CERTIFICATE #3478.01

TEST REPORT

EUT Description	**WLAN and BT, 1x1 PCIe M.2 2230 adapter card**
Brand Name	**Intel® Wireless-AC 9461**
Model Name	**9461NGW**
FCC ID	**PD99461NG**
Date of Test Start/End	**2017-07-28 / 2017-09-07**
Features	**802.11 a/b/g/n/ac Wireless LAN + Bluetooth 5** (see section 5)

Applicant	**Intel Mobile Communications**
Address	**100 Center Point Circle, Suite 200** **Columbia, South Carolina 29210** **USA**
Contact Person	**Steven Hackett**
Telephone/Fax/ Email	**steven.c.hackett@intel.com**

Reference Standards	**FCC CFR Title 47 Part 15 E** (see section 1)

Test Report identification	**170727-01.TR01**
Revision Control	**Rev. 00** **This test report revision replaces any previous test report revision** (see section 8)

The test results relate only to the samples tested.
The test report shall not be reproduced in full, without written approval of the laboratory.

Issued by

Digitally signed by Walid EL HAJJ
Date: 2017.09.12 12:12:29 +02'00'

Walid EL HAJJ
(Test Engineer Lead)

Reviewed by

Digitally signed by Olivier FARGANT
DN: cn=Olivier FARGANT, o=Intel Mobile Communications, ou=WRF Lab, email=olivier.fargant@intel.com, c=FR
Date: 2017.09.12 14:27:50 +02'00'

Olivier FARGANT
(Technical Manager)

Intel Mobile Communications France S.A.S – WRF Lab
425 rue de Goa – Le Cargo B6 - 06600, Antibes, France
Tel. +33493001400 / Fax +33493001401

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1. Standards, reference documents and applicable test methods

1. FCC 47 CFR part 15 – Subpart E – Unlicensed National Information Infrastructure Devices.
2. FCC 47 CFR part 15 - Subpart C – §15.207 Conducted emission limits.
3. FCC 47 CFR part 15 - Subpart C – §15.209 Radiated emission limits; general requirements.
4. FCC OET KDB 789033 D02 General U-NII Test Procedures New Rules v01r04 – Guidelines for compliance testing of Unlicensed National Information Infrastructure (U-NII) Devices (Part 15, Subpart E).
5. FCC OET KDB 644545 D03 Guidance for IEEE 802.11ac v01 - GUIDANCE FOR IEEE Std 802.11ac™ DEVICES EMISSION TESTING.
6. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

2. General conditions, competences and guarantees

- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2005 testing laboratory accredited by the American Association for Laboratory Accreditation (A2LA) with the certificate number 3478.01.
- ✓ Intel Mobile Communications France SAS Wireless RF Lab (Intel WRF Lab) is an Accredited Test Firm recognized by the FCC, with Designation Number FR0011.
- ✓ Intel WRF Lab only provides testing services and is committed to providing reliable, unbiased test results and interpretations.
- ✓ Intel WRF Lab is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.
- ✓ Intel WRF Lab has developed calibration and proficiency programs for its measurement equipment to ensure correlated and reliable results to its customers.
- ✓ This report is only referred to the item that has undergone the test.
- ✓ This report does not imply an approval of the product by the Certification Bodies or competent Authorities.

3. Environmental Conditions

- ✓ At the site where the measurements were performed the following limits were not exceeded during the tests:

Temperature	23ºC ± 1ºC
Humidity	60% ± 12%

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4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	170727-01.S01	Module	9461NGW	WFM 3413E86AD85D	2017-07-28	Used for conducted tests
	170524-02.S15	Extender Board	PCB00609_01	6092416-442	2017-05-30	
	170000-01.S04	Laptop	Latitude E5470	DMRKMC2	2017-05-10	
#02	170727-01.S06	Module	9461NGW	WFM 3413E86AD7B3	2017-07-28	Used for radiated tests
	170220-02.S03	Extender Board	PCB00609_01	6092416-446	2017-02-20	
	170000-01.S13	Laptop	Latitude E5470	FT6LMC2	2017-04-25	
#03	170727-01.S04	Module	9461NGW	WFM 3413E86AD7BD	2017-07-28	Used for AC power-line conducted emission measurements
	170524-02.S13	Extender Board	PCB00609_01	6092416-418	2017-02-20	
	170000-01.S02	Laptop	Latitude E5470	21HTPF2	2017-04-25	

5. EUT Features

Brand Name	Intel® Wireless-AC 9461
Model Name	9461NGW
FCC ID	PD99461NG
Software Version	10.1730.0-05594
Driver Version	99.0.28.6
Prototype / Production	Production
Supported Radios	802.11b/g/n 2.4GHz (2400.0 – 2483.5 MHz) 802.11a/n/ac 5.2GHz (5150.0 – 5350.0 MHz) 5.6GHz (5470.0 – 5725.0 MHz) 5.8GHz (5725.0 – 5850.0 MHz) Bluetooth 5 2.4GHz (2400.0 – 2483.5 MHz)
Antenna Information	**WLAN/BT:** Slot antenna. WiFi 2.4GHz & 5GHz and BT (DRTU CHAIN A)

6. Remarks and comments

N/A

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7. Test Verdicts summary

7.1. 802.11 a/n/ac – U-NII-1

FCC part	Test name	Verdict
15.407 (a) (1)	Power Limits. Maximum output power	P
15.407 (a) (1)	Peak power spectral density	P
15.407 (b) (1) 15.209	Undesirable emissions limits: Band Edge (conducted)	P
15.407 (b) (1) 15.209	Undesirable emissions limits (radiated)	P
15.407 (6) 15.207	AC power-line conducted emission	P

7.2. 802.11 a/n/ac – U-NII-2A

FCC part	Test name	Verdict
15.407 (a) (2)	Power Limits. Maximum output power	P
15.407 (a) (2)	Peak power spectral density	P
15.407 (b) (2) 15.209	Undesirable emissions limits: Band Edge (conducted)	P
15.407 (b) (2) 15.209	Undesirable emissions limits (radiated)	P
15.407 (6) 15.207	AC power-line conducted emission	P

P: Pass
F: Fail
NM: Not Measured
NA: Not Applicable

8. Document Revision History

Revision #	Date	Modified by	Revision Details
Rev. 00	2017-09-11	BLavenant	First Issue

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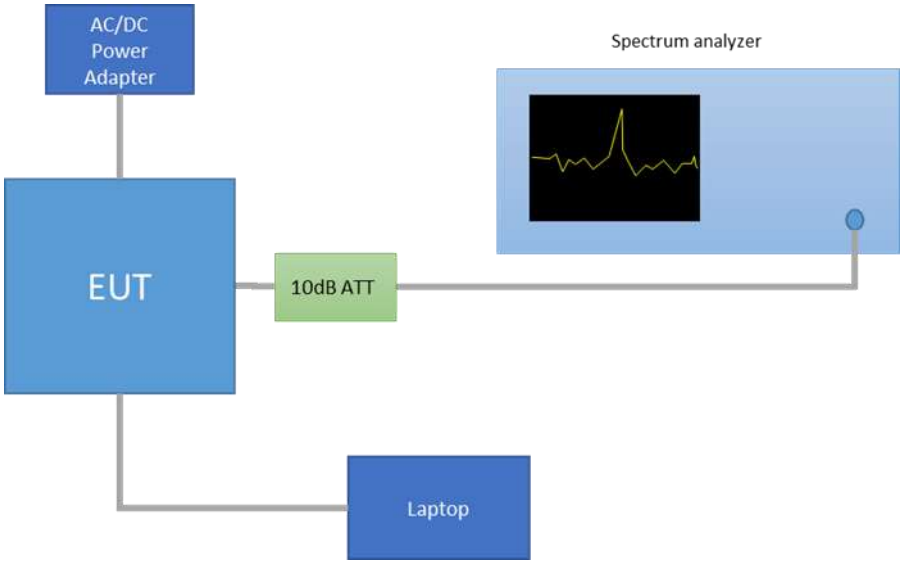
Annex A. Test & System Description

A.1 Measurement System

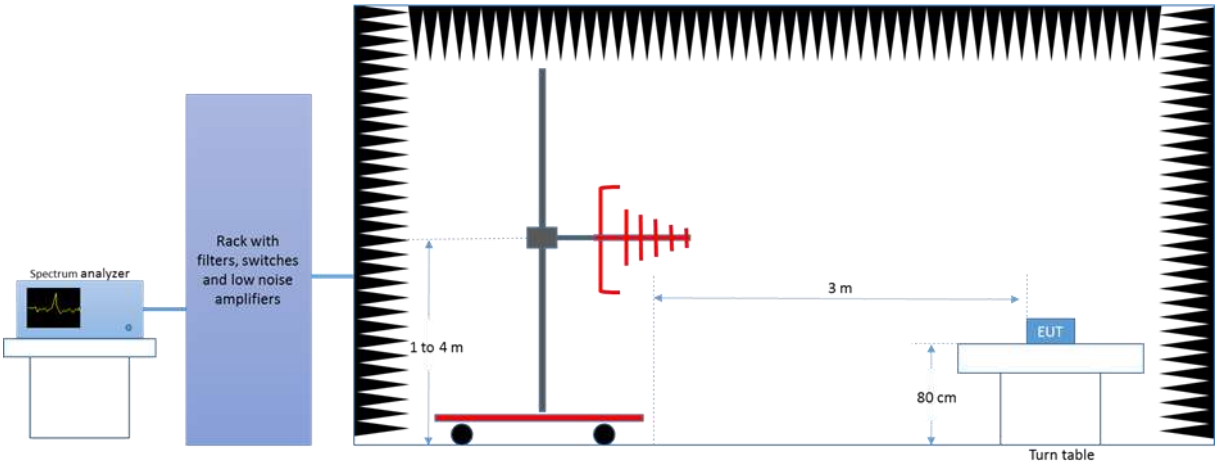
Measurements were performed using the following setups, made in accordance to the general provisions of FCC KDB 789033 D02 General U-NII Test Procedures

The DUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes, using the Intel proprietary tool DRTU.

Conducted Setup



Radiated Setup < 1GHz



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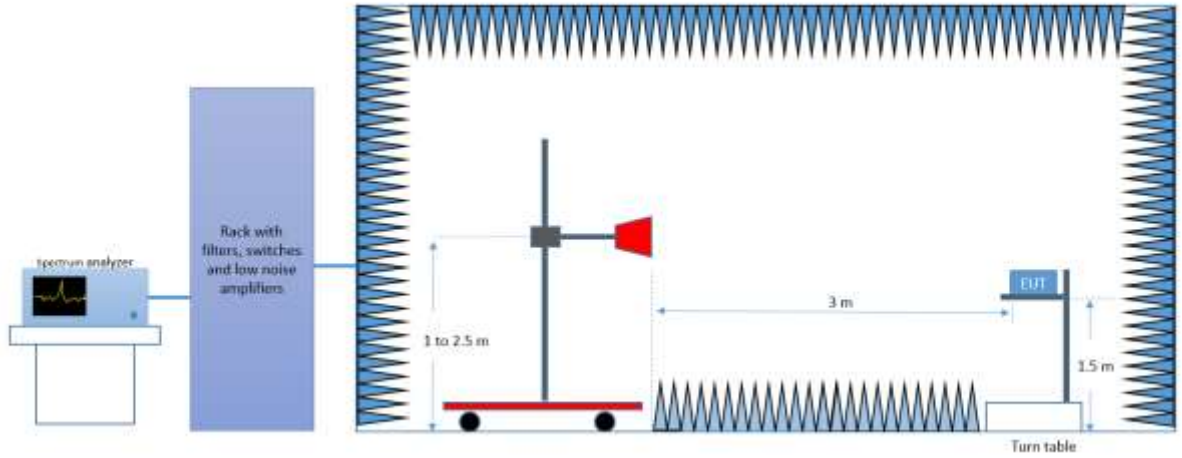
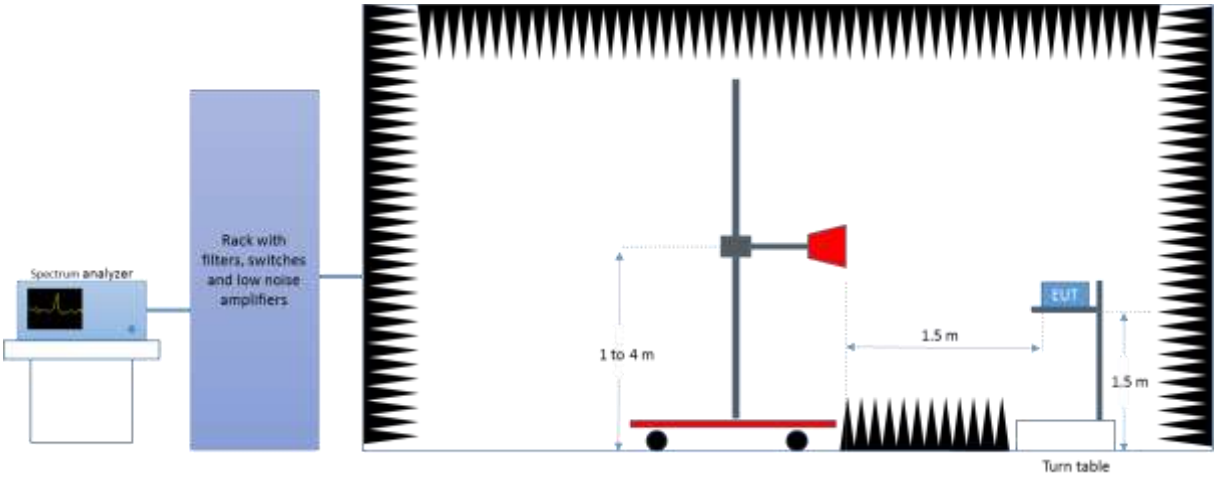
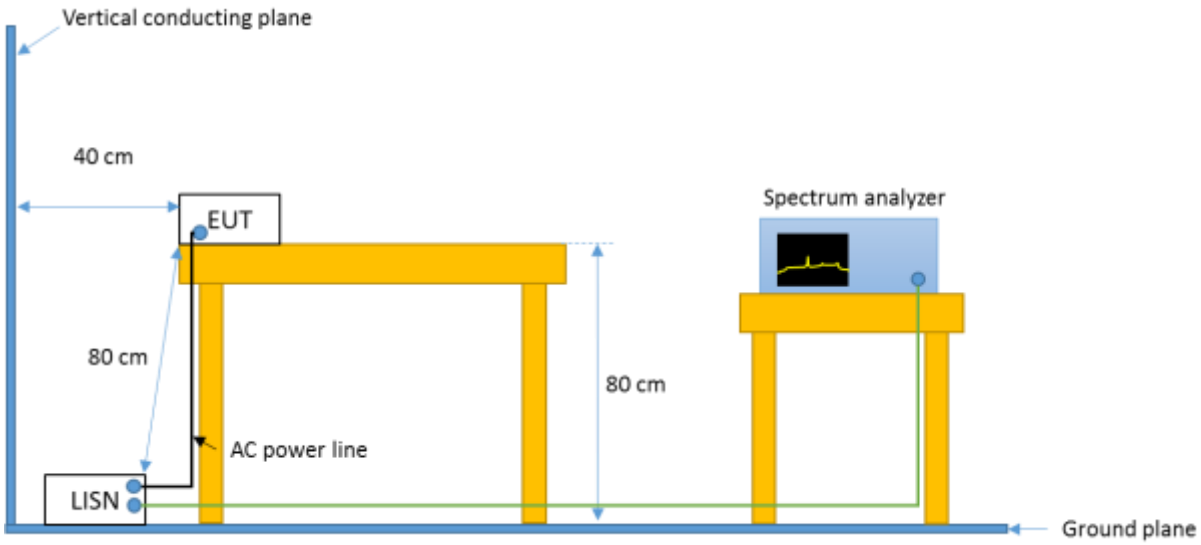
Radiated Setup 1 GHz – 18 GHz



Radiated Setup 18 GHz – 40 GHz



AC power-line conducted emission Setup 150 kHz – 30 MHz



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A.2 Test Equipment List

Conducted Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0316	Spectrum analyzer	FSV30	103309	Rohde & Schwarz	2017-01-30	2019-01-30

Radiated Setup-1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0133	Spectrum analyzer	FSV40	101358	Rohde & Schwarz	2016-04-15	2018-04-15
0137	Log antenna 30 MHz – 1 GHz	3142E	00156946	ETS Lindgren	2015-12-11	2017-12-11
0139	Horn Antenna 18 GHz - 26.5 GHz	114514	00167100	ETS Lindgren	2016-03-16	2018-03-16
0140	Horn Antenna 26.5 GHz - 40 GHz	120722	00169638	ETS Lindgren	2016-07-26	2018-07-26
0135	Semi Anechoic chamber	FACT 3	5720	ETS Lindgren	2016-04-28	2018-04-28
0530	Measurement Software	EMC32	100623	Rohde & Schwarz	N/A	N/A
0296	Power Supply	6673A	MY41000318	Agilent	N/A	N/A
0346	Multimeter	34401A	US36054685	HP	2016-02-04	2018-02-04

N/A: Not Applicable

Radiated Setup-2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0420	Spectrum analyzer	FSV40	101556	Rohde & Schwarz	2016-04-15	2018-04-15
0138	Horn antenna 1 GHz – 6.4 GHz	3117	00152266	ETS Lindgren	2016-03-14	2018-03-14
0141	Double Ridge Horn Antenna 1 GHz – 18 GHz	3117	00157736	ETS Lindgren	2016-04-13	2018-04-13
0409	PreAmplifier	3117-PA	00157993	ETS Lindgren	N/A	N/A
0337	Full Anechoic chamber	RFD_FA_100	5996	ETS Lindgren	2016-04-28	2018-04-28
0329	Measurement Software	EMC32	100401	Rohde & Schwarz	N/A	N/A

N/A: Not Applicable

Radiated Setup - shared equipments

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0014	Power Sensor	NRP-Z57	101280	Rohde & Schwarz	2017-04-25	2019-04-25

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AC power-line conducted emission Setup

ID#	Device	Type/Model	Serial Number	Manufacturer	Cal. Date	Cal. Due Date
0027	Measurement software	EMC32	1300.7010.02	Rohde & Schwarz	NA	NA
0317	Spectrum Analyzer	FSV30	103308	Rohde & Schwarz	2017-08-05	2019-08-05
0532	LISN	ENV216	101321	Rohde & Schwarz	2016-09-13	2018-09-13
0607	LISN	ENV216	101342	Rohde & Schwarz	2017-09-06	2018-09-06
0538	Transformer	Monophase	TIMM3.15	Montelem	NA	NA
095	Millivoltmeter	2000	4009301	KEITHLEY	2015-10-26	2017-10-26
0624	AC power source	61604	SM135546	CHROMA	NA	NA
0346	Multimeter	34401A	US36054685	HP	2016-02-04	2018-02-04

N/A: Not Applicable

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A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

Measurement type	Uncertainty [±dB]
Conducted Power	±1.0
Conducted Spurious Emission	±2.9
Radiated tests <1GHz	±3.8
Radiated tests 1GHz - 40 GHz	±4.7
AC power-line conducted emission	±1.45

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Annex B. Test Results U-NII-1 & U-NII-2A

B.1 Test Conditions

The conducted RF output power at chain A was adjusted according to the client's supplied Target values (see following table) using the Intel DRTU tool and measuring the power by using a spectrum analyser with the channel integration method according to point II) E) 2) e) (Method SA-2 Alternative) of Guidance 789033 D02.
Measured values for adjustment were within +/- 0.25 dB from the declared Target values.

U-NII-1					Conducted Power Target Value (dBm)
Mode	BW (MHz)	Data Rate	CH #	Freq. (MHz)	SISO Chain A
802.11a	20	6Mbps	36	5180	17.5
			40	5200	21.5
			48	5240	21
802.11n	20	HT0	36	5180	17.5
			40	5200	21.5
			48	5240	21
	40	HT0	38F	5190	18
			46F	5230	21.5
802.11ac	80	VHT0	42ac80	5210	18.5

..

U-NII-2A					Conducted Power Target Value (dBm)
Mode	BW (MHz)	Data Rate	CH #	Freq. (MHz)	SISO Chain A
802.11a	20	6Mbps	52	5260	20.50
			56	5280	21.00
			64	5320	17.50
802.11n	20	HT0	52	5260	23.00
			56	5280	23.00
			64	5320	19.50
	40	HT0	54F	5270	20.00
			62F	5310	15.50
802.11ac	80	VHT0	58ac80	5290	17.50

The following data rates were selected based on preliminary testing that identified those rates as the worst cases for output power and spurious levels at the band edges:

802.11a → 6Mbps
802.11n20 and 802.11n40 (SISO) → HT0
802.11ac80 (SISO) → VHT0

Alternative channels to the lowest and highest channels per band have been also tested for Band Edge compliance.

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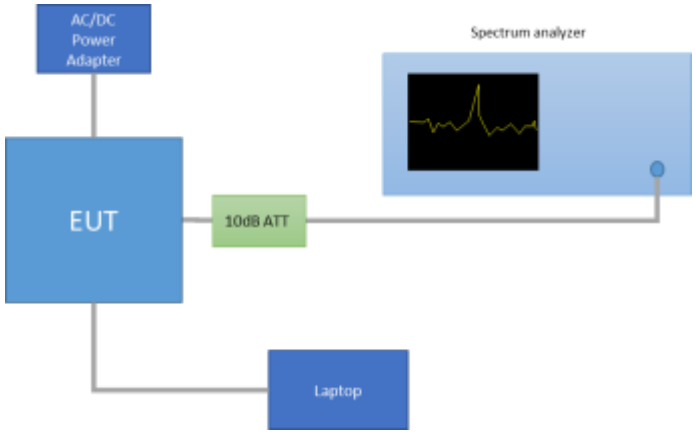
B.2 Test Results Tables U-NII-1

B.2.1 26dB & 99% Bandwidth

Test procedure

The setup below was used to measure the 26dB & 99% Bandwidth. The antenna terminal of the EUT is connected to the spectrum analyzer through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.



Results tables

Mode	Rate	Antenna	Channel	Frequency [MHz]	26dB BW [MHz]	99% BW [MHz]
802.11a	6Mbps	SISO CHAIN A	36	5180	24.62	17.92
			40	5200	28.38	18.28
			48	5240	41.99	**22.80**
802.11n20	HT0		36	5180	24.47	17.88
			40	5200	29.68	18.28
			48	5240	30.33	**18.44**
802.11n40	HT0		38F	5190	45.04	36.56
			46F	5230	50.45	**37.12**
802.11ac80	VHT0		42ac80	5210	83.68	**75.12**

Max Value

See Section B.3.1 and Section B.3.2 for the screenshot results.

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B.2.2 Power Limits. Maximum Output power & Peak power spectral density

Test limits

FCC part	Limits
15.407 (a) (1) (iv)	For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

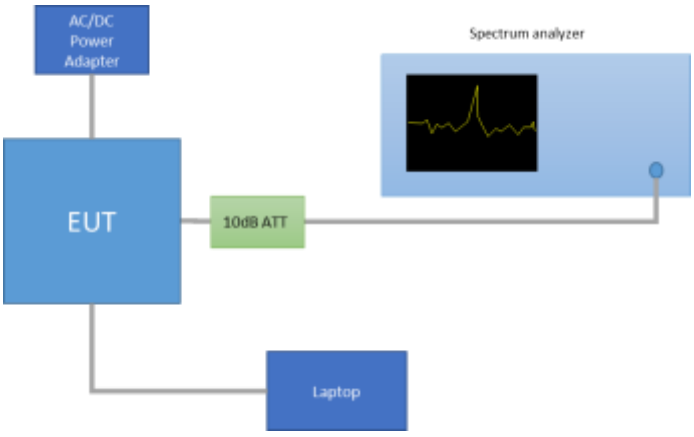
Test procedure

The Maximum Conducted Output Power was measured using the channel integration method according to point E) 2) e) (Method SA-2 Alternative) of KDB 789033 D02.
The maximum power spectral density (PSD) was measured using the method according to point F) (Method SA-2 Alternative) of KDB 789033 D02.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

The setup below was used to measure the maximum conducted output power and power spectral density. The antenna terminal of the EUT is connected to the spectrum analyser through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

The declared maximum antenna gain is 5dBi.



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Results tables

Duty cycle

Mode	Rate	Antenna	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
802.11a	6Mbps	SISO-A	2.036	2.071	98.31%
802.11n20	HT0	SISO-A	1.894	1.929	98.19%
802.11n40	HT0	SISO-A	0.937	0.969	96.70%
802.11ac80	VHT0	SISO-A	0.458	0.493	92.90%

Maximum output power

Mode	Rate	Channel	Freq. [MHz]	Antenna	Average Conducted Output Power [dBm]	Maximum* Conducted Output Power [dBm]	Maximum* Conducted Output Power [mW]	Max of EIRP [dBm]
802.11a	6Mbps	36	5180	SISO CHAIN A	17.38	17.38	**54.70**	22.38
		40	5200	SISO CHAIN A	21.43	21.43	**139.00**	26.43
		48	5240	SISO CHAIN A	21.16	21.16	130.62	26.16
802.11n20	HT0	36	5180	SISO CHAIN A	17.29	17.29	**53.58**	22.29
		40	5200	SISO CHAIN A	21.36	21.36	**136.77**	26.36
		48	5240	SISO CHAIN A	21.19	21.19	131.52	26.19
802.11n40	HT0	38F	5190	SISO CHAIN A	17.66	17.81	**60.34**	22.81
		46F	5230	SISO CHAIN A	21.35	21.50	**141.12**	26.50
802.11ac80	VHT0	42ac80	5210	SISO CHAIN A	17.95	18.27	**67.14**	23.27

* Maximum values are the duty cycle compensated values calculated from the average (measured) values

Max Value

Min Value

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Maximum power spectral Density (PSD)

Mode	Rate	Channel	Freq. [MHz]	Antenna	Average conducted PSD [dBm/MHz]	Maximum* conducted PSD [dBm/MHz]	Maximum* EIRP PSD [dBm/MHz]
802.11a	6Mbps	36	5180	SISO CHAIN A	5.47	5.47	10.47
		40	5200	SISO CHAIN A	9.45	9.45	14.45
		48	5240	SISO CHAIN A	9.44	9.44	14.44
802.11n20	HT0	36	5180	SISO CHAIN A	5.39	5.39	10.39
		40	5200	SISO CHAIN A	9.40	9.40	14.40
		48	5240	SISO CHAIN A	9.21	9.21	14.21
802.11n40	HT0	38F	5190	SISO CHAIN A	2.57	2.72	7.72
		46F	5230	SISO CHAIN A	6.29	6.44	11.44
802.11ac80	VHT0	42ac80	5210	SISO CHAIN A	0.51	0.83	5.83

* Maximum values are the duty cycle compensated values calculated from the measured average values

See Section B.3.3 for the screenshot results.

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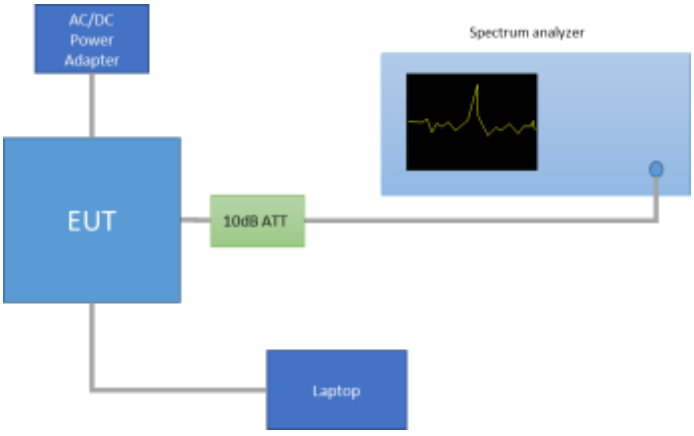
B.2.3 Undesirable emission limits : Band Edge (Conducted)

Test limits

<table>
<tr><th>FCC part</th><th>Limits</th></tr>
<tr><td>15.407 (b) (1)</td><td>For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.</td></tr>
<tr><td>15.209</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Strength (µV/m)</th><th>Field Strength (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

The setup below was used to measure undesirable emissions on the Band Edge domain. The antenna terminal of the EUT is connected to the spectrum analyzer through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss and the declared Antenna Gain.



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Band Edge measurements in average mode on the low frequency section was done with the Video Bandwidth Method was used according to section G) 6) (KDB 789033 D02), with the following parameters:

- When the duty cycle is > 98 %, VBW = 10Hz
- When the duty cycle is < 98 %, VBW > 1/T, where T is defined in section II.B.1.a

In case of Band Edge measurements falling in restricted bands, the declared Antenna Gain is also compensated in the graph. The declared maximum antenna gain is 5dBi.

For Band Edge measurements falling in restricted bands, the following limits in dBm were applied for the average detector after the conversion from the limits detailed above in dBµV/m, according to FCC 47 CFR part 15 - Subpart C – §15.209(a). The limits in dBm for peak detector are 20dB above the indicated values in the table.

§15.209(a)			Converted values	
Freq Range (MHz)	Distance (m)	Field strength (microvolts/meter)	Field strength (dB microvolts/meter)	Power (dBm)
Above 960	3	500	54.0	-41.2

See Section B.3.4 for the screenshot results.

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B.2.4 Radiated spurious emission

Standard references

<table>
<tr><th>FCC part</th><th>Limits</th></tr>
<tr><td>15.407 (b) (1)</td><td>For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.</td></tr>
<tr><td>15.209</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Strength (µV/m)</th><th>Field Strength (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>0.009-0.490</td><td>2400/f(kHz)</td><td>-</td><td>300</td></tr>
<tr><td>0.490-1.705</td><td>24000/f(kHz)</td><td>-</td><td>300</td></tr>
<tr><td>1.705-30.0</td><td>30</td><td>-</td><td>30</td></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

The setup below was used to measure the radiated spurious emissions.
Depending of the frequency range and bands being tested, different antennas and filters were used.
The final measurement is done by varying the antenna height, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
The radiated spurious emission was measured on the worst case configuration selected from the chapter B.2.2 and using the low, middle and high channel.

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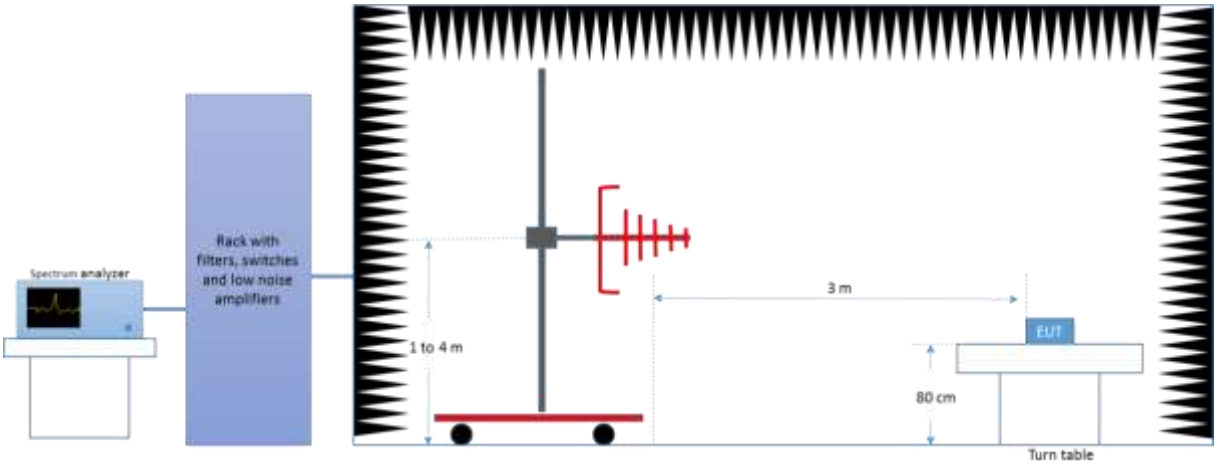
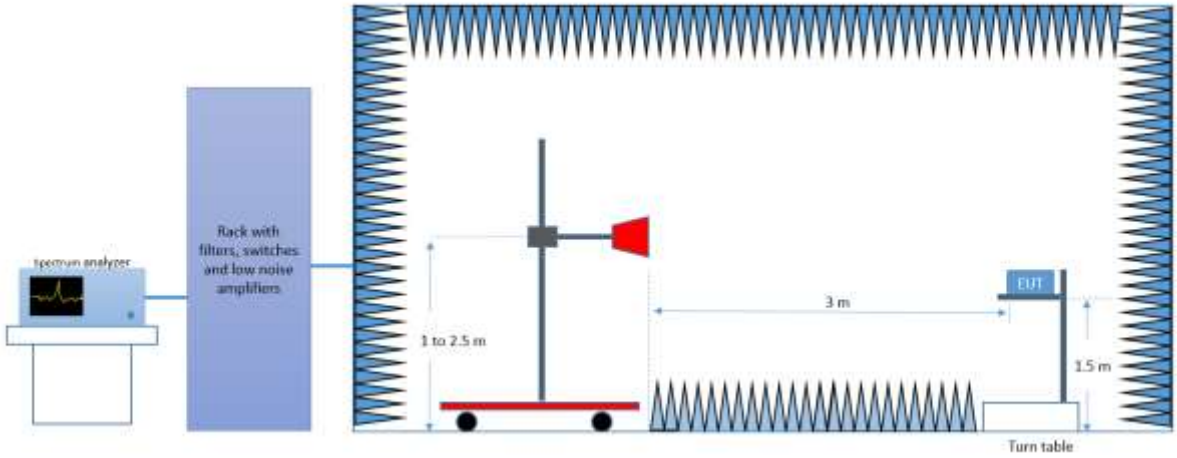
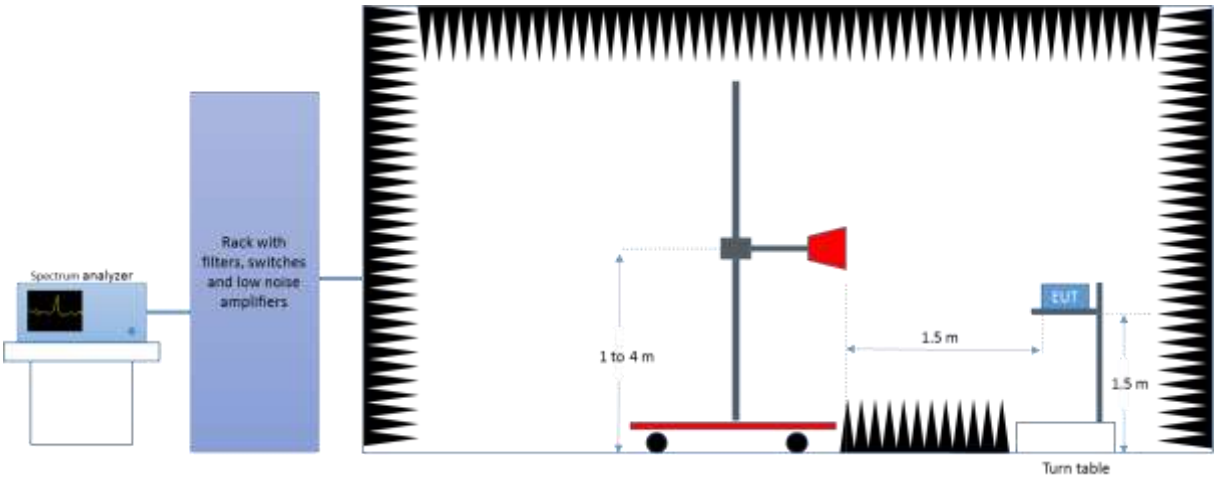
Radiated Setup < 1GHz



Radiated Setup 1 GHz - 18 GHz



Radiated Setup 18 GHz - 40 GHz



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Sample Calculation

The field strength is deduced from the radiated measurement using the following equation:

$$E = 126.8 - 20\log(\lambda) + P - G$$

where

E is the field strength of the emission at the measurement distance, in dBµV/m

P is the power measured at the output of the test antenna, in dBm

λ is the wavelength of the emission under investigation [300/f_{MHz}], in m

G is the gain of the test antenna, in dBi

NOTE – The measured power P includes all applicable instrument correction factors up to the connection to the test

Antenna e.g. cable losses, amplifier gains.

For field strength measurements made at other than the distance at which the applicable limit is specified, the field strength of the emission at the distance specified by the limit is deduced as follows:

$$E_{SpecLimit} = E_{Meas} + 20\log(D_{Meas}/D_{SpecLimit})$$

where

$E_{SpecLimit}$ *is the field strength of the emission at the distance specified by the limit, in dBµV/m*

E_{Meas} *is the field strength of the emission at the measurement distance, in dBµV/m*

D_{Meas} *is the measurement distance, in m*

$D_{SpecLimit}$ *is the distance specified by the limit, in m*

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Test Results

30 MHz – 40 GHz, 802.11a, 6Mbps, Chain A

Radiated Spurious – CH36

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
500.0	36.2	---	46.0	9.8
6072.1	---	48.6	54.0	5.4
6095.9	61.8	---	74.0	12.2
15540.4	54.9	---	74.0	19.1
15540.8	---	45.2	54.0	8.8
20720.0	---	39.0	54.0	15.0
20720.0	45.6	---	74.0	28.4
32139.1	46.4	---	74.0	27.6
32139.6	---	34.1	54.0	19.9

Radiated Spurious – CH40

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
500.0	36.4	---	46.0	9.6
6048.0	---	**49.1**	54.0	4.9
6149.6	59.9	---	74.0	14.1
15601.9	54.5	---	74.0	19.5
15602.4	---	44.2	54.0	9.8
20799.8	---	39.0	54.0	15.0
20800.3	45.4	---	74.0	28.6
37831.8	---	35.2	54.0	18.8
37831.8	47.2	---	74.0	26.8

Radiated Spurious – CH48

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.4	30.4	---	40.0	9.6
6019.5	---	48.9	54.0	5.1
6058.3	60.7	---	74.0	13.3
15720.2	---	44.2	54.0	9.8
15721.0	55.6	---	74.0	18.4
20959.9	---	39.2	54.0	14.9
20967.0	49.3	---	74.0	24.7
37811.1	46.6	---	74.0	27.4
37811.6	---	34.7	54.0	19.3

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30 MHz – 40 GHz, 802.11n20, HT0, Chain A

Radiated Spurious – CH36

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
500.0	37.5	---	46.0	8.6
6053.7	---	**49.3**	54.0	4.7
6071.1	62.0	---	74.0	12.0
15538.1	55.3	---	74.0	18.7
15544.4	---	44.7	54.0	9.3
20719.5	45.2	---	74.0	28.8
20720.0	---	37.8	54.0	16.2
39148.5	46.1	---	74.0	27.9
39151.9	---	34.6	54.0	19.4

Radiated Spurious – CH40

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.5	29.4	---	40.0	10.6
6098.1	61.0	---	74.0	13.0
6112.8	---	48.9	54.0	5.1
15603.3	---	43.8	54.0	10.2
15603.3	56.1	---	74.0	17.9
20799.8	---	39.0	54.0	15.1
20799.8	45.6	---	74.0	28.4
35044.1	---	35.1	54.0	18.9
35044.1	46.4	---	74.0	27.6

Radiated Spurious – CH48

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.5	28.9	---	40.0	11.1
6094.9	61.2	---	74.0	12.8
6103.5	---	48.8	54.0	5.2
15719.3	---	44.0	54.0	10.0
15722.4	55.4	---	74.0	18.6
20955.6	49.3	---	74.0	24.7
20959.9	---	38.8	54.0	15.2
37540.1	---	34.5	54.0	19.5
37545.9	45.9	---	74.0	28.1

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30 MHz – 40 GHz, 802.11n40, HT0, Chain A

Radiated Spurious – CH38F

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.5	28.5	---	40.0	11.5
6079.4	---	49.2	54.0	4.9
6139.3	60.2	---	74.0	13.8
17991.1	---	**49.8**	54.0	4.2
17996.4	60.5	---	74.0	13.5
20759.7	44.9	---	74.0	29.1
20759.7	---	38.7	54.0	15.3
37468.8	46.7	---	74.0	27.3
37469.2	---	34.2	54.0	19.8

Radiated Spurious – CH46F

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.5	28.3	---	40.0	11.7
6058.3	60.4	---	74.0	13.6
6072.3	---	48.9	54.0	5.2
17986.2	60.9	---	74.0	13.1
18000.0	---	49.8	54.0	4.3
20919.8	---	38.5	54.0	15.5
20919.8	45.2	---	74.0	28.9
36576.8	47.0	---	74.0	27.0
36580.2	---	34.9	54.0	19.1

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30 MHz – 40 GHz, 802.11ac80, VHT0, Chain A

Radiated Spurious – CH42ac80

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
500.0	35.8	---	46.0	10.2
6058.6	60.2	---	74.0	13.8
6087.0	---	49.1	54.0	4.9
17995.5	61.1	---	74.0	12.9
18000.0	---	49.8	54.0	**4.2**
20839.9	44.2	---	74.0	29.9
20839.9	---	38.6	54.0	15.4
35051.3	---	34.4	54.0	19.6
35051.8	48.0	---	74.0	26.0

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B.2.5 AC power-line conducted emission

Standard references:

<table>
<tr><th>FCC part</th><th>RSS part</th><th>Limits</th></tr>
<tr><td>15.207
15.407 (6)</td><td>RSS-GEN,
Clause 8.8</td><td>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 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.
<table>
<tr><th rowspan="2">Frequency of emission (MHz)</th><th colspan="2">Conducted limit (dBµV)</th></tr>
<tr><th>Quasi-peak</th><th>Average</th></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
*Decreases with the logarithm of the frequency.</td></tr>
</table>

Test procedure:

The EUT and peripherals are placed on a wooden table with a nominal size of 1.0 m by 1.5 m, raised 80 cm above the reference ground plane. The EUT is connected to AC-Power line through a Line Impedance Stabilization Network (LISN) to accommodate a 50 Ω/50 µH coupling impedance for the measurement system. The EUT control PC is considered as a peripheric and therefore is connected to a second LISN which has the measurement port connected to a 50 ohms impedance.

Each measurement is done for each current-carrying conductor (Line and Neutral) at the end plug of the EUT power cord. The EUT is tested for several transmission modes (frequency channel, modulation, etc.) and the result providing the maximum measured emission is reported.

The exploratory measurement is done over the frequency range from 150 kHz to 30 MHz, while the measurement receiver is recording the Peak and Average signal at 10 kHz steps in Max Hold mode. The cables manipulation is performed within the range of likely configurations to determine the maximum emission. Once the EUT cable configuration, arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is found the six highest AC power-line conducted emissions relative to 20 dB of the limit are reported as the final measurement. If fewer than six emission frequencies are within 20 dB of the limit, the noise level is reported. For the final measurement, the measurement receiver records the Quasi Peak values with 9 kHz resolution bandwidth and the average values with 10 kHz resolution bandwidth.

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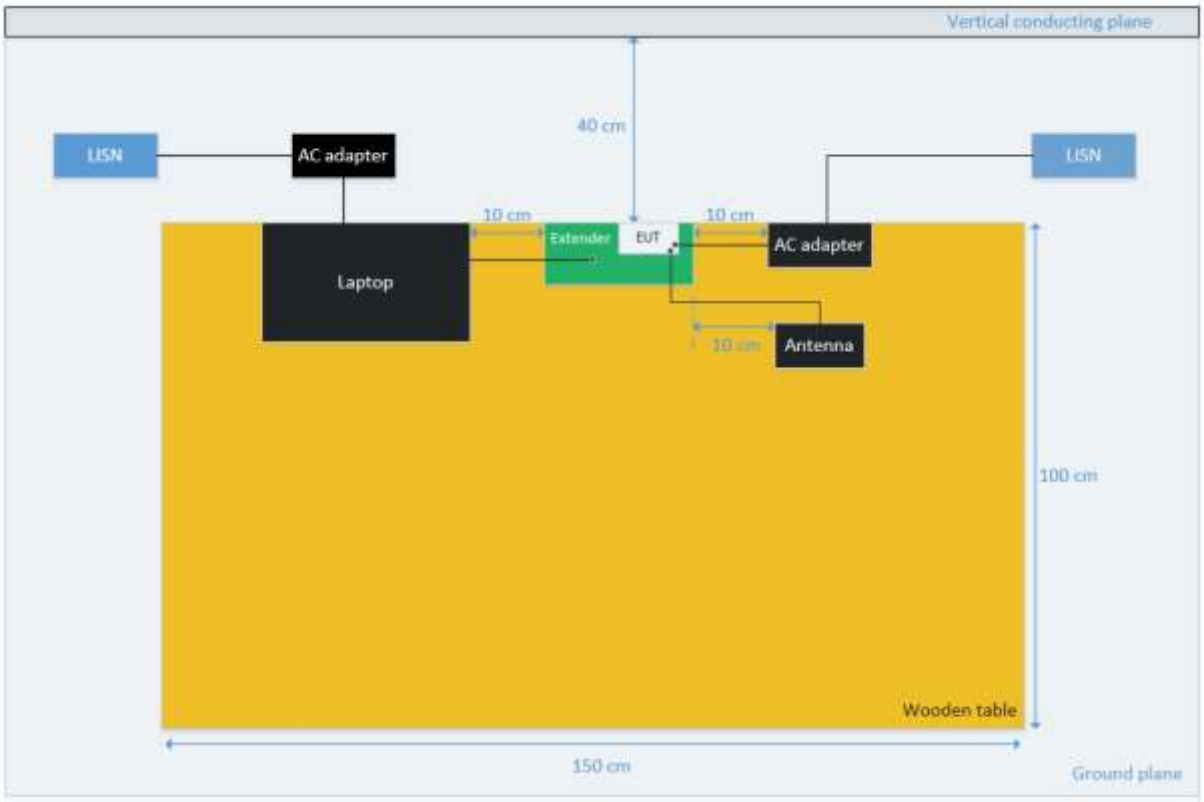
EUT arrangement for AC power-line conducted emission tests



Sample Calculation:

The measured level at the spectrum analyzer in dBuV is corrected by a transducer factor taking into account the losses of the RF cable and the LISN as follows:

Conducted Emission level (dBuV) = SA_{Level} + $RFCable_{Losses}$ + $LISN_{Losses}$

Where:
SA_{Level} is the voltage level displayed on the measurement receiver, in dBuV.
$RFCable_{Losses}$ is the value of the cable losses between the LISN and the measurement receiver, in dB.
$LISN_{Losses}$ is the value of the insertion losses of the LISN, in dB.

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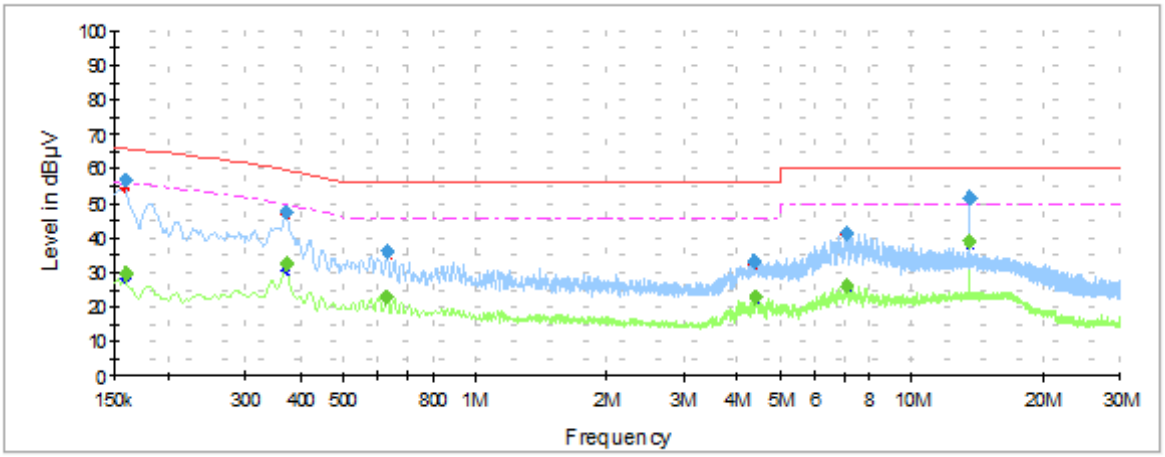
Test Results:

150kHz – 30MHz, all modes

AC power-line conducted – Phase L1



Peak measurements — Avg measurements — Limit FCC Ouasi-Peak — Limit FCC Avg

Frequency	Max Peak	Avg	Limit	Margin
MHz	dBµV	dBµV	dBµV	dB
0.1589	56.8	--	65.7	8.9
0.1589	--	29.7	55.7	26
0.3708	47.5	--	59.7	12.2
0.3708	--	32.3	49.7	17.4
0.6305	36.3	--	56.00	19.7
0.6335	--	22.8	46.00	23.2
4.358	33.2	--	60.00	26.8
4.373	--	22.9	50.00	27.1
7.091	41.3	--	60.00	18.7
7.093	--	26.2	50.00	23.8
13.561	51.5	--	60.00	8.5
13.570	--	38.9	50.00	11.1

Note: The emissions found do not change with the modulation and/or frequency.

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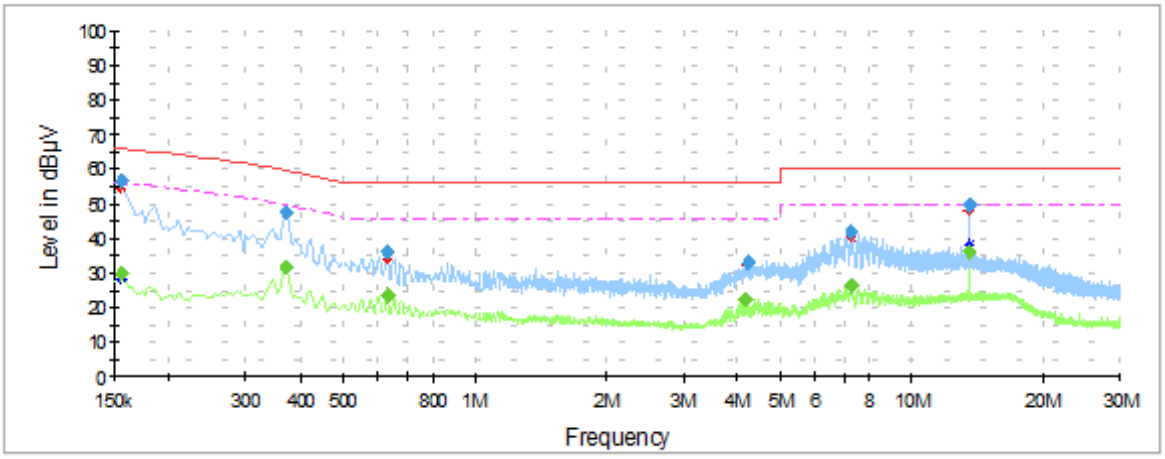
AC power-line conducted – Neutral N



Peak measurements Avg measurements Limit FCC Ouasi-Peak Limit FCC Avg

Frequency	Max Peak	Avg	Limit	Margin
MHz	dBµV	dBµV	dBµV	dB
0.1559	56.6	--	65.8	9.2
0.1559	--	29.8	55.8	26
0.3708	47.7	--	59.7	12
0.3708	--	31.7	49.7	18
0.6305	36.3	--	56.0	19.7
0.6333	--	23.7	46.0	22.3
4.155	32.8	--	60.0	27.2
4.215	--	22.4	50.0	27.6
7.275	42.0	--	60.0	18
7.281	--	26.2	50.0	23.8
13.555	49.8	--	60.0	10.2
13.573	--	36.3	50.0	13.7

Note: The emissions found do not change with the modulation and/or frequency.

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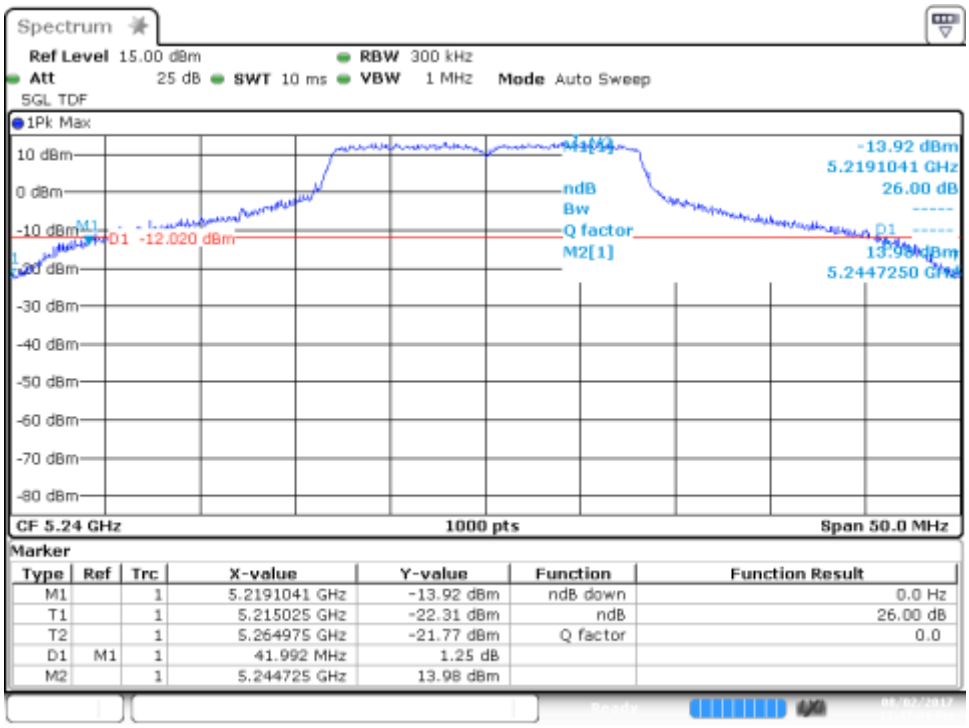
B.3 Test Results Screenshot U-NII-1

B.3.1 26dB Bandwidth

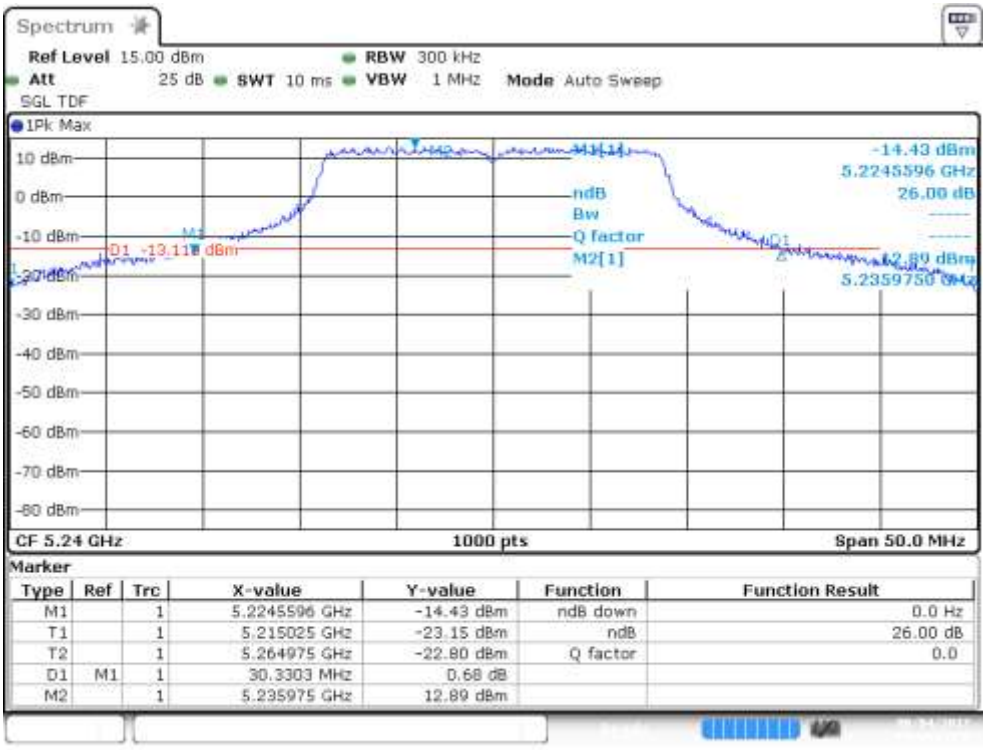
SISO-A, 802.11a, 6Mbps

Channel 48



SISO-A, 802.11n20, HT0

Channel 48



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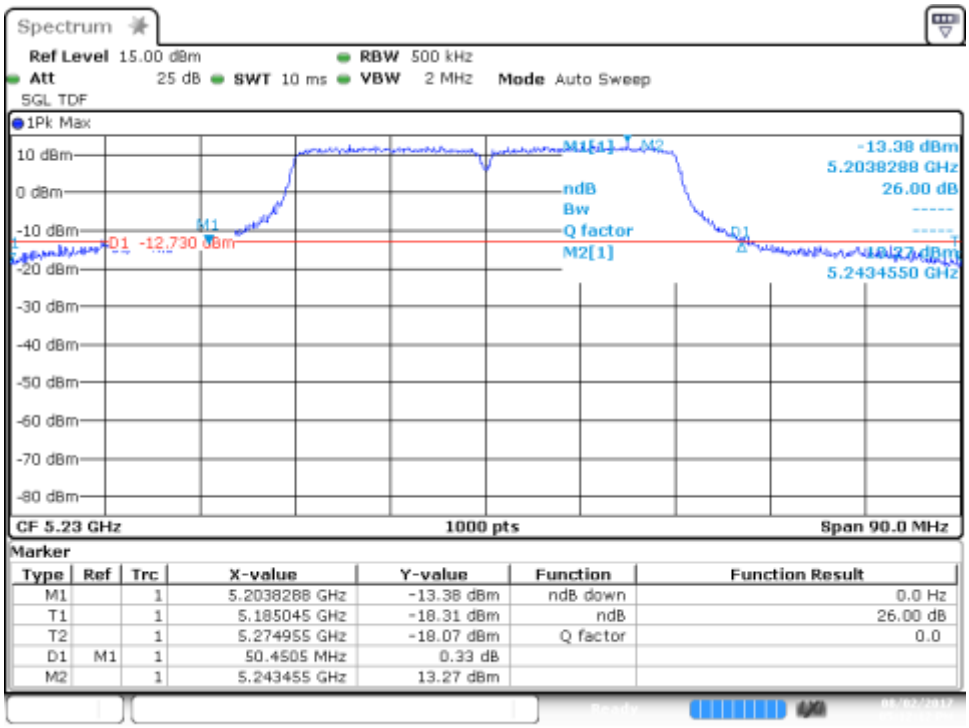
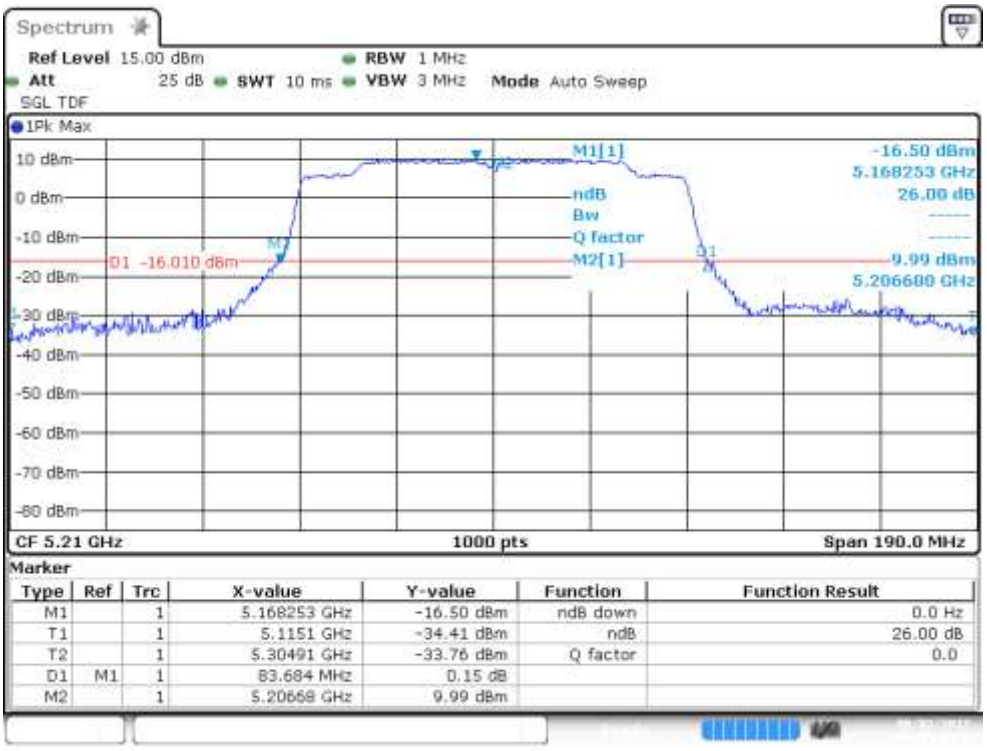
SISO-A, 802.11n40, HT0

Channel 46F



SISO-A, 802.11ac80, VHT0

Channel 42ac80



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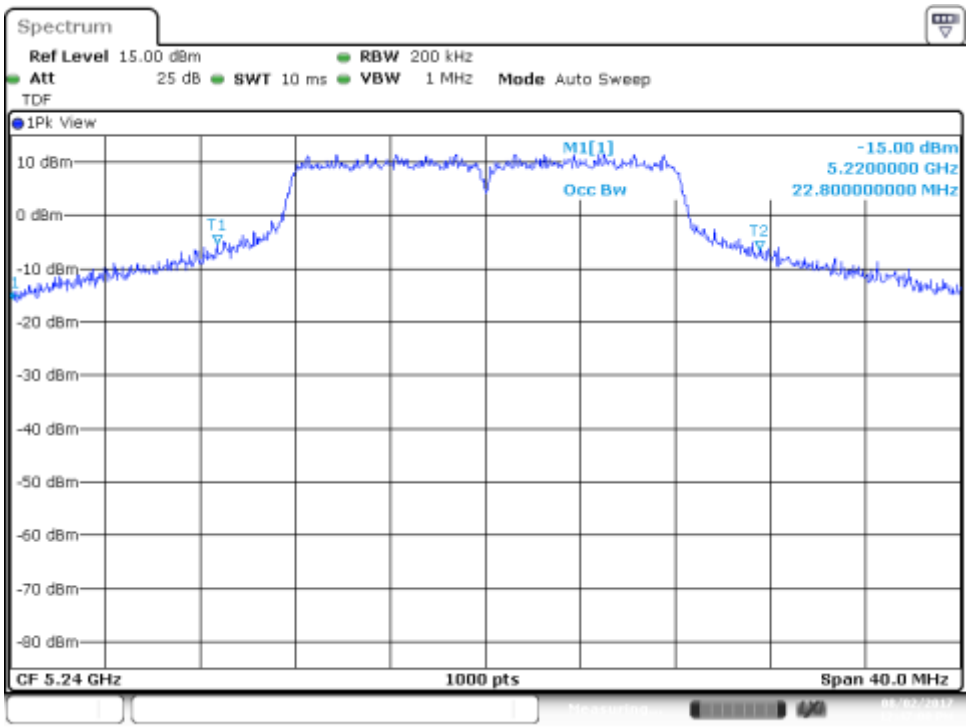
B.3.2 99% Bandwidth

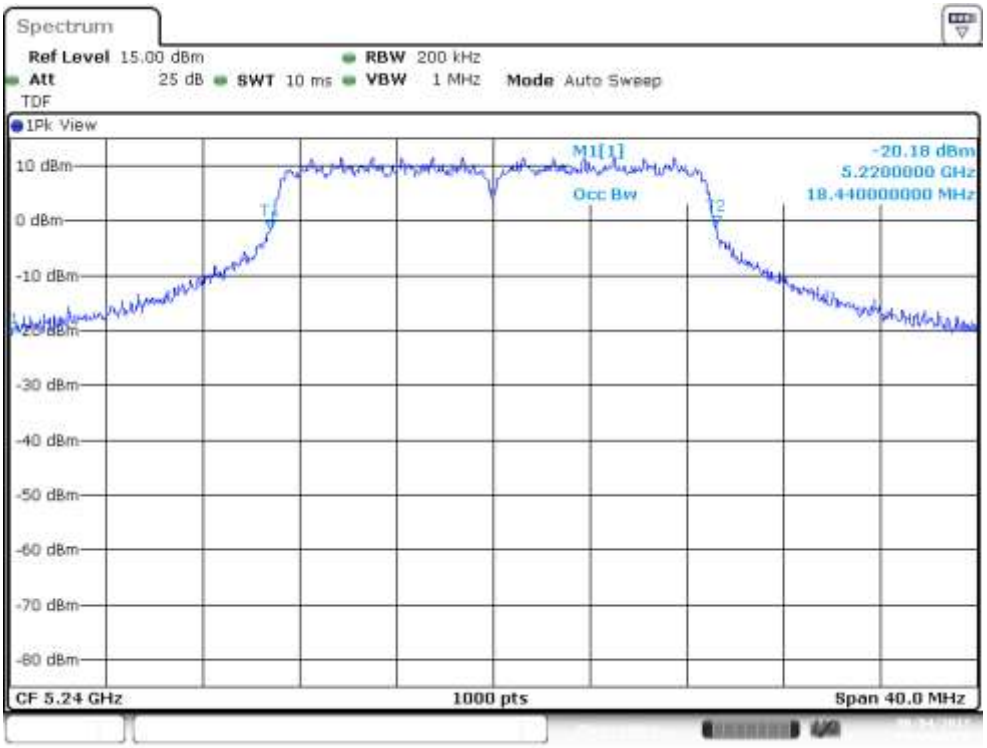
SISO-A, 802.11a, 6Mbps

Channel 48



SISO-A, 802.11n20, HT0

Channel 48



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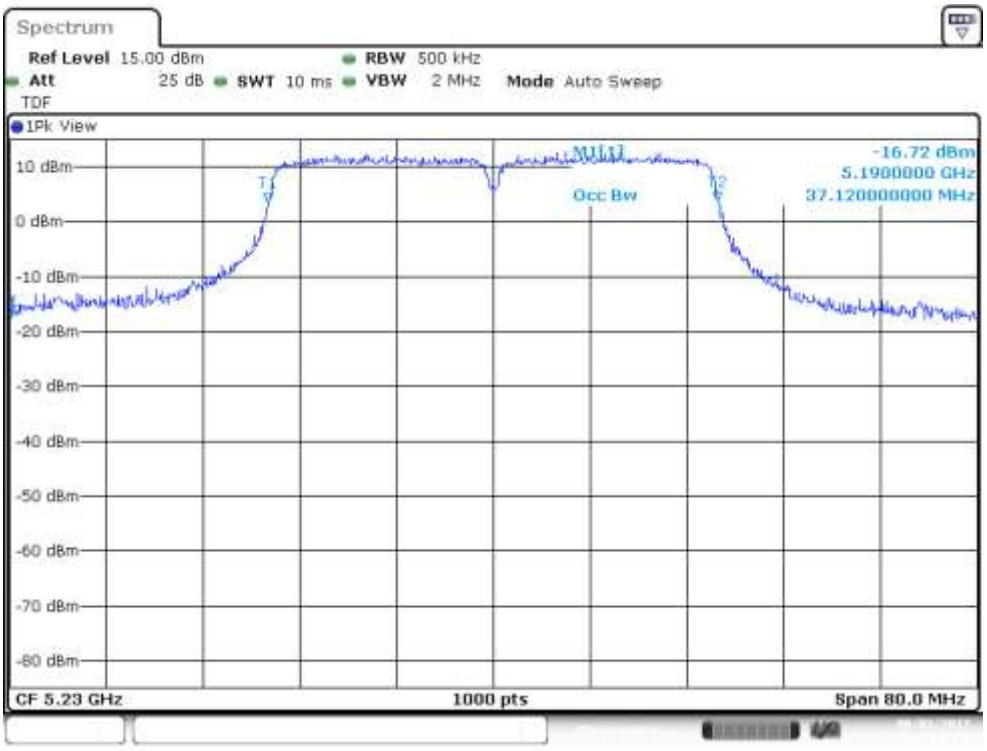
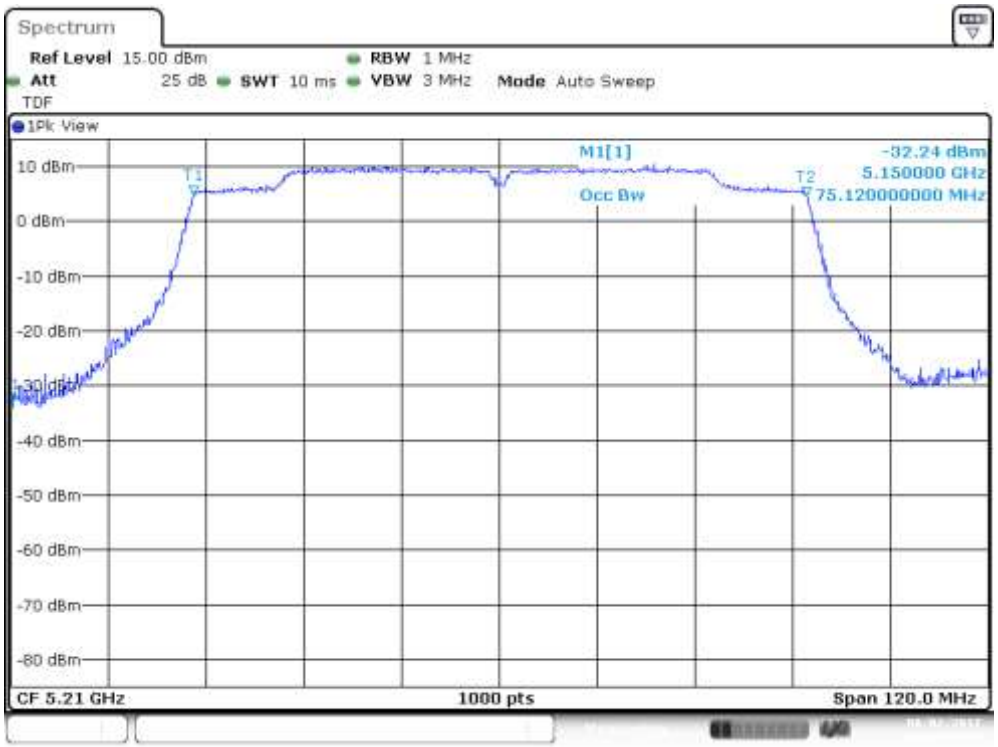
SISO-A, 802.11n40, HT0

Channel 46F



SISO-A, 802.11ac80, VHT0

Channel 42ac80



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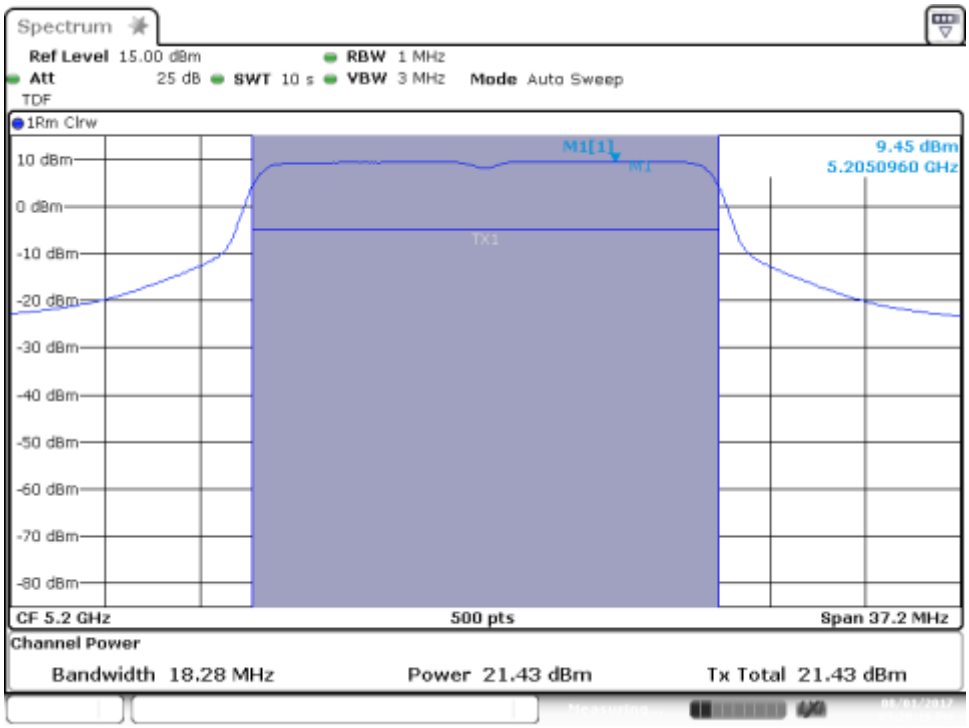
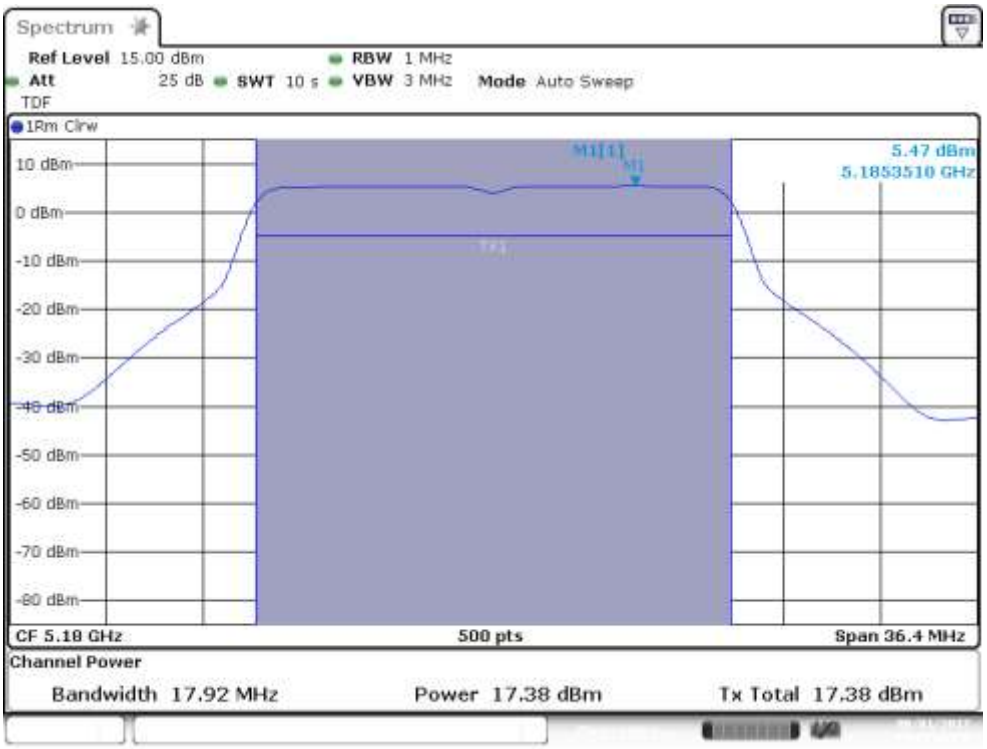
B.3.3 Power Limits. Maximum Output power & Peak power spectral density

SISO-A, 802.11a, 6Mbps

Channel 40



Channel 36



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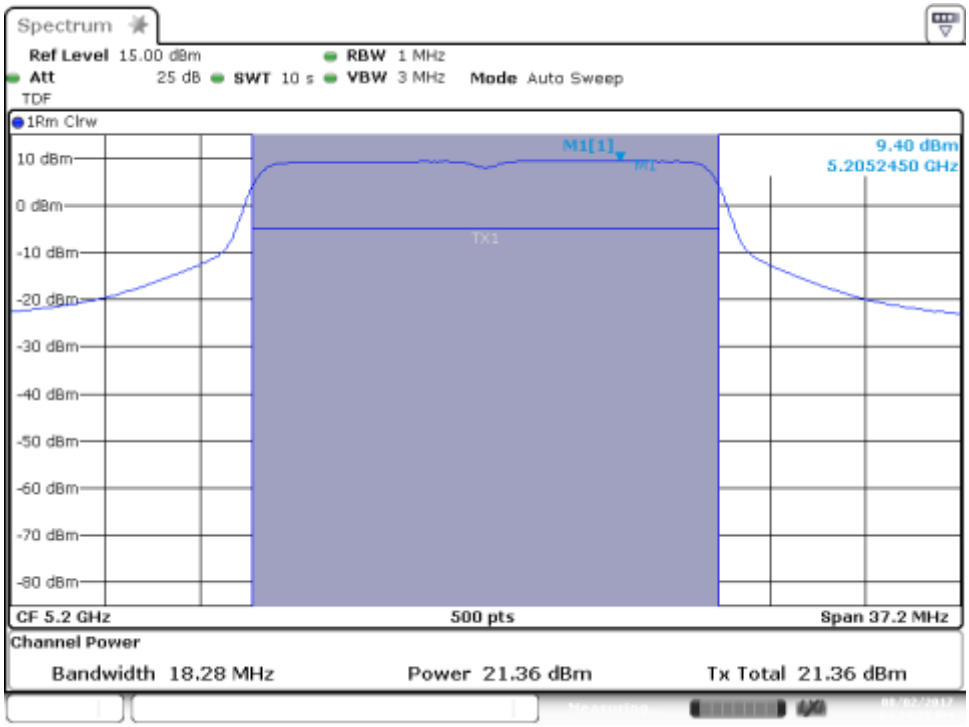
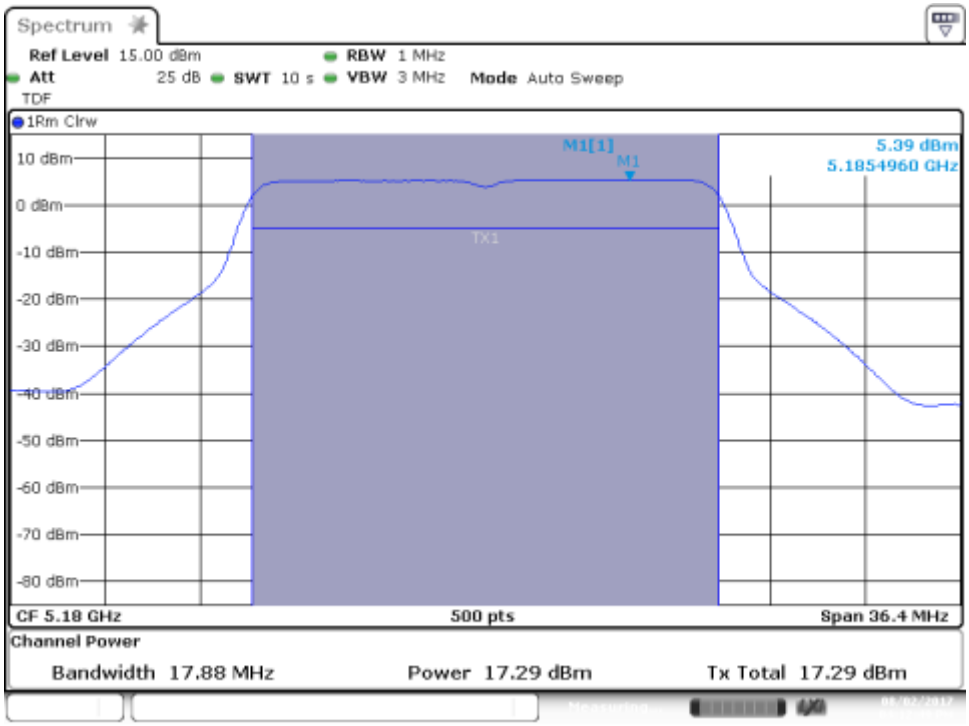
SISO-A, 802.11n20, HT0

Channel 40



Channel 36



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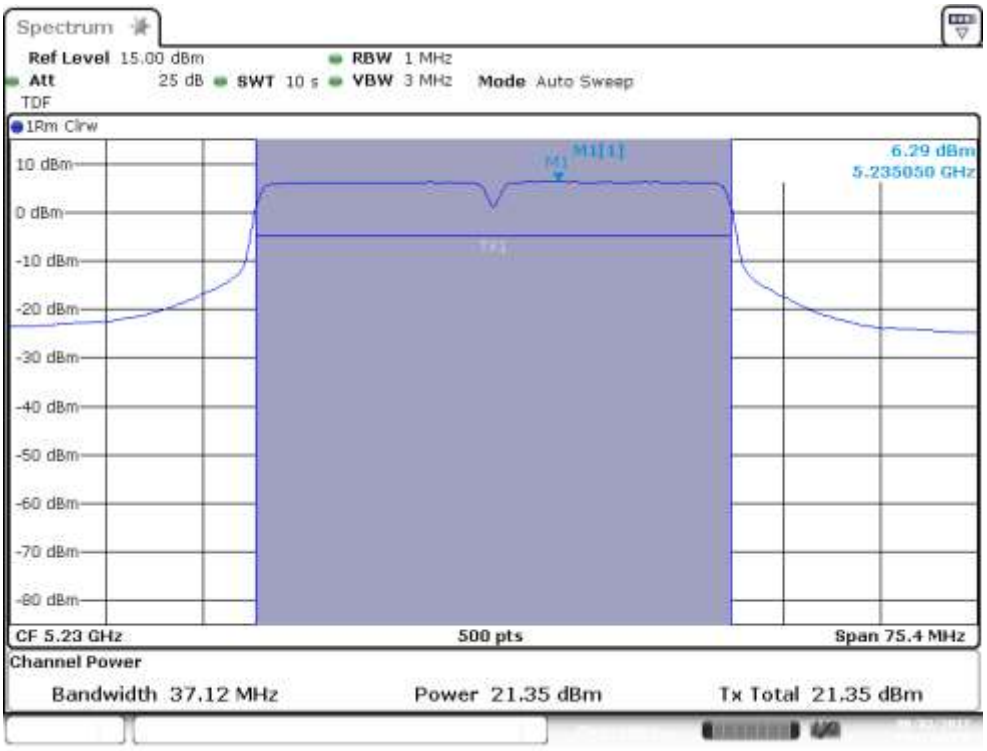
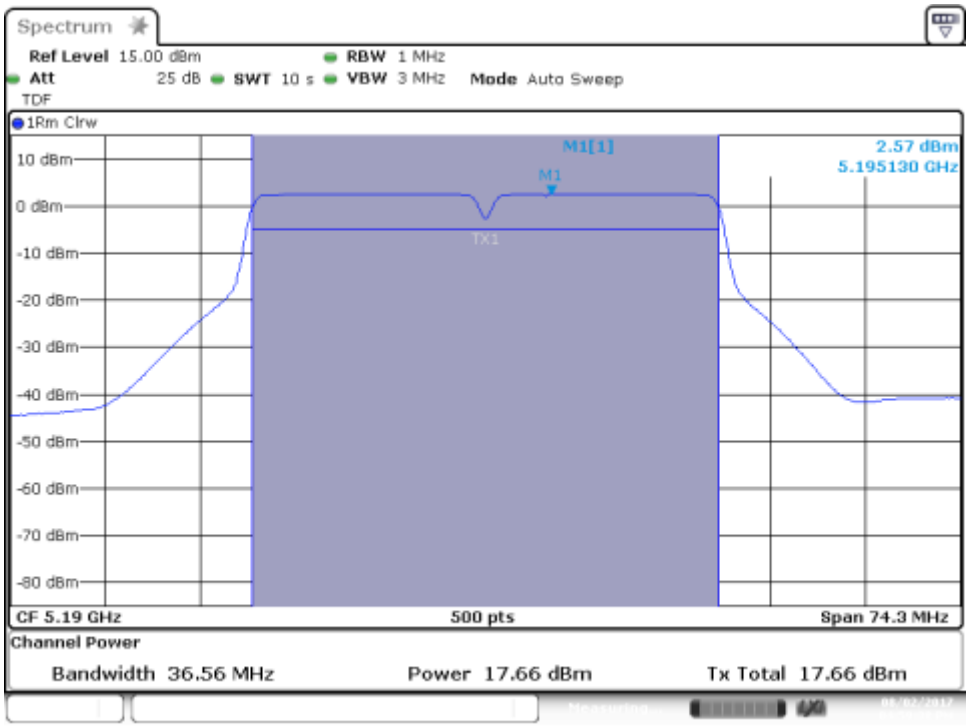
SISO-A, 802.11n40, HT0

Channel 46F



Channel 38F



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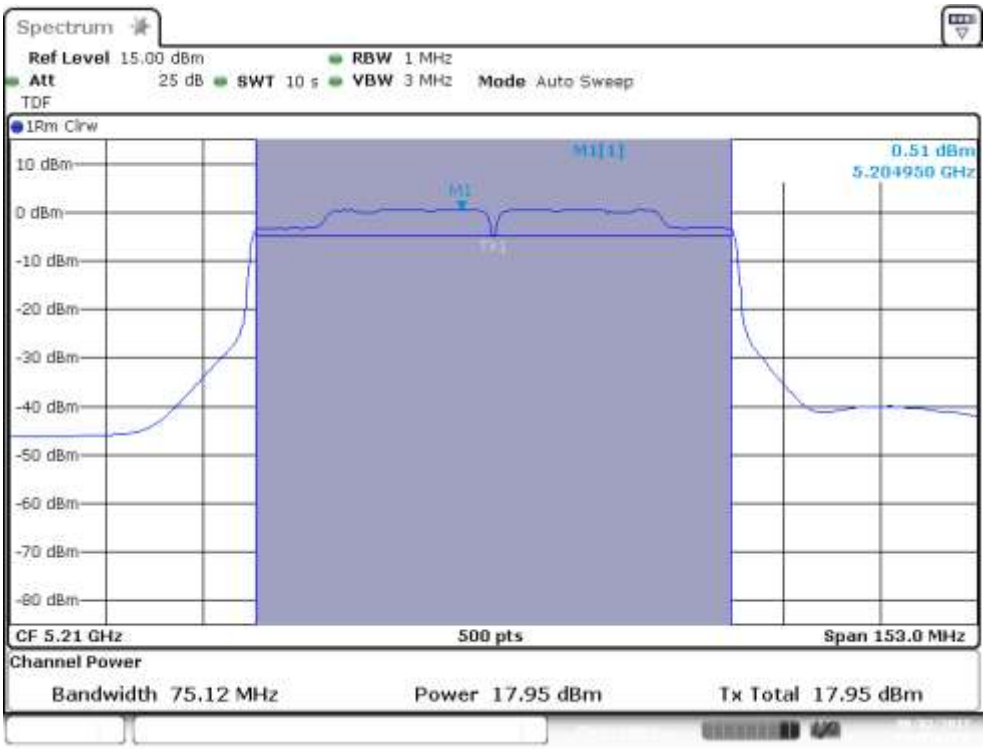
SISO-A, 802.11ac80, VHT0

Channel 42ac80



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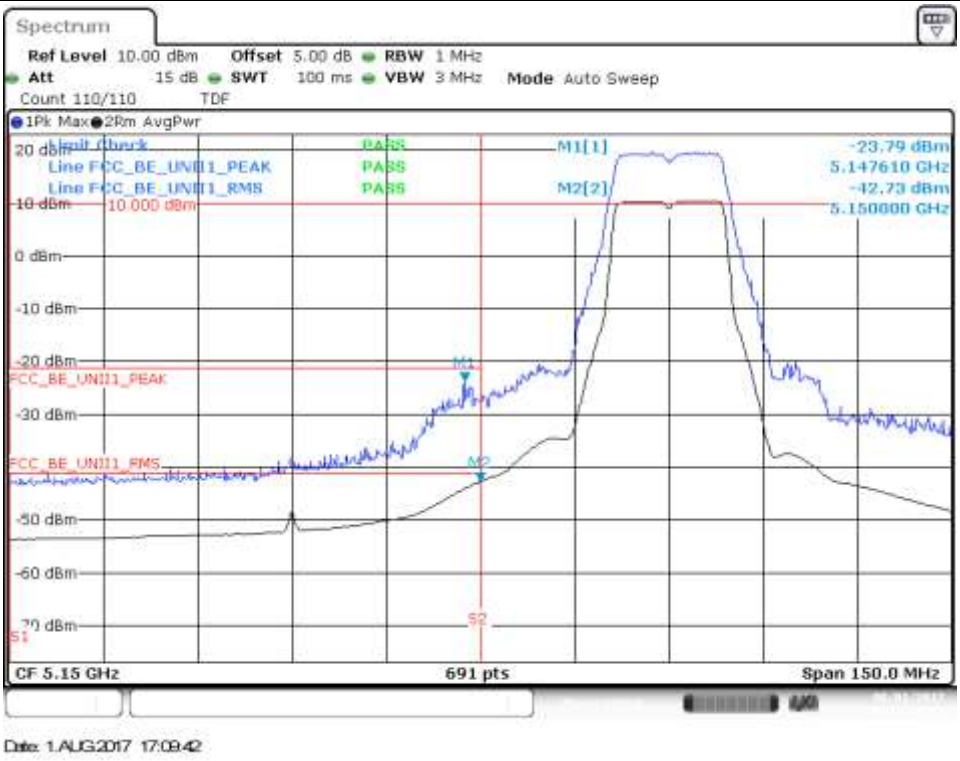
B.3.4 Undesirable emission limits : Band Edge (Conducted)

802.11a, 6Mbps – Chain A

BE Low Freq Section, Peak, RMS – CH36



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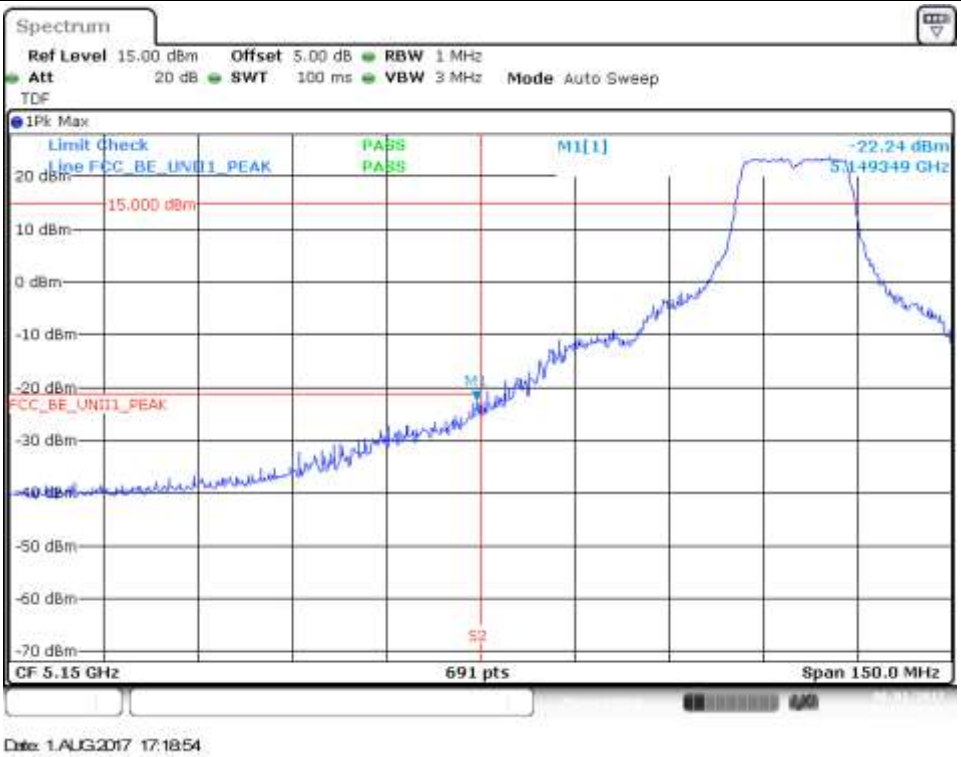
BE Low Freq Section, Peak – CH40



BE Low Freq Section, RMS – CH40

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802.11n20, HT0 (SISO) – Chain A

BE Low Freq Section, Peak, RMS – CH36

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BE Low Freq Section, Peak – CH40

BE Low Freq Section, RMS – CH40

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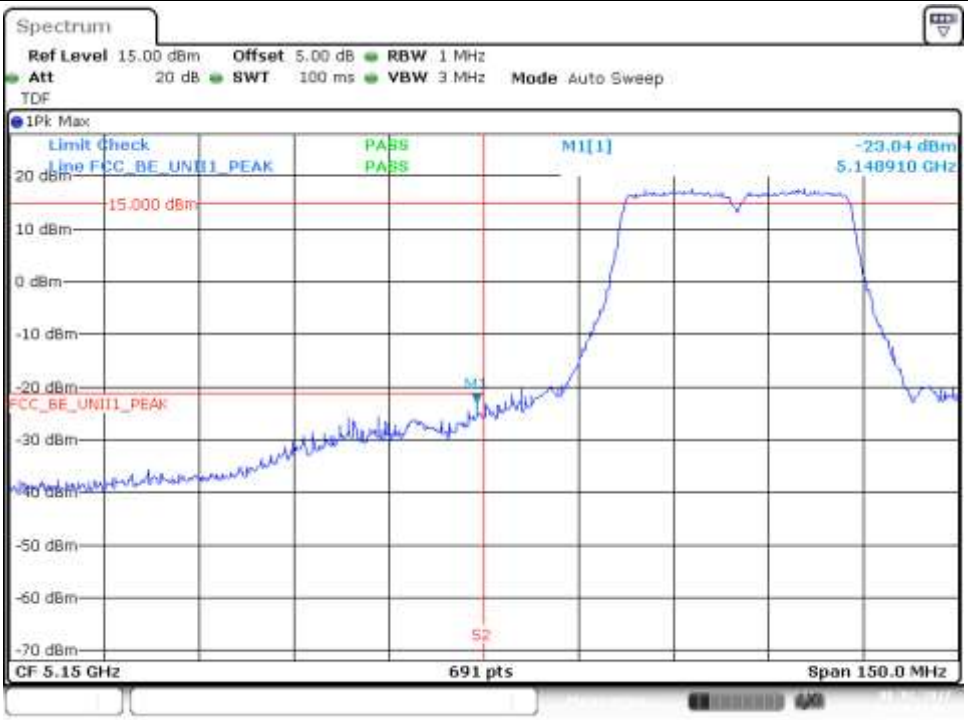
802.11n40, HT0 (SISO) – Chain A

BE Low Freq Section, Peak – CH38F



BE Low Freq Section, RMS – CH38F

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BE Low Freq Section, Peak – CH46F

BE Low Freq Section, RMS – CH46F

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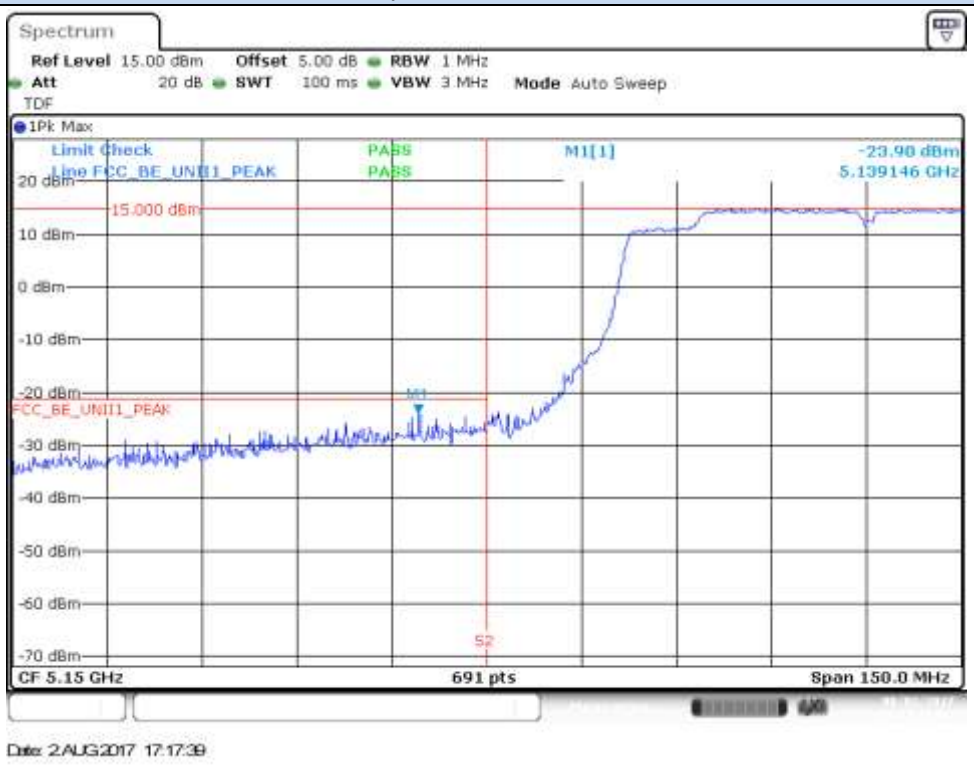
802.11ac80, VHT0 (SISO) – Chain A

BE Low Freq Section, Peak – CH42ac80



BE Low Freq Section, RMS – CH42ac80

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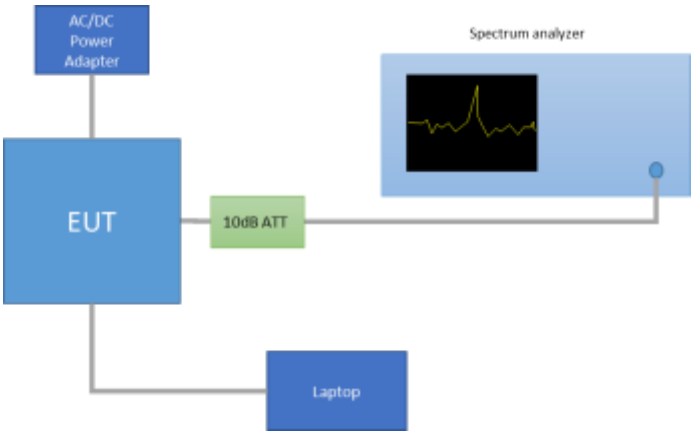
B.4 Test Results Tables U-NII-2A

B.4.1 26dB & 99% Bandwidth

Test procedure

The setup below was used to measure the 26dB & 99% Bandwidth. The antenna terminal of the EUT is connected to the spectrum through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.



Results tables

Mode	Rate	Antenna	Channel	Frequency [MHz]	26dB BW [MHz]	99% BW [MHz]
802.11a	6Mbps	SISO CHAIN A	52	5260	26.58	17.04
			56	5280	**31.83**	**17.92**
			64	5320	23.82	16.80
802.11n20	HT0		52	5260	28.88	18.32
			56	5280	**28.93**	**18.36**
			64	5320	24.62	17.88
802.11n40	HT0		54F	5270	**45.59**	**36.72**
			62F	5310	43.97	36.56
802.11ac80	VHT0		58ac80	5290	**86.35**	**75.24**

Max Value

See Section B.5.1 and Section B.5.2 for the screenshot results.

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B.4.2 Power Limits. Maximum Output power & Peak power spectral density

Test limits

FCC part	Limits
15.407 (a) (2)	For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band.

Test procedure

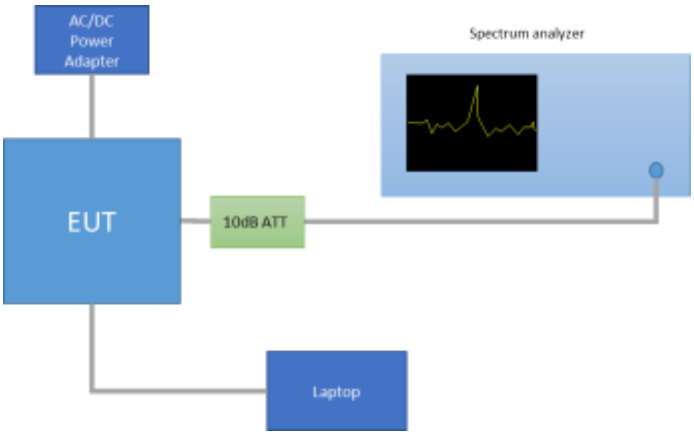
The Maximum Conducted Output Power was measured using the channel integration method according to point E) 2) e) (Method SA-2 Alternative) of KDB 789033 D02.

The maximum power spectral density (PSD) was measured using the method according to point F) (Method SA-2 Alternative) of KDB 789033 D02.

The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

The setup below was used to measure the maximum conducted output power and power spectral density. The antenna terminal of the EUT is connected to the spectrum analyzer through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss.

The declared maximum antenna gain is 5dBi.



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Results tables

Duty cycle

Mode	Rate	Antenna	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
802.11a	6Mbps	SISO-A	2.036	2.071	98.31%
802.11n20	HT0	SISO-A	1.894	1.929	98.19%
802.11n40	HT0	SISO-A	0.937	0.969	96.70%
802.11ac80	VHT0	SISO-A	0.458	0.493	92.90%

Maximum output power

Mode	Rate	Channel	Freq. [MHz]	Antenna	Average Conducted Output Power [dBm]	Maximum* Conducted Output Power [dBm]	Maximum* Conducted Output Power [mW]	Max of EIRP [dBm]
802.11a	6Mbps	52	5260	SISO CHAIN A	20.62	20.62	115.35	25.62
		56	5280	SISO CHAIN A	21.18	21.18	**131.22**	26.18
		64	5320	SISO CHAIN A	17.33	17.33	**54.08**	22.33
802.11n20	HT0	52	5260	SISO CHAIN A	22.89	22.89	**194.54**	27.89
		56	5280	SISO CHAIN A	22.78	22.78	189.67	27.78
		64	5320	SISO CHAIN A	19.29	19.29	**84.92**	24.29
802.11n40	HT0	54F	5270	SISO CHAIN A	20.04	20.19	**104.37**	25.19
		62F	5310	SISO CHAIN A	15.14	15.29	**33.77**	20.29
802.11ac80	VHT0	58ac80	5290	SISO CHAIN A	17.00	17.32	**53.95**	22.32

* Maximum values are the duty cycle compensated values calculated from the average (measured) values

Max Value

Min Value

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Maximum Power Spectral Density (PSD)

Mode	Rate	Channel	Freq. [MHz]	Antenna	Average conducted PSD [dBm/MHz]	Maximum* conducted PSD [dBm/MHz]
802.11a	6Mbps	52	5260	SISO CHAIN A	8.94	8.94
		56	5280	SISO CHAIN A	9.46	9.46
		64	5320	SISO CHAIN A	5.67	5.67
802.11n20	HT0	52	5260	SISO CHAIN A	10.91	10.91
		56	5280	SISO CHAIN A	10.89	10.89
		64	5320	SISO CHAIN A	7.35	7.35
802.11n40	HT0	54F	5270	SISO CHAIN A	4.94	5.09
		62F	5310	SISO CHAIN A	0.08	0.23
802.11ac80	VHT0	58ac80	5290	SISO CHAIN A	-0.40	-0.08

* Maximum values are the duty cycle compensated values calculated from the measured average values

See Section B.5.3 for the screenshot results.

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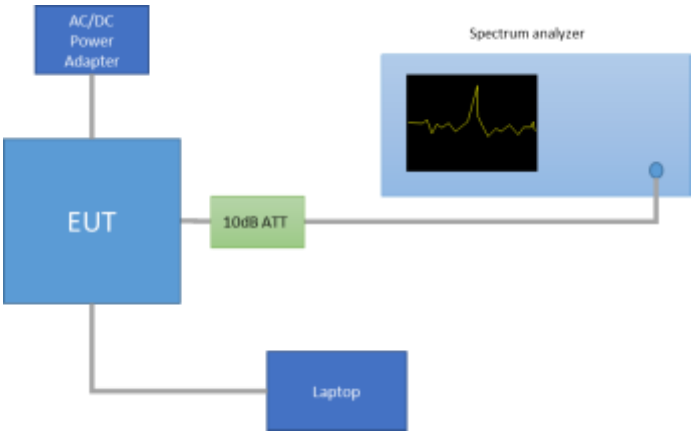
B.4.3 Undesirable emissions limits : Band Edge (Conducted)

Test limits

<table>
<tr><th>FCC part</th><th>Limits</th></tr>
<tr><td>15.407 (b) (2)</td><td>For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz.</td></tr>
<tr><td>15.209</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Strength (µV/m)</th><th>Field Strength (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

The setup below was used to measure undesirable emissions on the Band Edge domain. The antenna terminal of the EUT is connected to the spectrum analyzer through an attenuator, and the spectrum analyzer reading is compensated to include the RF path loss and the declared Antenna Gain.



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Band Edge measurements in average mode on the high frequency section was done with the primary and the Video Bandwidth Method according to section G) 6) (KDB 789033 D02), with the following parameters:

- When the duty cycle is > 98 %, VBW = 10Hz
- When the duty cycle is < 98 %, VBW > 1/T, where T is defined in section II.B.1.a

In case of Band Edge measurements falling in restricted bands, the declared Antenna Gain is also compensated in the graph. The declared maximum antenna gain is 5dBi.

The following limits in dBm were applied for the average detector after the conversion from the limits detailed above in dBµV/m, according to FCC 47 CFR part 15 - Subpart C – §15.209(a). The limits in dBm for peak detector are 20dB above the indicated values in the table.

§15.209(a)			Converted values	
Freq Range (MHz)	Distance (m)	Field strength (microvolts/meter)	Field strength (dB microvolts/meter)	Power (dBm)
960-25000	3	500	53.98	-41.2

See Section B.5.4 for the screenshot results.

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B.4.4 Radiated spurious emission

Standard references

<table>
<tr><th>FCC part</th><th>Limits</th></tr>
<tr><td>15.407 (b) (2)</td><td>For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.</td></tr>
<tr><td>15.209</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Strength (µV/m)</th><th>Field Strength (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

The below setups were used to measure the radiated spurious emissions.
Depending of the frequency range and bands being tested, different antennas and filters were used.
The final measurement is done by varying the antenna height, the EUT azimuth over 360º and for both Vertical and Horizontal polarizations.
The radiated spurious emissions were measured on the worst case configuration selected from the chapter B.4.2 and using the lowest, middle and highest channels.

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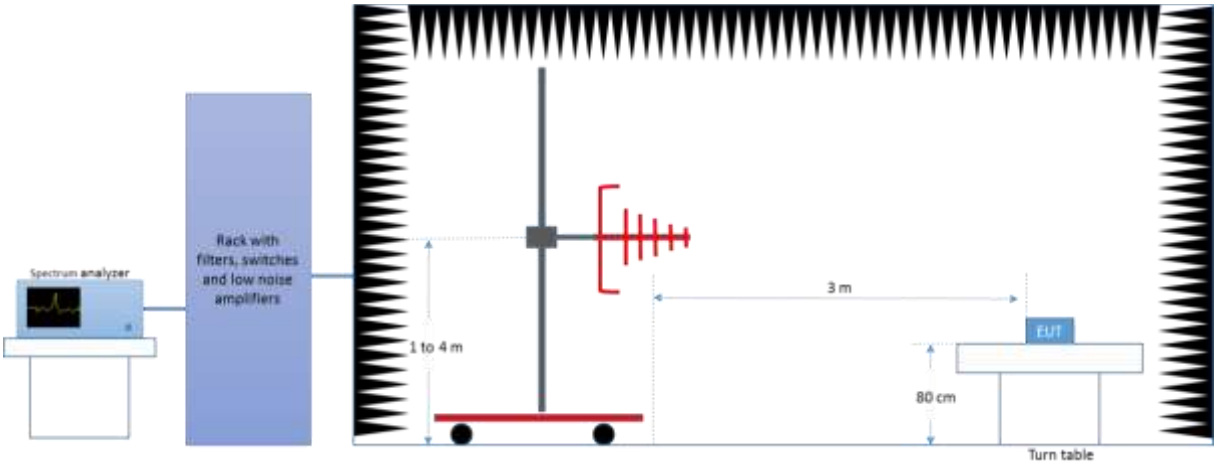
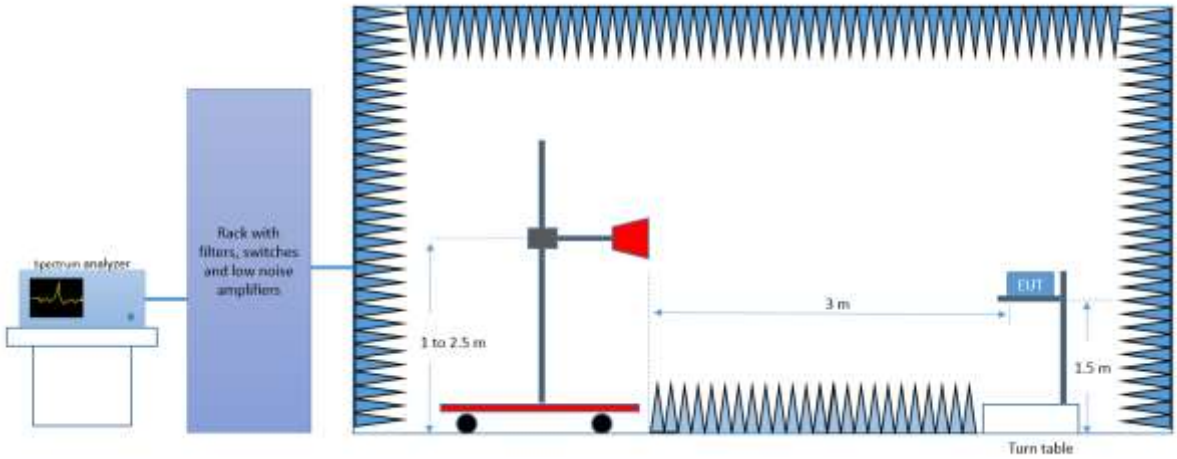
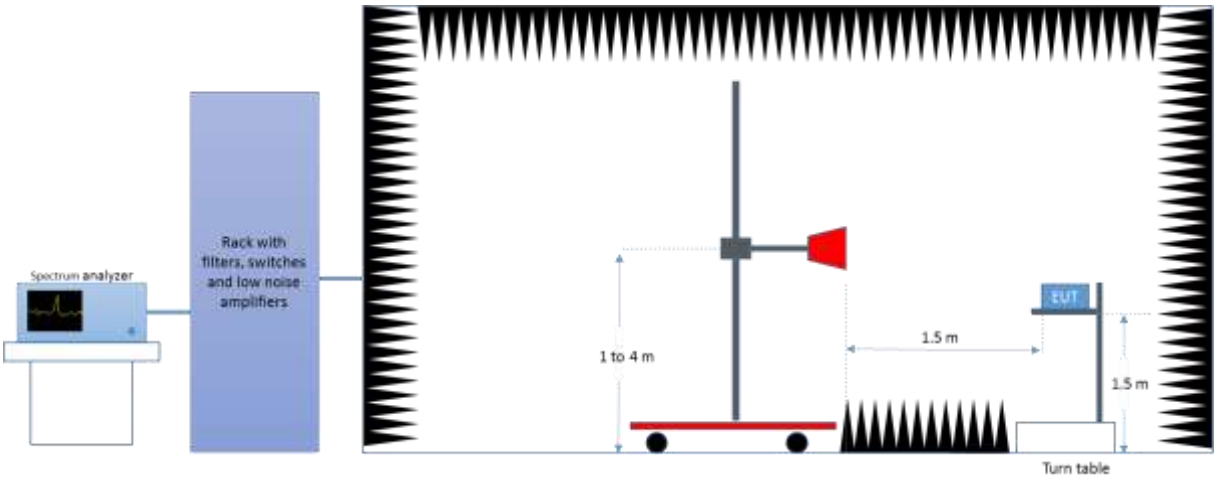
Radiated Setup < 1GHz



Radiated Setup 1 GHz - 18 GHz



Radiated Setup 18 GHz - 40 GHz



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Sample Calculation

The field strength is deduced from the radiated measurement using the following equation:

$$E = 126.8 - 20\log(\lambda) + P - G$$

where

E is the field strength of the emission at the measurement distance, in dBµV/m

P is the power measured at the output of the test antenna, in dBm

λ is the wavelength of the emission under investigation [300/f_{MHz}], in m

G is the gain of the test antenna, in dBi

NOTE – The measured power P includes all applicable instrument correction factors up to the connection to the test

Antenna e.g. cable losses, amplifier gains.

For field strength measurements made at other than the distance at which the applicable limit is specified, the field strength of the emission at the distance specified by the limit is deduced as follows:

$$E_{SpecLimit} = E_{Meas} + 20\log(D_{Meas}/D_{SpecLimit})$$

where

$E_{SpecLimit}$ *is the field strength of the emission at the distance specified by the limit, in dBµV/m*

E_{Meas} *is the field strength of the emission at the measurement distance, in dBµV/m*

D_{Meas} *is the measurement distance, in m*

$D_{SpecLimit}$ *is the distance specified by the limit, in m*

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Test Results

30 MHz – 40 GHz, 802.11a, 6Mbps, Chain A

Radiated Spurious – CH52

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
64.9	31.2	---	40.0	8.8
6017.8	60.0	---	74.0	14.0
6072.1	---	48.9	54.0	5.2
15783.1	55.2	---	74.0	18.8
15784.0	---	44.7	54.0	9.3
21035.4	47.2	---	74.0	26.8
21040.2	---	38.6	54.0	15.4
31784.3	---	32.9	54.0	21.2
31784.3	46.0	---	74.0	28.0

Radiated Spurious – CH56

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
47.4	32.6	---	40.0	7.5
6072.3	---	**49.0**	54.0	5.0
6083.9	60.2	---	74.0	13.8
15833.5	55.1	---	74.0	18.9
15839.7	---	45.0	54.0	9.0
21120.0	---	38.0	54.0	16.0
21120.4	44.4	---	74.0	29.6
31381.2	---	33.9	54.0	20.1
31381.2	46.4	---	74.0	27.6

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Radiated Spurious – CH64

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
46.6	34.2	---	40.0	5.8
6125.8	60.2	---	74.0	13.8
6143.0	---	48.9	54.0	5.1
15960.2	---	44.4	54.0	9.6
15961.1	56.4	---	74.0	17.6
21280.1	---	38.7	54.0	15.3
21280.1	44.3	---	74.0	29.7
31582.8	---	34.7	54.0	19.3
31583.2	46.2	---	74.0	27.8

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30 MHz – 40 GHz, 802.11n20, HT0, Chain A

Radiated Spurious – CH52

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.5	27.3	---	40.0	12.7
6057.3	---	**49.1**	54.0	4.9
6118.5	61.1	---	74.0	13.0
15777.3	---	44.5	54.0	9.5
15788.4	54.3	---	74.0	19.7
21039.2	47.8	---	74.0	26.2
21040.2	---	38.6	54.0	15.4
33079.3	45.9	---	74.0	28.1
33080.3	---	34.0	54.0	20.0

Radiated Spurious – CH56

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
52.9	32.4	---	40.0	7.6
6100.3	---	48.6	54.0	5.4
6141.8	60.8	---	74.0	13.2
15839.28	---	43.90	54.00	10.10
15845.52	55.17	---	74.00	18.83
21120.0	---	38.6	54.0	15.4
21120.0	44.2	---	74.0	29.9
35011.8	---	34.9	54.0	19.1
35011.8	46.1	---	74.0	28.0

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Radiated Spurious – CH64

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.5	31.6	---	40.0	8.4
6001.9	60.9	---	74.0	13.1
6012.9	---	48.9	54.0	5.2
15960.2	---	44.4	54.0	9.6
15966.4	54.9	---	74.0	19.1
21279.6	---	39.1	54.0	14.9
21280.1	45.8	---	74.0	28.2
36608.1	---	34.1	54.0	19.9
36608.1	47.0	---	74.0	27.0

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30 MHz – 40 GHz, 802.11n40, HT0, Chain A

Radiated Spurious – CH54F

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
46.8	33.2	---	40.0	6.8
6081.9	60.6	---	74.0	13.4
6092.4	---	48.8	54.0	5.2
17035.4	55.6	---	74.0	18.4
17036.3	---	44.5	54.0	9.5
21079.8	---	38.1	54.0	15.9
21079.8	44.8	---	74.0	29.2
35413.4	---	33.7	54.0	20.4
35413.4	46.6	---	74.0	27.5

Radiated Spurious – CH62F

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
46.8	32.4	---	40.0	7.6
2459.0	---	**49.1**	54.0	4.9
2459.2	58.1	---	74.0	15.9
6025.9	---	48.9	54.0	5.1
6046.3	60.1	---	74.0	13.9
15936.5	---	43.9	54.0	10.1
15980.7	55.1	---	74.0	18.9
21239.9	---	41.5	54.0	12.5
21239.9	45.9	---	74.0	28.1
36497.2	---	34.4	54.0	19.7
36497.7	46.3	---	74.0	27.7

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30 MHz – 40 GHz, 802.11ac80, HT0, Chain A

Radiated Spurious – CH58ac80

Frequency	MaxPeak	Avg	Limit	Margin
MHz	dBµV/m	dBµV/m	dBµV/m	dB
62.4	34.4	---	40.0	5.6
6094.7	60.0	---	74.0	14.0
6129.0	---	**48.8**	54.0	5.2
17996.0	---	49.5	54.0	4.5
17997.8	60.5	---	74.0	13.5
21160.1	---	38.6	54.0	15.4
21160.1	44.2	---	74.0	29.9
35049.4	---	34.5	54.0	19.5
35049.4	46.2	---	74.0	27.8

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B.4.5 AC power-line conducted emission

Standard references:

<table>
<tr><th>FCC part</th><th>RSS part</th><th>Limits</th></tr>
<tr><td>15.207
15.407 (6)</td><td>RSS-GEN,
Clause 8.8</td><td>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 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.
<table>
<tr><th rowspan="2">Frequency of emission (MHz)</th><th colspan="2">Conducted limit (dBµV)</th></tr>
<tr><th>Quasi-peak</th><th>Average</th></tr>
<tr><td>0.15-0.5</td><td>66 to 56*</td><td>56 to 46*</td></tr>
<tr><td>0.5-5</td><td>56</td><td>46</td></tr>
<tr><td>5-30</td><td>60</td><td>50</td></tr>
</table>
*Decreases with the logarithm of the frequency.</td></tr>
</table>

Test procedure:

The EUT and peripherals are placed on a wooden table with a nominal size of 1.0 m by 1.5 m, raised 80 cm above the reference ground plane. The EUT is connected to AC-Power line through a Line Impedance Stabilization Network (LISN) to accommodate a 50 Ω/50 µH coupling impedance for the measurement system. The EUT control PC is considered as a peripheric and therefore is connected to a second LISN which has the measurement port connected to a 50 ohms impedance.

Each measurement is done for each current-carrying conductor (Line and Neutral) at the end plug of the EUT power cord. The EUT is tested for several transmission modes (frequency channel, modulation, etc.) and the result providing the maximum measured emission is reported.

The exploratory measurement is done over the frequency range from 150 kHz to 30 MHz, while the measurement receiver is recording the Peak and Average signal at 10 kHz steps in Max Hold mode. The cables manipulation is performed within the range of likely configurations to determine the maximum emission. Once the EUT cable configuration, arrangement and mode of operation that produced the emission with the highest amplitude relative to the limit is found the six highest AC power-line conducted emissions relative to 20 dB of the limit are reported as the final measurement. If fewer than six emission frequencies are within 20 dB of the limit, the noise level is reported. For the final measurement, the measurement receiver records the Quasi Peak values with 9 kHz resolution bandwidth and the average values with 10 kHz resolution bandwidth.

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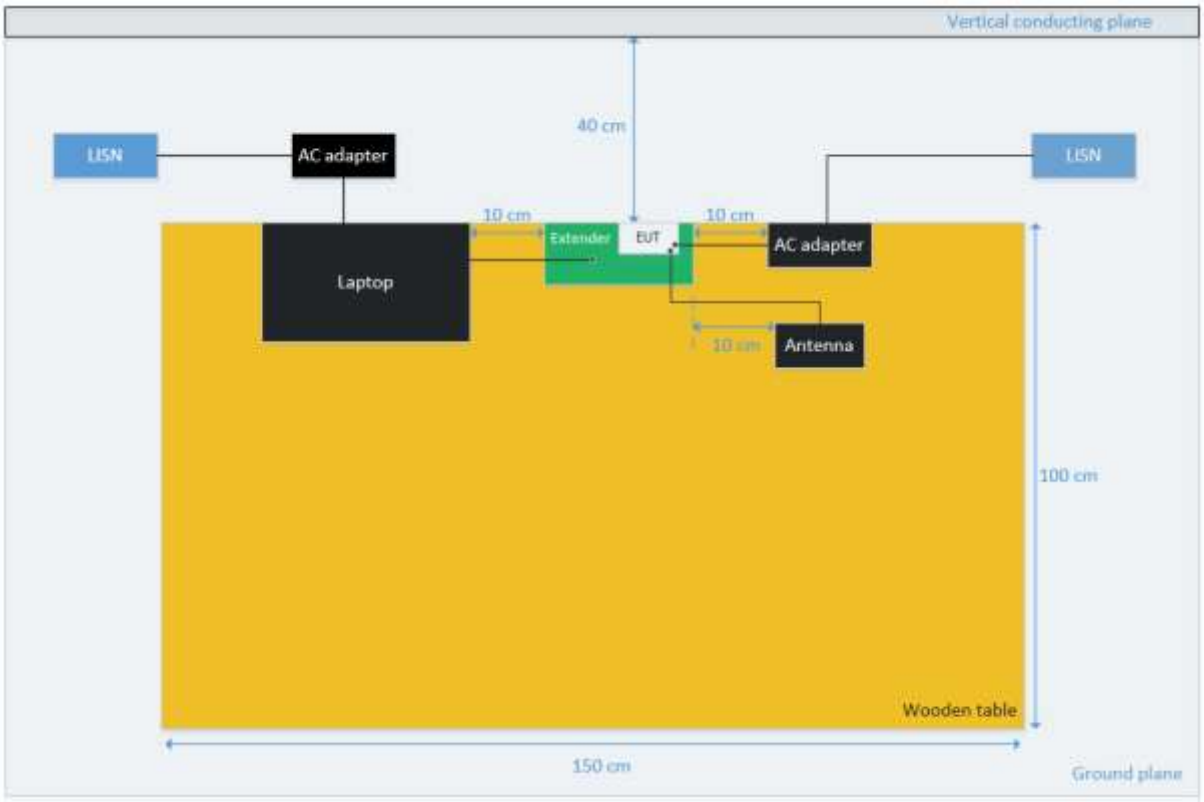
EUT arrangement for AC power-line conducted emission tests



Sample Calculation:

The measured level at the spectrum analyzer in dBuV is corrected by a transducer factor taking into account the losses of the RF cable and the LISN as follows:

Conducted Emission level (dBuV) = SA_{Level} + $RFCable_{Losses}$ + $LISN_{Losses}$

Where:
SA_{Level} is the voltage level displayed on the measurement receiver, in dBuV.
$RFCable_{Losses}$ is the value of the cable losses between the LISN and the measurement receiver, in dB.
$LISN_{Losses}$ is the value of the insertion losses of the LISN, in dB.

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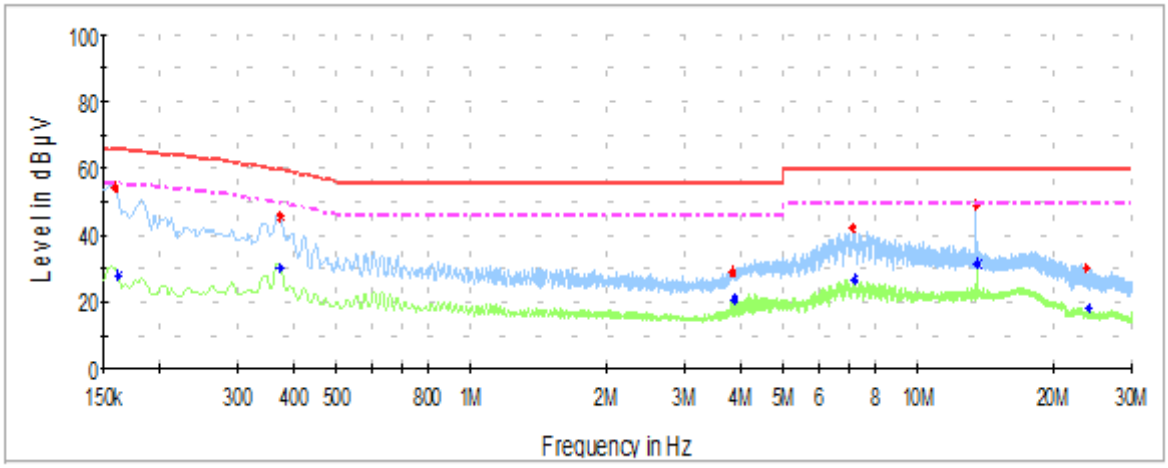
Test Results:

150kHz – 30MHz, all modes

AC power-line conducted – Phase L1



Peak measurements Avg measurements Limit FCC Ouasi-Peak Limit FCC Avg

Frequency	Max Peak	Avg	Limit	Margin
MHz	dBµV	dBµV	dBµV	dB
0.1590	54.1	---	65.7	11.6
0.1619	---	27.7	55.7	28.0
0.3739	45.4	---	59.6	14.2
0.3739	---	30.0	49.6	19.6
3.8424	28.8	---	56.0	27.2
3.8902	---	20.7	46.0	25.3
7.1468	41.9	---	60.0	18.1
7.1946	---	26.6	50.0	23.4
13.5467	48.9	---	60.0	11.1
13.5676	---	31.3	50.0	18.7
23.8748	30.0	---	60.0	30.0
24.1673	---	17.9	50.0	32.1

Note: The emissions found do not change with the modulation and/or frequency.

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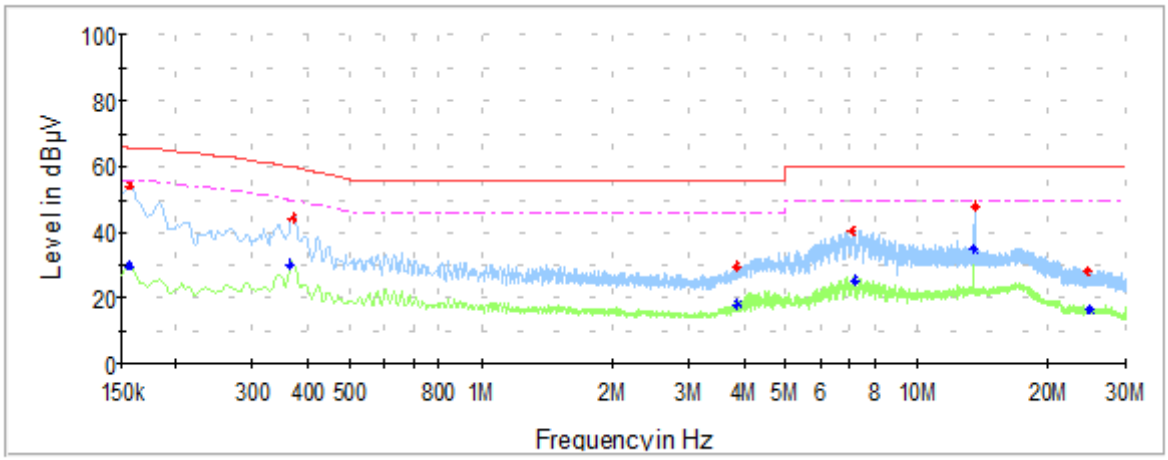
AC power-line conducted – Neutral N



Frequency	Max Peak	Avg	Limit	Margin
MHz	dBµV	dBµV	dBµV	dB
0.1560	54.2	---	65.8	11.6
0.1560	---	29.6	55.8	26.2
0.3709	44.4	---	59.7	15.3
0.3649	---	30.1	49.9	19.8
3.8604	29.8	---	56.0	26.2
3.8783	---	18.0	46.0	28.0
7.1170	40.3	---	60.0	19.7
7.1737	---	25.5	50.0	24.5
13.5735	47.7	---	60.0	12.3
13.5646	---	34.9	50.0	15.1
24.5554	27.7	---	60.0	32.3
24.8360	---	16.2	50.0	33.8

Note: The emissions found do not change with the modulation and/or frequency.

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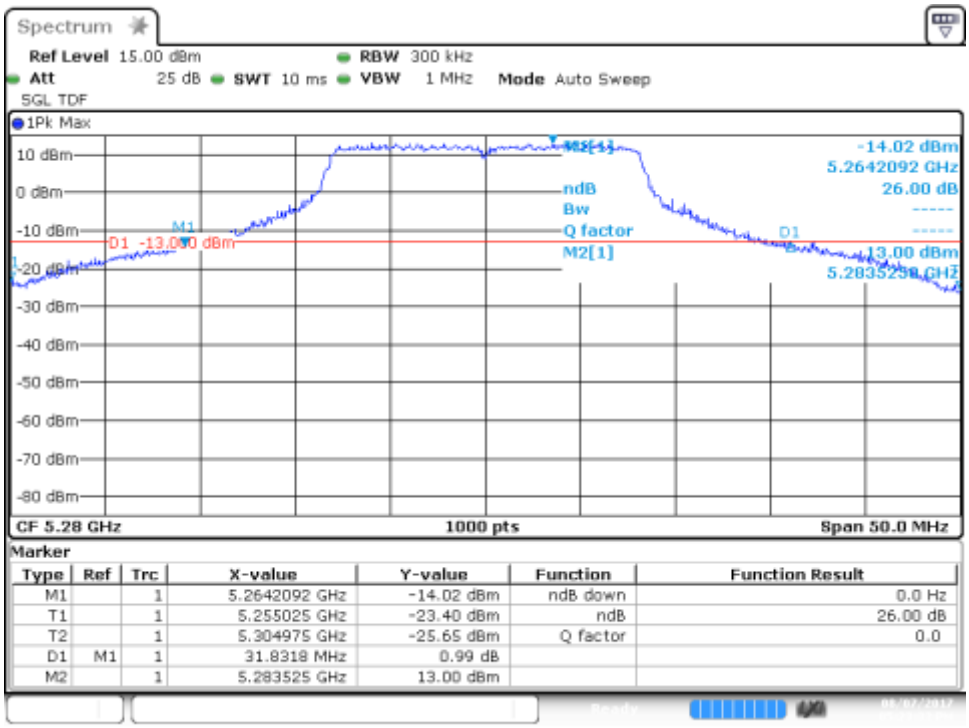
B.5 Test Results Screenshot U-NII-2A

B.5.1 26dB Bandwidth

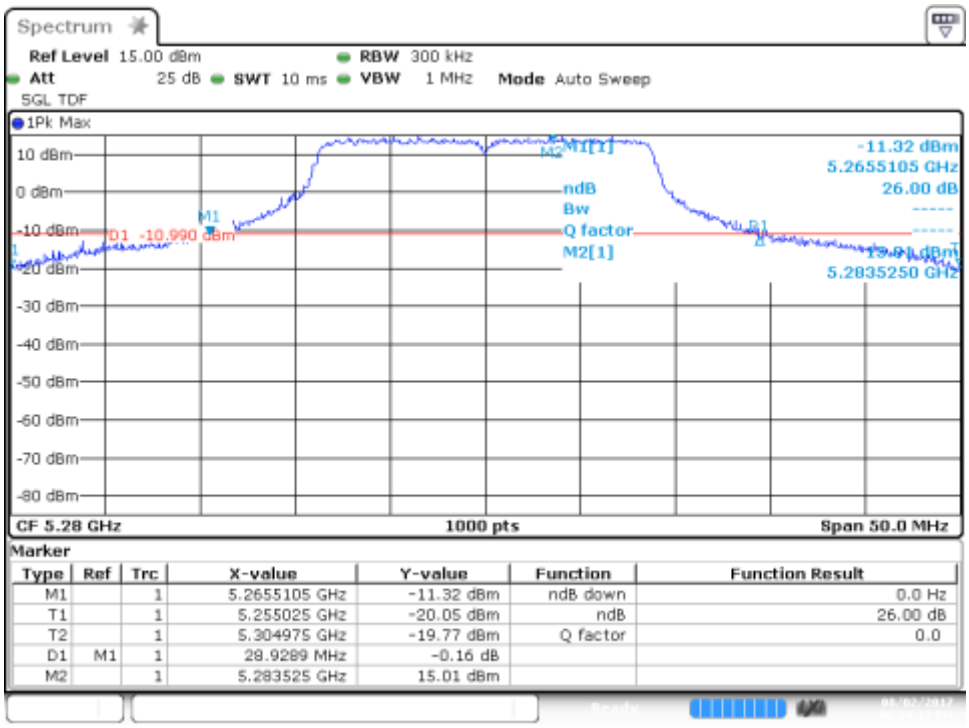
SISO-A, 802.11a, 6Mbps

Channel 56



SISO-A, 802.11n20, HT0

Channel 56



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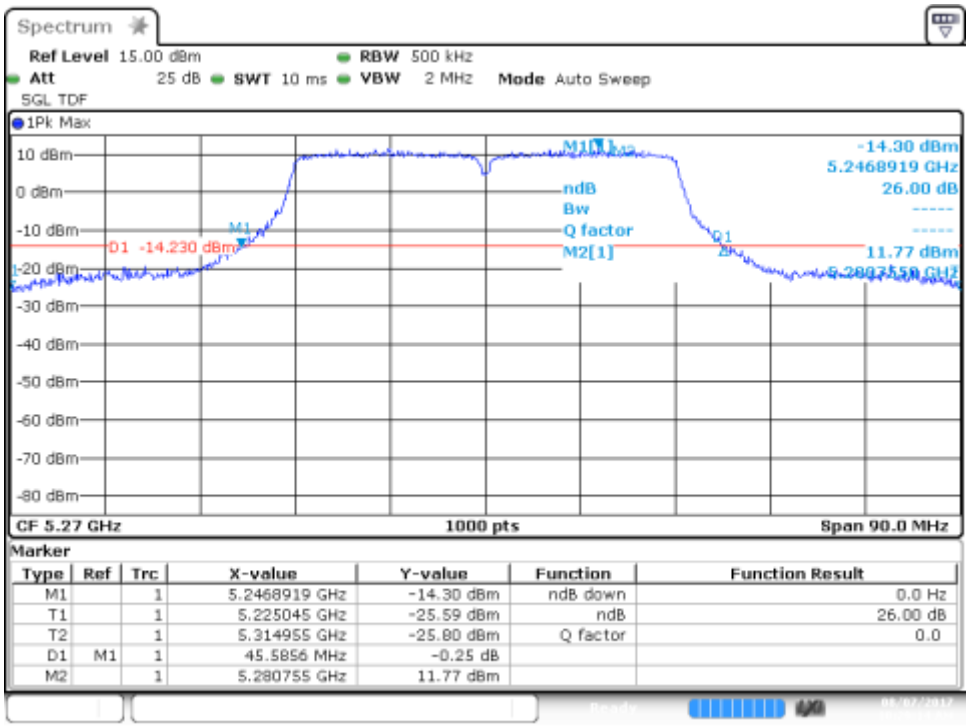
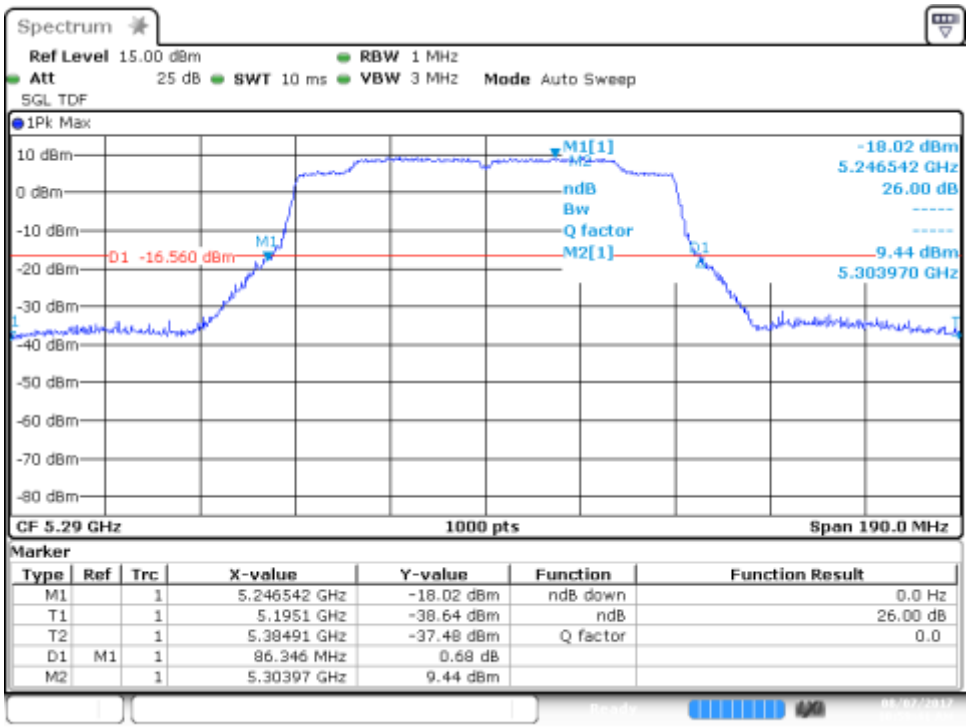
SISO-A, 802.11n40, HT0

Channel 54F



SISO-A, 802.11ac80, VHT0

Channel 58ac80



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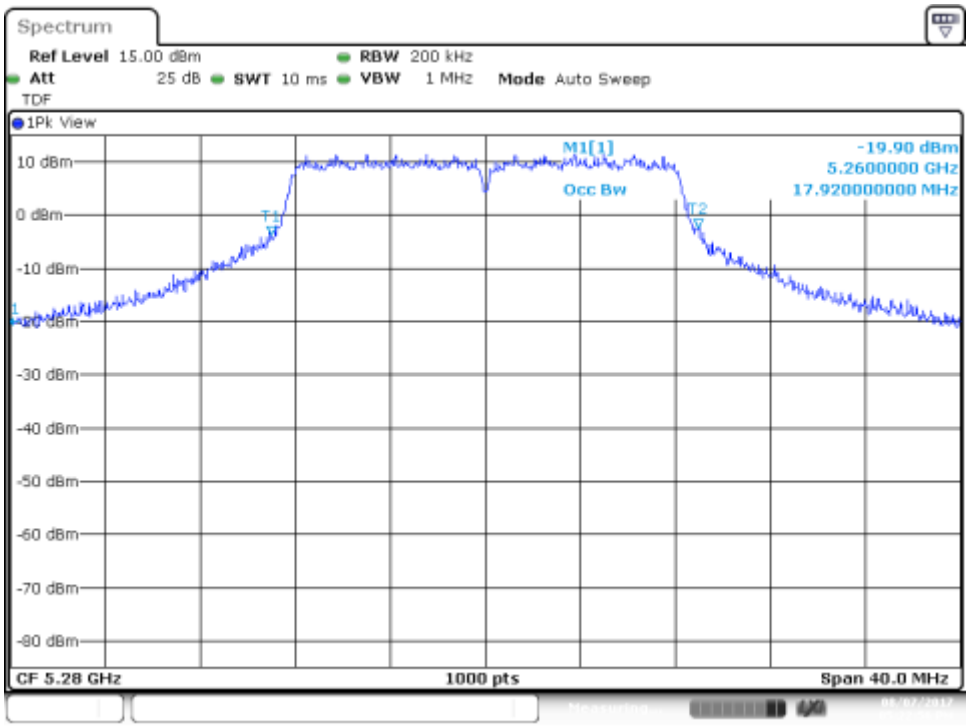
B.5.2 99% Bandwidth

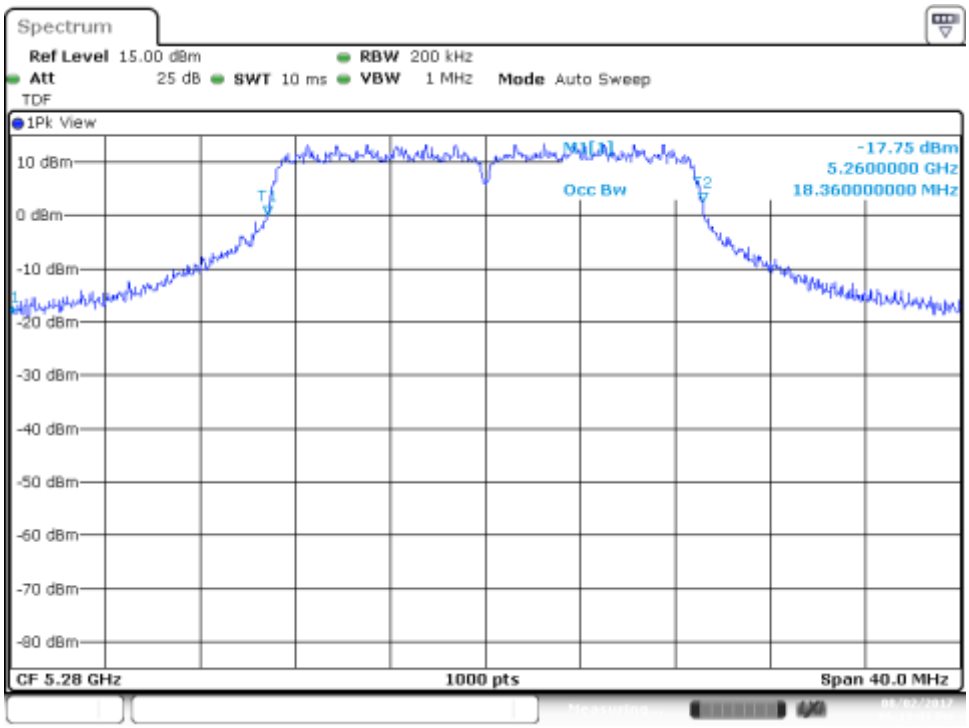
SISO-A, 802.11a, 6Mbps

Channel 56



SISO-A, 802.11n20, HT0

Channel 56



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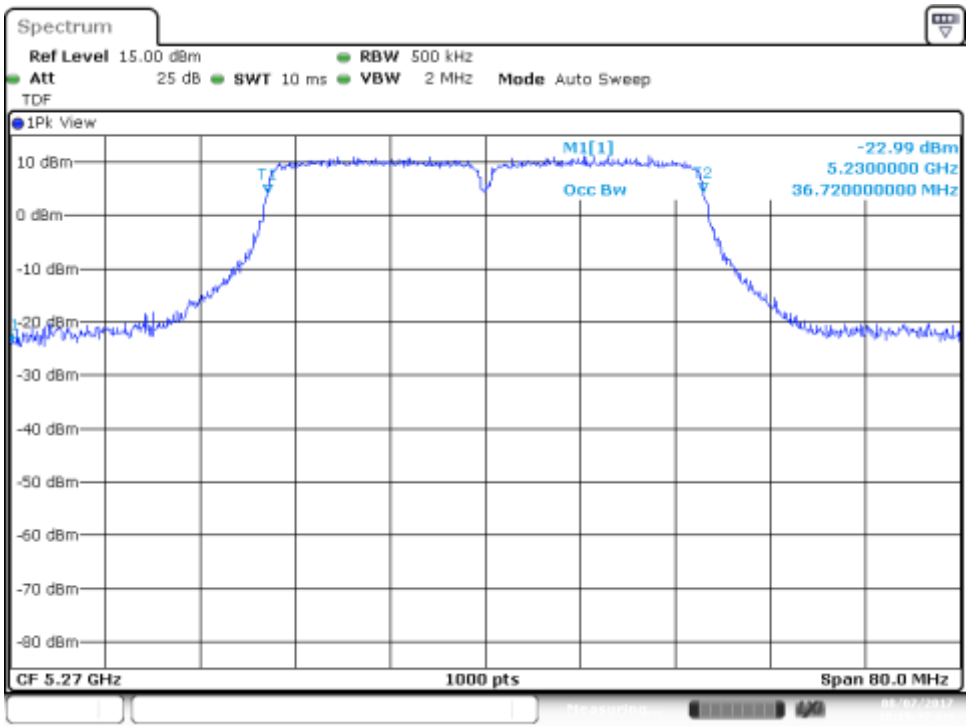
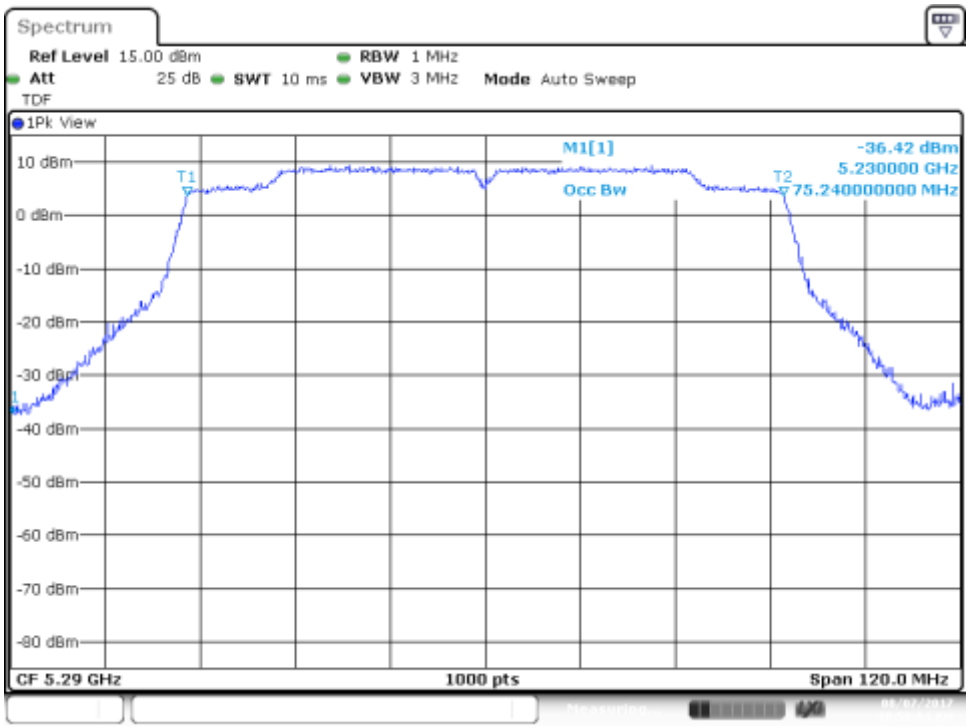
SISO-A, 802.11n40, HT0

Channel 54F



SISO-A, 802.11ac80, VHT0

Channel 58ac80



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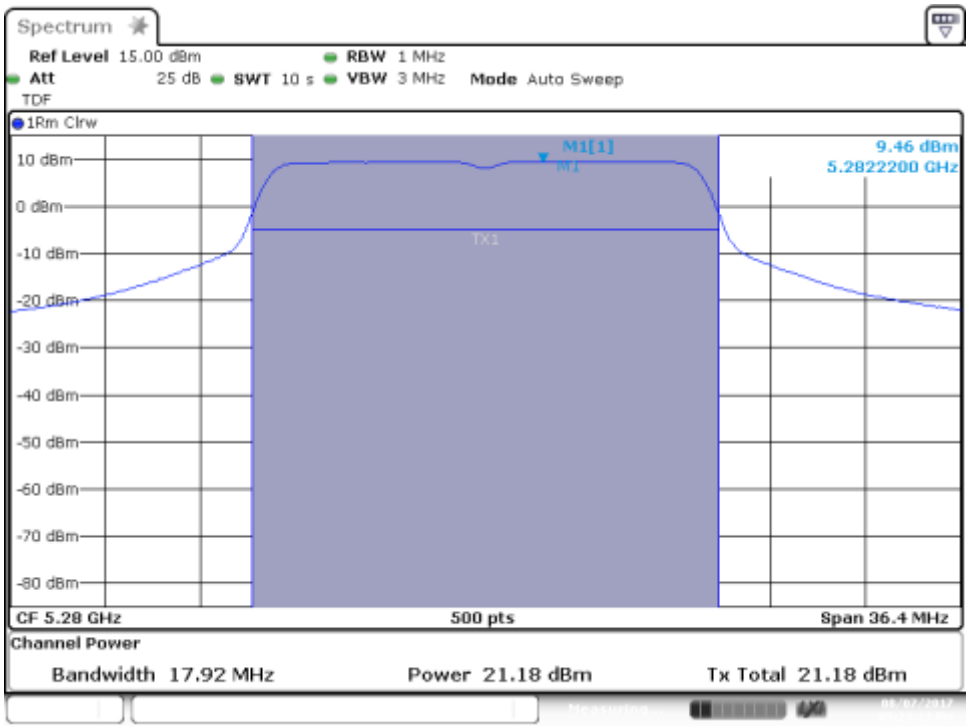
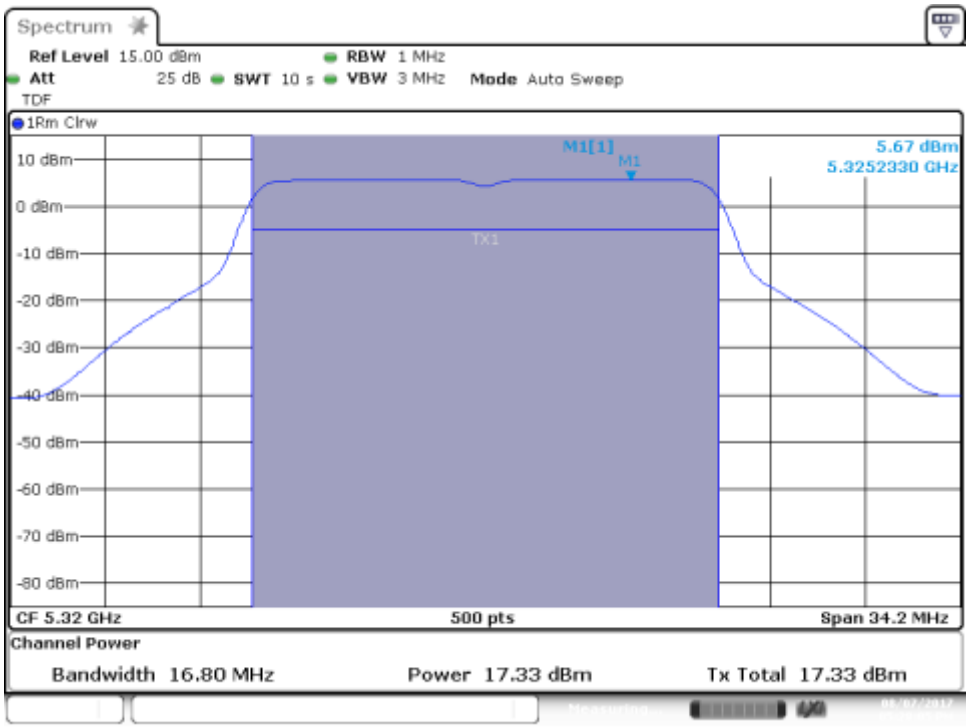
B.5.3 Power Limits. Maximum Output power & Peak power spectral density

SISO-A, 802.11a, 6Mbps

Channel 56



Channel 64



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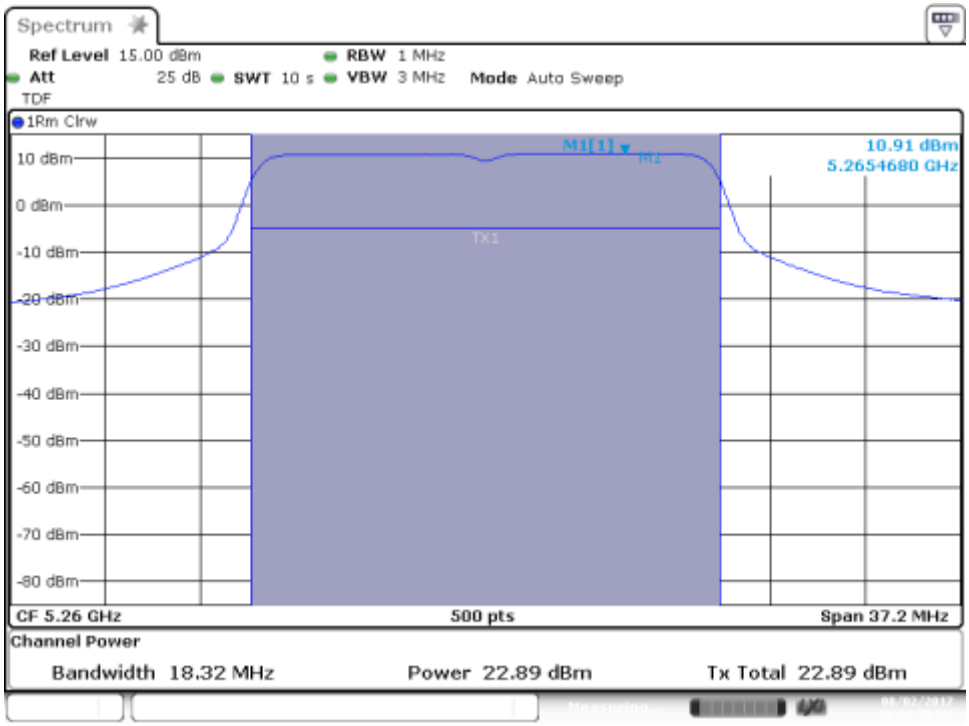
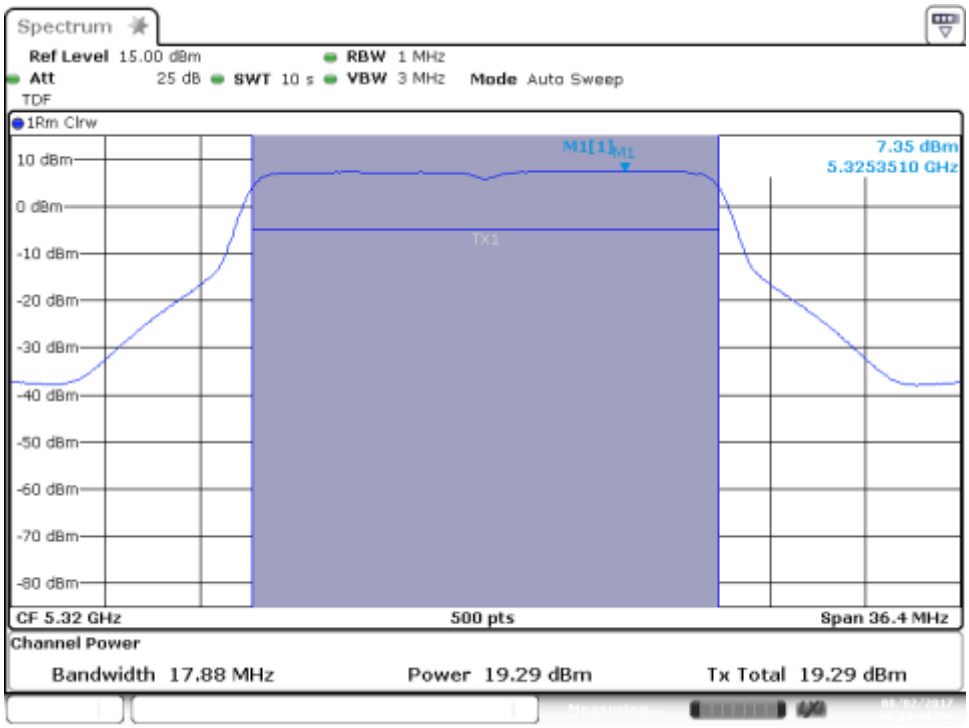
SISO-A, 802.11n20, HT0

Channel 52



Channel 64



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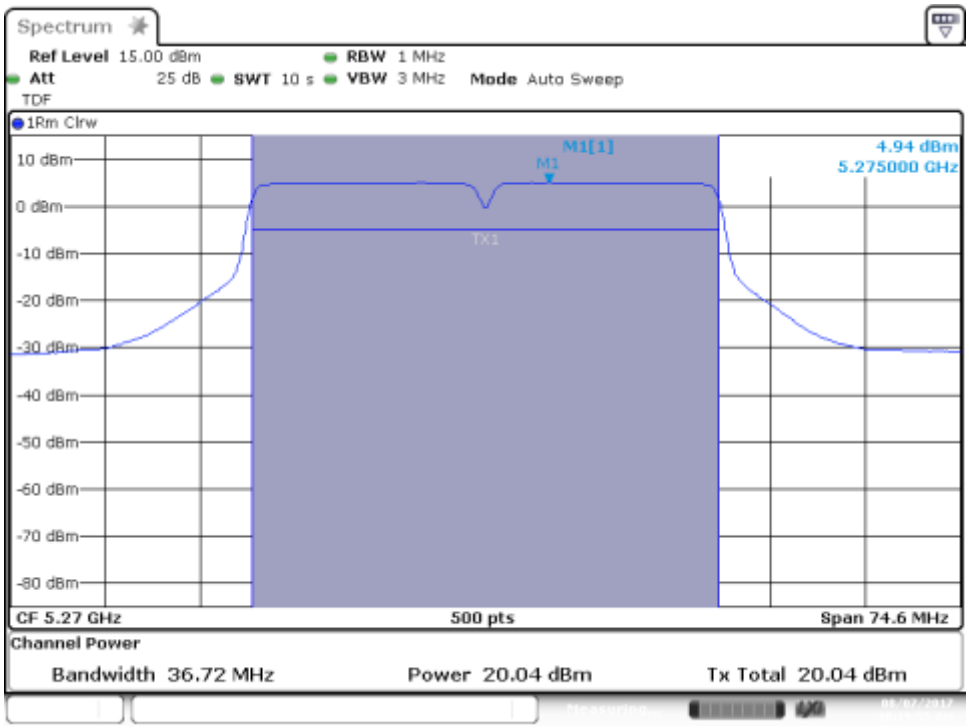
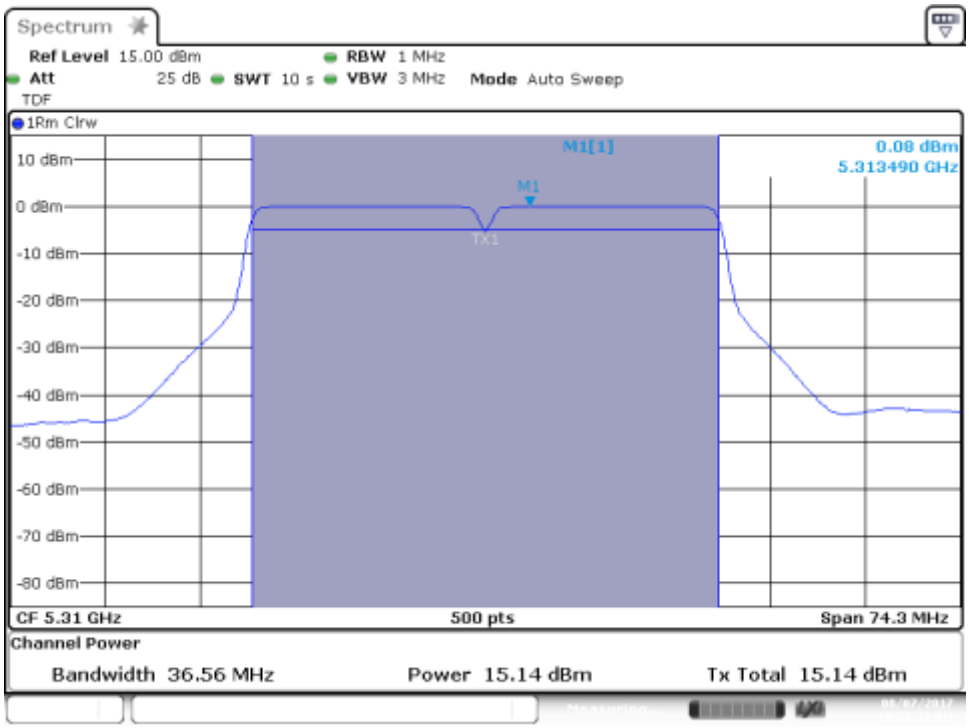
SISO-A, 802.11n40, HT0

Channel 54F



Channel 62F



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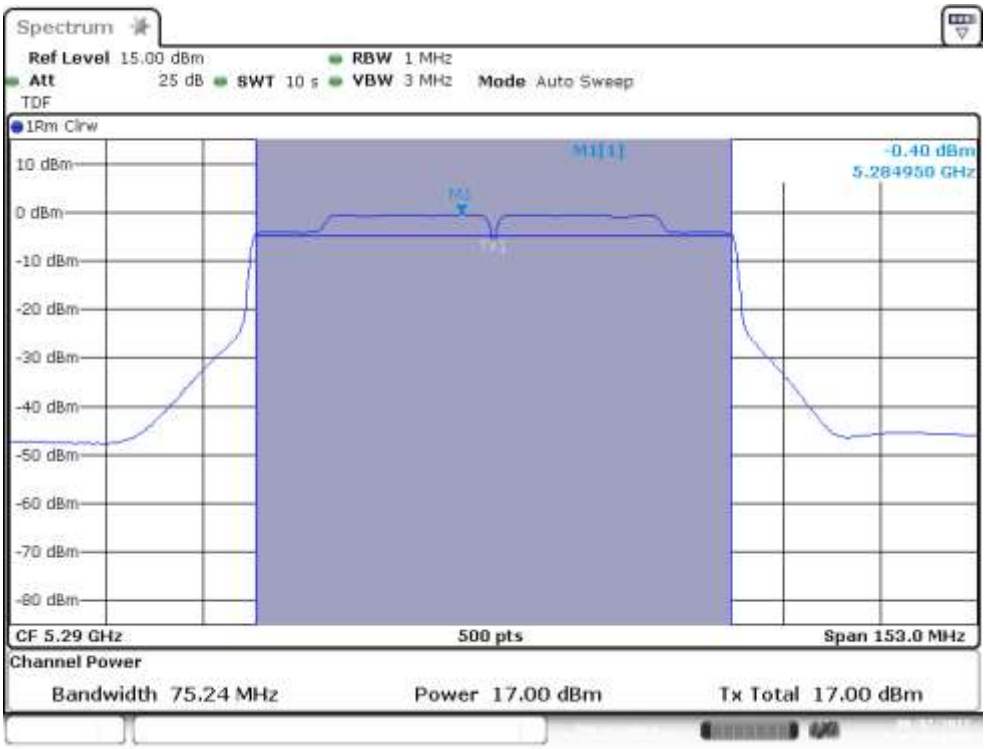
SISO-A, 802.11ac80, VHT0

Channel 58ac80



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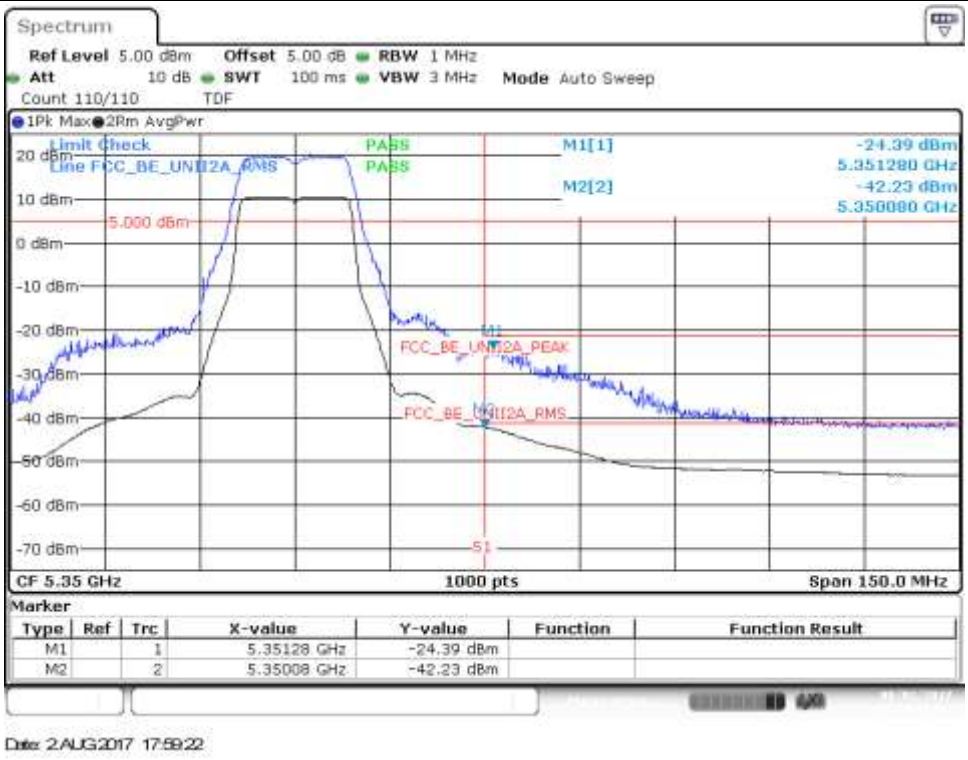
B.5.4 Undesirable emissions limits : Band Edge (Conducted)

802.11a, 6Mbps – Chain A

BE High Freq Section, Peak, RMS – CH64



802.11n20, HT0 (SISO) - Chain A

BE High Freq Section, Peak, RMS – CH64

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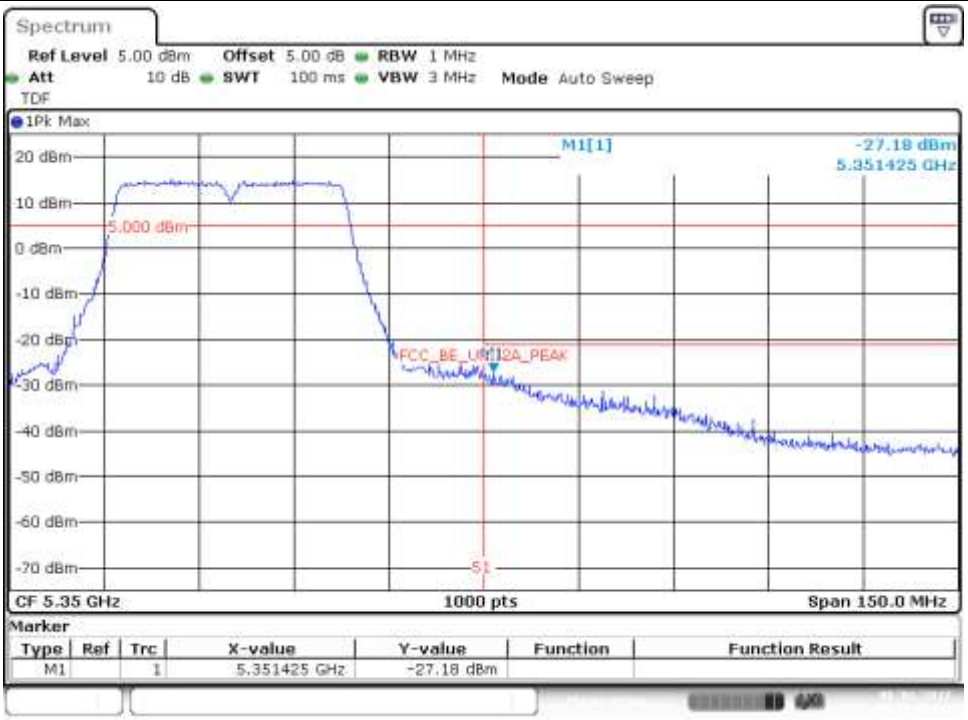
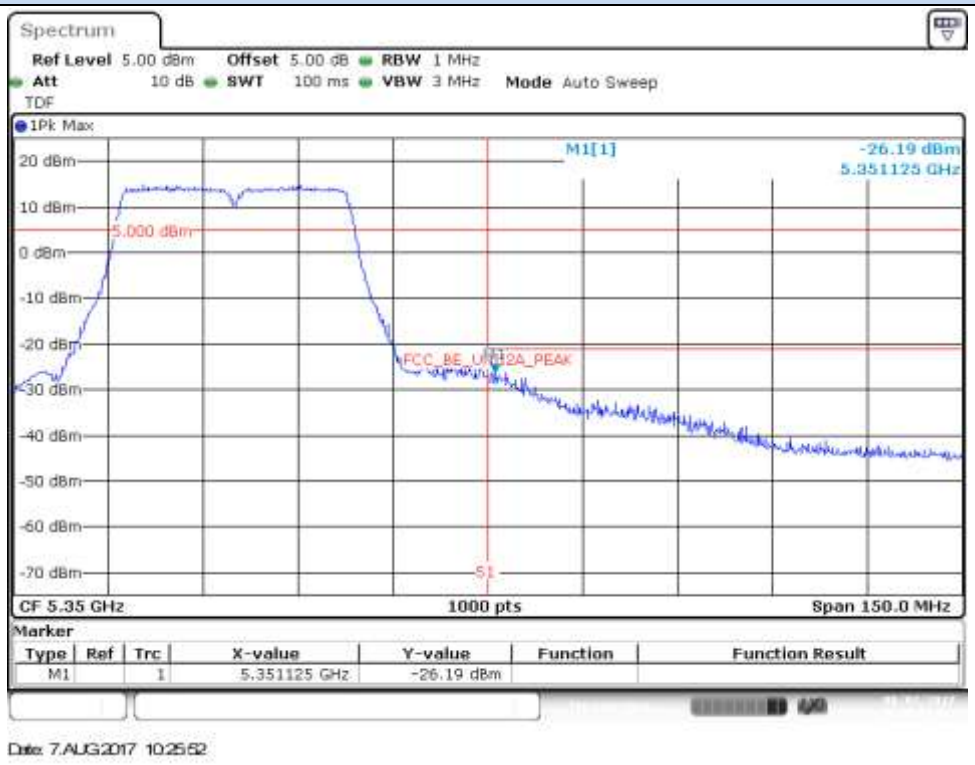
802.11n40, HT0 (SISO) - Chain A

BE High Freq Section, Peak – CH62F



BE High Freq Section, RMS – CH62F



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802.11ac80, VHT0 (SISO) - Chain A

BE High Freq Section, Peak – CH58ac80

Date: 7.AUG.2017 10:57:04

BE High Freq Section, RMS – CH58ac80

Date: 7.AUG.2017 10:58:28

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