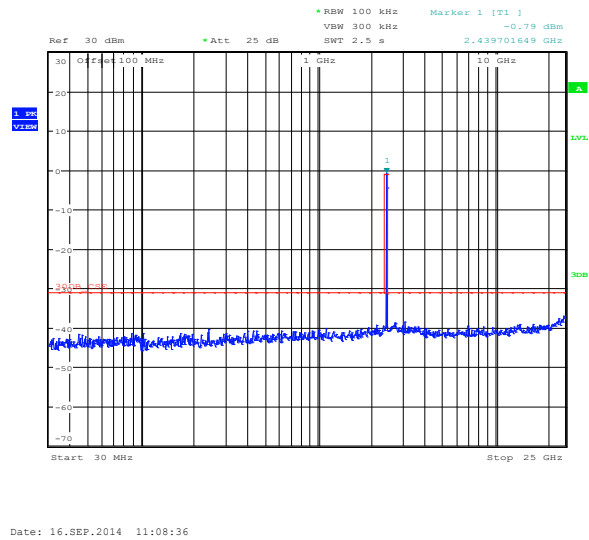


Figure 8.3-18: Conducted spurious emissions outside restricted bands for 802.11n HT20, MCS 7, mid channel

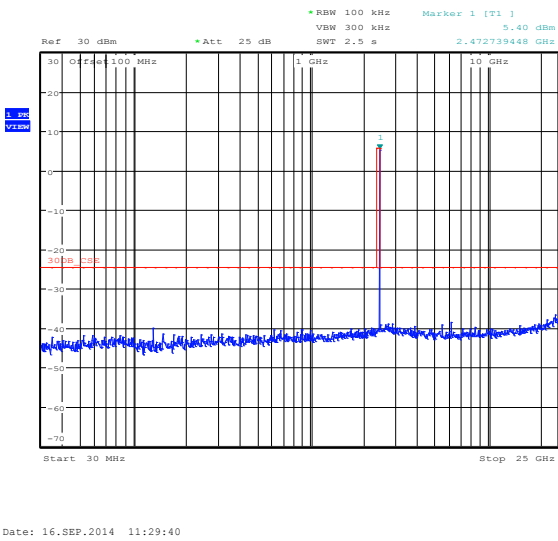


Figure 8.3-19: Conducted spurious emissions outside restricted bands for 802.11b, 11 Mbps, high channel

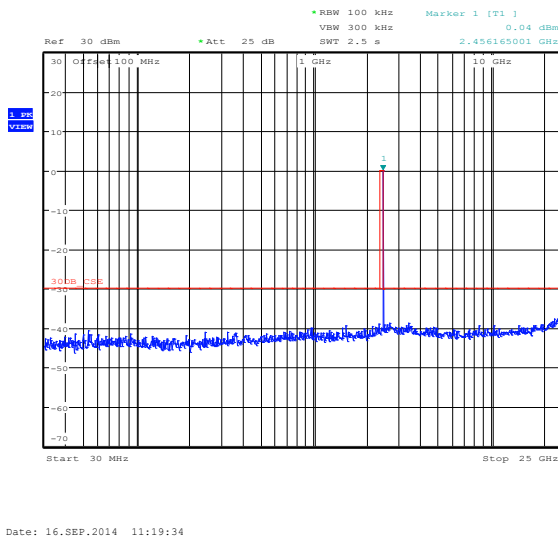
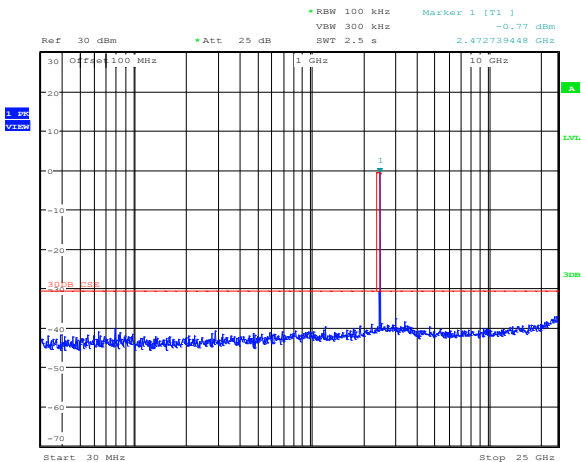


Figure 8.3-20: Conducted spurious emissions outside restricted bands for 802.11g, 54 Mbps, high channel

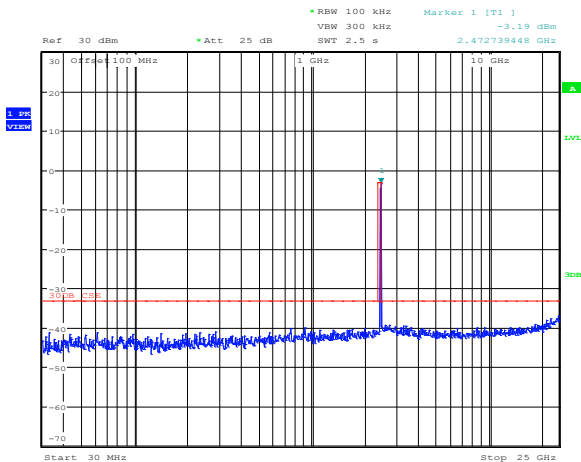
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Date: 16.SEP.2014 11:11:19

Figure 8.3-21: Conducted spurious emissions outside restricted bands for 802.11n HT20, MCS 7, high channel



Date: 16.SEP.2014 11:04:08

Figure 8.3-22: Conducted spurious emissions outside restricted bands for 802.11n HT40, MCS 7, high channel

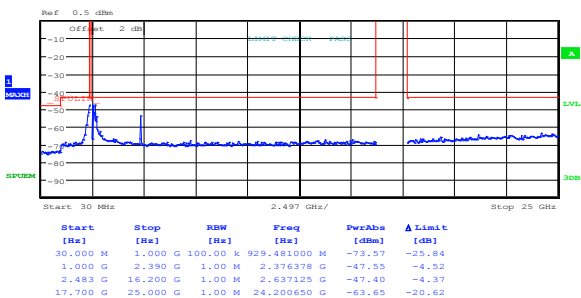


Figure 8.3-23: Conducted spurious emissions within restricted bands for 802.11b, 1 Mbps, low channel

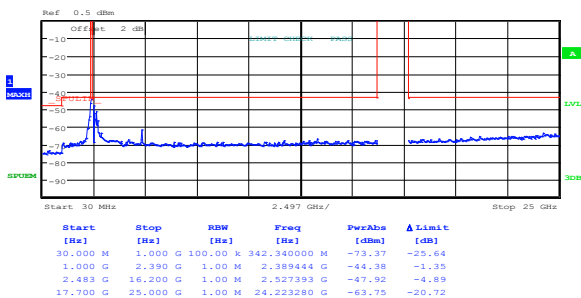


Figure 8.3-24: Conducted spurious emissions within restricted bands for 802.11g, 6 Mbps, low channel

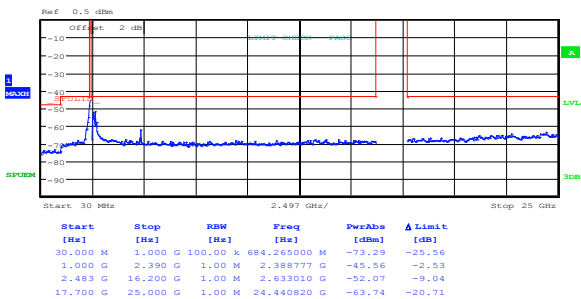


Figure 8.3-25: Conducted spurious emissions within restricted bands for 802.11n HT20, MCS 0, low channel

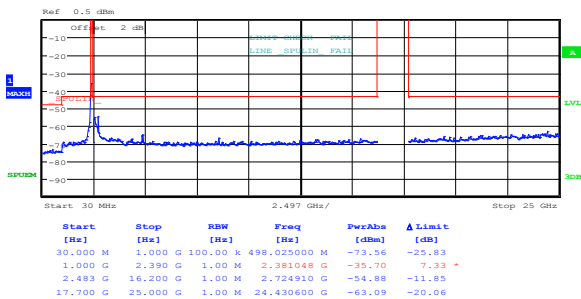


Figure 8.3-26: Conducted spurious emissions within restricted bands for 802.11n HT40, MCS 0, low channel

Note: measurement results indicated in red on the plots above were reassessed further down as band edge emissions.

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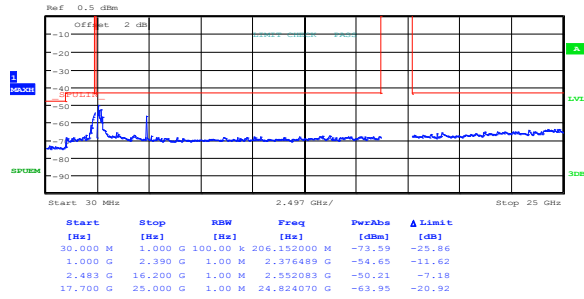


Figure 8.3-27: Conducted spurious emissions within restricted bands for 802.11b, 1 Mbps, mid channel

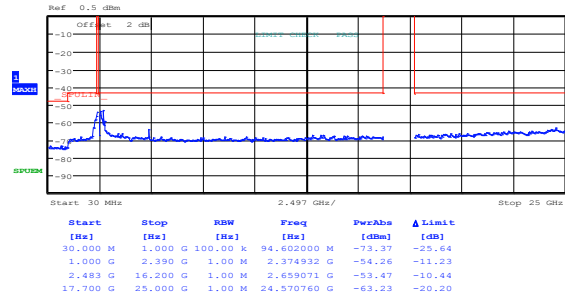


Figure 8.3-28: Conducted spurious emissions within restricted bands for 802.11g, 6 Mbps, mid channel

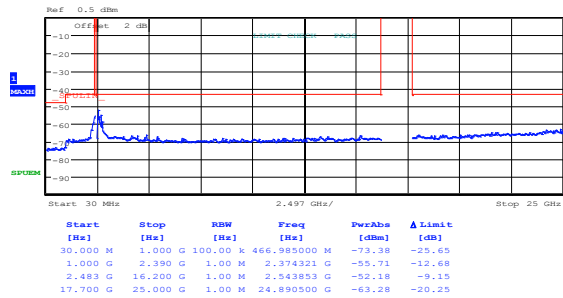


Figure 8.3-29: Conducted spurious emissions within restricted bands for 802.11n HT20, MCS 0, mid channel

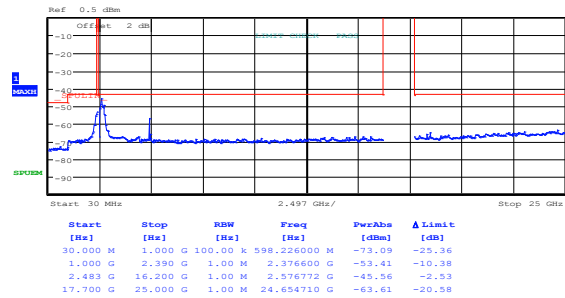


Figure 8.3-30: Conducted spurious emissions within restricted bands for 802.11b, 1 Mbps, high channel

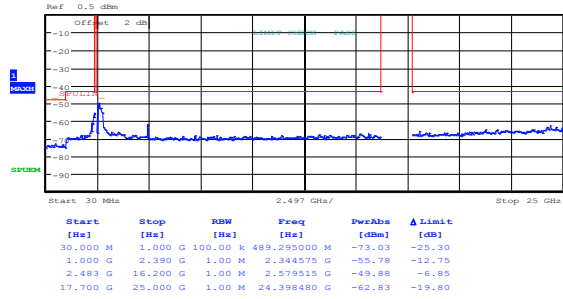


Figure 8.3-31: Conducted spurious emissions within restricted bands for 802.11g, 6 Mbps, high channel

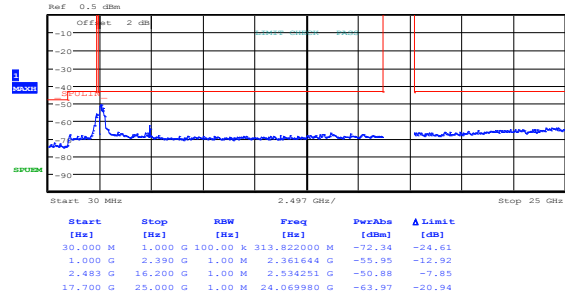


Figure 8.3-32: Conducted spurious emissions within restricted bands for 802.11n HT20, MCS 0, high channel

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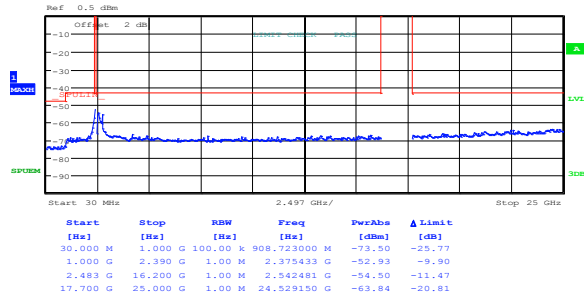


Figure 8.3-33: Conducted spurious emissions within restricted bands for 802.11n HT40, MCS 0, high channel

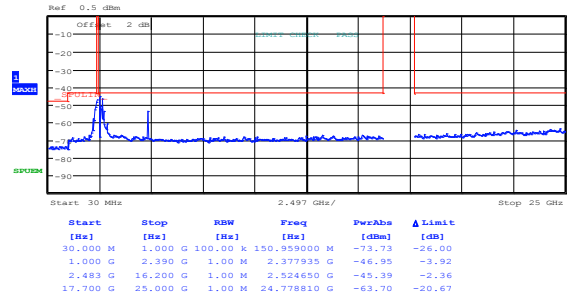


Figure 8.3-34: Conducted spurious emissions within restricted bands for 802.11b, 11 Mbps, low channel

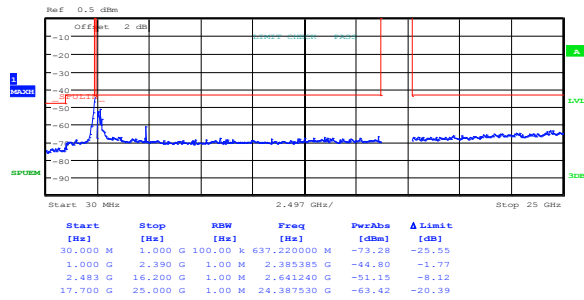


Figure 8.3-35: Conducted spurious emissions within restricted bands for 802.11g, 54 Mbps, low channel

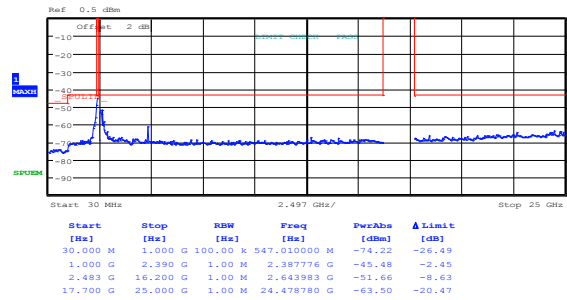


Figure 8.3-36: Conducted spurious emissions within restricted bands for 802.11n HT20, MCS 7, low channel

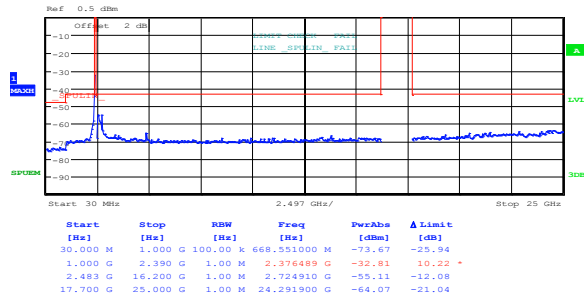


Figure 8.3-37: Conducted spurious emissions within restricted bands for 802.11n HT40, MCS 7, low channel

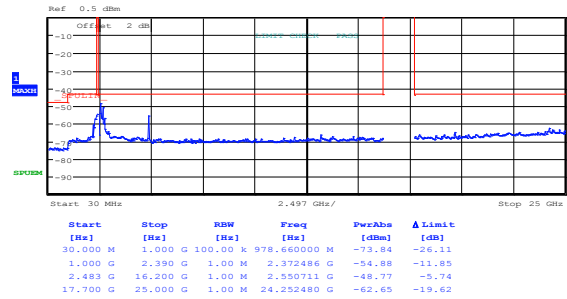


Figure 8.3-38: Conducted spurious emissions within restricted bands for 802.11b, 11 Mbps, mid channel

Note: measurement results indicated in red on the plots above were reassessed further down as band edge emissions.

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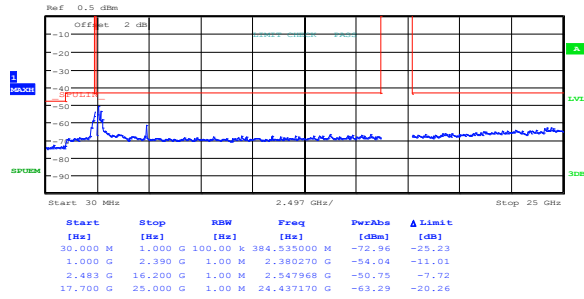


Figure 8.3-39: Conducted spurious emissions within restricted bands for 802.11g, 54 Mbps, mid channel

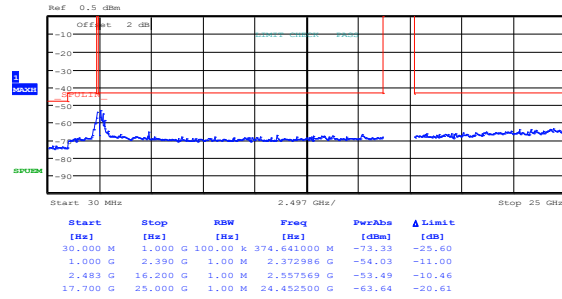


Figure 8.3-40: Conducted spurious emissions within restricted bands for 802.11n HT20, MCS 7, mid channel

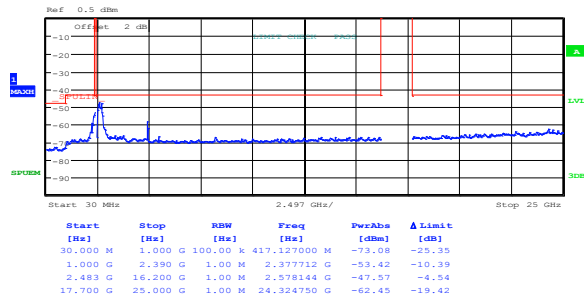


Figure 8.3-41: Conducted spurious emissions within restricted bands for 802.11b, 11 Mbps, high channel

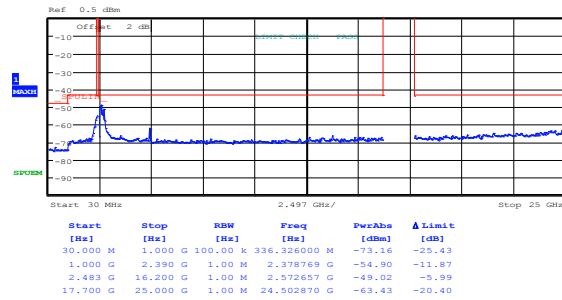


Figure 8.3-42: Conducted spurious emissions within restricted bands for 802.11g, 54 Mbps, high channel

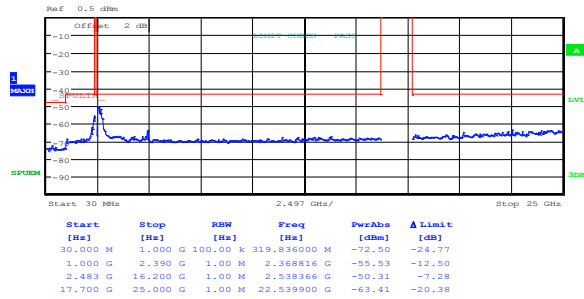


Figure 8.3-43: Conducted spurious emissions within restricted bands for 802.11n HT20, MCS 7, high channel

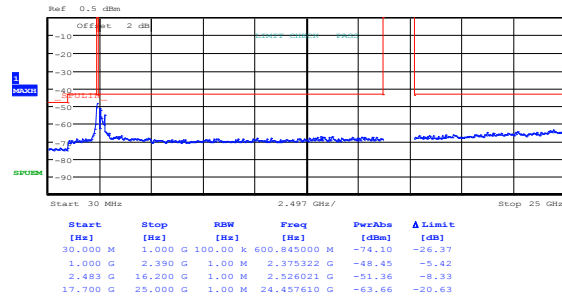
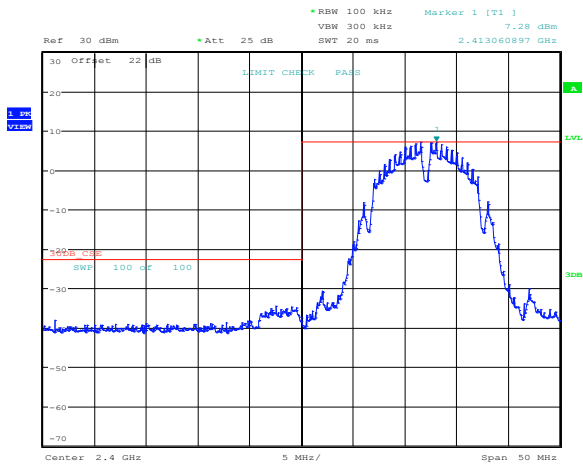


Figure 8.3-44: Conducted spurious emissions within restricted bands for 802.11n HT40, MCS 7, high channel

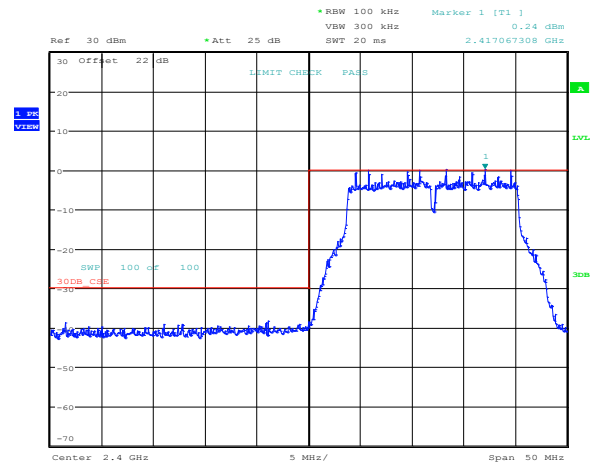
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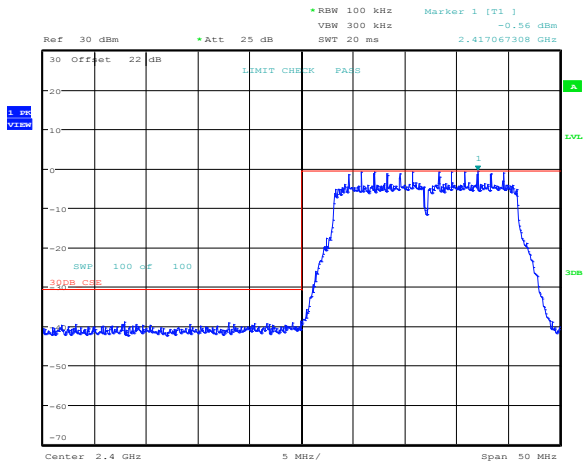
Date: 16.SEP.2014 10:46:32

Figure 8.3-45: Band edge emission outside restricted bands at 2.4 GHz for 802.11b, 1 Mbps



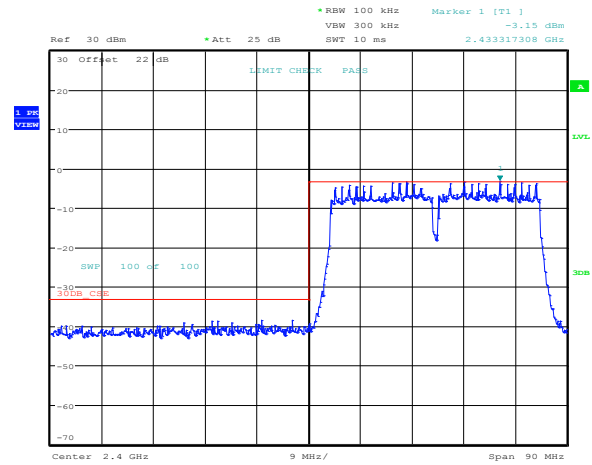
Date: 16.SEP.2014 10:44:35

Figure 8.3-46: Band edge emission outside restricted bands at 2.4 GHz for 802.11g, 6 Mbps



Date: 16.SEP.2014 10:39:33

Figure 8.3-47: Band edge emission outside restricted bands at 2.4 GHz for 802.11n HT20, MCS 0

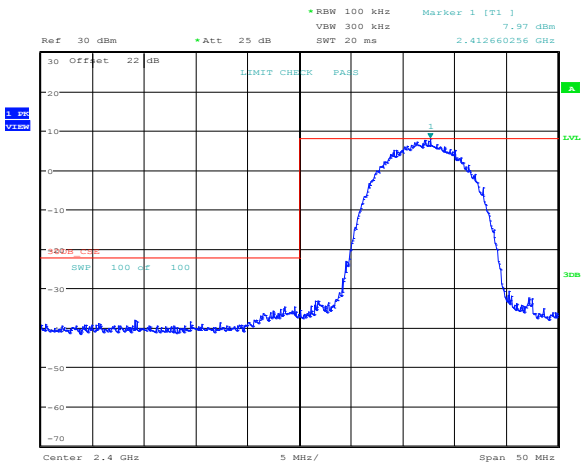


Date: 16.SEP.2014 10:36:13

Figure 8.3-48: Band edge emission outside restricted bands at 2.4 GHz for 802.11n HT40, MCS 0

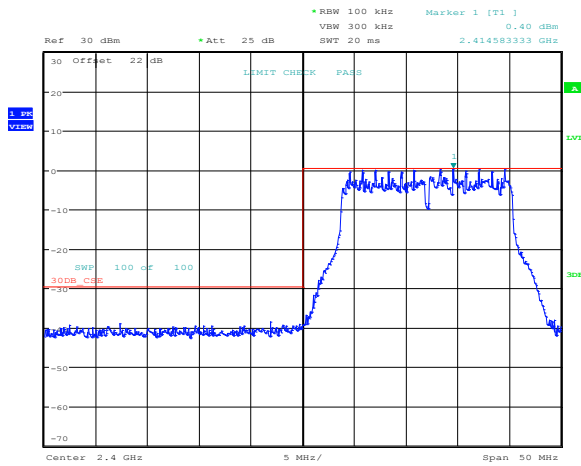
Section 8
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Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



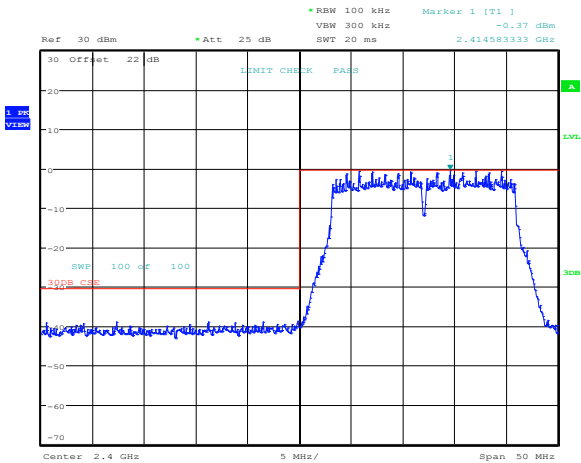
Date: 16.SEP.2014 10:47:55

Figure 8.3-49: Band edge emission outside restricted bands at 2.4 GHz for 802.11b, 11 Mbps



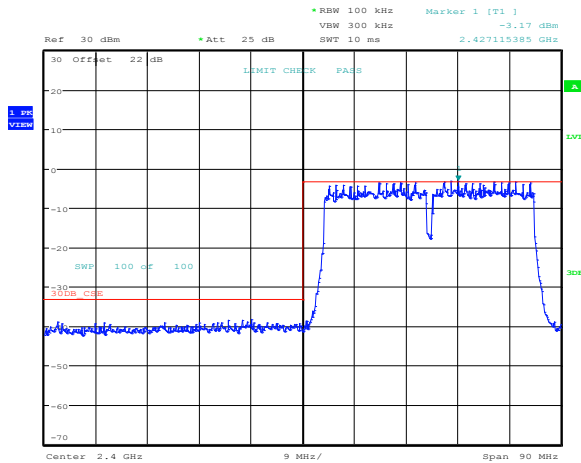
Date: 16.SEP.2014 10:43:45

Figure 8.3-50: Band edge emission outside restricted bands at 2.4 GHz for 802.11g, 54 Mbps



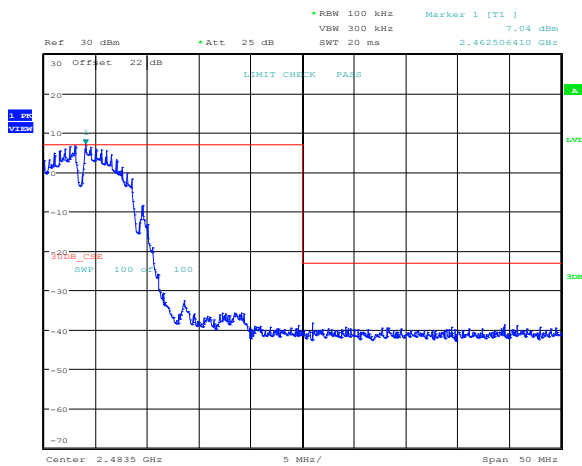
Date: 16.SEP.2014 10:40:18

Figure 8.3-51: Band edge emission outside restricted bands at 2.4 GHz for 802.11n HT20, MCS 7



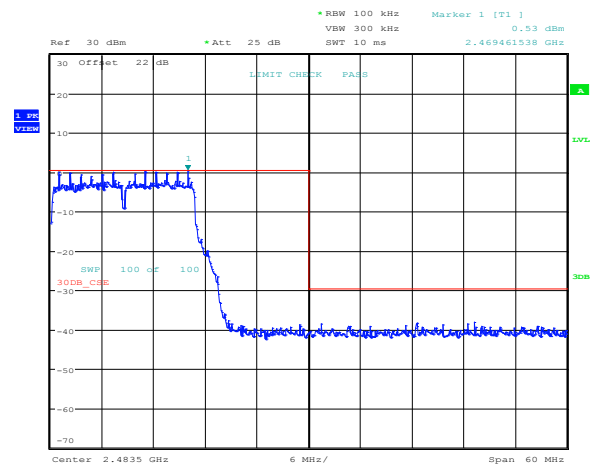
Date: 16.SEP.2014 10:35:30

Figure 8.3-52: Band edge emission outside restricted bands at 2.4 GHz for 802.11n HT40, MCS 7



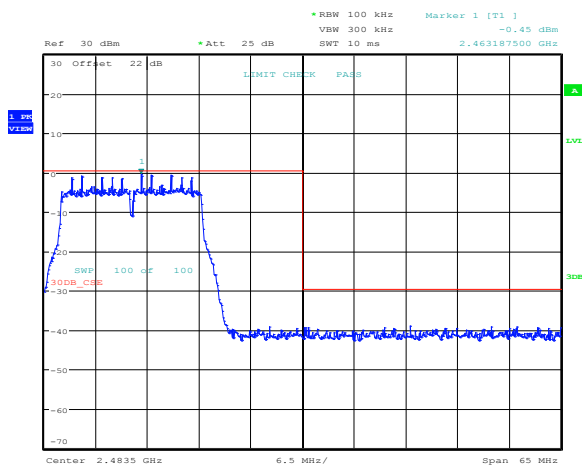
Date: 16.SEP.2014 10:50:55

Figure 8.3-53: Band edge emission outside restricted bands at 2.4835 GHz for 802.11b, 1 Mbps



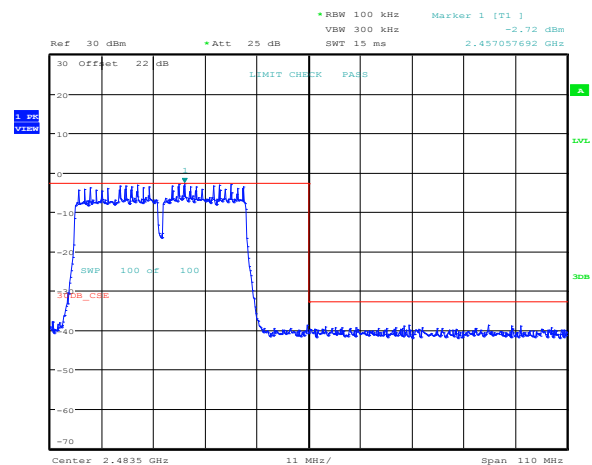
Date: 16.SEP.2014 10:54:46

Figure 8.3-54: Band edge emission outside restricted bands at 2.4835 GHz for 802.11g, 6 Mbps



Date: 16.SEP.2014 10:56:53

Figure 8.3-55: Band edge emission outside restricted bands at 2.4835 GHz
for 802.11n HT20, MCS 0

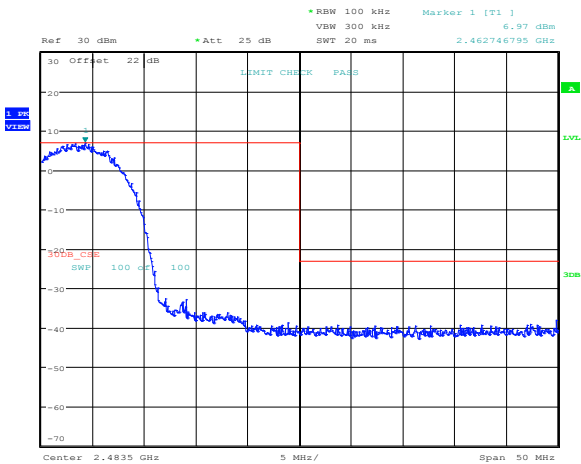


Date: 16.SEP.2014 10:59:33

Figure 8.3-56: Band edge emission outside restricted bands at 2.4835 GHz for 802.11n HT40, MCS 0

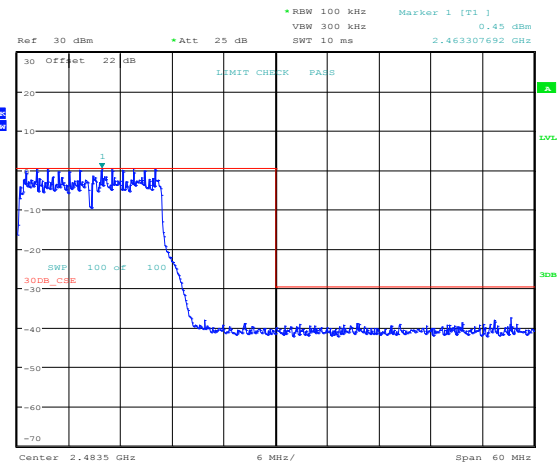
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



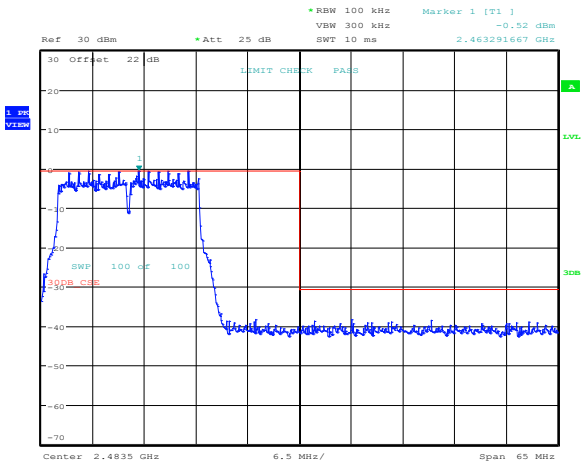
Date: 16.SEP.2014 10:50:19

Figure 8.3-57: Band edge emission outside restricted bands at 2.4835 GHz for 802.11b, 11 Mbps



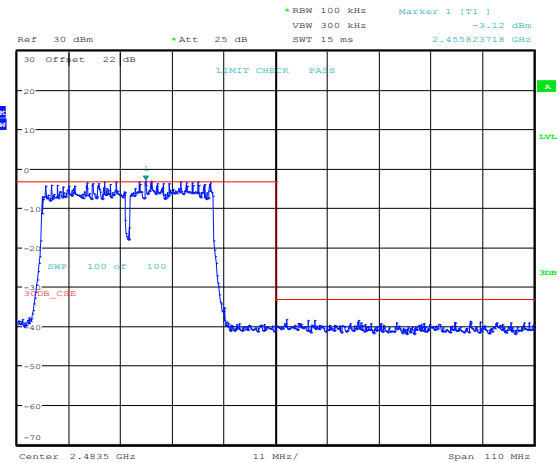
Date: 16.SEP.2014 10:55:38

Figure 8.3-58: Band edge emission outside restricted bands at 2.4835 GHz for 802.11g, 54 Mbps



Date: 16.SEP.2014 10:57:39

Figure 8.3-59: Band edge emission outside restricted bands at 2.4835 GHz for 802.11n HT20, MCS 7

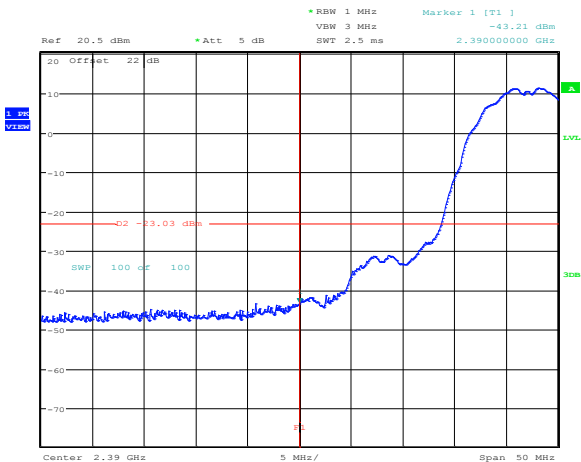


Date: 16.SEP.2014 10:58:55

Figure 8.3-60: Band edge emission outside restricted bands at 2.4835 GHz for 802.11n HT40, MCS 7

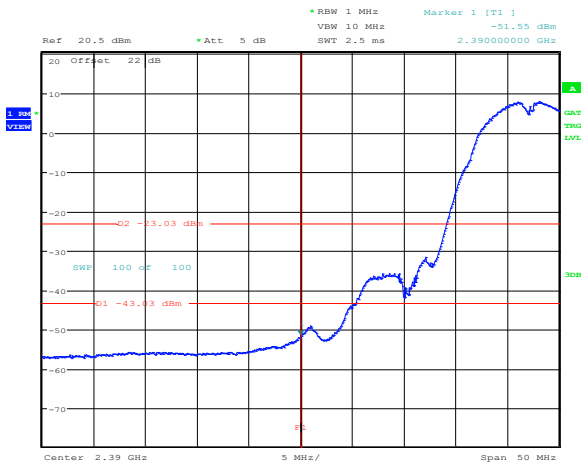
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



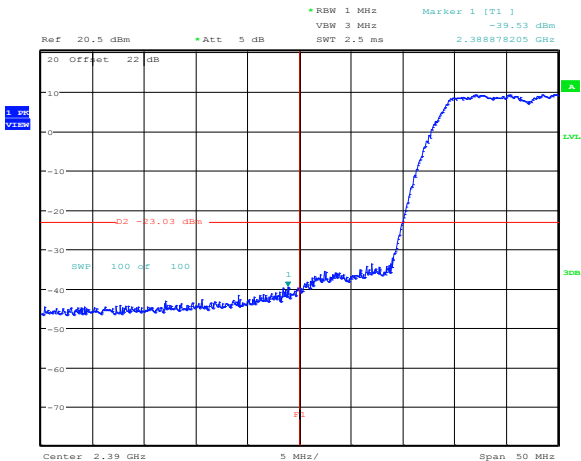
Date: 16.SEP.2014 14:49:59

Figure 8.3-61: Band edge emission within restricted bands at 2.4 GHz for 802.11b, 1 Mbps, peak



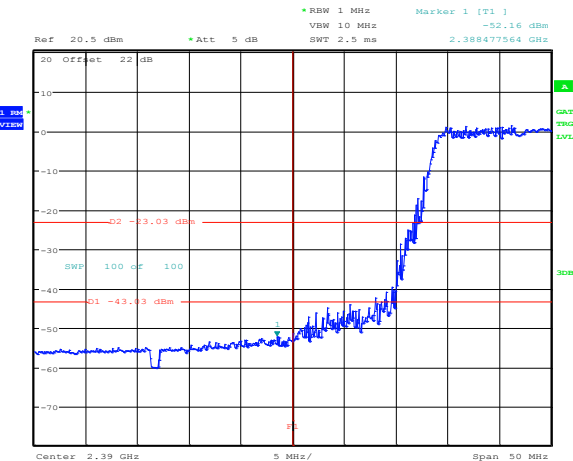
Date: 16.SEP.2014 14:53:16

Figure 8.3-62: Band edge emission within restricted bands at 2.4 GHz for 802.11b, 1 Mbps, average



Date: 16.SEP.2014 15:16:44

Figure 8.3-63: Band edge emission within restricted bands at 2.4 GHz for 802.11g, 6 Mbps, peak



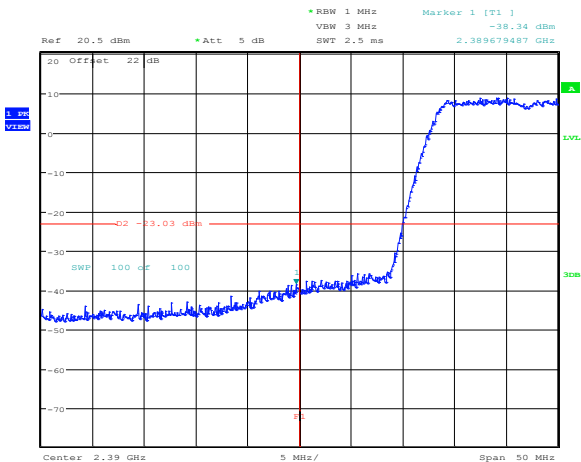
Date: 16.SEP.2014 14:59:56

Figure 8.3-64: Band edge emission within restricted bands at 2.4 GHz for 802.11g, 6 Mbps, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

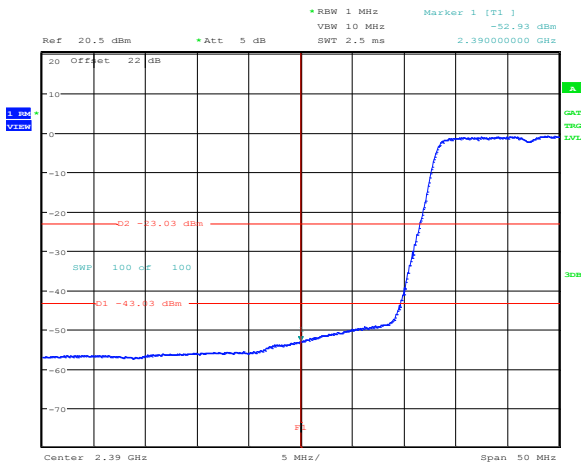
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



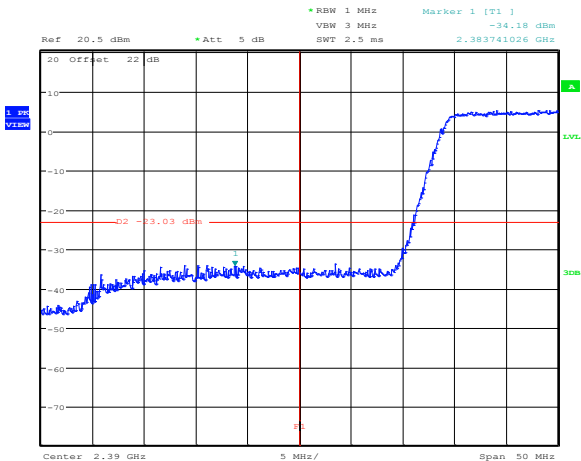
Date: 16.SEP.2014 15:14:20

Figure 8.3-65: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT20, MCS 0, peak



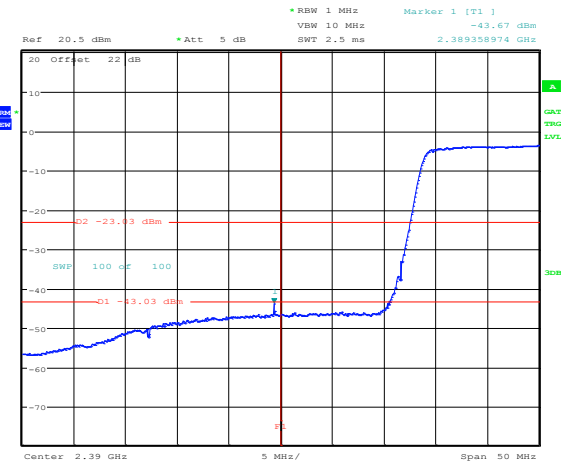
Date: 16.SEP.2014 15:08:22

Figure 8.3-66: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT20, MCS 0, average



Date: 16.SEP.2014 14:38:21

Figure 8.3-67: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT40, MCS 0, peak



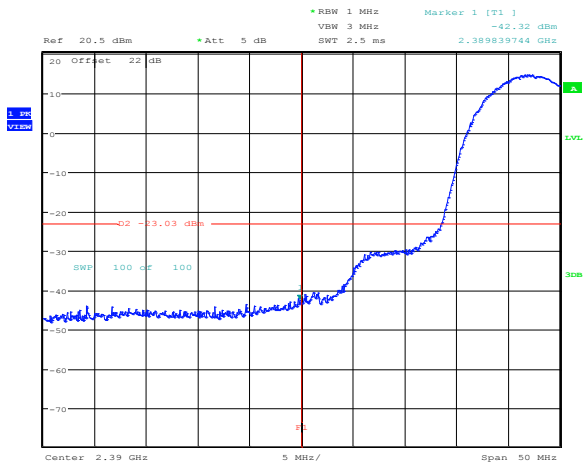
Date: 16.SEP.2014 14:39:52

Figure 8.3-68: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT40, MCS 0, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

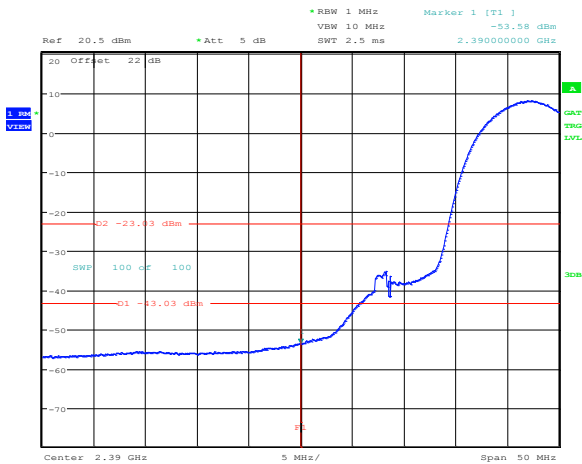
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



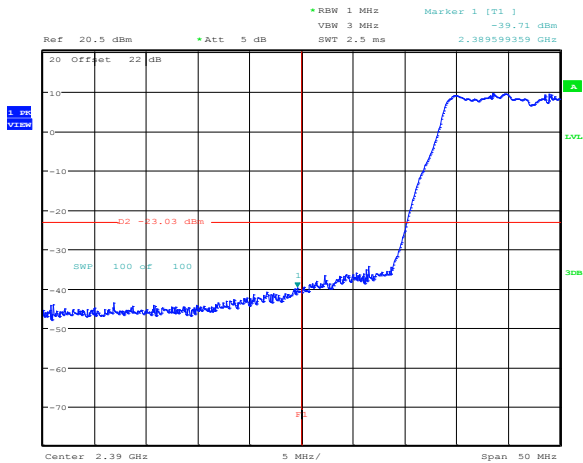
Date: 16.SEP.2014 14:51:15

Figure 8.3-69: Band edge emission within restricted bands at 2.4 GHz for 802.11b, 11 Mbps, peak



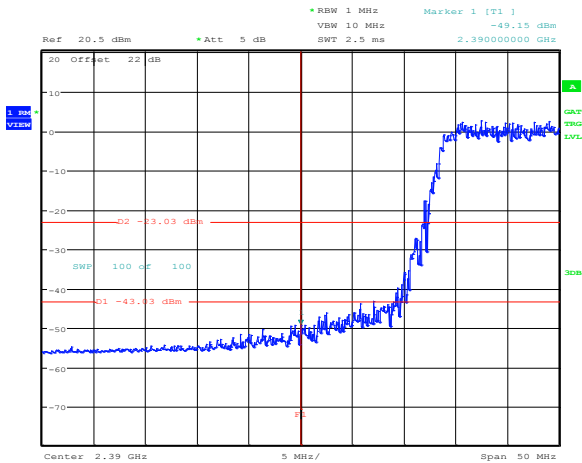
Date: 16.SEP.2014 14:52:12

Figure 8.3-70: Band edge emission within restricted bands at 2.4 GHz for 802.11b, 11 Mbps, average



Date: 16.SEP.2014 15:17:21

Figure 8.3-71: Band edge emission within restricted bands at 2.4 GHz for 802.11g, 54 Mbps, peak



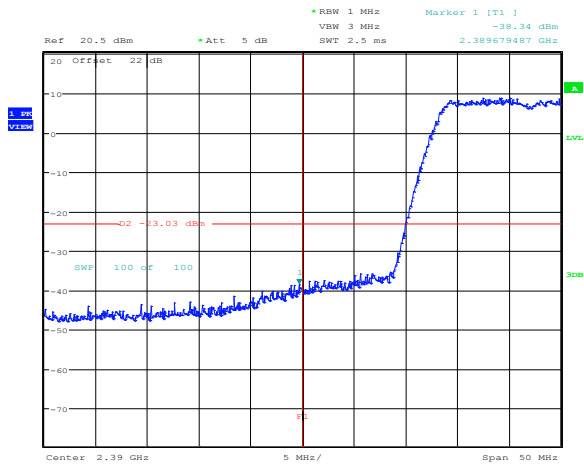
Date: 16.SEP.2014 14:58:25

Figure 8.3-72: Band edge emission within restricted bands at 2.4 GHz for 802.11g, 54 Mbps, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

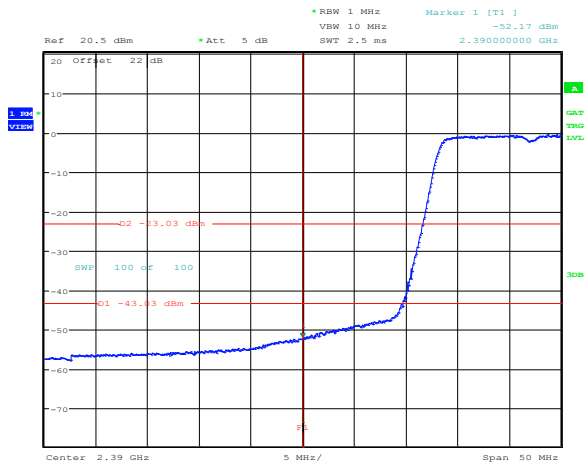
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



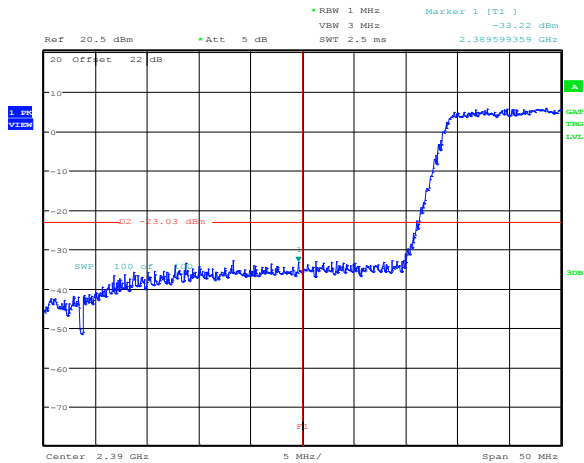
Date: 16.SEP.2014 15:14:20

Figure 8.3-73: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT20, MCS 7, peak



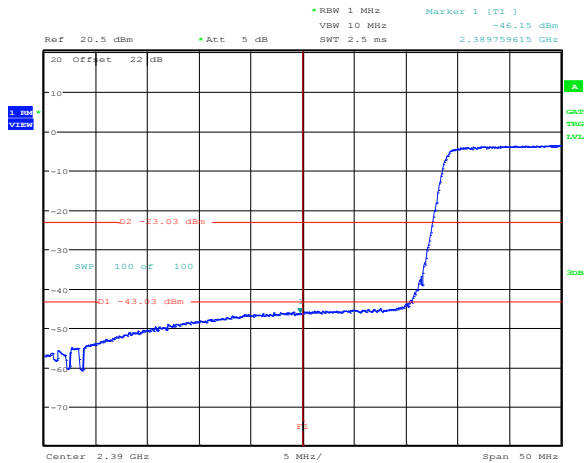
Date: 16.SEP.2014 15:10:27

Figure 8.3-74: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT20, MCS 7, average



Date: 16.SEP.2014 14:42:02

Figure 8.3-75: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT40, MCS 7, peak



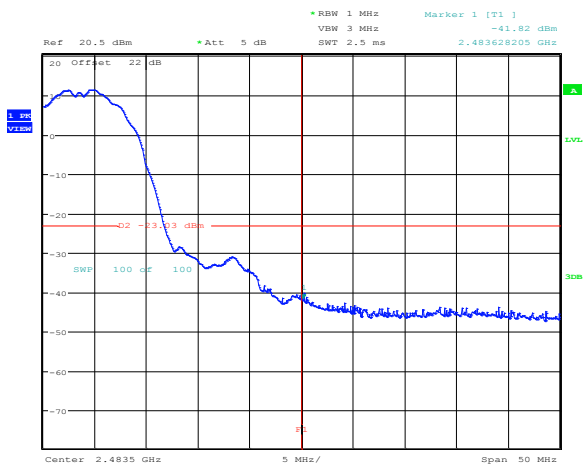
Date: 16.SEP.2014 14:41:28

Figure 8.3-76: Band edge emission within restricted bands at 2.4 GHz for 802.11n HT40, MCS 7, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

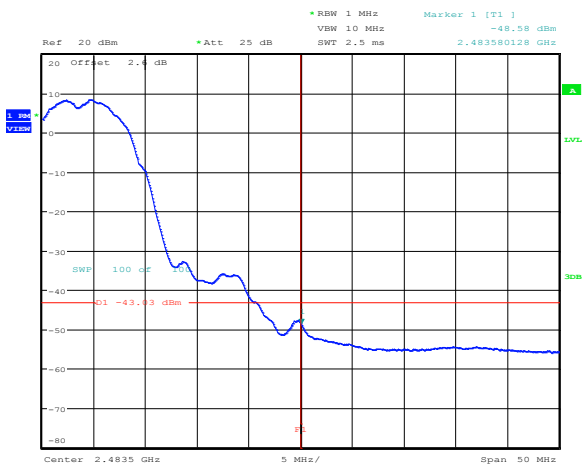
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



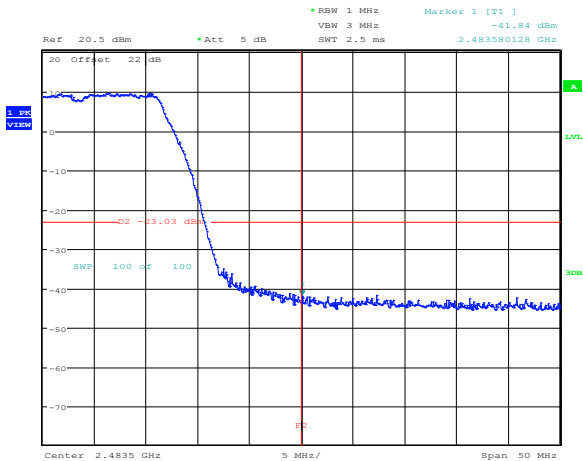
Date: 16.SEP.2014 14:49:05

Figure 8.3-77: Band edge emission within restricted bands at 2.4835 GHz for 802.11b, 1 Mbps, peak



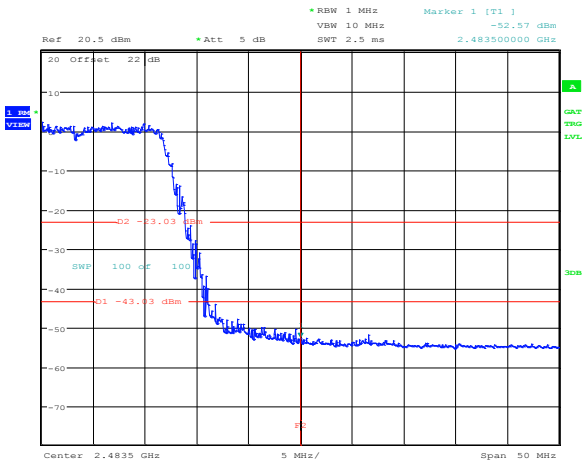
Date: 24.SEP.2014 15:43:38

Figure 8.3-78: Band edge emission within restricted bands at 2.4835 GHz for 802.11b, 1 Mbps, average



Date: 16.SEP.2014 15:18:54

Figure 8.3-79: Band edge emission within restricted bands at 2.4835 GHz for 802.11g, 6 Mbps, peak



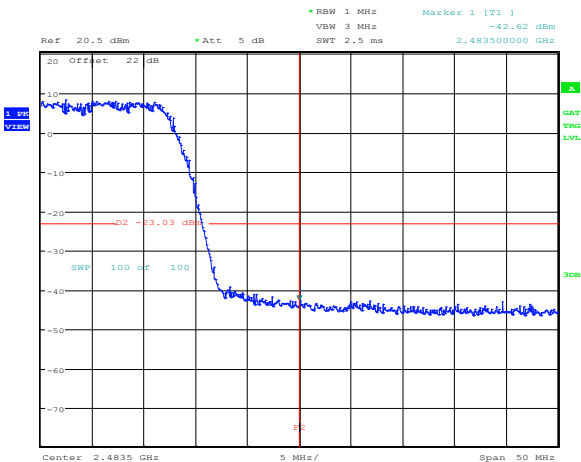
Date: 16.SEP.2014 14:56:31

Figure 8.3-80: Band edge emission within restricted bands at 2.4835 GHz for 802.11g, 6 Mbps, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

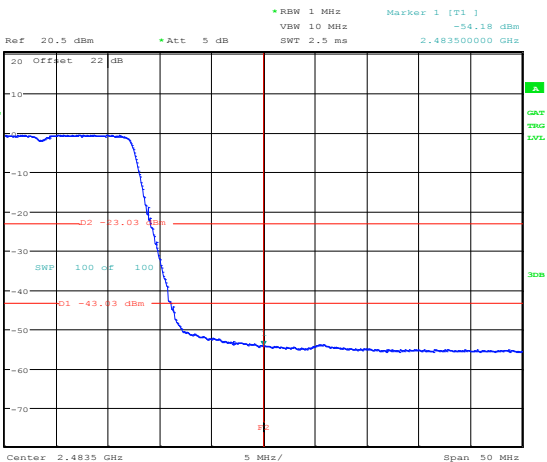
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



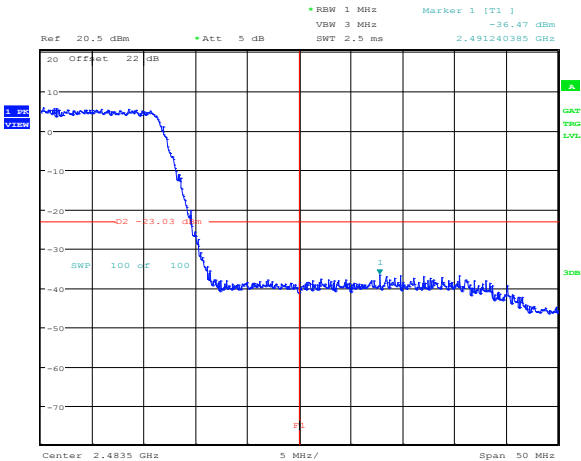
Date: 16.SEP.2014 15:12:44

Figure 8.3-81: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT20, MCS 0, peak



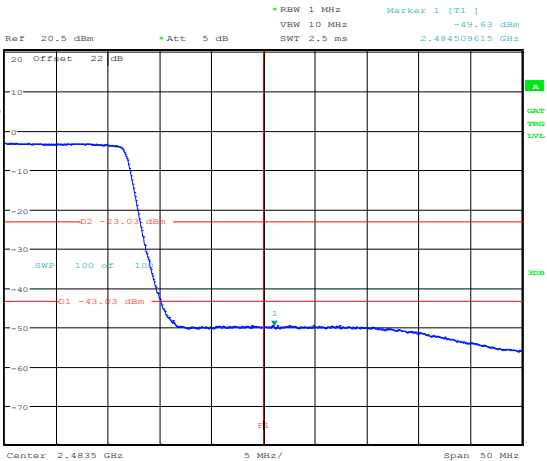
Date: 16.SEP.2014 15:12:01

Figure 8.3-82: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT20, MCS 0, average



Date: 16.SEP.2014 14:46:08

Figure 8.3-83: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT40, MCS 0, peak



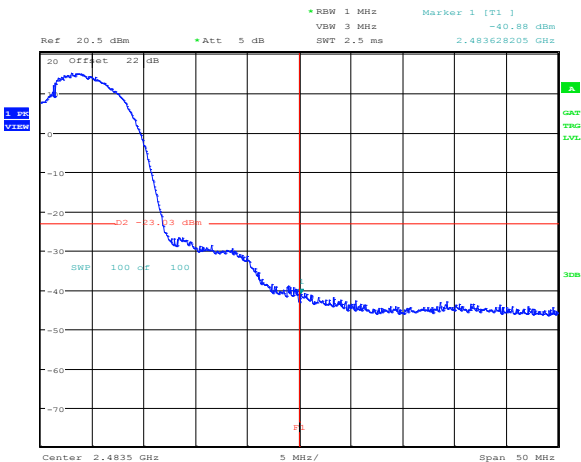
Date: 16.SEP.2014 14:45:33

Figure 8.3-84: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT40, MCS 0, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

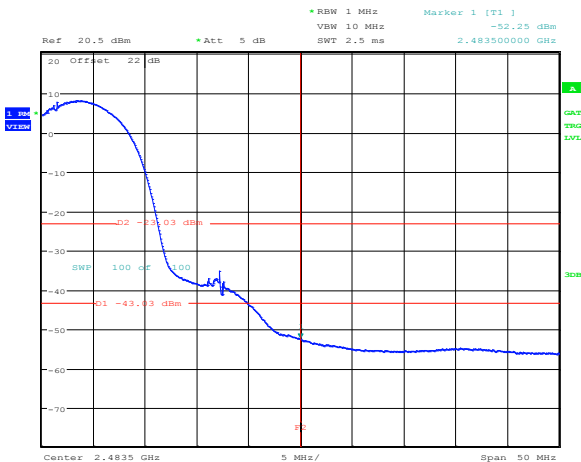
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



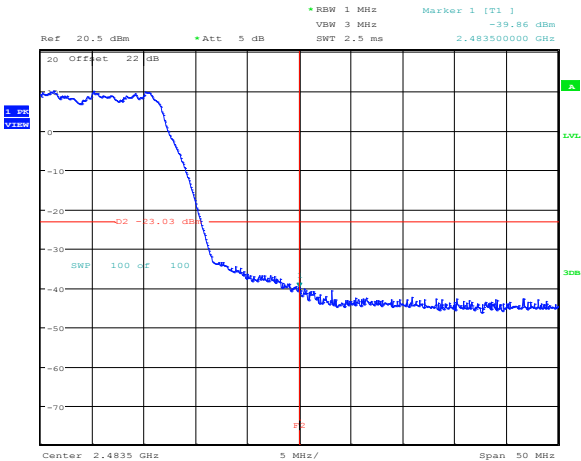
Date: 16.SEP.2014 14:48:08

Figure 8.3-85: Band edge emission within restricted bands at 2.4835 GHz for 802.11b, 11 Mbps, peak



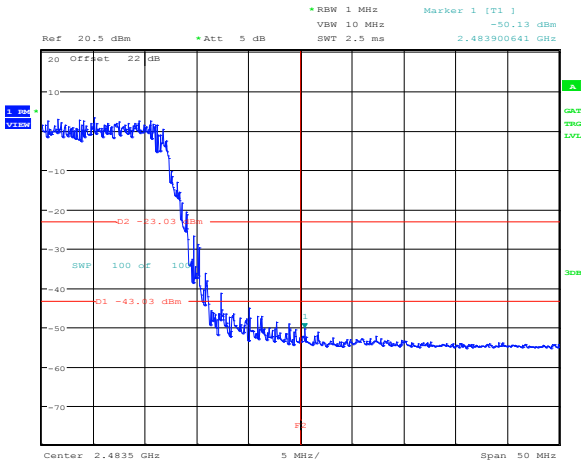
Date: 16.SEP.2014 14:54:54

Figure 8.3-86: Band edge emission within restricted bands at 2.4835 GHz for 802.11b, 11 Mbps, average



Date: 16.SEP.2014 15:18:14

Figure 8.3-87: Band edge emission within restricted bands at 2.4835 GHz for 802.11g, 54 Mbps, peak



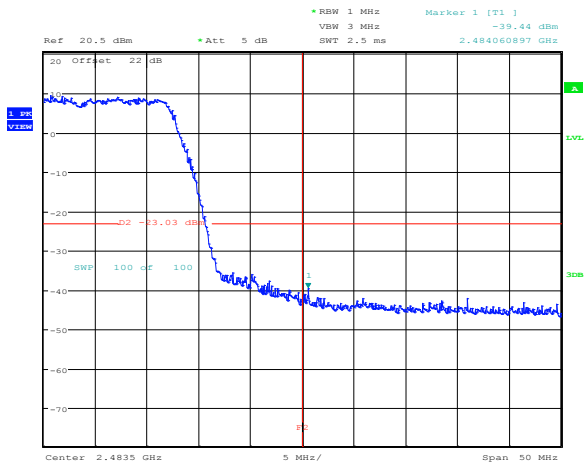
Date: 16.SEP.2014 14:57:25

Figure 8.3-88: Band edge emission within restricted bands at 2.4835 GHz for 802.11g, 54 Mbps, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

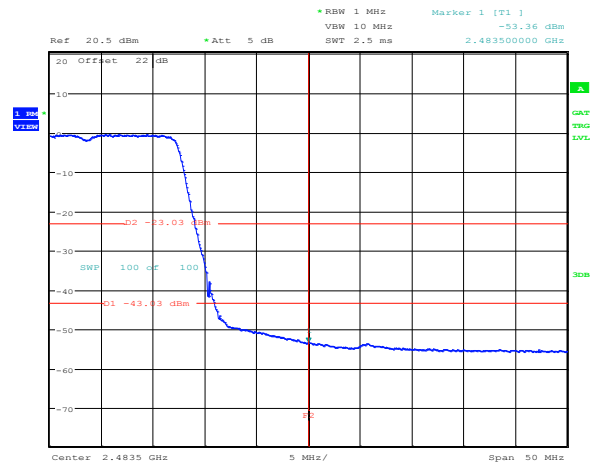
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



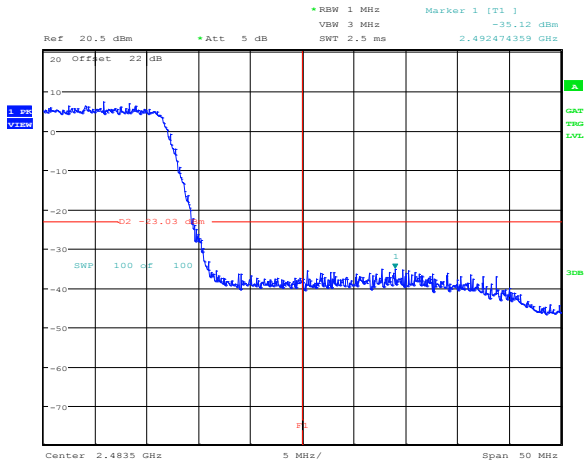
Date: 16.SEP.2014 15:13:23

Figure 8.3-89: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT20, MCS 7, peak



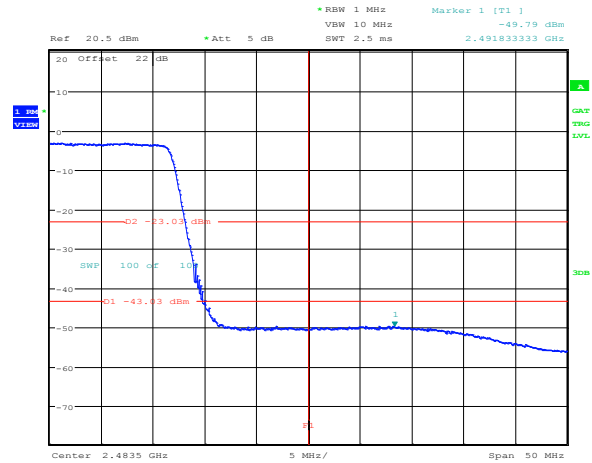
Date: 16.SEP.2014 15:11:17

Figure 8.3-90: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT20, MCS 7, average



Date: 16.SEP.2014 14:43:21

Figure 8.3-91: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT40, MCS 7, peak



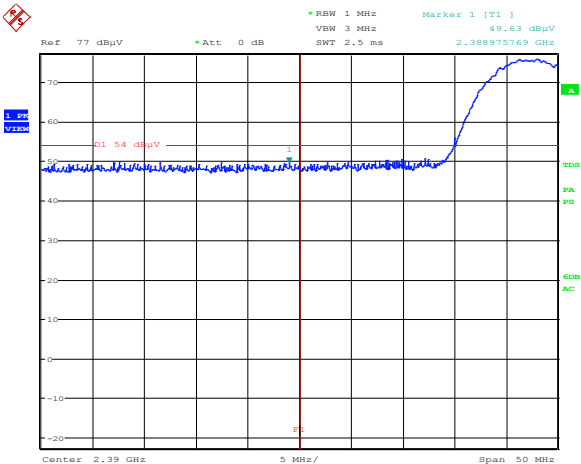
Date: 16.SEP.2014 14:44:32

Figure 8.3-92: Band edge emission within restricted bands at 2.4835 GHz for 802.11n HT40, MCS 7, average

Note: Peak limit is -22.06 dBm and the average limit is -42.06 dBm

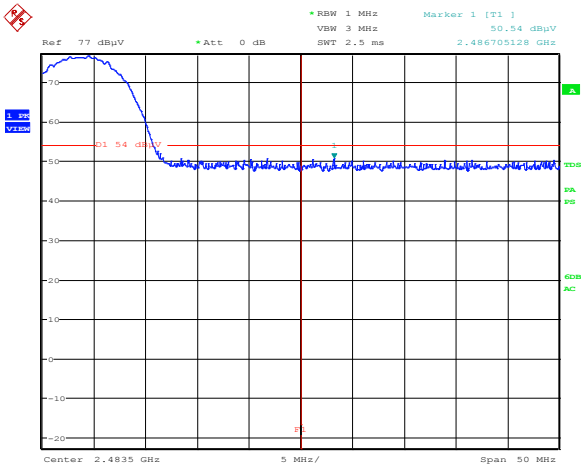
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



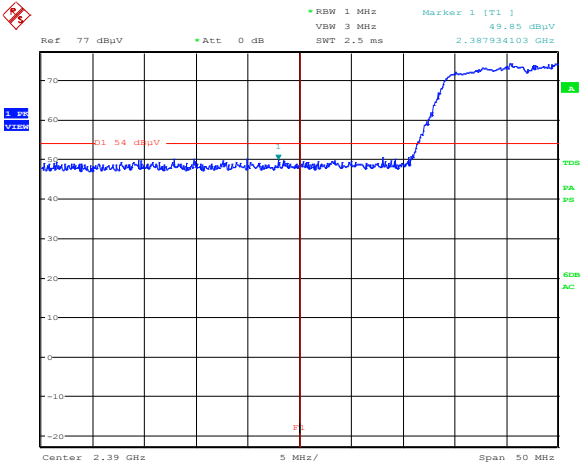
Date: 2.OCT.2014 16:44:03

Figure 8.3-93: Cabinet radiation at the restricted band edge at 2.39 GHz for 802.11b



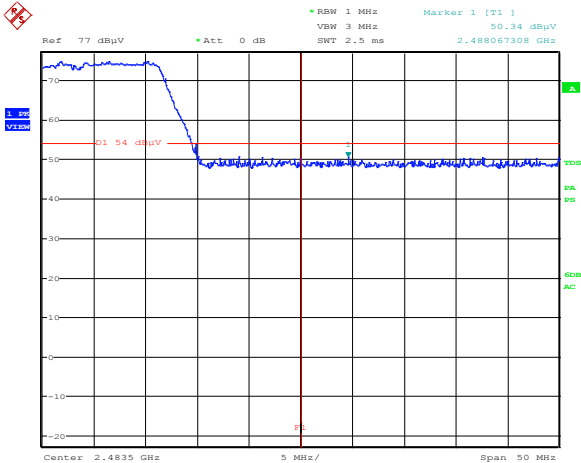
Date: 2.OCT.2014 16:52:46

Figure 8.3-94: Cabinet radiation at the restricted band edge at 2.4835 GHz for 802.11b



Date: 2.OCT.2014 16:45:19

Figure 8.3-95: Cabinet radiation at the restricted band edge at 2.39 GHz for 802.11g



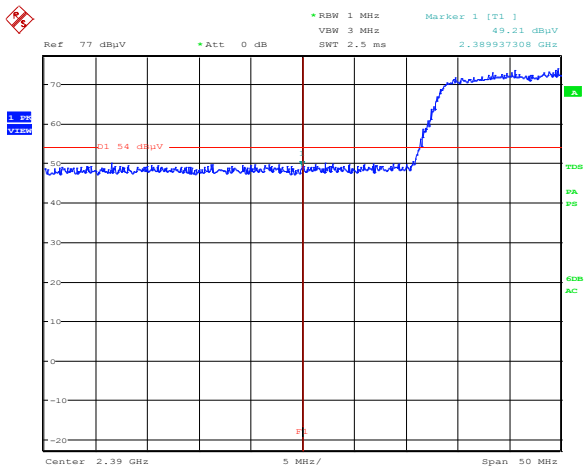
Date: 2.OCT.2014 16:51:38

Figure 8.3-96: Cabinet radiation at the restricted band edge at 2.4835 GHz for 802.11g

Note: Average measurements were not performed because Peak measurements performed comply with average limit.

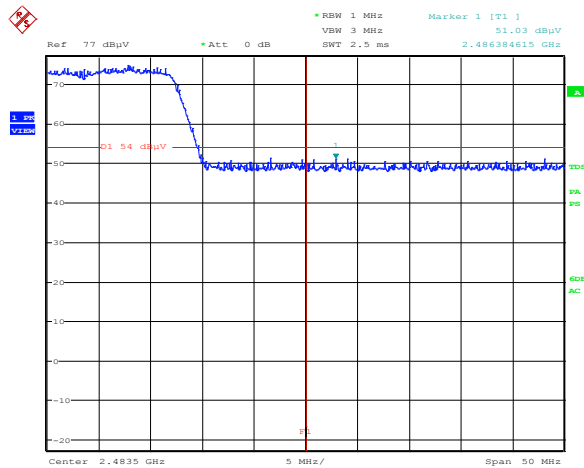
Section 8
Test name
Specification

Testing data
FCC 15.247(d) Spurious (out-of-band) emissions
FCC Part 15 Subpart C



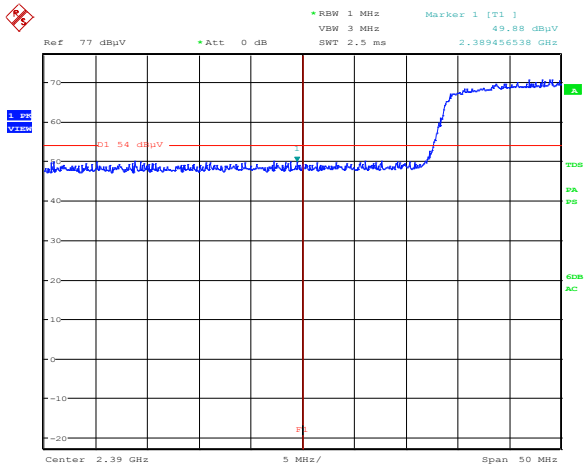
Date: 2.OCT.2014 16:46:32

Figure 8.3-97: Cabinet radiation at the restricted band edge at 2.39 GHz for 802.11n HT20



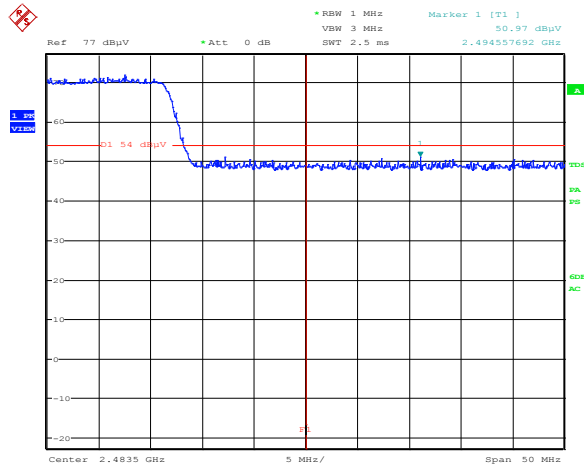
Date: 2.OCT.2014 16:50:26

Figure 8.3-98: Cabinet radiation at the restricted band edge at 2.4835 GHz for 802.11n HT20



Date: 2.OCT.2014 16:47:42

Figure 8.3-99: Cabinet radiation at the restricted band edge at 2.39 GHz for 802.11n HT40



Date: 2.OCT.2014 16:48:51

Figure 8.3-100: Cabinet radiation at the restricted band edge at 2.4835 GHz for 802.11n HT40

Note: Average measurements were not performed because Peak measurements performed comply with average limit.

8.4 FCC 15.247(e) Power spectral density for digitally modulated devices

8.4.1 Definitions and limits

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

8.4.2 Test summary

Test date	September 16, 2014	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	32 %

8.4.3 Observations, settings and special notes

The test was performed using method described in section 10.3 Method AVGPSD-1 (trace averaging with EUT transmitting at full power throughout each sweep). Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	1 MHz
Detector mode	RMS
Trace mode	Power average
Averaging sweeps number	100

8.4.4 Test data

Table 8.4-1: PSD measurements results for 802.11b

Frequency, MHz	Data rate	PSD, dBm/100 kHz	PSD limit, dBm/3 kHz	Margin, dB
2412	1 Mbps	-1.40	8.00	-9.40
2412	11 Mbps	-1.59	8.00	-9.59
2437	1 Mbps	-1.16	8.00	-9.16
2437	11 Mbps	-1.81	8.00	-9.81
2462	1 Mbps	-1.17	8.00	-9.17
2462	11 Mbps	-1.19	8.00	-9.19

Table 8.4-2: PSD measurements results for 802.11g

Frequency, MHz	Data rate	PSD, dBm/100 kHz	PSD limit, dBm/3 kHz	Margin, dB
2412	6 Mbps	-7.57	8.00	-15.57
2412	54 Mbps	-7.24	8.00	-15.24
2437	6 Mbps	-7.15	8.00	-15.15
2437	54 Mbps	-7.09	8.00	-15.09
2462	6 Mbps	-6.70	8.00	-14.70
2462	54 Mbps	-5.95	8.00	-13.95

Table 8.4-3: PSD measurements results for 802.11n HT20

Frequency, MHz	Data rate	PSD, dBm/100 kHz	PSD limit, dBm/3 kHz	Margin, dB
2412	MCS 0	-9.70	8.00	-17.70
2412	MCS 7	-9.41	8.00	-17.41
2437	MCS 0	-9.09	8.00	-17.09
2437	MCS 7	-9.22	8.00	-17.22
2462	MCS 0	-9.17	8.00	-17.17
2462	MCS 7	-9.05	8.00	-17.05

Table 8.4-4: PSD measurements results for 802.11n HT40

Frequency, MHz	Data rate	PSD, dBm/100 kHz	PSD limit, dBm/3 kHz	Margin, dB
2422	MCS 0	-12.58	8.00	-20.58
2422	MCS 7	-11.03	8.00	-19.03
2452	MCS 0	-12.28	8.00	-20.28
2452	MCS 7	-10.20	8.00	-18.20

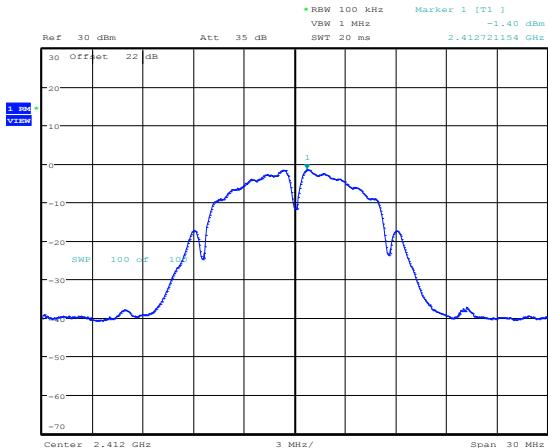


Figure 8.4-1: PSD sample plot on 802.11b

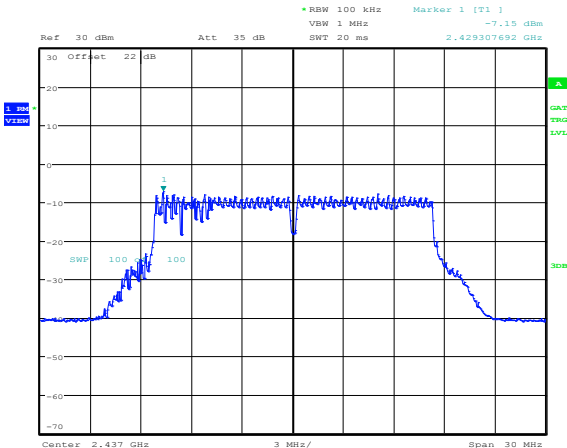
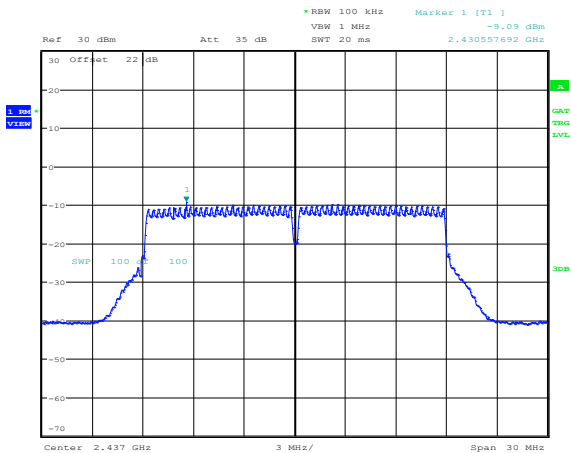
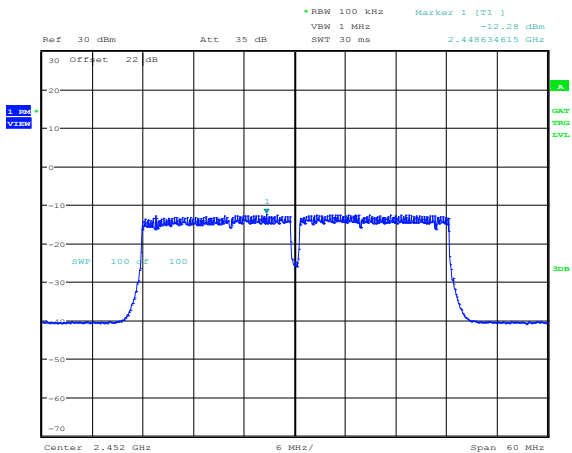


Figure 8.4-2: PSD sample plot on 802.11g



Date: 16.SEP.2014 10:18:13

Figure 8.4-3: PSD sample plot on 802.11n HT20

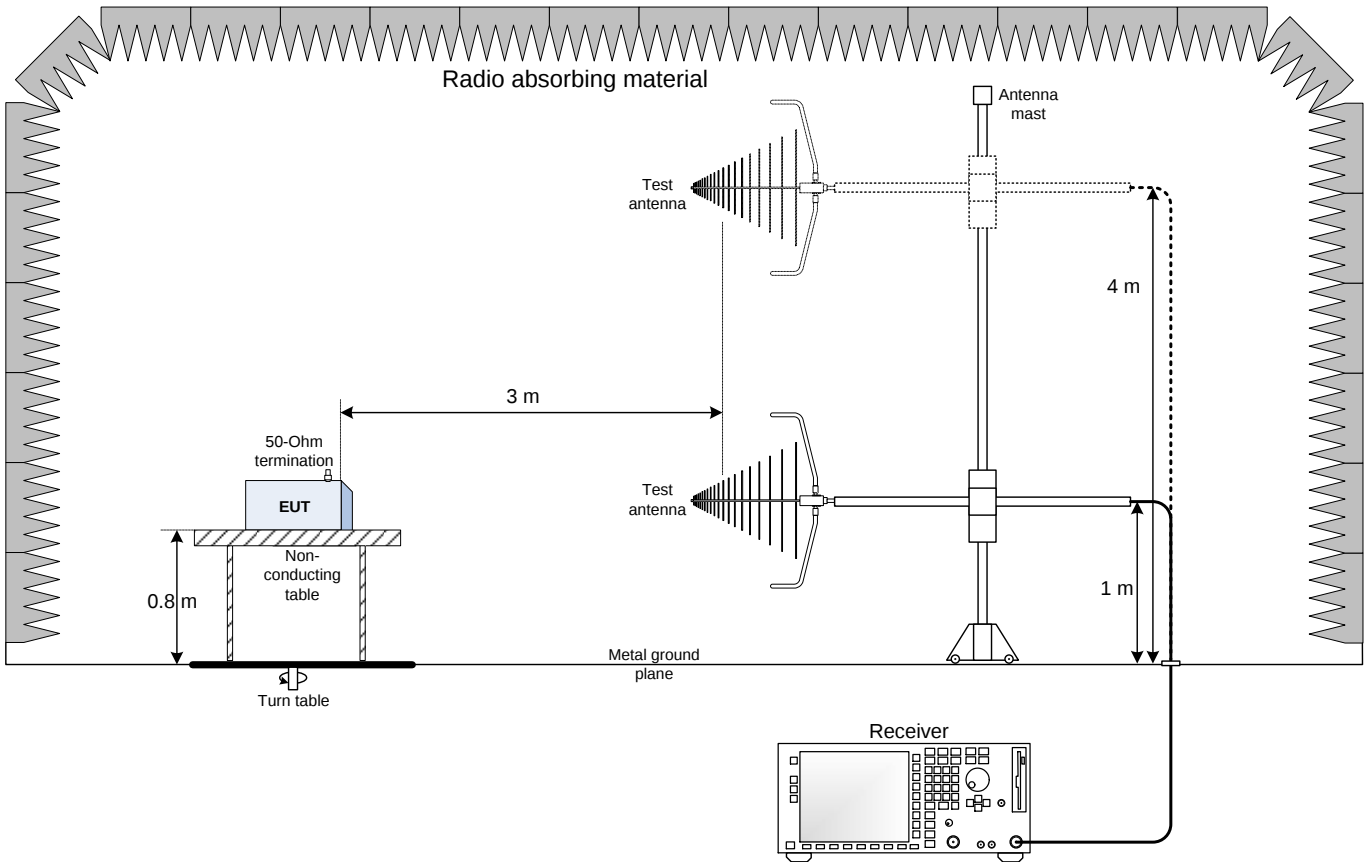


Date: 16.SEP.2014 10:23:07

Figure 8.4-4: PSD sample plot on 802.11n HT40

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Antenna terminal set-up

