

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:	5500 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.

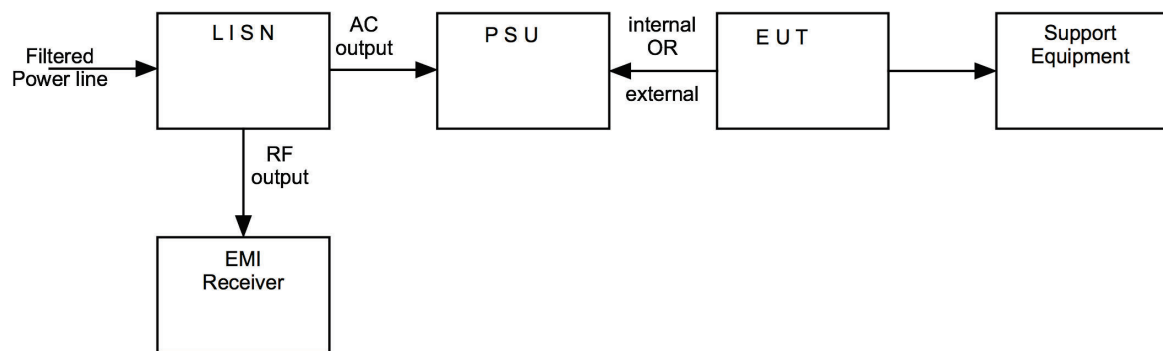
12.4 Test Method

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



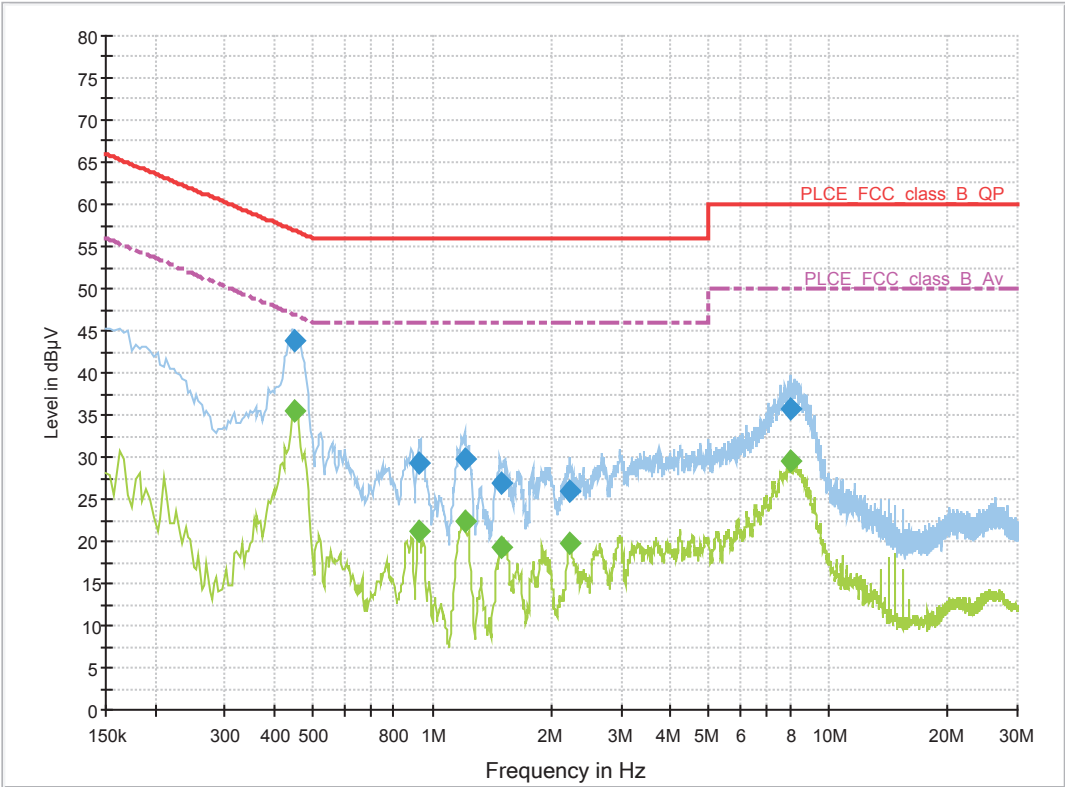
12.6 Test Equipment

Equipment Type	Manufacturer	Equipment Description	Element No	Due For Calibration
Measuring Receiver	R&S	ESHS10	RFG125	2021-01-22
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)

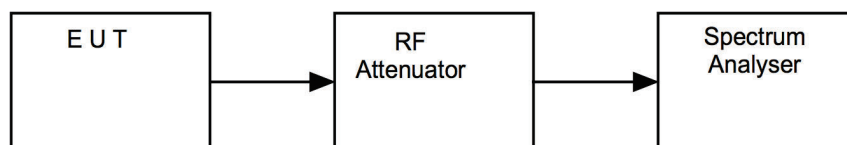
Test Limits

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

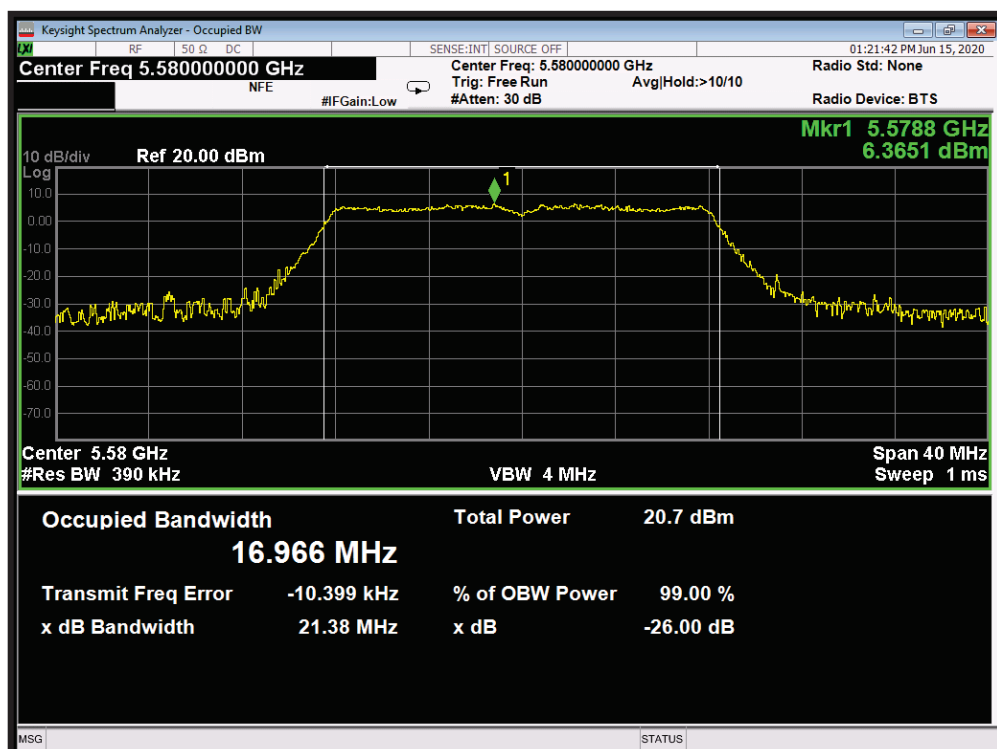
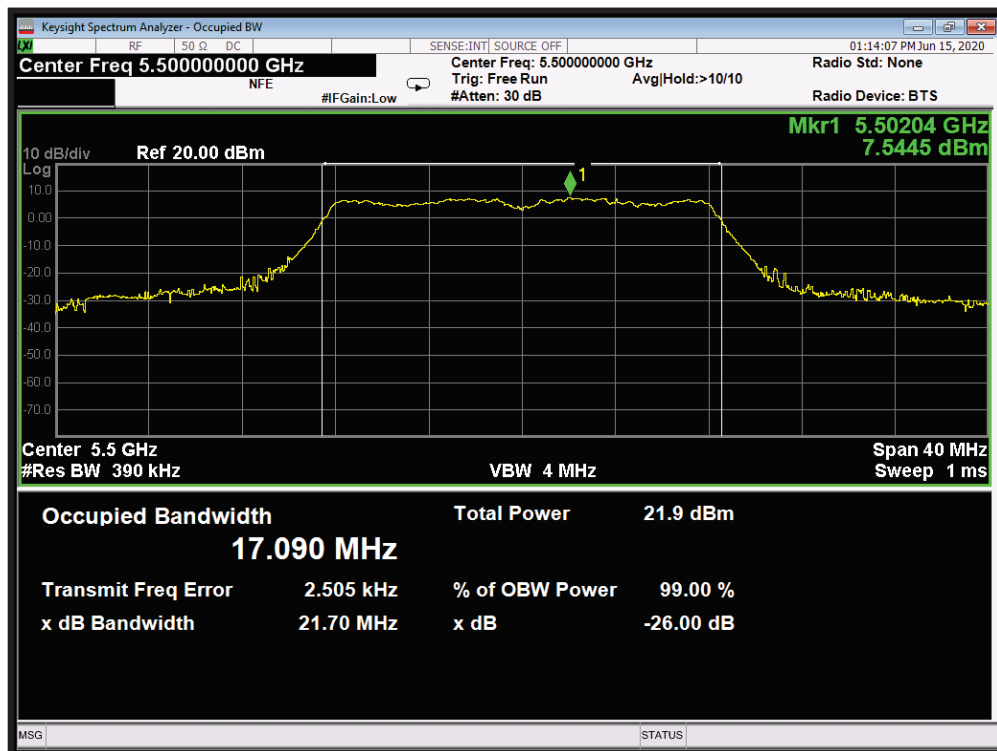


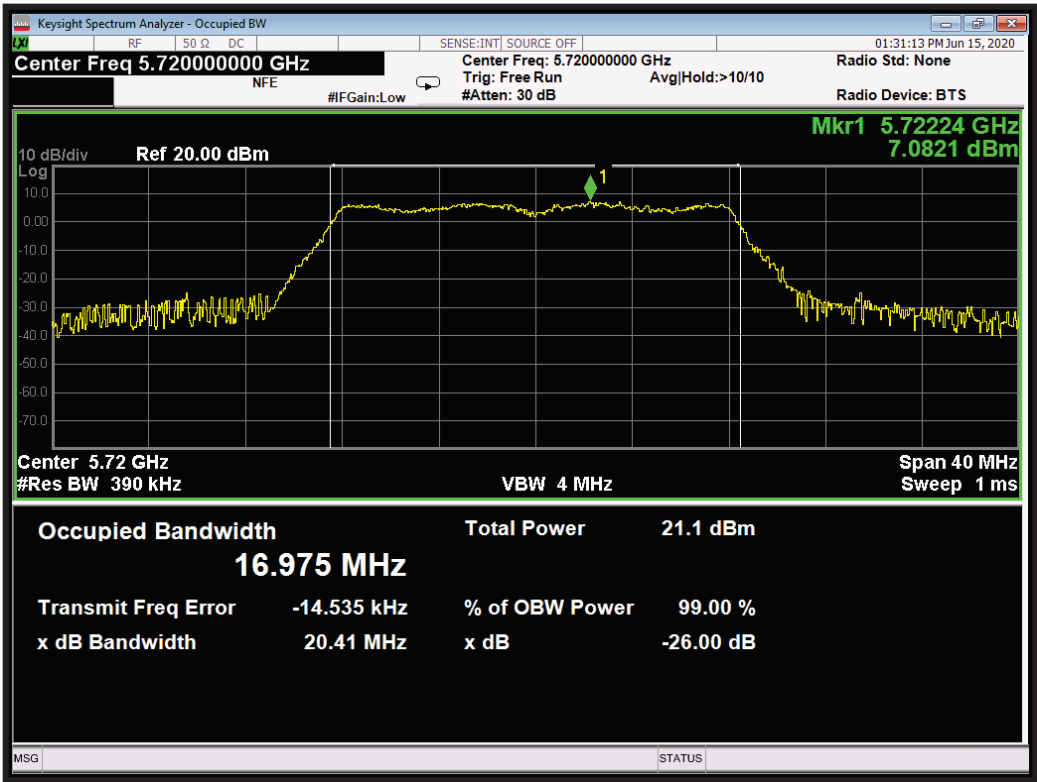
13.4 Test Equipment

<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

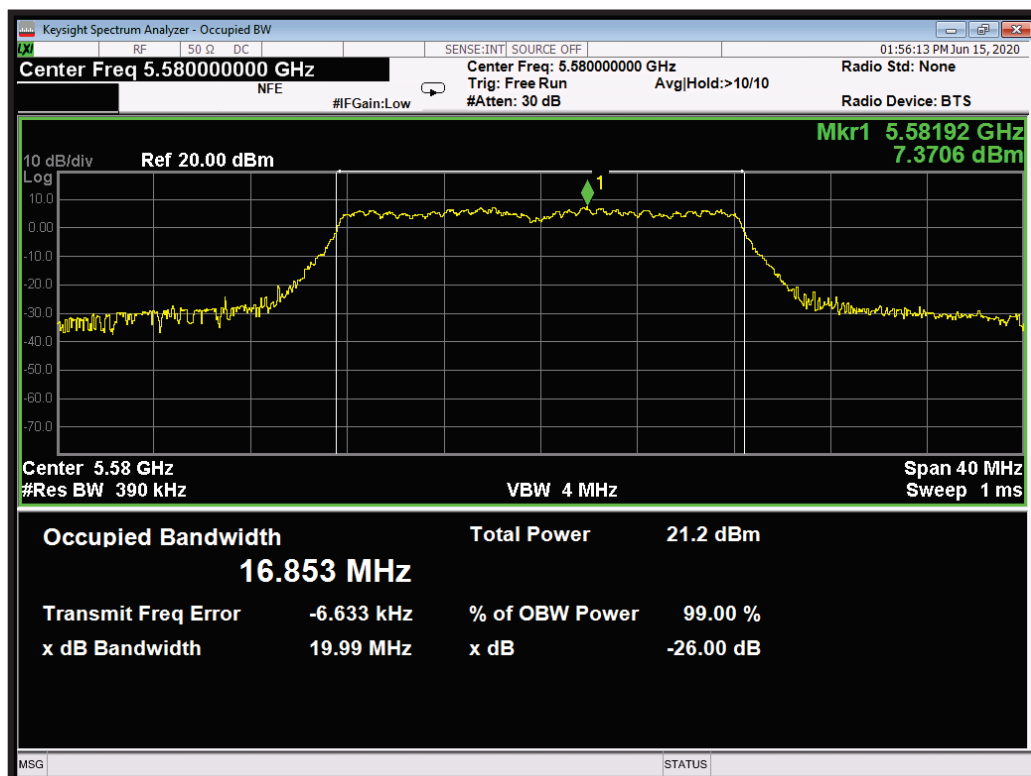
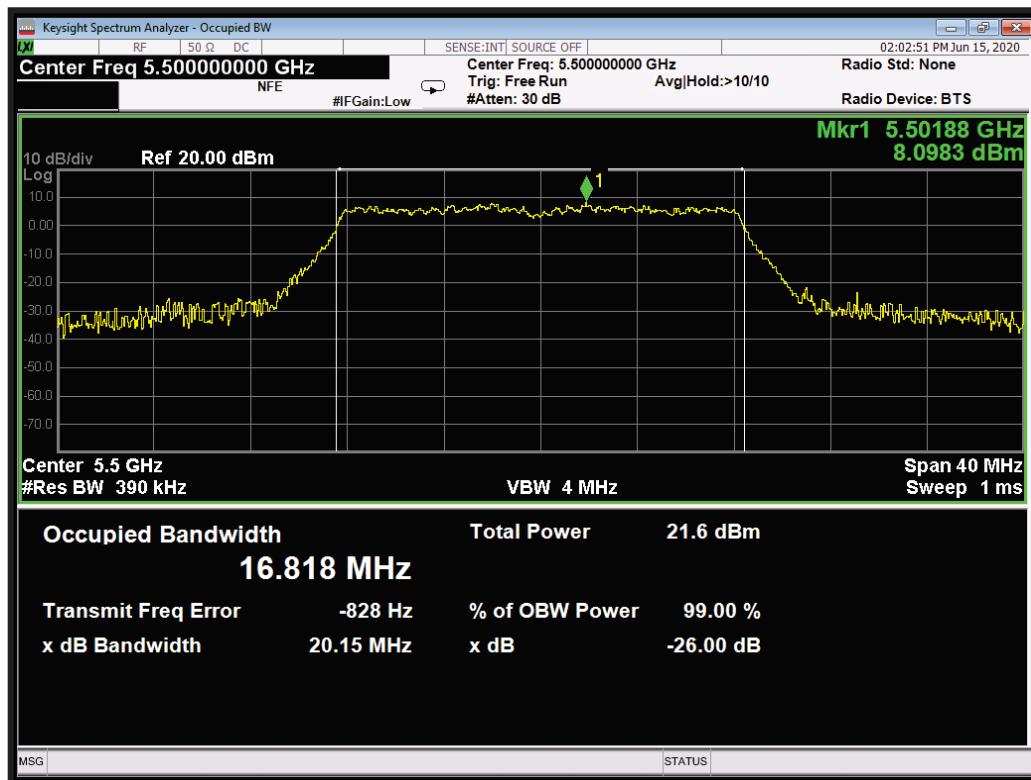
13.5 Test Results

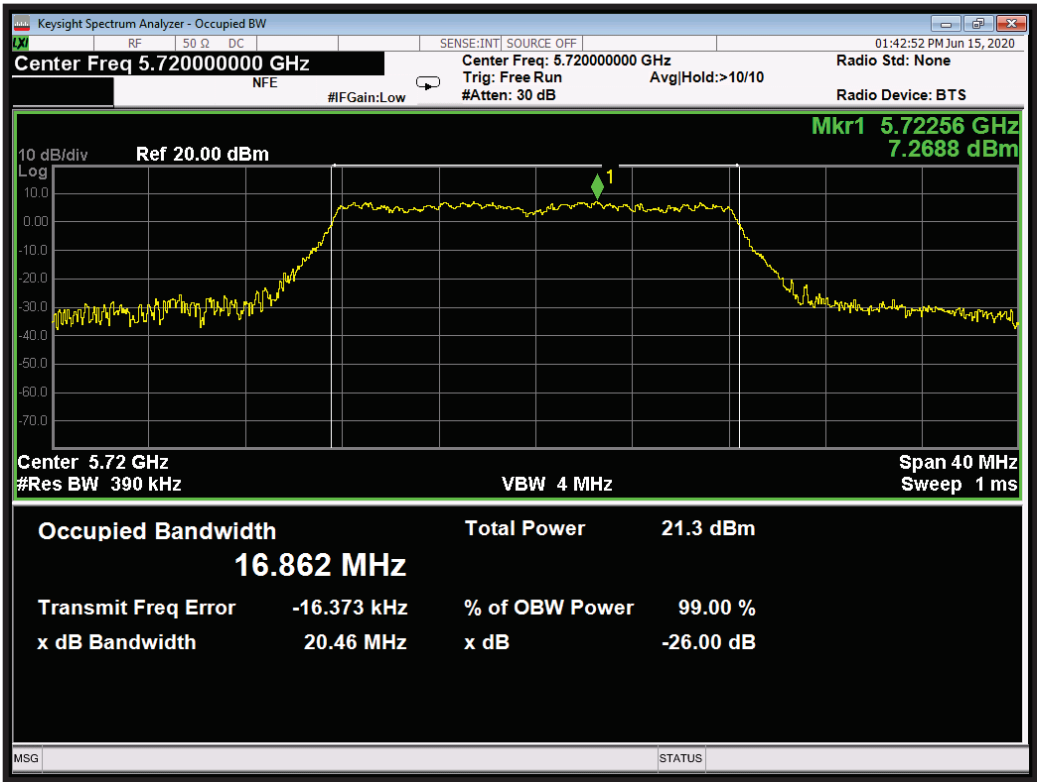
Modulation: 802.11a; Data rate: 6 Mbit/s; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	21.70	17.090	N/A
5580	21.38	16.966	N/A
5720	20.41	16.975	N/A



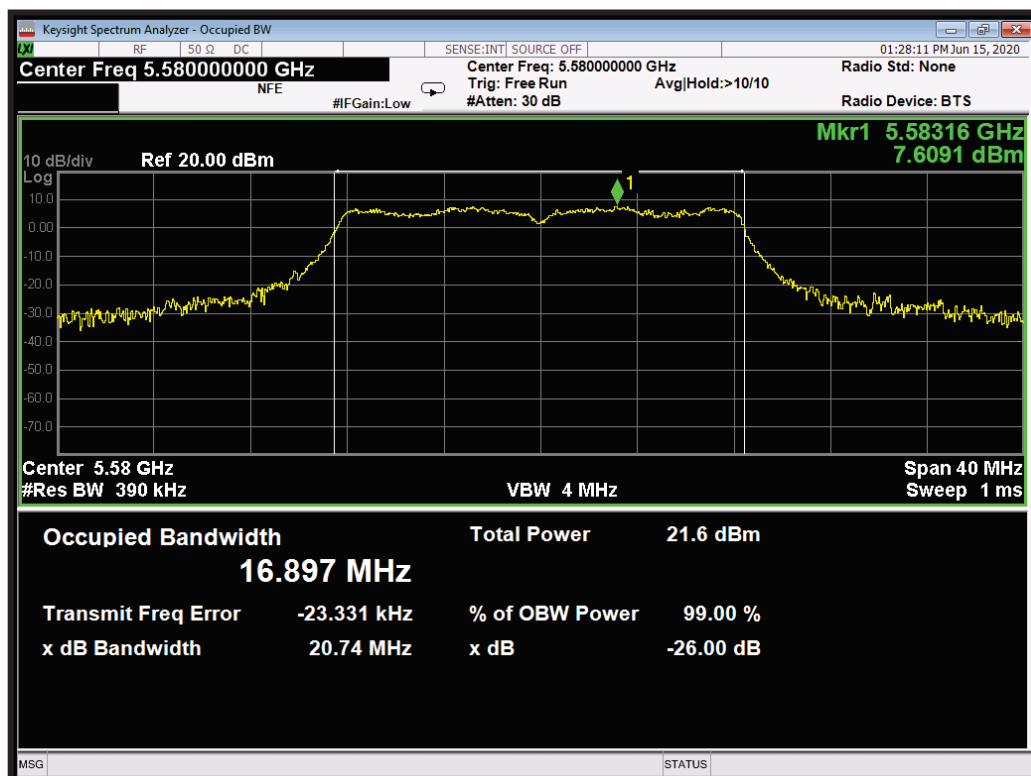
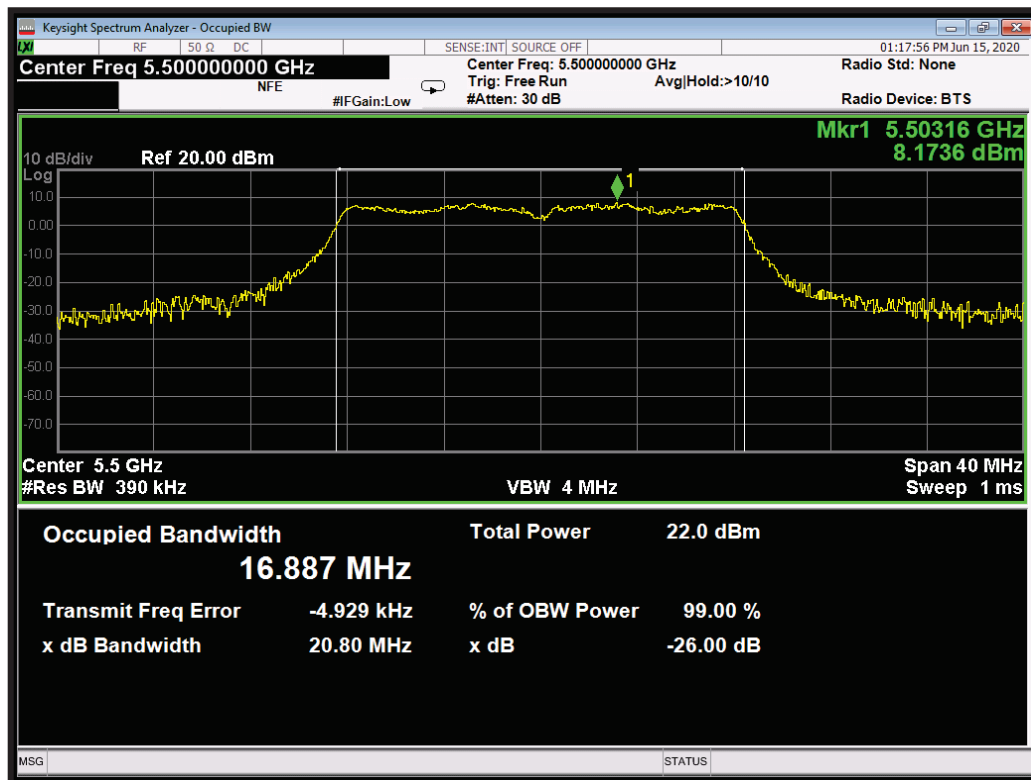


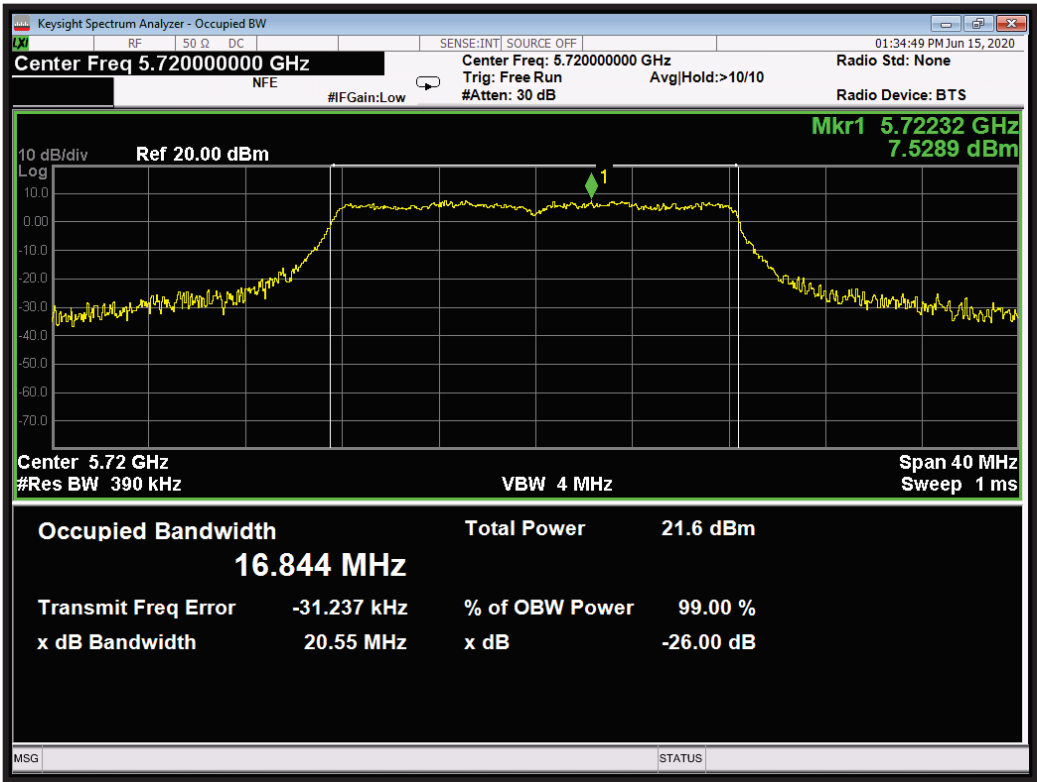
Modulation: 802.11a; Data rate: 6 Mbit/s; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.15	16.818	N/A
5580	19.99	16.853	N/A
5720	20.46	16.862	N/A



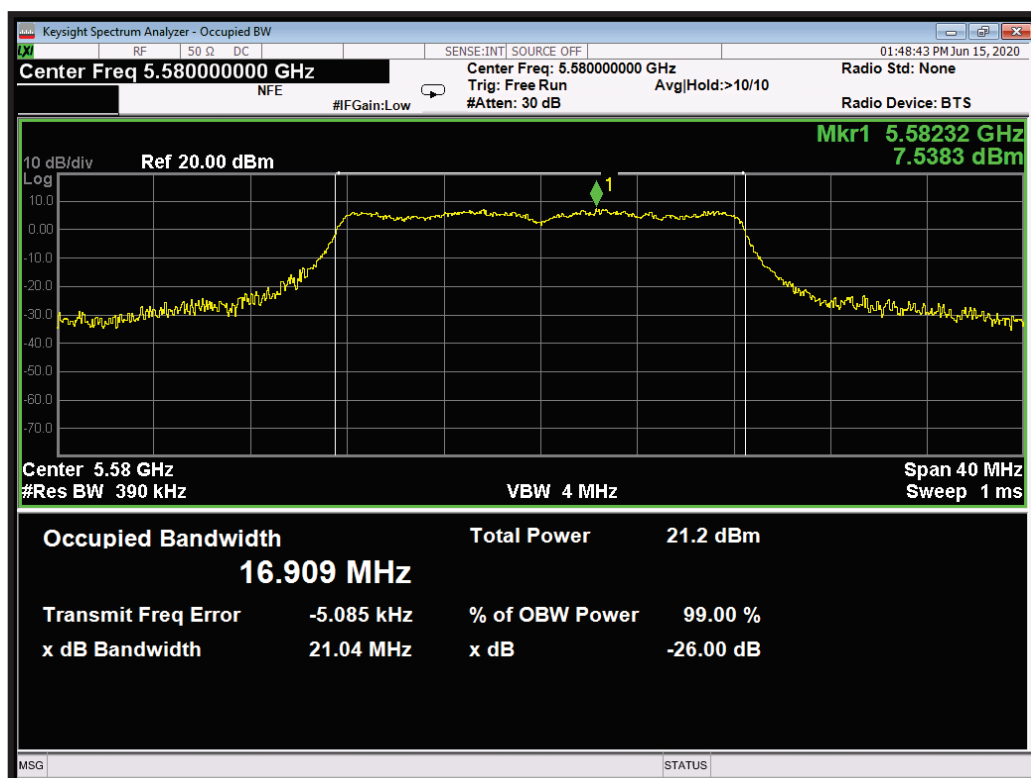
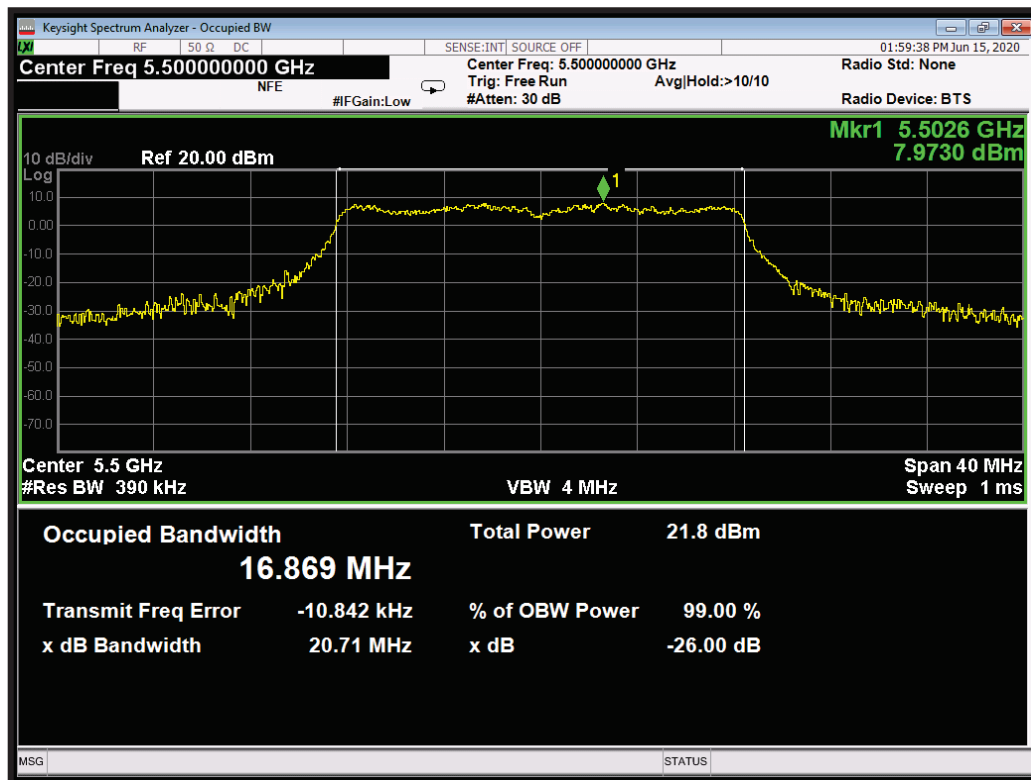


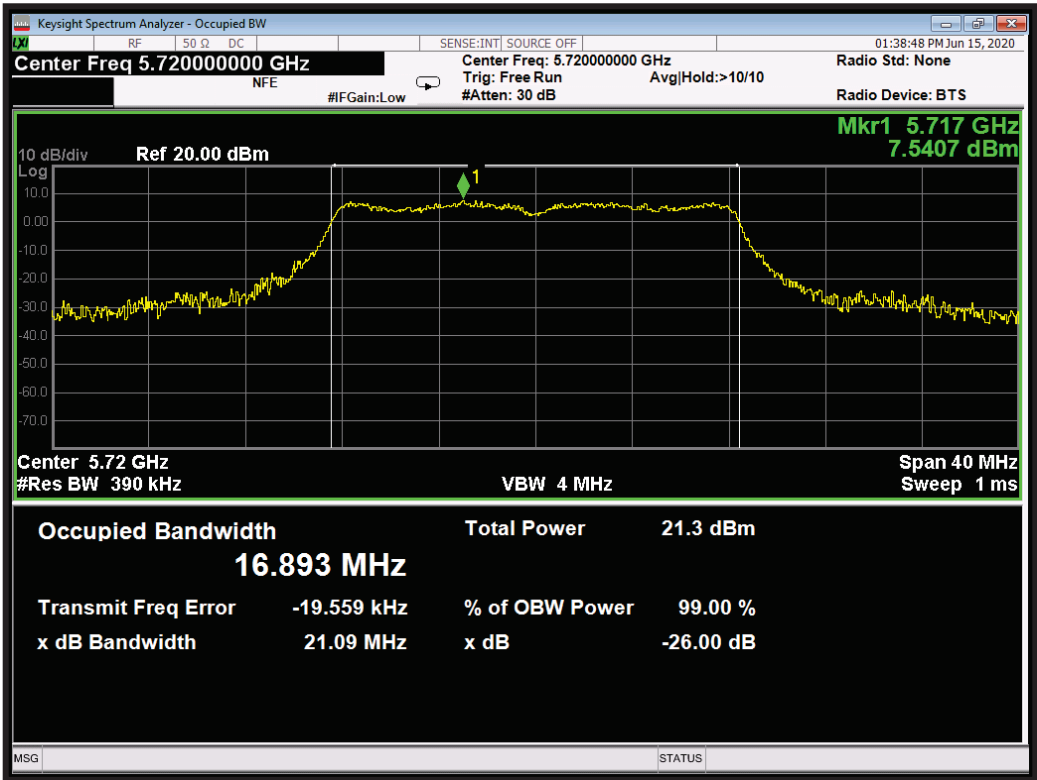
Modulation: 802.11a; Data rate: 54 Mbit/s; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.80	16.887	N/A
5580	20.74	16.897	N/A
5720	20.55	16.844	N/A





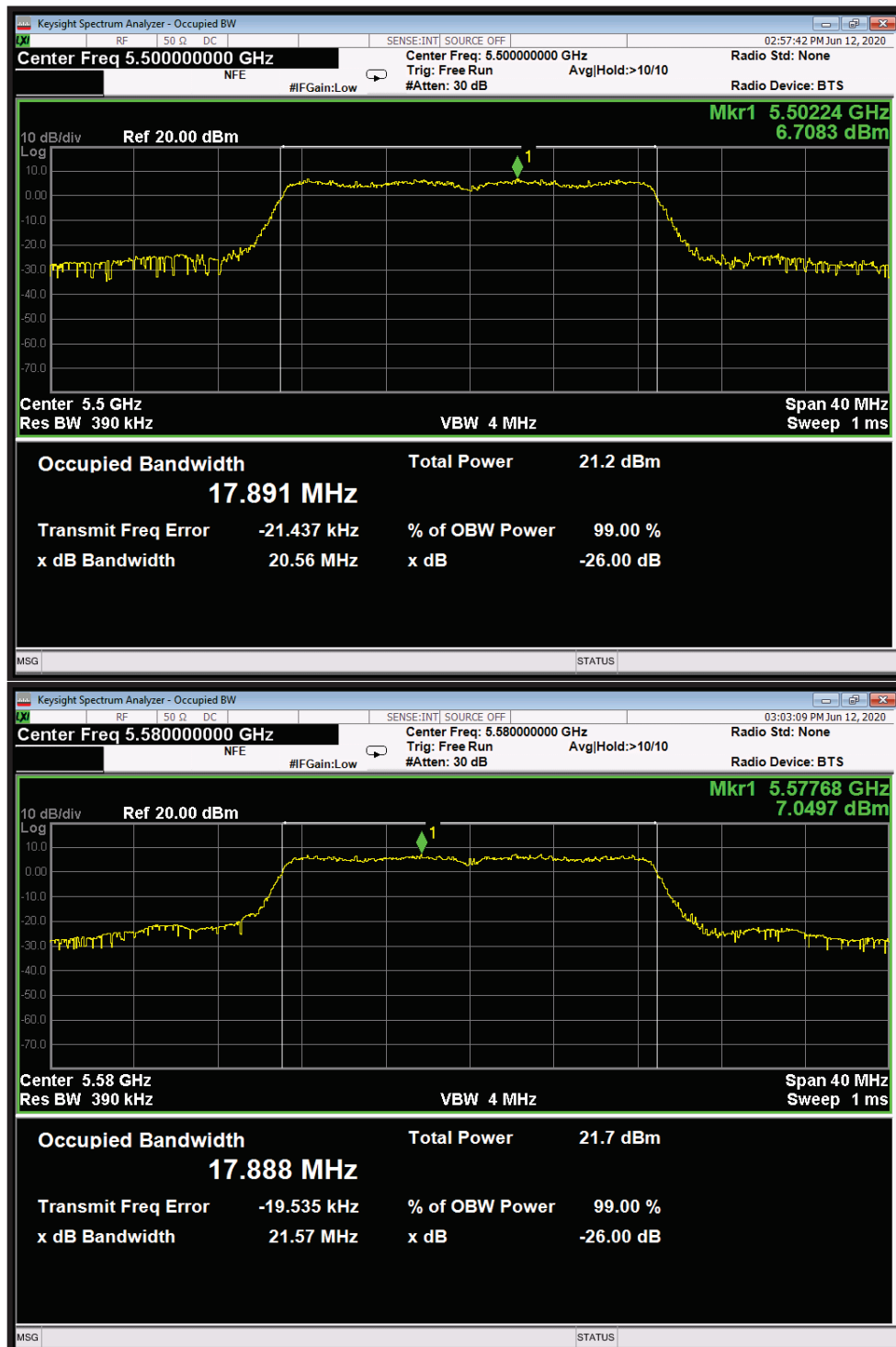
Modulation: 802.11a; Data rate: 54 Mbit/s; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.71	16.869	N/A
5580	21.04	16.909	N/A
5720	21.09	16.893	N/A

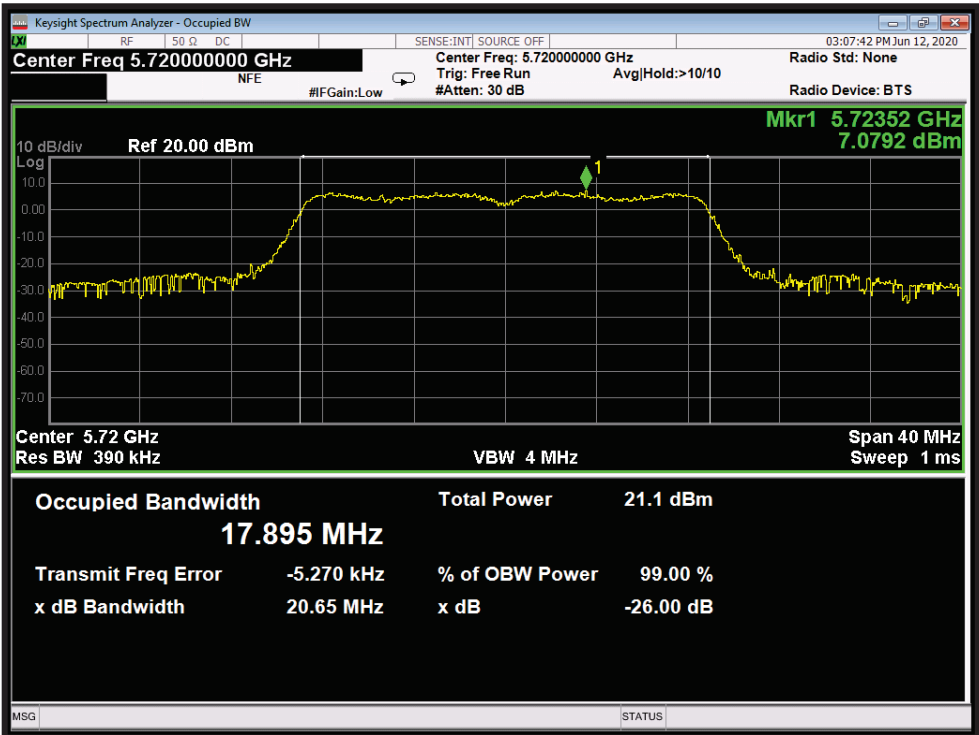




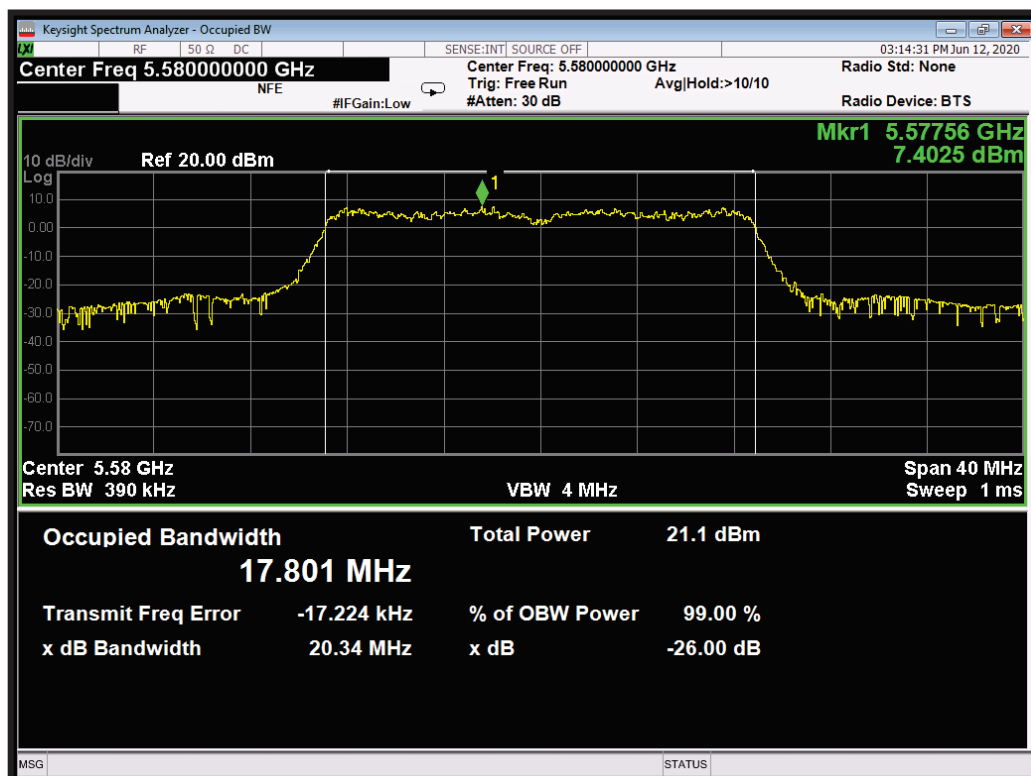
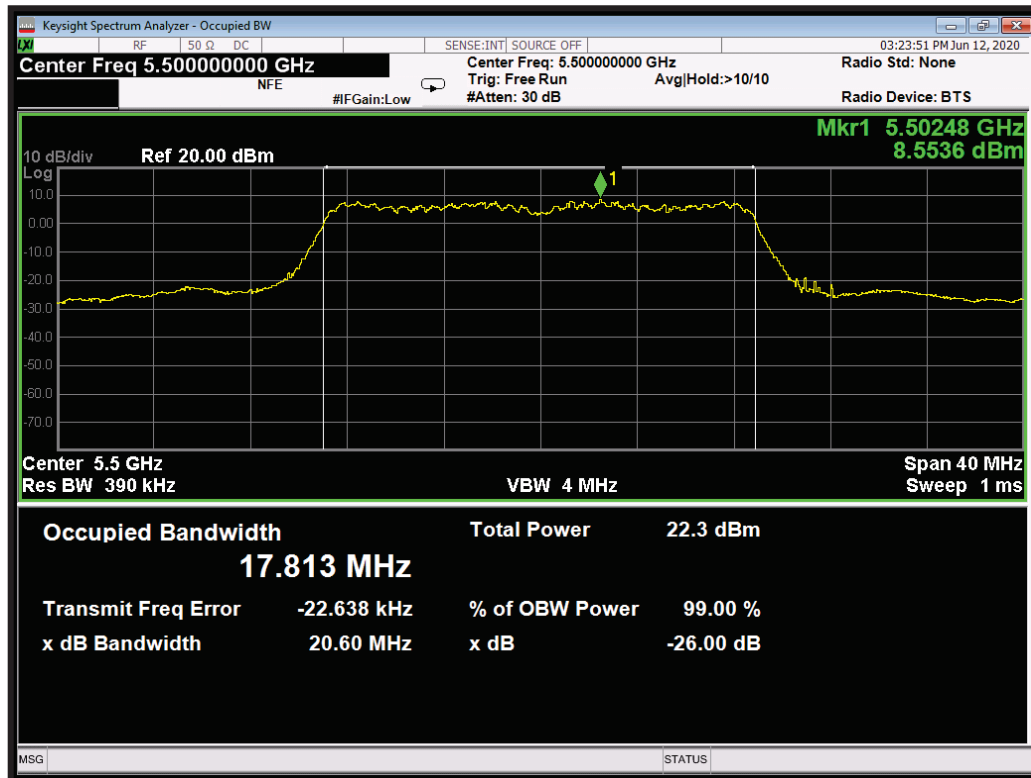
Limited 802.11n mode results are presented. The power setting for MCS0 is higher than for the corresponding 802.11ac modes which are otherwise equivalent. At higher data rates the power setting was the same for both 802.11n and 802.11ac modes so the measurements for the legacy (802.11n) modes have not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

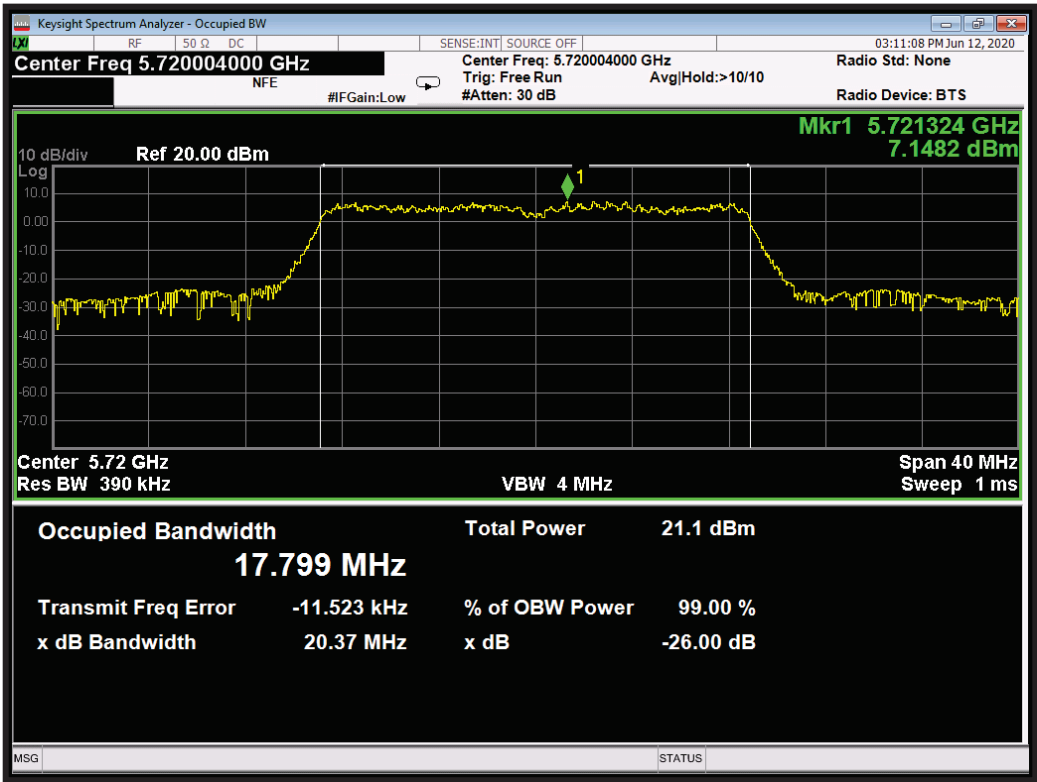
Modulation: 802.11n-20; Data rate: MCS0; Main Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.56	17.891	N/A
5580	21.57	17.888	N/A
5720	20.65	17.895	N/A





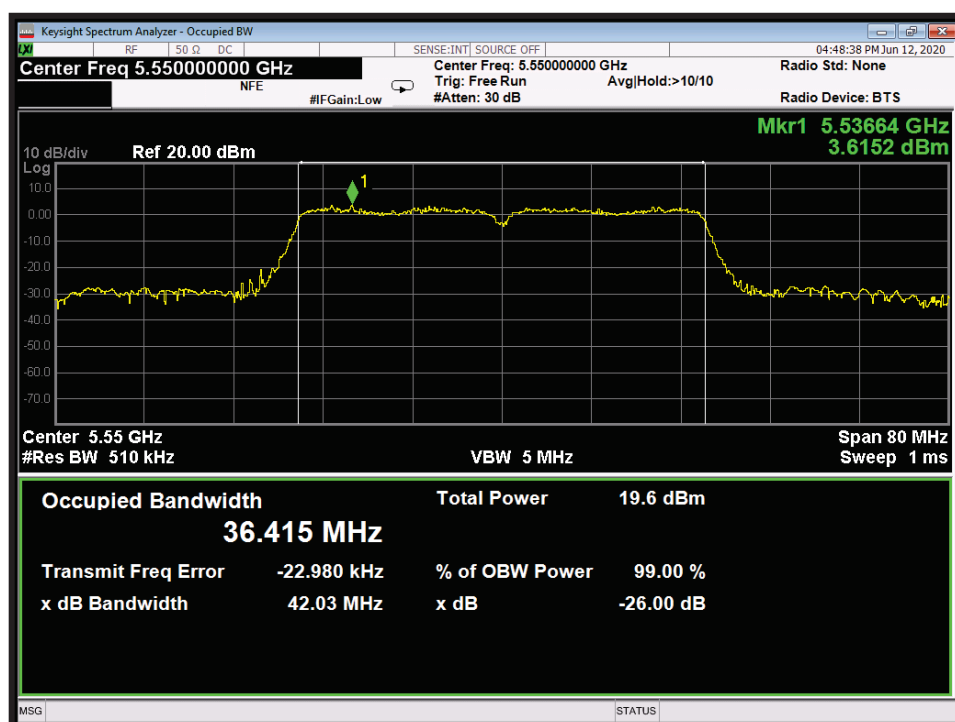
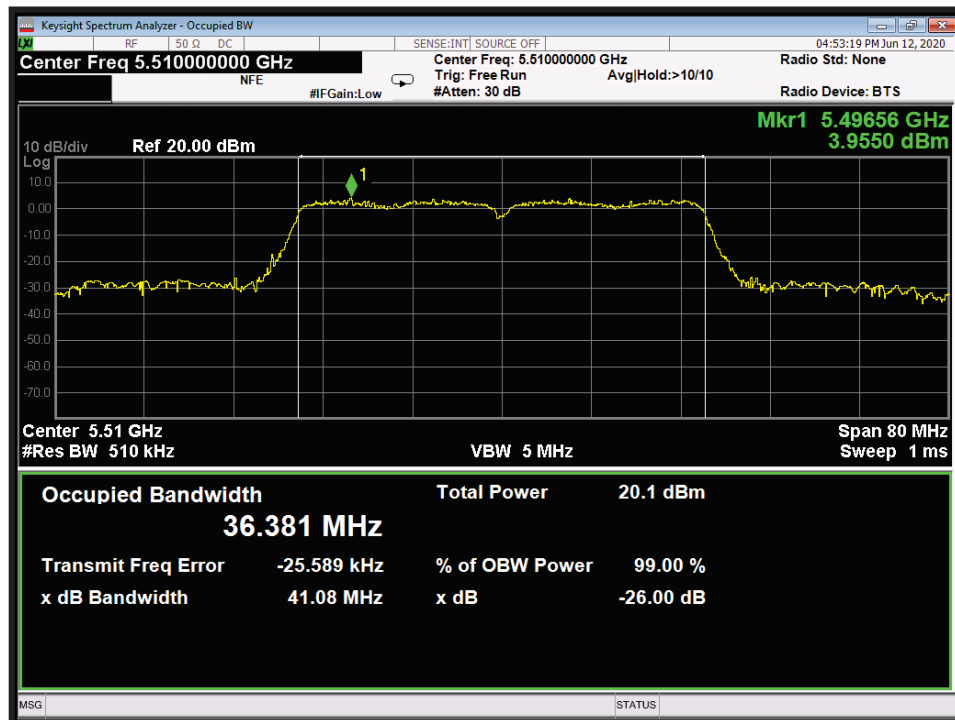
Modulation: 802.11n-20; Data rate: MCS0; Aux Antenna			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.60	17.813	N/A
5580	20.34	17.801	N/A
5720	20.37	17.799	N/A

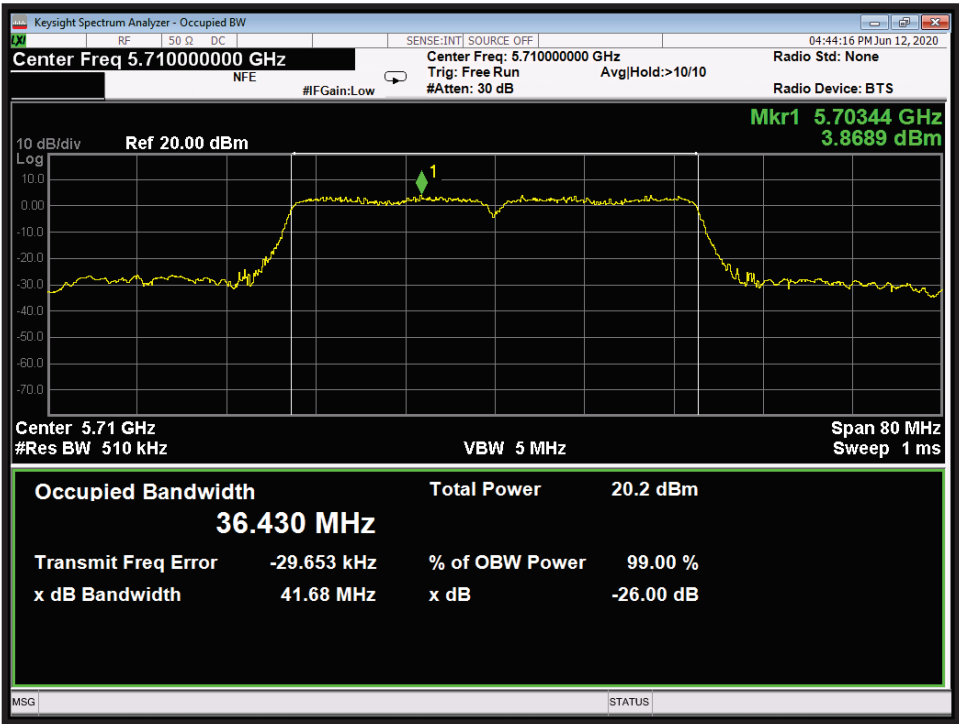




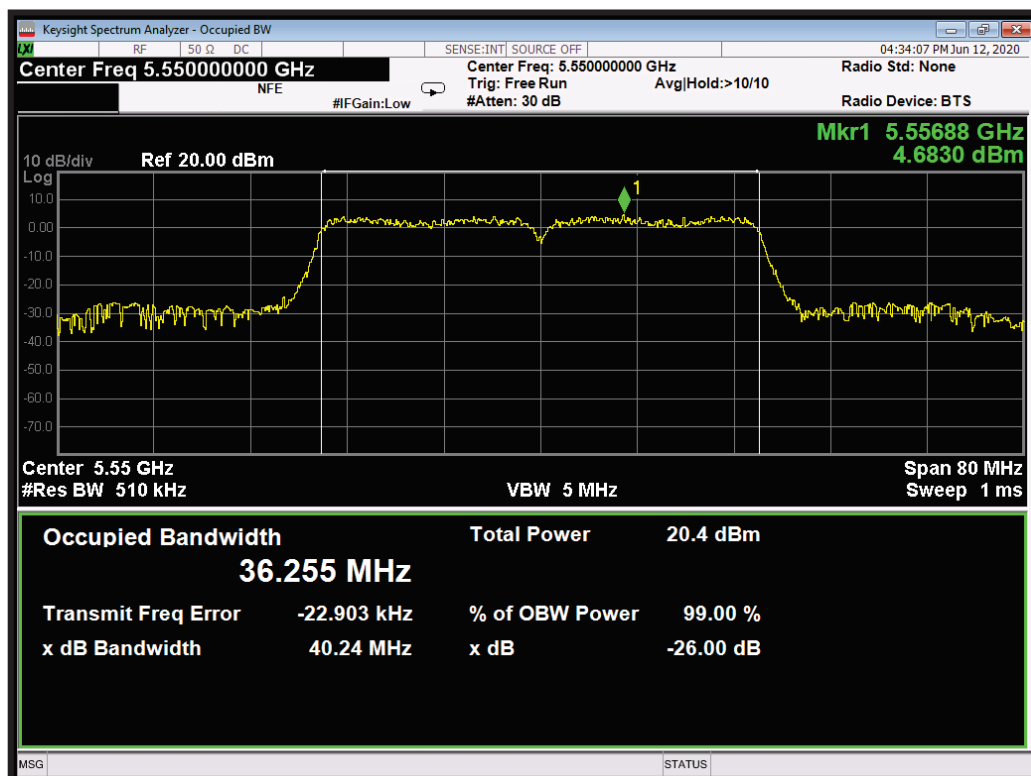
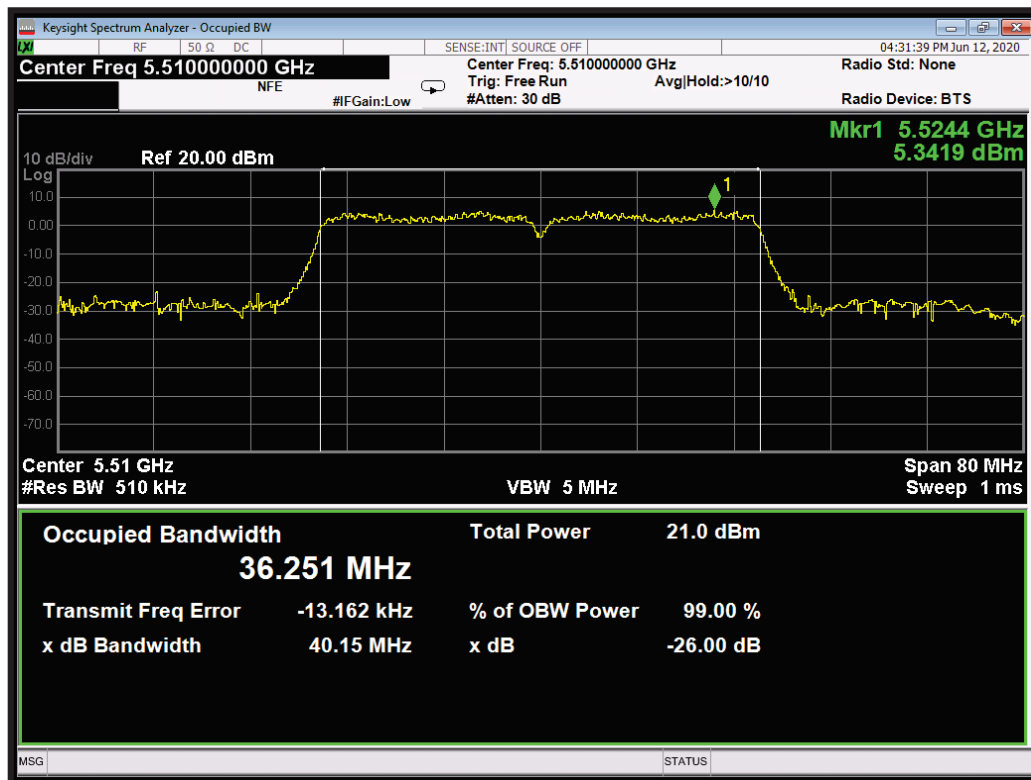
Limited 802.11n mode results are presented. The power setting for MCS0 is higher than for the corresponding 802.11ac modes which are otherwise equivalent. At higher data rates the power setting was the same for both 802.11n and 802.11ac modes so the measurements for the legacy (802.11n) modes have not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

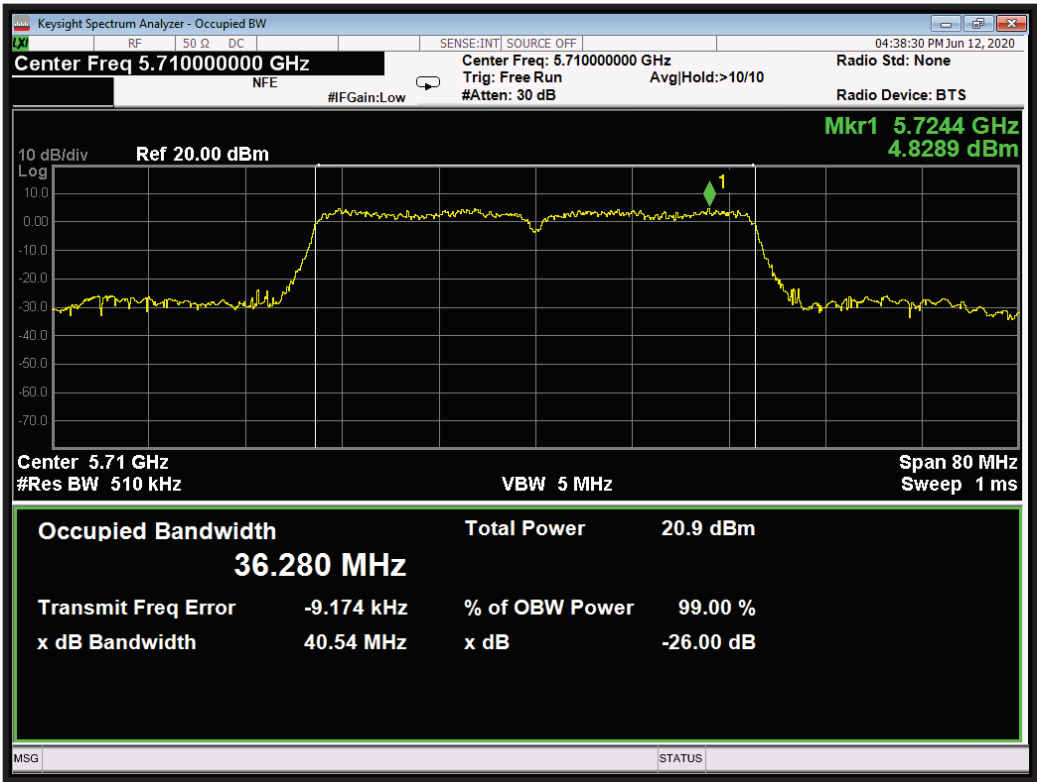
Modulation: 802.11n-40; Data rate: MCS0; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	41.08	36.381	N/A
5550	42.03	36.415	N/A
5710	41.68	36.430	N/A



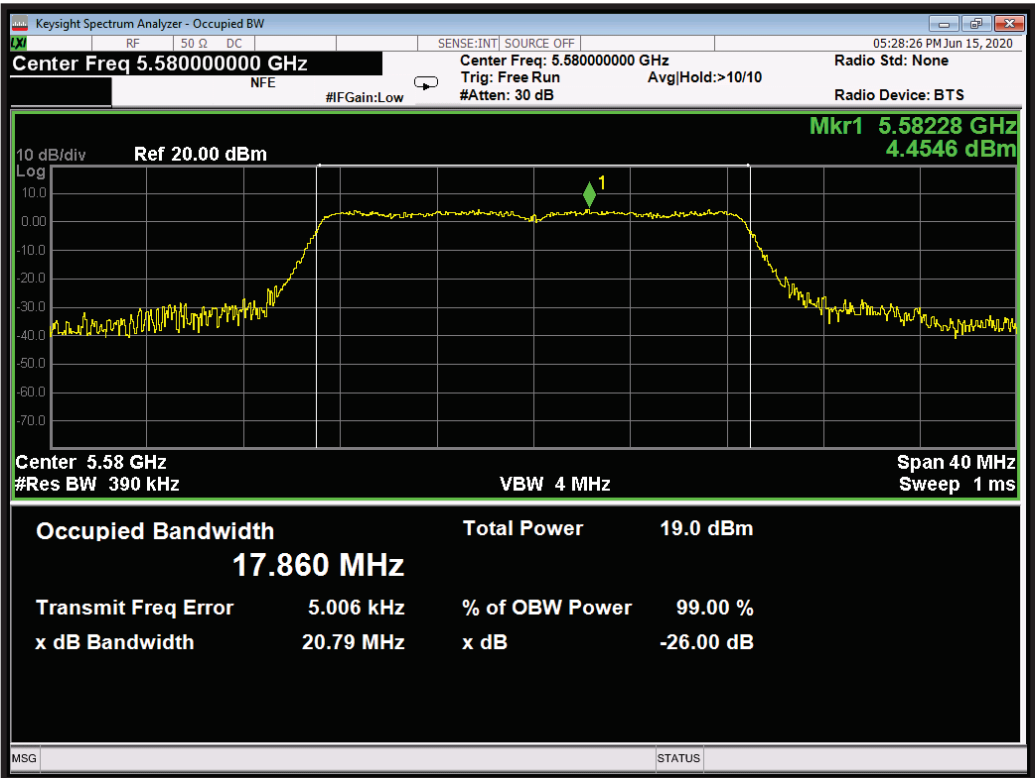
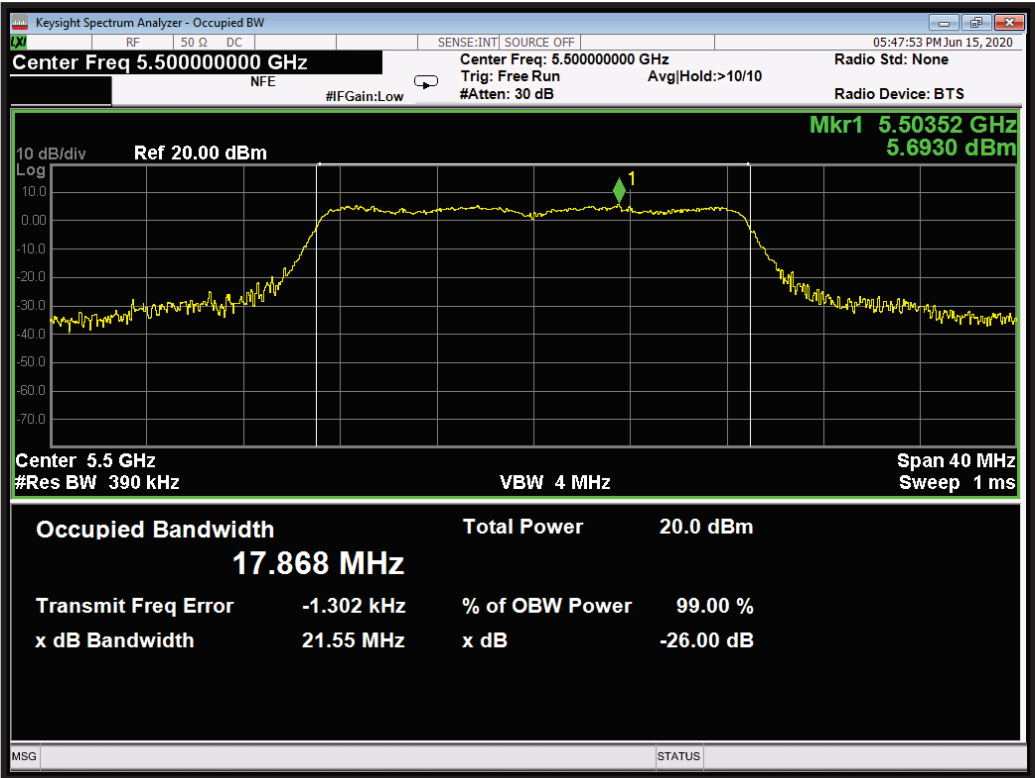


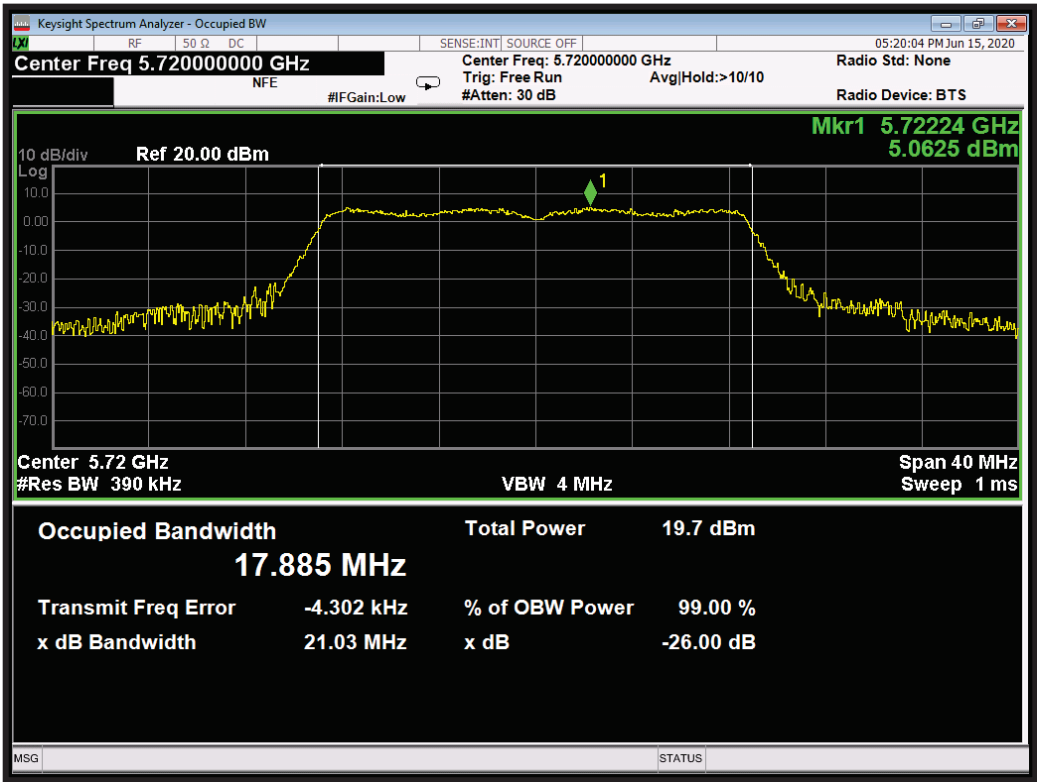
Modulation: 802.11n-40; Data rate: MCS0; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	40.15	36.251	N/A
5550	40.24	36.255	N/A
5710	40.54	36.280	N/A



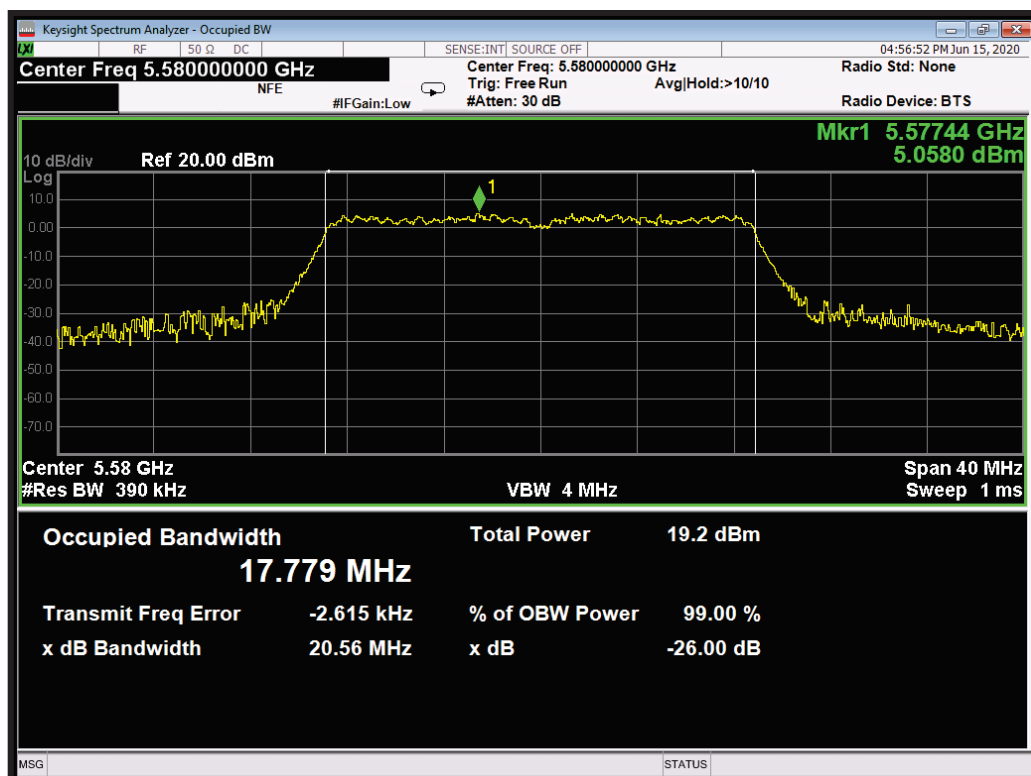
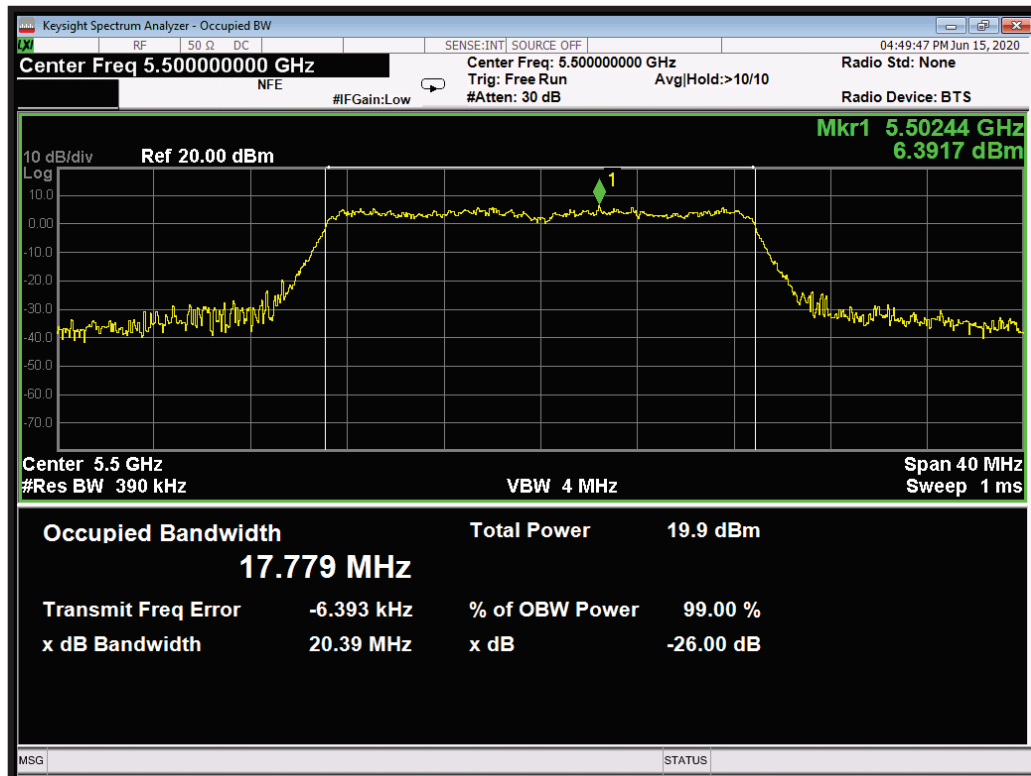


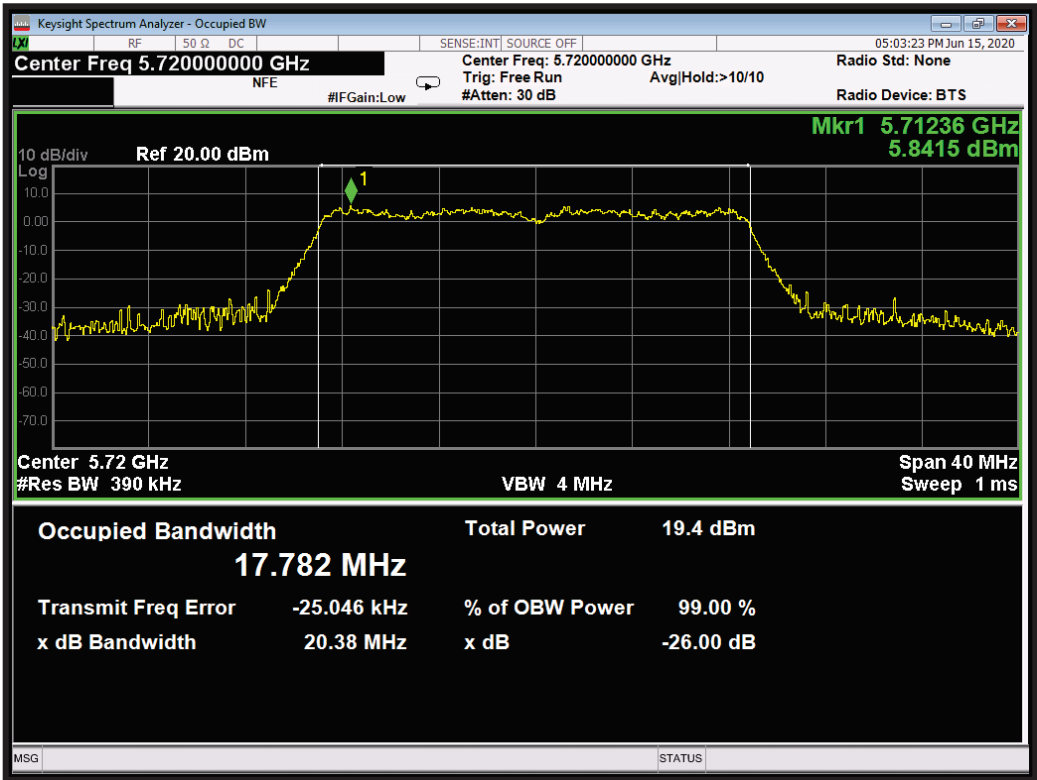
Modulation: 802.11ac-20; Data rate: MCS0 1SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	21.55	17.868	N/A
5580	20.79	17.860	N/A
5720	21.03	17.885	N/A



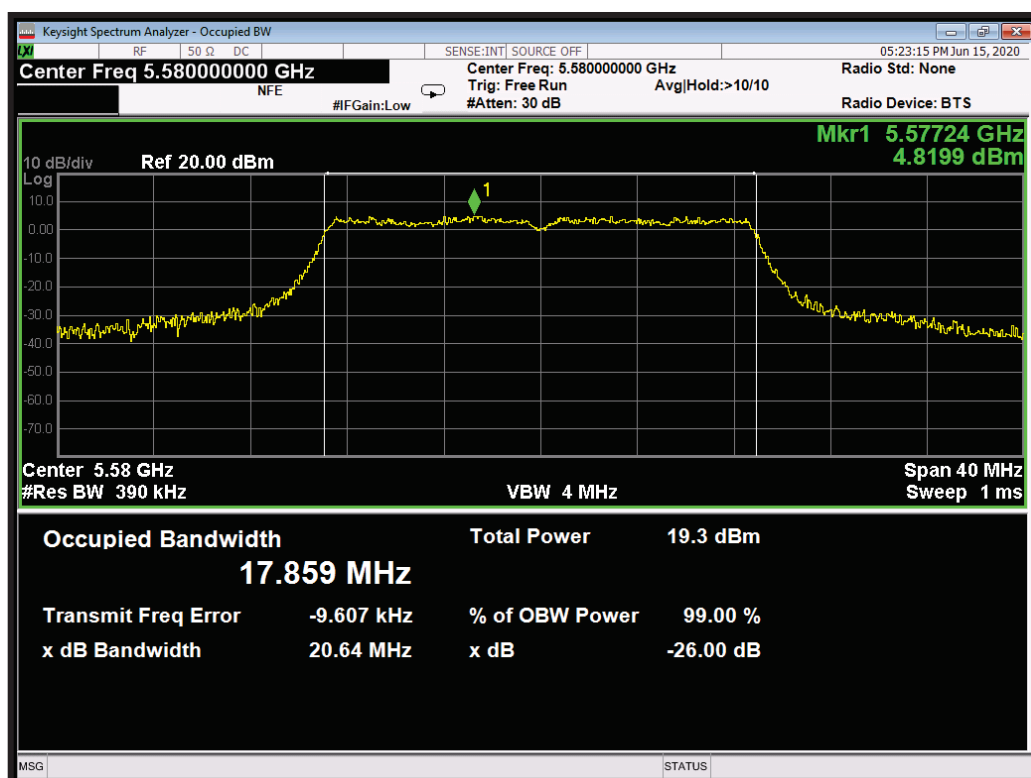
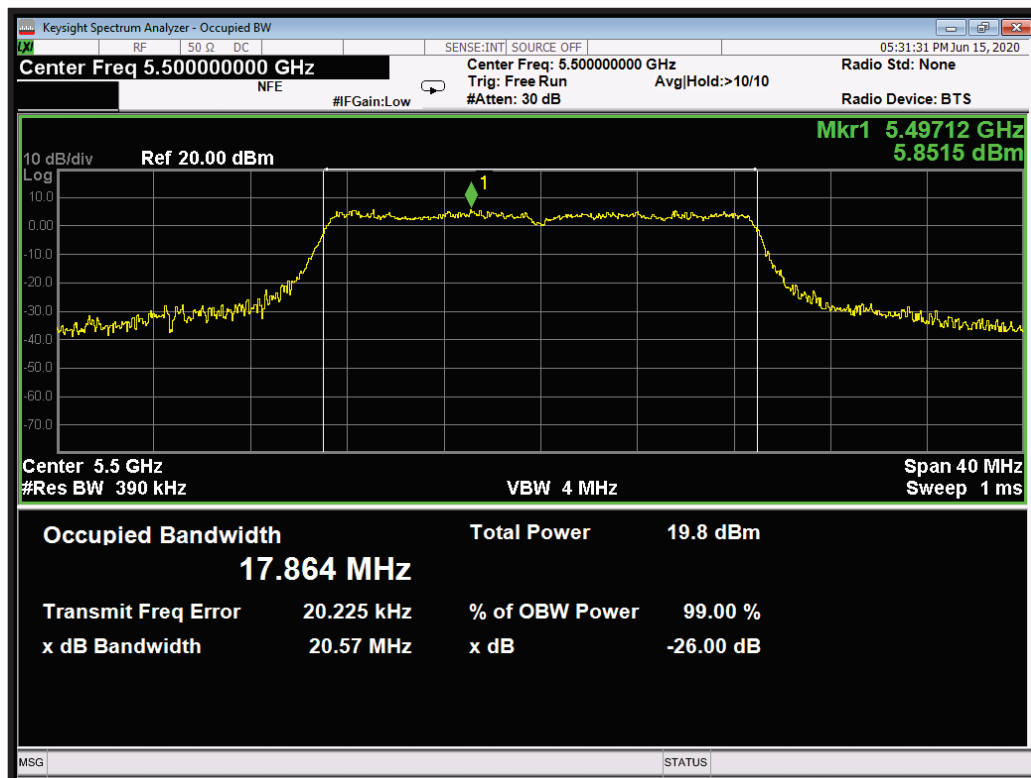


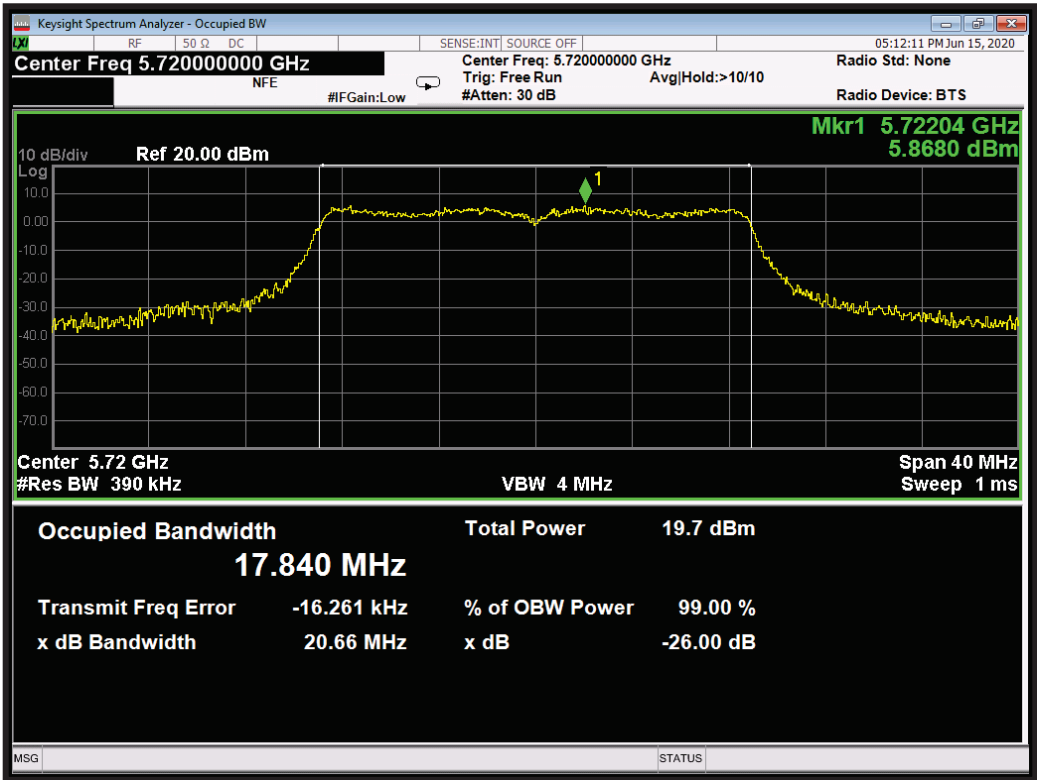
Modulation: 802.11ac-20; Data rate: MCS0 1SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.39	17.779	N/A
5580	20.56	17.779	N/A
5720	20.38	17.782	N/A



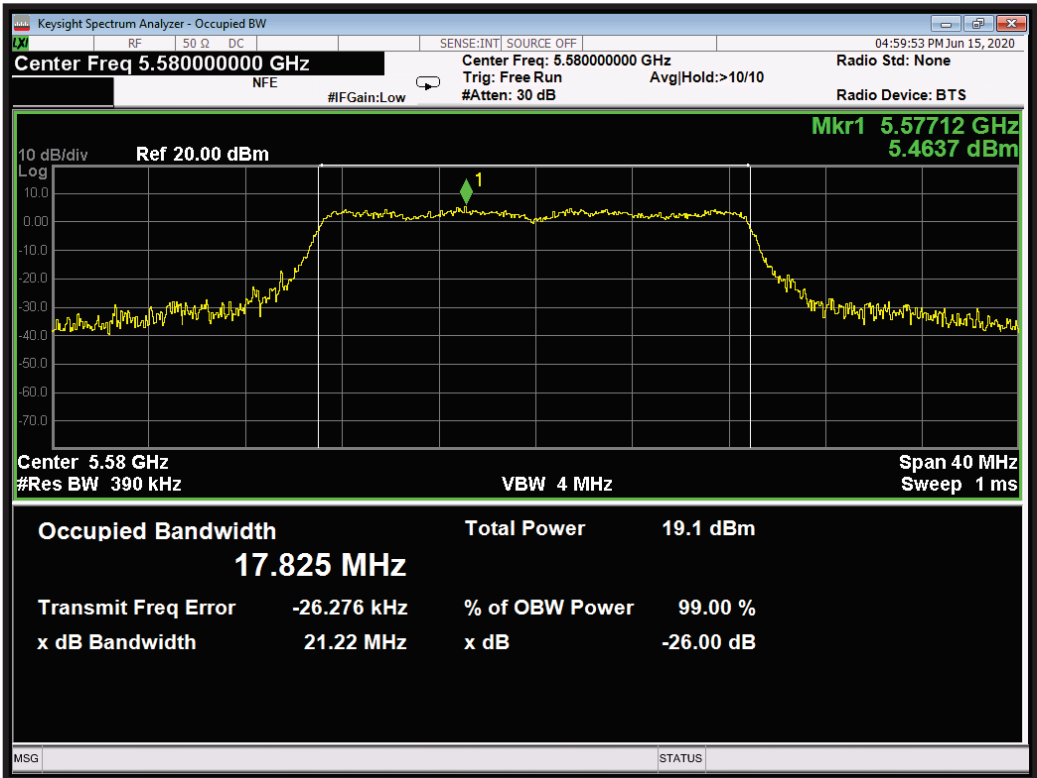
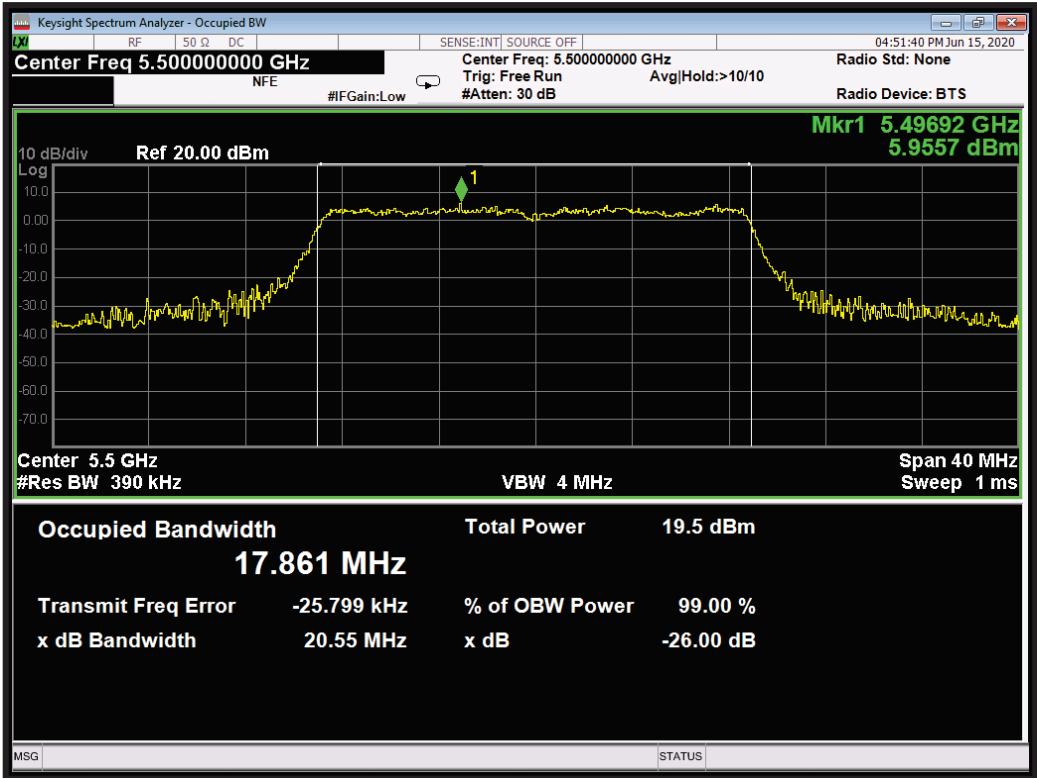


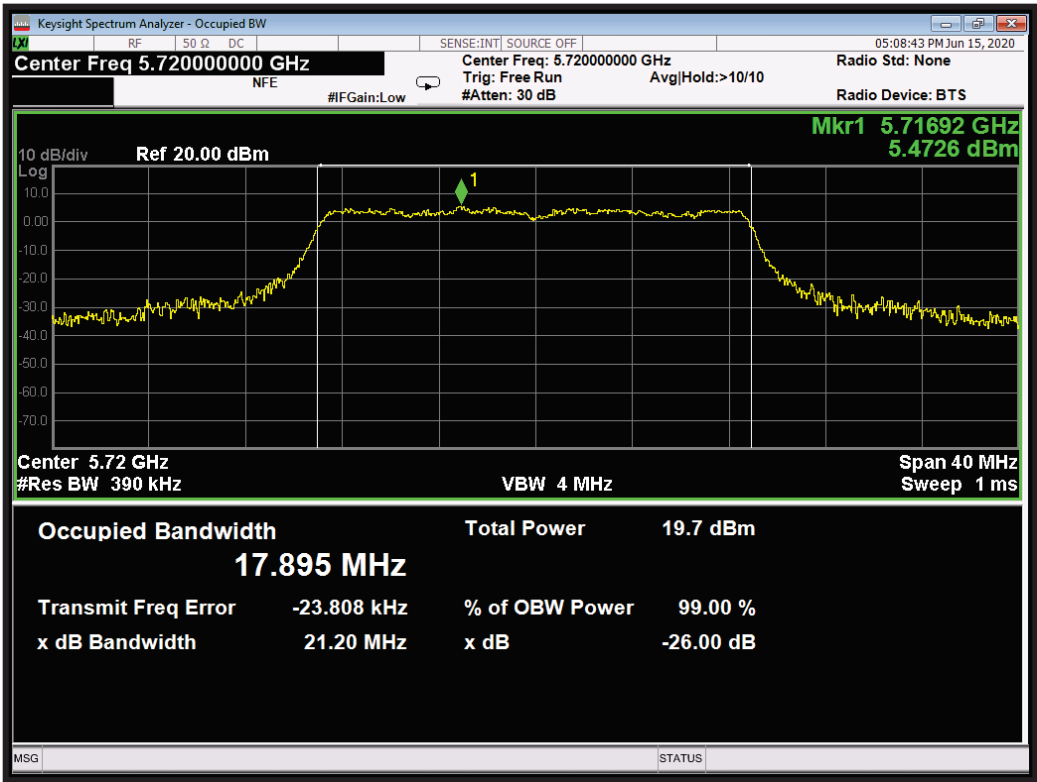
Modulation: 802.11ac-20; Data rate: MCS8 1SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.57	17.864	N/A
5580	20.64	17.859	N/A
5720	20.66	17.840	N/A



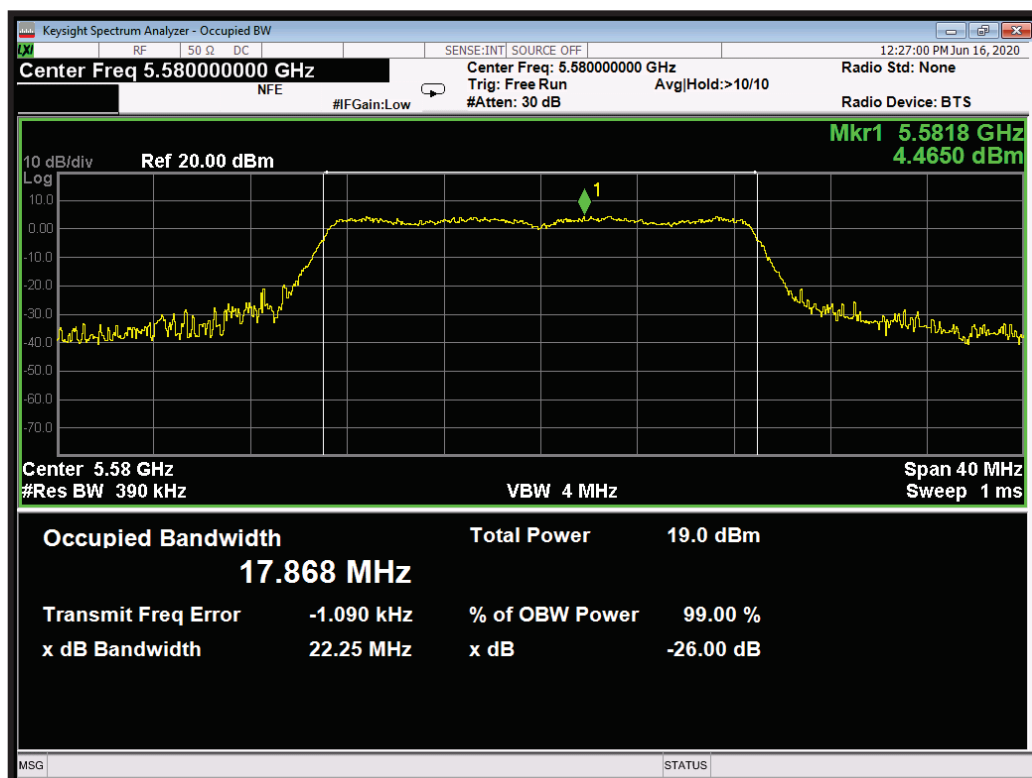
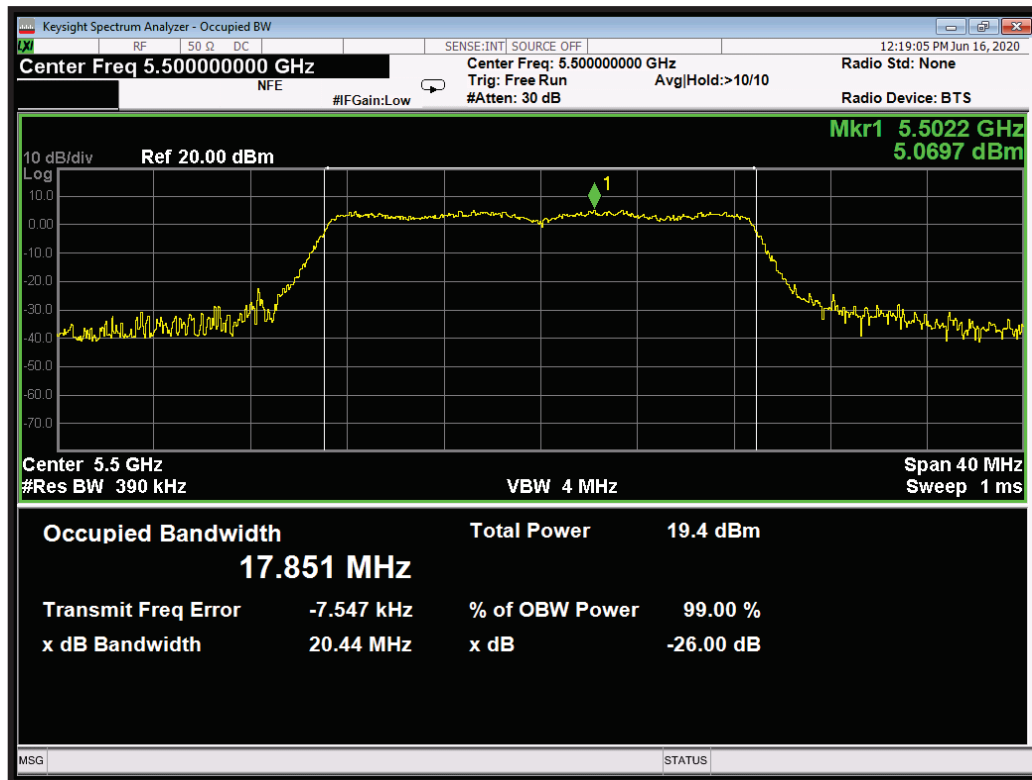


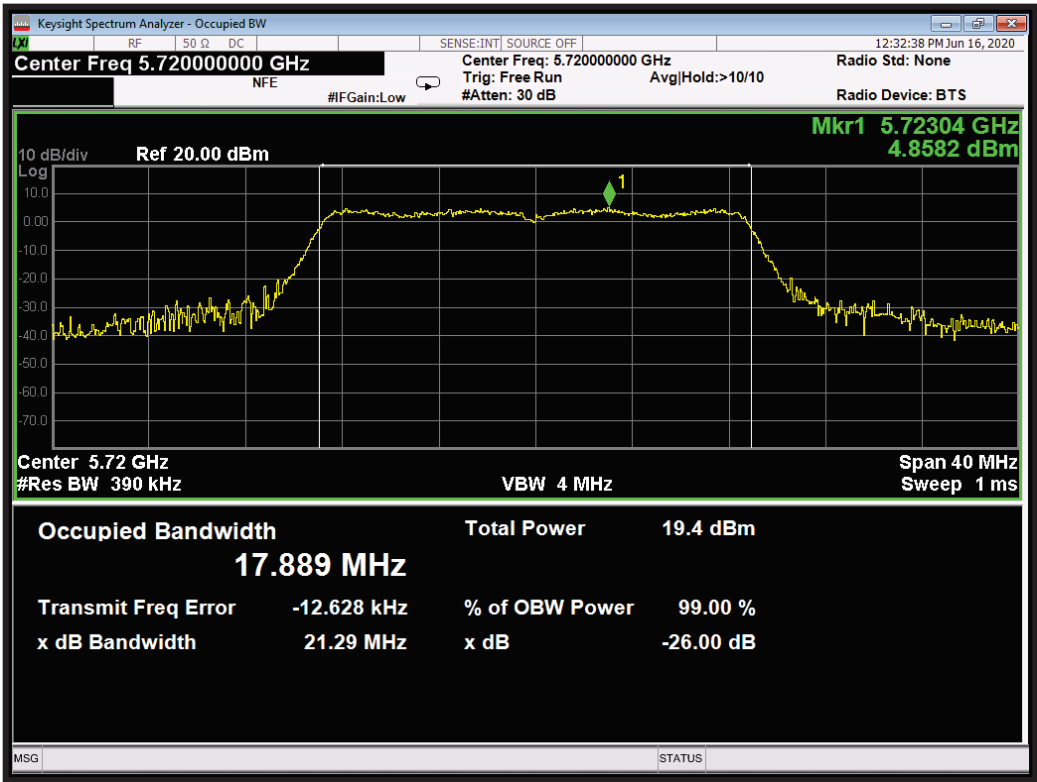
Modulation: 802.11ac-20; Data rate: MCS8 1SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.55	17.861	N/A
5580	21.22	17.825	N/A
5720	21.20	17.895	N/A



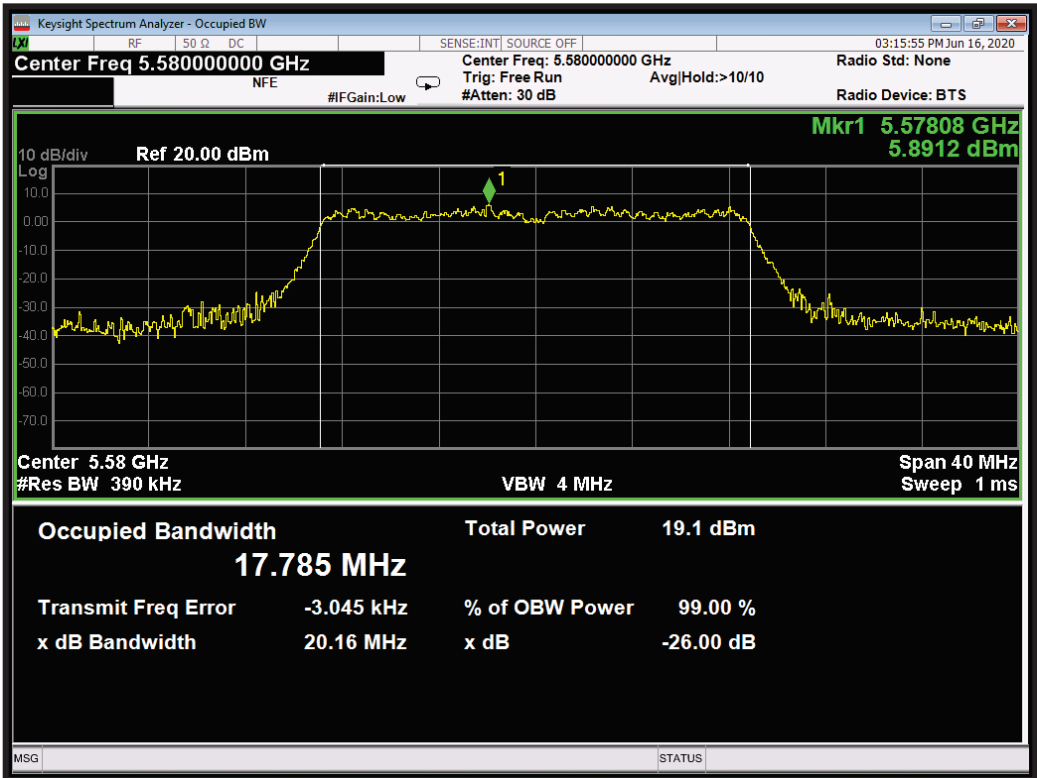
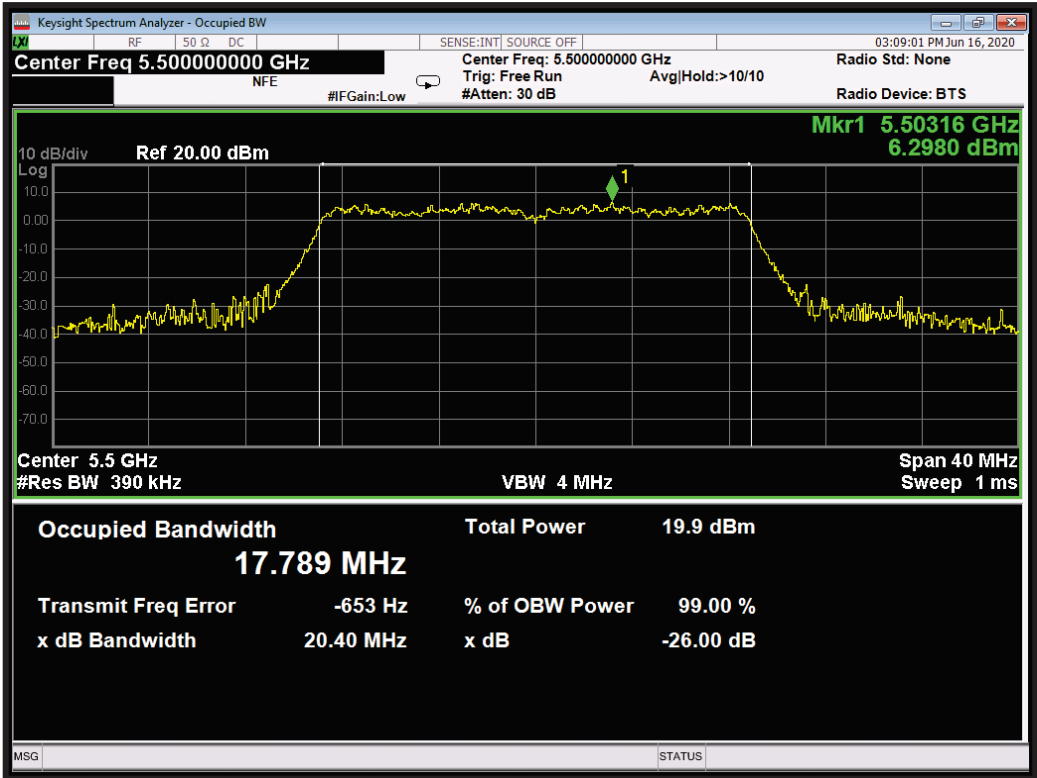


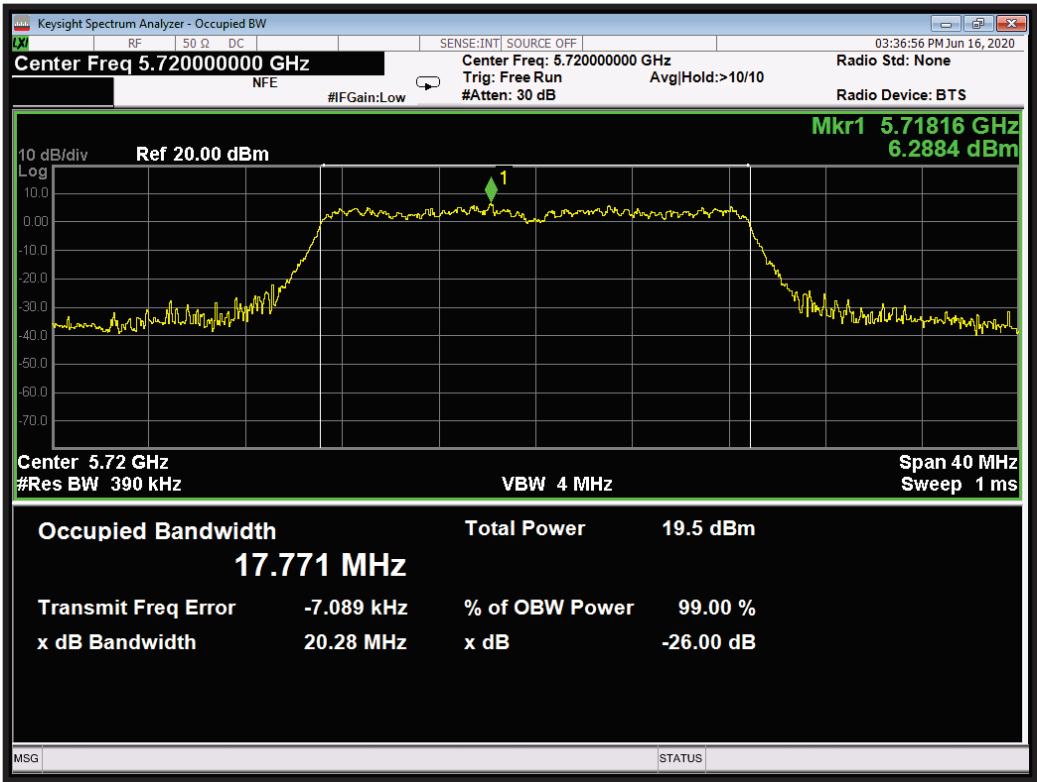
Modulation: 802.11ac-20; Data rate: MCS0 2SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.44	17.851	N/A
5580	22.25	17.868	N/A
5720	21.29	17.889	N/A



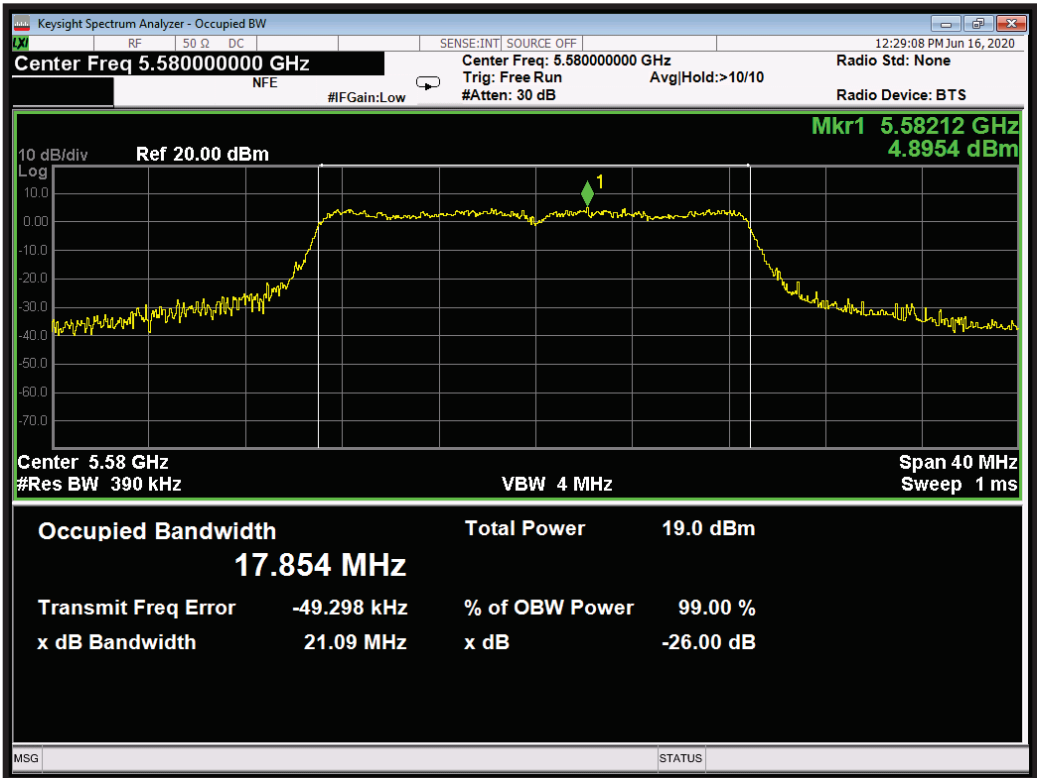
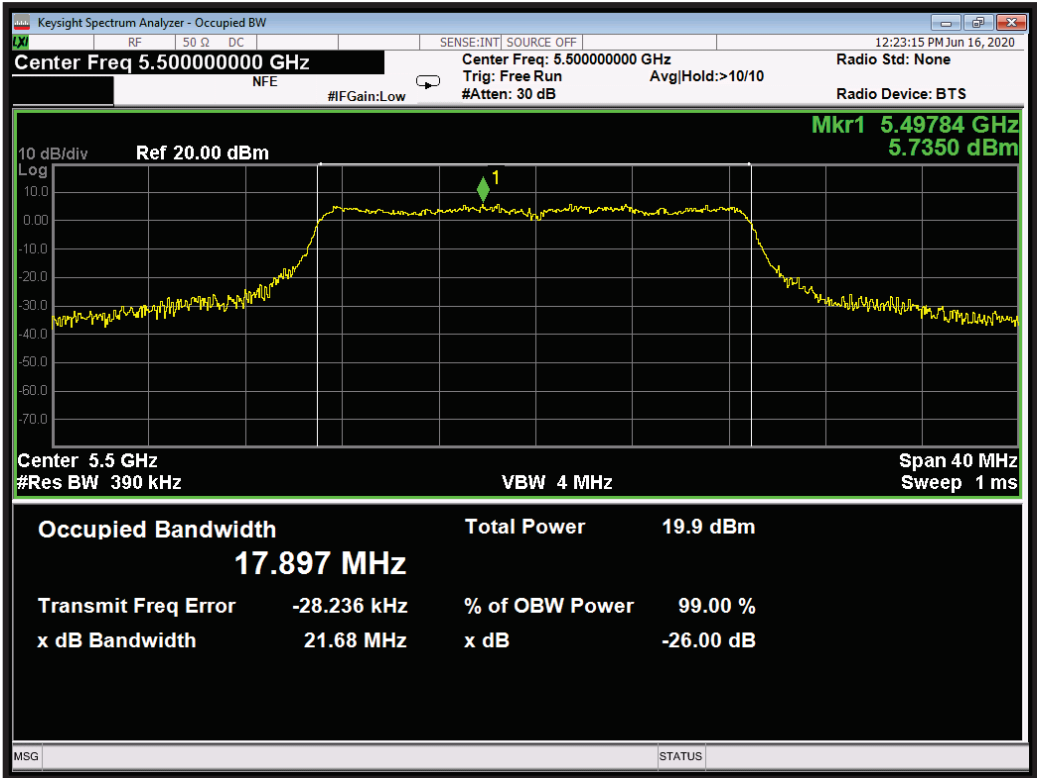


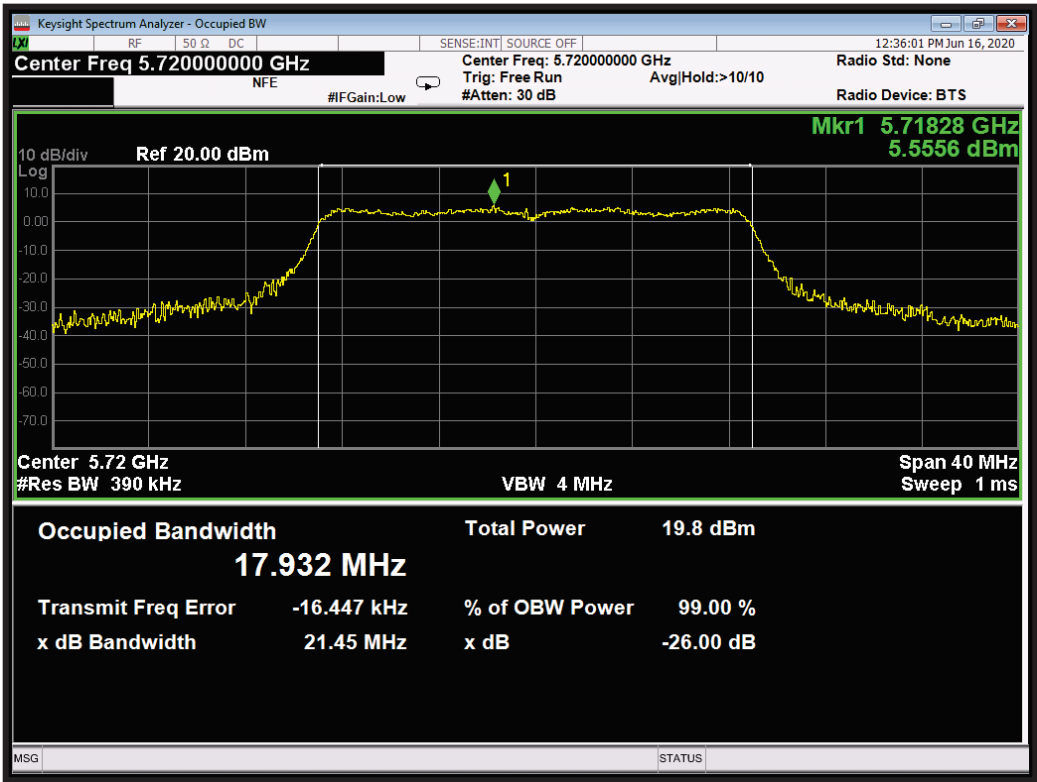
Modulation: 802.11ac-20; Data rate: MCS0 2SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.40	17.789	N/A
5580	20.16	17.785	N/A
5720	20.28	17.771	N/A



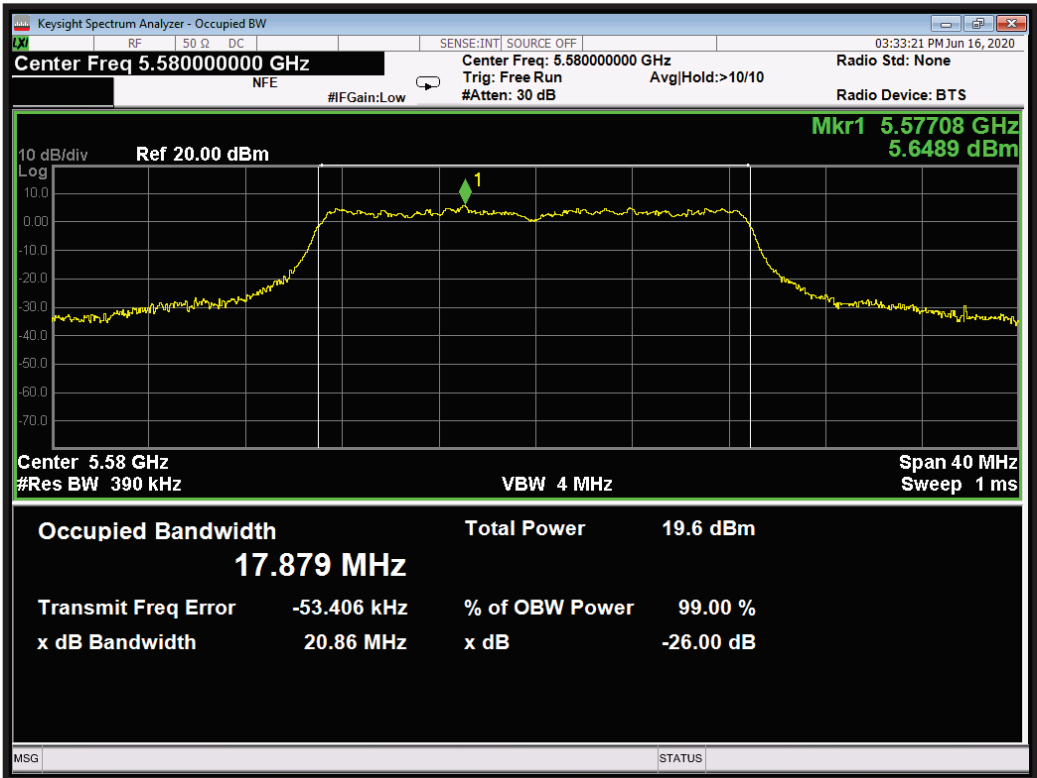
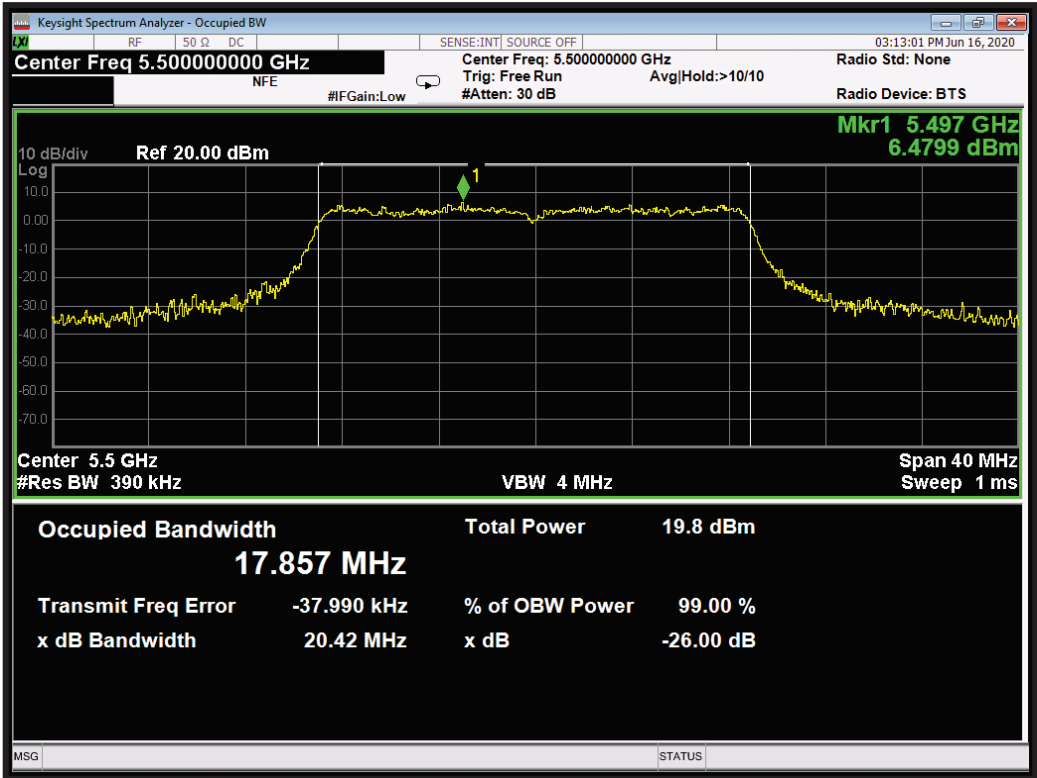


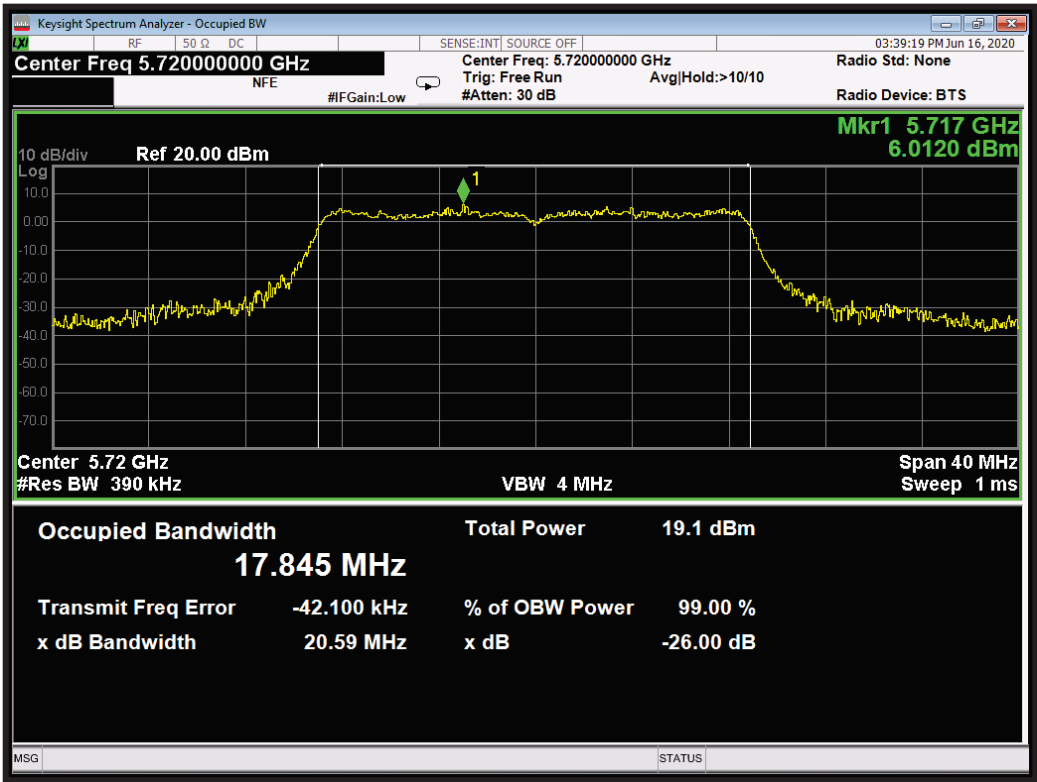
Modulation: 802.11ac-20; Data rate: MCS8 2SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	21.68	17.897	N/A
5580	21.09	17.854	N/A
5720	21.45	17.932	N/A



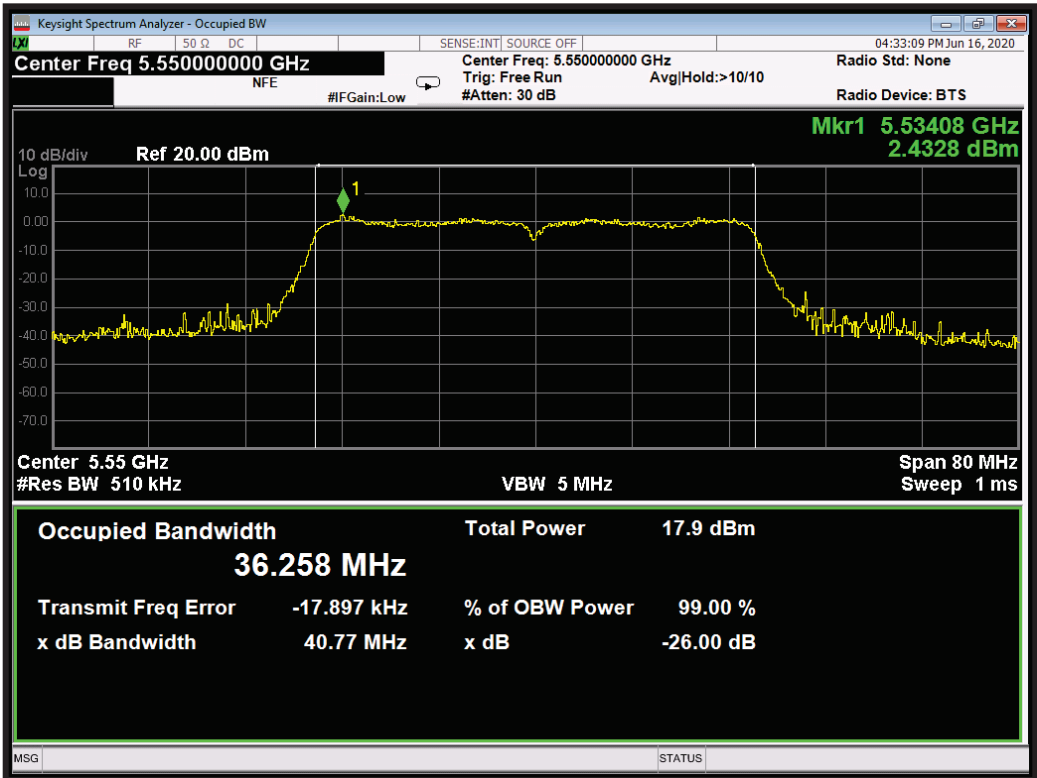
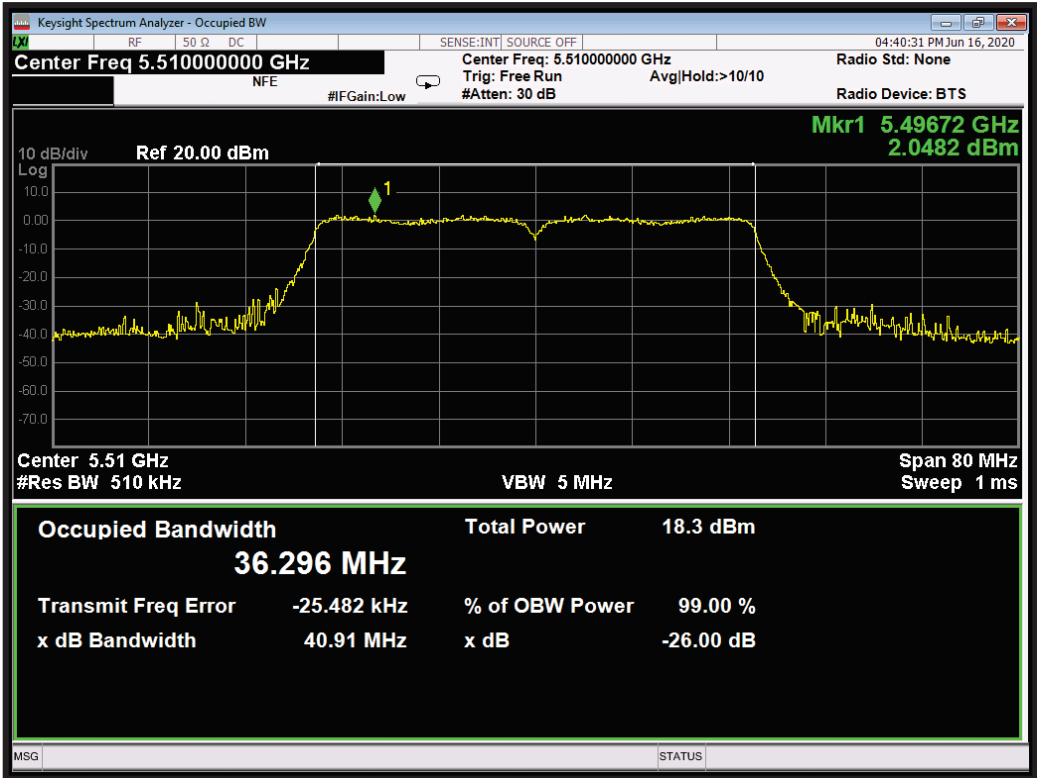


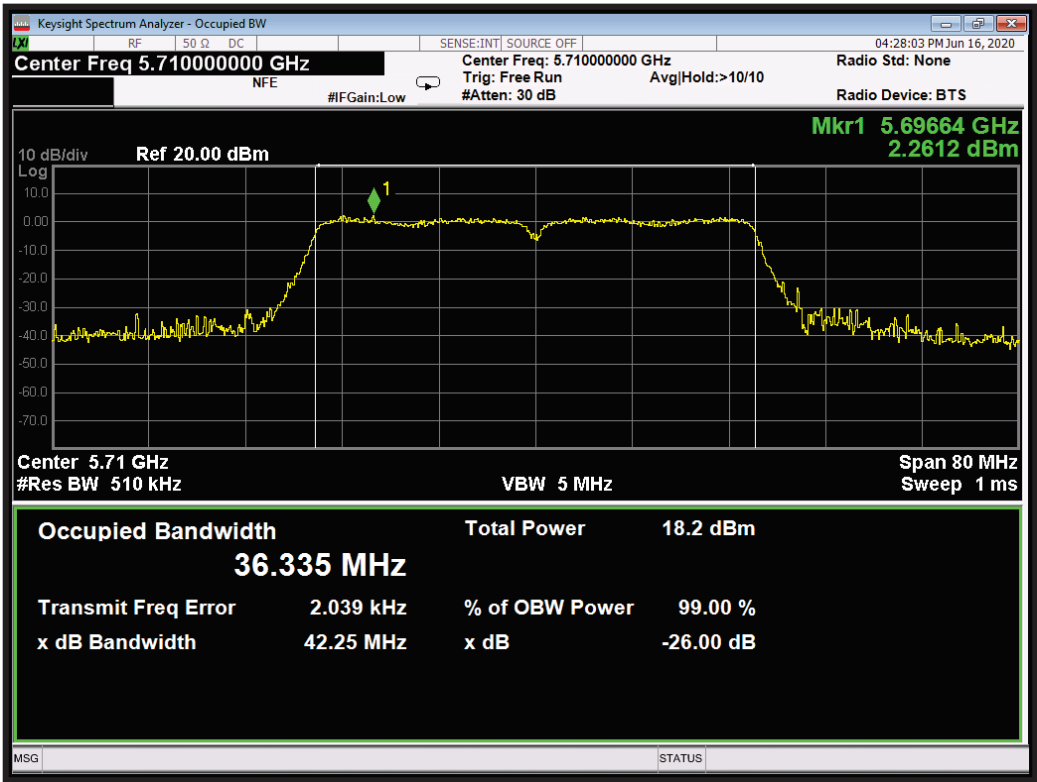
Modulation: 802.11ac-20; Data rate: MCS8 2SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5500	20.42	17.857	N/A
5580	20.86	17.879	N/A
5720	20.59	17.845	N/A



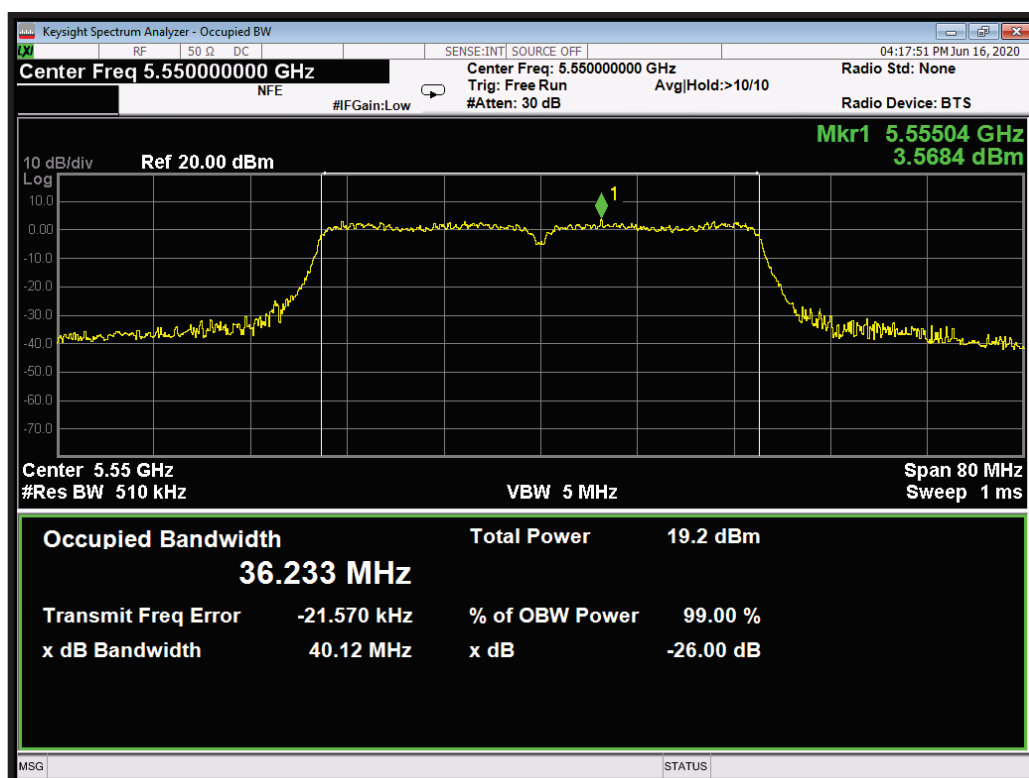
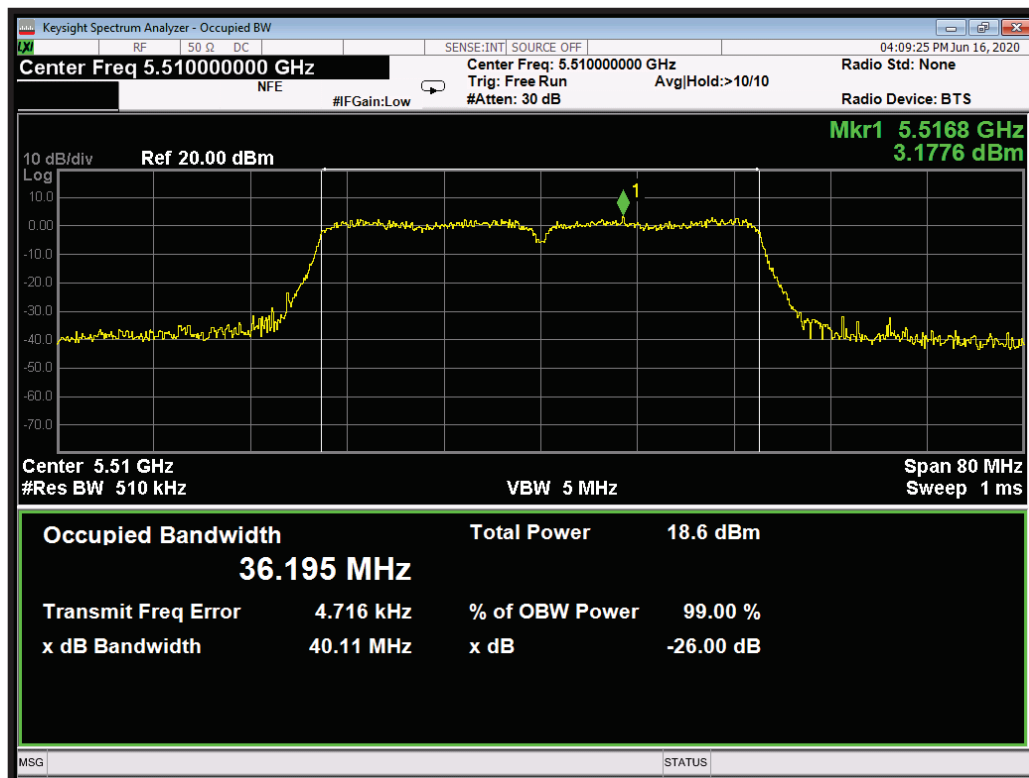


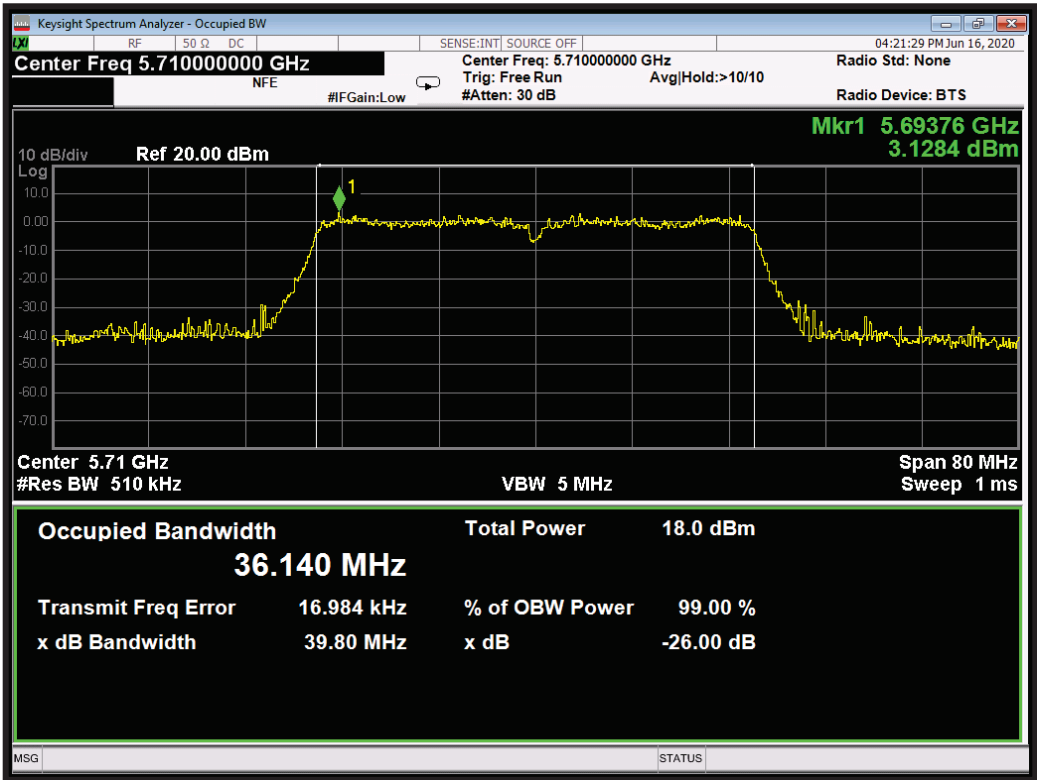
Modulation: 802.11ac-40; Data rate: MCS0 1SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	40.91	36.296	N/A
5550	40.77	36.258	N/A
5710	42.25	36.335	N/A



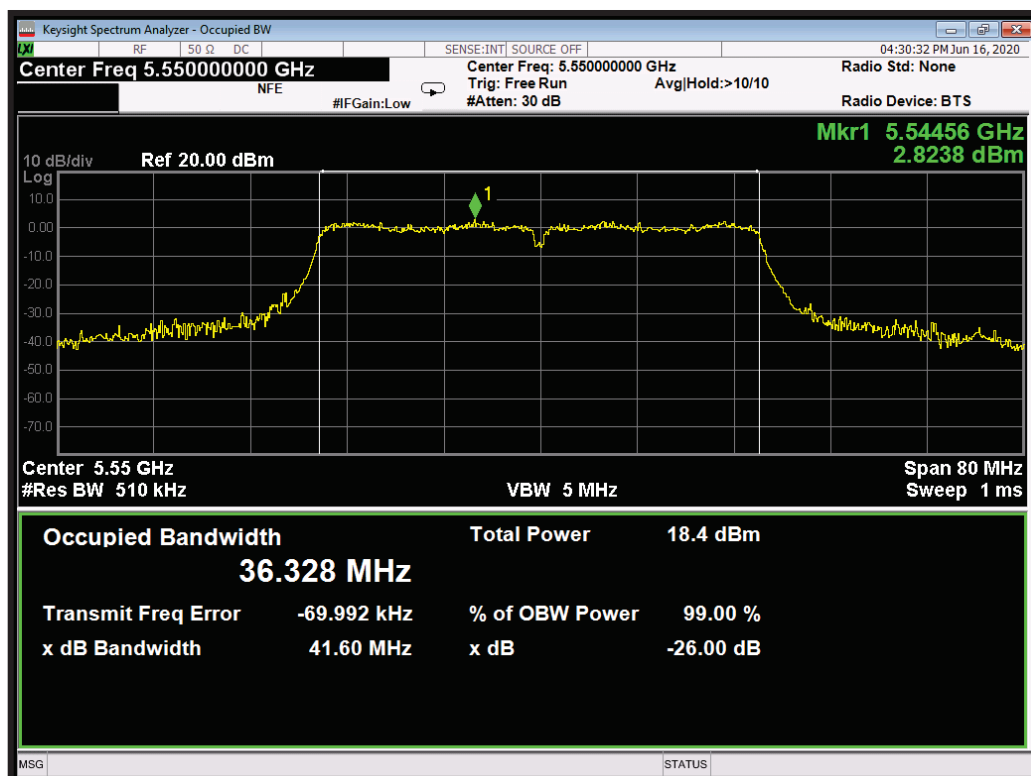
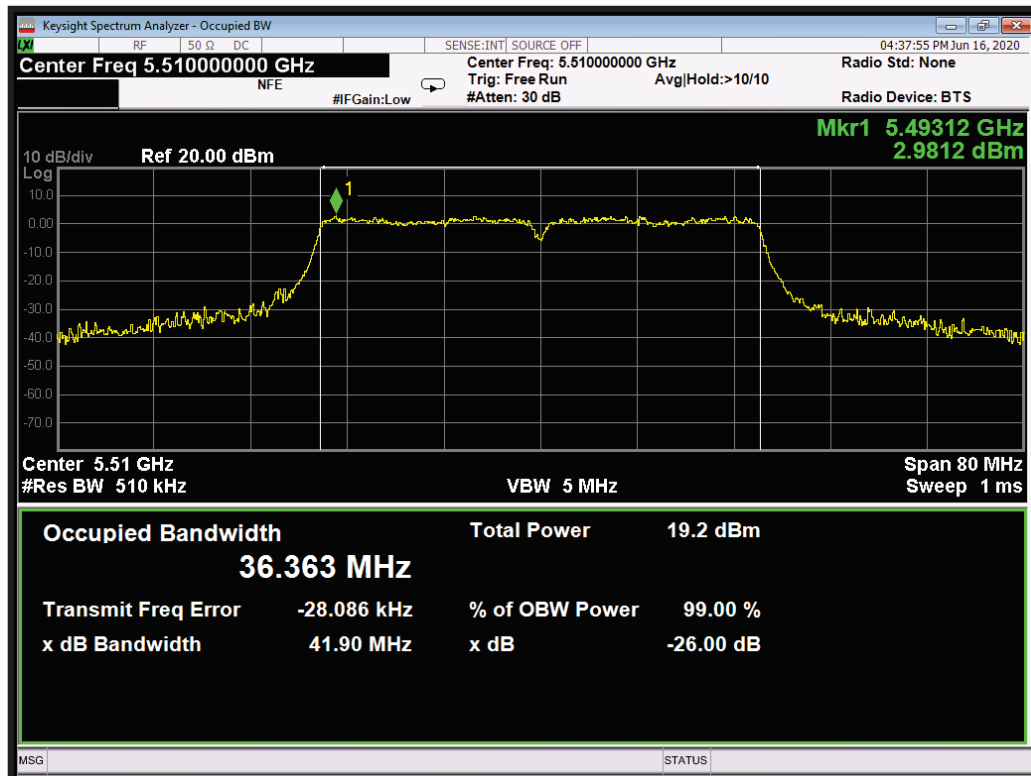


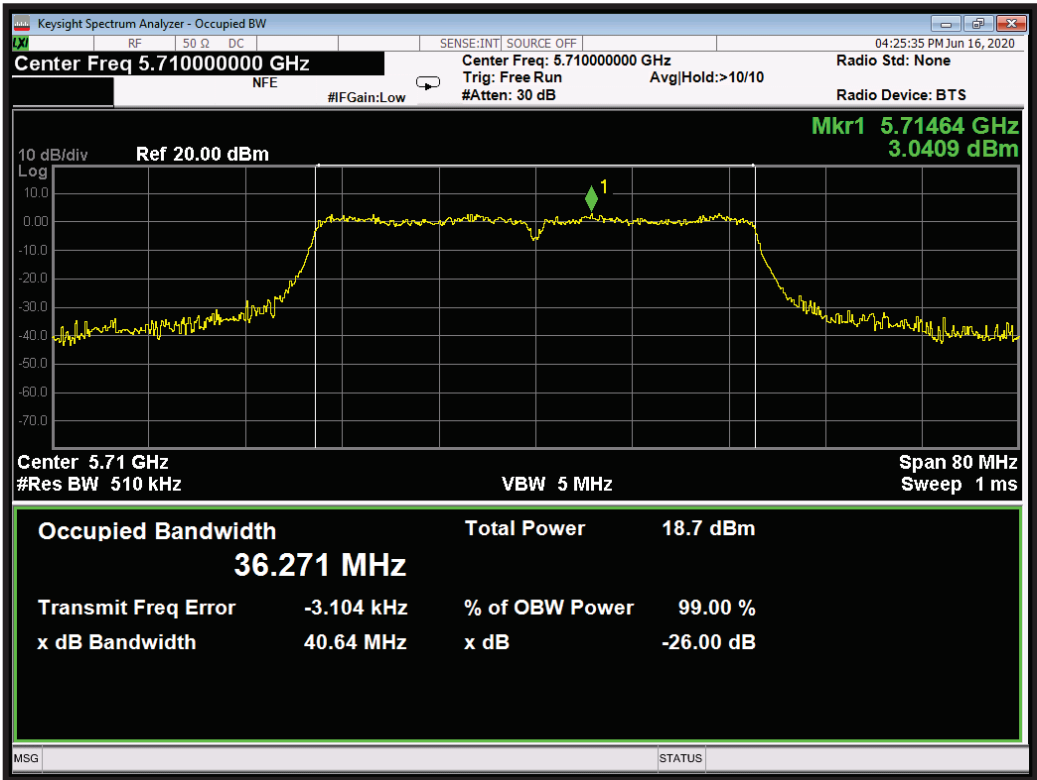
Modulation: 802.11ac-40; Data rate: MCS0 1SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	40.11	36.195	N/A
5550	40.12	36.233	N/A
5710	39.80	36.140	N/A



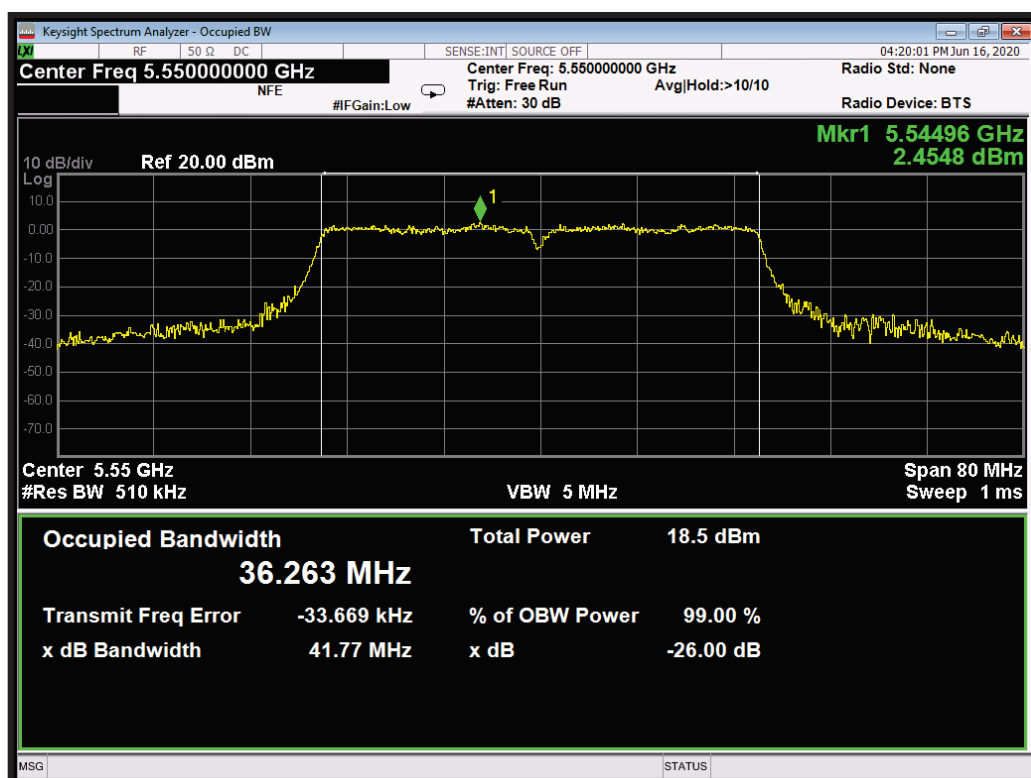
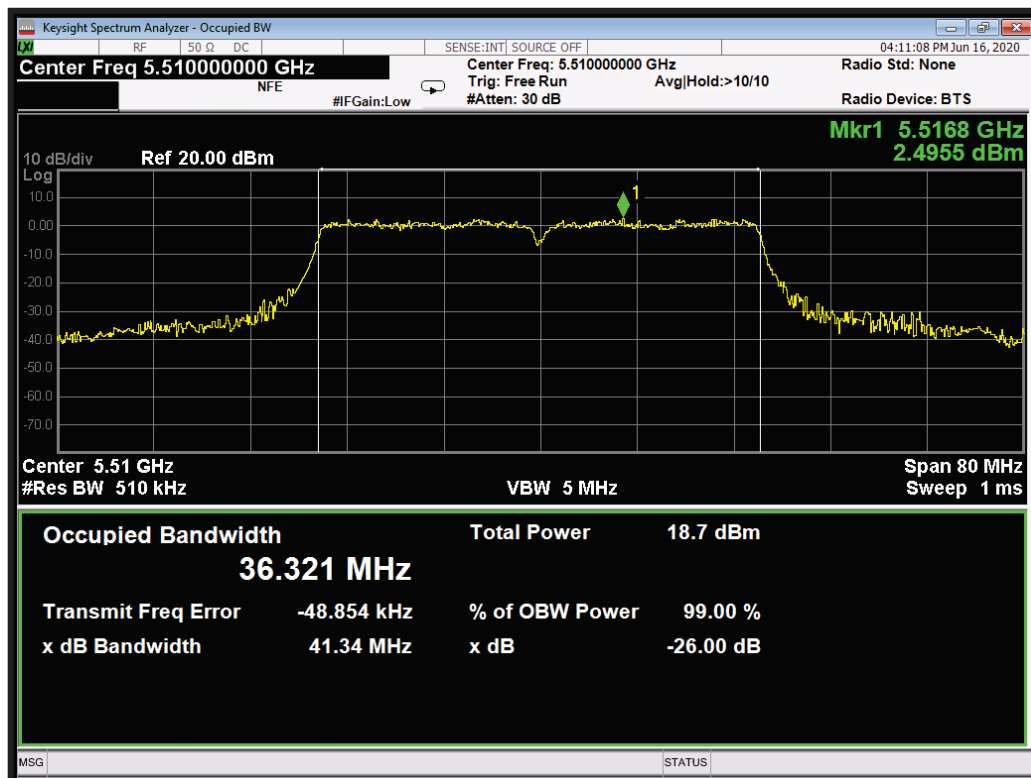


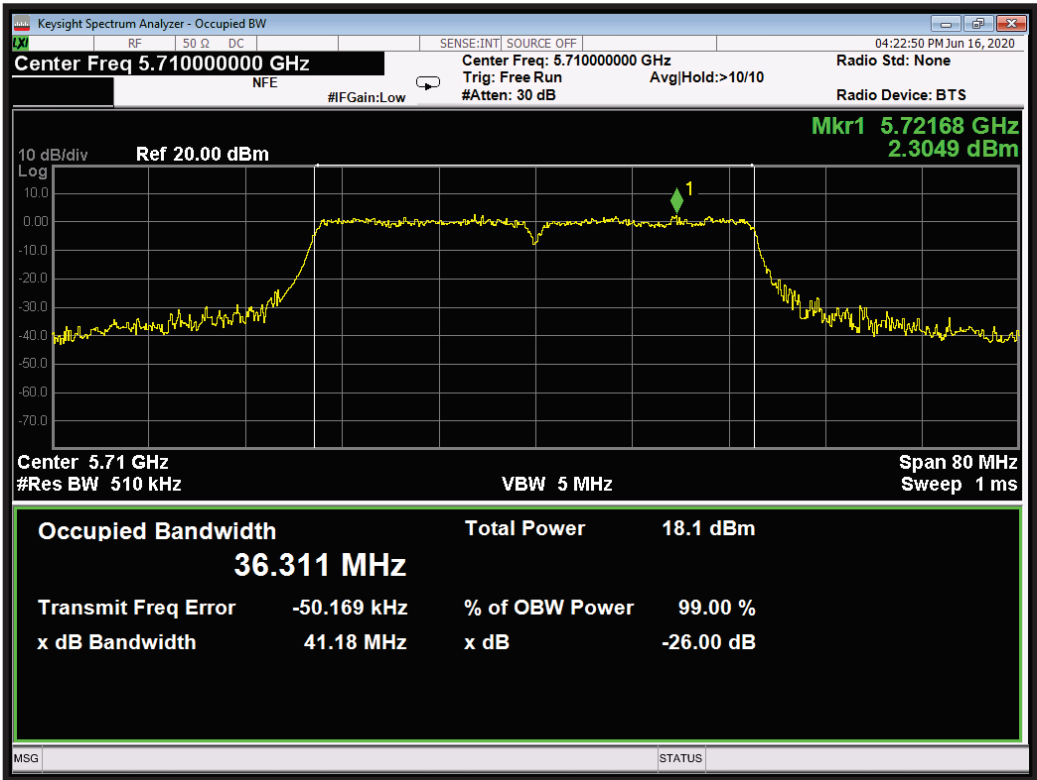
Modulation: 802.11ac-40; Data rate: MCS9 1SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	41.90	36.363	N/A
5550	41.60	36.328	N/A
5710	40.64	36.271	N/A



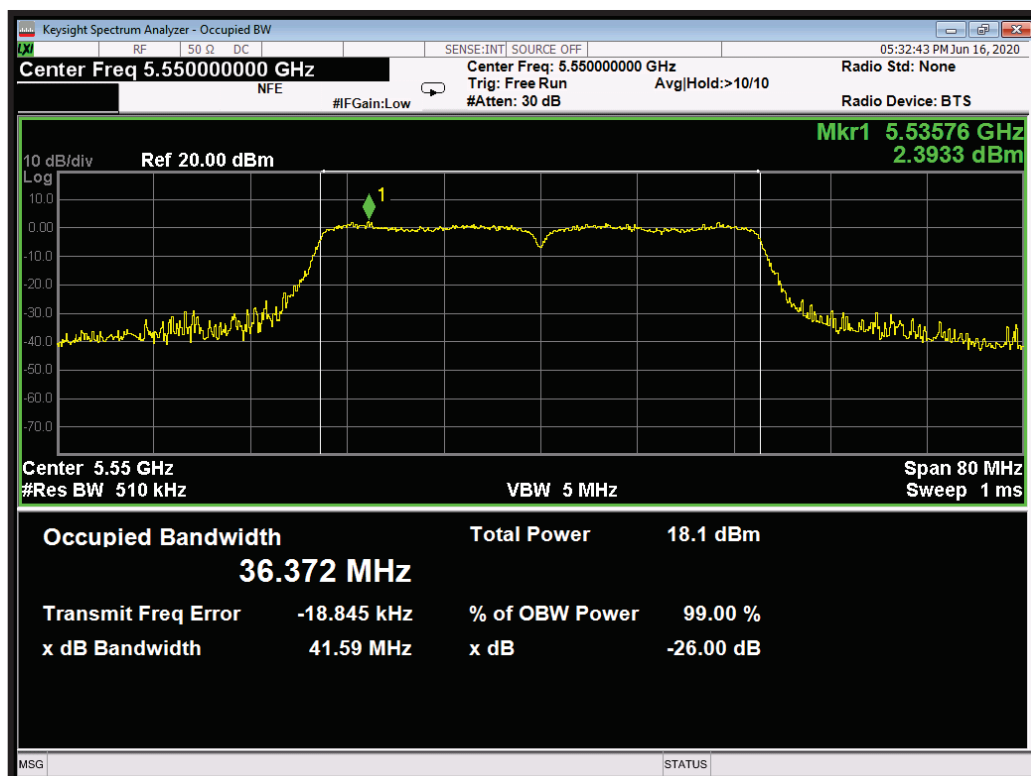
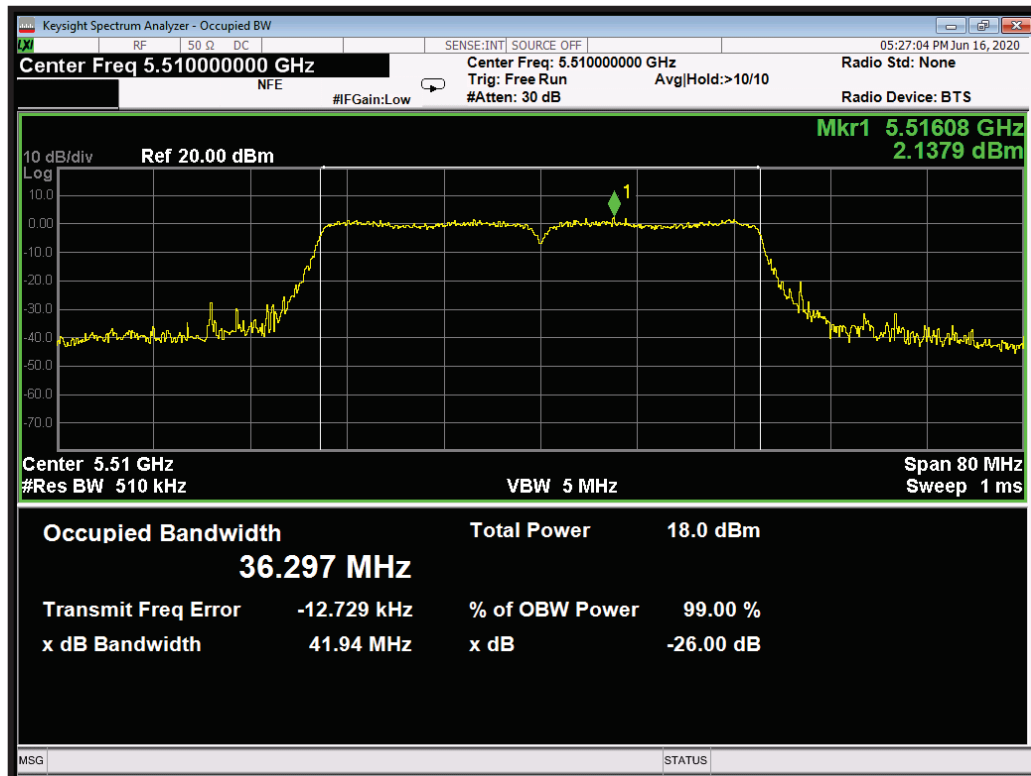


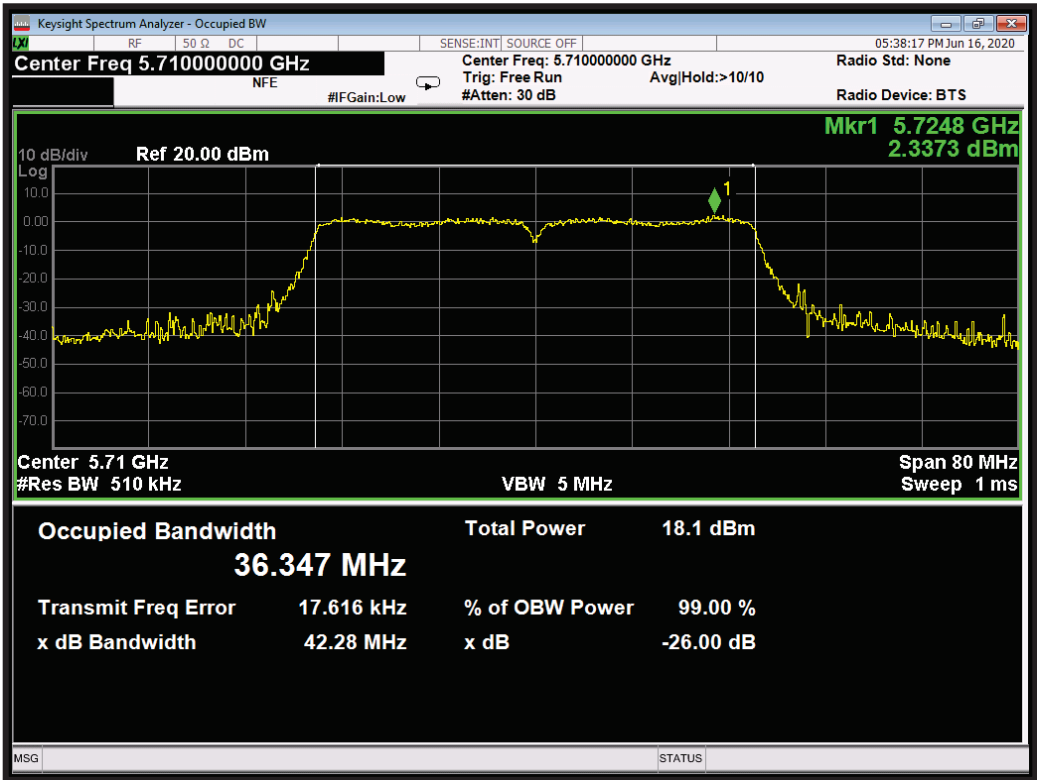
Modulation: 802.11ac-40; Data rate: MCS9 1SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	41.34	36.321	N/A
5550	41.77	36.263	N/A
5710	41.18	36.311	N/A



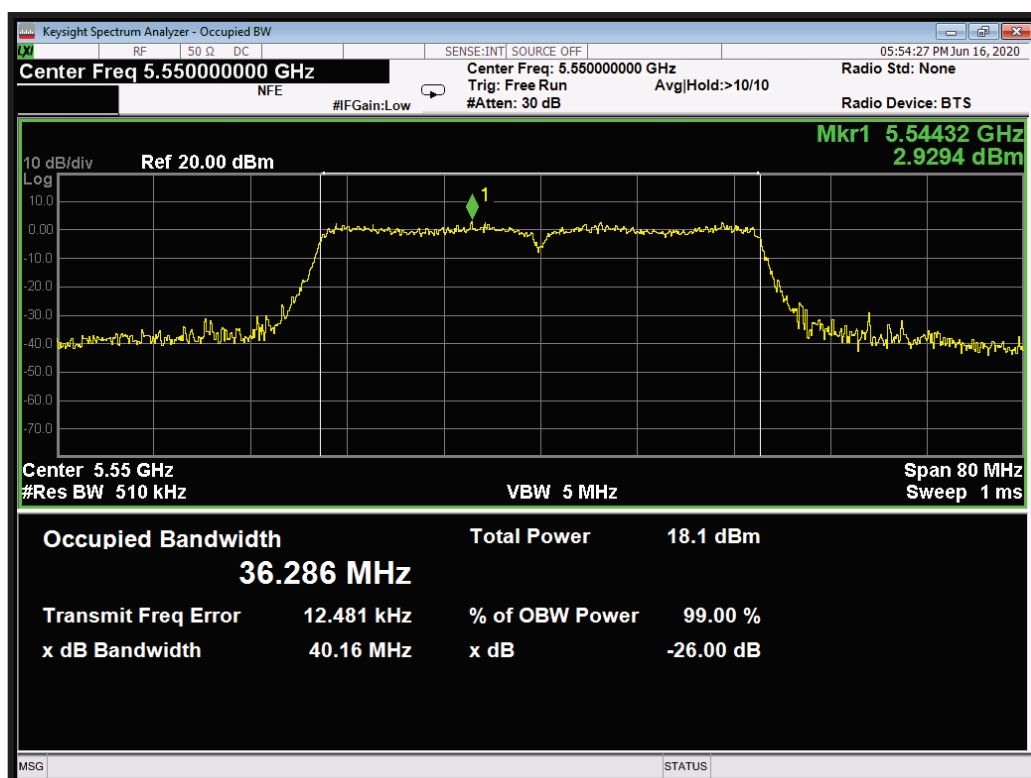
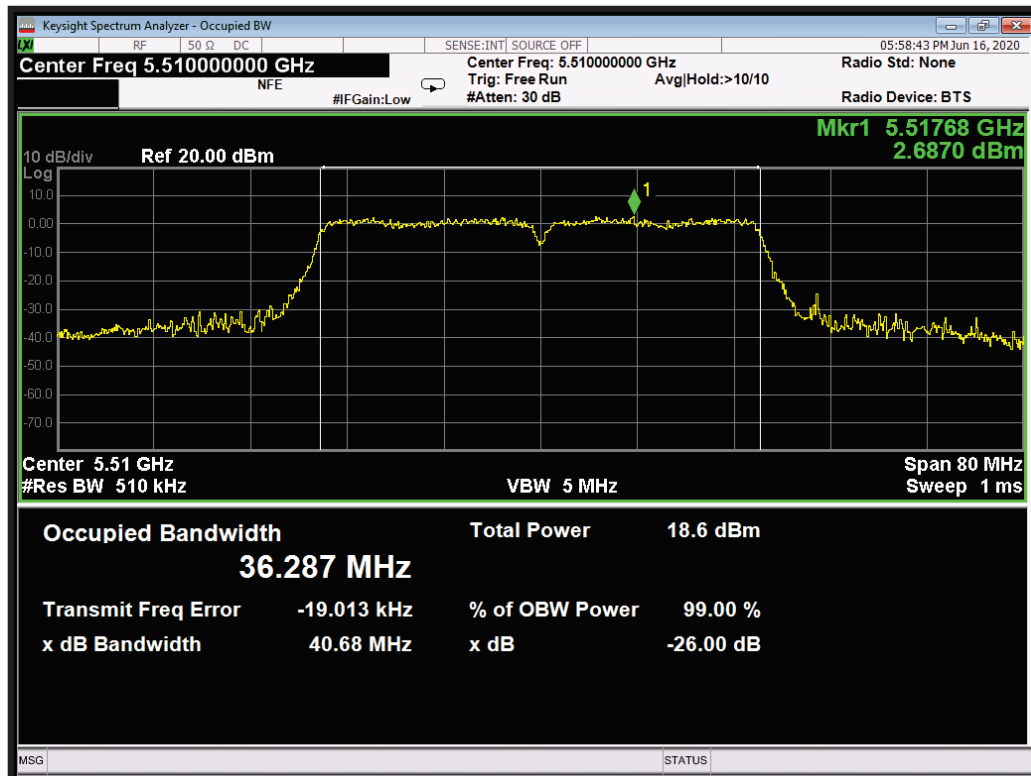


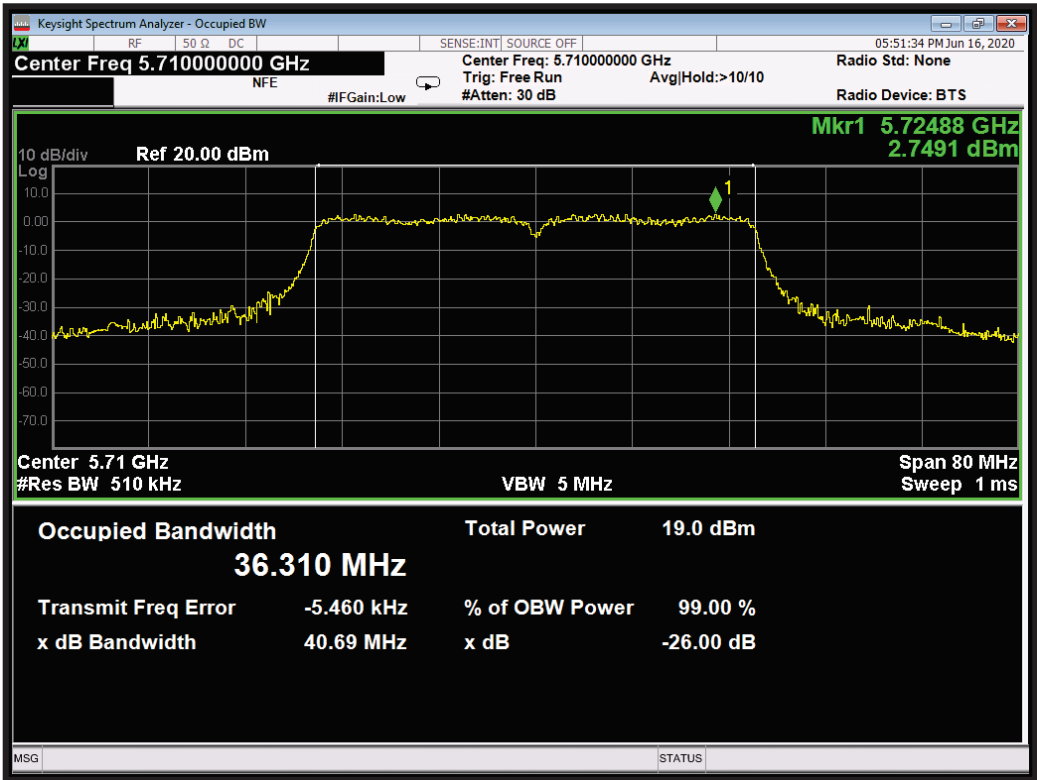
Modulation: 802.11ac-40; Data rate: MCS0 2SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	41.94	36.297	N/A
5550	41.59	36.372	N/A
5710	42.28	36.347	N/A



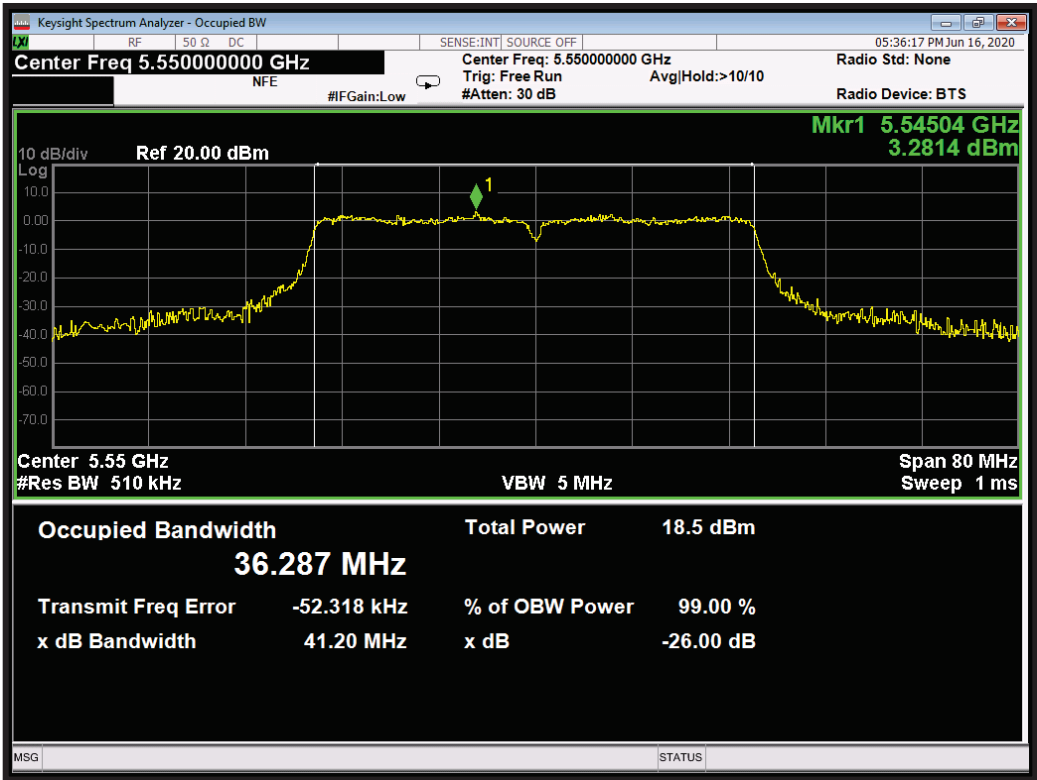
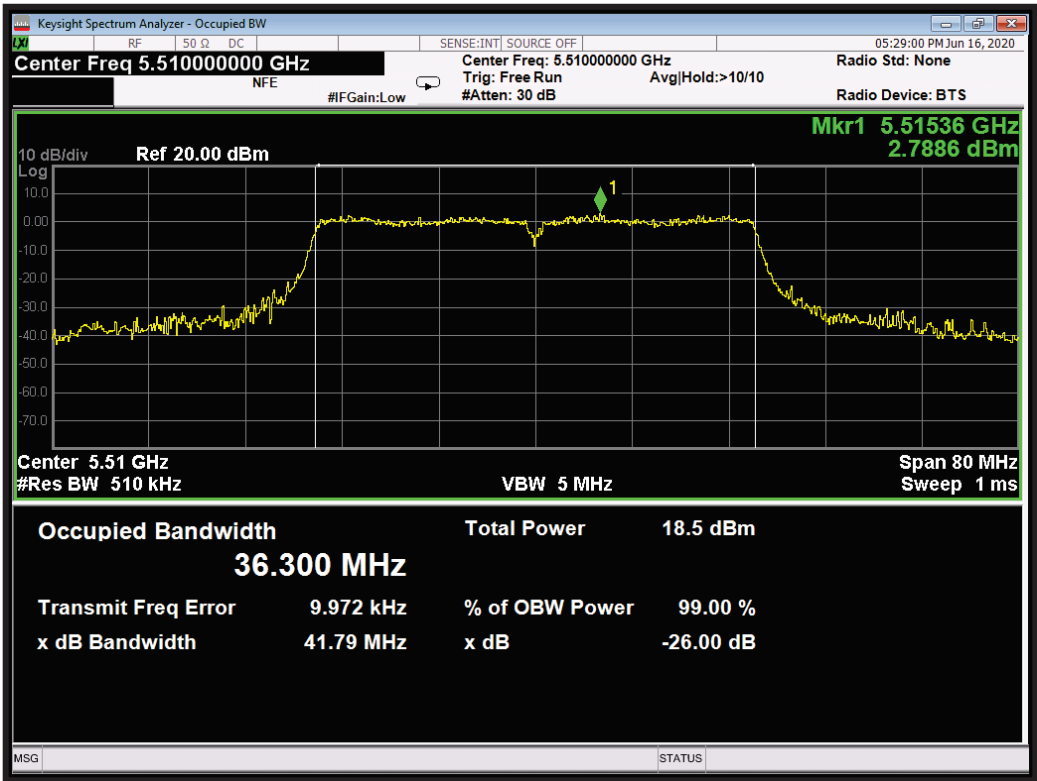


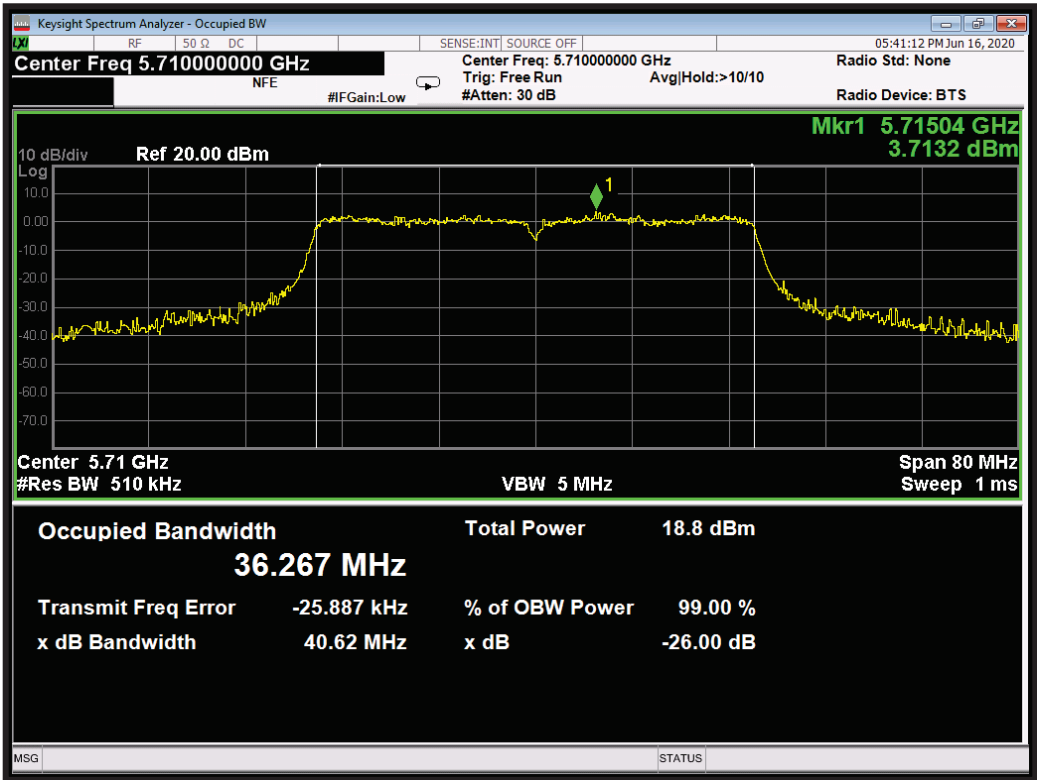
Modulation: 802.11ac-40; Data rate: MCS0 2SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	40.68	36.287	N/A
5550	40.16	36.286	N/A
5710	40.69	36.310	N/A



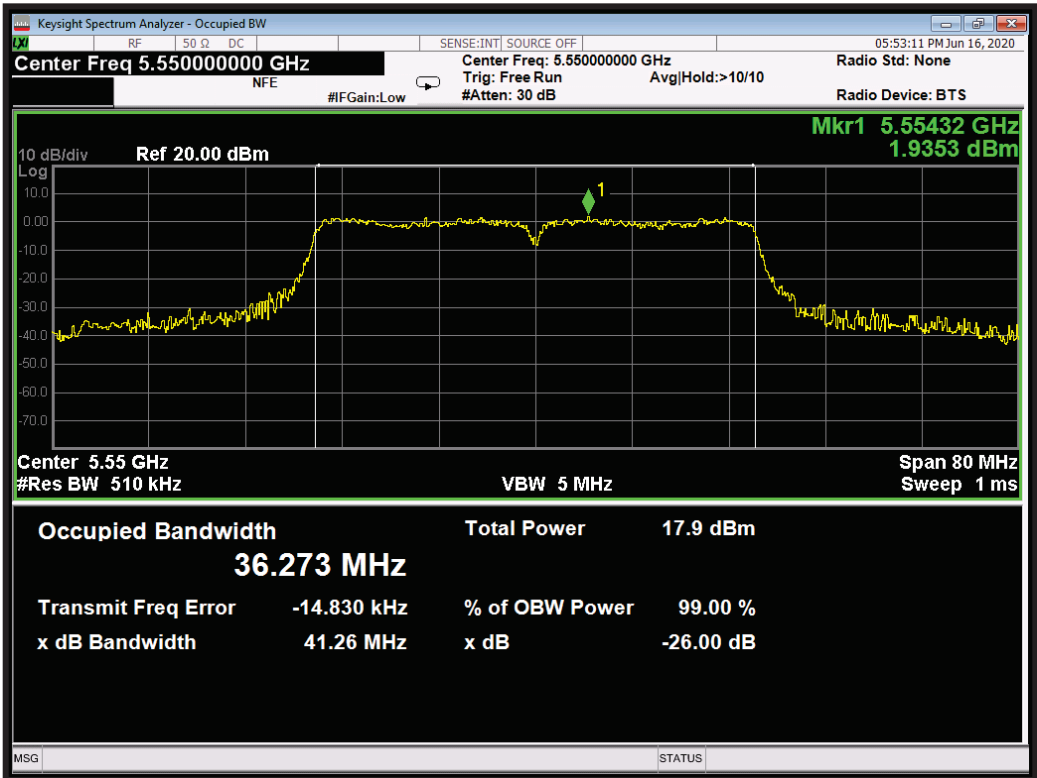
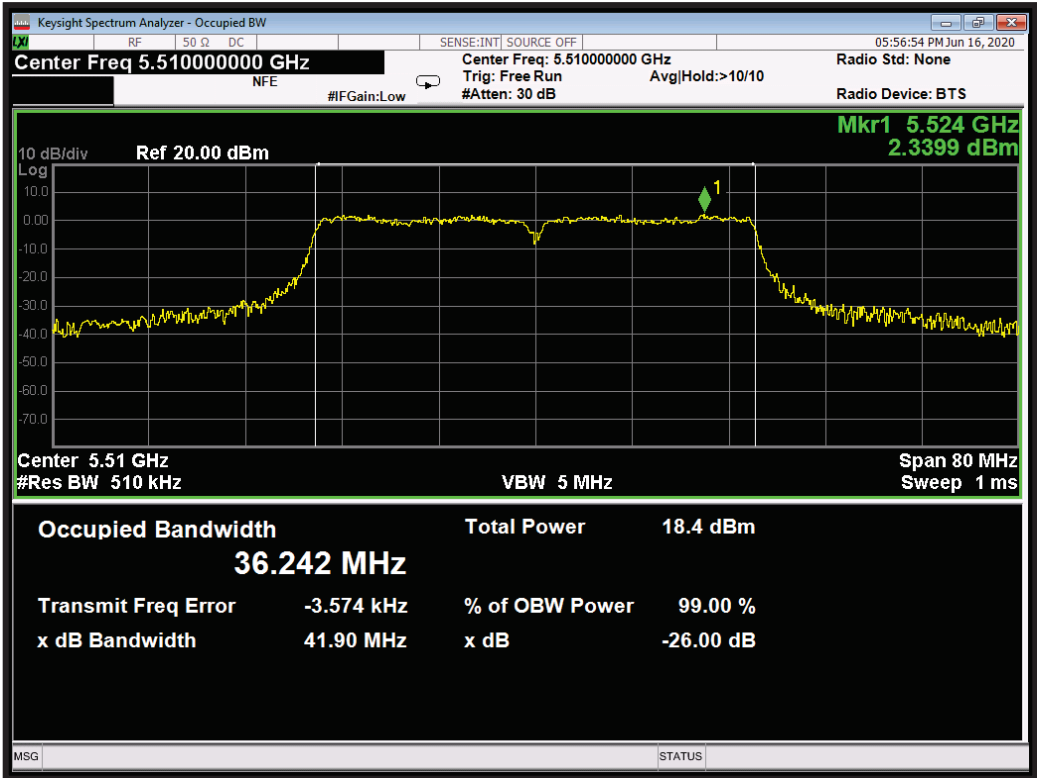


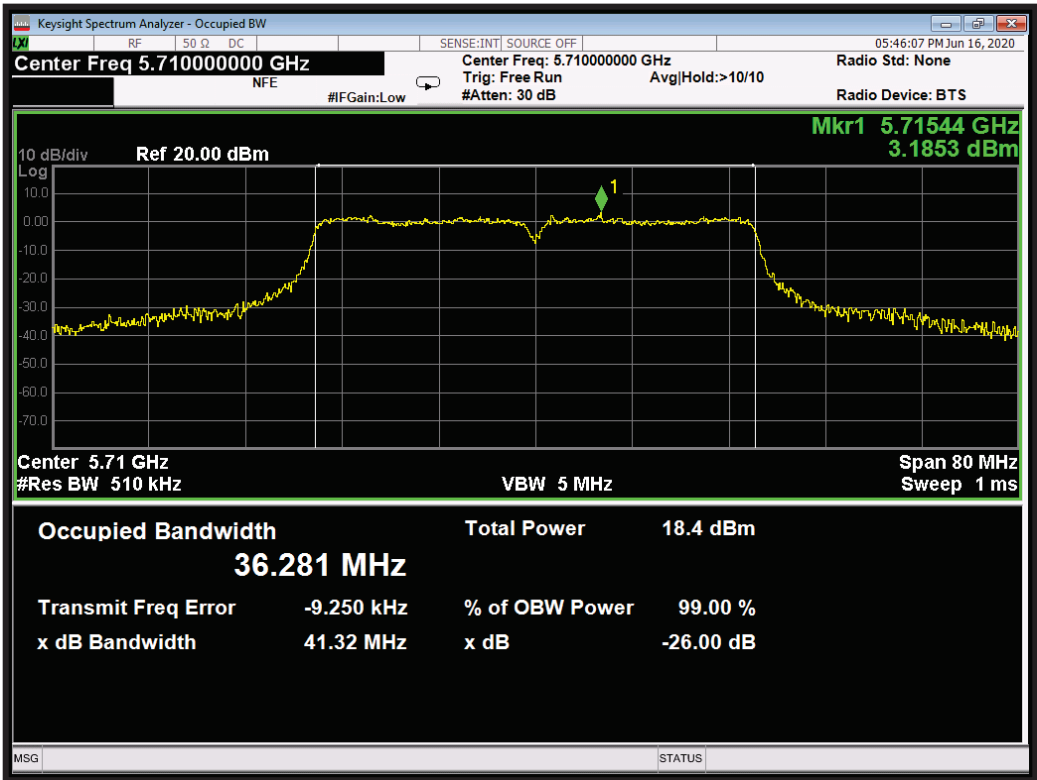
Modulation: 802.11ac-40; Data rate: MCS9 2SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	41.79	36.300	N/A
5550	41.20	36.287	N/A
5710	40.62	36.267	N/A



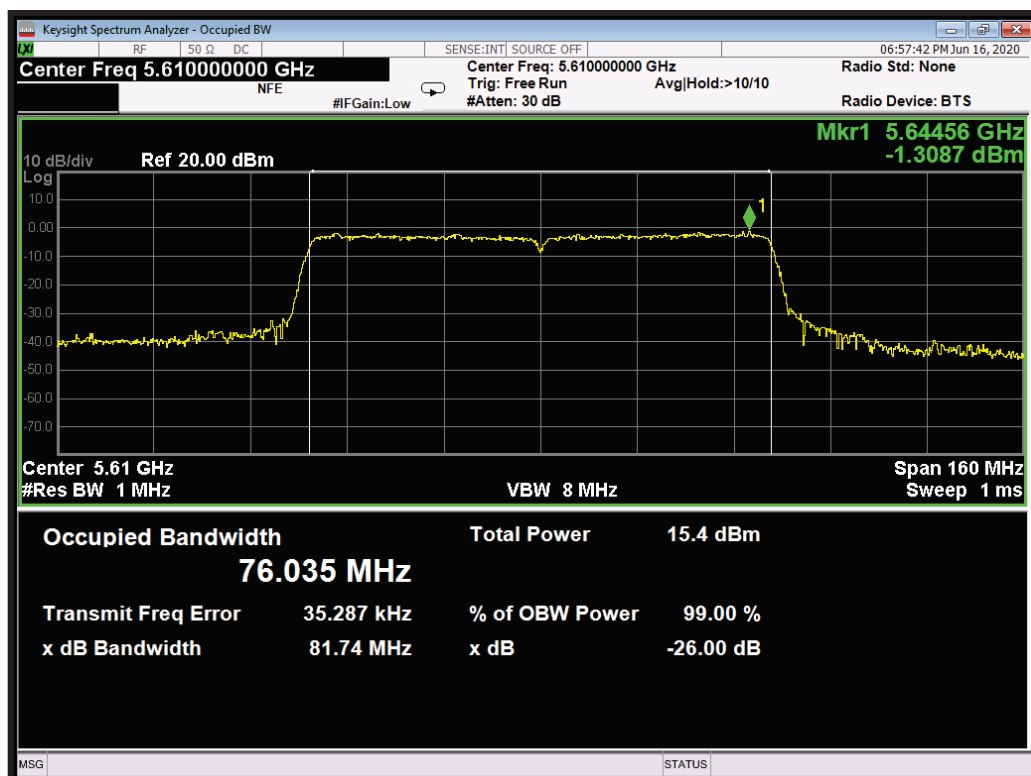
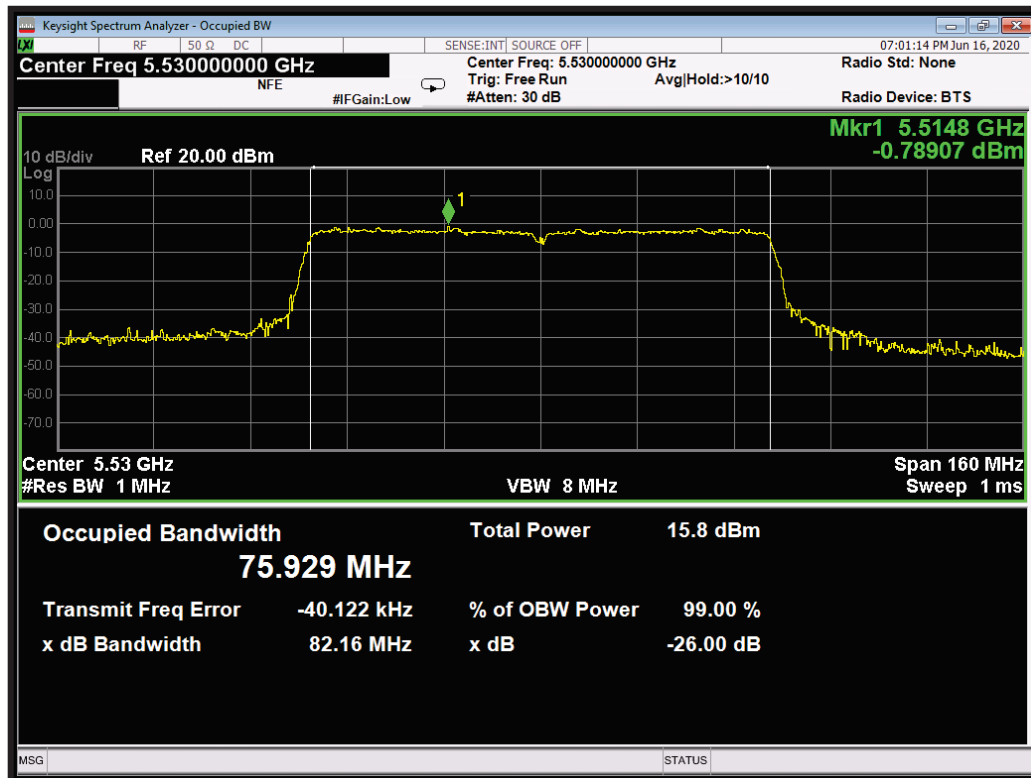


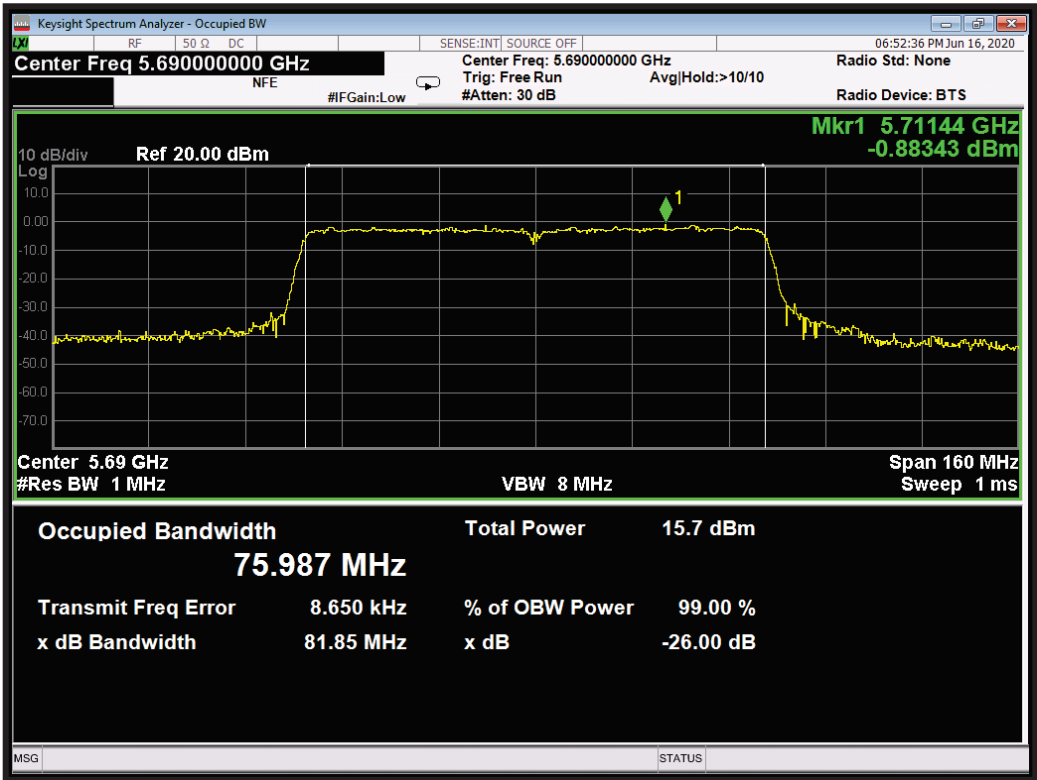
Modulation: 802.11ac-40; Data rate: MCS9 2SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5510	41.90	36.242	N/A
5550	41.26	36.273	N/A
5710	41.32	36.281	N/A



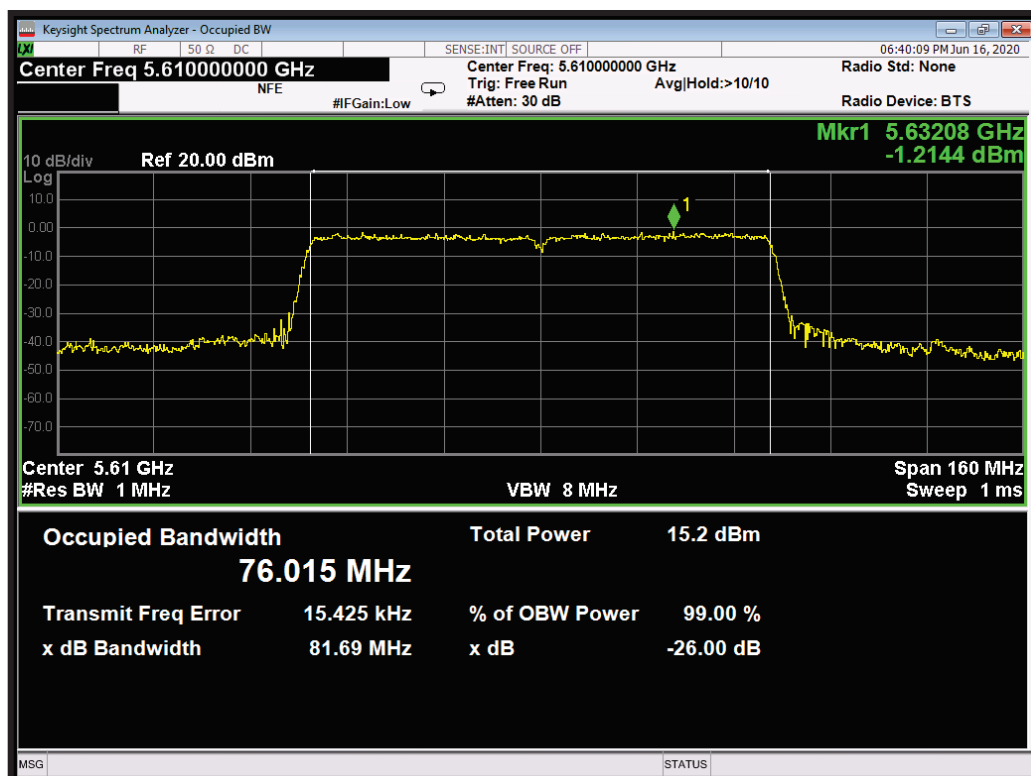
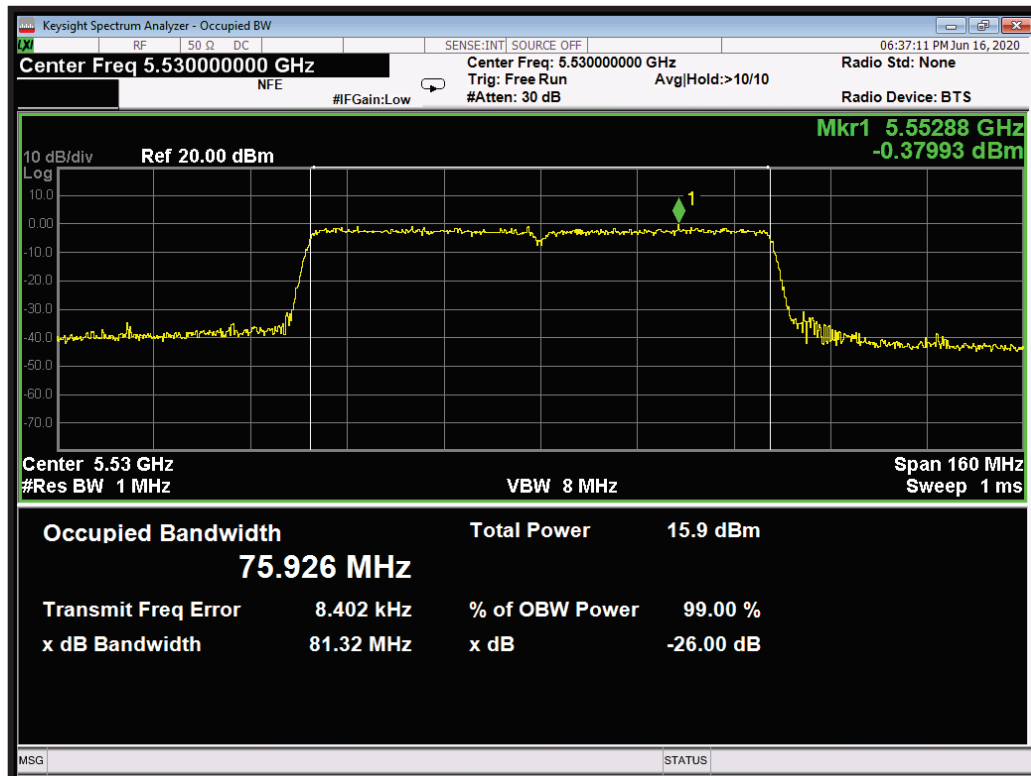


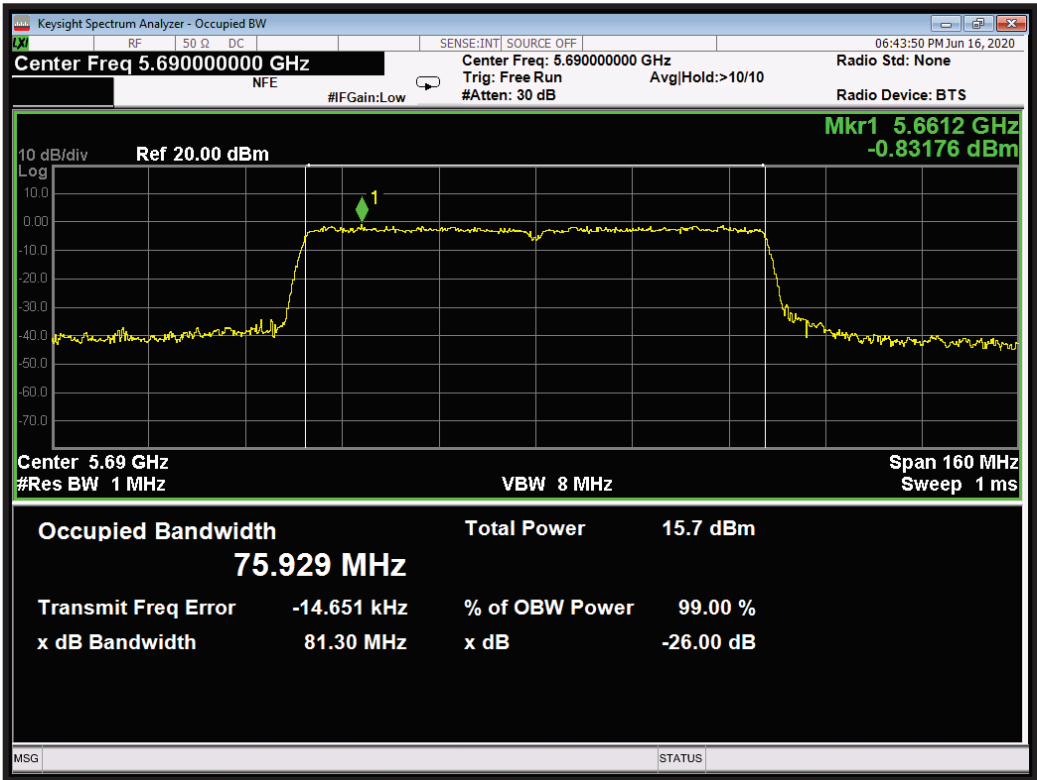
Modulation: 802.11ac-80; Data rate: MCS0 1SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	82.16	75.929	N/A
5610	81.74	76.035	N/A
5690	81.85	75.987	N/A



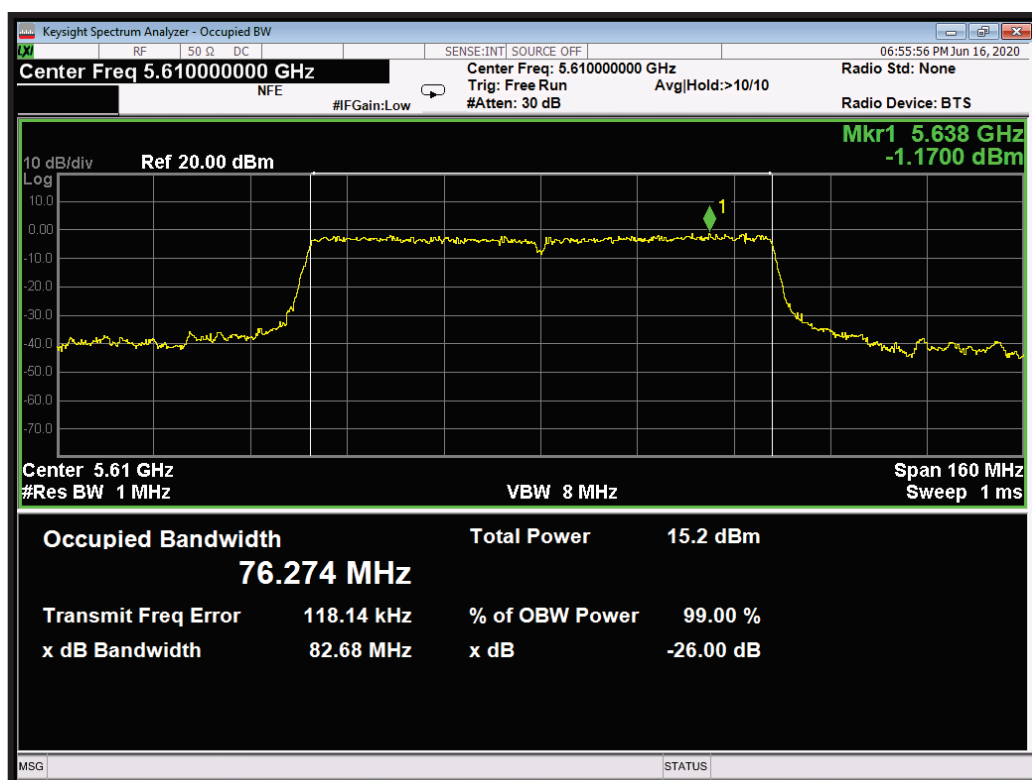
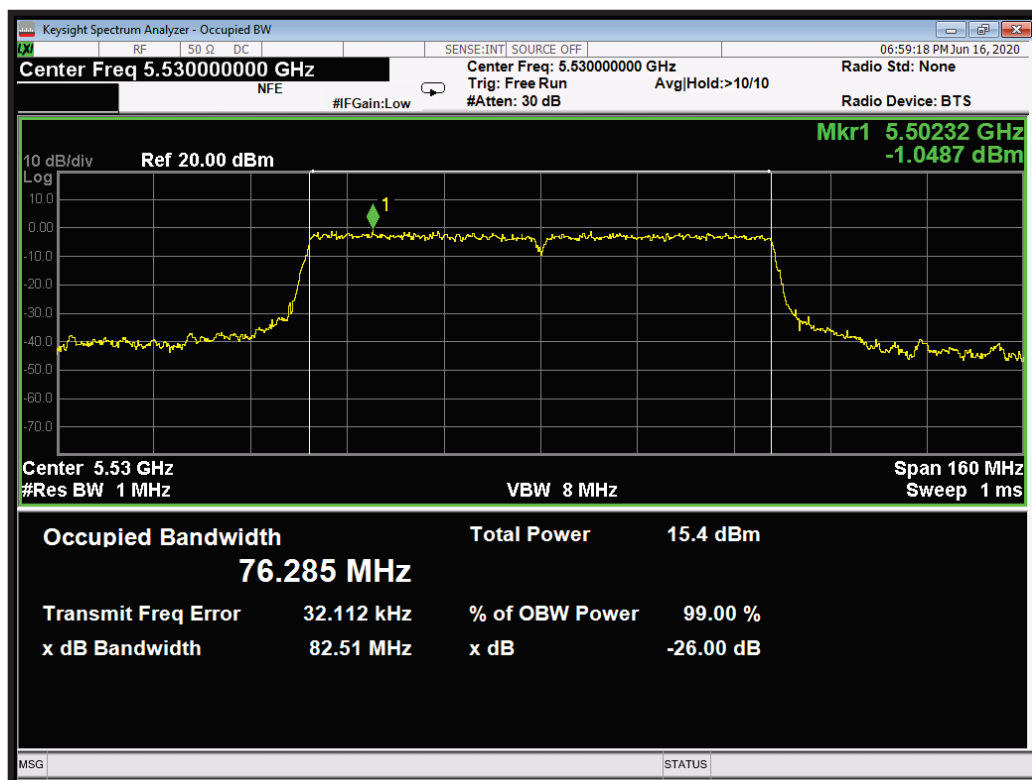


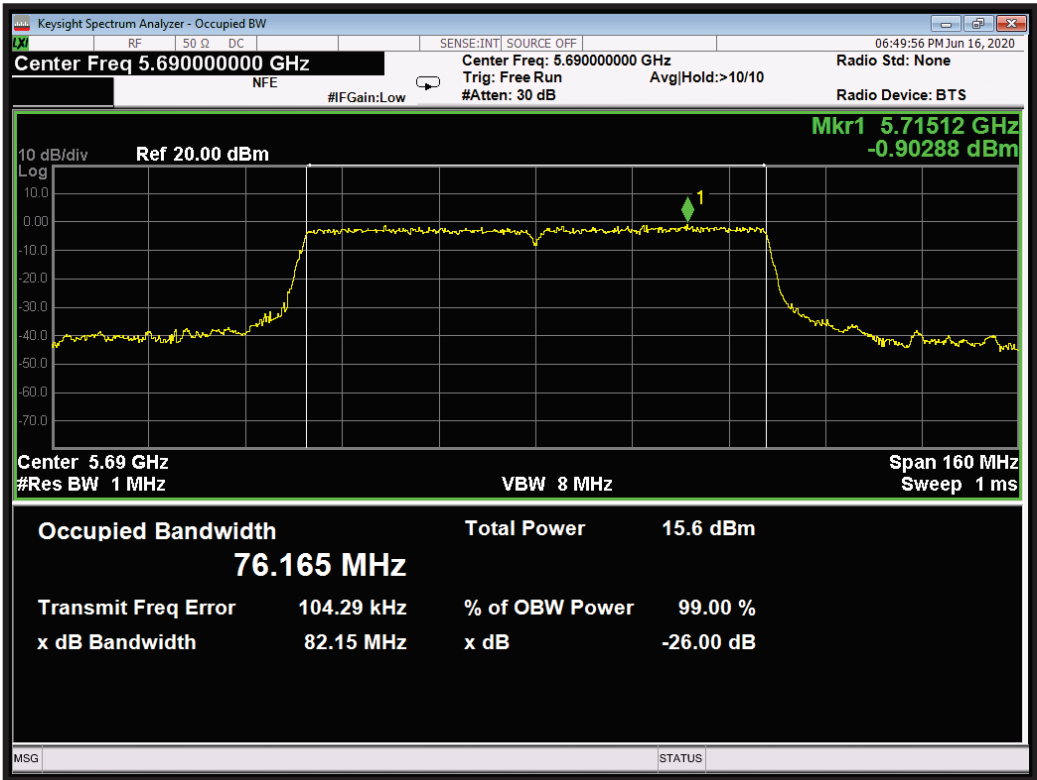
Modulation: 802.11ac-80; Data rate: MCS0 1SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	81.32	75.926	N/A
5610	81.69	76.015	N/A
5690	81.30	75.929	N/A



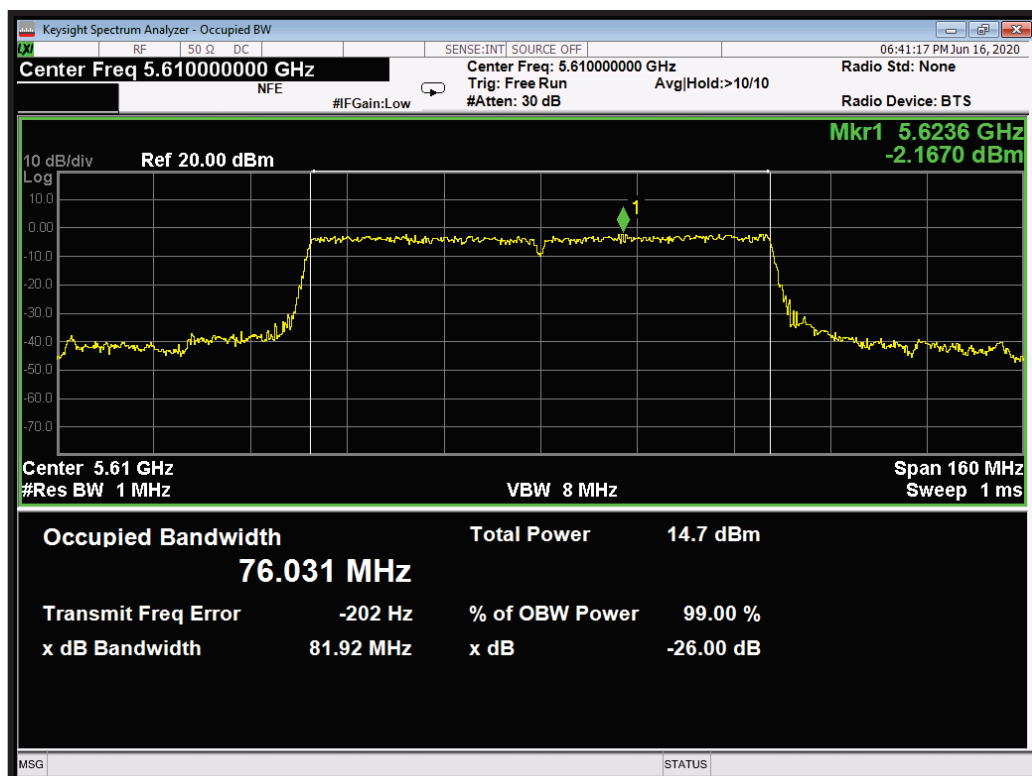
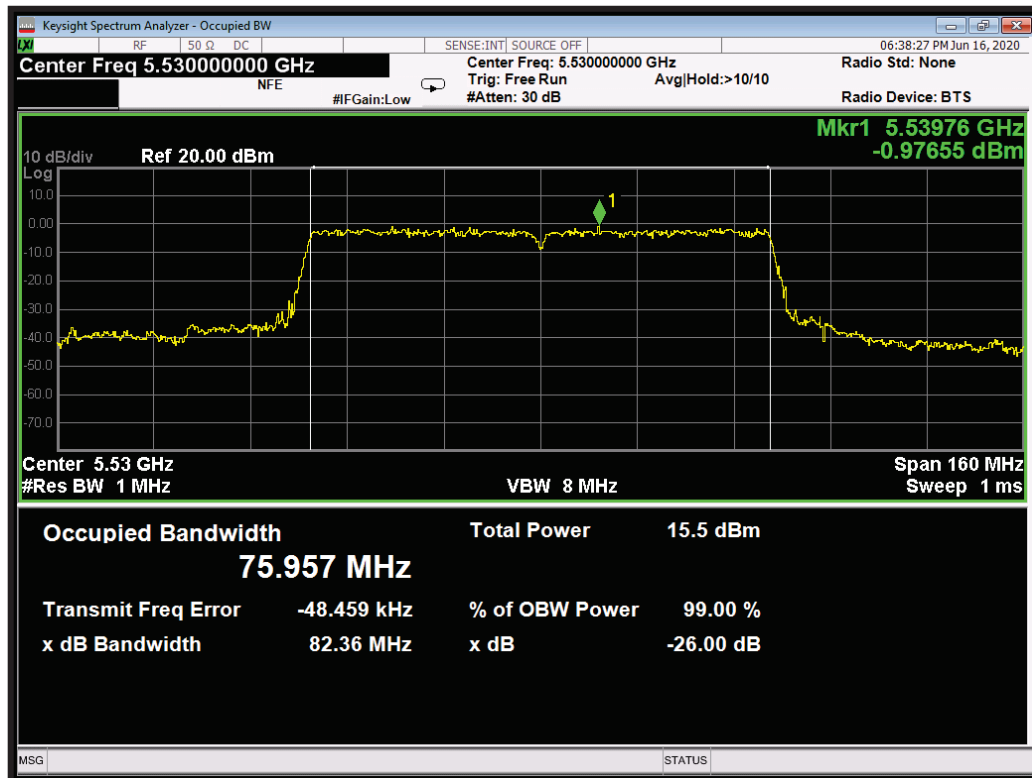


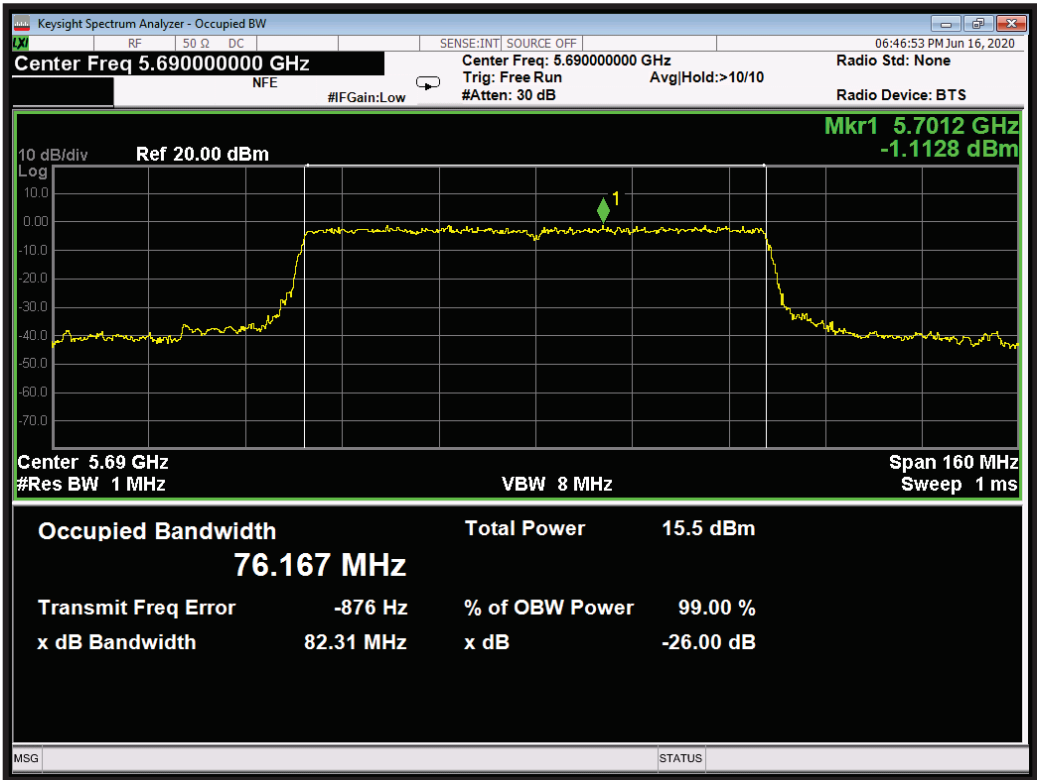
Modulation: 802.11ac-80; Data rate: MCS9 1SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	82.51	76.285	N/A
5610	82.68	76.274	N/A
5690	82.15	76.165	N/A



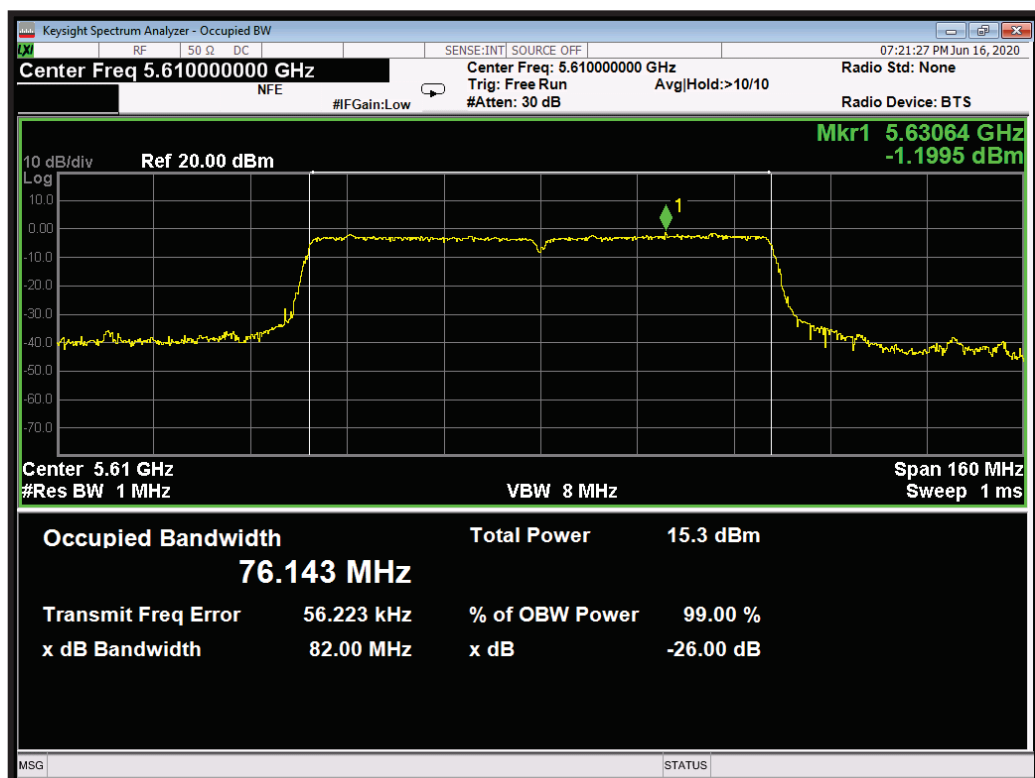
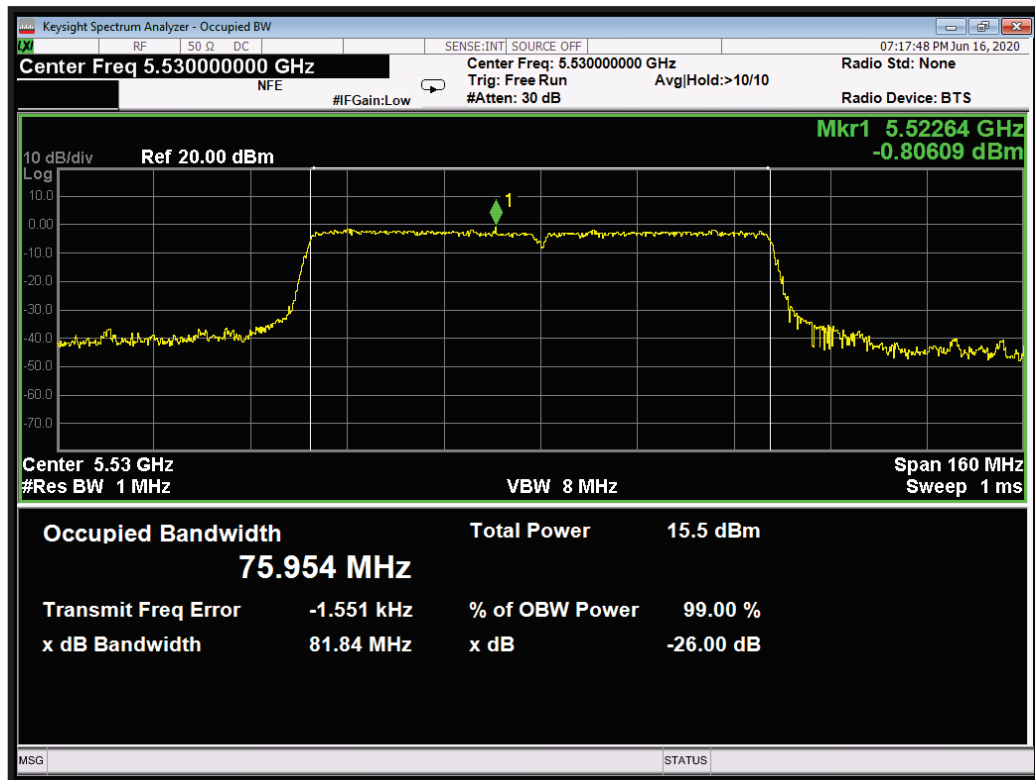


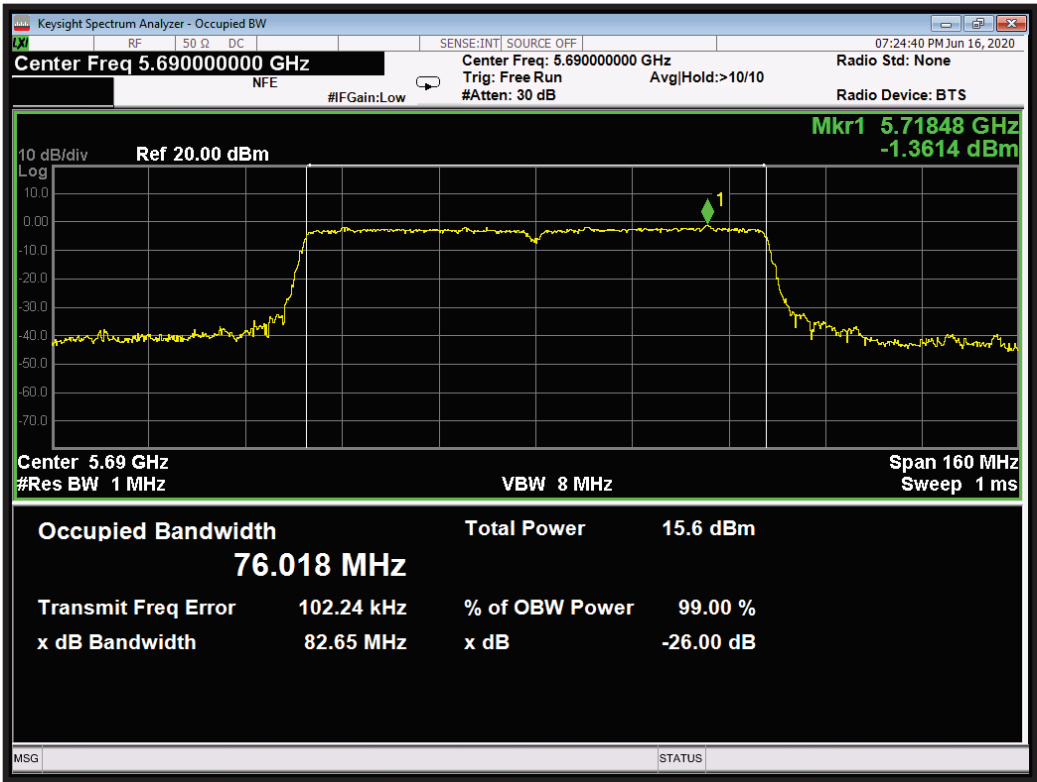
Modulation: 802.11ac-80; Data rate: MCS9 1SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	82.36	75.957	N/A
5610	81.92	76.031	N/A
5690	82.31	76.167	N/A



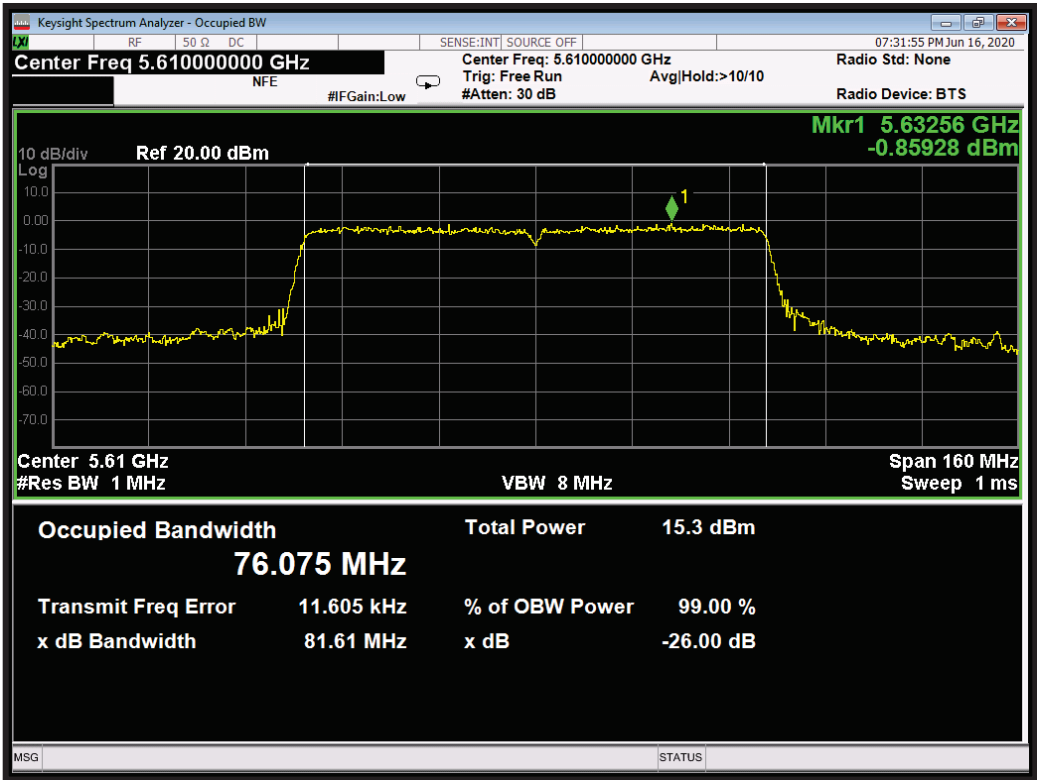
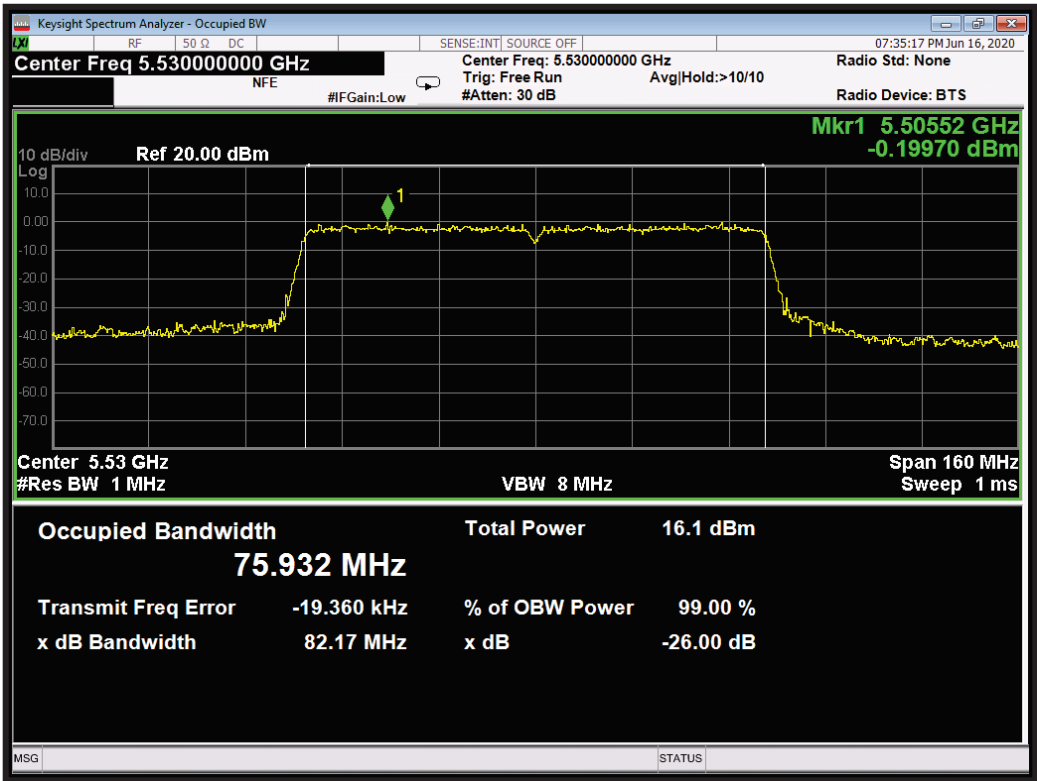


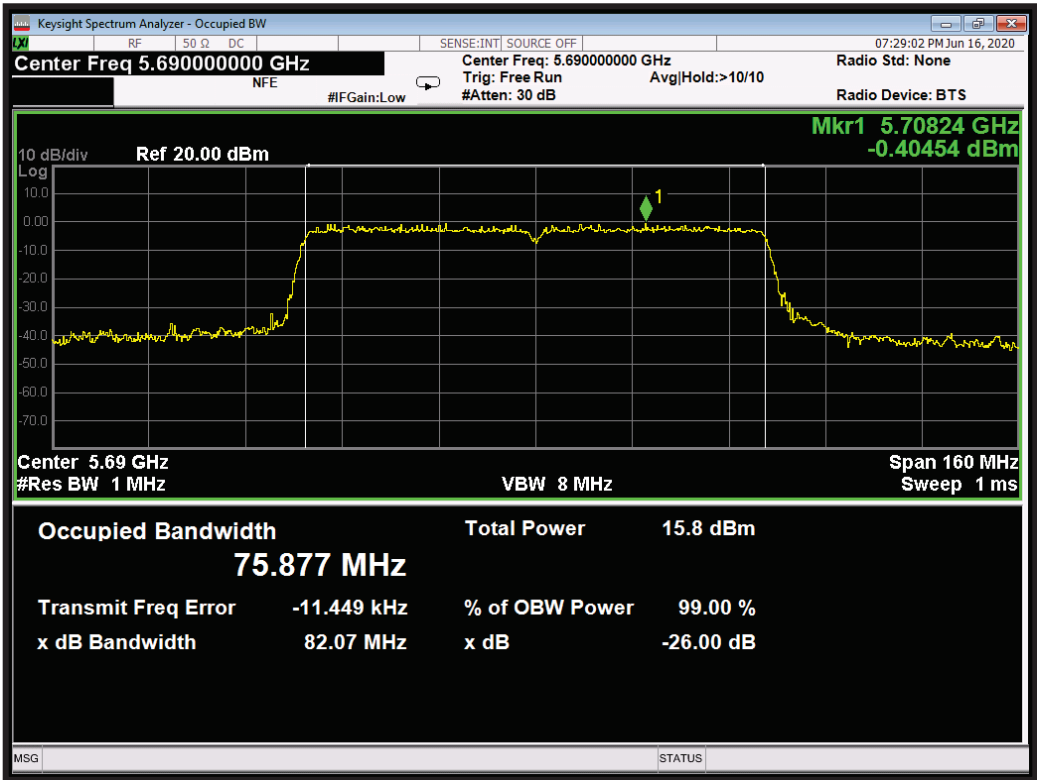
Modulation: 802.11ac-80; Data rate: MCS0 2SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	81.84	75.954	N/A
5610	82.00	76.143	N/A
5690	82.65	76.018	N/A



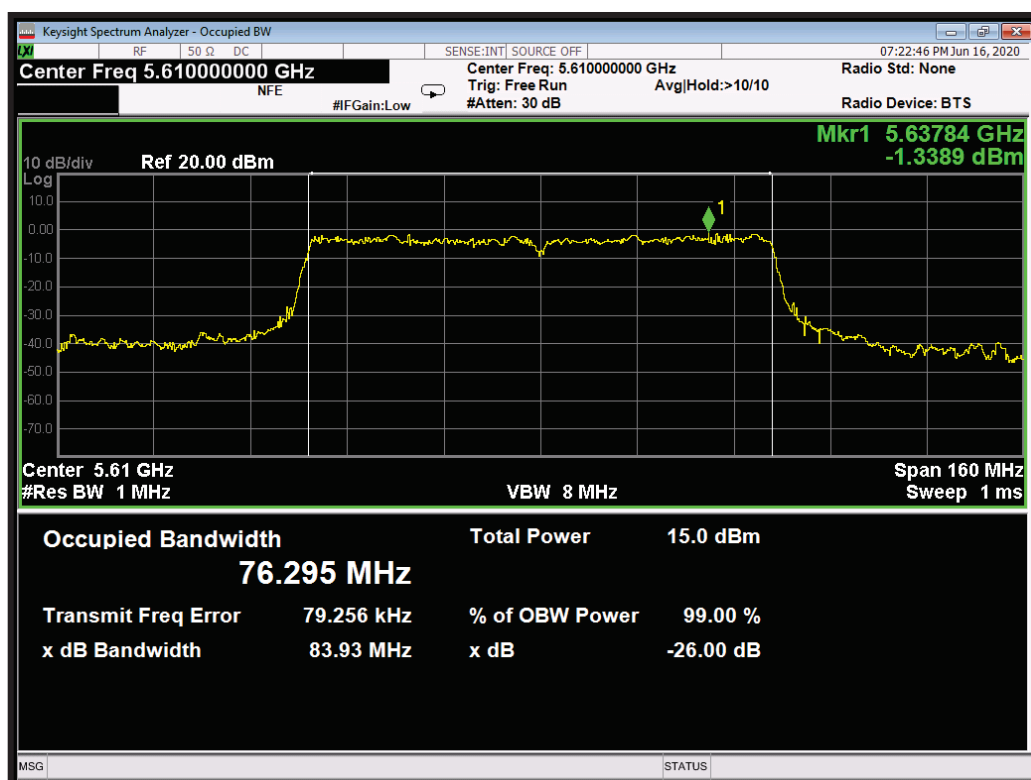
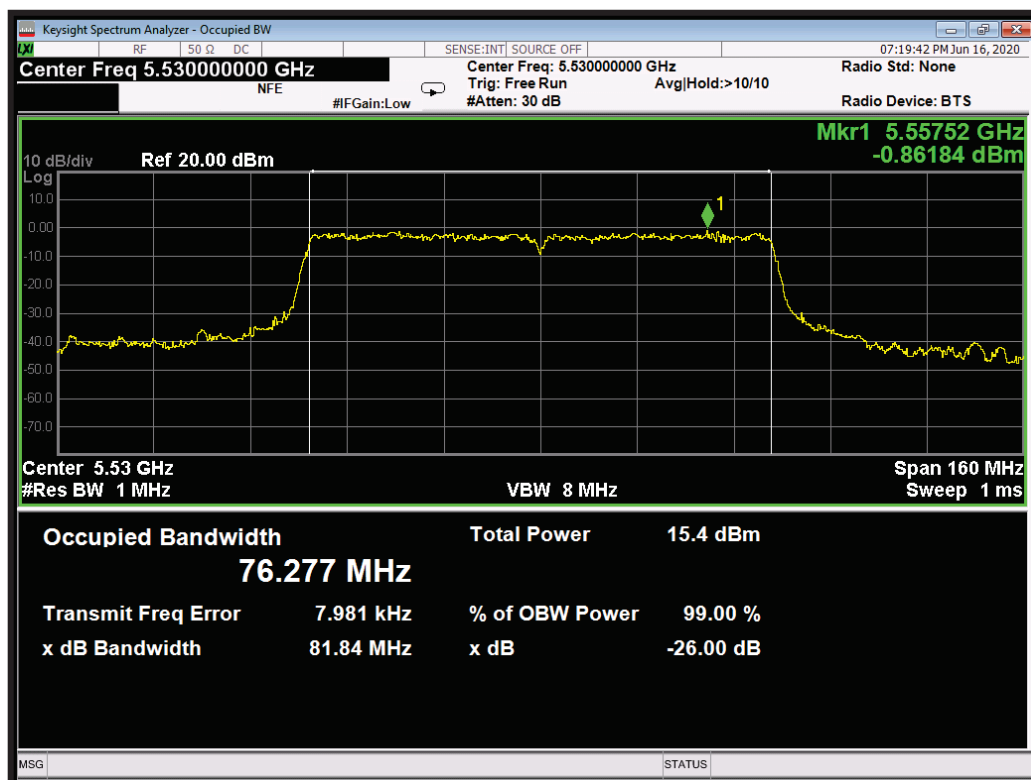


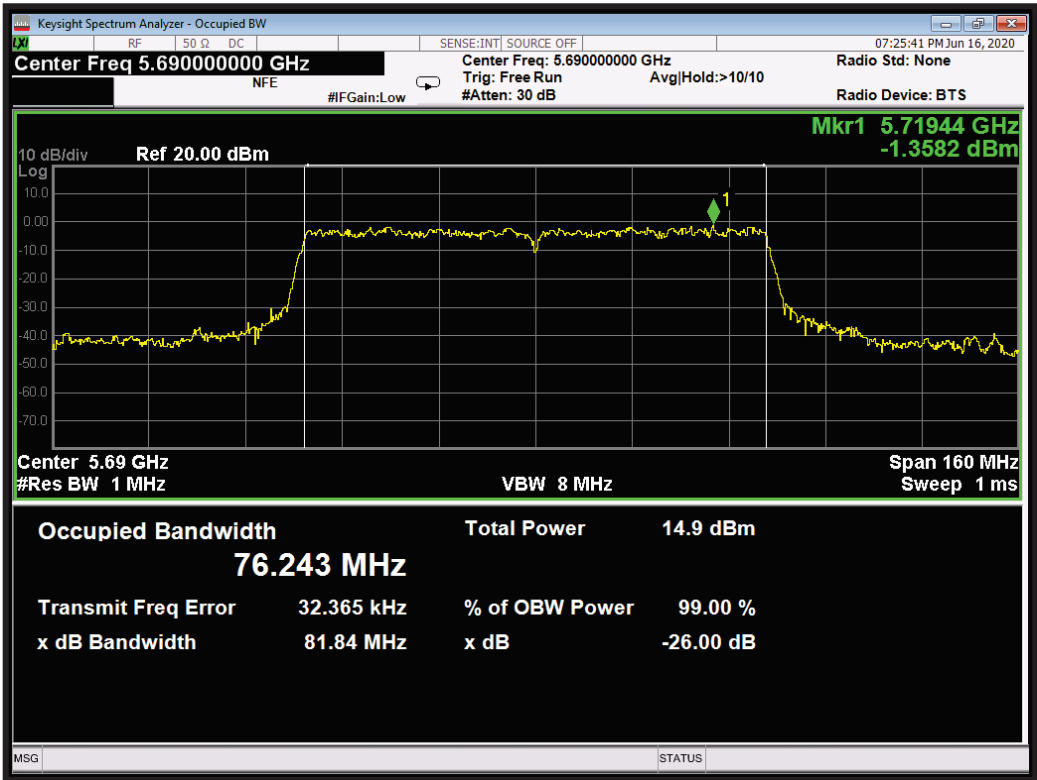
Modulation: 802.11ac-80; Data rate: MCS0 2SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	82.17	75.932	N/A
5610	81.61	76.075	N/A
5690	82.07	75.877	N/A



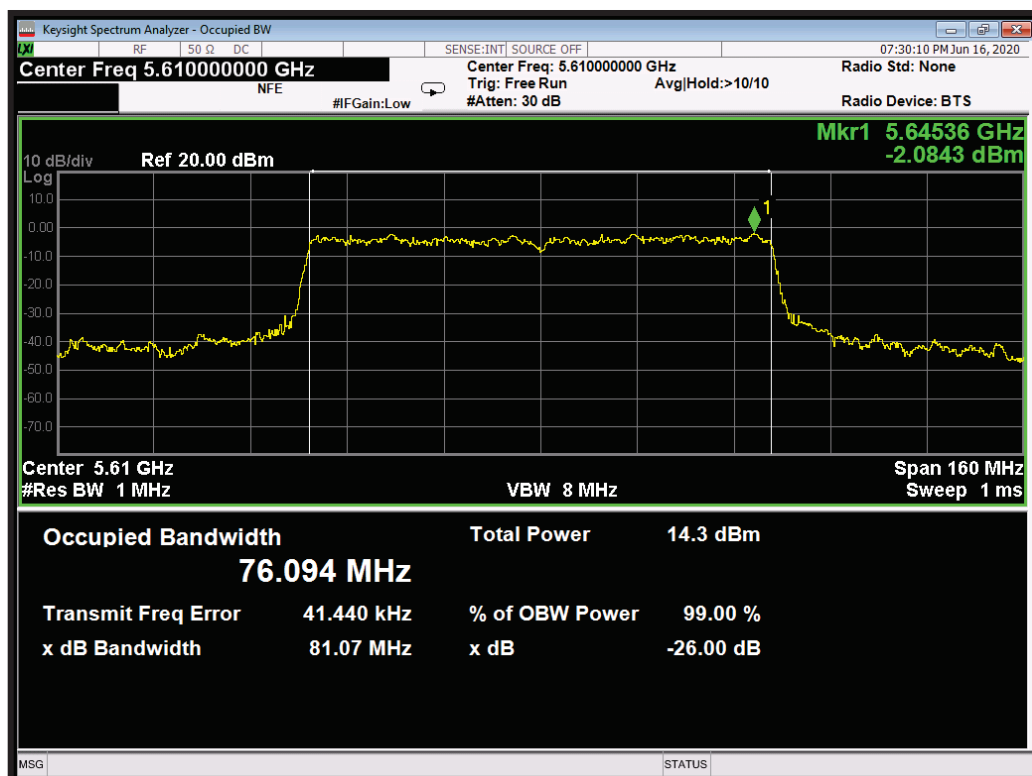
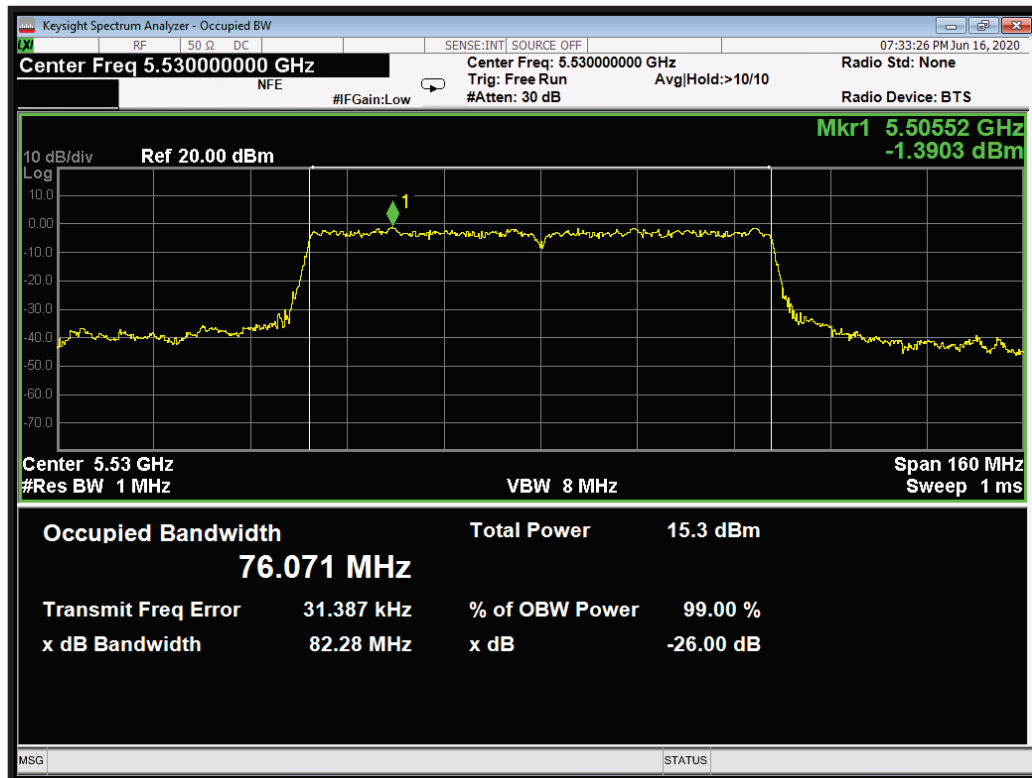


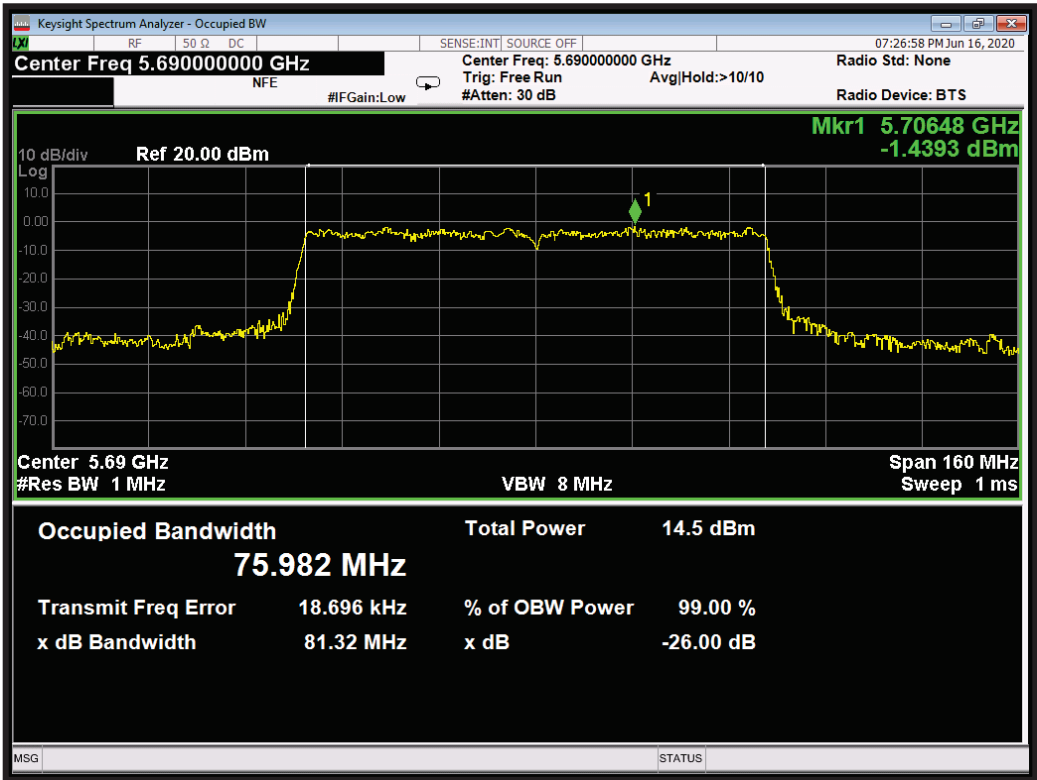
Modulation: 802.11ac-80; Data rate: MCS9 2SS; Main Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	81.84	76.277	N/A
5610	83.93	76.295	N/A
5690	81.84	76.243	N/A





Modulation: 802.11ac-80; Data rate: MCS9 2SS; Aux Antenna;			
Channel Frequency (MHz)	26dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5530	82.28	76.071	N/A
5610	81.07	76.094	N/A
5690	81.32	75.982	N/A





14 Maximum conducted output power

14.1 Definition

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

14.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Laboratory 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 12.3
EUT Occupied Bandwidths:	20 MHz, 40 MHz & 80 MHz
Deviations From Standard:	None
Measurement BW:	Wideband power meter used
Measurement Span:	Wideband power meter used
Measurement Points:	Wideband power meter used
Measurement Detector:	RMS

Environmental Conditions (Normal Environment)

Temperature: 23 °C	+15 °C to +35 °C (as declared)
Humidity: 43 %RH	20%RH to 75%RH (as declared)

Test Limits

For 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW (24 dBm) or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz.

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

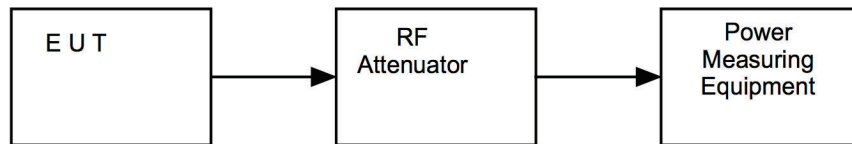
Number of antennas	2
Correlated signals	No
Maximum gain (dBi)	6.9
Exceeds 6 dBi by (dB)	0.9
Spec. limit (dBm)	$11 + 10 \log B$
Minimum 26 dB bandwidth (MHz)	20
Adjusted limit (dBm)	23.1

14.3 Test Method

With The EUT was connected as per Figure iv, the power was measured on the power meter, having taken account of all path losses.

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 iv Test Setup



14.4 Test Equipment

<i>Equipment Description</i>	<i>Manufacturer</i>	<i>Equipment Type</i>	<i>Element No</i>	<i>Due For Calibration</i>
Power Meter	ETS Lindgren	7002-006	REF2279	2022-03-18
Power Meter	ETS Lindgren	7002-006	REF2324	2022-01-29
Power Supply	Farnell	LT30-2	RFG035	Cal with REF887
Multimeter	Agilent	34405A	REF887	2021-10-12

14.5 Test Results

<i>Modulation: 802.11a; Main and Aux ports measured simultaneously; Channel Bandwidth: 20 MHz</i>					
<i>Data Rate (Mbps)</i>	<i>Channel (MHz)</i>	<i>EUT power setting</i>	<i>Measured level (dBm)</i>	<i>Limit (dBm)</i>	<i>Result</i>
6	5500	15	18.8	23.1	Pass
6	5580	15	19.1	23.1	Pass
6	5720	15	18.4	23.1	Pass
54	5500	15	18.8	23.1	Pass
54	5580	15	18.8	23.1	Pass
54	5720	15	18.4	23.1	Pass

<i>Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 20 MHz; Spatial Streams: 1</i>					
<i>Data Rate (MCS)</i>	<i>Channel (MHz)</i>	<i>EUT power setting</i>	<i>Measured level (dBm)</i>	<i>Limit (dBm)</i>	<i>Result</i>
0	5500	13	16.9	23.1	Pass
0	5580	13	17.2	23.1	Pass
0	5720	13	16.5	23.1	Pass
8	5500	13	16.9	23.1	Pass
8	5580	13	17.0	23.1	Pass
8	5720	13	16.5	23.1	Pass

Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 20 MHz; Spatial Streams: 2					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5500	13	17.1	23.1	Pass
0	5580	13	17.4	23.1	Pass
0	5720	13	16.6	23.1	Pass
8	5500	13	17.1	23.1	Pass
8	5580	13	17.0	23.1	Pass
8	5720	13	16.6	23.1	Pass

Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 40 MHz; Spatial Streams: 1					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5510	12	16.0	23.1	Pass
0	5550	12	16.0	23.1	Pass
0	5710	12	15.6	23.1	Pass
9	5510	12	16.1	23.1	Pass
9	5550	12	16.1	23.1	Pass
9	5710	12	15.7	23.1	Pass

Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 40 MHz; Spatial Streams: 2					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5510	12	16.0	23.1	Pass
0	5550	12	16.0	23.1	Pass
0	5710	12	15.6	23.1	Pass
9	5510	12	16.1	23.1	Pass
9	5550	12	16.1	23.1	Pass
9	5710	12	15.6	23.1	Pass

Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 80 MHz; Spatial Streams: 1					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5530	8	12.4	23.1	Pass
0	5610	8	12.3	23.1	Pass
0	5690	8	12.1	23.1	Pass
9	5530	8	12.6	23.1	Pass
9	5610	8	12.5	23.1	Pass
9	5690	8	12.3	23.1	Pass

Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 80 MHz; Spatial Streams: 2					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5530	8	12.4	23.1	Pass
0	5610	8	12.3	23.1	Pass
0	5690	8	12.1	23.1	Pass
9	5530	8	12.5	23.1	Pass
9	5610	8	12.5	23.1	Pass
9	5690	8	12.2	23.1	Pass

Measurements in 802.11n mode were only performed for channel and operating mode combinations where the EUT power setting was different from that used for 802.11ac mode. These additional measurements are presented in the tables below:

Modulation: 802.11n; Main and Aux ports measured simultaneously; Channel Bandwidth: 20 MHz					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5500	15	19.1	23.1	Pass
0	5580	15	19.4	23.1	Pass
0	5720	15	18.7	23.1	Pass

Modulation: 802.11n; Main and Aux ports measured simultaneously; Channel Bandwidth: 40 MHz					
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level (dBm)	Limit (dBm)	Result
0	5510	14	18.0	23.1	Pass
0	5550	14	17.9	23.1	Pass
0	5710	14	17.6	23.1	Pass

15 Power spectral density

15.1 Definition

The power spectral density is the total energy output per unit bandwidth from a pulse or sequence of pulses for which the transmit power is at its maximum level, divided by the total duration of the pulses.

15.2 Test Parameters

Test Location:	Element Hull
Test Chamber:	Wireless Laboratory 1
Test Standard and Clause:	ANSI C63.10-2013, Clause 12.5
EUT Channel Bandwidths:	20 MHz, 40 MHz & 80 MHz
Deviations From Standard:	None
Measurement BW:	1 MHz
Spectrum Analyzer Video BW:	3 MHz
Measurement Span:	30 MHz, 60 MHz & 90 MHz
Measurement Detector:	RMS

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

For the 5.47-5.725 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

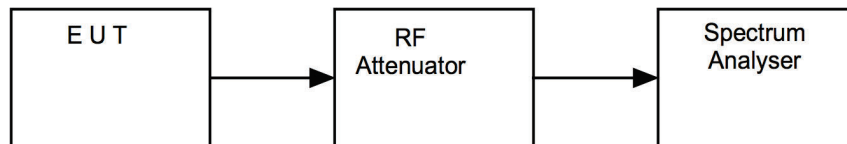
Number of antennas	2
Correlated signals	No
Maximum Gain (dBi)	6.9
Exceeds 6 dBi by (dB)	0.9
Spec. limit (dBm/MHz)	11.0
Adjusted limit (dBm/MHz)	10.1

15.3 Test Method

With the EUT connected as per Figure v, the peak emission of the EUT was measured on a spectrum analyser, with path losses taken into account.

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 v Test Setup



15.4 Test Equipment

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

15.5 Test Results

Modulation: 802.11a; Main and Aux ports measured separately and combined; Channel Bandwidth: 20 MHz							
Data Rate (Mbps)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
6	5500	15	5.2	4.7	8.0	10.1	Pass
6	5580	15	4.6	4.5	7.6	10.1	Pass
6	5720	15	4.2	3.8	7.0	10.1	Pass
54	5500	15	5.0	4.3	7.7	10.1	Pass
54	5580	15	4.8	4.4	7.6	10.1	Pass
54	5720	15	4.5	3.5	7.0	10.1	Pass

Modulation: 802.11ac; Main and Aux ports measured separately and combined; Channel Bandwidth: 20 MHz; Spatial Streams: 1							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5500	13	3.0	2.6	5.8	10.1	Pass
0	5580	13	3.1	2.2	5.7	10.1	Pass
0	5720	13	2.7	2.1	5.4	10.1	Pass
8	5500	13	2.4	2.4	5.4	10.1	Pass
8	5580	13	2.7	1.8	5.3	10.1	Pass
8	5720	13	2.0	1.8	4.9	10.1	Pass

Modulation: 802.11ac; Main and Aux ports measured separately and combined; Channel Bandwidth: 20 MHz; Spatial Streams: 2							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5500	13	2.8	2.7	5.8	10.1	Pass
0	5580	13	2.9	2.3	5.6	10.1	Pass
0	5720	13	2.6	2.1	5.4	10.1	Pass
8	5500	13	2.4	2.3	5.4	10.1	Pass
8	5580	13	2.6	1.9	5.3	10.1	Pass
8	5720	13	2.1	1.8	5.0	10.1	Pass

Modulation: 802.11ac; Main and Aux ports measured separately and combined; Channel Bandwidth: 40 MHz; Spatial Streams: 1							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5510	12	-0.8	-1.0	2.1	10.1	Pass
0	5550	12	-1.1	-1.2	1.9	10.1	Pass
0	5710	12	-1.1	-1.8	1.6	10.1	Pass
9	5510	12	-1.5	-1.4	1.6	10.1	Pass
9	5550	12	-1.7	-1.6	1.4	10.1	Pass
9	5710	12	-1.5	-2.2	1.2	10.1	Pass

Modulation: 802.11ac; Main and Aux ports measured separately and combined; Channel Bandwidth: 40 MHz; Spatial Streams: 2							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5510	12	-1.1	-1.1	1.9	10.1	Pass
0	5550	12	-1.3	-1.4	1.7	10.1	Pass
0	5710	12	-1.4	-1.8	1.4	10.1	Pass
9	5510	12	-1.5	-1.4	1.6	10.1	Pass
9	5550	12	-1.7	-1.6	1.4	10.1	Pass
9	5710	12	-2.0	-1.9	1.1	10.1	Pass

Modulation: 802.11ac; Main and Aux ports measured separately and combined; Channel Bandwidth: 80 MHz; Spatial Streams: 1							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5530	8	-8.2	-8.4	-5.3	10.1	Pass
0	5610	8	-8.2	-8.5	-5.3	10.1	Pass
0	5690	8	-8.4	-8.8	-5.6	10.1	Pass
9	5530	8	-8.3	-8.5	-5.4	10.1	Pass
9	5610	8	-8.2	-8.6	-5.4	10.1	Pass
9	5690	8	-8.5	-8.8	-5.6	10.1	Pass

Modulation: 802.11ac; Main and Aux ports measured separately and combined; Channel Bandwidth: 80 MHz; Spatial Streams: 2							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5530	8	-8.5	-8.5	-5.5	10.1	Pass
0	5610	8	-8.3	-8.6	-5.4	10.1	Pass
0	5690	8	-8.6	-8.8	-5.7	10.1	Pass
9	5530	8	-8.5	-8.6	-5.5	10.1	Pass
9	5610	8	-8.3	-8.6	-5.4	10.1	Pass
9	5690	8	-8.5	-8.8	-5.6	10.1	Pass

Measurements in 802.11n mode were only performed for channel and operating mode combinations where the EUT power setting was different from that used for 802.11ac mode. These additional measurements are presented in the tables below:

Modulation: 802.11n; Main and Aux ports measured separately and combined; Channel Bandwidth: 20 MHz							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5500	15	4.7	4.5	7.6	10.1	Pass
0	5580	15	5.5	4.6	8.1	10.1	Pass
0	5720	15	3.9	4.1	7.0	10.1	Pass

Modulation: 802.11n; Main and Aux ports measured separately and combined; Channel Bandwidth: 40 MHz							
Data Rate (MCS)	Channel (MHz)	EUT power setting	Measured level Main (dBm/MHz)	Measured level Aux (dBm/MHz)	Combined PSD (dBm/MHz)	Limit (dBm/MHz)	Result
0	5510	14	0.4	0.8	3.6	10.1	Pass
0	5550	14	0.0	0.7	3.4	10.1	Pass
0	5710	14	0.5	0.1	3.3	10.1	Pass

16 Measurement Uncertainty

Calculated Measurement Uncertainties

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence:

[1] Radiated spurious emissions

Uncertainty in test result (30 MHz – 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz – 18 GHz) = **4.7 dB**

[2] AC power line conducted emissions

Uncertainty in test result = **3.4 dB**

[3] Occupied bandwidth

Uncertainty in test result = **15.5%**

[4] Conducted carrier power

Uncertainty in test result (Power Meter) = **1.08 dB**

[5] Conducted / radiated RF power out-of-band

Uncertainty in test result – Up to 8.1 GHz = **3.31 dB**

Uncertainty in test result – 8.1 GHz – 15.3 GHz = **4.43 dB**

Uncertainty in test result (30 MHz – 1 GHz) = **4.6 dB**

Uncertainty in test result (1 GHz – 18 GHz) = **4.7 dB**

[6] Power spectral density

Uncertainty in test result (Spectrum Analyser) = **2.48 dB**

[7] AC Power Line conducted emissions

Uncertainty in test result (Spectrum Analyser) = **3.42 dB**