

## FCC Test Report (Co-Located)

**Report No.:** RF180330C21A-2

**FCC ID:** YOR-MR2200AC

**Test Model:** MR2200ac

**Received Date:** Mar. 30, 2018

**Test Date:** Jun. 27 ~ Jun. 28, 2018

**Issued Date:** Jun. 29, 2018

**Applicant:** Synology Incorporated

**Address:** 3F-3, No. 106, Chang An W. Rd., Taipei Taiwan 103

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

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

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

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



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.

## Table of Contents

|                                                            |           |
|------------------------------------------------------------|-----------|
| <b>Release Control Record</b>                              | <b>3</b>  |
| <b>1 Certificate of Conformity</b>                         | <b>4</b>  |
| <b>2 Summary of Test Results</b>                           | <b>5</b>  |
| 2.1 Measurement Uncertainty                                | 5         |
| 2.2 Modification Record                                    | 5         |
| <b>3 General Information</b>                               | <b>6</b>  |
| 3.1 General Description of EUT                             | 6         |
| 3.2 Description of Test Modes                              | 9         |
| 3.2.1 Test Mode Applicability and Tested Channel Detail    | 11        |
| 3.3 Description of Support Units                           | 13        |
| 3.3.1 Configuration of System under Test                   | 13        |
| 3.4 General Description of Applied Standards               | 13        |
| <b>4 Test Types and Results</b>                            | <b>14</b> |
| 4.1 Radiated Emission and Bandedge Measurement             | 14        |
| 4.1.1 Limits of Radiated Emission and Bandedge Measurement | 14        |
| 4.1.2 Test Instruments                                     | 15        |
| 4.1.3 Test Procedures                                      | 16        |
| 4.1.4 Deviation from Test Standard                         | 16        |
| 4.1.5 Test Setup                                           | 17        |
| 4.1.6 EUT Operating Conditions                             | 18        |
| 4.1.7 Test Results                                         | 19        |
| 4.2 Conducted Emission Measurement                         | 23        |
| 4.2.1 Limits of Conducted Emission Measurement             | 23        |
| 4.2.2 Test Instruments                                     | 23        |
| 4.2.3 Test Procedures                                      | 24        |
| 4.2.4 Deviation from Test Standard                         | 24        |
| 4.2.5 Test Setup                                           | 24        |
| 4.2.6 EUT Operating Conditions                             | 24        |
| 4.2.7 Test Results                                         | 25        |
| <b>5 Pictures of Test Arrangements</b>                     | <b>29</b> |
| <b>Appendix – Information on the Testing Laboratories</b>  | <b>30</b> |

### Release Control Record

| Issue No.      | Description      | Date Issued   |
|----------------|------------------|---------------|
| RF180330C21A-2 | Original release | Jun. 29, 2018 |

## 1 Certificate of Conformity

**Product:** 802.11ac Wireless Router

**Brand:** Synology

**Test Model:** MR2200ac

**Sample Status:** Engineering sample

**Applicant:** Synology Incorporated

**Test Date:** Jun. 27 ~ Jun. 28, 2018

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)  
47 CFR FCC Part 15, Subpart E (Section 15.407)  
ANSI C63.10-2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

**Prepared by :** Celine Chou , **Date:** Jun. 29, 2018  
Celine Chou / Specialist

**Approved by :** Bruce Chen , **Date:** Jun. 29, 2018  
Bruce Chen / Project Engineer

## 2 Summary of Test Results

| Applied Standard:                                                | 47 CFR FCC Part 15, Subpart C (Section 15.247)<br>47 CFR FCC Part 15, Subpart E (Section 15.407) |        |                                                                                     |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------|-------------------------------------------------------------------------------------|
| FCC Clause                                                       | Test Item                                                                                        | Result | Remarks                                                                             |
| 15.207<br>15.407(b)(6)                                           | AC Power Conducted Emission                                                                      | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -12.21dB at 0.31422MHz. |
| 15.205 / 15.209 /<br>15.247(d)<br>15.407(b)<br>(1/2/3/4(i/ii)/6) | Radiated Emissions                                                                               | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -0.3dB at 10600.00MHz.  |

### 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) ( $\pm$ ) |
|------------------------------------|------------------|--------------------------------------|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz   | 2.94 dB                              |
| Radiated Emissions up to 1 GHz     | 30MHz ~ 200MHz   | 3.59 dB                              |
|                                    | 200MHz ~ 1000MHz | 3.60 dB                              |
| Radiated Emissions above 1 GHz     | 1GHz ~ 18GHz     | 2.29 dB                              |
|                                    | 18GHz ~ 40GHz    | 2.29 dB                              |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product             | 802.11ac Wireless Router                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Brand               | Synology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Test Model          | MR2200ac                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Status of EUT       | Engineering sample                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Power Supply Rating | 12Vdc (Adapter)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Modulation Type     | CCK, DQPSK, DBPSK for DSSS<br>256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Transfer Rate       | 802.11b: 11/5.5/2/1Mbps<br>802.11a/g: 54/48/36/24/18/12/9/6Mbps<br>802.11n: up to 400Mbps (For 2.4GHz)<br>802.11n: up to 300Mbps (For 5GHz)<br>802.11ac: up to 867Mbps                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Operating Frequency | 2.4GHz: 2412 ~ 2462MHz<br>5.0GHz: 5180 ~ 5240MHz, 5260 ~ 5320MHz, 5500 ~ 5700MHz,<br>5745 ~ 5825MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Number of Channel   | 2412 ~ 2462MHz:<br>802.11b, 802.11g, 802.11n (HT20): 11<br>802.11n (HT40): 7<br>5180 ~ 5240MHz:<br>802.11a, 802.11n (HT20), 802.11ac (VHT20): 4<br>802.11n (HT40), 802.11ac (VHT40): 2<br>802.11ac (VHT80): 1<br>5260 ~ 5320MHz:<br>802.11a, 802.11n (HT20), 802.11ac (VHT20): 4<br>802.11n (HT40), 802.11ac (VHT40): 2<br>802.11ac (VHT80): 1<br>5500 ~ 5700MHz:<br>802.11a, 802.11n (HT20), 802.11ac (VHT20): 11<br>802.11n (HT40), 802.11ac (VHT40): 2<br>802.11ac (VHT80): 2<br>5745 ~ 5825MHz:<br>802.11a, 802.11n (HT20), 802.11ac (VHT20): 5<br>802.11n (HT40), 802.11ac (VHT40): 2<br>802.11ac (VHT80): 1 |

|                   |                                                                                                                                                                                                                                                                                                                                  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Power      | CDD Mode:<br>2412 ~ 2462MHz: 505.398mW<br>5180 ~ 5240MHz: 321.764mW<br>5260 ~ 5320MHz: 227.458mW<br>5500 ~ 5700MHz: 236.600mW<br>5745 ~ 5825MHz: 343.504mW<br>Beamforming Mode:<br>2412 ~ 2462MHz: 102.224mW<br>5180 ~ 5240MHz: 160.893mW<br>5260 ~ 5320MHz: 113.737mW<br>5500 ~ 5700MHz: 118.309mW<br>5745 ~ 5825MHz: 171.764mW |
| Antenna Type      | Refer to note                                                                                                                                                                                                                                                                                                                    |
| Antenna Connector | Refer to note                                                                                                                                                                                                                                                                                                                    |
| Accessory Device  | Adapter                                                                                                                                                                                                                                                                                                                          |
| Cable Supplied    | 1m non-shielded LAN cable without core                                                                                                                                                                                                                                                                                           |

Note:

1. This report is prepared for FCC class II permissive change. The difference compared with the original report (BV CPS report no.: RF180330C21-2) is adding 5.26GHz to 5.32GHz and 5.50GHz to 5.70GHz by software.
2. The EUT incorporates a MIMO function. Physically, the EUT provides 2 completed transmitters and 2 receivers.

| Band   | Modulation Mode  | Beamforming Mode | TX Function |
|--------|------------------|------------------|-------------|
| 2.4GHz | 802.11b          | Not Support      | 2TX         |
|        | 802.11g          | Not Support      | 2TX         |
|        | 802.11n (HT20)   | Support          | 2TX         |
|        | 802.11n (HT40)   | Support          | 2TX         |
| 5GHz   | 802.11a          | Not Support      | 2TX         |
|        | 802.11n (HT20)   | Support          | 2TX         |
|        | 802.11n (HT40)   | Support          | 2TX         |
|        | 802.11ac (VHT20) | Support          | 2TX         |
|        | 802.11ac (VHT40) | Support          | 2TX         |
|        | 802.11ac (VHT80) | Support          | 2TX         |

\* The modulation and bandwidth are similar for 802.11n mode for 20MHz/40MHz and 802.11ac mode for 20MHz/40MHz, therefore investigated worst case to representative mode in test report. (Final test mode refer section 3.2.1)

3. The following chips are used for the EUT.

| Chip    | Antenna        | Function  | Band              |
|---------|----------------|-----------|-------------------|
| IPQ4019 | Ant. 1, Ant. 2 | WLAN 2.4G | 2.4G              |
|         | Ant. 3, Ant. 4 | WLAN 5G   | U-NII-1/ U-NII-2A |
| QCA9886 | Ant. 5, Ant. 6 | WLAN 5G   | UNII-2C/UNII-3    |

4. The EUT consumes power from the following adapter.

| Adapter    |                                             |
|------------|---------------------------------------------|
| Brand      | Asian Power Devices Inc.                    |
| Model      | WB-24J12FU                                  |
| Input      | 100-240Vac, 50-60Hz, 0.7A Max.              |
| Output     | 12Vdc, 2A                                   |
| Power Line | 1.5m cable without core attached on adapter |

5. The following antennas were provided to the EUT.

| No. | Brand   | Model            | Type     | Connector | Gain (dBi) |      |      |      |      |      |      |      |      |
|-----|---------|------------------|----------|-----------|------------|------|------|------|------|------|------|------|------|
|     |         |                  |          |           | 2400       |      |      | 2450 |      |      | 2500 |      |      |
| 1   | lynwave | ALX17P-051XXE-01 | PIFA     | I-PEX     | 3.70       |      |      | 3.49 |      |      | 3.61 |      |      |
| 2   | lynwave | ALX17P-051XXE-00 | PIFA     | I-PEX     | 3.15       |      |      | 3.78 |      |      | 3.53 |      |      |
| No. | Brand   | Model            | Type     | Connector | Gain (dBi) |      |      |      |      |      |      |      |      |
|     |         |                  |          |           | 5150       | 5250 | 5350 | 5450 | 5550 | 5650 | 5725 | 5775 | 5825 |
| 3   | lynwave | ALX17M-091XX2-00 | Embedded | I-PEX     | 2.22       | 1.75 | 2.15 | -    | -    | -    | -    | -    | -    |
| 4   | lynwave | ALX17M-091XX2-01 | Embedded | I-PEX     | 2.73       | 1.97 | 2.60 | -    | -    | -    | -    | -    | -    |
| 5   | lynwave | ALX17P-091XXB-01 | PIFA     | I-PEX     | -          | -    | -    | 3.08 | 3.87 | 3.49 | 3.75 | 3.44 | 3.27 |
| 6   | lynwave | ALX17P-091XXB-00 | PIFA     | I-PEX     | -          | -    | -    | 2.90 | 3.72 | 3.68 | 3.32 | 3.50 | 3.51 |

### 3.2 Description of Test Modes

#### For 2.4GHz

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

| 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):

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

#### For 5180 ~ 5240MHz:

4 channels are provided for 802.11a, 802.11n (HT20):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 36      | 5180 MHz  | 44      | 5220 MHz  |
| 40      | 5200 MHz  | 48      | 5240 MHz  |

2 channels are provided for 802.11n (HT40):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 38      | 5190 MHz  | 46      | 5230 MHz  |

1 channel is provided for 802.11ac (VHT80):

| Channel | Frequency |
|---------|-----------|
| 42      | 5210MHz   |

#### For 5260 ~ 5320MHz:

4 channels are provided for 802.11a, 802.11n (HT20):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 52      | 5260 MHz  | 60      | 5300 MHz  |
| 56      | 5280 MHz  | 64      | 5320 MHz  |

2 channels are provided for 802.11n (HT40):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 54      | 5270 MHz  | 62      | 5310 MHz  |

1 channel is provided for 802.11ac (VHT80):

| Channel | Frequency |
|---------|-----------|
| 58      | 5290MHz   |

#### For 5500 ~ 5700MHz:

11 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 100     | 5500 MHz  | 124     | 5620 MHz  |
| 104     | 5520 MHz  | 128     | 5640 MHz  |
| 108     | 5540 MHz  | 132     | 5660 MHz  |
| 112     | 5560 MHz  | 136     | 5680 MHz  |
| 116     | 5580 MHz  | 140     | 5700 MHz  |
| 120     | 5600 MHz  |         |           |

5 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 102     | 5510 MHz  | 126     | 5630 MHz  |
| 110     | 5550 MHz  | 134     | 5670 MHz  |
| 118     | 5590 MHz  |         |           |

2 channels are provided for 802.11ac (VHT80):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 106     | 5530 MHz  | 122     | 5610 MHz  |

#### For 5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (HT20):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 149     | 5745MHz   | 161     | 5805MHz   |
| 153     | 5765MHz   | 165     | 5825MHz   |
| 157     | 5785MHz   |         |           |

2 channels are provided for 802.11n (HT40):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 151     | 5755MHz   | 159     | 5795MHz   |

1 channel is provided for 802.11ac (VHT80):

| Channel | Frequency |
|---------|-----------|
| 155     | 5775MHz   |

### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT Configure Mode | Applicable to |       |     | Description |
|--------------------|---------------|-------|-----|-------------|
|                    | RE $\geq$ 1G  | RE<1G | PLC |             |
| -                  | √             | √     | √   | -           |

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement  
 RE<1G: Radiated Emission below 1GHz  
 PLC: Power Line Conducted Emission

#### **Radiated Emission Test (Above 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                        | Freq. Range (MHz) | Available Channel | Tested Channel | Modulation Technology |
|--------------------|-----------------------------|-------------------|-------------------|----------------|-----------------------|
| -                  | 802.11b +<br>802.11n (HT20) | 2412 ~ 2462       | 1 to 11           | 6 + 60         | DSSS                  |
|                    |                             | 5260 ~ 5320       | 52 to 64          |                | OFDM                  |
| -                  | 802.11b +<br>802.11n (HT20) | 2412 ~ 2462       | 1 to 11           | 6 + 116        | DSSS                  |
|                    |                             | 5500 ~ 5700       | 100, 116, 140     |                | OFDM                  |

#### **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                        | Freq. Range (MHz) | Available Channel | Tested Channel | Modulation Technology |
|--------------------|-----------------------------|-------------------|-------------------|----------------|-----------------------|
| -                  | 802.11b +<br>802.11n (HT20) | 2412 ~ 2462       | 1 to 11           | 6 + 60         | DSSS                  |
|                    |                             | 5260 ~ 5320       | 52 to 64          |                | OFDM                  |
| -                  | 802.11b +<br>802.11n (HT20) | 2412 ~ 2462       | 1 to 11           | 6 + 116        | DSSS                  |
|                    |                             | 5500 ~ 5700       | 100, 116, 140     |                | OFDM                  |

#### **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                        | Freq. Range (MHz) | Available Channel | Tested Channel | Modulation Technology |
|--------------------|-----------------------------|-------------------|-------------------|----------------|-----------------------|
| -                  | 802.11b +<br>802.11n (HT20) | 2412 ~ 2462       | 1 to 11           | 6 + 60         | DSSS                  |
|                    |                             | 5260 ~ 5320       | 52 to 64          |                | OFDM                  |
| -                  | 802.11b +<br>802.11n (HT20) | 2412 ~ 2462       | 1 to 11           | 6 + 116        | DSSS                  |
|                    |                             | 5500 ~ 5700       | 100, 116, 140     |                | OFDM                  |

**Test Condition:**

| Applicable to | Environmental Conditions | Input Power  | Tested by |
|---------------|--------------------------|--------------|-----------|
| RE $\geq$ 1G  | 25 deg. C, 66% RH        | 120Vac, 60Hz | Greg Lin  |
| RE<1G         | 25 deg. C, 65% RH        | 120Vac, 60Hz | Greg Lin  |
| PLC           | 25 deg. C, 75% RH        | 120Vac, 60Hz | Greg Lin  |

### 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.

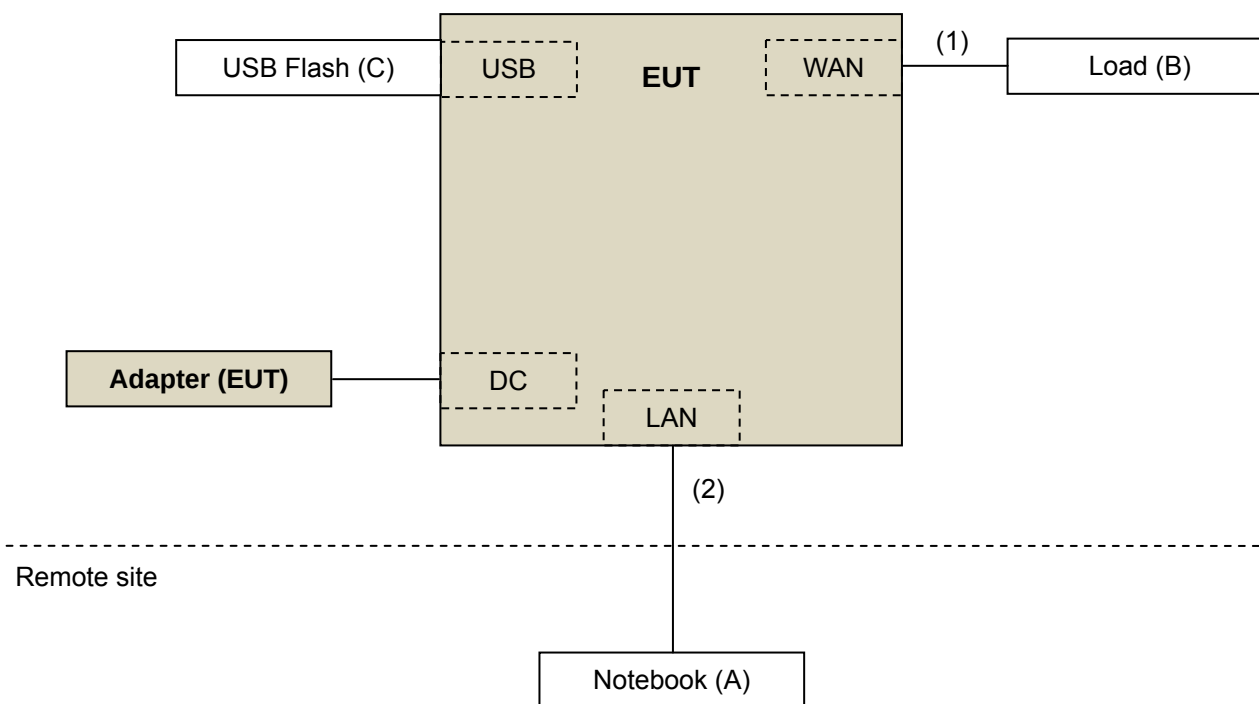
| ID | Product   | Brand | Model No. | Serial No. | FCC ID           | Remarks |
|----|-----------|-------|-----------|------------|------------------|---------|
| A. | Notebook  | DELL  | E5410     | 1HC2XM1    | FCC DoC Approved | -       |
| B. | Load      | NA    | NA        | NA         | NA               | -       |
| C. | USB Flash | HP    | v250W     | 01         | 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, Cat5e  | 1    | 1.5        | N                  | 0            | -       |
| 2. | RJ45, Cat5e  | 1    | 6          | N                  | 0            | -       |

#### 3.3.1 Configuration of System under Test



### 3.4 General Description of Applied Standards

The EUT is a RF Product. According to the specification of the EUT declared by the manufacturer, it must comply with the requirements of the following standards:

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

**FCC Part 15, Subpart E (15.407)**

ANSI C63.10-2013

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

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

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/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.

Limits of unwanted emission out of the restricted bands

| Applicable To                                                                                    |                                     |                  | Limit                                                                                                                                   |                                                                                                                                           |
|--------------------------------------------------------------------------------------------------|-------------------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 789033 D02 General UNII Test Procedure<br>New Rules v02r01                                       |                                     |                  | Field Strength at 3m                                                                                                                    |                                                                                                                                           |
|                                                                                                  |                                     |                  | PK: 74 (dBµV/m)                                                                                                                         | AV: 54 (dBµV/m)                                                                                                                           |
| Frequency Band                                                                                   | Applicable To                       |                  | EIRP Limit                                                                                                                              | Equivalent Field Strength at 3m                                                                                                           |
| 5150~5250 MHz                                                                                    | 15.407(b)(1)                        |                  | PK: -27 (dBm/MHz)                                                                                                                       | PK: 68.2(dBµV/m)                                                                                                                          |
| 5250~5350 MHz                                                                                    | 15.407(b)(2)                        |                  |                                                                                                                                         |                                                                                                                                           |
| 5470~5725 MHz                                                                                    | 15.407(b)(3)                        |                  |                                                                                                                                         |                                                                                                                                           |
| 5725~5850 MHz                                                                                    | <input checked="" type="checkbox"/> | 15.407(b)(4)(i)  | PK: -27 (dBm/MHz) <sup>*1</sup><br>PK: 10 (dBm/MHz) <sup>*2</sup><br>PK: 15.6 (dBm/MHz) <sup>*3</sup><br>PK: 27 (dBm/MHz) <sup>*4</sup> | PK: 68.2(dBµV/m) <sup>*1</sup><br>PK: 105.2 (dBµV/m) <sup>*2</sup><br>PK: 110.8(dBµV/m) <sup>*3</sup><br>PK: 122.2 (dBµV/m) <sup>*4</sup> |
|                                                                                                  | <input type="checkbox"/>            | 15.407(b)(4)(ii) | Emission limits in section 15.247(d)                                                                                                    |                                                                                                                                           |
| <sup>*1</sup> beyond 75 MHz or more above of the band edge.                                      |                                     |                  | <sup>*2</sup> below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above.                                                    |                                                                                                                                           |
| <sup>*3</sup> below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above. |                                     |                  | <sup>*4</sup> from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.                    |                                                                                                                                           |

Note: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000 \sqrt{30P}}{3} \mu\text{V/m, where P is the eirp (Watts).}$$

#### 4.1.2 Test Instruments

| Description & Manufacturer              | Model No.                          | Serial No.                      | Cal. Date     | Cal. Due      |
|-----------------------------------------|------------------------------------|---------------------------------|---------------|---------------|
| Test Receiver<br>KEYSIGHT               | N9038A                             | MY55420137                      | Apr. 11, 2018 | Apr. 10, 2019 |
| Spectrum Analyzer<br>ROHDE & SCHWARZ    | FSP40                              | 100040                          | Aug. 18, 2017 | Aug. 17, 2018 |
| BILOG Antenna<br>SCHWARZBECK            | VULB9168                           | 9168-148                        | Dec. 11, 2017 | Dec. 10, 2018 |
| HORN Antenna<br>SCHWARZBECK             | BBHA 9120 D                        | 9120D-1169                      | Dec. 12, 2017 | Dec. 11, 2018 |
| HORN Antenna<br>SCHWARZBECK             | BBHA 9170                          | BBHA9170241                     | Dec. 01, 2017 | Nov. 30, 2018 |
| Loop Antenna<br>EMCI                    | EM-6879                            | 269                             | Aug. 11, 2017 | Aug. 10, 2018 |
| Preamplifier<br>Agilent<br>(Below 1GHz) | 8447D                              | 2944A10638                      | Aug. 08, 2017 | Aug. 07, 2018 |
| Preamplifier<br>Agilent<br>(Above 1GHz) | 8449B                              | 3008A01638                      | Feb. 22, 2018 | Feb. 21, 2019 |
| RF signal cable<br>HUBER+SUHNER&EMCI    | SUCOFLEX 104 &<br>EMC104-SM-SM8000 | CABLE-CH9-02<br>(248780+171006) | Jan. 15, 2018 | Jan. 14, 2019 |
| RF signal cable<br>HUBER+SUHNER         | SUCOFLEX 104                       | CABLE-CH9-(250795/4)            | Aug. 08, 2017 | Aug. 07, 2018 |
| RF signal cable<br>Woken                | 8D-FB                              | Cable-CH9-01                    | Aug. 01, 2017 | Jul. 31, 2018 |
| Software<br>BV ADT                      | ADT_Radiated_<br>V7.6.15.9.5       | NA                              | NA            | NA            |
| Antenna Tower<br>EMCO                   | 2070/2080                          | 512.835.4684                    | NA            | NA            |
| Turn Table<br>EMCO                      | 2087-2.03                          | NA                              | NA            | NA            |
| Antenna Tower & Turn<br>BV ADT          | AT100                              | AT93021705                      | NA            | NA            |
| Turn Table<br>BV ADT                    | TT100                              | TT93021705                      | NA            | NA            |
| Turn Table Controller<br>BV ADT         | SC100                              | SC93021705                      | NA            | NA            |
| Boresight Antenna Fixture               | FBA-01                             | FBA-SIP01                       | NA            | NA            |
| 26GHz ~ 40GHz Amplifier<br>Agilent      | 8449B                              | 3008A1960                       | Aug. 08, 2017 | Aug. 07, 2018 |

- 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 9.
  3. The FCC Designation Number is TW0003. The number will be varied with the Lab location and scope as attached.
  4. The IC Site Registration No. is IC 7450F-9.

#### 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 (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) 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.
- f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

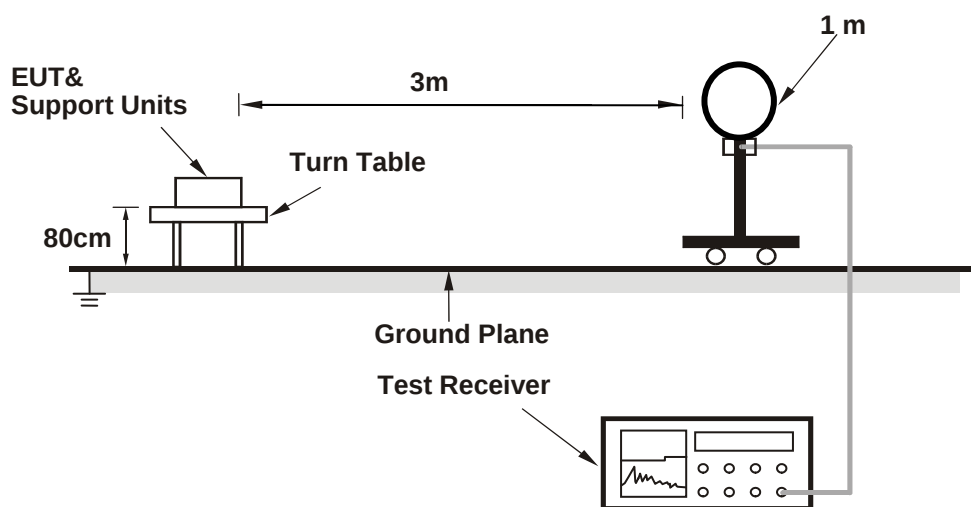
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle < 98%) or 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

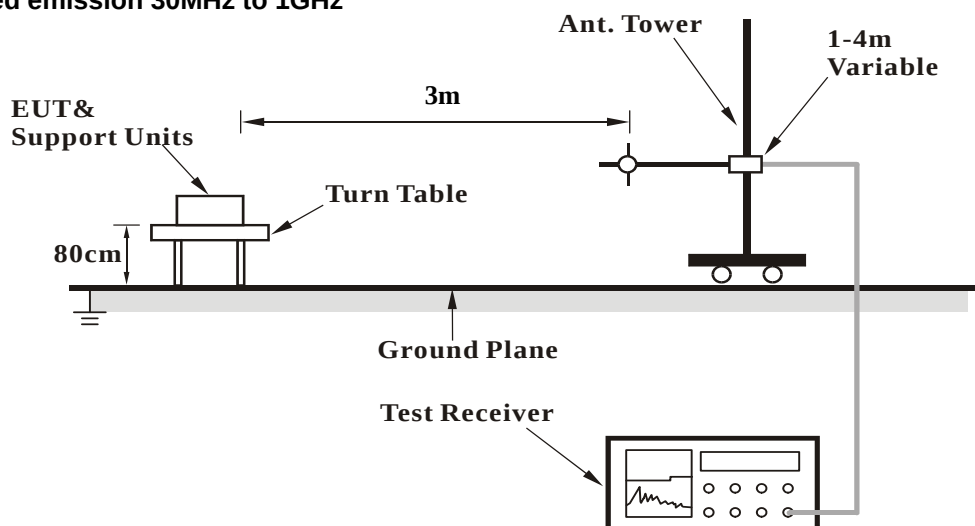
No deviation.

#### 4.1.5 Test Setup

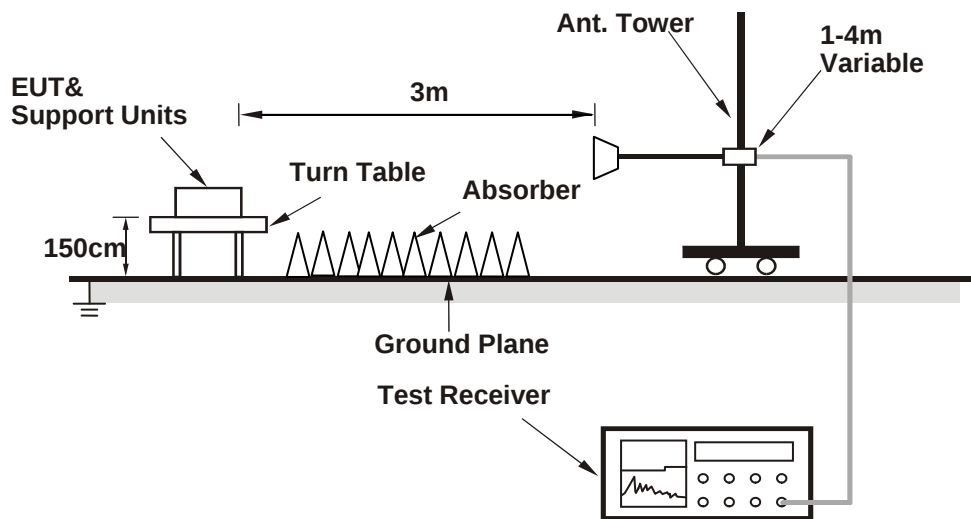
##### For Radiated emission below 30MHz



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



#### For Radiated emission above 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

Above 1GHz Data:

802.11b + 802.11n (HT20)

|                 |              |                   |                           |
|-----------------|--------------|-------------------|---------------------------|
| CHANNEL         | CH 6 + CH 60 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
| FREQUENCY RANGE | 1GHz ~ 40GHz |                   |                           |

| 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                                                   | *2437.00        | 112.8 PK                |                |             | 2.21 H             | 143                  | 80.8             | 32.0                     |
| 2                                                   | *2437.00        | 109.5 AV                |                |             | 2.21 H             | 143                  | 77.5             | 32.0                     |
| 3                                                   | 4874.00         | 46.2 PK                 | 74.0           | -27.8       | 1.77 H             | 272                  | 44.9             | 1.3                      |
| 4                                                   | 4874.00         | 38.2 AV                 | 54.0           | -15.8       | 1.77 H             | 272                  | 36.9             | 1.3                      |
| 7                                                   | *5300.00        | 116.3 PK                |                |             | 2.03 H             | 317                  | 77.8             | 38.5                     |
| 8                                                   | *5300.00        | 106.1 AV                |                |             | 2.03 H             | 317                  | 67.6             | 38.5                     |
| 9                                                   | 10600.00        | 66.7 PK                 | 74.0           | -7.3        | 2.58 H             | 194                  | 51.6             | 15.1                     |
| 10                                                  | 10600.00        | 52.2 AV                 | 54.0           | -1.8        | 2.58 H             | 194                  | 37.1             | 15.1                     |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL 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                                                   | *2437.00        | 118.6 PK                |                |             | 2.06 V             | 163                  | 86.6             | 32.0                     |
| 2                                                   | *2437.00        | 115.8 AV                |                |             | 2.06 V             | 163                  | 83.8             | 32.0                     |
| 3                                                   | 4874.00         | 46.8 PK                 | 74.0           | -27.2       | 2.86 V             | 12                   | 45.5             | 1.3                      |
| 4                                                   | 4874.00         | 39.1 AV                 | 54.0           | -14.9       | 2.86 V             | 12                   | 37.8             | 1.3                      |
| 7                                                   | *5300.00        | 117.0 PK                |                |             | 1.92 V             | 283                  | 78.5             | 38.5                     |
| 8                                                   | *5300.00        | 106.6 AV                |                |             | 1.92 V             | 283                  | 68.1             | 38.5                     |
| 9                                                   | 10600.00        | 67.2 PK                 | 74.0           | -6.8        | 2.34 V             | 175                  | 52.1             | 15.1                     |
| 10                                                  | <b>10600.00</b> | <b>53.7 AV</b>          | <b>54.0</b>    | <b>-0.3</b> | <b>2.34 V</b>      | <b>175</b>           | <b>38.6</b>      | <b>15.1</b>              |

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.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

# 802.11b + 802.11n (HT20)

|                 |               |                   |                           |
|-----------------|---------------|-------------------|---------------------------|
| CHANNEL         | CH 6 + CH 116 | DETECTOR FUNCTION | Peak (PK)<br>Average (AV) |
| FREQUENCY RANGE | 1GHz ~ 40GHz  |                   |                           |

| 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                                                   | *2437.00    | 111.6 PK                |                |             | 2.16 H             | 137                  | 79.6             | 32.0                     |
| 2                                                   | *2437.00    | 108.3 AV                |                |             | 2.16 H             | 137                  | 76.3             | 32.0                     |
| 3                                                   | 4874.00     | 45.9 PK                 | 74.0           | -28.1       | 1.86 H             | 258                  | 44.6             | 1.3                      |
| 4                                                   | 4874.00     | 38.0 AV                 | 54.0           | -16.0       | 1.86 H             | 258                  | 36.7             | 1.3                      |
| 7                                                   | *5580.00    | 114.3 PK                |                |             | 1.65 H             | 194                  | 74.9             | 39.4                     |
| 8                                                   | *5580.00    | 104.1 AV                |                |             | 1.65 H             | 194                  | 64.7             | 39.4                     |
| 9                                                   | 11160.00    | 57.8 PK                 | 74.0           | -16.2       | 1.43 H             | 318                  | 41.8             | 16.0                     |
| 10                                                  | 11160.00    | 51.4 AV                 | 54.0           | -2.6        | 1.43 H             | 318                  | 35.4             | 16.0                     |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL 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                                                   | *2437.00    | 118.4 PK                |                |             | 2.13 V             | 158                  | 86.4             | 32.0                     |
| 2                                                   | *2437.00    | 115.6 AV                |                |             | 2.13 V             | 158                  | 83.6             | 32.0                     |
| 3                                                   | 4874.00     | 47.0 PK                 | 74.0           | -27.0       | 2.72 V             | 357                  | 45.7             | 1.3                      |
| 4                                                   | 4874.00     | 38.9 AV                 | 54.0           | -15.1       | 2.72 V             | 357                  | 37.6             | 1.3                      |
| 7                                                   | *5580.00    | 117.2 PK                |                |             | 2.47 V             | 156                  | 77.8             | 39.4                     |
| 8                                                   | *5580.00    | 106.9 AV                |                |             | 2.47 V             | 156                  | 67.5             | 39.4                     |
| 9                                                   | 11160.00    | 67.4 PK                 | 74.0           | -6.6        | 2.23 V             | 72                   | 51.4             | 16.0                     |
| 10                                                  | 11160.00    | 53.1 AV                 | 54.0           | -0.9        | 2.23 V             | 72                   | 37.1             | 16.0                     |

## 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.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

Below 1GHz data

802.11b + 802.11n (HT20)

|                 |              |                      |                 |
|-----------------|--------------|----------------------|-----------------|
| CHANNEL         | CH 6 + CH 60 | DETECTOR<br>FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | 9kHz ~ 1GHz  |                      |                 |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M |                |                               |                   |                |                          |                            |                        |                                |
|-----------------------------------------------------|----------------|-------------------------------|-------------------|----------------|--------------------------|----------------------------|------------------------|--------------------------------|
| NO.                                                 | FREQ.<br>(MHz) | EMISSION<br>LEVEL<br>(dBuV/m) | LIMIT<br>(dBuV/m) | MARGIN<br>(dB) | ANTENNA<br>HEIGHT<br>(m) | TABLE<br>ANGLE<br>(Degree) | RAW<br>VALUE<br>(dBuV) | CORRECTION<br>FACTOR<br>(dB/m) |
| 1                                                   | 57.12          | 27.8 QP                       | 40.0              | -12.2          | 1.25 H                   | 215                        | 36.5                   | -8.7                           |
| 2                                                   | 212.66         | 28.4 QP                       | 43.5              | -15.1          | 1.50 H                   | 77                         | 39.3                   | -10.9                          |
| 3                                                   | 401.26         | 34.0 QP                       | 46.0              | -12.0          | 2.00 H                   | 198                        | 39.3                   | -5.3                           |
| 4                                                   | 517.92         | 32.4 QP                       | 46.0              | -13.6          | 1.50 H                   | 126                        | 35.5                   | -3.1                           |
| 5                                                   | 673.46         | 32.0 QP                       | 46.0              | -14.0          | 1.00 H                   | 269                        | 32.1                   | -0.1                           |
| 6                                                   | 881.50         | 30.2 QP                       | 46.0              | -15.8          | 1.50 H                   | 159                        | 26.7                   | 3.5                            |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M   |                |                               |                   |                |                          |                            |                        |                                |
| NO.                                                 | FREQ.<br>(MHz) | EMISSION<br>LEVEL<br>(dBuV/m) | LIMIT<br>(dBuV/m) | MARGIN<br>(dB) | ANTENNA<br>HEIGHT<br>(m) | TABLE<br>ANGLE<br>(Degree) | RAW<br>VALUE<br>(dBuV) | CORRECTION<br>FACTOR<br>(dB/m) |
| 1                                                   | 47.40          | 32.6 QP                       | 40.0              | -7.4           | 1.50 V                   | 2                          | 46.9                   | -14.3                          |
| 2                                                   | 292.38         | 28.7 QP                       | 46.0              | -17.3          | 1.00 V                   | 28                         | 41.6                   | -12.9                          |
| 3                                                   | 409.04         | 33.8 QP                       | 46.0              | -12.2          | 1.25 V                   | 27                         | 44.9                   | -11.1                          |
| 4                                                   | 498.47         | 31.3 QP                       | 46.0              | -14.7          | 2.00 V                   | 156                        | 40.7                   | -9.4                           |
| 5                                                   | 782.34         | 28.9 QP                       | 46.0              | -17.1          | 1.50 V                   | 130                        | 33.4                   | -4.5                           |
| 6                                                   | 914.55         | 31.0 QP                       | 46.0              | -15.0          | 1.50 V                   | 2                          | 33.2                   | -2.2                           |

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.
4. Margin value = Emission Level – Limit value

# 802.11b + 802.11n (HT20)

|                 |               |                      |                 |
|-----------------|---------------|----------------------|-----------------|
| CHANNEL         | CH 6 + CH 116 | DETECTOR<br>FUNCTION | Quasi-Peak (QP) |
| FREQUENCY RANGE | 9kHz ~ 1GHz   |                      |                 |

| ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M |                |                               |                   |                |                          |                            |                        |                                |
|-----------------------------------------------------|----------------|-------------------------------|-------------------|----------------|--------------------------|----------------------------|------------------------|--------------------------------|
| NO.                                                 | FREQ.<br>(MHz) | EMISSION<br>LEVEL<br>(dBuV/m) | LIMIT<br>(dBuV/m) | MARGIN<br>(dB) | ANTENNA<br>HEIGHT<br>(m) | TABLE<br>ANGLE<br>(Degree) | RAW<br>VALUE<br>(dBuV) | CORRECTION<br>FACTOR<br>(dB/m) |
| 1                                                   | 70.73          | 25.9 QP                       | 40.0              | -14.1          | 1.25 H                   | 205                        | 42.1                   | -16.2                          |
| 2                                                   | 179.61         | 29.7 QP                       | 43.5              | -13.8          | 1.50 H                   | 232                        | 44.7                   | -15.0                          |
| 3                                                   | 430.42         | 34.1 QP                       | 46.0              | -11.9          | 2.00 H                   | 226                        | 44.5                   | -10.4                          |
| 4                                                   | 498.47         | 32.6 QP                       | 46.0              | -13.4          | 2.00 H                   | 205                        | 42.0                   | -9.4                           |
| 5                                                   | 729.84         | 30.0 QP                       | 46.0              | -16.0          | 1.50 H                   | 285                        | 35.2                   | -5.2                           |
| 6                                                   | 875.67         | 29.2 QP                       | 46.0              | -16.8          | 1.00 H                   | 223                        | 31.9                   | -2.7                           |
| ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M   |                |                               |                   |                |                          |                            |                        |                                |
| NO.                                                 | FREQ.<br>(MHz) | EMISSION<br>LEVEL<br>(dBuV/m) | LIMIT<br>(dBuV/m) | MARGIN<br>(dB) | ANTENNA<br>HEIGHT<br>(m) | TABLE<br>ANGLE<br>(Degree) | RAW<br>VALUE<br>(dBuV) | CORRECTION<br>FACTOR<br>(dB/m) |
| 1                                                   | 45.45          | 33.3 QP                       | 40.0              | -6.7           | 1.00 V                   | 15                         | 47.7                   | -14.4                          |
| 2                                                   | 175.72         | 27.2 QP                       | 43.5              | -16.3          | 1.00 V                   | 136                        | 41.7                   | -14.5                          |
| 3                                                   | 410.98         | 35.1 QP                       | 46.0              | -10.9          | 2.00 V                   | 21                         | 46.1                   | -11.0                          |
| 4                                                   | 519.86         | 28.6 QP                       | 46.0              | -17.4          | 1.25 V                   | 173                        | 37.7                   | -9.1                           |
| 5                                                   | 768.73         | 29.6 QP                       | 46.0              | -16.4          | 1.50 V                   | 1                          | 34.2                   | -4.6                           |
| 6                                                   | 980.66         | 30.8 QP                       | 54.0              | -23.2          | 1.25 V                   | 248                        | 32.2                   | -1.4                           |

## 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.
4. Margin value = Emission Level – Limit value

## 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         | Nov. 23, 2017 | Nov. 22, 2018 |
| RF signal cable (with 10dB PAD)<br>Woken | 5D-FB                    | Cable-cond1-01 | Sep. 05, 2017 | Sep. 04, 2018 |
| LISN<br>ROHDE & SCHWARZ<br>(EUT)         | ESH3-Z5                  | 835239/001     | Mar. 06, 2018 | Mar. 05, 2019 |
| LISN<br>ROHDE & SCHWARZ<br>(Peripheral)  | ESH3-Z5                  | 100311         | Aug. 15, 2017 | Aug. 14, 2018 |
| 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-2040.

### 4.2.3 Test Procedures

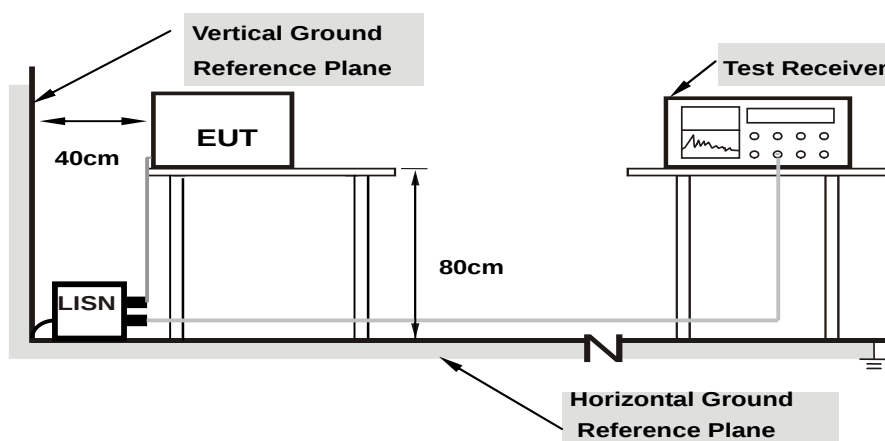
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- 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

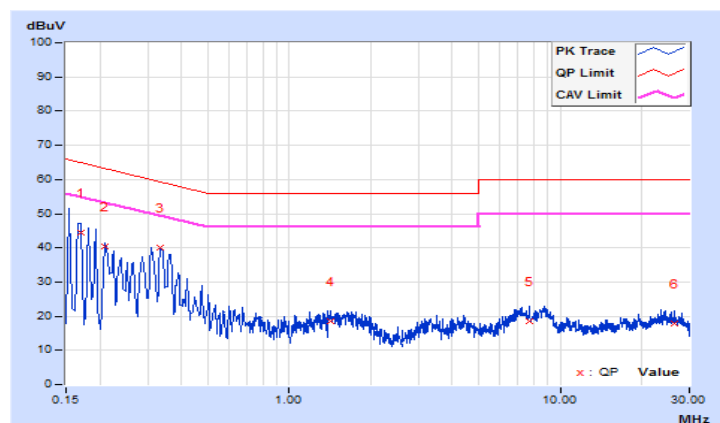
802.11b + 802.11n (HT20)

| Phase   | Line (L)     | Detector Function | Quasi-Peak (QP) / Average (AV) |
|---------|--------------|-------------------|--------------------------------|
| Channel | CH 6 + CH 60 |                   |                                |

| No | Freq.<br>[MHz] | Corr.<br>Factor<br>(dB) | Reading Value<br>[dB (uV)] |       | Emission Level<br>[dB (uV)] |       | Limit<br>[dB (uV)] |       | Margin<br>(dB) |        |
|----|----------------|-------------------------|----------------------------|-------|-----------------------------|-------|--------------------|-------|----------------|--------|
|    |                |                         | Q.P.                       | AV.   | Q.P.                        | AV.   | Q.P.               | AV.   | Q.P.           | AV.    |
| 1  | 0.16955        | 10.16                   | 34.13                      | 24.01 | 44.29                       | 34.17 | 64.98              | 54.98 | -20.69         | -20.81 |
| 2  | 0.20865        | 10.16                   | 30.26                      | 19.43 | 40.42                       | 29.59 | 63.26              | 53.26 | -22.84         | -23.67 |
| 3  | 0.33396        | 10.19                   | 30.00                      | 25.25 | 40.19                       | 35.44 | 59.35              | 49.35 | -19.16         | -13.91 |
| 4  | 1.41684        | 10.20                   | 8.45                       | 0.92  | 18.65                       | 11.12 | 56.00              | 46.00 | -37.35         | -34.88 |
| 5  | 7.70803        | 10.53                   | 7.96                       | 1.31  | 18.49                       | 11.84 | 60.00              | 50.00 | -41.51         | -38.16 |
| 6  | 26.37046       | 11.37                   | 6.53                       | 2.42  | 17.90                       | 13.79 | 60.00              | 50.00 | -42.10         | -36.21 |

#### 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.

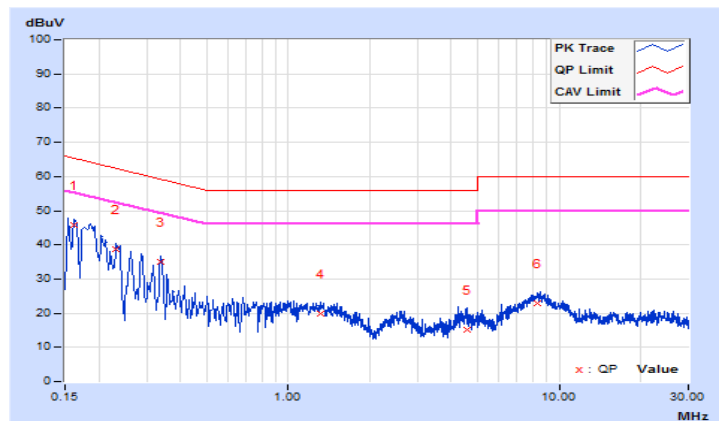


|         |              |                   |                                |
|---------|--------------|-------------------|--------------------------------|
| Phase   | Neutral (N)  | Detector Function | Quasi-Peak (QP) / Average (AV) |
| Channel | CH 6 + CH 60 |                   |                                |

| No | Freq.<br>[MHz] | Corr.<br>Factor<br>(dB) | Reading Value<br>[dB (uV)] |       | Emission Level<br>[dB (uV)] |       | Limit<br>[dB (uV)] |       | Margin<br>(dB) |        |
|----|----------------|-------------------------|----------------------------|-------|-----------------------------|-------|--------------------|-------|----------------|--------|
|    |                |                         |                            |       |                             |       |                    |       |                |        |
|    |                |                         | Q.P.                       | AV.   | Q.P.                        | AV.   | Q.P.               | AV.   | Q.P.           | AV.    |
| 1  | 0.16181        | 10.15                   | 35.57                      | 24.50 | 45.72                       | 34.65 | 65.37              | 55.37 | -19.65         | -20.72 |
| 2  | 0.23216        | 10.17                   | 28.42                      | 22.17 | 38.59                       | 32.34 | 62.37              | 52.37 | -23.78         | -20.03 |
| 3  | 0.33768        | 10.19                   | 24.66                      | 17.90 | 34.85                       | 28.09 | 59.26              | 49.26 | -24.41         | -21.17 |
| 4  | 1.31909        | 10.21                   | 9.54                       | 3.83  | 19.75                       | 14.04 | 56.00              | 46.00 | -36.25         | -31.96 |
| 5  | 4.56439        | 10.37                   | 4.93                       | 1.19  | 15.30                       | 11.56 | 56.00              | 46.00 | -40.70         | -34.44 |
| 6  | 8.27107        | 10.50                   | 12.24                      | 4.19  | 22.74                       | 14.69 | 60.00              | 50.00 | -37.26         | -35.31 |

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.



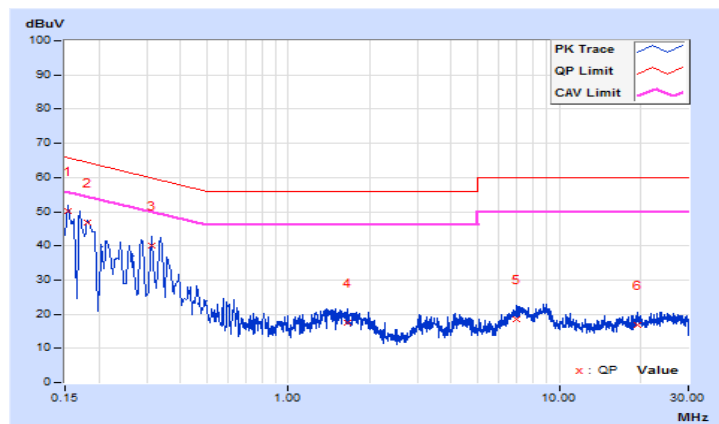
## 802.11b + 802.11n (HT20)

| Phase   | Line (L)      | Detector Function | Quasi-Peak (QP) /<br>Average (AV) |
|---------|---------------|-------------------|-----------------------------------|
| Channel | CH 6 + CH 116 |                   |                                   |

| No       | Freq.<br>[MHz] | Corr.<br>Factor<br>(dB) | Reading Value<br>[dB (uV)] |              | Emission Level<br>[dB (uV)] |              | Limit<br>[dB (uV)] |              | Margin<br>(dB) |               |
|----------|----------------|-------------------------|----------------------------|--------------|-----------------------------|--------------|--------------------|--------------|----------------|---------------|
|          |                |                         |                            |              |                             |              |                    |              |                |               |
|          |                |                         | Q.P.                       | AV.          | Q.P.                        | AV.          | Q.P.               | AV.          | Q.P.           | AV.           |
| 1        | 0.15391        | 10.16                   | 39.94                      | 23.88        | 50.10                       | 34.04        | 65.79              | 55.79        | -15.69         | -21.75        |
| 2        | 0.18122        | 10.16                   | 36.53                      | 21.49        | 46.69                       | 31.65        | 64.43              | 54.43        | -17.74         | -22.78        |
| <b>3</b> | <b>0.31422</b> | <b>10.18</b>            | <b>29.84</b>               | <b>27.47</b> | <b>40.02</b>                | <b>37.65</b> | <b>59.86</b>       | <b>49.86</b> | <b>-19.84</b>  | <b>-12.21</b> |
| 4        | 1.65144        | 10.22                   | 7.14                       | 1.79         | 17.36                       | 12.01        | 56.00              | 46.00        | -38.64         | -33.99        |
| 5        | 6.97686        | 10.50                   | 7.89                       | 1.97         | 18.39                       | 12.47        | 60.00              | 50.00        | -41.61         | -37.53        |
| 6        | 19.45758       | 11.22                   | 5.67                       | 1.20         | 16.89                       | 12.42        | 60.00              | 50.00        | -43.11         | -37.58        |

## 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.

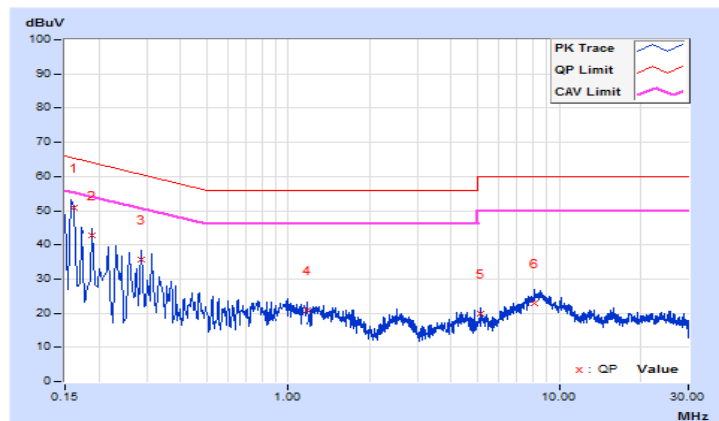


|         |               |                   |                                |
|---------|---------------|-------------------|--------------------------------|
| Phase   | Neutral (N)   | Detector Function | Quasi-Peak (QP) / Average (AV) |
| Channel | CH 6 + CH 116 |                   |                                |

| No | Freq.<br>[MHz] | Corr.<br>Factor<br>(dB) | Reading Value<br>[dB (uV)] |       | Emission Level<br>[dB (uV)] |       | Limit<br>[dB (uV)] |       | Margin<br>(dB) |        |
|----|----------------|-------------------------|----------------------------|-------|-----------------------------|-------|--------------------|-------|----------------|--------|
|    |                |                         |                            |       |                             |       |                    |       |                |        |
|    |                |                         | Q.P.                       | AV.   | Q.P.                        | AV.   | Q.P.               | AV.   | Q.P.           | AV.    |
| 1  | 0.16173        | 10.15                   | 40.84                      | 25.68 | 50.99                       | 35.83 | 65.37              | 55.37 | -14.38         | -19.54 |
| 2  | 0.18910        | 10.16                   | 32.45                      | 18.32 | 42.61                       | 28.48 | 64.08              | 54.08 | -21.47         | -25.60 |
| 3  | 0.28685        | 10.18                   | 25.37                      | 17.96 | 35.55                       | 28.14 | 60.62              | 50.62 | -25.07         | -22.48 |
| 4  | 1.17365        | 10.21                   | 10.74                      | 4.58  | 20.95                       | 14.79 | 56.00              | 46.00 | -35.05         | -31.21 |
| 5  | 5.15480        | 10.39                   | 9.62                       | 4.57  | 20.01                       | 14.96 | 60.00              | 50.00 | -39.99         | -35.04 |
| 6  | 8.08730        | 10.50                   | 12.47                      | 4.68  | 22.97                       | 15.18 | 60.00              | 50.00 | -37.03         | -34.82 |

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.



## 5 Pictures of Test Arrangements

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

## Appendix – Information on 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:

**Linko 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.

--- END ---