



**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

## FCC PART 15 SUBPART C TEST REPORT

### FCC PART 15.407

**Report Reference No.**.....: **GTS20210915006-1-4**

**FCC ID**.....: **A5M-W20**

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Date of issue .....: Oct. 19, 2021

**Representative Laboratory Name.:** **Shenzhen Global Test Service Co.,Ltd.**

Address .....: No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong, China

**Applicant's name**.....: **Lenovo (Beijing) Limited**

Address .....: 201-H2-6, Floor2, Building 2, No. 6 Shangdi West Road, Haidian District, Beijing, China

**Test specification** .....

Standard .....: **FCC Part 15.407: General technical requirements**

TRF Originator.....: Shenzhen Global Test Service Co.,Ltd.

Master TRF .....: Dated 2014-12

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**Test item description** .....: **Lenovo W20 Wireless Transmitter**

Trade Mark .....: Lenovo

Manufacturer .....: Lenovo (Beijing) Limited

Model/Type reference .....: Lenovo W20

Listed Models .....: N/A

Operation Frequency.....: From 5180MHz to 5240MHz/ 5745MHz to 5825MHz

Hardware Version .....: v0.3

Software Version.....: 1.0.3.2221

Rating .....: DC 5.0V

Result .....: **PASS**

**TEST REPORT**

|                                                    |                                |
|----------------------------------------------------|--------------------------------|
| <b>Test Report No. :</b> <b>GTS20210915006-1-4</b> | Oct. 19, 2021<br>Date of issue |
|----------------------------------------------------|--------------------------------|

Equipment under Test        :        Lenovo W20 Wireless Transmitter

Model /Type                    :        Lenovo W20

Listed model                   :        N/A

**Applicant**                     :        **Lenovo (Beijing) Limited**

Address                         :        201-H2-6, Floor2, Building 2, No. 6 Shangdi West Road, Haidian District, Beijing, China

**Manufacturer**                :        **Lenovo (Beijing) Limited**

Address                         :        201-H2-6, Floor2, Building 2, No. 6 Shangdi West Road, Haidian District, Beijing, China

|                     |             |
|---------------------|-------------|
| <b>Test Result:</b> | <b>PASS</b> |
|---------------------|-------------|

The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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## 1. TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 15.407](#): General technical requirements.

[ANSI C63.10-2013](#): American National Standard for Testing Unlicensed Wireless Devices

[KDB 789033 D02 General U-NII Test Procedures New Rules v02r01](#): UNII, U-NII, U-NII Test Procedures

## 2. SUMMARY

### 2.1. General Remarks

|                                |   |                |
|--------------------------------|---|----------------|
| Date of receipt of test sample | : | Sept. 25, 2021 |
|                                | : |                |
| Testing commenced on           | : | Sept. 25, 2021 |
|                                | : |                |
| Testing concluded on           | : | Oct. 19, 2021  |

### 2.2. Product Description

|                      |                                                                                                                                         |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Product Name         | Lenovo W20 Wireless Transmitter                                                                                                         |
| Trade Mark           | Lenovo                                                                                                                                  |
| Model/Type reference | Lenovo W20                                                                                                                              |
| List Models          | N/A                                                                                                                                     |
| Model Declaration    | N/A                                                                                                                                     |
| Power supply:        | DC 5.0V                                                                                                                                 |
| Sample ID            | GTS20210915006-1-1# & GTS20210915006-1-2#                                                                                               |
| WIFI(2.4G Band)      |                                                                                                                                         |
| Frequency Range      | 2412MHz ~ 2462MHz                                                                                                                       |
| Channel Spacing      | 5MHz                                                                                                                                    |
| Channel Number       | 11 Channel for 20MHz bandwidth(2412~2462MHz)                                                                                            |
| Modulation Type      | 802.11b: DSSS; 802.11g/n: OFDM                                                                                                          |
| WIFI(5.2G Band)      |                                                                                                                                         |
| Frequency Range      | 5180MHz ~ 5240MHz                                                                                                                       |
| Channel Number       | 4 channels for 20MHz bandwidth(5180-5240MHz)<br>2 channels for 40MHz bandwidth(5190~5230MHz)<br>1 channels for 80MHz bandwidth(5210MHz) |
| Modulation Type      | 802.11a/n/ac: OFDM                                                                                                                      |
| WIFI (5.8G Band)     |                                                                                                                                         |
| Frequency Range      | 5745MHz ~ 5825MHz                                                                                                                       |
| Channel Number       | 5 channels for 20MHz bandwidth(5745-5825MHz)<br>2 channels for 40MHz bandwidth(5755~5795MHz)<br>1 channels for 80MHz bandwidth(5775MHz) |
| Modulation Type      | 802.11a/n/ac: OFDM                                                                                                                      |
| Antenna Description  | Internal Antenna, 3.32 dBi(Max.) for 2.4G Band and 2.52 dBi(Max.) for 5G Band                                                           |

## 2.3. Equipment Under Test

### Power supply system utilised

|                      |   |                                                                   |                                   |
|----------------------|---|-------------------------------------------------------------------|-----------------------------------|
| Power supply voltage | : | <input type="radio"/> 230V / 50 Hz                                | <input type="radio"/> 120V / 60Hz |
|                      |   | <input type="radio"/> 12 V DC                                     | <input type="radio"/> 24 V DC     |
|                      |   | <input checked="" type="radio"/> Other (specified in blank below) |                                   |

DC 5.0V

## 2.4. Short description of the Equipment under Test (EUT)

This is a Lenovo W20 Wireless Transmitter.

For more details, refer to the user's manual of the EUT.

## 2.5. EUT operation mode

The application provider specific test software to control sample in continuous TX and RX.

| Antenna        | Chain0 (ANT0)                       |                                     |                                     | Chain1 (ANT1)            |                          |                          | Simultaneously           |
|----------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Bandwidth Mode | 20MHz                               | 40MHz                               | 80MHz                               | 20MHz                    | 40MHz                    | 80MHz                    | /                        |
| IEEE 802.11a   | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| IEEE 802.11n   | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>            | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| IEEE 802.11ac  | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

IEEE 802.11a/ac20/ac40/ac80/n20/n40:

| UNII-1    |                 | UNII-1  |                 | UNII-1  |                 |
|-----------|-----------------|---------|-----------------|---------|-----------------|
| Channel   | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| <b>36</b> | <b>5180</b>     | 38      | 5190            | 42      | 5210            |
| <b>40</b> | <b>5200</b>     | 46      | 5230            |         |                 |
| 44        | 5220            |         |                 |         |                 |
| <b>48</b> | <b>5240</b>     |         |                 |         |                 |

| UNII-3     |                 | UNII-3  |                 | UNII-3  |                 |
|------------|-----------------|---------|-----------------|---------|-----------------|
| Channel    | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| <b>149</b> | <b>5745</b>     | 151     | 5755            | 155     | 5775            |
| 153        | 5765            | 159     | 5795            |         |                 |
| <b>157</b> | <b>5785</b>     |         |                 |         |                 |
| 161        | 5805            |         |                 |         |                 |
| <b>165</b> | <b>5825</b>     |         |                 |         |                 |

The EUT has been tested under operating condition.

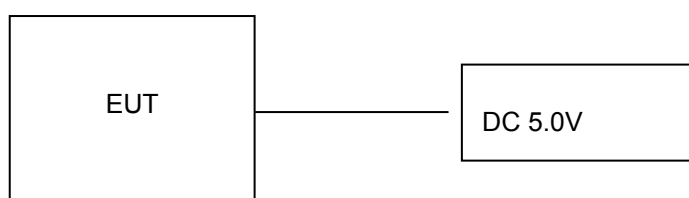
This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

AC main conducted emission pre-test voltage at both AC 120V/60Hz and AC 240V/60Hz, recorded worst case;

AC main conducted emission pre-test at charge from PC modes, recorded worst case;

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be IEEE 802.11ac VHT20 mode (HCH).

## 2.6. Block Diagram of Test Setup



## 2.7. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: A5M-W20** filing to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.

## 2.8. EUT Exercise Software

The system is configured to test and change the test channel under continuous transmission conditions through ADB commands.

## 2.9. Special Accessories

| Manufacturer | Description | Model           | Serial Number | Certificate |
|--------------|-------------|-----------------|---------------|-------------|
| LENOVO       | PC          | DESKYOP-EUIVCNR | --            | SDOC        |
| HUAWEI       | Phone       | ALA-AN70        | --            | SDOC        |

**Note:**The test accessory PC and Phone only used for testing and is not shipped with the product.

## 2.10. External I/O Cable

| I/O Port Description | Quantity | Cable                  |
|----------------------|----------|------------------------|
| HDMI Port            | 1        | 1.0M, Unscreened Cable |

## 2.11. Modifications

No modifications were implemented to meet testing criteria.

### 3. TEST ENVIRONMENT

#### 3.1. Address of the test laboratory

**Shenzhen Global Test Service Co.,Ltd.**

No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong, China.

#### 3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

CNAS (No. CNAS L8169)

Shenzhen Global Test Service Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2019 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA (Certificate No. 4758.01)

Shenzhen Global Test Service Co., Ltd. has been assessed by the American Association for Laboratory Accreditation (A2LA). Certificate No. 4758.01.

Industry Canada Registration Number. is 24189.

FCC Designation Number is CN1234.

FCC Registered Test Site Number is 165725.

#### 3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

|                       |              |
|-----------------------|--------------|
| Temperature:          | 15-35 ° C    |
|                       |              |
| Humidity:             | 30-60 %      |
|                       |              |
| Atmospheric pressure: | 950-1050mbar |

#### 3.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

| Test                  | Range      | Measurement Uncertainty | Notes |
|-----------------------|------------|-------------------------|-------|
| Radiated Emission     | 30~1000MHz | 4.10 dB                 | (1)   |
| Radiated Emission     | 1~18GHz    | 4.32 dB                 | (1)   |
| Radiated Emission     | 18-40GHz   | 5.54 dB                 | (1)   |
| Conducted Disturbance | 0.15~30MHz | 3.12 dB                 | (1)   |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

### 3.5. Test Description

| Applied Standard: FCC Part 15 Subpart E |                                      |                                            |           |        |
|-----------------------------------------|--------------------------------------|--------------------------------------------|-----------|--------|
| FCC Rules                               | Description of Test                  | Test Sample                                | Result    | Remark |
| /                                       | On Time and Duty Cycle               | GTS20210915006-1-1#                        | Compliant | Note 1 |
| §15.407(a)                              | Maximum Conducted Output Power       | GTS20210915006-1-1#                        | Compliant | Note 1 |
| §15.407(a)                              | Power Spectral Density               | GTS20210915006-1-1#                        | Compliant | Note 1 |
| §15.407(a)                              | 26dB&6dB Bandwidth and 99% Bandwidth | GTS20210915006-1-1#                        | Compliant | Note 1 |
| §15.209,<br>§15.407(b)                  | Radiated Emissions                   | GTS20210915006-1-1#<br>GTS20210915006-1-2# | Compliant | Note 1 |
| §15.209,<br>§15.407(b)                  | Emissions at Restricted Band         | GTS20210915006-1-1#<br>GTS20210915006-1-2# | Compliant | Note 1 |
| §15.407(g)                              | Frequency Stability                  | GTS20210915006-1-1#                        | Compliant | Note 1 |
| §15.207(a)                              | AC Mians Line Conducted Emissions    | GTS20210915006-1-2#                        | Compliant | Note 1 |
| §15.203<br>§15.407(h)                   | Antenna Requirements                 | GTS20210915006-1-1#                        | Compliant | Note 1 |
| §15.407 §2.1093                         | RF Exposure                          | /                                          | Compliant | Note 2 |

Remark:

1. The measurement uncertainty is not included in the test result.
2. NA = Not Applicable; NP = Not Performed
3. Note 1 – Test results inside test report;
4. Note 2 – Test results in other test report (SAR Report).
5. We tested all test mode and recorded worst case in report

PreLenovoary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

| Test Items                                                                     | Mode                                    | Data Rate |
|--------------------------------------------------------------------------------|-----------------------------------------|-----------|
| Maximum Peak Conducted Output Power                                            | 802.11a                                 | 6 Mbps    |
| Power Spectral Density                                                         | 802.11ac20/ac40/ac80<br>802.11n HT20/40 | MCS0      |
| 6dB Bandwidth                                                                  |                                         |           |
| 26dB Bandwidth                                                                 |                                         |           |
| Radiated Emission30M~1GHz&<br>Radiated Emission 1GHz~10 <sup>th</sup> Harmonic | 802.11a                                 | 6 Mbps    |
| Band Edge                                                                      | 802.11ac20/ac40/ac80<br>802.11n HT20/40 | MCS0      |

### 3.6. Equipments Used during the Test

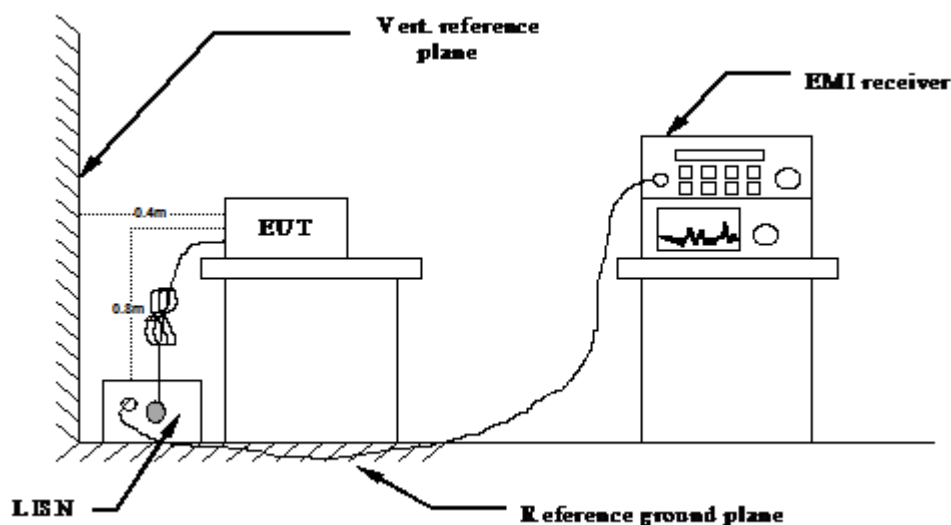
| Test Equipment             | Manufacturer                      | Model No.             | Serial No.      | Calibration Date | Calibration Due Date |
|----------------------------|-----------------------------------|-----------------------|-----------------|------------------|----------------------|
| LISN                       | CYBERTEK                          | EM5040A               | E1850400105     | 2021/07/17       | 2022/07/16           |
| LISN                       | R&S                               | ESH2-Z5               | 893606/008      | 2021/07/17       | 2022/07/16           |
| EMI Test Receiver          | R&S                               | ESPI3                 | 101841-cd       | 2021/07/17       | 2022/07/16           |
| EMI Test Receiver          | R&S                               | ESCI7                 | 101102          | 2021/09/19       | 2022/09/18           |
| Spectrum Analyzer          | Agilent                           | N9020A                | MY48010425      | 2021/09/19       | 2022/09/18           |
| Spectrum Analyzer          | R&S                               | FSV40                 | 100019          | 2021/07/17       | 2022/07/16           |
| Vector Signal generator    | Agilent                           | N5181A                | MY49060502      | 2021/07/17       | 2022/07/16           |
| Signal generator           | Agilent                           | N5182A                | 3610AO1069      | 2021/09/19       | 2022/09/18           |
| Climate Chamber            | ESPEC                             | EL-10KA               | A20120523       | 2021/09/19       | 2022/09/18           |
| Controller                 | EM Electronics                    | Controller EM 1000    | N/A             | N/A              | N/A                  |
| Horn Antenna               | Schwarzbeck                       | BBHA 9120D            | 01622           | 2020/11/08       | 2021/11/07           |
| Active Loop Antenna        | Beijing Da Ze Technology Co.,Ltd. | ZN30900C              | 15006           | 2021/10/10       | 2022/10/09           |
| Bilog Antenna              | Schwarzbeck                       | VULB9163              | 000976          | 2021/08/08       | 2022/08/07           |
| Broadband Horn Antenna     | SCHWARZBECK                       | BBHA 9170             | 791             | 2020/11/08       | 2021/11/07           |
| Amplifier                  | Schwarzbeck                       | BBV 9743              | #202            | 2021/07/17       | 2022/07/16           |
| Amplifier                  | Schwarzbeck                       | BBV9179               | 9719-025        | 2021/07/17       | 2022/07/16           |
| Amplifier                  | EMCI                              | EMC051845B            | 980355          | 2021/07/17       | 2022/07/16           |
| Temperature/Humidity Meter | Gangxing                          | CTH-608               | 02              | 2021/07/17       | 2022/07/16           |
| High-Pass Filter           | K&L                               | 9SH10-2700/X12750-O/O | KL142031        | 2021/07/17       | 2022/07/16           |
| High-Pass Filter           | K&L                               | 41H10-1375/U12750-O/O | KL142032        | 2021/07/17       | 2022/07/16           |
| RF Cable(below 1GHz)       | HUBER+SUHNER                      | RG214                 | RE01            | 2021/07/17       | 2022/07/16           |
| RF Cable(above 1GHz)       | HUBER+SUHNER                      | RG214                 | RE02            | 2021/07/17       | 2022/07/16           |
| Data acquisition card      | Agilent                           | U2531A                | TW53323507      | 2021/07/17       | 2022/07/16           |
| Power Sensor               | Agilent                           | U2021XA               | MY5365004       | 2021/07/17       | 2022/07/16           |
| Test Control Unit          | Tonscend                          | JS0806-1              | 178060067       | 2021/07/17       | 2022/07/16           |
| Automated filter bank      | Tonscend                          | JS0806-F              | 19F8060177      | 2021/07/17       | 2022/07/16           |
| EMI Test Software          | Tonscend                          | JS1120-1              | Ver 2.6.8.0518  | /                | /                    |
| EMI Test Software          | Tonscend                          | JS1120-3              | Ver 2.5.77.0418 | /                | /                    |
| EMI Test Software          | Tonscend                          | JS32-CE               | Ver 2.5         | /                | /                    |
| EMI Test Software          | Tonscend                          | JS32-RE               | Ver 2.5.1.8     | /                | /                    |

Note: The Cal.Interval was one year.

## 4. TEST CONDITIONS AND RESULTS

### 4.1. AC Power Conducted Emission

#### TEST CONFIGURATION



#### TEST PROCEDURE

- 1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2 Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4 The EUT received DC5V power, the PC received AC120V/60Hz or AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5 All support equipments received AC power from a second LISN, if any.
- 6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8 During the above scans, the emissions were maximized by cable manipulation.

#### AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

| Frequency range (MHz) | Limit (dBuV) |           |
|-----------------------|--------------|-----------|
|                       | Quasi-peak   | Average   |
| 0.15-0.5              | 66 to 56*    | 56 to 46* |
| 0.5-5                 | 56           | 46        |
| 5-30                  | 60           | 50        |

\* Decreases with the logarithm of the frequency.

#### TEST RESULTS

Remark: We measured Conducted Emission at all mode in AC 120V/60Hz, the worst case was recorded .

|               |           |                |                     |
|---------------|-----------|----------------|---------------------|
| Temperature   | 24.5°C    | Humidity       | 53.7%               |
| Test Engineer | Oliver Ou | Configurations | IEEE 802.11ac20 HCH |

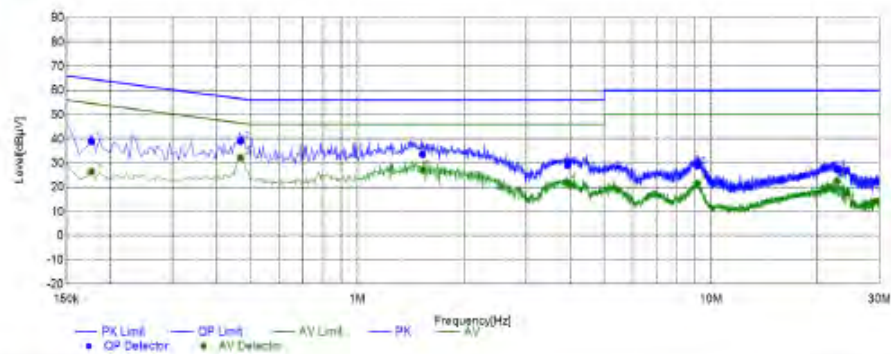
Power supply:

AC 120V/60Hz

Polarization

L

Test Graph



Final Data List

| NO. | Frequency<br>[MHz] | QP<br>Reading<br>[dBμV] | AVG.<br>Reading<br>[dBμV] | Factor<br>[dB] | QP<br>Result<br>[dBμV] | AVG.<br>Result<br>[dBμV] | QP<br>Limit<br>[dBμV] | AVG.<br>Limit<br>[dBμV] | QP<br>Margin<br>[dB] | AVG.<br>Margin<br>[dB] | Line | Remark |
|-----|--------------------|-------------------------|---------------------------|----------------|------------------------|--------------------------|-----------------------|-------------------------|----------------------|------------------------|------|--------|
| 1   | 0.1768             | 28.88                   | 16.39                     | 10.05          | 38.93                  | 26.44                    | 64.63                 | 54.63                   | 25.70                | 28.19                  | L1   | PASS   |
| 2   | 0.4668             | 29.04                   | 22.11                     | 10.05          | 39.09                  | 32.16                    | 56.57                 | 46.57                   | 17.48                | 14.41                  | L1   | PASS   |
| 3   | 1.5290             | 23.58                   | 16.95                     | 10.11          | 33.69                  | 27.06                    | 56.00                 | 46.00                   | 22.31                | 18.94                  | L1   | PASS   |
| 4   | 3.9350             | 18.67                   | 11.71                     | 10.40          | 29.07                  | 22.11                    | 56.00                 | 46.00                   | 26.93                | 23.89                  | L1   | PASS   |
| 5   | 9.1546             | 18.19                   | 10.87                     | 10.66          | 28.85                  | 21.53                    | 60.00                 | 50.00                   | 31.15                | 28.47                  | L1   | PASS   |
| 6   | 22.7840            | 15.66                   | 10.99                     | 11.60          | 27.56                  | 22.59                    | 60.00                 | 50.00                   | 32.44                | 27.41                  | L1   | PASS   |

Note:1. Result (dBμV) = Reading (dBμV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

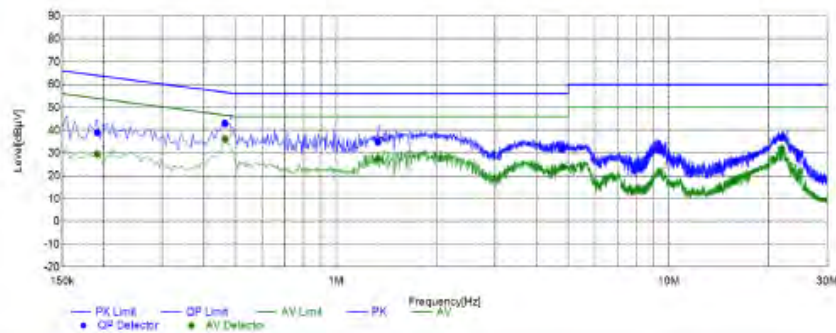
Power supply:

AC 120V/60Hz

Polarization

N

Test Graph



Final Data List

| NO. | Frequency<br>[MHz] | QP<br>Reading<br>[dBμV] | AVG.<br>Reading<br>[dBμV] | Factor<br>[dB] | QP<br>Result<br>[dBμV] | AVG.<br>Result<br>[dBμV] | QP<br>Limit<br>[dBμV] | AVG.<br>Limit<br>[dBμV] | QP<br>Margin<br>[dB] | AVG.<br>Margin<br>[dB] | Line | Remark |
|-----|--------------------|-------------------------|---------------------------|----------------|------------------------|--------------------------|-----------------------|-------------------------|----------------------|------------------------|------|--------|
| 1   | 0.1911             | 28.82                   | 19.49                     | 10.06          | 38.88                  | 29.55                    | 63.99                 | 53.99                   | 25.11                | 24.44                  | N    | PASS   |
| 2   | 0.4623             | 32.92                   | 26.04                     | 10.05          | 42.97                  | 36.09                    | 56.65                 | 46.65                   | 13.68                | 10.56                  | N    | PASS   |
| 3   | 1.3362             | 24.66                   | 17.52                     | 10.09          | 34.75                  | 27.61                    | 56.00                 | 46.00                   | 21.25                | 18.39                  | N    | PASS   |
| 4   | 4.7898             | 21.06                   | 13.45                     | 10.46          | 31.52                  | 23.91                    | 56.00                 | 46.00                   | 24.48                | 22.09                  | N    | PASS   |
| 5   | 9.4144             | 20.31                   | 11.28                     | 10.66          | 30.99                  | 21.96                    | 60.00                 | 50.00                   | 29.01                | 28.04                  | N    | PASS   |
| 6   | 21.8864            | 25.08                   | 20.50                     | 11.49          | 36.57                  | 31.99                    | 60.00                 | 50.00                   | 23.43                | 18.01                  | N    | PASS   |

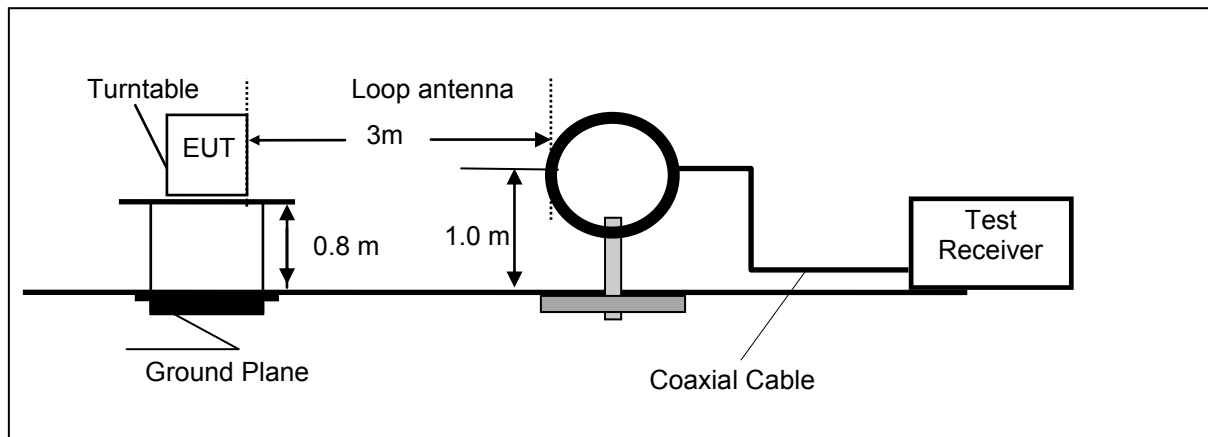
Note:1. Result (dBμV) = Reading (dBμV) + Factor (dB).

2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

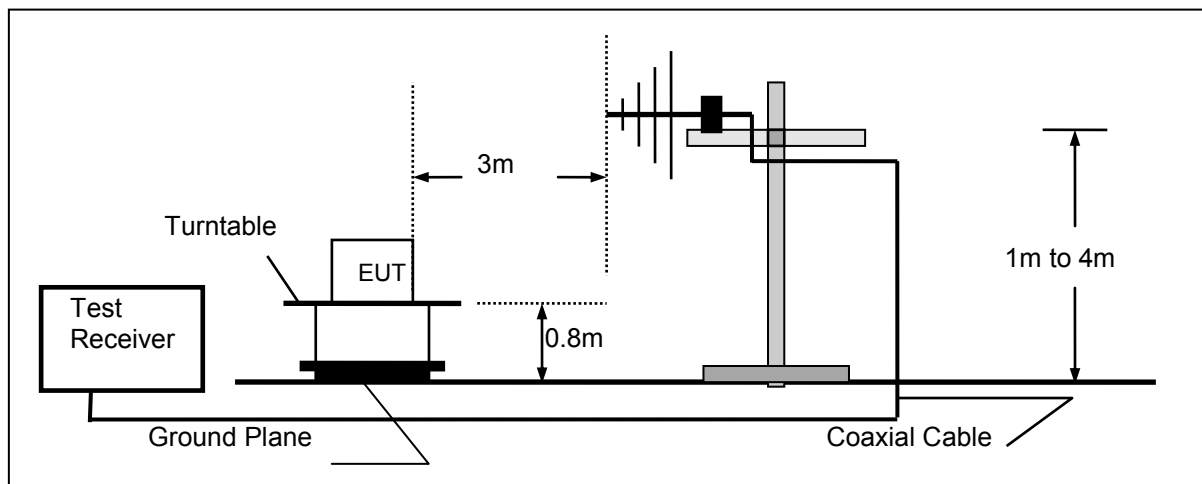
## 4.2. Radiated Emission

### TEST CONFIGURATION

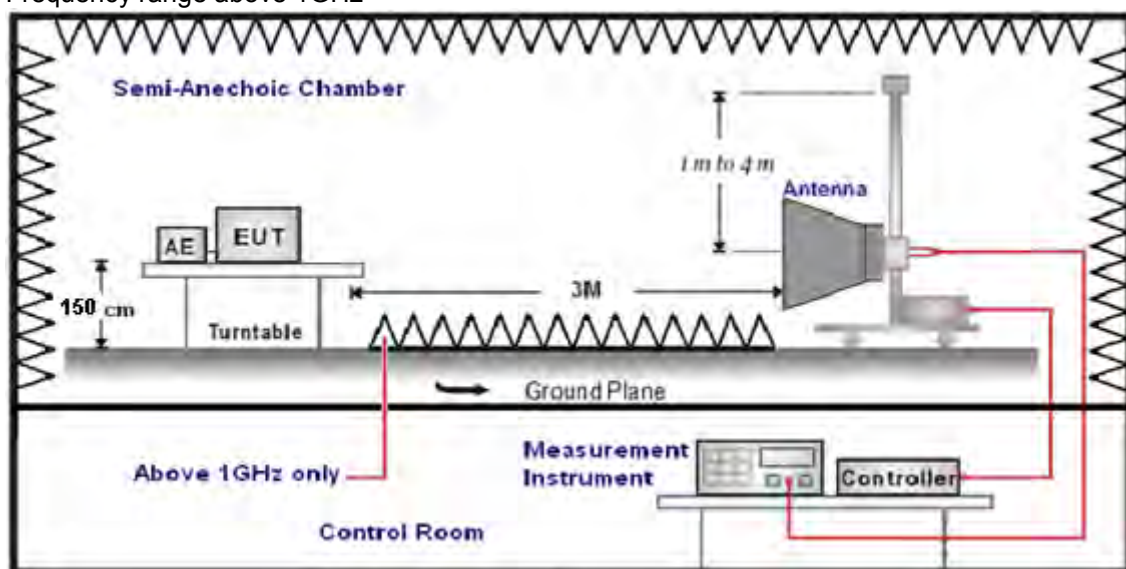
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz



**TEST PROCEDURE**

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing above 1GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0° to 360° to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 24MHz and maximum operation frequency was 5825MHz.so radiated emission test frequency band from 9KHz to 40GHz.
6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type          | Test Distance |
|----------------------|----------------------------|---------------|
| 9KHz-30MHz           | Active Loop Antenna        | 3             |
| 30MHz-1GHz           | Ultra-Broadband Antenna    | 3             |
| 1GHz-18GHz           | Double Ridged Horn Antenna | 3             |
| 18GHz-25GHz          | Horn Antenna               | 1             |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting                                                                            | Detector |
|----------------------|-----------------------------------------------------------------------------------------------------------|----------|
| 9KHz-150KHz          | RBW=200Hz/VBW=3KHz, Sweep time=Auto                                                                       | QP       |
| 150KHz-30MHz         | RBW=9KHz/VBW=100KHz, Sweep time=Auto                                                                      | QP       |
| 30MHz-1GHz           | RBW=120KHz/VBW=1000KHz, Sweep time=Auto                                                                   | QP       |
| 1GHz-40GHz           | Peak Value: RBW=1MHz/VBW=3MHz,<br>Sweep time=Auto<br>Average Value: RBW=1MHz/VBW=10Hz,<br>Sweep time=Auto | Peak     |

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

|                           |                                            |
|---------------------------|--------------------------------------------|
| Where FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| RA = Reading Amplitude    | AG = Amplifier Gain                        |
| AF = Antenna Factor       |                                            |

$$Transd=AF +CL-AG$$

**RADIATION LIMIT**

According to §15.407 (b): Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits

| Frequency (MHz) | EIRP Limit (dBm)                   | Equivalent Field Strength at 3m (dBμV/m) |
|-----------------|------------------------------------|------------------------------------------|
| 5150-5250       | -27                                | 68.2                                     |
| 5250-5350       | -27                                | 68.2                                     |
| 5470-5725       | -27                                | 68.2                                     |
| 5725-5850       | -27 (beyond 10MHz of the bandedge) | 68.2                                     |
|                 | -17 (within 10 MHz of band edge)   | 78.2                                     |

| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m)                          | Radiated (μV/m)       |
|-----------------|-------------------|--------------------------------------------|-----------------------|
| 0.009-0.49      | 3                 | $20\log(2400/F(\text{KHz}))+40\log(300/3)$ | $2400/F(\text{KHz})$  |
| 0.49-1.705      | 3                 | $20\log(24000/F(\text{KHz}))+40\log(30/3)$ | $24000/F(\text{KHz})$ |
| 1.705-30        | 3                 | $20\log(30)+40\log(30/3)$                  | 30                    |
| 30-88           | 3                 | 40.0                                       | 100                   |
| 88-216          | 3                 | 43.5                                       | 150                   |
| 216-960         | 3                 | 46.0                                       | 200                   |
| Above 960       | 3                 | 54.0                                       | 500                   |

**TEST RESULTS**

Remark: We measured Radiated Emission at all mode from 30MHz to 25GHz in AC 120V/60Hz and the worst case was recorded.

|               |           |                |                     |
|---------------|-----------|----------------|---------------------|
| Temperature   | 23.4°C    | Humidity       | 54.5%               |
| Test Engineer | Oliver Ou | Configurations | IEEE 802.11ac20 HCH |

**For 9 KHz~30MHz**

| Freq. (MHz) | Level (dBuV) | Over Limit (dB) | Over Limit (dBuV) | Remark   |
|-------------|--------------|-----------------|-------------------|----------|
| -           | -            | -               | -                 | See Note |

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

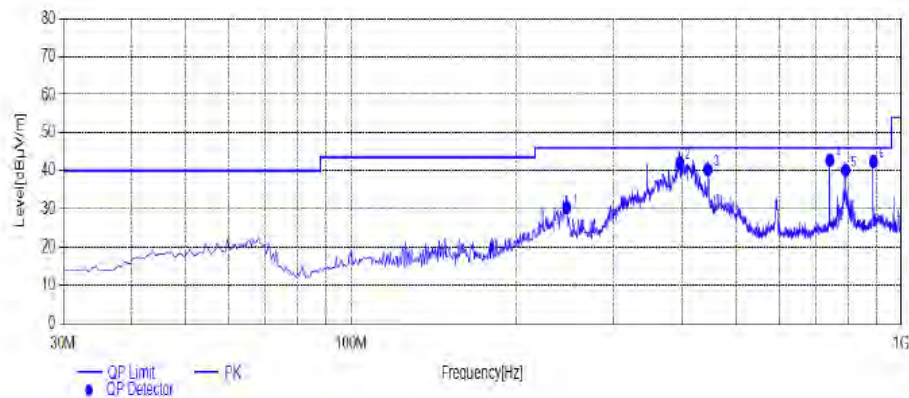
Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

## For 30MHz-1GHz

## Horizontal

Test Graph



Quasi-peak Final Data List

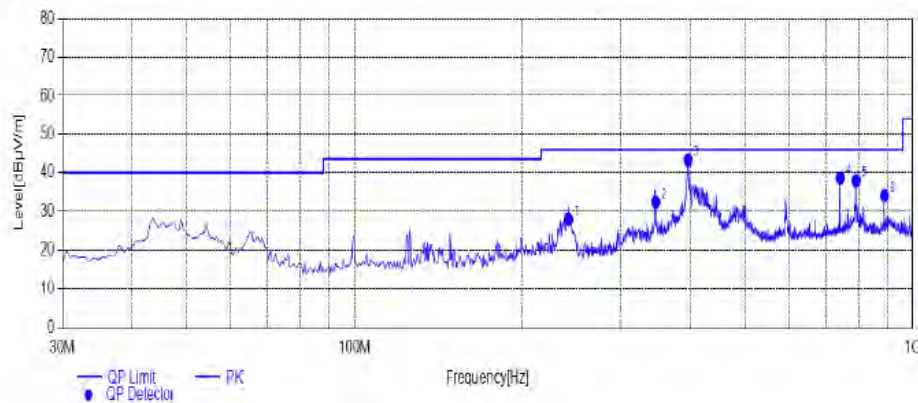
| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity   | Remark |
|-----|-----------------|------------------|-------------|-----------------|----------------|-------------|-------------|-----------|------------|--------|
| 1   | 246.7950        | 38.36            | -8.14       | 30.22           | 46.00          | 15.78       | 100         | 360       | Horizontal | PASS   |
| 2   | 396.1750        | 47.06            | -5.03       | 42.03           | 46.00          | 3.97        | 100         | 2         | Horizontal | PASS   |
| 3   | 445.1600        | 44.20            | -3.96       | 40.24           | 46.00          | 5.76        | 100         | 358       | Horizontal | PASS   |
| 4   | 741.9800        | 41.69            | 0.98        | 42.67           | 46.00          | 3.33        | 100         | 360       | Horizontal | PASS   |
| 5   | 792.4200        | 38.41            | 1.64        | 40.05           | 46.00          | 5.95        | 100         | 359       | Horizontal | PASS   |
| 6   | 890.3900        | 39.72            | 2.57        | 42.29           | 46.00          | 3.71        | 100         | 15        | Horizontal | PASS   |

Note: 1. Result (dBμV/m) = Reading (dBμV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

## Vertical

Test Graph



Quasi-peak Final Data List

| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Polarity | Remark |
|-----|-----------------|------------------|-------------|-----------------|----------------|-------------|-------------|-----------|----------|--------|
| 1   | 241.9450        | 36.14            | -8.31       | 27.83           | 46.00          | 18.17       | 100         | 249       | Vertical | PASS   |
| 2   | 346.7050        | 38.01            | -5.73       | 32.28           | 46.00          | 13.72       | 100         | 332       | Vertical | PASS   |
| 3   | 396.1750        | 48.30            | -5.03       | 43.27           | 46.00          | 2.73        | 100         | 306       | Vertical | PASS   |
| 4   | 741.9800        | 37.61            | 0.98        | 38.59           | 46.00          | 7.41        | 100         | 287       | Vertical | PASS   |
| 5   | 792.4200        | 36.27            | 1.64        | 37.91           | 46.00          | 8.09        | 100         | 5         | Vertical | PASS   |
| 6   | 890.3900        | 31.41            | 2.57        | 33.98           | 46.00          | 12.02       | 100         | 18        | Vertical | PASS   |

Note: 1. Result (dBμV/m) = Reading (dBμV/m) + Factor (dB) .

2. Factor (dB) = Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB).

For 1GHz to 40GHz  
5150-5250MHz:

## 802.11a Mode Channel 36 5180 MHz

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10360      | 41.59             | 38.55                 | 33.13         | 11.26           | 58.27                 | 68.20               | -9.93       | Peak     | Horizontal   |
| 1           | 10360      | 30.74             | 38.55                 | 33.13         | 11.26           | 47.42                 | 54.00               | -6.58       | AV       | Horizontal   |
| 1           | 10360      | 41.52             | 38.55                 | 33.13         | 11.26           | 58.20                 | 68.20               | -10.00      | Peak     | Vertical     |
| 1           | 10360      | 29.04             | 38.55                 | 33.13         | 11.26           | 45.72                 | 54.00               | -8.28       | AV       | Vertical     |

## 802.11a Mode Channel 40 5200 MHz

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10400      | 39.15             | 38.55                 | 33.13         | 11.26           | 55.83                 | 68.20               | -12.37      | Peak     | Horizontal   |
| 1           | 10400      | 32.35             | 38.55                 | 33.13         | 11.26           | 49.03                 | 54.00               | -4.97       | AV       | Horizontal   |
| 1           | 10400      | 40.76             | 38.55                 | 33.13         | 11.26           | 57.44                 | 68.20               | -10.76      | Peak     | Vertical     |
| 1           | 10400      | 27.48             | 38.55                 | 33.13         | 11.26           | 44.16                 | 54.00               | -9.84       | AV       | Vertical     |

## 802.11a Mode Channel 48 5240 MHz

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10480      | 40.09             | 38.55                 | 33.13         | 11.26           | 56.77                 | 68.20               | -11.43      | Peak     | Horizontal   |
| 1           | 10480      | 31.47             | 38.55                 | 33.13         | 11.26           | 48.15                 | 54.00               | -5.85       | AV       | Horizontal   |
| 1           | 10480      | 41.53             | 38.55                 | 33.13         | 11.26           | 58.21                 | 68.20               | -9.99       | Peak     | Vertical     |
| 1           | 10480      | 28.88             | 38.55                 | 33.13         | 11.26           | 45.56                 | 54.00               | -8.44       | AV       | Vertical     |

## 802.11n20 Mode Channel 36 5180 MHz

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10360      | 40.51             | 38.55                 | 33.13         | 11.26           | 57.19                 | 68.20               | -11.01      | Peak     | Horizontal   |
| 1           | 10360      | 30.27             | 38.55                 | 33.13         | 11.26           | 46.95                 | 54.00               | -7.05       | AV       | Horizontal   |
| 1           | 10360      | 42.24             | 38.55                 | 33.13         | 11.26           | 58.92                 | 68.20               | -9.28       | Peak     | Vertical     |
| 1           | 10360      | 30.16             | 38.55                 | 33.13         | 11.26           | 46.84                 | 54.00               | -7.16       | AV       | Vertical     |

## 802.11n20 Mode Channel 40 5200 MHz

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10400      | 39.17             | 38.55                 | 33.13         | 11.26           | 55.85                 | 68.20               | -12.35      | Peak     | Horizontal   |
| 1           | 10400      | 31.15             | 38.55                 | 33.13         | 11.26           | 47.83                 | 54.00               | -6.17       | AV       | Horizontal   |
| 1           | 10400      | 40.57             | 38.55                 | 33.13         | 11.26           | 57.25                 | 68.20               | -10.95      | Peak     | Vertical     |
| 1           | 10400      | 28.57             | 38.55                 | 33.13         | 11.26           | 45.25                 | 54.00               | -8.75       | AV       | Vertical     |

## 802.11n20 Mode Channel 48 5240 MHz

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10480      | 39.70             | 38.55                 | 33.13         | 11.26           | 56.38                 | 68.20               | -11.82      | Peak     | Horizontal   |
| 1           | 10480      | 30.66             | 38.55                 | 33.13         | 11.26           | 47.34                 | 54.00               | -6.66       | AV       | Horizontal   |
| 1           | 10480      | 40.77             | 38.55                 | 33.13         | 11.26           | 57.45                 | 68.20               | -10.75      | Peak     | Vertical     |
| 1           | 10480      | 30.23             | 38.55                 | 33.13         | 11.26           | 46.91                 | 54.00               | -7.09       | AV       | Vertical     |

**802.11n40 Mode Channel 38 5190 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10380      | 40.21             | 38.55                 | 33.13         | 11.26           | 56.89                 | 68.20               | -11.31      | Peak     | Horizontal   |
| 1           | 10380      | 31.54             | 38.55                 | 33.13         | 11.26           | 48.22                 | 54.00               | -5.78       | AV       | Horizontal   |
| 1           | 10380      | 41.05             | 38.55                 | 33.13         | 11.26           | 57.73                 | 68.20               | -10.47      | Peak     | Vertical     |
| 1           | 10380      | 29.69             | 38.55                 | 33.13         | 11.26           | 46.37                 | 54.00               | -7.63       | AV       | Vertical     |

**802.11n40 Mode Channel 46 5230 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10460      | 40.58             | 38.55                 | 33.13         | 11.26           | 57.26                 | 68.20               | -10.94      | Peak     | Horizontal   |
| 1           | 10460      | 31.44             | 38.55                 | 33.13         | 11.26           | 48.12                 | 54.00               | -5.88       | AV       | Horizontal   |
| 1           | 10460      | 41.07             | 38.55                 | 33.13         | 11.26           | 57.75                 | 68.20               | -10.45      | Peak     | Vertical     |
| 1           | 10460      | 28.59             | 38.55                 | 33.13         | 11.26           | 45.27                 | 54.00               | -8.73       | AV       | Vertical     |

**802.11ac20 Mode Channel 36 5180 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10360      | 41.05             | 38.55                 | 33.13         | 11.26           | 57.73                 | 68.20               | -10.47      | Peak     | Horizontal   |
| 1           | 10360      | 31.03             | 38.55                 | 33.13         | 11.26           | 47.71                 | 54.00               | -6.29       | AV       | Horizontal   |
| 1           | 10360      | 40.63             | 38.55                 | 33.13         | 11.26           | 57.31                 | 68.20               | -10.89      | Peak     | Vertical     |
| 1           | 10360      | 29.09             | 38.55                 | 33.13         | 11.26           | 45.77                 | 54.00               | -8.23       | AV       | Vertical     |

**802.11ac20 Mode Channel 40 5200 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10400      | 40.42             | 38.55                 | 33.13         | 11.26           | 57.10                 | 68.20               | -11.10      | Peak     | Horizontal   |
| 1           | 10400      | 31.51             | 38.55                 | 33.13         | 11.26           | 48.19                 | 54.00               | -5.81       | AV       | Horizontal   |
| 1           | 10400      | 40.76             | 38.55                 | 33.13         | 11.26           | 57.44                 | 68.20               | -10.76      | Peak     | Vertical     |
| 1           | 10400      | 28.18             | 38.55                 | 33.13         | 11.26           | 44.86                 | 54.00               | -9.14       | AV       | Vertical     |

**802.11ac20 Mode Channel 48 5240 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10480      | 39.19             | 38.55                 | 33.13         | 11.26           | 55.87                 | 68.20               | -12.33      | Peak     | Horizontal   |
| 1           | 10480      | 30.59             | 38.55                 | 33.13         | 11.26           | 47.27                 | 54.00               | -6.73       | AV       | Horizontal   |
| 1           | 10480      | 41.02             | 38.55                 | 33.13         | 11.26           | 57.70                 | 68.20               | -10.50      | Peak     | Vertical     |
| 1           | 10480      | 29.05             | 38.55                 | 33.13         | 11.26           | 45.73                 | 54.00               | -8.27       | AV       | Vertical     |

**802.11ac40 Mode Channel 38 5190 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10380      | 40.66             | 38.55                 | 33.13         | 11.26           | 57.34                 | 68.20               | -10.86      | Peak     | Horizontal   |
| 1           | 10380      | 29.78             | 38.55                 | 33.13         | 11.26           | 46.46                 | 54.00               | -7.54       | AV       | Horizontal   |
| 1           | 10380      | 41.20             | 38.55                 | 33.13         | 11.26           | 57.88                 | 68.20               | -10.32      | Peak     | Vertical     |
| 1           | 10380      | 28.16             | 38.55                 | 33.13         | 11.26           | 44.84                 | 54.00               | -9.16       | AV       | Vertical     |

**802.11ac40 Mode\_Channel 46\_ 5230 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10460      | 39.18             | 38.55                 | 33.13         | 11.26           | 55.86                 | 68.20               | -12.34      | Peak     | Horizontal   |
| 1           | 10460      | 31.61             | 38.55                 | 33.13         | 11.26           | 48.29                 | 54.00               | -5.71       | AV       | Horizontal   |
| 1           | 10460      | 40.97             | 38.55                 | 33.13         | 11.26           | 57.65                 | 68.20               | -10.55      | Peak     | Vertical     |
| 1           | 10460      | 30.81             | 38.55                 | 33.13         | 11.26           | 47.49                 | 54.00               | -6.51       | AV       | Vertical     |

**802.11ac80 Mode\_Channel 42\_ 5210 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 10420      | 38.66             | 38.55                 | 33.13         | 11.26           | 55.34                 | 68.20               | -12.86      | Peak     | Horizontal   |
| 1           | 10420      | 31.51             | 38.55                 | 33.13         | 11.26           | 48.19                 | 54.00               | -5.81       | AV       | Horizontal   |
| 1           | 10420      | 42.56             | 38.55                 | 33.13         | 11.26           | 59.24                 | 68.20               | -8.96       | Peak     | Vertical     |
| 1           | 10420      | 28.20             | 38.55                 | 33.13         | 11.26           | 44.88                 | 54.00               | -9.12       | AV       | Vertical     |

**5725-5850MHz:****802.11a Mode\_Channel 149\_ 5745 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11490      | 41.27             | 38.55                 | 33.13         | 11.26           | 57.95                 | 68.20               | -10.25      | Peak     | Horizontal   |
| 1           | 11490      | 30.23             | 38.55                 | 33.13         | 11.26           | 46.91                 | 54.00               | -7.09       | AV       | Horizontal   |
| 1           | 11490      | 41.56             | 38.55                 | 33.13         | 11.26           | 58.24                 | 68.20               | -9.96       | Peak     | Vertical     |
| 1           | 11490      | 28.04             | 38.55                 | 33.13         | 11.26           | 44.72                 | 54.00               | -9.28       | AV       | Vertical     |

**802.11a Mode\_Channel 157\_ 5785 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11570      | 39.17             | 38.55                 | 33.13         | 11.26           | 55.85                 | 68.20               | -12.35      | Peak     | Horizontal   |
| 1           | 11570      | 30.40             | 38.55                 | 33.13         | 11.26           | 47.08                 | 54.00               | -6.92       | AV       | Horizontal   |
| 1           | 11570      | 41.51             | 38.55                 | 33.13         | 11.26           | 58.19                 | 68.20               | -10.01      | Peak     | Vertical     |
| 1           | 11570      | 30.24             | 38.55                 | 33.13         | 11.26           | 46.92                 | 54.00               | -7.08       | AV       | Vertical     |

**802.11a Mode\_Channel 165\_ 5825 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11650      | 38.74             | 38.55                 | 33.13         | 11.26           | 55.42                 | 68.20               | -12.78      | Peak     | Horizontal   |
| 1           | 11650      | 30.82             | 38.55                 | 33.13         | 11.26           | 47.50                 | 54.00               | -6.50       | AV       | Horizontal   |
| 1           | 11650      | 39.70             | 38.55                 | 33.13         | 11.26           | 56.38                 | 68.20               | -11.82      | Peak     | Vertical     |
| 1           | 11650      | 28.81             | 38.55                 | 33.13         | 11.26           | 45.49                 | 54.00               | -8.51       | AV       | Vertical     |

**802.11n20 Mode\_Channel 149\_ 5745 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11490      | 40.70             | 38.55                 | 33.13         | 11.26           | 57.38                 | 68.20               | -10.82      | Peak     | Horizontal   |
| 1           | 11490      | 30.52             | 38.55                 | 33.13         | 11.26           | 47.20                 | 54.00               | -6.80       | AV       | Horizontal   |
| 1           | 11490      | 39.87             | 38.55                 | 33.13         | 11.26           | 56.55                 | 68.20               | -11.65      | Peak     | Vertical     |
| 1           | 11490      | 28.48             | 38.55                 | 33.13         | 11.26           | 45.16                 | 54.00               | -8.84       | AV       | Vertical     |

**802.11n20 Mode Channel 157 5785 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11570      | 40.65             | 38.55                 | 33.13         | 11.26           | 57.33                 | 68.20               | -10.87      | Peak     | Horizontal   |
| 1           | 11570      | 31.10             | 38.55                 | 33.13         | 11.26           | 47.78                 | 54.00               | -6.22       | AV       | Horizontal   |
| 1           | 11570      | 39.58             | 38.55                 | 33.13         | 11.26           | 56.26                 | 68.20               | -11.94      | Peak     | Vertical     |
| 1           | 11570      | 28.23             | 38.55                 | 33.13         | 11.26           | 44.91                 | 54.00               | -9.09       | AV       | Vertical     |

**802.11n20 Mode Channel 165 5825 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11650      | 39.59             | 38.55                 | 33.13         | 11.26           | 56.27                 | 68.20               | -11.93      | Peak     | Horizontal   |
| 1           | 11650      | 31.80             | 38.55                 | 33.13         | 11.26           | 48.48                 | 54.00               | -5.52       | AV       | Horizontal   |
| 1           | 11650      | 41.65             | 38.55                 | 33.13         | 11.26           | 58.33                 | 68.20               | -9.87       | Peak     | Vertical     |
| 1           | 11650      | 28.11             | 38.55                 | 33.13         | 11.26           | 44.79                 | 54.00               | -9.21       | AV       | Vertical     |

**802.11n40 Mode Channel 151 5755 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11510      | 39.54             | 38.55                 | 33.13         | 11.26           | 56.22                 | 68.20               | -11.98      | Peak     | Horizontal   |
| 1           | 11510      | 30.79             | 38.55                 | 33.13         | 11.26           | 47.47                 | 54.00               | -6.53       | AV       | Horizontal   |
| 1           | 11510      | 40.53             | 38.55                 | 33.13         | 11.26           | 57.21                 | 68.20               | -10.99      | Peak     | Vertical     |
| 1           | 11510      | 29.56             | 38.55                 | 33.13         | 11.26           | 46.24                 | 54.00               | -7.76       | AV       | Vertical     |

**802.11n40 Mode Channel 159 5795MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11590      | 39.35             | 38.55                 | 33.13         | 11.26           | 56.03                 | 68.20               | -12.17      | Peak     | Horizontal   |
| 1           | 11590      | 30.66             | 38.55                 | 33.13         | 11.26           | 47.34                 | 54.00               | -6.66       | AV       | Horizontal   |
| 1           | 11590      | 41.23             | 38.55                 | 33.13         | 11.26           | 57.91                 | 68.20               | -10.29      | Peak     | Vertical     |
| 1           | 11590      | 29.53             | 38.55                 | 33.13         | 11.26           | 46.21                 | 54.00               | -7.79       | AV       | Vertical     |

**802.11ac20 Mode Channel 149 5745 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11490      | 38.93             | 38.55                 | 33.13         | 11.26           | 55.61                 | 68.20               | -12.59      | Peak     | Horizontal   |
| 1           | 11490      | 30.92             | 38.55                 | 33.13         | 11.26           | 47.60                 | 54.00               | -6.40       | AV       | Horizontal   |
| 1           | 11490      | 42.48             | 38.55                 | 33.13         | 11.26           | 59.16                 | 68.20               | -9.04       | Peak     | Vertical     |
| 1           | 11490      | 29.04             | 38.55                 | 33.13         | 11.26           | 45.72                 | 54.00               | -8.28       | AV       | Vertical     |

**802.11ac20 Mode Channel 157 5785 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11570      | 41.07             | 38.55                 | 33.13         | 11.26           | 57.75                 | 68.20               | -10.45      | Peak     | Horizontal   |
| 1           | 11570      | 30.22             | 38.55                 | 33.13         | 11.26           | 46.90                 | 54.00               | -7.10       | AV       | Horizontal   |
| 1           | 11570      | 40.65             | 38.55                 | 33.13         | 11.26           | 57.33                 | 68.20               | -10.87      | Peak     | Vertical     |
| 1           | 11570      | 30.04             | 38.55                 | 33.13         | 11.26           | 46.72                 | 54.00               | -7.28       | AV       | Vertical     |

**802.11ac20 Mode Channel 165 5825 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11650      | 40.77             | 38.55                 | 33.13         | 11.26           | 57.45                 | 68.20               | -10.75      | Peak     | Horizontal   |
| 1           | 11650      | 31.17             | 38.55                 | 33.13         | 11.26           | 47.85                 | 54.00               | -6.15       | AV       | Horizontal   |
| 1           | 11650      | 40.90             | 38.55                 | 33.13         | 11.26           | 57.58                 | 68.20               | -10.62      | Peak     | Vertical     |
| 1           | 11650      | 28.56             | 38.55                 | 33.13         | 11.26           | 45.24                 | 54.00               | -8.76       | AV       | Vertical     |

**802.11ac40 Mode\_Channel 151 \_5755 MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11510      | 41.31             | 38.55                 | 33.13         | 11.26           | 57.99                 | 68.20               | -10.21      | Peak     | Horizontal   |
| 1           | 11510      | 30.08             | 38.55                 | 33.13         | 11.26           | 46.76                 | 54.00               | -7.24       | AV       | Horizontal   |
| 1           | 11510      | 42.25             | 38.55                 | 33.13         | 11.26           | 58.93                 | 68.20               | -9.27       | Peak     | Vertical     |
| 1           | 11510      | 28.71             | 38.55                 | 33.13         | 11.26           | 45.39                 | 54.00               | -8.61       | AV       | Vertical     |

**802.11ac40 Mode\_Channel 159 \_5795MHz**

| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11590      | 40.13             | 38.55                 | 33.13         | 11.26           | 56.81                 | 68.20               | -11.39      | Peak     | Horizontal   |
| 1           | 11590      | 30.04             | 38.55                 | 33.13         | 11.26           | 46.72                 | 54.00               | -7.28       | AV       | Horizontal   |
| 1           | 11590      | 39.80             | 38.55                 | 33.13         | 11.26           | 56.48                 | 68.20               | -11.72      | Peak     | Vertical     |
| 1           | 11590      | 28.16             | 38.55                 | 33.13         | 11.26           | 44.84                 | 54.00               | -9.16       | AV       | Vertical     |

**802.11ac80 Mode\_Channel 155 \_5775 MHz**

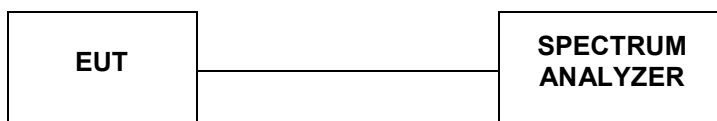
| Item (Mark) | Freq (MHz) | Read Level (dBμV) | Antenna Factor (dB/m) | PRM Factor dB | Cable Loss (dB) | Result Level (dBμV/m) | Limit Line (dBμV/m) | Margin (dB) | Detector | Polarization |
|-------------|------------|-------------------|-----------------------|---------------|-----------------|-----------------------|---------------------|-------------|----------|--------------|
| 1           | 11550      | 39.68             | 38.55                 | 33.13         | 11.26           | 56.36                 | 68.20               | -11.84      | Peak     | Horizontal   |
| 1           | 11550      | 30.10             | 38.55                 | 33.13         | 11.26           | 46.78                 | 54.00               | -7.22       | AV       | Horizontal   |
| 1           | 11550      | 40.22             | 38.55                 | 33.13         | 11.26           | 56.90                 | 68.20               | -11.30      | Peak     | Vertical     |
| 1           | 11550      | 30.08             | 38.55                 | 33.13         | 11.26           | 46.76                 | 54.00               | -7.24       | AV       | Vertical     |

**REMARKS:**

1. Result Level = Read Level + Antenna Factor + Cable loss - PRM Factor.
2. Margin = Result Level - Limit
3. The other emission levels were very low against the limit.
4. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;

### 4.3. Duty Cycle

#### TEST CONFIGURATION



#### TEST PROCEDURE

According to KDB789033 D02 General U-NII Test Procedures New Rules v02r01 Duty Cycle (x), Transmission Duration (T):

- A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on and off times of the transmitted signal
- The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW  $\geq$  EBW if possible; otherwise, set RBW to the largest available value. Set VBW  $\geq$  RBW. Set detector = peak or average. The zerospan measurement method shall not be used unless both RBW and VBW are  $> 50/T$ , where T is defined in section II.B.1.a), and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if  $T \leq 16.7$  microseconds.)

#### TEST RESULTS

|               |           |                |                   |
|---------------|-----------|----------------|-------------------|
| Temperature   | 23.6°C    | Humidity       | 55.7%             |
| Test Engineer | Oliver Ou | Configurations | IEEE 802.11a/n/ac |

**Antenna 0:**  
**5150-5250MHz:**

##### **802.11a Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 40      | 5200            | 0.83       | 0.82             |

##### **802.11n HT20 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 40      | 5200            | 0.76       | 1.19             |

##### **802.11n HT40 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 38      | 5190            | 0.50       | 3.01             |

##### **802.11ac20 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 40      | 5200            | 0.97       | 0.15             |

##### **802.11ac40 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 38      | 5190            | 0.47       | 3.24             |

##### **802.11ac80 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 42      | 5210            | 0.35       | 4.52             |

**5725-5850MHz:****802.11a Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 157     | 5785            | 0.83       | 0.82             |

**802.11n HT20 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 157     | 5785            | 0.76       | 1.19             |

**802.11n HT40 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 151     | 5755            | 0.50       | 3.01             |

**802.11ac20 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 157     | 5785            | 0.96       | 0.16             |

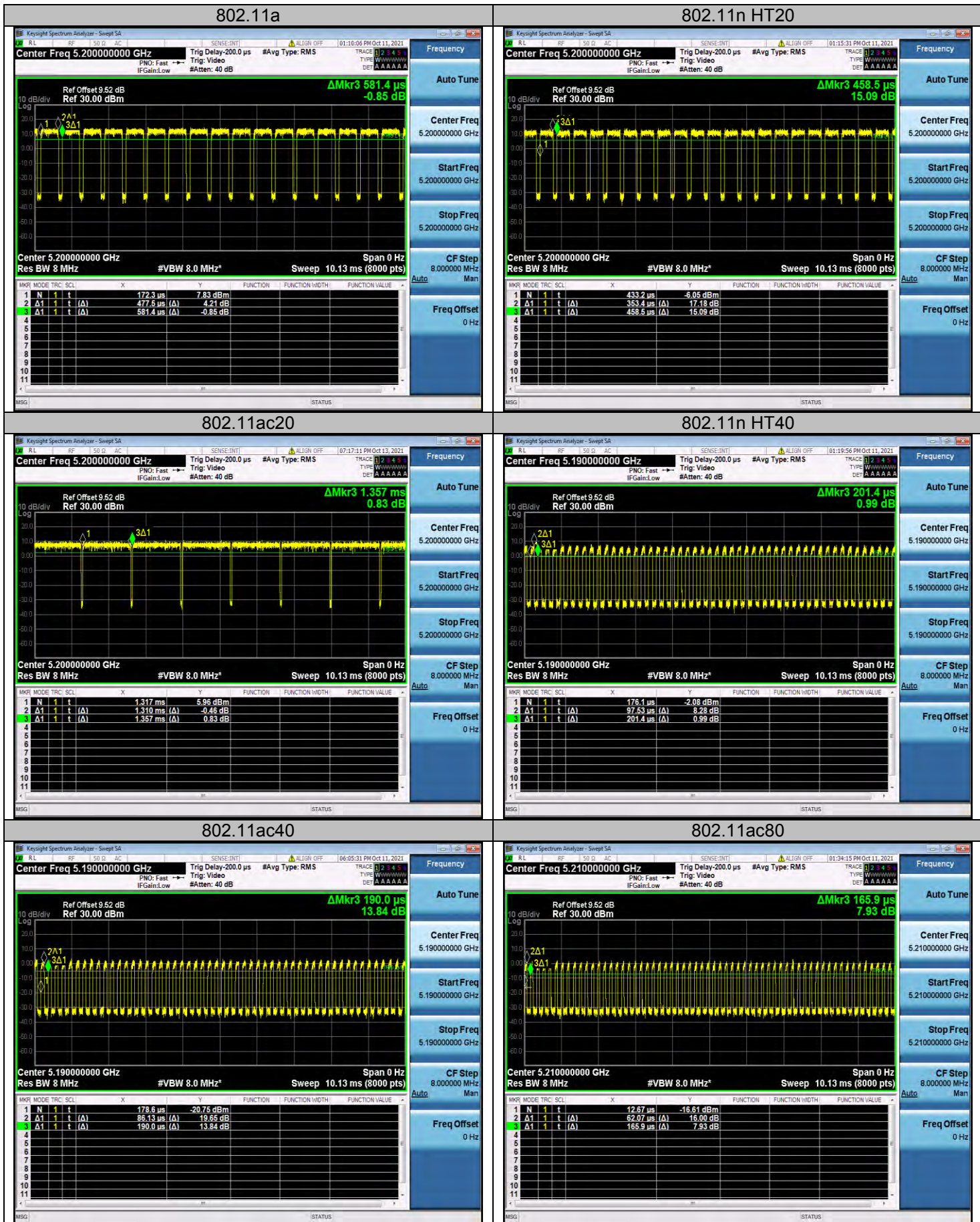
**802.11ac40 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 151     | 5755            | 0.47       | 3.24             |

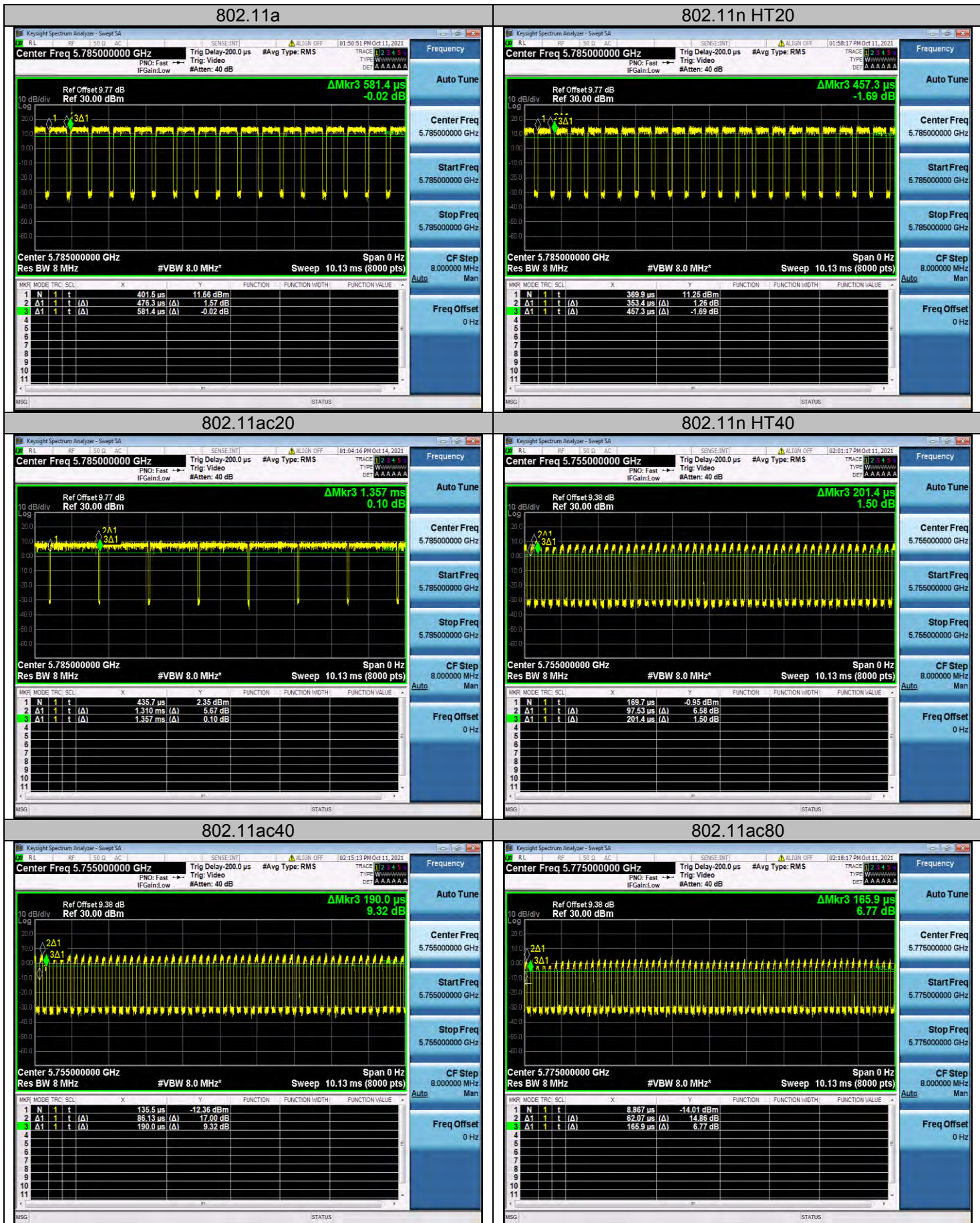
**802.11ac80 Test Mode**

| Channel | Frequency (MHz) | Duty Cycle | Duty factor (dB) |
|---------|-----------------|------------|------------------|
| 155     | 5775            | 0.35       | 4.52             |

## 5150-5250MHz:

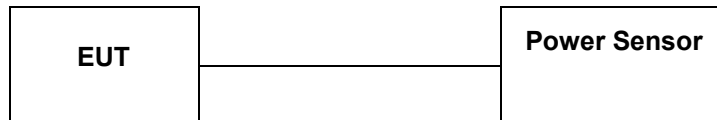


## 5725-5850MHz:



#### 4.4. Maximum Average Output Power

##### TEST CONFIGURATION



##### TEST PROCEDURE

According to KDB789033 D02 General U-NII Test Procedures New Rules v02r01 Measurement using a Power Meter (PM):

- a. Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied
  1. The EUT is configured to transmit continuously or to transmit with a constant duty cycle
  2. At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
  3. The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- b. If the transmitter does not transmit continuously, measure the duty cycle,  $x$ , of the transmitter output signal as described in section II.B
- c. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

Adjust the measurement in dBm by adding  $10 \log(1/x)$  where  $x$  is the duty cycle (e.g.,  $10 \log(1/0.25)$  if the duty cycle is 25 percent).

##### LIMIT

According to §15.407(a): The maximum output power should be not exceed follow:

| Frequency Range (MHz)                                                                                                       | Limit                                                       |
|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| 5150-5250                                                                                                                   | Fixed: 1 Watt (30dBm)<br>Mobile and portable: 250mW (24dBm) |
| 5250-5350                                                                                                                   | 250mW (24dBm)                                               |
| 5470-5725                                                                                                                   | 250mW (24dBm)                                               |
| 5725-5850                                                                                                                   | 1 Watt (30dBm)                                              |
| Note: The maximum e.i.r.p at any elevation angle above 30 degrees as measured from the horizon must not exceed 125mW(21dBm) |                                                             |

##### TEST RESULTS

|               |           |                |                   |
|---------------|-----------|----------------|-------------------|
| Temperature   | 23.6°C    | Humidity       | 55.7%             |
| Test Engineer | Oliver Ou | Configurations | IEEE 802.11a/n/ac |

**5150-5250MHz:**

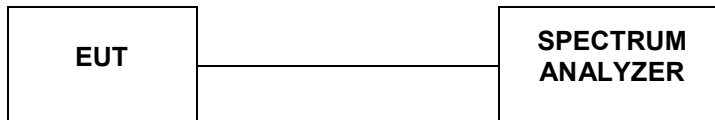
| Channel    | Frequency (MHz) | Output Power AV (dBm) | Duty factor (dB) | Output Power AV + Duty factor (dBm) | Limits (dBm) | Verdict |
|------------|-----------------|-----------------------|------------------|-------------------------------------|--------------|---------|
| 802.11a    |                 |                       |                  |                                     |              |         |
| 36         | 5180            | 13.25                 | 0.82             | 14.07                               | 24.00        | PASS    |
| 40         | 5200            | 13.94                 | 0.82             | 14.76                               | 24.00        | PASS    |
| 48         | 5240            | 14.02                 | 0.82             | 14.84                               | 24.00        | PASS    |
| 802.11n20  |                 |                       |                  |                                     |              |         |
| 36         | 5180            | 12.98                 | 1.19             | 14.17                               | 24.00        | PASS    |
| 40         | 5200            | 13.46                 | 1.19             | 14.65                               | 24.00        | PASS    |
| 48         | 5240            | 13.72                 | 1.19             | 14.91                               | 24.00        | PASS    |
| 802.11ac20 |                 |                       |                  |                                     |              |         |
| 36         | 5180            | 12.42                 | 0.15             | 12.57                               | 24.00        | PASS    |
| 40         | 5200            | 12.14                 | 0.15             | 12.29                               | 24.00        | PASS    |
| 48         | 5240            | 11.56                 | 0.15             | 11.71                               | 24.00        | PASS    |
| 802.11n40  |                 |                       |                  |                                     |              |         |
| 38         | 5190            | 9.68                  | 3.01             | 12.69                               | 24.00        | PASS    |
| 46         | 5230            | 10.53                 | 3.01             | 13.54                               | 24.00        | PASS    |
| 802.11ac40 |                 |                       |                  |                                     |              |         |
| 38         | 5190            | 9.52                  | 3.24             | 12.76                               | 24.00        | PASS    |
| 46         | 5230            | 9.64                  | 3.24             | 12.88                               | 24.00        | PASS    |
| 802.11ac80 |                 |                       |                  |                                     |              |         |
| 42         | 5210            | 9.13                  | 4.52             | 13.65                               | 24.00        | PASS    |

**5725-5850MHz:**

| Channel    | Frequency (MHz) | Output Power AV (dBm) | Duty factor (dB) | Output Power AV + Duty factor (dBm) | Limits (dBm) | Verdict |
|------------|-----------------|-----------------------|------------------|-------------------------------------|--------------|---------|
| 802.11a    |                 |                       |                  |                                     |              |         |
| 149        | 5745            | 15.81                 | 0.82             | 16.63                               | 30.00        | PASS    |
| 157        | 5785            | 15.94                 | 0.82             | 16.76                               | 30.00        | PASS    |
| 165        | 5825            | 16.19                 | 0.82             | 17.01                               | 30.00        | PASS    |
| 802.11n20  |                 |                       |                  |                                     |              |         |
| 129        | 5745            | 16.00                 | 1.19             | 17.19                               | 30.00        | PASS    |
| 157        | 5785            | 15.88                 | 1.19             | 17.07                               | 30.00        | PASS    |
| 165        | 5825            | 16.18                 | 1.19             | 17.37                               | 30.00        | PASS    |
| 802.11ac20 |                 |                       |                  |                                     |              |         |
| 149        | 5745            | 16.43                 | 0.16             | 16.59                               | 30.00        | PASS    |
| 157        | 5785            | 16.14                 | 0.16             | 16.31                               | 30.00        | PASS    |
| 165        | 5825            | 16.40                 | 0.16             | 16.57                               | 30.00        | PASS    |
| 802.11n40  |                 |                       |                  |                                     |              |         |
| 151        | 5755            | 16.19                 | 3.01             | 19.20                               | 30.00        | PASS    |
| 159        | 5795            | 16.37                 | 3.01             | 19.38                               | 30.00        | PASS    |
| 802.11ac40 |                 |                       |                  |                                     |              |         |
| 151        | 5755            | 16.43                 | 3.24             | 19.67                               | 30.00        | PASS    |
| 159        | 5795            | 15.81                 | 3.24             | 19.06                               | 30.00        | PASS    |
| 802.11ac80 |                 |                       |                  |                                     |              |         |
| 155        | 5775            | 13.94                 | 4.52             | 18.46                               | 30.00        | PASS    |

## 4.5. Power Spectral Density

### TEST CONFIGURATION



### TEST PROCEDURE

According to KDB789033 D02 General U-NII Test Procedures New Rules v02r01: The rules requires “maximum power spectral density” measurements where the intent is to measure the maximum value of the time average of the power spectral density measured during a period of continuous transmission

- a. Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power...”. (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
- b. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
- c. Make the following adjustments to the peak value of the spectrum, if applicable:
  1. If Method SA-2 or SA-2 Alternative was used, add  $10 \log(1/x)$ , where x is the duty cycle, to the peak of the spectrum.
  2. ) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
- d. The result is the Maximum PSD over 1 MHz reference bandwidth.
- e. For devices operating in the bands 5.15-5.25 GHz, 5.25-5.35 GHz, and 5.47-5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in § 15.407(a)(5). For devices operating in the band 5.725-5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 KHz bandwidth, the following adjustments to the procedures apply:
  1. Set  $RBW \geq 1/T$ , where T is defined in section II.B.I.a).
  2. Set  $VBW \geq 3 \text{ RBW}$ .
  3. If measurement bandwidth of Maximum PSD is specified in 500 kHz, add  $10\log(500\text{kHz}/\text{RBW})$  to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
  4. If measurement bandwidth of Maximum PSD is specified in 1 MHz, add  $10\log(1\text{MHz}/\text{RBW})$  to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
  5. Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 KHz for the sections 5.c) and 5.d) above, since RBW=100 KHz is available on nearly all spectrum analyzers.
- f. Adjust the measurement in dBm by adding  $10 \log(1/x)$  where x is the duty cycle (e.g.,  $10 \log(1/0.25)$  if the duty cycle is 25 percent).

### LIMIT

According to §15.407(a): The maximum output power should be not exceed follow:

| Frequency Range (MHz) | Limit                                                                     |
|-----------------------|---------------------------------------------------------------------------|
| 5150-5250             | Other then Mobile and portable:17dBm/MHz<br>Mobile and portable:11dBm/MHz |
| 5250-5350             | 11dBm/MHz                                                                 |
| 5470-5725             | 11dBm/MHz                                                                 |
| 5725-5850             | 30dBm/500kHz                                                              |

**TEST RESULTS**

|               |           |                |                   |
|---------------|-----------|----------------|-------------------|
| Temperature   | 23.6°C    | Humidity       | 55.7%             |
| Test Engineer | Oliver Ou | Configurations | IEEE 802.11a/n/ac |

**5150-5250MHz:****802.11a Test Mode**

| Channel | Frequency (MHz) | Report PSD (dBm/1MHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/1MHz) | Limits (dBm/1MHz) | Verdict |
|---------|-----------------|-----------------------|------------------|-----------------|------------------------------------------------|-------------------|---------|
| 36      | 5180            | 2.00                  | 0.82             | 0               | 2.82                                           | 11                | PASS    |
| 40      | 5200            | 2.40                  | 0.82             | 0               | 3.22                                           | 11                | PASS    |
| 48      | 5240            | 2.65                  | 0.82             | 0               | 3.47                                           | 11                | PASS    |

**802.11n HT20 Test Mode**

| Channel | Frequency (MHz) | Report PSD (dBm/1MHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/1MHz) | Limits (dBm/1MHz) | Verdict |
|---------|-----------------|-----------------------|------------------|-----------------|------------------------------------------------|-------------------|---------|
| 36      | 5180            | 3.00                  | 1.19             | 0               | 4.19                                           | 11                | PASS    |
| 40      | 5200            | 2.79                  | 1.19             | 0               | 3.98                                           | 11                | PASS    |
| 48      | 5240            | 2.55                  | 1.19             | 0               | 3.74                                           | 11                | PASS    |

**802.11ac20 Test Mode**

| Channel | Frequency (MHz) | Report PSD (dBm/1MHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/1MHz) | Limits (dBm/1MHz) | Verdict |
|---------|-----------------|-----------------------|------------------|-----------------|------------------------------------------------|-------------------|---------|
| 36      | 5180            | 2.47                  | 0.15             | 0               | 2.62                                           | 11                | PASS    |
| 40      | 5200            | 2.18                  | 0.15             | 0               | 2.33                                           | 11                | PASS    |
| 48      | 5240            | 2.40                  | 0.15             | 0               | 2.55                                           | 11                | PASS    |

**802.11n40 Test Mode**

| Channel | Frequency (MHz) | Report PSD (dBm/1MHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/1MHz) | Limits (dBm/1MHz) | Verdict |
|---------|-----------------|-----------------------|------------------|-----------------|------------------------------------------------|-------------------|---------|
| 38      | 5190            | -1.03                 | 3.01             | 0               | 1.98                                           | 11                | PASS    |
| 46      | 5230            | -0.52                 | 3.01             | 0               | 2.49                                           | 11                | PASS    |

**802.11ac40 Test Mode**

| Channel | Frequency (MHz) | Report PSD (dBm/1MHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/1MHz) | Limits (dBm/1MHz) | Verdict |
|---------|-----------------|-----------------------|------------------|-----------------|------------------------------------------------|-------------------|---------|
| 38      | 5190            | -0.29                 | 3.24             | 0               | 2.95                                           | 11                | PASS    |
| 46      | 5230            | -0.54                 | 3.24             | 0               | 2.70                                           | 11                | PASS    |

**802.11ac80 Test Mode**

| Channel | Frequency (MHz) | Report PSD (dBm/1MHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/1MHz) | Limits (dBm/1MHz) | Verdict |
|---------|-----------------|-----------------------|------------------|-----------------|------------------------------------------------|-------------------|---------|
| 42      | 5210            | -3.26                 | 4.52             | 0               | 1.26                                           | 11                | PASS    |

## 5725-5850MHz:

## 802.11a Test Mode

| Channel | Frequency (MHz) | Report PSD (dBm/300KHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/500kHz) | Limits (dBm/500kHz) | Verdict |
|---------|-----------------|-------------------------|------------------|-----------------|--------------------------------------------------|---------------------|---------|
| 149     | 5745            | -1.20                   | 0.82             | 2.2             | 1.82                                             | 30                  | PASS    |
| 157     | 5785            | 1.69                    | 0.82             | 2.2             | 4.71                                             | 30                  | PASS    |
| 165     | 5825            | -2.59                   | 0.82             | 2.2             | 0.43                                             | 30                  | PASS    |

## 802.11n HT20 Test Mode

| Channel | Frequency (MHz) | Report PSD (dBm/300KHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/500kHz) | Limits (dBm/500kHz) | Verdict |
|---------|-----------------|-------------------------|------------------|-----------------|--------------------------------------------------|---------------------|---------|
| 149     | 5745            | -2.23                   | 1.19             | 2.2             | 1.16                                             | 30                  | PASS    |
| 157     | 5785            | -1.74                   | 1.19             | 2.2             | 1.65                                             | 30                  | PASS    |
| 165     | 5825            | -2.69                   | 1.19             | 2.2             | 0.70                                             | 30                  | PASS    |

## 802.11ac20 Test Mode

| Channel | Frequency (MHz) | Report PSD (dBm/300KHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/500kHz) | Limits (dBm/500kHz) | Verdict |
|---------|-----------------|-------------------------|------------------|-----------------|--------------------------------------------------|---------------------|---------|
| 149     | 5745            | 0.32                    | 0.16             | 2.2             | 2.68                                             | 30                  | PASS    |
| 157     | 5785            | 0.48                    | 0.16             | 2.2             | 2.84                                             | 30                  | PASS    |
| 165     | 5825            | 0.22                    | 0.16             | 2.2             | 2.58                                             | 30                  | PASS    |

## 802.11n40Test Mode

| Channel | Frequency (MHz) | Report PSD (dBm/300KHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/500kHz) | Limits (dBm/500kHz) | Verdict |
|---------|-----------------|-------------------------|------------------|-----------------|--------------------------------------------------|---------------------|---------|
| 149     | 5755            | -3.19                   | 3.01             | 2.2             | 2.02                                             | 30                  | PASS    |
| 157     | 5795            | -2.32                   | 3.01             | 2.2             | 2.89                                             | 30                  | PASS    |

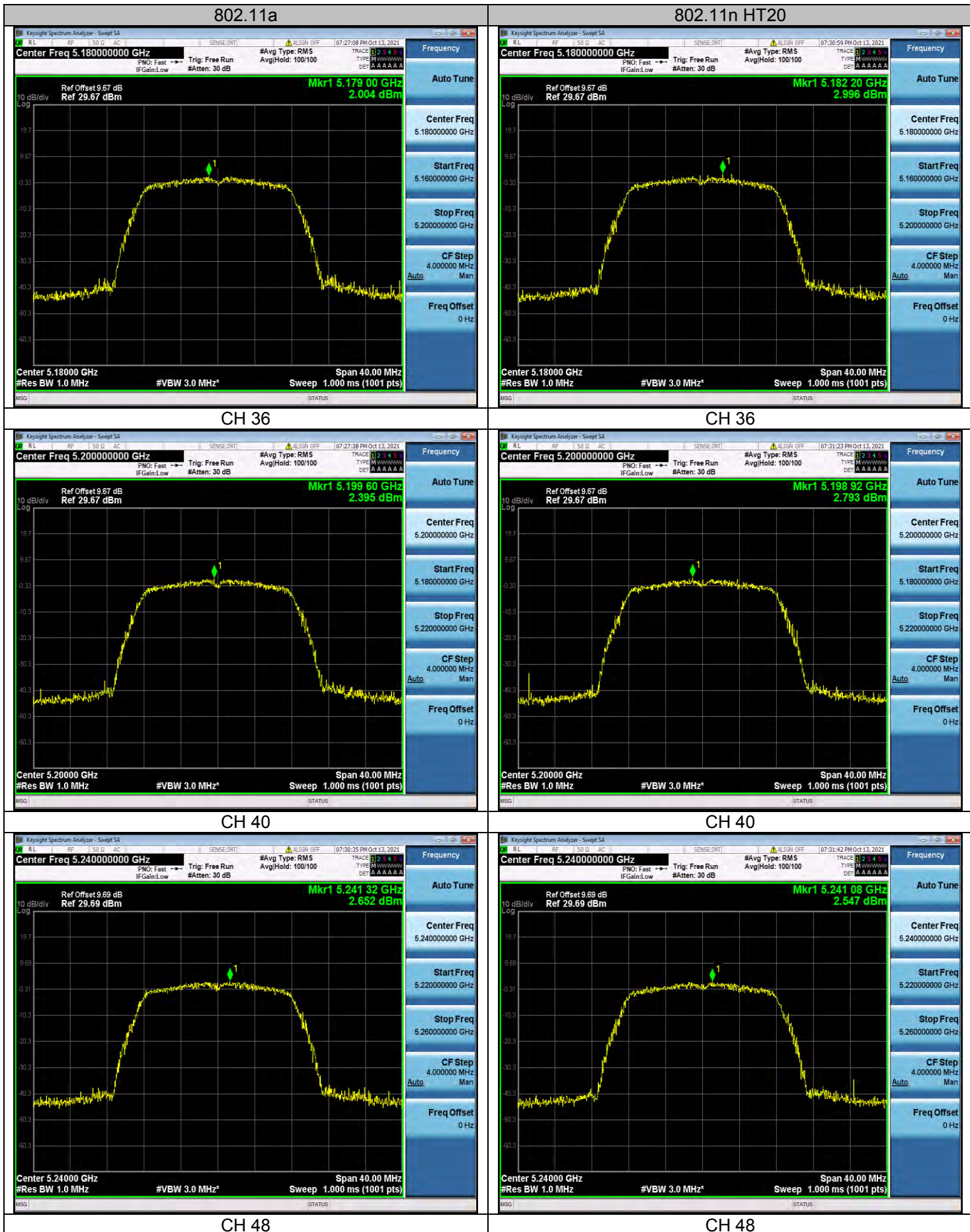
## 802.11ac40 Test Mode

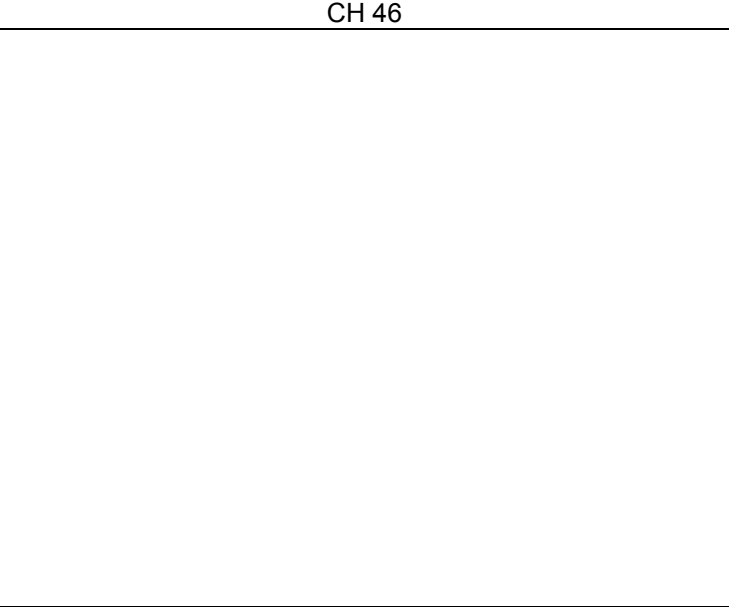
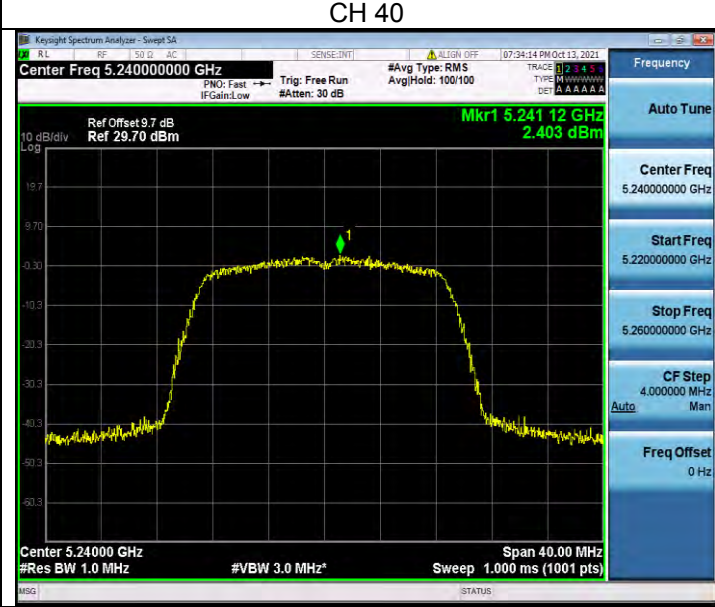
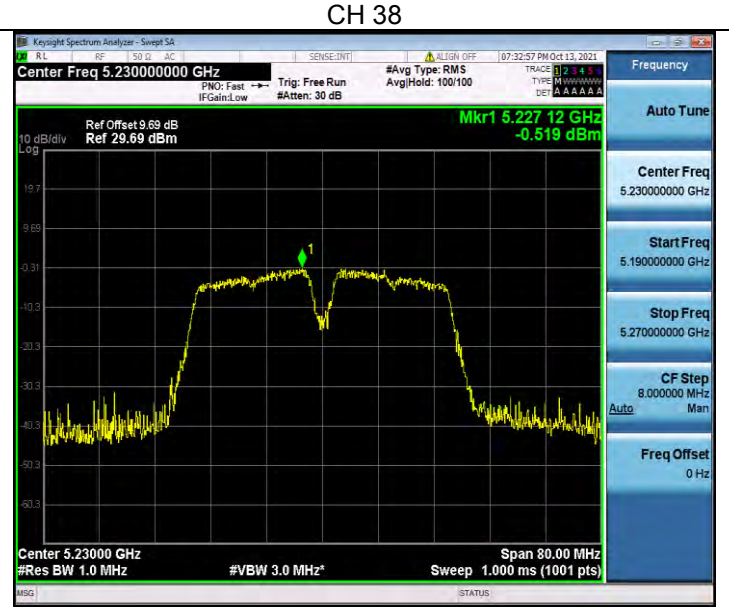
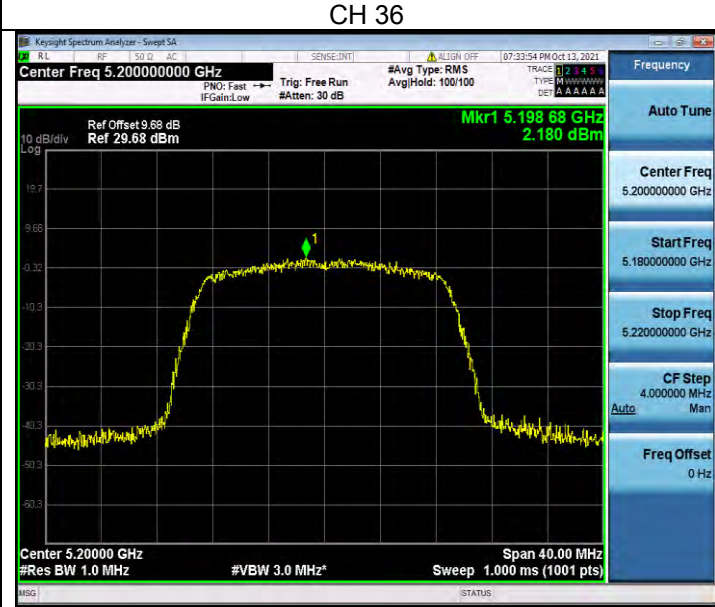
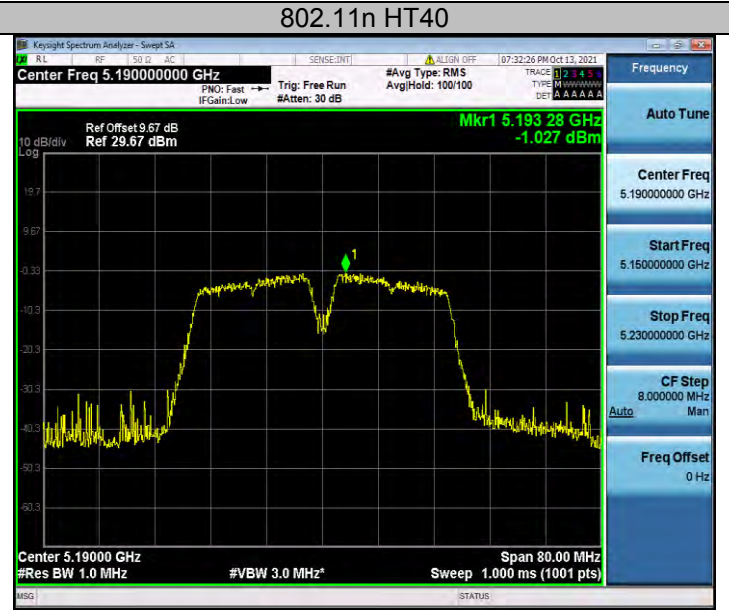
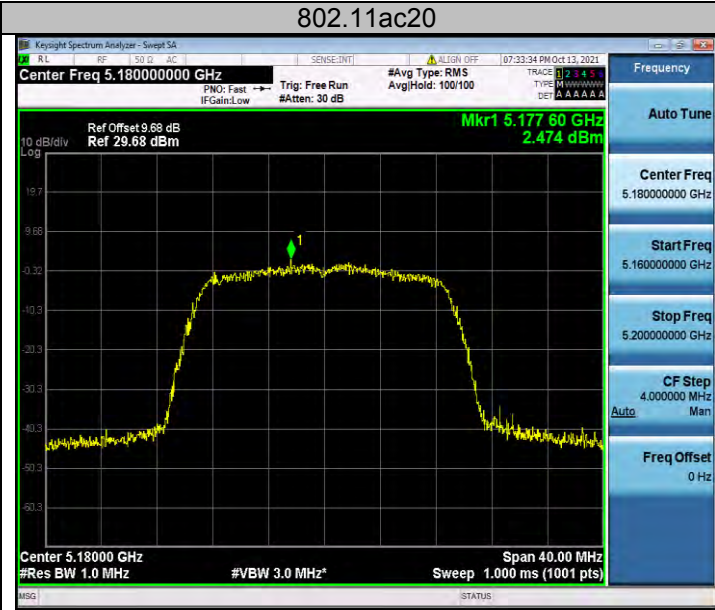
| Channel | Frequency (MHz) | Report PSD (dBm/300KHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/500kHz) | Limits (dBm/500kHz) | Verdict |
|---------|-----------------|-------------------------|------------------|-----------------|--------------------------------------------------|---------------------|---------|
| 149     | 5755            | -2.81                   | 3.24             | 2.2             | 2.63                                             | 30                  | PASS    |
| 157     | 5795            | -2.23                   | 3.24             | 2.2             | 3.21                                             | 30                  | PASS    |

## 802.11ac80 Test Mode

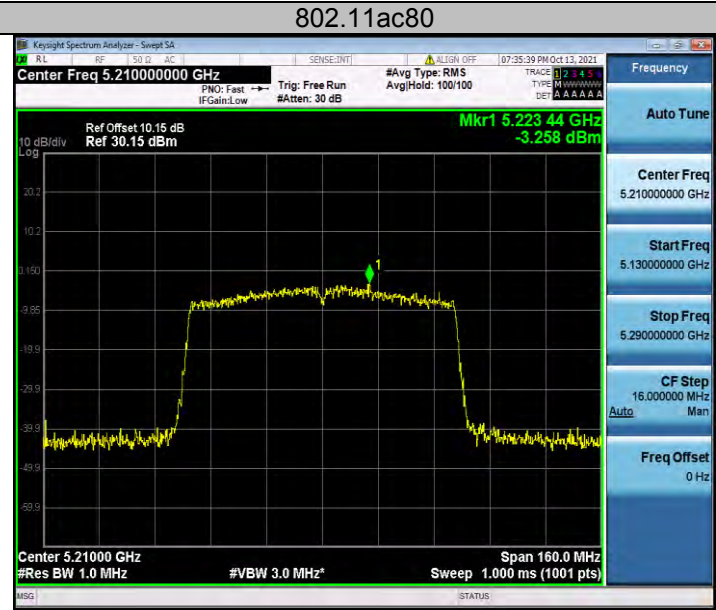
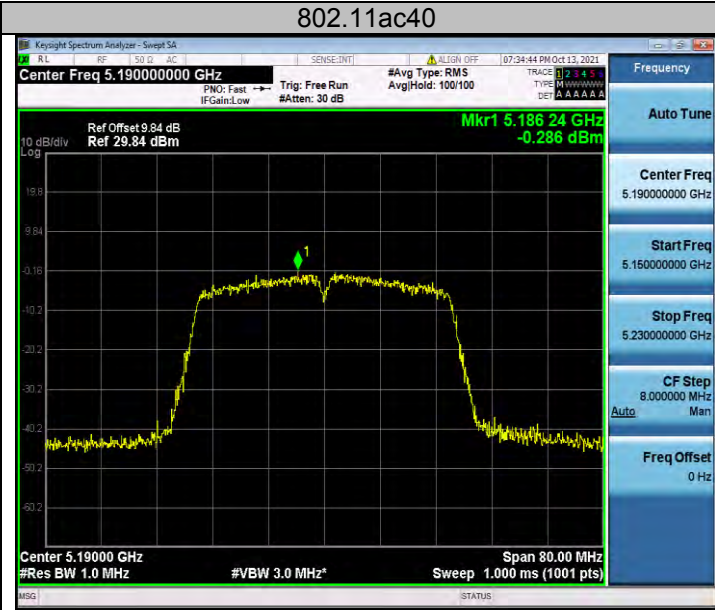
| Channel | Frequency (MHz) | Report PSD (dBm/300KHz) | Duty factor (dB) | RBW factor (dB) | Report PSD+ Duty factor+ RBW factor (dBm/500kHz) | Limits (dBm/500kHz) | Verdict |
|---------|-----------------|-------------------------|------------------|-----------------|--------------------------------------------------|---------------------|---------|
| 155     | 5775            | -5.36                   | 4.52             | 2.2             | 1.36                                             | 30                  | PASS    |

5150-5250MHz:

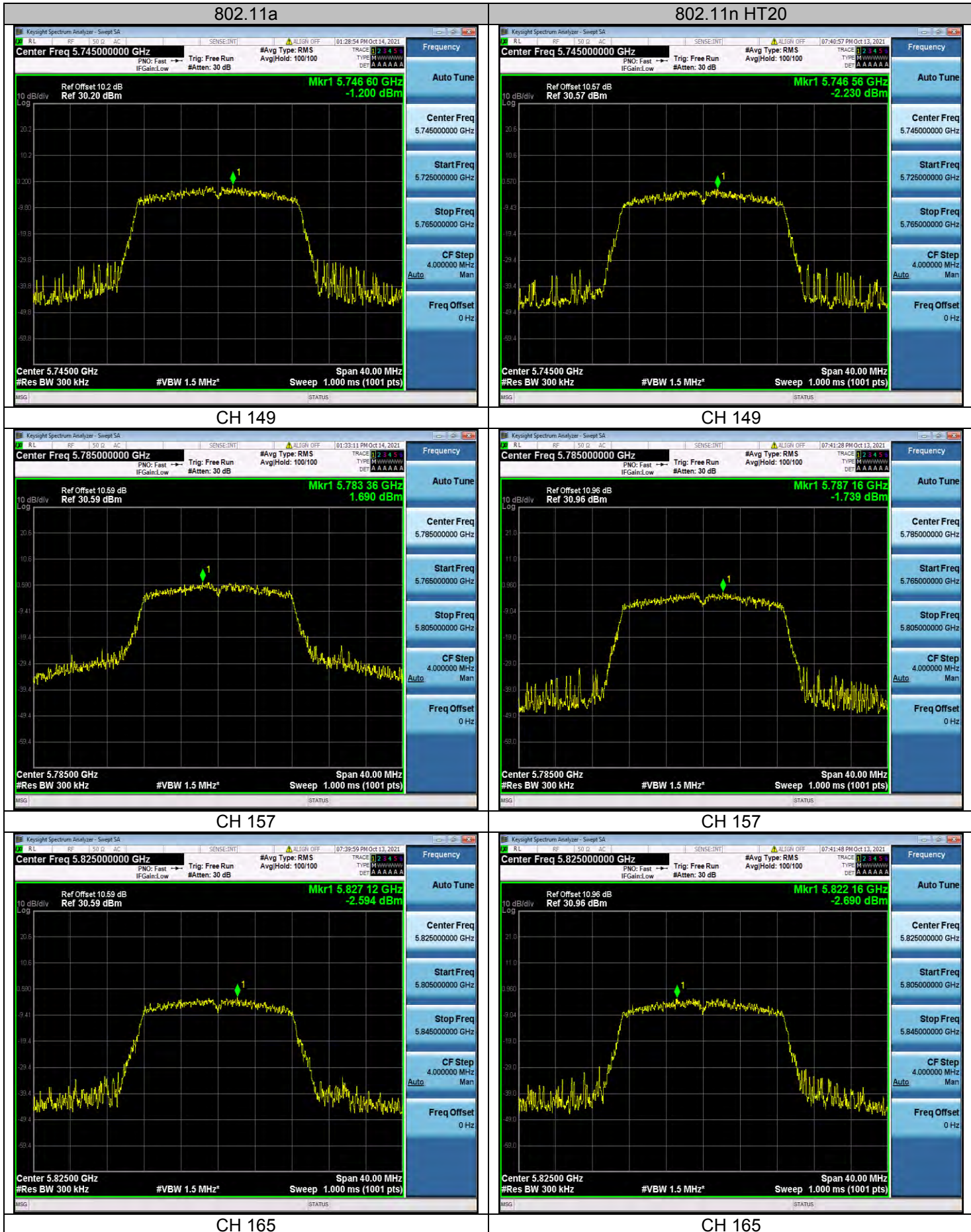


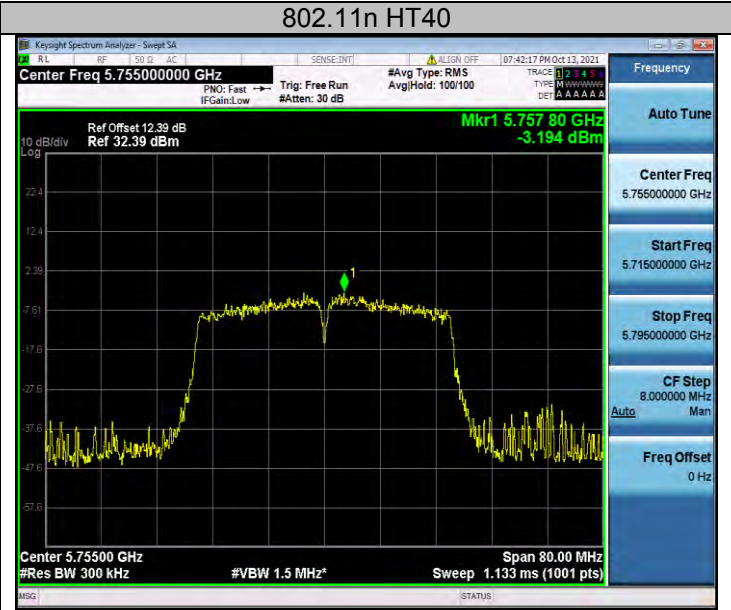
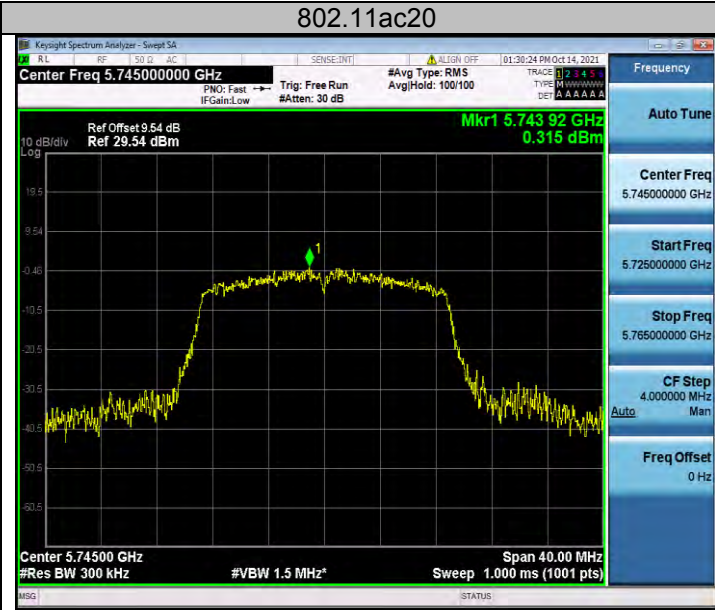


CH 48



5725-5850MHz:

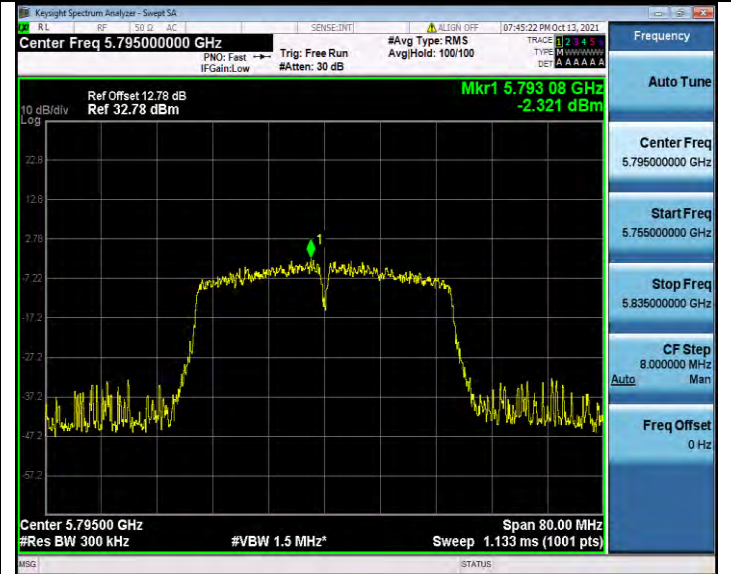




CH 149



CH 157



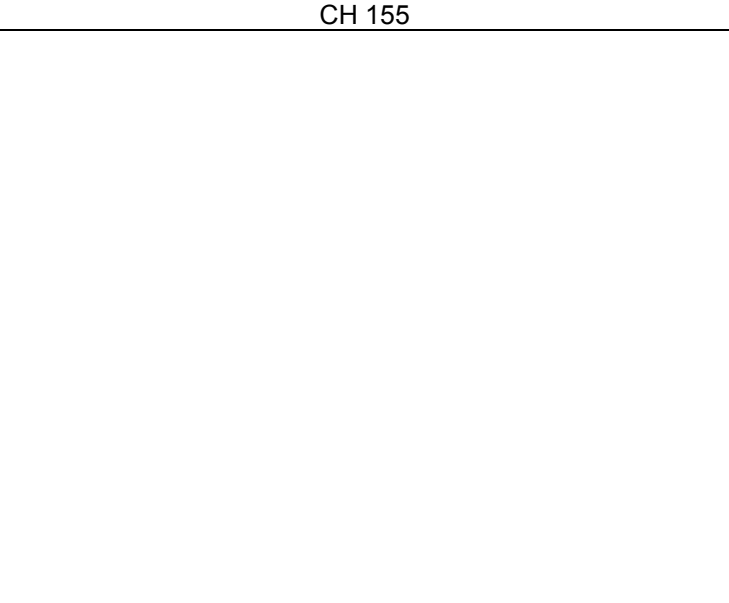
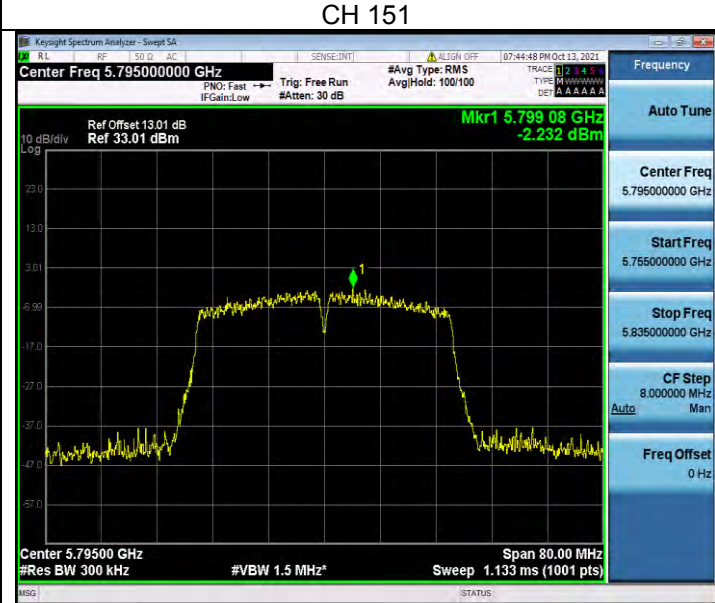
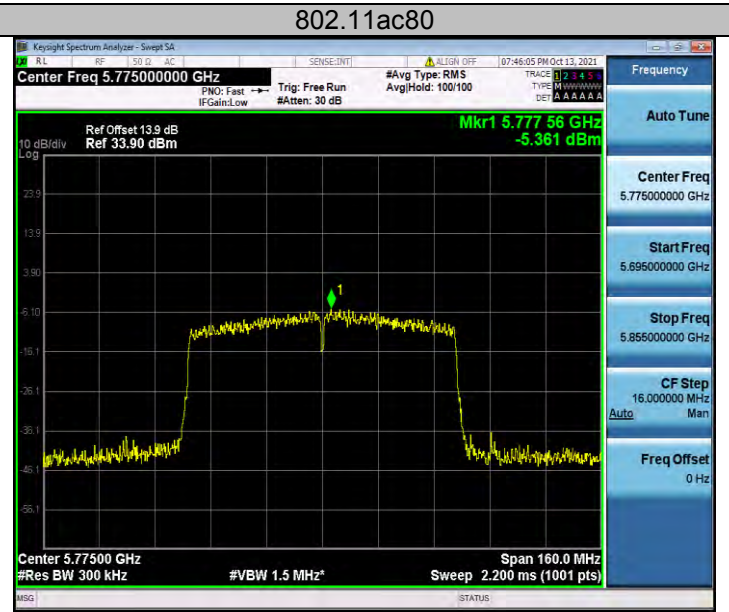
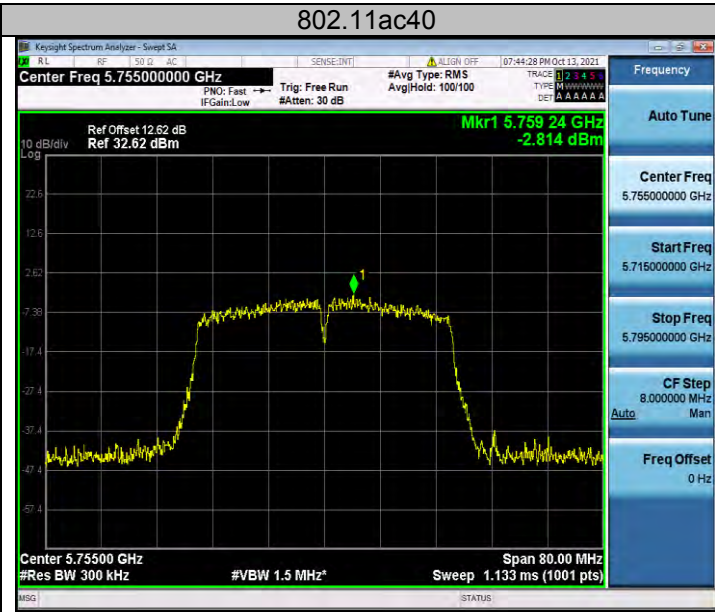
CH 151



CH 165



CH 159



CH 159