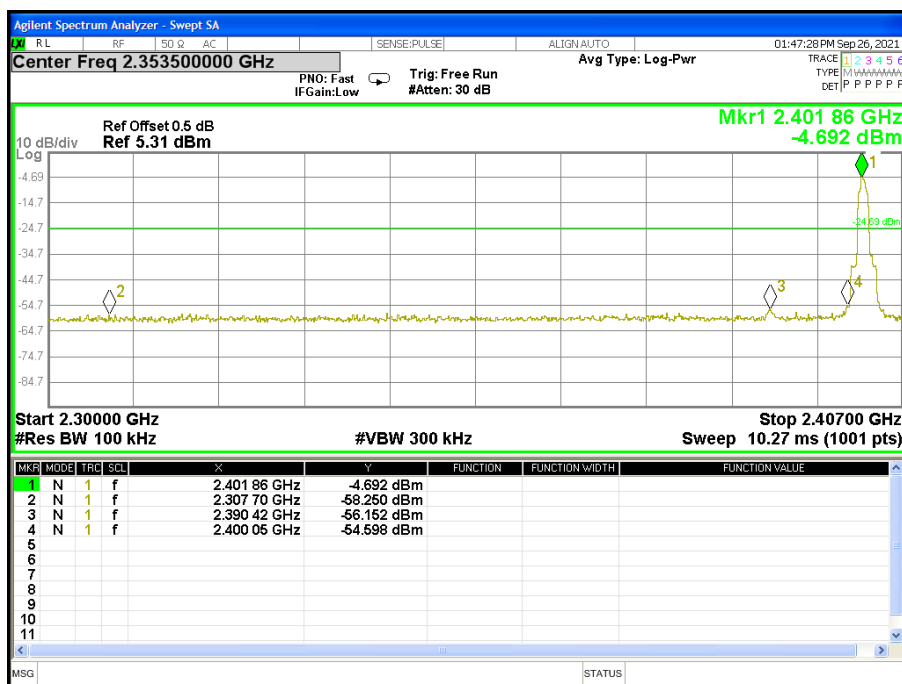


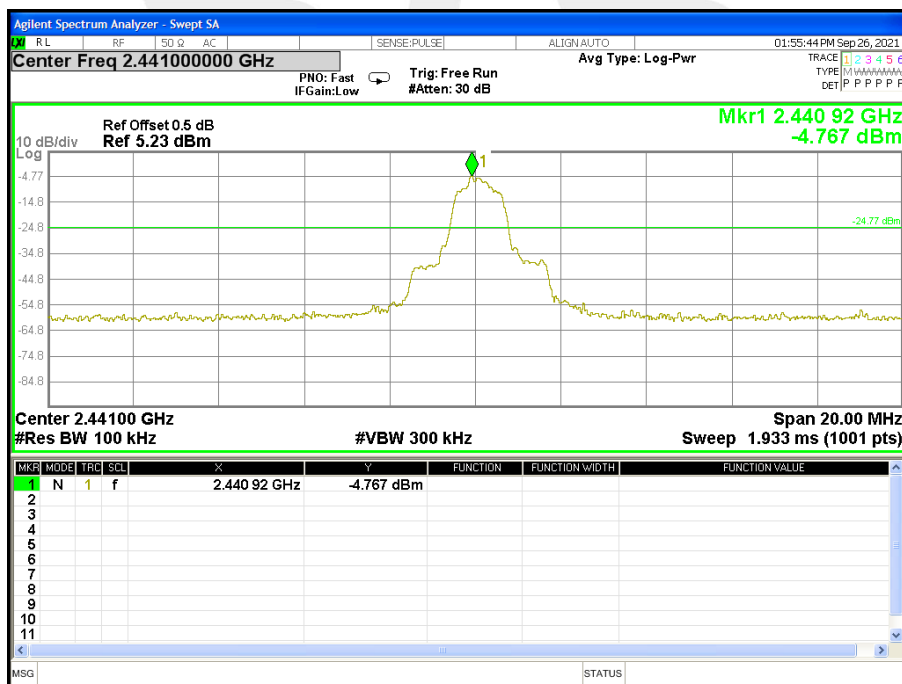


For Band edge(it's also the reference level for conducted spurious emission)

00 CH

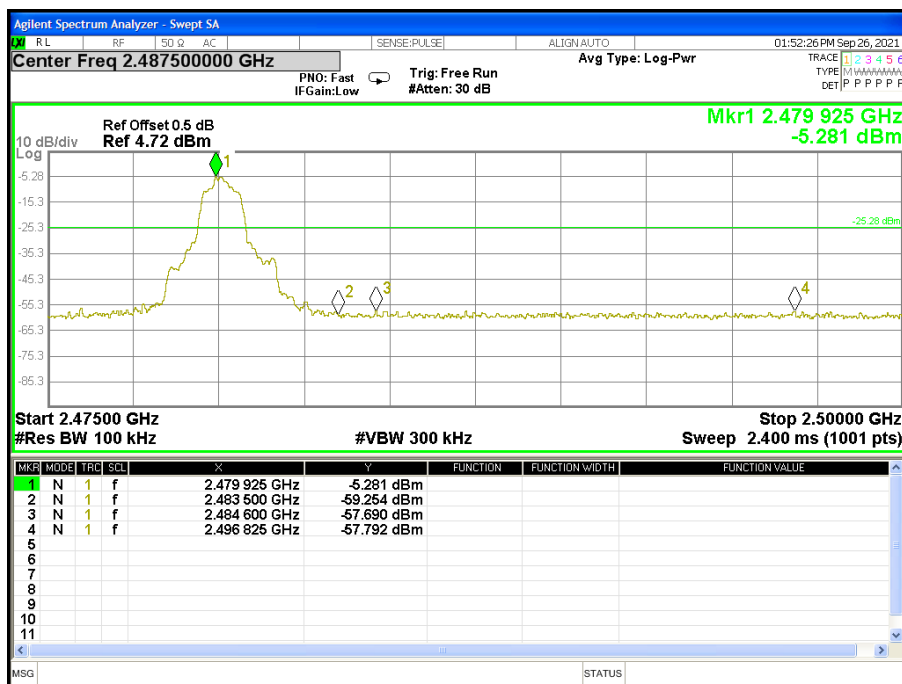


39 CH





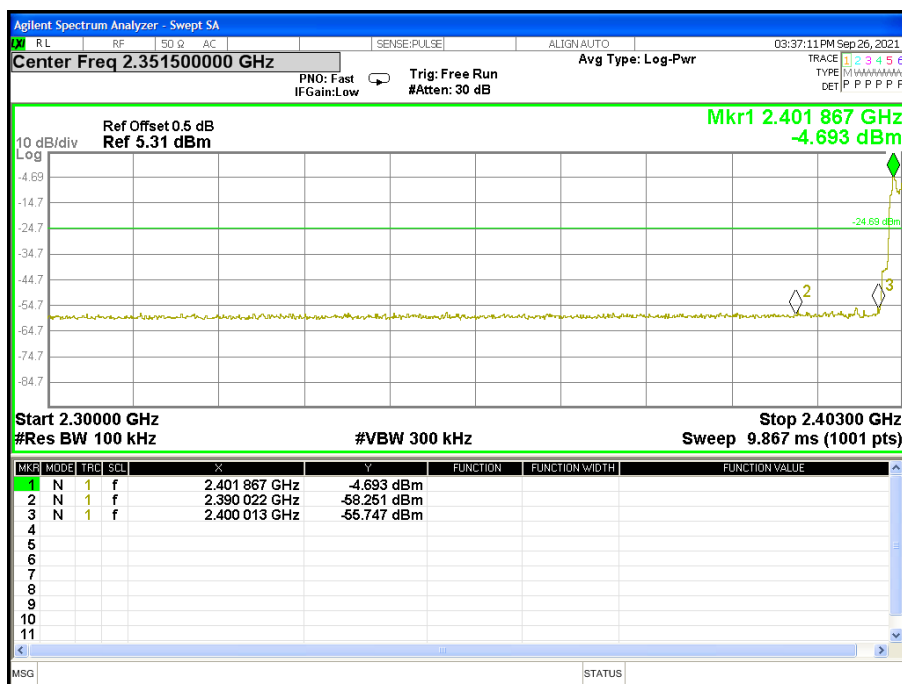
78 CH



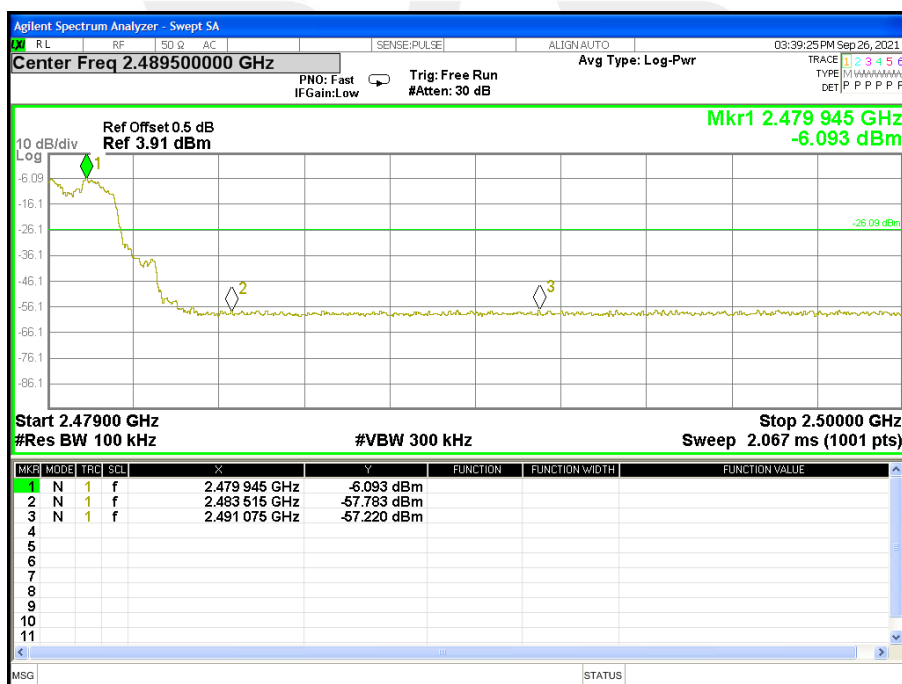


For Hopping Band edge

00 CH



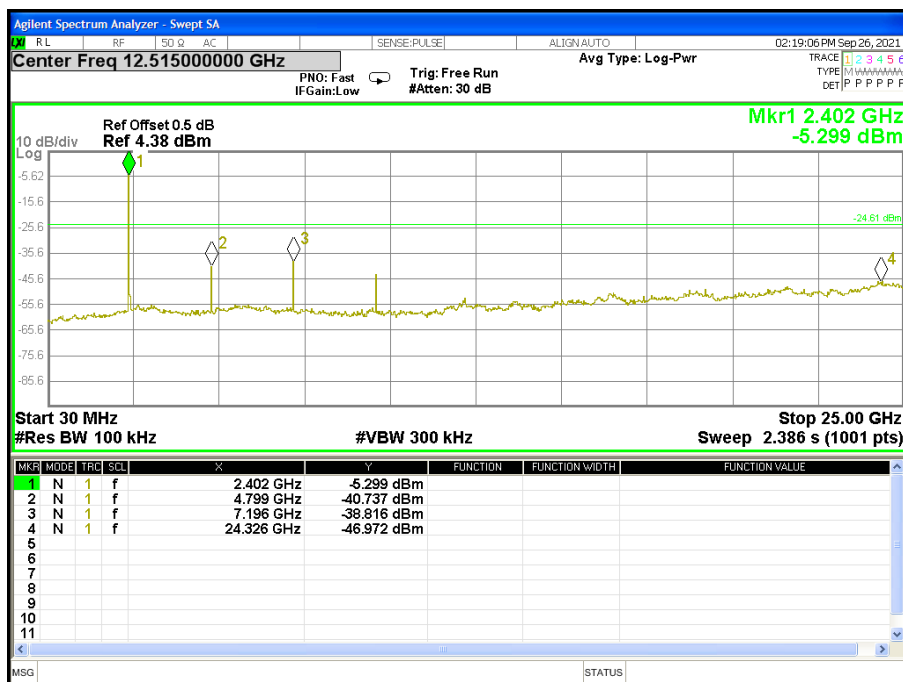
78 CH



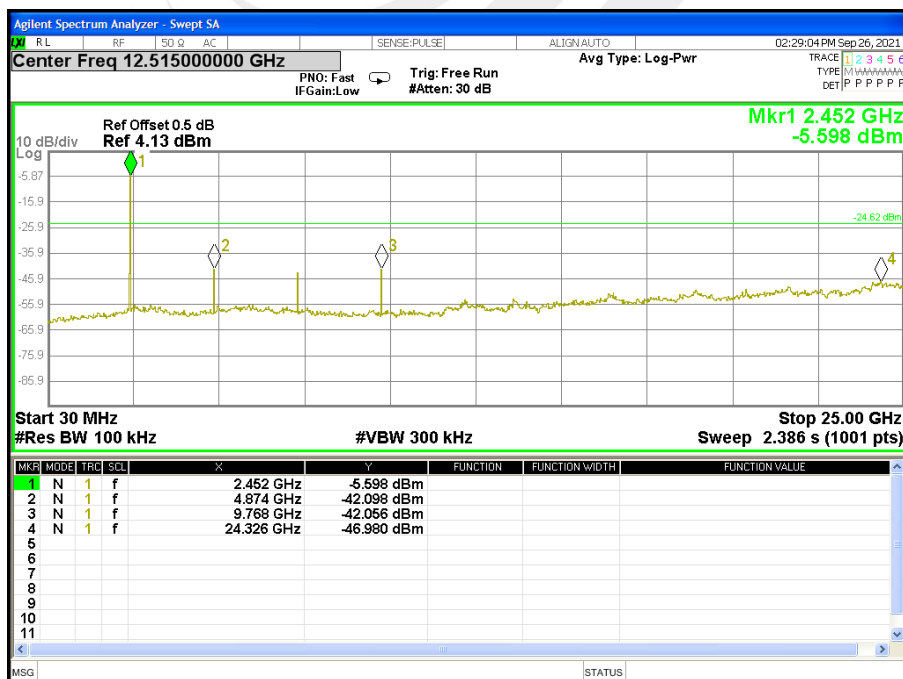


| | | | |
|--------------|---------------------------|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | 8DPSK(3Mbps) -00/39/78 CH | Test Voltage: | AC 120V/60Hz |

00 CH

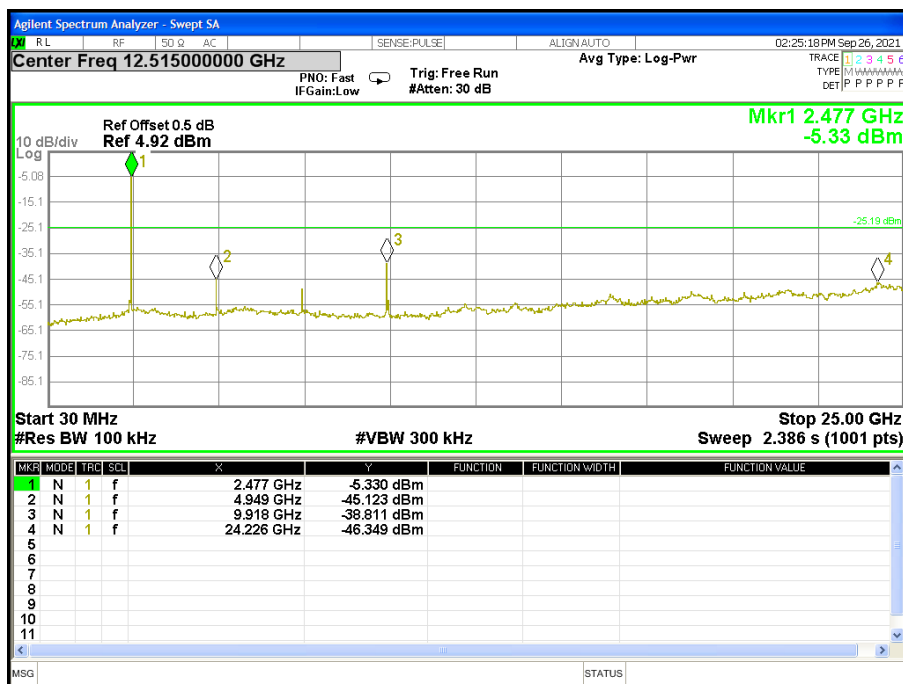


39 CH





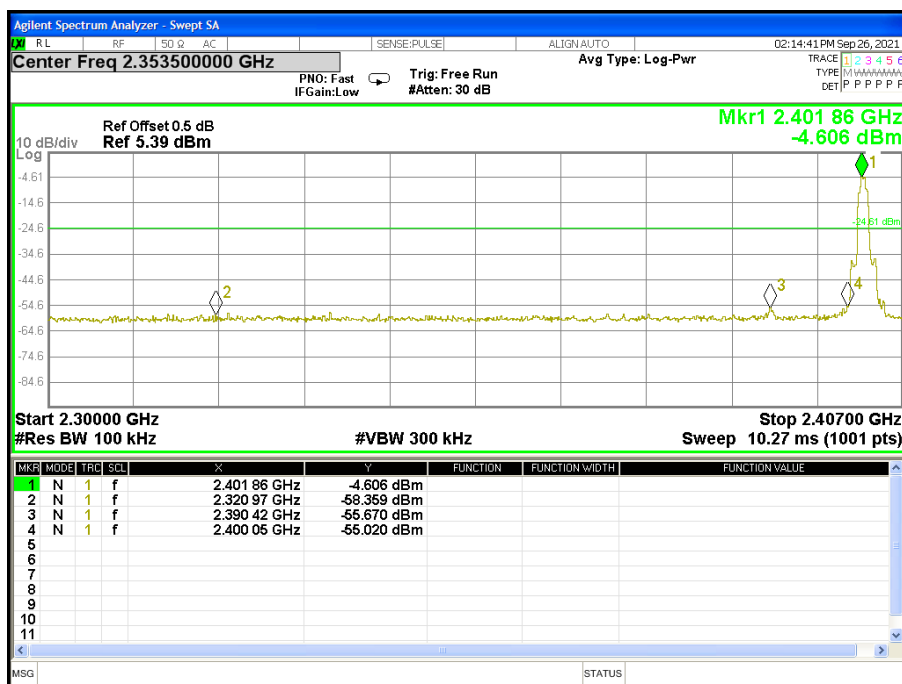
78 CH



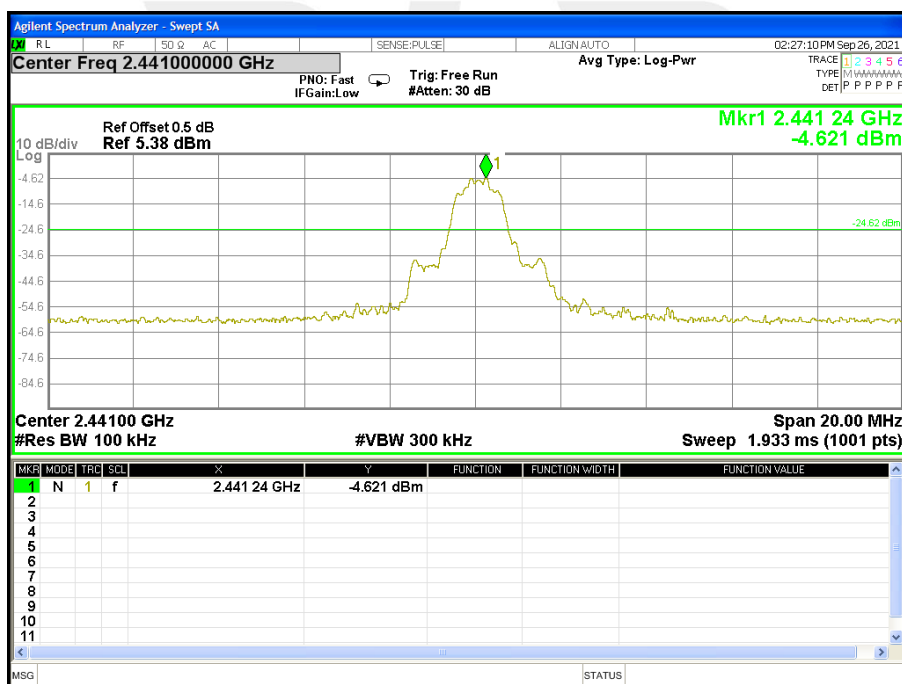


For Band edge(it's also the reference level for conducted spurious emission)

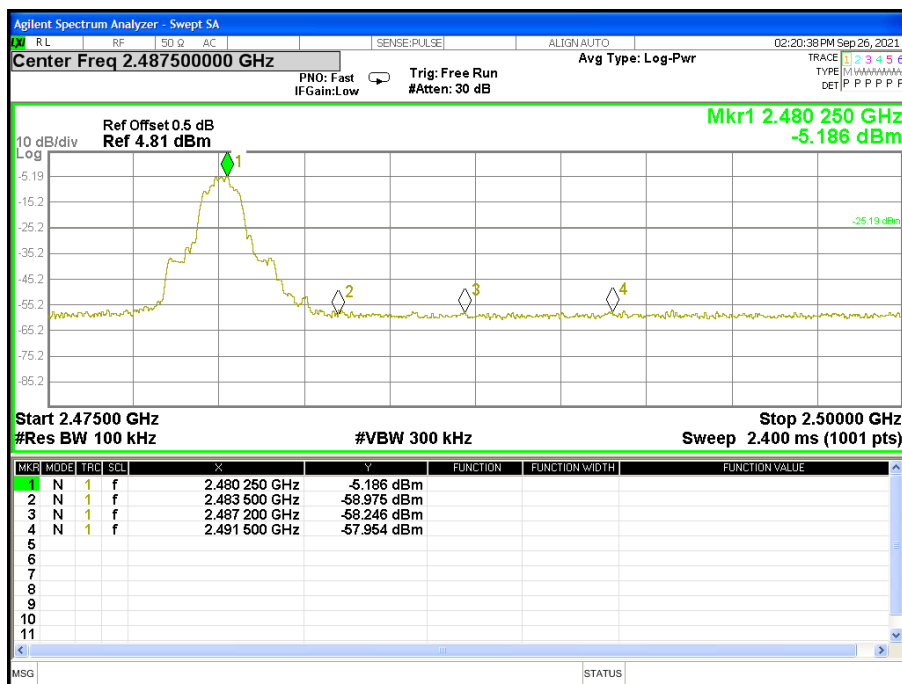
00 CH



39 CH



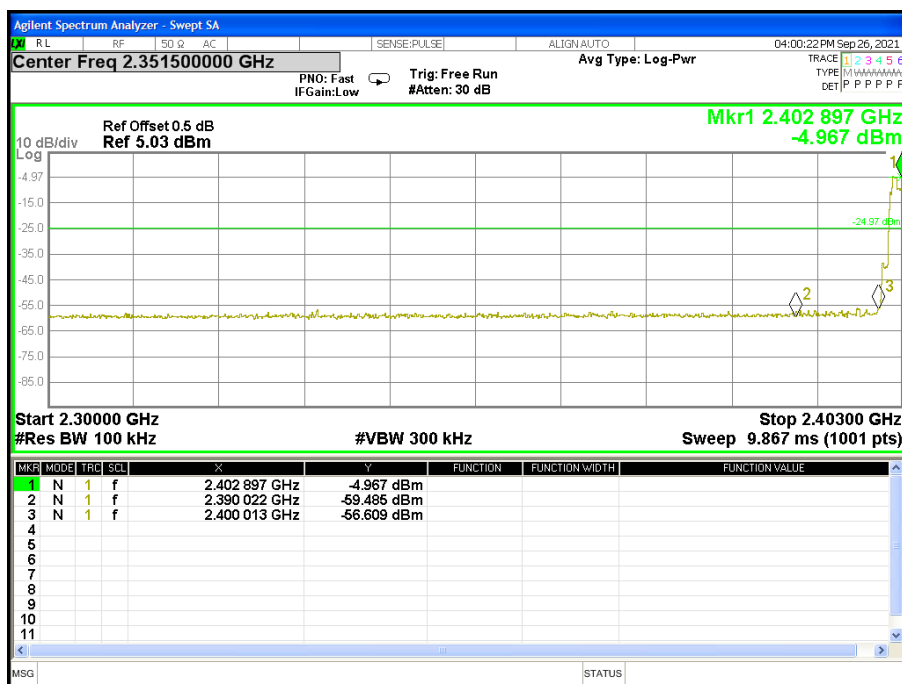
78 CH



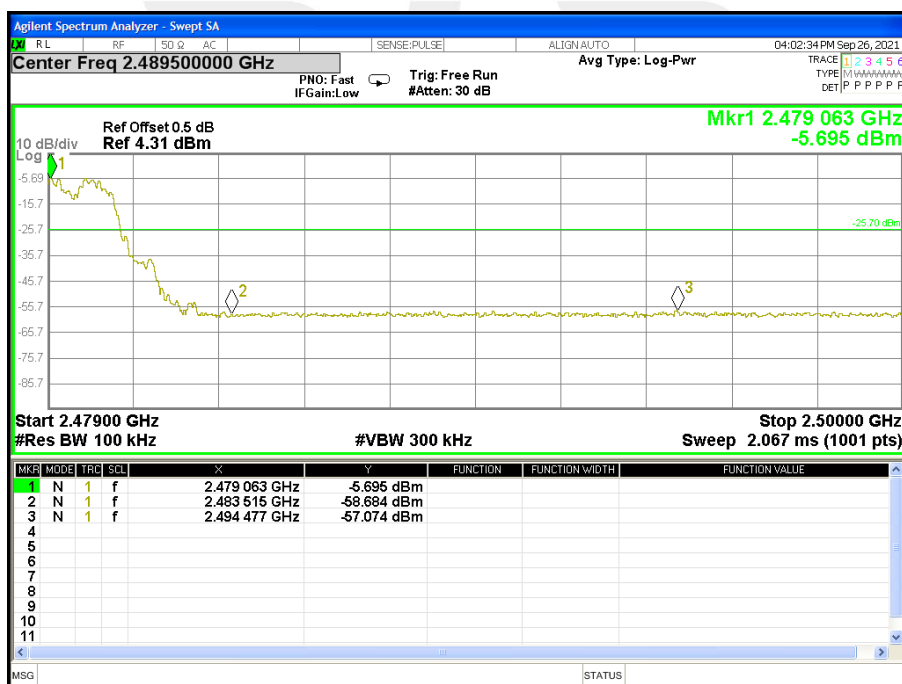


For Hopping Band edge

00 CH



78 CH





5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

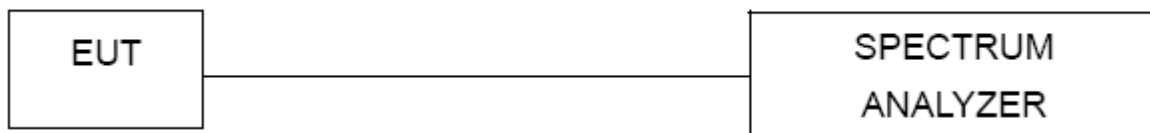
| FCC Part 15.247, Subpart C RSS-247 Issue 2 | | | | |
|---|---------------------------|-----------|-----------------------|--------|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247 (a)(1)(iii) RSS-247 | Number of Hopping Channel | ≥ 15 | 2400-2483.5 | PASS |

| Spectrum Parameters | Setting |
|---------------------|-----------------------------|
| Attenuation | Auto |
| Span Frequency | > Operating Frequency Range |
| RB | 300KHz |
| VB | 300KHz |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

5.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as shown in the block diagram below.
- Spectrum Setting: RBW= 300KHz, VBW=300KHz, Sweep time = Auto.

5.3 TEST SETUP



5.4 EUT OPERATION CONDITIONS

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



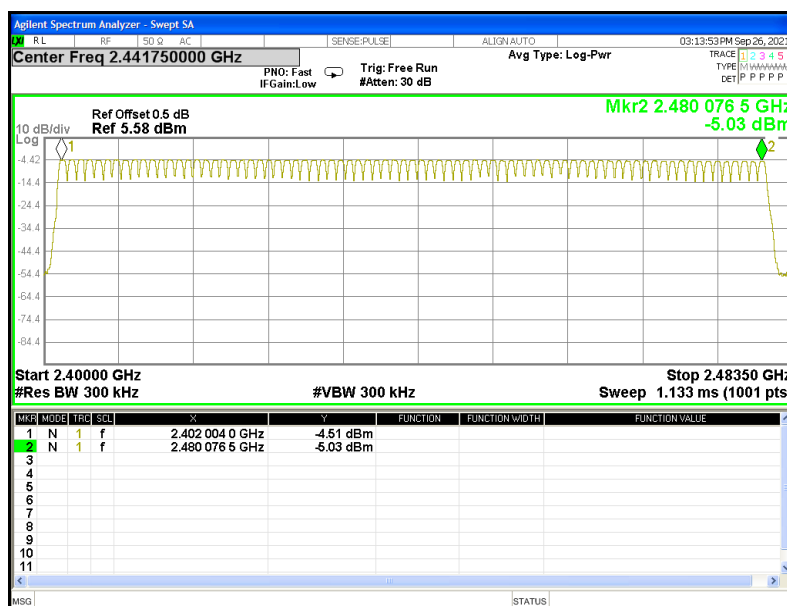
5.5 TEST RESULTS

| | | | |
|--------------|-------------------------|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 60% |
| Test Mode: | Hopping Mode -GFSK Mode | Test Voltage: | AC 120V/60Hz |

Number of Hopping Channel

79

Hopping channel





6. AVERAGE TIME OF OCCUPANCY

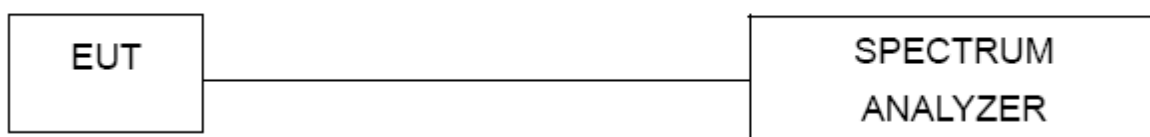
6.1 LIMIT

| FCC Part 15.247, Subpart C RSS-247 Issue 2 | | | | |
|---|---------------------------|--------|-----------------------|--------|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247 (a)(1)(iii) RSS-247 | Average Time of Occupancy | 0.4sec | 2400-2483.5 | PASS |

6.2 TEST PROCEDURE

- The transmitter output (antenna port) was connected to the spectrum analyzer.
- Set RBW = 1MHz/VBW = 3MHz.
- Use a video trigger with the trigger level set to enable triggering only on full pulses.
- Sweep Time is more than once pulse time.
Set the center frequency on any frequency would be measure and set the frequency span to
- zero span.
- Measure the maximum time duration of one single pulse.
- Set the EUT for DH5, DH3 and DH1 packet transmitting.
- Measure the maximum time duration of one single pulse.
- DH5 Packet permit maximum $1600 / 79 / 6 = 3.37$ hops per second in each channel (5 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is $3.37 \times 31.6 = 106.6$.
- DH3 Packet permit maximum $1600 / 79 / 4 = 5.06$ hops per second in each channel (3 time slots RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is $5.06 \times 31.6 = 160$.
- DH1 Packet permit maximum $1600 / 79 / 2 = 10.12$ hops per second in each channel (1 time slot RX, 1 time slot TX). So the number of pulses in the observation period of 31.6 seconds is $10.12 \times 31.6 = 320$.

6.3 TEST SETUP



6.4 EUT OPERATION CONDITIONS

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



6.5 TEST RESULTS

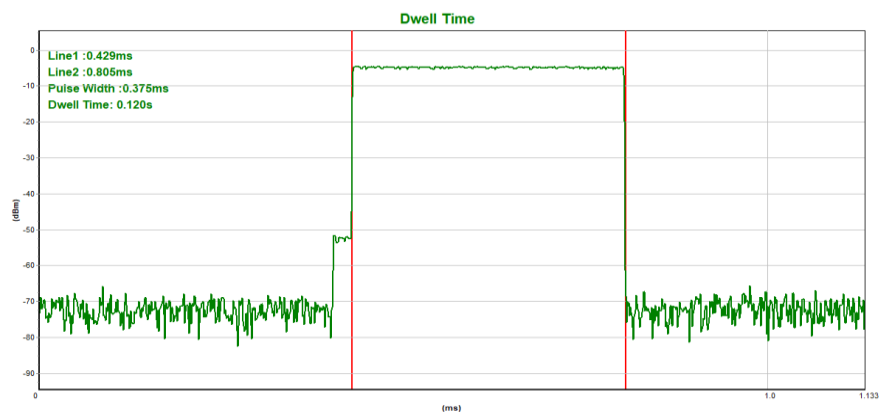
| | | | |
|--------------|-------------------------|--------------------|--------------|
| Temperature: | 25℃ | Relative Humidity: | 50% |
| Test Mode: | GFSK(1Mbps)-DH1/DH3/DH5 | Test Voltage: | AC 120V/60Hz |

| Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|-------------|---------|----------------|---------------|-----------|
| DH1 | middle | 0.375 | 0.120 | 0.4 |
| DH3 | middle | 1.626 | 0.260 | 0.4 |
| DH5 | middle | 2.872 | 0.306 | 0.4 |

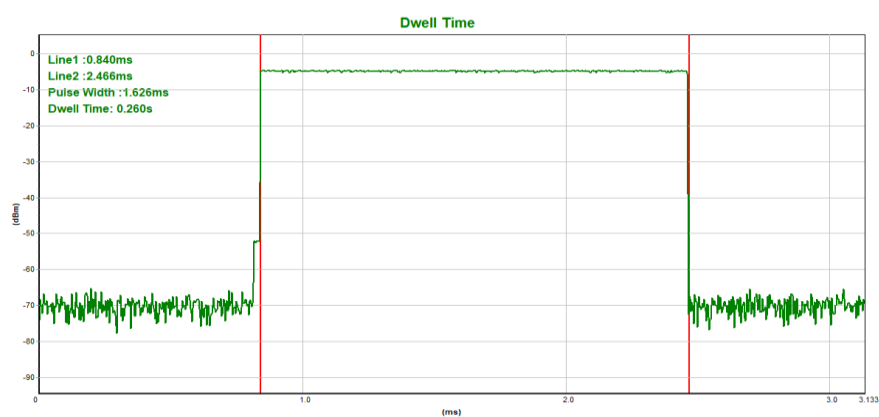




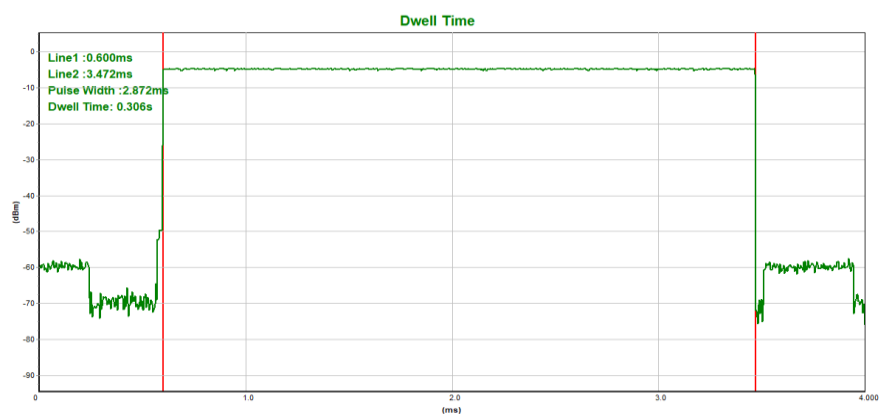
CH39-DH1



CH39-DH3



CH39-DH5





| | | | |
|--------------|--|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | $\pi/4$ -DQPSK(2Mbps)– 2DH1/2DH3/2DH5 | Test Voltage: | AC 120V/60Hz |

| Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|-------------|---------|----------------|---------------|-----------|
| 2DH1 | middle | 0.383 | 0.123 | 0.4 |
| 2DH3 | middle | 1.637 | 0.262 | 0.4 |
| 2DH5 | middle | 2.885 | 0.308 | 0.4 |

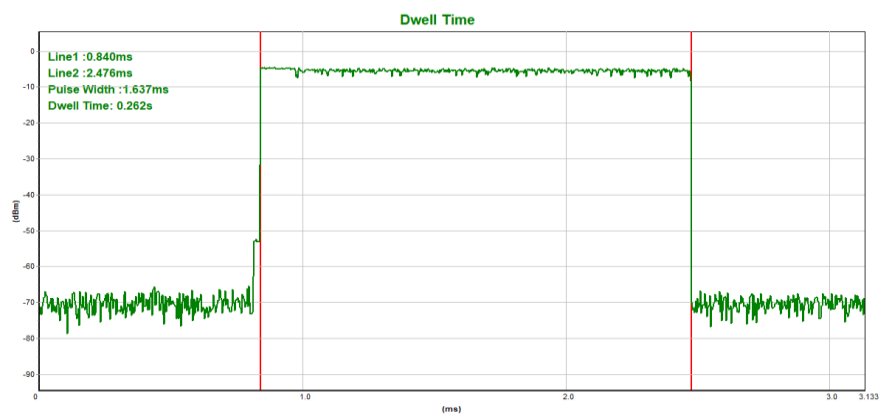




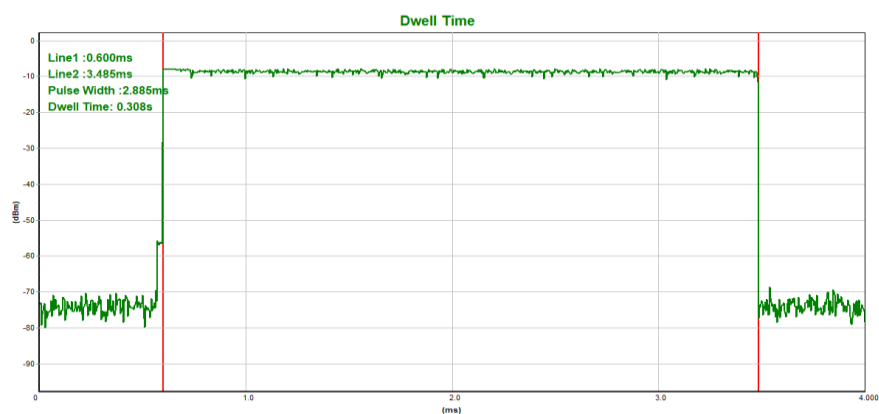
CH39-2DH1



CH39-2DH3



CH39-2DH5





| | | | |
|--------------|---------------------------------|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | 8DPSK(3Mbps)– 3DH1/3DH3/3DH5 | Test Voltage: | AC 120V/60Hz |

| Data Packet | Channel | pulse time(ms) | Dwell Time(s) | Limits(s) |
|-------------|---------|----------------|---------------|-----------|
| 3DH1 | middle | 0.383 | 0.123 | 0.4 |
| 3DH3 | middle | 1.632 | 0.261 | 0.4 |
| 3DH5 | middle | 2.886 | 0.308 | 0.4 |

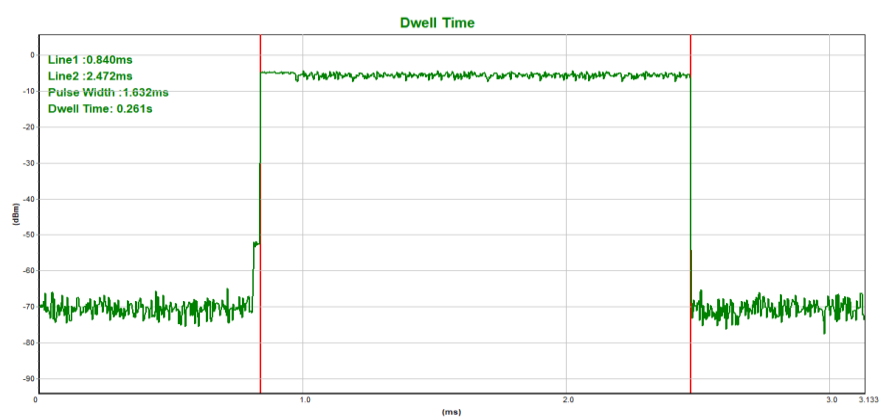




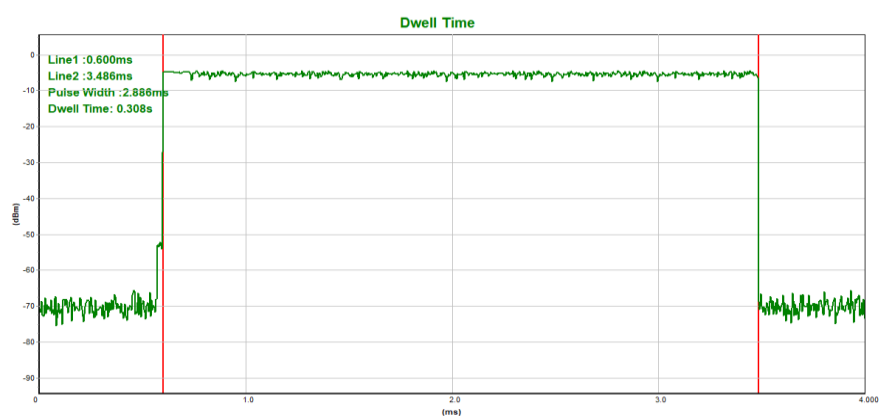
CH39-3DH1



CH39-3DH3



CH39-3DH5



7. HOPPING CHANNEL SEPARATION MEASUREMENT

7.1 LIMIT

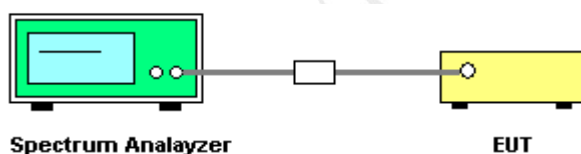
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

| Spectrum Parameter | Setting |
|--------------------|---|
| Attenuation | Auto |
| Span Frequency | > 20 dB Bandwidth or Channel Separation |
| RB | 30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation) |
| VB | 100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation) |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

7.2 TEST PROCEDURE

- The transmitter output (antenna port) was connected to the spectrum analyser in peak hold mode.
- The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for 20 dB bandwidth measurement.
- The resolution bandwidth of 30 kHz and the video bandwidth of 100 kHz were utilised for channel separation measurement.

7.3 TEST SETUP



7.4 EUT OPERATION CONDITIONS

The EUT was programmed to be in continuously transmitting mode.



7.5 TEST RESULTS

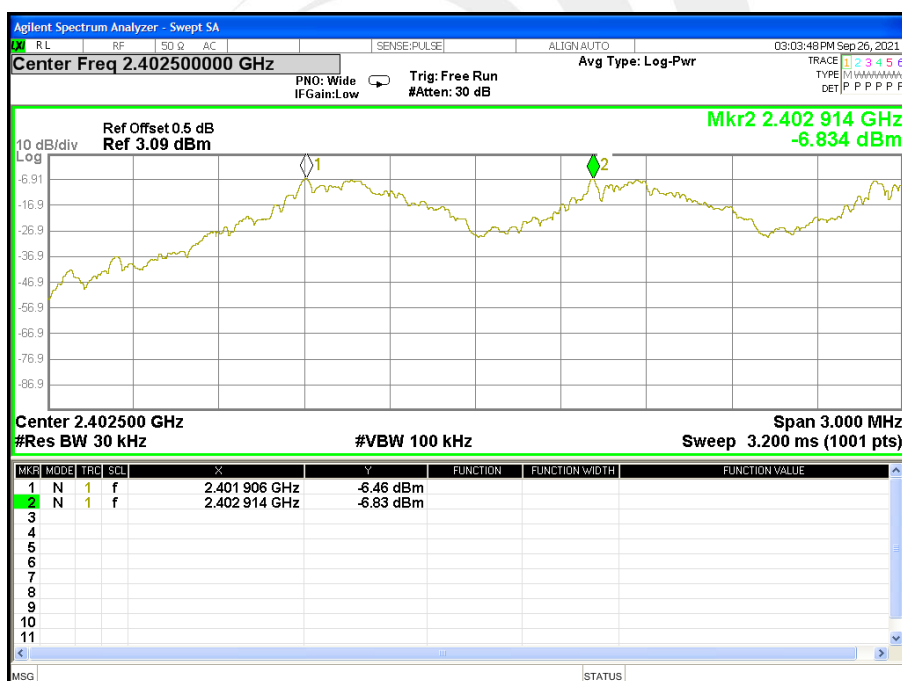
| | | | |
|--------------|--|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | CH00 / CH39 / CH78 (GFSK(1Mbps) Mode) | Test Voltage: | AC 120V/60Hz |

| Frequency | Mark1 Frequency (MHz) | Mark2 Frequency (MHz) | Ch. Separation (MHz) | Limit (MHz) | Result |
|-----------|-----------------------------|-----------------------------|----------------------------|-------------|----------|
| 2402 MHz | 2401.906 | 2402.914 | 1.008 | 0.969 | Complies |
| 2441 MHz | 2440.906 | 2441.908 | 1.002 | 0.677 | Complies |
| 2480 MHz | 2478.915 | 2479.911 | 0.996 | 0.691 | Complies |

For GFSK: Ch. Separation Limits: > 20dB bandwidth (CH00)

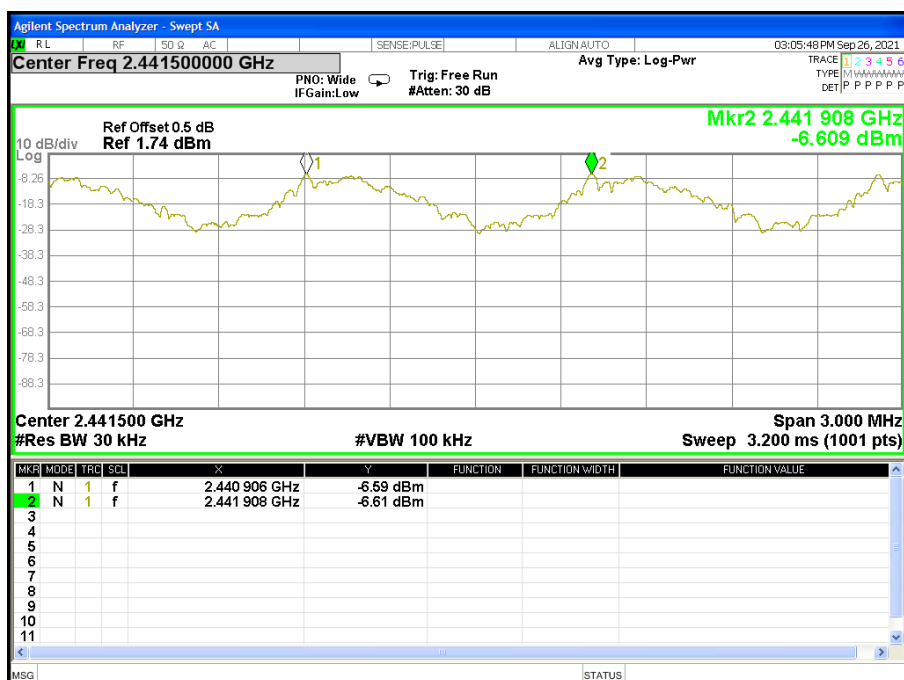
For GFSK: Ch. Separation Limits: > two-thirds 20dB bandwidth (CH39 & CH78)

CH00 -1Mbps

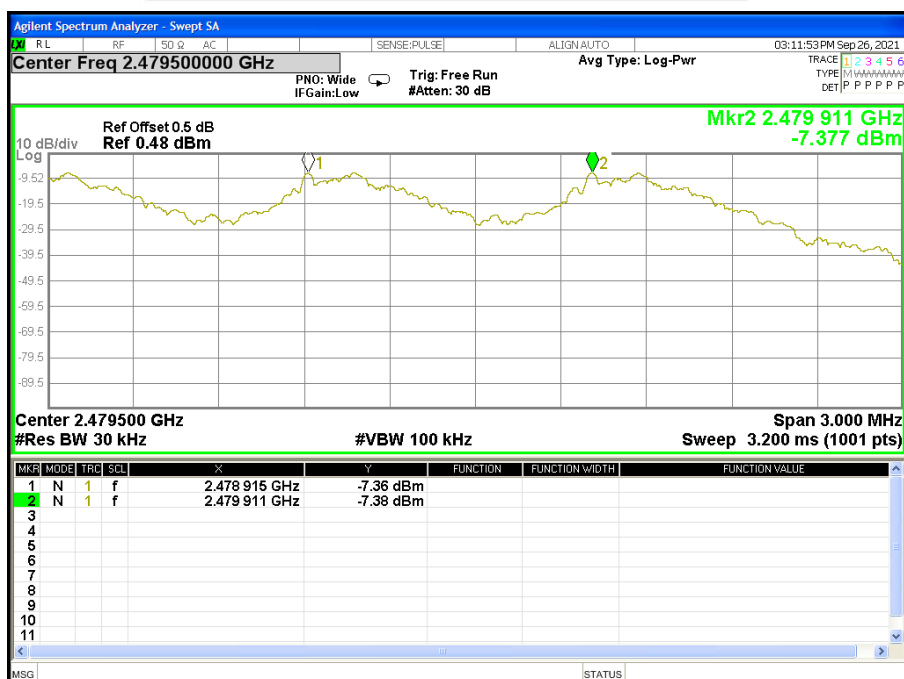




CH39 -1Mbps



CH78 -1Mbps



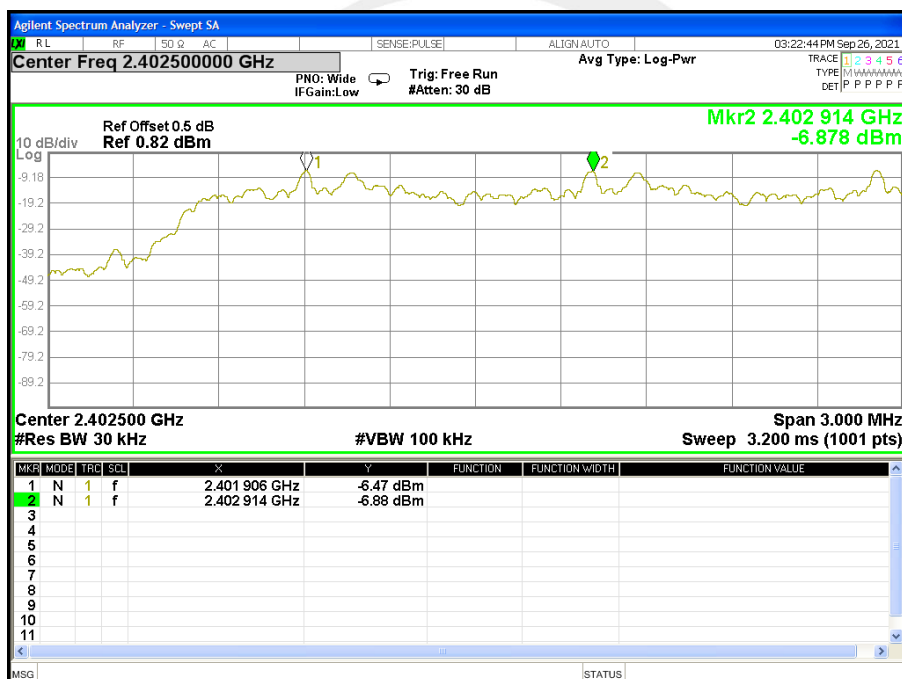


| | | | |
|--------------|---|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | CH00 / CH39 / CH78 ($\pi/4$ -DQPSK(2Mbps) Mode) | Test Voltage: | AC 120V/60Hz |

| Frequency | Mark1 Frequency (MHz) | Mark2 Frequency (MHz) | Ch. Separation (MHz) | Limit (MHz) | Result |
|-----------|-----------------------------|-----------------------------|----------------------------|-------------|----------|
| 2402 MHz | 2401.906 | 2402.914 | 1.008 | 0.831 | Complies |
| 2441 MHz | 2440.903 | 2441.914 | 1.011 | 0.835 | Complies |
| 2480 MHz | 2478.915 | 2479.911 | 0.996 | 0.841 | Complies |

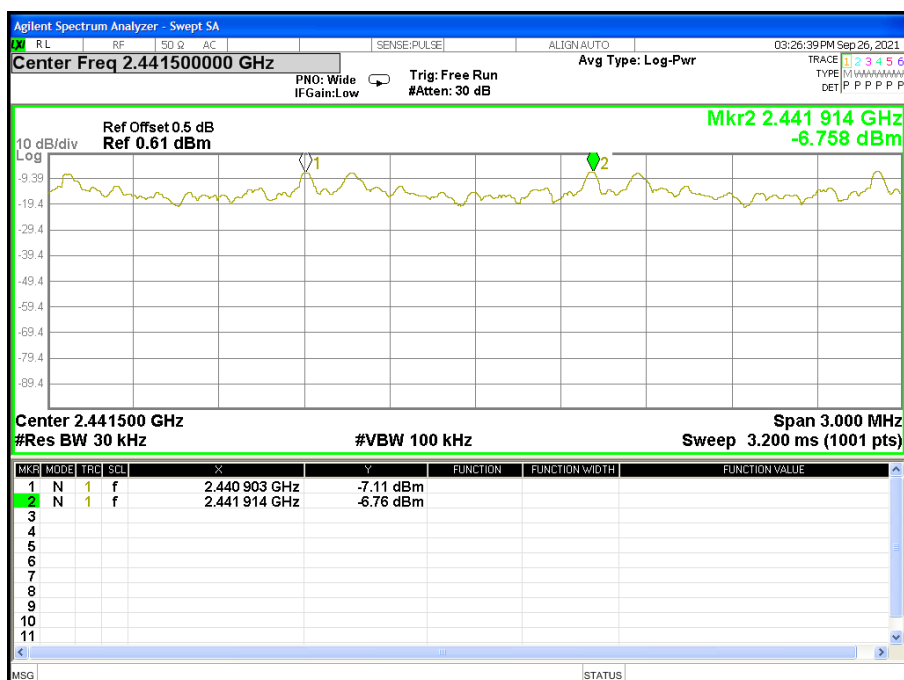
For $\pi/4$ -DQPSK(2Mbps): Ch. Separation Limits: > two-thirds 20dB bandwidth

CH00 -2Mbps

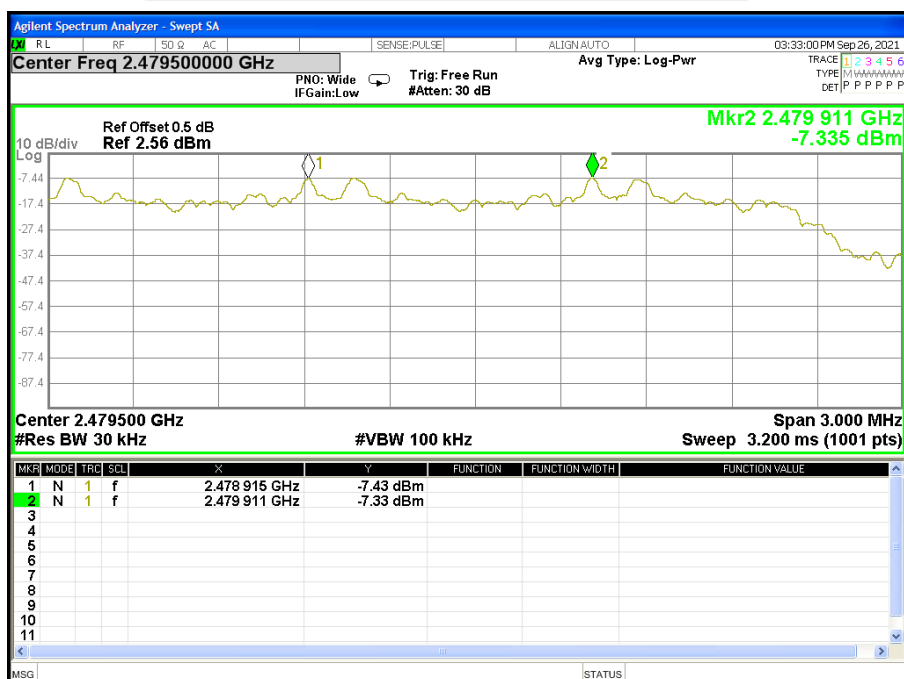




CH39 -2Mbps



CH78 -2Mbps



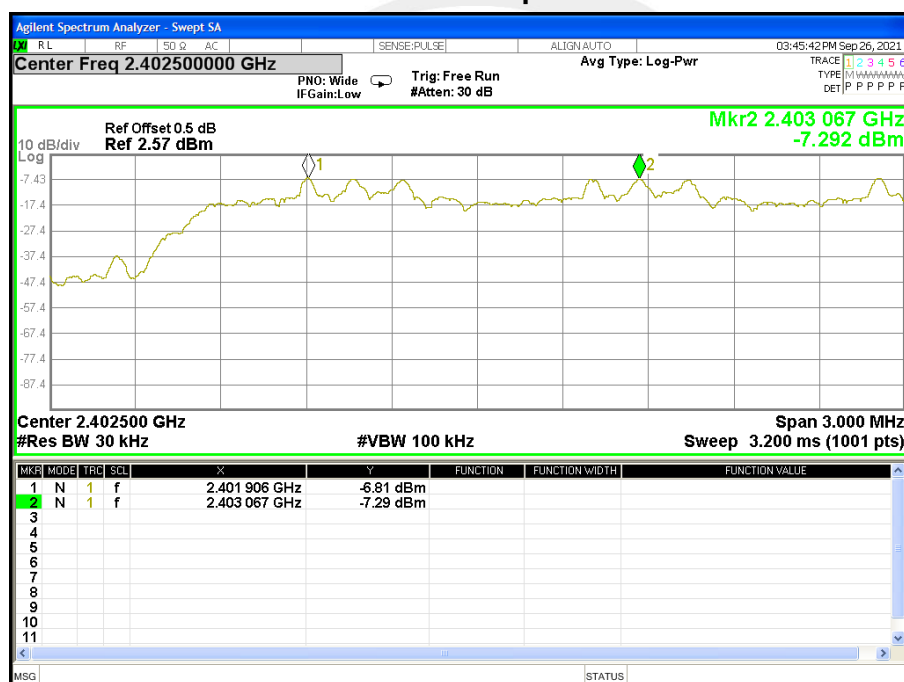


| | | | |
|--------------|--|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | CH00 / CH39 / CH78 (8DPSK(3Mbps)Mode) | Test Voltage: | AC 120V/60Hz |

| Frequency | Mark1 Frequency (MHz) | Mark2 Frequency (MHz) | Ch. Separation (MHz) | Limit (MHz) | Result |
|-----------|-----------------------------|-----------------------------|----------------------------|-------------|----------|
| 2402 MHz | 2401.906 | 2403.067 | 1.161 | 0.817 | Complies |
| 2441 MHz | 2440.900 | 2441.905 | 1.005 | 0.817 | Complies |
| 2480 MHz | 2479.074 | 2480.073 | 0.999 | 0.828 | Complies |

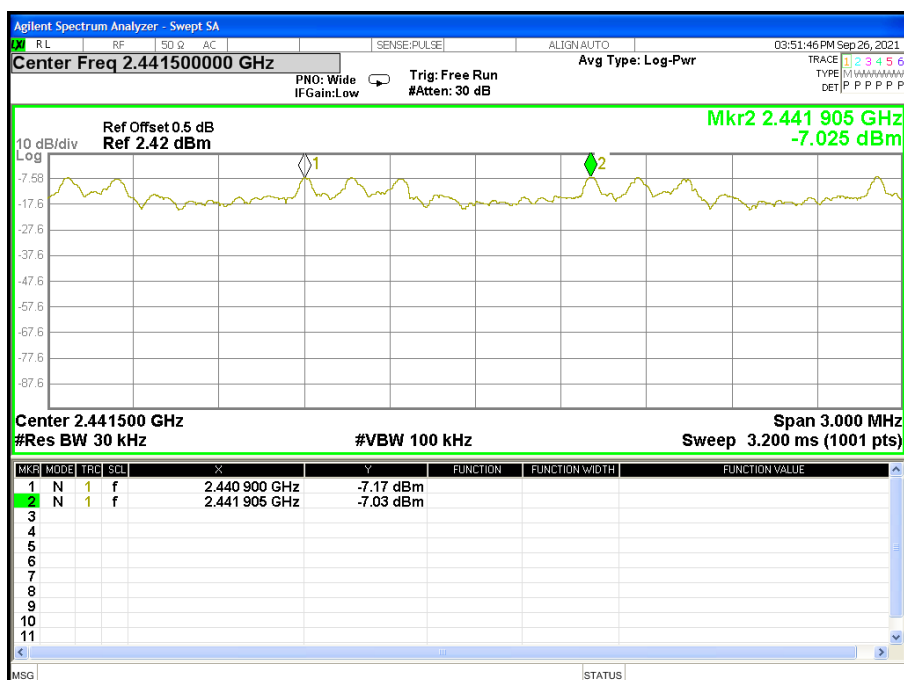
For 8DPSK(3Mbps):Ch. Separation Limits: > two-thirds 20dB bandwidth

CH00 -3Mbps

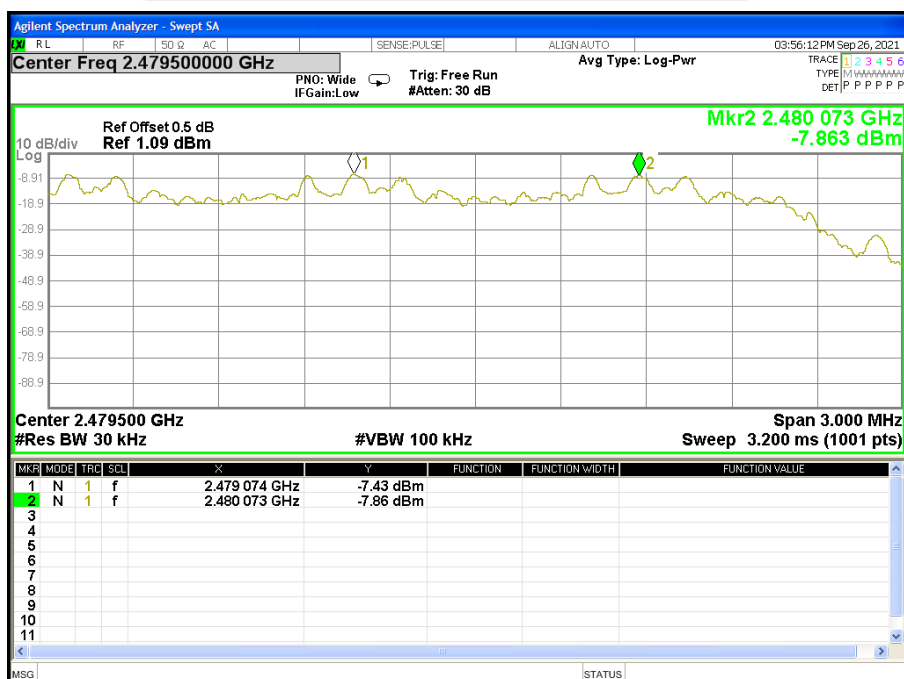




CH39 -3Mbps



CH78 -3Mbps





8. BANDWIDTH TEST

8.1 LIMIT

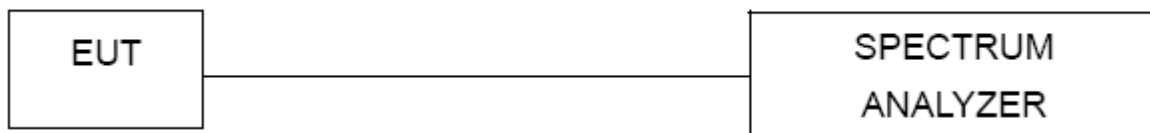
| FCC Part15 15.247,Subpart C RSS-247 Issue 2 | | | | |
|--|-----------|-------------------------|-------------------------|--------|
| Section | Test Item | Limit | FrequencyRange (MHz) | Result |
| 15.247(a)(1) RSS-247 | Bandwidth | (20dB&99% bandwidth) | 2400-2483.5 | PASS |

| Spectrum Parameter | Setting |
|--------------------|---|
| Attenuation | Auto |
| Span Frequency | > Measurement Bandwidth or Channel Separation |
| RB | 30 kHz (20dB Bandwidth) / 30 kHz (Channel Separation) |
| VB | 100 kHz (20dB Bandwidth) / 100 kHz (Channel Separation) |
| Detector | Peak |
| Trace | Max Hold |
| Sweep Time | Auto |

8.2 TEST PROCEDURE

- The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- Spectrum Setting: RBW= 30KHz, VBW=100KHz, Sweep time = Auto.

8.3 TEST SETUP



8.4 EUT OPERATION CONDITIONS

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

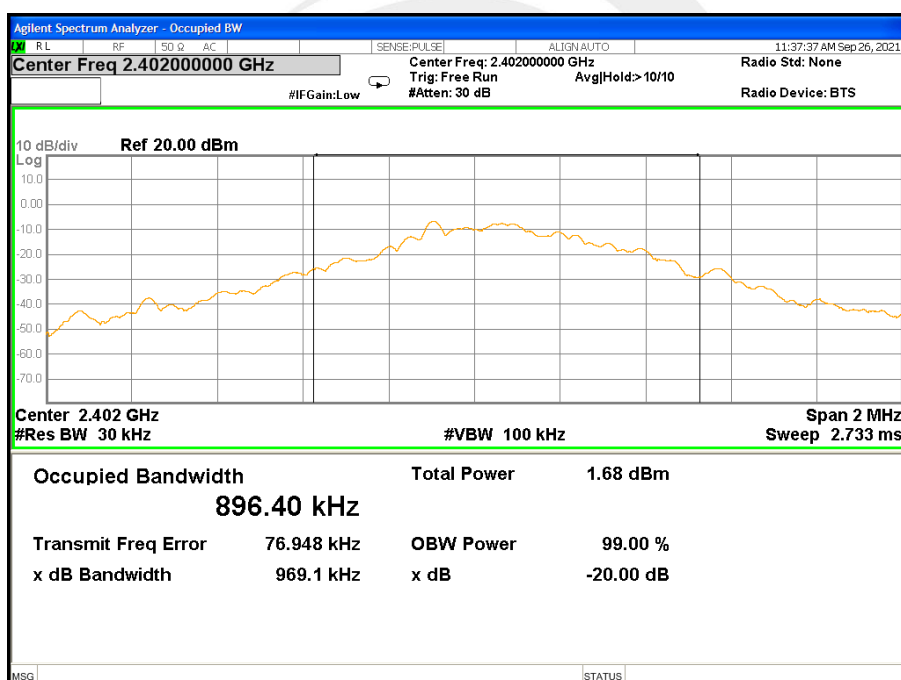


8.5 TEST RESULTS

| | | | |
|--------------|----------------------------------|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | GFSK(1Mbps) CH00 / CH39 / C78 | Test Voltage: | AC 120V/60Hz |

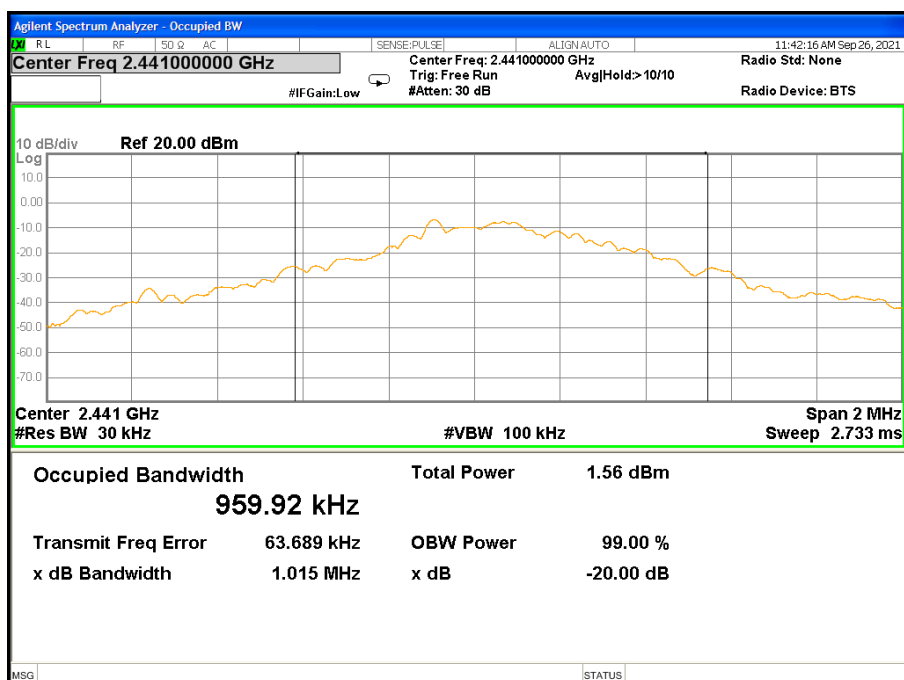
| Frequency | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Result |
|-----------|-------------------------|------------------------|--------|
| 2402 MHz | 0.9691 | 0.8964 | PASS |
| 2441 MHz | 1.0150 | 0.9599 | PASS |
| 2480 MHz | 1.0370 | 1.0031 | PASS |

CH00 -1Mbps

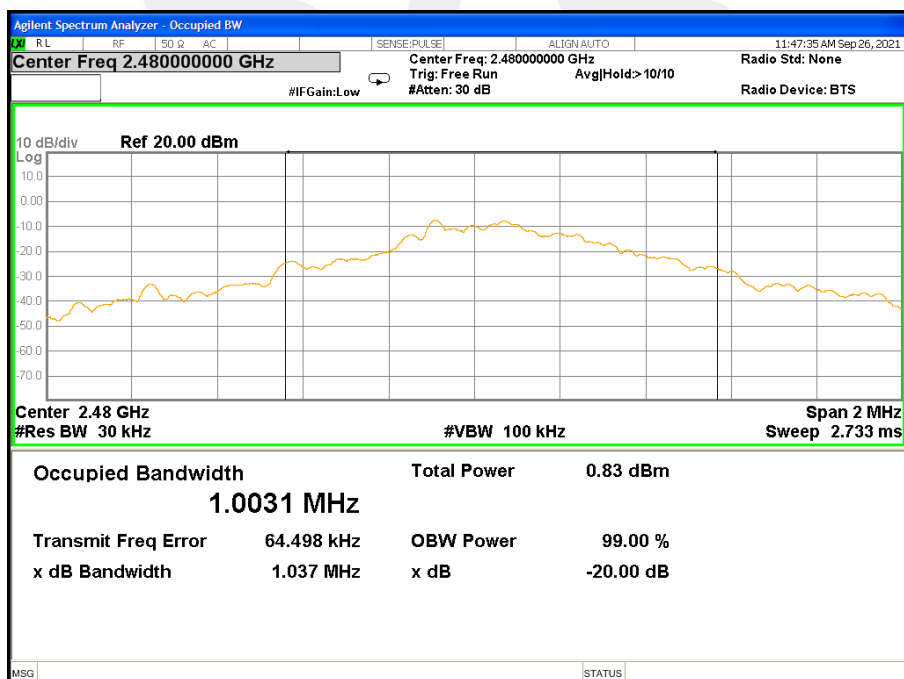




CH39 -1Mbps



CH78 -1Mbps

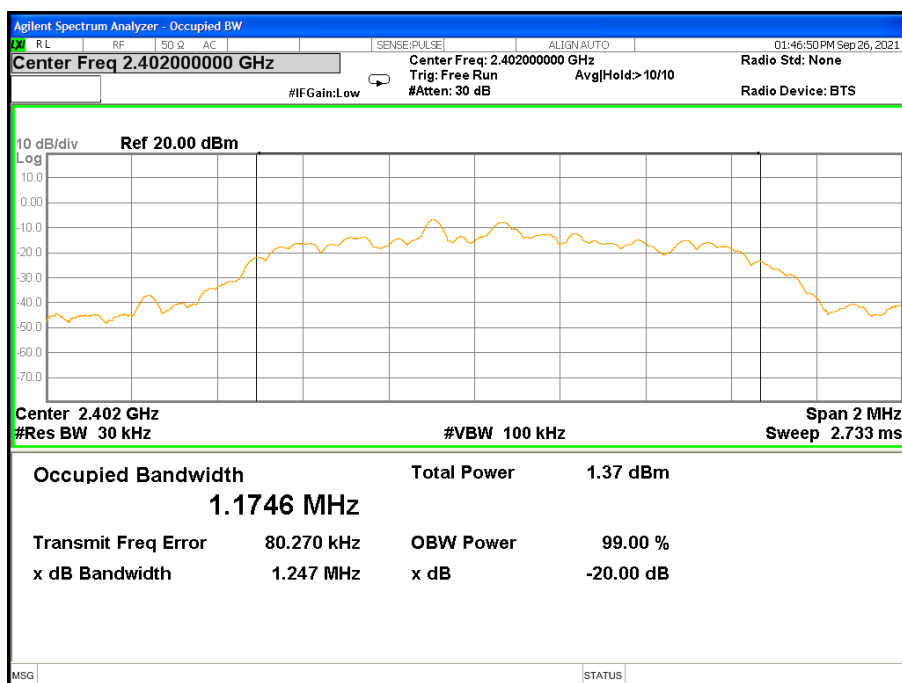




| | | | |
|--------------|--|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | $\pi/4$ -DQPSK(2Mbps) CH00 / CH39 / C78 | Test Voltage: | AC 120V/60Hz |

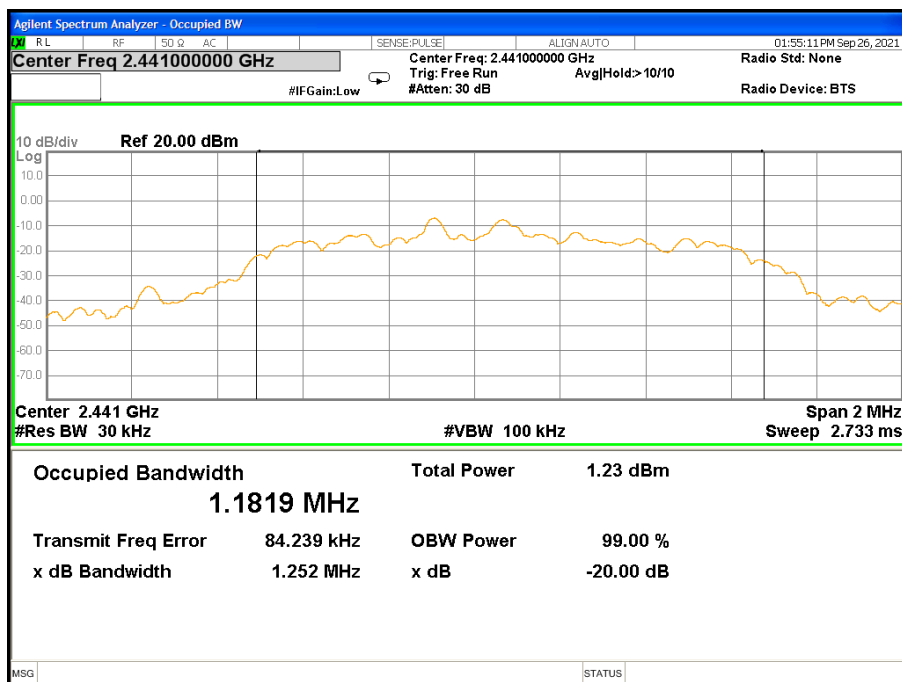
| Frequency | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Result |
|-----------|----------------------|---------------------|--------|
| 2402 MHz | 1.247 | 1.1746 | PASS |
| 2441 MHz | 1.252 | 1.1819 | PASS |
| 2480 MHz | 1.262 | 1.1933 | PASS |

CH00 -2Mbps

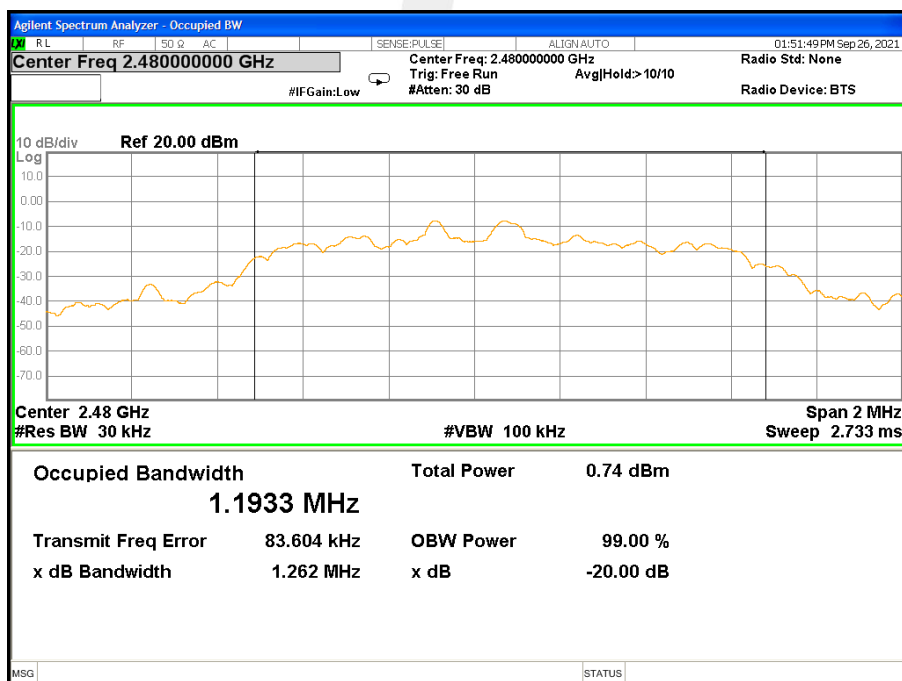




CH39 -2Mbps



CH78 -2Mbps

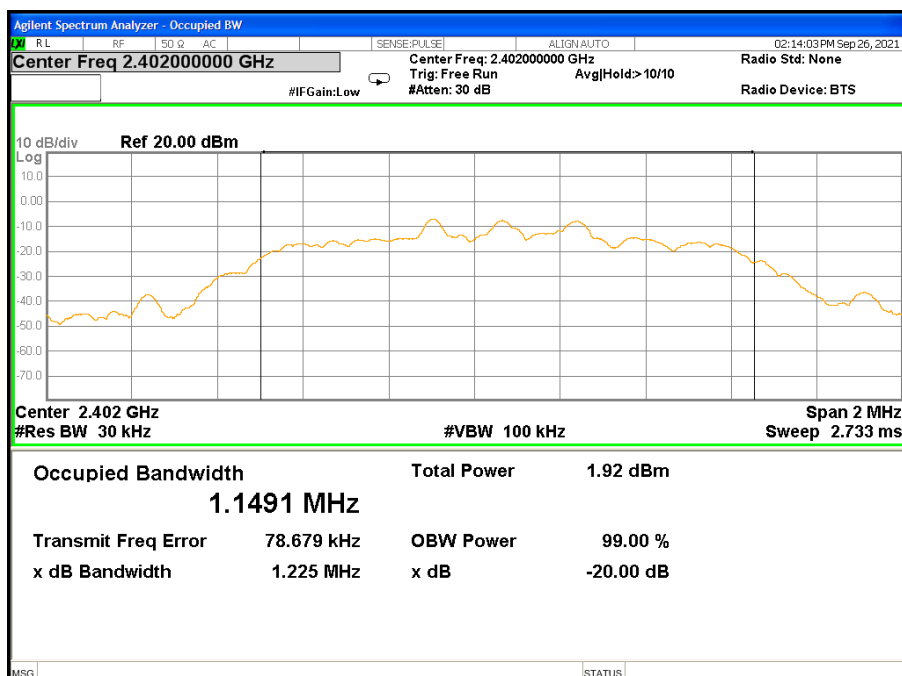




| | | | |
|--------------|------------------------------------|--------------------|--------------|
| Temperature: | 25°C | Relative Humidity: | 50% |
| Test Mode: | 8DPSK(3Mbps) CH00 / CH39 / CH78 | Test Voltage: | AC 120V/60Hz |

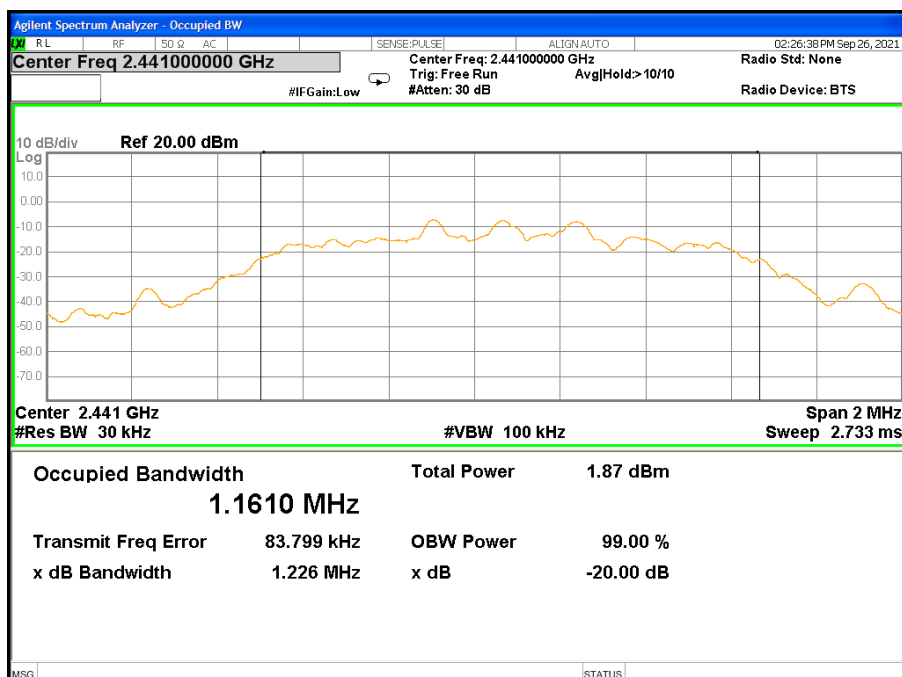
| Frequency | 20dB Bandwidth (MHz) | 99% Bandwidth (MHz) | Result |
|-----------|-------------------------|------------------------|--------|
| 2402 MHz | 1.225 | 1.1491 | PASS |
| 2441 MHz | 1.226 | 1.1610 | PASS |
| 2480 MHz | 1.242 | 1.1835 | PASS |

CH00 -3Mbps

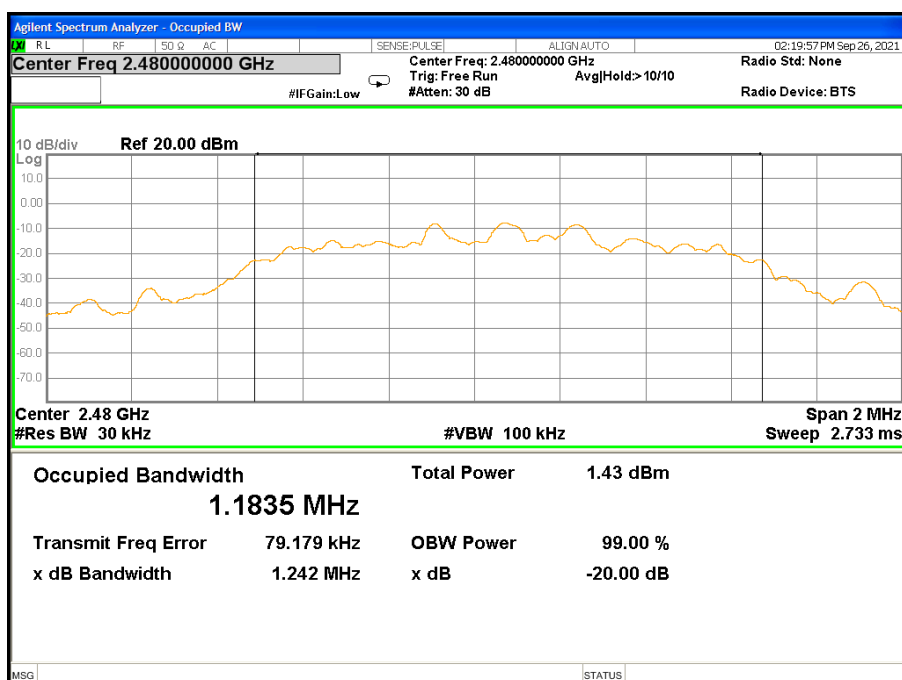




CH39 -3Mbps



CH78 -3Mbps





9. OUTPUT POWER TEST

9.1 LIMIT

| FCC Part 15.247, Subpart C RSS-247 Issue 2 | | | | |
|---|--------------|--|-----------------------|--------|
| Section | Test Item | Limit | Frequency Range (MHz) | Result |
| 15.247 (a)(1)&(b)(1) RSS-247 | Output Power | 1 W or 0.125W if channel separation > 2/3 bandwidth provided the systems operate with an output power no greater than 125 mW (20.97dBm) | 2400-2483.5 | PASS |
| RSS-247 | EIRP | 4W | 2400-2483.5 | PASS |

9.2 TEST PROCEDURE

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:

1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.

2) RBW > 20 dB bandwidth of the emission being measured.

3) VBW ≥ RBW.

4) Sweep: Auto.

5) Detector function: Peak.

6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.

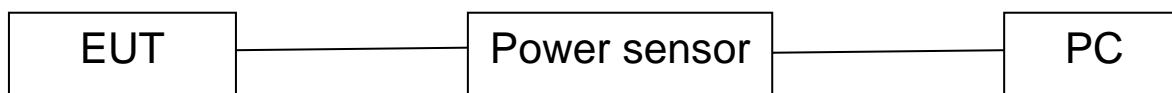
e) A plot of the test results and setup description shall be included in the test report.

NOTE—A peak responding power meter may be used, where the power meter and sensor system video bandwidth is greater than the occupied bandwidth of the unlicensed wireless device, rather than a spectrum analyzer.

PKPM1 Peak power meter method:

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DSS bandwidth and shall use a fast-responding diode detector.

9.3 TEST SETUP



9.4 EUT OPERATION CONDITIONS

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



9.5 TEST RESULTS

| | | | |
|---------------|--------------|--------------------|-----|
| Temperature: | 25°C | Relative Humidity: | 60% |
| Test Voltage: | AC 120V/60Hz | | |

| Mode | Channel Number | Frequency (MHz) | Peak Power | Average Power | Limit |
|----------|----------------|-----------------|------------|---------------|-------|
| | | | (dBm) | (dBm) | (dBm) |
| GFSK(1M) | 0 | 2402 | -4.17 | -5.67 | 30.00 |
| | 39 | 2441 | -4.39 | -5.89 | 20.97 |
| | 78 | 2480 | -4.68 | -6.18 | 20.97 |

Note: For CH 00, the channel separation >20dB bandwidth

For CH 39 & CH78, the channel separation >2/3 20dB bandwidth

| Mode | Channel Number | Frequency (MHz) | Peak Power | Average Power | Limit |
|--------------------|----------------|-----------------|------------|---------------|-------|
| | | | (dBm) | (dBm) | (dBm) |
| $\pi/4$ -DQPSK(2M) | 0 | 2402 | -3.54 | -6.91 | 20.97 |
| | 39 | 2441 | -3.79 | -7.14 | 20.97 |
| | 78 | 2480 | -4.08 | -7.40 | 20.97 |

Note: the channel separation >2/3 20dB bandwidth

| Mode | Channel Number | Frequency (MHz) | Peak Power | Average Power | Limit |
|------------|----------------|-----------------|------------|---------------|-------|
| | | | (dBm) | (dBm) | (dBm) |
| 8-DPSK(3M) | 0 | 2402 | -3.15 | -6.92 | 20.97 |
| | 39 | 2441 | -3.40 | -7.12 | 20.97 |
| | 78 | 2480 | -3.73 | -7.42 | 20.97 |

Note: the channel separation >2/3 20dB bandwidth



EIRP Power

| Mode | Channel Number | Frequency (MHz) | Peak Power | Antenna Gain | EIRP Power | Limit |
|--------------------|----------------|-----------------|------------|--------------|------------|-------|
| | | | (dBm) | (dBi) | (dBm) | (dBm) |
| GFSK(1M) | 0 | 2402 | -4.17 | 2.13 | -2.04 | 36.02 |
| | 39 | 2441 | -4.39 | 2.13 | -2.26 | 36.02 |
| | 78 | 2480 | -4.68 | 2.13 | -2.55 | 36.02 |
| Mode | Channel Number | Frequency (MHz) | Peak Power | Antenna Gain | EIRP Power | Limit |
| | | | (dBm) | (dBi) | (dBm) | (dBm) |
| $\pi/4$ -DQPSK(2M) | 0 | 2402 | -3.54 | 2.13 | -1.41 | 36.02 |
| | 39 | 2441 | -3.79 | 2.13 | -1.66 | 36.02 |
| | 78 | 2480 | -4.08 | 2.13 | -1.95 | 36.02 |
| Mode | Channel Number | Frequency (MHz) | Peak Power | Antenna Gain | EIRP Power | Limit |
| | | | (dBm) | (dBi) | (dBm) | (dBm) |
| 8-DPSK(3M) | 0 | 2402 | -3.15 | 2.13 | -1.02 | 36.02 |
| | 39 | 2441 | -3.40 | 2.13 | -1.27 | 36.02 |
| | 78 | 2480 | -3.73 | 2.13 | -1.60 | 36.02 |



10. ANTENNA REQUIREMENT

10.1 STANDARD REQUIREMENT

15.203&RSS-Gen Issue 5 requirement: For intentional device, according to 15.203&RSS-Gen Issue 5: an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

10.2 EUT ANTENNA

The EUT antenna is PIFA Antenna. It comply with the standard requirement.





11. FREQUENCY STABILITY

11.1 LIMITS OF FREQUENCY STABILITY MEASUREMENT

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.02\%$ of the operating frequency over a temperature variation of -30 degrees to 50 degrees C at normal supply voltage, and for a variation in primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees.

11.2 TEST PROCEDURE

1. The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
2. Turn the EUT on and couple its output to spectrum analyzer.
3. Turn the EUT off and set the chamber to the highest temperature specified.
4. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.
5. Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6. The test chamber was allowed to stabilize at $+20$ degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

11.3 TEST RESULT

Channel 39 (2441MHz)

Voltage vs. Frequency Stability

| Voltage(V) | Measurement Frequency(MHz) |
|--------------------|----------------------------|
| 12.765 | 2441.0023 |
| 11.1 | 2441.0014 |
| 9.435 | 2441.0022 |
| Max.Deviation(MHz) | 0.0023 |
| Max.Deviation(ppm) | 0.94 |

Rated working voltage: AC 120V/60Hz

Temperature vs. Frequency Stability

| Temperature($^{\circ}$ C) | Measurement Frequency(MHz) |
|----------------------------|----------------------------|
| -30 | 2441.0029 |
| -20 | 2441.0022 |
| -10 | 2441.0021 |
| 0 | 2441.0022 |
| 10 | 2441.0022 |
| 20 | 2441.0021 |
| 30 | 2441.0021 |
| 40 | 2441.0025 |
| 50 | 2441.0021 |
| Max.Deviation(MHz) | 0.0029 |
| Max.Deviation(ppm) | 1.19 |



APPENDIX-PHOTOS OF TEST SETUP

Note: See test photos in setup photo document for the actual connections between Product and support equipment.

※※※※※END OF THE REPORT※※※※※

