



TEST REPORT

EUT Description	WLAN and BT, 2x2 PCIe M.2 2230 adapter card
Brand Name	Intel®
Model Name	BE201NGW
FCC	PD9BE201NG
Date of Test Start/End	2023-12-04 / 2023-12-13
Features	2x2 WiFi - Bluetooth® (see section 5)

Applicant	Intel Corporation SAS
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Contact Person	Benjamin Lavenant
Telephone/Fax/ Email	Benjamin.lavenant@intel.com

Reference Standards	FCC CFR Title 47 Part 15 E (see section 1)
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Test Report identification	231109-05.TR02
Revision Control	Rev. 00 This test report revision replaces any previous test report revision (see section 8)

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

Issued by _____

Reviewed by _____

Khodor RIDA
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1. Standards, reference documents and applicable test methods

FCC	<ol style="list-style-type: none">1. FCC Title 47 CFR part 15 – Subpart E – Unlicensed National Information Infrastructure Devices. 2021-10-01 Edition2. FCC Title 47 CFR part 15 – Subpart C – §15.209 Radiated emission limits; general requirements. 2021-10-01 Edition3. 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 E5. ANSI C63.10-2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.6. FCC OET KDB 291074 D01 v01 - General Requirements7. FCC OET KDB 291074 D02 v01 - EMC Measurement8. FCC OET KDB 291074 D03 v01 - QA General Questions and Answers9. FCC OET KDB 291074 D04 v01 – UN5GHz Checklist v01
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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	24.3°C ± 0.7°C
Humidity	32.0% ± 5.9%

4. Test samples

Sample	Control #	Description	Model	Serial #	Date of receipt	Note
#01	231109-03.S29	WiFi 7 Module	BE201NGW	A002A5B1A61B	2023-11-13	Used for Radiated Spurious Emissions tests
	220225-03.S07	Microwave Absorber	Eccosorb BSR-1	-	2022-03-14	
	231109-03.S48	Adaptor	PCB00866-00_A	124627	2023-11-24	
	200611-03.S31	Extender	ADEXELEC	-	2020-08-19	
	200504-04.S07	Laptop	Latitude 5401	BVHLK13	2020-06-02	
	230526-08.S71	Monopole Antenna	OEM Hong-Bo	AD03	2023-06-26	
	230526-08.S72	Monopole Antenna	OEM Hong-Bo	AD04	2023-06-26	
#02	231109-03.S01	WiFi 7 Module	BE201NGW	A002A5B1A620	2023-11-24	Used for Radiated Spurious Emissions tests
	220225-03.S07	Microwave Absorber	Eccosorb BSR-1	-	2022-03-14	
	231109-03.S47	Adaptor	PCB00866-00_A	124727	2023-11-24	
	220915-09.S01	Extender	ADEXELEC	-	2022-04-06	
	200611-03.S30	Laptop	Latitude 5401	6DJLK13	2020-08-19	
	230526-08.S69	Monopole Antenna	OEM Hong-Bo	AD01	2023-06-26	
	230526-08.S70	Monopole Antenna	OEM Hong-Bo	AD02	2023-06-26	

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®		
Model Name	BE201NGW		
Software Version	DRTU.05312.99.0.84		
Driver Version	99.0.84.6		
Prototype / Production	Production		
Supported Radios	802.11b/g/n/ax/be	2.4GHz	
	802.11a/n/ac/ax/be	5.2GHz	
		5.6GHz	
		5.8GHz	
		5.9GHz	
	802.11ax/be	6.0GHz	
Bluetooth	2.4GHz		
Antenna Information	Transmitter	Main(2)/Chain A	Aux(1)/Chain B
	Manufacturer	Changshu HongBo	Changshu HongBo
	Antenna type	Monopole	Monopole
	Part number	260-25095	260-25095
	Declared Antenna gain (dBi) – 5.9 GHz	+4.43	+4.43

6. Remarks and comments

The low, mid, high channels were tested for each RF chain (A, B or A+B), bandwidth, modulation and sub-band. 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.

7.1. 802.11 a/n/ac/ax/be – 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

Annex A. Test & System Description

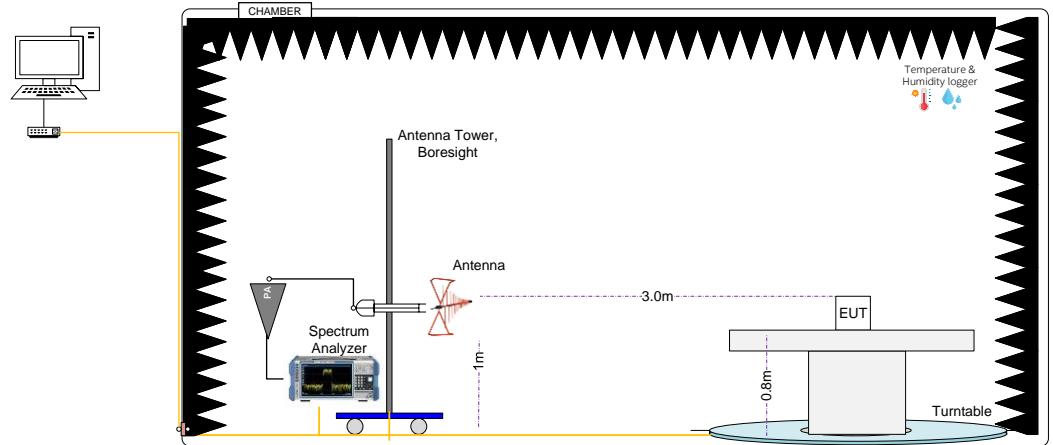
A.1 Measurement System

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

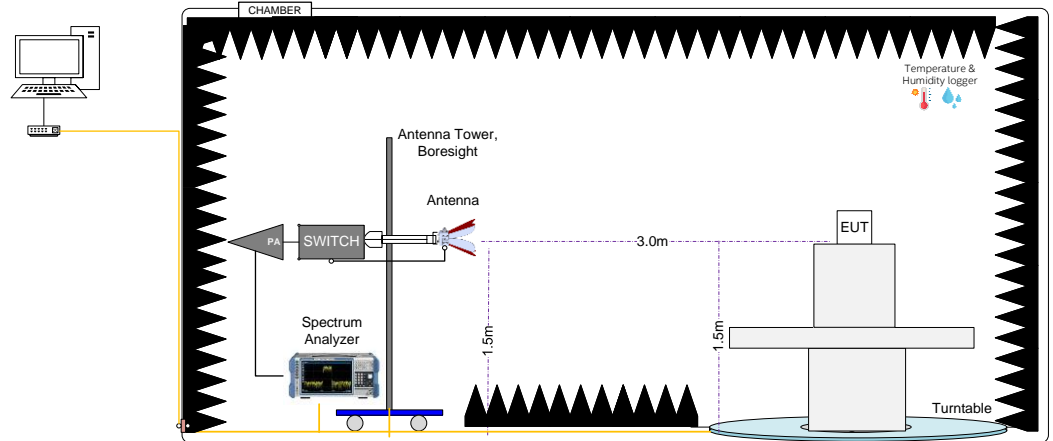
The DUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit at a specified output power using all different modes and modulation schemes, using the Intel proprietary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

Radiated test setup

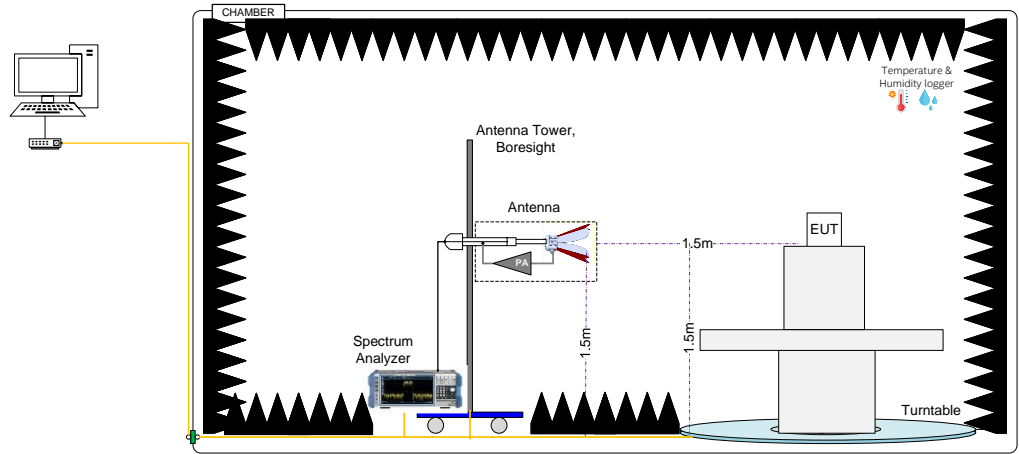
Radiated Setup 30MHz - 1GHz (Transmitter tests)



Radiated Setup 1GHz - 11GHz (Transmitter tests)



Radiated Setup 11GHz – 40GHz (Transmitter tests)



Sample Calculation

The spurious received voltage $V(\text{dB}\mu\text{V})$ in the spectrum Analyzer is converted to Electric field strength using the transducer factor F corresponding to the Rx path Loss:

$$F (\text{dB/m}) = \text{Rx Antenna Factor (dB/m)} + \text{Cable losses (dB)} - \text{Amplifiers Gain (dBi)}$$

$$E (\text{dB}\mu\text{V/m}) = V(\text{dB}\mu\text{V}) + F (\text{dB/m})$$

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:

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

where

$E_{\text{SpecLimit}}$ is the field strength of the emission at the distance specified by the limit, in $\text{dB}\mu\text{V/m}$

E_{Meas} is the field strength of the emission at the measurement distance, in $\text{dB}\mu\text{V/m}$

D_{Meas} is the measurement distance, in m

$D_{\text{SpecLimit}}$ 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	FACT3	5720	ETS-Lindgren	2022-01-21	2024-01-21
006-008	Measurement SW, v11.30	EMC32	100623	Rohde & Schwarz	N/A	N/A
259-000	Temp & Humidity Logger	RA12E-TH-RAS	RA12-B9BD70	Avtech	2022-06-27	2024-06-27
006-001	Turn Table	ETS	-	ETS-Lindgren	N/A	N/A
006-011	Boresight antenna mast	BAM 4.0-P	P/278/2890.01	Maturo	N/A	N/A
007-008	Double Horn Ridged antenna +PA	3116C-PA	00169308bis + 00196308	ETS-Lindgren	2023-05-30	2025-05-30
057-000	Double Horn Ridged antenna	3117	167062	ETS-Lindgren	2022-07-08	2024-07-08
006-061	Bi-Log Periodic antenna	CBL6143A	61382	Teseq	2022-10-24	2024-10-24
147-000	Spectrum analyzer	FSW43	101847	Rohde & Schwarz	2022-11-30	2024-11-30
301-000	Amplifier 9kHz-1300MHz	8447F	3113A07440	HP	2023-03-03	2024-03-03
261-000	Amplifier 1GHz-18GHz	3117-PA	00157993	ETS-Lindgren	2023-02-20	2024-02-20
006-068	RF Switch	RC-2SP6T-40	02112090061	Micro-Circuits	2023-08-22	2024-08-22
006-059	Cable 7m – 25MHz to 40GHz	R286304174	20.46.369	Radiall	2023-02-20	2024-02-20
006-063	Cable 30cm – 1GHz to 40GHz	PE371-12	-	Pasternack	2023-02-27	2024-02-27
006-064	Cable 30cm – 1GHz to 40GHz	PE371-12	-	Pasternack	2023-02-27	2024-02-27
006-065	Cable 60cm – 25MHz to 1GHz	PE300-24	-	Pasternack	2023-06-02	2024-06-02

N/A: Not Applicable

Radiated Setup #2

ID#	Device	Type/Model	Serial #	Manufacturer	Cal. Date	Cal. Due Date
127-000	Spectrum Analyzer	FSV40	101358	Rohde & Schwarz	2023-01-27	2025-01-27
007-007	Double Ridge Horn (1- 18GHz)	3117	00152266	ETS Lindgren	2022-03-29	2024-03-29
007-006	Switch & Positioner	EMCenter	00151232	ETS Lindgren	N/A	N/A
007-011	RF Cable 1-18GHz - 6.5m	140-8500-11-51	001	Atem	2023-02-15	2024-02-15
007-005	Measurement SW, v11.20.00	EMC32	100401	Rohde & Schwarz	N/A	N/A
007-000	Anechoic chamber	RFD-FA-100	5996	ETS Lindgren	2021-09-14	2024-03-14
007-003	Antenna Tower	2171B-3.0M	00150123	ETS Lindgren	N/A	N/A
007-002	Turntable	-	-	ETS Lindgren	N/A	N/A
007-014	RF Cable 18-40 GHz 6m	R286304009	1747364	Radiall	2023-02-16	2024-02-16
007-022	RF Cable 1-18GHz, 1.5m	0501050991200GX	19.23.493	Radiall	2023-02-13	2024-02-13
007-015	RF Cable 1GHz-18GHz 1.5m	-	-	Spirent	2023-02-13	2024-02-13
007-018	RF Cable 1-9.5GHz 1.2m	0500990991200KE	-	Radiall	2023-02-13	2024-02-13
007-020	RF Cable 1-18GHz, 1.2 m	2301761761200PJ	12.22.1104	Radiall	2023-02-15	2024-02-15
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 V2.1	-	-	Intel	NA	NA
139-000	Power Sensor	NRP-Z81	104383	Rohde & Schwarz	2023-04-21	2025-04-21
061-000	Power Sensor	NRP-Z81	104386	Rohde & Schwarz	2022-03-25	2024-03-25
140-000	Power Sensor	NRP-Z81	104382	Rohde & Schwarz	2022-03-25	2024-03-25
423-000	Power Sensor	NRP-Z81	101152	Rohde & Schwarz	2022-05-18	2024-05-18

N/A: Not Applicable

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 <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	K.Khatib, R.Simonini

B.1 Test Conditions

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 (160MHz 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 the spurious level:

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

B.2 Test Results Tables

B.2.1 Radiated spurious emission

FCC part	Limits																				
15.407 (b) (5) (iii)	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.																				
15.407 (b) (5) (ii)	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																				
15.209	<p>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):</p> <table border="1" data-bbox="309 869 1453 1093"> <thead> <tr> <th data-bbox="309 869 595 929">Freq Range (MHz)</th> <th data-bbox="595 869 880 929">Field Strength (µV/m)</th> <th data-bbox="880 869 1166 929">Field Strength (dBµV/m)</th> <th data-bbox="1166 869 1453 929">Meas. Distance (m)</th> </tr> </thead> <tbody> <tr> <td data-bbox="309 929 595 972">30-88</td> <td data-bbox="595 929 880 972">100</td> <td data-bbox="880 929 1166 972">40</td> <td data-bbox="1166 929 1453 972">3</td> </tr> <tr> <td data-bbox="309 972 595 1014">88-216</td> <td data-bbox="595 972 880 1014">150</td> <td data-bbox="880 972 1166 1014">43.5</td> <td data-bbox="1166 972 1453 1014">3</td> </tr> <tr> <td data-bbox="309 1014 595 1057">216-960</td> <td data-bbox="595 1014 880 1057">200</td> <td data-bbox="880 1014 1166 1057">46</td> <td data-bbox="1166 1014 1453 1057">3</td> </tr> <tr> <td data-bbox="309 1057 595 1093">Above 960</td> <td data-bbox="595 1057 880 1093">500</td> <td data-bbox="880 1057 1166 1093">54</td> <td data-bbox="1166 1057 1453 1093">3</td> </tr> </tbody> </table> <p>The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency 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.</p>	Freq Range (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Meas. Distance (m)	30-88	100	40	3	88-216	150	43.5	3	216-960	200	46	3	Above 960	500	54	3
Freq Range (MHz)	Field Strength (µV/m)	Field Strength (dBµV/m)	Meas. Distance (m)																		
30-88	100	40	3																		
88-216	150	43.5	3																		
216-960	200	46	3																		
Above 960	500	54	3																		

Test procedure

The radiated setups shown in section 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 360° and for both Vertical and Horizontal polarizations.

Test Results

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

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dB μ V/m	---	dB μ V/m	dB	---
39.5	33.7	Quasi-Peak	40.0	6.3	V
44.9	33.6	Quasi-Peak	40.0	6.4	V
62.5	34.8	Quasi-Peak	40.0	5.2	V
106.7	37.7	Quasi-Peak	43.5	5.8	V

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

[802.11n](#)**1 GHz – 40 GHz, 802.11n20, HT8, Chain A+B****Radiated Spurious – CH169**

Frequency	Level	Detector	Limit	Margin	Polar
MHz	dB μ V/m	---	dB μ V/m	dB	---
8758.5	58.8	Peak	88.2	29.4	H
8767.3	48.6	RMS	68.2	19.6	H
23979.0	48.5	Peak	74.0	25.5	H
23979.0	40.6	Average	54.0	13.4	H
39958.4	55.3	Peak	74.0	18.7	V
39958.4	47.9	Average	54.0	6.1	H