

## FCC Test Report

**Report No.:** FCC\_RF\_SL20081901-ROK-003\_2.4G Rev\_1.0

**FCC ID:** TC2-R1039

**Test Model:** RC-MC1

**Received Date:** 09/18/2020

**Test Date:** 09/21/2020-09/25/2020

**Issued Date:** 10/27/2020

**Applicant:** Roku, Inc.

**Address:** 1155 Coleman Ave, San Jose, CA 95110

**Manufacturer:** Roku, Inc.

**Address:** 1155 Coleman Ave, San Jose, CA 95110

**Issued By:** Bureau Veritas Consumer Products Services, Inc.

**Lab Address:** 775 Montague Expressway, Milpitas, CA 95035

**Test Location (1):** 775 Montague Expressway, Milpitas, CA 95035

**FCC Registration /  
Designation Number:** 540430

**ISED# / CAB identifier:** 4842D



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### Release Control Record

| Issue No.                              | Description       | Date Issued |
|----------------------------------------|-------------------|-------------|
| FCC_RF_SL20081901-ROK-003_2.4G         | Original Release  | 10/02/2020  |
| FCC_RF_SL20081901-ROK-003_2.4G Rev_1.0 | Update per review | 10/27/2020  |

## 1 Certificate of Conformity

**Product:** Remote Control

**Brand:** Roku, Inc.

**Test Model:** RC-MC1

**Sample Status:** Engineering Sample

**Applicant:** Roku, Inc.

**Test Date:** 09/21/2020-09/25/2020

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

ANSI C63.10: 2013

558074 D01 15.247 Meas Guidance v05r02

The above equipment has been tested by **Bureau Veritas Consumer Products Services, Inc., Milpitas Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**Prepared by :**

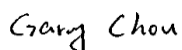


**Date:**

10/27/2020

Deon Dai / Test Engineer

**Approved by :**



**Date:**

10/27/2020

Gary Chou / Engineer Reviewer

## 2 Summary of Test Results

| 47 CFR FCC Part 15, Subpart C (Section 15.247) |                                                 |        |                                                                     |
|------------------------------------------------|-------------------------------------------------|--------|---------------------------------------------------------------------|
| Standard                                       | Test Item                                       | Result | Remarks                                                             |
| 15.207                                         | AC Power Conducted Emission                     | PASS   | Meet the requirement of limit.                                      |
| 15.205<br>&15.209 &<br>15.247(d)               | Radiated Emissions and Band<br>Edge Measurement | PASS   | Meet the requirement of limit.                                      |
| 15.247(a)(2)                                   | 6dB bandwidth & 99% bandwidth                   | PASS   | Meet the requirement of limit.                                      |
| 15.247(b)                                      | Conducted power                                 | PASS   | Meet the requirement of limit.                                      |
| 15.247(e)                                      | Power Spectral Density                          | PASS   | Meet the requirement of limit.                                      |
| 15.203                                         | Antenna Requirement                             | PASS   | The EUT uses a chip antenna to<br>permanently attach to the device. |

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

| Measurement                        | Frequency      | Expanded Uncertainty<br>(k=2) (±) |
|------------------------------------|----------------|-----------------------------------|
| Conducted Emissions at mains ports | 150kHz ~ 30MHz | 3.51dB                            |
| Radiated Emissions up to 1 GHz     | 30MHz ~ 1GHz   | 3.73dB                            |
| Radiated Emissions above 1 GHz     | 1GHz ~ 6GHz    | 4.64dB                            |
|                                    | 6GHz ~ 18GHz   | 4.82dB                            |
|                                    | 18GHz ~ 40GHz  | 4.91dB                            |

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

|                           |                                                                          |
|---------------------------|--------------------------------------------------------------------------|
| Product                   | Remote Control                                                           |
| Brand                     | Roku, Inc.                                                               |
| Test Model                | RC-MC1                                                                   |
| Identification No. of EUT | N/A                                                                      |
| Series Model              | N/A                                                                      |
| Model Difference          | N/A                                                                      |
| Status of EUT             | Engineering Sample                                                       |
| Power Supply Rating       | battery 3.8V                                                             |
| Modulation Type           | CCK, DQPSK, DBPSK for DSSS<br>64QAM, 16QAM, QPSK, BPSK for OFDM          |
| Modulation Technology     | DSSS, OFDM                                                               |
| Transfer Rate             | 802.11b: up to 11Mbps<br>802.11g: up to 54Mbps<br>802.11n: up to 300Mbps |
| Operating Frequency       | 2.412 ~ 2.462GHz                                                         |
| Number of Channel         | 11 for 802.11b, 802.11g, 802.11n (HT20)                                  |
| Antenna Information       | Chip Antenna<br>2412MHz: -0.8 dBi<br>2437-2462MHz: 0.7 dBi               |
| Antenna Connector         | N/A                                                                      |

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

### 3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

| Channel | Frequency | Channel | Frequency |
|---------|-----------|---------|-----------|
| 1       | 2412MHz   | 7       | 2442MHz   |
| 2       | 2417MHz   | 8       | 2447MHz   |
| 3       | 2422MHz   | 9       | 2452MHz   |
| 4       | 2427MHz   | 10      | 2457MHz   |
| 5       | 2432MHz   | 11      | 2462MHz   |
| 6       | 2437MHz   |         |           |

Power setting is as below:

| 802.11b |               |         | 802.11g |               |         |
|---------|---------------|---------|---------|---------------|---------|
| Channel | Power Setting |         | Channel | Power Setting |         |
|         | Chain 0       | Chain 1 |         | Chain 0       | Chain 1 |
| 1       | 73            | 73      | 1       | 72            | 72      |
| 6       | 66            | 66      | 6       | 65            | 65      |
| 11      | 66            | 66      | 11      | 65            | 65      |
| 802.11n |               |         |         |               |         |
| Channel | Power Setting |         |         |               |         |
|         | Chain 0       | Chain 1 |         |               |         |
| 1       | 72            | 72      |         |               |         |
| 6       | 65            | 66      |         |               |         |
| 11      | 65            | 66      |         |               |         |



### 3.2.1 Test Mode Applicability and Tested Channel Detail

| EUT CONFIGURE MODE | APPLICABLE TO |       |     |      | DESCRIPTION |
|--------------------|---------------|-------|-----|------|-------------|
|                    | RE $\geq$ 1G  | RE<1G | PLC | APCM |             |
| -                  | √             | √     | √   | √    | -           |

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement  
 RE<1G: Radiated Emission below 1GHz  
 PLC: Power Line Conducted Emission  
 APCM: Antenna Port Conducted Measurement

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

**NOTE:** "-" means no effect.

#### **Radiated Emission Test (Above 1GHz):**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT CONFIGURE MODE | MODE           | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|--------------------|----------------|-------------------|----------------|-----------------------|-----------------|------------------|
| -                  | 802.11b        | 1 to 11           | 1, 6, 11       | DSSS                  | DBPSK           | 1                |
| -                  | 802.11g        | 1 to 11           | 1, 6, 11       | OFDM                  | BPSK            | 6                |
| -                  | 802.11n (HT20) | 1 to 11           | 1, 6, 11       | OFDM                  | BPSK            | 6.5              |

#### **Radiated Emission Test (Below 1GHz):**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT CONFIGURE MODE | MODE            | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|--------------------|-----------------|-------------------|----------------|-----------------------|-----------------|------------------|
| -                  | 802.11n (20MHz) | 1 to 11           | 6              | OFDM                  | BPSK            | 6.5              |

#### **Power Line Conducted Emission Test:**

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT CONFIGURE MODE | MODE           | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|--------------------|----------------|-------------------|----------------|-----------------------|-----------------|------------------|
| -                  | 802.11n (HT20) | 1 to 11           | 6              | OFDM                  | BPSK            | 6.5              |

### Antenna Port Conducted Measurement:

- ☐ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channel(s) was (were) selected for the final test as listed below.

| EUT CONFIGURE MODE | MODE           | AVAILABLE CHANNEL | TESTED CHANNEL | MODULATION TECHNOLOGY | MODULATION TYPE | DATA RATE (Mbps) |
|--------------------|----------------|-------------------|----------------|-----------------------|-----------------|------------------|
| -                  | 802.11b        | 1 to 11           | 1, 6, 11       | DSSS                  | DBPSK           | 1                |
| -                  | 802.11g        | 1 to 11           | 1, 6, 11       | OFDM                  | BPSK            | 6                |
| -                  | 802.11n (HT20) | 1 to 11           | 1, 6, 11       | OFDM                  | BPSK            | 6.5              |

### Test Condition:

| APPLICABLE TO | ENVIRONMENTAL CONDITIONS | INPUT POWER  | TESTED BY |
|---------------|--------------------------|--------------|-----------|
| RE≥1G         | 25deg. C, 65%RH          | 120Vac, 60Hz | Deon Dai  |
| RE<1G         | 25deg. C, 65%RH          | 120Vac, 60Hz | Deon Dai  |
| PLC           | 25deg. C, 68%RH          | 120Vac, 60Hz | Deon Dai  |
| APCM          | 21deg. C, 60%RH          | 120Vac, 60Hz | Deon Dai  |

### 3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

| ID | Product        | Brand | Model No.     | Serial No. | FCC ID | Remarks             |
|----|----------------|-------|---------------|------------|--------|---------------------|
| A. | Laptop         | Dell  | Latitude 3550 | N/A        | N/A    | Provide by Lab      |
| B. | Switch adapter | Roku  | ADS-6RA-06    | 0505EPCU-L | N/A    | Provide by Customer |
| C. |                |       |               |            |        |                     |
| D. |                |       |               |            |        |                     |
| E. |                |       |               |            |        |                     |
| F. |                |       |               |            |        |                     |
| G. |                |       |               |            |        |                     |

| ID | Descriptions | Qty. | Length (m) | Shielding (Yes/No) | Cores (Qty.) | Remarks                    |
|----|--------------|------|------------|--------------------|--------------|----------------------------|
| 1. | USB          | 1    | 0.8m       | No                 | 0            | Connect from EUT to Laptop |
| 2. |              |      |            |                    |              |                            |
| 3. |              |      |            |                    |              |                            |

### 3.3.1 Duty Cycle of Test Signal

Duty cycle of test signal is  $\geq 98\%$ , duty factor is not required.

Duty cycle of test signal is  $< 98\%$ , duty factor is required.

802.11b: Duty cycle = 100%

802.11g: Duty cycle = 100%

802.11n: Duty cycle = 100%



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

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

**47 CFR FCC Part 15, Subpart C (Section 15.247)**

**ANSI C63.10: 2013**

**558074 D01 15.247 Meas Guidance v05r02**

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

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

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

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-------------------|-----------------------------------|-------------------------------|
| 0.009 ~ 0.490     | 2400/F(kHz)                       | 300                           |
| 0.490 ~ 1.705     | 24000/F(kHz)                      | 30                            |
| 1.705 ~ 30.0      | 30                                | 30                            |
| 30 ~ 88           | 100                               | 3                             |
| 88 ~ 216          | 150                               | 3                             |
| 216 ~ 960         | 200                               | 3                             |
| Above 960         | 500                               | 3                             |

#### NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

## 4.1.2 Test Instruments

| DESCRIPTION & MANUFACTURER      | MODEL NO.   | SERIAL NO.  | DATE OF CALIBRATION | DUE DATE OF CALIBRATION |
|---------------------------------|-------------|-------------|---------------------|-------------------------|
| PXA Signal Analyzer<br>KEYSIGHT | N9030B      | MY57140374  | 07/22/2020          | 07/22/2021              |
| Biconilog Antenna<br>Sunol      | JB6         | A111717     | 09/04/2020          | 09/04/2021              |
| Horn Antenna<br>ETS-Lindgren    | 3117        | 218554      | 11/22/2019          | 11/22/2020              |
| Pre-Amplifier<br>RF-Lambda      | RAMP00M50GA | 17032300048 | 06/18/2020          | 06/18/2021              |

#### 4.1.3 Test Procedures

##### **For Radiated emission below 30MHz**

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

##### **NOTE:**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz at frequency below 30MHz.

##### **For Radiated emission above 30MHz**

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detects function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

##### **Note:**

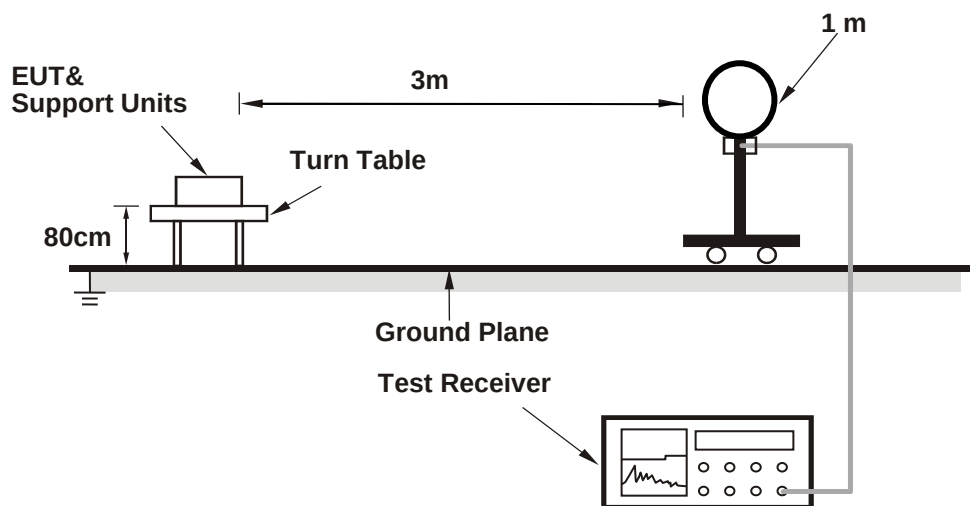
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is  $\geq 1/T$  (Duty cycle  $< 98\%$ ) or 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

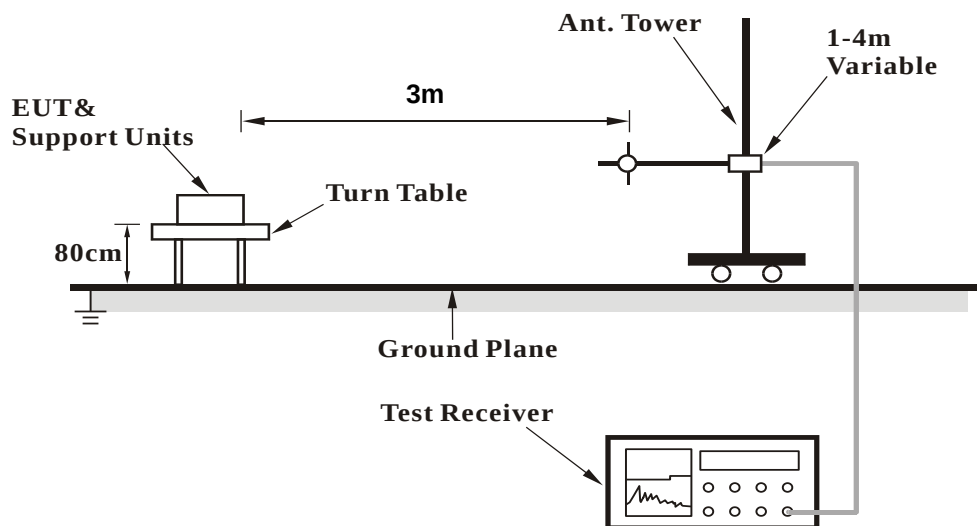
No deviation.

#### 4.1.5 Test Setup

##### For Radiated emission below 30MHz

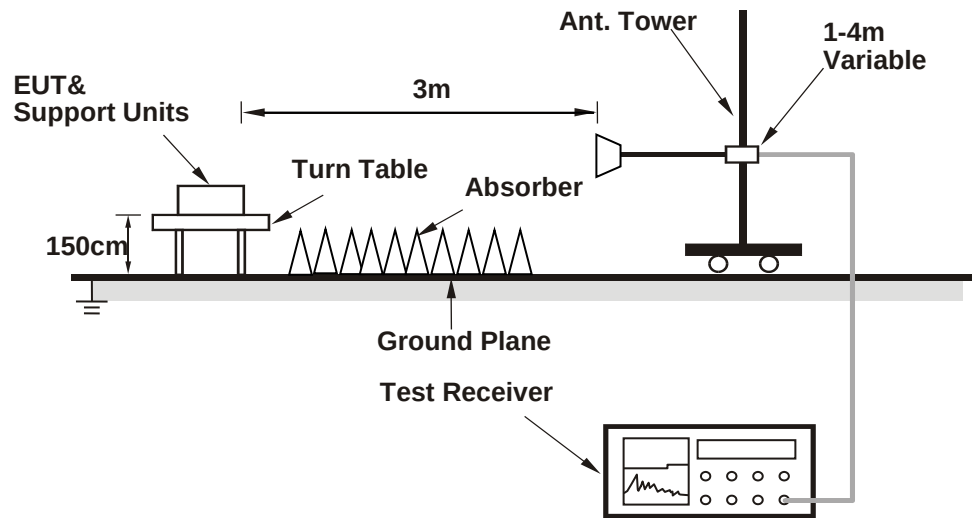


##### For Radiated emission 30MHz to 1GHz





### For Radiated emission above 1GHz



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.6 EUT Operating Conditions

- a. Connected the EUT with the Notebook Computer which is placed on remote site.
- b. Controlling software has been activated to set the EUT on specific status.

#### 4.1.7 Test Results

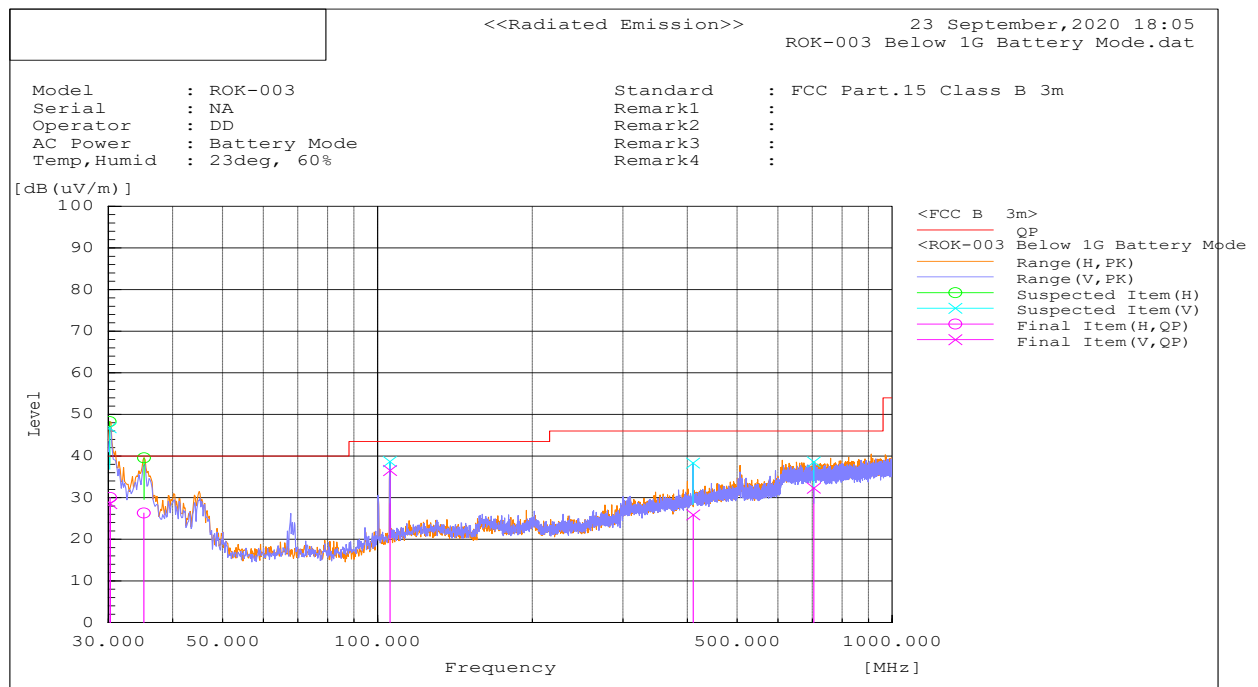
##### BELOW 1GHz WORST-CASE DATA:

|                 |                   |                      |            |
|-----------------|-------------------|----------------------|------------|
| CHANNEL         | 802.11n Channel 6 | DETECTOR<br>FUNCTION | Quasi Peak |
| FREQUENCY RANGE | 30MHz – 1GHz      |                      |            |

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                  |                     |                   |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|------------------|---------------------|-------------------|----------------|-------------|-------------|-----------|
| No.                                                             | Frequency (MHz) | Polarization (H/V) | Reading QP [dB(uV)] | Factor [dB(1/m)] | Level QP [dB(uV/m)] | Limit\QP dB(uV/m) | Margin QP [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 30.254          | V                  | 3.3                 | 25.3             | 28.6                | 40                | -11.4          | 366         | 211         | Pass      |
| 2                                                               | 30.232          | H                  | 3.3                 | 26.7             | 30                  | 40                | -10            | 100         | 103         | Pass      |
| 3                                                               | 35.139          | H                  | 3                   | 23.3             | 26.3                | 40                | -13.7          | 272         | 111         | Pass      |
| 4                                                               | 105.738         | V                  | 18.6                | 17.9             | 36.5                | 43.5              | -7             | 400         | 305         | Pass      |
| 5                                                               | 410.449         | V                  | 3                   | 22.9             | 25.9                | 46                | -20.1          | 383         | 178         | Pass      |
| 6                                                               | 704.448         | V                  | 4.3                 | 28               | 32.3                | 46                | -13.7          | 247         | 67.8        | Pass      |

#### REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Cable Loss (dB) + AF (dB)
2. AF (dB/m) = Antenna Factor (dB/m) – Preamplifier Gain (dB).
3. The emission levels of other frequencies were less than 20dB margin against the limit.
4. Margin value = Emission level – Limit value.



## Above 1GHz Test Data:

### Above 1GHz-25GHz – 802.11b – 2412MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 1594.943        | V                  | 39.6                | 61.9                | -10.3            | 29.3                | 51.6                | 54                  | 74                  | -24.7          | -22.4          | 179         | 266.4       | Pass      |
| 2                                                               | 4823.137        | H                  | 31.7                | 44.4                | -1.9             | 29.8                | 42.5                | 54                  | 74                  | -24.2          | -31.5          | 100         | 249.1       | Pass      |
| 3                                                               | 6406.263        | H                  | 30.6                | 43.8                | 1.5              | 32.1                | 45.3                | 54                  | 74                  | -21.9          | -28.7          | 234         | 206.9       | Pass      |

### Above 1GHz-25GHz- 802.11b - 2437MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 1815.322        | V                  | 39.2                | 52.8                | -7.7             | 31.5                | 45.1                | 54                  | 74                  | -22.5          | -28.9          | 215         | 0           | Pass      |
| 2                                                               | 3006.261        | H                  | 36.3                | 49.5                | -5.2             | 31.1                | 44.3                | 54                  | 74                  | -22.9          | -29.7          | 294         | 276.5       | Pass      |
| 3                                                               | 4874.188        | V                  | 34                  | 46.5                | -2.1             | 31.9                | 44.4                | 54                  | 74                  | -22.1          | -29.6          | 172         | 162.7       | Pass      |

### Above 1GHz-25GHz – 802.11b – 2462MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 3686.243        | H                  | 36.6                | 49.8                | -3.7             | 32.9                | 46.1                | 54                  | 74                  | -21.1          | -27.9          | 169         | 22.5        | Pass      |
| 2                                                               | 4923.197        | V                  | 34.6                | 51.9                | -2.1             | 32.5                | 49.8                | 54                  | 74                  | -21.5          | -24.2          | 100         | 0           | Pass      |
| 3                                                               | 8226.475        | H                  | 28                  | 41.1                | 5.2              | 33.2                | 46.3                | 54                  | 74                  | -20.8          | -27.7          | 122         | 332.7       | Pass      |

## REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

### Above 1GHz-25GHz- 802.11g - 2412MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 1185.442        | V                  | 40.7                | 60.1                | -10.3            | 30.4                | 49.8                | 54                  | 74                  | -23.6          | -24.2          | 137         | 96.8        | Pass      |
| 2                                                               | 4823.811        | H                  | 31.7                | 44.7                | -1.9             | 29.8                | 42.8                | 54                  | 74                  | -24.2          | -31.2          | 258         | 147.9       | Pass      |
| 3                                                               | 6271.096        | H                  | 30.8                | 44.2                | 1.2              | 32                  | 45.4                | 54                  | 74                  | -22            | -28.6          | 151         | 313.9       | Pass      |

### Above 1GHz-25GHz – 802.11g – 2437MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 2393.393        | H                  | 37.7                | 50.9                | -5.8             | 31.9                | 45.1                | 54                  | 74                  | -22.1          | -28.9          | 244         | 235.9       | Pass      |
| 2                                                               | 3006.777        | V                  | 36.8                | 50                  | -5.2             | 31.6                | 44.8                | 54                  | 74                  | -22.4          | -29.2          | 102         | 178.7       | Pass      |
| 3                                                               | 4874.798        | V                  | 33.7                | 46.3                | -2.1             | 31.6                | 44.2                | 54                  | 74                  | -22.4          | -29.8          | 208         | 104.6       | Pass      |

### Above 1GHz-25GHz- 802.11g - 2462MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 3788.292        | V                  | 35.7                | 49.8                | -2.9             | 32.8                | 46.9                | 54                  | 74                  | -21.2          | -27.1          | 174         | 192.2       | Pass      |
| 2                                                               | 4923.786        | H                  | 34.3                | 48.3                | -2.1             | 32.2                | 46.2                | 54                  | 74                  | -21.8          | -27.8          | 265         | 9.2         | Pass      |
| 3                                                               | 8226.007        | H                  | 28.1                | 41.3                | 5.2              | 33.3                | 46.5                | 54                  | 74                  | -20.7          | -27.5          | 100         | 171.8       | Pass      |

#### REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

### Above 1GHz-25GHz- 802.11n20 - 2412MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 1034.985        | V                  | 41.4                | 54.2                | -11.2            | 30.2                | 43                  | 54                  | 74                  | -23.8          | -31            | 129         | 1.4         | Pass      |
| 2                                                               | 1798.637        | H                  | 39.1                | 52.8                | -7.9             | 31.2                | 44.9                | 54                  | 74                  | -22.8          | -29.1          | 387         | 113.1       | Pass      |
| 3                                                               | 4822.788        | H                  | 31.6                | 53.3                | -1.9             | 29.7                | 51.4                | 54                  | 74                  | -24.3          | -22.6          | 165         | 0           | Pass      |

### Above 1GHz-25GHz – 802.11n20 – 2437MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 3413.339        | H                  | 36.9                | 50.3                | -3.9             | 33                  | 46.4                | 54                  | 74                  | -21            | -27.6          | 144         | 314.3       | Pass      |
| 2                                                               | 4874.119        | V                  | 34                  | 47.1                | -2.1             | 31.9                | 45                  | 54                  | 74                  | -22.1          | -29            | 100         | 271.9       | Pass      |
| 3                                                               | 11149.175       | V                  | 24.1                | 38                  | 8.7              | 32.8                | 46.7                | 54                  | 74                  | -21.2          | -27.3          | 348         | 204.9       | Pass      |

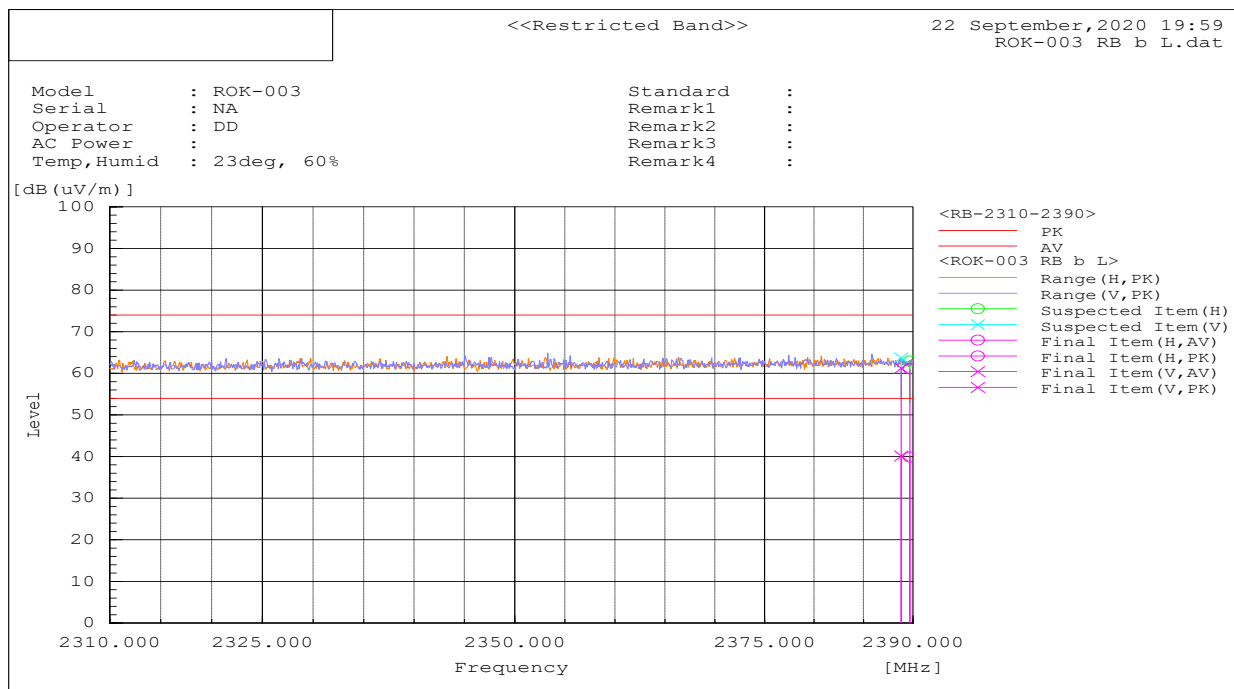
### Above 1GHz-25GHz- 802.11n20 - 2462MHz

| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 3822.429        | H                  | 36.5                | 49.9                | -2.9             | 33.6                | 47                  | 54                  | 74                  | -20.4          | -27            | 120         | 0.7         | Pass      |
| 2                                                               | 4923.318        | H                  | 34.4                | 48                  | -2.1             | 32.3                | 45.9                | 54                  | 74                  | -21.7          | -28.1          | 129         | 297.6       | Pass      |
| 3                                                               | 6950.412        | V                  | 29.3                | 43.1                | 2.5              | 31.8                | 45.6                | 54                  | 74                  | -22.2          | -28.4          | 372         | 133.7       | Pass      |

#### REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

# RESTRICTED BAND (802.11b LOW CHANNEL)

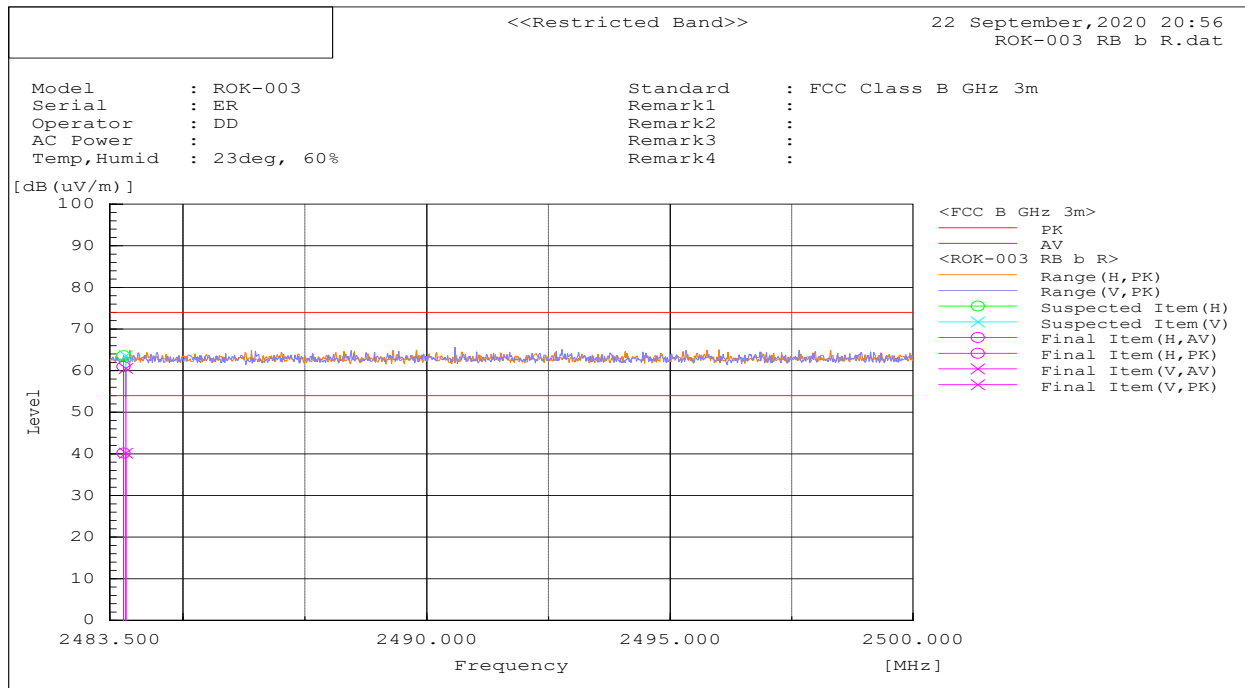


| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 2388.8          | V                  | 1                   | 22.2                | 39.1             | 40.1                | 61.3                | 54                  | 74                  | -13.9          | -12.7          | 120         | 218         | Pass      |
| 2                                                               | 2389.68         | H                  | 0.8                 | 22                  | 39.1             | 39.9                | 61.1                | 54                  | 74                  | -14.1          | -12.9          | 390         | 184         | Pass      |

## REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

# RESTRICTED BAND (802.11b High CHANNEL)



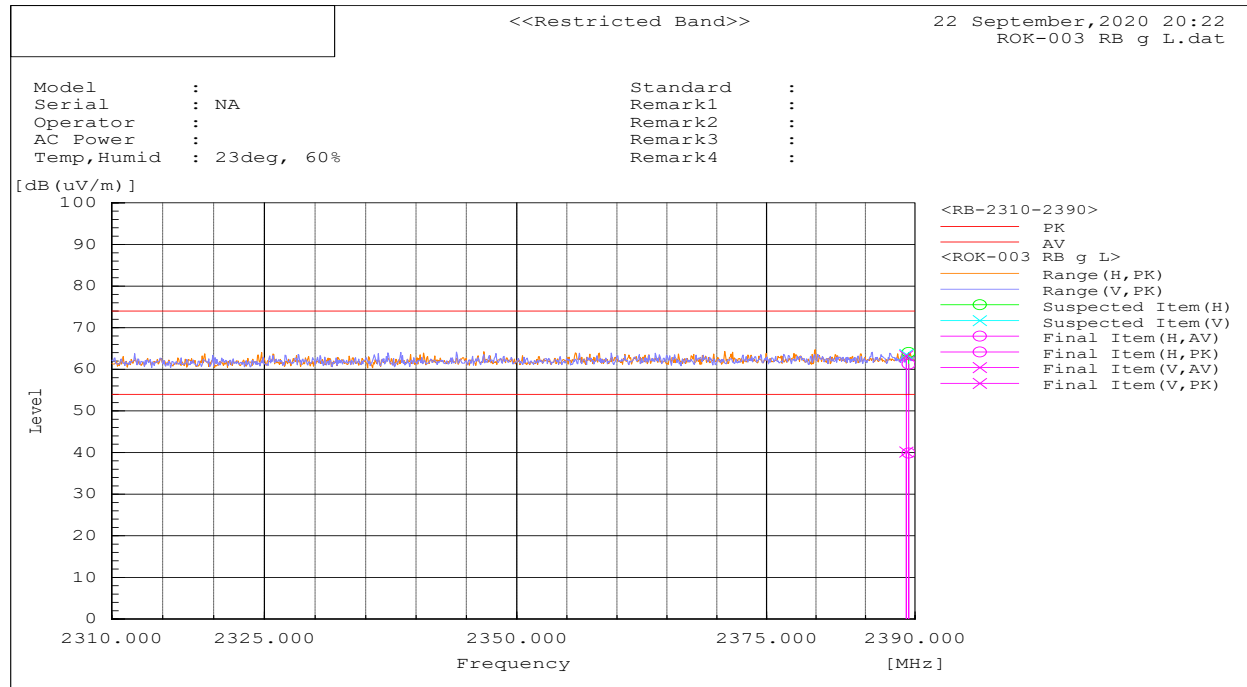
Antenna Polarity & Test Distance: Vertical and Horizontal at 3m

| No | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
|----|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| 1  | 2483.781        | H                  | 0.6                 | 21.4                | 39.6             | 40.2                | 61                  | 54                  | 74                  | -13.8          | -13            | 281         | 305.9       | Pass      |
| 2  | 2483.83         | V                  | 0.6                 | 20.9                | 39.6             | 40.2                | 60.5                | 54                  | 74                  | -13.8          | -13.5          | 179         | 289.2       | Pass      |

## REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

# RESTRICTED BAND (802.11g LOW CHANNEL)



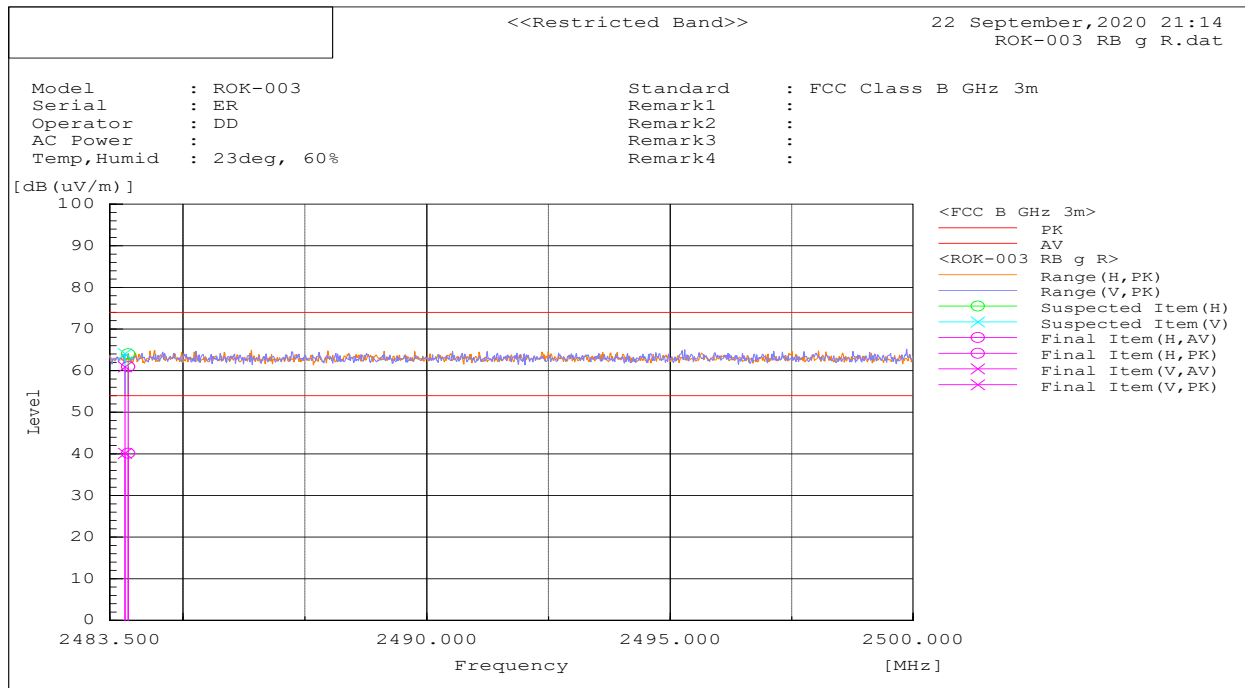
| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 2389.12         | V                  | 1                   | 24.2                | 39.1             | 40.1                | 63.3                | 54                  | 74                  | -13.9          | -10.7          | 230         | 250.5       | Pass      |
| 2                                                               | 2389.36         | H                  | 0.8                 | 22.2                | 39.1             | 39.9                | 61.3                | 54                  | 74                  | -14.1          | -12.7          | 357         | 188.8       | Pass      |

## REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)



# RESTRICTED BAND (802.11g High CHANNEL)

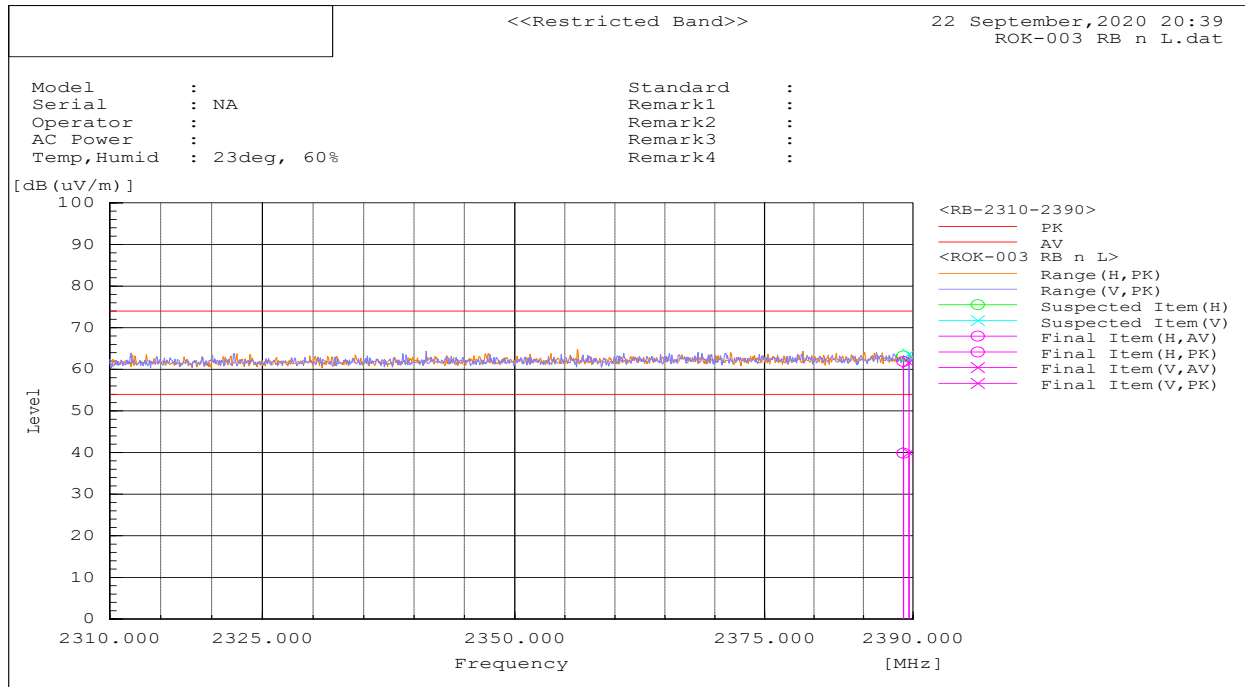


| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 2483.814        | V                  | 0.6                 | 21.3                | 39.6             | 40.2                | 60.9                | 54                  | 74                  | -13.8          | -13.1          | 188         | 4           | Pass      |
| 2                                                               | 2483.88         | H                  | 0.6                 | 21.3                | 39.6             | 40.2                | 60.9                | 54                  | 74                  | -13.8          | -13.1          | 373         | 46.2        | Pass      |

## REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

# RESTRICTED BAND (802.11n LOW CHANNEL)

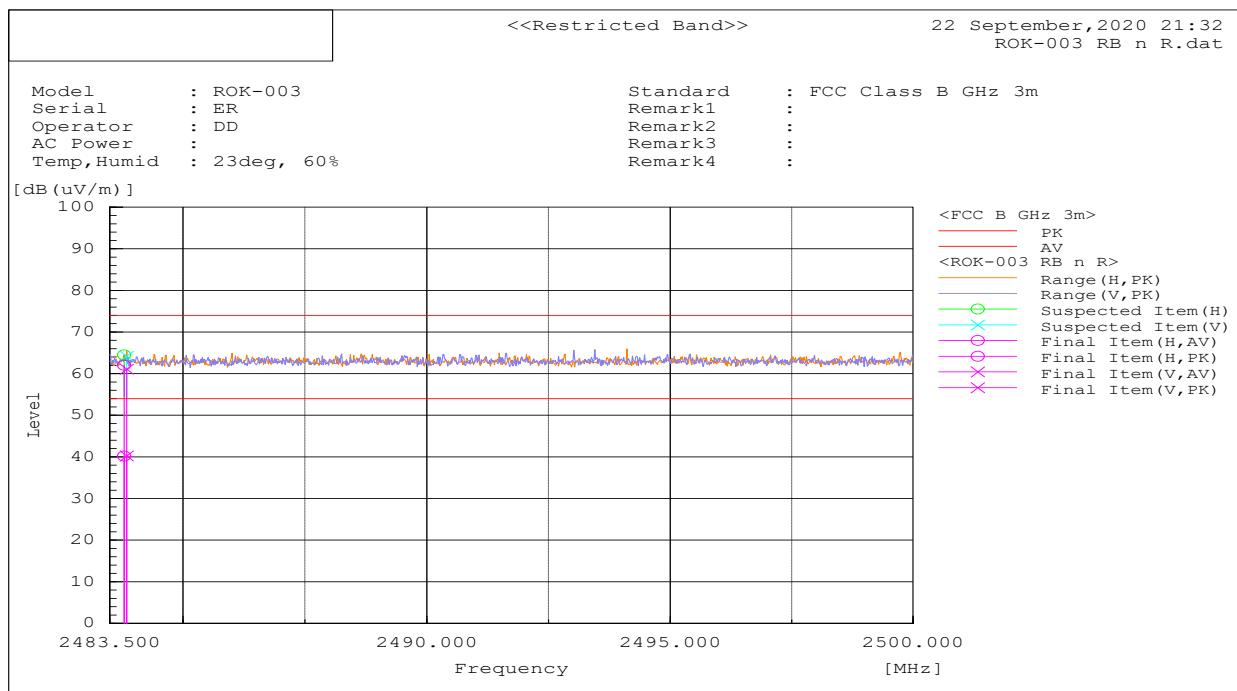


| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 2389.04         | H                  | 0.8                 | 22.8                | 39.1             | 39.9                | 61.9                | 54                  | 74                  | -14.1          | -12.1          | 171         | 179.3       | Pass      |
| 2                                                               | 2389.6          | V                  | 0.9                 | 22.5                | 39.1             | 40                  | 61.6                | 54                  | 74                  | -14            | -12.4          | 281         | 293.7       | Pass      |

## REMARKS:

- Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
- Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) –Preamplifier Gain (dB)
- Margin = Level (dBuV/m) - Limit value (dBuV/m)

# RESTRICTED BAND (802.11n High CHANNEL)



| Antenna Polarity & Test Distance: Vertical and Horizontal at 3m |                 |                    |                     |                     |                  |                     |                     |                     |                     |                |                |             |             |           |
|-----------------------------------------------------------------|-----------------|--------------------|---------------------|---------------------|------------------|---------------------|---------------------|---------------------|---------------------|----------------|----------------|-------------|-------------|-----------|
| No                                                              | Frequency (MHz) | Polarization (H/V) | Reading AV [dB(uV)] | Reading PK [dB(uV)] | Factor [dB(1/m)] | Level AV [dB(uV/m)] | Level PK [dB(uV/m)] | Limit AV [dB(uV/m)] | Limit PK [dB(uV/m)] | Margin AV [dB] | Margin PK [dB] | Height (cm) | Angle (Deg) | Pass/Fail |
| 1                                                               | 2483.797        | H                  | 0.6                 | 22.4                | 39.6             | 40.2                | 62                  | 54                  | 74                  | -13.8          | -12            | 154         | 126         | Pass      |
| 2                                                               | 2483.847        | V                  | 0.6                 | 21.5                | 39.6             | 40.2                | 61.1                | 54                  | 74                  | -13.8          | -12.9          | 196         | 247.7       | Pass      |

## REMARKS:

1. Level (dBuV) = Reading (dBuV) + Factor (dB(1/m)).
2. Factor (dB(1/m)) = Antenna Factor(AF) (dB(1/m)) + Cable Loss (dB) -Preamplifier Gain (dB)
3. Margin = Level (dBuV/m) - Limit value (dBuV/m)

## 4.2 Conducted Emission Measurement

### 4.2.1 Limits of Conducted Emission Measurement

| Frequency (MHz) | Conducted Limit (dBuV) |         |
|-----------------|------------------------|---------|
|                 | Quasi-peak             | Average |
| 0.15 - 0.5      | 66 - 56                | 56 - 46 |
| 0.50 - 5.0      | 56                     | 46      |
| 5.0 - 30.0      | 60                     | 50      |

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

### 4.2.2 Test Instruments

| Description & Manufacturer           | Model No. | Serial No. | Date Of Calibration | Due Date Of Calibration |
|--------------------------------------|-----------|------------|---------------------|-------------------------|
| EMI Test Receiver<br>Rohde & Schwarz | ESIB 40   | 100179     | 11/1/2019           | 11/1/2020               |
| Transient Limiter<br>Electro-Metrics | EM-7600-5 | 106        | 12/31/2019          | 12/31/2020              |
| LISN<br>ETS-Lindgren                 | 3816/2NM  | 214372     | 1/14/2020           | 1/14/2021               |

#### 4.2.3 Test Procedures

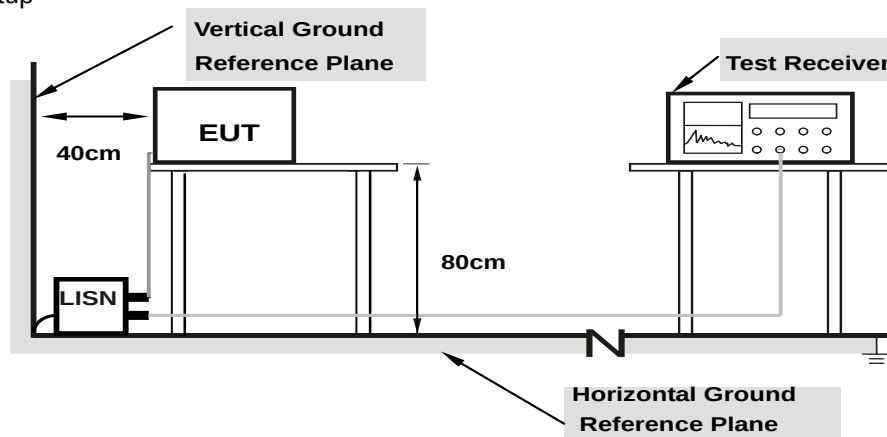
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

**NOTE:** The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

#### 4.2.4 Deviation from Test Standard

No deviation.

#### 4.2.5 Test Setup



**Note:** 1.Support units were connected to second LISN.

For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.2.6 EUT Operating Conditions

Same as 4.1.6.

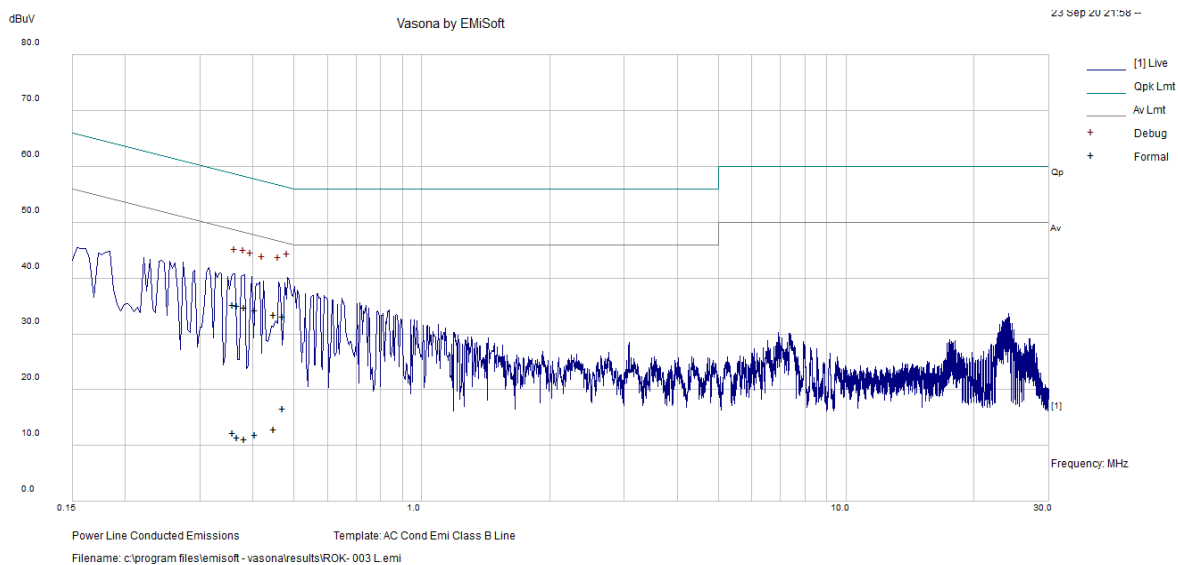
#### 4.2.7 Test Results

|                 |                |                          |                 |
|-----------------|----------------|--------------------------|-----------------|
| Frequency Range | 0.15-30 MHz    | Phase                    | {Line}          |
| Input Power     | 120 Vac, 60 Hz | Environmental Conditions | {22 °C, 55% RH} |
| Tested by       | Deon Dai       | Test Date                | 09/23/2020      |
| Test Mode       | TX             |                          |                 |

| No | Frequency (MHz) | Reading Value (dBuV) | Cable Loss (dB) | Insertion Loss (dB) | Emission Level Corrected (dBuV) | Measurement Type | Line/ Neutral | Limit (dBuV) | Margin (dB) | Pass/ Fail |
|----|-----------------|----------------------|-----------------|---------------------|---------------------------------|------------------|---------------|--------------|-------------|------------|
| 1  | 0.471812        | 23.6                 | 9.45            | 0.04                | 33.09                           | Quasi Peak       | Line          | 56.48        | -23.39      | Pass       |
| 2  | 0.448726        | 24.05                | 9.45            | 0.04                | 33.53                           | Quasi Peak       | Line          | 56.9         | -23.36      | Pass       |
| 3  | 0.367888        | 25.65                | 9.44            | 0.04                | 35.13                           | Quasi Peak       | Line          | 58.55        | -23.42      | Pass       |
| 4  | 0.383784        | 25.26                | 9.44            | 0.04                | 34.74                           | Quasi Peak       | Line          | 58.2         | -23.46      | Pass       |
| 5  | 0.359002        | 25.82                | 9.44            | 0.04                | 35.3                            | Quasi Peak       | Line          | 58.75        | -23.45      | Pass       |
| 6  | 0.406858        | 24.85                | 9.45            | 0.04                | 34.33                           | Quasi Peak       | Line          | 57.71        | -23.38      | Pass       |
| 7  | 0.471812        | 7.12                 | 9.45            | 0.04                | 16.6                            | Average          | Line          | 46.48        | -29.88      | Pass       |
| 8  | 0.448726        | 3.39                 | 9.45            | 0.04                | 12.88                           | Average          | Line          | 46.9         | -34.02      | Pass       |
| 9  | 0.367888        | 2.06                 | 9.44            | 0.04                | 11.54                           | Average          | Line          | 48.55        | -37.01      | Pass       |
| 10 | 0.383784        | 1.69                 | 9.44            | 0.04                | 11.17                           | Average          | Line          | 48.2         | -37.03      | Pass       |
| 11 | 0.359002        | 2.75                 | 9.44            | 0.04                | 12.23                           | Average          | Line          | 48.75        | -36.52      | Pass       |
| 12 | 0.406858        | 2.41                 | 9.45            | 0.04                | 11.89                           | Average          | Line          | 47.71        | -35.82      | Pass       |

#### Remarks:

1. The emission levels of other frequencies were very low against the limit.
2. Margin value = Emission level – Limit value
3. Correction factor = Insertion loss + Cable loss
4. Emission Level = Correction Factor + Reading Value

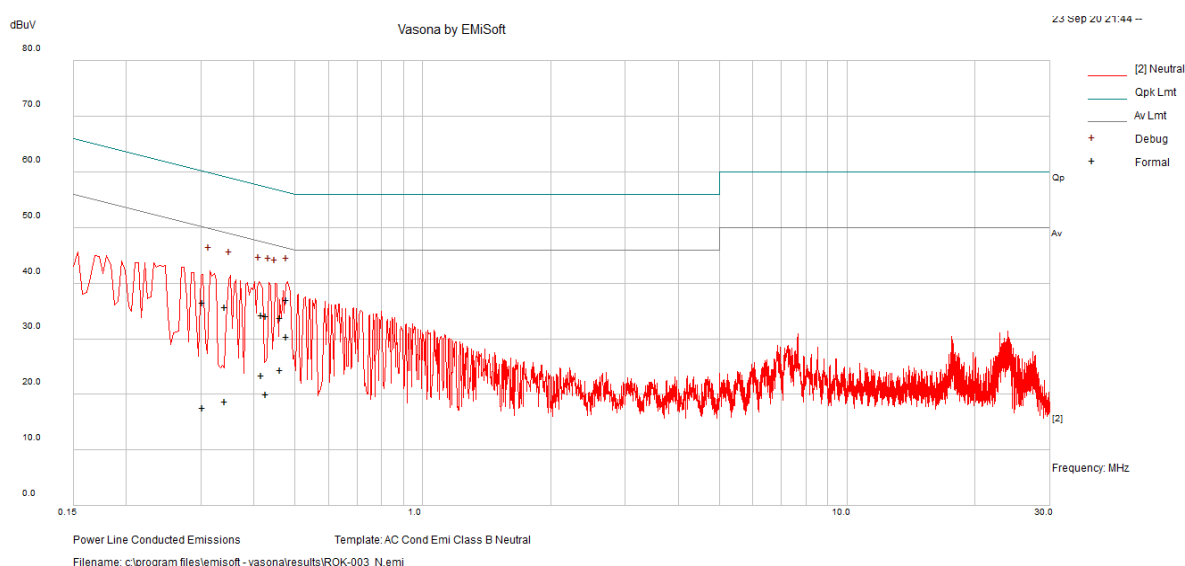


|                 |                |                          |                 |
|-----------------|----------------|--------------------------|-----------------|
| Frequency Range | 0.15-30 MHz    | Phase                    | {Neutral}       |
| Input Power     | 120 Vac, 60 Hz | Environmental Conditions | {22 °C, 55% RH} |
| Tested by       | Deon Dai       | Test Date                | 09/23/2020      |
| Test Mode       | TX             |                          |                 |

| No | Frequency (MHz) | Reading Value (dBuV) | Cable Loss (dB) | Insertion Loss (dB) | Emission Level Corrected (dBuV) | Measurement Type | Line/ Neutral | Limit (dBuV) | Margin (dB) | Pass/ Fail |
|----|-----------------|----------------------|-----------------|---------------------|---------------------------------|------------------|---------------|--------------|-------------|------------|
| 1  | 0.479471        | 27.54                | 9.45            | 0.03                | 37.02                           | Quasi Peak       | Neutral       | 56.35        | -19.33      | Pass       |
| 2  | 0.427455        | 24.59                | 9.45            | 0.03                | 34.06                           | Quasi Peak       | Neutral       | 57.3         | -23.24      | Pass       |
| 3  | 0.462108        | 24.37                | 9.45            | 0.03                | 33.85                           | Quasi Peak       | Neutral       | 56.65        | -22.81      | Pass       |
| 4  | 0.417139        | 24.78                | 9.45            | 0.03                | 34.25                           | Quasi Peak       | Neutral       | 57.5         | -23.25      | Pass       |
| 5  | 0.343383        | 26.24                | 9.44            | 0.03                | 35.71                           | Quasi Peak       | Neutral       | 59.12        | -23.41      | Pass       |
| 6  | 0.303607        | 27.1                 | 9.44            | 0.03                | 36.56                           | Quasi Peak       | Neutral       | 60.14        | -23.58      | Pass       |
| 7  | 0.479471        | 20.94                | 9.45            | 0.03                | 30.42                           | Average          | Neutral       | 46.35        | -15.93      | Pass       |
| 8  | 0.427455        | 10.58                | 9.45            | 0.03                | 20.06                           | Average          | Neutral       | 47.3         | -27.24      | Pass       |
| 9  | 0.462108        | 14.88                | 9.45            | 0.03                | 24.36                           | Average          | Neutral       | 46.65        | -22.3       | Pass       |
| 10 | 0.417139        | 14.01                | 9.45            | 0.03                | 23.49                           | Average          | Neutral       | 47.5         | -24.02      | Pass       |
| 11 | 0.343383        | 9.27                 | 9.44            | 0.03                | 18.74                           | Average          | Neutral       | 49.12        | -30.38      | Pass       |
| 12 | 0.303607        | 8.09                 | 9.44            | 0.03                | 17.56                           | Average          | Neutral       | 50.14        | -32.58      | Pass       |

#### Remarks:

1. The emission levels of other frequencies were very low against the limit.
2. Margin value = Emission level – Limit value
3. Correction factor = Insertion loss + Cable loss
4. Emission Level = Correction Factor + Reading Value

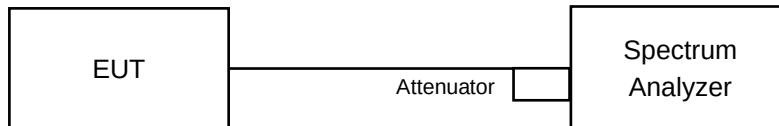


### 4.3 6dB Bandwidth Measurement

#### 4.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

#### 4.3.2 Test Setup



#### 4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4 Test Procedure

- Set resolution bandwidth (RBW) = 100kHz
- Set the video bandwidth (VBW)  $\geq 3 \times$  RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

#### 4.3.5 Deviation from Test Standard

No deviation.

#### 4.3.6 EUT Operating Conditions

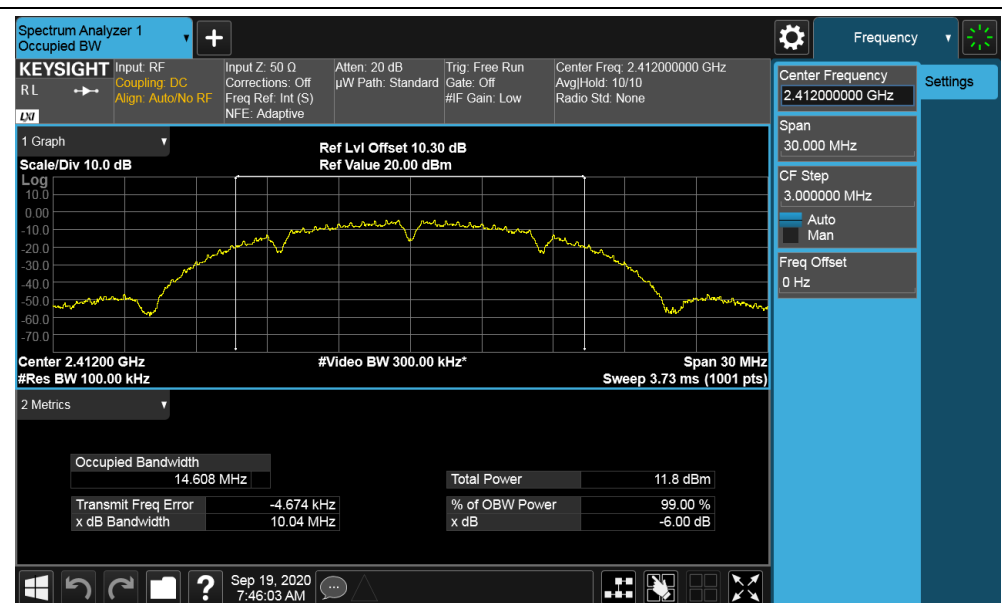
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.



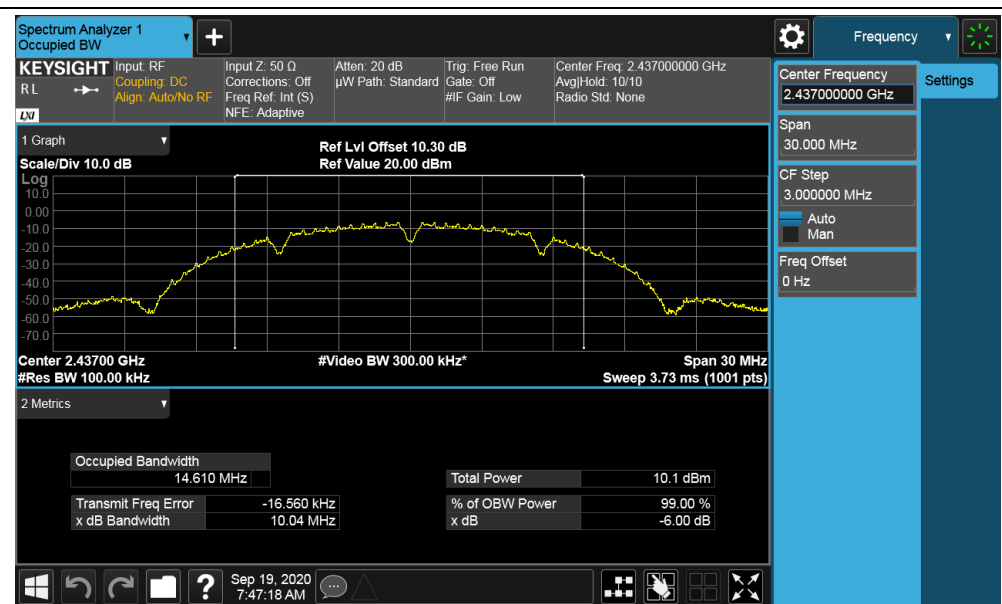
#### 4.3.7 Test Result

| Mode         | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) | Minimum Limit (MHz) | Pass / Fail |
|--------------|---------|-----------------|---------------------|---------------------|-------------|
| 802.11b      | 1       | 2412            | 10.04               | 0.5                 | PASS        |
|              | 6       | 2437            | 10.04               | 0.5                 | PASS        |
|              | 11      | 2462            | 10.04               | 0.5                 | PASS        |
| 802.11g      | 1       | 2412            | 16.42               | 0.5                 | PASS        |
|              | 6       | 2437            | 16.44               | 0.5                 | PASS        |
|              | 11      | 2462            | 16.47               | 0.5                 | PASS        |
| 802.11n-HT20 | 1       | 2412            | 17.63               | 0.5                 | PASS        |
|              | 6       | 2437            | 17.62               | 0.5                 | PASS        |
|              | 11      | 2462            | 17.61               | 0.5                 | PASS        |

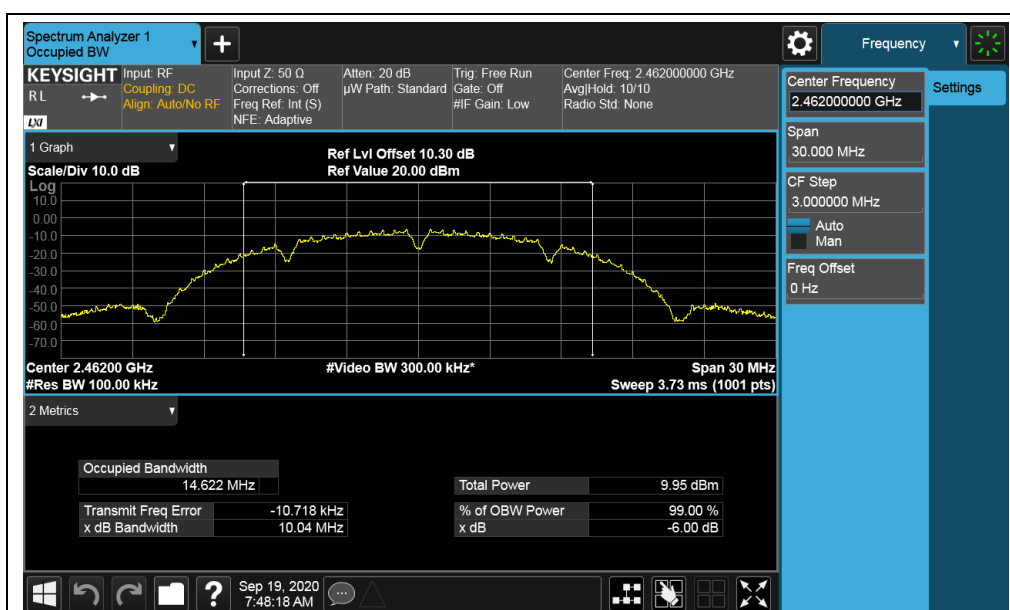
## Test Plots:



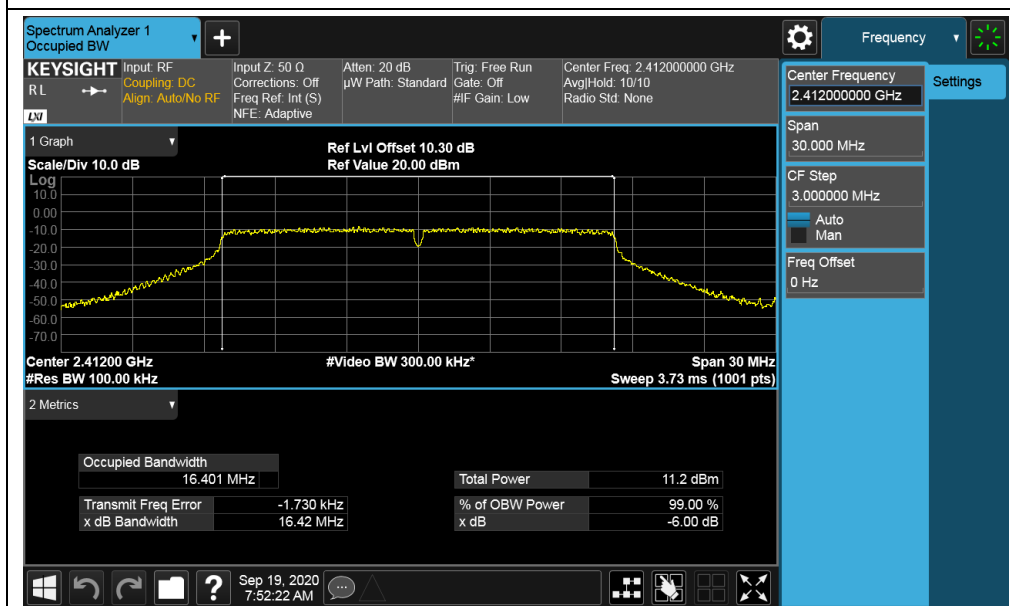
802.11b-2412MHz



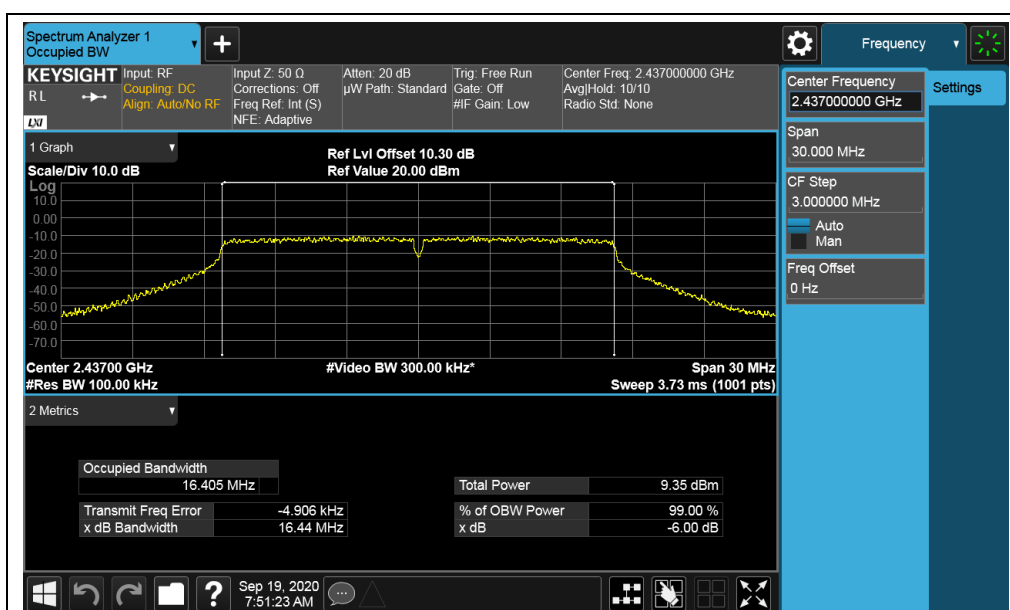
802.11b-2437MHz



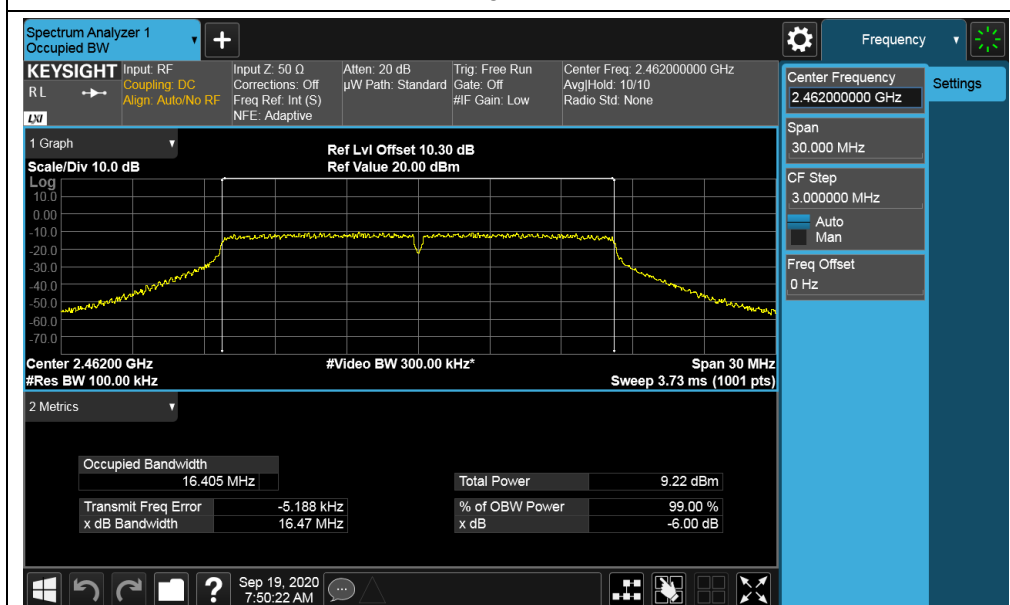
802.11b-2462MHz



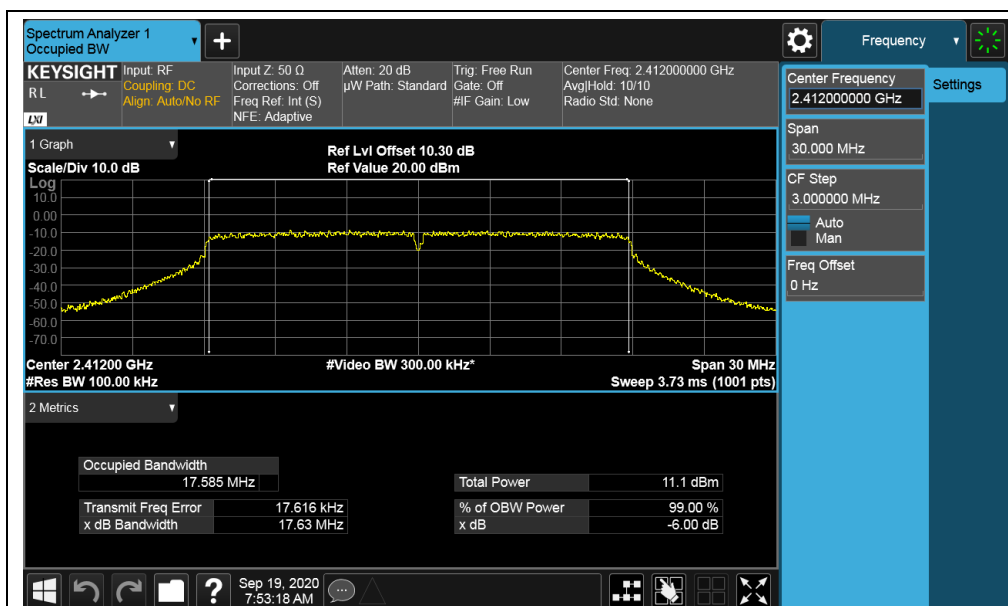
802.11g-2412MHz



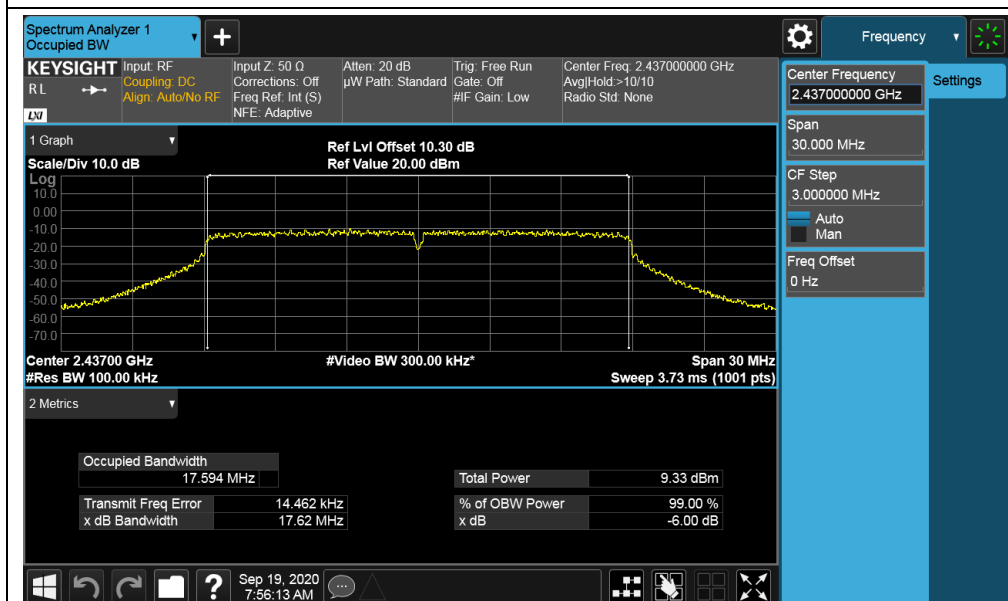
802.11g-2437MHz



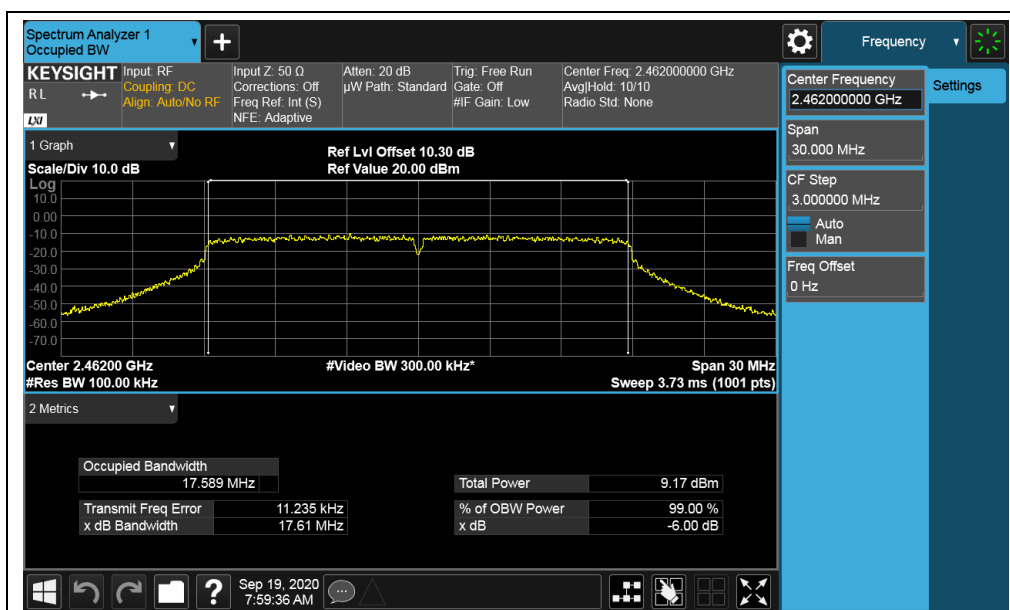
802.11g-2462MHz



802.11n-HT20-2412MHz



802.11n-HT20-2437MHz



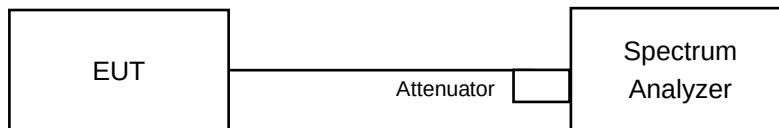
802.11n-HT20-2462MHz

#### 4.4 Conducted Output Power Measurement

##### 4.4.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

##### 4.4.2 Test Setup



##### 4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

##### 4.4.4 Test Procedures

- Set span to at least 1.5 times the OBW.
- Set RBW = 1-5% of the OBW, not to exceed 1 MHz.
- Set VBW  $\geq 3 \times$  RBW.
- Number of points in sweep  $\geq 2 \times$  span / RBW
- Sweep time = auto.
- Detector = RMS (i.e., power averaging), or sample detector mode.
- If transmit duty cycle  $< 98\%$ , use a sweep trigger with the level set to enable triggering only on full power pulses. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle  $\geq 98\%$ , and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- Trace average at least 100 traces in power averaging (i.e., RMS) mode.

##### 4.4.5 Deviation from Test Standard

No deviation.

##### 4.4.6 EUT Operating Conditions

Same as Item 4.3.6.

#### 4.4.7 Test Results

##### 802.11b

| Channel | Frequency (MHz) | Conducted Power (dBm) |         | Limit (dBm) | Pass/Fail |
|---------|-----------------|-----------------------|---------|-------------|-----------|
|         |                 | Chain 0               | Chain 1 |             |           |
| 1       | 2412            | 5.98                  | 6.03    | 30          | Pass      |
| 6       | 2437            | 4.25                  | 4.21    | 30          | Pass      |
| 11      | 2462            | 4.17                  | 4.04    | 30          | Pass      |

##### 802.11g

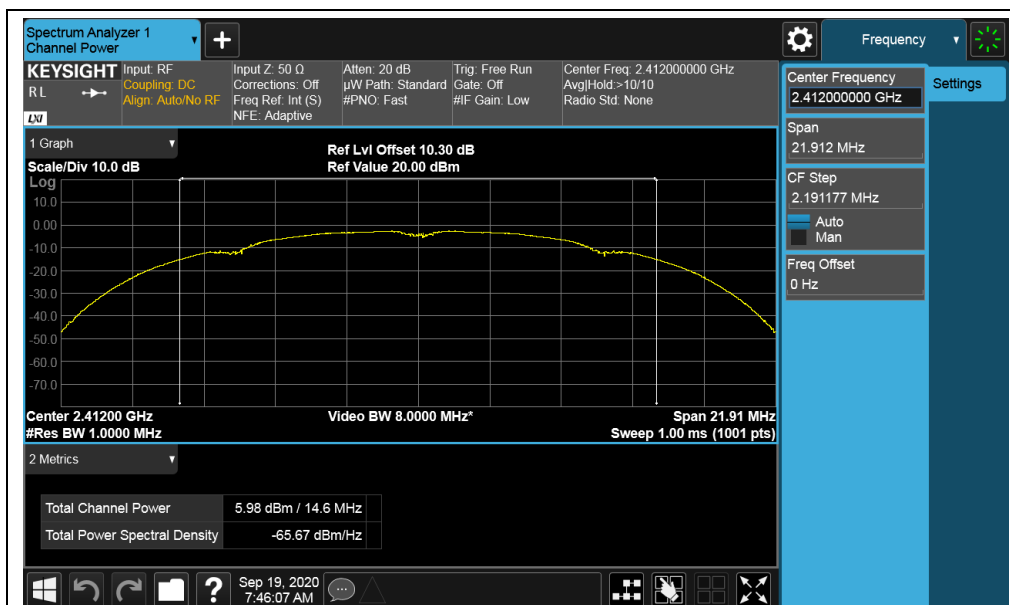
| Channel | Frequency (MHz) | Conducted Power (dBm) |         | Limit (dBm) | Pass/Fail |
|---------|-----------------|-----------------------|---------|-------------|-----------|
|         |                 | Chain 0               | Chain 1 |             |           |
| 1       | 2412            | 6.01                  | 5.98    | 30          | Pass      |
| 6       | 2437            | 4.27                  | 4.24    | 30          | Pass      |
| 11      | 2462            | 4.14                  | 4.06    | 30          | Pass      |

##### 802.11n-HT20

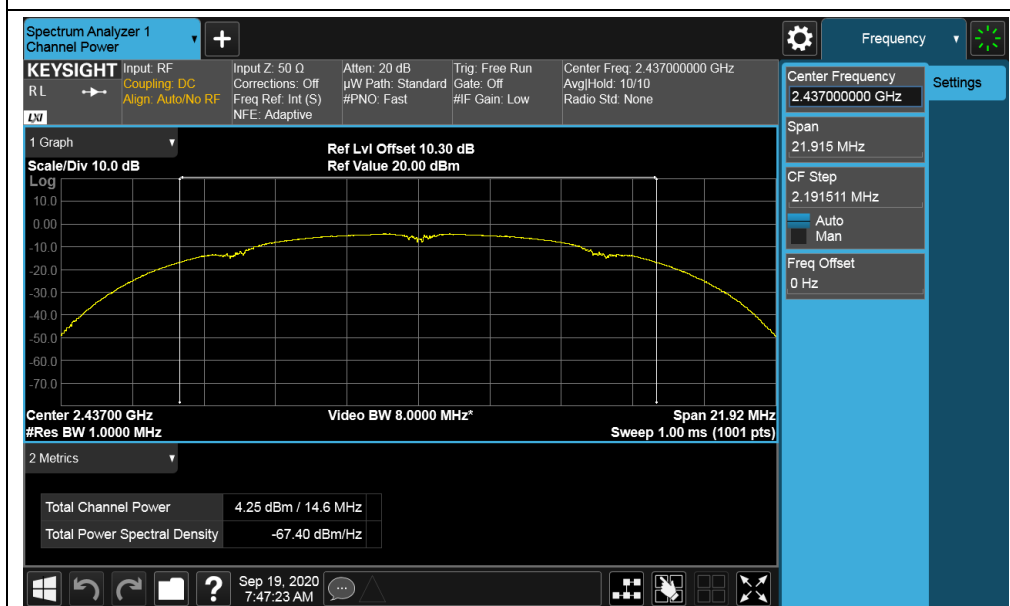
| Channel | Frequency (MHz) | Conducted Power (dBm) |         | Limit (dBm) | Pass/Fail |
|---------|-----------------|-----------------------|---------|-------------|-----------|
|         |                 | Chain 0               | Chain 1 |             |           |
| 1       | 2412            | 6.01                  | 5.90    | 30          | Pass      |
| 6       | 2437            | 4.29                  | 4.33    | 30          | Pass      |
| 11      | 2462            | 4.08                  | 4.18    | 30          | Pass      |



Test Plots:  
Chain 0



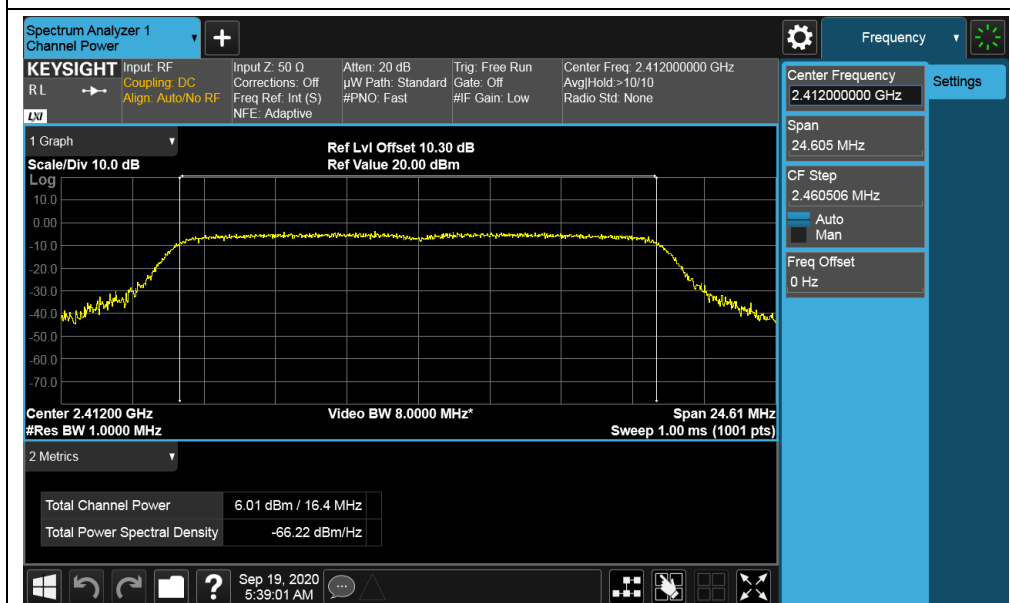
802.11b-2412MHz



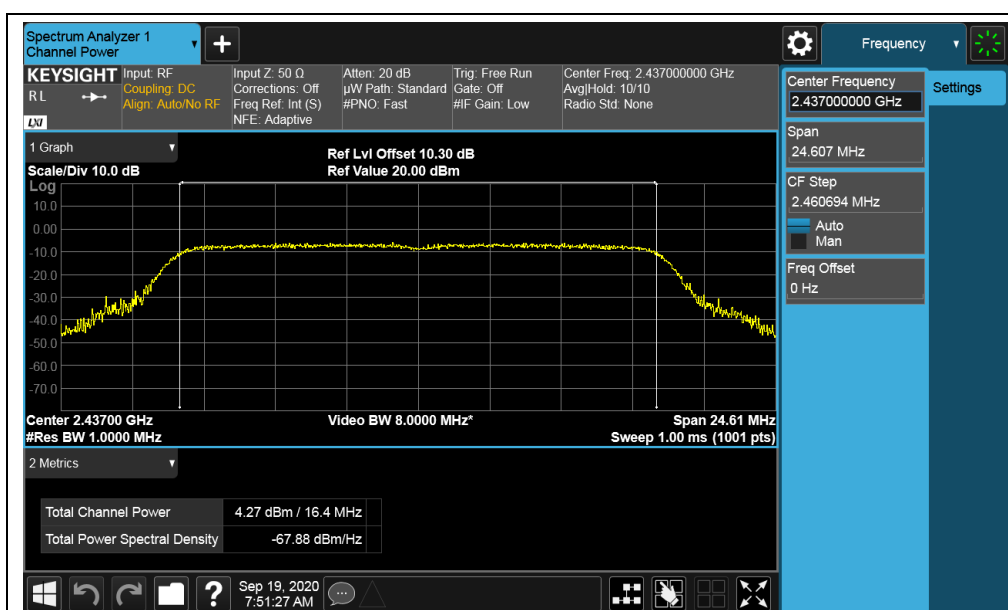
802.11b-2437MHz



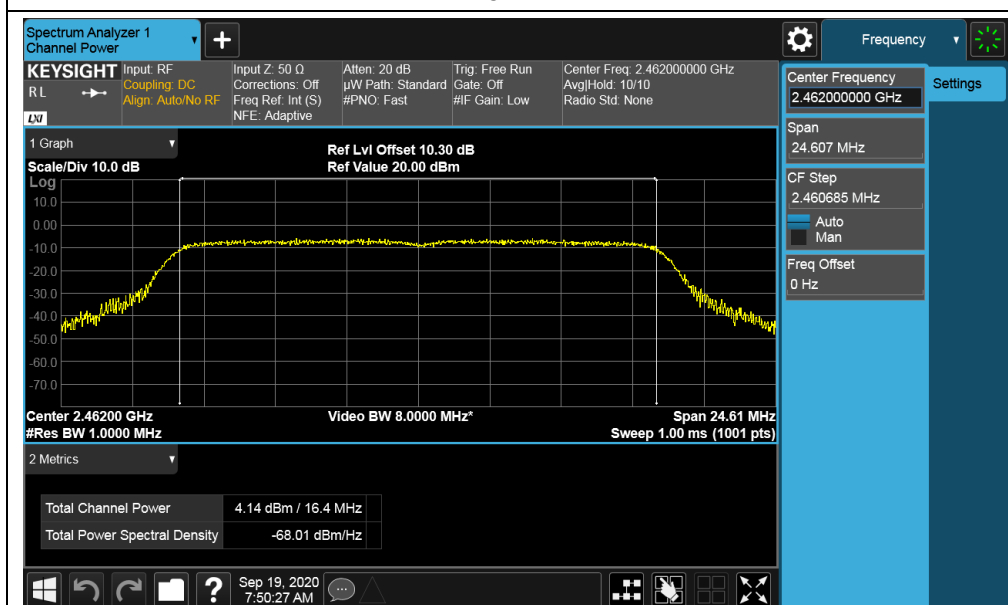
802.11b-2462MHz



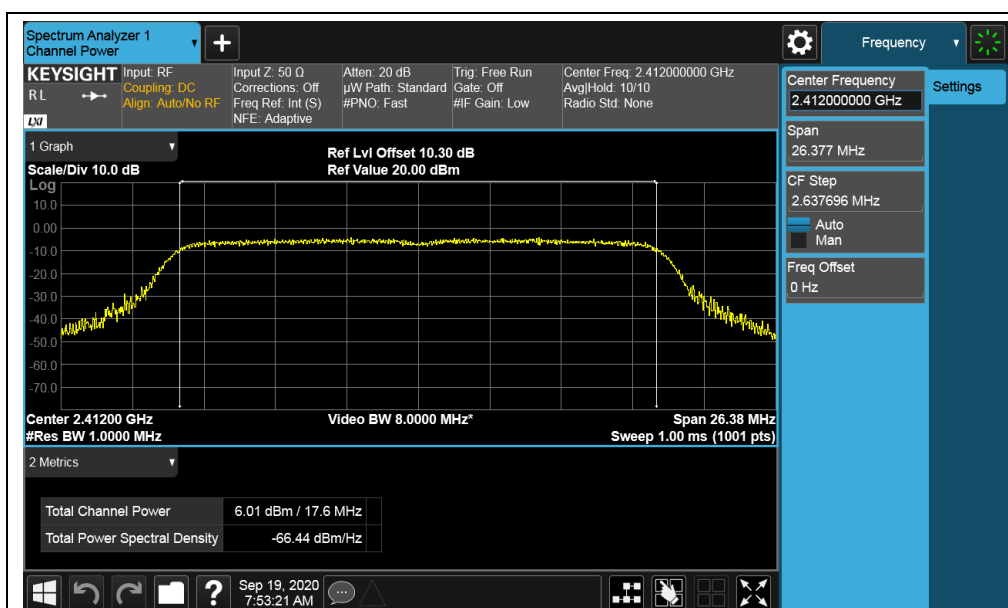
802.11g-2412MHz



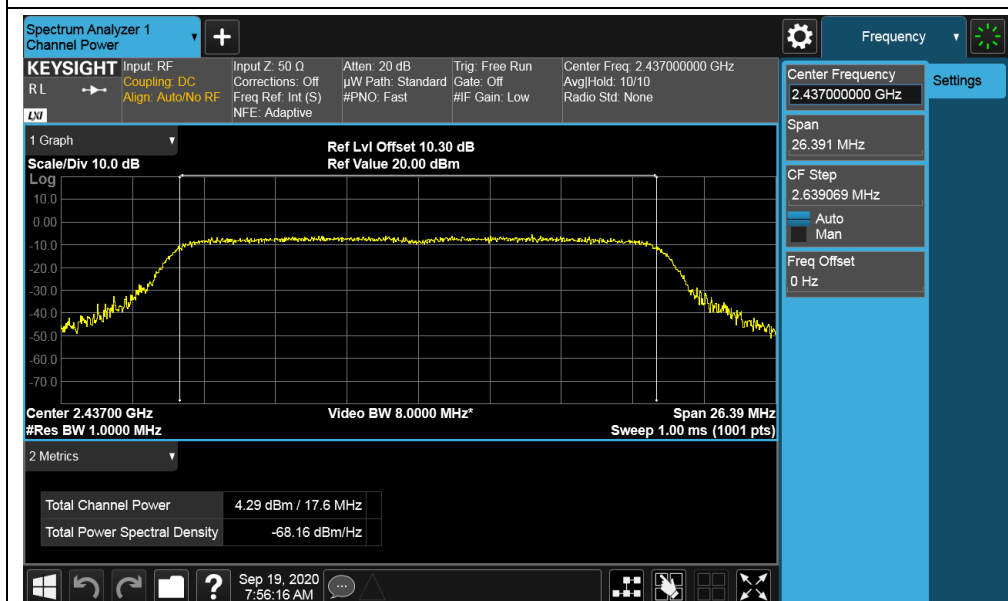
802.11g-2437MHz



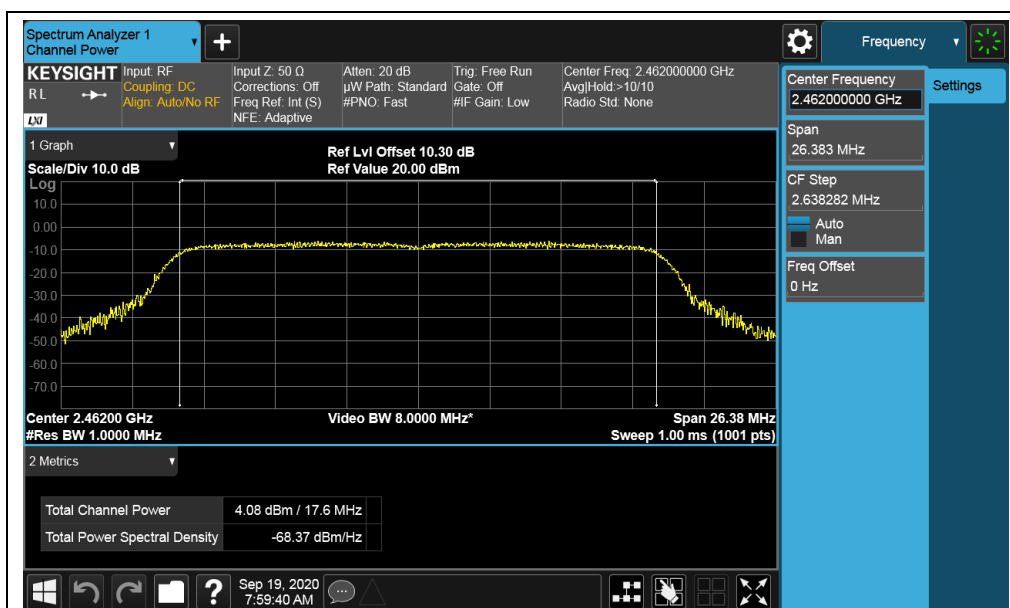
802.11g-2462MHz



802.11n-HT20-2412MHz

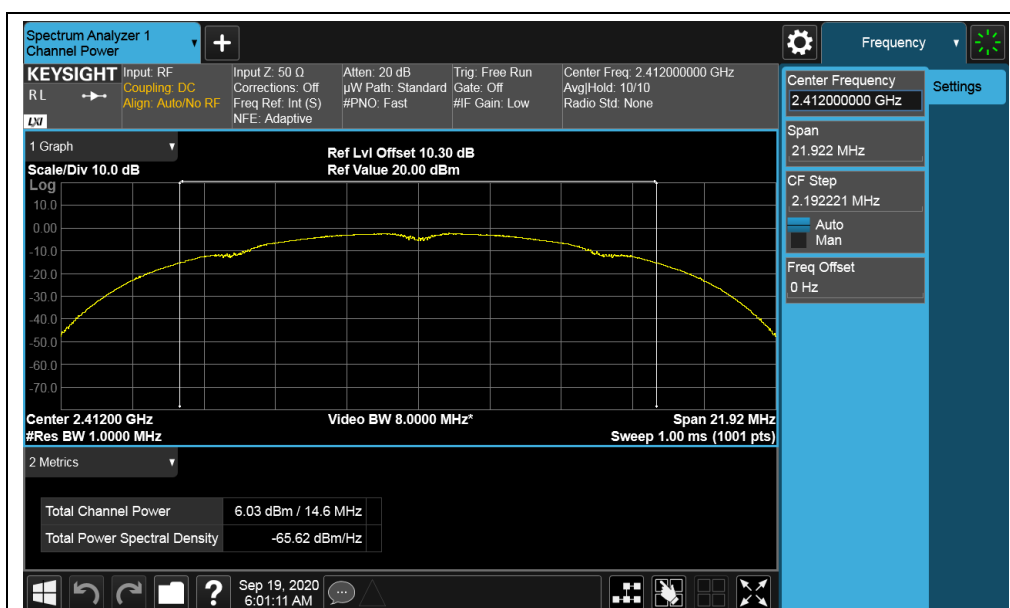


802.11n-HT20-2437MHz

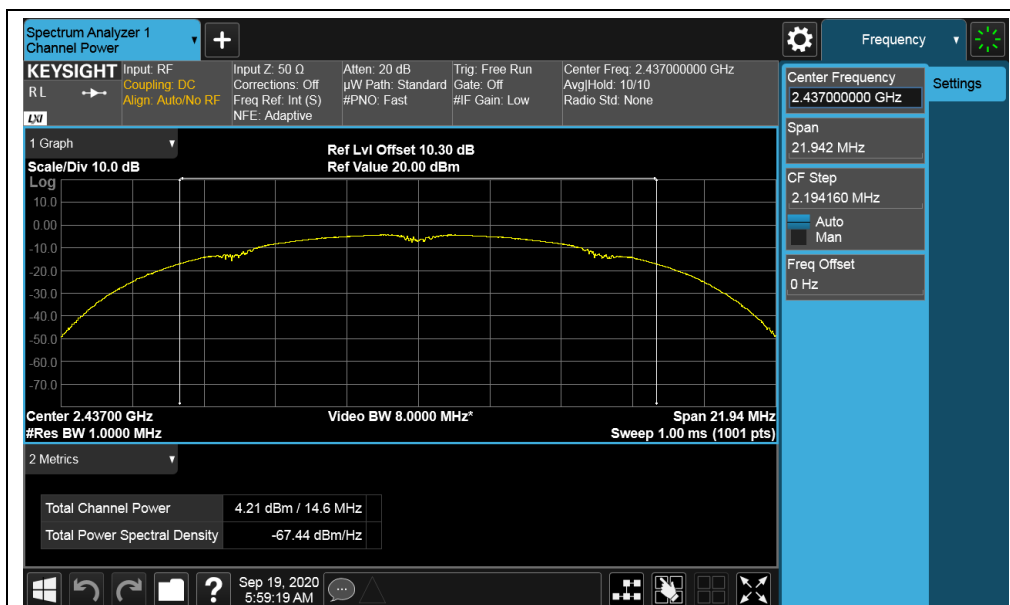


802.11n-HT20-2462MHz

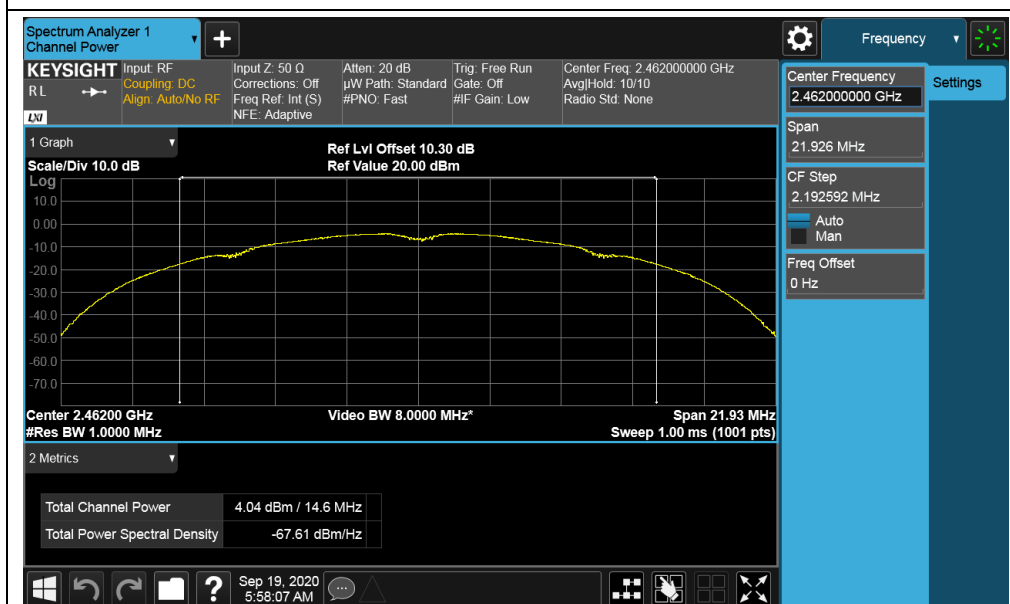
Chain 1



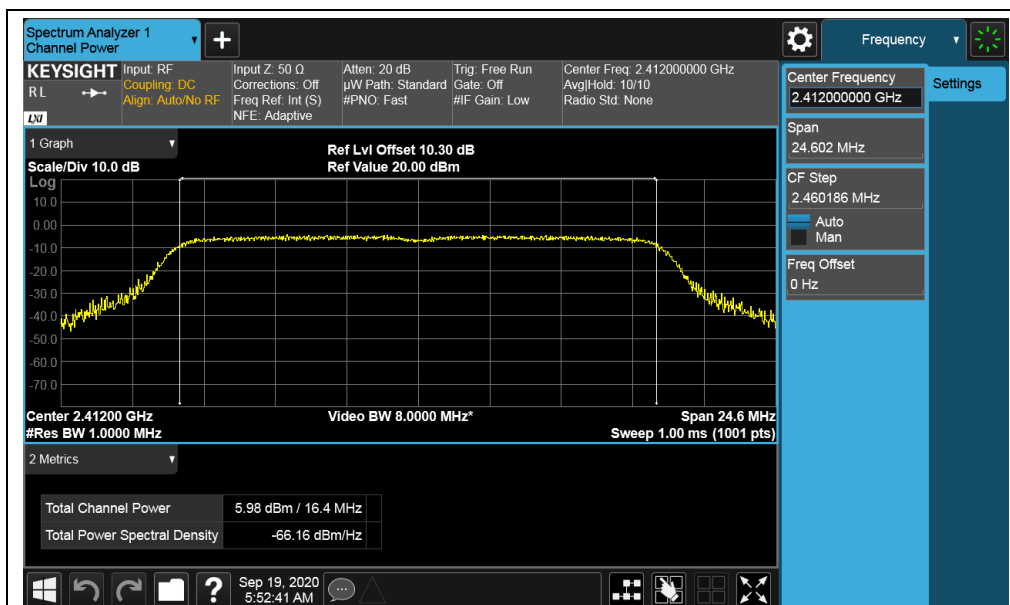
802.11b-2412MHz



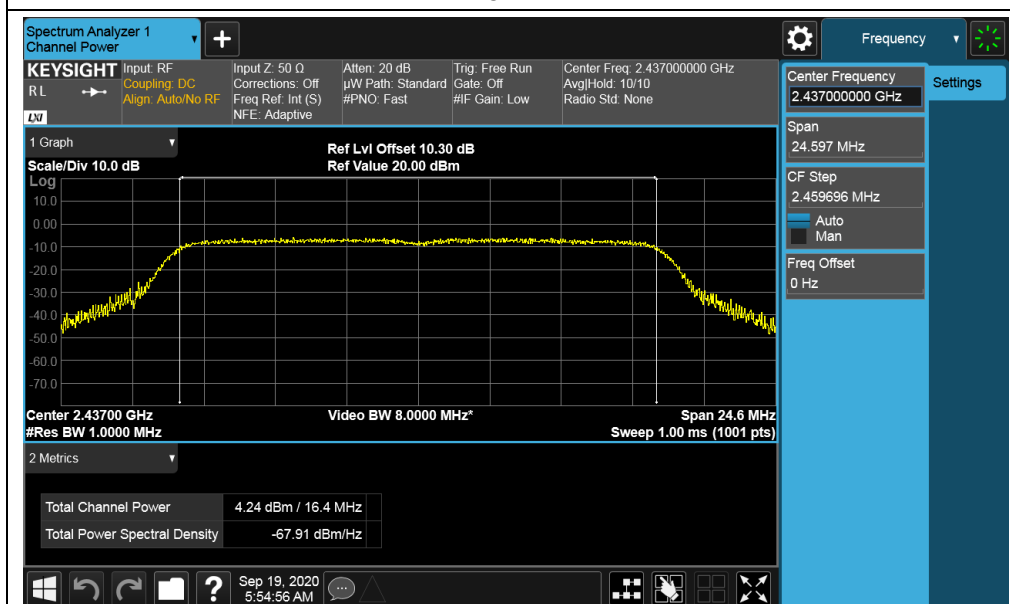
802.11b-2437MHz



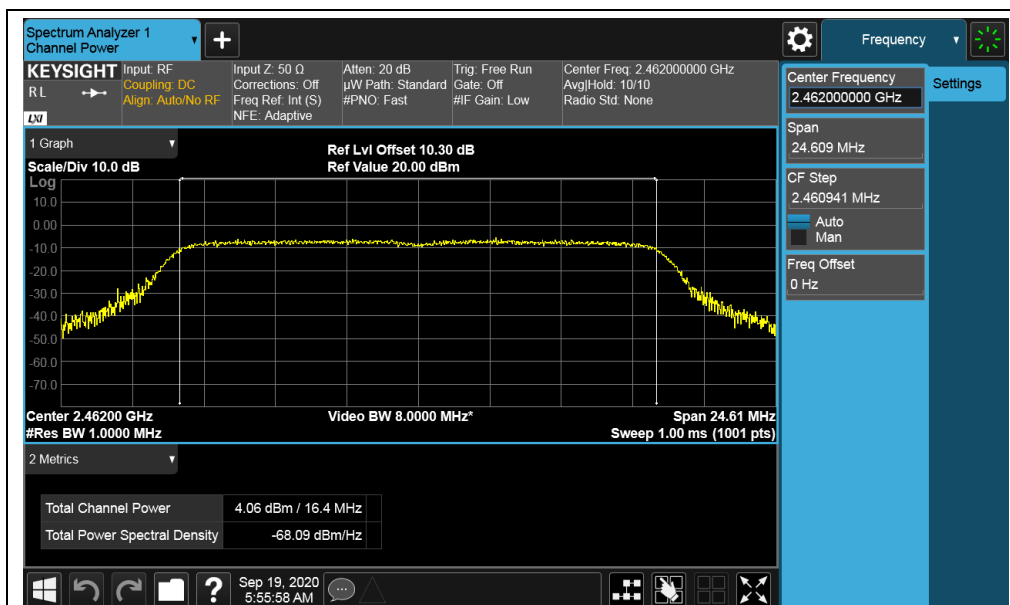
802.11b-2462MHz



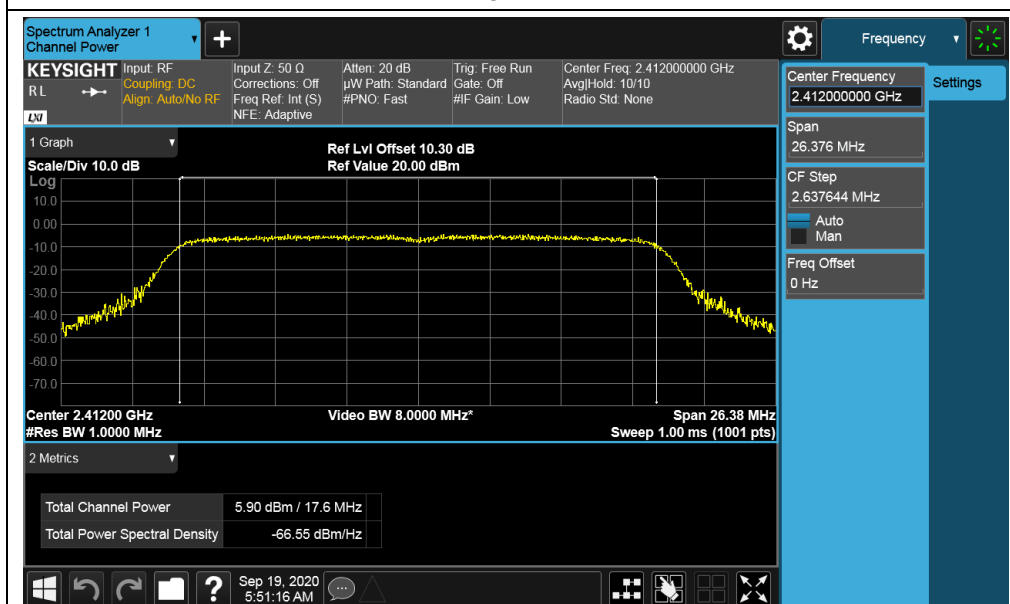
802.11g-2412MHz



802.11g-2437MHz

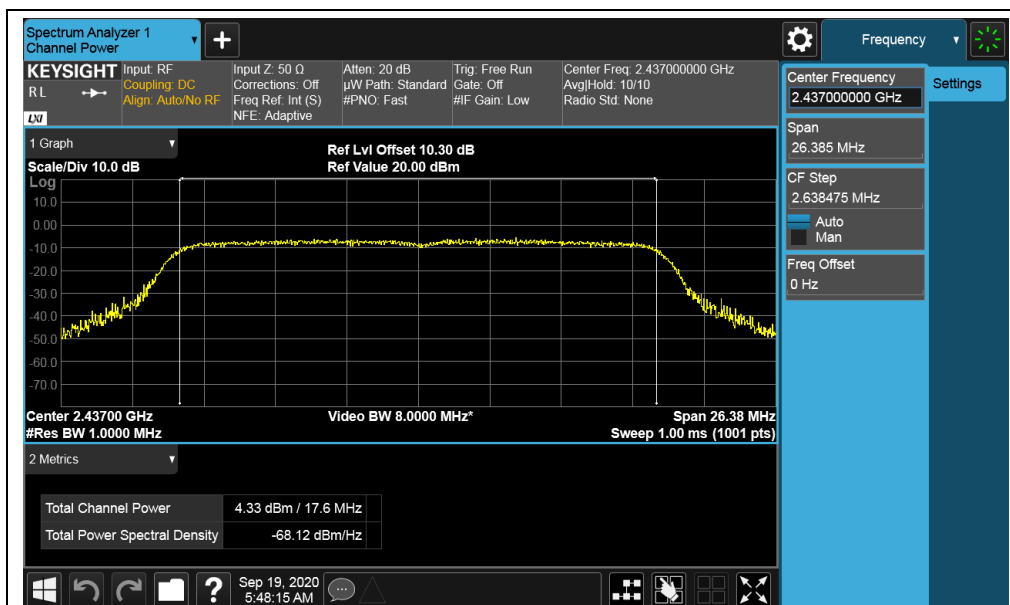


802.11g-2462MHz

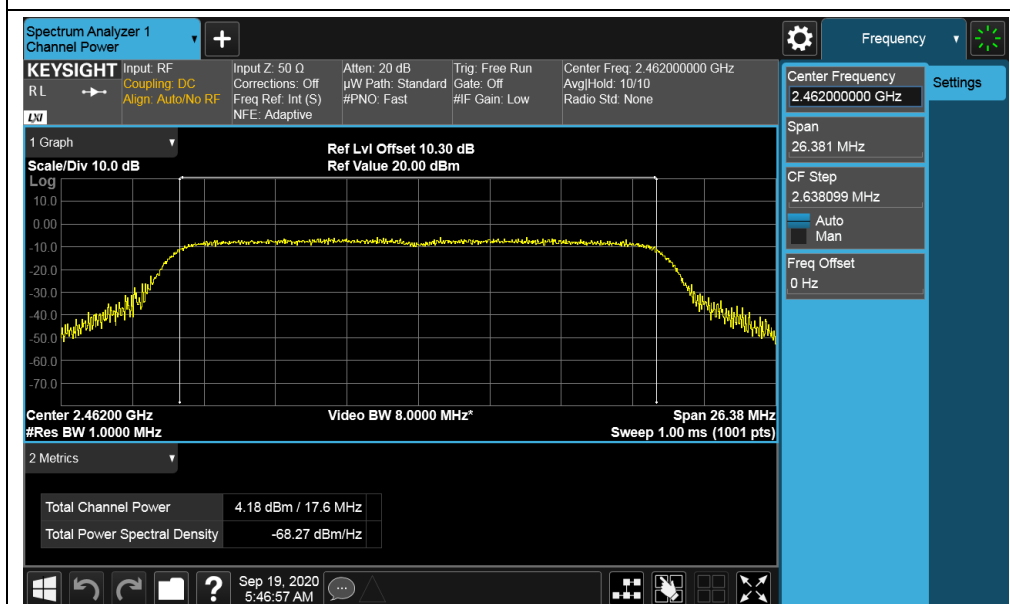


802.11n-HT20-2412MHz





802.11n-HT20-2437MHz



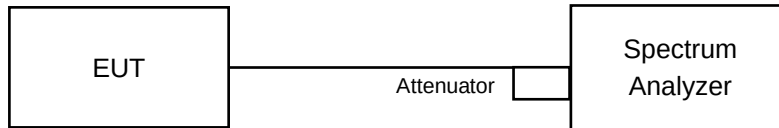
802.11n-HT20-2462MHz

## 4.5 Power Spectral Density Measurement

### 4.5.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm in any 3 kHz.

### 4.5.2 Test Setup



### 4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.5.4 Test Procedure

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- Set the VBW  $\geq 3 \times \text{RBW}$ .
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.

### 4.5.5 Deviation from Test Standard

No deviation.

### 4.5.6 EUT Operating Condition

Same as Item 4.3.6

#### 4.5.7 Test Results

##### 802.11b

| Channel | Frequency (MHz) | PSD (dBm/3kHz) |         | Limit<br>(dBm/3kHz) | Pass/Fail |
|---------|-----------------|----------------|---------|---------------------|-----------|
|         |                 | Chain 0        | Chain 1 |                     |           |
| 1       | 2402            | -23.89         | -23.86  | 8                   | Pass      |
| 6       | 2437            | -25.65         | -25.66  | 8                   | Pass      |
| 11      | 2462            | -25.76         | -25.91  | 8                   | Pass      |

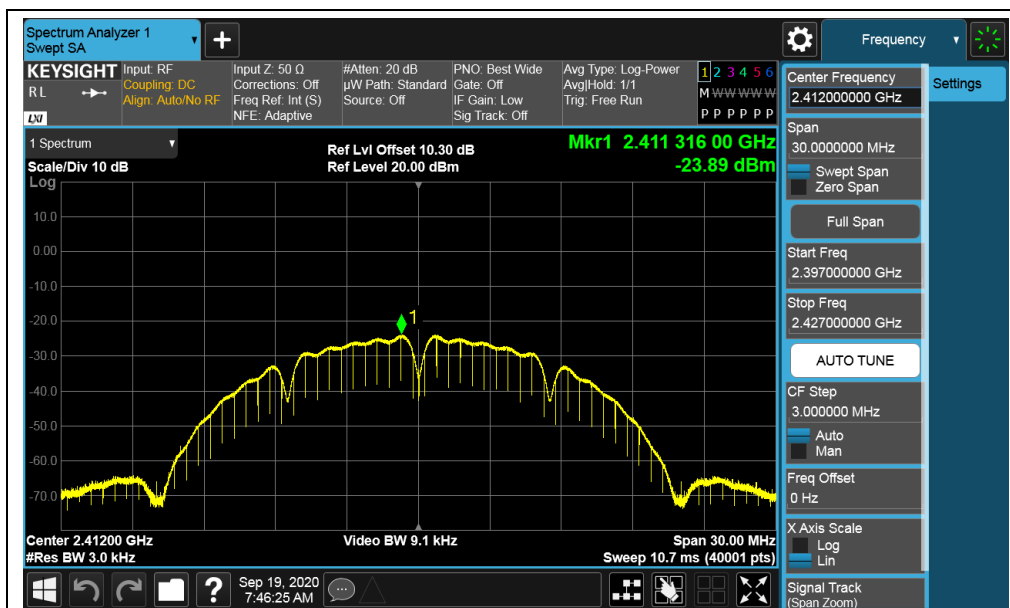
##### 802.11g

| Channel | Frequency (MHz) | PSD (dBm/3kHz) |         | Limit<br>(dBm/3kHz) | Pass/Fail |
|---------|-----------------|----------------|---------|---------------------|-----------|
|         |                 | Chain 0        | Chain 1 |                     |           |
| 1       | 2402            | -22.27         | -22.37  | 8                   | Pass      |
| 6       | 2437            | -24.10         | -24.10  | 8                   | Pass      |
| 11      | 2462            | -24.19         | -24.21  | 8                   | Pass      |

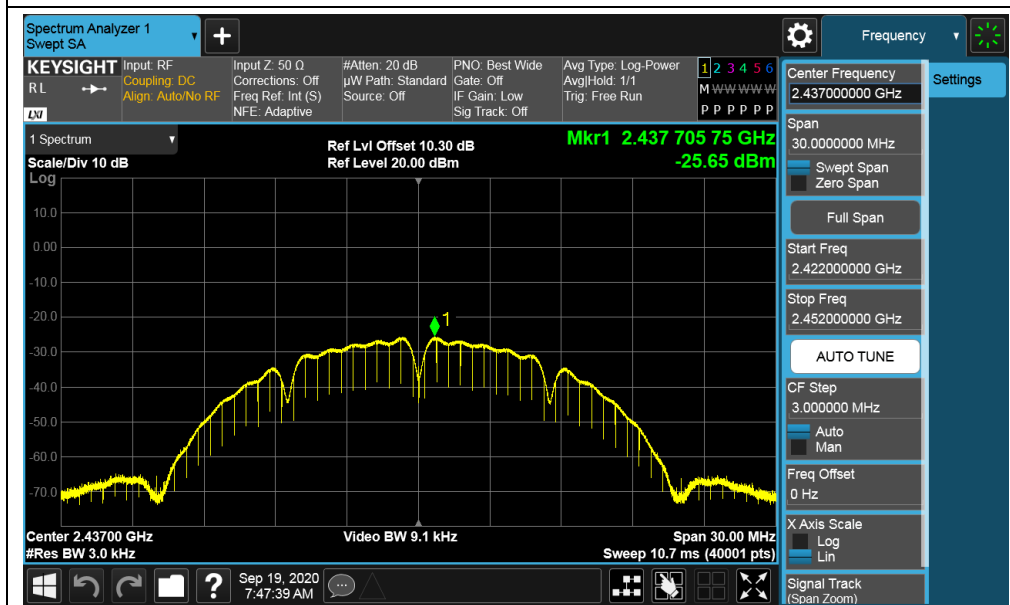
##### 802.11n-HT20

| Channel | Frequency (MHz) | PSD (dBm/3kHz) |         | Limit<br>(dBm/3kHz) | Pass/Fail |
|---------|-----------------|----------------|---------|---------------------|-----------|
|         |                 | Chain 0        | Chain 1 |                     |           |
| 1       | 2402            | -21.75         | -21.92  | 8                   | Pass      |
| 6       | 2437            | -23.51         | -23.48  | 8                   | Pass      |
| 11      | 2462            | -23.77         | -23.67  | 8                   | Pass      |

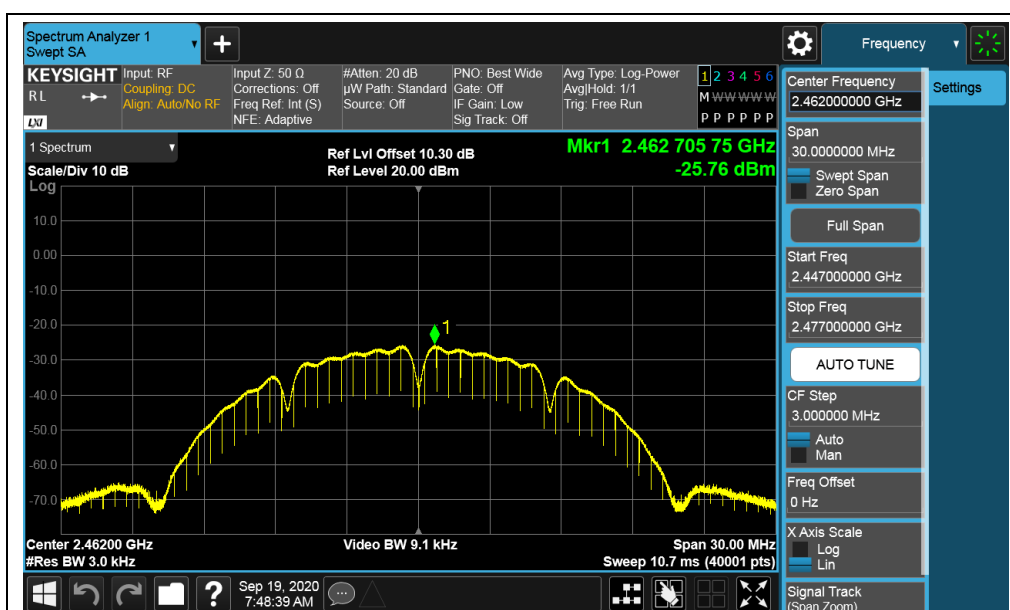
Test Plots:  
Chain 0



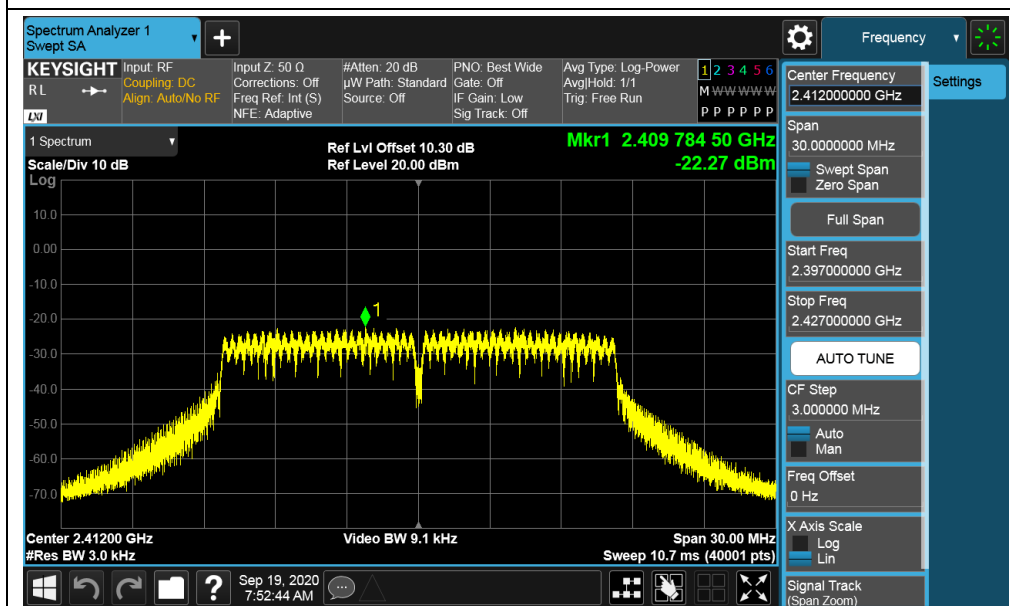
802.11b-2412MHz



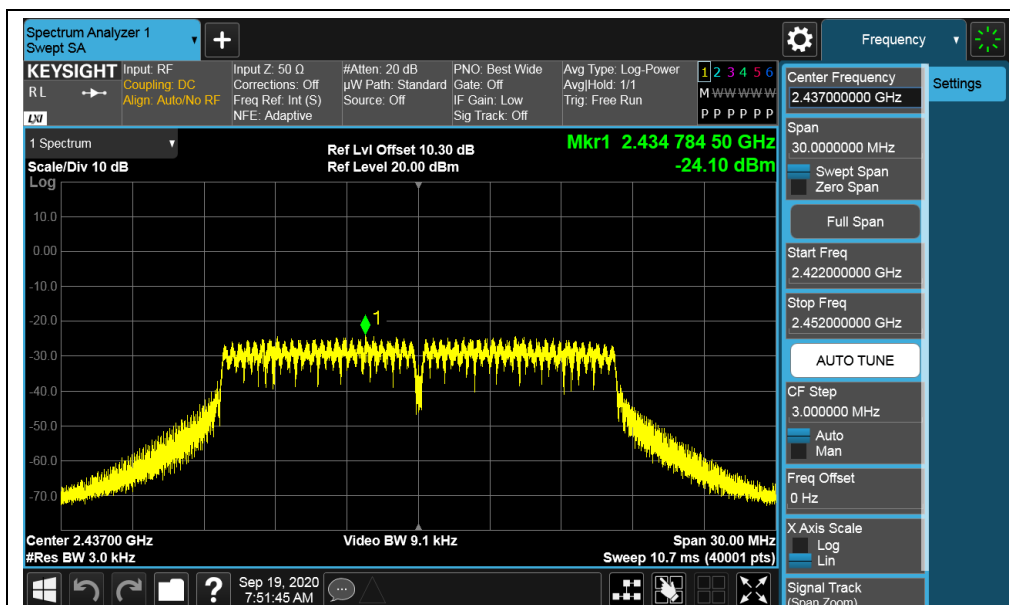
802.11b-2437MHz



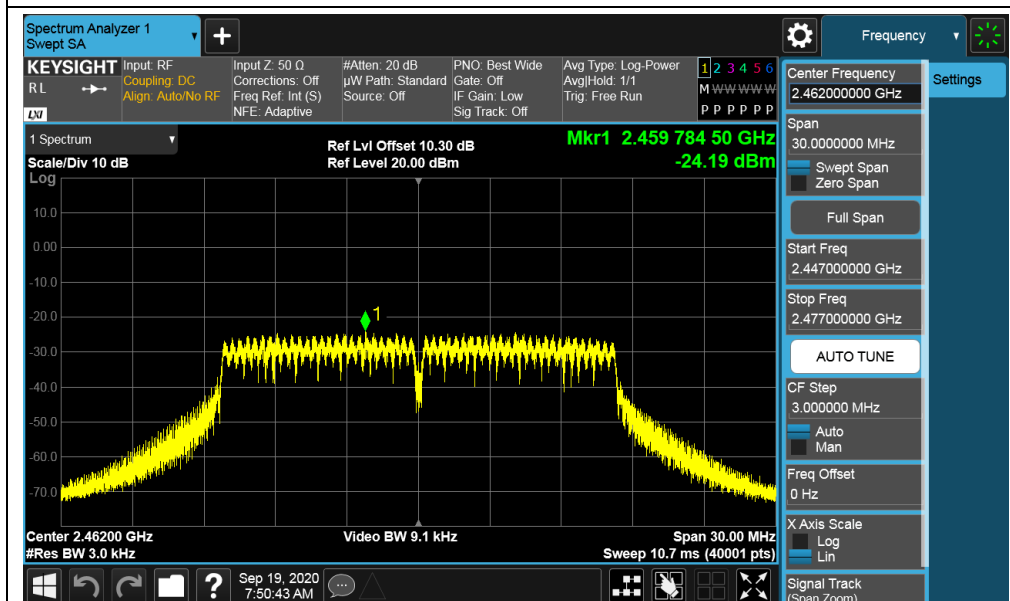
802.11b-2462MHz



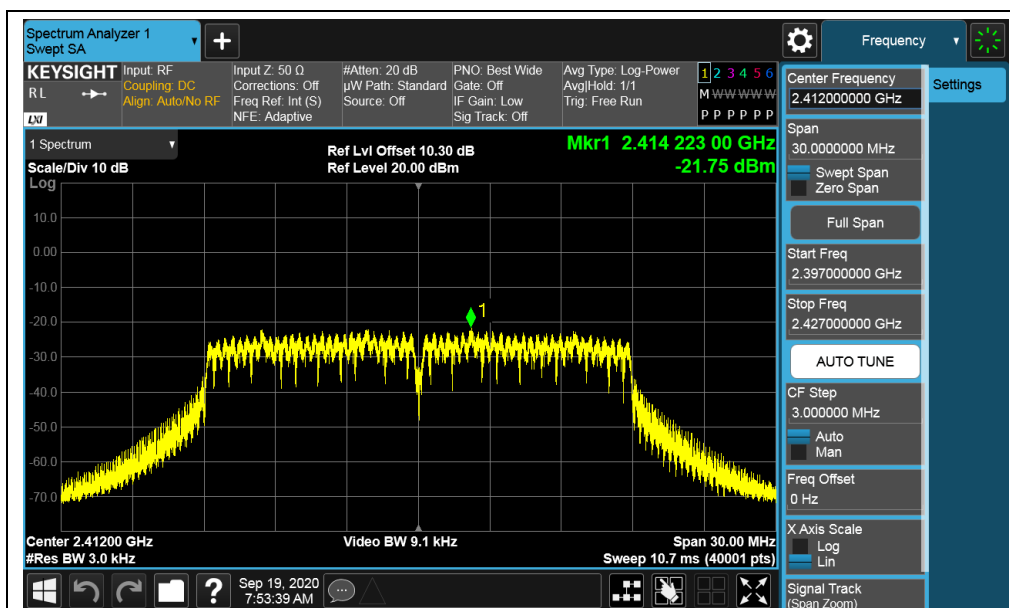
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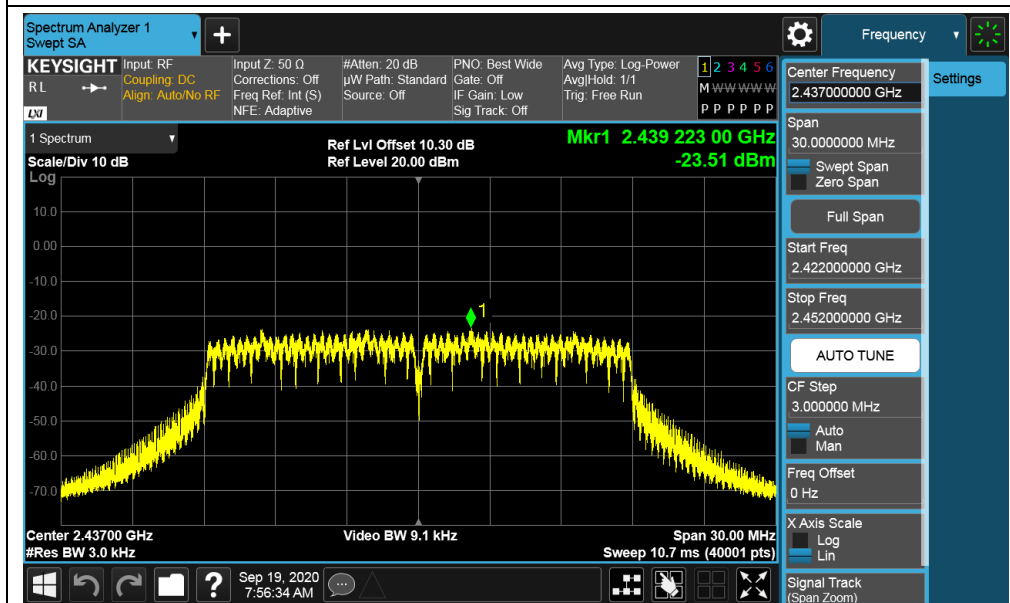
802.11g-2437MHz



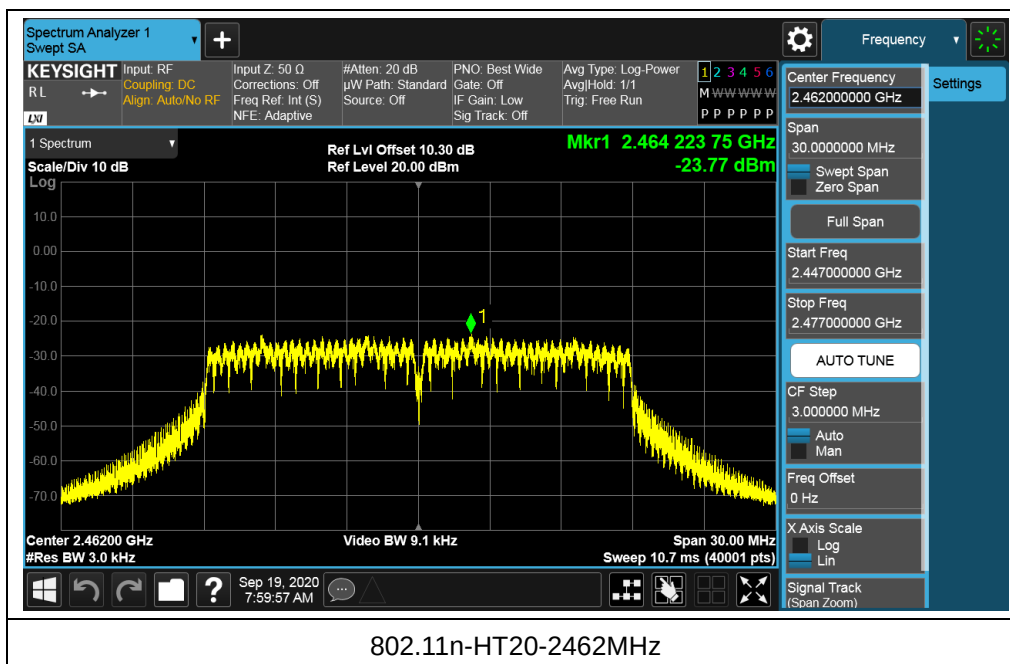
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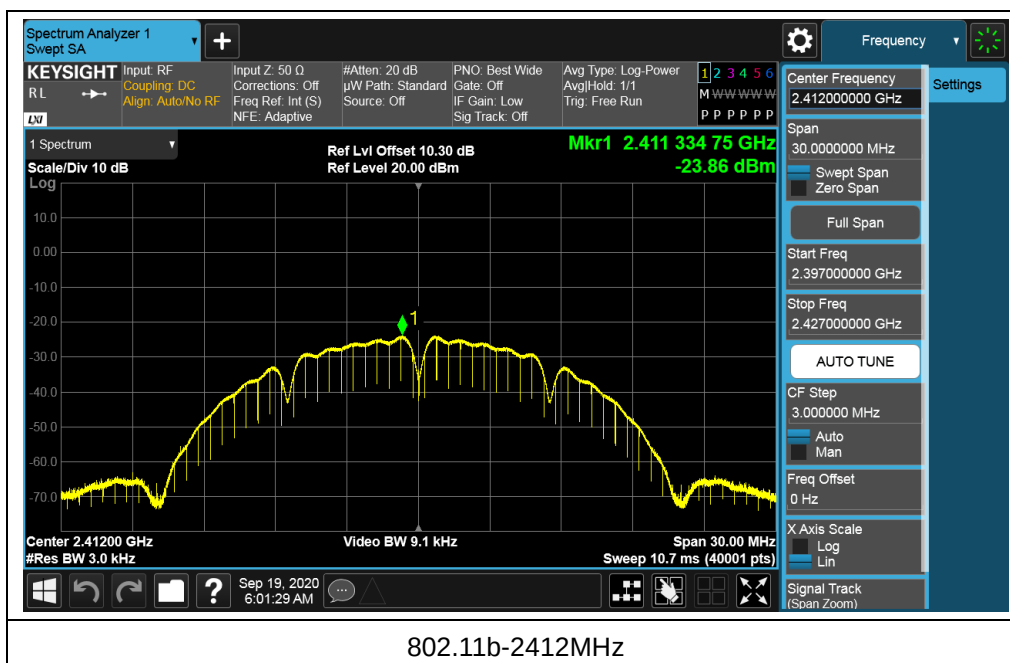
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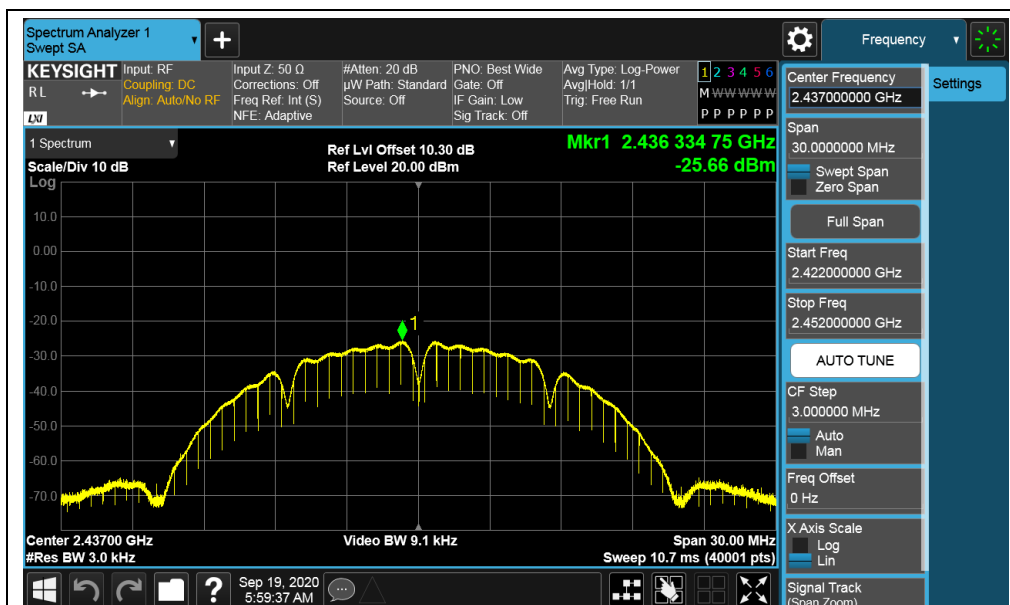
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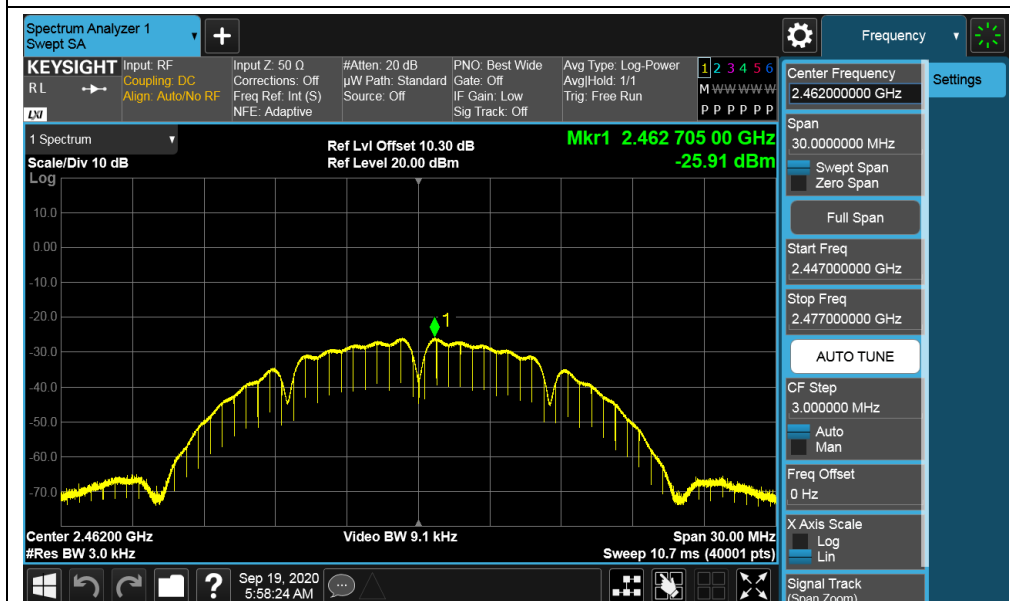
Chain 1



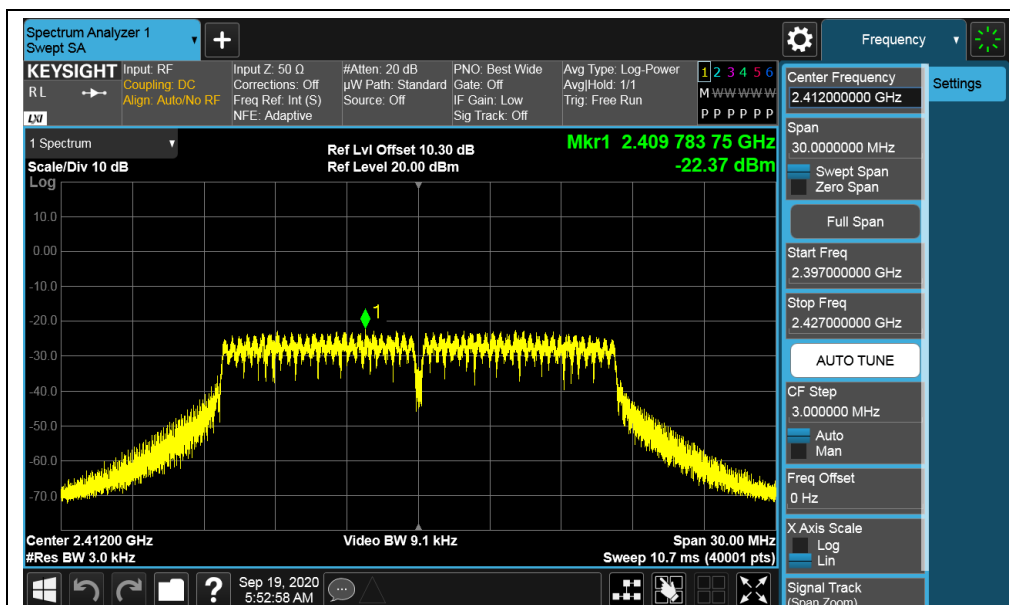




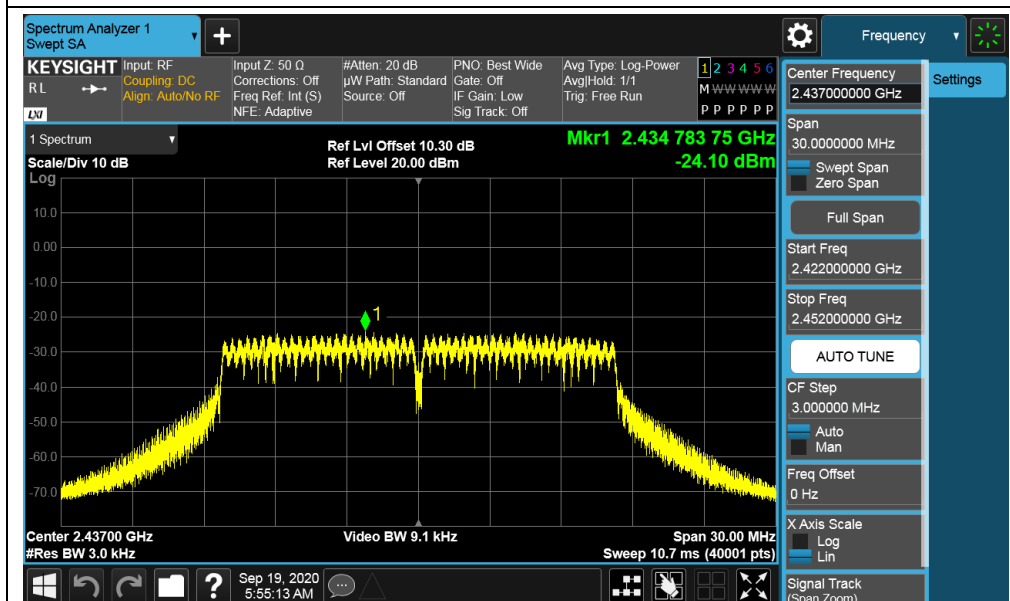
802.11b-2437MHz



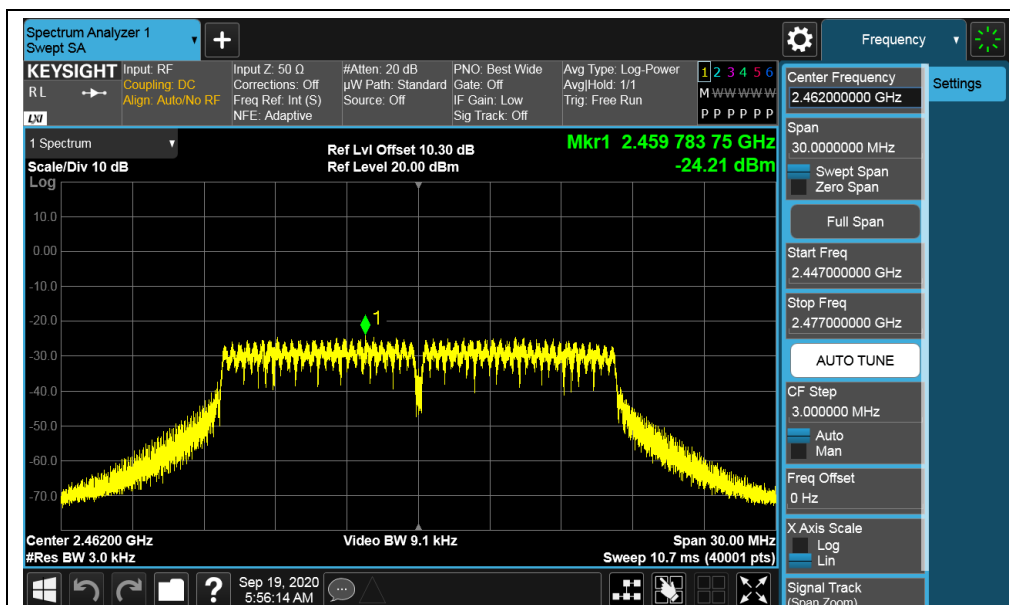
802.11b-2462MHz



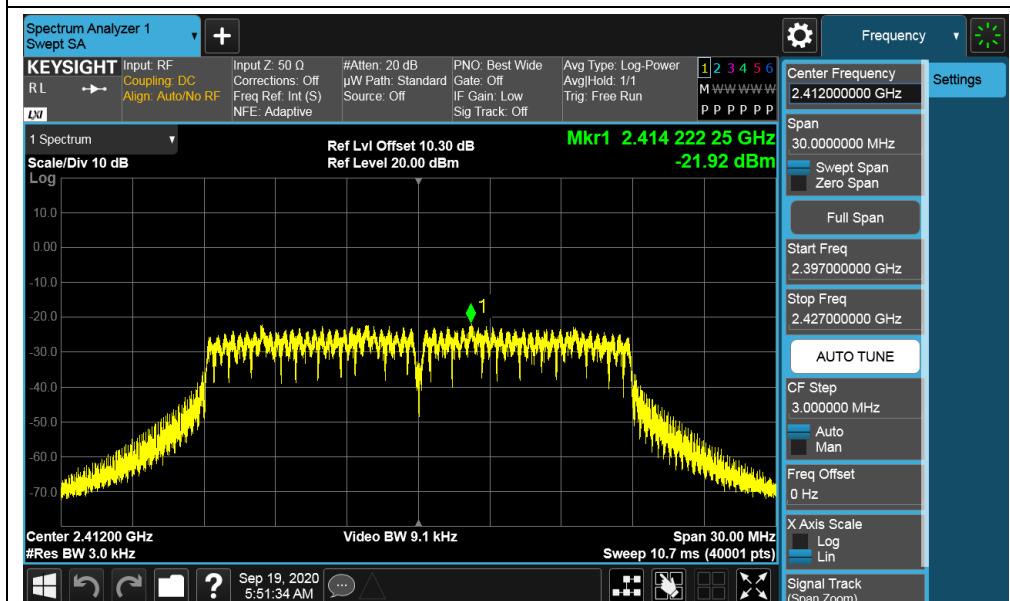
802.11g-2412MHz



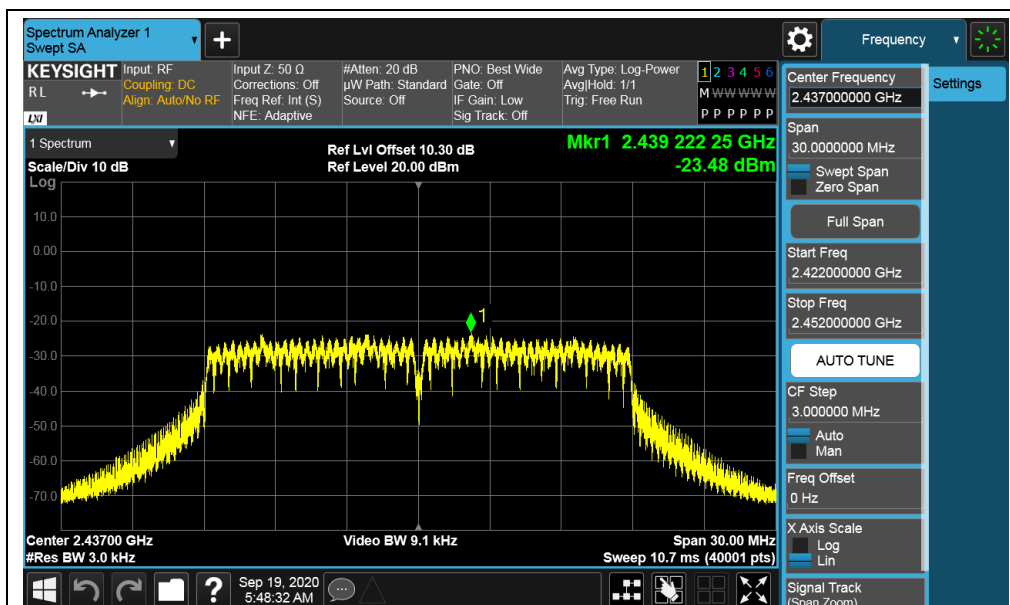
802.11g-2437MHz



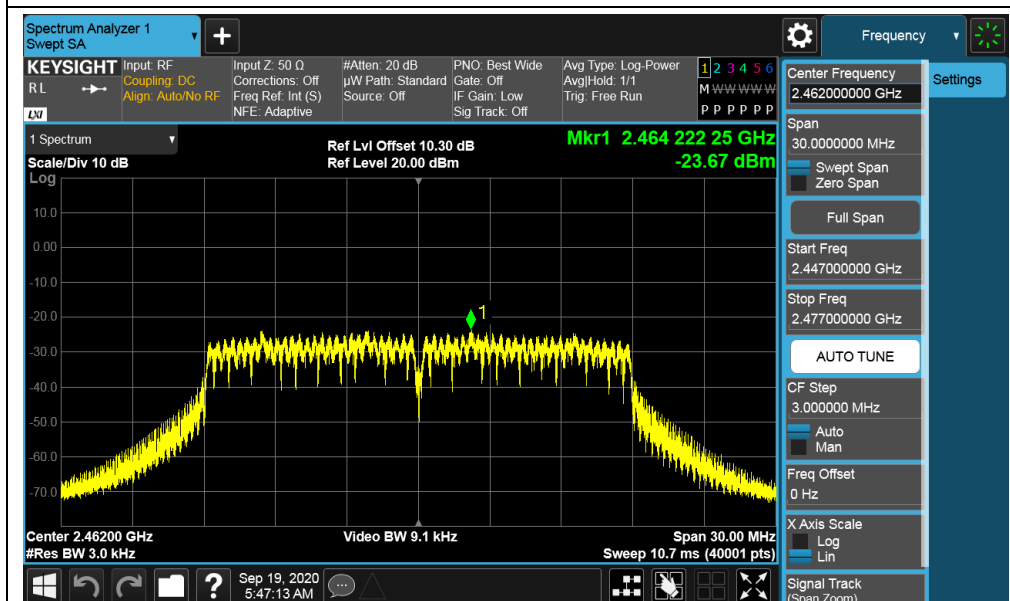
802.11g-2462MHz



802.11n-HT20-2412MHz



802.11n-HT20-2437MHz



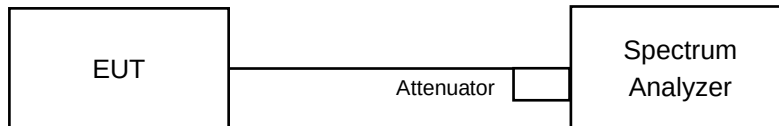
802.11n-HT20-2462MHz

## 4.6 Conducted Out of Band Emission Measurement

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

Below 30dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 4.6.2 Test Setup



### 4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

### 4.6.4 Test Procedure

#### MEASUREMENT PROCEDURE REF

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

#### MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

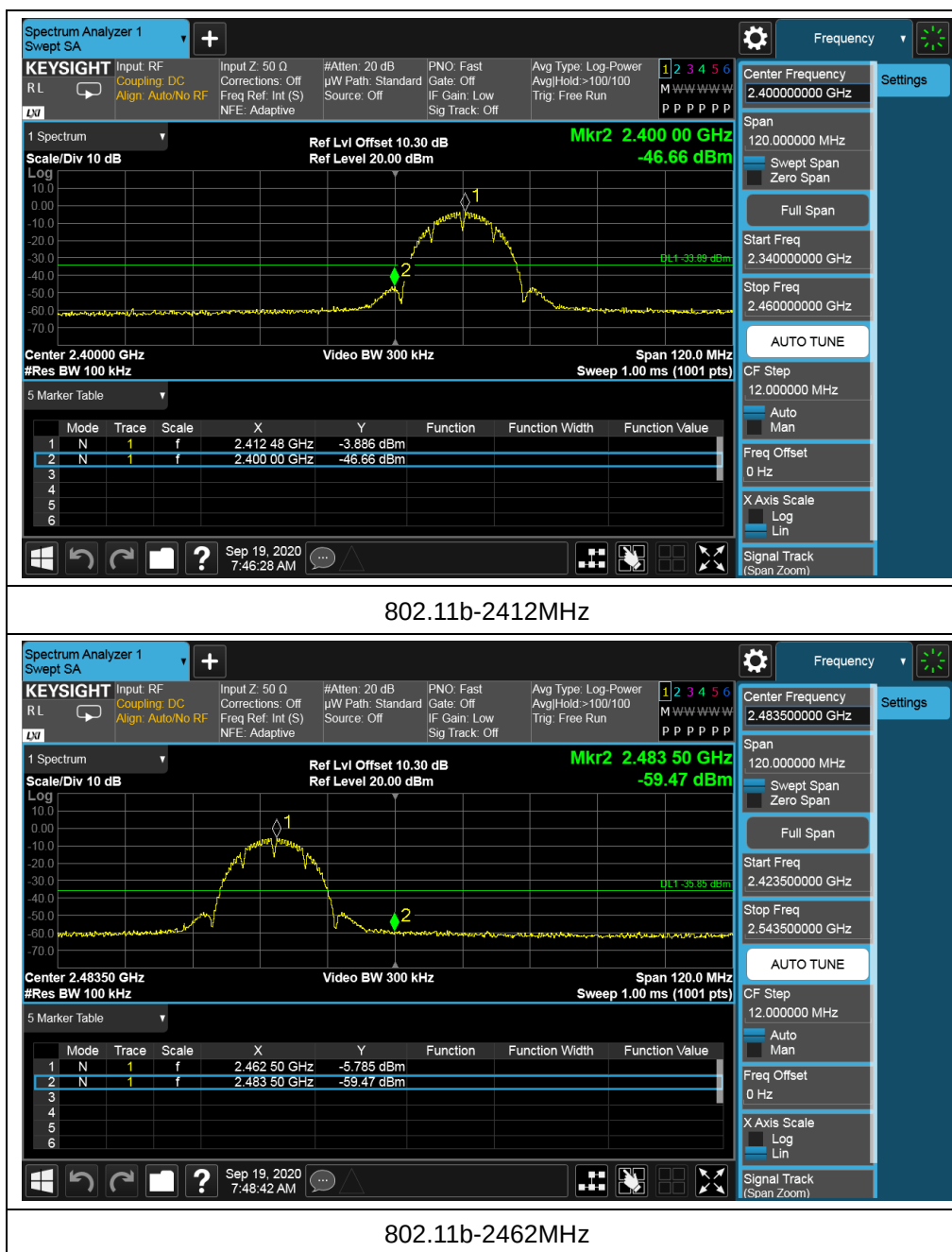
### 4.6.5 Deviation from Test Standard

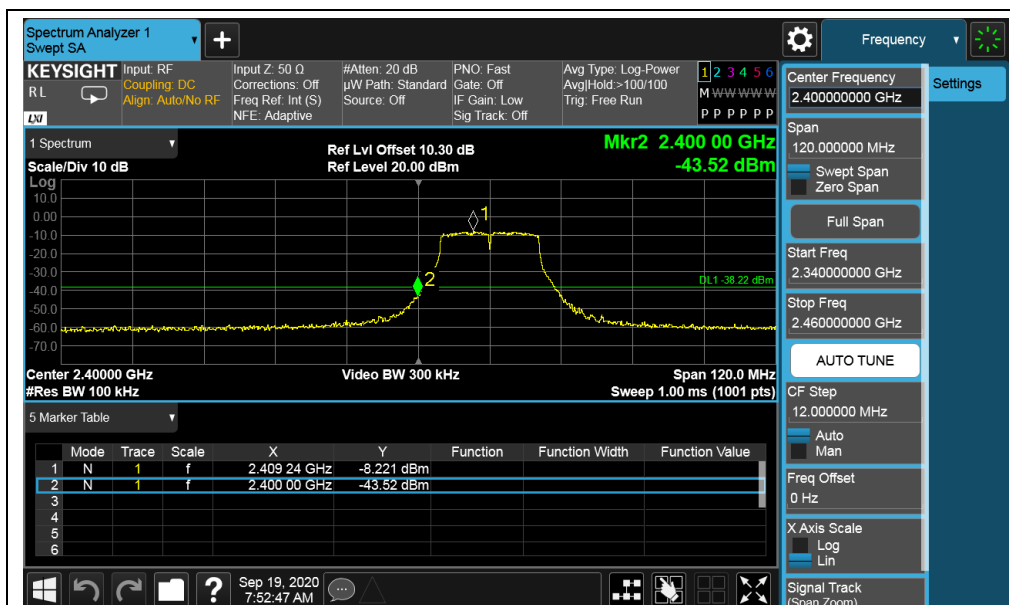
No deviation.

### 4.6.6 EUT Operating Condition

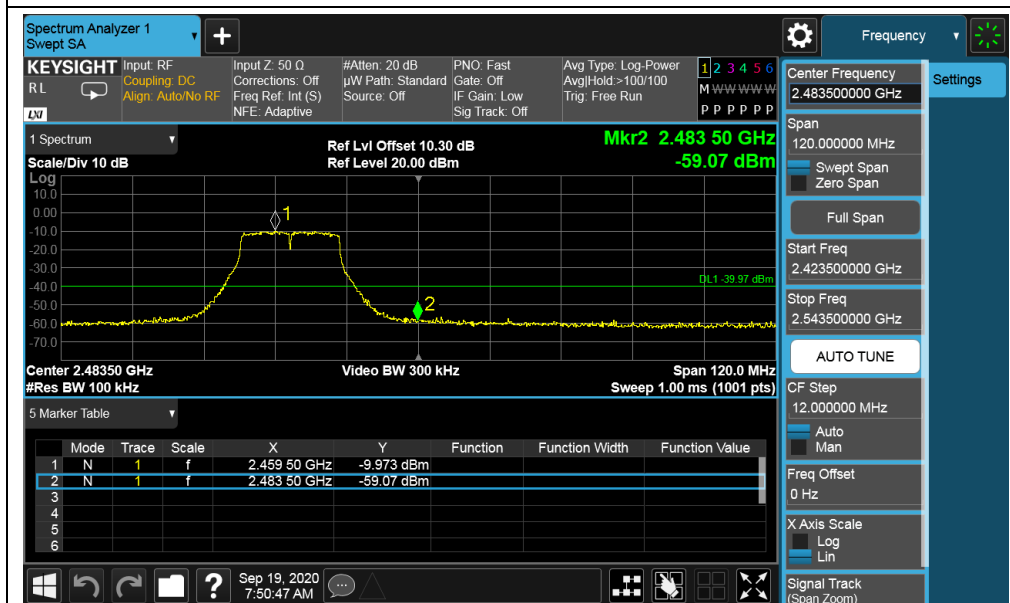
Same as Item 4.3.6

## 4.6.7 Test Results

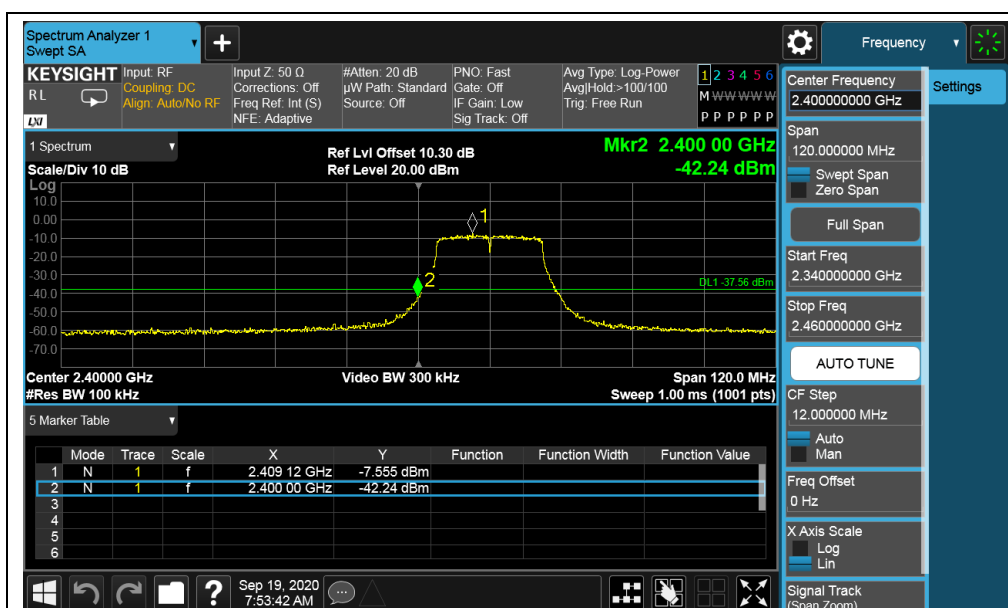




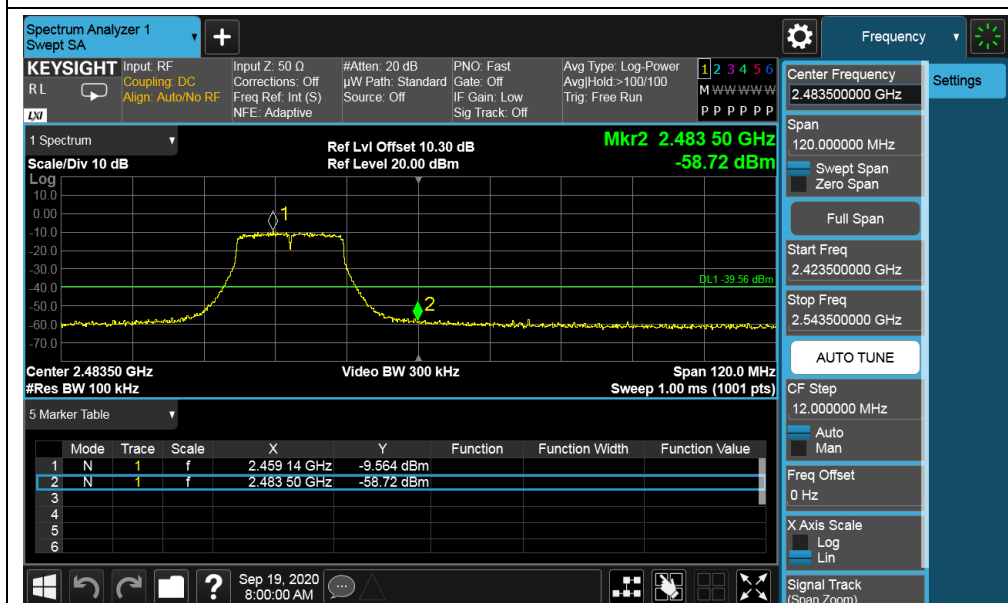
802.11g-2412MHz



802.11g-2462MHz



802.11n-HT20-2412MHz



802.11n-HT20-2462MHz



## 5 Pictures of Test Arrangements

Please see setup photo file.

## Appendix – Information on the Testing Laboratories

Bureau Veritas is a global leader in testing, inspection and certification (TIC) services. We help businesses improve safety, sustainability and productivity; and our clients include the majority of leading brands in retail, manufacturing and other industries. With a presence in every major country around the world, our quality assurance and compliance solutions are vital in helping our customers enhance product quality and concept-to-consumer journeys. We also assist with increasing speed to market, profitability and brand equity throughout the supply chain. Bureau Veritas is a leading wireless/IoT testing, inspection, audit and certification provider, with a global network of test laboratories to support the IoT industry in areas of connectivity, security, interoperability as well as quality, health & safety, and environmental/chemical requirements.

If you have any comments, please feel free to contact us at the following:

**Milpitas EMC/RF/Safety/Telecom Lab**

775 Montague Expressway, Milpitas, CA 95035  
Tel: +1 408 526 1188

**Sunnyvale OTA/Bluetooth Lab**

1293 Anvilwood Avenue, Sunnyvale, CA  
94089  
Tel: +1 669 600 5293

**Littleton EMC/RF/Safety/Environmental Lab**

1 Distribution Center Cir #1, Littleton, MA 01460  
Tel: +1 978 486 8880

**Email:** [sales.eaw@us.bureauveritas.com](mailto:sales.eaw@us.bureauveritas.com)

**Web Site:** [www.cpsusa-bureauveritas.com](http://www.cpsusa-bureauveritas.com)

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

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