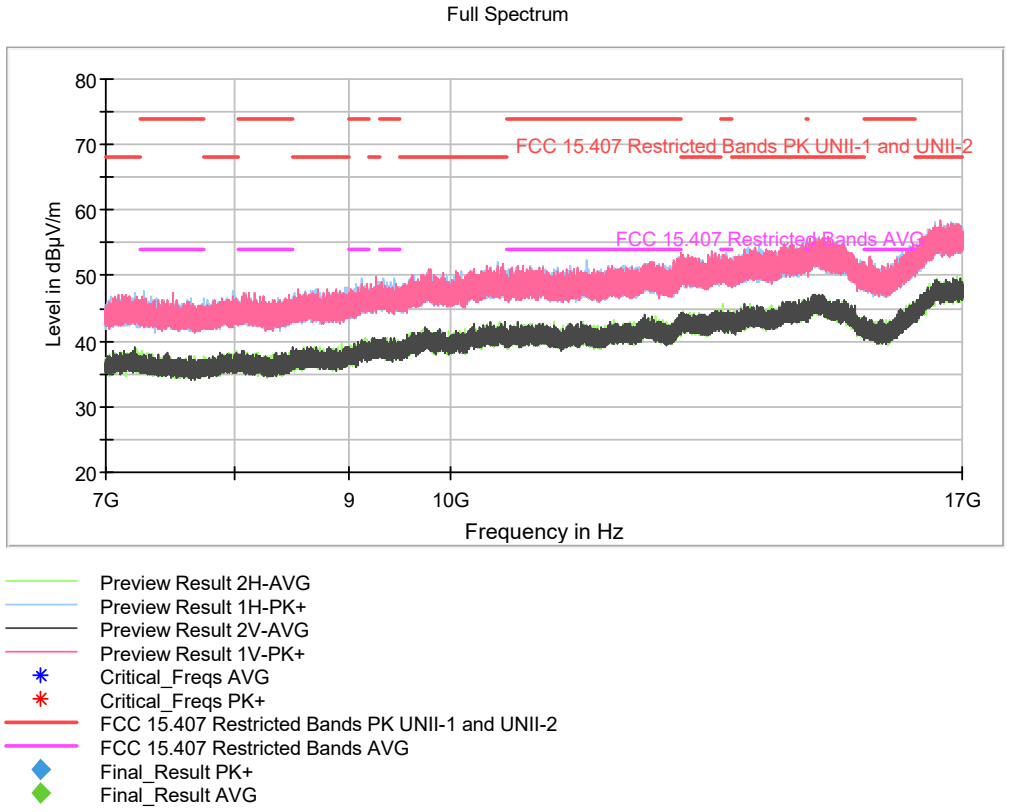
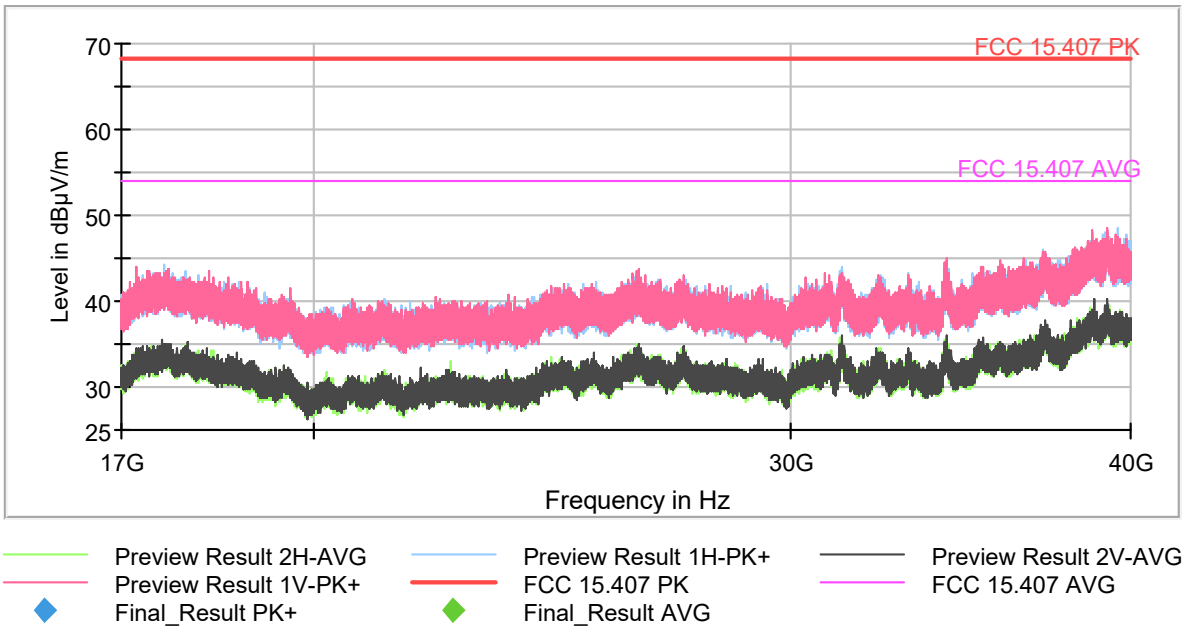
- High Channel:



FREQUENCY RANGE 17 - 40 GHz:

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



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)
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 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: For U-NII-1 band edge spurious emissions inside of the Restricted Bands: 4.50-5.15 GHz and 5.35-5.46 GHz.
The lower Band Edge and the Upper Band Edge Channel were tested for all modes.

The next results are for the FCC power adjustment. The RSS power adjustment is lower, hence results also comply with the applicable standards.

- **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)
5.1475	58.12	H	Peak	<± 4.60
	44.16		Average	

- 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)
5.1471	56.73	H	Peak	<± 4.60
	42.94		Average	

- 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)
5.1429	59.15	H	Peak	<± 4.60
	45.71		Average	

- 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)
5.1498	68.74	H	Peak	<± 4.60
	50.92		Average	

- 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)
5.1486	68.53	H	Peak	<± 4.60
	47.49		Average	

- 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)
5.0941	61.05	H	Peak	<± 4.60
	44.59		Average	
5.1352	66.02	H	Peak	<± 4.60
	50.16		Average	

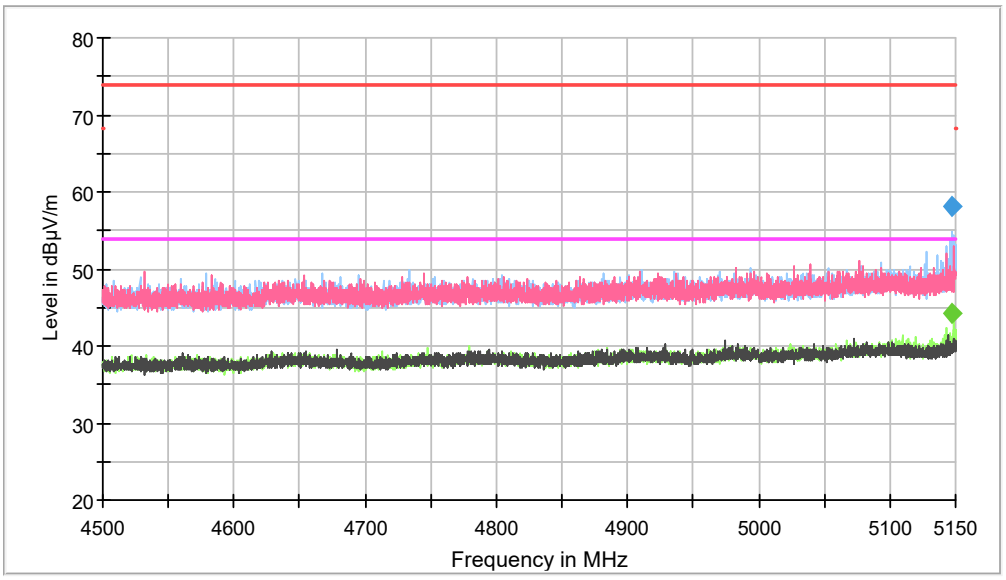
- Upper Band Edge Channel 42 (5210 MHz). Inside the Restricted Band 5.35-5.46 GHz:

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

Verdict: PASS

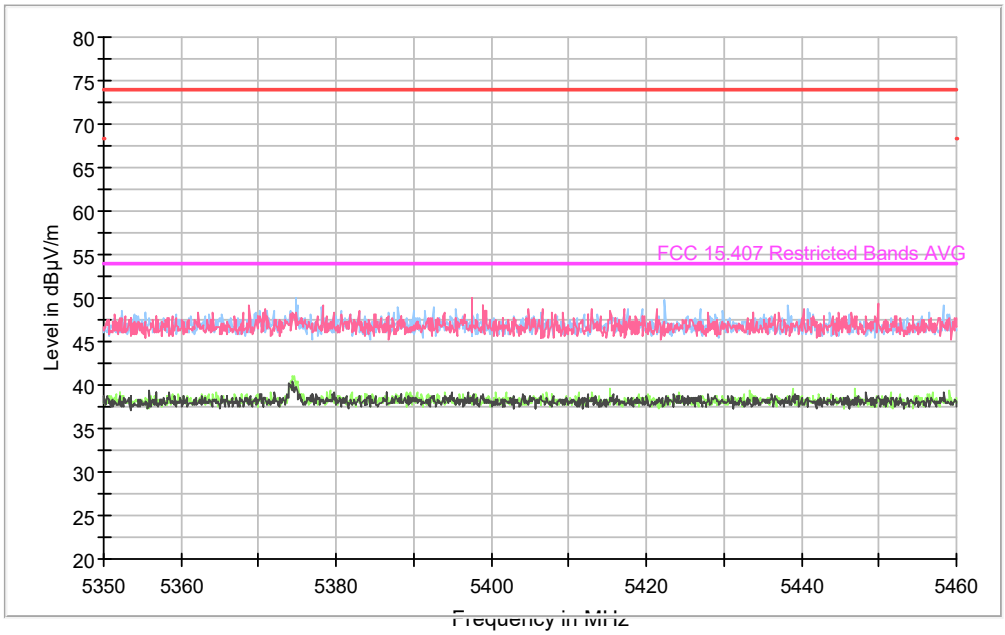
- **802.11 a20:**

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



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

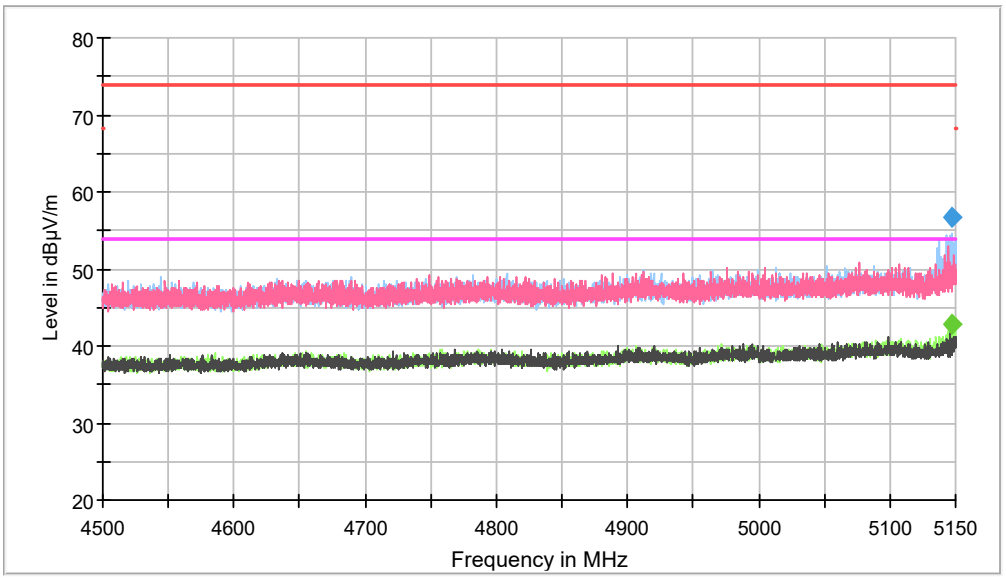
- Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz



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

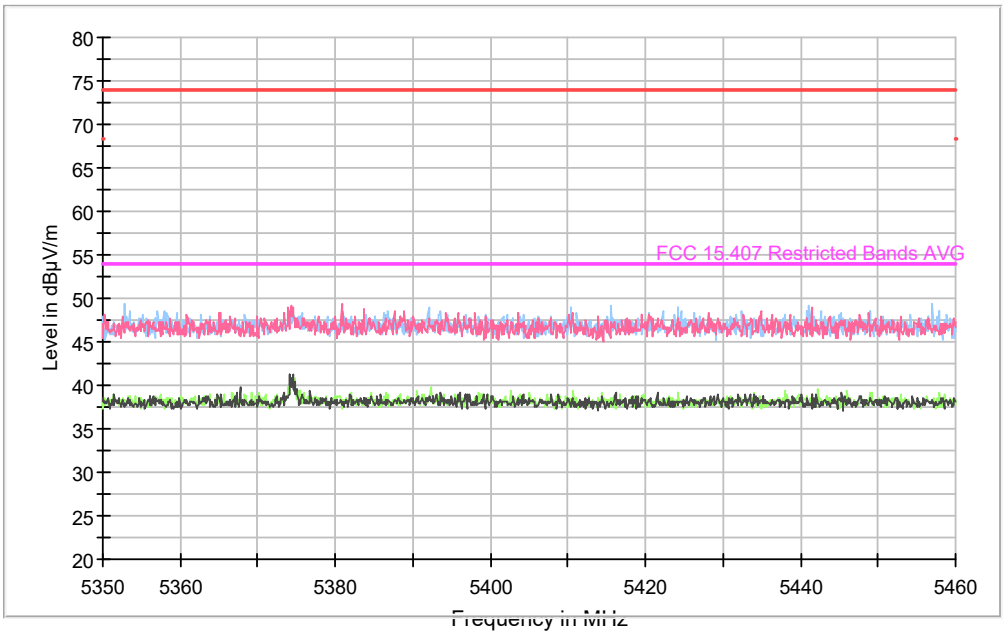
- **802.11 n20:**

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



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

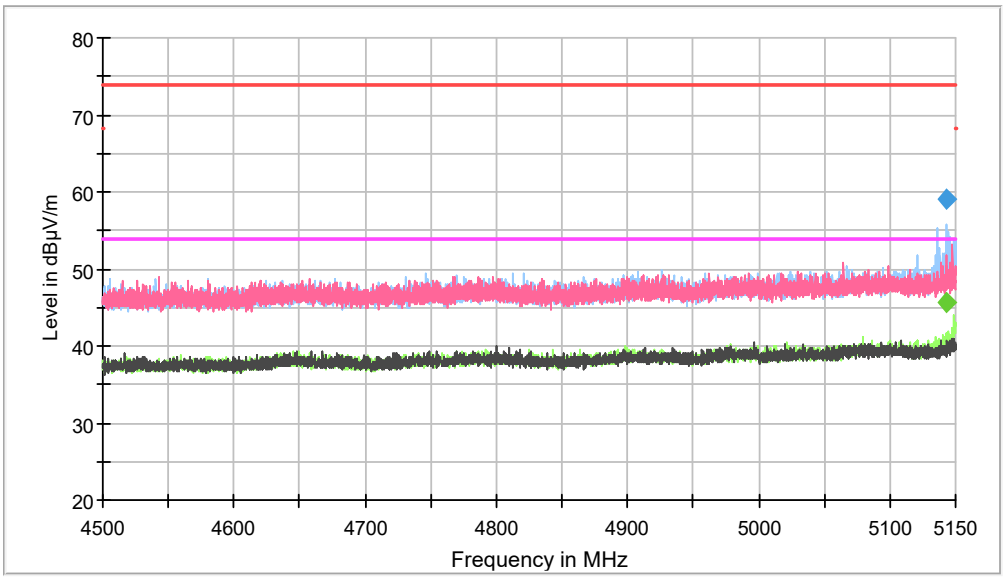
- Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)



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

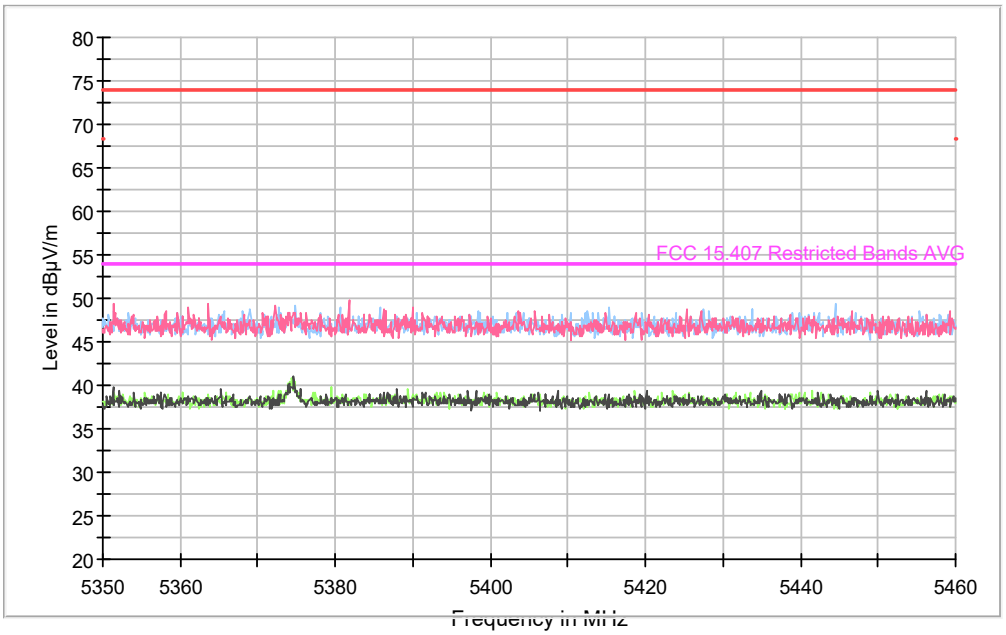
- **802.11 ac20:**

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



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

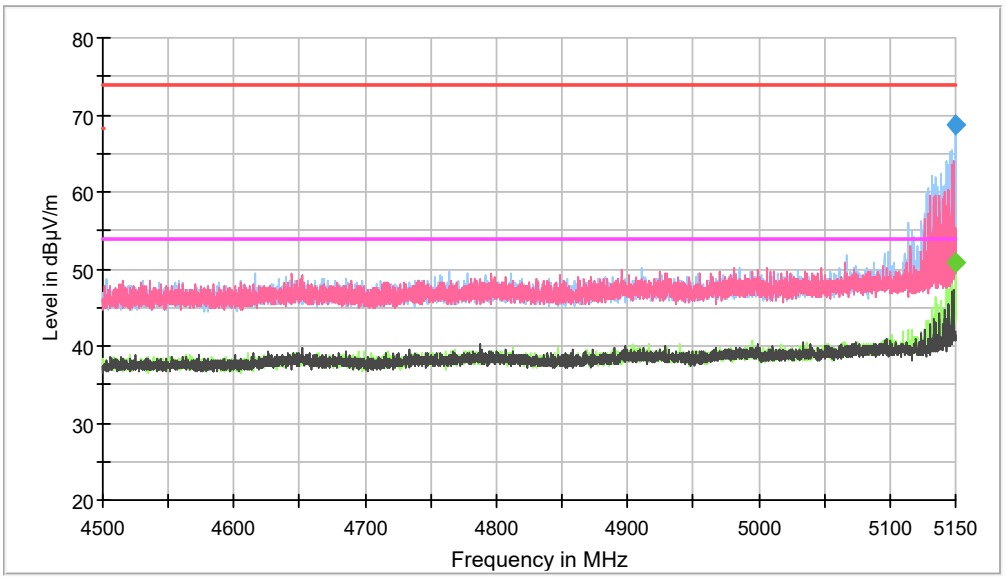
- Upper Band Edge Channel 48 (Restricted Band 5.35-5.46 GHz)



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

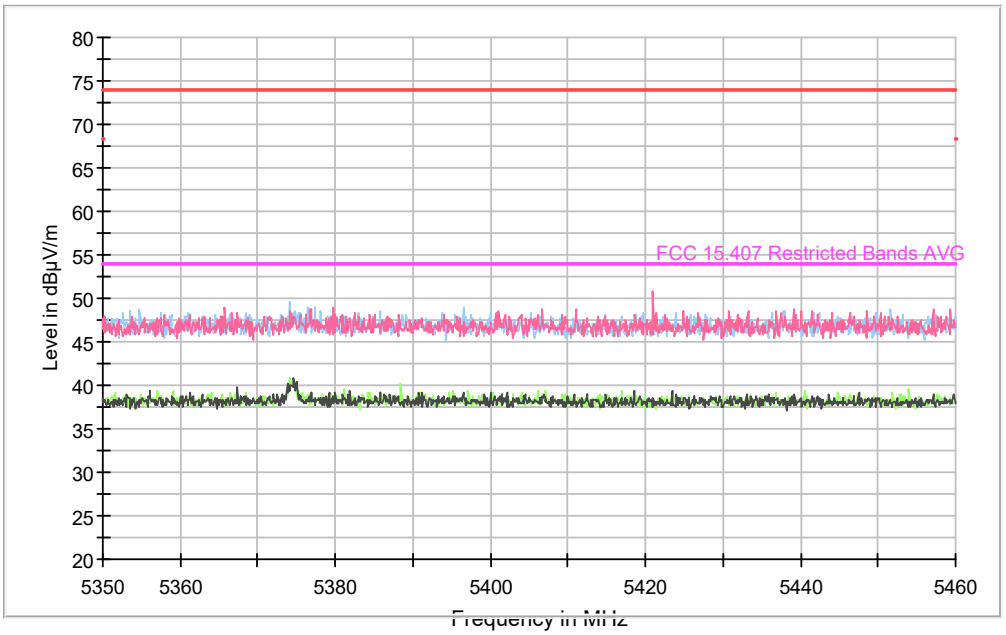
- **802.11 n40:**

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



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

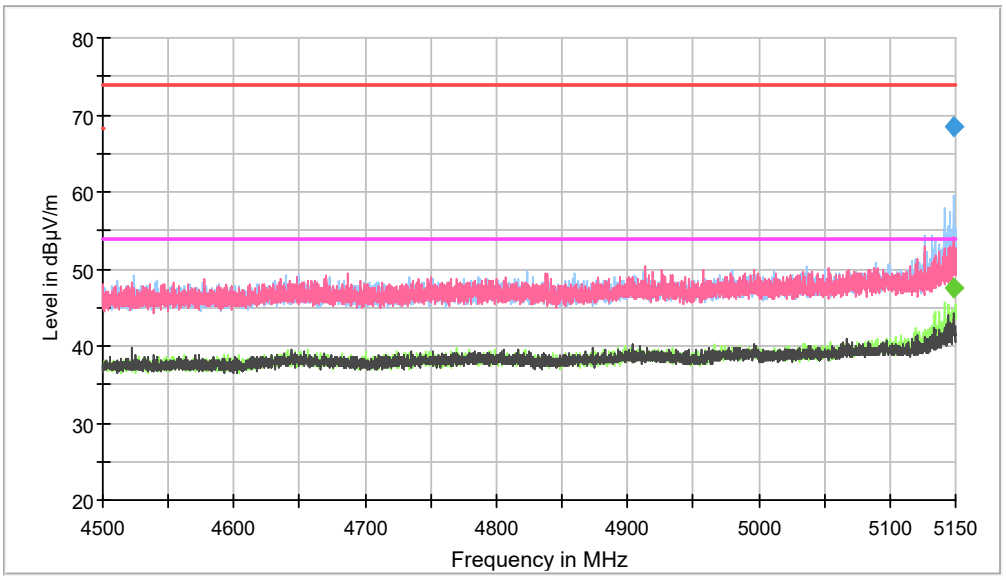
- Upper Band Edge Channel 46 (Restricted Band 5.35-5.46 GHz)



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

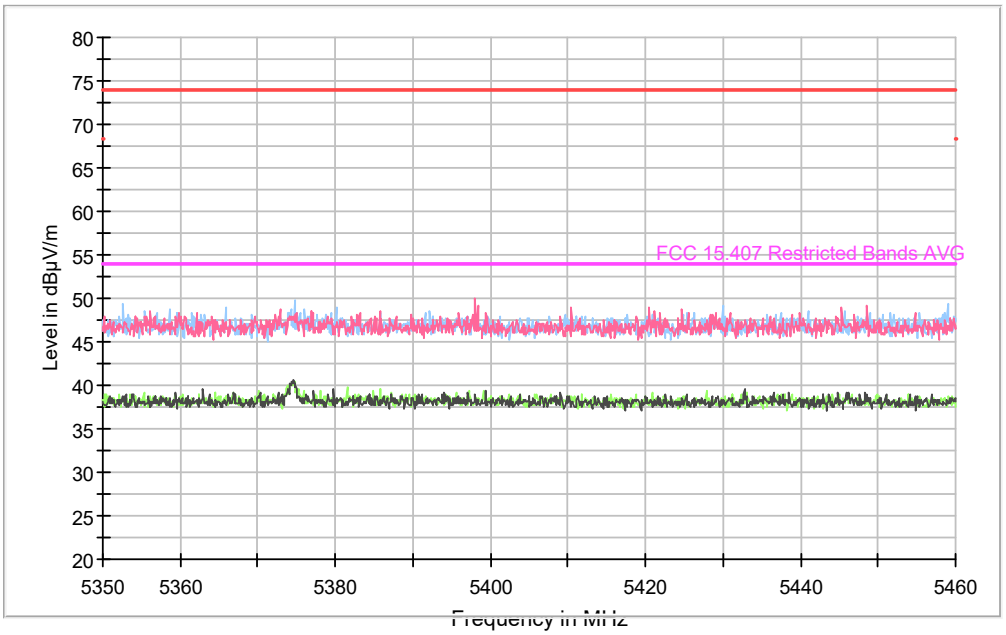
- **802.11 ac40:**

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



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

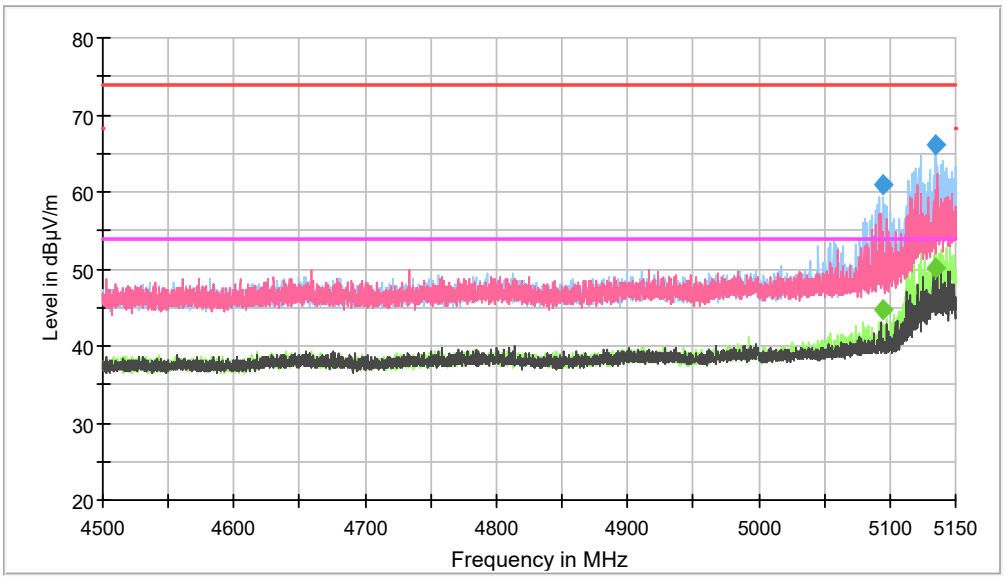
- Upper Band Edge Channel 46 (Restricted Band 5.35-5.46 GHz)



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

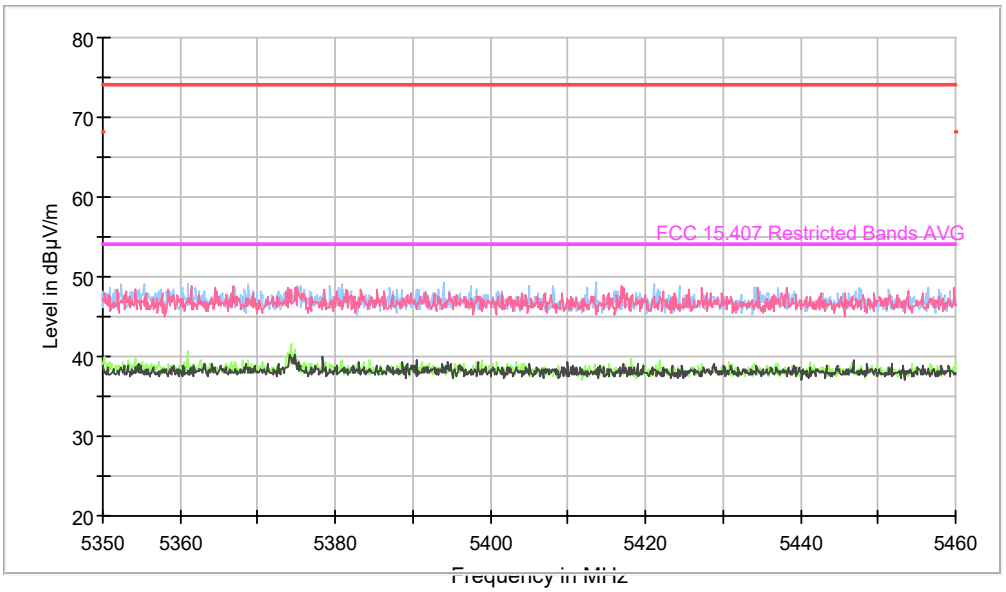
- **802.11 ac80:**

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



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

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



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

Appendix C: Test 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 External (Car Battery).

ANTENNA:

Type of Antenna: External.

Maximum Declared Antenna Gain: +0.90 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:	One port.	
Beamforming:	No	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 149	5745
	Middle: 157	5785
	High: 165	5825
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 151	5755
	High: 159	5795
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 155	5775

POWER SETTING (*):

UNII-3 FCC & Canada:

Channel	Frequency	11a	11n	11ac
149	5745 MHz	16	16	16
157	5785 MHz	16	16	16
165	5825 MHz	17	17	17
151	5755 MHz		16	16
159	5795 MHz		16	16
155	5775 MHz			16

The test set-up was made in accordance to the general provisions of ANSI C63.10: 2013 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated 12/14/2017.

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.

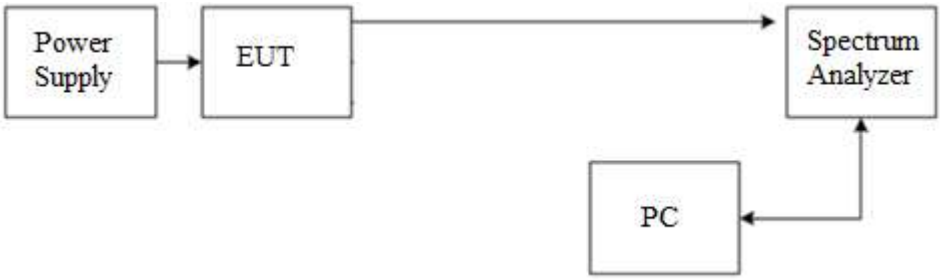
The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 802.11a20: 6 Mbit/s
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

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 1000 MHz) and 1 GHz-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1m for the frequency range 17 GHz-40 GHz (18 GHz-40 GHz horn antenna).

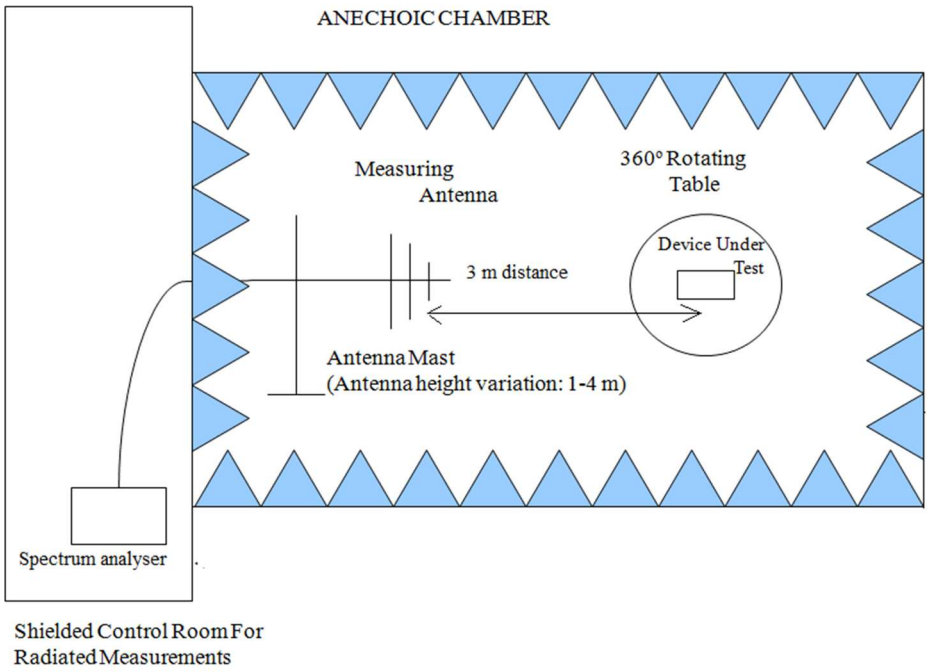
For radiated emissions in the range 17 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

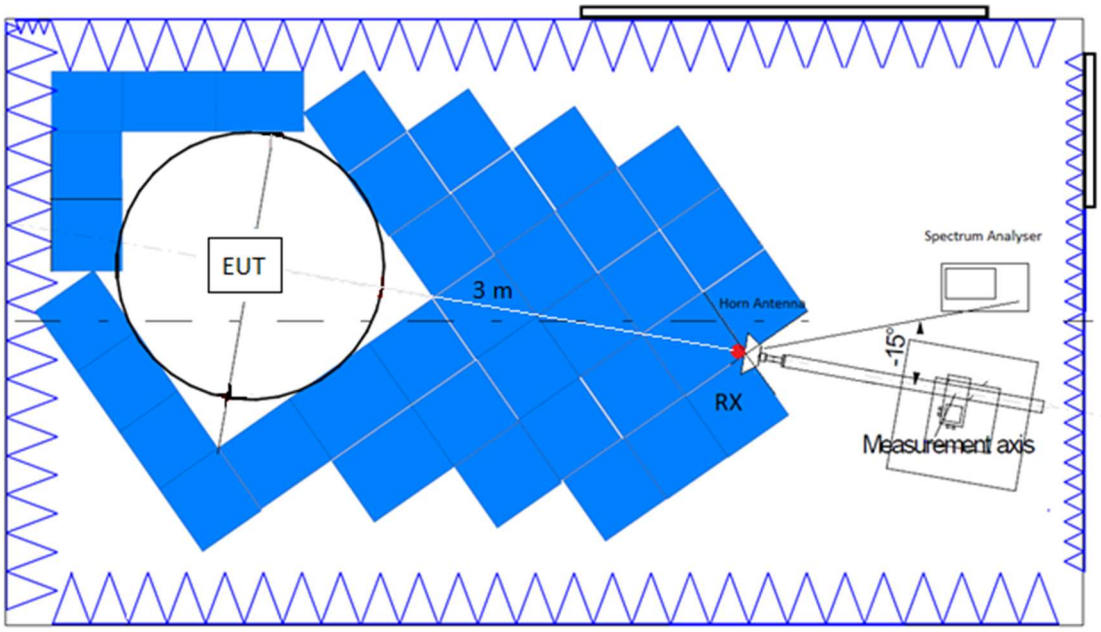
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

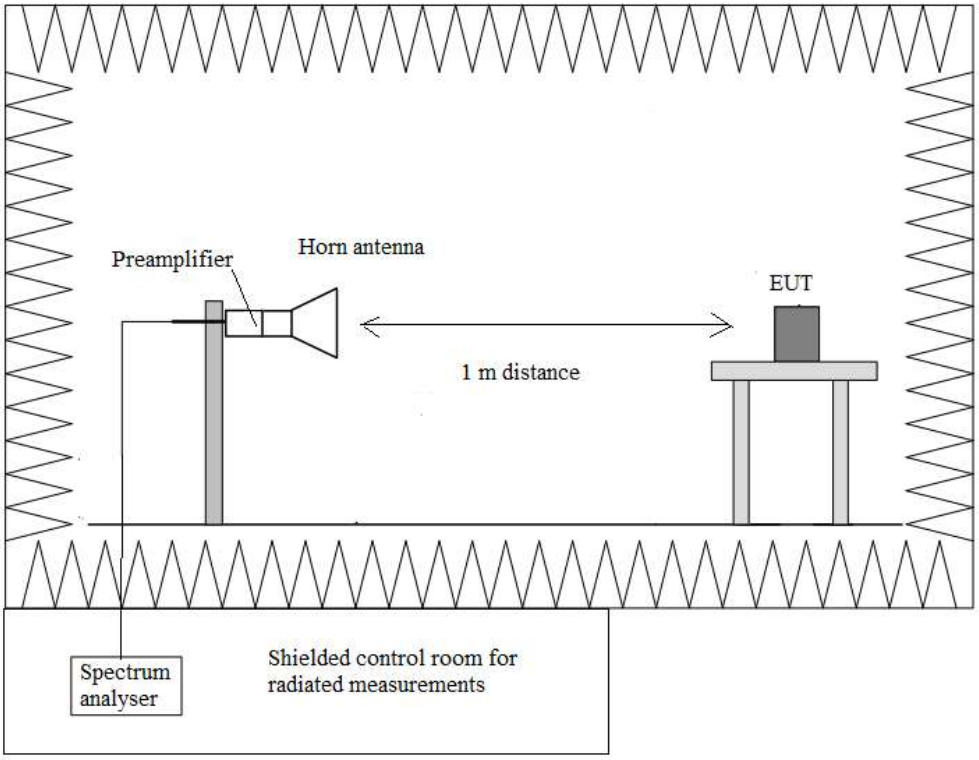
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup f > 17 GHz:



FCC 15.247 (e) / RSS-247 6.2.4.1. 6 dB Bandwidth

SPECIFICATION:

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

The following modes and data rates were selected based on preliminary testing that identified those corresponding to the worst cases:

- 802.11a20: 6 Mbit/s
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT80: MCS0

Mode 802.11 a20:

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	16.40	16.45	16.45
Measurement uncertainty (%)	<±1.17		

Mode 802.11 n20 (HT20):

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	17.40	17.40	17.40
Measurement uncertainty (%)	<±1.17		

Mode 802.11 ac20 (VHT20):

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	17.30	17.40	17.35
Measurement uncertainty (%)	<±1.17		

Mode 802.11 n40 (HT40):

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
6 dB Bandwidth (MHz)	35.55	35.90
Measurement uncertainty (%)	<±1.17	

Mode 802.11 ac40 (VHT40):

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
6 dB Bandwidth (MHz)	35.55	35.90
Measurement uncertainty (%)	<±1.17	

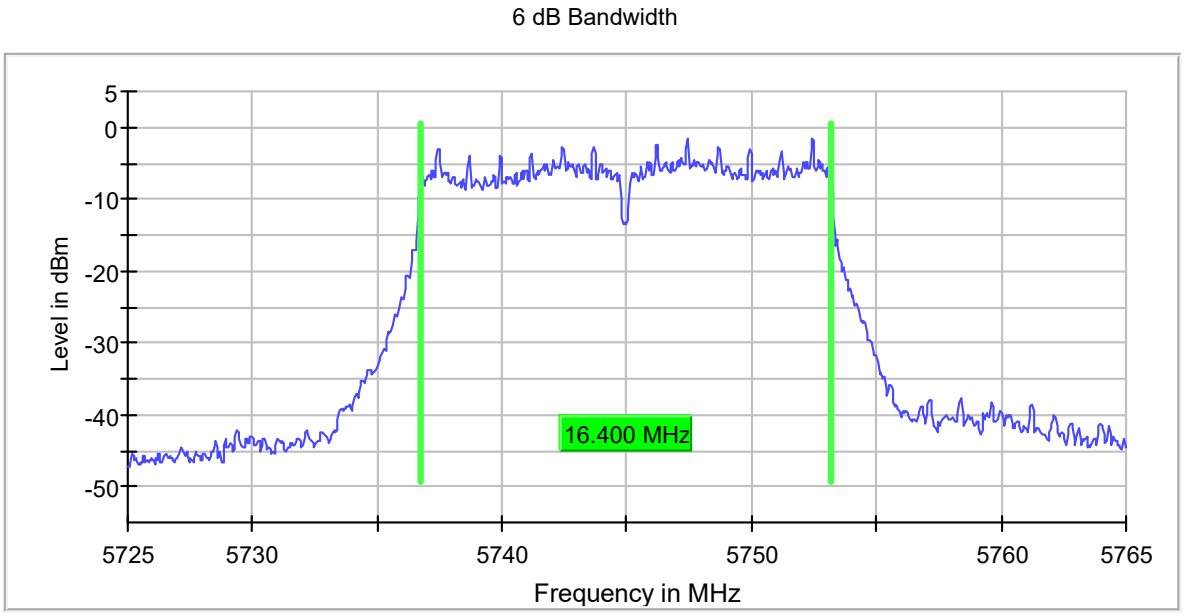
Mode 802.11 ac80 (VHT80):

	Single Channel 155 (5775 MHz)
6 dB bandwidth (MHz)	76.15
Measurement uncertainty (%)	<±1.17

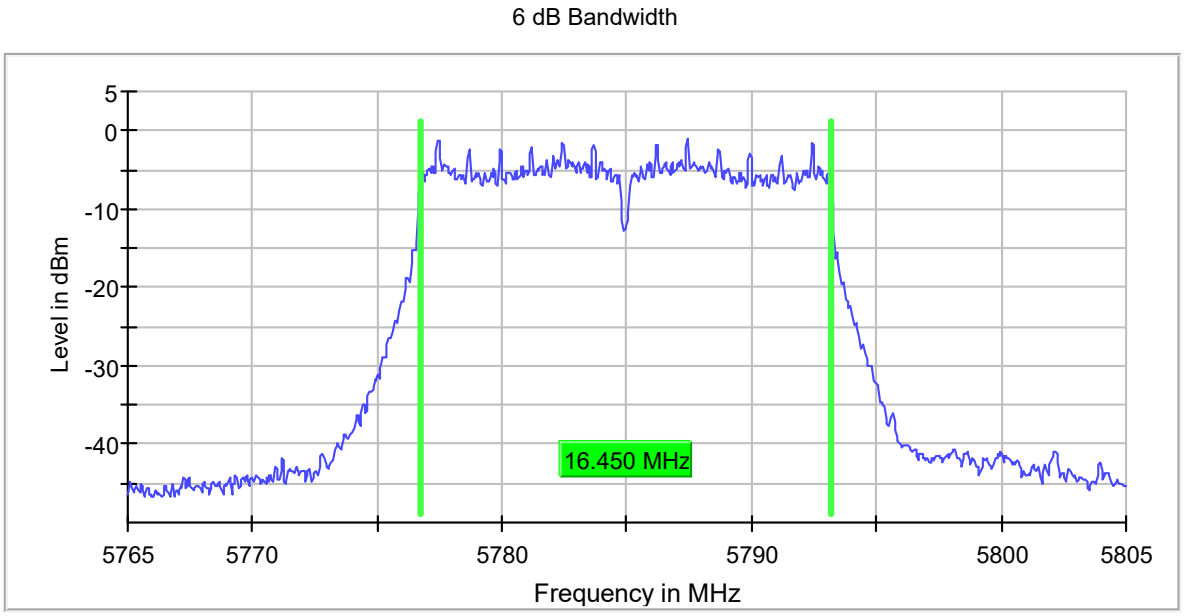
Verdict: PASS

Mode 802.11 a20:

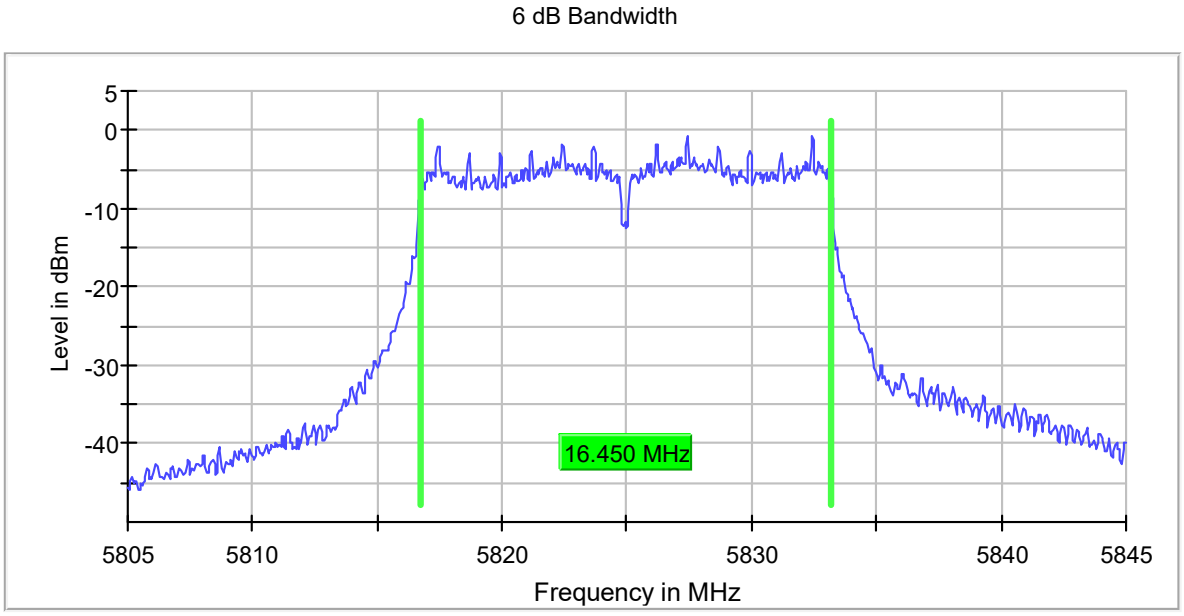
- Low Channel:



- Middle Channel:

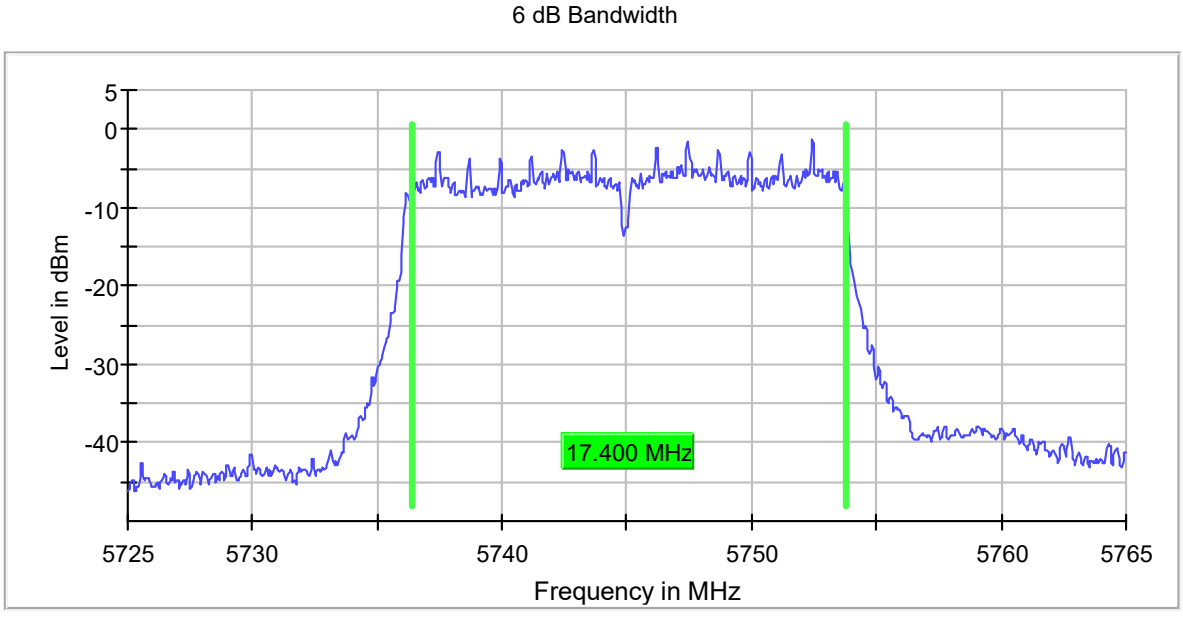


- High Channel:

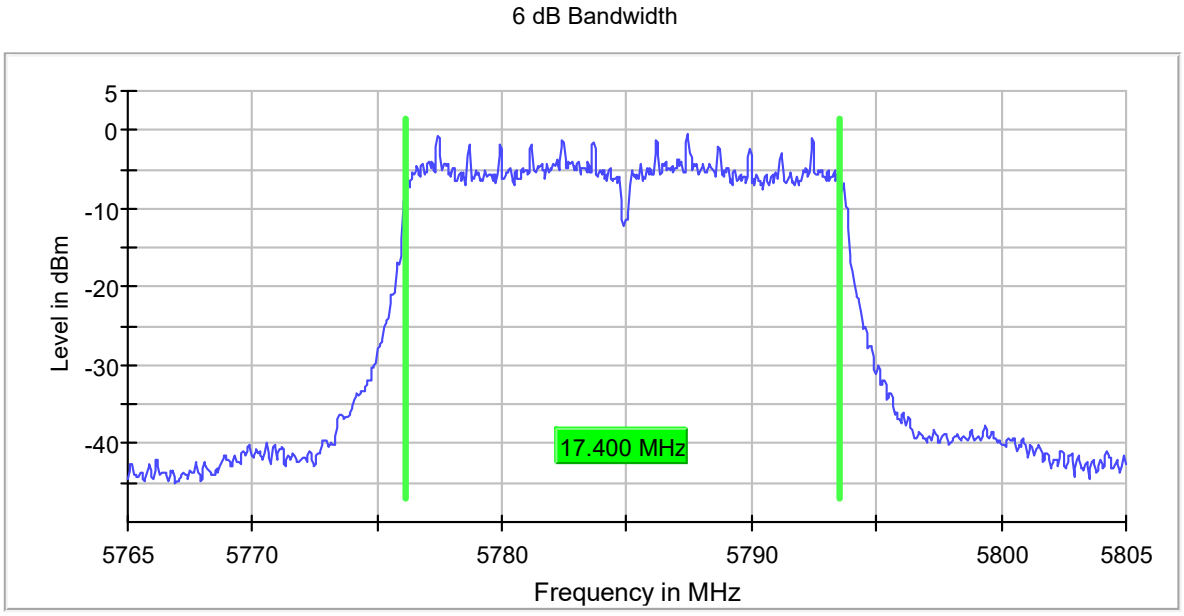


Mode 802.11 n20 (HT20):

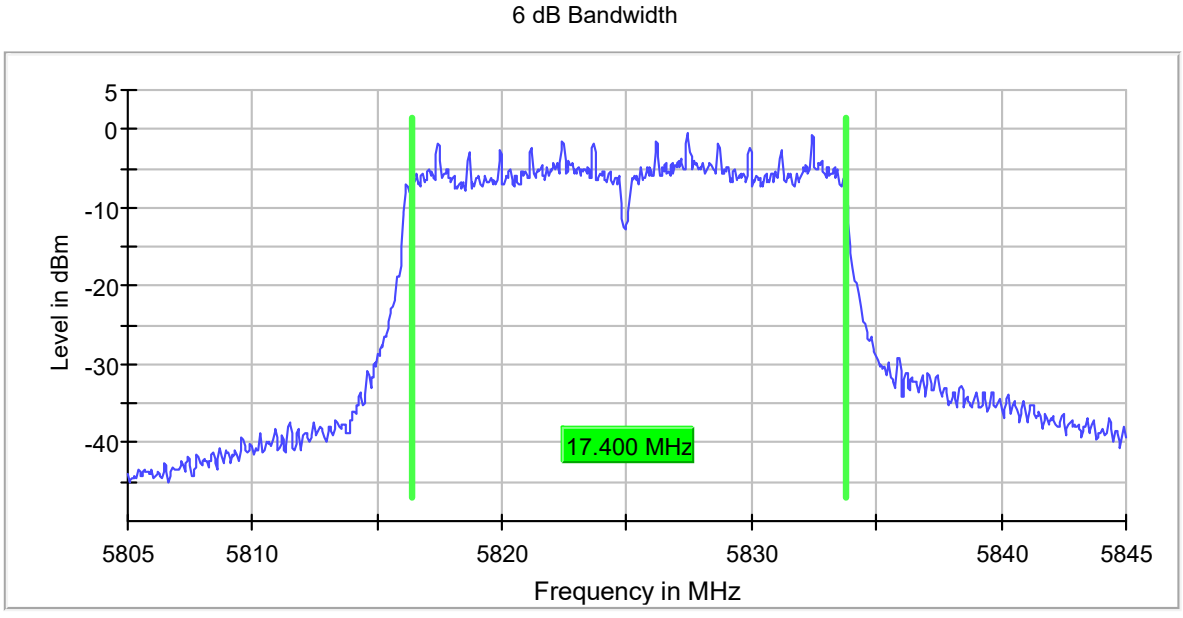
- Low Channel:



- Middle Channel:

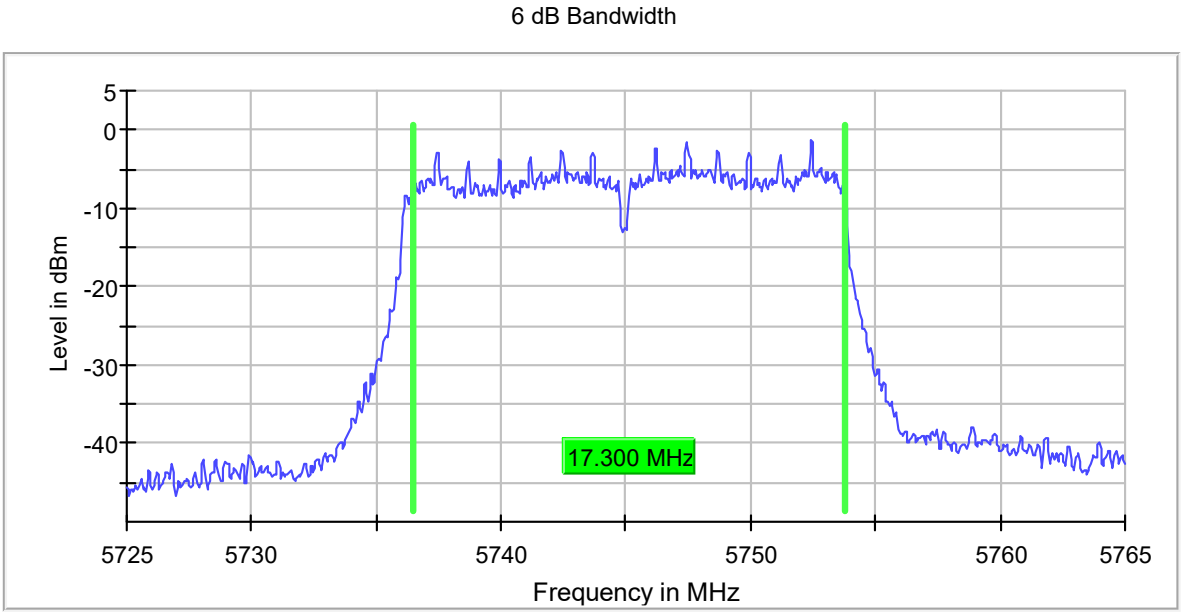


- High Channel:

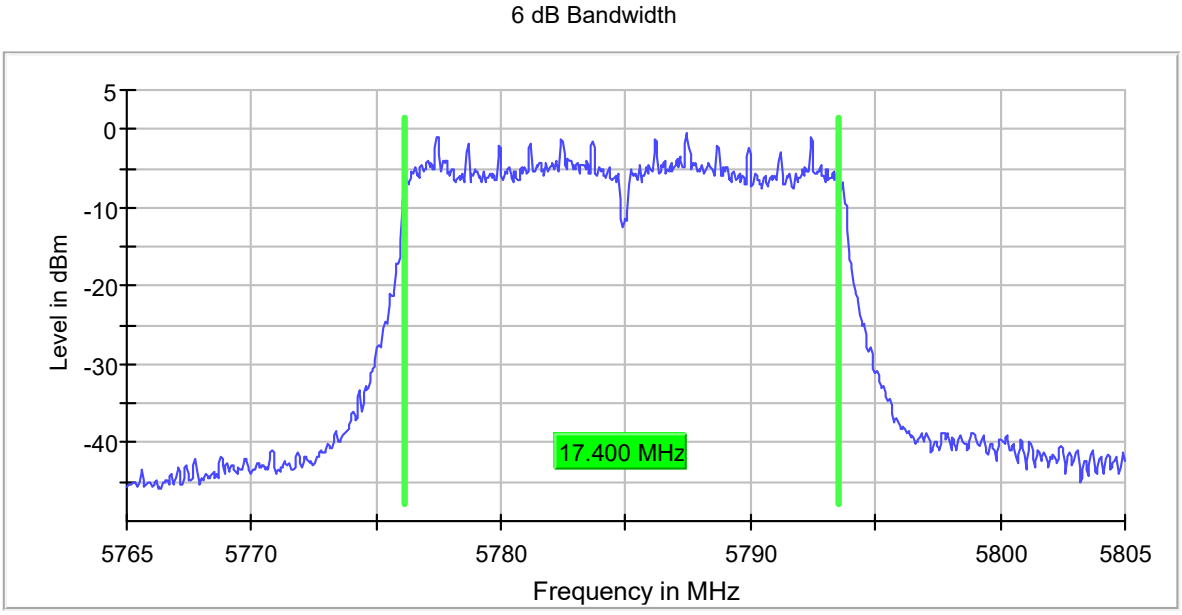


Mode 802.11 ac20 (VHT20):

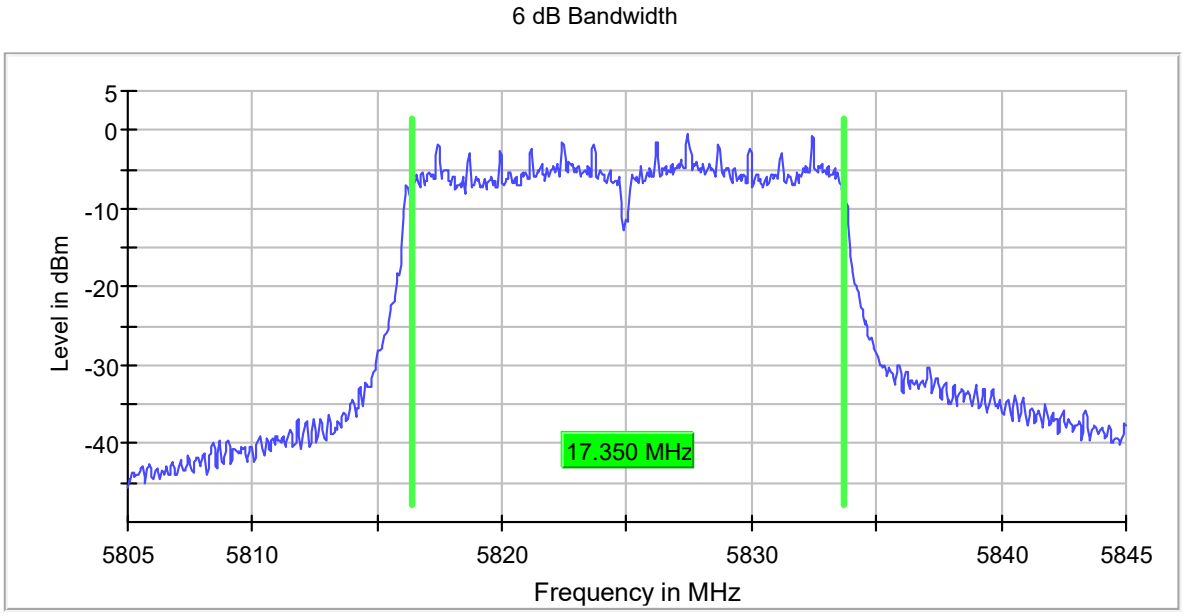
- Low Channel:



- Middle Channel:

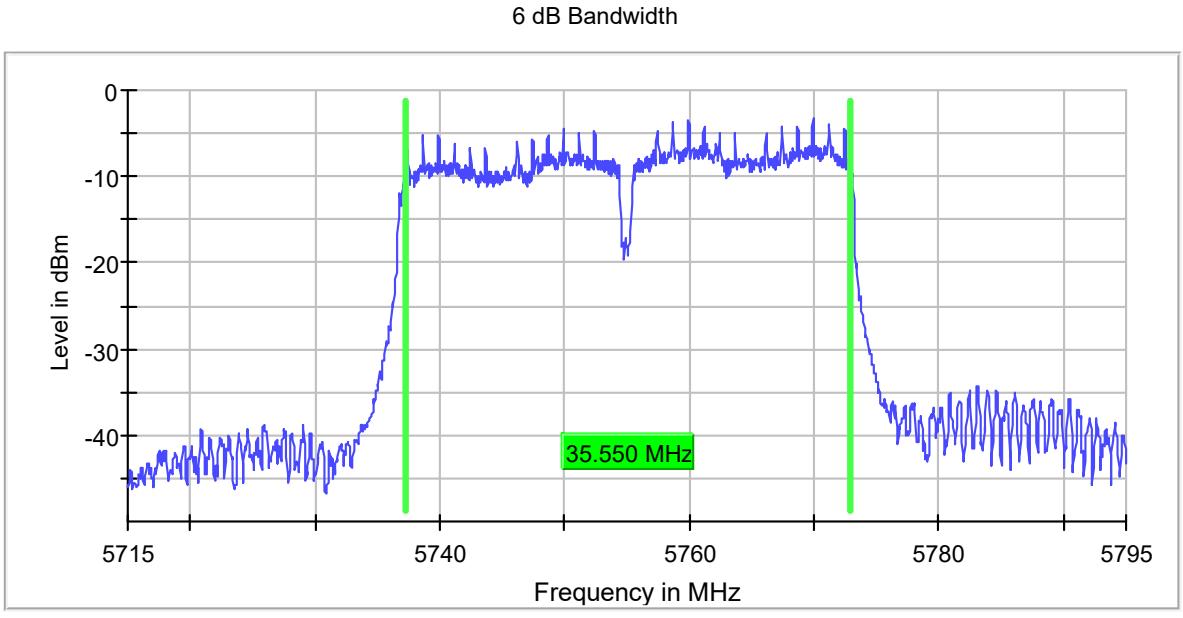


- High Channel:

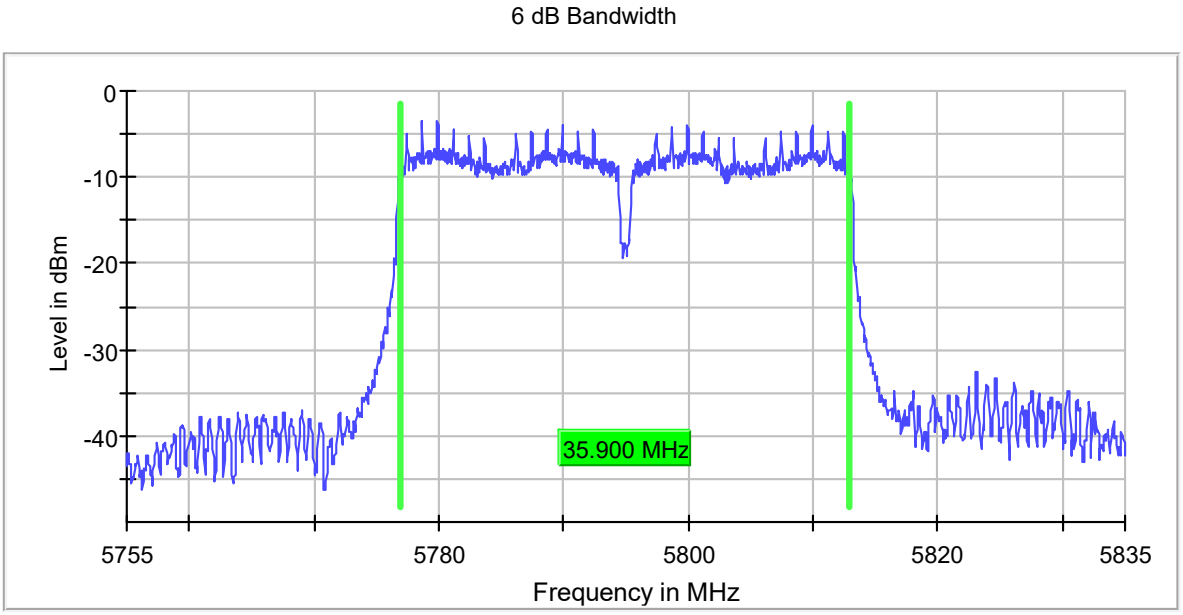


Mode 802.11 n40 (HT40):

- Low Channel:

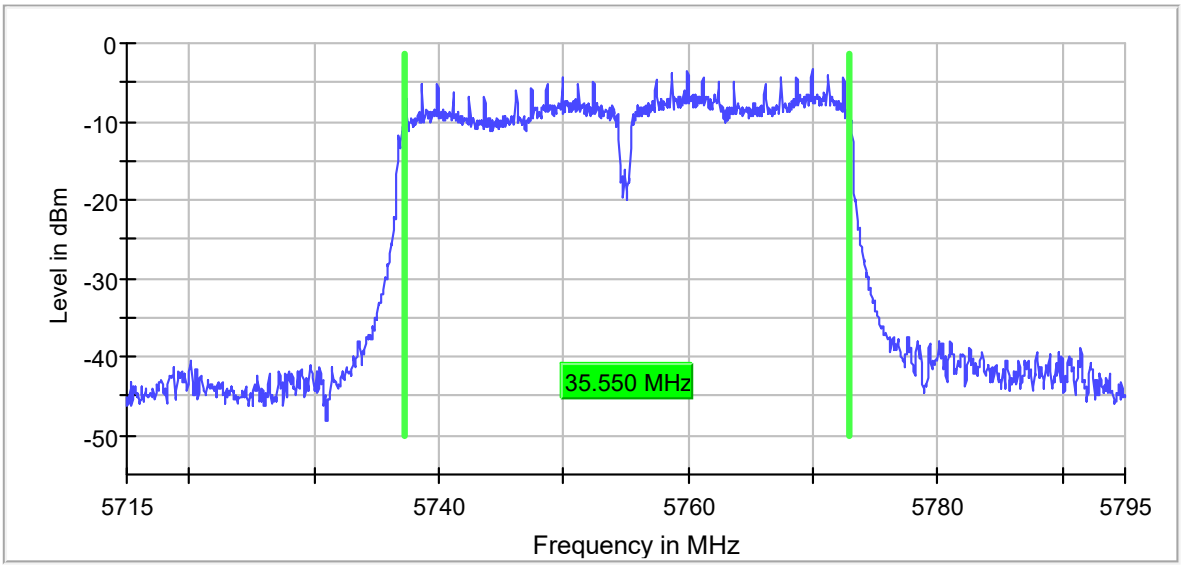


- High Channel:

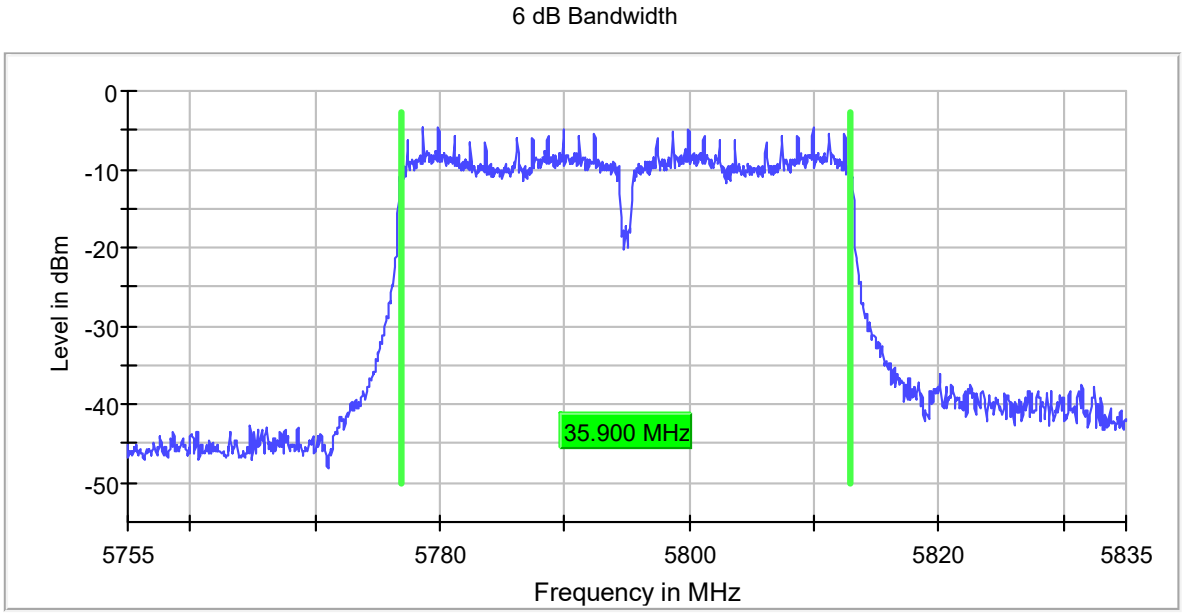


Mode 802.11 ac40 (VHT40):

- Low Channel:

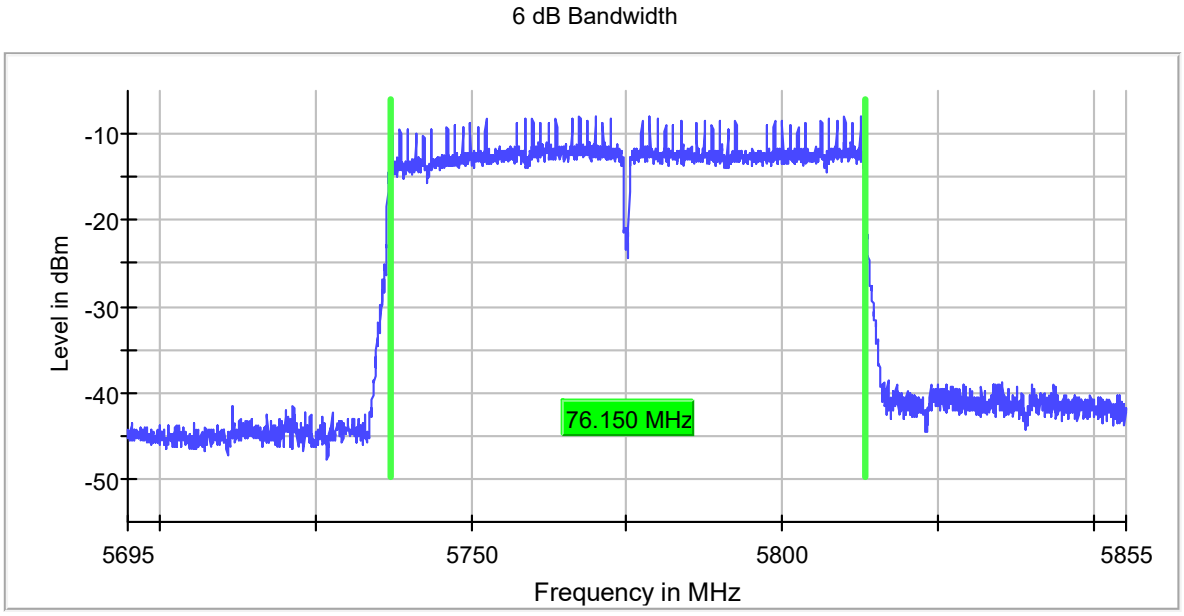


- High Channel:



Mode 802.11 ac80 (VHT80):

- Single Channel:



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

SPECIFICATION:

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1W (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.

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

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

Maximum Declared Antenna Gain: +0.9 dBi

Mode 802.11 a20:

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	10.89	11.65	11.46
Max. EIRP power (dBm)	11.79	12.55	12.36
Measurement uncertainty (dB)	<±0.48		

Mode 802.11 n20 (HT20):

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	10.79	11.83	11.43
Max. EIRP power (dBm)	11.69	12.73	12.33
Measurement uncertainty (dB)	<±0.48		

Mode 802.11 ac20 (VHT20):

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	10.80	11.73	11.38
Max. EIRP power (dBm)	11.70	12.63	12.28
Measurement uncertainty (dB)	<±0.48		

Mode 802.11 n40 (HT40):

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Max. Conducted Power (dBm)	11.46	11.48
Duty Cycle Correction Factor (dB)	0.10	0.10
Max. Conducted Power Corrected (dBm)	11.56	11.58
Max. EIRP Power Corrected (dBm)	12.46	12.48
Measurement uncertainty (dB)	<±0.48	

Mode 802.11 ac40 (VHT40):

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Max. Conducted Power (dBm)	11.42	10.57
Duty Cycle Correction Factor (dB)	0.10	0.10
Max. Conducted Power Corrected (dBm)	11.52	10.67
Max. EIRP Power Corrected (dBm)	12.42	11.57
Measurement uncertainty (dB)	<±0.48	

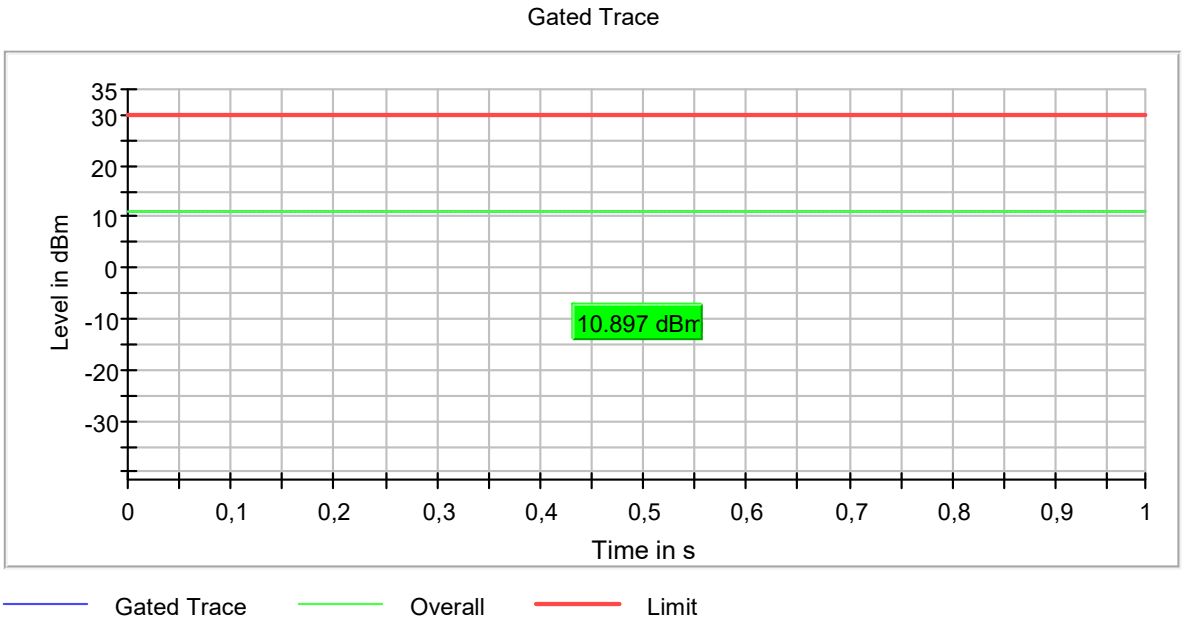
Mode 802.11 ac80 (VHT80):

	Single Channel 155 (5775 MHz)
Max. Conducted Power (dBm)	10.55
Duty Cycle Correction Factor (dB)	0.10
Max. Conducted Power Corrected (dBm)	10.65
Max. EIRP Power Corrected (dBm)	11.55
Measurement uncertainty (dB)	<±0.48

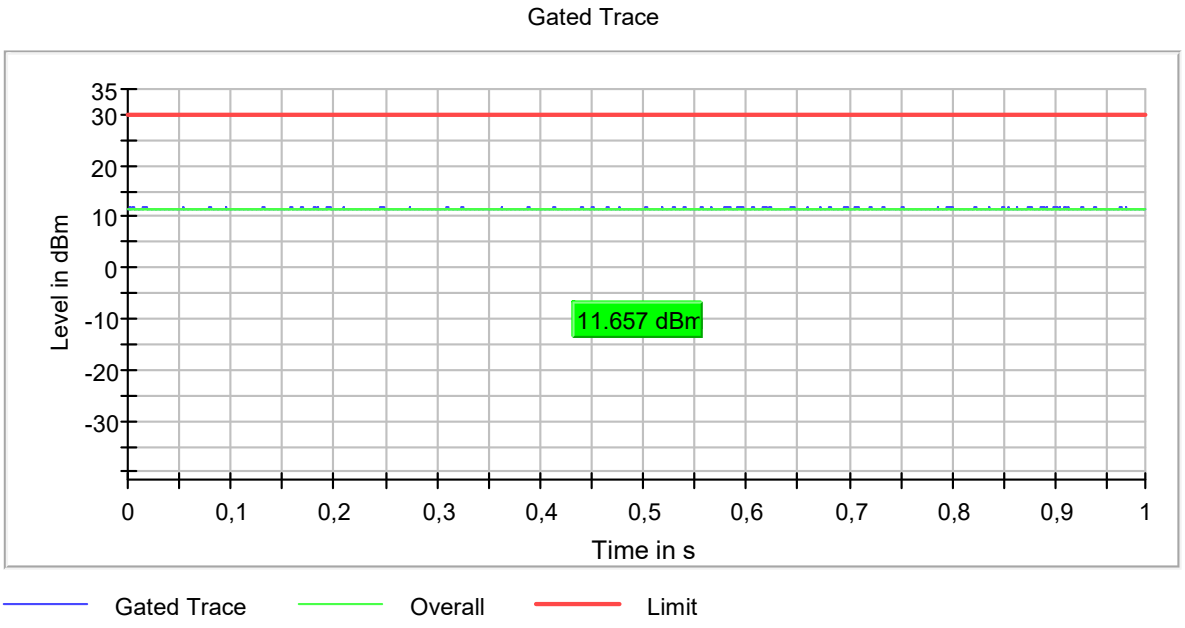
Verdict: PASS

Mode 802.11 a20:

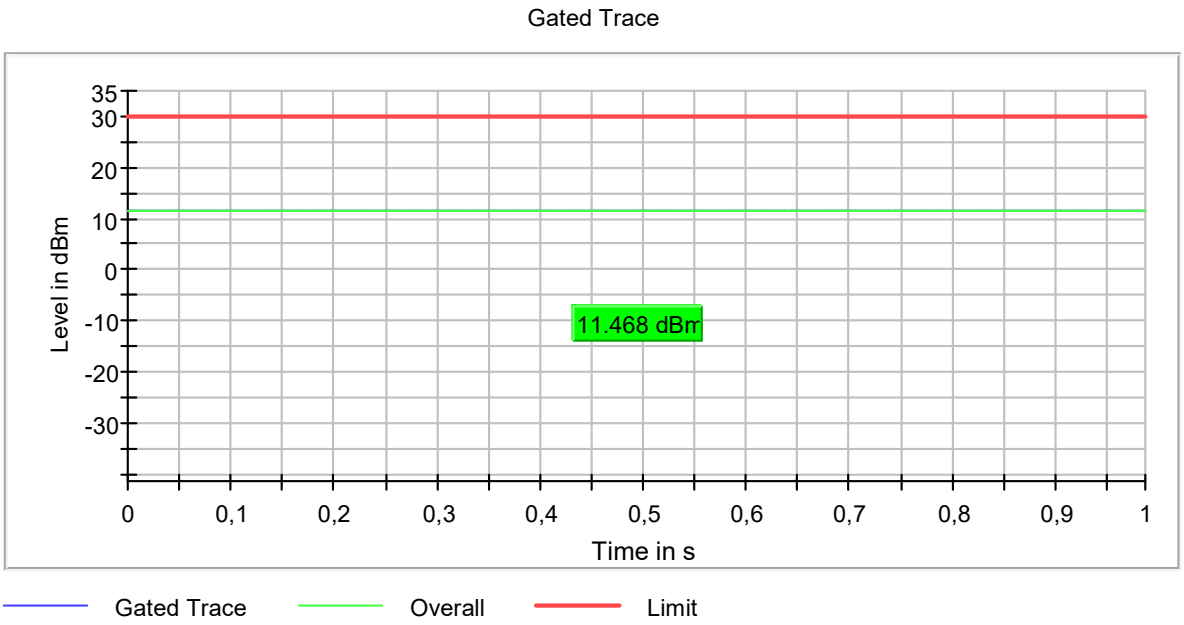
- Low Channel:



- Middle Channel:



- High Channel:



Mode 802.11 n20 (HT20):

- Low Channel: