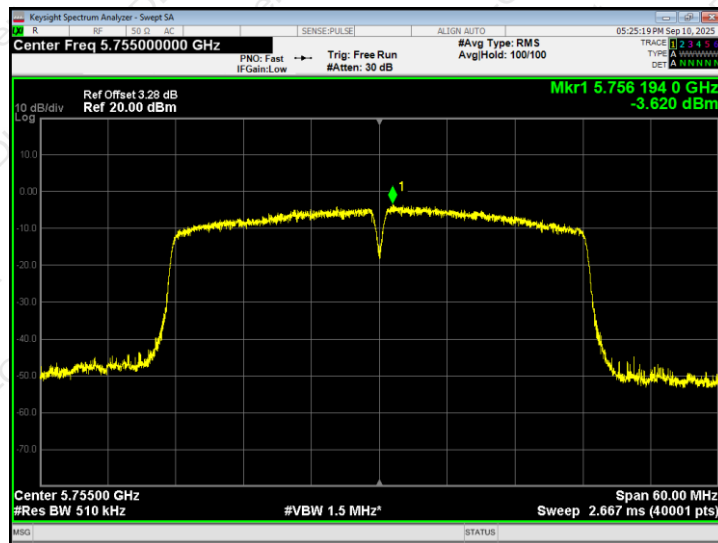




802.11n40

CH151



CH159





6. 26DB EMISSION BANDWIDTH & 6DB OCCUPIED BANDWIDTH

6.1 APPLIED PROCEDURES / LIMIT

The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band, the minimum bandwidth 6 dB bandwidth of U-NII devices shall be at least 500KHz. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

6.2 TEST PROCEDURE

1) Emission bandwidth for the band 5.725 GHz to 5.85 GHz.

The following procedure shall be used for measuring this bandwidth:

- a) Set RBW = 100 kHz.
- b) Set the video bandwidth (VBW) $\geq 3 \times \text{RBW}$.
- c) Detector = Peak.
- d) Trace mode = max-hold.
- e) Sweep = No faster than coupled (auto) time.
- f) Allow the trace to stabilize.
- g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

2) Emission bandwidth for all other bands 5.15 GHz to 5.35 GHz.

The procedure for this method is as follows:

- a) Set RBW = shall be in the range of 1% to 5% of the emission bandwidth.
- b) Set the VBW $> \text{RBW}$.
- c) Detector = peak.
- d) Trace mode = max-hold.
- e) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the instrument. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is in the range of 1% to 5%.

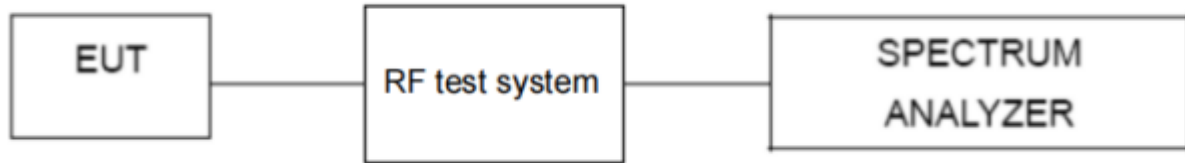
Note: The automatic bandwidth measurement capability of a spectrum analyzer or an EMI receiver may be employed if it implements the functionality described in the preceding items.

6.3 DEVIATION FROM STANDARD

No deviation.



6.4 TEST SETUP



6.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of chapter 3, Unless otherwise a special operating condition is specified in the follows during the testing.

6.6 TEST RESULTS

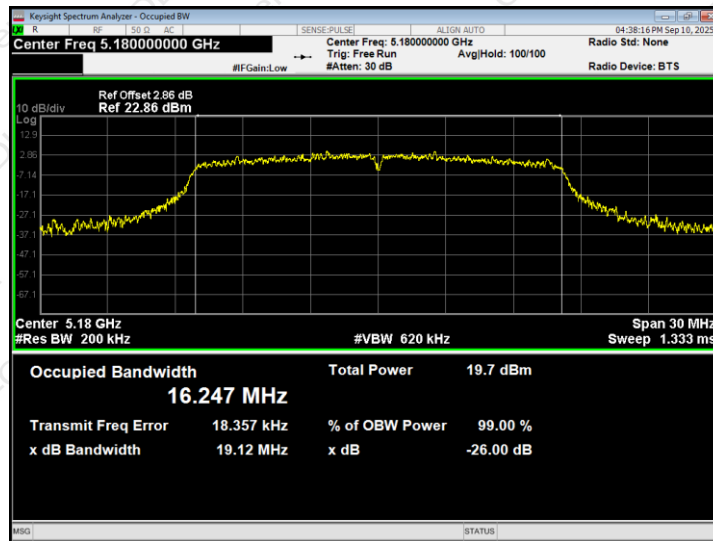
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V
Test Band :	5.2G		

Test Mode	Frequency (MHz)	26dB Emission Bandwidth (MHz)	Limit (MHz)	Result
802.11a	5180	19.12	N/A	Pass
	5200	19.13		
	5240	18.87		
802.11n20	5180	19.86	N/A	Pass
	5200	19.57		
	5240	19.48		
802.11n40	5190	37.96	N/A	Pass
	5230	37.99		

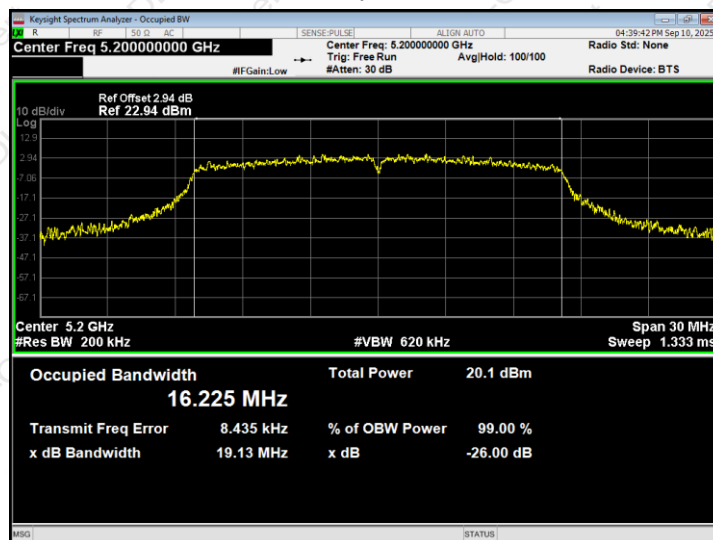


802.11a

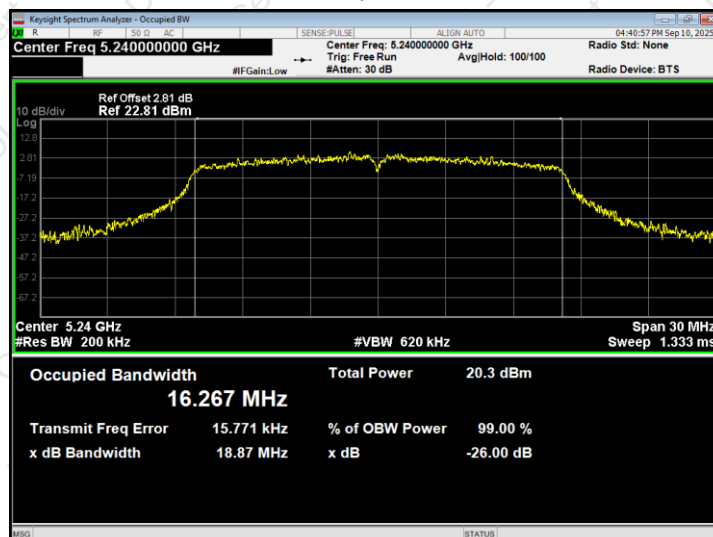
26dB Bandwidth plot on channel 36



26dB Bandwidth plot on channel 40



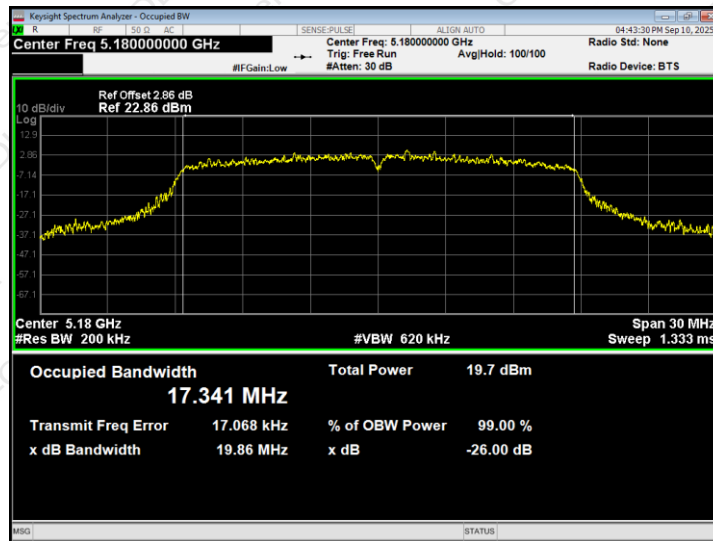
26dB Bandwidth plot on channel 48



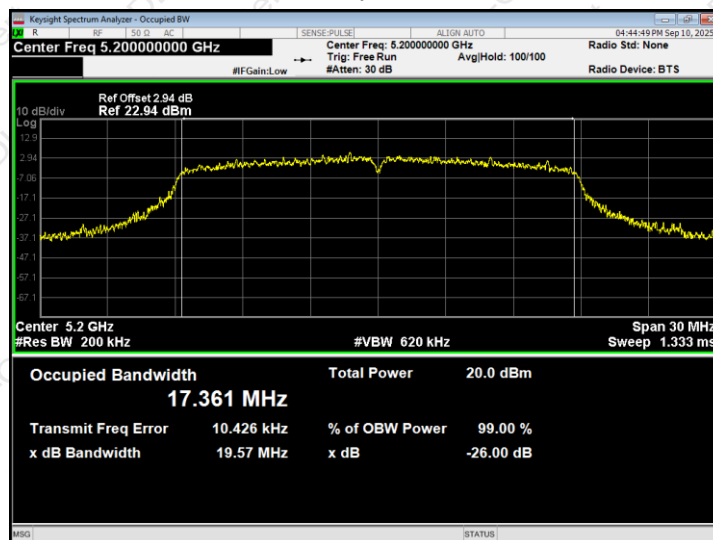


802.11n20

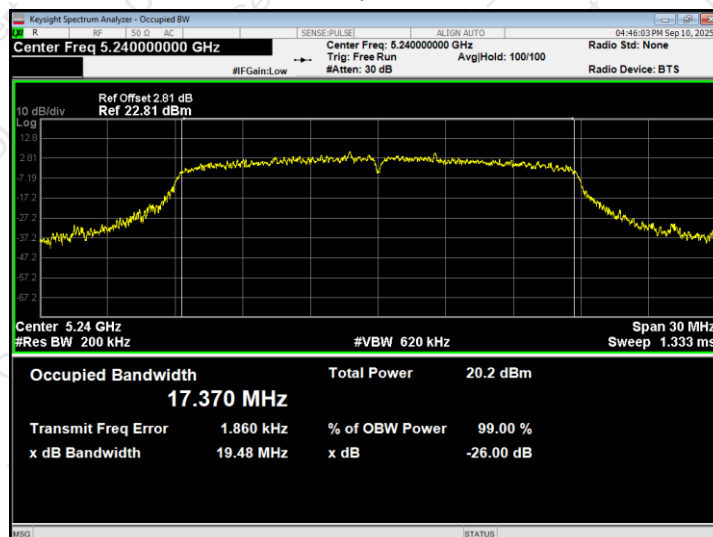
26dB Bandwidth plot on channel 36



26dB Bandwidth plot on channel 40



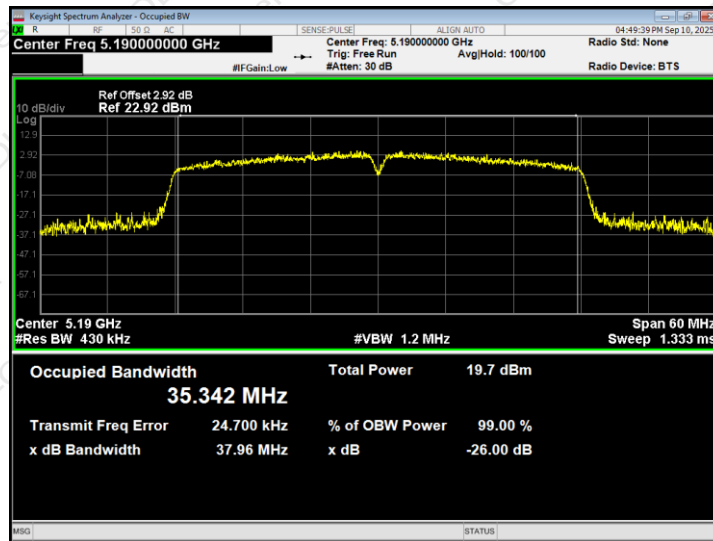
26dB Bandwidth plot on channel 48



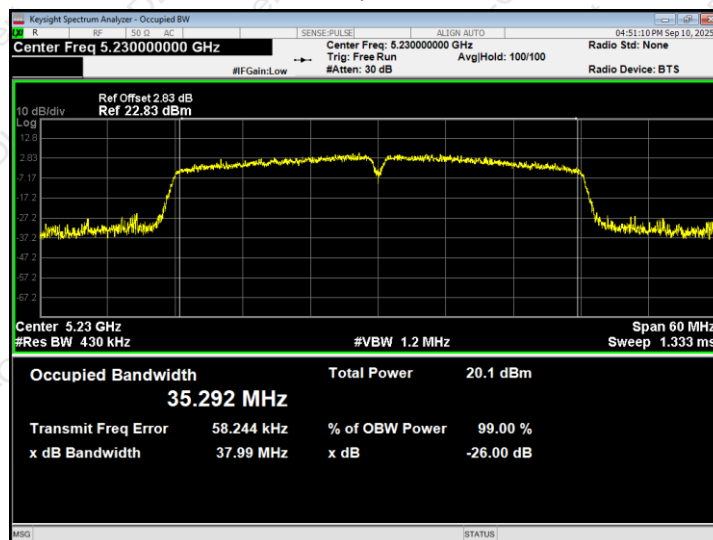


802.11n40

26dB Bandwidth plot on channel 38



26dB Bandwidth plot on channel 46





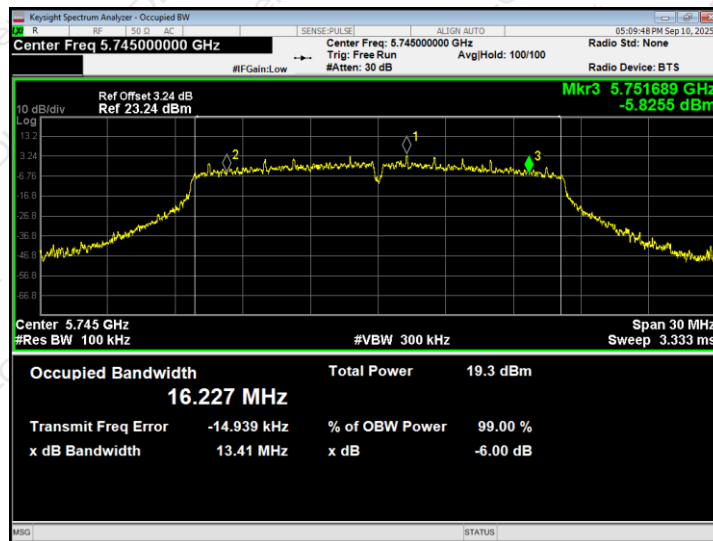
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	101kPa	Test Voltage :	DC 5V
Test Band :	5.8G		

Test Mode	Test Channel (MHz)	6dB Bandwidth (MHz)	Limit (kHz)	Result
802.11a	5745	13.41	>500	Pass
	5785	13.86		
	5825	15.04		
802.11n20	5745	12.83	>500	Pass
	5785	15.04		
	5825	12.51		
802.11n40	5755	28.86	>500	Pass
	5795	35.05		

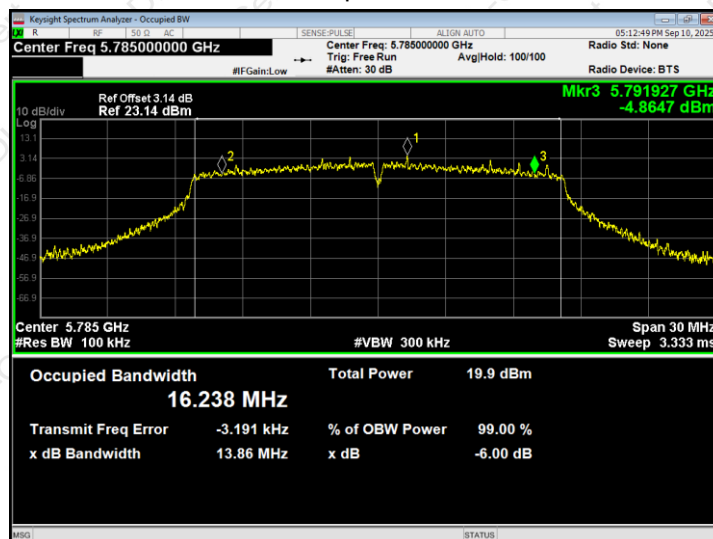


802.11a

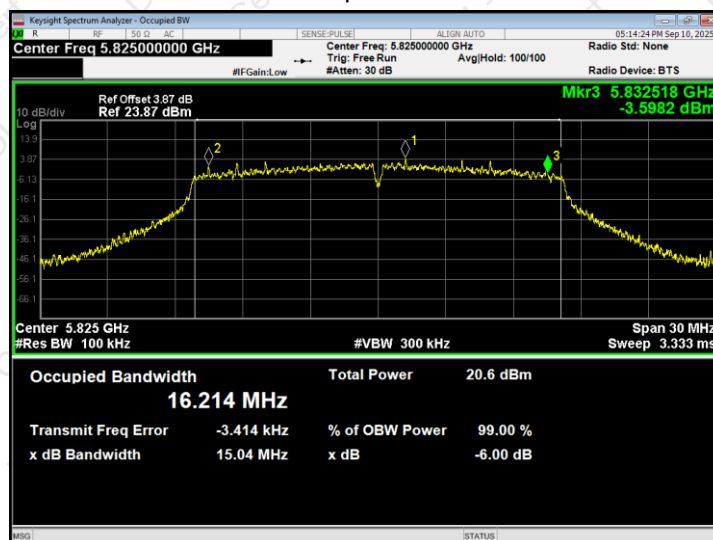
6dB Bandwidth plot on channel 149



6dB Bandwidth plot on channel 157



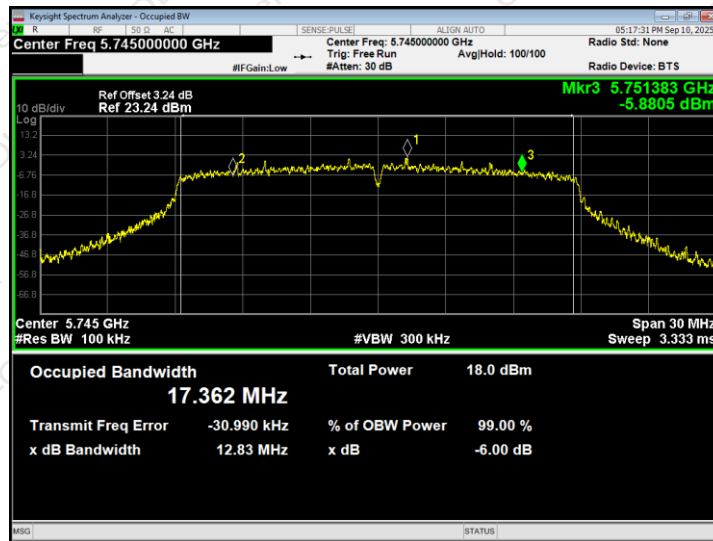
6dB Bandwidth plot on channel 165



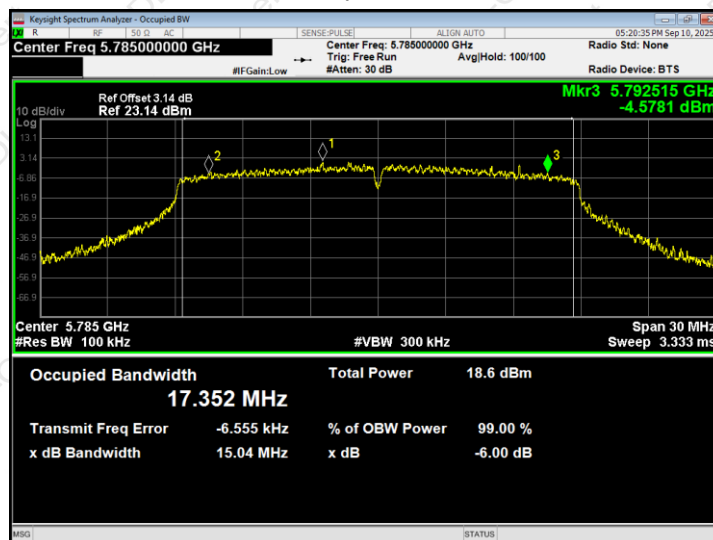


802.11n20

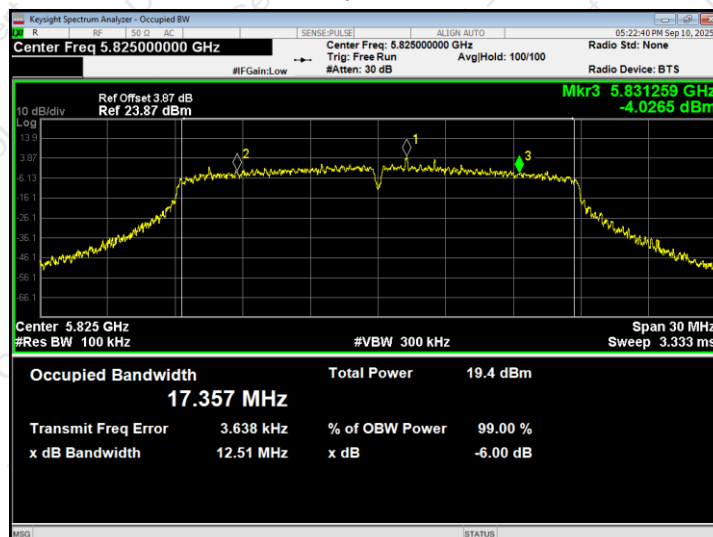
6dB Bandwidth plot on channel 149



6dB Bandwidth plot on channel 157



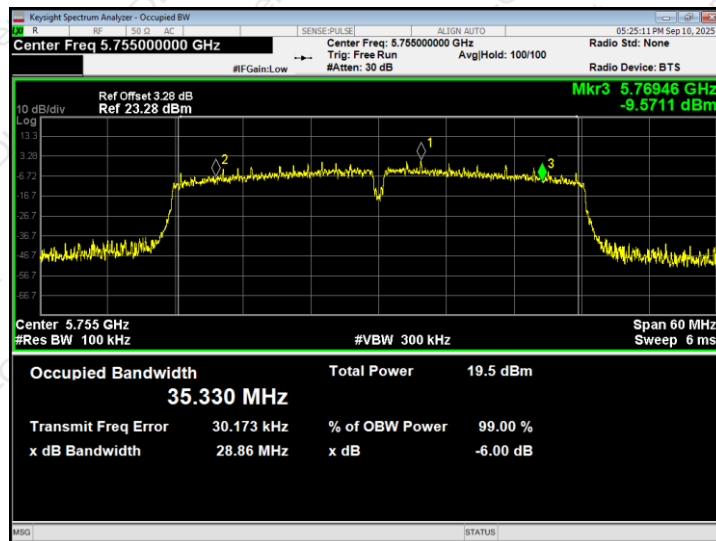
6dB Bandwidth plot on channel 165



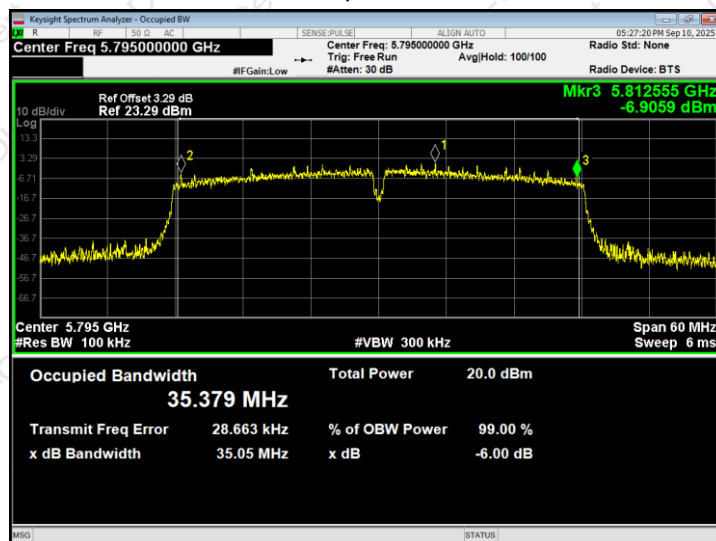


802.11n40

6dB Bandwidth plot on channel 151



6dB Bandwidth plot on channel 159





7. MAXIMUM CONDUCTED OUTPUT POWER

7.1 PPLIED PROCEDURES / LIMIT

According to FCC §15.407 (a)(1) & (a)(3)(i)
The maximum conducted output power should not exceed:

Frequency Band(MHz)	Limit
5150~5250	250mW
5725~5850	1W

7.2 TEST PROCEDURE

According 789033 D02 General UNII Test Procedures New Rules v02r01.

EUT Measurement using a Power Meter (PM)

a) Method PM (Measurement using an RF average power meter):

(i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the following conditions are satisfied:

- The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
- At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
- The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

(ii) If the transmitter does not transmit continuously, measure the duty cycle, x, of the transmitter output signal as described in II.B.

(iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

(iv) Adjust the measurement in dBm by adding $10 \log (1/x)$ where x is the duty cycle (e.g., $10 \log (1/0.25)$ if the duty cycle is 25%).

7.3 DEVIATION FROM STANDARD

No deviation.

7.4 TEST SETUP



7.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of chapter 3, Unless otherwise a special operating condition is specified in the follows during the testing.



7.6 TEST RESULTS

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V

Test Mode	Frequency (MHz)	Output Power (dBm)	Duty Cycle Factor (dB)	Total Power (dBm)	Limit (dBm)	Result
802.11 a	5180	12.926	1.36	14.286	23.98	Pass
	5200	13.083	1.36	14.443	23.98	Pass
	5240	13.658	1.36	15.018	23.98	Pass
802.11 n20	5180	12.793	1.44	14.233	23.98	Pass
	5200	12.834	1.44	14.274	23.98	Pass
	5240	13.638	1.44	15.078	23.98	Pass
802.11 n40	5190	12.174	2.56	14.734	23.98	Pass
	5230	12.926	2.56	15.486	23.98	Pass

Note: Total Power = Output Power + Duty Cycle Factor.

Test Mode	Frequency (MHz)	Output Power (dBm)	Duty Cycle Factor (dB)	Total Power (dBm)	Limit (dBm)	Result
802.11 a	5745	12.303	1.37	13.673	30	Pass
	5785	12.753	1.37	14.123	30	Pass
	5825	13.722	1.37	15.092	30	Pass
802.11 n20	5745	11.022	1.44	12.462	30	Pass
	5785	11.797	1.44	13.237	30	Pass
	5825	12.530	1.44	13.970	30	Pass
802.11 n40	5755	11.116	2.53	13.646	30	Pass
	5785	11.713	2.53	14.243	30	Pass

Note: Total Power = Output Power + Duty Cycle Factor.



8. CONDUCTED BAND EDGE

8.1 APPLICABLE STANDARD

According to FCC §15.407(b)

Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) 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 e.i.r.p. of -27 dBm/MHz.

(2) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of -27 dBm/MHz 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.

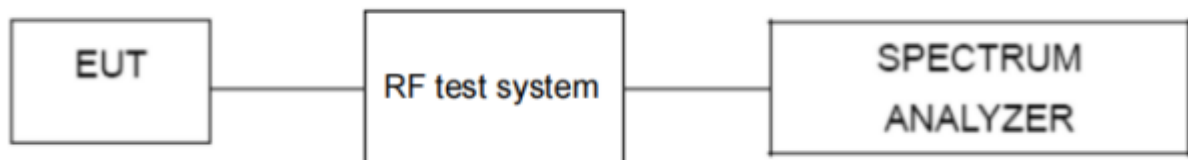
8.2 TEST PROCEDURE

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 1 MHz with a convenient frequency span.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

8.3 DEVIATION FROM STANDARD

No deviation.

8.4 TEST SETUP



8.5 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of chapter 3, Unless otherwise a special operating condition is specified in the follows during the testing.



8.6 TEST RESULTS

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V
Test band :	5.2G		

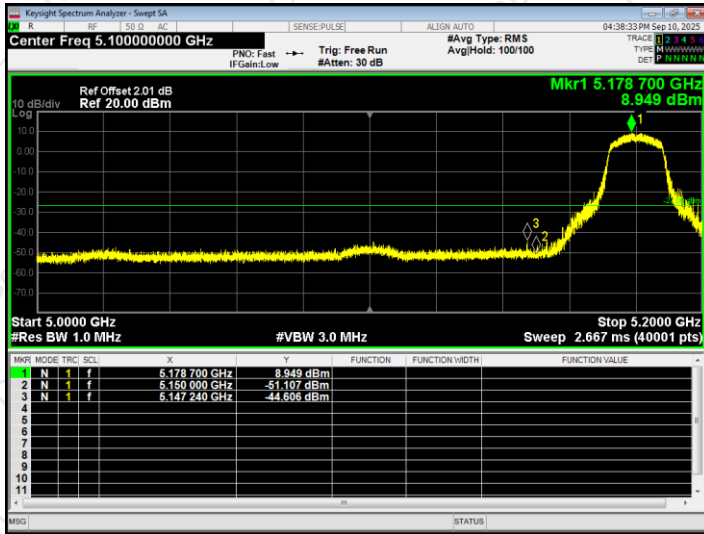
Test Mode	Frequency (MHz)	Emission Frequency (MHz)	Measurement Value Max (dBc)	Antenna gain (dBi)	RF Cable Loss (dB)	Total Value Max (dBc)	Result
802.11a	5180	5147.240	-48.716	2.01	2.10	-44.606	Pass
	5240	5400.835	-50.599	2.01	2.10	-46.489	Pass
802.11n20	5180	5102.460	-49.217	2.01	2.10	-45.107	Pass
	5240	5398.490	-51.373	2.01	2.10	-47.263	Pass
802.11n40	5190	5148.675	-42.086	2.01	2.10	-37.976	Pass
	5230	5385.560	-52.177	2.01	2.10	-48.067	Pass

Note: Total Value = Measurement Value + RF Cable Loss + Antenna gain.
The test diagram has added a calibration factor.

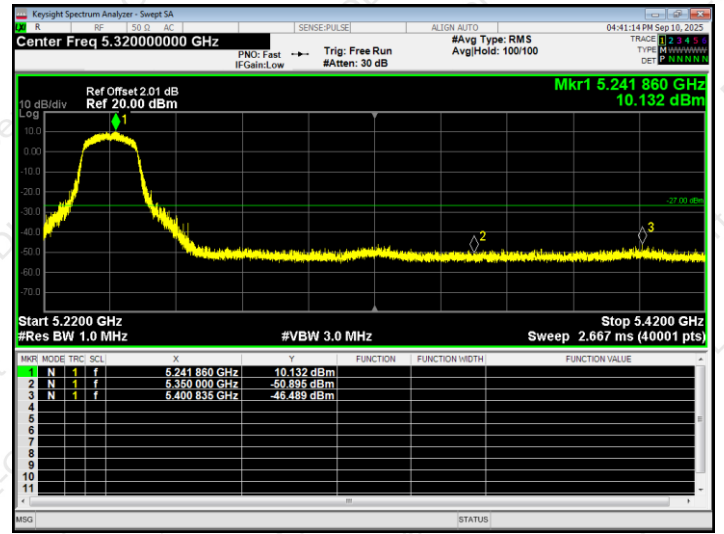


5.180~5.240 GHz

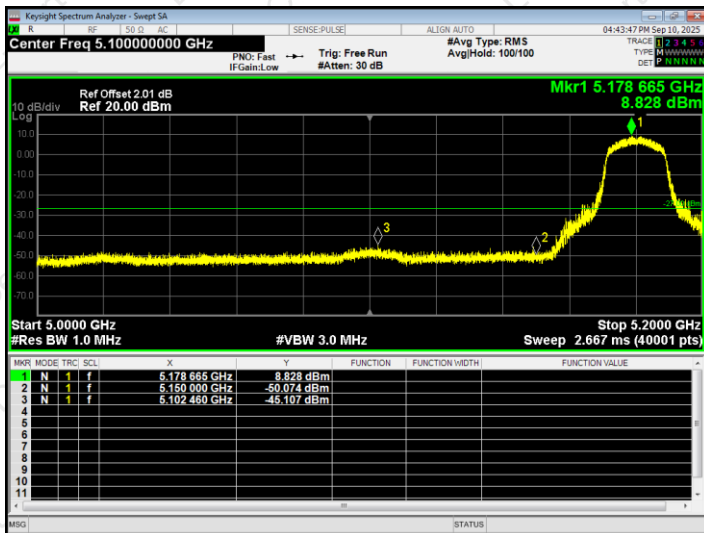
(802.11a) Band Edge, Left Side



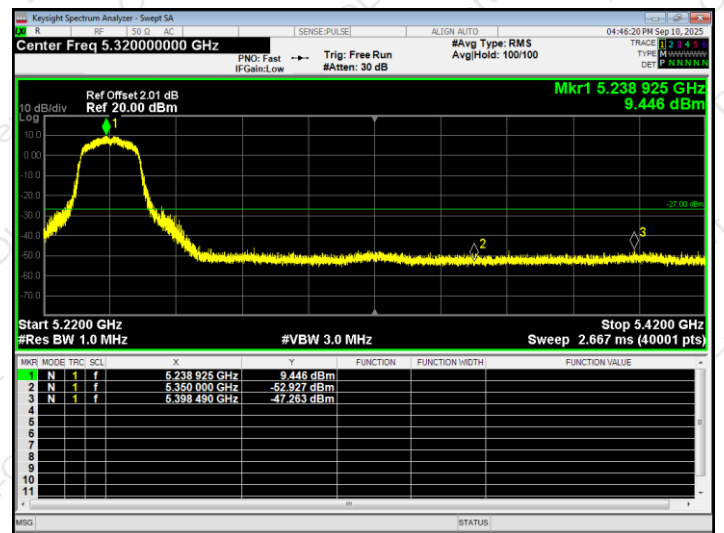
(802.11a) Band Edge, Right Side



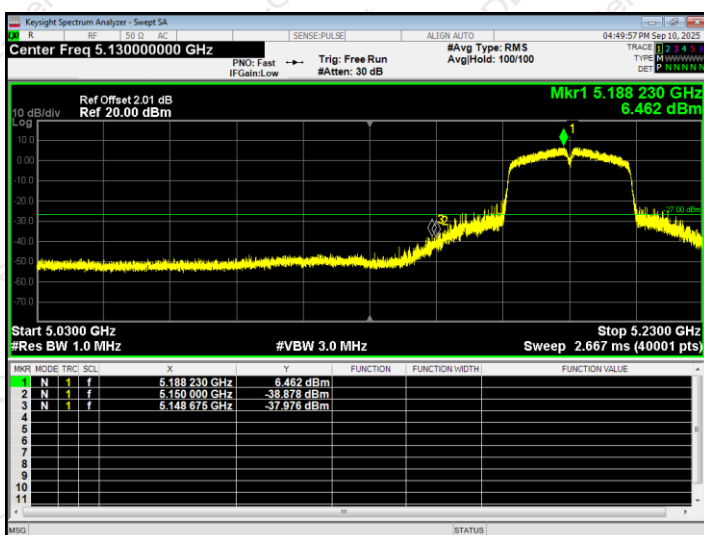
(802.11n20) Band Edge, Left Side



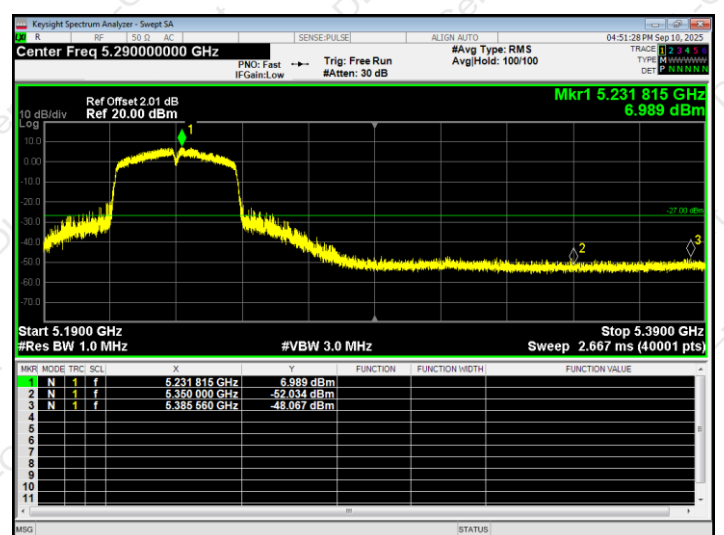
(802.11n20) Band Edge, Right Side



(802.11n40) Band Edge, Left Side



(802.11n40) Band Edge, Right Side





Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V
Test band :	5.8G		

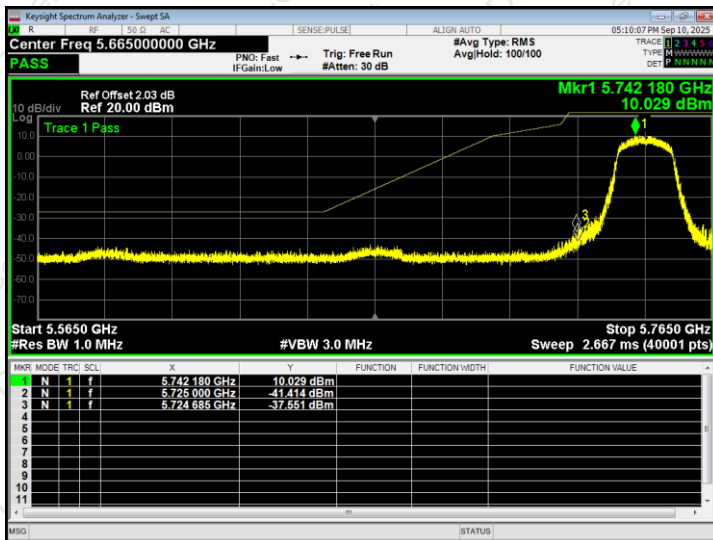
Test Mode	Frequency (MHz)	Emission Frequency (MHz)	Measurement Value Max (dBc)	Antenna gain (dBi)	RF Cable Loss (dB)	Total Value Max (dBc)	Result
802.11a	5745	5724.685	-41.711	2.03	2.13	-37.551	Pass
	5825	5980.255	-48.578	2.03	2.13	-44.418	Pass
802.11n20	5745	5724.825	-43.745	2.03	2.13	-39.585	Pass
	5825	5982.220	-49.491	2.03	2.13	-45.331	Pass
802.11n40	5755	5724.625	-33.530	2.03	2.13	-29.370	Pass
	5785	5850.345	-49.143	2.03	2.13	-44.983	Pass

Note: Total Value = Measurement Value + RF Cable Loss + Antenna gain.
The test diagram has added a calibration factor.

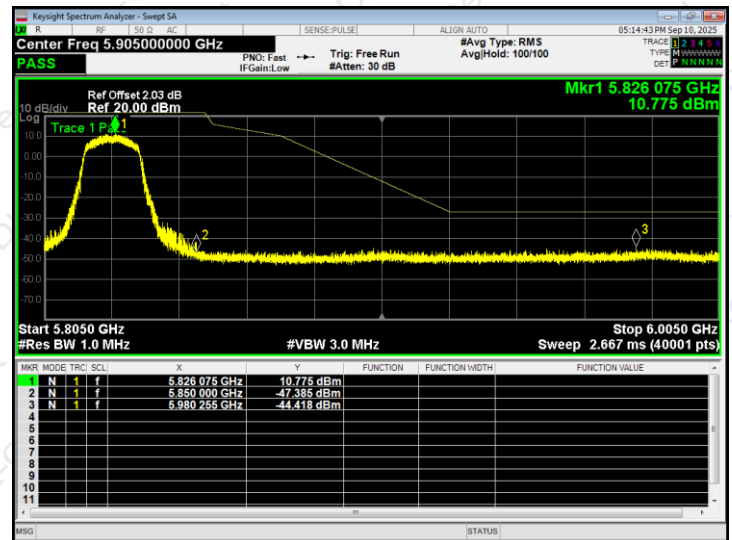


5.745~5.825 GHz

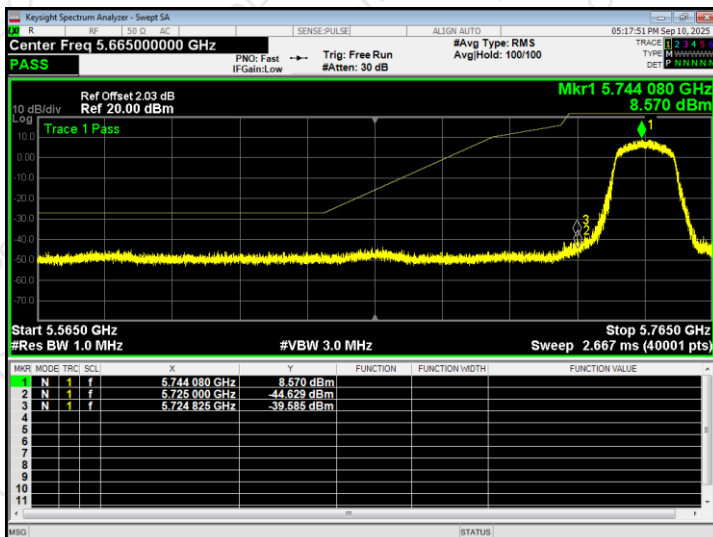
(802.11a) Band Edge, Left Side



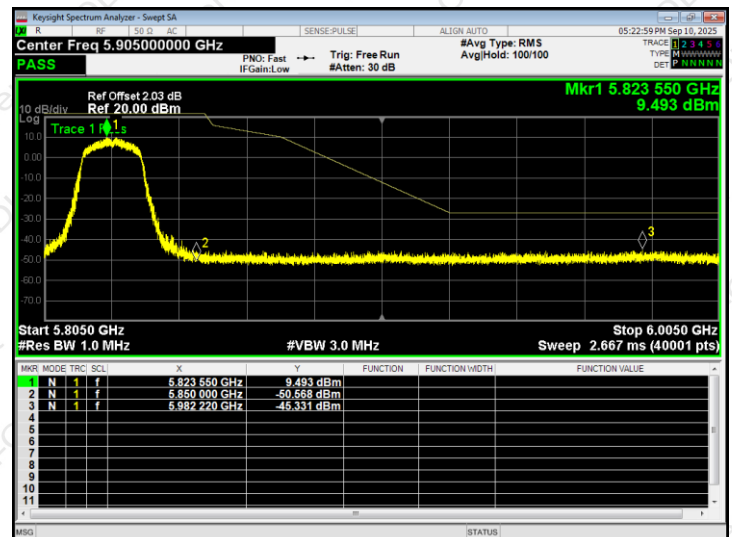
(802.11a) Band Edge, Right Side



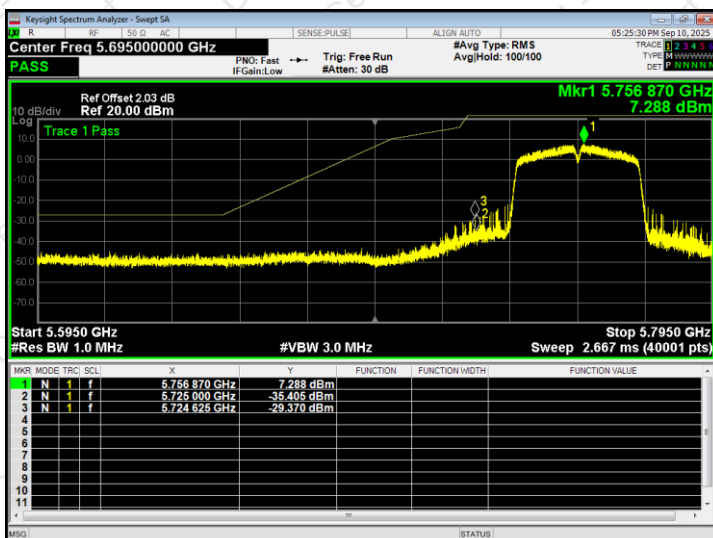
(802.11n20) Band Edge, Left Side



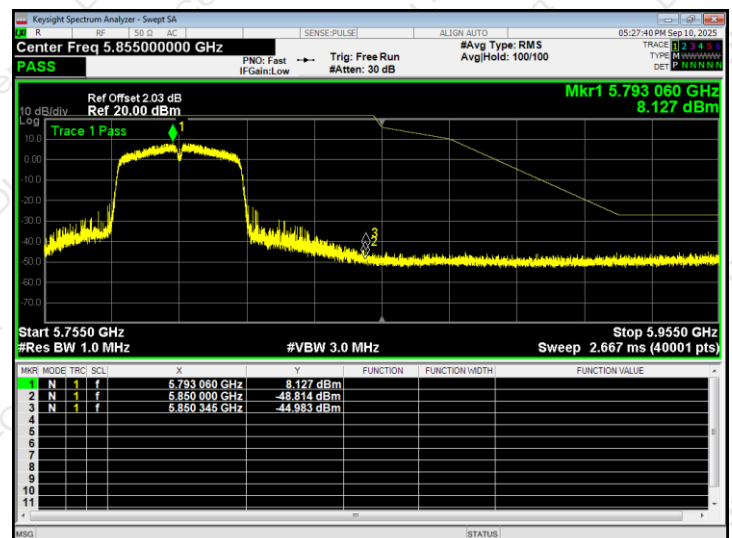
(802.11n20) Band Edge, Right Side



(802.11n40) Band Edge, Left Side



(802.11n40) Band Edge, Right Side





9. FREQUENCY STABILITY MEASUREMENT

9.1 LIMIT

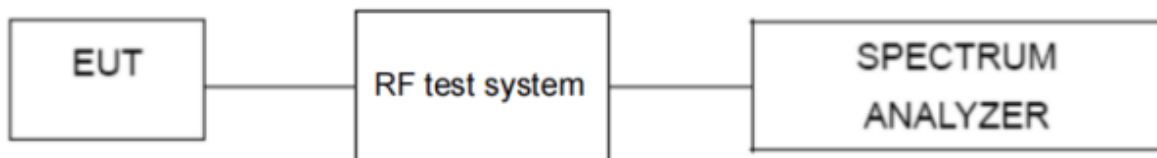
Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

The transmitter center frequency tolerance shall be (IEEE 802.11n specification).

9.2 TEST PROCEDURES

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 10 kHz, VBW = 10 kHz with peak detector and maxhold settings.
5. f_c is declaring of channel frequency. Then the frequency error formula is $(f_c - f) / f_c \times 10^6$ ppm.
6. The test extreme voltage is to change the primary supply voltage from 85% to 115% percent of the nominal value.
7. Extreme temperature is -20°C~70°C.

9.3 TEST SETUP LAYOUT



9.4 EUT OPERATION DURING TEST

The EUT tested system was configured as the statements of chapter 3, Unless otherwise a special operating condition is specified in the follows during the testing.



9.5 TEST RESULTS

Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V
Note: Note: All channels have been tested, and only the worst test data is recorded in this report.			

Extreme temperature frequency stability:

Reference Frequency: 802.11a - 5180MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
70	5	5179.990	-1.978
60	5	5179.972	-5.465
50	5	5179.987	-2.588
40	5	5179.977	-4.427
30	5	5179.970	-5.786
25	5	5179.982	-3.547
10	5	5179.972	-5.405
0	5	5179.981	-3.606
-10	5	5179.988	-2.387
-20	5	5179.984	-3.184

Reference Frequency: 802.11n20 - 5180MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
70	5	5179.970	-5.773
60	5	5179.963	-7.121
50	5	5179.984	-3.095
40	5	5179.987	-2.575
30	5	5179.971	-5.655
25	5	5179.973	-5.237
10	5	5179.976	-4.708
0	5	5179.989	-2.056
-10	5	5179.986	-2.662
-20	5	5179.976	-4.647



Reference Frequency: 802.11n40 - 5190MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
70	5	5189.986	-2.703
60	5	5189.960	-7.634
50	5	5189.985	-2.910
40	5	5189.986	-2.734
30	5	5189.976	-4.540
25	5	5189.977	-4.373
10	5	5189.972	-5.454
0	5	5189.987	-2.444
-10	5	5189.989	-2.063
-20	5	5189.971	-5.507

Reference Frequency: 802.11a - 5745MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
70	5	5744.970	-5.185
60	5	5744.969	-5.313
50	5	5744.974	-4.540
40	5	5744.965	-6.100
30	5	5744.974	-4.566
25	5	5744.974	-4.587
10	5	5744.952	-8.317
0	5	5744.972	-4.960
-10	5	5744.971	-5.028
-20	5	5744.963	-6.422



Reference Frequency: 802.11n20 - 5745MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
70	5	5744.976	-4.229
60	5	5744.978	-3.788
50	5	5744.960	-6.939
40	5	5744.955	-7.869
30	5	5744.966	-5.871
25	5	5744.973	-4.643
10	5	5744.964	-6.221
0	5	5744.968	-5.535
-10	5	5744.955	-7.837
-20	5	5744.979	-3.714

Reference Frequency: 802.11n40 - 5755MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
70	5	5754.980	-3.499
60	5	5754.964	-6.198
50	5	5754.975	-4.365
40	5	5754.971	-5.090
30	5	5754.966	-5.923
25	5	5754.957	-7.413
10	5	5754.956	-7.729
0	5	5754.979	-3.732
-10	5	5754.959	-7.135
-20	5	5754.970	-5.133



Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V
Note: Note: All channels have been tested, and only the worst test data is recorded in this report.			

Extreme voltage frequency stability:

Reference Frequency: 802.11a - 5180MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
25	5.75	5179.986	-2.632
25	5.25	5179.989	-2.118
25	5	5179.988	-2.344
25	4.75	5179.976	-4.566
25	4.25	5179.985	-2.867

Reference Frequency: 802.11n20 - 5180MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
25	5.75	5179.986	-2.768
25	5.25	5179.983	-3.276
25	5	5179.981	-3.610
25	4.75	5179.980	-3.883
25	4.25	5179.979	-4.045

Reference Frequency: 802.11n40 - 5190MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
25	5.75	5189.987	-2.573
25	5.25	5189.983	-3.216
25	5	5189.987	-2.413
25	4.75	5189.984	-3.144
25	4.25	5189.984	-3.019



Reference Frequency: 802.11a - 5745MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
25	5.75	5744.975	-4.338
25	5.25	5744.958	-7.327
25	5	5744.973	-4.737
25	4.75	5744.954	-8.083
25	4.25	5744.976	-4.264

Reference Frequency: 802.11n20 - 5745MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
25	5.75	5744.972	-4.808
25	5.25	5744.956	-7.746
25	5	5744.974	-4.608
25	4.75	5744.967	-5.785
25	4.25	5744.970	-5.178

Reference Frequency: 802.11n40 - 5755MHz			
Environment Temperature (°C)	Power Supplied (VDC)	Frequency Measure with Time Elapsed	
		Measured Frequency (MHz)	Deviation (ppm)
25	5.75	5754.974	-4.448
25	5.25	5754.969	-5.439
25	5	5754.972	-4.887
25	4.75	5754.968	-5.503
25	4.25	5754.965	-6.099



10. DUTY CYCLE

10.1 APPLIED PROCEDURES / LIMIT

Measurements of duty cycle and transmission duration shall be performed using one of the following techniques:

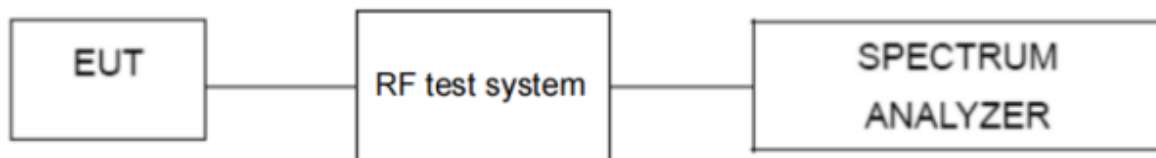
- 1) A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the ON and OFF times of the transmitted signal.
- 2) The zero-span mode on a spectrum analyzer or EMI receiver, if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the ON and OFF times of the transmitted signal:
 - i) Set the center frequency of the instrument to the center frequency of the transmission.
 - ii) Set RBW $\geq$ EBW if possible; otherwise, set RBW to the largest available value.
 - iii) Set VBW $\geq$ RBW.
 - iv) Set detector = peak.
 - v) The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$, where T is defined in item a1) of 12.2, and the number of sweep points across duration T exceeds 100.

For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7 \mu\text{s}$.

10.2 DEVIATION FROM STANDARD

No deviation.

10.3 TEST SETUP



10.4 EUT OPERATION CONDITIONS

The EUT tested system was configured as the statements of chapter 3, Unless otherwise a special operating condition is specified in the follows during the testing.



10.5 TEST RESULTS

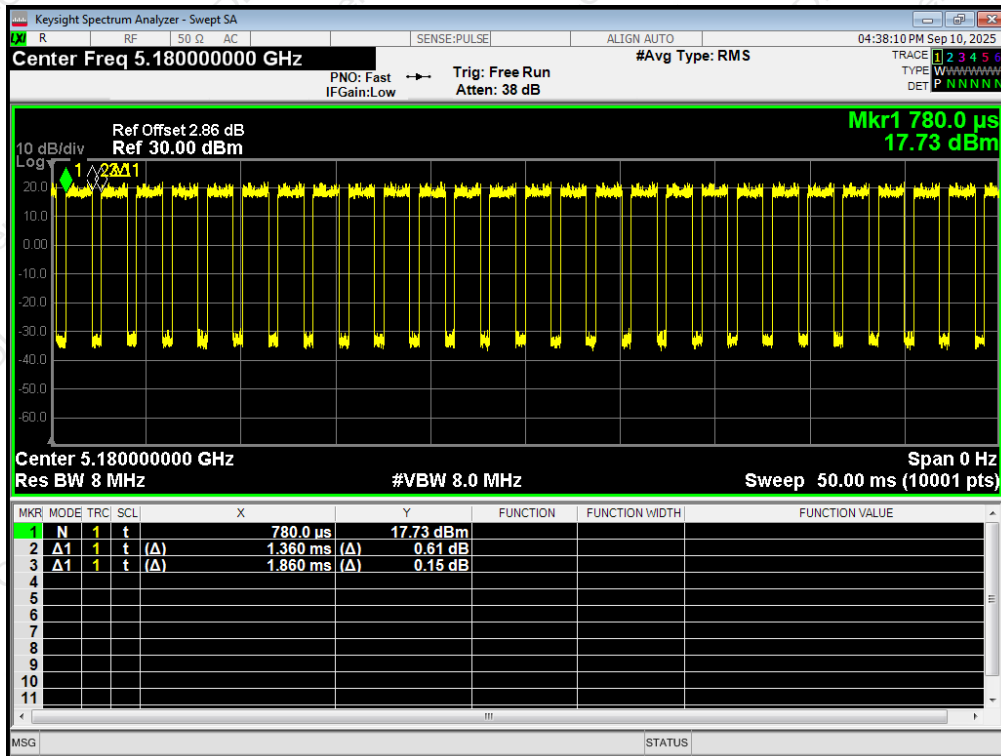
Temperature :	26 °C	Relative Humidity :	54%
Pressure :	1012 hPa	Test Voltage :	DC 5V
Note: All channels have been tested, and only the worst test data is recorded in this report.			

Test Mode	Frequency (MHz)	Duty Cycle (%)	Factor (dB)	Result
802.11a	5180	73.12	1.36	Pass
802.11n20	5180	71.83	1.44	Pass
802.11n40	5190	55.51	2.56	Pass
Note: Duty Cycle= Ton /Total*100% Duty Cycle Correction Factor = 10log (1/Duty Cycle)				

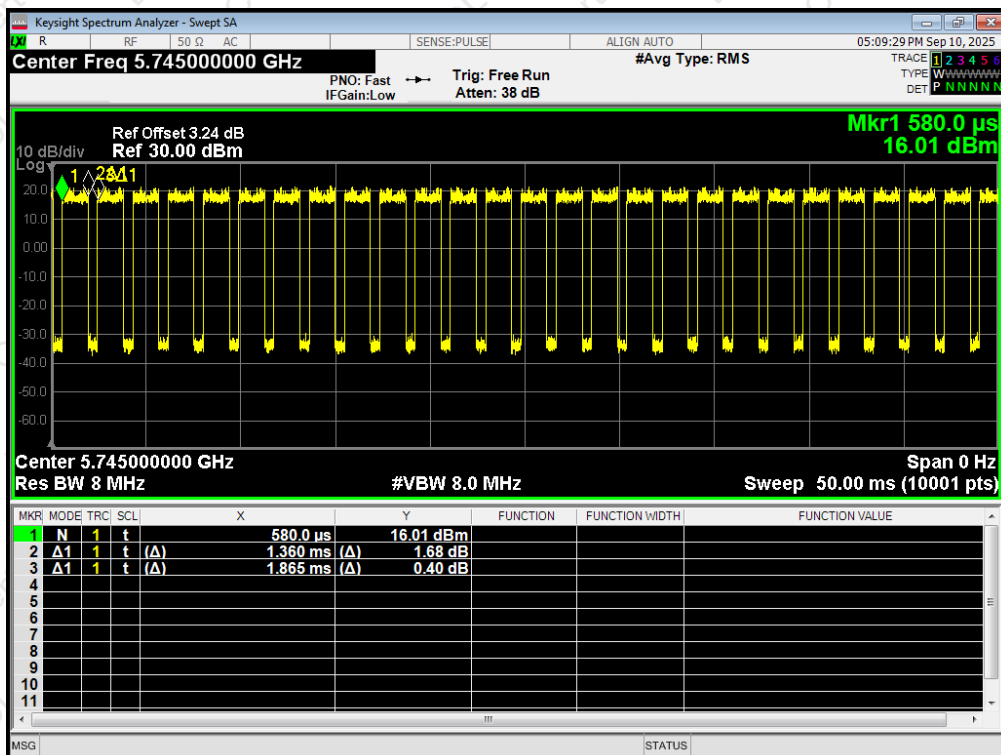
Test Mode	Frequency (MHz)	Duty Cycle (%)	Factor (dB)	Result
802.11a	5745	72.92	1.37	Pass
802.11n20	5745	71.70	1.44	Pass
802.11n40	5755	55.82	2.53	Pass
Note: Duty Cycle= Ton /Total*100% Duty Cycle Correction Factor = 10log (1/Duty Cycle)				



802.11a - 5180MHz



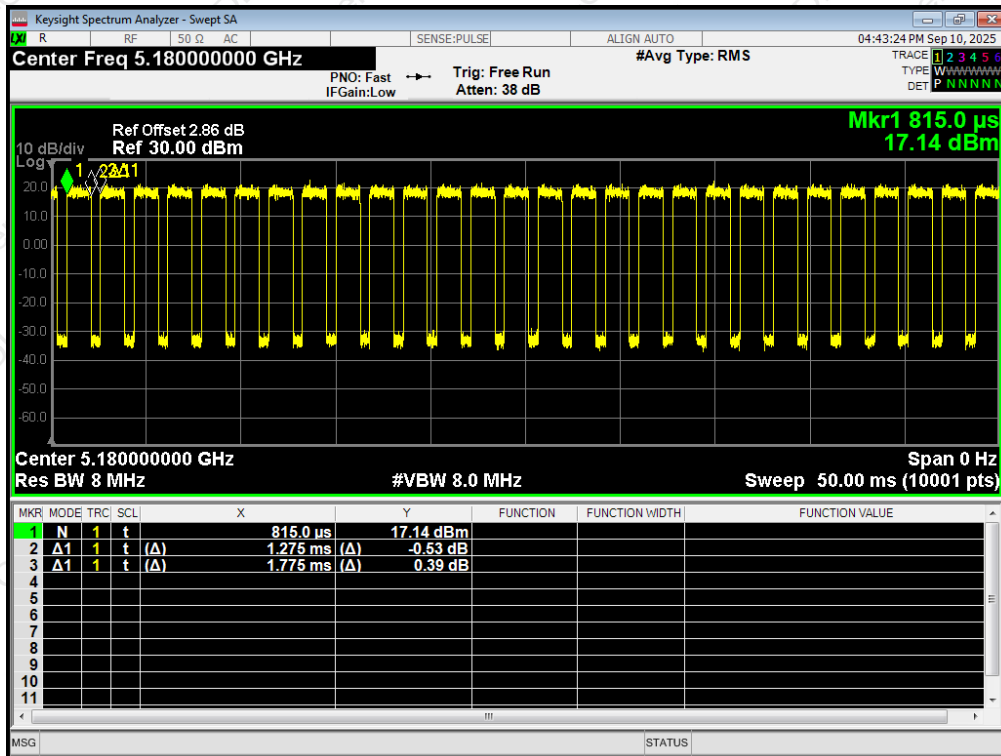
802.11a - 5745MHz



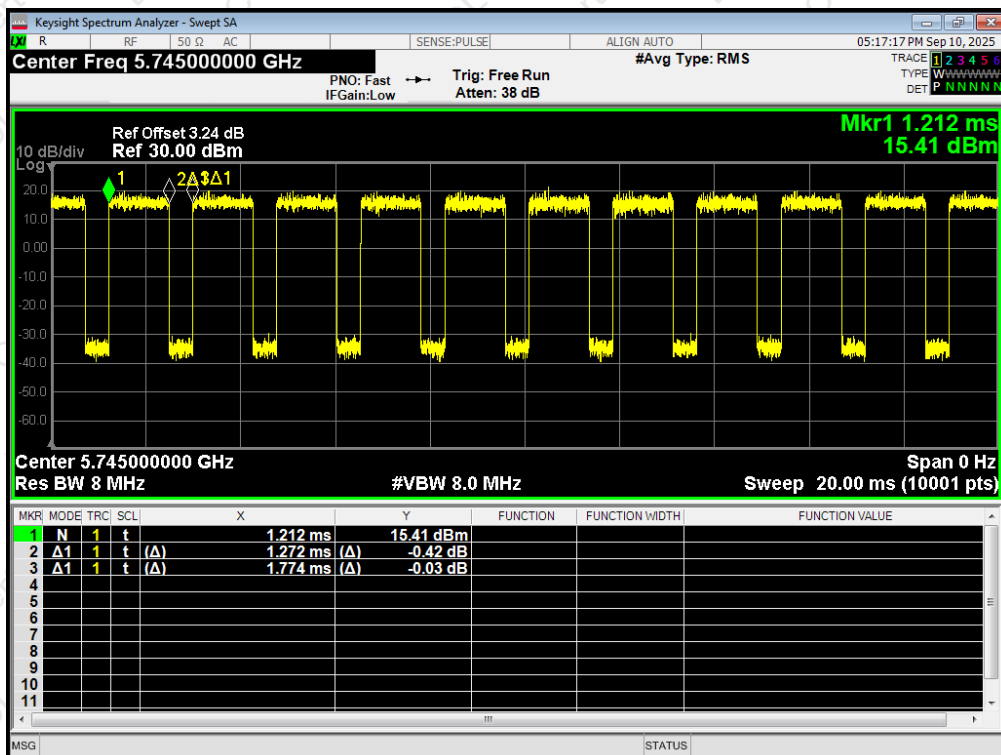
Note: All channel have been tested, and the report only reflects the worst case data.



802.11n20 - 5180MHz



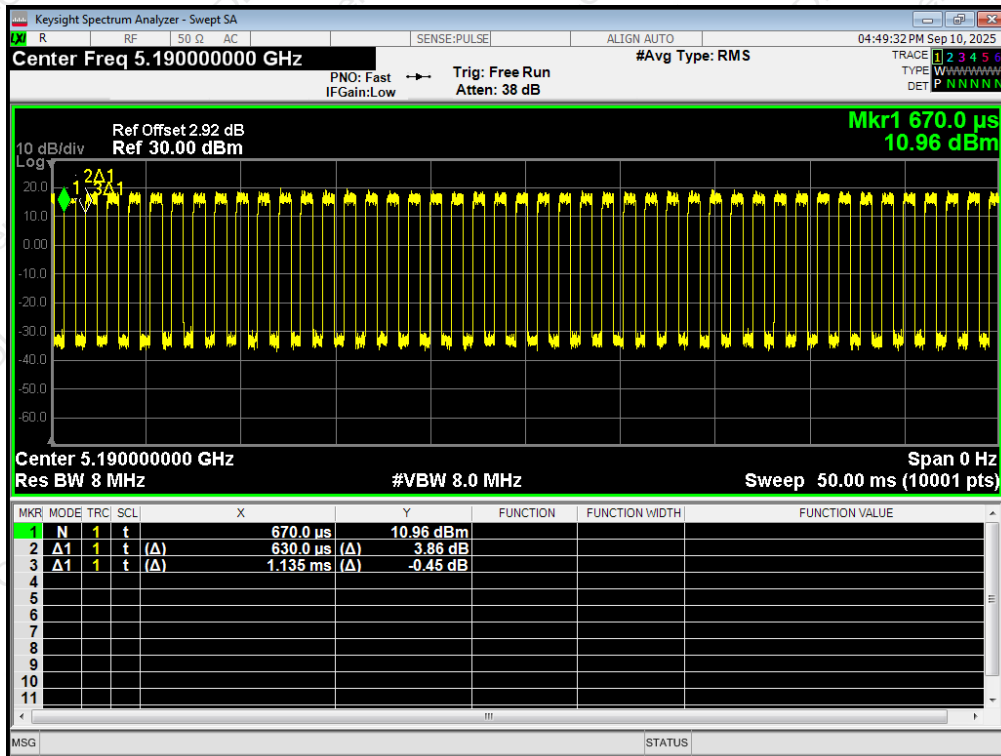
802.11n20 - 5745MHz



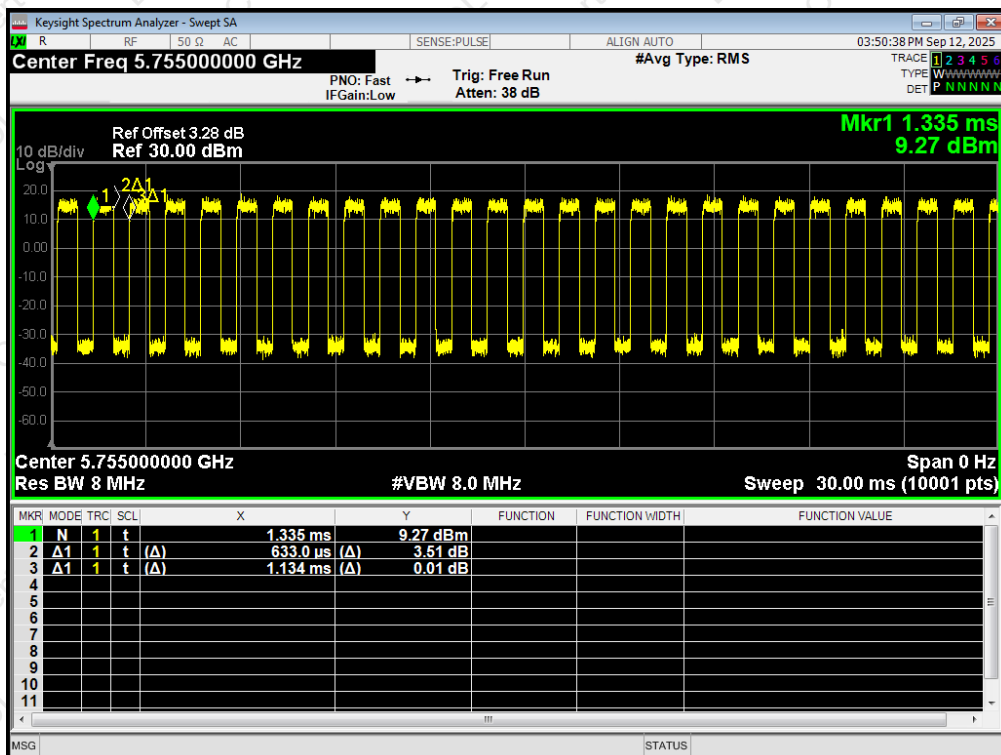
Note: All channel have been tested, and the report only reflects the worst case data.



802.11n40 - 5190MHz



802.11n40 - 5755MHz



Note: All channel have been tested, and the report only reflects the worst case data.

**11. ANTENNA REQUIREMENT**

Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.	
EUT Antenna:	
The antenna is PCB Antenna, the best case gain of the antenna is 2.01dBi for 5.2G and 2.03dBi for 5.8G, reference to the appendix II for details.	



12. TEST SETUP PHOTO

Reference to the appendix I for details.

13. EUT CONSTRUCTIONAL DETAILS

Reference to the appendix II for details.

***** END OF REPORT *****