

Test report

347879-4TRFWL

Date of issue: March 15, 2018

Applicant:

ARRIS

Product:

Xi6-A

Model:

Xi6-A

FCC ID:

ACQ-XI6

ISED ID:

109AS-XI6

Specifications:

- ◆ **FCC 47 CFR Part 15 Subpart E, §15.407**
Unlicensed National Information Infrastructure Devices
- ◆ **RSS-247, Issue 2, Section 6, Feb 2017**
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

Test location

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Website	www.nemko.com
Site number	FCC: CA2041; IC: 2040G-5 (3 m semi anechoic chamber)

Tested by	Yong Huang Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Review date	March 15, 2018
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 contained 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	ARRIS
Address	101 Tournament Drive
City	Horsham
Province/State	PA
Postal/Zip code	19044
Country	US

1.2 Test specifications

FCC 47 CFR Part 15, Subpart E, Clause 15.407 RSS-247, Issue 2, February 2017	Unlicensed National Information Infrastructure Devices Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
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1.3 Test methods

789033 D02 General UNII Test Procedures New Rules v02r01 (Dec 14, 2017)	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
FCC 16-24 (March 2, 2016)	Memorandum opinion and order for U-NII-3 (5.725–5.85 GHz) band
662911 D01 Multiple Transmitter Output v02r01 (October 31, 2013)	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
662911 D02 MIMO with Cross Polarized Antenna v01 (October 25, 2011)	Emissions testing of transmitters with multiple outputs in the same band (MIMO) with Cross Polarized Antenna
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

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

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

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

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

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

Notes: 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

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

2.2 FCC Part 15 Subpart E, test results

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

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

2.3 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 ISED RSS-247, Issue 2, 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	Pass
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: 802.11a/n/ac

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	January 29, 2018
Nemko sample ID number	Item #1

3.2 EUT information

Product name	Xi6-A
Model	Xi6-A
Serial number	M11742TK0022

3.3 Technical information

Applicant IC company number	109AS																														
IC UPN number	Xi6																														
All used IC test site(s) Reg. number	2040G-5																														
RSS number and Issue number	RSS-247 Issue 2, Section 6, February 2017																														
Frequency band	5725–5850 MHz																														
Frequency Min (MHz)	5745 (20 MHz channel), 5755 (40 MHz channel), 5775 (80 MHz channel)																														
Frequency Max (MHz)	5825 (20 MHz channel), 5795 (40 MHz channel), 5775 (80 MHz channel)																														
RF power Max (W), Conducted	0.0708 (18.5 dBm for 20 MHz channel), 0.0794(19.0 dBm for 40 MHz channel), 0.2455 (13.9 dBm for 80 MHz channel)																														
Measured BW (kHz) (26 dB)	20.78 (20 MHz channel), 42.64 (40 MHz channel), 84.08 (80 MHz channel)																														
Measured BW (kHz) (6 dB)	15.42 (20 MHz channel), 35.13 (40 MHz channel), 75.08 (80 MHz channel)																														
Type of modulation	802.11a/n/ac																														
Emission classification (F1D, G1D, D1D)	W7D																														
aTransmitter spurious, Units @ distance	43.5 dBuV/m at 3 m average at 5.443 GHz																														
Power requirements	120 V _{AC} , 60 Hz																														
Antenna information	<p>The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.</p> <p>Antenna gain as following:</p> <table border="1"> <thead> <tr> <th>frequency MHz</th> <th>ant 1,dbi</th> <th>ant2, dbi</th> </tr> </thead> <tbody> <tr> <td>5150</td> <td>3.8</td> <td>2.6</td> </tr> <tr> <td>5200</td> <td>3.4</td> <td>2.7</td> </tr> <tr> <td>5300</td> <td>3.1</td> <td>3.3</td> </tr> <tr> <td>5400</td> <td>3</td> <td>3.7</td> </tr> <tr> <td>5500</td> <td>3</td> <td>3.8</td> </tr> <tr> <td>5600</td> <td>2.7</td> <td>3.7</td> </tr> <tr> <td>5700</td> <td>2.9</td> <td>3.8</td> </tr> <tr> <td>5800</td> <td>3</td> <td>3.6</td> </tr> <tr> <td>5850</td> <td>3.1</td> <td>4</td> </tr> </tbody> </table>	frequency MHz	ant 1,dbi	ant2, dbi	5150	3.8	2.6	5200	3.4	2.7	5300	3.1	3.3	5400	3	3.7	5500	3	3.8	5600	2.7	3.7	5700	2.9	3.8	5800	3	3.6	5850	3.1	4
frequency MHz	ant 1,dbi	ant2, dbi																													
5150	3.8	2.6																													
5200	3.4	2.7																													
5300	3.1	3.3																													
5400	3	3.7																													
5500	3	3.8																													
5600	2.7	3.7																													
5700	2.9	3.8																													
5800	3	3.6																													
5850	3.1	4																													

3.4 Product description and theory of operation

The EUT was controlled to transmit continuously at desired frequency and modulation from laptop using QRCT interface

3.5 EUT setup diagram

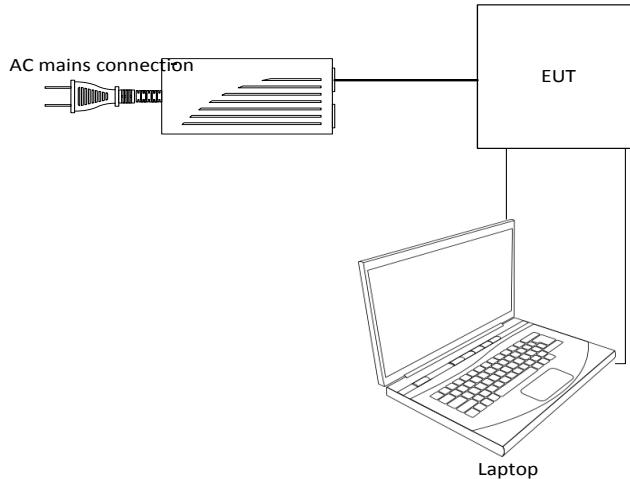


Figure 3.5-1: Setup diagram

3.6 EUT sub assemblies

Table 3.6-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
Xi6-A	ARRIS	M/N: AX061AEI	S/N: M11742TK0022

Table 3.6-2: Support equipment

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop D620	DELL	M/N:PP18L, P/N:PP18L, S/N:07898349890528
Master router	XFINITY	M/N: TG1682G, P/N: TG02DCG1682P3CT, S/N:1000191 TG1682G/CT-0

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

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

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

5.2 Power supply range

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

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

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

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

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
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	July 10/18
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
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Dec. 6/18
Horn antenna (1–18 GHz)	EMCO	3115	FA001451	1 year	April 5/18
Horn antenna (18–40 GHz)	EMCO	3116	FA002487	2 year	Aug. 16/18
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	May 8/18
Pre-amplifier (18–40 GHz)	COM-POWER	PAM-840	FA002508	1 year	May 8/18
5725-5850 MHz Notch Filter	Microwave Circuits	N0257881	FA002692	—	VOU
50 Ω coax cable	HUBER+SUHNER	SUCOFLEX 100	FA002564	—	VOU
Three phase power system	TESEQ	ProfLine 2115-400	FA002516	1 year	Aug. 21/18
Power sensor	Rohde & Schwarz	NRP18S	FA002730	1 year	July 21/18
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Sept. 18/18
Environmental Chamber	ESPEC	EPX-4H	FA002736	1 year	May 16/18
Multimeter	AMPPROBE	AM-530	FA002536	1 year	May 3/18
LISN	Rohde & Schwarz	ENV216	FA002514	1 year	Dec. 15/18

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

Section 8. Testing data

8.1 FCC 15.403(i) Emission bandwidth, 15.407(e) 6 dB bandwidth

8.1.1 Definitions and limits

FCC:

15.403(i) 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.
15.407(e) Within the 5.725–5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

8.1.2 Test summary

Test start date	February 20, 2018
Test engineer	Yong Huang

8.1.3 Observations, settings and special notes

Spectrum analyzer settings:

Resolution bandwidth	approximately 1% of EBW (for 26 dB BW), 100 kHz (for 6 dB BW)
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	19.08
	5785	19.46
	5825	19.92
802.11n HT20	5745	20.34
	5785	20.50
	5825	20.78
802.11n HT40	5755	41.52
	5795	42.52
	5745	20.42
802.11ac VHT20	5785	20.38
	5825	20.62
	5755	41.44
802.11ac VHT40	5795	42.64
	5775	84.08

Table 8.1-2: 6 dB bandwidth results

Modulation	Frequency, MHz	6 dB bandwidth, MHz	Minimum limit, MHz	Minimum margin, MHz
802.11a	5745	15.14	0.5	14.64
	5785	15.32	0.5	14.82
	5825	15.14	0.5	14.64
802.11n HT20	5745	15.42	0.5	14.92
	5785	15.08	0.5	14.58
	5825	15.14	0.5	14.64
802.11n HT40	5755	35.13	0.5	34.63
	5795	35.12	0.5	34.62
802.11ac VHT20	5745	15.14	0.5	16.92
	5785	15.16	0.5	16.96
	5825	15.12	0.5	16.98
802.11ac VHT40	5755	35.13	0.5	34.63
	5795	35.12	0.5	34.62
802.11ac VHT80	5775	75.08	0.5	74.58

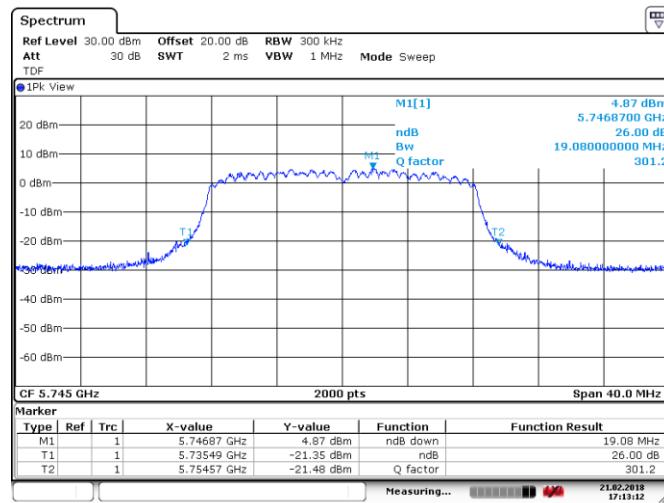


Figure 8.1-1: 26 dB bandwidth on 802.11a, sample plot

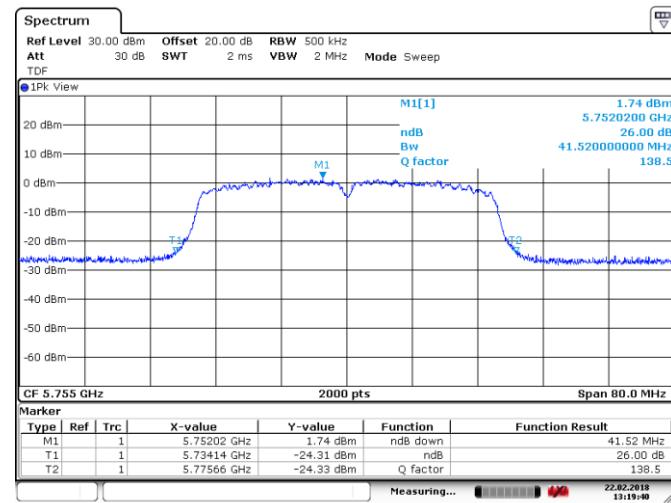


Figure 8.1-2: 26 dB bandwidth on 802.11n HT40, sample plot

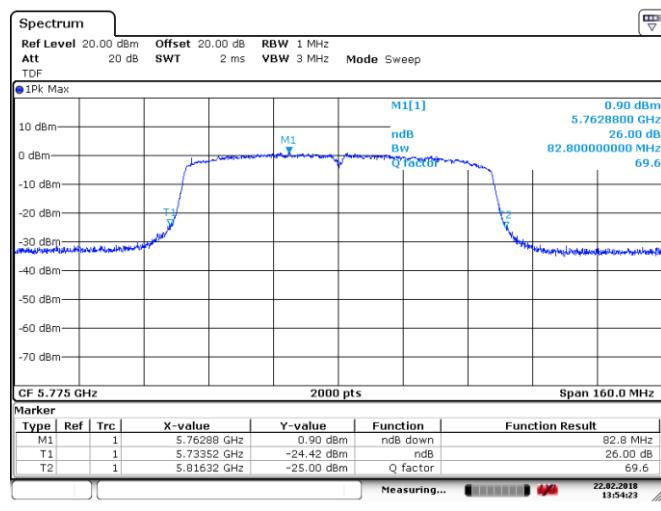
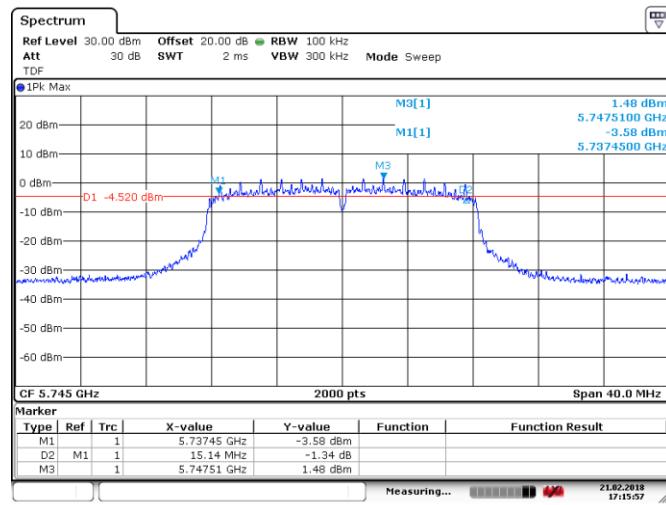
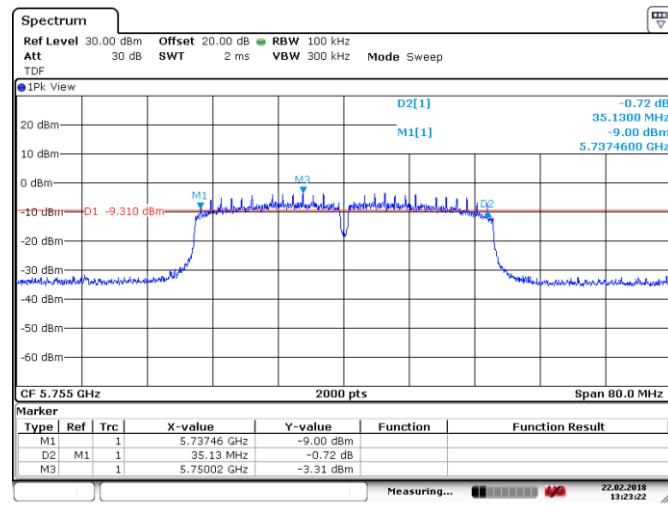


Figure 8.1-3: 26 dB bandwidth on 802.11ac VHT80, sample plot



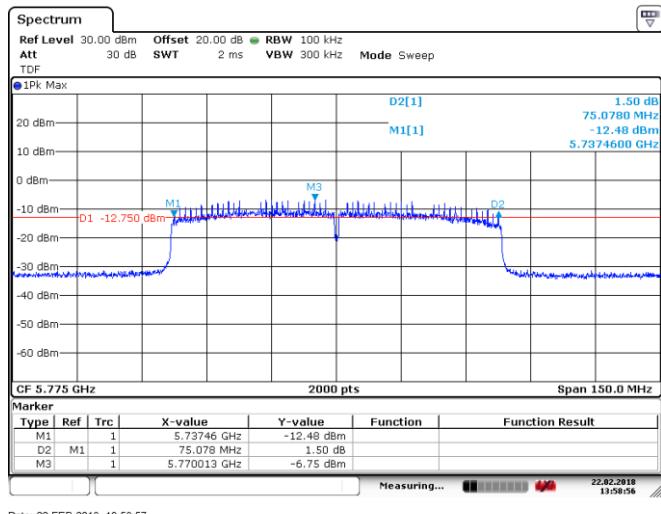
Date: 21.FEB.2018 17:15:57

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



Date: 22.FEB.2018 13:23:22

Figure 8.1-5: 6 dB bandwidth on 802.11n HT40, sample plot



Date: 22.FEB.2018 13:58:56

Figure 8.1-6: 6 dB bandwidth on 802.11ac VHT80, sample plot

8.2 RSS-Gen 6.6 Occupied bandwidth

8.2.1 Definitions and limits

The emission bandwidth (\times 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 \times 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 \times 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.

8.2.2 Test summary

Test start date	February 20, 2018
Test engineer	Yong Huang

8.2.3 Observations, settings and special notes

Spectrum analyzer settings:

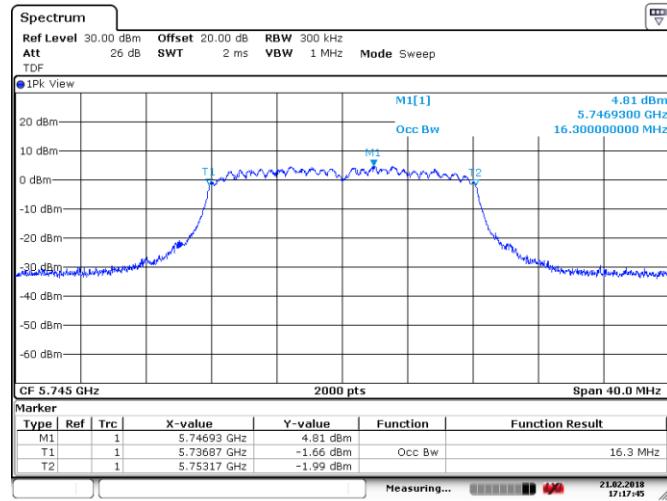
Resolution bandwidth:	1 % to 5 % of OBW
Video bandwidth:	$\geq 3 \times$ RBW
Detector mode:	Peak
Trace mode:	Max Hold

8.2.4 Test data

Table 8.2-1: 99 % bandwidth results

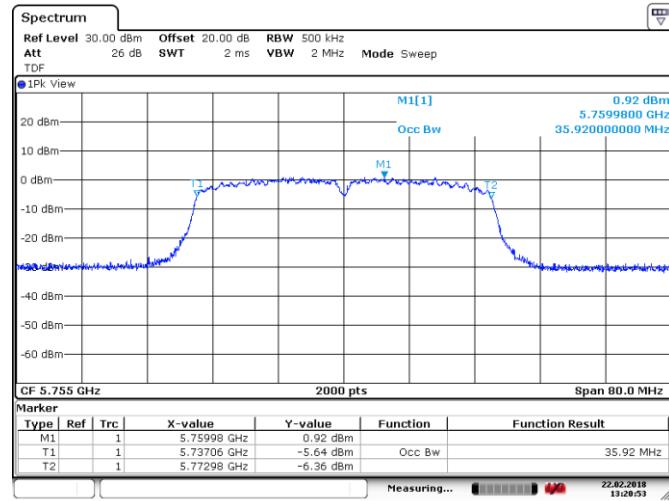
Modulation	Frequency, MHz	99 % bandwidth, MHz
802.11a	5745	16.30
	5785	16.34
	5825	16.30
802.11n HT20	5745	17.42
	5785	17.46
	5825	17.48
802.11n HT40	5755	35.92
	5795	36.00
	5745	17.42
802.11ac VHT20	5785	17.46
	5825	17.48
	5755	35.92
802.11ac VHT40	5795	36.04
	5775	75.52

8.2.4 Test data, continued



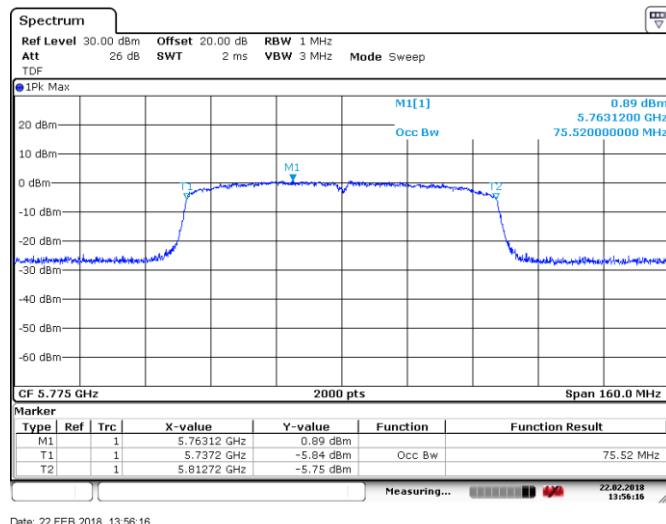
Date: 21.FEB.2018 17:17:45

Figure 8.2-1: 99 % bandwidth on 802.11a, sample plot



Date: 22.FEB.2018 13:20:53

Figure 8.2-2: 99 % bandwidth on 802.11n HT40, sample plot



Date: 22.FEB.2018 13:06:16

Figure 8.2-3: 99 % bandwidth 802.11ac VHT80, sample plot

8.3 FCC 15.407(a)(3) and RSS-247 6.2.4.1 5.725–5.85 GHz band output power and spectral density limits

8.3.1 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.

ISED:

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.

8.3.2 Test summary

Test start date:	February 20, 2018
Test engineer:	Yong Huang

8.3.3 Observations, settings and special notes

As per manufacturer declaration, EUT is for indoor use only. EUT was configured to continuous transmit mode during tests.

Output power was tested using RMS power meter.

The highest and lowest data rate setting have been investigated, only the worst-cases were presented.

Spectrum analyzer settings for PSD measurement:

Resolution bandwidth	500 kHz
Video bandwidth	2 MHz
Frequency span	> EBW
Detector mode	RMS
Trace mode	Power Averaging over 100 sweeps

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

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

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

Total antenna gain was calculated as follows: $\text{Directional gain} = 10 \log \left[\left(10^{\frac{G_1}{20}} + 10^{\frac{G_2}{20}} \right)^2 / N_{ANT} \right]$

Output power/EIRP/PSD limit adjustment(in case antenna gain is more than 6 dBi): Output power/EIRP/PSD limit – (Total antenna gain – 6 dBi).

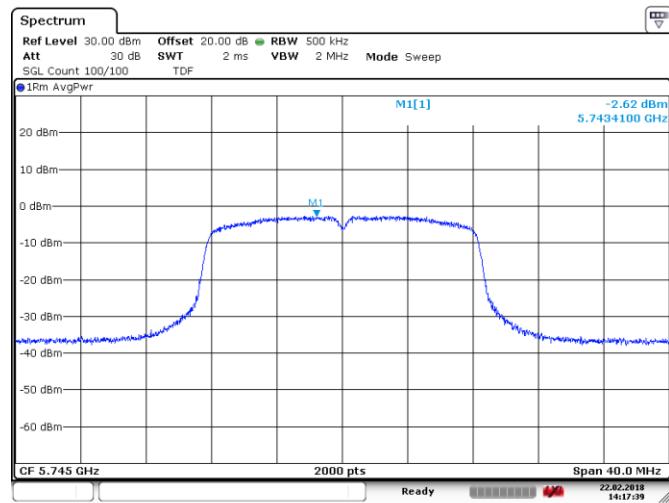
8.3.4 Test data

Table 8.3-1: Output power measurements results

Modulation	Frequency, MHz	Output power on ch0, dBm	Output power on ch1, dBm	Combined power, dBm	Power limit, dBm	Margin, dB
802.11a	5745	14.0	13.7	16.9	30.0	13.1
	5785	15.6	15.2	18.4	30.0	11.6
	5825	15.7	15.3	18.5	30.0	11.5
802.11n HT20	5745	14.1	13.5	16.8	30.0	13.2
	5785	15.6	15.0	18.3	30.0	11.7
	5825	15.7	15.2	18.5	30.0	11.5
802.11n HT40	5755	12.0	11.6	14.8	30.0	15.2
	5795	16.1	15.8	19.0	30.0	11.0
	5745	14.0	13.5	16.8	30.0	13.2
802.11ac VHT20	5785	15.5	15.0	18.3	30.0	11.7
	5825	15.6	15.1	18.4	30.0	11.6
	5755	12.0	11.8	14.9	30.0	15.1
802.11ac VHT40	5795	16.1	15.6	18.9	30.0	11.1
	5775	11.1	10.7	13.9	30.0	16.1
802.11ac VHT80						

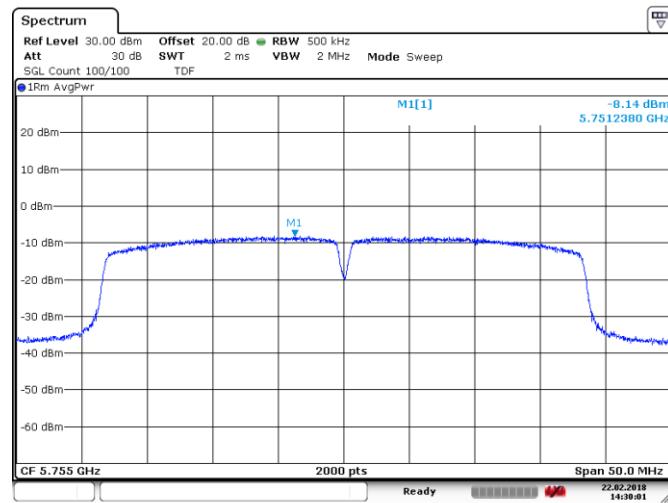
Table 8.3-2: PSD measurements results

Modulation	Frequency, MHz	PSD on ch0, dBm/500 kHz	PSD on ch1, dBm/500 kHz	Combined PSD, dBm/500 kHz	Limit, dBm/500 kHz	Margin, dB
802.11a	5745	-2.62	-1.17	1.18	30.00	28.82
	5785	-0.60	-0.15	2.64	30.00	27.36
	5825	-0.01	0.43	3.23	30.00	26.77
802.11n HT20	5745	-2.60	-1.71	0.88	30.00	29.12
	5785	-1.27	-0.26	2.27	30.00	27.73
	5825	-0.12	-0.17	2.87	30.00	27.13
802.11n HT40	5755	-8.14	-7.12	-4.59	30.00	34.59
	5795	-3.59	-3.36	-0.46	30.00	30.46
	5745	-2.95	-1.65	0.76	30.00	29.24
802.11ac VHT20	5785	-0.80	-0.30	2.47	30.00	27.53
	5825	-0.32	-0.42	2.64	30.00	27.36
	5755	-7.87	-7.25	-4.54	30.00	34.54
802.11ac VHT40	5795	-3.35	-3.10	-0.21	30.00	30.21
	5775	-9.79	-8.95	-6.34	30.00	36.34
802.11ac VHT80						



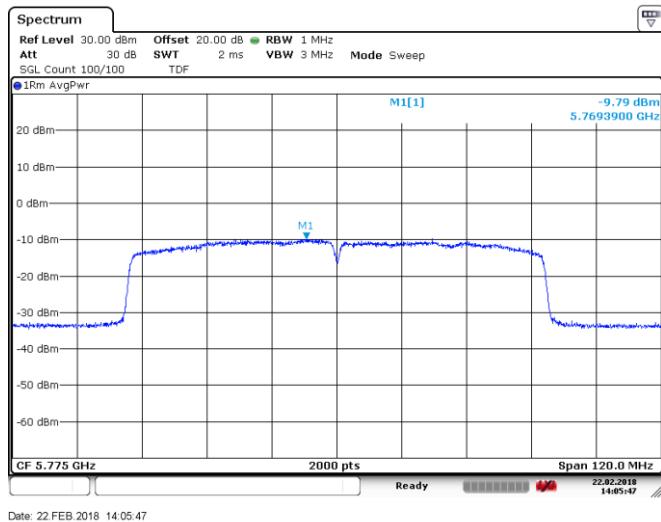
Date: 22.FEB.2018 14:17:39

Figure 8.3-1: PSD on 802.11a Sample plot



Date: 22.FEB.2018 14:30:01

Figure 8.3-2: PSD on 802.11n HT40, Sample plot



Date: 22.FEB.2018 14:05:47

Figure 8.3-3: PSD on 802.11ac VHT80, Sample plot

8.4 FCC 15.407(b) and RSS-247 6.2.4.2 Spurious (out-of-band) emissions

8.4.1 Definitions and limits

FCC:

- (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.

ISED:

Devices operating in the band $5725\text{--}5850 \text{ MHz}$ with antenna gain greater than 10 dBi can have unwanted emissions that comply with either the limits in this section or in section 5.5 until six (6) months after the publication date of this standard for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2018.

Devices operating in the band $5725\text{--}5850 \text{ MHz}$ with antenna gain of 10 dBi or less can have unwanted emissions that comply with either the limits in this section or in section 5.5 until April 1, 2018 for certification. Certified devices that do not comply with emission limits in this section shall not be manufactured, imported, distributed, leased, offered for sale or sold after April 1, 2020.

Devices operating in the band $5725\text{--}5850 \text{ MHz}$ shall have e.i.r.p. of unwanted emissions comply with the following:

- a. 27 dBm/MHz at frequencies from the band edges decreasing linearly to 15.6 dBm/MHz at 5 MHz above or below the band edges;
- b. 15.6 dBm/MHz at 5 MHz above or below the band edges decreasing linearly to 10 dBm/MHz at 25 MHz above or below the band edges;
- c. 10 dBm/MHz at 25 MHz above or below the band edges decreasing linearly to -27 dBm/MHz at 75 MHz above or below the band edges; and
- d. -27 dBm/MHz at frequencies more than 75 MHz above or below the band edges.

Table 8.4-1: 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

Table 8.4-2: ISED 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 8.4-2 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 8.4-3: 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			

8.4.2 Test summary

Test start date:	February 16, 2018
Test engineer:	Yong Huang

8.4.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz while the EUT was transmitting on both MIMO chains simultaneously. Conducted measurements were performed on each individual MIMO chain, with the highest and the lowest data rate, the worst case is presented. In the conducted plots below, the reference level offset was adjusted to include antenna gains. Radiated measurements below 18 GHz were performed at a distance of 3 m. Radiated measurements above 18 GHz were performed at a distance of 1 m. Cabinet radiation were performed while both antenna connectors were terminated with 50 Ω load. No emissions related to RF transmitter were detected within 6 dB below the limit. Where it is not specified in the figure comment, the power settings were set to a maximum between FCC and ISED.

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

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

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

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

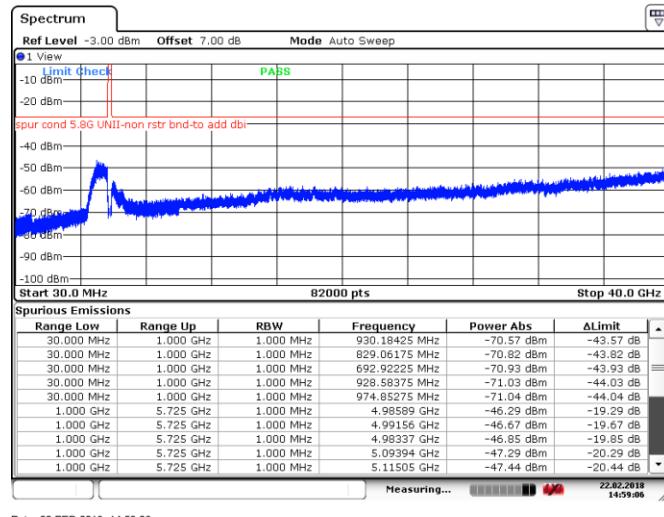
Spectrum analyser for average conducted measurements within restricted bands above 1 GHz for frequencies where peak results were above the average limit:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	RMS
Trace mode:	Power average
Number of averaging traces:	100

Spectrum analyser for peak conducted measurements outside restricted bands:

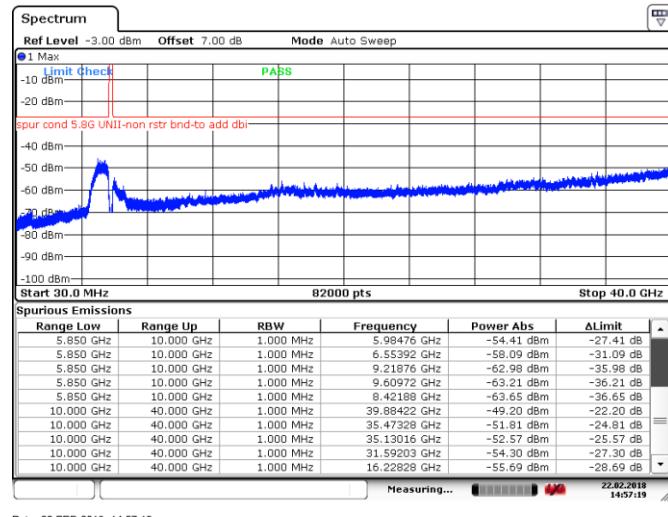
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.4.4 Test data



Date: 22.FEB.2018 14:59:06

Figure 8.4-1: Spurious emissions outside restricted bands, Tx on ch 149, 802.11a



Date: 22.FEB.2018 14:57:19

Figure 8.4-2: Spurious emissions outside restricted bands, Tx on ch 157, 802.11a

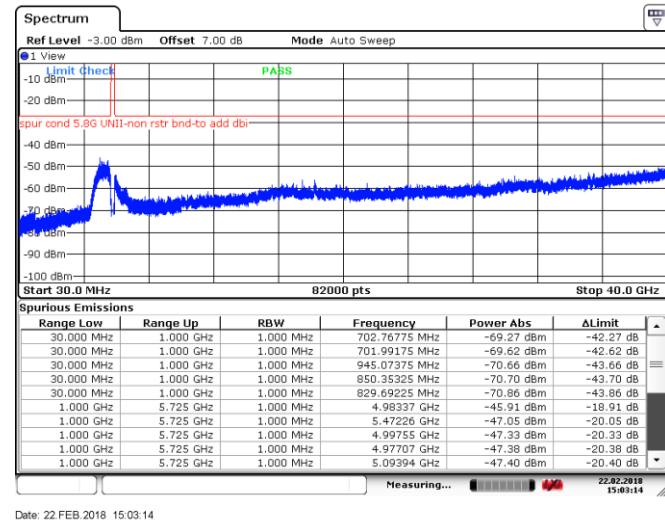
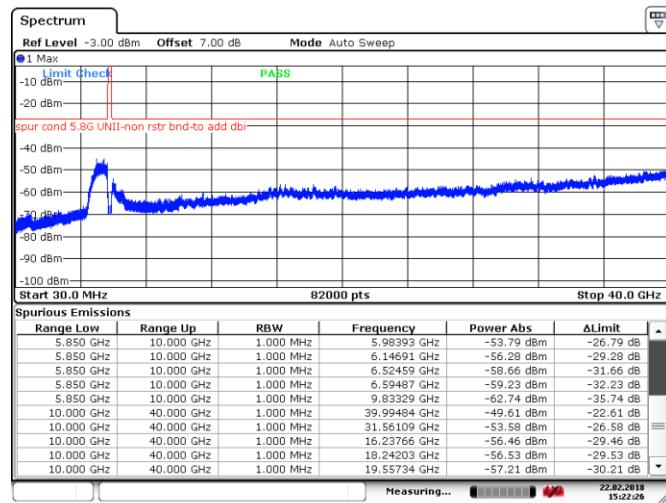
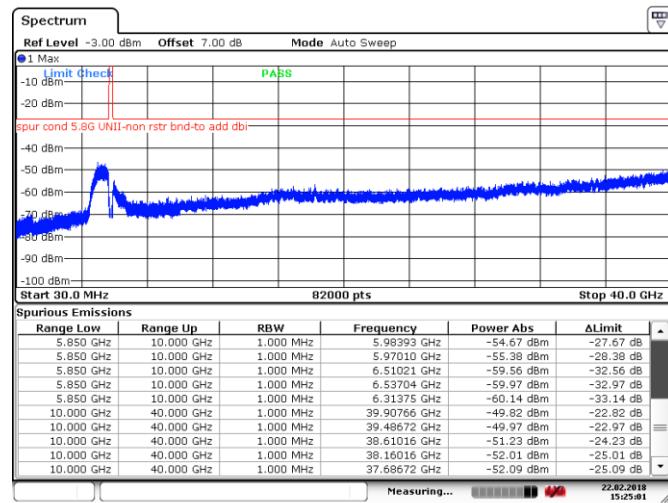


Figure 8.4-3: Spurious emissions outside restricted bands, Tx on ch 165, 802.11a



Date: 22.FEB.2018 15:22:26

Figure 8.4-4: Spurious emissions outside restricted bands, Tx on ch 149, 802.11n HT20



Date: 22.FEB.2018 15:25:00

Figure 8.4-5: Spurious emissions outside restricted bands, Tx on ch 157, 802.11n HT20

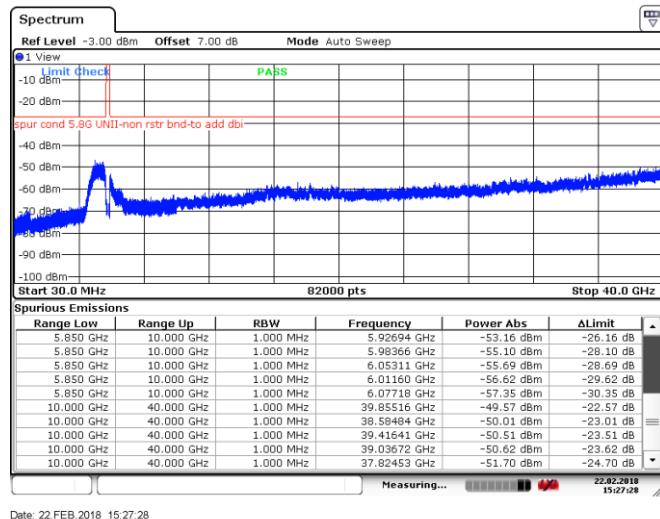
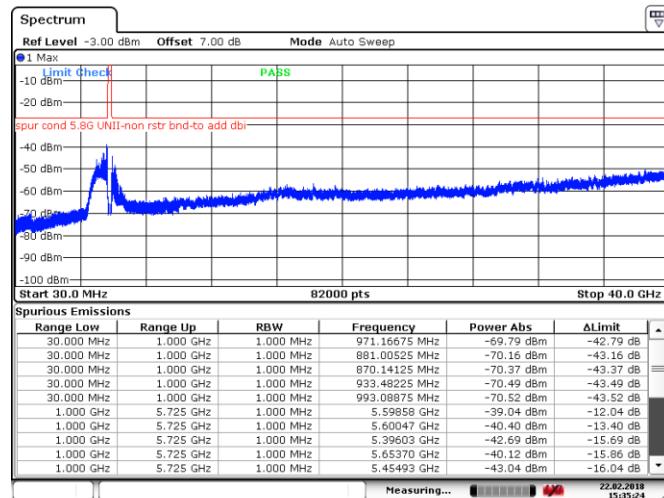
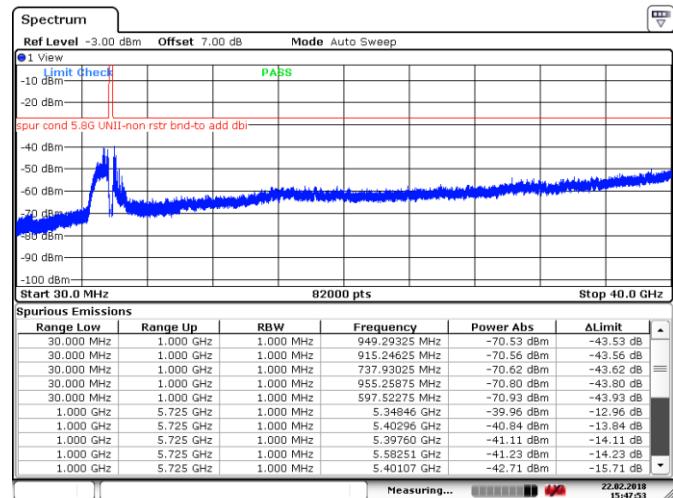


Figure 8.4-6: Spurious emissions outside restricted bands, Tx on ch 165, 802.11n HT20



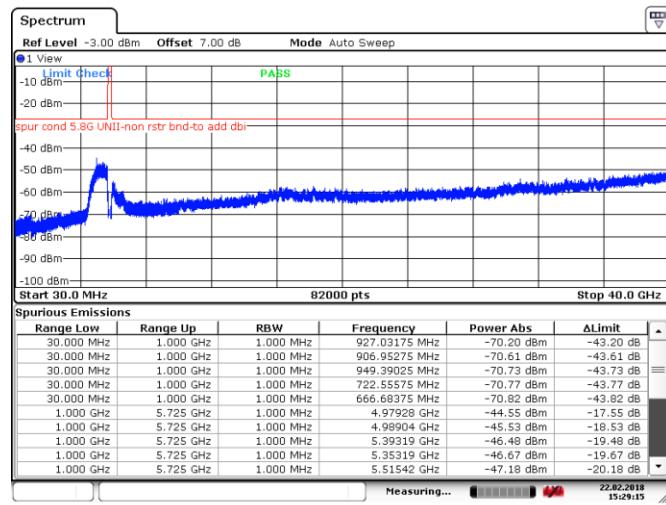
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Figure 8.4-7: Spurious emissions outside restricted bands, Tx on ch 151, 802.11n HT40



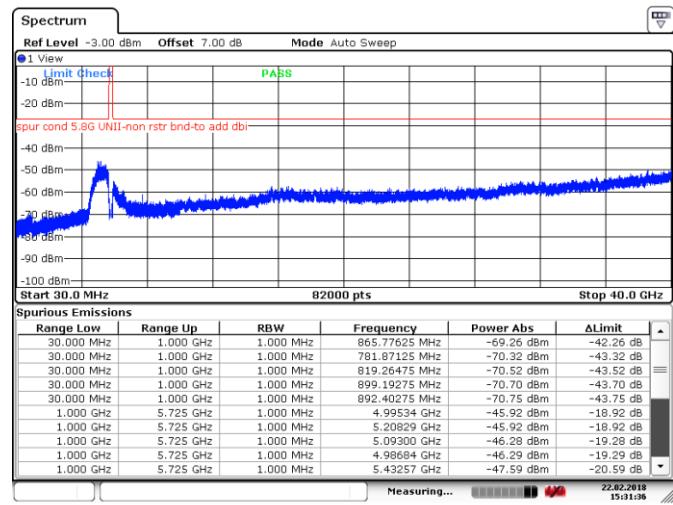
Date: 22.FEB.2018 15:47:52

Figure 8.4-8: Spurious emissions outside restricted bands, Tx on ch 159, 802.11n HT40



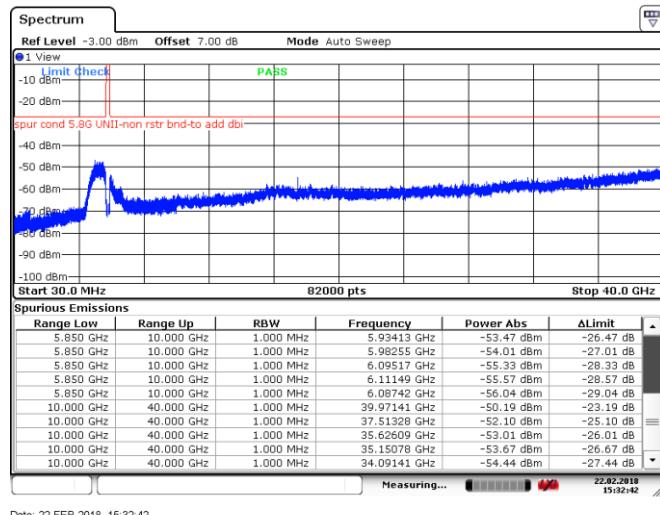
Date: 22.FEB.2018 15:29:15

Figure 8.4-9: Spurious emissions outside restricted bands, Tx on ch 149, 802.11ac VHT20



Date: 22.FEB.2018 15:31:36

Figure 8.4-10: Spurious emissions outside restricted bands, Tx on ch 157, 802.11ac VHT20



Date: 22.FEB.2018 15:32:42

Figure 8.4-11: Spurious emissions outside restricted bands, Tx on ch 165, 802.11ac VHT20

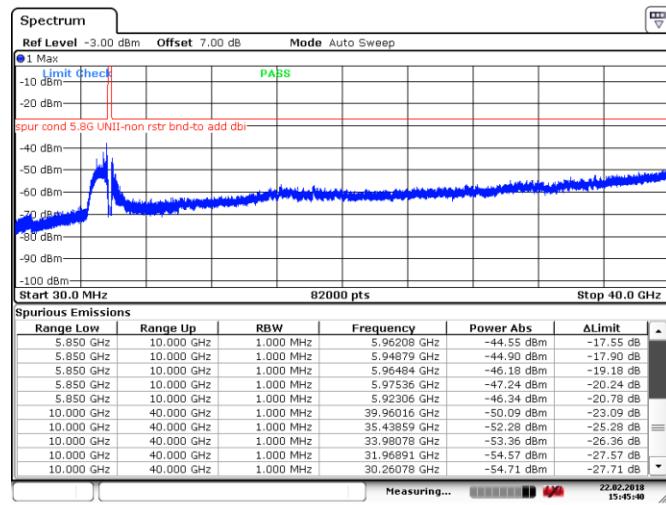


Figure 8.4-12: Spurious emissions outside restricted bands, Tx on ch 151, 802.11ac VHT40

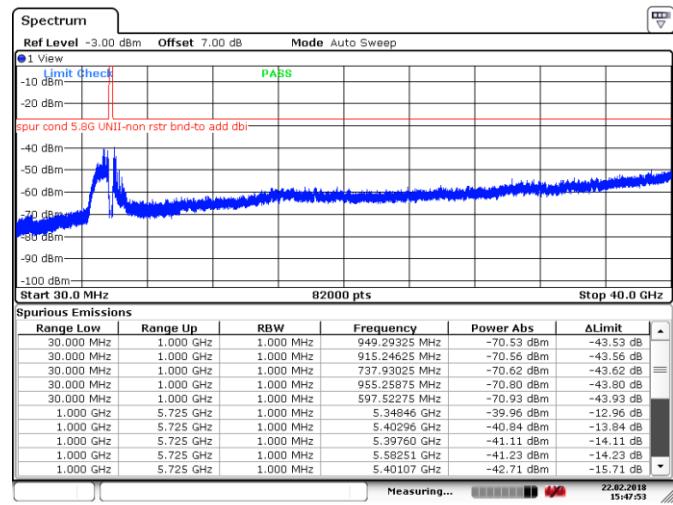


Figure 8.4-13: Spurious emissions outside restricted bands, Tx on ch 159, 802.11ac VHT40

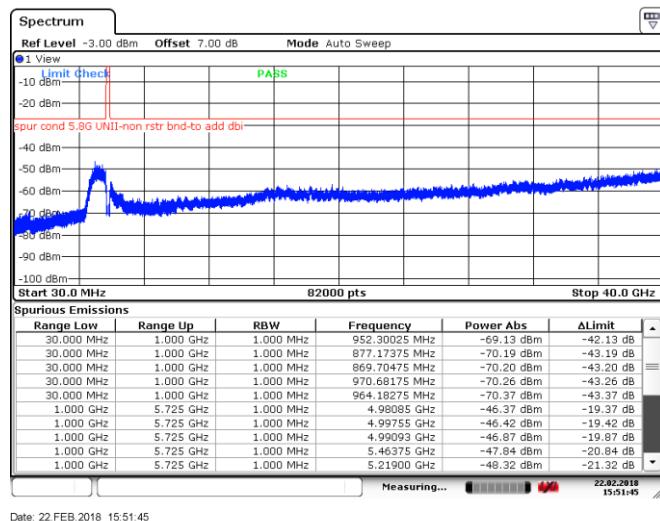
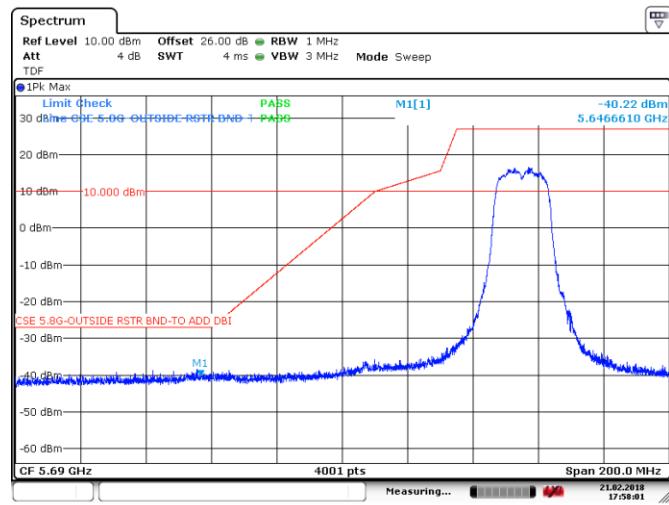
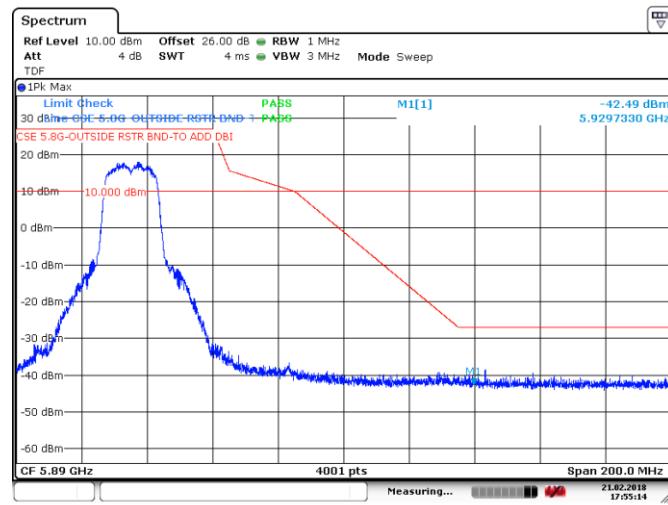


Figure 8.4-14: Spurious emissions outside restricted bands, Tx on ch 155, 802.11ac VHT80



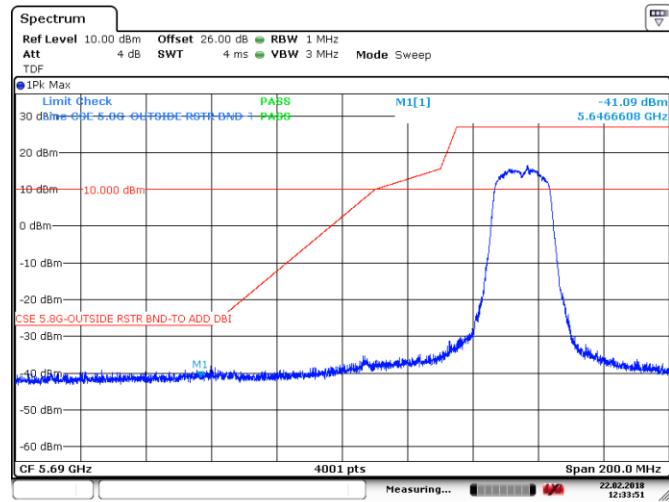
Date: 21.FEB.2018 17:58:01

Figure 8.4-15: Lower band edge, Tx on ch 149, 802.11a



Date: 21.FEB.2018 17:55:14

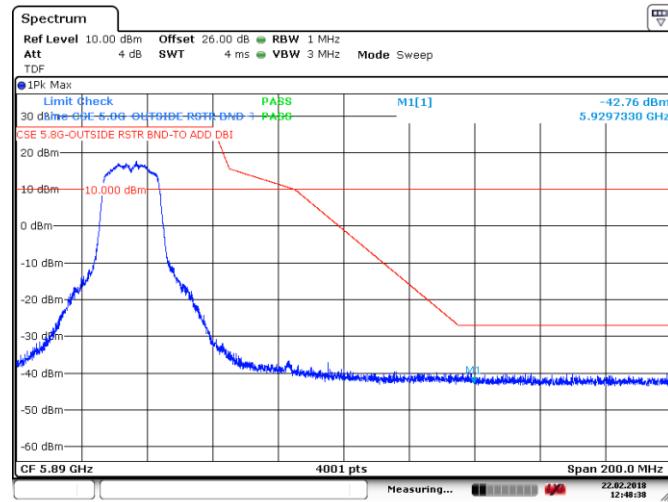
Figure 8.4-16: Upper band edge, Tx on ch 165, 802.11a



Date: 22.FEB.2018 12:33:51

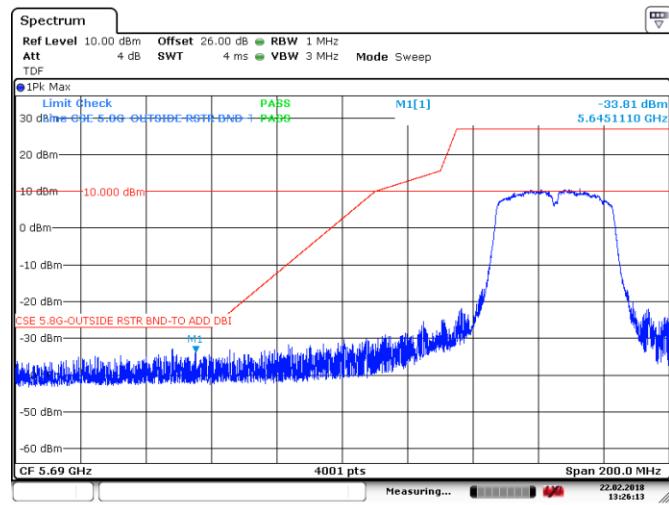
Figure 8.4-17: Lower band edge, Tx on ch 149, 802.11n HT20

Note: Peak limit EIRP equivalent: 74 dB μ V/m – 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m – 95.23 dB = -41.23 dBm



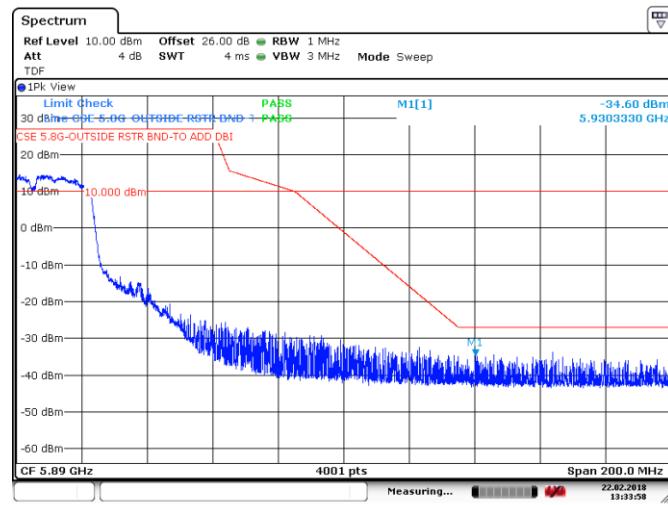
Date: 22.FEB.2018 12:48:38

Figure 8.4-18: Upper band edge, Tx on ch 165, 802.11n HT20



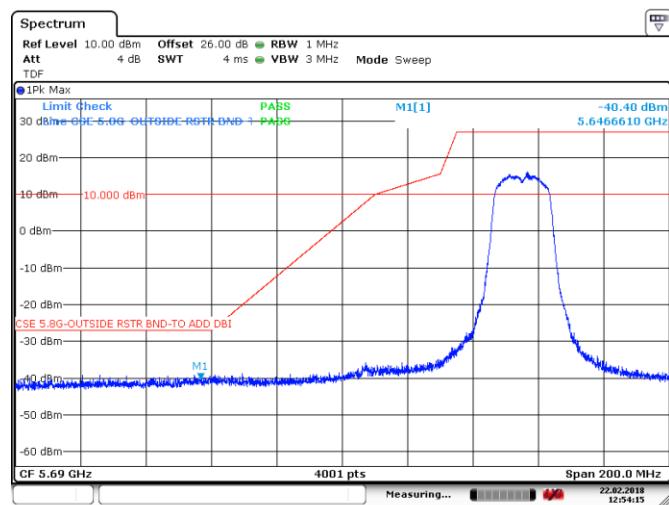
Date: 22.FEB.2018 13:26:14

Figure 8.4-19: Lower band edge, Tx on ch 151, 802.11n HT40



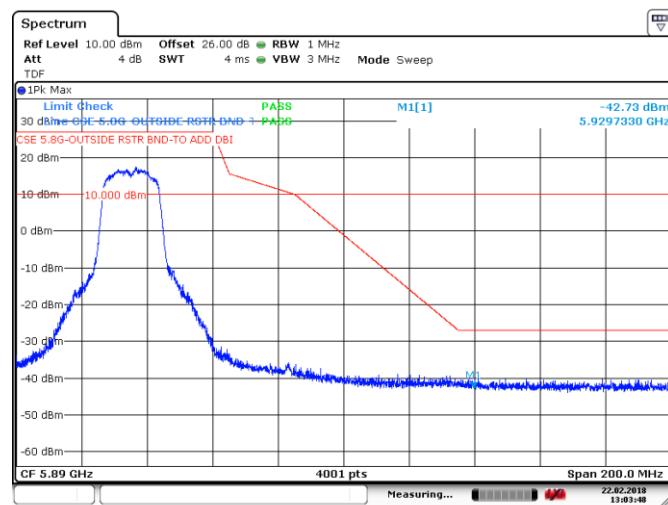
Date: 22.FEB.2018 13:33:58

Figure 8.4-20: Upper band edge, Tx on ch 159, 802.11n HT40



Date: 22.FEB.2018 12:54:15

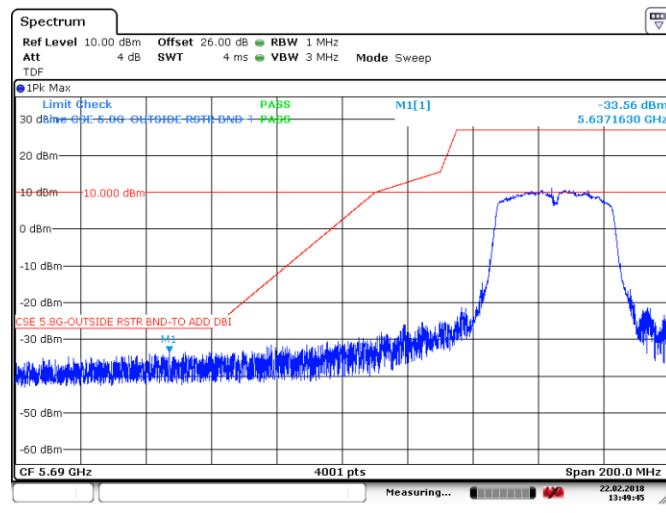
Figure 8.4-21: Lower band edge, Tx on ch 149, 802.11ac VHT20



Date: 22.FEB.2018 13:03:48

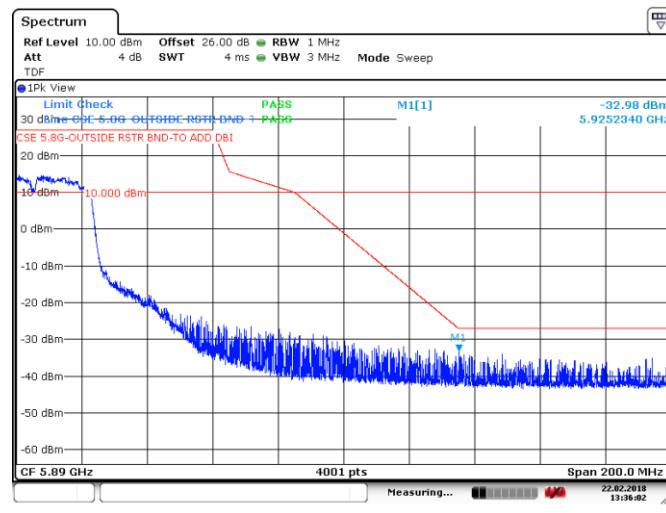
Figure 8.4-22: Upper band edge, Tx on ch 165, 802.11ac VHT20

Note: Peak limit EIRP equivalent: 74 dB μ V/m - 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m - 95.23 dB = -41.23 dBm



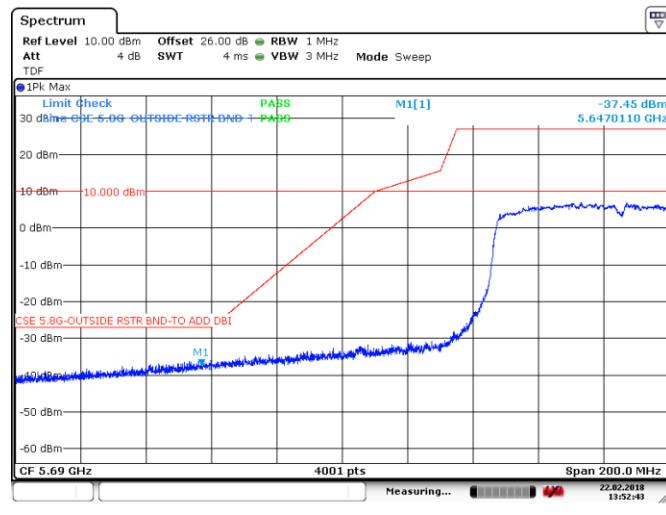
Date: 22.FEB.2018 13:49:45

Figure 8.4-23: Lower band edge, Tx on ch 151, 802.11ac VHT40



Date: 22.FEB.2018 13:36:03

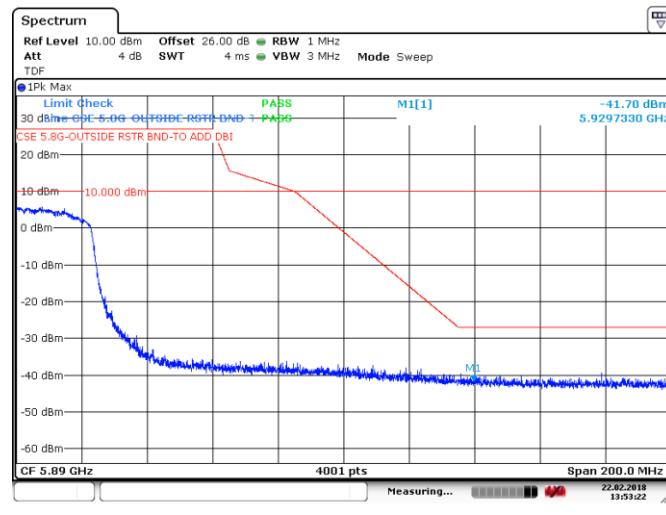
Figure 8.4-24: Upper band edge, Tx on ch 159, 802.11ac VHT40



Date: 22.FEB.2018 13:52:44

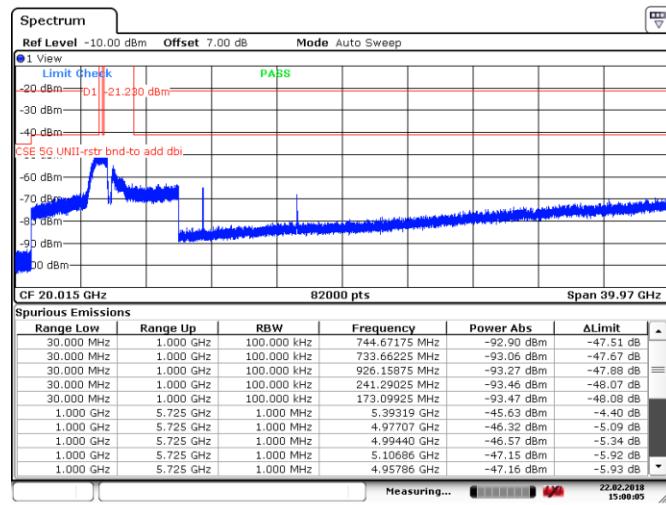
Figure 8.4-25: Lower band edge, Tx on ch 155, 802.11c VHT80

Note: Peak limit EIRP equivalent: 74 dB μ V/m – 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m – 95.23 dB = -41.23 dBm



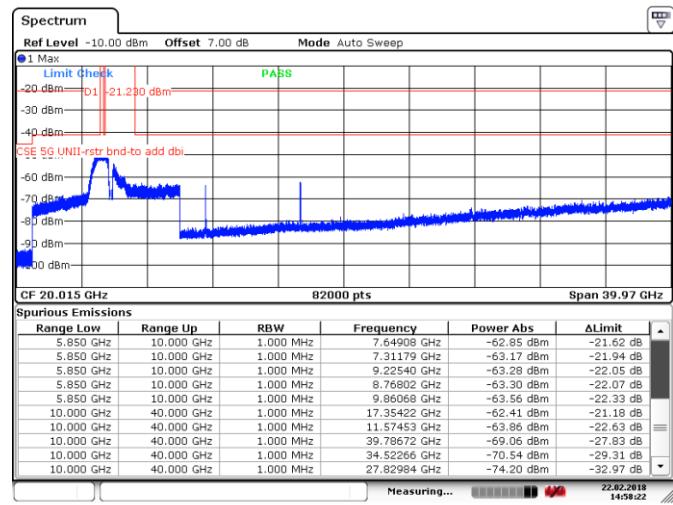
Date: 22.FEB.2018 13:53:22

Figure 8.4-26: Upper band edge, Tx on ch 155, 802.11c VHT80



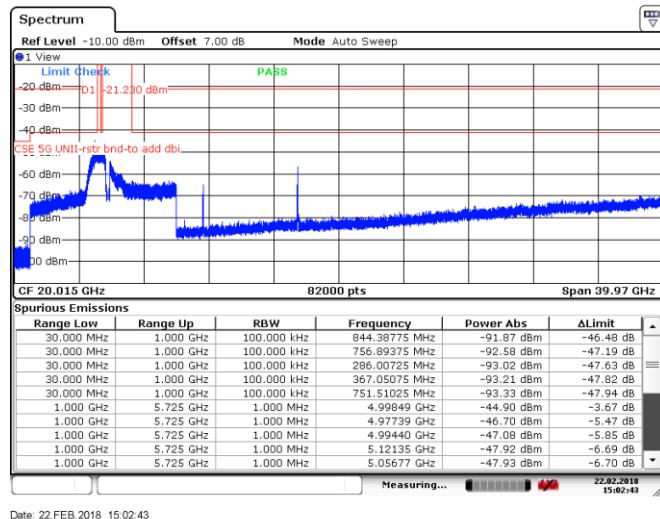
Date: 22.FEB.2018 15:00:05

Figure 8.4-27: Spurious emissions within restricted bands, Tx on ch 149, 802.11a



Date: 22.FEB.2018 14:58:21

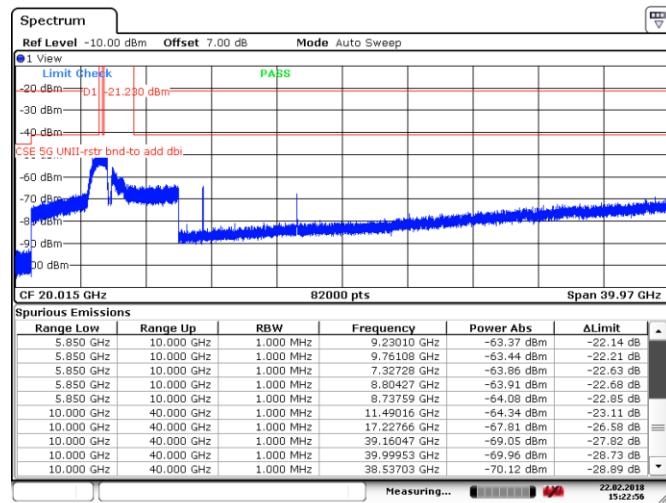
Figure 8.4-28: Spurious emissions within restricted bands, Tx on ch 157, 802.11a



Date: 22.FEB.2018 15:02:43

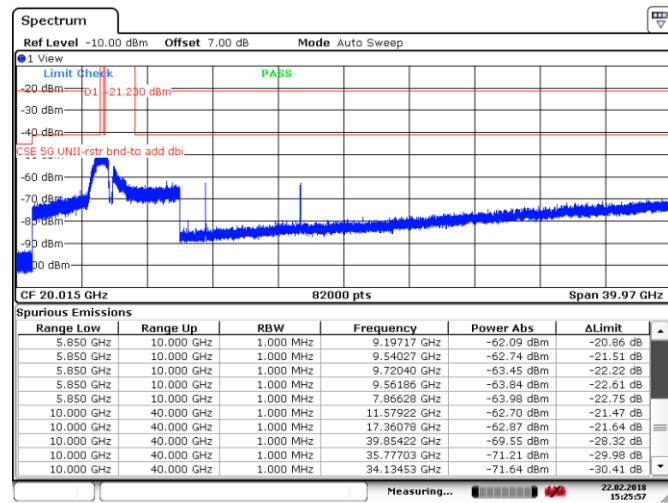
Figure 8.4-29: Spurious emissions within restricted bands, Tx on ch 165, 802.11a

Note: Peak limit EIRP equivalent: 74 dB μ V/m - 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m - 95.23 dB = -41.23 dBm



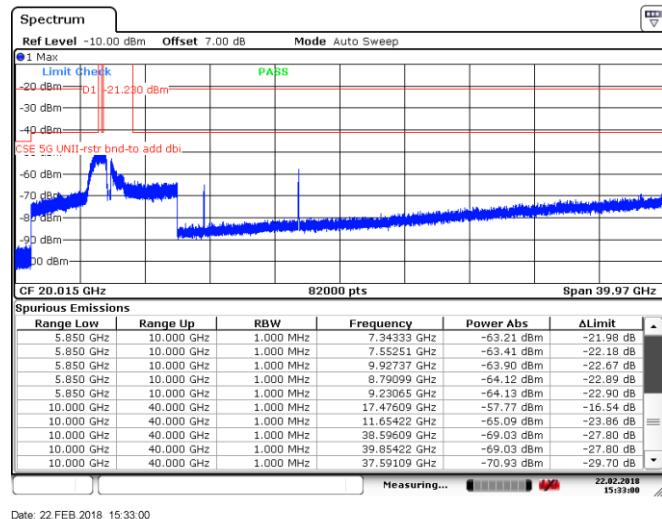
Date: 22.FEB.2018 15:22:56

Figure 8.4-30: Spurious emissions within restricted bands, Tx on ch 149, 802.11n HT20



Date: 22.FEB.2018 15:25:58

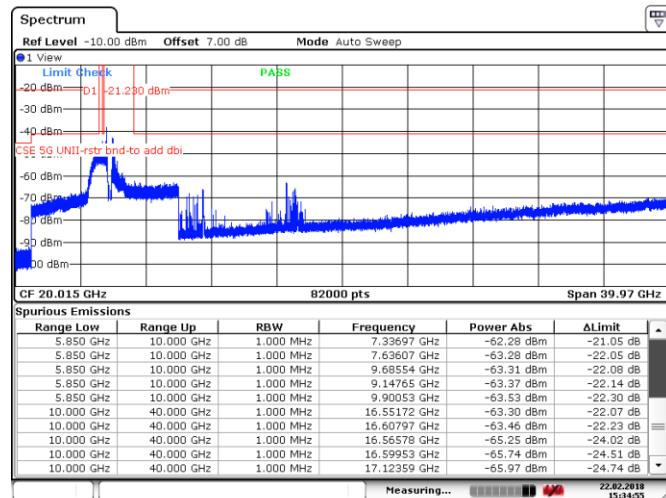
Figure 8.4-31: Spurious emissions within restricted bands, Tx on ch 157, 802.11n HT20



Date: 22.FEB.2018 15:33:00

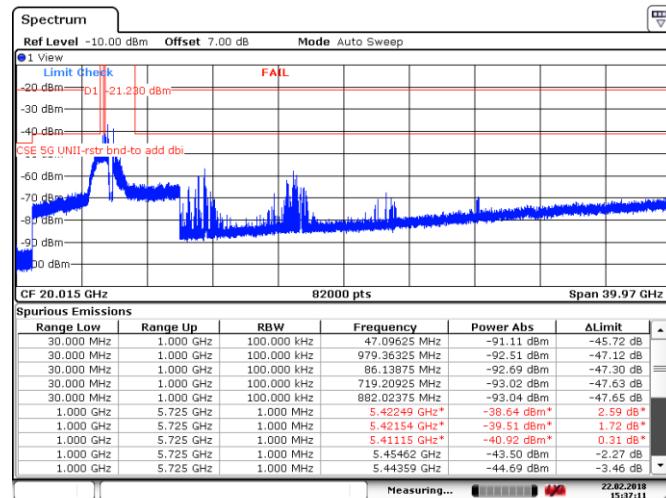
Figure 8.4-32: Spurious emissions within restricted bands, Tx on ch 165, 802.11n HT20

Note: Peak limit EIRP equivalent: 74 dB μ V/m - 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m - 95.23 dB = -41.23 dBm



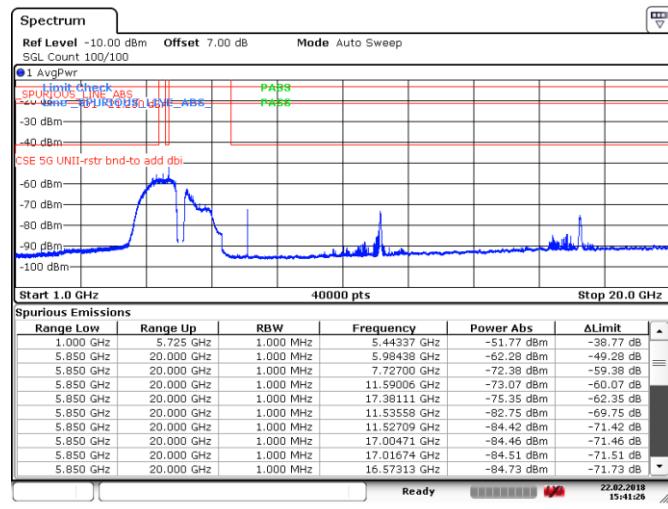
Date: 22.FEB.2018 15:34:55

Figure 8.4-33: Spurious emissions within restricted bands, Tx on ch 151, 802.11n HT40, Peak detector



Date: 22.FEB.2018 15:37:10

Figure 8.4-34: Peak Spurious emissions within restricted bands, Tx on ch 159, 802.11n HT40, Peak detector



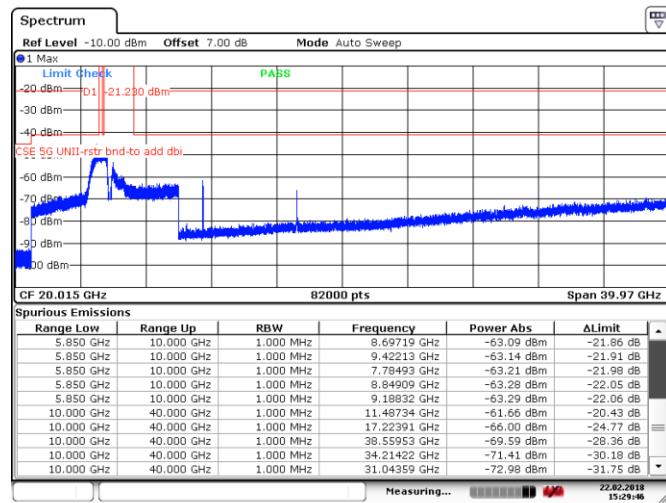
Date: 22.FEB.2018 15:41:26

Figure 8.4-35: Spurious emissions within restricted bands, Tx on ch 159, 802.11n HT40, RMS detector

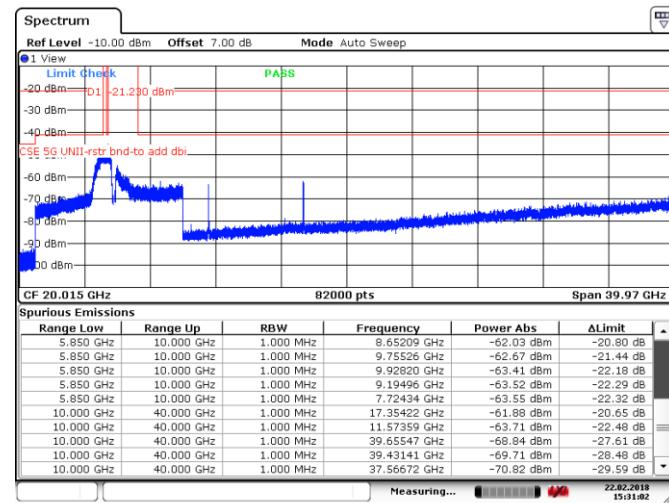
Note: Peak limit EIRP equivalent: 74 dB μ V/m - 95.23 dB = -21.23 dBm

Average limit EIRP equivalent: 54 dB μ V/m - 95.23 dB = -41.23 dBm

Where peak level of any emission had exceeded average limit line, those emissions were then re-measured with RMS detector.



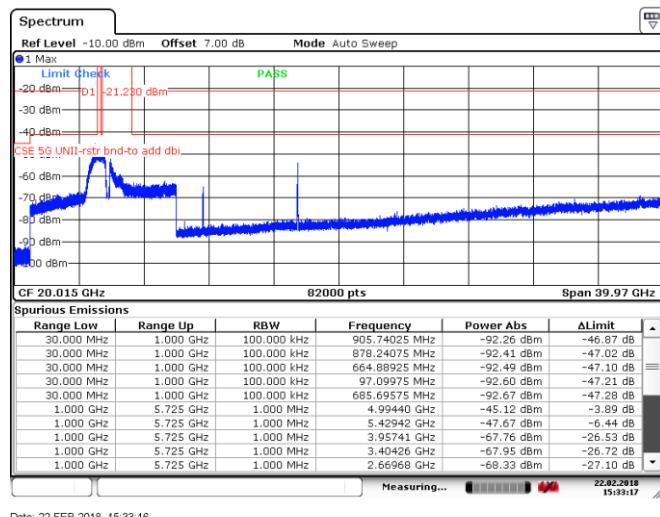
Date: 22.FEB.2018 15:29:45



Date: 22.FEB.2018 15:31:02

Figure 8.4-36: Spurious emissions within restricted bands, Tx on ch 149, 802.11ac VHT20

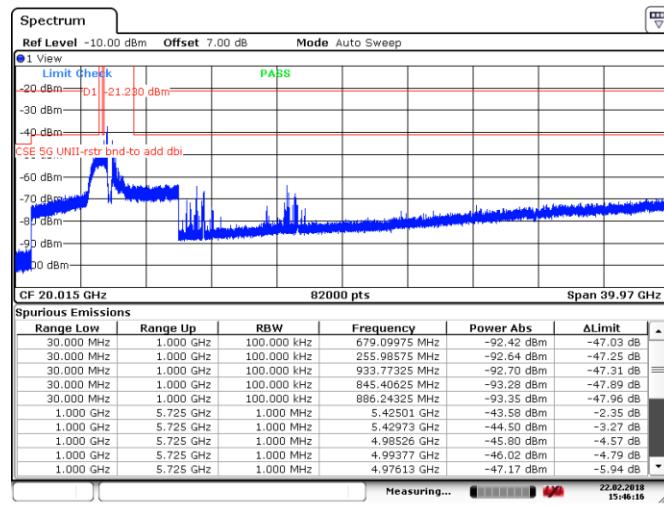
Figure 8.4-37: Spurious emissions within restricted bands, Tx on ch 157, 802.11ac VHT20



Date: 22.FEB.2018 15:33:16

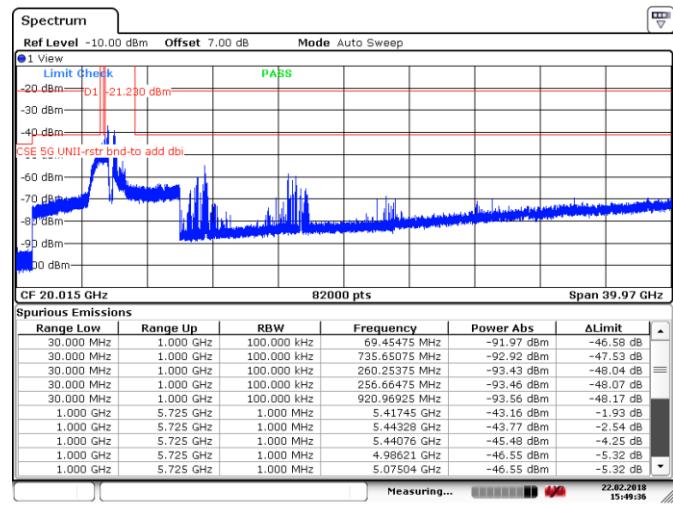
Figure 8.4-38: Spurious emissions within restricted bands, Tx on ch 165, 802.11ac VHT20

Note: Peak limit EIRP equivalent: 74 dB μ V/m - 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m - 95.23 dB = -41.23 dBm



Date: 22.FEB.2018 15:46:16

Figure 8.4-39: Spurious emissions within restricted bands, Tx on ch 151, 802.11ac VHT40, Peak detector



Date: 22.FEB.2018 15:49:36

Figure 8.4-40: Spurious emissions within restricted bands, Tx on ch 159, 802.11ac VHT40

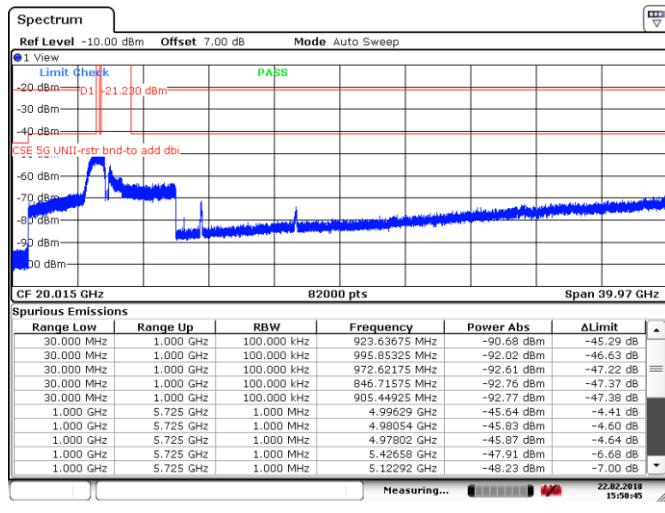


Figure 8.4-41: Spurious emissions within restricted bands, Tx on ch 155, 802.11ac VHT80

Note: Peak limit EIRP equivalent: 74 dB μ V/m - 95.23 dB = -21.23 dBm
Average limit EIRP equivalent: 54 dB μ V/m - 95.23 dB = -41.23 dBm

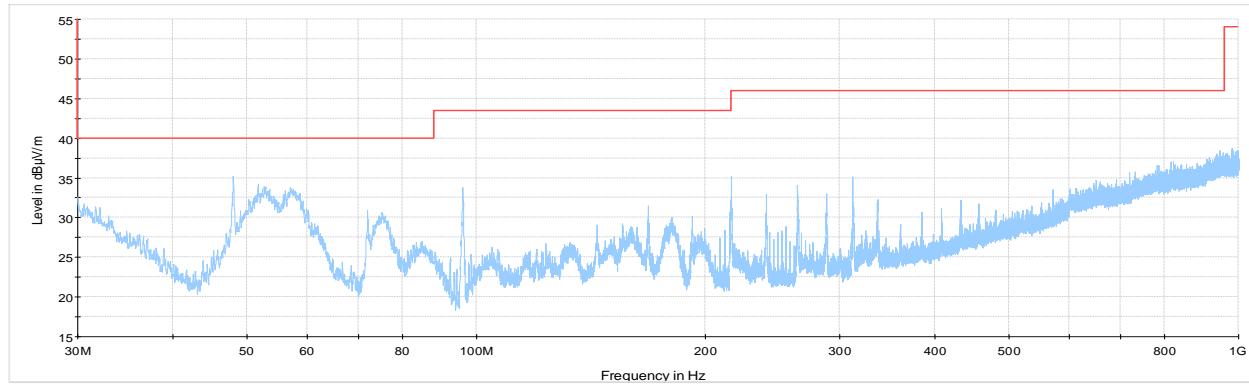


Figure 8.4-42: Cabinet Radiated spurious emission 30 MHz to 1 GHz sample plot

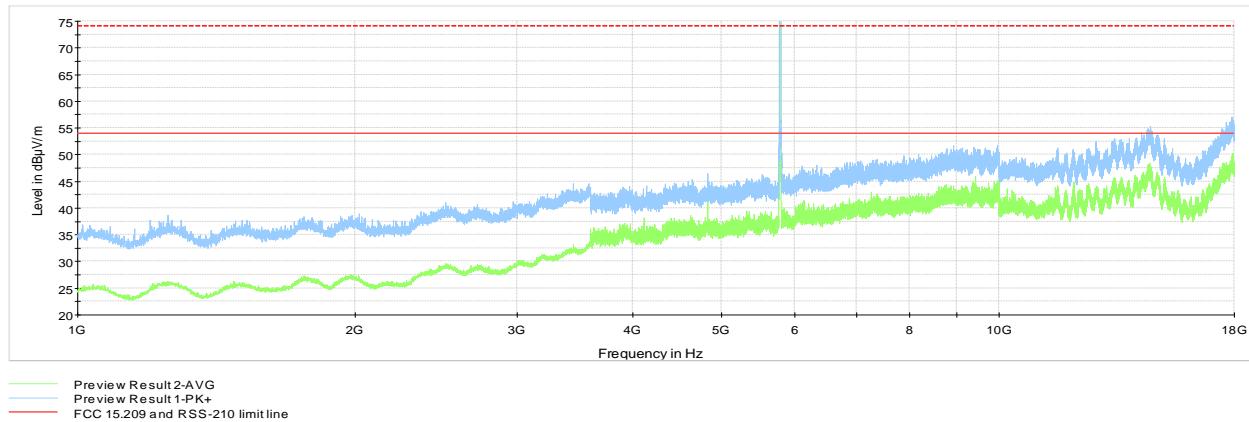


Figure 8.4-43: Cabinet Radiated spurious emission 1 to 18 GHz sample plot

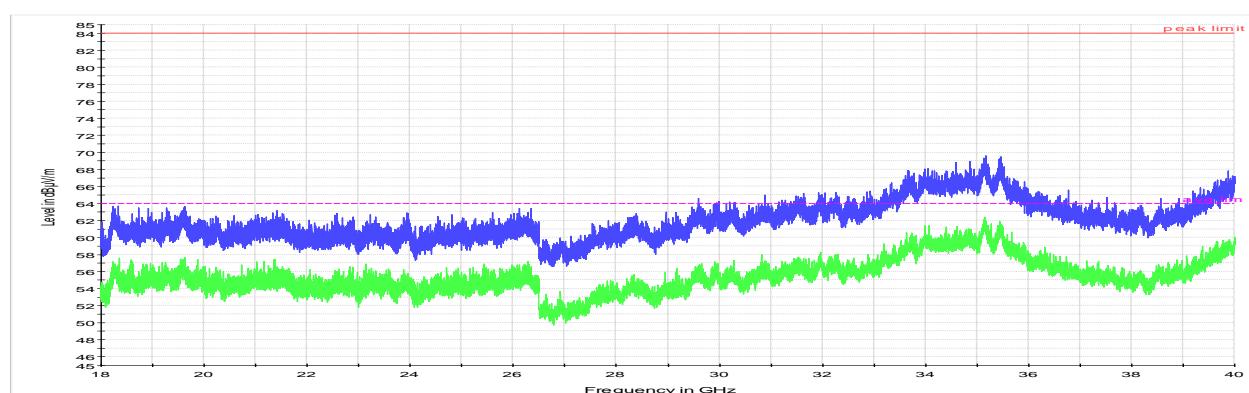


Figure 8.4-44: Cabinet Radiated spurious emission 18 to 40 GHz sample plot

Note: EUT was investigated in high/mid/low channels of 802.11a/802.11n/802.11ac modes, only worst case is presented.

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

8.5.1 Definitions and limits

FCC §15.407(6)(b):

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

FCC §15.207(a):

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

ISED:

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 8.5-1: Conducted emissions limit

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

Note: * - The level decreases linearly with the logarithm of the frequency.

** - A linear average detector is required.

8.5.2 Test summary

Test start date:	February 23, 2018
Test engineer:	Yong Huang

8.5.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

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

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

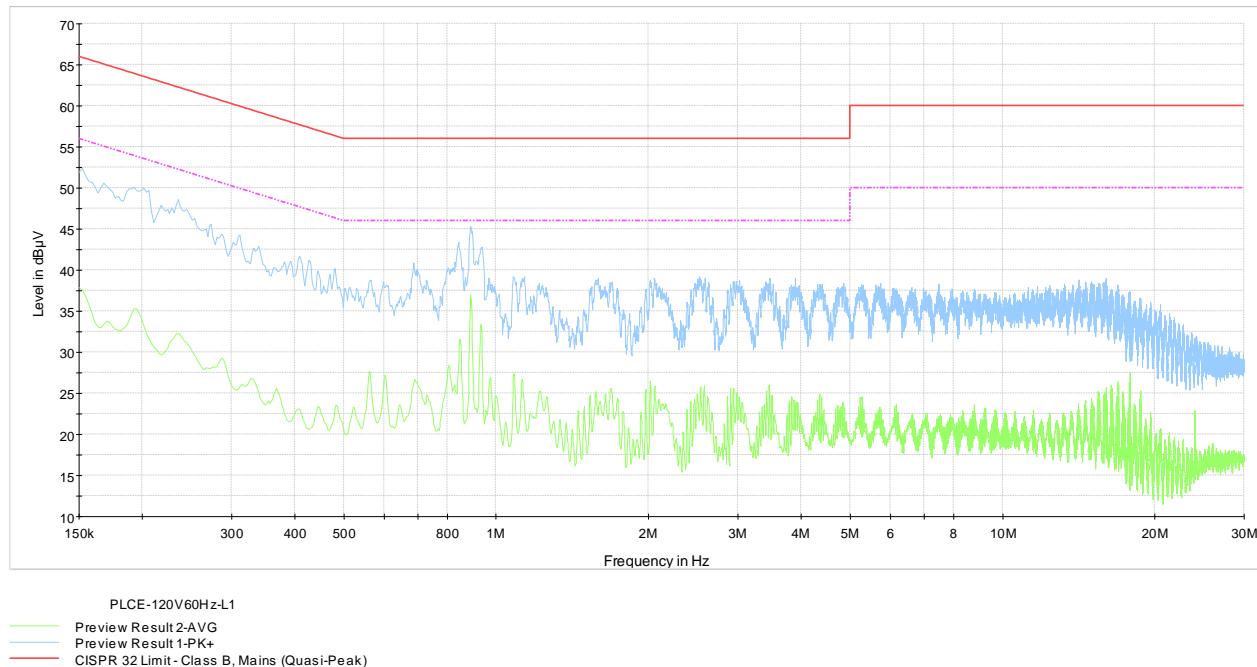
Receiver settings for preview measurements:

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

Receiver settings for final measurements:

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

8.5.4 Test data



Plot 8.5-1: Conducted emissions on phase line

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

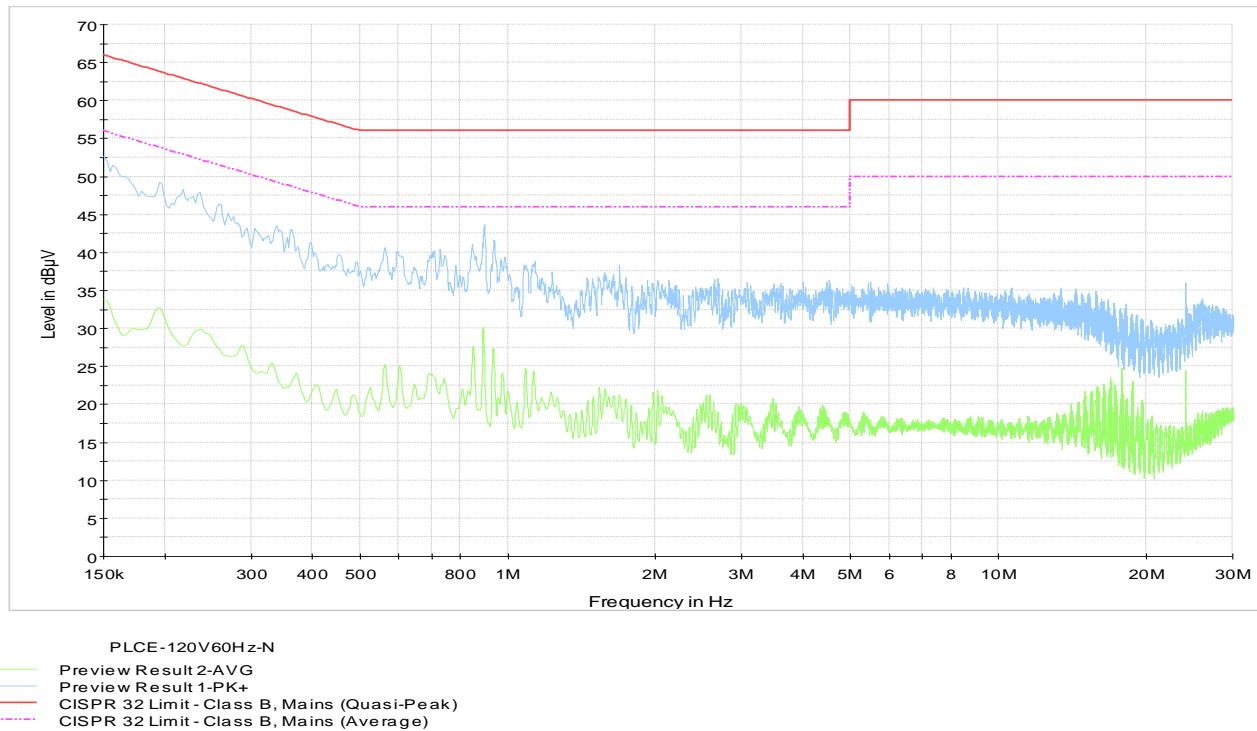
Frequency, MHz	Average result, dB μ V	Limit, dB μ V	Margin, dB	Meas. Time, ms	Bandwidth, kHz	Correction, dB
0.890	37.1	46.0	8.9	100	9	9.5

Notes: ¹ Result (dB μ V) = receiver/spectrum analyzer value (dB μ V) + correction factor (dB)

² Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB)

³ Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions have been recorded.

Sample calculation: 37.1 dB μ V (result) = 26.6 dB μ V (receiver reading) + 9.5 dB (Correction factor)



Plot 8.5-2: Conducted emissions on neutral line

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

8.6.1 Definitions and limits

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

8.6.2 Test summary

Test start date:	February 27, 2018
Test engineer:	Yong Huang

8.6.3 Observations, settings and special notes

Spectrum analyser settings:

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

8.6.4 Test data

Table 8.6-1: Frequency drift measurement

Test conditions	Nominal frequency, GHz	Frequency, GHz	Drift, Hz
+40 °C, Nominal	5.785	5.7850115620	-1000
+30 °C, Nominal	5.785	5.7850087500	-3812
+20 °C, +15 %	5.785	5.7850125620	0
+20 °C, Nominal	5.785	5.7850125620	reference
+20 °C, -15 %	5.785	5.7850125620	0
+10 °C, Nominal	5.785	5.7850138750	1313
0 °C, Nominal	5.785	5.7850276140	15052

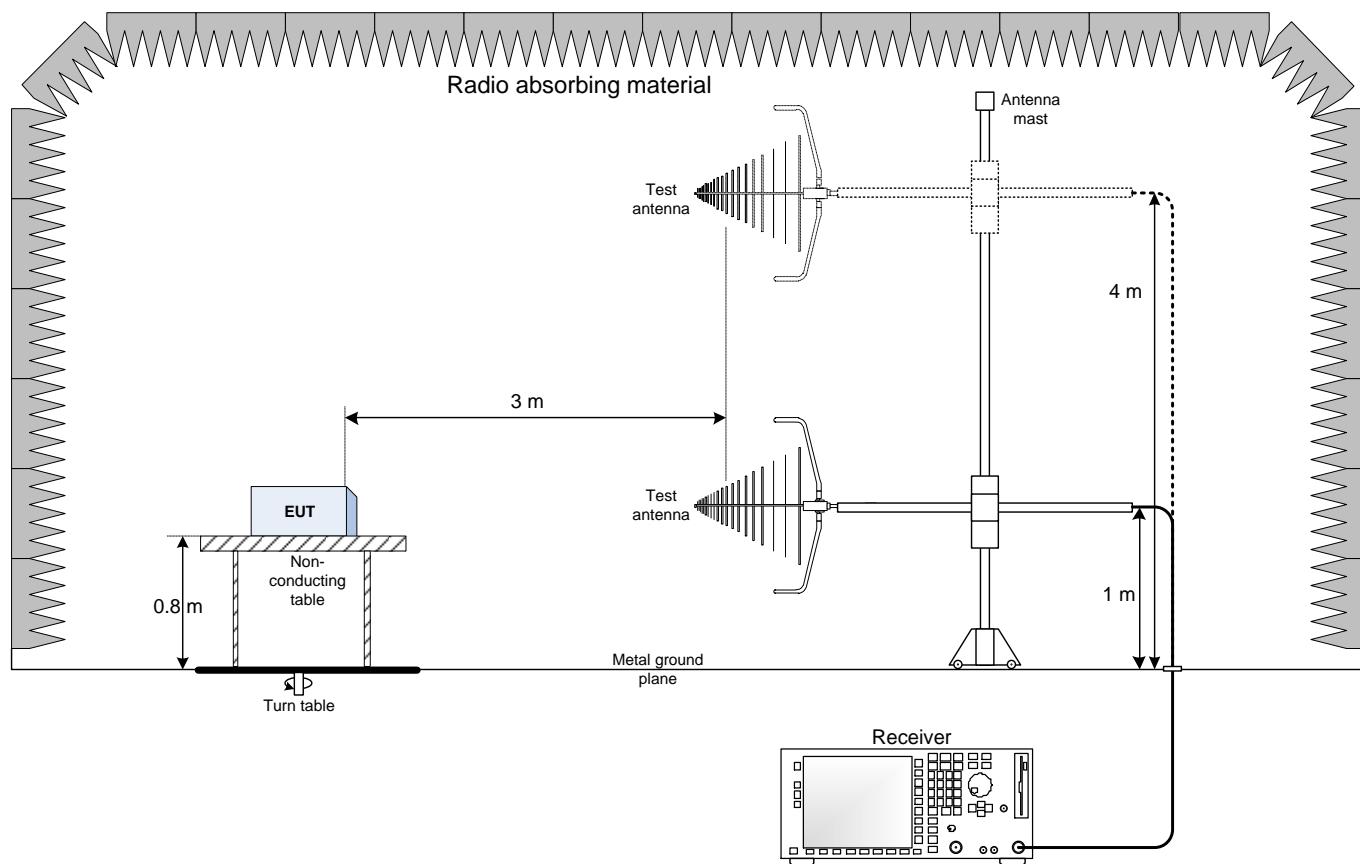
Minimum lower band edge margin is more than 4 kHz

Minimum upper band edge margin is more than 16 kHz

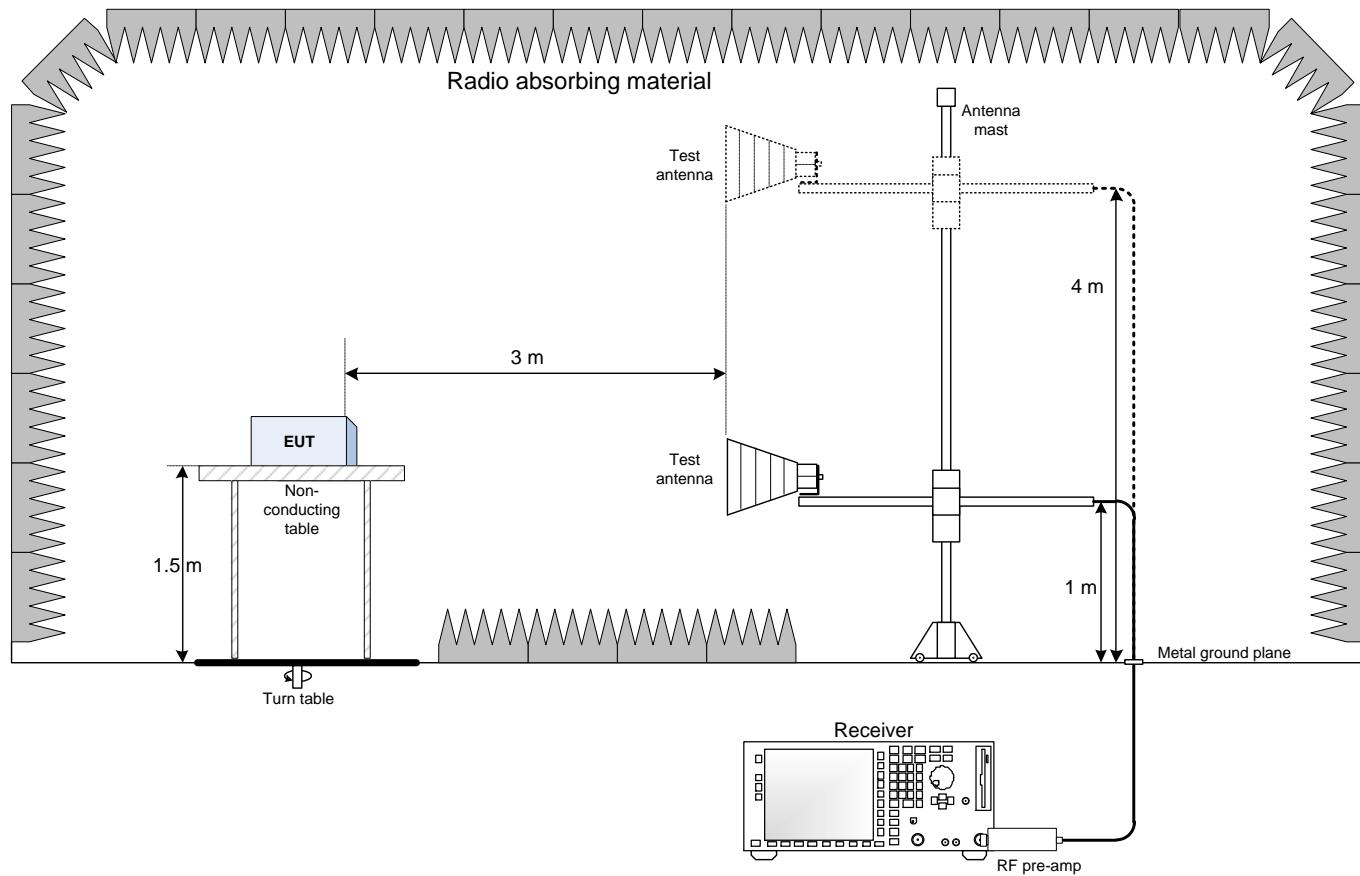
The frequency drifts in above table are within these minimum margins, the emissions are deemed to maintain within the band of operation.

Section 9. Block diagrams of test set-ups

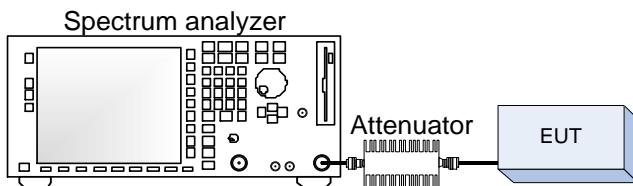
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Antenna port conducted measurements set-up



9.4 Conducted emissions on AC line set-up

