

## FCC Test Report (Co-Located)

**Report No.:** RF200427C09-6 R2

**FCC ID:** A4RGUIK2

**Model Name:** GUIK2

**Received Date:** Apr. 27, 2020

**Test Date:** Jun. 03 ~ Jun. 19, 2020

**Issued Date:** Jan. 06, 2021

**Applicant:** Google LLC

**Address:** 1600 Amphitheatre Parkway, Mountain View, CA 94043, USA

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

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33383, TAIWAN

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



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### Release Control Record

| Issue No.        | Description                               | Date Issued   |
|------------------|-------------------------------------------|---------------|
| RF200427C09-6    | Original Release                          | Jun. 20, 2020 |
| RF200427C09-6 R1 | Updated power supply rating               | Jun. 30, 2020 |
| RF200427C09-6 R2 | Revised frequency of 60GHz Tx Transmitter | Jan. 06, 2021 |

## 1 Certificate of Conformity

**Product:** Interactive Device

**Model Name:** GUIK2

**Sample Status:** Engineering Sample

**Applicant:** Google LLC

**Test Date:** Jun. 03 ~ Jun. 19, 2020

**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 :**



**Date:**

Jan. 06, 2021

Gina Liu / Specialist

**Approved by :**



**Date:**

Jan. 06, 2021

Dylan Chiou / Senior 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                                                                             |
| 15.205 / 15.209<br>/<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 -1.69 dB at 2483.5 MHz. |

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) (±) |
|--------------------------------|--------------------|--------------------------------|
| Radiated Emissions up to 1 GHz | 9 kHz ~ 30 MHz     | 3.04 dB                        |
|                                | 30 MHz ~ 200 MHz   | 2.93 dB                        |
|                                | 200 MHz ~ 1000 MHz | 2.95 dB                        |
| Radiated Emissions above 1 GHz | 1 GHz ~ 18 GHz     | 2.26 dB                        |
|                                | 18 GHz ~ 40 GHz    | 1.94 dB                        |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                     |                      |                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product             | Interactive Device   |                                                                                                                                                                                                                                                                                                                                                                                                               |
| Model Name          | GUIK2                |                                                                                                                                                                                                                                                                                                                                                                                                               |
| Status of EUT       | Engineering Sample   |                                                                                                                                                                                                                                                                                                                                                                                                               |
| Power Supply Rating | 14.0 Vdc (adapter)   |                                                                                                                                                                                                                                                                                                                                                                                                               |
| Modulation Type     | WLAN                 | 256QAM, 64QAM, 16QAM, QPSK, BPSK                                                                                                                                                                                                                                                                                                                                                                              |
|                     | Bluetooth EDR        | GFSK, $\pi/4$ -DQPSK, 8DPSK                                                                                                                                                                                                                                                                                                                                                                                   |
|                     | Thread               | O-QPSK                                                                                                                                                                                                                                                                                                                                                                                                        |
|                     | 60GHz Tx Transmitter | FMCW                                                                                                                                                                                                                                                                                                                                                                                                          |
| Transfer Rate       | WLAN                 | 802.11a: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0 Mbps<br>802.11n: up to 150.0 Mbps<br>802.11ac: up to 433.3 Mbps                                                                                                                                                                                                                                                                                         |
|                     | Bluetooth EDR        | 1/2/3 Mbps                                                                                                                                                                                                                                                                                                                                                                                                    |
|                     | Thread               | 250 kbps                                                                                                                                                                                                                                                                                                                                                                                                      |
|                     | 60GHz Tx Transmitter | N/A                                                                                                                                                                                                                                                                                                                                                                                                           |
| Operating Frequency | WLAN                 | 5180 ~ 5240 MHz, 5260 ~ 5320 MHz, 5500 ~ 5720 MHz, 5745 ~ 5825 MHz                                                                                                                                                                                                                                                                                                                                            |
|                     | Bluetooth EDR        | 2402 ~ 2480 MHz                                                                                                                                                                                                                                                                                                                                                                                               |
|                     | Thread               | 2405 ~ 2475 MHz                                                                                                                                                                                                                                                                                                                                                                                               |
|                     | 60GHz Tx Transmitter | 58 ~ 63.5 GHz                                                                                                                                                                                                                                                                                                                                                                                                 |
| Number of Channel   | WLAN                 | 5180 ~ 5240 MHz: 4 for 802.11a, 802.11n (HT20)<br>2 for 802.11n (HT40)<br>1 for 802.11ac (VHT80)<br>5260 ~ 5320 MHz: 4 for 802.11a, 802.11n (HT20)<br>2 for 802.11n (HT40)<br>1 for 802.11ac (VHT80)<br>5500 ~ 5720 MHz: 12 for 802.11a, 802.11n (HT20)<br>6 for 802.11n (HT40)<br>3 for 802.11ac (VHT80)<br>5745 ~ 5825 MHz: 5 for 802.11a, 802.11n (HT20)<br>2 for 802.11n (HT40)<br>1 for 802.11ac (VHT80) |
|                     | Bluetooth EDR        | 79                                                                                                                                                                                                                                                                                                                                                                                                            |
|                     | Thread               | 15                                                                                                                                                                                                                                                                                                                                                                                                            |
|                     | 60GHz Tx Transmitter | 1                                                                                                                                                                                                                                                                                                                                                                                                             |
| Output Power        | WLAN                 | 68.549 mW for 5180 ~ 5240 MHz<br>65.013 mW for 5260 ~ 5320 MHz<br>66.069 mW for 5500 ~ 5720 MHz<br>59.979 mW for 5745 ~ 5825 MHz                                                                                                                                                                                                                                                                              |
|                     | Bluetooth EDR        | 8.511 mW                                                                                                                                                                                                                                                                                                                                                                                                      |
|                     | Thread               | 104.954 mW                                                                                                                                                                                                                                                                                                                                                                                                    |
|                     | 60GHz Tx Transmitter | 19.953 mW                                                                                                                                                                                                                                                                                                                                                                                                     |

|                   |                                                           |                                                                                                                                                                                                              |
|-------------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Antenna Type      | WLAN                                                      | PIFA antenna with 4.0 dBi gain (5180 ~ 5240 MHz)<br>PIFA antenna with 4.0 dBi gain (5260 ~ 5320 MHz)<br>PIFA antenna with 4.0 dBi gain (5500 ~ 5720 MHz)<br>PIFA antenna with 4.8 dBi gain (5745 ~ 5825 MHz) |
|                   | Bluetooth EDR                                             | PIFA antenna with 4.3 dBi gain                                                                                                                                                                               |
|                   | Thread                                                    | PIFA antenna with 3.0 dBi gain                                                                                                                                                                               |
|                   | 60GHz Tx Transmitter                                      | Microstrip Patch <input checked="" type="checkbox"/> Integral <input type="checkbox"/> Exremal                                                                                                               |
| Antenna Connector | WLAN                                                      | i-pex(MHF)                                                                                                                                                                                                   |
|                   | Bluetooth EDR                                             |                                                                                                                                                                                                              |
|                   | Thread                                                    |                                                                                                                                                                                                              |
|                   | 60GHz Tx Transmitter                                      | N/A                                                                                                                                                                                                          |
| SN                | 1J365004810040204Q00135(MLB SN)<br>SEM000061016 (FATP SN) |                                                                                                                                                                                                              |
| Accessory Device  | Refer to Note as below                                    |                                                                                                                                                                                                              |
| Cable Supplied    | Refer to Note as below                                    |                                                                                                                                                                                                              |

Note:

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

| Modulation Mode  | Tx Function |
|------------------|-------------|
| 802.11a          | 1TX         |
| 802.11n (HT20)   | 1TX         |
| 802.11n (HT40)   | 1TX         |
| 802.11ac (VHT20) | 1TX         |
| 802.11ac (VHT40) | 1TX         |
| 802.11ac (VHT80) | 1TX         |

\* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40, therefore investigated worst case to representative mode in test report. (Final test mode refer section 3.2.1)

2. The EUT accessories list refers to EUT Photo.pdf.
3. The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
4. 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 5180 ~ 5240 MHz

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

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

2 channels are provided for 802.11n (HT40):

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

1 channel is provided for 802.11ac (VHT80):

| Channel | Frequency (MHz) |
|---------|-----------------|
| 42      | 5210            |

#### For 5260 ~ 5320 MHz

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

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

2 channels are provided for 802.11n (HT40):

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

1 channel is provided for 802.11ac (VHT80):

| Channel | Frequency (MHz) |
|---------|-----------------|
| 58      | 5290            |

### For 5500 ~ 5720 MHz

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

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 100     | 5500            | 124     | 5620            |
| 104     | 5520            | 128     | 5640            |
| 108     | 5540            | 132     | 5660            |
| 112     | 5560            | 136     | 5680            |
| 116     | 5580            | 140     | 5700            |
| 120     | 5600            | 144     | 5720            |

6 channels are provided for 802.11n (HT40):

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 102     | 5510            | 126     | 5630            |
| 110     | 5550            | 134     | 5670            |
| 118     | 5590            | 142     | 5710            |

3 channels are provided for 802.11ac (VHT80):

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 106     | 5530            | 138     | 5690            |
| 122     | 5610            |         |                 |

### For 5745 ~ 5825 MHz:

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

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

2 channels are provided for 802.11n (HT40):

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

1 channel is provided for 802.11ac (VHT80):

| Channel | Frequency (MHz) |
|---------|-----------------|
| 155     | 5775            |

### For Bluetooth EDR:

79 channels are provided to this EUT:

| Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|---------|-------------|---------|-------------|---------|-------------|---------|-------------|
| 0       | 2402        | 20      | 2422        | 40      | 2442        | 60      | 2462        |
| 1       | 2403        | 21      | 2423        | 41      | 2443        | 61      | 2463        |
| 2       | 2404        | 22      | 2424        | 42      | 2444        | 62      | 2464        |
| 3       | 2405        | 23      | 2425        | 43      | 2445        | 63      | 2465        |
| 4       | 2406        | 24      | 2426        | 44      | 2446        | 64      | 2466        |
| 5       | 2407        | 25      | 2427        | 45      | 2447        | 65      | 2467        |
| 6       | 2408        | 26      | 2428        | 46      | 2448        | 66      | 2468        |
| 7       | 2409        | 27      | 2429        | 47      | 2449        | 67      | 2469        |
| 8       | 2410        | 28      | 2430        | 48      | 2450        | 68      | 2470        |
| 9       | 2411        | 29      | 2431        | 49      | 2451        | 69      | 2471        |
| 10      | 2412        | 30      | 2432        | 50      | 2452        | 70      | 2472        |
| 11      | 2413        | 31      | 2433        | 51      | 2453        | 71      | 2473        |
| 12      | 2414        | 32      | 2434        | 52      | 2454        | 72      | 2474        |
| 13      | 2415        | 33      | 2435        | 53      | 2455        | 73      | 2475        |
| 14      | 2416        | 34      | 2436        | 54      | 2456        | 74      | 2476        |
| 15      | 2417        | 35      | 2437        | 55      | 2457        | 75      | 2477        |
| 16      | 2418        | 36      | 2438        | 56      | 2458        | 76      | 2478        |
| 17      | 2419        | 37      | 2439        | 57      | 2459        | 77      | 2479        |
| 18      | 2420        | 38      | 2440        | 58      | 2460        | 78      | 2480        |
| 19      | 2421        | 39      | 2441        | 59      | 2461        |         |             |

### For Thread:

15 channels are provided to this EUT:

| Channel | Frequency (MHz) | Channel | Frequency (MHz) |
|---------|-----------------|---------|-----------------|
| 11      | 2405            | 19      | 2445            |
| 12      | 2410            | 20      | 2450            |
| 13      | 2415            | 21      | 2455            |
| 14      | 2420            | 22      | 2460            |
| 15      | 2425            | 23      | 2465            |
| 16      | 2430            | 24      | 2470            |
| 17      | 2435            | 25      | 2475            |
| 18      | 2440            |         |                 |

### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT Configure Mode | Applicable To |       |    | Description |
|--------------------|---------------|-------|----|-------------|
|                    | RE $\geq$ 1G  | RE<1G | OB |             |
| -                  | √             | √     | √  | -           |

Where **RE $\geq$ 1G**: Radiated Emission above 1 GHz **RE<1G**: Radiated Emission below 1 GHz

**OB**: Conducted Out-Band Emission Measurement

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

Note: For radiated emission test items chosen the worst maximum power 5G and BT radio channel.

#### 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 |
|--------------------|----------------------------|-------------------|-------------------|----------------|-----------------------|
| -                  | BT EDR + 802.11 a + Thread | 2402 ~ 2480       | 0 to 78           | 78 + 40 + 11   | FHSS                  |
|                    |                            | 5180-5240         | 36 to 48          |                | BPSK                  |
|                    |                            | 2450 ~ 2475       | 11 to 25          |                | O-QPSK                |

Note: 60GHz Tx Transmitter is always on.

#### 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 |
|--------------------|----------------------------|-------------------|-------------------|----------------|-----------------------|
| -                  | BT EDR + 802.11 a + Thread | 2402 ~ 2480       | 0 to 78           | 78 + 40 + 11   | FHSS                  |
|                    |                            | 5180-5240         | 36 to 48          |                | BPSK                  |
|                    |                            | 2450 ~ 2475       | 11 to 25          |                | O-QPSK                |

Note: 60GHz Tx Transmitter is always on.

#### Conducted Out-Band Emission Measurement

- ☒ 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 |
|--------------------|------------------|-------------------|-------------------|----------------|-----------------------|
| -                  | BT EDR + 802.11a | 2402 ~ 2480       | 0 to 78           | 78 + 40        | FHSS                  |
|                    |                  | 5180-5240         | 36 to 48          |                | BPSK                  |

Note: Both of the BT EDR and 802.11a can transmit simultaneously at same antenna.

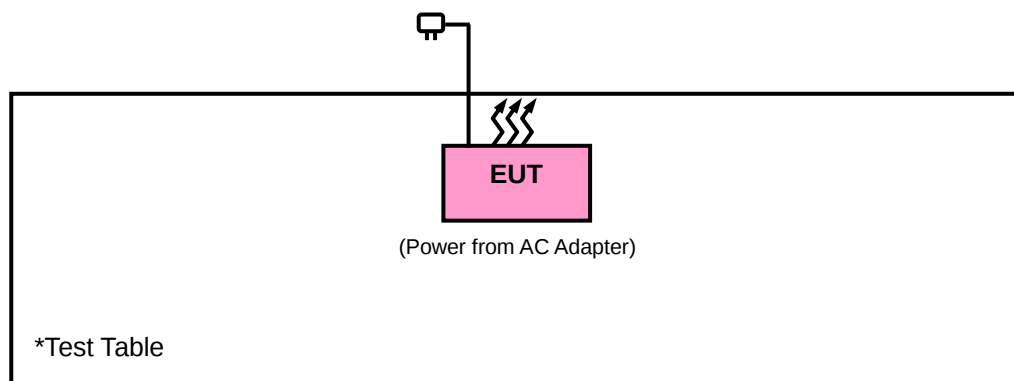
### **Test Condition:**

| Applicable to | Environmental Conditions | Input Power  | Tested by |
|---------------|--------------------------|--------------|-----------|
| RE $\geq$ 1G  | 25 deg. C, 65 % RH       | 120Vac, 60Hz | Tim Chen  |
| RE<1G         | 25 deg. C, 65 % RH       | 120Vac, 60Hz | Tim Chen  |
| OB            | 25 deg. C, 65 % RH       | 120Vac, 60Hz | Tim Chen  |

### **3.3 Description of Support Units**

The EUT has been tested as an independent unit together with other necessary accessories or support units.

#### **3.3.1 Configuration of System under Test**



### **3.4 General Description of Applied Standards**

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

#### **Test Standard:**

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

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

ANSI C63.10-2013

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

#### **References Test Guidance:**

**KDB 558074 D01 15.247 Meas Guidance v05r02**

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

**KDB 414788 D01 Radiated Test Site v01r01**

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

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

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

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

| 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:

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

#### 4.1.2 Test Instruments

| Description & Manufacturer                     | Model No.              | Serial No.                | Date of Calibration | Due Date of Calibration |
|------------------------------------------------|------------------------|---------------------------|---------------------|-------------------------|
| Test Receiver<br>Agilent                       | N9038A                 | MY51210203                | Mar. 18, 2020       | Mar. 17, 2021           |
| Spectrum Analyzer<br>Agilent                   | N9010A                 | MY52220314                | Dec. 12, 2019       | Dec. 11, 2020           |
| Spectrum Analyzer<br>ROHDE & SCHWARZ           | FSU43                  | 101261                    | Apr. 16, 2020       | Apr. 15, 2021           |
| Spectrum Analyzer<br>ROHDE & SCHWARZ           | FSW26                  | 102023                    | Oct. 08, 2019       | Oct. 07, 2020           |
| Broadband Horn Antenna<br>SCHWARZBECK          | BBHA 9170              | 148                       | Nov. 24, 2019       | Nov. 23, 2020           |
| HORN Antenna<br>SCHWARZBECK                    | BBHA 9120D             | 9120D-969                 | Nov. 24, 2019       | Nov. 23, 2020           |
| BILOG Antenna<br>SCHWARZBECK                   | VULB 9168              | 9168-472                  | Nov. 08, 2019       | Nov. 07, 2020           |
| Fixed Attenuator<br>WOKEN                      | MDCS18N-10             | MDCS18N-10-01             | Apr. 14, 2020       | Apr. 13, 2021           |
| Loop Antenna                                   | HLA 6121               | 45745                     | Jul. 01, 2019       | Jun. 30, 2020           |
| Preamplifier<br>EMCI                           | EMC001340              | 980201                    | Oct. 14, 2019       | Oct. 13, 2020           |
| Bluetooth Tester<br>R&S                        | CBT                    | 100946                    | Aug. 09, 2018       | Aug. 08, 2020           |
| Preamplifier<br>EMCI                           | EMC 012645             | 980115                    | Oct. 08, 2019       | Oct. 07, 2020           |
| Preamplifier<br>EMCI                           | EMC 184045             | 980116                    | Oct. 08, 2019       | Oct. 07, 2020           |
| Preamplifier<br>EMCI                           | EMC 330H               | 980112                    | Oct. 08, 2019       | Oct. 07, 2020           |
| RF Coaxial Cable<br>HUBER+SUHNNER              | EMC104-SM-SM-8000&3000 | 140811+170717             | Oct. 08, 2019       | Oct. 07, 2020           |
| RF Coaxial Cable<br>HUBER+SUHNNER              | SUCOFLEX 104           | EMC104-SM-SM-1000(140807) | Oct. 08, 2019       | Oct. 07, 2020           |
| RF Coaxial Cable<br>WOKEN                      | 8D-FB                  | Cable-Ch10-01             | Oct. 08, 2019       | Oct. 07, 2020           |
| Software<br>BV ADT                             | E3<br>6.120103         | NA                        | NA                  | NA                      |
| Antenna Tower<br>MF                            | MFA-440H               | NA                        | NA                  | NA                      |
| Turn Table<br>MF                               | MFT-201SS              | NA                        | NA                  | NA                      |
| Antenna Tower & Turn<br>Table Controller<br>MF | MF-7802                | NA                        | NA                  | NA                      |

- Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.

#### 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:

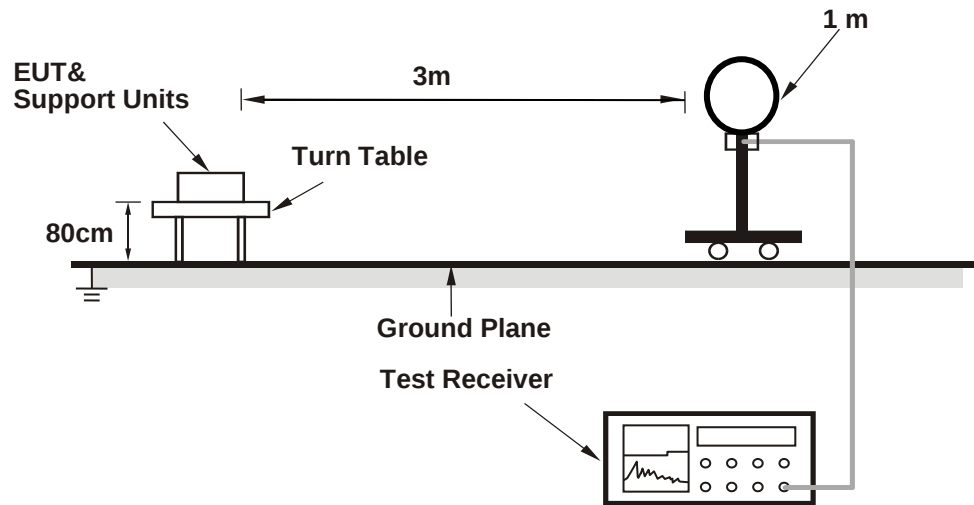
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at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

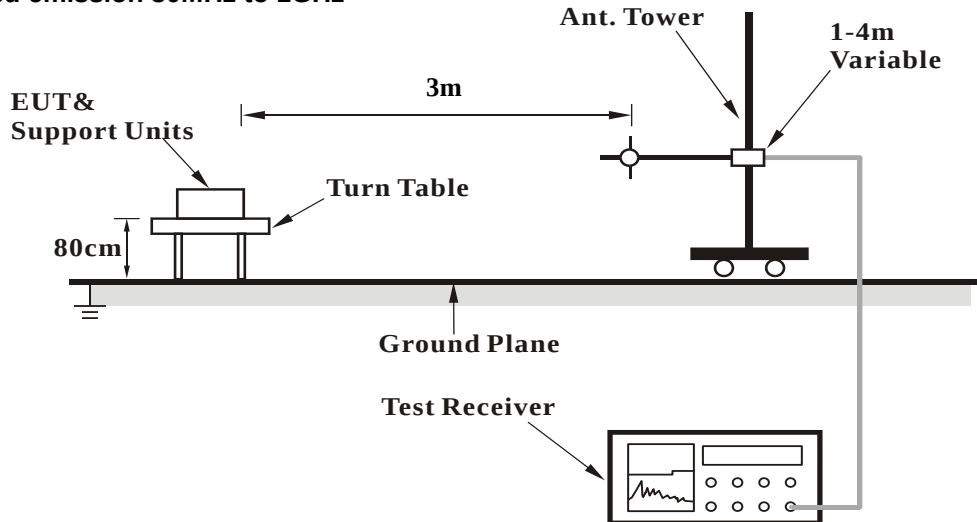
No deviation.

#### 4.1.5 Test Setup

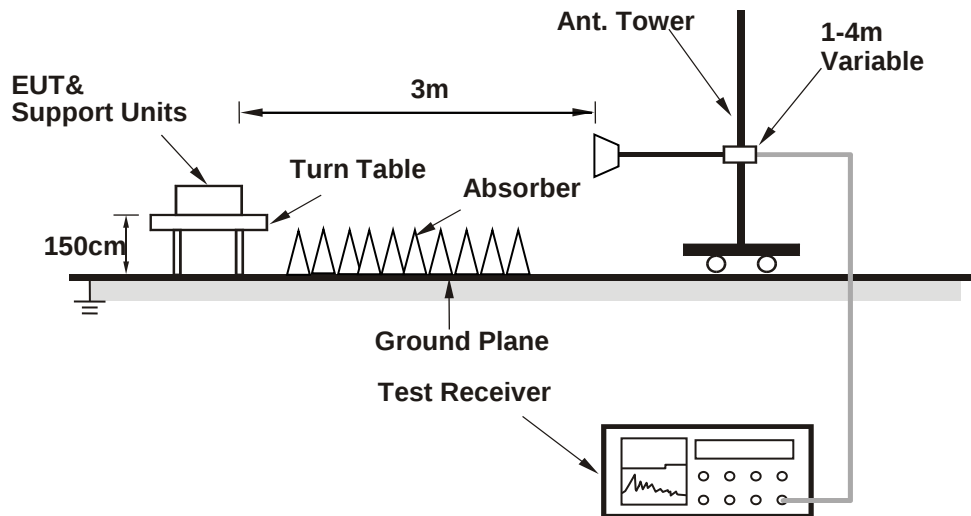
##### For Radiated emission below 30MHz



##### 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).

#### KDB 414788 OATS and Chamber Correlation Justification

- Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in regulations; however, an attempt should be made to avoid making measurements in the near field.
- Open-field site and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

#### 4.1.6 EUT Operating Conditions

- a. Placed the EUT on the testing table.
- b. Prepared a notebook to act as a communication partner and placed it outside of testing area.
- c. 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.
- d. The communication partner sent data to EUT by command "PING".

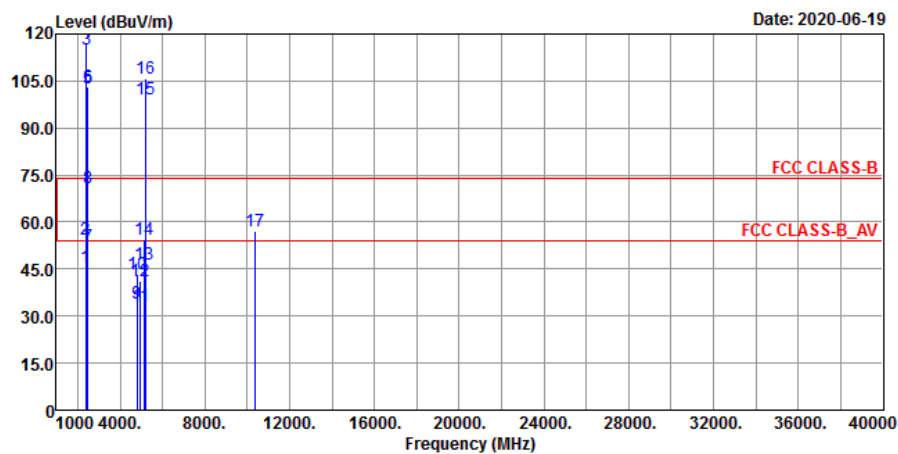
#### 4.1.7 Test Results

Above 1 GHz Data :

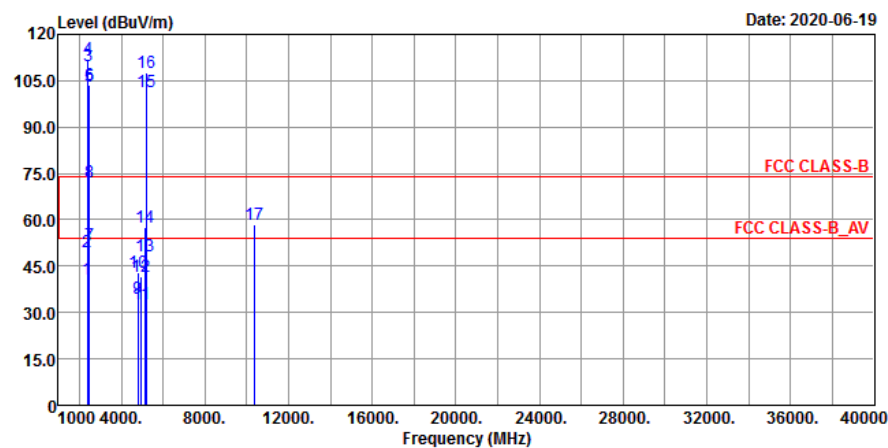
BT EDR + 802.11a + Thread

| EUT Test Condition       |                       | Measurement Detail |                           |
|--------------------------|-----------------------|--------------------|---------------------------|
| Channel                  | CH 78 + CH 40 + CH 11 | Frequency Range    | 1 GHz ~ 40 GHz            |
| Input Power              | 120 Vac, 60 Hz        | Detector Function  | Peak (PK)<br>Average (AV) |
| Environmental Conditions | 25 deg. C, 65 % RH    | Tested By          | Tim Chen                  |

#### Horizontal



#### Vertical



| Antenna Polarity & Test Distance: Horizontal at 3 m |                         |                   |               |                |             |                     |                      |         |
|-----------------------------------------------------|-------------------------|-------------------|---------------|----------------|-------------|---------------------|----------------------|---------|
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2390                                                | 45.82                   | 67.39             | -21.57        | 54             | -8.18       | 111                 | 103                  | Average |
| 2390                                                | 54.35                   | 75.92             | -21.57        | 74             | -19.65      | 111                 | 103                  | Peak    |
| 2405                                                | 115.31                  | 136.88            | -21.57        | -----          | -----       | 111                 | 103                  | Average |
| 2405                                                | 117.54                  | 139.11            | -21.57        | -----          | -----       | 111                 | 103                  | Peak    |
| 2480                                                | 102.8                   | 124.26            | -21.46        | -----          | -----       | 100                 | 128                  | Average |
| 2480                                                | 103.24                  | 124.7             | -21.46        | -----          | -----       | 100                 | 128                  | Peak    |
| 2483.5                                              | 52.31                   | 73.78             | -21.47        | 54             | -1.69       | 100                 | 128                  | Average |
| 2483.5                                              | 70.74                   | 92.21             | -21.47        | 74             | -3.26       | 100                 | 128                  | Peak    |
| 4810                                                | 34.3                    | 49.94             | -15.64        | 54             | -19.7       | 102                 | 134                  | Average |
| 4810                                                | 43.25                   | 58.89             | -15.64        | 74             | -30.75      | 102                 | 134                  | Peak    |
| 4960                                                | 33.08                   | 48.53             | -15.45        | 54             | -20.92      | 118                 | 29                   | Average |
| 4960                                                | 41.04                   | 56.49             | -15.45        | 74             | -32.96      | 118                 | 29                   | Peak    |
| 5150                                                | 46.62                   | 61.17             | -14.55        | 54             | -7.38       | 142                 | 202                  | Average |
| 5150                                                | 54.53                   | 69.08             | -14.55        | 74             | -19.47      | 142                 | 202                  | Peak    |
| 5200                                                | 99.03                   | 113.75            | -14.72        | -----          | -----       | 142                 | 202                  | Average |
| 5200                                                | 105.72                  | 120.44            | -14.72        | -----          | -----       | 142                 | 202                  | Peak    |
| 10400                                               | 57.21                   | 59.03             | -1.82         | 68.2           | -10.99      | 123                 | 152                  | Peak    |
| Antenna Polarity & Test Distance: Vertical at 3 m   |                         |                   |               |                |             |                     |                      |         |
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark  |
| 2390                                                | 40.79                   | 62.36             | -21.57        | 54             | -13.21      | 100                 | 313                  | Average |
| 2390                                                | 49.47                   | 71.04             | -21.57        | 74             | -24.53      | 100                 | 313                  | Peak    |
| 2405                                                | 109.97                  | 131.54            | -21.57        | -----          | -----       | 100                 | 313                  | Average |
| 2405                                                | 112.24                  | 133.81            | -21.57        | -----          | -----       | 100                 | 313                  | Peak    |
| 2480                                                | 103.09                  | 124.55            | -21.46        | -----          | -----       | 312                 | 230                  | Average |
| 2480                                                | 103.78                  | 125.24            | -21.46        | -----          | -----       | 312                 | 230                  | Peak    |
| 2483.5                                              | 51.7                    | 73.17             | -21.47        | 54             | -2.3        | 312                 | 230                  | Average |
| 2483.5                                              | 72.31                   | 93.78             | -21.47        | 74             | -1.69       | 312                 | 230                  | Peak    |
| 4810                                                | 34.4                    | 50.04             | -15.64        | 54             | -19.6       | 123                 | 164                  | Average |
| 4810                                                | 42.94                   | 58.58             | -15.64        | 74             | -31.06      | 123                 | 164                  | Peak    |
| 4960                                                | 32.69                   | 48.14             | -15.45        | 54             | -21.31      | 112                 | 267                  | Average |
| 4960                                                | 41.53                   | 56.98             | -15.45        | 74             | -32.47      | 112                 | 267                  | Peak    |
| 5150                                                | 48.34                   | 62.89             | -14.55        | 54             | -5.66       | 192                 | 92                   | Average |
| 5150                                                | 57.43                   | 71.98             | -14.55        | 74             | -16.57      | 192                 | 92                   | Peak    |
| 5200                                                | 101.28                  | 116               | -14.72        | -----          | -----       | 192                 | 92                   | Average |
| 5200                                                | 107.41                  | 122.13            | -14.72        | -----          | -----       | 192                 | 92                   | Peak    |
| 10400                                               | 58.44                   | 60.26             | -1.82         | 68.2           | -9.76       | 107                 | 15                   | Peak    |

Remarks:

1. Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
2. 2405 MHz & 2480 MHz & 5200 MHz: Fundamental Frequency
3. \*: Out of Restricted Band
4. The emission levels of other frequencies were very low against the limit

### 9 kHz ~ 30 MHz Data:

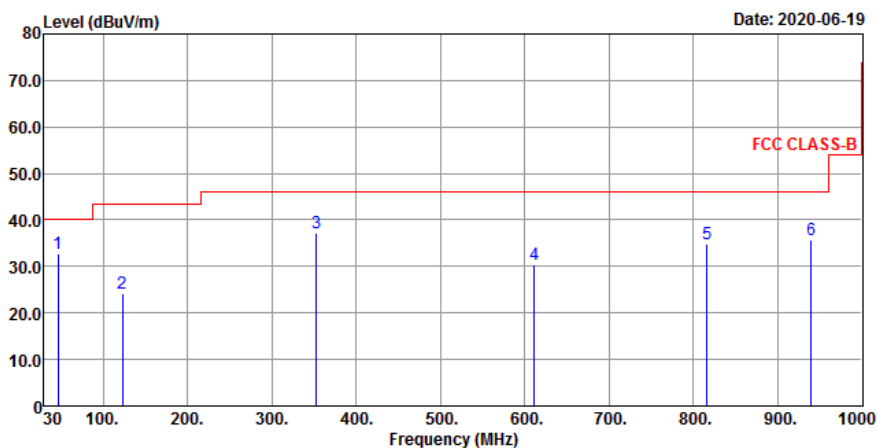
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

### 30 MHz ~ 1 GHz Worst-Case Data:

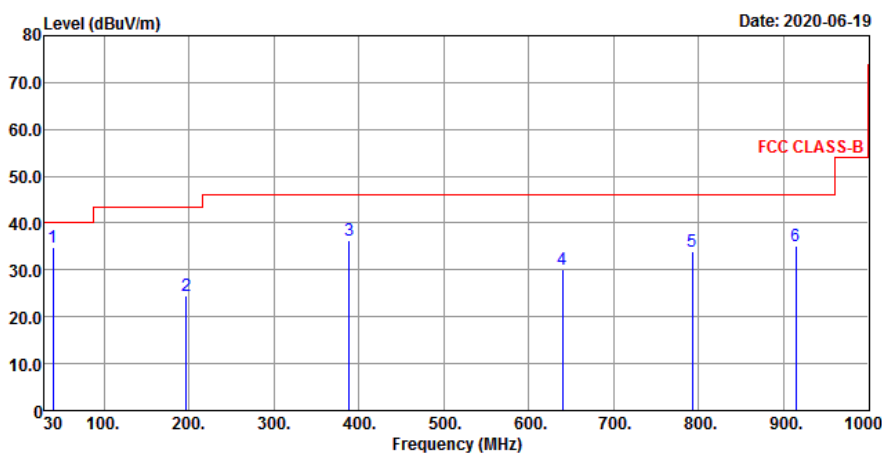
#### BT EDR + 802.11a + Thread

| EUT Test Condition       |                       | Measurement Detail |                              |
|--------------------------|-----------------------|--------------------|------------------------------|
| Channel                  | CH 78 + CH 40 + CH 11 | Frequency Range    | 30 MHz ~ 1 GHz               |
| Input Power              | 120 Vac, 60 Hz        | Detector Function  | Peak (PK)<br>Quasi-peak (QP) |
| Environmental Conditions | 25 deg. C, 65 % RH    | Tested By          | Tim Chen                     |

#### Horizontal



#### Vertical



| Antenna Polarity & Test Distance: Horizontal at 3 m |                         |                   |               |                |             |                     |                      |        |
|-----------------------------------------------------|-------------------------|-------------------|---------------|----------------|-------------|---------------------|----------------------|--------|
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark |
| 46.49                                               | 32.9                    | 44.67             | -11.77        | 40             | -7.1        | 112                 | 134                  | Peak   |
| 123.12                                              | 24.13                   | 37.67             | -13.54        | 43.5           | -19.37      | 124                 | 155                  | Peak   |
| 353.01                                              | 37.22                   | 46.89             | -9.67         | 46             | -8.78       | 132                 | 168                  | Peak   |
| 611.03                                              | 30.37                   | 32.76             | -2.39         | 46             | -15.63      | 103                 | 18                   | Peak   |
| 815.7                                               | 34.97                   | 32.92             | 2.05          | 46             | -11.03      | 178                 | 231                  | Peak   |
| 939.86                                              | 35.65                   | 32.17             | 3.48          | 46             | -10.35      | 102                 | 55                   | Peak   |
| Antenna Polarity & Test Distance: Vertical at 3 m   |                         |                   |               |                |             |                     |                      |        |
| Frequency (MHz)                                     | Emission Level (dBuV/m) | Read Level (dBuV) | Factor (dB/m) | Limit (dBuV/m) | Margin (dB) | Antenna Height (cm) | Table Angle (Degree) | Remark |
| 39.7                                                | 34.95                   | 47.2              | -12.25        | 40             | -5.05       | 102                 | 153                  | Peak   |
| 196.84                                              | 24.46                   | 39.45             | -14.99        | 43.5           | -19.04      | 163                 | 196                  | Peak   |
| 388.9                                               | 36.31                   | 44.91             | -8.6          | 46             | -9.69       | 115                 | 241                  | Peak   |
| 640.13                                              | 30.16                   | 31.86             | -1.7          | 46             | -15.84      | 102                 | 96                   | Peak   |
| 792.42                                              | 33.96                   | 32.42             | 1.54          | 46             | -12.04      | 118                 | 25                   | Peak   |
| 914.64                                              | 35.15                   | 31.92             | 3.23          | 46             | -10.85      | 131                 | 169                  | Peak   |

Remarks:

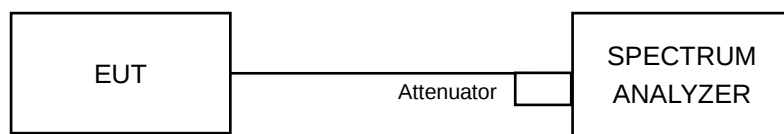
- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- The emission levels of other frequencies were very low against the limit

## 4.2 Conducted Out of Band Emission Measurement

### 4.2.1 Limits of Conducted Out of Band Emission Measurement

Below 20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

### 4.2.2 Test Setup



### 4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.2.4 Test Procedure

#### MEASUREMENT PROCEDURE REF

- Set the RBW = 100 kHz.
- Set the VBW  $\geq$  300 kHz.
- Detector = average.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

- Set RBW = 100 kHz.
- Set VBW  $\geq$  300 kHz.
- Detector = average.
- Sweep = auto couple.
- Trace Mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.

### 4.2.5 Deviation from Test Standard

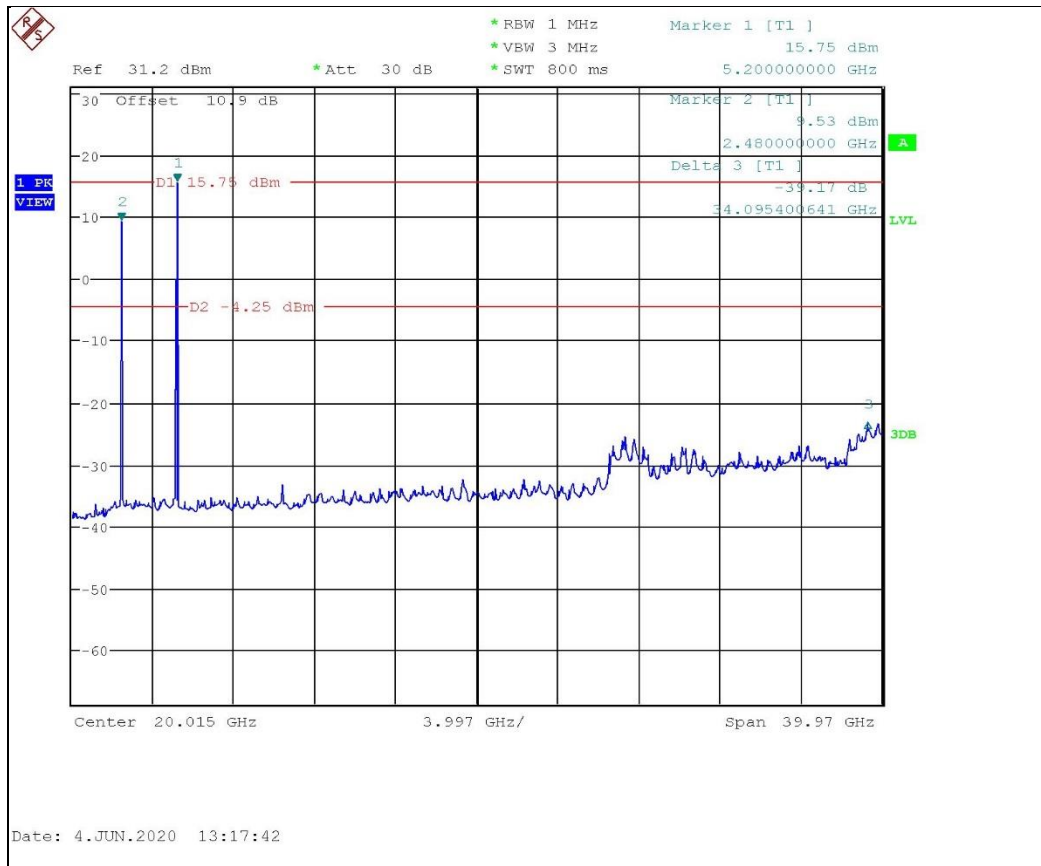
No deviation.

### 4.2.6 EUT Operating Condition

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

#### 4.2.7 Test Results

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

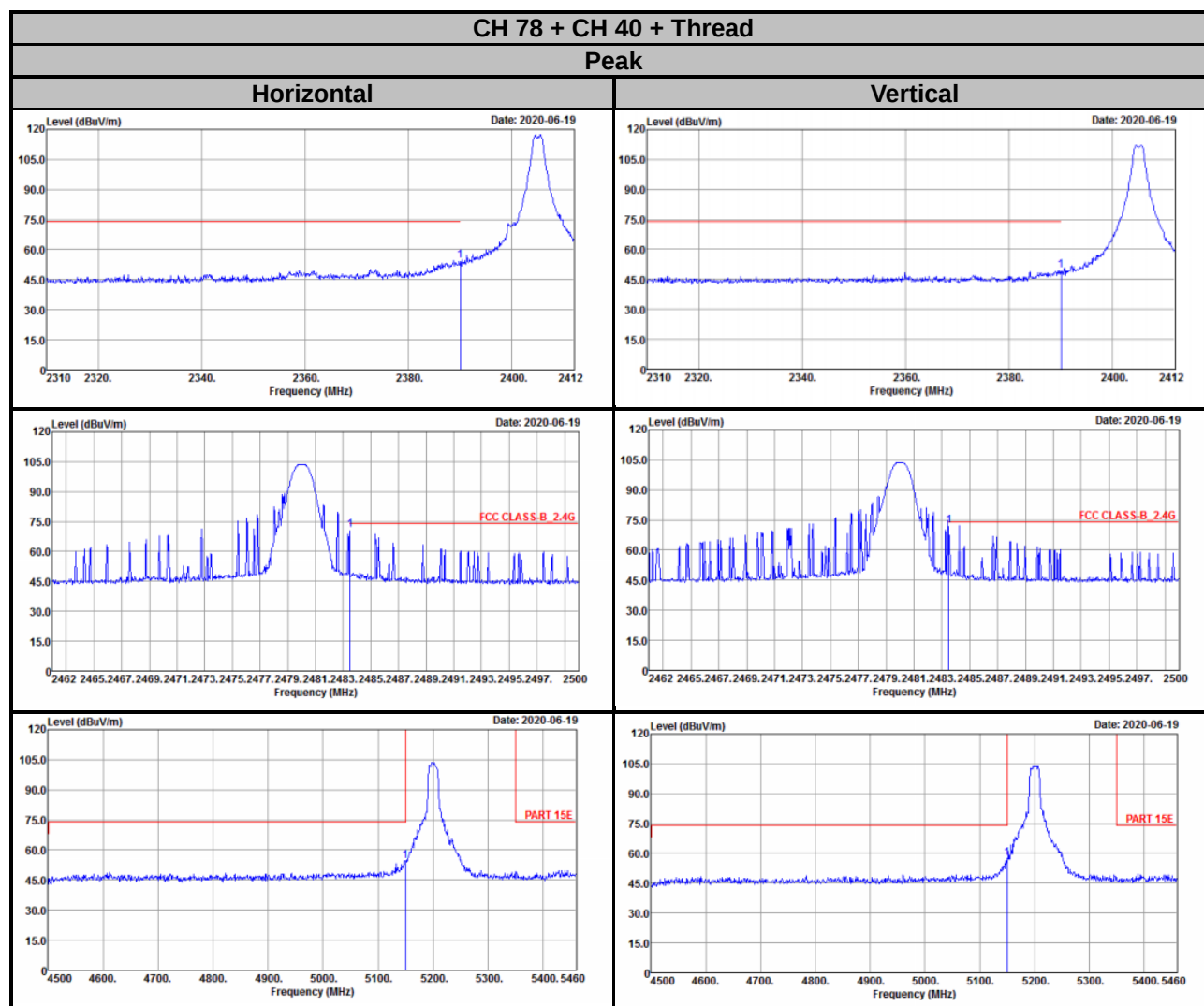


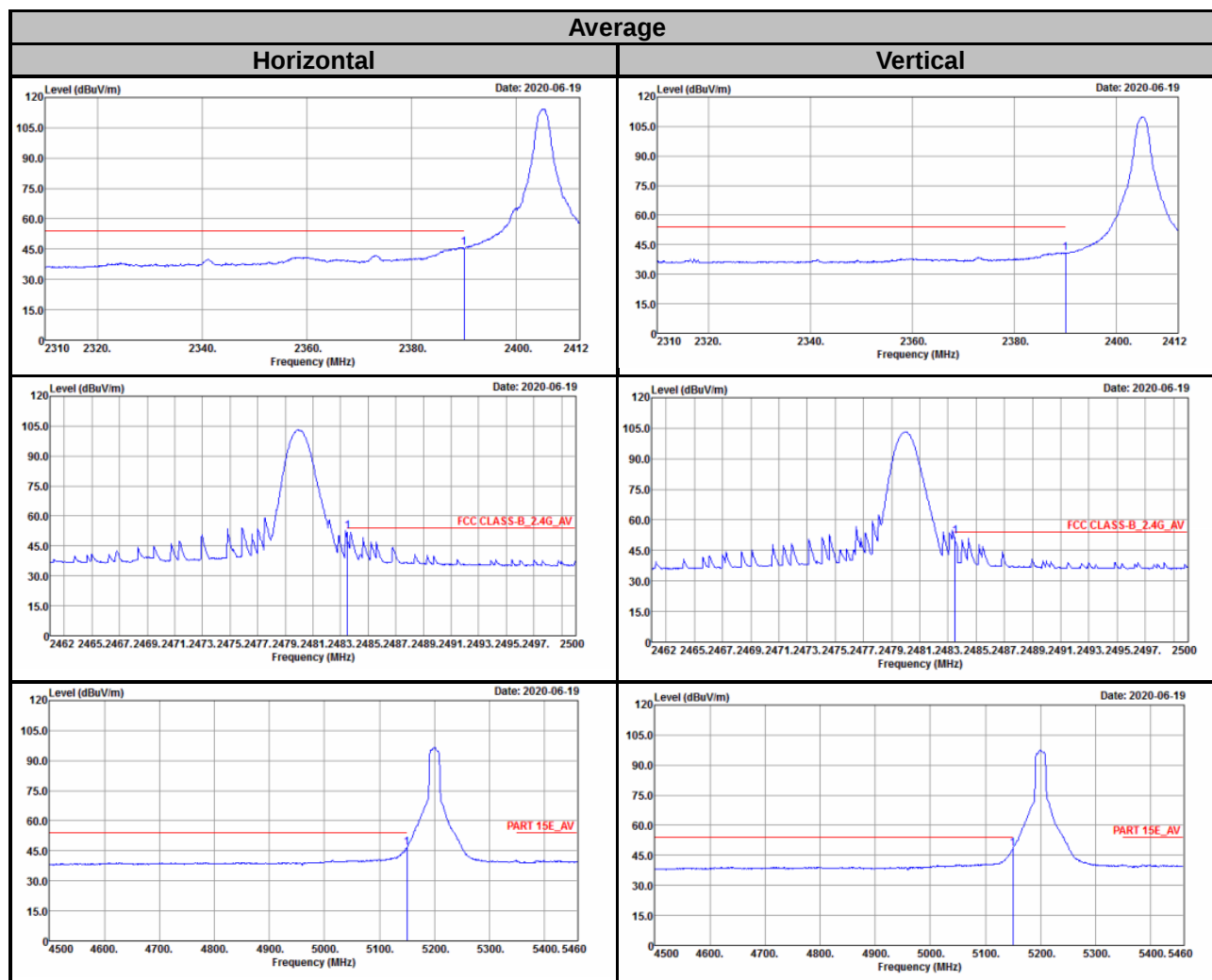
Note: Both of the BT EDR and 802.11a can transmit simultaneously at same antenna.

## 5 Pictures of Test Arrangements

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

## Annex A- Band-edge measurement





## Appendix – Information of the Testing Laboratories

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

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

--- END ---