

Qingdao Intelligent&Precise Electronics Co., Ltd

C2PC RF TEST REPORT

Report Type:

FCC Part 15.247 & ISED RSS-247 RF report

Model:

ZDGF7618BU-PT

REPORT NUMBER:

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No.218, Qianwangang Road, Qingdao Economic&Technological
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FCC ID: 2AJVQ-7618BUPT
IC: 22470-7618BUPT

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

47CFR Part 15 (2019): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-247 Issue 2 (February 2017): Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 5 (March 2019) Amendment 1: General Requirements for Compliance of Radio Apparatus

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TEST REPORT

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Revision History

| Report No. | Version | Description | Issued Date |
|------------------|---------|-------------------------|------------------|
| 210200457SHA-001 | Rev. 01 | Initial issue of report | February 4, 2021 |
| | | | |
| | | | |

Measurement result summary

| TEST ITEM | FCC REFERENCE | IC REFERENCE | RESULT |
|--|-----------------------------|------------------------------------|--------|
| Maximum conducted output power and e.i.r.p. | 15.247(b)(3) | RSS-247 Issue 2 Clause 5.4 | Pass |
| Radiated Emissions in restricted frequency bands | 15.247(d), 15.205&15.209 | RSS-Gen Issue 5 Clause 8.9&8.10 | Pass |

Notes: 1: NA =Not Applicable

TEST REPORT

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

| | |
|-----------------------|--|
| Product name: | Wireless Module |
| Type/Model: | ZDGF7618BU-PT |
| PMN: | ZDGF7618BU-PT |
| Description of EUT: | This product is based on the original FCC ID:2AJVQ-2AJVQ-7618BUPT, IC: 22470-7618BUPT. This time client adds another factory's WIFI antenna duplexer. By technical analysis and evaluation, only the worst case of Maximum conducted output power and Radiated Emissions in restricted frequency bands was retested. |
| Rating: | DC 3.3V |
| EUT type: | <input checked="" type="checkbox"/> Table top <input type="checkbox"/> Floor standing |
| Software Version: | / |
| Hardware Version: | / |
| Sample received date: | January 20, 2021 |
| Date of test: | January 24,2021~ January 25, 2021 |

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1.2 Technical Specification

| | |
|----------------------|---|
| Frequency Band: | 2400MHz ~ 2483.5MHz |
| Support Standards: | IEEE 802.11b, IEEE 802.11g, IEEE 802.11n(HT20), IEEE 802.11n(HT40) |
| Type of Modulation: | IEEE 802.11b: DSSS (CCK, DQPSK, DBPSK) IEEE 802.11g: OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n(HT20): OFDM (64-QAM, 16-QAM, QPSK, BPSK) IEEE 802.11n(HT40): OFDM (64-QAM, 16-QAM, QPSK, BPSK) |
| Operating Frequency: | 2412MHz to 2462MHz for IEEE 802.11b/g/n(HT20) 2422MHz to 2452MHz for IEEE 802.11n(HT40) |
| Channel Number: | 11 Channels for 802.11b, 802.11g and 802.11n(HT20) 7 Channels for 802.11n(HT40) |
| Channel Separation: | 5 MHz |
| Antenna: | PCB Antenna Antenna 0: 1.048dBi, Antenna 1: 1.255dBi |

1.3 Antenna information

| Mode | Tx/Rx Function | Beamforming function | CDD function | Directional gain (dBi) |
|--|----------------|----------------------|--------------|------------------------|
| 802.11b | 1Tx/1Rx | NO | NO | - |
| 802.11g | 1Tx/1Rx | NO | NO | - |
| 802.11n(HT20) | 2Tx/2Rx | NO | NO | 1.153 |
| 802.11n(HT40) | 2Tx/2Rx | NO | NO | 1.153 |
| Note: For 802.11b and 802.11g mode, it only supports 1TX. For 802.11n modes, it can support 2TX, all the two transmit signals are completely uncorrelated with each other, so the directional gain = $10 \log ((10^{G1/10} + 10^{G2/10} + \dots + 10^{Gn/10}) / N_{ANT})$ | | | | |

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1.4 Description of Test Facility

| | |
|------------|--|
| Name: | Intertek Testing Services Shanghai |
| Address: | Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China |
| Telephone: | 86 21 61278200 |
| Telefax: | 86 21 54262353 |

| | |
|---|--|
| The test facility is recognized, certified, or accredited by these organizations: | CNAS Accreditation Lab Registration No. CNAS L0139 |
| | FCC Accredited Lab Designation Number: CN1175 |
| | IC Registration Lab Registration code No.: 2042B-1 |
| | VCCI Registration Lab Registration No.: R-4243, G-845, C-4723, T-2252 |
| | A2LA Accreditation Lab Certificate Number: 3309.02 |

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2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2019)
ANSI C63.10 (2013)
KDB 558074 (v05r02)
RSS-247 Issue 2 (February 2017)
RSS-Gen Issue 5 (March 2019) Amendment 1

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

| Software name | Manufacturer | Version | Supplied by |
|---------------|--------------|---------|-------------|
| QA Tool | - | - | Client |

The lowest, middle and highest channel were tested as representatives.

| Frequency Band (MHz) | Mode | Lowest (MHz) | Middle (MHz) | Highest (MHz) |
|----------------------|---------------|--------------|--------------|---------------|
| 2400-2483.5 | 802.11b | 2412 | 2437 | 2462 |
| | 802.11g | 2412 | 2437 | 2462 |
| | 802.11n(HT20) | 2412 | 2437 | 2462 |
| | 802.11n(HT40) | 2422 | 2437 | 2452 |

Data rate and Power setting:

The pre-scan for the conducted power with all rates in each modulation and bands was used, and the worst case was found and used in all test cases. After this pre-scan, we choose the following table of the data rate as the worst case.

| Frequency Band (MHz) | Mode | Worst case data rate |
|----------------------|---------------|----------------------|
| 2400-2483.5 | 802.11b | 1Mbps |
| | 802.11g | 6Mbps |
| | 802.11n(HT20) | MCS8 |
| | 802.11n(HT40) | MCS8 |

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2.3 Test software list

| Test Items | Software | Manufacturer | Version |
|--------------------|----------|--------------|---------|
| Conducted emission | ESxS-K1 | R&S | V2.1.0 |
| Radiated emission | ES-K1 | R&S | V1.71 |

2.4 Test peripherals list

| Item No. | Name | Band and Model | Description |
|----------|-----------------|----------------|-------------|
| 1 | Laptop computer | DELL 5480 | - |

2.5 Test environment condition:

| Test items | Temperature | Humidity |
|--|-------------|----------|
| Radiated Emissions in restricted frequency bands | 22°C | 53% RH |
| Maximum conducted output power and e.i.r.p. | 23°C | 53% RH |

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2.6 Instrument list

| Radiated Emission | | | | | |
|-------------------------------------|------------------------|-------------------|------------------------|--------------|------------|
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| <input checked="" type="checkbox"/> | Test Receiver | R&S | ESIB 26 | EC 3045 | 2021-09-15 |
| <input checked="" type="checkbox"/> | Bilog Antenna | TESEQ | CBL 6112D | EC 4206 | 2021-09-24 |
| <input checked="" type="checkbox"/> | Pre-amplifier | R&S | AFS42-00101800-25-S-42 | EC5262 | 2021-06-11 |
| <input checked="" type="checkbox"/> | Horn antenna | R&S | HF 906 | EC 3049 | 2022-01-16 |
| <input type="checkbox"/> | Horn antenna | ETS | 3117 | EC 4792-1 | 2021-02-25 |
| <input type="checkbox"/> | Horn antenna | TOYO | HAP18-26W | EC 4792-3 | 2021-07-09 |
| <input type="checkbox"/> | Active loop antenna | Schwarzbeck | FMZB1519 | EC 5345 | 2021-03-14 |
| Tet Site | | | | | |
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| <input type="checkbox"/> | Shielded room | Zhongyu | - | EC 2838 | 2022-01-11 |
| <input type="checkbox"/> | Shielded room | Zhongyu | - | EC 2839 | 2022-01-11 |
| <input checked="" type="checkbox"/> | Semi-anechoic chamber | Albatross project | - | EC 3048 | 2021-07-14 |
| <input type="checkbox"/> | Fully-anechoic chamber | Albatross project | - | EC 3047 | 2021-07-14 |
| Additional instrument | | | | | |
| Used | Equipment | Manufacturer | Type | Internal no. | Due date |
| <input type="checkbox"/> | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3783 | 2021-03-03 |
| <input type="checkbox"/> | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3481 | 2022-01-04 |
| <input type="checkbox"/> | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3442 | 2022-01-04 |
| <input checked="" type="checkbox"/> | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3324 | 2021-09-05 |
| <input type="checkbox"/> | Pressure meter | YM3 | Shanghai Mengde | EC 3320 | 2021-07-14 |

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2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| Test item | Measurement uncertainty |
|---|-------------------------|
| Maximum peak output power | $\pm 0.74\text{dB}$ |
| Radiated Emissions in restricted frequency bands below 1GHz | $\pm 4.90\text{dB}$ |
| Radiated Emissions in restricted frequency bands above 1GHz | $\pm 5.02\text{dB}$ |
| Emission outside the frequency band | $\pm 2.89\text{dB}$ |
| Power line conducted emission | $\pm 3.19\text{dB}$ |

3 Maximum conducted output power and e.i.r.p.

Test result: Pass

3.1 Limit

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 W. (The e.i.r.p. shall not exceed 4 W)

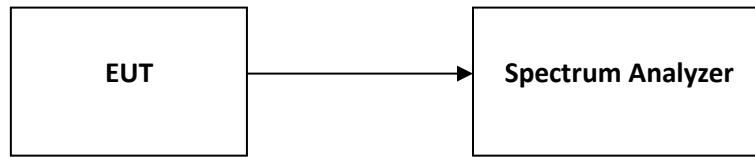
If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 30dBm and 30+ (6 –antenna gain-beam forming gain).

3.2 Measurement Procedure

- a) Measure the duty cycle, x , of the transmitter output signal as described in Section 6.0.
- b) Set span to at least $1.5 \times \text{OBW}$.
- c) Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz.
- d) Set VBW $\geq 3 \times \text{RBW}$.
- e) Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This gives bin-to-bin spacing $\leq \text{RBW}/2$, so that narrowband signals are not lost between frequency bins.)
- f) Sweep time = auto.
- g) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- h) Do not use sweep triggering. Allow the sweep to “free run”.
- i) Trace average at least 100 traces in power averaging (i.e., RMS) mode; however, the number of traces to be averaged shall be increased above 100 as needed such that the average accurately represents the true average over the on and off periods of the transmitter.
- j) Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.
- k) Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on- and off-times of the transmission). For example, add $10 \log (1/0.25) = 6 \text{ dB}$ if the duty cycle is 25 %.

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3.3 Test Configuration

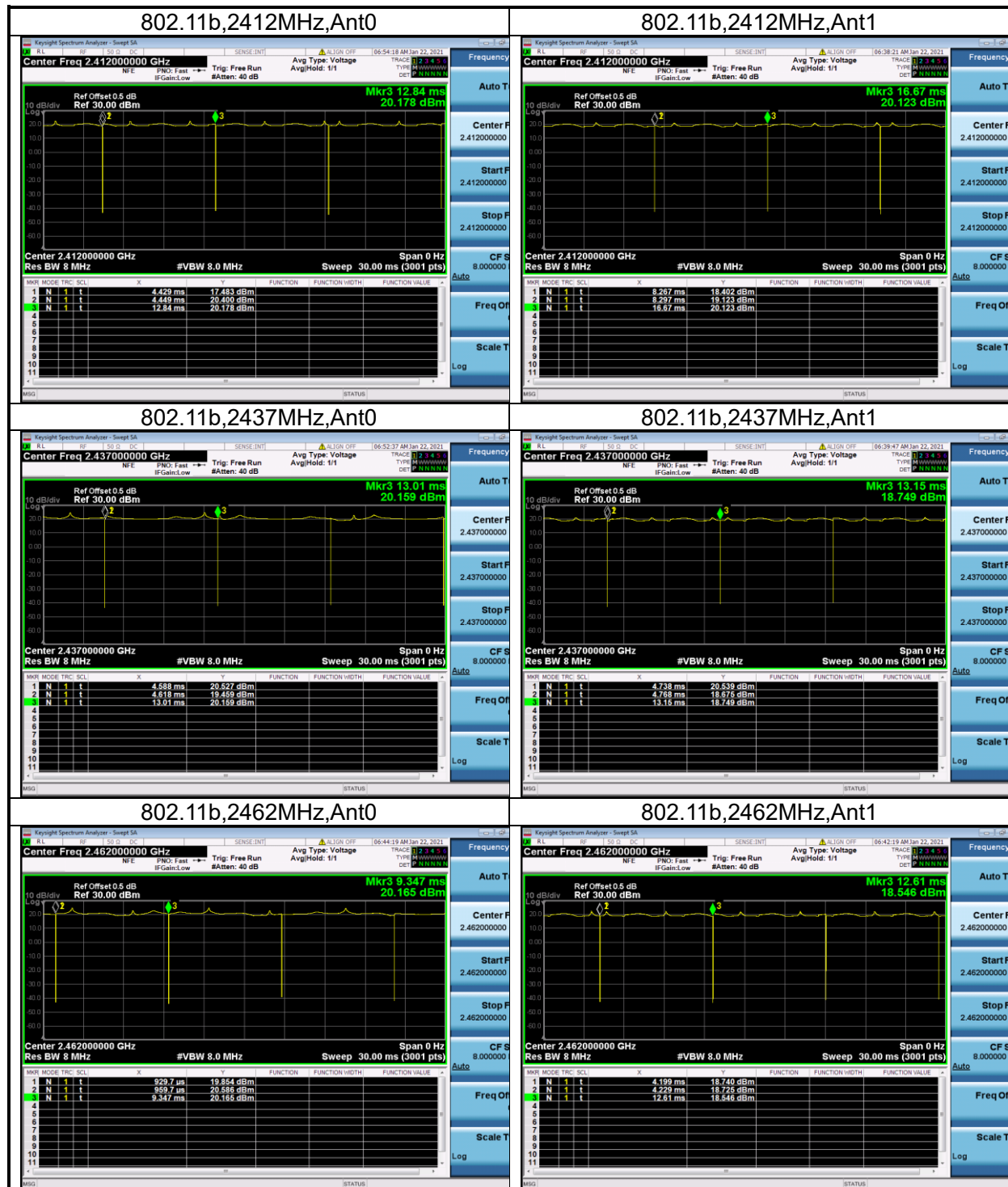


3.4 Test Results of Maximum conducted output power

802.11b

| WLAN Duty Cycle | | | | |
|-----------------|----------------------|------|----------------|------------------------|
| Mode | Test Frequency (MHz) | Ant | Duty Cycle (%) | Duty Cycle Factor (dB) |
| 802.11b | 2412 | Ant0 | 99.76 | 0.00 |
| 802.11b | 2412 | Ant1 | 99.64 | 0.00 |
| 802.11b | 2437 | Ant0 | 99.64 | 0.00 |
| 802.11b | 2437 | Ant1 | 99.64 | 0.00 |
| 802.11b | 2462 | Ant0 | 99.64 | 0.00 |
| 802.11b | 2462 | Ant1 | 99.64 | 0.00 |

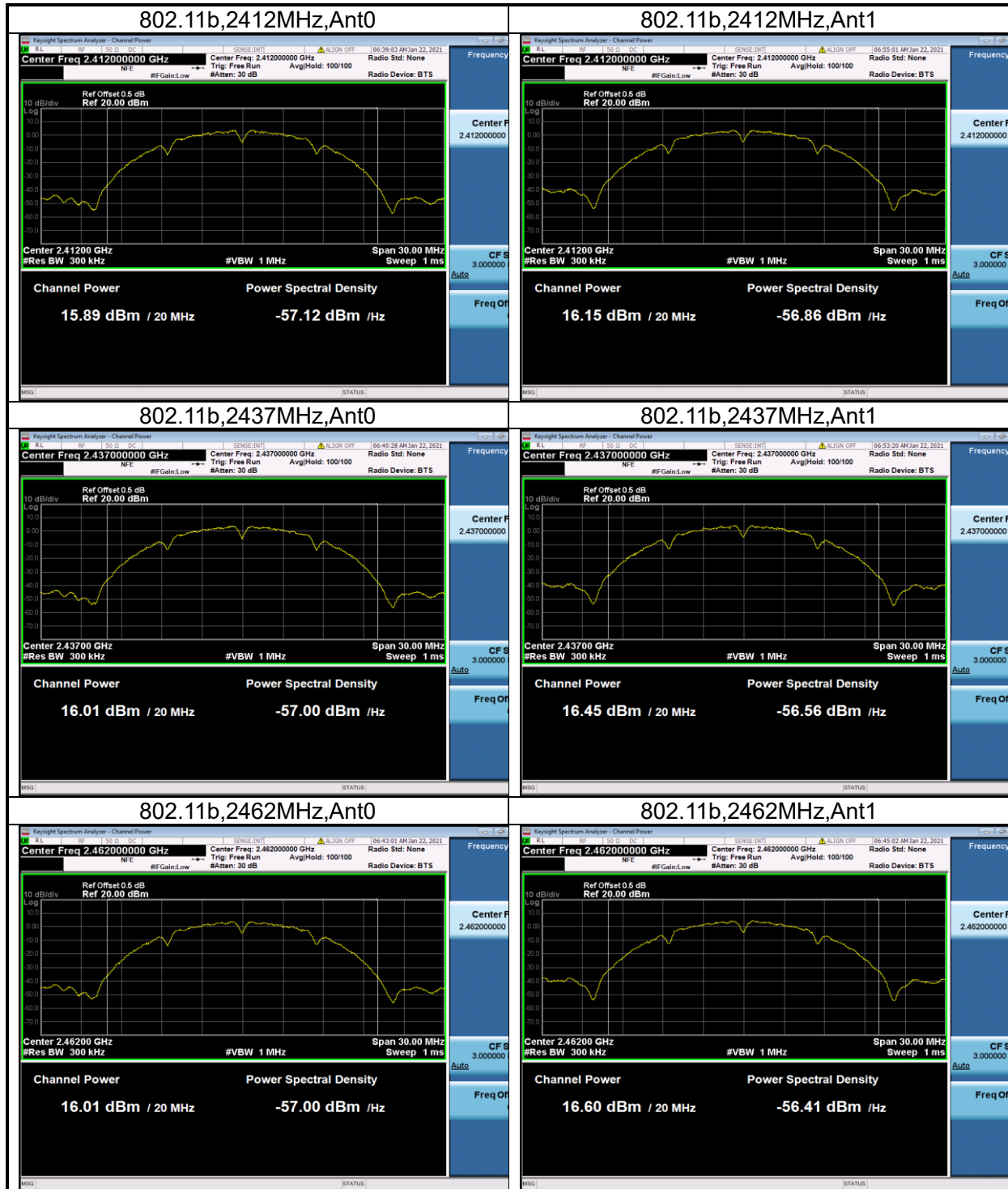
Test Plots



TEST REPORT

| WLAN AVGSA Output Power | | | | | | | |
|-------------------------|----------------------|------|------------------------|-----------------|-------------|------------|--------|
| Mode | Test Frequency (MHz) | Ant | Duty Cycle Factor (dB) | Max Power (dBm) | Limit (dBm) | EIRP (dBm) | Result |
| 802.11b | 2412 | Ant0 | 0.00 | 15.89 | 30 | 16.94 | Pass |
| 802.11b | 2412 | Ant1 | 0.00 | 16.15 | 30 | 17.41 | Pass |
| 802.11b | 2437 | Ant0 | 0.00 | 16.01 | 30 | 17.06 | Pass |
| 802.11b | 2437 | Ant1 | 0.00 | 16.45 | 30 | 17.71 | Pass |
| 802.11b | 2462 | Ant0 | 0.00 | 16.01 | 30 | 17.06 | Pass |
| 802.11b | 2462 | Ant1 | 0.00 | 16.60 | 30 | 17.86 | Pass |

Test Plots



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4 Radiated Emissions

Test result: Pass

4.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified showed as below:

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009 ~ 0.490 | 2400/F(kHz) | 300 |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 100 | 3 |
| 88 ~ 216 | 150 | 3 |
| 216 ~ 960 | 200 | 3 |
| Above 960 | 500 | 3 |

4.2 Measurement Procedure

For Radiated emission below 30MHz:

- The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- Both X and Y axes of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

- The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

TEST REPORT**For Radiated emission above 30MHz:**

- a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meters chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f) The test-receiver system was set to peak and average detector function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

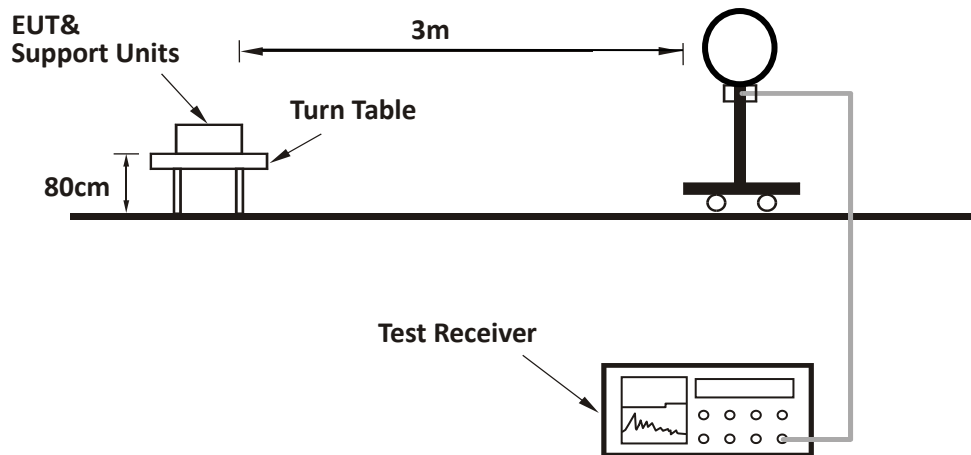
Note:

- 1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
- 2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
- 3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 3 x RBW (Duty cycle \geq 98%) for Average detection (AV) at frequency above 1GHz.
- 4. All modes of operation were evaluated and the worst-case emissions were reported

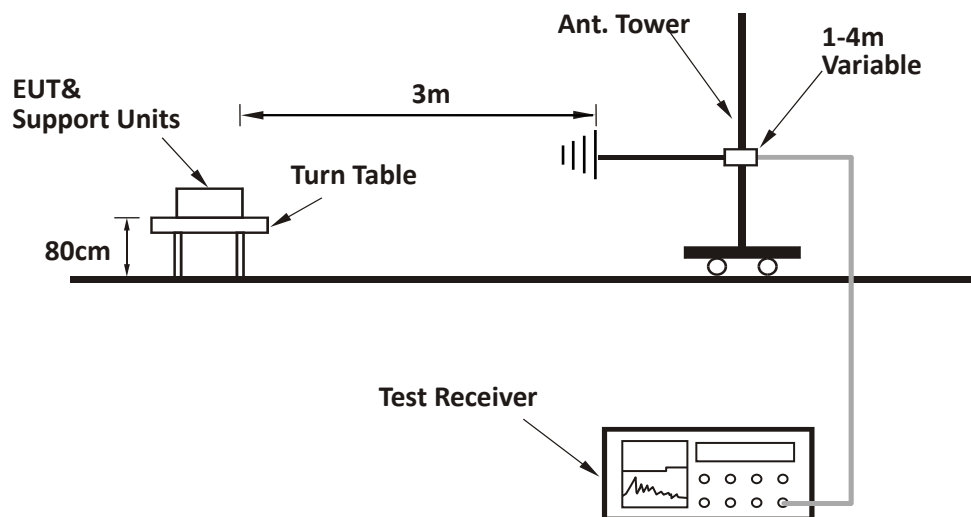
TEST REPORT

4.3 Test Configuration

For Radiated emission below 30MHz:

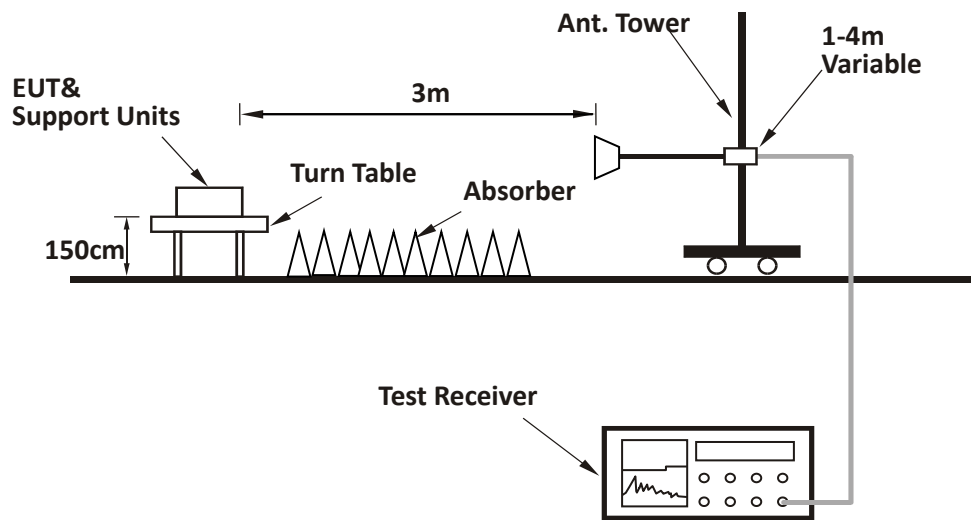


For Radiated emission 30MHz to 1GHz:



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For Radiated emission above 1GHz:



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4.4 Test Results of Radiated Emissions

Test result above 1GHz:

The emission was conducted from 1GHz to 25GHz

802.11n(HT40)

| CH | Antenna | Frequency (MHz) | Corrected Reading (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector |
|----|---------|-----------------|----------------------------|----------------|-------------|----------|
| L | H | 2422 | 107.80 | Fundamental | / | PK |
| | H | 2390 | 69.30 | 74.00 | 4.70 | PK |
| | H | 2390 | 52.70 | 54.00 | 1.30 | AV |
| M | H | 2437 | 108.30 | Fundamental | / | PK |
| H | H | 2452 | 108.40 | Fundamental | / | PK |
| | H | 2483.5 | 68.90 | 74.00 | 5.70 | PK |
| | H | 2483.5 | 52.10 | 54.00 | 1.90 | AV |

- Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

***** END *****