CERTIFICATE #3478.01

TEST REPORT

EUT Description	**WLAN and BT, 2x2 PCIe M.2 2230 adapter card**
Brand Name	**Intel® Wi-Fi 6 AX203**
Model Name	**AX203NGW**
FCC ID	**PD9AX203NG**
Date of Test Start/End	**2023-01-17 / 2023-01-18**
Features	**802.11ax, Dual Band, 2x2 Wi-Fi + Bluetooth® 5.2** (see section 5)

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

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

Test Report identification	**220915-14.TR03**
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.
Reference to accreditation shall be used only by full reproduction of test report.

Issued by

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1. Standards, reference documents and applicable test methods

FCC	1. FCC Title 47 CFR part 15 – Subpart E – Unlicensed National Information Infrastructure Devices. 2021-10-01 Edition 2. FCC Title 47 CFR part 15 – Subpart C – §15.209 Radiated emission limits; general requirements. 2021-10-01 Edition 3. FCC OET KDB 662911 D01 v02r01 - Emissions Testing of Transmitters with Multiple Outputs in the Same Band. 4. FCC OET KDB 789033 D02 v02r01 - Guidelines for compliance testing of unlicensed national information infrastructure (U-NII) devices part 15, subpart E 5. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. 6. FCC OET KDB 291074 D01 v01 - General Requirements 7. FCC OET KDB 291074 D02 v01 - EMC Measurement 8. FCC OET KDB 291074 D03 v01 - QA General Questions and Answers 9. FCC OET KDB 291074 D04 v01 – UN5GHz Checklist v01

2. General conditions, competences and guarantees

- ✓ Tests performed under FCC standards identified in section 1 are covered by A2LA accreditation.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an ISO/IEC 17025:2017 laboratory accredited by the American Association for Laboratory Accreditation (A2LA) with the certificate number 3478.01.
- ✓ Intel Corporation SAS Wireless RF Lab (Intel WRF Lab) is an Accredited Test Firm recognized by the FCC, with Designation Number FR0011.
- ✓ Intel WRF Lab only provides testing services and is committed to providing reliable, unbiased test results and interpretations.
- ✓ Intel WRF Lab is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.
- ✓ Intel WRF Lab has developed calibration and proficiency programs for its measurement equipment to ensure correlated and reliable results to its customers.
- ✓ This report is only referred to the item that has undergone the test.
- ✓ This report does not imply an approval of the product by the Certification Bodies or competent Authorities.

3. Environmental Conditions

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

Temperature	23.5ºC ± 0.7ºC
Humidity	29.6% ±6.8%

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	200928-01.S03	WiFi 6 Module	AX203NGW	WFM:FC4482148421	2020-10-02	Used for 30 MHz-1 GHz and 18 GHz-40 GHz Radiated Spurious Emissions tests
	200928-02.S11	Adaptor	HrP M2 Adaptor JnP 1216	6961919-172	2020-10-27	
	200611-03.S30	Laptop	Latitude 5401	6DJLK13	2020-08-19	
	220915-09.S01	Extender	ADEXELEC	-	2022-04-06	
	200921-01.S01	Dipole Antenna	ARY121-0009-002-H0	-	2020-09-28	
	200921-01.S02	Dipole Antenna	ARY121-0009-002-H0	-	2020-09-28	
#02	200928-01.S03	WiFi 6 Module	AX203NGW	WFM:FC4482148421	2020-10-02	Used for 1 GHz-18 GHz Radiated Spurious Emissions tests
	200928-02.S11	Adaptor	HrP M2 Adaptor JnP 1216	6961919-172	2020-10-27	
	170000-01.S13	Laptop	Latitude E5470	FT6LMC2	2017-05-30	
	220225-03.S23	Extender	ADEXELEC	-	2022-03-14	
	200921-01.S03	Dipole Antenna	ARY121-0009-002-H0	-	2020-09-28	
	200921-01.S04	Dipole Antenna	ARY121-0009-002-H0	-	2020-09-28	

5. 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® Wi-Fi 6 AX203
Model Name	AX203NGW
Software Version	DRTU Version: 22.21040.0.0-OEM.DRTU.11758
Driver Version	99.0.62.2
Prototype / Production	Production
Supported Radios	802.11b/g/n/ax 2.4 GHz (2400.0 – 2483.5 MHz) 802.11a/n/ac/ax 5.2 GHz (5150.0 – 5350.0 MHz) 5.6 GHz (5470.0 – 5725.0 MHz) 5.8 GHz (5725.0 – 5850.0 MHz) 5.9 GHz (5850.0 – 5895.0 MHz) Bluetooth 5.1 2.4 GHz (2400.0 – 2483.5 MHz)

Antenna Information

Transmitter	Chain A (1)	Chain B (2)
Manufacturer	Wieson	Wieson
Antenna type	Dipole	Dipole
Part number	ARY121-0009-002-H0	ARY121-0009-002-H0
Declared Antenna gain (dBi) - 2.4 GHz	+2.95	+2.95
Declared Antenna gain (dBi) – 5.2 & 5.3 GHz	+4.11	+4.11
Declared Antenna gain (dBi) – 5.6 GHz	+5.15	+5.15
Declared Antenna gain (dBi) – 5.8 GHz	+5.13	+5.13
Declared Antenna gain (dBi) – 5.9 GHz	+4.45	+4.45

6. Remarks and comments

1. No deviations were made from the test methods listed in section 1 of this report.
2. The low, mid and high channels were tested for each RF chain (A, B or A+B), bandwidth and modulation. Only the worst case among the low, mid and high channels has been reported.

7. 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.

802.11 a/n/ac/ax – U-NII- 4

FCC part	Test name	Verdict
15.407 (b) (3) 15.209	Undesirable emissions limits: Spurious emissions (radiated)	P

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

8. Document Revision History

Revision #	Modified by	Revision Details
Rev. 00	K.Khatib	First Issue
Rev. 01	R. LUCIANI	Standard reference update – section 1 Supported radios & Antenna information update – section 5

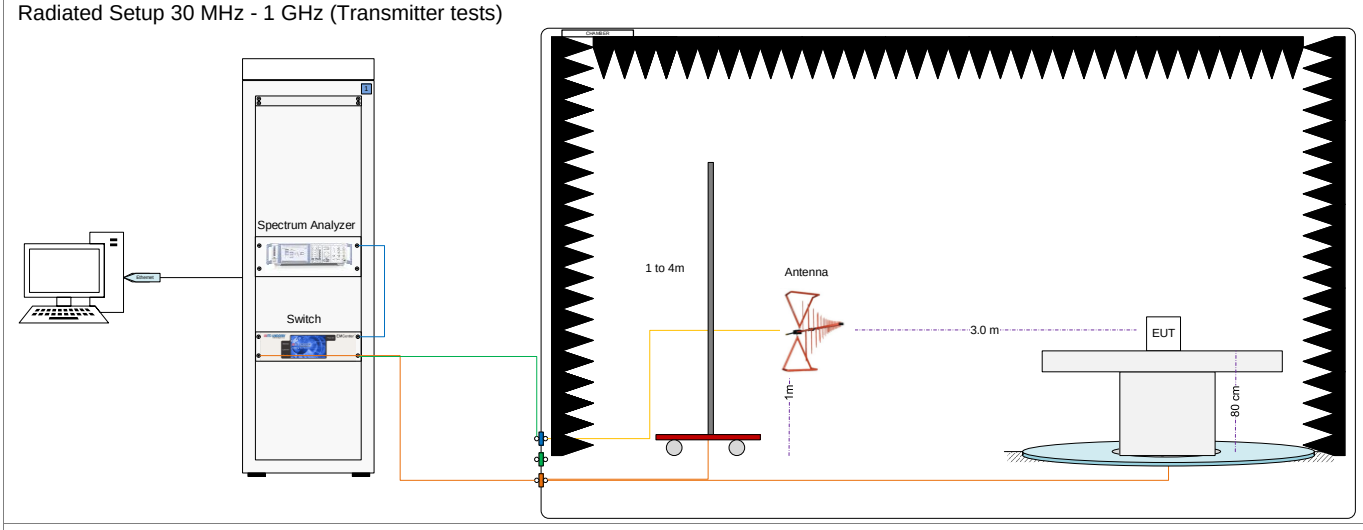
Annex A. Test & System Description

A.1 Measurement System

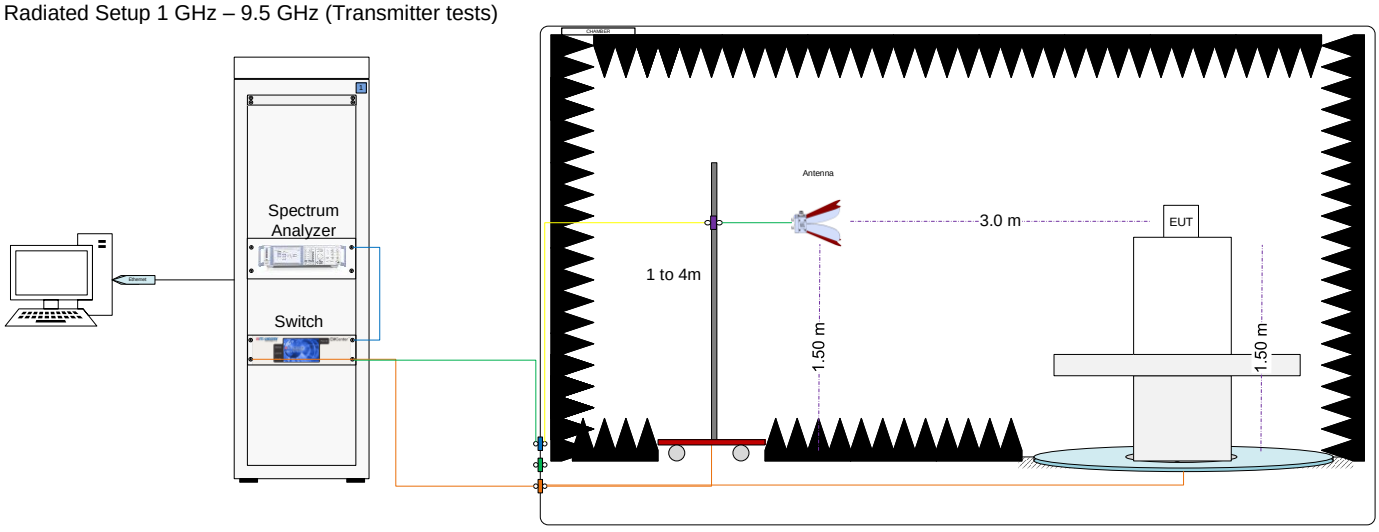
Measurements were performed using the following setups, made in accordance to the general provisions of ANSI C63.10 2013.
The DUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes, using the Intel proprietary tool DRTU.

Radiated test setup

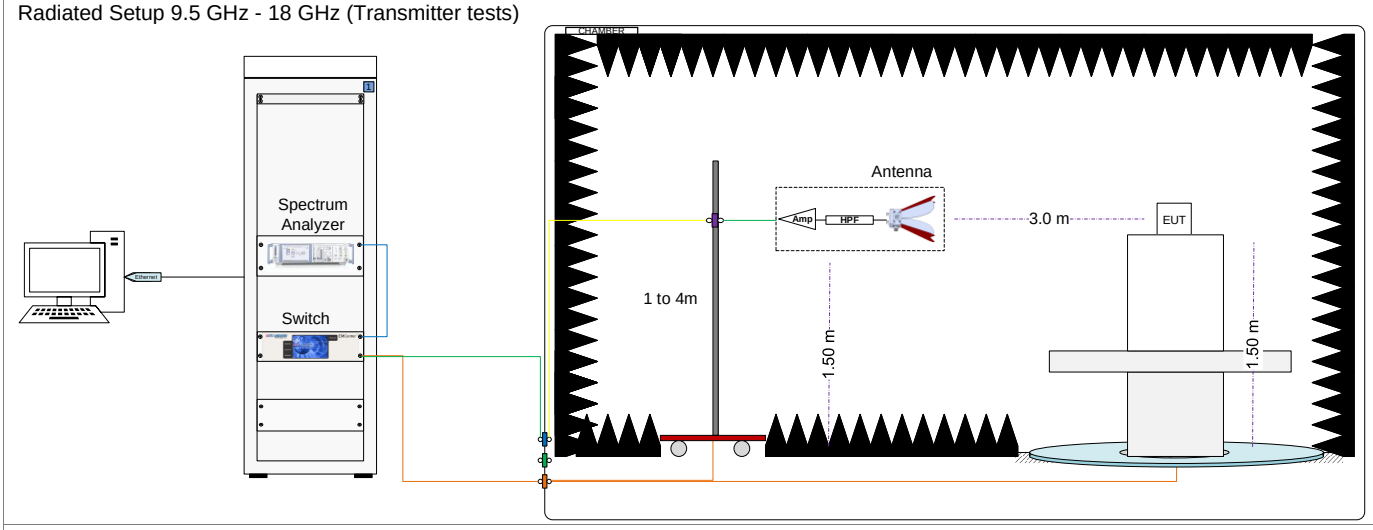
Radiated Setup 30 MHz - 1 GHz (Transmitter tests)



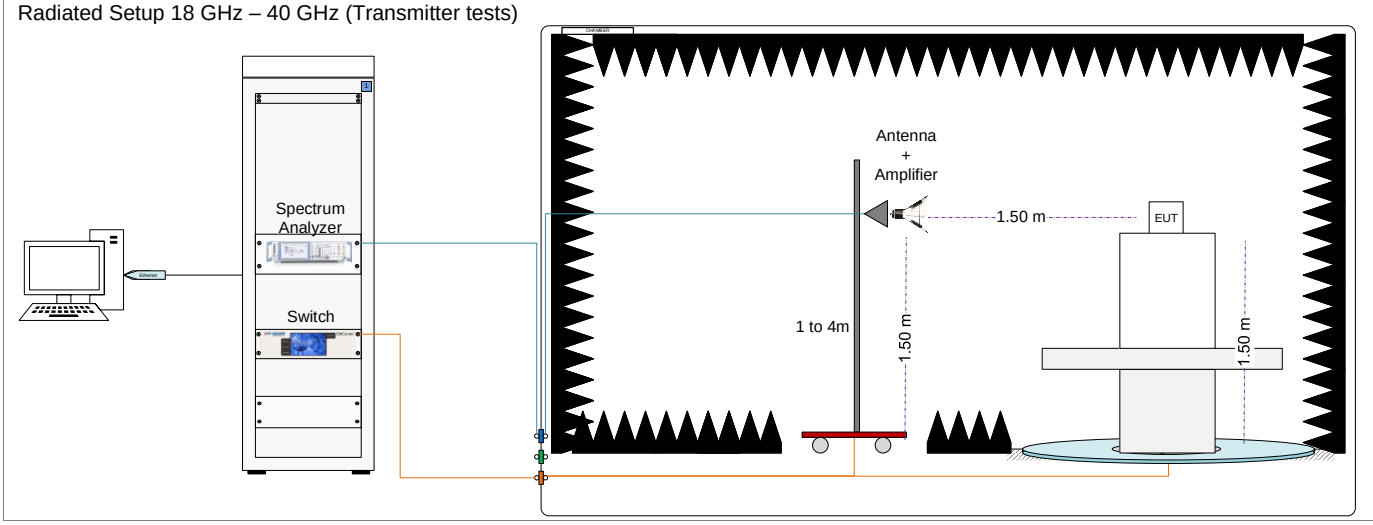
Radiated Setup 1 GHz – 9.5 GHz (Transmitter tests)



Radiated Setup 9.5 GHz - 18 GHz (Transmitter tests)



Radiated Setup 18 GHz – 40 GHz (Transmitter tests)



Sample Calculation

The spurious received voltage V(dBµV) in the spectrum Analyzer is converted to Electric field strength using the transducer factor F corresponding to the Rx path Loss:

F (dB/m)= Rx Antenna Factor (dB/m) + Cable losses (dB) – Amplifiers Gain (dBi)
E (dBµV/m) = V(dBµV) + F (dB/m)

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

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

where

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

A.2 Test Equipment List

Radiated Setup #1

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
006-000	Anechoic chamber	FACT 3	5720	ETS Lindgren	2022-01-21`	2024-01-21
006-001	Turntable	-	-	ETS Lindgren	N/A	N/A
006-008	Measurement Software v11.30.00	EMC32	100623	Rohde & Schwarz	N/A	N/A
147-000	Spectrum analyzer	FSW43	101847	Rohde & Schwarz	2022-11-30	2024-11-30
006-002	Switch & Positioning	EMC center	00159757	ETS Lindgren	N/A	N/A
006-011	Boresight antenna mast	BAM4.0-P	P/278/2890.01	Maturo	N/A	N/A
006-061	Log-periodic Antenna 30 MHz – 1 GHz	CBL6143A	61382	Teseq	2022-10-24	2024-10-24
006-020	Double Ridged Horn Antenna 1 GHz – 18 GHz	3117	00157734	ETS Lindgren	2021-08-05	2023-08-05
066-000	Horn Antenna 3117 + Amplifier + HPF9.5	3117-PA	00103954+00161429	ETS-Lindgren	2022-07-08	2024-07-08
007-025	Horn antenna	DE-0540	71	Diamond Engineering	2021-04-05	2023-04-05
006-059	RF Cable 7.0m	R286304174	20.46.369	Radiall	2022-08-25	2023-02-25
006-051	RF Cable 1.0m	CBL-1.5M-SMSM+	202879	Mini-Circuits	2022-08-29	2023-02-01
006-030	RF Cable 1.2m	UFA147A-0-0480-200200	MFR 64639223720-003	Micro-coax	2022-08-25	2023-02-25
006-034	Cable 1m - 1GHz to 18GHz	UFA147A	-	Utilflex	2022-08-25	2023-02-25
026-018	RF Cable 1.2m	0500990991200KE	18.23.179	Radiall	2022-08-29	2023-02-01
006-039	RF Cable 2.5m	0500990992500KE	19.23.395	Radiall	2022-08-25	2023-02-25
365-000	Temperature & Humidity logger	RA12E-TH1-RAS	00-80-A3-E1-6E-55	Avtech	2021-03-08	2023-03-08

N/A: Not Applicable

Radiated Setup #2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
007-000	Anechoic chamber	RFD-FA-100	5996	ETS Lindgren	2021-09-14	2023-09-14
007-002	Turntable	-	-	ETS Lindgren	N/A	N/A
007-003	Antenna Tower	2171B-3.0M	00150123	ETS Lindgren	N/A	N/A
007-006	Switch & Positioner	EMCenter	00151232	ETS Lindgren	N/A	N/A
007-005	Measurement SW, V11.20.00	EMC32	100401	Rohde & Schwarz	N/A	N/A
137-000	Spectrum Analyzer	FSW67	103266	Rohde & Schwarz	2022-12-14	2024-12-14
007-007	Double Ridge Horn (1- 18GHz)	3117	00152266	ETS Lindgren	2022-03-29	2024-03-29
066-000	Horn Antenna 3117 + Amplifier + HPF9.5	3117-PA	00103954+00161429	ETS-Lindgren	2022-07-08	2024-07-08
007-008	Double Horn Ridged antenna	3116C-PA	00169308bis + 00196308	ETS-Lindgren	2021-08-05	2023-08-05
059-000	Double ridged horn antenna	3117-PA	00201542	ETS-Lindgren	2021-08-05	2023-08-05
007-022	RF Cable 1-18GHz, 1.5m	0501050991200GX	19.23.493	Radiall	2022-08-30	2023-02-30
007-020	RF Cable 1-18GHz, 1.2 m	2301761761200PJ	12.22.1104	Radiall	2022-08-31	2023-02-31
007-011	RF Cable 1-18GHz – 6.5m	140-8500-11-51	001	Spectrum	2022-08-31	2023-02-31
007-015	RF Cable 1GHz-18GHz 1.5m	-	-	Spirent	2022-09-01	2023-03-01
007-014	RF Cable 18-40 GHz 6m	R286304009	1747364	Radiall	2022-08-31	2023-02-31
007-023	RF Cable 1m DC-40GHz	PE360-100CM	-	Pasternack	2022-08-30	2023-02-30
007-018	RF Cable 1-9.5GHz 1.2m	0500990991200KE	-	Radiall	2022-08-31	2023-02-31
325-000	Temp & Humidity Logger	RA12E-TH1-RAS	RA12-B9B7C6	Avtech	2022-01-17	2024-01-17

N/A: Not applicable

Shared Radiated Equipment

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
412-000	DRTU Power finder V2.0	-	-	Intel	NA	NA
139-000	Power Sensor	NRP-Z81	104383	Rohde & Schwarz	2021-04-07	2023-04-07
140-000	Power Sensor	NRP-Z81	104382	Rohde & Schwarz	2022-03-25	2024-03-25

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	Unit
Radiated tests below 1GHz	±6.40	dB
Radiated tests 1GHz – 40 GHz	±6.04	dB

Annex B. Test Results U-NII-4

The herein test results were performed by:

Test case measurement	Test Personnel
Radiated spurious emissions	R.Simonini, K.Khatib

B.1 Test Condition

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

For 802.11n20 & 802.11ax20 (20 MHz channel bandwidth), 802.11n40 & 802.11ax40 (40MHz channel bandwidth) and 802.11ac80 & 802.11ax80 (80MHz 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
	802.11ax	20/40/80	HE0
MIMO	802.11n	20/40	HT8
	802.11ac	80	VHT0
	802.11ax	20/40/80	HE0

B.2 Test Results Tables

B.2.1 Radiated spurious emission

Standard references

<table>
<tr><th>FCC part</th><th>Limits</th></tr>
<tr><td>15.407 (b) (5) (iii)</td><td>For transmitters operating solely in the 5.850-5.895 GHz band or operating on a channel that spans across 5.725-5.895 GHz: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.
.</td></tr>
<tr><td>15.407 (b) (5) (ii)</td><td>For a client device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of −5 dBm/MHz and shall decrease linearly to an e.i.r.p. of −27 dBm/MHz at or above 5.925 GHz</td></tr>
<tr><td>15.209</td><td>Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a):
<table>
<tr><th>Freq Range (MHz)</th><th>Field Strength (µV/m)</th><th>Field Strength (dBµV/m)</th><th>Meas. Distance (m)</th></tr>
<tr><td>30-88</td><td>100</td><td>40</td><td>3</td></tr>
<tr><td>88-216</td><td>150</td><td>43.5</td><td>3</td></tr>
<tr><td>216-960</td><td>200</td><td>46</td><td>3</td></tr>
<tr><td>Above 960</td><td>500</td><td>54</td><td>3</td></tr>
</table>
The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
For average radiated emission measurements above 1000 MHz, there is also a limit specified when measuring with peak detector function, corresponding to 20 dB above the indicated values in the table.</td></tr>
</table>

Test procedure

The radiated setups shown in section *Test & System Description* were used to measure the radiated spurious emissions.

Depending of the frequency range and bands being tested, different antennas and filters were used.

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

The radiated spurious emission was measured on the worst case configuration selected from the section B.1and using the low, middle and high channels.

Test Results

30 MHz – 1 GHz, Radiated spurious emissions

Radiated Spurious – All modes

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dBµV/m	---	dBµV/m	dB	---
427.4	34.7	Quasi-Peak	46.0	11.3	V

Note 1: The detected spurious signals do not depend on either the operating channel or the modulation mode.

Radiated spurious – 1 GHz to 40 GHz

802.11ax

802.11ax40, HE0, Chain A+B

CH167

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dBµV/m	---	dBµV/m	dB	---
9065.5	57.7	Peak	74.0	16.3	V
9065.5	46.7	Average	54.0	7.3	V
11649.5	58.0	Peak	74.0	16.0	V
11650.5	50.6	Average	54.0	3.4	V
23300.8	51.6	Peak	88.2	36.6	V
23301.6	42.6	RMS	68.2	25.6	V