



TEST REPORT

| | |
|------------------------|---|
| EUT Description | WLAN and BT, 2x2 PCIe M.2 1216 adapter card |
| Brand Name | Intel® |
| Model Name | BE201D2W |
| FCC ID | PD9BE201D2 |
| Date of Test Start/End | 2024-01-29 / 2024-02-27 |
| Features | 2x2 WiFi - Bluetooth® (see section 5) |

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

| | |
|----------------------------|--|
| Test Report identification | 231120-07.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 _____

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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 |
|-----|---|

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 | 23.1°C ±1.2°C |
| Humidity | 40.1% ± 5.9% |

4. Test samples

| Sample | Control # | Description | Model | Serial # | Date of receipt | Note |
|--------|---------------|--------------------|----------------|--------------|-----------------|--|
| #01 | 231120-05.S03 | WiFi 7 Module | BE201D2W | 60452EB8A3BC | 2024-01-05 | 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 | Hong-Bo | AD03 | 2023-06-26 | |
| | 230526-08.S72 | Monopole Antenna | Hong-Bo | AD04 | 2023-06-26 | |
| | 231120-05.S21 | WiFi 7 Module | BE201D2W | F8FE5CDCA49 | 2024-02-07 | |
| | 180001-01.S21 | Socket | 1216SD to M.2 | - | 2021-06-07 | |
| #02 | 231120-05.S02 | WiFi 7 Module | BE201D2W | 60452EB8A407 | 2024-01-05 | |
| | 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 | Hong-Bo | AD01 | 2023-06-26 | |
| | 230526-08.S70 | Monopole Antenna | Hong-Bo | AD02 | 2023-06-26 | |
| | 231120-05.S20 | WiFi 7 Module | BE201D2W | F8FE5ECDCA43 | 2024-02-07 | |
| | 180001-01.S21 | Socket | 1216SD to M.2 | - | 2021-06-07 | |

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 | BE201D2W | | |
| Software Version | DRTU.05726.99.0.86 | | |
| Driver Version | 99.0.86.4 | | |
| 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 | R.SIMONINI | First Issue |

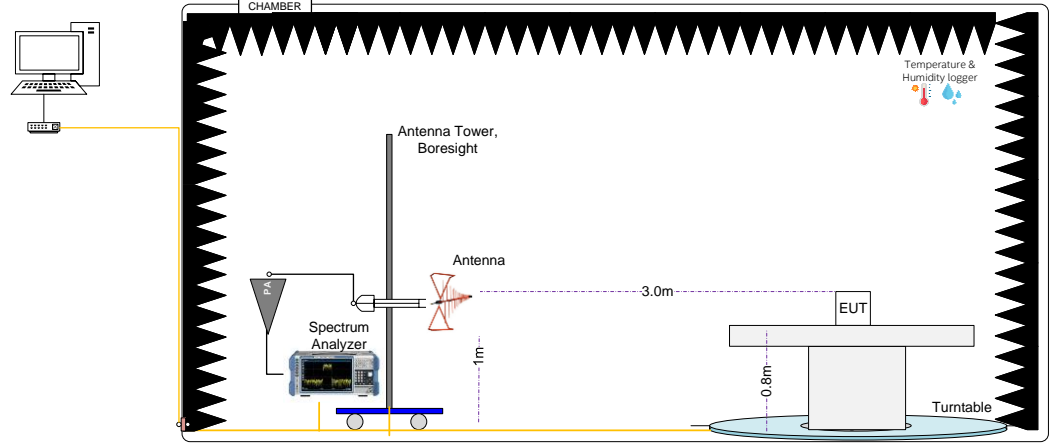
Annex A. Test & System Description

A.1 Measurement System

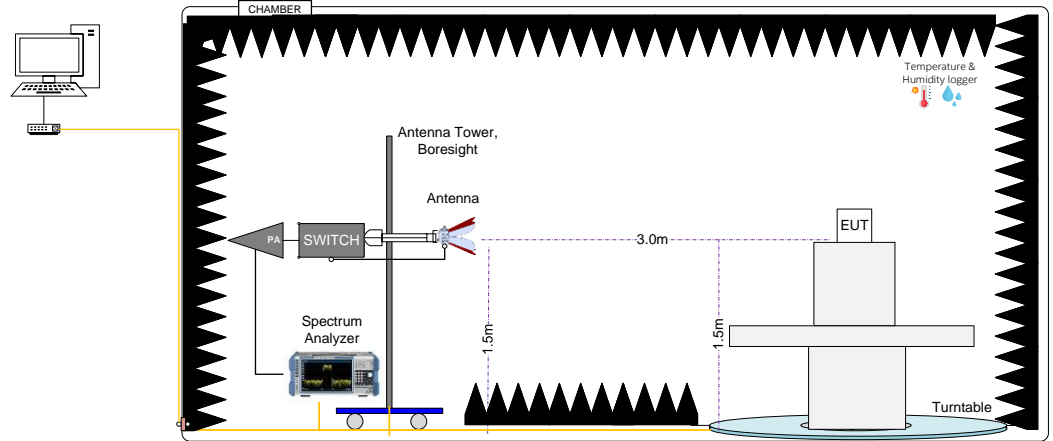
Measurements were performed using the following setups, made in accordance with ANSI C63.10-2013 test procedure. The DUT was installed in a test fixture and this test fixture is connected to a laptop computer and AC/DC power adapter. The laptop computer was used to configure the EUT to continuously transmit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

Radiated test setup

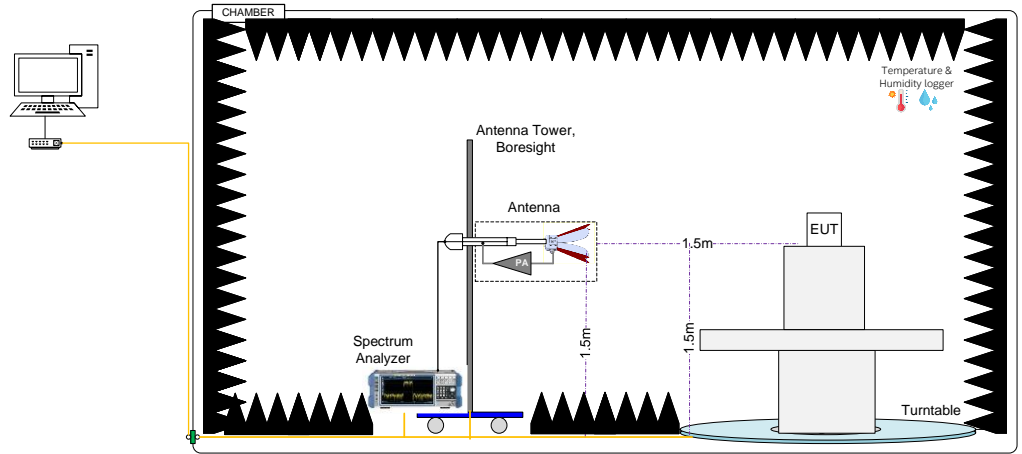
Radiated Setup 30MHz - 1GHz (Transmitter tests)



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 | 2024-01-17 | 2026-01-17 |
| 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 |
| 057-000 | Double Horn Ridged antenna | 3117 | 167062 | ETS-Lindgren | 2022-07-08 | 2024-07-08 |
| 058-000 | Double Horn Ridged antenna | 3116C | 157511 | ETS-Lindgren | 2022-10-21 | 2024-10-21 |
| 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 | 2024-03-20 |
| 502-006 | Amplifier 0.5GHz-40GHz | DEPA0540-43 | 2023A05 | Diamond Engineering | 2023-06-09 | 2024-06-09 |
| 009-007 | RF Filter | ZHSS-k11G+ | 8493 1831830 | Mini-Circuits | 2023-06-09 | 2024-06-09 |
| 006-068 | RF Switch | RC-2SP6T-40 | 02112090061 | Micro-Circuits | 2023-08-22 | 2024-08-22 |
| 006-066 | Cable 7m – 25MHz to 40GHz | R286304174 | 20.46.370 | Radiall | 2023-08-16 | 2024-08-16 |
| 006-063* | Cable 30cm – 1GHz to 40GHz | PE371-12 | - | Pasternack | 2023-02-27 | 2024-03-27 |
| 006-064* | Cable 30cm – 1GHz to 40GHz | PE371-12 | - | Pasternack | 2023-02-27 | 2024-03-27 |
| 006-065 | Cable 60cm – 25MHz to 1GHz | PE300-24 | - | Pasternack | 2023-06-02 | 2024-06-02 |

N/A: Not Applicable

*Within a grace period of 30 days

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 |
| 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 |
| 059-000 | Double Ridge Horn (1- 18GHz) | 3117 | 201542 | ETS-Lindgren | 2023-09-26 | 2025-09-26 |
| 264-000* | Amplifier 1GHz-18GHz | 3117-PA | 00169546 | ETS-Lindgren | 2023-02-20 | 2024-03-20 |
| 007-011* | RF Cable 1-18GHz - 6.5m | 140-8500-11-51 | 001 | Atem | 2023-02-15 | 2024-03-15 |
| 007-005 | Measurement SW, v11.20.00 | EMC32 | 100401 | Rohde & Schwarz | N/A | N/A |
| 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 | 2024-03-16 |
| 007-022* | RF Cable 1-18GHz, 1.5m | 0501050991200GX | 19.23.493 | Radiall | 2023-02-13 | 2024-03-13 |
| 007-015* | RF Cable 1GHz-18GHz 1.5m | - | - | Spirent | 2023-02-13 | 2024-03-13 |
| 007-018* | RF Cable 1-9.5GHz 1.2m | 0500990991200KE | - | Radiall | 2023-02-13 | 2024-03-13 |
| 007-020* | RF Cable 1-18GHz, 1.2 m | 2301761761200PJ | 12.22.1104 | Radiall | 2023-02-15 | 2024-03-15 |
| 349-000 | Temp & Humidity Logger | RA12E-TH1-RAS | RA12-D4F8C3 | Avtech | 2023-11-30 | 2025-11-30 |

N/A: Not Applicable

*Within a grace period of 30 day

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 | 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"> <thead> <tr> <th>Freq Range (MHz)</th> <th>Field Strength ($\mu\text{V}/\text{m}$)</th> <th>Field Strength ($\text{dB}\mu\text{V}/\text{m}$)</th> <th>Meas. Distance (m)</th> </tr> </thead> <tbody> <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> </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 ($\mu\text{V}/\text{m}$) | Field Strength ($\text{dB}\mu\text{V}/\text{m}$) | 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 ($\mu\text{V}/\text{m}$) | Field Strength ($\text{dB}\mu\text{V}/\text{m}$) | 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 | --- |
| 50.4 | 31.4 | Quasi-Peak | 40.0 | 8.6 | V |
| 76.0 | 31.0 | Quasi-Peak | 40.0 | 9.0 | V |

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

1 GHz – 40 GHz, 802.11ax/be80, MCS0, Chain B**Radiated Spurious – CH171**

| Frequency | Level | Detector | Limit | Margin | Polar |
|-----------|--------------|----------|--------------|--------|-------|
| MHz | dB μ V/m | --- | dB μ V/m | dB | --- |
| 1628.3 | 50.7 | Peak | 88.2 | 37.5 | V |
| 1628.3 | 42.1 | RMS | 68.2 | 26.1 | V |
| 5160.0 | 59.4 | Peak | 88.2 | 28.9 | V |
| 5160.0 | 50.1 | RMS | 68.2 | 18.1 | V |
| 17499.9 | 49.1 | Peak | 88.2 | 39.1 | H |
| 17500.3 | 41.8 | RMS | 68.2 | 26.4 | V |
| 23332.7 | 52.4 | Peak | 88.2 | 35.9 | V |
| 23334.7 | 44.8 | RMS | 68.2 | 23.4 | V |
| 29166.1 | 54.0 | Peak | 88.2 | 34.2 | V |
| 29168.5 | 45.7 | RMS | 68.2 | 22.5 | H |