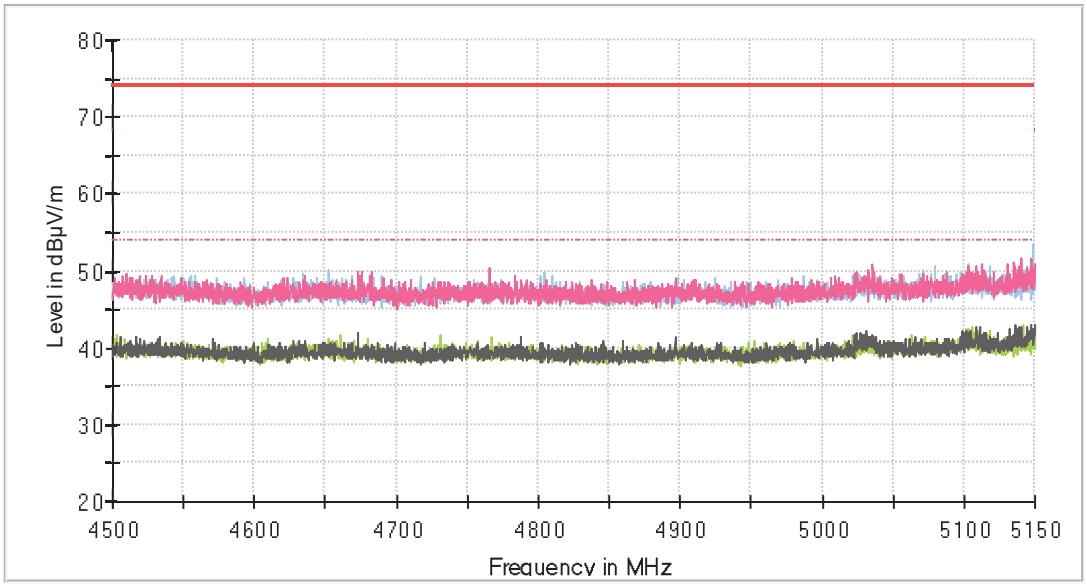
- **802.11 a20:**

  Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

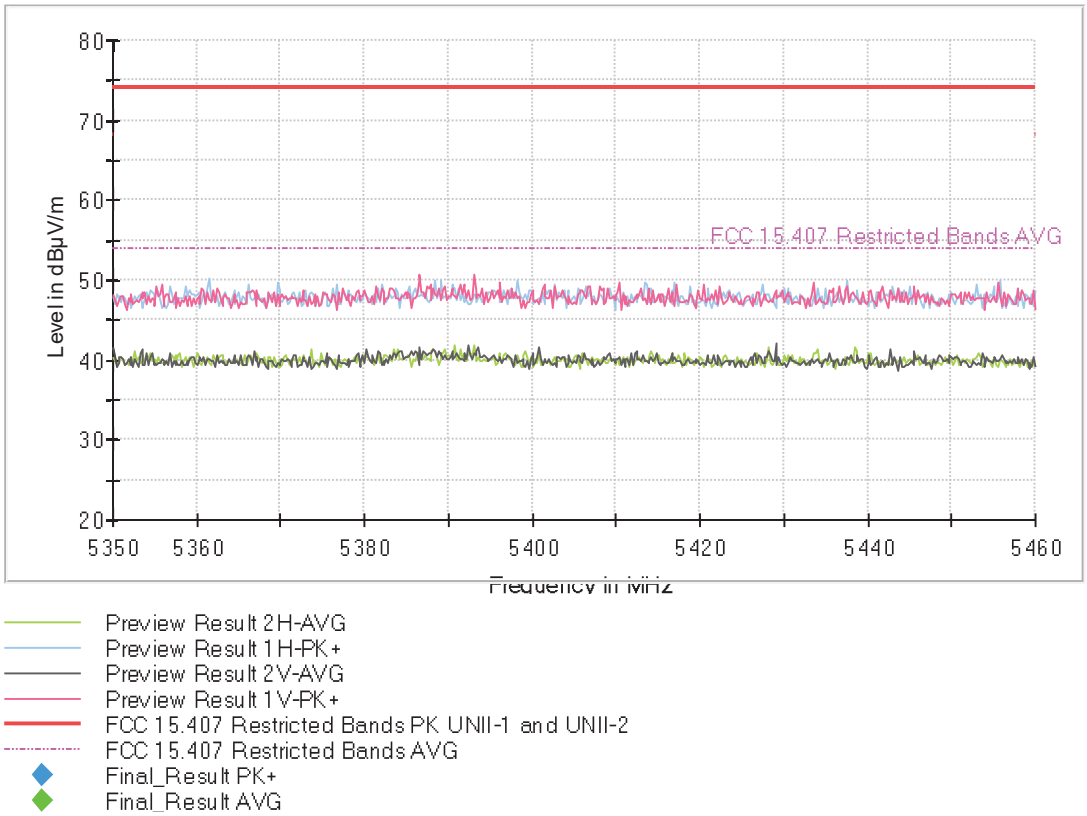
  - Lower Band Edge Channel 36 (4500 to 5150 MHz)



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

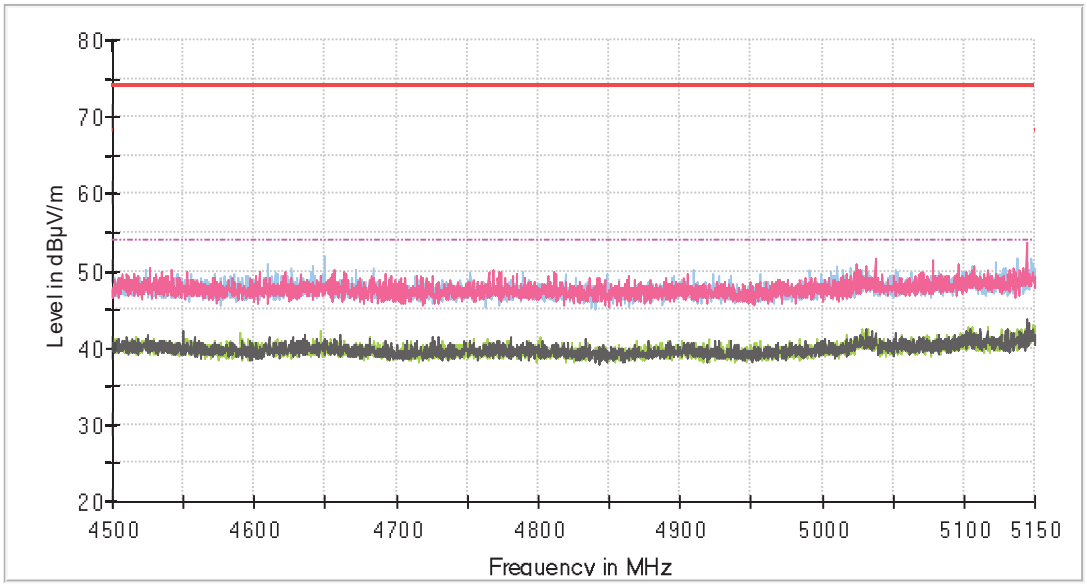
- Upper Band Edge Channel 48 (5350 to 5460 MHz)



- **802.11 n20:**

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

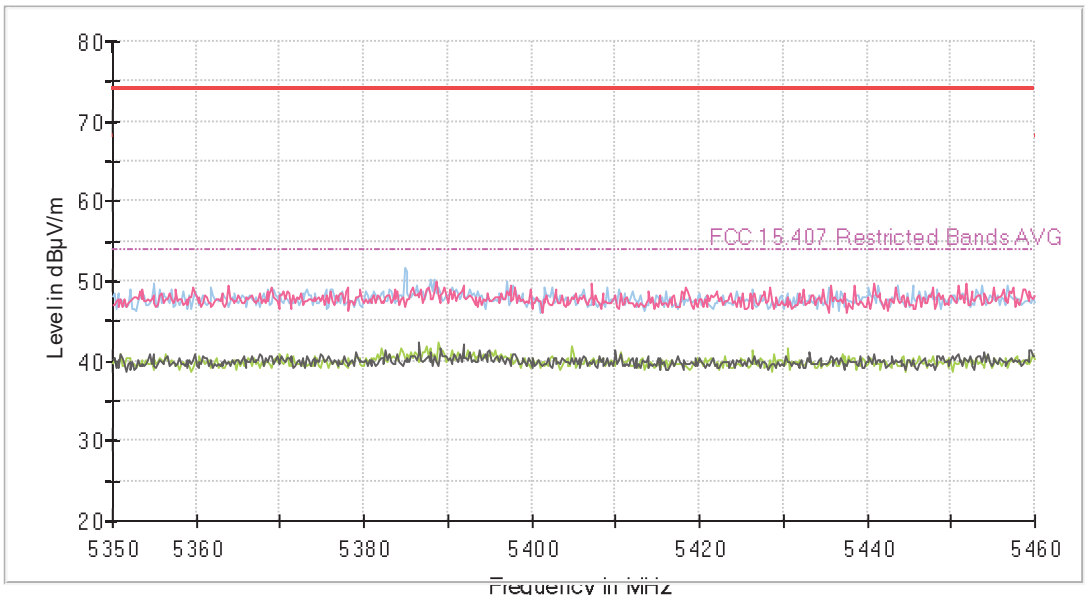
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

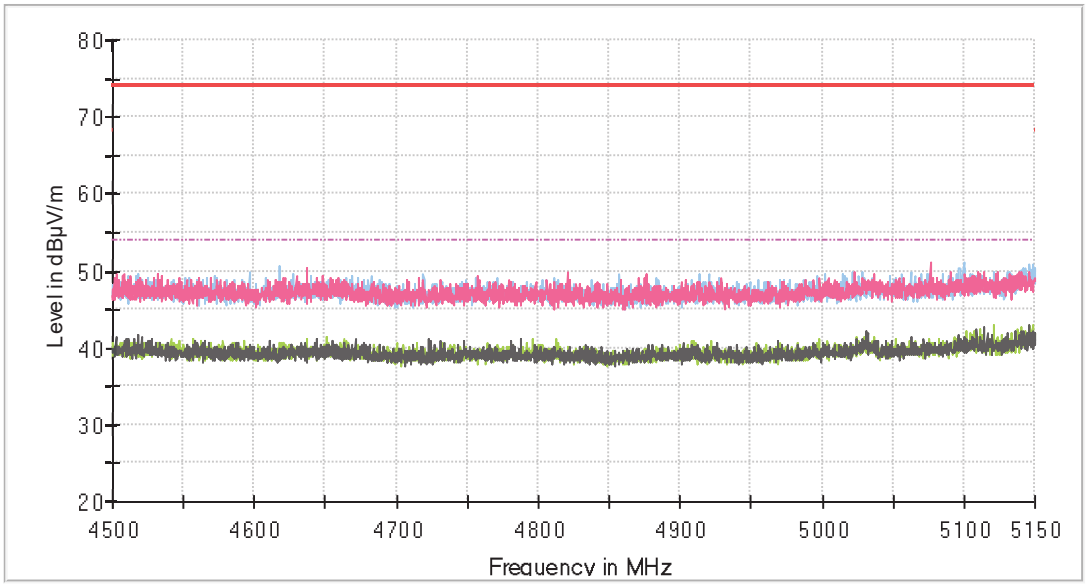
- Upper Band Edge Channel 48 (5350 to 5460 MHz)



- **802.11 ac20:**

  Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

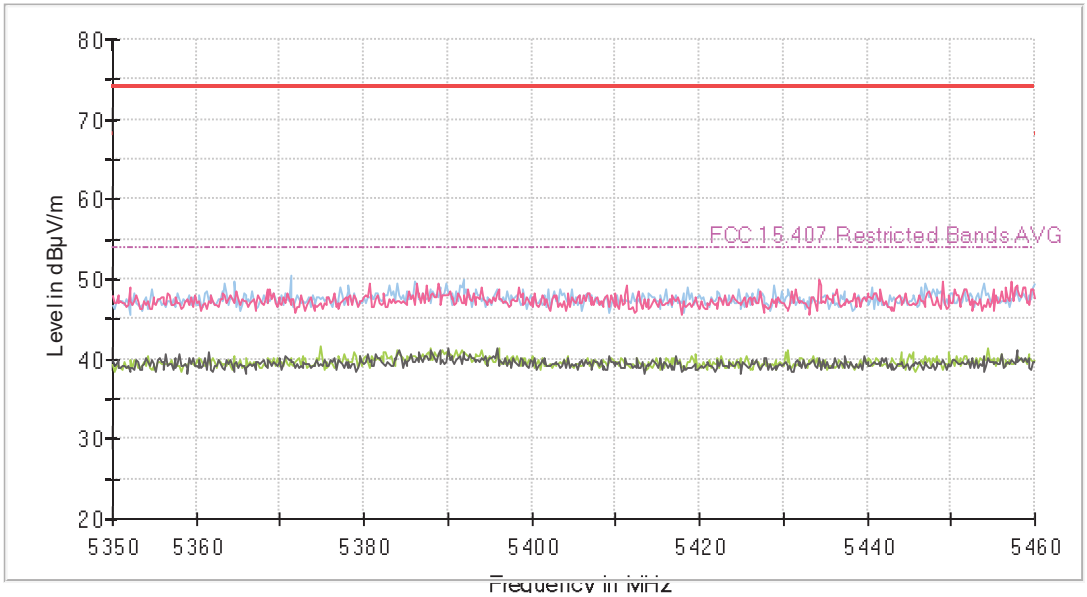
  - Lower Band Edge Channel 36 (4500 to 5150 MHz)



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

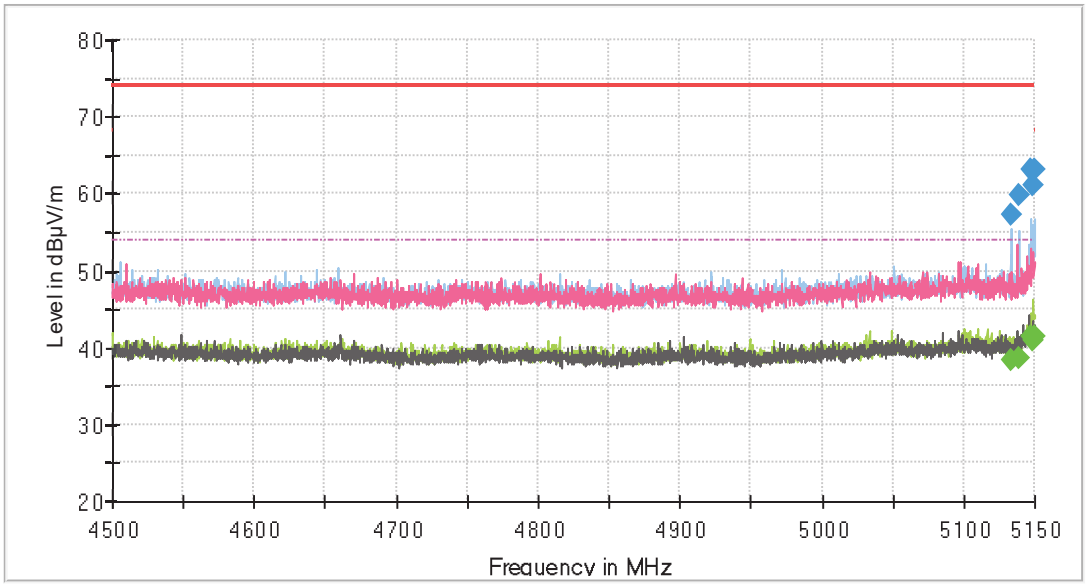
- Upper Band Edge Channel 48 (5350 to 5460 MHz)



- **802.11 n40:**

  Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

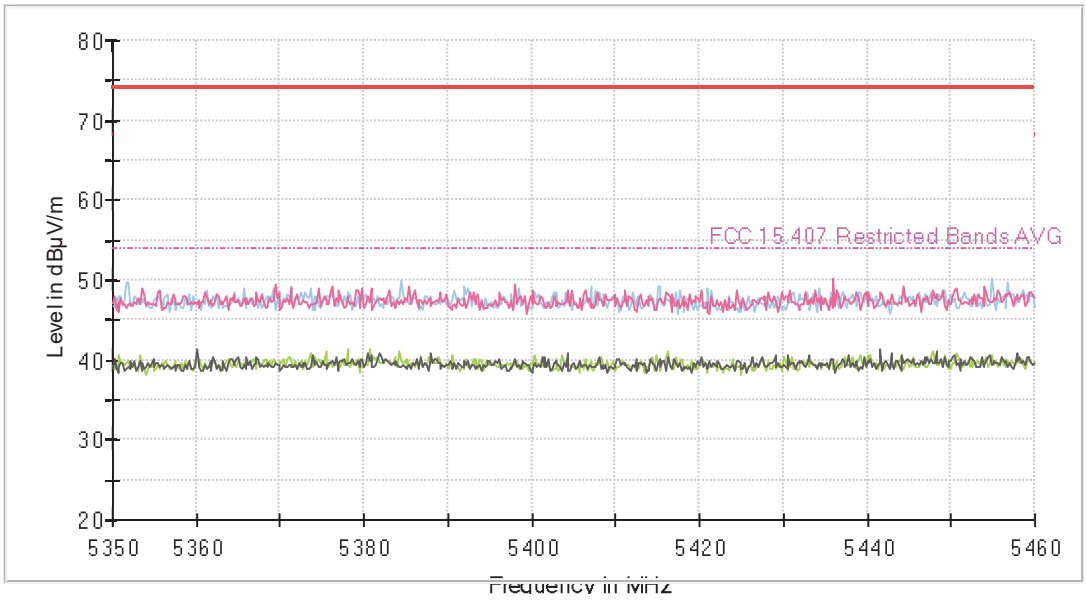
  - Lower Band Edge Channel 38 (4500 to 5150 MHz)



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 46 (5350 to 5460 MHz)

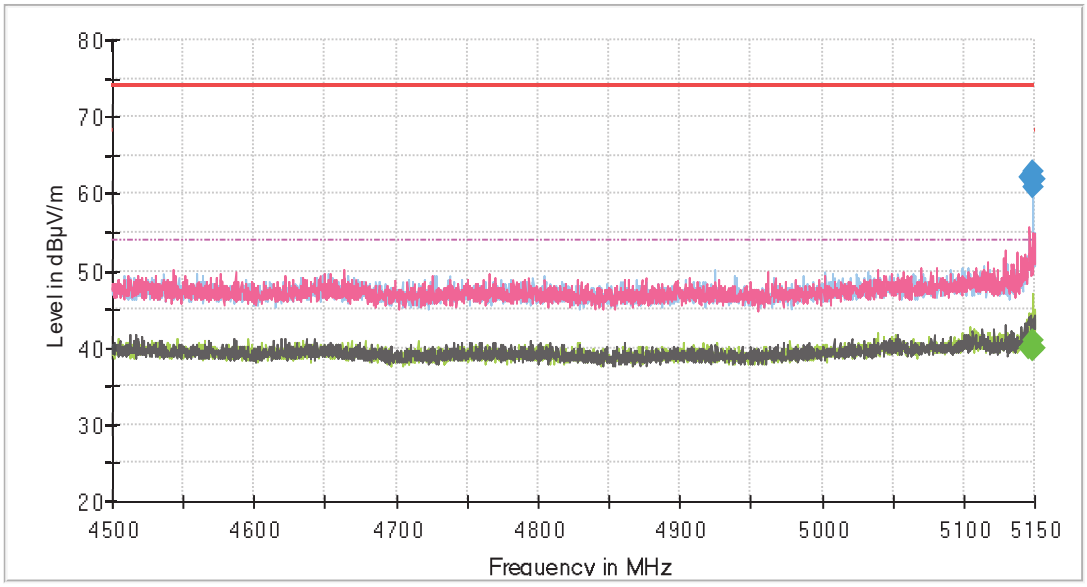


Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- **802.11 ac40:**

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

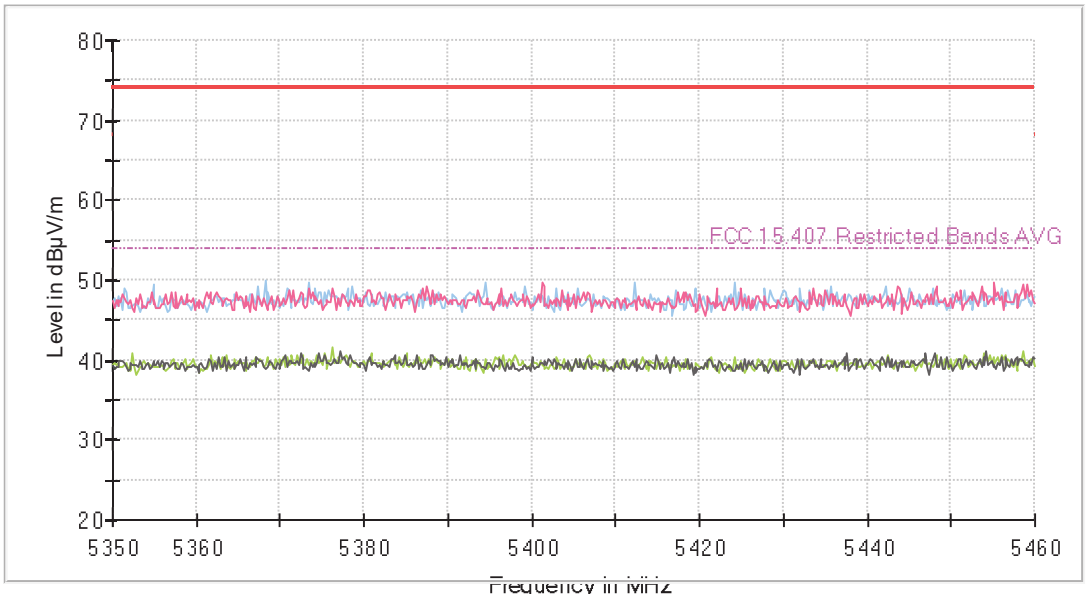
- Lower Band Edge Channel 38 (4500 to 5150 MHz)



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

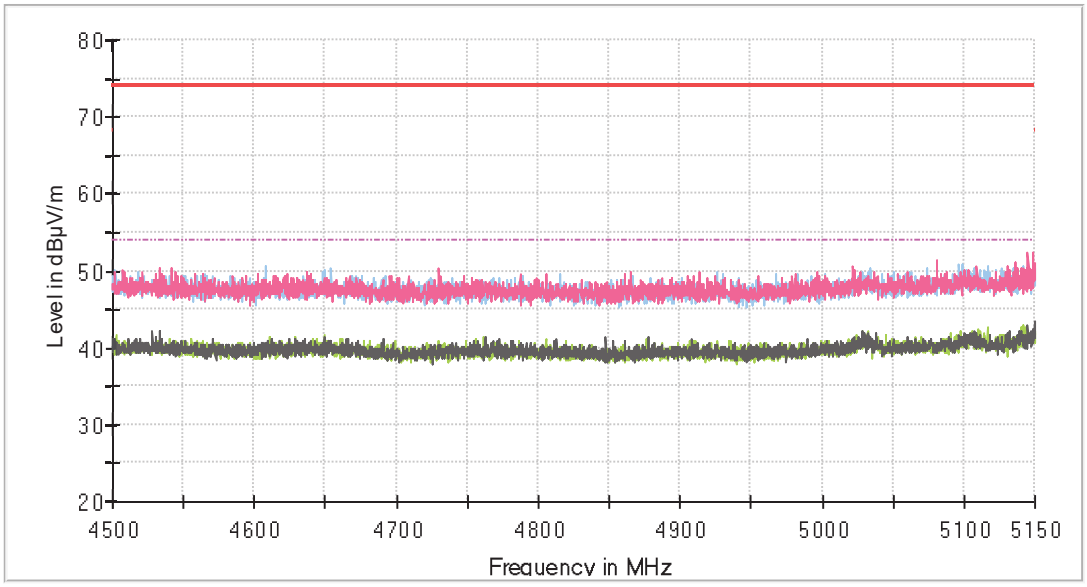
- Upper Band Edge Channel 46 (5350 to 5460 MHz)



- **802.11 ac80:**

Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz

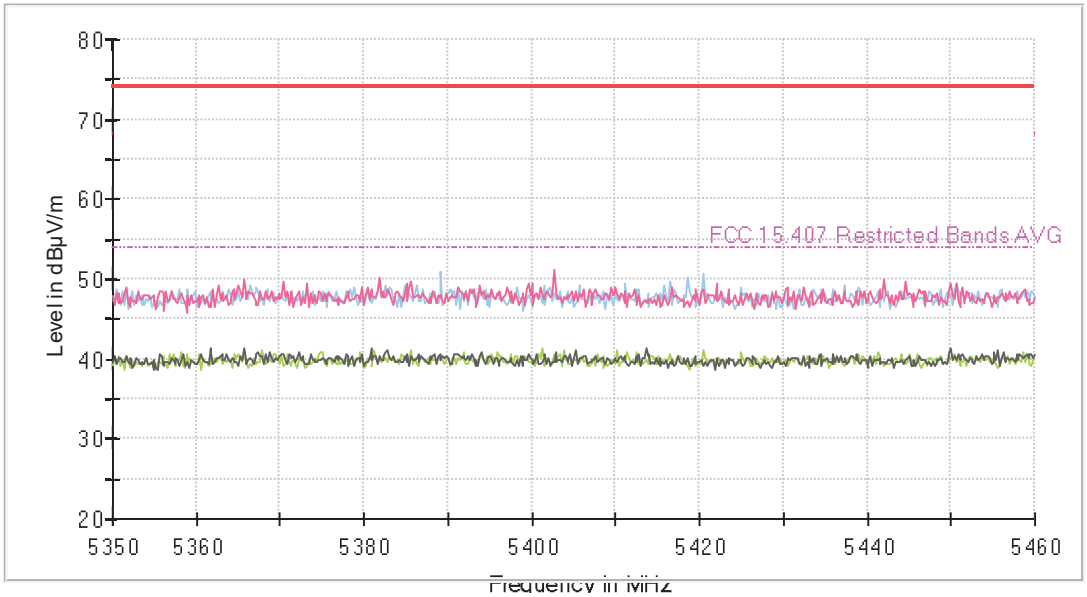
- Lower Band Edge Channel 42 (4500 to 5150 MHz)



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 42 (5350 to 5460 MHz)



Appendix C: Tests results for the U-NII-3 Band 5.725 – 5.85 GHz

INDEX

TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 12 Vdc

Type of Power Supply: DC voltage from external power supply (car battery).

ANTENNAS:

Type of Antenna: External.

Antennas Gain:

- SISO – CORE0_Port3 Antenna – Maximum Declared Antenna Gain: +2.5 dBi

TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a/n/ac): U-NII-3 band	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS7	
	802.11n HT40: MCS0 to MCS7	
	802.11ac VHT20: MCS0 to MCS8	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	SISO CORE0_Port3.	
Beamforming:	No	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 149	5745
	Middle: 157	5785
	Highest: 165	5825
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 151	5755
	Highest: 159	5795
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 155	5775

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode individually on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied scripts to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 802.11a20: 6 Mbits
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

WIFI FCC:

tx_test.sh -a wlan0 stop

a20 - Core0

tx_test.sh -a wlan0 149 0 -d x -r 6 20 –c US

tx_test.sh -a wlan0 157 0 -d x -r 6 20 -c US

tx_test.sh -a wlan0 165 0 -d x -r 6 20 -c US

n20 - Core0

tx_test.sh -a wlan0 149 0 -d x -h 0 20 -c US

tx_test.sh -a wlan0 157 0 -d x -h 0 20 -c US

tx_test.sh -a wlan0 165 0 -d x -h 0 20 -c US

ac20 - Core0

tx_test.sh -a wlan0 149 0 -d x -v 0 20 -c US

tx_test.sh -a wlan0 157 0 -d x -v 0 20 -c US

tx_test.sh -a wlan0 165 0 -d x -v 0 20 -c US

n40 - Core0

tx_test.sh -a wlan0 153 0 -d x -h 0 40 -c US

tx_test.sh -a wlan0 161 0 -d x -h 0 40 -c US

ac40 - Core0

tx_test.sh -a wlan0 153 0 -d x -v 0 40 -c US

tx_test.sh -a wlan0 161 0 -d x -v 0 40 -c US

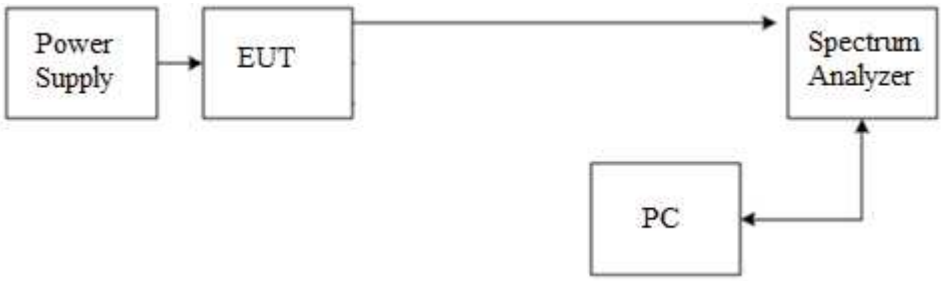
ac80 - Core0

tx_test.sh -a wlan0 161 0 -d x -v 0 80 -c US

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low loss RF cable. The reading in the spectrum analyzer is corrected taking into account the internal and external RF cable loss.

For all modes:



The DC supply voltage is applied using an external power supply.

RADIATED MEASUREMENTS:

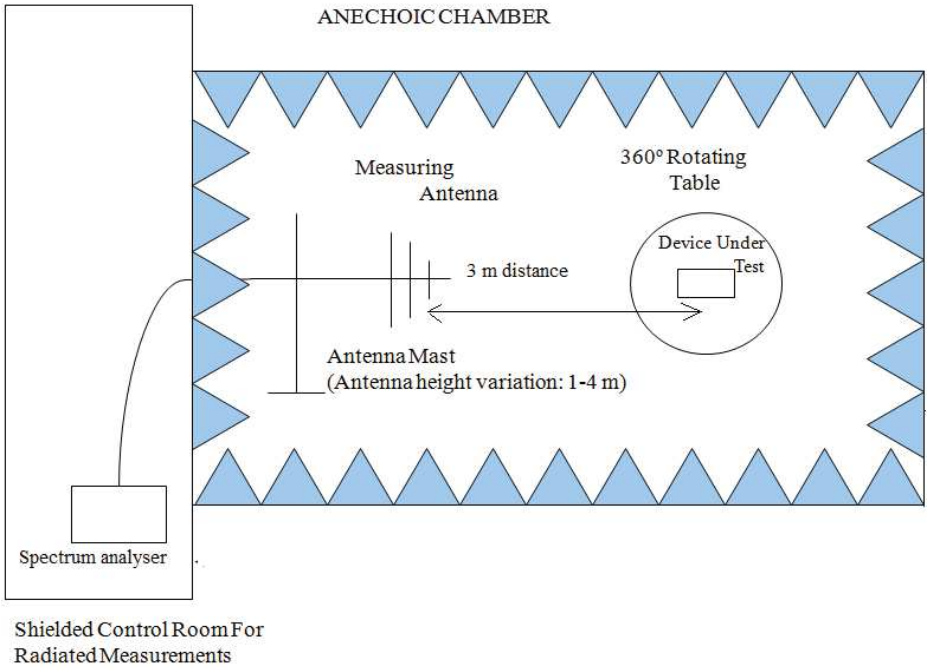
All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1 GHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m and at a distance of 1m for the frequency range 17 GHz-26 GHz (17 GHz-26 GHz horn antenna).

For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

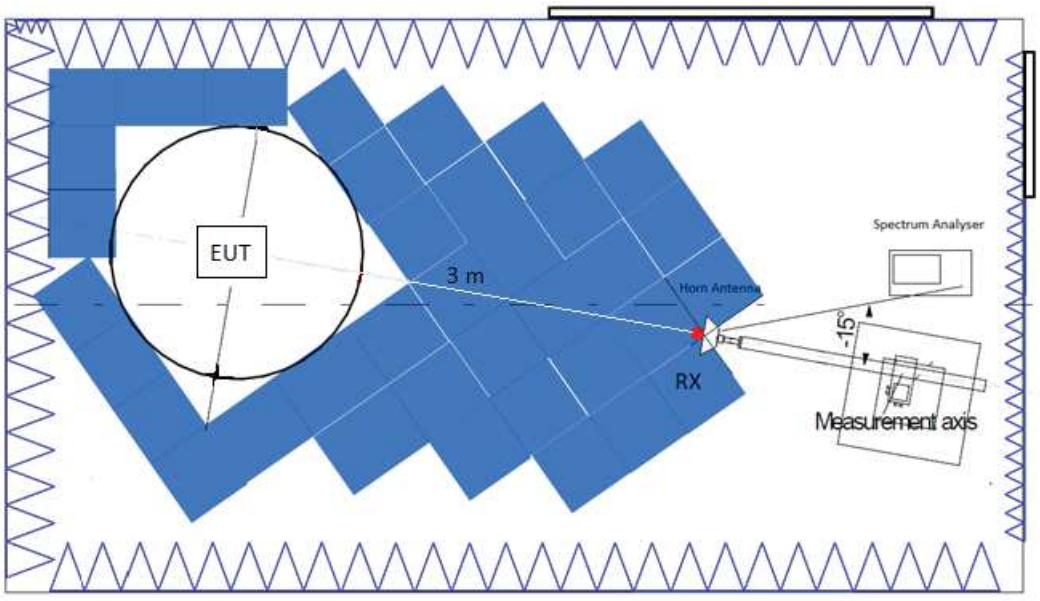
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

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

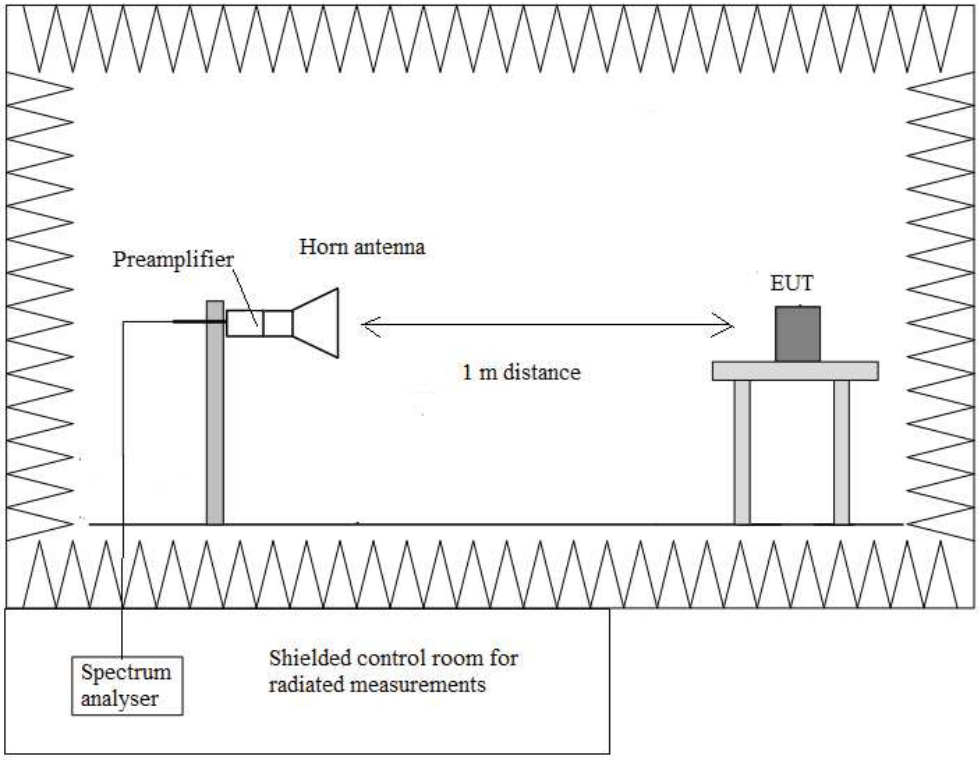
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 17 GHz:



FCC 15.407 (a)(3) / RSS-247 6.2.4.1. Maximum Conducted Output Power

SPECIFICATION:

FCC 15.407 / RSS-247: For the band 5.725-5.850 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30 dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RESULTS:

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is >98% and the channel power integration method according to point E) 2) d) (Method SA-2) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is <98%.

For data rates where the EUT was transmitting at <98% duty cycle, the duty calculated in Appendix A was added to the measured power in order to calculate the total average power during the actual transmission time.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

- SISO – CORE0_Port3 Antenna – Maximum Declared Antenna Gain: +2.5 dBi

For all modes of operation, the antenna gain is less than 6 dBi.

SISO – CORE0_Port3 Antenna:

- **802.11 a20:**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	10.64	10.19	10.19
Duty Cycle Correction Factor (dB)	0.98		
Max. Conducted Power Corrected (dBm)	11.62	11.17	11.17
Max. EIRP power Corrected (dBm)	14.12	13.67	13.67
Measurement uncertainty (dB)	<±2.57		

- **802.11 n20:**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	10.47	10.12	10
Duty Cycle Correction Factor (dB)	1.05		
Max. Conducted Power Corrected (dBm)	11.52	11.17	11.05
Max. EIRP power Corrected (dBm)	14.02	13.67	13.55
Measurement uncertainty (dB)	<±2.57		

- **802.11 n40:**

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	9.29	9.23
Duty Cycle Correction Factor (dB)	1.94	
Max. Conducted Power Corrected (dBm)	11.23	11.17
Max. EIRP power Corrected (dBm)	13.73	13.67
Measurement uncertainty (dB)	<±2.57	

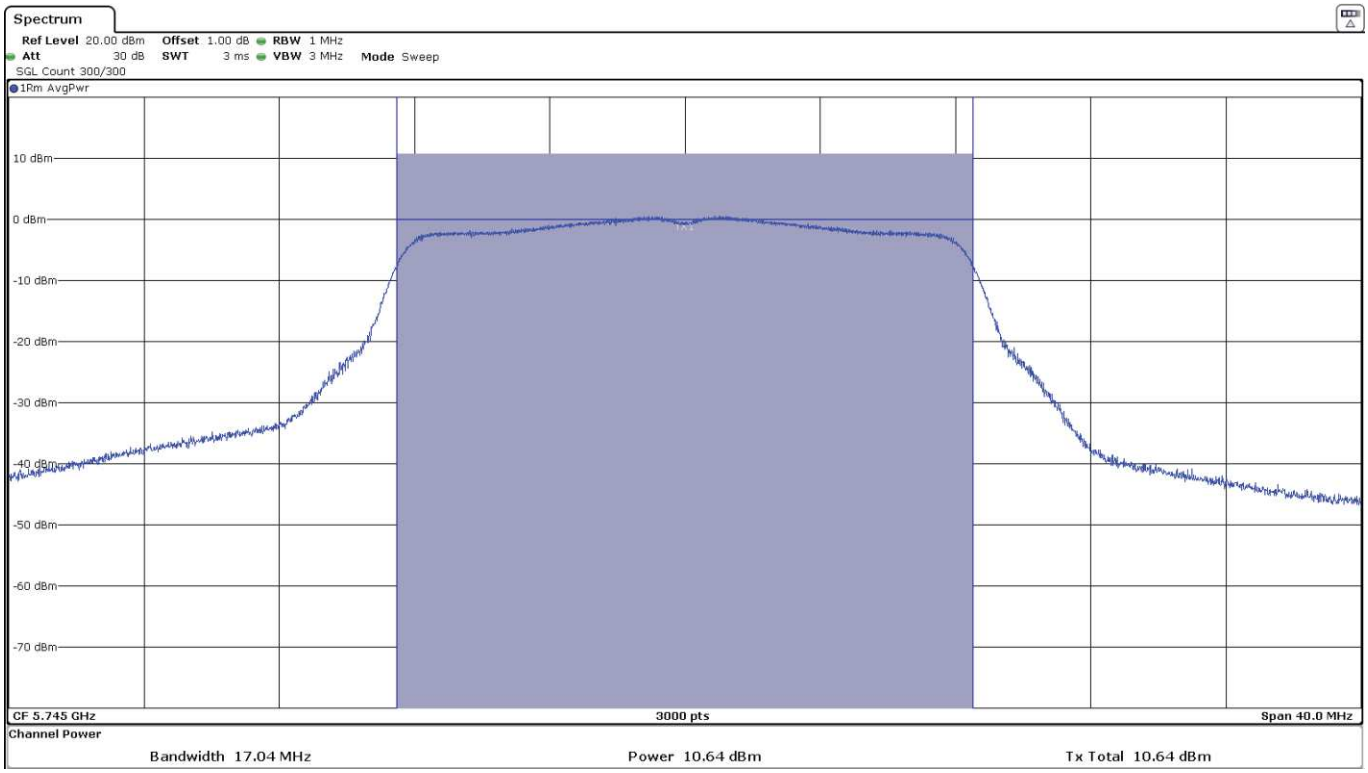
- **802.11 ac80:**

	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	7.7
Duty Cycle Correction Factor (dB)	3.30
Max. Conducted Power Corrected (dBm)	11
Max. EIRP power Corrected (dBm)	13.50
Measurement uncertainty (dB)	<±2.57

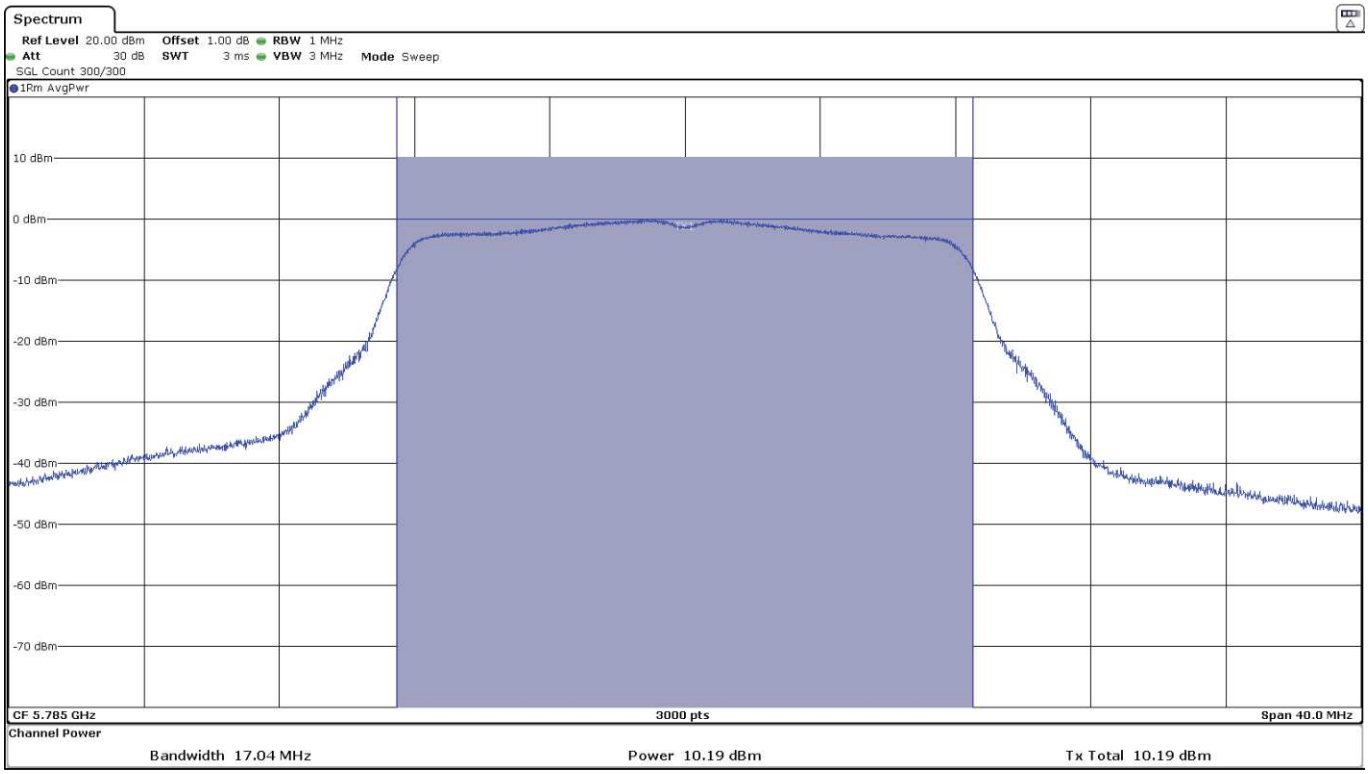
Verdict: PASS

- **802.11 a20:**

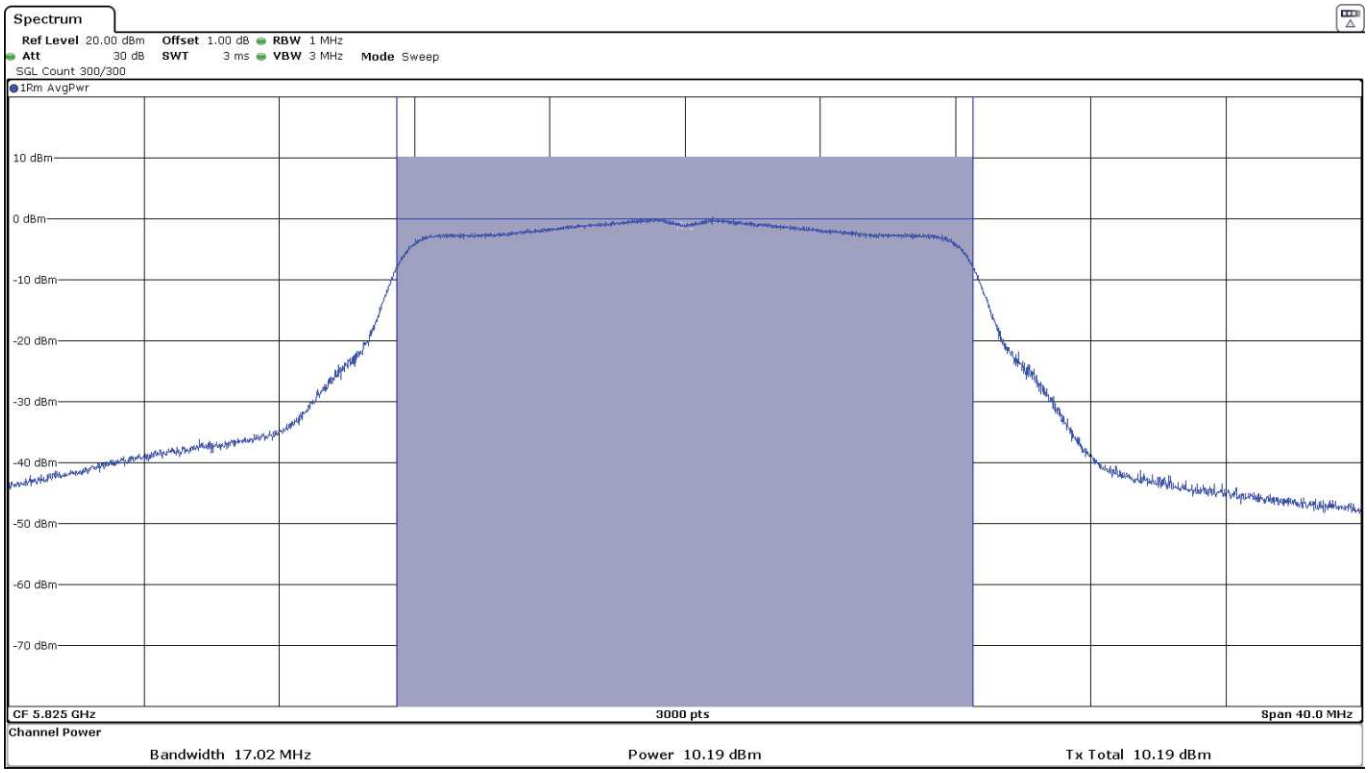
- Low Channel 149:



- Middle Channel 157:

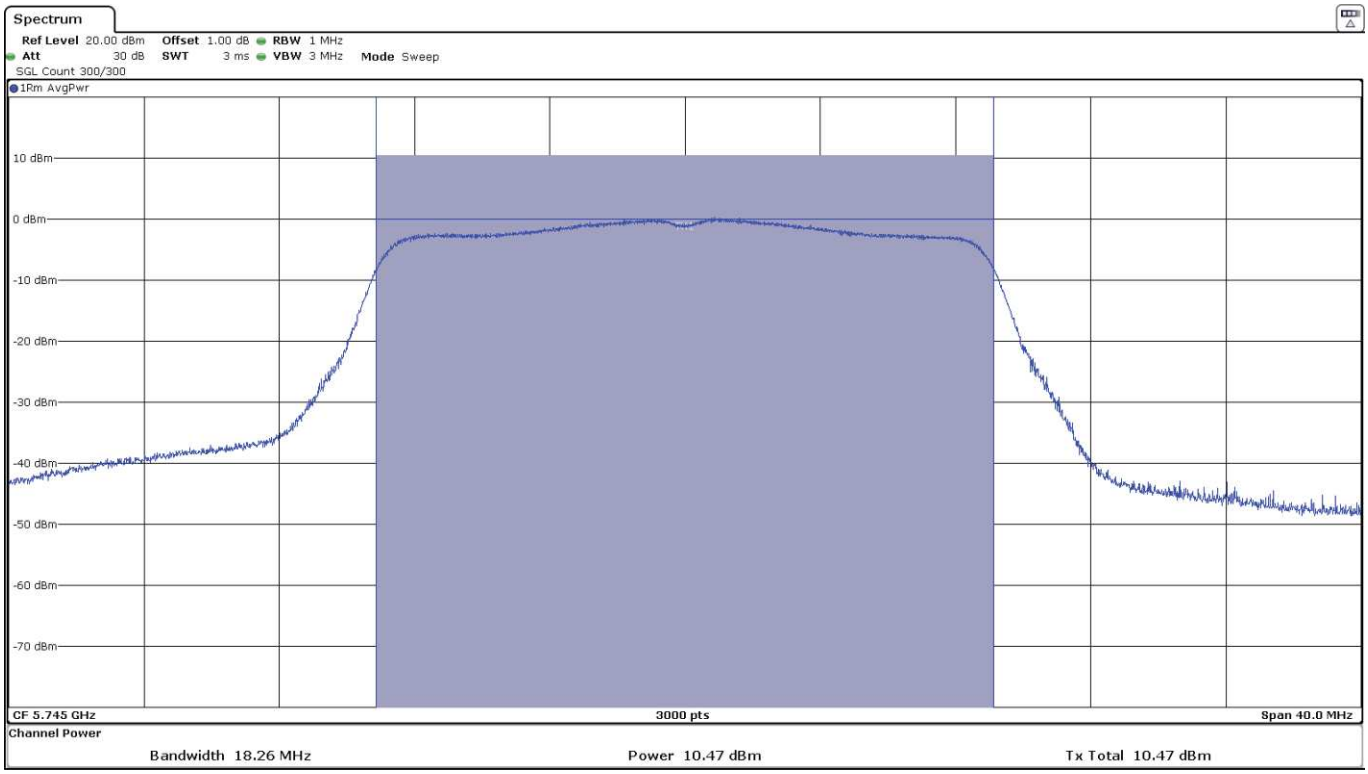


- High Channel 165:

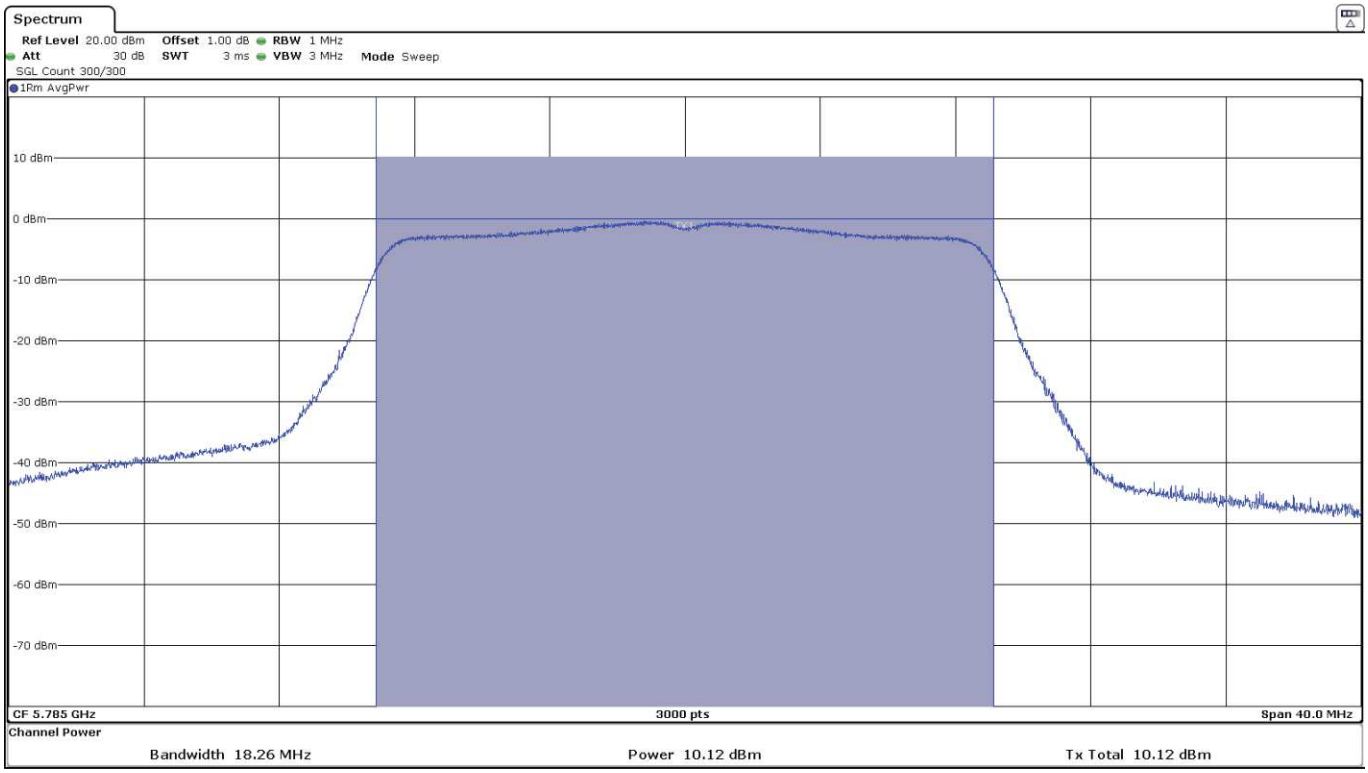


- **802.11 n20:**

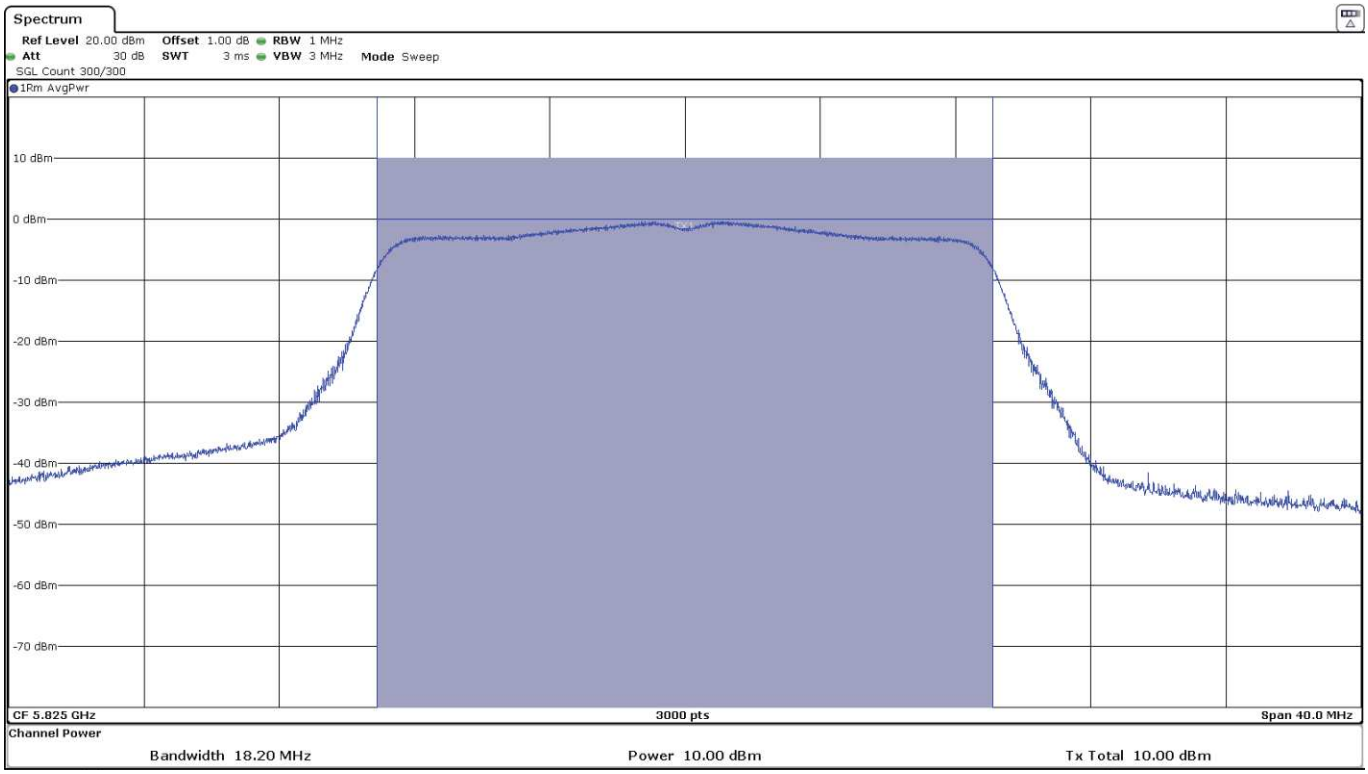
- Low Channel 149:



- Middle Channel 157:

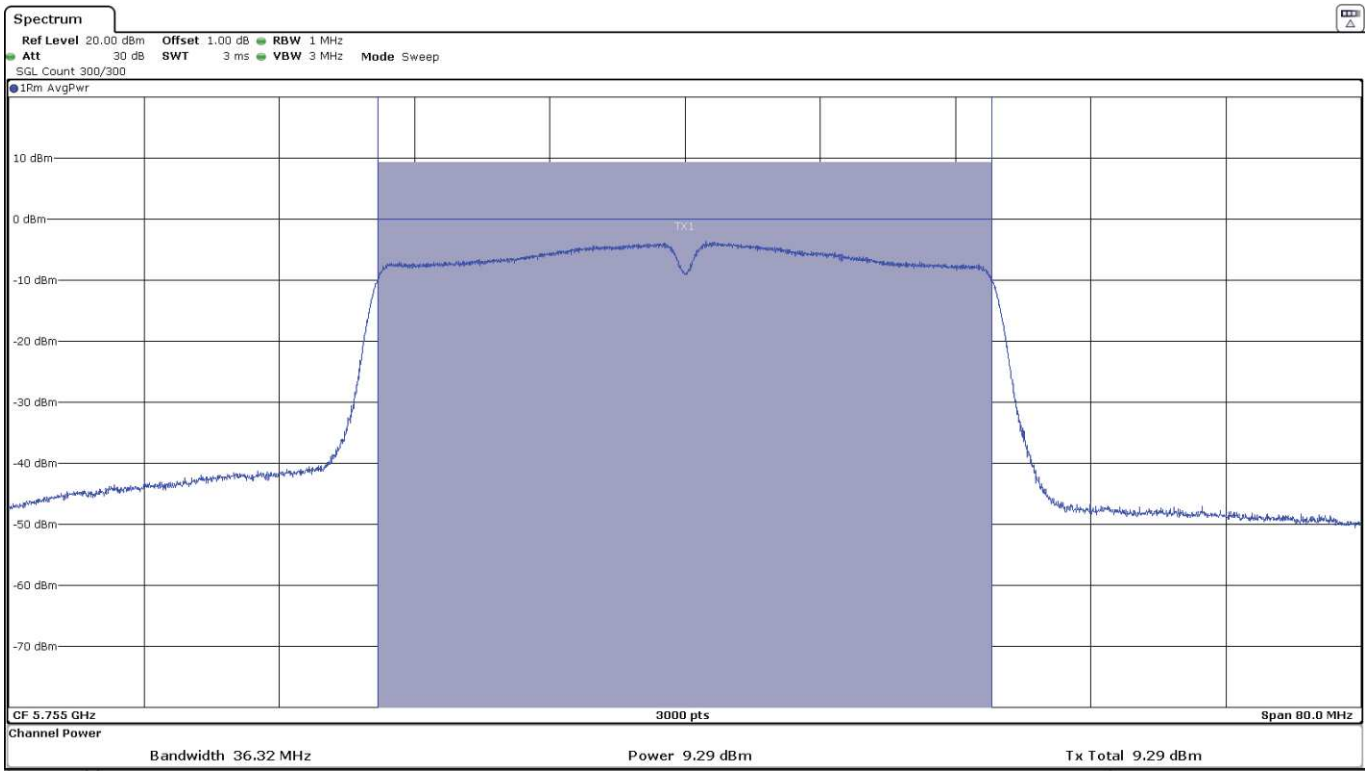


- High Channel 165:

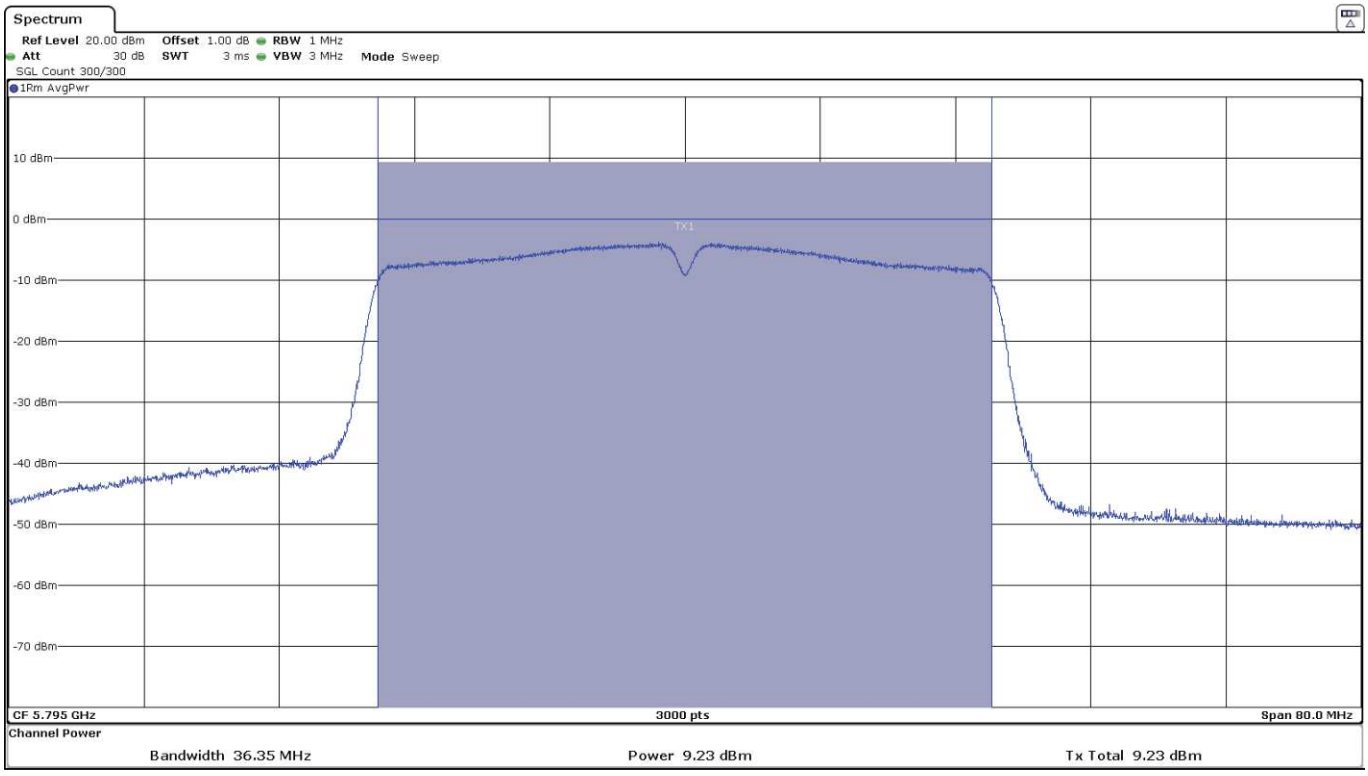


- **802.11 n40:**

- Low Channel 151:

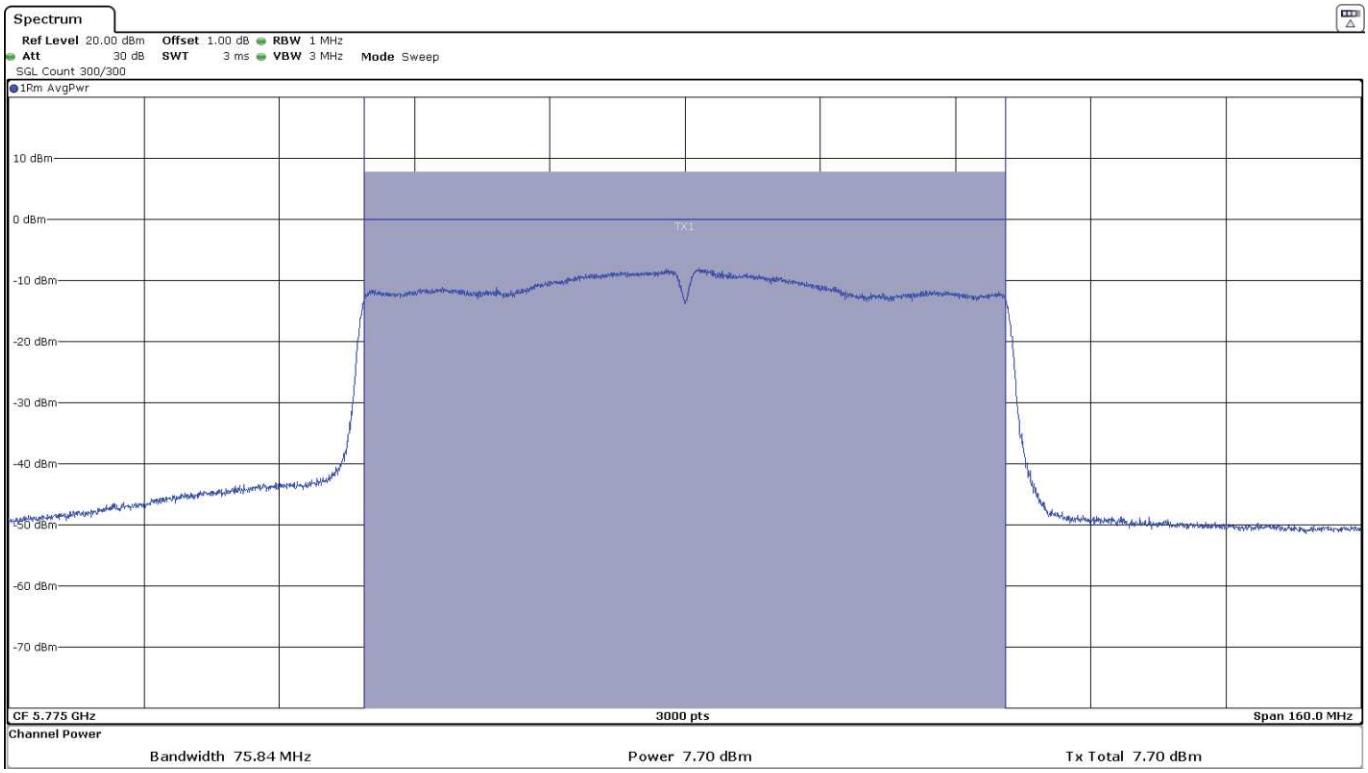


- High Channel 159:



- **802.11 ac80:**

- Single Channel 155:



FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2. Out of Band Radiated Emissions and Band Edge Radiated Emissions

SPECIFICATION:

For transmitters operating in the 5.725–5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz (68.23 dBµV/m at 3 m distance) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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 360º 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 17 – 40 GHz and a distance of 3m for frequency range 30 MHz – 17 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.

SISO – CORE0_Port3 Antenna:

Frequency range 30 MHz - 1 GHz:

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

Spurious frequencies operating (radiated) detected at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
374.980500	28.76	46	V	Quasi-Peak	<±5.08

Frequency range 1 - 40 GHz:

The results in the next tables show the maximum measured levels in the 1-40 GHz range including the 5.650 - 5.725 GHz and 5.850 - 5.925 GHz adjacent bands (see following plots).

Spurious frequencies 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.

OUT OF BAND EMISSIONS: For outside emissions of the band 5.65 - 5.925 GHz, the OFDM worst mode case was determined after preliminary measurements. It was tested in the Low, Middle and High Channels.

BAND EDGE EMISSIONS: For band edge emissions of the bands 5.65 – 5.725 and 5.850 - 5.925 GHz, all modes were tested in the Low Middle and High Channels.

OUT OF BAND EMISSIONS. Spurious emissions out of 5.65 - 5.925 GHz:

- **802.11 a20 (worst case):**

- Low Channel:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.48767	60.34	68.23	H	Peak	<± 5.13

- Middle Channel:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.573	56.69	68.23	H	Peak	<± 5.13

- High Channel:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.64567	55.95	68.23	H	Peak	<± 5.13
39.67263	56.82	68.23	H	Peak	<± 5.14

Measurement Uncertainty (dB): 1GHz-7GHz <±4.11
17GHz-26GHz <±4.82

Verdict: PASS

BAND EDGE EMISSIONS. Spurious band edge emissions inside 5.65 – 5.925 GHz:

- **802.11 a20 (worst case):**

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

- **802.11 n20:**

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

- **802.11 ac20:**

- Low Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

- **802.11 n40:**

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

- **802.11 ac40:**

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

- **802.11 ac80:**

- Single Channel 155 (5775 MHz):

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

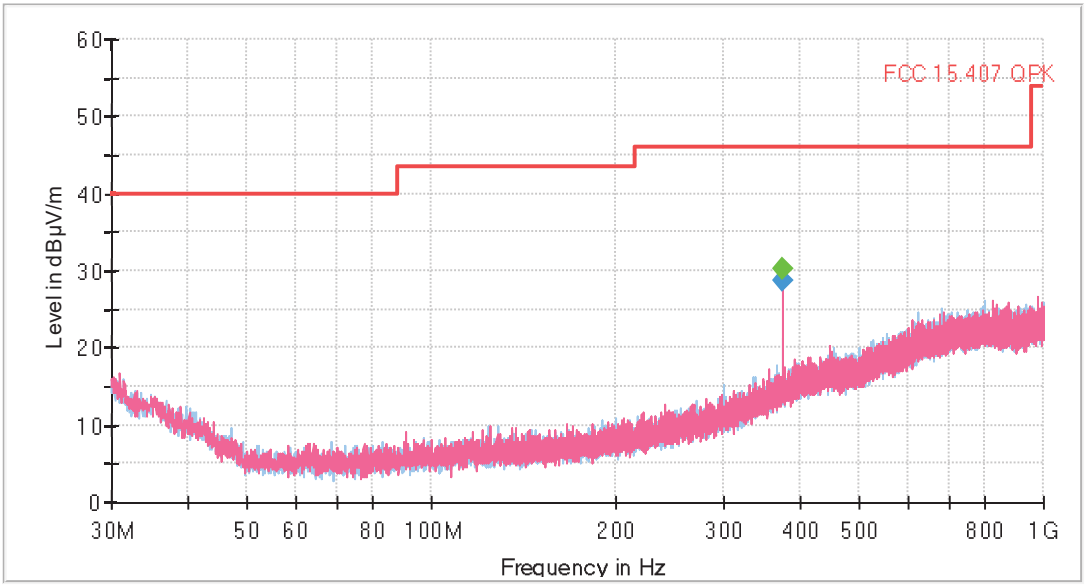
Verdict: PASS

SISO – CORE0_Port3 Antenna:

OUT OF BAND EMISSIONS:

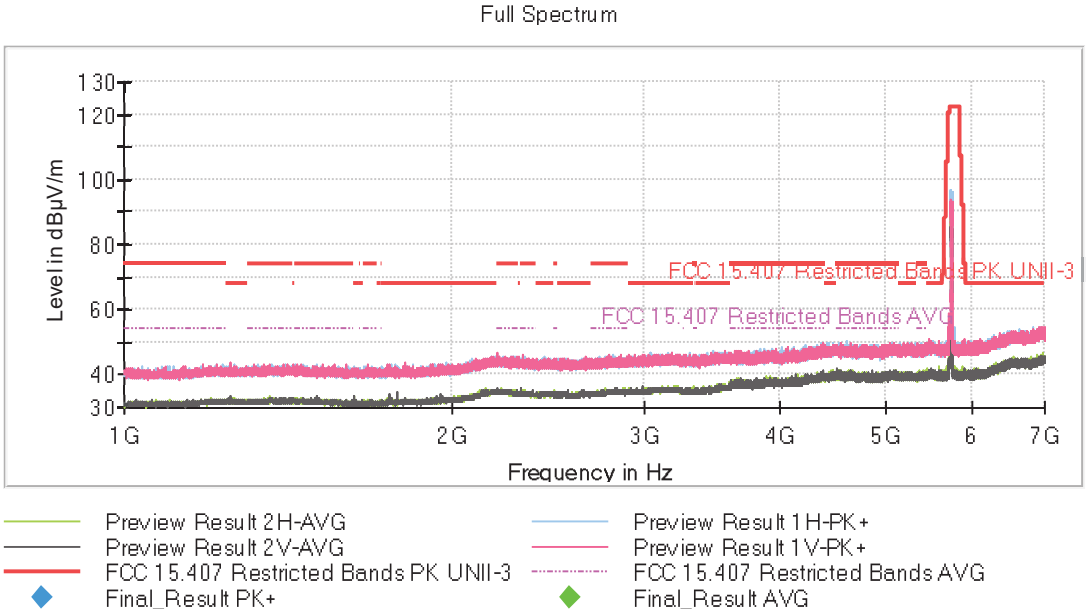
FREQUENCY RANGE 30 MHz - 1 GHz (worst case)

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

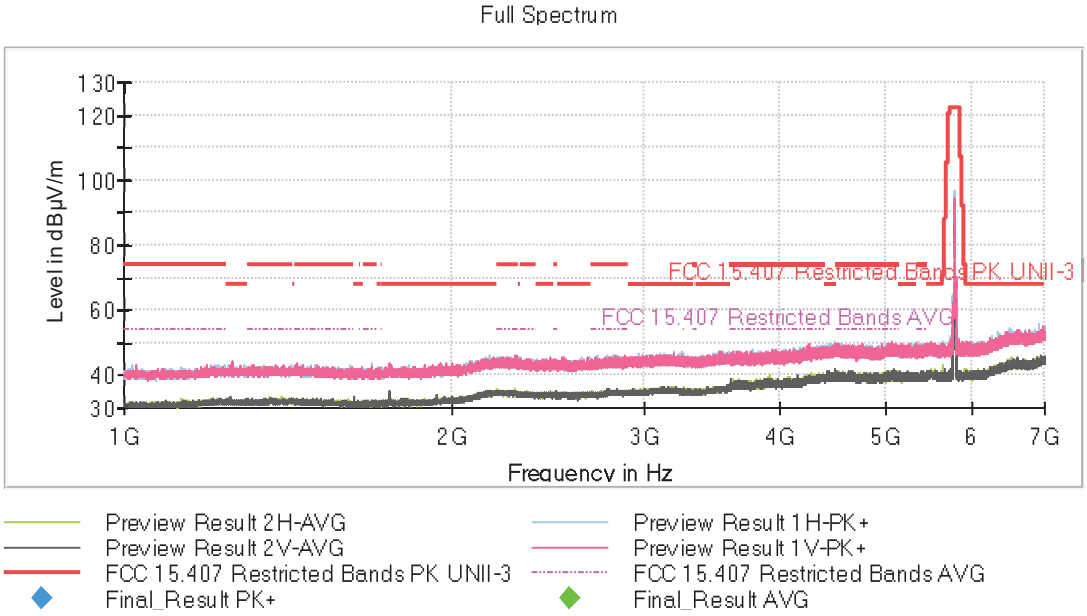


FREQUENCY RANGE 1 – 7 GHz (worst case)

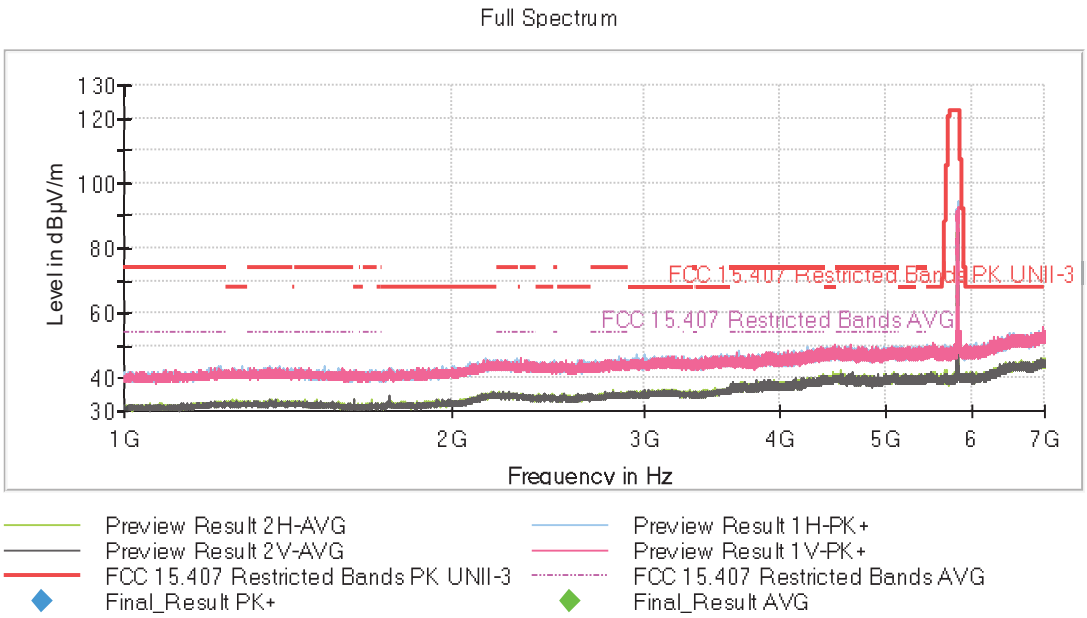
- Low Channel:



- Middle Channel:

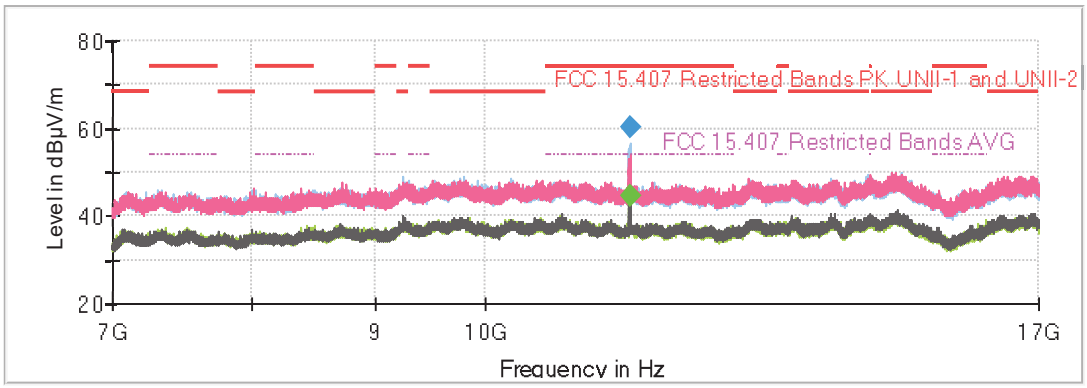


- High Channel:



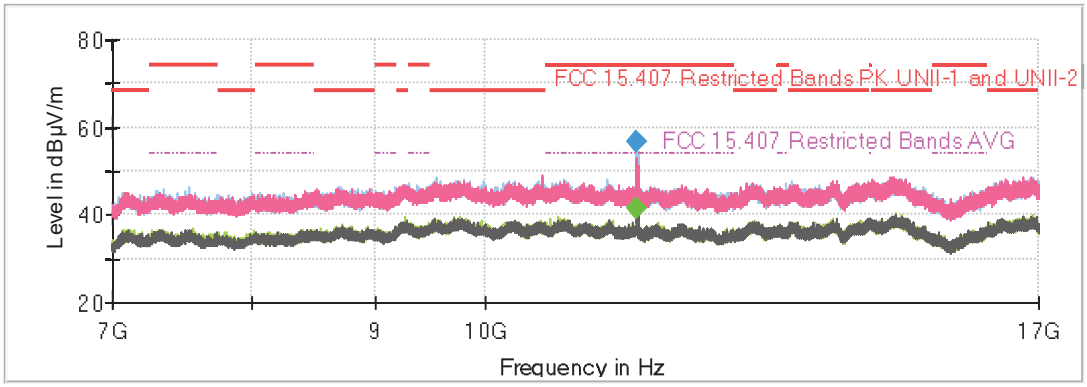
FREQUENCY RANGE 7 - 17 GHz (worst case)

- Low Channel:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG

- Middle Channel:



Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC 15.407 Restricted Bands PK UNII-1 and UNII-2
FCC 15.407 Restricted Bands AVG
Final_Result PK+
Final_Result AVG