



# FCC RADIO TEST REPORT

**FCC ID** : A4RG025I  
**Equipment** : Phone  
**Model Name** : G025I, G025H  
**Applicant** : Google LLC  
1600 Amphitheatre Parkway,  
Mountain View, California, 94043 USA  
**Standard** : FCC Part 15 Subpart C §15.247

The product was received on May 08, 2020 and testing was started from Jun. 11, 2020 and completed on Jul. 02, 2020. We, SPORTON INTERNATIONAL INC., EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Louis Wu

**SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory**  
No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)



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### History of this test report

| Report No.   | Version | Description                                 | Issued Date   |
|--------------|---------|---|---------------|
| FR022521-04C | 01      | Initial issue of report                     | Jul. 10, 2020 |
| FR022521-04C | 02      | Revising the remark description in summary. | Jul. 23, 2020 |
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### Summary of Test Result

| Report Clause | Ref Std. Clause    | Test Items   | Result (PASS/FAIL) | Remark                              |
|---------------|--------------------|--|--------------------|-------------------------------------|
| -             | 15.247(a)(2)       | 6dB Bandwidth                                      | Not Required       | -                                   |
| -             | 2.1049             | 99% Occupied Bandwidth                             | Not Required       | -                                   |
| 3.1           | 15.247(b)          | Power Output Measurement                           | Pass               | -                                   |
| -             | 15.247(e)          | Power Spectral Density                             | Not Required       | -                                   |
| -             | 15.247(d)          | Conducted Band Edges                               | Not Required       | -                                   |
|               |                    | Conducted Spurious Emission                        | Not Required       | -                                   |
| 3.2           | 15.247(d)          | Radiated Band Edges and Radiated Spurious Emission | Pass               | Under limit 2.56 dB at 2483.520 MHz |
| -             | 15.207             | AC Conducted Emission                              | Not Required       | -                                   |
| 3.3           | 15.203 & 15.247(b) | Antenna Requirement                                | Pass               | -                                   |

**Note:**

1. Not required means after assessing, test items are not necessary to carry out.
2. This is a variant report which can be referred Product Equality Declaration. After spot-checking the tests, the parent test results were worse than variant test results, thus this test report was reuse parent test data, all the test cases were performed on original report which can be referred to Sporton Report Number FR022521-02C.

**Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

**Comments and Explanations:**

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

**Reviewed by: Wii Chang**

**Report Producer: Vivian Hsu**



# 1 General Description

## 1.1 Product Feature of Equipment Under Test

| Product Feature                 |  |
|---------------------------------|--|
| Equipment                       | Phone  |
| Model Name                      | G025I, G025H   |
| FCC ID                          | A4RG025I   |
| EUT supports Radios application | GSM/EGPRS/WCDMA/HSPA/LTE/NFC/GNSS/5G NR<br>WLAN 11b/g/n HT20<br>WLAN 11a/n HT20/HT40<br>WLAN 11ac VHT20/VHT40/VHT80<br>Bluetooth BR/EDR/LE |

Remark: The above EUT's information was declared by manufacturer.

| EUT Information List |                            |
|----------------------|----------------------------|
| S/N                  | Performed Test Item        |
| 04271FQCB00001       | Conducted Measurement      |
| 04241FQCB00343       | Radiated Spurious Emission |

## 1.2 Product Specification of Equipment Under Test

| Standards-related Product Specification   |   |        |        |        |                      |   |   |
|---|---|--------|--------|--------|----------------------|---|---|
| Tx/Rx Channel Frequency Range             | 2412 MHz ~ 2462 MHz   |        |        |        |                      |   |   |
| Maximum (Average) Output Power to antenna | <b>MIMO &lt;Ant. 4+3&gt;</b><br>802.11b : 22.26 dBm (0.1683 W)<br>802.11g : 22.11 dBm (0.1626 W)<br>802.11n HT20 : 22.01 dBm (0.1589 W)<br>802.11ac VHT20 : 21.91 dBm (0.1552 W)  |        |        |        |                      |   |   |
| Antenna Type / Gain                       | <b>&lt;Ant. 4&gt;</b> Monopole Antenna type with gain 0.40 dBi<br><b>&lt;Ant. 3&gt;</b> PIFA Antenna type with gain -0.30 dBi   |        |        |        |                      |   |   |
| Type of Modulation                        | 802.11b : DSSS (DBPSK / DQPSK / CCK)<br>802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)<br>802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)                                  |        |        |        |                      |   |   |
| Antenna Function for Transmitter          | <table border="1"> <thead> <tr> <th></th> <th>Ant. 4</th> <th>Ant. 3</th> </tr> </thead> <tbody> <tr> <td>802.11 b/g/n/ac MIMO</td> <td>V</td> <td>V</td> </tr> </tbody> </table> |        | Ant. 4 | Ant. 3 | 802.11 b/g/n/ac MIMO | V | V |
|   | Ant. 4  | Ant. 3 |        |        |                      |   |   |
| 802.11 b/g/n/ac MIMO                      | V   | V      |        |        |                      |   |   |

Note: MIMO Ant. 4+3 is a calculated result from sum of the power MIMO Ant. 4 and MIMO Ant. 3.

## 1.3 Modification of EUT

No modifications are made to the EUT during all test items.



### 1.4 Testing Location

|                    |   |           |
|--------------------|---|-----------|
| Test Site          | SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory   |           |
| Test Site Location | No.52, Huaya 1st Rd., Guishan Dist.,<br>Taoyuan City, Taiwan (R.O.C.)<br>TEL: +886-3-327-3456<br>FAX: +886-3-328-4978 |           |
| Test Site No.      | Sporton Site No.  |           |
|                    | TH05-HY   | 03CH07-HY |

**Note:** The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190

### 1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.



## 2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (X plane) were recorded in this report.

### 2.1 Carrier Frequency and Channel

| Frequency Band  | Channel | Freq. (MHz) | Channel | Freq. (MHz) |
|-----------------|---------|-------------|---------|-------------|
| 2400-2483.5 MHz | 1       | 2412        | 7       | 2442        |
|                 | 2       | 2417        | 8       | 2447        |
|                 | 3       | 2422        | 9       | 2452        |
|                 | 4       | 2427        | 10      | 2457        |
|                 | 5       | 2432        | 11      | 2462        |
|                 | 6       | 2437        |         |             |



## 2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

| Modulation     | Data Rate |
|----------------|-----------|
| 802.11b        | 1 Mbps    |
| 802.11g        | 6 Mbps    |
| 802.11n HT20   | MCS0      |
| 802.11ac VHT20 | MCS0      |

| Ch. #  | 2400-2483.5 MHz |
|--------|-----------------|
|        | 802.11n HT20    |
| Low    | -               |
| Middle | -               |
| High   | 11              |

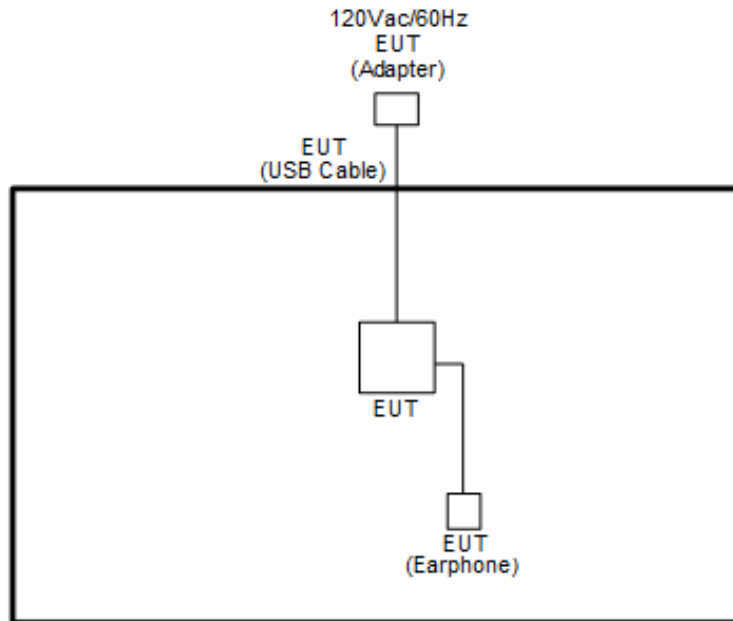
**Remark:**

1. For radiation spurious emission, the final modulation and the worst data rate was reference the max RF conducted power.
2. For Radiated Test Cases, the tests were performed with Adapter 1 and USB Cable 1



## 2.3 Connection Diagram of Test System

<WLAN Tx Mode>



## 2.4 EUT Operation Test Setup

The RF test items, utility "QRCT4\_v 4.0.00158.0" was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

### 3 Test Result

#### 3.1 Output Power Measurement

##### 3.1.1 Limit of Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

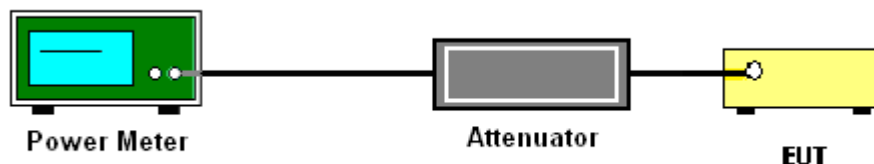
##### 3.1.2 Measuring Instruments

See list of measuring equipment of this test report.

##### 3.1.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of Average Output Power

Please refer to Appendix A.



### 3.2 Radiated Band Edges and Spurious Emission Measurement

#### 3.2.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

| Frequency (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                             |

#### 3.2.2 Measuring Instruments

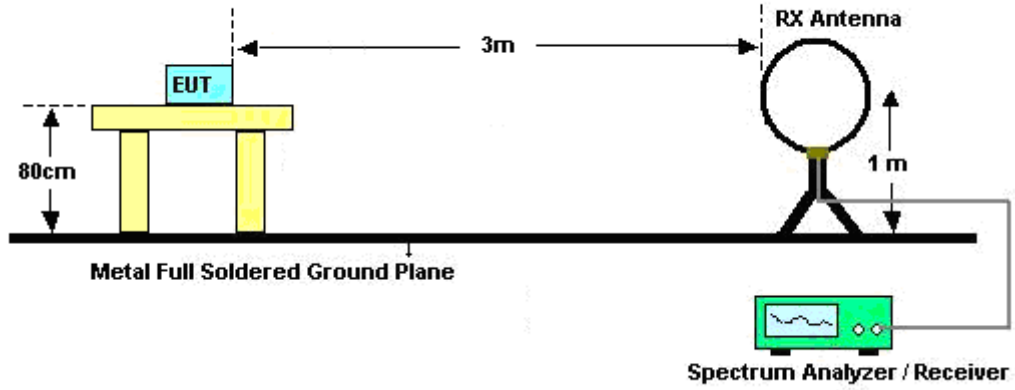
See list of measuring equipment of this test report.

**3.2.3 Test Procedures**

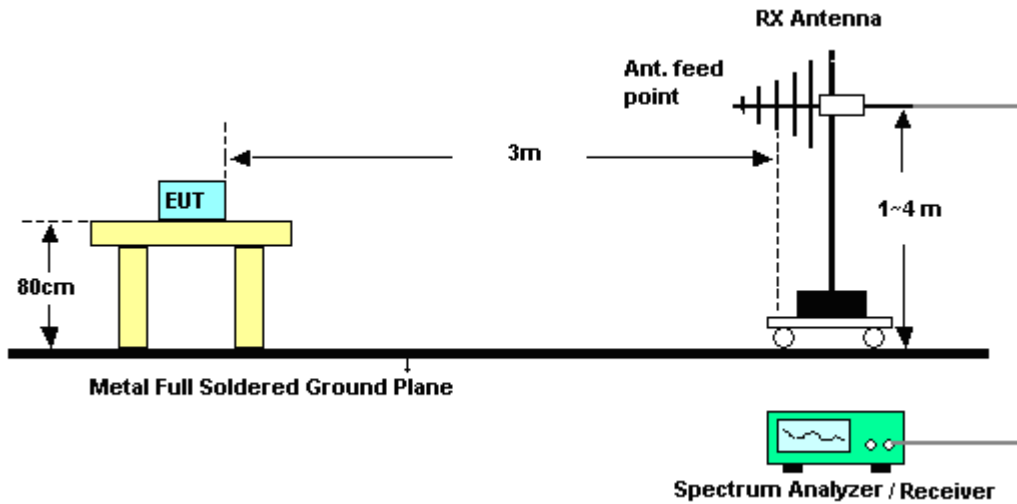
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
  - (1) Span shall wide enough to fully capture the emission being measured;
  - (2) Set RBW=100 kHz for  $f < 1$  GHz;  $VBW \geq RBW$ ; Sweep = auto; Detector function = peak; Trace = max hold;
  - (3) Set RBW = 1 MHz, VBW= 3MHz for  $f \geq 1$  GHz for peak measurement.  
For average measurement:
    - $VBW = 10$  Hz, when duty cycle is no less than 98 percent.
    - $VBW \geq 1/T$ , when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

### 3.2.4 Test Setup

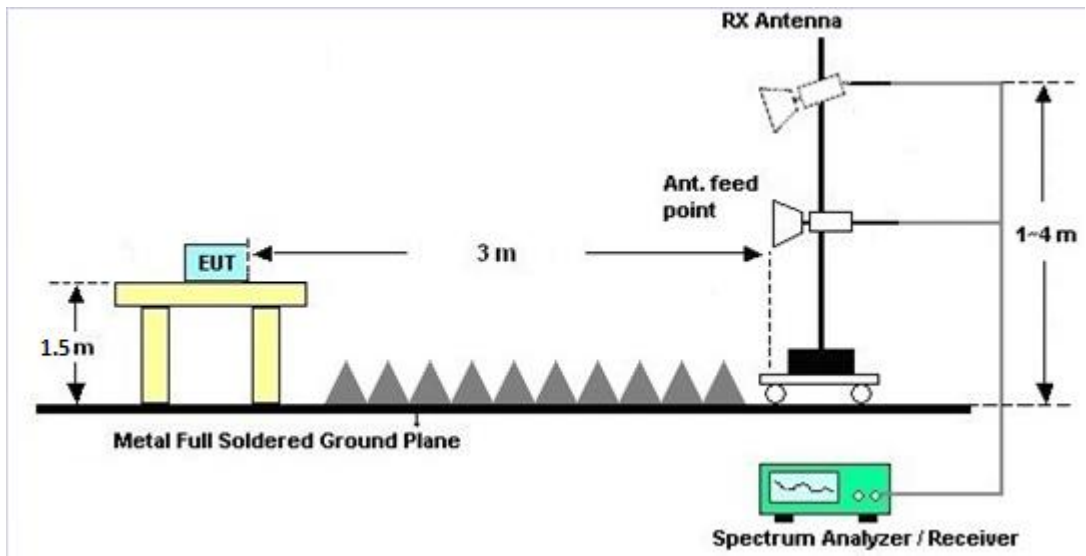
For radiated emissions below 30MHz



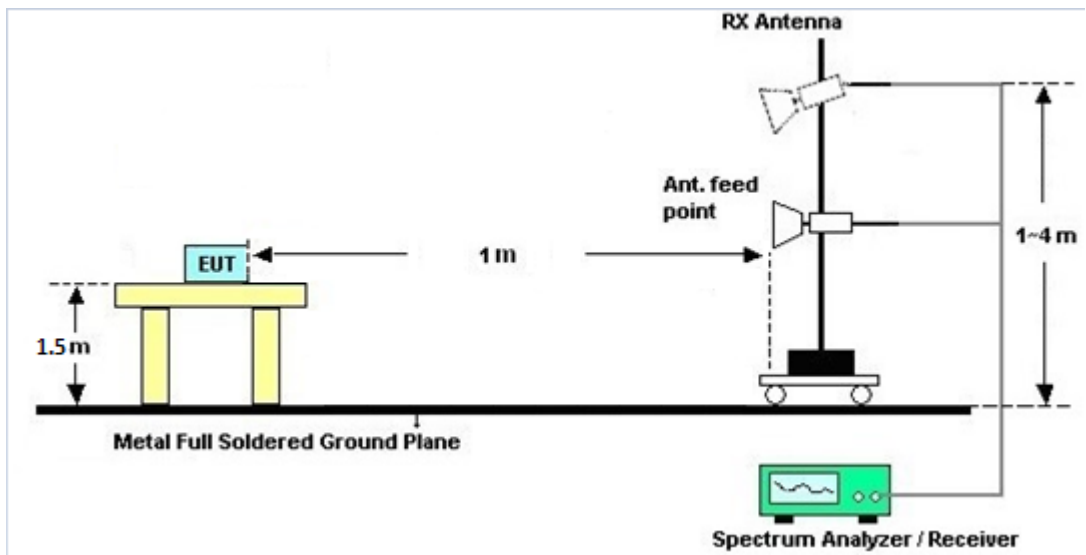
For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



For radiated emissions above 18GHz





### **3.2.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)**

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

### **3.2.6 Test Result of Radiated Spurious at Band Edges**

Please refer to Appendix B and C.

### **3.2.7 Duty Cycle**

Please refer to Appendix D.

### **3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10<sup>th</sup> Harmonic)**

Please refer to Appendix B and C.



### **3.3 Antenna Requirements**

#### **3.3.1 Standard Applicable**

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached Antenna or of an Antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

#### **3.3.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.

#### **3.3.3 Antenna Gain**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.





## 4 List of Measuring Equipment

| Instrument                | Manufacturer      | Model No.                         | Serial No.  | Characteristics | Calibration Date | Test Date                        | Due Date      | Remark                |
|---------------------------|-------------------|-----------------------------------|---|-----------------|------------------|----------------------------------|---------------|-----------------------|
| Hygrometer                | TECEPEL           | DYM-303B                          | P161250   | N/A             | May 08, 2020     | Jun. 18, 2020                    | May 07, 2021  | Conducted (TH05-HY)   |
| Power Sensor              | DARE              | RPR3006W                          | 16I00054S<br>NO10                                 | 10MHz~6GHz      | Dec. 23, 2019    | Jun. 18, 2020                    | Dec. 22, 2020 | Conducted (TH05-HY)   |
| Power Supply              | GW Instek         | SPS-606                           | GES84293<br>1                                     | NA              | Aug. 19, 2019    | Jun. 18, 2020                    | Aug. 18, 2020 | Conducted (TH05-HY)   |
| Spectrum Analyzer         | Rohde & Schwarz   | FSP40                             | 100055  | 9kHz-40GHz      | Aug. 14, 2019    | Jun. 18, 2020                    | Aug. 13, 2020 | Conducted (TH05-HY)   |
| Switch Control Manframe   | Burgeon           | ETF-058                           | EC130048<br>4                                     | N/A             | Aug. 22, 2019    | Jun. 18, 2020                    | Aug. 21, 2020 | Conducted (TH05-HY)   |
| Bilog Antenna             | TESEQ             | CBL 6111D &<br>00800N1D01<br>N-06 | 35419 &<br>03                                     | 30MHz~1GHz      | Apr. 29, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Apr. 28, 2021 | Radiation (03CH07-HY) |
| Double Ridge Horn Antenna | ESCO              | 3117                              | 00075962  | 1GHz ~ 18GHz    | Dec. 06, 2019    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Dec. 05, 2020 | Radiation (03CH07-HY) |
| EMI Test Receiver         | Agilent           | N9038A<br>(MXE)                   | MY532900<br>53                                    | 20Hz~26.5GHz    | Jan. 18, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Jan. 17, 2021 | Radiation (03CH07-HY) |
| Spectrum Analyzer         | Agilent           | N9030A                            | MY523502<br>76                                    | 3Hz~44GHz       | Jun. 09, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Jun. 08, 2020 | Radiation (03CH07-HY) |
| Loop Antenna              | Rohde & Schwarz   | HFH2-Z2                           | 100315  | 9 kHz~30 MHz    | Dec. 26, 2019    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Dec. 25, 2020 | Radiation (03CH07-HY) |
| Preamplifier              | MITEQ             | AMF-7D-0010<br>1800-30-10P        | 1590075   | 1GHz~18GHz      | Apr. 23, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Apr. 22, 2021 | Radiation (03CH07-HY) |
| Preamplifier              | COM-POWER         | PA-103A                           | 161241  | 10MHz~1GHz      | May 19, 2020     | Jun. 11, 2020 ~<br>Jul. 02, 2020 | May 18, 2021  | Radiation (03CH07-HY) |
| Preamplifier              | Agilent           | 8449B                             | 3008A023<br>62                                    | 1GHz~26.5GHz    | Nov. 01, 2019    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Oct. 31, 2020 | Radiation (03CH07-HY) |
| RF Cable                  | HUBER +<br>SUHNER | SUCOFLEX<br>102                   | MY2858/2,<br>801606/2                             | 18GHz~40GHz     | Feb. 25, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Feb. 24, 2021 | Radiation (03CH07-HY) |
| RF Cable                  | HUBER +<br>SUHNER | SUCOFLEX<br>104                   | MY24971/<br>4,<br>MY28655/<br>4                   | 9kHz~30MHz      | Feb. 25, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Feb. 24, 2021 | Radiation (03CH07-HY) |
| RF Cable                  | HUBER +<br>SUHNER | SUCOFLEX<br>104                   | MY28655/<br>4,<br>MY24971/<br>4,<br>MY15682/<br>4 | 30MHz~1GHz      | Feb. 25, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Feb. 24, 2021 | Radiation (03CH07-HY) |
| RF Cable                  | HUBER +<br>SUHNER | SUCOFLEX<br>104                   | MY28655/<br>4,<br>MY24971/<br>4,<br>MY15682/<br>4 | 1GHz~18GHz      | Feb. 25, 2020    | Jun. 11, 2020 ~<br>Jul. 02, 2020 | Feb. 24, 2021 | Radiation (03CH07-HY) |



| Instrument           | Manufacturer | Model No.      | Serial No.  | Characteristics    | Calibration Date | Test Date                     | Due Date      | Remark                |
|----------------------|--------------|----------------|-------------|--------------------|------------------|-------------------------------|---------------|-----------------------|
| Controller           | ChainTek     | Chaintek 3000  | N/A         | Control Turn table | N/A              | Jun. 11, 2020 ~ Jul. 02, 2020 | N/A           | Radiation (03CH07-HY) |
| Controller           | Max-Full     | MF7802         | MF780208368 | Control Ant Mast   | N/A              | Jun. 11, 2020 ~ Jul. 02, 2020 | N/A           | Radiation (03CH07-HY) |
| Antenna Mast         | Max-Full     | MFA520BS       | N/A         | 1m~4m              | N/A              | Jun. 11, 2020 ~ Jul. 02, 2020 | N/A           | Radiation (03CH07-HY) |
| Turn Table           | ChainTek     | Chaintek 3000  | N/A         | 0~360 Degree       | N/A              | Jun. 11, 2020 ~ Jul. 02, 2020 | N/A           | Radiation (03CH07-HY) |
| USB Data Logger      | TECPEL       | TR-32          | HE17XB2495  | N/A                | N/A              | Jun. 11, 2020 ~ Jul. 02, 2020 | N/A           | Radiation (03CH07-HY) |
| Spectrum Analyzer    | Keysight     | N9010A         | MY54200486  | 10Hz~44GHz         | Oct. 28, 2019    | Jun. 11, 2020 ~ Jul. 02, 2020 | Oct. 27, 2020 | Radiation (03CH07-HY) |
| SHF-EHF Horn Antenna | SCHWARZBECK  | BBHA 9170      | BBHA9170584 | 18GHz~40GHz        | Dec. 10, 2019    | Jun. 11, 2020 ~ Jul. 02, 2020 | Dec. 09, 2020 | Radiation (03CH07-HY) |
| Software             | Audix        | E3 6.2009-8-24 | N/A         | N/A                | N/A              | Jun. 11, 2020 ~ Jul. 02, 2020 | N/A           | Radiation (03CH07-HY) |
| Preamplifier         | EMEC         | EM18G40G       | 060715      | 18GHz~40GHz        | Dec. 13, 2019    | Jun. 11, 2020 ~ Jul. 02, 2020 | Dec. 12, 2020 | Radiation (03CH07-HY) |



## 5 Uncertainty of Evaluation

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 4.6 |
|---|-----|

### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 5.2 |
|---|-----|

### Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

|   |     |
|---|-----|
| Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ ) | 5.3 |
|---|-----|

**Appendix A. Test Result of Conducted Test Items**

|                |            |                    |           |    |
|----------------|------------|--------------------|-----------|----|
| Test Engineer: | Kathy Chen | Temperature:       | 20.1~22.2 | °C |
| Test Date:     | 2020/6/18  | Relative Humidity: | 45.7~58.8 | %  |

**TEST RESULTS DATA**  
**Average Output Power**

| 2.4GHz Band MIMO |           |     |     |             |                               |       |       |                             |      |          |      |                  |      |                        |      |            |
|------------------|-----------|-----|-----|-------------|-------------------------------|-------|-------|-----------------------------|------|----------|------|------------------|------|------------------------|------|------------|
| Mod.             | Data Rate | NTX | CH. | Freq. (MHz) | Average Conducted Power (dBm) |       |       | Conducted Power Limit (dBm) |      | DG (dBi) |      | EIRP Power (dBm) |      | EIRP Power Limit (dBm) |      | Pass /Fail |
|                  |           |     |     |             | Ant4                          | Ant3  | SUM   | Ant4                        | Ant3 | Ant4     | Ant3 | Ant4             | Ant3 | Ant4                   | Ant3 |            |
| 11b              | 1Mbps     | 2   | 1   | 2412        | 19.20                         | 19.10 | 22.16 | 30.00                       |      | 0.40     |      | 22.56            |      | 36.00                  |      | Pass       |
| 11b              | 1Mbps     | 2   | 6   | 2437        | 19.40                         | 19.10 | 22.26 | 30.00                       |      | 0.40     |      | 22.66            |      | 36.00                  |      | Pass       |
| 11b              | 1Mbps     | 2   | 11  | 2462        | 19.00                         | 19.40 | 22.21 | 30.00                       |      | 0.40     |      | 22.61            |      | 36.00                  |      | Pass       |
| 11g              | 6Mbps     | 2   | 1   | 2412        | 16.90                         | 17.00 | 19.96 | 30.00                       |      | 0.40     |      | 20.36            |      | 36.00                  |      | Pass       |
| 11g              | 6Mbps     | 2   | 6   | 2437        | 19.20                         | 19.00 | 22.11 | 30.00                       |      | 0.40     |      | 22.51            |      | 36.00                  |      | Pass       |
| 11g              | 6Mbps     | 2   | 11  | 2462        | 17.50                         | 17.90 | 20.71 | 30.00                       |      | 0.40     |      | 21.11            |      | 36.00                  |      | Pass       |
| HT20             | MCS0      | 2   | 1   | 2412        | 16.00                         | 16.10 | 19.06 | 30.00                       |      | 0.40     |      | 19.46            |      | 36.00                  |      | Pass       |
| HT20             | MCS0      | 2   | 6   | 2437        | 19.20                         | 18.80 | 22.01 | 30.00                       |      | 0.40     |      | 22.41            |      | 36.00                  |      | Pass       |
| HT20             | MCS0      | 2   | 11  | 2462        | 16.00                         | 16.30 | 19.16 | 30.00                       |      | 0.40     |      | 19.56            |      | 36.00                  |      | Pass       |
| VHT20            | MCS0      | 2   | 1   | 2412        | 15.90                         | 16.00 | 18.96 | 30.00                       |      | 0.40     |      | 19.36            |      | 36.00                  |      | Pass       |
| VHT20            | MCS0      | 2   | 6   | 2437        | 19.10                         | 18.70 | 21.91 | 30.00                       |      | 0.40     |      | 22.31            |      | 36.00                  |      | Pass       |
| VHT20            | MCS0      | 2   | 11  | 2462        | 15.90                         | 16.20 | 19.06 | 30.00                       |      | 0.40     |      | 19.46            |      | 36.00                  |      | Pass       |

Note: Measured power (dBm) has offset with cable loss.



### Appendix B. Radiated Spurious Emission

|                 |                                   |                     |         |
|-----------------|-----------------------------------|---------------------|---------|
| Test Engineer : | Jesse Wang, Stan Hsieh and Ken Wu | Temperature :       | 23~26°C |
|                 |                                   | Relative Humidity : | 45~52%  |

#### 2.4GHz 2400~2483.5MHz

#### WIFI 802.11n HT20 (Band Edge @ 3m)

| WIFI Ant.                  | Note  | Frequency ( MHz ) | Level ( dBμV/m ) | Over Limit ( dB ) | Limit Line ( dBμV/m ) | Read Level ( dBμV ) | Antenna Factor ( dB/m ) | Path Loss ( dB ) | Preamp Factor ( dB ) | Ant Pos ( cm ) | Table Pos ( deg ) | Peak Avg. ( P/A ) | Pol. ( H/V ) |   |
|----------------------------|---|-------------------|------------------|-------------------|-----------------------|---------------------|-------------------------|------------------|----------------------|----------------|-------------------|-------------------|--------------|---|
| 802.11n HT20 CH 11 2462MHz | *   | 2462              | 112.94           | -                 | -                     | 98.1                | 32.03                   | 18.09            | 35.28                | 108            | 85                | P                 | H            |   |
|                            | *   | 2462              | 104.64           | -                 | -                     | 89.8                | 32.03                   | 18.09            | 35.28                | 108            | 85                | A                 | H            |   |
|                            |   | 2483.88           | 61.4             | -12.6             | 74                    | 46.5                | 32.07                   | 18.12            | 35.29                | 108            | 85                | P                 | H            |   |
|                            |   | 2483.52           | 51.44            | -2.56             | 54                    | 36.54               | 32.07                   | 18.12            | 35.29                | 108            | 85                | A                 | H            |   |
|                            |   |                   |                  |                   |                       |                     |                         |                  |                      |                |                   |                   | H            |   |
|                            |   |                   |                  |                   |                       |                     |                         |                  |                      |                |                   |                   |              | H |
|                            | *   | 2462              | 110.4            | -                 | -                     | 95.56               | 32.03                   | 18.09            | 35.28                | 393            | 94                | P                 | V            |   |
|                            | *   | 2462              | 101.02           | -                 | -                     | 86.18               | 32.03                   | 18.09            | 35.28                | 393            | 94                | A                 | V            |   |
|                            |   | 2483.76           | 57.56            | -16.44            | 74                    | 42.66               | 32.07                   | 18.12            | 35.29                | 393            | 94                | P                 | V            |   |
|                            |   | 2483.56           | 48.72            | -5.28             | 54                    | 33.82               | 32.07                   | 18.12            | 35.29                | 393            | 94                | A                 | V            |   |
|                            |   |                   |                  |                   |                       |                     |                         |                  |                      |                |                   |                   | V            |   |
|                            |   |                   |                  |                   |                       |                     |                         |                  |                      |                |                   |                   | V            |   |
| Remark                     | 1. No other spurious found.<br>2. All results are PASS against Peak and Average limit line. |                   |                  |                   |                       |                     |                         |                  |                      |                |                   |                   |              |   |



2.4GHz 2400~2483.5MHz
WIFI 802.11n HT20 (Harmonic @ 3m)

Table with 14 columns: WIFI Ant. 4+3, Note, Frequency (MHz), Level (dBµV/m), Over Limit (dB), Limit Line (dBµV/m), Read Level (dBµV), Antenna Factor (dB/m), Path Loss (dB), Preamp Factor (dB), Ant Pos (cm), Table Pos (deg), Peak Avg. (P/A), Pol. (H/V). Rows include data for 802.11n HT20 CH 11 at 4874 and 7386 MHz, and a Remark section.



2.4GHz 2400~2483.5MHz

Emission above 18GHz

2.4GHz WIFI 802.11n HT20 (SHF)

| WIFI Ant.                        | Note   | Frequency | Level      | Over Limit | Limit Line | Read Level | Antenna Factor | Path Loss | Preamp Factor | Ant Pos | Table Pos | Peak Avg. | Pol.    |   |
|----------------------------------|--|-----------|------------|------------|------------|------------|----------------|-----------|---------------|---------|-----------|-----------|---------|---|
| 4+3                              |  | ( MHz )   | ( dBμV/m ) | ( dB )     | ( dBμV/m ) | ( dBμV )   | ( dB/m )       | ( dB )    | ( dB )        | ( cm )  | ( deg )   | ( P/A )   | ( H/V ) |   |
| 2.4GHz<br>802.11n<br>HT20<br>SHF |  | 24755     | 36.62      | -37.38     | 74         | 43.44      | 39.8           | 6.88      | 53.5          | 150     | 0         | P         | H       |   |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           | H       |   |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           | H       |   |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           | H       |   |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           | H       |   |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           | H       |   |
|                                  |  |           | 23649      | 37.64      | -36.36     | 74         | 45.1           | 39.42     | 6.42          | 53.3    | 150       | 0         | P       | V |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           |         | V |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           |         | V |
|                                  |  |           |            |            |            |            |                |           |               |         |           |           |         | V |
| Remark                           | 1. No other spurious found.<br>2. All results are PASS against limit line. |           |            |            |            |            |                |           |               |         |           |           |         |   |





Emission below 1GHz

2.4GHz WIFI 802.11n HT20 (LF)

| WIFI                            | Note   | Frequency | Level      | Over   | Limit      | Read     | Antenna  | Path   | Preamp | Ant    | Table   | Peak    | Pol.    |   |
|---------------------------------|--|-----------|------------|--------|------------|----------|----------|--------|--------|--------|---------|---------|---------|---|
| Ant.                            |  |           |            | Limit  | Line       | Level    | Factor   | Loss   | Factor | Pos    | Pos     | Avg.    |         |   |
| 4+3                             |  | ( MHz )   | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | ( dBμV ) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | ( P/A ) | ( H/V ) |   |
| 2.4GHz<br>802.11n<br>HT20<br>LF |  | 30.27     | 31.68      | -8.32  | 40         | 36.43    | 24.32    | 0.94   | 30.01  | 100    | 0       | P       | H       |   |
|                                 |  | 47.28     | 25.57      | -14.43 | 40         | 38.76    | 15.63    | 1.17   | 29.99  | -      | -       | P       | H       |   |
|                                 |  | 173.37    | 30.86      | -12.64 | 43.5       | 43.13    | 15.3     | 2.37   | 29.94  | -      | -       | P       | H       |   |
|                                 |  | 710.9     | 29.66      | -16.34 | 46         | 28.29    | 26.33    | 4.69   | 29.65  | -      | -       | P       | H       |   |
|                                 |  | 794.2     | 31.62      | -14.38 | 46         | 28.26    | 27.78    | 5.04   | 29.46  | -      | -       | P       | H       |   |
|                                 |  | 946.1     | 33.64      | -12.36 | 46         | 26.89    | 29.9     | 5.57   | 28.72  | -      | -       | P       | H       |   |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         |         | H |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         |         | H |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         |         | H |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         |         | H |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         |         | H |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         |         | H |
|                                 |  |           | 30.54      | 32.31  | -7.69      | 40       | 37.25    | 24.12  | 0.95   | 30.01  | 100     | 0       | P       | V |
|                                 |  |           | 37.56      | 25.9   | -14.1      | 40       | 34.38    | 20.47  | 1.05   | 30     | -       | -       | P       | V |
|                                 |  |           | 49.44      | 22.76  | -17.24     | 40       | 36.76    | 14.78  | 1.21   | 29.99  | -       | -       | P       | V |
|                                 |  |           | 756.4      | 31.22  | -14.78     | 46       | 28.18    | 27.74  | 4.85   | 29.55  | -       | -       | P       | V |
|                                 |  |           | 861.4      | 32.89  | -13.11     | 46       | 27.92    | 28.89  | 5.25   | 29.17  | -       | -       | P       | V |
|                                 |  |           | 956.6      | 34.74  | -11.26     | 46       | 27.3     | 30.5   | 5.6    | 28.66  | -       | -       | P       | V |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         | V       |   |
|                                 |  |           |            |        |            |          |          |        |        |        |         |         | V       |   |
| Remark                          | 1. No other spurious found.<br>2. All results are PASS against limit line. |           |            |        |            |          |          |        |        |        |         |         |         |   |



**Note symbol**

|     |  |
|-----|--|
| *   | <b>Fundamental Frequency</b> which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. |
| !   | Test result is <b>over limit</b> line.   |
| P/A | <b>Peak</b> or <b>Average</b>  |
| H/V | <b>Horizontal</b> or <b>Vertical</b>   |



A calculation example for radiated spurious emission is shown as below:

| WIFI    | Note | Frequency | Level      | Over   | Limit      | Read     | Antenna  | Path   | Preamp | Ant    | Table   | Peak    | Pol.    |
|---------|------|-----------|------------|--------|------------|----------|----------|--------|--------|--------|---------|---------|---------|
| Ant.    |      |           |            | Limit  | Line       | Level    | Factor   | Loss   | Factor | Pos    | Pos     | Avg.    |         |
| 1+2     |      | ( MHz )   | ( dBμV/m ) | ( dB ) | ( dBμV/m ) | ( dBμV ) | ( dB/m ) | ( dB ) | ( dB ) | ( cm ) | ( deg ) | ( P/A ) | ( H/V ) |
| 802.11b |      | 2390      | 55.45      | -18.55 | 74         | 54.51    | 32.22    | 4.58   | 35.86  | 103    | 308     | P       | H       |
| CH 01   |      |           |            |        |            |          |          |        |        |        |         |         |         |
| 2412MHz |      | 2390      | 43.54      | -10.46 | 54         | 42.6     | 32.22    | 4.58   | 35.86  | 103    | 308     | A       | H       |

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =  
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)  
= 55.45 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 55.45(dBμV/m) – 74(dBμV/m)  
= -18.55(dB)

**For Average Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)  
= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)  
= 43.54 (dBμV/m)
2. Over Limit(dB)  
= Level(dBμV/m) – Limit Line(dBμV/m)  
= 43.54(dBμV/m) – 54(dBμV/m)  
= -10.46(dB)

**Both peak and average measured complies with the limit line, so test result is “PASS”.**



## Appendix C. Radiated Spurious Emission Plots

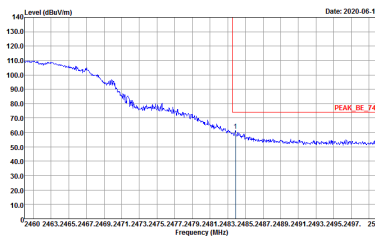
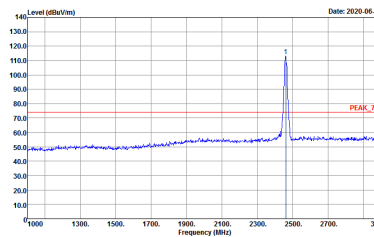
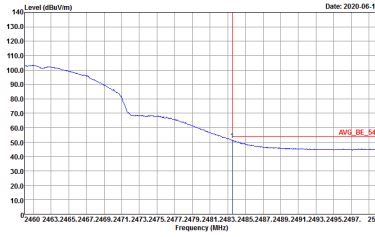
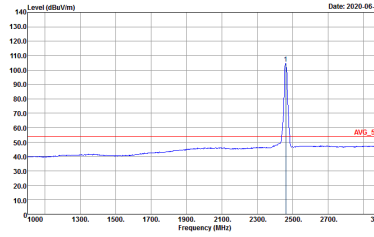
|                 |                                   |                     |         |
|-----------------|-----------------------------------|---------------------|---------|
| Test Engineer : | Jesse Wang, Stan Hsieh and Ken Wu | Temperature :       | 23~26°C |
|                 |                                   | Relative Humidity : | 45~52%  |

### Note symbol

|    |                       |
|----|-----------------------|
| -L | Low channel location  |
| -R | High channel location |



2.4GHz 2400~2483.5MHz  
 WIFI 802.11n HT20 (Band Edge @ 3m)

| WIFI | 2.4GHz 2400~2483.5MHz Band Edge @ 3m  |   |
|------|---|---|
| ANT  | 802.11n HT20 CH11 2462MHz   |   |
| 4+3  | Horizontal  | Fundamental   |
| Peak |  <p>Site : 03CH07-HY<br/>           Condition : PEAK_BE_74 3m HF_ANT_00075962 HORIZONTAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : 21</p>  |  <p>Site : 03CH07-HY<br/>           Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : 21</p>  |
| Avg. |  <p>Site : 03CH07-HY<br/>           Condition : AVG_BE_54 3m HF_ANT_00075962 HORIZONTAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : 21</p> |  <p>Site : 03CH07-HY<br/>           Condition : AVG_54 3m HF_ANT_00075962 HORIZONTAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : 21</p> |



| WIFI               | 2.4GHz 2400~2483.5MHz Fundamental @ 3m   |   |
|--------------------|--|---|
| ANT                | 802.11n HT20 CH11 2462MHz  |   |
| 4+3                | Vertical   | Fundamental   |
| <p><b>Peak</b></p> | <p>Site : 03CH07-HY<br/>           Condition : PEAK_BE_74 3m HF_ANT_00075962 VERTICAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : Z1</p> | <p>Site : 03CH07-HY<br/>           Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : Z1</p> |
| <p><b>Avg.</b></p> | <p>Site : 03CH07-HY<br/>           Condition : AVG_BE_54 3m HF_ANT_00075962 VERTICAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : Z1</p>  | <p>Site : 03CH07-HY<br/>           Condition : AVG_54 3m HF_ANT_00075962 VERTICAL<br/>           Detector : Peak<br/>           Project : 022521-02<br/>           Mode : Z1</p>  |



2.4GHz 2400~2483.5MHz  
 WIFI 802.11n HT20 (Harmonic @ 3m)

|              |   |   |
|--------------|---|---|
| WIFI         | 2.4GHz 2400~2483.5MHz Harmonic @ 3m   |   |
| ANT          | 802.11n HT20 CH11 2462MHz   |   |
| 4+3          | Horizontal  | Vertical  |
| Peak<br>Avg. | <p>Site : 03CH07-HY<br/>         Condition : PEAK_74 3m HF_ANT_00075962 HORIZONTAL<br/>         Detector : Peak<br/>         Project : 022521-02<br/>         Mode : 21</p> | <p>Site : 03CH07-HY<br/>         Condition : PEAK_74 3m HF_ANT_00075962 VERTICAL<br/>         Detector : Peak<br/>         Project : 022521-02<br/>         Mode : 21</p> |



Emission above 18GHz  
2.4GHz WIFI 802.11n HT20 (SHF)

| WIFI                       | 2.4GHz 2400~2483.5MHz   |   |
|----------------------------|---|---|
| ANT                        | 802.11n HT20 SHF  |   |
| 4+3                        | Horizontal  | Vertical  |
| <b>Peak</b><br><b>Avg.</b> | <p>Site : 09CH07-HY<br/>Condition : PEAK_74 5m SHF-EHF_9170584 HORIZONTAL<br/>Detector : Peak<br/>Project : 022521-04<br/>Mode : 27</p> | <p>Site : 09CH07-HY<br/>Condition : PEAK_74 5m SHF-EHF_9170584 VERTICAL<br/>Detector : Peak<br/>Project : 022521-04<br/>Mode : 27</p> |

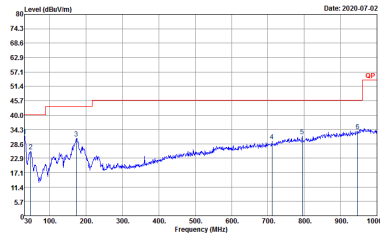
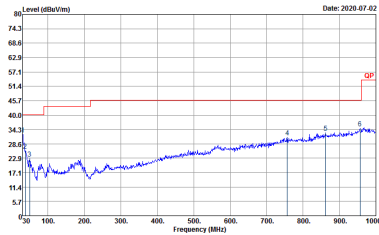




2.4GHz 2400~2483.5MHz

Emission below 1GHz

2.4GHz WIFI 802.11n HT20 (LF)

|              |  |   |
|--------------|--|---|
| WIFI         | 2.4GHz 2400~2483.5MHz  |   |
| ANT          | 802.11n HT20 LF  |   |
| 4+3          | Horizontal   | Vertical  |
| QP /<br>Peak |  <p>Site : 03CH07-HY<br/>Condition : QP-3m LF-ANT-35419(G) HORIZONTAL<br/>Detector : Peak<br/>Project : 022521-04<br/>Mode : 22</p> |  <p>Site : 03CH07-HY<br/>Condition : QP-3m LF-ANT-35419(G) VERTICAL<br/>Detector : Peak<br/>Project : 022521-04<br/>Mode : 22</p> |



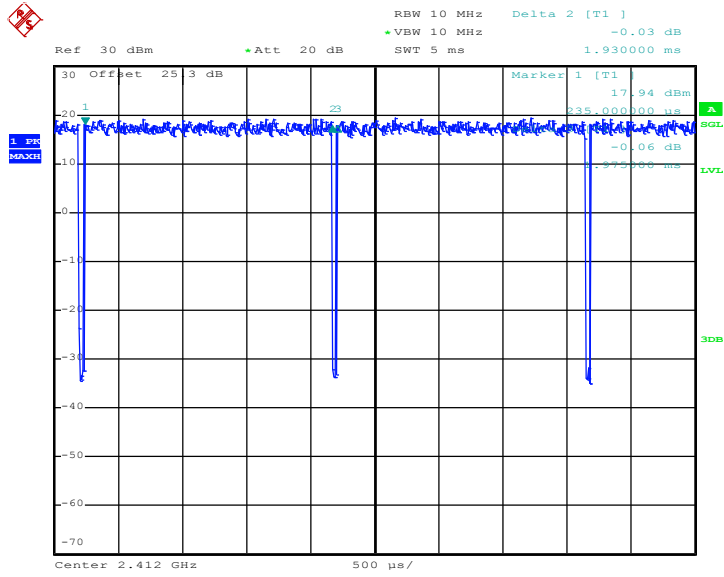
### Appendix D. Duty Cycle Plots

| Antenna | Band                         | Duty Cycle(%) | T(us) | 1/T(kHz) | VBW Setting | Duty Factor(dB) |
|---------|------------------------------|---------------|-------|----------|-------------|-----------------|
| 4+3     | 2.4GHz 802.11n HT20 for Ant4 | 97.72         | 1930  | 0.52     | 1kHz        | 0.10            |
| 4+3     | 2.4GHz 802.11n HT20 for Ant3 | 97.47         | 1925  | 0.52     | 1kHz        | 0.11            |



MIMO <Ant. 4>

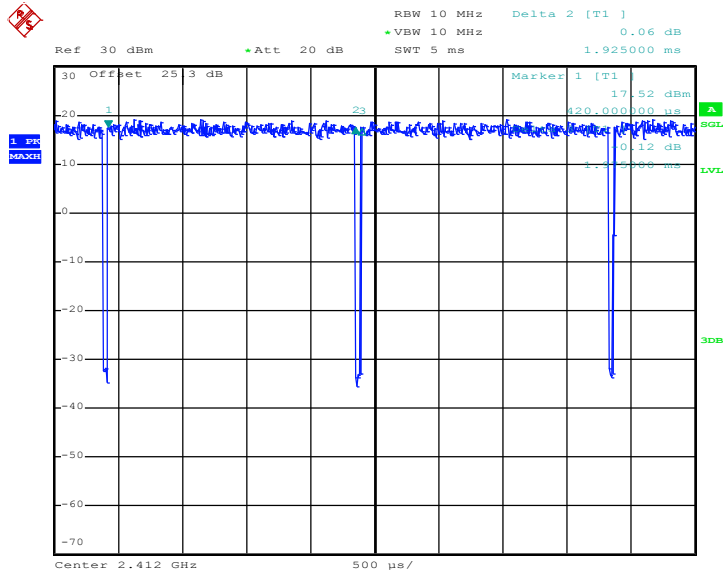
802.11n HT20



Date: 18.JUN.2020 19:14:59

MIMO <Ant. 3>

802.11n HT20



Date: 18.JUN.2020 19:15:34

—THE END—