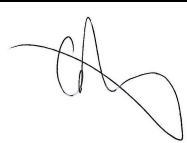


TEST REPORT

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	2018-09-13 / 2019-01-17
Features	802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth® 5 (see section 5)
Applicant	Intel Corporation SAS
Address	425 rue de Goa - Le Cargo B6 - 06600, Antibes, FRANCE
Contact Person	Laurence Peignot
Telephone/Fax/ Email	laurence.peignot@intel.com
Reference Standards	ETSI EN 300 328 v2.1.1 (see section 1)
Test Report identification	180717-02.TR14
Revision Control	Rev. 01 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
Gregory ROUSTAN
Date: 2019.01.17 18:15:03
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Gregory Roustan
(Test Engineer Lead)

Reviewed by



Digitally signed by In Cheiel
Date: 2019.01.18 15:20:17
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2015.006.30464

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1. Standards, reference documents and applicable test methods

1. ETSI EN 300 328 V2.1.1 – Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; 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 °C ±3 °C
Humidity	50% ± 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.S07	RF MODULE	AX201NGW	WFM : 3413E8CA866D	2018-09-06	Radiated Spurious emission from 30 MHz to 1 GHz
	180326-01.S03	EXTENDER	PCB00651_01	6510818-198	2018-03-27	
	170209-01.S16	LAPTOP	LATITUDE E7470	C1HTPF2	2017-02-09	
#4	180717-02.S08	RF MODULE	AX201NGW	WFM:3413E8CA8681	2018-09-06	Radiated Spurious emission from 1 GHz to 12.75 GHz
	180717-03.S18	EXTENDER	PCB00651_01	6510817-133	2018-08-21	
	170801-01.S10	LAPTOP	LATITUDE E7470	7KNOXF2	2017-09-07	

5. EUT Features

Brand Name	Intel® Wi-Fi 6 AX201		
Model Name	AX201NGW		
Software Version	OEM DRTU_08048_11_1832_0G		
Driver Version	20.70.0.2		
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	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 & 5GHz		
Additional Information			

6. Remarks and comments

According to the applicant declaration, the device AX201NGW operating in BLE mode is non adaptive equipment so it is considered as receiver category 2.

7. Test Verdicts summary

7.1. BT Low Energy

Mode	ETSI part	Test	Verdict
2.4GHz	4.3.2.2	RF output power	P
	4.3.2.3	Power spectral density	P
	4.3.2.4	Duty Cycle, Tx-sequence, TX gap	NA
	4.3.2.5	Medium Utilization (MU) factor.	NA
	4.3.2.6	Adaptivity (adaptive equipment using modulations other than FHSS)	NA
	4.3.2.7	Occupied Channel Bandwidth	P
	4.3.2.8	Transmitter unwanted emissions in the out-of-band domain	P
	4.3.2.9	Transmitter unwanted emissions in the spurious domain	P
	4.3.2.10	Receiver spurious emissions	P
	4.3.2.11	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	M.Lefebvre A. Hagrass	First Issue
Rev. 01	2018-01-17	G.Roustan	Corrected wrong results values in section B.2 & B.3

Annex A. Test & System Description

A.1 Measurement System

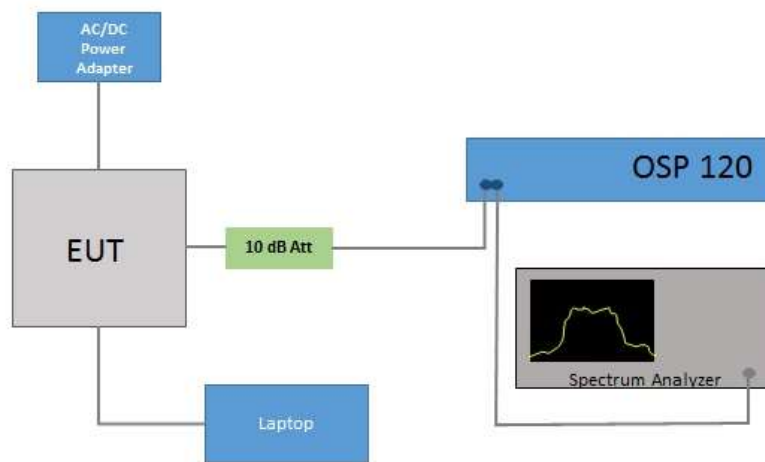
Bluetooth LE does not fulfill the FHSS requirements in clause §4.2.1. Instead, ETSI classifies Bluetooth LE as a system using DSSS modulation. Measurements were performed using the following setups and made in accordance to the general provisions of ETSI EN 300 328 V2.1.1 agreeing to the requirements for DSSS modulation.

Rohde & Schwarz TS8997 system with the switching unit OSP120, OSP B-157 and software EMC32 were employed.

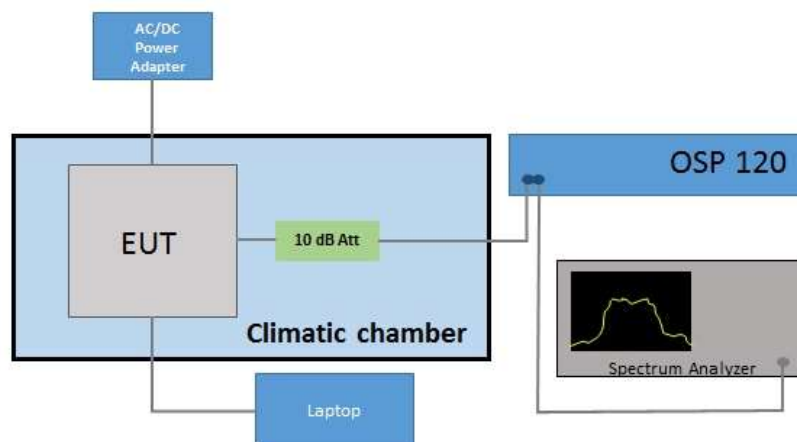
The DUT was installed in a test fixture and then connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using the Intel proprietary tool DRTU.

Setups for conducted and radiated measurements are shown below.

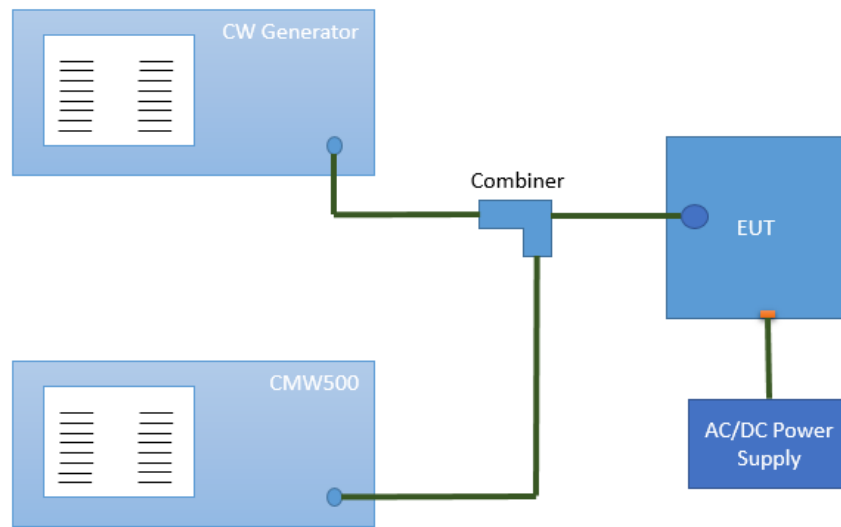
Conducted Setup (Normal condition)



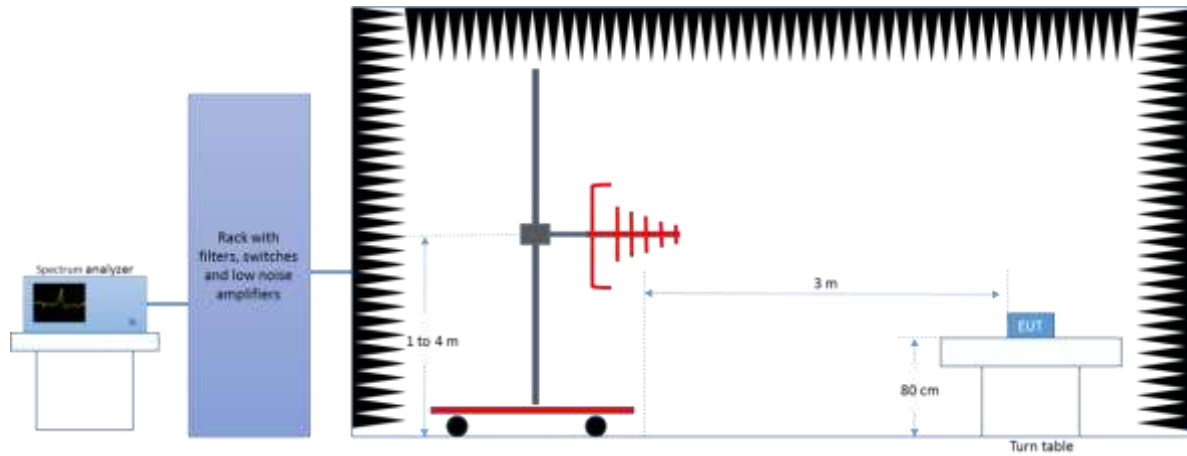
Conducted Setup (Extreme conditions)



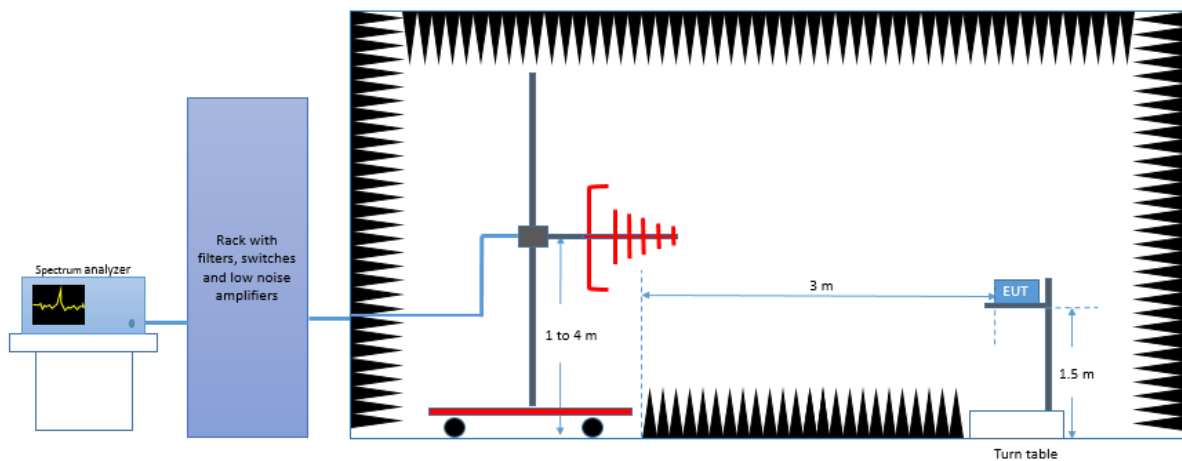
Receiver Blocking Setup



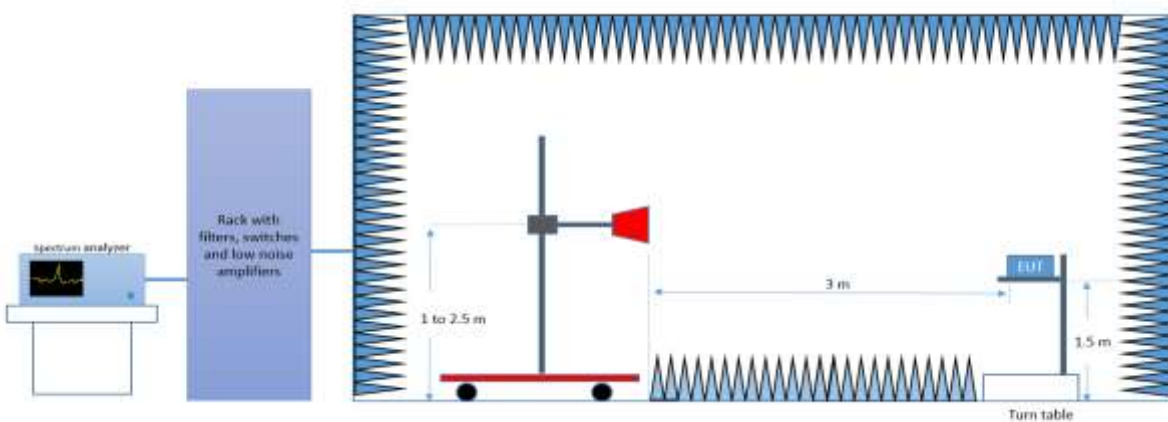
Radiated Setup 30MHz -1 GHz (Transmitter Tests)



Radiated Setup 30MHz -1 GHz (Receiver Tests)



Radiated Setup 1 GHz - 12.75 GHz



A.2 Test Equipment List

Conducted Setup-1

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

Conducted Setup-2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
0316	Spectrum analyzer	FSV30	103309	Rohde & Schwarz	2017-09-22	2019-09-22
0056	Switch unit	OSP 120	100834 / 101172 / 18C0B45	Rohde & Schwarz	N/A	N/A
0300	Climatic chamber	SLT34/40	56746020930010	SECASI	2017-03-09	2019-03-09
R049	Measurement Software	EMC32 v9.22.00	008224	Rohde & Schwarz	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 emulator	CMW500	129337	Rohde & Schwarz	2017-07-18	2019-07-18

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
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
0138	Double Ridged Horn antenna 1 GHz – 18 GHz	3117	00152266	ETS Lindgren	2018-03-29	2020-03-29
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
0618	Power Sensor 50MHz-18GHz	NRP-Z81	104382	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 [±dB]
Conducted Power	±1.0
Conducted spurious emission	±2.9
Radiated test < 1GHz	±3.8
Radiated test 1GHz - 40 GHz	±4.7

Annex B. Test Results

B.1 Test Conditions

ETSI part	Conditions	ETSI EN 300 328 v2.1.1 Annex E
5.1.2.1	The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges: • Temperature: +15 °C to +35 °C; • Relative humidity: 20 % to 75 %.	
5.1.2.2	The normal test voltage for the equipment shall be the nominal voltage for which the equipment was designed.	
5.1.3	Some tests in the present document need to be repeated at extreme temperatures. Where that is the case, measurements shall be made over the extremes of the operating temperature range as declared by the manufacturer.	

B.2 RF output power

Test limits

ETSI part	Limits
4.3.2.2.3	For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm (E.I.R.P.). This limit shall apply for any combination of power level and intended antenna assembly.

Test conditions

ETSI part	Conditions
5.4.2.1	The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range. For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest, the middle, and the highest channel on which the equipment can operate.

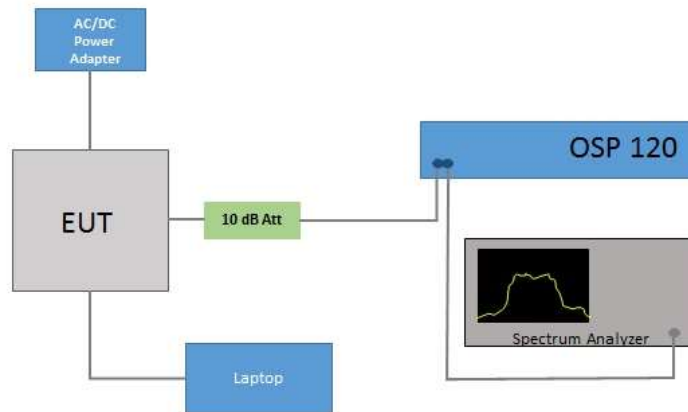
Test procedure

The setup below was used to measure the RF output power. The antenna terminal of the EUT is connected to the OSP120 through a 10dB attenuator and a cable, the spectrum analyzer is connected to the receiver port of the OSP. System connection cable loss is compensated by the EMC32 software

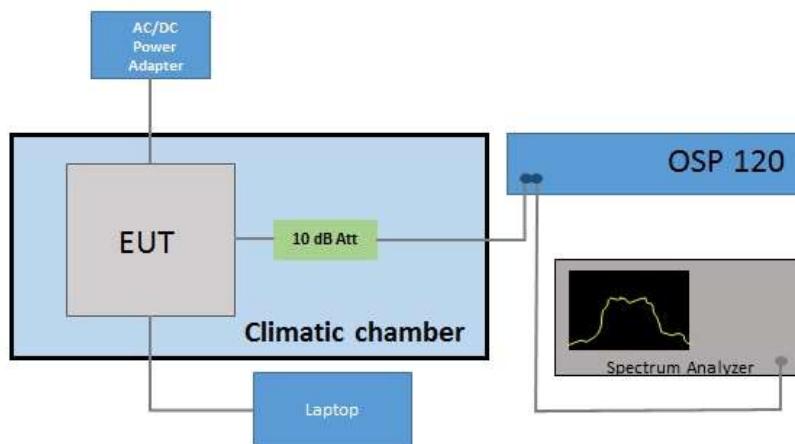
Antenna gain is taken in account and added by the software to the measurements. The EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

The declared maximum antenna gain is +3dBi.

Conducted Setup (Normal Conditions)



Conducted Setup (Extreme conditions)



Results tables

Normal conditions

Temperature: 24°C ± 1°C

Humidity: 37% ± 2%

Antenna gain: +3dBi

Mode	Meas. Duty Cycle [%]	Channel	Freq. [MHz]	Power [dBm]	
				Measured Conducted	EIRP
BLE	62.9	0	2402	6.3	9.3
		20	2442	6.3	9.3
		39	2480	6.1	9.1

Extreme temperature conditions (Tmax = +70°C)

Antenna gain: +3 dBi

Mode	Meas. Duty Cycle [%]	Channel	Freq. [MHz]	Power [dBm]	
				Measured Conducted	EIRP
BLE	62.9	0	2402	5.6	8.6
		20	2442	5.6	8.6
		39	2480	5.4	8.4

Extreme temperature conditions (Tmin = -10°C)

Antenna gain: +3dBi

Mode	Meas. Duty Cycle [%]	Channel	Freq. [MHz]	Power [dBm]	
				Measured Conducted	EIRP
BLE	62.9	0	2402	6.7	9.7
		20	2442	6.7	9.7
		39	2480	6.6	9.6

B.3 Power Spectral Density

Test limits

ETSI part	Limits
4.3.2.3.3	For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz.

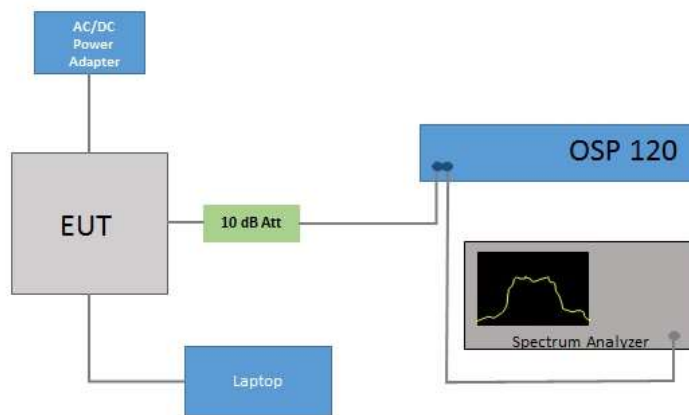
Test conditions

ETSI part	Conditions
5.4.3.1	These measurements shall only be performed at normal test conditions. The measurement shall be repeated for the equipment being configured to operate at the lowest, the middle, and the highest frequency of the stated frequency range. For the duration of the test, the equipment shall not change its operating frequency.

Test procedure

The setup below was used to measure the power spectral density (PSD) accordingly to the test method described in EN 300 328 V2.1.1 §5.4.3.2.1. The antenna terminal of the EUT is connected to the OSP120 through a 10dB 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.

Conducted Setup (Normal Conditions)



Results tables

Normal conditions

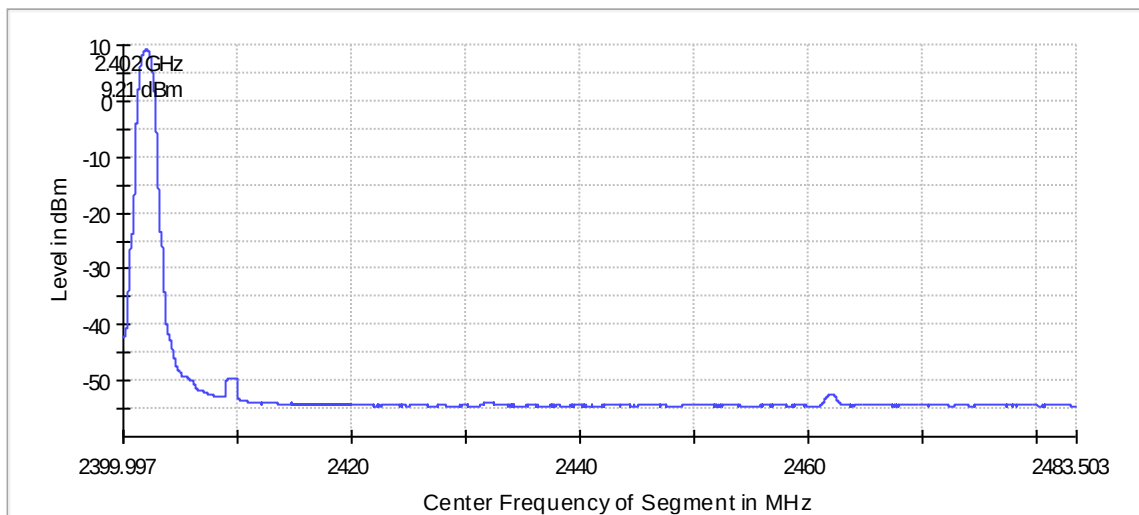
Temperature: 24°C ± 1°C
 Humidity: 37% ± 2%
 Antenna gain: +3dBi

Mode	Meas. Duty Cycle [%]	Channel	Freq. [MHz]	PSD [dBm/MHz]
BLE	62.64	0	2402	9.2
		20	2442	9.2
		39	2480	9.0

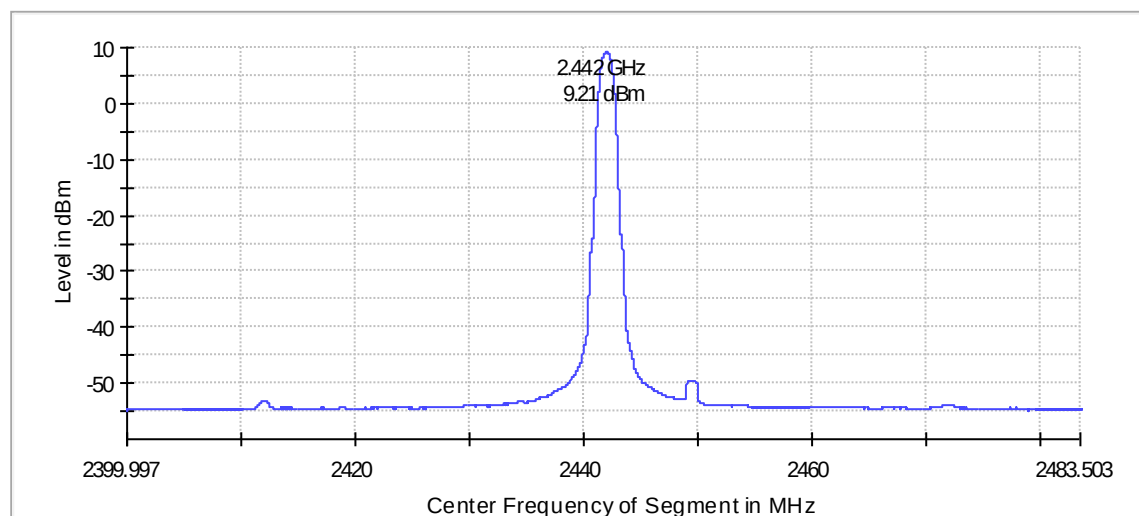
Results screenshot

BLE

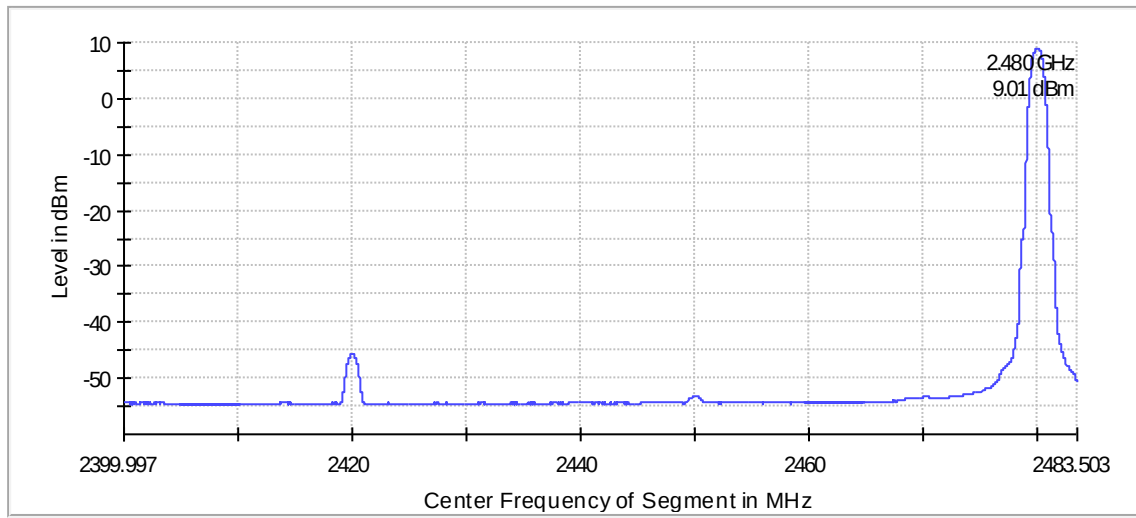
PSD – Channel 0



PSD – Channel 20



PSD – Channel 39



B.4 Occupied Channel Bandwidth

Tests limits

ETSI part	Limits						
4.3.2.7.3	The Occupied Channel Bandwidth shall fall completely within the band given in Table 1 (2.4 GHz to 2.4835 GHz). Table 1: Service frequency bands <table> <tr> <th></th><th>Service frequency bands</th></tr> <tr> <td>Transmit</td><td>2 400 MHz to 2 483,5 MHz</td></tr> <tr> <td>Receive</td><td>2 400 MHz to 2 483,5 MHz</td></tr> </table> In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.		Service frequency bands	Transmit	2 400 MHz to 2 483,5 MHz	Receive	2 400 MHz to 2 483,5 MHz
	Service frequency bands						
Transmit	2 400 MHz to 2 483,5 MHz						
Receive	2 400 MHz to 2 483,5 MHz						

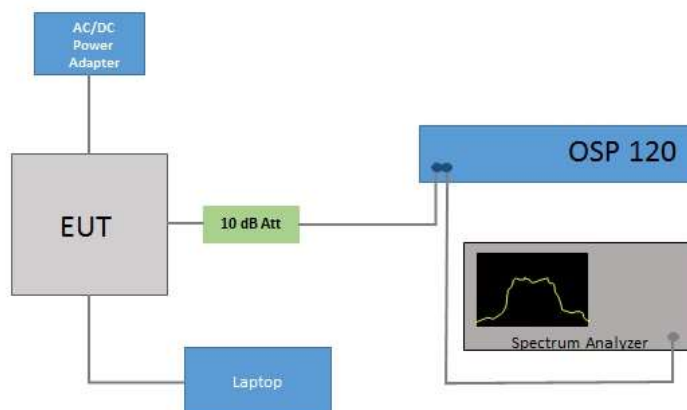
Test conditions

ETSI part	Conditions
5.4.7.1	These measurements shall only be performed at normal test conditions. In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains) measurements need only to be performed on one of the active transmit chains (antenna outputs). The measurement shall be performed only on the lowest and the highest frequency within the stated frequency range. If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

Test procedure

The setup below was used to measure the occupied bandwidth accordingly to the test method described in EN 300 328 V2.1.1 §5.4.7.2.1. The antenna terminal of the EUT is connected to the OSP120 through a 10 dB 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.

Conducted Setup (Normal Conditions)



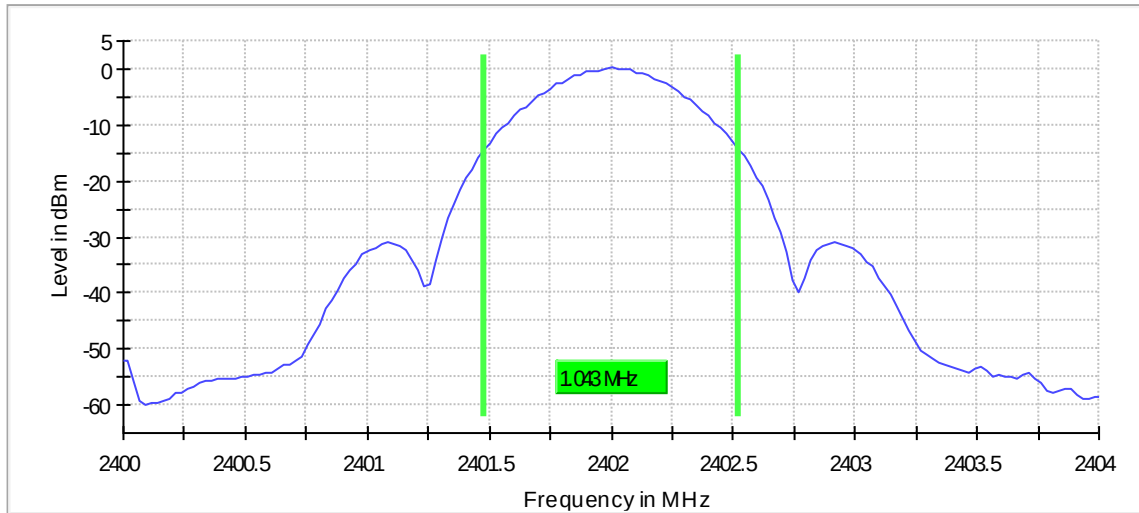
Results tables

Mode	CH	Frequency [MHz]	Channel Nominal Bandwidth (MHz)	Channel Center Frequency (MHz)	Occupied Channel Bandwidth (MHz)	Lower Band Edge (MHz)	Upper Band Edge (MHz)
BLE	0	2402	1.00	2402.0	1.043478	2401.478261	2402.521739
	39	2480	1.00	2480.0	1.043478	2479.478261	2480.521739

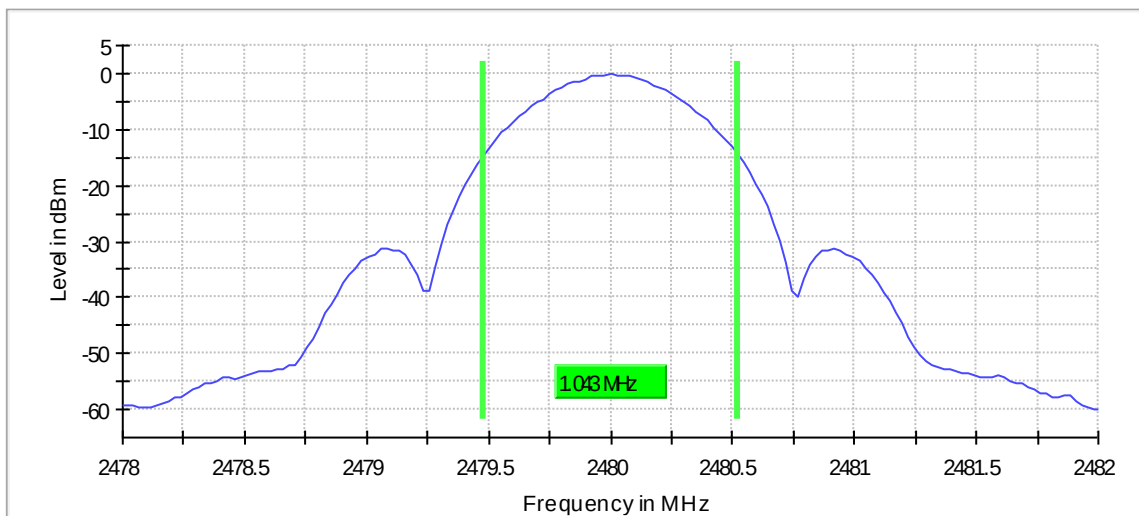
Results screenshot

BLE

OBW – Channel 0

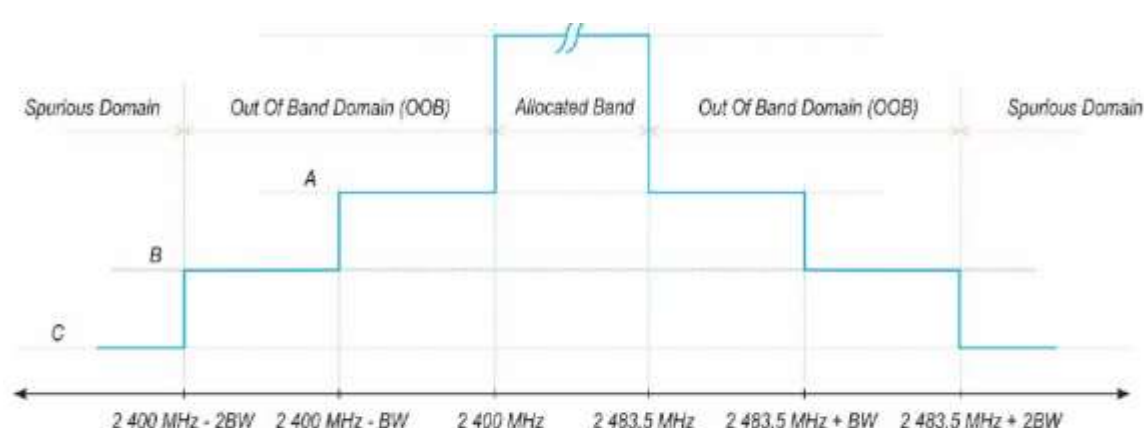


OBW – Channel 39



B.5 Transmitter unwanted emission in the out-of-band domain

Test limits Test limits

ETSI part	Limits
4.3.2.8.3	The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask below  A: -10 dBm/MHz e.i.r.p. B: -20 dBm/MHz e.i.r.p. C: Spurious Domain limits BW = Occupied Channel Bandwidth in MHz or 1 MHz whichever is greater

Test conditions

ETSI part	Conditions
5.3.8.1	These measurements shall only be performed at normal test conditions. For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate. The equipment shall be configured to operate under its worst case situation with respect to output power. If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then each channel bandwidth shall be tested separately.

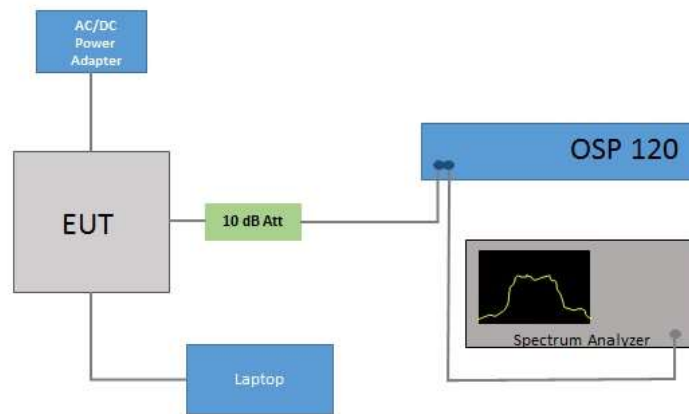
Test procedure

The setup below was used to measure the unwanted emissions in the out of band domain accordingly to the test method described in EN 300 328 V2.1.1 §5.4.9.2.1. The antenna terminal of the EUT is connected to the OSP120 through a 10dB 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 into account and added by the software to the measurements. The declared maximum antenna gain is +3dBi.

EMC32 provides the mask and the frequency limits based in the measured channel bandwidth. Maximum values for each limit level (-10dBm and -20dBm) are pointed using markers.

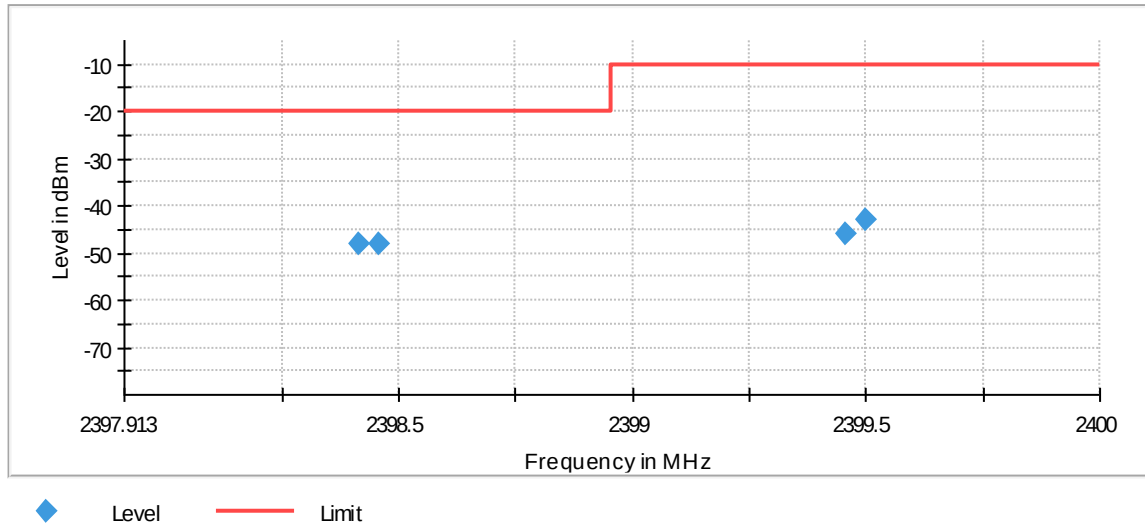
Conducted Setup (Normal Conditions)



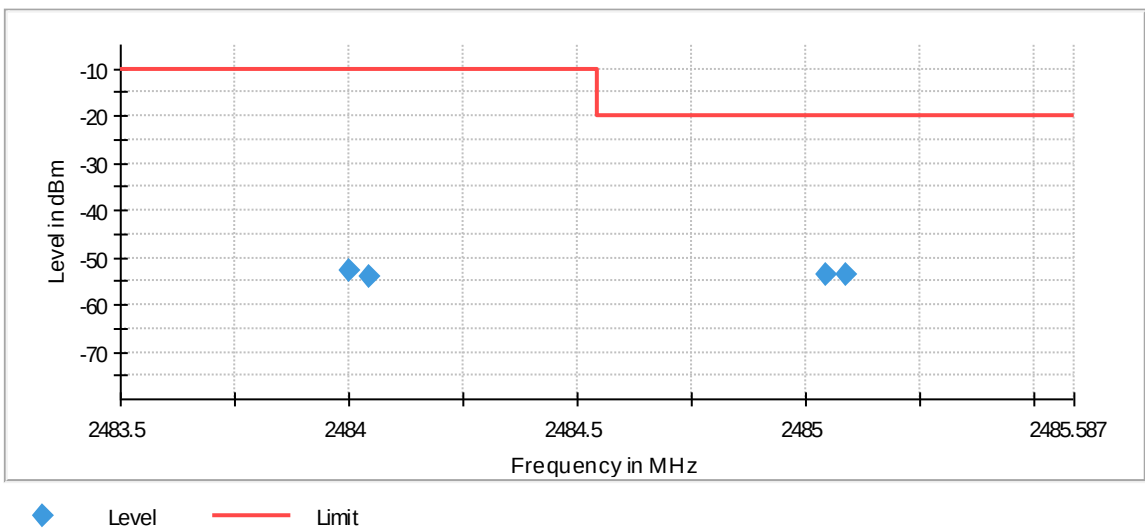
Results Screenshot

BLE

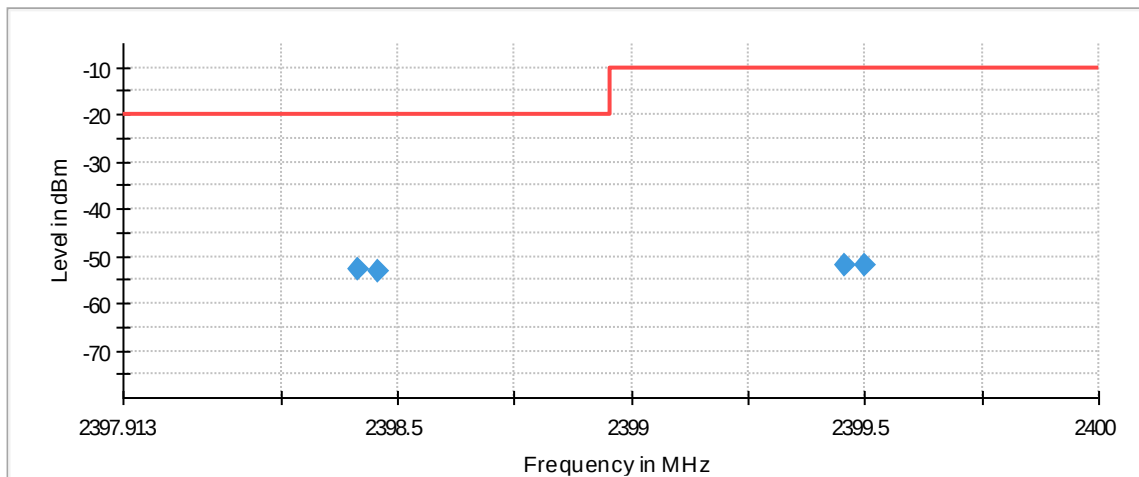
UNWANTED OOB Low Freq Section, Channel 0



UNWANTED OOB High Freq Section, Channel 0

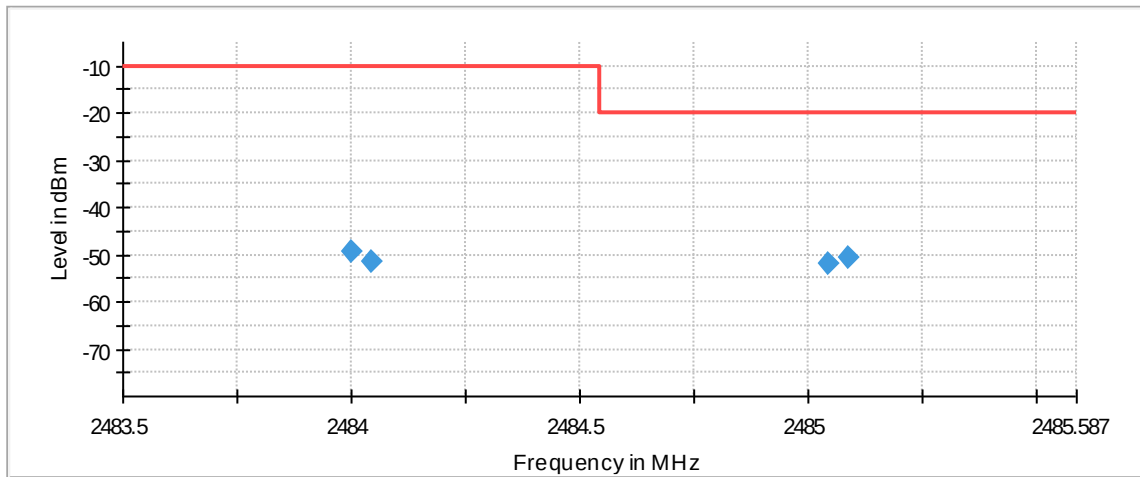


UNWANTED OOB Low Freq Section, Channel 39



◆ Level — Limit

UNWANTED OOB High Freq Section, Channel 39



◆ Level — Limit

B.6 Transmitter unwanted emissions in the spurious domain

Test limits

ETSI part	Limits																																	
4.3.2.9.3	The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table below.																																	
	<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 12.75 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 12.75 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 12.75 GHz	-30 dBm	1 MHz																																

Test conditions

ETSI part	Conditions
5.4.9.1	These measurements shall only be performed at normal test conditions.
	For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate.
	The equipment shall be configured to operate under its worst case situation with respect to output power.
	If the equipment can operate with different Nominal Channel Bandwidths (e.g. 20 MHz and 40 MHz), then the equipment shall be configured to operate under its worst case situation with respect to spurious emissions.

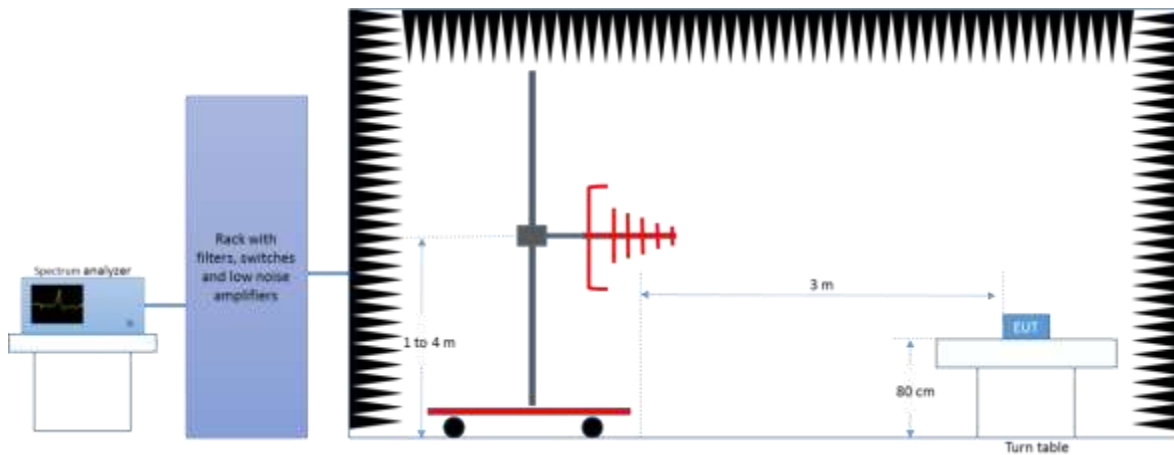
Test procedure

The setup below is used to measure the transmission spurious emissions accordingly with ETSI EN 300 328 V2.1.1 § 5.4.9.2.2. Depending of the frequency range and bands being tested, different antennas and filters were used; in consequence different setups are employed.

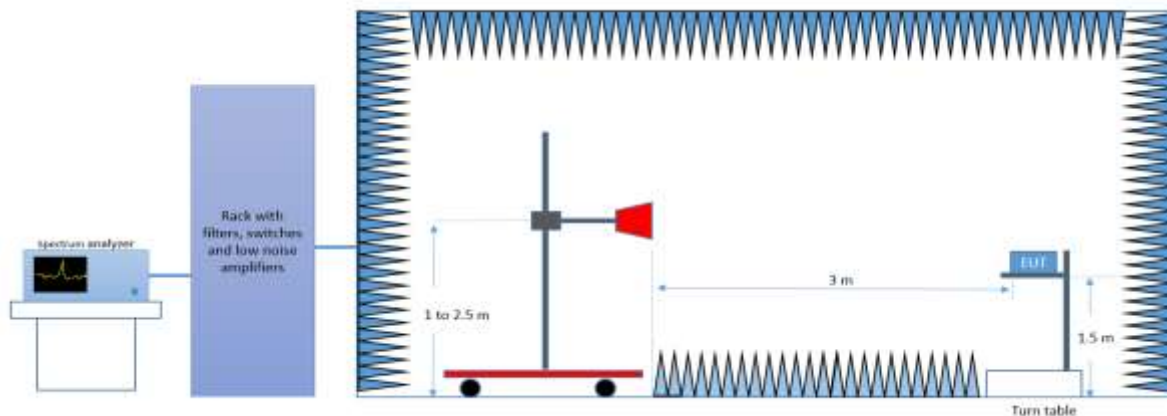
The final measurement is done by varying the antenna height from 1 to 4 meters, the EUT azimuth over 360° and for both Vertical and Horizontal polarizations.

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

Radiated Setup 30MHz- 1GHz



Radiated Setup 1GHz – 12.75GHz



Test Results

Tx Spurious Emissions – 30MHz to 12.75GHz

Tx Spurious Emissions – Bluetooth BLE , CH0

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
128.2	-69.9	-36.0	33.9
829.5	-67.8	-54.0	13.8
3387.5	-45.7	-30.0	15.7
12701.2	-54.6	-30.0	24.6

Tx Spurious Emissions – Bluetooth BLE , CH39

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
128.1	-74.2	-36.0	38.2
624.0	-65.2	-54.0	11.2
3395.5	-46.0	-30.0	16.0
12695.4	-54.4	-30.0	24.4

B.7 Receiver spurious emissions

Test limits

ETSI part	Limits								
4.3.2.10.3	The spurious emissions of the receiver shall not exceed the values given in table 13.								
	For emissions radiated by the cabinet or for emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.								
	Table 13: Spurious emission 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 12.75 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 12.75 GHz	-47 dBm
Frequency range	Maximum power	Bandwidth							
30 MHz to 1GHz	-57 dBm	100 kHz							
1GHz to 12.75 GHz	-47 dBm	1 MHz							

Test conditions

ETSI part	Conditions
5.3.10.1	These measurements shall only be performed at normal test conditions. Testing shall be performed when the equipment is in a receive-only mode. For equipment using wide band modulations other than FHSS, the measurement shall be performed at the lowest and the highest channel on which the equipment can operate.

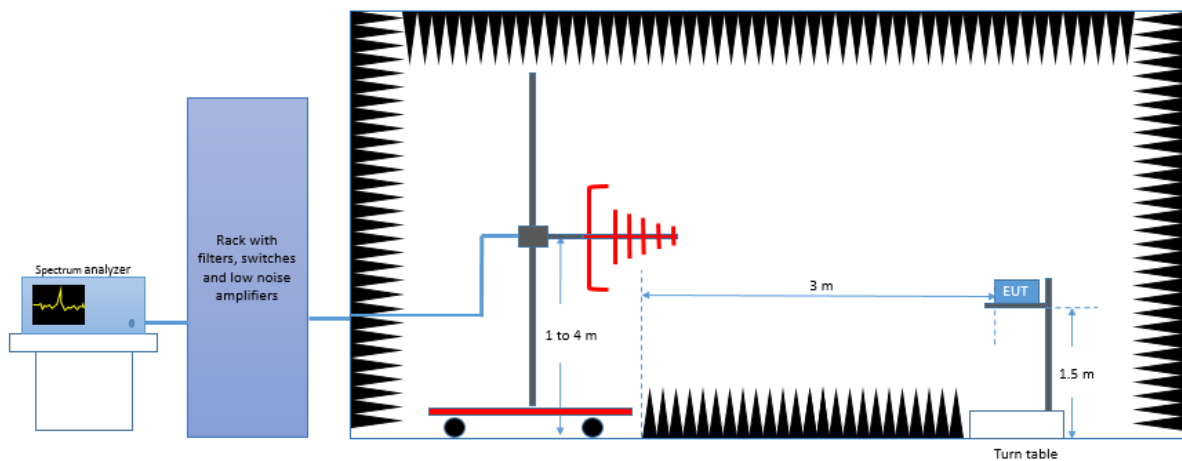
Test procedure

The setup below is used to measure receiver spurious emissions accordingly with ETSI EN 300 328 V2.1.1 § 5.4.10.2.2. Depending of the frequency range and bands being tested, different antennas and filters were used.

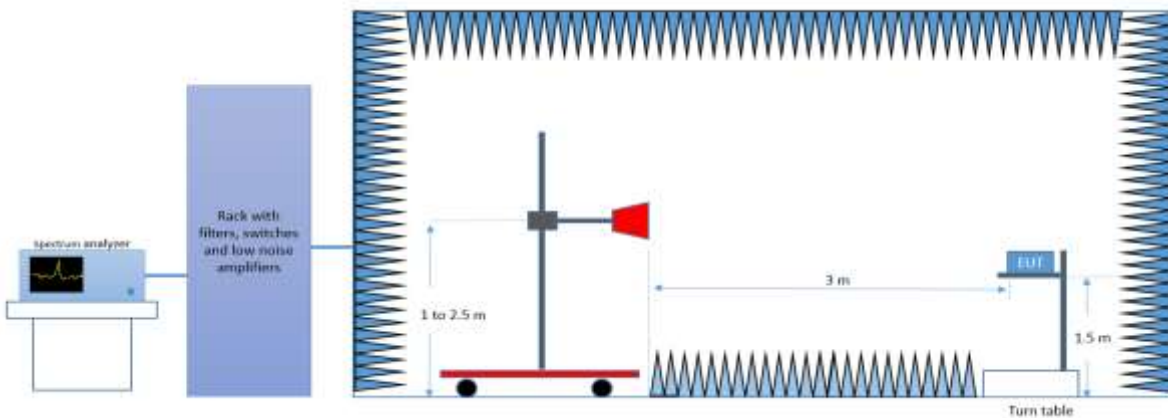
The final measurement is done by varying the antenna height from 1 to 4 meters, the EUT azimuth over 360° and for both Vertical and Horizontal polarizations.

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

Radiated Setup 30 MHz - 1 GHz



Radiated Setup 1 GHz - 12.75 GHz



Test Results

Rx Spurious Emissions – 30MHz to 12.75GHz

Rx Spurious Emissions – Bluetooth BLE , CH0

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
62.3	-66.5	-57.0	9.5
1166.5	-66.9	-47.0	19.9
1289.3	-67.0	-47.0	20.0
1330.0	-62.9	-47.0	15.9
2018.3	-63.7	-47.0	16.7
2089.8	-63.5	-47.0	16.5
2165.2	-60.5	-47.0	13.5

Rx Spurious Emissions – Bluetooth BLE , CH39

Frequency	RMS	Limit	Margin
MHz	dBm	dBm	dB
62.4	-66.5	-57.0	9.5
1163.0	-66.6	-47.0	19.6
1328.5	-62.9	-47.0	15.9
1332.9	-62.2	-47.0	15.2
2127.5	-62.7	-47.0	15.7
2162.3	-63.9	-47.0	16.9

B.8 Receiver Blocking

Test limits

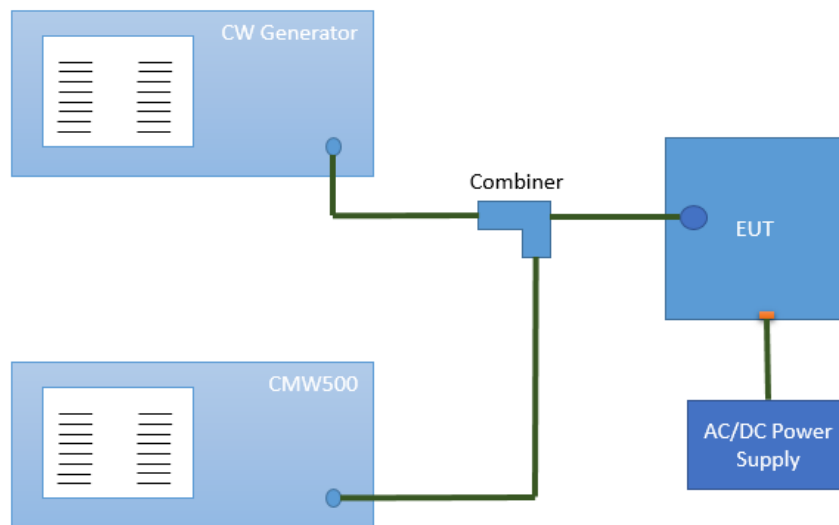
ETSI part	Limits												
4.3.2.11.3	The minimum performance criterion shall be a PER less than or equal to 10 %.												
4.3.2.11.4	While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table below. Receiver blocking parameters for Receiver Category 2 equipment <table><tr><th>Wanted signal mean power from companion device (dBm)</th><th>Blocking signal frequency (MHz)</th><th>Blocking signal power (dBm) (see note 2)</th><th>Type of blocking signal</th></tr><tr><td>$P_{\min} + 6 \text{ dB}$</td><td>2 380 2 503,5</td><td>-57</td><td>CW</td></tr><tr><td>$P_{\min} + 6 \text{ dB}$</td><td>2 300 2583.5</td><td>-47</td><td>CW</td></tr></table> NOTE 1: $P_{\min}$ is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 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 levels have to be corrected by the actual antenna assembly gain.	Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal	$P_{\min} + 6 \text{ dB}$	2 380 2 503,5	-57	CW	$P_{\min} + 6 \text{ dB}$	2 300 2583.5	-47	CW
Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal										
$P_{\min} + 6 \text{ dB}$	2 380 2 503,5	-57	CW										
$P_{\min} + 6 \text{ dB}$	2 300 2583.5	-47	CW										

Test conditions

ETSI part	Conditions
5.4.11.1	These measurements shall only be performed at normal test conditions. For non-frequency hopping equipment, having more than one operating channel, the equipment shall be tested operating at both the lowest and highest operating channels. It shall be verified that this performance criteria as declared by the manufacturer is achieved.

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.

The declared antenna gain is +3dBi.

Test results

Configuration tested: BLE, Chain A, Channel 0

Minimum performance result without interferer

Wanted signal mean power from companion device: Pmin [dBm]	PER [%]
-94.00	9.76

Minimum performance results with interferer

Wanted signal mean power from companion device:

✓ Pmin [dBm] + 6dB = - 88.00 dBm

Blocking signal Frequency [MHz]	Blocking signal Power [dBm]	PER [%]	Verdict
2380	-54	4.39	PASS
2503.5	-54	4.20	PASS
2300	-44	4.50	PASS
2583.5	-44	4.15	PASS

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Configuration tested: BLE, Chain A, Channel 39

- **Minimum performance result without interferer**

Wanted signal mean power from companion device: Pmin [dBm]	PER [%]
-95.00	9.03

- **Minimum performance results with interferer**

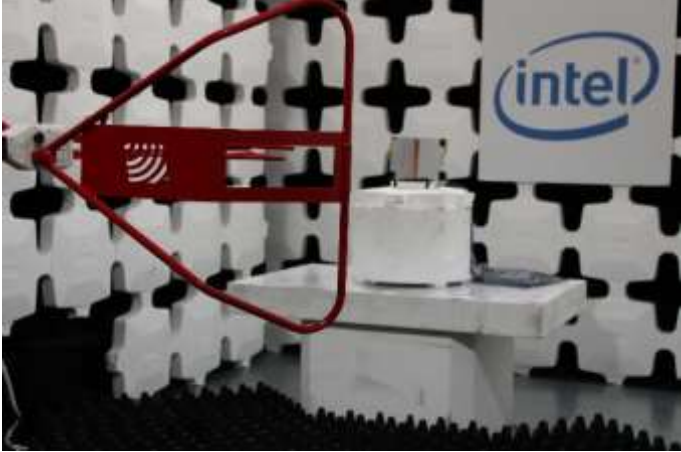
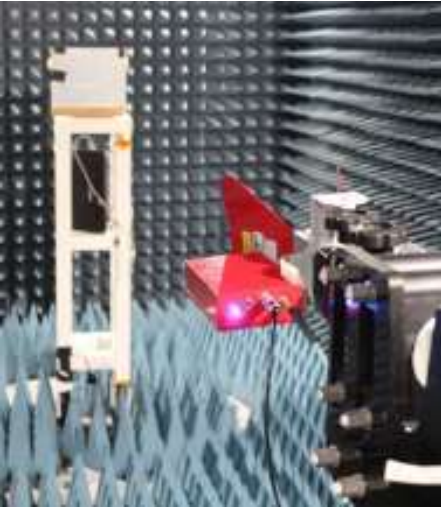
Wanted signal mean power from companion device:

✓ Pmin [dBm] + 6dB = - 89.00 dBm

Blocking signal [MHz]	Blocking signal Power [dBm]	PER [%]	Verdict
2380	-54	1.74	PASS
2503.5	-54	2.20	PASS
2300	-44	2.50	PASS
2583.5	-44	1.95	PASS

Annex C. Photographs

C.1 Test Setup

Radiated Setup-1 30 MHz – 1 GHz (Transmitter tests)	Radiated Setup-1 30 MHz – 1 GHz (Receiver tests)
	
Radiated Setup-2 1 GHz – 12.75 GHz	
	

C.2 Test Sample

Sample #01	
Module Front	Module Back
	
Extender board	Laptop
	

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

