RF TEST REPORT

Applicant	Shanghai Smawave Technology Co. ,Ltd
FCC ID	2AU8HSPH420-BQ
Product	Industrial smart handheld terminal
Brand	Smawave
Model	SPH420-bq
Report No.	R2212A1269-R4
Issue Date	January 12, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15E (2022)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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Approved by: Xu Kai

TA Technology (Shanghai) Co., Ltd.

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TABLE OF CONTENT

Summary of measurement results

Number	Test Case	Clause in FCC rules	Verdict
1	Average output power	15.407(a)	PASS
2	Occupied bandwidth	15.407(e)	PASS
3	Frequency stability	15.407(g)	PASS
4	Power spectral density	15.407(a)	PASS
5	Unwanted Emissions	15.407(b)	PASS
6	Conducted Emissions	15.207	PASS
Date of Testing: December 12, 2022~January 9, 2023 Date of Sample Received: December 12, 2022			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard. All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

1. Test Laboratory

1.1. Notes of the test report

This report shall not be reproduced in full or partial, without the written approval of **TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3. Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	Building 3, No.145, Jintang Rd, Pudong Shanghai, P.R.China
City:	Shanghai
Post code:	201201
Country:	P. R. China
Contact:	Xu Kai
Telephone:	+86-021-50791141/2/3
Fax:	+86-021-50791141/2/3-8000
Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

2. General Description of Equipment under Test

2.1. Applicant and Manufacturer Information

Applicant	Shanghai Smawave Technology Co. ,Ltd
Applicant address	3/F, Building 8, 1001 North Qinzhou Road，Xuhui District, Shanghai, China
Manufacturer	Shanghai Smawave Technology Co. ,Ltd
Manufacturer address	3/F, Building 8, 1001 North Qinzhou Road，Xuhui District, Shanghai, China

2.2. General information

EUT Description	
Model	SPH420-bq
IMEI	862165041023688
Hardware Version	V1.0.2
Software Version	20230106_01_SPHX20-aq_NDAC_V1.0.23
Power Supply	Battery / AC adapter
Antenna Type	Internal Antenna
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)
Antenna Gain	-0.22 dBi
Operating Frequency Range(s)	U-NII-1: 5150MHz-5250MHz U-NII-2A:5250MHz -5350MHz U-NII-2C: 5470MHz-5600MHz ,5650MHz-5725MHz U-NII-3: 5725MHz -5850MHz
Modulation Type	802.11a/n (HT20/HT40) : OFDM 802.11ac (VHT20/VHT40/VHT80): OFDM
Max. Output Power	13.82 dBm
Testing temperature range	-20 ° C to 50° C
Operating temperature range	-20 ° C to 60 ° C
Operating voltage range	3.7 V to 4.4 V
State DC voltage:	3.8 V
EUT Accessory	
Adapter	Manufacturer: Zhuzhou Dachuan Electronic Technology Co.,Ltd Model: DCT12W050200ZZ-H1 (Adapters: 94001-00001-EU; 94001-00002-UK; 94001-00003-US)
Battery	Manufacturer: GuangDong FengHua New Energy Co., Ltd.

	Model: FHPK626263P

Note:

1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.
2. This device support automatically discontinue transmission, while the device is not transmitting any information, the device can automatically discontinue transmission and become standby mode for power saving. The device can detect the controlling signal of ACK message transmitting from remote device and verify whether it shall resend or discontinue transmission.
3. (a) Manufacturers implements security features in any digitally modulated devices capable of operating in any of the U-NII bands, so that third parties are not able to reprogram the device to operate outside the parameters for which the device was certified. The software prevents the user from operating the transmitter with operating frequencies, output power, modulation types or other radio frequency parameters outside those that were approved for the device. Manufacturers uses means including, but not limited to the use of a private network that allows only authenticated users to download software, electronic signatures in software or coding in hardware that is decoded by software to verify that new software can be legally loaded into a device to meet these requirements and must describe the methods in their application for equipment authorization.
(b) Manufacturers take steps to ensure that DFS functionality cannot be disabled by the operator of the U-NII device.
4. There is more than one Adapter, each one should be applied throughout the compliance test respectively, and however, only the worst case (94001-00003-US) will be recorded in this report.

3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR47 Part 15E (2022) Unlicensed National Information Infrastructure Devices

ANSI C63.10-2013

Reference standard:

KDB 789033 D02 General UNII Test Procedures New Rules v02r01

4. Test Configuration

Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

In order to find the worst case condition, Pre-tests are needed at the presence of different data rate. Preliminary tests have been done on all the configuration for confirming worst case. Data rate below means worst-case rate of each test item.

Worst-case data rates are shown as following table.

Mode	Data Rate
802.11a	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0
802.11ac VHT20	MCS0
802.11ac VHT40	MCS0
802.11ac VHT80	MCS0

Wireless Technology and Frequency Range

Wireless Technology		Bandwidth	Channel	Frequency
Wi-Fi	U-NII-1	20 MHz	36	5180MHz
			40	5200MHz
			44	5220MHz
			48	5240MHz
		40 MHz	38	5190MHz
			46	5230MHz
		80 MHz	42	5210MHz
	U-NII-2A	20 MHz	52	5260MHz
			56	5280MHz
			60	5300MHz
			64	5320MHz
		40 MHz	54	5270MHz
			62	5310MHz
		80 MHz	58	5290MHz
	U-NII-2C	20 MHz	100	5500MHz
			104	5520MHz
			108	5540MHz
			112	5560MHz
			116	5580MHz
			132	5660MHz
			136	5680MHz
			140	5700MHz
			144	5720MHz
		40 MHz	102	5510MHz
			110	5550MHz
			134	5670MHz
			142	5710MHz
		80 MHz	106	5530MHz
			138	5690MHz
	U-NII-3	20 MHz	149	5745MHz
			153	5765MHz
			157	5785MHz
			161	5805MHz
			165	5825MHz
		40 MHz	151	5755MHz
			159	5795MHz
		80 MHz	155	5775MHz
Does this device support TPC Function? ☐Yes ☒No				
Does this device support TDWR Band? ☐Yes ☒No				

5. Test Case Results

5.1. Occupied Bandwidth

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable.

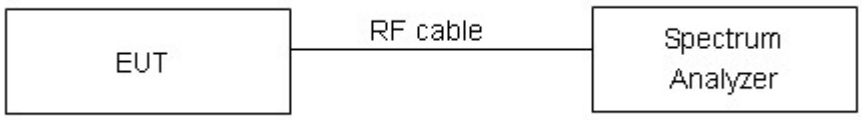
For U-NII-1/U-NII-2A/U-NII-2C, set RBW ≈1% OCB kHz, VBW ≥ 3 × RBW, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 26 dB relative to the maximum level measured in the fundamental emission.

For U-NII-3, Set RBW = 100 kHz, VBW ≥ 3 × RBW, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

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

Use the 99 % power bandwidth function of the instrument

Test Setup



Limits

Rule FCC Part §15.407(e)

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

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936 Hz.

Test Results:

U-NII-1

Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5180	16.628	21.533	PASS
	5200	16.596	22.511	PASS
	5240	16.591	21.876	PASS
802.11n HT20	5180	17.815	22.977	PASS
	5200	17.807	22.852	PASS
	5240	17.785	22.817	PASS
802.11n HT40	5190	36.208	41.082	PASS
	5230	36.290	41.615	PASS
802.11ac VHT20	5180	17.815	22.810	PASS
	5200	17.811	22.866	PASS
	5240	17.822	22.648	PASS
802.11ac VHT40	5190	36.212	41.118	PASS
	5230	36.234	41.826	PASS
802.11ac VHT80	5210	75.683	85.443	PASS

U-NII-2A

Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5260	16.590	21.563	PASS
	5300	16.606	21.294	PASS
	5320	16.607	23.207	PASS
802.11n HT20	5260	17.798	22.590	PASS
	5300	17.785	22.559	PASS
	5320	17.801	22.680	PASS
802.11n HT40	5270	36.185	41.350	PASS
	5310	36.365	42.032	PASS
802.11ac VHT20	5260	17.795	22.463	PASS
	5300	17.790	22.980	PASS
	5320	17.811	22.758	PASS
802.11ac VHT40	5270	36.141	41.365	PASS
	5310	36.306	41.715	PASS
802.11ac VHT80	5290	75.769	89.708	PASS

U-NII-2C

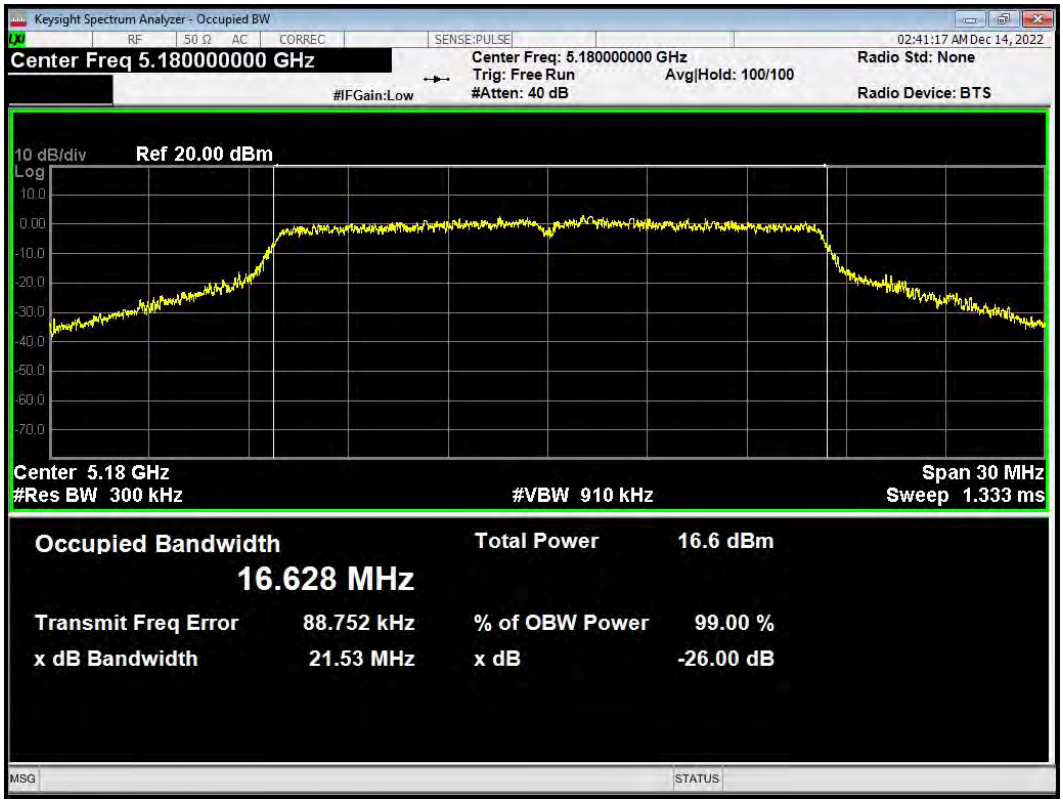
Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5500	16.567	22.091	PASS
	5580	16.596	21.505	PASS
	5700	16.585	22.139	PASS
	5720	16.616	22.914	PASS
802.11n HT20	5500	17.783	22.851	PASS
	5580	17.798	22.610	PASS
	5700	17.758	22.617	PASS
	5720	17.790	22.821	PASS
802.11n HT40	5510	36.248	41.503	PASS
	5550	36.252	41.847	PASS
	5670	36.305	41.892	PASS
	5710	36.199	41.097	PASS
802.11ac VHT20	5500	17.766	22.997	PASS
	5580	17.793	23.040	PASS
	5700	17.773	22.386	PASS
	5720	17.800	22.382	PASS
802.11ac VHT40	5510	36.202	41.340	PASS
	5550	36.218	41.868	PASS
	5670	36.291	41.319	PASS
	5710	36.163	41.338	PASS
802.11ac VHT80	5530	75.734	83.739	PASS
	5690	75.685	84.069	PASS

U-NII-3

Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11a	5745	16.679	15.105	500	PASS
	5785	16.632	15.035	500	PASS
	5825	16.646	15.059	500	PASS
802.11n HT20	5745	17.840	15.131	500	PASS
	5785	17.794	16.789	500	PASS
	5825	17.823	16.762	500	PASS
802.11n HT40	5755	36.262	35.699	500	PASS
	5795	36.273	35.730	500	PASS
802.11ac VHT20	5745	17.840	16.910	500	PASS
	5785	17.844	16.515	500	PASS
	5825	17.839	15.042	500	PASS
802.11ac VHT40	5755	36.259	35.432	500	PASS
	5795	36.230	35.353	500	PASS
802.11ac VHT80	5775	75.701	75.122	500	PASS

U-NII-1

OBW 802.11a 5180MHz



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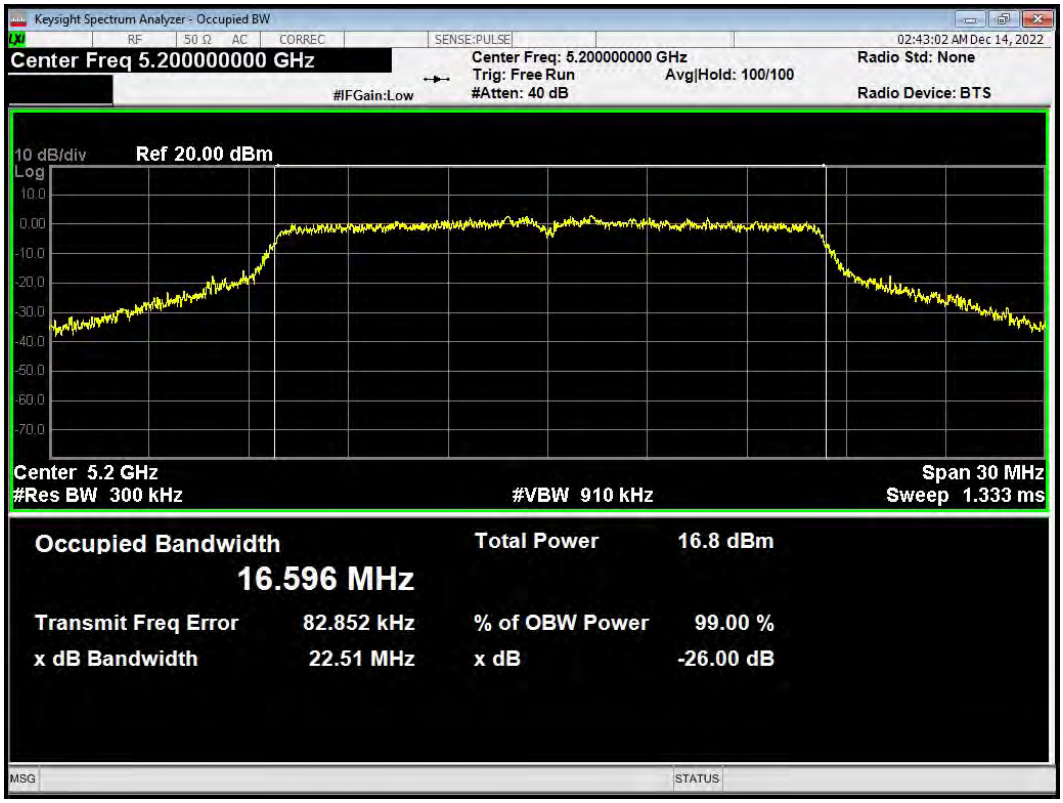

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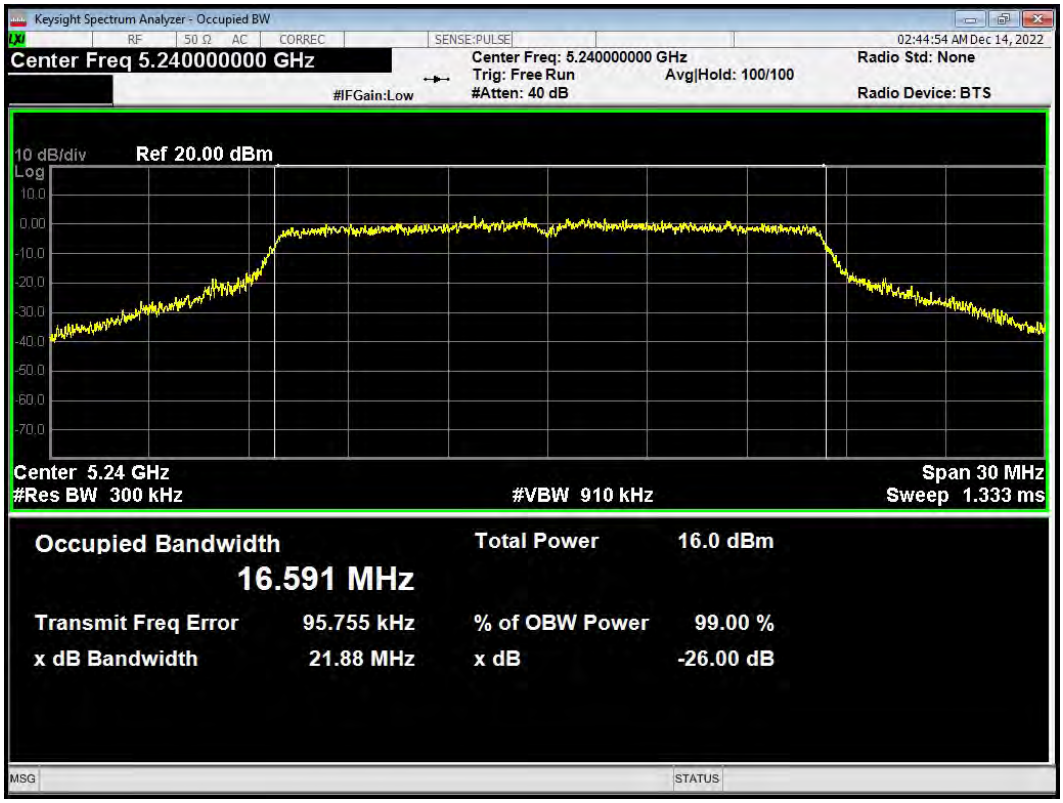

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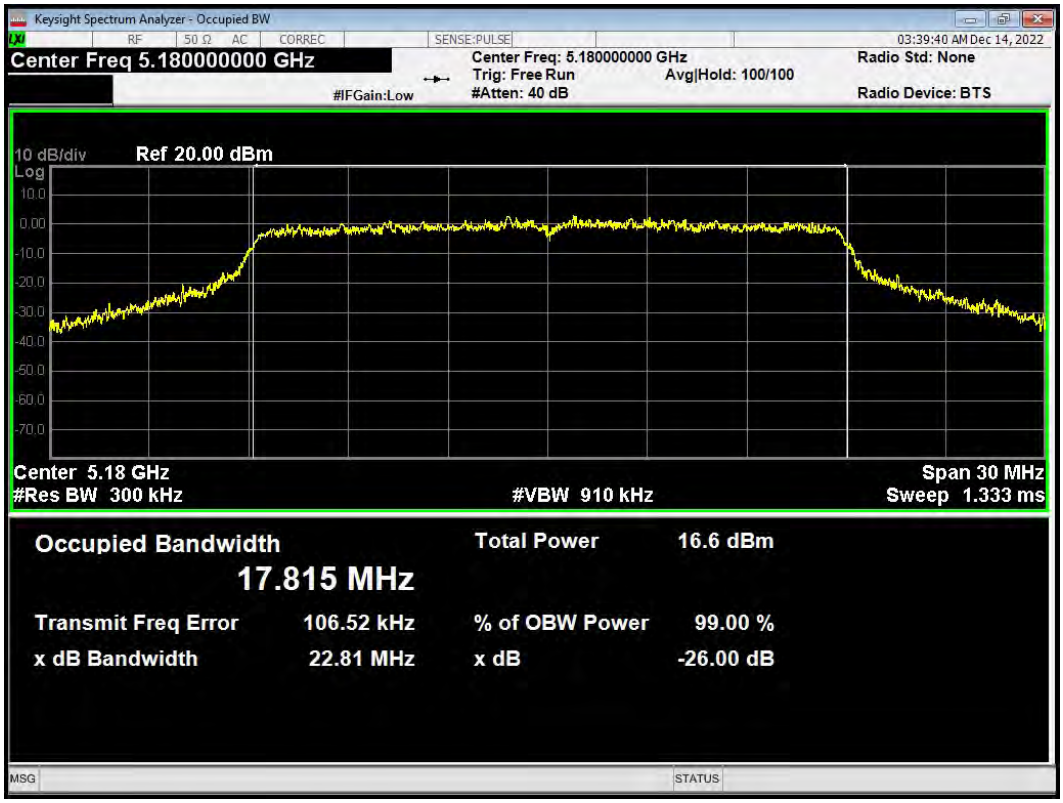

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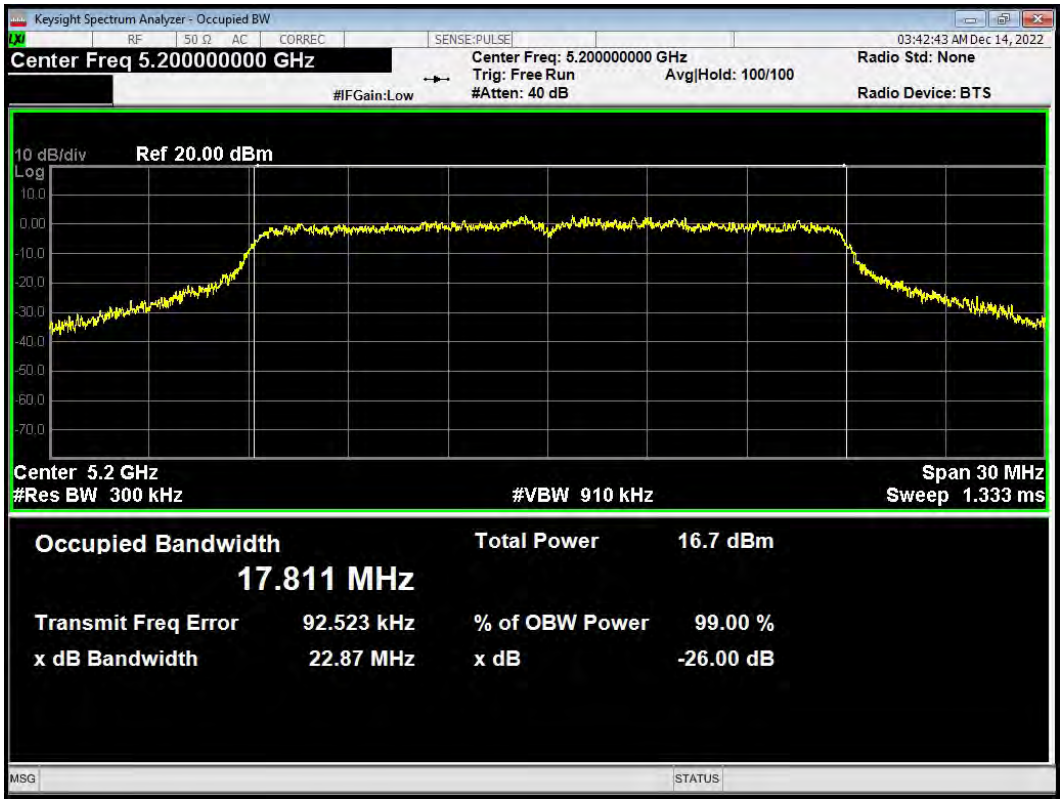

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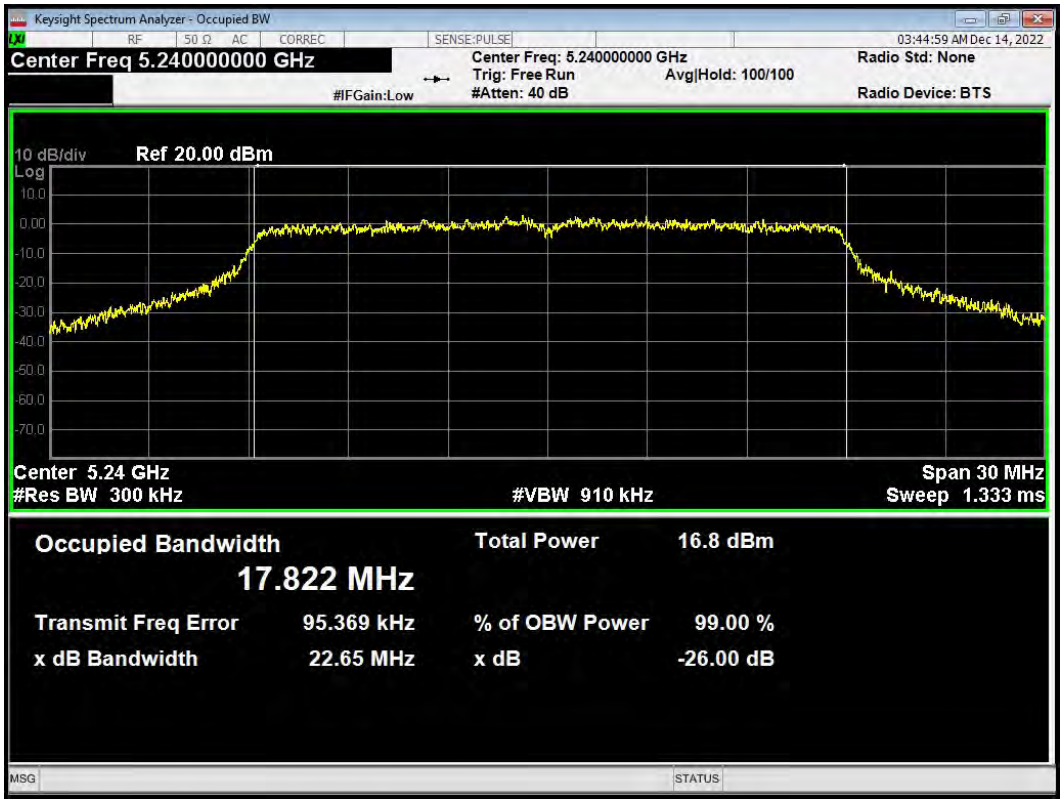

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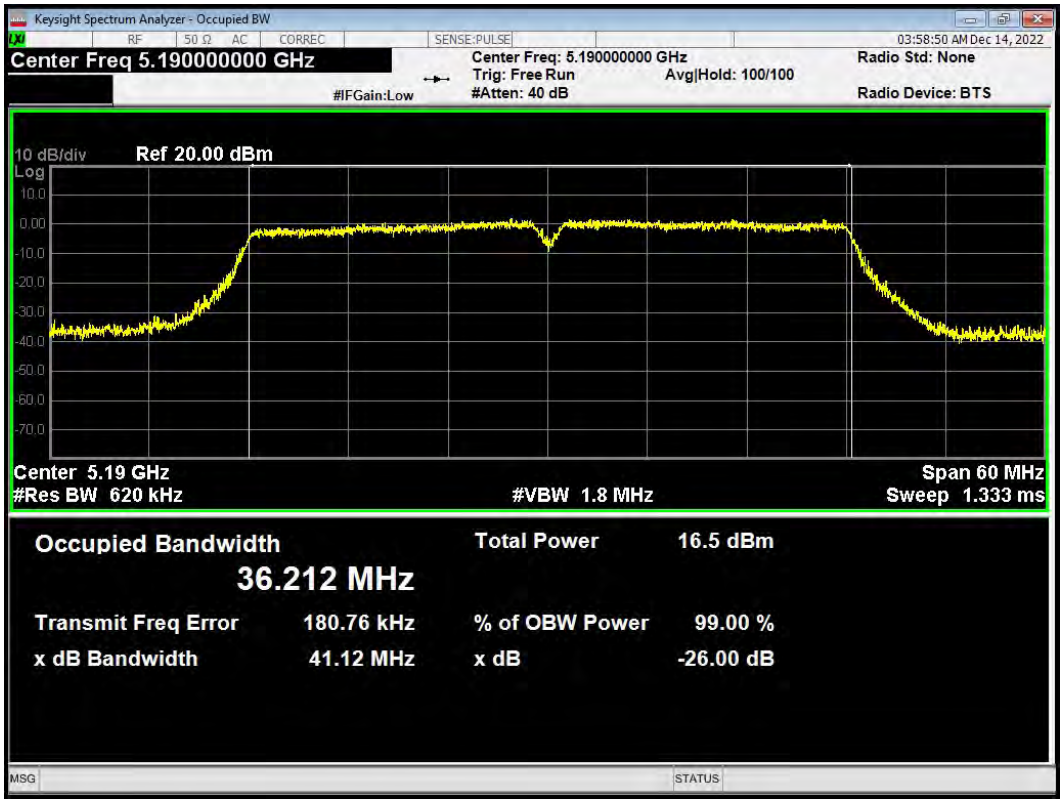

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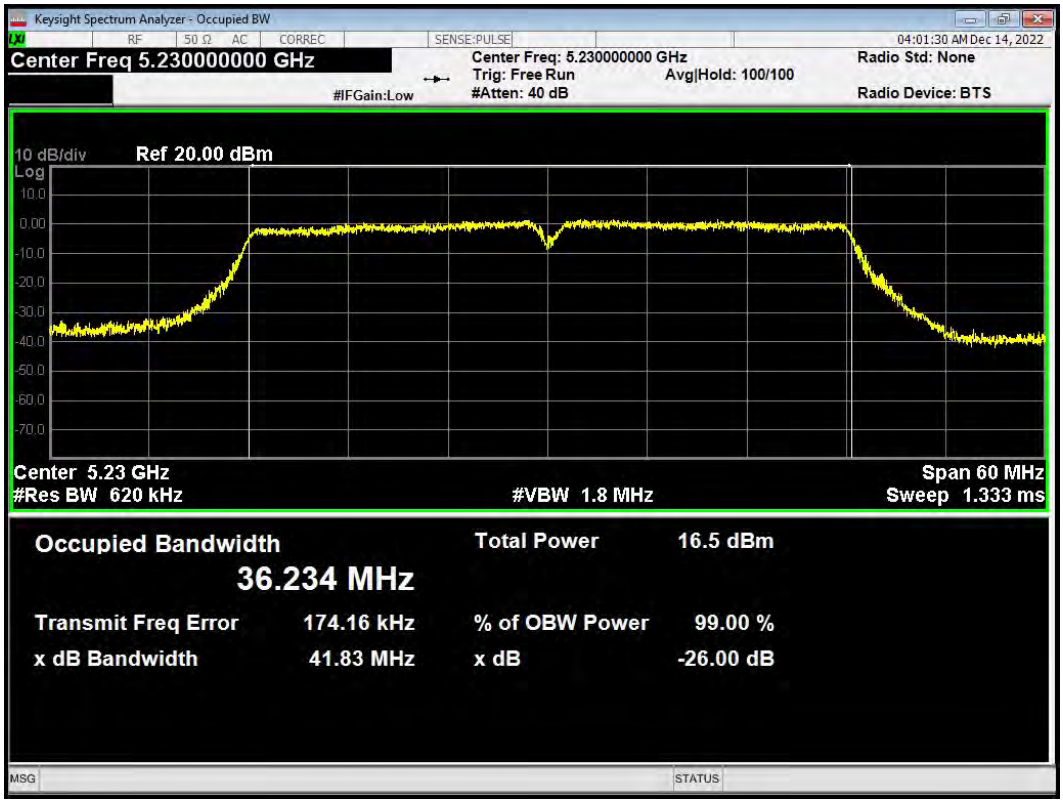

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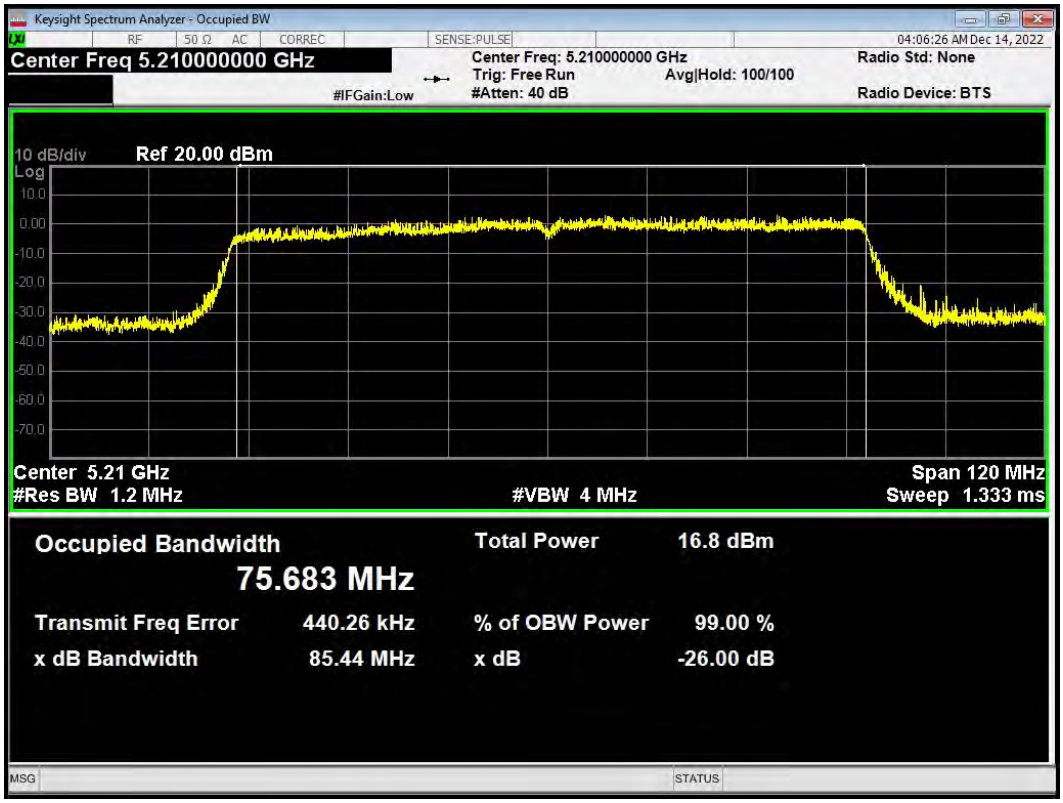

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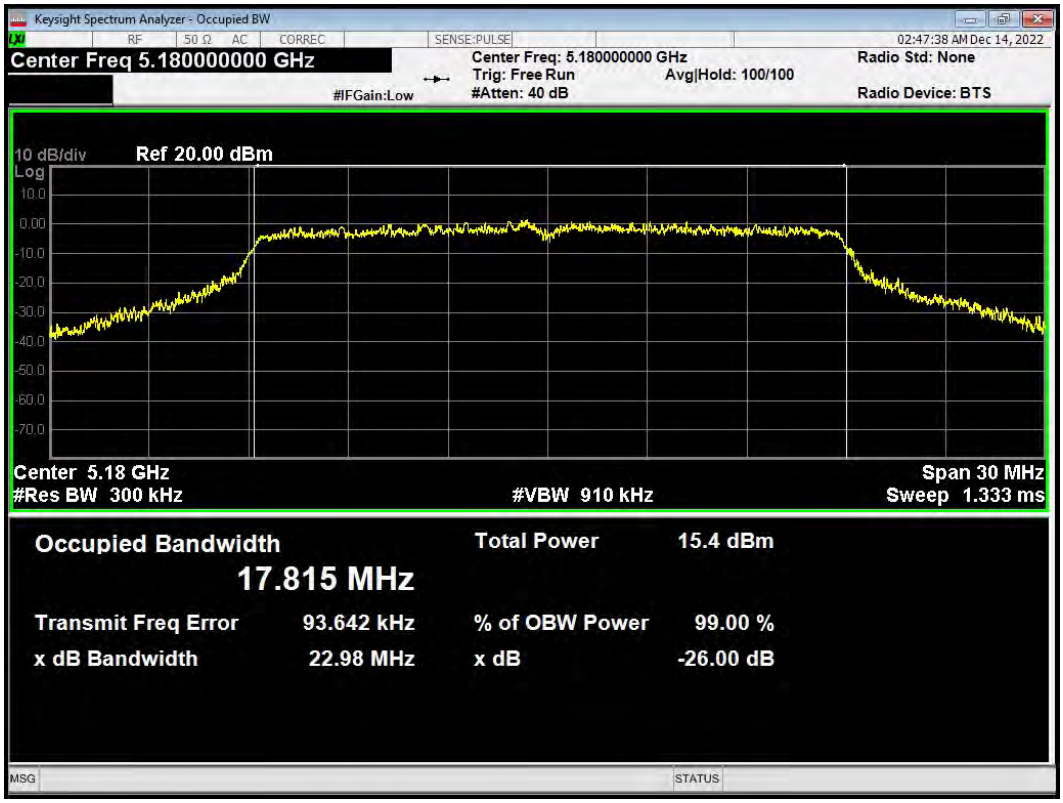

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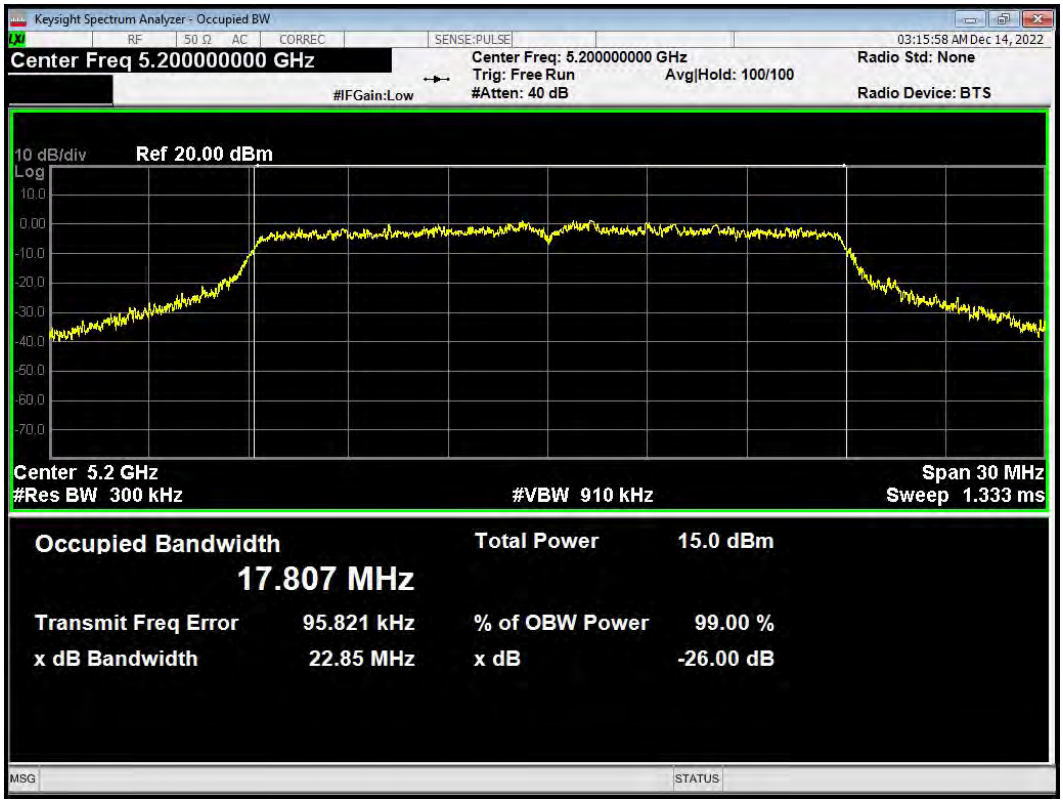

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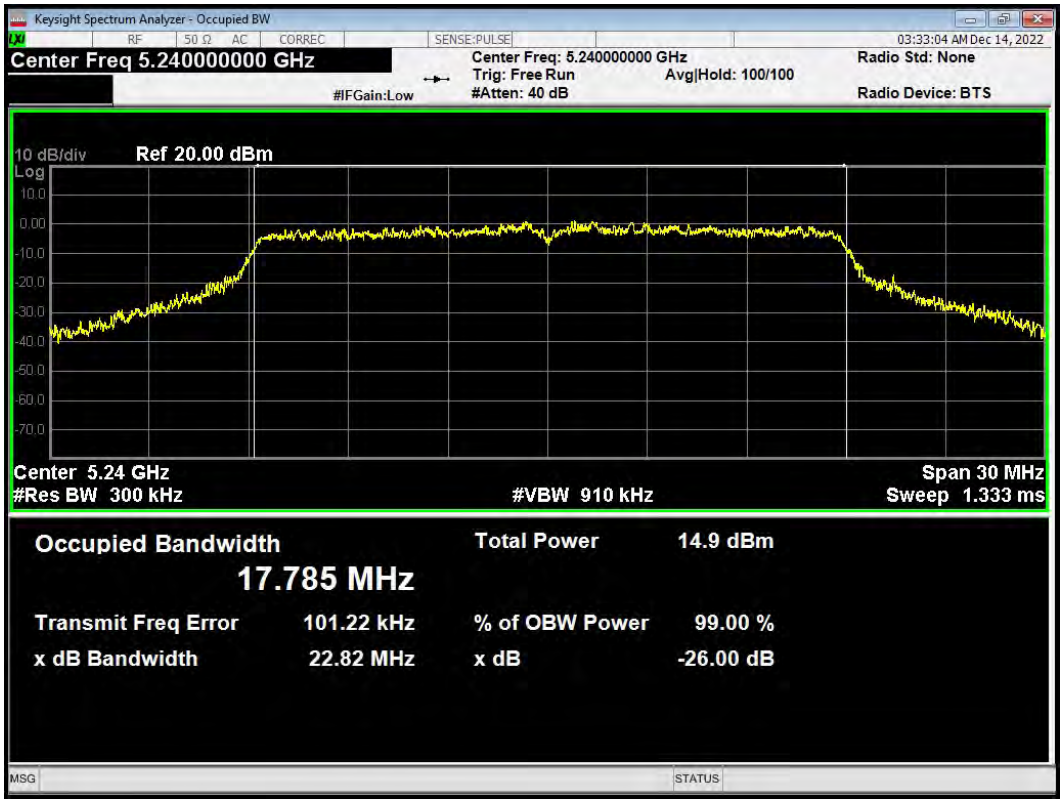

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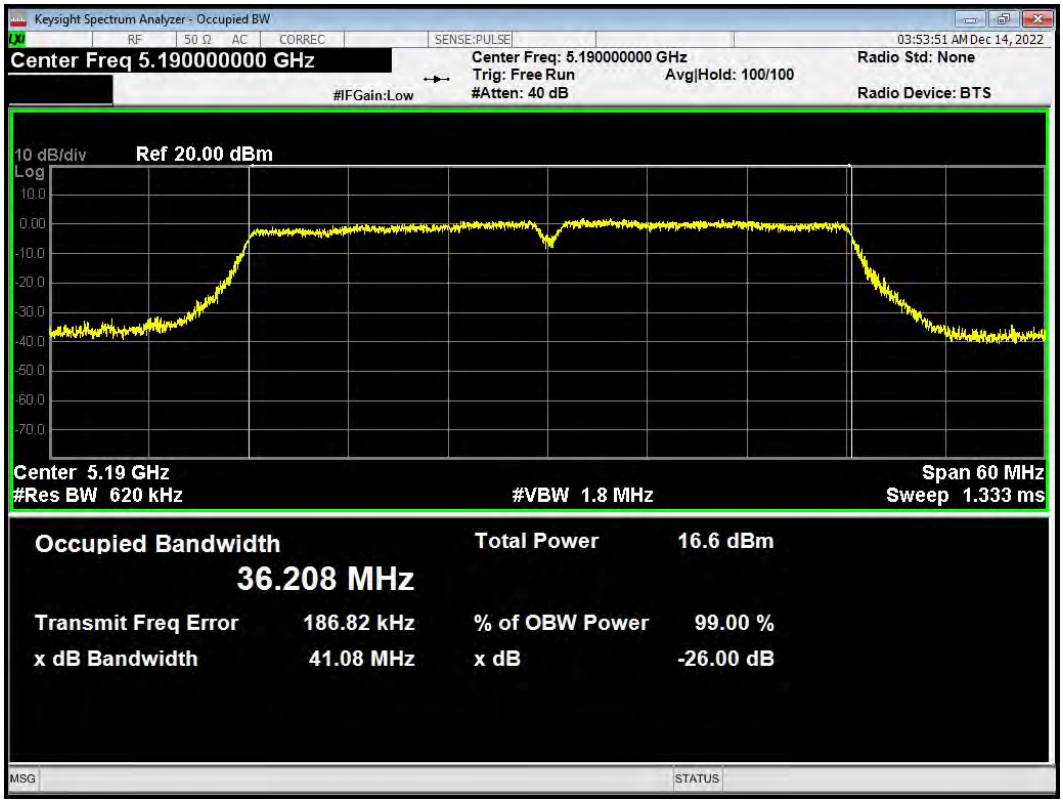

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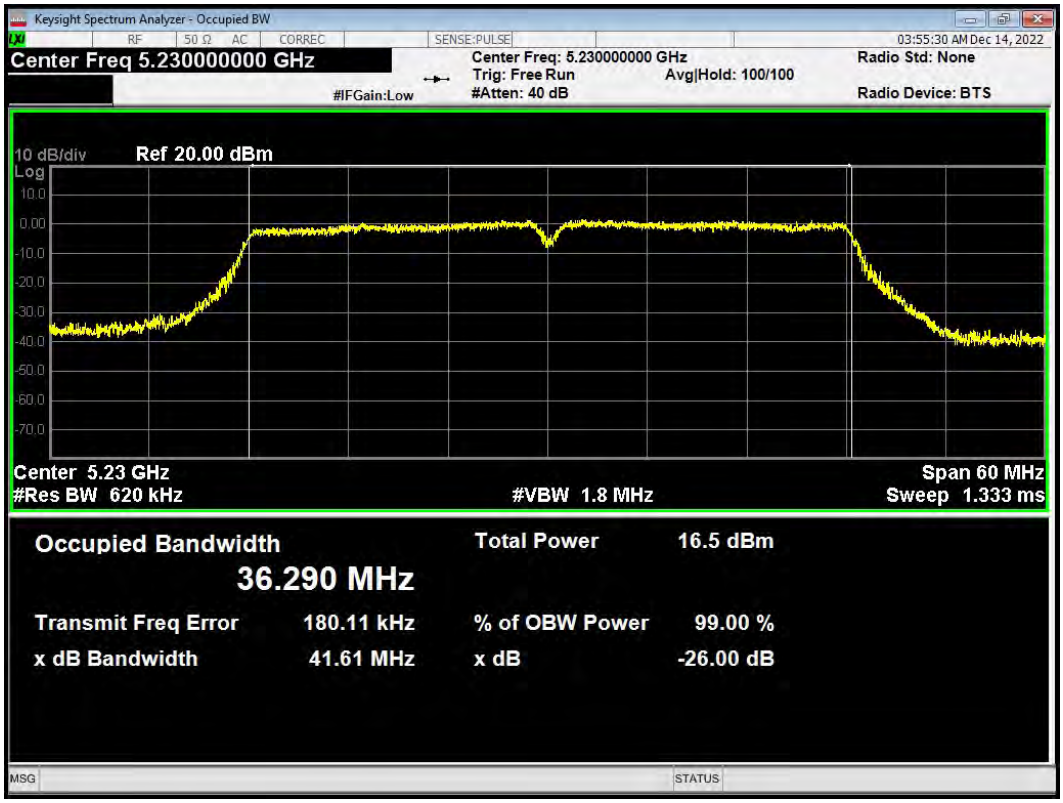
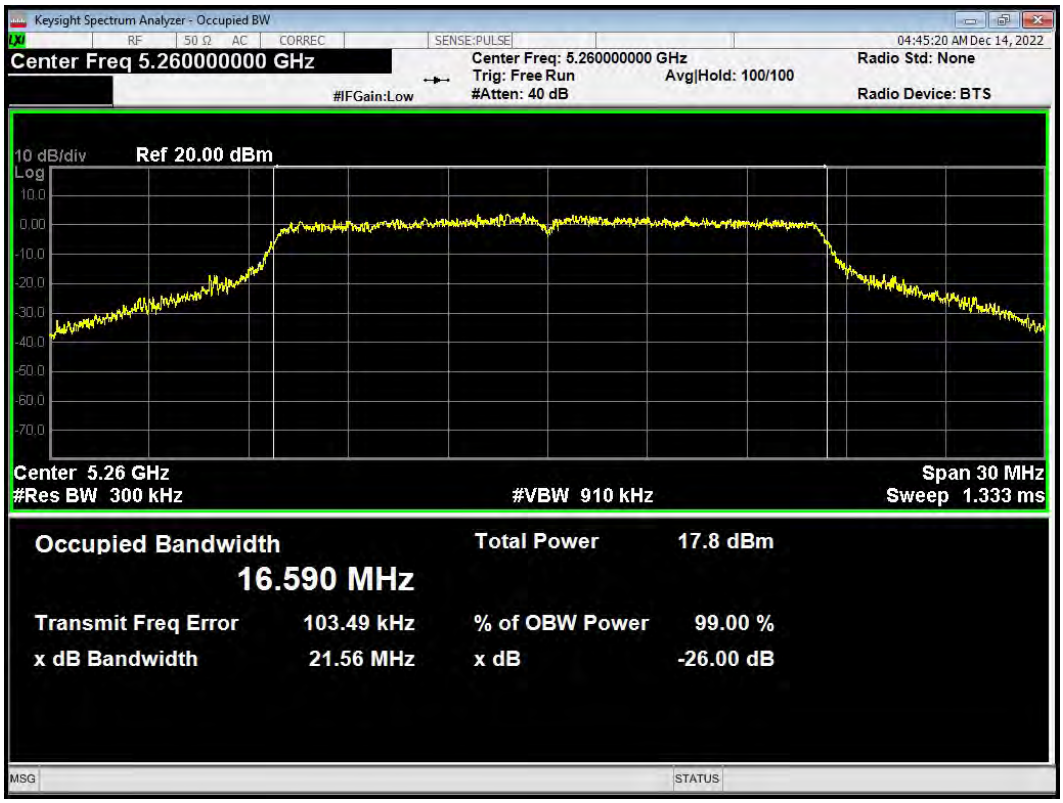


U-NII-2A

OBW 802.11a 5260MHz



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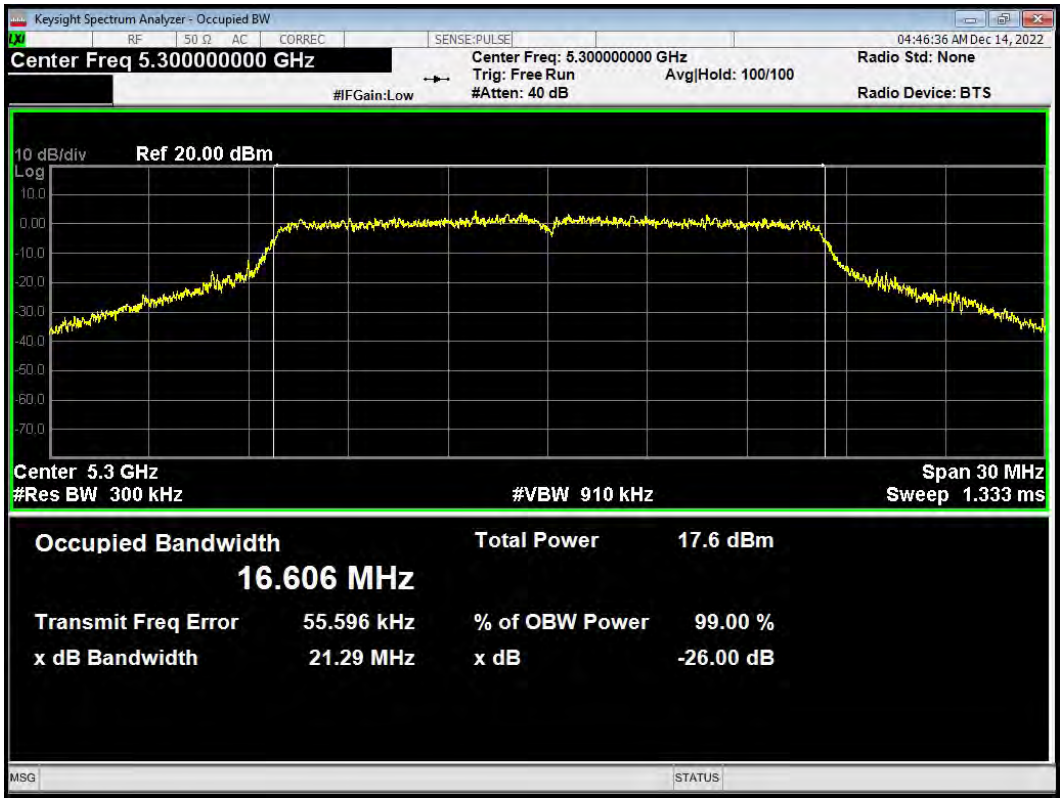

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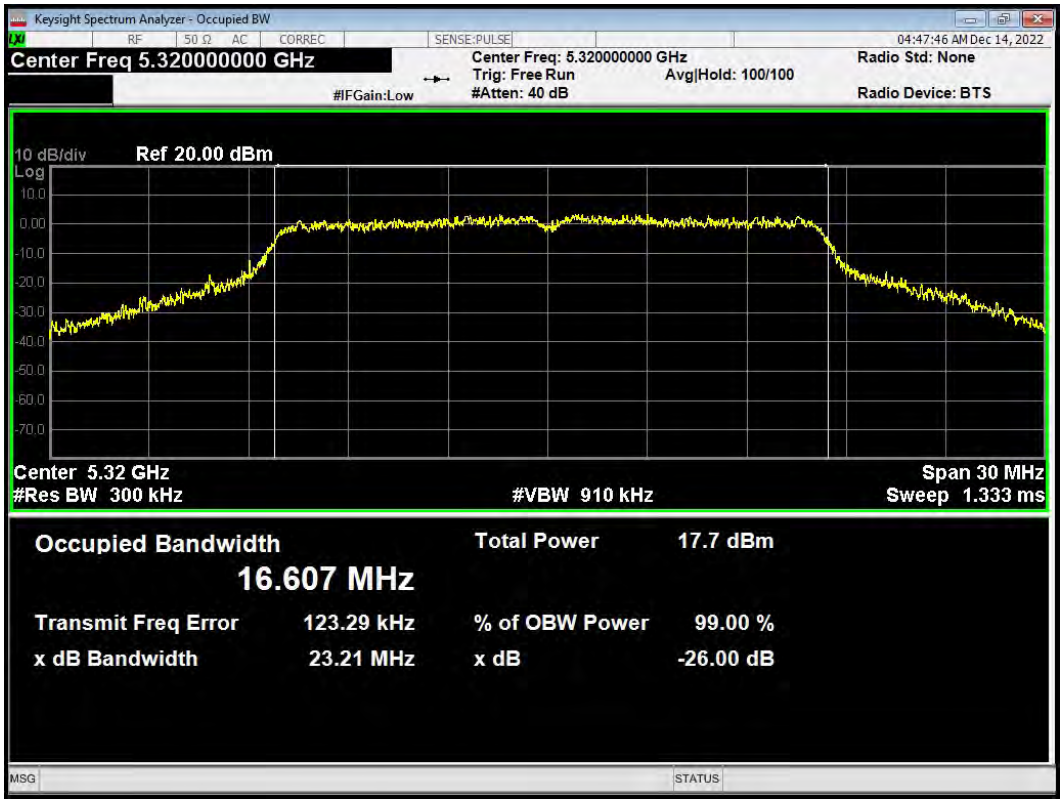
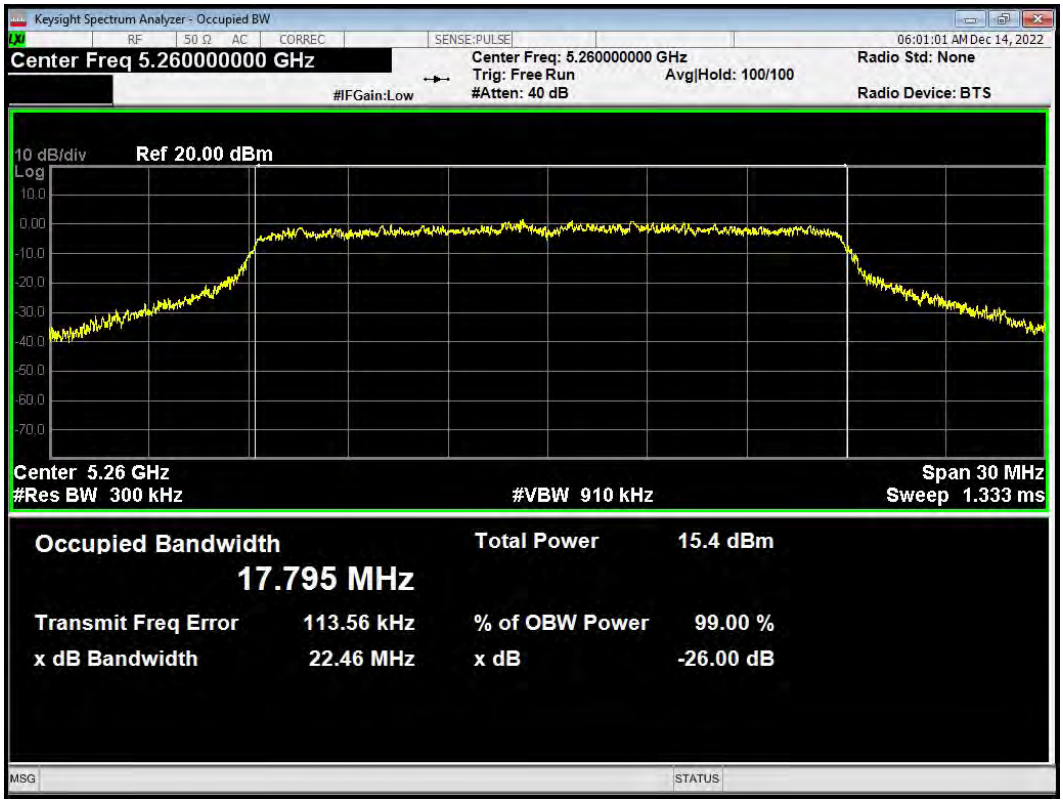


OBW 802.11ac(VHT20) 5260MHz



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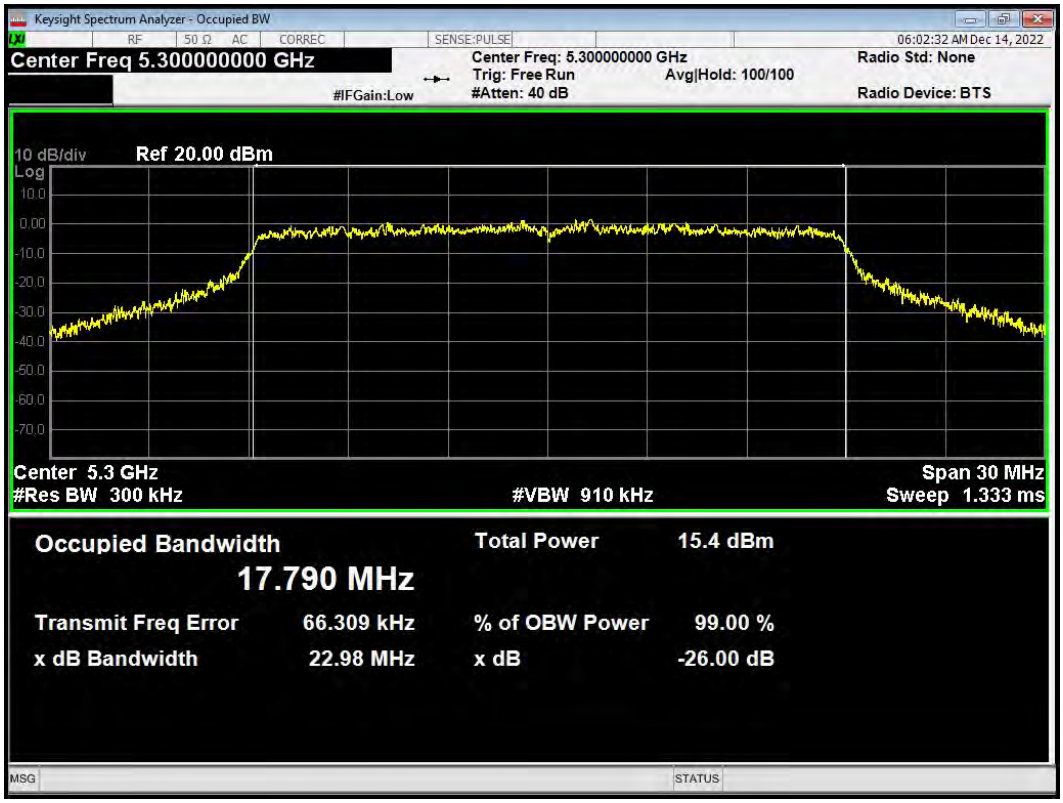

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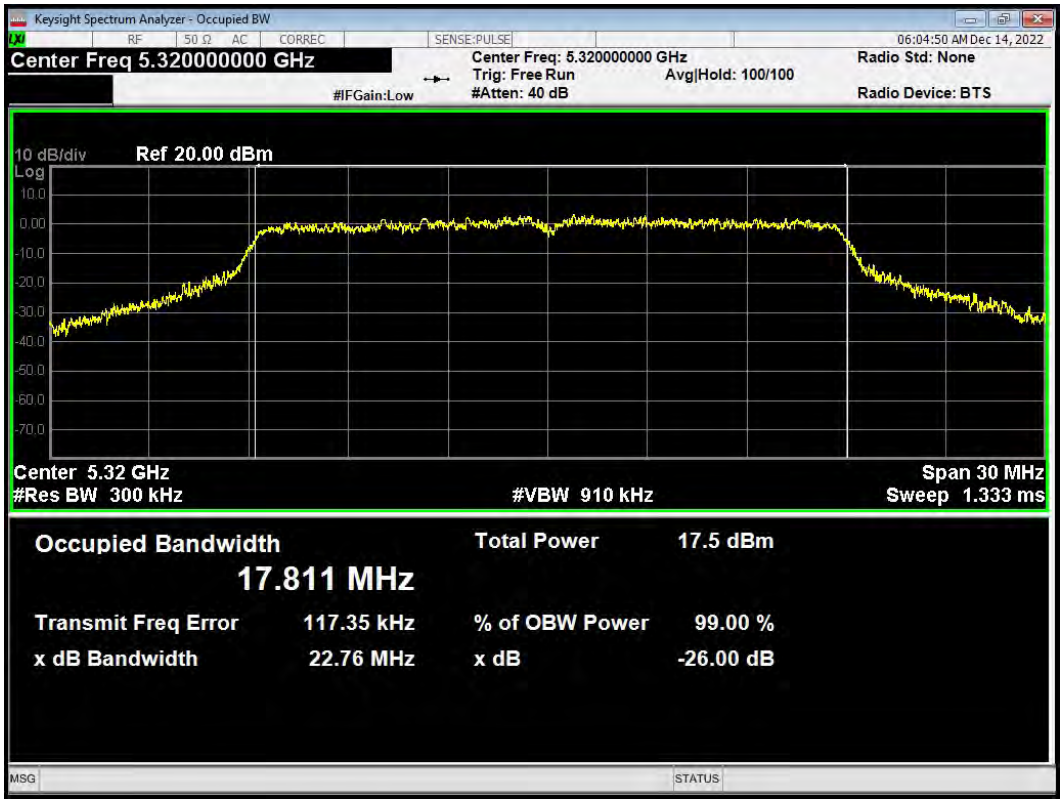

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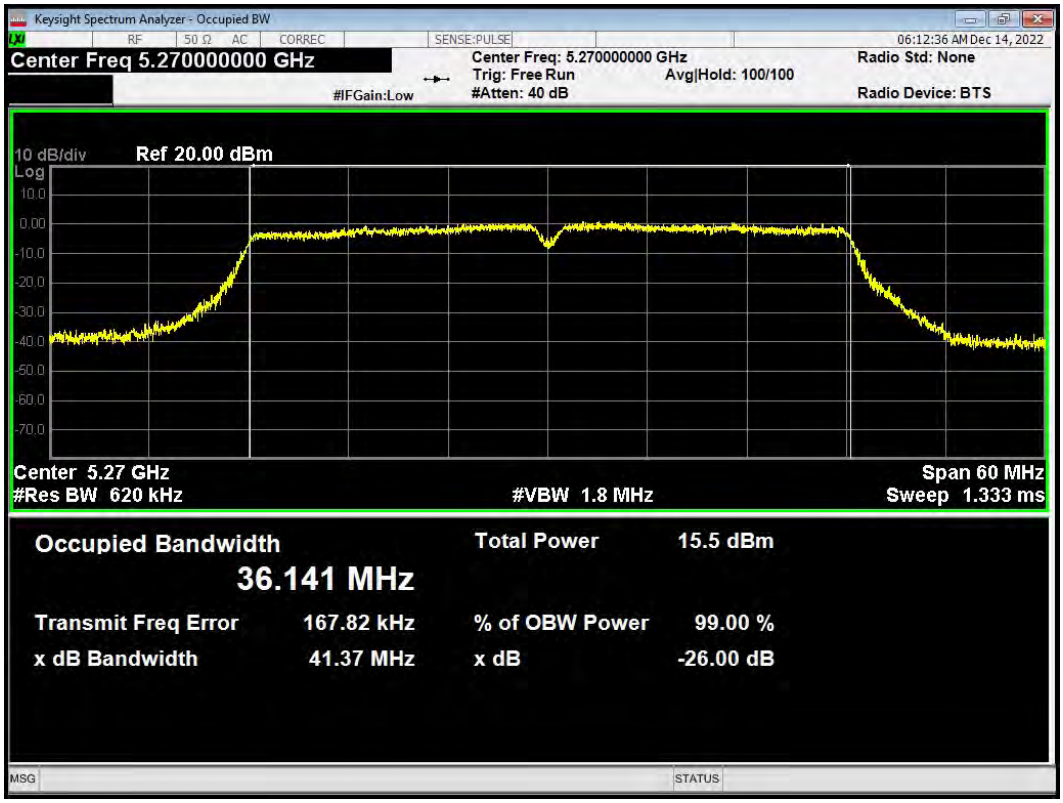

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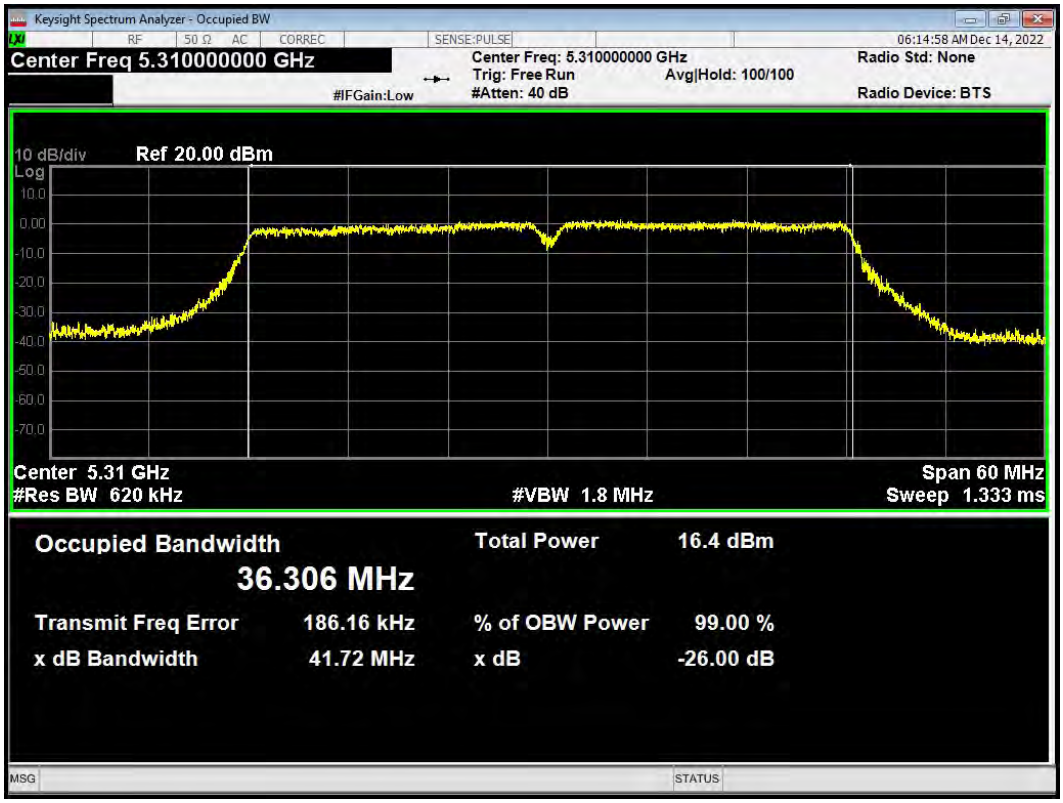

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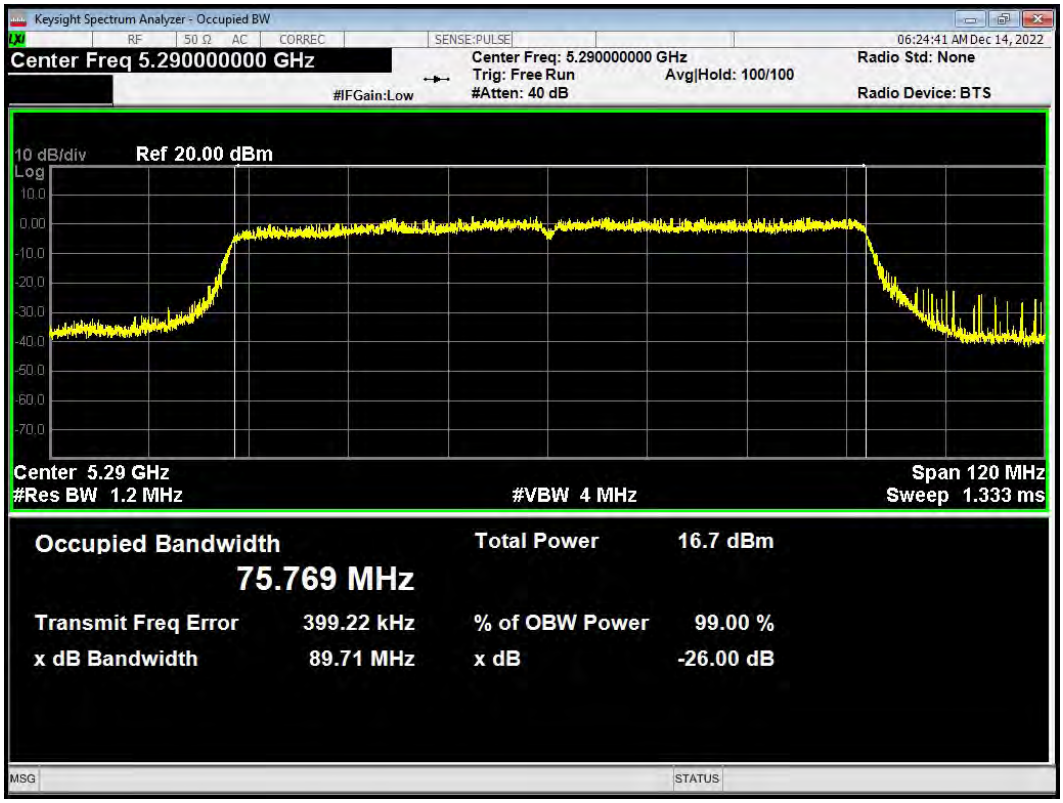

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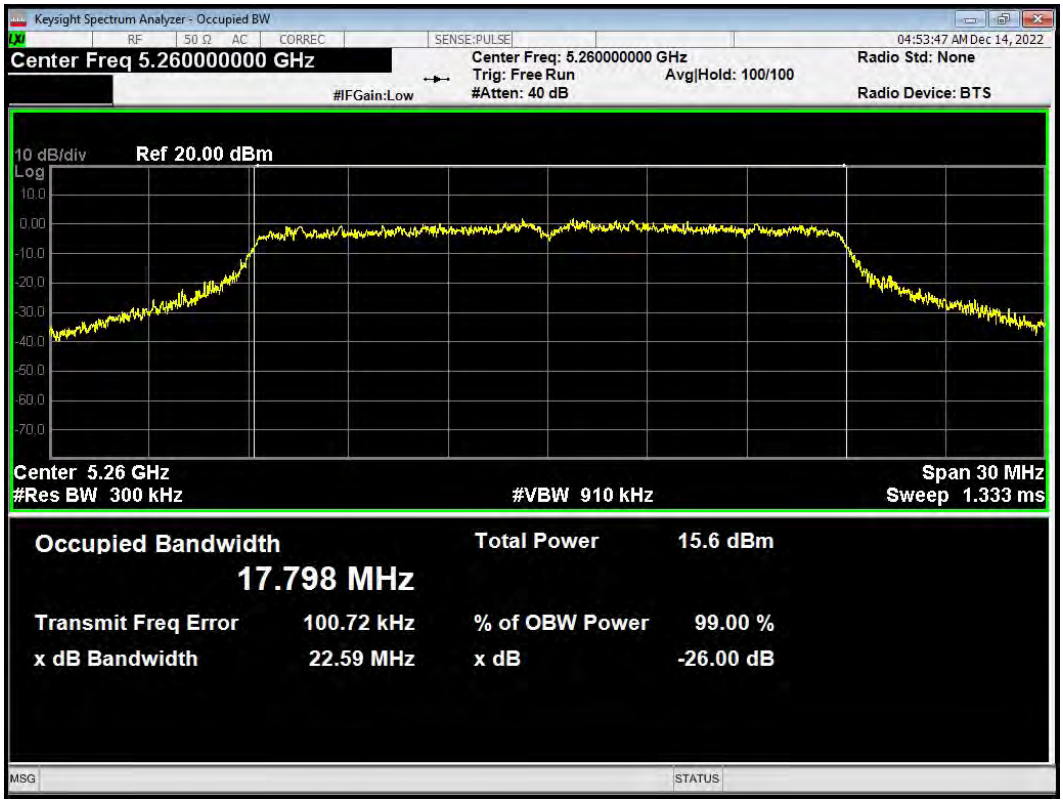

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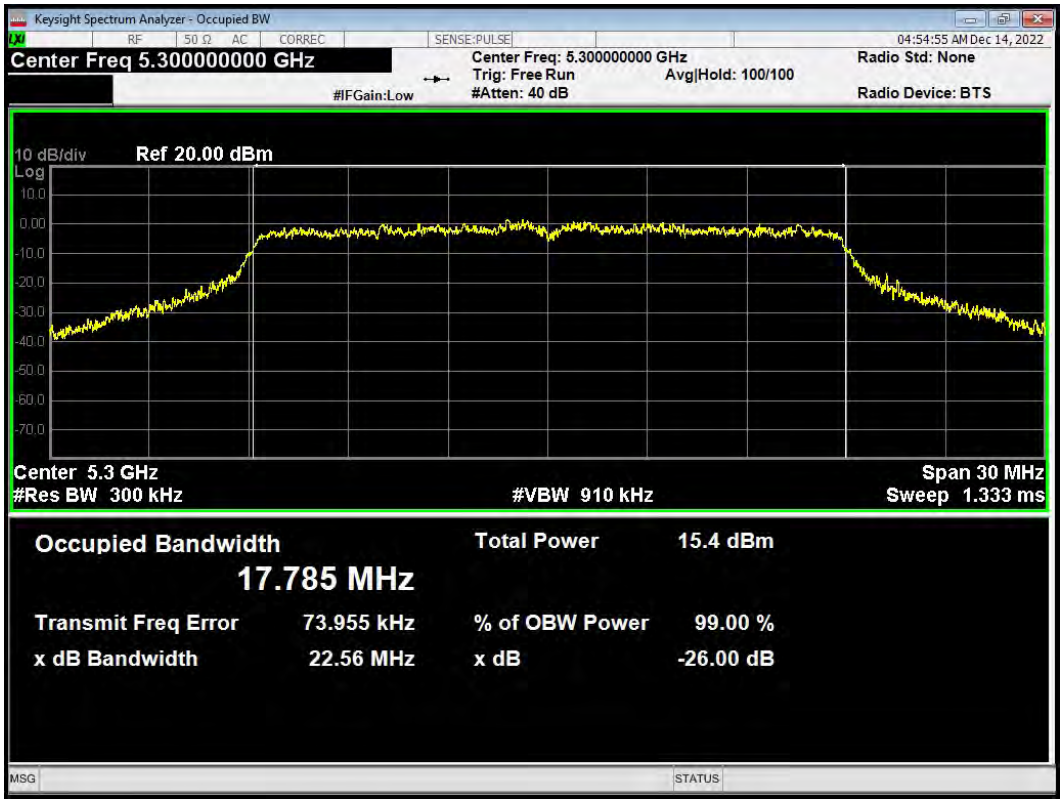

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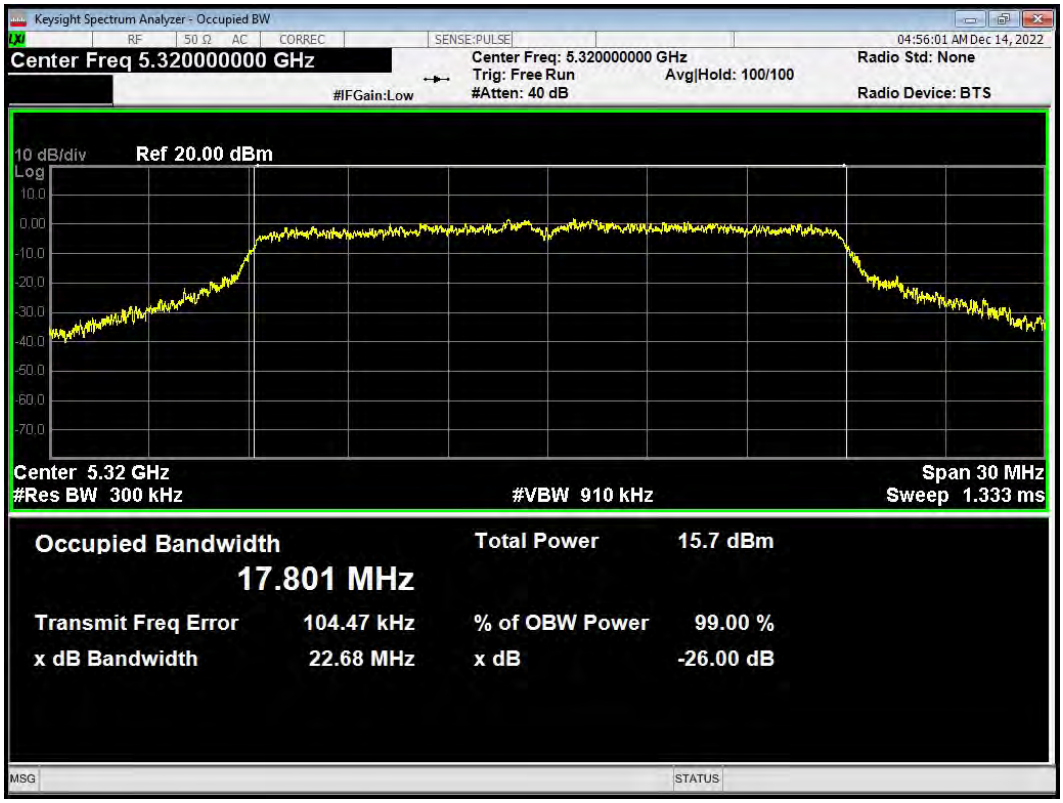
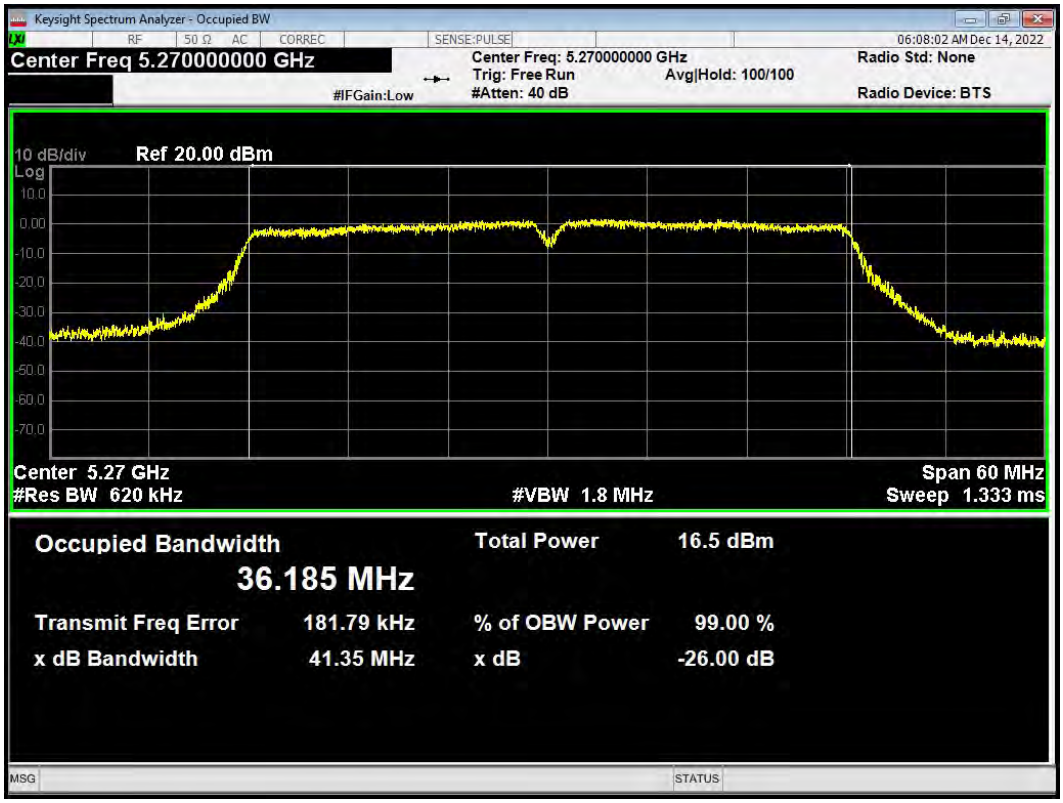
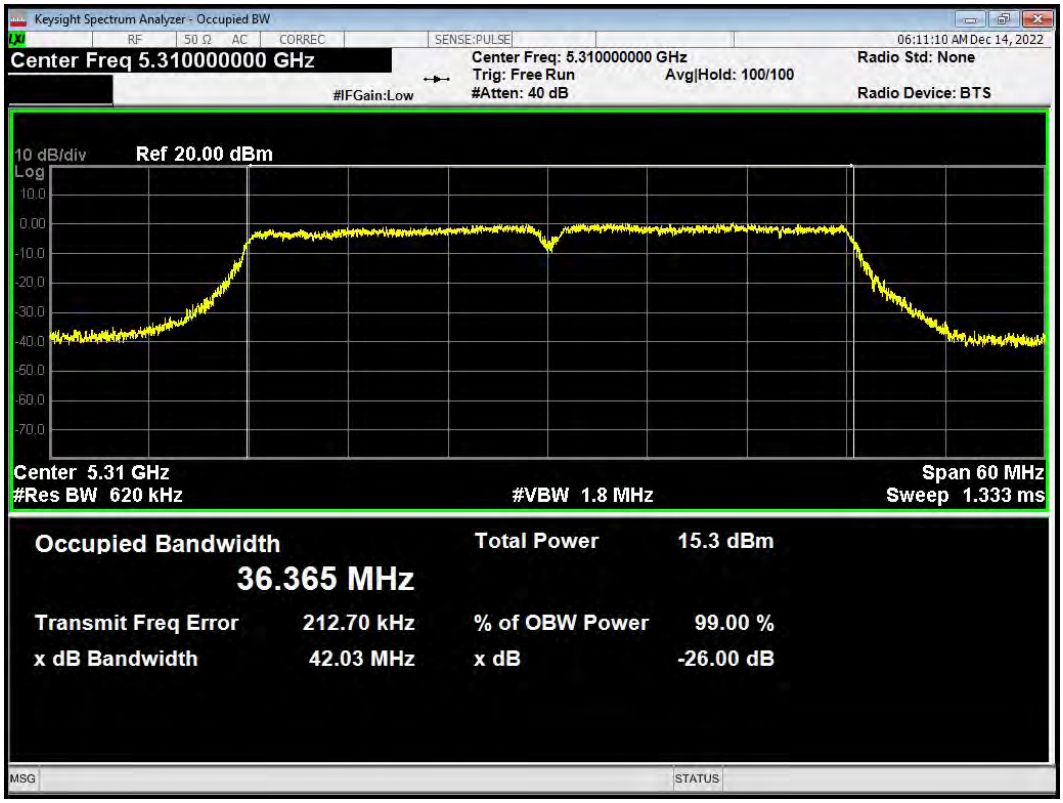


OBW 802.11n(HT40) 5270MHz

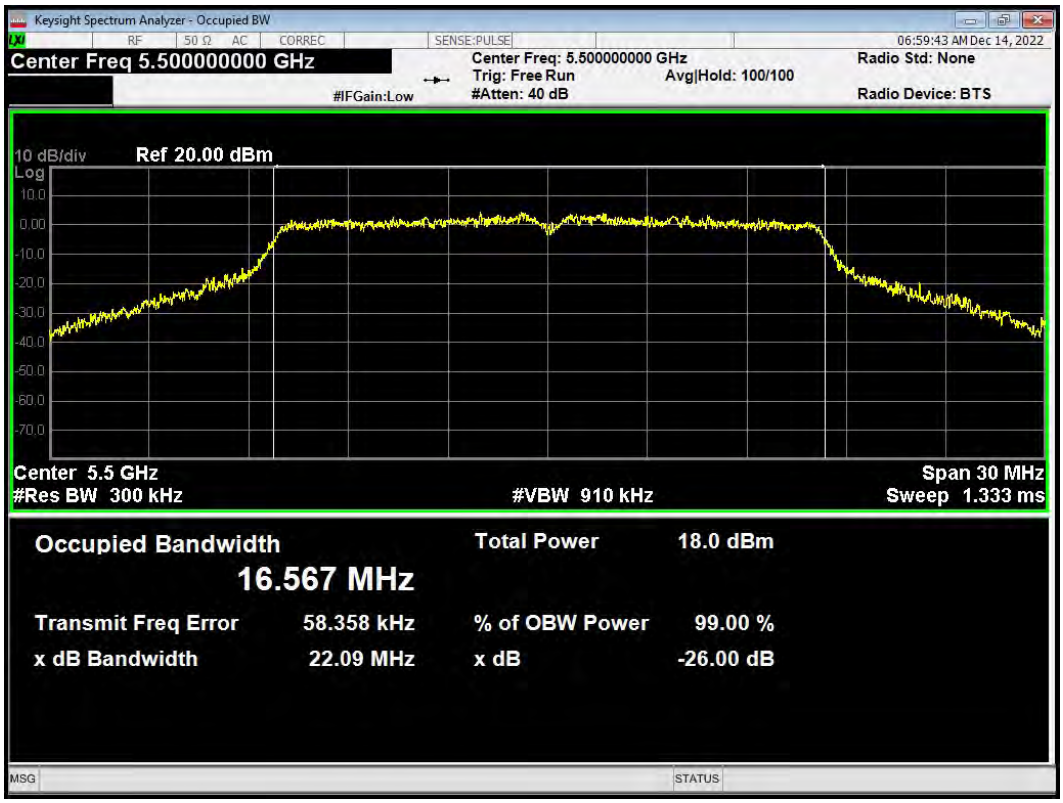


OBW 802.11n(HT40) 5310MHz



U-NII-2C

OBW 802.11a 5500MHz



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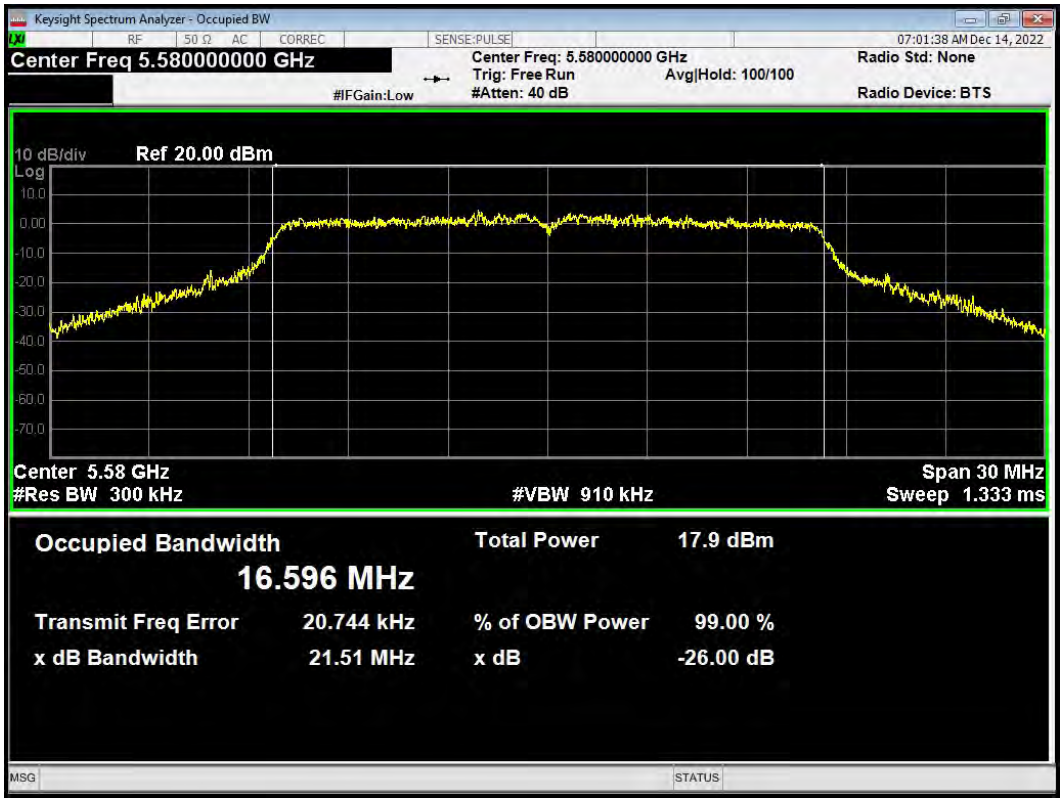
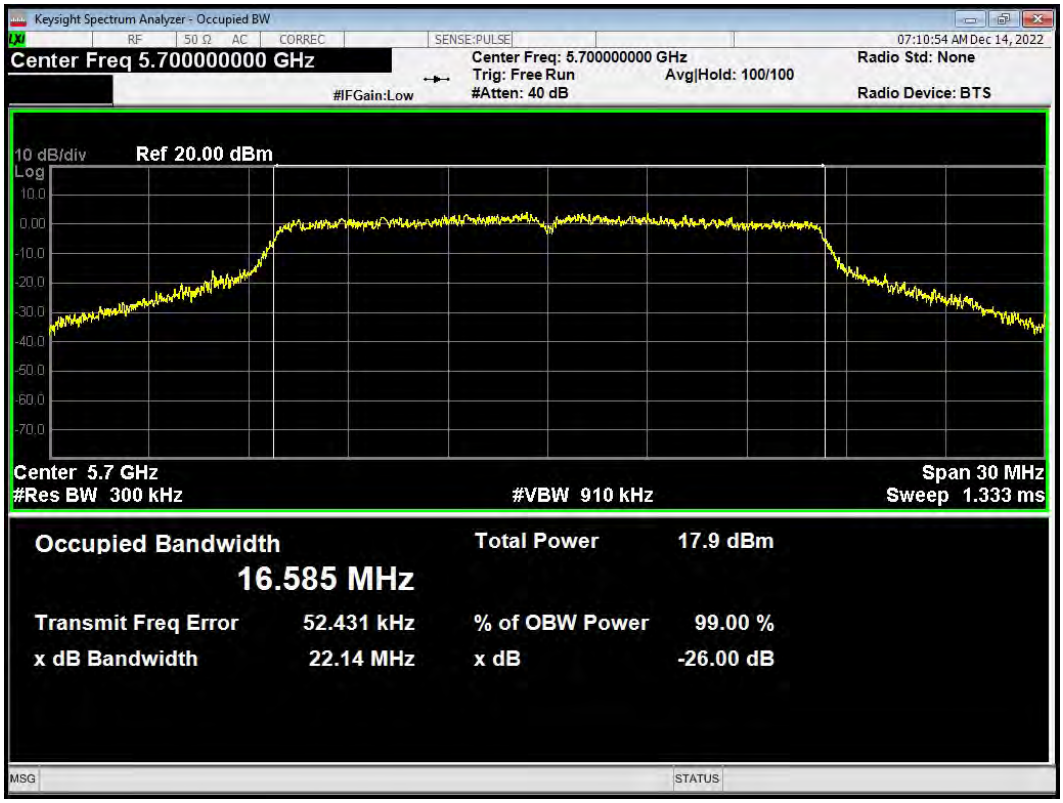
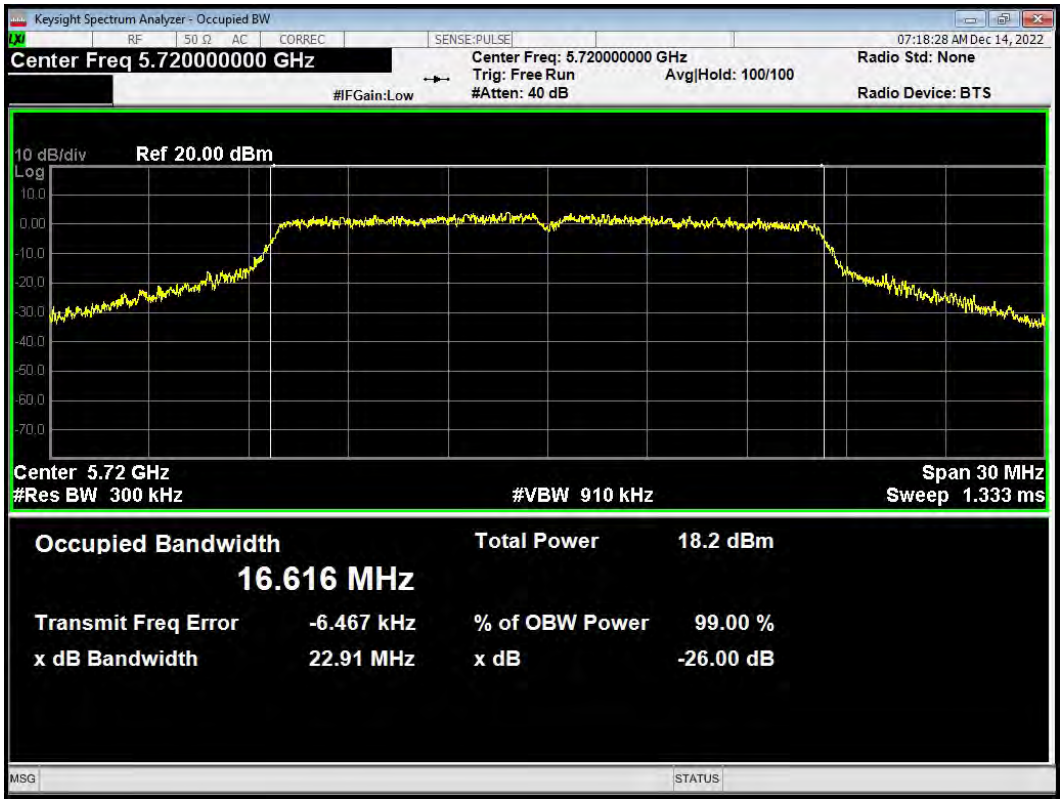


OBW 802.11a 5700MHz



OBW 802.11a 5720MHz



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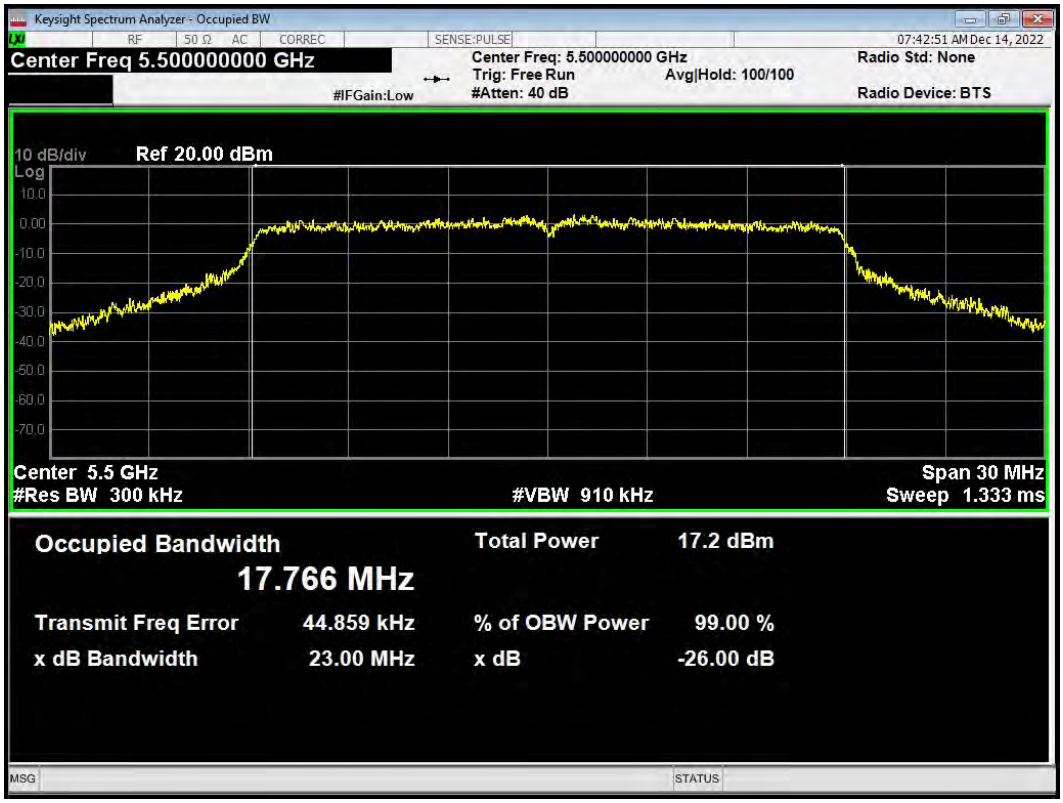
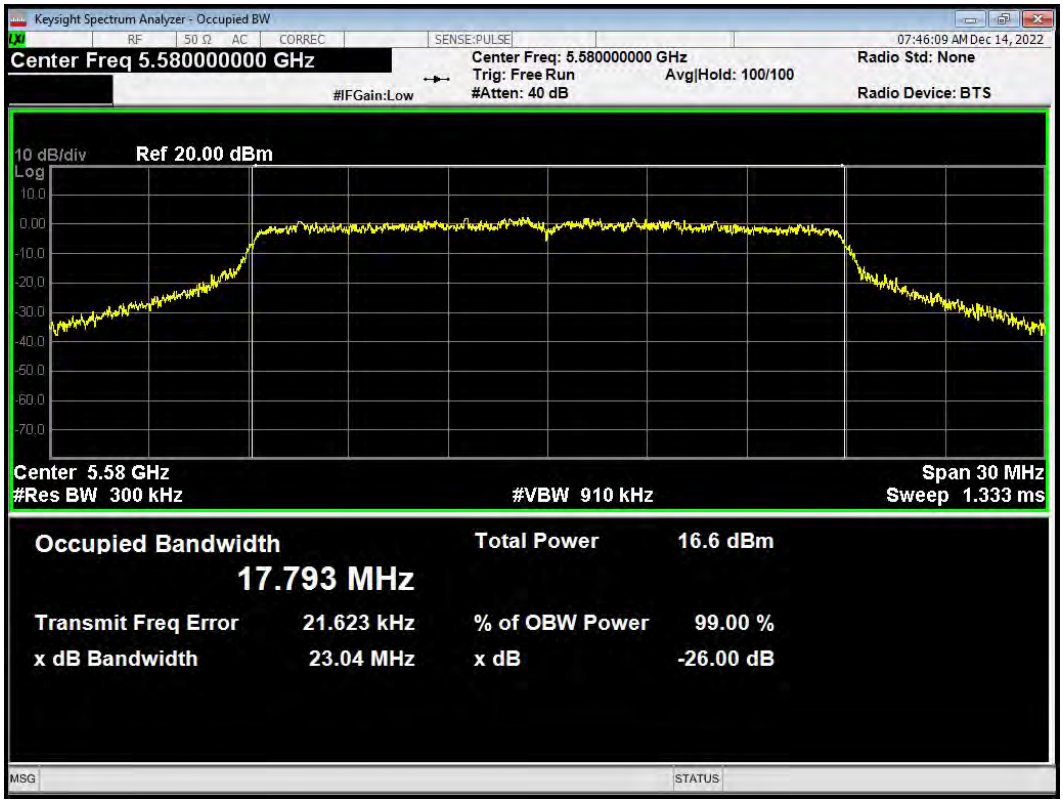


OBW 802.11ac(VHT20) 5580MHz



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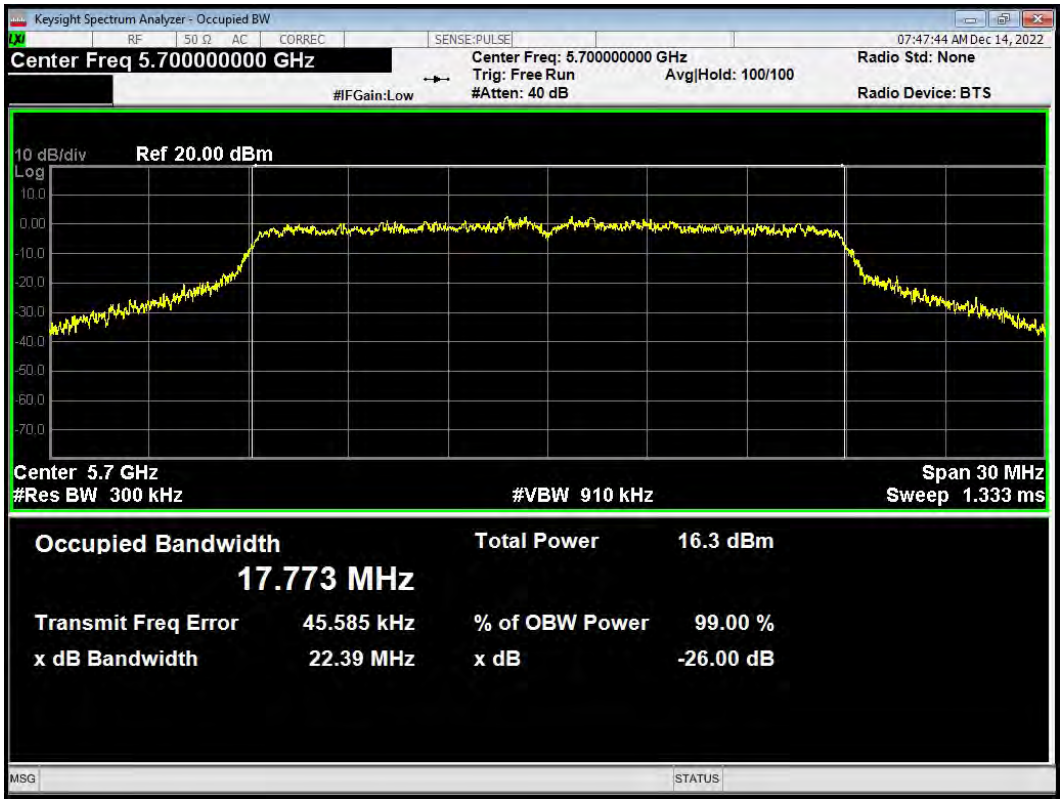

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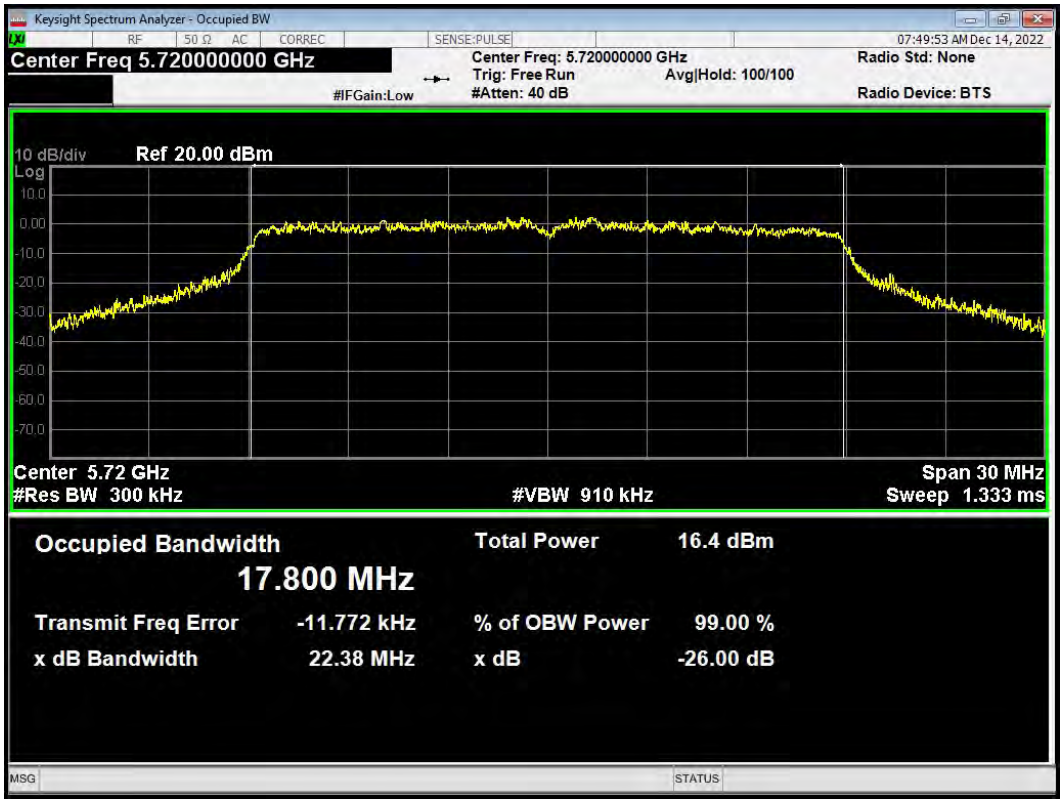

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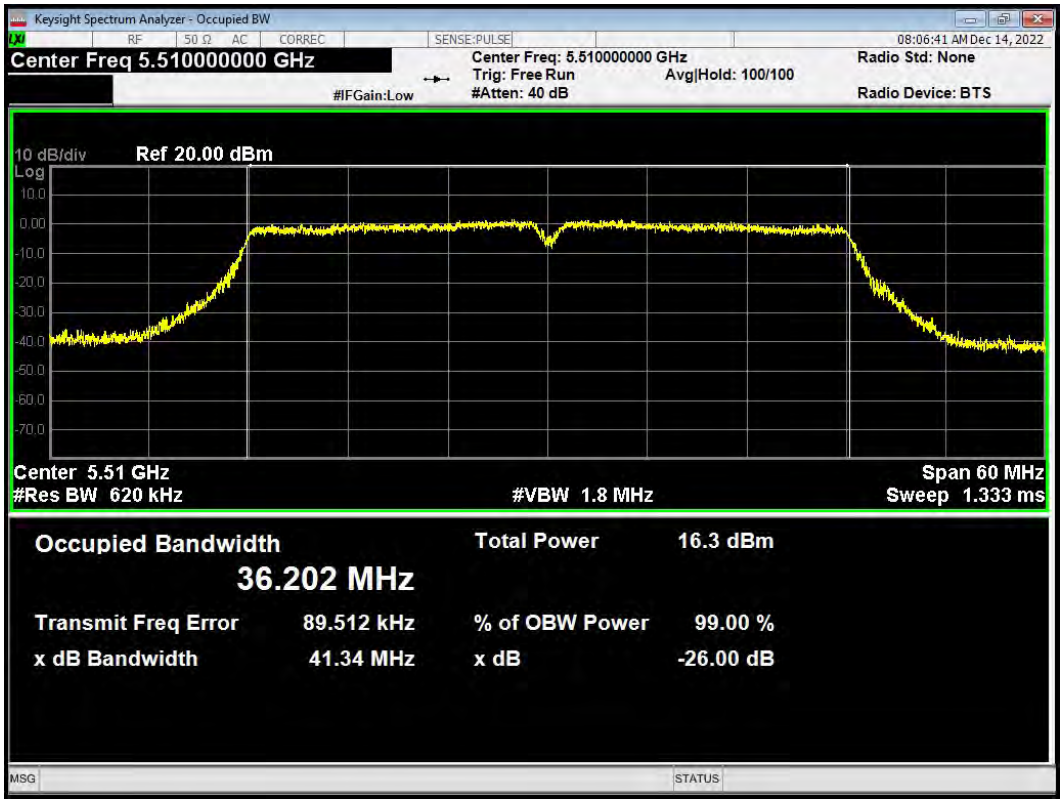

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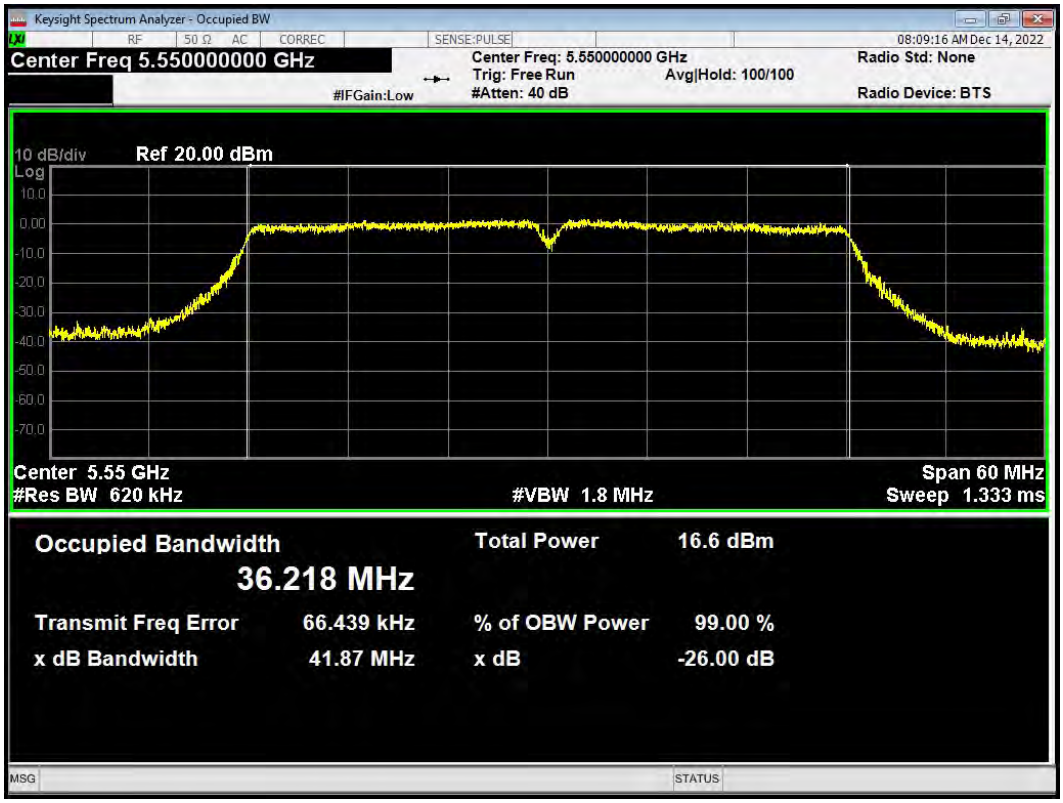

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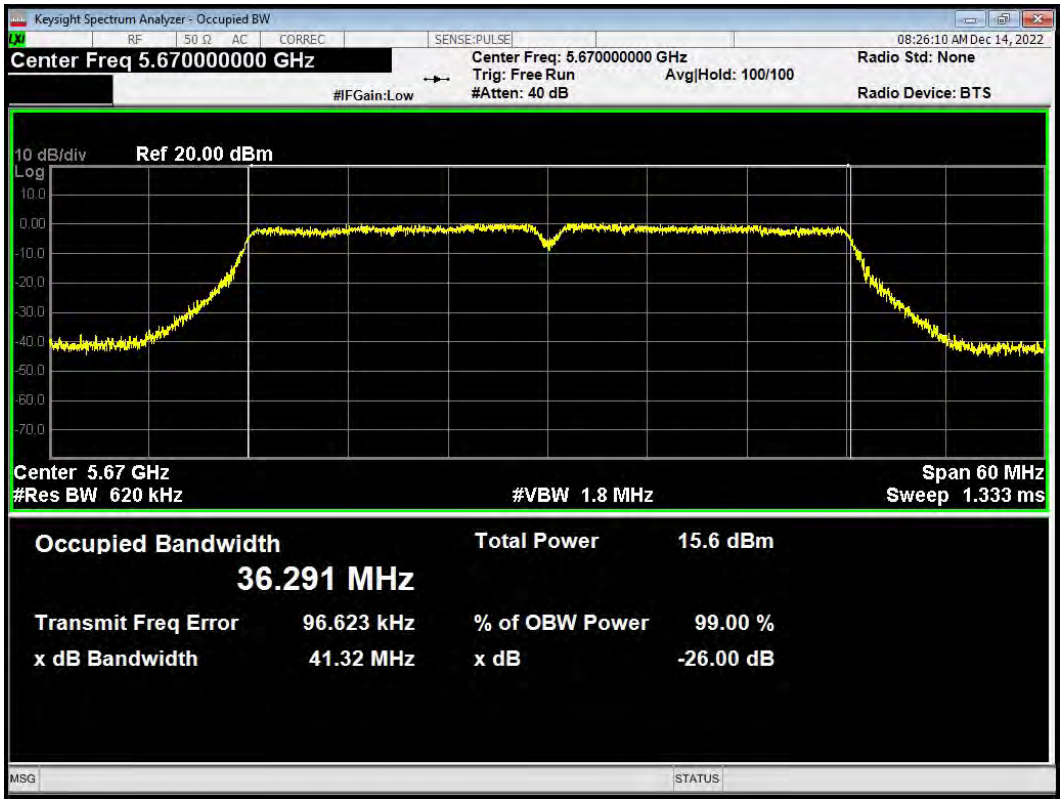
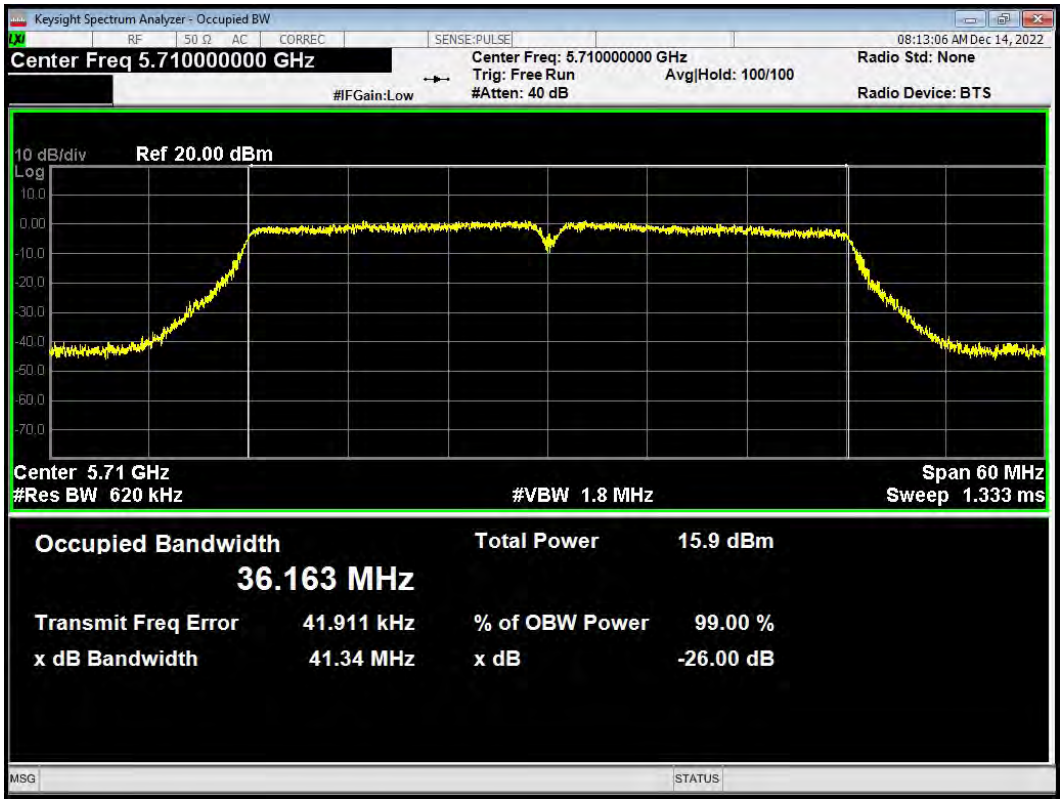
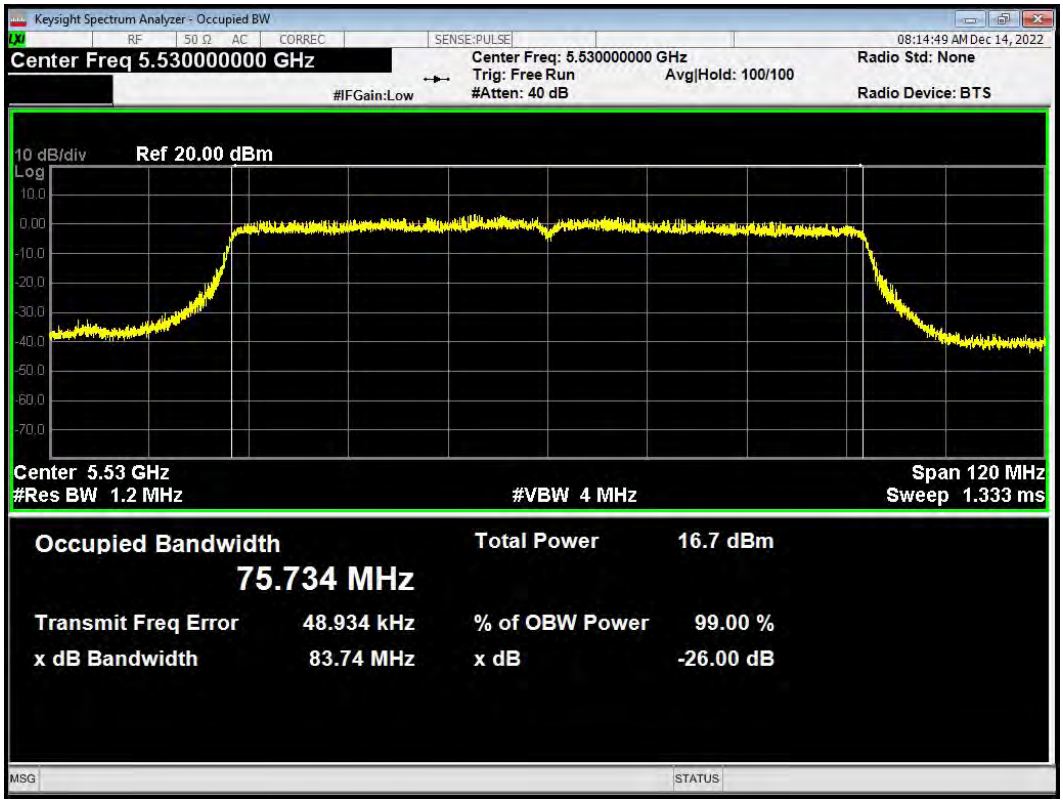


OBW 802.11ac(VHT40) 5710MHz



OBW 802.11ac(VHT80) 5530MHz



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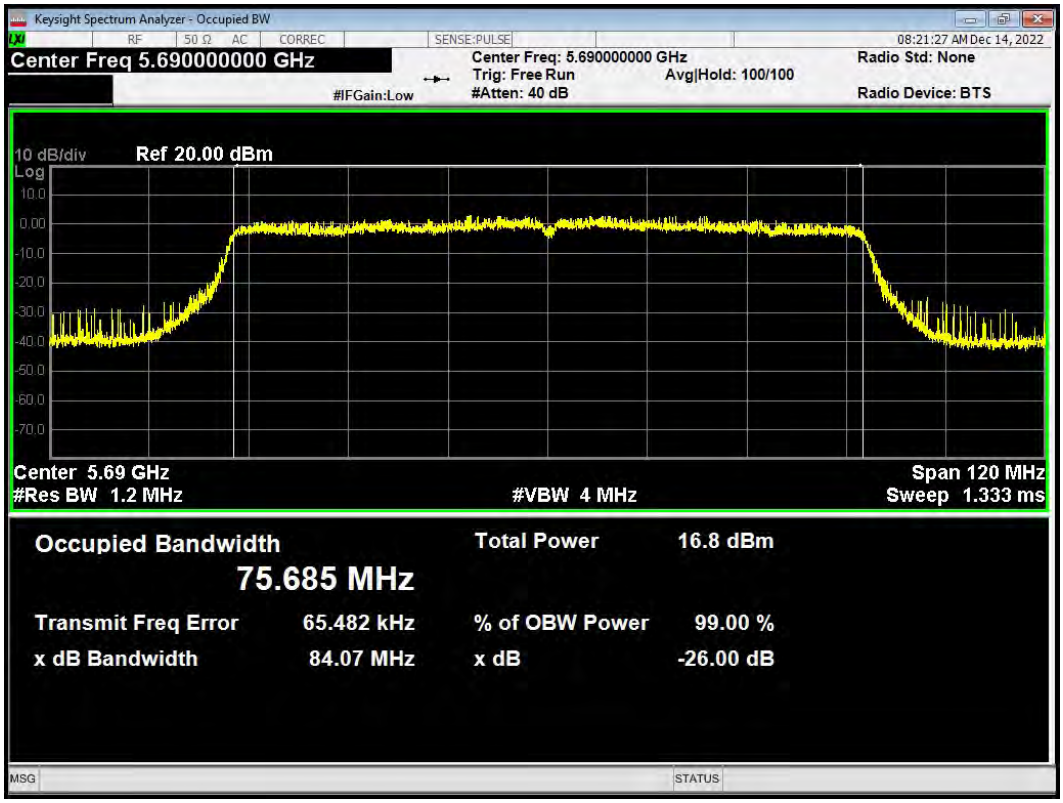

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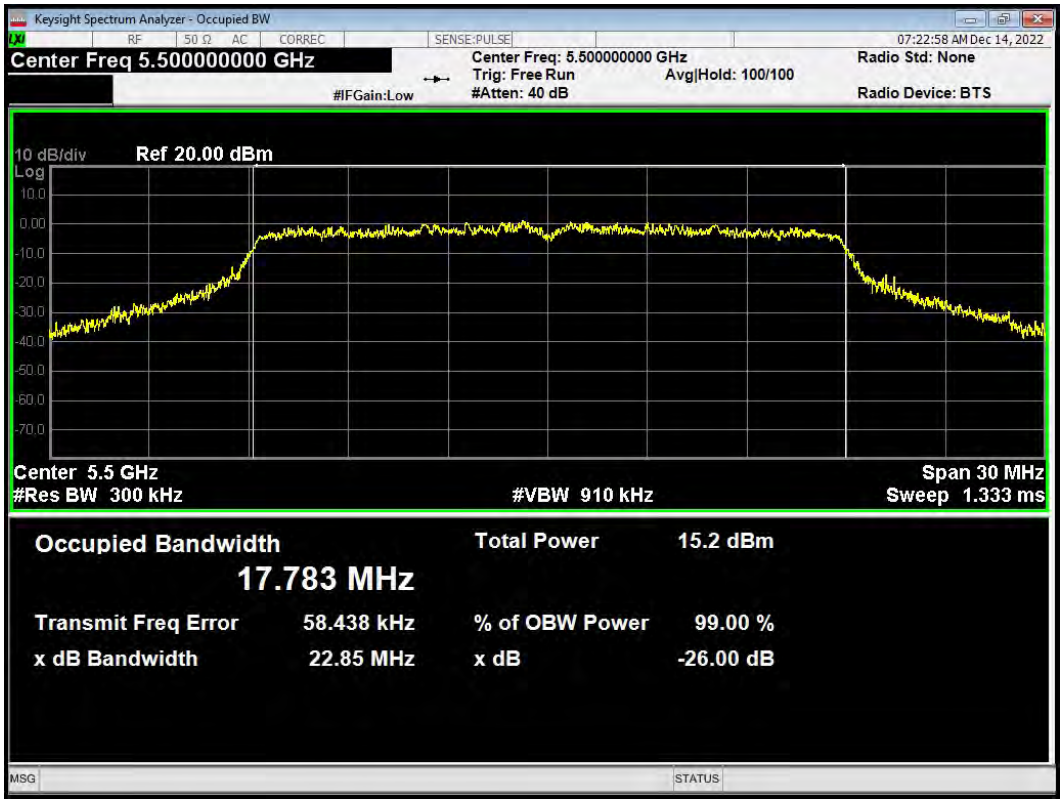

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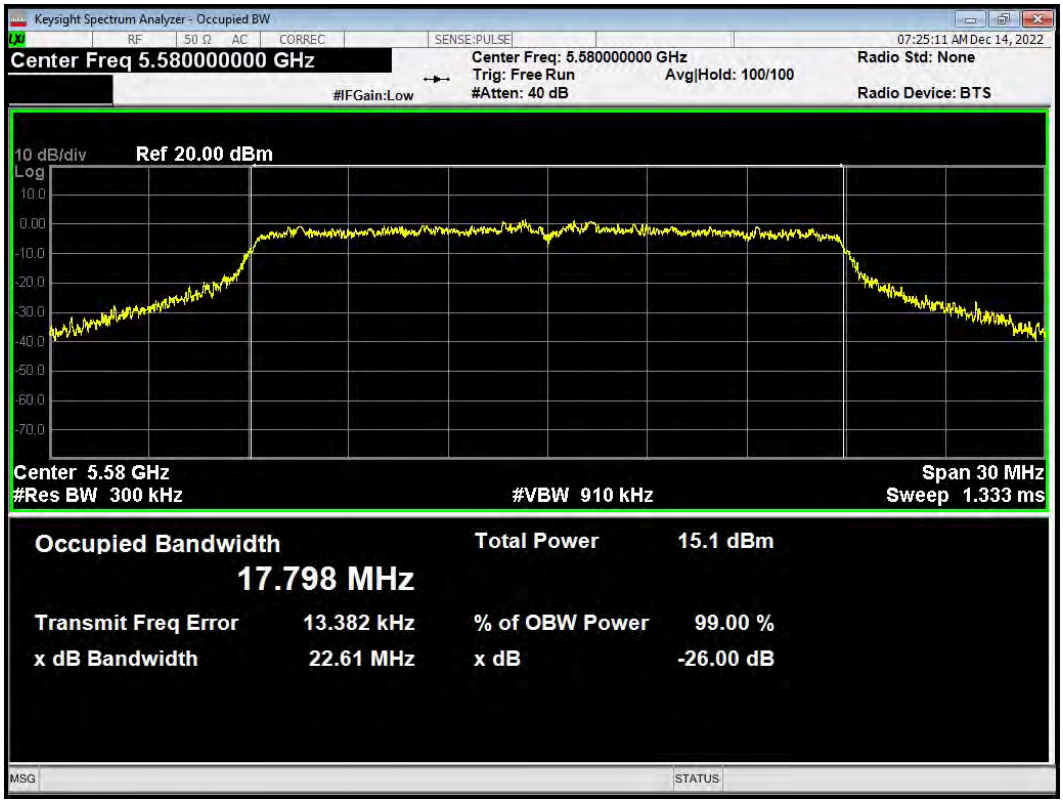

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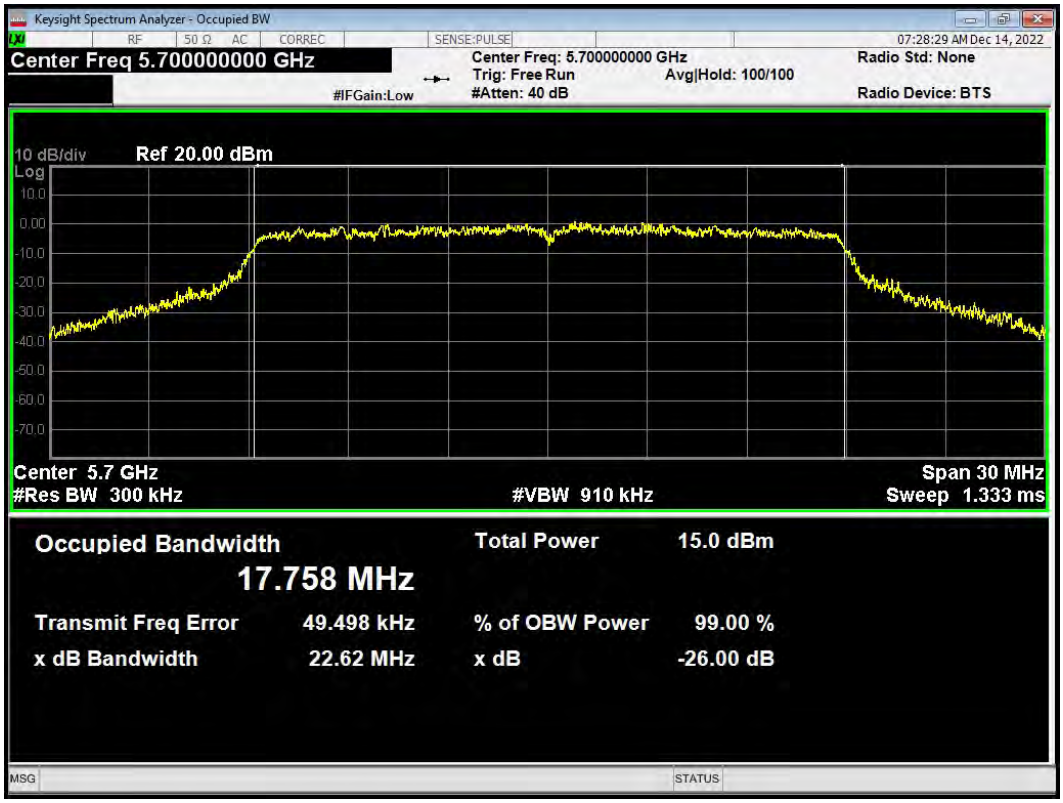
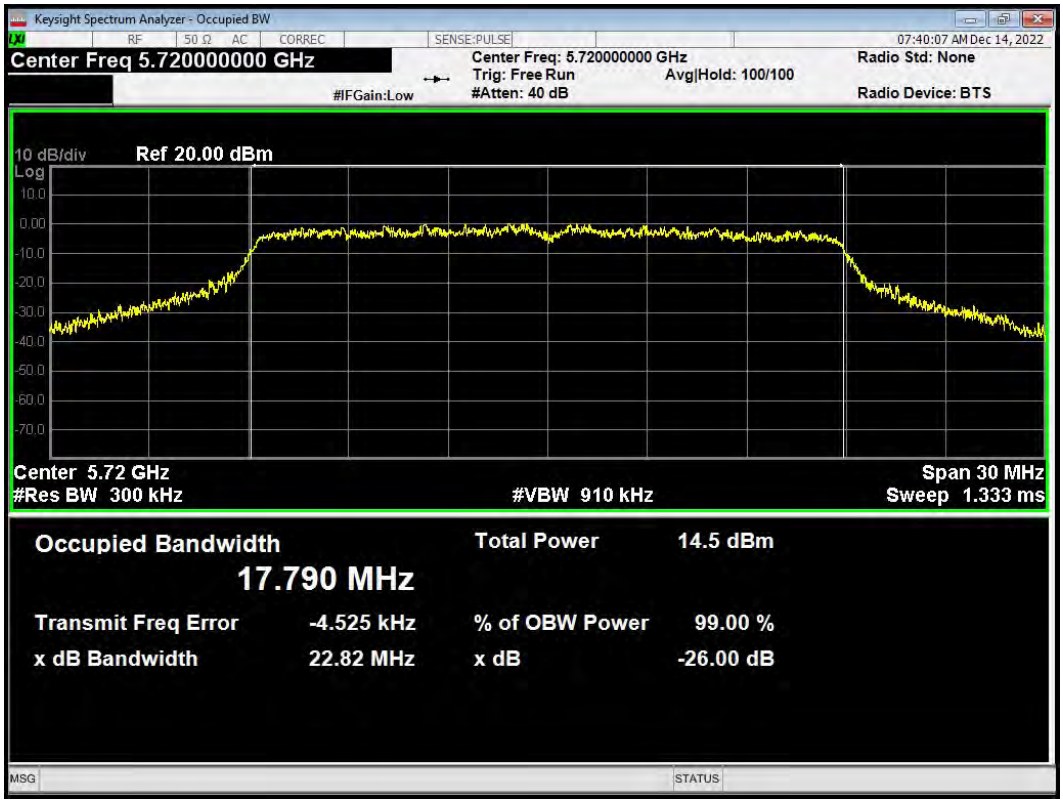


OBW 802.11n(HT20) 5720MHz



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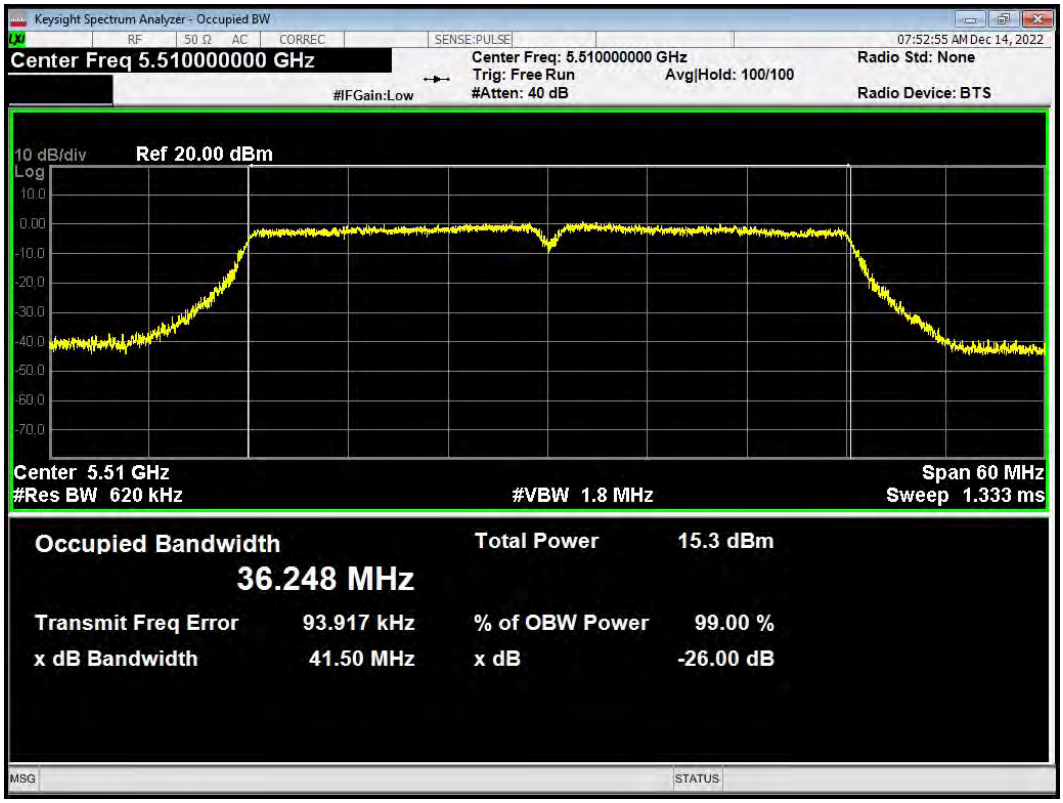
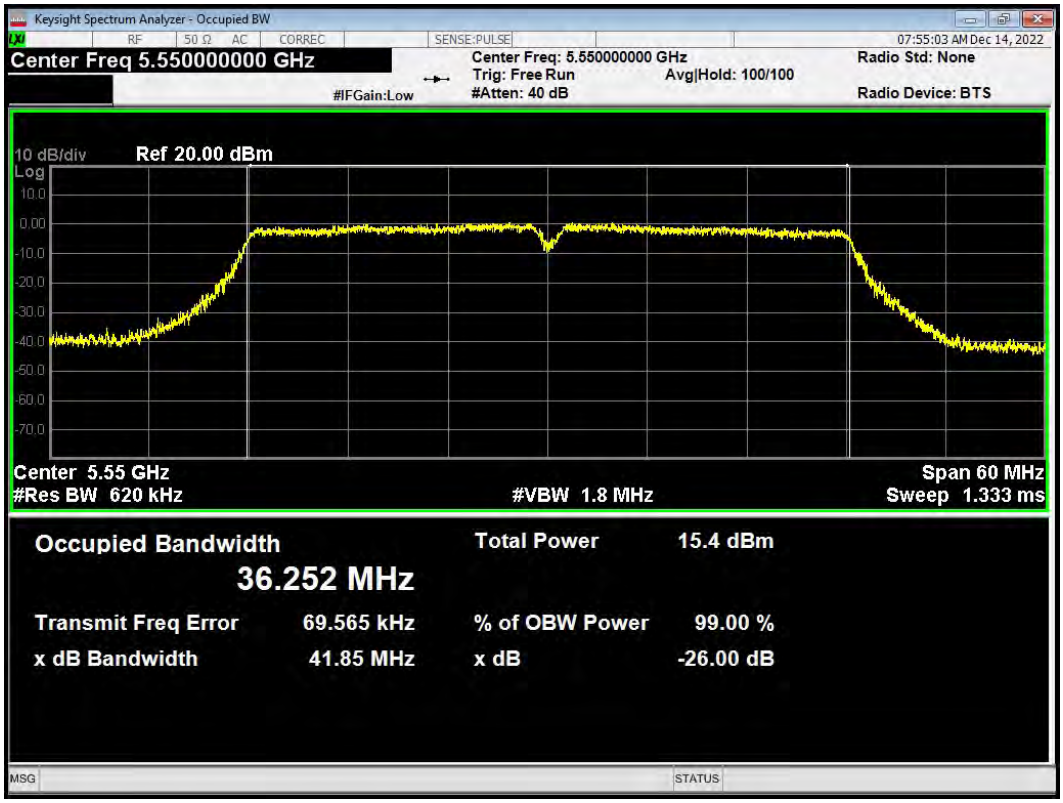


OBW 802.11n(HT40) 5550MHz



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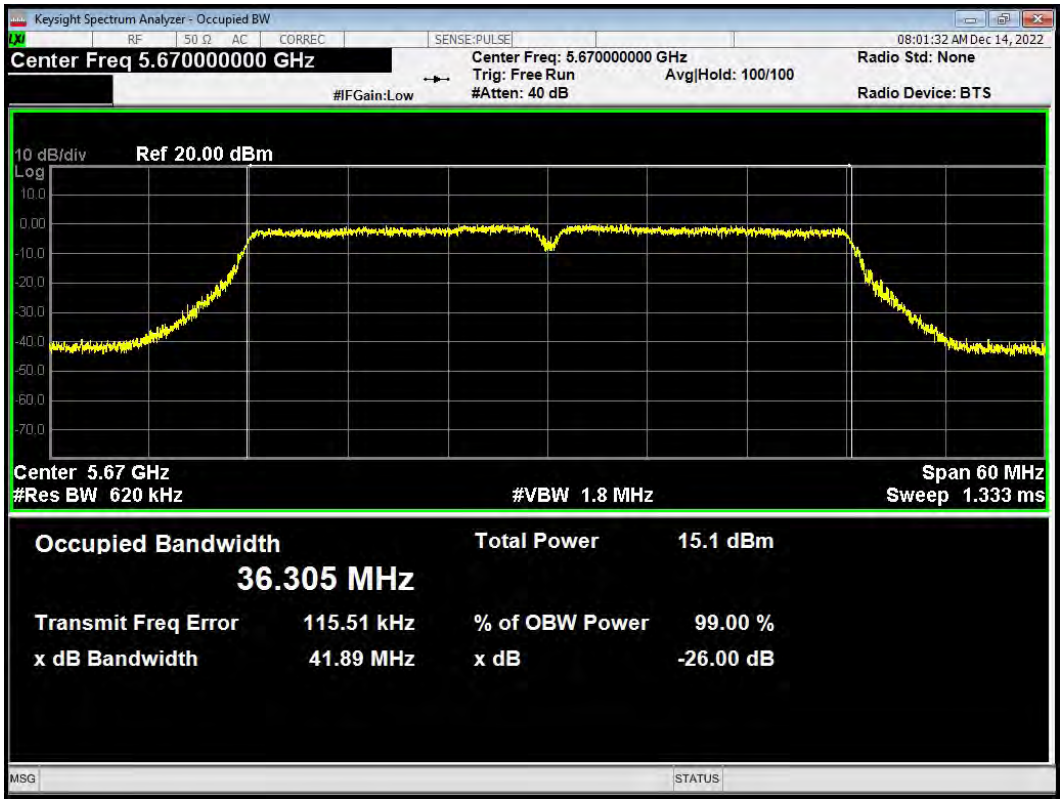
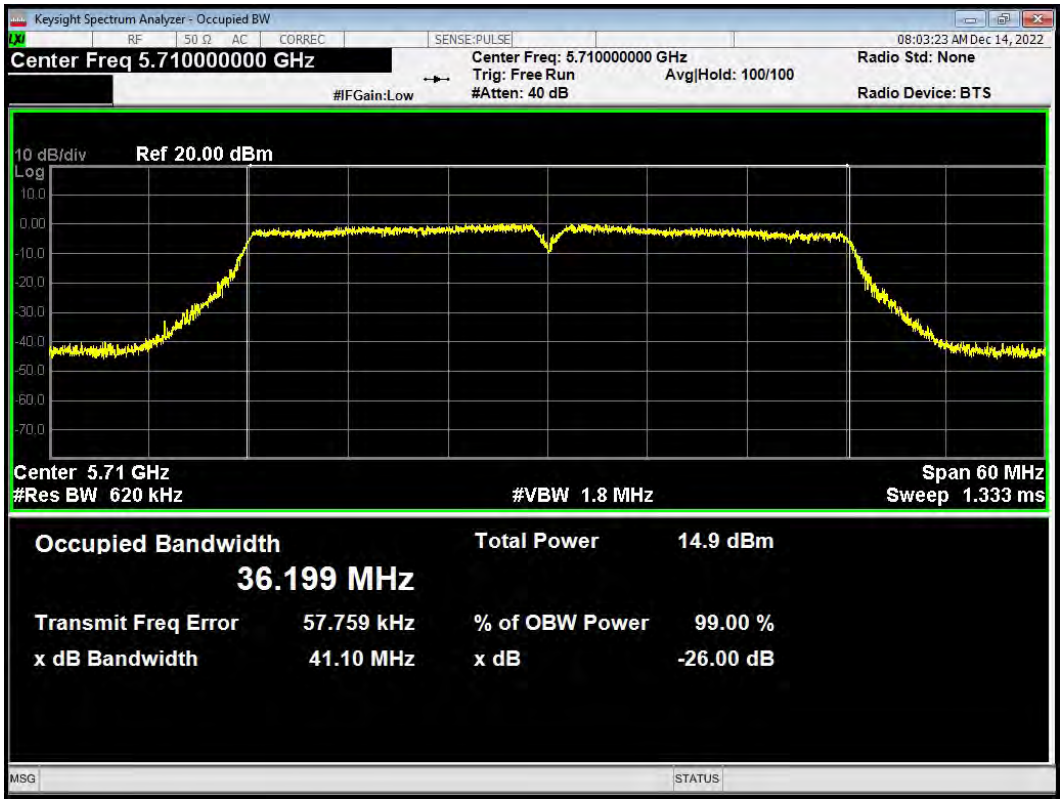


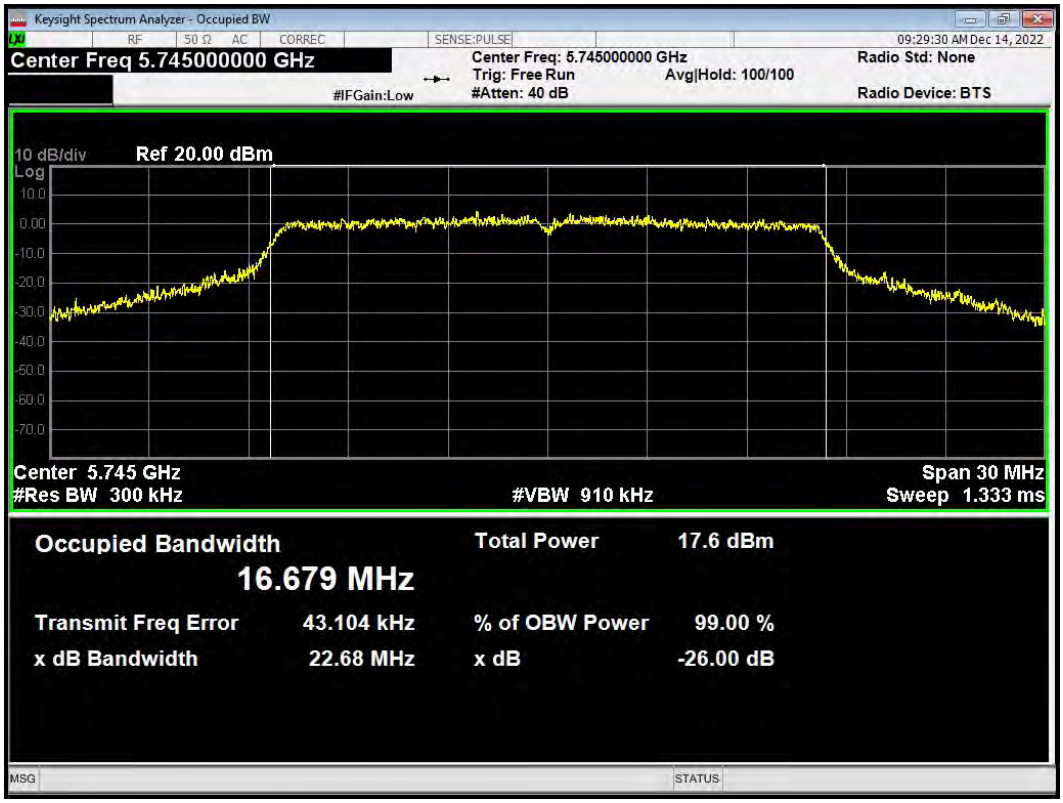
OBW 802.11n(HT40) 5710MHz



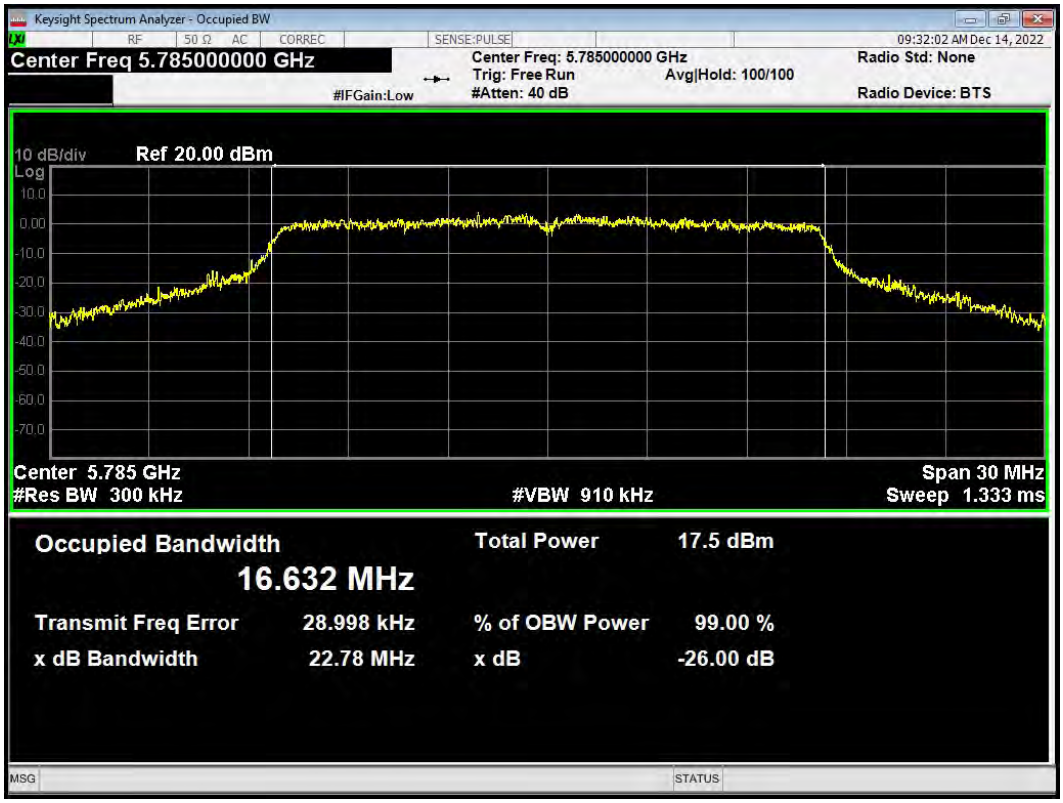
U-NII-3

99% bandwidth

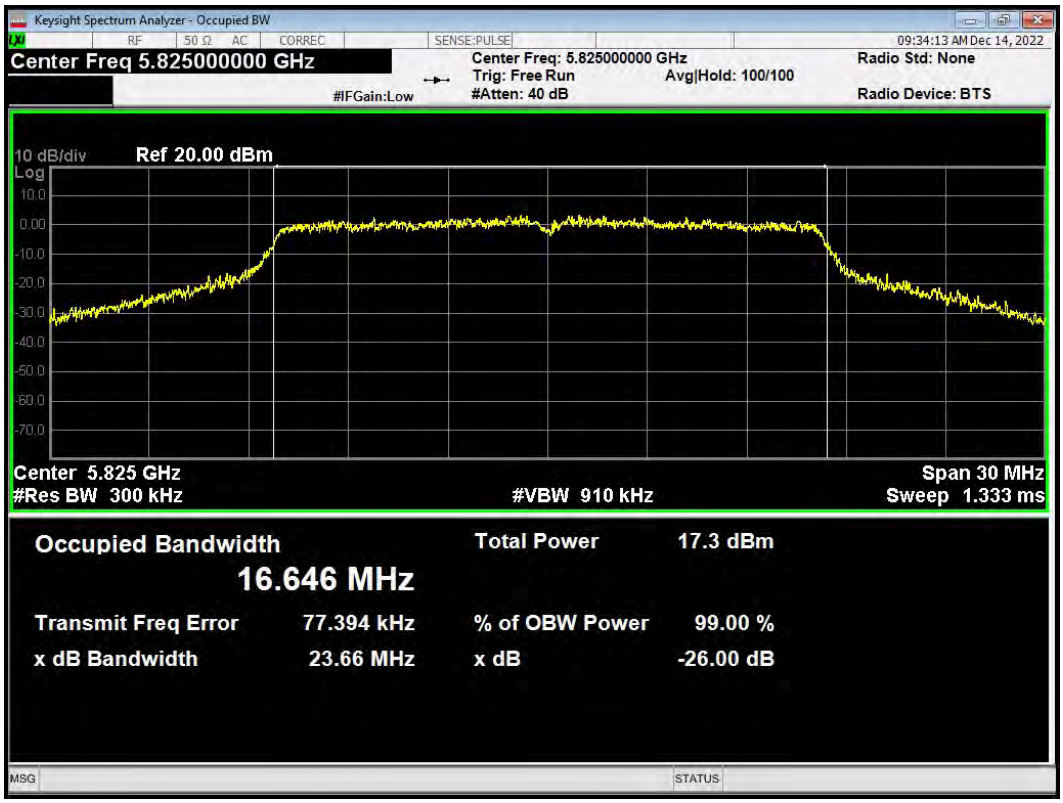
OBW 802.11a 5745MHz



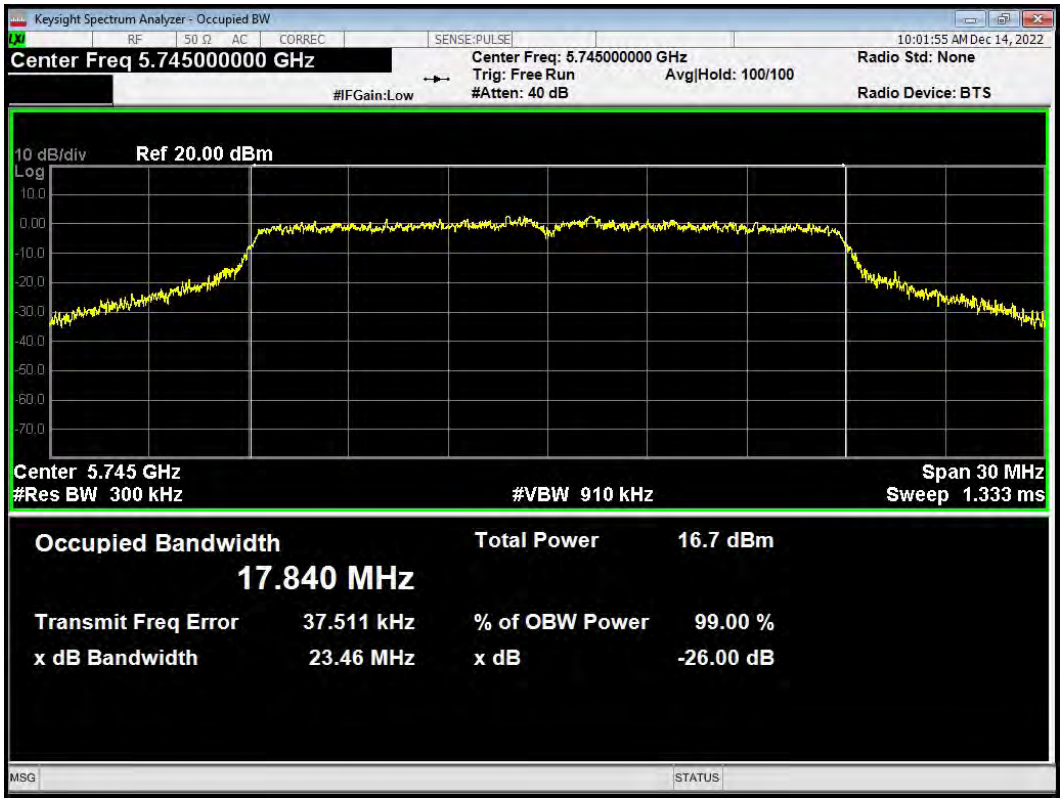
OBW 802.11a 5785MHz



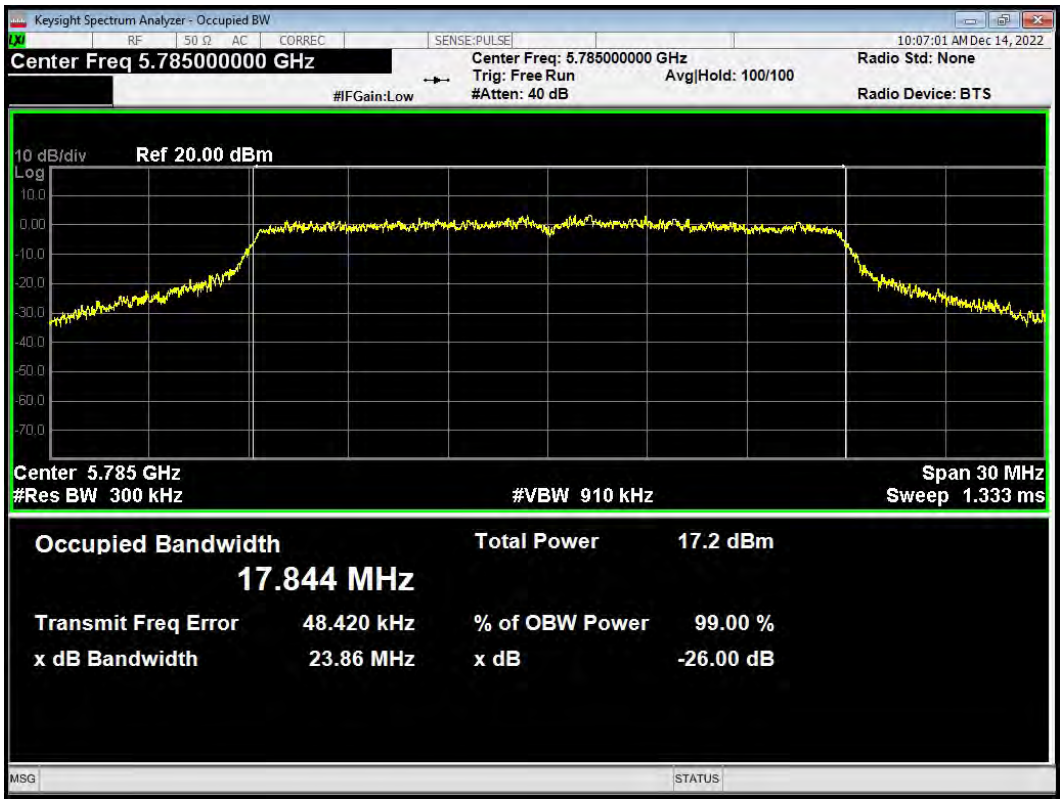
OBW 802.11a 5825MHz



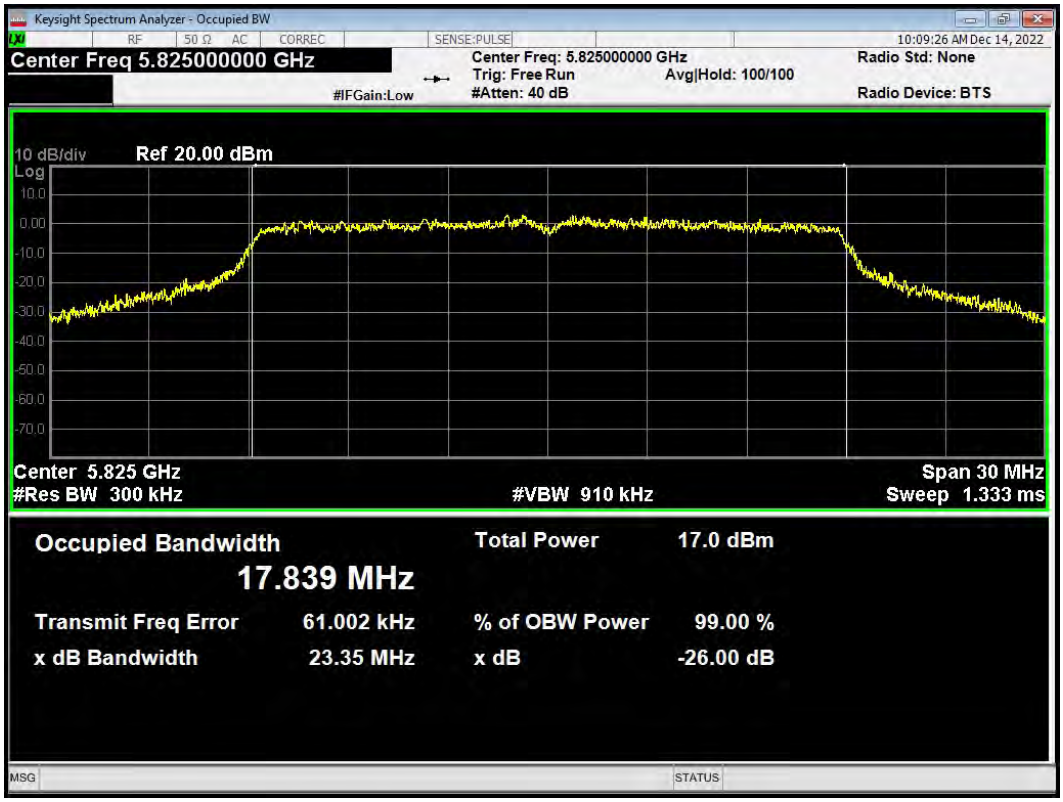
OBW 802.11ac(VHT20) 5745MHz



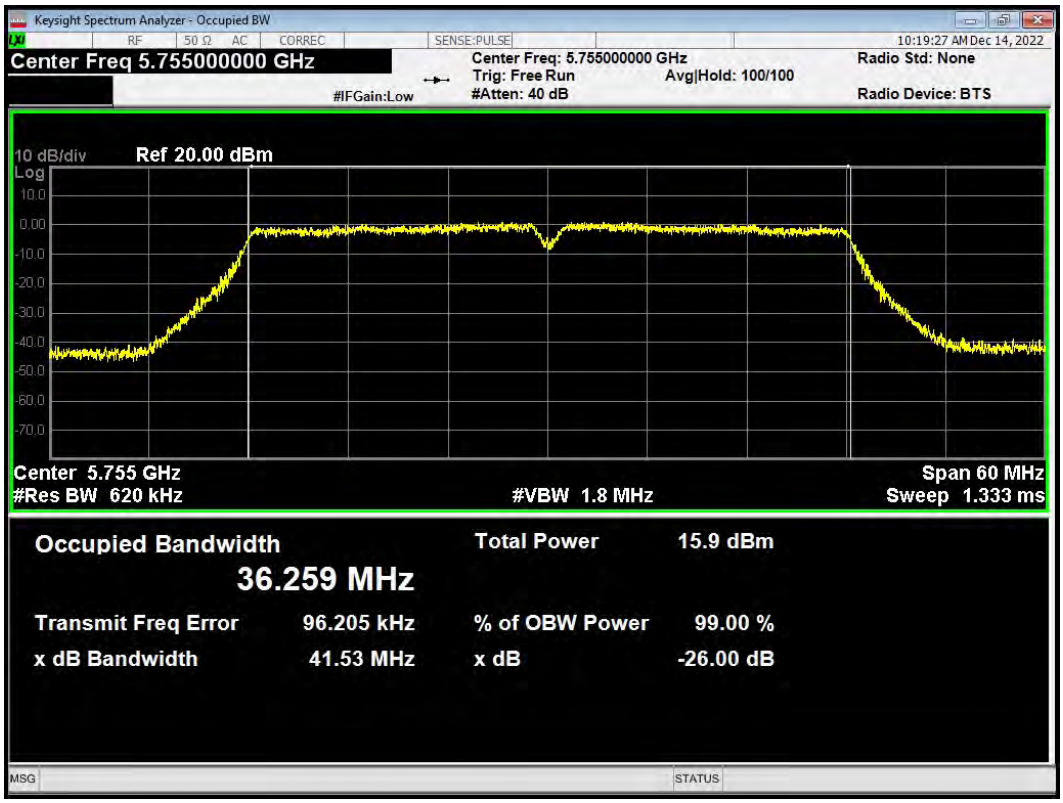
OBW 802.11ac(VHT20) 5785MHz



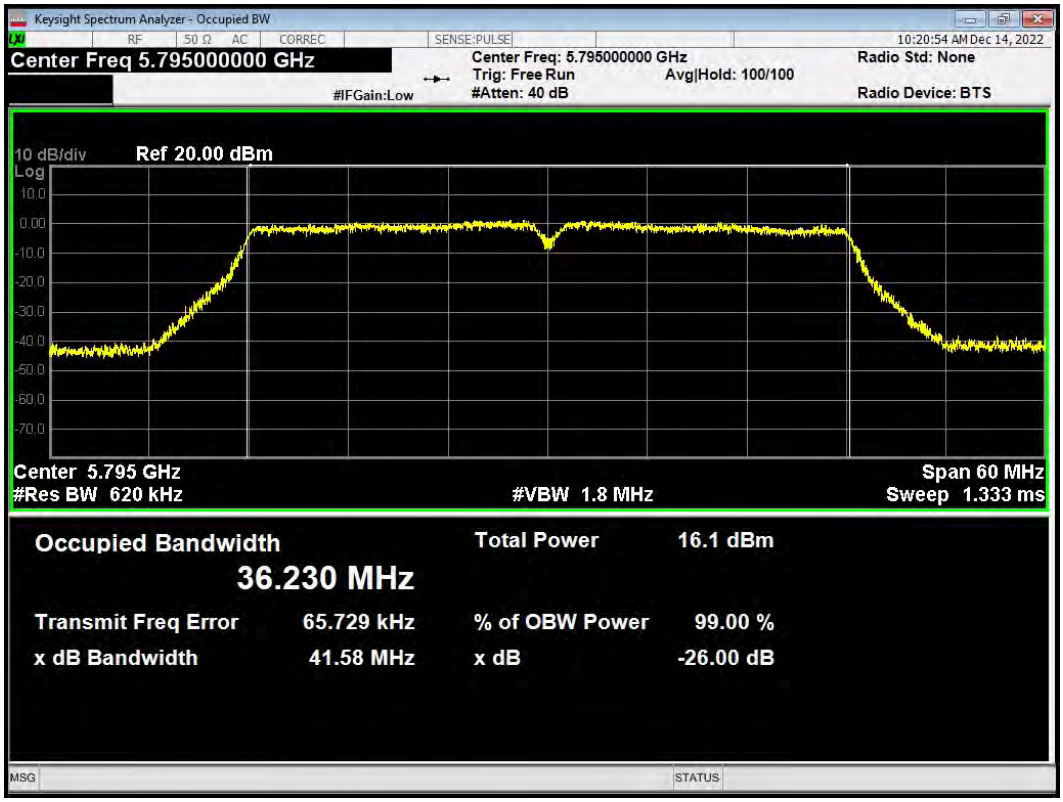
OBW 802.11ac(VHT20) 5825MHz



OBW 802.11ac(VHT40) 5755MHz



OBW 802.11ac(VHT40) 5795MHz



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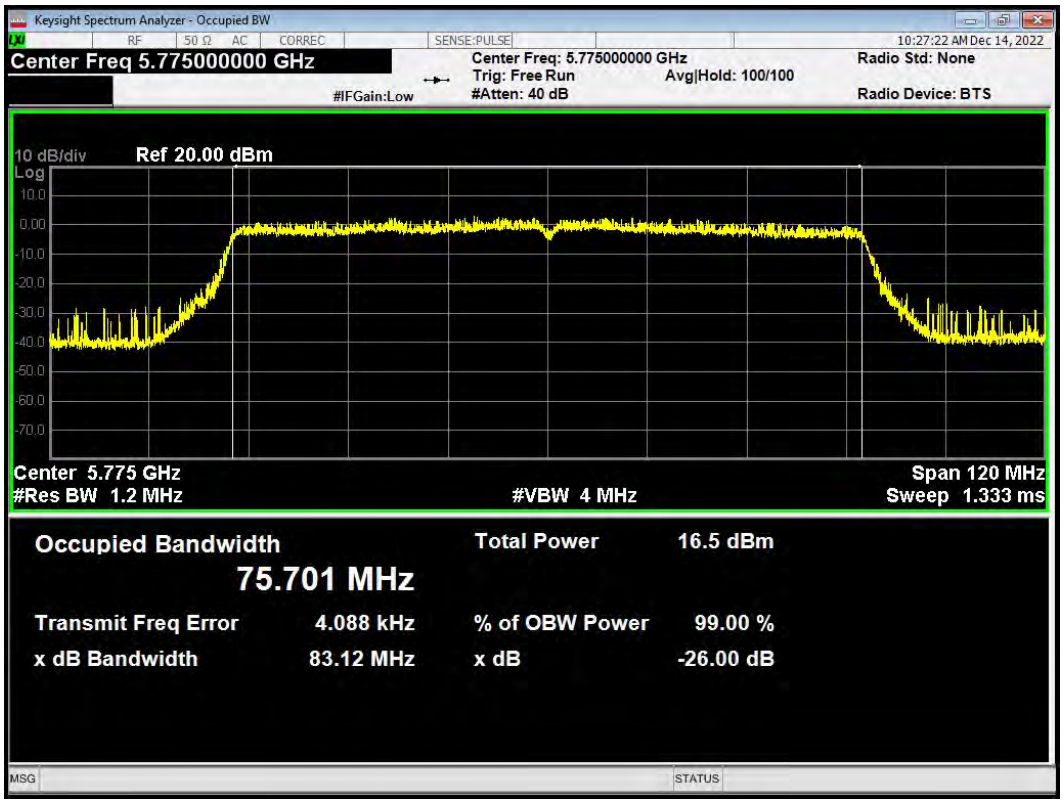
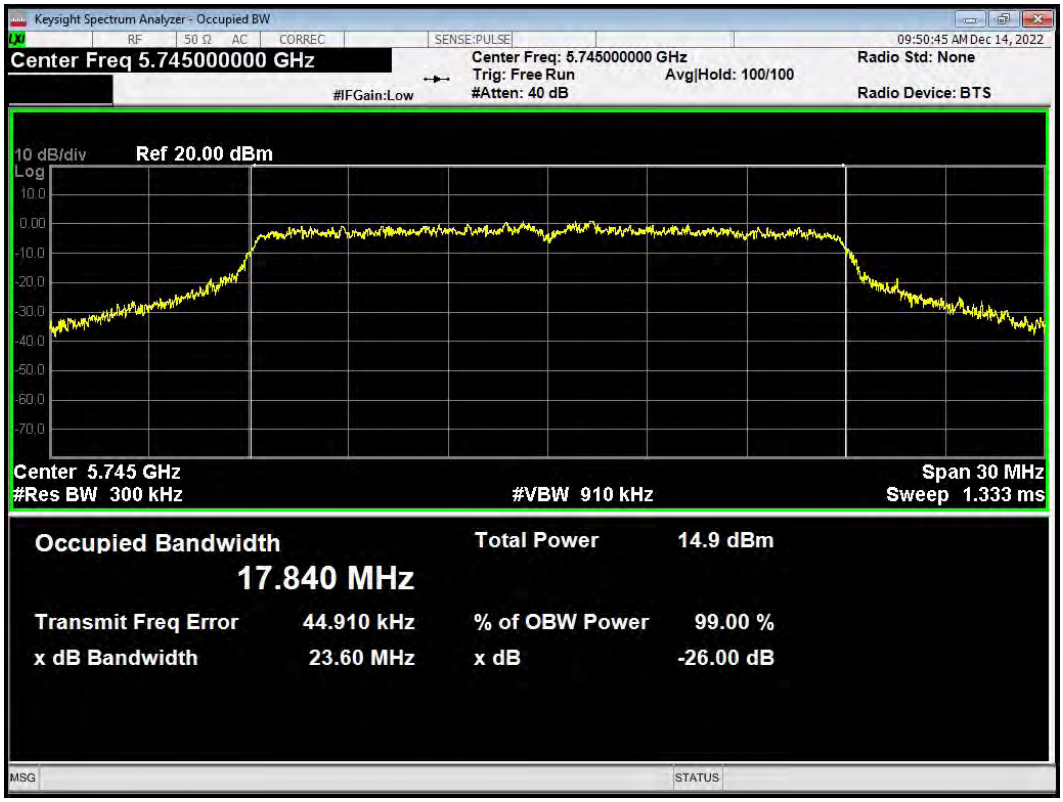
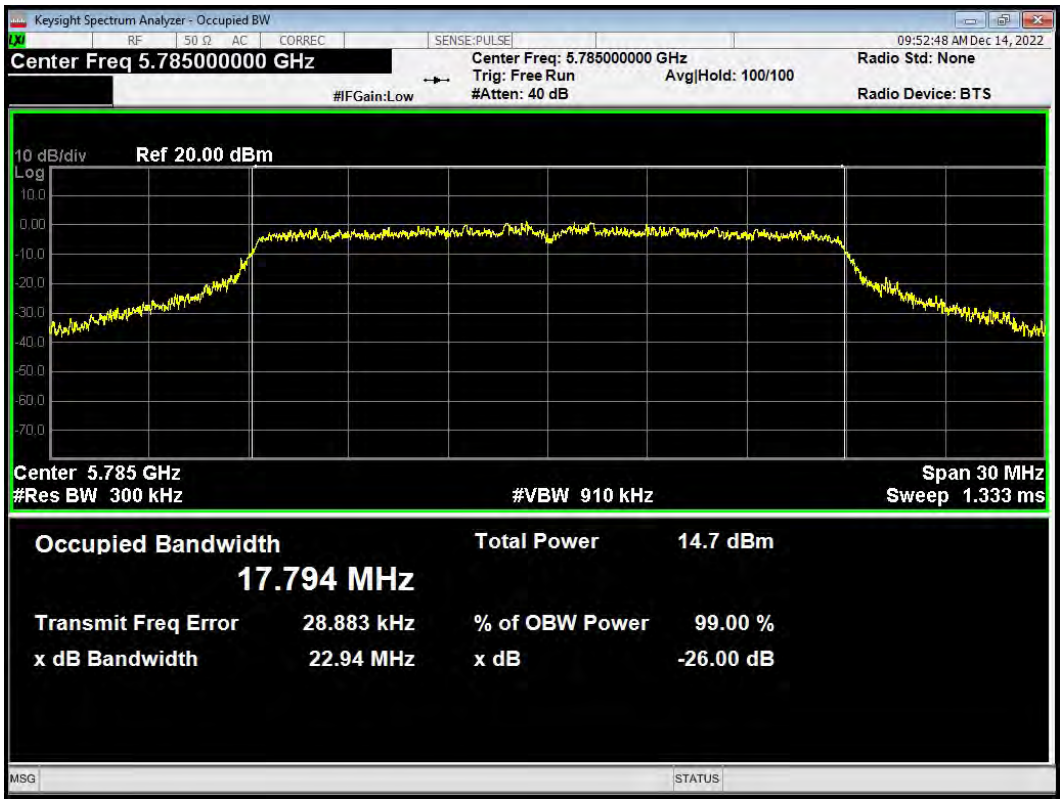


OBW 802.11n(HT20) 5745MHz



OBW 802.11n(HT20) 5785MHz



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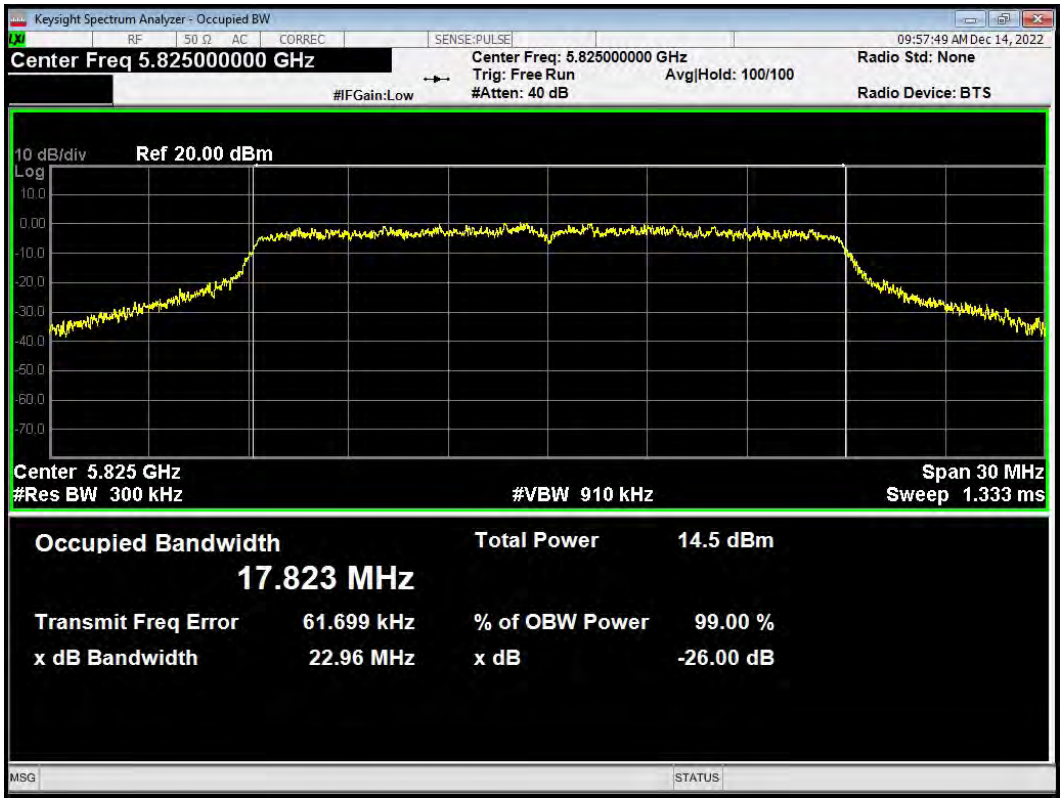

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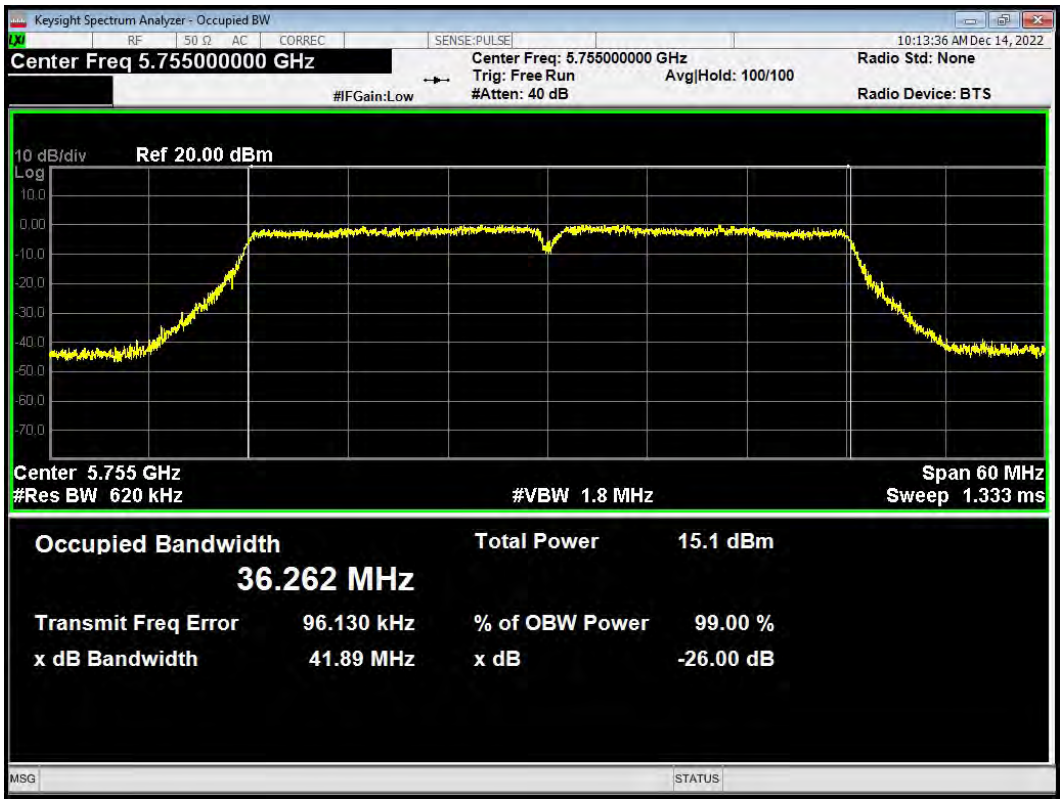
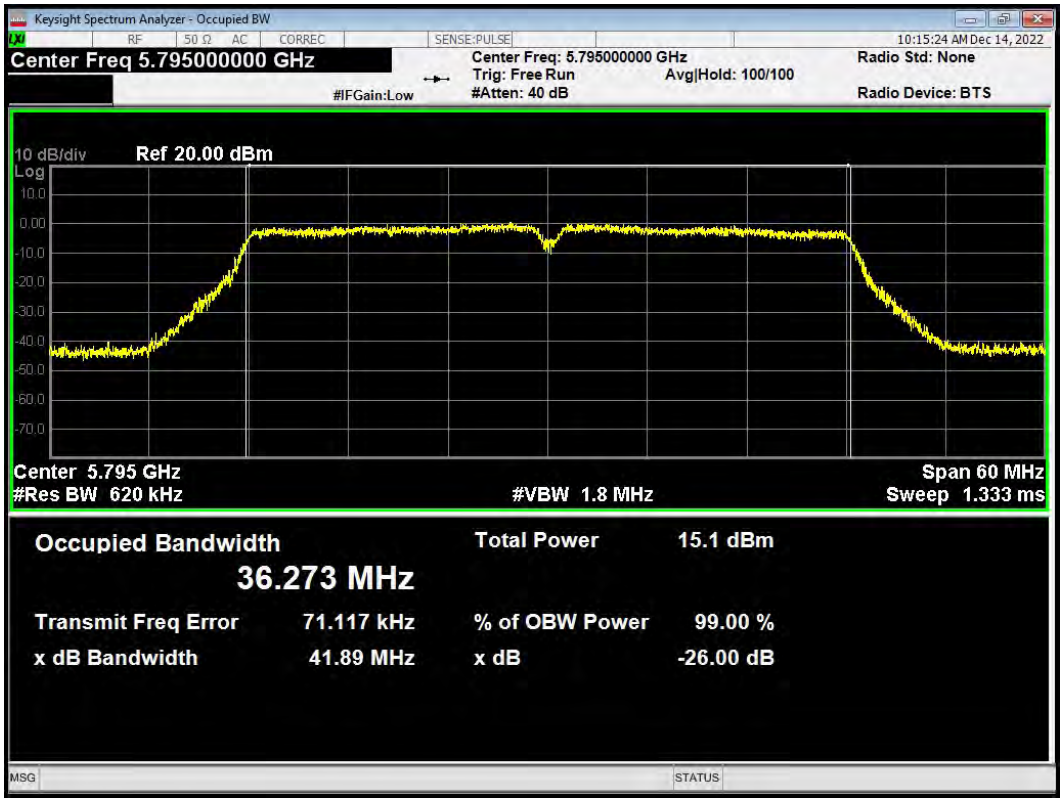
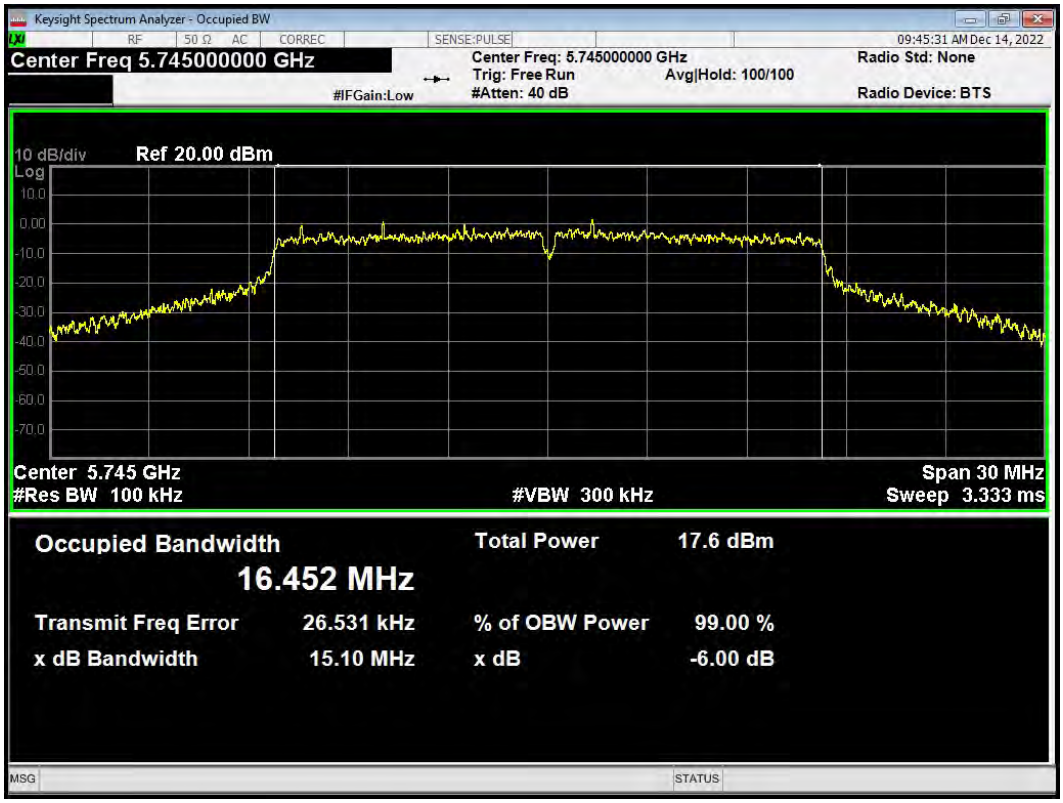


OBW 802.11n(HT40) 5795MHz

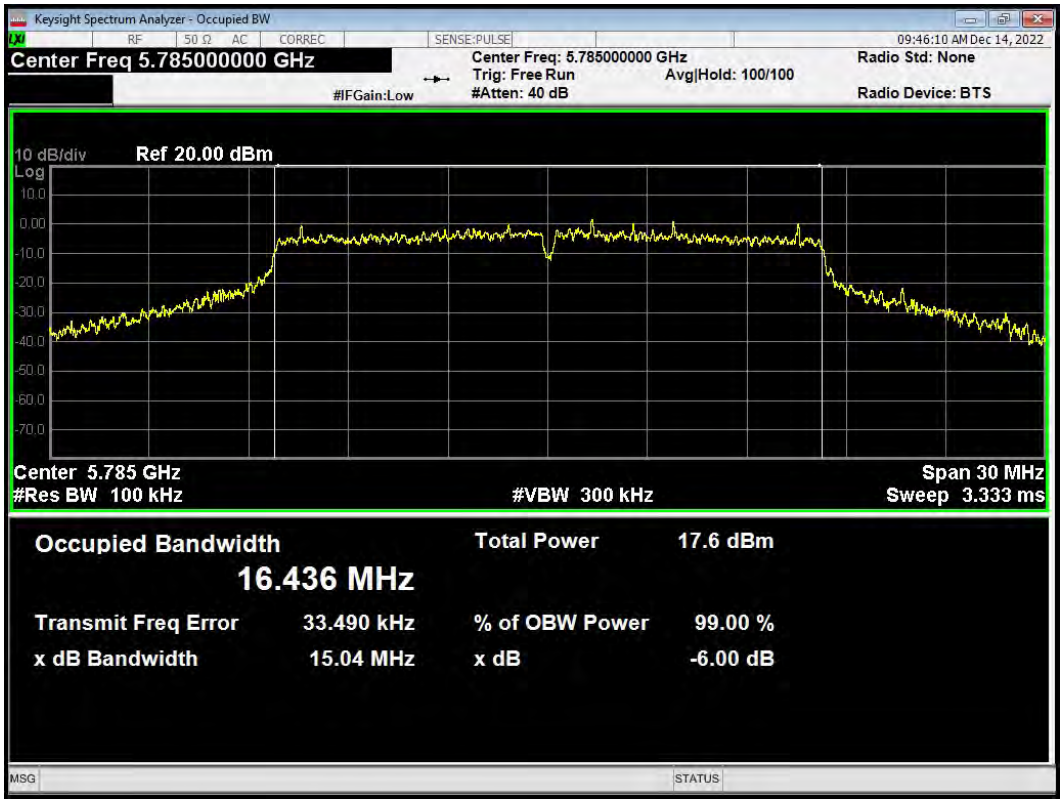


Minimum 6 dB bandwidth

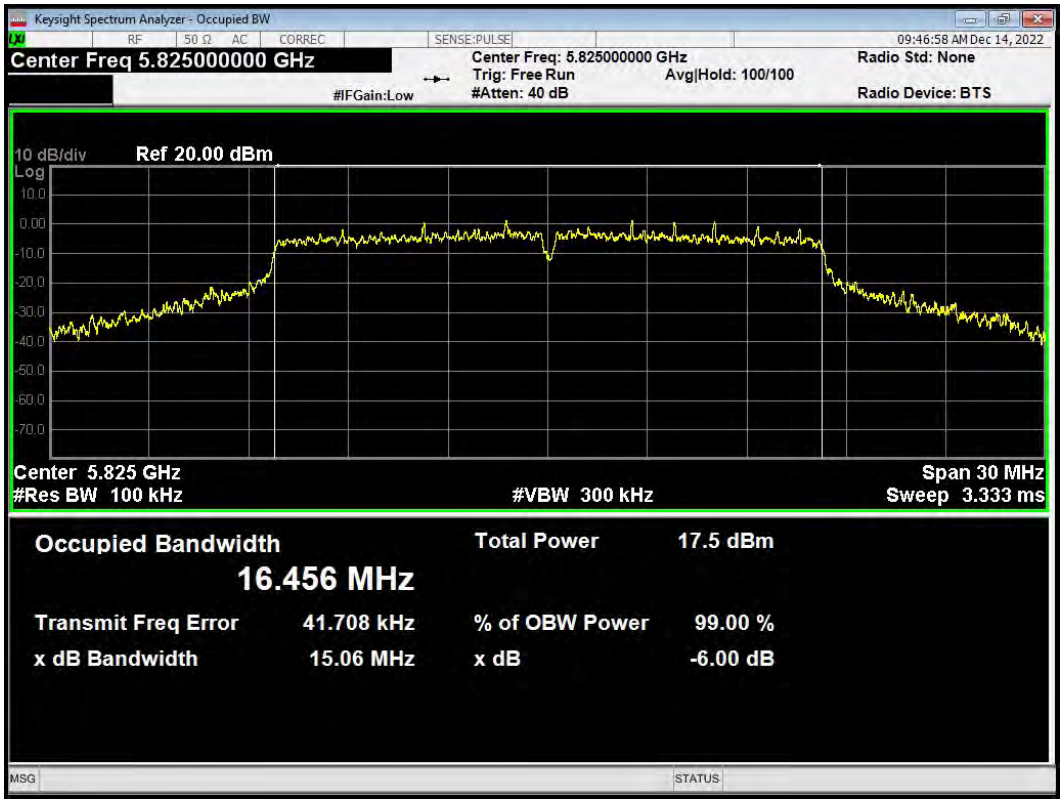
-6dB Bandwidth 802.11a 5745MHz



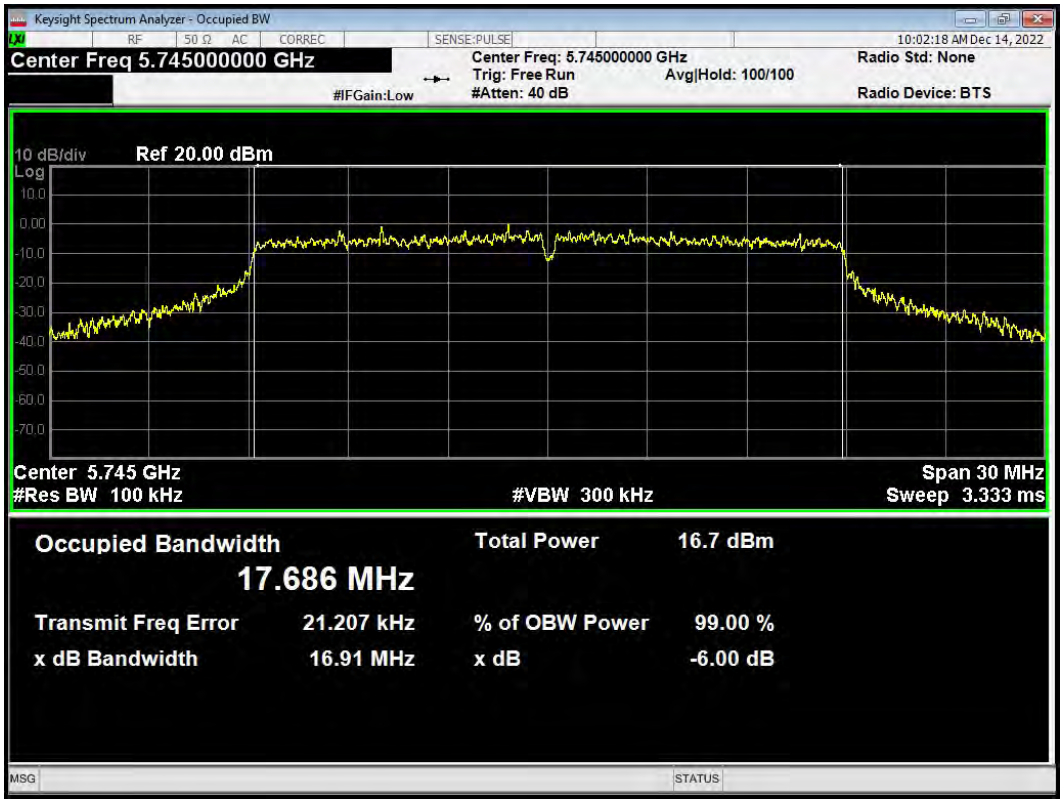
-6dB Bandwidth 802.11a 5785MHz



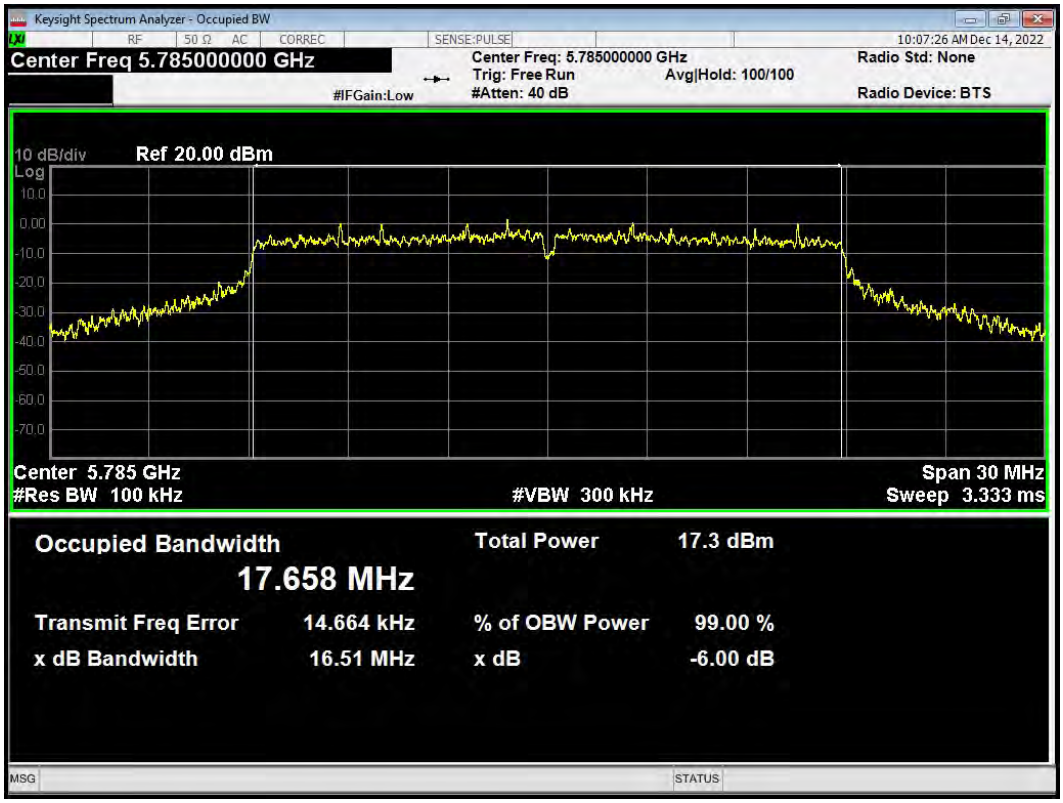
-6dB Bandwidth 802.11a 5825MHz



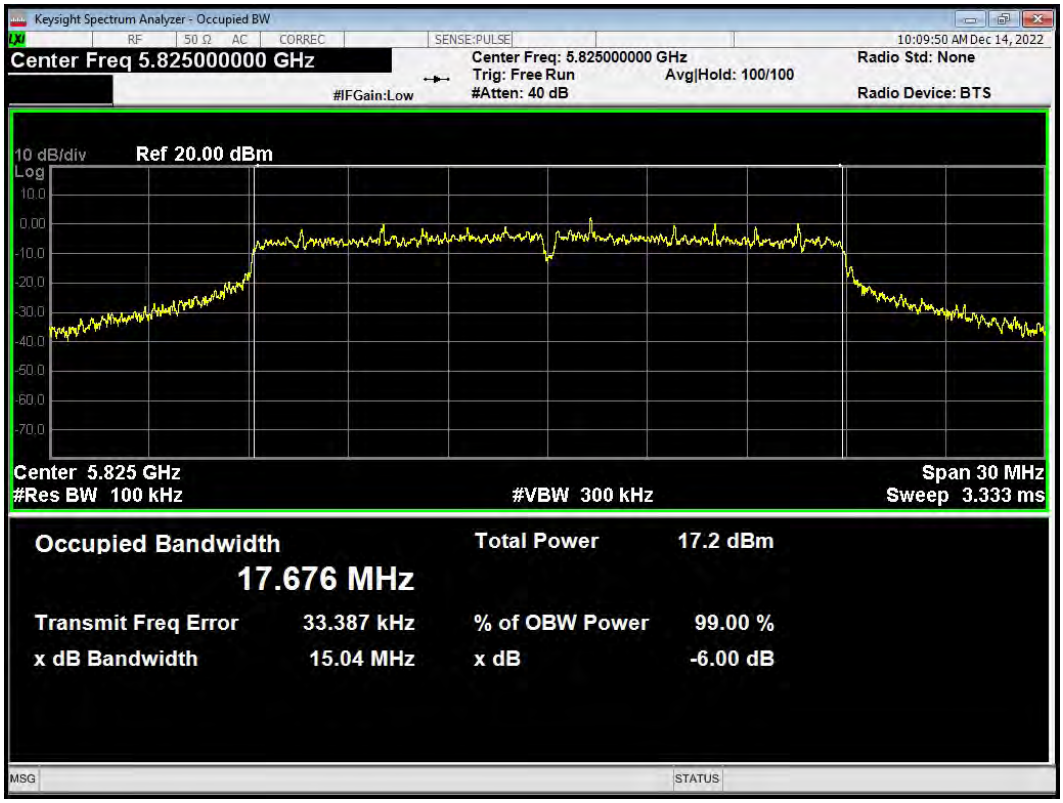
-6dB Bandwidth 802.11ac(VHT20) 5745MHz



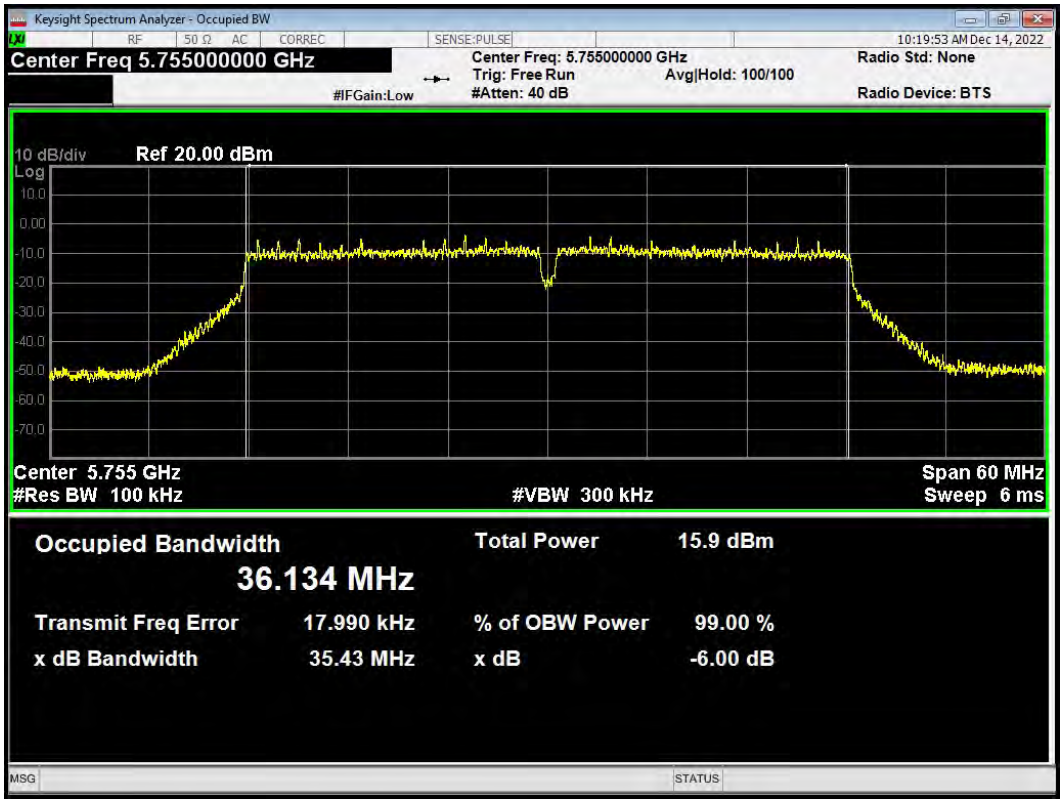
-6dB Bandwidth 802.11ac(VHT20) 5785MHz



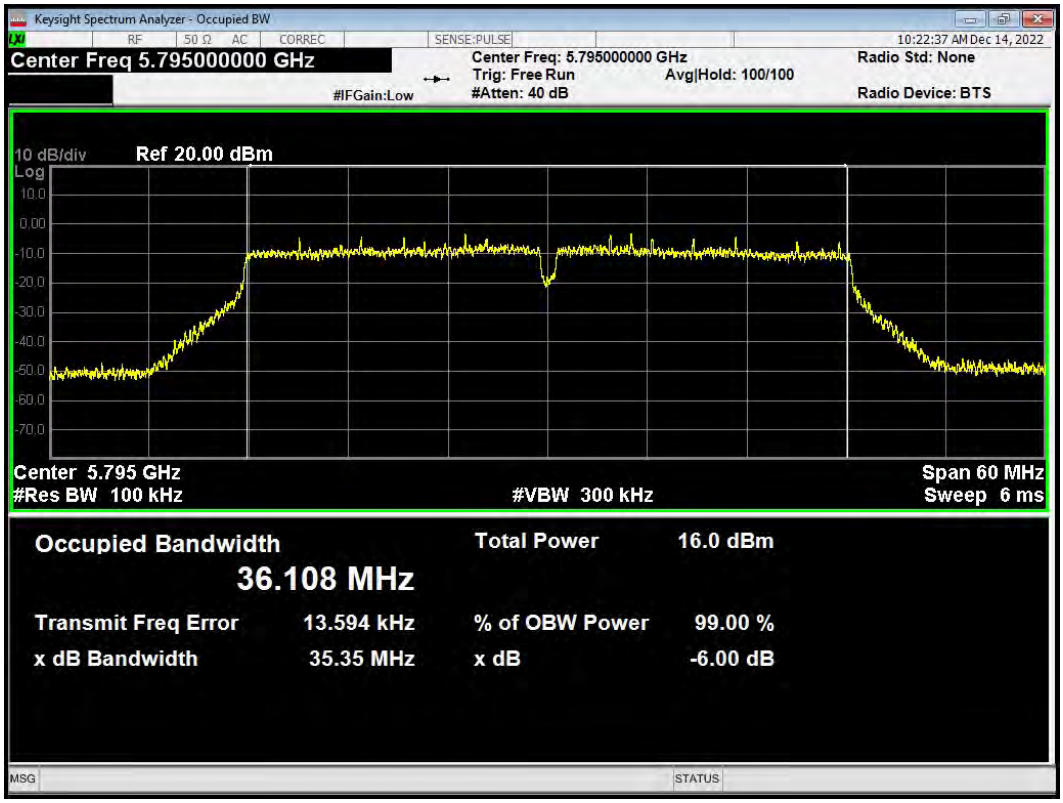
-6dB Bandwidth 802.11ac(VHT20) 5825MHz



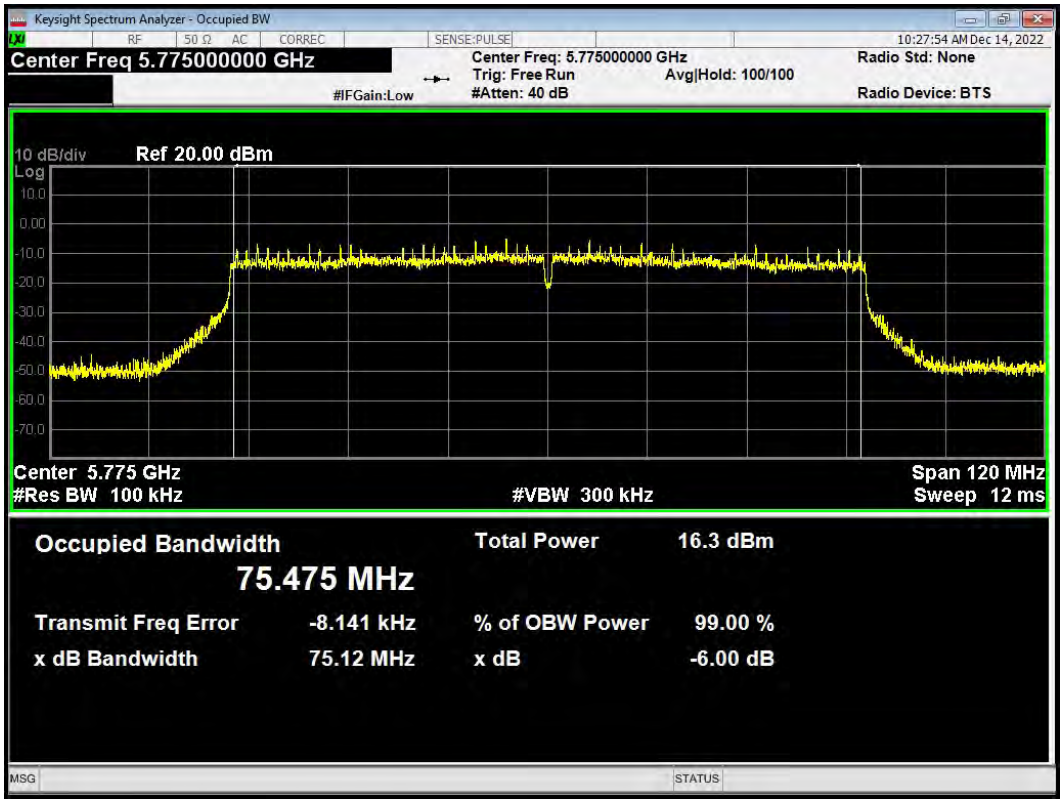
-6dB Bandwidth 802.11ac(VHT40) 5755MHz



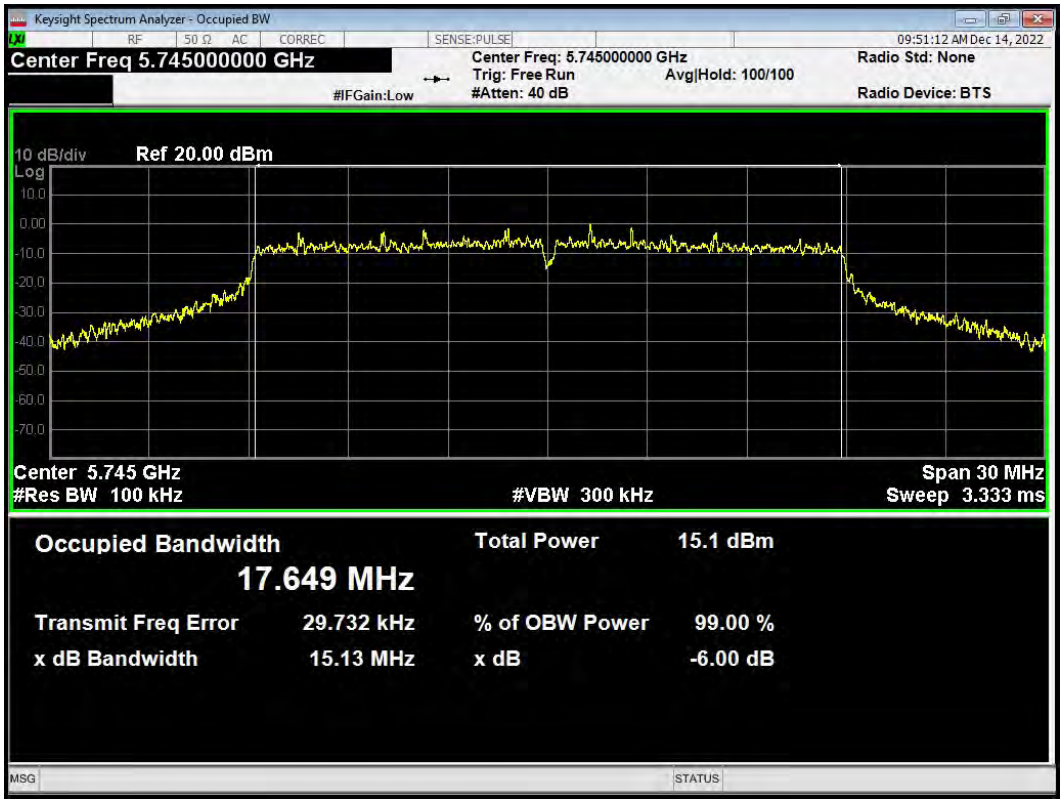
-6dB Bandwidth 802.11ac(VHT40) 5795MHz



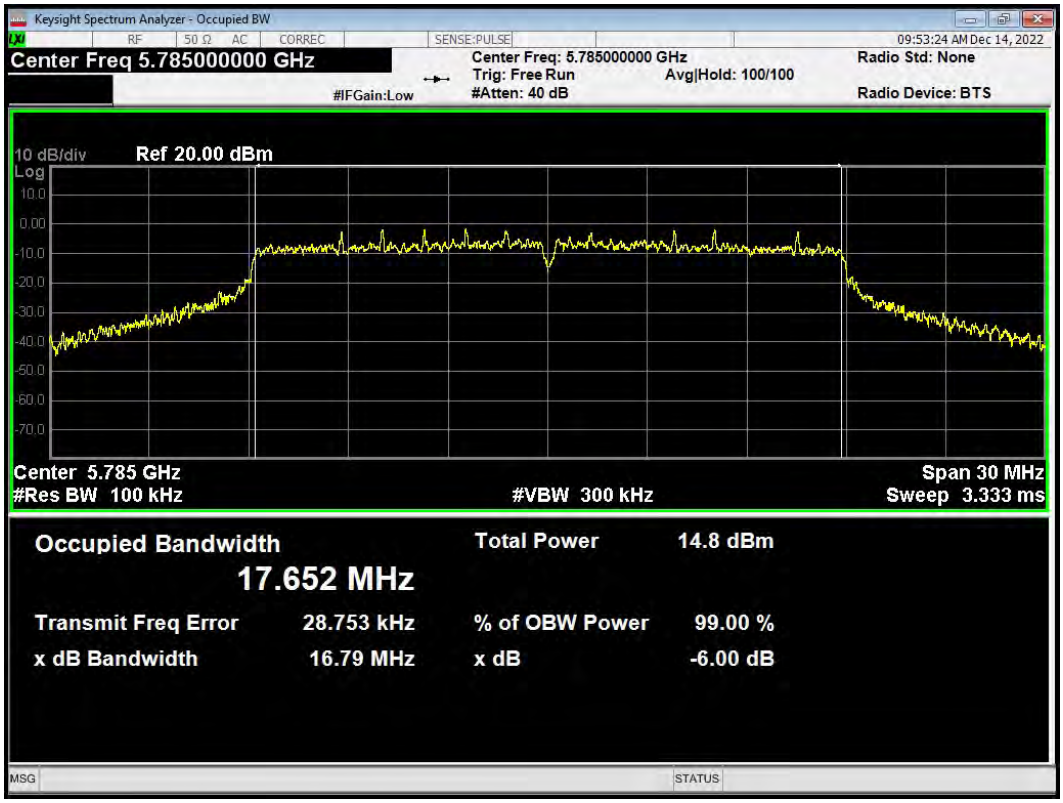
-6dB Bandwidth 802.11ac(VHT80) 5775MHz



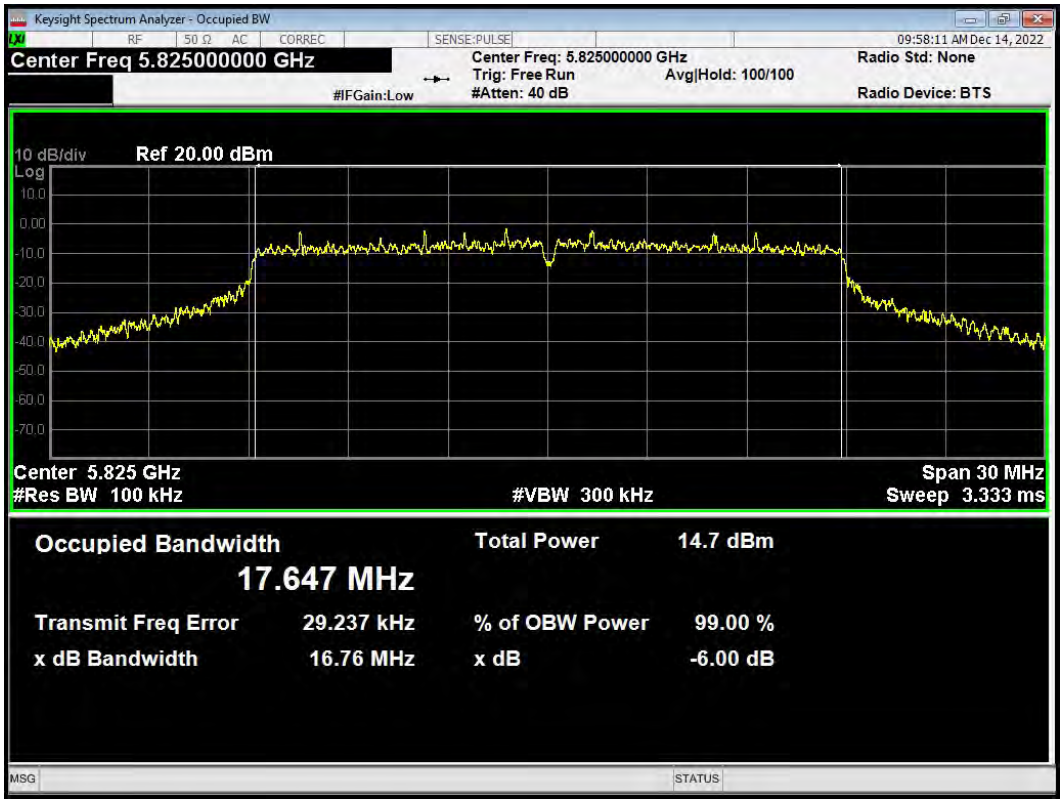
-6dB Bandwidth 802.11n(HT20) 5745MHz



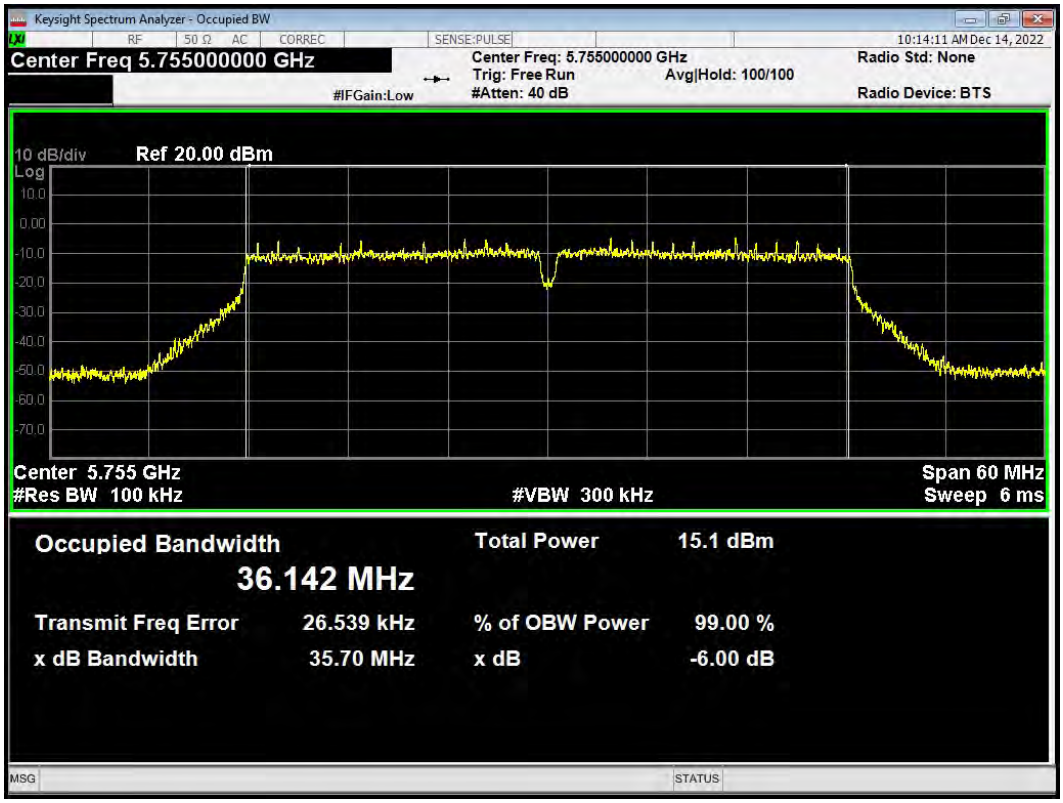
-6dB Bandwidth 802.11n(HT20) 5785MHz



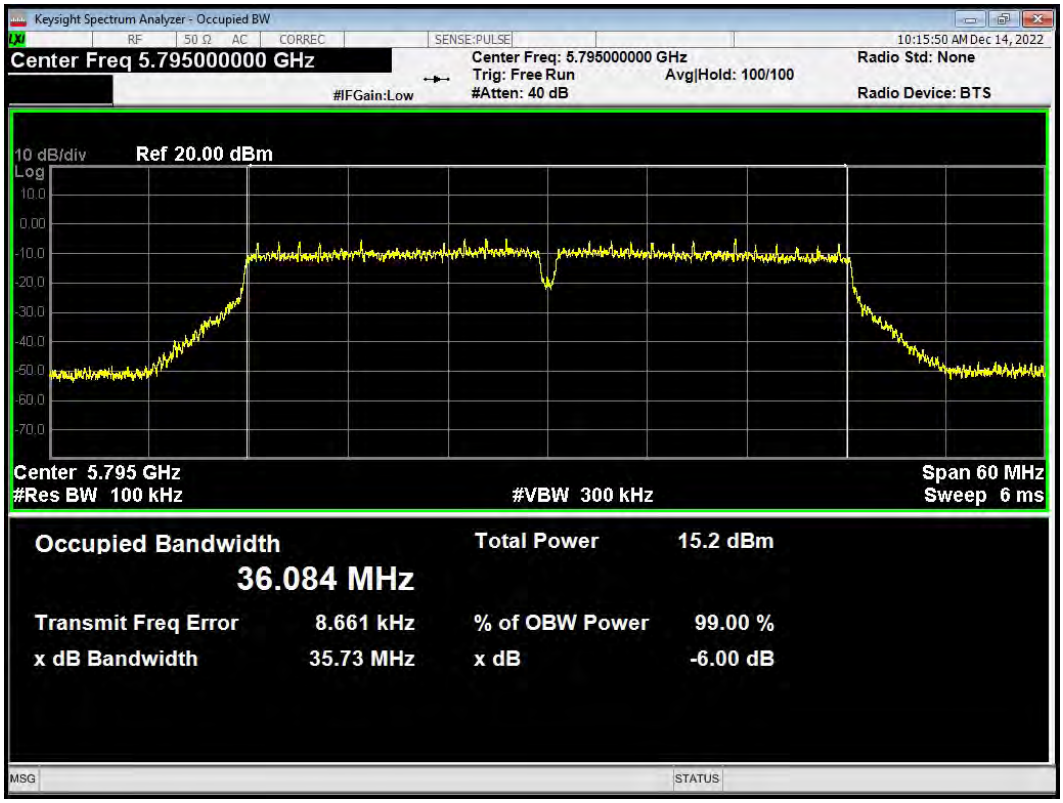
-6dB Bandwidth 802.11n(HT20) 5825MHz



-6dB Bandwidth 802.11n(HT40) 5755MHz



-6dB Bandwidth 802.11n(HT40) 5795MHz



5.2. Average Power Output

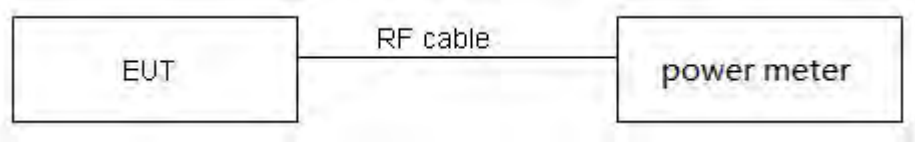
Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT was connected to the average power meter through an external attenuator and a known loss cable. The EUT is max power transmission with proper modulation. We use Maximum average Conducted Output Power Level Method in KDB789033 for this test

Test Setup



Limits

Rule FCC Part 15.407(a)(1)(2)(3)
(1) For the band 5.15-5.25 GHz.
(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).
(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 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.
(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude

the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, 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.

(2) For the 5.25-5.35 GHz and 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 or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, 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.

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

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.44 dB.

Test Results

Mode	Duty cycle	Duty cycle correction Factor(dB)
802.11a	0.98	0.00
802.11n HT20	0.98	0.00
802.11n HT40	0.97	0.15
802.11ac VHT20	0.98	0.00
802.11ac VHT40	0.97	0.15
802.11ac VHT80	0.93	0.32
Note: when Duty cycle≥0.98, Duty cycle correction Factor not required.		

Power Index								
Channel	802.11a	802.11n HT20	802.11ac VHT20	Channel	802.11n HT40	802.11ac VHT40	Channel	802.11ac VHT80
CH36	17	16	17	CH38	16	16	CH42	16
CH40	17	16	17	CH46	16	14	/	/
CH48	16	16	17	/	/	/	/	/
CH52	17	15	17	CH54	14	15	CH58	15
CH60	17	15	17	CH62	14	15	/	/
CH64	17	15	17	/	/	/	/	/
CH100	15	12	14	CH102	11	12	CH106	13
CH116	17	15	16	CH110	13	14	/	
CH140	19	16	17	CH134	15	16	CH138	17
CH144	20	16	18	CH142	15	16	/	/
CH149	21	18	20	CH151	17	18	CH155	18
CH157	20	17	20	CH159	17	18	/	/
CH165	21	18	21	/	/	/	/	/

Test Mode		Channel/Frequency (MHz)	B=26 dB bandwidth (MHz)	Limit 11 dBm + 10 log B (dBm)	Final Limit (dBm)
U-NII-2A	802.11a	52/5260	21.56	24.34>24	24
		60/5300	21.29	24.28>24	24
		64/5320	23.21	24.66>24	24
	802.11n HT20	52/5260	22.59	24.54>24	24
		60/5300	22.56	25.53>24	24
		64/5320	22.68	24.56>24	24
	802.11n HT40	54/5270	41.35	27.16>24	24
		62/5310	42.03	27.24>24	24
	802.11ac VHT20	52/5260	22.46	24.51>24	24
		60/5300	22.98	24.61>24	24
		64/5320	22.76	24.57>24	24
	802.11ac VHT40	54/5270	41.37	27.17>24	24
		62/5310	41.72	27.20>24	24
	802.11ac VHT80	58/5290	89.71	30.53>24	24
U-NII-2C	802.11a	100/5500	22.09	24.44>24	24
		116/5580	21.51	24.33>24	24
		140/5700	22.14	24.45>24	24
		144/5720	22.91	24.60>24	24
	802.11n HT20	100/5500	22.85	24.59>24	24
		116/5580	22.61	24.54>24	24
		140/5700	22.62	24.54>24	24
		144/5720	22.82	24.58>24	24
	802.11n HT40	102/5510	41.50	27.18>24	24
		110/5550	41.85	27.22>24	24
		134/5670	41.89	27.22>24	24
		142/5710	41.10	27.14>24	24
	802.11ac VHT20	100/5500	23.00	24.62>24	24
		116/5580	23.04	24.62>24	24
		140/5700	22.39	24.50>24	24
		144/5720	22.38	24.50>24	24
	802.11ac VHT40	102/5510	41.34	27.16>24	24
		110/5550	41.87	27.22>24	24
		134/5670	41.32	27.16>24	24
		142/5710	41.34	27.16>24	24
	802.11ac VHT80	106/5530	83.74	30.23>24	24
		138/5690	84.07	30.25>24	24
Note: 250mW=24dBm					

U-NII-1

Test Mode	Channel/ Frequency (MHz)	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11a	36/5180	12.24	12.24	24	PASS
	40/5200	12.40	12.40	24	PASS
	48/5240	11.65	11.65	24	PASS
802.11n HT20	36/5180	11.09	11.09	24	PASS
	40/5200	10.50	10.50	24	PASS
	48/5240	10.50	10.50	24	PASS
802.11n HT40	38/5190	11.85	12.00	24	PASS
	46/5230	11.83	11.98	24	PASS
802.11ac VHT20	36/5180	12.14	12.14	24	PASS
	40/5200	12.33	12.33	24	PASS
	48/5240	12.39	12.39	24	PASS
802.11ac VHT40	38/5190	11.83	11.98	24	PASS
	46/5230	11.81	11.96	24	PASS
802.11ac VHT80	42/5210	11.40	11.72	24	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

U-NII-2A

Test Mode	Channel/ Frequency (MHz)	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11a	52/5260	13.40	13.40	24	PASS
	60/5300	13.18	13.18	24	PASS
	64/5320	13.42	13.42	24	PASS
802.11n HT20	52/5260	11.20	11.20	24	PASS
	60/5300	11.04	11.04	24	PASS
	64/5320	11.24	11.24	24	PASS
802.11n HT40	54/5270	10.86	11.01	24	PASS
	62/5310	10.65	10.80	24	PASS
802.11ac VHT20	52/5260	13.11	13.11	24	PASS
	60/5300	12.90	12.90	24	PASS
	64/5320	13.14	13.14	24	PASS
802.11ac VHT40	54/5270	11.98	12.13	24	PASS
	62/5310	11.77	11.92	24	PASS

802.11ac VHT80	58/5290	11.41	11.73	24	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

U-NII-2C

Test Mode	Channel/ Frequency (MHz)	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11a	100/5500	13.70	13.70	24	PASS
	116/5580	13.70	13.70	24	PASS
	140/5700	13.82	13.82	24	PASS
	144/5720	13.22	13.22	24	PASS
802.11n HT20	100/5500	10.85	10.85	24	PASS
	116/5580	10.86	10.86	24	PASS
	140/5700	10.92	10.92	24	PASS
	144/5720	9.52	9.52	24	PASS
802.11n HT40	102/5510	10.64	10.79	24	PASS
	110/5550	10.77	10.92	24	PASS
	134/5670	10.49	10.64	24	PASS
	142/5710	10.28	10.43	24	PASS
802.11ac VHT20	100/5500	12.86	12.86	24	PASS
	116/5580	12.36	12.36	24	PASS
	140/5700	12.09	12.09	24	PASS
	144/5720	11.37	11.37	24	PASS
802.11ac VHT40	102/5510	11.66	11.81	24	PASS
	110/5550	11.97	12.12	24	PASS
	134/5670	11.20	11.35	24	PASS
	142/5710	11.26	11.41	24	PASS
802.11ac VHT80	106/5530	11.13	11.45	24	PASS
	138/5690	11.30	11.62	24	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

U-NII-3

Test Mode	Channel/ Frequency (MHz)	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11a	144/5720	5.97	5.97	30	PASS
	149/5745	13.26	13.26	30	PASS
	157/5785	13.16	13.16	30	PASS
	165/5825	13.03	13.03	30	PASS
802.11n HT20	144/5720	2.32	2.32	30	PASS
	149/5745	10.49	10.49	30	PASS
	157/5785	10.32	10.32	30	PASS
	165/5825	10.21	10.21	30	PASS
802.11n HT40	142/5710	-1.80	-1.65	30	PASS
	151/5755	10.37	10.52	30	PASS
	159/5795	10.58	10.73	30	PASS
802.11ac VHT20	144/5720	4.27	4.27	30	PASS
	149/5745	12.30	12.30	30	PASS
	157/5785	12.98	12.98	30	PASS
	165/5825	12.80	12.80	30	PASS
802.11ac VHT40	142/5710	-0.75	-0.60	30	PASS
	151/5755	11.28	11.43	30	PASS
	159/5795	11.47	11.62	30	PASS
802.11ac VHT80	138/5690	-3.20	-2.88	30	PASS
	155/5775	11.11	11.43	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

5.3. Frequency Stability

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

1. Frequency stability with respect to ambient temperature

a) Supply the EUT with a nominal ac voltage or install a new or fully charged battery in the EUT. If possible, a dummy load shall be connected to the EUT because an antenna near the metallic walls of an environmental test chamber could affect the output frequency of the EUT. If the EUT is equipped with a permanently attached, adjustable-length antenna, then the EUT shall be placed in the center of the chamber with the antenna adjusted to the shortest length possible. Turn ON the EUT and tune it to one of the number of frequencies shown in 5.6.

b) Couple the unlicensed wireless device output to the measuring instrument by connecting an antenna to the measuring instrument with a suitable length of coaxial cable and placing the measuring antenna near the EUT (e.g., 15 cm away), or by connecting a dummy load to the measuring instrument, through an attenuator if necessary.

c) Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).

d) Turn the EUT OFF and place it inside the environmental temperature chamber. For devices that have oscillator heaters, energize only the heater circuit.

e) Set the temperature control on the chamber to the highest specified in the regulatory requirements for the type of device and allow the oscillator heater and the chamber temperature to stabilize.

f) While maintaining a constant temperature inside the environmental chamber, turn the EUT ON and record the operating frequency at startup, and at 2 minutes, 5 minutes, and 10 minutes after the EUT is energized. Four measurements in total are made.

g) Measure the frequency at each of frequencies specified in 5.6.

h) Switch OFF the EUT but do not switch OFF the oscillator heater.

i) Lower the chamber temperature by not more that 10°C, and allow the temperature inside the chamber to stabilize.

j) Repeat step f) through step i) down to the lowest specified temperature.

2. Frequency stability when varying supply voltage

Unless otherwise specified, these tests shall be made at ambient room temperature (+15°C to +25 °C). An antenna shall be connected to the antenna output terminals of the EUT if possible. If the EUT is equipped with or uses an adjustable-length antenna, then it shall be fully extended.

a) Supply the EUT with nominal voltage or install a new or fully charged battery in the EUT. Turn ON the EUT and couple its output to a frequency counter or other frequency-measuring instrument.

b) Tune the EUT to one of the number of frequencies required in 5.6. Adjust the location of the measurement antenna and the controls on the measurement instrument to obtain a suitable signal level (i.e., a level that will not overload the measurement instrument but is strong enough to allow measurement of the operating or fundamental frequency of the EUT).
c) Measure the frequency at each of the frequencies specified in 5.6.
d) Repeat the above procedure at 85% and 115% of the nominal supply voltage.

Limit

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

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 936Hz

Test Results

Voltage (V)	Temperature (°C)	U-NII-1 Test Results			
		5200MHz			
		1min	2min	5min	10min
3.8	-20	5200.000267	5199.999444	5199.992737	5199.991490
3.8	-10	5199.995577	5199.995607	5199.990543	5199.983828
3.8	0	5199.991908	5199.990960	5199.987359	5199.978010
3.8	10	5199.983972	5199.990132	5199.986377	5199.974039
3.8	20	5199.981605	5199.989536	5199.980787	5199.973133
3.8	30	5199.977686	5199.985733	5199.979812	5199.967779
3.8	40	5199.971568	5199.981013	5199.978413	5199.962631
3.8	50	5199.966057	5199.974068	5199.973966	5199.960762
3.7	20	5199.963216	5199.969817	5199.968747	5199.957713
4.4	20	5199.962051	5199.966198	5199.960465	5199.953959
Max. ΔMHz		-0.037949	-0.033802	-0.039535	-0.046041
PPM		-7.297950	-6.500290	-7.602833	-8.854056

Voltage (V)	Temperature (°C)	U-NII-2A Test Results			
		5300MHz			
		1min	2min	5min	10min
3.8	-20	5300.003996	5300.000970	5299.995988	5299.992785
3.8	-10	5299.998230	5300.000349	5299.988224	5299.983243
3.8	0	5299.994510	5299.994579	5299.982833	5299.979392
3.8	10	5299.987169	5299.991458	5299.974432	5299.979078
3.8	20	5299.980220	5299.989030	5299.968005	5299.974602
3.8	30	5299.972107	5299.987797	5299.961956	5299.969284
3.8	40	5299.963604	5299.983086	5299.955313	5299.962384
3.8	50	5299.956510	5299.981524	5299.952869	5299.957959
3.7	20	5299.949843	5299.979117	5299.945107	5299.948927
4.4	20	5299.943799	5299.974077	5299.938957	5299.939388
Max. ΔMHz		-0.056201	-0.025923	-0.061043	-0.060612
PPM		-10.603982	-4.891050	-11.517571	-11.436149

Voltage (V)	Temperature (°C)	U-NII-2C Test Results			
		5580MHz			
		1min	2min	5min	10min
3.8	-20	5580.004875	5580.002641	5579.996585	5579.995695
3.8	-10	5579.999948	5579.995548	5579.996116	5579.990899
3.8	0	5579.993190	5579.990732	5579.994042	5579.985447
3.8	10	5579.990206	5579.990510	5579.985294	5579.979096
3.8	20	5579.983436	5579.980780	5579.975482	5579.970251
3.8	30	5579.974819	5579.980593	5579.967407	5579.965475
3.8	40	5579.967801	5579.972036	5579.966283	5579.956702
3.8	50	5579.967740	5579.962728	5579.962333	5579.953312
3.7	20	5579.959587	5579.960446	5579.961324	5579.947489
4.4	20	5579.953859	5579.955792	5579.952379	5579.946736
Max. ΔMHz		-0.046141	-0.044208	-0.047621	-0.053264
PPM		-8.269011	-7.922566	-8.534179	-9.545488

Voltage (V)	Temperature (°C)	U-NII-3 Test Results			
		5785MHz			
		1min	2min	5min	10min
3.8	-20	5785.003273	5784.997863	5784.994742	5784.994702
3.8	-10	5785.001935	5784.997696	5784.986990	5784.988230
3.8	0	5784.992420	5784.991672	5784.981711	5784.985781
3.8	10	5784.991501	5784.988567	5784.972909	5784.977910
3.8	20	5784.989640	5784.983246	5784.972600	5784.970694
3.8	30	5784.987241	5784.974024	5784.966211	5784.963127
3.8	40	5784.977727	5784.968969	5784.961400	5784.961098
3.8	50	5784.973339	5784.960323	5784.959138	5784.959801
3.7	20	5784.971532	5784.954030	5784.949335	5784.951284
4.4	20	5784.970457	5784.953157	5784.946105	5784.949452
Max. ΔMHz		-0.029543	-0.046843	-0.053895	-0.050548
PPM		-5.106856	-8.097322	-9.316334	-8.737690

5.4. Power Spectral Density

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

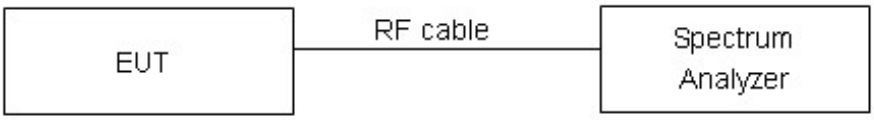
Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable.

Set RBW = 1MHz, VBW =3MHz for the band 5.150-5.250GHz, 5.250-5.350GHz, 5.470-5.725GHz.
Set RBW = 470kHz, VBW =1.5MHz for the band 5.725-5.850GHz

The conducted PSD is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically.

Test setup



Limits

Rule FCC Part 15.407(a)(1)/ Part 15.407(a)(2) / Part 15.407(a)(3)
For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 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.
For client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, 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.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, 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.
For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500kHz band. If transmittingantennas 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.

Frequency Bands/MHz	Limits
5150-5250	11dBm/MHz
5.25-5.35 GHz and 5.47-5.725 GHz	11dBm/MHz
5725-5850	30dBm/500kHz

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 2, U= 0.75dB.

Test Results:

Note: Power Spectral Density =Read Value+Duty cycle correction factor

U-NII-1

Mode	Channel Number	Read Value (dBm /MHz)	Power Spectral Density (dBm /MHz)	Limit (dBm /MHz)	Conclusion
802.11a	36	2.44	2.44	11	PASS
	40	2.37	2.37	11	PASS
	48	1.52	1.52	11	PASS
802.11n HT20	36	0.94	0.94	11	PASS
	40	0.61	0.61	11	PASS
	48	0.30	0.30	11	PASS
802.11n HT40	38	-1.33	-1.18	11	PASS
	46	-1.45	-1.30	11	PASS
802.11ac VHT20	36	1.87	1.87	11	PASS
	40	1.96	1.96	11	PASS
	48	2.28	2.28	11	PASS
802.11ac VHT40	38	-1.47	-1.32	11	PASS
	46	-1.67	-1.52	11	PASS
802.11ac VHT80	42	-4.83	-4.51	11	PASS

U-NII-2A

Mode	Channel Number	Read Value (dBm /MHz)	Power Spectral Density (dBm /MHz)	Limit (dBm /MHz)	Conclusion
802.11a	52	3.44	3.44	11	PASS
	60	3.34	3.34	11	PASS
	64	3.22	3.22	11	PASS
802.11n HT20	52	1.09	1.09	11	PASS
	60	0.78	0.78	11	PASS
	64	1.15	1.15	11	PASS
802.11n HT40	54	-2.38	-2.23	11	PASS
	62	-2.96	-2.81	11	PASS
802.11ac VHT20	52	2.75	2.75	11	PASS
	60	2.71	2.71	11	PASS
	64	2.84	2.84	11	PASS

802.11ac VHT40	54	-1.13	-0.98	11	PASS
	62	-1.76	-1.61	11	PASS
802.11ac VHT80	58	-4.78	-4.46	11	PASS

U-NII-2C

Mode	Channel Number	Read Value (dBm /MHz)	Power Spectral Density (dBm /MHz)	Limit (dBm /MHz)	Conclusion
802.11a	100	3.73	3.73	11	PASS
	116	3.84	3.84	11	PASS
	140	3.75	3.75	11	PASS
	144	4.26	4.26	11	PASS
802.11n HT20	100	0.29	0.29	11	PASS
	116	0.66	0.66	11	PASS
	140	0.37	0.37	11	PASS
	144	0.13	0.13	11	PASS
802.11n HT40	102	-2.5	-2.35	11	PASS
	110	-2.71	-2.56	11	PASS
	134	-2.95	-2.80	11	PASS
	142	-2.82	-2.67	11	PASS
802.11ac VHT20	100	2.64	2.64	11	PASS
	116	2.01	2.01	11	PASS
	140	2.17	2.17	11	PASS
	144	2.2	2.20	11	PASS
802.11ac VHT40	102	-1.5	-1.35	11	PASS
	110	-1.22	-1.07	11	PASS
	134	-2.29	-2.14	11	PASS
	142	-1.82	-1.67	11	PASS
802.11ac VHT80	106	-5.34	-5.02	11	PASS
	138	-4.5	-4.18	11	PASS

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Mode	Channel Number	Read Value (dBm/470kHz)	Power Spectral Density (dBm/500kHz)	Limit (dBm/500kHz)	Conclusion
802.11a	144	-1.43	-1.16	30	PASS
	149	0.13	0.40	30	PASS
	157	-0.05	0.22	30	ASS
	165	-0.38	-0.11	30	ASS
802.11n HT20	144	-5.54	-5.27	30	ASS
	149	-2.94	-2.67	30	ASS
	157	-2.99	-2.72	30	ASS
	165	-3.33	-3.06	30	ASS
802.11n HT40	142	-9.15	-8.73	30	ASS
	151	-6.48	-6.06	30	ASS
	159	-6.16	-5.74	30	ASS
802.11ac VHT20	144	-3.69	-3.42	30	ASS
	149	-1.04	-0.77	30	ASS
	157	-0.65	-0.38	30	ASS
	165	-0.81	-0.54	30	ASS
802.11ac VHT40	142	-8.17	-7.75	30	ASS
	151	-5.52	-5.10	30	ASS
	159	-5.35	-4.93	30	ASS
802.11ac VHT80	138	-10.99	-10.40	30	ASS
	155	-8.42	-7.83	30	ASS
Note: PSD=Read Value+Duty cycle correction factor +10*log(500/470) correction factor					

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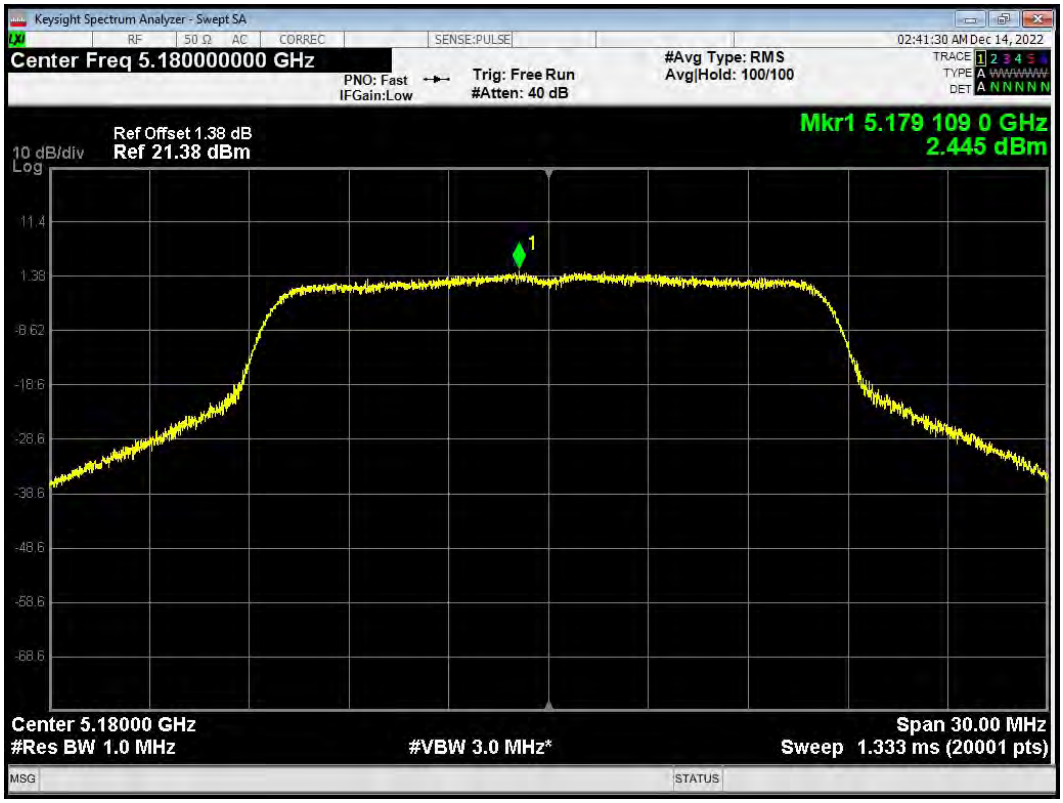
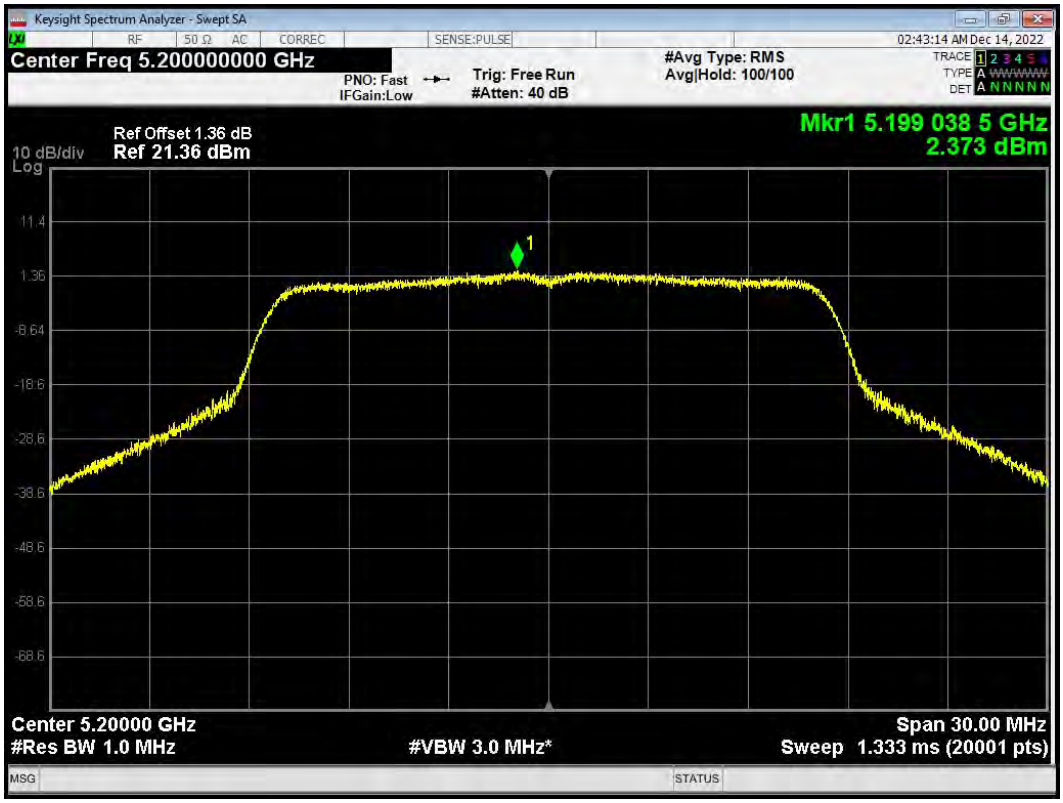
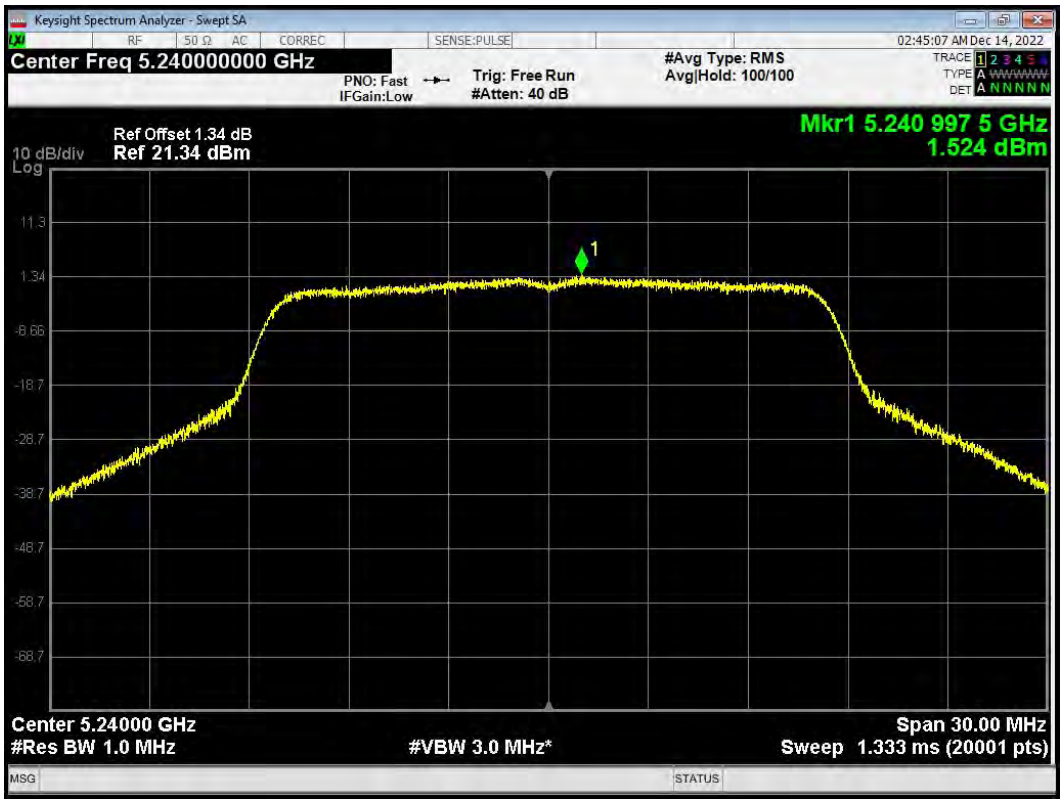
PSD 802.11a 5180MHz



PSD 802.11a 5200MHz



PSD 802.11a 5240MHz



PSD 802.11ac(VHT20) 5180MHz