

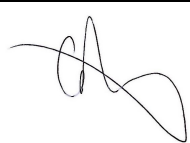
TEST REPORT

EUT Description	WLAN and BT, 2x2 PCIe M.2 2230 adapter card
Brand Name	Intel® Wi-Fi 6 AX201
Model Name	AX201NGW
Date of Test Start/End	2018-10-2 / 2018-11-30
Features	802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth® 5 (see section 5)
Applicant	Intel Corporation SAS
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Contact Person	Laurence Peignot
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Reference Standards	ETSI EN 301 893 V2.1.1 (see section 1)
Test Report identification	180717-02.TR15
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

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1. Standards, reference documents and applicable test methods

1. ETSI EN 301 893 V2.1.1 – GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU.

2. General conditions, competences and guarantees

- ✓ Intel Corporation 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 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	$23 \pm 2^{\circ}\text{C}$
Humidity	$50\% \pm 15\%$

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#1	170000-01.S14	LAPTOP	Latitude E5470	90LKMC2	2017-05-30	Used for conducted tests
	180326-01.S05	EXTENDER	PCB00651_01	6510818-199	2018-07-05	
	180717-02.S03	RF MODULE	AX201NGW	WFM:3413E8CA8726	2018-09-06	
#2	170000-01.S13	LAPTOP	Latitude E5470	FT6LMC2	2017-05-30	Used for Receiver Blocking tests (Conducted)
	180717-03.S21	EXTENDER	PCB00653_01	AS000653-1-300630818-186	2018-09-14	
	180717-02.S04	RF MODULE	AX201NGW	WFM:3413E8CA8816	2018-09-06	
#3	180717-02.S05	RF MODULE	AX201NGW	WFM : 3413E8CA86BD	2018-09-06	Used for Adaptivity and DFS tests (Conducted)
	180522-02.S03	EXTENDER	PCB00651_01	6510818-190	2018-05-31	
	170000-01.S04	LAPTOP	LATITUDE E5470	DMRKMC2	2017-05-10	
#4	180717-02.S07	RF MODULE	AX201NGW	WFM : 3413E8CA866D	2018-09-06	Radiated Spurious emission from 30 MHz to 6.4 GHz for Tx tests and from 30MHz to 1GHz for Rx tests
	180326-01.S03	EXTENDER	PCB00651_01	6510818-198	2018-03-27	
	170209-01.S16	LAPTOP	LATITUDE E7470	C1HTPF2	2017-02-09	
#5	180717-02.S08	RF MODULE	AX201NGW	WFM:3413E8CA8681	2018-09-06	Radiated Spurious emission from 6.4 GHz to 26.5 GHz for Tx tests
	180717-03.S18	EXTENDER	PCB00651_01	6510817-133	2018-08-21	
	170801-01.S10	LAPTOP	LATITUDE E7470	7KNOXF2	2017-09-07	
#6	180717-02.S11	LAPTOP Used for receiver spurious emission test in 1 GHz – 26.5 GHz	LATITUDE 7490	17640389594	2018-09-24	Radiated Spurious emission from 1 GHz to 26.5 GHz for Rx tests
	180717-02.S08	RF MODULE	AX201NGW	WFM:3413E8CA8681	2018-09-06	

5. EUT Features

Brand Name	Intel® Wi-Fi 6 AX201		
Model Name	AX201NGW		
Software Version	OEM DRTU_08048_11_1832_0G		
Driver Version	99.0.39.11 (V010.16)		
Prototype / Production	Production		
Supported Radios	802.11b/g/n/ax	2.4GHz (2400.0 – 2483.5 MHz)	
	802.11a/n/ac/ax	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	CHAIN A: PIFA antenna. WiFi 2.4GHz & 5GHz and BT CHAIN B: PIFA antenna. WiFi 2.4GHz & 5 GHz		
Additional Information			

6. Remarks and comments

- At customer request, all tests except RF Output Power (4.2.3.1.1) & Power Spectral Density (4.2.3.1.3) were carried out at higher Tx Power: +3dB vs nominal declared power.
- Channel Access Mechanism and maximum Channel Occupancy Time are declared compliant with requirement by manufacturer. Both items are not evaluated.
- In extreme conditions at high temperature, MIMO has been tested at +60°C as per manufacturer declaration, otherwise +70 °C was used for all tests.
- According to applicant's request, the Rx Radiated Spurious tests in 1-26 GHz band were performed with the module embedded inside a host as indicated in the section 4, sample #6

7. Test Verdicts summary

7.1. 802.11a/n/ac/ax

Mode	ETSI Part	Test	Verdict
5.2GHz	4.2.1	Nominal Centre Frequencies	P
	4.2.2	Nominal Channel Bandwidth and Occupied Channel Bandwidth	P
	4.2.3.1.1	RF output power	P
	4.2.3.1.2	Transmit Power Control (TPC)	P
	4.2.3.1.3	Power Density	P
	4.2.4.1	Transmitter unwanted emissions outside the 5GHz RLAN bands	P
	4.2.4.2	Transmitter unwanted emissions within the 5GHz RLAN bands	P
	4.2.5	Receiver spurious emissions	P
	4.2.6	Dynamic Frequency Selection	P
	4.2.7	Adaptivity(Channel Access Mechanism)	P
	4.2.8	Receiver Blocking	P

P: Pass

F: Fail

NM: Not Measured

NA: Not Applicable

8. Document Revision History

Revision #	Date	Modified by	Revision Details
Rev. 00	2018-12-13	A.Hagras M.Lefebvre	First Issue

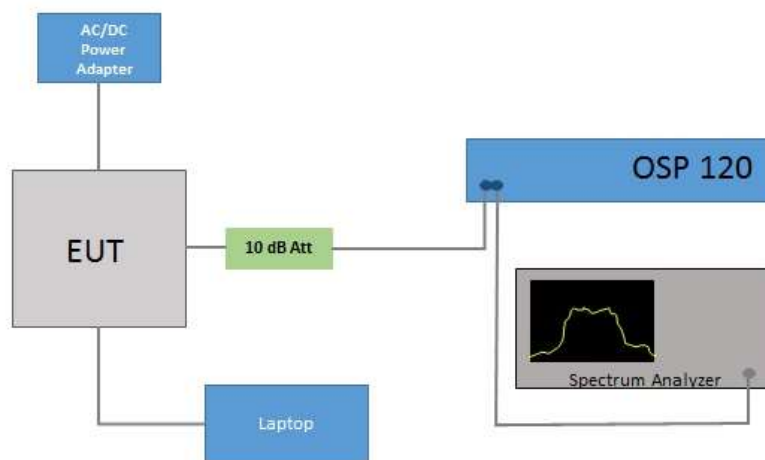
Annex A. Test & System Description

A.1 Measurement System

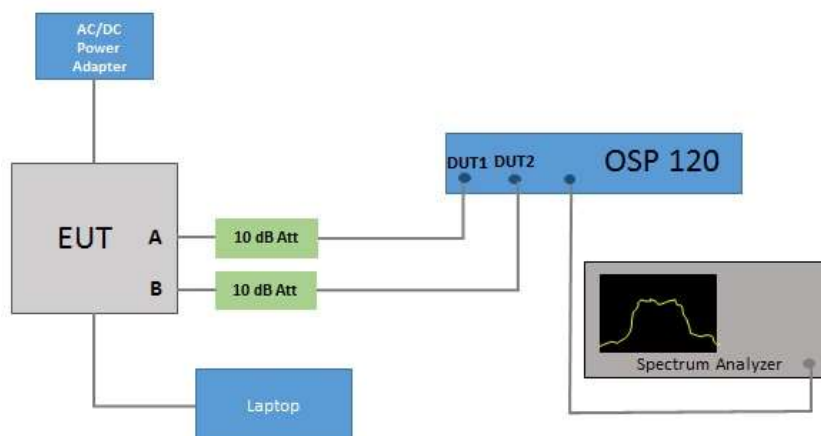
Measurements were performed using the following setups, made in accordance to the general provisions of ETSI EN 301 893 V2.1.1 Test Procedures. Rohde & Schwarz TS9887 system with the switching unit OSP120, OSP B-157 and software EMC32 were employed.

The EUT 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. Setups for conducted and radiated measurements are shown below.

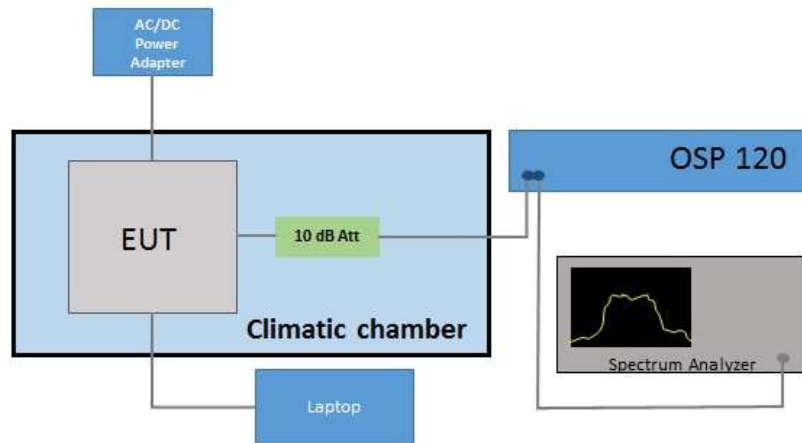
Conducted Setup



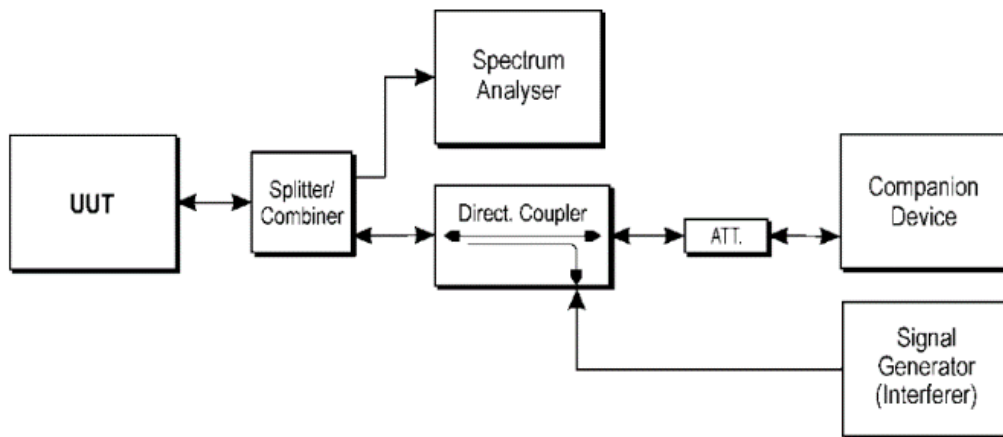
Conducted Setup (MIMO Measurements)



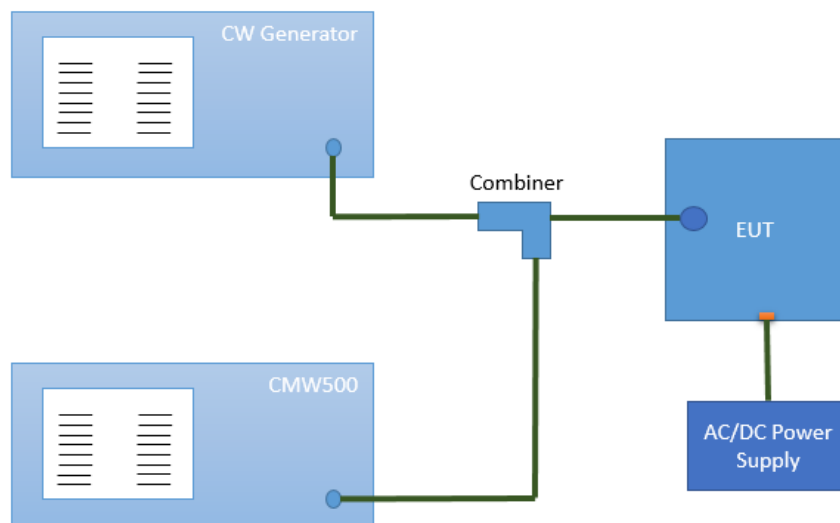
Conducted Setup (Extreme conditions)



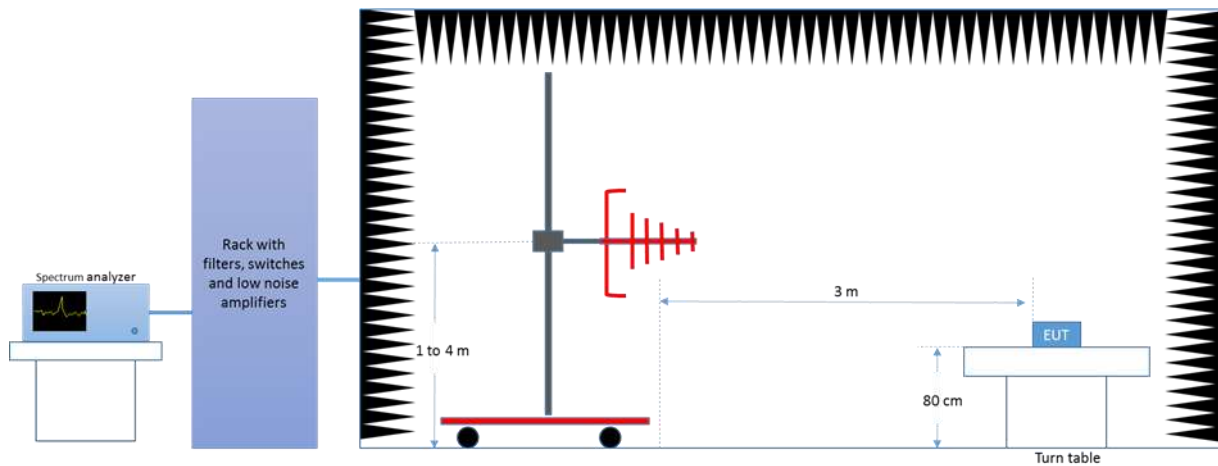
Adaptivity Setup



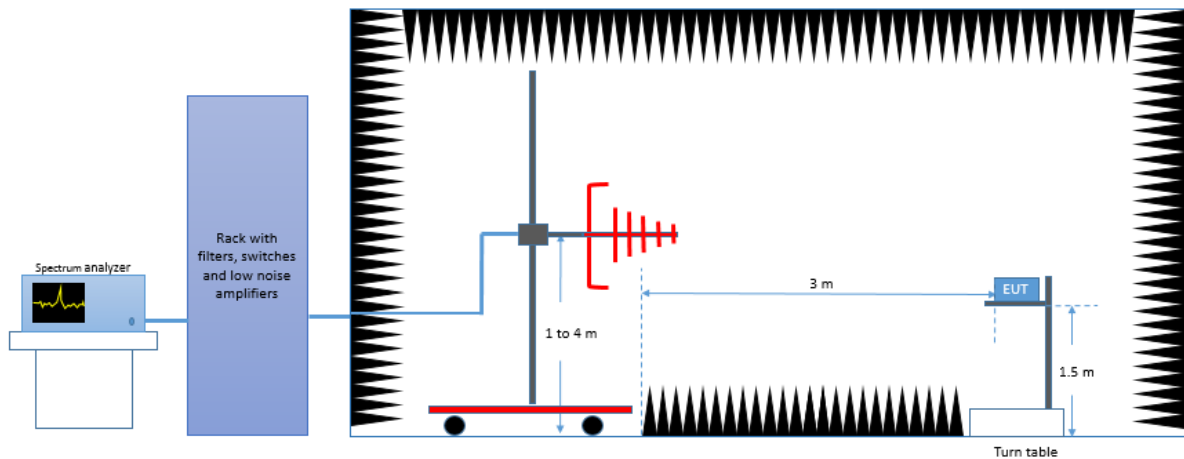
Receiver Blocking Setup



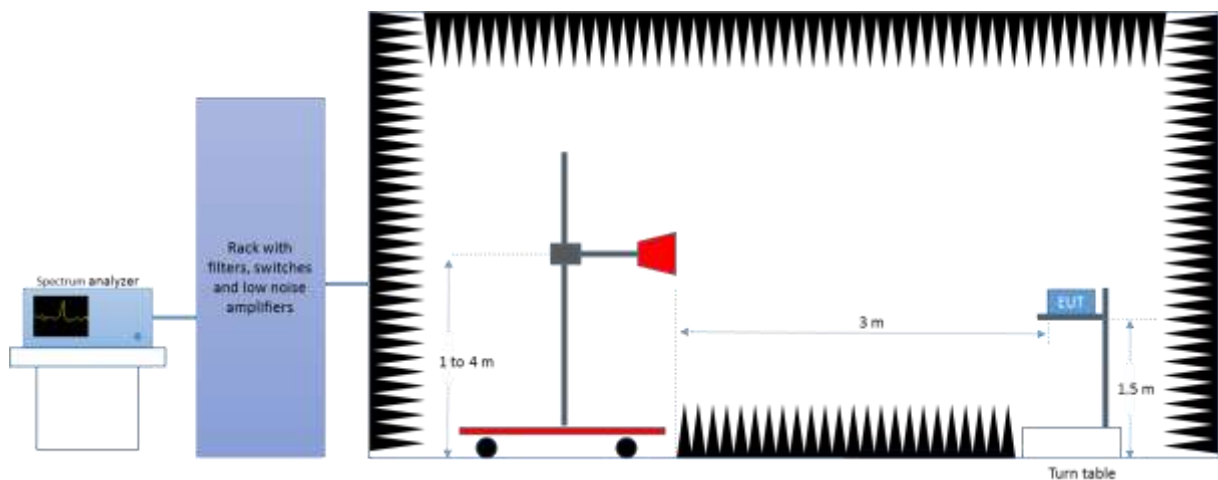
Radiated Setup 30 MHz - 1 GHz (Transmitter tests)



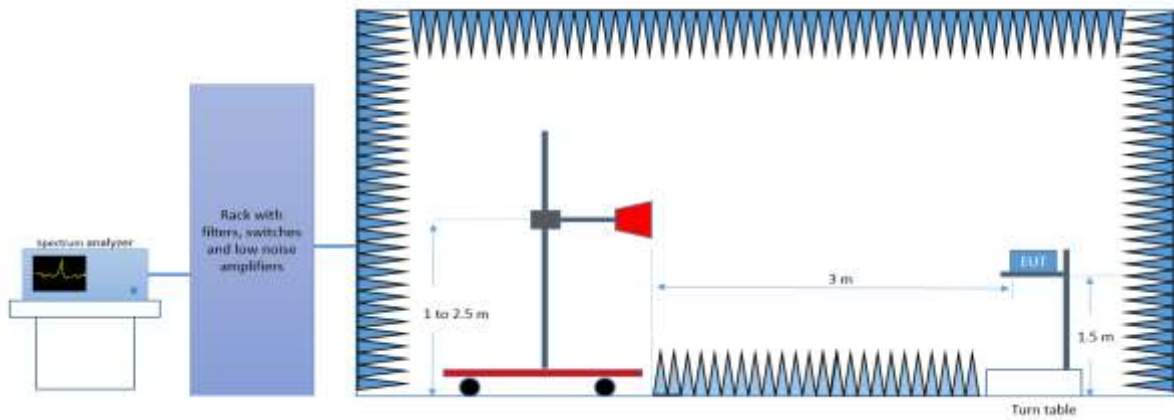
Radiated Setup 30 MHz - 1 GHz (Receiver tests)



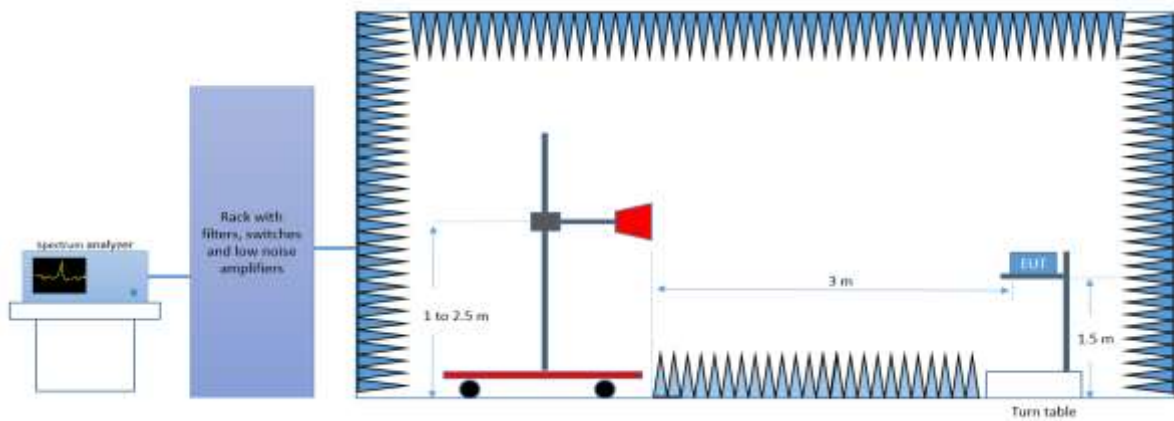
Radiated Setup 1 GHz – 6.4 GHz (Transmitter tests)



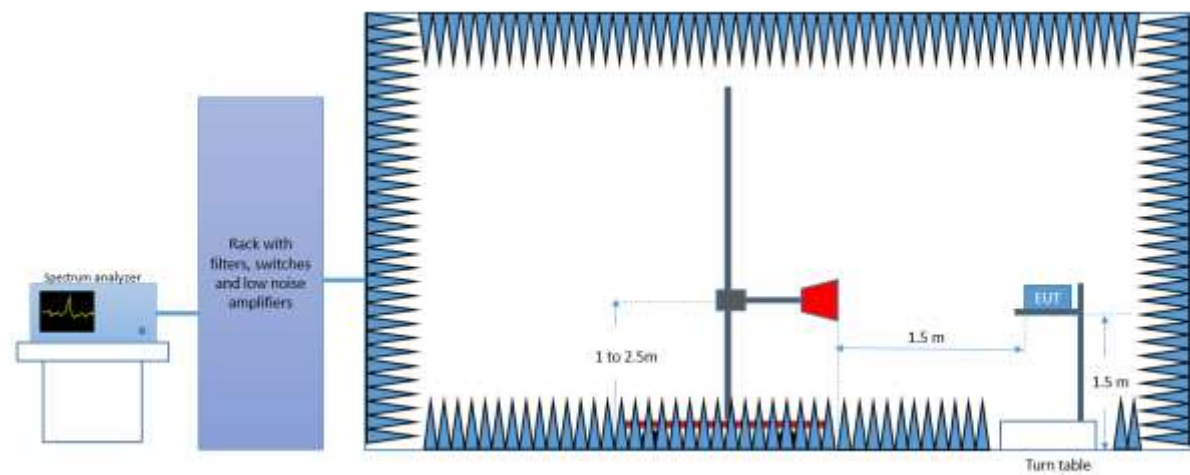
Radiated Setup 6.4 GHz – 18 GHz (Transmitter tests)



Radiated Setup 1 GHz - 18 GHz (Receiver tests)



Radiated Setup 18 GHz - 26 GHz



A.2 Test Equipment List

Conducted Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0033	Spectrum analyzer	FSV40	101072	Rohde & Schwarz	2018-01-26	2020-01-26
0347	Switch unit	OSP 120	101396 / 100907 / 19C1D19	Rohde & Schwarz	2018-04-12	2020-04-12
0300	Climatic chamber	SLT34/40	56746020930010	SECASI	2017-03-09	2019-03-09
0741	Measurement Software	EMC32 v10.30.00	200226	Rohde & Schwarz	N/A	N/A

N/A: Not Applicable

DFS/Adaptivity Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0316	Spectrum analyzer	FSV30	103309	Rohde & Schwarz	2017-09-22	2019-09-22
0017	Vector signal generator	SMJ100A	100458	Rohde & Schwarz	2017-11-24	2019-11-24
0261	Access point	Aironet IOS	FTX134390GV	Cisco	N/A	N/A

N/A: Not Applicable

Receiver blocking Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0309	Signal generator	SMB100A	178217	Rohde & Schwarz	2018-04-17	2020-04-17
0100	Network simulator	CMW500	129337	Rohde & Schwarz	2017-07-18	2019-07-18

Radiated Setup

Radiated Setup-1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0420	Spectrum analyzer	FSV40	101556	Rohde & Schwarz	2018-05-17	2020-05-17
0137	Log antenna 30 MHz – 1 GHz	3142E	00156946	ETS Lindgren	2017-12-19	2019-12-19
0325	Double Ridged Horn Antenna 1 GHz – 18 GHz	3117	00157734	ETS Lindgren	2017-08-22	2019-08-22
0135	Semi Anechoic chamber	FACT 3	5720	ETS Lindgren	2018-04-18	2020-04-18
0530	Measurement Software	EMC32	100623	Rohde & Schwarz	N/A	N/A

N/A: Not Applicable

Radiated Setup-2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0133	Spectrum analyzer	FSV40	101358	Rohde & Schwarz	2018-04-11	2020-04-11
0141	Double Ridged Horn Antenna 1 GHz – 18 GHz	3117	00157736	ETS Lindgren	2018-05-11	2020-05-11
0334	Double Ridged Horn Antenna 18 GHz – 40 GHz	3116C-PA	00196308	ETS Lindgren	2017-08-22	2019-08-22
0343	Double ridged Horn antenna with preamplifier 1 GHz – 18 GHz	3117-PA	00201875	ETS Lindgren	2017-08-22	2019-08-22
0337	Full Anechoic chamber	RFD_FA_100	5996	ETS Lindgren	2018-04-17	2020-04-17
0329	Measurement Software	EMC32	100401	Rohde & Schwarz	N/A	N/A

N/A: Not Applicable

Radiated Setup - shared equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0616	Power Sensor 50MHz-18GHz	NRP-Z81	104385	Rohde & Schwarz	2018-04-16	2020-04-16
0617	Power Sensor 50MHz-18GHz	NRP-Z81	104386	Rohde & Schwarz	2018-04-16	2020-04-16

A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the below table:

Measurement type	Uncertainty [$\pm$ dB]
Conducted Power	± 1.0
Conducted spurious emission	± 2.9
Radiated test < 1GHz	± 3.8
Radiated test 1GHz - 40GHz	± 4.7

Annex B. Test Results

B.1 Test Conditions

ETSI part	Conditions	ETSI EN 301 893 v.2.1.1 Annex G
5.1.1	Tests defined in the present document shall be carried out at representative points within the boundary limits of the declared operational environmental profile, see clause 5.4.1, item m). Where technical performance varies subject to environmental conditions, tests shall be carried out under a sufficient variety of environmental conditions (within the boundary limits of the declared operational environmental profile) to give confidence of compliance for the affected technical requirements. For each test defined in the present document, the environmental condition(s) at which the test has to be performed is specified in the clause on test conditions for that particular test.	
5.4.1, item m).	The operational environmental profile (e.g. the normal test conditions and the extreme test conditions) that applies to the equipment.	

For 802.11a mode the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually, but not simultaneously.

For 802.11n20, 802.11ax20 (20 MHz channel bandwidth), 802.11n40, 802.11ax40 (40MHz channel bandwidth), 802.11ac80, 802.11ax80 (80MHz channel bandwidth) and 802.11ac160, 802.11ax160 (160 MHz channel bandwidth) modes the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually, and also simultaneously.

The conducted RF output power at each chain 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 calibrated average power meter. Measured values for adjustment were within -0.25 dB/+0.25 dB from the declared Target values.

					Conducted Power Target Value (dBm)		
Mode	BW (MHz)	Data Rate	CH #	Freq. (MHz)	SISO Chain A	SISO Chain B	MIMO at both ports A and B
802.11a	20	6Mbps	36	5180	16.5	16.5	-
			64	5320	16.5	16.5	-
802.11n	20	HT0 HT8*	36	5180	17.0	16.5	17.0
			64	5320	17.0	17.0	17.0
	40	HT0 HT8*	38F	5190	17.5	17.5	17.5
			62F	5310	17.5	17.5	17.5
802.11ac80	80	VHT0	42	5210	17.5	17.5	17.5
			58	5290	17.5	17.5	17.5
802.11ac160	160	VHT0	50	5250	17.5	17.5	17.5
802.11ax	20	HE0	36	5180	17.0	17.5	17.0
			64	5320	17.0	17.0	17.0
	40		38F	5190	17.5	17.5	17.5
			62F	5310	17.5	17.5	17.5
	80		42	5210	17.5	17.5	17.5
			58	5290	17.5	17.5	17.5
	160		50	5250	17.5	17.5	17.5

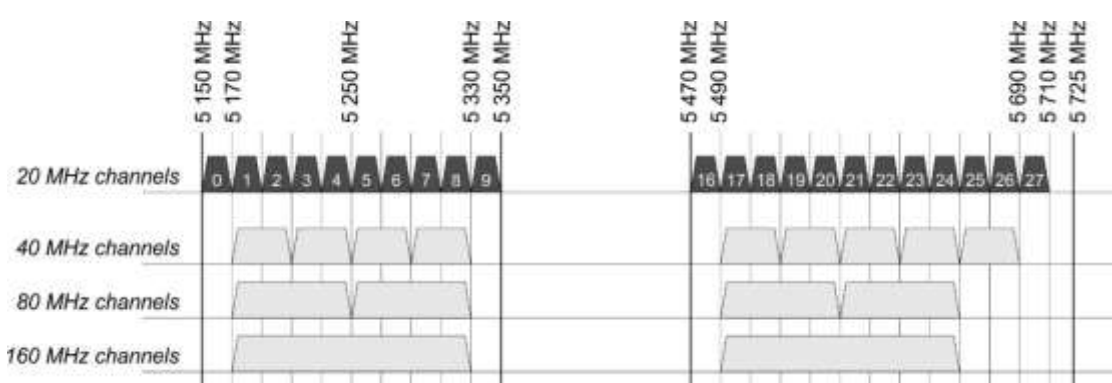
* Note: HT8 for MIMO modes only.

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
802.11n20 and 802.11n40 (MIMO) → HT8
802.11ax20 and 802.11ax40 (SISO) → HE0
802.11ax20 and 802.11ax40 (MIMO) → HE0
802.11ac80 (SISO) → VHT0. 802.11ax80 (SISO) → HE0
802.11ac80 (MIMO) → VHT0. 802.11ax80 (MIMO) → HE0
802.11ac160 (SISO) → VHT0. 802.11ax160 (SISO) → HE0
802.11ac160 (MIMO) → VHT0. 802.11ax160 (MIMO) → HE0

B.2 Centre frequencies

Test limits

ETSI part	Limits
4.2.1.3	The Nominal Centre Frequencies (f_c) for a Nominal Channel Bandwidth of 20 MHz are defined by equation (1). See also figure 3. $f_c = 5\,160 + (g \times 20)$ MHz, where $0 \leq g \leq 9$ or $16 \leq g \leq 27$ and where g shall be an integer. (1)  Figure 3 A maximum offset of the Nominal Centre Frequency of ± 200 kHz is permitted. Where the manufacturer decides to make use of this frequency offset, the manufacturer shall declare the actual centre frequencies used by the equipment. See clause 5.4.1, item a). The actual centre frequency for any given channel shall be maintained within the range $f_c \pm 20$ ppm.

Test conditions

ETSI part	Conditions
5.4.2.1	These measurements shall be performed under both normal and extreme test conditions The UUT shall be configured to operate at a normal RF Output Power level. In addition, the UUT shall be configured to operate on a single channel.

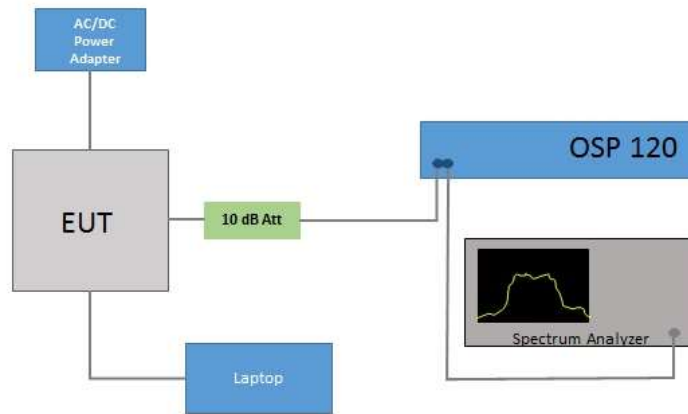
Test procedure

The setup below was used to measure the center frequency accordingly to the test procedure described in EN 301 893 V2.1.1. The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on measured parameters.

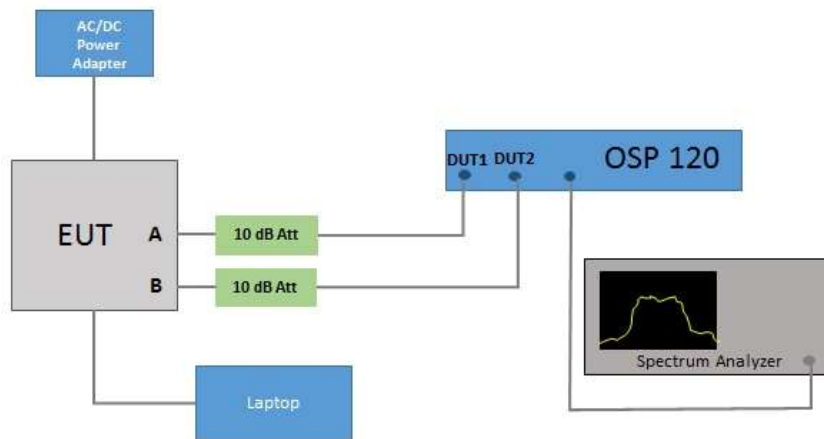
For MIMO transmission modes, measurements are taken from chain A on the EUT.

The declared maximum antenna gain is +5dBi.

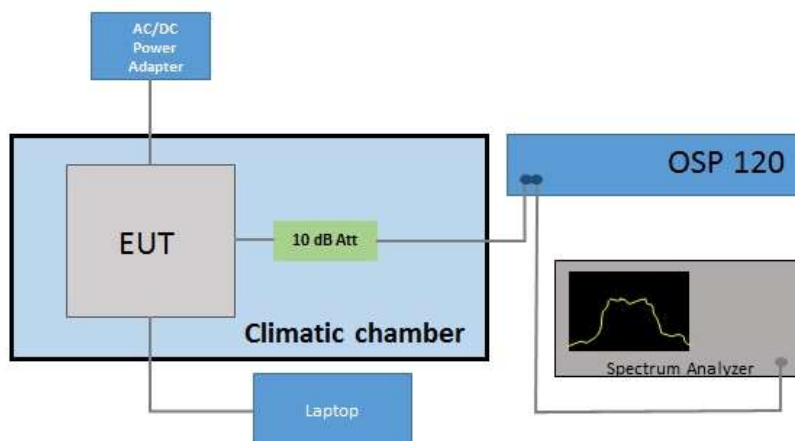
Conducted Setup (Normal Conditions)



Conducted Setup (MIMO Measurements)



Conducted Setup (Extreme conditions)



Results tables

Normal conditions

Temperature: 23 ± 2°C
Humidity: 54% ± 20%
Antenna gain: +5dBi

Mode	Rate	CH	Freq. [MHz]	Antenna	Centre frequency [MHz]	Deviation [ppm]
802.11a	6Mbps	36	5180	SISO CHAIN A	5180.02000	3.089
				SISO CHAIN B	5180.00900	1.737
802.11n20	HT0	36	5180	SISO CHAIN A	5180.01300	2.509
				SISO CHAIN B	5180.00900	1.737
	HT8	36	5180	MIMO	5180.00700	1.351
802.11n40	HT0	38F	5190	SISO CHAIN A	5190.01000	1.927
				SISO CHAIN B	5190.00400	0.771
	HT8	38F	5190	MIMO	5190.02600	5.009
802.11ac80	VHT0	42	5210	SISO CHAIN A	5210.02000	3.838
				SISO CHAIN B	5210.00000	0.000
	VHT0	42	5210	MIMO	5210.04000	7.677
802.11ac160	VHT0	50	5250	SISO CHAIN A	5250.00800	1.524
				SISO CHAIN B	5250.00800	1.524
	VHT0	50	5250	MIMO	5249.96000	7.618
802.11ax20	HE0	36	5180	SISO CHAIN A	5180.00800	1.544
				SISO CHAIN B	5180.01100	2.123
		36	5180	MIMO	5180.00300	0.579
802.11ax40		38F	5190	SISO CHAIN A	5190.00200	0.385
				SISO CHAIN B	5190.00800	1.541
		38F	5190	MIMO	5190.02506	4.828
802.11ax80		42	5210	SISO CHAIN A	5210.03200	6.141
				SISO CHAIN B	5210.00800	1.535
		42	5210	MIMO	5210.10399	19.960
802.11ax160		50	5250	SISO CHAIN A	5250.00800	1.524
				SISO CHAIN B	5250.00800	1.524
		50	5250	MIMO	5250.03200	6.095

Extreme conditions temperature ($T_{max} = +70^{\circ}\text{C}$ for SISO and $T_{max} = +60^{\circ}\text{C}$ for MIMO)

Mode	Rate	CH	Freq. [MHz]	Antenna	Centre frequency [MHz]	Deviation [ppm]
802.11a	6Mbps	36	5180	SISO CHAIN A	5179.98700	2.509
				SISO CHAIN B	5180.03400	6.563
802.11n20	HT0	36	5180	SISO CHAIN A	5180.08799	16.987
				SISO CHAIN B	5180.04000	7.910
	HT8	36	5180	MIMO*	5180.06299	12.160
802.11n40	HT0	38F	5190	SISO CHAIN A	5190.08305	16.002
				SISO CHAIN B	5190.03600	6.936
	HT8	38F	5190	MIMO*	5189.98600	2.697
802.11ac80	VHT0	42	5210	SISO CHAIN A	5210.07811	14.993
				SISO CHAIN B	5210.02000	3.838
	VHT0	42	5210	MIMO*	5209.99200	1.535
802.11ac160	VHT0	50	5250	SISO CHAIN A	5249.97600	4.571
				SISO CHAIN B	5250.00800	1.524
	VHT0	50	5250	MIMO*	5249.99200	1.524
802.11ax20	HE0	36	5180	SISO CHAIN A	5180.01000	1.544
				SISO CHAIN B	5180.07000	13.035
		36	5180	MIMO*	5180.07452	14.387
802.11ax40		38F	5190	SISO CHAIN A	5190.02000	4.624
				SISO CHAIN B	5190.00000	0.385
		38F	5190	MIMO*	5190.08905	17.158
802.11ax80		42	5210	SISO CHAIN A	5209.99000	1.535
				SISO CHAIN B	5210.02000	3.071
		42	5210	MIMO*	5210.06799	13.050
802.11ax160		50	5250	SISO CHAIN A	5249.99200	1.524
				SISO CHAIN B	5250.02000	3.047
		50	5250	MIMO*	5250.00800	1.524

*Test executed at +60°C as per manufacturer declaration

Extreme conditions temperature ($T_{min} = -10^{\circ}\text{C}$)

Mode	Rate	CH	Freq. [MHz]	Antenna	Centre frequency [MHz]	Deviation [ppm]
802.11a	6Mbps	36	5180	SISO CHAIN A	5180.02300	4.440
				SISO CHAIN B	5180.02000	3.861
802.11n20	HT0	36	5180	SISO CHAIN A	5180.01600	3.089
				SISO CHAIN B	5180.01200	2.316
	HT8	36	5180	MIMO	5180.01300	2.509
802.11n40	HT0	38F	5190	SISO CHAIN A	5190.01200	2.312
				SISO CHAIN B	5190.00800	1.541
	HT8	38F	5190	MIMO	5190.00400	0.771
802.11ac80	VHT0	42	5210	SISO CHAIN A	5210.02400	4.606
				SISO CHAIN B	5210.01200	2.303
	VHT0	42	5210	MIMO	5210.01600	3.071
802.11ac160	VHT0	50	5250	SISO CHAIN A	5250.02400	4.571
				SISO CHAIN B	5250.02400	4.571
	VHT0	50	5250	MIMO	5250.02400	4.571
802.11ax20	HE0	36	5180	SISO CHAIN A	5180.01900	3.668
				SISO CHAIN B	5180.01600	3.089
		36	5180	MIMO	5180.01000	1.930
802.11ax40		38F	5190	SISO CHAIN A	5190.02400	4.624
				SISO CHAIN B	5190.01600	3.083
		38F	5190	MIMO	5189.99000	1.927
802.11ax80		42	5210	SISO CHAIN A	5210.04800	9.212
				SISO CHAIN B	5209.99200	1.535
		42	5210	MIMO	5209.98000	3.838
802.11ax160		50	5250	SISO CHAIN A	5250.02400	4.571
				SISO CHAIN B	5250.04000	7.618
		50	5250	MIMO	5250.01600	3.047

B.3 Occupied Channel Bandwidth

Test limits

ETSI part	Limits
4.2.2.2	The Nominal Channel Bandwidth for a single Operating Channel shall be 20 MHz. Alternatively, equipment may implement a lower Nominal Channel Bandwidth with a minimum of 5 MHz, providing they still comply with the Nominal Centre Frequencies defined in clause 4.2.1 (20 MHz raster). The Occupied Channel Bandwidth shall be between 80 % and 100 % of the Nominal Channel Bandwidth. In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement. The Occupied Channel Bandwidth might change with time/payload. During a Channel Occupancy Time (COT), equipment may operate temporarily with an Occupied Channel Bandwidth of less than 80 % of its Nominal Channel Bandwidth with a minimum of 2 MHz.

Test conditions

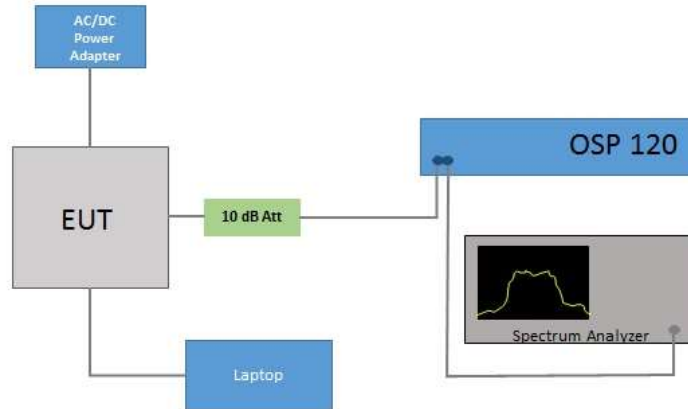
ETSI part	Conditions
5.4.3.1	The conformance requirements in clause 4.2.2 shall be verified only under normal operating conditions, and on those channels and channel bandwidths defined in clause 5.3.2. The measurements shall be performed using normal operation of the equipment with the test signal applied (see clause 5.3.1.1). The UUT shall be configured to operate at a typical RF power output level used for normal operation. When equipment has simultaneous transmissions in adjacent channels, these transmissions may be considered as one signal with an actual <i>Nominal Channel Bandwidth</i> of "n" times the individual <i>Nominal Channel Bandwidth</i> where "n" is the number of adjacent channels. When equipment has simultaneous transmissions in non-adjacent channels, each power envelope shall be considered separately.

Test procedure

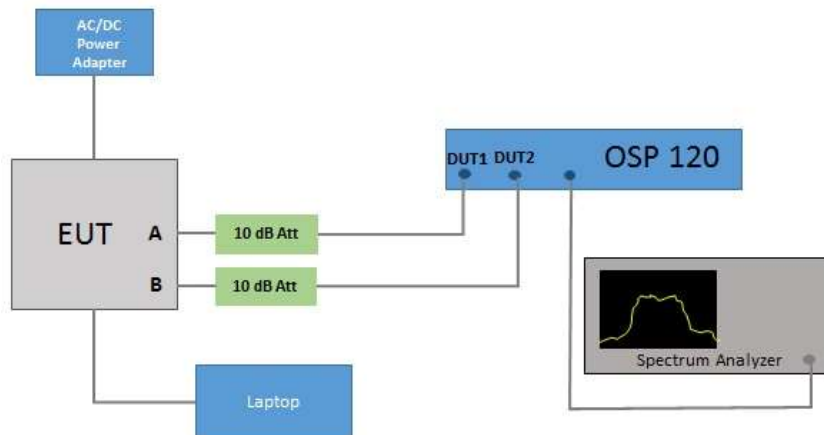
The setup below was used to measure the occupied channel bandwidth accordingly to the test procedure described in EN 301 893 V2.1.1. The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on measured parameters.

For MIMO transmission mode measurements are taken from chain A on the EUT.

Conducted Setup (Normal Conditions)



Conducted Setup (MIMO Measurements)



Results tables

						OBW limits [MHz]	
Mode	Rate	CH	Freq. [MHz]	Antenna	Measured OBW [MHz]	Min OBW 80%	Max OBW 100%
802.11a	6Mbps	36	5180	SISO CHAIN A	16.50	16.00	20.00
				SISO CHAIN B	16.60	16.00	20.00
802.11n20	HT0	36	5180	SISO CHAIN A	17.70	16.00	20.00
				SISO CHAIN B	17.70	16.00	20.00
	HT8	36	5180	MIMO	17.70	16.00	20.00
802.11n40	HT0	38F	5190	SISO CHAIN A	36.40	32.00	40.00
				SISO CHAIN B	36.30	32.00	40.00
	HT8	38F	5190	MIMO	36.30	32.00	40.00
802.11ac80	VHT0	42	5210	SISO CHAIN A	75.40	64.00	80.00
				SISO CHAIN B	75.50	64.00	80.00
	VHT0	42	5210	MIMO	75.10	64.00	80.00
802.11ac160	VHT0	50	5250	SISO CHAIN A	155.90	128.00	160.00
				SISO CHAIN B	154.70	128.00	160.00
	VHT0	50	5250	MIMO	153.50	128.00	160.00
802.11ax20	HE0	36	5180	SISO CHAIN A	18.90	16.00	20.00
				SISO CHAIN B	19.10	16.00	20.00
		36	5180	MIMO	18.90	16.00	20.00
802.11ax40				38F	5190	SISO CHAIN A	37.90
		SISO CHAIN B	37.90			32.00	40.00
		38F	5190	MIMO	37.80	32.00	40.00
802.11ax80		42	5210	SISO CHAIN A	76.80	64.00	80.00
				SISO CHAIN B	76.90	64.00	80.00
		42	5210	MIMO	76.60	64.00	80.00
802.11ax160		50	5250	SISO CHAIN A	155.90	128.00	160.00
				SISO CHAIN B	158.40	128.00	160.00
		50	5250	MIMO	154.80	128.00	160.00

B.4 RF Output Power at the highest power

Test limits

ETSI part	Limits																			
4.2.3.2.1	TPC is not required for channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz. For devices with TPC, the RF output power and the Power Density when configured to operate at the highest stated power level (P_H) of the TPC range shall not exceed the levels given in table 2. Devices are allowed to operate without TPC. See table 2 for the applicable limits that shall apply in this case.																			
	Table 2: Mean e.i.r.p. limits for RF output and Power Density at the highest power level (P_H)																			
	<table><tr><th rowspan="2">Frequency range [MHz]</th><th colspan="2">Mean e.i.r.p. limit for P_H [dBm]</th><th colspan="2">Mean e.i.r.p. density limit [dBm/MHz]</th></tr><tr><th>With TPC</th><th>Without TPC</th><th>With TPC</th><th>Without TPC</th></tr><tr><td>5 150 to 5 350</td><td>23</td><td>20/23 (see note 1)</td><td>10</td><td>7/10 (see note 2)</td></tr><tr><td>5 470 to 5 725</td><td>30 (see note 3)</td><td>27 (see note 3)</td><td>17 (see note 3)</td><td>14 (see note 3)</td></tr></table>	Frequency range [MHz]	Mean e.i.r.p. limit for P_H [dBm]		Mean e.i.r.p. density limit [dBm/MHz]		With TPC	Without TPC	With TPC	Without TPC	5 150 to 5 350	23	20/23 (see note 1)	10	7/10 (see note 2)	5 470 to 5 725	30 (see note 3)	27 (see note 3)	17 (see note 3)	14 (see note 3)
	Frequency range [MHz]		Mean e.i.r.p. limit for P_H [dBm]		Mean e.i.r.p. density limit [dBm/MHz]															
		With TPC	Without TPC	With TPC	Without TPC															
	5 150 to 5 350	23	20/23 (see note 1)	10	7/10 (see note 2)															
	5 470 to 5 725	30 (see note 3)	27 (see note 3)	17 (see note 3)	14 (see note 3)															
NOTE 1:	The applicable limit is 20 dBm, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 23 dBm.																			
NOTE 2:	The applicable limit is 7 dBm/MHz, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 10 dBm/MHz.																			
NOTE 3:	Slave devices without a Radar Interference Detection function shall comply with the limits for the frequency range 5 250 MHz to 5 350 MHz.																			

Test conditions

ETSI part	Conditions
5.4.4.2.1.1.1	These measurements shall be performed under both normal and extreme test conditions The UUT shall be configured to operate at: - the highest stated transmitter output power level of the TPC range; or - the maximum stated transmitter output power level in case the equipment has no TPC feature.

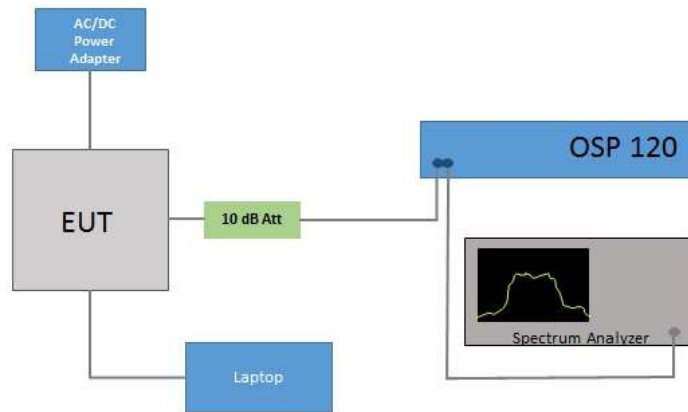
Test procedure

The setup below was used to measure the RF output power at the highest power. The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on the measured parameters.

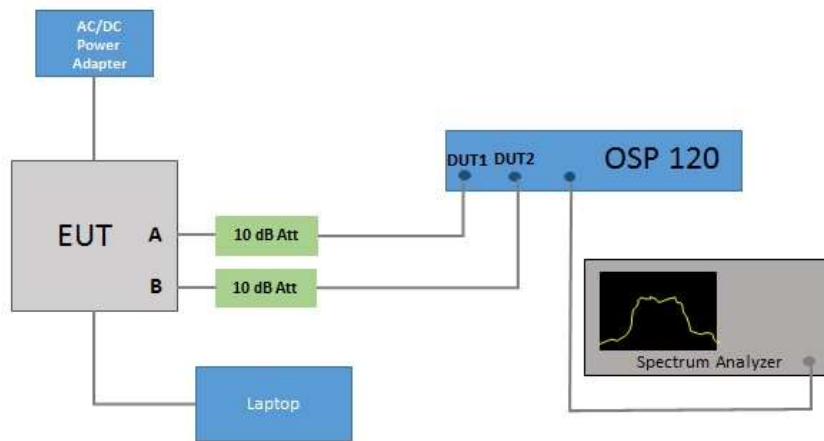
Antenna gain is taken in count and added by the software to the measurements. The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power. The declared maximum antenna gain is +5dBi.

According to the test procedure described in EN 301 893 V2.1.1, the measurement for MIMO modes is done synchronously on all transmit ports, the power of the individual samples is sum for all ports and then the reported power is the highest calculated RMS power for the active bursts.

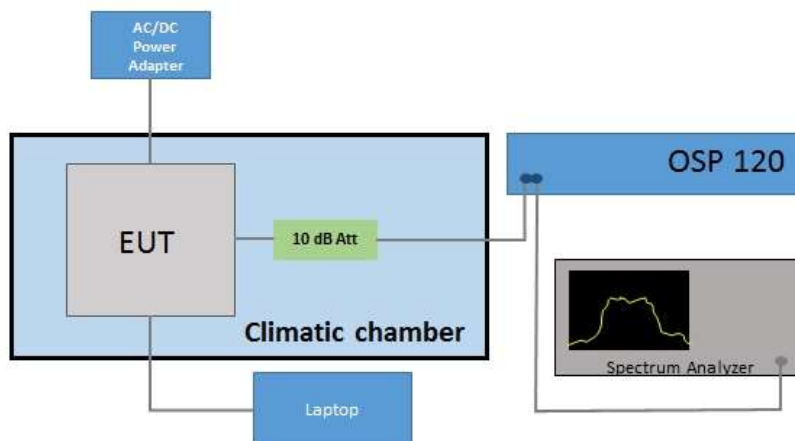
Conducted Setup (Normal Conditions)



Conducted Setup (MIMO Measurements)



Conducted Setup (Extreme conditions)



Results tables

Normal conditions

Temperature: $23 \pm 2^{\circ}\text{C}$
 Humidity: $54\% \pm 20\%$
 Antenna gain: +5dBi

Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Power [dBm]	
						Measured Conducted	EIRP
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	16.47	21.47
					SISO CHAIN B	16.53	21.53
			64	5320	SISO CHAIN A	16.39	21.39
					SISO CHAIN B	16.41	21.41
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	17.20	22.20
					SISO CHAIN B	16.67	21.67
			64	5320	SISO CHAIN A	16.80	21.80
					SISO CHAIN B	16.95	21.95
	HT8	98.65	36	5180	MIMO	17.05	22.05
			64	5320	MIMO	16.78	21.78
802.11n40	HT0	98.74	38F	5190	SISO CHAIN A	17.49	22.49
					SISO CHAIN B	17.57	22.57
			62F	5310	SISO CHAIN A	17.61	22.61
					SISO CHAIN B	17.60	22.60
	HT8	98.73	38F	5190	MIMO	17.42	22.42
			62F	5310	MIMO	17.42	22.42
802.11ac80	VHT0	98.66	42	5210	SISO CHAIN A	17.56	22.56
					SISO CHAIN B	17.51	22.51
			58	5290	SISO CHAIN A	17.48	22.48
					SISO CHAIN B	17.36	22.36
	VHT0	98.60	42	5210	MIMO	17.62	22.62
			58	5290	MIMO	17.45	22.45
802.11ac160	VHT0	98.66	50	5250	SISO CHAIN A	17.60	22.60
					SISO CHAIN B	17.66	22.66
	VHT0	98.19	50	5250	MIMO	17.66	22.66

						Power [dBm]		
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP	
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	17.20	22.20	
					SISO CHAIN B	17.48	22.48	
			64	5320	SISO CHAIN A	17.19	22.19	
					SISO CHAIN B	17.19	22.19	
		98.67	36	5180	MIMO	17.20	22.20	
			64	5320	MIMO	17.10	22.10	
802.11ax40		98.86	38F	5190	SISO CHAIN A	17.42	22.42	
					SISO CHAIN B	17.52	22.52	
			62F	5310	SISO CHAIN A	17.47	22.47	
					SISO CHAIN B	17.60	22.60	
			98.73	38F	5190	MIMO	17.60	22.60
				62F	5310	MIMO	17.70	22.70
802.11ax80	98.66	42	5210	SISO CHAIN A	17.53	22.53		
				SISO CHAIN B	17.54	22.54		
		58	5290	SISO CHAIN A	17.64	22.64		
				SISO CHAIN B	17.58	22.58		
		98.67	42	5210	MIMO	17.47	22.47	
			58	5290	MIMO	17.70	22.70	
802.11ax160	98.66	50	5250	SISO CHAIN A	17.60	22.60		
				SISO CHAIN B	17.66	22.66		
		98.02	50	5250	MIMO	17.51	22.51	

Extreme conditions temperature ($T_{max} = +70^{\circ}\text{C}$ for SISO and $T_{max} = +60^{\circ}\text{C}$ for MIMO)

Antenna gain: +5dBi

						Power [dBm]	
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	16.70	21.70
					SISO CHAIN B	16.45	21.45
			64	5320	SISO CHAIN A	16.60	21.60
					SISO CHAIN B	16.42	21.42
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	16.61	21.61
					SISO CHAIN B	16.13	21.13
			64	5320	SISO CHAIN A	16.46	21.46
					SISO CHAIN B	16.13	21.13
	HT8	98.65	36	5180	MIMO*	16.85	21.85
			64	5320	MIMO*	16.89	21.89
802.11n40	HT0	98.74	38F	5190	SISO CHAIN A	17.25	22.25
					SISO CHAIN B	16.68	21.68
			62F	5310	SISO CHAIN A	17.50	22.50
					SISO CHAIN B	16.81	21.81
	HT8	98.73	38F	5190	MIMO*	17.20	22.20
			62F	5310	MIMO*	17.30	22.30
802.11ac80	VHT0	98.66	42	5210	SISO CHAIN A	17.51	22.51
					SISO CHAIN B	16.98	21.98
			58	5290	SISO CHAIN A	17.41	22.41
					SISO CHAIN B	17.29	22.29
	VHT0	98.60	42	5210	MIMO*	17.70	22.70
			58	5290	MIMO*	17.90	22.90
802.11ac160	VHT0	98.66	50	5250	SISO CHAIN A	17.91	22.91
					SISO CHAIN B	17.74	22.74
	VHT0	98.19	50	5250	MIMO*	18.00	23.00

*Test executed at +60°C as per manufacturer declaration

						Power [dBm]		
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP	
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	17.30	22.30	
					SISO CHAIN B	17.75	22.75	
			64	5320	SISO CHAIN A	17.24	22.24	
					SISO CHAIN B	17.98	22.98	
		98.67	36	5180	MIMO*	17.18	22.18	
			64	5320	MIMO*	17.14	22.14	
802.11ax40		98.86	38F	5190	SISO CHAIN A	17.67	22.67	
					SISO CHAIN B	18.00	23.00	
			62F	5310	SISO CHAIN A	17.88	22.88	
					SISO CHAIN B	17.90	22.90	
		98.73	38F	5190	MIMO*	17.98	22.98	
			62F	5310	MIMO*	17.98	22.98	
802.11ax80		98.66	42	5210	SISO CHAIN A	17.88	22.88	
					SISO CHAIN B	17.81	22.81	
			58	5290	SISO CHAIN A	17.86	22.86	
					SISO CHAIN B	17.80	22.80	
			98.67	42	5210	MIMO*	17.15	22.15
				58	5290	MIMO*	17.54	22.54
802.11ax160	98.66	50	5250	SISO CHAIN A	17.91	22.91		
				SISO CHAIN B	18.00	23.00		
		98.02	50	5250	MIMO*	17.40	22.40	

*Test executed at +60°C as per manufacturer declaration

Extreme conditions temperature ($T_{min} = -10^{\circ}\text{C}$)

Antenna gain: +5dBi

						Power [dBm]	
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	17.60	22.60
					SISO CHAIN B	18.00	23.00
			64	5320	SISO CHAIN A	17.60	22.60
					SISO CHAIN B	17.90	22.90
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	17.70	22.70
					SISO CHAIN B	18.00	23.00
			64	5320	SISO CHAIN A	17.40	22.40
					SISO CHAIN B	17.90	22.90
	HT8	98.65	36	5180	MIMO	17.30	22.30
			64	5320	MIMO	17.10	22.10
802.11n40	HT0	98.74	38F	5190	SISO CHAIN A	17.89	22.89
					SISO CHAIN B	17.56	22.56
			62F	5310	SISO CHAIN A	17.96	22.96
					SISO CHAIN B	17.51	22.51
	HT8	98.73	38F	5190	MIMO	17.50	22.50
			62F	5310	MIMO	17.40	22.40
802.11ac80	VHT0	98.66	42	5210	SISO CHAIN A	17.92	22.92
					SISO CHAIN B	17.59	22.59
			58	5290	SISO CHAIN A	17.98	22.98
					SISO CHAIN B	17.65	22.65
	VHT0	98.60	42	5210	MIMO	17.90	22.90
			58	5290	MIMO	17.90	22.90
802.11ac160	VHT0	98.66	50	5250	SISO CHAIN A	17.98	22.98
					SISO CHAIN B	17.65	22.65
	VHT0	98.19	50	5250	MIMO	18.00	23.00

						Power [dBm]			
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP		
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	17.86	22.86		
					SISO CHAIN B	17.81	22.81		
			64	5320	SISO CHAIN A	18.00	23.00		
					SISO CHAIN B	17.65	22.65		
		98.67	36	5180	MIMO	17.50	22.50		
					64	5320	MIMO	17.50	22.50
802.11ax40		98.86	38F	5190	SISO CHAIN A	17.81	22.81		
					SISO CHAIN B	17.85	22.85		
			62F	5310	SISO CHAIN A	17.89	22.89		
					SISO CHAIN B	17.94	22.94		
		98.73	38F	5190	MIMO	18.00	23.00		
					62F	5310	MIMO	18.00	23.00
802.11ax80		98.66	42	5210	SISO CHAIN A	17.88	22.88		
					SISO CHAIN B	17.87	22.87		
					58	5290	SISO CHAIN A	17.81	22.81
							SISO CHAIN B	17.93	22.93
			98.67	42	5210	MIMO	17.90	22.90	
						58	5290	MIMO	18.00
802.11ax160	98.66	50	5250	SISO CHAIN A	17.89	22.89			
				SISO CHAIN B	17.76	22.76			
		98.02	50	5250	MIMO	17.90	22.90		

B.5 RF Output Power at the lowest level of the TPC range

Test limits

ETSI part	Limits								
4.2.3.2.3	For devices using TPC, the RF Output Power during a transmission burst when configured to operate at the lowest stated power level (PL) of the TPC range shall not exceed the levels given in table 3. For devices without TPC, the limits in table 3 do not apply. Table 3: Mean e.i.r.p. limits for RF Output Power at the lowest power level of the TPC range <table> <tr> <th>Frequency range</th><th>Mean e.i.r.p. [dBm]</th></tr> <tr> <td>5 250 MHz to 5 350 MHz</td><td>17</td></tr> <tr> <td>5 470 MHz to 5 725 MHz</td><td>24 (see note)</td></tr> <tr> <td colspan="2">NOTE: Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHz to 5 350 MHz.</td></tr> </table>	Frequency range	Mean e.i.r.p. [dBm]	5 250 MHz to 5 350 MHz	17	5 470 MHz to 5 725 MHz	24 (see note)	NOTE: Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHz to 5 350 MHz.	
Frequency range	Mean e.i.r.p. [dBm]								
5 250 MHz to 5 350 MHz	17								
5 470 MHz to 5 725 MHz	24 (see note)								
NOTE: Slave devices without a Radar Interference Detection function shall comply with the limits for the band 5 250 MHz to 5 350 MHz.									

Test conditions

ETSI part	Conditions
5.4.4.2.1.2.1	This test is only required for equipment with a TPC feature. These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.3). The UUT shall be configured to operate at the lowest stated transmitter output power level of the TPC range.

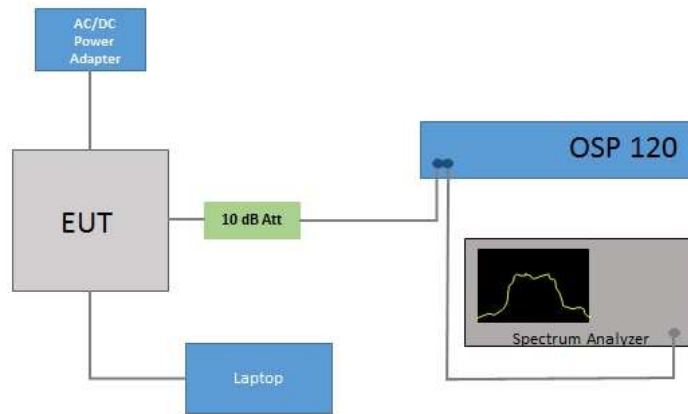
Test procedure

The setup below was used to measure the RF output power at the lowest level of the TPC. The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on the measured parameters.

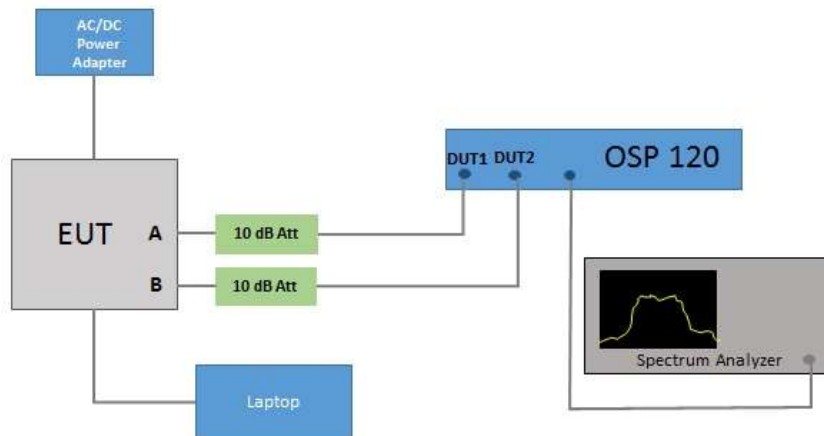
Antenna gain is taken in count and added by the software to the measurements. The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power. The declared maximum antenna gain is +5dBi.

According to the test procedure described in EN 301 893 V2.1.1, the measurement for MIMO modes is done synchronously on all transmit ports, the power of the individual samples is sum for all ports and then the reported power is the highest calculated RMS power for the active bursts.

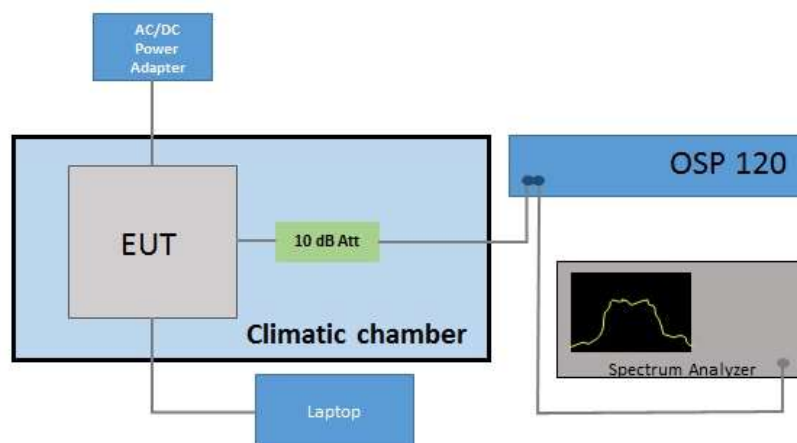
Conducted Setup (Normal Conditions)



Conducted Setup (MIMO Measurements)



Conducted Setup (Extreme conditions)



Results tables

Normal conditions

Temperature: $23 \pm 2^{\circ}\text{C}$
 Humidity: $54\% \pm 20\%$
 Antenna gain: +5dBi

Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Power [dBm]	
						Measured Conducted	EIRP
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			64	5320	SISO CHAIN A	10.55	15.55
					SISO CHAIN B	10.51	15.51
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			64	5320	SISO CHAIN A	10.92	15.92
					SISO CHAIN B	10.97	15.97
	HT8	98.65	36	5180	MIMO	--	--
			64	5320	MIMO	11.20	16.20
802.11n40	HT0	98.74	38F	5190	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			62F	5310	SISO CHAIN A	11.33	16.33
					SISO CHAIN B	11.18	16.18
	HT8	98.73	38F	5190	MIMO	--	--
			62F	5310	MIMO	11.70	16.70
802.11ac80	VHT0	98.66	42	5210	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			58	5290	SISO CHAIN A	11.37	16.37
					SISO CHAIN B	11.38	16.38
	VHT0	98.60	42	5210	MIMO	--	--
			58	5290	MIMO	11.20	16.20
802.11ac160	VHT0	98.66	50	5250	SISO CHAIN A	11.61	16.61
					SISO CHAIN B	11.52	16.52
	VHT0	98.19	50	5250	MIMO	11.50	16.50

						Power [dBm]		
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP	
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	--	--	
					SISO CHAIN B	--	--	
			64	5320	SISO CHAIN A	11.27	16.27	
					SISO CHAIN B	11.34	16.34	
		98.67	36	5180	MIMO	--	--	
			64	5320	MIMO	10.85	15.85	
802.11ax40		98.86	38F	5190	SISO CHAIN A	--	--	
					SISO CHAIN B	--	--	
			62F	5310	SISO CHAIN A	11.05	16.05	
					SISO CHAIN B	10.79	15.79	
			98.73	38F	5190	MIMO	--	--
				62F	5310	MIMO	11.52	16.52
802.11ax80	98.66		42	5210	SISO CHAIN A	--	--	
					SISO CHAIN B	--	--	
		58	5290	SISO CHAIN A	11.74	16.74		
				SISO CHAIN B	11.36	16.36		
		98.67	42	5210	MIMO	--	--	
			58	5290	MIMO	11.26	16.26	
802.11ax160	98.66	50	5250	SISO CHAIN A	10.62	15.62		
				SISO CHAIN B	10.97	15.97		
		98.02	50	5250	MIMO	11.30	16.30	

Extreme conditions temperature ($T_{max} = +70^{\circ}\text{C}$ for SISO and $T_{max} = +60^{\circ}\text{C}$ for MIMO)

Antenna gain: +5dBi

						Power [dBm]	
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			64	5320	SISO CHAIN A	11.90	16.90
					SISO CHAIN B	12.00	17.00
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			64	5320	SISO CHAIN A	11.90	16.90
					SISO CHAIN B	11.90	16.90
	HT8	98.65	36	5180	MIMO*	--	--
			64	5320	MIMO*	11.00	16.00
802.11n40	HT0	98.74	38F	5190	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			62F	5310	SISO CHAIN A	11.96	16.96
					SISO CHAIN B	11.24	16.24
	HT8	98.73	38F	5190	MIMO*	--	--
			62F	5310	MIMO*	11.50	16.50
802.11ac80	VHT0	98.66	42	5210	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			58	5290	SISO CHAIN A	11.94	16.94
					SISO CHAIN B	11.42	16.42
	VHT0	98.60	42	5210	MIMO*	--	--
			58	5290	MIMO*	11.90	16.90
802.11ac160	VHT0	98.66	50	5250	SISO CHAIN A	11.96	16.96
					SISO CHAIN B	11.35	16.35
	VHT0	98.19	50	5250	MIMO*	12.00	17.00

*Test executed at +60°C as per manufacturer declaration

						Power [dBm]			
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP		
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	--	--		
					SISO CHAIN B	--	--		
			64	5320	SISO CHAIN A	11.82	16.82		
					SISO CHAIN B	11.98	16.98		
		98.67	36	5180	MIMO*	--	--		
					64	5320	MIMO*	11.10	16.10
802.11ax40		98.86	38F	5190	SISO CHAIN A	--	--		
					SISO CHAIN B	--	--		
			62F	5310	SISO CHAIN A	11.46	16.46		
					SISO CHAIN B	11.96	16.96		
		98.73	38F	5190	MIMO*	--	--		
					62F	5310	MIMO*	11.60	16.60
802.11ax80		98.66	42	5210	SISO CHAIN A	--	--		
					SISO CHAIN B	--	--		
					58	5290	SISO CHAIN A	11.99	16.99
							SISO CHAIN B	11.78	16.78
			98.67	42	5210	MIMO*	--	--	
						58	5290	MIMO*	11.20
802.11ax160	98.66	50	5250	SISO CHAIN A	11.99	16.99			
				SISO CHAIN B	11.53	16.53			
		98.02	50	5250	MIMO*	11.70	16.70		

*Test executed at +60°C as per manufacturer declaration

Extreme conditions temperature ($T_{max} = -10^{\circ}\text{C}$)

Antenna gain: +5dBi

						Power [dBm]	
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			64	5320	SISO CHAIN A	10.28	15.28
					SISO CHAIN B	10.29	15.29
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			64	5320	SISO CHAIN A	10.56	15.56
					SISO CHAIN B	9.94	14.94
	HT8	98.65	36	5180	MIMO	--	--
			64	5320	MIMO	10.40	15.40
802.11n40	HT0	98.74	38F	5190	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			62F	5310	SISO CHAIN A	11.04	16.04
					SISO CHAIN B	10.25	15.25
	HT8	98.73	38F	5190	MIMO	--	--
			62F	5310	MIMO	11.30	16.30
802.11ac80	VHT0	98.66	42	5210	SISO CHAIN A	--	--
					SISO CHAIN B	--	--
			58	5290	SISO CHAIN A	11.34	16.34
					SISO CHAIN B	11.18	16.18
	VHT0	98.60	42	5210	MIMO	--	--
			58	5290	MIMO	11.90	16.90
802.11ac160	VHT0	98.66	50	5250	SISO CHAIN A	11.62	16.62
					SISO CHAIN B	11.40	16.40
	VHT0	98.19	50	5250	MIMO	12.00	17.00

						Power [dBm]		
Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	Measured Conducted	EIRP	
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	--	--	
					SISO CHAIN B	--	--	
			64	5320	SISO CHAIN A	11.38	16.38	
					SISO CHAIN B	11.48	16.48	
		98.67	36	5180	MIMO	--	--	
			64	5320	MIMO	10.94	15.94	
802.11ax40		98.86	38F	5190	SISO CHAIN A	--	--	
					SISO CHAIN B	--	--	
			62F	5310	SISO CHAIN A	11.48	16.48	
					SISO CHAIN B	11.73	16.73	
		98.73	38F	5190	MIMO	--	--	
			62F	5310	MIMO	11.77	16.77	
802.11ax80		98.66	42	5210	SISO CHAIN A	--	--	
					SISO CHAIN B	--	--	
			58	5290	SISO CHAIN A	11.38	16.38	
					SISO CHAIN B	11.75	16.75	
			98.67	42	5210	MIMO	--	--
				58	5290	MIMO	11.59	16.59
802.11ax160	98.66	50	5250	SISO CHAIN A	11.84	16.84		
				SISO CHAIN B	11.80	16.80		
		98.02	50	5250	MIMO	11.40	16.40	

B.6 Power Density

Test limits

ETSI part	Limits																			
4.2.3.2.1	TPC is not required for channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz. For devices with TPC, the RF output power and the Power Density when configured to operate at the highest stated power level (P_H) of the TPC range shall not exceed the levels given in table 2. Devices are allowed to operate without TPC. See table 2 for the applicable limits that shall apply in this case.																			
	Table 2: Mean e.i.r.p. limits for RF output and Power Density at the highest power level (P_H)																			
	<table><tr><th rowspan="2">Frequency range [MHz]</th><th colspan="2">Mean e.i.r.p. limit for P_H [dBm]</th><th colspan="2">Mean e.i.r.p. density limit [dBm/MHz]</th></tr><tr><th>With TPC</th><th>Without TPC</th><th>With TPC</th><th>Without TPC</th></tr><tr><td>5 150 to 5 350</td><td>23</td><td>20/23 (see note 1)</td><td>10</td><td>7/10 (see note 2)</td></tr><tr><td>5 470 to 5 725</td><td>30 (see note 3)</td><td>27 (see note 3)</td><td>17 (see note 3)</td><td>14 (see note 3)</td></tr></table>	Frequency range [MHz]	Mean e.i.r.p. limit for P_H [dBm]		Mean e.i.r.p. density limit [dBm/MHz]		With TPC	Without TPC	With TPC	Without TPC	5 150 to 5 350	23	20/23 (see note 1)	10	7/10 (see note 2)	5 470 to 5 725	30 (see note 3)	27 (see note 3)	17 (see note 3)	14 (see note 3)
	Frequency range [MHz]		Mean e.i.r.p. limit for P_H [dBm]		Mean e.i.r.p. density limit [dBm/MHz]															
		With TPC	Without TPC	With TPC	Without TPC															
	5 150 to 5 350	23	20/23 (see note 1)	10	7/10 (see note 2)															
	5 470 to 5 725	30 (see note 3)	27 (see note 3)	17 (see note 3)	14 (see note 3)															
NOTE 1:	The applicable limit is 20 dBm, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 23 dBm.																			
NOTE 2:	The applicable limit is 7 dBm/MHz, except for transmissions whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz, in which case the applicable limit is 10 dBm/MHz.																			
NOTE 3:	Slave devices without a Radar Interference Detection function shall comply with the limits for the frequency range 5 250 MHz to 5 350 MHz.																			

Test conditions

ETSI part	Conditions
5.4.4.2.1.3.1	These measurements shall only be performed at normal test conditions (see clause 5.1.2). The UUT shall be configured to operate at the lowest nominal Channel Bandwidth with: - the highest stated transmitter output power level of its TPC range; or - the maximum stated transmitter output power level in case the equipment has no TPC feature.

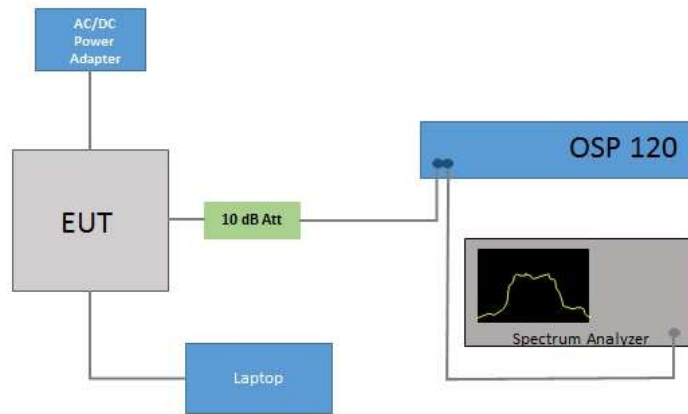
Test procedure

The setup below was used to measure the power spectral density (PSD). The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software to measure all parameters.

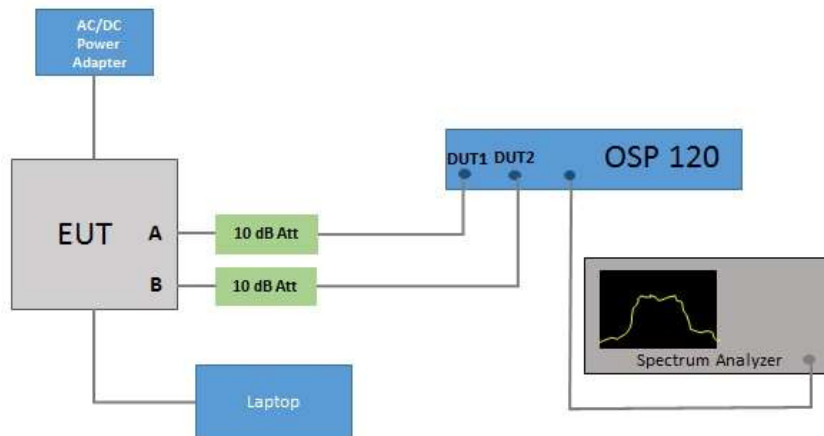
Antenna gain is taken in count and added by the software to the measurements. The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power. The declared maximum antenna gain is +5dBi.

According to the test procedure described in EN 301 893 V2.1.1 the measurement for MIMO modes is done separately on each transmit ports and the power of the individual samples per frequency is sum for all ports. Finally, the software takes the highest PSD among the all the 1MHz calculated segments.

Conducted Setup (Normal Conditions)



Conducted Setup (MIMO Measurements)

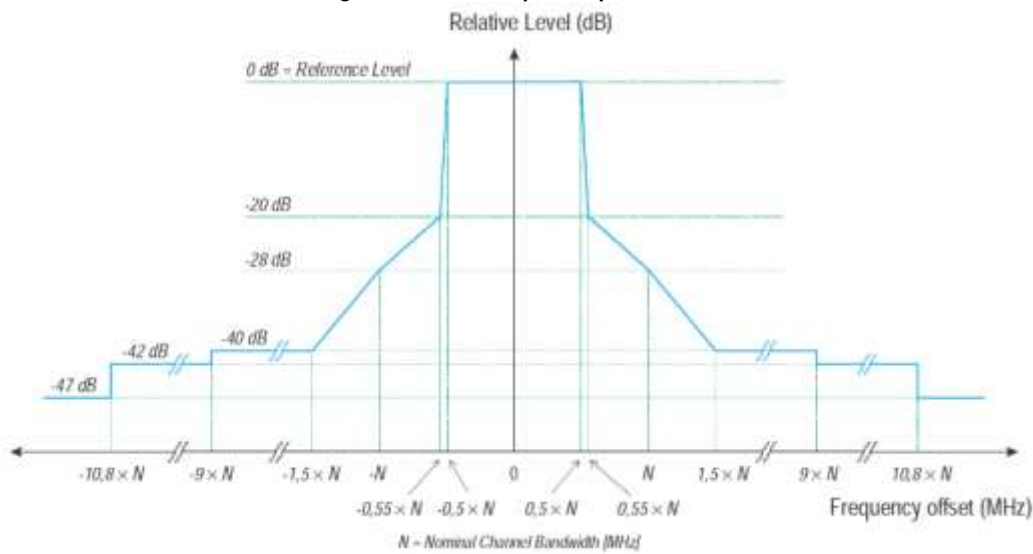


Results tables

Mode	Rate	Meas. Duty Cycle [%]	CH	Freq. [MHz]	Antenna	PSD EIRP [dBm/MHz]
802.11a	6Mbps	97.50	36	5180	SISO CHAIN A	9.74
					SISO CHAIN B	9.88
			64	5320	SISO CHAIN A	9.72
					SISO CHAIN B	9.70
802.11n20	HT0	98.65	36	5180	SISO CHAIN A	9.80
					SISO CHAIN B	9.69
			64	5320	SISO CHAIN A	9.68
					SISO CHAIN B	9.84
	HT8	98.65	36	5180	MIMO	9.85
			64	5320	MIMO	9.72
802.11ax20	HE0	98.67	36	5180	SISO CHAIN A	9.86
					SISO CHAIN B	9.93
			64	5320	SISO CHAIN A	9.81
					SISO CHAIN B	9.79
		98.67	36	5180	MIMO	9.79
			64	5320	MIMO	9.63

B.7 Transmitter unwanted emissions within the 5GHz RLAN bands

Test limits

ETSI part	Limits
4.2.4.2.2	The mean Power Density (measured with a 1 MHz measurement bandwidth) of the transmitter unwanted emissions within the 5 GHz RLAN bands shall not exceed the limits of the mask provided in figure 1 or an absolute level of -30 dBm/MHz, whichever is greater. The limits in figure 1 are relative to the maximum Power Density of the RLAN device when measured with a reference bandwidth of 1 MHz. The mask is only applicable within the band of operation. Beyond the band edges the requirements of clause 4.2.4.1 apply. In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet the limits provided in figure 1. Figure 1. Transmit spectral power mask 

Test conditions

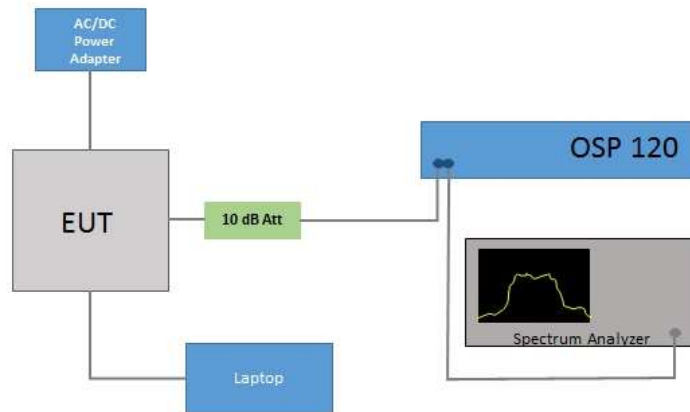
ETSI part	Conditions
5.4.6.1	The conformance requirements in clause 4.2.4.2 shall be verified only under normal operating conditions, and when operating on those channels and channel bandwidths defined in clause 5.3.2. The equipment shall be configured to operate under its worst case situation with respect to unwanted emissions within the 5 GHz RLAN bands. In case of conducted measurements on smart antenna systems (devices with multiple transmit chains) operating in a mode with more than one transmit chain being active simultaneously, measurements shall only be performed on one of the transmit chains (antenna outputs).

Test procedure

The setup below was used to measure the unwanted emissions within the 5GHz WLAN bands (Band Edge). The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on measured parameters.

Antenna gain is taken in count and added by the software to the measurements. The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power. EMC32 provides the mask and the frequency limits based in the measured channel bandwidth. The declared maximum antenna gain is +5dBi. For MIMO transmission mode measurements are taken from chain A on the EUT.

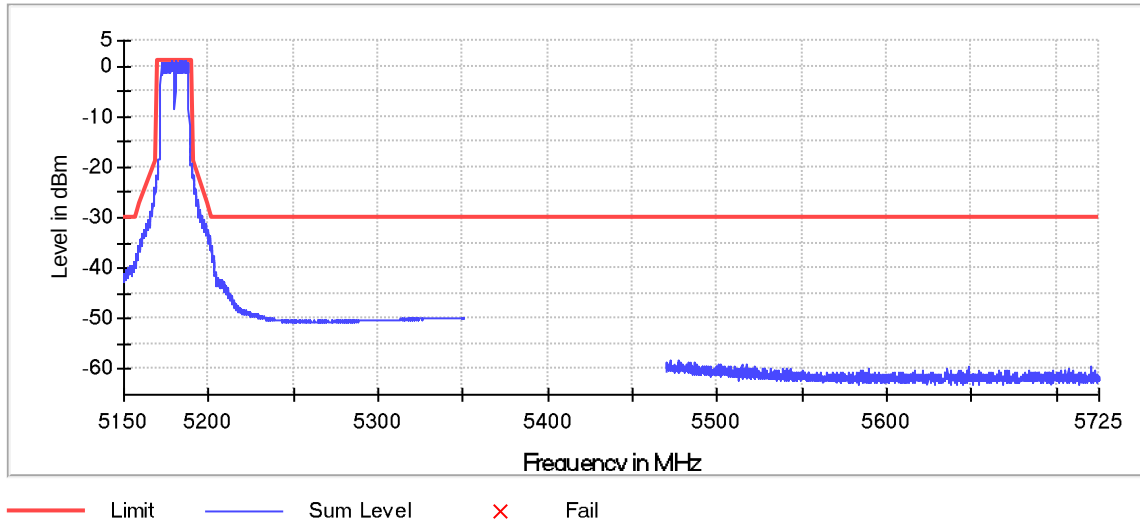
Conducted Setup (Normal Conditions)



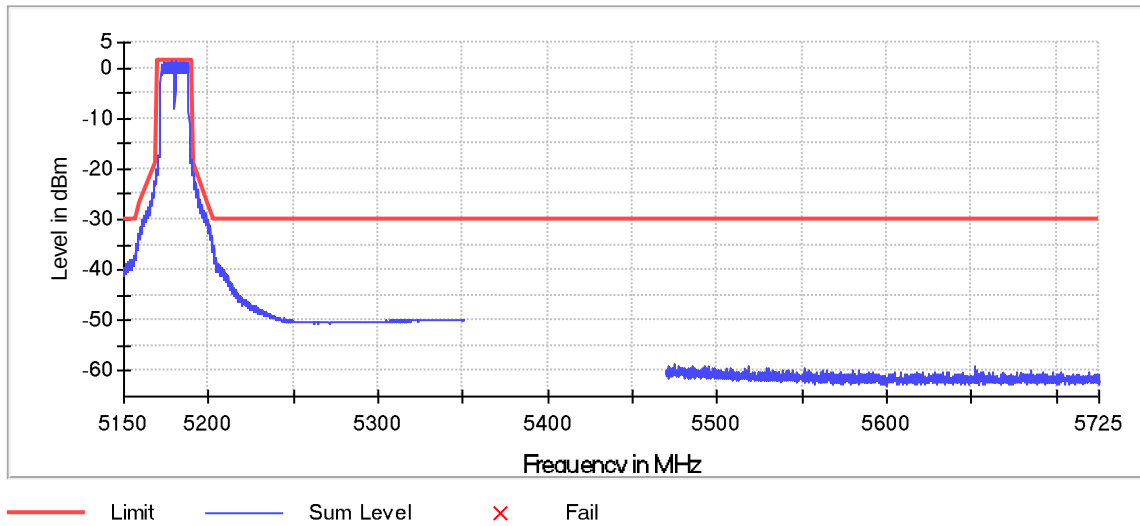
Results Screenshot

802.11a, 6Mbps – Channel 36

Channel 36 – Chain A

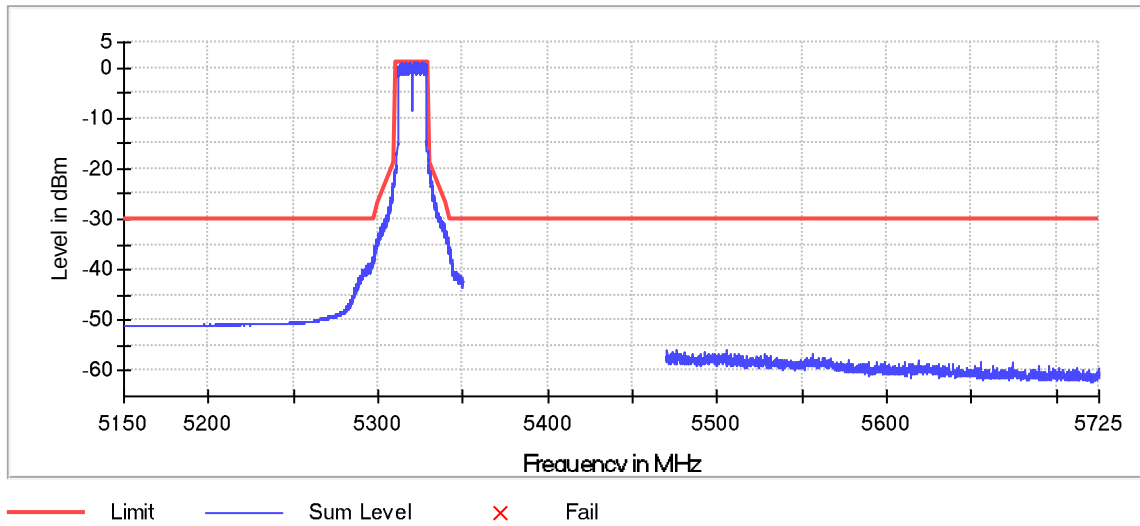


Channel 36 – Chain B

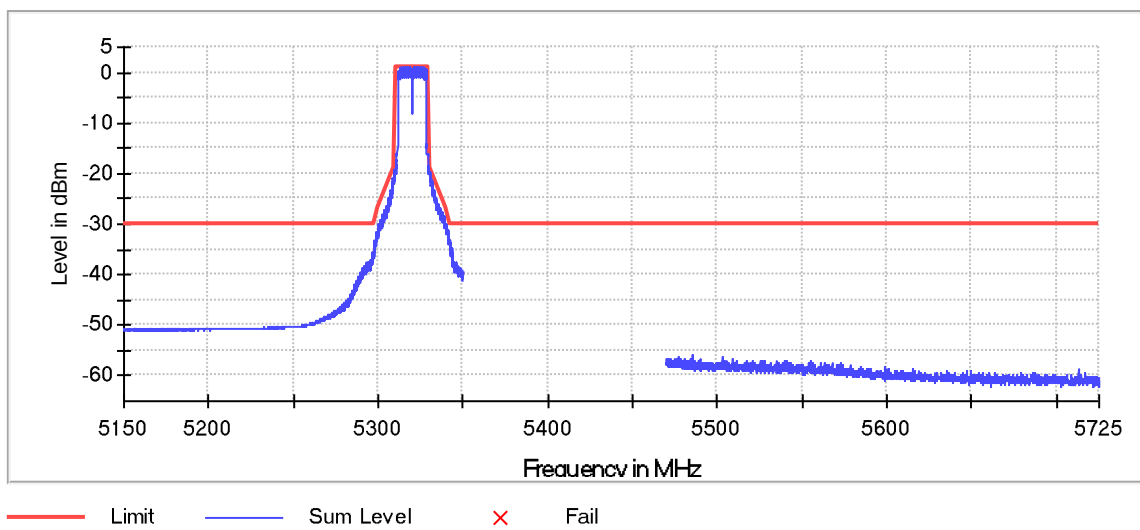


802.11a, 6Mbps – Channel 64

Channel 64 – Chain A

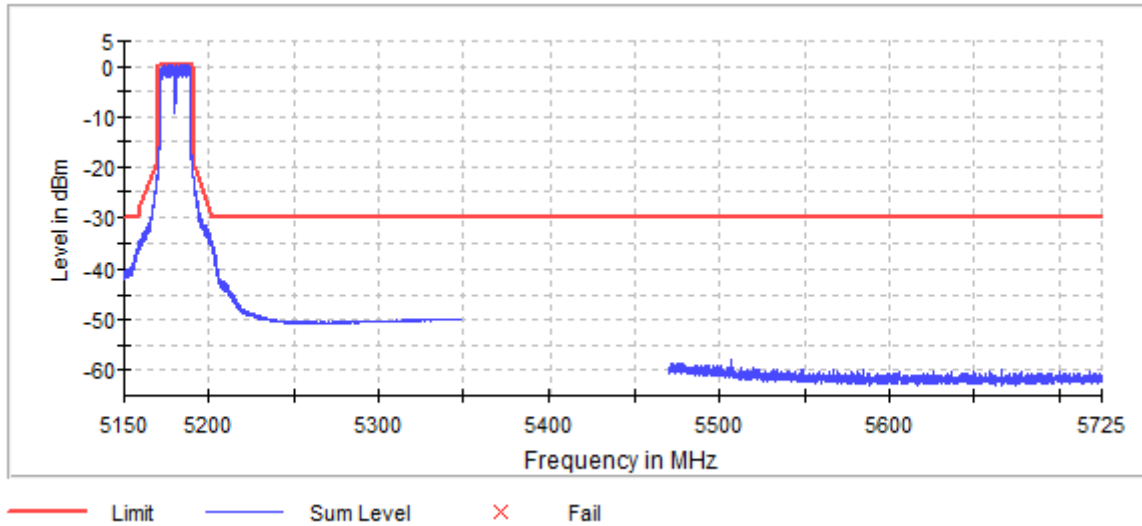


Channel 64 – Chain B

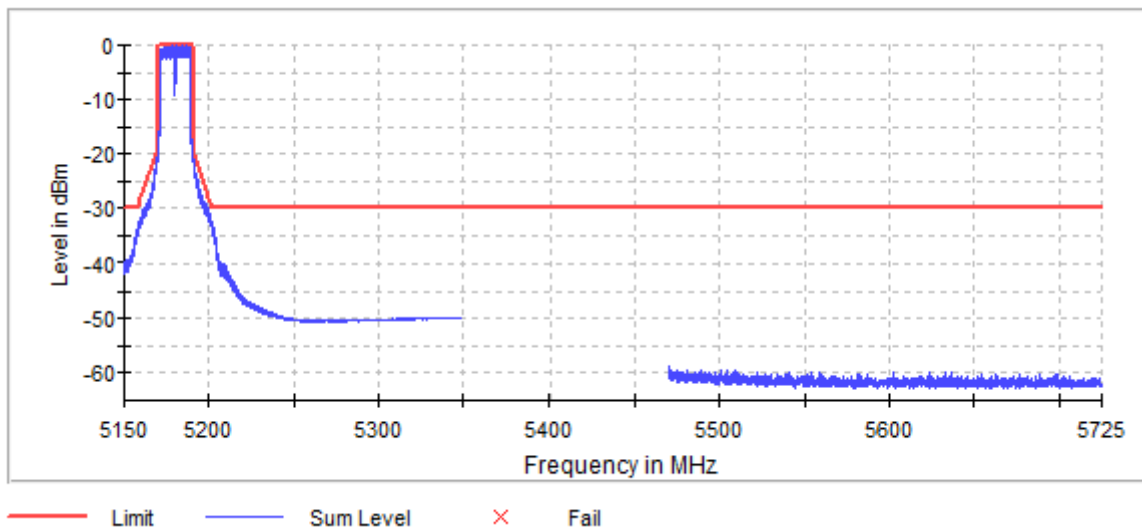


802.11n20 (SISO), HT0 – Channel 36

Channel 36 – Chain A

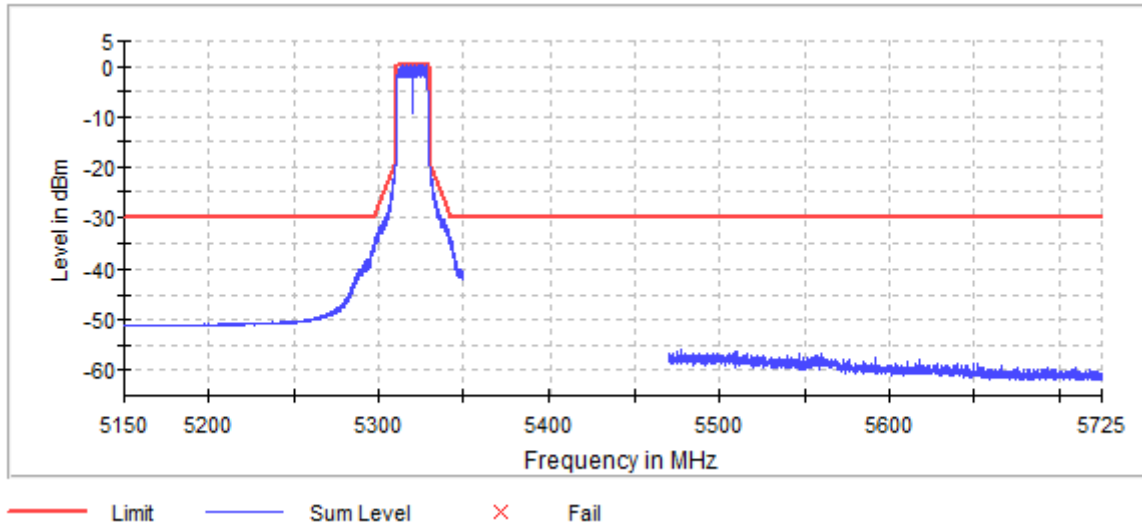


Channel 36 – Chain B

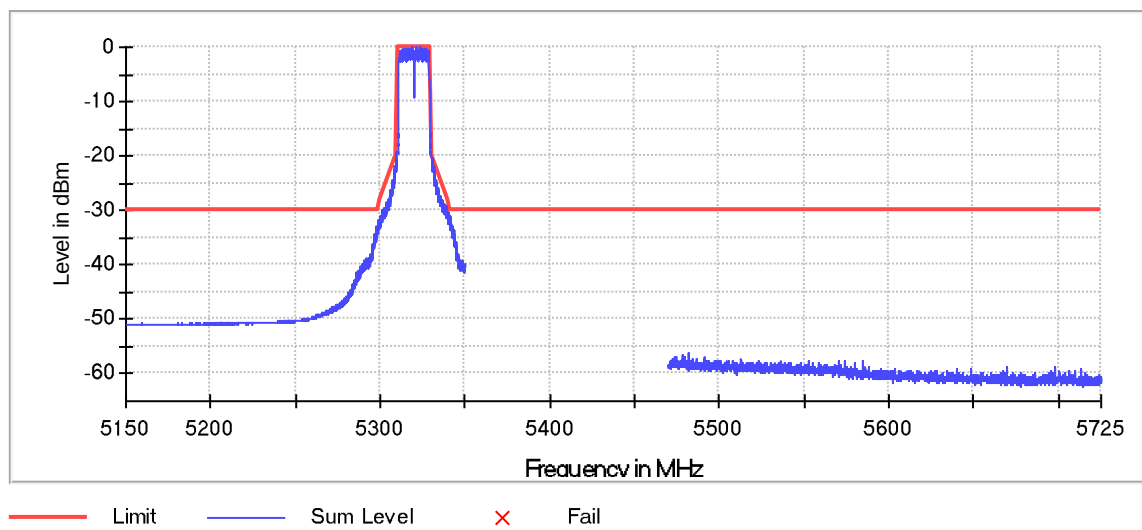


802.11n20 (SISO), HT0 – Channel 64

Channel 64 – Chain A

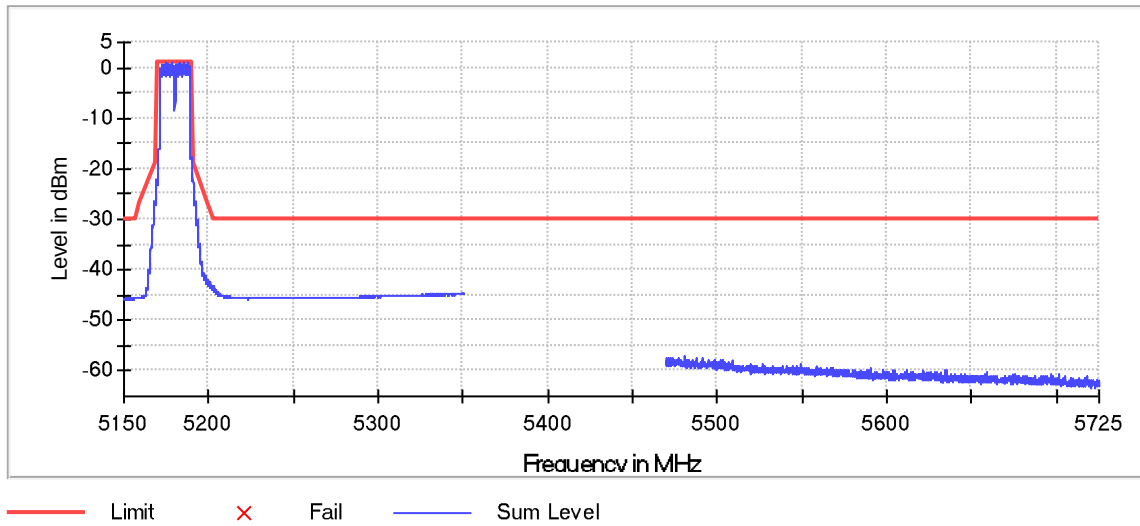


Channel 64 – Chain B

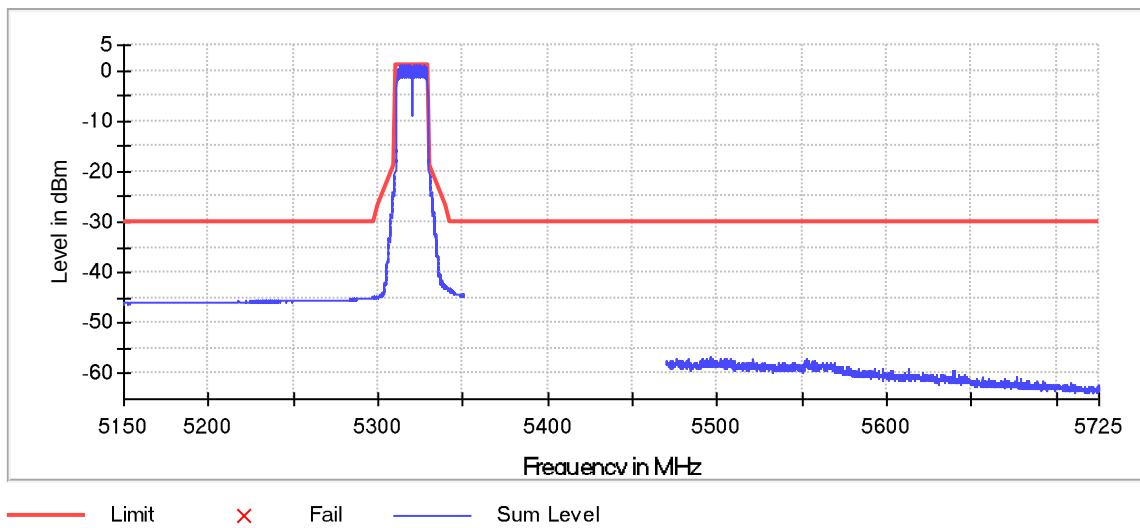


802.11n20 (MIMO), HT8

Channel 36 – Chain AB

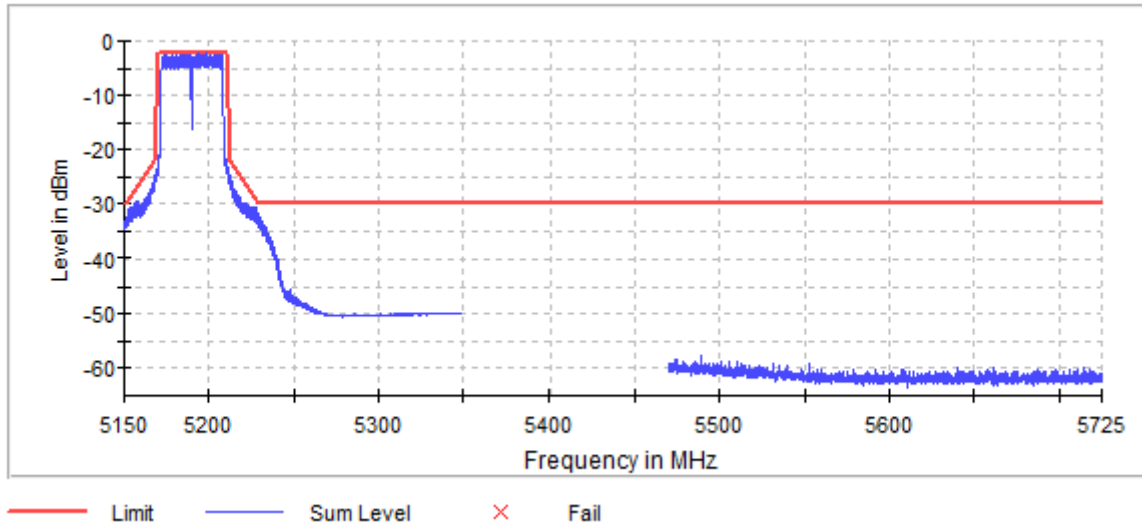


Channel 64 – Chain AB

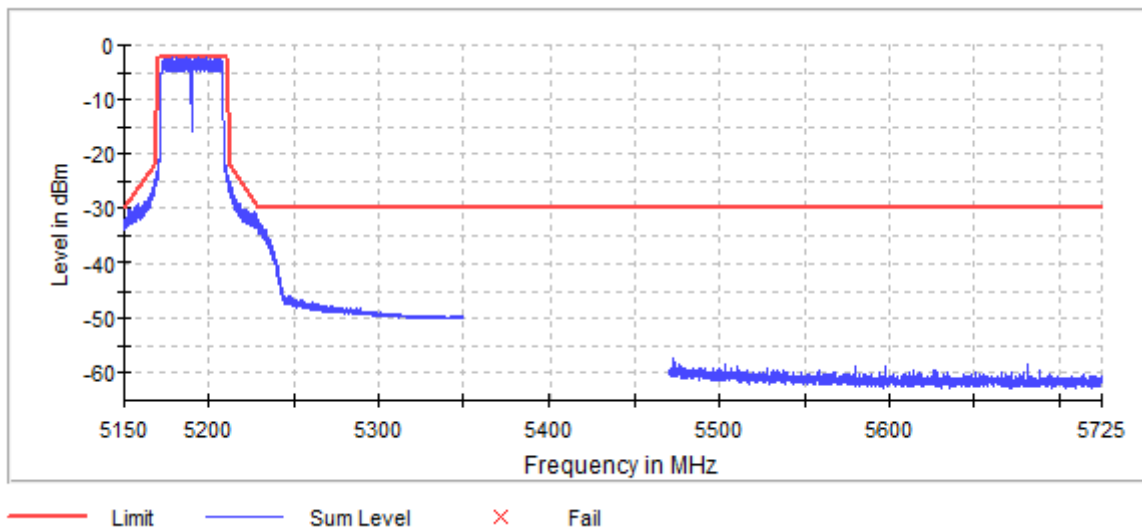


802.11n40 (SISO), HT0 – Channel 38F

Channel 38F – Chain A

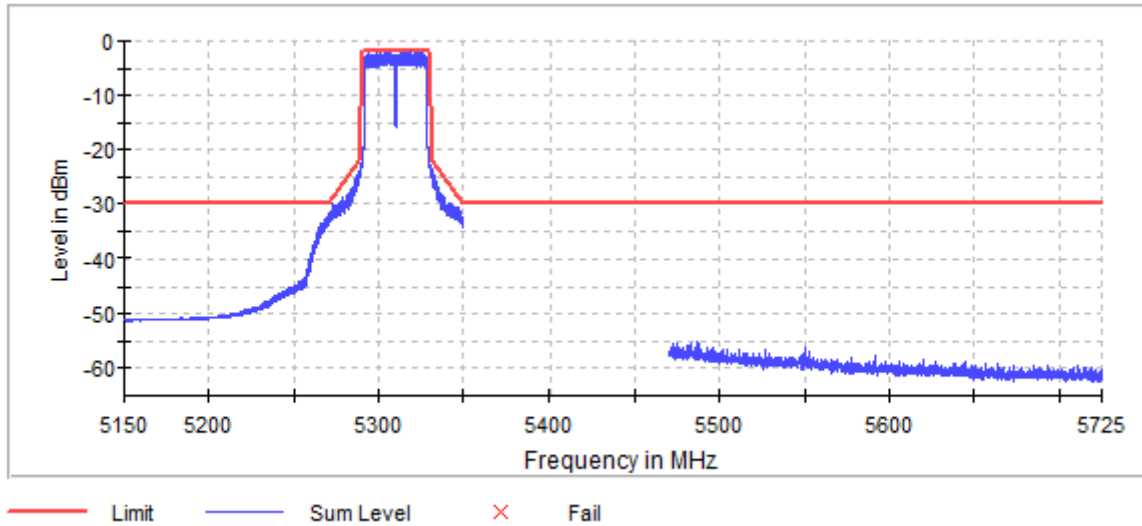


Channel 38F – Chain B

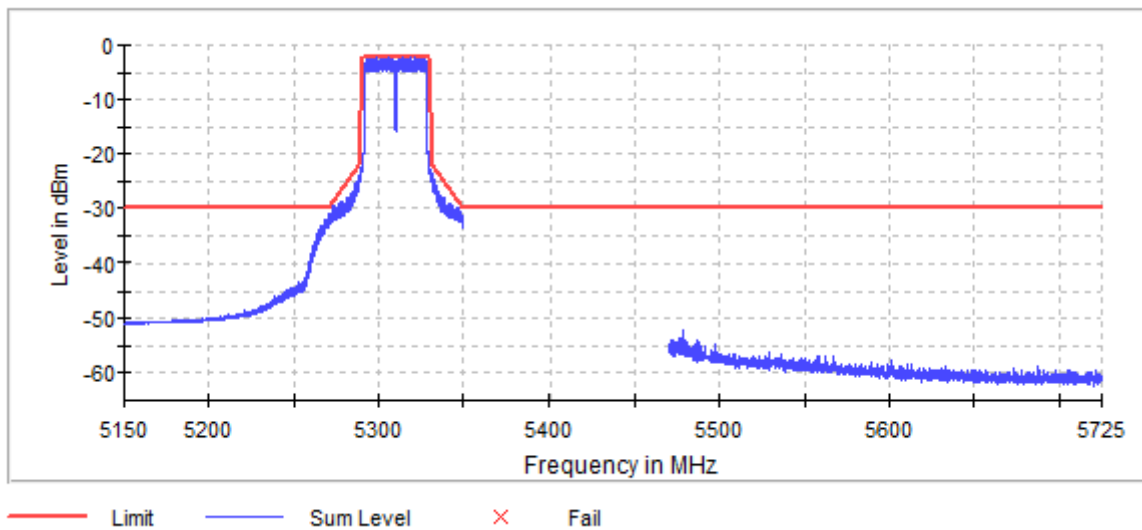


802.11n40 (SISO), HT0 – Channel 62F

Channel 62F – Chain A

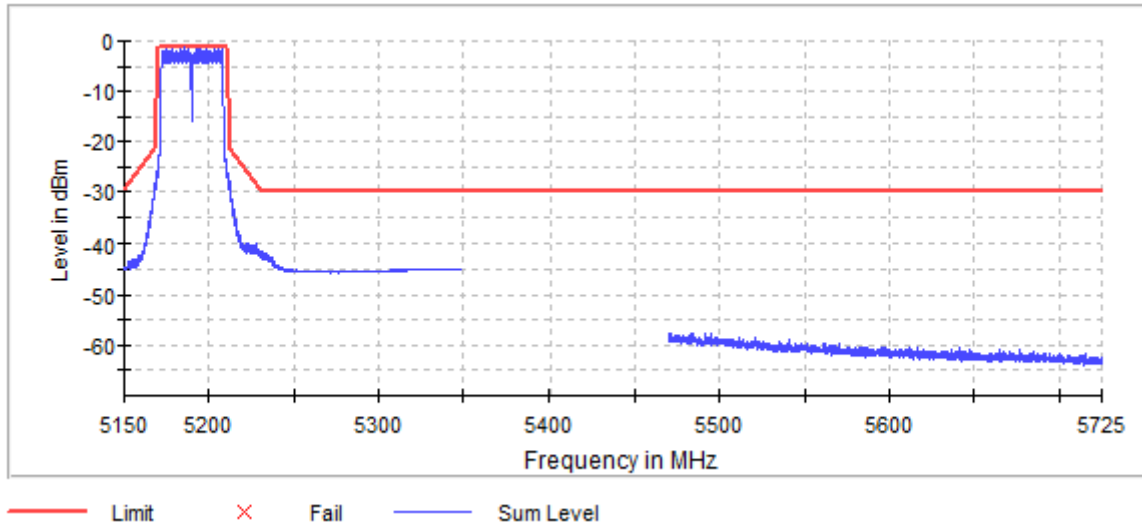


Channel 62F – Chain B

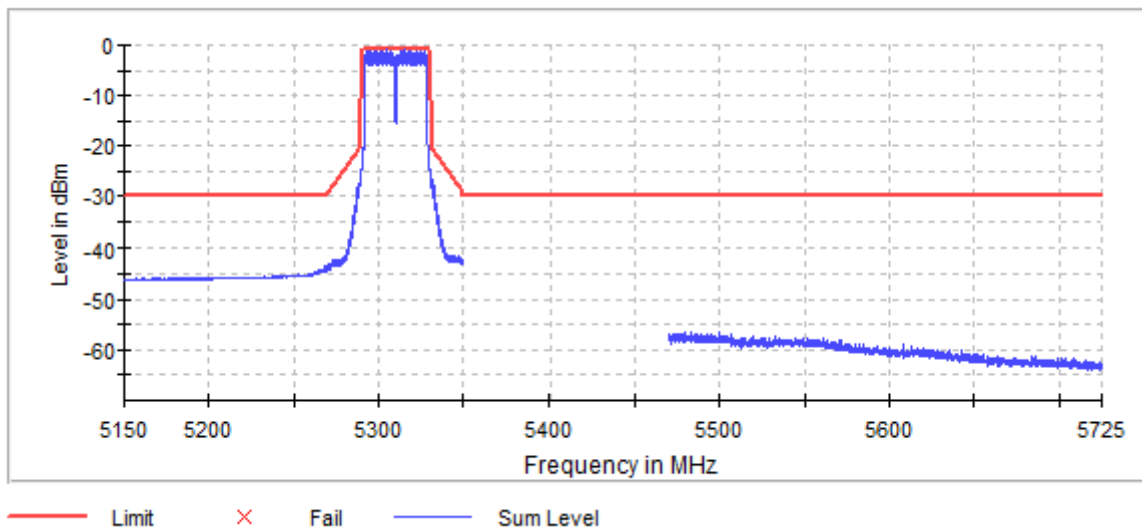


802.11n40 (MIMO), HT8

Channel 38F – Chain AB

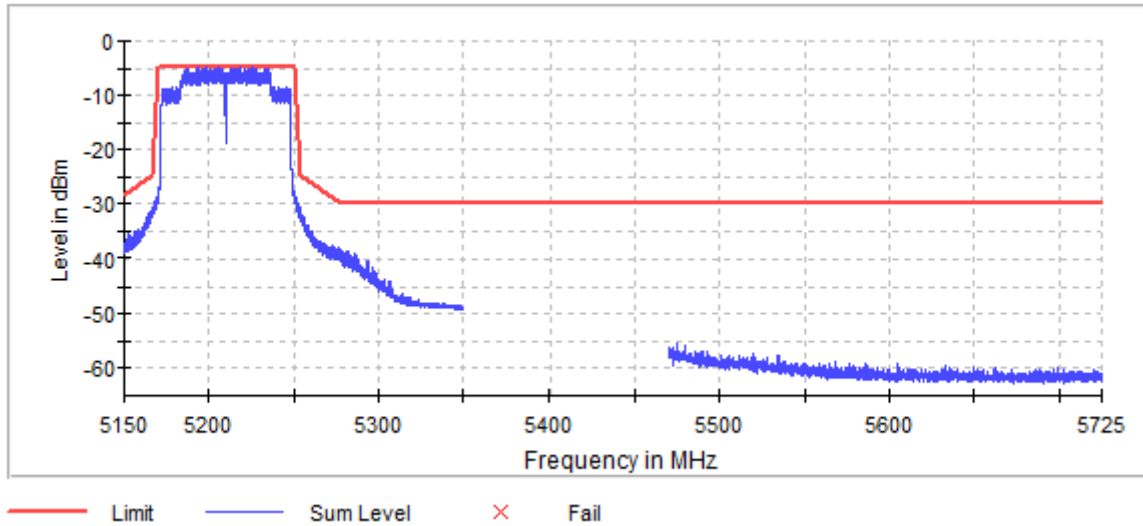


Channel 62F – Chain AB

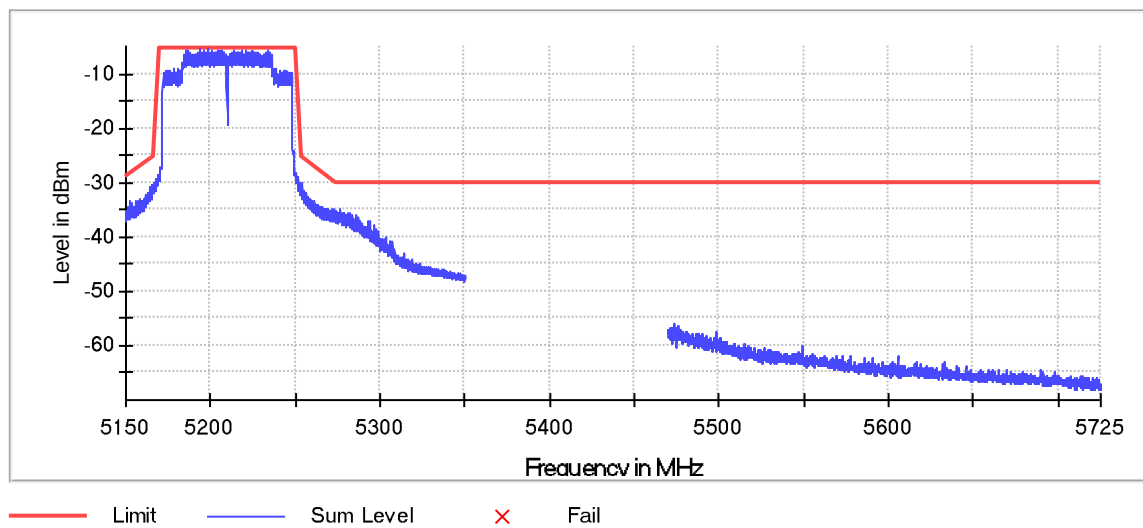


802.11ac80 (SISO), VHT0 – Channel 42

Channel 42 – Chain A

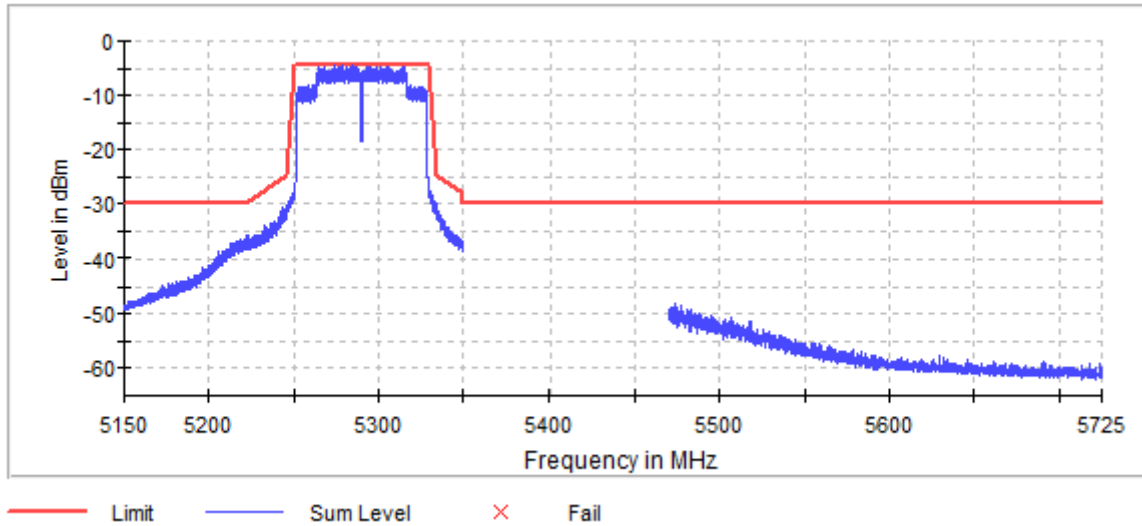


Channel 42 – Chain B

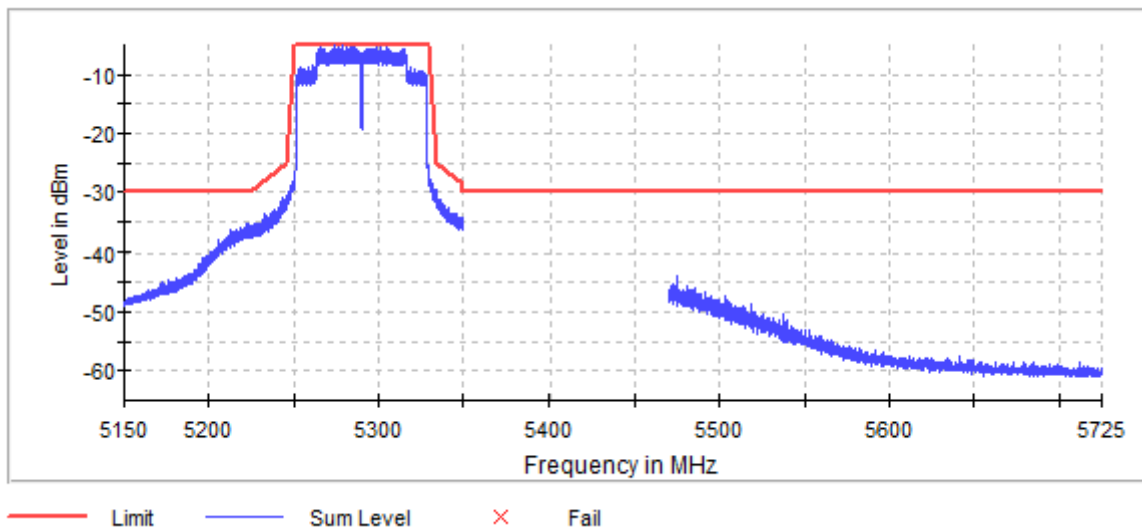


802.11ac80 (SISO), VHT0 – Channel 58

Channel 58 – Chain A

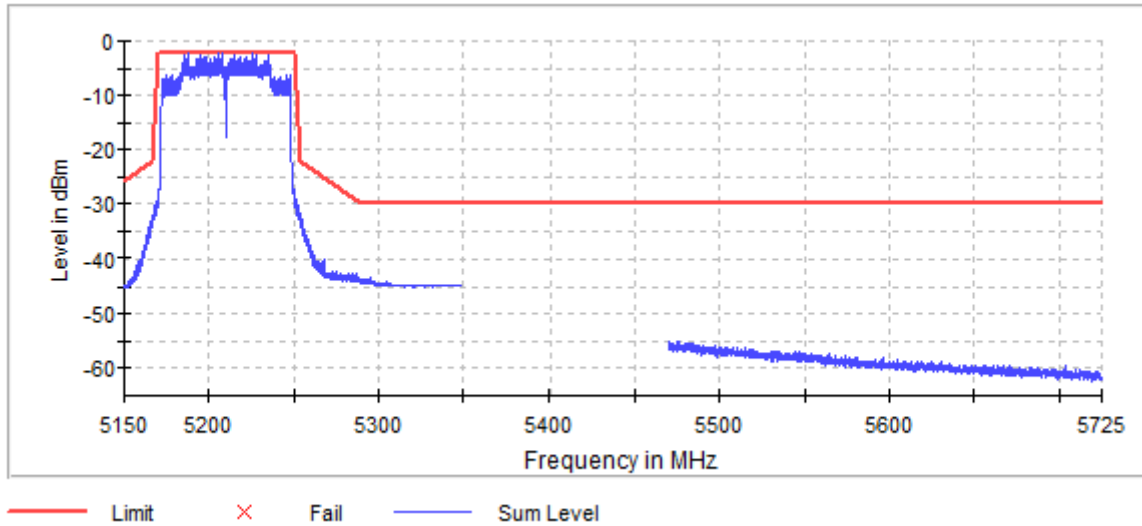


Channel 58 – Chain B

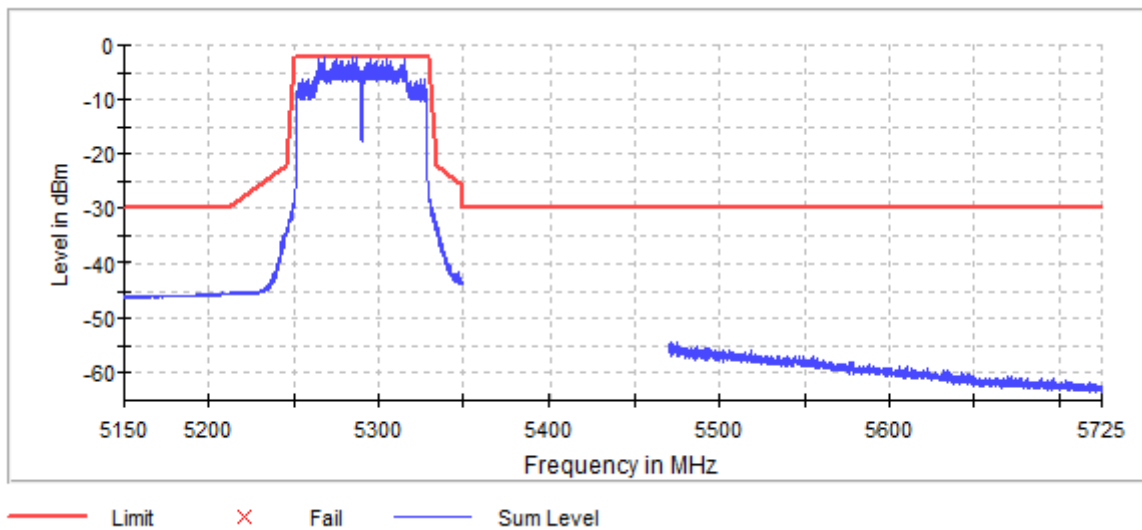


802.11ac80 (MIMO), VHT0

Channel 42 – Chain AB

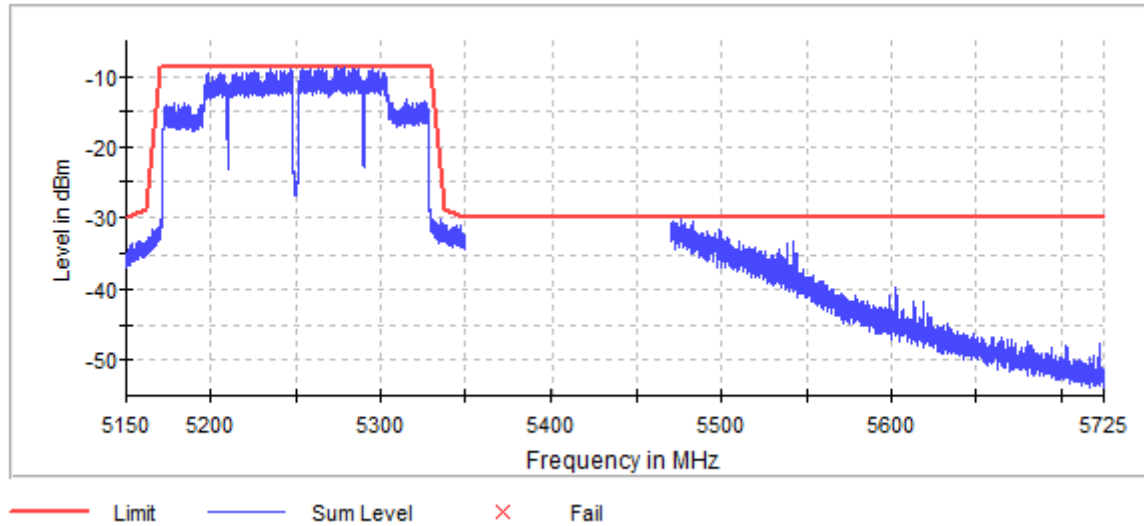


Channel 58 – Chain AB

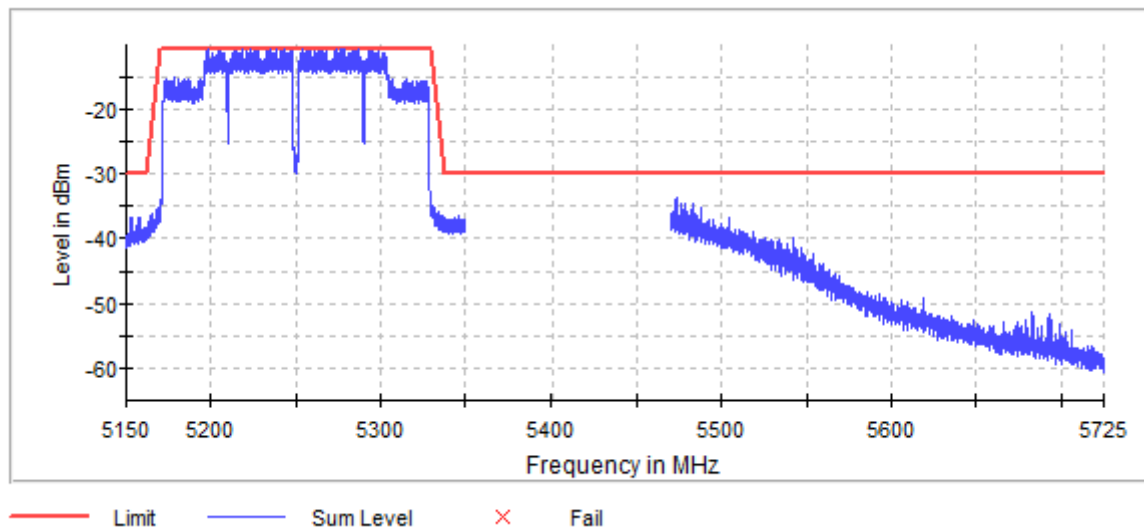


802.11ac160 (SISO), VHT0 – Channel 50

Channel 50 – Chain A

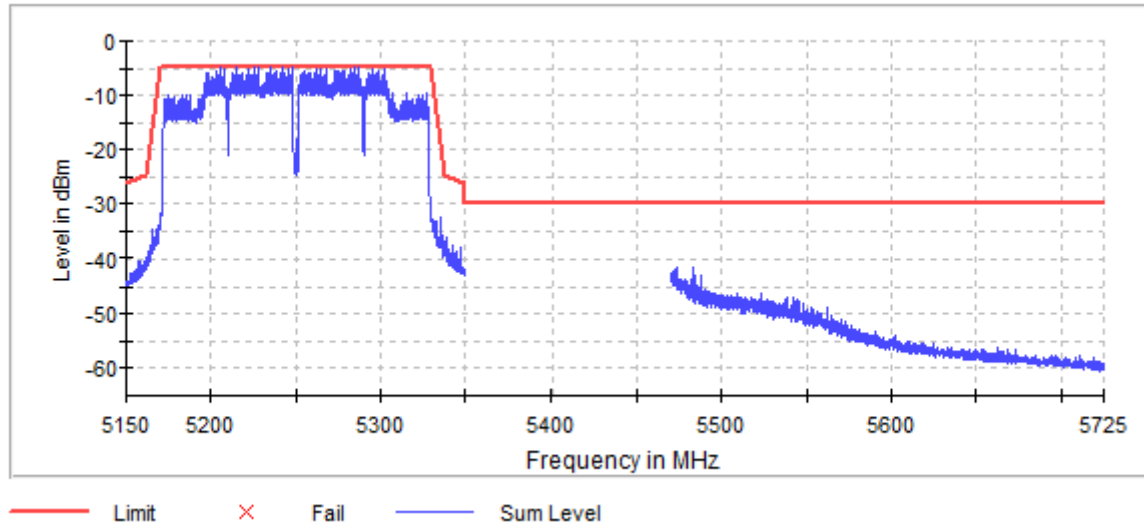


Channel 50 – Chain B



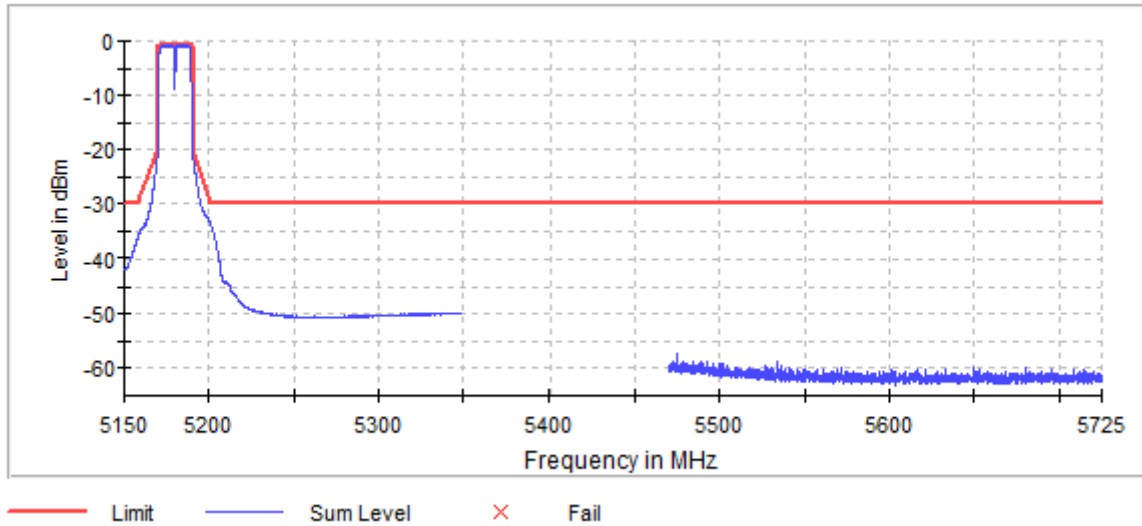
802.11ac160 (MIMO), VHT0

Channel 50 – Chain AB

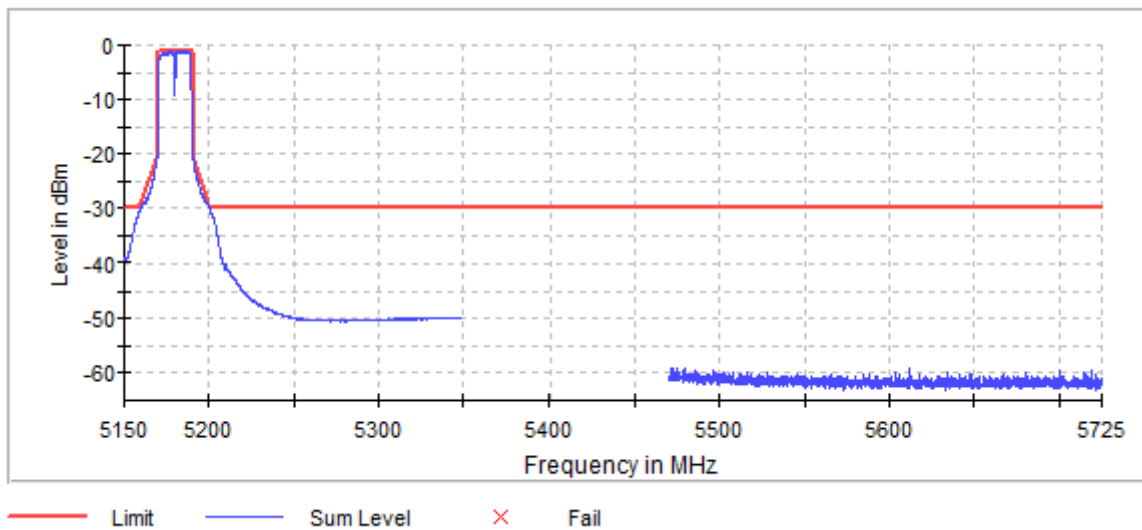


802.11ax20 (SISO), HE0 – Channel 36

Channel 36 – Chain A

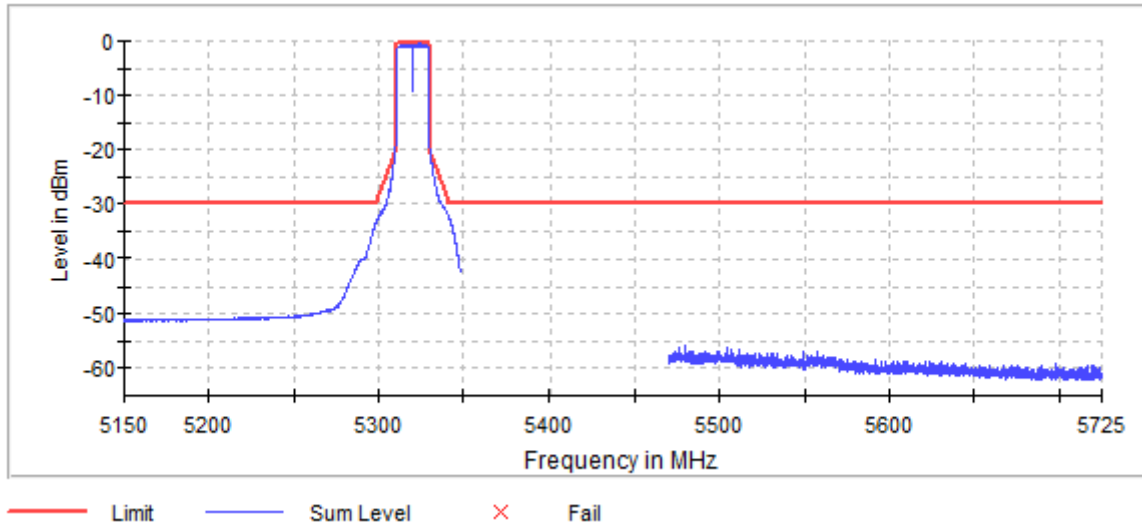


Channel 36 – Chain B

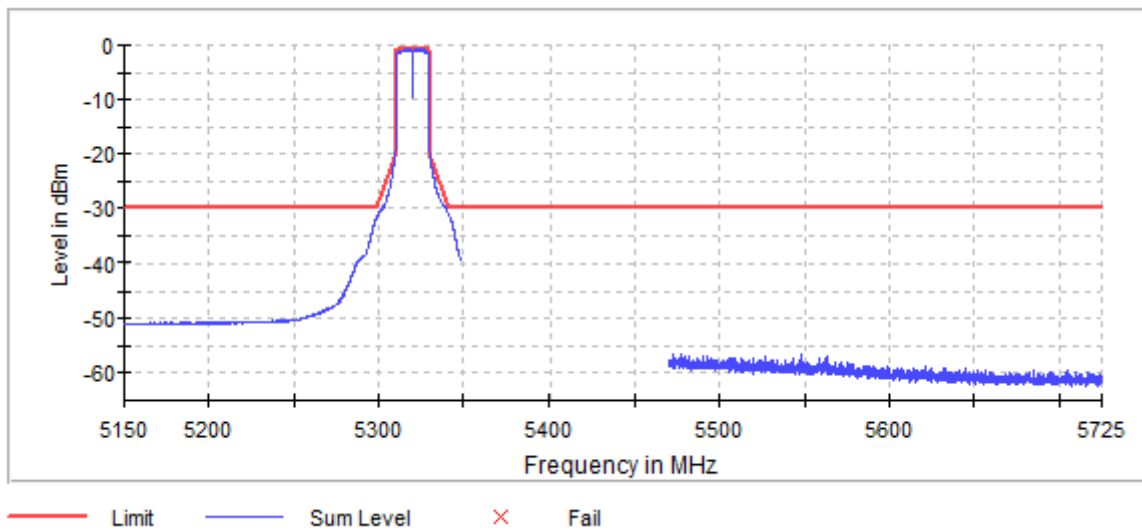


802.11ax20 (SISO), HE0 – Channel 64

Channel 64 – Chain A

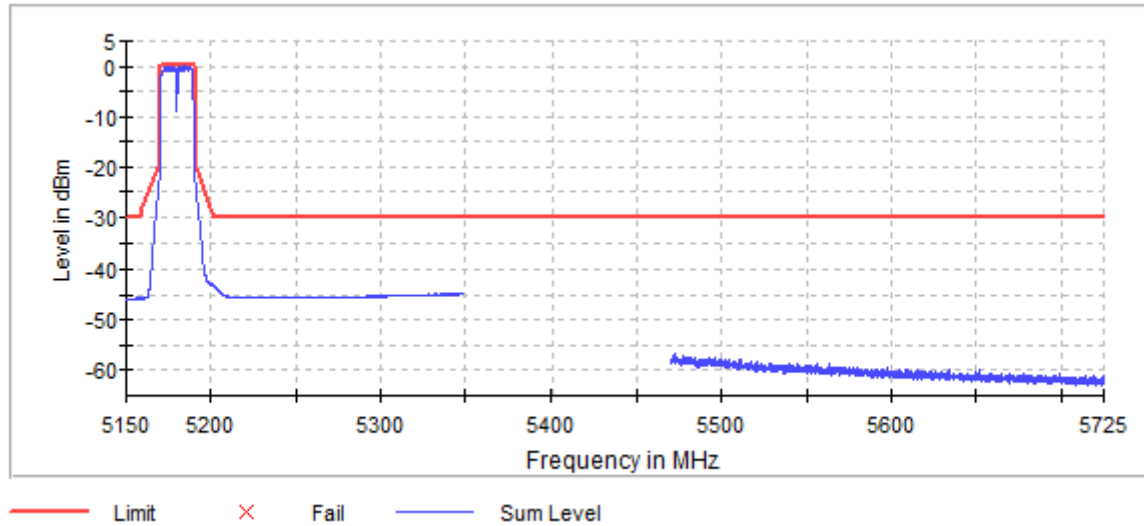


Channel 64 – Chain B

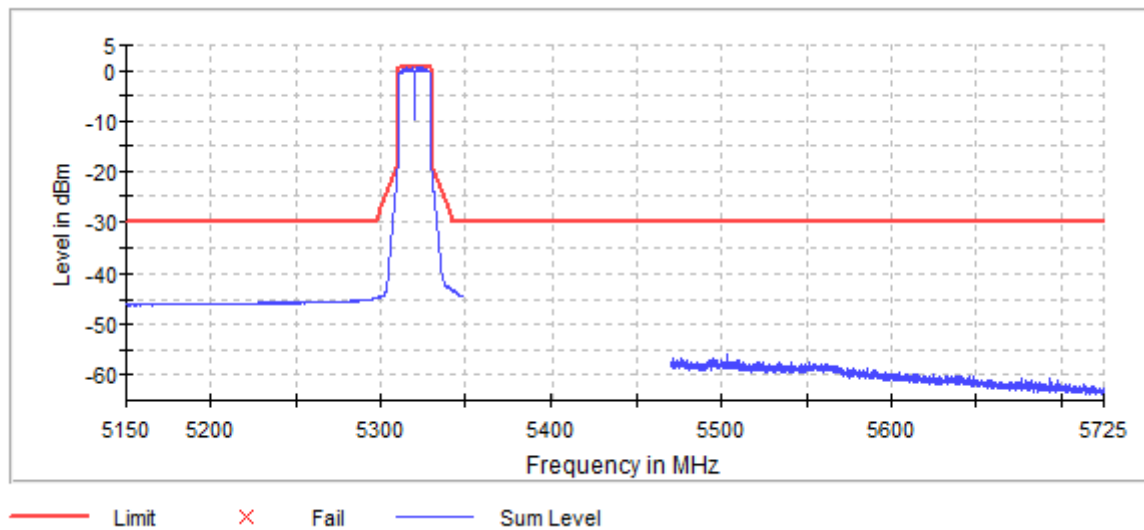


802.11ax20 (MIMO), HE0

Channel 36 – Chain AB

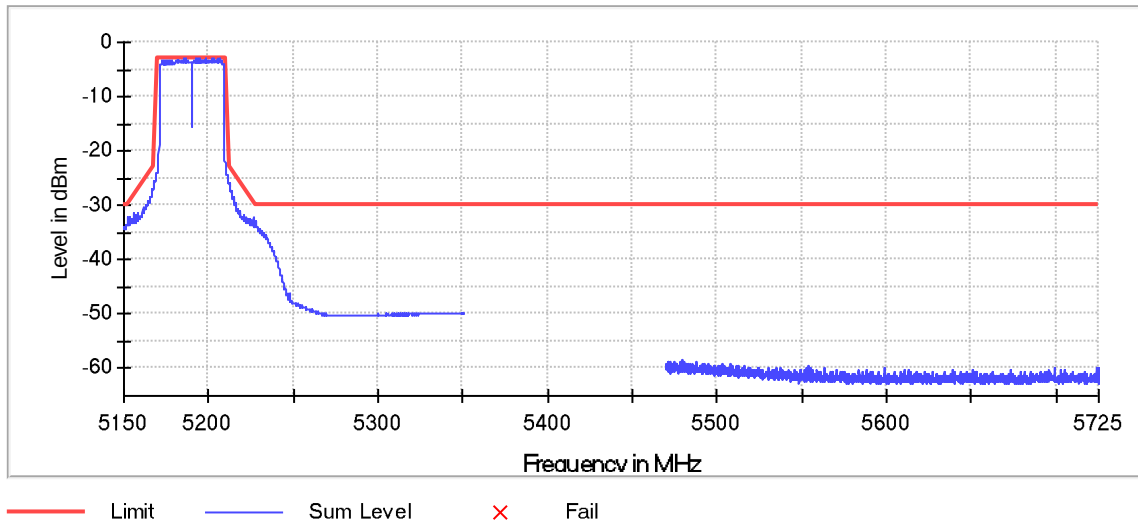


Channel 64 – Chain AB

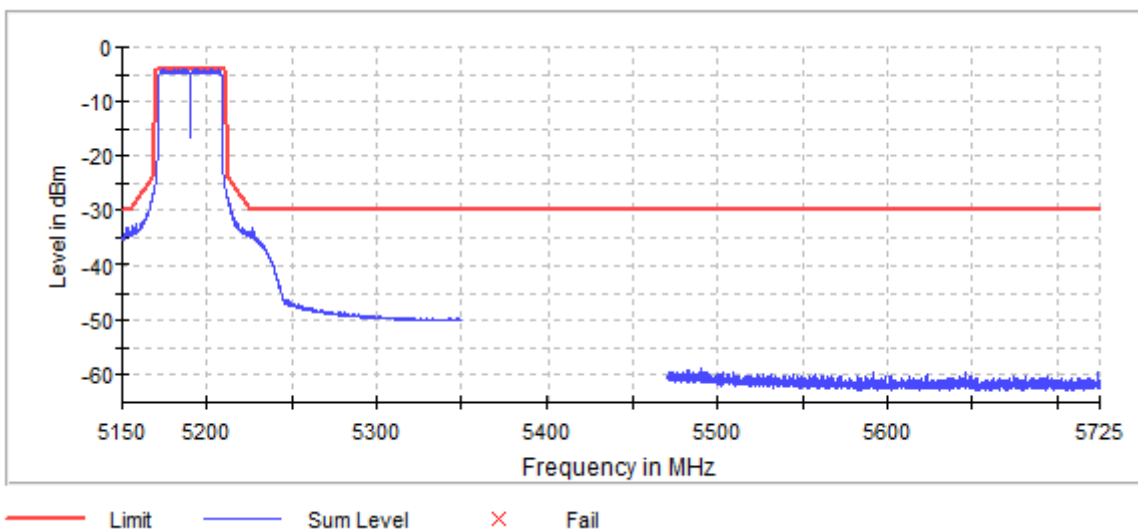


802.11ax40 (SISO), HE0 – Channel 38F

Channel 38F – Chain A

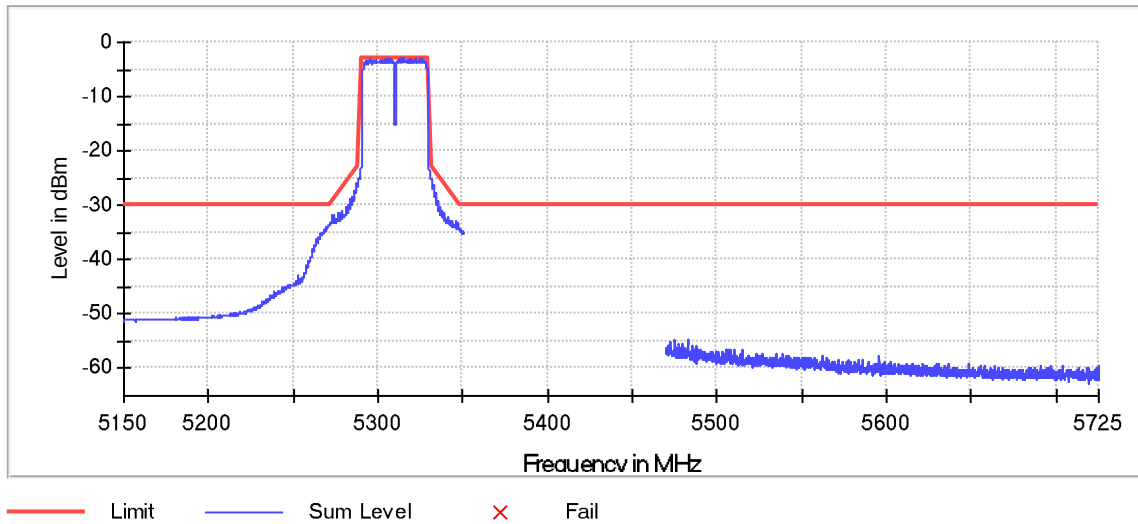


Channel 38F – Chain B

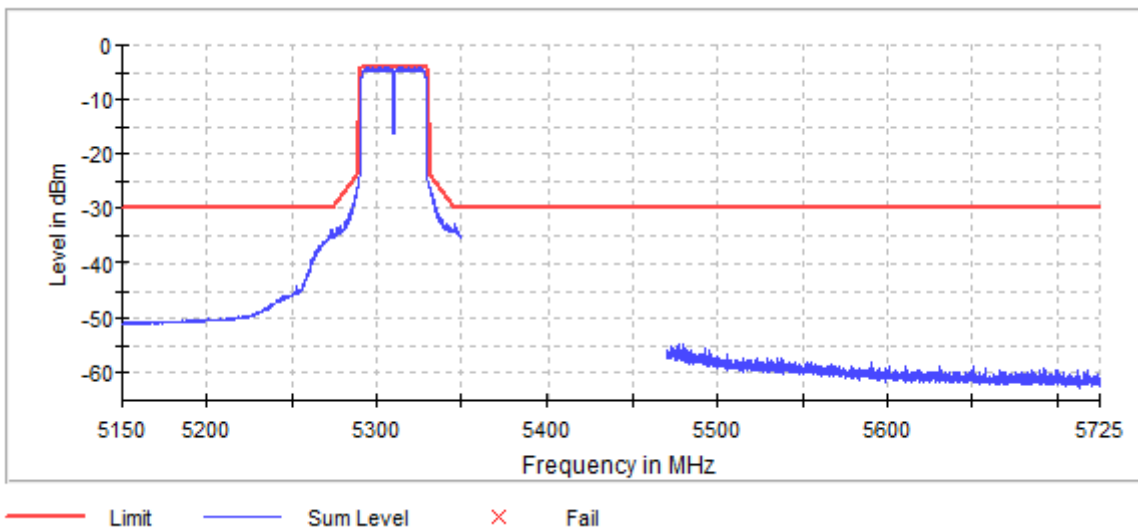


802.11ax40 (SISO), HE0 – Channel 62F

Channel 62F – Chain A

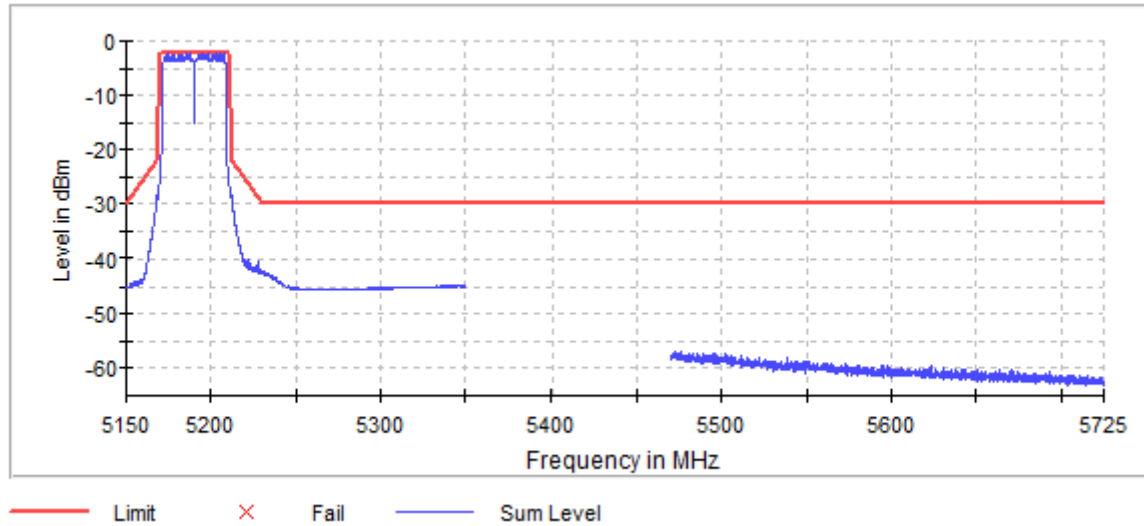


Channel 62F – Chain B

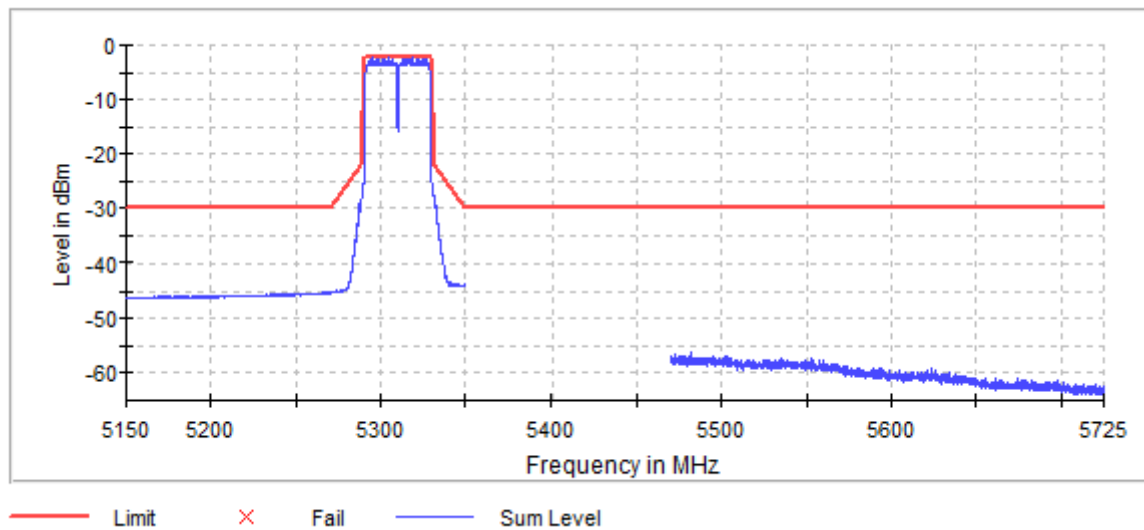


802.11ax40 (MIMO), HE0

Channel 38F – Chain AB

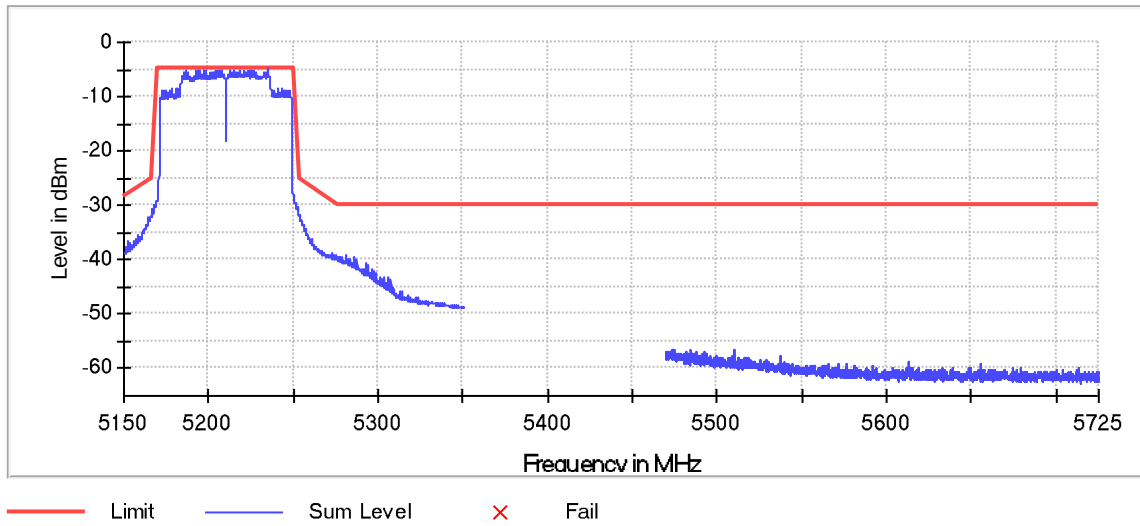


Channel 62F – Chain AB

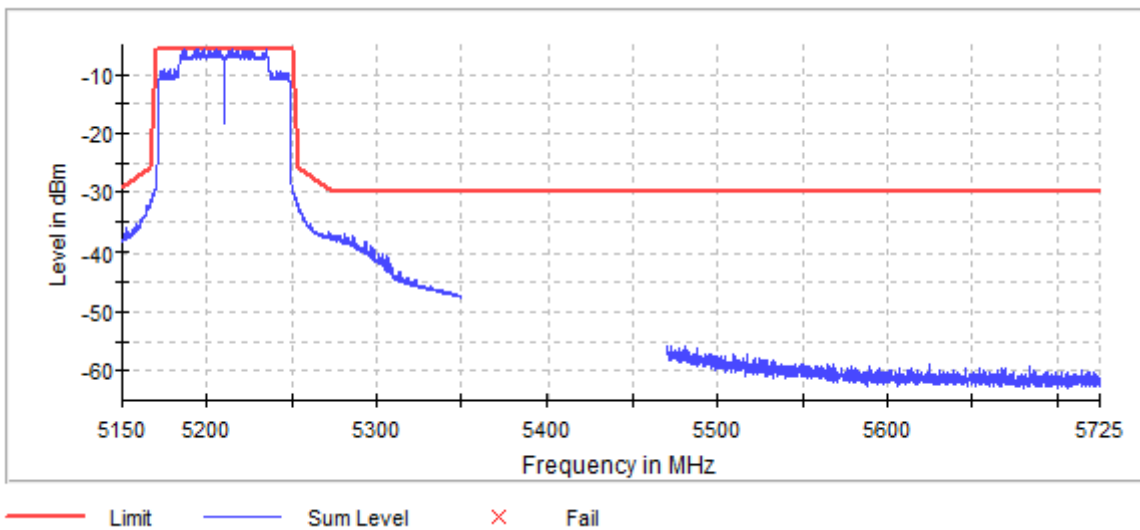


802.11ax80 (SISO), HE0 – Channel 42

Channel 42 – Chain A

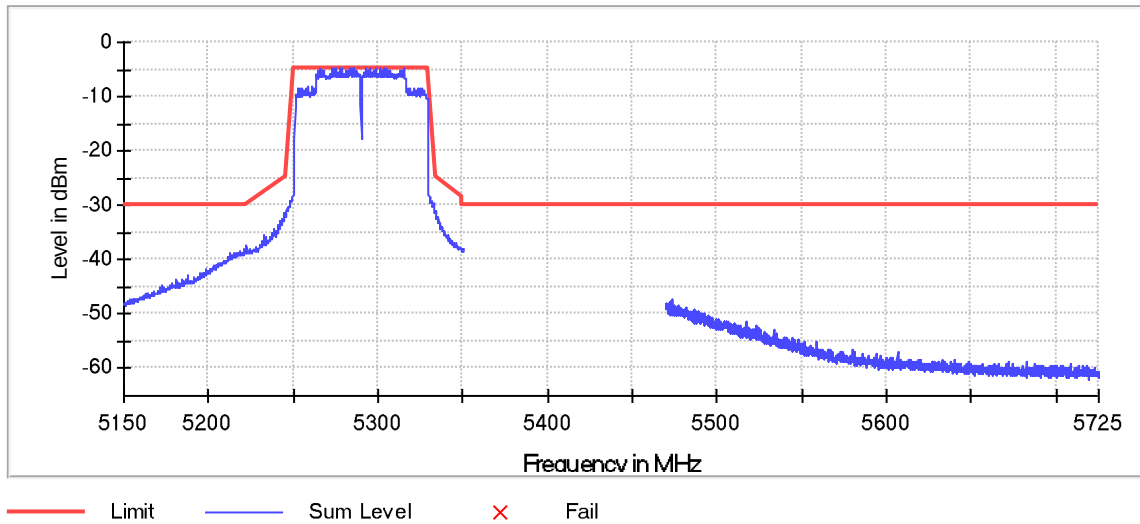


Channel 42 – Chain B

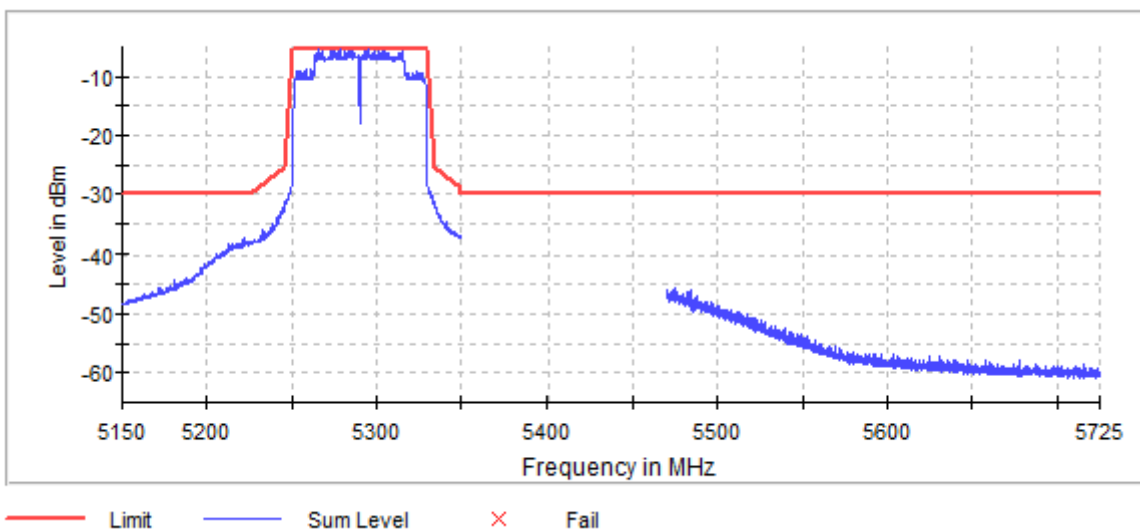


802.11ax80 (SISO), HE0 – Channel 58

Channel 58 – Chain A

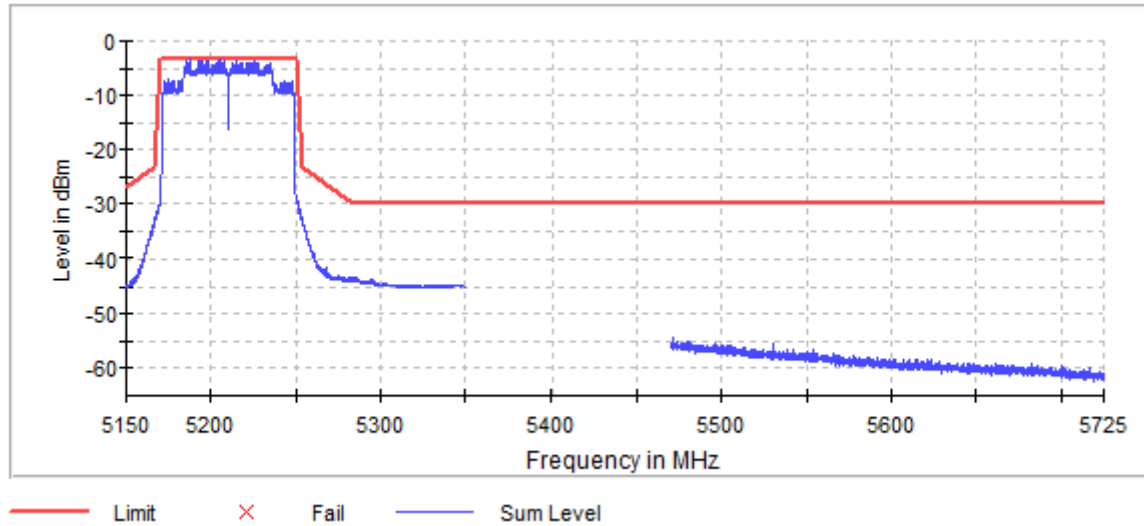


Channel 58 – Chain B

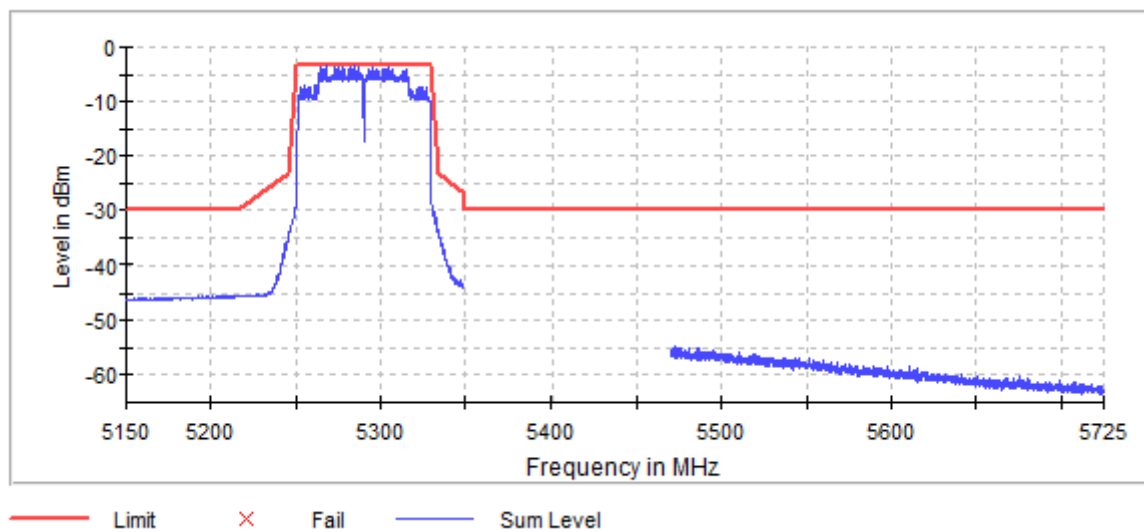


802.11ax80 (MIMO), HE0

Channel 42 – Chain AB

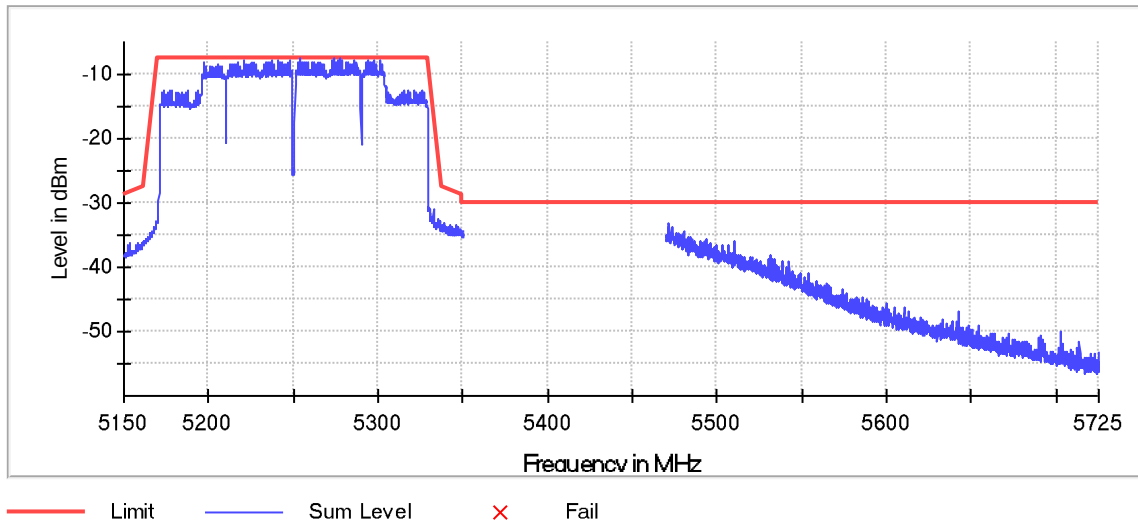


Channel 58 – Chain AB

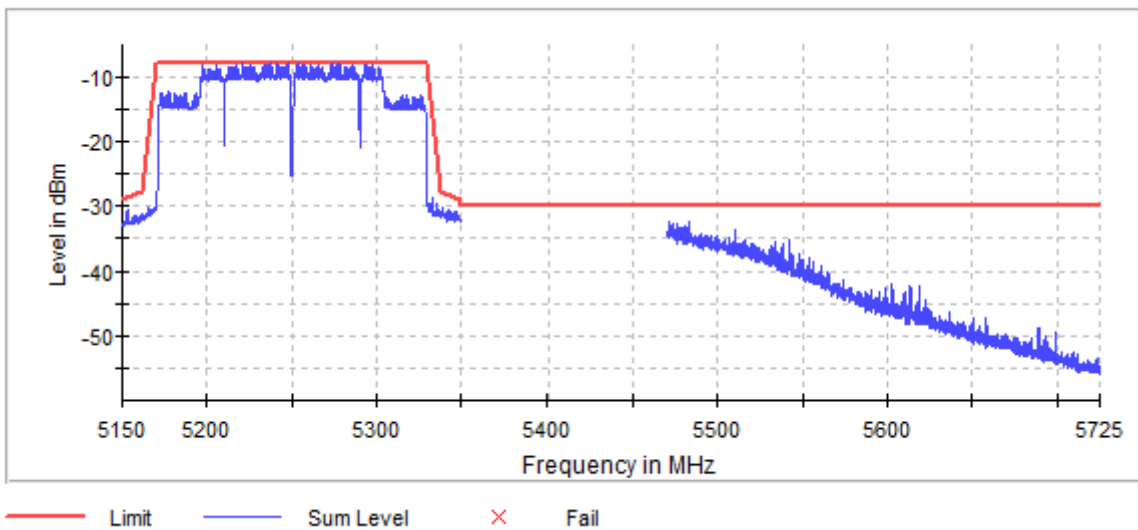


802.11ax160 (SISO), HE0 – Channel 50

Channel 50 – Chain A

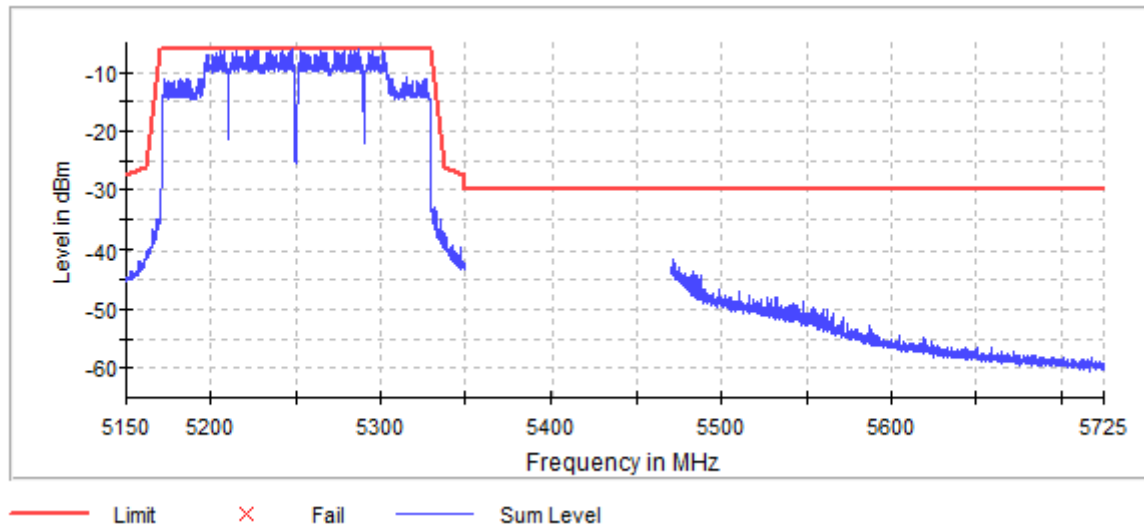


Channel 50 – Chain B



802.11ax160 (MIMO), HE0

Channel 50 – Chain AB



B.8 Transmitter unwanted emissions outside the 5GHz RLAN bands

Standard references

ETSI part	Limits																																							
4.2.4.1.2	The level of transmitter unwanted emissions outside the 5 GHz RLAN bands shall not exceed the limits given in table 4.																																							
	Table 4. Transmitter unwanted emission limits outside the 5GHz RLAN bands																																							
	<table><tr><th>Frequency range</th><th>Maximum power</th><th>Bandwidth</th></tr><tr><td>30 MHz to 47 MHz</td><td>-36 dBm</td><td>100 KHz</td></tr><tr><td>47 MHz to 74 MHz</td><td>-54 dBm</td><td>100 KHz</td></tr><tr><td>74 MHz to 87.5 MHz</td><td>-36 dBm</td><td>100 KHz</td></tr><tr><td>87.5 MHz to 118 MHz</td><td>-54 dBm</td><td>100 KHz</td></tr><tr><td>118 MHz to 174 MHz</td><td>-36 dBm</td><td>100 KHz</td></tr><tr><td>174 MHz to 230 MHz</td><td>-54 dBm</td><td>100 KHz</td></tr><tr><td>230 MHz to 470 MHz</td><td>-36 dBm</td><td>100 KHz</td></tr><tr><td>470 MHz to 862 MHz</td><td>-54 dBm</td><td>100 KHz</td></tr><tr><td>862 MHz to 1 GHz</td><td>-36 dBm</td><td>100 KHz</td></tr><tr><td>1 GHz to 5.15 GHz</td><td>-30 dBm</td><td>1 MHz</td></tr><tr><td>5.35 GHz to 5.47 GHz</td><td>-30 dBm</td><td>1 MHz</td></tr><tr><td>5.725 GHz to 26 GHz</td><td>-30 dBm</td><td>1 MHz</td></tr></table>	Frequency range	Maximum power	Bandwidth	30 MHz to 47 MHz	-36 dBm	100 KHz	47 MHz to 74 MHz	-54 dBm	100 KHz	74 MHz to 87.5 MHz	-36 dBm	100 KHz	87.5 MHz to 118 MHz	-54 dBm	100 KHz	118 MHz to 174 MHz	-36 dBm	100 KHz	174 MHz to 230 MHz	-54 dBm	100 KHz	230 MHz to 470 MHz	-36 dBm	100 KHz	470 MHz to 862 MHz	-54 dBm	100 KHz	862 MHz to 1 GHz	-36 dBm	100 KHz	1 GHz to 5.15 GHz	-30 dBm	1 MHz	5.35 GHz to 5.47 GHz	-30 dBm	1 MHz	5.725 GHz to 26 GHz	-30 dBm	1 MHz
	Frequency range	Maximum power	Bandwidth																																					
	30 MHz to 47 MHz	-36 dBm	100 KHz																																					
	47 MHz to 74 MHz	-54 dBm	100 KHz																																					
	74 MHz to 87.5 MHz	-36 dBm	100 KHz																																					
	87.5 MHz to 118 MHz	-54 dBm	100 KHz																																					
	118 MHz to 174 MHz	-36 dBm	100 KHz																																					
	174 MHz to 230 MHz	-54 dBm	100 KHz																																					
	230 MHz to 470 MHz	-36 dBm	100 KHz																																					
	470 MHz to 862 MHz	-54 dBm	100 KHz																																					
	862 MHz to 1 GHz	-36 dBm	100 KHz																																					
	1 GHz to 5.15 GHz	-30 dBm	1 MHz																																					
5.35 GHz to 5.47 GHz	-30 dBm	1 MHz																																						
5.725 GHz to 26 GHz	-30 dBm	1 MHz																																						

Test conditions

ETSI part	Conditions
5.4.5.1	The conformance requirements in clause 4.2.4.1 shall be verified only under normal operating conditions, and when operating on those channels defined in clause 5.3.2.
	The equipment shall be configured to operate under its worst case situation with respect to unwanted emissions outside the 5 GHz RLAN bands.
	If possible, the UUT shall be set to continuous transmit (duty cycle = 1) for the duration of this test.
	If continuous transmit is not possible, the UUT should be configured to operate at its maximum duty cycle.
	The level of transmitter unwanted emissions shall be measured as, either: a) their power in a specified load (conducted emissions) and their radiated power (e.r.p. or e.i.r.p as given in clause 4.2.4.1.2) when radiated by the cabinet or structure of the equipment (cabinet radiation); or b) their radiated power (e.r.p. or e.i.r.p as given in clause 4.2.4.1.2) when radiated by cabinet and antenna.

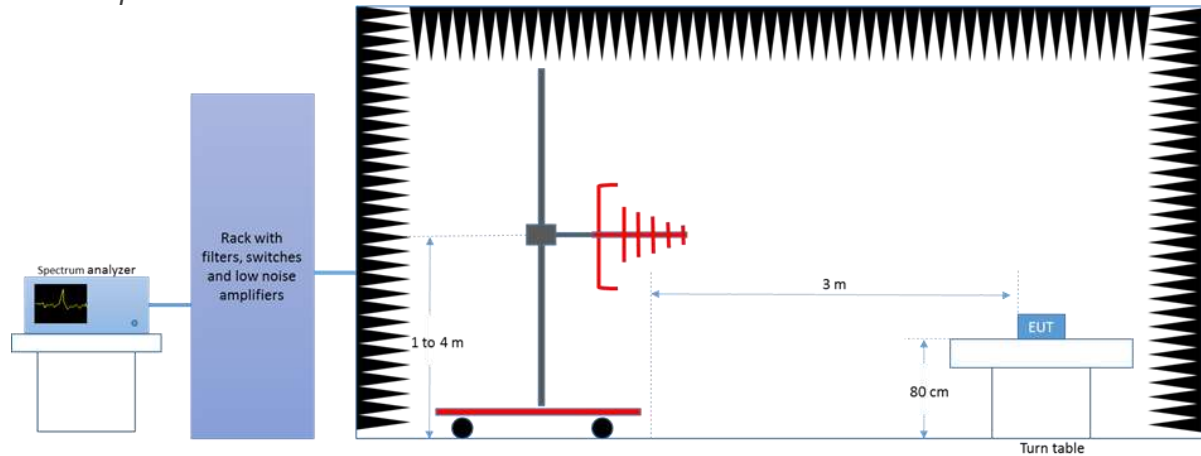
Test procedure

The setup bellow is used to measure the transmission spurious emissions. Depending of the frequency range and bands being tested, different antennas and filters were used; in consequence different setups are employed.

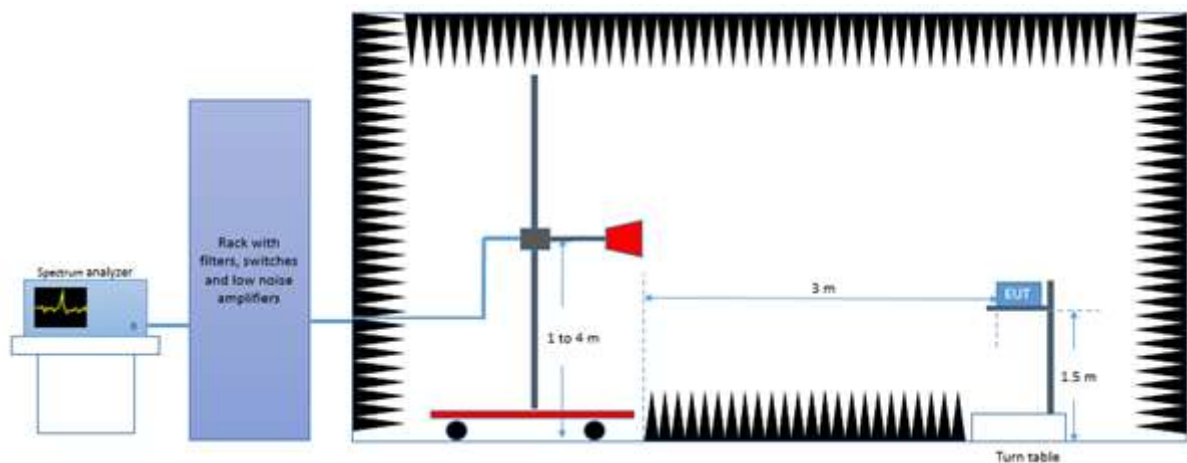
The final measurement is done by varying the antenna height , the EUT azimuth over 360° and for both Vertical and Horizontal polarizations

The radiated spurious emission was measured on the worst case configuration on one channel for each transmission mode.

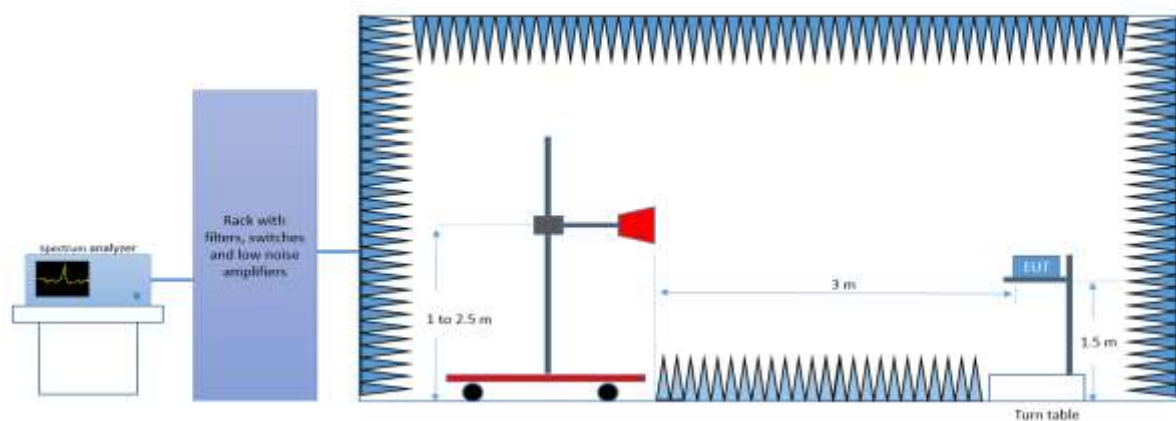
Radiated Setup 30 MHz - 1 GHz



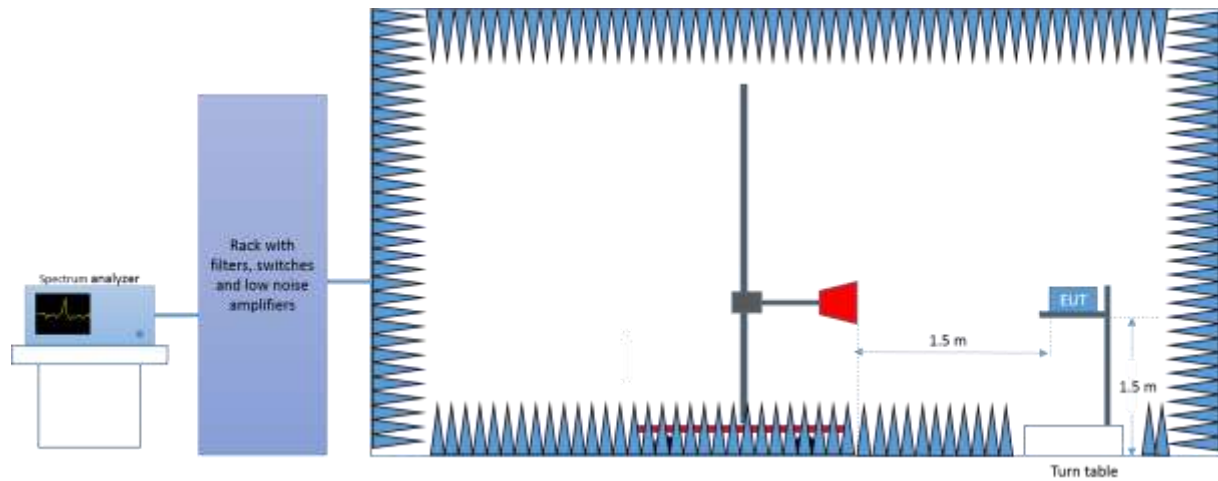
Radiated Setup 1 GHz – 6.4 GHz



Radiated Setup 6.4 GHz - 18 GHz



Radiated Setup 18 GHz - 26 GHz



Test Results

Tx Spurious Emissions – 30 MHz to 26 GHz

Tx Spurious Emissions – 802.11a (SISO), Chain A, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
624.0	-67.1	-54.0	13.1
1050.0	-62.1	-30.0	32.1
6575.0	-58.7	-30.0	28.7
10521.9	-55.7	-30.0	25.7
21040.1	-43.7	-30.0	13.7

Tx Spurious Emissions – 802.11a (SISO), Chain B, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
549.1	-66.2	-54.0	12.2
1051.0	-61.9	-30.0	31.9
6575.0	-58.9	-30.0	28.9
10519.9	-54.1	-30.0	24.1
21040.1	-42.9	-30.0	12.9

Tx Spurious Emissions – 802.11n20 (SISO), Chain A, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
549.1	-67.1	-54.0	13.1
1054.5	-60.4	-30.0	30.4
10520.4	-55.4	-30.0	25.4
21040.1	-44.0	-30.0	14.0

Tx Spurious Emissions – 802.11n20 (SISO), Chain B, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
549.1	-66.7	-54.0	12.7
1054.5	-60.1	-30.0	30.1
10521.9	-54.4	-30.0	24.4
21040.1	-43.3	-30.0	13.3

Tx Spurious Emissions – 802.11n20 (MIMO), Chain A+B, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
624.0	-66.6	-54.0	12.6
1054.5	-60.6	-30.0	30.6
10520.9	-54.6	-30.0	24.6
21040.1	-44.0	-30.0	14.0

Tx Spurious Emissions – 802.11ax20 (SISO), Chain A, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
540.8	-67.9	-54.0	13.9
1046.5	-53.2	-30.0	23.2
10503.0	-47.8	-30.0	17.8
21040.1	-42.4	-30.0	12.4

Tx Spurious Emissions – 802.11ax20 (SISO), Chain B, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
549.1	-67.4	-54.0	13.4
1046.5	-52.3	-30.0	22.3
6574.5	-58.8	-30.0	28.8
10503.0	-49.6	-30.0	19.6
21040.1	-42.8	-30.0	12.8

Tx Spurious Emissions – 802.11ax20 (MIMO), Chain A+B, CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
624.0	-67.3	-54.0	13.3
1046.5	-53.2	-30.0	23.2
10503.0	-47.4	-30.0	17.4
21040.1	-43.7	-30.0	13.7

Tx Spurious Emissions – 802.11n40 (SISO), Chain A, CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
122.8	-66.2	-36.0	30.2
247.8	-70.3	-36.0	34.3
6321.5	-52.0	-30.0	22.0
6487.0	-55.7	-30.0	25.7
10385.1	-51.6	-30.0	21.6
20760.1	-44.1	-30.0	14.1

Tx Spurious Emissions – 802.11n40 (SISO), Chain B, CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
124.0	-66.9	-36.0	30.9
312.0	-63.8	-36.0	27.8
6018.5	-53.6	-30.0	23.6
6487.5	-58.3	-30.0	28.3
10359.0	-57.3	-30.0	27.3
20709.6	-57.5	-30.0	27.5
20760.1	-45.0	-30.0	15.0

Tx Spurious Emissions – 802.11n40 (MIMO), Chain A+B, CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
124.0	-66.7	-36.0	30.7
624.0	-67.3	-54.0	13.3
6324.5	-51.7	-30.0	21.7
6487.5	-57.6	-30.0	27.6
10382.2	-51.4	-30.0	21.4
20760.1	-45.5	-30.0	15.5

Tx Spurious Emissions – 802.11ax40 (SISO), Chain A, CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
124.5	-67.1	-36.0	31.1
549.1	-65.2	-54.0	11.2
6297.5	-52.2	-30.0	22.2
6487.0	-55.4	-30.0	25.4
10344.0	-46.6	-30.0	16.6
20760.1	-44.6	-30.0	14.6

Tx Spurious Emissions – 802.11ax40 (SISO), Chain B, CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
123.4	-70.6	-36.0	34.6
540.8	-66.0	-54.0	12.0
6090.5	-53.9	-30.0	23.9
6487.0	-58.5	-30.0	28.5
10344.0	-46.9	-30.0	16.9
20688.1	-56.7	-30.0	26.7
20759.8	-44.9	-30.0	14.9

Tx Spurious Emissions – 802.11ax40 (MIMO), Chain A+B, CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
122.8	-65.0	-36.0	29.0
244.7	-66.9	-36.0	30.9
4931.0	-52.6	-30.0	22.6
10344.5	-45.6	-30.0	15.6
20760.1	-45.2	-30.0	15.2
122.8	-65.0	-36.0	29.0

Tx Spurious Emissions – 802.11ac80 (SISO), Chain A, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
122.8	-65.4	-36.0	29.4
312.0	-64.0	-36.0	28.0
3907.5	-56.0	-30.0	26.0
6512.1	-54.1	-30.0	24.1
10419.4	-56.1	-30.0	26.1
20840.1	-43.3	-30.0	13.3

Tx Spurious Emissions – 802.11ac80 (SISO), Chain B, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
540.8	-65.7	-54.0	11.7
6259.0	-51.9	-30.0	21.9
6512.6	-57.2	-30.0	27.2
16351.8	-55.8	-30.0	25.8
20840.1	-44.5	-30.0	14.5

Tx Spurious Emissions – 802.11ac80 (MIMO), Chain A+B, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
672.0	-65.4	-54.0	11.4
6260.0	-52.1	-30.0	22.1
6512.6	-54.0	-30.0	24.0
10425.7	-54.9	-30.0	24.9
20840.1	-44.7	-30.0	14.7

Tx Spurious Emissions – 802.11ax80 (SISO), Chain A, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
540.8	-67.6	-54.0	13.6
3869.5	-54.6	-30.0	24.6
6474.0	-55.2	-30.0	25.2
10344.0	-44.5	-30.0	14.5
20840.1	-44.0	-30.0	14.0

Tx Spurious Emissions – 802.11ax80 (SISO), Chain B, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
841.4	-63.5	-54.0	9.5
5019.8	-45.3	-30.0	15.3
10344.0	-48.1	-30.0	18.1
20840.1	-43.8	-30.0	13.8

Tx Spurious Emissions – 802.11ax80 (MIMO), Chain A+B, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
841.2	-68.4	-54.0	14.4
1195.5	-60.1	-30.0	30.1
10343.5	-45.7	-30.0	15.7
20840.1	-44.6	-30.0	14.6

Tx Spurious Emissions – 802.11ac160 (SISO), Chain A, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
549.1	-65.9	-54.0	11.9
1018.0	-65.7	-30.0	35.7
10435.4	-54.4	-30.0	24.4
21000.0	-43.2	-30.0	13.2

Tx Spurious Emissions – 802.11ac160 (SISO), Chain B, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
841.1	-65.8	-54.0	11.8
6320.0	-51.5	-30.0	21.5
16712.9	-54.8	-30.0	24.8
21000.0	-43.3	-30.0	13.3

Tx Spurious Emissions – 802.11ac160 (MIMO), Chain A+B, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
833.0	-65.5	-54.0	11.5
1198.5	-60.4	-30.0	30.4
10450.3	-53.4	-30.0	23.4
21000.2	-44.2	-30.0	14.2

Tx Spurious Emissions – 802.11ax160 (SISO), Chain A, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
835.3	-65.6	-54.0	11.6
1196.0	-59.9	-30.0	29.9
6484.6	-53.1	-30.0	23.1
10344.0	-43.7	-30.0	13.7
21000.0	-43.3	-30.0	13.3

Tx Spurious Emissions – 802.11ax160 (SISO), Chain B, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
832.8	-63.5	-54.0	9.5
5484.5	-45.4	-30.0	15.4
6484.1	-58.9	-30.0	28.9
10343.5	-47.2	-30.0	17.2
21000.2	-43.4	-30.0	13.4

Tx Spurious Emissions – 802.11ax160 (MIMO), Chain A+B, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
672.0	-64.2	-54.0	10.2
5484.5	-44.8	-30.0	14.8
6484.1	-54.0	-30.0	24.0
10344.0	-45.2	-30.0	15.2
21000.0	-43.3	-30.0	13.3

B.9 Receiver spurious emissions

Test limits

ETSI part	Limits									
4.2.5.2	The spurious emissions of the receiver shall not exceed the limits given in table 5.									
	Table 5: Spurious emissions limits for receivers									
	<table><tr><th>Frequency range</th><th>Maximum power</th><th>Bandwidth</th></tr><tr><td>30 MHz to 1GHz</td><td>-57 dBm</td><td>100 KHz</td></tr><tr><td>1GHz to 26 GHz</td><td>-47 dBm</td><td>1 MHz</td></tr></table>	Frequency range	Maximum power	Bandwidth	30 MHz to 1GHz	-57 dBm	100 KHz	1GHz to 26 GHz	-47 dBm	1 MHz
	Frequency range	Maximum power	Bandwidth							
	30 MHz to 1GHz	-57 dBm	100 KHz							
1GHz to 26 GHz	-47 dBm	1 MHz								

Test conditions

ETSI part	Conditions
5.4.7.1	The conformance requirements in clause 4.2.5 shall be verified only under normal operating conditions, and when operating on those channels defined in clause 5.3.2. For equipment having different operating modes (see clause 5.3.3.2) the measurements described in the present clause may not need to be repeated for all the operating modes. The test method in clause 5.4.7.2 below assumes, that for the duration of the test, the UUT is configured into a continuous receive mode, or is operated in a mode where no transmissions occur.

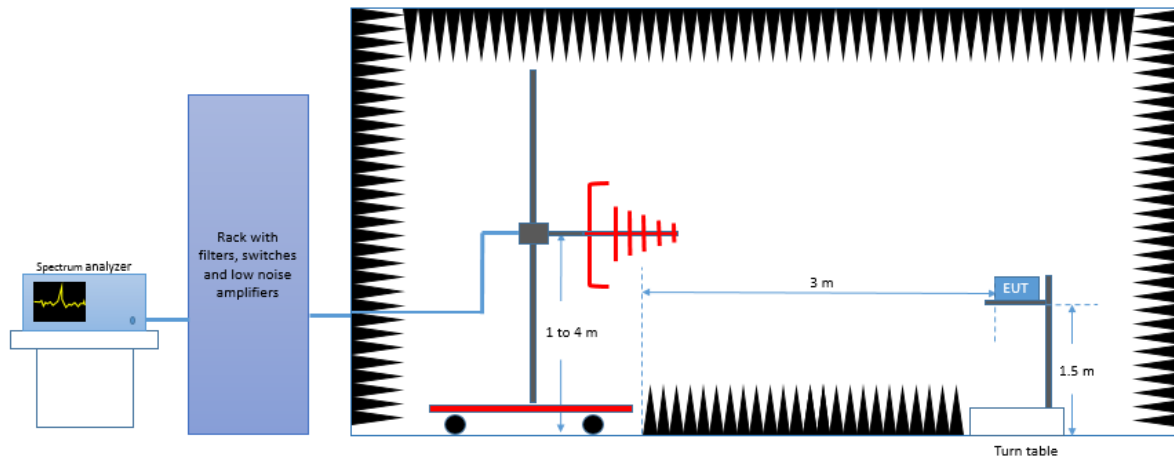
Test procedure

The setup bellow is used to measure the receiver spurious emissions. Depending of the frequency range and bands being tested, different antennas and filters were used, in consequence different setups are employed.

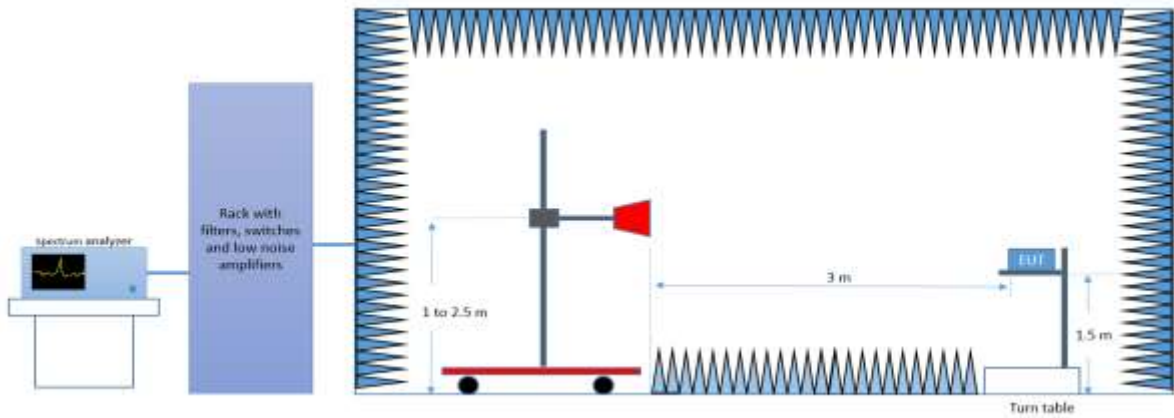
The final measurement is done by varying the antenna height, the EUT azimuth over 360° and for both Vertical and Horizontal polarizations.

The radiated spurious emission was measured on the worst case configuration on one channel for each transmission mode.

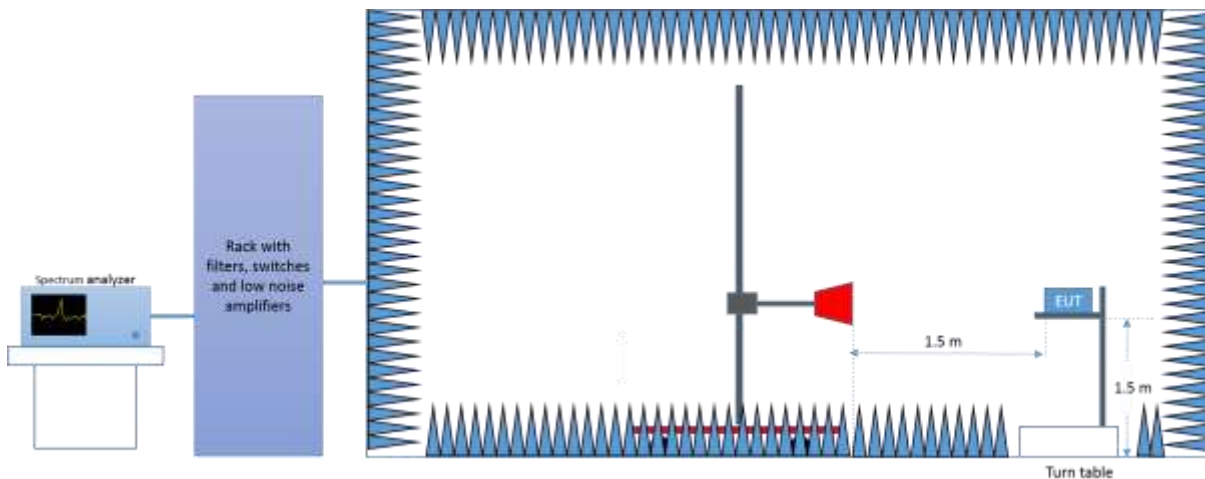
Radiated Setup 30 MHz - 1 GHz



Radiated Setup 1 GHz - 18 GHz



Radiated Setup 18 GHz - 26 GHz



Test Results Rx

Rx Spurious Emissions – 30 MHz to 26 GHz

Rx Spurious Emissions – 802.11a/n20 (MIMO), Chain A+B CH52

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
672.0	-68.2	-57.0	11.2
1222.3	-65.8	-47.0	18.8
6387.9	-58.2	-47.0	11.2
21040.0	-47.8	-47.0	0.8

Rx Spurious Emissions – 802.11b,n40 (MIMO), Chain A+B CH38F

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
672.0	-68.3	-57.0	11.3
1164.5	-64.9	-47.0	17.9
1598.3	-60.2	-47.0	13.2
1950.8	-64.9	-47.0	17.9
2329.2	-63.3	-47.0	16.3
23862.5	-55.1	-47.0	8.1

Rx Spurious Emissions – 802.11ac80 (MIMO), Chain A+B, CH42

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
408.0	-72.0	-57.0	15.0
1653.6	-64.7	-47.0	17.7
1658.5	-64.1	-47.0	17.1
1953.2	-62.9	-47.0	15.9
2350.3	-63.6	-47.0	16.6
2654.8	-63.5	-47.0	16.5
24225.8	-55.1	-47.0	8.1

Rx Spurious Emissions – 802.11ac160 (MIMO), Chain A+B, CH50

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
375.0	-69.6	-57.0	12.6
2433.0	-61.4	-47.0	14.4
15327.8	-54.0	-47.0	7.0
21000.0	-48.3	-47.0	1.3

B.10 Dynamic Frequency Selection

Test limits

ETSI part	Limits														
4.2.6.2.1	The table below lists the DFS related technical requirements and their applicability for every operational mode. If the RLAN device is capable of operating in more than one operational mode then every operating mode shall be assessed separately. <table> <tr> <th>Requirement</th><th>Slave without radar detection</th></tr> <tr> <td>Channel Availability Check</td><td>Not required</td></tr> <tr> <td>Off-Channel CAC (see note 1)</td><td>Not required</td></tr> <tr> <td>In-Service Monitoring</td><td>Not required</td></tr> <tr> <td>Channel Shutdown</td><td>✓</td></tr> <tr> <td>Non-Occupancy Period</td><td>Not required</td></tr> <tr> <td>Uniform Spreading</td><td>Not required</td></tr> </table>	Requirement	Slave without radar detection	Channel Availability Check	Not required	Off-Channel CAC (see note 1)	Not required	In-Service Monitoring	Not required	Channel Shutdown	✓	Non-Occupancy Period	Not required	Uniform Spreading	Not required
Requirement	Slave without radar detection														
Channel Availability Check	Not required														
Off-Channel CAC (see note 1)	Not required														
In-Service Monitoring	Not required														
Channel Shutdown	✓														
Non-Occupancy Period	Not required														
Uniform Spreading	Not required														
4.2.6.2.5	Channel Shutdown The Channel Move Time shall not exceed the limit defined in table D.1. The Channel Closing Transmission Time shall not exceed the limit defined in table D.1.														
Annex D	Table D.1. DFS requirement values <table> <tr> <th>Parameter</th><th>Value</th></tr> <tr> <td>Channel Move Time</td><td>10 s</td></tr> <tr> <td>Channel Closing Transmission Time</td><td>1s</td></tr> </table>	Parameter	Value	Channel Move Time	10 s	Channel Closing Transmission Time	1s								
Parameter	Value														
Channel Move Time	10 s														
Channel Closing Transmission Time	1s														

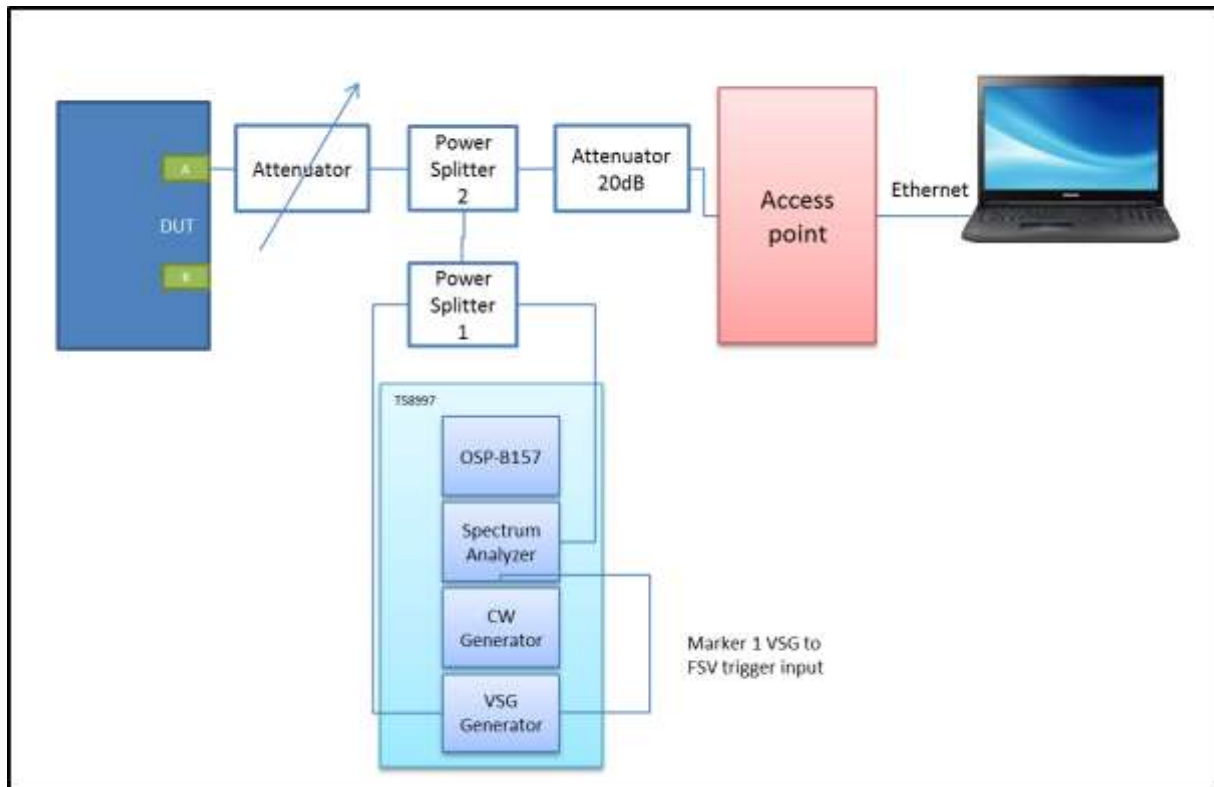
Test conditions

ETSI part	Conditions
5.4.8.1.1	The conformance requirements in clause 4.2.6 shall be verified only under normal operating conditions. The channels and the channel bandwidths to be used for testing are defined in clause 5.3.2. The UUT is capable of transmitting a test transmission sequence as described in clause 5.3.1.2. The UUT shall be configured to operate at its maximum <i>Channel Occupancy Time</i> without the use of any pauses in between transmissions.

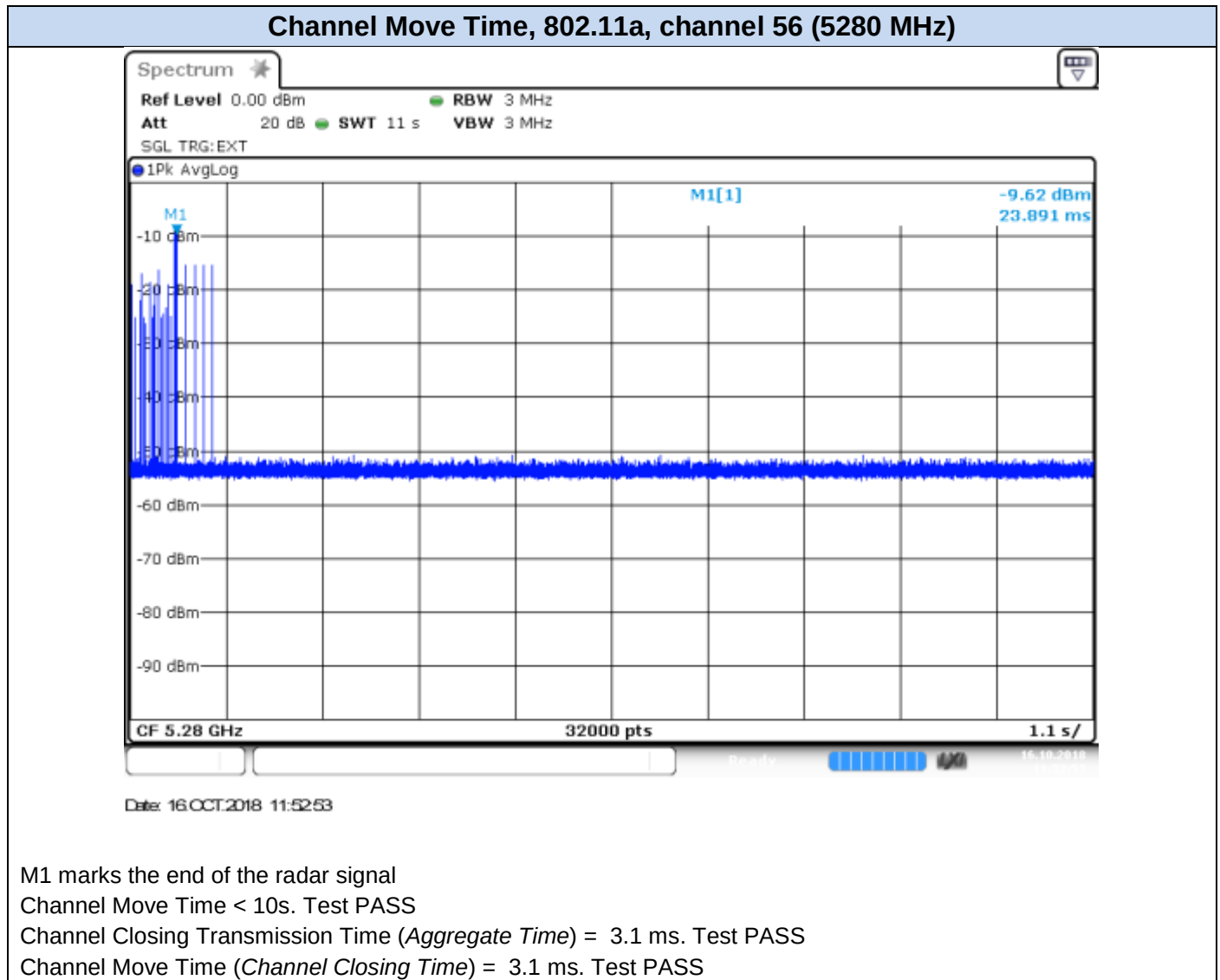
Test procedure

The setup below was used to measure the Dynamic Frequency Selection (DFS). The DUT (slave device) is connected to the access point through an attenuator and a power splitter. A laptop is connected to the access point (master device) through an Ethernet connection and it receives the broadcasted data from the DUT.

For the DFS measurement, the vector signal generator (VSG) send the reference DFS test signal to the access point. Then the access point should detected the radar, the DUT (slave) should stop its transmission on the current channel whenever instructed by the master device. All signals – master, slave, radar – are captured by the spectrum analyzer.



Results Screenshot



B.11 Adaptivity (Channel Access Mechanism)

Test limits

ETSI part	Limits
4.2.7.3.2	<i>Load Based Equipment.</i> Load based Equipment shall implement a Listen Before Talk (LBT) based Channel Access Mechanism to detect the presence of other RLAN transmissions on an Operating Channel.
4.2.7.3.2.5 Option 1	<i>ED Threshold Level.</i> For equipment that for its operation in the 5 GHz bands is conforming to IEEE 802.11™ - 2016 [9], clause 17, clause 19 or clause 21, or any combination of these clauses, the ED Threshold Level (TL) is independent of the equipment's maximum transmit power (PH). Assuming a 0 dBi receive antenna the ED Threshold Level (TL) shall be: TL = -75 dBm/MHz
4.2.7.3.3.3	<i>Short control signalling transmissions:</i> • within an observation period of 50 ms, the number of Short Control Signalling Transmissions by the equipment shall be equal to or less than 50; and • the total duration of the equipment's Control Signalling Transmissions shall be less than 2 500 µs within said observation period.

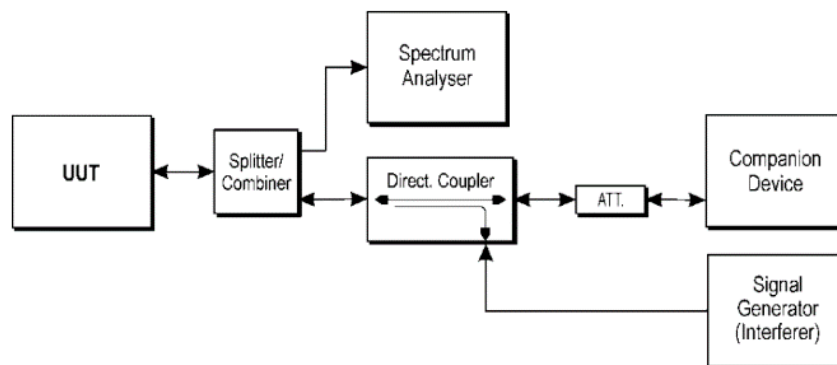
Test conditions

ETSI part	Conditions
5.4.9.1	See clause 5.1 for the test conditions. These measurements shall only be performed at normal test conditions. The channel(s) to be used for testing is defined in clause 5.3.2. The device shall be configured to operate at its maximum output power level.

Test procedure

ETSI part	Conducted measurements, verification of reaction to the interference signal.
5.4.9.2.2	It shall be verified that: - The UUT stops transmissions on the current operating channel. - Apart from Short Control Signaling Transmissions there shall be no subsequent transmissions while the interfering signal is present. - The Short Control Signalling Transmissions shall comply with the limits defined in clause 4.2.7.3.3.

The setup below was used to verify the adaptivity of the UUT.



The UUT connects to a companion device with the maximum possible payload.

The spectrum analyzer monitors the transmissions in response to three different interference signals.

These interferers are three 100% duty cycle noise signal: one Gaussian noise signal, one OFDM signal and one LTE type signal. These signals are injected on the current operating channel of the UUT

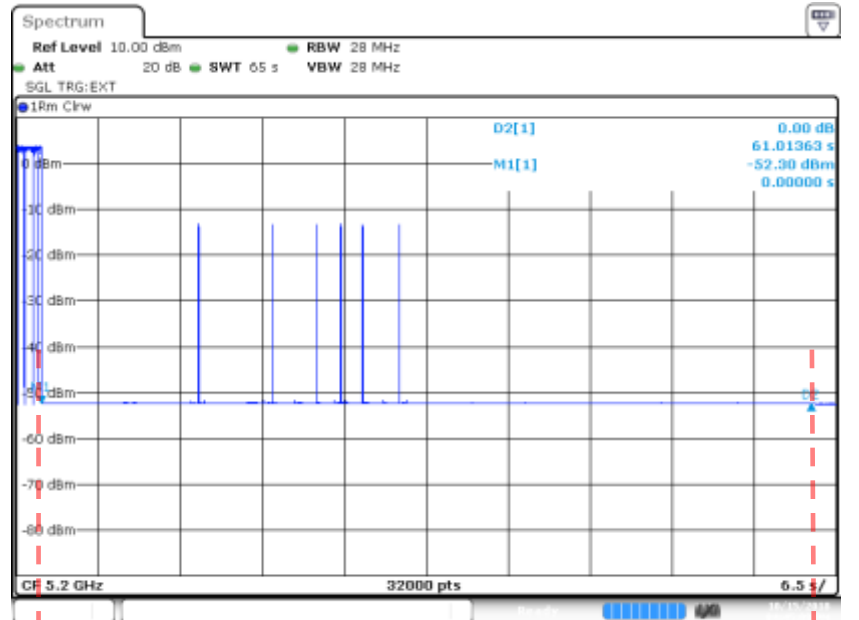
The power levels for the signals at the input of the receiver are as follows:

- Companion device= -50dBm/MHz
- Interference signal = **$TL + Antenna\ gain - Margin$** = -77dBm/MHz
 TL = -75 dBm/MHz, limit of the ED Threshold Level assuming 0dBi antenna gain
Antenna gain = Antenna gain declared by the applicant (+5dBi)
Margin = Additional margin requested by the applicant (7dB)

Results Screenshot

Verification of reaction to the interference signal

AWGN (20MHz) interference signal - 802.11a Channel 40, 6Mbps
60 seconds



Date: 15.OCT.2018 16:45:09

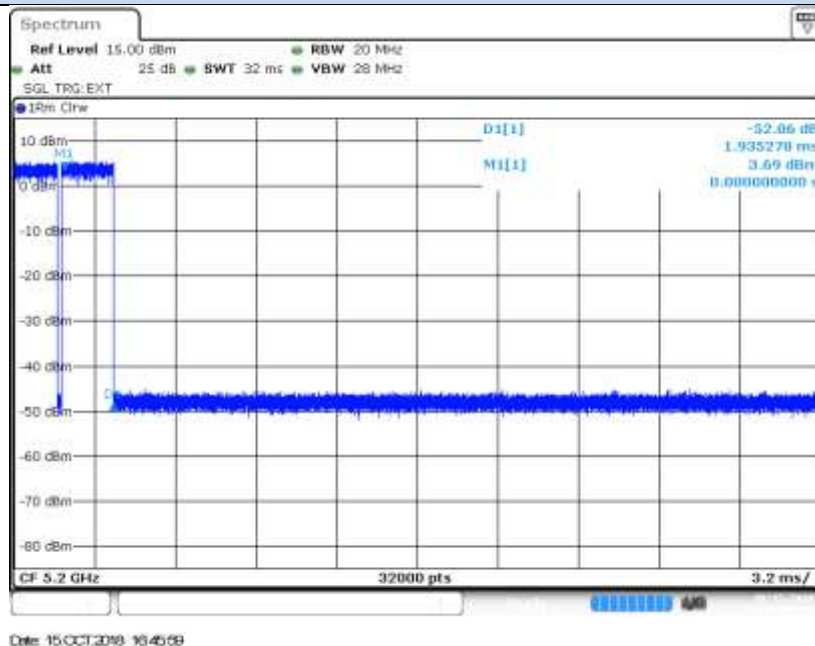
Adding
interferer

Removing
interferer

The UUT is not resuming normal transmissions as long as the interference remain present.
Some Short Control Signaling can be observed.

→ Test PASS

AWGN (20MHz) interference signal - 802.11a Channel 40, 6Mbps
32 milliseconds

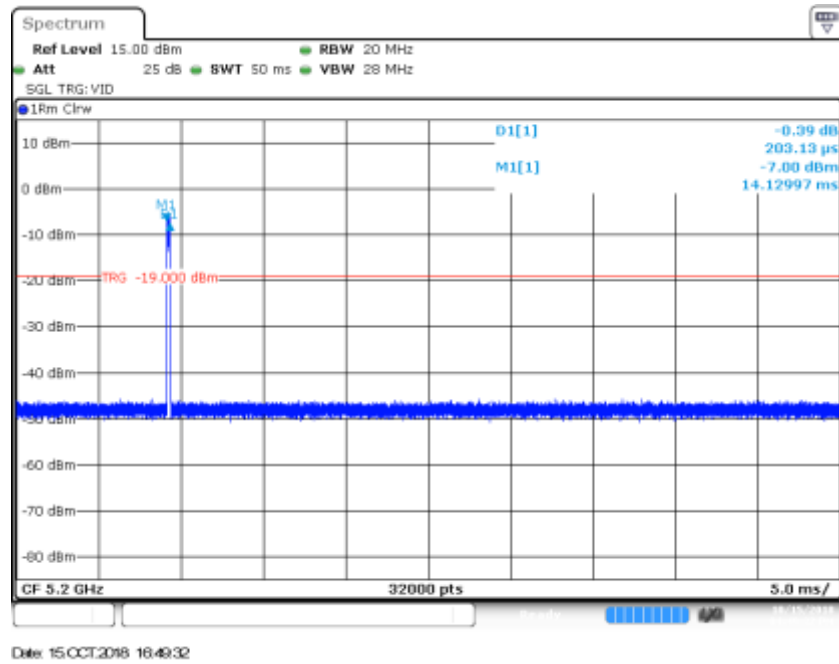


Date: 15.OCT.2018 16:45:09

M1: Shows the beginning of the interference signal
Stop Transmissions period (M1 - D1) = 1.94 ms, Limit = 6 ms (Max Channel Occupancy Time)

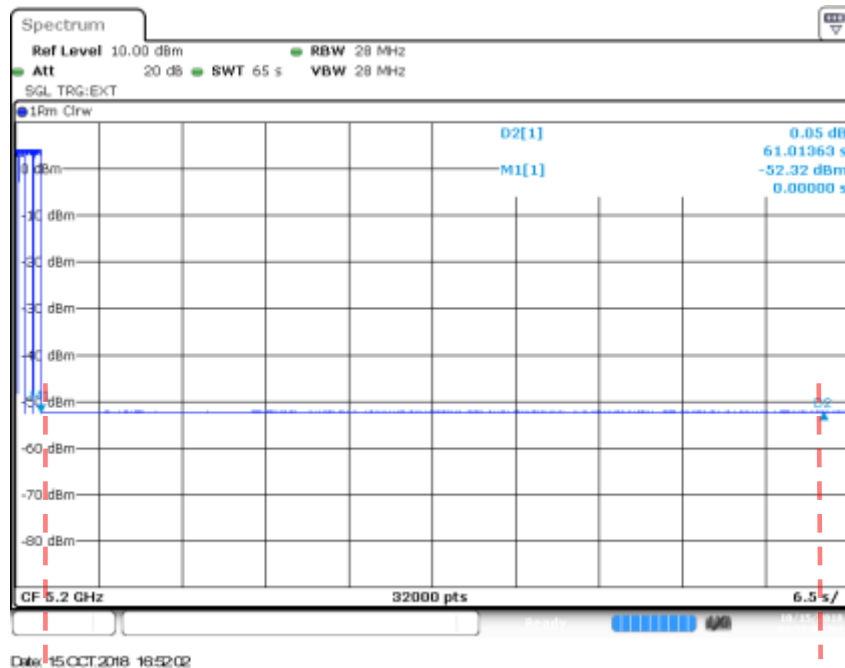
→ Test PASS

AWGN (20MHz) interference signal - 802.11a Channel 40, 6Mbps
Maximum Short control Signaling over 50 milliseconds



One burst observed, duration 203.13 μs
→ Test PASS

LTE (20MHz) interference signal - 802.11a Channel 40, 6Mbps
60 seconds



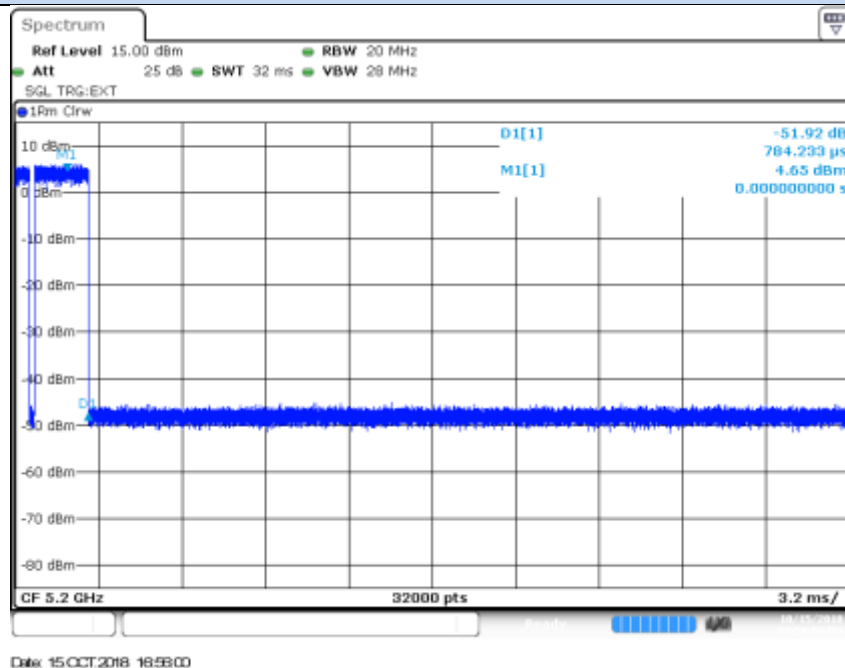
Adding
interferer

Removing
interferer

The UUT is not resuming normal transmissions as long as the interference remain present.
No Short Control Signaling can be observed.

➔ Test PASS

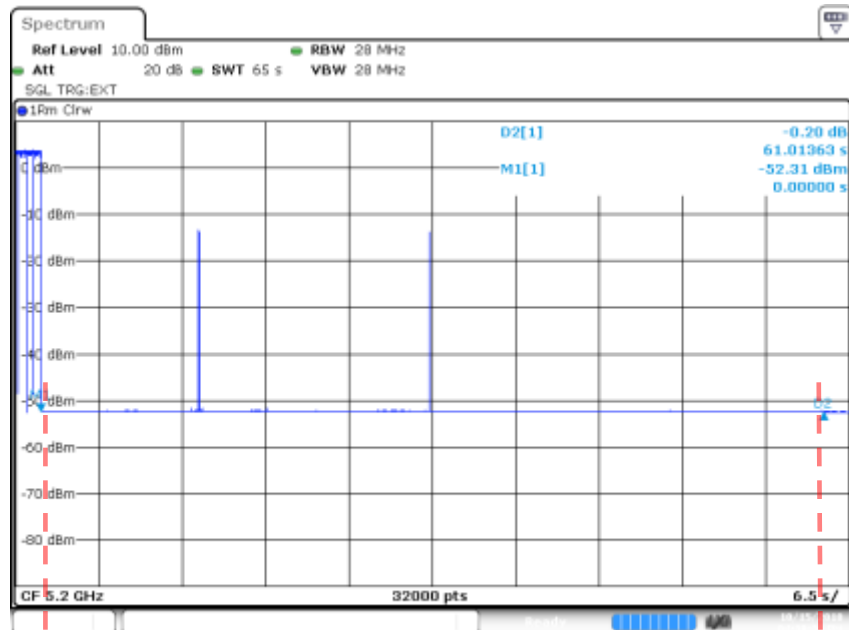
LTE (20MHz) interference signal - 802.11a Channel 40, 6Mbps
32 milliseconds



M1: Shows the beginning of the Interference signal
Stop Transmissions period (M1 - D1) = 784.23 μ s, Limit = 6 ms (Max Channel Occupancy Time)

➔ Test PASS

OFDM (20MHz) interference signal - 802.11a Channel 40, 6Mbps 60 seconds



Date: 15 OCT 2018 16:38:30

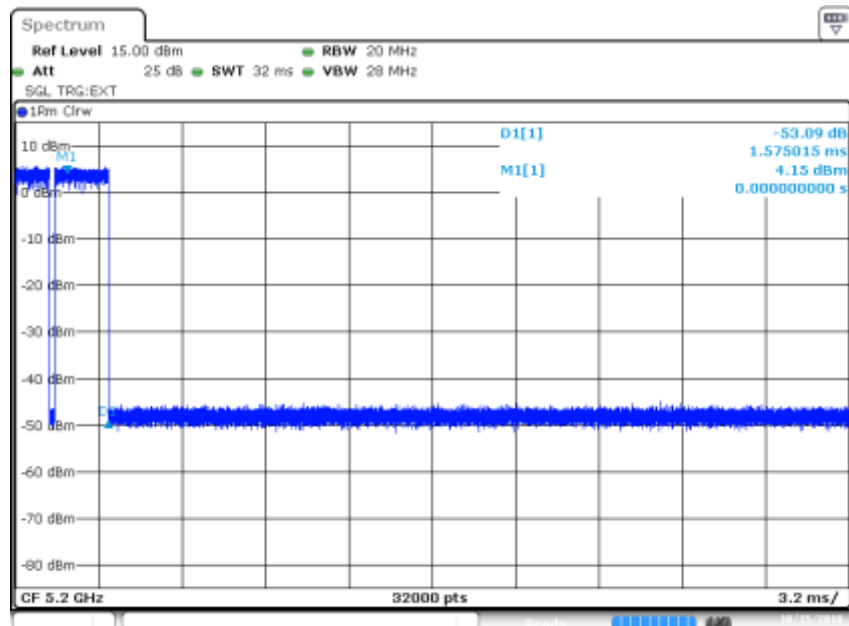
Adding
interferer

Removing
interferer

The UUT is not resuming normal transmissions as long as the interference remain present.
Some Short Control Signaling can be observed.

➔ Test PASS

OFDM (20MHz) interference signal - 802.11a Channel 40, 6Mbps 32 milliseconds

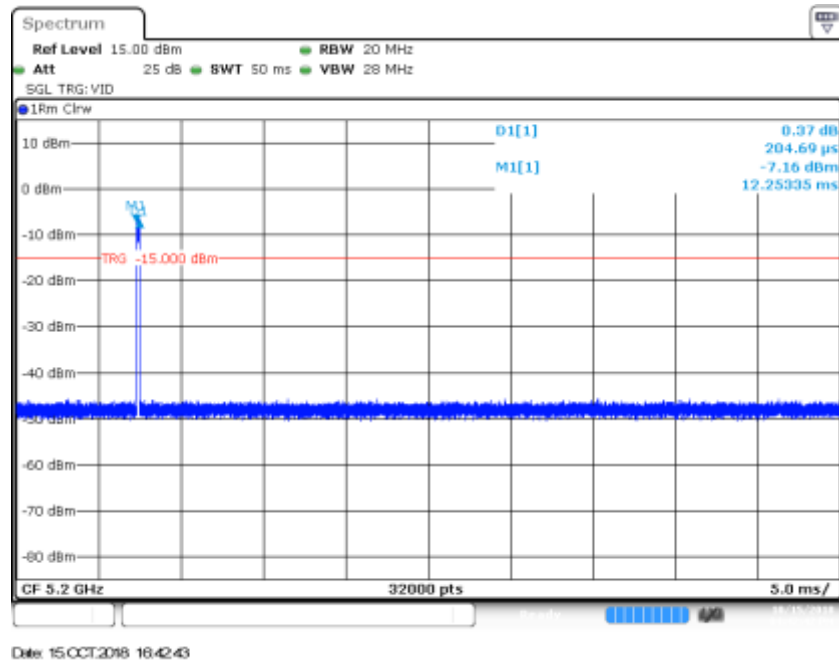


Date: 15 OCT 2018 16:39:57

M1: Shows the beginning of the Interference signal
Stop Transmissions period (M1 - D1) = 1.57 ms, Limit = 6 ms (Max Channel Occupancy Time)

➔ Test PASS

OFDM (20MHz) interference signal - 802.11a Channel 40, 6Mbps
Maximum Short control Signaling over 50 milliseconds



One burst observed, duration 204.69 μs
→ Test PASS

B.12 Receiver Blocking

Test limits

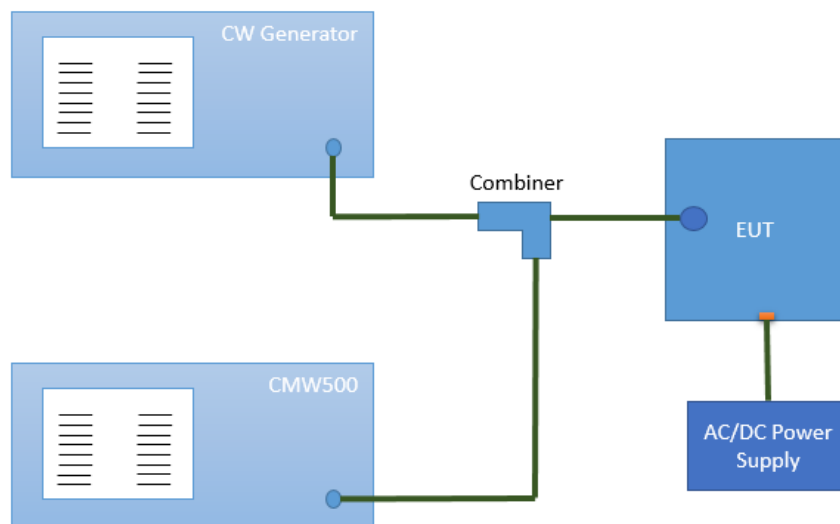
ETSI part	Limits																	
4.2.8.3 4.2.8.4	The minimum performance criterion shall be a PER of less than or equal to 10 %.																	
	While maintaining the minimum performance criteria as defined in clause 4.2.8.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined in table 9.																	
	Table 9: Receiver Blocking parameters																	
	<table><tr><th rowspan="2">Wanted signal mean power from companion device (dBm)</th><th rowspan="2">Blocking signal frequency (MHz)</th><th colspan="2">Blocking signal power (dBm) (see note 2)</th><th rowspan="2">Type of blocking signal</th></tr><tr><th>Master or Slave signal with radar detection (see table D.2, note 2)</th><th>Slave without radar detection (see table D.2, note 2)</th></tr><tr><td>Pmin + 6 dB</td><td>5 100</td><td>-53</td><td>-59</td><td>Continuous Wave</td></tr><tr><td>Pmin + 6 dB</td><td>4 900 5 000 5 975</td><td>-47</td><td>-53</td><td>Continuous Wave</td></tr></table>	Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)		Type of blocking signal	Master or Slave signal with radar detection (see table D.2, note 2)	Slave without radar detection (see table D.2, note 2)	Pmin + 6 dB	5 100	-53	-59	Continuous Wave	Pmin + 6 dB	4 900 5 000 5 975	-47	-53	Continuous Wave
	Wanted signal mean power from companion device (dBm)			Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)		Type of blocking signal											
		Master or Slave signal with radar detection (see table D.2, note 2)	Slave without radar detection (see table D.2, note 2)															
	Pmin + 6 dB	5 100	-53	-59	Continuous Wave													
Pmin + 6 dB	4 900 5 000 5 975	-47	-53	Continuous Wave														
NOTE 1:	P _{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined clause 4.2.8.3 in the absence of any blocking signal.																	
NOTE 2:	The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the same levels should be used at the antenna connector irrespective of antenna gain.																	

Test conditions

ETSI part	Conditions
5.4.10.1	These measurements shall only be performed at normal test conditions. The UUT shall operate in its normal operational mode. If the equipment can be configured to operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz) and different data rates, then the combination of the smallest channel bandwidth and the lowest data rate for this channel bandwidth which still allows the equipment to operate as intended shall be used. It shall be verified that this performance criteria as defined by the manufacturer is achieved during the blocking test.

Test procedure

The setup below was used to measure receiver blocking signal. The signaling Unit in our case is the CMW500.



The packet error rate (PER) is measured with the CMW500. The blocking signal is emulated by the Signal generator SMB100A. According to the applicant declaration, the device is considered as a slave device.

Test results

Configuration tested: 802.11a, Chain A, Channel 36, 6Mbps.

- Minimum performance result without interferer**

Wanted signal mean power from companion device: Pmin [dBm]	PER [%]
-90.00	8.45

- Minimum performance results with interferer**

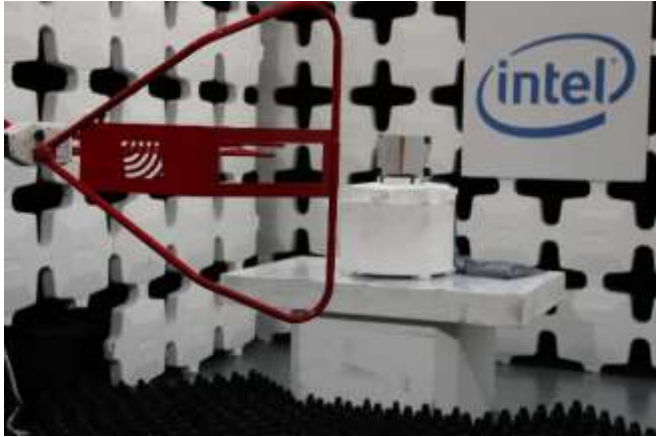
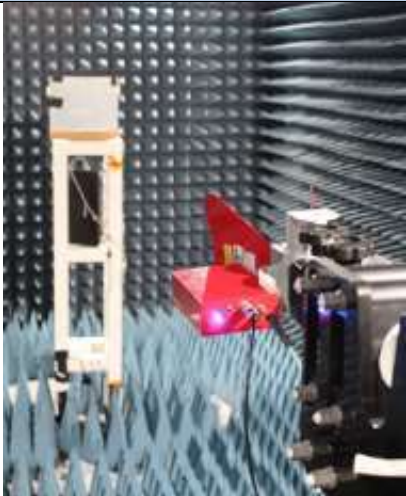
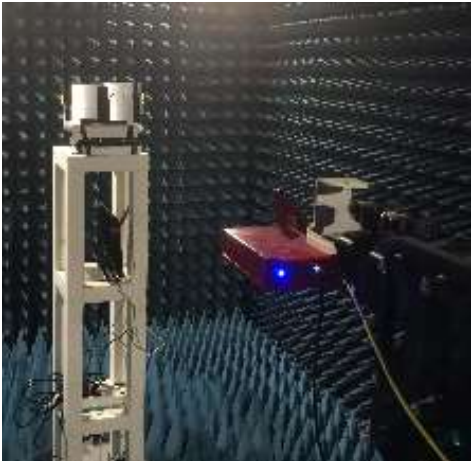
Wanted signal mean power from companion device:

✓ Pmin [dBm] + 6dB = -84.00 dBm

Blocking signal Frequency [MHz]	Blocking signal Power [dBm]	PER [%]	Verdict
5100	-59	2.30	Pass
4900	-53	0.20	Pass
5000	-53	0.95	Pass
5975	-53	0.15	Pass

Annex C. Photographs

C.1 Test Setup

Radiated Setup-1 25 MHz – 1 GHz Tx tests	Radiated Setup-1 25 MHz – 1 GHz Rx tests
	
Radiated Setup-1 1 GHz – 6.4 GHz Tx tests	Radiated Setup-2 6.4 GHz – 18 GHz Tx tests and 1 GHz – 18 GHz Rx tests
	
Radiated Setup-2 18 GHz – 26.5 GHz tests	
	



Sample #02

Module Front



Module Back

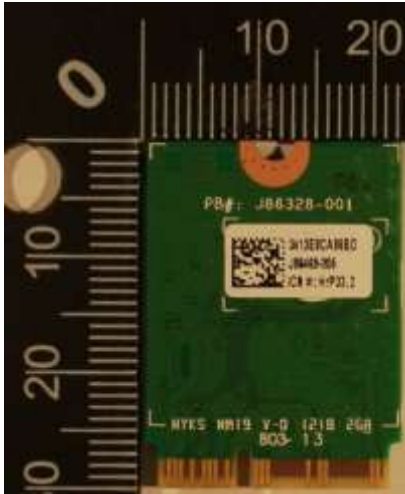


Extender board



Laptop



Sample #03	
Module Front	Module Back
	
Extender board	Laptop
	

Sample #04

Module Front



Module Back



Extender board



Laptop



Sample #05

Module Front



Module Back



Extender board



Laptop



Sample #06

Module Front



Module Back



Laptop

