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:	5745 MHz
Deviations From Standard:	None
Measurement Detectors:	Quasi-Peak and Average

Environmental Conditions (Normal Environment)

Temperature: 21 °C	+15 ºC to +35 ºC (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

Frequency (MHz)	*Conducted limit (dBµV)*	
	Quasi-Peak	*Average***
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.

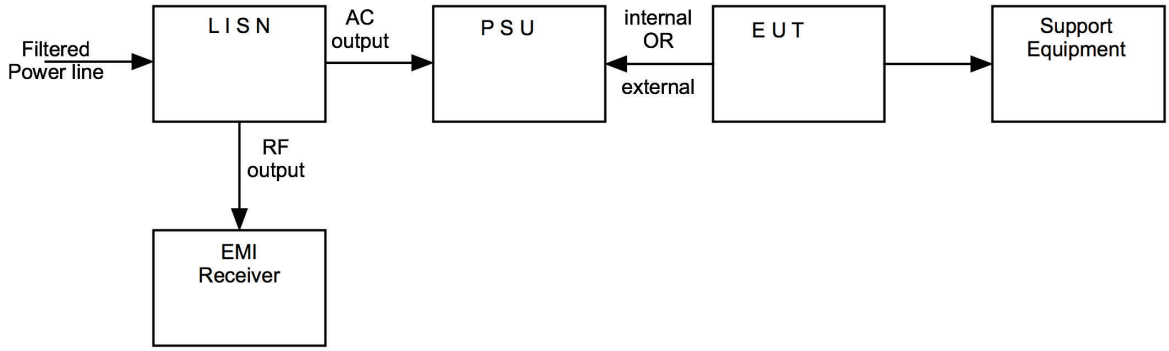
12.4 Test Method

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

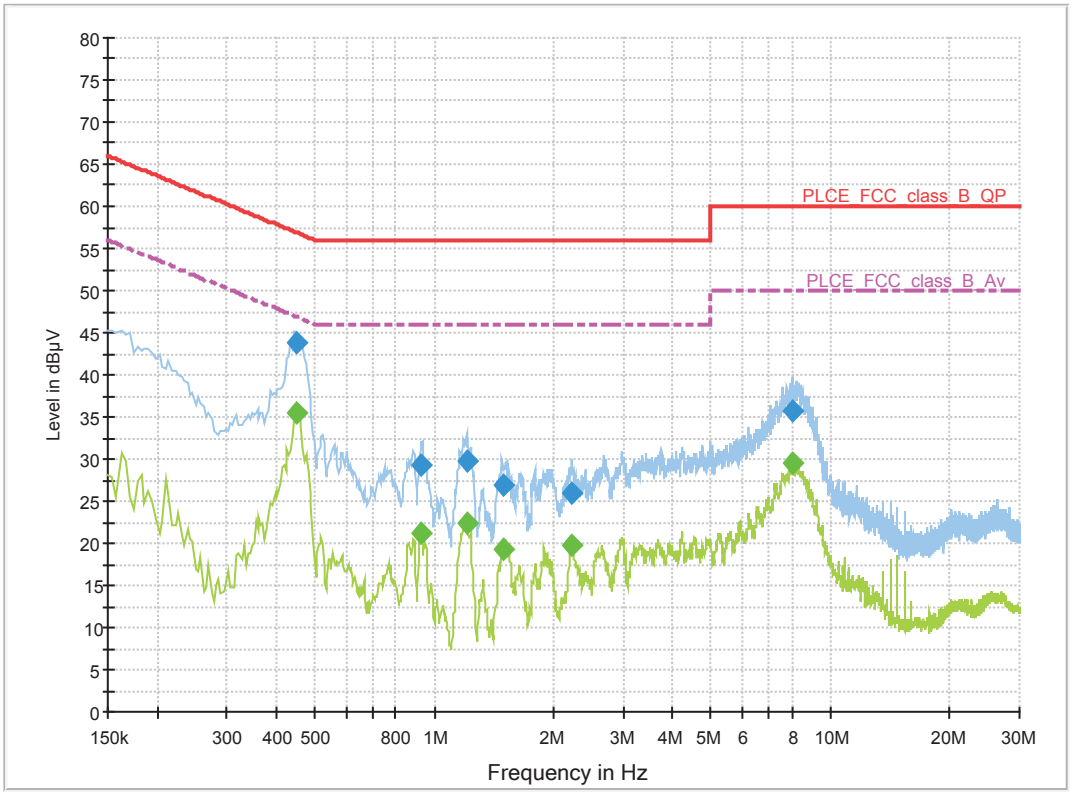
12.6 Test Equipment

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

AC power-line conducted emissions, Transmit mode						
Results measured using the average detector						
Reference Number	***Frequency (MHz)***	***Conductor***	***Result (dBuV)***	***Specification Limit (dBuV)***	***Margin (dB)***	***Result Summary***
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

Results measured using the quasi-peak detector						
Reference Number	***Frequency (MHz)***	***Conductor***	***Result (dBuV)***	***Specification Limit (dBuV)***	***Margin (dB)***	***Result Summary***
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


PLCE_FCC_class_B_QP
PLCE_FCC_class_B_Av
Level in dBµV
Frequency in Hz
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
150k
300
400
500
800
1M
2M
3M
4M
5M
6
8
10M
20M
30M

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 ºC to +35 ºC (as declared)
Humidity: 42 %RH	20%RH to 75%RH (as declared)

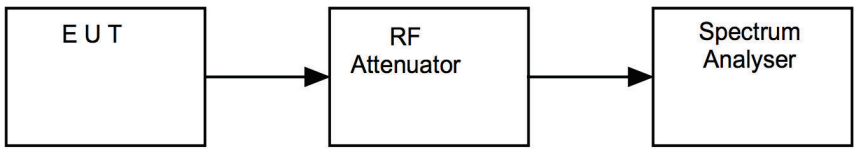
Test Limits

Within the 5.725–5.85 GHz band, the minimum 6 dB bandwidth of U–NII devices shall be at least 500 kHz.

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

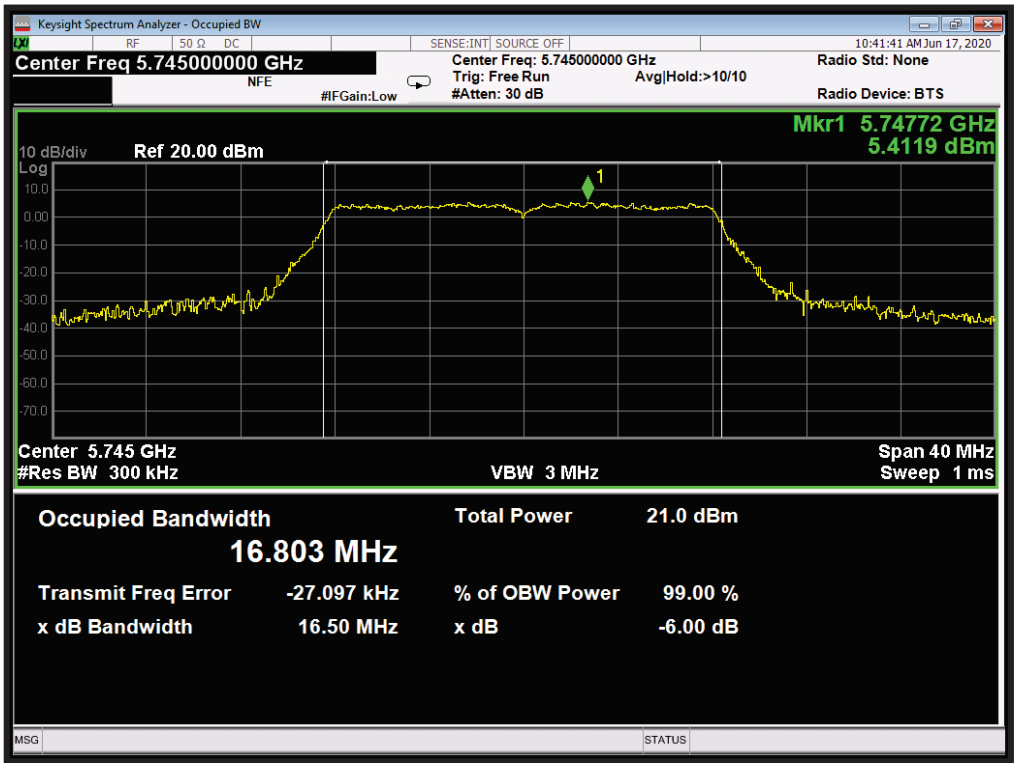


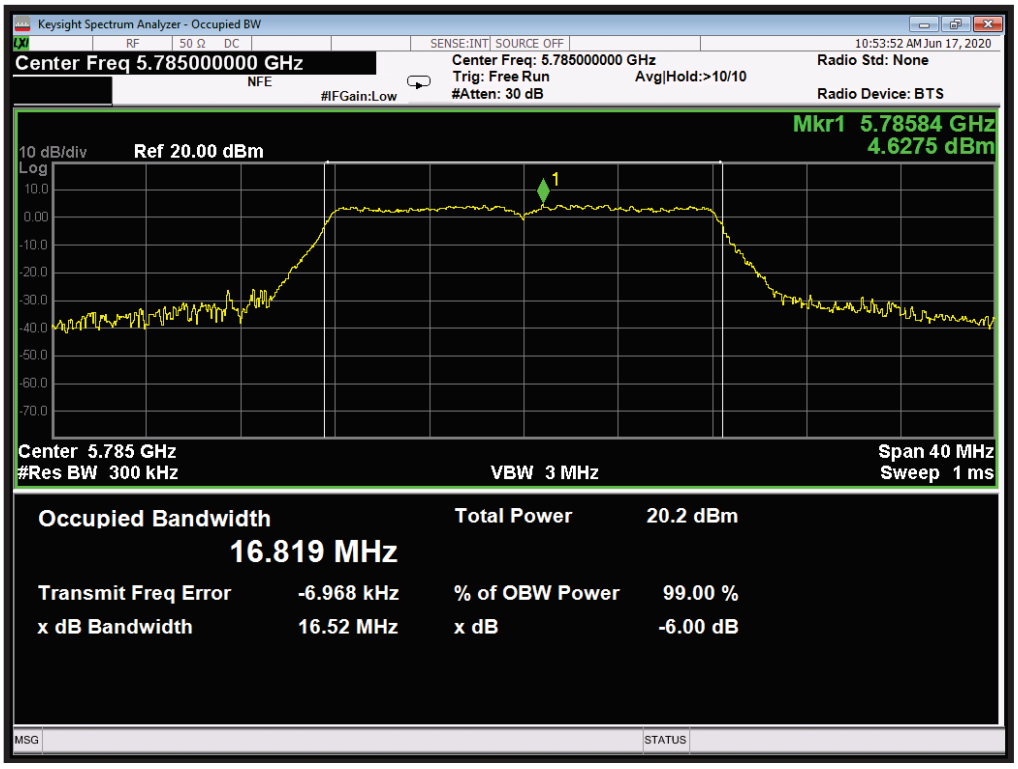
13.4 Test Equipment

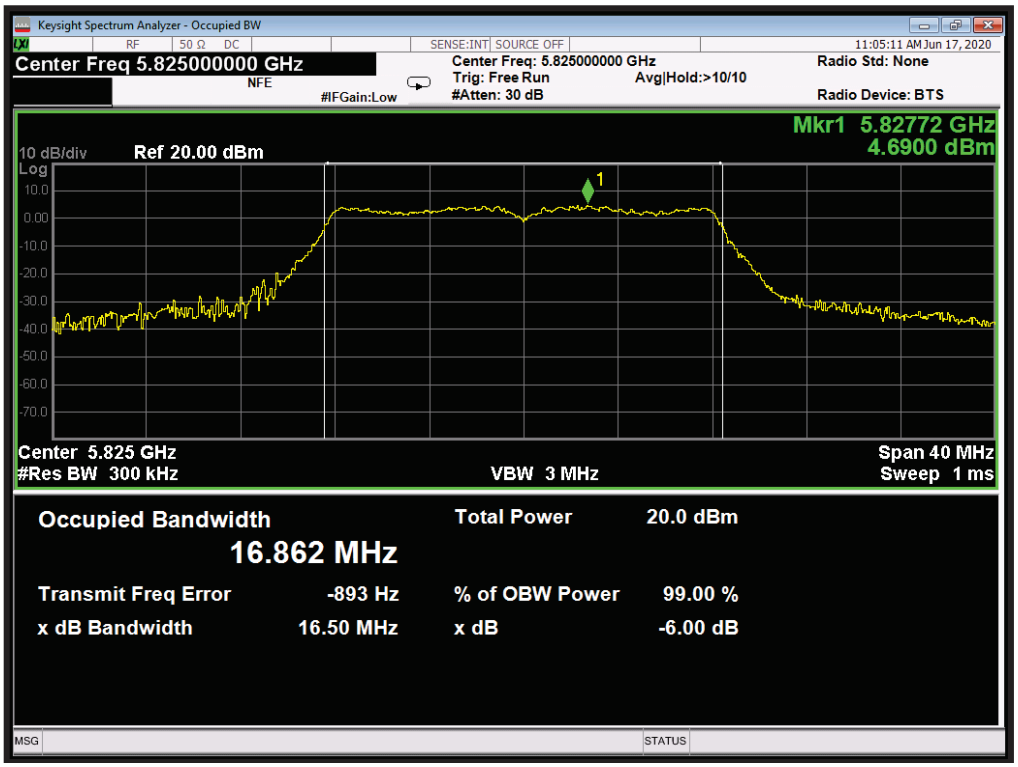
Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
Spectrum Analyser	Agilent	N9030A	REF2167	2021-08-19
Power Supply	Farnell	LT30-2	RFG035	Cal with REF887
Multimeter	Agilent	34405A	REF887	2021-10-12

13.5 Test Results

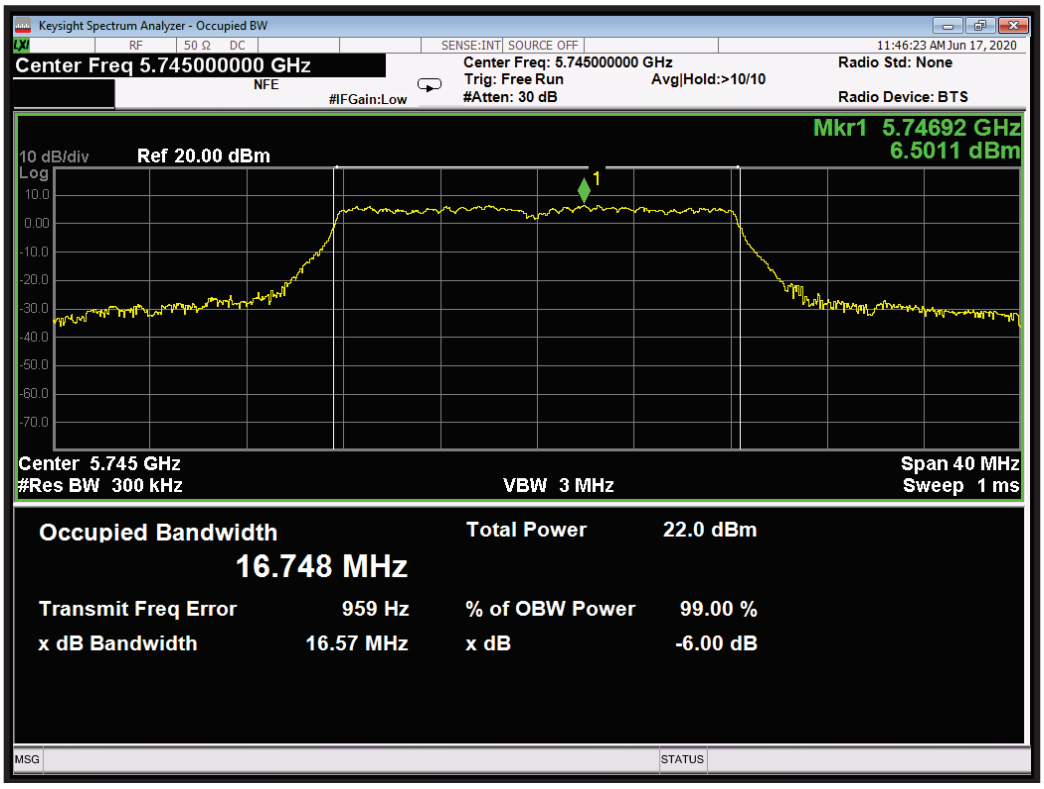
Modulation: 802.11a; Data rate: 6 Mbit/s; Main Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5745	16.50	16.803	PASS
5785	16.52	16.819	PASS
5825	16.50	16.862	PASS

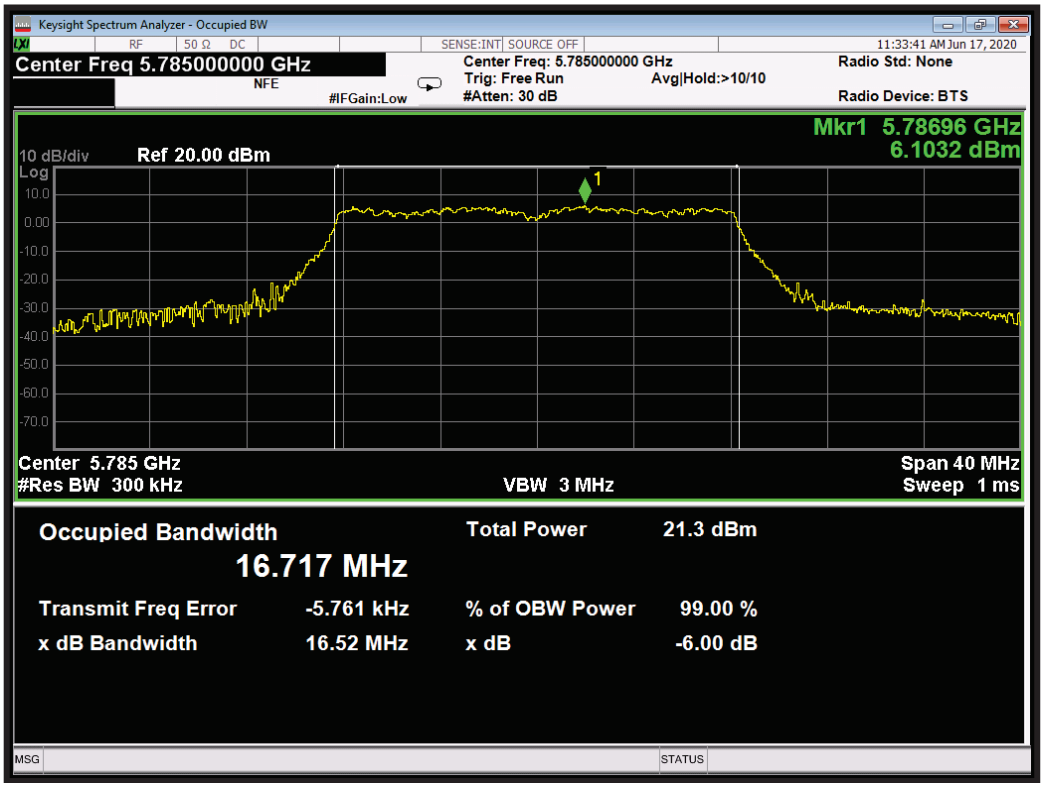


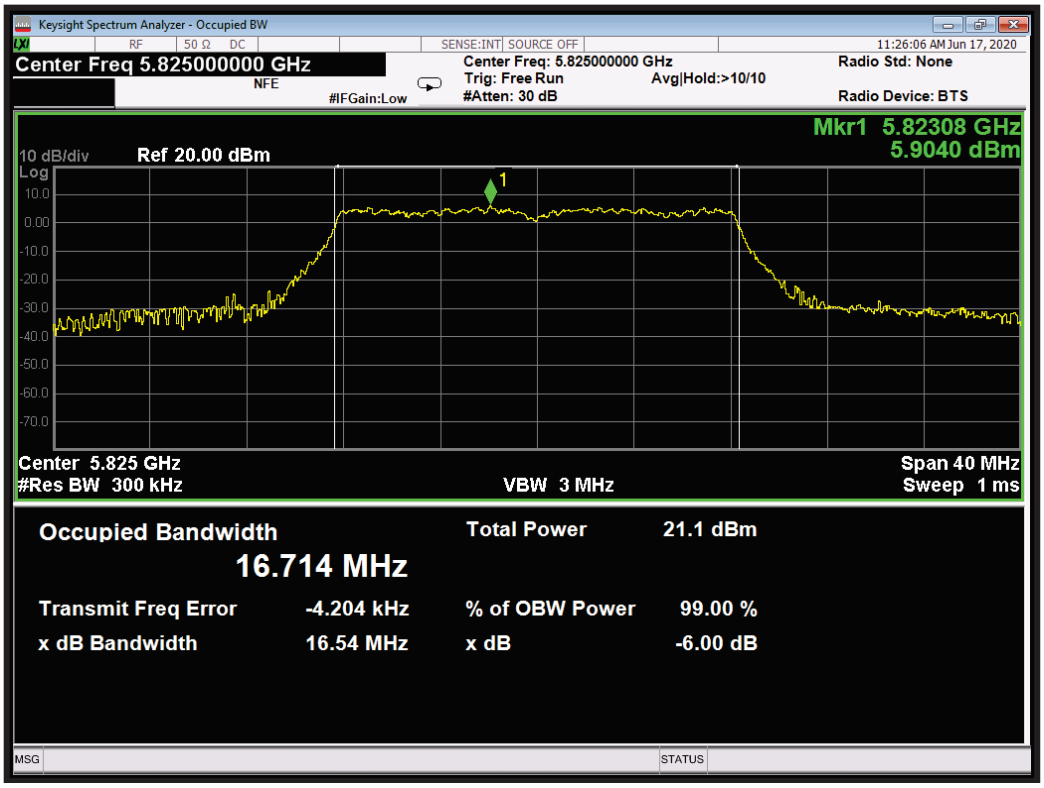



Keysight Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT SOURCE OFF
11:05:11 AM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82772 GHz
4.6900 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
16.862 MHz
Total Power 20.0 dBm
Transmit Freq Error -893 Hz
% of OBW Power 99.00 %
x dB Bandwidth 16.50 MHz
x dB -6.00 dB
MSG
STATUS

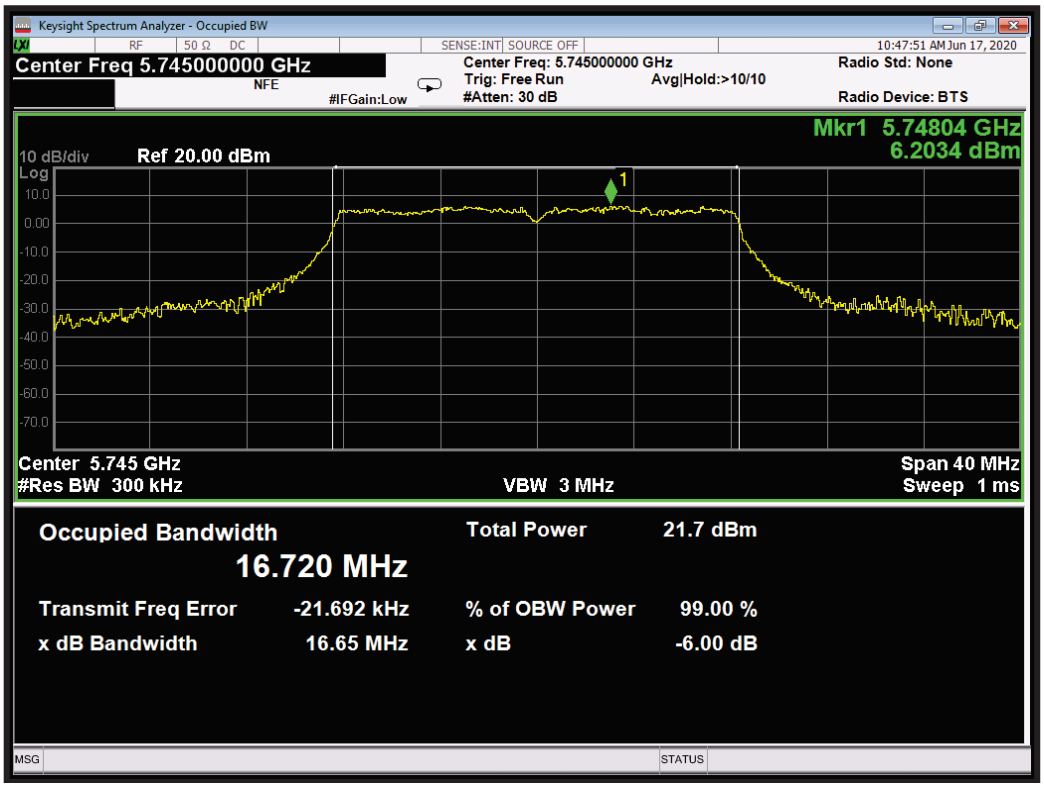
Modulation: 802.11a; Data rate: 6 Mbit/s; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	16.57	16.748	PASS
5785	16.52	16.717	PASS
5825	16.54	16.714	PASS

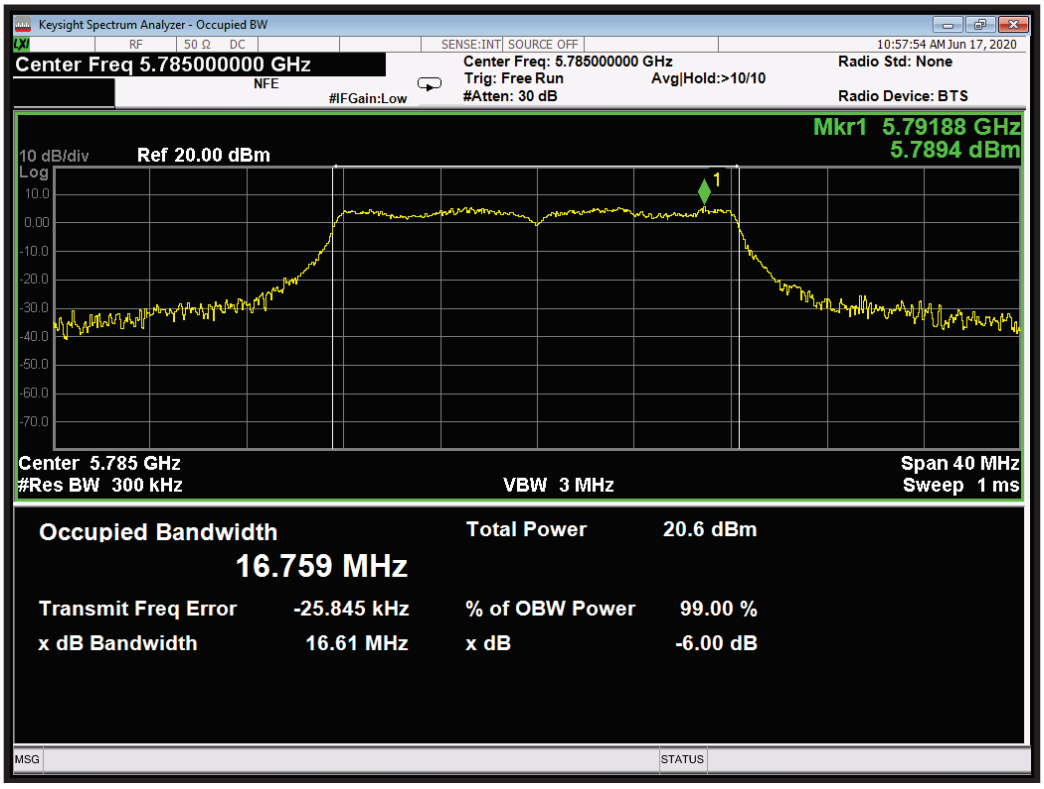


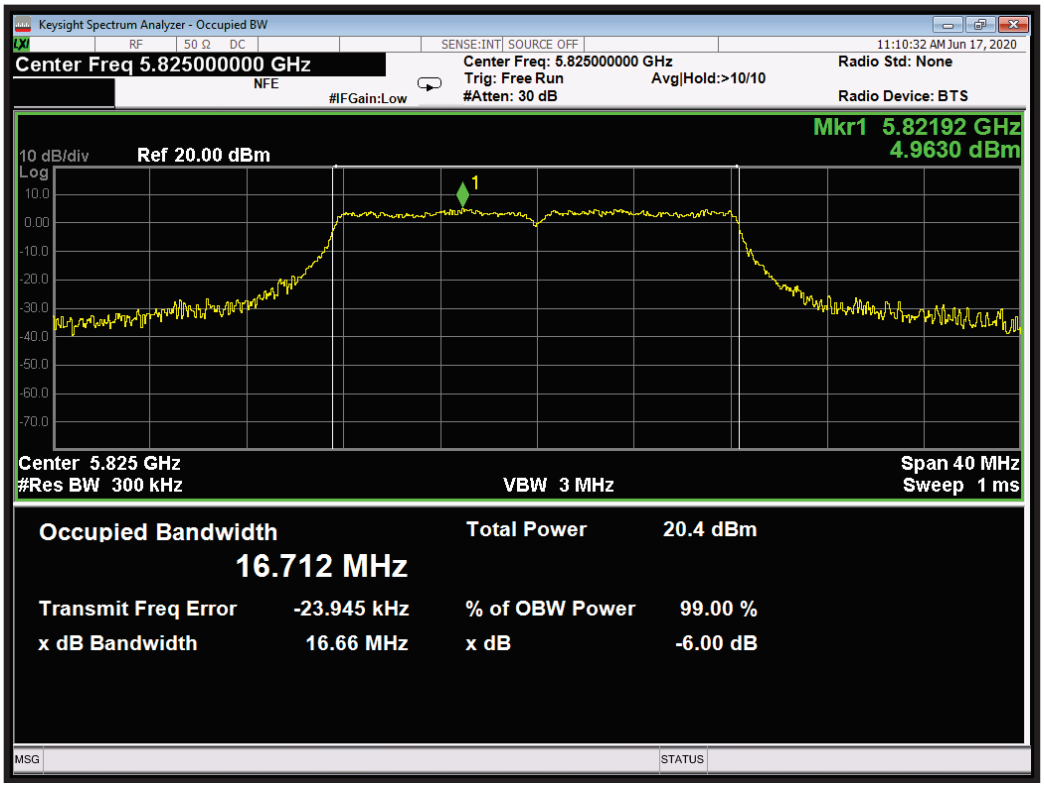



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
SOURCE OFF
11:26:06 AM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82308 GHz
5.9040 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
16.714 MHz
Total Power 21.1 dBm
Transmit Freq Error -4.204 kHz
% of OBW Power 99.00 %
x dB Bandwidth 16.54 MHz
x dB -6.00 dB
MSG
STATUS

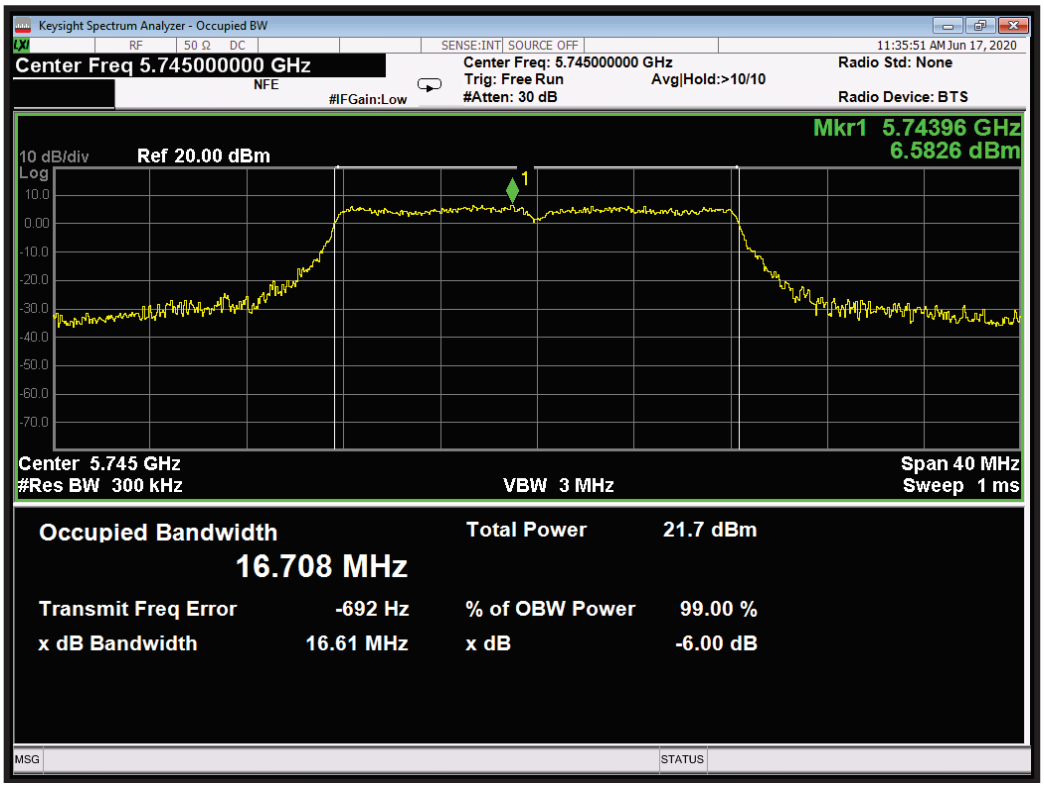
Modulation: 802.11a; Data rate: 54 Mbit/s; Main Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5745	16.65	16.720	PASS
5785	16.61	16.759	PASS
5825	16.66	16.712	PASS

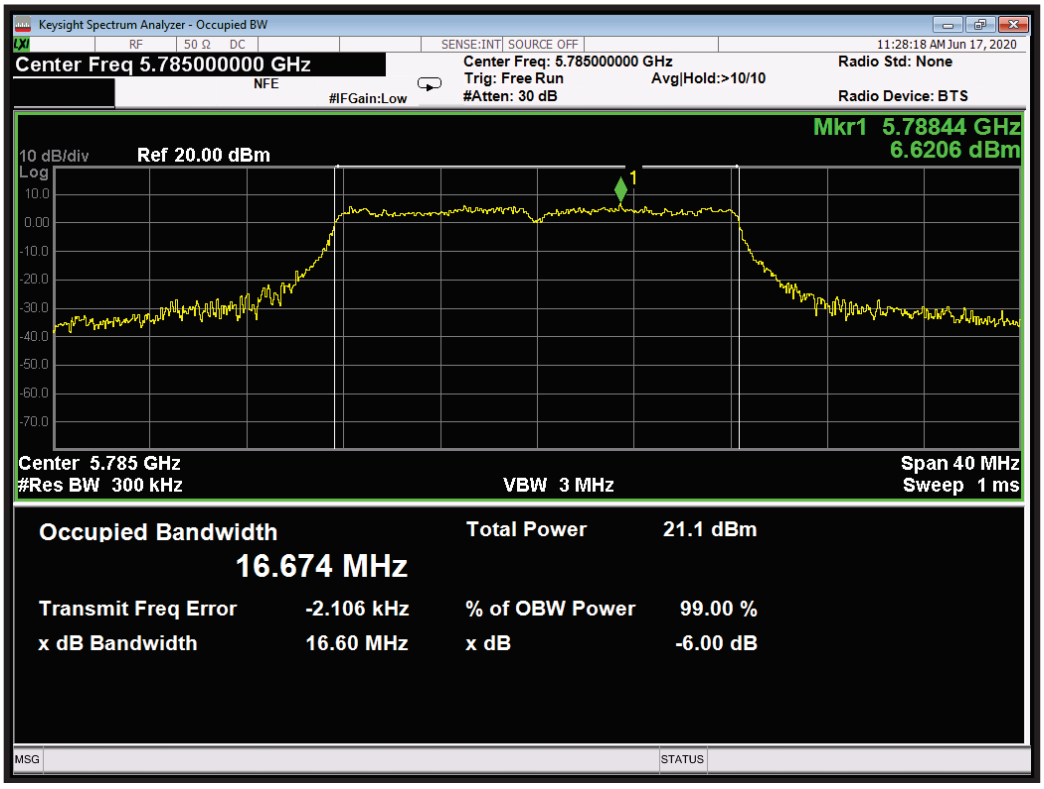


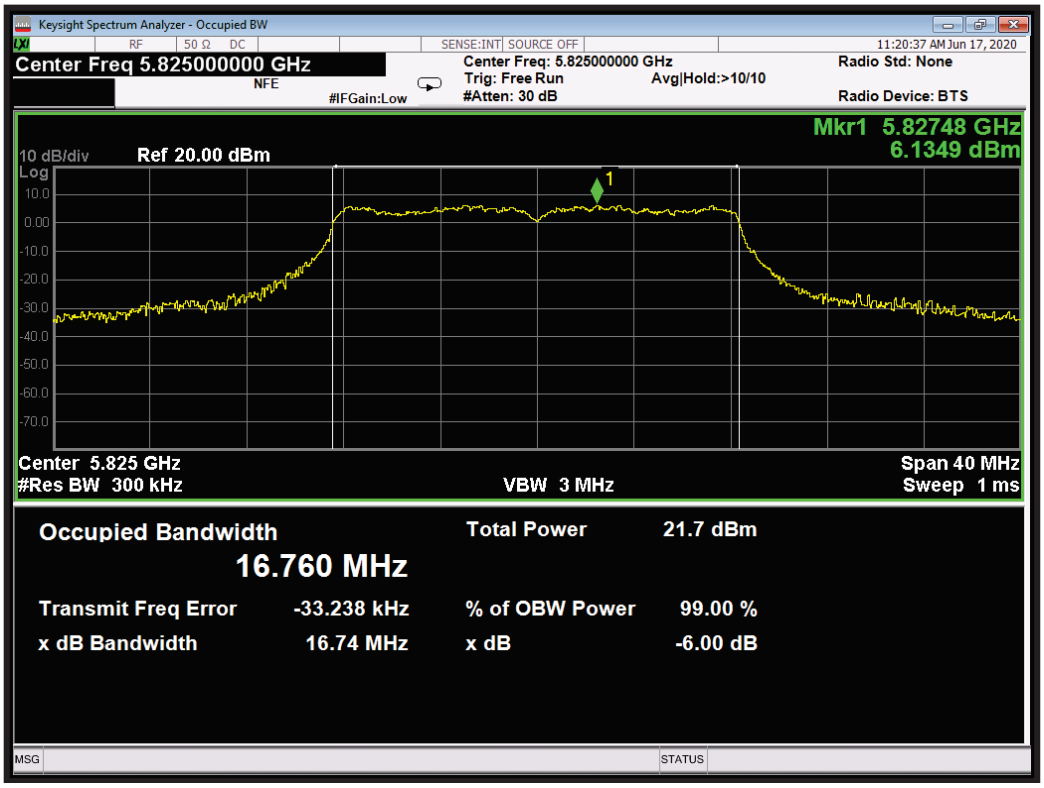



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
SOURCE OFF
11:10:32 AM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82192 GHz
4.9630 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
16.712 MHz
Total Power 20.4 dBm
Transmit Freq Error -23.945 kHz
% of OBW Power 99.00 %
x dB Bandwidth 16.66 MHz
x dB -6.00 dB
MSG
STATUS

Modulation: 802.11a; Data rate: 54 Mbit/s; Aux Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5745	16.61	16.708	PASS
5785	16.60	16.674	PASS
5825	16.74	16.760	PASS

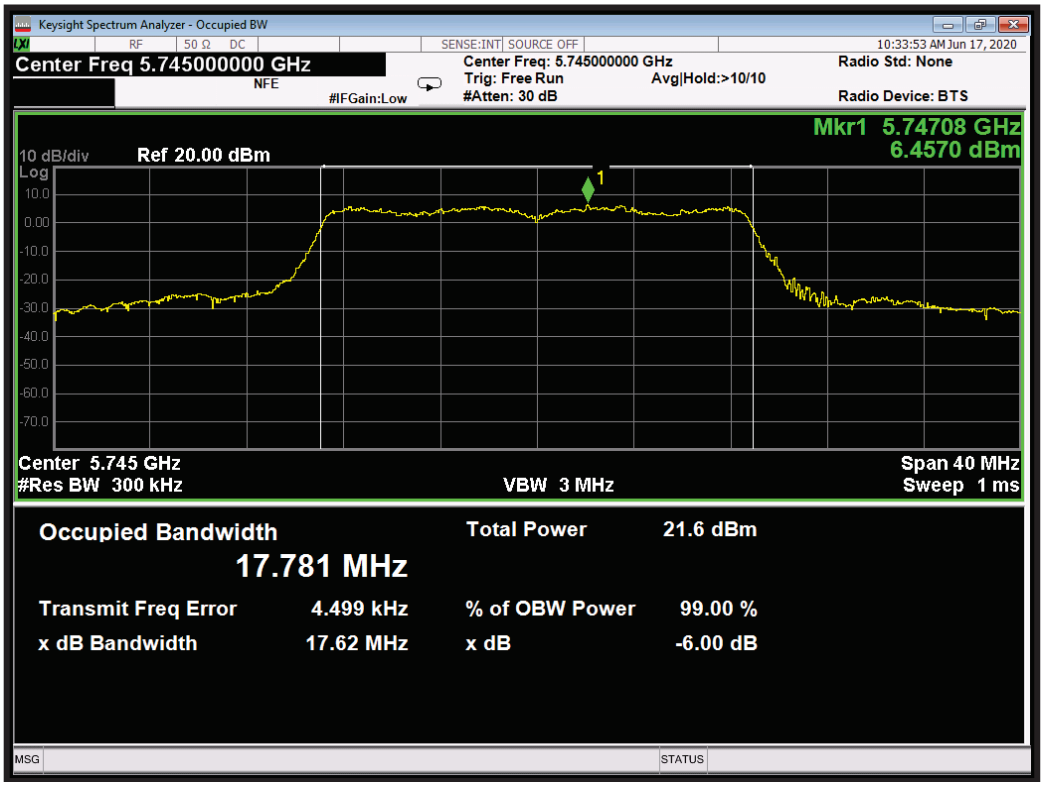


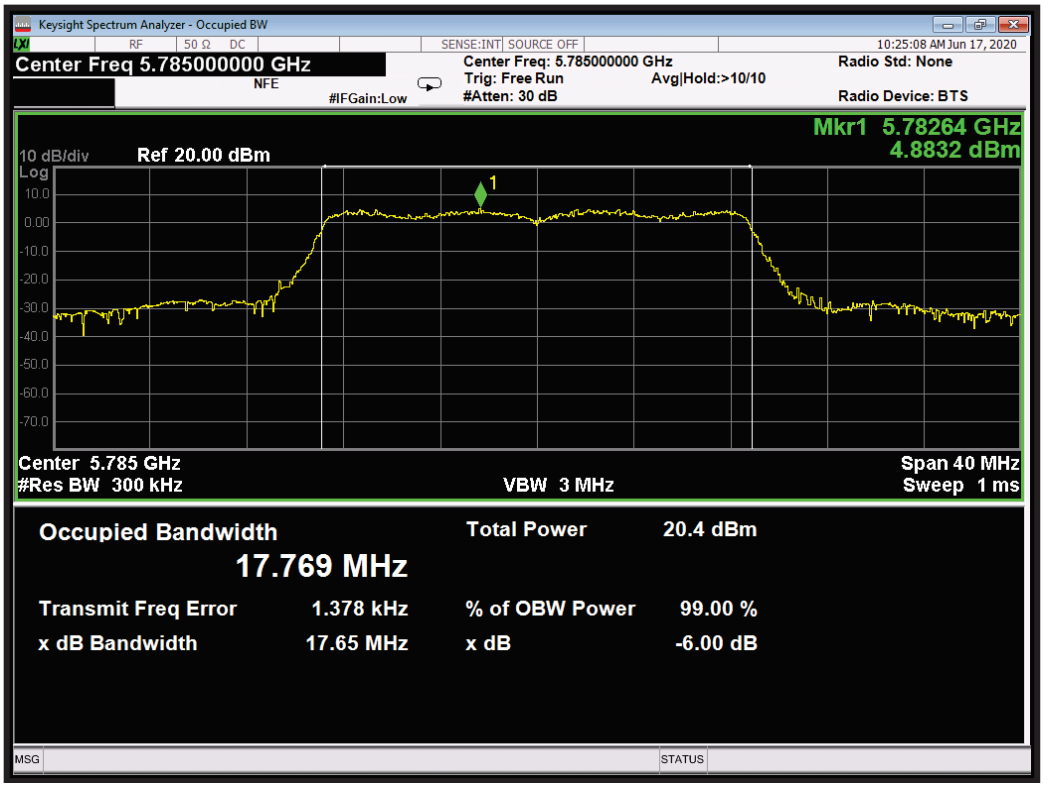


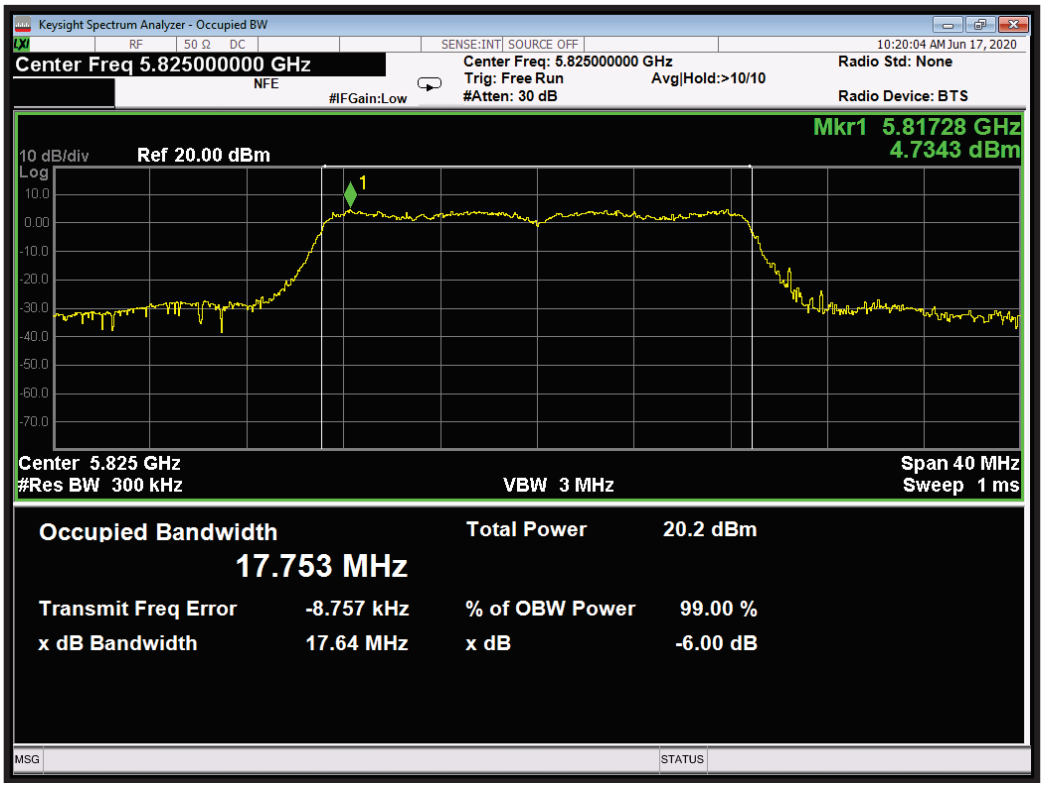

Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT SOURCE OFF
11:20:37 AM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82748 GHz
6.1349 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
16.760 MHz
Total Power 21.7 dBm
Transmit Freq Error -33.238 kHz
% of OBW Power 99.00 %
x dB Bandwidth 16.74 MHz
x dB -6.00 dB
MSG
STATUS

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.

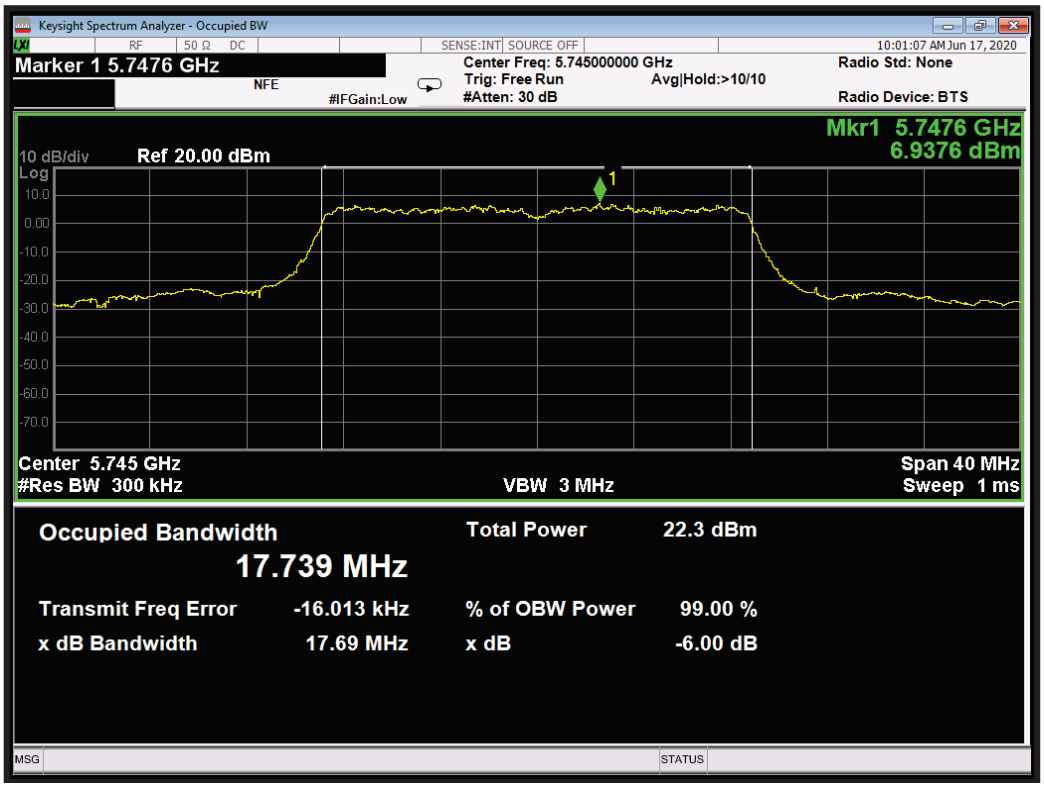
Modulation: 802.11n-20; Data rate: MCS0; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.62	17.781	PASS
5785	17.65	17.769	PASS
5825	17.64	17.753	PASS

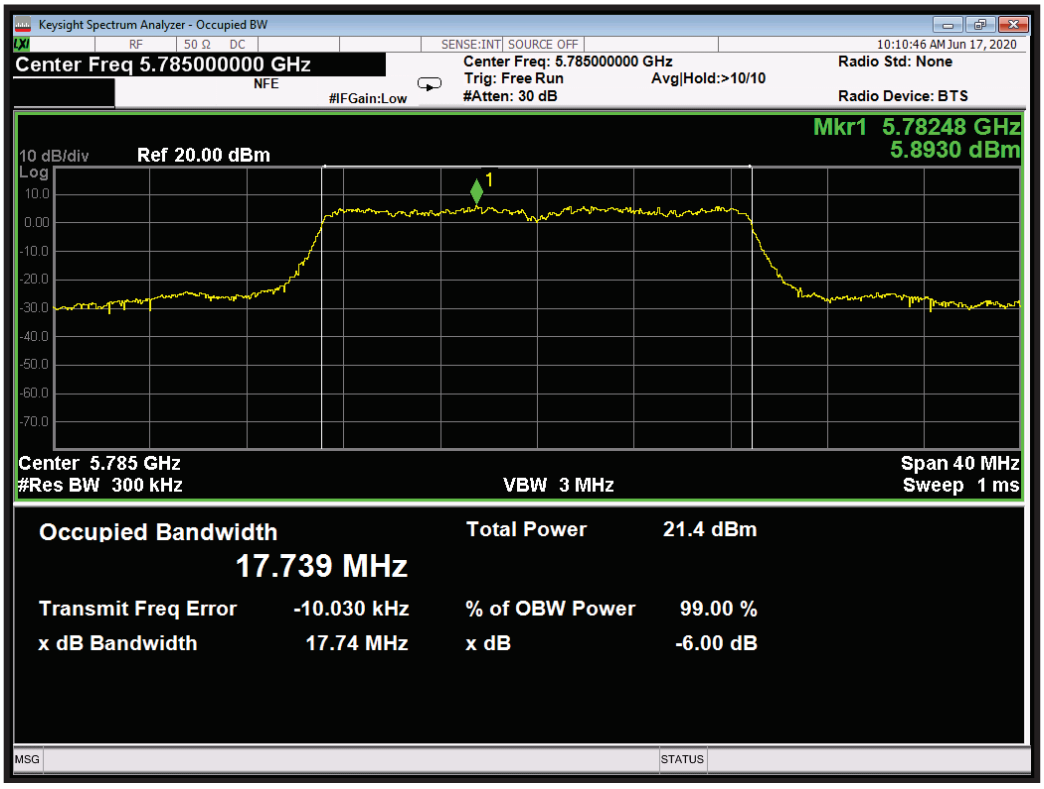


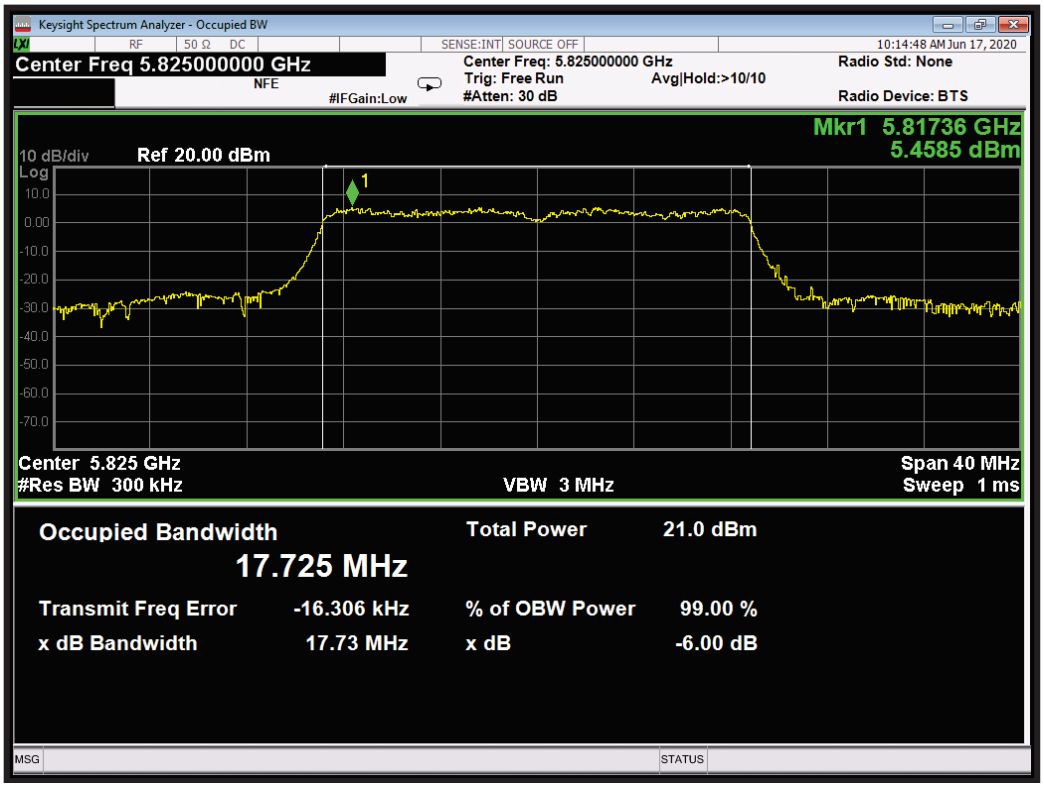

Keysight Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT SOURCE OFF
10:25:08 AM Jun 17, 2020
Center Freq 5.785000000 GHz
NFE
#IFGain:Low
Center Freq: 5.785000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.78264 GHz
4.8832 dBm
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.785 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.769 MHz
Total Power 20.4 dBm
Transmit Freq Error 1.378 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.65 MHz
x dB -6.00 dB
MSG
STATUS


Keysight Spectrum Analyzer - Occupied BW
RF 50 Ω DC
SENSE:INT SOURCE OFF
10:20:04 AM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.81728 GHz
4.7343 dBm
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.753 MHz
Total Power 20.2 dBm
Transmit Freq Error -8.757 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.64 MHz
x dB -6.00 dB
MSG
STATUS

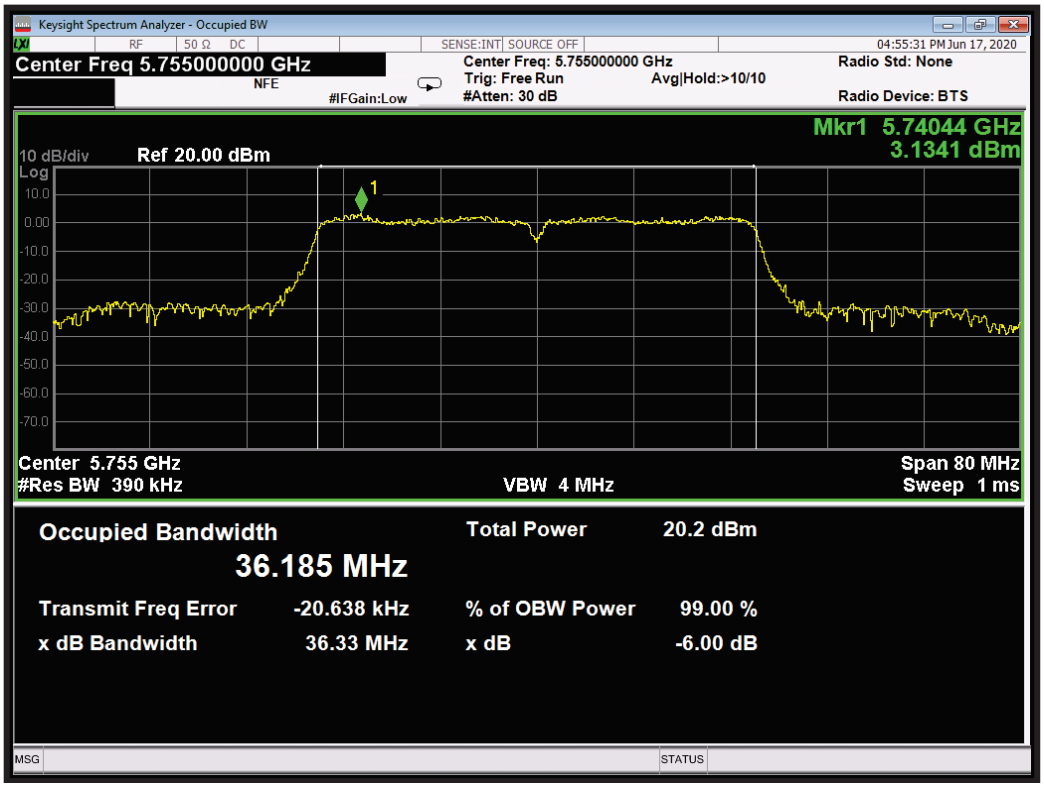
Modulation: 802.11n-20; Data rate: MCS0; Aux Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5745	17.69	17.739	PASS
5785	17.74	17.739	PASS
5825	17.73	17.725	PASS

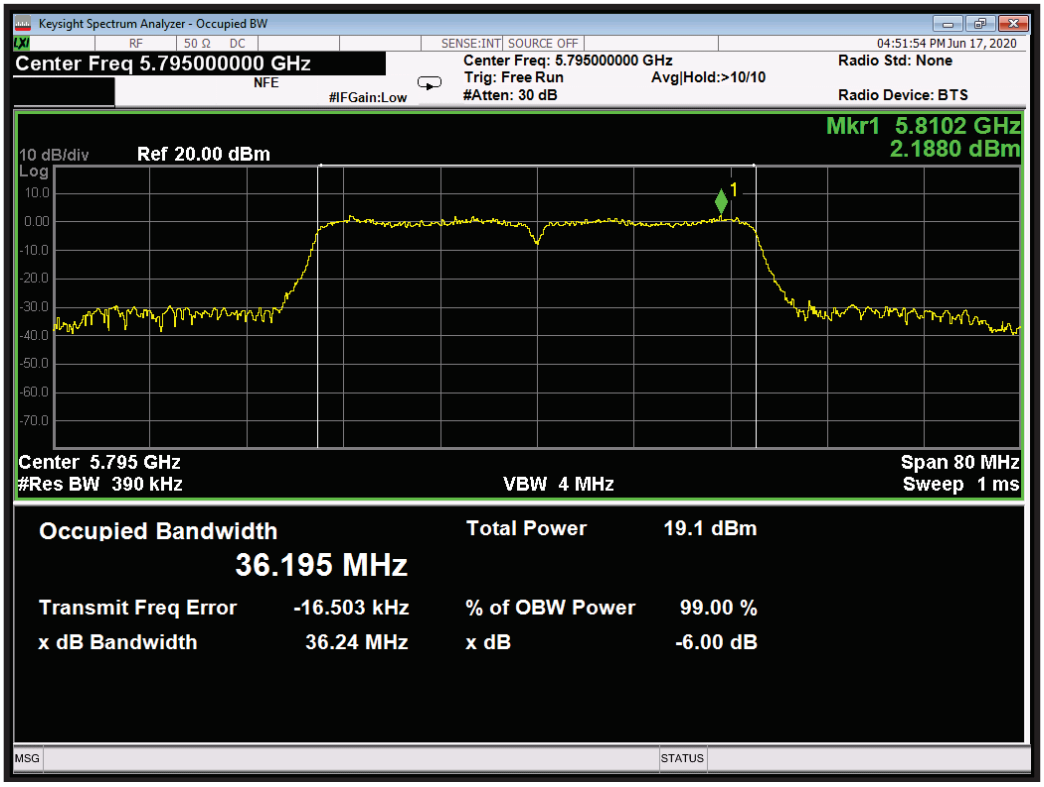




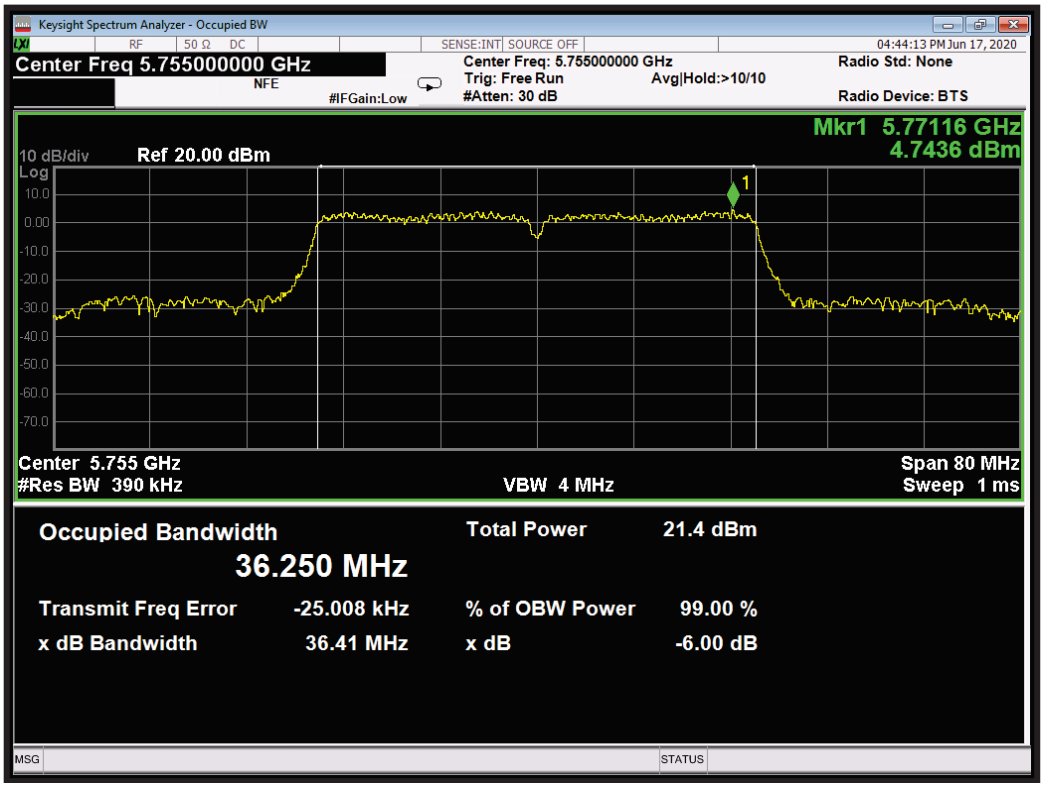

Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
SOURCE OFF
10:14:48 AM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.81736 GHz
5.4585 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.725 MHz
Total Power 21.0 dBm
Transmit Freq Error -16.306 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.73 MHz
x dB -6.00 dB
MSG
STATUS

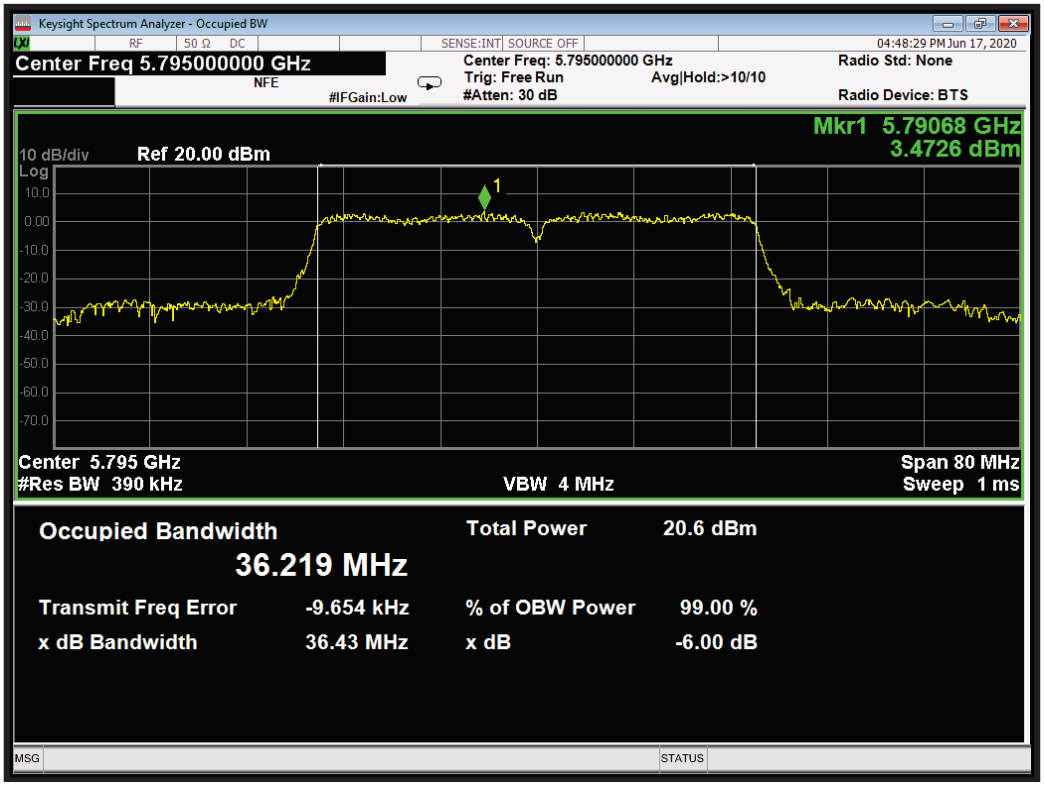
Modulation: 802.11n-40; Data rate: MCS0; Main Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5755	36.33	36.185	PASS
5795	36.24	36.195	PASS



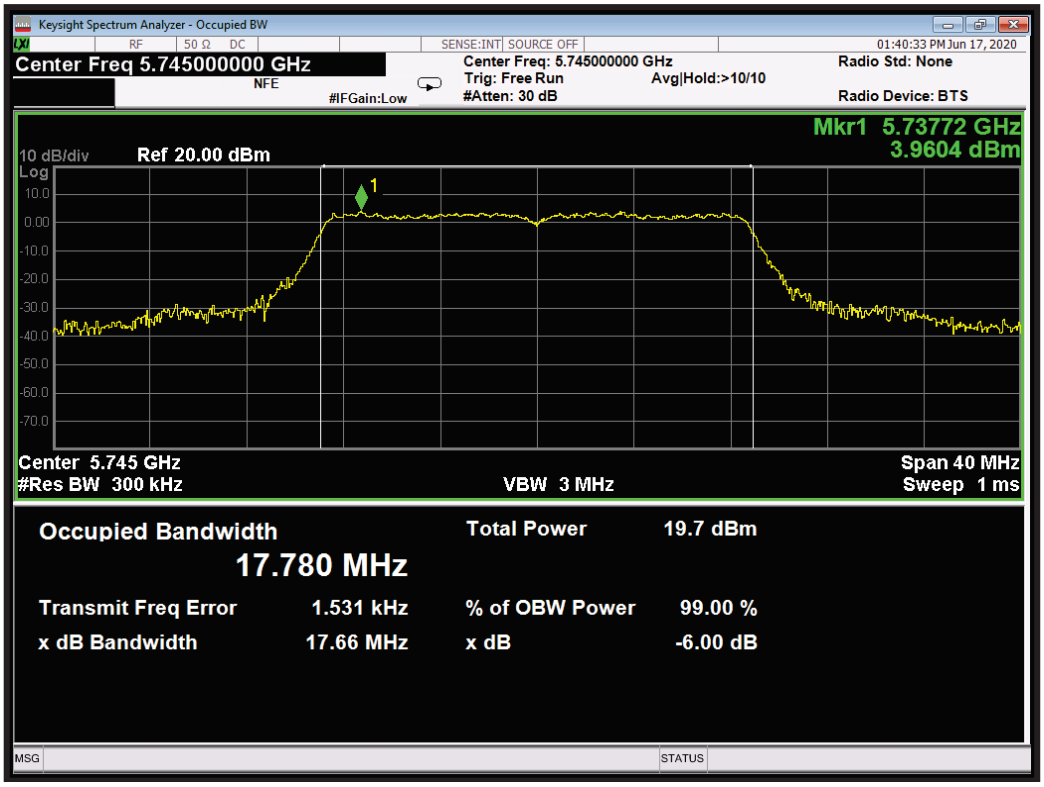


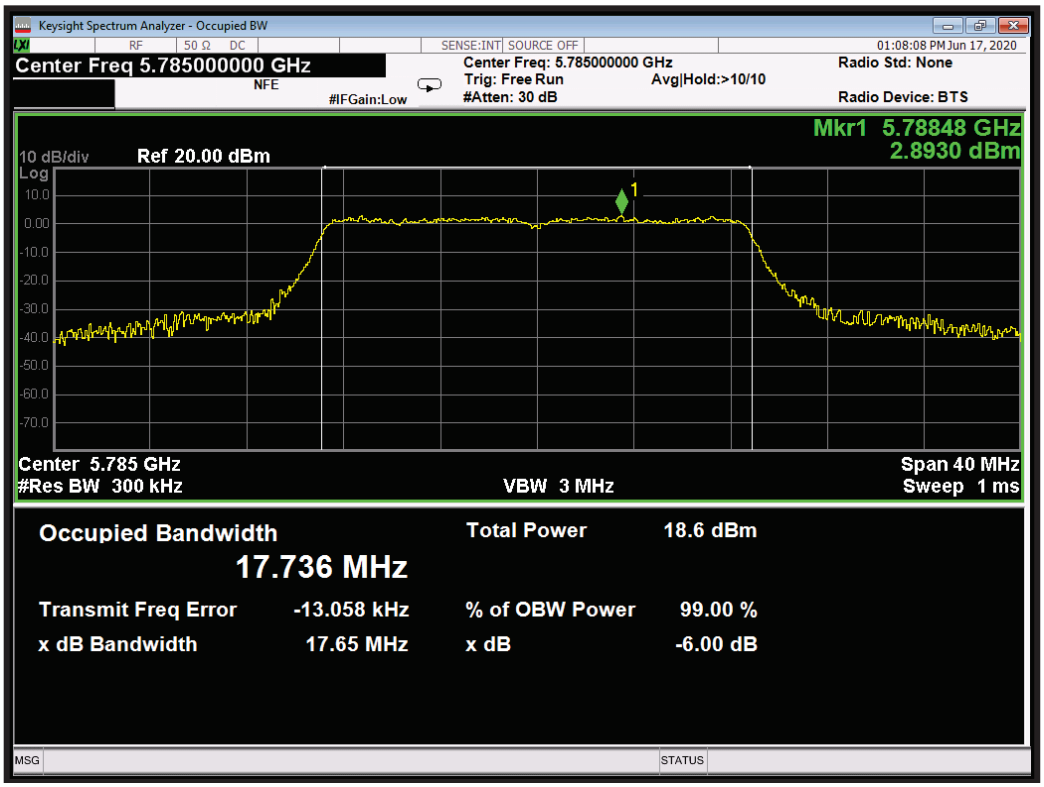
Modulation: 802.11n-40; Data rate: MCS0; Main Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5755	36.41	36.250	PASS
5795	36.43	36.219	PASS

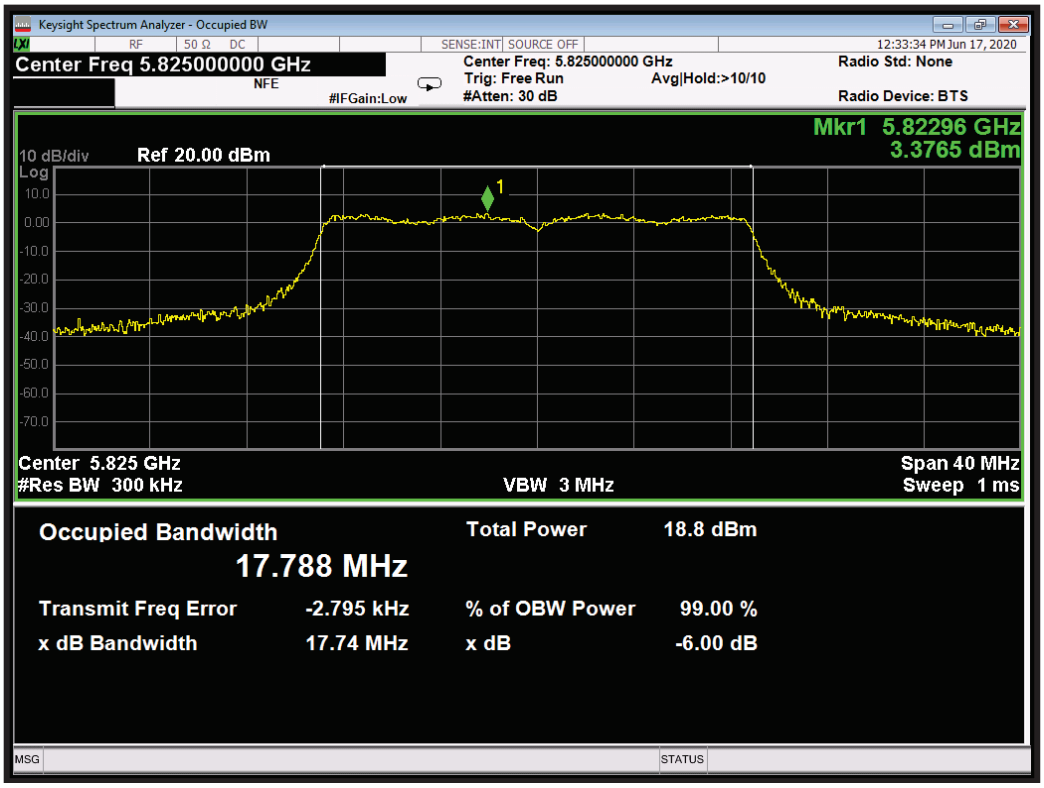




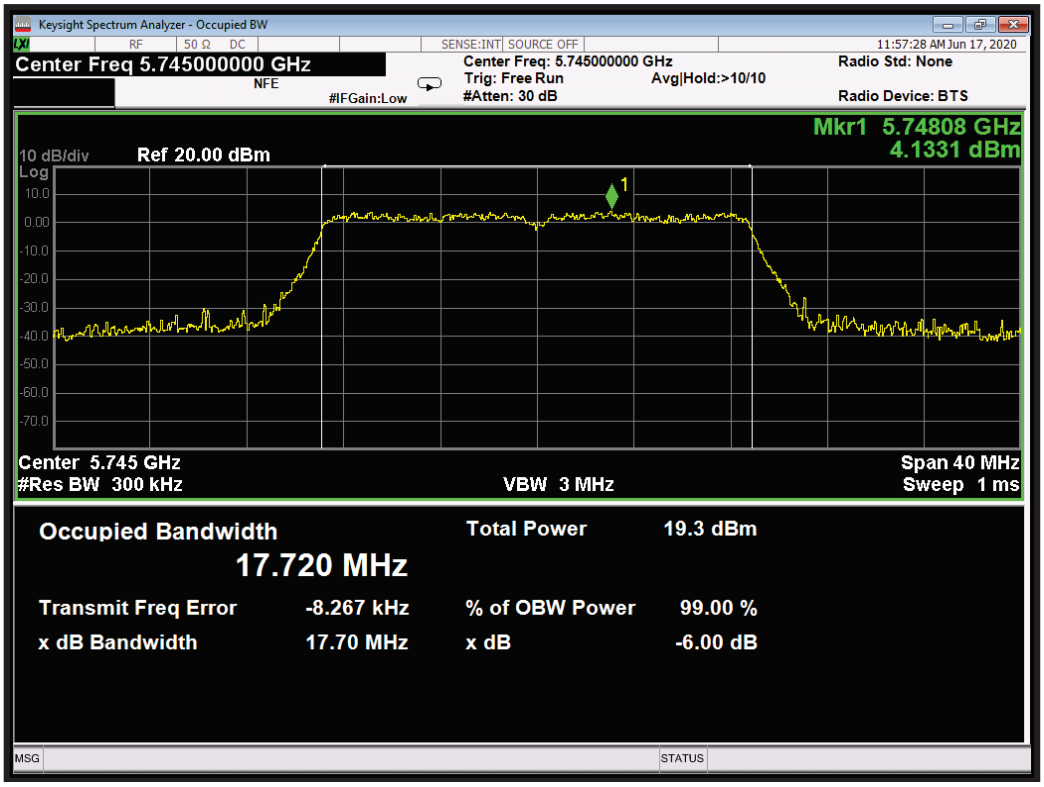
Modulation: 802.11ac-20; Data rate: MCS0 1SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.66	17.780	PASS
5785	17.65	17.736	PASS
5825	17.74	17.788	PASS

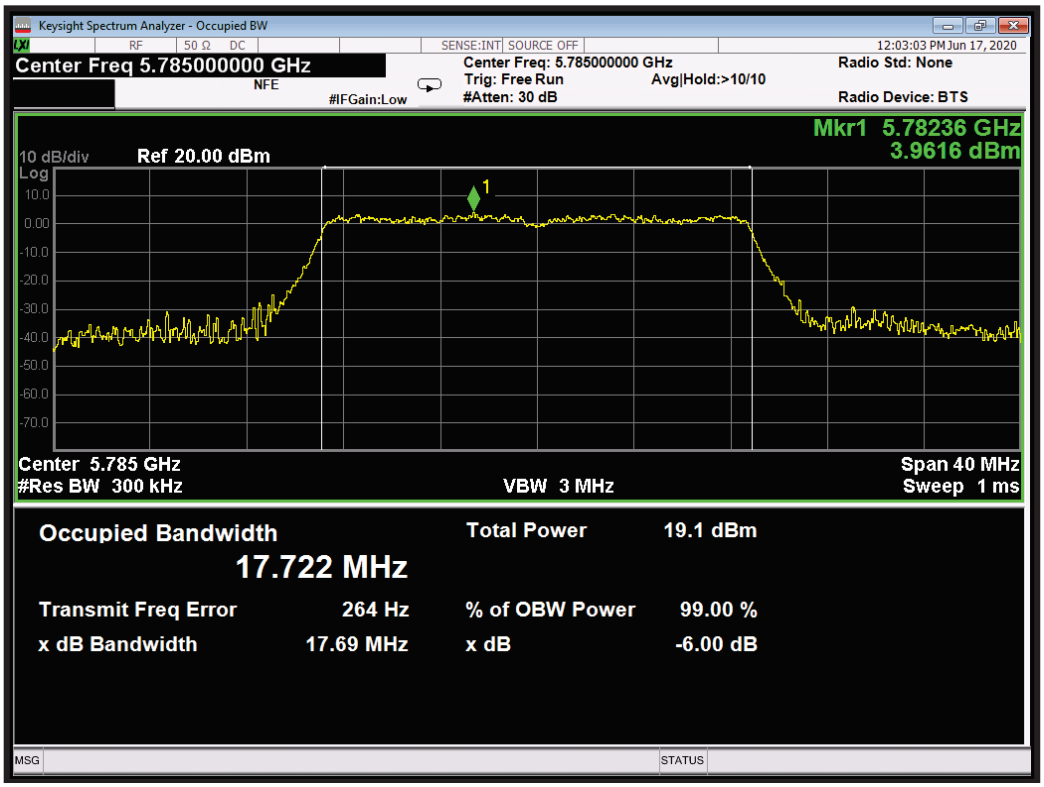


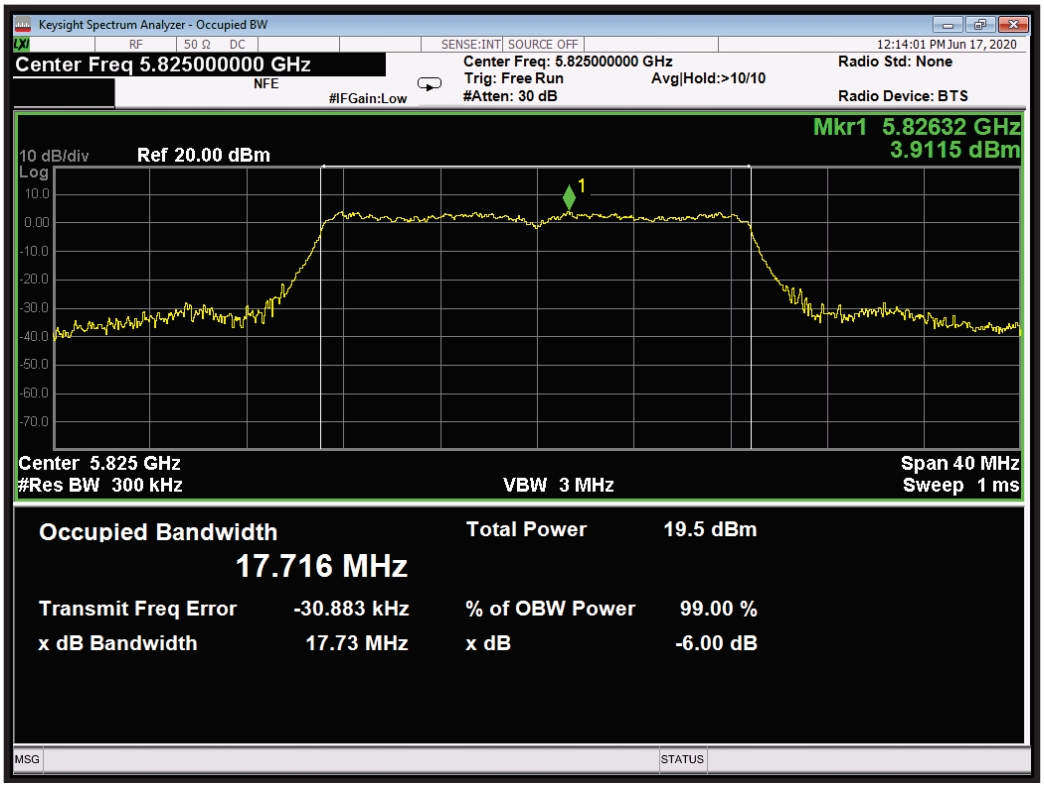



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT SOURCE OFF
12:33:34 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82296 GHz
3.3765 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.788 MHz
Total Power 18.8 dBm
Transmit Freq Error -2.795 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.74 MHz
x dB -6.00 dB
MSG
STATUS

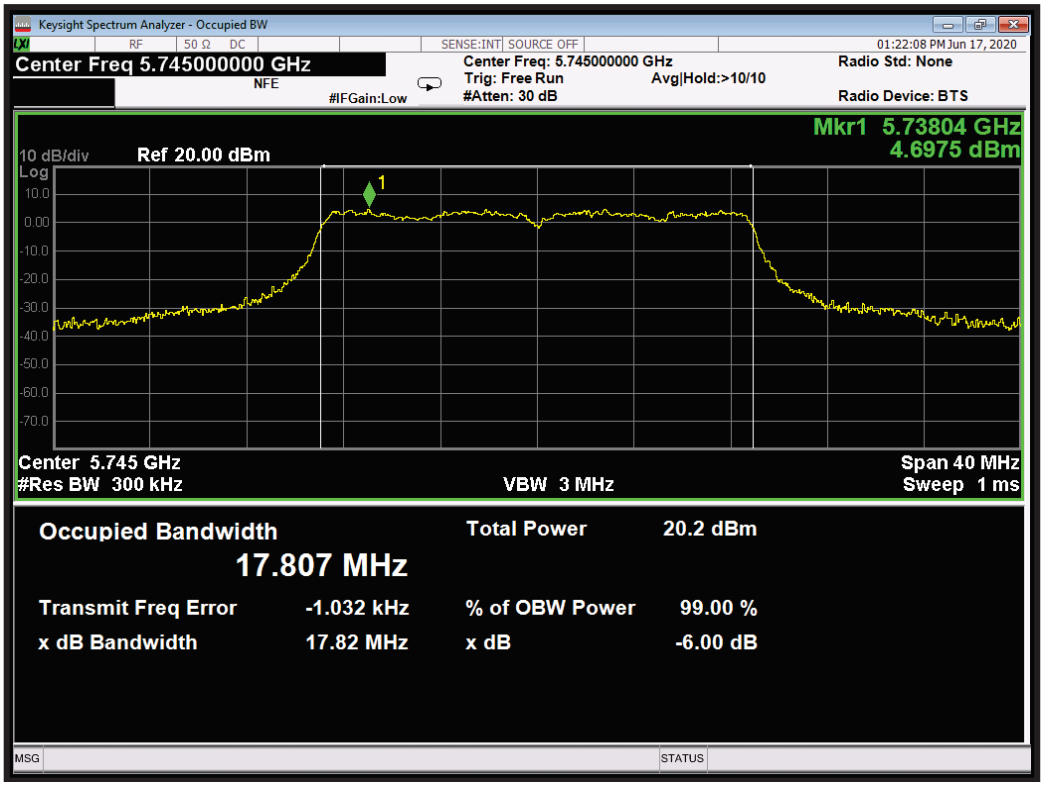
Modulation: 802.11ac-20; Data rate: MCS0 1SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.70	17.720	PASS
5785	17.69	17.722	PASS
5825	17.73	17.716	PASS

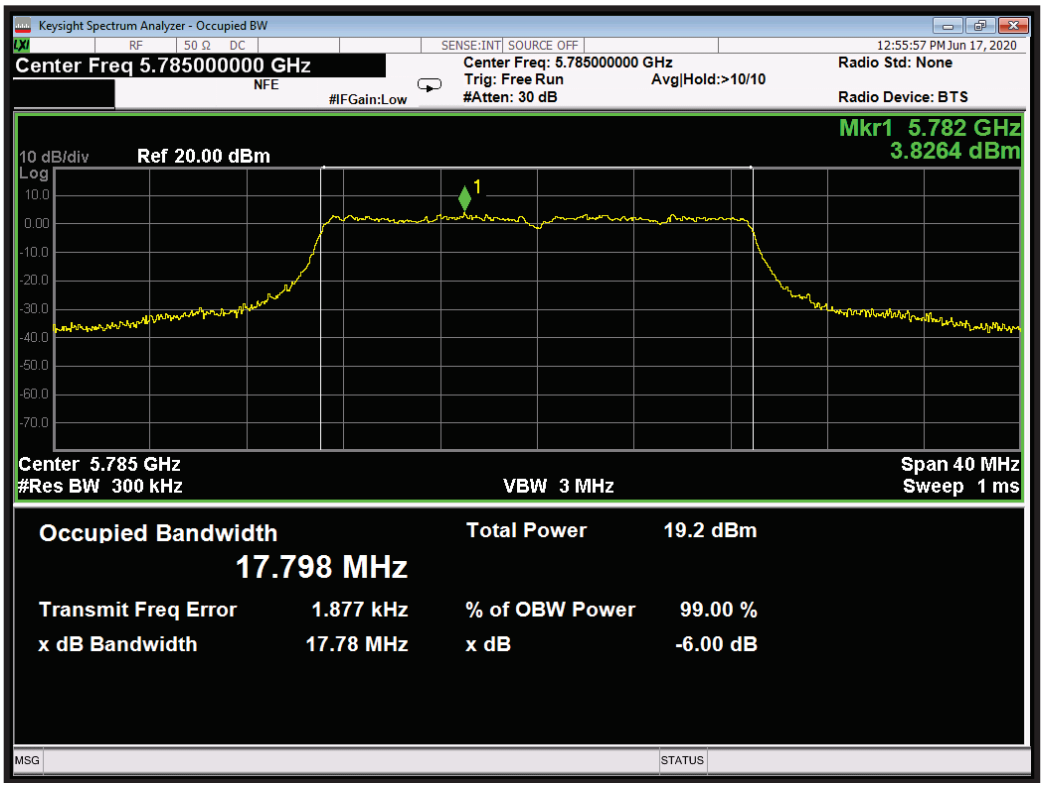


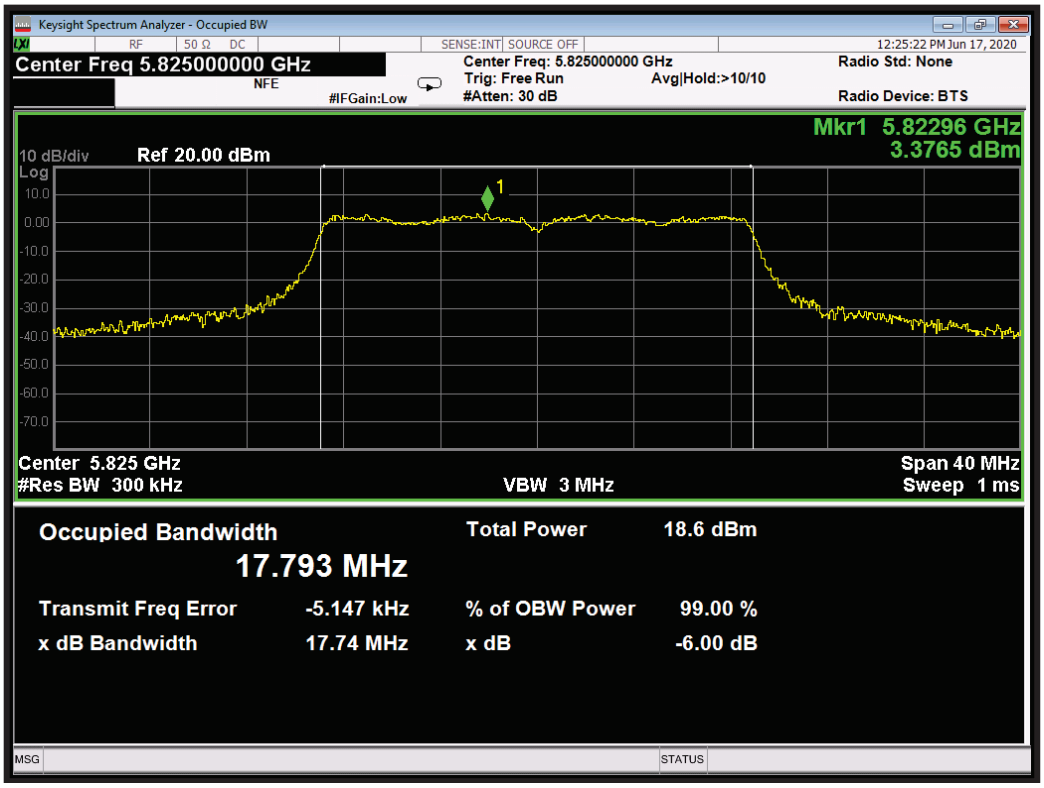



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
SOURCE OFF
12:14:01 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82632 GHz
3.9115 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.716 MHz
Total Power 19.5 dBm
Transmit Freq Error -30.883 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.73 MHz
x dB -6.00 dB
MSG
STATUS

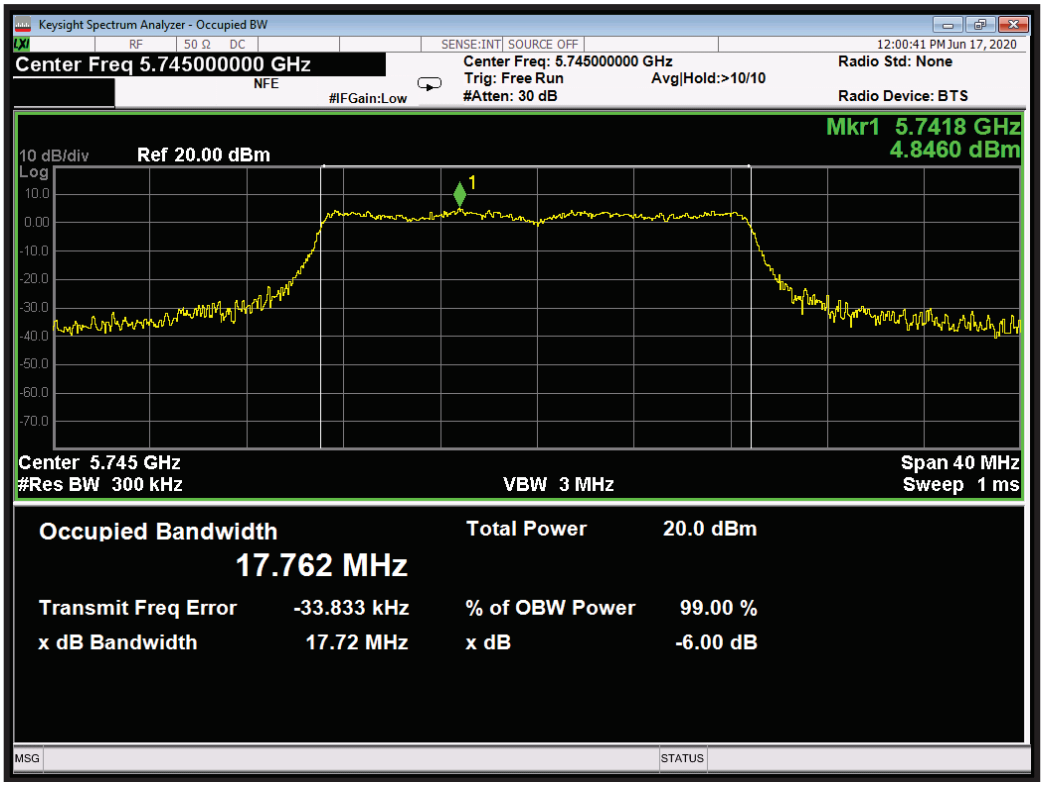
Modulation: 802.11ac-20; Data rate: MCS8 1SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.82	17.807	PASS
5785	17.78	17.798	PASS
5825	17.74	17.793	PASS

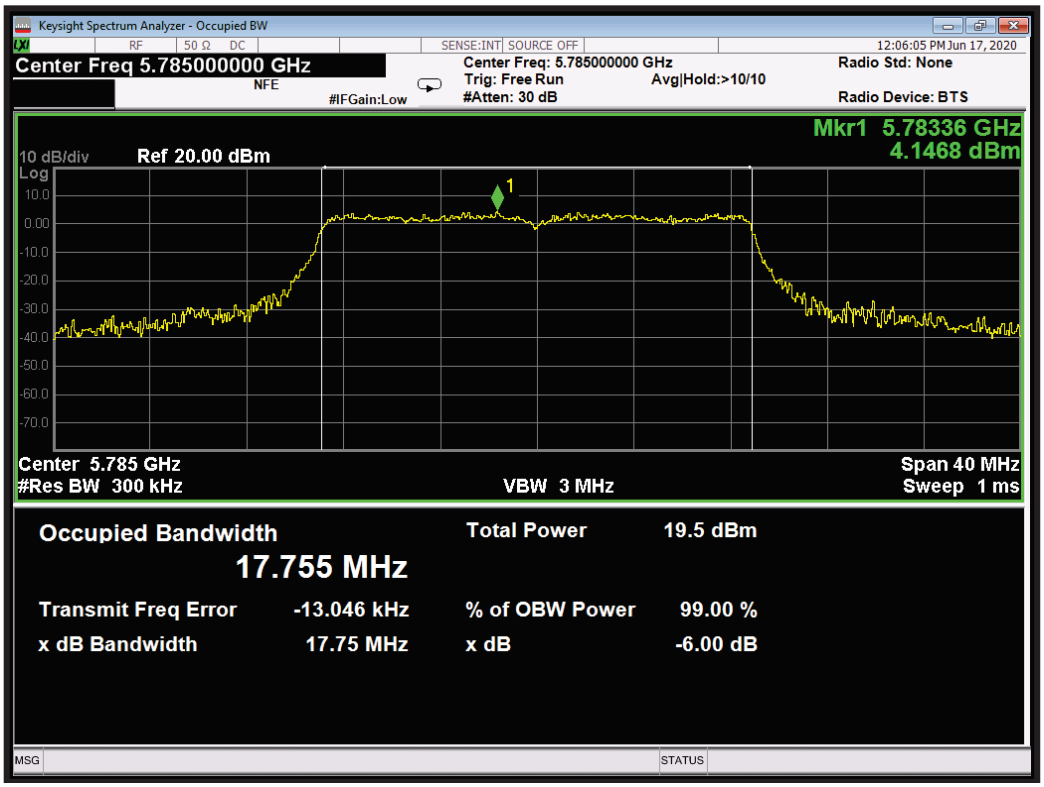


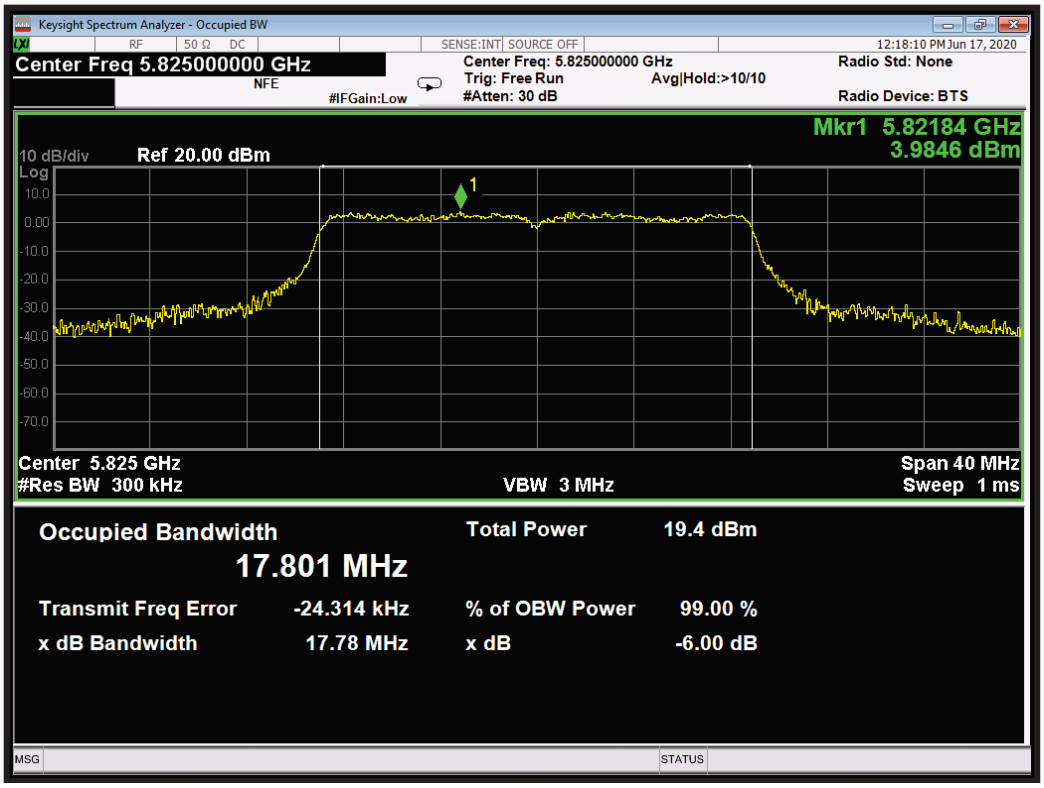



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT SOURCE OFF
12:25:22 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82296 GHz
3.3765 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.793 MHz
Total Power 18.6 dBm
Transmit Freq Error -5.147 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.74 MHz
x dB -6.00 dB
MSG
STATUS

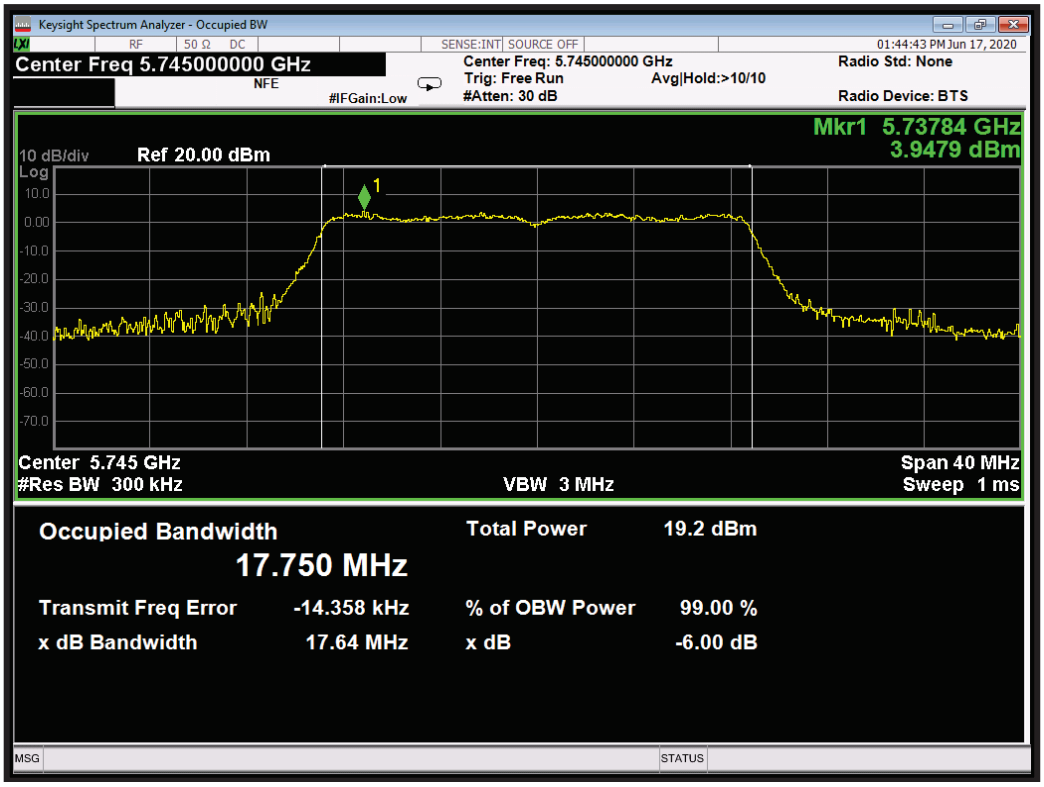
Modulation: 802.11ac-20; Data rate: MCS8 1SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.72	17.762	PASS
5785	17.75	17.755	PASS
5825	17.78	17.801	PASS

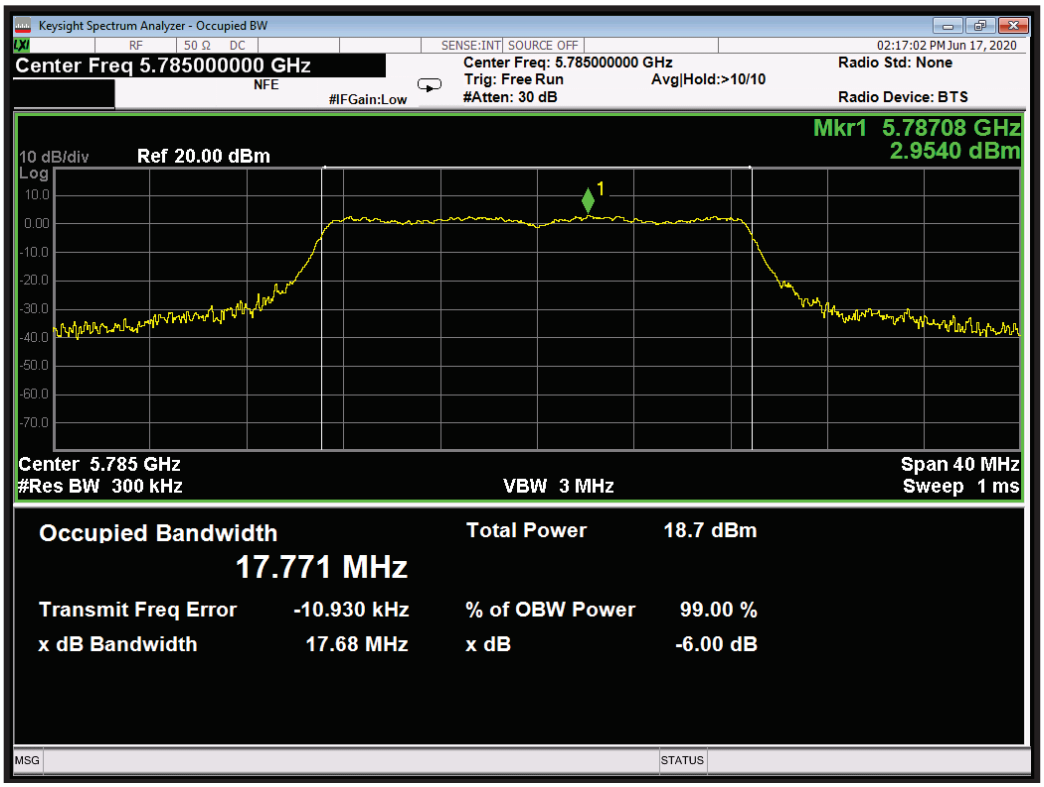


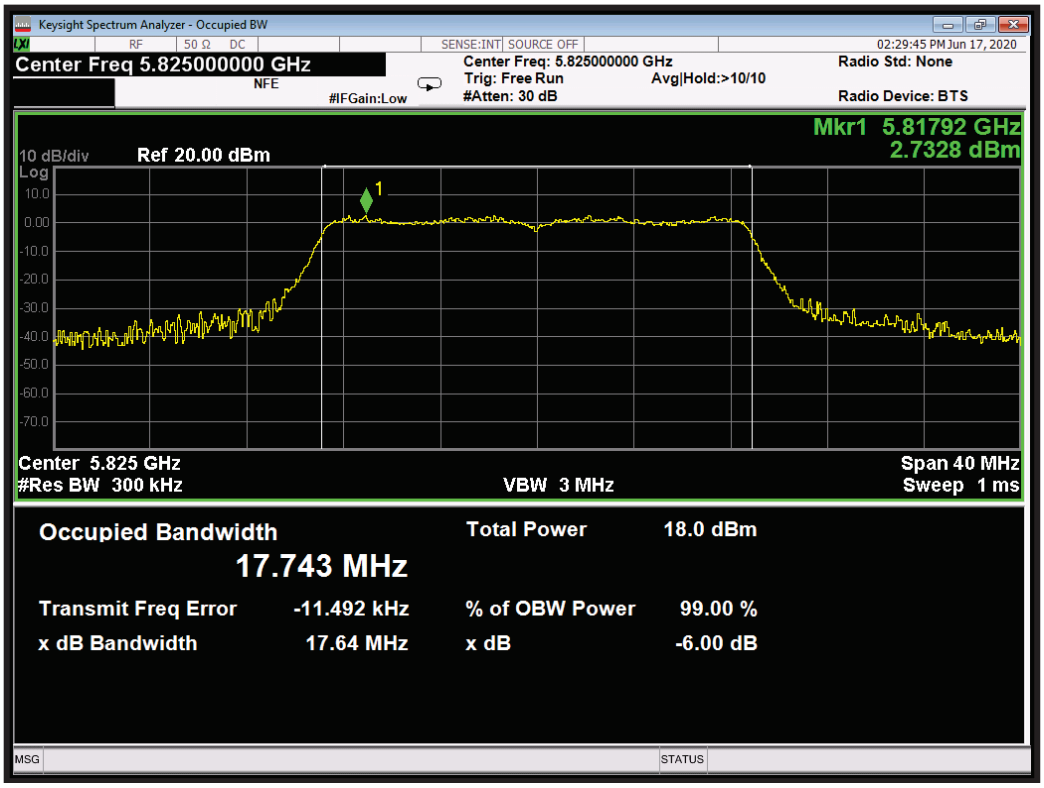



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
SOURCE OFF
12:18:10 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82184 GHz
3.9846 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.801 MHz
Total Power 19.4 dBm
Transmit Freq Error -24.314 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.78 MHz
x dB -6.00 dB
MSG
STATUS

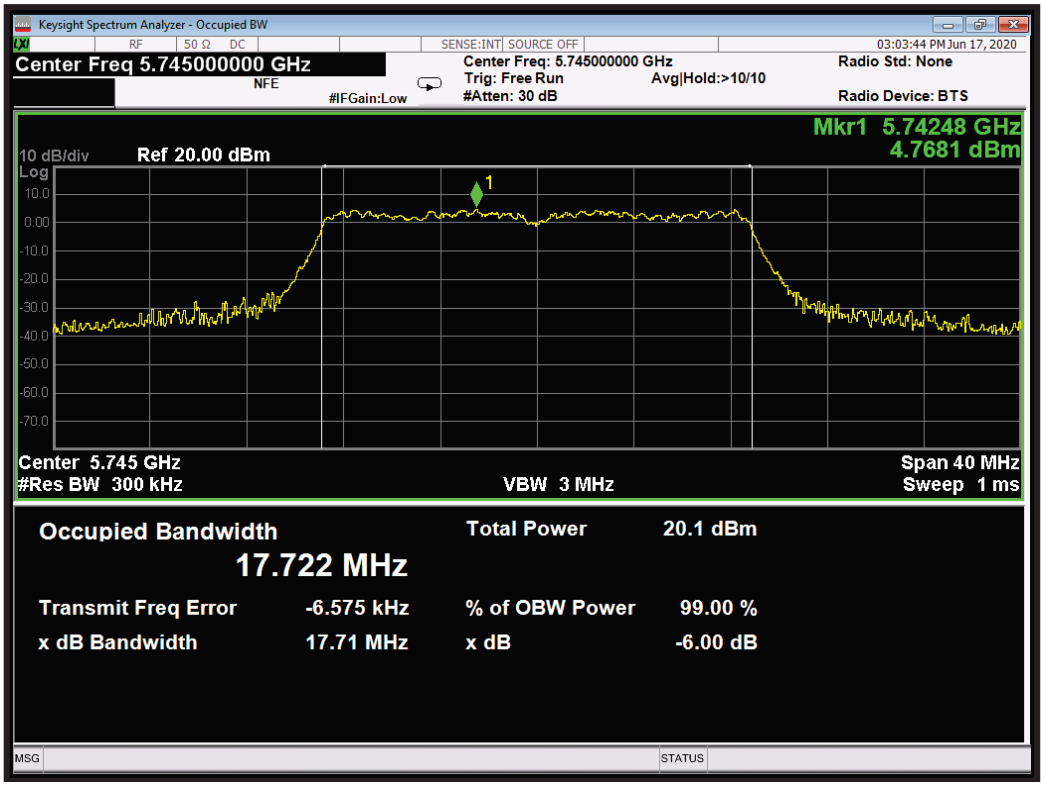
Modulation: 802.11ac-20; Data rate: MCS0 2SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.64	17.750	PASS
5785	17.68	17.771	PASS
5825	17.64	17.743	PASS

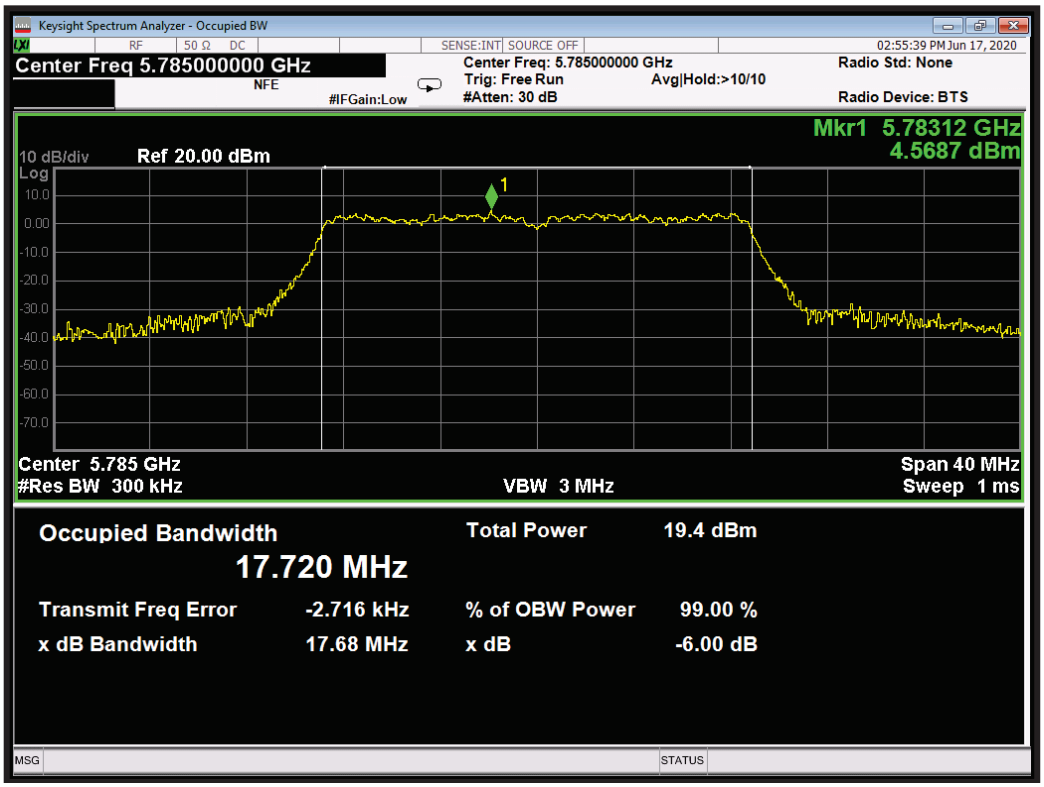


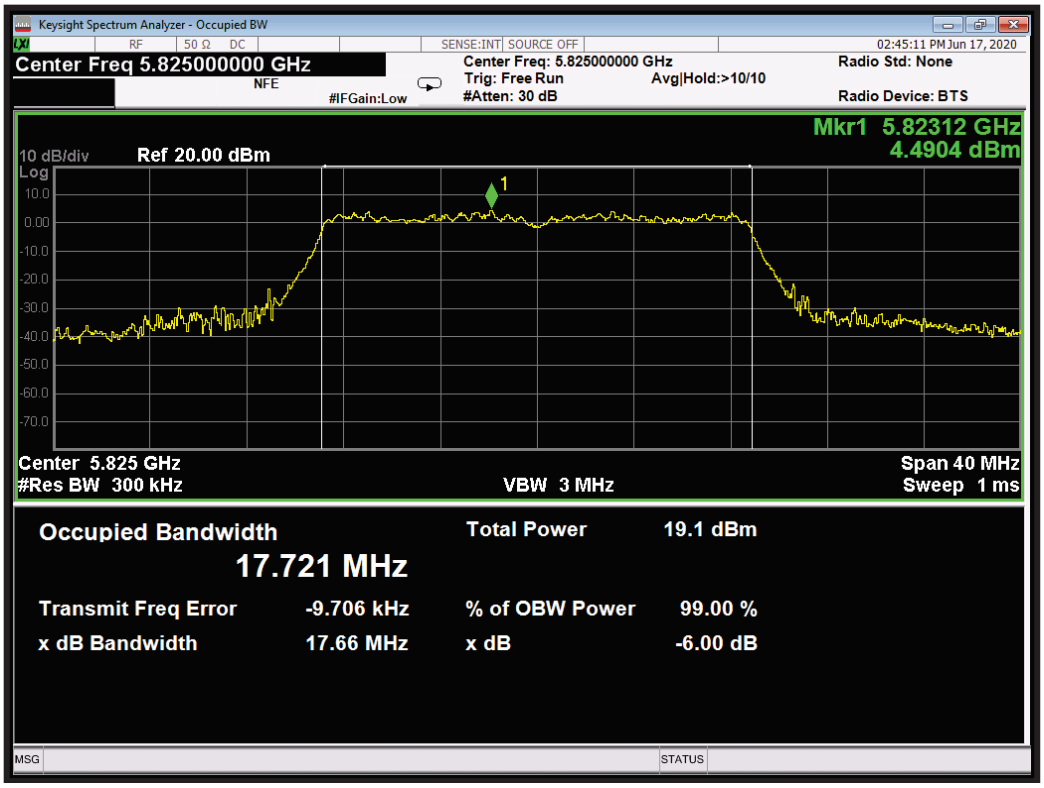



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT SOURCE OFF
02:29:45 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.81792 GHz
2.7328 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.743 MHz
Total Power 18.0 dBm
Transmit Freq Error -11.492 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.64 MHz
x dB -6.00 dB
MSG
STATUS

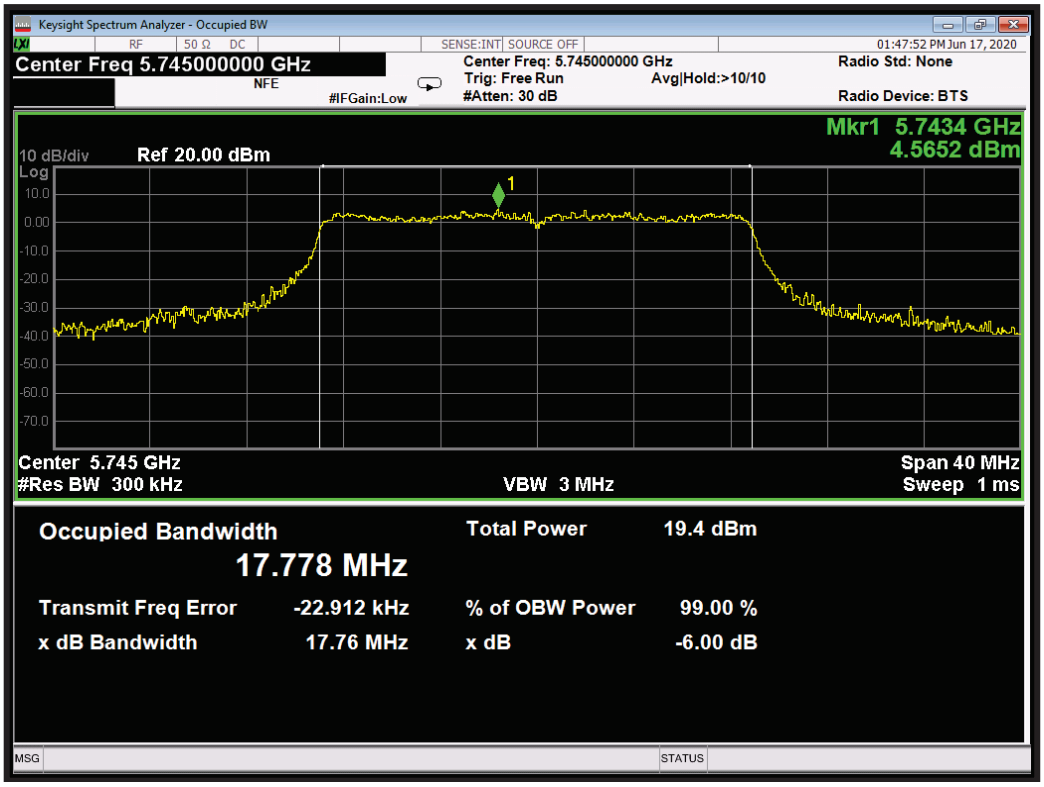
Modulation: 802.11ac-20; Data rate: MCS0 2SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.71	17.722	PASS
5785	17.68	17.720	PASS
5825	17.66	17.721	PASS

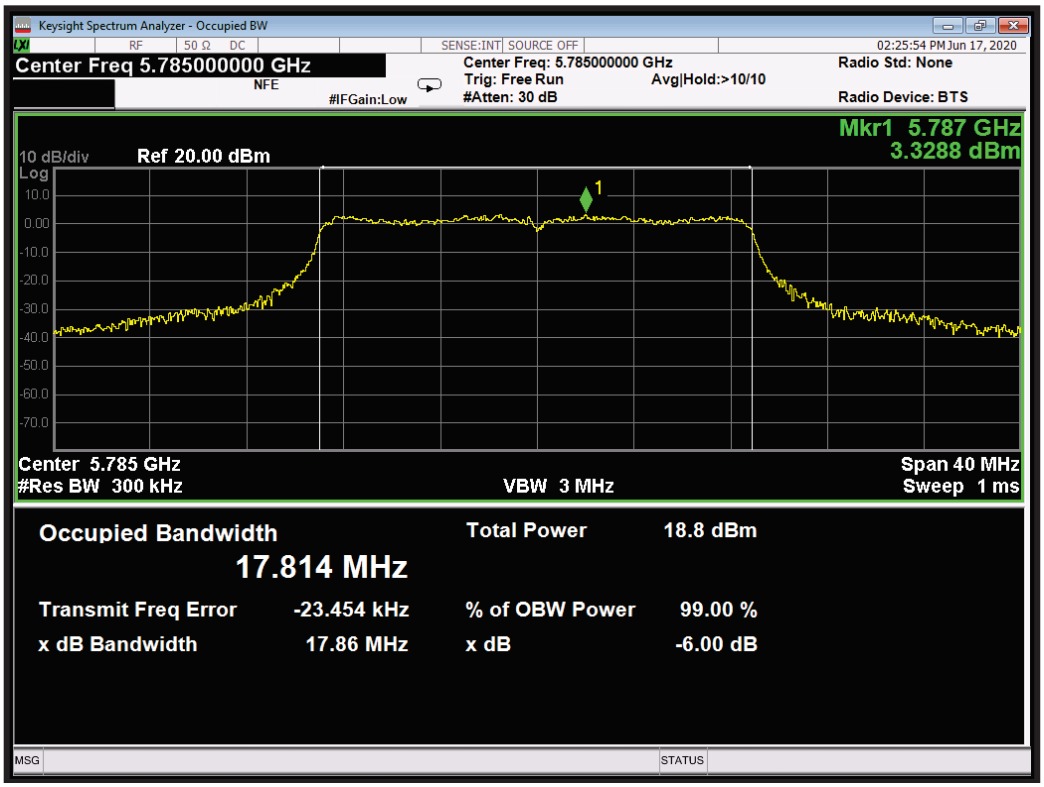


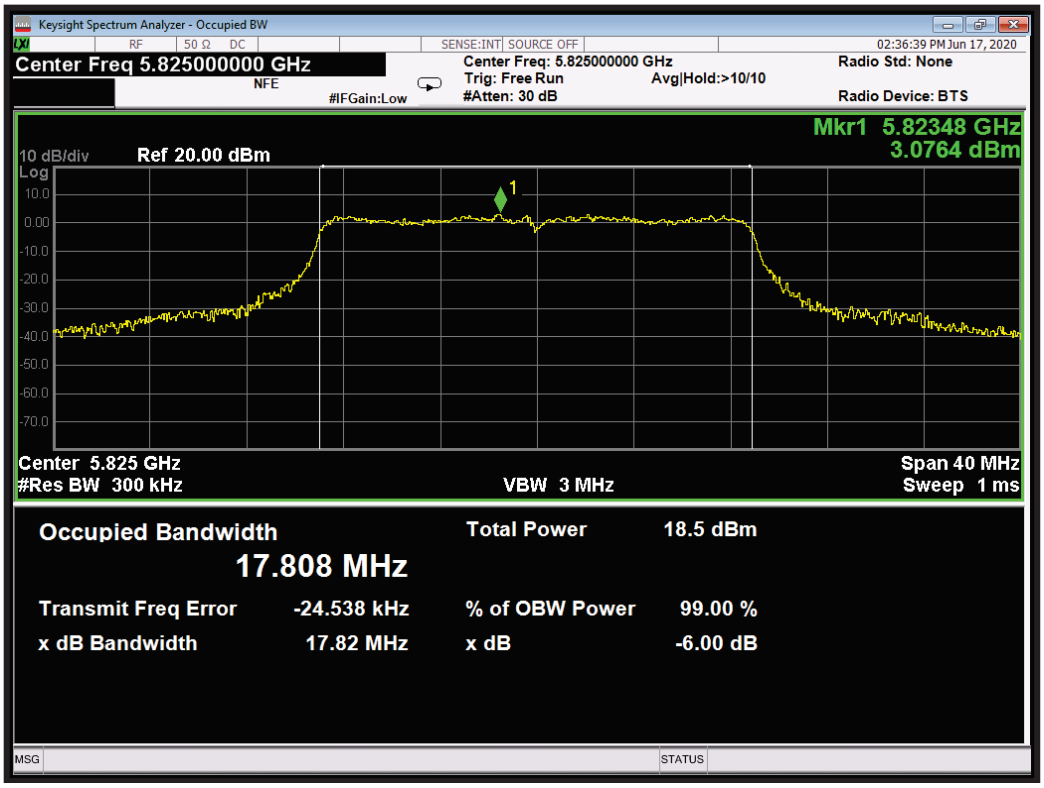



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT SOURCE OFF
02:45:11 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82312 GHz
4.4904 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.721 MHz
Total Power 19.1 dBm
Transmit Freq Error -9.706 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.66 MHz
x dB -6.00 dB
MSG
STATUS

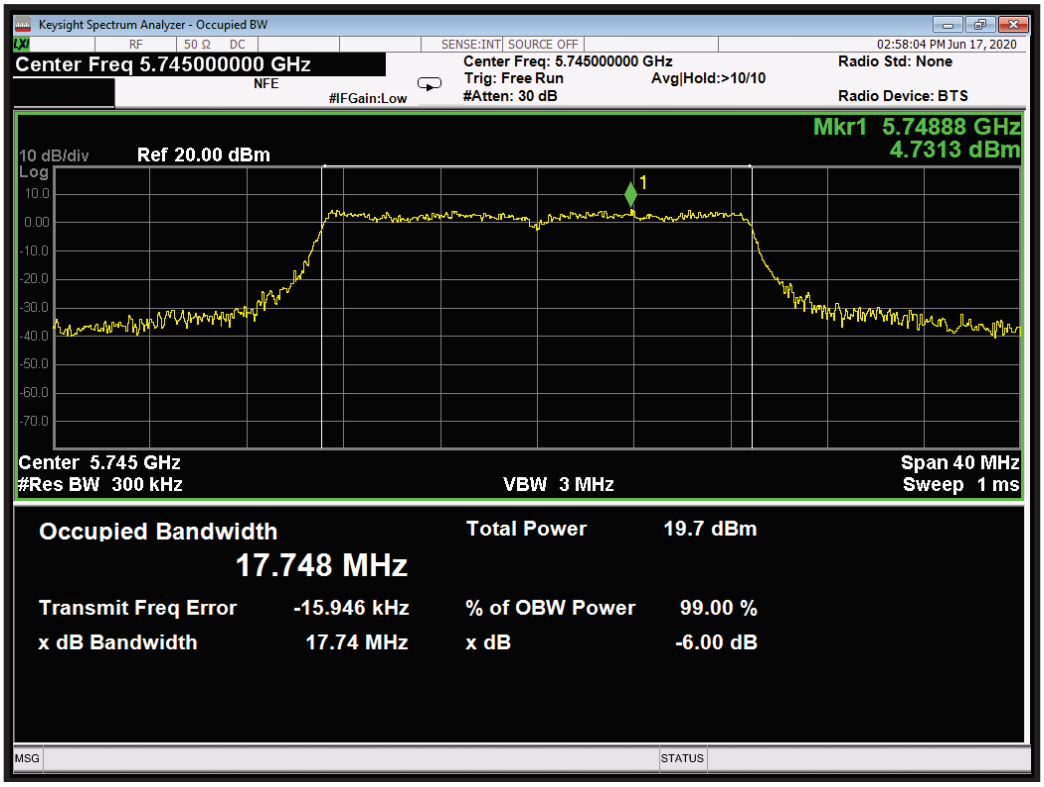
Modulation: 802.11ac-20; Data rate: MCS8 2SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.76	17.778	PASS
5785	17.86	17.814	PASS
5825	17.82	17.808	PASS

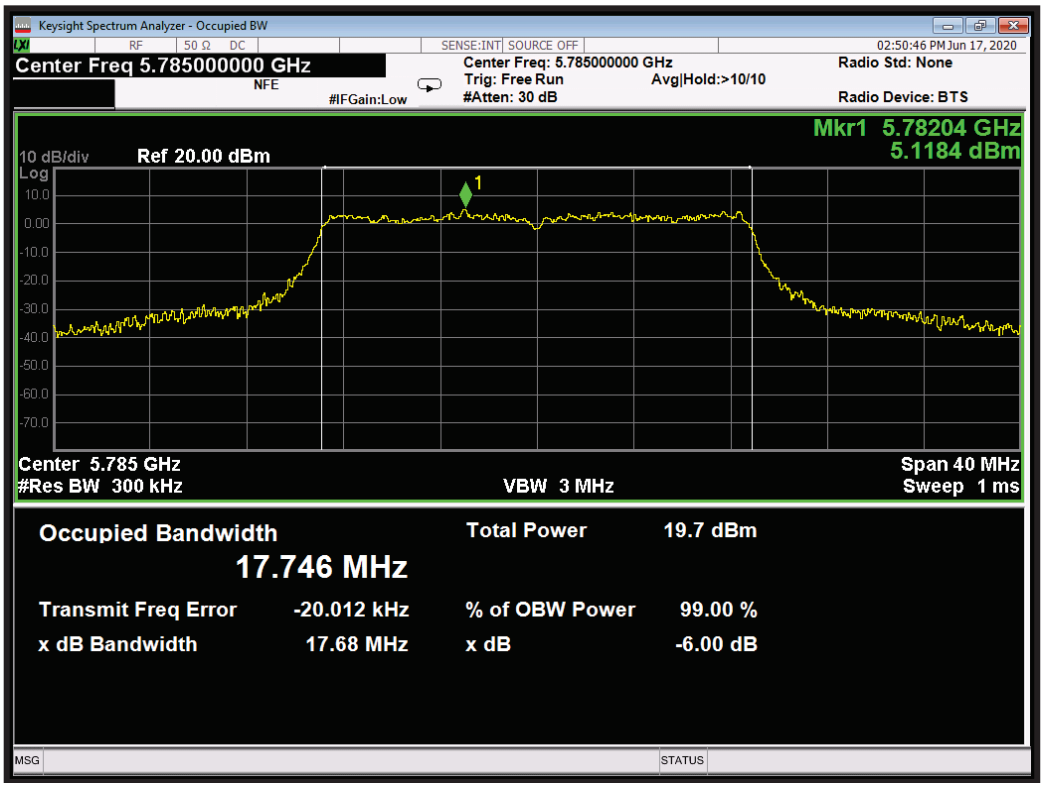


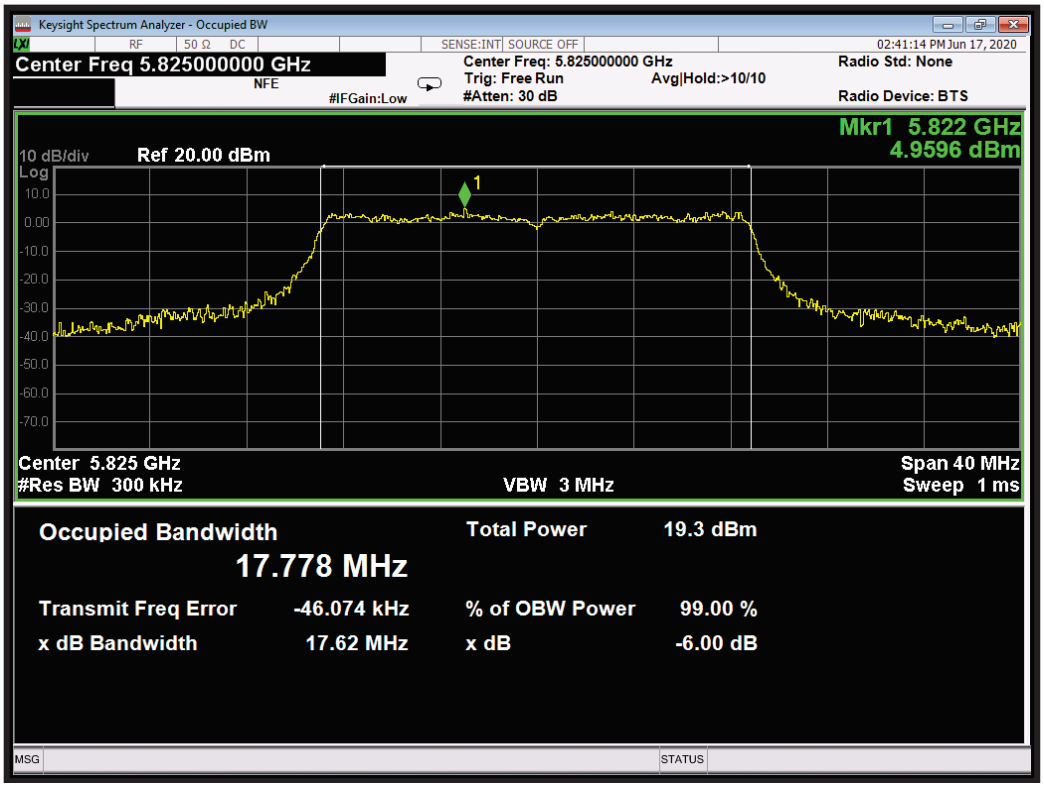



Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
SOURCE OFF
02:36:39 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.82348 GHz
3.0764 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.808 MHz
Total Power 18.5 dBm
Transmit Freq Error -24.538 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.82 MHz
x dB -6.00 dB
MSG
STATUS

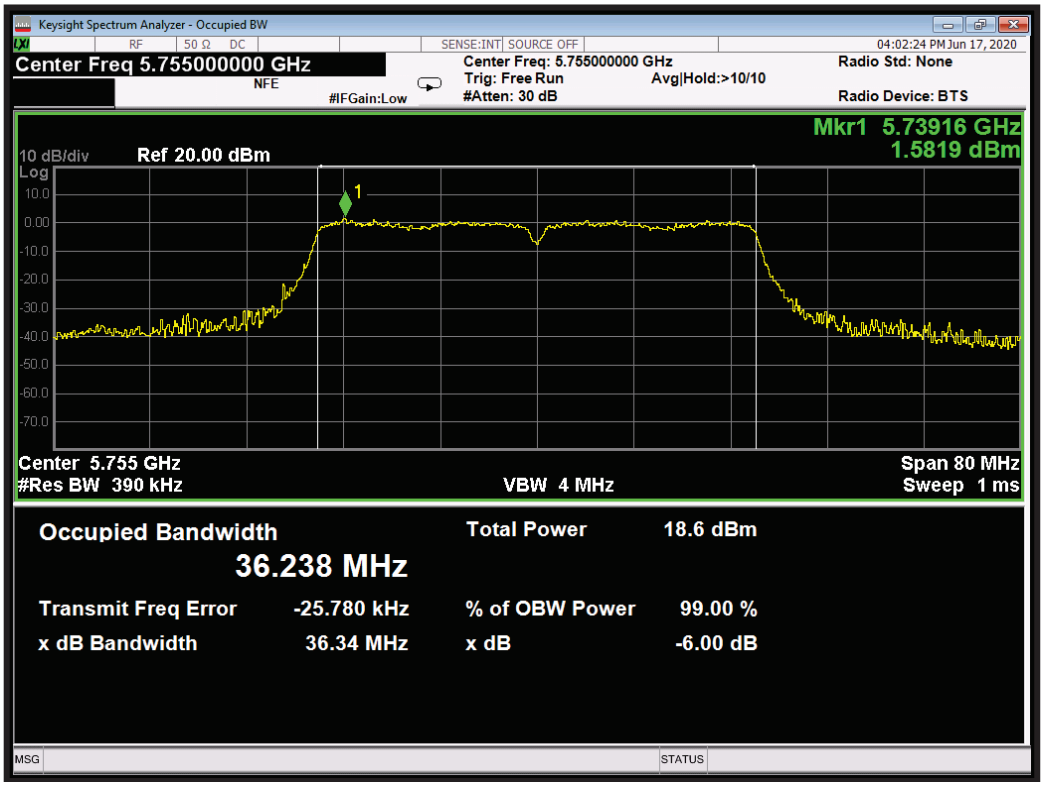
Modulation: 802.11ac-20; Data rate: MCS8 2SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5745	17.74	17.748	PASS
5785	17.68	17.746	PASS
5825	17.62	17.778	PASS

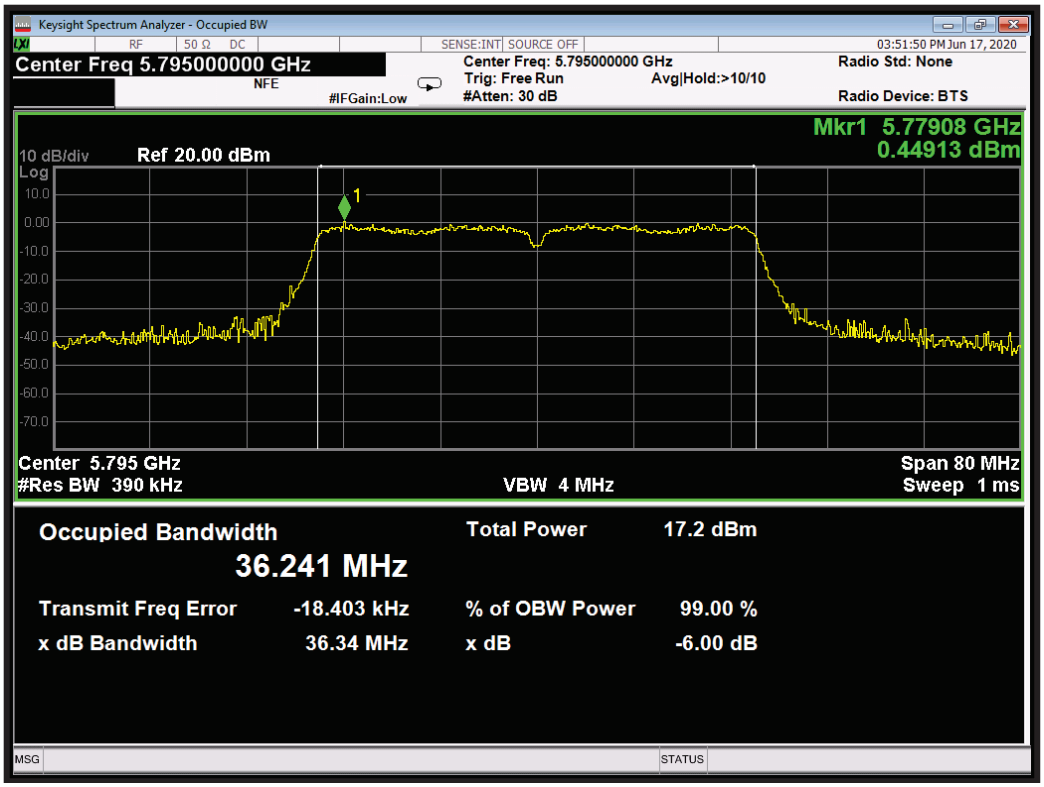




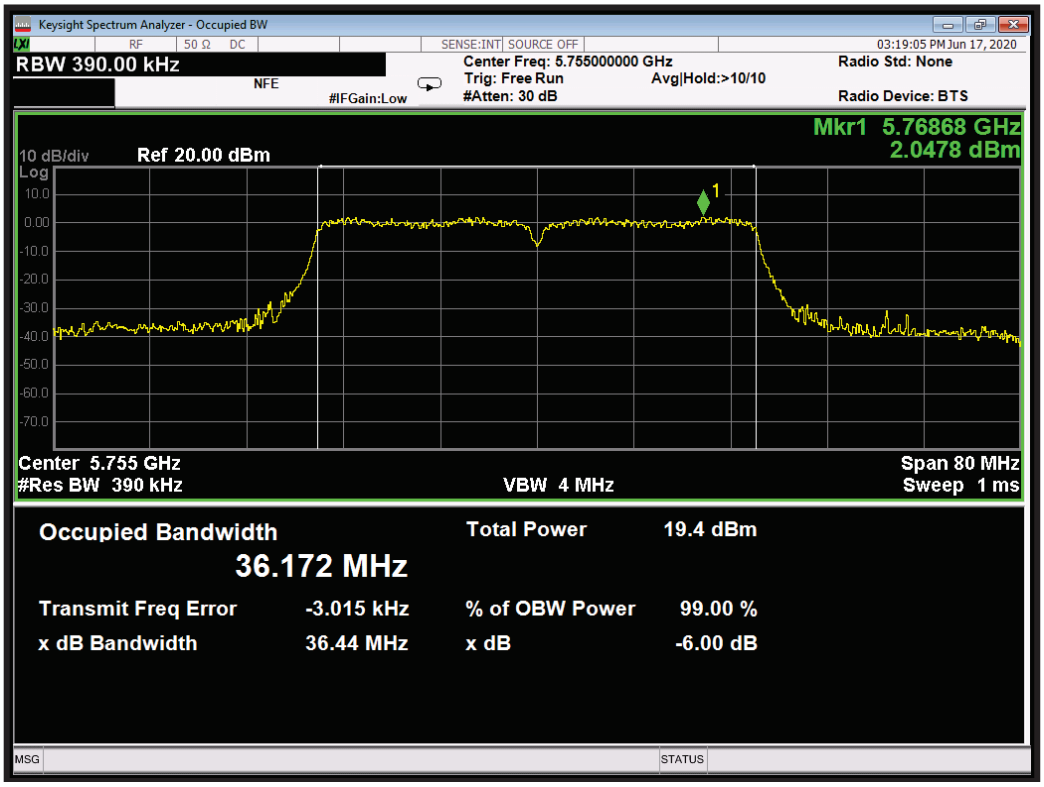

Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT SOURCE OFF
02:41:14 PM Jun 17, 2020
Center Freq 5.825000000 GHz
NFE
#IFGain:Low
Center Freq: 5.825000000 GHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 30 dB
Radio Std: None
Radio Device: BTS
Mkr1 5.822 GHz
4.9596 dBm
10 dB/div
Log
Ref 20.00 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
Center 5.825 GHz
#Res BW 300 kHz
VBW 3 MHz
Span 40 MHz
Sweep 1 ms
Occupied Bandwidth
17.778 MHz
Total Power 19.3 dBm
Transmit Freq Error -46.074 kHz
% of OBW Power 99.00 %
x dB Bandwidth 17.62 MHz
x dB -6.00 dB
MSG
STATUS

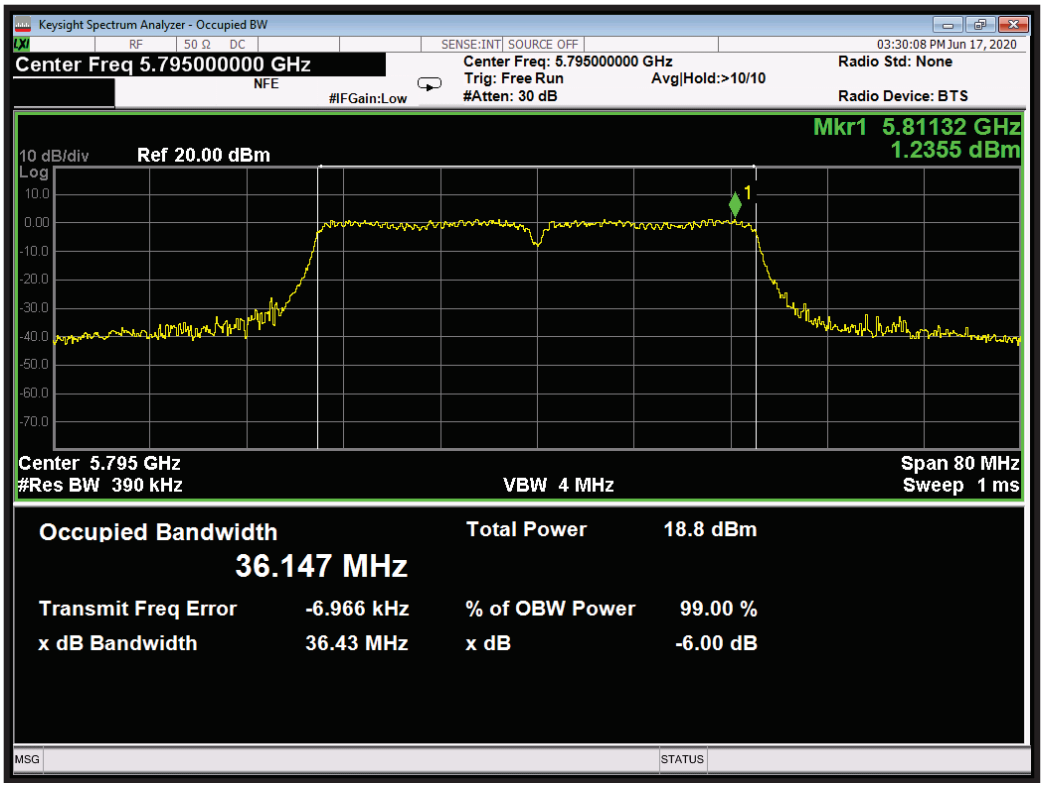
Modulation: 802.11ac-40; Data rate: MCS0 1SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.34	36.238	PASS
5795	36.34	36.241	PASS



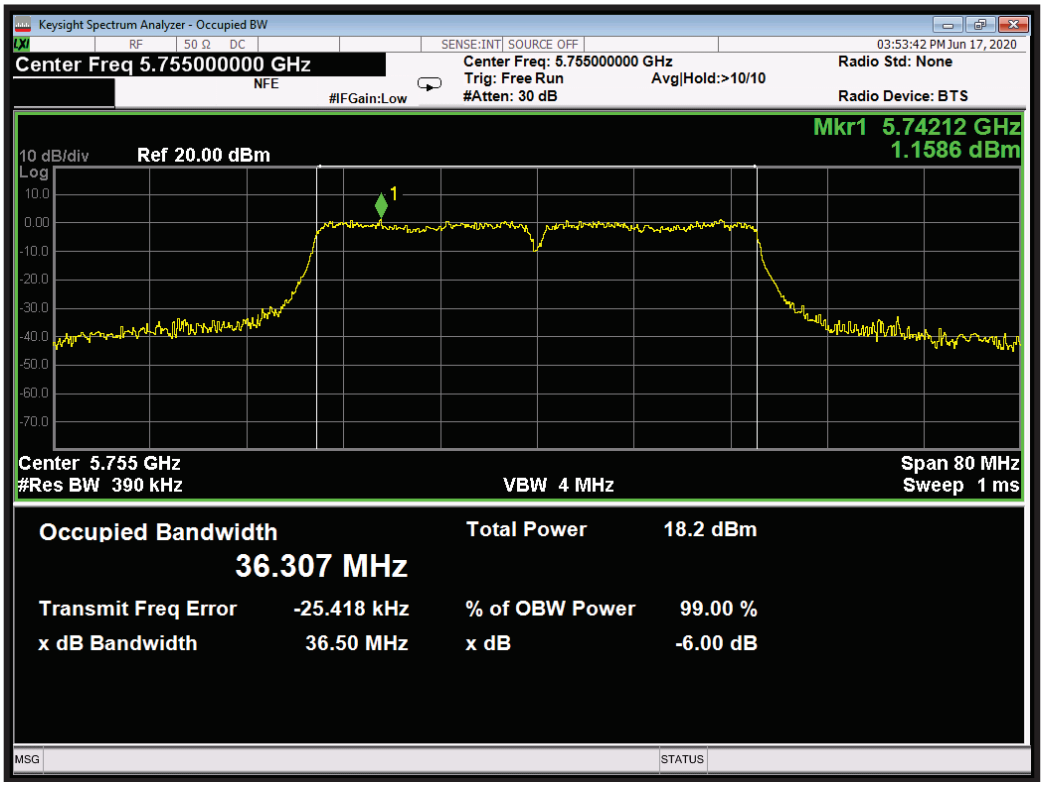


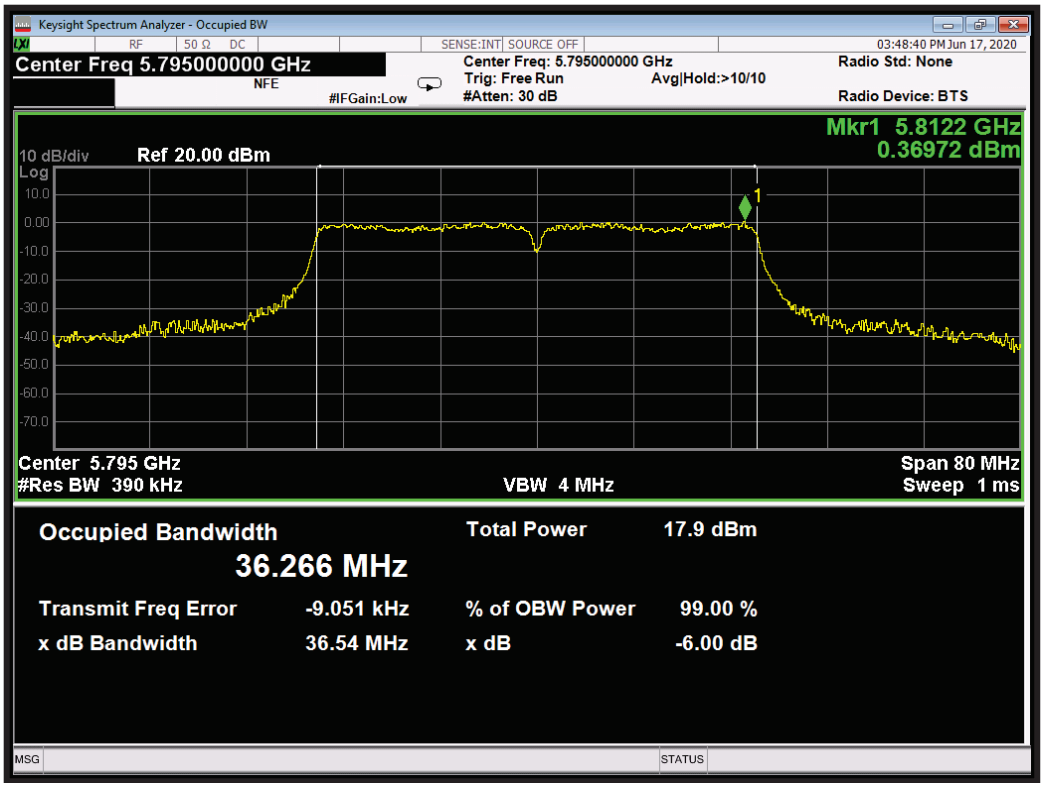
Modulation: 802.11ac-40; Data rate: MCS0 1SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.44	36.172	PASS
5795	36.43	36.147	PASS



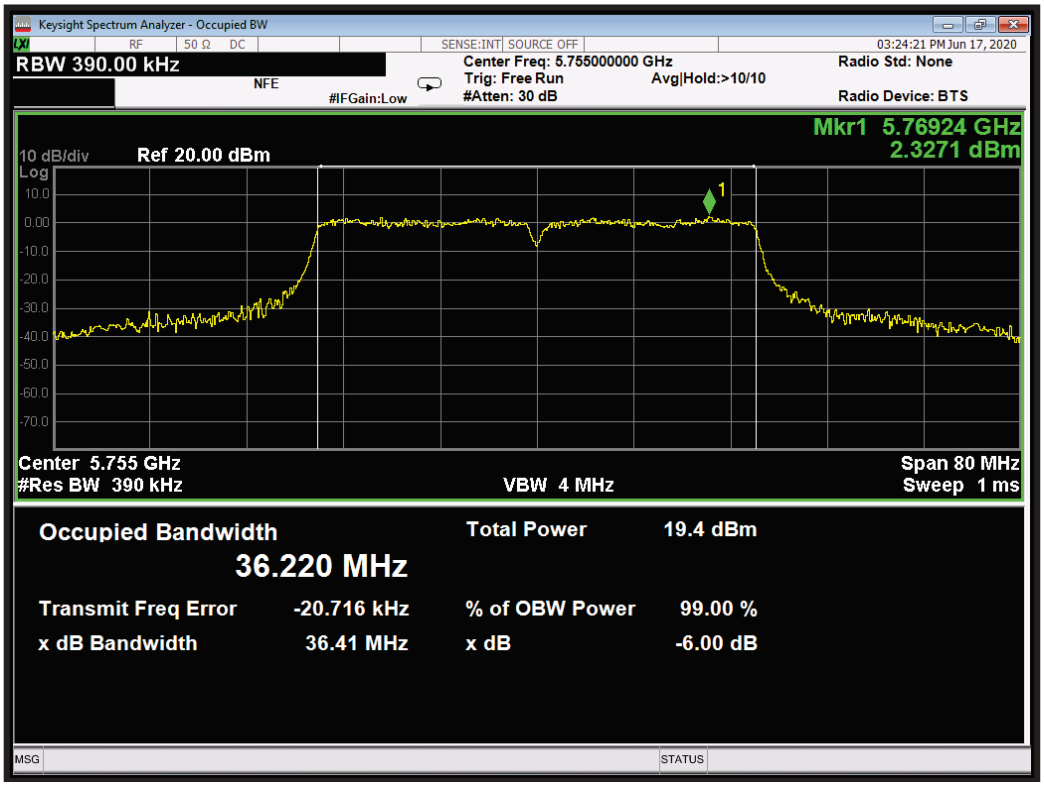


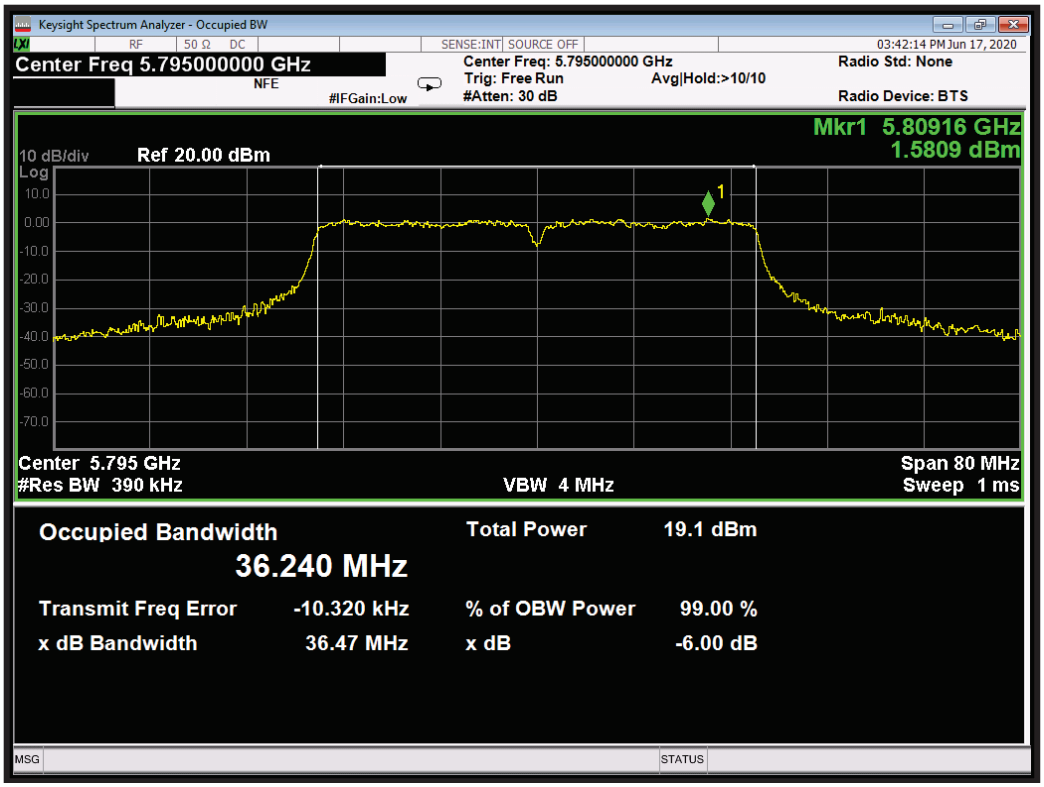
Modulation: 802.11ac-40; Data rate: MCS9 1SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.50	36.307	PASS
5795	36.54	36.266	PASS



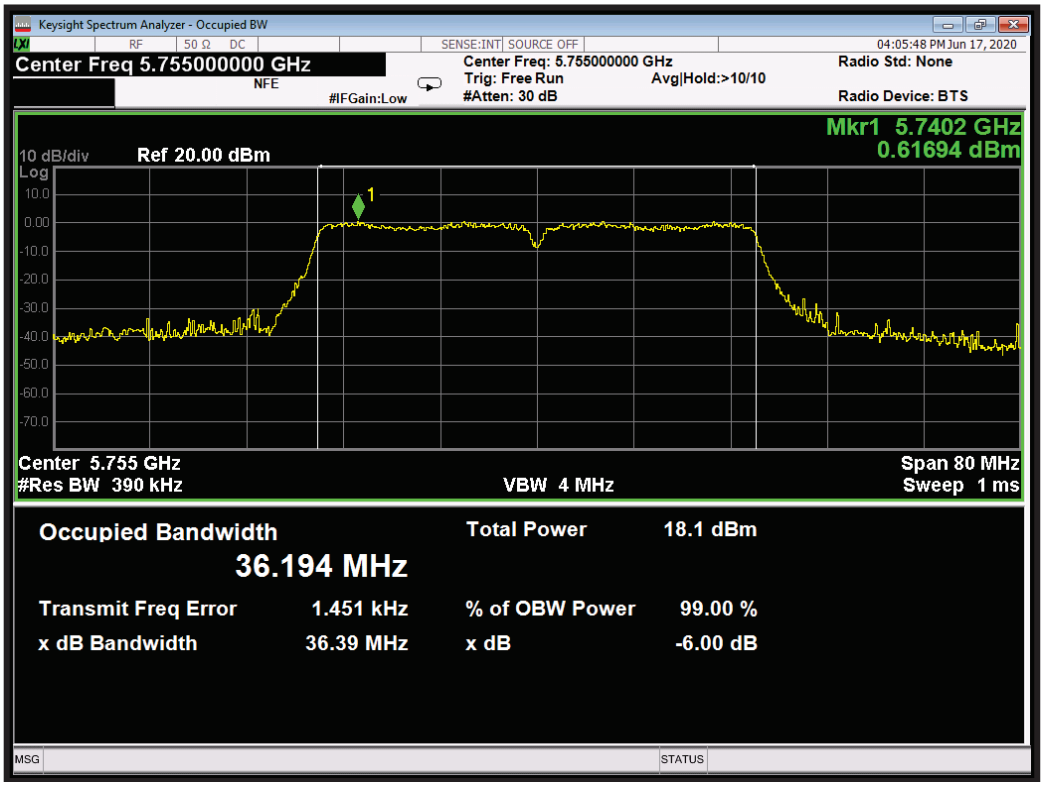


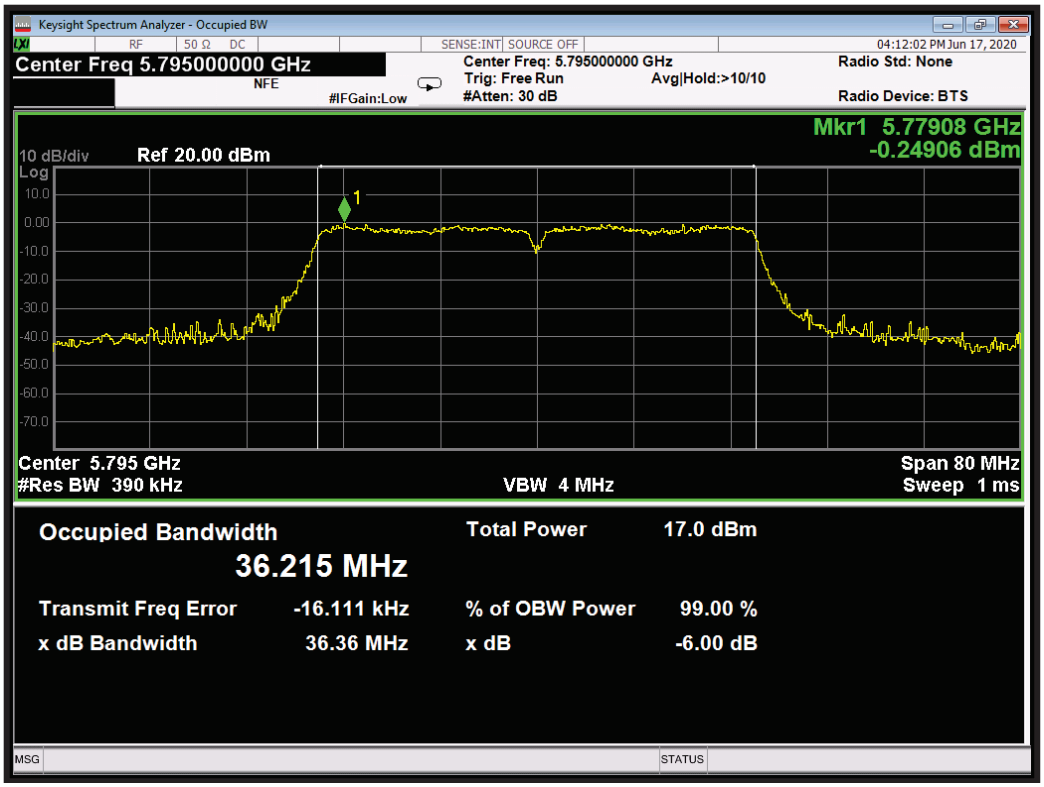
Modulation: 802.11ac-40; Data rate: MCS9 1SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.41	36.220	PASS
5795	36.47	36.240	PASS



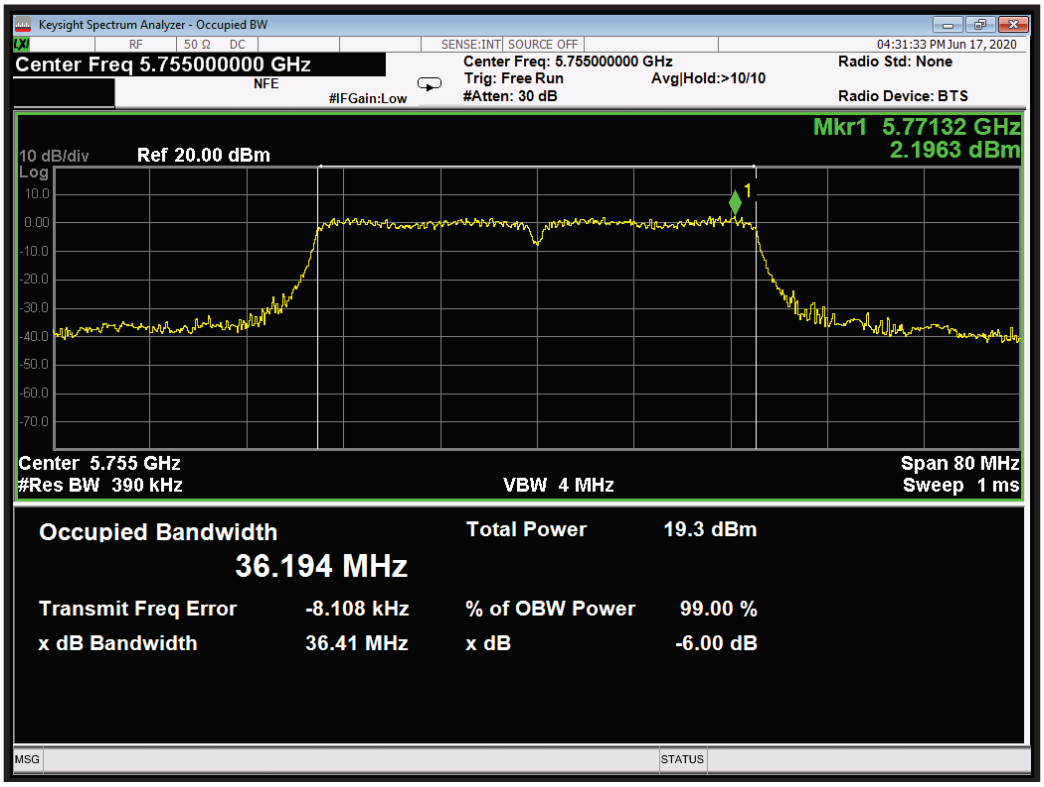


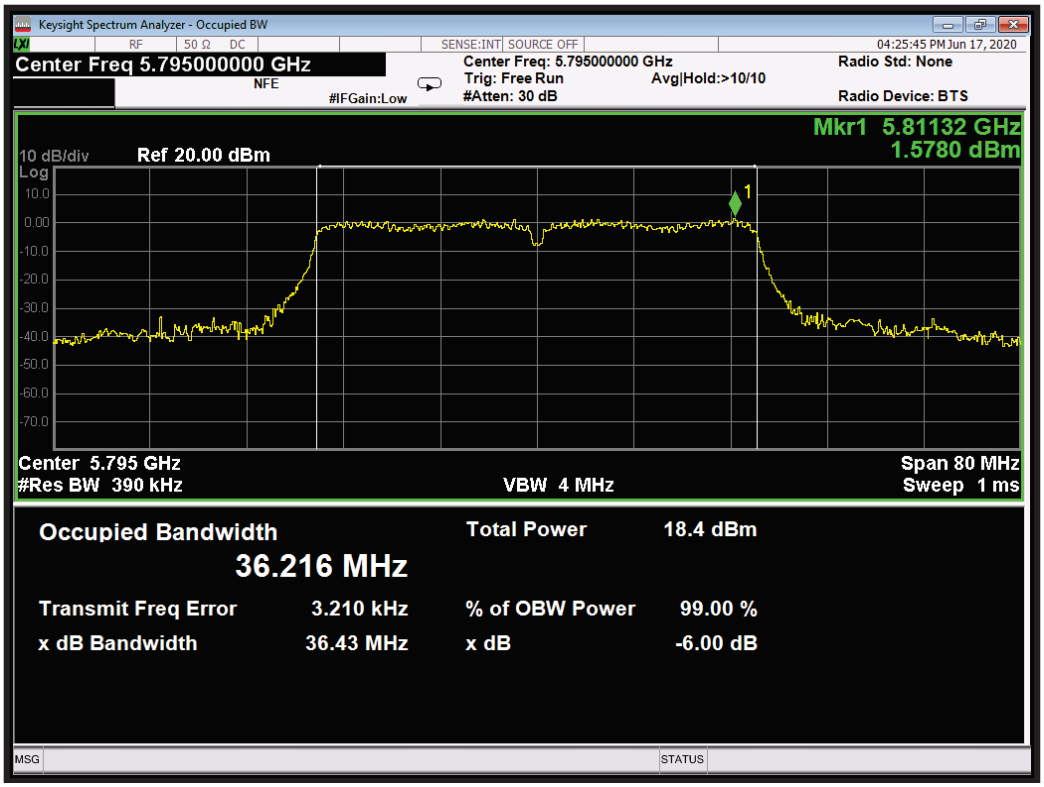
Modulation: 802.11ac-40; Data rate: MCS0 2SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.39	36.194	PASS
5795	36.36	36.215	PASS



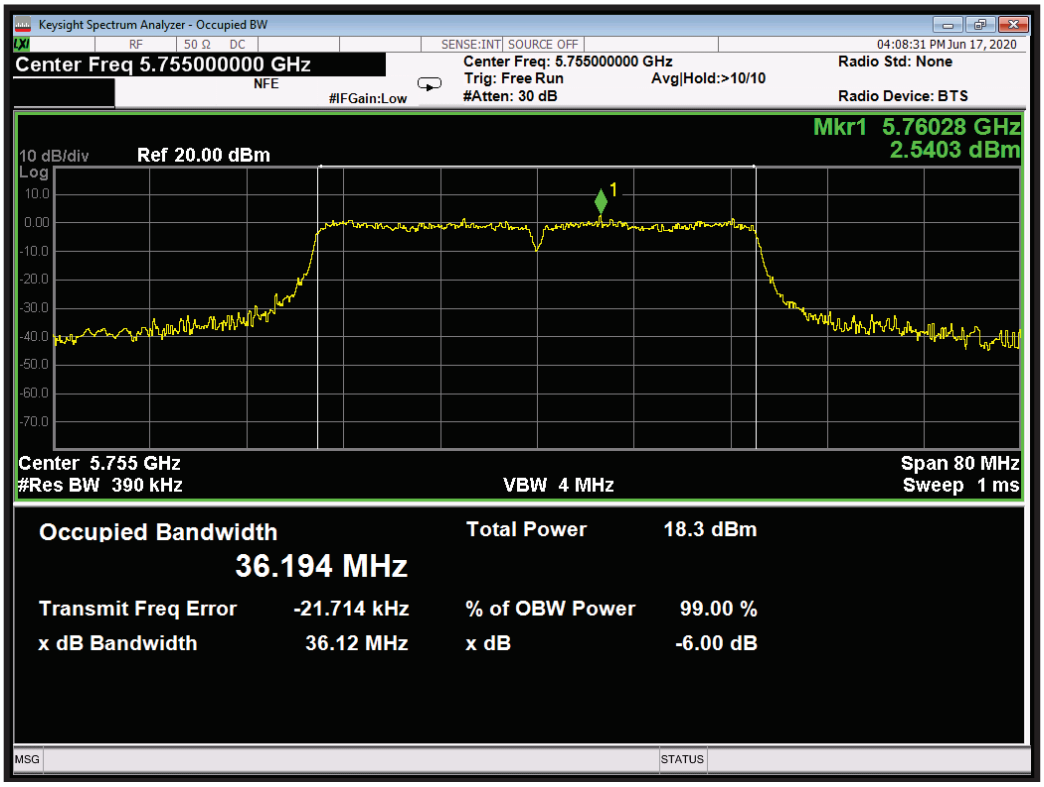


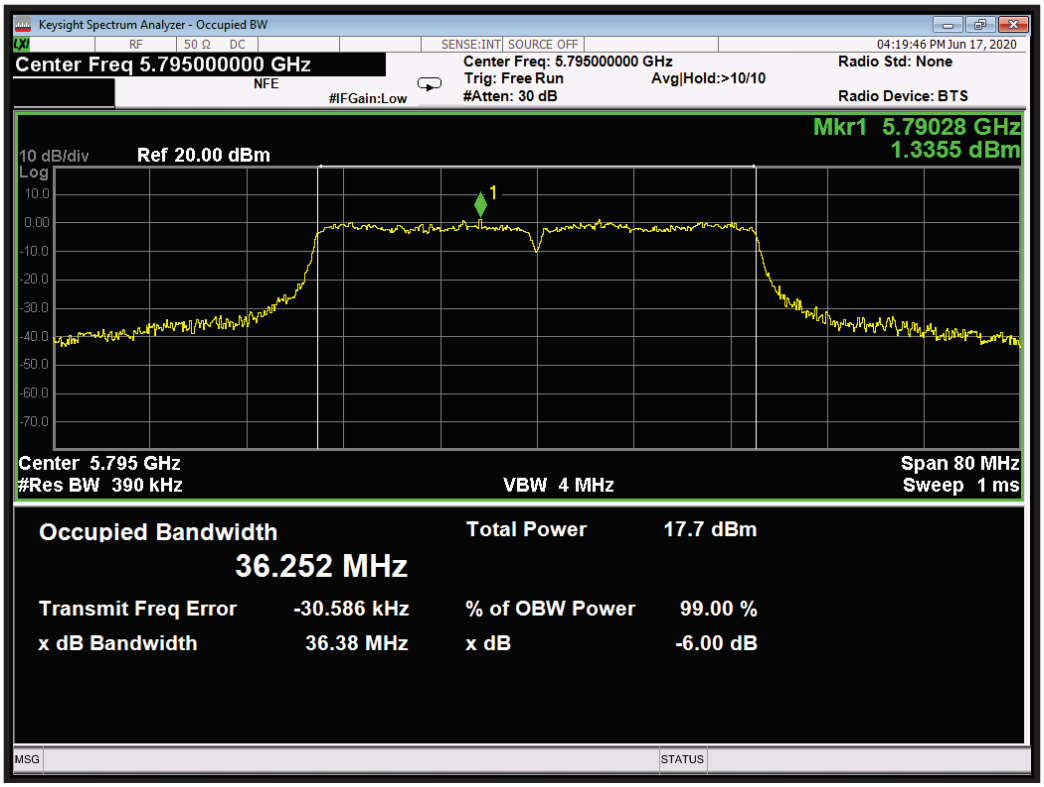
Modulation: 802.11ac-40; Data rate: MCS0 2SS; Aux Antenna;			
Channel Frequency (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
5755	36.41	36.194	PASS
5795	36.43	36.216	PASS



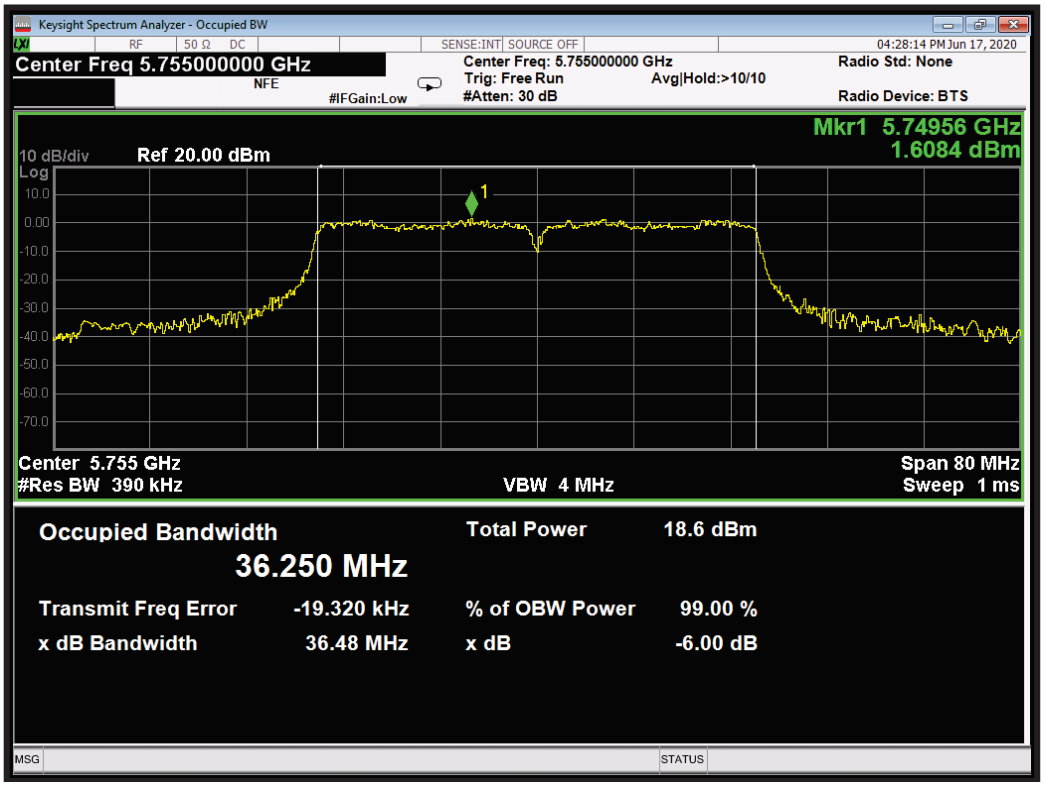


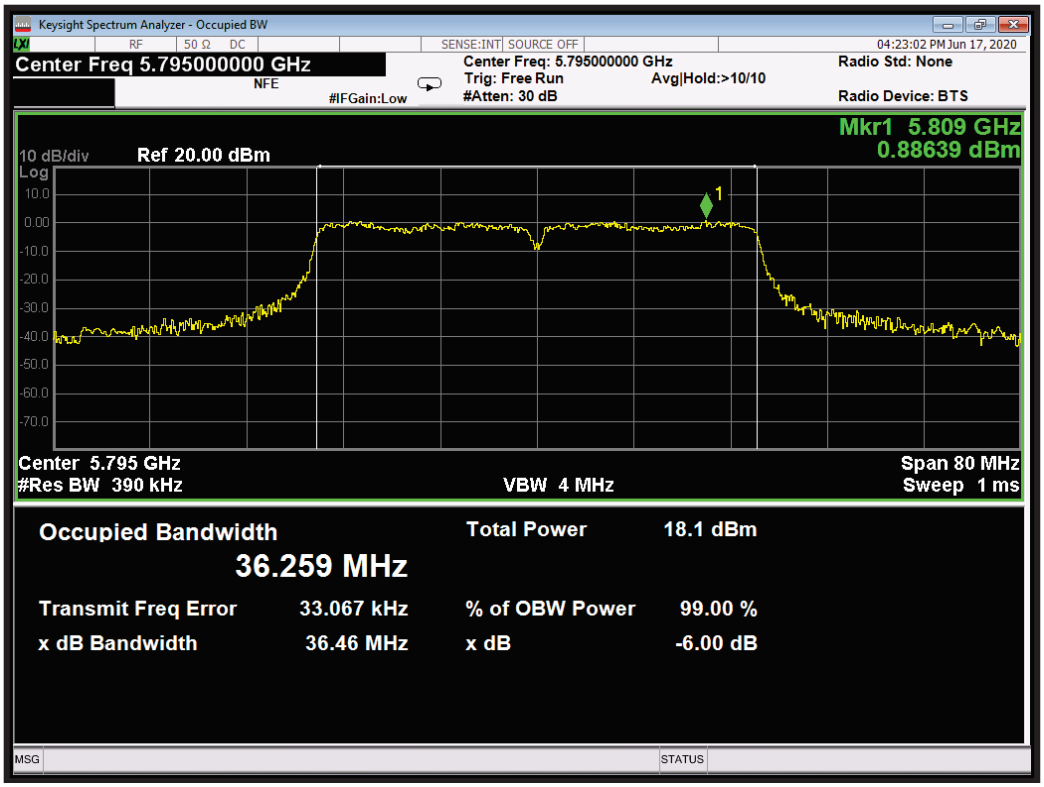
Modulation: 802.11ac-40; Data rate: MCS9 2SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.12	36.194	PASS
5795	36.38	36.252	PASS



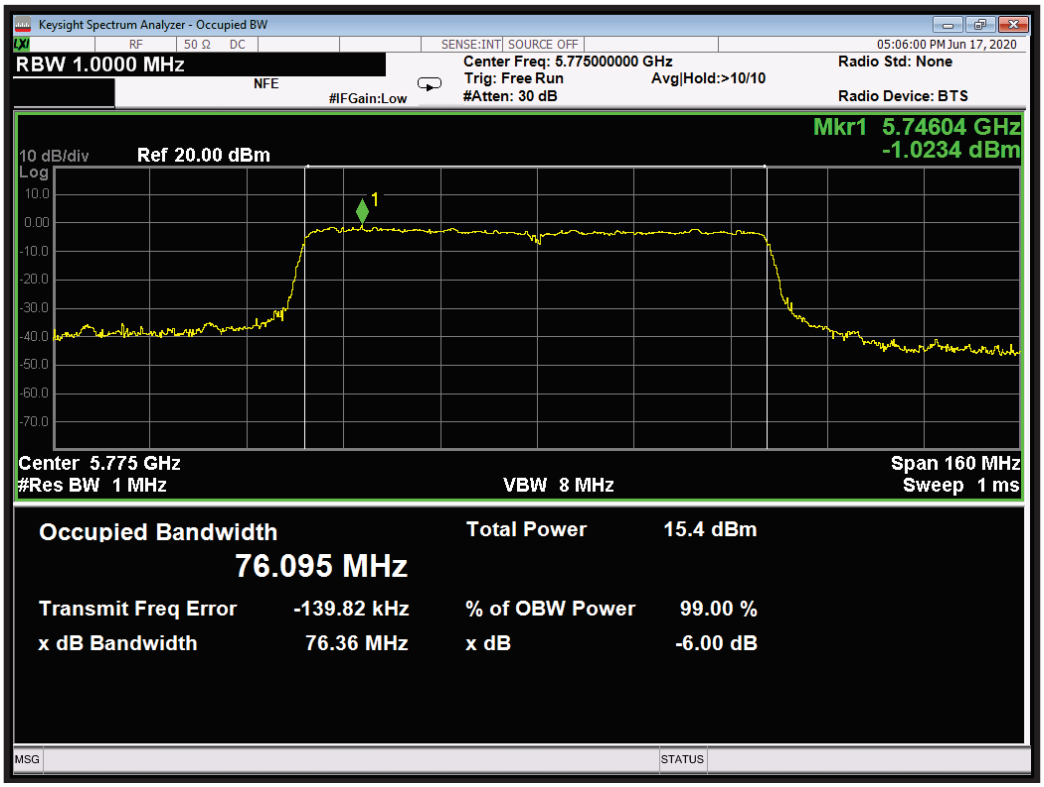


Modulation: 802.11ac-40; Data rate: MCS9 2SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5755	36.48	36.250	PASS
5795	36.46	36.529	PASS

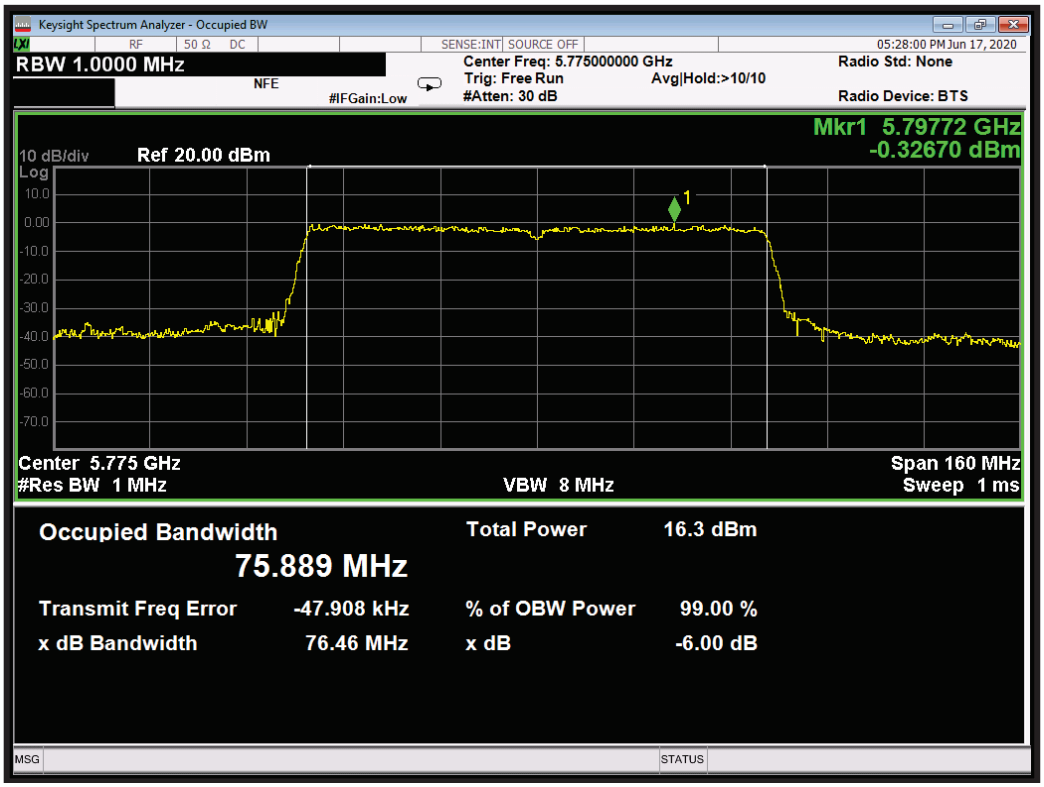




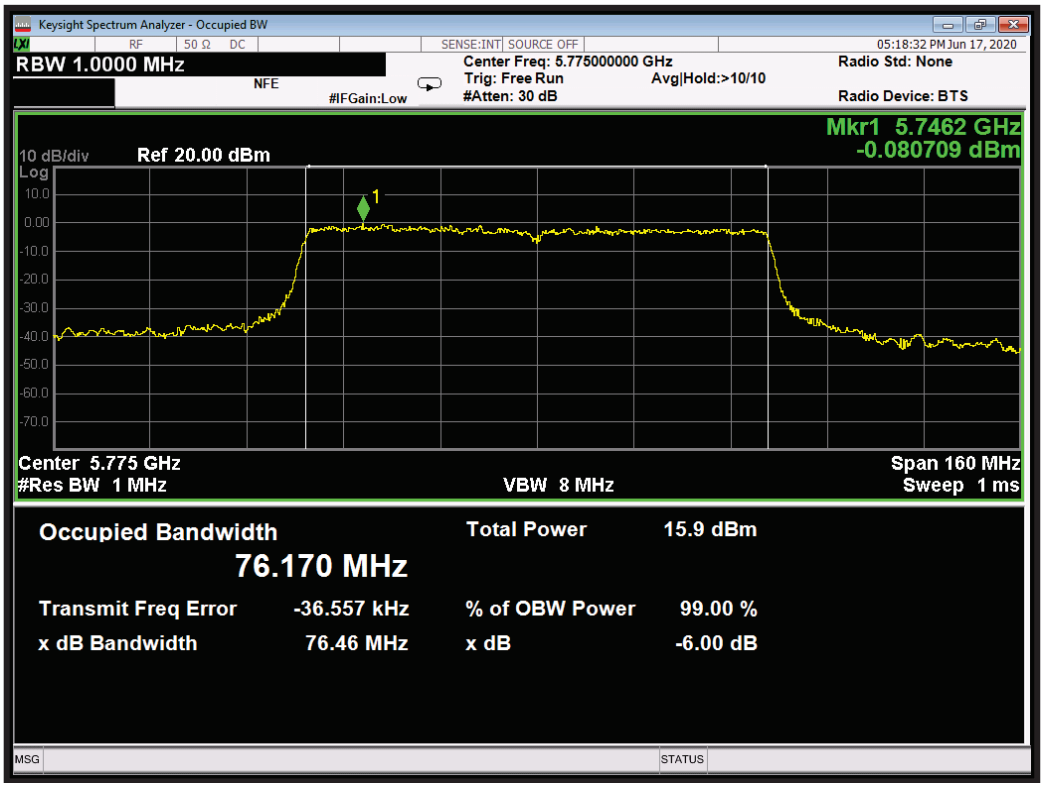
Modulation: 802.11ac-80; Data rate: MCS0 1SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.36	76.095	PASS



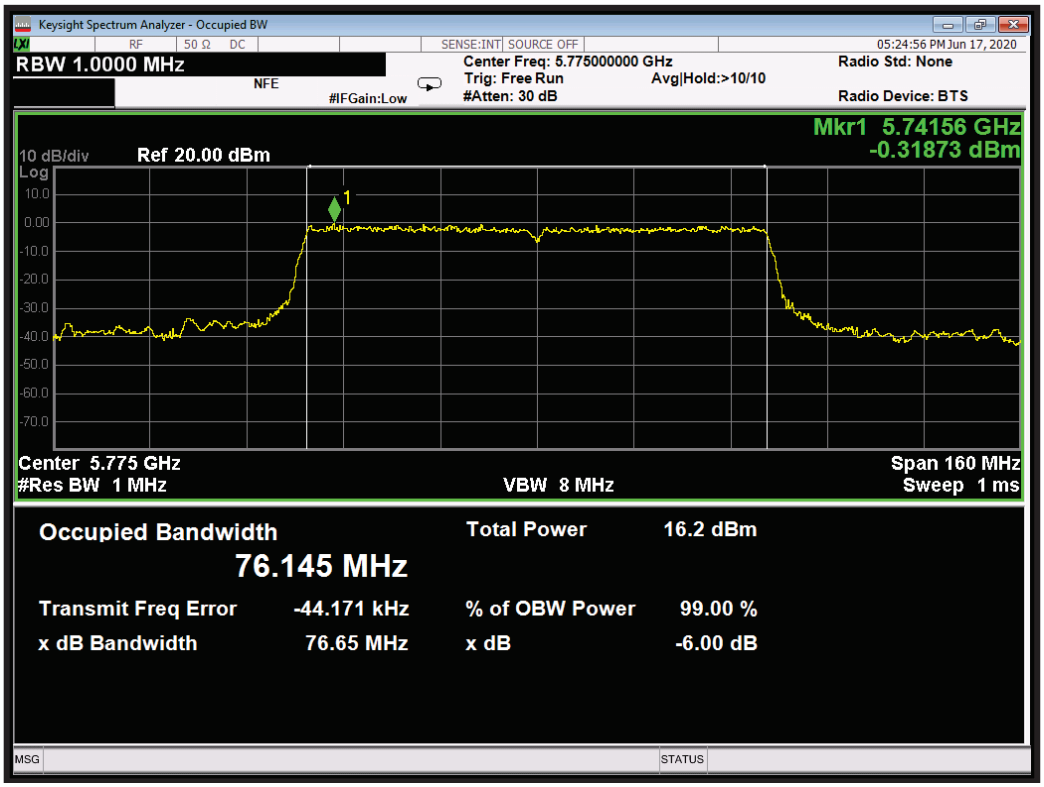
Modulation: 802.11ac-80; Data rate: MCS0 1SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.46	75.889	PASS



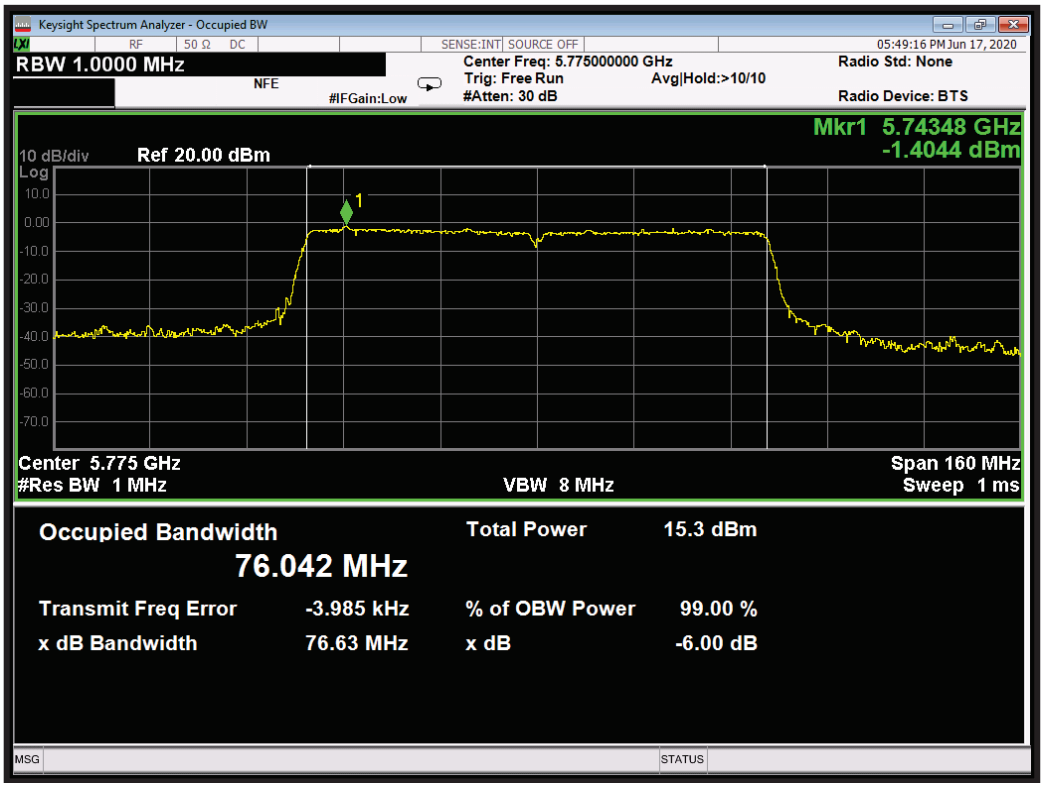
Modulation: 802.11ac-80; Data rate: MCS9 1SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.46	76.170	PASS



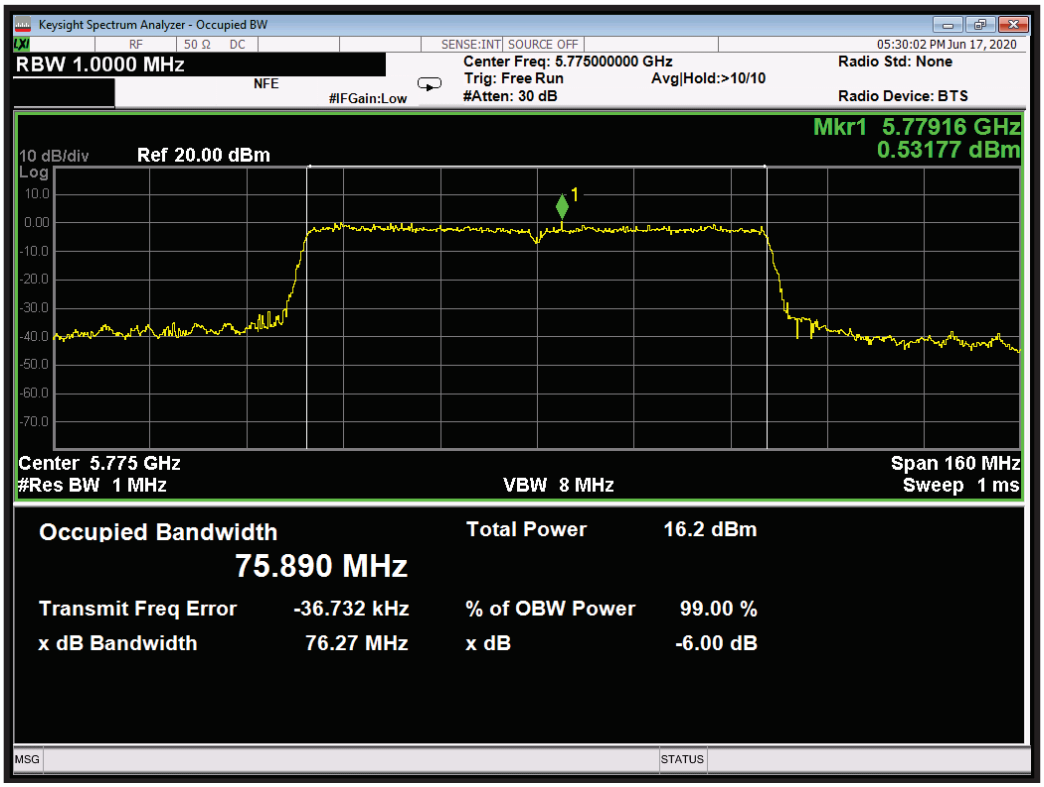
Modulation: 802.11ac-80; Data rate: MCS9 1SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.65	76.145	PASS



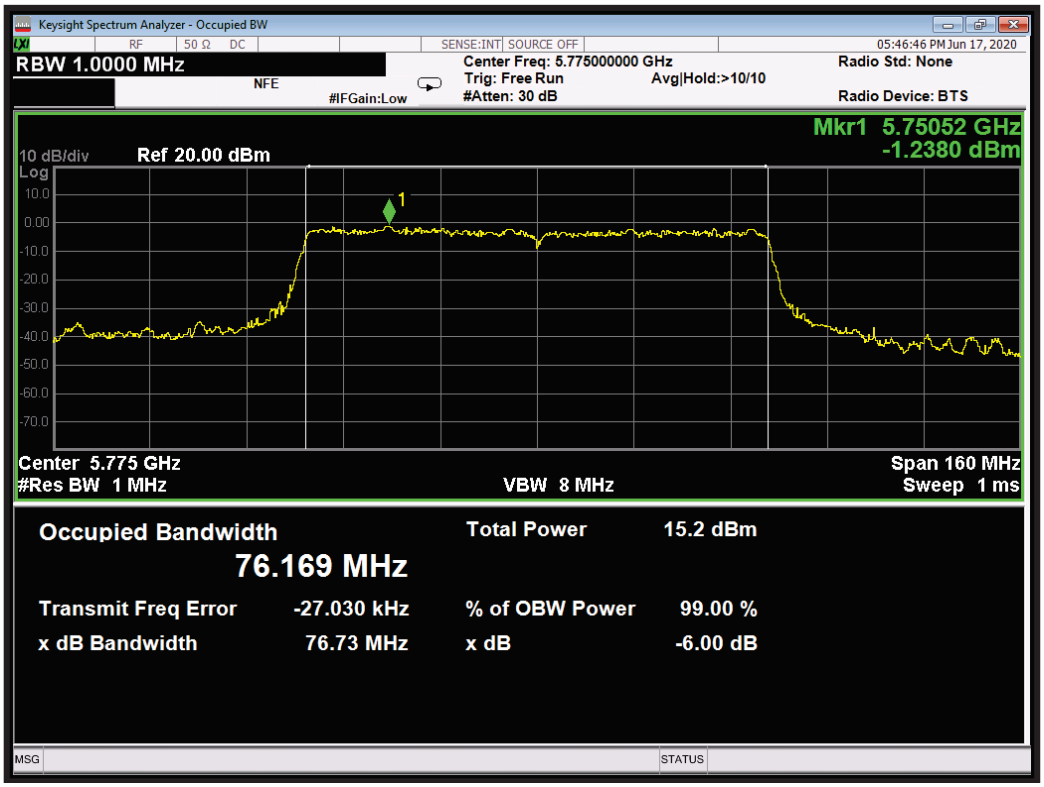
Modulation: 802.11ac-80; Data rate: MCS0 2SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.63	76.042	PASS



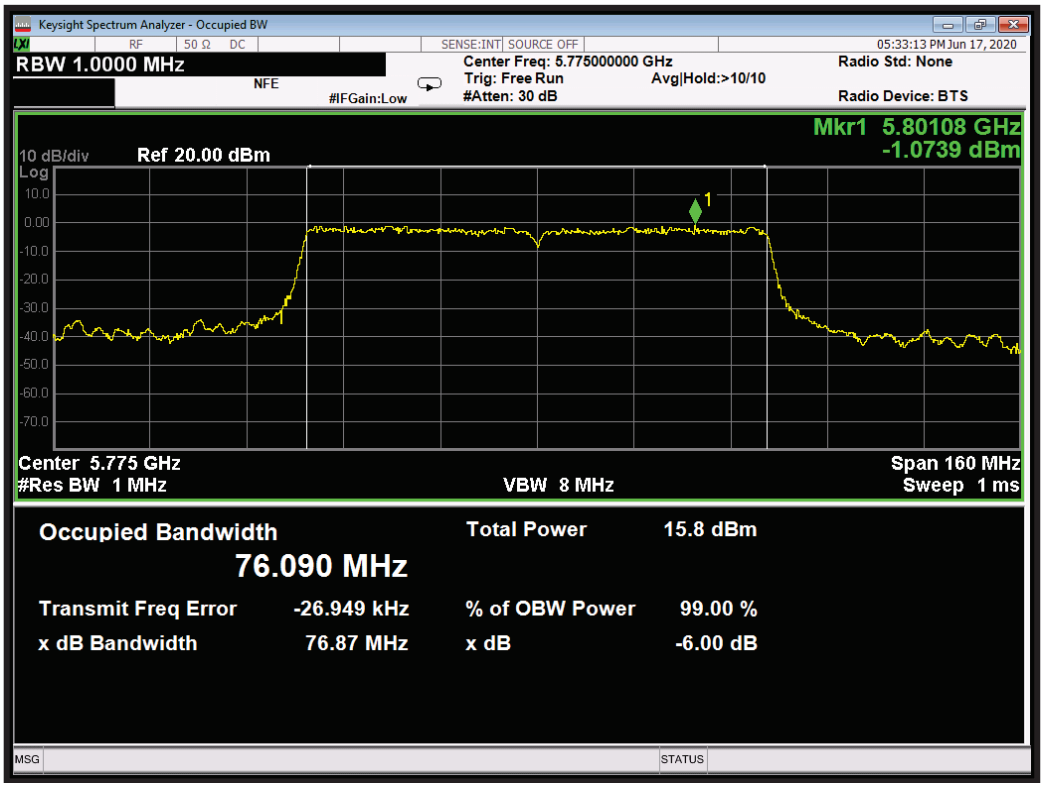
Modulation: 802.11ac-80; Data rate: MCS0 2SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.27	75.890	PASS



Modulation: 802.11ac-80; Data rate: MCS9 2SS; Main Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.73	76.169	PASS



Modulation: 802.11ac-80; Data rate: MCS9 2SS; Aux Antenna;			
Channel Frequency (MHz)	***6dB bandwidth (MHz)***	***99% bandwidth (MHz)***	***Result***
5775	76.87	76.090	PASS



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 ºC to +35 ºC (as declared)
Humidity: 43 %RH	20%RH to 75%RH (as declared)

Test Limits

For the 5.725–5.85 GHz band, the maximum conducted output power over the frequency bands of operation shall not exceed 1 W (30 dBm).

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.

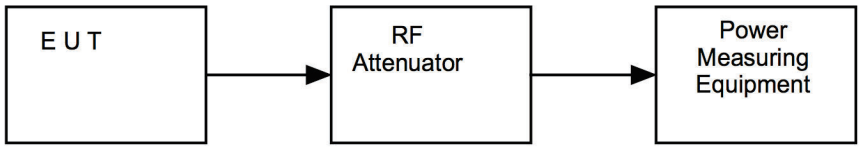
Number of antennas	2
Correlated signals	No
Maximum gain (dBi)	6.9
Exceeds 6 dBi by (dB)	0.9
Spec. limit (dBm)	30.0
Minimum 26 dB bandwidth (MHz)	20 MHz
Adjusted limit (dBm)	29.1

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

Equipment Description	*Manufacturer*	*Equipment Type*	*Element No*	*Due For Calibration*
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

Modulation: 802.11a; Main and Aux ports measured simultaneously; Channel Bandwidth: 20 MHz					
Data Rate (Mbps)	*Channel (MHz)*	*EUT power setting*	*Measured level (dBm)*	*Limit (dBm)*	*Result*
6	5745	15	18.7	29.1	Pass
6	5785	15	18.4	29.1	Pass
6	5825	15	18.2	29.1	Pass
54	5745	15	18.8	29.1	Pass
54	5785	15	18.5	29.1	Pass
54	5825	15	18.2	29.1	Pass

Modulation: 802.11ac; Main and Aux ports measured simultaneously; Channel Bandwidth: 20 MHz; Spatial Streams: 1					
Data Rate (MCS)	*Channel (MHz)*	*EUT power setting*	*Measured level (dBm)*	*Limit (dBm)*	*Result*
0	5745	13	16.9	29.1	Pass
0	5785	13	16.6	29.1	Pass
0	5825	13	16.4	29.1	Pass
8	5745	13	16.9	29.1	Pass
8	5785	13	16.6	29.1	Pass
8	5825	13	16.4	29.1	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	5745	13	16.9	29.1	Pass
0	5785	13	16.6	29.1	Pass
0	5825	13	16.3	29.1	Pass
8	5745	13	16.9	29.1	Pass
8	5785	13	16.6	29.1	Pass
8	5825	13	16.3	29.1	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	5755	12	15.7	29.1	Pass
0	5795	12	15.4	29.1	Pass
9	5755	12	15.8	29.1	Pass
9	5795	12	15.5	29.1	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	5755	12	15.7	29.1	Pass
0	5795	12	15.4	29.1	Pass
9	5755	12	15.8	29.1	Pass
9	5795	12	15.5	29.1	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	5775	8	12.0	29.1	Pass
9	5775	8	12.2	29.1	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	5775	8	12.0	29.1	Pass
9	5775	8	12.2	29.1	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	5745	15	18.9	29.1	Pass
0	5785	15	18.6	29.1	Pass
0	5825	15	18.3	29.1	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	5755	14	17.7	29.1	Pass
0	5795	14	17.4	29.1	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 ºC to +35 ºC (as declared)
Humidity: 42 %RH	20%RH to 75%RH (as declared)

Test Limits

For the 5.725–5.85 GHz band, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz 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.

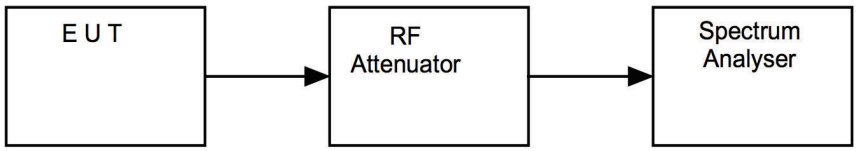
Number of antennas	2
Correlated signals	No
Maximum Gain (dBi)	6.9
Exceeds 6 dBi by (dB)	0.9
Spec. limit (dBm/500 kHz)	30
Adjusted limit (dBm/500 kHz)	29.1

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/500 kHz)*	*Measured level Aux (dBm/500 kHz)*	*Combined PSD (dBm/500 kHz)*	*Limit (dBm/500 kHz)*	*Result*
6	5745	15	1.9	2.2	5.1	29.1	Pass
6	5785	15	1.0	2.3	4.7	29.1	Pass
6	5825	15	1.2	2.1	4.7	29.1	Pass
54	5745	15	1.3	2.2	4.8	29.1	Pass
54	5785	15	0.9	2.3	4.7	29.1	Pass
54	5825	15	0.6	2.0	4.4	29.1	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/500 kHz)*	*Measured level Aux (dBm/500 kHz)*	*Combined PSD (dBm/500 kHz)*	*Limit (dBm/500 kHz)*	*Result*
0	5745	13	-0.7	0.0	2.7	29.1	Pass
0	5785	13	-0.4	-0.2	2.7	29.1	Pass
0	5825	13	-0.9	-0.4	2.4	29.1	Pass
8	5745	13	-0.6	-0.1	2.7	29.1	Pass
8	5785	13	-1.0	-0.1	2.5	29.1	Pass
8	5825	13	-0.7	-0.2	2.6	29.1	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/500 kHz)	Measured level Aux (dBm/500 kHz)	Combined PSD (dBm/500 kHz)	Limit (dBm/500 kHz)	Result
0	5745	13	-0.4	0.0	2.8	29.1	Pass
0	5785	13	-0.7	-0.1	2.6	29.1	Pass
0	5825	13	-1.2	-0.3	2.3	29.1	Pass
8	5745	13	-0.4	0.2	2.9	29.1	Pass
8	5785	13	-0.8	0.1	2.7	29.1	Pass
8	5825	13	-1.3	-0.2	2.3	29.1	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/500 kHz)	Measured level Aux (dBm/500 kHz)	Combined PSD (dBm/500 kHz)	Limit (dBm/500 kHz)	Result
0	5755	12	-4.3	-4.0	-1.1	29.1	Pass
0	5795	12	-4.7	-4.2	-1.4	29.1	Pass
9	5755	12	-4.0	-4.0	-1.0	29.1	Pass
9	5795	12	-4.8	-4.1	-1.4	29.1	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/500 kHz)	Measured level Aux (dBm/500 kHz)	Combined PSD (dBm/500 kHz)	Limit (dBm/500 kHz)	Result
0	5755	12	-4.4	-4.0	-1.2	29.1	Pass
0	5795	12	-4.8	-4.2	-1.5	29.1	Pass
9	5755	12	-4.1	-3.5	-0.8	29.1	Pass
9	5795	12	-4.7	-3.9	-1.3	29.1	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/500 kHz)	Measured level Aux (dBm/500 kHz)	Combined PSD (dBm/500 kHz)	Limit (dBm/500 kHz)	Result
0	5775	8	-11.2	-11.1	-8.1	29.1	Pass
9	5775	8	-10.5	-10.7	-7.6	29.1	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/500 kHz)	Measured level Aux (dBm/500 kHz)	Combined PSD (dBm/500 kHz)	Limit (dBm/500 kHz)	Result
0	5775	8	-11.4	-10.9	-8.1	29.1	Pass
9	5775	8	-11.0	-10.3	-7.6	29.1	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/500 kHz)***	***Measured level Aux (dBm/500 kHz)***	***Combined PSD (dBm/500 kHz)***	***Limit (dBm/500 kHz)***	***Result***
0	5785	15	0.9	1.9	4.4	29.1	Pass
0	5825	15	0.5	1.7	4.2	29.1	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/500 kHz)***	***Measured level Aux (dBm/500 kHz)***	***Combined PSD (dBm/500 kHz)***	***Limit (dBm/500 kHz)***	***Result***
0	5755	14	-2.3	-1.9	0.9	29.1	Pass
0	5795	14	-2.9	-2.1	0.5	29.1	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**