

## FCC Test Report

**Report No.:** RF181219C02D

**FCC ID:** 2ANBG-OR100

**Regulatory Model:** APOR100

**Marketing Model:** APOR100-B18, APOR100-X00, APOR100-C23, APOR100-C18

**Received Date:** Dec. 20, 2018

**Test Date:** Jan. 29, 2019 (For Conducted power)

Jun. 03, 2020 (For AC Power Conducted Emission and Radiated Emissions below 1GHz)

**Issued Date:** Jun. 08, 2020

**Applicant:** KeyWest Networks, Inc.

**Address:** 3033 Oliver Dr, San Jose, CA - 95135 USA

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch  
Lin Kou Laboratories

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

**Test Location:** No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City  
33383, TAIWAN

**FCC Registration /** 788550 / **TW0003**  
**Designation Number:**



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### Release Control Record

| Issue No.    | Description      | Date Issued   |
|--------------|------------------|---------------|
| RF181219C02D | Original release | Jun. 08, 2020 |

## 1 Certificate of Conformity

**Product:** Outdoor Wireless Radios

**Brand:** KeyWest Radios

**Regulatory Model:** APOR100

**Marketing Model:** APOR100-B18, APOR100-X00, APOR100-C23, APOR100-C18

**Sample Status:** Engineering sample

**Applicant:** KeyWest Networks, Inc.

**Test Date:** Jan. 29, 2019 (For Conducted power)

Jun. 03, 2020 (For AC Power Conducted Emission and Radiated Emissions below 1GHz)

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

ANSI C63.10:2013

This report is issued as a supplementary report of RF181219C02. This report shall be used combined together with its original report.

**Prepared by :** Celine Chou, **Date:** Jun. 08, 2020  
Celine Chou / Senior Specialist

**Approved by :** Bruce Chen, **Date:** Jun. 08, 2020  
Bruce Chen / Senior Project Engineer

Note: Radiated emission below 1GHz and conducted emission are performed for the addendum. Refer to original report for the other test data.

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247) |  |        |   |
|--|--|--------|---|
| FCC Clause                                     | Test Item                                    | Result | Remarks   |
| 15.207   | AC Power Conducted Emission                  | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -13.02dB at 0.39400MHz. |
| 15.205 /<br>15.209 /<br>15.247(d)              | Radiated Emissions and Band Edge Measurement | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -1.8dB at 56.71MHz.     |
| 15.247(d)                                      | Antenna Port Emission                        | N/A    | Refer to Note 1   |
| 15.247(a)(2)                                   | 6dB bandwidth                                | N/A    | Refer to Note 1   |
| 15.247(b)                                      | Conducted power                              | Pass   | Refer to Note 2   |
| 15.247(e)                                      | Power Spectral Density                       | N/A    | Refer to Note 1   |
| 15.203   | Antenna Requirement                          | Pass   | Antenna connector is IPEX not standard connector.                                   |

Note:

1. Radiated emission below 1GHz and conducted emission are performed for the addendum. Refer to original report for the other test data.
2. According to customer requirements, we recorded 2.4GHz conducted power in this report, the test data were copy from the original test report (Report No.: RF181219C02).
3. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

| Measurement                        | Frequency       | Expanded Uncertainty (k=2) (±) |
|------------------------------------|-----------------|--------------------------------|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz  | 2.79 dB                        |
| Radiated Emissions up to 1 GHz     | 9kHz ~ 30MHz    | 3.04 dB                        |
|                                    | 30MHz ~ 200MHz  | 3.86 dB                        |
|                                    | 200MHz ~1000MHz | 3.87 dB                        |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                       |   |
|-----------------------|---|
| Product               | Outdoor Wireless Radios   |
| Brand                 | KeyWest Radios  |
| Regulatory Model      | APOR100   |
| Marketing Model       | APOR100-B18, APOR100-X00, APOR100-C23, APOR100-C18  |
| Model Difference      | Refer to note for more details  |
| Sample Status         | Engineering sample  |
| Power Supply Rating   | 48Vdc (PoE)   |
| Modulation Type       | CCK, DQPSK, DBPSK for DSSS<br>256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM   |
| Modulation Technology | DSSS, OFDM  |
| Transfer Rate         | 802.11b:11/5.5/2/1Mbps<br>802.11g: 54/48/36/24/18/12/9/6Mbps<br>802.11n: up to 200Mbps  |
| Operating Frequency   | 2412 ~ 2462MHz  |
| Number of Channel     | 11 for 802.11b, 802.11g, 802.11n (HT20), 802.11n (VHT20)<br>7 for 802.11n (HT40), 802.11n (VHT40)   |
| Output Power          | 207.014mW   |
| Antenna Type          | PCB antenna with 6dBi gain (Brand: LYNwave Technology Ltd., Model: ALA150-05102C-00) (The Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.) |
| Antenna Connector     | IPEX  |
| Accessory Device      | PoE   |
| Cable Supplied        | NA  |

Note:

1. This report is prepared for FCC class II permissive change. The difference compared with the original report (BV CPS report no.: RF181219C02) are listing as below. Radiated emission below 1GHz and conducted emission are performed for the addendum. Refer to original report for the other test data.
  - Added one PoE.
  - Added two antennas.
  - Software enable 5.25GHz to 5.35GHz and 5.47GHz to 5.725GHz bands.
  - Added 5G Band 1, 4 channels via software changing.

2. All models are listed as below.

| Brand          | Regulatory Model | Marketing Model | Ant. (For 5GHz Band only)   | Remark           |
|----------------|------------------|-----------------|---|------------------|
| KeyWest Radios | APOR100          | APOR100-B18     | 18dBi (MA-WC56-DP17 Ant. with i-pex(MHF) connector) 2x2 V&H Polarized Sector antenna          | For outdoor only |
|                |                  |                 | 17dBi (MT055S17VH/KYU Ant. with MMCX connector) 2x2 V&H Polarized Sector antenna              |                  |
|                |                  | APOR100-X00     | 10dBi (APOR100-X00 Ant. with i-pex(MHF) connector) 2x2 V&H Polarized Omni antenna             | For outdoor only |
|                |                  | APOR100-C23     | 23dBi (MA-WA56-DP23 Ant. with i-pex(MHF) connector) 2x2 V&H Polarized panel antenna           | For P to P only  |
|                |                  |                 | 22.5dBi (MT-465039/CVH/F Ant. with MMCX connector) 2x2 V&H Polarized panel antenna            |                  |
|                |                  | APOR100-C18     | 18dBi (MT-485053-CVH-B_ICD_KW Ant. with i-pex(MHF) connector) 2x2 V&H Polarized panel antenna | For P to P only  |

3. The EUT provides one completed transmitter and one receiver.

| Modulation Mode | TX Function |
|-----------------|-------------|
| 802.11b         | 1TX         |
| 802.11g         | 1TX         |
| 802.11n (HT20)  | 1TX         |
| 802.11n (HT40)  | 1TX         |
| 802.11n (VHT20) | 1TX         |
| 802.11n (VHT40) | 1TX         |

\* The bandwidth and modulation are similar for HT20/HT40 on 802.11n mode and VHT20/VHT40 on 802.11n mode. Therefore the investigated worst case is the representative mode in test report. (Final test mode refer section 3.2.1)

4. The EUT is powered by the following PoE. (The new PoE is PoE 2)

| PoE 1        |                             |
|--------------|-----------------------------|
| Brand        | Powertron Electronics Corp. |
| Model        | POE1024-480T1A050           |
| Input Power  | 100-240Vac, 50-60Hz, 1.0A   |
| Output Power | +48Vdc, 0.50A               |

| PoE 2        |                           |
|--------------|---------------------------|
| Brand        | KEYWEST                   |
| Model        | KW-P1024-48056K           |
| Input Power  | 100-240Vac, 50-60Hz, 1.0A |
| Output Power | +48Vdc, 0.50A             |

### 3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g, 802.11n (HT20) and 802.11n (VHT20):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 1       | 2412MHz   | 7       | 2442MHz   |
| 2       | 2417MHz   | 8       | 2447MHz   |
| 3       | 2422MHz   | 9       | 2452MHz   |
| 4       | 2427MHz   | 10      | 2457MHz   |
| 5       | 2432MHz   | 11      | 2462MHz   |
| 6       | 2437MHz   |         |           |

7 channels are provided for 802.11n (HT40) and 802.11n (VHT40):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 3       | 2422MHz   | 7       | 2442MHz   |
| 4       | 2427MHz   | 8       | 2447MHz   |
| 5       | 2432MHz   | 9       | 2452MHz   |
| 6       | 2437MHz   |         |           |

### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT Configure Mode | Applicable to |     | Description      |
|--------------------|---------------|-----|------------------|
|                    | RE<1G         | PLC |                  |
| -                  | √             | √   | Powered by POE 2 |

Where RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

Note: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.

#### Radiated Emission Test (Below 1GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Mode    | Available Channel | Tested Channel | Modulation Technology | Modulation Type | Data Rate (Mbps) |
|--------------------|---------|-------------------|----------------|-----------------------|-----------------|------------------|
| -                  | 802.11b | 1 to 11           | 6              | DSSS                  | DBPSK           | 1.0              |

#### Power Line Conducted Emission Test:

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

| EUT Configure Mode | Mode    | Available Channel | Tested Channel | Modulation Technology | Modulation Type | Data Rate (Mbps) |
|--------------------|---------|-------------------|----------------|-----------------------|-----------------|------------------|
| -                  | 802.11b | 1 to 11           | 6              | DSSS                  | DBPSK           | 1.0              |

#### Test Condition:

| Applicable to | Environmental Conditions | Input Power  | Tested by |
|---------------|--------------------------|--------------|-----------|
| RE<1G         | 23 deg. C, 66% RH        | 120Vac, 60Hz | Titan Hsu |
| PLC           | 23 deg. C, 66% RH        | 120Vac, 60Hz | Titan Hsu |

### 3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| ID | Product  | Brand  | Model No. | Serial No. | FCC ID           | Remarks |
|----|----------|--------|-----------|------------|------------------|---------|
| A. | Notebook | Lenovo | 80Q7      | PF0KUGU6   | FCC DoC Approved | -       |

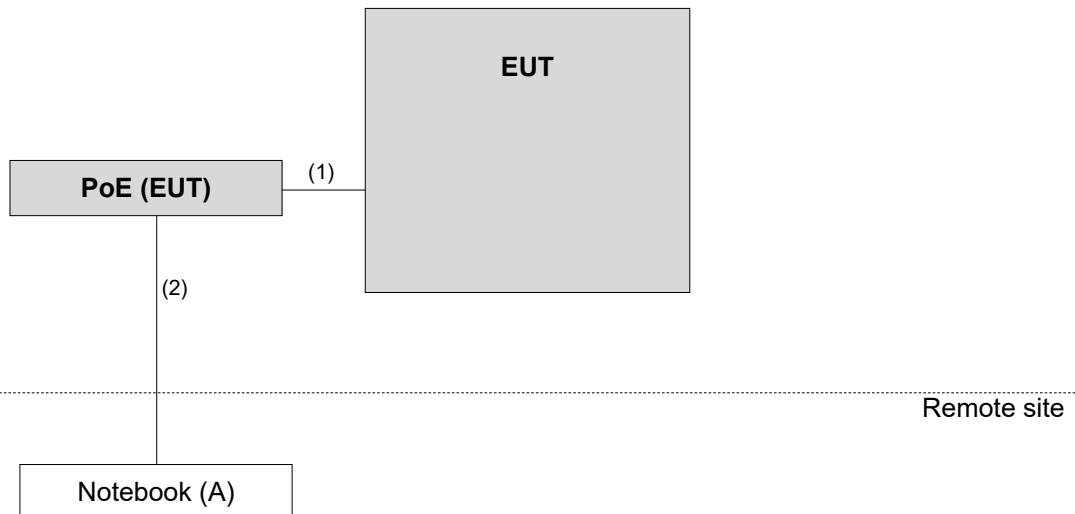
Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item A acted as a communication partner to transfer data.

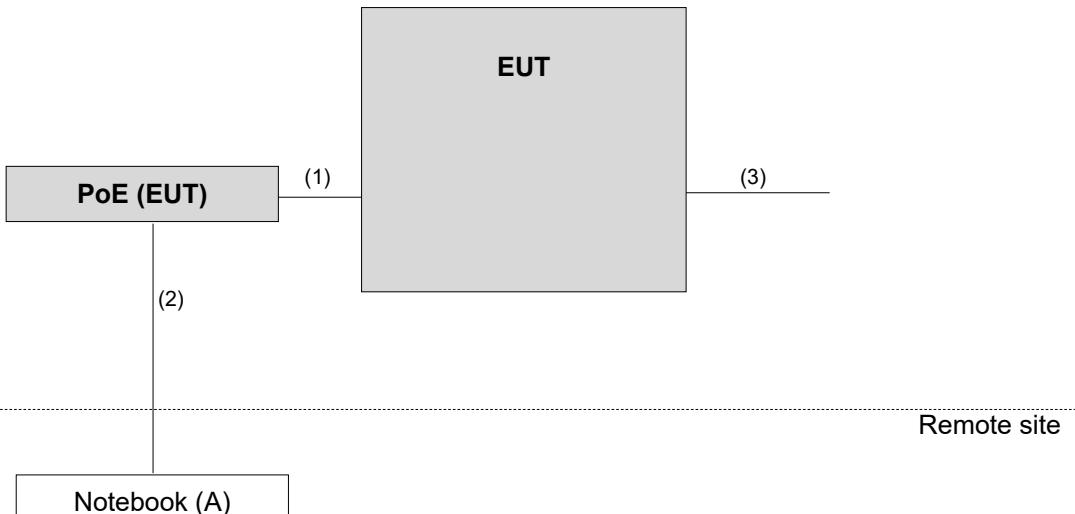
| ID | Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks            |
|----|--------------|------|------------|--------------------|--------------|--------------------|
| 1. | RJ45 Cable   | 1    | 1.5        | N                  | 0            | -                  |
| 2. | RJ45 Cable   | 1    | 6          | N                  | 0            | -                  |
| 3. | Ground Cable | 1    | 1.81       | N                  | 0            | Provided by client |

#### 3.3.1 Configuration of System under Test

For AC Power Conducted Emission



For Radiated Emissions



### 3.4 General Description of Applied Standards and References

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards and references:

**Test standard:**

**FCC Part 15, Subpart C (15.247)**

ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

**References Test Guidance:**

**KDB 558074 D01 15.247 Meas Guidance v05r02**

All test items have been performed as a reference to the above KDB test guidance.

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

#### 4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 30dB below the highest level of the desired power:

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB<sub>UV</sub>/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

#### 4.1.2 Test Instruments

| Description & Manufacturer                | Model No.                             | Serial No.                      | Cal. Date     | Cal. Due      |
|---|---------------------------------------|---------------------------------|---------------|---------------|
| Test Receiver<br>ROHDE & SCHWARZ          | ESR3                                  | 102579                          | Jun. 27, 2019 | Jun. 26, 2020 |
| BILOG Antenna<br>SCHWARZBECK              | VULB9168                              | 9168-171                        | Nov. 11, 2019 | Nov. 10, 2020 |
| HORN Antenna<br>SCHWARZBECK               | 9120D                                 | 209                             | Nov. 24, 2019 | Nov. 23, 2020 |
| HORN Antenna<br>SCHWARZBECK               | BBHA 9170                             | BBHA9170241                     | Nov. 24, 2019 | Nov. 23, 2020 |
| Loop Antenna<br>TESEQ                     | HLA 6121                              | 45745                           | Jul. 01, 2019 | Jun. 30, 2020 |
| Preamplifier<br>Agilent<br>(Below 1GHz)   | 8447D                                 | 2944A10738                      | Aug. 20, 2019 | Aug. 19, 2020 |
| Preamplifier<br>Agilent<br>(Above 1GHz)   | 8449B                                 | 3008A02367                      | Feb. 18, 2020 | Feb. 17, 2021 |
| RF Coaxial Cable<br>WOKEN<br>With 5dB PAD | 8D-FB                                 | Cable-CH3-01                    | Aug. 20, 2019 | Aug. 19, 2020 |
| RF signal cable<br>HUBER+SUHNER           | SUCOFLEX 104                          | Cable-CH3-03<br>(223653/4)      | Aug. 20, 2019 | Aug. 19, 2020 |
| RF signal cable<br>HUBER+SUHNER&<br>EMCI  | SUCOFLEX<br>104&EMC104-SM-S<br>M-8000 | Cable-CH3-03<br>(309224+170907) | Aug. 20, 2019 | Aug. 19, 2020 |
| Software<br>BV ADT                        | ADT_Radiated_<br>V7.6.15.9.5          | NA                              | NA            | NA            |
| Antenna Tower<br>inn-co GmbH              | MA 4000                               | 013303                          | NA            | NA            |
| Antenna Tower Controller<br>BV ADT        | AT100                                 | AT93021702                      | NA            | NA            |
| Turn Table<br>BV ADT                      | TT100                                 | TT93021702                      | NA            | NA            |
| Turn Table Controller<br>BV ADT           | SC100                                 | SC93021702                      | NA            | NA            |
| Boresight Antenna Fixture                 | FBA-01                                | FBA-SIP01                       | NA            | NA            |

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.  
 2. The test was performed in HwaYa Chamber 3.

#### 4.1.3 Test Procedures

##### For Radiated emission below 30MHz

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

Note:

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

##### For Radiated emission above 30MHz

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

Note:

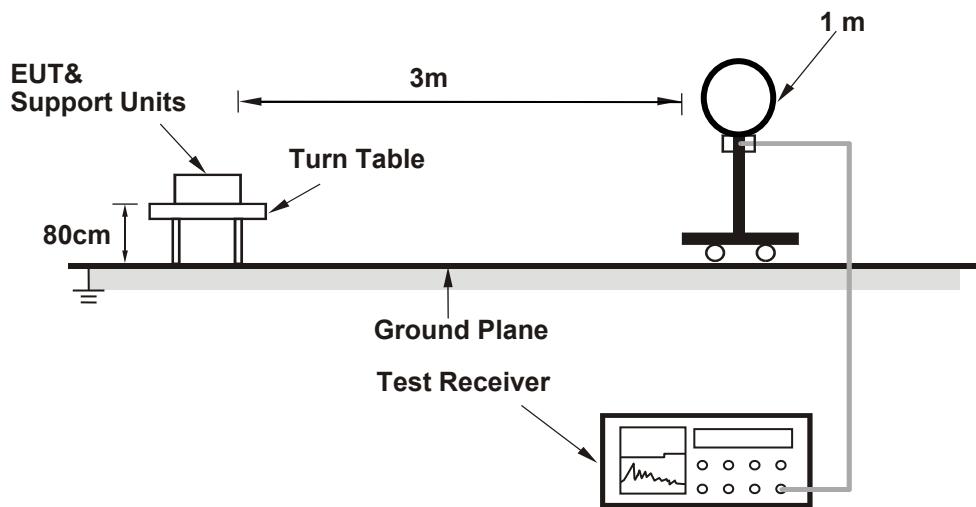
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

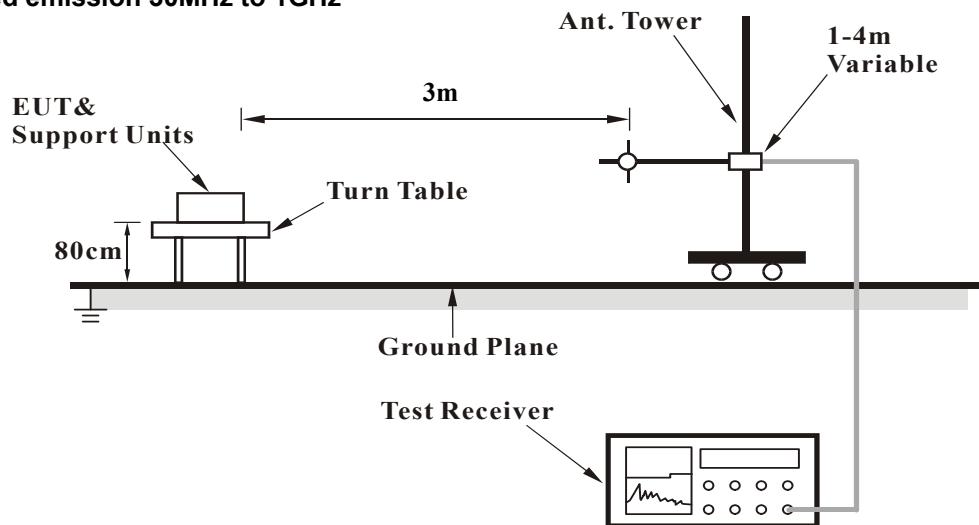
No deviation.

#### 4.1.5 Test Setup

##### For Radiated emission below 30MHz



##### For Radiated emission 30MHz to 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.6 EUT Operating Conditions

- Placed the EUT on the testing table.
- Prepared a notebook to act as a communication partner and placed it outside of testing area.
- The communication partner connected with EUT via a RJ45 cable and ran a test program (provided by manufacturer) to enable EUT under transmission condition continuously at specific channel frequency.
- The communication partner sent data to EUT by command "PING".

#### 4.1.7 Test Results

Below 1GHz worst-case data:

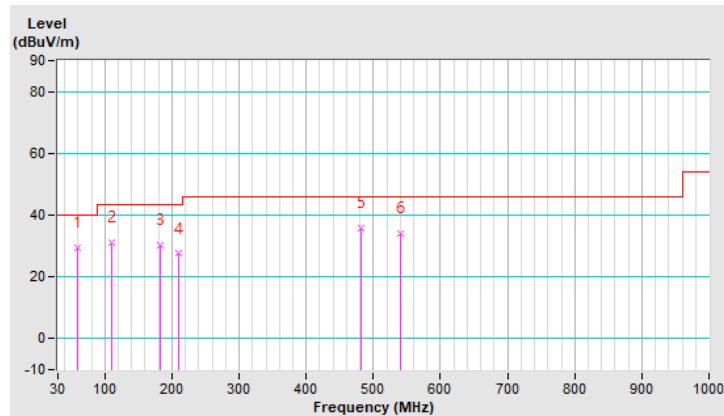
802.11b

|                 |              |                   |                 |
|-----------------|--------------|-------------------|-----------------|
| CHANNEL         | TX Channel 6 | DETECTOR FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | 9kHz ~ 1GHz  |                   |                 |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M |             |                         |                |             |                    |                      |                  |                          |
|---|-------------|-------------------------|----------------|-------------|--------------------|----------------------|------------------|--------------------------|
| NO.   | FREQ. (MHz) | EMISSION LEVEL (dBuV/m) | LIMIT (dBuV/m) | MARGIN (dB) | ANTENNA HEIGHT (m) | TABLE ANGLE (Degree) | RAW VALUE (dBuV) | CORRECTION FACTOR (dB/m) |
| 1   | 59.52       | 29.6 QP                 | 40.0           | -10.4       | 1.00 H             | 61                   | 38.8             | -9.2                     |
| 2   | 110.13      | 30.9 QP                 | 43.5           | -12.6       | 1.00 H             | 233                  | 42.7             | -11.8                    |
| 3   | 183.23      | 30.1 QP                 | 43.5           | -13.4       | 1.50 H             | 104                  | 40.3             | -10.2                    |
| 4   | 209.94      | 27.5 QP                 | 43.5           | -16.0       | 1.50 H             | 232                  | 39.0             | -11.5                    |
| 5   | 482.67      | 35.8 QP                 | 46.0           | -10.2       | 2.00 H             | 150                  | 37.7             | -1.9                     |
| 6   | 540.30      | 34.2 QP                 | 46.0           | -11.8       | 1.50 H             | 175                  | 34.9             | -0.7                     |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

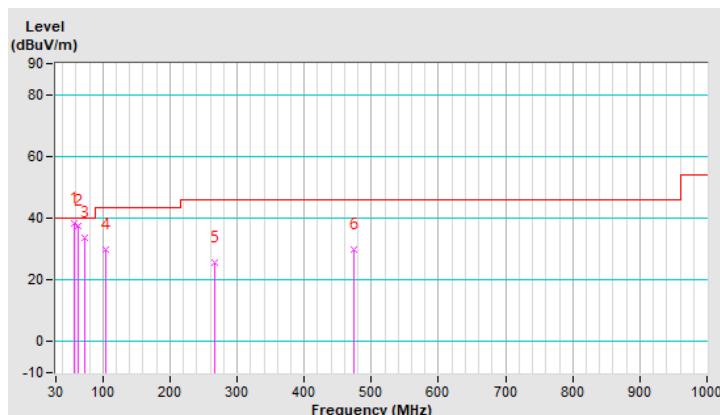


|                 |              |                      |                 |
|-----------------|--------------|----------------------|-----------------|
| CHANNEL         | TX Channel 6 | DETECTOR<br>FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | 9kHz ~ 1GHz  |                      |                 |

| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M |              |                               |                   |             |                       |                            |                     |                                |
|---|--------------|-------------------------------|-------------------|-------------|-----------------------|----------------------------|---------------------|--------------------------------|
| NO.   | FREQ. (MHz)  | EMISSION<br>LEVEL<br>(dBuV/m) | LIMIT<br>(dBuV/m) | MARGIN (dB) | ANTENNA<br>HEIGHT (m) | TABLE<br>ANGLE<br>(Degree) | RAW VALUE<br>(dBuV) | CORRECTION<br>FACTOR<br>(dB/m) |
| 1   | <b>56.71</b> | <b>38.2 QP</b>                | <b>40.0</b>       | <b>-1.8</b> | <b>1.00 V</b>         | <b>328</b>                 | <b>47.3</b>         | <b>-9.1</b>                    |
| 2   | 63.74        | 37.5 QP                       | 40.0              | -2.5        | 1.00 V                | 288                        | 47.0                | -9.5                           |
| 3   | 73.58        | 33.5 QP                       | 40.0              | -6.5        | 1.50 V                | 162                        | 45.2                | -11.7                          |
| 4   | 104.51       | 29.9 QP                       | 43.5              | -13.6       | 2.00 V                | 73                         | 42.3                | -12.4                          |
| 5   | 267.58       | 25.4 QP                       | 46.0              | -20.6       | 1.50 V                | 150                        | 34.0                | -8.6                           |
| 6   | 474.23       | 29.8 QP                       | 46.0              | -16.2       | 1.00 V                | 159                        | 31.8                | -2.0                           |

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m).
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz.
4. Margin value = Emission Level – Limit value.
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



## 4.2 Conducted Emission Measurement

### 4.2.1 Limits of Conducted Emission Measurement

| Frequency (MHz) | Conducted Limit (dBuV) |         |
|-----------------|------------------------|---------|
|                 | Quasi-peak             | Average |
| 0.15 - 0.5      | 66 - 56                | 56 - 46 |
| 0.50 - 5.0      | 56                     | 46      |
| 5.0 - 30.0      | 60                     | 50      |

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 4.2.2 Test Instruments

| Description & Manufacturer              | Model No.                | Serial No.     | Cal. Date     | Cal. Due      |
|---|--------------------------|----------------|---------------|---------------|
| Test Receiver<br>ROHDE & SCHWARZ        | ESCI                     | 100613         | Dec. 11, 2019 | Dec. 10, 2020 |
| RF signal cable<br>Woken                | 5D-FB                    | Cable-cond1-01 | Sep. 05, 2019 | Sep. 04, 2020 |
| LISN<br>ROHDE & SCHWARZ<br>(EUT)        | ENV216                   | 101826         | Feb. 20, 2020 | Feb. 19, 2021 |
| LISN<br>ROHDE & SCHWARZ<br>(Peripheral) | ESH3-Z5                  | 100311         | Aug. 22, 2019 | Aug. 21, 2020 |
| Software<br>ADT                         | BV ADT_Cond_<br>V7.3.7.4 | NA             | NA            | NA            |

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.  
 2. The test was performed in HwaYa Shielded Room 1.  
 3. The VCCI Site Registration No. is C-12040.

#### 4.2.3 Test Procedures

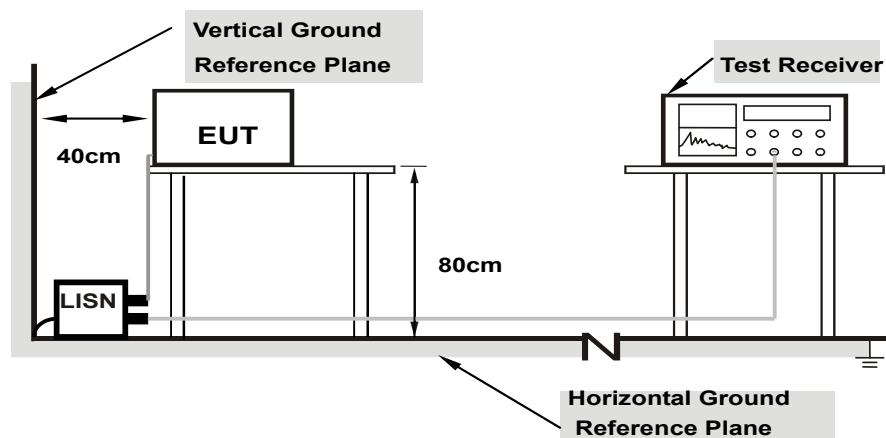
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

#### 4.2.4 Deviation from Test Standard

No deviation.

#### 4.2.5 Test Setup



Note: 1. Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.2.6 EUT Operating Conditions

Same as 4.1.6.

#### 4.2.7 Test Results

Worst-case data:

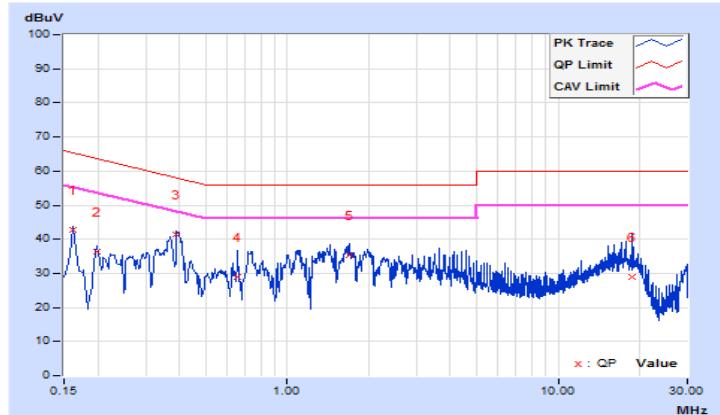
802.11b

| Phase |  | Line (L) |  | Detector Function |  | Quasi-Peak (QP) / Average (AV) |  |
|-------|--|----------|--|-------------------|--|--------------------------------|--|
|-------|--|----------|--|-------------------|--|--------------------------------|--|

| No | Freq.<br>[MHz] | Corr.<br>Factor<br>(dB) | Reading Value |       | Emission Level |       | Limit     |       | Margin |        |
|----|----------------|-------------------------|---------------|-------|----------------|-------|-----------|-------|--------|--------|
|    |                |                         | [dB (uV)]     |       | [dB (uV)]      |       | [dB (uV)] |       | (dB)   |        |
|    |                |                         | Q.P.          | AV.   | Q.P.           | AV.   | Q.P.      | AV.   | Q.P.   | AV.    |
| 1  | 0.16200        | 9.63                    | 33.11         | 22.76 | 42.74          | 32.39 | 65.36     | 55.36 | -22.62 | -22.97 |
| 2  | 0.19780        | 9.62                    | 26.64         | 19.02 | 36.26          | 28.64 | 63.70     | 53.70 | -27.44 | -25.06 |
| 3  | 0.39000        | 9.65                    | 31.83         | 22.85 | 41.48          | 32.50 | 58.06     | 48.06 | -16.58 | -15.56 |
| 4  | 0.65800        | 9.66                    | 19.24         | 8.63  | 28.90          | 18.29 | 56.00     | 46.00 | -27.10 | -27.71 |
| 5  | 1.69800        | 9.71                    | 25.59         | 17.30 | 35.30          | 27.01 | 56.00     | 46.00 | -20.70 | -18.99 |
| 6  | 18.86200       | 9.91                    | 18.88         | 13.08 | 28.79          | 22.99 | 60.00     | 50.00 | -31.21 | -27.01 |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

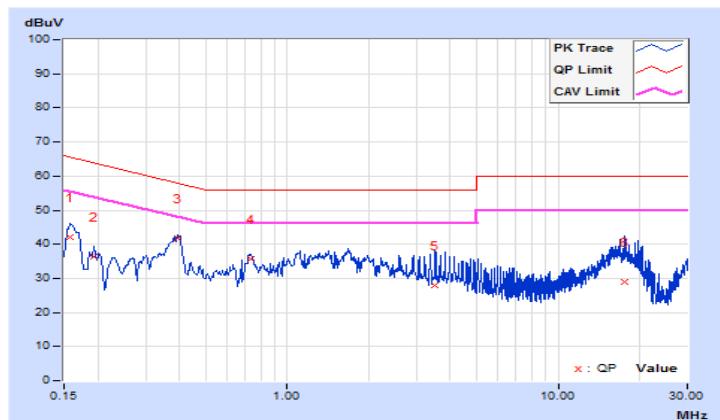


| Phase | Neutral (N) |  | Detector Function |  | Quasi-Peak (QP) / Average (AV) |  |
|-------|-------------|--|-------------------|--|--------------------------------|--|
|-------|-------------|--|-------------------|--|--------------------------------|--|

| No       | Freq.          | Corr. Factor | Reading Value |              | Emission Level |              | Limit        |              | Margin        |               |
|----------|----------------|--------------|---------------|--------------|----------------|--------------|--------------|--------------|---------------|---------------|
|          |                |              | [dB (uV)]     |              | [dB (uV)]      |              | [dB (uV)]    |              | (dB)          |               |
|          |                |              | [MHz]         | (dB)         | Q.P.           | AV.          | Q.P.         | AV.          | Q.P.          | AV.           |
| 1        | 0.15800        | 9.66         | 32.44         | 17.86        | 42.10          | 27.52        | 65.57        | 55.57        | -23.47        | -28.05        |
| 2        | 0.19400        | 9.64         | 26.56         | 17.23        | 36.20          | 26.87        | 63.86        | 53.86        | -27.66        | -26.99        |
| <b>3</b> | <b>0.39400</b> | <b>9.67</b>  | <b>32.13</b>  | <b>25.29</b> | <b>41.80</b>   | <b>34.96</b> | <b>57.98</b> | <b>47.98</b> | <b>-16.18</b> | <b>-13.02</b> |
| 4        | 0.73000        | 9.69         | 25.90         | 18.30        | 35.59          | 27.99        | 56.00        | 46.00        | -20.41        | -18.01        |
| 5        | 3.51800        | 9.81         | 18.29         | 12.50        | 28.10          | 22.31        | 56.00        | 46.00        | -27.90        | -23.69        |
| 6        | 17.58200       | 10.01        | 18.87         | 12.76        | 28.88          | 22.77        | 60.00        | 50.00        | -31.12        | -27.23        |

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.



### 4.3 Conducted Output Power Measurement

#### 4.3.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

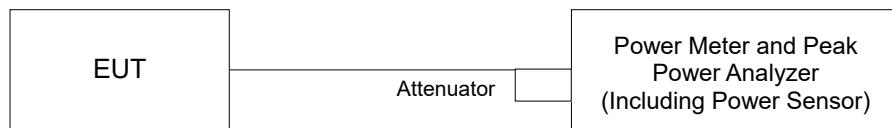
Array Gain = 0 dB (i.e., no array gain) for  $N_{ANT} \leq 4$ ;

Array Gain = 0 dB (i.e., no array gain) for channel widths  $\geq 40$  MHz for any  $N_{ANT}$ ;

Array Gain =  $5 \log(N_{ANT}/N_{SS})$  dB or 3 dB, whichever is less for 20-MHz channel widths with  $N_{ANT} \geq 5$ .

For power measurements on all other devices: Array Gain =  $10 \log(N_{ANT}/N_{SS})$  dB.

#### 4.3.2 Test Setup



#### 4.3.3 Test Instruments

| Description & Manufacturer            | Model No. | Serial No.                                  | Cal. Date     | Cal. Due      |
|---------------------------------------|-----------|---|---------------|---------------|
| USB Wideband Power Sensor<br>KEYSIGHT | U2021XA   | MY55050005/MY55190004/MY55190007/MY55210005 | Jul. 17, 2018 | Jul. 16, 2019 |

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

#### 4.3.4 Test Procedures

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

#### 4.3.5 Deviation from Test Standard

No deviation.

#### 4.3.6 EUT Operating Conditions

Same as item 4.3.6.

#### 4.3.7 Test Results

##### 802.11b

| Channel | Frequency (MHz) | Average Power (mW) | Average Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|--------------------|---------------------|-------------|-------------|
| 1       | 2412            | 28.054             | 14.48               | 30          | Pass        |
| 6       | 2437            | 27.353             | 14.37               | 30          | Pass        |
| 11      | 2462            | 56.624             | 17.53               | 30          | Pass        |

##### 802.11g

| Channel | Frequency (MHz) | Average Power (mW) | Average Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|--------------------|---------------------|-------------|-------------|
| 1       | 2412            | 119.399            | 20.77               | 30          | Pass        |
| 6       | 2437            | 196.789            | 22.94               | 30          | Pass        |
| 11      | 2462            | 143.880            | 21.58               | 30          | Pass        |

##### 802.11n (HT20)

| Channel | Frequency (MHz) | Average Power (mW) | Average Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|--------------------|---------------------|-------------|-------------|
| 1       | 2412            | 108.143            | 20.34               | 30          | Pass        |
| 6       | 2437            | 203.236            | 23.08               | 30          | Pass        |
| 11      | 2462            | 141.906            | 21.52               | 30          | Pass        |

##### 802.11n (HT40)

| Channel | Frequency (MHz) | Average Power (mW) | Average Power (dBm) | Limit (dBm) | Pass / Fail |
|---------|-----------------|--------------------|---------------------|-------------|-------------|
| 3       | 2422            | 74.302             | 18.71               | 30          | Pass        |
| 6       | 2437            | <b>207.014</b>     | 23.16               | 30          | Pass        |
| 9       | 2452            | 103.276            | 20.14               | 30          | Pass        |

## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

## Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

### **Lin Kou EMC/RF Lab**

Tel: 886-2-26052180

Fax: 886-2-26051924

### **Hsin Chu EMC/RF/Telecom Lab**

Tel: 886-3-6668565

Fax: 886-3-6668323

### **Hwa Ya EMC/RF/Safety Lab**

Tel: 886-3-3183232

Fax: 886-3-3270892

**Email:** [service.adt@tw.bureauveritas.com](mailto:service.adt@tw.bureauveritas.com)

**Web Site:** [www.bureauveritas-adt.com](http://www.bureauveritas-adt.com)

The address and road map of all our labs can be found in our web site also.

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