

**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 TEST REPORT****FCC PART 15 SUBPART E 15.407****Report Reference No.**.....: **GTS20200906013-1-4****FCC ID**.....: **2AFO3-HW500**

Compiled by

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Date of issue.....: Sep. 08, 2020

**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**.....: **GuangZhou Ostec Electronic Technology Co.,Limited****Address** .....: 2 of No.8 West Lane, Jiangcheng Road, Bangjiang East Village, Dalong Street,Panyu District, Guangzhou City, Guangdong, P.R.China**Test specification** .....Standard .....: **FCC Part 15 Subpart E 15.407**

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

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

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**Test item description** .....: Intelligent All-In-One MachineTrade Mark .....: **KoPa®****Manufacturer**.....: **GuangZhou Ostec Electronic Technology Co.,Limited**

Model/Type reference.....: HW500

Listed Models .....: See next page

Ratings .....: 12V---5A

Modulation .....: OFDM

Hardware version .....: XW46-TP2-V1.3

Software version .....: V1.0

Frequency.....: From 5180MHz-5240MHz, 5745MHz-5825MHz

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

**TEST REPORT**

|                                                    |                                |
|----------------------------------------------------|--------------------------------|
| <b>Test Report No. :</b> <b>GTS20200906013-1-4</b> | Sep. 08, 2020<br>Date of issue |
|----------------------------------------------------|--------------------------------|

Equipment under Test : Intelligent All-In-One Machine

Model /Type : HW500

Listed Models : HW200, HW200(N), HW200(L), HW500(N), HW500(L), HW800, HW800(N), HW800(L), HW1200, HW1200(N), HW1200(L), HW200-M, HW200-M(N), HW200-M(L), HW500-M, HW500-M(N), HW500-M(L), HW800-M, HW800-M(N), HW800-M(L), HW1200-M, HW1200-M(N), HW1200-M(L), BC1200, BC1200(O), BC1200(N), HW200Z, HW500Z, HW800Z, HW1200Z, HW200-MZ, HW500-MZ, HW800-MZ, HW1200-MZ, BC1200Z, CA800, CA800 (BX), CA800(N), CA800(NK), CA800(L), CA800(OT), CA800 (NT), HC4K, HC4K (BX), HC4K(N), HC4K(NK), HC4K(L), MC500W-O, MC4KW-O, MC500W-N, MC4KW-N, MC500W-G1, MC4KW-G1, MC500W-G2, MC4KW-G2, MC500-G3, MC4K, CA800Z, HC4KZ, DM210, DM350-C, CW01, 3D800, 3D800(N), TE500, TE800, TE1200, TE2000, TE500-M, TE800-M, TE1200-M, TE2000-M, TE500-N, TE800-N, TE1200-N, TE2000-N, TE500-MN, TE800-MN, TE1200-MN, TE2000-MN, TE500-L, TE800-L, TE1200-L, TE2000-L, TE500-ML, TE800-ML, TE1200-ML, TE500-Z, TE800-Z, TE1200-Z, TE2000-Z, TE500-MZ, TE800-MZ, TE1200-MZ, TE2000-MZ, MC1200-M, MC1200-MN, MC1200-ML, MC1200-MZ, MC1200-MC, MC2000, MC2000W-G1, MC2000-M, MC2000-MN, MC2000-ML, MC2000-MZ, MC2000-MC, CA2000

Applicant : GuangZhou Ostec Electronic Technology Co., Limited

Address : 2 of No.8 West Lane, Jiangcheng Road, Bangjiang East Village, Dalong Street, Panyu District, Guangzhou City, Guangdong, P.R.China

Manufacturer : GuangZhou Ostec Electronic Technology Co., Limited

Address : 2 of No.8 West Lane, Jiangcheng Road, Bangjiang East Village, Dalong Street, Panyu District, Guangzhou City, Guangdong, P.R.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 Subpart E](#)—Unlicensed National Information Infrastructure Devices

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

[KDB789033 D02](#): General UNII Test Procedures New Rules v01r02

## 2 SUMMARY

### 2.1 General Remarks

|                                |   |               |
|--------------------------------|---|---------------|
| Date of receipt of test sample | : | Aug. 20, 2020 |
|                                |   |               |
| Testing commenced on           | : | Aug. 21, 2020 |
|                                |   |               |
| Testing concluded on           | : | Sep. 07, 2020 |

### 2.2 Product Description

|                      |                                              |                                    |                    |               |
|----------------------|----------------------------------------------|------------------------------------|--------------------|---------------|
| Product Description: | Intelligent All-In-One Machine               |                                    |                    |               |
| Model:               | HW500                                        |                                    |                    |               |
| Power supply:        | DC 12V from adapter                          |                                    |                    |               |
| Sample ID:           | GTS20200906013-1-4-1#/ GTS20200906013-1-4-2# |                                    |                    |               |
| WIFI                 |                                              |                                    |                    |               |
| Supported type:      | 20MHz system                                 | 40MHz system                       | 80MHz system       | 160MHz system |
|                      | 802.11a<br>802.11n<br>802.11ac               | 802.11n<br>802.11ac                | 802.11ac           | N/A           |
| Operation frequency: | 5180MHz-5240MHz<br>5745MHz-5825MHz           | 5190MHz-5230MHz<br>5755MHz-5795MHz | 5210MHz<br>5775MHz | N/A           |
| Modulation:          | OFDM                                         | OFDM                               | OFDM               | N/A           |
| Channel number:      | 9                                            | 4                                  | 2                  | N/A           |
| Channel separation:  | 20MHz                                        | 40MHz                              | 80MHz              | N/A           |
| Antenna type:        | External antenna                             |                                    |                    |               |
| Antenna gain:        | 5.0dBi                                       |                                    |                    |               |

### 2.3 Test Sample

The application provides 2 samples to meet requirement.

| Sample Number         | Description                           |
|-----------------------|---------------------------------------|
| GTS20200906013-1-4-1# | Engineer sample – continuous transmit |
| GTS20200906013-1-4-2# | Normal sample – Intermittent transmit |

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

This is an Intelligent All-In-One Machine.

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

## 2.5 EUT operation mode

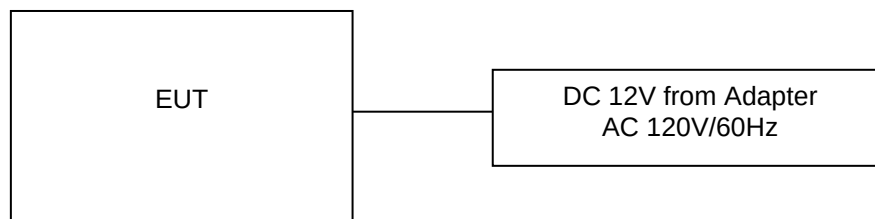
The Applicant provides communication tools software(MT76xxE\_AP.exe) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.  
All test performed at the low, middle and high of operational frequency range of each mode.

Operation Frequency List WIFI on 5G Band:

| Operating band               | 20MHz   |                 | 40MHz   |                 | 80MHz   |                 |
|------------------------------|---------|-----------------|---------|-----------------|---------|-----------------|
|                              | Channel | Frequency (MHz) | Channel | Frequency (MHz) | Channel | Frequency (MHz) |
| U-NII 1<br>(5150MHz-5250MHz) | 36      | 5180            | 38      | 5190            | 42      | 5210            |
|                              | 40      | 5200            |         |                 |         |                 |
|                              | 44      | 5220            | 46      | 5230            |         |                 |
|                              | 48      | 5240            |         |                 |         |                 |
| U-NII 3<br>(5725MHz-5850MHz) | 149     | 5745            | 151     | 5755            | 155     | 5775            |
|                              | 153     | 5765            |         |                 |         |                 |
|                              | 157     | 5785            | 159     | 5795            |         |                 |
|                              | 161     | 5805            |         |                 |         |                 |
|                              | 165     | 5825            | --      | --              | --      | --              |

Note: The line display in grey is those Channels/Frequencies select to test in this report for each operation mode.

## 2.6 Block Diagram of Test Setup



## 2.7 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

| Description | Manufacturer | Model | Technical Parameters | Certificate | Provided by |
|-------------|--------------|-------|----------------------|-------------|-------------|
| /           | /            | /     | /                    | /           | /           |
| /           | /            | /     | /                    | /           | /           |
| /           | /            | /     | /                    | /           | /           |
| /           | /            | /     | /                    | /           | /           |

## 2.8 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with Section 15.407 of the FCC Part 15, Subpart E Rules.

## 2.9 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

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

#### **3.2 Test Facility**

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

**FCC-Registration No.: 165725**

Shenzhen Global Test Service Co.,Ltd EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

**A2LA-Lab Cert. No.: 4758.01**

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

**CNAS-Lab Code: 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: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2024.

#### **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 Test Description

| FCC Requirement                  |                                            |                       |
|----------------------------------|--------------------------------------------|-----------------------|
| FCC Part 15.207                  | AC Power Conducted Emission                | PASS                  |
| FCC Part 15.407(a)               | Emission Bandwidth(26dBm Bandwidth)        | PASS <sup>Note1</sup> |
| FCC Part 15.407(e)               | Minimum Emission Bandwidth(6dBm Bandwidth) | PASS <sup>Note2</sup> |
| FCC Part 15.407(a)               | Maximum Conducted Output Power             | PASS                  |
| FCC Part 15.407(a)               | Peak Power Spectral Density                | PASS                  |
| FCC Part 15.407(g)               | Frequency Stability                        | PASS                  |
| FCC Part 15.407(b)               | Undesirable emission                       | PASS                  |
| FCC Part 15.407(b)/15.205/15.209 | Radiated Emissions                         | PASS                  |
| FCC Part 15.407(h)               | Dynamic Frequency Selection                | N/A <sup>Note 3</sup> |
| FCC Part 15.203/15.247(b)        | Antenna Requirement                        | PASS                  |

Note 1: Apply to U-NII 1, U-NII 2A, and U-NII 2C band.

Note 2: Apply to U-NII 3 band only.

Note 3: This device not work in DFS band.

#### Data Rate Used:

Preliminary 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 Conducted Output Power<br>Power Spectral Density<br>Emission Bandwidth(26dBm Bandwidth)<br>Minimum Emission Bandwidth(6dBm Bandwidth)<br>Undesirable emission<br>Frequency Stability | 11a/OFDM                    | 6 Mbps    |
|                                                                                                                                                                                              | 11n(20MHz),11ac(20MHz)/OFDM | 7.2 Mbps  |
|                                                                                                                                                                                              | 11n(40MHz),11ac(40MHz)/OFDM | 15.0Mbps  |
|                                                                                                                                                                                              | 11ac(80MHz)/OFDM            | 65.0Mbps  |

### 3.5 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)   |

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



### 3.6 Equipments Used during the Test

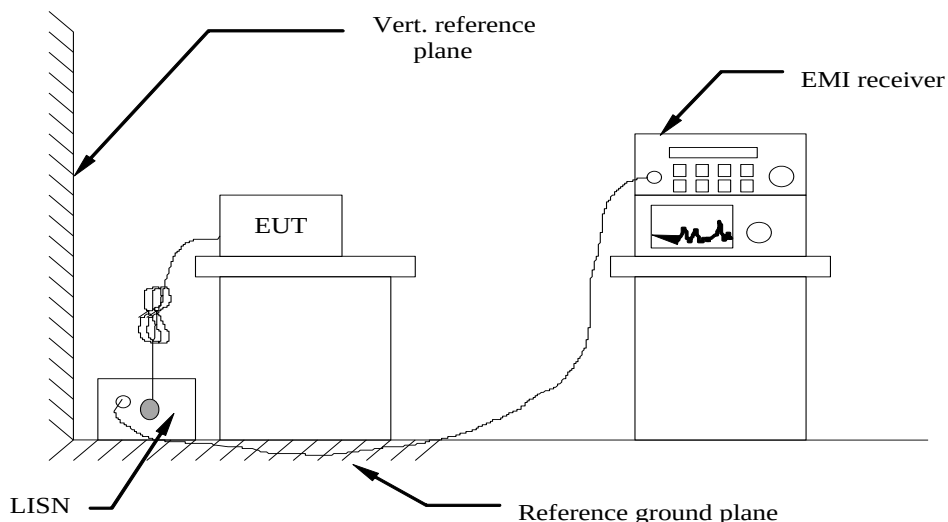
| Test Equipment             | Manufacturer                      | Model No.             | Serial No.      | Calibration Date | Calibration Due Date |
|----------------------------|-----------------------------------|-----------------------|-----------------|------------------|----------------------|
| LISN                       | R&S                               | ENV216                | 3560.6550.08    | 2019/09/20       | 2020/09/19           |
| LISN                       | R&S                               | ESH2-Z5               | 893606/008      | 2019/09/20       | 2020/09/19           |
| EMI Test Receiver          | R&S                               | ESPI3                 | 101841-cd       | 2019/09/20       | 2020/09/19           |
| EMI Test Receiver          | R&S                               | ESCI7                 | 101102          | 2019/09/20       | 2020/09/19           |
| Spectrum Analyzer          | Agilent                           | N9020A                | MY48010425      | 2019/09/20       | 2020/09/19           |
| Spectrum Analyzer          | Agilent                           | E4407B                | MY45132751      | 2019/09/20       | 2020/09/19           |
| Spectrum Analyzer          | R&S                               | FSV40                 | 100019          | 2019/09/20       | 2020/09/19           |
| Vector Signal generator    | Agilent                           | N5181A                | MY49060502      | 2019/09/20       | 2020/09/19           |
| Signal generator           | Agilent                           | E4421B                | 3610AO1069      | 2019/09/20       | 2020/09/19           |
| Climate Chamber            | ESPEC                             | EL-10KA               | A20120523       | 2019/09/20       | 2020/09/19           |
| Controller                 | EM Electronics                    | Controller EM 1000    | N/A             | N/A              | N/A                  |
| Horn Antenna               | Schwarzbeck                       | BBHA 9120D            | 01622           | 2019/09/23       | 2020/09/22           |
| Active Loop Antenna        | Beijing Da Ze Technology Co.,Ltd. | ZN30900C              | 15006           | 2019/10/12       | 2020/10/11           |
| Bilog Antenna              | Schwarzbeck                       | VULB9163              | 000976          | 2020/05/24       | 2021/05/23           |
| Broadband Horn Antenna     | SCHWARZBECK                       | BBHA 9170             | 791             | 2019/09/20       | 2020/09/19           |
| Amplifier                  | Schwarzbeck                       | BBV 9743              | #202            | 2019/09/20       | 2020/09/19           |
| Amplifier                  | Schwarzbeck                       | BBV9179               | 9719-025        | 2019/09/20       | 2020/09/19           |
| Amplifier                  | EMCI                              | EMC051845B            | 980355          | 2019/09/20       | 2020/09/19           |
| Temperature/Humidity Meter | Gangxing                          | CTH-608               | 02              | 2019/09/20       | 2020/09/19           |
| High-Pass Filter           | K&L                               | 9SH10-2700/X12750-O/O | KL142031        | 2019/09/20       | 2020/09/19           |
| High-Pass Filter           | K&L                               | 41H10-1375/U12750-O/O | KL142032        | 2019/09/20       | 2020/09/19           |
| RF Cable(below 1GHz)       | HUBER+SUHNER                      | RG214                 | RE01            | 2019/09/20       | 2020/09/19           |
| RF Cable(above 1GHz)       | HUBER+SUHNER                      | RG214                 | RE02            | 2019/09/20       | 2020/09/19           |
| Data acquisition card      | Agilent                           | U2531A                | TW53323507      | 2019/09/20       | 2020/09/19           |
| Power Sensor               | Agilent                           | U2021XA               | MY5365004       | 2019/09/20       | 2020/09/19           |
| Test Control Unit          | Tonscend                          | JS0806-1              | 178060067       | 2020/06/18       | 2021/06/17           |
| Automated filter bank      | Tonscend                          | JS0806-F              | 19F8060177      | 2020/06/18       | 2021/06/17           |
| 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 DC 12V power from adapter, the adapter received AC120V/60Hz and 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.

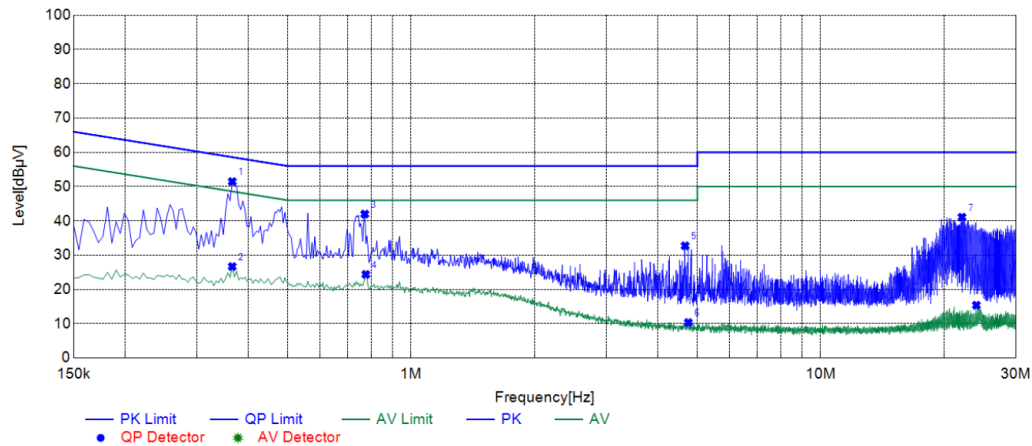
**TEST RESULTS**

|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

Remark:

- All modes of 802.11a/n were tested at Low, Middle, and High channel; only the worst result of 802.11a CH36 was reported as below:
- Both 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz power supply have been tested, only the worst result of 120 VAC, 60 Hz was reported as below:

|               |                       |              |   |
|---------------|-----------------------|--------------|---|
| Power supply: | AC 120V/60Hz(adapter) | Polarization | L |
|---------------|-----------------------|--------------|---|

**Test Graph****Suspected List**

| NO. | Frequency [MHz] | Reading [dBμV] | Factor [dB] | Result [dBμV] | Limit [dBμV] | Margin [dB] | Detector | Line | Remark |
|-----|-----------------|----------------|-------------|---------------|--------------|-------------|----------|------|--------|
| 1   | 0.3660          | 41.45          | 10.01       | 51.46         | 58.59        | 7.13        | PK       | L1   | PASS   |
| 2   | 0.3660          | 16.65          | 10.01       | 26.66         | 48.59        | 21.93       | AV       | L1   | PASS   |
| 3   | 0.7710          | 31.92          | 10.06       | 41.98         | 56.00        | 14.02       | PK       | L1   | PASS   |
| 4   | 0.7755          | 14.30          | 10.07       | 24.37         | 46.00        | 21.63       | AV       | L1   | PASS   |
| 5   | 4.6680          | 22.26          | 10.46       | 32.72         | 56.00        | 23.28       | PK       | L1   | PASS   |
| 6   | 4.7535          | -0.13          | 10.46       | 10.33         | 46.00        | 35.67       | AV       | L1   | PASS   |
| 7   | 22.1325         | 29.49          | 11.58       | 41.07         | 60.00        | 18.93       | PK       | L1   | PASS   |
| 8   | 24.0000         | 3.73           | 11.64       | 15.37         | 50.00        | 34.63       | AV       | L1   | PASS   |

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

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

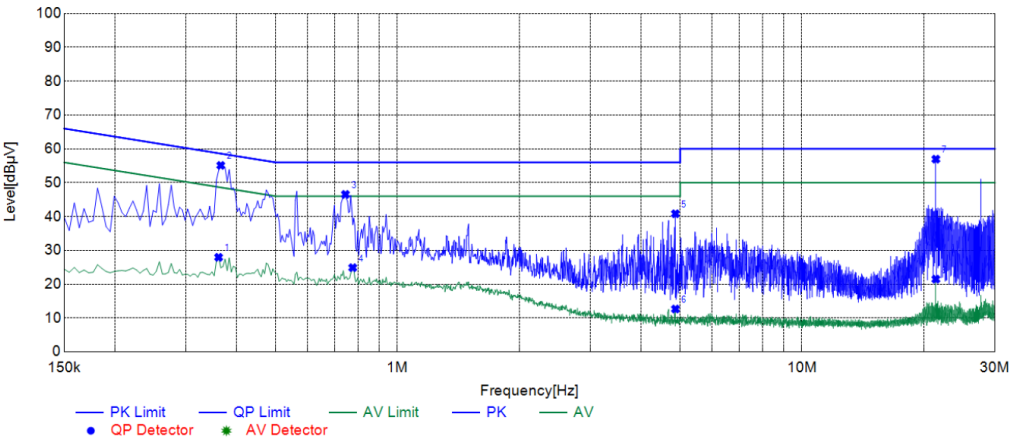
Power supply:

AC 120V/60Hz(adapter)

Polarization

N

Test Graph



| Suspected List |                 |                |             |               |              |             |          |      |        |
|----------------|-----------------|----------------|-------------|---------------|--------------|-------------|----------|------|--------|
| NO.            | Frequency [MHz] | Reading [dBμV] | Factor [dB] | Result [dBμV] | Limit [dBμV] | Margin [dB] | Detector | Line | Remark |
| 1              | 0.3615          | 17.92          | 10.01       | 27.93         | 48.69        | 20.76       | AV       | N    | PASS   |
| 2              | 0.3660          | 45.10          | 10.01       | 55.11         | 58.59        | 3.48        | PK       | N    | PASS   |
| 3              | 0.7440          | 36.47          | 10.06       | 46.53         | 56.00        | 9.47        | PK       | N    | PASS   |
| 4              | 0.7755          | 14.80          | 10.07       | 24.87         | 46.00        | 21.13       | AV       | N    | PASS   |
| 5              | 4.8660          | 30.35          | 10.46       | 40.81         | 56.00        | 15.19       | PK       | N    | PASS   |
| 6              | 4.8660          | 2.19           | 10.46       | 12.65         | 46.00        | 33.35       | AV       | N    | PASS   |
| 7              | 21.4260         | 45.48          | 11.47       | 56.95         | 60.00        | 3.05        | PK       | N    | PASS   |
| 8              | 21.4260         | 10.00          | 11.47       | 21.47         | 50.00        | 28.53       | AV       | N    | PASS   |

Note:1. Result (dBμV) = Reading (dBμV) + Factor (dB).  
2. Factor (dB) = Cable loss (dB) + LISN Factor (dB).

## 4.2 Radiated Emissions

### Limit

The maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

- (1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
- (4) For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

### Undesirable emission limits

| Requirement  | Limit(EIRP)     | Limit (Field strength at 3m) <small>Note1</small> |
|--------------|-----------------|---------------------------------------------------|
| 15.407(b)(1) | PK:-27(dBm/MHz) | PK:68.2(dBμV/m)                                   |
| 15.407(b)(2) |                 |                                                   |
| 15.407(b)(3) |                 |                                                   |
| 15.407(b)(4) |                 |                                                   |

Note1: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

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

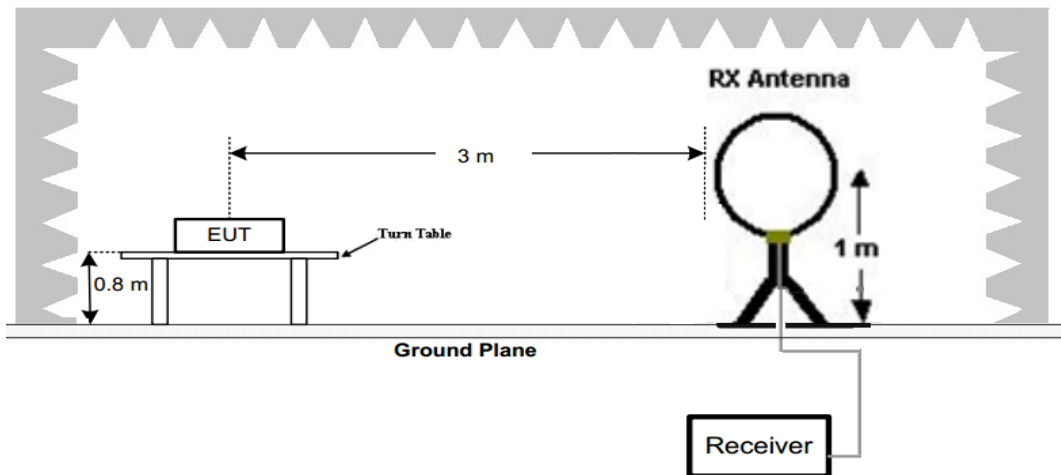
- (5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209
- (6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

### Radiated emission limits

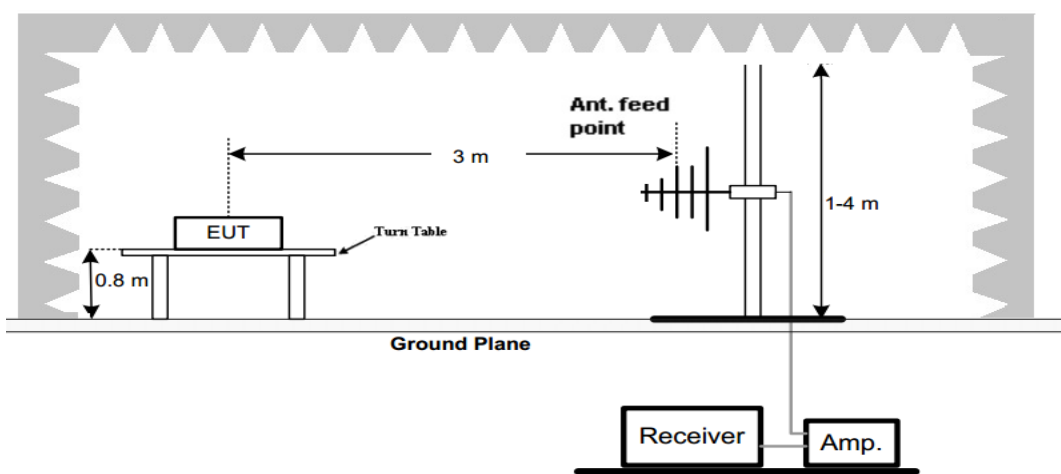
| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m)                | Radiated (μV/m) |
|-----------------|-------------------|----------------------------------|-----------------|
| 0.009-0.49      | 3                 | 20log(2400/F(KHz))+40log(300/3)  | 2400/F(KHz)     |
| 0.49-1.705      | 3                 | 20log(24000/F(KHz))+ 40log(30/3) | 24000/F(KHz)    |
| 1.705-30        | 3                 | 20log(30)+ 40log(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 CONFIGURATION**

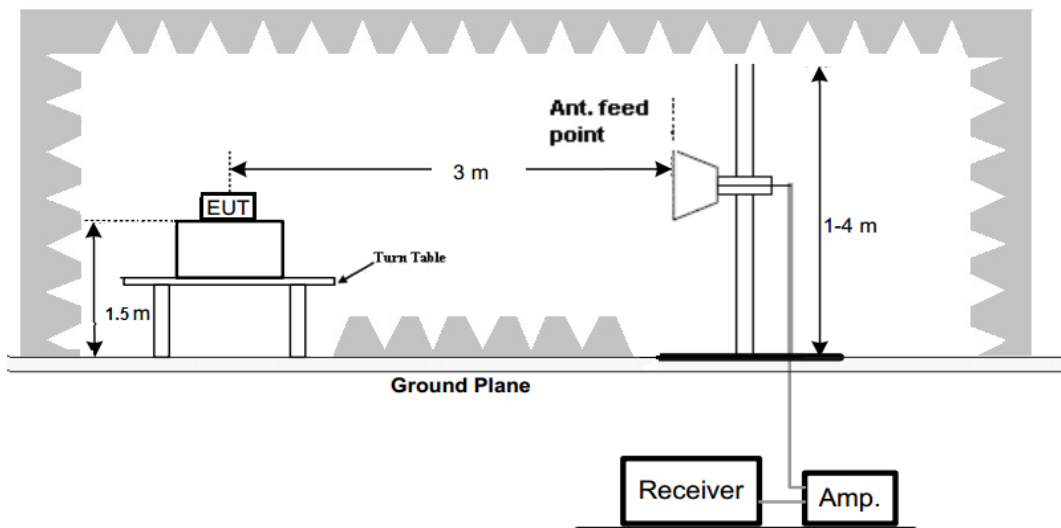
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency below 1000MHz



(C) Radiated Emission Test Set-Up, Frequency above 1000MHz



**Test Procedure**

- Below 1GHz measurement the EUT is placed on a turntable which is 0.8m above ground plane, and above 1GHz measurement EUT was placed on a low permittivity and low loss tangent turn table which is 1.5m above ground plane.
- 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
- And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- Repeat above procedures until all frequency measurements have been completed.
- Radiated emission test frequency band from 9KHz to 40GHz.
- 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           | Bilog Antenna       | 3             |
| 1GHz-18GHz           | Horn Antenna        | 3             |
| 18GHz-25GHz          | Horn Antenna        | 1             |

- 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     |

**TEST RESULTS**

|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

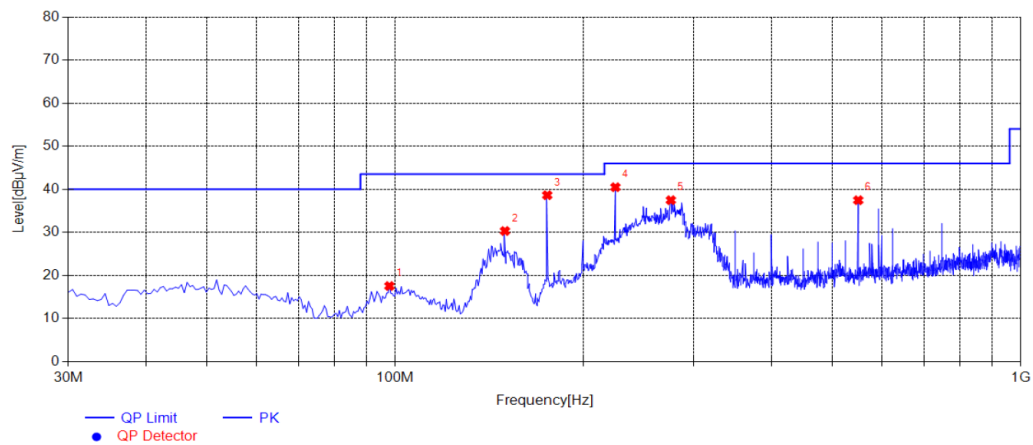
## Remark:

- All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for below 1GHz test, only the worst case 802.11a low channel of U-NII 1 band was recorded.
- All 802.11a / 802.11n (HT20) / 802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11a was recorded.
- Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

## For 30MHz-1GHz

## Horizontal

## Test Graph

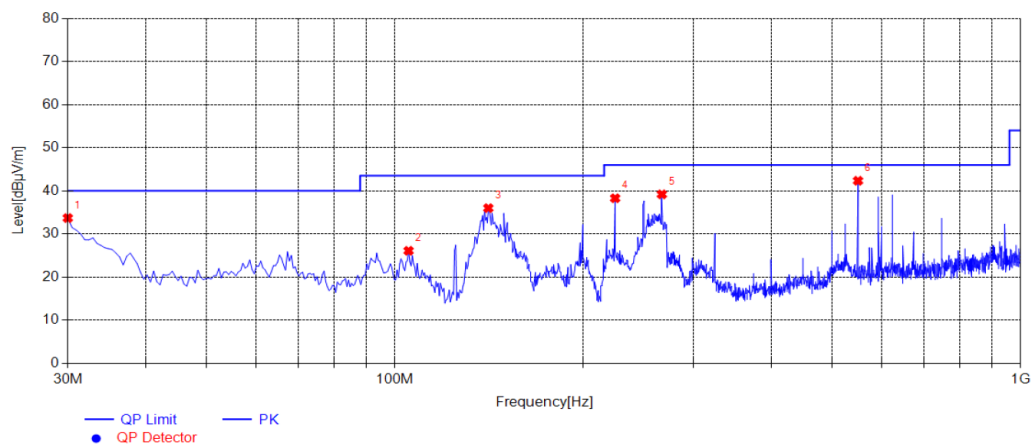


## Suspected List

| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Detector | Polarity   | Remark |
|-----|-----------------|------------------|-------------|-----------------|----------------|-------------|-------------|-----------|----------|------------|--------|
| 1   | 97.9000         | 26.25            | -8.69       | 17.56           | 43.50          | 25.94       | 100         | 60        | PK       | Horizontal | PASS   |
| 2   | 149.7950        | 43.19            | -12.86      | 30.33           | 43.50          | 13.17       | 100         | 10        | PK       | Horizontal | PASS   |
| 3   | 175.0150        | 49.74            | -11.11      | 38.63           | 43.50          | 4.87        | 100         | 30        | PK       | Horizontal | PASS   |
| 4   | 224.9700        | 49.56            | -9.07       | 40.49           | 46.00          | 5.51        | 100         | 50        | PK       | Horizontal | PASS   |
| 5   | 275.8950        | 45.33            | -7.85       | 37.48           | 46.00          | 8.52        | 100         | 40        | PK       | Horizontal | PASS   |
| 6   | 549.9200        | 40.50            | -3.03       | 37.47           | 46.00          | 8.53        | 100         | 40        | PK       | Horizontal | PASS   |

## Vertical

## Test Graph



## Suspected List

| NO. | Frequency [MHz] | Reading [dBμV/m] | Factor [dB] | Result [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Height [cm] | Angle [°] | Detector | Polarity | Remark |
|-----|-----------------|------------------|-------------|-----------------|----------------|-------------|-------------|-----------|----------|----------|--------|
| 1   | 30.0000         | 43.66            | -9.96       | 33.70           | 40.00          | 6.30        | 100         | 50        | PK       | Vertical | PASS   |
| 2   | 105.1750        | 34.23            | -8.12       | 26.11           | 43.50          | 17.39       | 100         | 20        | PK       | Vertical | PASS   |
| 3   | 141.0650        | 48.31            | -12.31      | 36.00           | 43.50          | 7.50        | 100         | 30        | PK       | Vertical | PASS   |
| 4   | 224.9700        | 47.36            | -9.07       | 38.29           | 46.00          | 7.71        | 100         | 30        | PK       | Vertical | PASS   |
| 5   | 267.1650        | 47.18            | -7.98       | 39.20           | 46.00          | 6.80        | 100         | 10        | PK       | Vertical | PASS   |
| 6   | 549.9200        | 45.38            | -3.03       | 42.35           | 46.00          | 3.65        | 100         | 10        | PK       | 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 25GHz**

Note: All 802.11a / 802.11n (HT20) /802.11n (HT40) modes have been tested for above 1GHz test, only the worst case 802.11a was recorded.

**U-NII 1 & 802.11a Mode (above 1GHz)**

| Tested Channel     | Frequency (MHz) | Emission Level (dBuV/m) | Detector Mode | ANT Pol | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre amplifier (dB) | Correction Factor (dB/m) |
|--------------------|-----------------|-------------------------|---------------|---------|----------------|-------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| 36.00<br>(5180MHz) | 5150.00         | 51.47                   | PK            | H       | 68.20          | 16.73       | 44.19            | 34.44                 | 7.12              | 34.28              | 7.28                     |
|                    | 5150.00         | 44.20                   | AV            | H       | 54.00          | 9.80        | 36.92            | 34.44                 | 7.12              | 34.28              | 7.28                     |
|                    | 10360.00        | 48.95                   | PK            | H       | 68.20          | 19.25       | 33.22            | 39.20                 | 11.45             | 34.92              | 15.73                    |
|                    | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 40.00<br>(5200MHz) | 10400.00        | 49.62                   | PK            | H       | 68.20          | 18.58       | 33.81            | 39.22                 | 11.48             | 34.89              | 15.81                    |
|                    | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 48.00<br>(5240MHz) | 5350.50         | 46.33                   | PK            | H       | 68.20          | 21.87       | 39.30            | 34.23                 | 7.36              | 34.56              | 7.03                     |
|                    | 10480.00        | 49.18                   | PK            | H       | 68.20          | 19.02       | 32.03            | 39.41                 | 11.83             | 34.09              | 17.15                    |
|                    | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

| Tested Channel     | Frequency (MHz) | Emission Level (dBuV/m) | Detector Mode | ANT Pol | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre amplifier (dB) | Correction Factor (dB/m) |
|--------------------|-----------------|-------------------------|---------------|---------|----------------|-------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| 36.00<br>(5180MHz) | 5150.00         | 52.14                   | PK            | V       | 68.20          | 16.06       | 44.86            | 34.44                 | 7.12              | 34.28              | 7.28                     |
|                    | 5150.00         | 45.87                   | AV            | V       | 54.00          | 8.13        | 38.59            | 34.44                 | 7.12              | 34.28              | 7.28                     |
|                    | 10360.00        | 49.21                   | PK            | V       | 68.20          | 18.99       | 33.48            | 39.20                 | 11.45             | 34.92              | 15.73                    |
|                    | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 40.00<br>(5200MHz) | 10400.00        | 50.07                   | PK            | V       | 68.20          | 18.13       | 34.26            | 39.22                 | 11.48             | 34.89              | 15.81                    |
|                    | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 48.00<br>(5240MHz) | 5350.50         | 47.11                   | PK            | V       | 68.20          | 21.09       | 40.08            | 34.23                 | 7.36              | 34.56              | 7.03                     |
|                    | 10480.00        | 50.23                   | PK            | V       | 68.20          | 17.97       | 33.08            | 39.41                 | 11.83             | 34.09              | 17.15                    |
|                    | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

**U-NII 3 & 802.11a Mode (above 1GHz)**

| Tested Channel      | Frequency (MHz) | Emission Level (dBuV/m) | Detector Mode | ANT Pol | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre amplifier (dB) | Correction Factor (dB/m) |
|---------------------|-----------------|-------------------------|---------------|---------|----------------|-------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
|                     | 5720.00         | 49.25                   | PK            | H       | 68.20          | 18.95       | 41.97            | 34.44                 | 7.12              | 34.28              | 7.28                     |
| 149.00<br>(5745MHz) | 5720.00         | 41.25                   | AV            | H       | 54.00          | 12.75       | 29.74            | 37.64                 | 9.28              | 35.41              | 11.51                    |
|                     | 11490.00        | 47.25                   | PK            | H       | 68.20          | 20.95       | 28.99            | 39.69                 | 12.90             | 34.33              | 18.26                    |
|                     | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 157.00<br>(5785MHz) | 11570.00        | 48.25                   | PK            | H       | 68.20          | 19.95       | 29.80            | 39.71                 | 13.05             | 34.31              | 18.45                    |
|                     | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 48.00<br>(5825MHz)  | 5855.00         | 48.25                   | PK            | H       | 68.20          | 19.95       | 36.71            | 37.64                 | 9.28              | 35.38              | 11.54                    |
|                     | 11650.00        | 50.24                   | PK            | H       | 68.20          | 17.96       | 31.62            | 39.73                 | 13.19             | 34.30              | 18.62                    |
|                     | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

| Tested Channel      | Frequency (MHz) | Emission Level (dBuV/m) | Detector Mode | ANT Pol | Limit (dBuV/m) | Margin (dB) | Raw Value (dBuV) | Antenna Factor (dB/m) | Cable Factor (dB) | Pre amplifier (dB) | Correction Factor (dB/m) |
|---------------------|-----------------|-------------------------|---------------|---------|----------------|-------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
|                     | 5720.00         | 50.36                   | PK            | V       | 68.20          | 17.84       | 43.08            | 34.44                 | 7.12              | 34.28              | 7.28                     |
| 149.00<br>(5745MHz) | 5720.00         | 43.25                   | AV            | V       | 54.00          | 10.75       | 31.74            | 37.64                 | 9.28              | 35.41              | 11.51                    |
|                     | 11490.00        | 48.59                   | PK            | V       | 68.20          | 19.61       | 30.33            | 39.69                 | 12.90             | 34.33              | 18.26                    |
|                     | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 157.00<br>(5785MHz) | 11570.00        | 49.55                   | PK            | V       | 68.20          | 18.65       | 31.10            | 39.71                 | 13.05             | 34.31              | 18.45                    |
|                     | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 48.00<br>(5825MHz)  | 5855.00         | 49.25                   | PK            | V       | 68.20          | 18.95       | 37.71            | 37.64                 | 9.28              | 35.38              | 11.54                    |
|                     | 11650.00        | 51.42                   | PK            | V       | 68.20          | 16.78       | 32.80            | 39.73                 | 13.19             | 34.30              | 18.62                    |
|                     | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

**REMARKS:**

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
3. Margin value = Limit value- Emission level.
4. -- Mean the other emission levels were very low against the limit.
5. RBW1MHz VBW3MHz Peak detector is for PK value; RBW 1MHz VBW10Hz Peak detector is

for AV value.

6. Worst case data at 6Mbps at IEEE 802.11a; MCS0 at IEEE 802.11n HT20, IEEE 802.11n HT40, IEEE 802.11ac VHT20 ,IEEE 802.11ac VHT40 and IEEE 802.11ac VHT80;

### 4.3 Maximum Conducted Average Output Power

#### Limit

##### **For the band 5.15-5.25 GHz.**

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi.

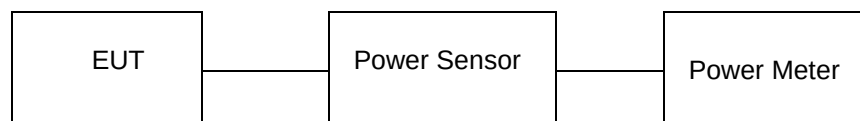
**For the 5.25-5.35 GHz and 5.47-5.725 GHz bands**, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or  $11 \text{ dBm} + 10 \log B$ , where B is the 26 dB emission bandwidth in megahertz.

**For the band 5.725-5.85 GHz**, the maximum conducted output power over the frequency band of operation shall not exceed 1 W

#### Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

#### Test Configuration



**Test Results**

|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

**U-NII 1**

| Type           | Channel | Output power (dBm) | Limit (dBm) | Result |
|----------------|---------|--------------------|-------------|--------|
| 802.11a        | 36      | 6.65               | 23.98       | Pass   |
|                | 40      | 7.16               |             |        |
|                | 48      | 7.63               |             |        |
| 802.11n(HT20)  | 36      | 6.55               | 23.98       | Pass   |
|                | 40      | 6.97               |             |        |
|                | 48      | 7.52               |             |        |
| 802.11n(HT40)  | 38      | 6.30               | 23.98       | Pass   |
|                | 46      | 7.10               |             |        |
| 802.11ac(HT20) | 36      | 6.45               | 23.98       | Pass   |
|                | 40      | 7.11               |             |        |
|                | 48      | 7.56               |             |        |
| 802.11ac(HT40) | 38      | 6.46               | 23.98       | Pass   |
|                | 46      | 6.96               |             |        |
| 802.11ac(HT80) | 42      | 5.99               | 23.98       | Pass   |

**U-NII 3**

| Type           | Channel | Output power (dBm) | Limit (dBm) | Result |
|----------------|---------|--------------------|-------------|--------|
| 802.11a        | 149     | 6.40               | 30.00       | Pass   |
|                | 157     | 5.75               |             |        |
|                | 165     | 6.59               |             |        |
| 802.11n(HT20)  | 149     | 6.43               | 30.00       | Pass   |
|                | 157     | 5.85               |             |        |
|                | 165     | 6.59               |             |        |
| 802.11n(HT40)  | 151     | 6.48               | 30.00       | Pass   |
|                | 159     | 6.16               |             |        |
| 802.11ac(HT20) | 149     | 6.67               | 30.00       | Pass   |
|                | 157     | 5.76               |             |        |
|                | 165     | 6.46               |             |        |
| 802.11ac(HT40) | 151     | 5.62               | 30.00       | Pass   |
|                | 159     | 5.31               |             |        |
| 802.11ac(HT80) | 155     | 4.67               | 30.00       | Pass   |

## 4.4 Power Spectral Density

### Limit

(1) For the band 5.15 - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band. <sup>note1</sup>

(ii) For an indoor access point operating in the band 5.15 - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band. <sup>note1</sup>

(iii) For fixed point-to-point access points operating in the band 5.15 - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15 - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band. <sup>note1</sup>

(2) For the 5.25 - 5.35 GHz and 5.47 - 5.725 GHz bands, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. <sup>note1</sup>

(3) For the band 5.725 - 5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band. <sup>note1, note2</sup>

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

### Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 1MHz for U-NII 1, U-NII 2A, U-NII C band and 510KHz for U-NII 3 band.
3. Set the VBW  $\geq 3 \times$  RBW.
4. Set the span to encompass the entire EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level.

### Test Configuration



**Test Results**

|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

| Type            | Bands   | Channel | Power Spectral Density (dBm/MHz) | Limit (dBm/MHz) | Result |
|-----------------|---------|---------|----------------------------------|-----------------|--------|
| 802.11a         | U-NII 1 | 36      | -4.256                           | 11              | Pass   |
|                 |         | 40      | -3.384                           |                 |        |
|                 |         | 48      | -3.085                           |                 |        |
| 802.11n (HT20)  | U-NII 1 | 36      | -4.537                           |                 |        |
|                 |         | 40      | -3.691                           |                 |        |
|                 |         | 48      | -3.346                           |                 |        |
| 802.11n (HT40)  | U-NII 1 | 38      | -7.627                           |                 |        |
|                 |         | 46      | -7.225                           |                 |        |
| 802.11ac (HT20) | U-NII 1 | 36      | -4.052                           |                 |        |
|                 |         | 40      | -3.945                           |                 |        |
|                 |         | 48      | -3.784                           |                 |        |
| 802.11ac (HT40) | U-NII 1 | 38      | -7.823                           |                 |        |
|                 |         | 46      | -7.065                           |                 |        |
| 802.11ac (HT80) | U-NII 1 | 42      | -10.720                          |                 |        |

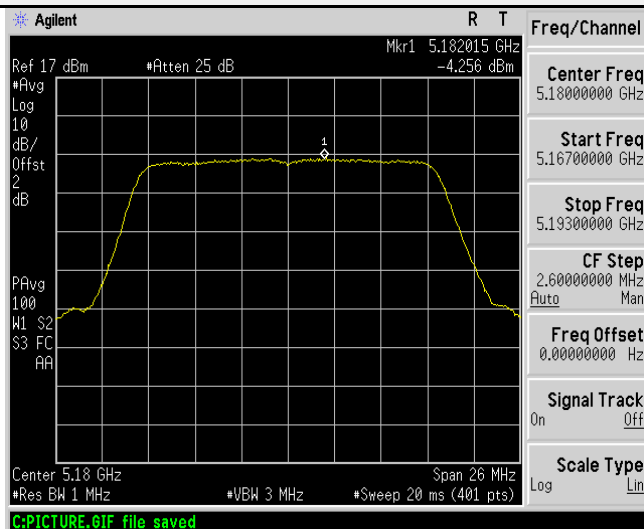
| Type            | Bands   | Channel | Power Spectral Density (dBm/300KHz) | Power Spectral Density (dBm/500KHz) | Limit (dBm/500KHz) | Result |
|-----------------|---------|---------|-------------------------------------|-------------------------------------|--------------------|--------|
| 802.11a         | U-NII 3 | 149     | -8.759                              | -6.541                              | 30                 | Pass   |
|                 |         | 157     | -9.362                              | -7.144                              |                    |        |
|                 |         | 165     | -8.570                              | -6.352                              |                    |        |
| 802.11n (HT20)  | U-NII 3 | 149     | -9.216                              | -6.998                              |                    |        |
|                 |         | 157     | -10.180                             | -7.962                              |                    |        |
|                 |         | 165     | -9.196                              | -6.978                              |                    |        |
| 802.11n (HT40)  | U-NII 3 | 151     | -13.330                             | -11.112                             |                    |        |
|                 |         | 159     | -13.490                             | -11.272                             |                    |        |
| 802.11ac (HT20) | U-NII 3 | 149     | -8.843                              | -6.625                              |                    |        |
|                 |         | 157     | -9.824                              | -7.606                              |                    |        |
|                 |         | 165     | -9.396                              | -7.178                              |                    |        |
| 802.11ac (HT40) | U-NII 3 | 151     | -12.800                             | -10.582                             |                    |        |
|                 |         | 159     | -13.450                             | -11.232                             |                    |        |
| 802.11ac (HT80) | U-NII 3 | 155     | -17.230                             | -15.012                             |                    |        |

Remark: P.S.D(dBm/500KHz)= P.S.D(dBm/300KHz)+10 log (500 kHz/300KHz).

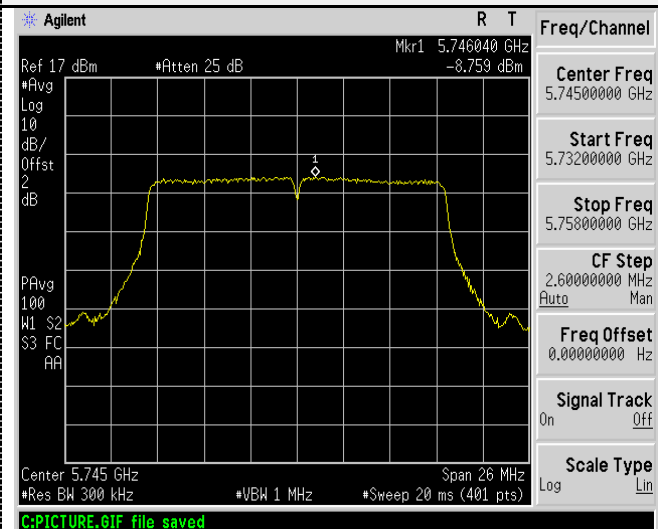
Test plot as follows:

## 802.11a

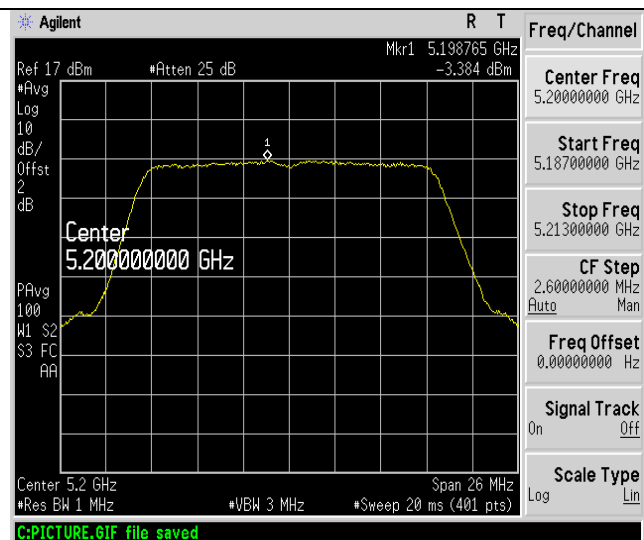
## U-NII 1



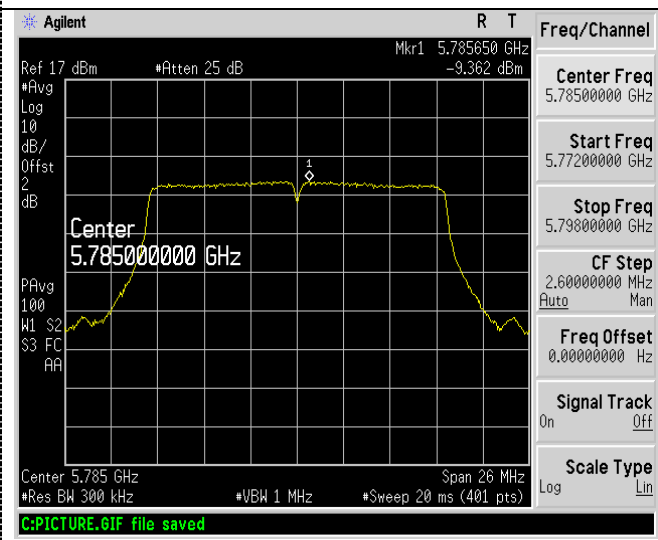
## U-NII 3



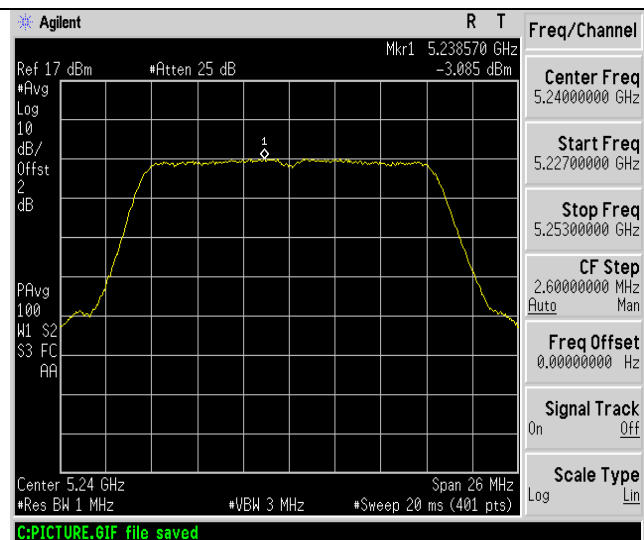
## CH36



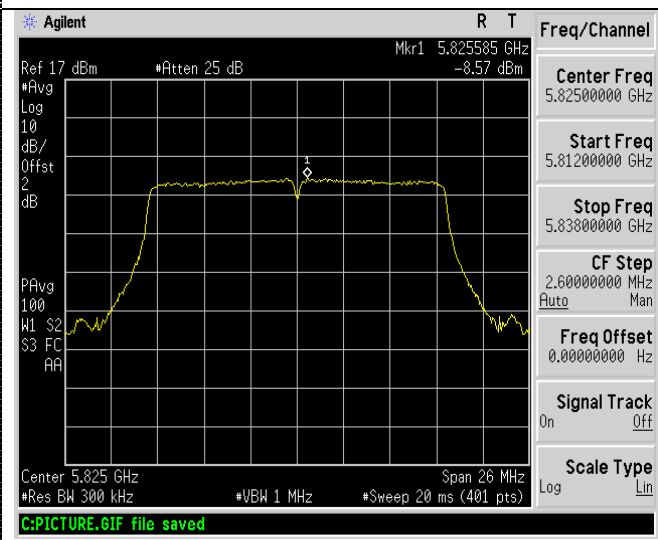
## CH149



## CH40

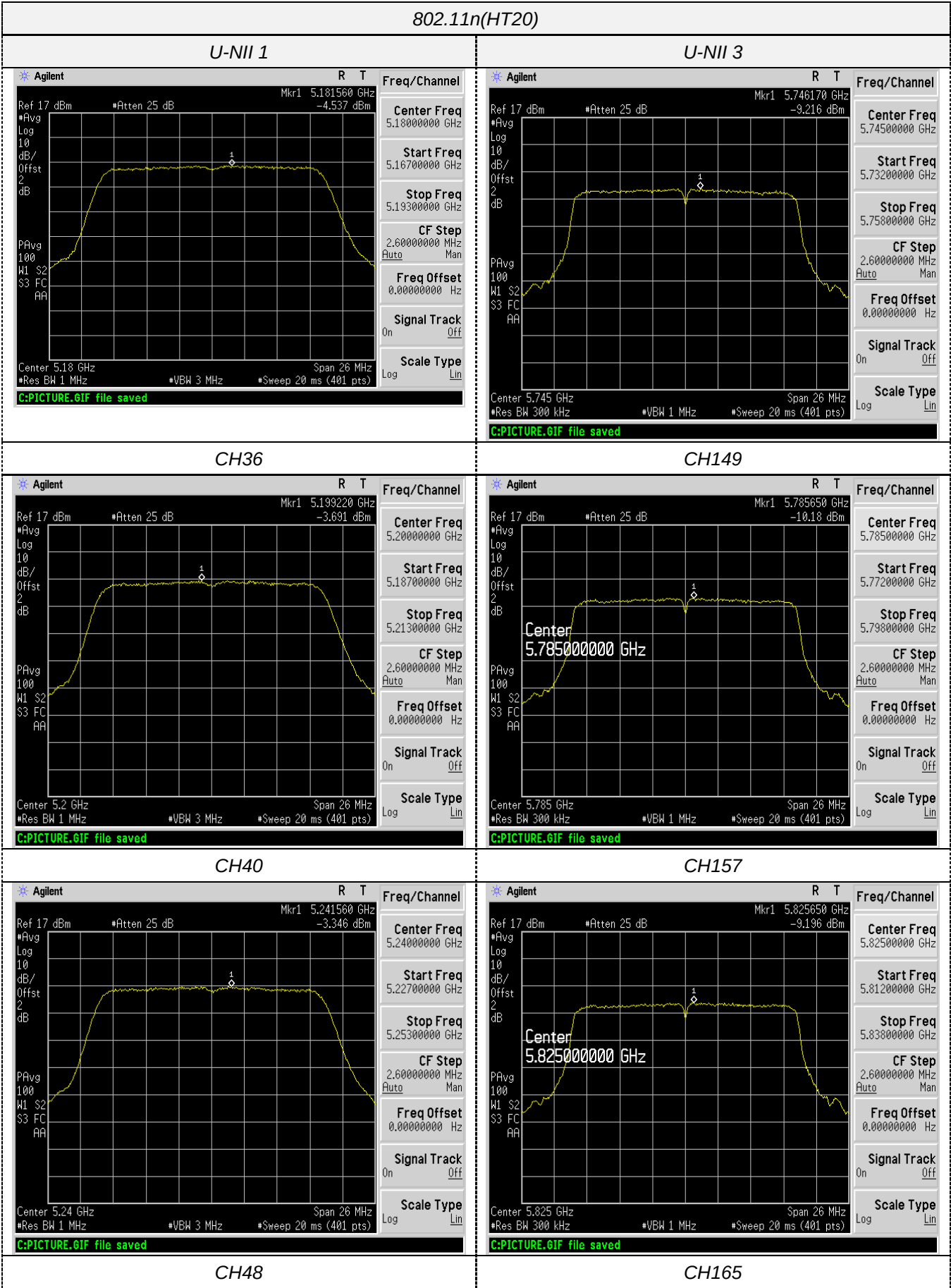


## CH157

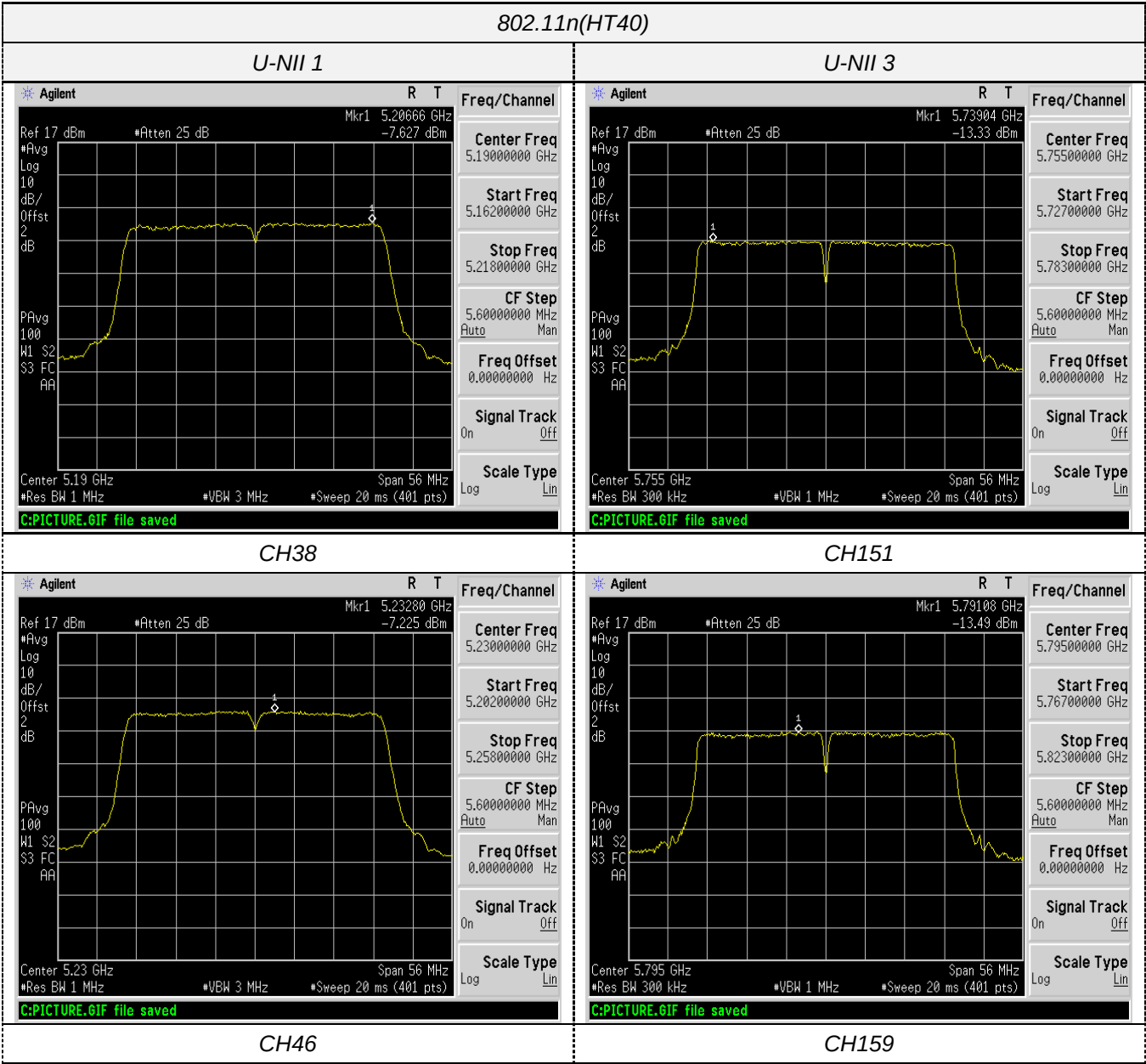


## CH48

## CH165

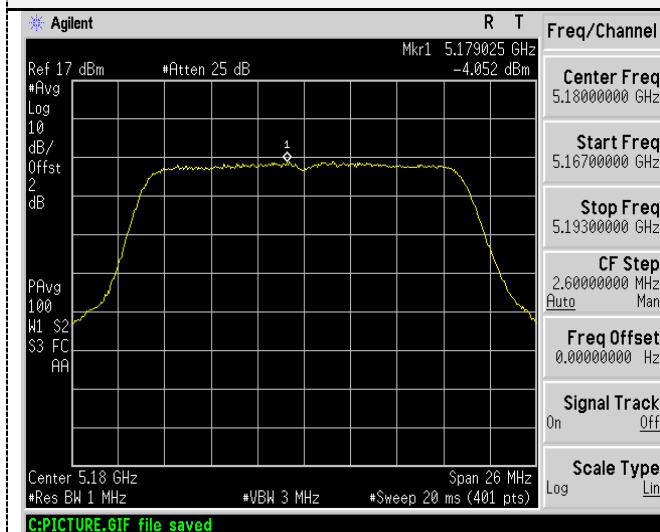




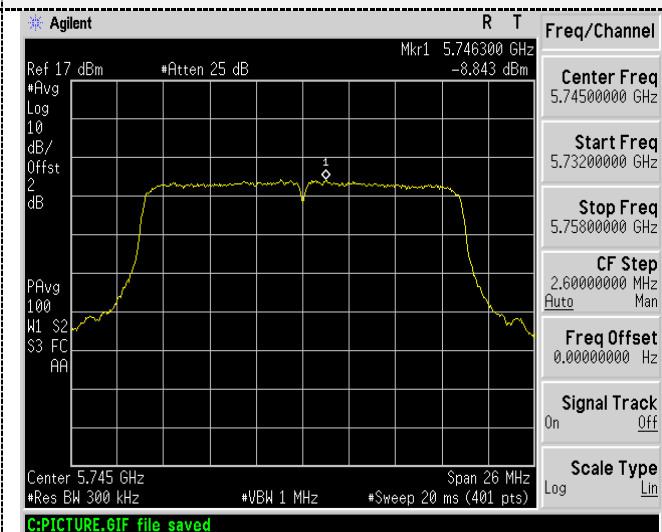


## 802.11ac(HT20)

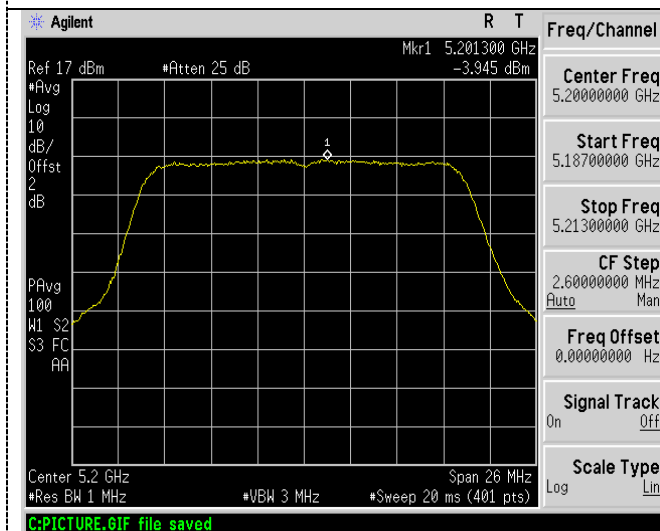
## U-NII 1



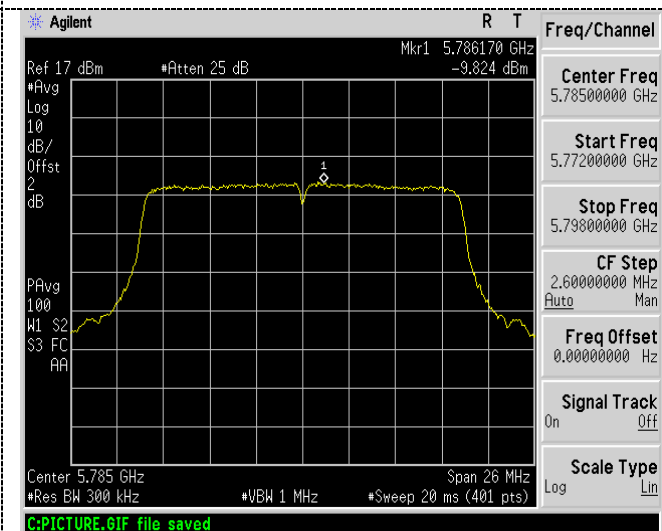
## U-NII 3



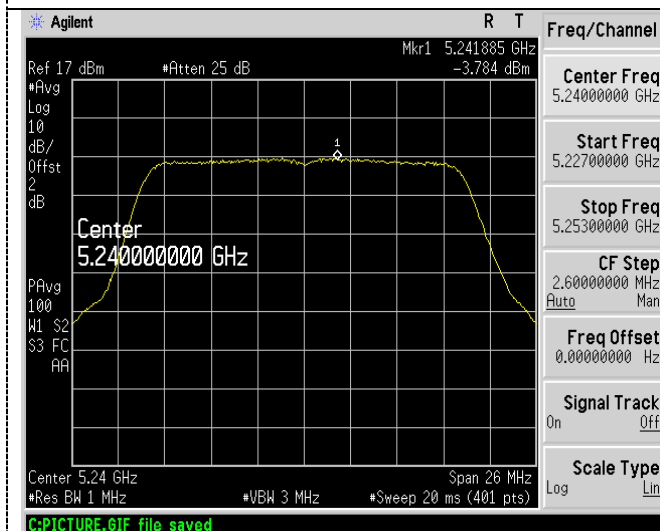
## CH36



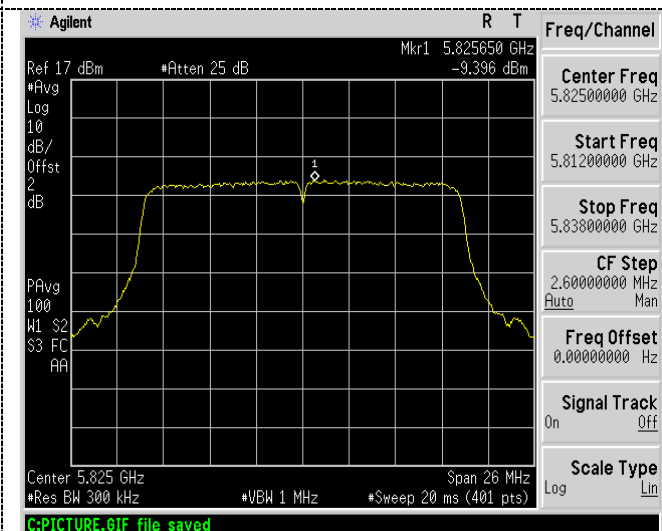
## CH149



## CH40



## CH157



## CH48

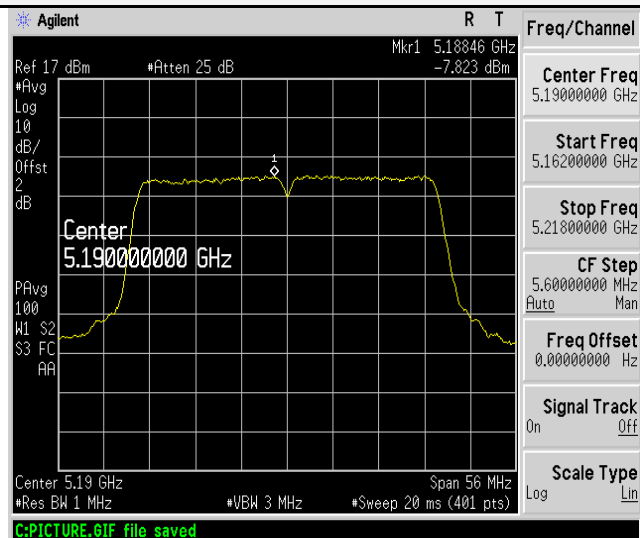


## CH165

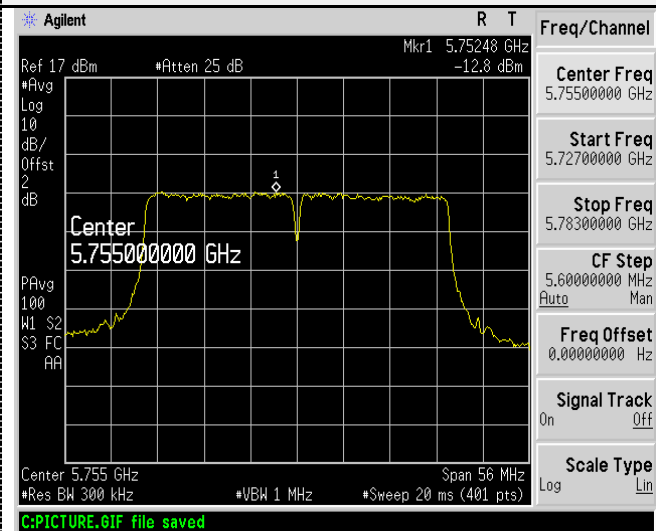


## 802.11ac(HT40)

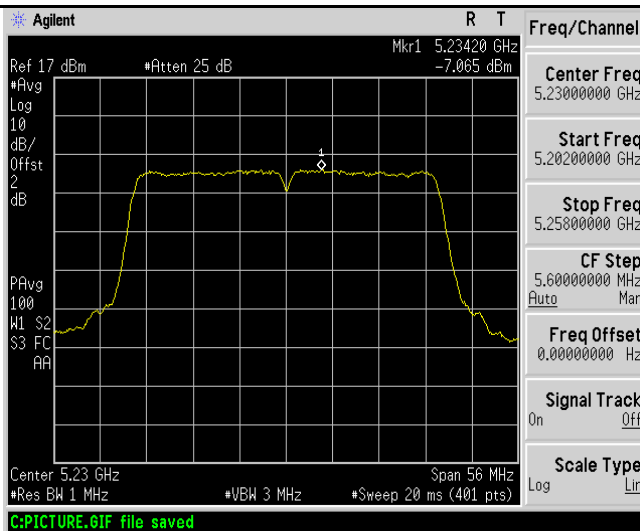
## U-NII 1



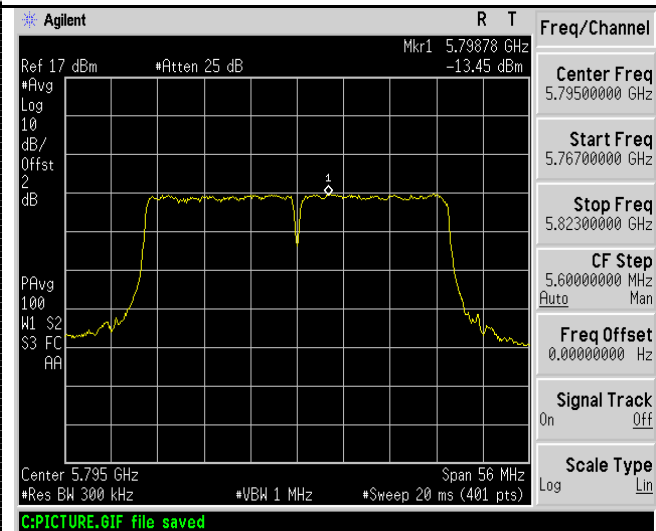
## U-NII 3



## CH38



## CH151

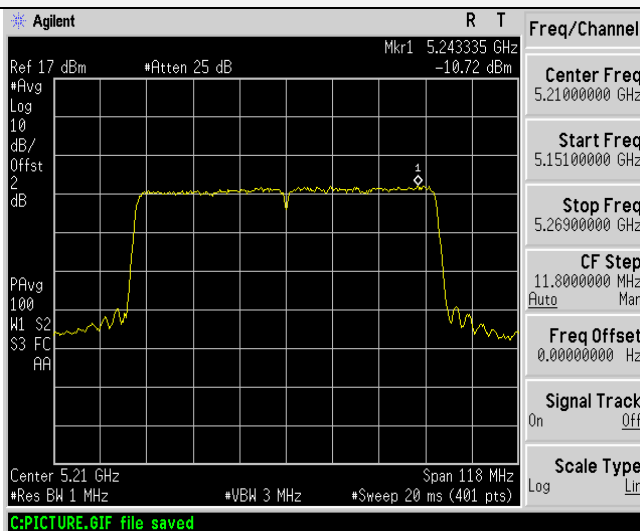


## CH46

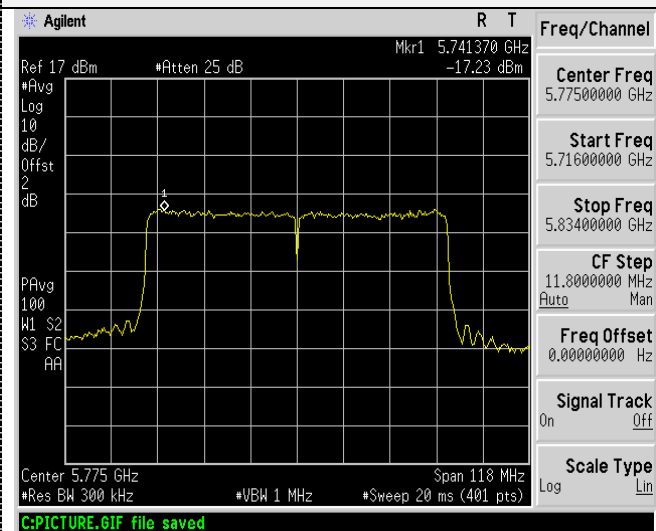
## CH159

## 802.11ac(HT80)

## U-NII 1



## U-NII 3



## CH42

## CH155

#### 4.5 Emission Bandwidth (26dBm Bandwidth)

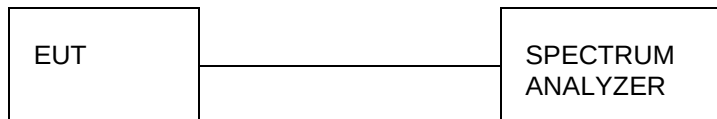
##### Limit

N/A

##### Test Procedure

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

##### Test Configuration

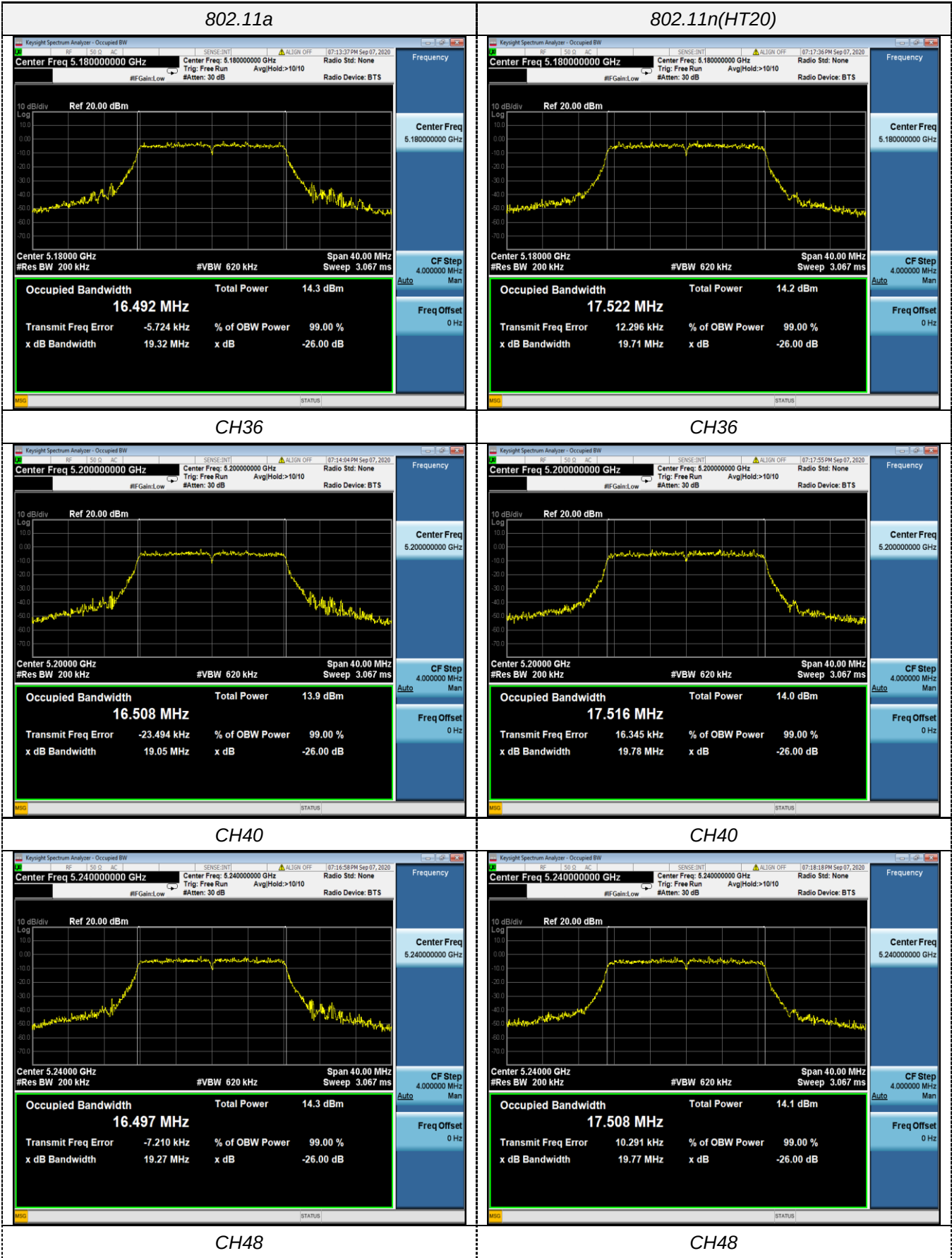


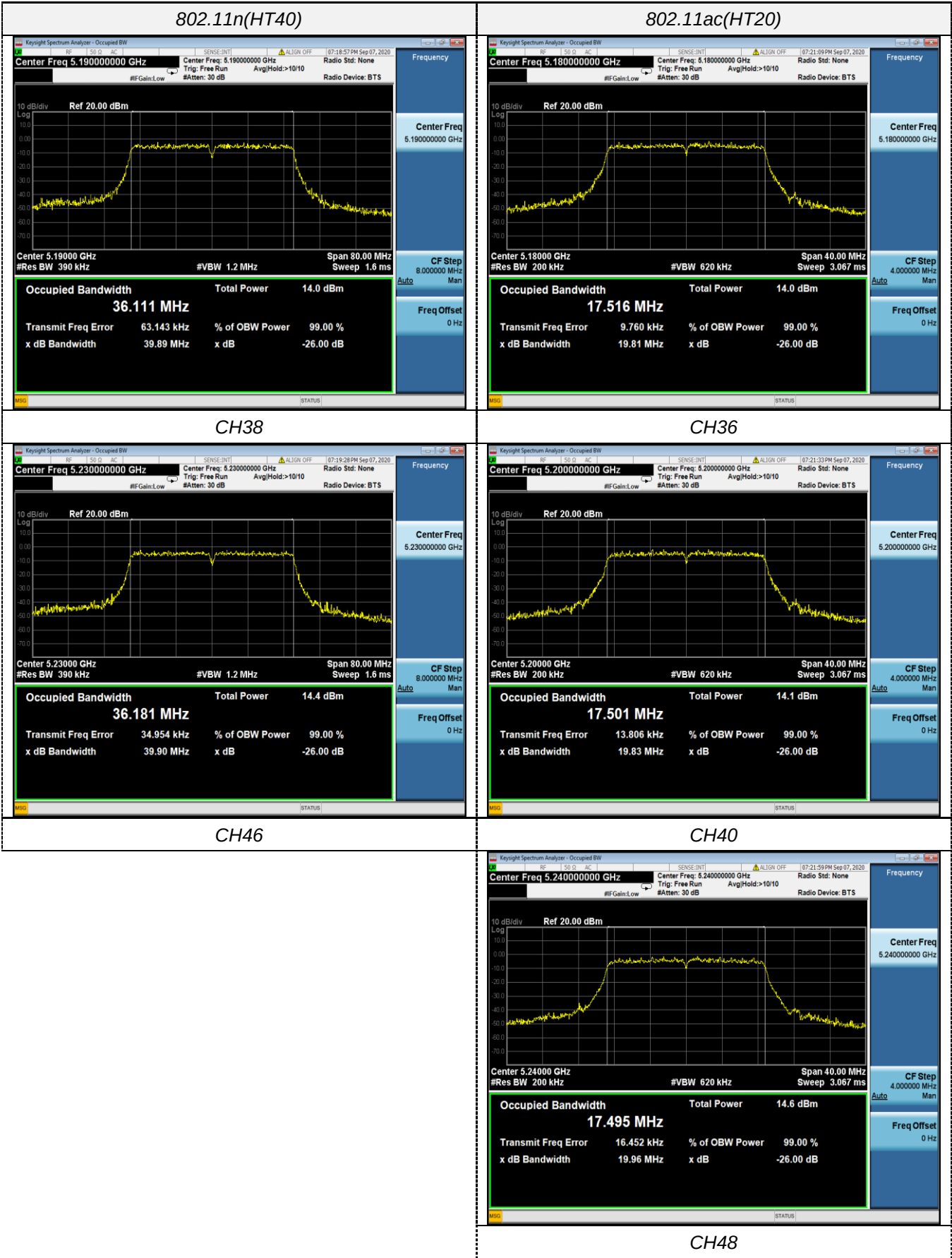
##### Test Results

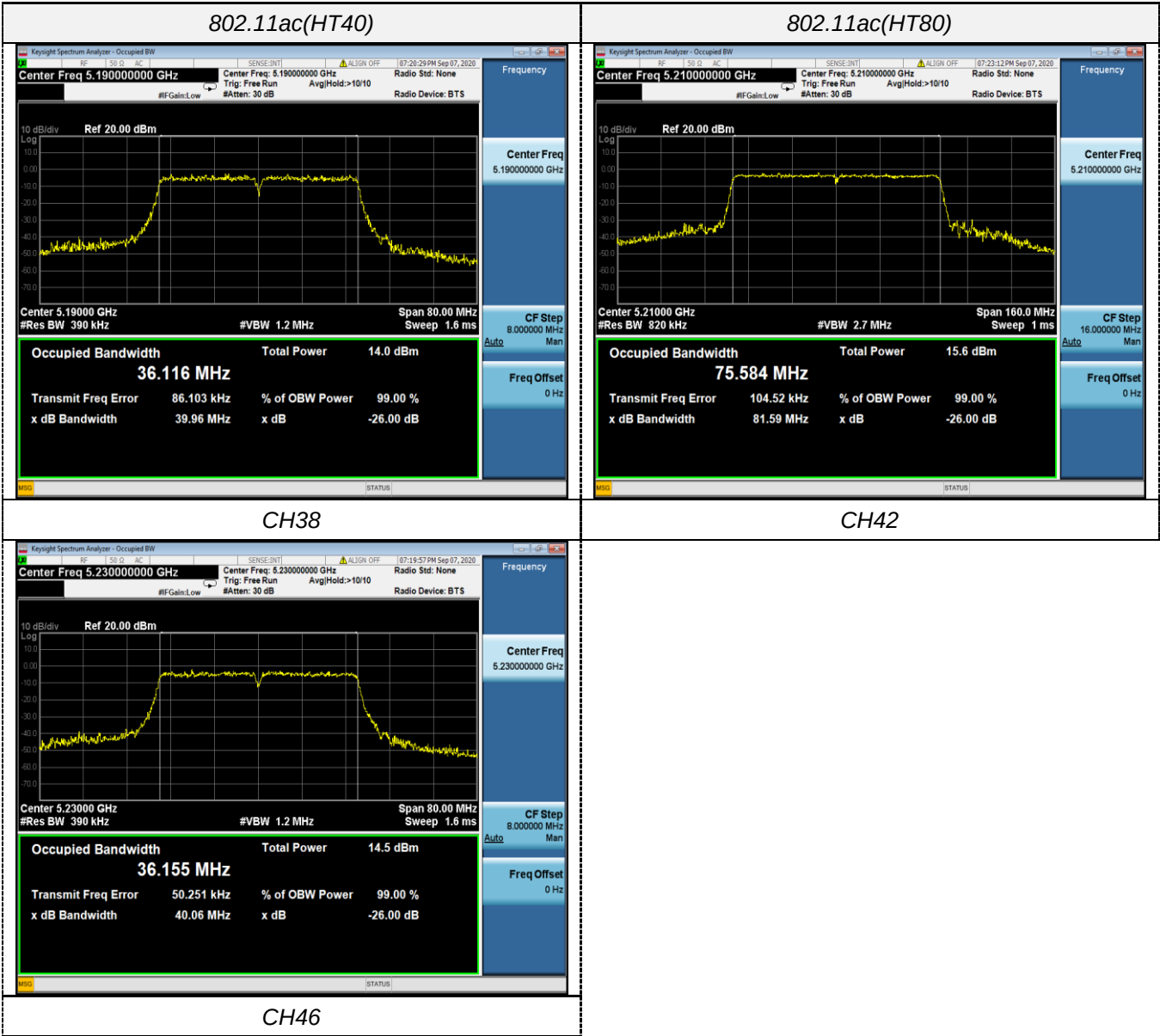
|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

| Type           | Bands   | Channel | 26dB Bandwidth (MHz) | Limit (MHz) | Result |
|----------------|---------|---------|----------------------|-------------|--------|
| 802.11a        | U-NII 1 | 36      | 19.32                | N/A         | Pass   |
|                |         | 40      | 19.05                |             |        |
|                |         | 48      | 19.27                |             |        |
| 802.11n(HT20)  | U-NII 1 | 36      | 19.71                |             |        |
|                |         | 40      | 19.78                |             |        |
|                |         | 48      | 19.77                |             |        |
| 802.11n(HT40)  | U-NII 1 | 38      | 39.89                |             |        |
|                |         | 46      | 39.90                |             |        |
| 802.11ac(HT20) | U-NII 1 | 36      | 19.81                |             |        |
|                |         | 40      | 19.83                |             |        |
|                |         | 48      | 19.96                |             |        |
| 802.11ac(HT40) | U-NII 1 | 38      | 39.96                |             |        |
|                |         | 46      | 40.06                |             |        |
| 802.11ac(HT80) | U-NII 1 | 42      | 81.59                |             |        |

Test plot as follows:







#### 4.6 Minimum Emission Bandwidth (6dBm Bandwidth)

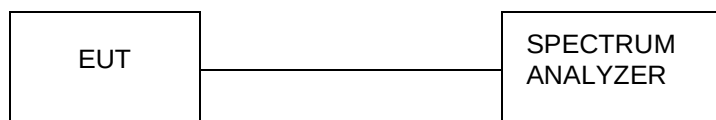
##### Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

##### Test Procedure

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max hold.
5. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

##### Test Configuration



##### Test Results

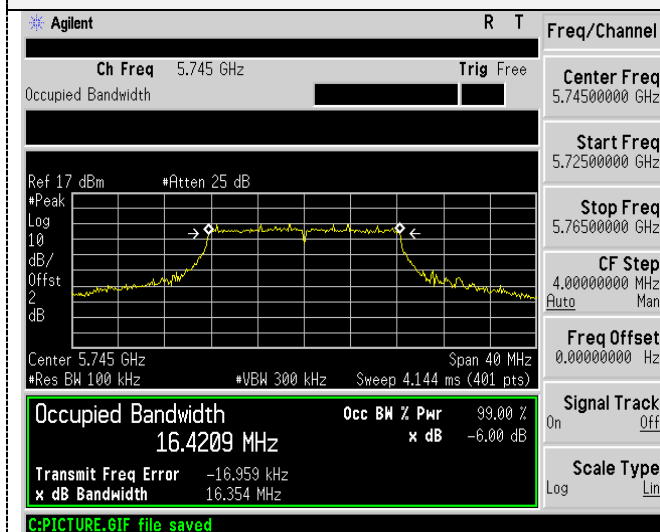
|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

| Type           | Bands   | Channel | 6dB Bandwidth (MHz) | Limit (KHz) | Result |
|----------------|---------|---------|---------------------|-------------|--------|
| 802.11a        | U-NII 3 | 149     | 16.354              | ≥500KHz     | Pass   |
|                |         | 157     | 16.165              |             |        |
|                |         | 165     | 16.406              |             |        |
| 802.11n(HT20)  | U-NII 3 | 149     | 16.874              |             |        |
|                |         | 157     | 17.064              |             |        |
|                |         | 165     | 16.682              |             |        |
| 802.11n(HT40)  | U-NII 3 | 151     | 36.162              |             |        |
|                |         | 159     | 35.992              |             |        |
| 802.11ac(HT20) | U-NII 3 | 149     | 16.954              |             |        |
|                |         | 157     | 16.990              |             |        |
|                |         | 165     | 17.071              |             |        |
| 802.11ac(HT40) | U-NII 3 | 151     | 35.589              |             |        |
|                |         | 159     | 36.165              |             |        |
| 802.11ac(HT80) | U-NII 3 | 155     | 75.849              |             |        |

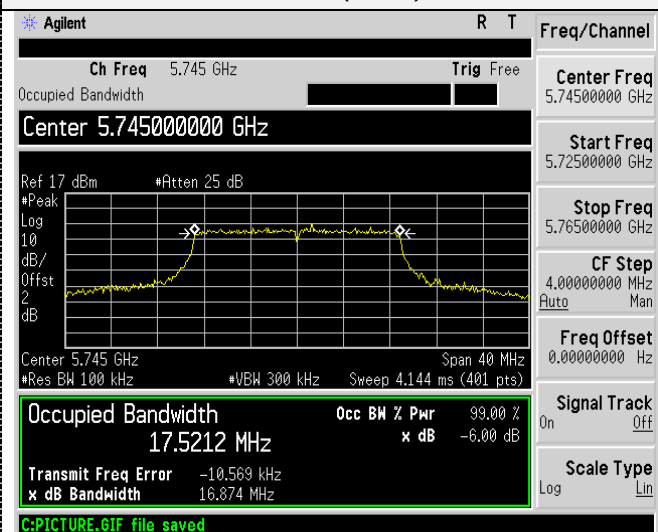
Test plot as follows:



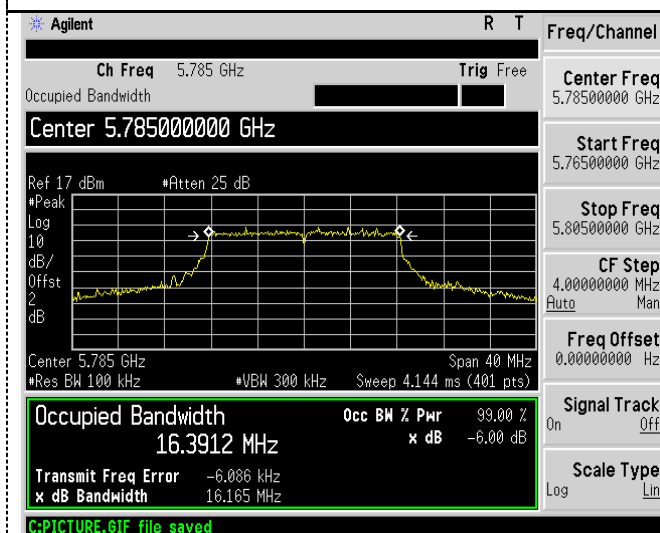
## 802.11a



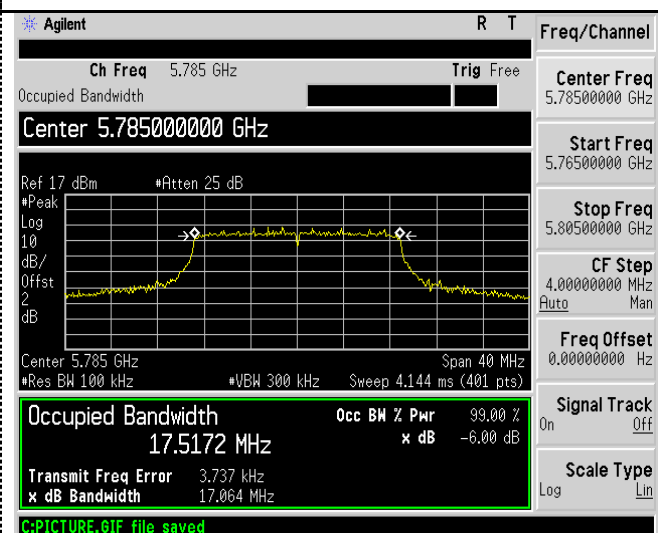
## 802.11n(HT20)



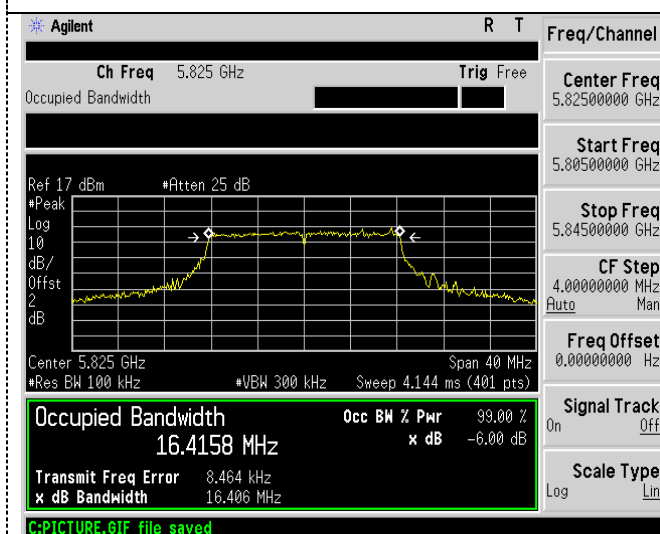
## CH149



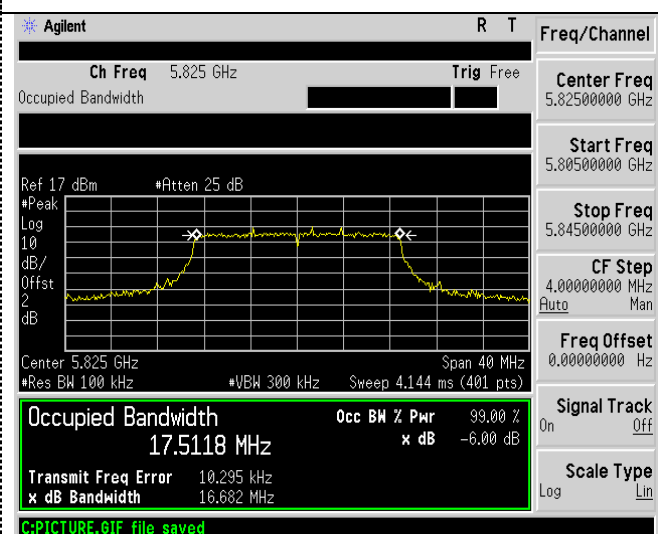
## CH149



## CH157



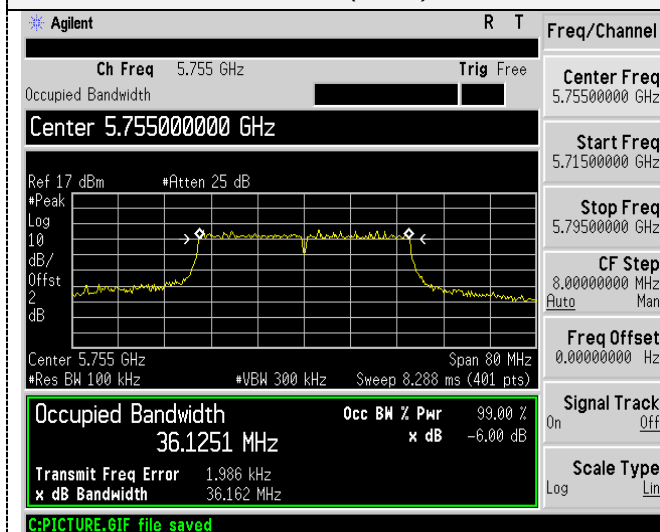
## CH157



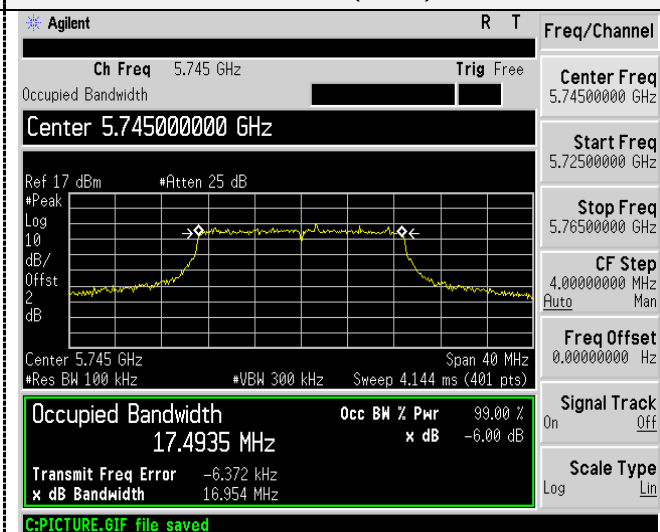
## CH165

## CH165

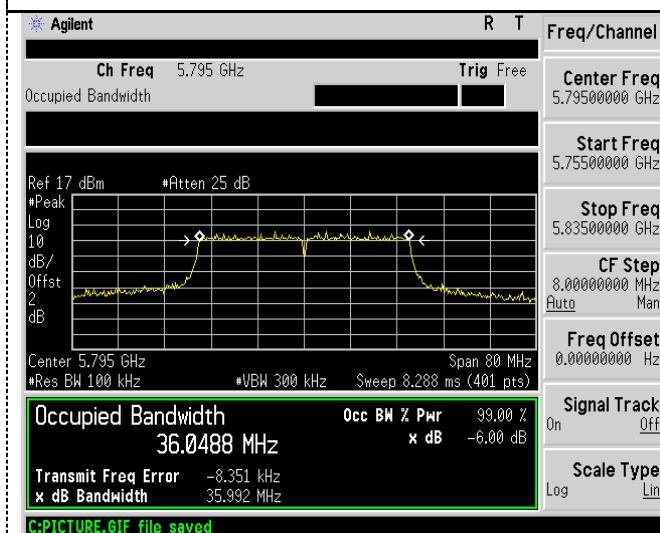
## 802.11n(HT40)



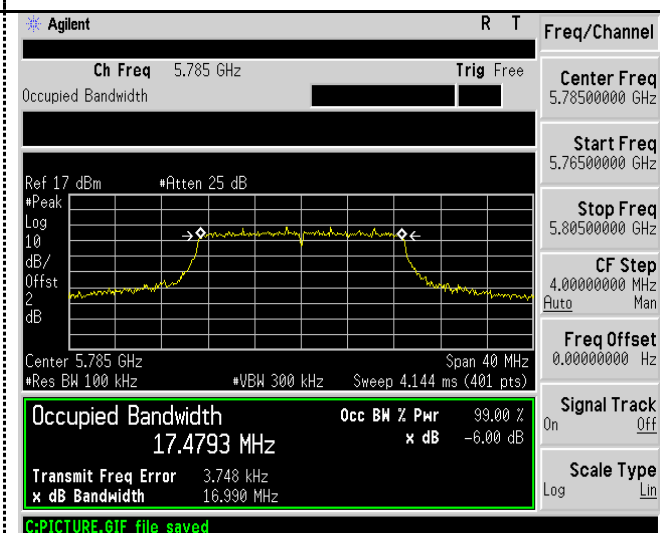
## 802.11ac(HT20)



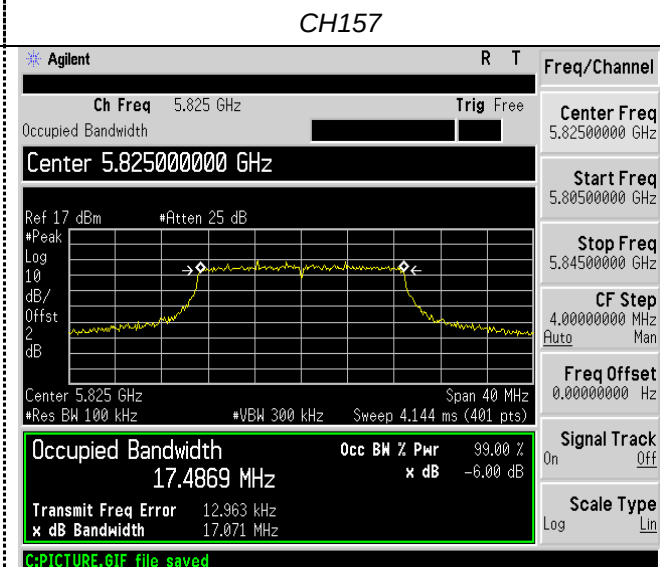
## CH151



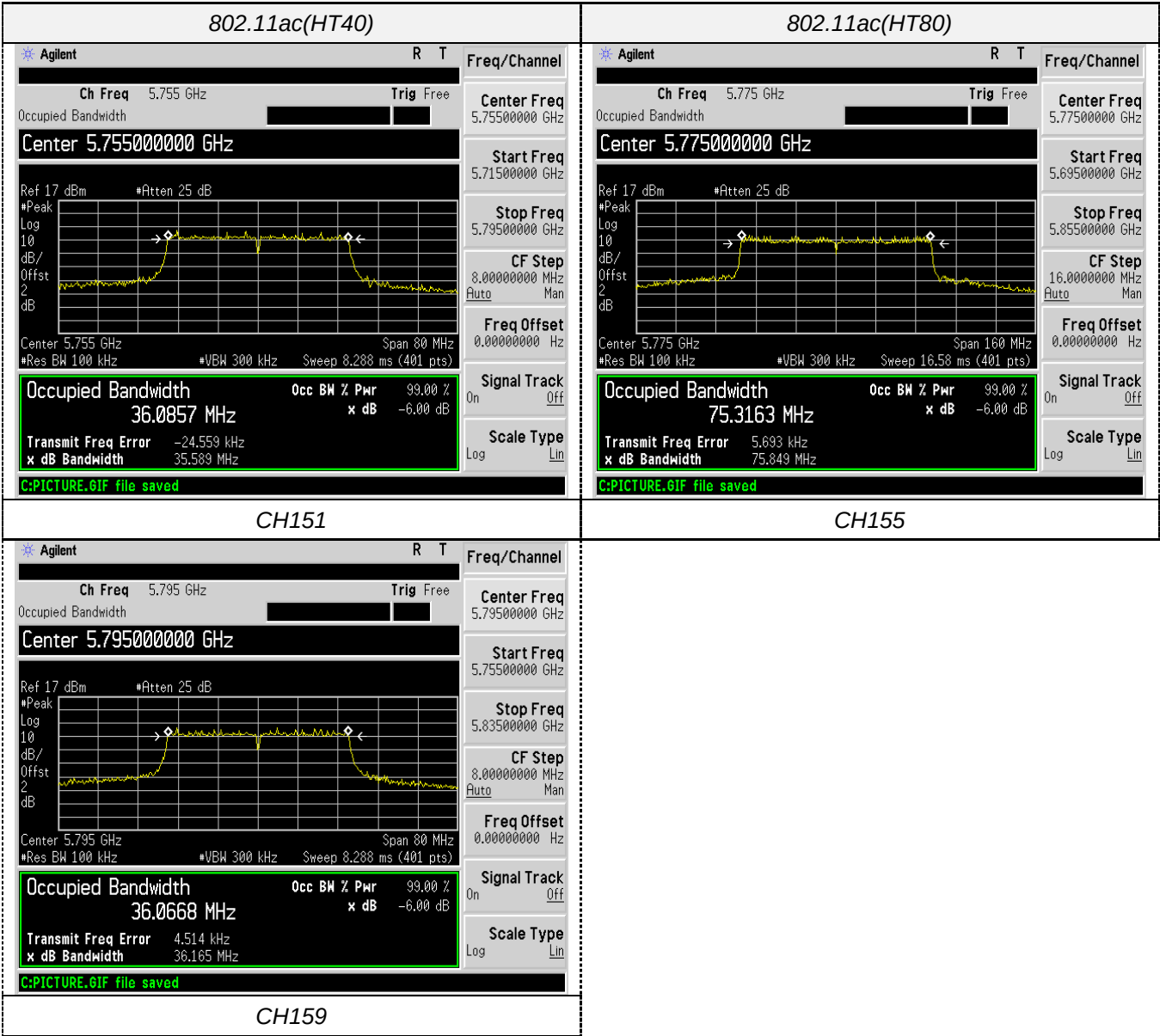
## CH149



## CH159



## CH165

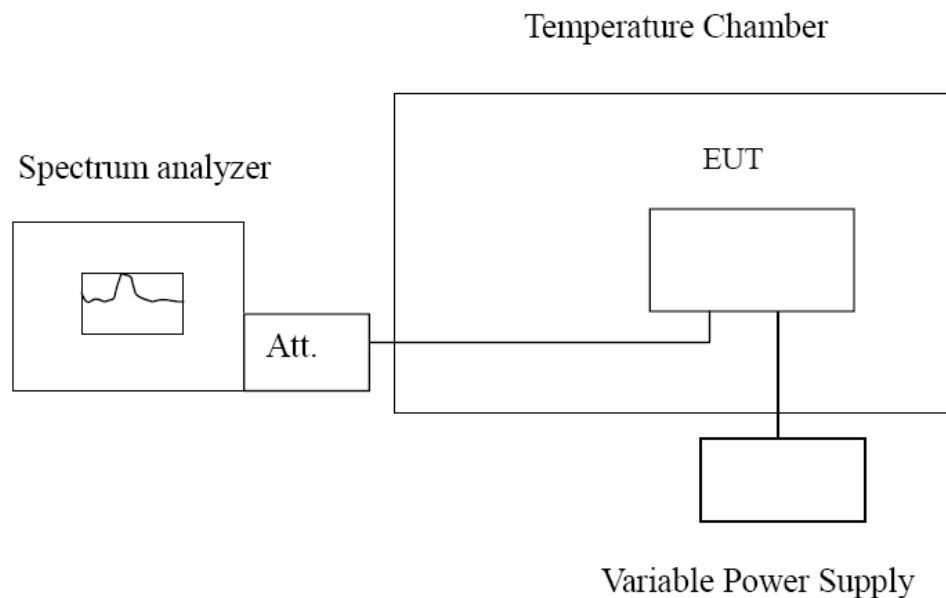


## 4.7 Frequency Stability

### LIMIT

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

### TEST CONFIGURATION



### TEST PROCEDURE

#### **Frequency Stability under Temperature Variations:**

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of +50°C reached.

#### **Frequency Stability under Voltage Variations:**

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation ( $\pm 15\%$ ) and endpoint, record the maximum frequency change.

### TEST RESULTS

|               |          |                |         |
|---------------|----------|----------------|---------|
| Temperature   | 22.8°C   | Humidity       | 56%     |
| Test Engineer | Moon Tan | Configurations | WLAN 5G |

Record worst case as below:

| Reference Frequency: 802.11ac channel=36 frequency=5180MHz |                  |                 |       |                              |        |
|------------------------------------------------------------|------------------|-----------------|-------|------------------------------|--------|
| Voltage ( V )                                              | Temperature (°C) | Frequency error |       | Limit (ppm)                  | Result |
|                                                            |                  | Hz              | ppm   |                              |        |
| 120                                                        | -30              | 59.28           | 0.011 | Within the band of operation | Pass   |
|                                                            | -20              | 83.29           | 0.016 |                              |        |
|                                                            | -10              | 39.78           | 0.008 |                              |        |
|                                                            | 0                | 34.65           | 0.007 |                              |        |
|                                                            | 10               | 65.49           | 0.013 |                              |        |
|                                                            | 20               | 70.66           | 0.014 |                              |        |
|                                                            | 30               | 46.92           | 0.009 |                              |        |
|                                                            | 40               | 69.78           | 0.013 |                              |        |
|                                                            | 50               | 81.29           | 0.016 |                              |        |
| 138                                                        | 25               | 88.66           | 0.017 | Within the band of operation | Pass   |
| 102                                                        | 25               | 79.08           | 0.015 |                              |        |

| Reference Frequency: 802.11ac channel=149 frequency=5745MHz |                  |                 |       |                              |        |
|-------------------------------------------------------------|------------------|-----------------|-------|------------------------------|--------|
| Voltage ( V )                                               | Temperature (°C) | Frequency error |       | Limit (ppm)                  | Result |
|                                                             |                  | Hz              | ppm   |                              |        |
| 120                                                         | -30              | 88.50           | 0.015 | Within the band of operation | Pass   |
|                                                             | -20              | 59.58           | 0.010 |                              |        |
|                                                             | -10              | 61.42           | 0.011 |                              |        |
|                                                             | 0                | 44.51           | 0.008 |                              |        |
|                                                             | 10               | 94.57           | 0.016 |                              |        |
|                                                             | 20               | 88.30           | 0.015 |                              |        |
|                                                             | 30               | 96.48           | 0.017 |                              |        |
|                                                             | 40               | 40.78           | 0.007 |                              |        |
|                                                             | 50               | 59.64           | 0.010 |                              |        |
| 138                                                         | 25               | 66.21           | 0.012 | Within the band of operation | Pass   |
| 102                                                         | 25               | 37.31           | 0.006 |                              |        |

## 5 Test Setup Photos of the EUT





## 6 Photos of the EUT

### External photos

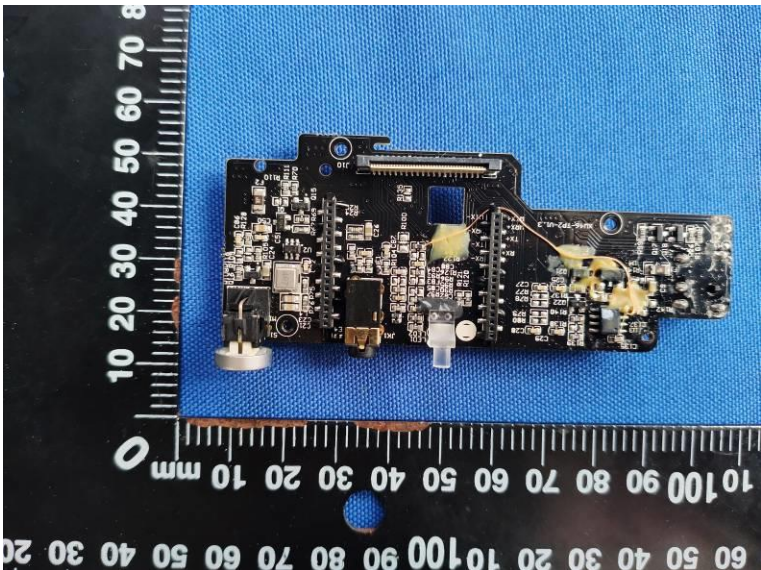
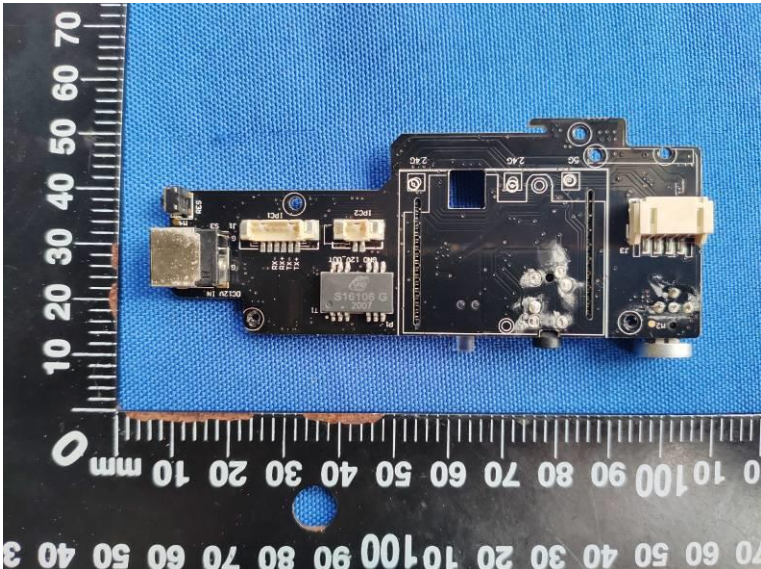
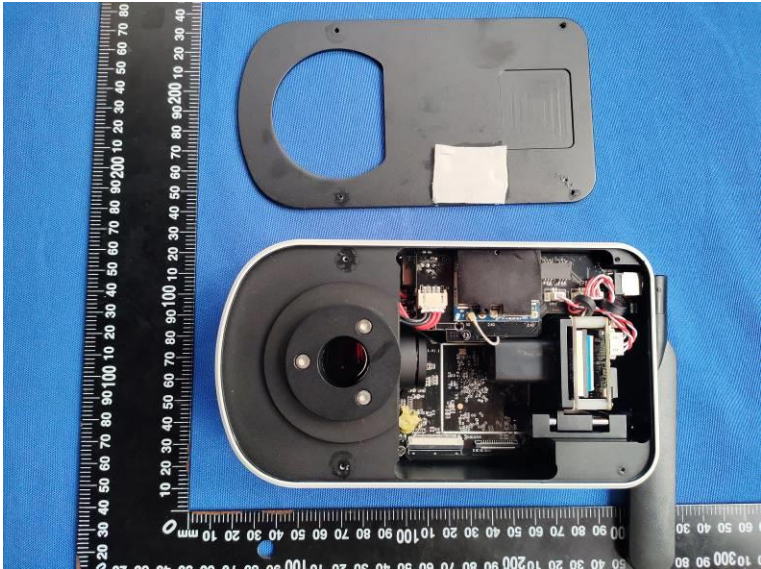




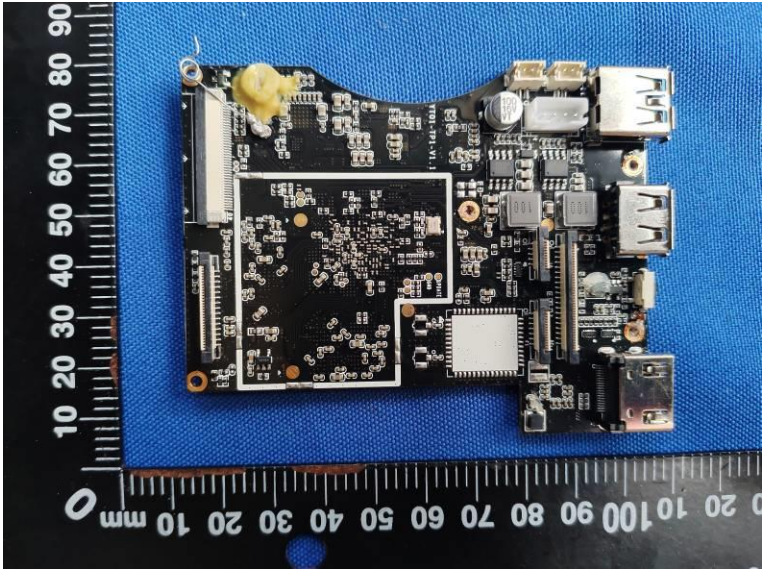
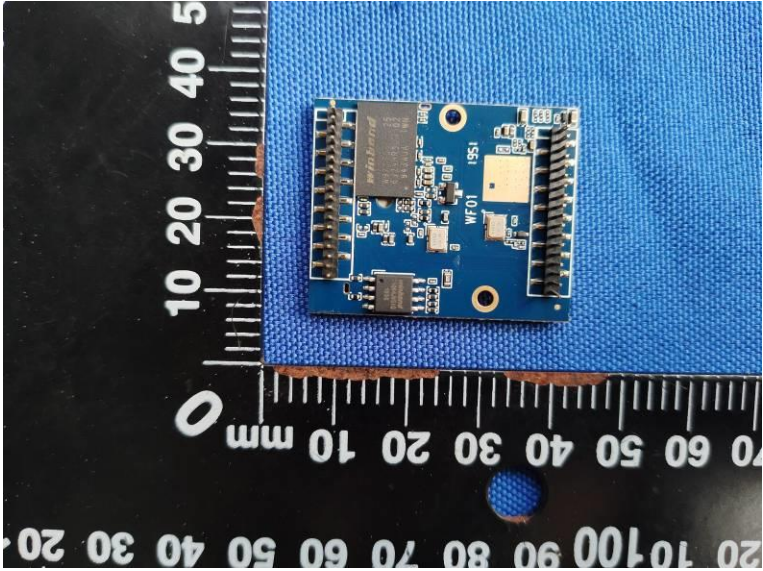
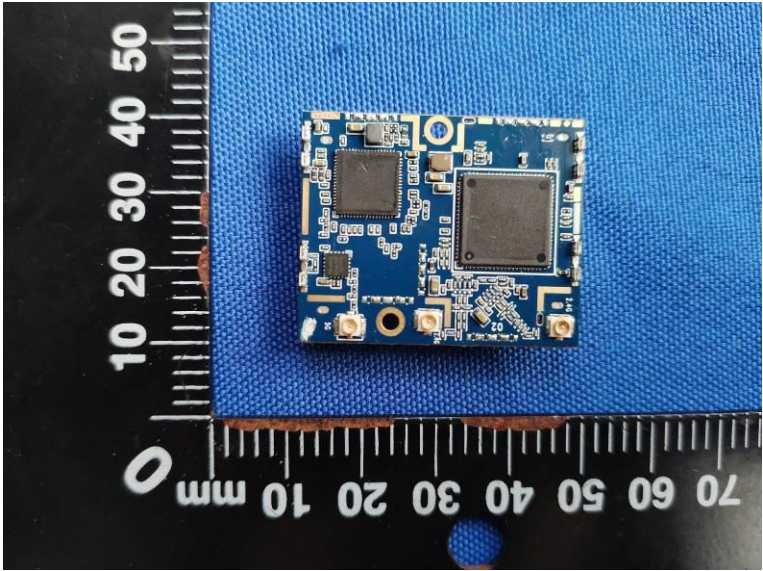




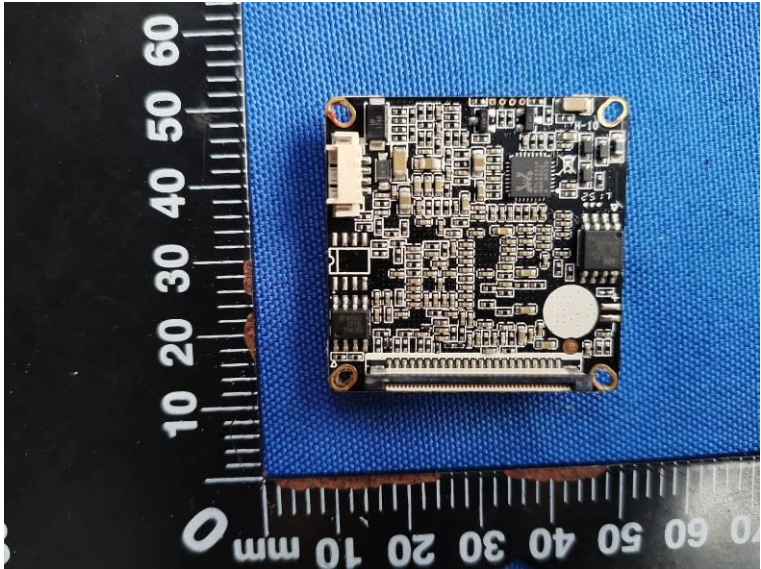
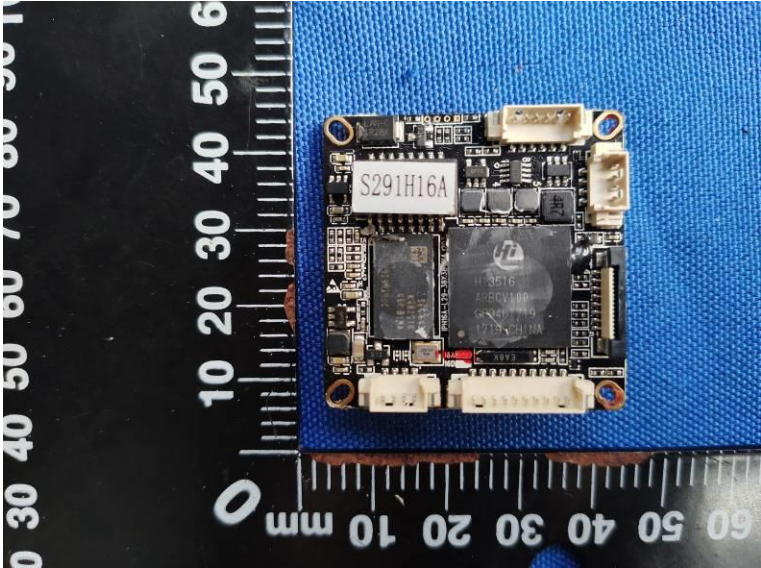
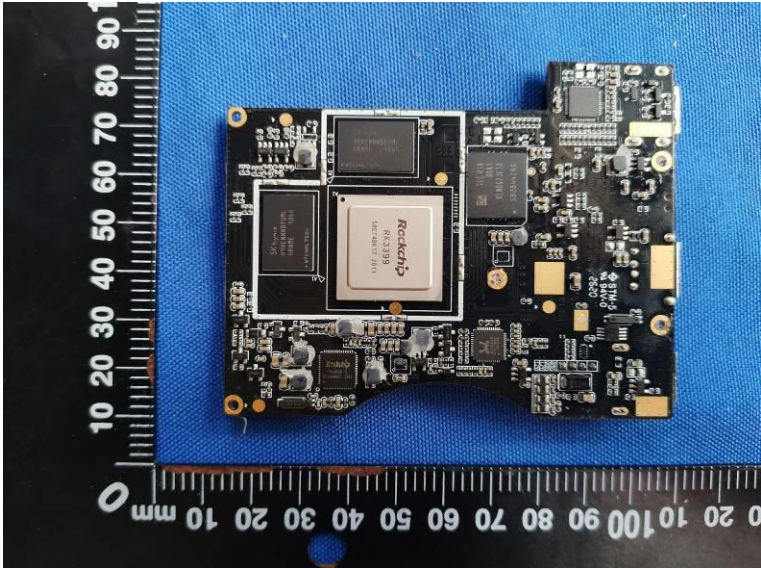
Internal photos

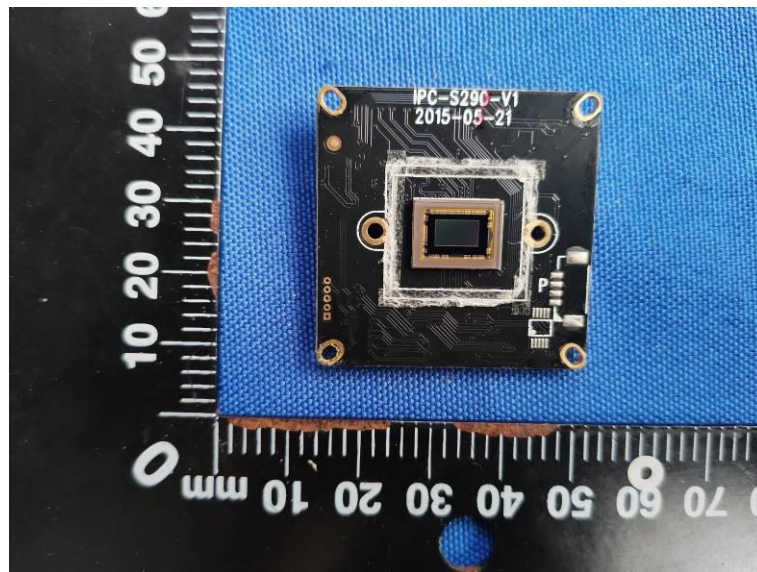
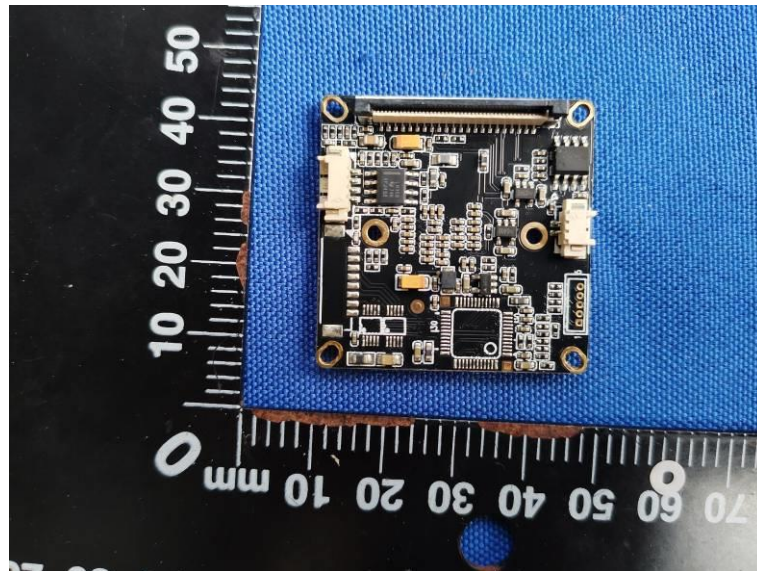












\*\*\*\*\* End of Report \*\*\*\*\*