

## FCC Test Report (DFS Band)

### (Spot Check)

**Report No.:** RF180830E03G-1

**FCC ID:** 2APLE18300394

**Original FCC ID:** 2APLE18300398

**Test Model:** VMB5000

**Revision:** V035

**Received Date:** June 02, 2019

**Test Date:** June 02 to July 01, 2019

**Issued Date:** July 18, 2019

**Applicant:** Arlo Technologies, Inc.

**Address:** 2200 Faraday Ave. Suite 150, Carlsbad, CA 92008, United States

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

**Lab Address:** E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,  
Taiwan R.O.C.

**Test Location:** E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300,  
Taiwan R.O.C.

**FCC Registration /  
Designation Number:** 723255 / TW2022



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## 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 .....    | 10        |
| 3.3 Duty Cycle of Test Signal .....                              | 12        |
| 3.4 Description of Support Units .....                           | 13        |
| 3.4.1 Configuration of System under Test .....                   | 13        |
| 3.5 General Description of Applied Standard .....                | 14        |
| <b>4 Test Types and Results .....</b>                            | <b>15</b> |
| 4.1 Radiated Emission and Bandedge Measurement .....             | 15        |
| 4.1.1 Limits of Radiated Emission and Bandedge Measurement ..... | 15        |
| 4.1.2 Test Instruments .....                                     | 16        |
| 4.1.3 Test Procedure .....                                       | 18        |
| 4.1.4 Deviation from Test Standard .....                         | 19        |
| 4.1.5 Test Setup .....   | 19        |
| 4.1.6 EUT Operating Condition .....                              | 20        |
| 4.1.7 Test Results .....   | 21        |
| 4.2 Conducted Emission Measurement .....                         | 29        |
| 4.2.1 Limits of Conducted Emission Measurement .....             | 29        |
| 4.2.2 Test Instruments .....                                     | 29        |
| 4.2.3 Test Procedure .....                                       | 30        |
| 4.2.4 Deviation from Test Standard .....                         | 30        |
| 4.2.5 Test Setup .....   | 30        |
| 4.2.6 EUT Operating Condition .....                              | 30        |
| 4.2.7 Test Results .....   | 31        |
| 4.3 Transmit Power Measurement .....                             | 33        |
| 4.3.1 Limits of Transmit Power Measurement .....                 | 33        |
| 4.3.2 Test Setup .....   | 33        |
| 4.3.3 Test Instruments .....                                     | 33        |
| 4.3.4 Test Procedure .....                                       | 34        |
| 4.3.5 Deviation from Test Standard .....                         | 34        |
| 4.3.6 EUT Operating Condition .....                              | 34        |
| 4.3.7 Test Result .....  | 35        |
| <b>5 Pictures of Test Arrangements .....</b>                     | <b>37</b> |
| <b>Appendix – Information on the Testing Laboratories .....</b>  | <b>38</b> |

### Release Control Record

| Issue No.      | Description       | Date Issued   |
|----------------|-------------------|---------------|
| RF180830E03G-1 | Original release. | July 18, 2019 |

## 1 Certificate of Conformity

**Product:** Alro Gen5 Entry Hub

**Brand:** Arlo

**Test Model:** VMB5000

**Revision:** V035

**Sample Status:** Pre Production Unit

**Applicant:** Arlo Technologies, Inc.

**Test Date:** June 02 to July 01, 2019

**Standard:** 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 EMC characteristics under the conditions specified in this report.

**Prepared by :** Wendy Wu , **Date:** July 18, 2019  
Wendy Wu / Specialist

**Approved by :** May Chen , **Date:** July 18, 2019  
May Chen / Manager

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart E (Section 15.407) |  |        |   |
|--|--|--------|---|
| FCC Clause                                     | Test Item                                  | Result | Remarks   |
| 15.407(b)(6)                                   | AC Power Conducted Emissions               | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -11.48dB at 0.15000MHz. |
| 15.407(b)<br>(1/2/3/4(i/ii)/6)                 | Radiated Emissions & Band Edge Measurement | Pass   | Meet the requirement of limit.<br>Minimum passing margin is -0.5dB at 5725.00MHz.   |
| 15.407(a)(1/2/3)                               | Max Average Transmit Power                 | Pass   | Meet the requirement of limit.  |

Note:

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) ( $\pm$ ) |
|------------------------------------|----------------|--------------------------------------|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz | 1.8 dB                               |
| Radiated Emissions up to 1 GHz     | 30MHz ~ 1GHz   | 5.1 dB                               |
| Radiated Emissions above 1 GHz     | 1GHz ~ 6GHz    | 5.1 dB                               |
|                                    | 6GHz ~ 18GHz   | 5.0 dB                               |
|                                    | 18GHz ~ 40GHz  | 5.2 dB                               |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                       |  |
|-----------------------|--|
| Product               | Alro Gen5 Entry Hub  |
| Brand                 | Arlo   |
| Test Model            | VMB5000  |
| Status of EUT         | Pre Production Unit  |
| Revision              | V035   |
| S/N                   | 5GP1897VA0006  |
| Power Supply Rating   | 12Vdc from power adapter   |
| Modulation Type       | 64QAM, 16QAM, QPSK, BPSK for OFDM<br>256QAM for OFDM in 11ac mode only               |
| Modulation Technology | OFDM   |
| Transfer Rate         | 802.11a: up to 54Mbps<br>802.11n: up to 300Mbps<br>802.11ac: up to 866.7Mbps         |
| Operating Frequency   | 5.26~ 5.32GHz, 5.50 ~ 5.70GHz  |
| Number of Channel     | 802.11a, 802.11n (HT20), 802.11ac (VHT20): 15<br>802.11n (HT40), 802.11ac (VHT40): 7 |
| Output Power          | <b>5.26~ 5.32GHz:</b> 243.799mW<br><b>5.50 ~ 5.70GHz:</b> 242.787mW                  |
| Antenna Type          | Refer to Note  |
| Antenna Connector     | Refer to Note  |
| Accessory Device      | Adapter x1   |
| Data Cable Supplied   | NA   |

Note:

- This report is prepared for FCC class II permissive change. The difference compared with the Report No.: RF180830E03-1 as the following:  
◆ Add DFS band <5.26 ~ 5.32GHz, 5.5 ~ 5.70GHz>
- Exhibit prepared for FCC Spot Check Verification Report, the format, test items and amount of spot-check test data are decided by applicant's engineering judgment, for more details please refer to declaration letter exhibit. (Original FCC ID: 2APLE18300398, report no.: RF180830E03C-1)
- There are WLAN, Z-Wave, Zigbee and Sub-GHz technology used for the EUT. The EUT has below radios as following table:

| Radio 1                 | Radio 2 | Radio 3 | Radio 4 |
|-------------------------|---------|---------|---------|
| WLAN (2.4GHz+5GHz band) | Z-Wave  | Zigbee  | Sub-GHz |

- Simultaneously transmission condition.

| Condition | Technology  |           |        |        |         |
|-----------|-------------|-----------|--------|--------|---------|
| 1         | WLAN 2.4GHz | WLAN 5GHz | Z-Wave | Zigbee | Sub-GHz |

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

5. The EUT must be supplied with a power adapter and following different models could be chosen as following table:

| No. | Brand | Model No.     | Spec.  |
|-----|-------|---------------|--|
| 1   | Arlo  | AD2076F10     | Input: 100-120Vac, 0.56A, 50/60Hz<br>Output: 12Vdc, 1.5A<br>DC output cable (Unshielded, 1.8m) |
| 2   | Arlo  | AD2067M20     | Input: 100-240Vac, 1.0A, 50/60Hz<br>Output: 12Vdc, 2.5A<br>DC output cable (Unshielded, 1.8m)  |
| 3   | Arlo  | 2ABB018F 1 NJ | Input: 100-120Vac, 0.6A, 50/60Hz<br>Output: 12Vdc, 1.5A<br>DC output cable (Unshielded, 1.8m)  |
| 4   | Arlo  | P030WM1251    | Input: 100-240Vac, 1.0A, 50/60Hz<br>Output: 12Vdc, 2.5A<br>DC output cable (Unshielded, 1.8m)  |

Note: From the above models, the worst radiated emission and AC power conducted emission test was found in **Adapter 2**. Therefore only the test data of the modes were recorded in this report.

6. The antennas provided to the EUT, please refer to the following table:

| Sub-GHz |                            |                  |                        |                      |              |                |                   |
|---------|----------------------------|------------------|------------------------|----------------------|--------------|----------------|-------------------|
| Ant No. | Brand                      | Model            | Antenna Gain (dBi)     | Frequency rang (MHz) | Antenna type | Connector type |                   |
| 1       | NA                         | 902P00214N0      | 1.5                    | 860~930              | PIFA         | NA             |                   |
| Z-Wave  |                            |                  |                        |                      |              |                |                   |
| Ant No. | Brand                      | Model            | Antenna Gain (dBi)     | Frequency rang (MHz) | Antenna type | Connector type |                   |
| 1       | NA                         | 902P00213N0      | 2.5                    | 860~930              | PIFA         | NA             |                   |
| Zigbee  |                            |                  |                        |                      |              |                |                   |
| Ant No. | Brand                      | Model            | Antenna Gain (dBi)     | Frequency rang (GHz) | Antenna type | Connector type |                   |
| 1       | INPAQ TECHNOLOGY CO., LTD. | ACA-5036-A2-CC-S | 3.5                    | 2.4~2.4835           | CHIP         | NA             |                   |
| WLAN    |                            |                  |                        |                      |              |                |                   |
| Ant No. | Brand                      | Model            | Antenna Net Gain (dBi) | Frequency rang (GHz) | Antenna type | Connector type | Cable Length (mm) |
| 1       | NA                         | 9 07X01052X0     | 2.5                    | 2.4~2.4835           | Dipole       | i-pex          | 75                |
|         |                            |                  | 1.8                    | 5.15~5.25            |              |                |                   |
|         |                            |                  | 2                      | 5.25~5.35            |              |                |                   |
|         |                            |                  | 2.2                    | 5.47~5.725           |              |                |                   |
|         |                            |                  | 1.6                    | 5.725~5.85           |              |                |                   |
| 2       | NA                         | 9 07X00747X19    | 2.5                    | 2.4~2.4835           | Dipole       | i-pex          | 90                |
|         |                            |                  | 2.2                    | 5.15~5.25            |              |                |                   |
|         |                            |                  | 1.2                    | 5.25~5.35            |              |                |                   |
|         |                            |                  | 3.2                    | 5.47~5.725           |              |                |                   |
|         |                            |                  | 3.5                    | 5.725~5.85           |              |                |                   |

7. The EUT incorporates a MIMO function.

| 2.4GHz Band      |                 |                       |     |
|------------------|-----------------|-----------------------|-----|
| MODULATION MODE  | DATA RATE (MCS) | TX & RX CONFIGURATION |     |
| 802.11b          | 1 ~ 11Mbps      | 2TX                   | 2RX |
| 802.11g          | 6 ~ 54Mbps      | 2TX                   | 2RX |
| 802.11n (HT20)   | MCS 0~7         | 2TX                   | 2RX |
|                  | MCS 8~15        | 2TX                   | 2RX |
| 802.11n (HT40)   | MCS 0~7         | 2TX                   | 2RX |
|                  | MCS 8~15        | 2TX                   | 2RX |
| 5GHz Band        |                 |                       |     |
| MODULATION MODE  | DATA RATE (MCS) | TX & RX CONFIGURATION |     |
| 802.11a          | 6 ~ 54Mbps      | 2TX                   | 2RX |
| 802.11n (HT20)   | MCS 0~7         | 2TX                   | 2RX |
|                  | MCS 8~15        | 2TX                   | 2RX |
| 802.11n (HT40)   | MCS 0~7         | 2TX                   | 2RX |
|                  | MCS 8~15        | 2TX                   | 2RX |
| 802.11ac (VHT20) | MCS0~8 Nss=1    | 2TX                   | 2RX |
|                  | MCS0~8 Nss=2    | 2TX                   | 2RX |
| 802.11ac (VHT40) | MCS0~9 Nss=1    | 2TX                   | 2RX |
|                  | MCS0~9 Nss=2    | 2TX                   | 2RX |

Note:

1. 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)

8. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.



### 3.2 Description of Test Modes

#### FOR 5260 ~ 5320MHz

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

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

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

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

#### 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  |         |           |

### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT<br>Configure<br>Mode | Applicable To |       |     |      | Description |
|--------------------------|---------------|-------|-----|------|-------------|
|                          | RE≥1G         | RE<1G | PLC | APCM |             |
| -                        | √             | √     | √   | √    | -           |

Where **RE≥1G**: Radiated Emission above 1GHz **RE<1G**: Radiated Emission below 1GHz  
**PLC**: Power Line Conducted Emission **APCM**: Antenna Port Conducted Measurement

#### **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.

| Mode             | FREQ. Band (MHz)       | Available Channel      | Tested Channel | Modulation Technology | Modulation Type | Data Rate (Mbps) |
|------------------|------------------------|------------------------|----------------|-----------------------|-----------------|------------------|
| 802.11ac (VHT20) | 5260-5320<br>5500-5700 | 52 to 64<br>100 to 140 | 52, 60, 64     | OFDM                  | BPSK            | 6.5              |
| 802.11ac (VHT40) | 5500-5700<br>5500-5700 | 54 to 62<br>102 to 134 | 102, 110, 134  | OFDM                  | BPSK            | 13.5             |

#### **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.

| Mode             | FREQ. Band (MHz)       | Available Channel      | Tested Channel | Modulation Technology | Modulation Type | Data Rate (Mbps) |
|------------------|------------------------|------------------------|----------------|-----------------------|-----------------|------------------|
| 802.11ac (VHT20) | 5260-5320<br>5500-5700 | 52 to 64<br>100 to 140 | 64             | OFDM                  | BPSK            | 6.5              |

#### **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.

| Mode             | FREQ. Band (MHz)       | Available Channel      | Tested Channel | Modulation Technology | Modulation Type | Data Rate (Mbps) |
|------------------|------------------------|------------------------|----------------|-----------------------|-----------------|------------------|
| 802.11ac (VHT20) | 5260-5320<br>5500-5700 | 52 to 64<br>100 to 140 | 64             | OFDM                  | BPSK            | 6.5              |

### **Antenna Port Conducted Measurement:**

- ☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ 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.

| Mode             | FREQ. Band (MHz)       | Available Channel      | Tested Channel | Modulation Technology | Modulation Type | Data Rate (Mbps) |
|------------------|------------------------|------------------------|----------------|-----------------------|-----------------|------------------|
| 802.11ac (VHT20) | 5260-5320<br>5500-5700 | 52 to 64<br>100 to 140 | 52, 60, 64     | OFDM                  | BPSK            | 6.5              |
| 802.11ac (VHT40) | 5500-5700<br>5500-5700 | 54 to 62<br>102 to 134 | 102, 110, 134  | OFDM                  | BPSK            | 13.5             |

### **Test Condition:**

| Applicable To | Environmental Conditions | Input Power  | Tested By    |
|---------------|--------------------------|--------------|--------------|
| RE $\geq$ 1G  | 23deg. C, 68%RH          | 120Vac, 60Hz | Robert Cheng |
| RE<1G         | 23deg. C, 68%RH          | 120Vac, 60Hz | Robert Cheng |
| PLC           | 25deg. C, 75%RH          | 120Vac, 60Hz | Andy Ho      |
| APCM          | 25deg. C, 60%RH          | 120Vac, 60Hz | Robert Cheng |

### 3.3 Duty Cycle of Test Signal

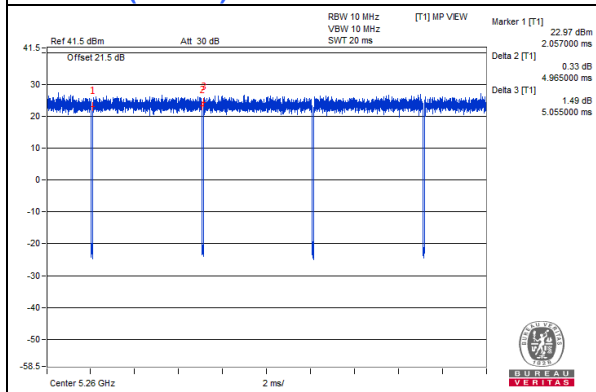
If duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

If duty cycle of test signal is  $< 98\%$ , duty factor shall be considered.

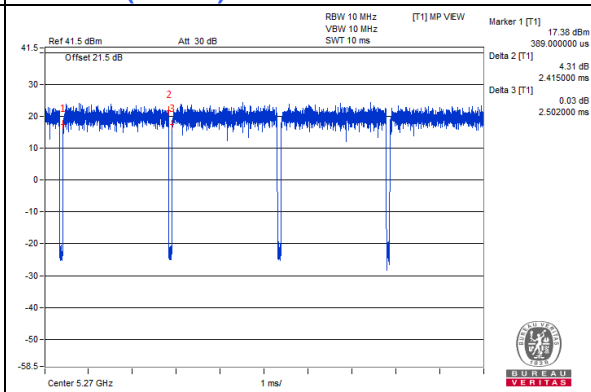
**802.11ac (VHT20):** Duty cycle =  $4.965 \text{ ms} / 5.055 \text{ ms} = 0.982$

**802.11ac (VHT40):** Duty cycle =  $2.415 \text{ ms} / 2.502 \text{ ms} = 0.965$ , Duty factor =  $10 * \log(1/\text{Duty cycle}) = 0.15$

**802.11ac (VHT20)**



**802.11ac (VHT40)**



### 3.4 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.

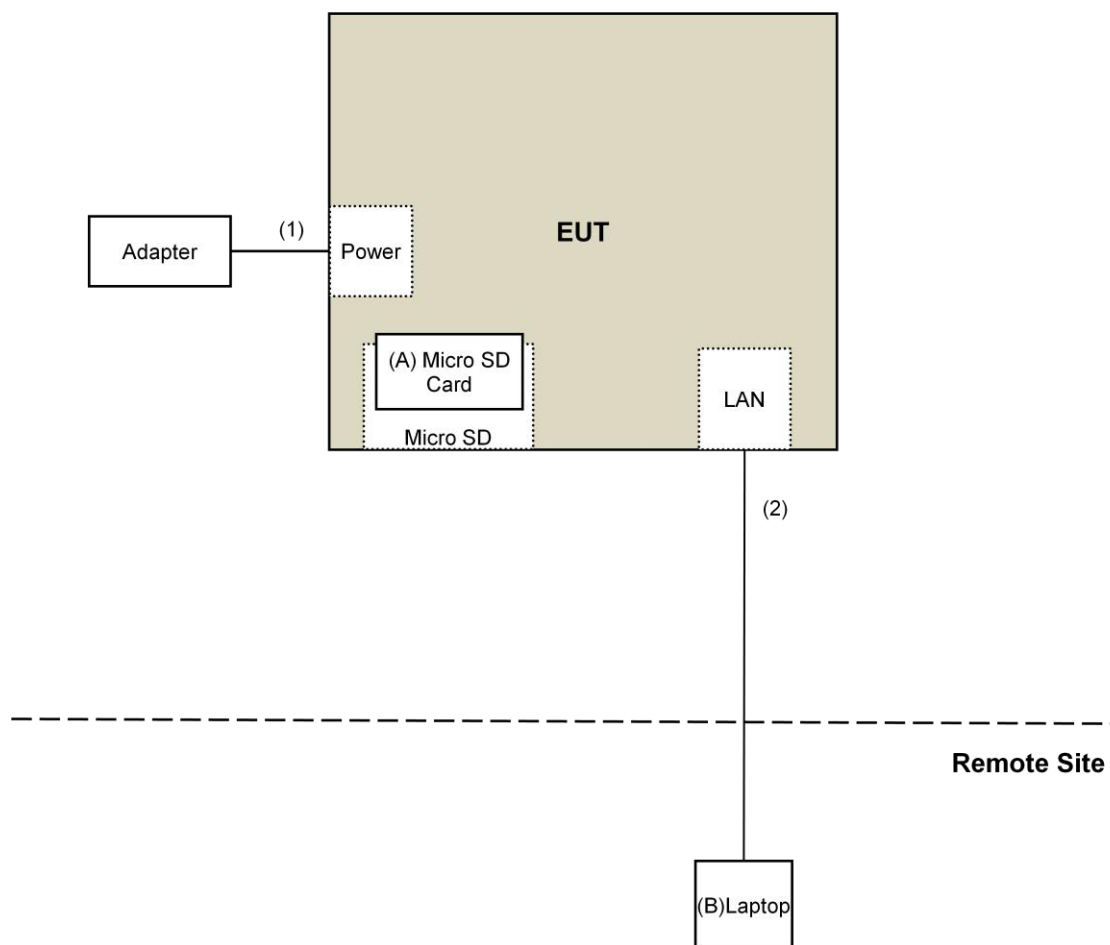
| ID | Product      | Brand   | Model No. | Serial No. | FCC ID  | Remarks         |
|----|--------------|---------|-----------|------------|---------|-----------------|
| A. | MicroSD Card | SanDisk | 8GB       | NA         | NA      | Provided by Lab |
| B. | Laptop       | DELL    | E6420     | B92T3R1    | FCC DoC | Provided by Lab |

Note:

1. All power cords of the above support units are non-shielded (1.8m).

| ID | Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks            |
|----|--------------|------|------------|--------------------|--------------|--------------------|
| 1. | DC Cable     | 1    | 1.8        | No                 | 0            | Supplied by client |
| 2. | RJ-45 Cable  | 1    | 10         | No                 | 0            | Provided by Lab    |

#### 3.4.1 Configuration of System under Test



### 3.5 General Description of Applied Standard

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

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

**KDB 789033 D02 General UNII Test Procedure New Rules v02r01**

**KDB 662911 D01 Multiple Transmitter Output v02r01**

**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.

| 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:

- The lower limit shall apply at the transition frequencies.
- Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 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 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

For radiated emission test:

| DESCRIPTION & MANUFACTURER              | MODEL NO.            | SERIAL NO.  | CALIBRATED DATE | CALIBRATED UNTIL |
|---|----------------------|-------------|-----------------|------------------|
| Test Receiver<br>Agilent                | N9038A               | MY50010156  | July 12, 2018   | July 11, 2019    |
| Pre-Amplifier<br>EMCI                   | EMC001340            | 980142      | Jan. 25, 2019   | Jan. 24, 2020    |
| Loop Antenna<br>Electro-Metrics         | EM-6879              | 269         | Sep. 07, 2018   | Sep. 06, 2019    |
| RF Cable                                | NA                   | LOOPCAB-001 | Jan. 14, 2019   | Jan. 13, 2020    |
| RF Cable                                | NA                   | LOOPCAB-002 | Jan. 14, 2019   | Jan. 13, 2020    |
| Pre-Amplifier<br>Mini-Circuits          | ZFL-1000VH2B         | AMP-ZFL-05  | Apr. 30, 2019   | Apr. 29, 2020    |
| Trilog Broadband Antenna<br>SCHWARZBECK | VULB 9168            | 9168-361    | Nov. 22, 2018   | Nov. 21, 2019    |
| RF Cable                                | 8D                   | 966-3-1     | Mar. 18, 2019   | Mar. 17, 2020    |
| RF Cable                                | 8D                   | 966-3-2     | Mar. 18, 2019   | Mar. 17, 2020    |
| RF Cable                                | 8D                   | 966-3-3     | Mar. 18, 2019   | Mar. 17, 2020    |
| Fixed attenuator<br>Mini-Circuits       | UNAT-5+              | PAD-3m-3-01 | Sep. 27, 2018   | Sep. 26, 2019    |
| Horn_Antenna<br>SCHWARZBECK             | BBHA9120-D           | 9120D-406   | Nov. 25, 2018   | Nov. 24, 2019    |
| Pre-Amplifier<br>EMCI                   | EMC12630SE           | 980384      | Jan. 28, 2019   | Jan. 27, 2020    |
| RF Cable                                | EMC104-SM-SM-1200    | 160922      | Jan. 28, 2019   | Jan. 27, 2020    |
| RF Cable                                | EMC104-SM-SM-2000    | 180601      | June 10, 2019   | June 09, 2020    |
| RF Cable                                | EMC104-SM-SM-6000    | 180602      | June 10, 2019   | June 09, 2020    |
| Spectrum Analyzer<br>Keysight           | N9030A               | MY54490679  | July 23, 2018   | July 22, 2019    |
| Pre-Amplifier<br>EMCI                   | EMC184045SE          | 980387      | Jan. 28, 2019   | Jan. 27, 2020    |
| Horn_Antenna<br>SCHWARZBECK             | BBHA 9170            | BBHA9170519 | Nov. 25, 2018   | Nov. 24, 2019    |
| RF Cable                                | EMC102-KM-KM-1200    | 160924      | Jan. 28, 2019   | Jan. 27, 2020    |
| RF Cable                                | EMC102-KM-KM-1200    | 160925      | Jan. 28, 2019   | Jan. 27, 2020    |
| Software                                | ADT_Radiated_V8.7.08 | NA          | NA              | NA               |
| Antenna Tower & Turn Table<br>Max-Full  | MF-7802              | MF780208406 | 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 966 Chamber No. 3.
3. Loop antenna was used for all emissions below 30 MHz.
4. Tested Date: June 28 to July 01, 2019



For other test:

| DESCRIPTION & MANUFACTURER | MODEL NO. | SERIAL NO. | CALIBRATED DATE | CALIBRATED UNTIL |
|----------------------------|-----------|------------|-----------------|------------------|
| Spectrum Analyzer<br>R&S   | FSV40     | 100964     | June 20, 2018   | June 19, 2019    |
| Power meter<br>Anritsu     | ML2495A   | 1014008    | May 13, 2019    | May 12, 2020     |
| Power sensor<br>Anritsu    | MA2411B   | 0917122    | May 13, 2019    | May 12, 2020     |

- NOTE:**
1. The test was performed in Oven room 2.
  2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
  3. Tested Date: June 02, 2019

#### 4.1.3 Test Procedure

##### **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 detects 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:**

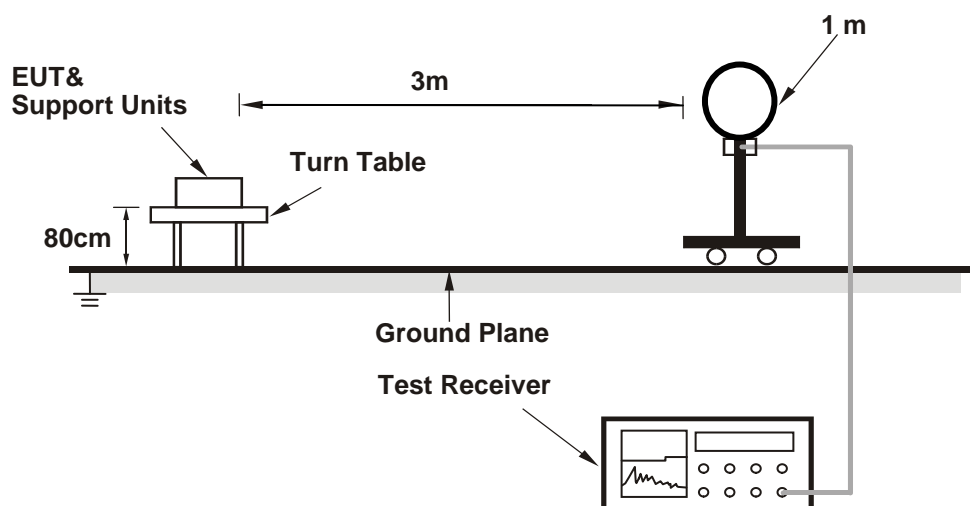
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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

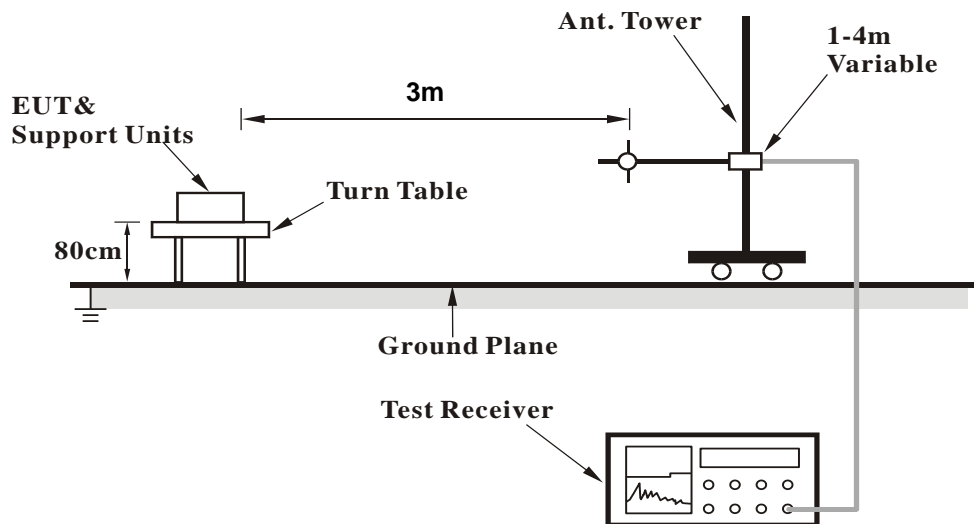
No deviation.

#### 4.1.5 Test Setup

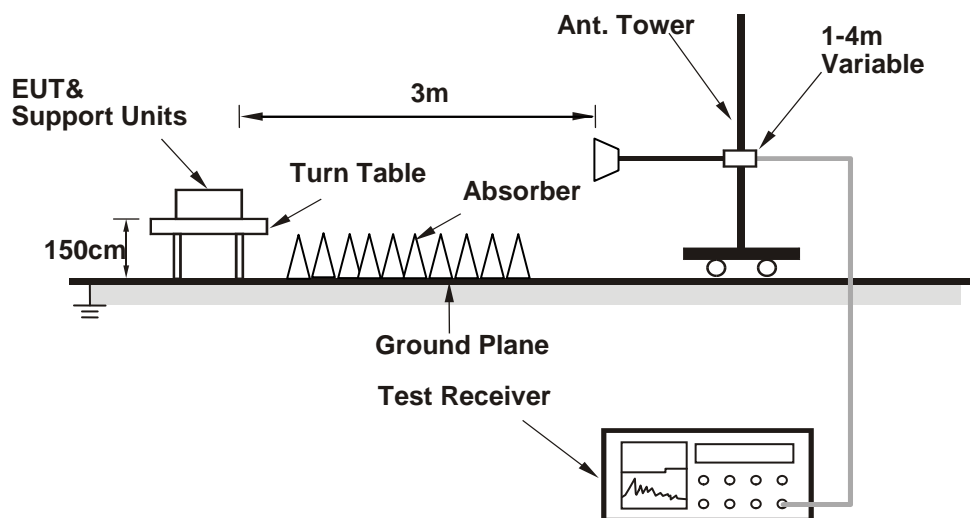
##### For Radiated emission below 30MHz



##### 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 Condition

- Connected the EUT with the Laptop which is placed on remote site.
- Controlling software (QDART-connectivity (1.0.40)) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

#### 4.1.7 Test Results

##### Above 1GHz Data:

##### 802.11ac (VHT20)

|                        |               |                              |              |
|------------------------|---------------|------------------------------|--------------|
| <b>CHANNEL</b>         | TX Channel 52 | <b>DETECTOR<br/>FUNCTION</b> | Peak (PK)    |
| <b>FREQUENCY RANGE</b> | 1GHz ~ 40GHz  |                              | Average (AV) |

| 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   | 5150.00        | 45.6 PK                       | 74.0              | -28.4          | 1.53 H                   | 328                        | 42.3                   | 3.3                            |
| 2   | 5150.00        | 35.5 AV                       | 54.0              | -18.5          | 1.53 H                   | 328                        | 32.2                   | 3.3                            |
| 3   | *5260.00       | 107.1 PK                      |                   |                | 1.53 H                   | 328                        | 104.4                  | 2.7                            |
| 4   | *5260.00       | 97.5 AV                       |                   |                | 1.53 H                   | 328                        | 94.8                   | 2.7                            |
| 5   | #10520.00      | 45.6 PK                       | 68.2              | -22.6          | 1.52 H                   | 114                        | 33.0                   | 12.6                           |
| 6   | 15780.00       | 48.0 PK                       | 74.0              | -26.0          | 1.42 H                   | 71                         | 36.0                   | 12.0                           |
| 7   | 15780.00       | 35.3 AV                       | 54.0              | -18.7          | 1.42 H                   | 71                         | 23.3                   | 12.0                           |
| 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   | 5150.00        | 49.8 PK                       | 74.0              | -24.2          | 1.75 V                   | 281                        | 46.5                   | 3.3                            |
| 2   | 5150.00        | 39.8 AV                       | 54.0              | -14.2          | 1.75 V                   | 281                        | 36.5                   | 3.3                            |
| 3   | *5260.00       | 116.1 PK                      |                   |                | 1.75 V                   | 281                        | 113.4                  | 2.7                            |
| 4   | *5260.00       | 105.2 AV                      |                   |                | 1.75 V                   | 281                        | 102.5                  | 2.7                            |
| 5   | #10520.00      | 45.4 PK                       | 68.2              | -22.8          | 1.64 V                   | 230                        | 32.8                   | 12.6                           |
| 6   | 15780.00       | 48.9 PK                       | 74.0              | -25.1          | 1.93 V                   | 302                        | 36.9                   | 12.0                           |
| 7   | 15780.00       | 36.3 AV                       | 54.0              | -17.7          | 1.93 V                   | 302                        | 24.3                   | 12.0                           |

#### 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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

|                        |               |                              |              |
|------------------------|---------------|------------------------------|--------------|
| <b>CHANNEL</b>         | TX Channel 60 | <b>DETECTOR<br/>FUNCTION</b> | Peak (PK)    |
| <b>FREQUENCY RANGE</b> | 1GHz ~ 40GHz  |                              | Average (AV) |

| 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   | *5300.00       | 107.4 PK                      |                   |                | 1.44 H                   | 355                        | 104.6                  | 2.8                            |
| 2   | *5300.00       | 97.9 AV                       |                   |                | 1.44 H                   | 355                        | 95.1                   | 2.8                            |
| 3   | 10600.00       | 45.9 PK                       | 74.0              | -28.1          | 1.58 H                   | 89                         | 33.4                   | 12.5                           |
| 4   | 10600.00       | 34.0 AV                       | 54.0              | -20.0          | 1.58 H                   | 89                         | 21.5                   | 12.5                           |
| 5   | 15900.00       | 48.7 PK                       | 74.0              | -25.3          | 1.24 H                   | 52                         | 36.4                   | 12.3                           |
| 6   | 15900.00       | 36.0 AV                       | 54.0              | -18.0          | 1.24 H                   | 52                         | 23.7                   | 12.3                           |
| 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   | *5300.00       | 116.7 PK                      |                   |                | 1.79 V                   | 258                        | 113.9                  | 2.8                            |
| 2   | *5300.00       | 105.8 AV                      |                   |                | 1.79 V                   | 258                        | 103.0                  | 2.8                            |
| 3   | 10600.00       | 45.0 PK                       | 74.0              | -29.0          | 1.52 V                   | 194                        | 32.5                   | 12.5                           |
| 4   | 10600.00       | 33.1 AV                       | 54.0              | -20.9          | 1.52 V                   | 194                        | 20.6                   | 12.5                           |
| 5   | 15900.00       | 48.6 PK                       | 74.0              | -25.4          | 2.06 V                   | 311                        | 36.3                   | 12.3                           |
| 6   | 15900.00       | 35.9 AV                       | 54.0              | -18.1          | 2.06 V                   | 311                        | 23.6                   | 12.3                           |

**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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.

|                        |               |                              |              |
|------------------------|---------------|------------------------------|--------------|
| <b>CHANNEL</b>         | TX Channel 64 | <b>DETECTOR<br/>FUNCTION</b> | Peak (PK)    |
| <b>FREQUENCY RANGE</b> | 1GHz ~ 40GHz  |                              | Average (AV) |

| 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   | *5320.00       | 106.9 PK                      |                   |                | 1.55 H                   | 317                        | 104.1                  | 2.8                            |
| 2   | *5320.00       | 97.4 AV                       |                   |                | 1.55 H                   | 317                        | 94.6                   | 2.8                            |
| 3   | 5350.00        | 64.0 PK                       | 74.0              | -10.0          | 1.55 H                   | 317                        | 61.0                   | 3.0                            |
| 4   | 5350.00        | 47.2 AV                       | 54.0              | -6.8           | 1.55 H                   | 317                        | 44.2                   | 3.0                            |
| 5   | 10640.00       | 45.0 PK                       | 74.0              | -29.0          | 1.58 H                   | 134                        | 32.5                   | 12.5                           |
| 6   | 10640.00       | 33.3 AV                       | 54.0              | -20.7          | 1.58 H                   | 134                        | 20.8                   | 12.5                           |
| 7   | 15960.00       | 48.7 PK                       | 74.0              | -25.3          | 1.25 H                   | 48                         | 36.0                   | 12.7                           |
| 8   | 15960.00       | 35.9 AV                       | 54.0              | -18.1          | 1.25 H                   | 48                         | 23.2                   | 12.7                           |
| 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   | *5320.00       | 116.3 PK                      |                   |                | 1.76 V                   | 264                        | 113.5                  | 2.8                            |
| 2   | *5320.00       | 105.2 AV                      |                   |                | 1.76 V                   | 264                        | 102.4                  | 2.8                            |
| 3   | 5350.00        | 67.3 PK                       | 74.0              | -6.7           | 1.76 V                   | 264                        | 64.3                   | 3.0                            |
| 4   | 5350.00        | 52.2 AV                       | 54.0              | -1.8           | 1.76 V                   | 264                        | 49.2                   | 3.0                            |
| 5   | 10640.00       | 45.0 PK                       | 74.0              | -29.0          | 1.55 V                   | 233                        | 32.5                   | 12.5                           |
| 6   | 10640.00       | 33.6 AV                       | 54.0              | -20.4          | 1.55 V                   | 233                        | 21.1                   | 12.5                           |
| 7   | 15960.00       | 49.2 PK                       | 74.0              | -24.8          | 2.11 V                   | 321                        | 36.5                   | 12.7                           |
| 8   | 15960.00       | 36.4 AV                       | 54.0              | -17.6          | 2.11 V                   | 321                        | 23.7                   | 12.7                           |

**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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.

**802.11ac (VHT40)**

|                        |                |                              |              |
|------------------------|----------------|------------------------------|--------------|
| <b>CHANNEL</b>         | TX Channel 102 | <b>DETECTOR<br/>FUNCTION</b> | Peak (PK)    |
| <b>FREQUENCY RANGE</b> | 1GHz ~ 40GHz   |                              | Average (AV) |

| 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   | 5460.00        | 54.6 PK                       | 74.0              | -19.4          | 1.50 H                   | 352                        | 51.3                   | 3.3                            |
| 2   | 5460.00        | 38.6 AV                       | 54.0              | -15.4          | 1.50 H                   | 352                        | 35.3                   | 3.3                            |
| 3   | #5470.00       | 64.3 PK                       | 68.2              | -3.9           | 1.50 H                   | 352                        | 61.0                   | 3.3                            |
| 4   | *5510.00       | 99.8 PK                       |                   |                | 1.50 H                   | 352                        | 96.5                   | 3.3                            |
| 5   | *5510.00       | 90.4 AV                       |                   |                | 1.50 H                   | 352                        | 87.1                   | 3.3                            |
| 6   | 11020.00       | 46.0 PK                       | 74.0              | -28.0          | 1.51 H                   | 122                        | 33.0                   | 13.0                           |
| 7   | 11020.00       | 33.5 AV                       | 54.0              | -20.5          | 1.51 H                   | 122                        | 20.5                   | 13.0                           |
| 8   | #16530.00      | 48.0 PK                       | 68.2              | -20.2          | 1.34 H                   | 64                         | 33.4                   | 14.6                           |
| 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   | 5460.00        | 62.1 PK                       | 74.0              | -11.9          | 1.88 V                   | 255                        | 58.8                   | 3.3                            |
| 2   | 5460.00        | 45.4 AV                       | 54.0              | -8.6           | 1.88 V                   | 255                        | 42.1                   | 3.3                            |
| 3   | #5470.00       | 67.2 PK                       | 68.2              | -1.0           | 1.88 V                   | 255                        | 63.9                   | 3.3                            |
| 4   | *5510.00       | 109.2 PK                      |                   |                | 1.88 V                   | 255                        | 105.9                  | 3.3                            |
| 5   | *5510.00       | 99.5 AV                       |                   |                | 1.88 V                   | 255                        | 96.2                   | 3.3                            |
| 6   | 11020.00       | 45.9 PK                       | 74.0              | -28.1          | 1.51 V                   | 215                        | 32.9                   | 13.0                           |
| 7   | 11020.00       | 34.0 AV                       | 54.0              | -20.0          | 1.51 V                   | 215                        | 21.0                   | 13.0                           |
| 8   | #16530.00      | 48.6 PK                       | 68.2              | -19.6          | 2.00 V                   | 335                        | 34.0                   | 14.6                           |

**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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.



|                        |                |                              |              |
|------------------------|----------------|------------------------------|--------------|
| <b>CHANNEL</b>         | TX Channel 110 | <b>DETECTOR<br/>FUNCTION</b> | Peak (PK)    |
| <b>FREQUENCY RANGE</b> | 1GHz ~ 40GHz   |                              | Average (AV) |

| 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   | *5550.00       | 104.9 PK                      |                   |                | 1.48 H                   | 324                        | 101.6                  | 3.3                            |
| 2   | *5550.00       | 95.1 AV                       |                   |                | 1.48 H                   | 324                        | 91.8                   | 3.3                            |
| 3   | 11100.00       | 46.2 PK                       | 74.0              | -27.8          | 1.60 H                   | 129                        | 33.5                   | 12.7                           |
| 4   | 11100.00       | 33.7 AV                       | 54.0              | -20.3          | 1.60 H                   | 129                        | 21.0                   | 12.7                           |
| 5   | #16650.00      | 48.0 PK                       | 68.2              | -20.2          | 1.47 H                   | 56                         | 32.8                   | 15.2                           |
| 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   | *5550.00       | 112.6 PK                      |                   |                | 1.86 V                   | 285                        | 109.3                  | 3.3                            |
| 2   | *5550.00       | 103.2 AV                      |                   |                | 1.86 V                   | 285                        | 99.9                   | 3.3                            |
| 3   | 11100.00       | 45.9 PK                       | 74.0              | -28.1          | 1.49 V                   | 219                        | 33.2                   | 12.7                           |
| 4   | 11100.00       | 33.8 AV                       | 54.0              | -20.2          | 1.49 V                   | 219                        | 21.1                   | 12.7                           |
| 5   | #16650.00      | 48.2 PK                       | 68.2              | -20.0          | 1.91 V                   | 314                        | 33.0                   | 15.2                           |

**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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

|                        |                |                              |              |
|------------------------|----------------|------------------------------|--------------|
| <b>CHANNEL</b>         | TX Channel 134 | <b>DETECTOR<br/>FUNCTION</b> | Peak (PK)    |
| <b>FREQUENCY RANGE</b> | 1GHz ~ 40GHz   |                              | Average (AV) |

| 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   | *5670.00       | 102.1 PK                      |                   |                | 1.58 H                   | 326                        | 98.7                   | 3.4                            |
| 2   | *5670.00       | 92.7 AV                       |                   |                | 1.58 H                   | 326                        | 89.3                   | 3.4                            |
| 3   | #5725.00       | 62.7 PK                       | 68.2              | -5.5           | 1.58 H                   | 326                        | 59.2                   | 3.5                            |
| 4   | 11340.00       | 46.7 PK                       | 74.0              | -27.3          | 1.51 H                   | 97                         | 33.3                   | 13.4                           |
| 5   | 11340.00       | 34.1 AV                       | 54.0              | -19.9          | 1.51 H                   | 97                         | 20.7                   | 13.4                           |
| 6   | #17010.00      | 48.8 PK                       | 68.2              | -19.4          | 1.41 H                   | 41                         | 32.6                   | 16.2                           |
| 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   | *5670.00       | 111.5 PK                      |                   |                | 1.96 V                   | 280                        | 108.1                  | 3.4                            |
| 2   | *5670.00       | 101.7 AV                      |                   |                | 1.96 V                   | 280                        | 98.3                   | 3.4                            |
| 3   | #5725.00       | 67.7 PK                       | 68.2              | -0.5           | 1.96 V                   | 280                        | 64.2                   | 3.5                            |
| 4   | 11340.00       | 45.4 PK                       | 74.0              | -28.6          | 1.61 V                   | 236                        | 32.0                   | 13.4                           |
| 5   | 11340.00       | 33.2 AV                       | 54.0              | -20.8          | 1.61 V                   | 236                        | 19.8                   | 13.4                           |
| 6   | #17010.00      | 48.5 PK                       | 68.2              | -19.7          | 2.04 V                   | 321                        | 32.3                   | 16.2                           |

**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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " \* ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

# Below 1GHz Data:

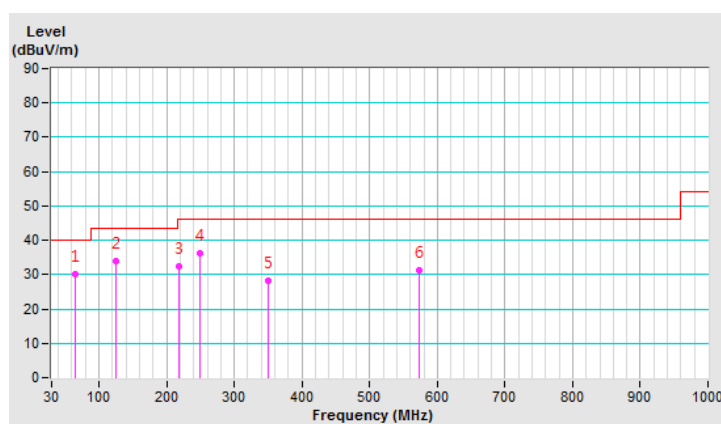
## 802.11ac (VHT20)

|                 |               |                      |                 |
|-----------------|---------------|----------------------|-----------------|
| CHANNEL         | TX Channel 64 | 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   | 64.11          | 30.1 QP                       | 40.0              | -9.9           | 1.95 H                   | 135                        | 39.5                   | -9.4                           |
| 2   | 125.06         | 34.0 QP                       | 43.5              | -9.5           | 1.35 H                   | 95                         | 43.6                   | -9.6                           |
| 3   | 217.40         | 32.4 QP                       | 46.0              | -13.6          | 1.20 H                   | 95                         | 42.3                   | -9.9                           |
| 4   | 249.70         | 36.1 QP                       | 46.0              | -9.9           | 1.35 H                   | 100                        | 44.5                   | -8.4                           |
| 5   | 349.30         | 28.3 QP                       | 46.0              | -17.7          | 1.44 H                   | 277                        | 33.7                   | -5.4                           |
| 6   | 574.10         | 31.3 QP                       | 46.0              | -14.7          | 1.24 H                   | 102                        | 31.2                   | 0.1                            |

### 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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
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.

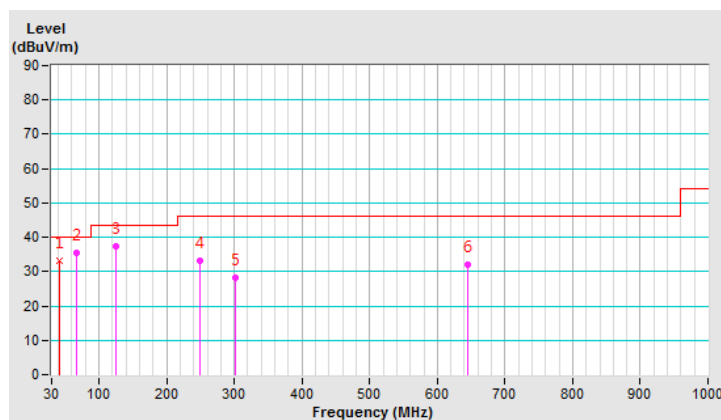


|                        |               |                          |                 |
|------------------------|---------------|--------------------------|-----------------|
| <b>CHANNEL</b>         | TX Channel 64 | <b>DETECTOR FUNCTION</b> | Quasi-Peak (QP) |
| <b>FREQUENCY RANGE</b> | 9kHz ~ 1GHz   |                          |                 |

| 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   | 41.89       | 33.1 QP                 | 40.0           | -6.9        | 1.21 V             | 101                  | 42.1             | -9.0                     |
| 2   | 66.11       | 35.3 QP                 | 40.0           | -4.7        | 1.35 V             | 99                   | 45.0             | -9.7                     |
| 3   | 125.20      | 37.2 QP                 | 43.5           | -6.3        | 1.66 V             | 88                   | 46.8             | -9.6                     |
| 4   | 250.03      | 33.1 QP                 | 46.0           | -12.9       | 1.20 V             | 165                  | 41.4             | -8.3                     |
| 5   | 302.11      | 28.1 QP                 | 46.0           | -17.9       | 1.02 V             | 230                  | 34.6             | -6.5                     |
| 6   | 644.12      | 32.1 QP                 | 46.0           | -13.9       | 1.65 V             | 77                   | 30.4             | 1.7                      |

#### 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. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit of frequency range 30MHz~1000MHz.
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. | CALIBRATED DATE | CALIBRATED UNTIL |
|--|-------------------------|------------|-----------------|------------------|
| Test Receiver<br>R&S   | ESCS 30                 | 847124/029 | Oct. 24, 2018   | Oct. 23, 2019    |
| Line-Impedance<br>Stabilization Network<br>(for EUT)<br>R&S        | ESH3-Z5                 | 848773/004 | Oct. 22, 2018   | Oct. 21, 2019    |
| Line-Impedance<br>Stabilization Network<br>(for Peripheral)<br>R&S | ESH3-Z5                 | 835239/001 | Mar. 17, 2019   | Mar. 16, 2020    |
| 50 ohms Terminator   | N/A                     | 3          | Oct. 22, 2018   | Oct. 21, 2019    |
| RF Cable   | 5D-FB                   | COCCAB-001 | Sep. 28, 2018   | Sep. 27, 2019    |
| Fixed attenuator<br>EMCI   | STI02-2200-10           | 003        | Mar. 14, 2019   | Mar. 13, 2020    |
| Software<br>BVADT  | BVADT_Cond_<br>V7.3.7.4 | NA         | NA              | NA               |

#### Note:

1. The calibration interval of the above test instruments are 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in Conduction 1.
- 3 Tested Date: June 27, 2019

#### 4.2.3 Test Procedure

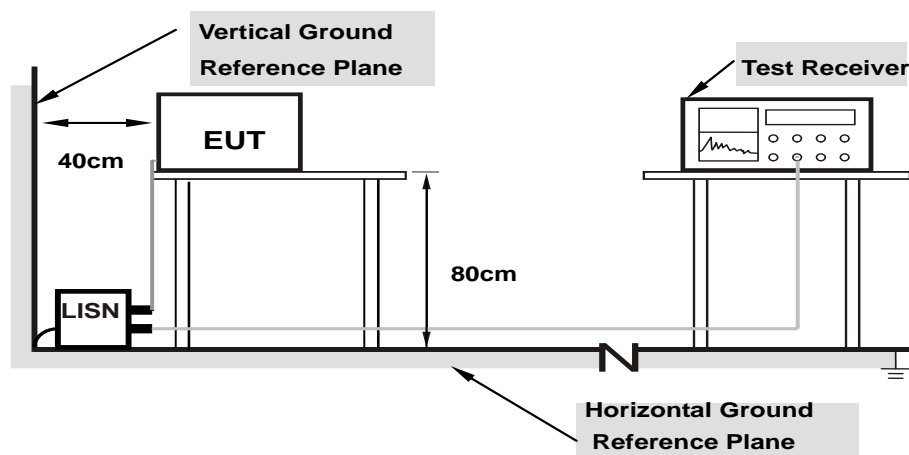
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance 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:** All modes of operation were investigated and the worst-case emissions are reported.

#### 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 Condition

Same as 4.1.6.

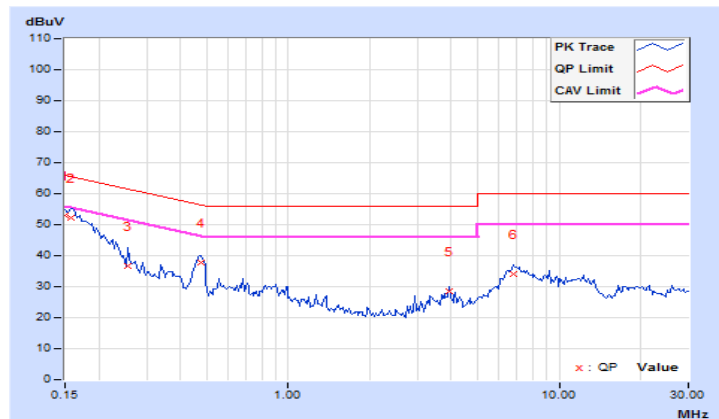
#### 4.2.7 Test Results

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

| No | Freq.<br>[MHz] | Corr.<br>Factor | Reading Value<br>[dB (uV)] |       | Emission Level<br>[dB (uV)] |       | Limit<br>[dB (uV)] |       | Margin<br>(dB) |        |
|----|----------------|-----------------|----------------------------|-------|-----------------------------|-------|--------------------|-------|----------------|--------|
|    |                | (dB)            | Q.P.                       | AV.   | Q.P.                        | AV.   | Q.P.               | AV.   | Q.P.           | AV.    |
|    |                |                 |                            |       |                             |       |                    |       |                |        |
| 1  | 0.15000        | 10.03           | 42.83                      | 26.45 | 52.86                       | 36.48 | 66.00              | 56.00 | -13.14         | -19.52 |
| 2  | 0.15781        | 10.03           | 42.13                      | 28.08 | 52.16                       | 38.11 | 65.58              | 55.58 | -13.42         | -17.47 |
| 3  | 0.25547        | 10.06           | 26.66                      | 13.45 | 36.72                       | 23.51 | 61.58              | 51.58 | -24.86         | -28.07 |
| 4  | 0.47813        | 10.09           | 27.60                      | 18.73 | 37.69                       | 28.82 | 56.37              | 46.37 | -18.68         | -17.55 |
| 5  | 3.93359        | 10.32           | 18.14                      | 11.80 | 28.46                       | 22.12 | 56.00              | 46.00 | -27.54         | -23.88 |
| 6  | 6.78125        | 10.50           | 23.56                      | 18.54 | 34.06                       | 29.04 | 60.00              | 50.00 | -25.94         | -20.96 |

#### 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.

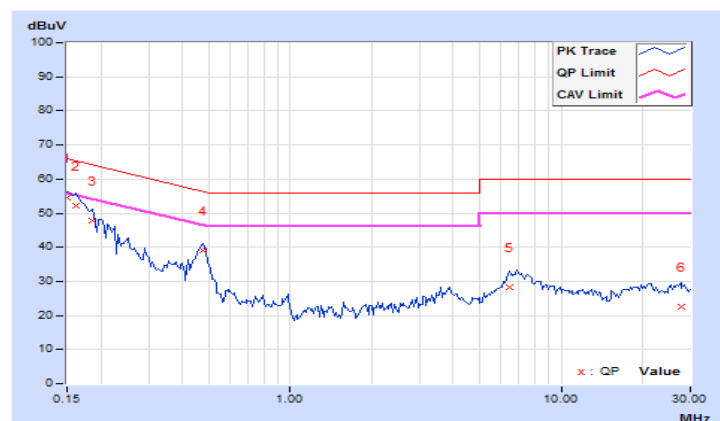


|       |             |                   |                                |
|-------|-------------|-------------------|--------------------------------|
| Phase | Neutral (N) | Detector Function | Quasi-Peak (QP) / Average (AV) |
|-------|-------------|-------------------|--------------------------------|

| No | Freq.    | Corr.  | Reading Value |       | Emission Level |       | Limit     |       | Margin |        |
|----|----------|--------|---------------|-------|----------------|-------|-----------|-------|--------|--------|
|    | [MHz]    | Factor | [dB (uV)]     |       | [dB (uV)]      |       | [dB (uV)] |       | (dB)   |        |
|    |          | (dB)   | Q.P.          | AV.   | Q.P.           | AV.   | Q.P.      | AV.   | Q.P.   | AV.    |
| 1  | 0.15000  | 9.94   | 44.58         | 28.10 | 54.52          | 38.04 | 66.00     | 56.00 | -11.48 | -17.96 |
| 2  | 0.16172  | 9.94   | 42.29         | 25.22 | 52.23          | 35.16 | 65.38     | 55.38 | -13.15 | -20.22 |
| 3  | 0.18516  | 9.95   | 37.87         | 21.04 | 47.82          | 30.99 | 64.25     | 54.25 | -16.43 | -23.26 |
| 4  | 0.47813  | 9.98   | 28.94         | 19.67 | 38.92          | 29.65 | 56.37     | 46.37 | -17.45 | -16.72 |
| 5  | 6.46484  | 10.32  | 17.80         | 12.26 | 28.12          | 22.58 | 60.00     | 50.00 | -31.88 | -27.42 |
| 6  | 27.62500 | 11.27  | 11.44         | 5.90  | 22.71          | 17.17 | 60.00     | 50.00 | -37.29 | -32.83 |

#### 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 Transmit Power Measurement

#### 4.3.1 Limits of Transmit Power Measurement

| Operation Band | EUT Category   |                                   | Limit   |
|----------------|----------------|-----------------------------------|---|
| U-NII-1        |                | Outdoor Access Point              | 1 Watt (30 dBm)<br>(Max. e.i.r.p $\leq$ 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon) |
|                |                | Fixed point-to-point Access Point | 1 Watt (30 dBm)   |
|                |                | Indoor Access Point               | 1 Watt (30 dBm)   |
|                |                | Client device                     | 250mW (24 dBm)  |
| U-NII-2A       | $\sqrt{\quad}$ |                                   | 250mW (24 dBm) or 11 dBm+10 log B*  |
| U-NII-2C       | $\sqrt{\quad}$ |                                   | 250mW (24 dBm) or 11 dBm+10 log B*  |
| U-NII-3        |                |                                   | 1 Watt (30 dBm)   |

\*B is the 26 dB emission bandwidth in megahertz

Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices,

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

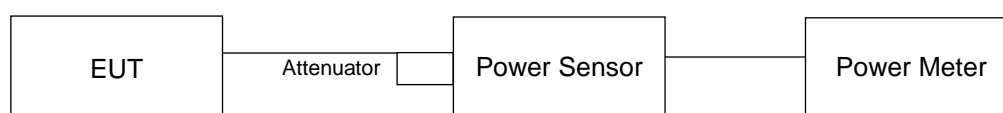
Array Gain = 0 dB (i.e., no array gain) for channel widths  $\geq 40$  MHz for any  $N_{ANT}$ ;

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

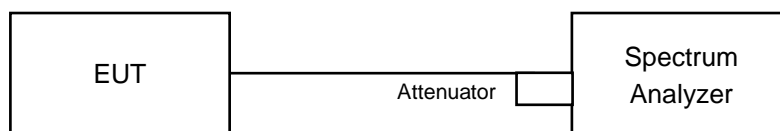
For power measurements on all other devices: Array Gain =  $10 \log(N_{ANT}/N_{SS})$  dB.

#### 4.3.2 Test Setup

##### FOR POWER OUTPUT MEASUREMENT



##### FOR 26dB OCCUPIED BANDWIDTH



#### 4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4 Test Procedure

##### For Average Power Measurement

Method PM is 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.

##### FOR 26dB OCCUPIED BANDWIDTH

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

#### 4.3.5 Deviation from Test Standard

No deviation.

#### 4.3.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

#### 4.3.7 Test Result

##### 802.11ac (VHT20)

##### Power Output:

| Chan. | Chan. Freq. (MHz) | Maximum Conducted Power (dBm) |         | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|-------|-------------------|-------------------------------|---------|------------------|-------------------|-------------|-------------|
|       |                   | Chain 0                       | Chain 1 |                  |                   |             |             |
| 52    | 5260              | 20.87                         | 20.61   | 237.26           | 23.75             | 24.00       | Pass        |
| 60    | 5300              | 20.98                         | 20.63   | 240.925          | 23.82             | 24.00       | Pass        |
| 64    | 5320              | 20.87                         | 20.85   | 243.799          | 23.87             | 24.00       | Pass        |

##### 26dB BANDWIDTH:

| Channel | Frequency (MHz) | 26dBc Bandwidth (MHz) |         |
|---------|-----------------|-----------------------|---------|
|         |                 | Chain 0               | Chain 1 |
| 52      | 5260            | 20.95                 | 21.51   |
| 60      | 5300            | 20.93                 | 21.24   |
| 64      | 5320            | 20.76                 | 22.48   |

**Note: For U-NII-2A Band output power limitation is determined based on 26dBc bandwidth.**

| Power Limit = 11dBm + 10logB < U-NII-2A > |            |             |                                  |
|---|------------|-------------|----------------------------------|
| Channel Number                            | Freq.(MHz) | Min. B(MHz) | Determined Conducted Limit (dBm) |
| 52  | 5260       | 20.95       | 24.21 > 24                       |
| 60  | 5300       | 20.93       | 24.2 > 24                        |
| 64  | 5320       | 20.76       | 24.17 > 24                       |

## 802.11ac (VHT40)

### Power Output:

| Chan. | Chan. Freq. (MHz) | Maximum Conducted Power (dBm) |         | Total Power (mW) | Total Power (dBm) | Limit (dBm) | Pass / Fail |
|-------|-------------------|-------------------------------|---------|------------------|-------------------|-------------|-------------|
|       |                   | Chain 0                       | Chain 1 |                  |                   |             |             |
| 102   | 5510              | 17.31                         | 17.24   | 106.793          | 20.29             | 24.00       | Pass        |
| 110   | 5550              | 20.71                         | 20.97   | 242.787          | 23.85             | 24.00       | Pass        |
| 134   | 5670              | 18.91                         | 18.92   | 155.787          | 21.93             | 24.00       | Pass        |

### 26dB BANDWIDTH:

| Channel | Frequency (MHz) | 26dBc Bandwidth (MHz) |         |
|---------|-----------------|-----------------------|---------|
|         |                 | Chain 0               | Chain 1 |
| 102     | 5510            | 40.92                 | 40.87   |
| 110     | 5550            | 40.96                 | 41.96   |
| 134     | 5670            | 41.02                 | 40.81   |

**Note: For U-NII-2C Band output power limitation is determined based on 26dBc bandwidth.**

| Power Limit = 11dBm + 10logB < U-NII-2C > |            |             |                                  |
|---|------------|-------------|----------------------------------|
| Channel Number                            | Freq.(MHz) | Min. B(MHz) | Determined Conducted Limit (dBm) |
| 102                                       | 5510       | 40.87       | 27.11 > 24                       |
| 110                                       | 5550       | 40.96       | 27.12 > 24                       |
| 134                                       | 5670       | 40.81       | 27.1 > 24                        |

## 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 according to ISO/IEC 17025.

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

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

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