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Test report

312742-5R1TRFWL

Date of issue: November 28, 2016

Applicant:

Seiko Epson Corporation

Product:

Smart Glasses

Model:

H756A (BT-300)

FCC ID:

SKSH756A

IC Registration number:

1052D-H756A

Specifications:

- FCC 47 CFR Part 15 Subpart E, §15.407

  Unlicensed National Information Infrastructure Devises

- RSS-247, Issue 1, Section 6, May 2015

  Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

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Site number	FCC: 722545; IC: 2040G-5 (3 m semi anechoic chamber)

Tested by	Yong Huang, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Review date	November 28, 2016
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	Seiko Epson Corporation
Address	6925 Tazawa, Toyoshina, Azumino-shi, Nagano 399-8285 Japan

1.2 Test specifications

FCC 47 CFR Part 15, Subpart E, Clause 15.407	Unlicensed National Information Infrastructure Devises
RSS-247, Issue 1, May 2015	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

789033 D02 General U-NII Test Procedures New Rules v01r03 (August 22, 2016)	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

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

See “Summary of test results” for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued
R1TRF	Revised as per TCB review, typo corrected.

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]

Notes: [1]Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between 85 % and 115 % of the nominal rated supply voltage. No noticeable output power variation was observed

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

2.2 FCC Part 15 Subpart E, test results

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

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

2.3 IC RSS-GEN, Issue 4, test results

Part	Test description	Verdict
6.6	Occupied Bandwidth	Pass
7.1.2[1]	Receiver radiated emission limits	Not applicable
7.1.3[1]	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Pass
8.11[2]	Frequency stability	Pass

Notes: [1]According to sections 5.2 and 5.3 of RSS-Gen, Issue 4: if EUT does not have a stand-alone receiver neither scanner receiver, then it exempt from receiver requirements.

[2]According to section 8.11 of RSS-Gen, Issue 4: if the frequency stability of the licence-exempt radio apparatus is not specified in the applicable standard (RSS), measurement of the frequency stability is not required

2.4 IC RSS-247, Issue 1, test results

Section	Test description	Verdict
6.1 (1)[1]	Types of Modulation	Pass
6.2.1 (1)	Power limits for 5150–5250 MHz band	Not applicable
6.2.2 (1)	Power limits for 5250–5350 MHz band	Not applicable
6.2.3 (1)	Power limits for 5470–5600 MHz and 5650–5725 MHz bands	Not applicable
6.2.4 (1)	Power limits for 5725–5850 MHz band	Pass
6.2.4 (1)	Minimum 6 dB bandwidth	Not applicable
6.2.1 (2)	Unwanted emission limits for 5150–5250 MHz band	Not applicable
6.2.2 (2)	Unwanted emission limits for 5250–5350 MHz band	Not applicable
6.2.2 (2)	TPC requirements for devices with a maximum e.i.r.p. greater than 500 mW	Not applicable
6.2.2 (3)	e.i.r.p. at different elevations restrictions for 5250–5350 MHz band	Not applicable
6.2.3 (2)	Unwanted emission limits for 5470–5600 MHz and 5650–5725 MHz bands	Not applicable
6.2.4 (2)	Unwanted emission limits for 5725–5850 MHz band	Pass
6.3	Dynamic Frequency Selection (DFS) for devices operating in the bands 5250–5350 MHz, 5470–5600 MHz and 5650–5725 MHz	Not applicable

Notes: [1] The EUT employs digital modulations, such as: 802.11a, 802.11n HT20 and 802.11n HT40

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	October 4, 2016
Nemko sample ID number	133-003152 (Conducted sample) and 133-003139 (Radiated sample)

3.2 EUT information

Product name	Smart Glasses
Model	H756A (BT-300)
Model variant	N/A
Serial number	TCW27560112

3.3 Technical information

Applicant IC company number	1052D
IC UPN number	H756A
All used IC test site(s) Reg. number	2040G-5
RSS number and Issue number	RSS-247 Issue 1, Section 6, May 2015
Frequency band	5725–5850 MHz
Frequency Min (MHz)	5745(802.11a, 802.11n HT20 and 802.11ac VHT20) 5755(802.11n HT40 and 802.11ac VHT40) 5775(802.11ac VHT80)
Frequency Max (MHz)	5825(802.11a, 802.11n HT20 and 802.11ac VHT20) 5795(802.11n HT40 and 802.11ac VHT40) 5775(802.11ac VHT80)
RF power Min (W), Conducted	N/A
RF power Max (W), Conducted	0.0101(10.3 dBm, 802.11a) 0.0107(10.4 dBm, 802.11n. HT20) 0.0098(9.6 dBm, 802.11n.HT40) 0.0102(10.4 dBm, 802.11ac.VHT20) 0.0098(9.6 dBm, 802.11ac.VHT40) 0.0096(9.2 dBm,802.11ac VHT80)
Field strength, Units @ distance	N/A
Measured BW (kHz) (99% dB)	16730(802.11a) 18070(802.11n. HT20) 36590(802.11n.HT40) 18000(802.11ac.VHT20) 36490(802.11ac.VHT40) 76130 (802.11ac VHT80)
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	802.11a/n/ac
Emission classification (F1D, G1D, D1D)	W7D
Transmitter spurious, Units @ distance	44.3 dBµV/m @ 3m, Quasi-peak
Power requirements	5 VDC (Powered via external AC-DC adapter 100–240 VAC 50–60 Hz) and via battery
Antenna information	The EUT uses a non-detachable antenna to the intentional radiator. As per customer the antenna gain is 2.4 dBi at 5 GHz band

3.4 Product description and theory of operation

EUT is a smart glass with see-through lenses, which allows to overlay images on actual view. The virtual images were provided by a controller.

3.5 EUT exercise details

EUT was set to test modes during tests, by software drivers provided by customer.

3.6 EUT setup diagram

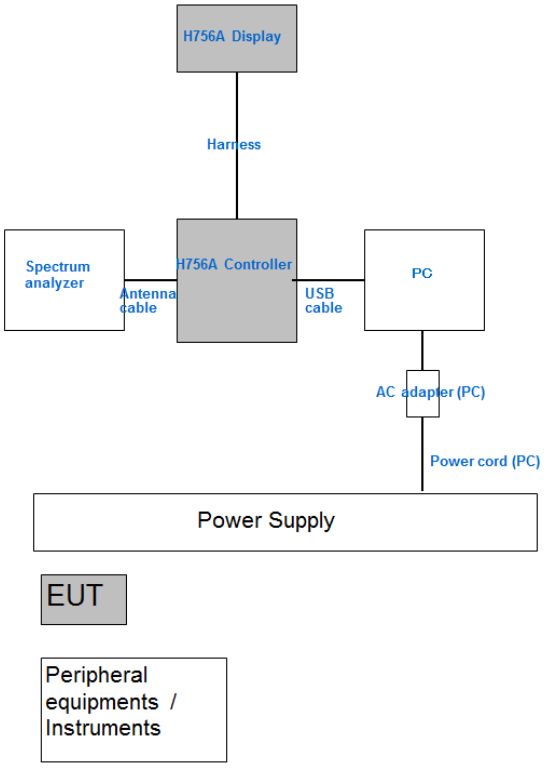


Figure 3.6-1: *Setup diagram*

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

EUT could be configured to different data rates. From preliminary investigation, the following was chosen to be worst case to present in this report: 6Mbps in 802.11a, MCS0 in 802.11n and MCS0 in 802.11ac.

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

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

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

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002532	2 year	May 25/17
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
spectrum analyzer	Rohde & Schwarz	FSV 40	FA002731	1 year	Apr 06/17
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	March 23/17
Biconical antenna (30–300 MHz)	Sunol	BC2	FA002078	1 year	March 4/17
Log periodic antenna (200–5000 MHz)	Sunol	LP5	FA002077	1 year	March 14/17
Horn antenna (1–18 GHz)	EMCO	RGA-60	FA002577	1 year	April 5/17
Horn antenna (18–40 GHz)	EMCO	3116	FA002487	2 year	Aug. 16/17
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	May 6/17
Pre-amplifier (18–40 GHz)	COM-POWER	PAM-840	FA002508	1 year	May 6/17
50 Ω coax cable	C.C.A.	None	FA002603	—	VOU
50 Ω coax cable	C.C.A.	None	FA002605	—	VOU
50 Ω coax cable	C.C.A.	None	FA002607	—	VOU
Signal generator	Rohde & Schwarz	SMR 40	FA002698	1 year	May 10/17
Power Sensor	Rhode & Schwarz	NRP18S	FA002730	1 year	Mar. 14/17
Environmental Chamber	ESPEC	EPX-4H	FA002736	1 year	Jan. 18/17
LISN	Rohde & Schwarz	ENV216	FA002514	1 year	Nov. 20/16
Power source	California Instruments	5001ix	FA002494	1 year	Apr 29/17

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

Section 8. Testing data

8.1 FCC 15.403(i) Emission bandwidth

8.1.1 Definitions and limits

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

8.1.2 Test summary

Test date	November 8, 2016	Temperature	25 °C
Test engineer	Yong Huang	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	30 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	approximately 1% of the emission bandwidth
Video bandwidth	> RBW
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Table 8.1-1: *26 dB bandwidth results*

Modulation	Frequency, MHz	26 dB bandwidth, MHz
802.11a	5745	21.50
	5785	21.38
	5825	21.47
802.11n HT20	5745	21.73
	5785	21.62
	5825	21.70
802.11n HT40	5755	40.32
	5795	40.27
802.11ac VHT20	5745	21.67
	5785	21.67
	5825	21.57
802.11ac VHT40	5755	40.32
	5795	40.44
802.11ac VHT80	5775	82.00

8.1.4 Test data, continued

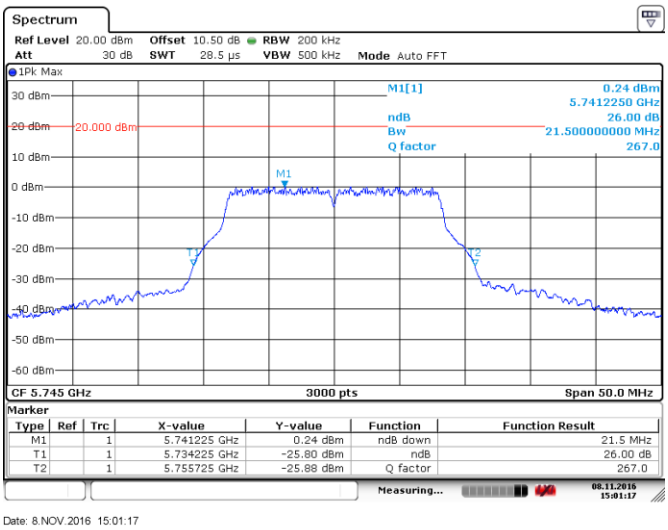


Figure 8.1-1: *26 dB bandwidth on 802.11a, sample plot*

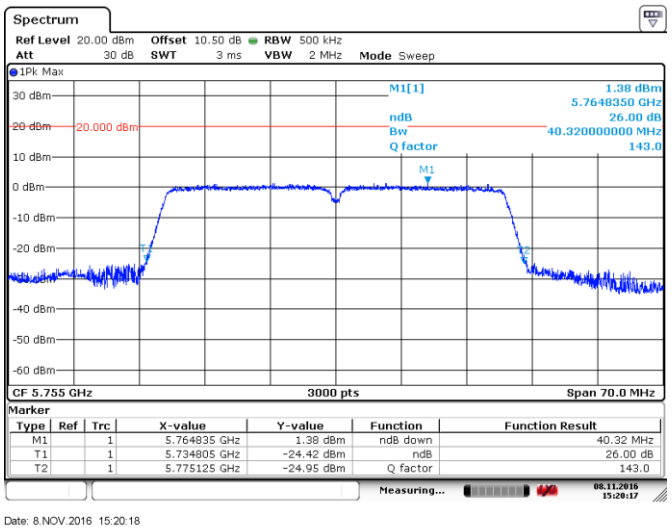


Figure 8.1-2: *26 dB bandwidth on 802.11n HT40, sample plot*

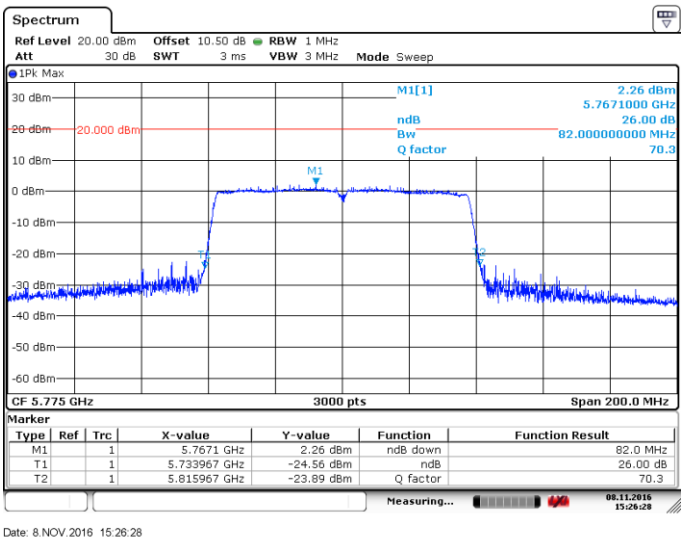


Figure 8.1-3: *26 dB bandwidth on 802.11ac VHT80, sample plot*

8.2 FCC 15.407(e) and RSS-247 6.2.4 (1) Minimum 6 dB bandwidth

8.2.1 Definitions and limits

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

8.2.2 Test summary

Test date	November 8, 2016	Temperature	25 °C
Test engineer	Yong Huang	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	30 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

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

8.2.4 Test data

Table 8.2-1: *6 dB bandwidth results*

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Margin, MHz
802.11a	5745	16.34	0.5	15.84
	5785	16.42	0.5	15.92
	5825	16.40	0.5	15.90
802.11n HT20	5745	17.68	0.5	17.18
	5785	17.68	0.5	17.18
	5825	17.65	0.5	17.15
802.11n HT40	5755	36.12	0.5	35.62
	5795	36.17	0.5	35.67
802.11ac VHT20	5745	17.67	0.5	17.17
	5785	17.65	0.5	17.15
	5825	17.65	0.5	17.15
802.11ac VHT40	5755	36.49	0.5	35.99
	5795	36.51	0.5	36.01
802.11ac VHT80	5775	76.06	0.5	75.56

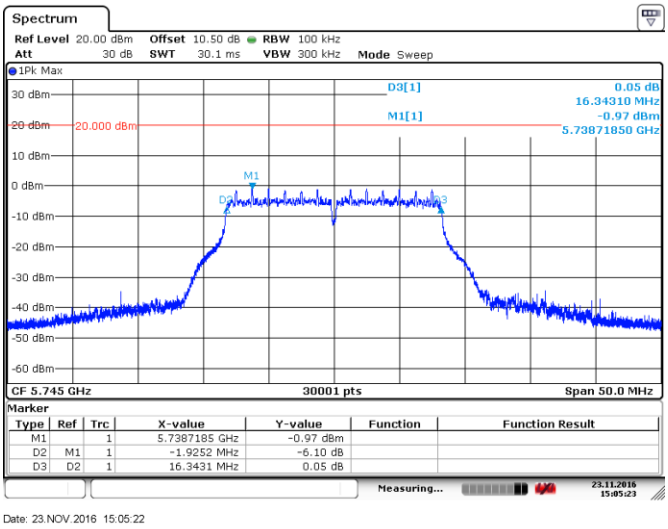


Figure 8.2-1: *6 dB bandwidth on 802.11a, sample plot*

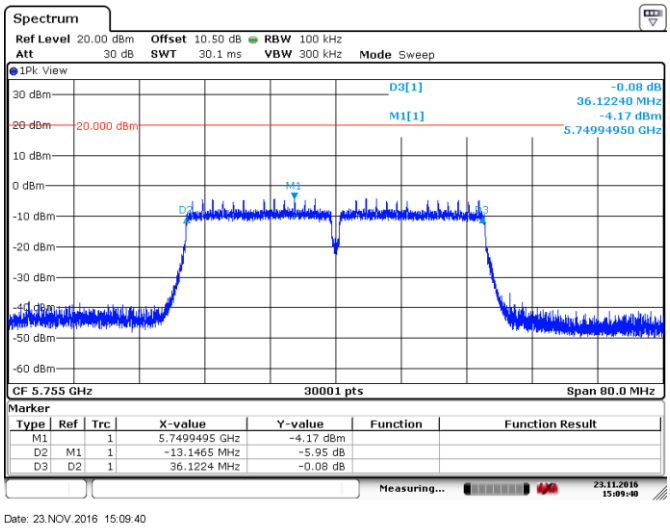


Figure 8.2-2: *6 dB bandwidth on 802.11n HT40, sample plot*

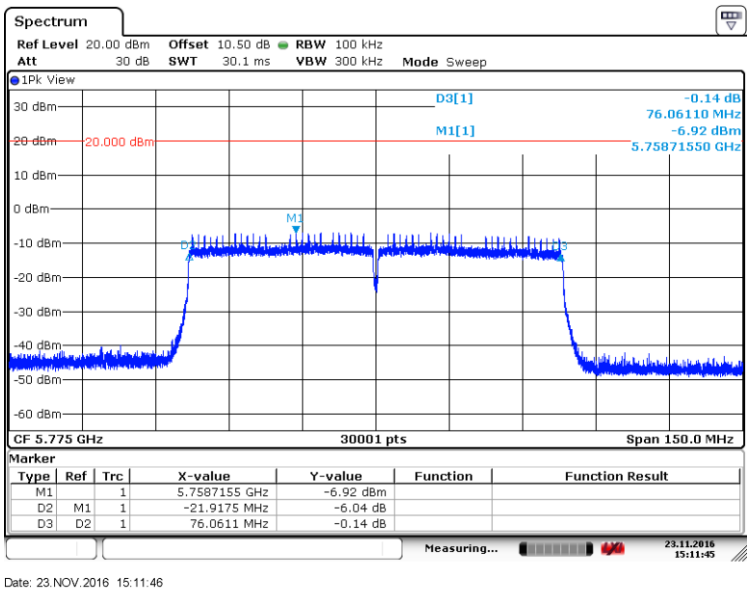


Figure 8.2-3: *6 dB bandwidth on 802.11ac VHT80, sample plot*

8.3 RSS-Gen 6.6 Occupied bandwidth

8.3.1 Definitions and limits

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

8.3.2 Test summary

Test date	November 8, 2016	Temperature	25 °C
Test engineer	Yong Huang	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	30 %

8.3.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	1 % to 5 % of the OBW
Video bandwidth:	≥3 × RBW
Detector mode:	Peak
Trace mode:	Max Hold

8.3.4 Test data

Table 8.3-1: *99 % bandwidth results*

Modulation	Frequency, MHz	99 % bandwidth, MHz
802.11a	5745	16.62
	5785	16.67
	5825	16.73
802.11n HT20	5745	18.03
	5785	17.95
	5825	18.07
802.11n HT40	5755	36.54
	5795	36.59
802.11ac VHT20	5745	17.93
	5785	17.95
	5825	18.00
802.11ac VHT40	5755	36.49
	5795	36.49
802.11ac VHT80	5775	76.13

8.3.4 Test data, continued

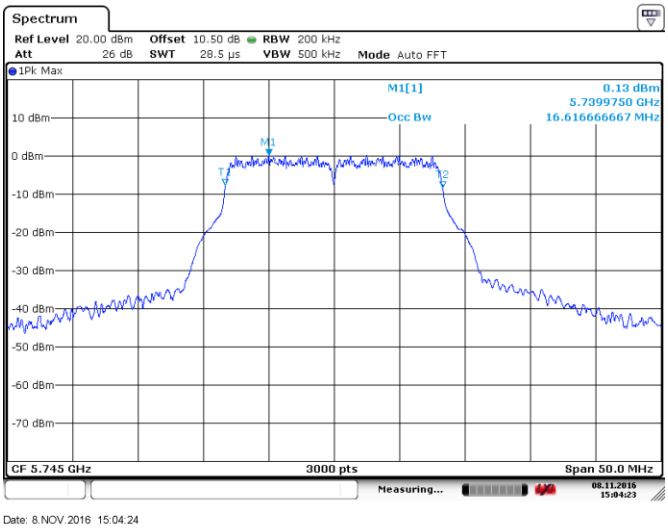


Figure 8.3-1: *99 % bandwidth on 802.11a, sample plot*

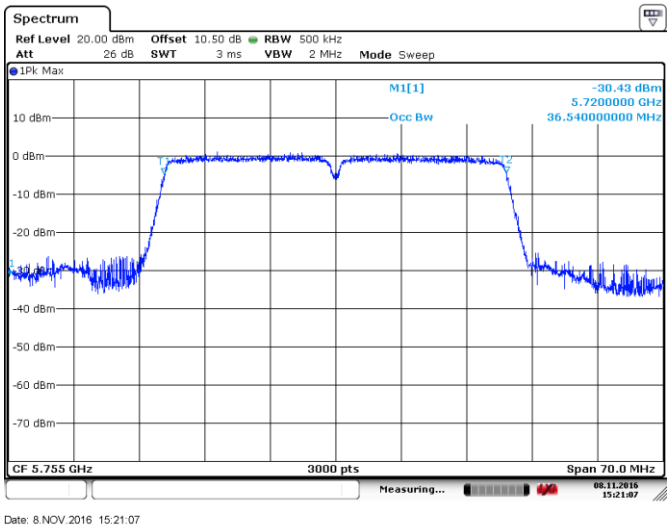


Figure 8.3-2: *99 % bandwidth on 802.11n HT40, sample plot*

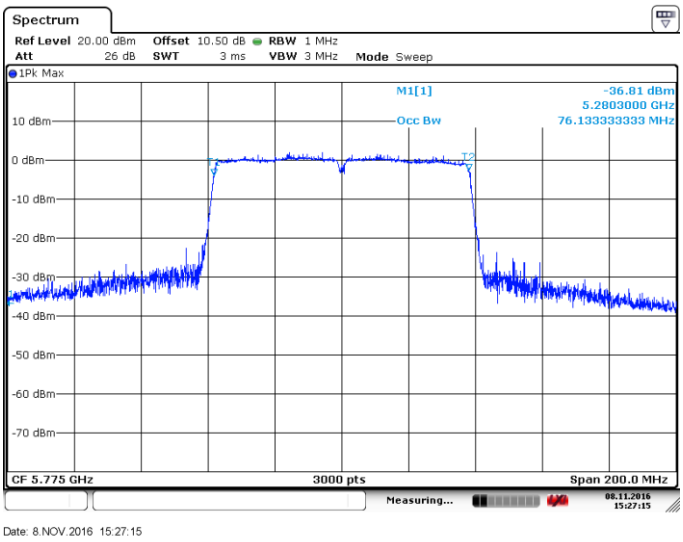


Figure 8.3-3: *99 % bandwidth on 802.11ac VHT80, sample plot*

8.4 FCC 15.407(a)(3) and RSS-247 6.2.4(1) 5.725–5.85 GHz band output power and spectral density limits

8.4.1 Definitions and limits

FCC:
For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

IC:
The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

8.4.2 Test summary

Test date	November 8, 2016	Temperature	25 °C
Test engineer	Yong Huang	Air pressure	1015 mbar
Verdict	Pass	Relative humidity	30 %

8.4.3 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).

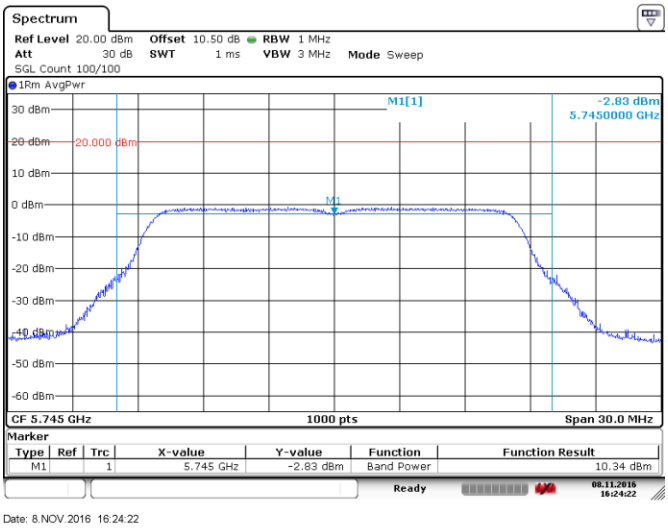
8.4.4 Test data

Table 8.4-1: *Output power measurements results*

Modulation	Frequency, MHz	Conducted output power, dBm	Power limit, dBm	Margin, dB
802.11a	5745	10.3	30	19.7
	5785	10.0	30	20.0
	5825	9.6	30	20.4
802.11n HT20	5745	10.4	30	19.6
	5785	10.0	30	20.0
	5825	9.6	30	20.4
802.11n HT40	5755	9.6	30	20.4
	5795	9.2	30	20.8
802.11ac VHT20	5745	10.4	30	19.6
	5785	9.9	30	20.1
	5825	9.7	30	20.3
802.11ac VHT40	5755	9.6	30	20.4
	5795	9.2	30	20.8
802.11ac VHT80	5775	9.2	30	20.8

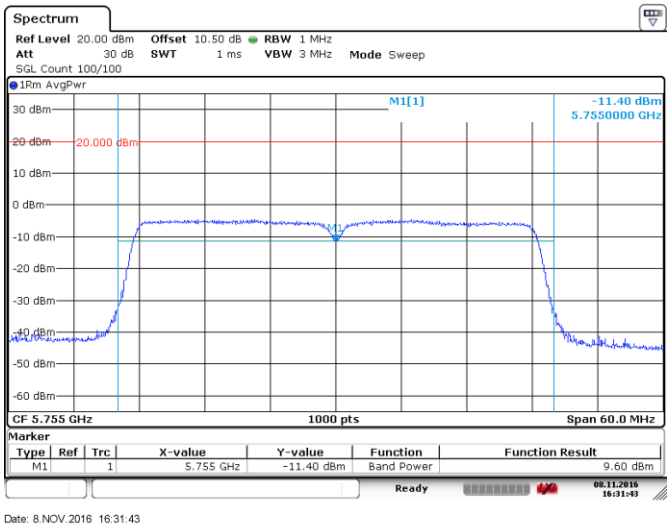
Table 8.4-2: *PSD measurements results*

Modulation	Frequency, MHz	PSD, dBm/0.5 MHz	PSD limit, dBm/0.5 MHz	Margin, dB
802.11a	5745	-3.3	30	33.29
	5785	-3.6	30	33.61
	5825	-4.2	30	34.24
802.11n HT20	5745	-3.8	30	33.8
	5785	-4.1	30	34.1
	5825	-4.6	30	34.6
802.11n HT40	5755	-7.3	30	37.3
	5795	-7.7	30	37.7
802.11ac VHT20	5745	-3.7	30	33.74
	5785	-4.0	30	34.04
	5825	-4.4	30	34.4
802.11ac VHT40	5755	-7.4	30	37.4
	5795	-7.9	30	37.9
802.11ac VHT80	5775	-10.6	30	40.6



Date: 8.NOV.2016 16:24:22

Figure 8.4-1: *Sample plot for power on 802.11a*



Date: 8.NOV.2016 16:31:43

Figure 8.4-2: *Sample plot for power on 802.11n HT40*

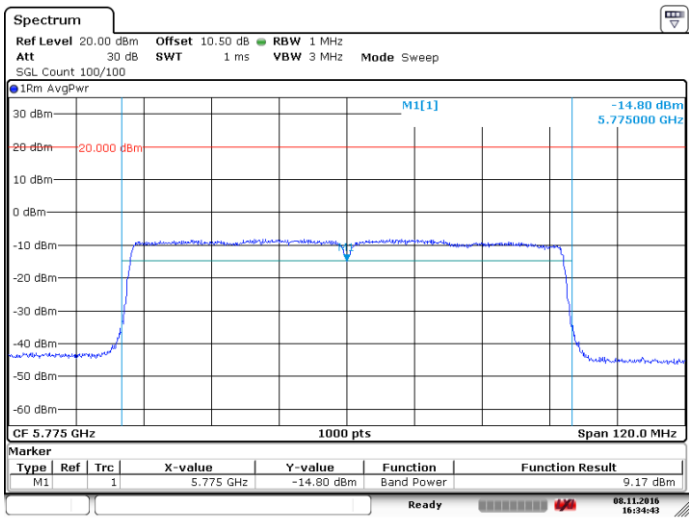


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Figure 8.4-3: *Sample plot for power and PSD on 802.11ac VHT80*

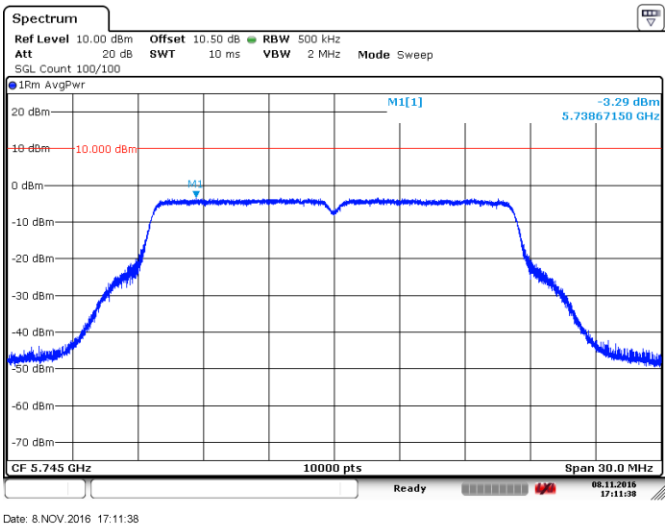

Figure 8.4-4: *Sample plot for PSD on 802.11a*

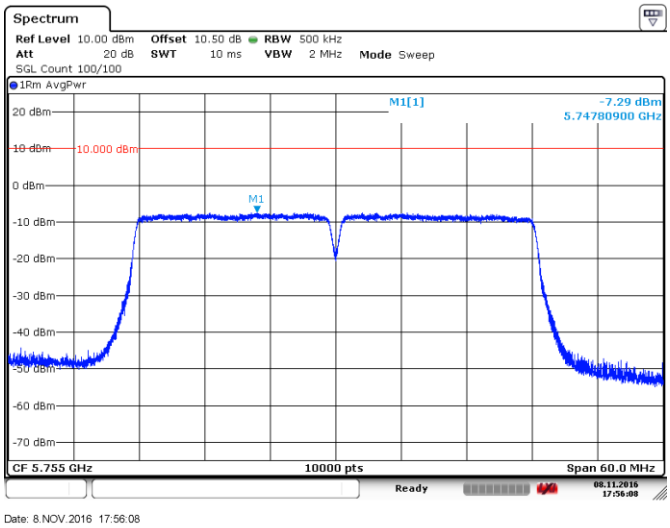

Figure 8.4-5: *Sample plot for PSD on 802.11n HT40*

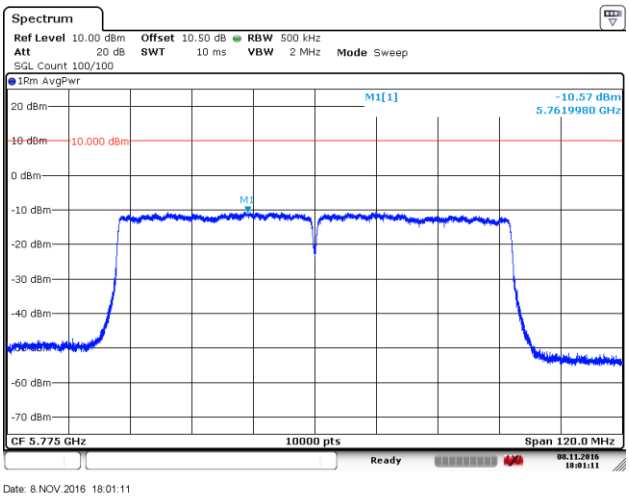

Figure 8.4-6: *Sample plot for PSD on 802.11ac VHT80*

8.5 FCC 15.407(b) and RSS-247 6.2.2(2) Undesirable (unwanted) emissions

8.5.1 Definitions and limits

FCC:
(4) For transmitters operating in the 5.725–5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

(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.

IC:
For the band 5725–5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz e.i.r.p.

For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed -27 dBm/MHz.

RSS-Gen 8.10 Emissions falling within restricted frequency bands
Restricted bands, identified in Table 8.5-2, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:
(a) fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of below;
(b) unwanted emissions falling into restricted bands of below shall comply with the limits specified in RSS-Gen;
(c) unwanted emissions not falling within restricted frequency bands shall either comply with the limits specified in the applicable RSS, or with those specified in RSS-Gen.

Table 8.5-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

Frequency, MHz	Field strength of emissions µV/m	Field strength of emissions dBµV/m	Measurement distance, m
0.009–0.490	2400/F *(F in kHz)*	$67.6 – 20 \times \log_{10}(F)$ *(F in kHz)*	300
0.490–1.705	24000/F *(F in kHz)*	$87.6 – 20 \times \log_{10}(F)$ *(F in kHz)*	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

8.5.1 Definitions and limits, continued

Table 8.5-2: *IC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.5-2 and above 38.6 GHz are designated for low-power license-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

Table 8.5-3: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.5.2 Test summary

Test date:	November 8, 2016 to November 13, 2016	Temperature:	24 °C
Test engineer:	Yong Huang	Air pressure:	1010 mbar
Verdict:	Pass	Relative humidity:	40 %

8.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz.
EUT was set to transmit with 100 % duty cycle.
Radiated measurements were performed at a distance of 3 m. Radiated emissions were performed 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 – 4.7 dB = -45.93 dBm
Antenna gain is included in the offset of the measurement.

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 = -41.23 dBm/MHz
Antenna gain is included in the offset of the measurement.

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: -41.23 dBm/MHz + 20 dB = -21.23 dBm/MHz
Antenna gain is included in the offset of the measurement.

Spectrum analyser for peak conducted measurements outside restricted bands:

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

8.5.4 Test data

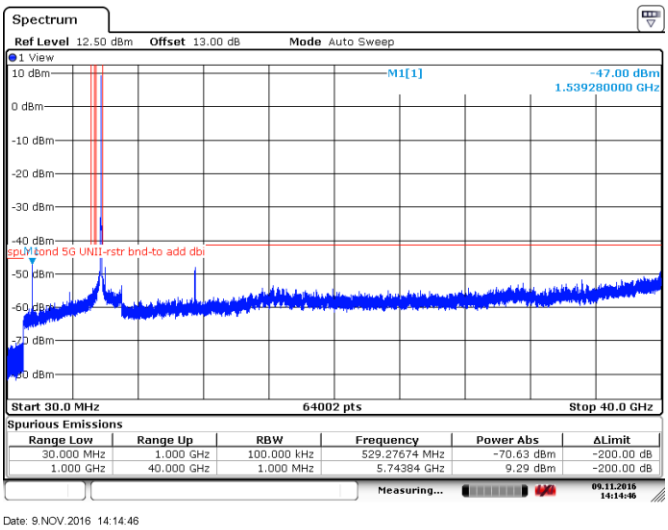

Figure 8.5-1: *Peak spurious emissions within restricted bands at low channel, 802.11a, ch149*

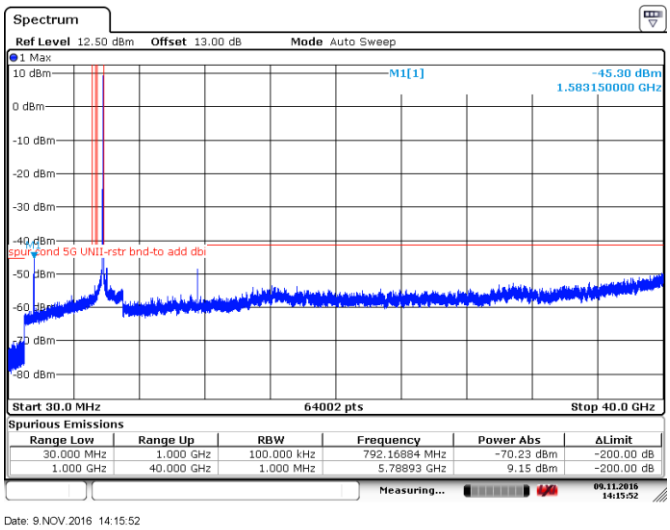

Figure 8.5-2: *Peak spurious emissions within restricted bands at mid channel, 802.11a, ch157*

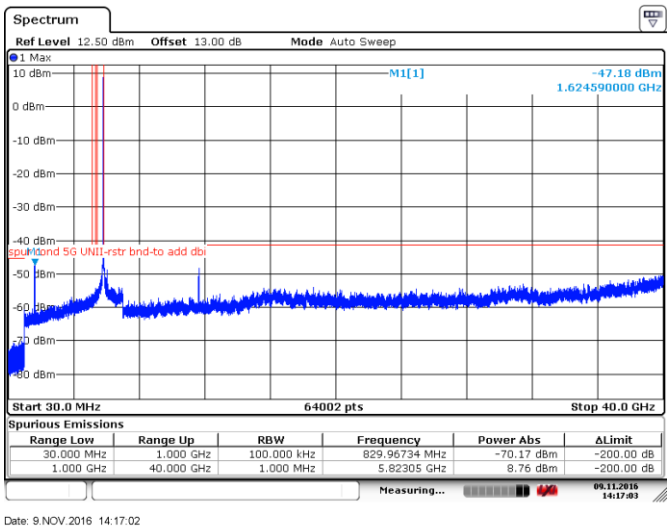

Figure 8.5-3: *Peak spurious emissions within restricted bands at high channel, 802.11a, ch165*

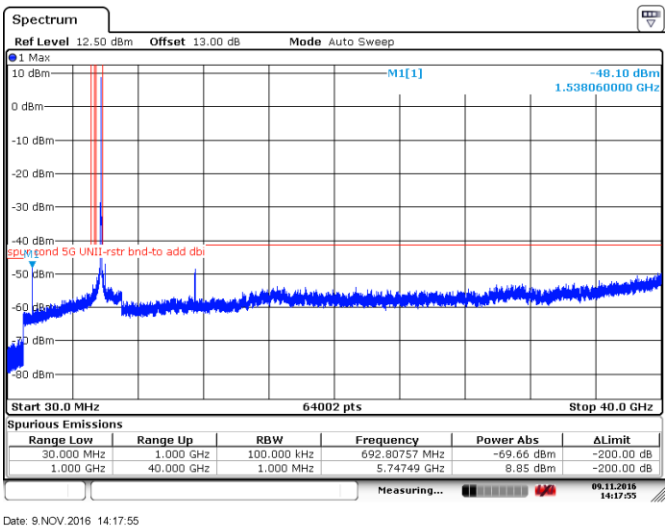

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Figure 8.5-4: *Peak spurious emissions within restricted bands at low channel, 802.11n-HT20, ch149*

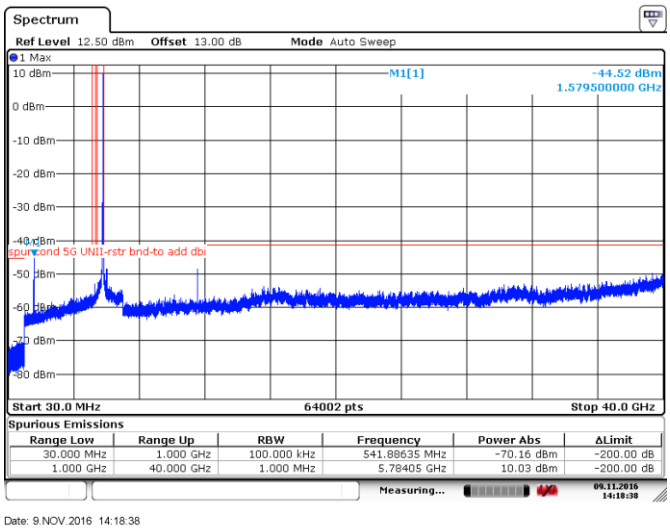

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Figure 8.5-5: *Peak spurious emissions within restricted bands at mid channel, 802.11n-HT20, ch157*

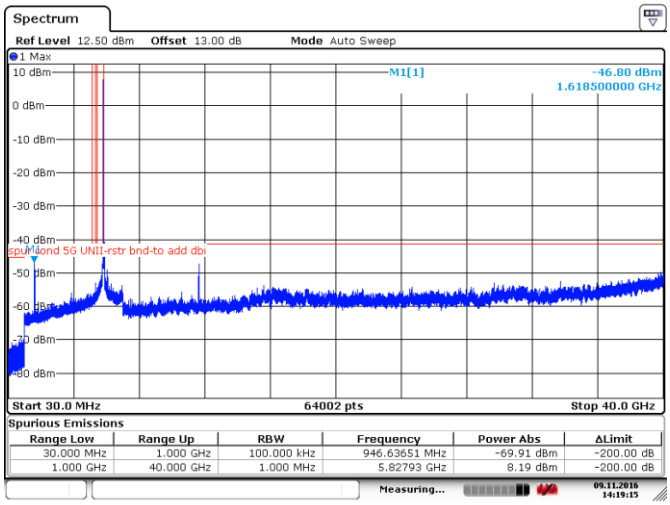

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Figure 8.5-6: *Peak spurious emissions within restricted bands at high channel, 802.11n-HT20, ch165*

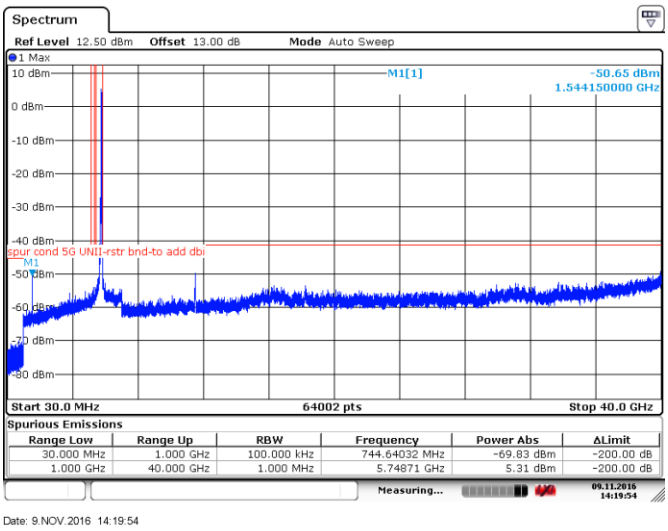

Figure 8.5-7: *Peak spurious emissions within restricted bands at low channel, 802.11n-HT40, ch149*

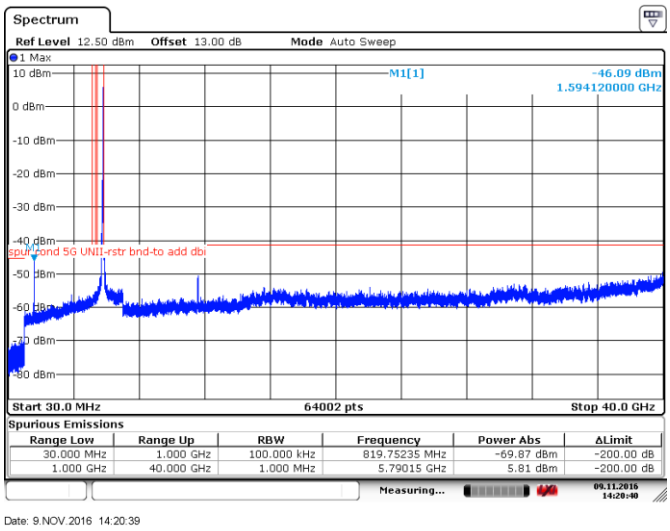

Figure 8.5-8: *Peak spurious emissions within restricted bands at high channel, 802.11n-HT40, ch157*

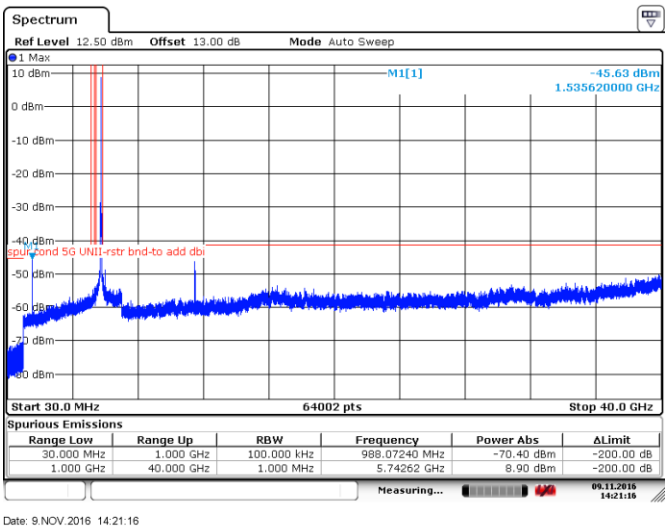

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Figure 8.5-9: *Peak spurious emissions within restricted bands at low channel, 802.11ac-VHT20, ch149*

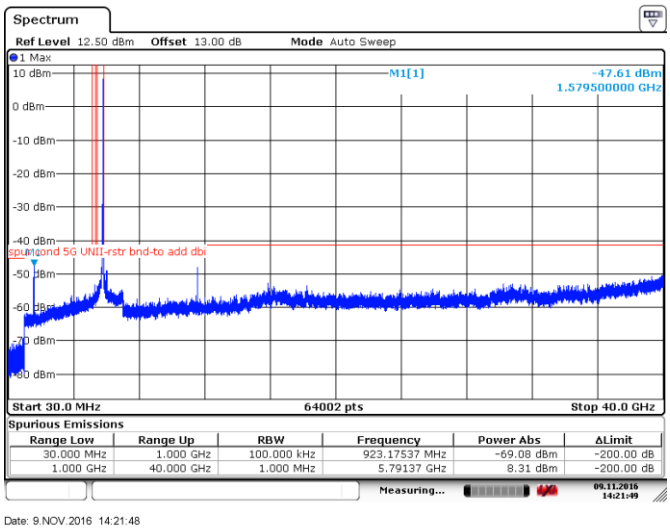

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Figure 8.5-10: *Peak spurious emissions within restricted bands at mid channel, 802.11ac-VHT20, ch157*

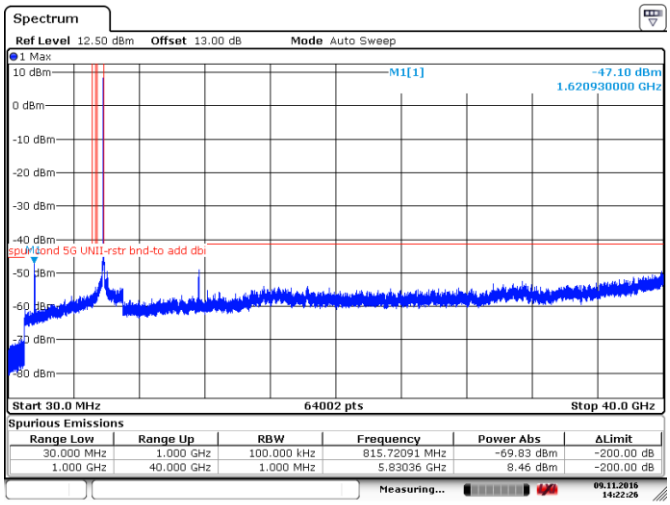

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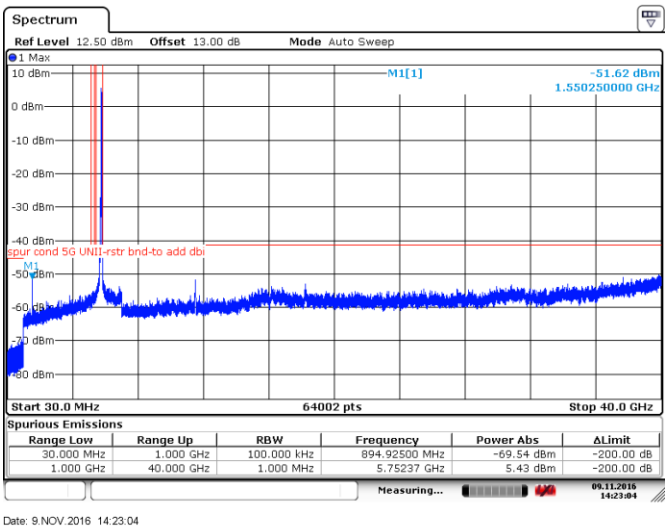
Figure 8.5-11: *Peak spurious emissions within restricted bands at high channel, 802.11ac-VHT20, ch165*



Date: 9.NOV.2016 14:23:04

Figure 8.5-12: *Peak spurious emissions within restricted bands at low channel, 802.11ac-VHT40, ch149*

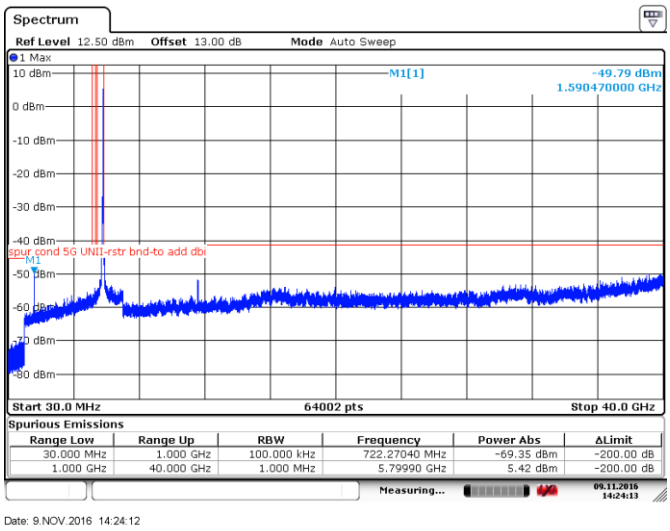


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Figure 8.5-13: *Peak spurious emissions within restricted bands at high channel, 802.11ac-VHT40, ch157*

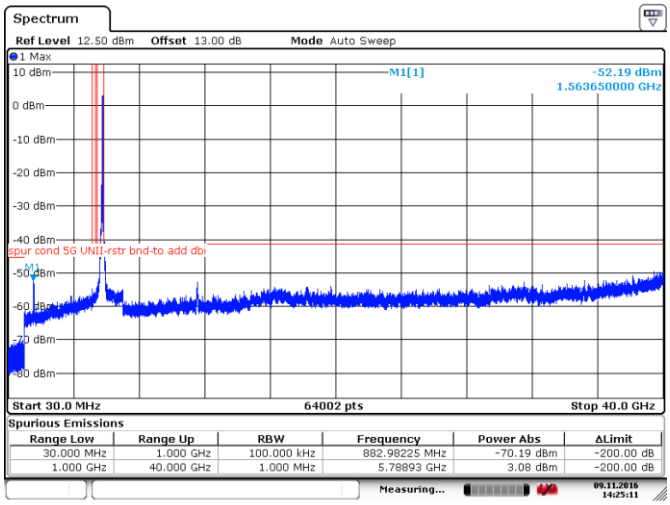

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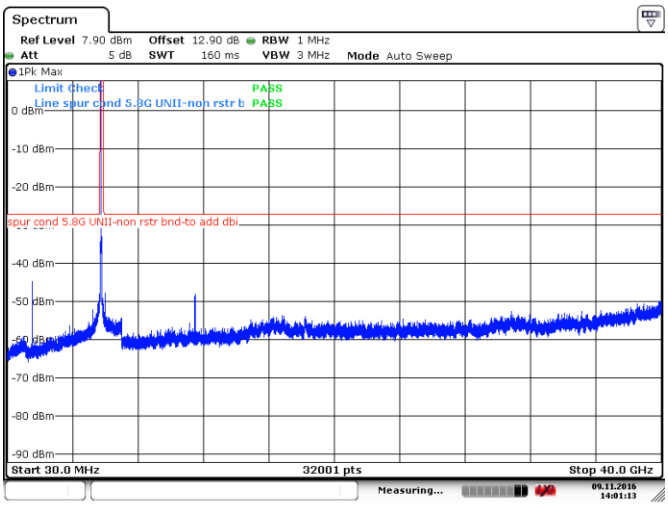
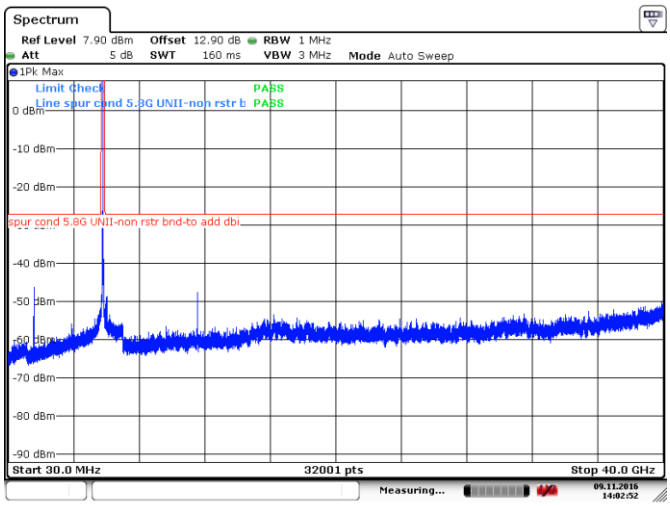
Figure 8.5-14: *Peak spurious emissions within restricted bands, 802.11ac-VHT80, ch149*



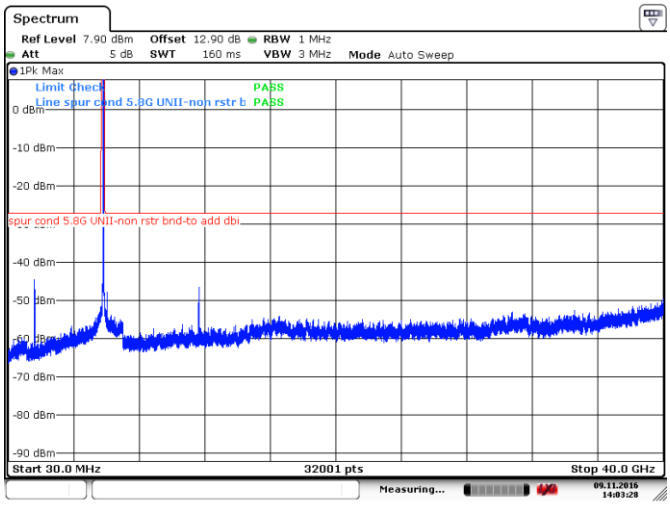
Date: 9.NOV.2016 14:01:13

Figure 8.5-15: *Peak spurious emissions outside restricted bands at low channel, 802.11a, ch149*



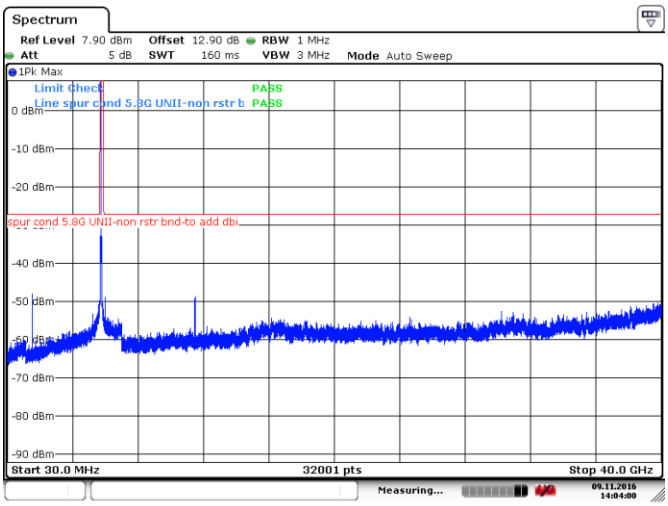
Date: 9.NOV.2016 14:02:52

Figure 8.5-16: *Peak spurious emissions outside restricted bands at mid channel, 802.11a, ch157*



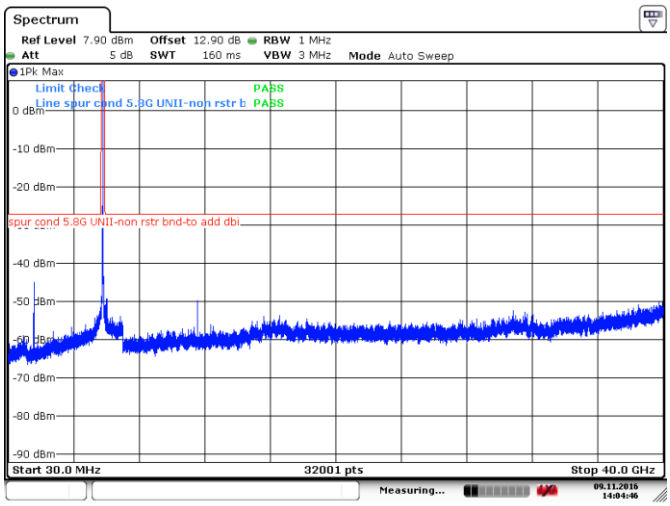
Date: 9.NOV.2016 14:03:28

Figure 8.5-17: *Peak spurious emissions outside restricted bands at high channel, 802.11a, ch165*



Date: 9.NOV.2016 14:04:00

Figure 8.5-18: *Peak spurious emissions outside restricted bands at low channel, 802.11n-HT20, ch149*



Date: 9.NOV.2016 14:04:45

Figure 8.5-19: *Peak spurious emissions outside restricted bands at mid channel, 802.11n-HT20, ch157*

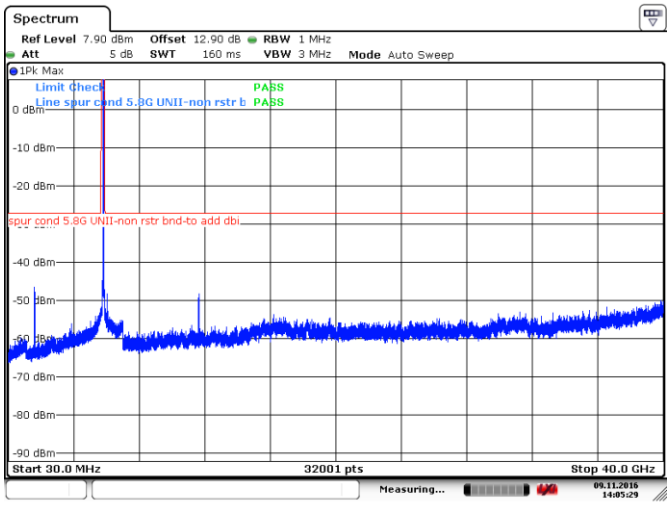


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Figure 8.5-20: *Peak spurious emissions outside restricted bands at high channel, 802.11n-HT20, ch165*

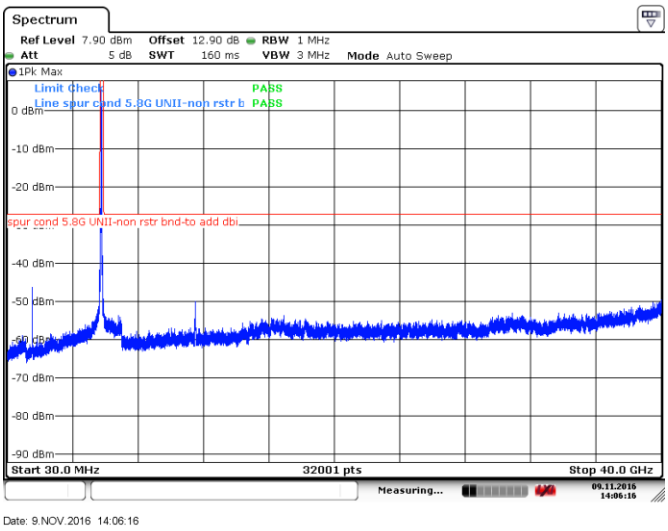

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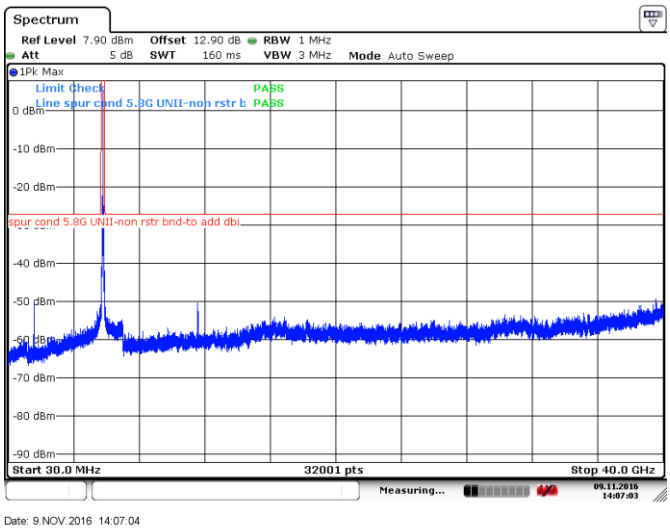
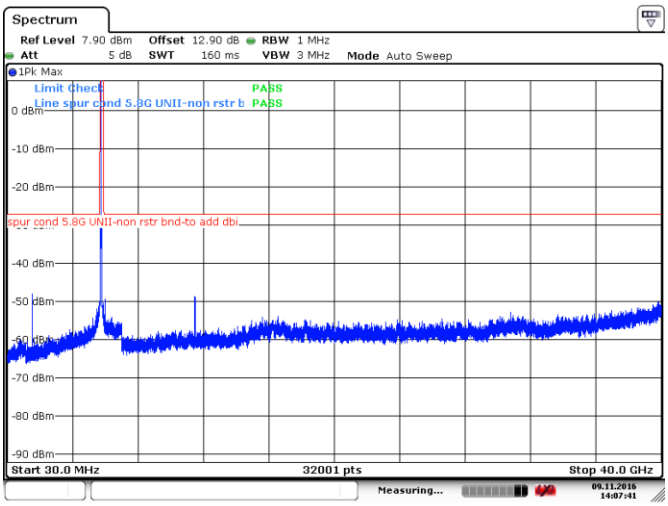
Figure 8.5-21: *Peak spurious emissions outside restricted bands at low channel, 802.11n-HT40, ch149*



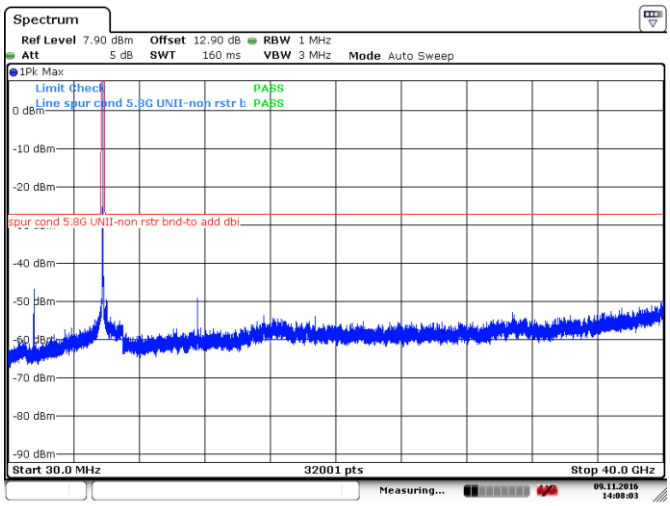
Date: 9.NOV.2016 14:07:04

Figure 8.5-22: *Peak spurious emissions outside restricted bands at high channel, 802.11n-HT40, ch157*



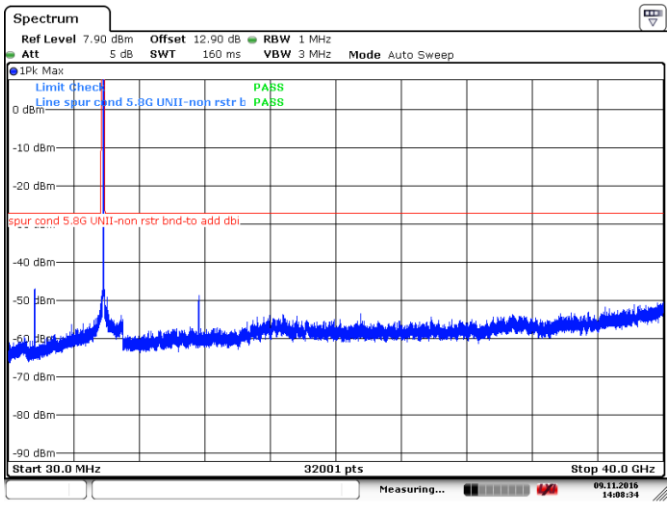
Date: 9.NOV.2016 14:07:41

Figure 8.5-23: *Peak spurious emissions outside restricted bands at low channel, 802.11ac-VHT20, ch149*



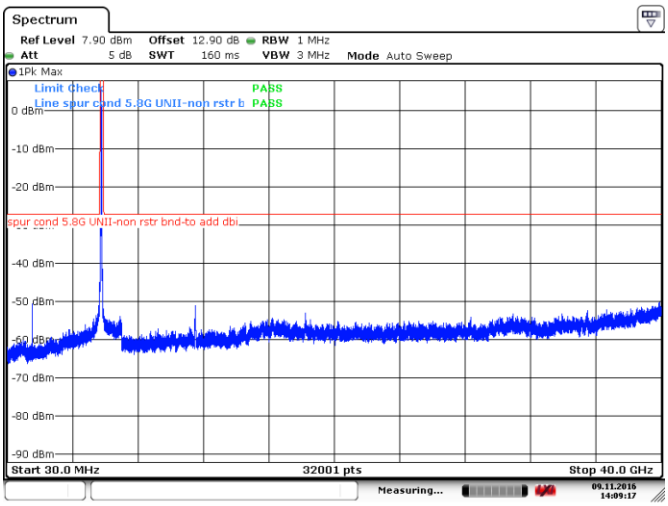
Date: 9.NOV.2016 14:08:04

Figure 8.5-24: *Peak spurious emissions outside restricted bands at mid channel, 802.11ac-VHT20, ch157*



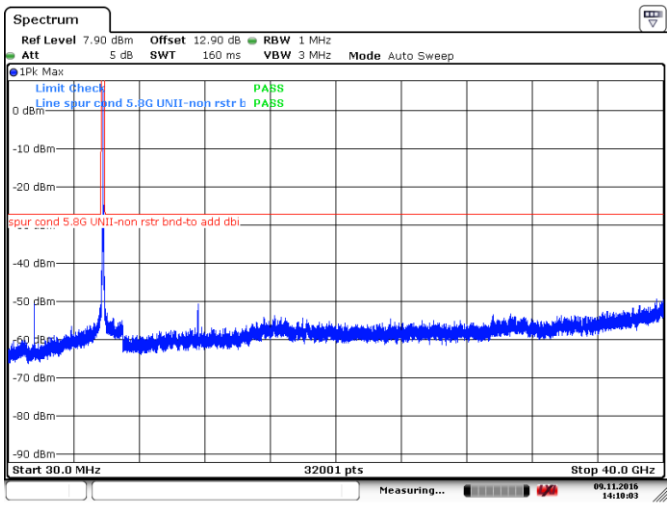
Date: 9.NOV.2016 14:08:34

Figure 8.5-25: *Peak spurious emissions outside restricted bands at high channel, 802.11ac-VHT20, ch165*



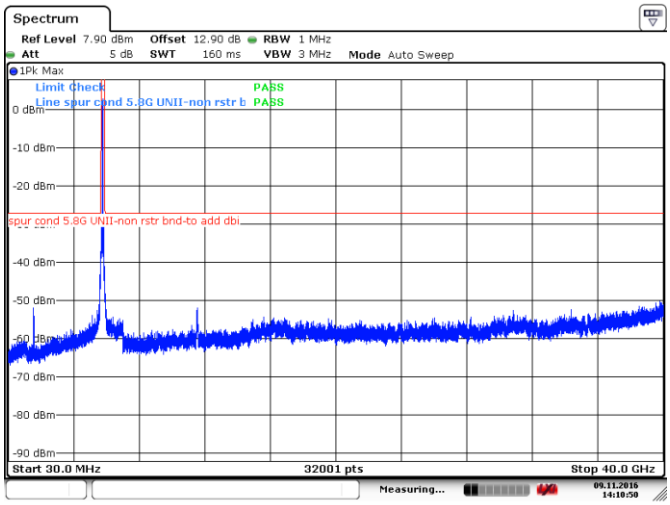
Date: 9.NOV.2016 14:09:17

Figure 8.5-26: *Peak spurious emissions outside restricted bands at low channel, 802.11ac-VHT40, ch149*



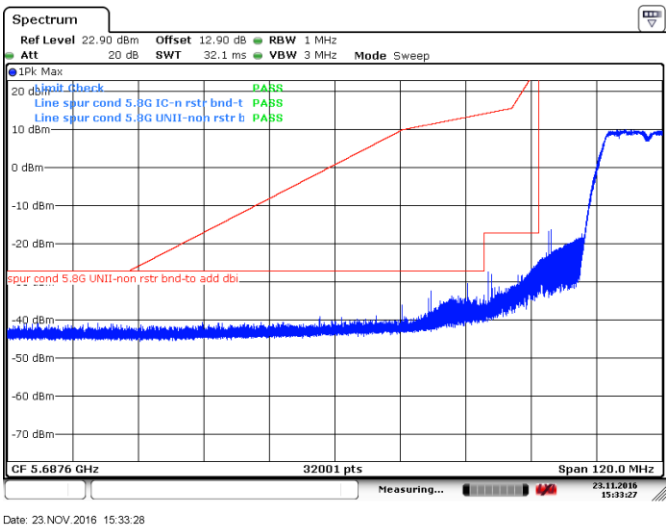
Date: 9.NOV.2016 14:10:03

Figure 8.5-27: *Peak spurious emissions outside restricted bands at high channel, 802.11ac-VHT40, ch157*



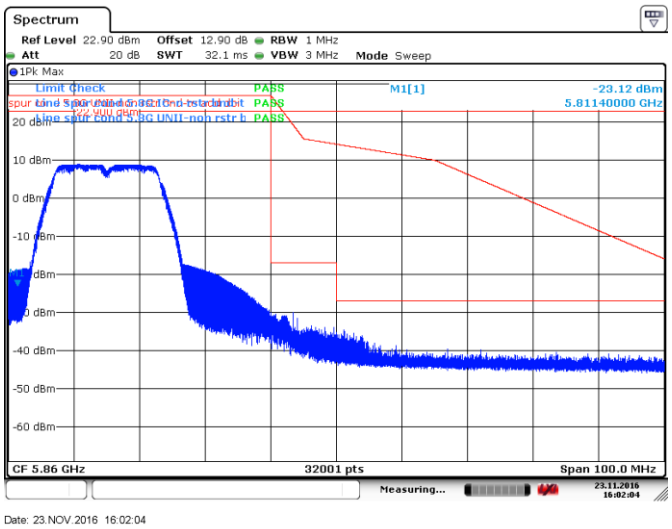
Date: 9.NOV.2016 14:10:49

Figure 8.5-28: *Peak spurious emissions outside restricted bands , 802.11ac-VHT80, ch149*



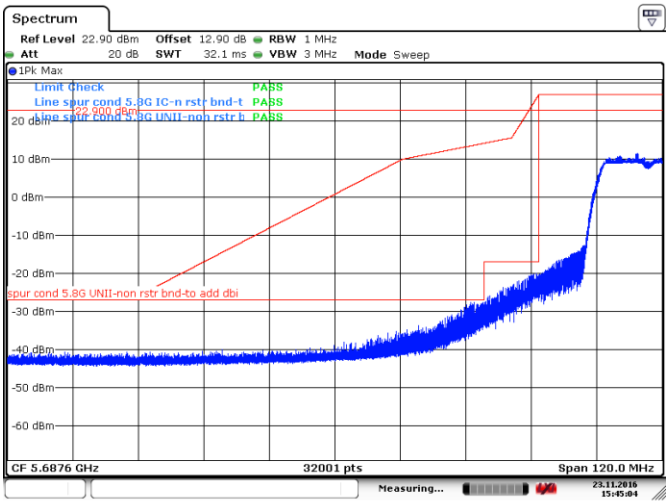
Date: 23.NOV.2016 15:33:28

Figure 8.5-29: *Lower band edge emission, 802.11a*



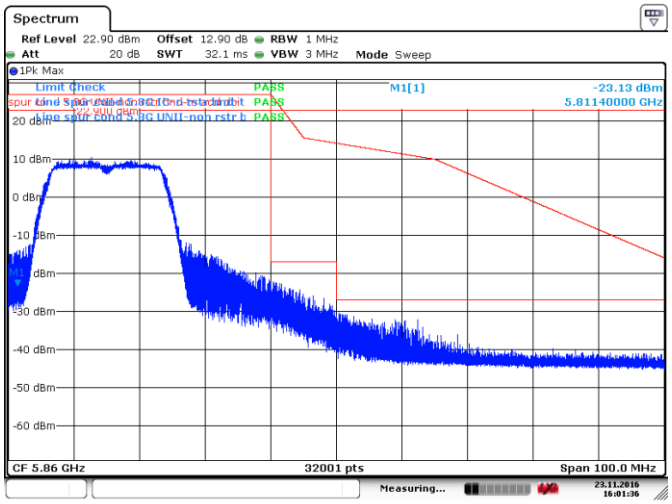
Date: 23.NOV.2016 16:02:04

Figure 8.5-30: *Upper band edge emission, 802.11a*



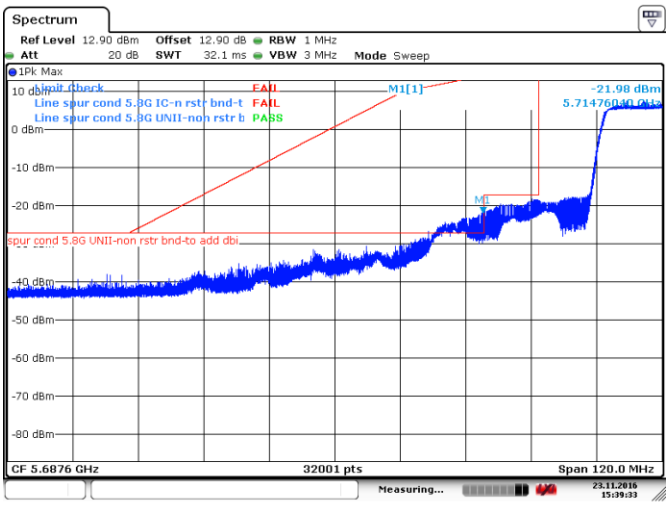
Date: 23.NOV.2016 15:45:04

Figure 8.5-31: *Lower band edge emission, 802.11n-HT20*



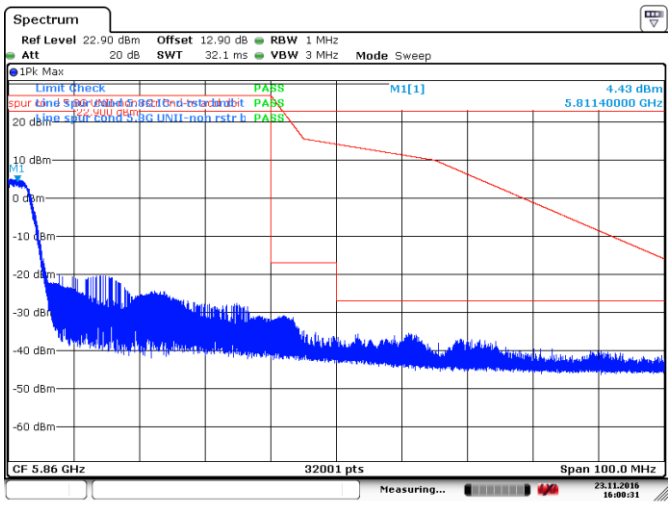
Date: 23.NOV.2016 16:01:35

Figure 8.5-32: *Upper band edge emission, 802.11n-HT20*



Date: 23.NOV.2016 15:39:32

Figure 8.5-33: *Lower band edge emission, 802.11n-HT40*



Date: 23.NOV.2016 16:00:31

Figure 8.5-34: *Upper band edge emission, 802.11n-HT40*

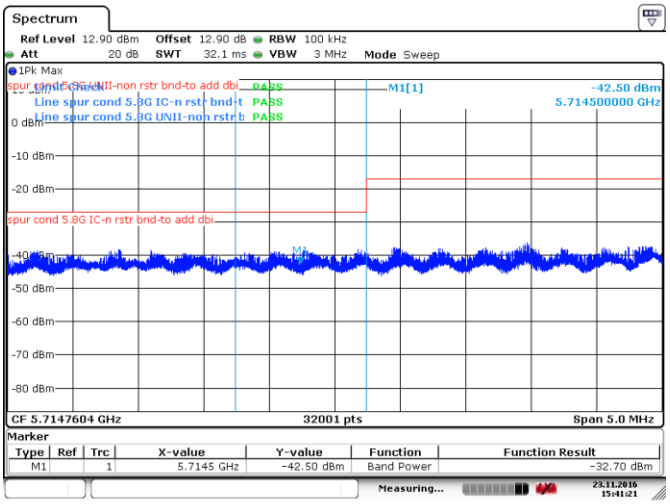


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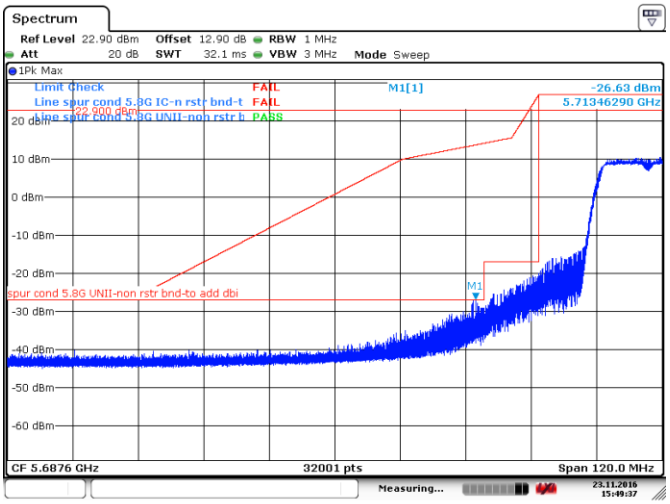
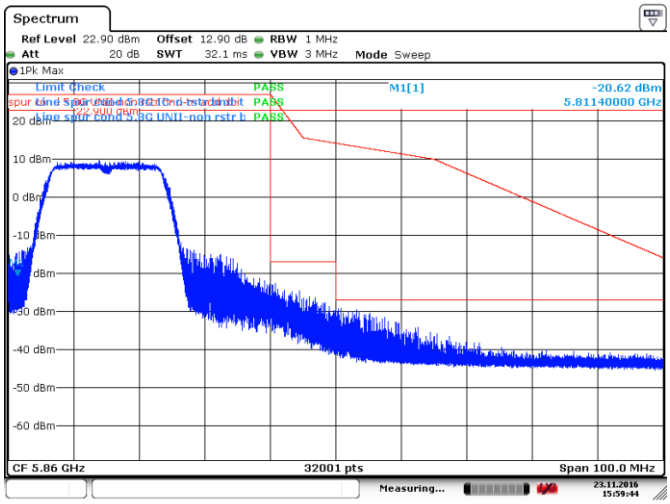
Figure 8.5-35: *Lower band edge emission at 5714.5 MHz, 802.11n-HT40*



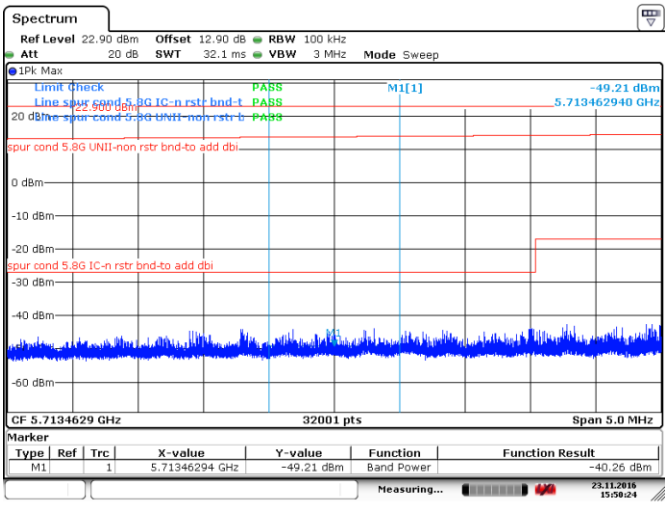
Date: 23.NOV.2016 15:49:36

Figure 8.5-36: *Lower band edge emission, 802.11ac-VHT20*



Date: 23.NOV.2016 15:59:44

Figure 8.5-37: *Upper band edge emission, 802.11ac-VHT20*



Date: 23.NOV.2016 15:50:24

Figure 8.5-38: *Lower band edge emission at 5713.5 MHz, 802.11ac-VHT20*

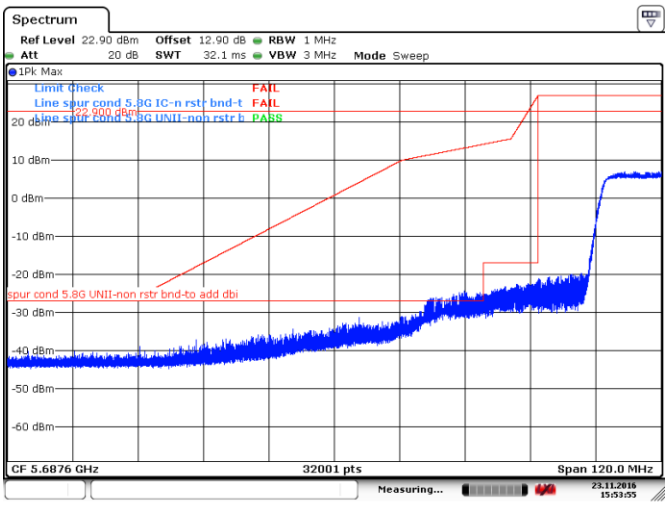


Figure 8.5-39: *Lower band edge emission, 802.11ac-VHT40*

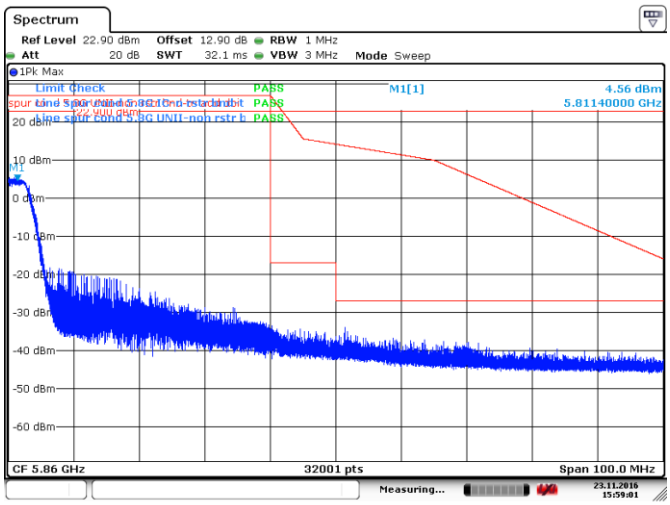


Figure 8.5-40: *Upper band edge emission, 802.11ac-VHT40*

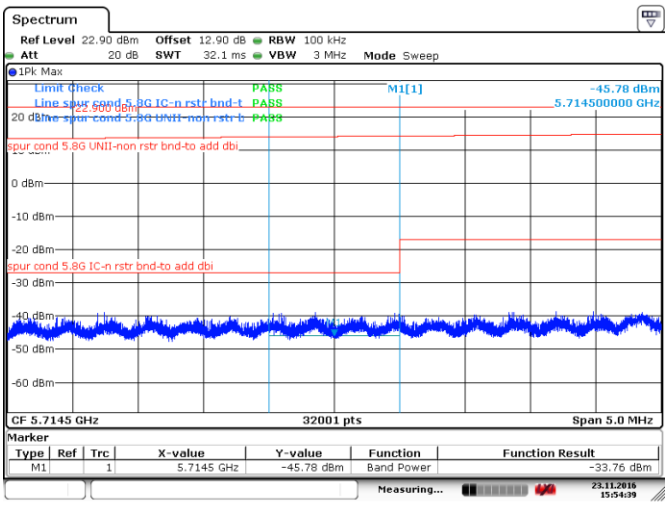
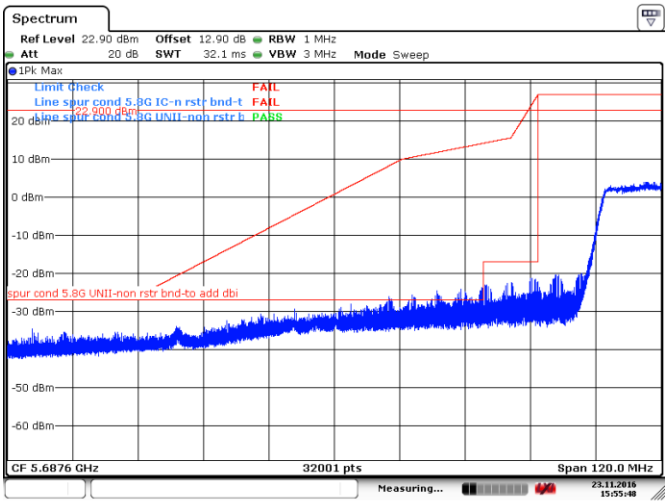
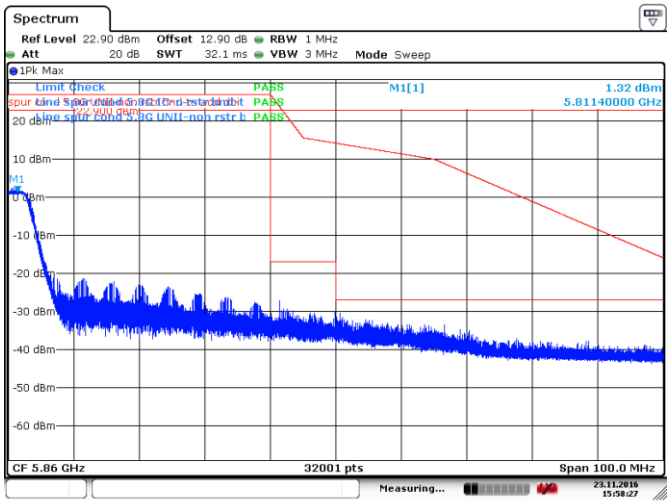


Figure 8.5-41: *Lower band edge emission at 5714.5 MHz, 802.11ac-VHT40*



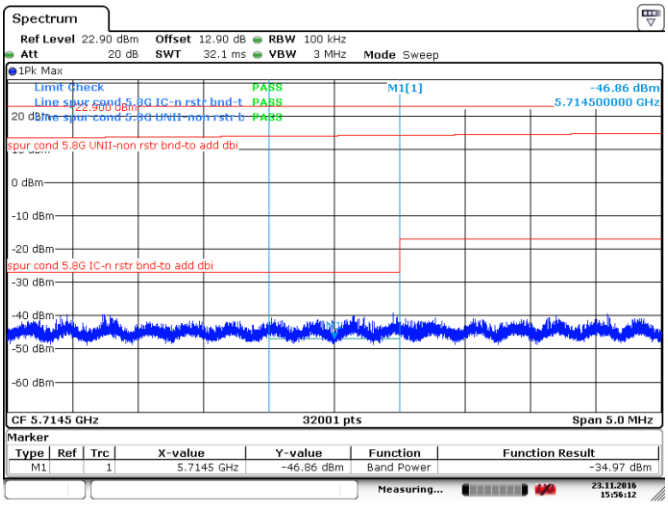
Date: 23.NOV.2016 15:55:48

Figure 8.5-42: *Lower band edge emission, 802.11ac-VHT80*



Date: 23.NOV.2016 15:58:27

Figure 8.5-43: *Upper band edge emission, 802.11ac-VHT80*



Date: 23.NOV.2016 15:56:12

Figure 8.5-44: *Lower band edge emission at 5714.5 MHz, 802.11ac-VHT80*

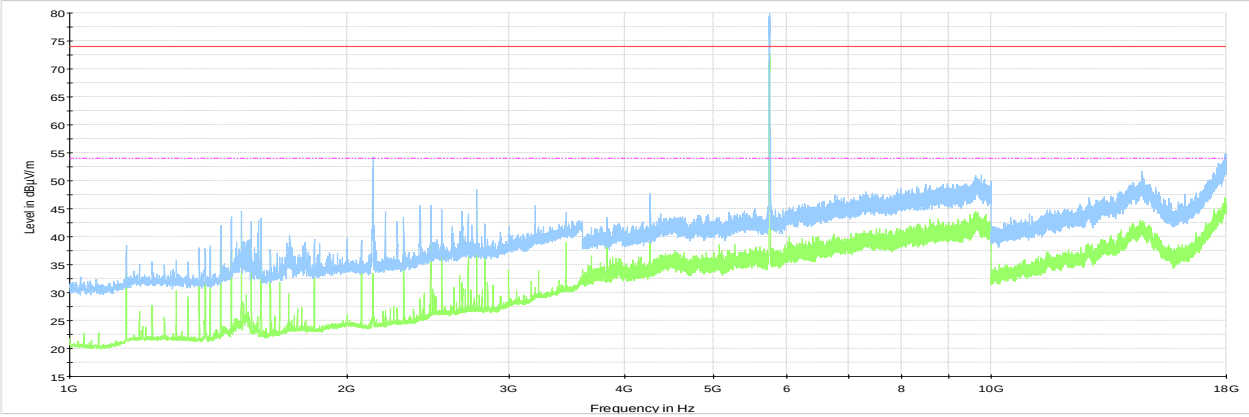


Figure 8.5-45: *Cabinet Radiated spurious emission 1to18 GHz sample plot, low channel*

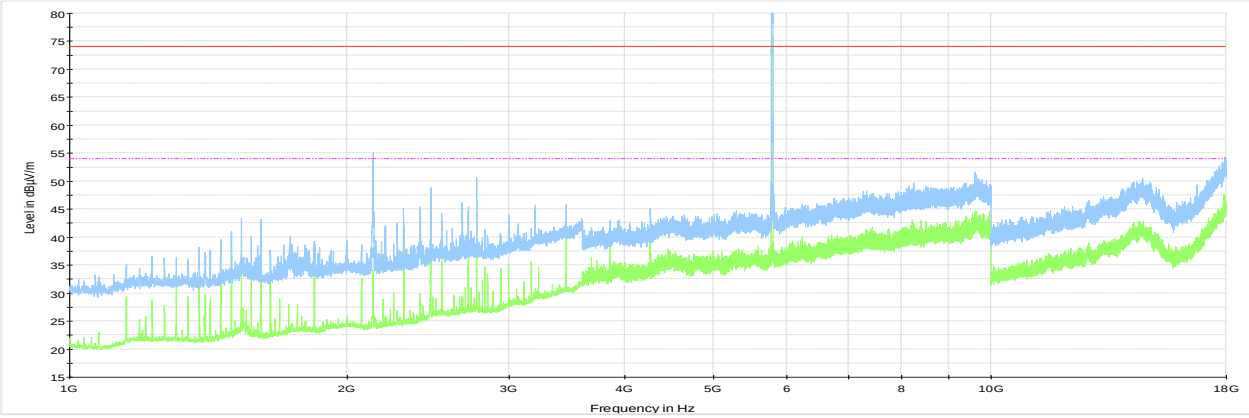


Figure 8.5-46: *Cabinet Radiated spurious emission 1to18 GHz sample plot, mid channel*

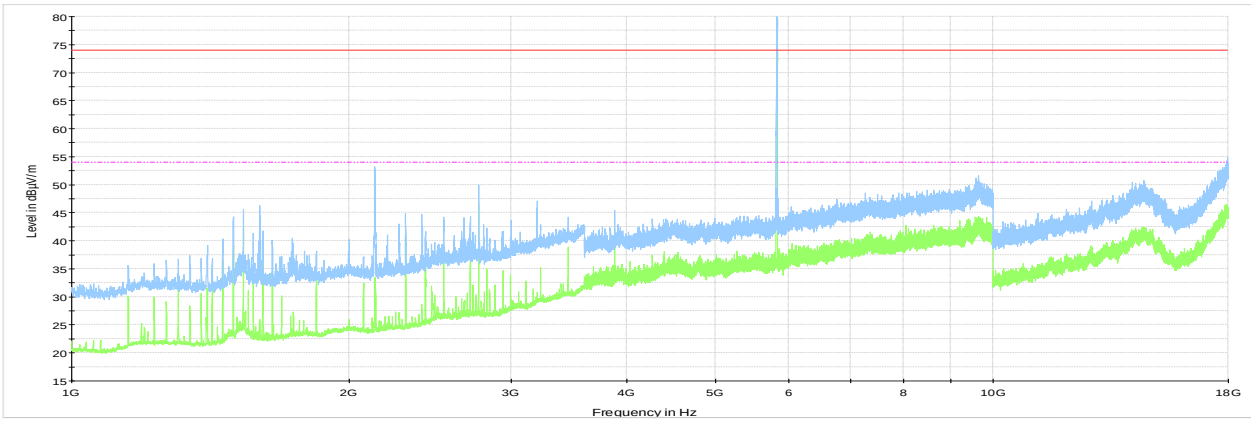


Figure 8.5-47: *Cabinet Radiated spurious emission 1to18 GHz sample plot, high channel*

Note: Spectrum were investigated from 30 MHz to 25 GHz, no emission were detected above 18 GHz within 10 dB below the limit.
EUT was investigated in 802.11a/802.11n/802.11ac modes, only worst case was presented.

Table 8.5-4: *Radiated field strength measurement results below 1 GHz*

Frequency, MHz	Peak Field strength, dBµV/m	Limit, dBµV/m	Margin, dB
30.2	32.1	40.0	7.9
246.4	44.1	46.0	1.9
584.0	44.3	46.0	1.7

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

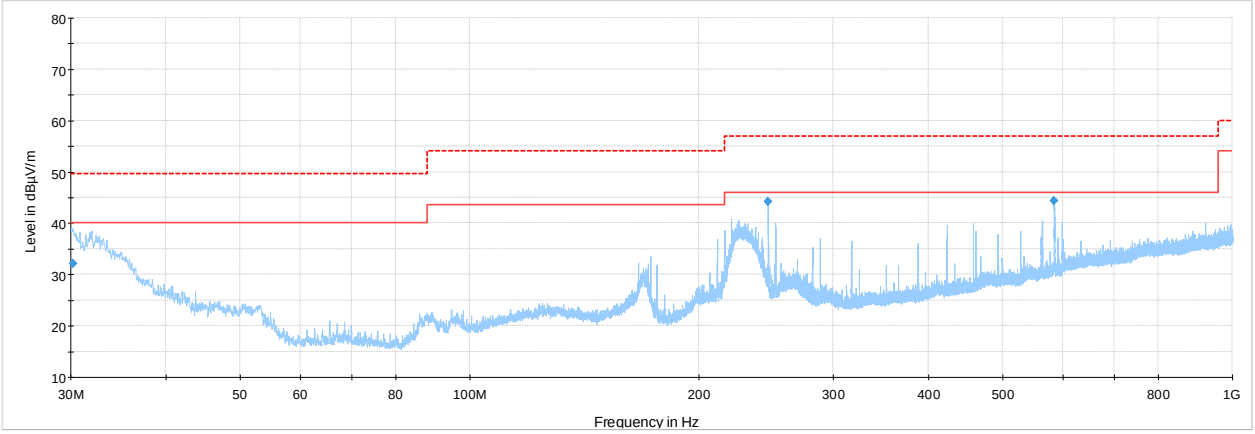


Figure 8.5-48: *Radiated spurious emission below 1 GHz sample plot*

Note: EUT was investigated in 802.11b/802.11G/802.11n modes, only the worst case was presented.

8.6 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.6.1 Definitions and limits

FCC §15.407(6)(b):

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

FCC §15.207(a):
Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

IC:
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.6-1: *Conducted emissions limit*

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

Note: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.6.2 Test summary

Test date	October 6, 2016	Temperature	25 °C
Test engineer	Yong Huang	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	40 %

8.6.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

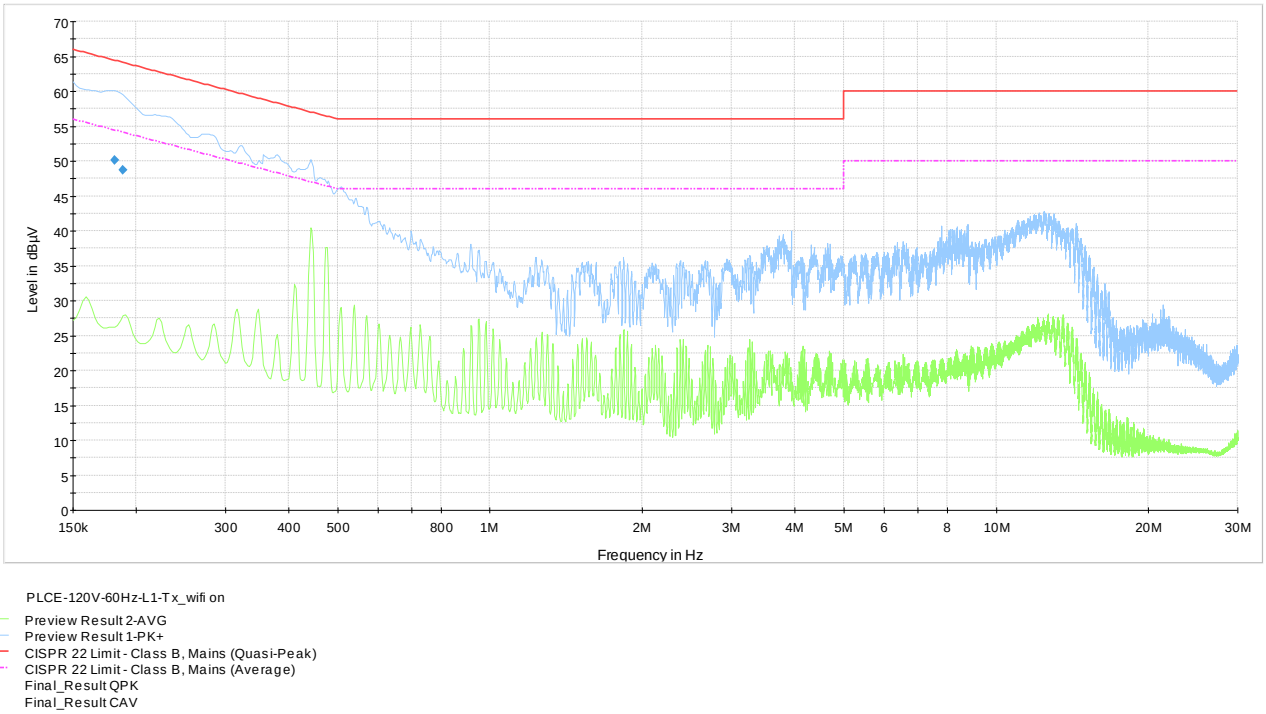
Receiver settings for preview measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average
Trace mode	Max Hold
Measurement time	100 ms

Receiver settings for final measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Quasi-Peak and Average
Trace mode	Max Hold
Measurement time	100 ms

8.6.1 Test data



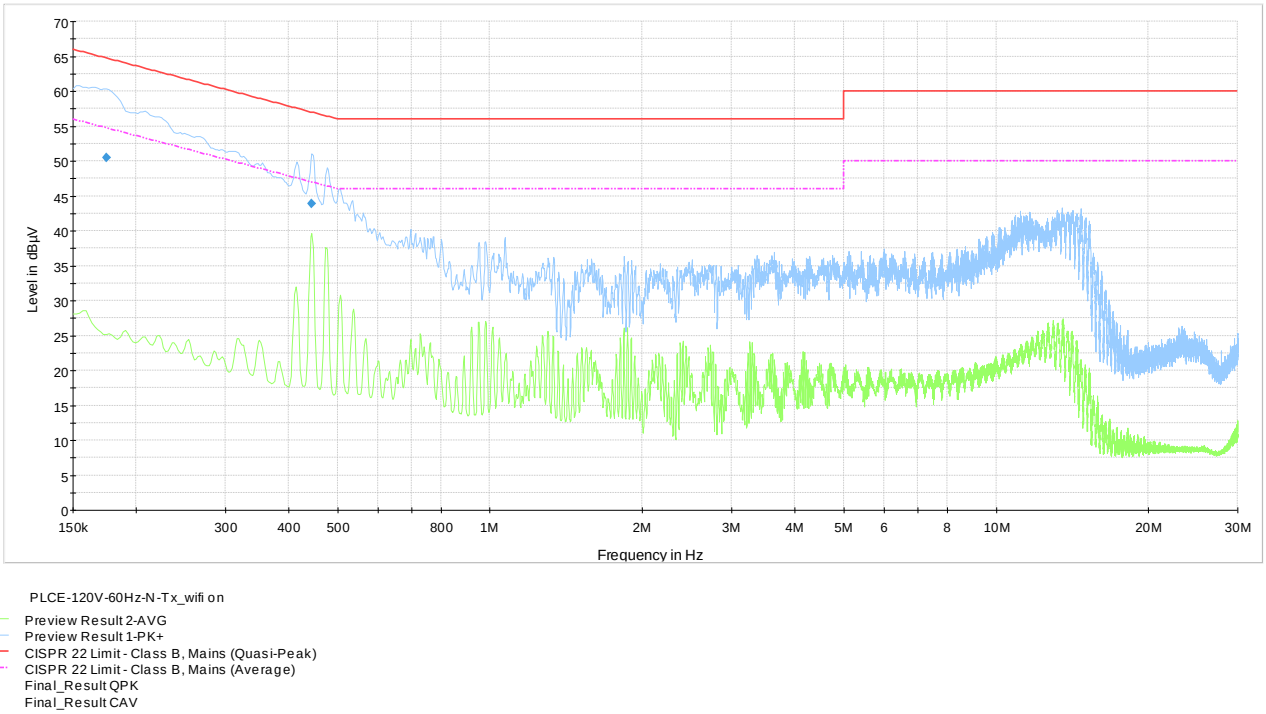
Plot 8.6-1: *Conducted emissions on phase line*

Table 8.6-2: *Quasi-Peak results AC power line conducted emissions limits – phase line*

Frequency (MHz)	Quasi-Peak result[1 and 3] (dBµV)	Quasi-Peak limit (dBµV)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Conductor	Filter	Correction factor[2] (dB)
0.181500	50.1	64.4	14.3	100.0	9	L1	ON	10.2
0.188250	48.8	64.1	15.4	100.0	9	L1	ON	10.2

Notes: [1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.

Sample calculation: 53.4 dBµV (result) = 43.3 dBµV (receiver reading) + 9.9 dB (Correction factor)



Plot 8.6-2: *Conducted emissions on neutral line*

Table 8.6-3: *Quasi-Peak results AC power line conducted emissions limits – neutral line*

Frequency (MHz)	Quasi-Peak result[1 and 3] (dBµV)	Quasi-Peak limit (dBµV)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Conductor	Filter	Correction factor[2] (dB)
0.174750	50.4	64.7	14.3	100.0	9	N	ON	10.2
0.444750	43.9	57.0	13.1	100.0	9	N	ON	10.0

Notes: [1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)
[3] The maximum measured value observed over a period of 15 seconds was recorded.

Sample calculation: 53.4 dBµV (result) = 43.3 dBµV (receiver reading) + 9.9 dB (Correction factor)

8.7 FCC 15.407(g) and RSS-Gen 8.11 Frequency stability

8.7.1 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.

8.7.2 Test summary

Test date:	November 10, 2016	Temperature:	24 °C
Test engineer:	Yong Huang	Air pressure:	1009 mbar
Verdict:	Pass	Relative humidity:	37 %

8.7.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	10 Hz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.7.4 Test data

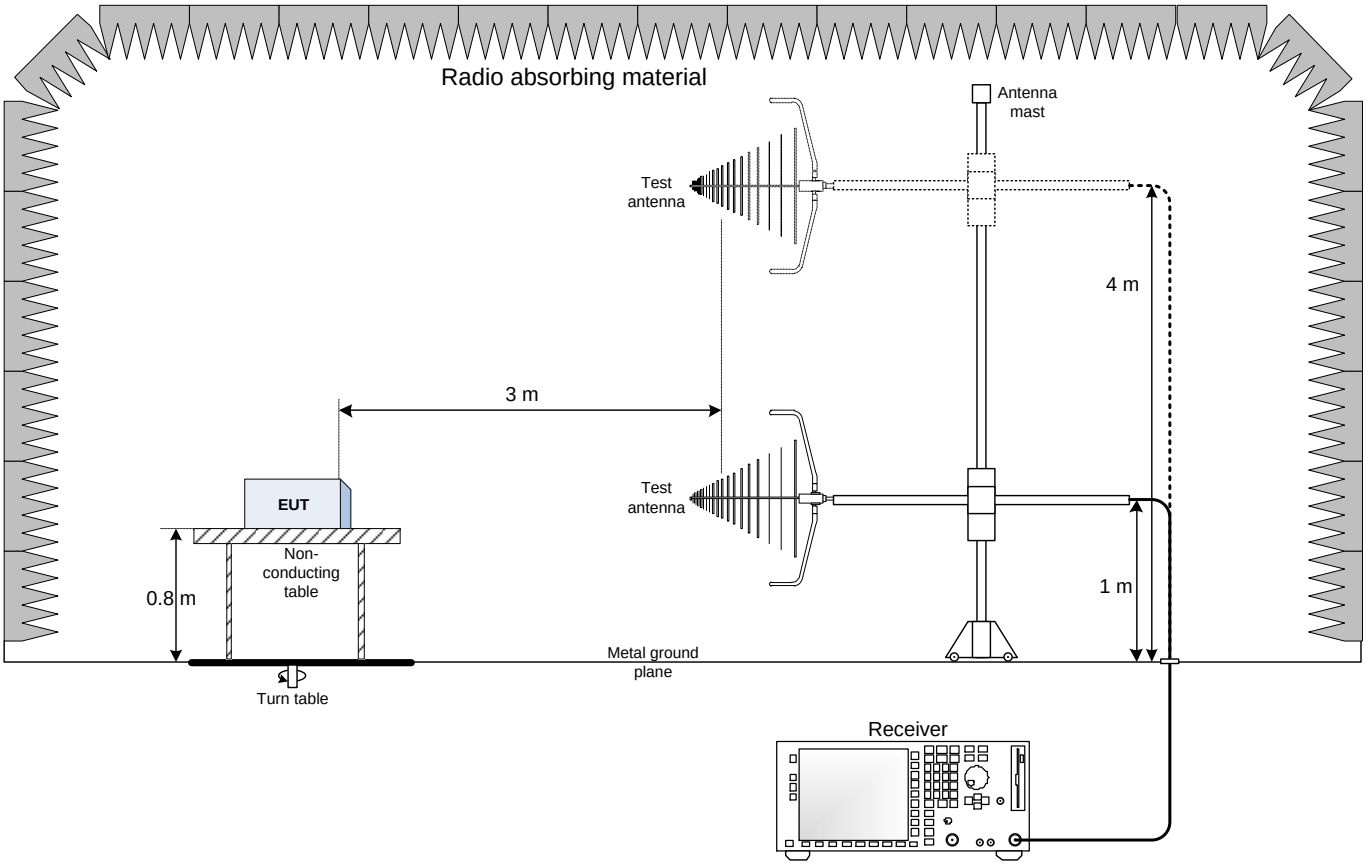
Table 8.7-1: *Frequency drift measurement*

Test conditions	Frequency, GHz	Drift, Hz
+35 °C, Nominal	5.74496524	-5145
+30 °C, Nominal	5.74496854	-1850
+20 °C, +15 %	5.74497039	0
+20 °C, Nominal	5.74497039	*Reference*
+20 °C, −15 %	5.74497039	0
+10 °C, Nominal	5.74498659	16203
+5 °C, Nominal	5.74500395	33568

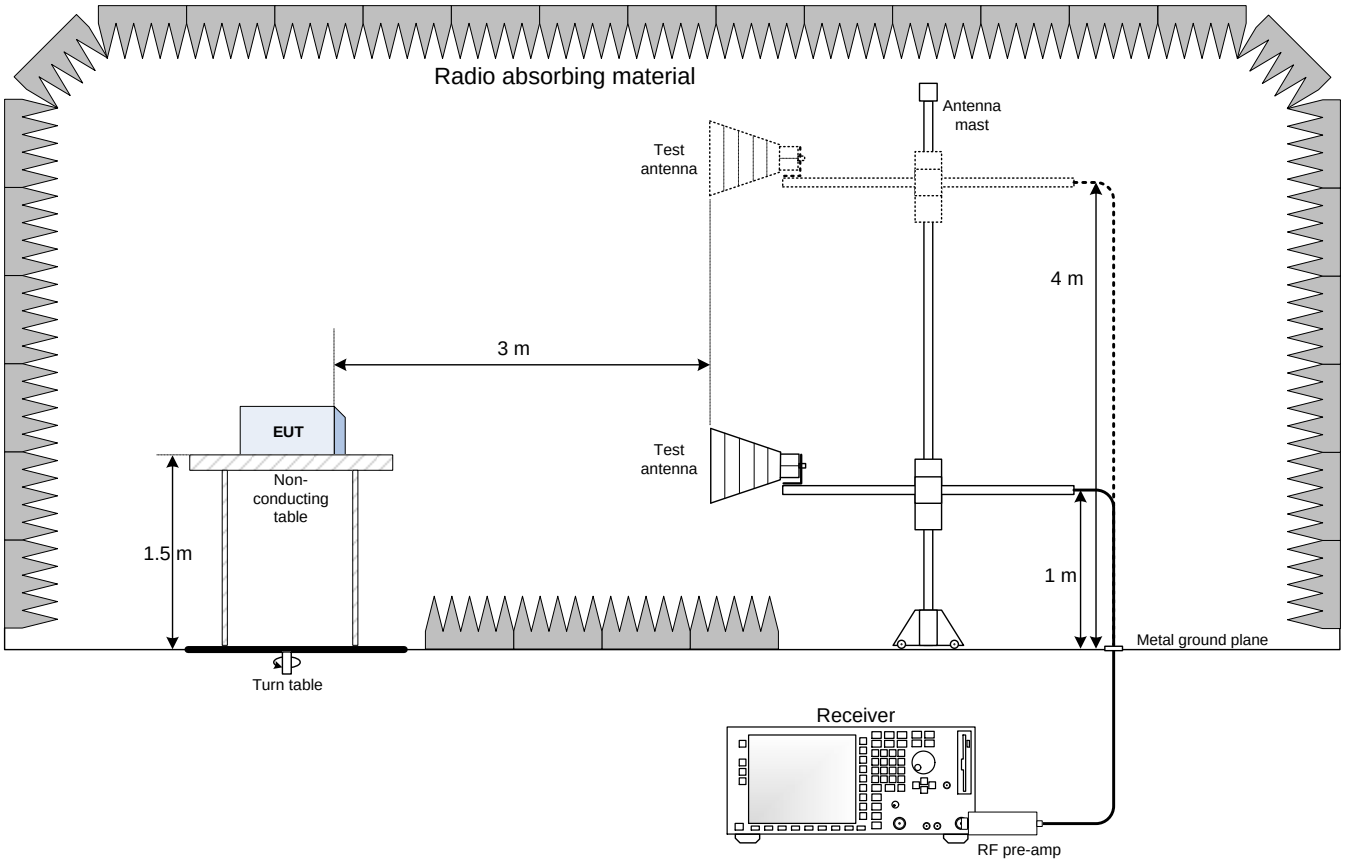
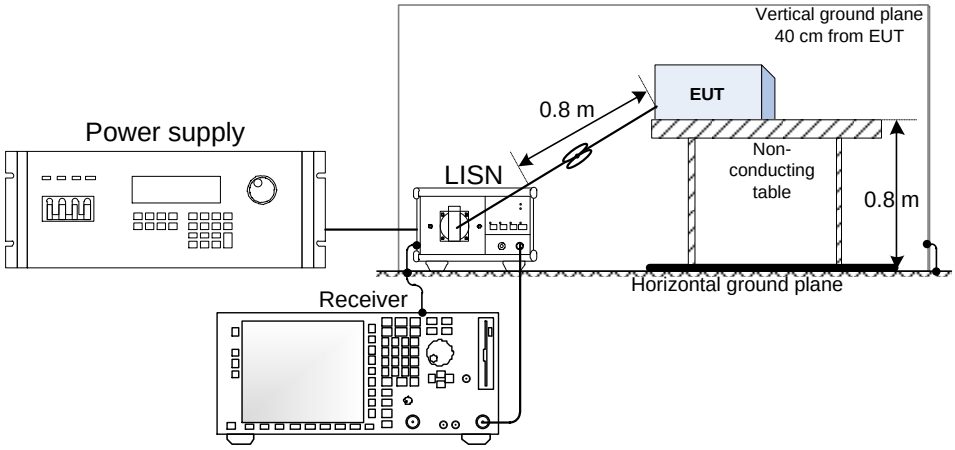
Note: Frequency stability was assessed between two +5 °C and +35 °C, as per client's manual.
Maximum recorded frequency drift was 34 kHz, which is 6 ppm

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up