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Test report

268950-3TRFWL

Date of issue: March 23, 2015

Applicant:

TableTop Media

Product:

ZIOSK

Model:

Z400

FCC ID:

XOX-Z400

Specifications:

- FCC 47 CFR Part 15 Subpart E, §15.407

  Unlicensed National Information Infrastructure Devises

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: 176392 (3 m semi anechoic chamber)

Tested by	Andrey Adelberg, Senior Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	March 23, 2015
Signature of the reviewer	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

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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 E, Clause 15.407	Unlicensed National Information Infrastructure Devises

1.3 Test methods

789033 D02 General UNII Test Procedures New Rules v01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
905462 D02 UNII DFS Compliance Procedures New Rules v01r01	Compliance measurement procedures for Unlicensed-National Information Infrastructure devices operating in the 5250–5350 MHz and 5470–5725 MHz bands incorporating dynamic frequency selection
905462 D02 Client Without DFS New Rules v01r01	U-NII client devices without radar detection capability

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

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

See “Summary of test results” for full details.

1.5 Exclusions

None

1.6 Test report revision history

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

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable[1]
§15.31(e)	Variation of power source	Pass[2]
§15.203	Antenna requirement	Pass[3]

Notes: [1]The EUT is a battery powered device

[2]The tests were performed with fully charged batteries

[3]The 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	Pass
§15.407(a)(1)	5.15–5.25 GHz band power and density limits	Not applicable
§15.407(a)(2)	5.25–5.35 GHz and 5.47–5.725 GHz bands power and density limits	Pass
§15.407(a)(3)	5.725–5.85 GHz band power and density limits	Not applicable
§15.407(b)(1)	5.15–5.25 GHz band undesired emission limits	Not applicable
§15.407(b)(2)	5.25–5.35 GHz band undesired emission limits	Pass
§15.407(b)(3)	5.47–5.725 GHz band undesired emission limits	Not applicable
§15.407(b)(4)	5.725–5.85 GHz band undesired emission limits	Not applicable
§15.407(e)	Minimum 6 dB bandwidth within the 5.725–5.85 GHz bandh	Not applicable
§15.407(g)	Frequency stability	Pass
§15.407(h)(1)	Transmit power control (TPC) for 5.25–5.35 GHz and 5.47–5.725 GHz bands	Not applicable[1]
§15.407(h)(2)	Dynamic Frequency Selection (DFS) for 5.25–5.35 GHz and 5.47–5.725 GHz bands	Pass

Note: [1]EUT maximum EIRP is less than 500 mW (24 dBm), therefore a TPC mechanism is not required

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	5250–5350 MHz
Operating frequencies	20 MHz channels: 5260–5320 MHz; 40 MHz channels: 5270–5310 MHz; 80 MHz channel: 5290 MHz
Modulation type	802.11a: 6–54 Mbps; 802.11n HT20: MCS 0–7; 802.11n HT40: MCS 0–7; 802.11ac VHT40: MCS 0–9; 802.11ac VHT80: MCS 0–9
Occupied bandwidth (99 %)	17.31 MHz (802.11a); 18.37 MHz (802.11n HT20); 36.62 MHz (802.11n HT40 and 802.11ac VHT40); 76.12 MHz (802.11ac VHT80)
Emission designator	W7D
Power requirements	7.4 V_{DC} Lithium battery
Antenna information	1.31 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

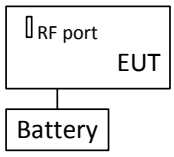


Figure 3.6-1: *Setup diagram*

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 ±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
Temperature chamber	Thermotron	SM-16C	FA001030	1 year	NCR
Multimeter	Fluke	16	FA001831	1 year	Feb. 04/15

Note: NCR - no calibration required

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	October 16, 2014	Temperature	21 °C
Test engineer	Andrey Adelberg	Air pressure	1007 mbar
Verdict	Pass	Relative humidity	31 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth for 26 dB BW test	300 kHz for channels up to 40 MHz; 1 MHz for 80 MHz channel
Resolution bandwidth for 99% OBW test	300 kHz for 20 MHz channel; 500 kHz for 40 MHz channel; 1 MHz for 80 MHz channel
Video bandwidth	≥3 × RBW
Frequency span for 26 dB BW test	30 MHz for 20 MHz channel; 60 MHz for 40 MHz channel; 100 MHz for 80 MHz channel
Frequency span for 99% OBW test	30 MHz for 20 MHz channel; 50 MHz for 40 MHz channel; 100 MHz for 80 MHz channel
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Table 8.1-1: *Occupied bandwidth results for 802.11a*

Frequency, MHz	Data rate	26 dB bandwidth, MHz	99% bandwidth, MHz
5260	6 Mbps	21.92	17.31
5260	54 Mbps	21.35	16.78
5300	6 Mbps	21.83	17.26
5300	54 Mbps	21.39	16.78
5320	6 Mbps	21.83	17.31
5320	54 Mbps	21.39	16.78

Table 8.1-2: *Occupied bandwidth results for 802.11n HT20*

Frequency, MHz	Data rate	26 dB bandwidth, MHz	99% bandwidth, MHz
5260	MCS 0	22.02	18.37
5260	MCS 7	21.83	18.08
5300	MCS 0	22.02	18.32
5300	MCS 7	21.73	18.13
5320	MCS 0	22.12	18.32
5320	MCS 7	21.73	18.13

Table 8.1-3: *Occupied bandwidth results for 802.11n HT40*

Frequency, MHz	Data rate	26 dB bandwidth, MHz	99% bandwidth, MHz
5270	MCS 0	39.90	36.62
5270	MCS 7	39.42	36.46
5310	MCS 0	40.10	36.62
5310	MCS 7	39.62	36.46

Table 8.1-4: *Occupied bandwidth results for 802.11ac VHT40*

Frequency, MHz	Data rate	26 dB bandwidth, MHz	99% bandwidth, MHz
5270	MCS 0	40.19	36.62
5270	MCS 9	39.71	36.54
5310	MCS 0	40.00	36.62
5310	MCS 9	39.62	36.54

Table 8.1-5: *Occupied bandwidth results for 802.11ac VHT80*

Frequency, MHz	Data rate	26 dB bandwidth, MHz	99% bandwidth, MHz
5290	MCS 0	82.85	76.12
5290	MCS 9	82.21	76.12

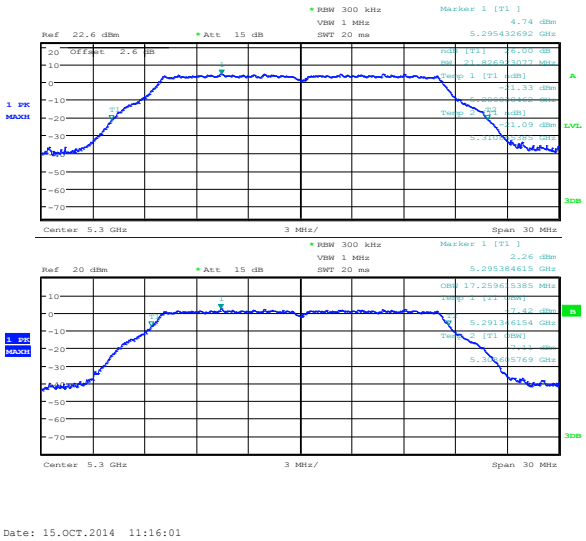


Figure 8.1-1: *26 dB and 99% occupied bandwidth on 802.11a, sample plot*

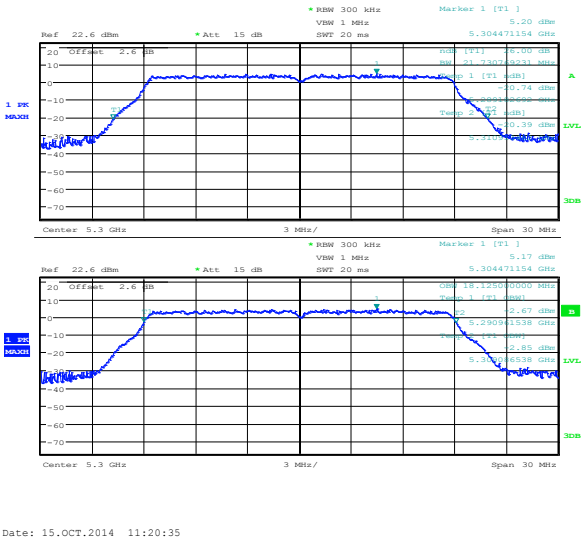


Figure 8.1-2: *26 dB and 99% occupied bandwidth on 802.11n HT20, sample plot*

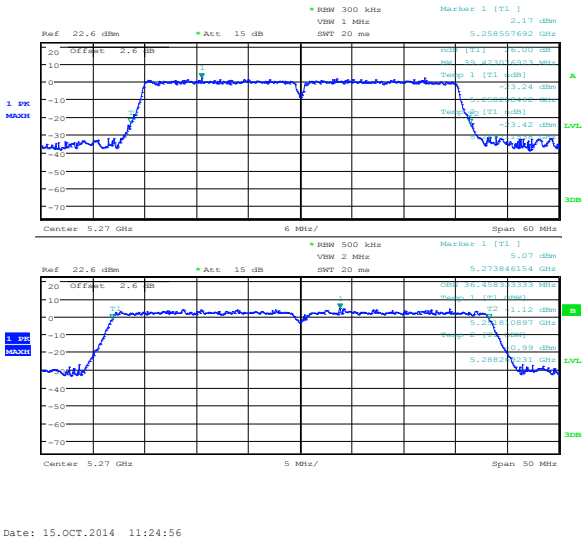


Figure 8.1-3: *26 dB bandwidth and 99% occupied on 802.11n HT40, sample plot*

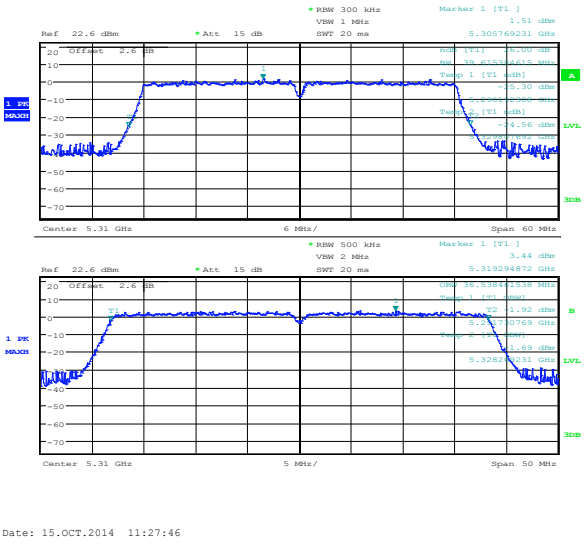


Figure 8.1-4: *26 dB bandwidth and 99% occupied on 802.11ac VHT40, sample plot*

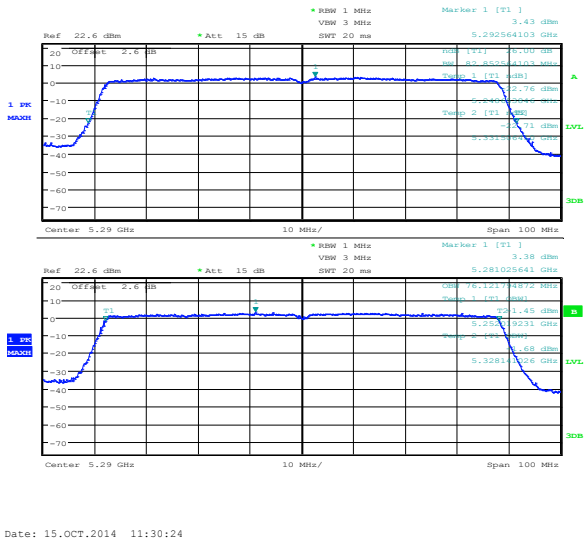


Figure 8.1-5: *26 dB bandwidth and 99% occupied on 802.11ac VHT80, sample plot*

8.2 FCC 15.407(a)(2) 5.25–5.35 GHz band output power, EIRP and spectral density limits

8.2.1 Definitions and limits

(2) For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW (24 dBm) or 11 dBm + 10 × $\log_{10}$ B, where B is the 26 dB emission bandwidth in MHz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.2.2 Test summary

Test date	October 16, 2014	Temperature	21 °C
Test engineer	Andrey Adelberg	Air pressure	1007 mbar
Verdict	Pass	Relative humidity	31 %

8.2.3 Observations, settings and special notes

The test was performed according to 789033 D02 General UNII Test Procedures New Rules v01 section E) 2) b) Method SA-1 (trace averaging with the EUT transmitting at full power throughout each sweep).

Limit calculation.
802.11a: 11 + 10 × $\log_{10}$ (21.92) = 24.41 dBm > **24 dBm**
802.11n HT20: 11 + 10 × $\log_{10}$ (22.12) = 24.45 dBm **> 24 dBm**
802.11n HT40: 11 + 10 × $\log_{10}$ (40.10) = 27.03 dBm > **24 dBm**
802.11ac VHT40: 11 + 10 × $\log_{10}$ (40.19) = 27.04 dBm > **24 dBm**
802.11ac VHT80: 11 + 10 × $\log_{10}$ (82.85) = 30.18 dBm > **24 dBm**

Since all bandwidth-calculated limits are higher than 24 dBm therefor limit level of 24 dBm was selected for the measurements

Spectrum analyser settings:

Resolution bandwidth	1 MHz
Video bandwidth	10 MHz
Frequency span	30 MHz for 20 MHz channel; 50 MHz for 40 MHz channel; 100 MHz for 80 MHz channel
Detector mode	RMS
Trace mode	Triggered power averaging over 100 sweeps with EBW integration for power measurement

8.2.4 Test data

Table 8.2-1: *Output power measurements results for 802.11a*

Frequency, MHz	Data rate	Output power level, dBm	Power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm
5260	6 Mbps	12.80	24.00	11.20	1.31	14.11
5260	54 Mbps	13.05	24.00	10.95	1.31	14.36
5300	6 Mbps	12.79	24.00	11.21	1.31	14.10
5300	54 Mbps	13.05	24.00	10.95	1.31	14.36
5320	6 Mbps	12.75	24.00	11.25	1.31	14.06
5320	54 Mbps	12.97	24.00	11.03	1.31	14.28

Note: highest EIRP is 14.36 dBm, it's less than 27 dBm (500 mW), and therefore a TPC mechanism is not required.

Table 8.2-2: *Output power measurements results for 802.11n HT20*

Frequency, MHz	Data rate	Output power level, dBm	Power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm
5260	MCS 0	11.76	24.00	12.24	1.31	13.07
5260	MCS 7	12.12	24.00	11.88	1.31	13.43
5300	MCS 0	11.84	24.00	12.16	1.31	13.15
5300	MCS 7	12.06	24.00	11.94	1.31	13.37
5320	MCS 0	11.76	24.00	12.24	1.31	13.07
5320	MCS 7	11.99	24.00	12.01	1.31	13.30

Note: highest EIRP is 13.43 dBm, it's less than 27 dBm (500 mW), and therefore a TPC mechanism is not required.

Table 8.2-3: *FCC Output power measurements results for 802.11n HT40*

Frequency, MHz	Data rate	Output power level, dBm	Power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm
5270	MCS 0	11.99	24.00	12.01	1.31	13.30
5270	MCS 7	12.15	24.00	11.85	1.31	13.46
5310	MCS 0	11.97	24.00	12.03	1.31	13.28
5310	MCS 7	12.08	24.00	11.92	1.31	13.39

Note: highest EIRP is 13.46 dBm, it's less than 27 dBm (500 mW), and therefore a TPC mechanism is not required.

Table 8.2-4: *Output power measurements results for 802.11ac VHT40*

Frequency, MHz	Data rate	Output power level, dBm	Power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm
5270	MCS 0	11.09	24.00	12.91	1.31	12.40
5270	MCS 9	11.03	24.00	12.97	1.31	12.34
5310	MCS 0	11.01	24.00	12.99	1.31	12.32
5310	MCS 9	11.02	24.00	12.98	1.31	12.33

Note: highest EIRP is 12.34 dBm, it's less than 27 dBm (500 mW), and therefore a TPC mechanism is not required.

Table 8.2-5: *Output power measurements results for 802.11ac VHT80*

Frequency, MHz	Data rate	Output power level, dBm	Power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm
5290	MCS 0	10.73	24.00	13.27	1.31	12.04
5290	MCS 9	11.17	24.00	12.83	1.31	12.48

Note: highest EIRP is 12.48 dBm, it's less than 27 dBm (500 mW), and therefore a TPC mechanism is not required.

Table 8.2-6: *Power spectral density measurements results for 802.11a*

Frequency, MHz	Data rate	PSD level, dBm/MHz	PSD limit, dBm/MHz	Margin, dB
5260	6 Mbps	1.53	11.00	9.47
5260	54 Mbps	2.17	11.00	8.83
5300	6 Mbps	1.72	11.00	9.28
5300	54 Mbps	2.19	11.00	8.81
5320	6 Mbps	1.50	11.00	9.50
5320	54 Mbps	2.24	11.00	8.76

Table 8.2-7: *Power spectral density measurements results for 802.11n HT20*

Frequency, MHz	Data rate	PSD level, dBm/MHz	PSD limit, dBm/MHz	Margin, dB
5260	MCS 0	0.13	11.00	10.87
5260	MCS 7	0.65	11.00	10.35
5300	MCS 0	0.34	11.00	10.66
5300	MCS 7	0.66	11.00	10.34
5320	MCS 0	0.14	11.00	10.86
5320	MCS 7	0.50	11.00	10.50

Table 8.2-8: *Power spectral density measurements results for 802.11n HT40*

Frequency, MHz	Data rate	PSD level, dBm/MHz	PSD limit, dBm/MHz	Margin, dB
5270	MCS 0	-2.63	11.00	13.63
5270	MCS 7	-2.35	11.00	13.35
5310	MCS 0	-2.58	11.00	13.58
5310	MCS 7	-2.47	11.00	13.47

Table 8.2-9: *Power spectral density measurements results for 802.11ac VHT40*

Frequency, MHz	Data rate	PSD level, dBm/MHz	PSD limit, dBm/MHz	Margin, dB
5270	MCS 0	-3.54	11.00	14.54
5270	MCS 9	-3.55	11.00	14.55
5310	MCS 0	-3.51	11.00	14.51
5310	MCS 9	-3.48	11.00	14.48

Table 8.2-10: *Power spectral density measurements results for 802.11ac VHT80*

Frequency, MHz	Data rate	PSD level, dBm/MHz	PSD limit, dBm/MHz	Margin, dB
5290	MCS 0	-6.72	11.00	17.72
5290	MCS 9	-6.13	11.00	17.13

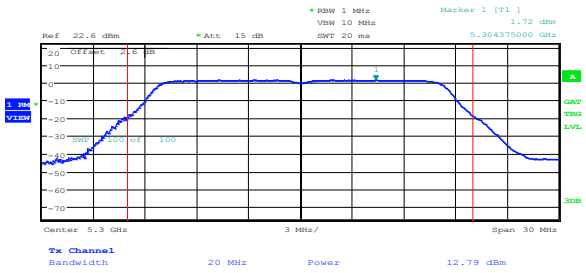


Figure 8.2-1: *Sample plot for power and PSD on 802.11a*

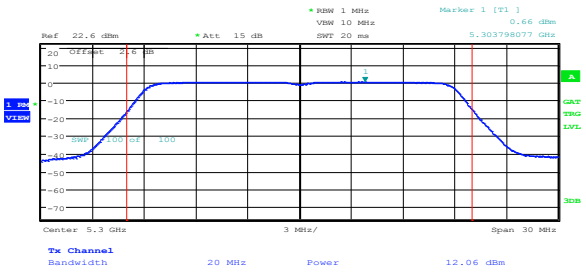


Figure 8.2-2: *Sample plot for power and PSD on 802.11n HT20*

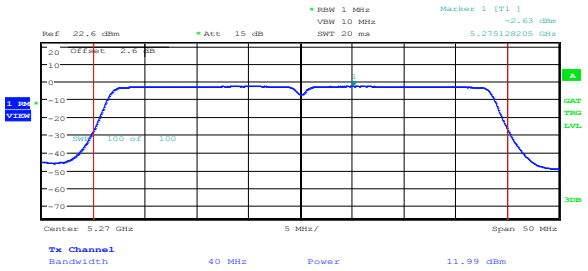


Figure 8.2-3: *Sample plot for power and PSD on 802.11n HT40*

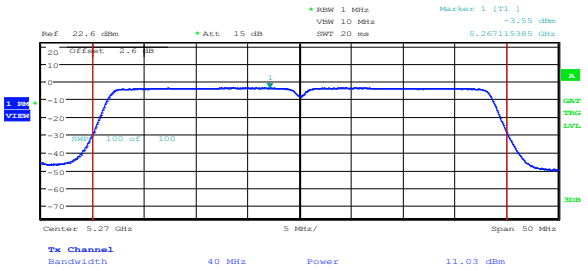


Figure 8.2-4: *Sample plot for power and PSD on 802.11ac VHT40*

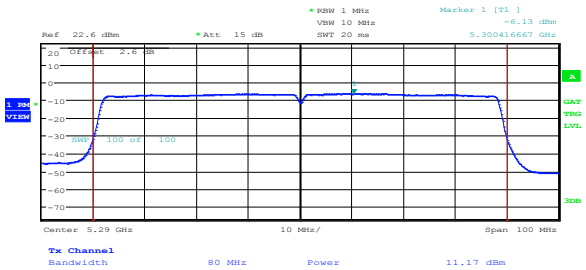


Figure 8.2-5: *Sample plot for power and PSD on 802.11ac VHT80*

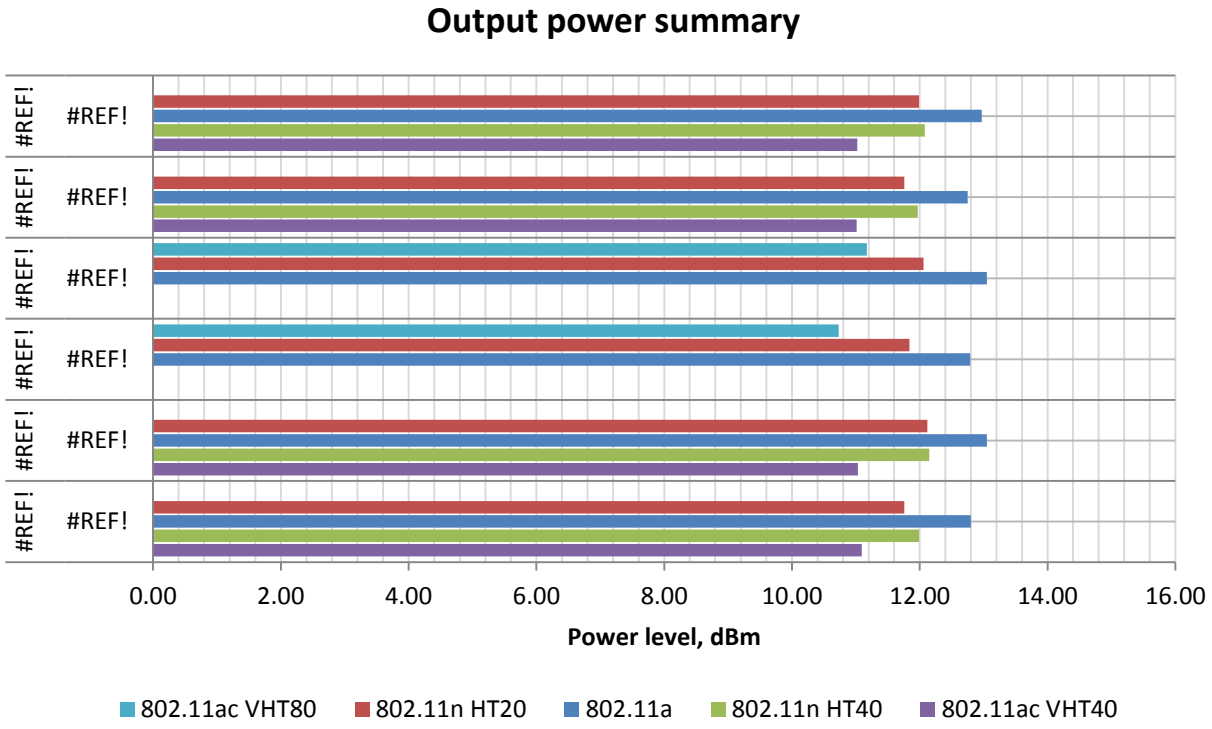


Figure 8.2-6: *Output power summary*

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

8.3.1 Definitions and limits

(2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of −27 dBm/MHz.
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209.
(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 8.3-1: *FCC §15.209 – Radiated emission limits*

Frequency, MHz	Field strength of emissions		Measurement distance,
	µV/m	dBµV/m	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: *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			

8.3.2 Test summary

Test date	October 16, 2014	Temperature	21 °C
Test engineer	Andrey Adelberg	Air pressure	1007 mbar
Verdict	Pass	Relative humidity	31 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz.
Cabinet radiation measurements were performed at a distance of 3 m while antenna connector was terminated with 50 Ω load.

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

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

Average limit line was set as follows: 54 dBµV/m – 95.23 dB – 1.31 dBi – 4.7 dB = −47.27 dBm

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

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

Average limit line was set as follows: 54 dBµV/m – 95.23 dB – 1.31 dBi = −42.54 dBm/MHz

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

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

Peak limit is 20 dB higher than the average limit: −42.54 dBm/MHz + 20 dB = −22.54 dBm/MHz

Spectrum analyser for peak conducted measurements outside restricted bands:

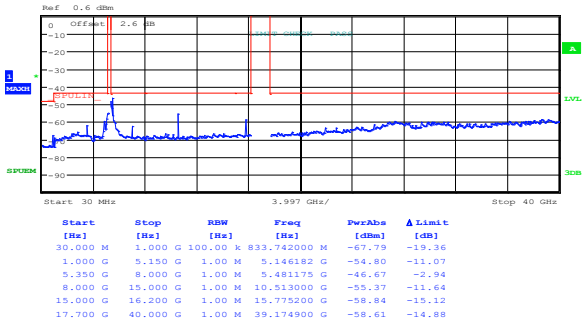
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak
Trace mode	Max Hold

The limit was adjusted to include antenna directional gain of 3 dBi: −27 dBm/MHz – 1.31 dBi = −28.31 dBm/MHz

As per 789033 D02 General UNII Test Procedures New Rule sv01: If an out-of-band emission complies with both the peak and average limits of §15.209 is not required to satisfy the −27 dBm/MHz or −17 dBm/MHz maximum emission limit.

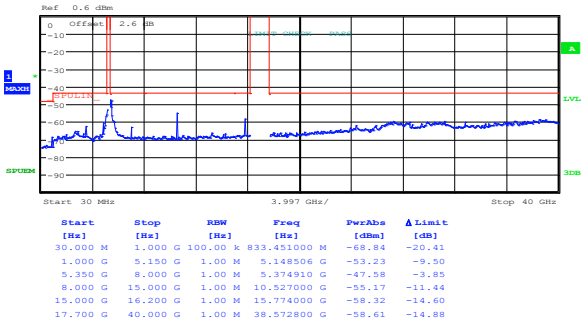
All limit lines on the plots are lower by 1.23 dB than the ones calculated above, due to wrong initial antenna gain.
Every margin depicted on the plots is 1.23 dB higher.

8.3.4 Test data



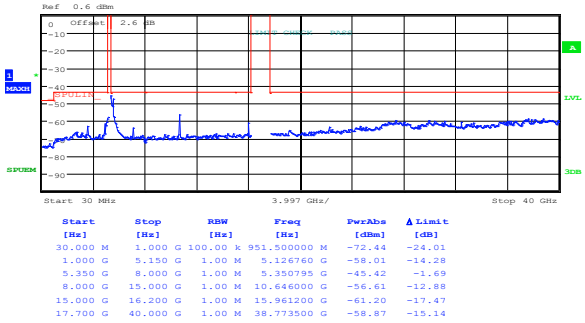
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	833.742000 M	-67.79	-19.36
1.000 G	5.150 G	1.00 M	5.146182 G	-54.80	-11.07
5.350 G	8.000 G	1.00 M	5.481175 G	-46.67	-2.94
8.000 G	15.000 G	1.00 M	10.513000 G	-55.37	-11.64
15.000 G	16.200 G	1.00 M	15.775200 G	-58.84	-15.12
17.700 G	40.000 G	1.00 M	39.174900 G	-58.61	-14.88

Figure 8.3-1: *Spurious emissions within restricted bands at low channel, 802.11a, 6 Mbps*



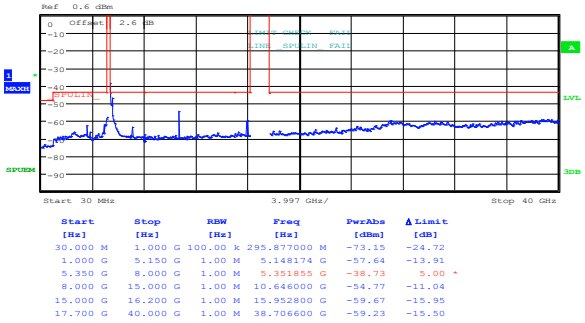
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	833.451000 M	-68.84	-20.41
1.000 G	5.150 G	1.00 M	5.148506 G	-53.23	-9.50
5.350 G	8.000 G	1.00 M	5.374910 G	-47.58	-3.85
8.000 G	15.000 G	1.00 M	10.527000 G	-55.17	-11.44
15.000 G	16.200 G	1.00 M	15.774000 G	-58.32	-14.60
17.700 G	40.000 G	1.00 M	38.572800 G	-58.61	-14.88

Figure 8.3-2: *Spurious emissions within restricted bands at low channel, 802.11a, 54 Mbps*



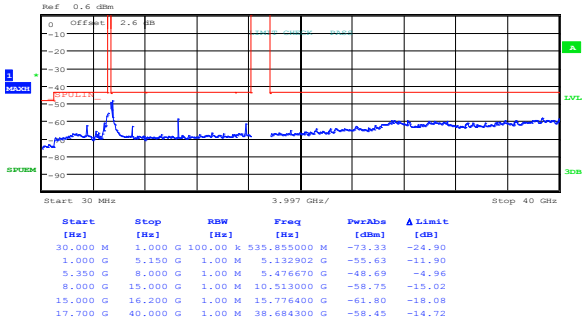
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	951.500000 M	-72.44	-24.01
1.000 G	5.150 G	1.00 M	5.126760 G	-58.01	-14.28
5.350 G	8.000 G	1.00 M	5.350795 G	-45.42	-1.69
8.000 G	15.000 G	1.00 M	10.646000 G	-56.61	-12.88
15.000 G	16.200 G	1.00 M	15.961200 G	-61.20	-17.47
17.700 G	40.000 G	1.00 M	38.773500 G	-58.87	-15.14

Figure 8.3-3: *Spurious emissions within restricted bands at high channel, 802.11a, 6 Mbps*



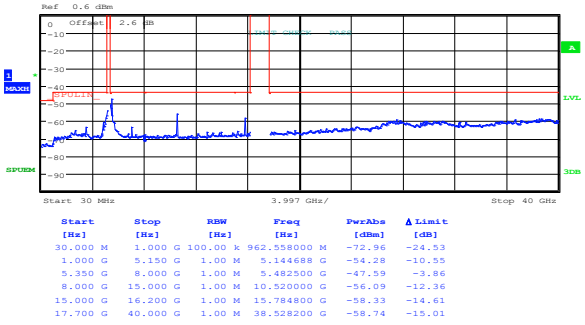
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	295.877000 M	-73.15	-24.72
1.000 G	5.150 G	1.00 M	5.148174 G	-57.64	-13.91
5.350 G	8.000 G	1.00 M	5.351855 G	-38.73	5.00 *
8.000 G	15.000 G	1.00 M	10.646000 G	-54.77	-11.04
15.000 G	16.200 G	1.00 M	15.952800 G	-59.67	-15.95
17.700 G	40.000 G	1.00 M	38.706600 G	-59.23	-15.50

Figure 8.3-4: *Spurious emissions within restricted bands at high channel, 802.11a, 54 Mbps*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	535.855000 M	-73.33	-24.90
1.000 G	5.150 G	1.00 M	5.132902 G	-55.63	-11.90
5.350 G	8.000 G	1.00 M	5.476670 G	-48.69	-4.96
8.000 G	15.000 G	1.00 M	10.513000 G	-58.75	-15.02
15.000 G	16.200 G	1.00 M	15.776400 G	-61.80	-18.08
17.700 G	40.000 G	1.00 M	38.684300 G	-58.45	-14.72

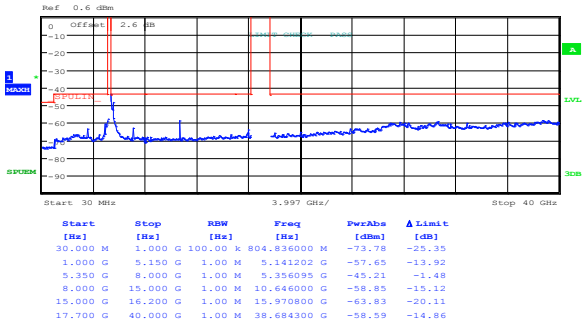
Figure 8.3-5: *Spurious emissions within restricted bands at low channel, 802.11n HT20, MCS 0*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	962.558000 M	-72.96	-24.53
1.000 G	5.150 G	1.00 M	5.144688 G	-54.28	-10.55
5.350 G	8.000 G	1.00 M	5.482500 G	-47.59	-3.86
8.000 G	15.000 G	1.00 M	10.520000 G	-56.09	-12.36
15.000 G	16.200 G	1.00 M	15.784800 G	-58.33	-14.61
17.700 G	40.000 G	1.00 M	38.528200 G	-58.74	-15.01

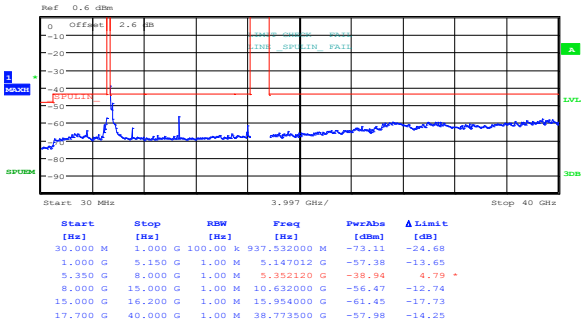
Figure 8.3-6: *Spurious emissions within restricted bands at low channel, 802.11n HT20, MCS 7*

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



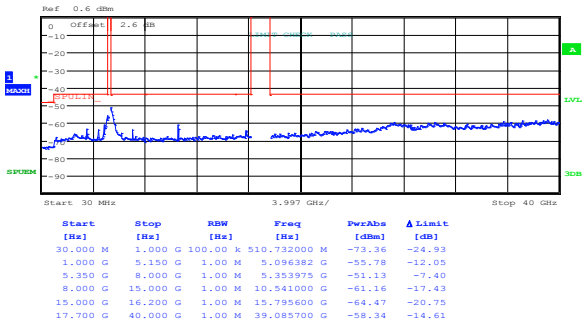
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	804.836000 M	-73.78	-25.35
1.000 G	5.150 G	1.00 M	5.141202 G	-57.65	-13.92
5.350 G	8.000 G	1.00 M	5.356095 G	-45.21	-1.48
8.000 G	15.000 G	1.00 M	10.646000 G	-58.85	-15.12
15.000 G	16.200 G	1.00 M	15.970800 G	-63.83	-20.11
17.700 G	40.000 G	1.00 M	38.684300 G	-58.59	-14.86

Figure 8.3-7: *Spurious emissions within restricted bands at high channel, 802.11n HT20, MCS 0*



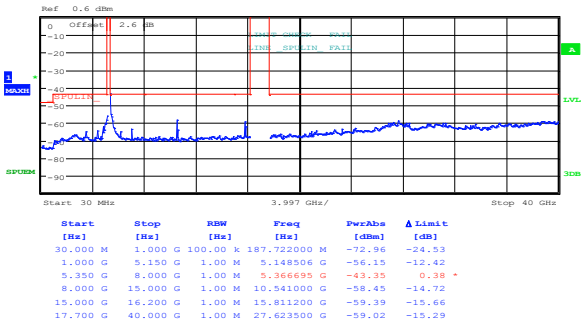
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	937.532000 M	-73.11	-24.68
1.000 G	5.150 G	1.00 M	5.147012 G	-57.38	-13.65
5.350 G	8.000 G	1.00 M	5.352120 G	-38.94	4.79 *
8.000 G	15.000 G	1.00 M	10.632000 G	-56.47	-12.74
15.000 G	16.200 G	1.00 M	15.954000 G	-61.45	-17.73
17.700 G	40.000 G	1.00 M	38.773500 G	-57.98	-14.25

Figure 8.3-8: *Spurious emissions within restricted bands at high channel, 802.11n HT20, MCS 7*



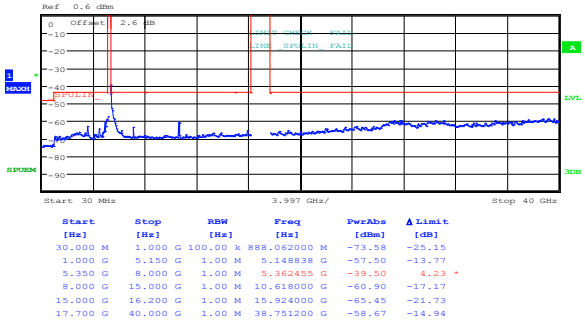
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	510.732000 M	-73.36	-24.93
1.000 G	5.150 G	1.00 M	5.096382 G	-55.78	-12.05
5.350 G	8.000 G	1.00 M	5.353975 G	-51.13	-7.40
8.000 G	15.000 G	1.00 M	10.541000 G	-61.16	-17.43
15.000 G	16.200 G	1.00 M	15.795600 G	-64.47	-20.75
17.700 G	40.000 G	1.00 M	39.085700 G	-58.34	-14.61

Figure 8.3-9: *Spurious emissions within restricted bands at low channel, 802.11n HT40, MCS 0*



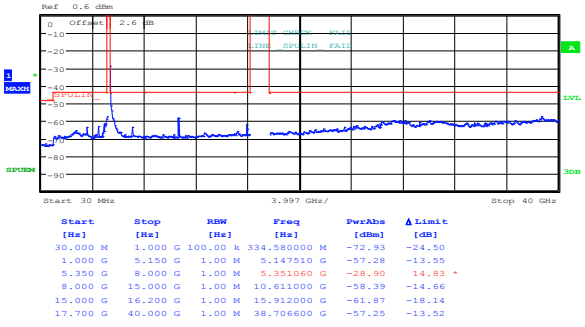
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	187.722000 M	-72.96	-24.53
1.000 G	5.150 G	1.00 M	5.148506 G	-56.15	-12.42
5.350 G	8.000 G	1.00 M	5.366695 G	-43.35	0.38 *
8.000 G	15.000 G	1.00 M	10.541000 G	-58.45	-14.72
15.000 G	16.200 G	1.00 M	15.811200 G	-59.39	-15.66
17.700 G	40.000 G	1.00 M	27.623500 G	-59.02	-15.29

Figure 8.3-10: *Spurious emissions within restricted bands at low channel, 802.11n HT40, MCS 7*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	888.062000 M	-73.58	-25.15
1.000 G	5.150 G	1.00 M	5.148838 G	-57.50	-13.77
5.350 G	8.000 G	1.00 M	5.362455 G	-39.50	4.23 *
8.000 G	15.000 G	1.00 M	10.618000 G	-60.90	-17.17
15.000 G	16.200 G	1.00 M	15.924000 G	-65.45	-21.73
17.700 G	40.000 G	1.00 M	38.751200 G	-58.67	-14.94

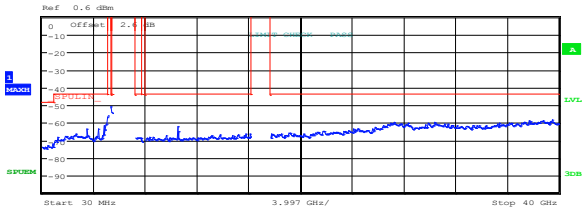
Figure 8.3-11: *Spurious emissions within restricted bands at high channel, 802.11n HT40, MCS 0*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	334.580000 M	-72.93	-24.50
1.000 G	5.150 G	1.00 M	5.147510 G	-57.28	-13.55
5.350 G	8.000 G	1.00 M	5.351060 G	-28.90	14.83 *
8.000 G	15.000 G	1.00 M	10.611000 G	-58.39	-14.66
15.000 G	16.200 G	1.00 M	15.912000 G	-61.87	-18.14
17.700 G	40.000 G	1.00 M	38.706600 G	-57.25	-13.52

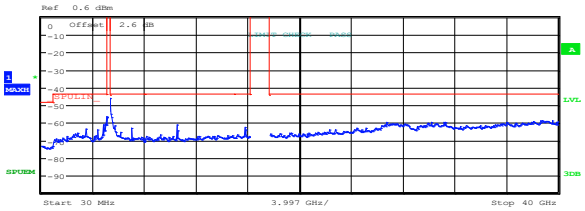
Figure 8.3-12: *Spurious emissions within restricted bands at high channel, 802.11n HT40, MCS 7*

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



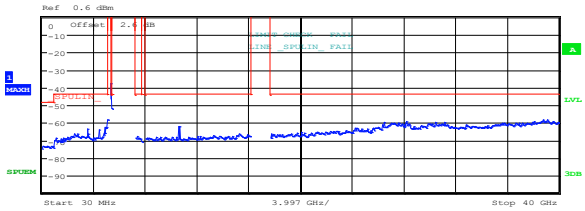
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	874.385000 M	-72.03	-23.60
1.000 G	5.150 G	1.00 M	5.148174 G	-56.18	-12.45
5.350 G	5.460 G	1.00 M	5.350121 G	-50.87	-7.14
7.250 G	7.750 G	1.00 M	7.292050 G	-68.45	-24.72
8.025 G	16.200 G	1.00 M	10.526550 G	-62.18	-18.45
17.700 G	40.000 G	1.00 M	39.487100 G	-58.31	-14.58

Figure 8.3-13: *Spurious emissions within restricted bands at low channel, 802.11ac VHT40, MCS 0*



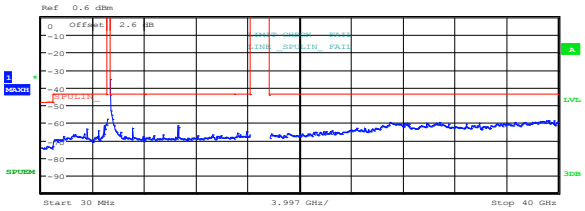
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	43.968000 M	-73.33	-24.90
1.000 G	5.150 G	1.00 M	5.112816 G	-56.27	-12.54
5.350 G	8.000 G	1.00 M	5.351325 G	-46.21	-2.48
8.000 G	15.000 G	1.00 M	10.534000 G	-61.26	-17.53
15.000 G	16.200 G	1.00 M	15.800400 G	-62.52	-18.79
17.700 G	40.000 G	1.00 M	38.773500 G	-58.84	-15.11

Figure 8.3-14: *Spurious emissions within restricted bands at low channel, 802.11ac VHT40, MCS 9*



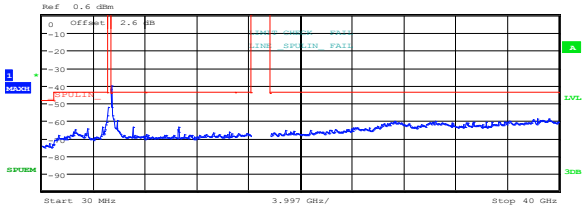
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	491.332000 M	-73.16	-24.73
1.000 G	5.150 G	1.00 M	5.134728 G	-58.20	-14.47
5.350 G	5.460 G	1.00 M	5.356666 G	-37.84	5.89 *
7.250 G	7.750 G	1.00 M	7.407200 G	-67.85	-24.12
8.025 G	16.200 G	1.00 M	10.616475 G	-61.93	-18.20
17.700 G	40.000 G	1.00 M	38.728900 G	-58.39	-14.66

Figure 8.3-15: *Spurious emissions within restricted bands at high channel, 802.11ac VHT40, MCS 0*



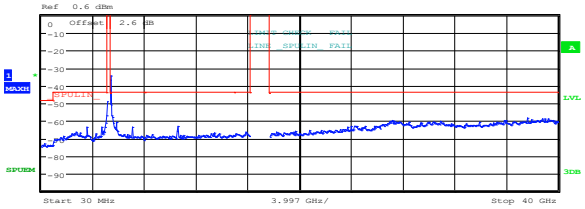
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	999.612000 M	-73.30	-24.87
1.000 G	5.150 G	1.00 M	5.133234 G	-57.94	-14.21
5.350 G	8.000 G	1.00 M	5.355035 G	-35.25	8.48 *
8.000 G	15.000 G	1.00 M	10.618000 G	-61.53	-17.80
15.000 G	16.200 G	1.00 M	15.933600 G	-64.69	-20.96
17.700 G	40.000 G	1.00 M	39.085700 G	-58.75	-15.02

Figure 8.3-16: *Spurious emissions within restricted bands at high channel, 802.11ac VHT40, MCS 9*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	632.176000 M	-72.76	-24.33
1.000 G	5.150 G	1.00 M	5.147676 G	-52.44	-8.71
5.350 G	8.000 G	1.00 M	5.381005 G	-40.03	3.70 *
8.000 G	15.000 G	1.00 M	10.590000 G	-63.69	-19.96
15.000 G	16.200 G	1.00 M	15.837600 G	-67.25	-23.52
17.700 G	40.000 G	1.00 M	38.305200 G	-58.94	-15.21

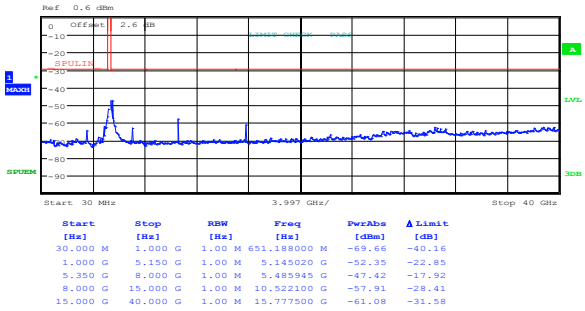
Figure 8.3-17: *Spurious emissions within restricted bands, 802.11ac VHT80, MCS 0*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	100.00 k	273.470000 M	-72.92	-24.49
1.000 G	5.150 G	1.00 M	5.139542 G	-48.85	-5.12
5.350 G	8.000 G	1.00 M	5.379945 G	-34.61	9.12 *
8.000 G	15.000 G	1.00 M	10.597000 G	-63.10	-19.37
15.000 G	16.200 G	1.00 M	15.846000 G	-66.26	-22.54
17.700 G	40.000 G	1.00 M	37.636200 G	-58.18	-14.45

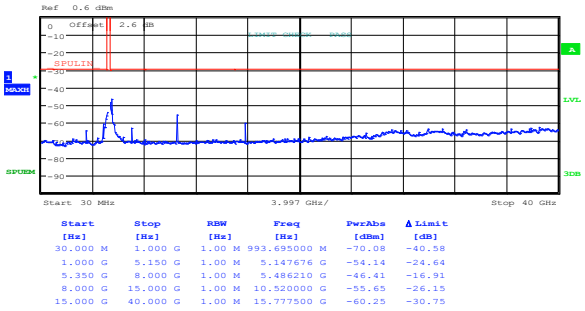
Figure 8.3-18: *Spurious emissions within restricted bands, 802.11ac VHT80, MCS 9*

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



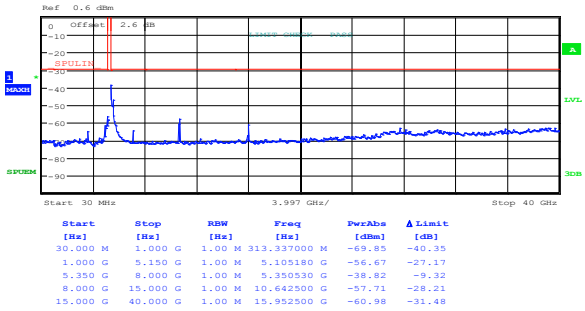
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	651.188000 M	-69.66	-40.16
1.000 G	5.150 G	1.00 M	5.145020 G	-52.35	-22.85
5.350 G	8.000 G	1.00 M	5.485945 G	-47.42	-17.92
8.000 G	15.000 G	1.00 M	10.522100 G	-57.91	-28.41
15.000 G	40.000 G	1.00 M	15.777500 G	-61.08	-31.58

Figure 8.3-19: *Spurious emissions outside restricted bands at low channel, 802.11a, 6 Mbps*



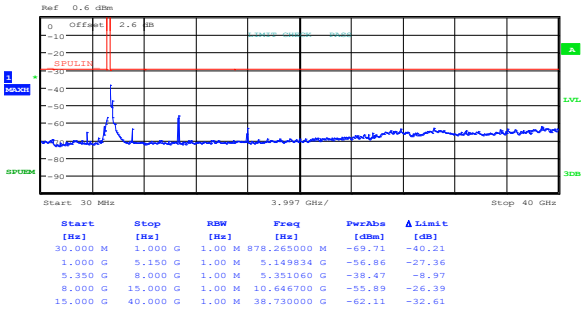
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	993.695000 M	-70.08	-40.58
1.000 G	5.150 G	1.00 M	5.147676 G	-54.14	-24.64
5.350 G	8.000 G	1.00 M	5.486210 G	-46.41	-16.91
8.000 G	15.000 G	1.00 M	10.520000 G	-55.65	-26.15
15.000 G	40.000 G	1.00 M	15.777500 G	-60.25	-30.75

Figure 8.3-20: *Spurious emissions outside restricted bands at low channel, 802.11a, 54 Mbps*



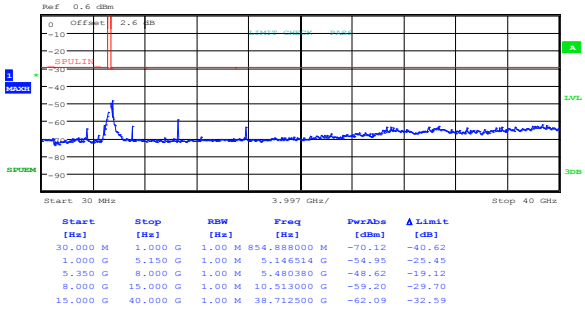
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	313.337000 M	-69.85	-40.35
1.000 G	5.150 G	1.00 M	5.105180 G	-56.67	-27.17
5.350 G	8.000 G	1.00 M	5.350530 G	-38.82	-9.32
8.000 G	15.000 G	1.00 M	10.642500 G	-57.71	-28.21
15.000 G	40.000 G	1.00 M	15.952500 G	-60.98	-31.48

Figure 8.3-21: *Spurious emissions outside restricted bands at high channel, 802.11a, 6 Mbps*



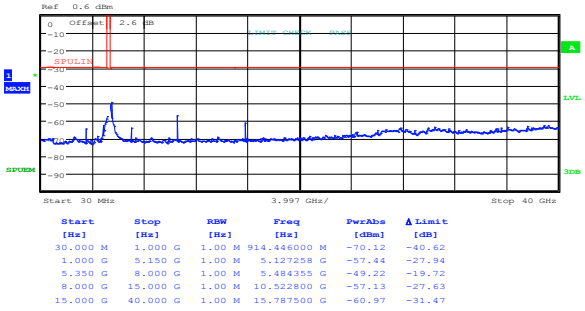
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	878.265000 M	-69.71	-40.21
1.000 G	5.150 G	1.00 M	5.149834 G	-56.86	-27.36
5.350 G	8.000 G	1.00 M	5.351060 G	-38.47	-8.97
8.000 G	15.000 G	1.00 M	10.646700 G	-55.89	-26.39
15.000 G	40.000 G	1.00 M	38.730000 G	-62.11	-32.61

Figure 8.3-22: *Spurious emissions outside restricted bands at high channel, 802.11a, 54 Mbps*



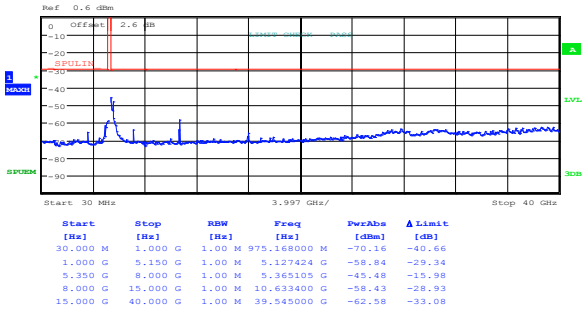
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	854.888000 M	-70.12	-40.62
1.000 G	5.150 G	1.00 M	5.146514 G	-54.95	-25.45
5.350 G	8.000 G	1.00 M	5.480380 G	-48.62	-19.12
8.000 G	15.000 G	1.00 M	10.513000 G	-59.20	-29.70
15.000 G	40.000 G	1.00 M	38.712500 G	-62.09	-32.59

Figure 8.3-23: *Spurious emissions outside restricted bands at low channel, 802.11n HT20, MCS 0*



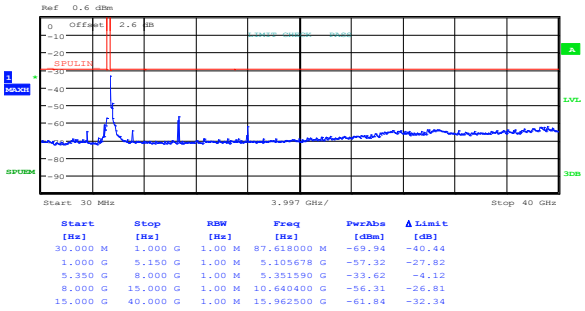
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	914.446000 M	-70.12	-40.62
1.000 G	5.150 G	1.00 M	5.127258 G	-57.44	-27.94
5.350 G	8.000 G	1.00 M	5.484355 G	-49.22	-19.72
8.000 G	15.000 G	1.00 M	10.522800 G	-57.13	-27.63
15.000 G	40.000 G	1.00 M	15.787500 G	-60.97	-31.47

Figure 8.3-24: *Spurious emissions outside restricted bands at low channel, 802.11n HT20, MCS 7*



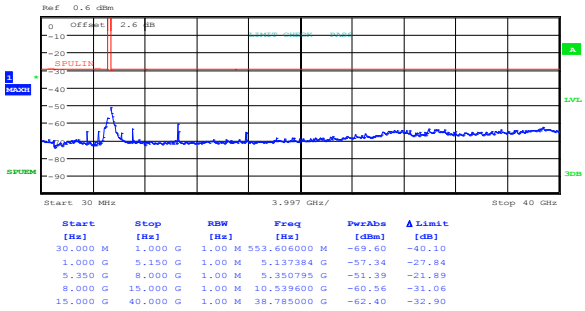
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	975.168000 M	-70.16	-40.66
1.000 G	5.150 G	1.00 M	5.127424 G	-58.84	-29.34
5.350 G	8.000 G	1.00 M	5.365105 G	-45.48	-15.98
8.000 G	15.000 G	1.00 M	10.633400 G	-58.43	-28.93
15.000 G	40.000 G	1.00 M	39.545000 G	-62.58	-33.08

Figure 8.3-25: *Spurious emissions outside restricted bands at high channel, 802.11n HT20, MCS 0*



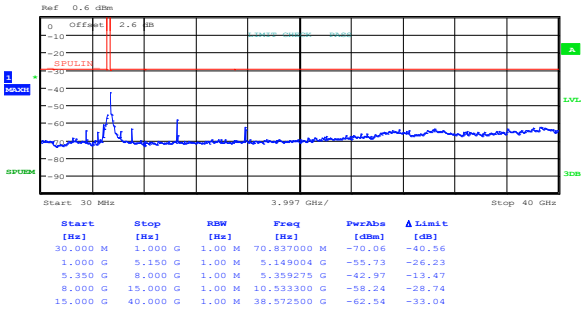
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	87.618000 M	-69.94	-40.44
1.000 G	5.150 G	1.00 M	5.105678 G	-57.32	-27.82
5.350 G	8.000 G	1.00 M	5.351590 G	-33.62	-4.12
8.000 G	15.000 G	1.00 M	10.640400 G	-56.31	-26.81
15.000 G	40.000 G	1.00 M	15.962500 G	-61.84	-32.34

Figure 8.3-26: *Spurious emissions outside restricted bands at high channel, 802.11n HT20, MCS 7*



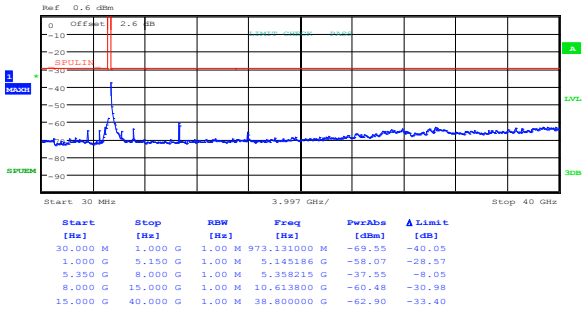
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	553.606000 M	-69.60	-40.10
1.000 G	5.150 G	1.00 M	5.137384 G	-57.34	-27.84
5.350 G	8.000 G	1.00 M	5.350795 G	-51.39	-21.89
8.000 G	15.000 G	1.00 M	10.539600 G	-60.56	-31.06
15.000 G	40.000 G	1.00 M	38.785000 G	-62.40	-32.90

Figure 8.3-27: *Spurious emissions outside restricted bands at low channel, 802.11n HT40, MCS 0*



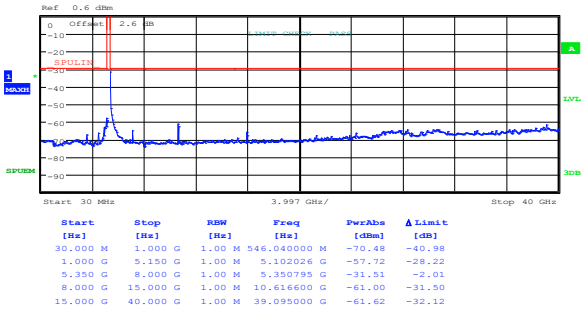
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	70.837000 M	-70.06	-40.56
1.000 G	5.150 G	1.00 M	5.149004 G	-55.73	-26.23
5.350 G	8.000 G	1.00 M	5.359275 G	-42.97	-13.47
8.000 G	15.000 G	1.00 M	10.533300 G	-58.24	-28.74
15.000 G	40.000 G	1.00 M	38.572500 G	-62.54	-33.04

Figure 8.3-28: *Spurious emissions outside restricted bands at low channel, 802.11n HT40, MCS 7*



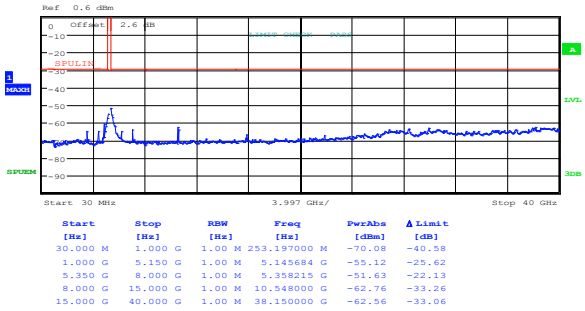
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	973.131000 M	-69.55	-40.05
1.000 G	5.150 G	1.00 M	5.145186 G	-58.07	-28.57
5.350 G	8.000 G	1.00 M	5.358215 G	-37.55	-8.05
8.000 G	15.000 G	1.00 M	10.613800 G	-60.48	-30.98
15.000 G	40.000 G	1.00 M	38.800000 G	-62.90	-33.40

Figure 8.3-29: *Spurious emissions outside restricted bands at high channel, 802.11n HT40, MCS 0*



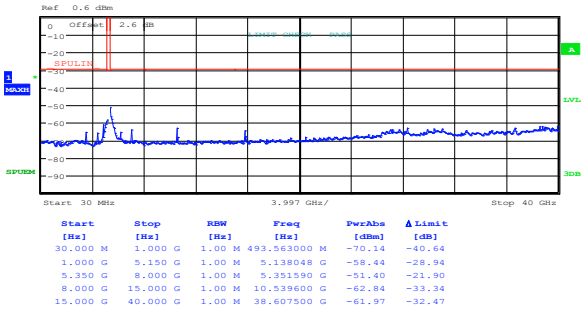
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	546.040000 M	-70.48	-40.98
1.000 G	5.150 G	1.00 M	5.102026 G	-57.72	-28.22
5.350 G	8.000 G	1.00 M	5.350795 G	-31.51	-2.01
8.000 G	15.000 G	1.00 M	10.616600 G	-61.00	-31.50
15.000 G	40.000 G	1.00 M	39.095000 G	-61.62	-32.12

Figure 8.3-30: *Spurious emissions outside restricted bands at high channel, 802.11n HT40, MCS 7*



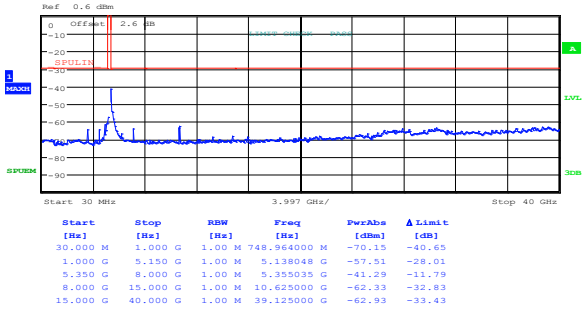
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	253.197000 M	-70.08	-40.58
1.000 G	5.150 G	1.00 M	5.145684 G	-55.12	-25.62
5.350 G	8.000 G	1.00 M	5.358215 G	-51.63	-22.13
8.000 G	15.000 G	1.00 M	10.548000 G	-62.76	-33.26
15.000 G	40.000 G	1.00 M	38.150000 G	-62.56	-33.06

Figure 8.3-31: *Spurious emissions outside restricted bands at low channel, 802.11ac VHT40, MCS 0*



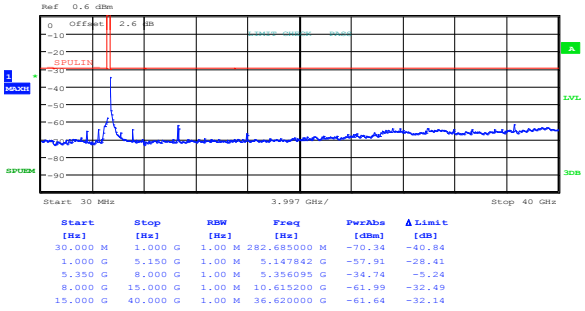
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	493.563000 M	-70.14	-40.64
1.000 G	5.150 G	1.00 M	5.138048 G	-58.44	-28.94
5.350 G	8.000 G	1.00 M	5.351590 G	-51.40	-21.90
8.000 G	15.000 G	1.00 M	10.539600 G	-62.84	-33.34
15.000 G	40.000 G	1.00 M	38.607500 G	-61.97	-32.47

Figure 8.3-32: *Spurious emissions outside restricted bands at low channel, 802.11ac VHT40, MCS 9*



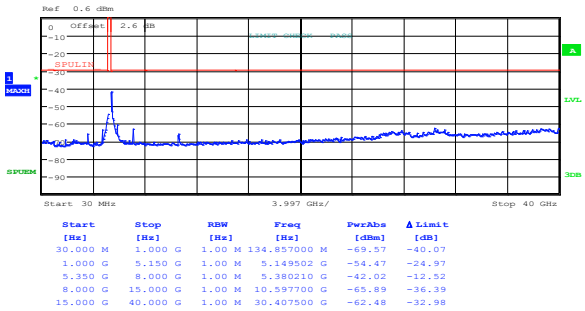
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	748.964000 M	-70.15	-40.65
1.000 G	5.150 G	1.00 M	5.138048 G	-57.51	-28.01
5.350 G	8.000 G	1.00 M	5.355035 G	-41.29	-11.79
8.000 G	15.000 G	1.00 M	10.625000 G	-62.33	-32.83
15.000 G	40.000 G	1.00 M	39.125000 G	-62.93	-33.43

Figure 8.3-33: *Spurious emissions outside restricted bands at high channel, 802.11ac VHT40, MCS 0*



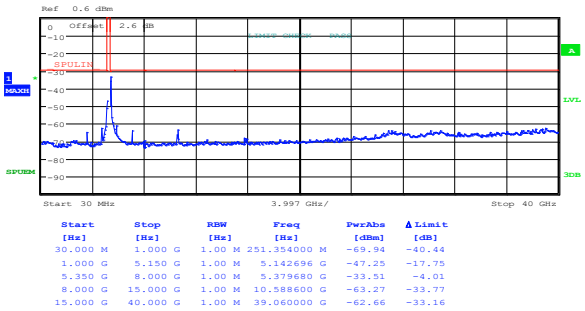
Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	282.685000 M	-70.34	-40.84
1.000 G	5.150 G	1.00 M	5.147842 G	-57.91	-28.41
5.350 G	8.000 G	1.00 M	5.356095 G	-34.74	-5.24
8.000 G	15.000 G	1.00 M	10.615200 G	-61.99	-32.49
15.000 G	40.000 G	1.00 M	36.620000 G	-61.64	-32.14

Figure 8.3-34: *Spurious emissions outside restricted bands at high channel, 802.11ac VHT40, MCS 9*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	134.857000 M	-69.57	-40.07
1.000 G	5.150 G	1.00 M	5.149502 G	-54.47	-24.97
5.350 G	8.000 G	1.00 M	5.380210 G	-42.02	-12.52
8.000 G	15.000 G	1.00 M	10.597700 G	-65.89	-36.39
15.000 G	40.000 G	1.00 M	30.407500 G	-62.48	-32.98

Figure 8.3-35: *Spurious emissions outside restricted bands, 802.11ac VHT80, MCS 0*



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	Δ Limit [dB]
30.000 M	1.000 G	1.00 M	251.354000 M	-69.94	-40.44
1.000 G	5.150 G	1.00 M	5.142696 G	-47.25	-17.75
5.350 G	8.000 G	1.00 M	5.379680 G	-33.51	-4.01
8.000 G	15.000 G	1.00 M	10.588600 G	-63.27	-33.77
15.000 G	40.000 G	1.00 M	39.060000 G	-62.66	-33.16

Figure 8.3-36: *Spurious emissions outside restricted bands, 802.11ac VHT80, MCS 9*

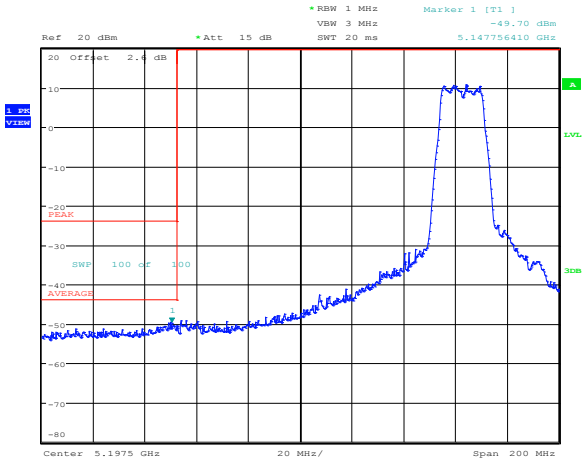


Figure 8.3-37: *Lower band edge emission for 802.11a with 6 Mbps, peak*

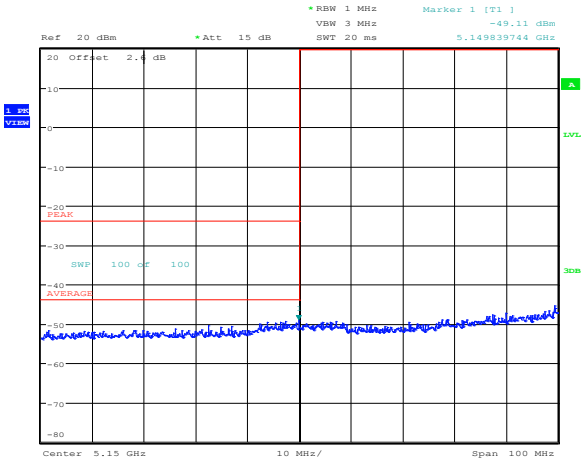


Figure 8.3-38: *Lower band edge emission for 802.11a with 54 Mbps, peak*

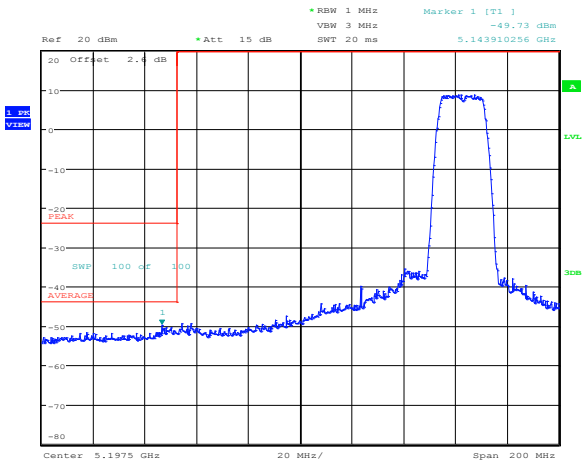


Figure 8.3-39: *Lower band edge emission for 802.11n HT20 with MCS 0, peak*

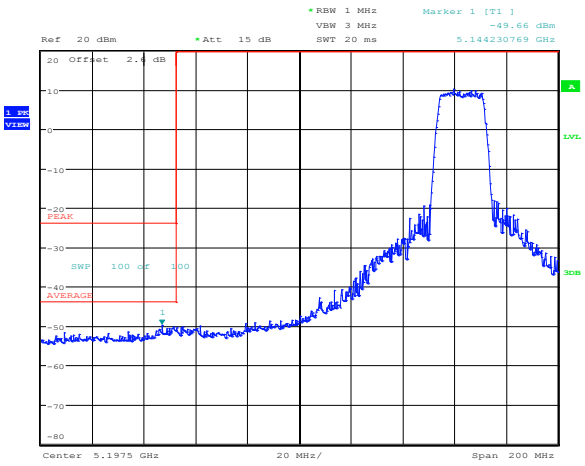


Figure 8.3-40: *Lower band edge emission for 802.11n HT20 with MCS 7, peak*

Note: in the plots above peak band edge value complies with average limit therefore average band edge measurement was not performed.

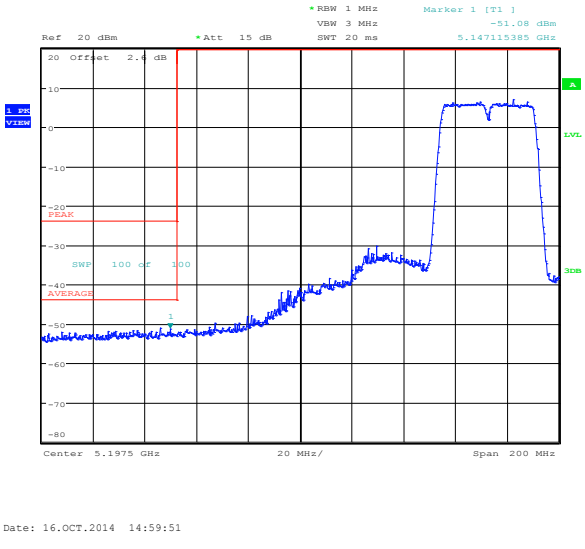


Figure 8.3-41: *Lower band edge emission for 802.11n HT40 with MCS 0, peak*

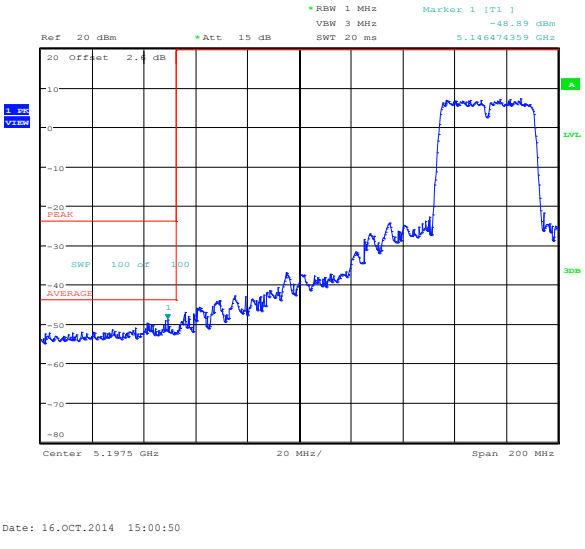


Figure 8.3-42: *Lower band edge emission for 802.11n HT40 with MCS 7, peak*

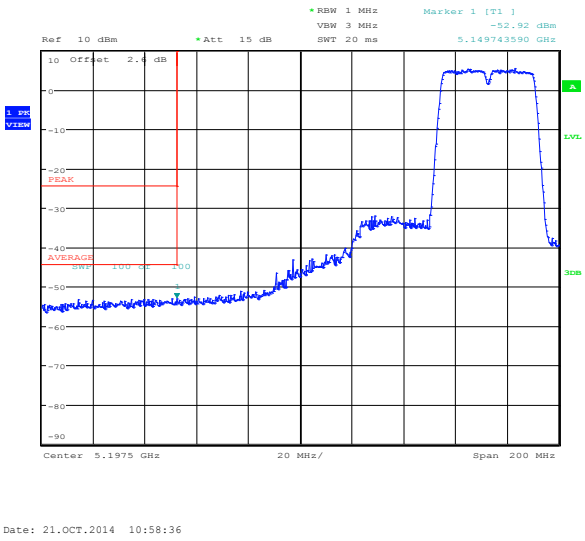


Figure 8.3-43: *Lower band edge emission for 802.11ac VHT40 with MCS 0, peak*

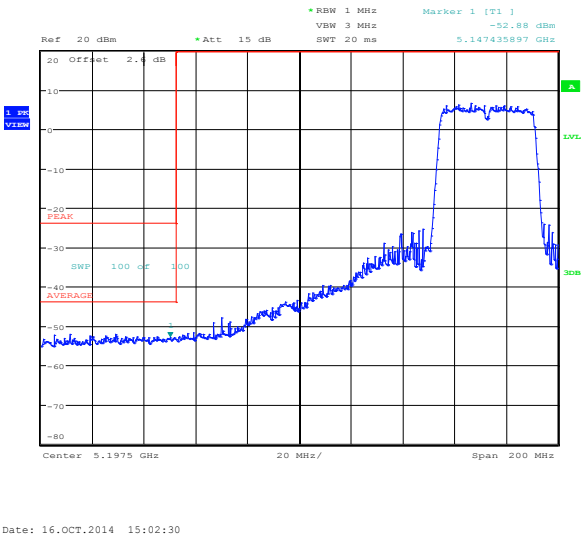


Figure 8.3-44: *Lower band edge emission for 802.11ac VHT40 with MCS 9, peak*

Note: in the plots above peak value complies with average limit therefore average measurement was not performed.

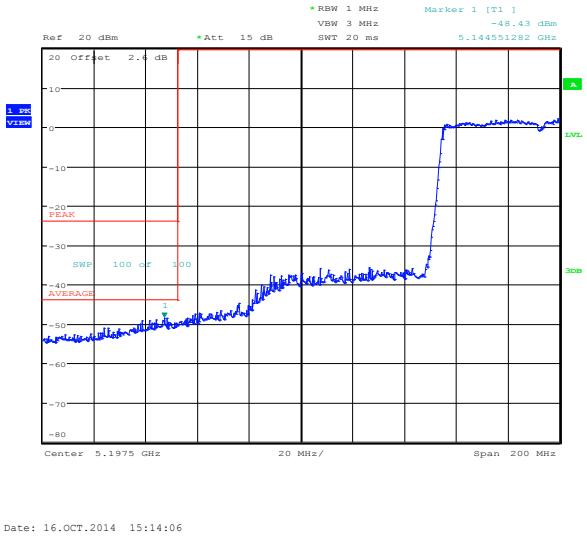


Figure 8.3-45: *Lower band edge emission for 802.11ac VHT80 with MCS 0, peak. Peak value complies with average limit therefore average measurement was not performed.*

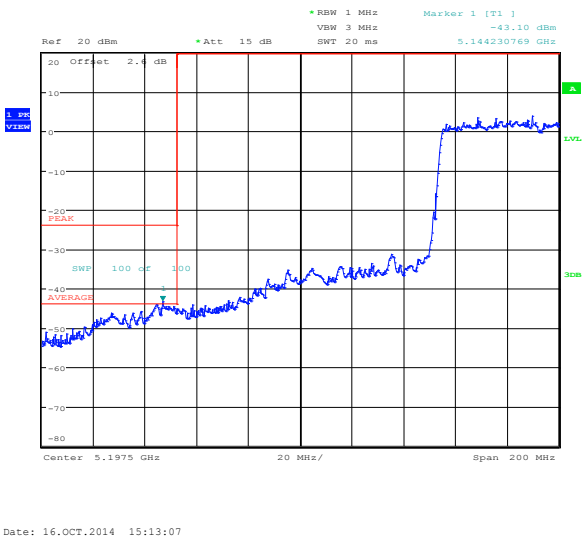


Figure 8.3-46: *Lower band edge emission for 802.11ac VHT80 with MCS 9, peak*

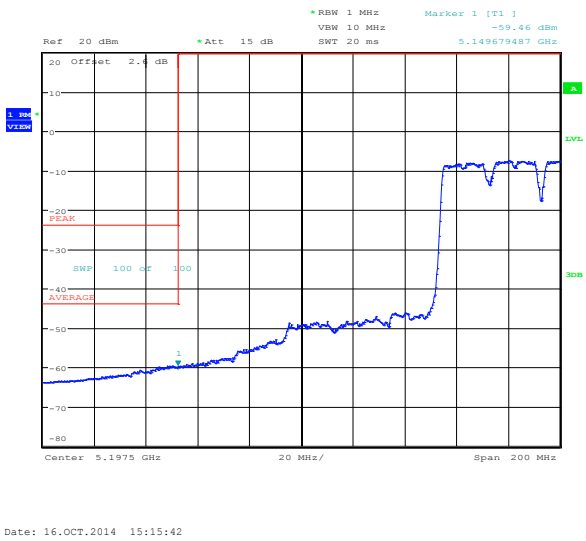


Figure 8.3-47: *Lower band edge emission for 802.11ac VHT80 with MCS 9, average*

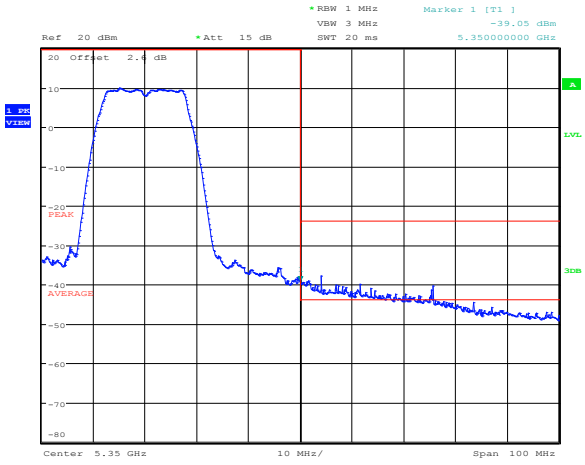


Figure 8.3-48: *Upper band edge emission for 802.11a with 6 Mbps, peak*

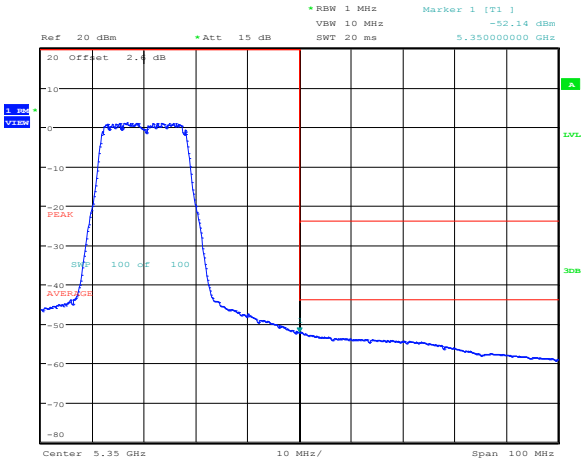


Figure 8.3-49: *Upper band edge emission for 802.11a with 6 Mbps, average*

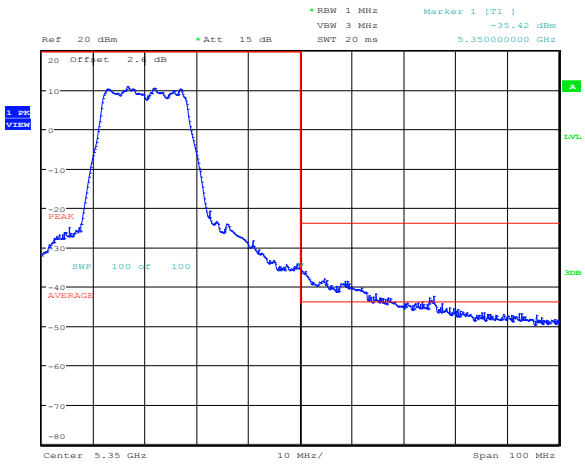


Figure 8.3-50: *Upper band edge emission for 802.11a with 54 Mbps, peak*

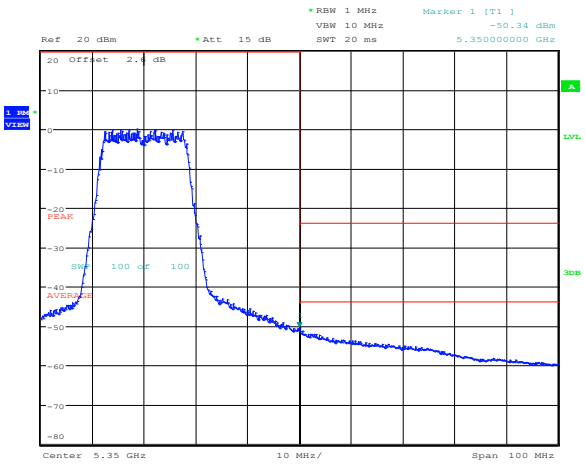


Figure 8.3-51: *Upper band edge emission for 802.11a with 54 Mbps, average*

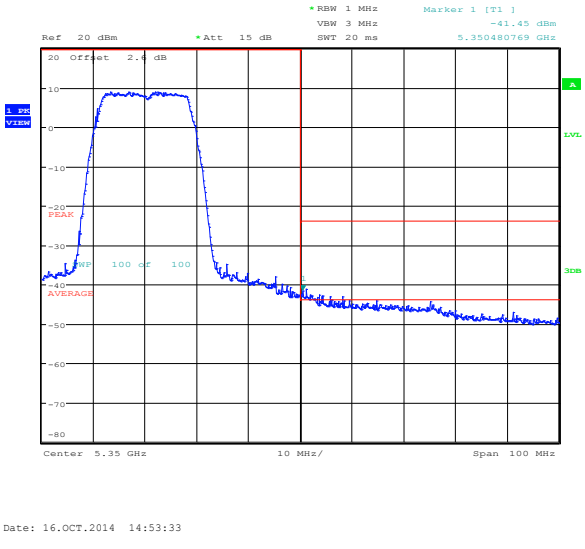


Figure 8.3-52: *Upper band edge emission for 802.11n HT20 with MCS 0, peak*

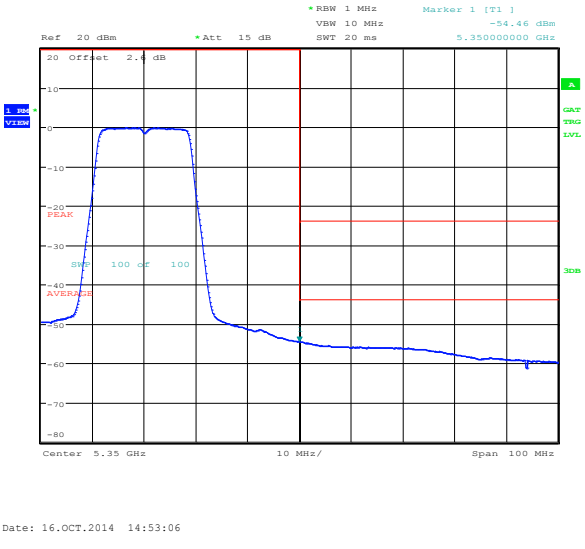


Figure 8.3-53: *Upper band edge emission 802.11n HT20 with MCS 0, average*

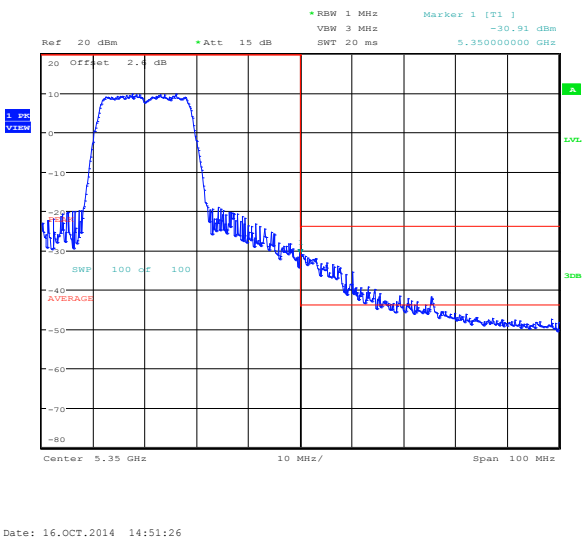


Figure 8.3-54: *Upper band edge emission for 802.11n HT20 with MCS 7, peak*

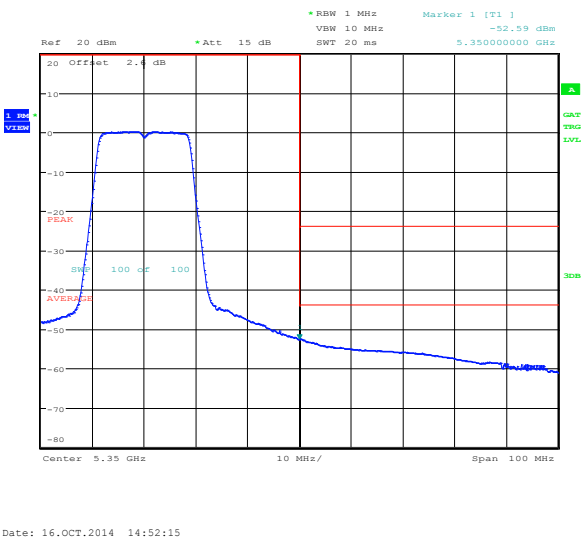


Figure 8.3-55: *Upper band edge emission 802.11n HT20 with MCS 7, average*

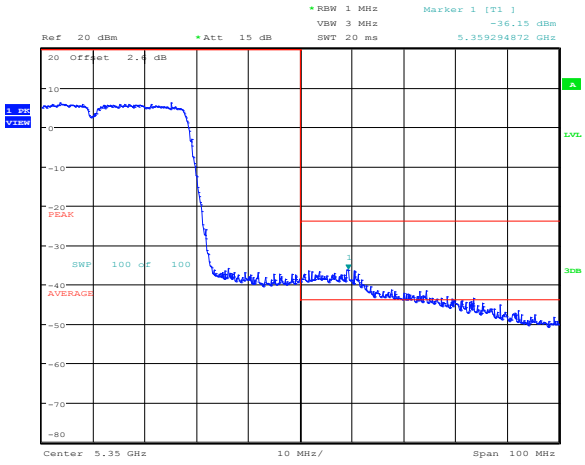


Figure 8.3-56: *Upper band edge emission for 802.11n HT40 with MCS 0, peak*

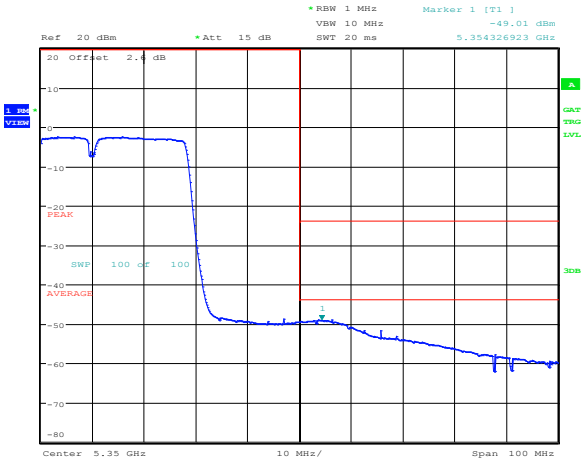


Figure 8.3-57: *Upper band edge emission 802.11n HT40 with MCS 0, average*

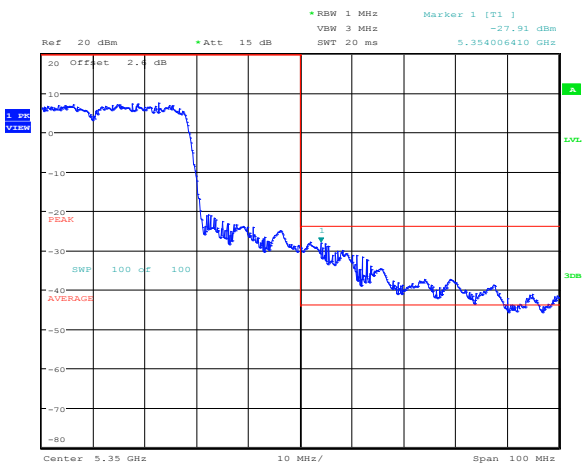


Figure 8.3-58: *Upper band edge emission for 802.11n HT40 with MCS 7, peak*

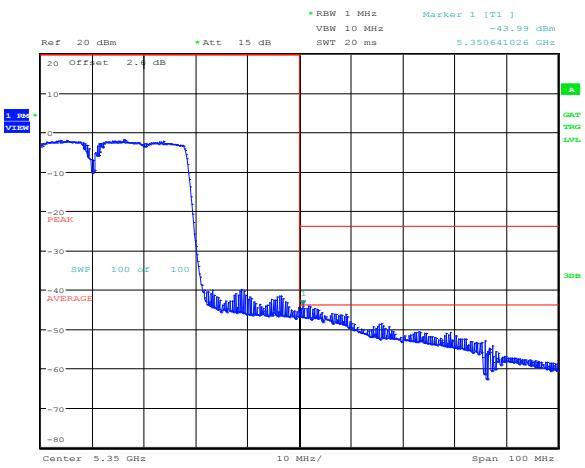


Figure 8.3-59: *Upper band edge emission 802.11n HT40 with MCS 7, average*

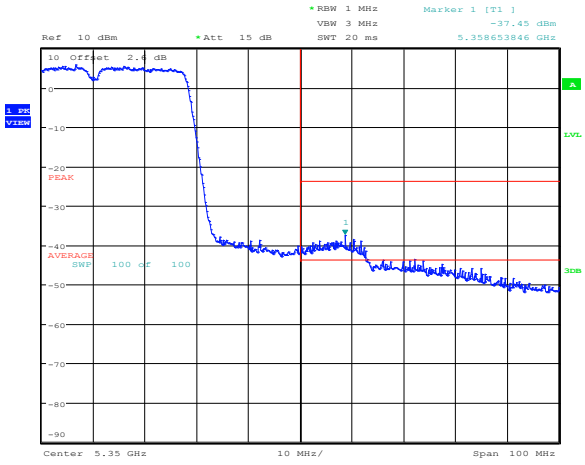


Figure 8.3-60: *Upper band edge emission for 802.11ac VHT40 with MCS 0, peak*

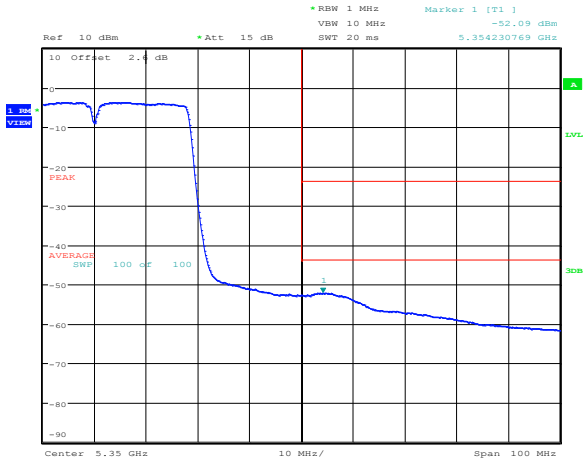


Figure 8.3-61: *Upper band edge emission for 802.11ac VHT40 with MCS 0, average*

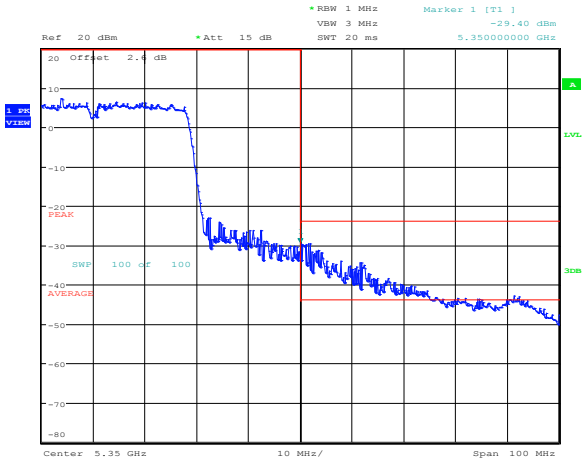


Figure 8.3-62: *Upper band edge emission for 802.11ac VHT40 with MCS 9, peak*

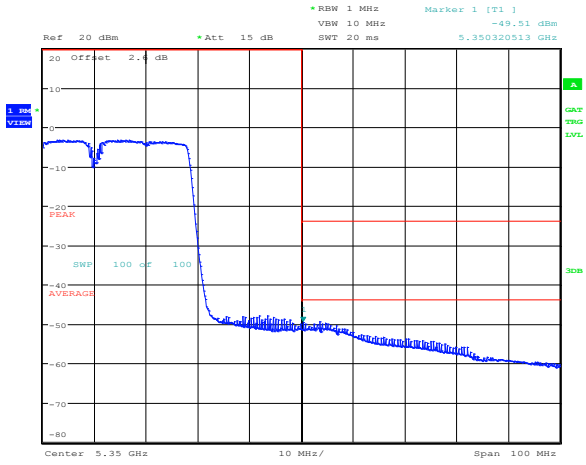


Figure 8.3-63: *Upper band edge emission for 802.11ac VHT40 with MCS 9, average*

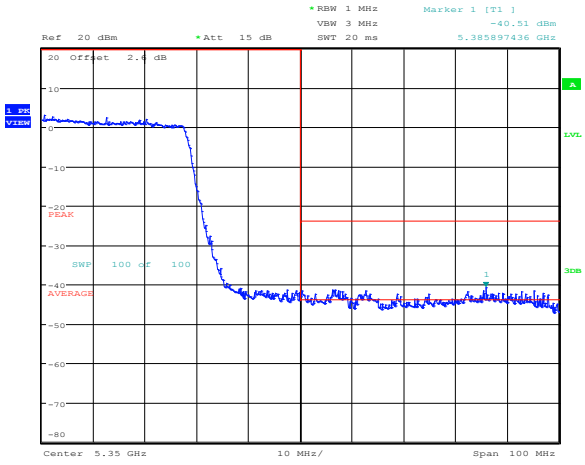


Figure 8.3-64: *Upper band edge emission for 802.11ac VHT80 with MCS 0, peak*

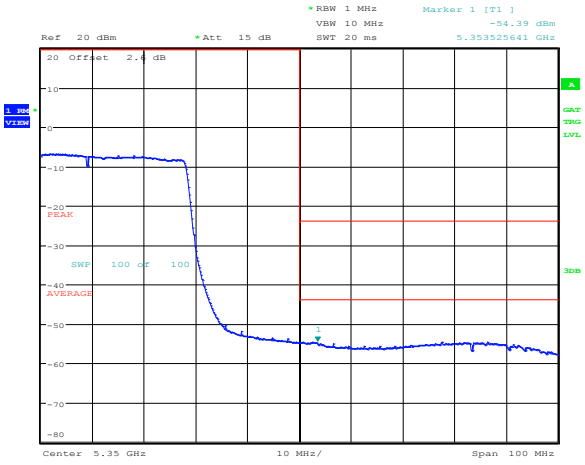


Figure 8.3-65: *Upper band edge emission for 802.11ac VHT80 with MCS 0, average*

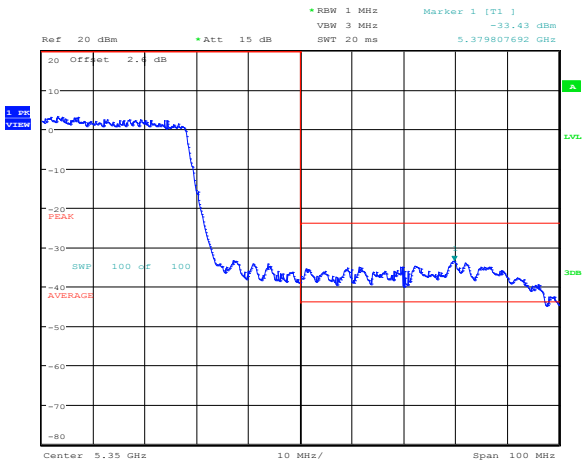


Figure 8.3-66: *Upper band edge emission for 802.11ac VHT80 with MCS 9, peak*

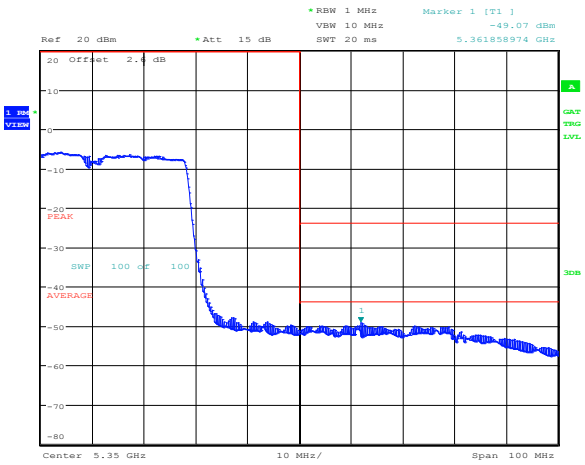


Figure 8.3-67: *Upper band edge emission for 802.11ac VHT80 with MCS 9, average*

Table 8.3-3: *Cabinet radiation measurements results within restricted bands*

Modulation	Frequency, MHz	Peak field strength, dBµV/m	Peak limit, dBµV/m	Peak margin, dB	Average field strength, dBµV/m	Average limit, dBµV/m	Average margin, dB
802.11a	5150	55.48	74.00	18.52	39.89	54.00	14.11
802.11a	5350	60.91	74.00	13.09	53.58	54.00	0.42
802.11n HT20	5150	58.38	74.00	15.62	33.98	54.00	20.02
802.11n HT20	5350	53.61	74.00	20.39	52.73	54.00	1.27
802.11n HT40	5150	46.28	74.00	27.72	35.21	54.00	18.79
802.11n HT40	5350	56.56	74.00	17.44	53.19	54.00	0.81
802.11ac VHT40	5150	43.89	74.00	30.11	34.17	54.00	19.83
802.11ac VHT40	5350	64.51	74.00	9.49	53.30	54.00	0.70
802.11ac VHT80	5150	53.25	74.00	20.75	45.13	54.00	8.87
802.11ac VHT80	5350	64.74	74.00	9.26	53.33	54.00	0.67

8.4 FCC 15.407(g) Frequency stability

8.4.1 Definitions and limits

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

8.4.2 Test summary

Test date	October 16, 2014	Temperature	21 °C
Test engineer	Andrey Adelberg	Air pressure	1007 mbar
Verdict	Pass	Relative humidity	31 %

8.4.3 Observations, settings and special notes

As per manufacturer specification the temperature operational range is 5–30 °C. Spectrum analyser settings:

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

8.4.4 Test data

Table 8.4-1: *Frequency drift measurement*

Test conditions	Frequency, GHz	Drift, Hz
+30 °C, Nominal	5.3000801285	0
+20 °C, +15 %	5.3000801285	0
+20 °C, Nominal	5.3000801285	*Reference*
+20 °C, −15 %	5.3000801285	0
+10 °C, Nominal	5.3000801285	0
+5 °C, Nominal	5.3001201925	40064

Table 8.4-2: *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	5.250275000	0	5.250275000	5.25	0.275000
802.11n HT20	5.250124615	0	5.250124615	5.25	0.124615
802.11n HT40	5.250096154	0	5.250096154	5.25	0.096154
802.11ac VHT40	5.250192208	0	5.250192208	5.25	0.192208
802.11ac VHT80	5.252019231	0	5.252019231	5.25	2.019231

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

Table 8.4-3: *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	5.330913402	40064	5.33095347	5.35	19.046534
802.11n HT20	5.330913462	40064	5.33095353	5.35	19.046474
802.11n HT40	5.330096154	40064	5.33013622	5.35	19.863782
802.11ac VHT40	5.329807892	40064	5.32984796	5.35	20.152044
802.11ac VHT80	5.331506410	40064	5.33154647	5.35	18.453526

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

8.5 FCC 15.407(h)(2) Radar Detection Function of Dynamic Frequency Selection (DFS)

8.5.1 Definitions and limits

(2) Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25–5.35 GHz and 5.47–5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W (23–30 dBm) is −64 dBm. For devices that operate with less than 200 mW (23 dBm) e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is −62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

(A) The requirement for channel availability check time applies in the master operational mode.

(B) The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

(iii) Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

Table 8.5-1: *DFS Response Requirement Values*

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds[1]
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period[1 and 2]
U-NII Detection Bandwidth	Minimum 80% of the 99% power bandwidth[3]

Notes:
[1] The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:
- For the Short pulse radar Test Signals this instant is the end of the Burst.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar Burst generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

[2] The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate Channel changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

[3] During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

Table 8.5-2: *Short Pulse Radar Test Waveforms*

Radar type	Pulse width, µs	Pulse Repetition Interval (PRI), µs	Number of pulses	Minimum percentage of successful detection	Minimum number of trials
0	1	1428	18	See note	See note
1	1	**Test A:** 15 unique PRI values randomly selected from the list of 23 PRI values in table below **Test B:** 15 unique PRI values randomly selected within the range of 518–3066 µs, with a minimum increment of 1 µs, excluding PRI values selected in Test A	Roundup{(1 ÷ 360) × (19 × 10^6 ÷ $PRI_{\mu s}$)}	60%	30
2	1–5	150–230	23–29	60%	30
3	6–10	200–500	16–18	60%	30
4	11–20	200–500	12–16	60%	30
Aggregate (Radar types 1–4)				80%	120

Note: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.

Table 8.5-3: *Pulse Repetition Intervals Values for Test A*

Pulse Repetition Frequency number	Pulse Repetition Frequency, Pulses per second	Pulse Repetition Interval (PRI), µs
1	1930.5	518
2	1818.7	538
3	1792.1	558
4	1730.1	578
5	1672.2	598
6	1618.1	618
7	1567.4	638
8	1519.8	658
9	1474.9	678
10	1432.7	698
11	1392.8	718
12	1355.0	738
13	1319.3	758
14	1285.3	778
15	1253.1	798
16	1222.5	818
17	1193.3	838
18	1165.6	858
19	1139.0	878
20	1113.6	898
21	1089.3	918
22	1066.1	938
23	326.2	3066

Table 8.5-4: *Long Pulse Radar Test Waveforms*

Radar type	Pulse width, µs	Chirp width, MHz	Pulse Repetition Interval (PRI), µs	Number of pulses per burst	Number of bursts	Minimum percentage of successful detection	Minimum number of trials
5	50–100	5–20	1000–2000	1–3	8–20	80%	30

Table 8.5-5: *Frequency Hopping Radar Test Waveforms*

Radar type	Pulse width, µs	Pulse Repetition Interval (PRI), µs	Pulses per hop	Hopping rate, kHz	Hopping sequence length, ms	Minimum percentage of successful detection	Minimum number of trials
6	1	333	9	0.333	300	70%	30

8.5.2 Test summary

Test date	January 22, 2015	Temperature	22 °C
Test engineer	Andrey Adelberg	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	32 %

8.5.3 Observations, settings and special notes

Since EUT is a client device without DFS radar detection mechanism, therefore only two tests are applicable: Channel Move Time and Channel Closing Transmission Time. Transmit channel was set at 5260 MHz. The Radar type 0 was supplied to a Master device antenna port. The testing was performed with the widest channel bandwidth, which is 80 MHz.

8.5.4 Test data

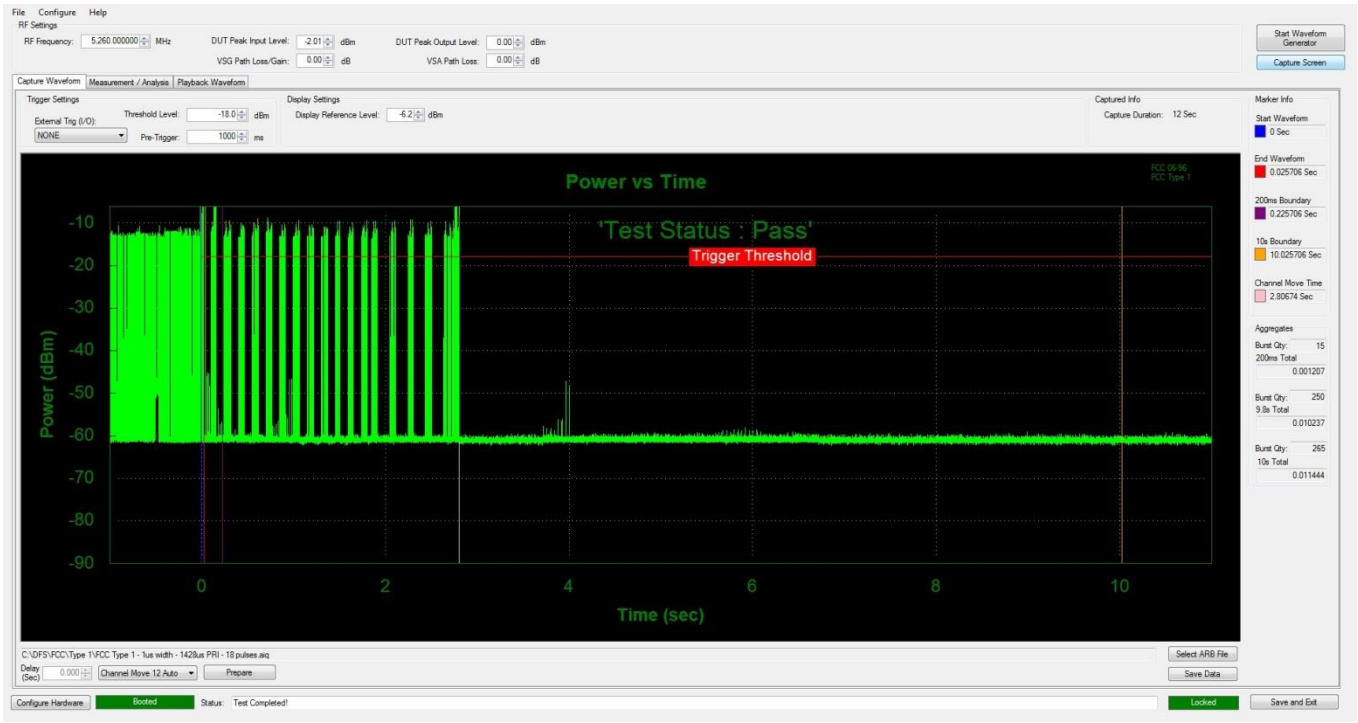


Figure 8.5-1: *Channel move time measurement*

Report Generated :22/01/2015

TestResult :Passed

Test Type :Channel Move Auto 12

Waveform : C:\DFS\FCC\Type 1\FCC Type 1 - 1us width - 1428us PRI - 18 pulses.aiq

Reported results are filtered. Any gaps in transmission less than 1E-05ms are assumed to be continuous transmission

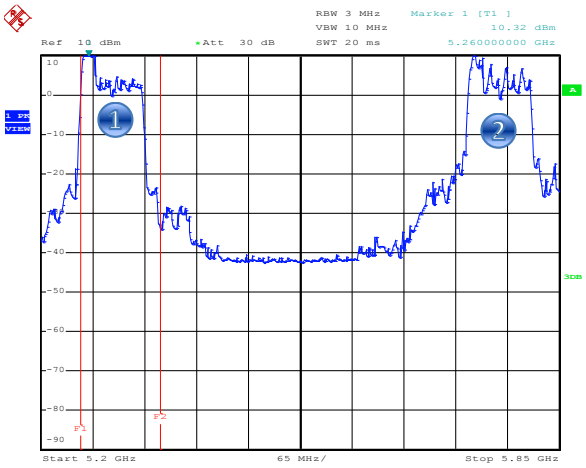
Aggregate time is calculated on filtered data

Timings Relative to Start of Capture

T1 : 25.706 (ms)

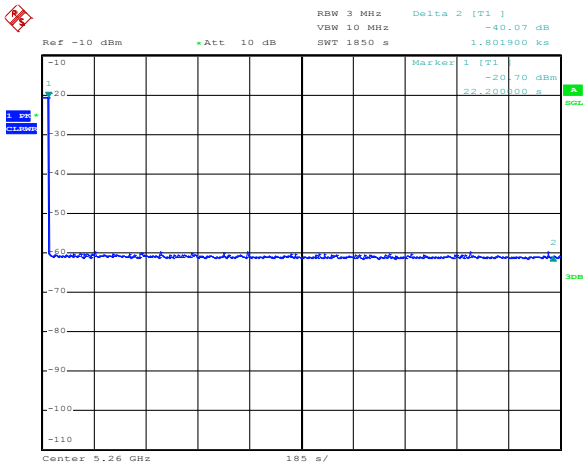
Transmission Duration by Region

Region	Start (sec)	End (sec)	Power Allowed (ms)	Power Measured (ms)	Pass/Fail
0	0	0.2	200	1.207	Pass
1	0.2	10	60	10.237	Pass
2	10	12	0	0	Pass



Date: 22.JAN.2015 13:19:10

Figure 8.5-2: *Channel move spectrum view. Initial transmission on channel marked as: 1, after Radar was detected, the channel was moved to 2. F1 and F2 depict the transmission band.*

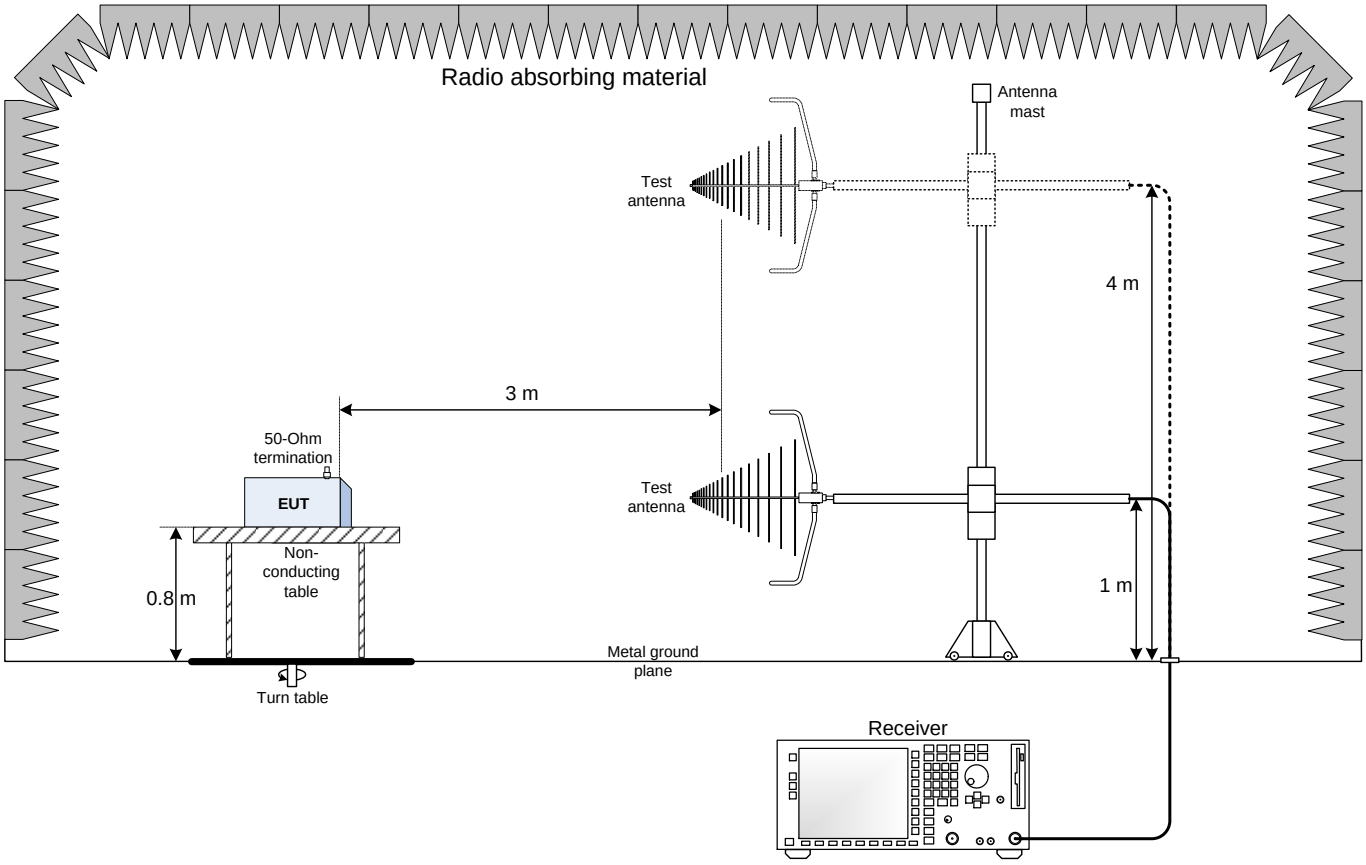


Date: 25.FEB.2015 11:21:07

Figure 8.5-3: *Client non-occupancy 30 minutes period test (30 minutes is 1800 seconds)*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Antenna terminal set-up