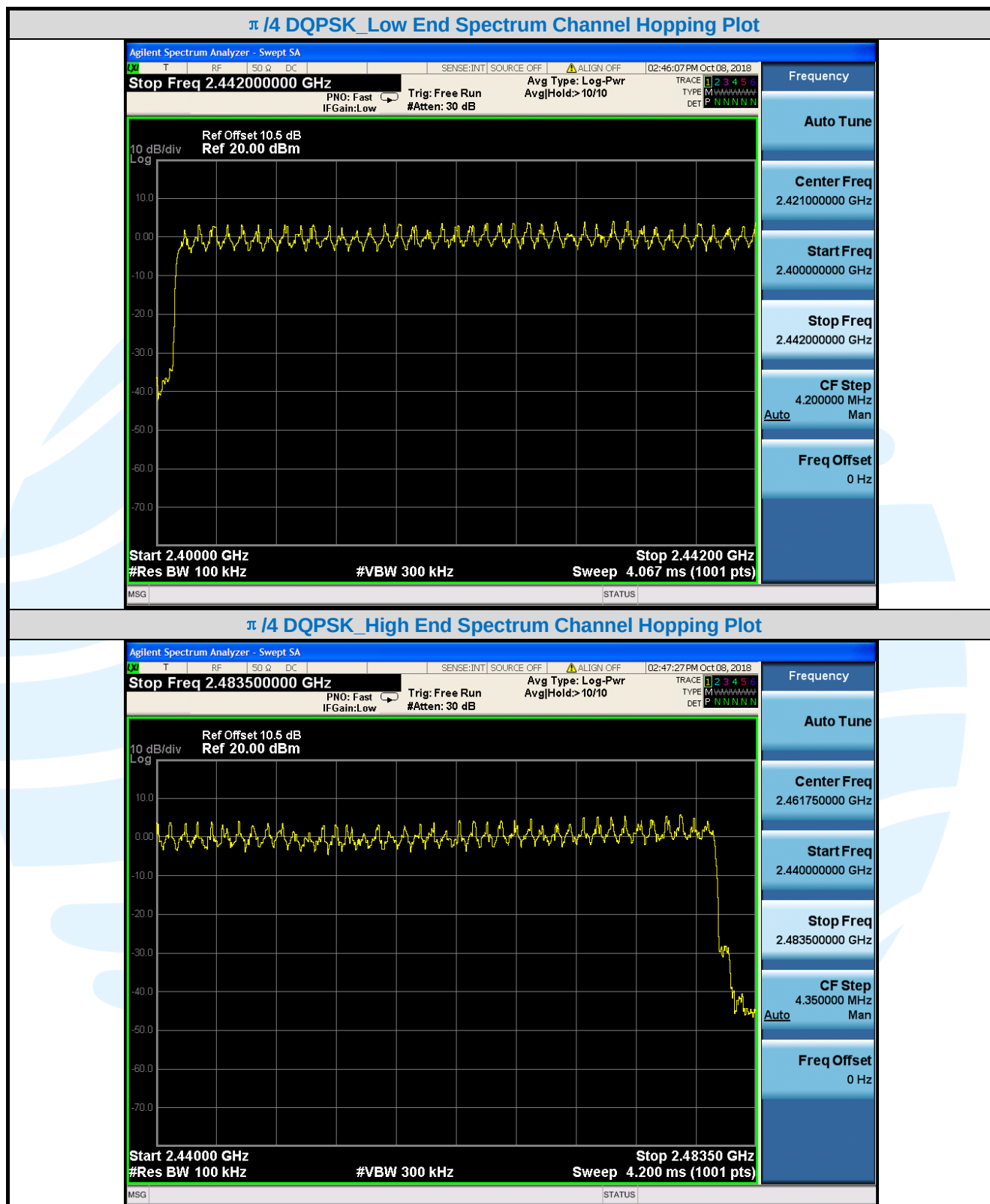
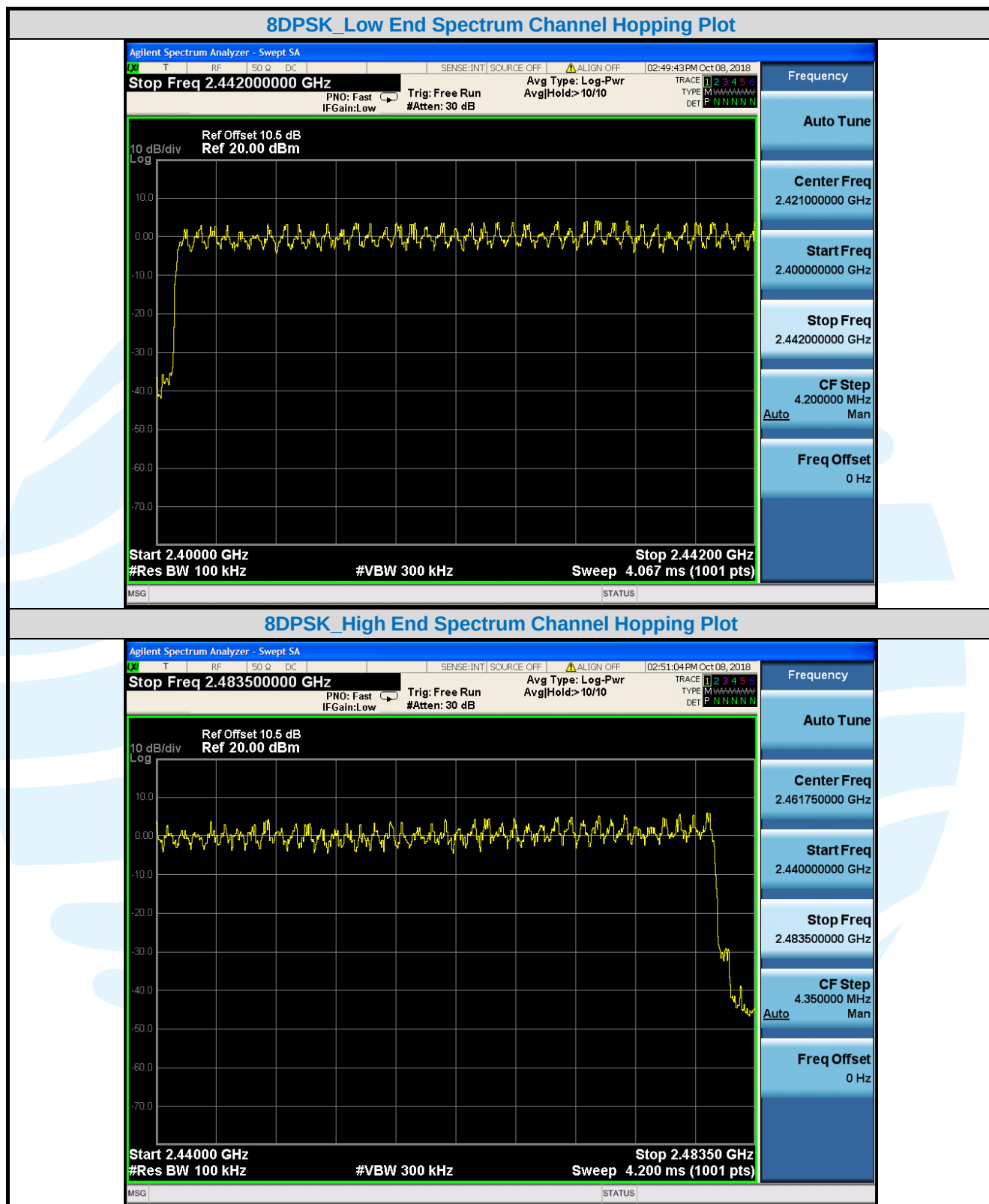






## 5.7 DWELL TIME

**Test Requirement:**

FCC 47 CFR Part 15 Subpart C Section 15.247(a)(1)  
RSS-247 Issue 2, Section 5.1(d)

**Test Method:**

ANSI C63.10-2013 Section 7.8.4

**Limit:**

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

**Test Procedure:**

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.  
Use the following spectrum analyzer settings:

- Span = zero span, centered on a hopping channel
- RBW shall be  $\leq$  channel spacing and where possible RBW should be set  $\gg 1/T$ , where T is the expected dwell time per channel.
- Sweep = As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- Detector function = peak
- Trace = max hold
- Use the marker-delta function to determine the dwell time

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

**Test Setup:**

Refer to section 4.5.3 for details.

**Instruments Used:**

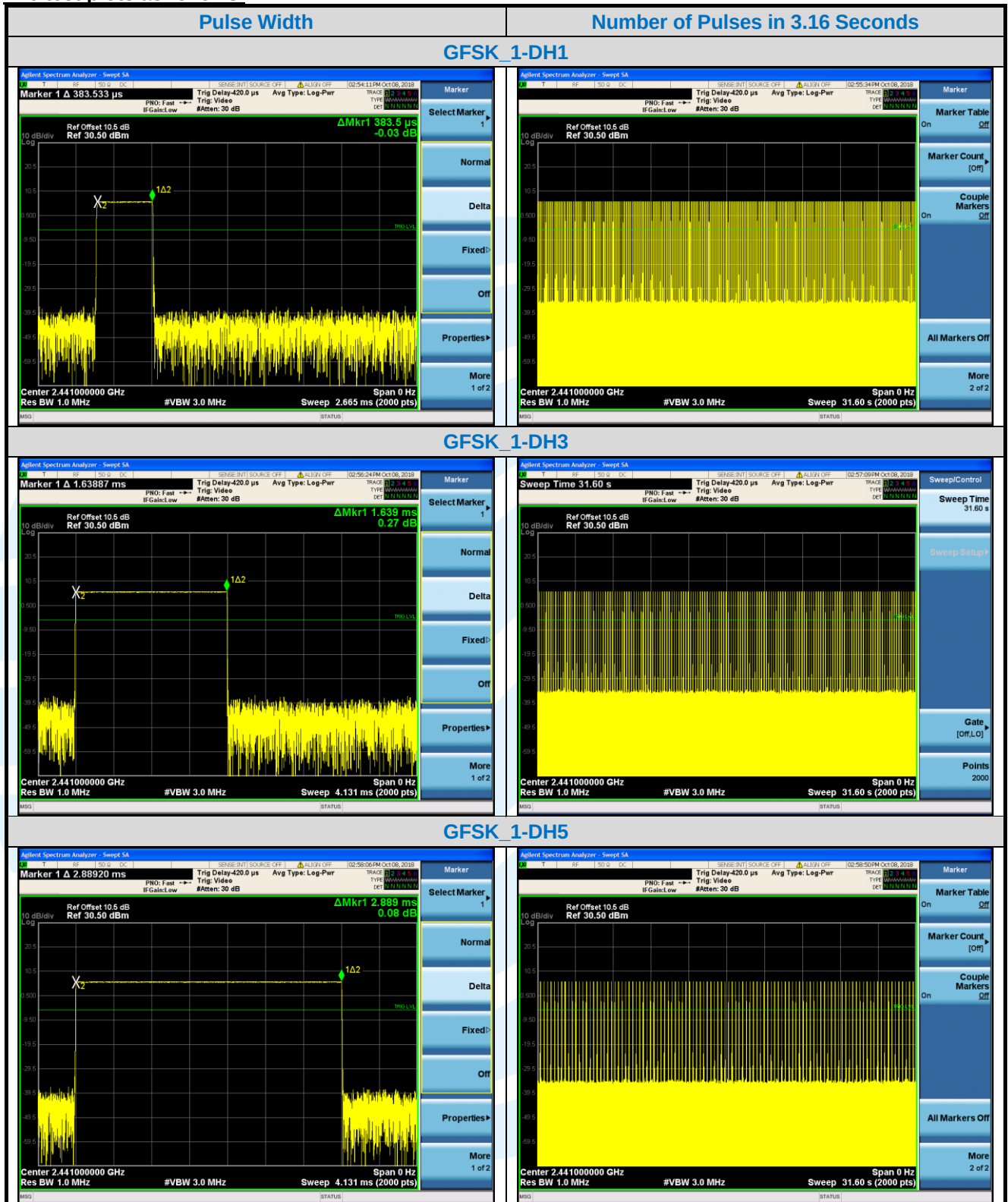
Refer to section 3 for details

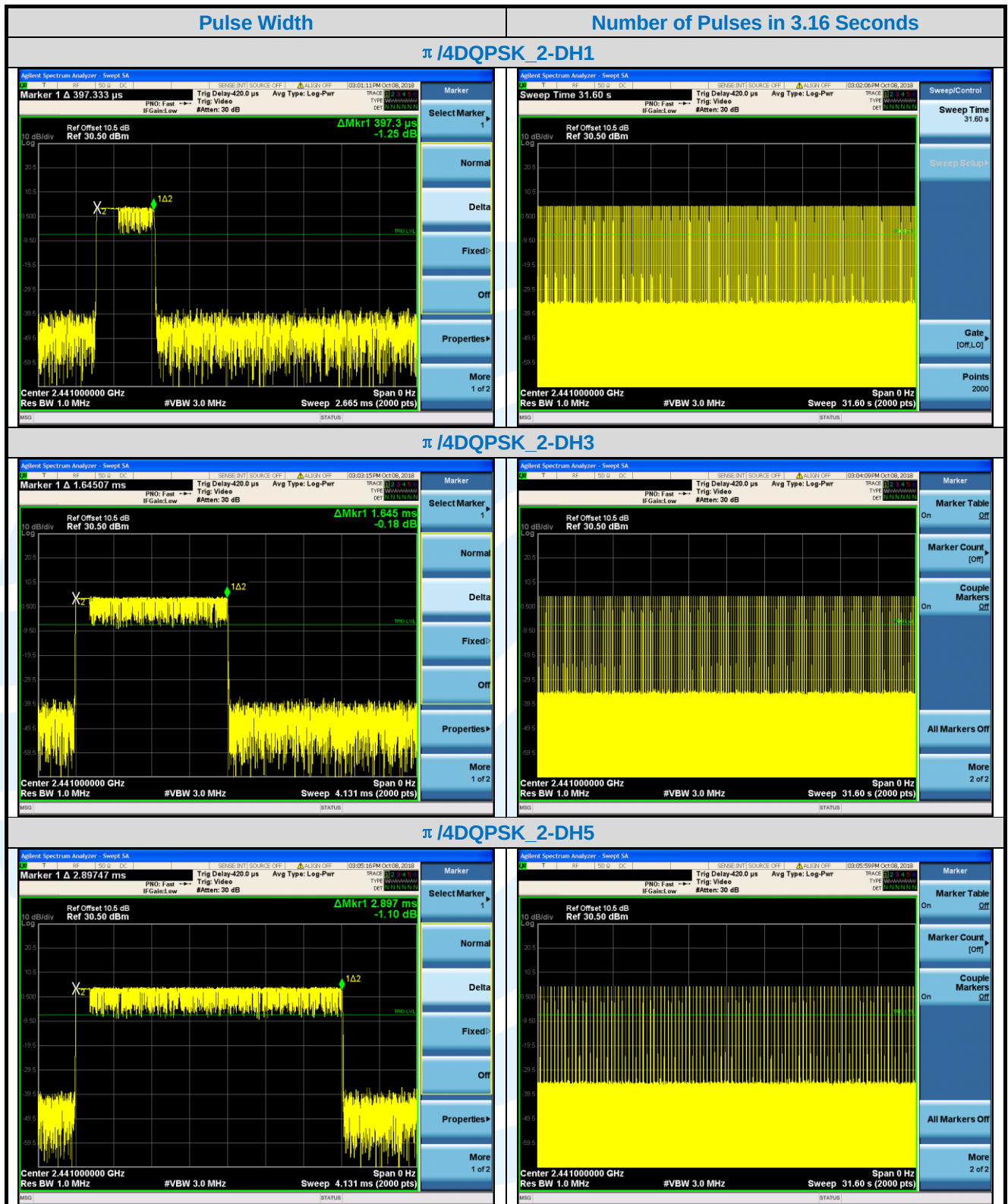
**Test Results:**

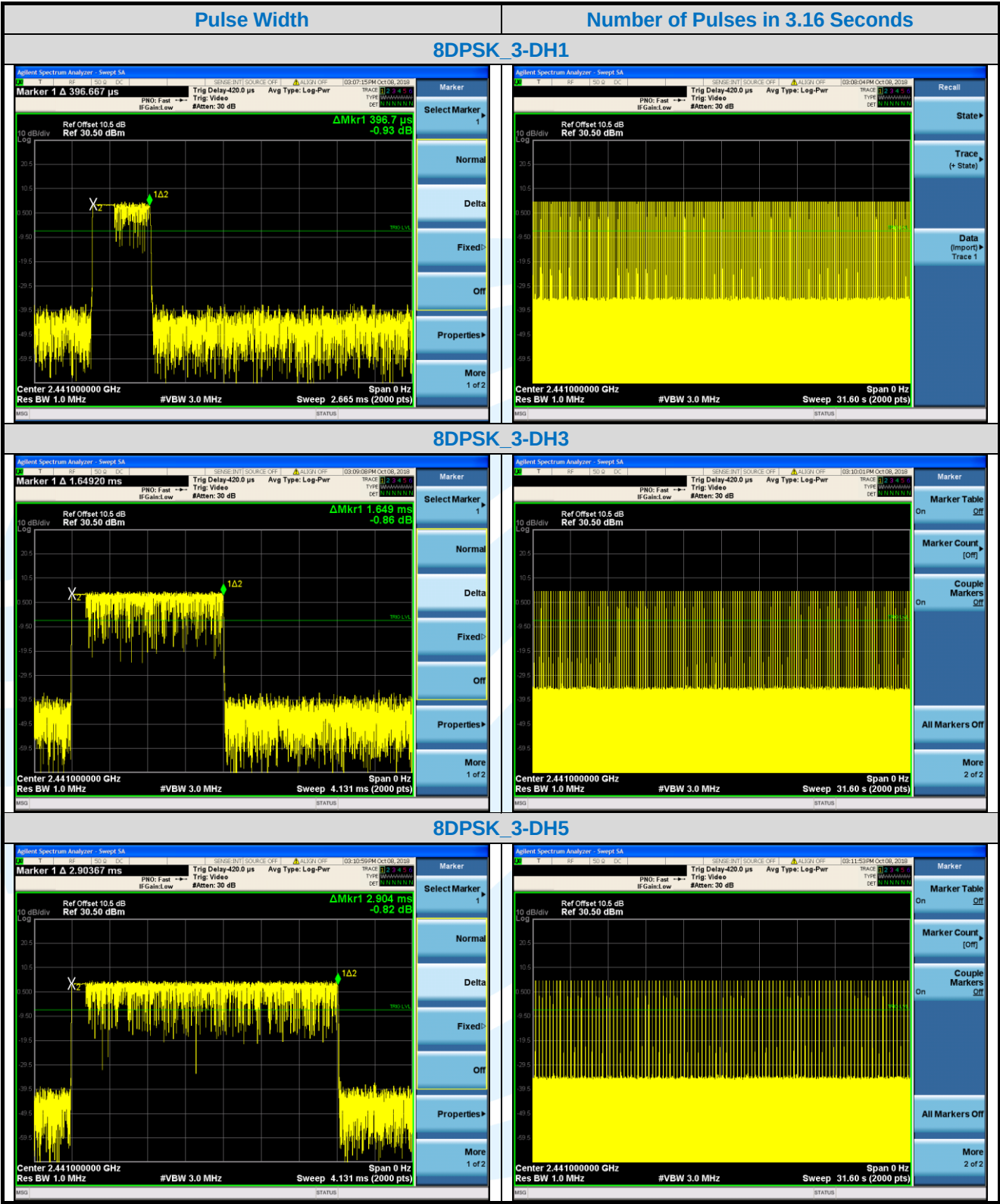
Pass

| Type of Modulation | Test Frequency | Packet | Pulse Width | Number of Pulses in 31.6 seconds | Dwell Time    | Limit |
|--------------------|----------------|--------|-------------|----------------------------------|---------------|-------|
|                    |                |        | ms          |                                  | ms            | ms    |
| GFSK               | 2441MHz        | 1-DH1  | 0.384       | 314.000                          | 120.42        | < 400 |
|                    |                | 1-DH3  | 1.639       | 160.000                          | 262.24        | < 400 |
|                    |                | 1-DH5  | 2.889       | 106.000                          | 306.23        | < 400 |
| $\pi/4$ DQPSK      | 2441MHz        | 2-DH1  | 0.397       | 314.000                          | 124.75        | < 400 |
|                    |                | 2-DH3  | 1.645       | 160.000                          | 263.20        | < 400 |
|                    |                | 2-DH5  | 2.897       | 106.000                          | 307.08        | < 400 |
| 8DPSK              | 2441MHz        | 3-DH1  | 0.397       | 314.000                          | 124.56        | < 400 |
|                    |                | 3-DH3  | 1.649       | 160.000                          | 263.84        | < 400 |
|                    |                | 3-DH5  | 2.904       | 106.000                          | <b>307.82</b> | < 400 |

The test plots as follows:







## 5.8 CONDUCTED OUT OF BAND EMISSION

|                          |                                                                                                                                                                                                                                                                                                                            |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Requirement:</b> | FCC 47 CFR Part 15 Subpart C Section 15.247(d)<br>RSS-247 Issue 2, Section 5.5                                                                                                                                                                                                                                             |
| <b>Test Method:</b>      | ANSI C63.10-2013 Section 6.10.4 & Section 7.8.8                                                                                                                                                                                                                                                                            |
| <b>Limit:</b>            | In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. |
| <b>Test Procedure:</b>   | Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.<br>Use the following spectrum analyzer settings:                                                                                                                                                      |

### Step 1: Measurement Procedure REF

- Set instrument center frequency to 2400 MHz or 2483.5 MHz.
- Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.
- Set the RBW = 100 kHz.
- Set the VBW  $\geq 3 \times$  RBW.
- Detector = peak.
- Sweep time = auto couple.
- Sweep points  $\geq 2 \times$  Span/RBW
- Trace mode = max hold.
- Allow the trace to stabilize.
- Set the marker on the emission at the band edge, or on the highest modulation product outside of the band, if this level is greater than that at the band edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

### Step 2: Measurement Procedure OOBE

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

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

|                          |                                      |
|--------------------------|--------------------------------------|
| <b>Test Setup:</b>       | Refer to section 4.5.3 for details.  |
| <b>Instruments Used:</b> | Refer to section 3 for details       |
| <b>Test Mode:</b>        | Hopping Frequencies Transmitter mode |
| <b>Test Results:</b>     | Pass                                 |
| <b>Test Data:</b>        |                                      |

GFSK

In-Band Reference Level

Out of Band Emission

Lowest Channel

Agilent Spectrum Analyzer - Sweep SA

Display Line -14.68 dBm

Ref Offset 10.5 dB  
Ref 20.00 dBm

Mkr1 2.40216 GHz  
5.316 dBm

Center 2.400000 GHz  
#Res BW 100 kHz  
#VBW 300 kHz  
Sweep 1.000 ms (1001 pts)

| MNR | MODE | TRC | SOL | X           | Y           | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|-------------|-------------|----------|----------------|----------------|
| 1   | N    | 1   | f   | 2.40216 GHz | 5.316 dBm   |          |                |                |
| 2   | N    | 1   | f   | 2.40000 GHz | -30.939 dBm |          |                |                |

Agilent Spectrum Analyzer - Sweep SA

Marker 1 3.17684250000 GHz

Ref Offset 10.5 dB  
Ref 30.50 dBm

Mkr1 3.1768 GHz  
-42.579 dBm

Start 30 MHz  
#Res BW 100 kHz  
#VBW 300 kHz  
Sweep 2.387 s (40001 pts)

| MNR | MODE | TRC | SOL | X          | Y           | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|------------|-------------|----------|----------------|----------------|
| 1   | N    | 1   | f   | 3.1768 GHz | -42.579 dBm |          |                |                |

Middle Channel

Agilent Spectrum Analyzer - Sweep SA

Display Line -13.83 dBm

Ref Offset 10.5 dB  
Ref 20.00 dBm

Mkr1 2.44116 GHz  
6.172 dBm

Center 2.441000 GHz  
#Res BW 100 kHz  
#VBW 300 kHz  
Sweep 1.000 ms (1001 pts)

| MNR | MODE | TRC | SOL | X           | Y         | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|-------------|-----------|----------|----------------|----------------|
| 1   | N    | 1   | f   | 2.44116 GHz | 6.172 dBm |          |                |                |

Agilent Spectrum Analyzer - Sweep SA

Marker 1 24.249027250000 GHz

Ref Offset 10.5 dB  
Ref 30.50 dBm

Mkr1 24.2490 GHz  
-41.876 dBm

Start 30 MHz  
#Res BW 100 kHz  
#VBW 300 kHz  
Sweep 2.387 s (40001 pts)

| MNR | MODE | TRC | SOL | X           | Y           | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|-------------|-------------|----------|----------------|----------------|
| 1   | N    | 1   | f   | 24.2490 GHz | -41.876 dBm |          |                |                |

Highest Channel

Agilent Spectrum Analyzer - Sweep SA

Display Line -12.21 dBm

Ref Offset 10.5 dB  
Ref 20.00 dBm

Mkr1 2.47984 GHz  
7.787 dBm

Center 2.483300 GHz  
#Res BW 100 kHz  
#VBW 300 kHz  
Sweep 1.000 ms (1001 pts)

| MNR | MODE | TRC | SOL | X           | Y           | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|-------------|-------------|----------|----------------|----------------|
| 1   | N    | 1   | f   | 2.47984 GHz | 7.787 dBm   |          |                |                |
| 2   | N    | 1   | f   | 2.48330 GHz | -46.544 dBm |          |                |                |

Agilent Spectrum Analyzer - Sweep SA

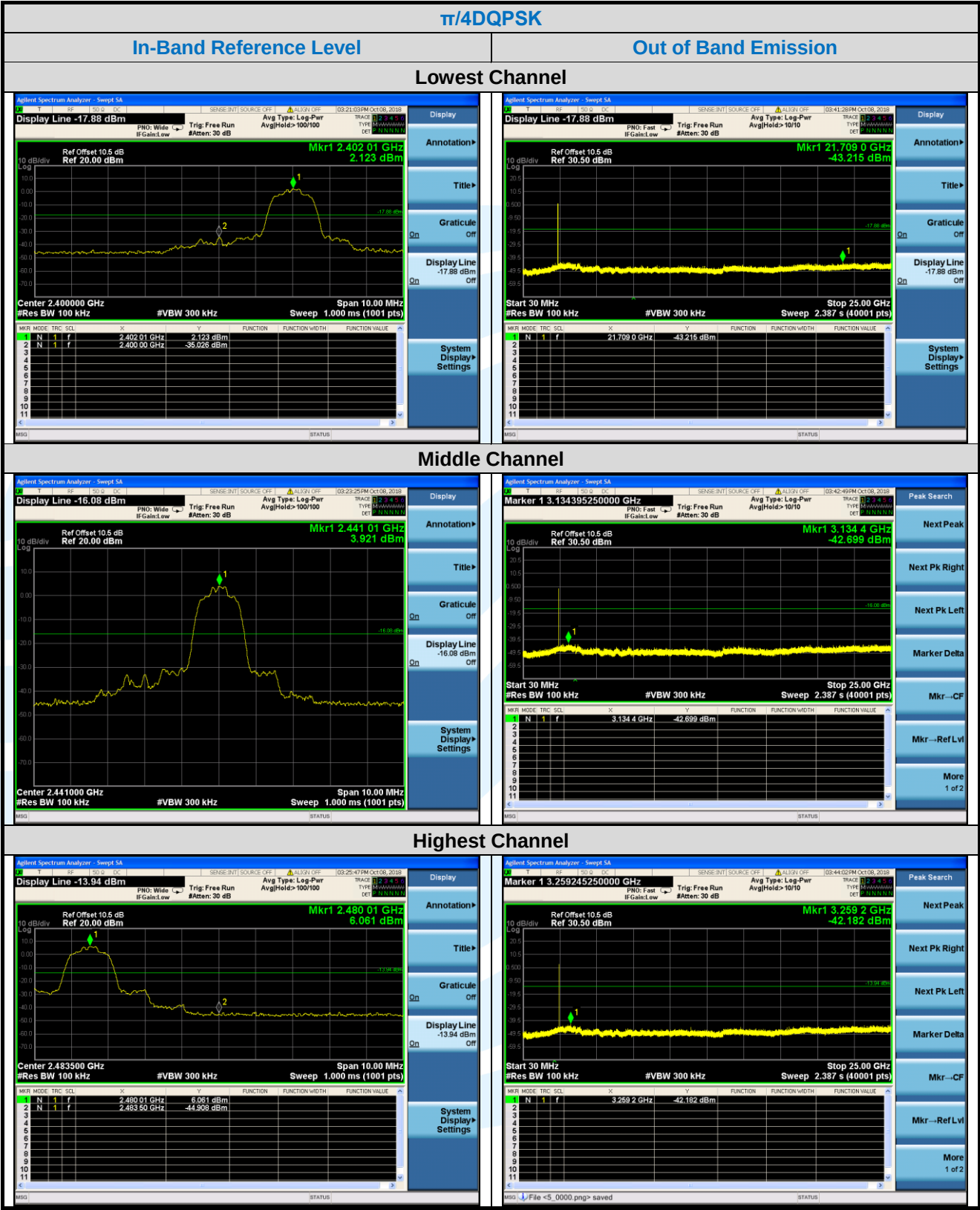
Marker 1 22.35255750000 GHz

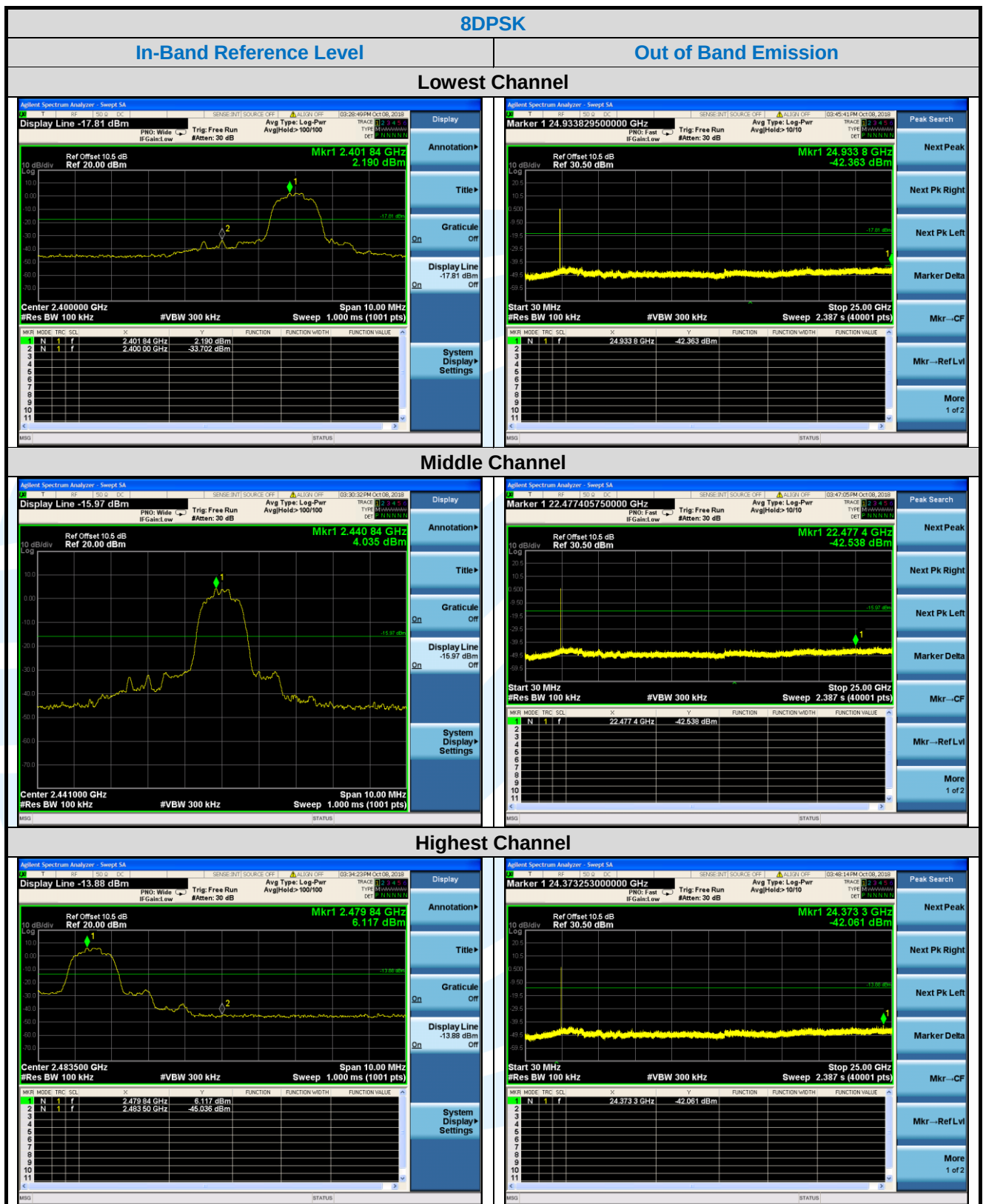
Ref Offset 10.5 dB  
Ref 30.50 dBm

Mkr1 22.3526 GHz  
-42.228 dBm

Start 30 MHz  
#Res BW 100 kHz  
#VBW 300 kHz  
Sweep 2.387 s (40001 pts)

| MNR | MODE | TRC | SOL | X           | Y           | FUNCTION | FUNCTION WIDTH | FUNCTION VALUE |
|-----|------|-----|-----|-------------|-------------|----------|----------------|----------------|
| 1   | N    | 1   | f   | 22.3526 GHz | -42.228 dBm |          |                |                |







## 5.9 RADIATED SPURIOUS EMISSIONS

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.205/15.209  
RSS-Gen Issue 5, Section 6.13/8.9/8.10

**Test Method:** ANSI C63.10-2013 Section 6.3 & 6.5 & 6.6

**Receiver Setup:**

| Frequency           | RBW         |
|---------------------|-------------|
| 0.009 MHz-0.150 MHz | 200/300 kHz |
| 0.150 MHz -30 MHz   | 9/10 kHz    |
| 30 MHz-1 GHz        | 100/120 kHz |
| Above 1 GHz         | 1 MHz       |

**Limits:**

**Spurious Emissions**

| Frequency           | Field strength (microvolt/meter) | Limit (dB $\mu$ V/m ) | Remark     | Measurement distance (m) |
|---------------------|----------------------------------|-----------------------|------------|--------------------------|
| 0.009 MHz-0.490 MHz | 2400/F(kHz)                      | --                    | --         | 300                      |
| 0.490 MHz-1.705 MHz | 24000/F(kHz)                     | --                    | --         | 30                       |
| 1.705 MHz-30 MHz    | 30                               | --                    | --         | 30                       |
| 30 MHz-88 MHz       | 100                              | 40.0                  | Quasi-peak | 3                        |
| 88 MHz-216 MHz      | 150                              | 43.5                  | Quasi-peak | 3                        |
| 216 MHz-960 MHz     | 200                              | 46.0                  | Quasi-peak | 3                        |
| 960MHz-1GHz         | 500                              | 54.0                  | Quasi-peak | 3                        |
| Above 1 GHz         | 500                              | 54.0                  | Average    | 3                        |

**Remark:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB $\mu$ V/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, 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 20 dB under any condition of modulation.

**Test Setup:** Refer to section 4.5.1 for details.

**Test Procedures:**

1. From 30 MHz to 1GHz test procedure as below:

- 1) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 3) The antenna height 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.
- 4) 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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
- 5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- 6) If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

2. Above 1GHz test procedure as below:

- 1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter( Above 18GHz the distance is 1 meter and table is 1.5 meter).
- 2) Test the EUT in the lowest channel ,middle channel, the Highest channel

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- 3) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the Y axis positioning which it is worse case.
- 4) Repeat above procedures until all frequencies measured was complete.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

**The measurement data as follows:**

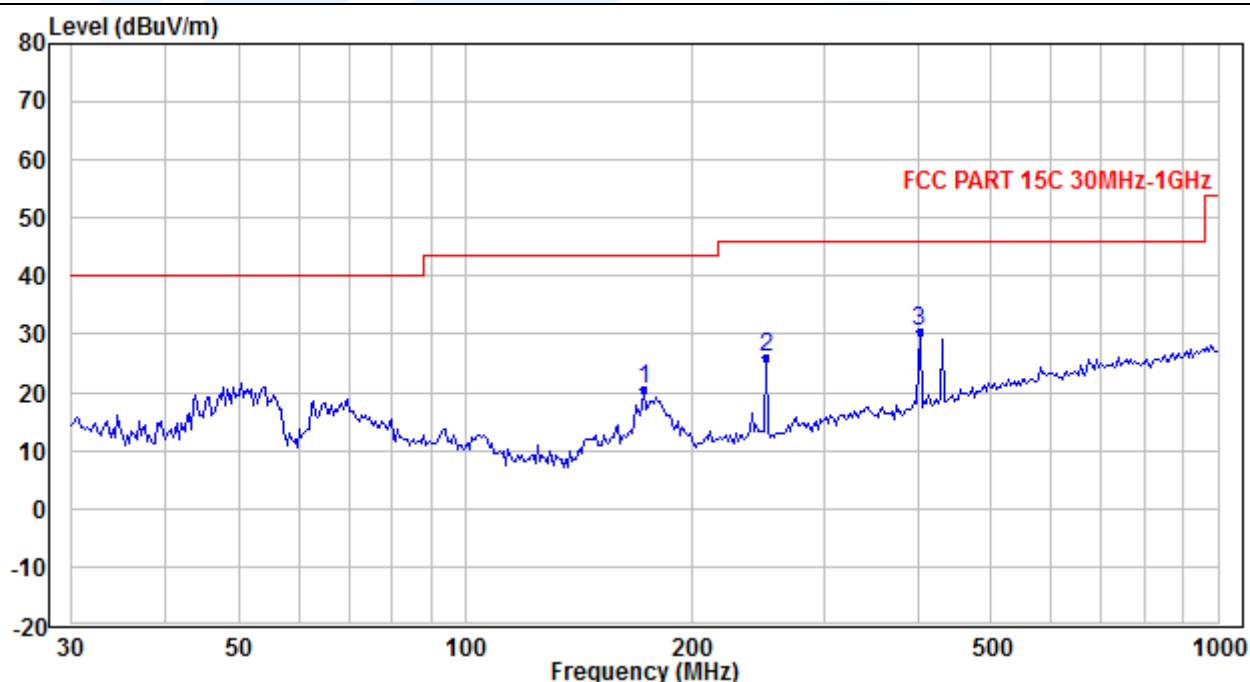
#### Radiated Emission Test Data (9 KHz ~ 30 MHz):

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

#### Radiated Emission Test Data (30 MHz ~ 1 GHz):

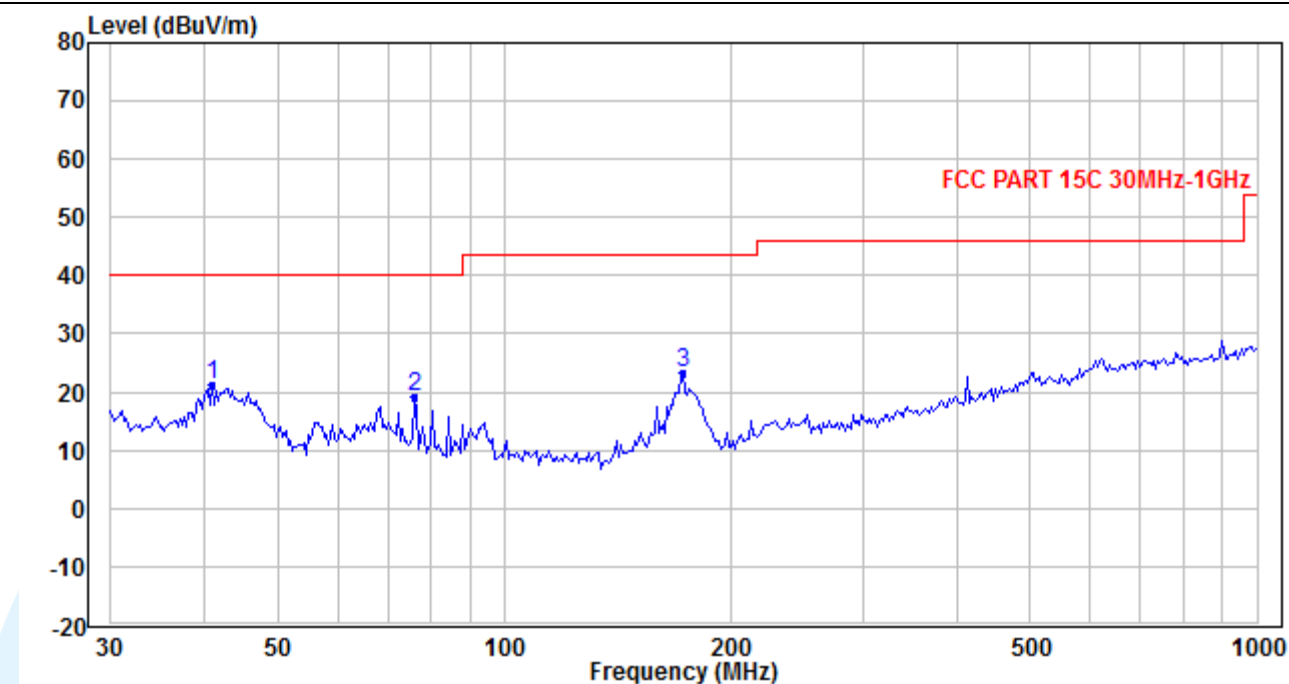
##### Worst-Case Configuration

##### Horizontal



| No. | Frequency (MHz) | Reading (dBuV) | Correction factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|------------------------|-----------------|----------------|-------------|--------|
| 1   | 172.598         | 36.33          | -15.90                 | 20.43           | 43.50          | -23.07      | QP     |
| 2   | 250.486         | 38.29          | -12.37                 | 25.92           | 46.00          | -20.08      | QP     |
| 3   | 401.105         | 38.38          | -7.91                  | 30.47           | 46.00          | -15.53      | QP     |

## Vertical



| No. | Frequency (MHz) | Reading (dBuV) | Correction factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----|-----------------|----------------|------------------------|-----------------|----------------|-------------|--------|
| 1   | 40.870          | 38.24          | -16.89                 | 21.35           | 40.00          | -18.65      | QP     |
| 2   | 75.852          | 38.66          | -19.38                 | 19.28           | 40.00          | -20.72      | QP     |
| 3   | 172.598         | 39.07          | -15.90                 | 23.17           | 43.50          | -20.33      | QP     |

**Radiated Emission Test Data (Above 1GHz):**
**Lowest Channel:**

| No. | Frequency (MHz) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Polaxis |
|-----|-----------------|-----------------|----------------|-------------|----------|-----------------|
| 1   | 4804.00         | 51.36           | 74.00          | -22.64      | Peak     | Horizontal      |
| 2   | 4804.00         | 34.36           | 54.00          | -19.64      | Average  | Horizontal      |
| 3   | 7206.00         | 50.08           | 74.00          | -23.92      | Peak     | Horizontal      |
| 4   | 7206.00         | 37.08           | 54.00          | -16.92      | Average  | Horizontal      |
| 5   | 4804.00         | 46.79           | 74.00          | -27.21      | Peak     | Vertical        |
| 6   | 4804.00         | 32.79           | 54.00          | -21.21      | Average  | Vertical        |
| 7   | 7206.00         | 51.15           | 74.00          | -22.85      | Peak     | Vertical        |
| 8   | 7206.00         | 38.15           | 54.00          | -15.85      | Average  | Vertical        |

**Middle Channel:**

| No. | Frequency (MHz) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Polaxis |
|-----|-----------------|-----------------|----------------|-------------|----------|-----------------|
| 1   | 4882.00         | 48.85           | 74.00          | -25.15      | Peak     | Horizontal      |
| 2   | 4882.00         | 33.73           | 54.00          | -20.27      | Average  | Horizontal      |
| 3   | 7323.00         | 51.34           | 74.00          | -22.66      | Peak     | Horizontal      |
| 4   | 7323.00         | 37.57           | 54.00          | -16.43      | Average  | Horizontal      |
| 5   | 4882.00         | 45.73           | 74.00          | -28.27      | Peak     | Vertical        |
| 6   | 4882.00         | 33.35           | 54.00          | -20.65      | Average  | Vertical        |
| 7   | 7323.00         | 53.57           | 74.00          | -20.43      | Peak     | Vertical        |
| 8   | 7323.00         | 38.59           | 54.00          | -15.41      | Average  | Vertical        |

**Highest Channel:**

| No. | Frequency (MHz) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Antenna Polaxis |
|-----|-----------------|-----------------|----------------|-------------|----------|-----------------|
| 1   | 4960.00         | 50.51           | 74.00          | -23.49      | Peak     | Horizontal      |
| 2   | 4960.00         | 33.64           | 54.00          | -20.36      | Average  | Horizontal      |
| 3   | 7440.00         | 51.02           | 74.00          | -22.98      | Peak     | Horizontal      |
| 4   | 7440.00         | 37.53           | 54.00          | -16.47      | Average  | Horizontal      |
| 5   | 4960.00         | 46.60           | 74.00          | -27.40      | Peak     | Vertical        |
| 6   | 4960.00         | 32.64           | 54.00          | -21.36      | Average  | Vertical        |
| 7   | 7440.00         | 53.10           | 74.00          | -20.90      | Peak     | Vertical        |
| 8   | 7440.00         | 37.53           | 54.00          | -16.47      | Average  | Vertical        |

## 5.10 BAND EDGE MEASUREMENTS (RADIATED)

**Test Requirement:** FCC 47 CFR Part 15 Subpart C Section 15.205/15.209  
RSS-247 Issue 2, Section 5.5

**Test Method:** ANSI C63.10-2013 Section 6.10.5

**Limits:**

Radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

| Frequency       | Limit (dBμV/m @3m) | Remark           |
|-----------------|--------------------|------------------|
| 30 MHz-88 MHz   | 40.0               | Quasi-peak Value |
| 88 MHz-216 MHz  | 43.5               | Quasi-peak Value |
| 216 MHz-960 MHz | 46.0               | Quasi-peak Value |
| 960 MHz-1 GHz   | 54.0               | Quasi-peak Value |
| Above 1 GHz     | 54.0               | Average Value    |
|                 | 74.0               | Peak Value       |

**Test Setup:** Refer to section 4.5.1 for details.

**Test Procedures:**

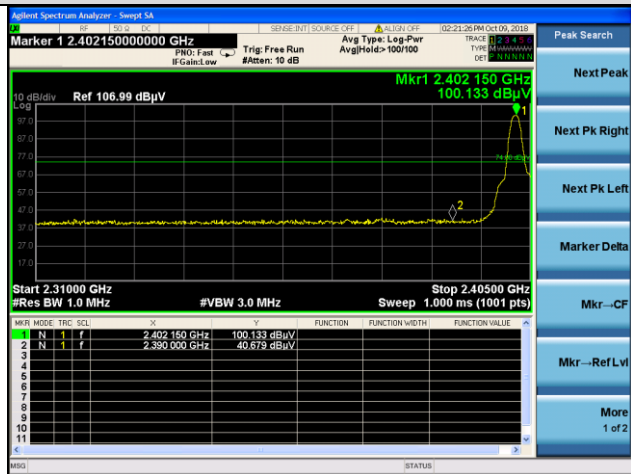
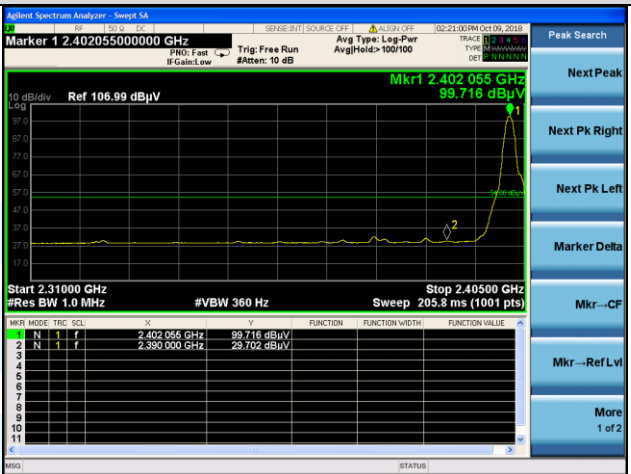
Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

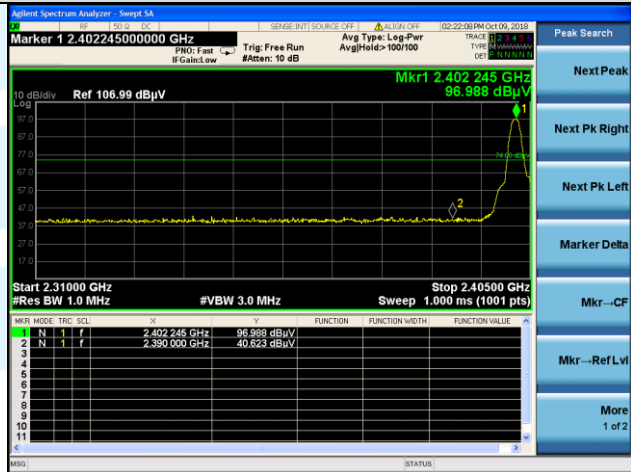
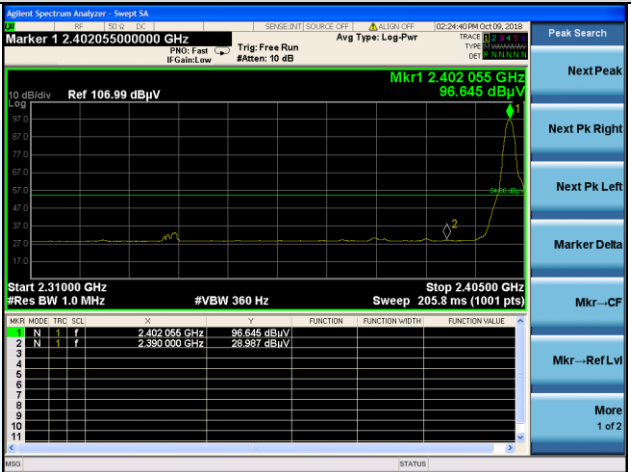
1. Use radiated spurious emission test procedure described in clause 5.10. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

**Equipment Used:** Refer to section 3 for details.

**Test Result:** Pass

**The measurement data as follows:**

| Test Channel:                                                                     |                     | Lowest Channel      |                   | Ant. Polar. :                                                                      |            | Horizontal |  |
|-----------------------------------------------------------------------------------|---------------------|---------------------|-------------------|------------------------------------------------------------------------------------|------------|------------|--|
| Peak                                                                              |                     |                     |                   | AV                                                                                 |            |            |  |
|  |                     |                     |                   |  |            |            |  |
| Frequency (MHz)                                                                   | Peak level (dBuV/m) | Peak Limit (dBuV/m) | AV level (dBuV/m) | AV Limit (dBuV/m)                                                                  | Conclusion |            |  |
| 2390.0000                                                                         | 40.68               | 74.00               | 29.70             | 54.00                                                                              | Pass       |            |  |

| Test Channel:                                                                       |                     | Lowest Channel      |                   | Ant. Polar. :                                                                        |            | Vertical |  |
|-------------------------------------------------------------------------------------|---------------------|---------------------|-------------------|--------------------------------------------------------------------------------------|------------|----------|--|
| Peak                                                                                |                     |                     |                   | AV                                                                                   |            |          |  |
|  |                     |                     |                   |  |            |          |  |
| Frequency (MHz)                                                                     | Peak level (dBuV/m) | Peak Limit (dBuV/m) | AV level (dBuV/m) | AV Limit (dBuV/m)                                                                    | Conclusion |          |  |
| 2390.0000                                                                           | 40.62               | 74.00               | 28.99             | 54.00                                                                                | Pass       |          |  |

| Test Channel:                                                                     |                     | Highest Channel     |                   | Ant. Polar. :                                                                      |            | Horizontal |  |
|-----------------------------------------------------------------------------------|---------------------|---------------------|-------------------|------------------------------------------------------------------------------------|------------|------------|--|
| Peak                                                                              |                     |                     |                   | AV                                                                                 |            |            |  |
|  |                     |                     |                   |  |            |            |  |
| Frequency (MHz)                                                                   | Peak level (dBuV/m) | Peak Limit (dBuV/m) | AV level (dBuV/m) | AV Limit (dBuV/m)                                                                  | Conclusion |            |  |
| 2483.5000                                                                         | 60.19               | 74.00               | 49.97             | 54.00                                                                              | Pass       |            |  |

| Test Channel:                                                                       |                     | Highest Channel     |                   | Ant. Polar. :                                                                        |            | Vertical |  |
|-------------------------------------------------------------------------------------|---------------------|---------------------|-------------------|--------------------------------------------------------------------------------------|------------|----------|--|
| Peak                                                                                |                     |                     |                   | AV                                                                                   |            |          |  |
|  |                     |                     |                   |  |            |          |  |
| Frequency (MHz)                                                                     | Peak level (dBuV/m) | Peak Limit (dBuV/m) | AV level (dBuV/m) | AV Limit (dBuV/m)                                                                    | Conclusion |          |  |
| 2483.5000                                                                           | 61.47               | 74.00               | 51.04             | 54.00                                                                                | Pass       |          |  |

## APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

## APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

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

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