



TEST REPORT

| APPLICANT | : | Ugreen Group Limited | |
|-----------|---|----------------------|--|
|-----------|---|----------------------|--|

PRODUCT NAME AC650 11ac Dual-Band Wireless

- USB Adapter
- **MODEL NAME** : CM448 20204
- BRAND NAME : UGREEN
- FCC ID : 2AQI5-CM448
- STANDARD(S) : 47 CFR Part 15 Subpart E
- **RECEIPT DATE** : 2020-12-28
- **TEST DATE** : 2020-12-30 to 2021-01-30
- **ISSUE DATE** : 2021-03-12

Edited by:

Pong Mi

Peng Mi (Rapporteur)

Approved by:

Peng Huarui (Supervisor)

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| Change History | | | | | | | |
|----------------|------------|-------------------|--|--|--|--|--|
| Version | Date | Reason for change | | | | | |
| 1.0 | 2021-03-12 | First edition | | | | | |
| | | | | | | | |





1. Technical Information

Note: Provide by applicant.

1.1. Applicant and Manufacturer Information

| Applicant: | Ugreen Group Limited |
|-----------------------|---|
| Applicant Address | UGREEN Building, Longcheng Industrial Park Longguanxi Road, |
| Applicant Address: | Longhua, ShenZhen, China |
| Manufacturer: | SHENZHEN TENDA TECHNOLOGY CO., LTD. |
| Manufacturer Address. | 6/F-8/F, Block E3, TCL Hi-tech Park, #1001 Zhongshanyua Rd, |
| Manufacturer Address: | Xili, Nanshan District. Shenzhen, China |

1.2. Equipment Under Test (EUT) Description

| Product Name: | AC650 11ac Dual-Band Wireless USB Adapter |
|----------------------------|---|
| Serial No.: | (N/A, marked #1 by test site) |
| Hardware Version: | V1.1 |
| Software Version: | V1.0.5.2 |
| Modulation Type: | OFDM |
| Modulation Mode | 802.11a, 802.11n (HT20), 802.11n (HT40) |
| Modulation Mode. | 802.11ac (VHT20), 802.11ac (VHT40), 802.11ac (VHT80), |
| Operating Frequency Range: | 5180MHz–5240MHz |
| Channel Number: | Refer to 1.3 |
| Antenna Type: | PIFA Antenna |
| Antenna Gain: | 0.5dBi |

Note 1: WIFI hotspot does not support U-NII band.

Note 2: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.





1.3. Modulation Type and Data Rate of EUT

| Modulation technology | Modulation Type | Data Rate (Mbps) _{Note1} |
|-----------------------|-----------------|-----------------------------------|
| | BPSK | 6 /9 |
| | QPSK | 12/18 |
| OFDM (802.11a) | 16QAM | 24/36 |
| | 64QAM | 48/54 |
| | BPSK | 6.5 |
| | QPSK | 13/19.5 |
| | 16QAM | 26/39 |
| | 64QAM | 52/58.5/65 |
| | BPSK | 6.5 |
| | QPSK | 13/19.5 |
| OFDM (802.11ac) | 16QAM | 26/39 |
| | 64QAM | 52/58.5/65 |
| | 256QAM | 78 |

Note1: The worst-case mode(black bold) in all data rates has been determined during the pre-scan, only the test data of the worst-case were recorded in this report.

1.4. The Channel Number and Frequency

| Frequency Range: 5180MHz-5240MHz | | | | | | | | |
|----------------------------------|---------|-----------------|---------|-----------------|--|--|--|--|
| Bandwidth | Channel | Frequency (MHz) | Channel | Frequency (MHz) | | | | |
| 2014 | 36 | 5180 | 40 | 5200 | | | | |
| | 44 | 5220 | 48 | 5240 | | | | |
| 40MHz | 38 | 5190 | 46 | 5230 | | | | |
| 80MHz | 42 | 5210 | | | | | | |

Note 1: The black bold channels were selected for test.





1.5. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 15 Subpart E (U-NII band) for the EUT FCC ID Certification:

| No. | Identity | Document Title | | | | |
|-----|--------------------------------|-------------------------|--|--|--|--|
| 1 | 47 CFR Part 15(5-1-14 Edition) | Radio Frequency Devices | | | | |

Test detailed items/section required by FCC rules and results are as below:

| No. | Section | Description | Test Date | Test Engineer | Result | Method determination /Remark |
|-----|------------------|--------------------------------------|--------------|---------------|--------|------------------------------------|
| 1 | 15.203 | Antenna Requirement | N/A | N/A | PASS | No deviation |
| 2 | ANSI C63.10 | Duty Cycle of the Test Signal | Jan 30, 2021 | Ouyang Feng | PASS | No deviation |
| 3 | 15.407(a) | Maximum Conducted Output Power | Jan 30, 2021 | Ouyang Feng | PASS | No deviation |
| 4 | 15.407(a) (e) | Emission Bandwidth | Jan 21, 2021 | Ouyang Feng | PASS | No deviation |
| 5 | 15.407(a) | Peak Power Spectral Density | Jan 15, 2021 | Ouyang Feng | PASS | No deviation |
| 6 | 15.407(g) | Frequency Stability | Jan 30, 2021 | Ouyang Feng | PASS | No deviation |
| 7 | 15.207 | Conducted Emission | Dec 30, 2020 | Huang Zhiye | PASS | No deviation |
| 8 | 15.407(b) | Restricted Frequency Bands | Jan 25, 2021 | Gao Jianrou | PASS | No deviation |
| 9 | 15.407(b) | Radiated Emission | Jan 25, 2021 | Gao Jianrou | PASS | No deviation |

Note 1: The tests of Conducted Emission and Radiated Emission were performed according to the method of measurements prescribed in ANSI C63.102013.

Note 2: These RF tests were performed according to the method of measurements prescribed in KDB789033 D02 v01r03.

Note 3: The path loss during the RF test is calibrated to correct the results by the offset setting in the test equipments. The Ref offset 2.0dB means the cable loss is 2.0dB.



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Note 4: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

Note 5: When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% risk level.

1.6. Environmental Conditions

During the measurement, the environmental conditions were within the listed ranges:

| Temperature (°C): | 15-35 |
|-----------------------------|--------|
| Relative Humidity (%): | 30-60 |
| Atmospheric Pressure (kPa): | 86-106 |







2.47 CFR Part 15E Requirements

2.1. Antenna Requirement

2.1.1.Applicable Standard

According to FCC 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

2.1.2.Test Result: Compliant

The EUT has a permanently and irreplaceable attached antenna. Please refer to the EUT internal photos.





2.2. Duty Cycle of the Test Signal

2.2.1.Requirement

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).

When continuous transmission cannot be achieved and sweep triggering/signal gating cannot be implemented, alternative procedures are provided that can be used to measure the average power; however, they will require an additional measurement of the transmitter duty cycle (D). Within this sub clause, the duty cycle refers to the fraction of time over which the transmitter is ON and is transmitting at its maximum power control level. The duty cycle is considered to be constant if variations are less than $\pm 2\%$; otherwise, the duty cycle is considered to be nonconstant.

2.2.2.Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.

2.2.3.Test Procedure

KDB 789033 Section B was used in order to prove compliance.



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2.2.4.Test Result

A.Test Verdict:

| Test Mode | Duty Cycle (%) (D) | Duty Factor (10*log[1/D]) |
|-----------------|-----------------------|------------------------------|
| 802.11a | 100.00 | 0.00 |
| 802.11n (HT20) | 100.00 | 0.00 |
| 802.11n (HT40) | 100.00 | 0.00 |
| 802.11ac(VHT20) | 100.00 | 0.00 |
| 802.11ac(VHT40) | 100.00 | 0.00 |
| 802.11ac(VHT80) | 100.00 | 0.00 |

B.Test Plot:

| Agilen | nt Spectrum | Analyzer - Sw | ept SA | | | | | | | | _ | |
|----------------|--------------------|------------------------------|--------------------|---------------|-------------|--------------|------------|---------------------|--|--|----------------------|-----------------------------------|
| Ave | rage/H | old Numb | ber 100 | | SEN | JSE:INT | Avg Type | LIGN OFF | 10:36:24 AF TRAC | M Jan 30, 2021 ^{XE} <mark>1 2 3 4 5 6</mark> | Me | as Setup |
| | | | P | NO: Fast 🔸 | Atten: 28 | dB | | | DE | | Ava | Hold Num |
| 10 dE | 3/div | Ref Offset 12 Ref 30.00 (| dB dBm | | | | | | | | | 100 |
| 20.0 | der tradition | forthathathathatha | htulut kortakeltyk | ahallhahallha | multilation | uluh pahanga | antan tana | IpHalvalvy-Halvalv) | with Lade Anna Marting | watar | Log-F <u>Auto</u> | Avg Type Pwr (Video) ► Man |
| 10.0 0.00 | | | | | | | | | | | | Limits► |
| -10.0 | | | | | | | | | | | N On | dB Points -3.01 dB Off |
| -20.0 | | | | | | | | | | | PI F Auto | nNoise Opt ast Tuning ► Man |
| -40.0 -50.0 | | | | | | | | | | | / | ADC Dither Medium ► |
| -60.0 | | | | | | | | | | | Auto | Man More |
| Cen Res | ter 5.18 BW 8 N | 0000000 G 1Hz | GHz | #VBW | 8.0 MHz | | | Sweep 1 | S 0.00 ms (| pan 0 Hz 1001 pts) | | 1 of 2 |
| MSG | | | | | | | | STATUS | | | | |

(Channel 36, 5180MHz, 802.11a)



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(Channel 36, 5180MHz, 802.11n (HT20))



(Channel 38, 5190MHz, 802.11n (HT40))

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(CH36_5180MHz _802.11ac (VHT20))



(CH38_5190MHz _802.11ac (VHT40))

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| Agilent Spectrum Analyzer - Swept SA | | | | | |
|---|---|----------------------|--|---------------------------------------|---|
| Average/Hold Number 10 | 0 SEP | Avg Type | ALIGN OFF 11:12:2 a: Log-Pwr T | 9 AM Jan 30, 2021 RACE 1 2 3 4 5 6 | Meas Setup |
| | PNO: Fast 🖵 Trig: Free IFGain:Low Atten: 28 | e Run I dB | | | Avg/Hold Num |
| Ref Offset 12 dB 10 dB/div Ref 30.00 dBm | | | | | 100 |
| 20.0 | | | | | Avg Type Log-Pwr (Video) ▶ Auto Man |
| 10.0 | eesi laan Mataraalaan ta middiita markkiin middiita | alan haanibbaailin a | يروا فللقوم الفاتو والفاز وسا الحلوم ي | unnalines attelens | |
| 0.00 | | | | | Limits► |
| -10.0 | | | | | N dB Points -3.01 dB On <u>Off</u> |
| -30.0 | | | | | PhNoise Opt |
| -40.0 | | | | | Fast Tuning▶ <u>Auto</u> Man |
| -50.0 | | | | | ADC Dither Medium ► Auto Man |
| -60.0 | | | | | More |
| Center 5.210000000 GHz Res BW 8 MHz | #VBW 8.0 MHz | | Sweep 100.0 ms | Span 0 Hz s (1001 pts) | 1 of 2 |
| MSG | | | STATUS | | |

(CH42_5210MHz _802.11ac (VHT80))



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2.3. Maximum Conducted Output Power

2.3.1.Requirement

(1) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250mW provided the maximum antenna gain does not exceed 6dBi.

(2)For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250mW or 11dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

(4) According to KDB662911D01Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.

(5) According to KDB 662911 D01, the directional gain = G_{ANT} +10log(N_{ANT})dBi, where G_{ANT} is the antenna gain in dBi, N_{ANT} is the number of outputs.

2.3.2.Test Description

Section E) 3) of KDB 789033 defines a methodology using a USB Wideband Power Sensor. **Test Setup:**



The EUT (Equipment under the test) which is coupled to the USB Wideband Power Sensor; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading, all test result in USB Wideband Power Sensor.





For ac (VHT80) mode power



The EUT (Equipment under the test) is coupled to the Spectrum analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading, all test result in Spectrum analyzer.



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2.3.3.Test Result

Maximum Average Conducted Output Power

802.11a Mode

| | | Average Power (dBm) | | | | | Limit | | |
|---------|--------------------|---------------------|------------|--------------------|---------------|-----|-------|---------|--|
| Channel | Frequency (MHz) | Measured | Duty | Duty fa Calcula | actor ated | (dE | Bm) | Verdict | |
| | (11112) | dBm | dBm Factor | dBm | W | dBm | W | | |
| 36 | 5180 | 13.67 | | 13.67 | 0.023 | | | | |
| 44 | 5220 | 13.77 | 0.00 | 13.77 | 0.024 | 24 | 0.25 | PASS | |
| 48 | 5240 | 13.75 | | 13.75 | 0.024 | | | | |

802.11n (HT20) Mode

| | | | Average Pc | wer (dBm) | r (dBm) | | Limit | |
|---------|--------------------|-----------|------------|--------------------|---------------|-----|-------|---------|
| Channel | Frequency (MHz) | Measured | Duty | Duty fa Calcula | actor ated | (dE | Bm) | Verdict |
| (| dBm | Bm Factor | dBm | W | dBm | W | | |
| 36 | 5180 | 13.47 | | 13.47 | 0.022 | | | |
| 44 | 5220 | 13.64 | 0.00 | 13.64 | 0.023 | 24 | 0.25 | PASS |
| 48 | 5240 | 13.81 | | 13.81 | 0.024 | | | |

802.11n (HT40) Mode

| | | | Average | Power | ower | | Limit | |
|---------|--------------------|----------|----------------|-------------------|---------------|-----|-------|---------|
| Channel | Frequency (MHz) | Measured | Duty Factor | Duty fa Calcul | actor ated | (dE | Bm) | Verdict |
| | | dBm | Factor | dBm | W | dBm | W | |
| 38 | 5190 | 13.22 | 0.00 | 13.22 | 0.021 | 24 | 0.05 | DACC |
| 46 | 5230 | 13.58 | | 13.58 | 0.023 | 24 | 0.25 | PASS |

802.11ac (VHT20) Mode

| | | | Average Power (dBm) | | | Limit | | |
|---------|----------|----------|---------------------|---------------|-----------|-------|------|---------|
| Channel | | Measured | Duty | Duty factor C | alculated | (dE | Bm) | Verdict |
| | (IVIFIZ) | dBm | Factor | dBm | W | dBm | W | |
| 36 | 5180 | 13.02 | | 13.02 | 0.020 | | | |
| 44 | 5220 | 13.63 | 0.00 | 13.63 | 0.023 | 24 | 0.25 | PASS |
| 48 | 5240 | 13.44 | | 13.44 | 0.022 | | | |





802.11ac (VHT40) Mode

| | Fraguanay | | Averag | Limit | | | | |
|---------|-----------|----------|--------|---------------|-----------|-----|------|---------|
| Channel | | Measured | Duty | Duty factor C | alculated | (dE | Bm) | Verdict |
| | | dBm | Factor | dBm | W | dBm | W | |
| 38 | 5190 | 13.28 | 0.00 | 13.28 | 0.021 | 24 | 0.05 | DAGG |
| 46 | 5230 | 13.85 | 0.00 | 13.85 | 0.024 | 24 | 0.25 | PASS |

802.11ac (VHT80) Mode

| | Fraguanay | | Average Power | | | Lii | nit | |
|---------|-----------|----------|---------------|-------------|------------|-----|------|---------|
| Channel | | Measured | Duty | Duty factor | Calculated | (dE | 3m) | Verdict |
| | | dBm | Factor | dBm | W | dBm | W | |
| 42 | 5210 | 13.36 | 0.00 | 13.36 | 0.022 | 24 | 0.25 | PASS |



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2.4. Emission Bandwidth

2.4.1.Requirement

For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement. Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

2.4.2.Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.

2.4.3.Test Procedure

- 1. KDB 789033 Section C) 1) Emission Bandwidth was used in order to prove compliance
- a) Set RBW = approximately 1% of the emission bandwidth.
- b) Set VBW > RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.

e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

2. KDB 789033 Section C) 2) minimum emission bandwidth for the band 5.725-5.85GHz was used in order to prove compliance.

Section 15.407(e) specifies the minimum 6 dB emission bandwidth of at least 500 KHz for theband5.715-5.85 GHz. The following procedure shall be used for measuring this bandwidth:





- a) Set RBW = 100 kHz.
- b) Set video bandwidth (VBW) \ge 3 × RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

2.4.4.Test Result

802.11a Mode

A.Test Verdict:

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| 36 | 5180 | 38.05 |
| 44 | 5220 | 37.42 |
| 48 | 5240 | 39.63 |

B.Plot:



(Channel 36, 5180MHz, 802.11a)



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| (Channel 44. | 5220 MHz. | 802.11a) |
|--------------|-----------|----------|
| | | 002.110, |



(Channel 48, 5240MHz, 802.11a)



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802.11n (HT20) Mode

A.Test Verdict:

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| 36 | 5180 | 34.36 |
| 44 | 5220 | 36.18 |
| 48 | 5240 | 36.74 |

B.Test Plot:



(Channel 36, 5180MHz, 802.11n (HT20))



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| (Channel 44, 5220MHz, 802.11n (HT |
|-----------------------------------|
|-----------------------------------|



(Channel 48, 5240MHz, 802.11n (HT20))



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802.11n (HT40) Test mode

A.Test Verdict:

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| 38 | 5190 | 83.84 |
| 46 | 5230 | 83.77 |

B.Test Plot:

| Agilent Spectrum Analyzer - Occupied BW A RF 50 Ω AC VBW 2.7000 MHz #II | Gain:Low | ISE:PULSE SOURCE OFF Freq: 5.190000000 GHz ee Run Avg Hol 18 dB | ALIGN AUTO 06:09:0 Radio S d:>10/10 Radio E | 2 PM Jan 21, 2021 Std: None Device: BTS | Meas Setup Avg/Hold Num |
|--|------------|--|--|---|-----------------------------|
| 10 dB/div Ref 20.00 dBm | | | | | 10 <u>On</u> Off |
| Log 10.0 0.00 | | a hander and a second and a second and a second and a second a s | | | Avg Mode Exp Repeat |
| -10.0 -20.0 | | | Congrate and the second s | me man for the man | |
| -50.0 | | | | | |
| -60.0 | | | | | OBW Power 99.00 % |
| Center 5.19 GHz #Res BW 820 kHz | #V | /BW 2.7 MHz | Sp S | an 100 MHz weep 1 ms | |
| Occupied Bandwidth | | Total Power | 24.5 dBm | | |
| 37.9 | 908 MHz | | | | x dB |
| Transmit Freq Error | 343.13 kHz | OBW Power | 99.00 % | | -26.00 dB |
| x dB Bandwidth | 83.84 MHz | x dB | -26.00 dB | | |
| | | | | | More 1 of 2 |
| MSG | | | STATUS | | |

(Channel 38, 5190MHz, 802.11n (HT40))



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| Agilent Spectrum Analyzer - Occupied BW | | | | | |
|---|--|--|-----------------|--|----------------------------|
| XI RF 50 Ω AC Center Freq 5.230000000 (| SHZ Center Trig: Fro #FGain:Low #Atten: | ISE:PULSE SOURCE OFF Freq: 5.230000000 GHz ee Run Avg Hol 18 dB | ALIGN AUTO | 06:09:33 PM Jan 21, 2021 Radio Std: None Radio Device: BTS | Meas Setup Avg/Hold Num |
| 10 dB/div Ref 20.00 dBm | | | | | 10 <u>On</u> Off |
| | and a second sec | And an | | | Avg Mode Exp Repeat |
| -20.0 -20.0 | | | "ILTI'S ANT AND | un Muunin ann ann ann | |
| -40.0 | | | | | OBWPower |
| -70.0 | | | | | 99.00 % |
| Center 5.23 GHz #Res BW 820 kHz | #V | 'BW 2.7 MHz | | Span 100 MHz Sweep 1 ms | |
| Occupied Bandwidth 38. | 202 MHz | Total Power | 24.8 | dBm | a di |
| Transmit Freq Error | 370.98 kHz | OBW Power | 99. | 00 % | -26.00 dB |
| x dB Bandwidth | 83.77 MHz | x dB | -26.0 | 0 dB | More 1 of 2 |
| MSG | | | STATUS | | |

(Channel 46, 5230MHz, 802.11n (HT40))



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802.11ac (VHT20) Test mode

A. Test Verdict:

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| 36 | 5180 | 34.73 |
| 44 | 5220 | 35.52 |
| 48 | 5240 | 35.28 |

B. Test Plot:

| Agilent Spectrum Analyzer - Occupied BW | | SENSE DU SE SOURCE OFF | ALIGN ALITO | 06:05:10 PM Jap 21, 2021 | |
|---|---------------|---------------------------|-----------------|----------------------------|-----------------------------|
| Center Freq 5.180000000 (| SHZ Ce | nter Freq: 5.180000000 GH | iz i | Radio Std: None | Meas Setup |
| # | IFGain:Low #A | ten: 18 dB | I | Radio Device: BTS | Avg/Hold Num |
| 10 dB/div Ref 20.00 dBm | | | | | <u>On</u> Off |
| 10.0 0.00 | | manny And Asher Marian. | 1 | | Avg Mode Exp Repeat |
| -10.0 -20.0 | | | Warwing War way | Welevel and a franking and | |
| -30.0 We^{t wet} | | | | | |
| -60.0 | | | | | OBW Power 99.00 % |
| Center 5.18 GHz #Res BW 390 kHz | | #VBW 1.2 MHz | | Span 50 MHz Sweep 1 ms | |
| Occupied Bandwidth | | Total Power | 24.4 (| dBm | |
| 18. | 425 MHz | | | | x dB |
| Transmit Freq Error | 16.685 kHz | OBW Power | 99.0 | 00 % | -26.00 dB |
| x dB Bandwidth | 34.73 MHz | x dB | -26.0 | 0 dB | |
| | | | | | More |
| | | | | | 1012 |
| MSG | | | STATUS | | |

(Channel 36, 5180MHz, 802.11ac (VHT20))









| (| Channel 44. | 5220 MHz. | 802.11ac (| (VHT20)) | ١ |
|---|-------------|----------------|------------|----------|---|
| ١ | onumer i, | 0220 mm 12 , | 002.1100 | viii20) | , |



(Channel 48, 5240MHz, 802.11ac (VHT20))



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802.11 ac (VHT40) Test mode

A. Test Verdict:

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| 38 | 5190 | 81.76 |
| 46 | 5230 | 81.62 |

B. Test Plot:

| Agilent Spectrum Analyzer - Occupied BW | | | | | | | |
|--|--|-----------------------|----------------|-----------------|------------------------|-----------|-----------------------------|
| X RF 50 Ω AC Contor Frog 5 1000000 C C C C | SEN Center | SE:PULSE SOURCE OFF | ALIGN AUTO | 06:10:07 PM | 4 Jan 21, 2021 None | М | eas Setup |
| *I | Trig: Free Run Avg Hold>10/10 #IFGain:Low #Atten: 18 dB Radio Device: BTS | | | | | | g/Hold Num |
| 10 dB/div Ref 20.00 dBm | | | | | | <u>On</u> | 10 Off |
| Log 10.0 0.00 | a a a a a a a a a a a a a a a a a a a | American aperson alon | | | | Ехр | Avg Mode Repeat |
| -10.0 -20.0 | and the second s | | Mary hater may | der allemaniple | ushed provide | | |
| -30.0 41 · · · · · · · · · · · · · · · · · · | | | | | | | |
| -60.0 | | | | | | | DBW Power 99.00 % |
| Center 5.19 GHz #Res BW 820 kHz | #V | BW 2.7 MHz | | Span Swe | 100 MHz ep 1 ms | | |
| Occupied Bandwidth | | Total Power | 24.5 | dBm | | | |
| 37. | 543 IVIHZ | | | | | | x dB |
| Transmit Freq Error | 366.96 kHz | OBW Power | 99. | .00 % | | | -26.00 dB |
| x dB Bandwidth | 81.76 MHz | x dB | -26.0 | 00 dB | | | |
| | | | | | | | More 1 of 2 |
| MSG | | | STATUS | | | | |

(Channel 38, 5190MHz, 802.11ac (VHT40))



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| Center Fried 5.230000000 GHz Center Fried 5.230000000 GHz AvgHold>100 Radio Stit. Note AvgHol 10 dB/div Ref 20.00 dBm Avg Avg Avg Avg 10 dB/div Ref 20.00 dBm Avg Avg Avg Avg 10 dB/div Ref 20.00 dBm Avg Avg Avg Avg 10 dB/div Ref 20.00 dBm Avg Avg Avg Avg 10 dB/div Ref 20.00 dBm Avg Avg Avg Avg 200 Image: State | RF 50 Ω AC | SE | | ALIGN AUTO | 06:10:50 P | M Jan 21, 2021 | М | eas Setup |
|---|--|--|--|--------------------|--------------|-----------------|-----------|------------------|
| Iterating of the same o | nter Freq 5.23000000 | Trig: Fr | ree Run Avg Hol | d:>10/10 | Radio Stu | inone BTC | A.v. | g/Hold Num |
| O dB/div Ref 20.00 dBm Image: Control of the second s | | IFGain:Low #Atten: | | | Radio Dev | rice: B15 | AV | g/Hold Num 10 |
| Classify in the 2000 disin Image: Classify in the 2000 disin 100 Image: Classify in the 2000 dis | | | | | | | <u>On</u> | Off |
| 100 1 | | | | | | | | |
| 0000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00000 000000 000000 000000 000000 000000 000000 0000000 0000000 0000000 <td< td=""><td></td><td>and the second second second</td><td>and an and the second and the second and the</td><td></td><td></td><td></td><td></td><td>Avg Mode</td></td<> | | and the second second second | and an and the second and the second and the | | | | | Avg Mode |
| 1000 10000 100000 100000 100000 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Exp</td> <td>Repea</td> | | | | | | | Exp | Repea |
| 2000 100 100 100 100 100 100 100 100 100 | 1 addrestrolythe Marth | w la | | Ant flage the must | wholes whole | Huther | | |
| 400 4 | Mary will we | | | | | Par Balling Way | | |
| 200 2 | | | | | | | | |
| and a | | | | | | | | |
| 200 2 | | | | | | | | OBWPowe |
| Center 5.23 GHz #Res BW 820 kHz Cocupied Bandwidth 38.684 MHz Transmit Freq Error 718.09 kHz OBW Power 99.00 % x dB Bandwidth 81.62 MHz x dB -26.00 dB | | | | | | | | 99.00 % |
| Center 5.23 GHz Span 100 MHz #Res BW 820 kHz #VBW 2.7 MHz Sweep 1 ms Occupied Bandwidth Total Power 25.0 dBm 38.684 MHz Transmit Freq Error 718.09 kHz OBW Power 99.00 % x dB Bandwidth 81.62 MHz x dB -26.00 dB 22 | | | | | | | | |
| #kes BW 820 kHz #VBW 2.7 MHz Sweep 1 ms Occupied Bandwidth Total Power 25.0 dBm 38.684 MHz 38.684 MHz Transmit Freq Error 718.09 kHz OBW Power 99.00 % x dB Bandwidth 81.62 MHz -26.00 dB | nter 5.23 GHz | | | | Span | 100 MHz | | |
| Occupied Bandwidth Total Power 25.0 dBm 38.684 MHz Transmit Freq Error 718.09 kHz OBW Power 99.00 % x dB Bandwidth 81.62 MHz x dB -26.00 dB | es BW 820 KHZ | #\ | /BW 2.7 MHz | | SWe | eep 1 ms | | |
| 38.684 MHz Transmit Freq Error 718.09 kHz OBW Power 99.00 % x dB Bandwidth 81.62 MHz x dB -26.00 dB | Occupied Bandwidf | | Total Power | 25.0 |) dBm | | | |
| Transmit Freq Error 718.09 kHz OBW Power 99.00 % x dB Bandwidth 81.62 MHz x dB -26.00 dB | 39 | 684 MHz | | | | | | |
| Transmit Freq Error 718.09 kHz OBW Power 99.00 % -2 x dB Bandwidth 81.62 MHz x dB -26.00 dB | 50 | | | | | | | x dB |
| x dB Bandwidth 81.62 MHz x dB -26.00 dB | Fransmit Freq Error | 718.09 kHz | OBW Power | 99 | 9.00 % | | | -26.00 dB |
| | dB Bandwidth | 81.62 MHz | x dB | -26. | 00 dB | | | |
| | | | | | | | | More |
| | | | | | | | | 1 of 2 |
| | | | | | | | | |

(Channel 46, 5230 MHz, 802.11ac (VHT40))



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802.11 ac (VHT80) Test mode

A. Test Verdict:

| Channel | Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---------|-----------------|-----------------------|
| 42 | 5210 | 120.00 |

B. Test Plot:

| Agilent Spectrum Analyzer - Occupied BW | | | | | | | |
|---|-------------------|--|------------|-----------------|---------------------------|-----------|-----------|
| VBW 4.0000 MHz | Cente | NSE:PULSE SOURCE OFF r Freq: 5.210000000 GHz | ALIGN AUTO | Radio Std | M Jan 21, 2021 : None | Me | as Setup |
| # | IFGain:Low #Atten | reeRun Avg Hol :18 dB | d:>10/10 | Radio Dev | rice: BTS | Avo | /Hold Num |
| | | | | | | - | 10 |
| 10 dB/div Ref 20.00 dBm | | | | _ | | <u>on</u> | Off |
| 10.0 | the allowing | at A when when | are and | 3. | | | Ava Mode |
| 0.00 | | | | 7 | | Exp | Repeat |
| -10.0 | | | | Vummer | مى الى مەركىيىلىكى الىرىپ | | |
| -20.0 | | | | | | | |
| -30.0 | | | | | | | |
| -40.0 | | | | | | | |
| -50.0 | | | | | | | DWD ower |
| -60.0 | | | | | | | 99.00 % |
| -70.0 | | | | | | | 00.00 % |
| Center 5.21 GHz | | | | Span | 120 MHz | | |
| #Res BW 1.3 MHz | # | VBW 4 MHz | | SWe | eep 1 ms | | |
| Occupied Bandwidth | | Total Power | 25.1 | dBm | | | |
| 76. | 318 MHz | | | | | | x dB |
| Transmit Fred Error | 153 29 kHz | OBW Power | 00 | 00 % | | | -26.00 dB |
| v dB Bandwidth | 420.0 MU= | v dP | 200 | 00-/0 00-/10 | | | |
| | | хав | -20.0 | | | | More |
| | | | | | | | 1 of 2 |
| | | | | | | | |
| MSG | | | STATUS | | | | |

(Channel 42, 5210MHz, 802.11ac (VHT80))





2.5. Peak Power Spectral Density

2.5.1.Requirement

(1)For client devices in the 5.15-5.25 GHz band, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

(2)For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11dBm in any 1 megahertz band.

(3) For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30dBm in any 500kHz band.

If transmitting antennas of directional gain greater than 6dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

(4) According to KDB662911D01Measure-and-sum technique, the conducted emission level (e.g., transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in units that are directly proportional to power.

(5) According to KDB 662911 D01, the directional gain = G_{ANT} +10log(N_{ANT}) dBi, where G_{ANT} is the antenna gain in dBi, N_{ANT} is the number of outputs.

2.5.2.Test Description

Test Setup:



The EUT is coupled to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 500hm; the path loss as the factor is calibrated to correct the reading.





2.5.3.Test Procedure

KDB 789033 Section F) Maximum Power Spectral Density (PSD) Method SA-1 was used in order to prove compliance

- 1) Set span to encompass the entire 26-dB emission bandwidth
- 2) Set RBW = 1MHz. Set VBW ≥ 3MHz
- 3) Number of points in sweep \geq 2 Span / RBW. Sweep time = auto
- 4) Detector = Average
- 5) Trace mode=Max hold
- 6) Record the max value

2.5.4.Test Result

802.11a Mode

A.Test Verdict:

| Channel | Frequency (MHz) | Measured PPSD (dBm/MHz) | Duty Factor | Corrected PPSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---------|--------------------|-------------------------------|----------------|--------------------------------|--------------------|---------|
| 36 | 5180 | 7.74 | | 7.74 | | |
| 44 | 5220 | 8.23 | 0.00 | 8.23 | 11 | PASS |
| 48 | 5240 | 8.28 | | 8.28 | | |







B.Test Plot:







(Channel 44, 5220MHz, 802.11a)



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E-mail: service@morlab.cn



| Agilent Spectrum Analyzer | - Swept SA | | | | | | | | |
|--------------------------------------|-----------------------|-------------------------|------------|--|--|---------------------|---------------------|--|---------------|
| ₩ Marker 1 5.24546 | 50 Ω AC 60000000 (| GHz | SENSE: | PULSE SOURC | Avg Type | ALIGN AUTO : RMS | 04:19:40 PM TRAC | A Jan 15, 2021 E <mark>1 2 3 4 5 6</mark> De Manadala | Peak Search |
| Ref Offs | et 12.5 dB | PNO: Fast IFGain:Low | Atten: 34 | dB | Arginolas | Mkr | DE 1 5.245 | 46 GHz | Next Peak |
| 10 dB/div Ref 35. | 00 dBm | | | | | | 8.2 | 76 dBm | |
| 25.0 | | | | | | | | | Next Pk Right |
| 5.00 | | | | and the second | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | ***** | | | Next Pk Leff |
| -5.00 | / | | | | | | | | Marker Delta |
| -15.0 | / | | | | | | New York | and the state of t | |
| -35.0 | | | | | | | | | Mkr→CF |
| -45.0 | | | | | | | | | Mkr→RefLv |
| -55.0 | | | | | | | | | More |
| Center 5.24000 GI #Res BW 1.0 MHz | łz | #VBW | 3.0 MHz* | | | #Sween | Span 3 | 0.00 MHz 1001 pts) | 1 of 2 |
| MSG | | <i>"</i> 0.544 | - AV 11112 | | | STATUS | inote 5 (| 1001 pas/ | |

(Channel 48, 5240MHz, 802.11a)



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802.11n (HT20) Mode

A.Test Verdict:

| Channel | Frequency (MHz) | Measured PPSD (dBm/MHz) | Duty Factor | Corrected PPSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---------|--------------------|-------------------------------|----------------|--------------------------------|--------------------|---------|
| 36 | 5180 | 7.32 | | 7.32 | | |
| 44 | 5220 | 7.78 | 0.00 | 7.78 | 11 | PASS |
| 48 | 5240 | 7.91 | | 7.91 | | |

B.Test Plot:



(Channel 36, 5180MHz, 802.11n (HT20))



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(Channel 44, 5220MHz, 802.11n (HT20))



(Channel 48, 5240MHz, 802.11n (HT20))



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802.11n (HT40) Mode

A.Test Verdict:

| Channel | Frequency (MHz) | Measured PPSD (dBm/MHz) | Duty Factor | Corrected PPSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---------|--------------------|-------------------------------|----------------|--------------------------------|--------------------|---------|
| 38 | 5190 | 3.36 | 0.00 | 3.36 | 11 | DAGG |
| 46 | 5230 | 3.43 | 0.00 | 3.43 | | FA33 |

B.Test Plot:



(Channel 38, 5190MHz, 802.11n (HT40))





| Agilent Spectr | um Analyzer - Swept SA | | | | | | | |
|------------------|------------------------|------------|-----------------|-----------------------------------|----------------------------------|----------------------------|---|---------------|
| Marker 1 | RF 50 Ω AC | GHz | Trig: Free Run | SOURCE OFF Avg Typ Avg Hold | ALIGN AUTO e: RMS d:>10/10 | 04:41:34 Pf TRAC TYI | 4 Jan 15, 2021 CE <mark>1 2 3 4 5 6</mark> DE M WWWWWW | Peak Search |
| | Ref Offset 12.5 dB | IFGain:Low | Atten: 34 dB | | Mkr | 1 5.243 | 56 GHz | NextPeak |
| 10 dB/div Log | Ref 35.00 dBm | | | | | 0.4 | 54 UBIII | |
| 25.0 | | | | | | | | Next Pk Right |
| 15.0 | | | | | | | | |
| 5.00 | | | | | <u>∲</u> 1 | | | Next Pk Left |
| -5.00 | (| | V | | | \ | | |
| -15.0 | | | | | | | | Marker Delta |
| -25.0 | | | | | | | | |
| 25.0 | | | | | | | | Mkr→CF |
| -55.0 | | | | | | | | |
| -43.0 | | | | | | | | WKr→RéfLv |
| -55.0 | | | | | | | | More |
| Center 5.2 | 23000 GHz | #\/B\/ | 3 0 MHz* | | #Sween | Span 6 | 0.00 MHz | 1 of 2 |
| MSG | | #VDV | 3.0 WITZ | | status | 1.000 S (| Too Ppts) | |

(Channel 46, 5230MHz, 802.11n (HT40))





802.11ac (VHT20) Test mode

A.Test Verdict:

| Channel | Frequency (MHz) | Measured PPSD (dBm/MHz) | Duty Factor | Corrected PPSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---------|--------------------|-------------------------------|----------------|--------------------------------|--------------------|---------|
| 36 | 5180 | 7.96 | | 7.96 | | |
| 44 | 5220 | 8.35 | 0.00 | 8.35 | 11 | PASS |
| 48 | 5240 | 7.32 | | 7.32 | | |

B.Test Plot:



(Channel 36, 5180MHz, 802.11ac (VHT20))



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(Channel 44, 5220 MHz, 802.11ac (VHT20))



(Channel 48, 5240MHz, 802.11ac (VHT20))



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802.11ac (VHT40) Test mode

A.Test Verdict:

| Channel | Frequency (MHz) | Measured PPSD (dBm/MHz) | Duty Factor | Corrected PPSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---------|--------------------|-------------------------------|----------------|--------------------------------|--------------------|---------|
| 38 | 5190 | 3.06 | 0.00 | 3.06 | 44 | DAGG |
| 46 | 5230 | 3.48 | 0.00 | 3.48 | | FA33 |

B.Test Plot:

| Marker 1 5.20464000000 GHz Pio: Fast Avg Type: RMS Avg Type: RMS Avg Type: RMS Pick Search Pio: Fast Pio: Fast Trig: Free Run Avg Type: RMS Avg Type: RMS Next Peak 0 dB/div Ref 0ffset 12.6 dB Mkr1 5.204 64 GHz Next Pk Right 250 Image: Ref 0ffset 12.6 dB Mkr1 5.204 64 GHz Next Pk Right 150 Image: Ref 0ffset 12.6 dB Mkr1 5.204 64 GHZ Next Pk Right 250 Image: Ref 0ffset 12.6 dB Mkr1 5.204 64 GHZ Next Pk Right 150 Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Next Pk Right 250 Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Next Pk Right 150 Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Next Pk Right 150 Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Next Pk Leff 150 Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Marker Detta 250 Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Image: Ref 0ffset 12.6 dB Mkr - Ref Lv 250 < | Agilent Spectr | um Analyzer - Swept SA | | | | | |
|--|--------------------|-------------------------------------|---------------------|----------------------------------|---|---|----------------|
| Ref Offset 12.5 dB Ref 35.00 dBm Mkr1 5.204 64 GHz 3.055 dBm Next Peak 250 Next Pk Right Next Pk Right Next Pk Right 150 1 Mkr1 5.204 64 GHz Next Pk Right 150 1 Next Pk Right Next Pk Right 150 1 1 Next Pk Left 500 1 1 1 500 1 1 1 500 1 1 1 500 1 1 1 500 1 1 1 1 500 1 1 1 1 500 <t< th=""><th>w Marker 1</th><th>RF 50 Ω AC 5.20464000000</th><th>DO GHz PNO: Fast</th><th>) Trig: Free Run Atten: 34 dB</th><th>DURCE OFF ALIGN AUTO Avg Type: RMS Avg Hold>10/10</th><th>04:34:05 PM Jan 15, 2021 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET A N N N N N</th><th>Peak Search</th></t<> | w Marker 1 | RF 50 Ω AC 5.20464000000 | DO GHz PNO: Fast |) Trig: Free Run Atten: 34 dB | DURCE OFF ALIGN AUTO Avg Type: RMS Avg Hold>10/10 | 04:34:05 PM Jan 15, 2021 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET A N N N N N | Peak Search |
| 250 250 1 Next Pk Right 150 1 1 Next Pk Right 500 1 1 Next Pk Left 500 1 1 Next Pk Left 500 1 1 Marker Detta 500 1 1 1 500 1 1 1 500 1 1 1 500 1 1 1 1 500 1 1 1 1 1 500 1 1 1 1 1 1 500 1 1 1 1 1 1 500 1 <t< td=""><td>10 dB/div</td><td>Ref Offset 12.5 dB Ref 35.00 dBm</td><td>I Gameon</td><td></td><td>Mkr</td><td>1 5.204 64 GHz 3.055 dBm</td><td>Next Peak</td></t<> | 10 dB/div | Ref Offset 12.5 dB Ref 35.00 dBm | I Gameon | | Mkr | 1 5.204 64 GHz 3.055 dBm | Next Peak |
| 150 1 1 Next Pk Lef 500 1 1 Marker Delta 150 1 1 Marker Delta 150 1 1 Marker Delta 250 1 1 Marker Delta 260 1 1 Marker Delta 260 1 1 Mkr→CF 360 1 1 1 260 1 1 1 260 1 1 1 360 1 1 1 360 1 1 1 360 1 1 1 360 1 1 1 360 1 1 1 1 360 1 1 1 1 1 360 1 1 1 1 1 1 360 1 1 1 1 1 1 1 360 1 1 1 1 1 1 1 360 | 25.0 | | | | | | Next Pk Right |
| 5.00 16.0 27.0 27.0 26.0 26.0 27.0 | 5.00 | | | | Û1 | | Next Pk Left |
| 250 Mkr→CF 350 Mkr→CF 450 Mkr→RefLv 550 Span 60.00 MHz Center 5.19000 GHz #VBW 3.0 MHz* Res BW 1.0 MHz #VBW 3.0 MHz* | 5.00 | | | | | | Marker Delta |
| 45.0 45.0 55.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 56.0 57.0 | 25.0 | | | | | | Mkr→CF |
| S50 More Center 5.19000 GHz Span 60.00 MHz Res BW 1.0 MHz #VBW 3.0 MHz* | 45.0 | | | | | | Mkr→RefLv |
| Res BW 1.0 MHz #VBW 3.0 MHz* #Sweep 1.000 s (1001 pts) | 55.0 Center 5.1 | 19000 GHz | | | | Spap 60.00 MHz | More 1 of 2 |
| | #Res BW | 1.0 MHz | #VBW | 3.0 MHz* | #Sweep | 1.000 s (1001 pts) | |

(Channel 38, 5190MHz, 802.11ac (VHT40))



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(Channel 46, 5230 MHz, 802.11ac (VHT40))





802.11ac (VHT80) Test mode

A.Test Verdict:

| Channel | Frequency (MHz) | Measured PPSD (dBm/MHz) | Duty Factor | Corrected PPSD (dBm/MHz) | Limit (dBm/MHz) | Verdict |
|---------|--------------------|-------------------------------|----------------|--------------------------------|--------------------|---------|
| 36 | 5180 | -1.19 | 0.00 | -1.19 | 11 | PASS |

B.Test Plot:

| Agilent Spectr | rum Analyzer - Swept SA | | | | | |
|----------------------------|-------------------------------------|-------------------|-----------------|---------------------------------|---|----------------|
| <mark>¤</mark> Marker 1 | RF 50 Ω AC | OGHz PNO: Fast | sense:PULse sou | AVG Type: RMS Avg Hold>10/10 | 04:43:26 PM Jan 15, 2021 TRACE 1 2 3 4 5 6 TYPE M WANNAW DET A N N N N N | Peak Search |
| 10 dB/div | Ref Offset 12.5 dB Ref 35.00 dBm | IFGain:Low / | atten: 34 db | Mkı | 1 5.237 24 GHz -1.189 dBm | Next Peak |
| 25.0 | | | | | | Next Pk Right |
| 5.00 | | | | | | Next Pk Left |
| -5.00 | | | | | | Marker Delta |
| -25.0 | | | | | han | Mkr→CF |
| -45.0 | | | | | | Mkr→RefLv |
| Center 5.2 | 21000 GHz 1.0 MHz | #VBW 3. | 0 MHz* | #Sweep | Span 120.0 MHz 1.000 s (1001 pts) | More 1 of 2 |
| ISG | | | | STATU | | |

(Channel 42, 5210MHz, 802.11ac (VHT80))



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2.6. Frequency Stability

2.6.1.Requirement

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

2.6.2.Test Procedure

The EUT was placed inside of an environmental chamber as the temperature in the chamber was varied between 5°Cto 40°C. The temperature was incremented by 10° intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded. Data for the worst case channel is shown below.

| | U-NII-1 (Ch. 36) | | | | | |
|---------|------------------|----------|-----------|-----------|--|--|
| | 5180MHz | | | | | |
| VOLTAGE | POWER | TEMP | Fre. Dev. | Deviation | | |
| (%) | (VDC) | (°C) | (kHz) | (ppm) | | |
| 100% | | +20(Ref) | 23 | 4.440 | | |
| 100% | | -30 | 30 | 5.792 | | |
| 100% | | -20 | 29 | 5.598 | | |
| 100% | | -10 | 27 | 5.212 | | |
| 100% | 5.00 | 0 | 26 | 5.019 | | |
| 100% | 5.00 | +10 | 23 | 4.440 | | |
| 100% | | +20 | 21 | 4.054 | | |
| 100% | | +30 | 23 | 4.440 | | |
| 100% | | +40 | 26 | 5.019 | | |
| 100% | | +50 | 23 | 4.440 | | |
| 85% | 4.25 | +20 | 28 | 5.405 | | |
| 115% | 5.75 | +20 | 30 | 5.792 | | |

2.6.3.Test Result



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2.7. Conducted Emission

2.7.1.Requirement

According to FCC section 15.207, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150kHz to 30MHz shall not exceed the limits in the following table, as measured using a 50μ H/ 50Ω line impedance stabilization network (LISN).

| | Conducted Limit (dBµV) | | |
|-------------|------------------------|----------|--|
| | Quai-peak | Average | |
| 0.15 - 0.50 | 66 to 56 | 56 to 46 | |
| 0.50 - 5 | 56 | 46 | |
| 5 - 30 | 60 | 50 | |

Note:

(a) The lower limit shall apply at the band edges.

(b) The limit decreases linearly with the logarithm of the frequency in the range 0.15 - 0.50MHz.

2.7.2.Test Description

Test Setup:



The Table-top EUT was placed upon a non-metallic table 0.8m above the horizontal metal reference ground plane. EUT was connected to LISN and LISN was connected to reference Ground Plane. EUT was 80cm from LISN. The set-up and test methods were according to ANSI C63.10: 2013.



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2.7.3.Test Result

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Set RBW=9kHz, VBW=30kHz. Refer to recorded points and plots below.

Note: Both of the test voltage AC 120V/60Hz and AC 230V/50Hzwere considered and tested respectively, only the results of the worst case AC 120V/60Hz were recorded in this report.

A.Test Setup:

Test Mode: EUT+PC+PC Adapter+wifi TX Test Voltage: AC 120V/60Hz The measurement results are obtained as below: $E [dB\mu V] = U_R + L_{Cable loss} [dB] + A_{Factor}$ U_R: Receiver Reading AFactor: Voltage division factor of LISN





B.Test Plot:



(L Phase)

| No. | Fre. Emission L | | .evel (dBµV) | Limit (| dBµV) | Power-line | Verdict |
|-----|-----------------|-----------|--------------|-----------|---------|------------|---------|
| | (MHz) | Quai-peak | Average | Quai-peak | Average | | |
| 1 | 0.1815 | 49.12 | 38.99 | 64.42 | 54.42 | | PASS |
| 2 | 0.3975 | 35.71 | 27.23 | 57.91 | 47.91 | | PASS |
| 3 | 0.4695 | 37.47 | 30.32 | 56.52 | 46.52 | Lino | PASS |
| 4 | 1.1710 | 35.22 | 25.40 | 56.00 | 46.00 | LITE | PASS |
| 5 | 5.1175 | 32.61 | 21.06 | 60.00 | 50.00 | | PASS |
| 6 | 21.7151 | 32.83 | 22.48 | 60.00 | 50.00 | | PASS |



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| (N | Phase) |
|----|--------|
|----|--------|

| No | Fre. | Emission L | .evel (dBµV) | Limit (| dBµV) | Power-line | Verdict |
|----|---------|-------------------------------------|--------------|---------|------------|------------|---------|
| | (MHz) | Quai-peak Average Quai-peak Average | | | v or allot | | |
| 1 | 0.1681 | 51.32 | 40.89 | 65.06 | 55.06 | | PASS |
| 2 | 0.2219 | 46.35 | 36.75 | 62.75 | 52.75 | | PASS |
| 3 | 0.3342 | 39.43 | 28.31 | 59.35 | 49.35 | Noutrol | PASS |
| 4 | 0.4743 | 38.04 | 29.48 | 56.44 | 46.44 | neutrai | PASS |
| 5 | 22.3400 | 35.65 | 25.98 | 60.00 | 50.00 | | PASS |
| 6 | 27.9081 | 33.43 | 23.42 | 60.00 | 50.00 | | PASS |



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2.8. Restricted Frequency Bands

2.8.1.Requirement

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.

(2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.

(3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of -27dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or 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 above or 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.

The following formula is used to convert the equipment isotropic radiated power(e.i.r.p.) to field strength (dBµV/m);

 $E = 1000000 \times \sqrt{30P} / 3 \text{ µV/m}$

where P is the EIRP in Watts

Therefore: -27 dBm/MHz = 68.23 dBuV/m



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Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (µV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 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 |

For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

2.8.2.Test Description

Test Setup





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The EUT is located in a 3m Semi-Anechoic Chamber; the antenna factors, cable loss and so on of the site as factors are calculated to correct the reading.

KDB 789033 Section H) 3)5)6(d)) was used in order to prove compliance

For the Test Antenna:

Test Antenna is 3m away from the EUT. Test Antenna height is varied from 1m to 4m above the ground to determine the maximum value of the field strength.

2.8.3.Test Result

The lowest and highest channels are tested to verify Restricted Frequency Bands.

The measurement results are obtained as below:

 $E [dB\mu V/m] = U_R + A_T + A_{Factor} [dB]; A_T = L_{Cable loss} [dB] - G_{preamp} [dB]$

AT: Total correction Factor except Antenna; UR: Receiver Reading

Gpreamp: Preamplifier Gain; AFactor: Antenna Factor at 3m

Note 1: Restricted Frequency Bands were performed when antenna was at vertical and horizontal polarity, and only the worse test condition (vertical) was recorded in this test report.

Note 2 All test modes and bandwidth were considered and evaluated respectively by performing full test, only the worst data were recorded for each bandwidth.

802.11a Mode

A.Test Verdict:

| | | Detector | Receiver | | | Max. | | |
|---------|-----------|----------|----------------|--------|---------------------|----------|----------|---------|
| | Frequency | Delector | Reading | AT | A _{Factor} | Emission | Limit | Vordict |
| Channel | (MHz) | | U _R | (dB) | (dB@3m) | E | (dBµV/m) | verdict |
| | | Prv Av | (dBµV) | | | (dBµV/m) | | |
| 36 | 5137.16 | PK | 42.66 | -16.92 | 32.20 | 57.94 | 74 | PASS |
| 36 | 5141.24 | AV | 32.41 | -16.92 | 32.20 | 47.69 | 54 | PASS |
| 48 | 5354.04 | PK | 42.34 | -16.92 | 32.20 | 57.62 | 74 | PASS |
| 48 | 5356.90 | AV | 30.62 | -16.92 | 32.20 | 45.90 | 54 | PASS |



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B.Test Plot:

| RL R | F PRESEL 50 Ω | DC | | SENS | E:INT | ALIGN OFF | 06:09:56 PM Jan 25, 202 | |
|----------------------|---|-------------------|---|--|--------------------|--|--|----------------|
| arker 1 t | 5.13716000 | 00000 | GHZ PNO: Fast | Trig: Free Atten: 10 | / Run A JB | Avg Type: Voltage .vg Hold:>100/100 | TRACE 1 2 3 4 5 TYPE M WWW DET P NNNN | |
| dB/div | Ref 106.99 | dBµV | | | | Mkr | 1 5.137 16 GH 42.658 dBµ | z v |
| 9 .0 .0 | | | | | | | | Norn |
| .0 | | | | | | | 1,2 | De |
| | U _L Therein Sciences and Barry | eulastradium | ويوني المحمد المحمد المحمد المحمد | and and a second se | ปรุงเทโลงหังไรของไ | and a second | Lander Station of the Mathematical Control of the Mathemat | Fixe |
| art 4.500 s BW (C | 00 GHz ISPR) 1 MH | z | #VB | W 3.0 MHz | | Sweep 1 | Stop 5.1800 GH .400 ms (1001 pts | z \$) |
| MODE TRC | f f | × 5.13 5.15 | 7 16 GHz 60 00 GHz | ¥ 42.658 dВµ 41.260 dВµ | FUNCTIO | N FUNCTION WIDTH | FUNCTION VALUE | Â Propertie |
| | | | | | | | | Mo |
| | | | | | | | | - |

(PEAK, Channel 36, 802.11a)



(AVERAGE, Channel 36, 802.11a)



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| Keysight Spectrum Analyzer - Swept SA RL RF PRESEL 50 Ω DC | | SENSE:INT | ALIGN OFF | 06:20:58 PM Jan 25, 2021 | |
|--|--|--------------------------------|--------------------------------|--|-------------|
| Marker 2 5.35404000000 | PNO: Fast Trig: F | Avg ree Run Avg 10 dB | Type: Voltage Hold:>100/100 | TRACE 123456 TYPE MWWWW DET PNNNN | Marker |
| 10 dB/div Ref 106.99 dBµV | | | Mkr | 2 5.354 04 GHz 42.344 dBµV | |
| 97.0 87.0 | | | | | Normal |
| 77.0 | | | | | |
| 57.0 | | 2 | | | Delta |
| 37.0 http://www.angle.com | anagurugurugurugurugurugurugurugurugurugur | anna marith than try tailed an | manda Addaedarthan | ห _ญ ยู่ไม่ส ^า นปูมาแล้วและสารก _า ณะสารก | Fixed⊳ |
| 17.0 | | | | | |
| Start 5.2400 GHz Res BW (CISPR) 1 MHz | #VBW 3.0 MI | Iz | Sweep 1 | Stop 5.4600 GHz .000 ms (1001 pts) | Off |
| MKR MODE TRC SCL X 1 N 1 f 5.3 2 N 1 f 5.3 | 50 00 GHz 39.169 54 04 GHz 42.344 | FUNCTION BUV BUV | FUNCTION WIDTH | FUNCTION VALUE | |
| 3 4 5 6 | | | | E | Properties► |
| 7 8 9 | | | | | More |
| | m | | | | 1 of 2 |
| MSG | | | STATUS | s | |

(PEAK, Channel 48, 802.11a)



(AVERAGE, Channel 48, 802.11a)



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802.11n (HT40) Mode

A.Test Verdict:

| | | Detector | Receiver | | | Max. | | |
|---------|-----------|----------|----------------|----------------|---------------------|----------|----------|---------|
| | Frequency | Delector | Reading | A _T | A _{Factor} | Emission | Limit | Vardiat |
| Channel | (MHz) | | U _R | (dB) | (dB@3m) | Е | (dBµV/m) | veruici |
| | | PN/AV | (dBµV) | | | (dBµV/m) | | |
| 38 | 5150.00 | PK | 43.94 | -16.92 | 32.20 | 59.22 | 74 | PASS |
| 38 | 5150.00 | AV | 32.80 | -16.92 | 32.20 | 48.08 | 54 | PASS |
| 48 | 5352.36 | PK | 41.67 | -16.92 | 32.20 | 56.95 | 74 | PASS |
| 48 | 5350.00 | AV | 30.70 | -16.92 | 32.20 | 45.98 | 54 | PASS |

B.Test Plot:



(PEAK, Channel 38, 802.11n (HT40))



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| 💓 Keysight S | pectrum Ana | lyzer - Swept SA | | SENS | E-INT | | 07:45:42 PM lan 2 | 5 2021 | |
|---------------------|-------------------|------------------|------------|--------------|----------------|----------------|------------------------------|---------------|----------------|
| Marker ' | 1 5.129 | 970000000 | GHz | Trig: Free F | Avg Run Avg | Type: Voltage | TRACE 1 2 TYPE MW | 3 4 5 6 | Marker |
| 1 | _ | | IFGain:Low | Atten: 10 c | IB | | DET PN | NNNN | Select Marker |
| 10 dB/div | Ref 1 | l06.99 dBµV | | | | Mkr | 1 5.129 97 (32.593 di | GHz BµV | 1 |
| 97.0 | | | | | | | | | Normal |
| 87.0 | | | | | | | | | Norma |
| 67.0 | | | | | | | | ~~ | |
| 57.0 | | | | | | | | | Delta |
| 47.0 37.0 | | | | | | | | 2 | |
| 27.0 | | | | | <u> </u> | | | | Fixed⊳ |
| 17.0 | | | | | | | | | |
| Start 4.5 Res BW | 000 GH (CISPR) | z 1 MHz | #VB | W 2.0 kHz | | Sweep | Stop 5.1900 79.12 s (1001 | GHz i pts) | Off |
| MKR MODE 1 | TRC SCL | X | | Y | FUNCTION | FUNCTION WIDTH | FUNCTION VALU | UE 🔺 | |
| 2 N | 1 f | 5.15 | 0 00 GHz | 32.802 dBµ | v | | | | Durantina |
| 4 5 | | | | | | | | = | Properties► |
| 6 7 | | | | | | | | | |
| 9 | | | | | | | | | Nore 1 of 2 |
| 11 | | | | | | | | • • | |
| MSG | | | | | | STATU | S | | |

(AVERAGE, Channel 38, 802.11n (HT40))



(PEAK, Channel 48, 802.11n (HT40))



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| Mikeysight Spectrum Analyzer - Swept SA Mikey RL RF PRESEL 50 Ω DC Marker 2 5.3530500000000 | GHz PNO: Fast | SENSE:INT Trig: Free Run Atten: 10 dB | Avg Type Avg Hold: | ALIGN OFF : Voltage :>100/100 | 07:50:27 PM TRAC TYP DE | I Jan 25, 2021 E 1 2 3 4 5 6 E M WWWWW T P N N N N N | Marker |
|---|------------------------------|---|-----------------------|-------------------------------------|----------------------------------|---|----------------|
| 10 dB/div Ref 106.99 dBµV | - Guilleon | | | Mkr | 2 5.353 30.67 | 05 GHz 3 dBµV | |
| 97.0 87.0 77.0 | | | | | | | Normal |
| 67.0 67.0 47.0 | | | | | | | Delta |
| 37.0 27.0 17.0 | | \$ | | | | | Fixed⊳ |
| Start 5.2300 GHz Res BW (CISPR) 1 MHz | #VBW 2 | .0 kHz | UNCTION FUN | Sweep | Stop 5.4 26.37 s (' | 600 GHz 1001 pts) | Off |
| 1 N 1 f 5.31 2 N 1 f 5.31 3 - - - - 4 - - - - 6 - - - - - | 50 00 GHz 30 53 05 GHz 30 | 0.697 dBµV 0.673 dBµV | | | | | Properties▶ |
| 7 8 9 9 9 9 10 11 1 1 1 1 1 1 1 1 1 1 1 1 1 | | | | | | - | More 1 of 2 |
| MSG | | | | STATUS | 3 <mark>.</mark> | • | |

(AVERAGE, Channel 48, 802.11n (HT40))





802.11 ac (VHT80) Test mode

A.Test Verdict:

| | | Detector | Receiver | | | Max. | | |
|---------|-----------|----------|----------------|--------|---------------------|----------|----------|---------|
| Channel | Frequency | Delector | Reading | AT | A _{Factor} | Emission | Limit | Vardiat |
| Channel | (MHz) | | U _R | (dB) | (dB@3m) | E | (dBµV/m) | veruici |
| | | Prv AV | (dBuV) | | | (dBµV/m) | | |
| 42 | 5146.20 | PK | 44.40 | -16.92 | 32.20 | 59.68 | 74 | PASS |
| 42 | 5146.20 | AV | 32.61 | -16.92 | 32.20 | 47.89 | 54 | PASS |
| 42 | 5366.00 | PK | 41.24 | -16.92 | 32.20 | 56.52 | 74 | PASS |
| 42 | 5350.00 | AV | 30.60 | -16.92 | 32.20 | 45.88 | 54 | PASS |

B.Test Plot:



(Channel 42, PEAK, 802.11ac (VHT80))



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| Marker | M Jan 25, 2021 CE 1 2 3 4 5 6 PE M WWWWW ET P N N N N N | 07:58:40 PI TRAC TYF DE | ALIGN OFF De: Voltage d:>100/100 | Avg Avg t | SE:INT | SEI | GHz PNO: Fast G | alyzer - Swept SA EL 50 Ω DC 52000000000 | t Spectrum A RF PRE 1 1 5.1 4 | RL RL arke |
|----------------|--|----------------------------------|--|--------------|--------|--|--|--|--|------------------------------------|
| Select Marker | 6 2 GHz 7 dBµV | r1 5.14 44.39 | Mk | | uв | Atten. It | IFGain:Low | 106.99 dBµV | v Ref | 0 dB/d |
| Norma | | | | | | | | | | 97.0 — 37.0 — |
| Delta | | | | | MAN - | 1 | | | | 77.0 |
| Fixed▷ | | h-hrunourfranuuk | warwer How An and | | | | | hili olyn Letti (yr Perfediolywyd) | | 37.0 |
| Of | 00.0 MHz (1001 pts) | Span 6 267 ms (| Sweep 1 | ICTION | | 3.0 MHz | #VBV | GHz) 1 MHz | 5.2100 V (CISP | enter es Bi |
| Properties | | TUNCTION | | | | 44.397 dB 41.620 dB 39.672 dB 41.238 dB | 46 2 GHz 50 0 GHz 50 0 GHz 66 0 GHz | 5.1 5.1 5.3 5.3 | 1 f 1 f 1 f 1 f | 1 N 2 N 3 N 4 N 5 6 |
| More 1 of 2 | | | | | | | | | | 7 8 9 0 |
| | • | | STATUS | | | | | | | G |

(Channel 42, AVG, 802.11ac (VHT80))





2.9. Radiated Emission

2.9.1.Requirement

The peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.

(2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of -27dBm/MHz.

(3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of -27dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

The following formula is used to convert the equipment isotropic radiated power(e.i.r.p.) to field strength (dBµV/m);

$E = \frac{1000000 \times \sqrt{30P}}{3} \mu \text{V/m}$ where P is the EIRP in Watts Therefore: -27 dBm/MHz = 68.23 dBuV/m

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength (µV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 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 |



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For Above 1000MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), also should comply with the radiated emission limits specified in Section 15.209(a)(above table).

2.9.2.Test Description

Test Setup:

1) For radiated emissions from 9kHz to 30MHz





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2) For radiated emissions from 30MHz to1GHz



3) For radiated emissions above 1GHz



The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.



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For measurements below 30MHz, the emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9kHz-90 kHz, 110kHz-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

For measurements below 1GHz the resolution bandwidth is set to 100kHz for peak detection measurements or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1GHz the resolution bandwidth is set to 1MHz, the video band width is set to 3MHz for peak measurements and as applicable for average measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

2.9.3.Test Result

According to ANSI C63.10, because of peak detection will yield amplitudes equal to or greater than amplitudes measured with the quasi-peak (or average) detector, the measurement data from a spectrum analyzer peak detector will represent the worst-case results, if the peak measured value complies with the quasi-peak (or average) limit, it is unnecessary to perform an quasi-peak measurement (or average).

The measurement results are obtained as below:

 $E [dB\mu V/m] = U_R + A_T + A_{Factor} [dB]; A_T = L_{Cable loss} [dB] - G_{preamp} [dB]$

A_T: Total correction Factor except Antenna

U_R: Receiver Reading

G_{preamp}: Preamplifier Gain

A_{Factor}: Antenna Factor at 3m

During the test, the total correction Factor A_T and A_{Factor} were built in test software.

Note 1: All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Note 2: For the frequency, which started from 9kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Note 3: For the frequency, which started from 18GHz to 40GHz, was pre-scanned and the result which was 20dB lower than the limit was not recorded.

Note 4: All test modes and bandwidth were considered and evaluated respectively by performing full test, only the worst data were recorded for each bandwidth.





802.11a Mode





(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel 44







(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel 48



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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802.11n (HT40) Mode

Plot for Channel 38



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Plot for Channel 46





(Antenna Vertical, 30MHz to 18GHz)



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802.11ac (VHT80) Mode

Plot for Channel 42



(Antenna Horizontal, 30MHz to 18GHz)



(Antenna Vertical, 30MHz to 18GHz)



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Annex A Test Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for test performed on the EUT as specified in CISPR 16-1-2:

| Test items | Uncertainty |
|------------------------------|-------------|
| Peak Output Power | ±2.22dB |
| Power spectral density (PSD) | ±2.22dB |
| Bandwidth | ±5% |
| Restricted Frequency Bands | ±5% |
| Radiated Emission | ±2.95dB |
| Conducted Emission | ±2.44dB |

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



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Annex B Testing Laboratory Information

1. Identification of the Responsible Testing Laboratory

| Laboratory Nama | Shenzhen Morlab Communications Technology Co., Ltd. | | | |
|---------------------|--|--|--|--|
| Laboratory Name: | Morlab Laboratory | | | |
| | FL.3, Building A, FeiYang Science Park, No.8 LongChang | | | |
| Laboratory Address: | Road, Block 67, BaoAn District, ShenZhen, GuangDong | | | |
| | Province, P. R. China | | | |
| Telephone: | +86 755 36698555 | | | |
| Facsimile: | +86 755 36698525 | | | |

2. Identification of the Responsible Testing Location

| Nama | Shenzhen Morlab Communications Technology Co., Ltd. | | |
|----------|--|--|--|
| Name. | Morlab Laboratory | | |
| | FL.3, Building A, FeiYang Science Park, No.8 LongChang | | |
| Address: | Road, Block 67, BaoAn District, ShenZhen, GuangDong | | |
| | Province, P. R. China | | |

3. Facilities and Accreditations

All measurement facilities used to collect the measurement data are located at FL.3, Building A, FeiYang Science Park, Block 67, BaoAn District, Shenzhen, 518101 P. R. China. The test site is constructed in conformance with the requirements of ANSI C63.10-2013and CISPR Publication 22; the FCC designation number is CN1192, the test firm registration number is 226174.





4. Test Equipments Utilized

4.1 Conducted Test Equipments

| Equipment | Serial No. | Туре | Manufacturer | Cal. Date | Due Date |
|------------------------|------------|-------------|------------------|------------|------------|
| Attenuator 1 | N/A | 10dB | Resnet | N/A | N/A |
| EXA Signal Analzyer | MY53470836 | N9010A | Agilent | 2020.04.01 | 2021.03.31 |
| USB Wideband | MY54210011 | U2021XA | Agilent | 2020.04.01 | 2021.03.31 |
| Power Sensor | | | | | |
| RF cable | CB01 | RF01 | Morlab | N/A | N/A |
| (30MHz-26GHz) | | | | | |
| Coaxial cable | CB02 | RF02 | Morlab | N/A | N/A |
| SMA connector | CN01 | RF03 | HUBER- SUHNER | N/A | N/A |
| Temperature Chamber | 12108015 | DTL-003S101 | YOMA | 2020.01.08 | 2021.01.07 |

4.2 Conducted Emission Test Equipments

| Equipment Name | Serial No. | Туре | Manufacturer | Cal. Date | Due Date |
|----------------|------------|--------|--------------|------------|------------|
| Receiver | MY56400093 | N9038A | KEYSIGHT | 2020.03.26 | 2021.03.25 |
| LISN | 812744 | NSLK | Schwarzbeck | 2020.03.26 | 2021.03.25 |
| | | 8127 | | | |
| Pulse Limiter | VTSD 9561 | VTSD | Sobworzbook | 2020 07 24 | 2021 07 23 |
| (10dB) | F-B #206 | 9561-F | Schwarzbeck | 2020.07.24 | 2021.07.23 |
| Coaxial | | | | | |
| cable(BNC) | CB01 | EMC01 | Morlab | N/A | N/A |
| (30MHz-26GHz) | | | | | |

4.3 List of Software Used

| Description | Manufacturer | Software Version |
|------------------|--------------|------------------|
| Test System | Tonscend | V2.6 |
| Power Panel | Agilent | V3.8 |
| MORLAB EMCR V1.2 | MORLAB | V1.0 |
| TS+ -[JS32-CE] | Tonscend | V2.5.0.0 |



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4.4Radiated Test Equipments

| Equipment Name | Serial No. | Туре | Manufacturer | Cal. Date | Due Date |
|--|------------------|--------------------|--------------|------------|------------|
| Receiver | MY54130016 | N9038A | Agilent | 2020.07.21 | 2021.07.20 |
| Test Antenna - Bi-Log | 9163-519 | VULB 9163 | Schwarzbeck | 2019.05.24 | 2022.05.23 |
| Test Antenna - Horn | BBHA9170 #774 | BBHA 9170 | Schwarzbeck | 2019.07.26 | 2022.07.25 |
| Test Antenna - Loop | 1519-022 | FMZB1519 | Schwarzbeck | 2019.02.14 | 2022.02.13 |
| Test Antenna - Horn | 01774 | BBHA 9120D | Schwarzbeck | 2019.07.26 | 2022.07.25 |
| Coaxial cable (N male) (9KHz-30MHz) | CB04 | EMC04 | Morlab | N/A | N/A |
| Coaxial cable (N male) (30MHz-26GHz) | CB02 | EMC02 | Morlab | N/A | N/A |
| Coaxial cable(N male) (30MHz-26GHz) | CB03 | EMC03 | Morlab | N/A | N/A |
| Coaxial cable(N male) (30MHz-40GHz) | CB05 | EMC05 | Morlab | N/A | N/A |
| 1-18GHz pre-Amplifier | 61171/61172 | S020180L32 03 | Tonscend | 2020.07.21 | 2021.07.20 |
| 26-40GHz pre-Amplifier | 56774 | S40M400L4 002 | Tonscend | 2020.07.21 | 2021.07.20 |
| 18-26.5GHz pre-Amplifier | 46732 | S10M100L38 02 | Tonscend | 2020.07.21 | 2021.07.20 |
| Notch Filter | N/A | WRCG- 5150-5350 | Wainwright | 2020.07.21 | 2021.07.20 |
| Notch Filter | N/A | WRCG- 5470-5725 | Wainwright | 2020.07.21 | 2021.07.20 |
| Notch Filter | N/A | WRCG- 5725-5850 | Wainwright | 2020.07.21 | 2021.07.20 |





| Equipment Name | Serial No. | Туре | Manufacturer | Cal. Date | Due Date |
|-------------------|------------|----------|--------------|------------|------------|
| Anechoic | NI/A | 9m*6m*6m | CPT | 2020 01 06 | 2023 01 05 |
| Chamber | IN/A | | | 2020.01.00 | 2023.01.05 |

_____ END OF REPORT _____



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