

12 AC power-line conducted emissions

12.1 Definition

Line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network.

12.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Screen Room 2
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.2
EUT Channels:	5250 MHz
Deviations From Standard:	None
Measurement Detectors:	Quasi-Peak and Average

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 40 % RH	20 % RH to 75 % RH (as declared)

12.3 Test Limit

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in Table 3.

Table 3 – AC Power Line Conducted Emission Limits

<i>Frequency (MHz)</i>	<i>Conducted limit (dBμV)</i>	
	<i>Quasi-Peak</i>	<i>Average**</i>
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

*The level decreases linearly with the logarithm of the frequency.

**A linear average detector is required.

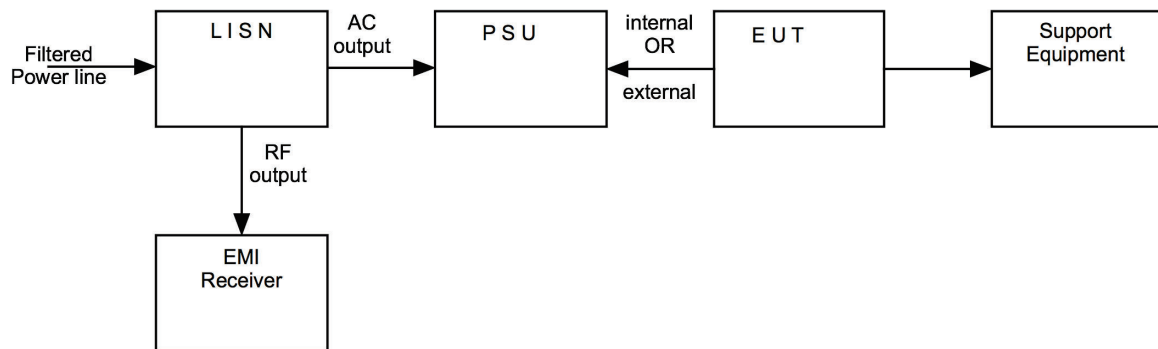
12.4 Test Method

With the EUT setup in a screened room, as per section 9 of this report and connected as per Figure ii, the power line emissions were measured on a spectrum analyzer / EMI receiver.

AC power line conducted emissions from the EUT are checked first by preview scans with peak and average detectors covering both live and neutral lines. A spectrum analyzer is used to determine if any periodic emissions are present.

Formal measurements using the correct detector(s) and bandwidth are made on frequencies identified from the preview scans. Final measurements were performed with EUT set at its maximum duty in transmit and receive modes.

Figure ii Test Setup



12.5 Test Set-up Photograph



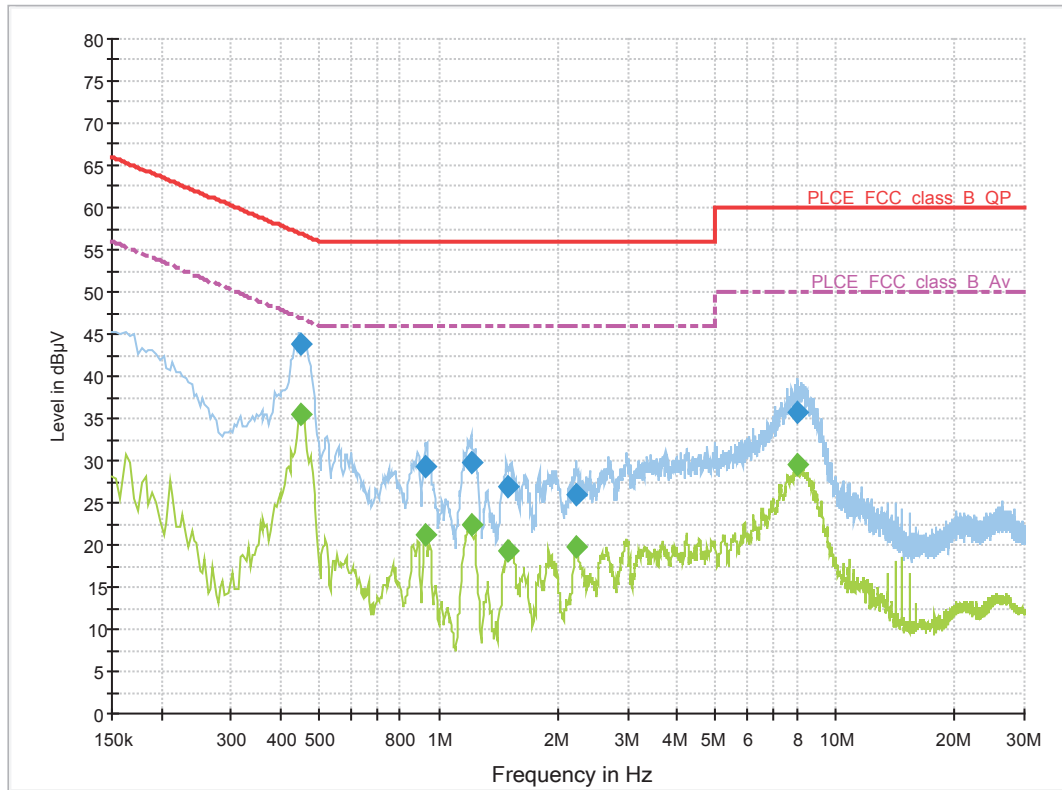
12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Measuring Receiver	R&S	ESHS10	RFG125	2022-03-29
LISN	R&S	ESH3-Z5	RFG732	2021-05-18
Pulse Limiter	R&S	ESH3-Z2	RFG680	2021-06-09

12.7 Test Results

<i>AC power-line conducted emissions, Transmit mode</i>						
<i>Results measured using the average detector</i>						
<i>Reference Number</i>	<i>Frequency (MHz)</i>	<i>Conductor</i>	<i>Result (dBuV)</i>	<i>Specification Limit (dBuV)</i>	<i>Margin (dB)</i>	<i>Result Summary</i>
1	0.449	L1	35.5	46.9	11.4	PASS
2	0.929	L1	21.2	46.0	24.8	PASS
3	1.209	L1	22.5	46.0	23.6	PASS
4	1.501	L1	19.3	46.0	26.7	PASS
5	2.229	L1	19.8	46.0	26.2	PASS
6	8.005	L1	29.6	50.0	20.4	PASS

<i>Results measured using the quasi-peak detector</i>						
<i>Reference Number</i>	<i>Frequency (MHz)</i>	<i>Conductor</i>	<i>Result (dBuV)</i>	<i>Specification Limit (dBuV)</i>	<i>Margin (dB)</i>	<i>Result Summary</i>
1	0.449	L1	43.8	56.9	13.1	PASS
2	0.929	L1	29.3	56.0	26.7	PASS
3	1.209	L1	29.7	56.0	26.3	PASS
4	1.501	L1	26.9	56.0	29.1	PASS
5	2.229	L1	26.1	56.0	29.9	PASS
6	8.005	L1	35.7	60.0	24.3	PASS



13 Occupied Bandwidth

13.1 Definition

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal.

13.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Laboratory 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 6.9
EUT Channel Bandwidths:	20 MHz, 40 MHz & 80 MHz
EUT Test Modulations:	802.11a/n/ac
Deviations From Standard:	None
Measurement BW:	390 kHz / 510 kHz / 1 MHz
Spectrum Analyzer Video BW:	4 MHz / 5 MHz / 8 MHz
Measurement Span:	40 MHz / 80 MHz / 160 MHz
Measurement Detector:	Peak

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 °C to +35 °C (as declared)
Humidity: 42 %RH	20%RH to 75%RH (as declared)

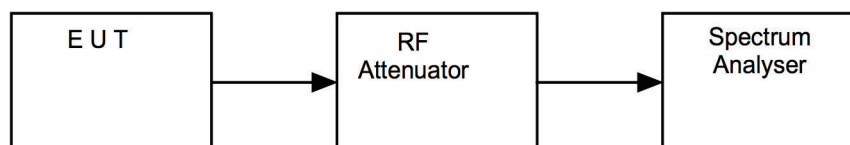
Test Limits

No limits are defined in the standard. Bandwidth is required to calculate the power limits.

13.3 Test Method

With the EUT connected as per Figure iii, the bandwidth of the EUT was measured on a spectrum analyser. The measurements were performed with EUT set at its maximum duty. All modulation schemes, data rates and power settings were used to observe the worst-case configuration in each bandwidth.

Figure iii Test Setup

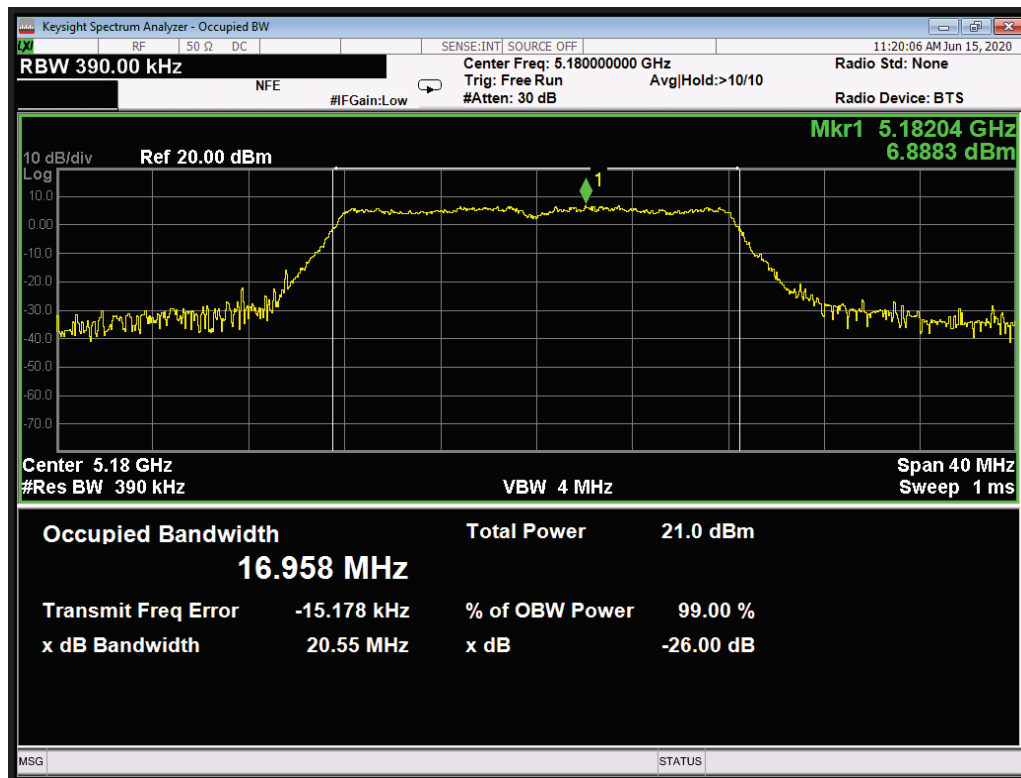


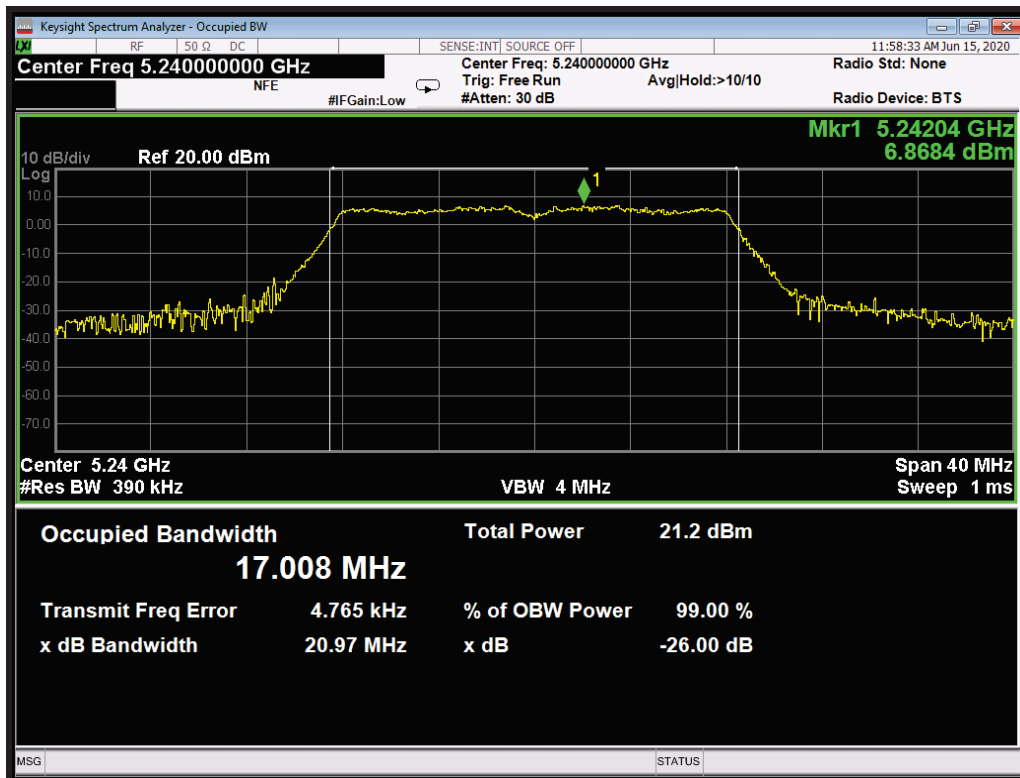
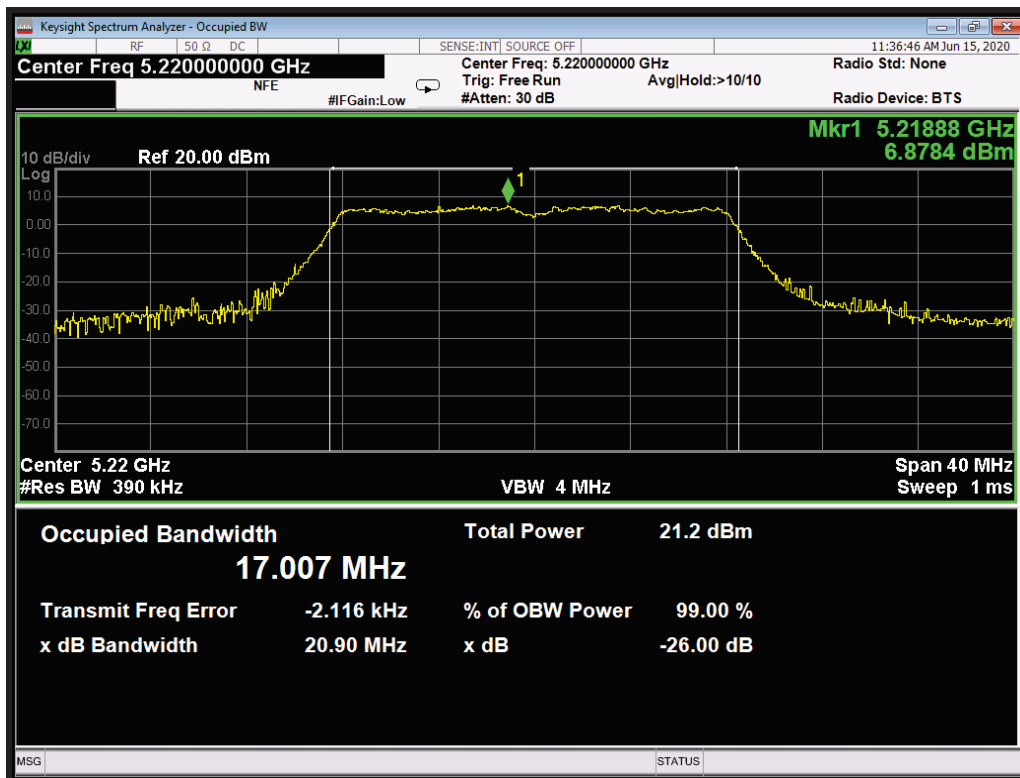
13.4 Test Equipment

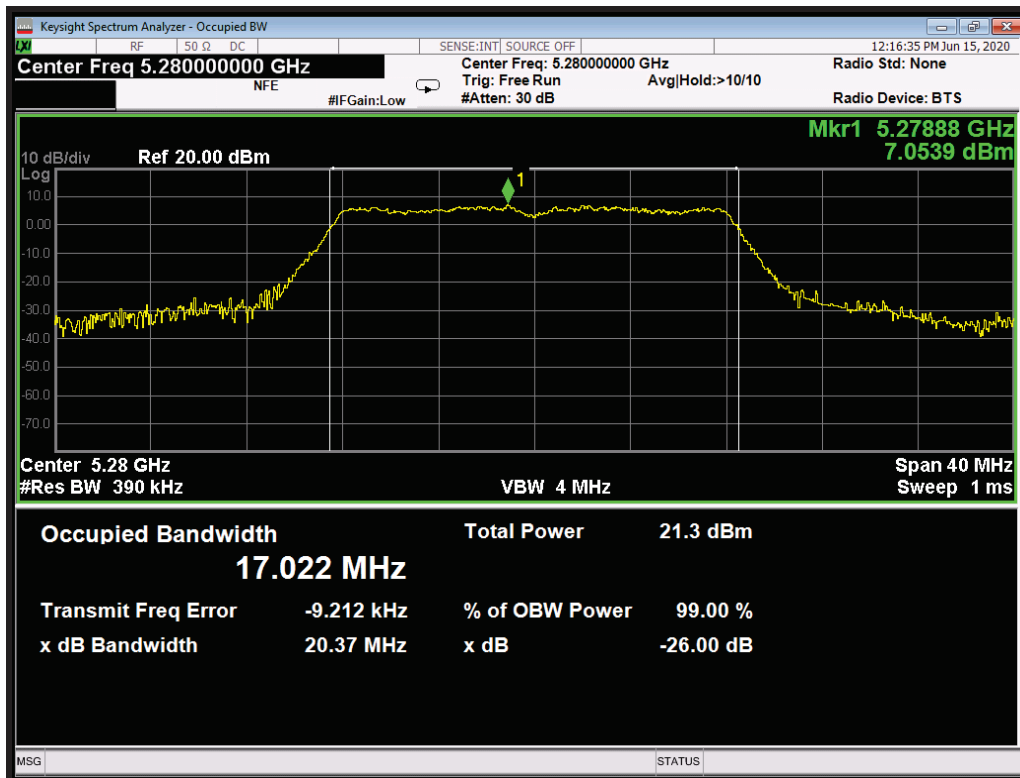
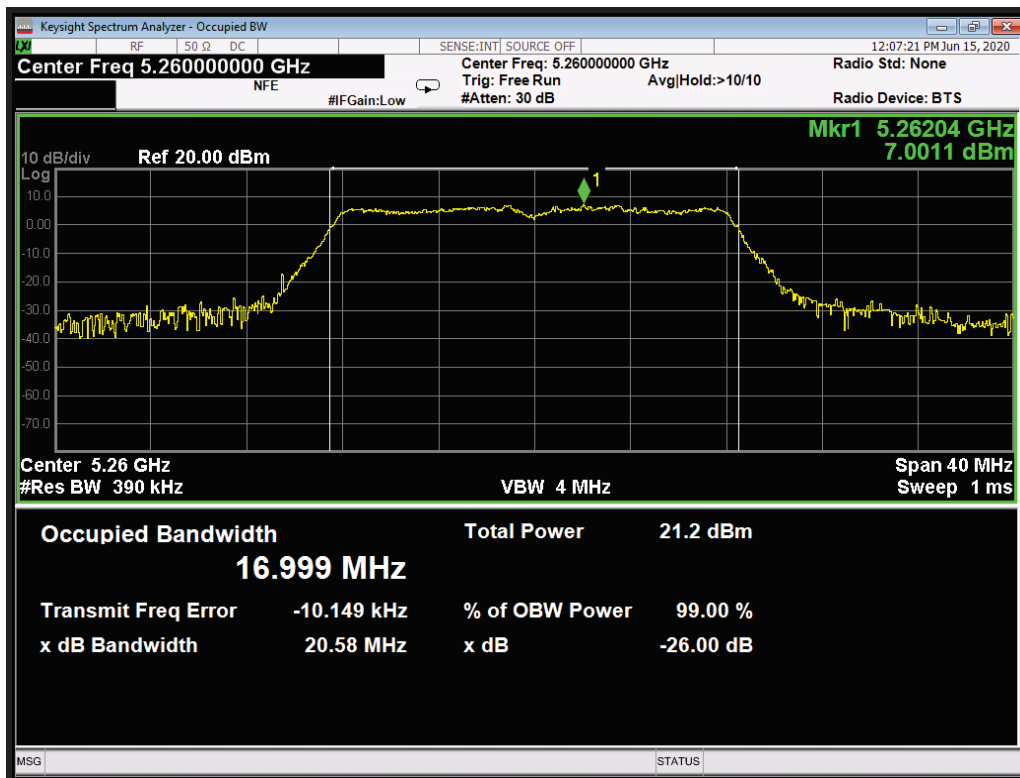
<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Due For Calibration</i>
Spectrum Analyser	Agilent	N9030A	REF2167	2021-08-19
Power Supply	Farnell	LT30-2	RFG035	Cal with REF887
Multimeter	Agilent	34405A	REF887	2021-10-12

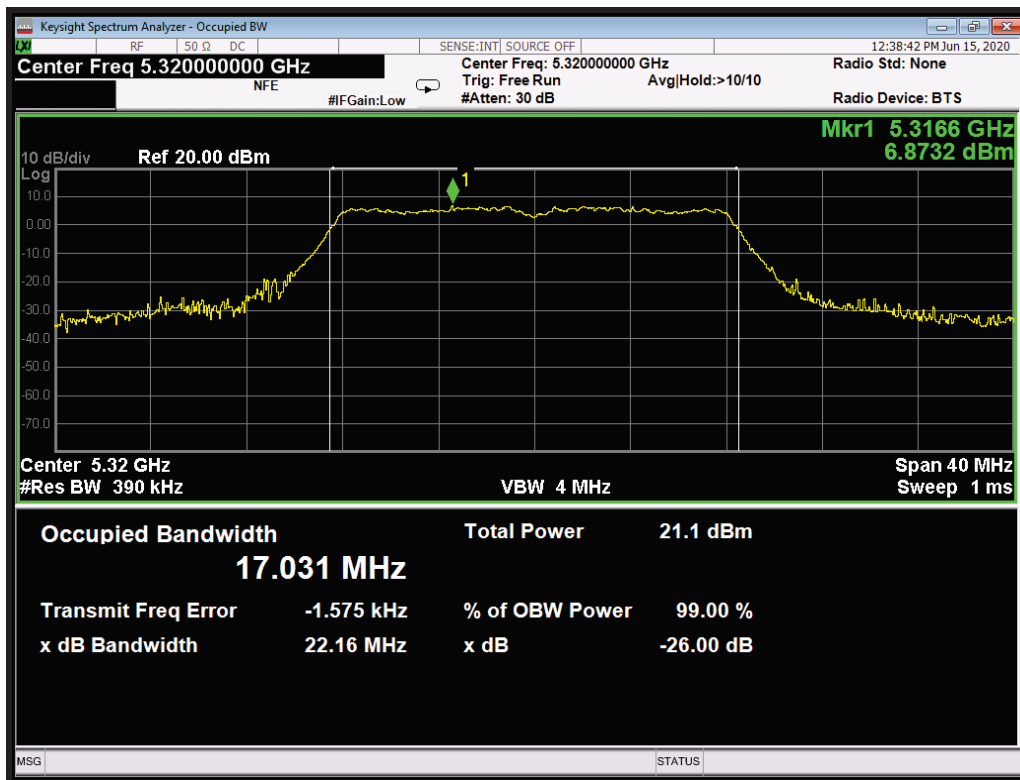
13.5 Test Results

Modulation: 802.11a; Data rate: 6 Mbit/s; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.55	16.958	N/A
5220	20.90	17.007	N/A
5240	20.97	17.008	N/A
5260	20.58	16.999	N/A
5280	20.37	17.022	N/A
5320	22.16	17.031	N/A

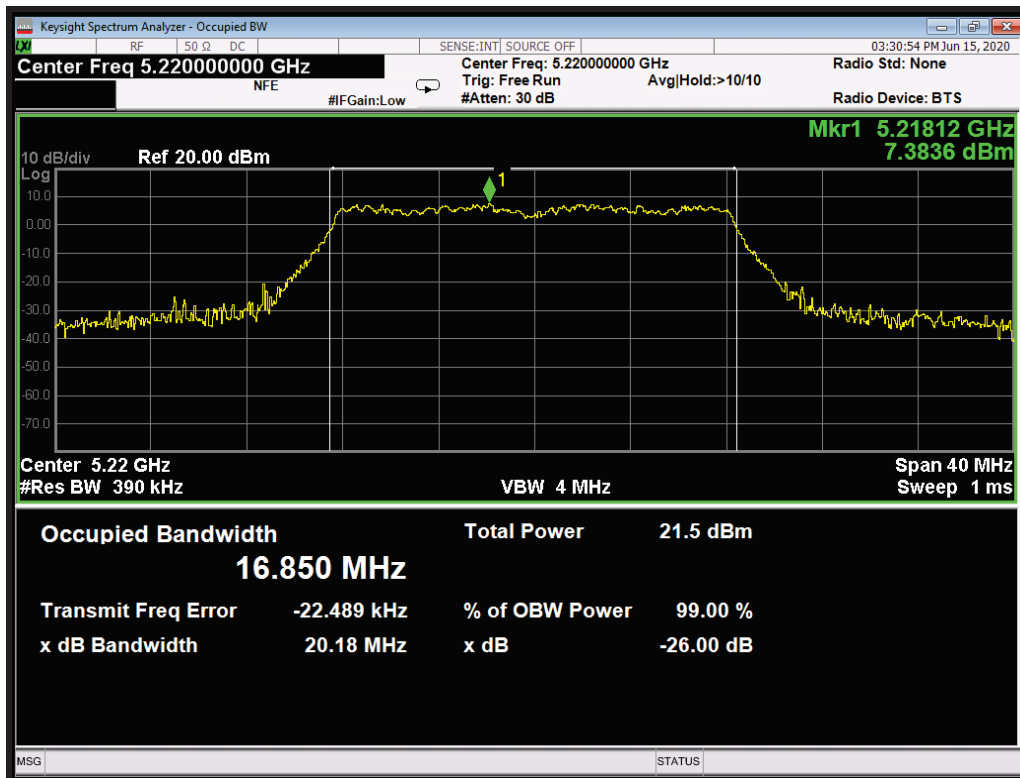
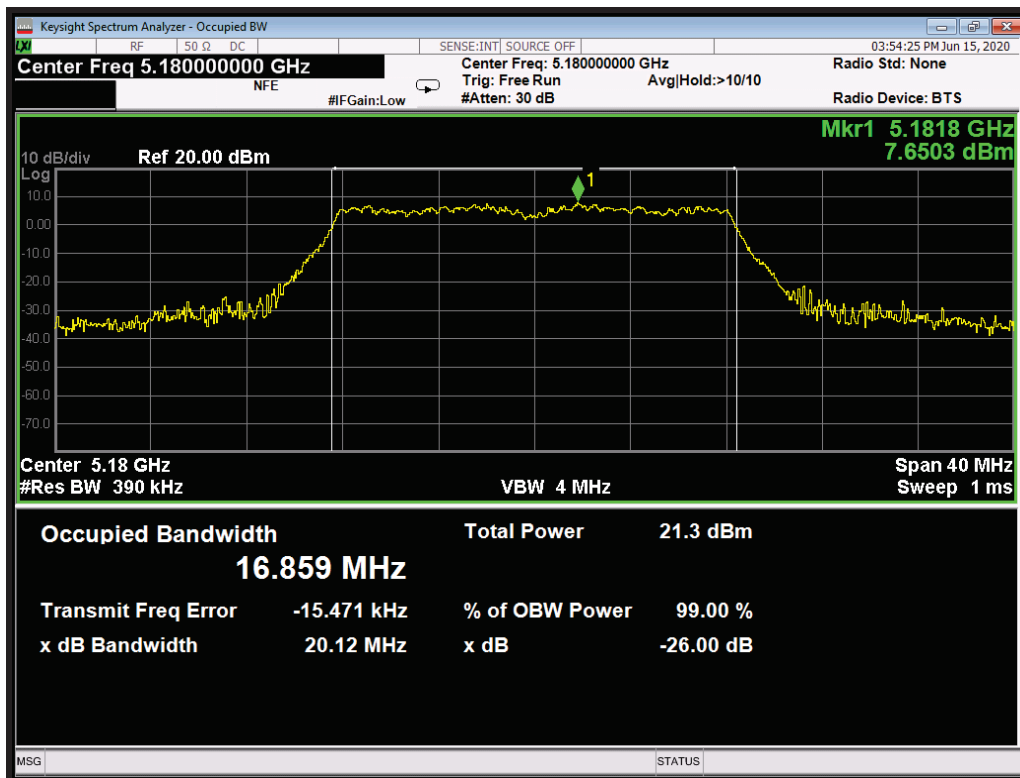


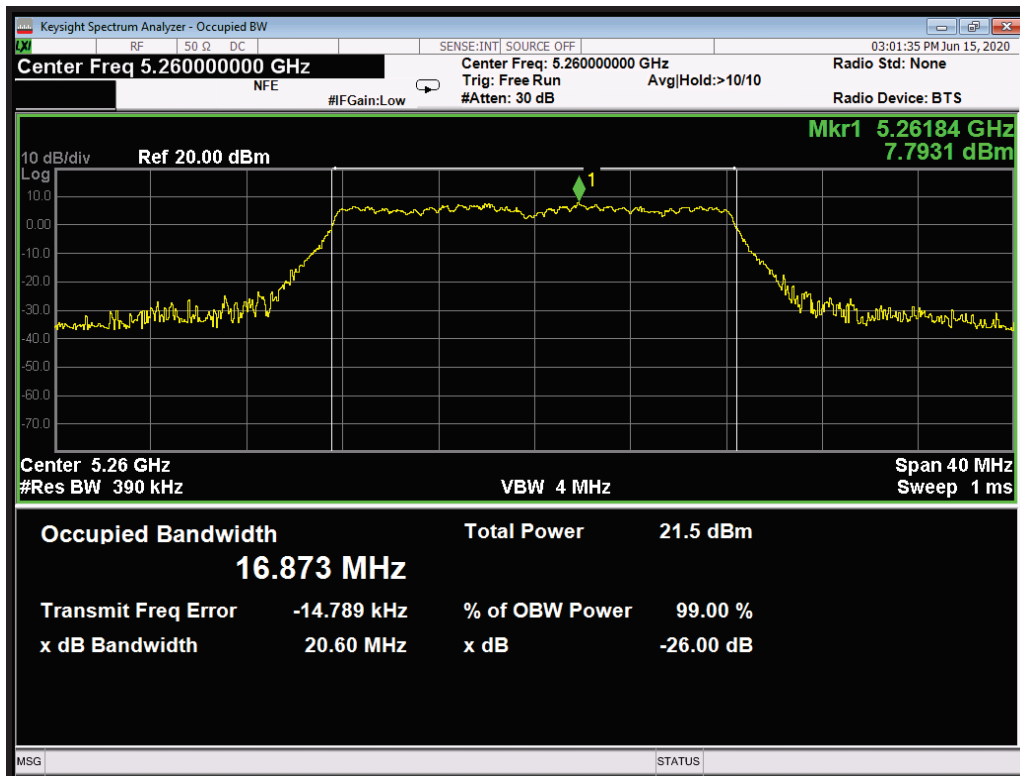
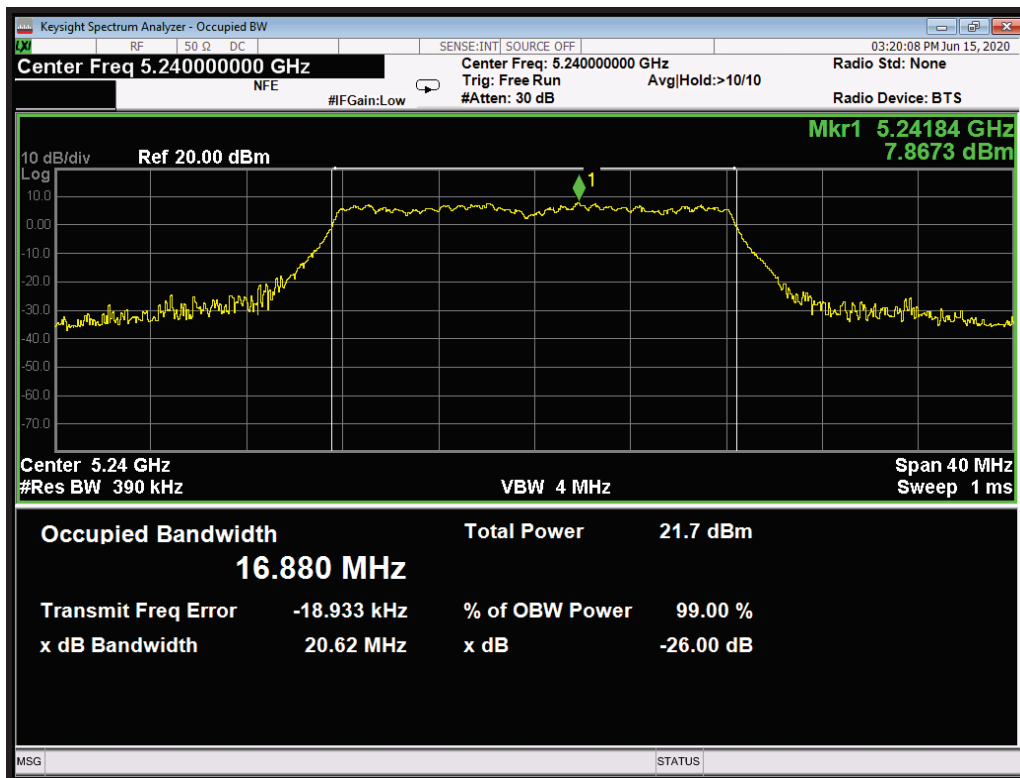


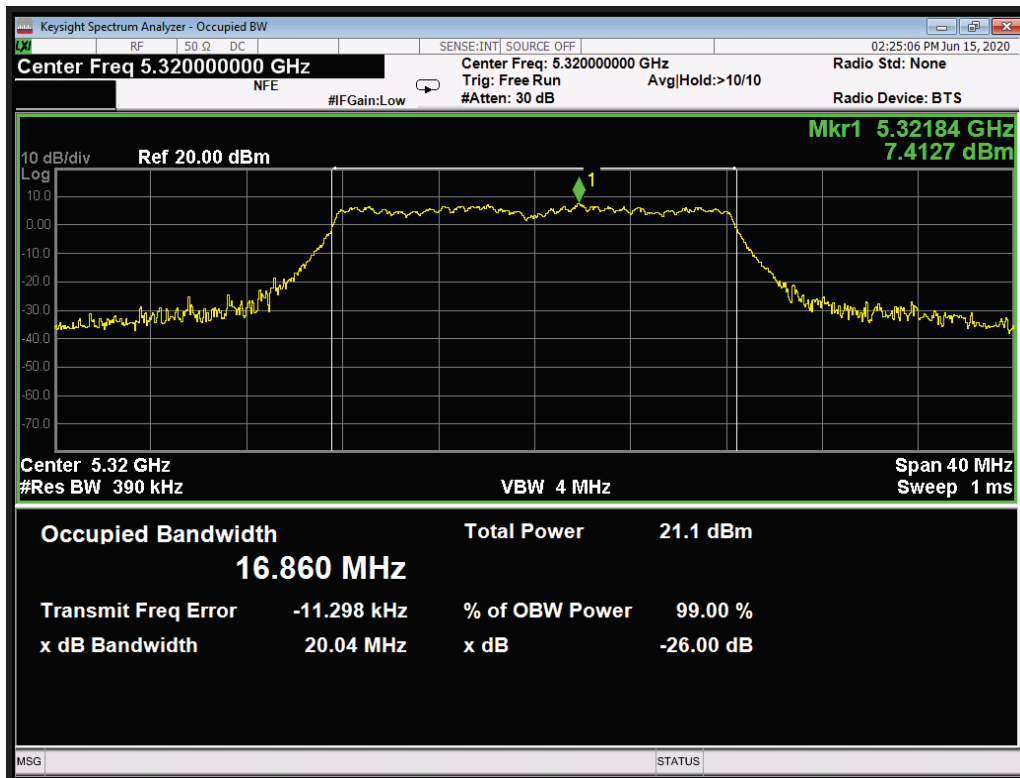
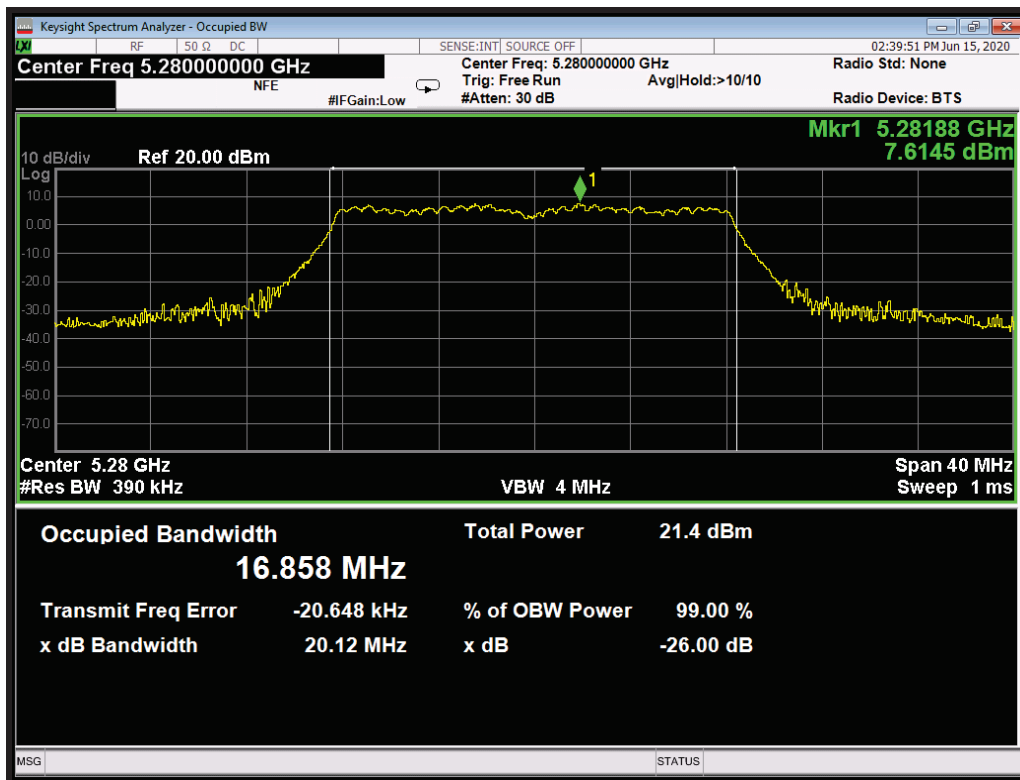




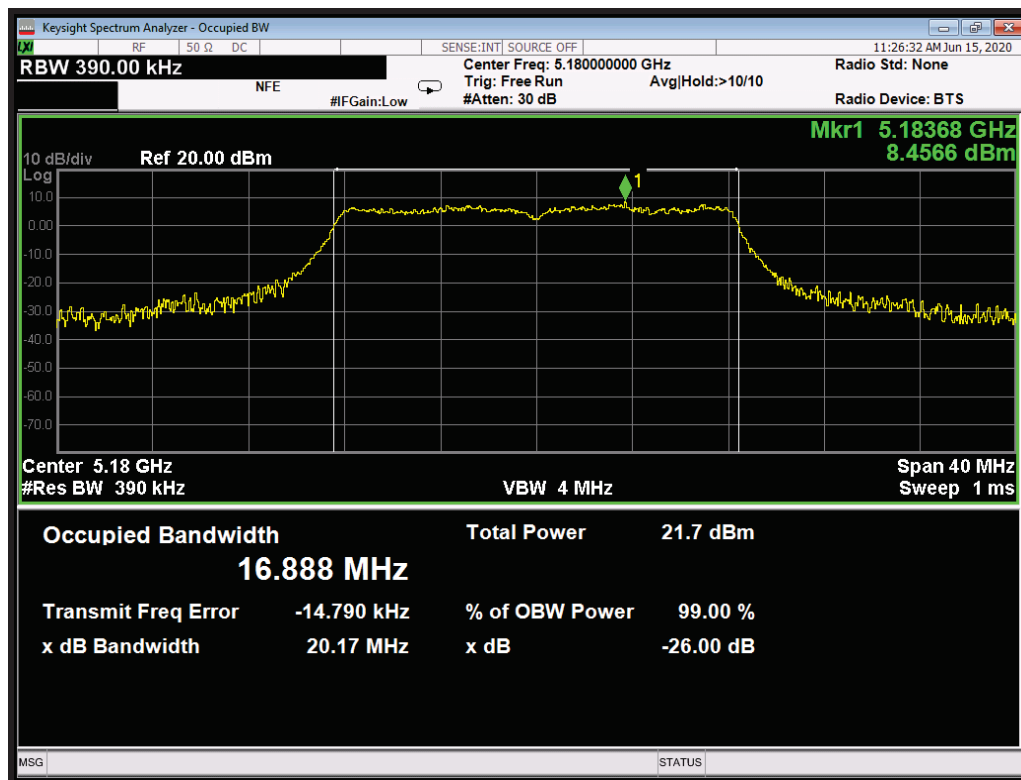
Modulation: 802.11a; Data rate: 6 Mbit/s; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.12	16.859	N/A
5220	20.18	16.850	N/A
5240	20.62	16.880	N/A
5260	20.60	16.873	N/A
5280	20.12	16.858	N/A
5320	20.04	16.860	N/A

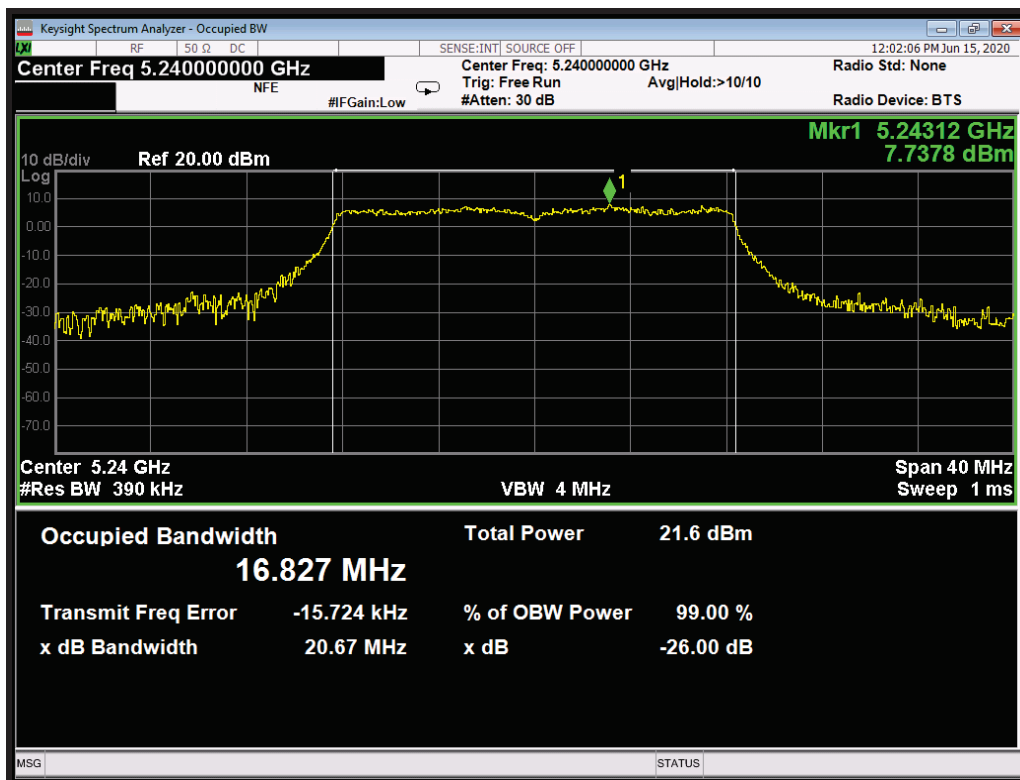
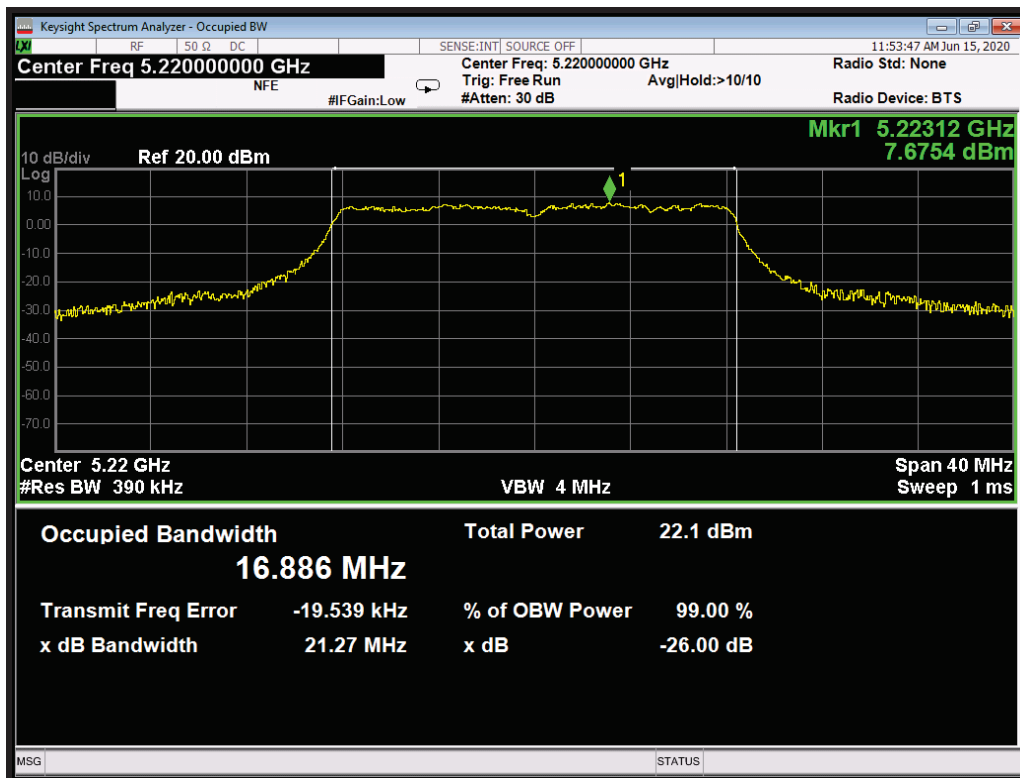


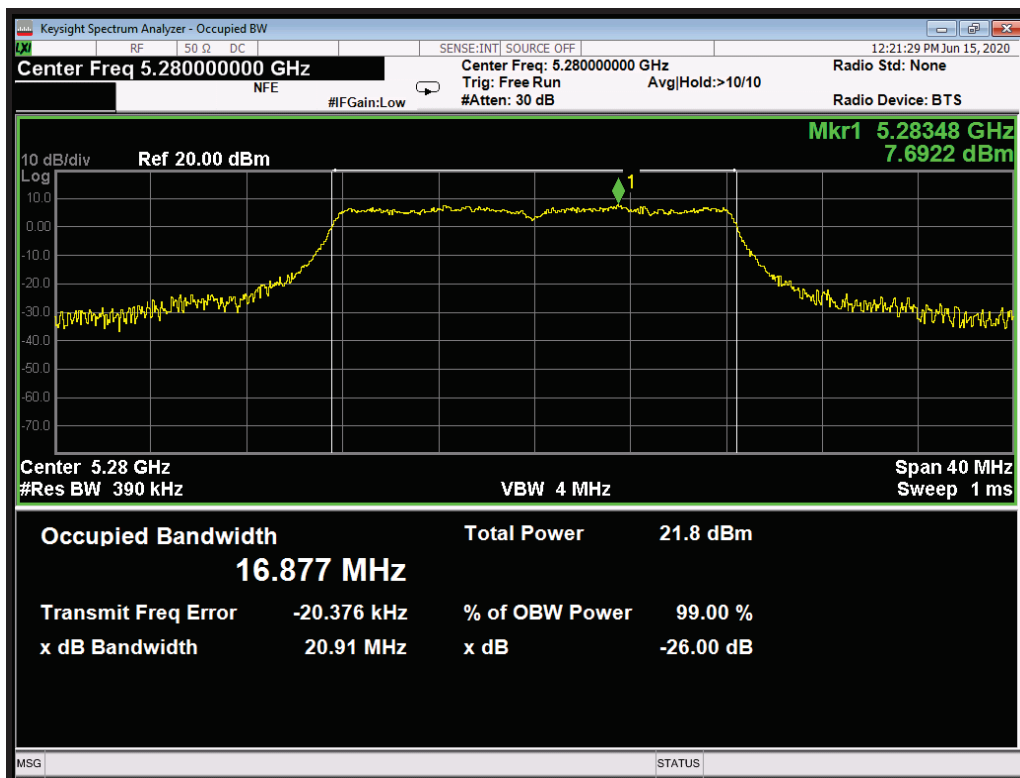
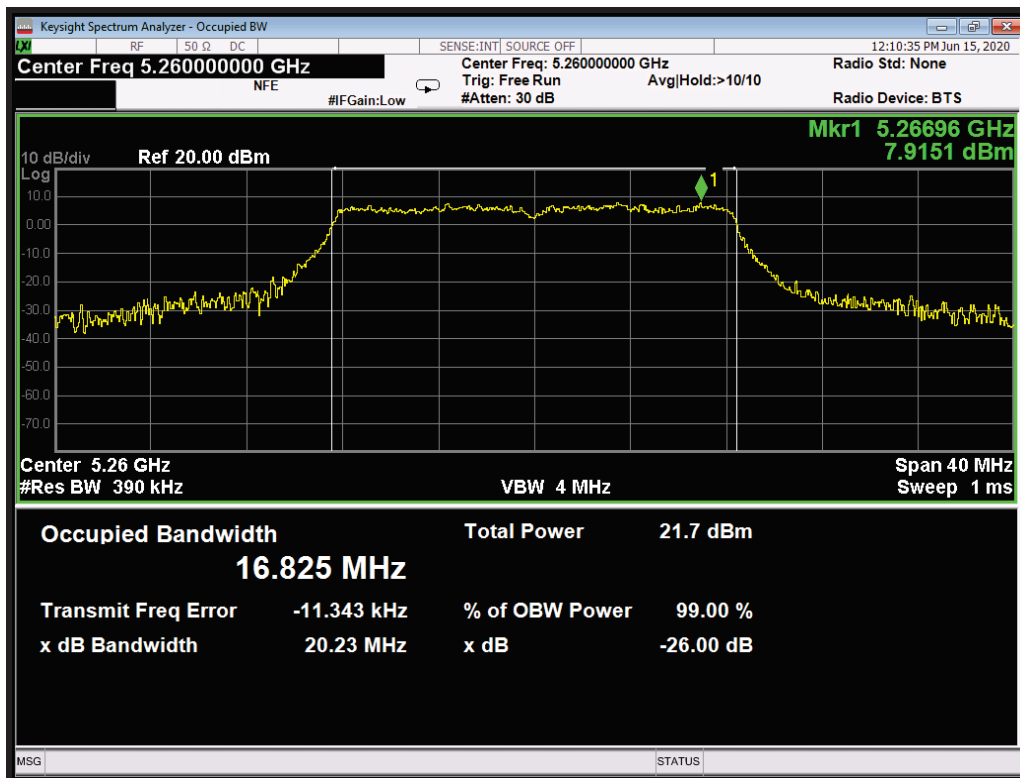


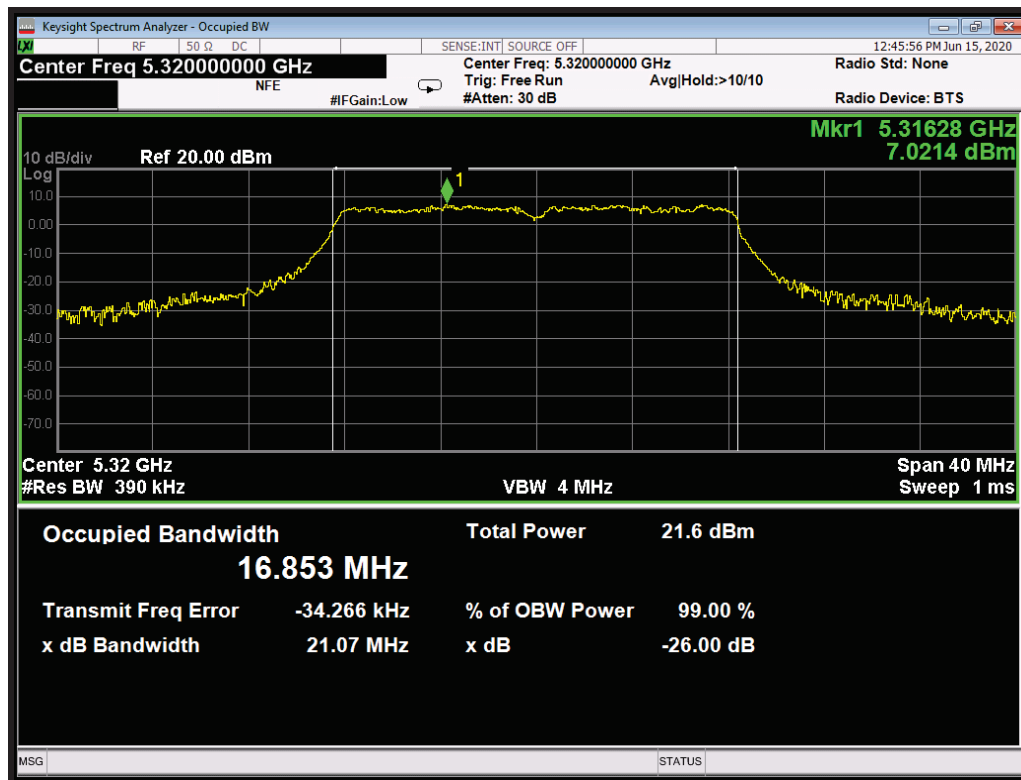


Modulation: 802.11a; Data rate: 54 Mbit/s; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.17	16.888	N/A
5220	21.27	16.886	N/A
5240	20.67	16.827	N/A
5260	20.23	16.825	N/A
5280	20.91	16.877	N/A
5320	21.07	16.853	N/A

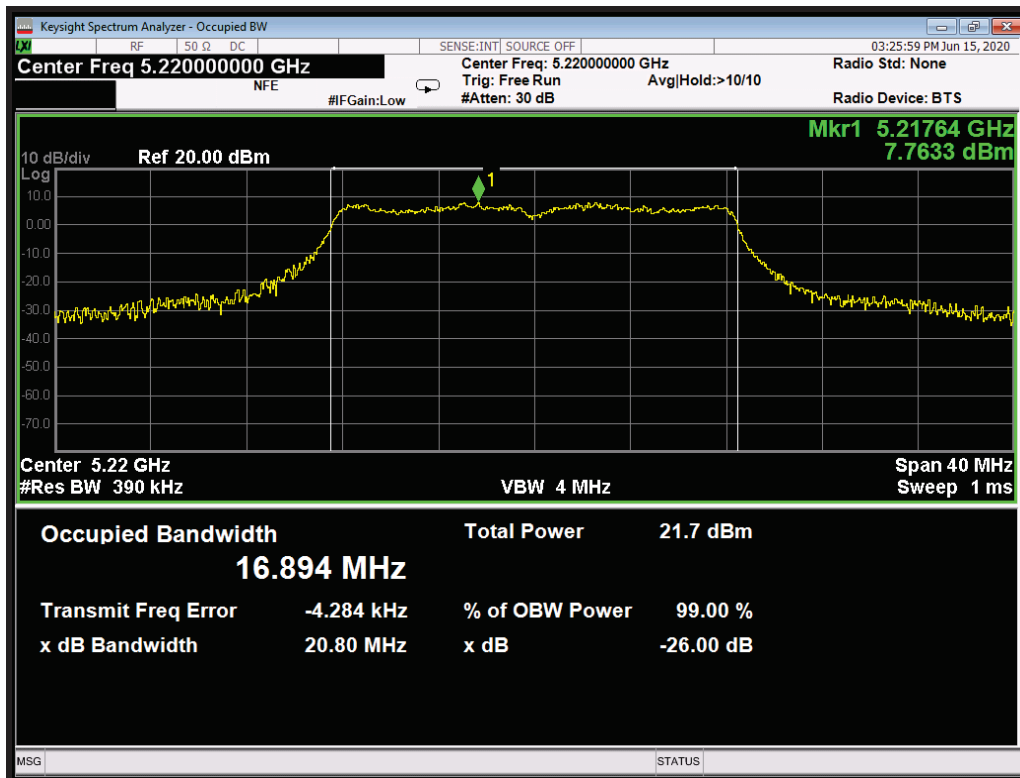
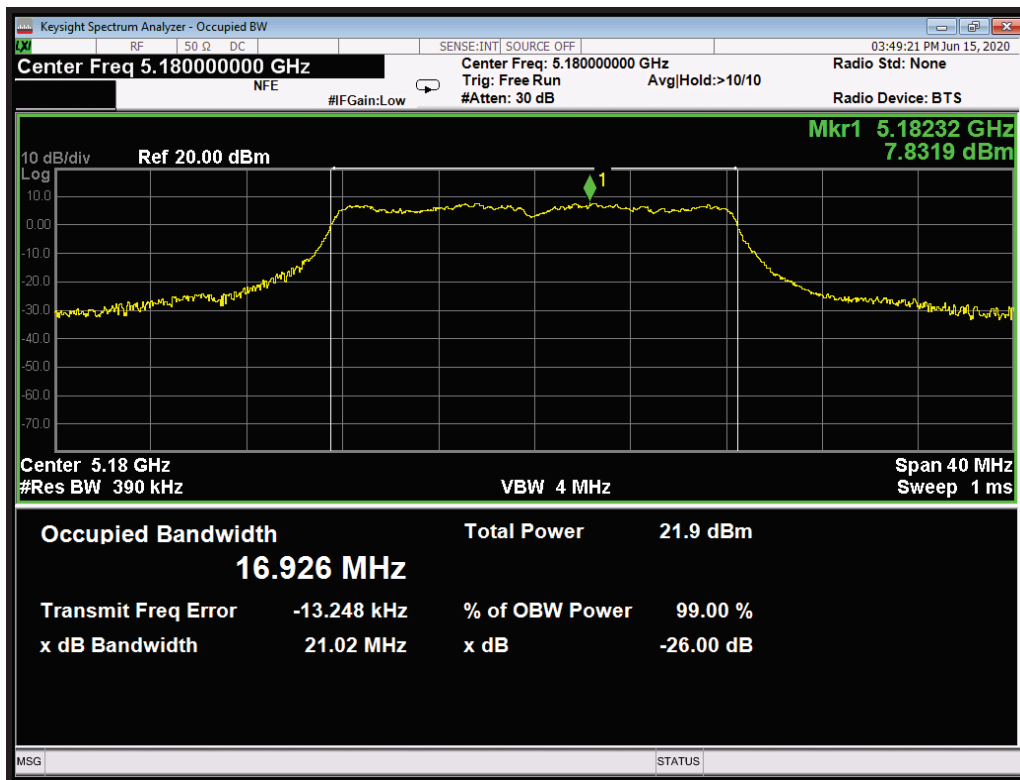


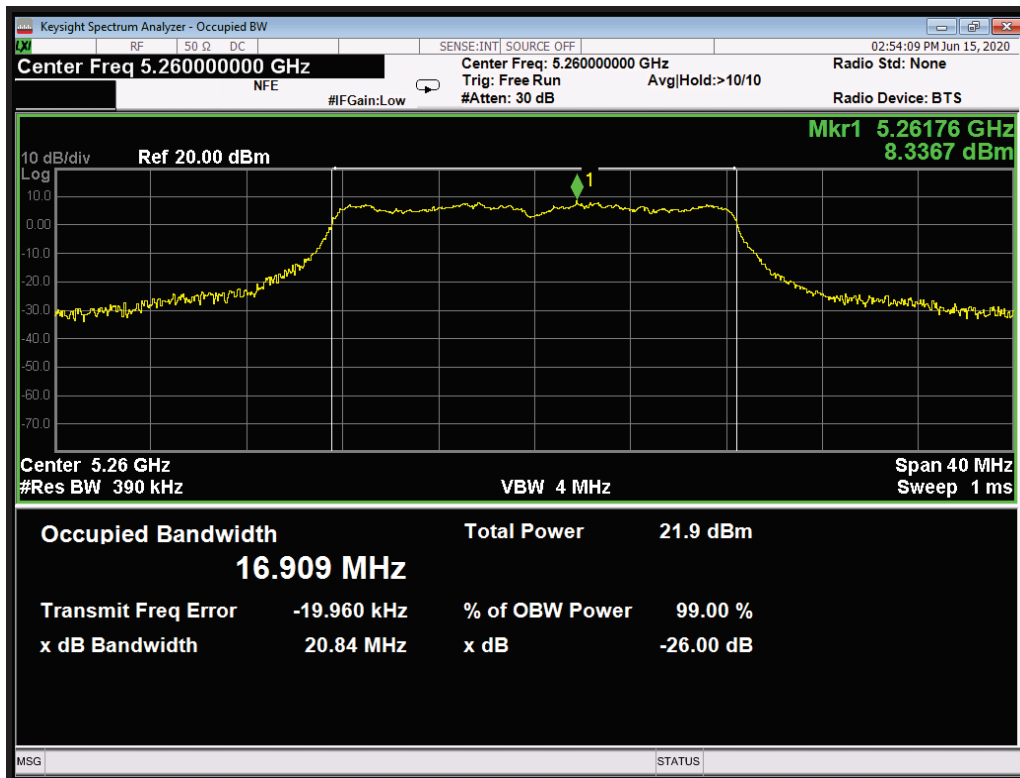
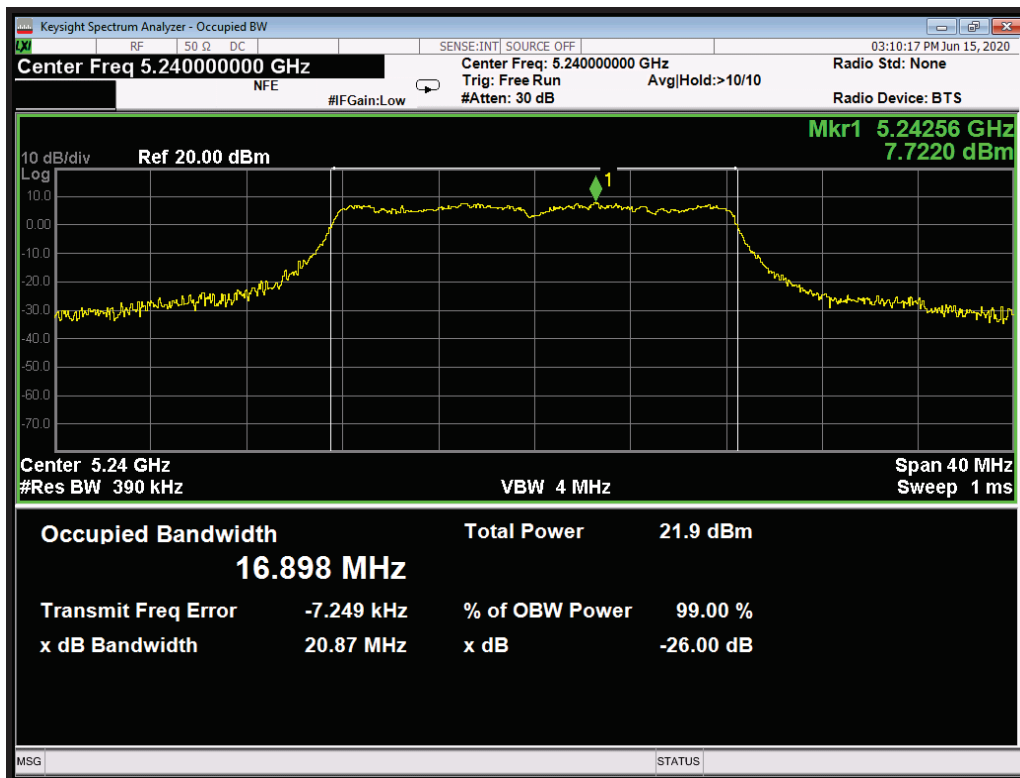


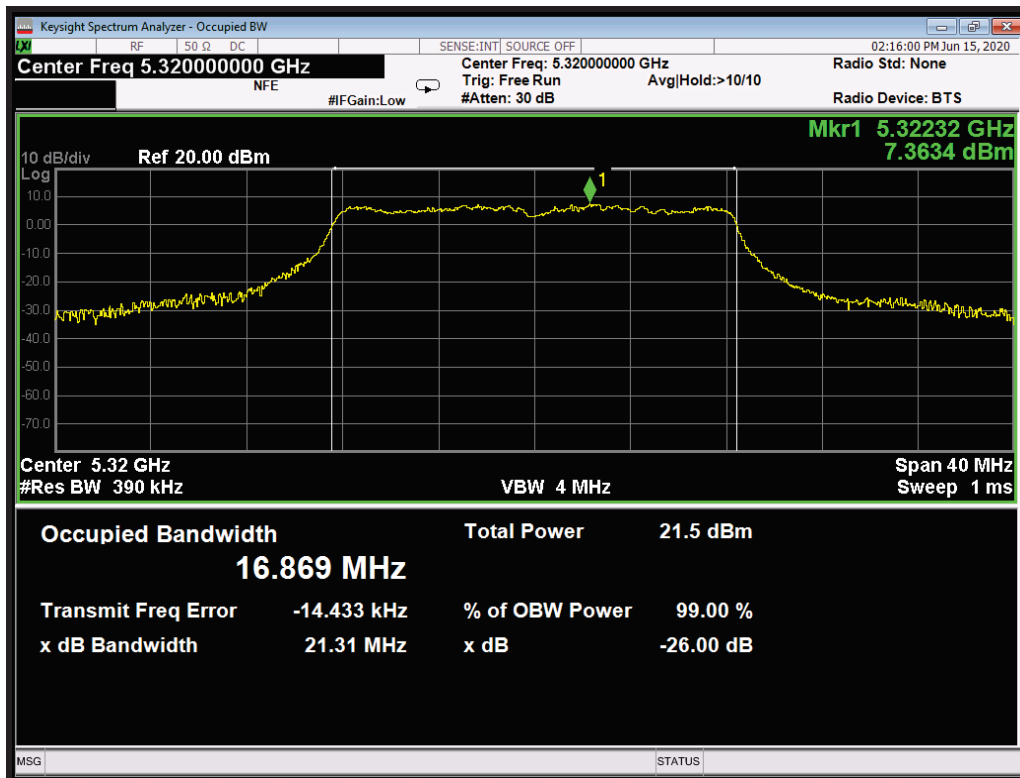
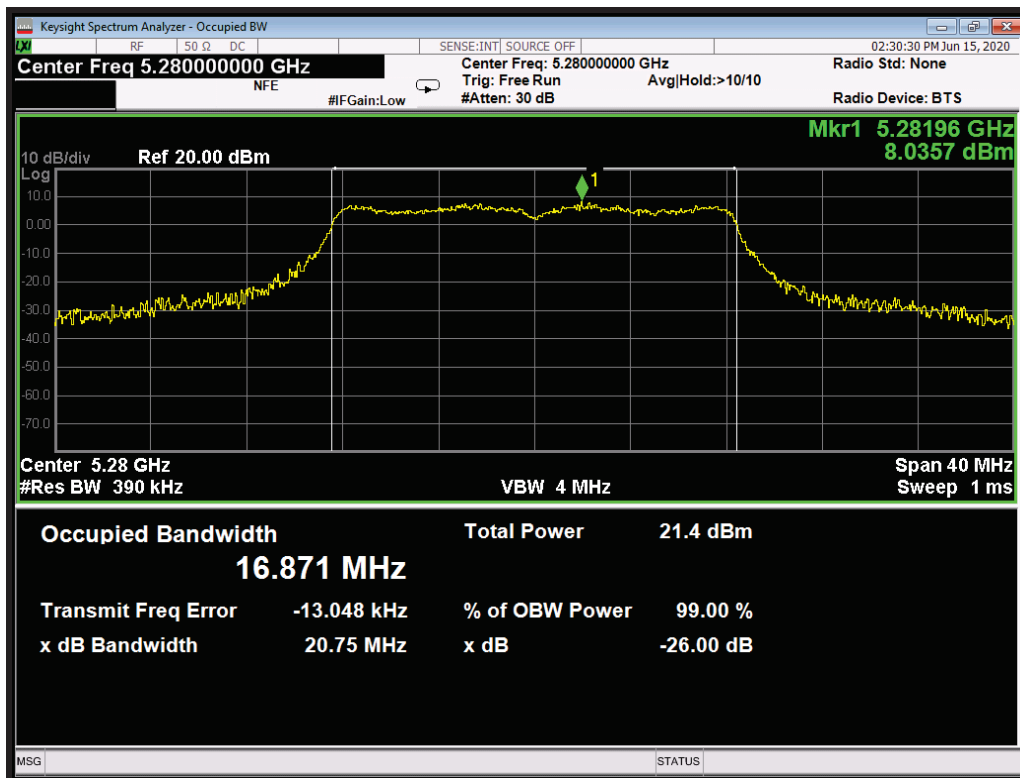




Modulation: 802.11a; Data rate: 54 Mbit/s; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	21.02	16.926	N/A
5220	20.80	16.894	N/A
5240	20.87	16.898	N/A
5260	20.84	16.909	N/A
5280	20.75	16.871	N/A
5320	20.31	16.869	N/A

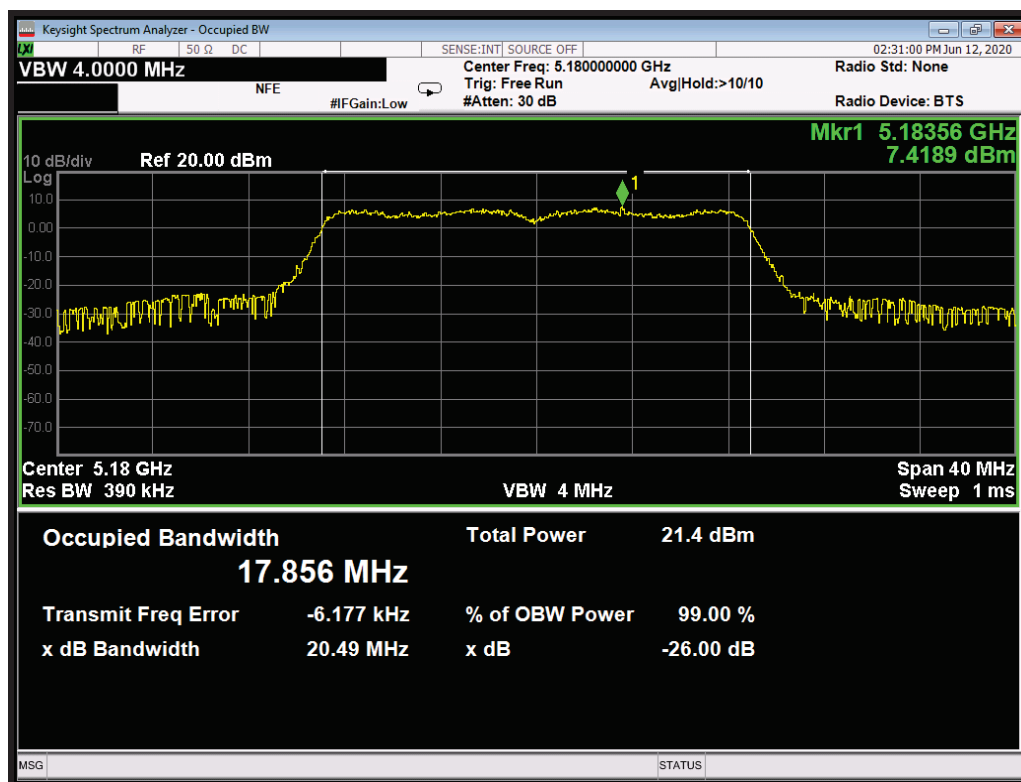


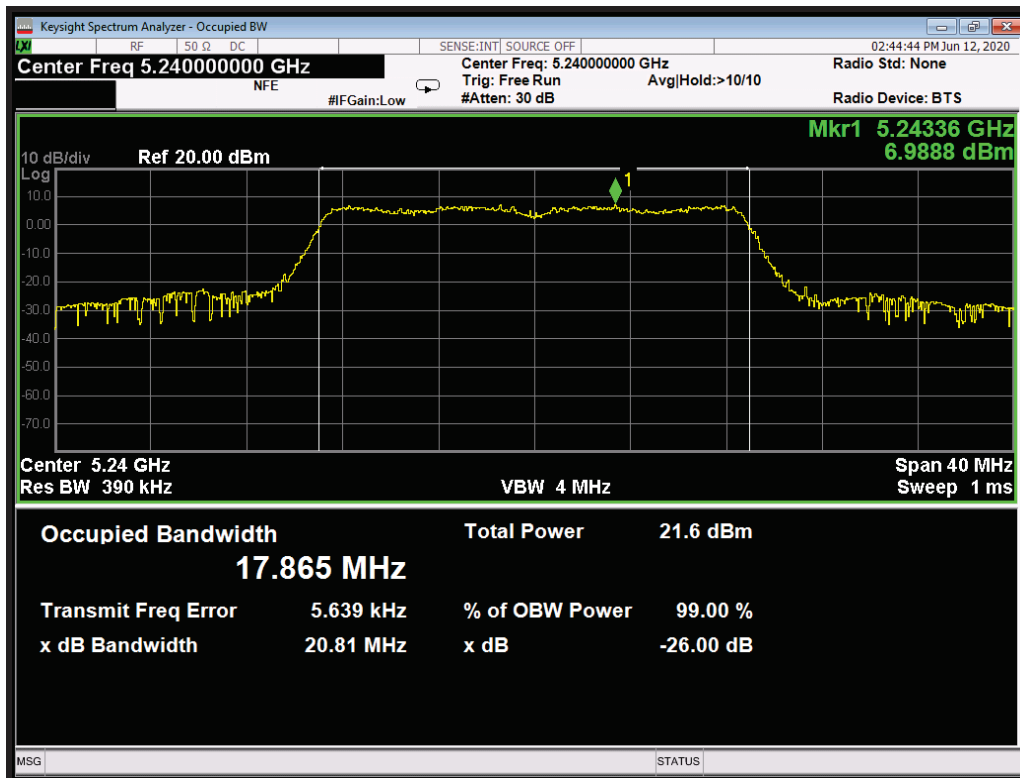
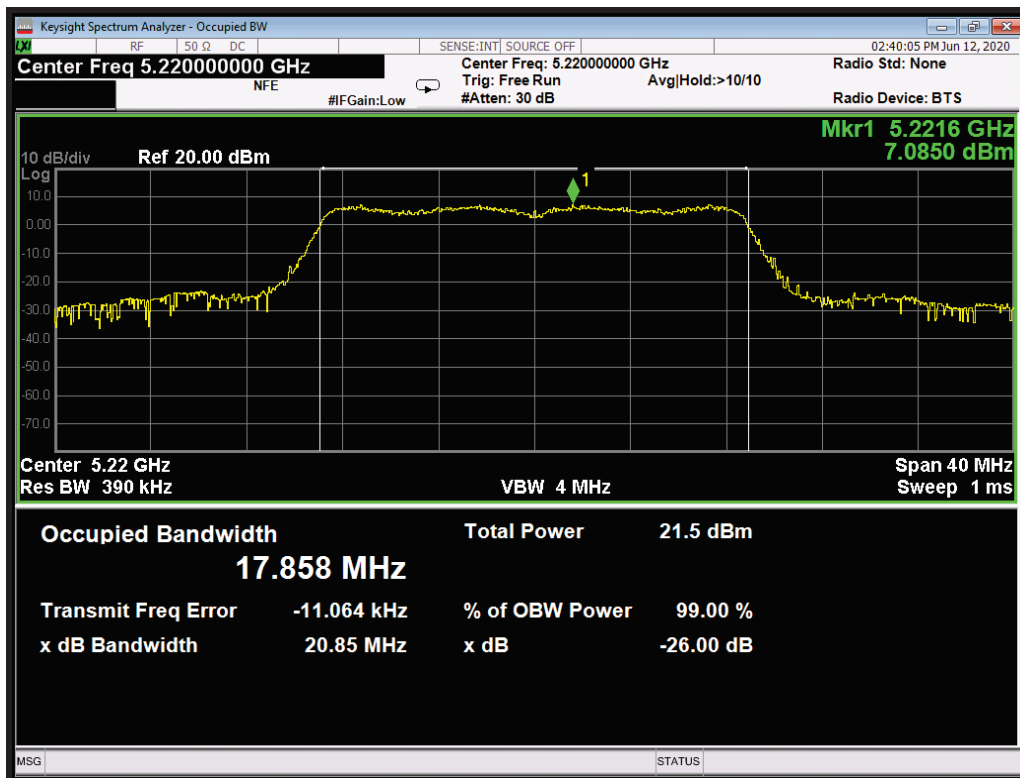


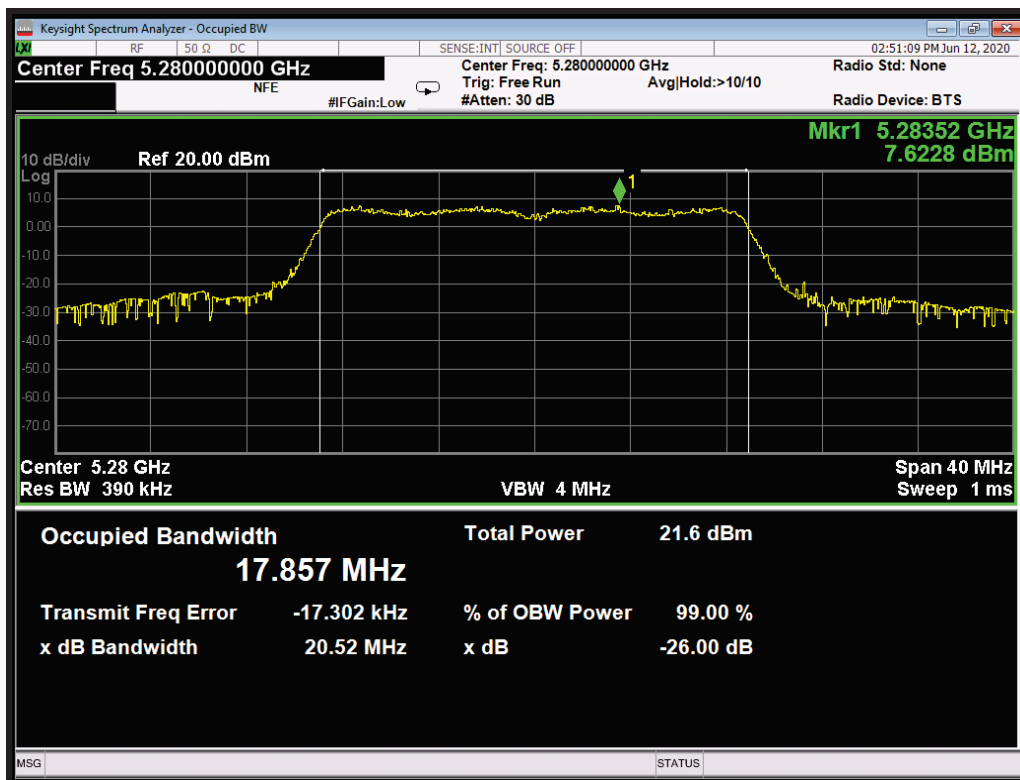
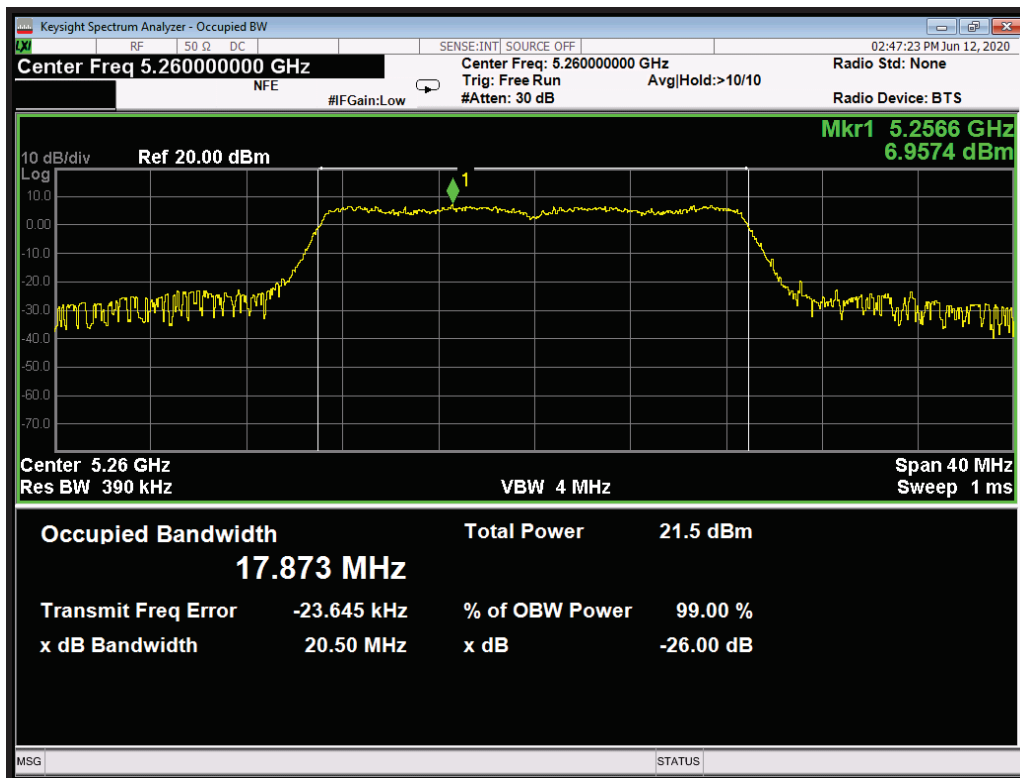


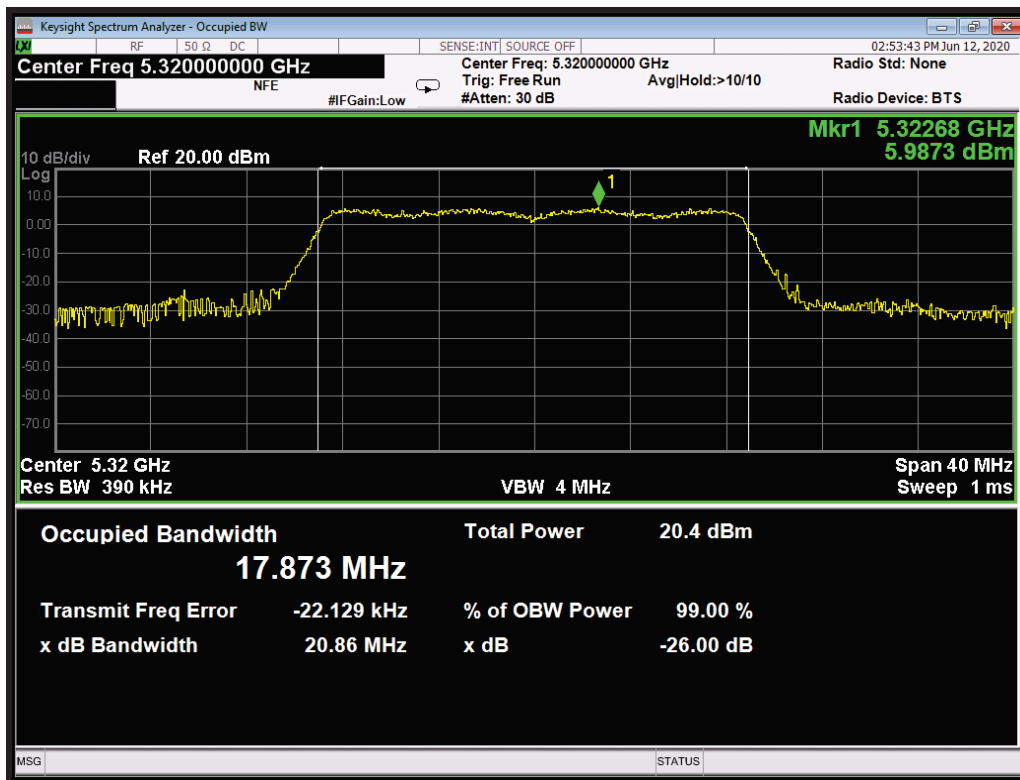
Limited 802.11n mode results are presented. The power setting for MCS0 is higher than for the corresponding 802.11ac modes which are otherwise equivalent. At higher data rates the power setting was the same for both 802.11n and 802.11ac modes so the measurements for the legacy (802.11n) modes have not been repeated.

Modulation: 802.11n-20; Data rate: MCS0; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.49	17.856	N/A
5220	20.85	17.858	N/A
5240	20.81	17.865	N/A
5260	20.50	17.873	N/A
5280	20.52	17.857	N/A
5320	20.86	17.873	N/A

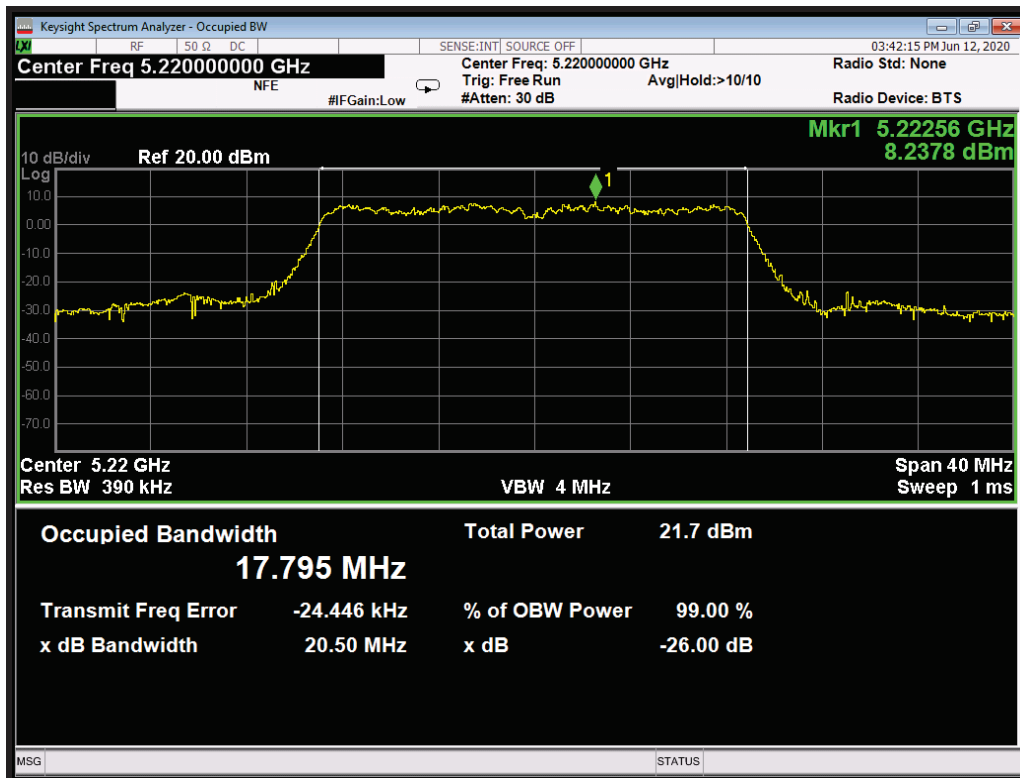
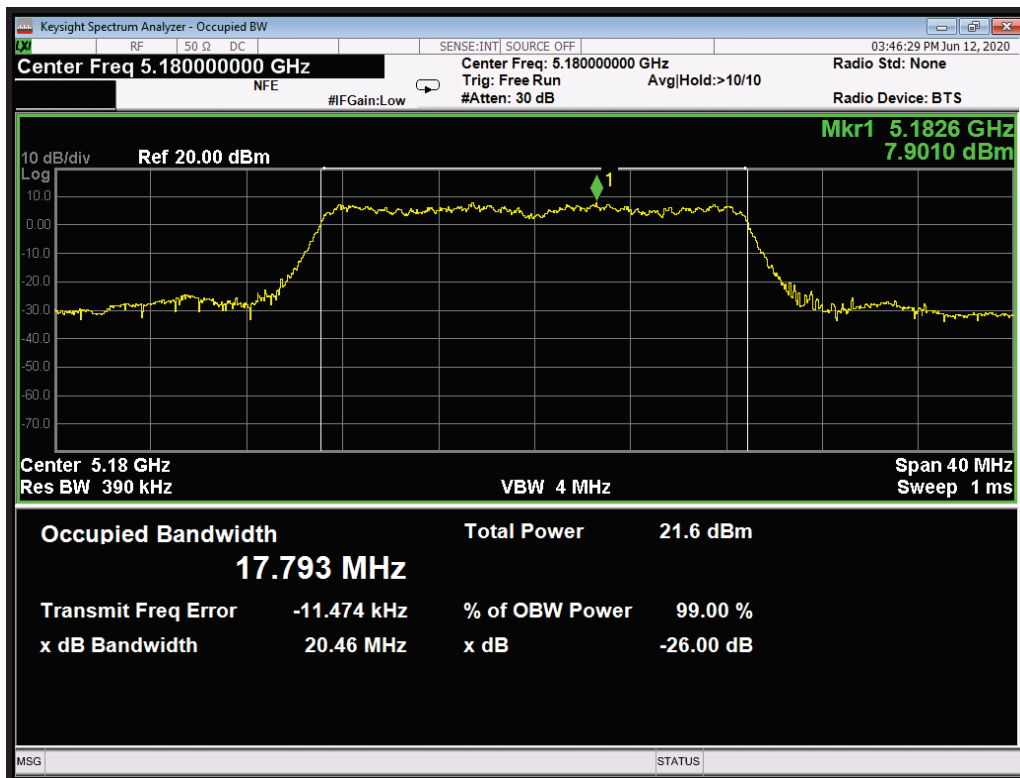


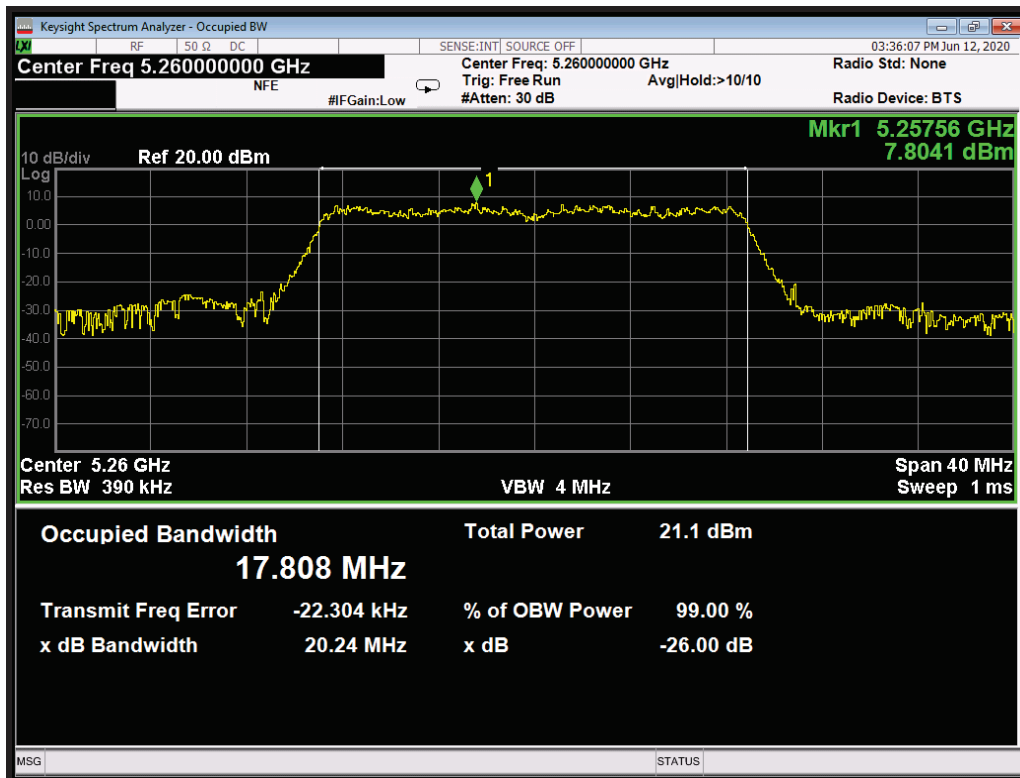
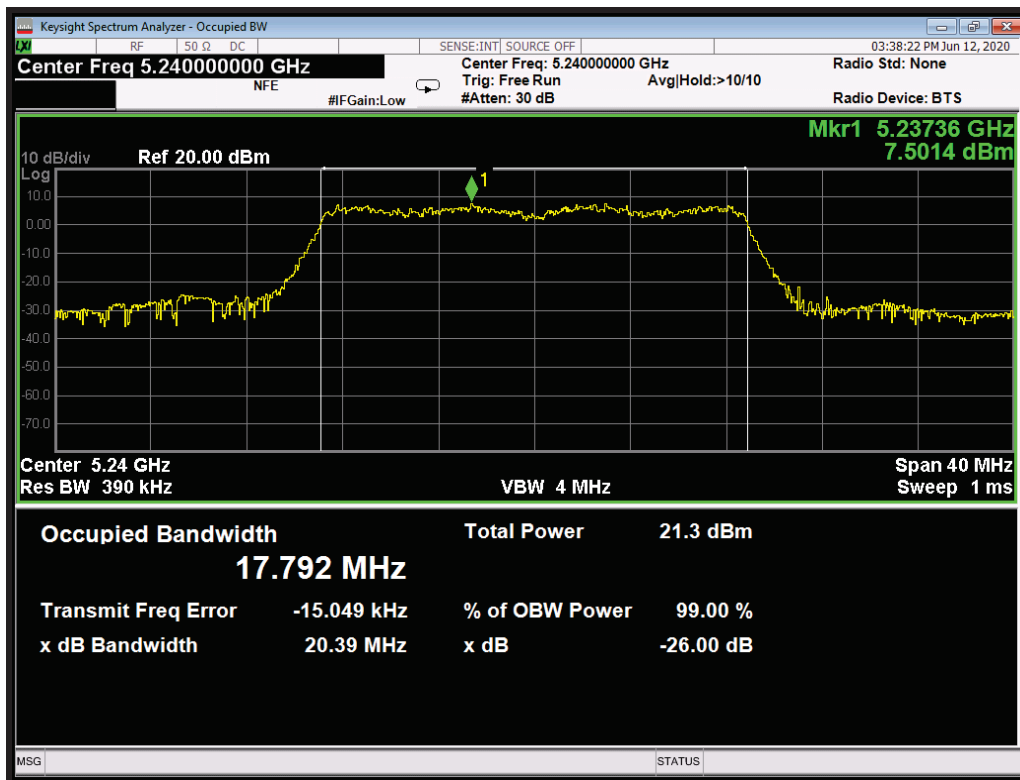


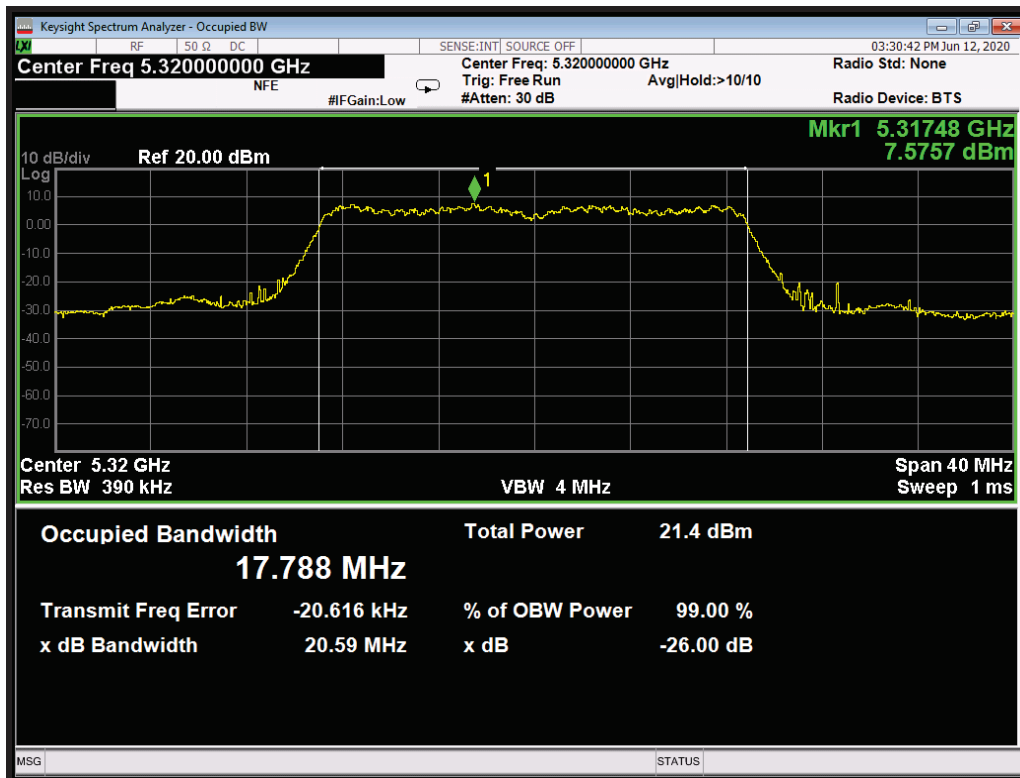
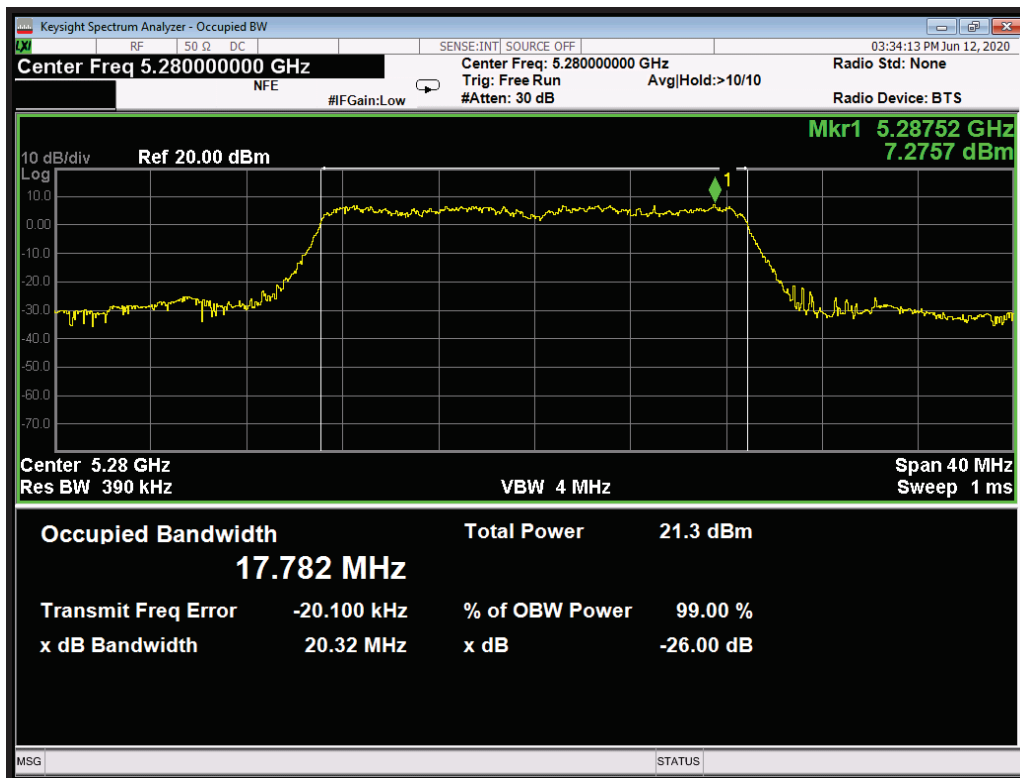




Modulation: 802.11n-20; Data rate: MCS0; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.46	17.793	N/A
5220	20.50	17.795	N/A
5240	20.39	17.792	N/A
5260	20.24	17.808	N/A
5280	20.32	17.782	N/A
5320	20.59	17.788	N/A

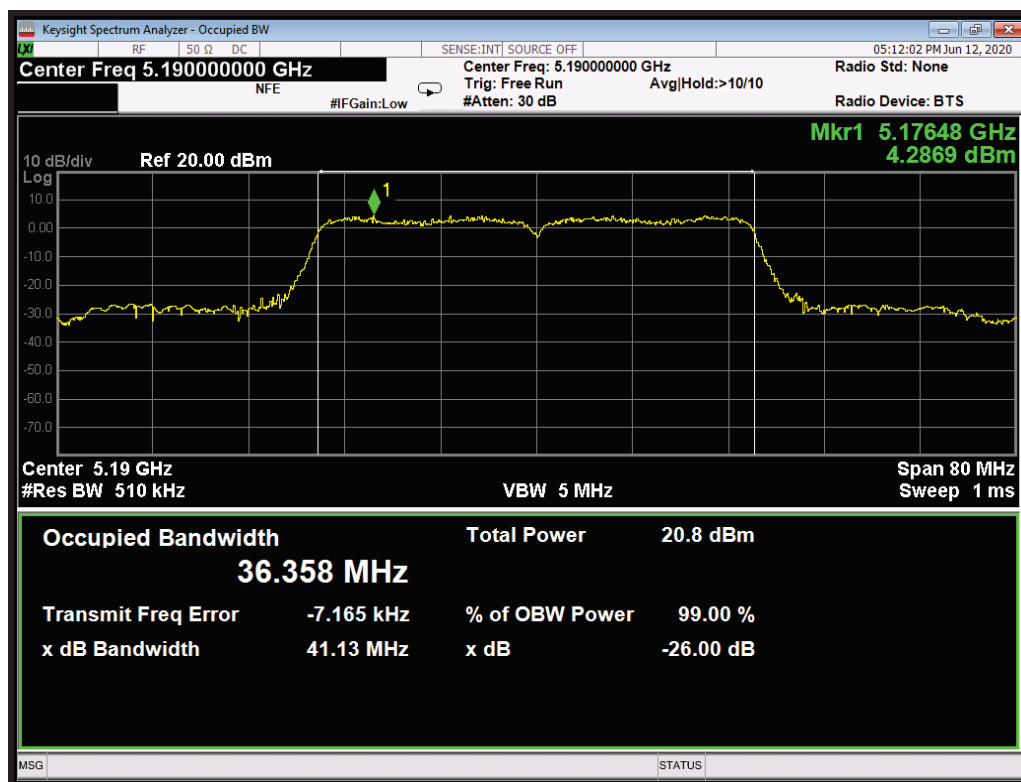


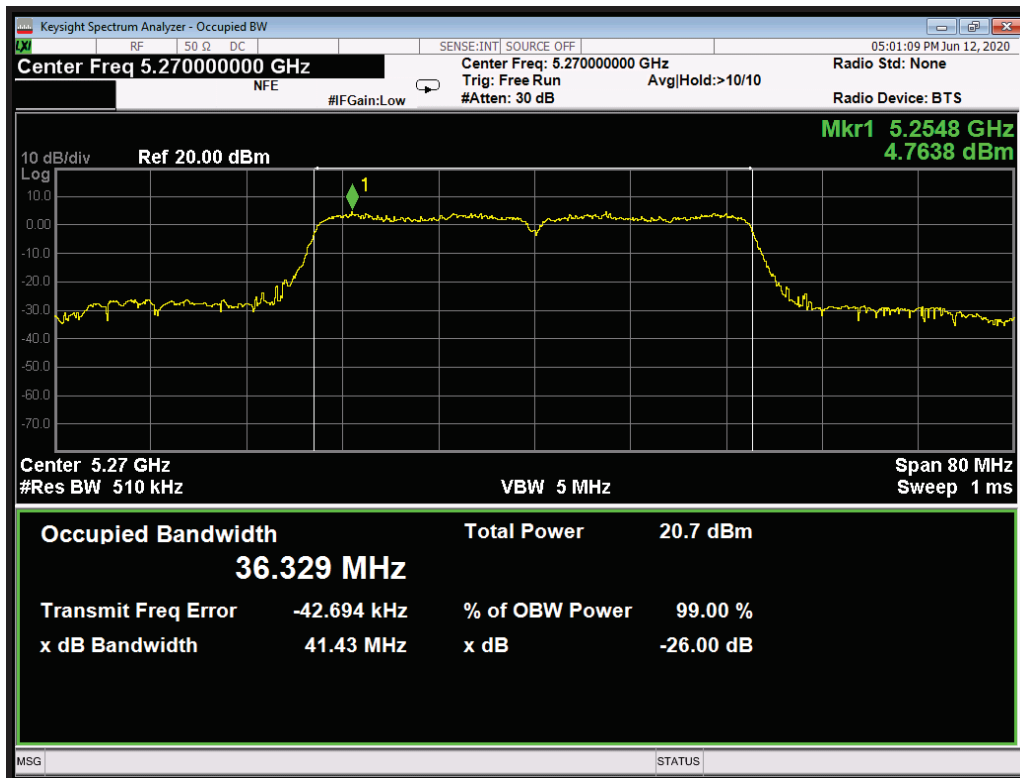
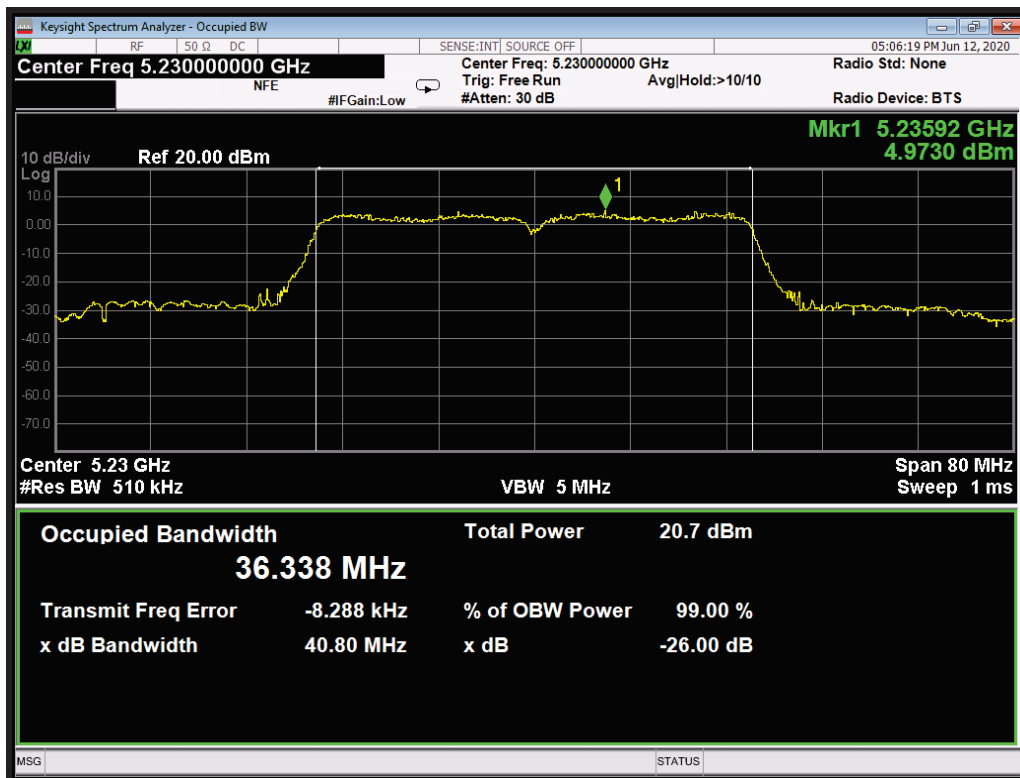


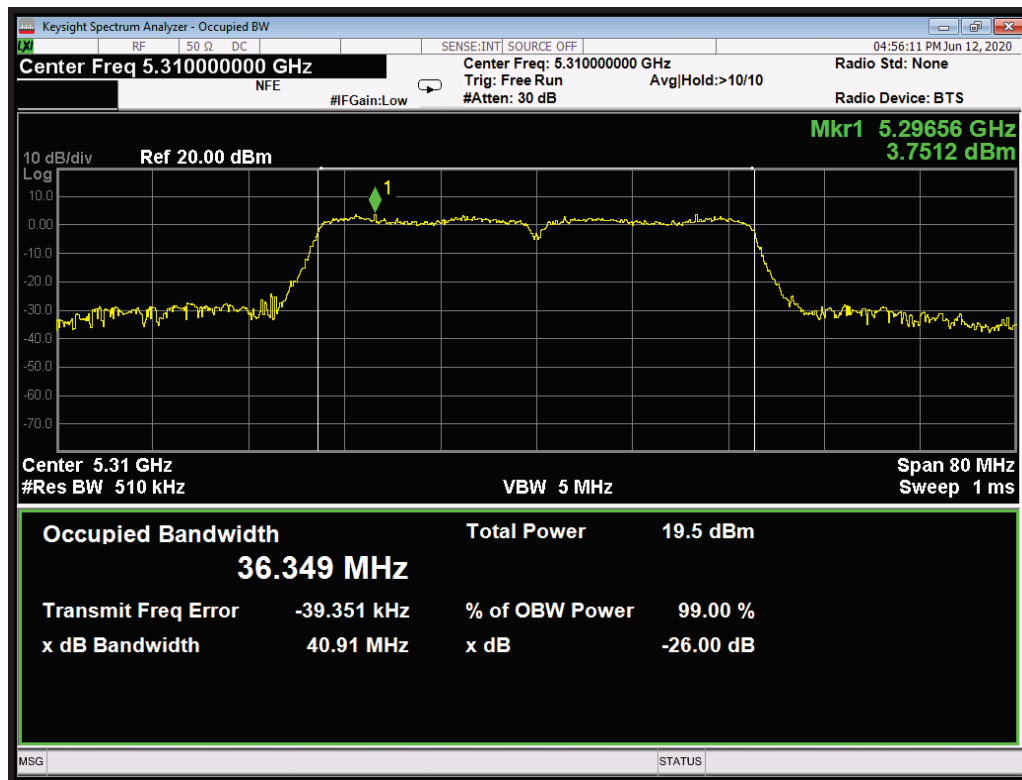


Limited 802.11n mode results are presented. The power setting for MCS0 is higher than for the corresponding 802.11ac modes which are otherwise equivalent. At higher data rates the power setting was the same for both 802.11n and 802.11ac modes so the measurements for the legacy (802.11n) modes have not been repeated.

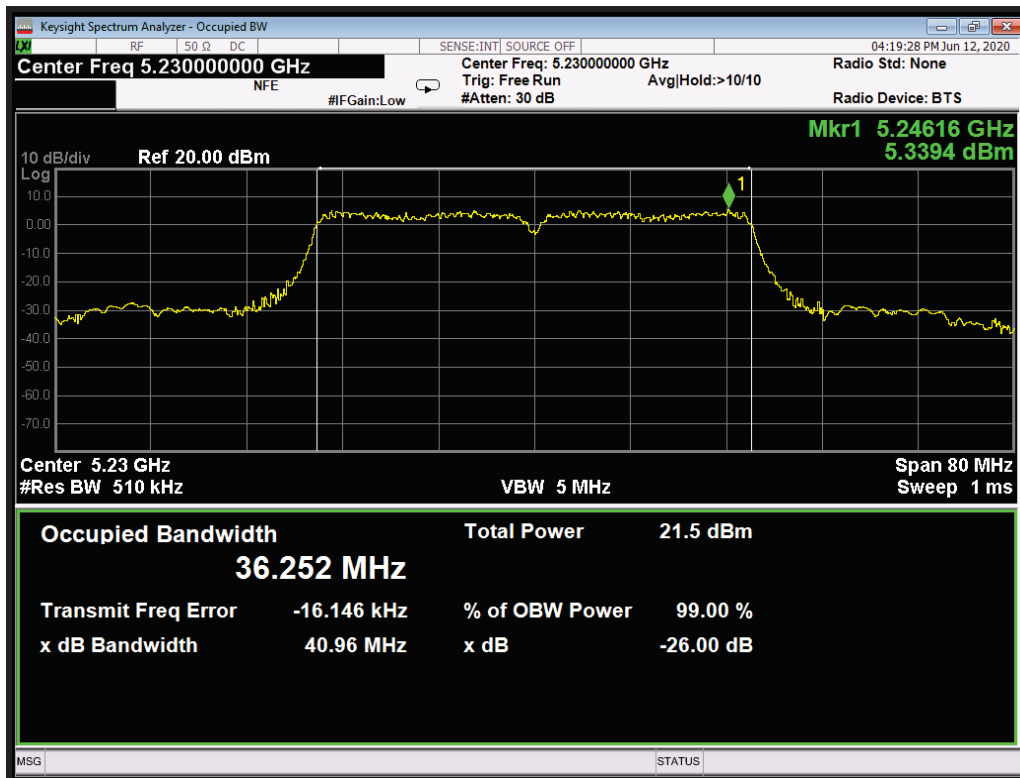
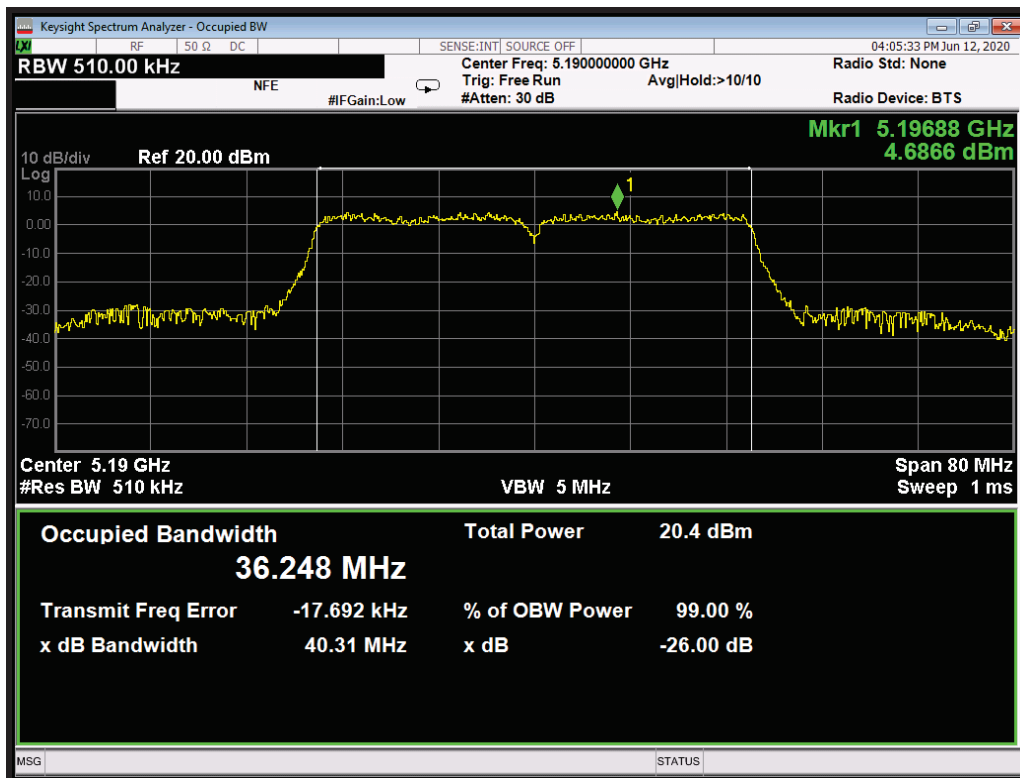
Modulation: 802.11n-40; Data rate: MCS0; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5190	41.13	36.358	N/A
5230	40.80	36.338	N/A
5270	41.43	36.329	N/A
5310	40.91	36.349	N/A

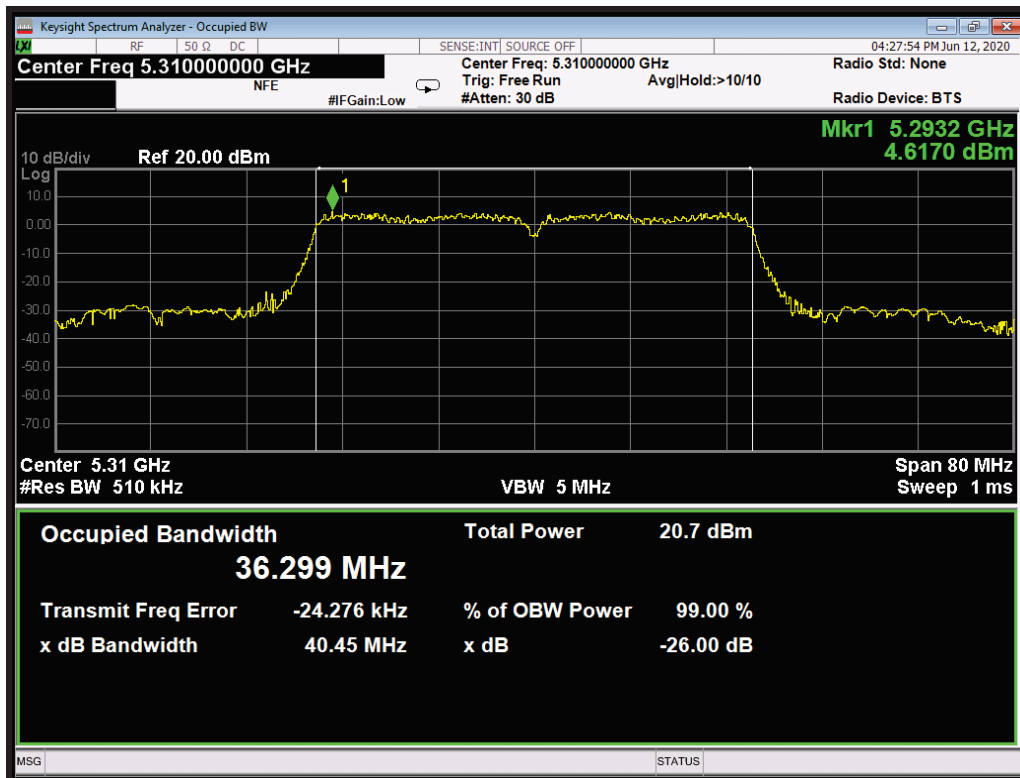
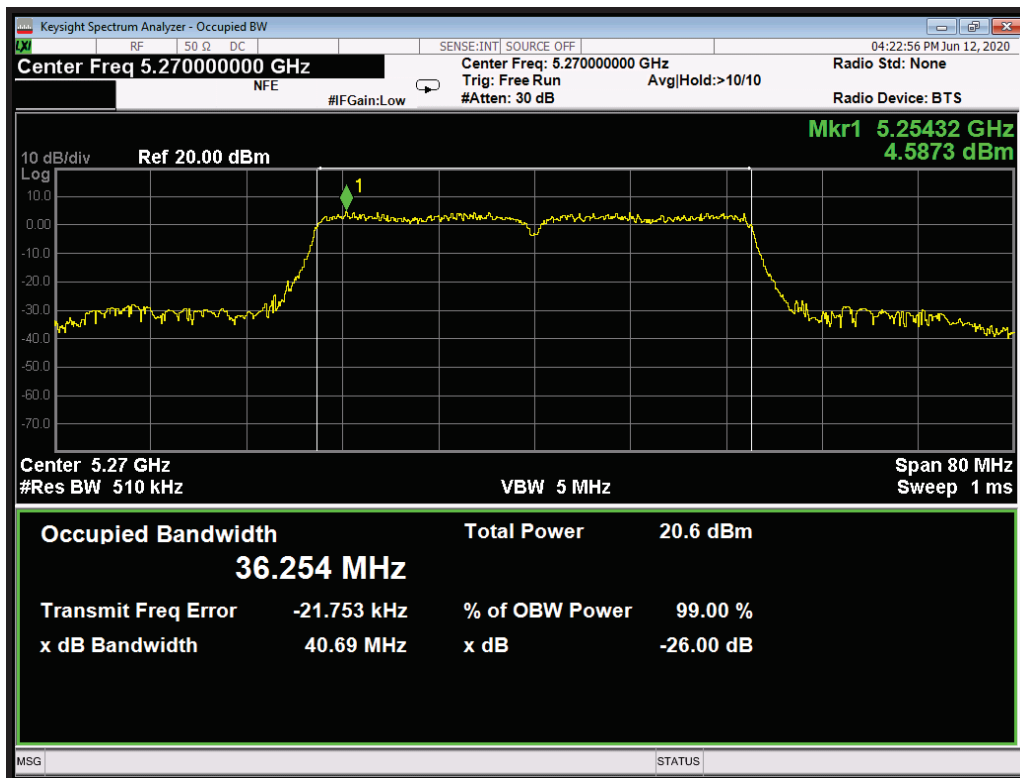




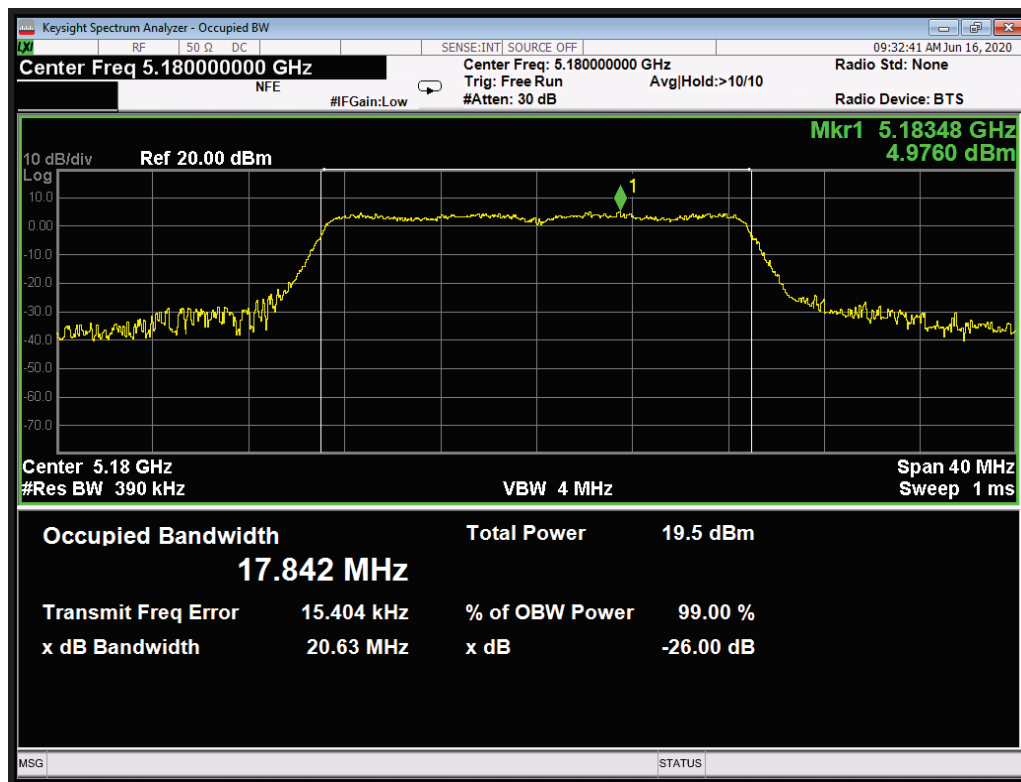


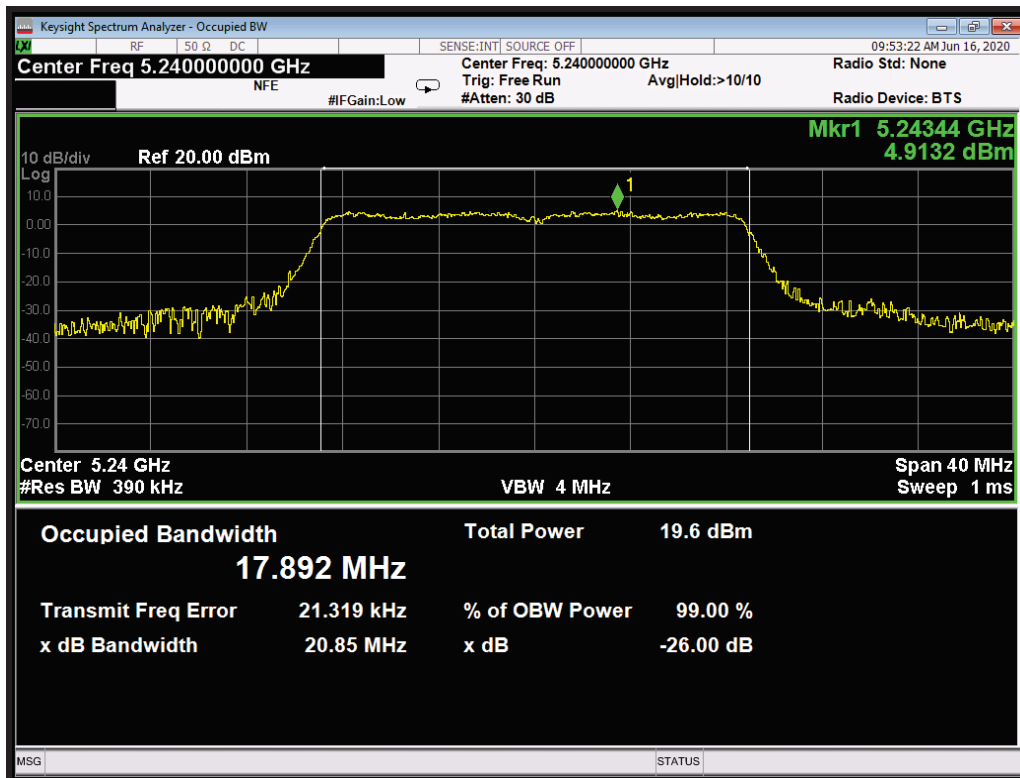
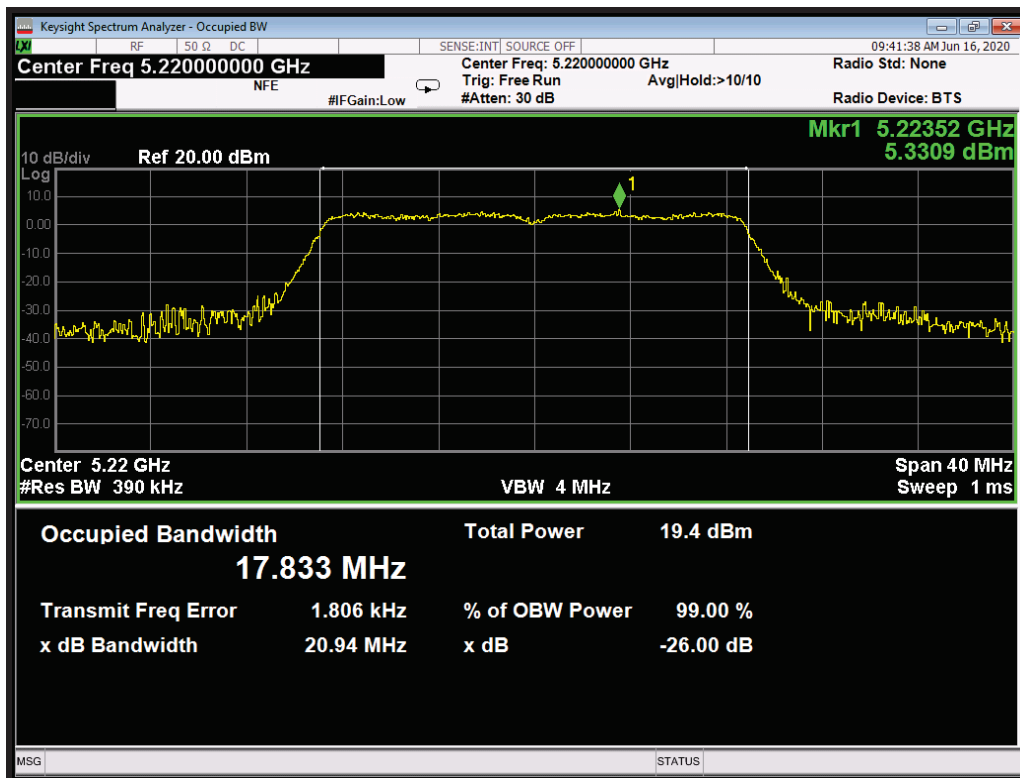
Modulation: 802.11n-40; Data rate: MCS0; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5190	40.31	36.248	N/A
5230	40.96	36.252	N/A
5270	40.69	36.254	N/A
5310	40.45	36.299	N/A

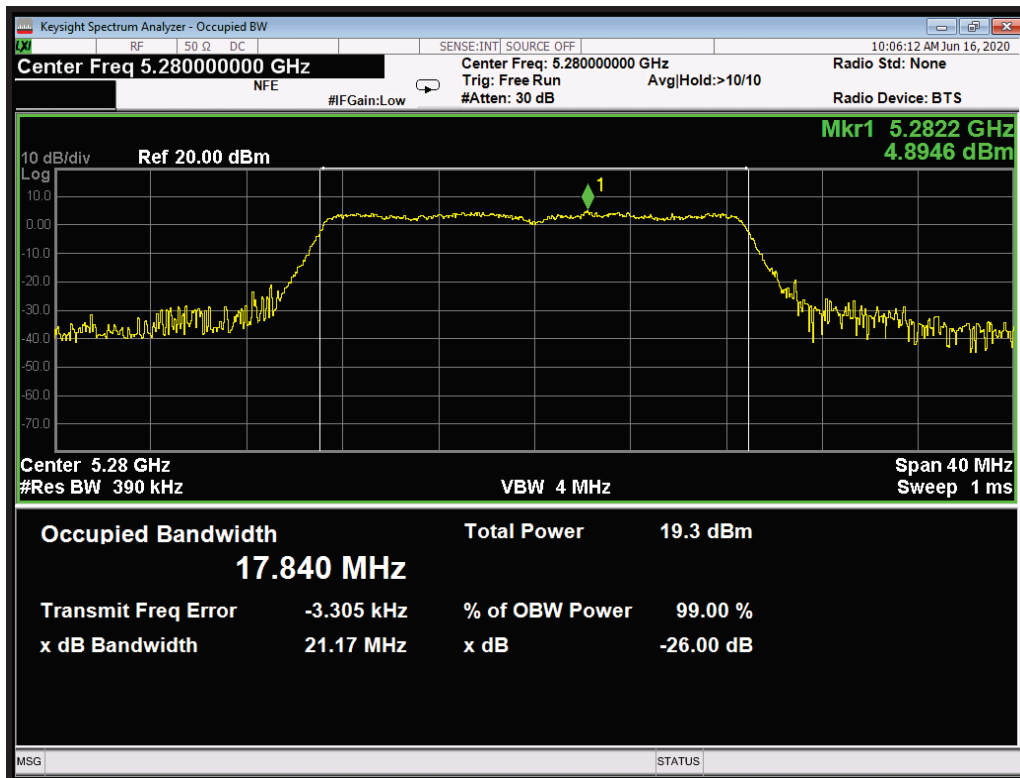
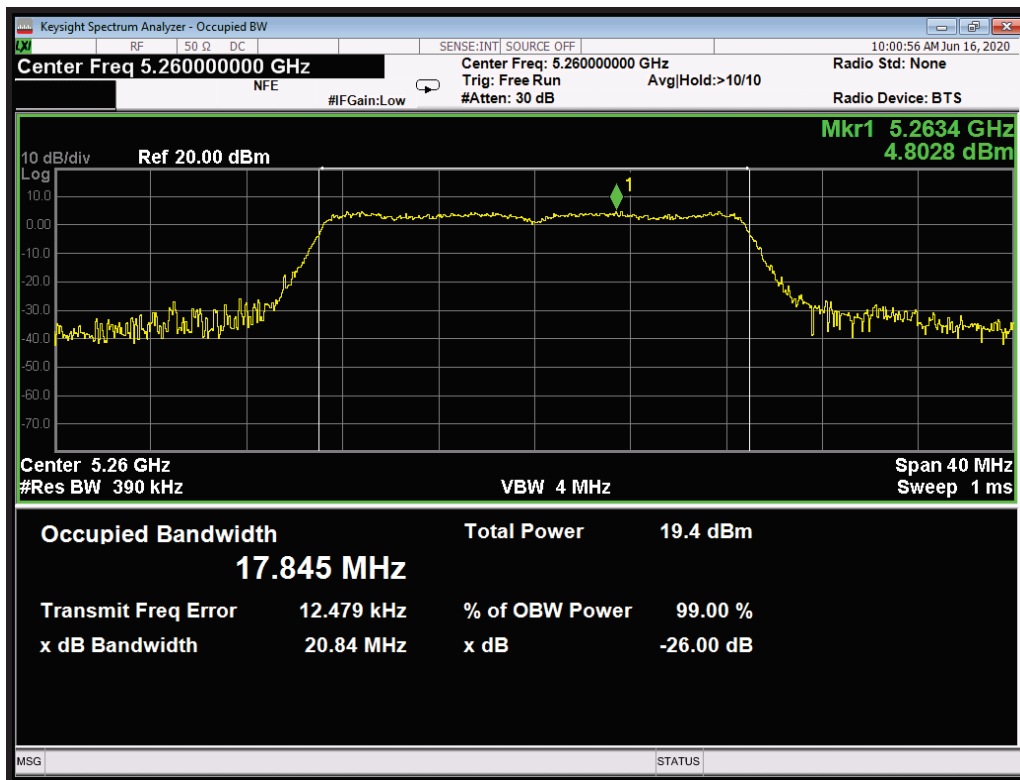


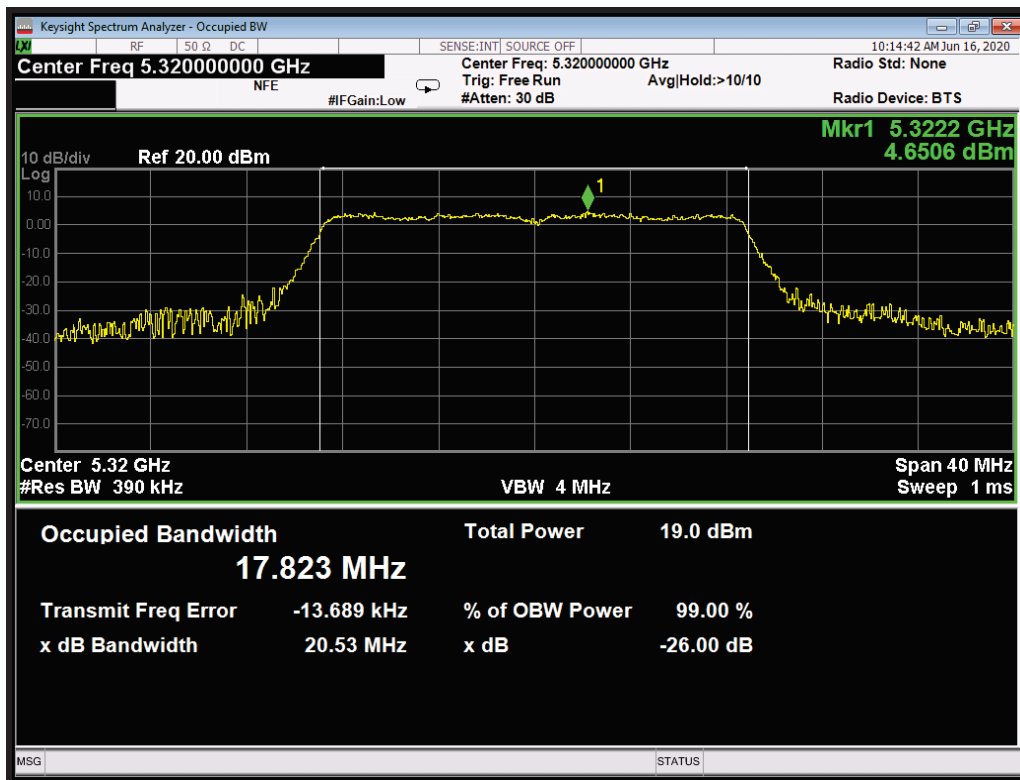


Modulation: 802.11ac-20; Data rate: MCS0 1SS; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.63	17.842	N/A
5220	20.94	17.833	N/A
5240	20.85	17.892	N/A
5260	20.84	17.845	N/A
5280	21.17	17.840	N/A
5320	20.53	17.823	N/A

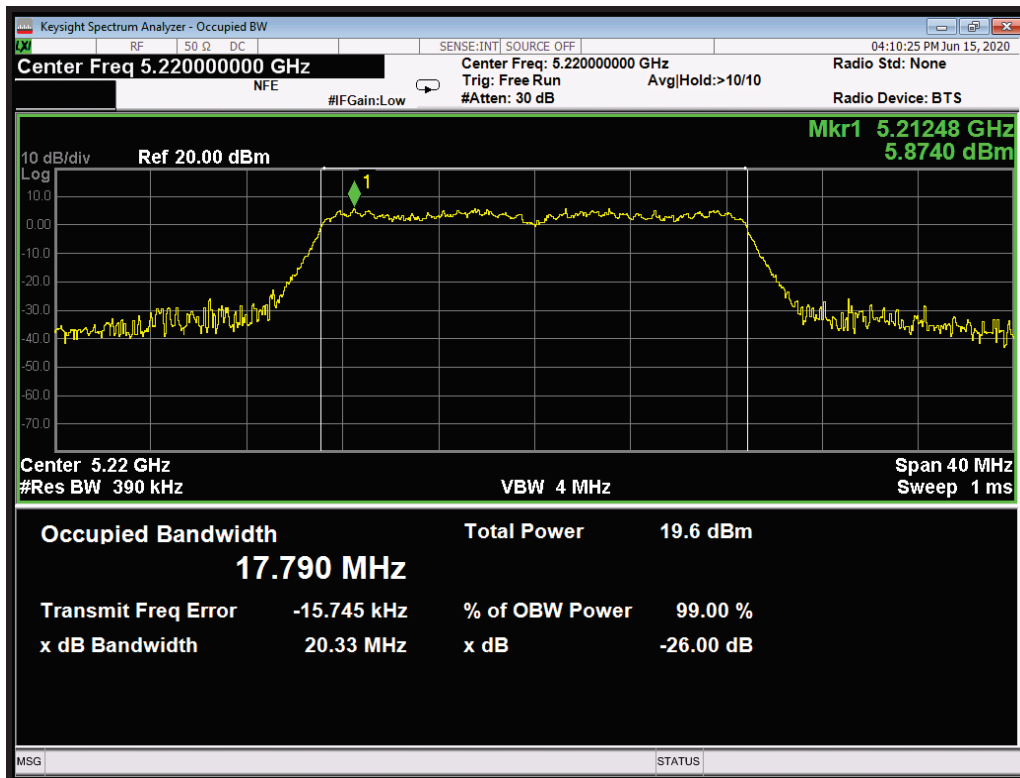
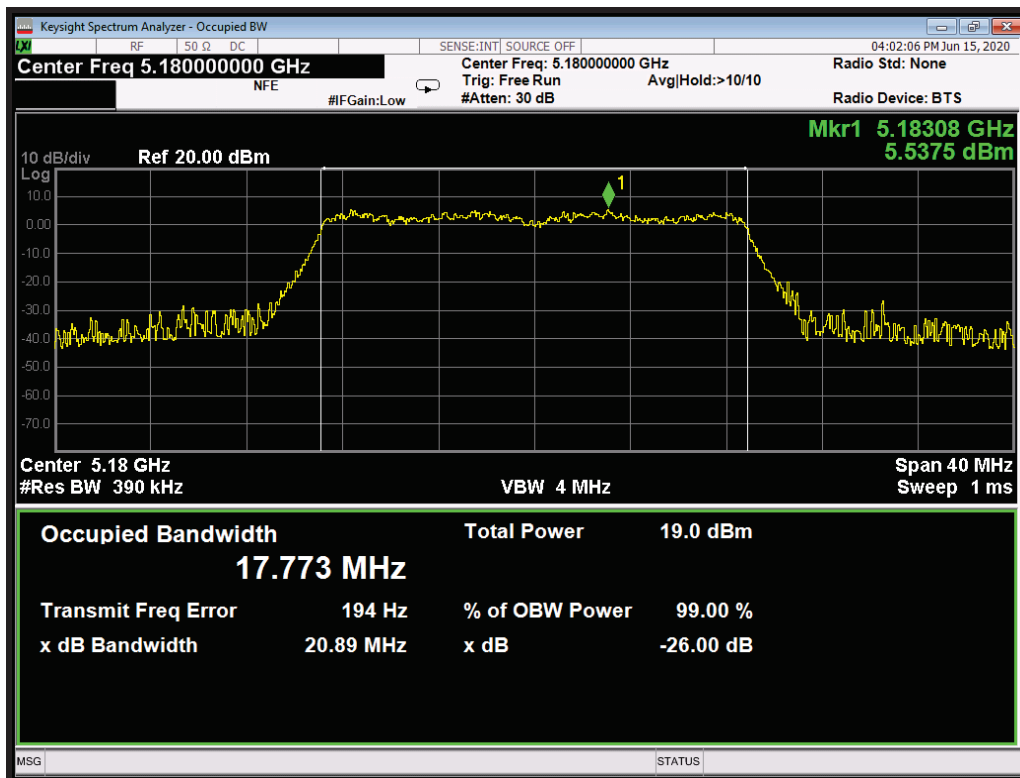


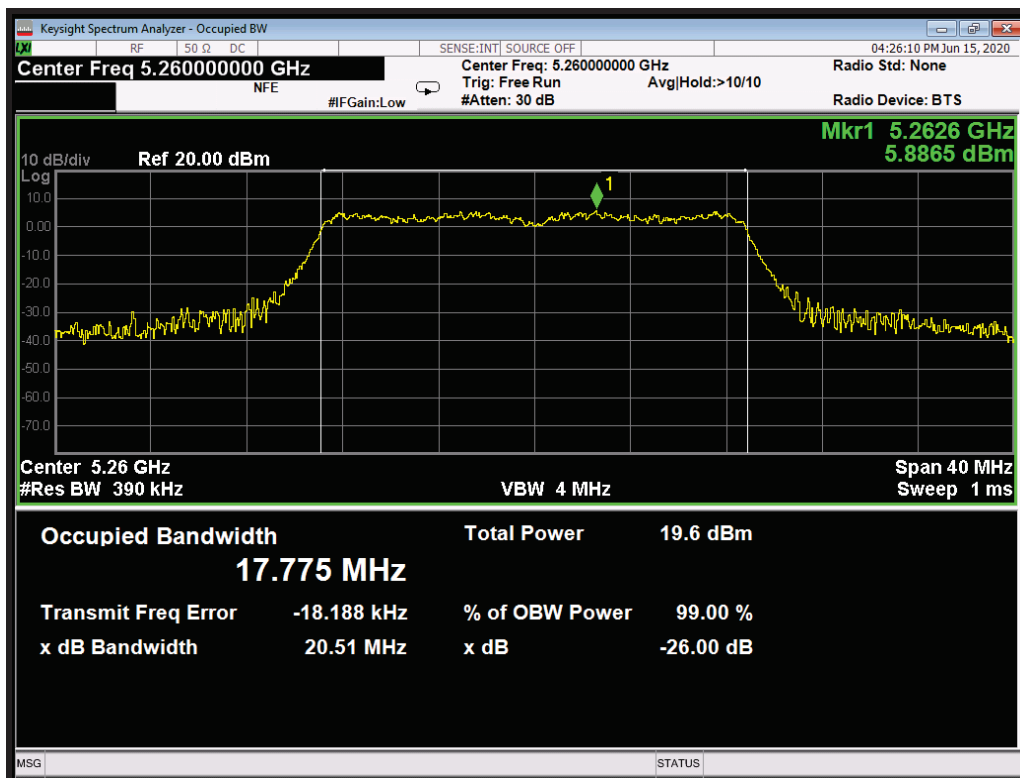
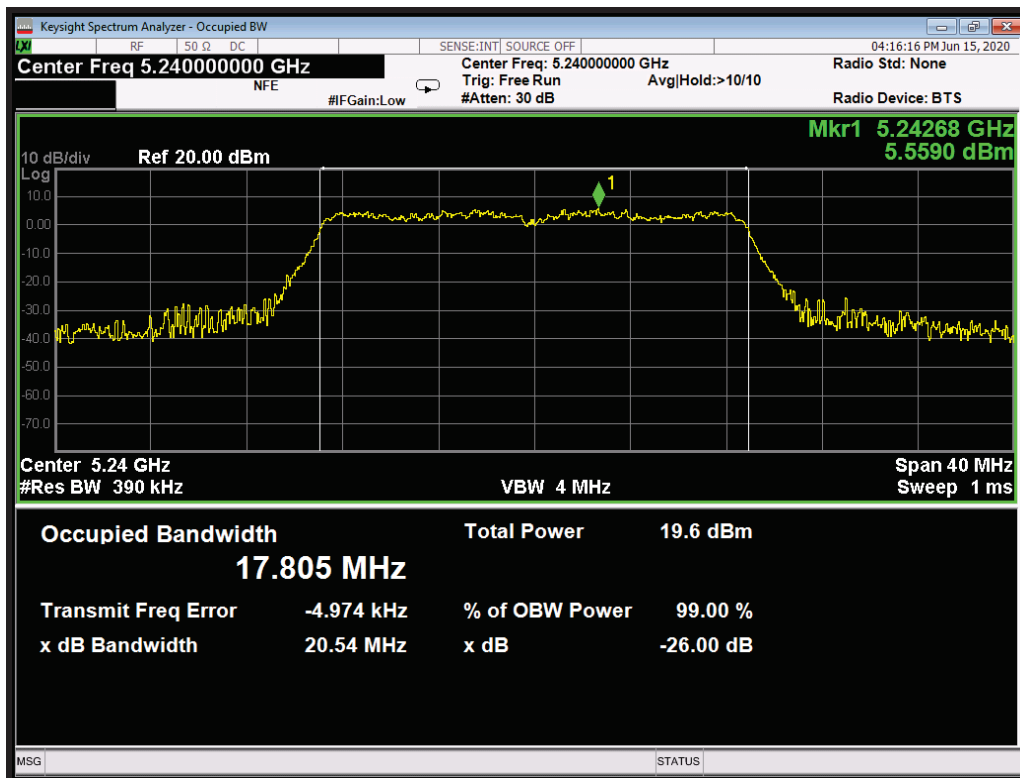


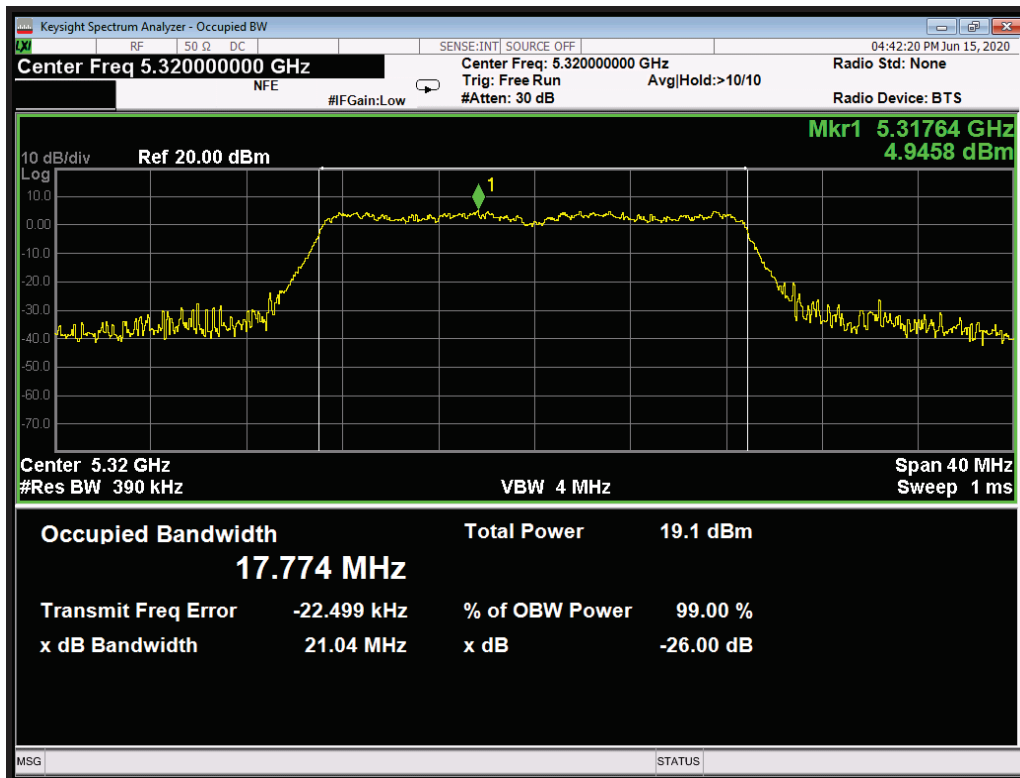
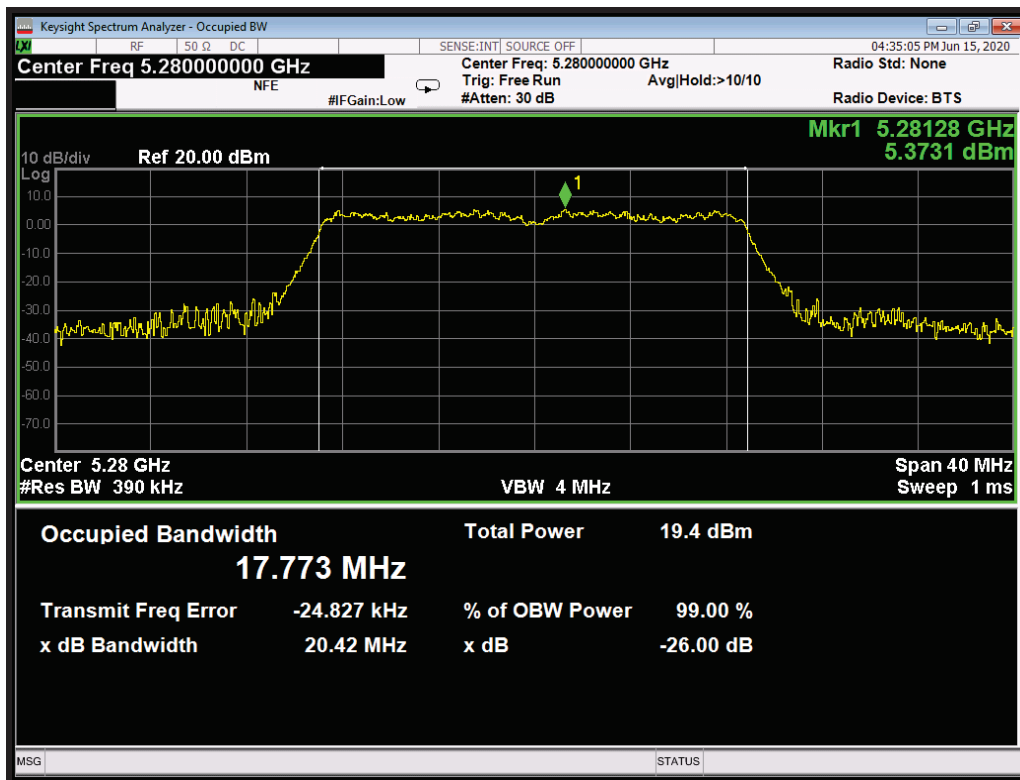




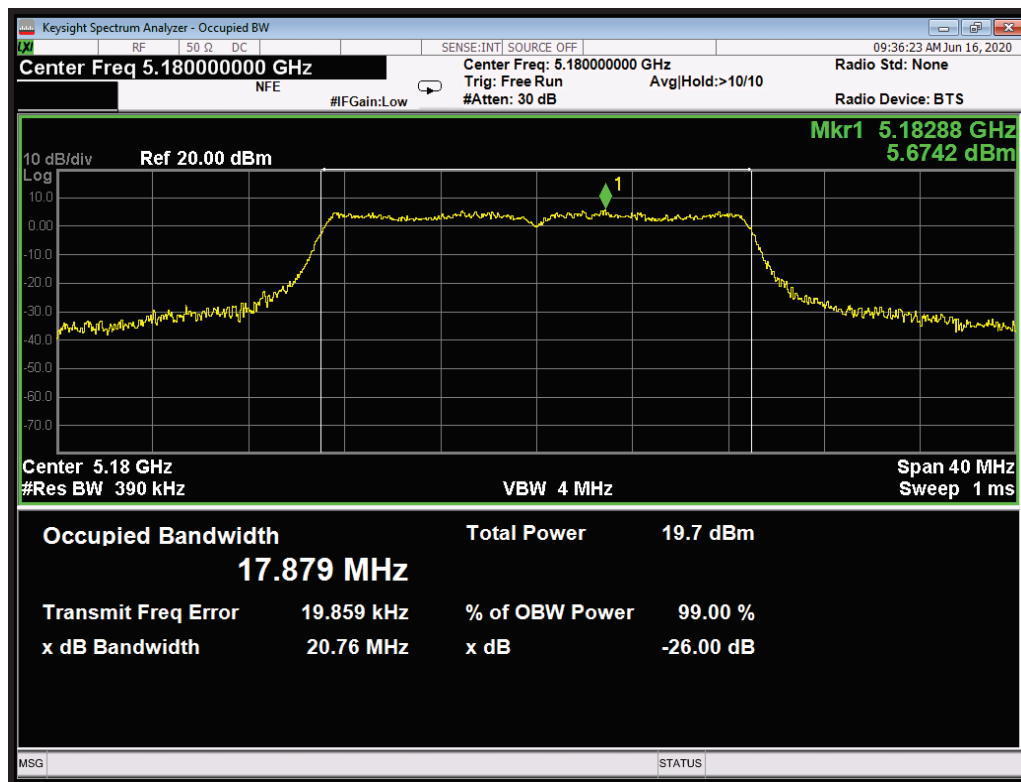
Modulation: 802.11ac-20; Data rate: MCS0 1SS; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.89	17.773	N/A
5220	20.33	17.790	N/A
5240	20.54	17.805	N/A
5260	20.51	17.775	N/A
5280	20.42	17.773	N/A
5320	21.04	17.774	N/A

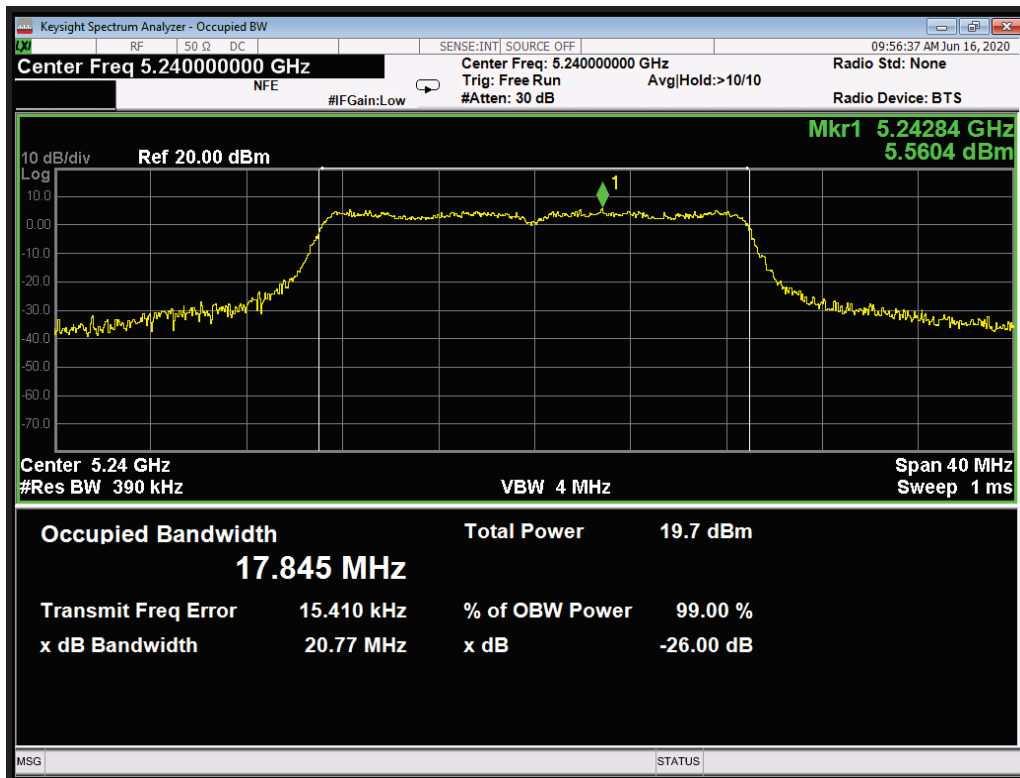
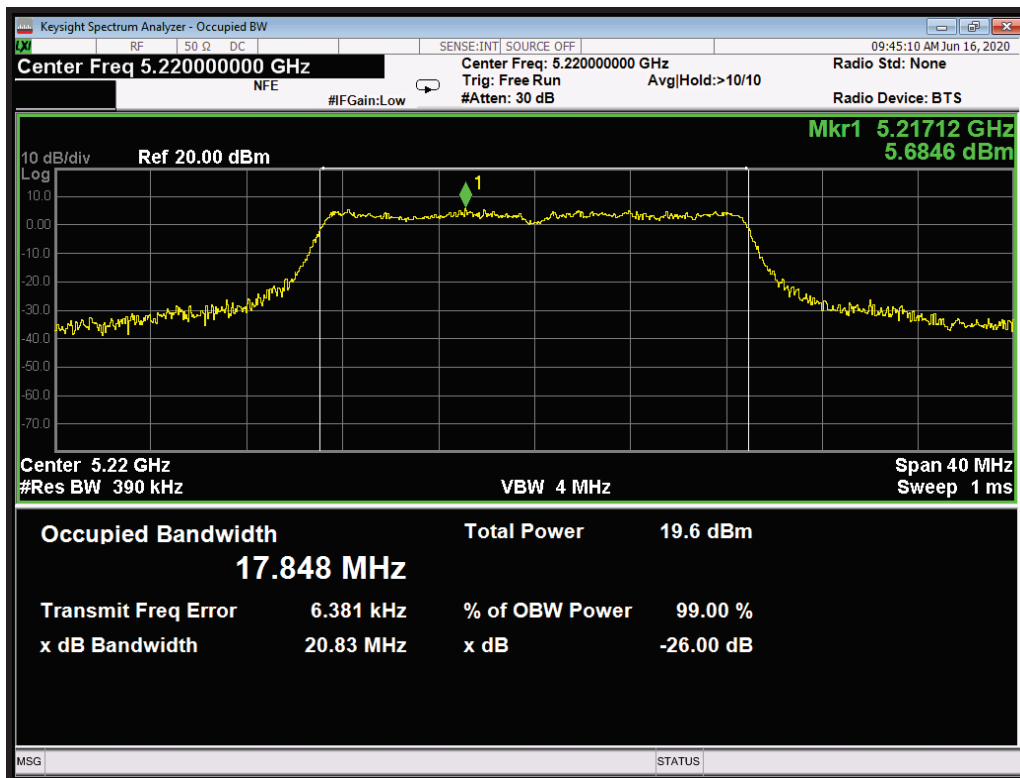


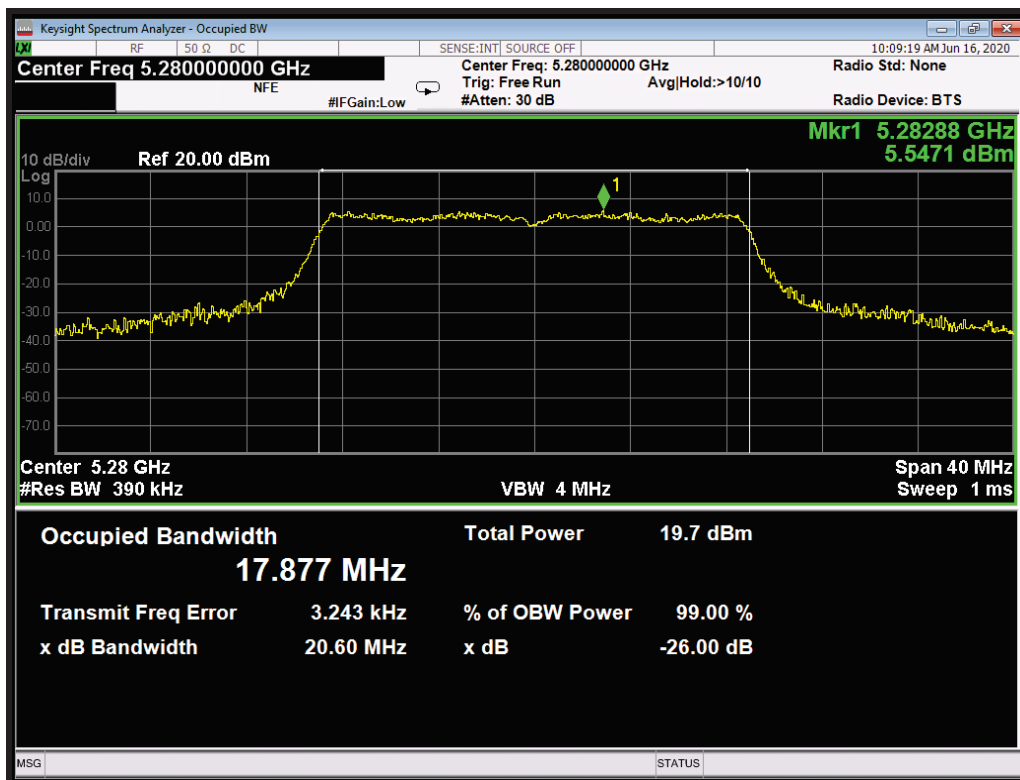
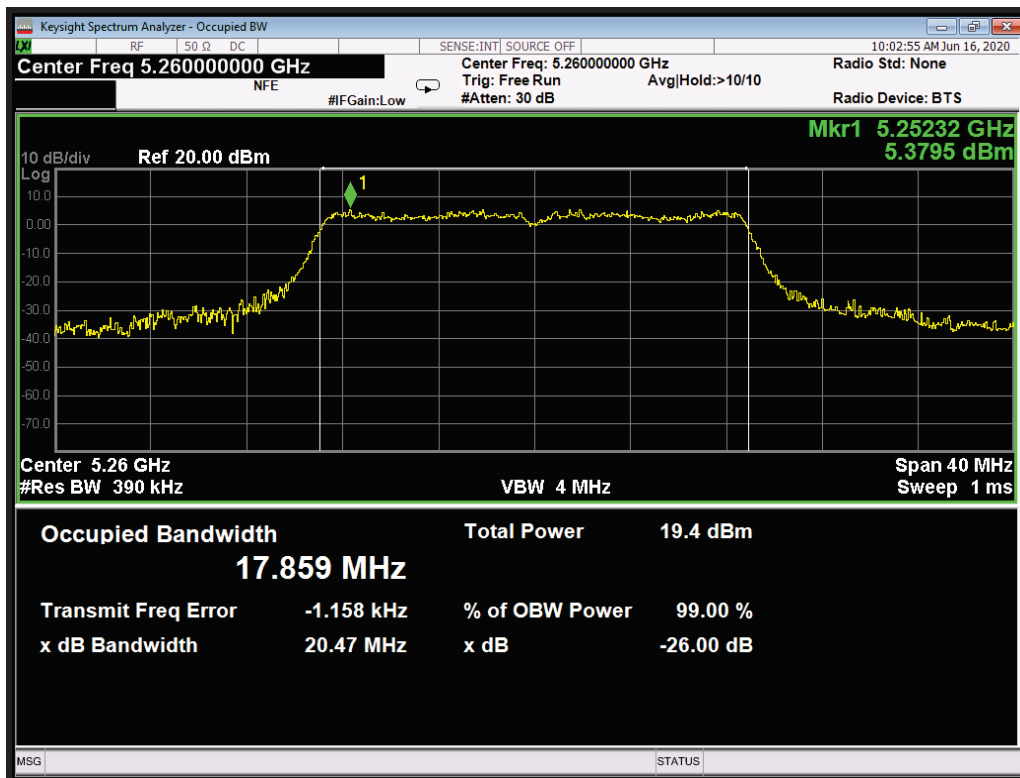


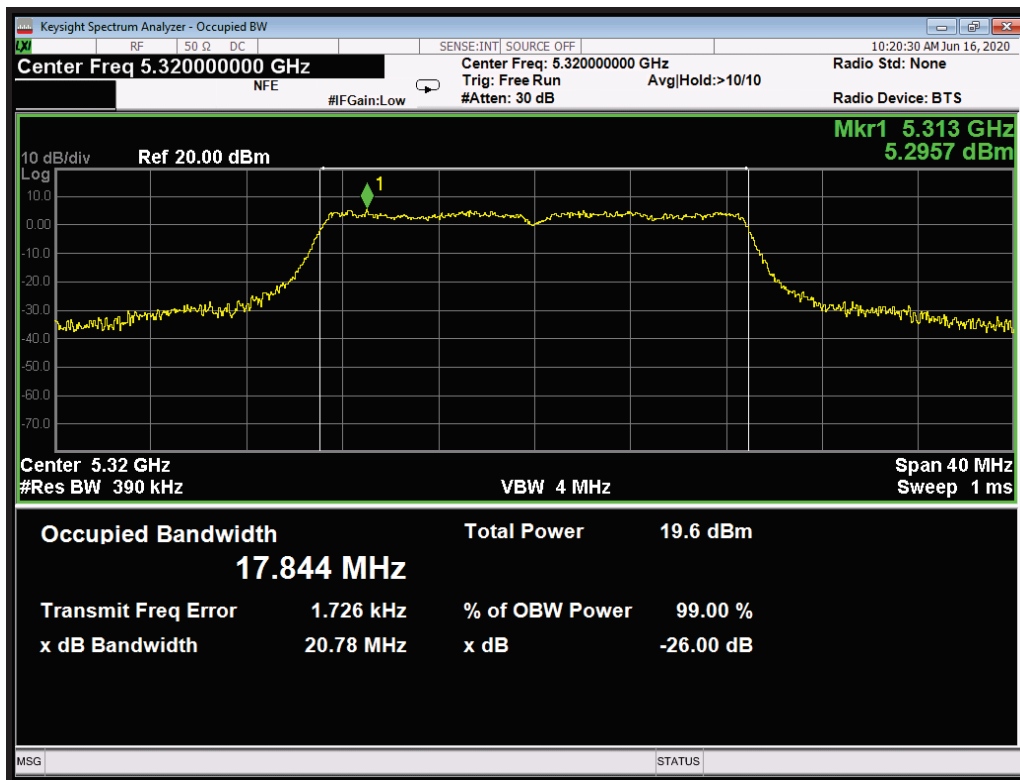


Modulation: 802.11ac-20; Data rate: MCS8 1SS; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	20.76	17.879	N/A
5220	20.83	17.848	N/A
5240	20.77	17.845	N/A
5260	20.47	17.859	N/A
5280	20.60	17.877	N/A
5320	20.78	17.844	N/A









Modulation: 802.11ac-20; Data rate: MCS8 1SS; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5180	21.02	17.888	N/A
5220	20.82	17.861	N/A
5240	20.87	17.890	N/A
5260	21.16	17.900	N/A
5280	21.16	17.868	N/A
5320	20.65	17.892	N/A

