*Audix Technology Corp.*
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# FCC 15.407 NII
# 5 GHz Test Report

**for**

## LG Electronics Inc.

## 222, LG-ro Jinwi-myeon, Pyeongtaek-Si, Gyeonggi-Do, 451-713, Korea

| | | |
|---|---|---|
| **Product Name** | **:** | **Notebook Computer** |
| **Model Name** | **:** | **15Z980** |
| **Brand** | **:** | **LG** |
| **FCC ID** | **:** | **BEJNT-15Z980** |

**Prepared by:** **:** **AUDIX Technology Corporation, EMC Department**

Testing Laboratory
1724

TESTING
NVLAP LAB CODE 200077-0

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# TEST REPORT CERTIFICATION

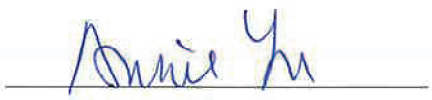
| | | |
|---|---|---|
| Applicant | : | LG Electronics Inc. |
| Factory | : | LG Electronics Nanjing New Technology Co., Ltd. |
| EUT Description | | |
| (1) Product | : | Notebook Computer |
| (2) Model | : | 15Z980 |
| (3) Brand | : | LG |
| (4) Power Rating | : | DC 19V, 2.53A |

Applicable Standards:

47 CFR FCC Part 15 Subpart E
ANSI C63.10:2013
KDB 789033 D02 General UNII Test Procedures New Rules v01r04

***Audix Technology Corp.*** tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.
***Audix Technology Corp.*** does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2017. 11. 30

Reviewed by:  (Annie Yu/Administrator)

Approved by:  (Ben Cheng/Manager)

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# 1. REVISION RECORD OF TEST REPORT

| Edition No | Issued Data | Revision Summary | Report Number |
|---|---|---|---|
| 0 | 2017. 11. 30 | Original Report | EM-F170751 |

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# 2. SUMMARY OF TEST RESULTS

| Rule | Description | Results |
|---|---|---|
| 15.207 | Conducted Emission | **PASS** |
| 15.205 | Radiated Band Edge and<br>Radiated Spurious Emission | **PASS** |
| 15.407(a)(5)/15.407(e) | Emission Bandwidth Measurement | **PASS** |
| 15.407(a) | Maximum Output | **PASS** |
| 15.407(b) | Conducted Band Edges and<br>Conducted Spurious Emission | **PASS** |
| 15.407(a) | Power Spectral Density | **PASS** |
| 15.203 | Antenna Requirement | **Compliance** |
| 15.407 | Frequency Stability | **PASS** |

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# 3. GENERAL INFORMATION

## 3.1. Description of Application

| | |
|---|---|
| Applicant | LG Electronics Inc.<br>222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do 451-713 Korea. |
| Factory | LG Electronics Nanjing New Technology Co., Ltd.<br>No.346,Yaoxin Road, Economic & Technical Development Zone, Nanjing, China. |
| Product | Notebook Computer |
| Model | 15Z980 |
| Brand | LG |

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## 3.2. Description of EUT

<table>
<tr><td>Test Model</td><td>15Z980</td></tr>
<tr><td>Serial Number</td><td>N/A</td></tr>
<tr><td>Power Rating</td><td>DC 19V, 2.53A</td></tr>
<tr><td>RF Features</td><td>WLAN:802.11a/b/g/n/ac<br>Bluetooth: BT and BLE</td></tr>
<tr><td>Transmit Type</td><td>
<table>
<tr><th colspan="2">2.4 GHz</th></tr>
<tr><td>802.11b</td><td>1T1R</td></tr>
<tr><td>802.11g</td><td>1T1R</td></tr>
<tr><td>802.11n-HT20</td><td>2T2R</td></tr>
<tr><td>802.11n-HT40</td><td>2T2R</td></tr>
<tr><td>BT/BLE</td><td>1T1R</td></tr>
</table>
<table>
<tr><th colspan="2">UNII Bands</th></tr>
<tr><td>802.11a</td><td>1T1R</td></tr>
<tr><td>802.11n-HT20/<br>802.11ac-VHT20</td><td>2T2R</td></tr>
<tr><td>802.11n-HT40/<br>802.11ac-VHT40</td><td>2T2R</td></tr>
<tr><td>802.11ac-VHT80</td><td>2T2R</td></tr>
</table>
</td></tr>
<tr><td>Device Category</td><td>☐Outdoor Access Point<br>☐Fixed point-to-point Access Point<br>☐Indoor Access Point<br>■Mobile and Portable client device</td></tr>
<tr><td>Sample Status</td><td>Production</td></tr>
<tr><td>Date of Receipt</td><td>2017. 11. 21</td></tr>
<tr><td>Date of Test</td><td>2017. 11. 28 ~ 30</td></tr>
<tr><td>I/O Ports List</td><td>• One SD Card Slot<br>• One Earphone Port<br>• Three USB 3.0 Ports<br>• One USB Type C Port<br>• One HDMI Port<br>• One DC Input Port</td></tr>
<tr><td>Accessories Supplied</td><td>• AC Adapter</td></tr>
</table>

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## 3.3. Antenna Information

| 2.4G Antenna | | | | | |
|---|---|---|---|---|---|
| **No.** | **Antenna Part Number** | **Manufacture** | **Antenna Type** | **Frequency (MHz)** | **Max Gain (dBi)** |
| 1 | WA-F-LBLB-04-056 (Main) | INPAQ | FPCB | 2400 | 1.39 |
| 2 | | | | 2450 | 1.54 |
| 3 | | | | 2500 | 2.06 |
| 4 | WA-F-LBLB-04-056 (AUX) | | FPCB | 2400 | 1.41 |
| 5 | | | | 2450 | 1.40 |
| 6 | | | | 2500 | 1.83 |

| 5G Antenna | | | | | |
|---|---|---|---|---|---|
| **No.** | **Antenna Part Number** | **Manufacture** | **Antenna Type** | **Frequency (MHz)** | **Max Gain (dBi)** |
| 1 | WA-F-LBLB-04-056 (Main) | INPAQ | FPCB | 5100 | 2.49 |
| 2 | | | | 5400 | 2.93 |
| 3 | | | | 5800 | 1.59 |
| 4 | WA-F-LBLB-04-056 (AUX) | | FPCB | 5100 | 2.57 |
| 5 | | | | 5400 | 2.97 |
| 6 | | | | 5800 | 2.84 |

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## 3.4. EUT Specifications Assessed in Current Report

| Mode | UNII Band | Fundamental Range (MHz) | Channel Number |
|---|---|---|---|
| 802.11a | I | 5180-5240 | 4 |
| | II-2A | 5260-5320 | 4 |
| | II-2C | 5500-5720 | 12 |
| | III | 5745-5825 | 5 |
| 802.11n-HT20/ 802.11ac-VHT20 | I | 5180-5240 | 4 |
| | II-2A | 5260-5320 | 4 |
| | II-2C | 5500-5720 | 12 |
| | III | 5745-5825 | 5 |
| 802.11n-HT40/ 802.11ac-VHT40 | I | 5190-5230 | 2 |
| | II-2A | 5270-5310 | 2 |
| | II-2C | 5510-5710 | 6 |
| | III | 5755-5795 | 2 |
| 802.11ac-VHT80 | I | 5210 | 1 |
| | II-2A | 5290 | 1 |
| | II-2C | 5530-5690 | 3 |
| | III | 5775 | 1 |
| Remark: UNII Band II-2A and II-2C (DFS Function, Slave/no In service monitor, no Ad-Hoc mode) | | | |

| Mode | Modulation | Data Rate (Mbps) |
|---|---|---|
| 802.11a | OFDM (BPSK/QPSK/16QAM/64QAM) | Up to 54 |
| 802.11n-HT20 | OFDM (BPSK/QPSK/16QAM/64QAM) | Up to 144.4 |
| 802.11n-HT40 | | Up to 300 |
| 802.11ac-VHT20 | OFDM (BPSK/QPSK/16QAM/64QAM/256QAM) | Up to 173.3 |
| 802.11ac-VHT40 | | Up to 400 |
| 802.11ac-VHT80 | | Up to 866.7 |

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| Channel List | | | | | |
|---|---|---|---|---|---|
| 802.11a/802.11n-HT20/802.11ac-VHT20 | | | | | |
| UNII Band | Channel Number | Frequency (MHz) | UNII Band | Channel Number | Frequency (MHz) |
| I | 36 | 5180 | II-2C | 120 | 5600 |
| | 40 | 5200 | | 124 | 5620 |
| | 44 | 5220 | | 128 | 5640 |
| | 48 | 5240 | | 132 | 5660 |
| II-2A | 52 | 5260 | | 136 | 5680 |
| | 56 | 5280 | | 140 | 5700 |
| | 60 | 5300 | | 144 | 5720 |
| | 64 | 5320 | III | 149 | 5745 |
| II-2C | 100 | 5500 | | 153 | 5765 |
| | 104 | 5520 | | 157 | 5785 |
| | 108 | 5540 | | 161 | 5805 |
| | 112 | 5560 | | 165 | 5825 |
| | 116 | 5580 | | | |

| Channel List | | | | | |
|---|---|---|---|---|---|
| 802.11n-HT40/802.11ac-VHT40 | | | | | |
| UNII Band | Channel Number | Frequency (MHz) | UNII Band | Channel Number | Frequency (MHz) |
| I | 38 | 5190 | II-2C | 118 | 5590 |
| | 46 | 5230 | | 126 | 5630 |
| II-2A | 54 | 5270 | | 134 | 5670 |
| | 62 | 5310 | | 142 | 5710 |
| II-2C | 102 | 5510 | III | 151 | 5755 |
| | 110 | 5550 | | 159 | 5795 |

| Channel List | | | | | |
|---|---|---|---|---|---|
| 802.11ac-VHT80 | | | | | |
| UNII Band | Channel Number | Frequency (MHz) | UNII Band | Channel Number | Frequency (MHz) |
| I | 42 | 5210 | II-2C | 138 | 5690 |
| II-2A | 58 | 5290 | III | 155 | 5775 |
| II-2C | 106 | 5530 | | | |
| | 122 | 5610 | | | |

Note Test modes are presented at section 3.7.

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## 3.5. Description of Key Components

### 3.5.1. For the All Component Lists

| Item | Vendor | Model name | Description |
|---|---|---|---|
| System | Microsoft | Windows 10 Home | --- |
| Main Board | LG | 14/15Z980 Main B/D PCB | (with Thunderbolt)<br>Manufacturer:<br>(1) Elec & Eltek Company (MCO) Limited<br>(2) Hannstar Board Tech(Jiang Yin) Corp.,Ltd.<br>(3) LG Innotek Co., Ltd. |
| | LG | 14/15Z980 Main B/D PCB | (without Thunderbolt)<br>Manufacturer:<br>(1) Elec & Eltek Company (MCO) Limited<br>(2) Hannstar Board Tech(Jiang Yin) Corp.,Ltd.<br>(3) LG Innotek Co., Ltd. |
| SUB Board | LG | 15Z980 WLAN SUB B/D | (with Finger Printer)<br>Manufacturer:<br>(1) Hannstar Board Tech(Jiang Yin) Corp.,Ltd.<br>(2) HYUNWOO |
| | LG | 15Z980 WLAN SUB B/D | (without Finger Printer)<br>Manufacturer:<br>(1) Hannstar Board Tech(Jiang Yin) Corp.,Ltd.<br>(2) HYUNWOO |
| CPU<br>(Socket: BGA1356) | Intel | i7-8550U | 1.80GHz, up to 4.0GHz |
| | Intel | i5-8250U | 1.60GHz, up to 3.4GHz |
| 15.6” LCD Panel | LG Display | LP156WFA(SP)(G1) | Resolution: 1920 x 1080, 60Hz<br>FHD IPSW/ Touch<br>(AIT Including touch) |
| | LG Display | LP156WF9(SP)(N1) | Resolution: 1920 x 1080, 60Hz<br>FHD IPS (Normal Non touch) |
| Storage (SSD) | SK hynix | HFS512G39TND-N210A BB | 512GB (SATA) |
| | SK hynix | HFS256G39TND-N210A BB | 256GB (SATA) |
| Memory (RAM)<br>(On Board) | SK hynix | H5ANAG6NAMR-UHC | 16GB DDR4 2400MHz * 4ea |
| | Samsung | K4A8G165WB-BCRC | 8GB DDR4 2400MHz * 4ea |
| Memory (RAM) | SK hynix | HMA81GS6AFR8N-UHN0 | 8GB DDR4 2400MHz |
| | Samsung | M471A5244CB0-CRC | 4GB DDR4 2400MHz |
| Battery Pack | LG | LBS1224E | DC 7.7V, 72Wh, Typ 9450mAh |

| Item | Vendor | Model name | Description |
|---|---|---|---|
| WLAN Combo Card | Intel | 8265D2W | 802.11a/b/g/n/ac 2.4GHz/5GHz + BT 4.2 BLE |
| WLAN Combo Antenna | LG (INPAQ) | WA-F-LBLB-04-056 | FPCB Type<br>Main: Black, Aux: Gray |
| Keyboard | LG | SN3870 | Black: BL, White: BL 1 |
| Web Camera | Lite-On | 7BF109N2 | With two MIC |
| Finger Print | SUNTEL | SFPC-L0016A(White) | --- |
| | SUNTEL | SFPC-L0016B(Black) | --- |
| LAN Gender (Type C to LAN) | LG | 80-5946-111 (White) | 10/100 Megabit Ethernet<br>Manufacturer:<br>SUZHOU MEC ELECTRONICS |
| | | 80-5946-101 (Black) | |
| | LG | GD-08MF-36-WH-LP05 (White) | 10/100 Megabit Ethernet<br>Manufacturer:<br>ARIN TECH CO. LTD |
| | | GD-08MF-36-BK-LP06 (Black) | |
| | Type C to LAN: Shielded, Undetached, 0.12m | | |
| AC Adapter | LG (Lite-on) | PA-1650-43 | I/P: AC 100-240V, 50/60Hz, 1.6A,<br>O/P: DC 19V, 3.42A |
| | DC Power Cord: Non-Shielded, Undetached, 1.8m, Bonded a ferrite core<br>AC Power Cord: Non-Shielded, Detached, 1.0m (3C) | | |

Remark: For more detailed features description, please refer to the manufacturer's specifications or the user.

### 3.5.2. For the All Component Lists

| SKU #1 | |
|---|---|
| Main Board | LG, 14/15Z980 Main B/D PCB(with Thunderbolt) |
| SUB Board | LG, 15Z980 WLAN SUB B/D/(with Finger Printer) |
| CPU | Intel, i7-8550U |
| 15.6" LCD Panel | LG Display, LP156WFA(SP)(G1)/(AIT Including touch) |
| Storage (SSD) | SK hynix, 512GB*2 |
| Memory (RAM) (On Board) | SK hynix, 16GB |
| Memory (RAM) | SK hynix, 8G |
| Battery Pack | LG, LBS1224E |
| WLAN Combo Card | Intel, 8265D2W |
| WLAN Combo Antenna | LG (INPAQ), WA-F-LBLB-04-056 |
| Keyboard | LG, SN3870 |
| Web Camera | Lite-On, 7BF109N2 |
| Finger Print | SUNTEL, SFPC-L0016B(Black) |
| LAN Gender (Type C to LAN) | LG, 80-5946-111 (White) |
| AC Adapter | LG (Lite-on), PA-1650-43 |

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## 3.6. Data Rate Relative to Output Power

| 802.11a | | | | 802.11n-HT20 | | | |
|---|---|---|---|---|---|---|---|
| Channel | Modulation | Date Rate | Power (dBm) | Channel | Modulation | Date Rate | Power (dBm) |
| 36 | BPSK | 6 | 16.87 | 36 | BPSK | HT MCS8 | 19.27 |
| 36 | QPSK | 9 | 16.71 | 36 | QPSK | HT MCS9 | 19.13 |
| 36 | QPSK | 12 | 16.58 | 36 | QPSK | HT MCS10 | 18.98 |
| 36 | 16-QAM | 18 | 16.41 | 36 | 16-QAM | HT MCS11 | 18.82 |
| 36 | 16-QAM | 24 | 16.28 | 36 | 16-QAM | HT MCS12 | 18.69 |
| 36 | 64-QAM | 36 | 16.11 | 36 | 64-QAM | HT MCS13 | 18.53 |
| 36 | 64-QAM | 48 | 16.03 | 36 | 64-QAM | HT MCS14 | 18.40 |
| 36 | 64-QAM | 54 | 15.92 | 36 | 64-QAM | HT MCS15 | 18.31 |

| 802.11n-HT40 | | | | 802.11ac-VHT80 | | | |
|---|---|---|---|---|---|---|---|
| Channel | Modulation | Date Rate | Power (dBm) | Channel | Modulation | Date Rate | Power (dBm) |
| 38 | BPSK | HT MCS8 | 15.43 | 42 | BPSK | VHT MCS0 | 13.90 |
| 38 | QPSK | HT MCS9 | 15.28 | 42 | QPSK | VHT MCS1 | 13.74 |
| 38 | QPSK | HT MCS10 | 15.10 | 42 | QPSK | VHT MCS2 | 13.61 |
| 38 | 16-QAM | HT MCS11 | 14.98 | 42 | 16-QAM | VHT MCS3 | 13.49 |
| 38 | 16-QAM | HT MCS12 | 14.84 | 42 | 16-QAM | VHT MCS4 | 13.32 |
| 38 | 64-QAM | HT MCS13 | 14.72 | 42 | 64-QAM | VHT MCS5 | 13.18 |
| 38 | 64-QAM | HT MCS14 | 14.58 | 42 | 64-QAM | VHT MCS6 | 13.04 |
| 38 | 64-QAM | HT MCS15 | 15.43 | 42 | 64-QAM | VHT MCS7 | 13.90 |
| | | | | 42 | 256-QAM | VHT MCS8 | 13.75 |
| | | | | 42 | 256-QAM | VHT MCS9 | 13.52 |

Note: Above results are assessed in average power.

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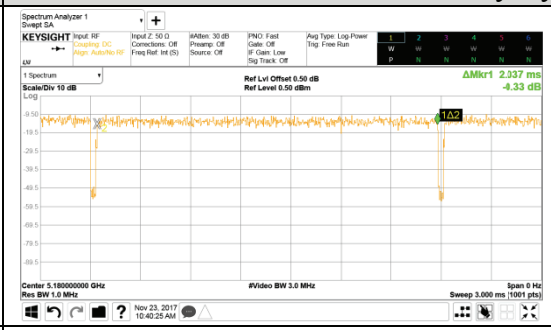
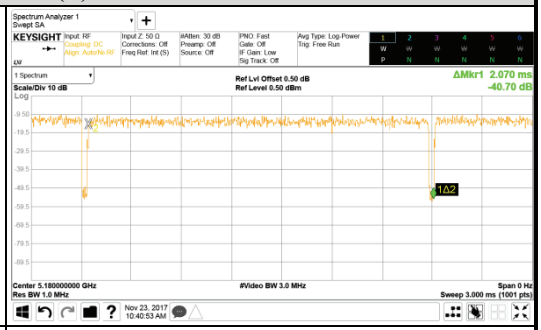
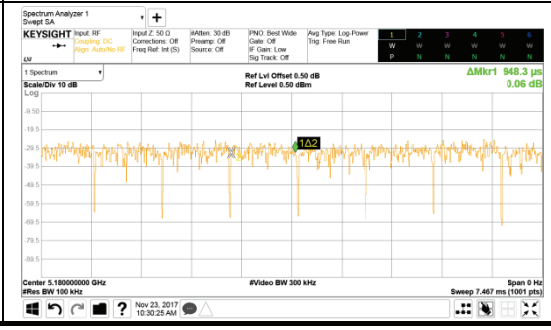
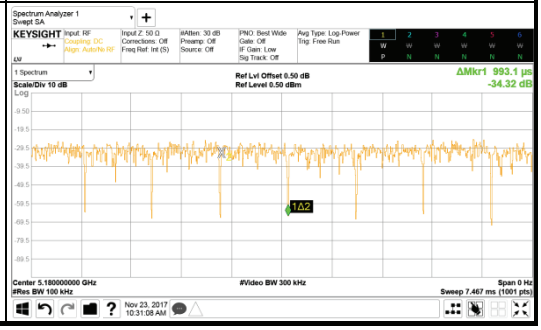
## 3.7. Test Configuration

| Mode | Duty Cycle (x) | T (ms) | Duty Cycle Factor (dB) |
|---|---|---|---|
| 802.11a | 1.00 | 2.037 | 0 |
| 802.11n-HT20 | 0.95 | 0.9483 | 0.22 |
| 802.11n-HT40 | 0.97 | 0.9450 | 0.13 |
| 802.11ac-VHT80 | 0.67 | 0.0656 | 1.74 |

Note: When duty cycle is less than 98% (0.98) that duty cycle factor 10log(1/x) is needed to add in conducted test items measured in average detector.

| Mode | Duty Cycle (x) | |
|---|---|---|
| 802.11a |  |  |
| 802.11n-HT20 |  |  |

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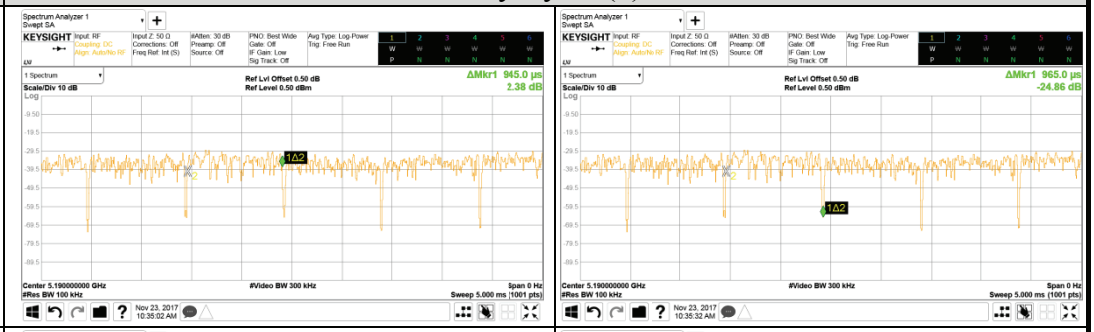
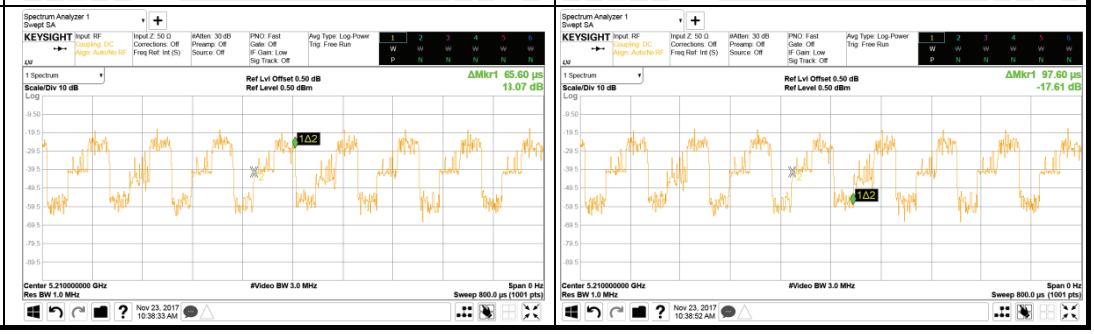
| Mode | Duty Cycle (x) |
|---|---|
| 802.11n-HT40 |  |
| 802.11ac-VHT80 |  |

| AC Conduction | |
|---|---|
| Test Case | Normal operation |

| Item | | Mode | Data Rate | Test Channel |
|---|---|---|---|---|
| Radiated Test Case | Radiated Band Edge Note1 | 802.11a | 6 Mbps | 36/64/100140 |
| | | 802.11n-HT20 | MCS8 | 36/64/100140 |
| | | 802.11n-HT40 | MCS8 | 38/62/102/134 |
| | | 802.11ac-VHT80 | MCS8 | 42/58/106/122 |
| | Radiated Spurious Emission Note1 & 2 | 802.11a | 6 Mbps | 40/52/116/140/157 |
| | | 802.11n-HT20 | MCS8 | 40/52/100/140/157 |
| | | 802.11n-HT40 | MCS8 | 46/54/118/142/159 |
| | | 802.11ac-VHT80 | MCS8 | 42/58/122138/155 |
| Conducted Test Case | Emission Bandwidth | 802.11a | 6 Mbps | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT20 | MCS8 | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT40 | MCS8 | 38/46/54/62/ 102/110/134/142/151/159 |
| | | 802.11ac-VHT80 | MCS8 | 42/58/106/122/138/155 |

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| Item | | Mode | Data Rate | Test Channel |
|---|---|---|---|---|
| Conducted Test Case | Maximum output power | 802.11a | 6 Mbps | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT20 | MCS8 | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT40 | MCS8 | 38/46/54/62/ 102/110/134/142/151/159 |
| | | 802.11ac-VHT80 | MCS8 | 42/58/106/122/138/155 |
| | Emission Limitations | 802.11a | 6 Mbps | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT20 | MCS8 | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT40 | MCS8 | 38/46/54/62/ 102/110/134/142/151/159 |
| | | 802.11ac-VHT80 | MCS8 | 42/58/106/122/138/155 |
| | Power spectral density | 802.11a | 6 Mbps | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT20 | MCS8 | 36/40/48/52/60/64/ 100/116/140/149/157/165 |
| | | 802.11n-HT40 | MCS8 | 38/46/54/62/ 102/110/134/142/151/159 |
| | | 802.11ac-VHT80 | MCS8 | 42/58/106/122/138/155 |

Note 1:

■Mobile Device

☐Portable Device, and 3 axis were assessed.

- ☐ Lie
- ☐ Side
- ☐ Stand

Note 2: Low, mid, and high channels were measured, only the worst channel of each modulation was presented in this report.

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## 3.8. Tested Supporting System List

### 3.8.1. Support Peripheral Unit

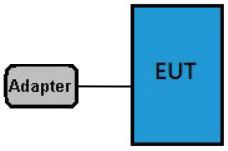
| No. | Product | Brand | Model No. | Serial No. | Approval |
|---|---|---|---|---|---|
| 1. | LCD Monitor | ASUS | VE228 | N/A | FCC By DoC |
| 2. | USB Mouse | Lenovo | 45J4886 | N/A | FCC By DoC |
| 3. | Earphone | APPLE | N/A | N/A | FCC By DoC |

### 3.8.2. Cable Lists

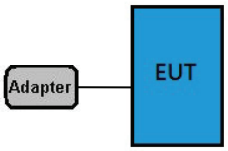
| No. | Cable Description Of The Above Support Units |
|---|---|
| 1. | HDMI Cable: Shielded, Detachable, 1.8m<br>AC Power Cord: Unshielded, Detachable, 1.8m |
| 2. | USB Cable: Unshielded, Undetachable, 1.8m |
| 3. | Earphone Cable: Unshielded, Undetachable, 2.0m |

## 3.9. Setup Configuration

### 3.9.1. EUT Configuration for Power Line & Radiated Emission




### 3.9.2. EUT Configuration for RF Conducted Test Items




## 3.10. Operating Condition of EUT

Test program “DRTU” is used for enabling EUT WLAN function under continues transmitting and choosing data rate/ channel.

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## 3.11.Description of Test Facility

| | |
|---|---|
| Name of Test Firm | Audix Technology Corporation / EMC Department<br>No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan<br>Tel: +886-2-26092133<br>Fax: +886-2-26099303<br>Website : www.audixtech.com<br>Contact e-mail: attemc_report@audixtech.com |
| Accreditations | The laboratory is accredited by following organizations under ISO/IEC 17025:2005<br>(1) NVLAP(USA)<br>NVLAP Lab Code 200077-0<br>(2) TAF(Taiwan)<br>No. 1724<br>(3) FCC OET Designation<br>No. TW1004 & TW1090 & TW1724 |
| Test Facilities | (1) No. 7 Shielding Room<br>(2) Semi-Anechoic Chamber<br>(IC Test Site Registration No.: 5183B-1)<br>(3) Fully Anechoic Chamber<br>(IC Test Site Registration No.: 5183B-4) |

## 3.12.Measurement Uncertainty

| Test Item | Frequency Range | Uncertainty |
|---|---|---|
| Conduction Test | 150kHz~30MHz | ±3.50dB |
| Radiation Test (Distance: 3m) | 30MHz~1000MHz | ± 3.68dB |
| | Above 1GHz | ± 5.82dB |

Remark：Uncertainty = $ku_c(y)$

| Test Item | Uncertainty |
|---|---|
| Emission Bandwidth | ± 0.2kHz |
| Maximum output power | ± 0.33dB |
| Power spectral density | ± 0.13dB |
| Conducted Emission Limitations | ± 0.13dB |

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# 4. MEASUREMENT EQUIPMENT LIST

## 4.1. Conducted Emission Measurement

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Test Receiver | R&S | ESCI | 101276 | 2017. 03. 23 | 1 Year |
| 2. | A.M.N. | R&S | ESH2-Z5 | 100366 | 2017. 07. 20 | 1 Year |
| 3. | L.I.S.N. | Kyoritsu | KNW-407 | 8-881-13 | 2016. 12. 28 | 1 Year |
| 4. | Pulse Limiter | R&S | ESH3-Z2 | 101495 | 2017. 01. 16 | 1 Year |
| 5. | Test Software | Audix | e3 | V.120619C | N.C.R. | N.C.R. |

## 4.2. Radiated Emission Measurement

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|---|
| 1. | Spectrum Analyzer | Agilent | N9010A-526 | MY53400071 | 2017. 09. 13 | 1 Year |
| 2. | Spectrum Analyzer | Agilent | N9010A-526 | MY52220368 | 2016. 12. 01 | 1 Year |
| 3. | Test Receiver | R & S | ESCS30 | 100338 | 2017. 06. 19 | 1 Year |
| 4. | Amplifier | HP | 8447D | 2944A06305 | 2017. 02. 16 | 1 Year |
| 5. | Amplifier | Sonoma | 310N | 187161 | 2017. 06. 08 | 1 Year |
| 6. | Bilog Antenna | CHASE | CBL6112D | 33821 | 2017. 01. 21 | 1 Year |
| 7. | Loop Antenna | R&S | HFH2-Z2 | 891847/27 | 2016. 12. 23 | 1 Year |
| 8. | Double-Ridged Waveguide Horn | ETS-Lindgren | 3117 | 00135902 | 2017. 03. 08 | 1 Year |
| 10. | 5G Notch Filter | Microware Circuits | N0452502 | 459775 | 2016. 12. 28 | 1 Year |
| 11. | 5G Notch Filter | Microware Circuits | N0555983 | 459481 | 2017. 05. 05 | 1 Year |
| 12. | 5G Notch Filter | Microware Circuits | N0257881 | 459776 | 2017. 02. 03 | 1 Year |
| 13. | Test Software | Audix | e3 | V.6.110601 | N.C.R. | N.C.R. |

## 4.3. RF Conducted Measurement

| Item | Type | Manufacturer | Model No. | Serial No. | Cal. Date | Cal. Due |
|---|---|---|---|---|---|---|
| 1. | Spectrum Analyzer | Keysight | N9010B-544 | MY55460198 | 2017. 04. 18 | 1 Year |
| 2. | Power Meter | Anritsu | ML2495A | 1145008 | 2017. 11. 03 | 1 Year |
| 3. | Power Sensor | Anritsu | MA2411B | 1126096 | 2017. 11. 03 | 1 Year |

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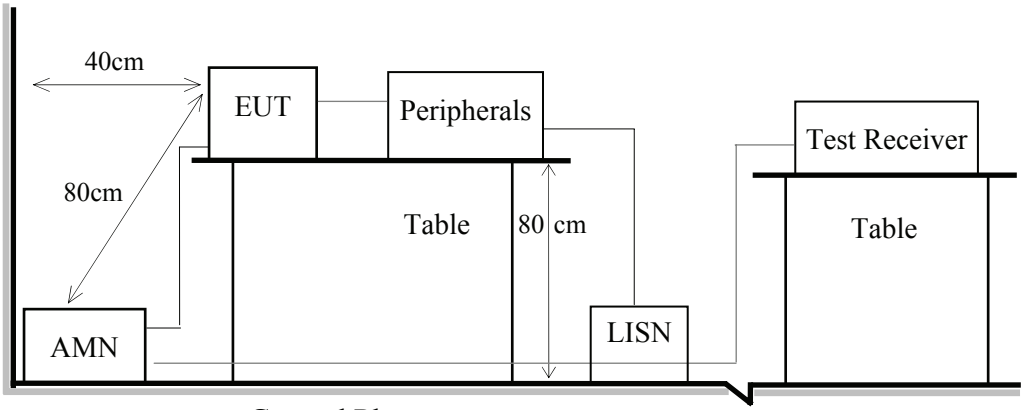
# 5. CONDUCTED EMISSION

## 5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.9

5.1.2. Shielded Room Setup Diagram




## 5.2. Conducted Emission Limit

| Frequency | Conducted Limit | |
|---|---|---|
| | Quasi-Peak Level | Average Level |
| 150kHz ~ 500kHz | 66 ~ 56 dBμV | 56 ~ 46 dBμV |
| 500kHz ~ 5MHz | 56 dBμV | 46 dBμV |
| 5MHz ~ 30MHz | 60 dBμV | 50 dBμV |

Remark 1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.
2.: The lower limit applies to the band edges.

## 5.3. Test Procedure

5.3.1. To set up the EUT as indicated in ANSI C 63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.

5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).

5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)

5.3.4. Checking frequency range from 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

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## 5.4. Test Results

Please refer to Appendix A.

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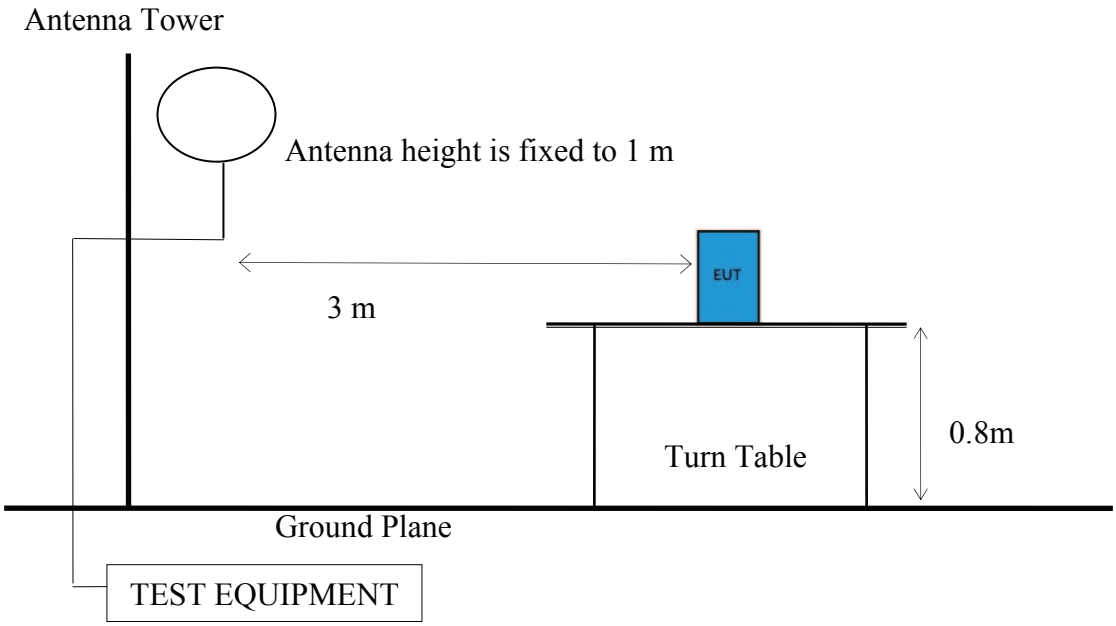
# 6. RADIATED EMISSION

## 6.1. Block Diagram of Test Setup

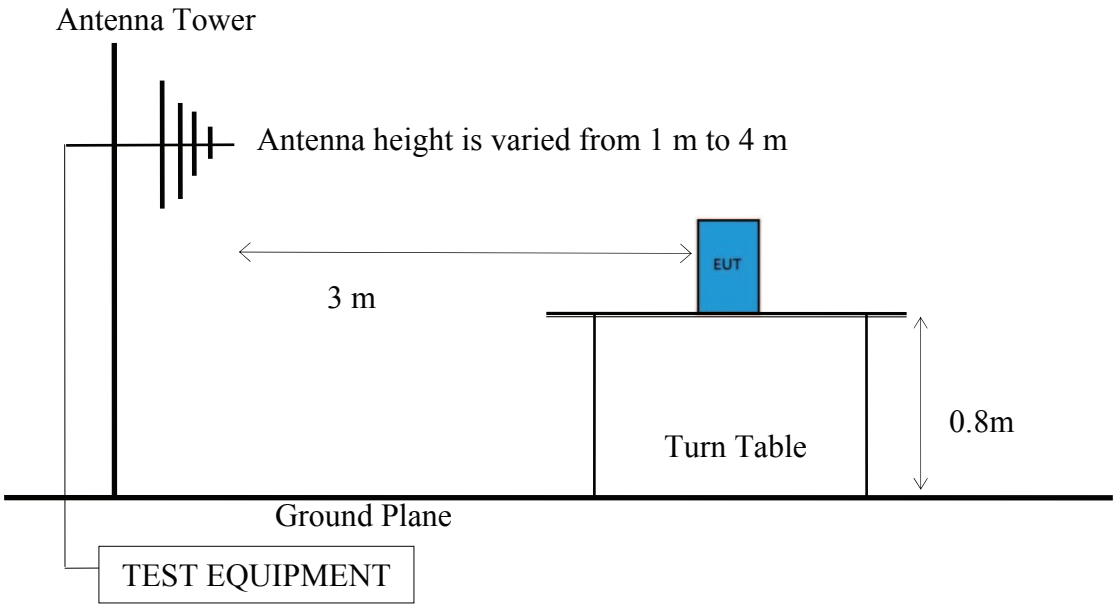
### 6.1.1. Block Diagram of EUT

Indicated as section 3.9

### 6.1.2. Setup Diagram for 9kHz-30MHz




### 6.1.3. Setup Diagram for 30-1000 MHz



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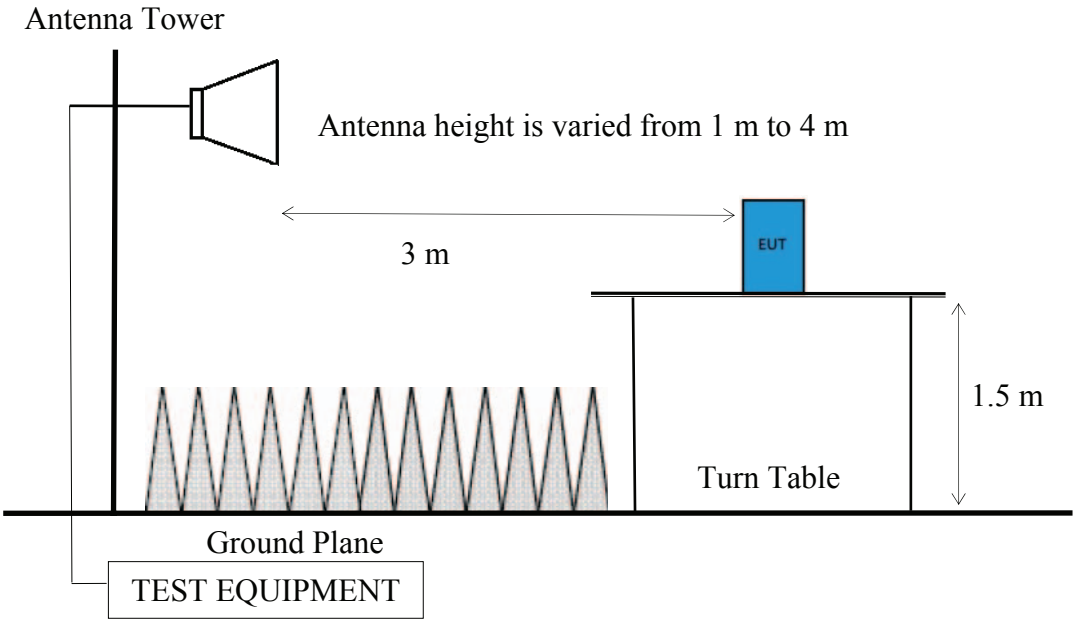
6.1.4. Setup Diagram for above 1GHz




## 6.2. Radiated Emission Limits

Radiated emissions fall in restricted bands, as defined in Section 15.205 must be in compliance with the radiated emission limits specified in 15.209 as below.

6.2.1. General Limit

| Frequency (MHz) | Distance (m) | Limits | |
|---|---|---|---|
| | | dBμV/m | μV/m |
| 0.009 - 0.490 | 300 | 67.6 | 2400/kHz |
| 0.490 - 1.705 | 30 | 87.6 | 24000/kHz |
| 1.705 - 30 | 30 | 29.5 | 30 |
| 30 - 88 | 3 | 40.0 | 100 |
| 88- 216 | 3 | 43.5 | 150 |
| 216- 960 | 3 | 46.0 | 200 |
| Above 960 | 3 | 54.0 | 500 |
| Above 1000 | 3 | 74.0 dBμV/m (Peak)<br>54.0 dBμV/m (Average) | |

Remark：(1) dBμV/m = 20 log (μV/m)
(2) The tighter limit applies to the edge between two frequency bands.
(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
(4) Fundamental and emission fall within operation band are exempted from this section.
(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

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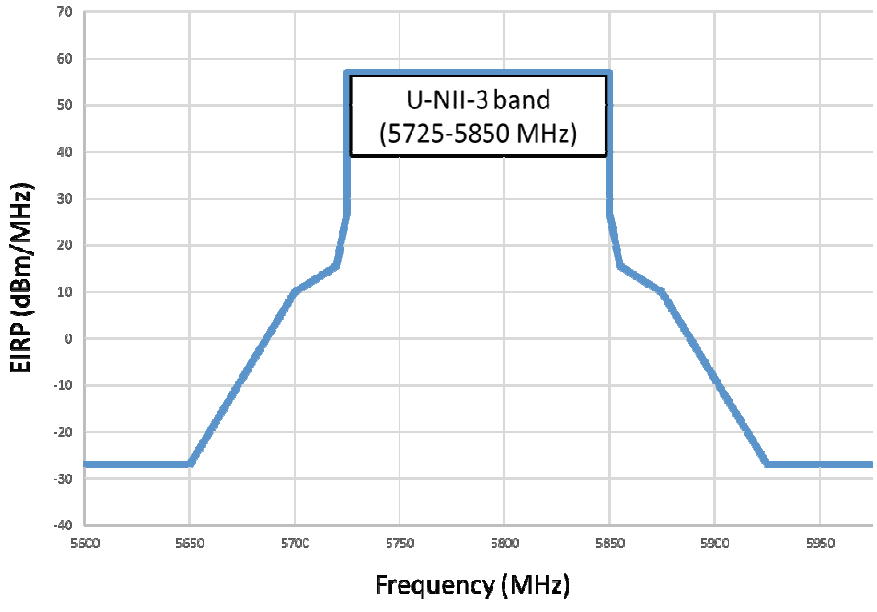
6.2.2. Limit for non-restricted frequency above 1 GHz

| Frequency Band (MHz) | E.I.R.P. Limit | Field Strength Limit at 3 m |
|---|---|---|
| 5150 to 5250 | -27 dBm | 68.2 |
| 5250 to 5350 | | 68.2 |
| 5470 to 5725 | | 68.2 |

Note: Field Strength at 3 m= E.I.R.P. + 95.2 dB

| Frequency Band (MHz) | Field Strength Limit at 3 m | |
|---|---|---|
| 5725 to 5850 | ☒ | 15.407(b)(4)(i) All emissions shall be limited to a level of 68.2 dBμV/m at 75 MHz or more above or below the band edge increasing linearly to 105.2dBμV/m 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 110.8 dBμV/m 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 68.2 dBμV/m at the band edge. |
| | ☐ | 15.407(b)(4)(ii) ,compliance with the emission limits in § 15.247(d) Shall be at least 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power,. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)) |



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## 6.3. Test Procedure

**Frequency Range 9kHz~30MHz:**
The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level.
In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

(1) RBW = 9kHz with peak and average detector.
(2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

**Frequency Range 30MHz ~ 40GHz:**
The EUT setup on the turn find table which has 80 cm (for 30-1000 MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

**Frequency below 1 GHz:**
Spectrum Analyzer is used for pre-testing with following setting:
(1)RBW = 120KHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
(7)When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

**Frequency above 1GHz to 10th harmonic (up to 40 GHz):**
**Peak Detector:**
(1)RBW = 1MHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
(7)When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average detector for finally measurement.

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**Average Detector:**

**■Option 1:**

(1)RBW = 1MHz

(2)VBW ≥ 1/ T.

| Modulation Type | T (ms) | 1/ T (kHz) | VBW Setting (kHz) |
|---|---|---|---|
| 802.11a | 2.037 | 0.491 | 10Hz |
| 802.11n-HT20 | 0.9483 | 1.055 | 1kHz |
| 802.11n-HT40 | 0.9450 | 1.058 | 2kHz |
| 802.11ac-VHT80 | 0.0656 | 1.524 | 15kHz |

N/A: 1/ T is not implemented when duty cycle presented in section 3.7 is ≥98 %.

(1)Detector = Peak.

(2)Sweep time = auto.

(3)Trace mode = max hold.

(4)Allow sweeps to continue until the trace stabilizes.

**□Option 2:**

Average Emission Level= Peak Emission Level+ D.C.C.F.

## 6.4. Measurement Result Explanation

■Peak Emission Level=Antenna Factor + Cable Loss + Meter Reading

■Average Emission Level l=Antenna Factor + Cable Loss + Meter Reading

□Average Emission Level= Peak Emission Level+ DCCF

Duty Cycle Correction Factor (DCCF)= 20log ($TX_{on}/TX_{on+off}$) presented in section 3.7

□ERP= Peak Emission Level-95.2dB-2.14dB

## 6.5. Test Results

Please refer to Appendix A.

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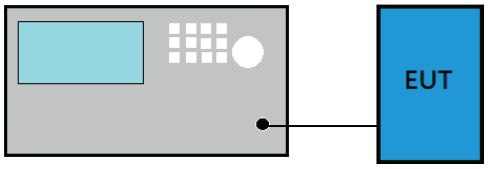
# 7. EMISSION BANDWIDTH

## 7.1. Block Diagram of Test Setup




## 7.2. Specification Limits

| Frequency Band (MHz) | Limit |
|---|---|
| 5150 to 5250 | Reference only |
| 5250 to 5350 | |
| 5470 to 5725 | |
| 5725 to 5850 | ≥ 500kHz |

## 7.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

■ Applicable to all bands except to 5725 MHz- 5850 MHz

(1) Set RBW= 1% of the emission bandwidth
(2) Set VBW > RBW
(3) Detector = Peak
(4) Trace mode = max hold
(5) Setting channel bandwidth function x dB to -26 dB to record the final bandwidth.

■ 5725 MHz- 5850 MHz

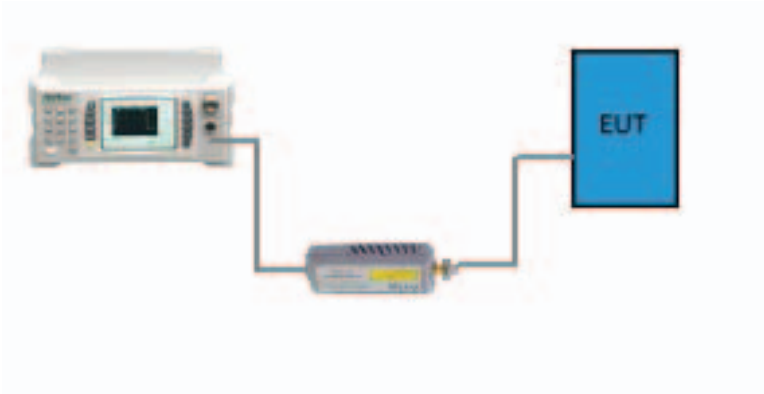
(1) Set RBW = 100 kHz.
(2) Set the video bandwidth (VBW) ≥ 3 × RBW.
(3) Detector = Peak.
(4) Trace mode = max hold.
(5) Sweep = auto couple.
(6) Allow the trace to stabilize.
(7) Setting channel bandwidth function x dB to -6 dB to record the final bandwidth.

## 7.4. Test Results

Please refer to Appendix A

# 8. MAXIMUM OUTPUT POWER

## 8.1. Block Diagram of Test Setup




## 8.2. Specification Limits

| Frequency Band (MHz) | Category | Limit |
|---|---|---|
| 5150 to 5250 | Outdoor Access Point | 1 W(30 dBm)/ Max e.i.r.p. ≤125 mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon |
| | Fixed point-to-point Access Point | 1 W(30 dBm) |
| | Indoor Access Point | 1 W(30 dBm) |
| | Mobile and Portable client device | 250 mW(24 dBm) |
| 5250 to 5350 | N/A | 250 mW or 11 dBm + 10 log B[Note1] |
| 5470 to 5725 | | 250 mW or 11 dBm + 10 log B[Note1] |
| 5725 to 5850 | | 1 W(30 dBm) |

Note 1: B is the 26 dB emission bandwidth, which presented in section 7 and appendix A.1.

## 8.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

■**Method AVGPM (Measurement using an RF average power meter):**

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

□**Method AVGSA-2 (Spectrum channel power)**

(1) Set span to at least 1.5 times the OBW

(2) Set RBW = 1 MHz

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(3) Set the video bandwidth (VBW) ≥ 3 MHz.
(4) Detector = RMS.
(5) Trace mode = trace average at least 100 traces
(6) Sweep = auto couple.
(7) 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.
(8) Duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

## 8.4. Test Results

Please refer to Appendix A

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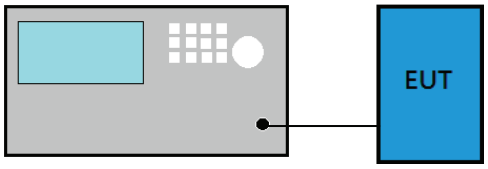
# 9. EMISSION LIMITATIONS MEASUREMENT

## 9.1. Block Diagram of Test Setup




## 9.2. Specification Limits

| Frequency Band (MHz) | E.I.R.P. Limit |
|---|---|
| 5150 to 5250 | -27 dBm |
| 5250 to 5350 | |
| 5470 to 5725 | |

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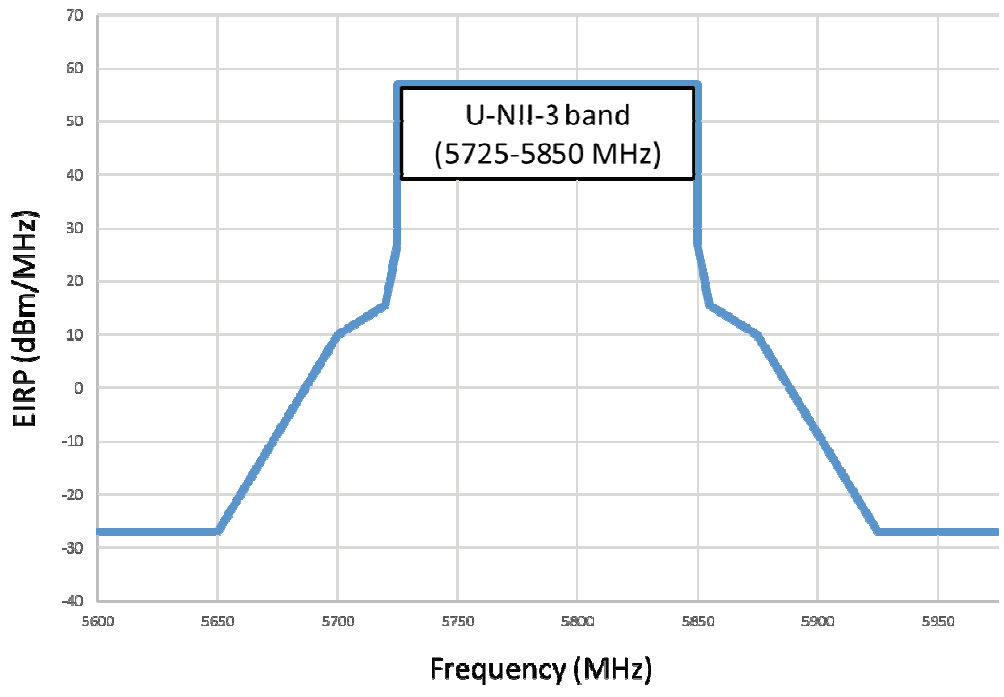
| Frequency Band (MHz) | E.I.R.P. Limit | |
|---|---|---|
| 5725 to 5850 | ☒ | 15.407(b)(4)(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below 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. |
| | ☐ | 15.407(b)(4)(ii) ,compliance with the emission limits in § 15.247(d) Shall be at least 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power,. Attenuation below the general limits specified in §15.209(a) is not required. In addition,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) (see §15.205(c)) |



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## 9.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

(1) RBW = 1 MHz
(2) VBW ≥ 3 x RBW
(3) Detector = Peak
(4) Sweep time = auto
(5) Trace mode = max hold
(6) Allow sweeps to continue until the trace stabilizes.

## 9.4. Test Results

Please refer to Appendix A

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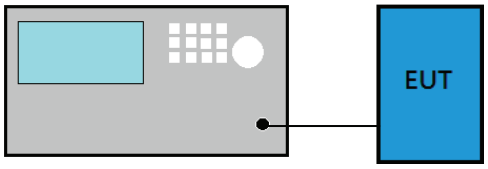
# 10. POWER SPECTRAL DENSITY

## 10.1. Block Diagram of Test Setup




## 10.2. Specification Limits

| Frequency Band (MHz) | Category | Limit |
|---|---|---|
| 5150 to 5250 | Outdoor Access Point | 17dBm |
| | Fixed point-to-point Access Point | |
| | Indoor Access Point | |
| | Mobile and Portable client device | 11 dBm/MHz |
| 5250 to 5350 | N/A | 11 dBm/MHz |
| 5470 to 5725 | | 11 dBm/MHz |
| 5725 to 5850 | | 30dBm/500 kHz |

## 10.3. Test Procedure

Following measurement procedure is reference to KDB 789033 D02 General UNII Test Procedures New Rules v01r04:

**■Method AVGSA-2 (Spectrum channel power)**

(1) Set span to at least 1.5 times the OBW
(2) Set RBW = 1 MHz
(3) Set the video bandwidth (VBW) ≥ 3 MHz.
(4) Detector = RMS.
(5) Trace mode = trace average at least 100 traces
(6) Sweep = auto couple.
(7) Use peak search function to find out the maximum power density.
(8) Duty cycle factor is added when duty cycle presented in section 3.7 is < 98%.

## 10.4. Test Results

Please refer to Appendix A

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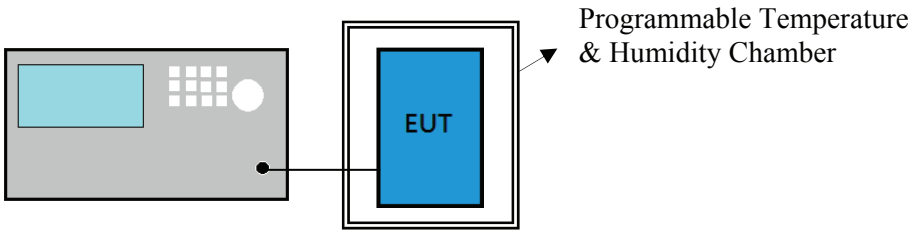
# 11. FREQUENCY STABILITY

## 11.1. Block Diagram of Test Setup




## 11.2. Specification Limits

NONE

## 11.3. Test Procedure

(1) Frequency: Test frequency.
(2) Span: enough to cover the complete power envelope
(3) RBW: 1MHz(modulation ON) ; 10KHz(CW)
(4) VBW: 1MHz(modulation ON) ; 10KHz(CW)
(5) Detector Mode: Positive Peak
(6) Indication mode: Max hold
(7) Find the peak frequency and take calculate by the formula:
(Measurement Value-declaration frequency)/ declaration frequency)

## 11.4. Test Results

Please refer to Appendix A

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# 12. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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# APPDNDIX A

## TEST DATA AND PLOTS

(Model: 15Z980)

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# APPDNDIX B

## TEST PHOTOGRAPHS

(Model: 15Z980)