

TEST REPORT

EUT Description	2x2 PCIe M.2 1216 adapter card
Brand Name	Intel®
Model Name	BE211D2W, BE211D2W M
Date of Test Start/End	2025-06-11 / 2025-07-21
Features	2x2 Wi-Fi + Bluetooth® (see section 5)

Applicant	Intel Corporation SAS
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Reference Standards	ETSI EN 301 893 V2.2.1 (see section 1)
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Test Report identification	250522-02.TR05
Revision Control	Rev. 01 This test report revision replaces any previous test report revision (see section 7)

The test results relate only to the samples tested.
 Reference to accreditation shall be used only by full reproduction of test report.

Reviewed by

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Standards, reference documents and applicable test methods

1. ETSI EN 301 893 V2.2.1 – 5GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU.

1. General conditions, competences and guarantees

- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2017 testing laboratory accredited by the French Committee for Accreditation (Cofrac) with the certificate number 1-6736.
- ✓ 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

2. Environmental Conditions

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

Temperature	Min.	20.59°C
	Max.	27.84°C
	Average	24.21°C
Humidity	Min.	26.15%rh
	Max.	63.35%rh
	Average	44.83%rh

3. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	250528-01.S01	Module	BE211D2W	289200F964C4	2025-05-28	Used for conducted Test
	240000-01.S03	Extender MotherBoard	PCB00887-008_A	2202207569	2024-12-12	
	210916-09.S03	Laptop	HP HSN-I45C	000176090Y	2021-12-10	
#02	250528-01.S07	Module	BE211D2W	289200F96596	2025-05-28	Used for Radiated Spurious Emissions tests
	200803-01.S01	Extender	ADEXELEC	139245	2020-08-31	
	170000-01.S57	Adapter	BNJ C0 V3	ASS00959-00-0C	2025-03-24	
	200611-03.S30	Test PC	Latitude 5401	6DJLK13	2020-08-19	
	230223-02.S48	Triband Antenna	-	006	2023-04-20	
	230526-09.S08	Triband Antenna	-	016	2023-07-06	
#03	250528-01.S07	Module	BE211D2W	289200F96596	2025-05-28	Used for Radiated Spurious Emissions tests
	200904-01.S14	Extender	ADEXELEC	12	2023-06-22	
	170000-01.S56	Adapter	BNJ C0 V3	E1578726888186A	2025-03-24	
	170000-01.S55	Test PC	LATITUDE 5530	004250000000002AA521	2025-03-24	
	230526-09.S06	Triband Antenna	-	014	2023-07-06	
	230526-09.S05	Triband Antenna	-	013	2023-07-06	
#04	250528-01.S07	Module	BE211D2W	289200F96596	2025-05-28	Used Rx Radiated Spurious Emission tests
	170000-01.S57	Adapter	BNJ C0 V3	ASS00959-00-0C	2025-03-24	
	200615-05.S06	Test PC (Host)	Dell Latitude 7940	63QRMQ2	2020-06-12	

4. EUT Features

The herein information is provided by the customer.

Intel WRF Lab declines any responsibility for the accuracy of the stated customer provided information, especially if it has any impact on the correctness of test results presented in this report.

Brand Name	Intel®		
Model Name	BE211D2W, BE211D2W M		
Software Version	DRTU.08798.99.0.99		
Driver Version	99.0.99.2		
Supported Radios	802.11b/g/n/ax/be 2.4GHz 802.11a/n/ac/ax/be 5.2GHz 5.3GHz 5.6GHz 5.8GHz 802.11ax/be 6.0GHz Bluetooth 2.4GHz		
Antenna Information	Transmitter	Chain A(1)	Chain B(2)
	Manufacturer	Intel WRF Lab	Intel WRF Lab
	Antenna type	PIFA	PIFA
	Part number	WRF-Tri Band-Antenna	WRF-Tri Band-Antenna
	Antenna peak gain (dBi)	+5.0	+5.0

5. Remarks and comments

- At customer request, all normal condition tests were carried out at tune up power (+0.5dB) Vs device setting.

6. Test Verdicts summary

The statement of conformity to applicable standards in the table below are based on the measured values, without taking into account the measurement uncertainties.

6.1. 802.11a/n/ac/ax/be

Mode	ETSI clause	Test	Verdict
5.3GHz	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
	4.2.9	Adjacent Channel Selectivity	P

P: Pass

F: Fail

NM: Not Measured

NA: Not Applicable

7. Document Revision History

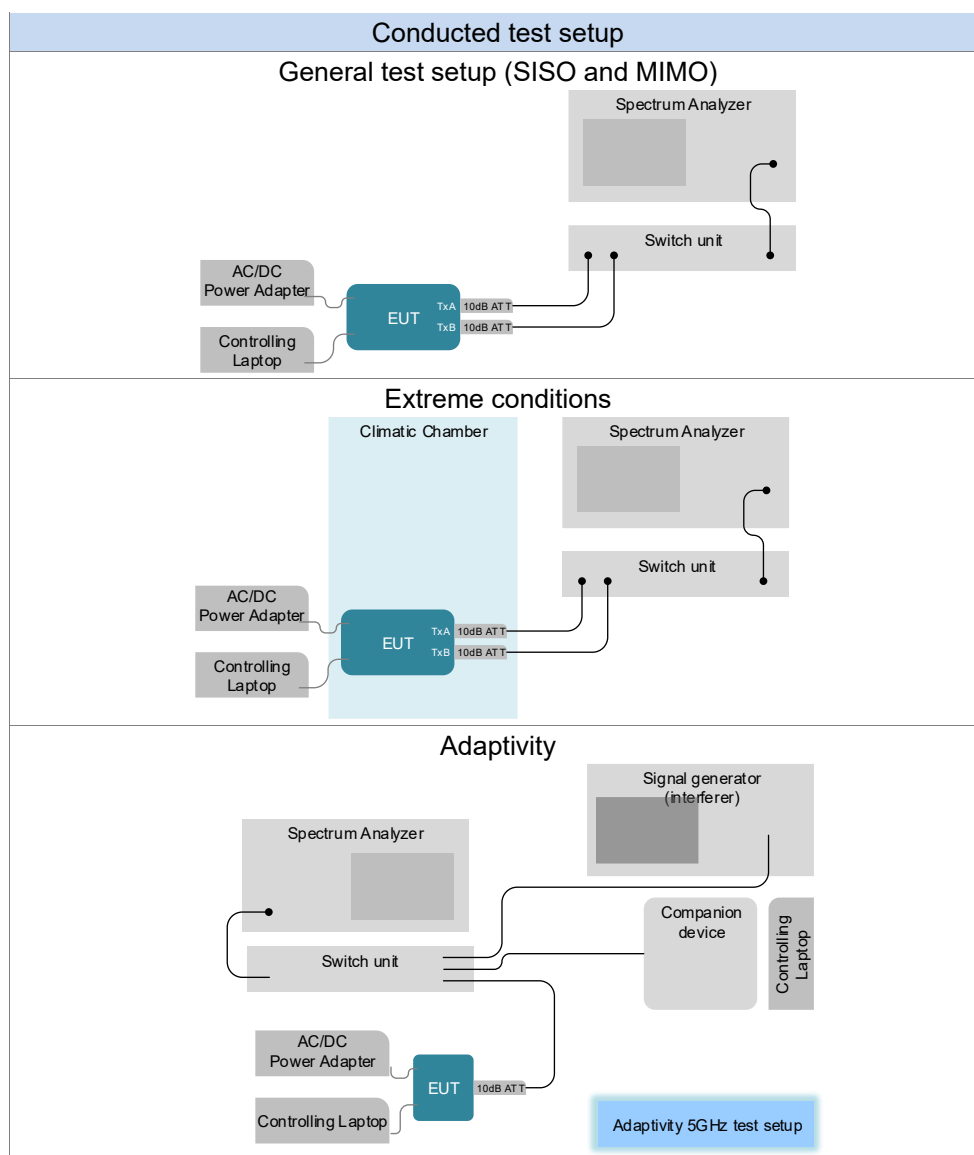
Revision #	Modified by	Revision Details
Rev. 00	T.GAMAIN K.RIDA	First Issue
Rev.01	Z.OUACHICHA	Editorial typo in section 6.1

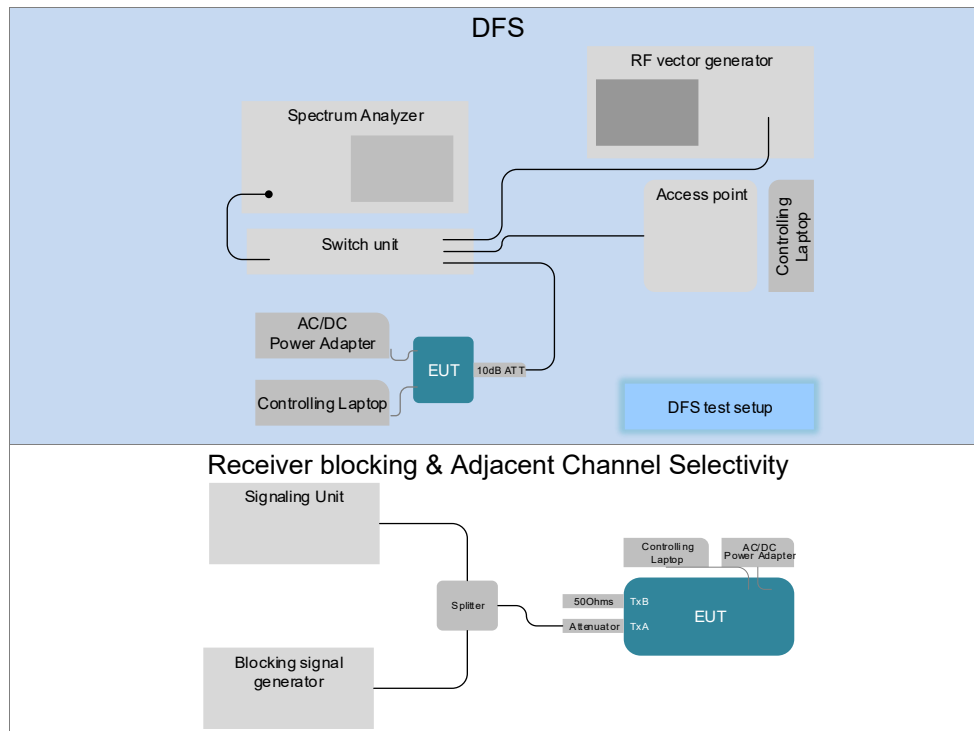
Annex A. Test & System Description

A.1 Measurement System

Measurements were performed using the following setups, made in accordance to the general provisions of ETSI EN 301 893 V2.2.1. Test Procedures. Rohde & Schwarz TS8997 system with the switching unit OSP120, OSP B-157 and software EMC32 were employed.

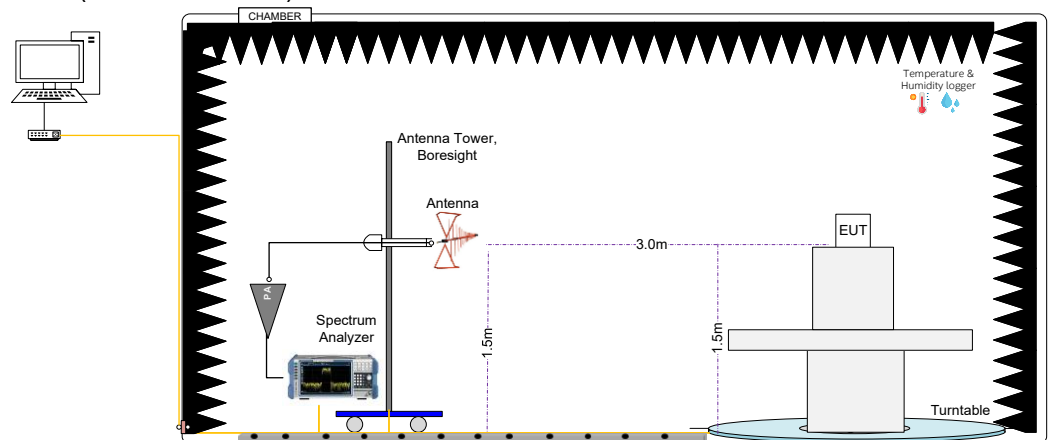
The EUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes, using the Intel proprietary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



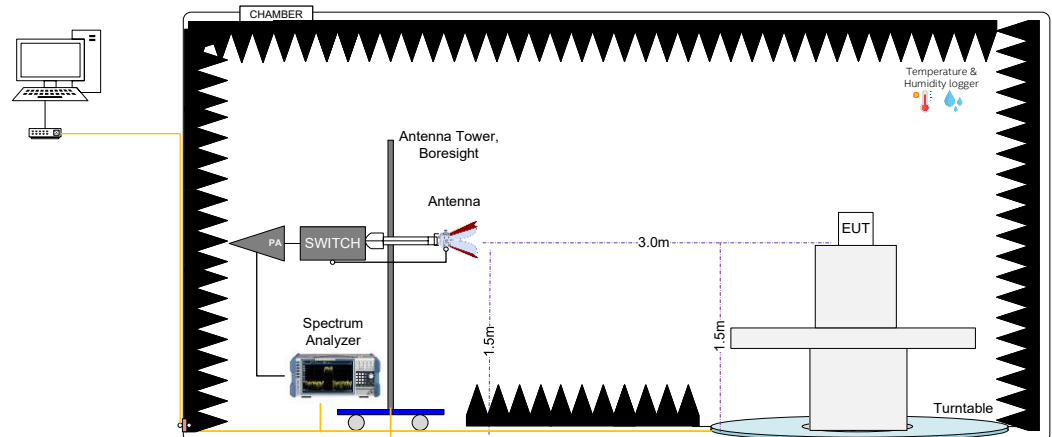


Radiated test setup

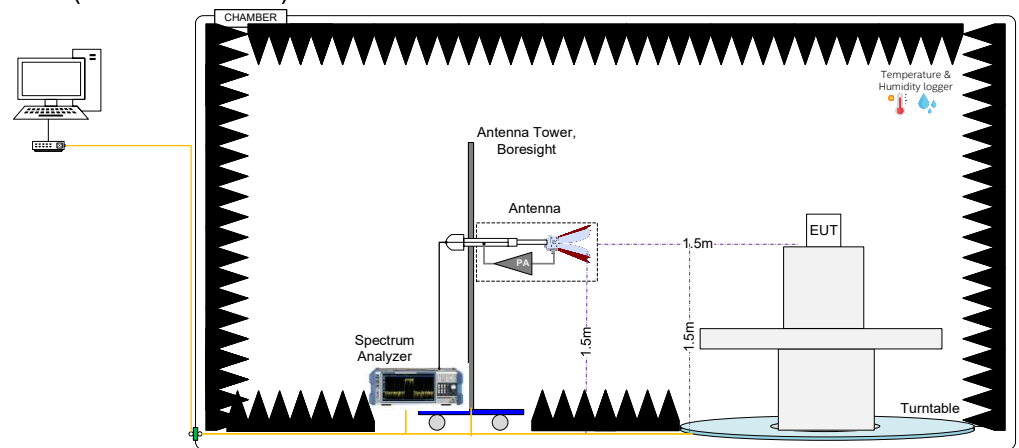
Radiated Setup 30 MHz - 1 GHz (Transmitter tests)



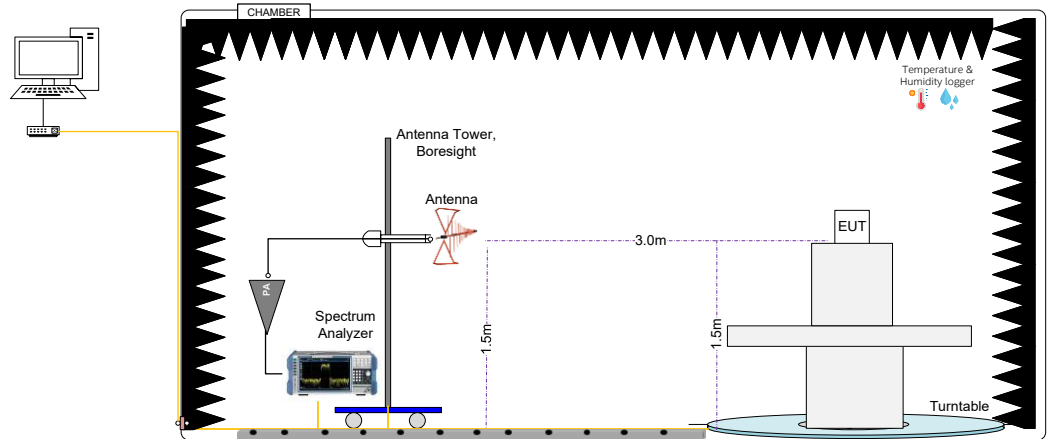
Radiated Setup 1 GHz – 11 GHz (Transmitter tests)



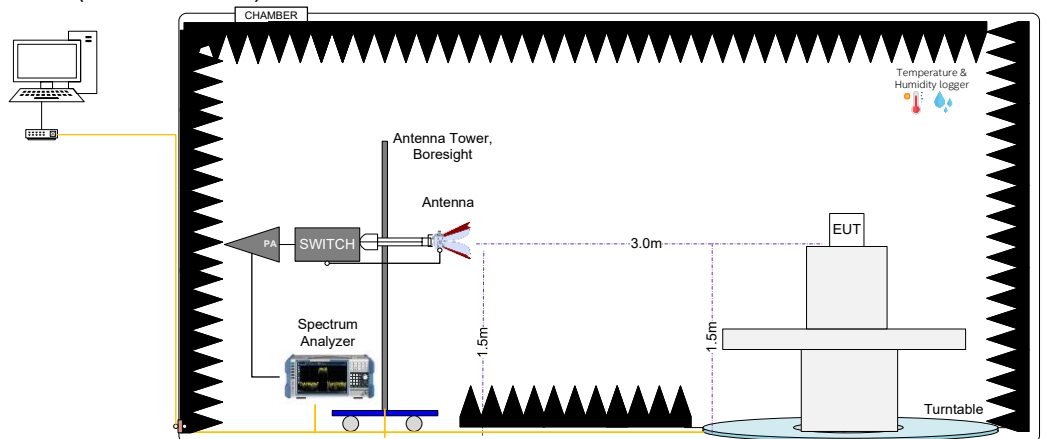
Radiated Setup 11 GHz - 26 GHz (Transmitter tests)



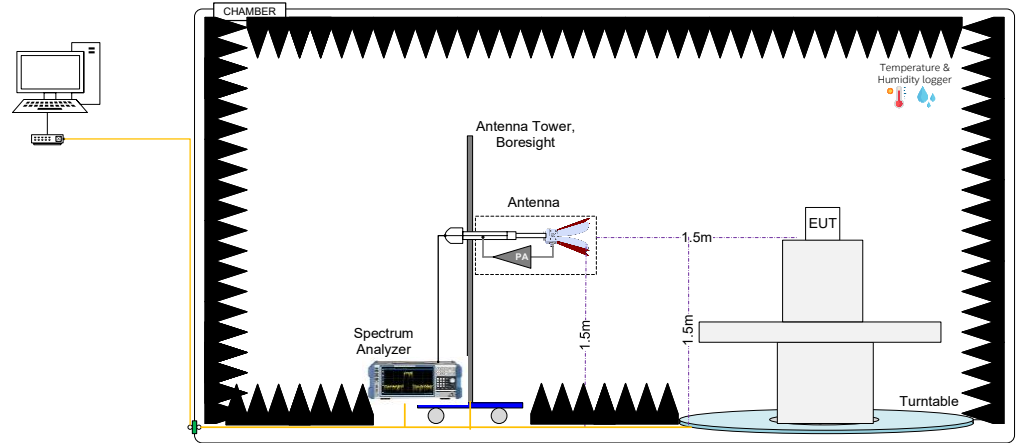
Radiated Setup 30 MHz – 1 GHz (Receiver tests)



Radiated Setup 1 GHz - 11 GHz (Receiver tests)



Radiated Setup 11 GHz - 26 GHz (Receiver tests)



A.2 Test Equipment List

Conducted Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
017-015	Switch unit	OSP 120	101172	Rohde & Schwarz	2024-05-22	2026-05-22
481-000	Access point 802.11n	AIR-CAP3502E-A-K9	FTX1438S6P4	Cisco	N/A	N/A
017-003	DC Power supply	E3640A	MY40006885	Agilent	N/A	N/A
133-000	Oscilloscope	RTE1052	101135	Rohde & Schwarz	2024-03-04	2026-03-04
299-000	Multimeter	34401A	US360546853146A00597	HPAgilent	2024-03-14	2026-03-14
311-000	Climatic chamber	SLT34/40	56746020930010	Secasi	2023-12-20	2025-12-20
017-038	Spectrum analyzer	FSVA3013	102344	Rohde & Schwarz	2024-05-29	2026-05-29
017-000	Measurement Software	WMS32 V11.40	200226	Rohde & Schwarz	N/A	N/A
412-000	Measurement Software	DRTU Power Finder V2	N/A	WRF Lab	N/A	N/A
094-004	Temp & Humidity Logger	RMS-HCD-S	24050483	Rotronic	2024-09-02	2026-09-02
237-000	10dB directional coupler	MC2047-10	01-062	Fairview	2025-02-24	2026-02-24
017-005	RF Cable 0.5m	PE3CA1039	-	Pasternack	2025-02-24	2026-02-24
017-006	RF Cable 1.2m	PE3C0666	-	Pasternack	2025-02-24	2026-02-24
017-007	Cable SMA Male to ML51-P	HRMP-ML51LP	DTR178-100RS	Hirose	2025-02-24	2026-02-24
017-008	Cable SMA Male to ML51-P	HRMP-ML51LP	DTR178-100RS	Hirose	2025-02-24	2026-02-24
281-000	Thermometer	t3000FC	46320036	Fluke	2024-04-17	2026-04-17
053-000	Thermometer	t3000FC	46320032	Fluke	2023-12-13	2025-12-13
017-011	RF Cable 2m	0900670672000PJ	1936949	Radiall	2025-02-24	2026-02-24
017-012	RF Cable 2m	0900670672000PJ	1936947	Radiall	2025-02-24	2026-02-24
017-019	10dB attenuator	-	-	Pasternack	2025-02-24	2026-02-24
017-020	10dB attenuator	-	-	Pasternack	2025-02-24	2026-02-24
008-025	Power Sensor	NRP-Z57	101280	Rohde & Schwarz	2024-05-22	2026-05-22

N/A: Not Applicable

Conducted setup #02 (Adaptivity)

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
221-000	Switch unit	OSP 120	101396	Rohde & Schwarz	2023-09-15	2025-09-15
122-000	Climatic chamber	LHU-113	1012-00-5753	ESPEC	2024-09-30	2026-09-30
017-039	Spectrum analyzer	FSVA3013	102345	Rohde & Schwarz	2024-05-29	2026-05-29
017-031	Measurement Software	WMS32 V11.40	101512	Rohde & Schwarz	N/A	N/A
094-004	Temp & Humidity Logger	RMS-HCD-S	24050483	Rotronic	2024-09-02	2026-09-02
234-000	RF Cable 0.5m	PE3CA1039-50	-	Pasternack	2025-02-24	2026-02-24
017-007	Cable SMA Male to ML51-P	HRMP-ML51LP	DTR178-100RS	Hirose	2025-02-24	2026-02-24
017-008	Cable SMA Male to ML51-P	HRMP-ML51LP	DTR178-100RS	Hirose	2025-02-24	2026-02-24
017-032	RF Cable 2m	NA500-18-SS-2	N/A	HESA	2025-02-24	2026-02-24
017-033	RF Cable 2m	NA500-18-SS-2	N/A	HESA	2025-02-24	2026-02-24
017-034	6dB attenuator	BW-S6W2+	N/A	Mini-Circuits	2025-02-24	2026-02-24
017-035	6dB attenuator	BW-S6W2+	N/A	Mini-Circuits	2025-02-24	2026-02-24
053-000	Thermometer	t3000FC	46320032	Fluke	2023-12-13	2025-12-13
281-000	Thermometer	t3000FC	46320036	Fluke	2024-04-17	2026-04-17
481-000	Access point 802.11n	AIR-CAP3502E-A-K9	FTX1438S6P4	Cisco	N/A	N/A
017-006	RF Cable 1.2m	PE3C0666	-	Pasternack	2025-02-24	2026-02-24

Receiver blocking Setup

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
125-000	Communication tester	CMW500	129337	Rohde & Schwarz	2025-05-28	2027-05-28
098-000	Signal generator	SMW200A	103732	Rohde & Schwarz	2023-07-26	2025-07-26
018-005	SMA-SMA 45cm RF Cable	FMC020285-18	-	Fairview Microwave	2025-02-21	2026-02-21
094-004	Temp & Humidity Logger	RMS-HCD-S	24050483	Rotronic	2024-09-02	2026-09-02
018-000	2 Way SMA Power Divider	PE2084	-	Pasternack	2025-02-21	2026-02-21
016-003	SMA-SMA 45cm RF Cable	FMC0202085-18	-	Fairview Microwave	2025-02-21	2026-02-21
018-006	SMA-SMA 45cm RF Cable	FMC0202085-18	-	Fairview Microwave	2025-02-21	2026-02-21

N/A: Not Applicable

Radiated Setup #1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
006-000	Anechoic Chamber	FACT3	5720	ETS-Lindgren	2024-01-17	2026-01-17
006-001	Turn Table	ETS	-	ETS-Lindgren	N/A	N/A
094-002	Temp & Humidity Logger	RMS-HCD-S	24050486	Rotronic	2024-09-02	2026-09-02
006-011	Boresight antenna mast	BAM 4.0-P	P/278/2890.01	Maturo	N/A	N/A
006-002	Switch & Positioning systems	EMCenter	00159757	ETS-Lindgren	N/A	N/A
147-000	Spectrum analyzer	FSW43	101847	Rohde & Schwarz	2025-03-07	2027-03-07
006-008	Measurement SW, v11.3	EMC32	100623	Rohde & Schwarz	N/A	N/A
301-000	Amplifier 9kHz-1300MHz	8447F	3113A07440	HP	2025-02-11	2026-02-11
006-067	Low Pass Filter 1.6GHz	LPM17671	G002	Micro-Tronics	2025-02-11	2026-02-11
007-034	Broadband RF Power Amplifier 0.5-40.0GHz	DEPA0540-43	2024A02	Diamond Engineering	2025-02-11	2026-02-11
189-000	Double Horn Ridged antenna 10GHz-40GHz	3116C	227716	ETS-Lindgren	2024-05-29	2026-05-29
057-000	Double ridged horn antenna (1GHz to 18GHz)	ETS-Lindgren-3117	167062	ETS-Lindgren	2024-07-23	2026-07-23
006-061	Bi-Log Periodic antenna	CBL6143A	61382	Teseq	2024-11-13	2026-11-13
006-068	RF Switch DC-40GHz	LPM17671	G002	Mini-Circuits	2025-02-11	2026-02-11
261-000	RF Amplifier Used for 1 GHz-11GHz	ETS-Lindgren-3117-PA	00157993	ETS-Lindgren	2025-02-11	2026-02-11
009-007	Filter HPF 11GHz	Mini-Circuits-ZHSS-k11G+	84931831830	Mini-Circuits	2025-02-11	2026-02-11
006-051	RF Cable 1.0m	CBL-1.5M-SMSM+	202879	Mini-Circuits	2025-03-12	2026-03-12
006-066	Cable 7m – 25MHz to 40GHz	R286304174	20.46.370	Radiall	2025-02-10	2026-02-10
006-063	Cable 30cm – 1GHz to 40GHz	PE371-12	-	Pasternack	2025-02-10	2026-02-10
006-064	Cable 30cm – 1GHz to 40GHz	PE371-12	-	Pasternack	2025-02-10	2026-02-10
006-065	Cable 60cm – 25MHz to 1GHz	PE300-24	-	Pasternack	2025-02-10	2026-02-10

Radiated Setup #2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
007-000	Anechoic chamber	RFD-FA-100	5996	ETS Lindgren	2024-01-18	2026-01-18
138-000	Spectrum Analyzer	FSV40**	101556	Rohde & Schwarz	2024-02-27	2026-02-27
137-000	Spectrum Analyzer	FSW67*	103266	Rohde & Schwarz	2025-02-11	2027-02-11
007-007	Double Ridge Horn Antenna (1- 18GHz)	3117	00152266	ETS Lindgren	2024-03-26	2026-03-26
059-000	Double-ridged horn antenna + PA (1 GHz to 18 GHz)	3117-PA	201542	ETS-Lindgren	2023-09-26	2025-09-26
026-008	Low noise amplifier 1-18GHz	LA1018N3209	J10100000407	A-INFO	2025-02-19	2026-02-19
007-004	Switch & Positioner	EMCenter	00162359	ETS Lindgren	N/A	N/A
007-006	EMControl & EMSwitch	EMCenter	00151232	ETS Lindgren	N/A	N/A
007-036	SMA-SMA 6.5m Cable	140-8500-11-51-001	001	Atem	2025-03-12	2026-03-12
007-005	Measurement SW, v11.30.00	EMC32	100401	Rohde & Schwarz	N/A	N/A
007-001	Styrofoam Column, 151mm	-	-	-	N/A	N/A
007-002	Turntable	-	-	ETS Lindgren	N/A	N/A
007-003	Antenna Tower	2171B-3.0M	00150123	ETS Lindgren	N/A	N/A
007-015	N-SMA 1.5m Cable	-	-	Spirent	2025-02-19	2026-02-19
007-018	SMA-SMA 1.2m Cable	0500990991200KE	-	Radiall	2025-02-19	2026-02-19
007-022	N-SMA 1.5m Cable	0501050991500GX	19.23.493	Radiall	2025-02-10	2026-02-10
094-001	Temp & Humidity Logger	RMS-HCD-S	24050487	Rotronic	2024-09-02	2026-09-02

Shared Radiated Equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
412-000	DRTU Power finder V2.1	-	-	Intel	NA	NA
139-000	Power Sensor	NRP-Z81	104383	Rohde & Schwarz	2025-05-20	2027-05-20
140-000	Power Sensor	NRP-Z81	104382	Rohde & Schwarz	2024-04-04	2026-04-04

A.3 Measurement Uncertainty Evaluation

The system uncertainty evaluation is shown in the table below with a coverage factor of $k = 2$ to indicate a 95% level of confidence:

Measurement type	Uncertainty	Limit	Unit
Frequency Stability	± 6.18	± 10	ppm
RF Output Power, conducted	± 0.99	± 1.5	dB
Power Spectral Density, conducted	± 0.99	± 1.5	dB
Unwanted Emission, conducted	± 1.53	± 3	dB
Radiated test < 1GHz	± 4.03	± 6	dB
Radiated test 1GHz - 26 GHz	± 4.68	± 6	dB
Temperature	± 0.23	± 2	°C
Humidity	± 1.99	± 5	%
Time	± 0.01	± 10	%

Annex B. Test Results

The herein test results were performed by:

Test case measurement	Test Personnel
Carrier frequencies	T.GAMAIN
Occupied channel bandwidth	T.GAMAIN
RF output power at the highest power	T.GAMAIN
RF output power at the lowest power of the TPC	T.GAMAIN
Power density	T.GAMAIN
Transmitter unwanted emissions within the 5GHz RLAN bands	T.GAMAIN
Transmitter unwanted emissions outside the 5GHz RLAN bands	K.RIDA
Receiver spurious emissions	K.RIDA
Dynamic Frequency Selection	T.GAMAIN
Adaptivity(Channel Access Mechanism)	T.GAMAIN
Receiver Blocking	T.GAMAIN
Adjacent Channel Selectivity	T.GAMAIN

B.1 Test Conditions

ETSI clause	Conditions	ETSI EN 301 893 V2.2.1.Annex H
5.1.1	Tests defined in the present document shall be carried out at representative points within the boundary limits of the operational environmental profile defined by its intended use (see clause 5.4.1, item n)).	"Information provided by the customer"
	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 operational environmental profile defined by its intended use) to give confidence of compliance for the affected technical requirements.	
5.4.1, item n).	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.	
	The operating temperature range that applies to the intended use of the equipment, if different from -20 °C to +55 °C.	

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

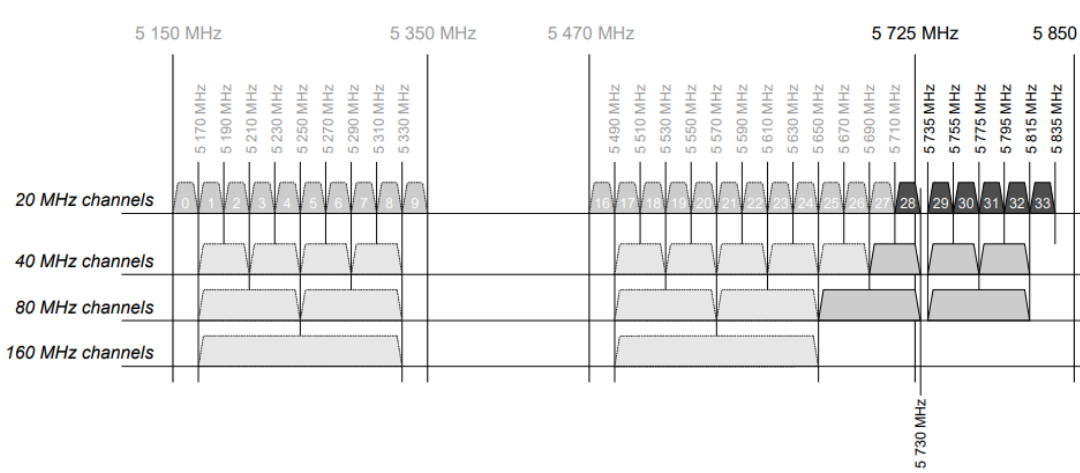
For 802.11n20, 802.11ax/be20 (20 MHz channel bandwidth), 802.11n40, 802.11ax/be40 (40MHz channel bandwidth), 802.11ac80, 802.11ax/be80 (80MHz channel bandwidth) and 802.11ac160, 802.11ax/be160 (160 MHz channel bandwidth) modes the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually, and also simultaneously.

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:

Transmission	Mode	Bandwidth (MHz)	Worst Case Data Rate
SISO	802.11a	20	6Mbps
	802.11n	20	HT0
		40	HT0
	802.11ac	80	VHT0
		160	VHT0
	802.11ax/be	20	MCS0
		40	MCS0
		80	MCS0
		160	MCS0
MIMO	802.11n	20/40	HT8
	802.11ac	80/160	VHT0
	802.11ax/be	20/40/80/160	MCS0

B.2 Carrier frequencies

Test limits

ETSI clause	Limits
4.2.1.3	The nominal centre frequencies (f_c) for channels whose nominal channel bandwidth falls partly or completely within sub-band 1, sub-band 2 or sub-band 3 shall be defined by equation (1). $f_c = 5\,160\text{ MHz} + (g \times 20\text{ MHz}) \pm f_{c_offset}, \text{ with } g \text{ integer and } 0 \leq g \leq 9 \text{ or } 16 \leq g \leq 28 \text{ (1)}$ Operation on the channel with $g = 28$ is only permitted where operation in sub-band 4 by RLAN devices is allowed by national frequency usage conditions.  Figure 3 An offset (f_{c_offset}) is permitted for each nominal centre frequency. The offset may be different for each nominal centre frequency, but it shall not be greater than 200 kHz. Where an offset is applied, the nominal centre frequencies used by the equipment shall be noted in the test report (see clause 5.4.1, item a)). The nominal centre frequency for any given channel shall be maintained within the range of $f_c \pm 0,002\%$.

Test conditions

ETSI clause	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 conducted setups shown in section *Test & System Description* were used to measure the center frequency accordingly to the test procedure described in ETSI EN 301 893 V2.2.1.. 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.

Results tables

Centre Frequencies			Normal condition Ambient Temperature +23°C		Extreme condition High Temperature +50°C		Extreme condition Low Temperature -10°C	
#Ch	Freq [MHz]	Chain	Centre frequency [MHz]	Deviation [ppm]	Centre frequency [MHz]	Deviation [ppm]	Centre frequency [MHz]	Deviation [ppm]
64	5320	A	5319.9930	1.316	5320.0030	0.564	5320.0260	4.887
		B	5319.9800	3.759	5319.9970	0.564	5320.0320	6.015

B.3 Occupied Channel Bandwidth

Test limits

ETSI clause	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 it still conforms to the limits defined for nominal centre frequencies (20 MHz raster). For channels whose nominal channel bandwidth falls partly or completely within sub-band 2 or sub-band 3, the occupied bandwidth shall not be less than 80 % 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 clause	Conditions
5.4.3.1	These measurements shall be performed only under normal operating conditions (see clause 5.1.2). 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. For equipment capable of multi-channel operation (see clause 4.2.7.3.1.3 or clause 4.2.7.3.2.3) using adjacent channels, the equipment shall be configured to have transmissions in all the channels. These transmissions may be considered as one signal with a total bandwidth of n times the nominal channel bandwidth of an individual channel where n is the number of adjacent channels. In case of conducted measurements on smart antenna systems (devices with multiple transmit chains) measurements need only to be performed on one of the active transmit chains (antenna outputs).

Test procedure

The conducted setups shown in section *Test & System Description* were used to measure the occupied channel bandwidth accordingly to the test procedure described in ETSI EN 301 893 V2.2.1.. 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.

Results tables

Mode	Rate	#Ch	Freq [MHz]	Chain	Measured 99% BW [MHz]
802.11a	6Mbps	64	5320	A	16.54
				B	16.54
802.11n20	HT0			A	17.74
	HT8			B	17.74
				A+B	17.74
802.11n40	HT0	62	5310	A	36.35
	HT8			B	36.35
				A+B	36.35
802.11ac80	VHT0	58	5290	A	75.95
	VHT0			B	75.95
				A+B	75.95
802.11ac160	VHT0	50	5250	A	155.15
	VHT0			B	155.15
				A+B	155.15
802.11ax/be20	MCS0	64	5320	A	18.95
	MCS0			B	18.95
				A+B	18.95
802.11ax/be40	MCS0	62	5310	A	37.75
	MCS0			B	37.75
				A+B	37.75
802.11ax/be80	MCS0	58	5290	A	77.35
	MCS0			B	77.35
				A+B	77.34
802.11ax/be160	MCS0	50	5250	A	156.55
	MCS0			B	156.55
				A+B	156.55

B.4 RF Output Power at the highest power

Test limits

ETSI clause	Limits																								
4.2.3.2.2	The maximum RF output power PH,sb and the PSD in sub-band sb shall not exceed the limits given in table 2 for that sub-band. If the device uses TPC, PH,sb is the RF output power in sub-band sb at the highest power level of the TPC range in sub-band sb. In case of multiple (adjacent or non-adjacent) channels, the limits for the maximum RF output power and the PSD apply per sub-band. NOTE: According to ECC/DEC/(04)08 [i.6] as well as Commission Implementing Decision (EU) 2022/179 [i.7] amended by Commission Implementing Decision (EU) 2022/2307 [i.8], for certain installations, the RF output power limit and the PSD limit might be lower than given in table 2.																								
	Table 2: RF output power and PSD limits																								
	<table><tr><th rowspan="2">Sub-band</th><th colspan="2">RF output power limit (dBm)</th><th colspan="2">PSD 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>Sub-band 1</td><td>23</td><td>23</td><td>10</td><td>10</td></tr><tr><td>Sub-band 2</td><td>23</td><td>20</td><td>10</td><td>7</td></tr><tr><td>Sub-band 3 (see note 2)</td><td>30 (see note 1)</td><td>27 (see note 1)</td><td>17 (see note 1)</td><td>14 (see note 1)</td></tr></table>	Sub-band	RF output power limit (dBm)		PSD limit (dBm/MHz)		With TPC	Without TPC	With TPC	Without TPC	Sub-band 1	23	23	10	10	Sub-band 2	23	20	10	7	Sub-band 3 (see note 2)	30 (see note 1)	27 (see note 1)	17 (see note 1)	14 (see note 1)
	Sub-band		RF output power limit (dBm)		PSD limit (dBm/MHz)																				
		With TPC	Without TPC	With TPC	Without TPC																				
	Sub-band 1	23	23	10	10																				
	Sub-band 2	23	20	10	7																				
	Sub-band 3 (see note 2)	30 (see note 1)	27 (see note 1)	17 (see note 1)	14 (see note 1)																				
	NOTE 1: Secondary devices without radar detection operating in sub-band 3 shall conform to the limits for sub-band 2.																								
	NOTE 2: National frequency usage conditions may allow devices to operate in sub-band 3 on a channel with a nominal channel bandwidth that extends into sub-band 4.																								
NOTE 3: If TPC is used, the RF output power in sub-band sb at the lowest power level of the TPC range in sub-band sb (PL,sb) shall be at least 6 dB less than the applicable RF output power limit with TPC.																									

Test conditions

ETSI clause	Conditions
5.4.4.2.1.1.1	These measurements shall be performed under both normal and extreme test conditions (see clause 5.1.2 and clause 5.1.3). The UUT shall be configured to operate at: - the highest transmitter output power level of the TPC range; or - the maximum transmitter output power level in case the equipment has no TPC feature.

Test procedure

The conducted setups shown in section *Test & System Description* were 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. System connection cable loss is compensated by the EMC32 software on the measured parameters.

Antenna gain is taken into 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.

According to the test procedure described in ETSI EN 301 893 V2.2.1., 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.

Results tables

RF Output Power						Normal condition Ambient Temperature +23°C		Extreme condition High Temperature +50°C		Extreme condition Low Temperature -10°C	
Mode	Meas Duty Cycle %	Rate	#Ch	Freq [MHz]	Chain	Measured Conducted [dBm]	EIRP [dBm]	Measured Conducted [dBm]	EIRP [dBm]	Measured Conducted [dBm]	EIRP [dBm]
802.11a	97.9	6Mbps	52	5260	A	16.7	21.7	15.6	20.6	16.1	21.1
					B	16.5	21.5	16.4	21.4	17.0	22.0
			64	5320	A	17.1	22.1	15.6	20.6	16.1	21.1
					B	16.7	21.7	16.3	21.3	17.0	22.0
802.11n20	98.9	HT0	52	5260	A	17.0	22.0	15.8	20.8	16.3	21.3
					B	17.0	22.0	16.6	21.6	17.2	22.2
			64	5320	A	16.9	21.9	15.8	20.8	16.3	21.3
					B	17.0	22.0	16.5	21.5	17.2	22.2
	98.9	HT8	52	5260	A+B	17.0	22.0	16.1	21.1	16.6	21.6
			64	5320	A+B	17.1	22.1	16.1	21.1	16.6	21.6
802.11n40	98.9	HT0	54	5270	A	17.9	22.9	16.6	21.6	17.1	22.1
					B	17.9	22.9	17.3	22.3	17.9	22.9
			62	5310	A	17.9	22.9	16.5	21.5	17.0	22.0
					B	17.9	22.9	17.1	22.1	17.8	22.8
	98.9	HT8	54	5270	A+B	17.9	22.9	16.8	21.8	17.4	22.4
			62	5310	A+B	17.9	22.9	16.7	21.7	17.3	22.3
802.11ac80	98.9	VHT0	58	5290	A	17.9	22.9	16.3	21.3	17.1	22.1
					B	17.9	22.9	17.3	22.3	17.9	22.9
					A+B	17.9	22.9	16.8	21.8	17.4	22.4
802.11ac160	98.9	VHT0	50	5250	A	17.9	22.9	16.6	21.6	16.8	21.8
	98.9	VHT0			B	17.9	22.9	17.1	22.1	17.7	22.7
					A+B	17.8	22.8	16.6	21.6	17.2	22.2
802.11ax/be20	98.8	MCS0	52	5260	A	17.3	22.3	16.2	21.2	16.7	21.7
					B	17.3	22.3	17.0	22.0	17.6	22.6
			64	5320	A	17.2	22.2	16.2	21.2	16.7	21.7
					B	17.3	22.3	11.5	16.5	17.6	22.6
	98.8	MCS0	52	5260	A+B	17.3	22.3	16.7	21.7	17.1	22.1
			64	5320	A+B	17.4	22.4	16.8	21.8	17.1	22.1
802.11ax/be40	98.9	MCS0	54	5270	A	17.9	22.9	8.2	13.2	6.8	11.8
					B	17.9	22.9	17.4	22.4	17.8	22.8
			62	5310	A	17.9	22.9	16.4	21.4	16.9	21.9
					B	17.9	22.9	17.1	22.1	17.7	22.7
	98.9	MCS0	54	5270	A+B	17.9	22.9	17.0	22.0	17.3	22.3
			62	5310	A+B	17.9	22.9	16.9	21.9	17.3	22.3
802.11ax/be80	98.9	MCS0	58	5290	A	17.9	22.9	16.5	21.5	17.0	22.0
					B	17.9	22.9	17.3	22.3	17.8	22.8
					A+B	17.9	22.9	17.0	22.0	17.3	22.3
802.11ax/be160	98.9	MCS0	50	5250	A	17.8	22.8	16.3	21.3	16.8	21.8
	98.9	MCS0			B	17.8	22.8	17.2	22.2	17.7	22.7
					A+B	17.8	22.8	16.8	21.8	17.1	22.1

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

Test limits

ETSI clause	Limits																								
4.2.3.1.2	Transmit Power Control (TPC) is a mechanism to ensure a mitigation factor of at least 3 dB on the aggregate power from a large number of devices, which implies a TPC range of at least 6 dB. The RF output power limit and the PSD limit might depend on whether an RLAN device operates with or without TPC. Table 2: RF output power and PSD limits <table><tr><th rowspan="2">Sub-band</th><th colspan="2">RF output power limit (dBm)</th><th colspan="2">PSD 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>Sub-band 1</td><td>23</td><td>23</td><td>10</td><td>10</td></tr><tr><td>Sub-band 2</td><td>23</td><td>20</td><td>10</td><td>7</td></tr><tr><td>Sub-band 3 (see note 2)</td><td>30 (see note 1)</td><td>27 (see note 1)</td><td>17 (see note 1)</td><td>14 (see note 1)</td></tr></table> NOTE 1: Secondary devices without radar detection operating in sub-band 3 shall conform to the limits for sub-band 2. NOTE 2: National frequency usage conditions may allow devices to operate in sub-band 3 on a channel with a nominal channel bandwidth that extends into sub-band 4. NOTE 3: If TPC is used, the RF output power in sub-band sb at the lowest power level of the TPC range in sub-band sb (PL,sb) shall be at least 6 dB less than the applicable RF output power limit with TPC.	Sub-band	RF output power limit (dBm)		PSD limit (dBm/MHz)		With TPC	Without TPC	With TPC	Without TPC	Sub-band 1	23	23	10	10	Sub-band 2	23	20	10	7	Sub-band 3 (see note 2)	30 (see note 1)	27 (see note 1)	17 (see note 1)	14 (see note 1)
Sub-band	RF output power limit (dBm)		PSD limit (dBm/MHz)																						
	With TPC	Without TPC	With TPC	Without TPC																					
Sub-band 1	23	23	10	10																					
Sub-band 2	23	20	10	7																					
Sub-band 3 (see note 2)	30 (see note 1)	27 (see note 1)	17 (see note 1)	14 (see note 1)																					

Test conditions

ETSI clause	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 5.1.2 and clause 5.1.3). The UUT shall be configured to operate at the lowest transmitter output power level of the TPC range

Test procedure

The conducted setups shown in section *Test & System Description* were 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. System connection cable loss is compensated by the EMC32 software on the measured parameters.

Antenna gain is taken into 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.

According to the test procedure described in ETSI EN 301 893 V2.2.1., 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.

Results tables

TPC RF Output Power						Normal condition Ambient Temperature +23°C		Extreme condition High Temperature +50°C		Extreme condition Low Temperature -10°C	
Mode	Meas Duty Cycle %	Rate	#Ch	Freq [MHz]	Chain	Measured Conducted [dBm]	EIRP [dBm]	Measured Conducted [dBm]	EIRP [dBm]	Measured Conducted [dBm]	EIRP [dBm]
802.11a	97.9	6Mbps	52	5260	A	11.9	16.7	10.7	15.7	11.1	16.1
					B	11.9	16.9	11.6	16.6	11.9	16.9
			64	5320	A	11.9	16.9	10.6	15.6	11.1	16.1
					B	11.8	16.8	11.6	16.6	11.9	16.9
802.11n20	98.9	HT0	52	5260	A	11.9	16.9	10.7	15.7	11.2	16.2
					B	11.9	16.9	11.5	16.5	11.9	16.9
			64	5320	A	11.9	16.9	10.6	15.6	11.1	16.1
					B	11.9	16.9	11.6	16.6	11.9	16.9
	98.9	HT8	52	5260	A+B	11.8	16.8	10.7	15.7	11.3	16.3
			64	5320	A+B	11.8	16.8	10.7	15.7	11.3	16.3
802.11n40	98.9	HT0	54	5270	A	11.9	16.9	10.6	15.6	11.1	16.1
					B	11.9	16.9	11.3	16.3	11.9	16.9
			62	5310	A	11.9	16.9	10.6	15.6	11.1	16.1
					B	11.9	16.9	11.5	16.5	11.9	16.9
	98.9	HT8	54	5270	A+B	11.7	16.7	11.5	16.5	11.2	16.2
			62	5310	A+B	11.8	16.8	11.7	16.7	11.3	16.3
802.11ac80	98.9	VHT0		5290	A	11.9	16.9	10.4	15.4	11.2	16.2
					B	11.9	16.9	11.5	16.5	11.9	16.9
					A+B	11.8	16.8	10.8	15.8	11.3	16.3
802.11ac160	98.9	VHT0	50	5250	A	11.9	16.9	10.4	15.4	10.9	15.9
	98.9	VHT0			B	11.9	16.9	11.4	16.4	11.9	16.9
					A+B	11.7	16.7	11.5	16.5	11.1	16.1
802.11ax/be20	98.8	MCS0	52	5260	A	11.9	16.9	10.6	15.6	11.1	16.1
					B	11.9	16.9	11.4	16.4	11.9	16.9
			64	5320	A	11.9	16.9	10.5	15.5	11.0	16.0
					B	11.9	16.9	11.5	16.5	11.9	16.9
	98.8	MCS0	52	5260	A+B	11.8	16.8	11.0	16.0	11.3	16.3
			64	5320	A+B	11.8	16.8	11.0	16.0	11.2	16.2
802.11ax/be40	98.9	MCS0	54	5270	A	11.9	16.9	10.5	15.5	11.0	16.0
					B	11.9	16.9	11.4	16.4	11.9	16.9
			62	5310	A	11.9	16.9	10.5	15.5	11.0	16.0
					B	11.9	16.9	11.5	16.5	11.9	16.9
	98.9	MCS0	54	5270	A+B	11.7	16.7	10.8	15.8	11.1	16.1
			62	5310	A+B	11.8	16.8	10.9	15.9	11.2	16.2
802.11ax/be80	98.9	MCS0	58	5290	A	11.9	16.9	10.6	15.6	11.1	16.1
		MCS0			B	11.9	16.9	11.5	16.5	11.9	16.9
					A+B	11.8	16.8	10.9	15.9	11.2	16.2
802.11ax/be160	98.9	MCS0	50	5250	A	11.9	16.9	10.4	15.4	10.8	15.8
	98.9	MCS0			B	11.9	16.9	11.4	16.4	11.9	16.9
					A+B	11.7	16.7	10.8	15.8	11.1	16.1

B.6 Power Density

Test limits

ETSI clause	Limits																								
4.2.3.2.2	The maximum RF output power PH,sb and the PSD in sub-band sb shall not exceed the limits given in table 2 for that sub-band. If the device uses TPC, PH,sb is the RF output power in sub-band sb at the highest power level of the TPC range in sub-band sb. In case of multiple (adjacent or non-adjacent) channels, the limits for the maximum RF output power and the PSD apply per sub-band. NOTE: According to ECC/DEC/(04)08 [i.6] as well as Commission Implementing Decision (EU) 2022/179 [i.7] amended by Commission Implementing Decision (EU) 2022/2307 [i.8], for certain installations, the RF output power limit and the PSD limit might be lower than given in table 2.																								
	Table 2: RF output power and PSD limits																								
	<table><tr><th rowspan="2">Sub-band</th><th colspan="2">RF output power limit (dBm)</th><th colspan="2">PSD 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>Sub-band 1</td><td>23</td><td>23</td><td>10</td><td>10</td></tr><tr><td>Sub-band 2</td><td>23</td><td>20</td><td>10</td><td>7</td></tr><tr><td>Sub-band 3 (see note 2)</td><td>30 (see note 1)</td><td>27 (see note 1)</td><td>17 (see note 1)</td><td>14 (see note 1)</td></tr></table>	Sub-band	RF output power limit (dBm)		PSD limit (dBm/MHz)		With TPC	Without TPC	With TPC	Without TPC	Sub-band 1	23	23	10	10	Sub-band 2	23	20	10	7	Sub-band 3 (see note 2)	30 (see note 1)	27 (see note 1)	17 (see note 1)	14 (see note 1)
	Sub-band		RF output power limit (dBm)		PSD limit (dBm/MHz)																				
		With TPC	Without TPC	With TPC	Without TPC																				
	Sub-band 1	23	23	10	10																				
	Sub-band 2	23	20	10	7																				
	Sub-band 3 (see note 2)	30 (see note 1)	27 (see note 1)	17 (see note 1)	14 (see note 1)																				
	NOTE 1: Secondary devices without radar detection operating in sub-band 3 shall conform to the limits for sub-band 2.																								
	NOTE 2: National frequency usage conditions may allow devices to operate in sub-band 3 on a channel with a nominal channel bandwidth that extends into sub-band 4.																								
NOTE 3: If TPC is used, the RF output power in sub-band sb at the lowest power level of the TPC range in sub-band sb (PL,sb) shall be at least 6 dB less than the applicable RF output power limit with TPC.																									

Test conditions

ETSI clause	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 transmitter output power level of its TPC range; or - the maximum transmitter output power level in case the equipment has no TPC feature.

Test procedure

The conducted setups shown in section *Test & System Description* were 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 into 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.

According to the test procedure described in ETSI EN 301 893 V2.2.1. 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 all the 1MHz calculated segments.

Results tables

Mode	Meas. Duty Cycle %	Rate	Ch Number	Frequency [MHz]	Chain	EIRP PSD [dBm/MHz]
802.11a	97.9	6Mbps	52	5260	A	9.87
					B	9.88
			64	5320	A	9.94
					B	9.91
802.11n20	98.9	HT0	52	5260	A	9.89
					B	9.83
			64	5320	A	9.80
					B	9.95
	98.9	HT8	52	5260	A+B	9.92
			64	5320	A+B	9.95
802.11ax/be20	98.9	MCS0	52	5260	A	9.78
					B	9.78
			64	5320	A	9.83
					B	9.80
	98.9	MCS0	52	5260	A+B	9.74
			64	5320	A+B	9.87

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

Test limits

ETSI clause	Limits
4.2.4.2.2	The mean PSD of the transmitter unwanted emissions within the transmitter's operating 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 PSD transmitted by the RLAN device when measured with a reference bandwidth of 1 MHz. The mask is only applicable within the band(s) of operation. Beyond the band edges, the requirements for transmitter unwanted emissions outside the transmitter's operating bands (see 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 for transmitter unwanted emissions within the transmitter's operating bands. Figure 1. Transmit spectral power mask $N = \text{Nominal Channel Bandwidth [MHz]}$

Test conditions

ETSI clause	Conditions
5.4.6.1	These measurements shall be performed only under normal test conditions (see clause 5.1.2). The equipment shall be configured to operate under conditions aligned with its intended use so that unwanted emissions within the transmitter's operating bands are maximized. For UUT without an integral antenna and for a UUT with an integral antenna but with one or more temporary antenna connectors, conducted measurements should be performed. Alternatively, if UUT has one or more integral antennas, but no temporary antenna connector(s), radiated measurements may be used. 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

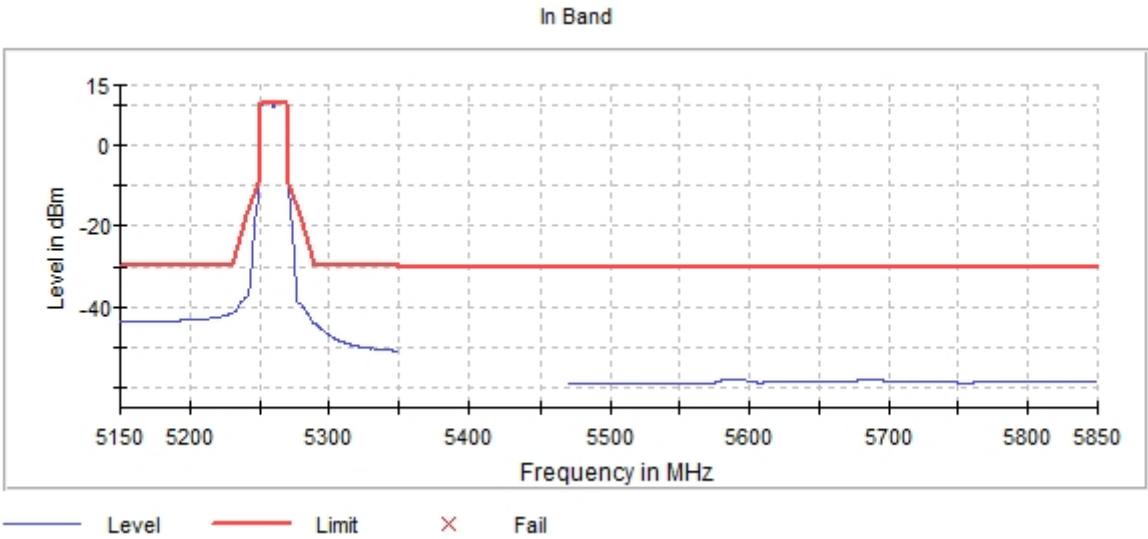
The conducted setups shown in section *Test & System Description* were used to measure the unwanted emissions within the 5GHz RLAN bands (Band Edge). The antenna terminal of the EUT is connected to the OSP120 through an attenuator and a cable, the spectrum analyzer is connected to the receiver port on the OSP. System connection cable loss is compensated by the EMC32 software on measured parameters.

Antenna gain is taken into 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. EMC32 provides the mask and the frequency limits based in the measured channel bandwidth. For MIMO transmission mode, measurements are taken from chain A on the EUT.

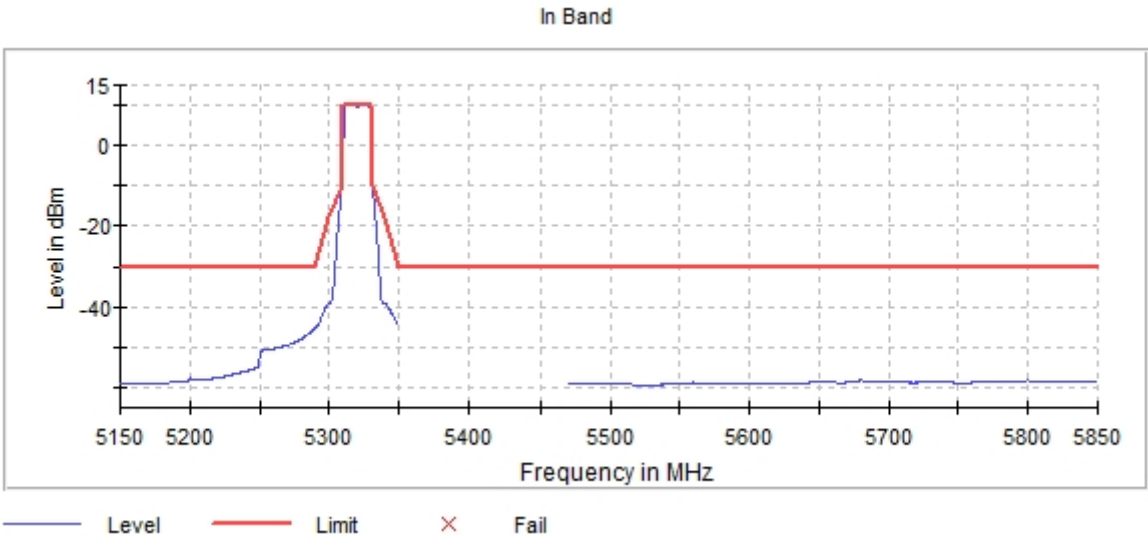
Results Screenshot

802.11ax/be20 (SISO), MCS0 – Chain A

Channel 52

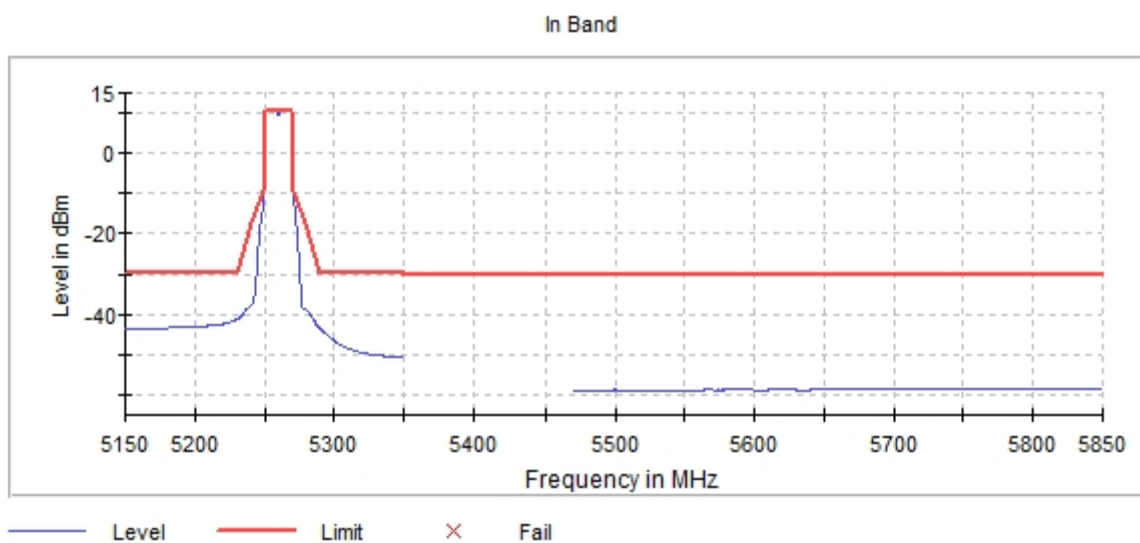


Channel 64

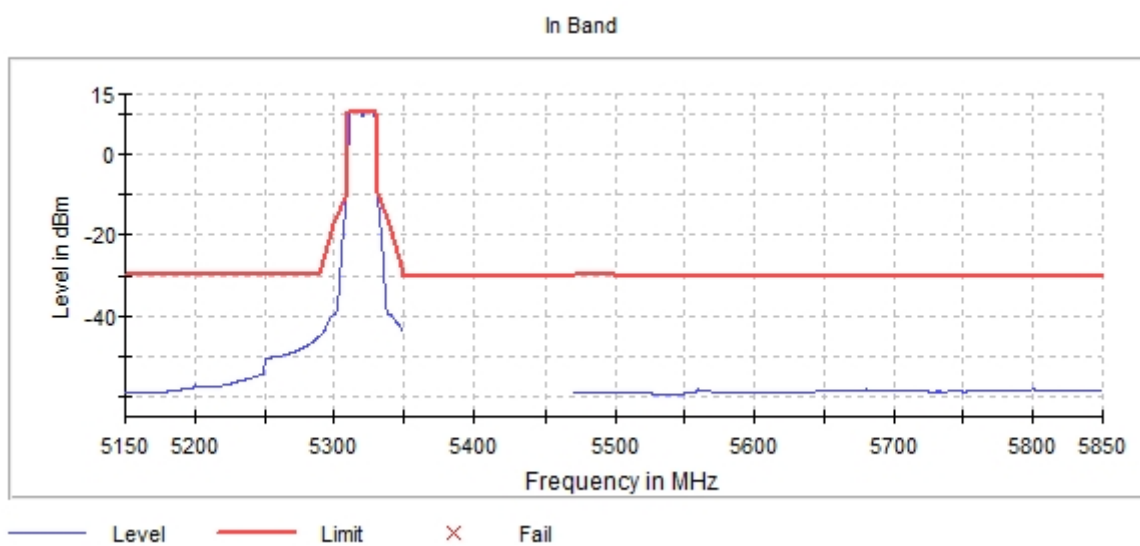


802.11ax/be20 (SISO), MCS0 – Chain B

Channel 52

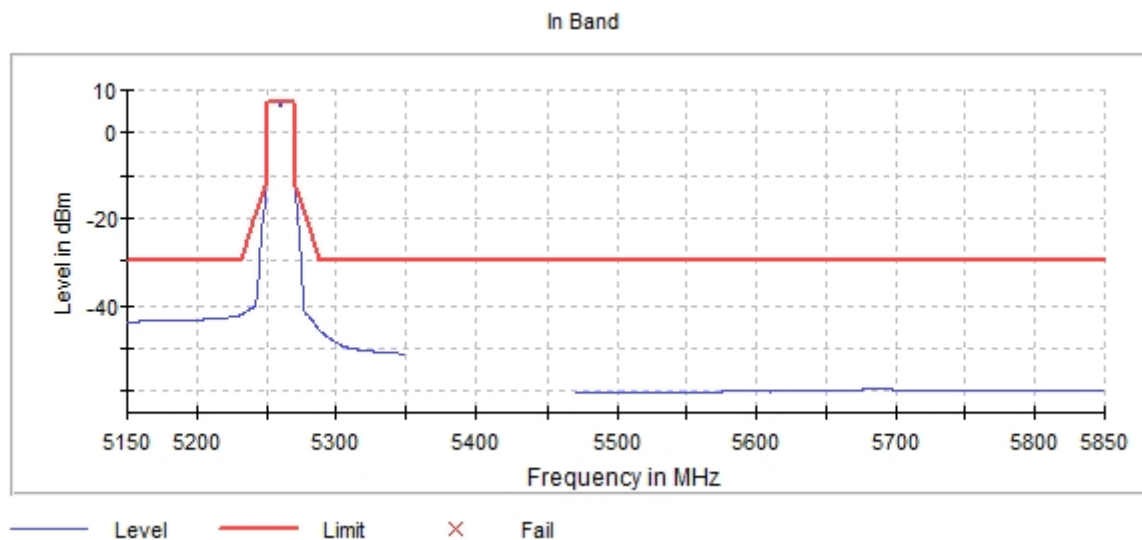


Channel 64

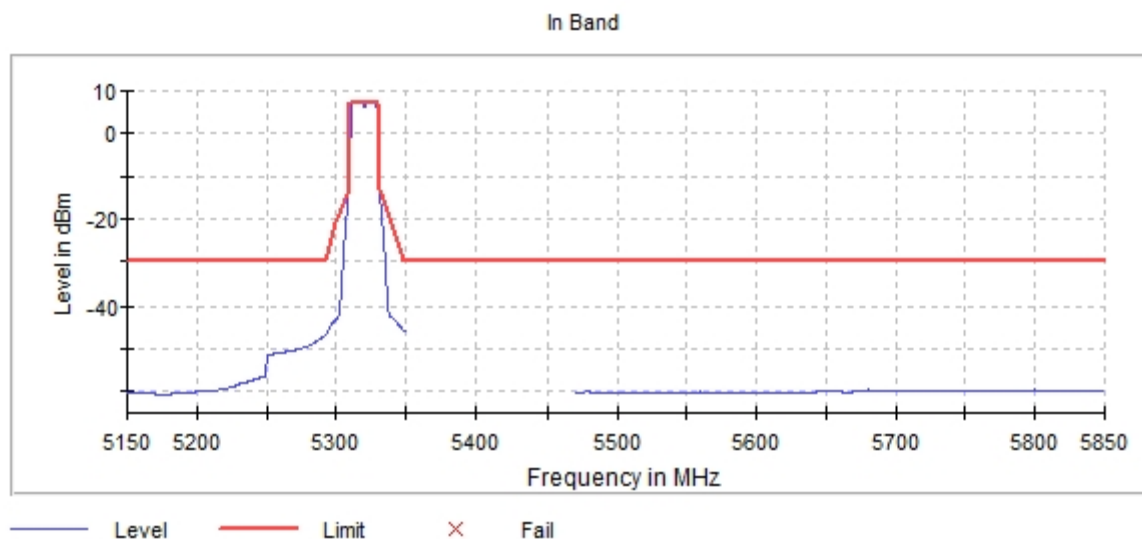


802.11ax/be20 (SISO), MCS0 – Chain AB

Channel 52



Channel 64



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

Standard references

ETSI clause	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 3.																											
	Table 3. 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 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 694 MHz</td><td>-54 dBm</td><td>100 kHz</td></tr><tr><td>694 MHz to 1 GHz</td><td>-36 dBm</td><td>100 kHz</td></tr><tr><td>1 GHz to 26 GHz</td><td>-30 dBm</td><td>1 MHz</td></tr></table>	Frequency range	Maximum power	Bandwidth	30 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 694 MHz	-54 dBm	100 kHz	694 MHz to 1 GHz	-36 dBm	100 kHz	1 GHz to 26 GHz	-30 dBm	1 MHz
	Frequency range	Maximum power	Bandwidth																									
	30 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 694 MHz	-54 dBm	100 kHz																									
694 MHz to 1 GHz	-36 dBm	100 kHz																										
1 GHz to 26 GHz	-30 dBm	1 MHz																										

Test conditions

ETSI clause	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: - 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 - 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 radiated setups (transmitter) shown in section *Test & System Description* were 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.

According to ETSI EN 301 893, the device under test shall be configured to operate under its worst-case condition. In order to determine the worst case, a comprehensive evaluation was performed by varying all available bandwidths and operational modes. The results indicated that the narrowest bandwidth (20 MHz) represents the worst case, as it resulted in the lowest margins to the applicable spurious emission limits. Radiated spurious emissions were measured on the one channel.

For the 20 MHz bandwidth, only the operational modes identified as worst-case were retained and reported in this test report.

Test Results**30 MHz – 1 GHz, Tx spurious emissions****Radiated Spurious – All modes**

Frequency	Level	Detector	Limit (e.i.r.p)	Margin	Polar
MHz	dBm	---	dBm	dB	---
424	-74.3	RMS	-33.9	40.4	H

Tx Spurious Emissions – 1 GHz to 26 GHz**Tx Spurious Emissions – 802.11ax/be20 (SISO), HE0, Chain A, CH52**

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dBm	---	dBm	dB	---
10440.0	-45.6	RMS	-30.0	15.6	V
22297.9	-57.1	RMS	-30.0	27.1	V

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

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dBm	---	dBm	dB	---
10440.0	-45.7	RMS	-30.0	15.7	H
15771.0	-56.1	RMS	-30.0	26.1	V

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

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dBm	---	dBm	dB	---
2656.6	-57.7	RMS	-30.0	27.7	H
12075.9	-58.2	RMS	-30.0	28.2	V
21040.0	-54.5	RMS	-30.0	24.5	V

B.9 Receiver spurious emissions

Test limits

ETSI clause	Limits									
4.2.5.2	The spurious emissions of the receiver shall not exceed the limits given in table 4.									
	Table 4: 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 clause	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 level of transmitter unwanted emissions shall be measured as, either: • their power in a specified load (conducted emissions) and their radiated power (e.r.p. or e.i.r.p as given in clause 4.2.5.2) when radiated by the cabinet or structure of the equipment (cabinet radiation); or • their radiated power (e.r.p. or e.i.r.p as given in clause 4.2.5.2) when radiated by cabinet and antenna. 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 radiated setups (receiver) shown in section *Test & System Description* were 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 emissions were measured for all bandwidths on one channel of each transmission mode. The worst-case configuration was reported.

Test Results Rx

Rx Spurious Emissions – 30 MHz to 26 GHz

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

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dBm	---	dBm	dB	---
424.8	-76.6	RMS	-54.9	21.7	H
2656.3	-57.5	RMS	-47.0	10.5	V
10733.7	-58.2	RMS	-47.0	11.2	H

B.10 Dynamic Frequency Selection

Test limits

ETSI clause	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 clause	Conditions
5.4.8.1.1	These measurements shall be performed only under normal test conditions (see clause 5.1.2). 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 DFS setup shown in section *Test & System Description* 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.

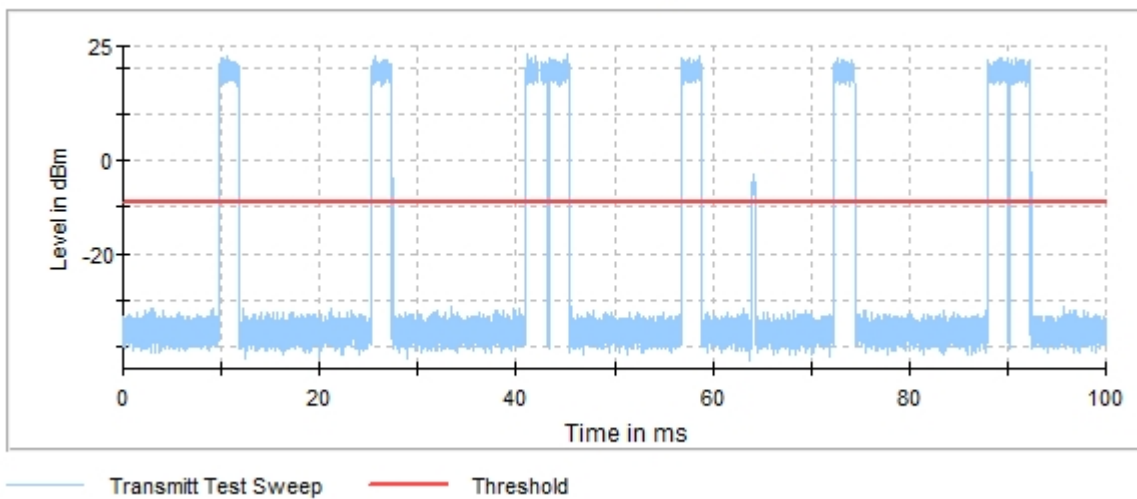
Results tables

Tested Channel: 64, Frequency: 5320 MHz

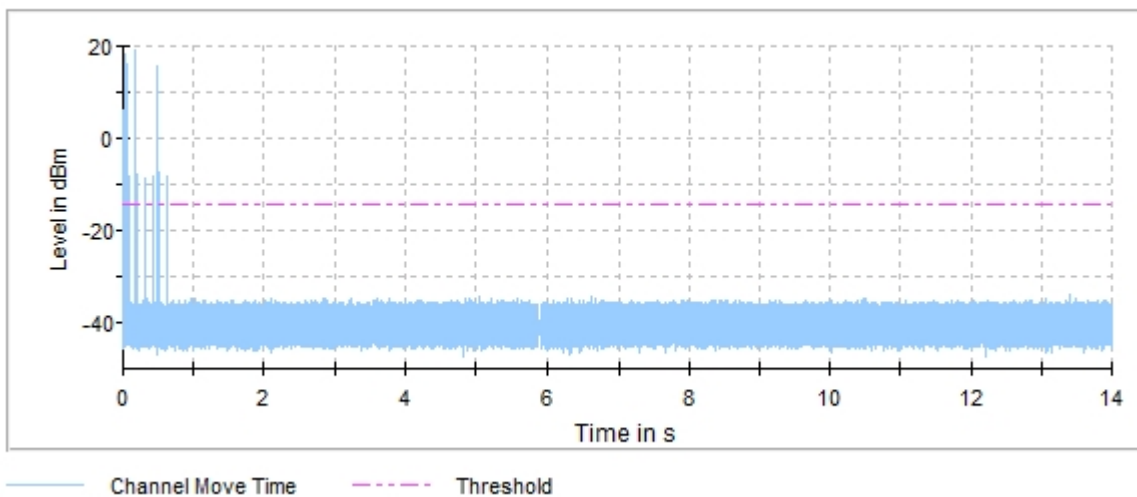
Test item	Results	Limit
Transmit Test Duty Cycle	17.23 %	-
Channel Closing Transmission Time	14.76 ms	1 second
Channel Move Time	0.621 ms	10 seconds

Results Screenshot

Transmitt Test Sweep



Channel Move Time



Channel Move Time < 10s. Test PASS

Channel Closing Transmission Time (*Aggregate Time*) = 14.76 ms. Test PASSChannel Move Time (*Channel Closing Time*) = 0.621 ms. Test PASS

B.11 Adaptivity (Channel Access Mechanism)**Test limits**

ETSI clause	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	<i>ED Threshold Level.</i> An operating channel is an occupied channel as long as transmissions in that channel are present at a power level greater than the Energy Detection Threshold (EDT). The power level is determined by integrating the received power over the channel and then normalized to per MHz power. The received power shall be determined at the interface between the equipment and the antenna assembly. If no transmissions are present at a power level greater than the EDT, the operating channel is an unoccupied channel. Equipment may consist of one or more devices. The EDT is proportional to the equipment's maximum configured RF output power and shall be: • -75 dBm/MHz for $P_{max} \leq 18$ dBm • -80 dBm/MHz + (23 dBm - P_{max}) for $18 \text{ dBm} < P_{max} < 23$ dBm (3) • -80 dBm/MHz for $P_{max} \geq 23$ dBm
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 clause	Conditions
5.4.9.1	These measurements shall only be performed at normal test conditions (see clause 5.1.2). The device shall be configured to operate at its maximum output power level. NOTE: Capabilities of the equipment that are relevant for the test method in the present clause have been noted in the test report per clause 5.4.1.

Test procedure

ETSI clause	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 adaptivity setup shown in section *Test & System Description* 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 - Margin*** = -81dBm/MHz
TL = -80 dBm/MHz, limit of the ED Threshold Level assuming 0dBi antenna gain
Margin = Additionnal margin requested by the applicant (1dB)

Test Results

According to ETSI EN 301 893 V2.2.1., table 10 of section 5.3.2, one channel out of the declared channels has been tested.

See report 250522-02.TR03 for the test results.

Compliance

PASS

B.12 Receiver Blocking

Test limits

ETSI clause	Limits																	
4.2.8.3	For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER less than or equal to 10 %.																	
4.2.8.4	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>P_{min} + 6 dB</td><td>5 100</td><td>-53</td><td>-59</td><td>Continuous Wave</td></tr><tr><td>P_{min} + 6 dB</td><td>4 900 5 000 5 975</td><td>-47</td><td>-53</td><td>Continuous Wave</td></tr></table> NOTE: 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.	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)	P _{min} + 6 dB	5 100	-53	-59	Continuous Wave	P _{min} + 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)															
P _{min} + 6 dB	5 100	-53	-59	Continuous Wave														
P _{min} + 6 dB	4 900 5 000 5 975	-47	-53	Continuous Wave														

Test conditions

ETSI clause	Conditions
5.4.10.1	These measurements shall only be performed at normal test conditions (see clause 5.1.2). The UUT shall operate in its normal operational mode. For devices which can change their operating frequency automatically (adaptive channel allocation), this function shall be disabled. If the equipment can be configured to operate with different nominal channel bandwidths 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. This mode of operation shall be aligned with the performance criteria defined in clause 4.2.8.3 and shall be described in the test report. It shall be verified that these performance criteria are achieved during the blocking test.

Test procedure

The receiver blocking setup shown in section *Test & System Description* was used to measure receiver blocking signal. The signaling Unit is a 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 64, 6Mbps

- Minimum performance result without interferer**

Wanted signal mean power from companion device: Pmin [dBm]	PER [%]
-89.00	1.30

- Minimum performance results with interferer**

Wanted signal mean power from companion device:

✓ Pmin [dBm] + 6dB = -83.00dBm

Blocking signal Frequency [MHz]	Blocking signal Power [dBm]	PER [%]	Verdict
5100	-59	1.60	Pass
4900	-53	0.75	Pass
5000	-53	0.90	Pass
5975	-53	0.90	Pass

B.13 Adjacent Channel Selectivity

Test limits

ETSI clause	Limits								
4.2.9.4	The limits defined in this clause apply when the equipment receives the wanted signal on a single channel and the occupied bandwidth of the interfering signal falls completely within a channel adjacent to this channel. Both channels have a nominal channel bandwidth as defined in clause 4.2.2. While maintaining the minimum performance criteria as defined in clause 4.2.9.3, the adjacent channel interferer level shall be equal to or greater than the limit given in table 9 corresponding to a frequency offset within the range specified in table 9. Table 9: Adjacent channel selectivity parameters <table><tr><th>Wanted signal mean power from companion device (dBm)</th><th>Interferer signal frequency offset range (MHz)</th><th>Interferer signal power (dBm) (see note 2 and note 3)</th><th>Type of interferer signal</th></tr><tr><td>$P_{\min} + 10 \text{ dB}$</td><td>20 (see note 4)</td><td>$P_{\min} + 26 \text{ dB}$</td><td>Same as the wanted signal with an equivalent nominal bandwidth</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 clause 4.3.9.3 in the absence of any interfering signal. NOTE 3: The level specified for the interferer signal applies at the lowest data rate	Wanted signal mean power from companion device (dBm)	Interferer signal frequency offset range (MHz)	Interferer signal power (dBm) (see note 2 and note 3)	Type of interferer signal	$P_{\min} + 10 \text{ dB}$	20 (see note 4)	$P_{\min} + 26 \text{ dB}$	Same as the wanted signal with an equivalent nominal bandwidth
Wanted signal mean power from companion device (dBm)	Interferer signal frequency offset range (MHz)	Interferer signal power (dBm) (see note 2 and note 3)	Type of interferer signal						
$P_{\min} + 10 \text{ dB}$	20 (see note 4)	$P_{\min} + 26 \text{ dB}$	Same as the wanted signal with an equivalent nominal bandwidth						

Test conditions

ETSI clause	Conditions
5.4.11.1	These measurements shall only be performed at normal test conditions (see clause 5.1.2). For devices which can change their operating frequency automatically (adaptive channel allocation), this function shall be disabled. The UUT shall operate in its normal operational mode, except that it shall be configured to operate with a nominal channel bandwidth of 20 MHz and at the lowest data rate for this channel bandwidth. It shall be verified that the performance criteria as defined in clause 4.2.9.3 are achieved during the adjacent channel selectivity test.

Test procedure

The receiver blocking setup shown in section A1 was used to measure receiver adjacent channel selectivity. The signaling Unit is the CMW500.

The packet error rate (PER) is measured with the CMW500. The blocking signal is emulated by the Signal generator SMW200A.

Configuration tested: 802.11a20, Chain A, Channel 64 (5320MHz) , 6Mbps

• Minimum performance result without interferer

Wanted signal mean power from companion device: Pmin [dBm]	PER [%]
-96.00	4.90

• Minimum performance results with interferer (frequency offset 20MHz)

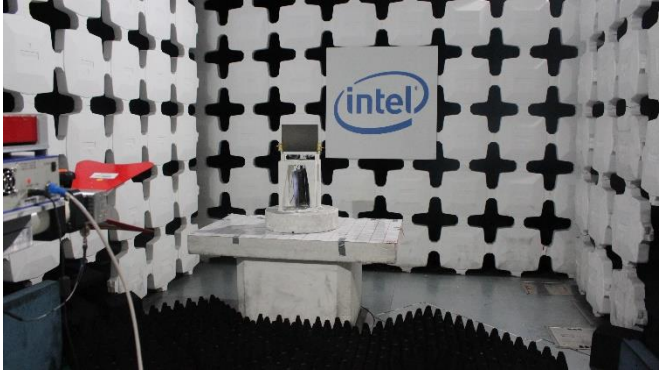
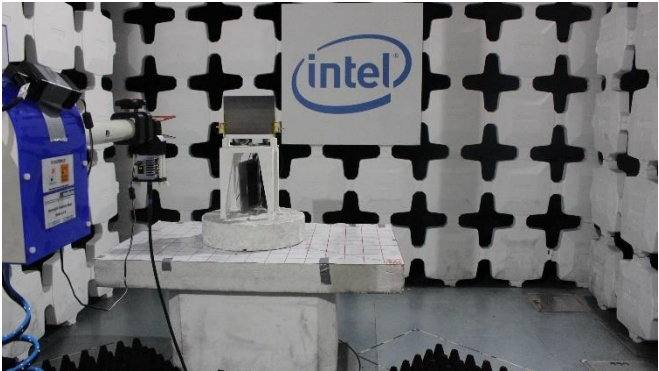
Wanted signal mean power from companion device:

- ✓ Pmin [dBm] + 10dB = -86.00
- ✓ Initial Interferer Signal power: Pmin [dBm] + 26dB = -70.00

Blocking signal Frequency (MHz)	Interferer signal frequency (MHz)	Minimum Blocking signal power (dBm)	PER (%)	Maximum Blocking signal power (dBm)	PER (%)	Verdict
5320	5300	-70.00	0.00	-37.00	1.00	Pass
	5340	-70.00	0.05	-38.00	8.70	Pass

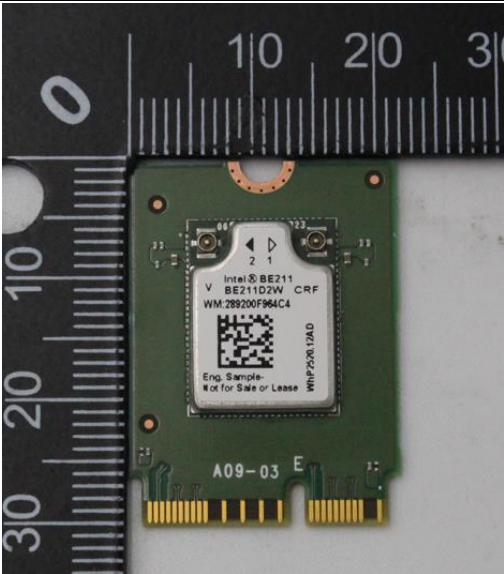
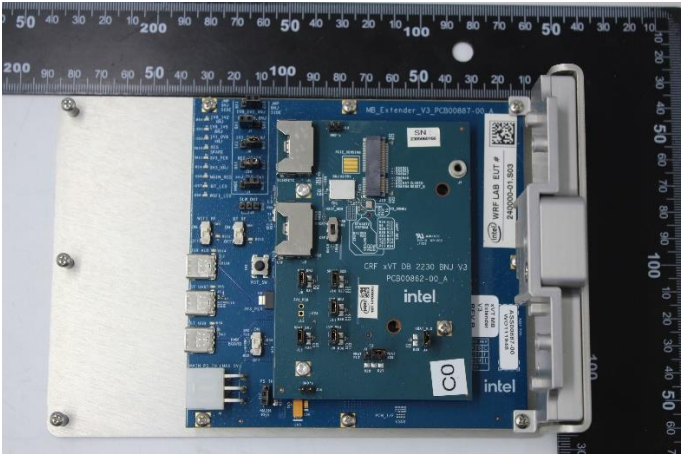
Annex C. Photographs

C.1 Test Setup

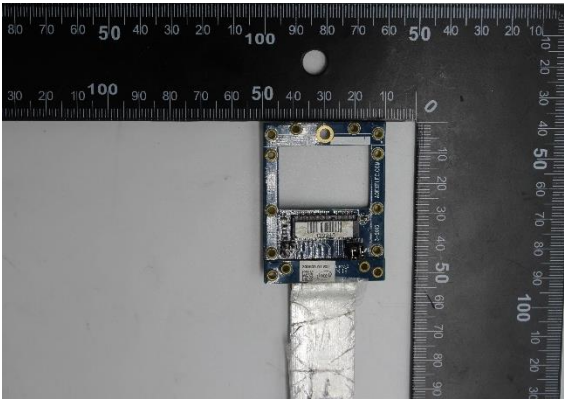
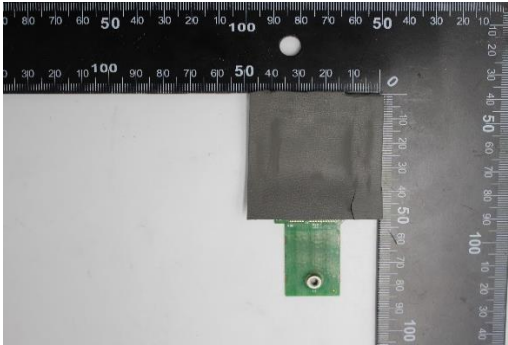
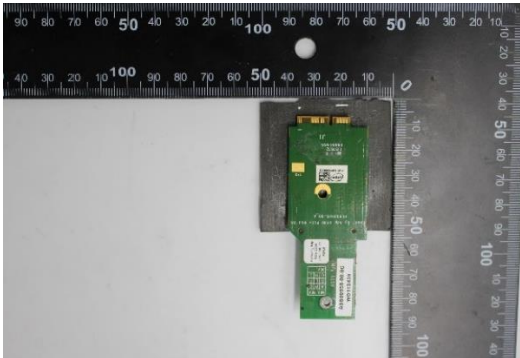
Radiated Setup 30 MHz – 1 GHz (Transmitter tests) 	Radiated Setup 1 GHz – 11 GHz (Transmitter tests) 
Radiated Setup 11 GHz – 26 GHz (Transmitter tests) 	

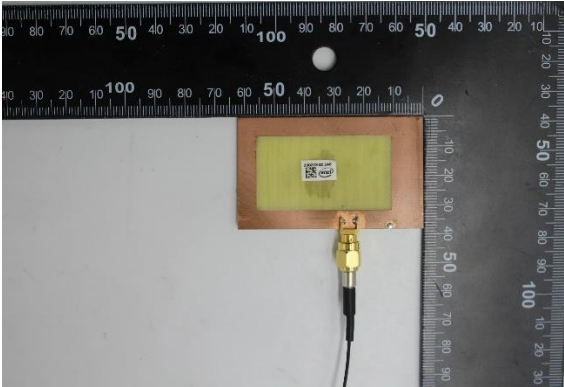
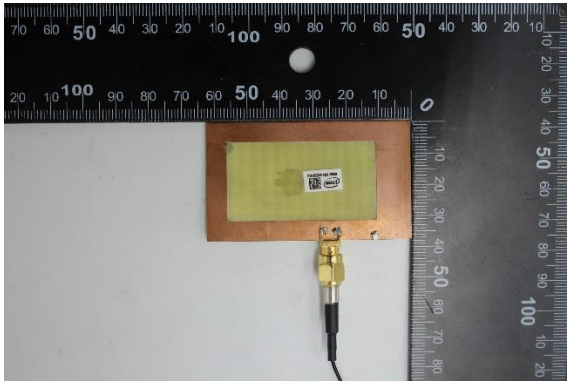
Radiated Setup 30 MHz – 1 GHz (Receiver tests) A photograph of a test chamber interior. The walls are covered with white, cross-shaped electromagnetic interference (EMI) absorbers. A blue and white antenna is mounted on a stand in the center. A red safety cage is visible on the right side. An Intel logo is visible on the wall.	Radiated Setup 1 GHz – 11 GHz (Receiver tests) A photograph of a test chamber interior. The walls are covered with white, cross-shaped electromagnetic interference (EMI) absorbers. A blue and white antenna is mounted on a stand in the center. A red safety cage is visible on the left side. An Intel logo is visible on the wall.
Radiated Setup 11 GHz – 26 GHz (Receiver tests) A photograph of a test chamber interior. The walls are covered with white, cross-shaped electromagnetic interference (EMI) absorbers. A blue and white antenna is mounted on a stand in the center. A red safety cage is visible on the left side. An Intel logo is visible on the wall.	

C.2 Test Sample

Sample #01	
Module Front	Module Back
	
Extender board	Laptop
	

Sample #02

Module Front 	Module Back 
Extender board 	Laptop 
Adaptor Front 	Adaptor Back 

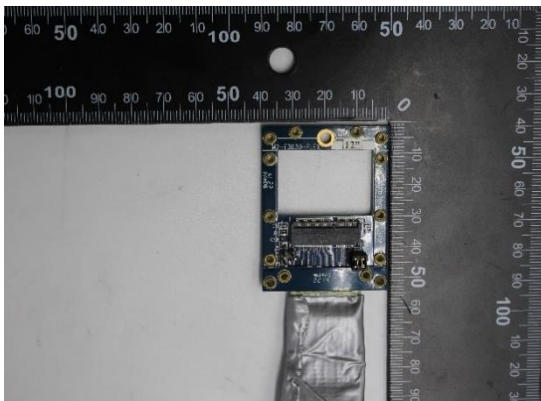
PIFA antenna (Main)	PIFA antenna (Aux)
	

Sample #03

Module Front

[Module Back](#)

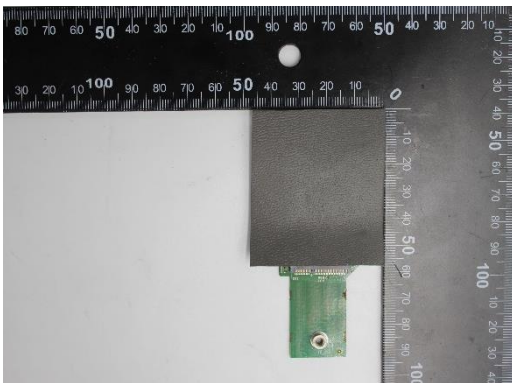
Extender board



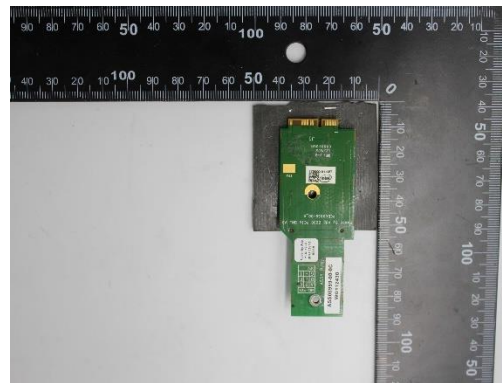
Laptop

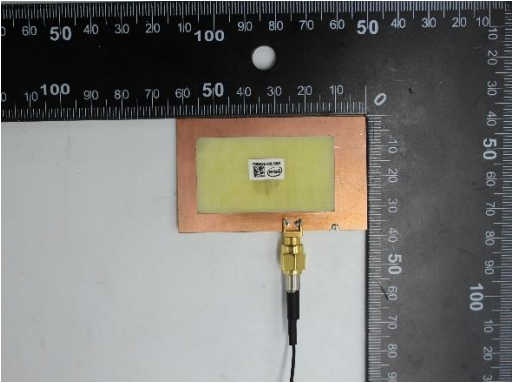
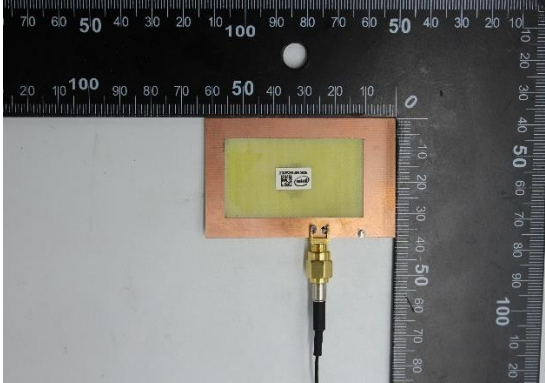


Adaptor Front



Adaptor Back



PIFA antenna (Main)	PIFA antenna (Aux)
	

End of the report

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