



#### 4.5.2. Test Instruments

| RF Test Room              |              |                            |               |                  |                 |
|---------------------------|--------------|----------------------------|---------------|------------------|-----------------|
| Equipment                 | Manufacturer | Model                      | Serial Number | Calibration Date | Calibration Due |
| Spectrum analyzer         | Agilent      | N9020A                     | HKE-025       | Feb. 20, 2024    | Feb. 19, 2025   |
| RF cable                  | Times        | 1-40G                      | HKE-034       | Feb. 20, 2024    | Feb. 19, 2025   |
| RF automatic control unit | Tonscend     | JS0806-2                   | HKE-060       | Feb. 20, 2024    | Feb. 19, 2025   |
| RF Test Software          | Tonscend     | JS1120-3<br>Version 3.3.23 | HKE-083       | N/A              | N/A             |

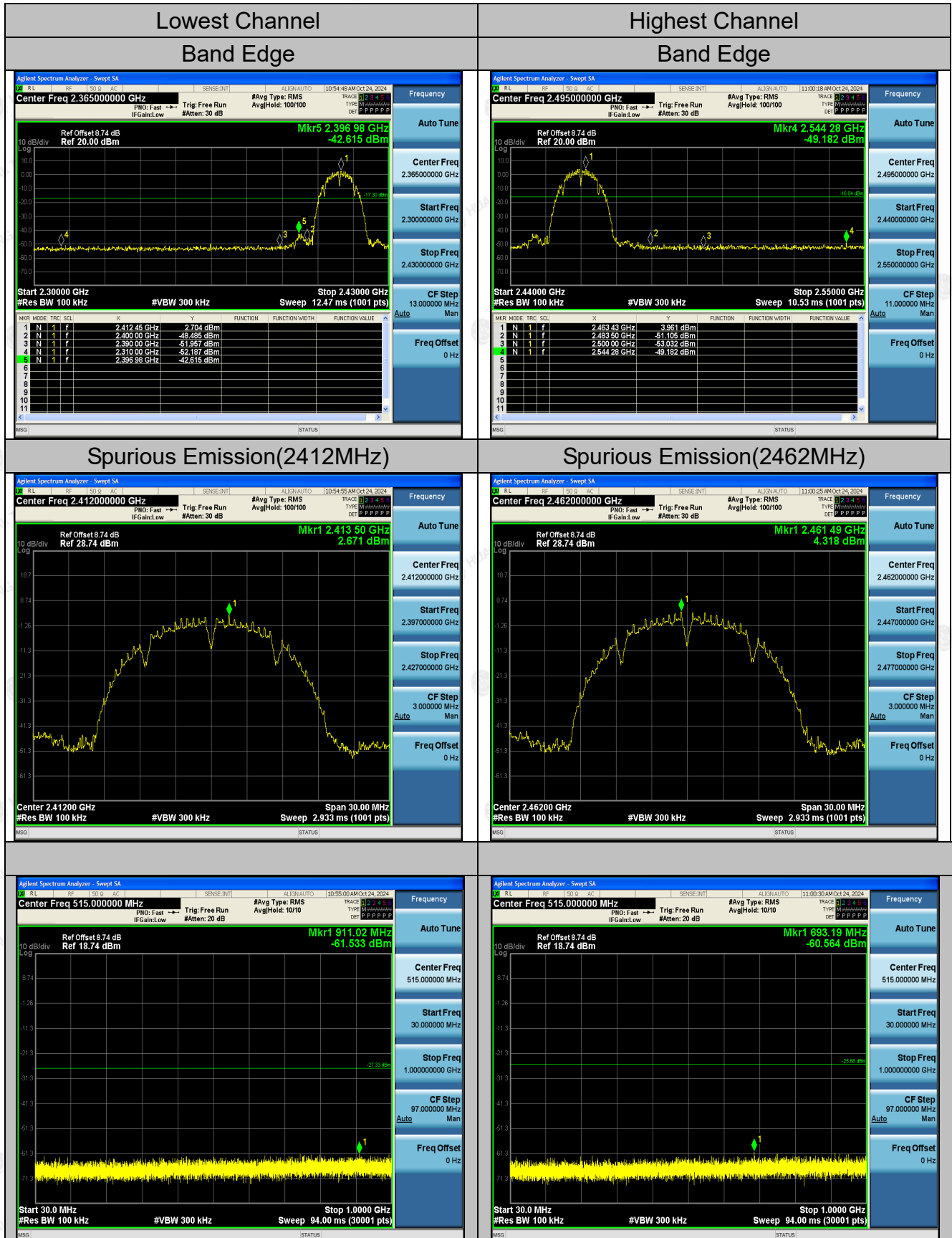
**Note:** The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).



### 4.5.3. Test Data

#### Chain 1

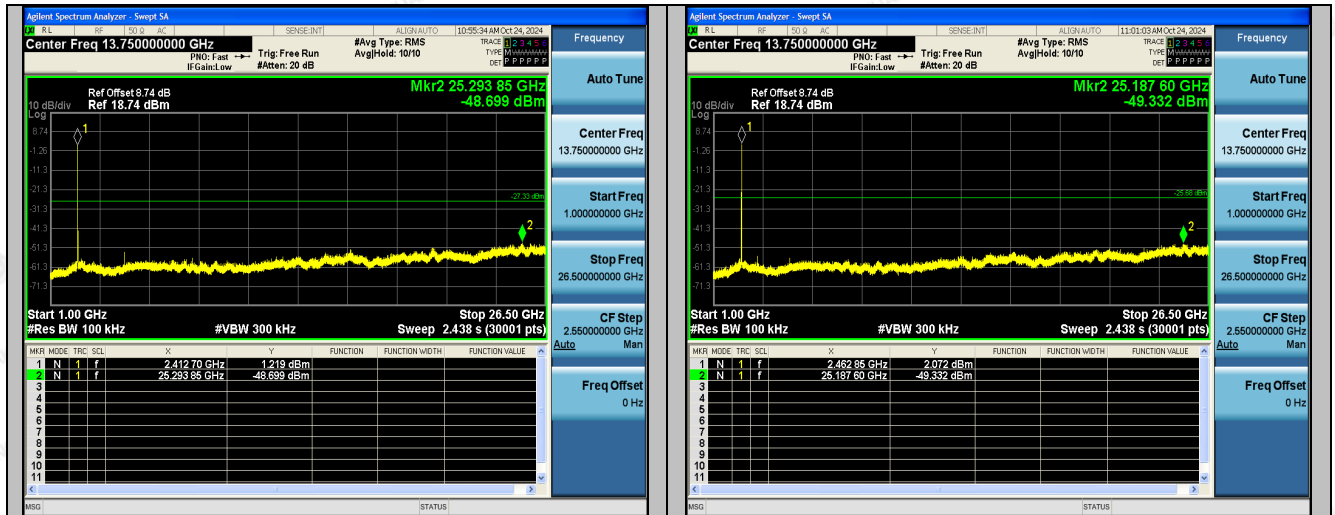
#### 802.11b Modulation



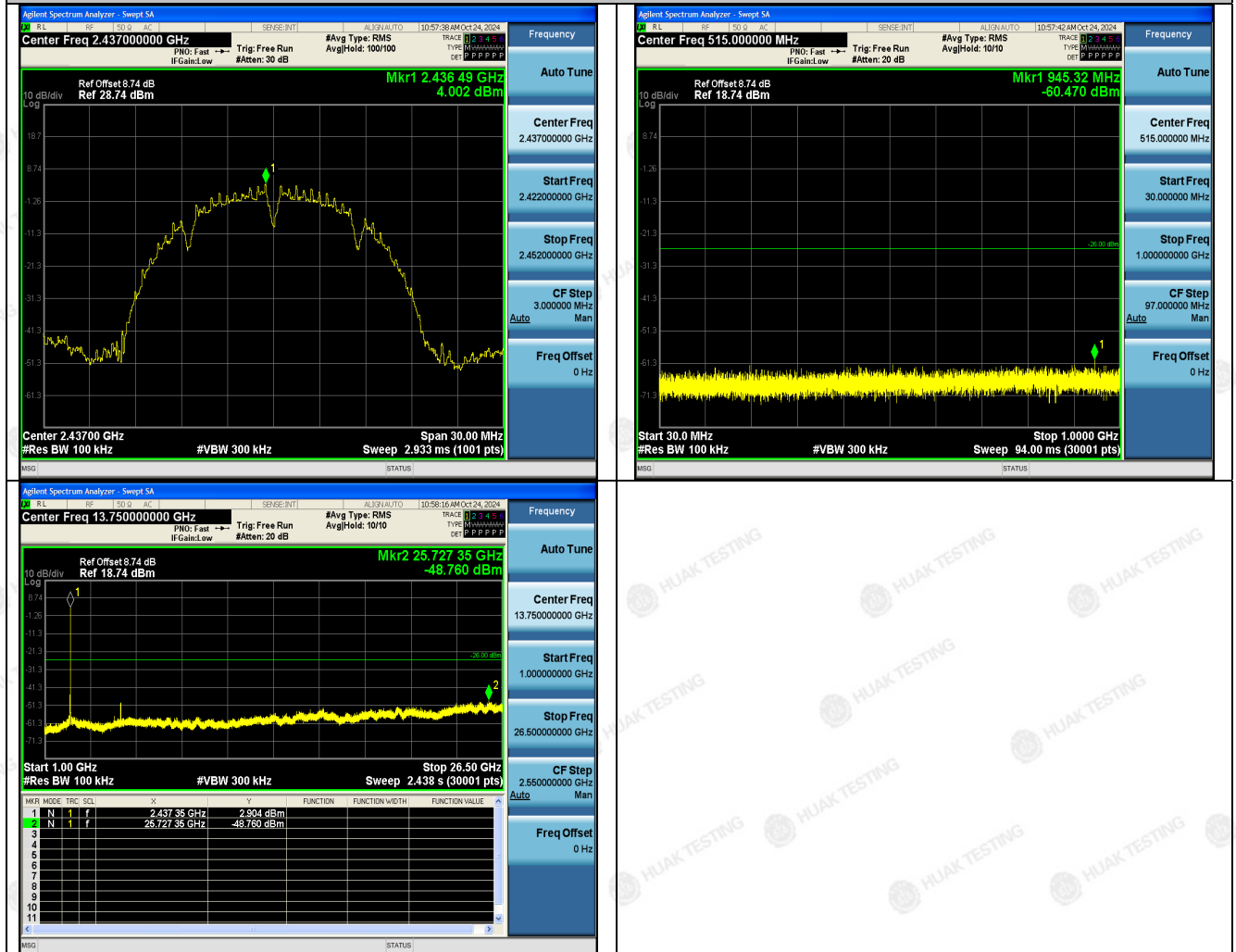
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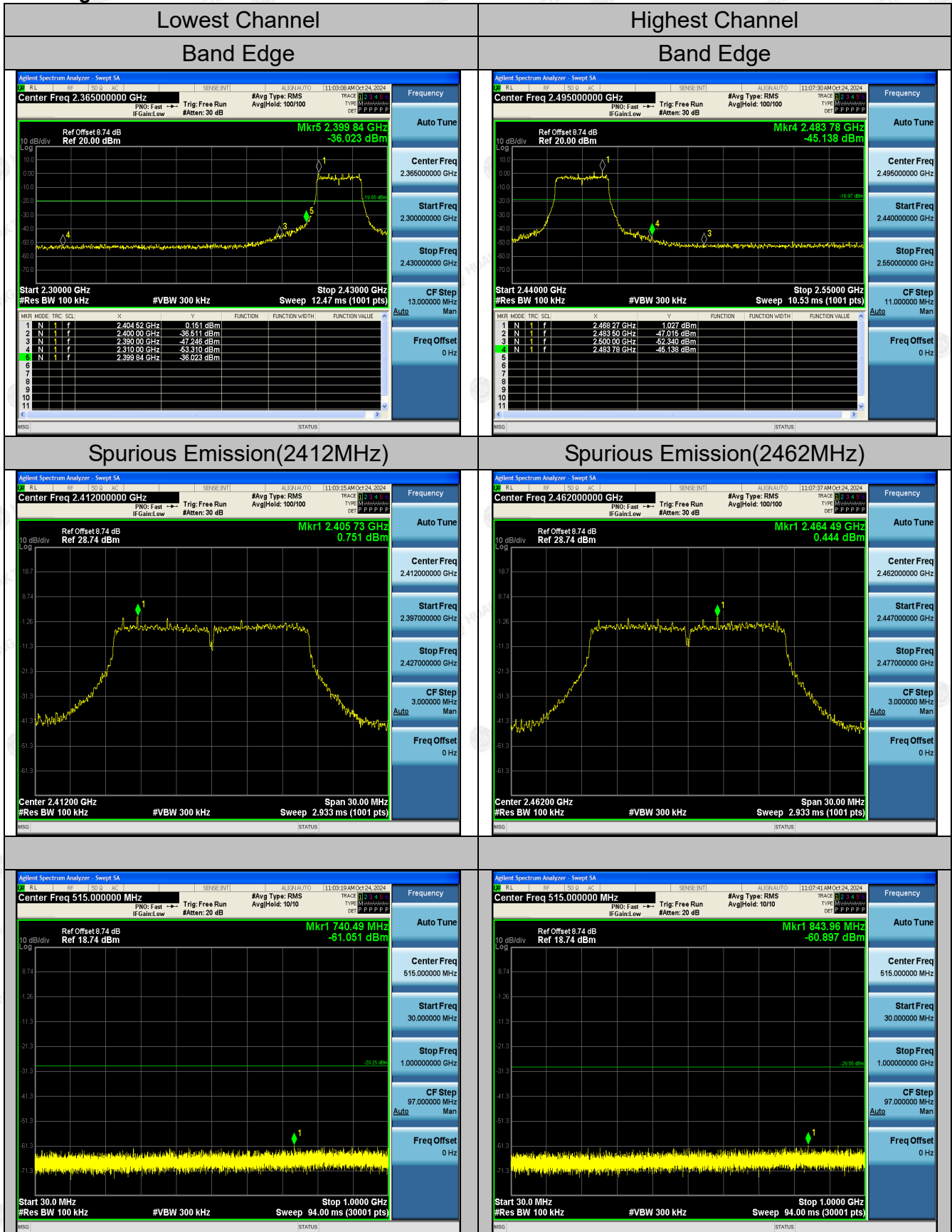


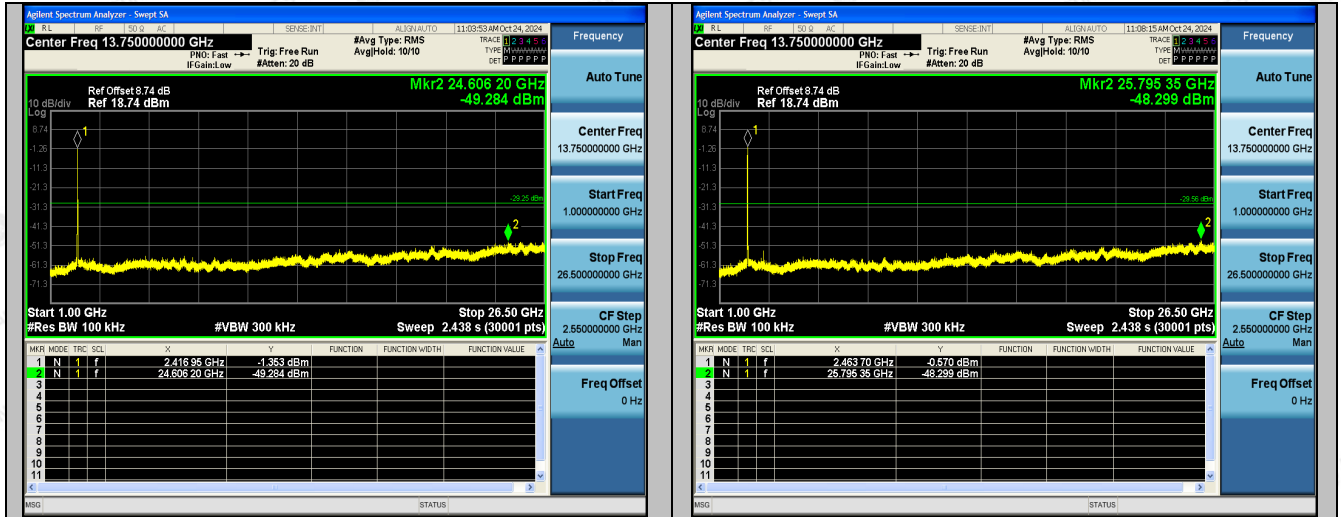
## Spurious Emission(2437MHz)



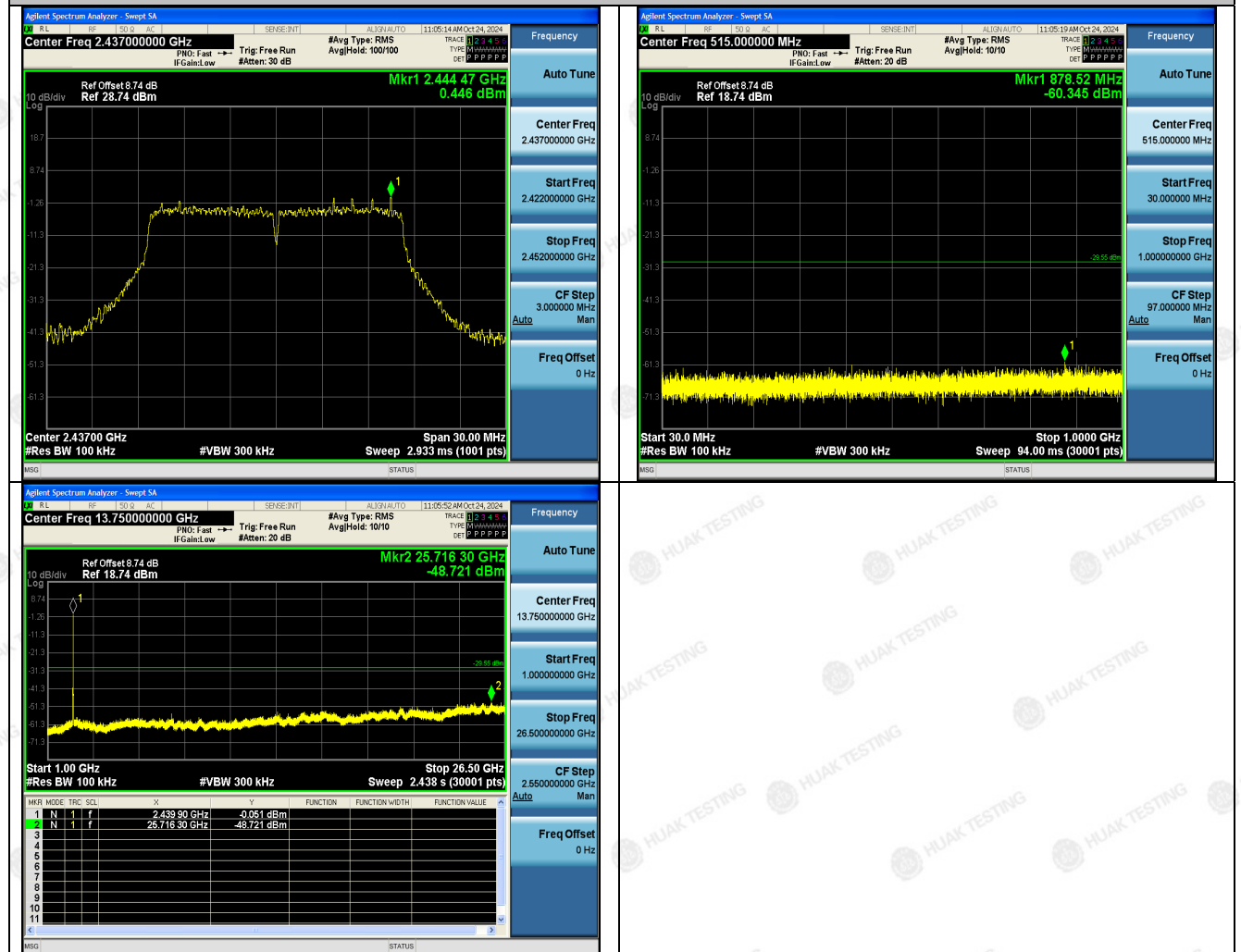


## 802.11g Modulation



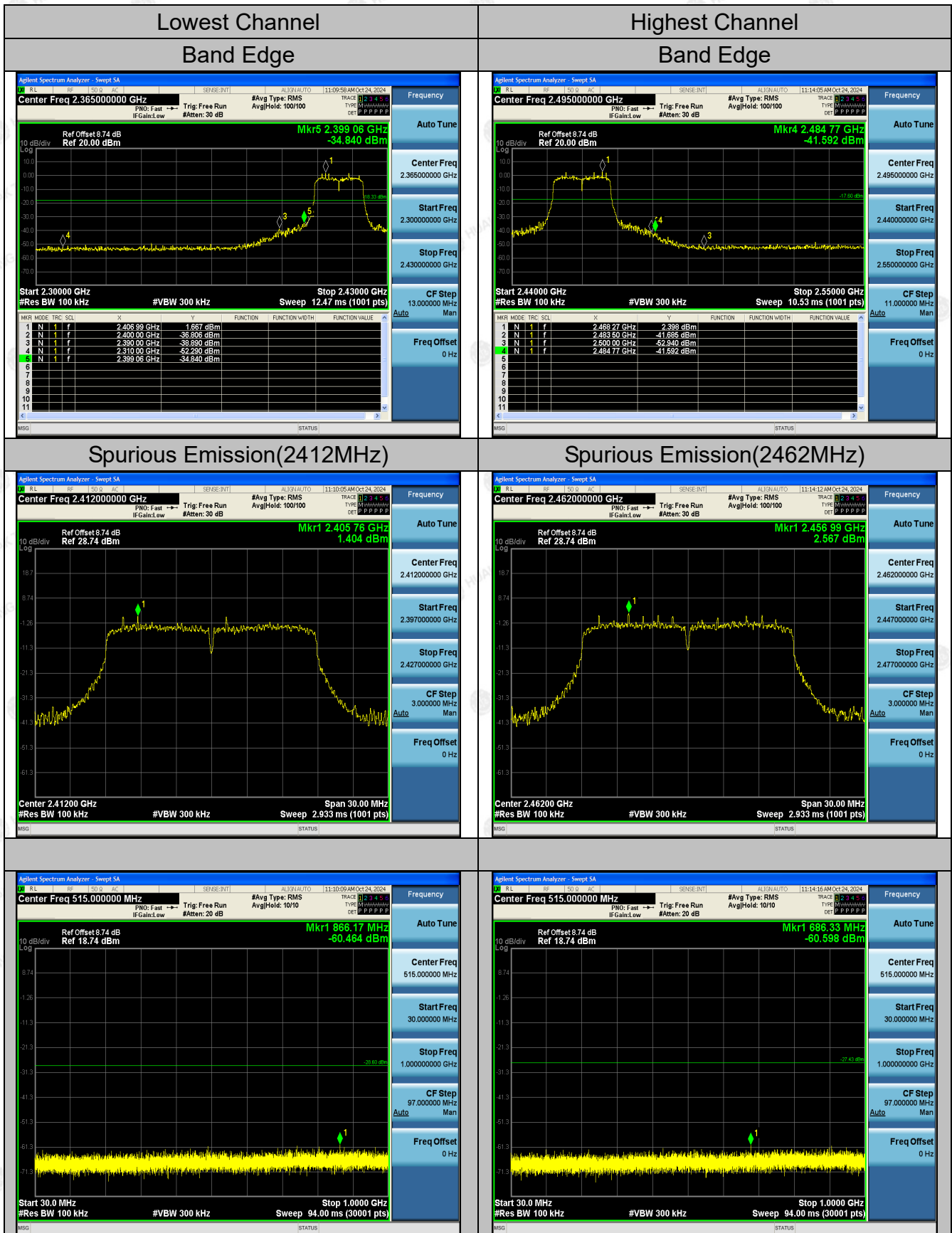


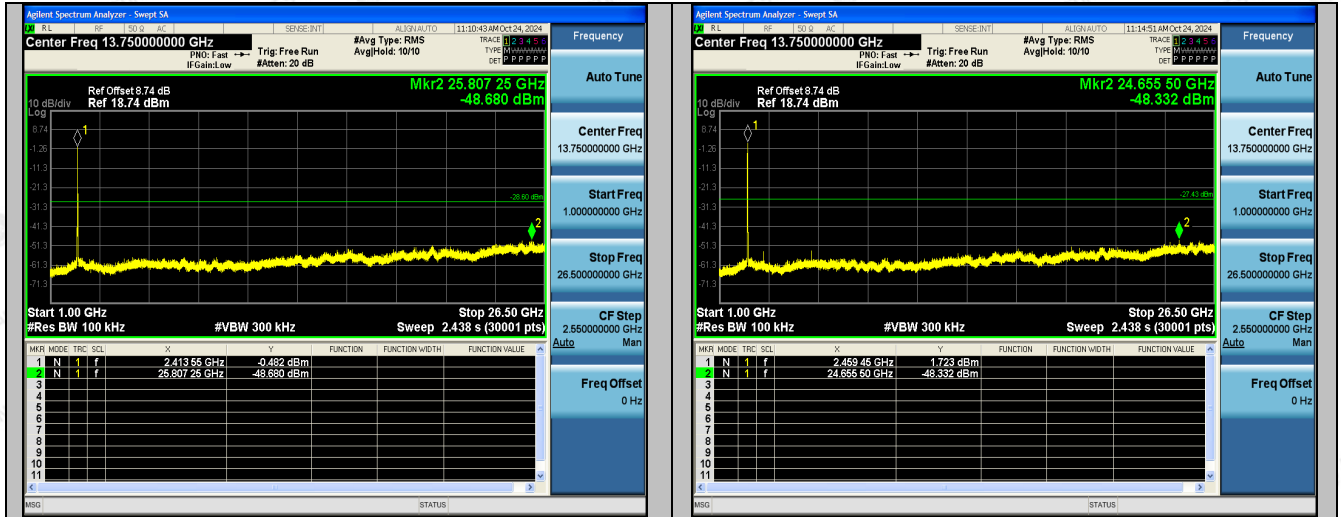
## Spurious Emission(2437MHz)



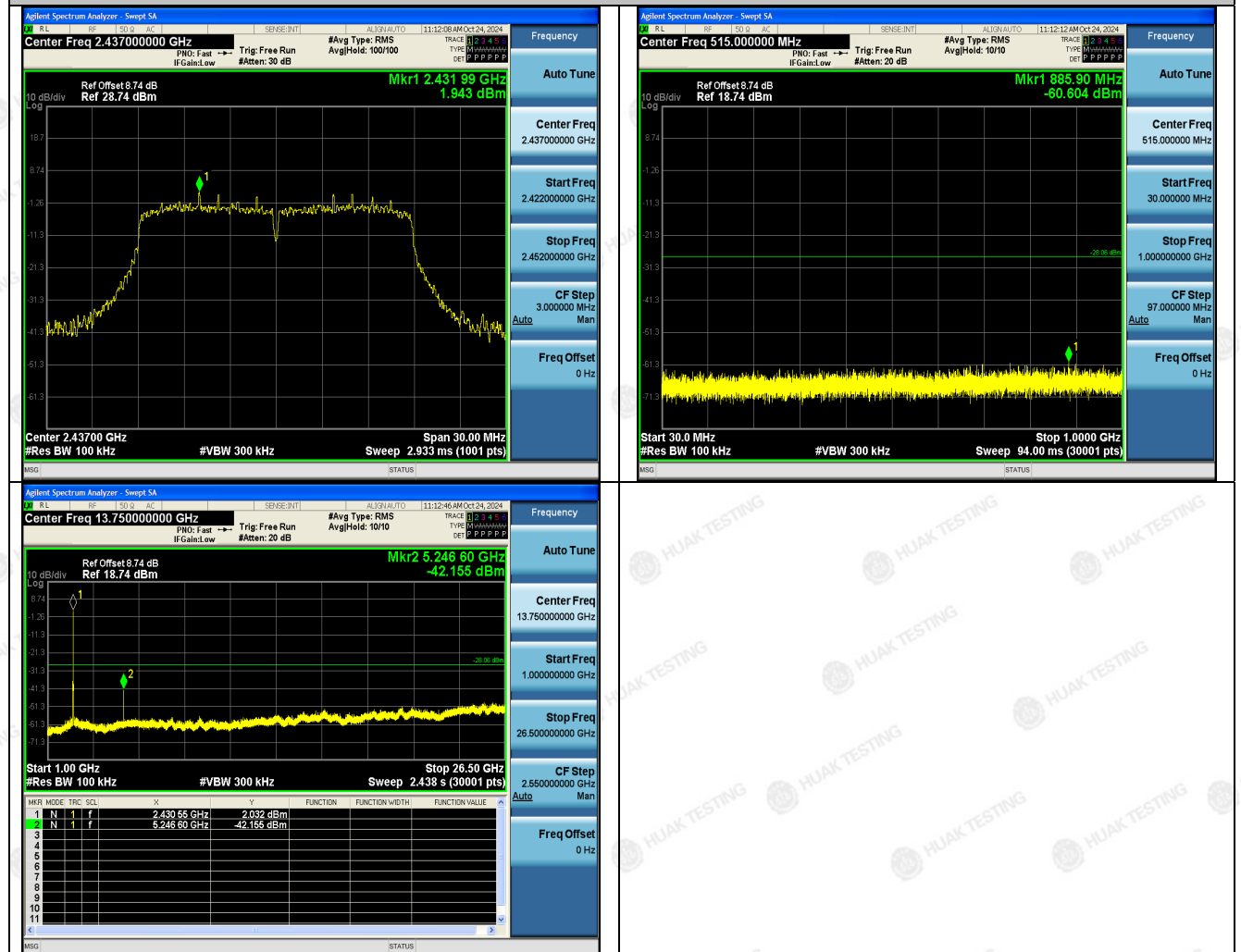


802.11n (HT20) Modulation





## Spurious Emission(2437MHz)





## 802.11n (HT40) Modulation

## Lowest Channel

## Band Edge

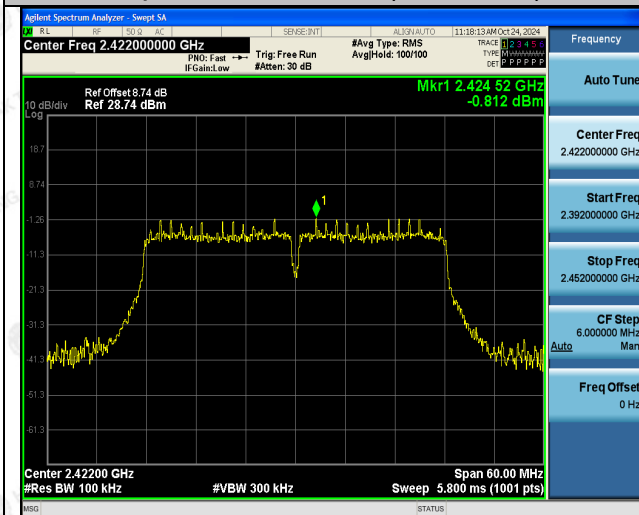


## Highest Channel

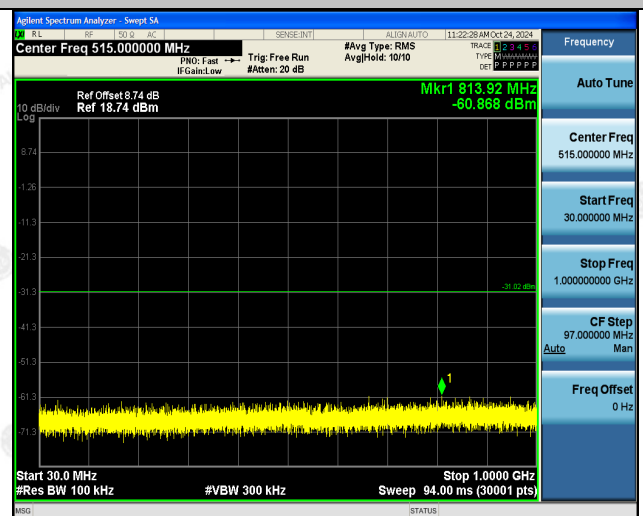
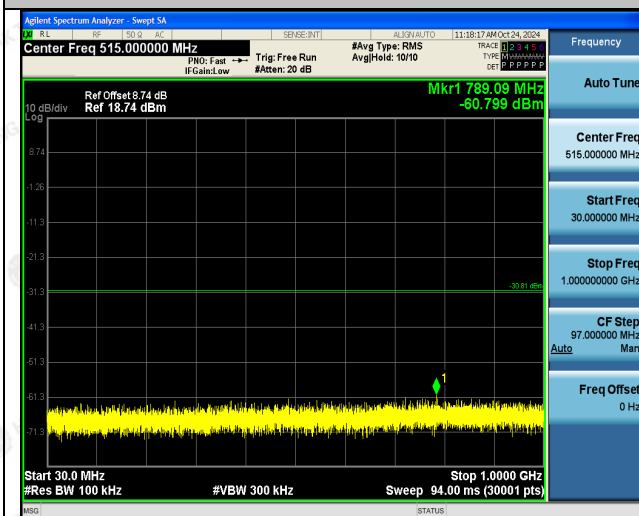
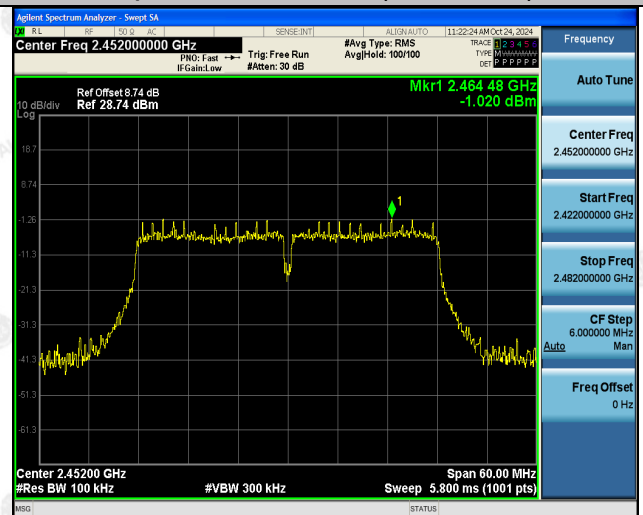
## Band Edge

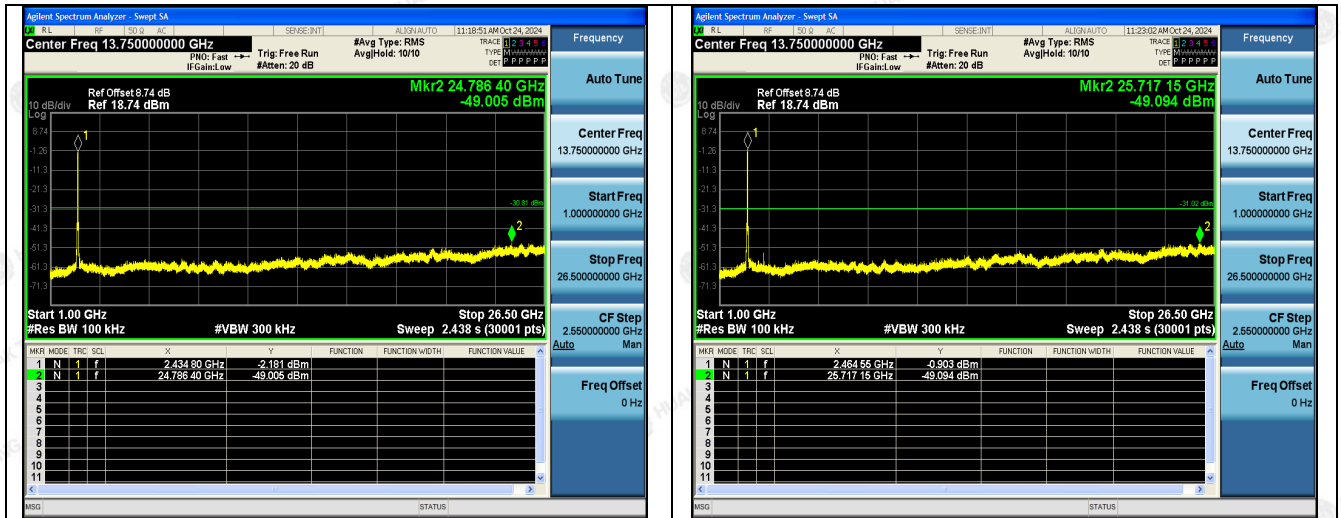


## Spurious Emission(2422MHz)

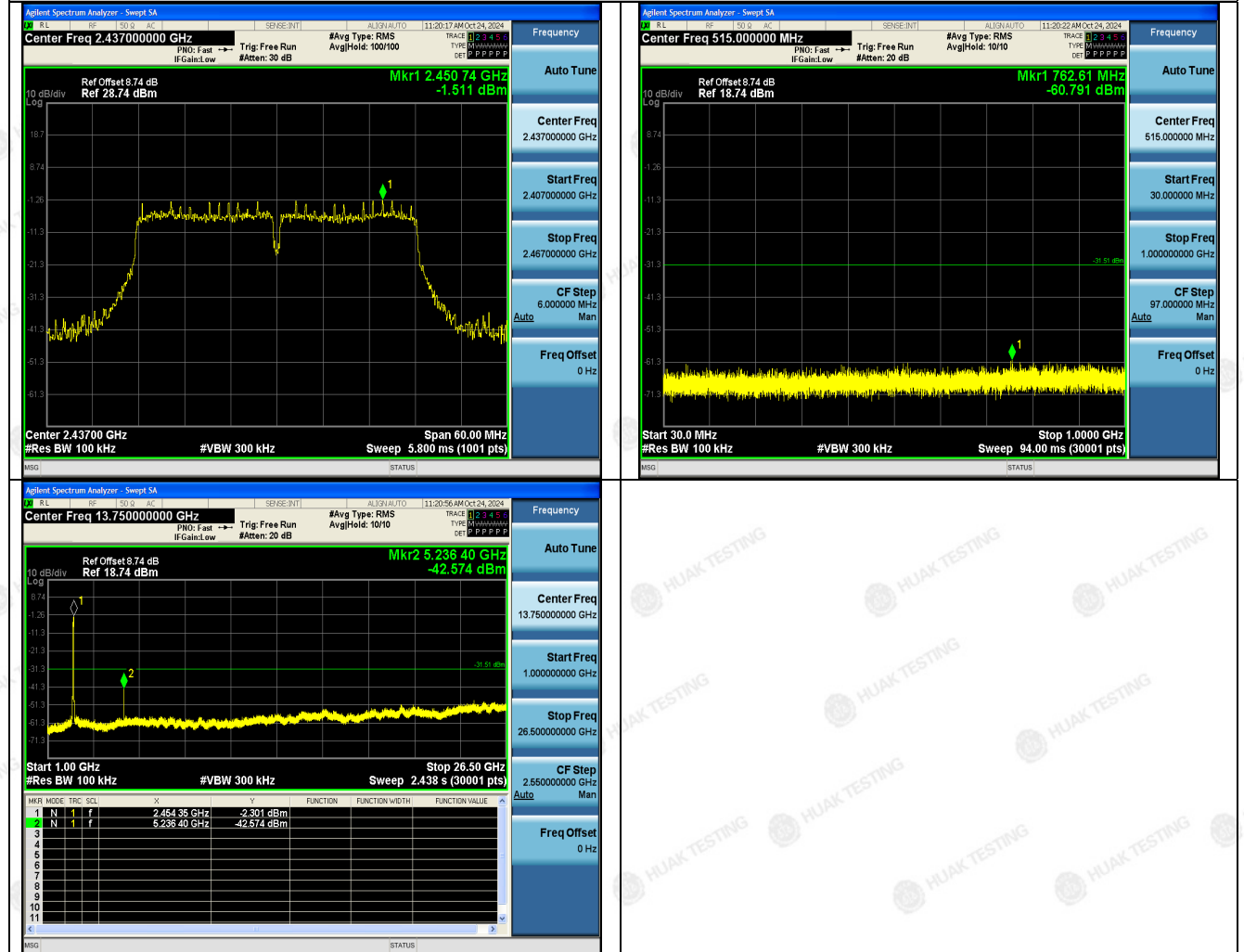


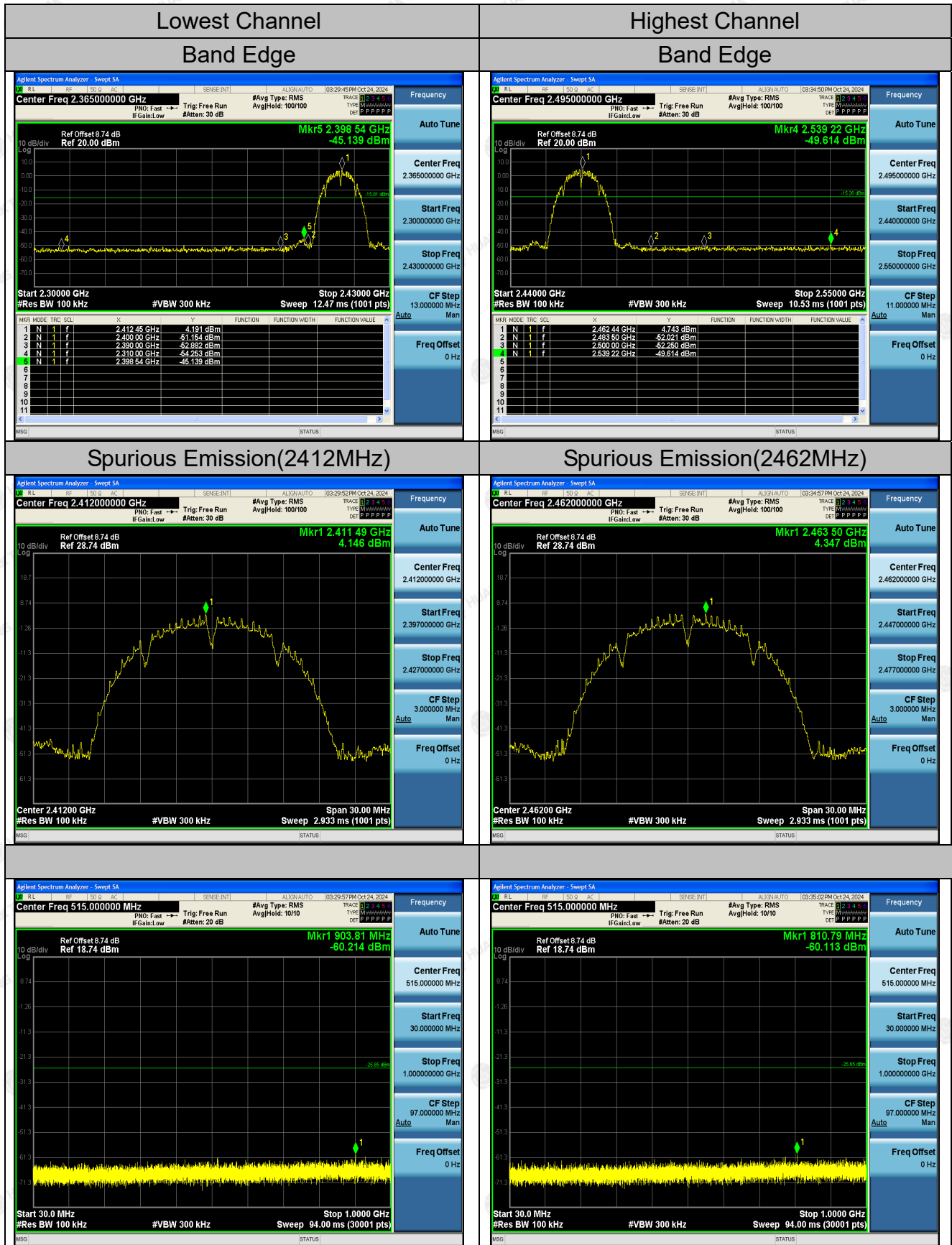
## Spurious Emission(2452MHz)





### Spurious Emission(2437MHz)

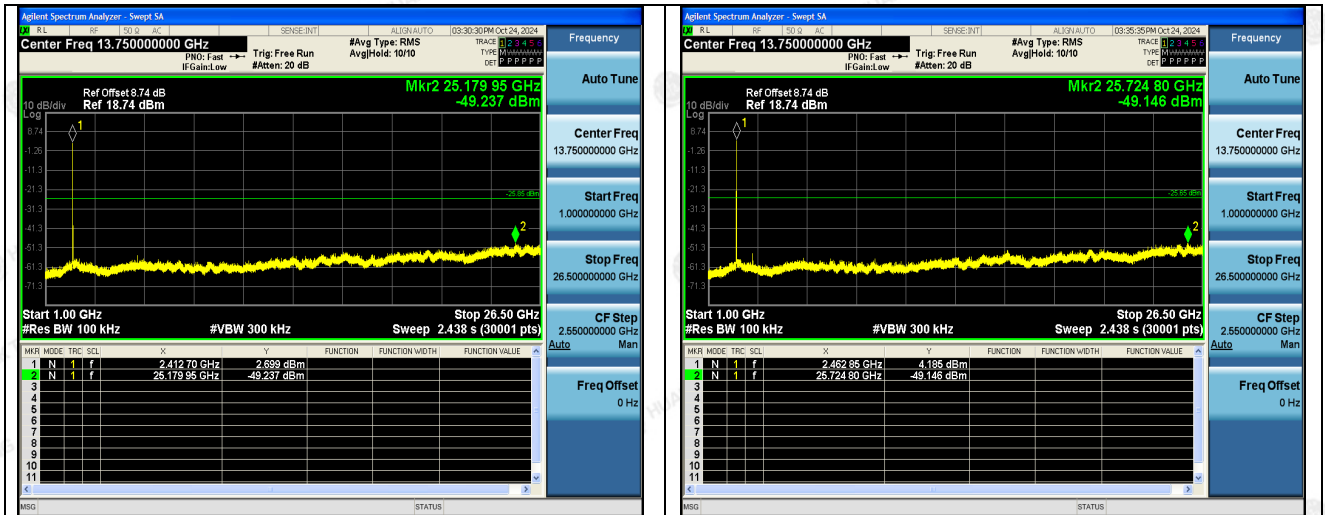


**Chain 2**  
**802.11b Modulation**

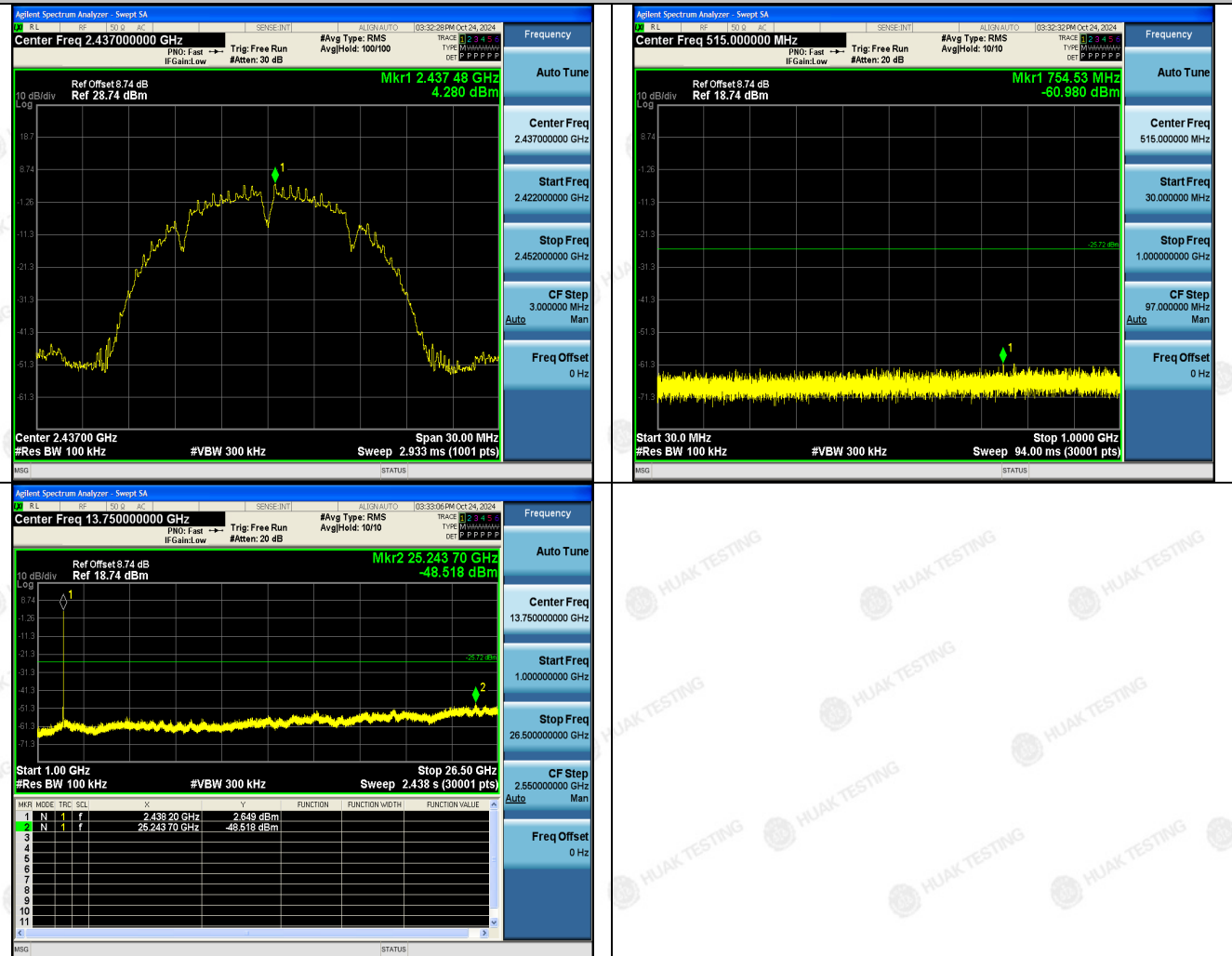
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## Spurious Emission(2437MHz)

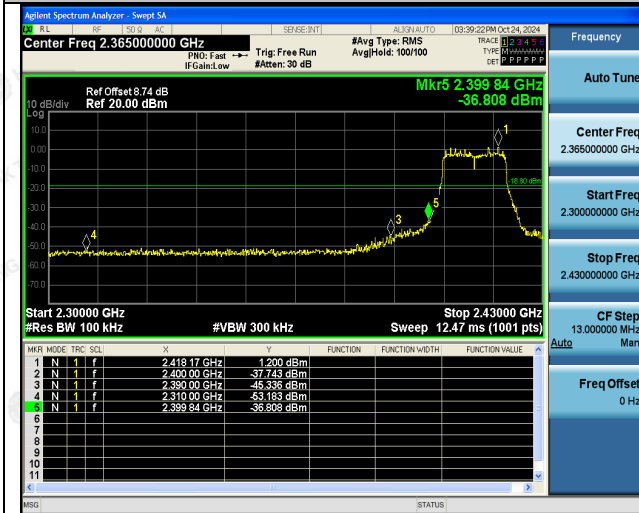




## 802.11g Modulation

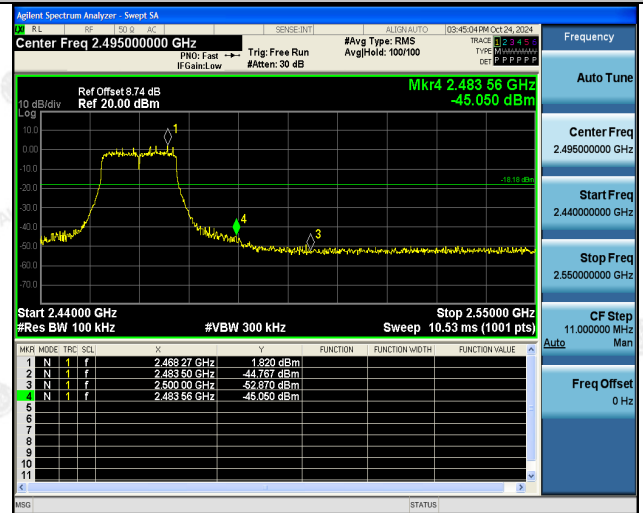
## Lowest Channel

## Band Edge

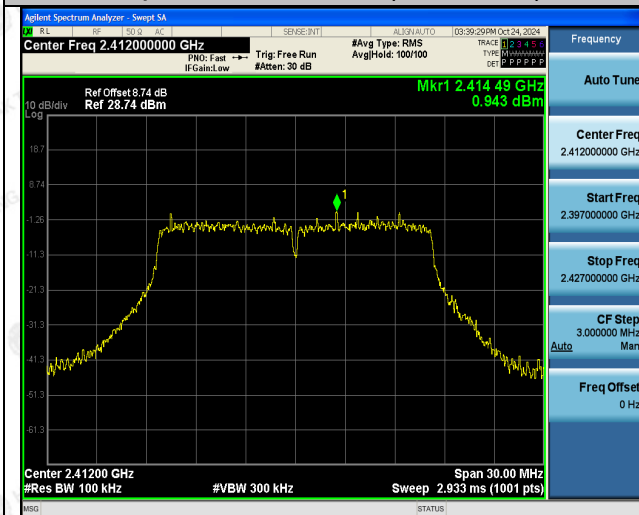


## Highest Channel

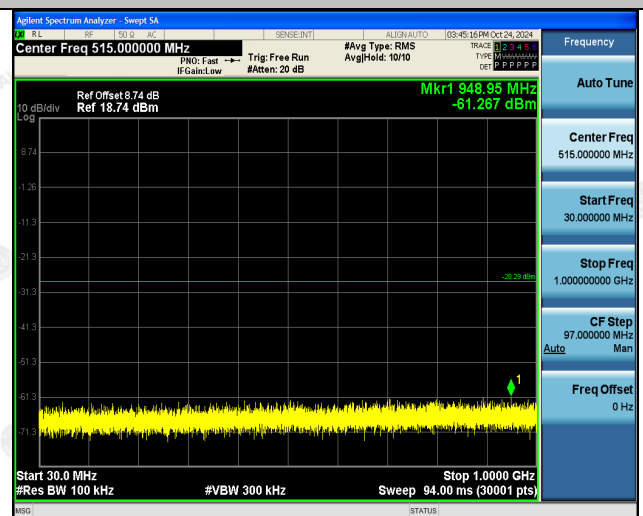
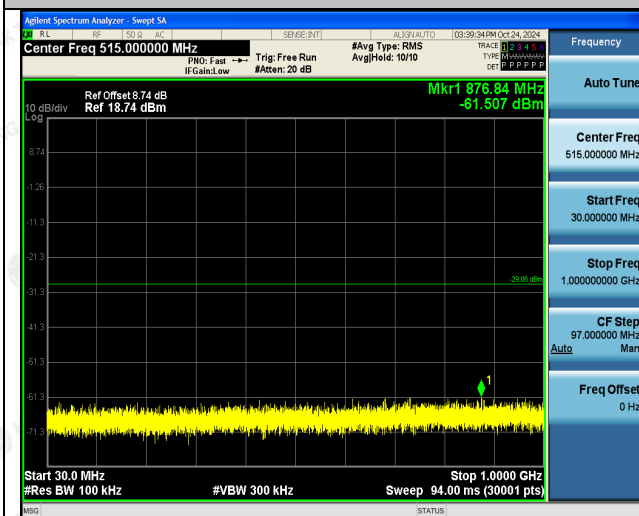
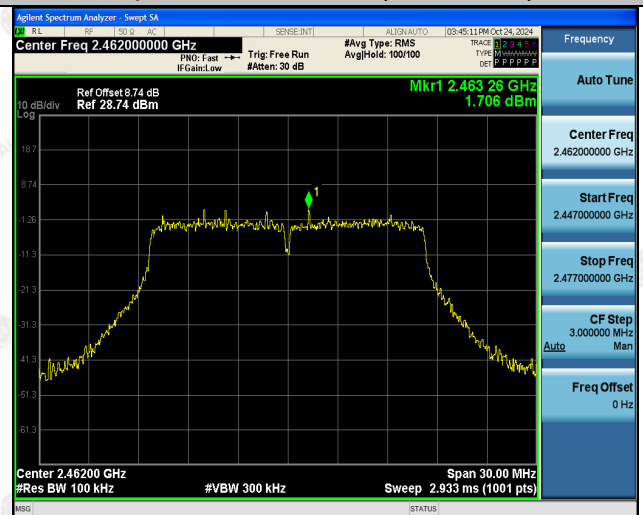
## Band Edge

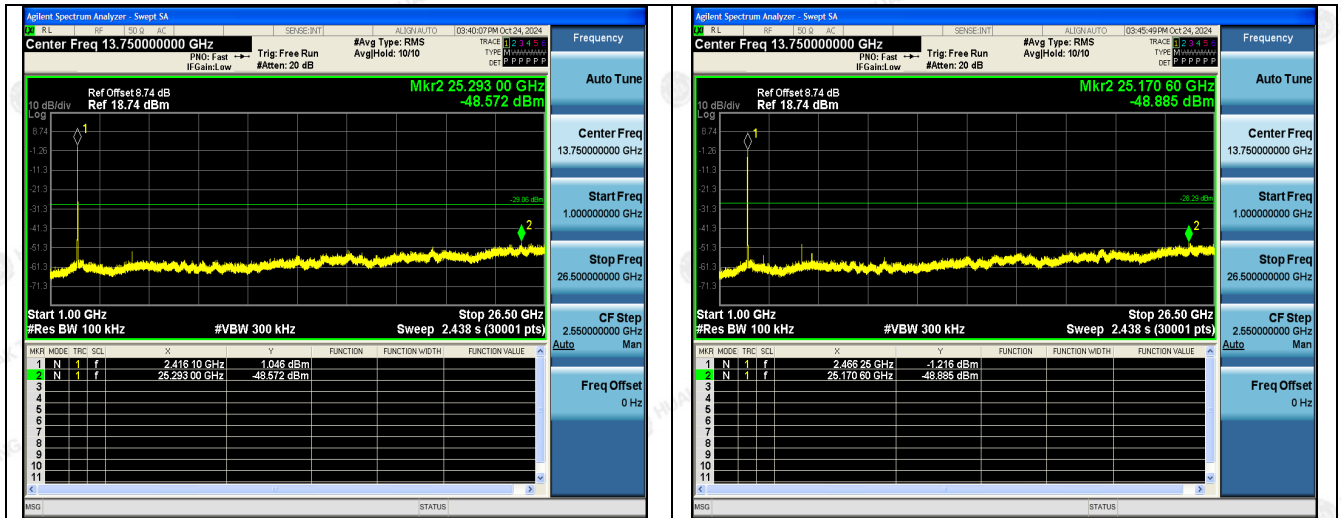


## Spurious Emission(2412MHz)

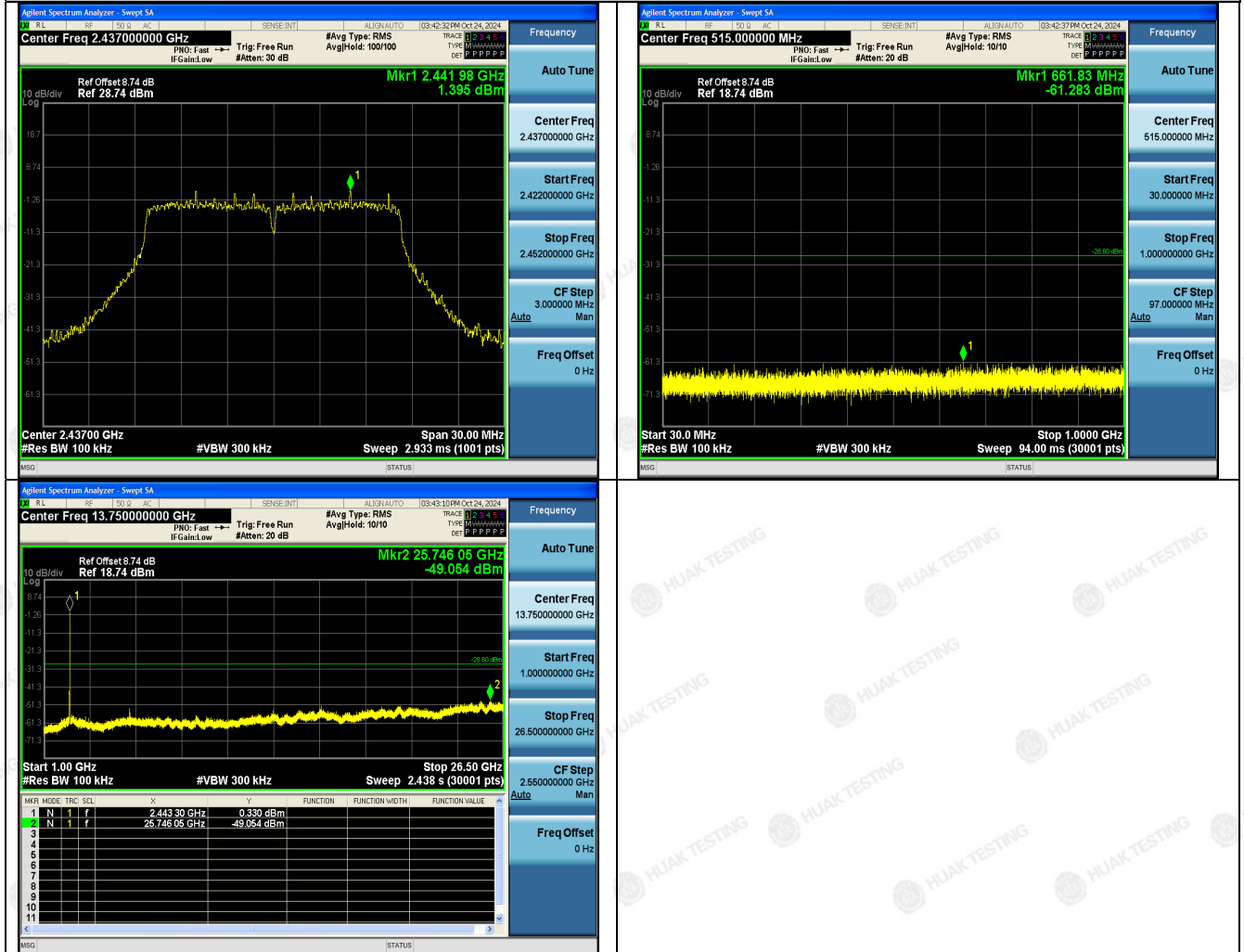


## Spurious Emission(2462MHz)





## Spurious Emission(2437MHz)





## 802.11n (HT20) Modulation

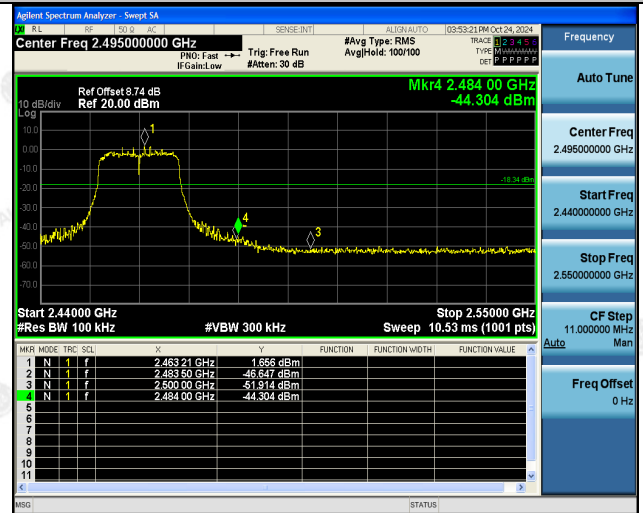
## Lowest Channel

## Band Edge

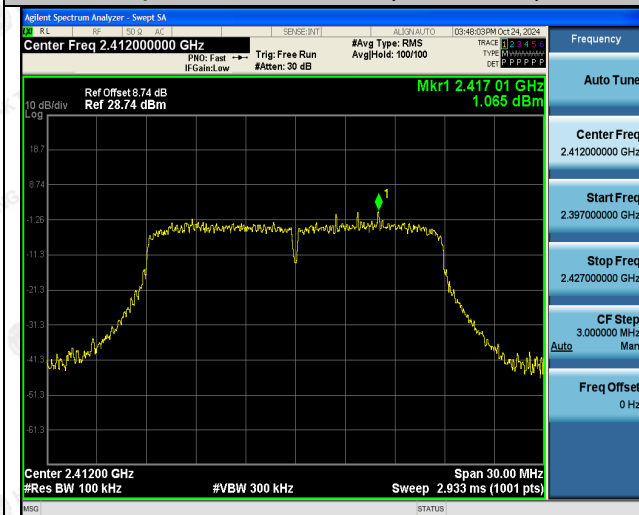


## Highest Channel

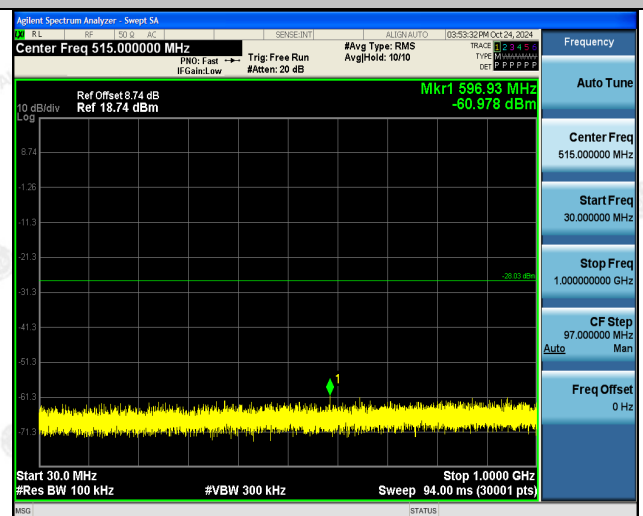
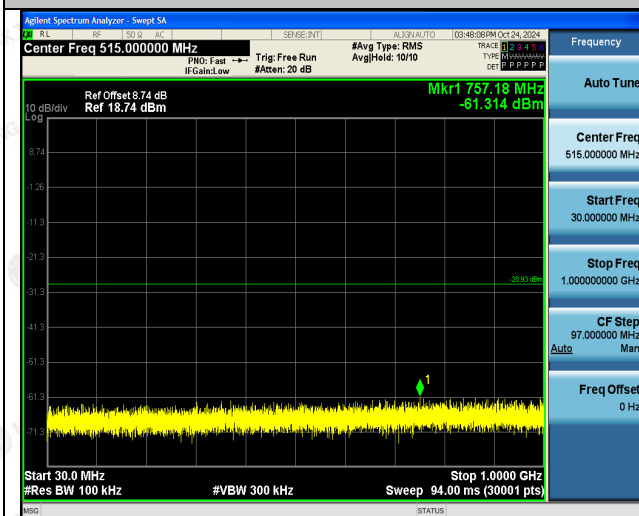
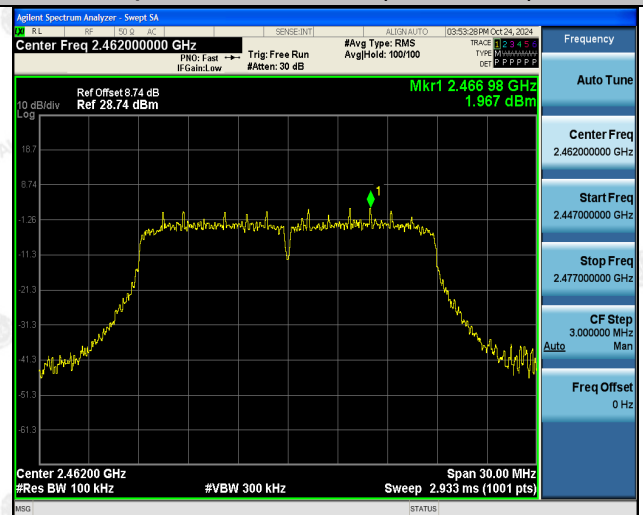
## Band Edge

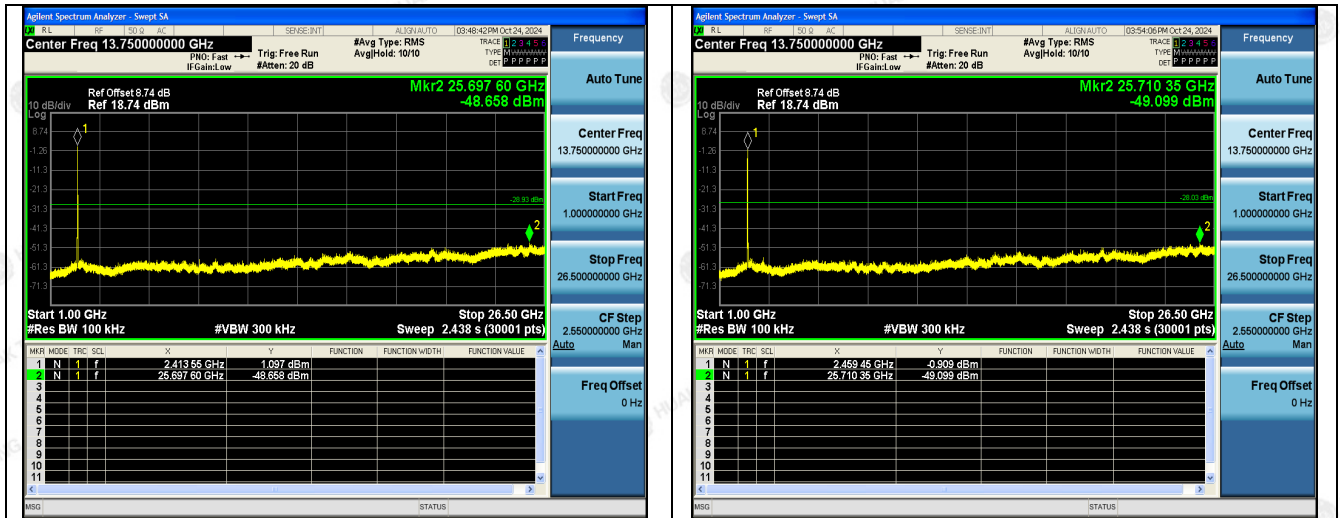


## Spurious Emission(2412MHz)

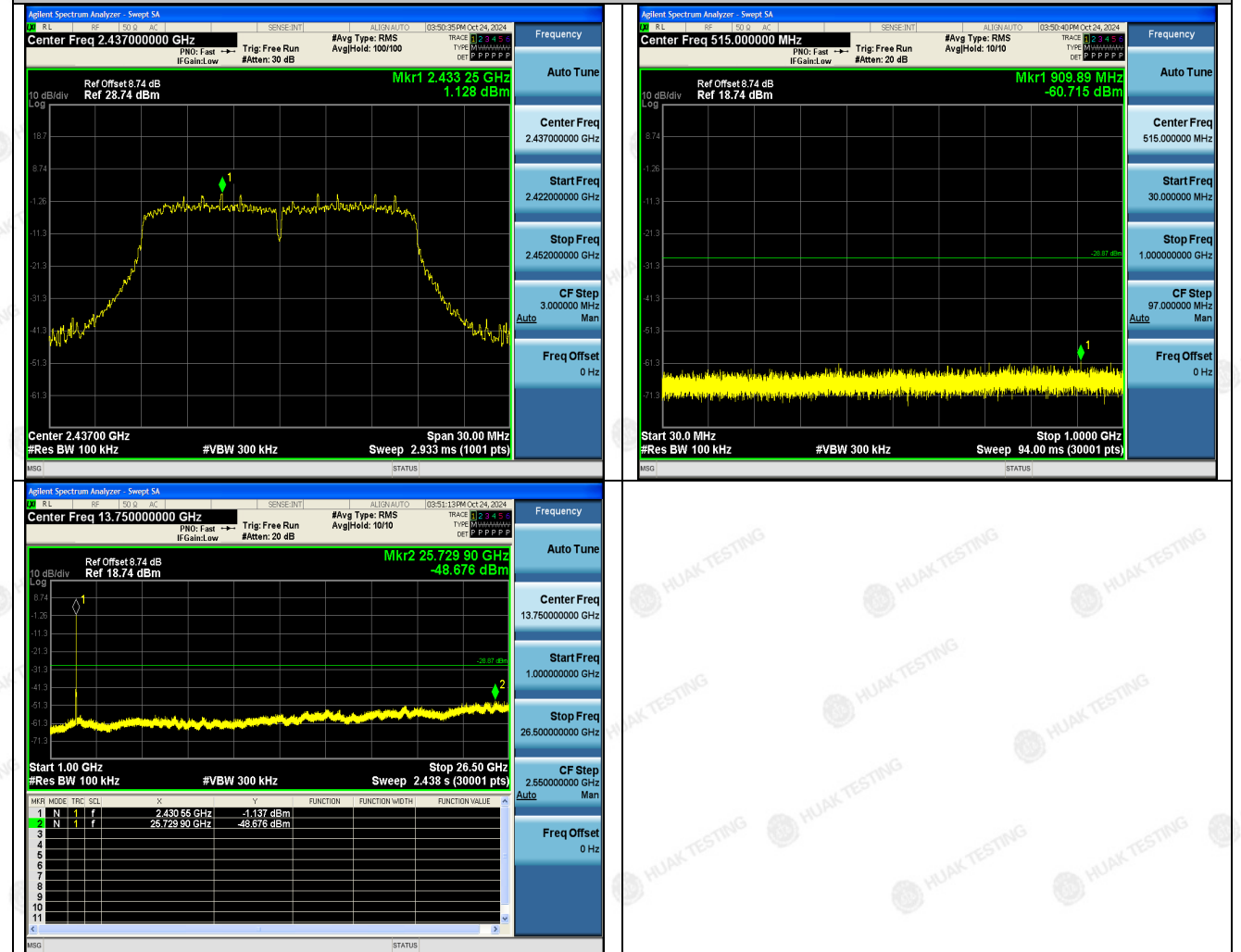


## Spurious Emission(2462MHz)



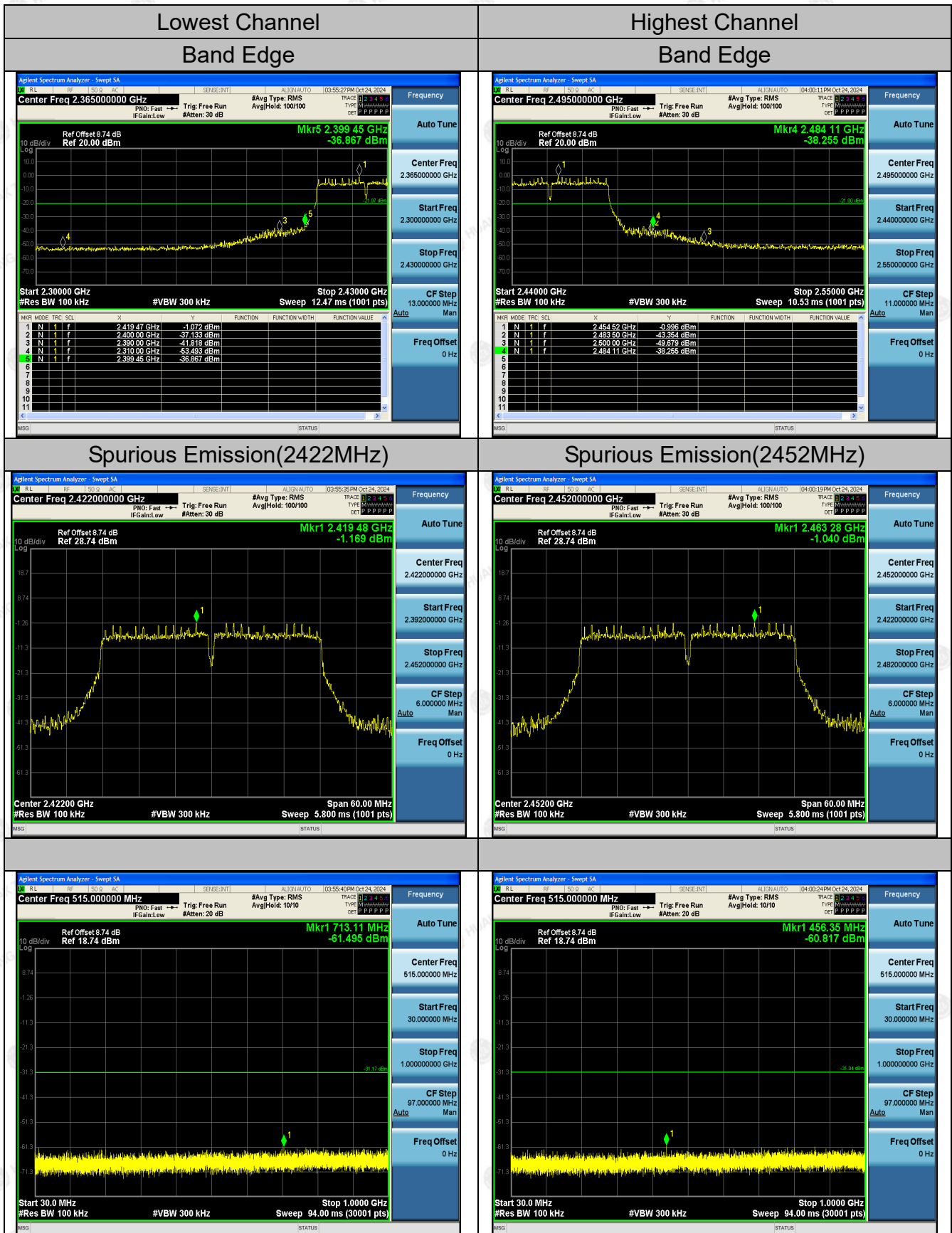


### Spurious Emission(2437MHz)





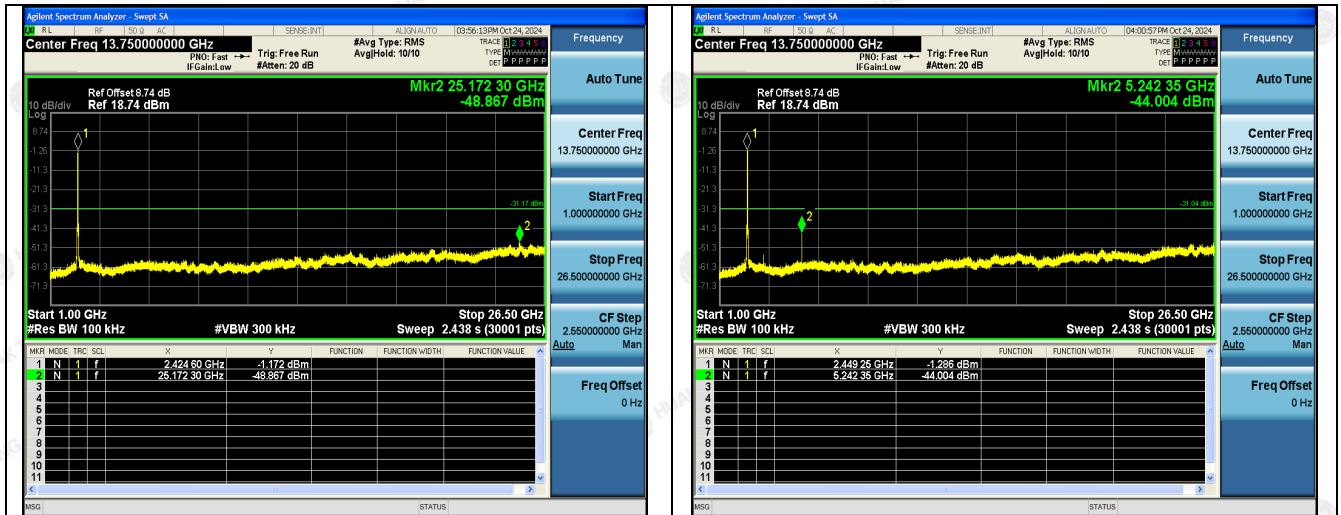
## 802.11n (HT40) Modulation



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## Spurious Emission(2437MHz)





## 4.6. Radiated Spurious Emission Measurement

### 4.6.1. Test Specification

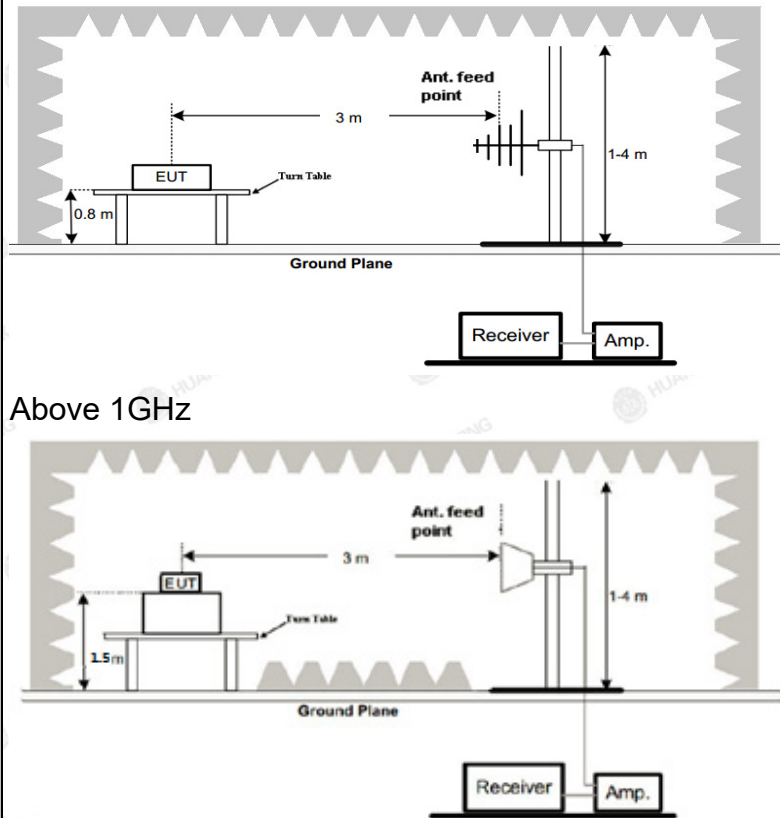
|                              |                                   |                                   |                               |          |
|------------------------------|-----------------------------------|-----------------------------------|-------------------------------|----------|
| <b>Test Requirement:</b>     | FCC Part15 C Section 15.209       |                                   |                               |          |
| <b>Test Method:</b>          | ANSI C63.10: 2013                 |                                   |                               |          |
| <b>Frequency Range:</b>      | 9 kHz to 25 GHz                   |                                   |                               |          |
| <b>Measurement Distance:</b> | 3 m                               |                                   |                               |          |
| <b>Antenna Polarization:</b> | Horizontal & Vertical             |                                   |                               |          |
| <b>Operation mode:</b>       | Transmitting mode with modulation |                                   |                               |          |
| <b>Receiver Setup:</b>       | Frequency                         | Detector                          | RBW                           | VBW      |
|                              | 9kHz- 150kHz                      | Quasi-peak                        | 200Hz                         | 1kHz     |
|                              | 150kHz- 30MHz                     | Quasi-peak                        | 9kHz                          | 30kHz    |
|                              | 30MHz-1GHz                        | Quasi-peak                        | 120KHz                        | 300KHz   |
|                              | Above 1GHz                        | Peak                              | 1MHz                          | 3MHz     |
| <b>Limit:</b>                | Frequency                         | Field Strength (microvolts/meter) | Measurement Distance (meters) | Remark   |
|                              | 9kHz- 150kHz                      | Quasi-peak                        | 200Hz                         | 1kHz     |
|                              | 150kHz- 30MHz                     | Quasi-peak                        | 9kHz                          | 30kHz    |
|                              | 30MHz-1GHz                        | Quasi-peak                        | 120KHz                        | 300KHz   |
|                              | Above 1GHz                        | Peak                              | 1MHz                          | 3MHz     |
| <b>Test setup:</b>           | Frequency                         | Field Strength (microvolts/meter) | Measurement Distance (meters) | Detector |
|                              | 9kHz- 150kHz                      | Quasi-peak                        | 200Hz                         | 1kHz     |
|                              | 150kHz- 30MHz                     | Quasi-peak                        | 9kHz                          | 30kHz    |
|                              | 30MHz-1GHz                        | Quasi-peak                        | 120KHz                        | 300KHz   |
|                              | Above 1GHz                        | Peak                              | 1MHz                          | 3MHz     |

|             |                                   |                               |
|-------------|-----------------------------------|-------------------------------|
| Frequency   | 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    | 30                                | 30                            |
| 30-88       | 100                               | 3                             |
| 88-216      | 150                               | 3                             |
| 216-960     | 200                               | 3                             |
| Above 960   | 500                               | 3                             |

|            |                                   |                               |          |
|------------|-----------------------------------|-------------------------------|----------|
| Frequency  | Field Strength (microvolts/meter) | Measurement Distance (meters) | Detector |
| Above 1GHz | 500                               | 3                             | Average  |
|            | 5000                              | 3                             | Peak     |

For radiated emissions below 30MHz

30MHz to 1GHz

**Test Procedure:**

1. For the radiated emission test below 1GHz:  
The EUT was placed on a turntable with 0.8 meter above ground. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high PASS filter are used for the test in order to get better signal level.
2. For the radiated emission test above 1GHz:  
Place the measurement antenna on a turntable with 1.5 meter above ground, which is away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal.



|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | <p>The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.</p> <p>3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level</p> <p>4. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.</p> <p>5. Use the following spectrum analyzer settings:</p> <p>(1) Span shall wide enough to fully capture the emission being measured;</p> <p>(2) Set RBW=100 kHz for <math>f &lt; 1</math> GHz; VBW <math>\geq</math> RBW; Sweep = auto; Detector function = peak; Trace = max hold;</p> <p>(3) Set RBW = 1 MHz, VBW= 3MHz for <math>f \geq 1</math> GHz for peak measurement.</p> <p>6. For average measurement: VBW = 10 Hz, when duty cycle is no less than 98 percent. VBW <math>\geq 1/T</math>, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.</p> |
| Test results: | PASS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |



## 4.6.2. Test Instruments

| Radiated Emission Test Site (966) |                 |                    |               |                  |                 |
|-----------------------------------|-----------------|--------------------|---------------|------------------|-----------------|
| Name of Equipment                 | Manufacturer    | Model              | Serial Number | Calibration Date | Calibration Due |
| Spectrum analyzer                 | Agilent         | N9020A             | HKE-025       | Feb. 20, 2024    | Feb. 19, 2025   |
| Spectrum analyzer                 | R&S             | FSV3044            | HKE-126       | Feb. 20, 2024    | Feb. 19, 2025   |
| Preamplifier                      | EMCI            | EMC051845<br>S     | HKE-006       | Feb. 20, 2024    | Feb. 19, 2025   |
| Preamplifier                      | Schwarzbeck     | BBV 9743           | HKE-016       | Feb. 20, 2024    | Feb. 19, 2025   |
| Preamplifier                      | A.H. Systems    | SAS-574            | HKE-182       | Feb. 20, 2024    | Feb. 19, 2025   |
| 6dB Attenuator                    | Pasternack      | 6db                | HKE-184       | Feb. 20, 2024    | Feb. 19, 2025   |
| EMI Test Receiver                 | Rohde & Schwarz | ESR-7              | HKE-010       | Feb. 20, 2024    | Feb. 19, 2025   |
| Broadband Antenna                 | Schwarzbeck     | VULB9168           | HKE-167       | Feb. 21, 2024    | Feb. 20, 2026   |
| Loop Antenna                      | COM-POWER       | AL-130R            | HKE-014       | Feb. 21, 2024    | Feb. 20, 2026   |
| Horn Antenna                      | Schwarzbeck     | 9120D              | HKE-013       | Feb. 21, 2024    | Feb. 20, 2026   |
| EMI Test Software                 | Tonscend        | JS32-RE<br>5.0.0   | HKE-082       | N/A              | N/A             |
| RSE Test Software                 | Tonscend        | JS36-RSE 5.<br>0.0 | HKE-184       | N/A              | N/A             |

**Note:** The calibration interval of the above test instruments is 12 months and the calibrations are traceable to international system unit (SI).

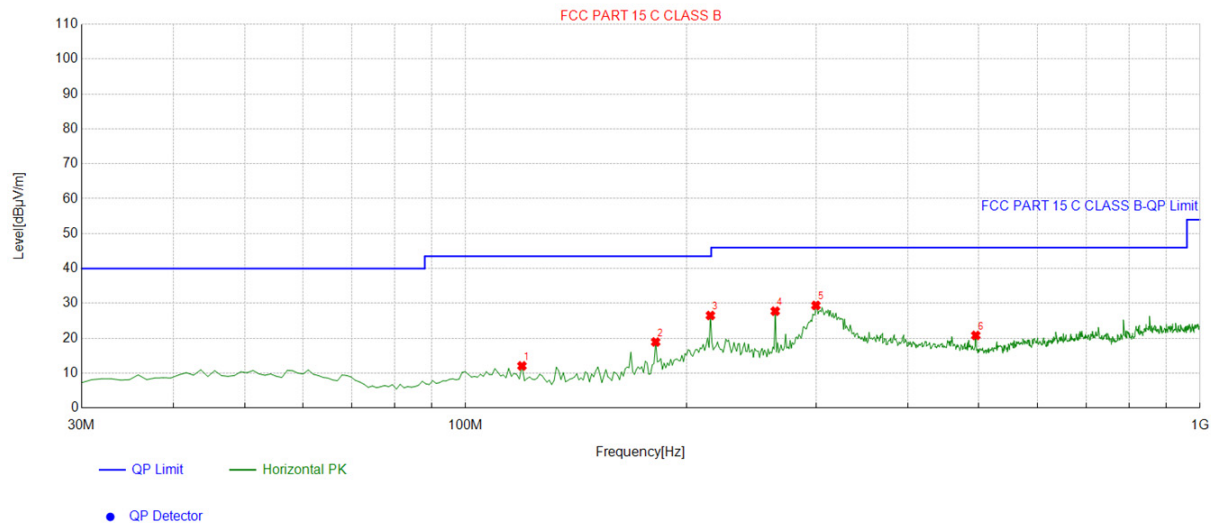


#### 4.6.3. Test Data

Please refer to following diagram for individual  
Below 1GHz

All the test modes completed for test. only the worst result of reported as below:

##### Horizontal

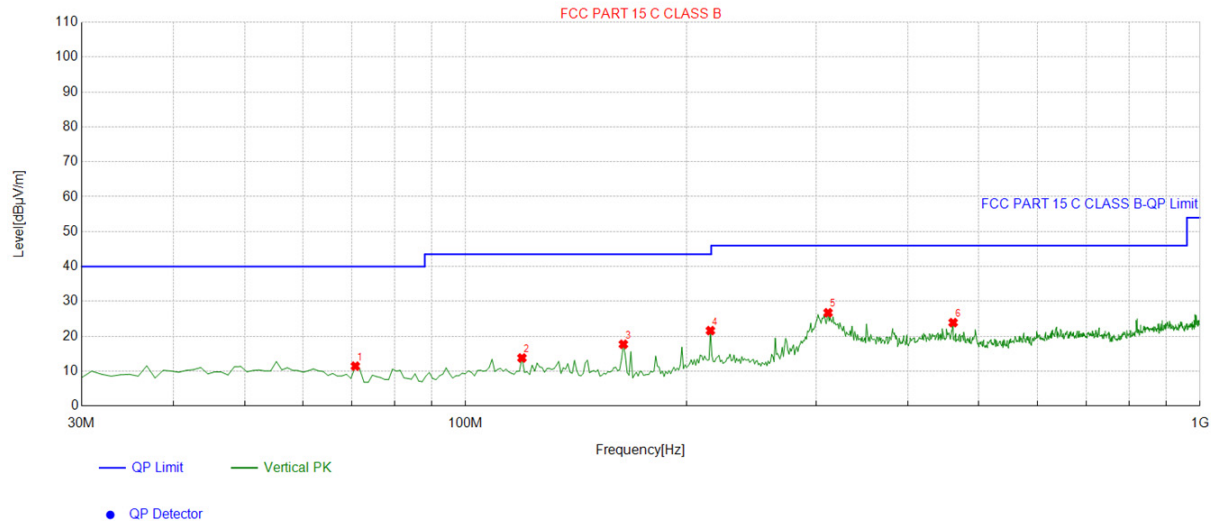


| Suspected List |                |                |                     |                   |                   |                |                |              |            |
|----------------|----------------|----------------|---------------------|-------------------|-------------------|----------------|----------------|--------------|------------|
| NO.            | Freq.<br>[MHz] | Factor<br>[dB] | Reading<br>[dBμV/m] | Level<br>[dBμV/m] | Limit<br>[dBμV/m] | Margin<br>[dB] | Height<br>[cm] | Angle<br>[°] | Polarity   |
| 1              | 119.32932      | -15.94         | 28.02               | 12.08             | 43.50             | 31.42          | 100            | 255          | Horizontal |
| 2              | 181.47147      | -16.13         | 35.07               | 18.94             | 43.50             | 24.56          | 100            | 108          | Horizontal |
| 3              | 215.45545      | -14.72         | 41.25               | 26.53             | 43.50             | 16.97          | 100            | 166          | Horizontal |
| 4              | 264.00400      | -13.15         | 40.91               | 27.76             | 46.00             | 18.24          | 100            | 191          | Horizontal |
| 5              | 299.92993      | -11.71         | 41.12               | 29.41             | 46.00             | 16.59          | 100            | 266          | Horizontal |
| 6              | 495.09509      | -7.84          | 28.65               | 20.81             | 46.00             | 25.19          | 100            | 277          | Horizontal |

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level



## Vertical



| Suspected List |                |                |                     |                   |                   |                |                |              |          |
|----------------|----------------|----------------|---------------------|-------------------|-------------------|----------------|----------------|--------------|----------|
| NO.            | Freq.<br>[MHz] | Factor<br>[dB] | Reading<br>[dBμV/m] | Level<br>[dBμV/m] | Limit<br>[dBμV/m] | Margin<br>[dB] | Height<br>[cm] | Angle<br>[°] | Polarity |
| 1              | 70.780781      | -16.89         | 28.33               | 11.44             | 40.00             | 28.56          | 100            | 230          | Vertical |
| 2              | 119.32932      | -15.94         | 29.72               | 13.78             | 43.50             | 29.72          | 100            | 155          | Vertical |
| 3              | 163.99399      | -17.59         | 35.29               | 17.70             | 43.50             | 25.80          | 100            | 91           | Vertical |
| 4              | 215.45545      | -14.72         | 36.34               | 21.62             | 43.50             | 21.88          | 100            | 236          | Vertical |
| 5              | 311.58158      | -11.70         | 38.43               | 26.73             | 46.00             | 19.27          | 100            | 158          | Vertical |
| 6              | 461.11111      | -8.91          | 32.82               | 23.91             | 46.00             | 22.09          | 100            | 147          | Vertical |

Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Limit – Level

## Harmonics and Spurious Emissions

## Frequency Range (9 kHz-30MHz)

| Frequency (MHz) | Level@3m (dBμV/m) | Limit@3m (dBμV/m) |
|-----------------|-------------------|-------------------|
| --              | --                | --                |
| --              | --                | --                |
| --              | --                | --                |
| --              | --                | --                |

**Note:** 1. Emission Level=Reading+ Cable loss-Antenna factor-Amp factor

2. The emission levels are 20 dB below the limit value, which are not reported. It is deemed to comply with the requirement

**Above 1GHz****RADIATED EMISSION TEST**

LOW CH1 (802.11b Mode)/2412

Horizontal:

| Frequency                                                                                                                 | Meter Reading | Factor | Emission Level | Limits   | Margin | Detector Type |
|---------------------------------------------------------------------------------------------------------------------------|---------------|--------|----------------|----------|--------|---------------|
| (MHz)                                                                                                                     | (dBμV)        | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |               |
| 4824                                                                                                                      | 54.83         | -3.64  | 51.19          | 74       | -22.81 | peak          |
| 4824                                                                                                                      | 41.56         | -3.64  | 37.92          | 54       | -16.08 | AVG           |
| 7236                                                                                                                      | 52.61         | -0.95  | 51.66          | 74       | -22.34 | peak          |
| 7236                                                                                                                      | 40.76         | -0.95  | 39.81          | 54       | -14.19 | AVG           |
| Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit. |               |        |                |          |        |               |

Vertical:

| Frequency                                                                                                                 | Meter Reading | Factor | Emission Level | Limits   | Margin | Detector Type |
|---------------------------------------------------------------------------------------------------------------------------|---------------|--------|----------------|----------|--------|---------------|
| (MHz)                                                                                                                     | (dBμV)        | (dB)   | (dBμV/m)       | (dBμV/m) | (dB)   |               |
| 4824                                                                                                                      | 54.51         | -3.64  | 50.87          | 74       | -23.13 | peak          |
| 4824                                                                                                                      | 42.63         | -3.64  | 38.99          | 54       | -15.01 | AVG           |
| 7236                                                                                                                      | 52.24         | -0.95  | 51.29          | 74       | -22.71 | peak          |
| 7236                                                                                                                      | 40.25         | -0.82  | 39.43          | 54       | -14.57 | AVG           |
| Remark: Factor = Cable loss + Antenna factor + Attenuator – Preamplifier; Level = Reading + Factor; Margin = Level-Limit. |               |        |                |          |        |               |