

FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions

SPECIFICATION:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

| Frequency Range (MHz) | Field strength (µV/m) | Field strength (dBµV/m) | Measurement distance (m) |
|-----------------------|-----------------------|-------------------------|--------------------------|
| 0.009-0.490 | 2400/F(kHz) | - | 300 |
| 0.490-1.705 | 24000/F(kHz) | - | 300 |
| 1.705 - 30.0 | 30 | - | 30 |
| 30 - 88 | 100 | 40 | 3 |
| 88 - 216 | 150 | 43.5 | 3 |
| 216 - 960 | 200 | 46 | 3 |
| 960 - 40000 | 500 | 54 | 3 |

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 1 GHz-40 GHz and a distance of 3m for frequency range 30 MHz-1 GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

OUT OF BAND EMISSIONS: For spurious emissions outside of the U-NII-1 band edge Restricted Bands 4.50-5.15 GHz and 5.35-5.46 GHz, the OFDM worst mode case was determined after preliminary measurements of the E.I.R.P. density (radiated).

The Low, Middle and High Channels were tested.

- **Worst case:** **802.11 n20** (index MCS0).

Frequency range 30 MHz - 1 GHz (worst case):

The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

Spurious frequencies detected at less than 20 dB below the limit:

| Spurious frequency (MHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|------------|------------------------------|
| 786.454500 | 28.42 | V | Quasi-Peak | <± 5.1 |
| 884.764000 | 31.86 | V | Quasi-Peak | <± 5.1 |

Frequency range 1 - 40 GHz (worst case):

The results in the next tables show the maximum measured levels in the 1 - 40 GHz frequency range.

The Low, Middle and High Channels were measured for out-of-band emissions for the worst mode.

Spurious frequencies in the restricted bands with peak levels above the average limit (54 dBµV/m at 3 m) are measured with an average detector for checking compliance with the average limit.

- LOW CHANNEL. Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 10.361875000 | 63.62 | V | Peak | <± 5.13 |

- MIDDLE CHANNEL. Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 10.398125000 | 66.56 | V | Peak | <± 5.13 |

- HIGH CHANNEL. Spurious frequencies at less than 20 dB below the limit:

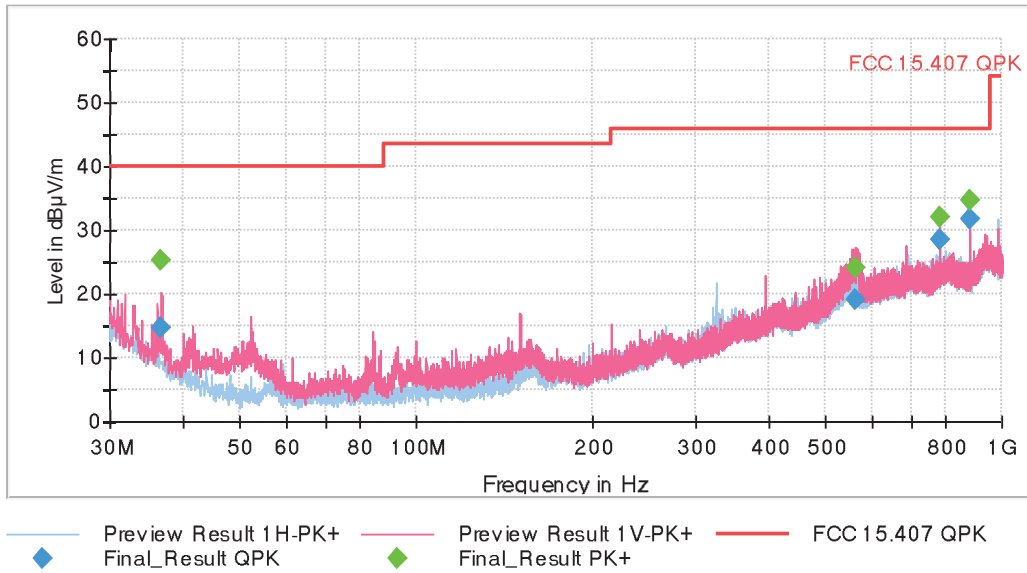
| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 10.474687500 | 65.07 | V | Peak | <± 5.13 |

Measurement Uncertainty (dB):
 1 GHz - 17 GHz <± 5.13
 17 GHz - 26.5 GHz <± 5.08
 26.5 GHz - 40 GHz <± 5.33

Verdict: PASS

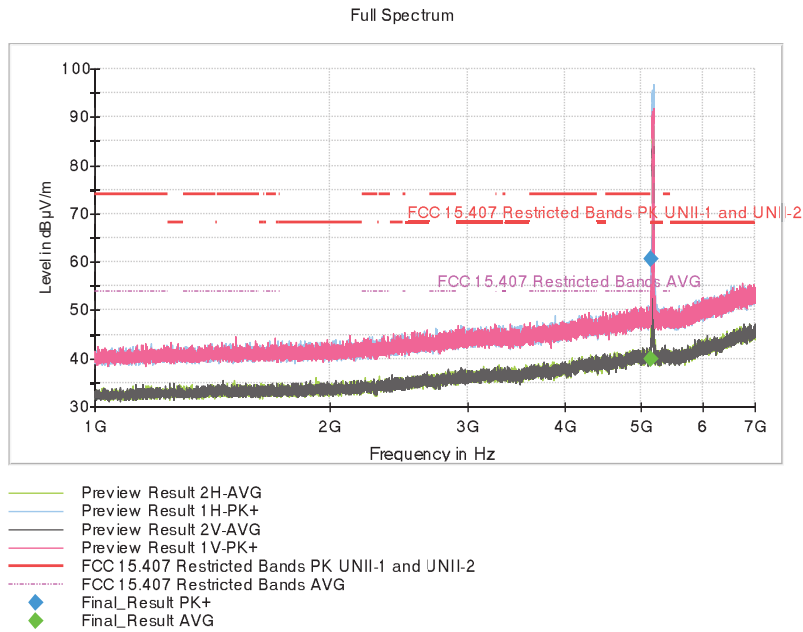
FREQUENCY RANGE 30 MHz - 1 GHz (worst case):

This plot is valid for the Low, Middle and High Channels and all the modulation modes.



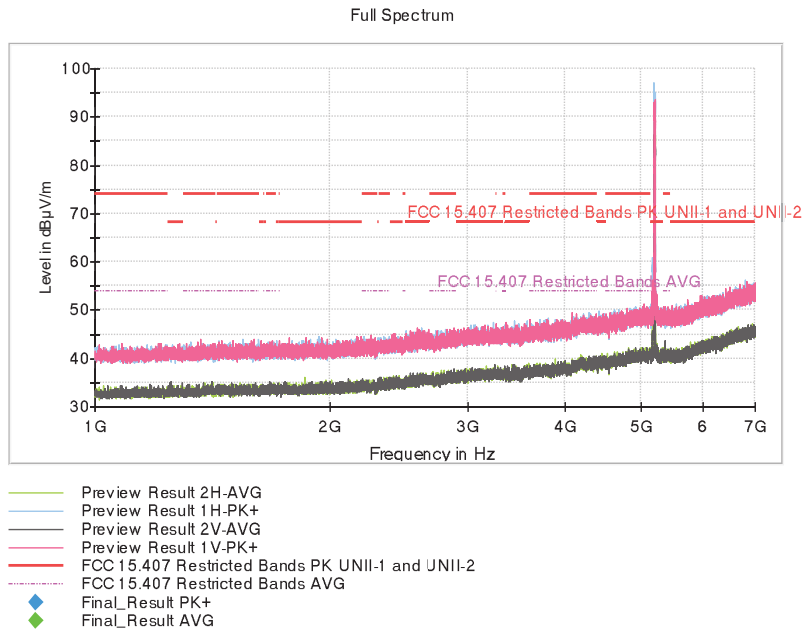
FREQUENCY RANGE 1 - 7 GHz (worst mode):

- Low Channel:



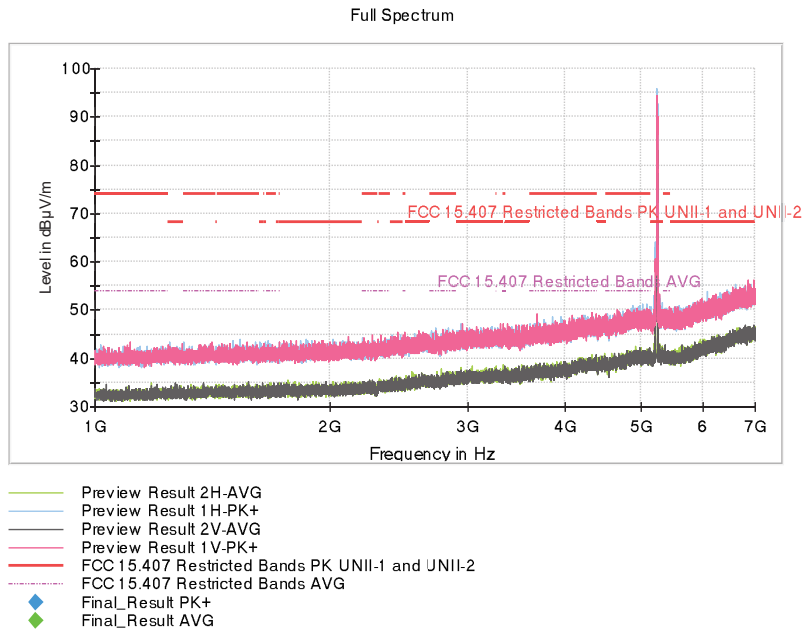
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

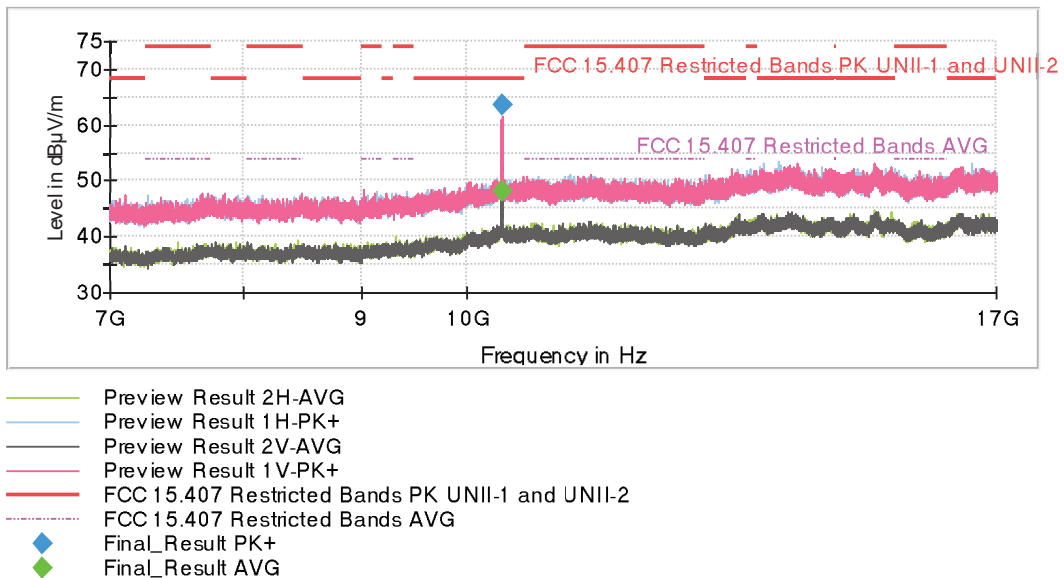
- High Channel:



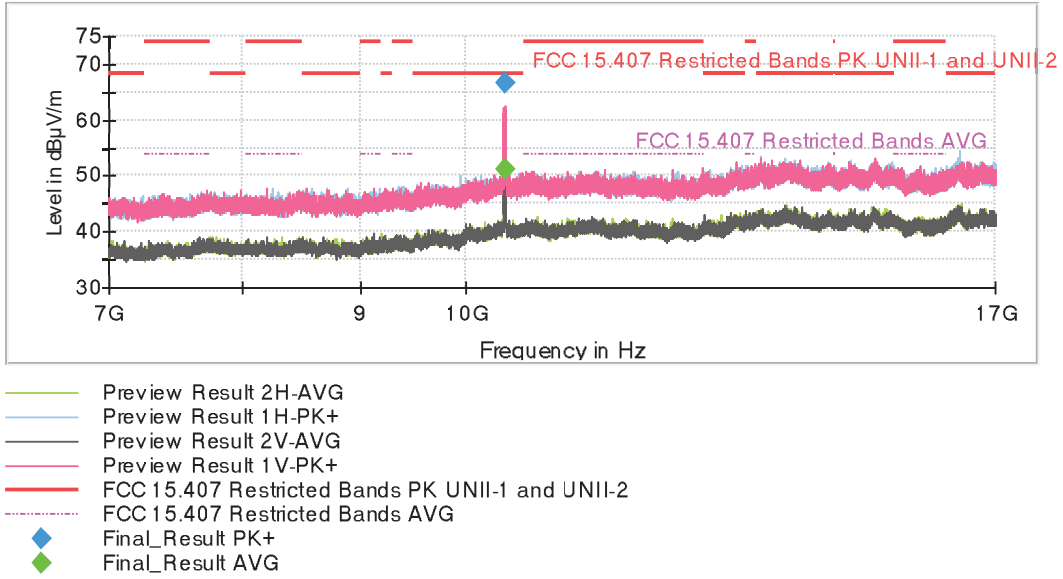
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz (worst mode):

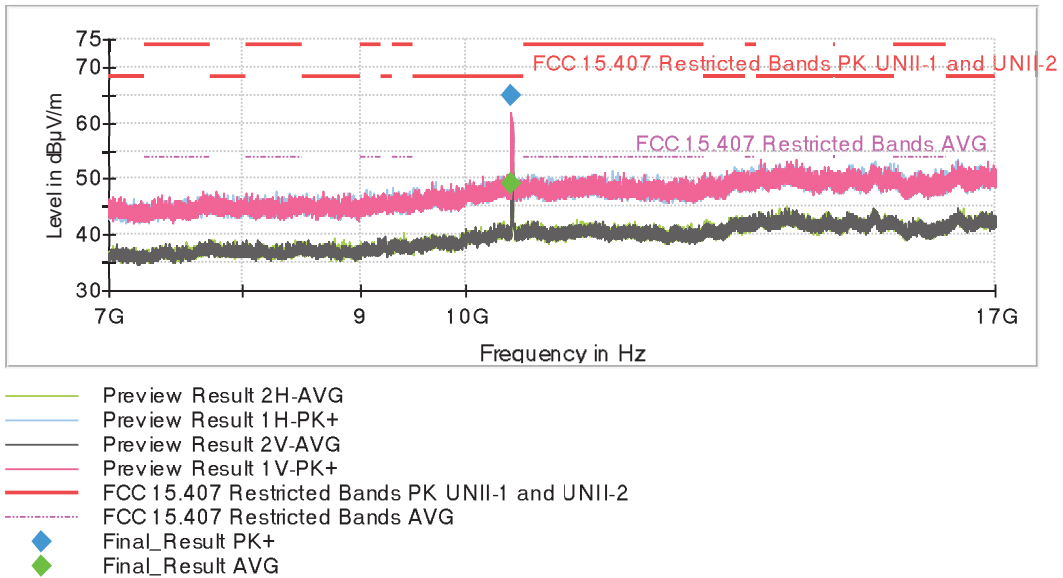
- Low Channel:



- Middle Channel:

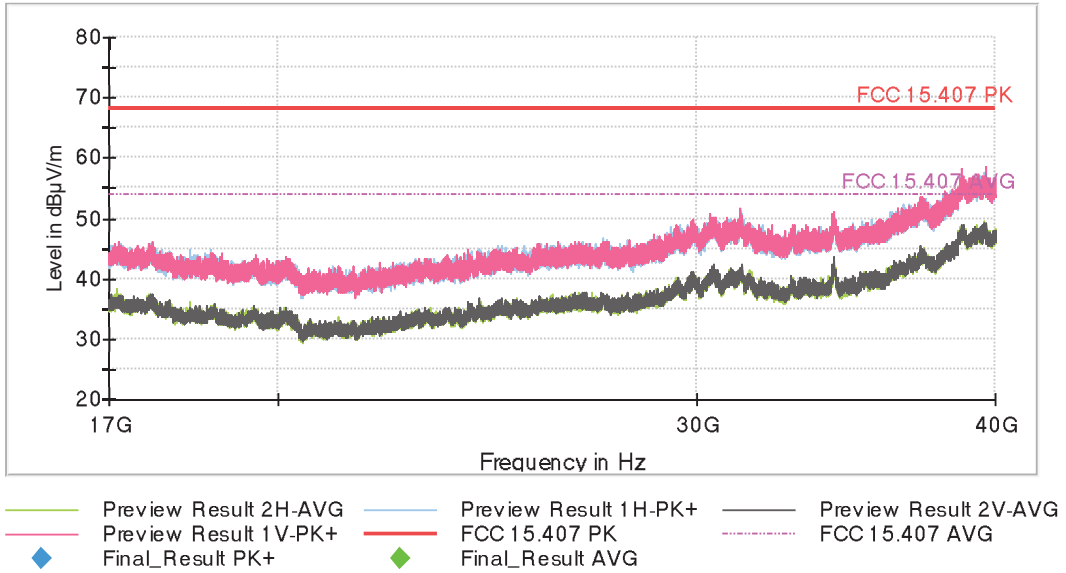


- High Channel:

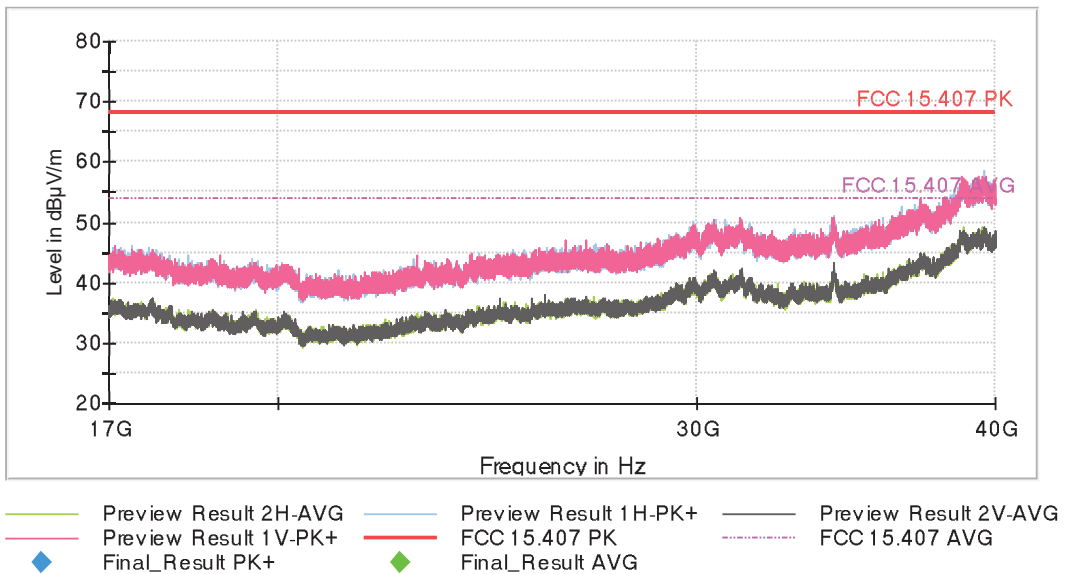


FREQUENCY RANGE 17 - 40 GHz:

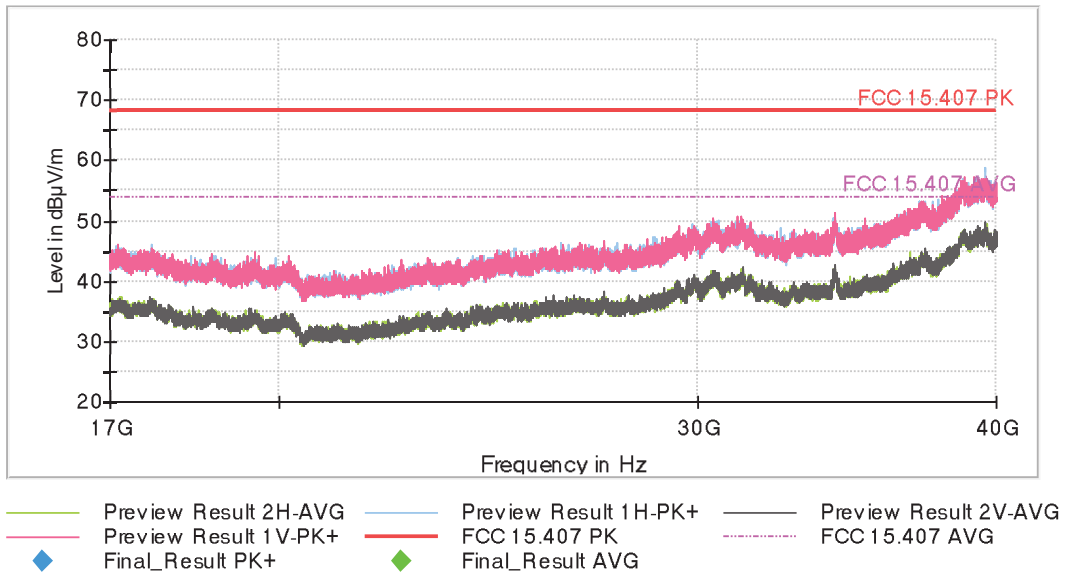
- Low Channel:



- Middle Channel:



- High Channel:



FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions

SPECIFICATION:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBμV/m at 3 m distance).

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

| Frequency Range (MHz) | Field strength (μV/m) | Field strength (dBμV/m) | Measurement distance (m) |
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The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

Measurements were made in both horizontal and vertical planes of polarization.

All emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm/MHz. There are restricted bands of operation below band edge at 4.50-5.15 GHz also above the upper band edge at 5.35-5.46 GHz therefore the provision of FCC Part 15.205 apply.

Field strength measurements using peak and average detector performed in the restricted bands below 5.15 GHz and above 5.35 GHz.

Test performed on the following worst cases modes in all relevant tests channels:

- 802.11a: 6 Mbit/s.
- 802.11n HT20: MCS0.
- 802.11ac VHT20: MCS0.
- 802.11n HT40: MCS0.
- 802.11ac VHT40: MCS0.
- 802.11ac VHT80: MCS0.

BAND EDGE EMISSIONS:

• **802.11 a20:**

- Lower Band Edge Channel 36 (5180 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 5.149 | 59 | V | Peak | <± 4.6 |
| | 40.07 | | Average | <± 4.6 |

- Upper Band Edge Channel 48 (5240 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious frequencies at less than 20 dB below the limit.

• **802.11 n20:**

- Lower Band Edge Channel 36 (5180 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 5.1468 | 60.62 | H | Peak | <± 4.6 |
| | 40.81 | | Average | <± 4.6 |

- Upper Band Edge Channel 48 (5240 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious frequencies at less than 20 dB below the limit.

• **802.11 ac20:**

- Lower Band Edge Channel 36 (5180 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 5.1476 | 61.51 | H | Peak | <± 4.6 |
| | 40.58 | | Average | <± 4.6 |

- Upper Band Edge Channel 48 (5240 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious frequencies at less than 20 dB below the limit.

• **802.11 n40:**

- Lower Band Edge Channel 38 (5190 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 5.1452 | 61.34 | H | Peak | <± 4.6 |
| | 42.72 | | Average | <± 4.6 |

- Upper Band Edge Channel 46 (5230 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious frequencies at less than 20 dB below the limit.

• **802.11 ac40:**

- Lower Band Edge Channel 38 (5190 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 5.1492 | 59.52 | H | Peak | <± 4.6 |
| | 42.01 | | Average | <± 4.6 |

- Upper Band Edge Channel 46 (5230 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious frequencies at less than 20 dB below the limit.

- **802.11 ac80:**

- Lower Band Edge Channel 42 (5210 MHz). Inside the Restricted Band 4.50-5.15 GHz:

Spurious frequencies at less than 20 dB below the limit:

| Spurious frequency (GHz) | Emission Level (dBµV/m) | Polarization | Detector | Measurement Uncertainty (dB) |
|--------------------------|-------------------------|--------------|----------|------------------------------|
| 5.1358 | 60.45 | H | Peak | <± 4.6 |
| | 45.83 | | Average | <± 4.6 |
| 5.1424 | 62.22 | H | Peak | <± 4.6 |
| | 45.81 | | Average | <± 4.6 |
| 5.149 | 58.69 | V | Peak | <± 4.6 |
| | 43.45 | | Average | <± 4.6 |
| 5.1494 | 63.68 | H | Peak | <± 4.6 |
| | 46.45 | | Average | <± 4.6 |

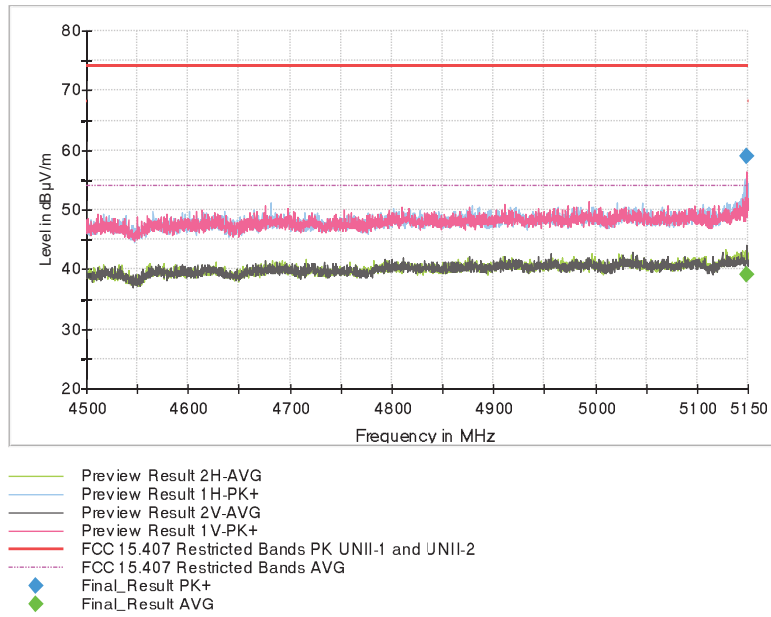
- Upper Band Edge Channel 42 (5210 MHz). Inside the Restricted Band 5.35-5.46 GHz:

No spurious frequencies at less than 20 dB below the limit.

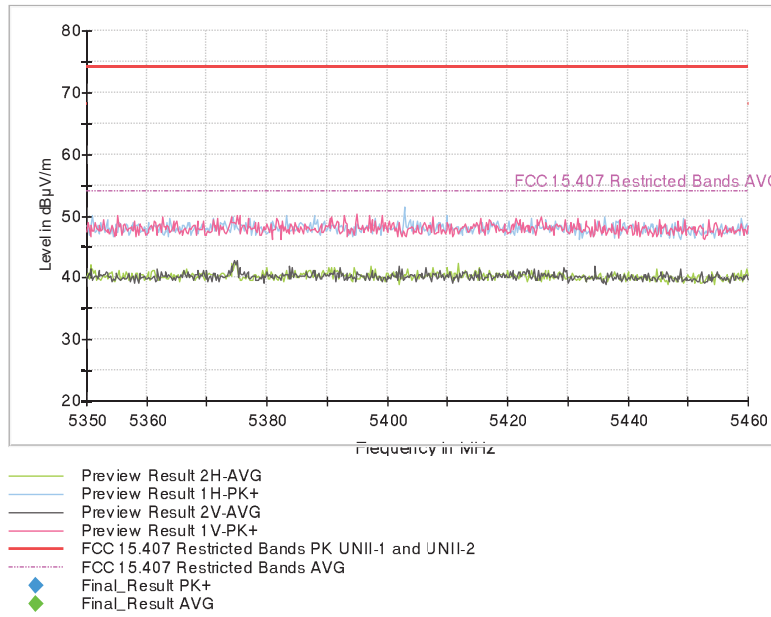
Verdict: PASS

• 802.11 a20:

- Lower Band Edge Channel 36 (Restricted Band 4.50-5.15 GHz)

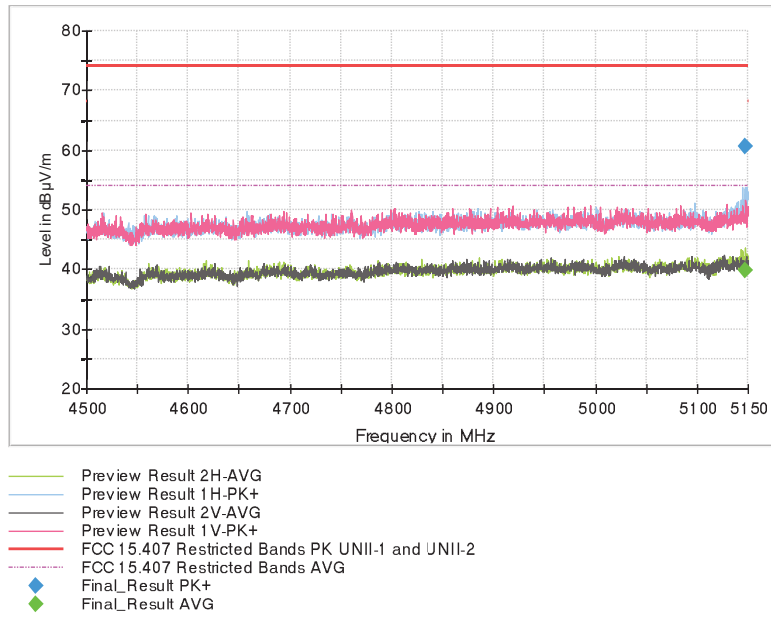


- Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)

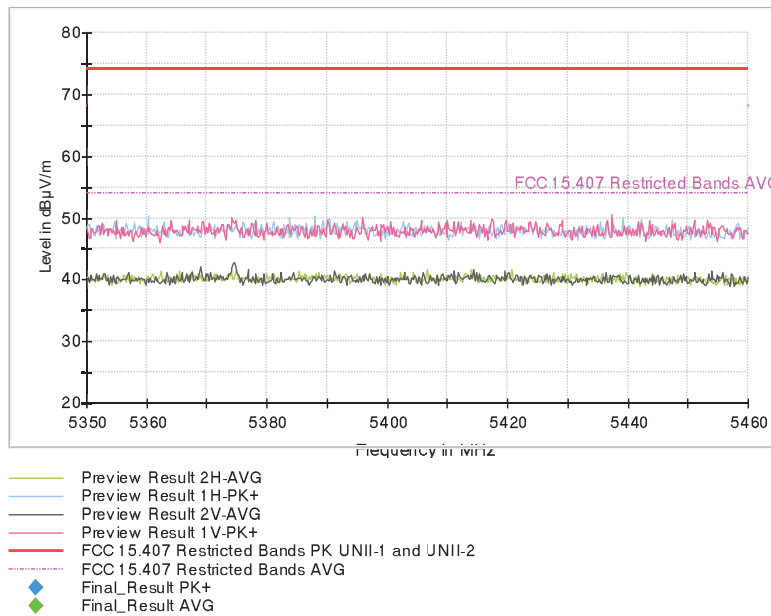


• 802.11 n20:

- Lower Band Edge Channel 36 (Restricted Band 4.50-5.15 GHz)

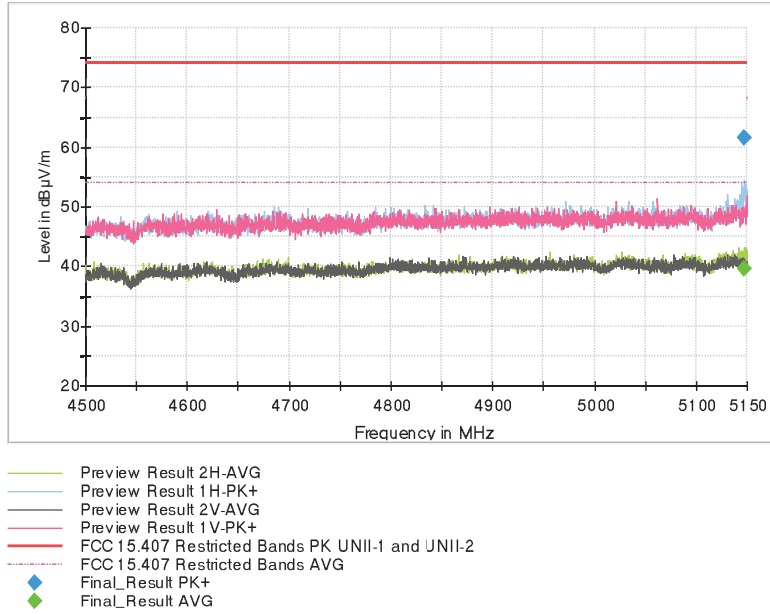


- Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)

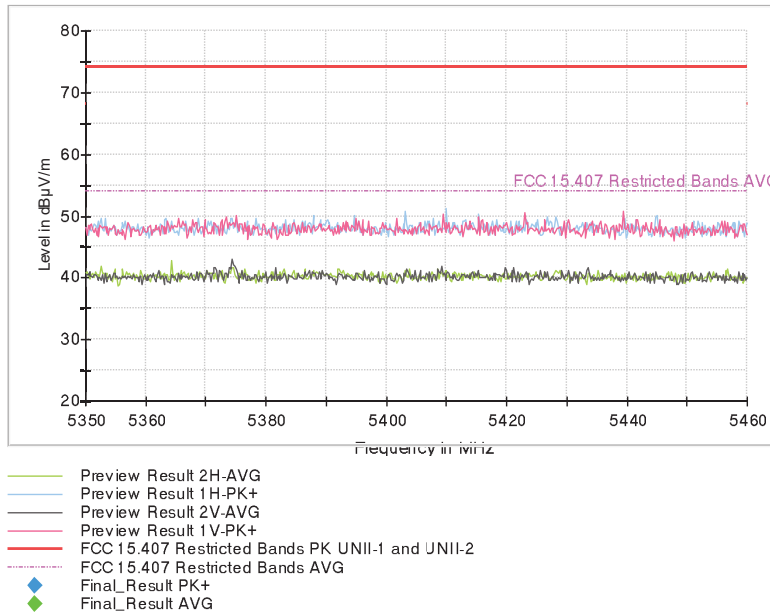


• 802.11 ac20:

- Lower Band Edge Channel 36 (Restricted Band 4.50-5.15 GHz)

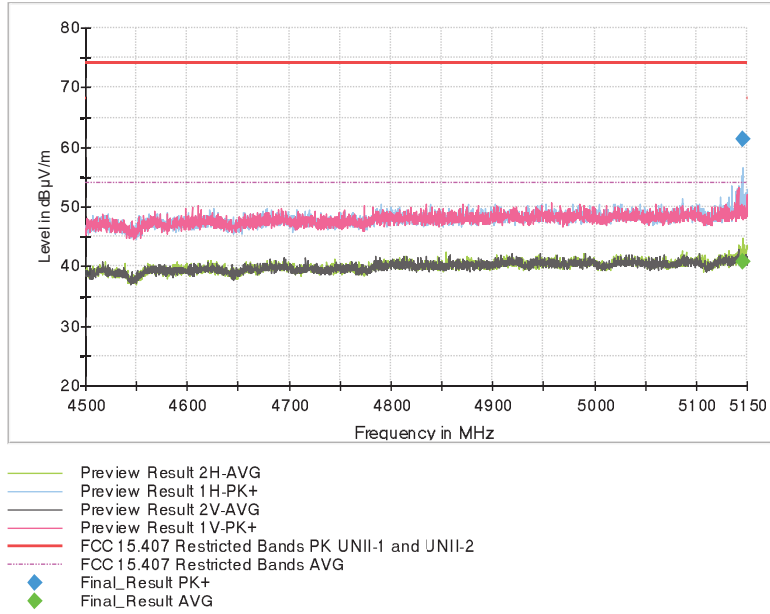


- Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)

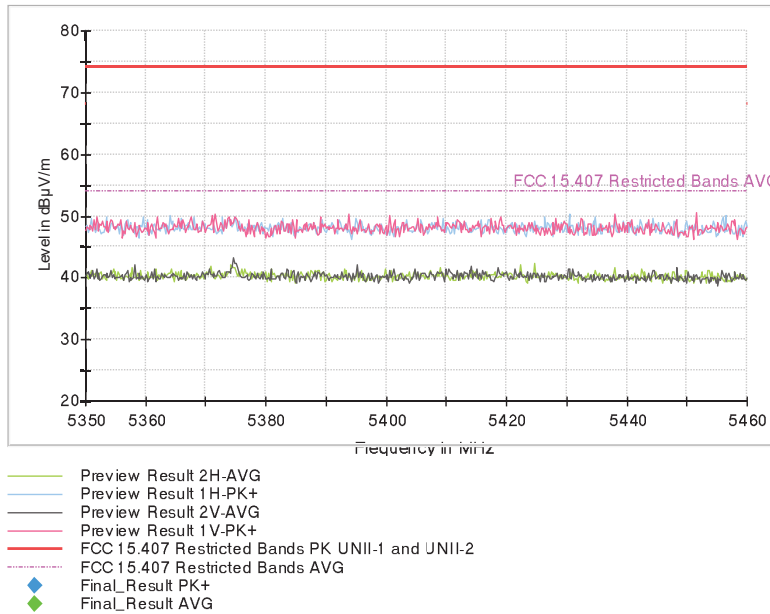


• 802.11 n40:

- Lower Band Edge Channel 38 (Restricted Band 4.50-5.15 GHz)

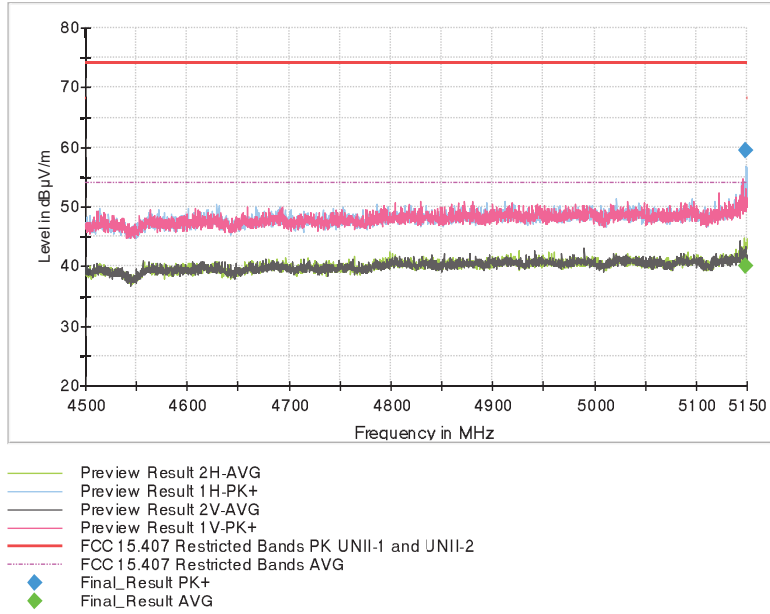


- Upper Band Edge Channel 46 (Restricted Band 5.35-5.46 GHz)

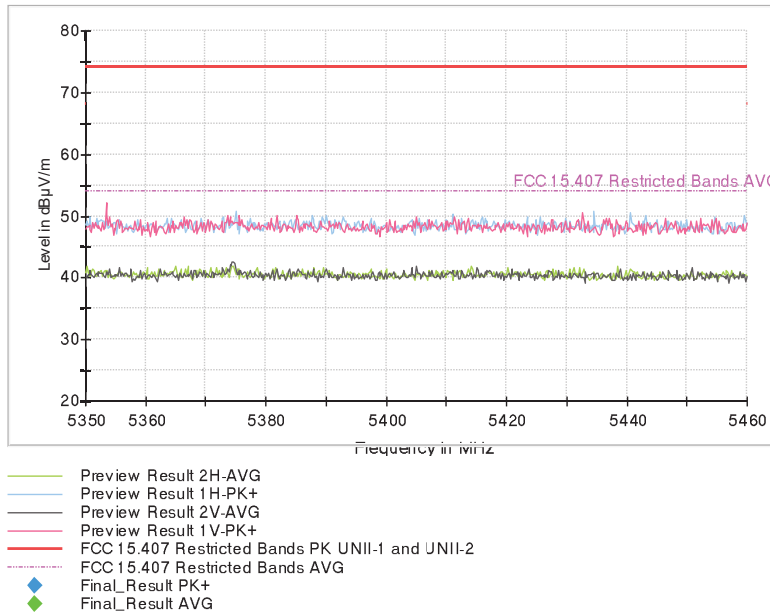


• 802.11 ac40:

- Lower Band Edge Channel 38 (Restricted Band 4.50-5.15 GHz)

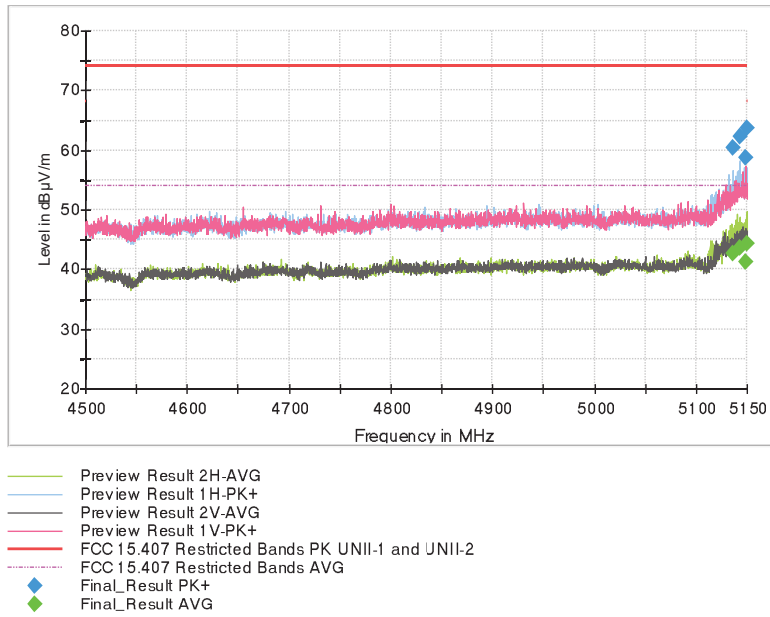


- Upper Band Edge Channel 46 (Restricted Band 5.35-5.46 GHz)



• 802.11 ac80:

- Lower Band Edge Channel 42 (Restricted Band 4.50-5.15 GHz)



- Upper Band Edge Channel 42 (Restricted Band 5.35-5.46 GHz)

