

**FCC PART 15 SUBPART C TEST REPORT****FCC PART 15 SUBPART E 15.407****Report Reference No..... : BSL23082101-P01R03****FCC ID..... : UP3-PCTOUCH**Compiled by  
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Date of issue.....: September 21, 2023

**Testing Laboratory Name..... : BSL Testing Co., Ltd.**Address.....: 1/F, Building B, Xinshidai GR Park, Shiyan Street, Bao'an District,  
Shenzhen, Guangdong, 518052, People' s Republic of China**Applicant's name..... : Lathem Time Corporation**

Address.....: 210 The Bluffs, Suite 107 SW Austell, GA 30168 United States

**Test specification..... :**Standard.....: **FCC CFR Title 47 Part 15 Subpart C Section 15.407**  
**ANSI C63.10:2013**  
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**Test item description..... : Time Clock**

Trade Mark.....: Lathem

Manufacturer.....: SHENZHEN HEROFUN BIO-TECH CO., LTD

Model/Type reference.....: PCTOUCH

Listed Models .....: N/A

Modulation Type.....: OFDM

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

Rating.....: DC 12V

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

## TEST REPORT

**Equipment under Test** : **Time Clock**

**Model /Type** : **PCTOUCH**

**Series Model No.** : **N/A**

**Applicant** : **Lathem Time Corporation**

**Address** : **210 The Bluffs, Suite 107 SW Austell, GA 30168 United States**

**Manufacturer** : **SHENZHEN HEROFUN BIO-TECH CO., LTD**

**Address** : **West 401, Building A2, TianRui Industrial Park, No. 35 FuYuan 1st Road, XinHe Community, FuHai Street, BaoAn District, Shenzhen, 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:

[CC 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 v02r01

## 2 SUMMARY

### 2.1 General Remarks

|                                |   |                    |
|--------------------------------|---|--------------------|
| Date of receipt of test sample | : | August 21, 2023    |
| Testing commenced on           | : | August 21, 2023    |
| Testing concluded on           | : | September 21, 2023 |

### 2.2 Product Description

|                       |                                                                                                                                                                              |                                    |                    |               |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------------------|---------------|
| Product Name:         | Time Clock                                                                                                                                                                   |                                    |                    |               |
| Model/Type reference: | PCTOUCH                                                                                                                                                                      |                                    |                    |               |
| Power supply:         | DC 12V                                                                                                                                                                       |                                    |                    |               |
| Adapter information   | Model: FX18U-120125J<br>Input: AC 100-240V 50/60Hz 0.6A<br>Output: DC 12V 1.25A<br>Firmware Version: EPTA5.14.2<br>Manufacture: Huizhou Dongyang Yienbi Electronics Co., Ltd |                                    |                    |               |
| testing sample ID:    | BSL23082101-P01R03-1# (Engineer sample),<br>BSL23082101-P01R03-2# (Normal sample)                                                                                            |                                    |                    |               |
| Hardware version:     | V1.0                                                                                                                                                                         |                                    |                    |               |
| Software version:     | V1.0                                                                                                                                                                         |                                    |                    |               |
| 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           |
| Modulation:           | 5180MHz-5240MHz<br>5745MHz-5825MHz                                                                                                                                           | 5190MHz-5230MHz<br>5755MHz-5795MHz | 5210MHz<br>5775MHz | N/A           |
| Operation frequency:  | OFDM                                                                                                                                                                         | OFDM                               | OFDM               | N/A           |
| Channel number:       | 9                                                                                                                                                                            | 4                                  | 2                  | N/A           |
| Channel separation:   | 20MHz                                                                                                                                                                        | 40MHz                              | 80MHz              | N/A           |
| Antenna type:         | FPC antenna                                                                                                                                                                  |                                    |                    |               |
| Antenna gain:         | 2.52 dBi                                                                                                                                                                     |                                    |                    |               |

### 2.3 Equipment Under Test

#### Power supply system utilised

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

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

This is PCTOUCH Time Clock.

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

## 2.5 EUT operation mode

The Applicant provides communication tools software (AT command) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing.

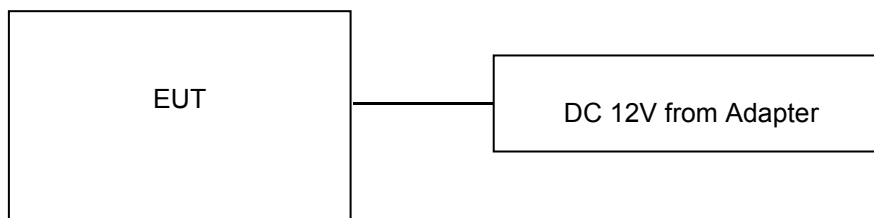
All test performed at the low, middle and high of operational frequency range of each mode.

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 Related Submittal(s) / Grant (s)

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

## 2.8 Modifications

No modifications were implemented to meet testing criteria.

### 3 TEST ENVIRONMENT

#### 3.1 Address of the test laboratory

**BSL Testing Co., Ltd.**

1/F, Building B, Xinshidai GR Park, Shiyan Street, Bao'an District, Shenzhen, Guangdong, 518052, People's Republic of China

#### 3.2 Test Facility

**FCC-Registration No.: 562200 Designation Number: CN1338**

BSL Testing Co.,Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

**Industry Canada Registration Number. Is: 11093A CAB identifier: CN0019**

The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing.

**A2LA-Lab Cert. No.: 4707.01**

BSL Testing Co.,Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

#### 3.3 Environmental conditions

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

Radiated Emission:

|                       |              |
|-----------------------|--------------|
| Temperature:          | 25 ° C       |
|                       |              |
| Humidity:             | 45 %         |
|                       |              |
| Atmospheric pressure: | 950-1050mbar |

Conducted testing:

|                       |              |
|-----------------------|--------------|
| Temperature:          | 25 ° C       |
|                       |              |
| Humidity:             | 44 %         |
|                       |              |
| Atmospheric pressure: | 950-1050mbar |

AC Power Conducted Emission

|                       |              |
|-----------------------|--------------|
| Temperature:          | 24 ° C       |
|                       |              |
| Humidity:             | 44 %         |
|                       |              |
| 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                  |
| 15.407(b)(1)/ 15.407(b)(2)<br>15.407(b)(3)/ 15.407(b)(4) | Band Edge                                  | PASS                  |
| 15.407(b)                                                | Spurious Emissions at Antenna Terminals    | 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                  |
| FCC Part 15.407(c)                                       | Automatically discontinue transmission     | PASS <sup>Note4</sup> |

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.

Note 4: While the EUT is not transmitting any information, the EUT can automatically discontinue transmission and become standby mode for power saving. The EUT can detect the controlling signal of ASK message transmitting from remote device and verify whether it shall resend or discontinue transmission. (Manufacturer declare)

#### 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 TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the BSL Testing 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 BSL Testing Co., Ltd.

| Test                  | Range      | Measurement Uncertainty | Notes |
|-----------------------|------------|-------------------------|-------|
| Radiated Emission     | 30~1000MHz | 4.06 dB                 | (1)   |
| Radiated Emission     | 1~18GHz    | 5.14 dB                 | (1)   |
| Radiated Emission     | 18-40GHz   | 5.38 dB                 | (1)   |
| Conducted Disturbance | 0.15~30MHz | 2.14 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

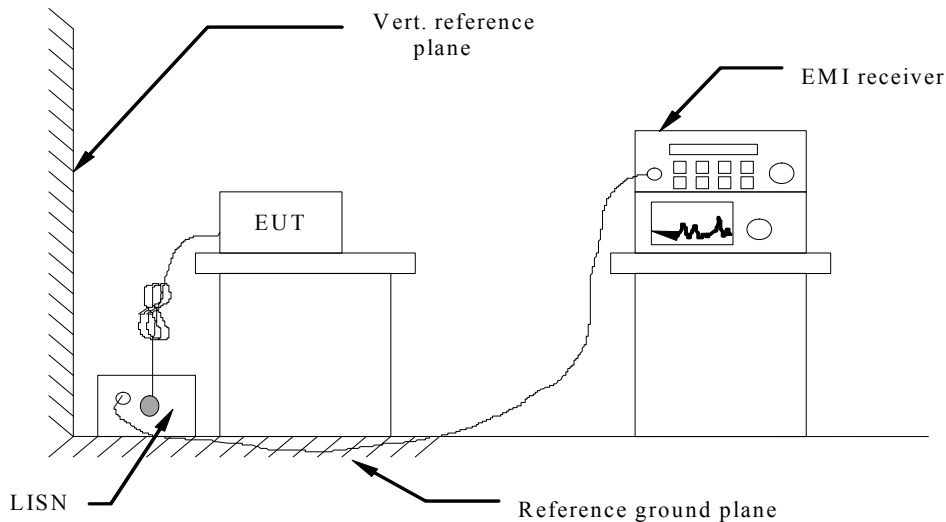
| Instrument Type                 | Manufacturer           | Model         | Serial No.         | Date of Cal. | Due Date   |
|---------------------------------|------------------------|---------------|--------------------|--------------|------------|
| ESPI Test Receiver              | ROHDE&SCHWARZ          | ESPI 3        | 100379             | 2022-10-28   | 2023-10-27 |
| Absorbing Clamp                 | ROHDE&SCHWARZ          | MDS-21        | 100126             | 2022-10-28   | 2023-10-27 |
| Electrostatic analog generator  | LIONCEL                | ESD-203B      | 0210502            | 2022-10-28   | 2023-10-27 |
| Signal Generator                | HP                     | 8648A         | 3633A02081         | 2022-10-28   | 2023-10-27 |
| Amplifier                       | A&R                    | 500A100       | 17034              | 2022-10-28   | 2023-10-27 |
| Amplifier                       | A&R                    | 100W/1000M1   | 17028              | 2022-10-28   | 2023-10-27 |
| Isotropic Field Monitor         | A&R                    | FM2000        | 16829              | 2022-10-28   | 2023-10-27 |
| Isotropic Field Probe           | A&R                    | FLW220100     | 16755              | 2022-10-28   | 2023-10-27 |
| Biconic Antenna                 | EMCO                   | EVOD PROTANK8 | 9507-2534          | 2022-10-28   | 2023-10-27 |
| Log-periodic Antenna            | A&R                    | AT1080        | 16812              | 2022-10-28   | 2023-10-27 |
| Injection Clamp                 | EMTEST                 | F-2031-23MM   | 368                | 2022-10-28   | 2023-10-27 |
| Attenuator                      | EMTEST                 | ATT6          | 0010222a           | 2022-10-28   | 2023-10-27 |
| Computer                        | IBM                    | 8434          | 1S8434KCE99BL XLO* | -            | -          |
| Oscillator                      | KENWOOD                | AG-203D       | 3070002            | 2022-10-28   | 2023-10-27 |
| Spectrum Analyzer               | HAMEG                  | HM5012        | -                  | -            | -          |
| Power Supply                    | LW                     | APS1502       | -                  | -            | -          |
| 5K VA AC Power Source           | California Instruments | 5001iX        | 56060              | 2022-10-28   | 2023-10-27 |
| CDN                             | EM TEST                | CDN M2/M3     | -                  | 2022-10-28   | 2023-10-27 |
| Attenuation                     | EM TEST                | ATT6/75       | -                  | 2022-10-28   | 2023-10-27 |
| Resistance                      | EM TEST                | R100          | -                  | 2022-10-28   | 2023-10-27 |
| Electromagnetic Injection Clamp | LITTHI                 | EM101         | 35708              | 2022-10-28   | 2023-10-27 |
| Inductive Components            | EM TEST                | MC2630        | -                  | 2022-10-28   | 2023-10-27 |
| Antenna                         | EM TEST                | MS100         | -                  | 2022-10-28   | 2023-10-27 |
| Signal Generator                | ROHDE&SCHWARZ          | SMT03         | 100029             | 2022-10-28   | 2023-10-27 |
| Power DJ MIXER                  | AR                     | 150W1000      | 300999             | 2022-10-28   | 2023-10-27 |
| Field probe                     | Holaday                | HI-6005       | 105152             | 2022-10-28   | 2023-10-27 |
| Bilog Antenna                   | Chase                  | CBL6111C      | 2576               | 2022-10-28   | 2023-10-27 |
| Loop Antenna                    | EMCO                   | 6502          | 00042960           | 2022-10-28   | 2023-10-27 |
| ESPI Test Receiver              | ROHDE&SCHWARZ          | ESI7          | 838786/013         | 2022-10-28   | 2023-10-27 |
| 3m OATS                         | --                     | --            | N/A                | 2022-10-28   | 2023-10-27 |
| Horn Antenna                    | SCHWARZBECK            | VULB9168      | N/A                | 2022-10-28   | 2023-10-27 |
| Horn Antenna                    | SCHWARZBECK            | BBHA9120D     | N/A                | 2022-10-28   | 2023-10-27 |
| Power meter                     | Anritsu                | ML2487A       | 6K00003613         | 2022-10-28   | 2023-10-27 |
| Power sensor                    | Anritsu                | MA2491A       | 32263              | 2022-10-28   | 2023-10-27 |
| Bilog Antenna                   | Schwarebeck            | VULB9163      | 9163/340           | 2022-10-28   | 2023-10-27 |
| 9*6*6 Anechoic                  | --                     | --            | N/A                | 2021-08-21   | 2024-8-20  |

|                                 |               |                  |            |            |            |
|---------------------------------|---------------|------------------|------------|------------|------------|
| Test Receiver                   | Rohde&Schwarz | ESC17(9kHz-7GHz) | 100336     | 2022-10-28 | 2023-10-27 |
| Broadband antenna               | Schwarzbeck   | VULB9168         | 01222      | 2022-10-28 | 2023-10-27 |
| Horn antenna                    | Schwarzbeck   | BBHA9120D        | 02476      | 2022-10-28 | 2023-10-27 |
| Preamplifier                    | Schwarzbeck   | BBV9745          | 00250      | 2022-10-28 | 2023-10-27 |
| Preamplifier                    | N/A           | TRLA-01018G440B  | 21081001   | 2022-10-28 | 2023-10-27 |
| 3M method semi anechoic chamber | SKET          | 9m*6m*6m         | 2021082304 | 2021-8-23  | 2024-8-22  |
| Pointer hygrometer              | M&G           | ARC92570         | N/A        | 2022-10-28 | 2023-10-27 |
| Spectrometer                    | ROHDE&SCHWARZ | FSP 9kHz-40GHz   | N/A        | 2022-10-28 | 2023-10-27 |
| Synthesizer                     | ROHDE&SCHWARZ | CMW500           | N/A        | 2022-10-28 | 2023-10-27 |
| LISN                            | R&S           | ENV216           | 308        | 2022-10-28 | 2023-10-27 |
| LISN                            | R&S           | ENV216           | 314        | 2022-10-28 | 2023-10-27 |

## 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 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.

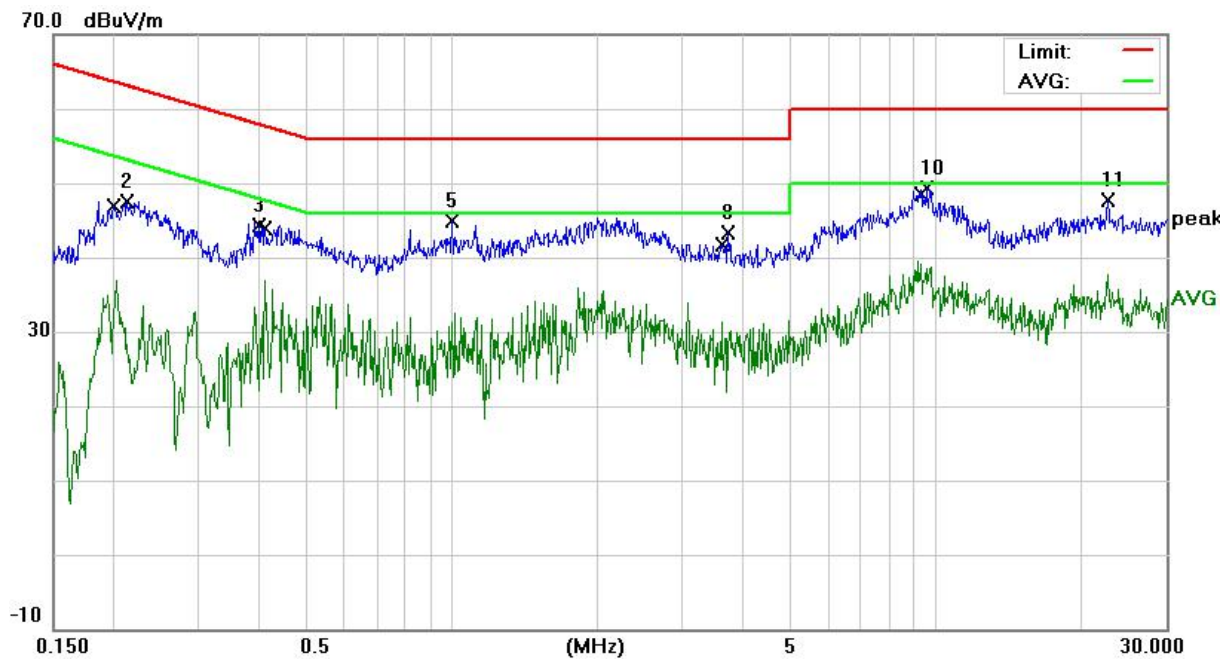
#### TEST RESULTS

Power supply:

DC 12V by adapter  
AC120V/60Hz

Polarization

L



| No. | Mk. | Freq.   | Reading Level | Correct Factor | Measurement | Limit  | Over   |          |
|-----|-----|---------|---------------|----------------|-------------|--------|--------|----------|
|     |     | MHz     | dBuV/m        | dB             | dBuV/m      | dBuV/m | dB     | Detector |
| 1   |     | 0.2017  | 27.06         | 9.84           | 36.90       | 53.54  | -16.64 | AVG      |
| 2   |     | 0.2127  | 37.66         | 9.84           | 47.50       | 63.10  | -15.60 | peak     |
| 3   |     | 0.3976  | 34.43         | 9.87           | 44.30       | 57.90  | -13.60 | peak     |
| 4   |     | 0.4102  | 27.01         | 9.88           | 36.89       | 47.64  | -10.75 | AVG      |
| 5   |     | 0.9996  | 35.00         | 9.90           | 44.90       | 56.00  | -11.10 | peak     |
| 6   |     | 1.0100  | 22.67         | 9.90           | 32.57       | 46.00  | -13.43 | AVG      |
| 7   |     | 3.6032  | 21.37         | 9.91           | 31.28       | 46.00  | -14.72 | AVG      |
| 8   |     | 3.7197  | 33.39         | 9.91           | 43.30       | 56.00  | -12.70 | peak     |
| 9   | *   | 9.1554  | 29.47         | 9.95           | 39.42       | 50.00  | -10.58 | AVG      |
| 10  |     | 9.5518  | 39.44         | 9.96           | 49.40       | 60.00  | -10.60 | peak     |
| 11  |     | 22.6551 | 46.80         | 1.00           | 47.80       | 60.00  | -12.20 | peak     |
| 12  |     | 22.6551 | 36.64         | 1.00           | 37.64       | 50.00  | -12.36 | AVG      |

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

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

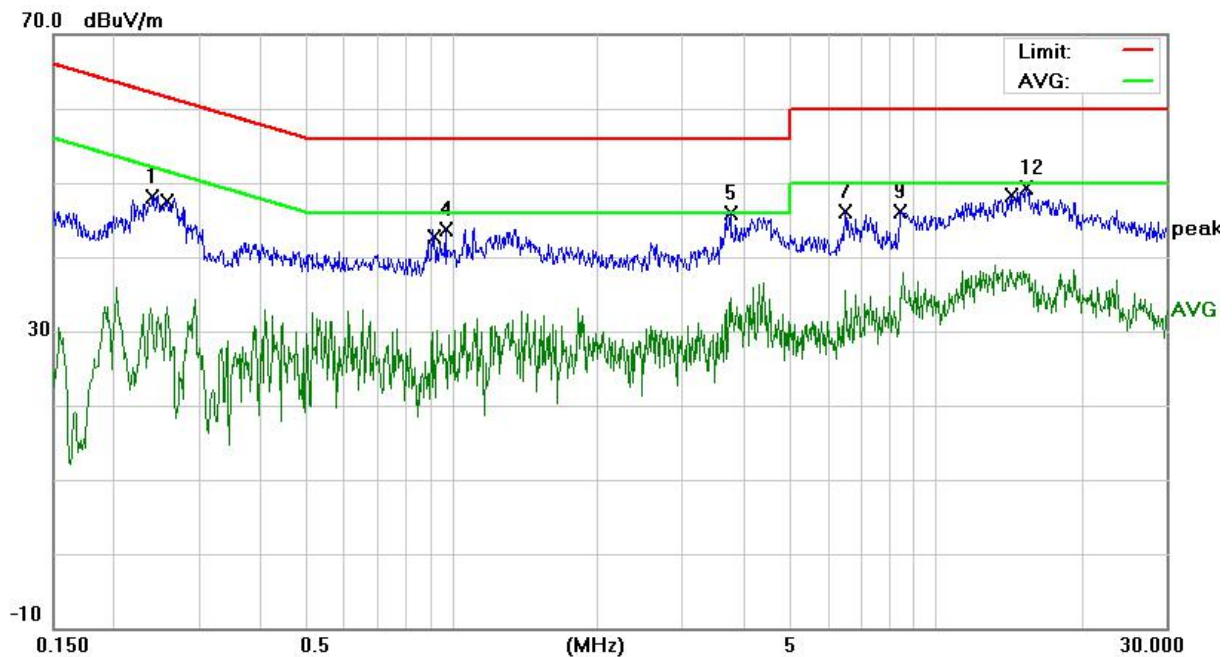
3). Margin (dB) = Limit (dBμV) - Level (dBμV)

Power supply:

DC 12V by adapter  
AC120V/60Hz

Polarization

N



| No. | Mk. | Freq.<br>MHz | Reading<br>Level<br>dBuV/m | Correct<br>Factor<br>dB | Measure-<br>ment<br>dBuV/m | Limit<br>dBuV/m | Over<br>dB | Detector |
|-----|-----|--------------|----------------------------|-------------------------|----------------------------|-----------------|------------|----------|
| 1   |     | 0.2403       | 38.37                      | 9.83                    | 48.20                      | 62.08           | -13.88     | peak     |
| 2   |     | 0.2575       | 23.47                      | 9.83                    | 33.30                      | 51.51           | -18.21     | AVG      |
| 3   |     | 0.9282       | 20.25                      | 9.88                    | 30.13                      | 46.00           | -15.87     | AVG      |
| 4   |     | 0.9684       | 33.81                      | 9.89                    | 43.70                      | 56.00           | -12.30     | peak     |
| 5   | *   | 3.7593       | 36.09                      | 9.91                    | 46.00                      | 56.00           | -10.00     | peak     |
| 6   |     | 3.7593       | 24.63                      | 9.91                    | 34.54                      | 46.00           | -11.46     | AVG      |
| 7   |     | 6.4881       | 36.16                      | 9.94                    | 46.10                      | 60.00           | -13.90     | peak     |
| 8   |     | 6.4881       | 25.65                      | 9.94                    | 35.59                      | 50.00           | -14.41     | AVG      |
| 9   |     | 8.4561       | 36.15                      | 9.95                    | 46.10                      | 60.00           | -13.90     | peak     |
| 10  |     | 8.5462       | 27.91                      | 9.95                    | 37.86                      | 50.00           | -12.14     | AVG      |
| 11  |     | 14.2126      | 37.26                      | 1.00                    | 38.26                      | 50.00           | -11.74     | AVG      |
| 12  |     | 15.3879      | 48.40                      | 1.00                    | 49.40                      | 60.00           | -10.60     | peak     |

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

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

3). Margin(dB) = Limit (dBμV) - Level (dBμV)

## 4.2 Radiated Emission

### 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) <sup>Note1</sup> |
|--------------|-----------------|-----------------------------------------------|
| 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:

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

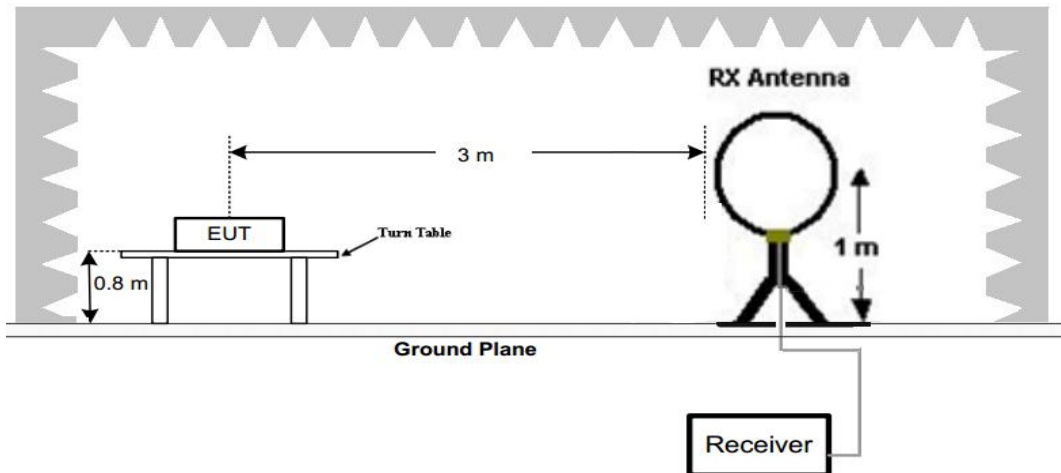
- (5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209
- (6) In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a)

#### Radiated emission limits

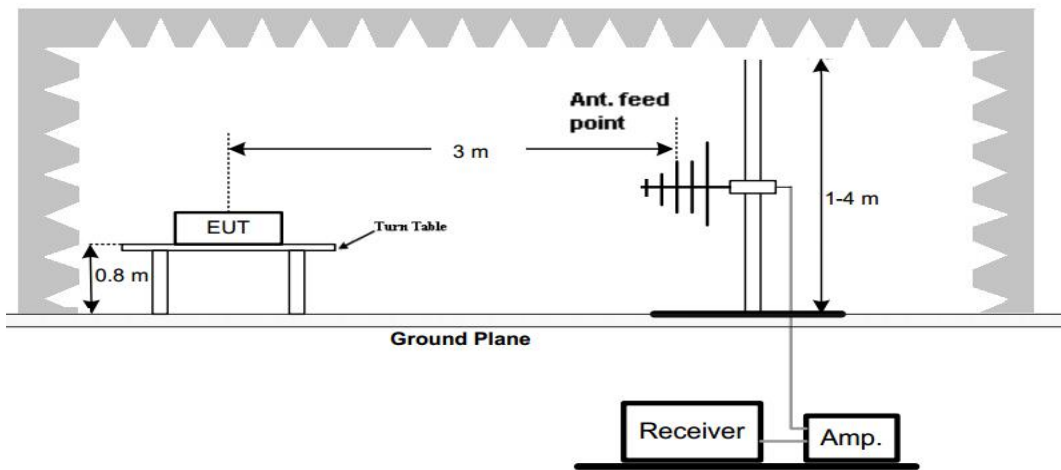
| Frequency (MHz) | Distance (Meters) | Radiated (dBμV/m)                | Radiated (μV/m) |
|-----------------|-------------------|----------------------------------|-----------------|
| 0.009-0.49      | 3                 | 20log(2400/F(KHz))+40log(300/3)  | 2400/F(KHz)     |
| 0.49-1.705      | 3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

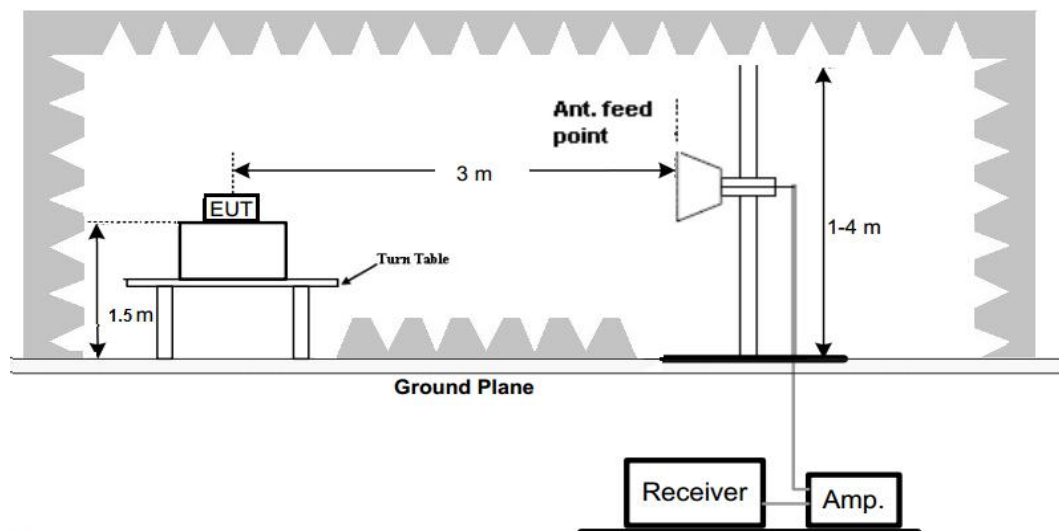
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(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     |

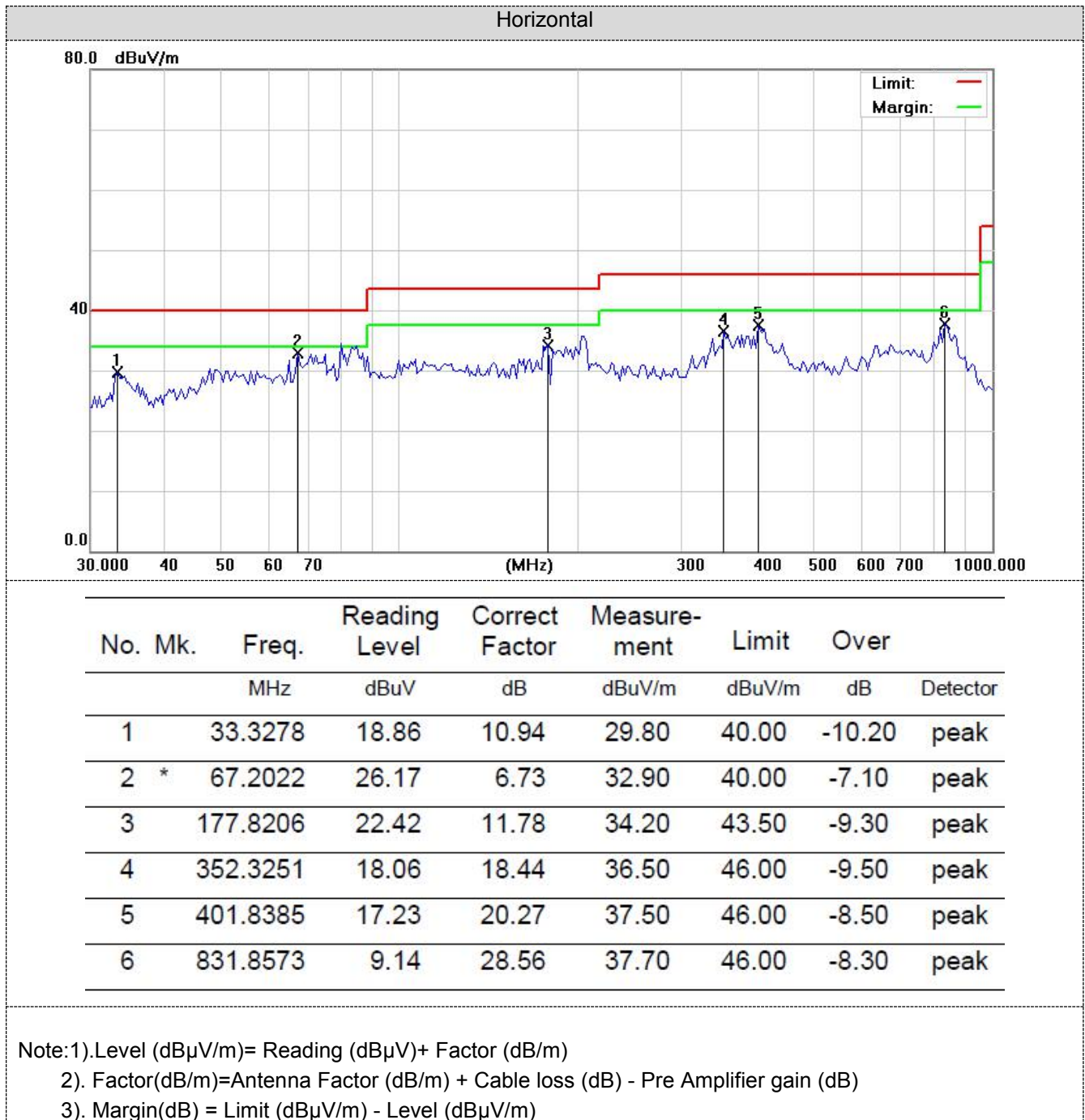
**TEST RESULTS**

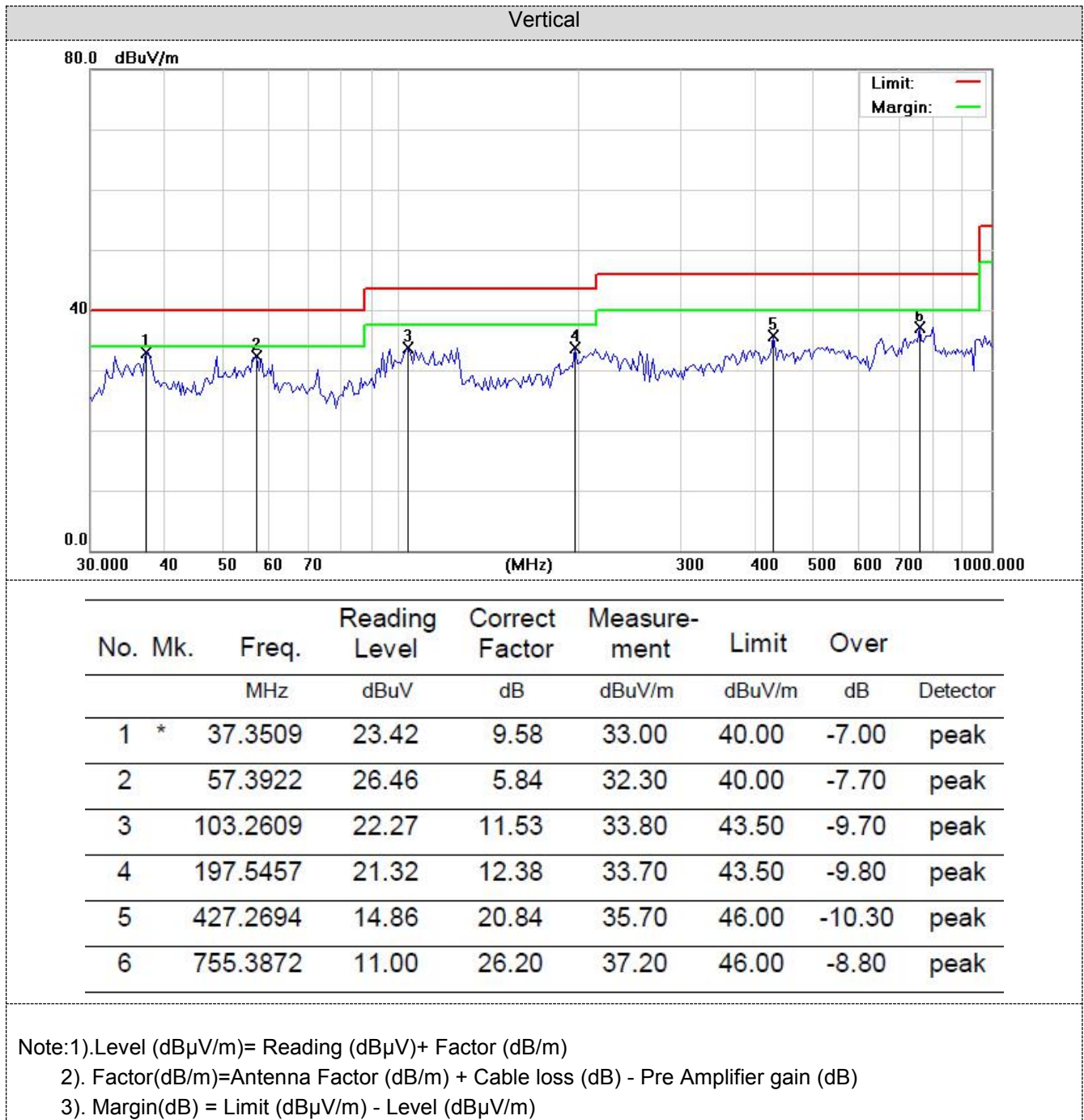
Between 9KHz – 30MHz

The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o) & RSS-Gen 6.13, the test result no need to reported.

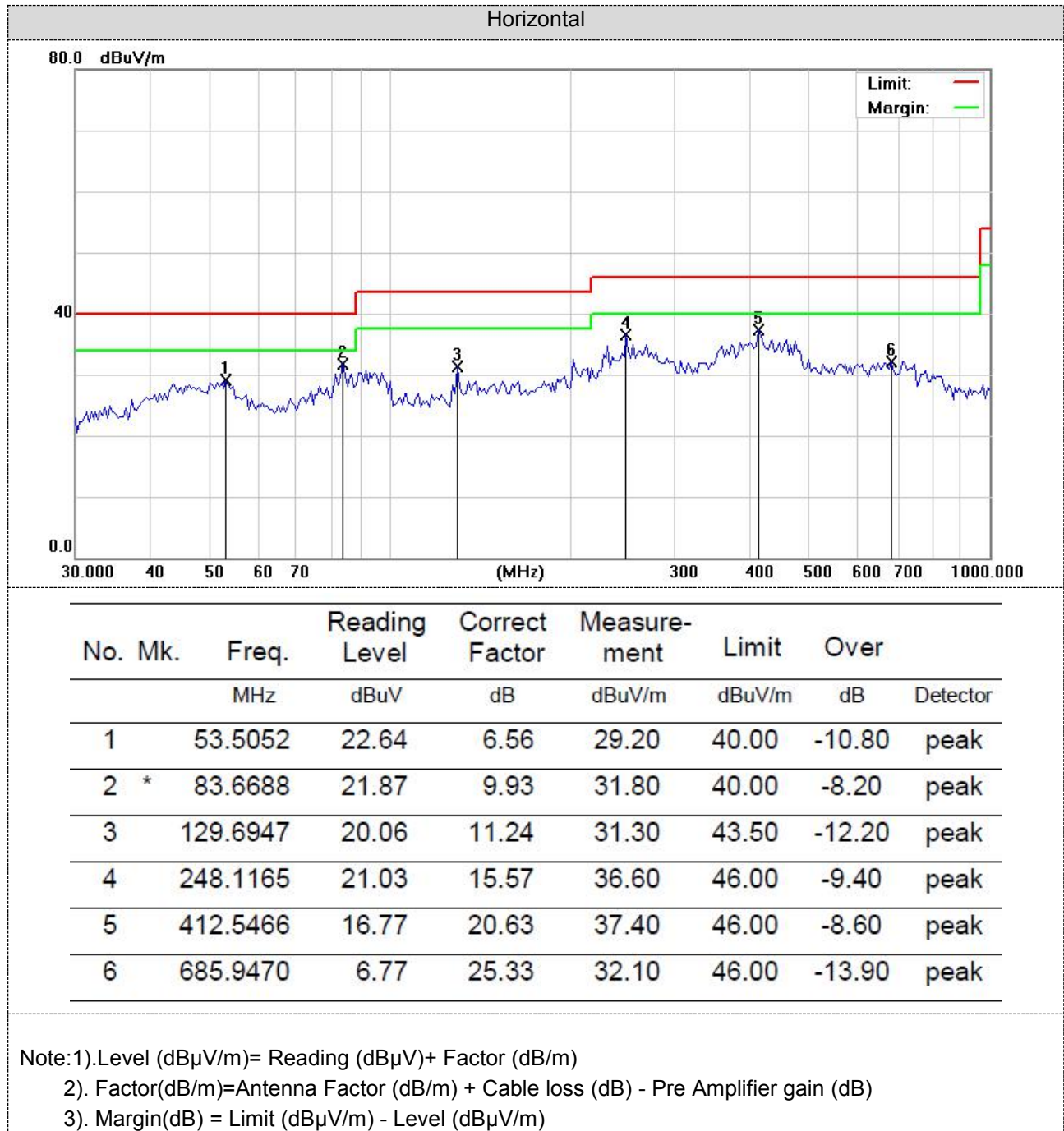
## For 30MHz-1GHz

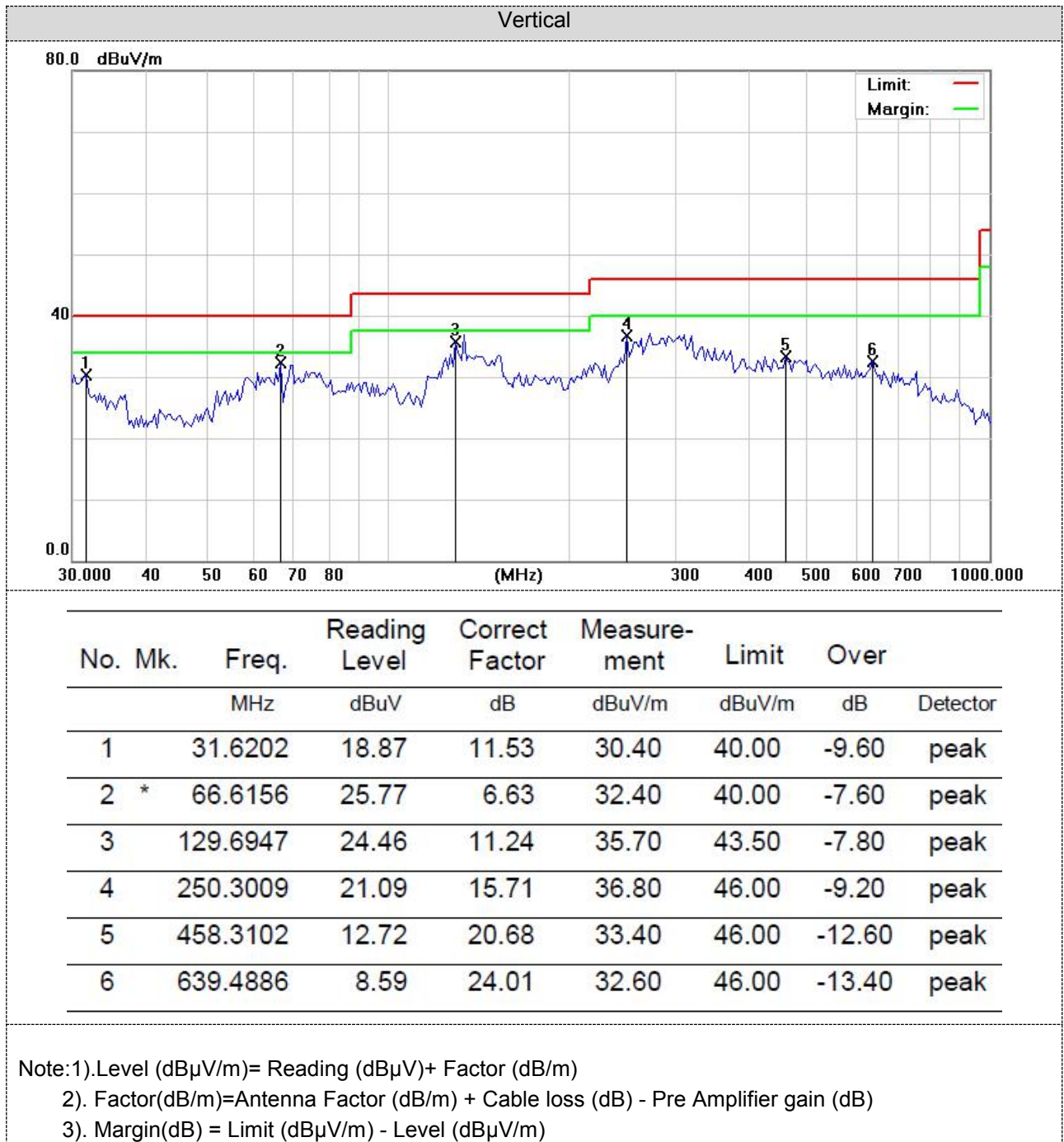
|              |          |                    |        |
|--------------|----------|--------------------|--------|
| Temperature: | 26°C     | Relative Humidity: | 54%    |
| Pressure:    | 101 kPa  | Test Voltage:      | DC 12V |
| Test Mode:   | TX(5.2G) |                    |        |





|              |          |                    |        |
|--------------|----------|--------------------|--------|
| Temperature: | 26℃      | Relative Humidity: | 54%    |
| Pressure:    | 101 kPa  | Test Voltage:      | DC 12V |
| Test Mode:   | TX(5.8G) |                    |        |





**For 1GHz to 40GHz**

Note: All 802.11a/n/ac (HT20), 802.11n/ac (HT40) and 802.11ac (HT80) modes have been tested for above 1GHz test, only the worst case 802.11a(HT20) was recorded.

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

| Tested Channel   | Frequency (MHz) | Emission Limit (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>5158MHz | 5150.00         | 53.23                   | PK            | H       | 68.20          | 14.97       | 50.24            | 32.40                 | 5.11              | 34.52              | 2.99                     |
|                  | 5150.00         | 43.22                   | AV            | H       | 54.00          | 10.78       | 40.23            | 32.40                 | 5.11              | 34.52              | 2.99                     |
|                  | 10360.00        | 42.30                   | PK            | H       | 68.20          | 25.90       | 35.14            | 36.51                 | 5.86              | 35.21              | 7.16                     |
|                  | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 40.00<br>5200MHz | 10400.00        | 42.55                   | PK            | H       | 68.20          | 25.65       | 35.26            | 36.58                 | 5.96              | 35.25              | 7.29                     |
|                  | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 48.00<br>5240MHz | 5350.50         | 44.30                   | PK            | H       | 68.20          | 23.90       | 41.26            | 32.45                 | 5.22              | 34.63              | 3.04                     |
|                  | 10480.00        | 43.56                   | PK            | H       | 68.20          | 24.64       | 36.21            | 36.68                 | 6.21              | 35.54              | 7.35                     |
|                  | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

| Tested Channel   | Frequency (MHz) | Emission Limit (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>5158MHz | 5150.00         | 54.20                   | PK            | V       | 68.20          | 14.00       | 51.21            | 32.40                 | 5.11              | 34.52              | 2.99                     |
|                  | 5150.00         | 43.20                   | AV            | V       | 54.00          | 10.80       | 40.21            | 32.40                 | 5.11              | 34.52              | 2.99                     |
|                  | 10360.00        | 47.40                   | PK            | V       | 68.20          | 20.80       | 40.24            | 36.51                 | 5.86              | 35.21              | 7.16                     |
|                  | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 40.00<br>5200MHz | 10400.00        | 47.50                   | PK            | V       | 68.20          | 20.70       | 40.21            | 36.58                 | 5.96              | 35.25              | 7.29                     |
|                  | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 48.00<br>5240MHz | 5350.50         | 48.25                   | PK            | V       | 68.20          | 19.95       | 45.21            | 32.45                 | 5.22              | 34.63              | 3.04                     |
|                  | 10480.00        | 47.48                   | PK            | V       | 68.20          | 20.72       | 40.13            | 36.68                 | 6.21              | 35.54              | 7.35                     |
|                  | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

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

| Tested Channel    | Frequency (MHz) | Emission Limit (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) |
|-------------------|-----------------|-------------------------|---------------|---------|----------------|-------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| 149.00<br>5745MHz | 5720.00         | 55.04                   | PK            | H       | 68.20          | 13.16       | 50.24            | 34.21                 | 5.11              | 34.52              | 4.80                     |
|                   | 5720.00         | 44.97                   | AV            | H       | 54.00          | 9.03        | 40.17            | 34.21                 | 5.11              | 34.52              | 4.80                     |
|                   | 11490.00        | 49.68                   | PK            | H       | 68.20          | 18.52       | 40.68            | 38.35                 | 5.86              | 35.21              | 9.00                     |
|                   | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 157.00<br>5785MHz | 11570.00        | 49.43                   | PK            | H       | 68.20          | 18.77       | 40.11            | 38.61                 | 5.96              | 35.25              | 9.32                     |
|                   | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 165.00<br>5825MHz | 5855.00         | 49.51                   | PK            | H       | 68.20          | 18.69       | 44.36            | 34.56                 | 5.22              | 34.63              | 5.15                     |
|                   | 11650.00        | 48.14                   | PK            | H       | 68.20          | 20.06       | 38.69            | 38.78                 | 6.21              | 35.54              | 9.45                     |
|                   | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

| Tested Channel    | Frequency (MHz) | Emission Limit (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) |
|-------------------|-----------------|-------------------------|---------------|---------|----------------|-------------|------------------|-----------------------|-------------------|--------------------|--------------------------|
| 149.00<br>5745MHz | 5720.00         | 54.94                   | PK            | V       | 68.20          | 13.26       | 50.14            | 34.21                 | 5.11              | 34.52              | 4.80                     |
|                   | 5720.00         | 45.16                   | AV            | V       | 54.00          | 8.84        | 40.36            | 34.21                 | 5.11              | 34.52              | 4.80                     |
|                   | 11490.00        | 49.12                   | PK            | V       | 68.20          | 19.08       | 40.12            | 38.35                 | 5.86              | 35.21              | 9.00                     |
|                   | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 157.00<br>5785MHz | 11570.00        | 49.84                   | PK            | V       | 68.20          | 18.36       | 40.52            | 38.61                 | 5.96              | 35.25              | 9.32                     |
|                   | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |
| 165.00<br>5825MHz | 5855.00         | 50.87                   | PK            | V       | 68.20          | 17.33       | 45.72            | 34.56                 | 5.22              | 34.63              | 5.15                     |
|                   | 11650.00        | 49.51                   | PK            | V       | 68.20          | 18.69       | 40.06            | 38.78                 | 6.21              | 35.54              | 9.45                     |
|                   | --              | --                      | --            | --      | --             | --          | --               | --                    | --                | --                 | --                       |

**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 Peak Conducted 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****U-NII 1**

| Type           | Channel | Output power (dBm) | Limit (dBm) | Result |
|----------------|---------|--------------------|-------------|--------|
| 802.11a        | 36      | 11.83              | 23.98       | Pass   |
|                | 40      | 12.22              |             |        |
|                | 48      | 12.54              |             |        |
| 802.11n(HT20)  | 36      | 11.97              | 23.98       | Pass   |
|                | 40      | 12.17              |             |        |
|                | 48      | 12.42              |             |        |
| 802.11n(HT40)  | 38      | 12.14              | 23.98       | Pass   |
|                | 46      | 12.41              |             |        |
| 802.11ac(HT20) | 36      | 11.89              | 23.98       | Pass   |
|                | 40      | 12.09              |             |        |
|                | 48      | 12.53              |             |        |
| 802.11ac(HT40) | 38      | 12.06              | 23.98       | Pass   |
|                | 46      | 12.33              |             |        |
| 802.11ac(HT80) | 42      | 11.05              | 23.98       | Pass   |

**U-NII 3**

| Type           | Channel | Output power (dBm) | Limit (dBm) | Result |
|----------------|---------|--------------------|-------------|--------|
| 802.11a        | 149     | 12.56              | 30.00       | Pass   |
|                | 157     | 12.14              |             |        |
|                | 165     | 11.89              |             |        |
| 802.11n(HT20)  | 149     | 12.53              | 30.00       | Pass   |
|                | 157     | 12.08              |             |        |
|                | 165     | 11.86              |             |        |
| 802.11n(HT40)  | 151     | 12.71              | 30.00       | Pass   |
|                | 159     | 12.46              |             |        |
| 802.11ac(HT20) | 149     | 12.50              | 30.00       | Pass   |
|                | 157     | 12.21              |             |        |
|                | 165     | 11.96              |             |        |
| 802.11ac(HT40) | 151     | 12.86              | 30.00       | Pass   |
|                | 159     | 12.30              |             |        |
| 802.11ac(HT80) | 155     | 11.56              | 30.00       | Pass   |

**Note:**

- 1) Measured output power at difference data rate for each mode and recorded worst case for each mode.
- 2) Test results including cable loss.
- 3) Worst case data at 1Mbps at IEEE 802.11b; 6Mbps at IEEE 802.11g; 6.5Mbps at IEEE 802.11n HT20; 13.5Mbps at IEEE 802.11n HT40;

## 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.  
transmission.

### 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



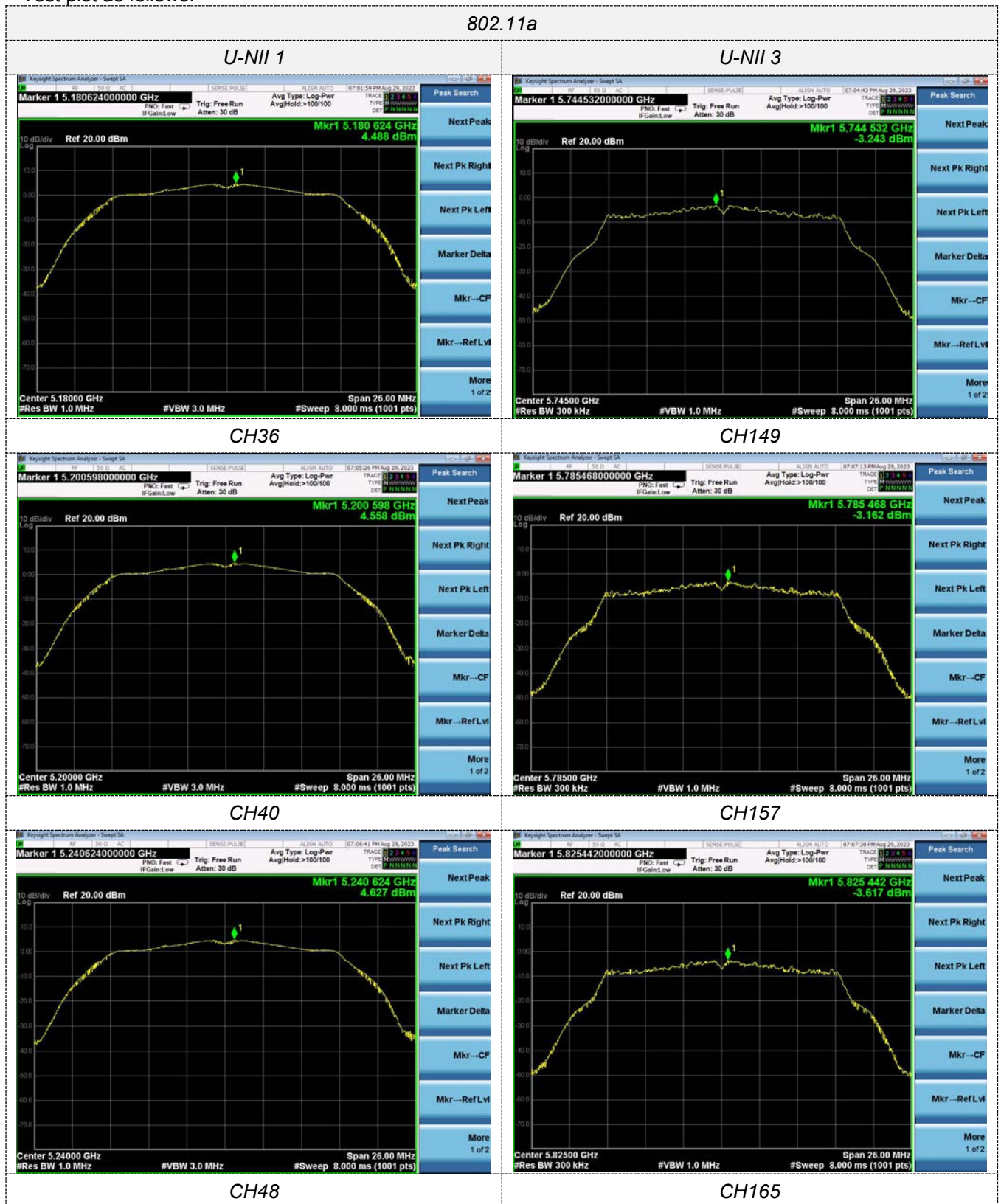
**Test Results**

| Type               | Bands   | Channel | Power Spectral Density<br>(dBm/MHz) | Limit<br>(dBm/MHz) | Result |
|--------------------|---------|---------|-------------------------------------|--------------------|--------|
| 802.11a            | U-NII 1 | 36      | 4.488                               | 11                 | Pass   |
|                    |         | 40      | 4.558                               |                    |        |
|                    |         | 48      | 4.627                               |                    |        |
| 802.11n<br>(HT20)  | U-NII 1 | 36      | 5.246                               |                    |        |
|                    |         | 40      | 5.838                               |                    |        |
|                    |         | 48      | 5.565                               |                    |        |
| 802.11n<br>(HT40)  | U-NII 1 | 38      | 1.371                               |                    |        |
|                    |         | 46      | 0.685                               |                    |        |
| 802.11ac<br>(HT20) | U-NII 1 | 36      | 6.312                               |                    |        |
|                    |         | 40      | 6.013                               |                    |        |
|                    |         | 48      | 6.490                               |                    |        |
| 802.11ac<br>(HT40) | U-NII 1 | 38      | 1.327                               |                    |        |
|                    |         | 46      | 1.261                               |                    |        |
| 802.11ac<br>(HT80) | U-NII 1 | 42      | -1.022                              |                    |        |

| Type               | Bands   | Channel | Power Spectral Density<br>(dBm/300KHz) | Power Spectral Density<br>(dBm/500KHz) | Limit<br>(dBm/500KHz) | Result |
|--------------------|---------|---------|----------------------------------------|----------------------------------------|-----------------------|--------|
| 802.11a            | U-NII 3 | 149     | -3.243                                 | -1.025                                 | 30                    | Pass   |
|                    |         | 157     | -3.162                                 | -0.944                                 |                       |        |
|                    |         | 165     | -3.617                                 | -1.399                                 |                       |        |
| 802.11n<br>(HT20)  | U-NII 3 | 149     | -2.019                                 | 0.200                                  |                       |        |
|                    |         | 157     | -1.719                                 | 0.500                                  |                       |        |
|                    |         | 165     | -2.775                                 | -0.557                                 |                       |        |
| 802.11n<br>(HT40)  | U-NII 3 | 151     | -6.376                                 | -4.158                                 |                       |        |
|                    |         | 159     | -7.052                                 | -4.834                                 |                       |        |
| 802.11ac<br>(HT20) | U-NII 3 | 149     | -1.931                                 | 0.288                                  |                       |        |
|                    |         | 157     | -2.526                                 | -0.308                                 |                       |        |
|                    |         | 165     | -0.628                                 | 1.591                                  |                       |        |
| 802.11ac<br>(HT40) | U-NII 3 | 151     | -6.772                                 | -4.554                                 |                       |        |
|                    |         | 159     | -6.806                                 | -4.588                                 |                       |        |
| 802.11ac<br>(HT80) | U-NII 3 | 155     | -9.230                                 | -7.012                                 |                       |        |

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

Test plot as follows:



## 802.11n(HT20)

U-NII 1



U-NII 3



CH36



CH149



CH40



CH157



CH48



CH165



## 802.11n(HT40)

## U-NII 1



## U-NII 3



## CH38



## CH151



## CH46

## CH159

## 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



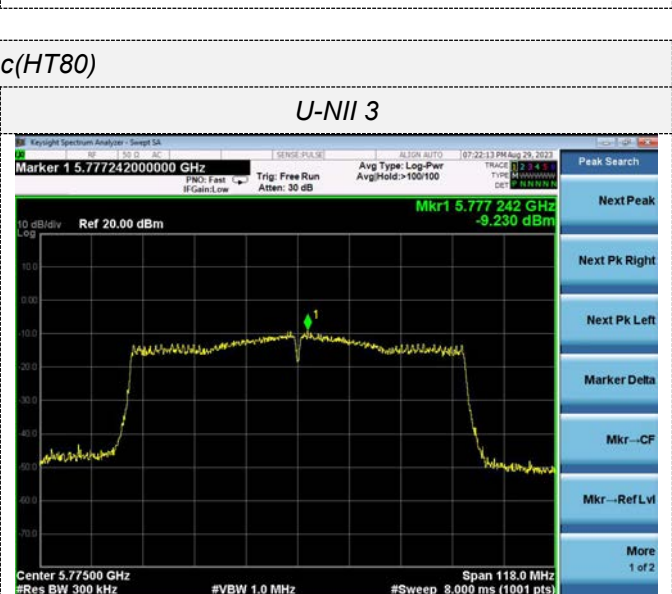
## CH151



## CH46



## CH159

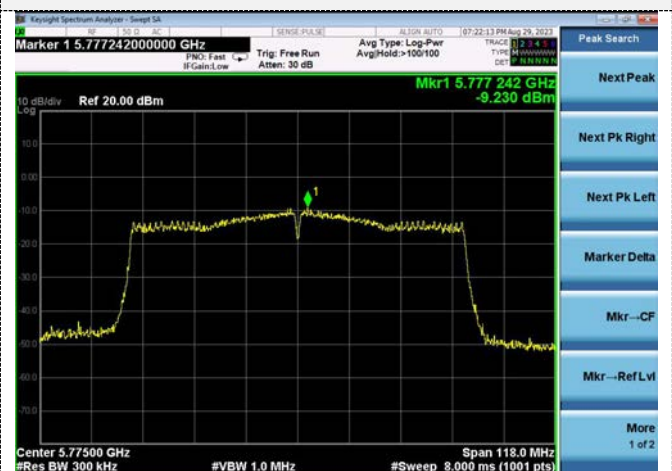


## 802.11ac(HT80)

## 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 %.

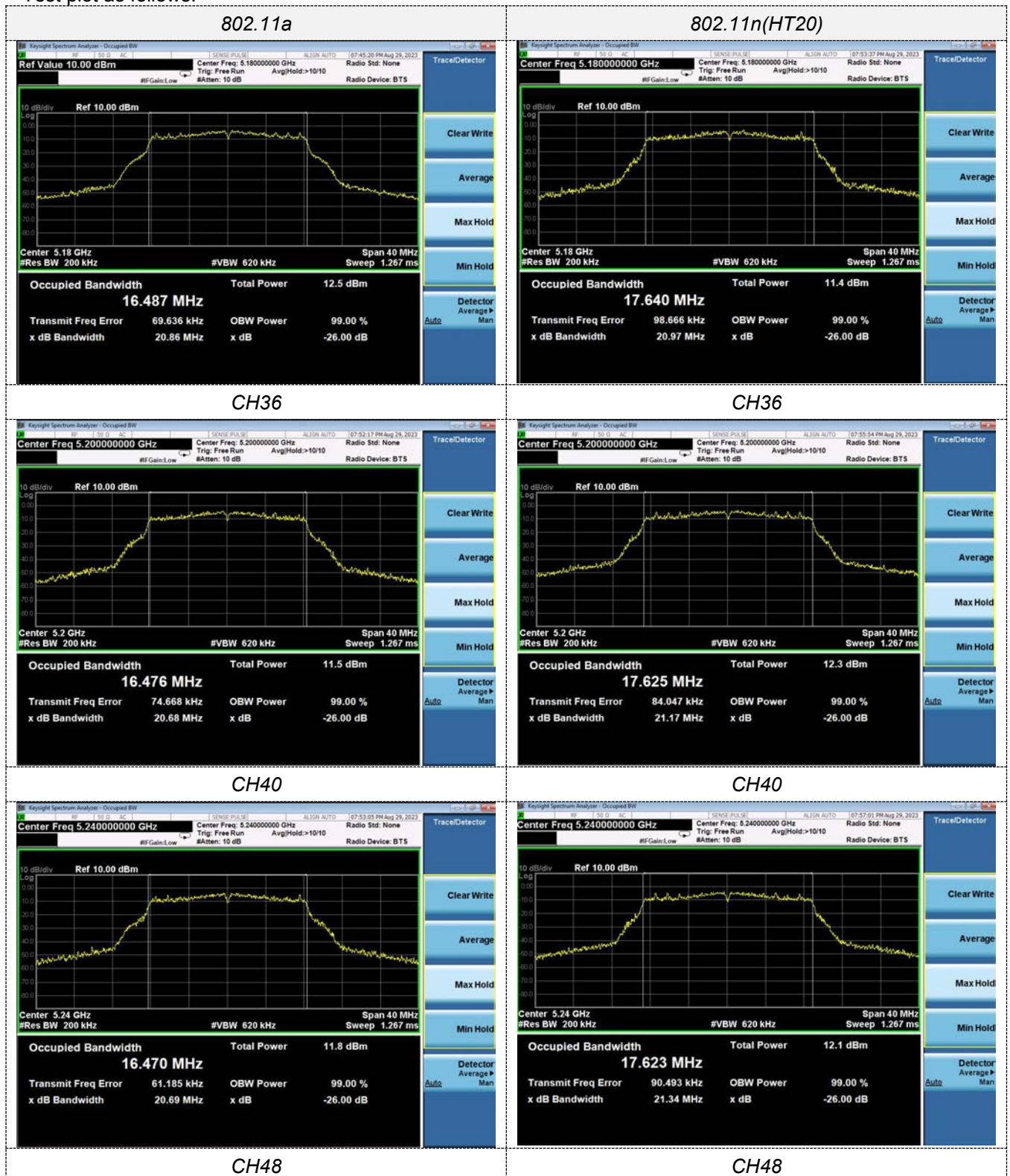
##### Test Configuration



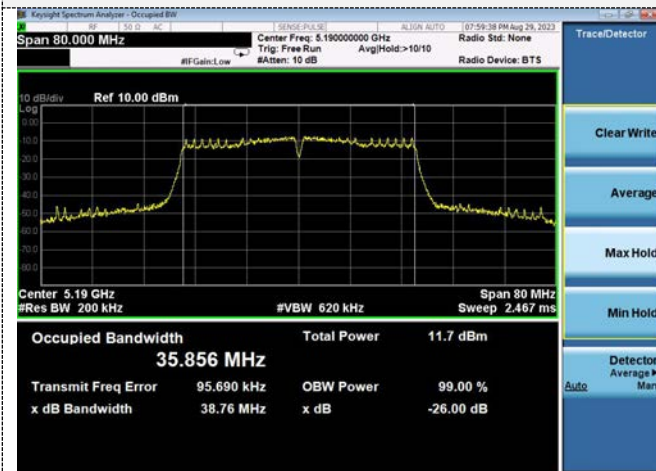
##### Test Results

| Type           | Bands   | Channel | 26dB Bandwidth (MHz) | Limit (MHz) | Result |
|----------------|---------|---------|----------------------|-------------|--------|
| 802.11a        | U-NII 1 | 36      | 20.86                | N/A         | Pass   |
|                |         | 40      | 20.68                |             |        |
|                |         | 48      | 20.69                |             |        |
| 802.11n(HT20)  | U-NII 1 | 36      | 20.97                |             |        |
|                |         | 40      | 21.17                |             |        |
|                |         | 48      | 21.34                |             |        |
| 802.11n(HT40)  | U-NII 1 | 38      | 38.76                |             |        |
|                |         | 46      | 38.87                |             |        |
| 802.11ac(HT20) | U-NII 1 | 36      | 21.04                |             |        |
|                |         | 40      | 21.30                |             |        |
|                |         | 48      | 21.01                |             |        |
| 802.11ac(HT40) | U-NII 1 | 38      | 38.77                |             |        |
|                |         | 46      | 38.80                |             |        |
| 802.11ac(HT80) | U-NII 1 | 42      | 78.64                |             |        |

Test plot as follows:



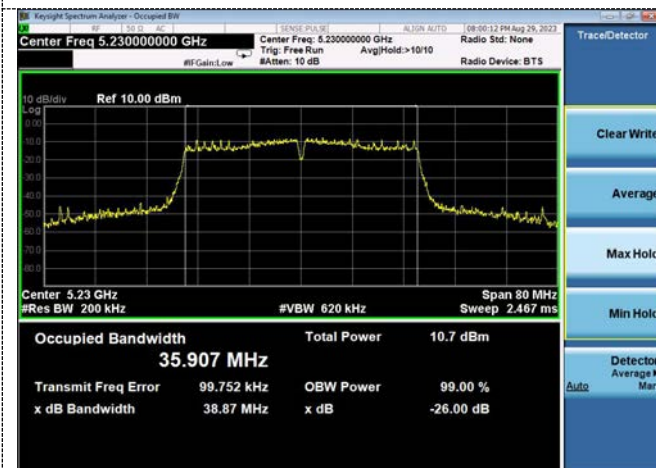
802.11n(HT40)



802.11ac(HT20)



CH38



CH36



CH46

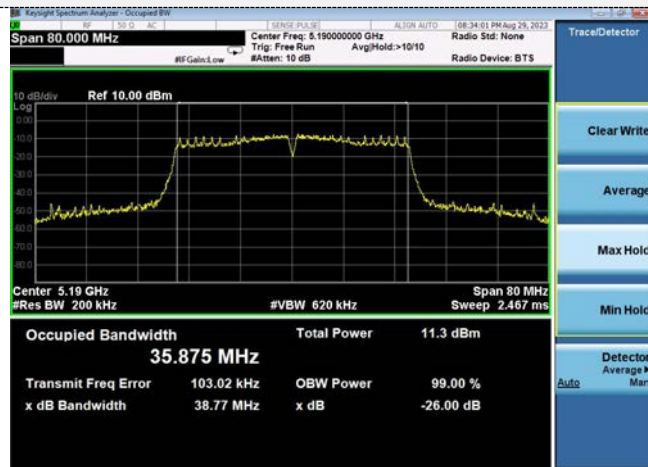


CH40

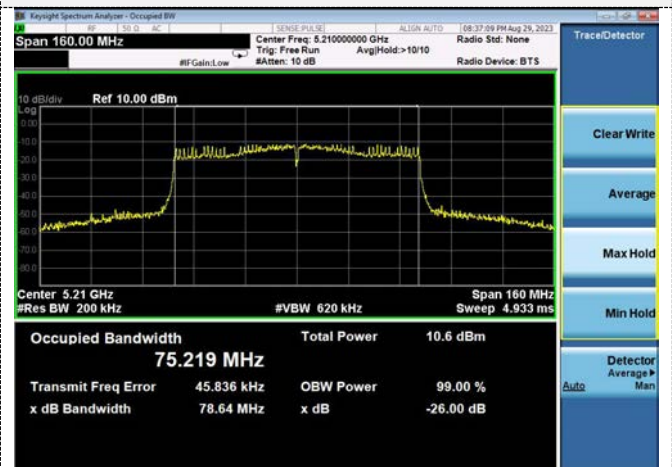


CH48

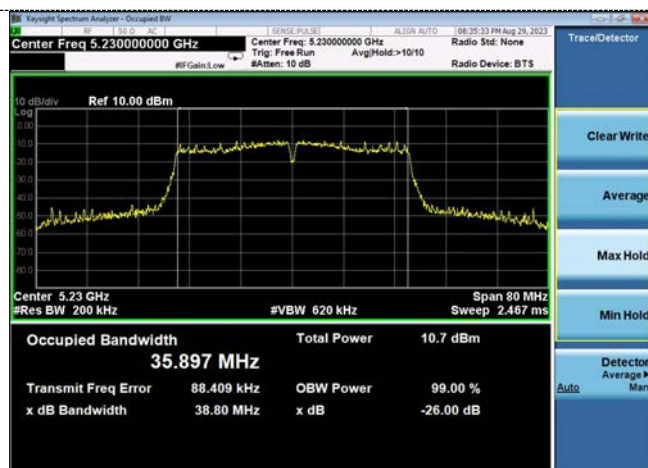
## 802.11ac(HT40)



## 802.11ac(HT80)



## CH38



## CH46

#### 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

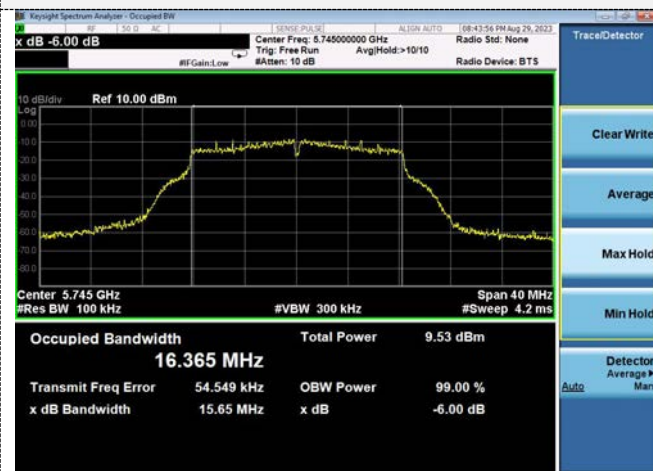


##### Test Results

| Type           | Bands   | Channel | 6dB Bandwidth (MHz) | Limit (KHz) | Result |
|----------------|---------|---------|---------------------|-------------|--------|
| 802.11a        | U-NII 3 | 149     | 15.65               | ≥500KHz     | Pass   |
|                |         | 157     | 16.02               |             |        |
|                |         | 165     | 16.29               |             |        |
| 802.11n(HT20)  | U-NII 3 | 149     | 16.53               |             |        |
|                |         | 157     | 17.25               |             |        |
|                |         | 165     | 17.14               |             |        |
| 802.11n(HT40)  | U-NII 3 | 151     | 35.51               |             |        |
|                |         | 159     | 35.68               |             |        |
| 802.11ac(HT20) | U-NII 3 | 149     | 14.22               |             |        |
|                |         | 157     | 16.78               |             |        |
|                |         | 165     | 17.06               |             |        |
| 802.11ac(HT40) | U-NII 3 | 151     | 35.43               |             |        |
|                |         | 159     | 35.57               |             |        |
| 802.11ac(HT80) | U-NII 3 | 155     | 75.80               |             |        |

Test plot as follows:

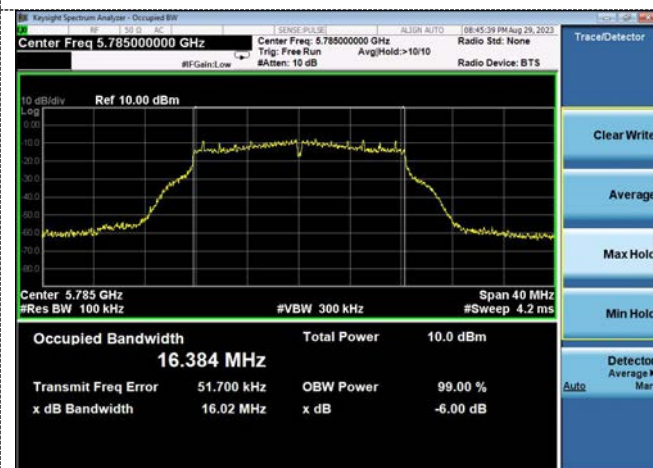
802.11a



802.11n(HT20)



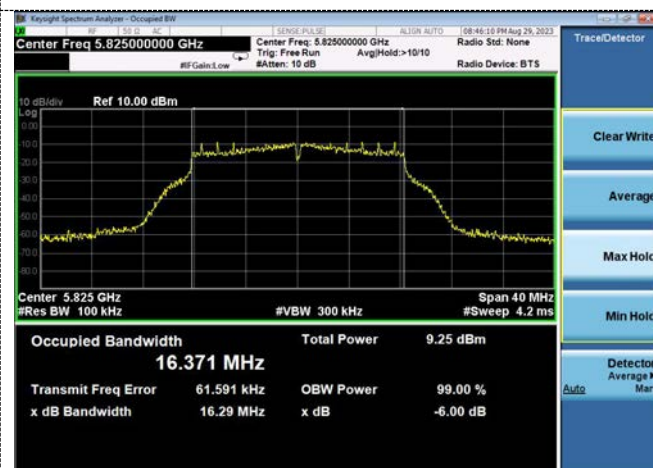
CH149



CH149



CH157



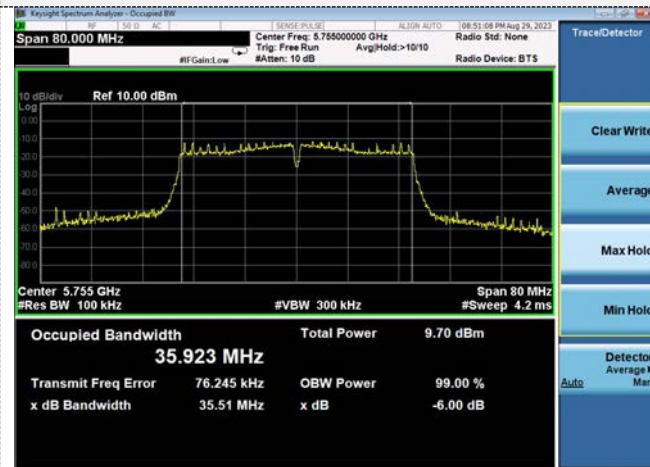
CH157



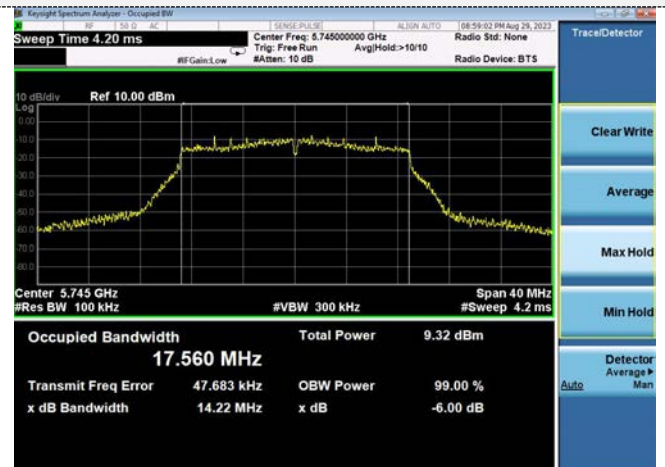
CH165

CH165

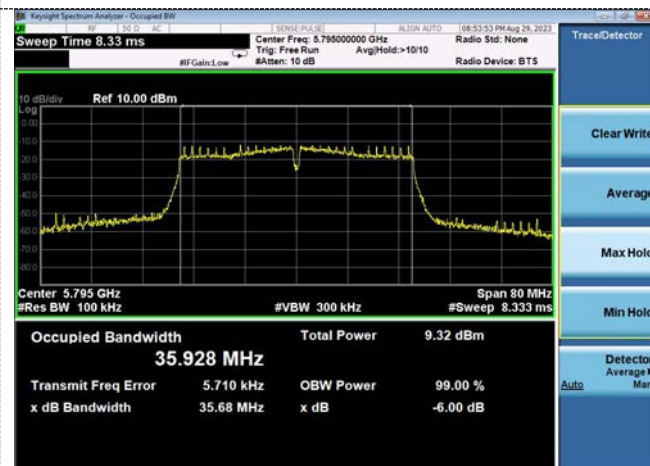
802.11n(HT40)



802.11ac(HT20)



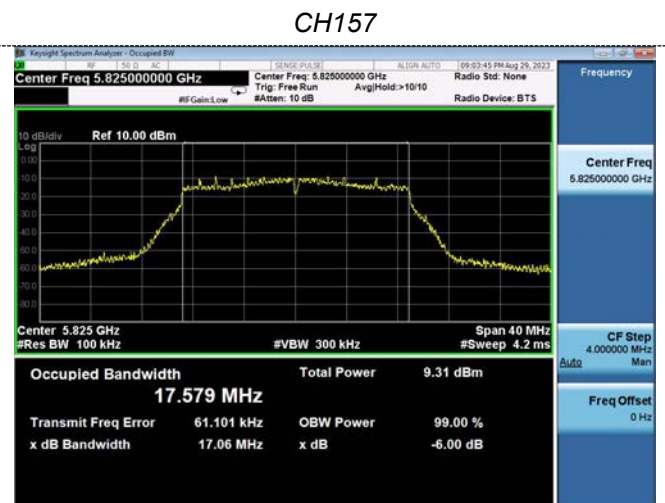
CH151



CH149

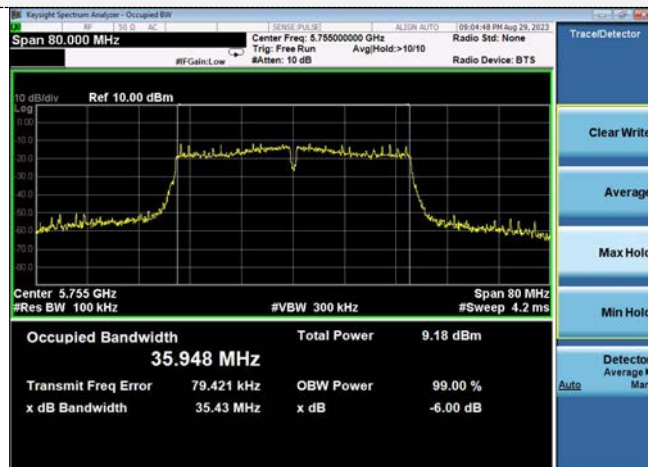


CH159

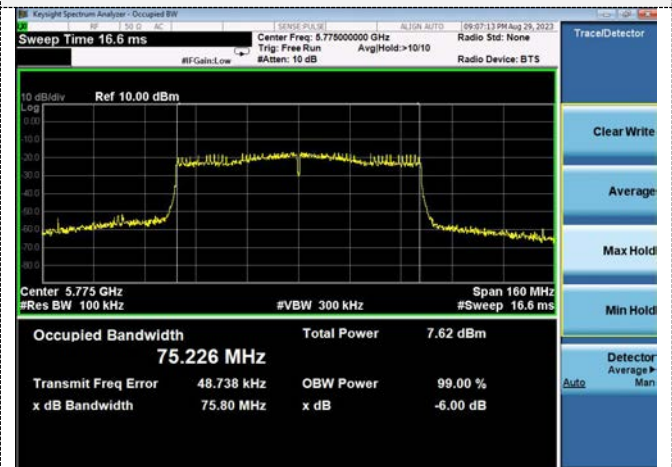


CH165

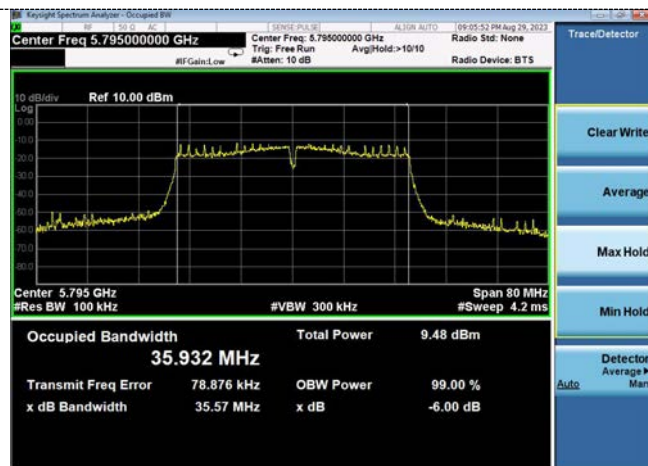
802.11ac(HT40)



802.11ac(HT80)



CH151



CH155

CH159

## 4.7 Out of Band Emissions

### 4.7.1 Applicable Standard

According to FCC §15.407(b)

Undesirable emission limits. 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:

(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 5.725-5.850 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.

### 4.7.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz with a convenient frequency span.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

### 4.7.3 DEVIATION FROM STANDARD

No deviation.

### 4.7.4 TEST SETUP



### 4.7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of 2.4 Unless otherwise a special operating condition is specified in the follows during the testing.

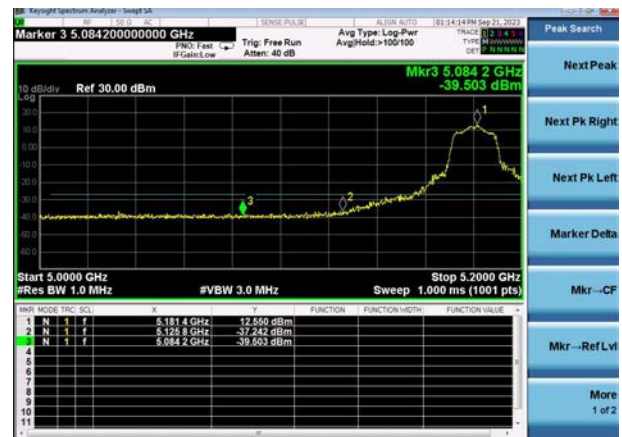
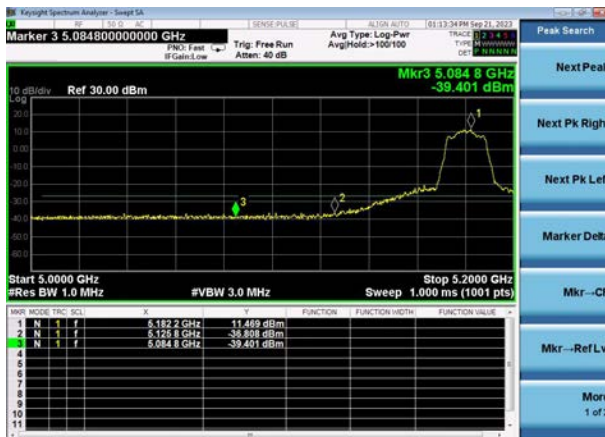
#### 4.7.6 TEST RESULTS

|              |          |                    |        |
|--------------|----------|--------------------|--------|
| Temperature: | 26 °C    | Relative Humidity: | 54%    |
| Pressure:    | 1012 hPa | Test Voltage :     | DC 12V |

5.180~5.240 GHz

(802.11a) Band Edge, Left Side

(802.11n20) Band Edge, Left Side



(802.11a) Band Edge, Right Side

(802.11n20) Band Edge, Right Side



5.180~5.240 GHz

(802.11n40) Band Edge, Left Side

(802.11ac80) Band Edge



(802.11n40) Band Edge, Right Side



5.745~5.825 GHz

(802.11a) Band Edge, Left Side

(802.11n20) Band Edge, Left Side



(802.11a) Band Edge, Right Side

(802.11n20) Band Edge, Right Side



(802.11a) & 802.11n20 Band Edge, Left Side

| Frequency(GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11a | Test Results(dbm)<br>802.11n20 |
|----------------|-------------|----------------|------------------------------|--------------------------------|
| 5.5650~5.6500  | -27         | 0              | -39.034                      | -42.380                        |
| 5.6500~5.7000  | -27~10.6    | 15.6           | -28.676                      | -30.980                        |
| 5.7000~5.7200  | 10.6~15.6   | 10             | -14.240                      | -23.749                        |
| 5.7200~5.7250  | 15.6~27     | 27             | -14.240                      | -23.749                        |
| 5.7250~5.7650  | 27          | 0              | 17.204                       | 13.525                         |

(802.11a) & 802.11n20 Band Edge, Right Side

| Frequency(GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11a | Test Results(dbm)<br>802.11n20 |
|----------------|-------------|----------------|------------------------------|--------------------------------|
| 5.8050~5.8500  | 27          | 0              | 12.382                       | 11.819                         |
| 5.8500~5.8550  | 27~15.6     | 27             | -22.837                      | -29.071                        |
| 5.8550~5.8750  | 15.6~10.6   | 10             | -40.801                      | -40.231                        |
| 5.8750~5.9250  | 10.6~-27    | 10.6           | -41.706                      | -42.661                        |
| 5.9250~6.0050  | -27         | 0              | -41.706                      | -42.661                        |

5.745~5.825 GHz

(802.11n40) Band Edge, Left Side



(802.11ac80) Band Edge



(802.11n40) Band Edge, Right Side



(802.11n40) Band Edge, Left Side

| Frequency(GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm) |
|----------------|-------------|----------------|-------------------|
| 5.5950~5.6500  | -27         | 0              | -40.415           |
| 5.6500~5.7000  | -27~10.6    | 15.6           | -26.746           |
| 5.7000~5.7200  | 10.6~15.6   | 10             | -10.824           |
| 5.7200~5.7250  | 15.6~27     | 27             | -10.824           |
| 5.7250~5.7950  | 27          | 0              | 11.614            |

(802.11n40) Band Edge, Right Side

| Frequency(GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm) |
|----------------|-------------|----------------|-------------------|
| 5.7550~5.8500  | 27          | 0              | 9.705             |
| 5.8500~5.8550  | 27~15.6     | 27             | -17.656           |
| 5.8550~5.8750  | 15.6~10.6   | 10             | -33.273           |
| 5.8750~5.9250  | 10.6~-27    | 10.6           | -40.050           |
| 5.9250~5.9550  | -27         | 0              | -40.050           |

(802.11ac80) Band Edge

| Frequency(GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm) |
|----------------|-------------|----------------|-------------------|
| 5.6500~5.7000  | -27~10.6    | 15.6           | -29.391           |
| 5.7000~5.7200  | 10.6~15.6   | 10             | -29.391           |
| 5.7200~5.7250  | 15.6~27     | 27             | -17.683           |
| 5.7250~5.8500  | 27          | 0              | 7.401             |
| 5.8500~5.8550  | 27~15.6     | 27             | -29.391           |

## 4.8 SPURIOUS RF CONDUCTED EMISSIONS

### 4.8.1 Conformance Limit

| Frequency Band (MHz) | Limit                                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5150 - 5250          | Outside of the 5.15-5.35 GHz band: e.i.r.p. -27 dBm                                                                                                                                                                                                                                                                                                                                                                             |
| 5250 - 5350          | Outside of the 5.15-5.35 GHz band: e.i.r.p. -27 dBm                                                                                                                                                                                                                                                                                                                                                                             |
| 5470 - 5725          | Outside of the 5.47-5.725 GHz band: e.i.r.p. -27 dBm                                                                                                                                                                                                                                                                                                                                                                            |
| 5725 - 5850          | 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. |

### 4.8.2 Measuring Instruments

The Measuring equipment is listed in the section 6.3 of this test report.

### 4.8.3 Test Setup



### 4.8.4 Test Procedure

The Spurious RF conducted emissions compliance of RF radiated emission should be measured by following the guidance in ANSI C63.10-2013 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization etc. Set RBW=1MHz and VBW= 3MHz to measure the peak field strength, and measure frequency range from 30MHz to 26.5GHz.

### 4.8.5 Test Results

## 5.2G

### Test Plot

802.11a on channel 36



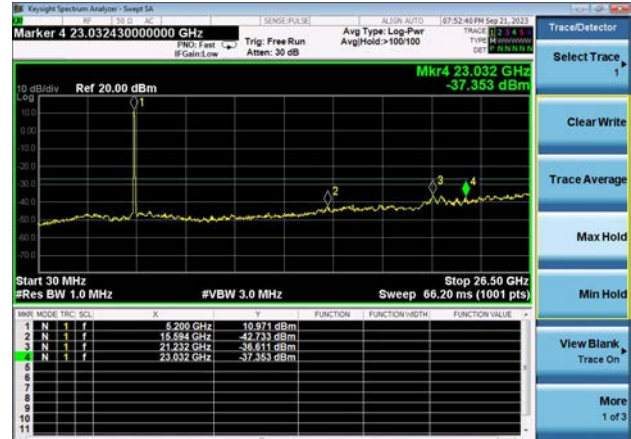
802.11n20 on channel 36



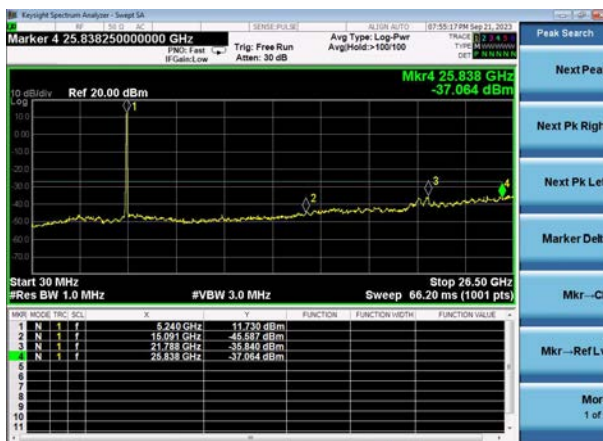
802.11a on channel 40



802.11n20 on channel 40



802.11a on channel 48

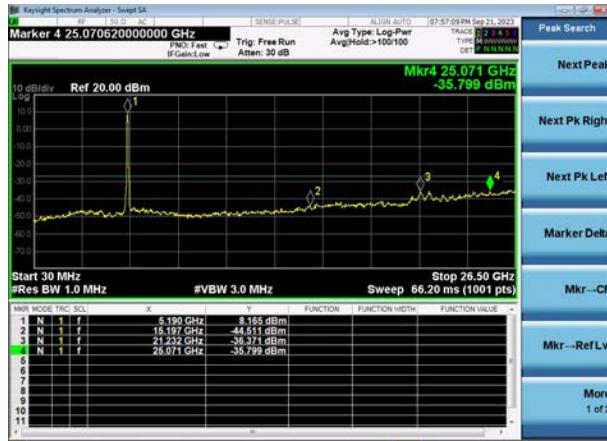


802.11n20 on channel 48

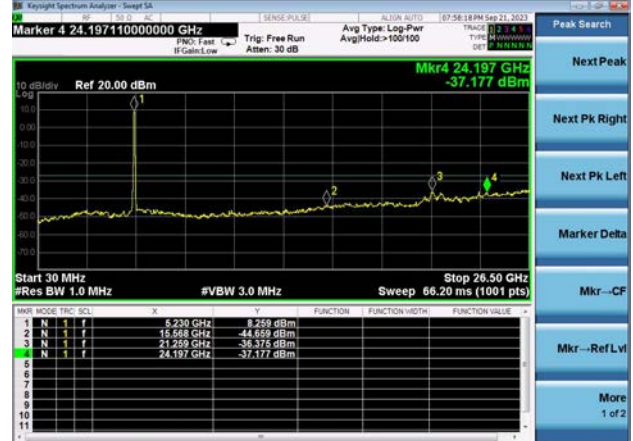


# Test Plot

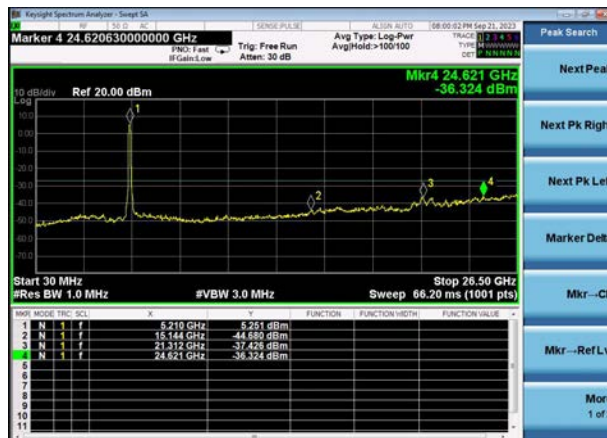
802.11n40 on channel 38



802.11n40 on channel 46



802.11ac80 on channel 42



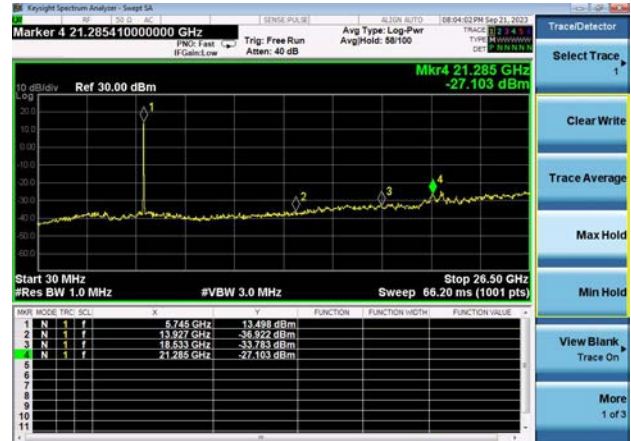
5.8G

Test Plot

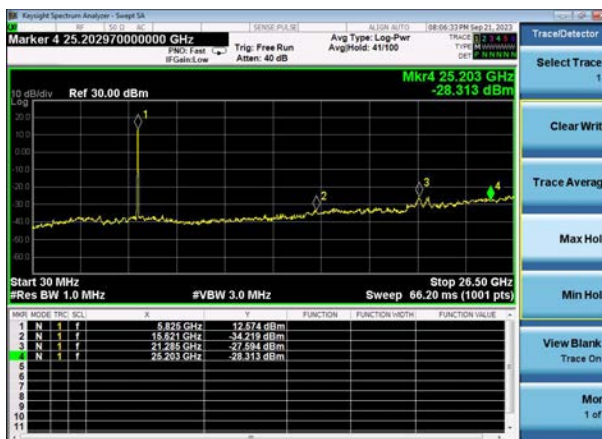
802.11a on channel 149



802.11n20 on channel 149



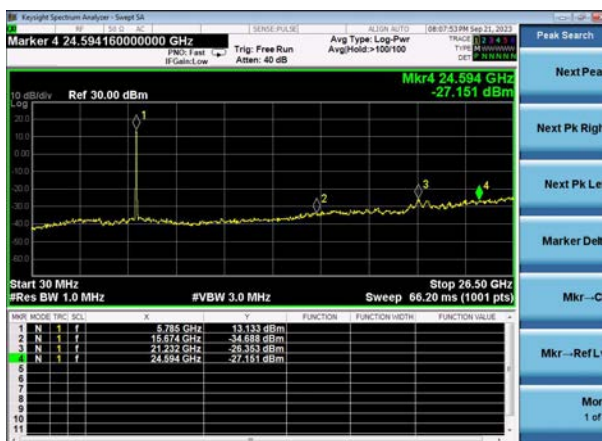
802.11a on channel 165



802.11n20 on channel 165



802.11a on channel 157



802.11n20 on channel 157

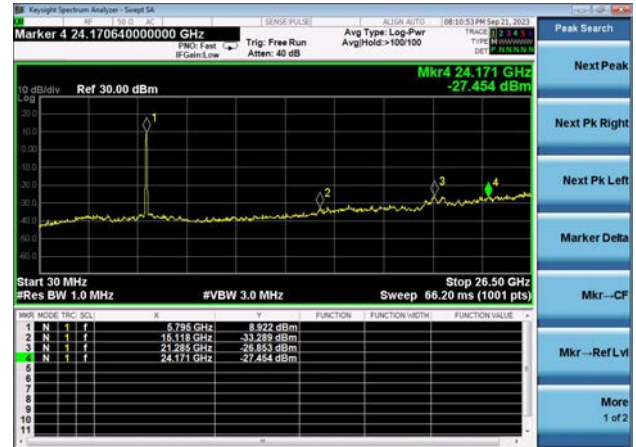


Test Plot

802.11n40 on channel 151



802.11n40 on channel 159



802.11ac80 on channel 155



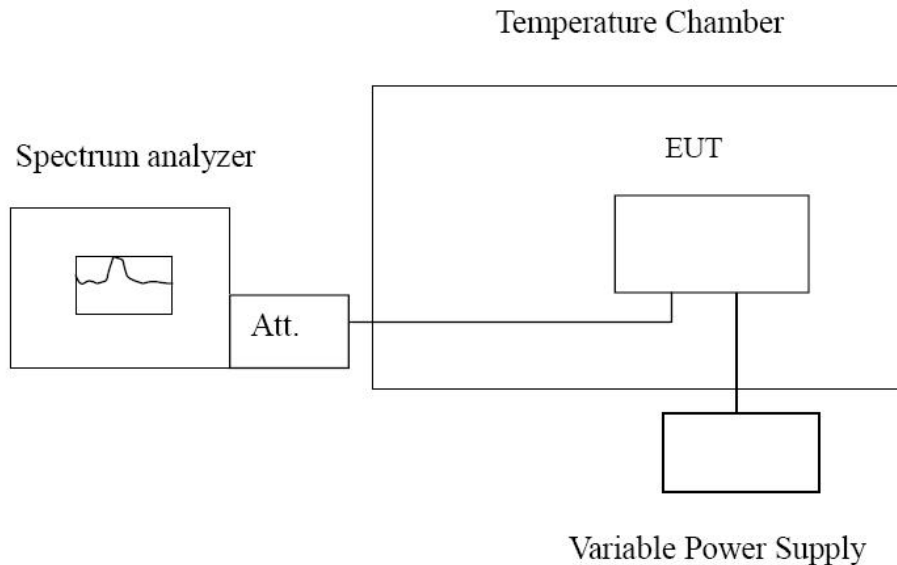
| Frequency (GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11a on channel 149    | Test Results(dbm)<br>802.11n20 on channel 149 |
|-----------------|-------------|----------------|------------------------------------------------|-----------------------------------------------|
| 0.030~5.7650    | /           | /              | -36.439                                        | -36.992                                       |
| 5.5650~5.6500   | -27         | 0              | -36.439                                        | -36.992                                       |
| 5.6500~5.7000   | -27~10.6    | 15.6           | -36.439                                        | -36.992                                       |
| 5.7000~5.7200   | 10.6~15.6   | 10             | -36.439                                        | -36.992                                       |
| 5.7200~5.7250   | 15.6~27     | 27             | -36.439                                        | -36.992                                       |
| 5.7250~5.7650   | 27          | 0              | 14.723                                         | 13.498                                        |
| 5.7650~26.5     | /           | /              | -32.565                                        | -27.103                                       |
| Frequency (GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11a on channel 165    | Test Results(dbm)<br>802.11n20 on channel 165 |
| 0.030~5.8050    | /           | /              | -34.219                                        | 13.027                                        |
| 5.8050~5.8500   | 27          | 0              | 12.574                                         | -33.721                                       |
| 5.8500~5.8550   | 27~15.6     | 27             | -27.594                                        | -27.676                                       |
| 5.8550~5.8750   | 15.6~10.6   | 10             | -27.594                                        | -27.676                                       |
| 5.8750~5.9250   | 10.6~27     | 10.6           | -27.594                                        | -27.676                                       |
| 5.9250~6.0050   | -27         | 0              | -27.594                                        | -27.676                                       |
| 6.0050~26.5     | /           | /              | -27.594                                        | -27.676                                       |
| Frequency (GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11a on channel 157    | Test Results(dbm)<br>802.11n20 on channel 157 |
| 0.030~5.7550    | /           | /              | -34.688                                        | -34.501                                       |
| 5.7550~5.8500   | 27          | 0              | 13.133                                         | 12.701                                        |
| 5.8500~5.8550   | 27~15.6     | 27             | -27.151                                        | -28.763                                       |
| 5.8550~5.8750   | 15.6~10.6   | 10             | -27.151                                        | -28.763                                       |
| 5.8750~5.9250   | 10.6~27     | 10.6           | -27.151                                        | -28.763                                       |
| 5.9250~5.9550   | -27         | 0              | -27.151                                        | -28.763                                       |
| 5.9550~26.5     | /           | /              | -27.151                                        | -28.763                                       |
| Frequency (GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11n40 on channel 151  | Test Results(dbm)<br>802.11n40 on channel 159 |
| 0.030~5.7550    | /           | /              | -35.487                                        | -33.289                                       |
| 5.7550~5.8500   | 27          | 0              | 10.552                                         | 8.922                                         |
| 5.8500~5.8550   | 27~15.6     | 27             | -27.516                                        | -27.454                                       |
| 5.8550~5.8750   | 15.6~10.6   | 10             | -27.516                                        | -27.454                                       |
| 5.8750~5.9250   | 10.6~27     | 10.6           | -27.516                                        | -27.454                                       |
| 5.9250~5.9550   | -27         | 0              | -27.516                                        | -27.454                                       |
| 5.9550~26.5     | /           | /              | -27.516                                        | -27.454                                       |
| Frequency (GHz) | Limit (dbm) | Rate (dBm/MHz) | Test Results(dbm)<br>802.11ac80 on channel 155 |                                               |
| 0.030~5.6500    | /           | /              | -35.370                                        |                                               |
| 5.6500~5.7000   | -27~10.6    | 15.6           | -35.370                                        |                                               |
| 5.7000~5.7200   | 10.6~15.6   | 10             | -35.370                                        |                                               |
| 5.7200~5.7250   | 15.6~27     | 27             | -35.370                                        |                                               |
| 5.7250~5.8500   | 27          | 0              | 6.928                                          |                                               |
| 5.8500~5.8550   | 27~15.6     | 27             | -25.212                                        |                                               |
| 5.8550~26.5     | /           | /              | -25.212                                        |                                               |

## 4.9 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 25°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 25°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.

| Reference Frequency: 802.11ac channel=36 frequency=5180MHz |                  |                 |       |                              |        |
|------------------------------------------------------------|------------------|-----------------|-------|------------------------------|--------|
| Voltage ( V )                                              | Temperature (°C) | Frequency error |       | Limit (ppm)                  | Result |
|                                                            |                  | Hz              | ppm   |                              |        |
| 12.00                                                      | -30              | 67.71           | 0.013 | Within the band of operation | Pass   |
|                                                            | -20              | 81.35           | 0.016 |                              |        |
|                                                            | -10              | 104.13          | 0.020 |                              |        |
|                                                            | 0                | 82.95           | 0.016 |                              |        |
|                                                            | 10               | 93.44           | 0.018 |                              |        |
|                                                            | 20               | 48.27           | 0.009 |                              |        |
|                                                            | 30               | 71.92           | 0.014 |                              |        |
|                                                            | 40               | 77.52           | 0.015 |                              |        |
|                                                            | 50               | 82.22           | 0.016 |                              |        |
| 13.8                                                       | 25               | 97.84           | 0.019 | Within the band of operation | Pass   |
| 10.2                                                       | 25               | 54.38           | 0.010 |                              |        |

| Reference Frequency: 802.11ac channel=149 frequency=5745MHz |                  |                 |       |                              |        |
|-------------------------------------------------------------|------------------|-----------------|-------|------------------------------|--------|
| Voltage ( V )                                               | Temperature (°C) | Frequency error |       | Limit (ppm)                  | Result |
|                                                             |                  | Hz              | ppm   |                              |        |
| 12.00                                                       | -30              | 108.22          | 0.019 | Within the band of operation | Pass   |
|                                                             | -20              | 89.51           | 0.016 |                              |        |
|                                                             | -10              | 49.27           | 0.009 |                              |        |
|                                                             | 0                | 62.58           | 0.011 |                              |        |
|                                                             | 10               | 56.98           | 0.010 |                              |        |
|                                                             | 20               | 51.16           | 0.009 |                              |        |
|                                                             | 30               | 52.57           | 0.009 |                              |        |
|                                                             | 40               | 84.92           | 0.015 |                              |        |
|                                                             | 50               | 109.91          | 0.019 |                              |        |
| 13.8                                                        | 25               | 54.60           | 0.010 | Within the band of operation | Pass   |
| 10.2                                                        | 25               | 53.89           | 0.009 |                              |        |

## **4.10 Antenna Requiremen**

### **Standard Applicable**

**For intentional device, according to FCC 47 CFR Section 15.203:**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited

**FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1) (I):**

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

### **Test Result:**

The maximum gain of antenna is 2.52 dBi.

Remark:The antenna gain is provided by the customer, if the data provided by the customer is not accurate, BSL Testing Co., Ltd. does not assume any responsibility.

## **5 Test Setup Photos of the EUT**

Reference to the appendix I for details.

## **6 Photos of the EUT**

Reference to the appendix II for details.

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