RF TEST REPORT

Applicant	Shanghai Smawave Technology Co. ,Ltd
FCC ID	2AU8HSPH320-AQ
Product	Industrial smart handheld terminal
Brand	Smawave
Model	SPH320-aq
Report No.	R2212A1268-R6
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

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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
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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	SPH320-aq
IMEI	862165040696583
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	14.63 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.

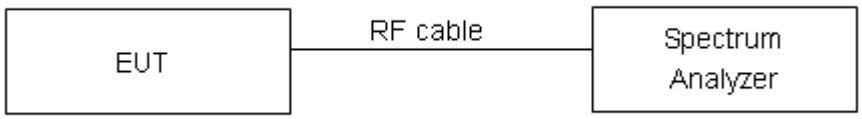
For U-NII-1/U-NII-2A/U-NII-2C, set RBW ≈1% OCB kHz, VBW ≥ 3 × RBW, measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 26 dB relative to the maximum level measured in the 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	16.617	23.972	PASS
	5200	16.633	23.313	PASS
	5240	16.574	22.916	PASS
802.11n HT20	5180	17.815	24.160	PASS
	5200	17.812	22.860	PASS
	5240	17.795	23.942	PASS
802.11n HT40	5190	36.273	41.795	PASS
	5230	36.272	41.402	PASS
802.11ac VHT20	5180	17.855	24.240	PASS
	5200	17.822	23.179	PASS
	5240	17.824	22.865	PASS
802.11ac VHT40	5190	36.266	41.948	PASS
	5230	36.253	41.621	PASS
802.11ac VHT80	5210	75.705	95.409	PASS

U-NII-2A

Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5260	16.613	22.321	PASS
	5300	16.582	22.035	PASS
	5320	16.588	22.618	PASS
802.11n HT20	5260	17.816	22.947	PASS
	5300	17.796	22.693	PASS
	5320	17.818	22.818	PASS
802.11n HT40	5270	36.286	42.146	PASS
	5310	36.309	42.216	PASS
802.11ac VHT20	5260	17.838	23.192	PASS
	5300	17.796	24.499	PASS
	5320	17.793	23.090	PASS
802.11ac VHT40	5270	36.286	42.134	PASS
	5310	36.270	41.930	PASS
802.11ac VHT80	5290	75.810	90.509	PASS

U-NII-2C

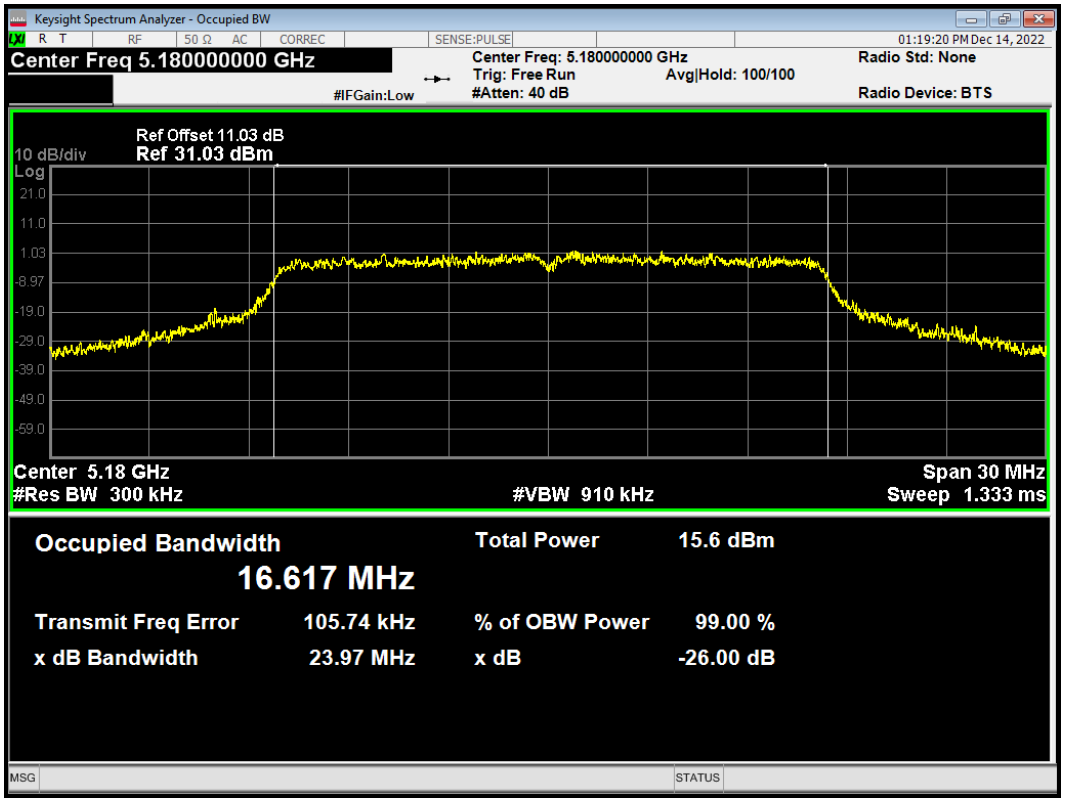
Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 26 dB bandwidth (MHz)	Conclusion
802.11a	5500	16.595	21.523	PASS
	5580	16.613	22.479	PASS
	5700	16.593	22.798	PASS
	5720	16.650	21.617	PASS
802.11n HT20	5500	16.585	22.110	PASS
	5580	16.618	23.032	PASS
	5700	16.622	22.757	PASS
	5720	16.639	23.116	PASS
802.11n HT40	5510	36.255	42.126	PASS
	5550	36.254	42.189	PASS
	5670	36.253	42.370	PASS
	5710	36.289	42.209	PASS
802.11ac VHT20	5500	17.797	22.817	PASS
	5580	17.795	22.907	PASS
	5700	17.834	22.907	PASS
	5720	17.828	22.576	PASS
802.11ac VHT40	5510	36.222	41.963	PASS
	5550	36.254	41.802	PASS
	5670	36.243	41.905	PASS
	5710	36.264	42.105	PASS
802.11ac VHT80	5530	75.763	83.528	PASS
	5690	75.788	83.494	PASS

U-NII-3

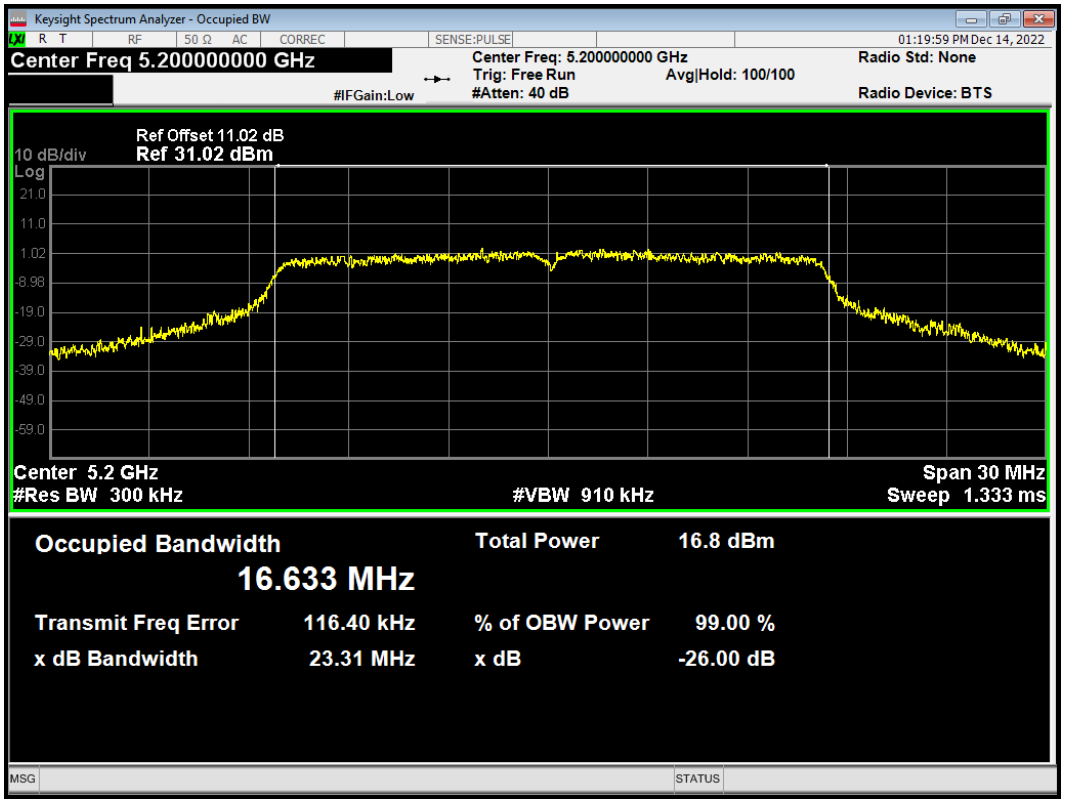
Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11a	5745	16.627	16.060	500	PASS
	5785	16.626	16.276	500	PASS
	5825	16.638	13.804	500	PASS
802.11n HT20	5745	17.803	16.330	500	PASS
	5785	17.825	15.897	500	PASS
	5825	16.609	15.331	500	PASS
802.11n HT40	5755	36.230	35.710	500	PASS
	5795	36.284	35.699	500	PASS
802.11ac VHT20	5745	17.821	16.895	500	PASS
	5785	17.826	14.974	500	PASS
	5825	17.842	15.097	500	PASS
802.11ac VHT40	5755	36.261	35.725	500	PASS
	5795	36.275	35.463	500	PASS
802.11ac VHT80	5775	75.852	73.829	500	PASS

U-NII-1

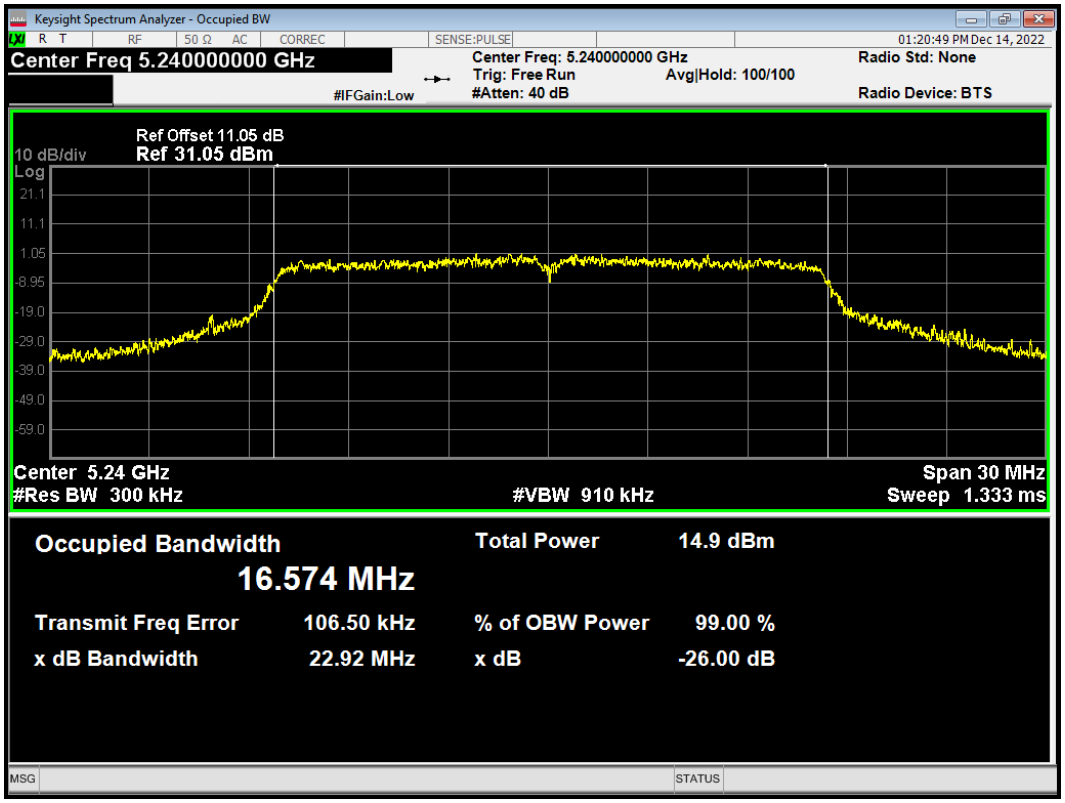
OBW 802.11a 5180MHz



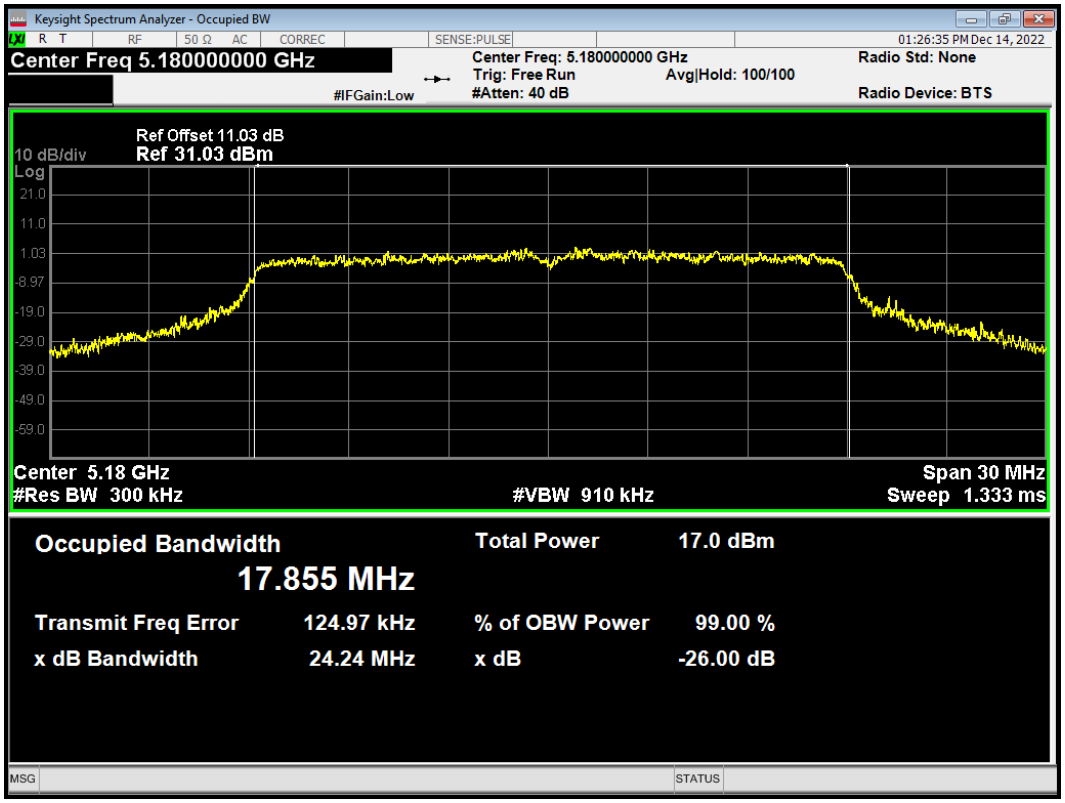
OBW 802.11a 5200MHz



OBW 802.11a 5240MHz



OBW 802.11ac(VHT20) 5180MHz



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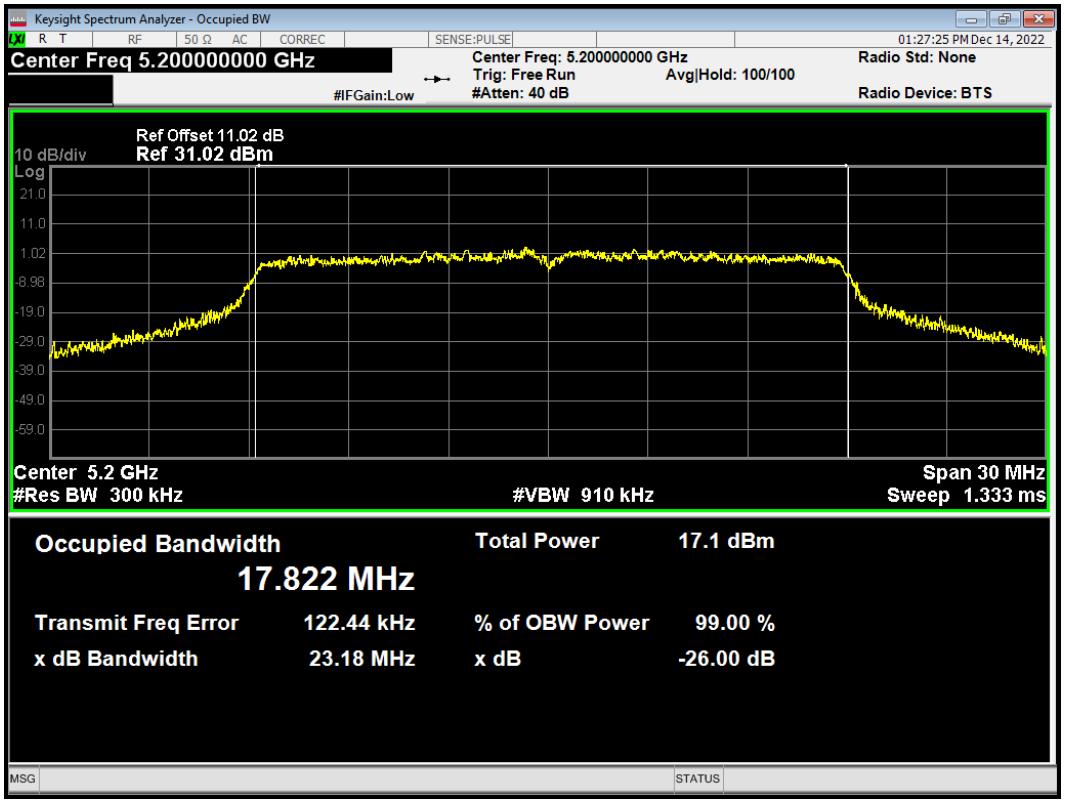

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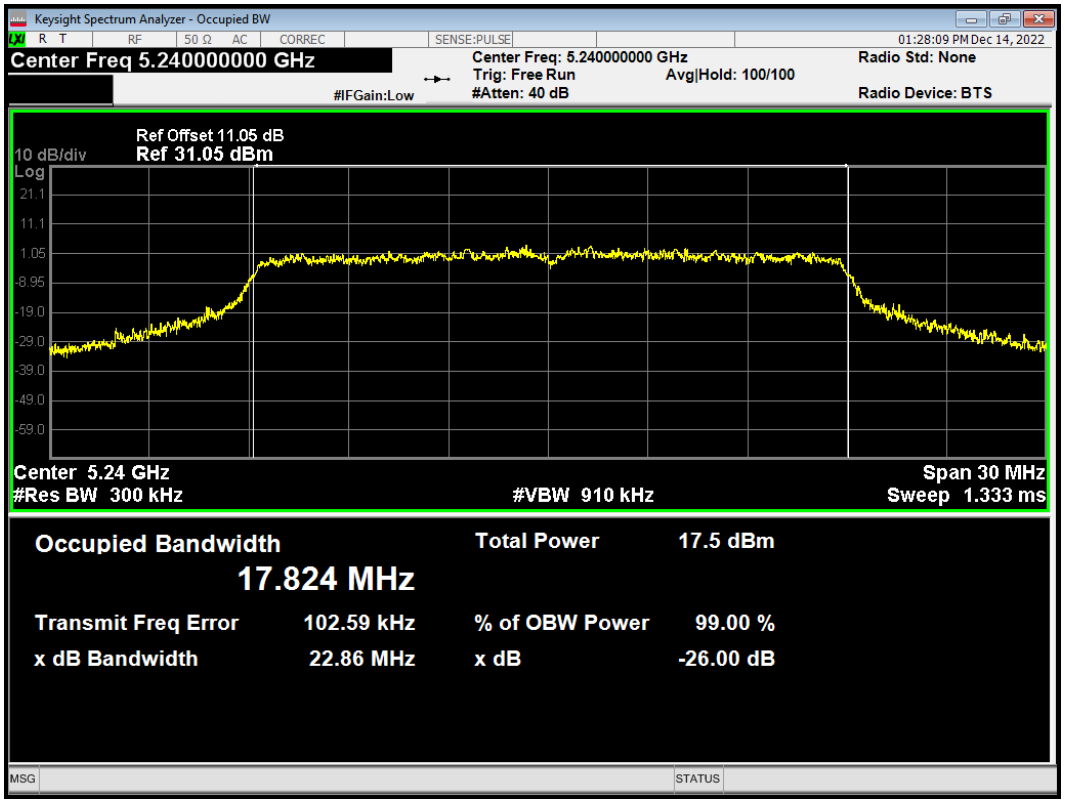
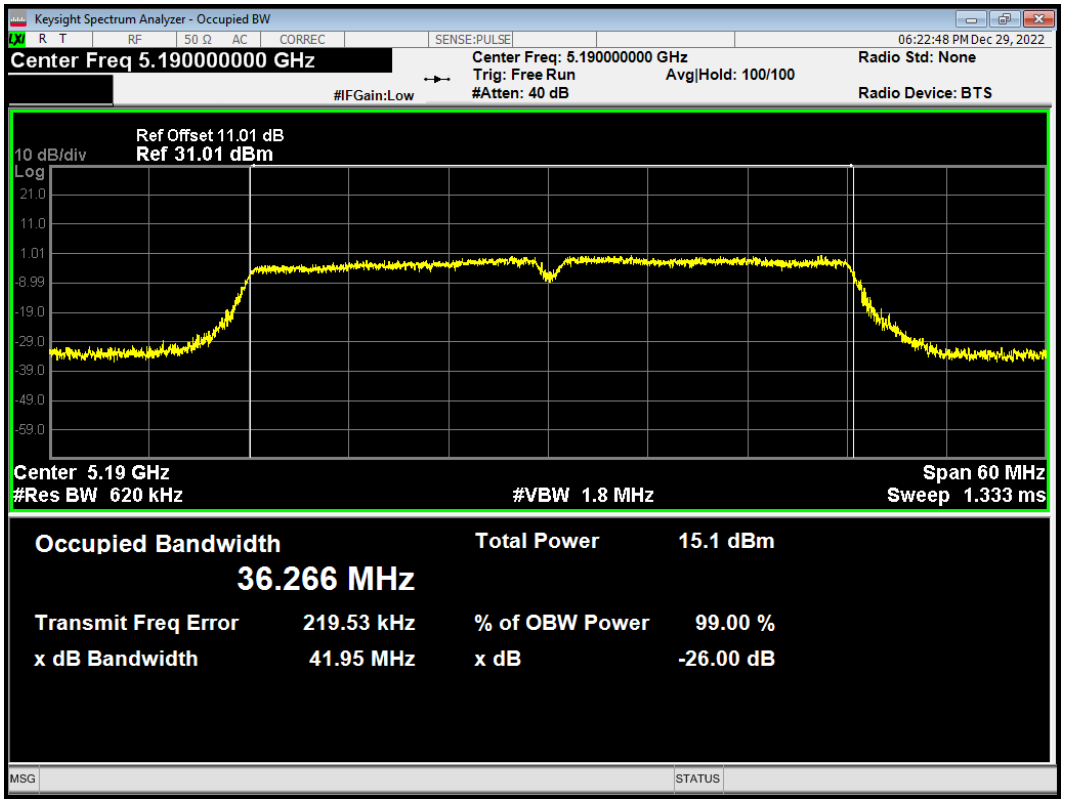
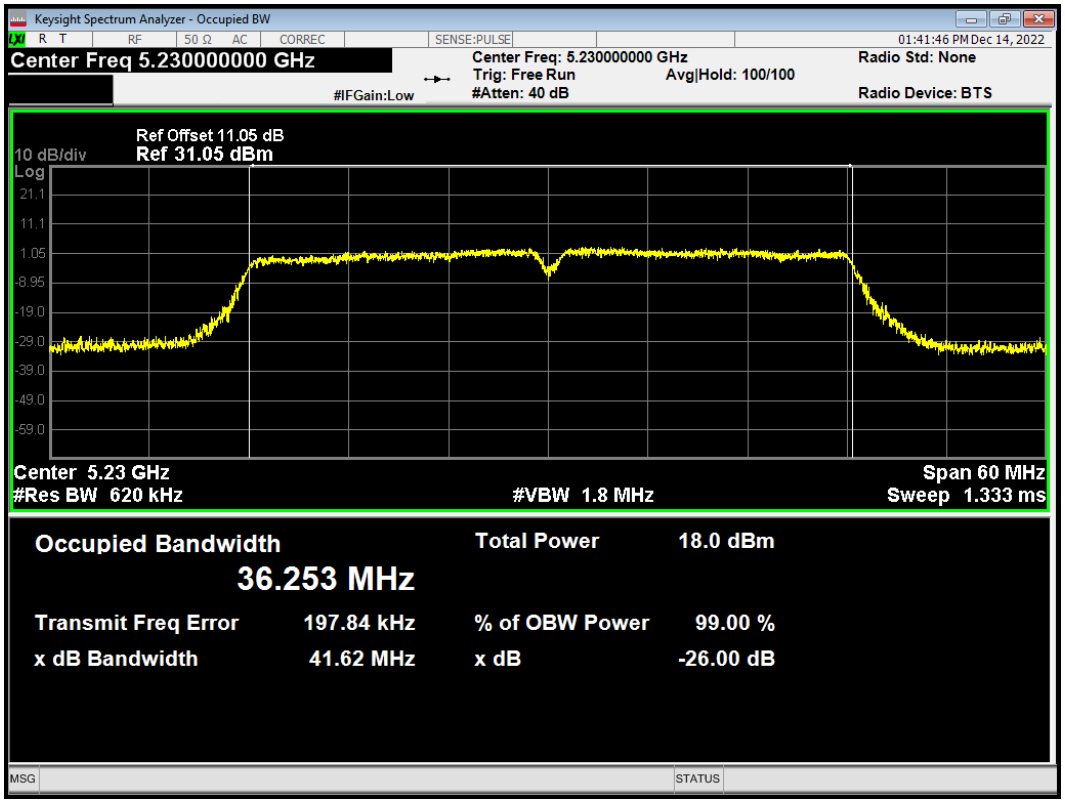


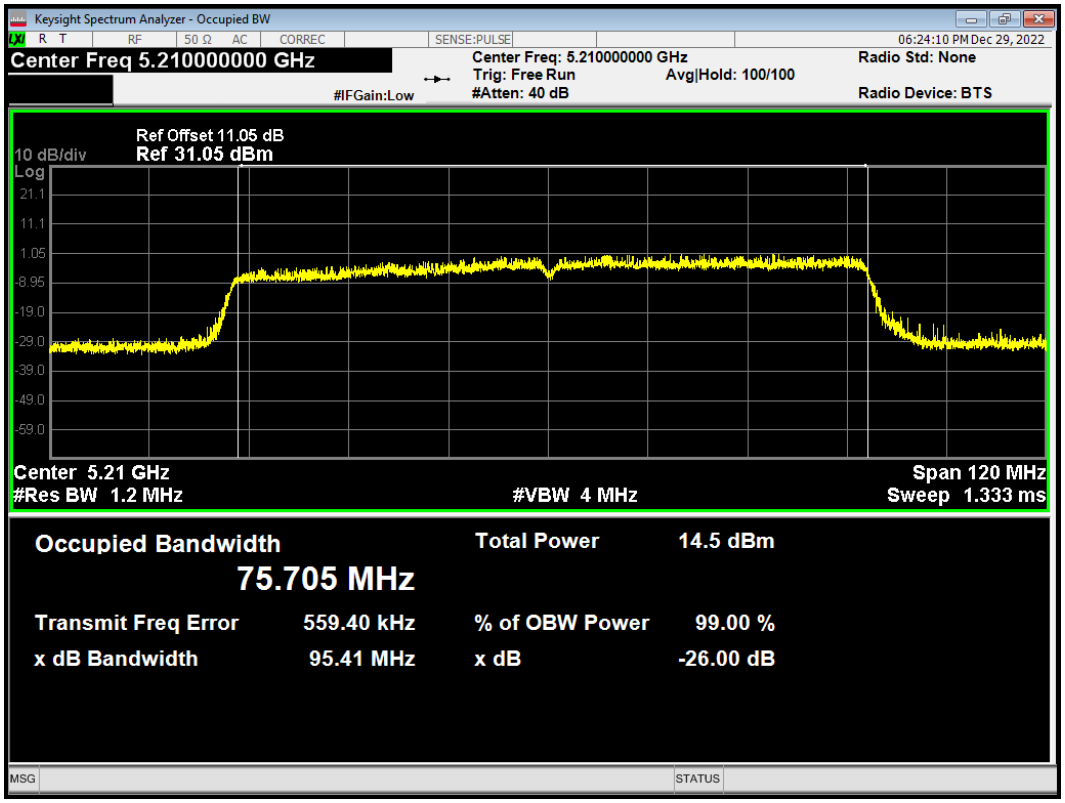
OBW 802.11ac(VHT40) 5190MHz



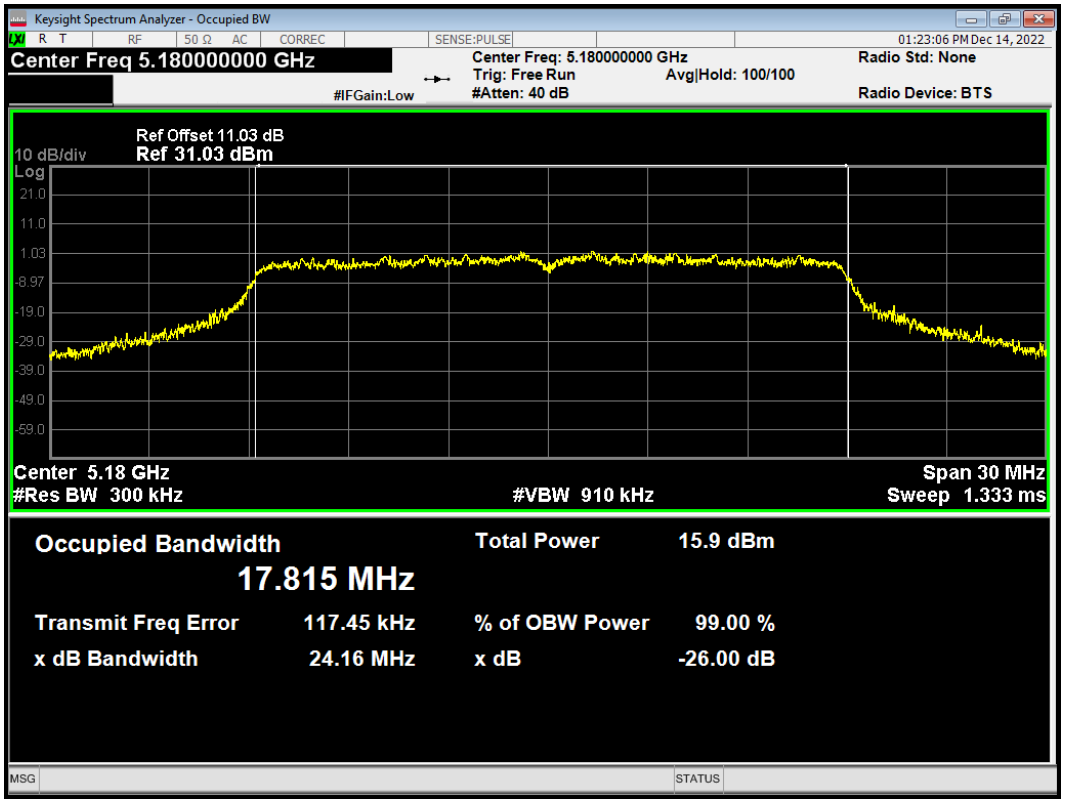
OBW 802.11ac(VHT40) 5230MHz



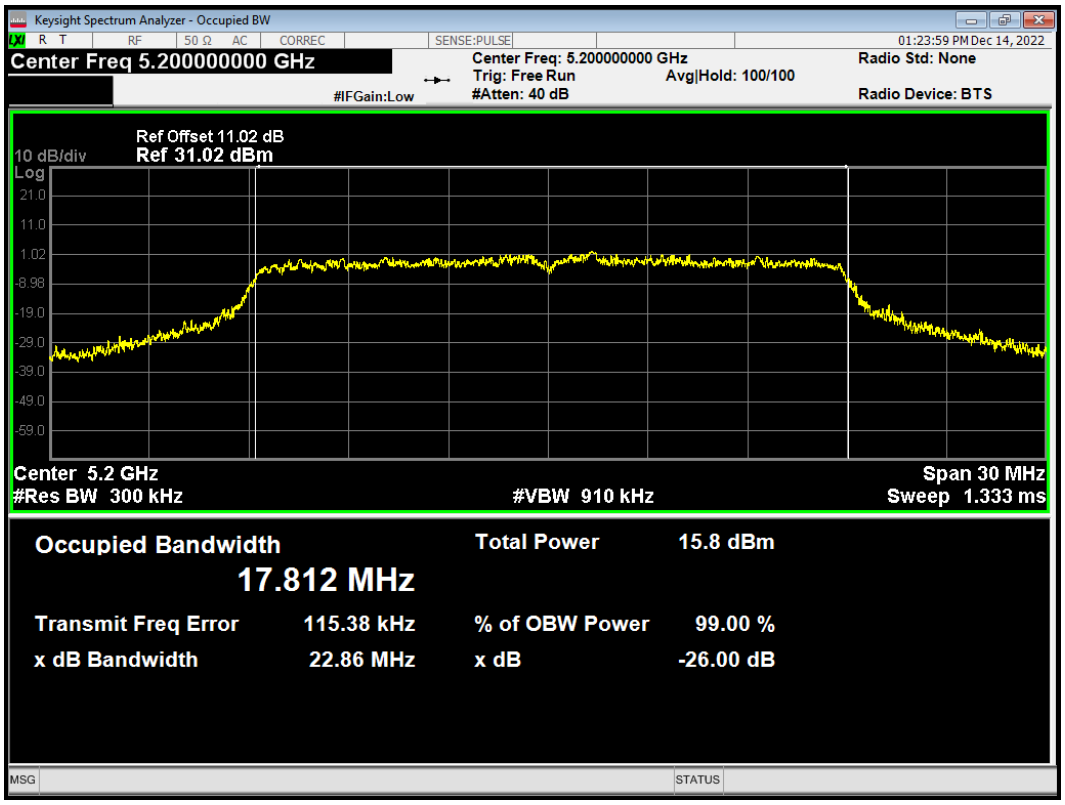
OBW 802.11ac(VHT80) 5210MHz



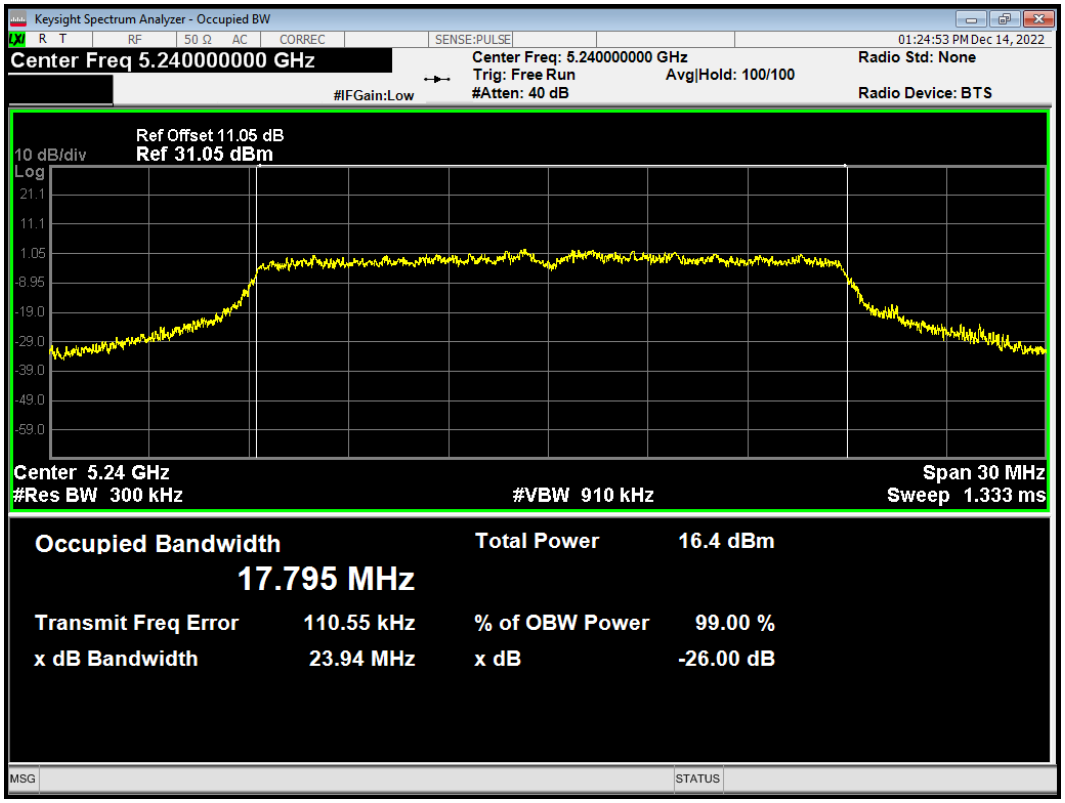
OBW 802.11n(HT20) 5180MHz



OBW 802.11n(HT20) 5200MHz



OBW 802.11n(HT20) 5240MHz



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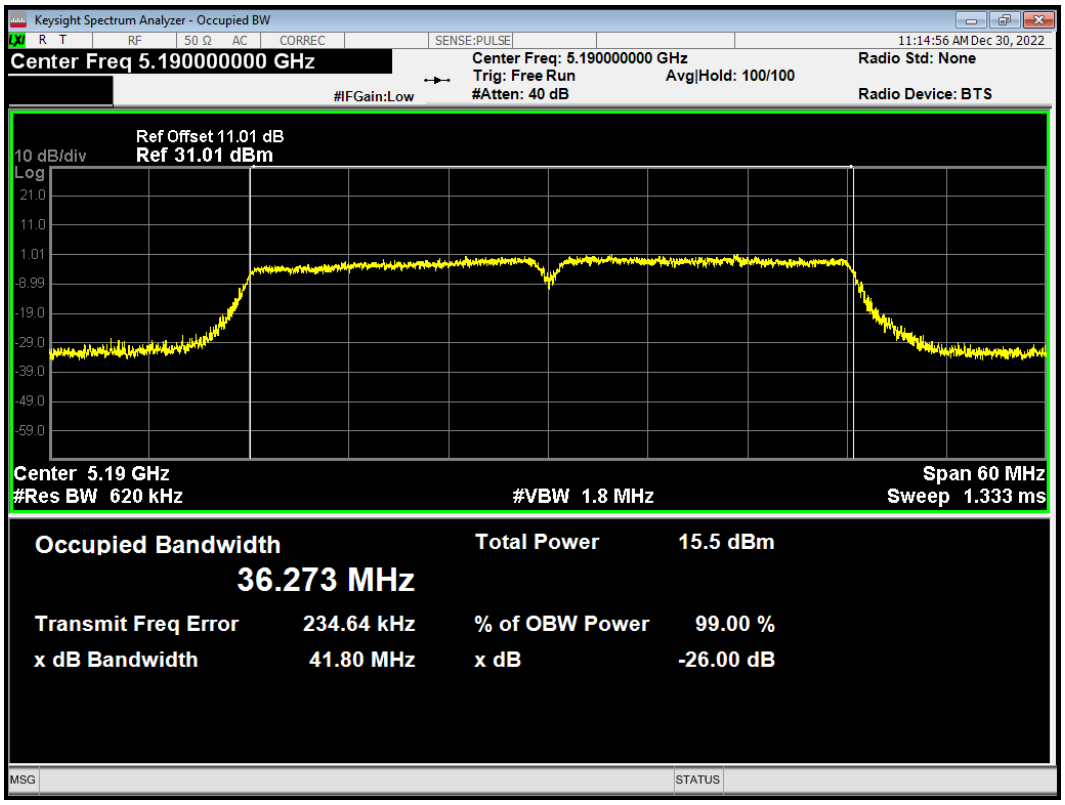
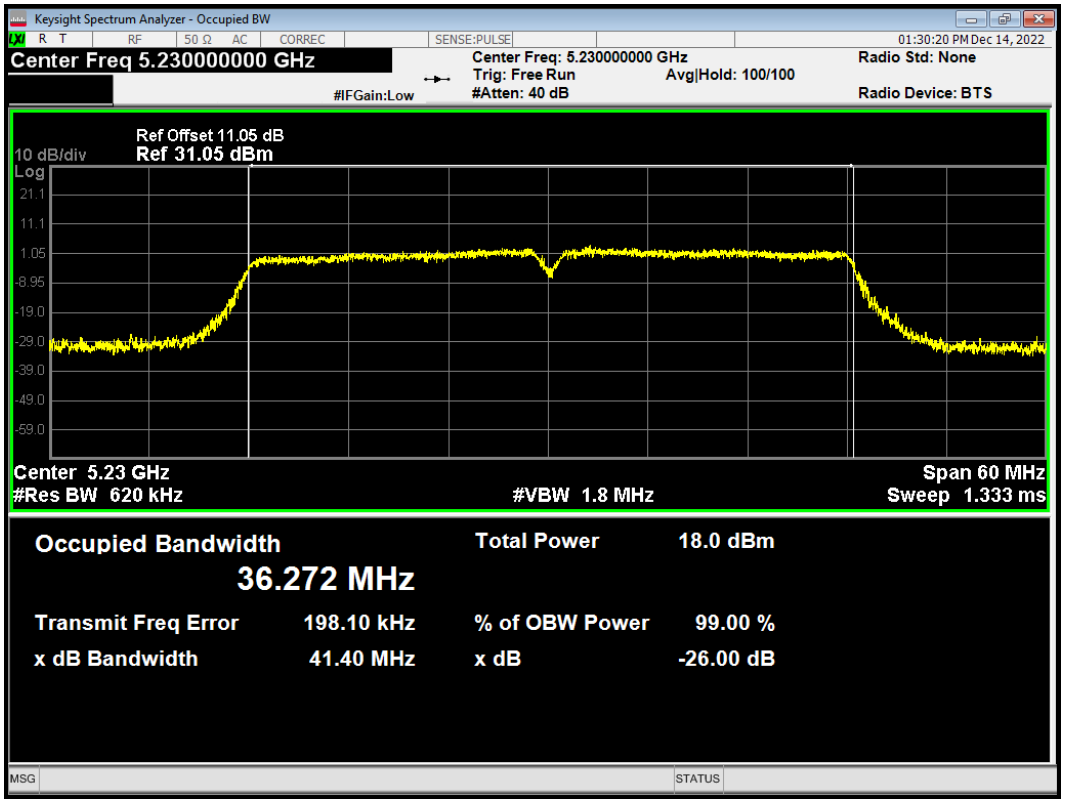
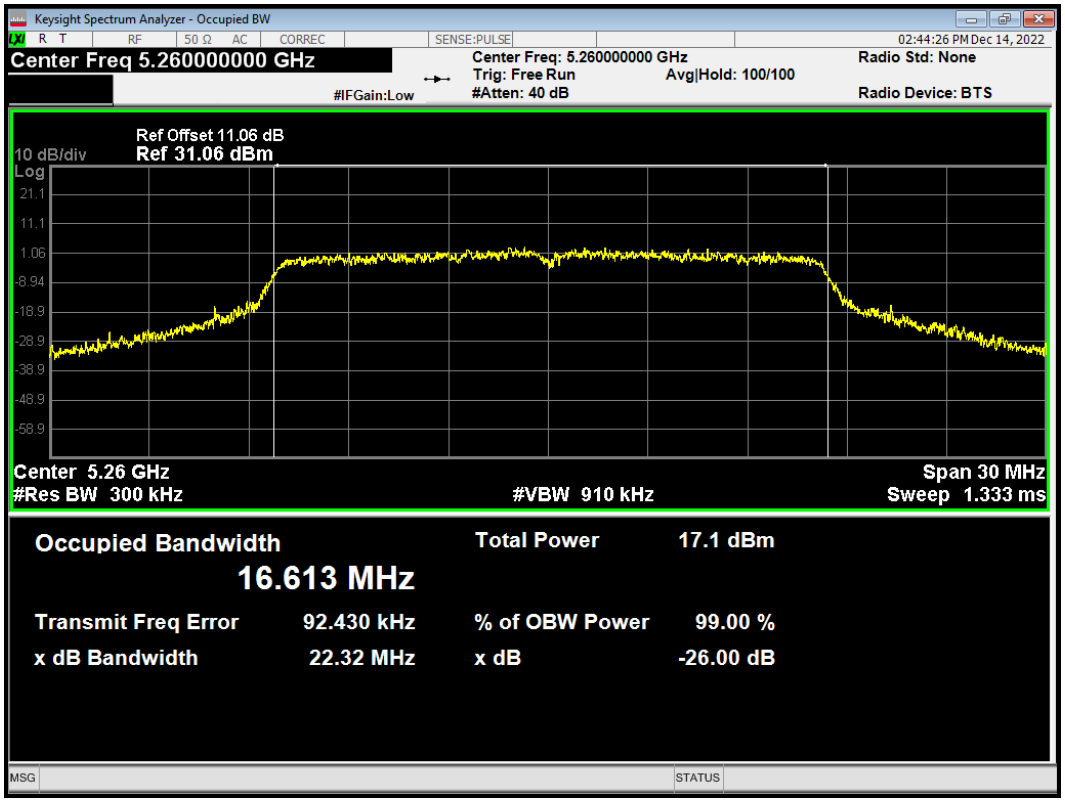


OBW 802.11n(HT40) 5230MHz

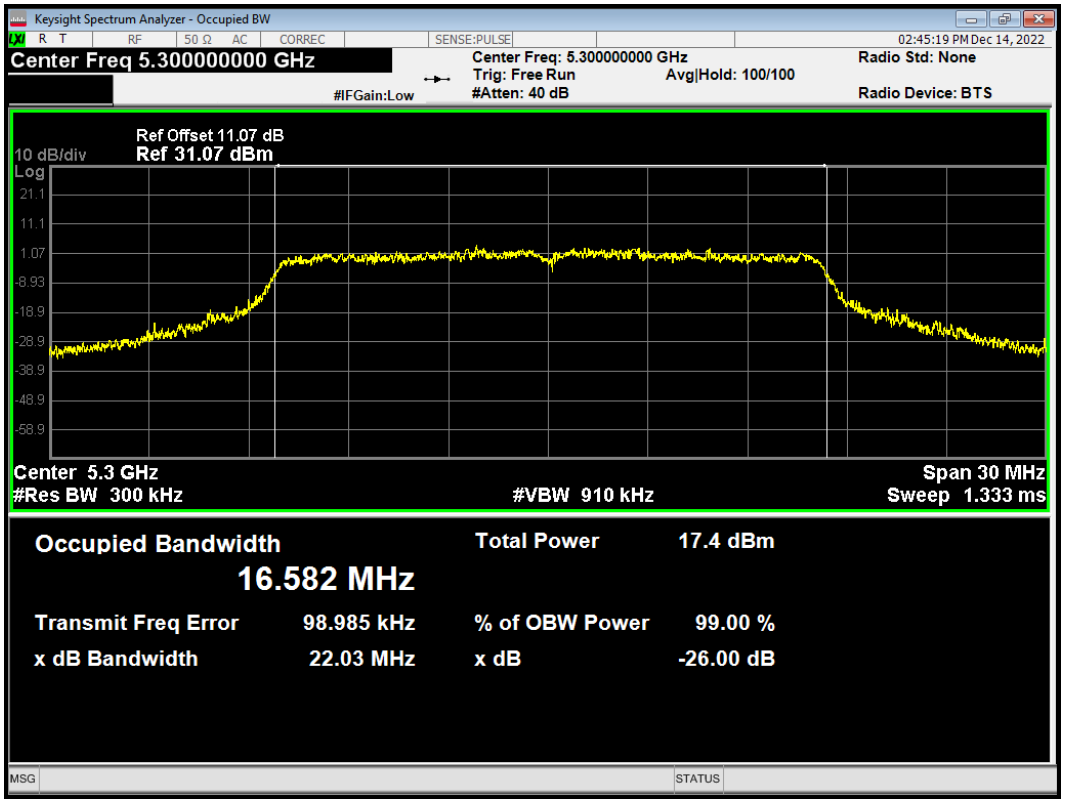


U-NII-2A

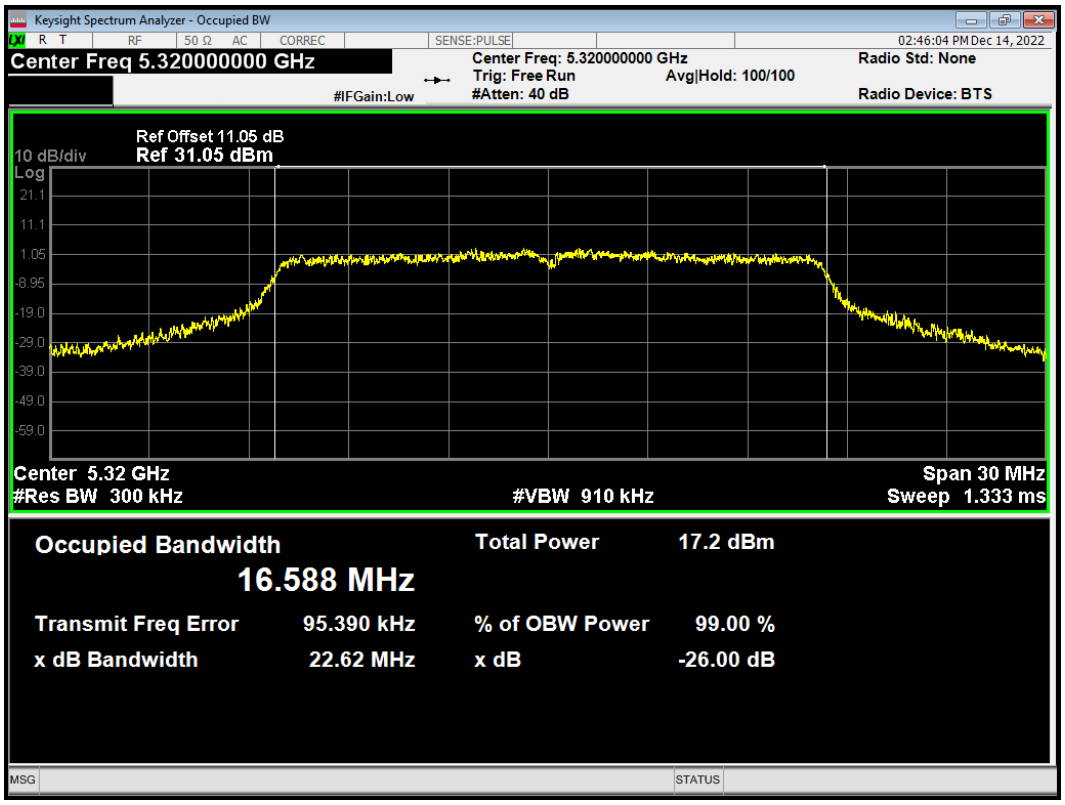
OBW 802.11a 5260MHz



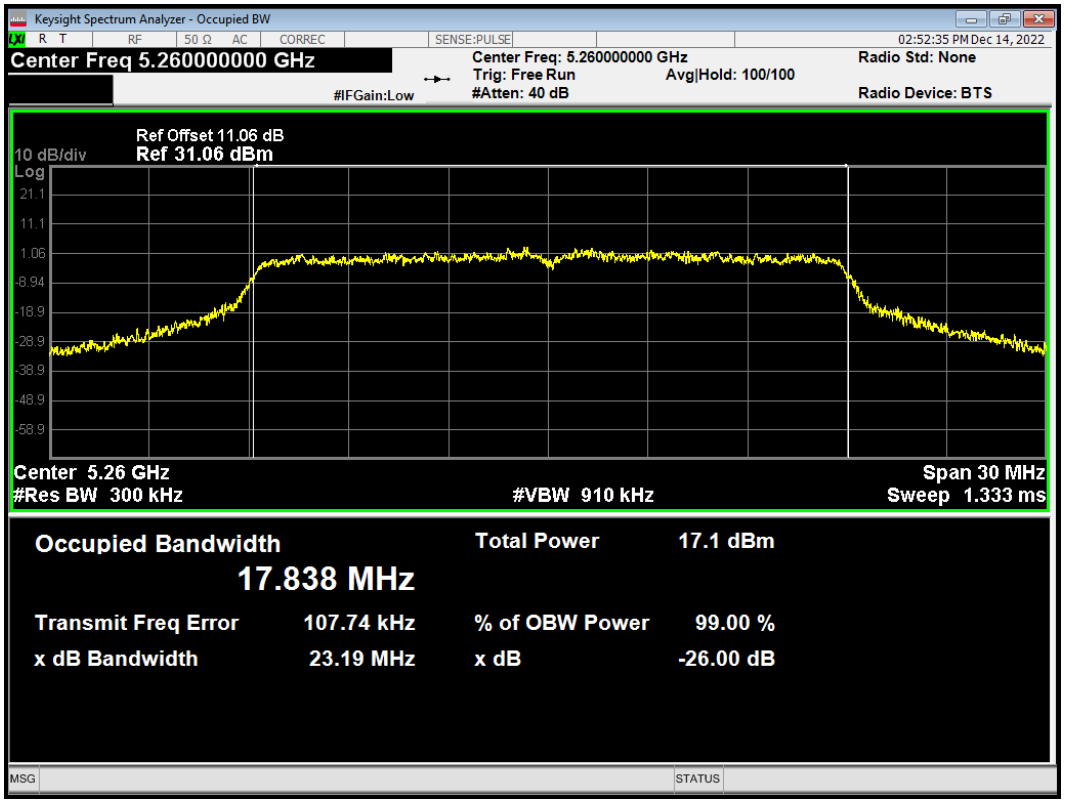
OBW 802.11a 5300MHz



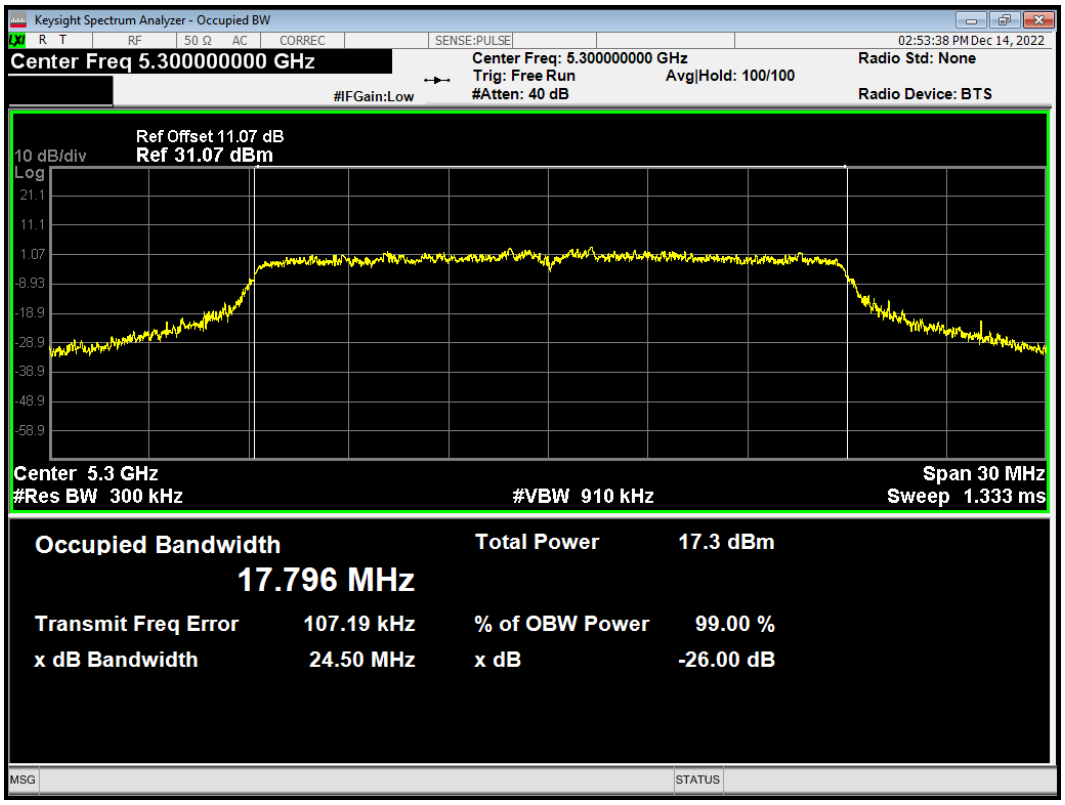
OBW 802.11a 5320MHz



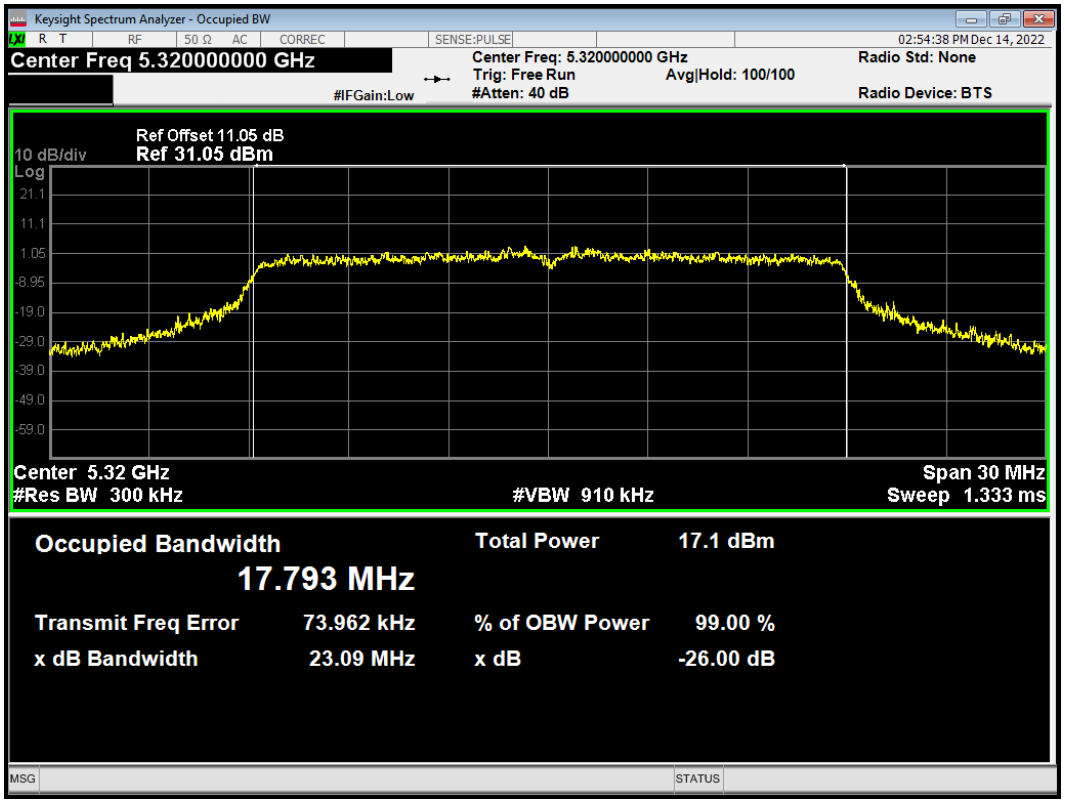
OBW 802.11ac(VHT20) 5260MHz



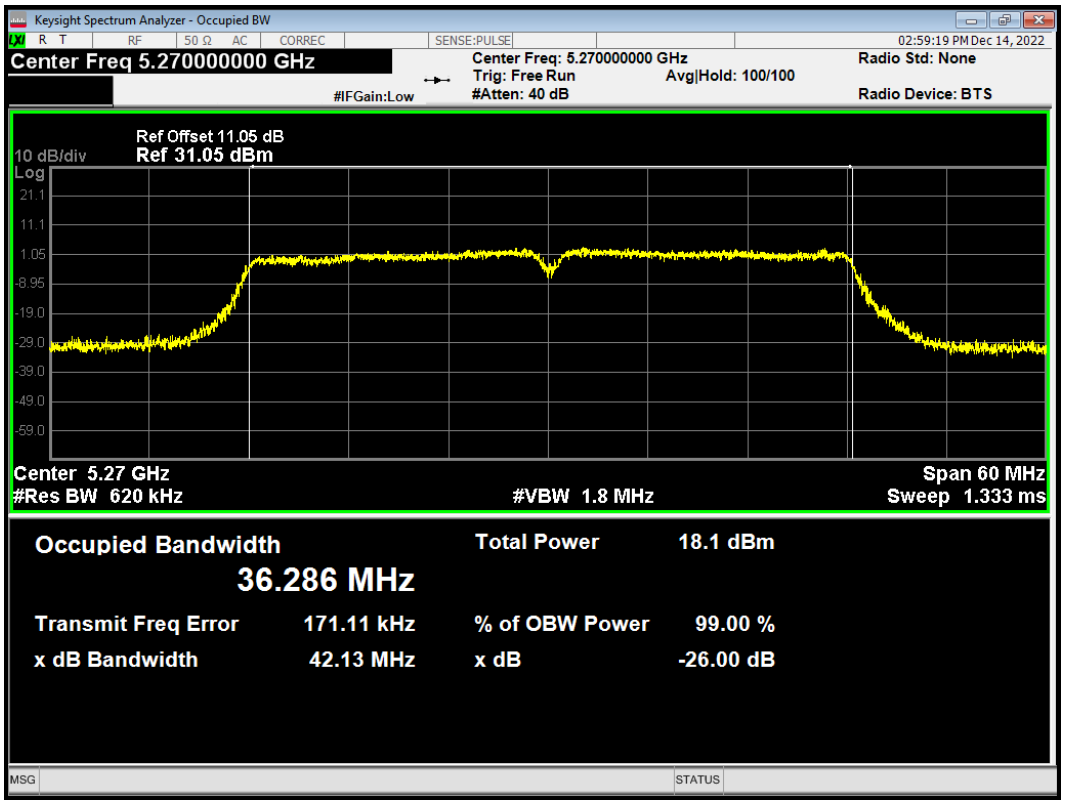
OBW 802.11ac(VHT20) 5300MHz



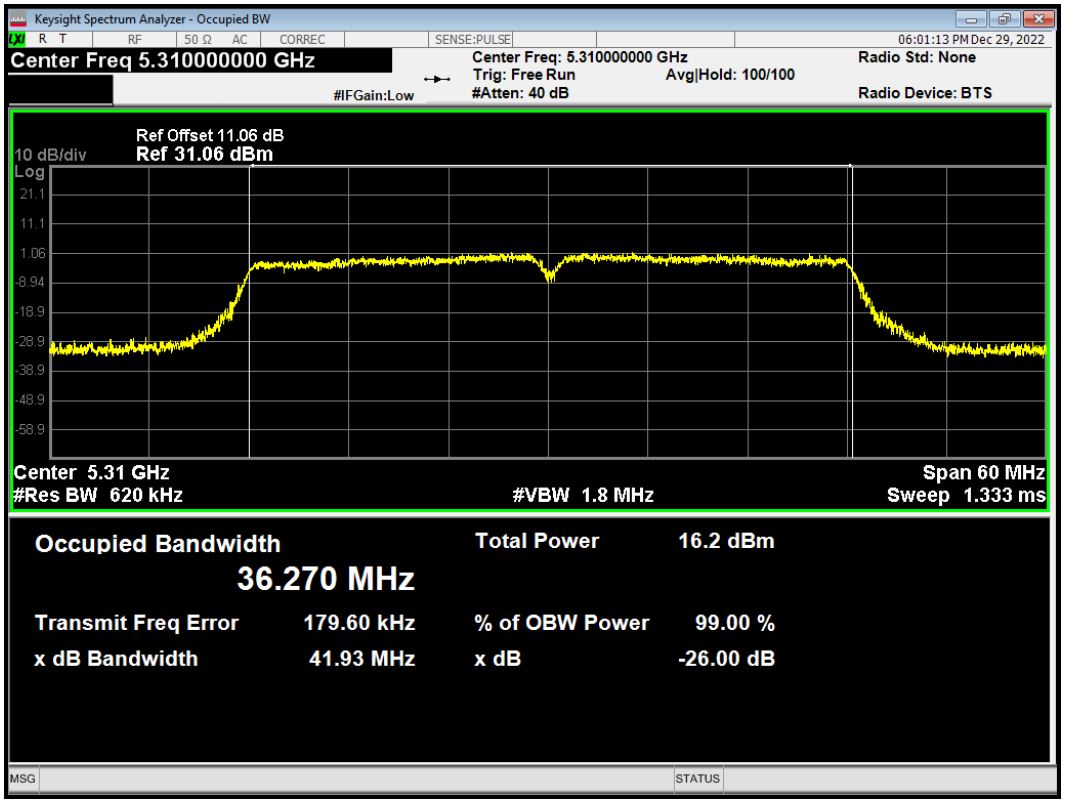
OBW 802.11ac(VHT20) 5320MHz



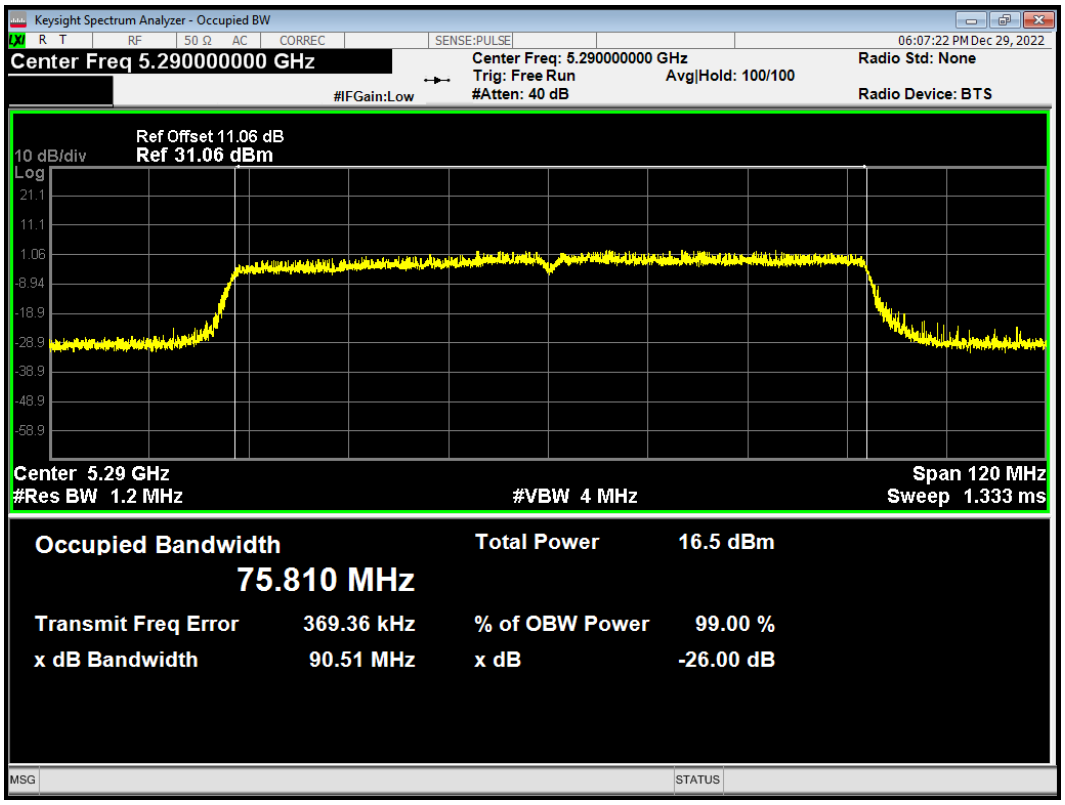
OBW 802.11ac(VHT40) 5270MHz



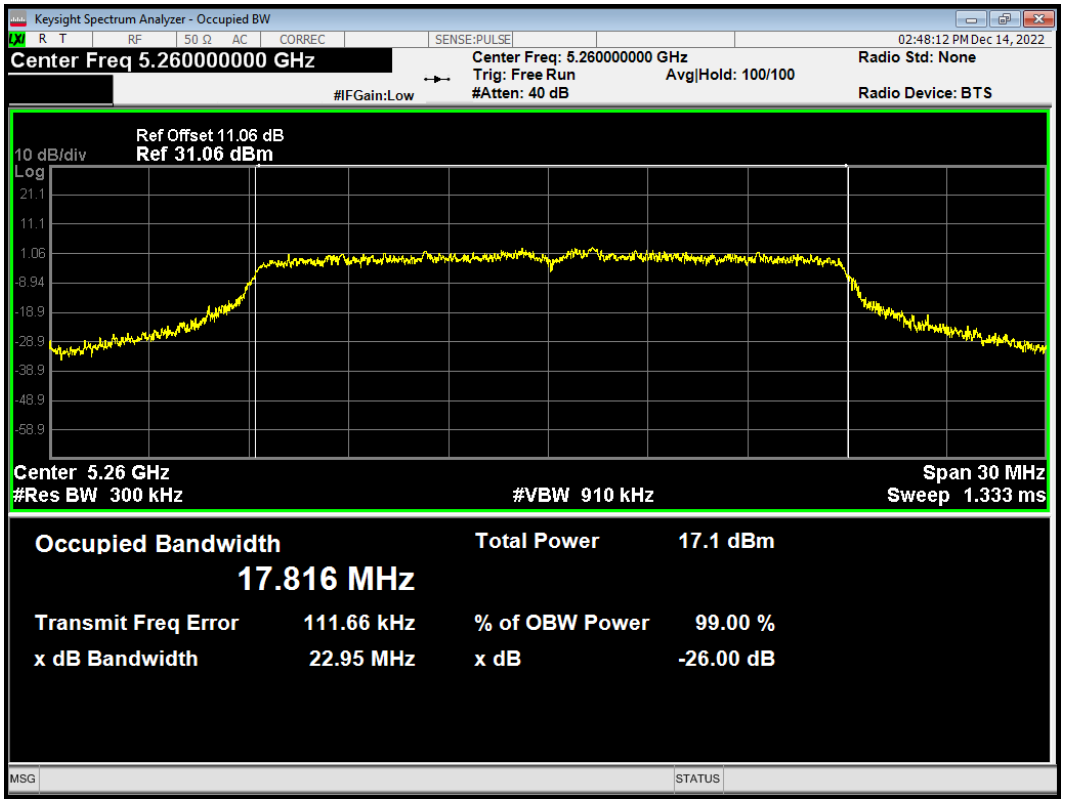
OBW 802.11ac(VHT40) 5310MHz



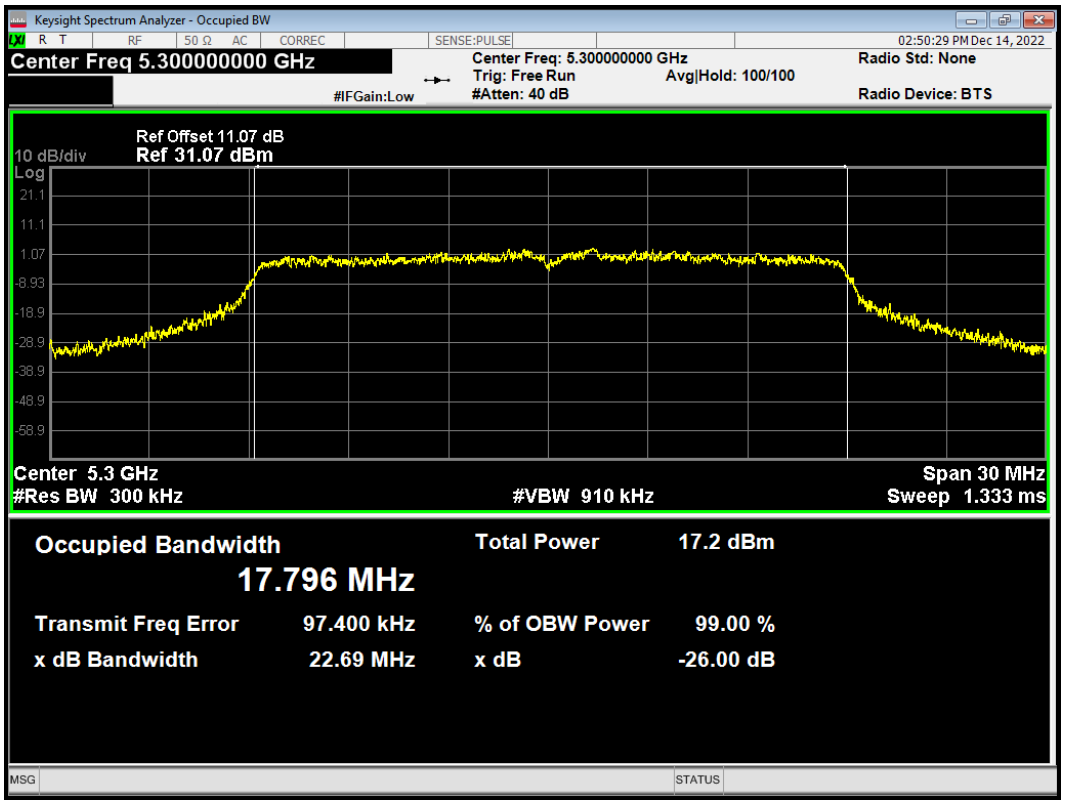
OBW 802.11ac(VHT80) 5290MHz



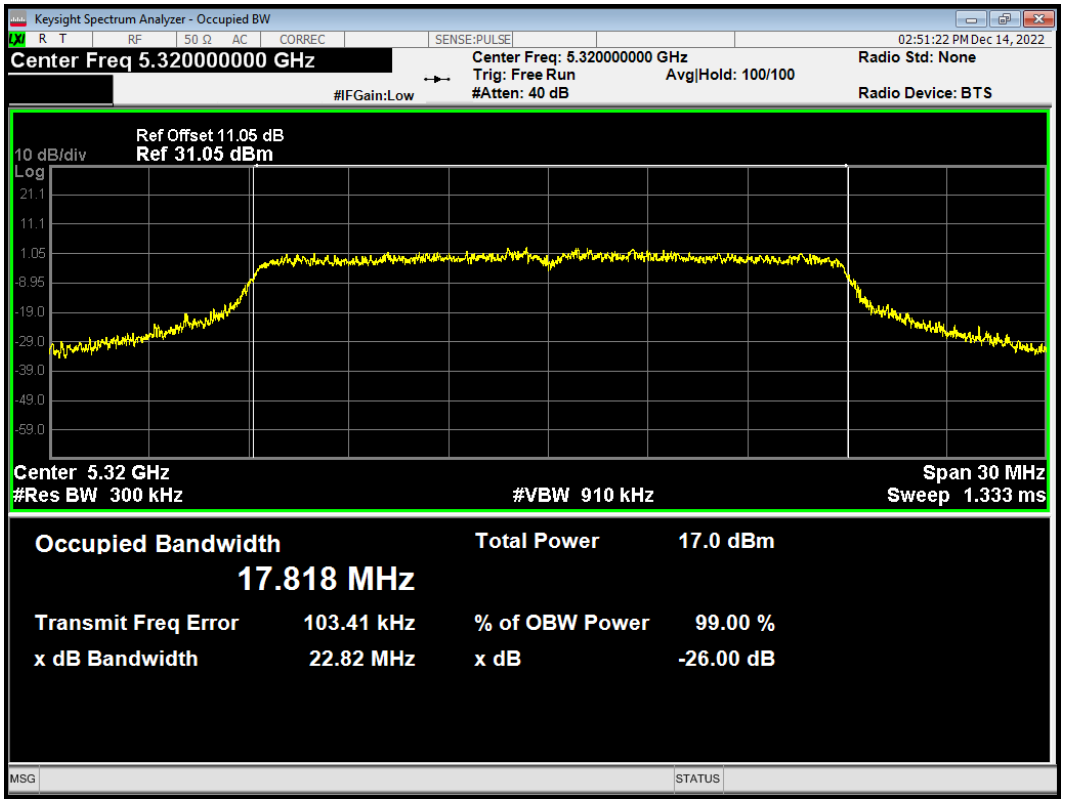
OBW 802.11n(HT20) 5260MHz



OBW 802.11n(HT20) 5300MHz



OBW 802.11n(HT20) 5320MHz



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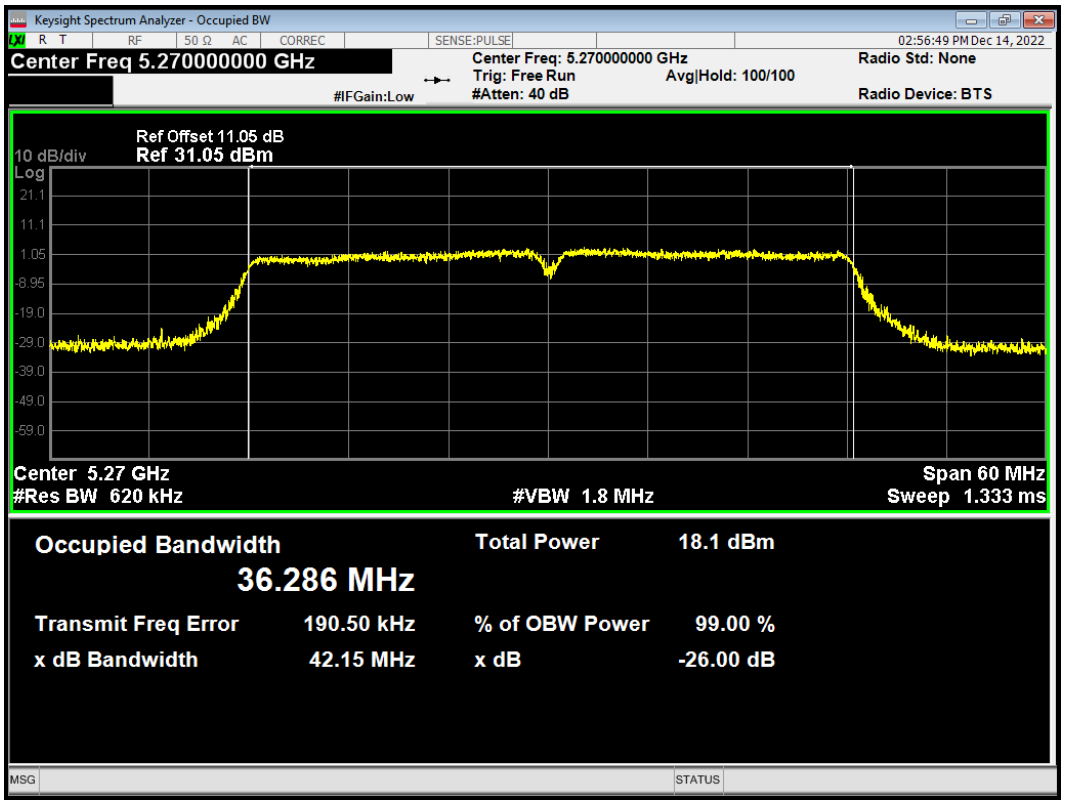

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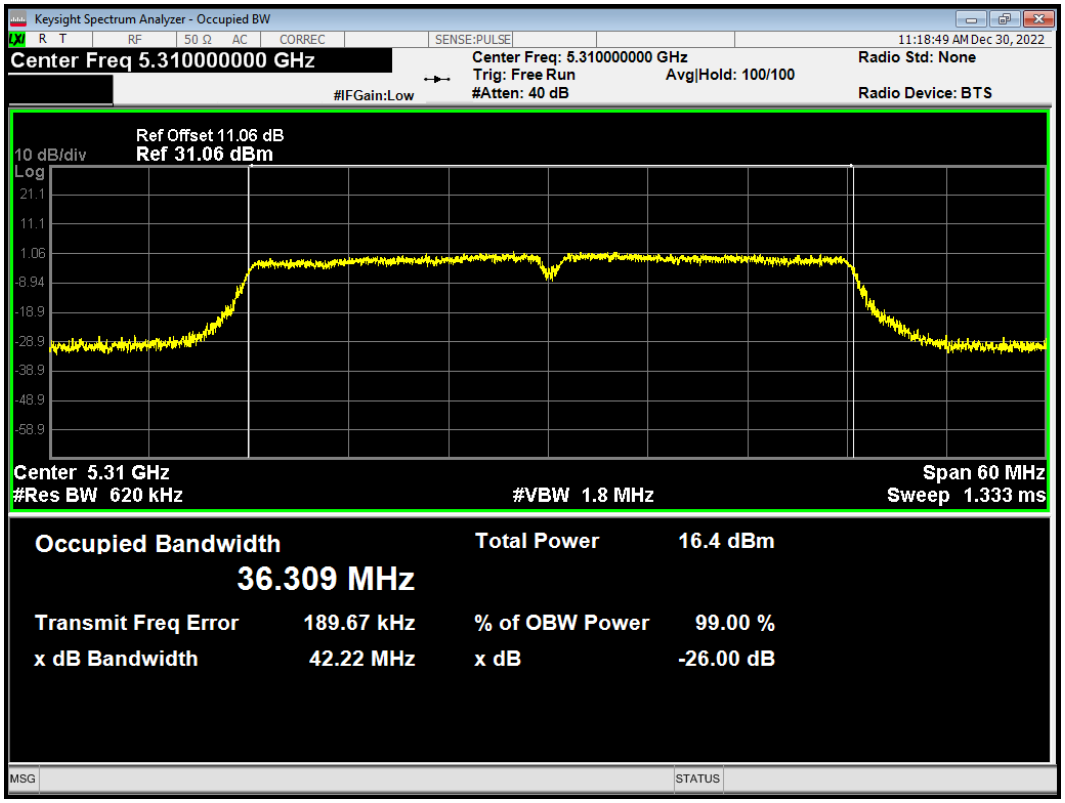
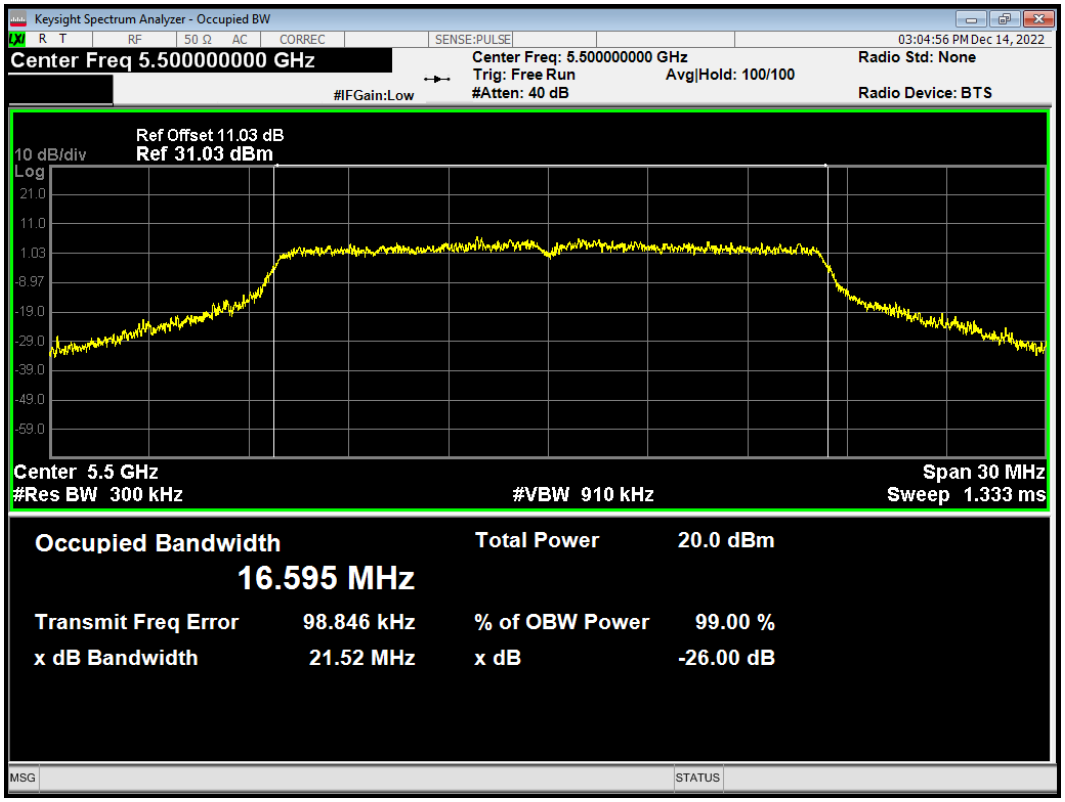
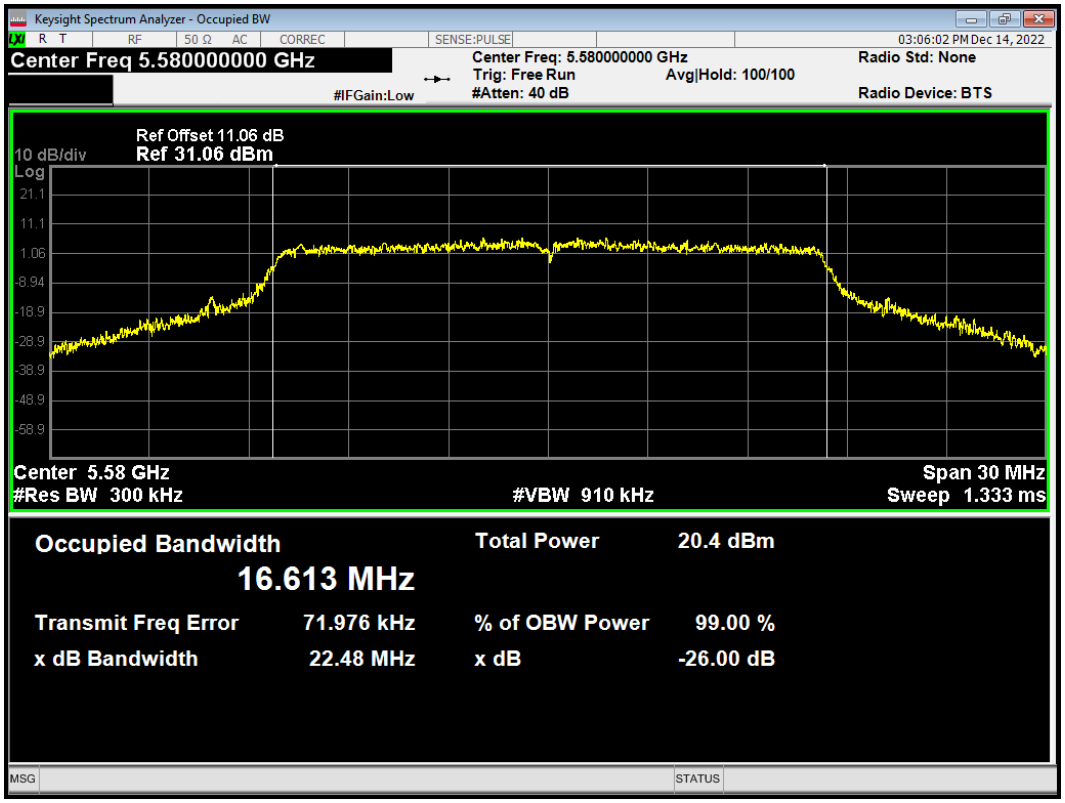


U-NII-2C

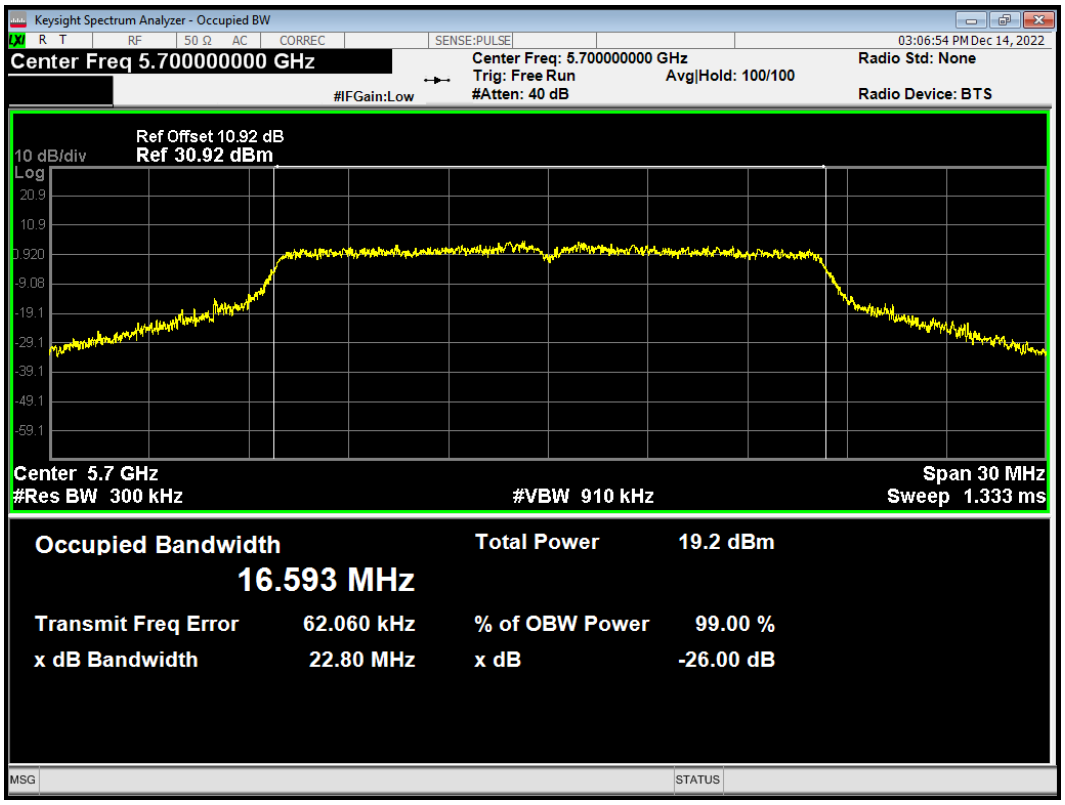
OBW 802.11a 5500MHz



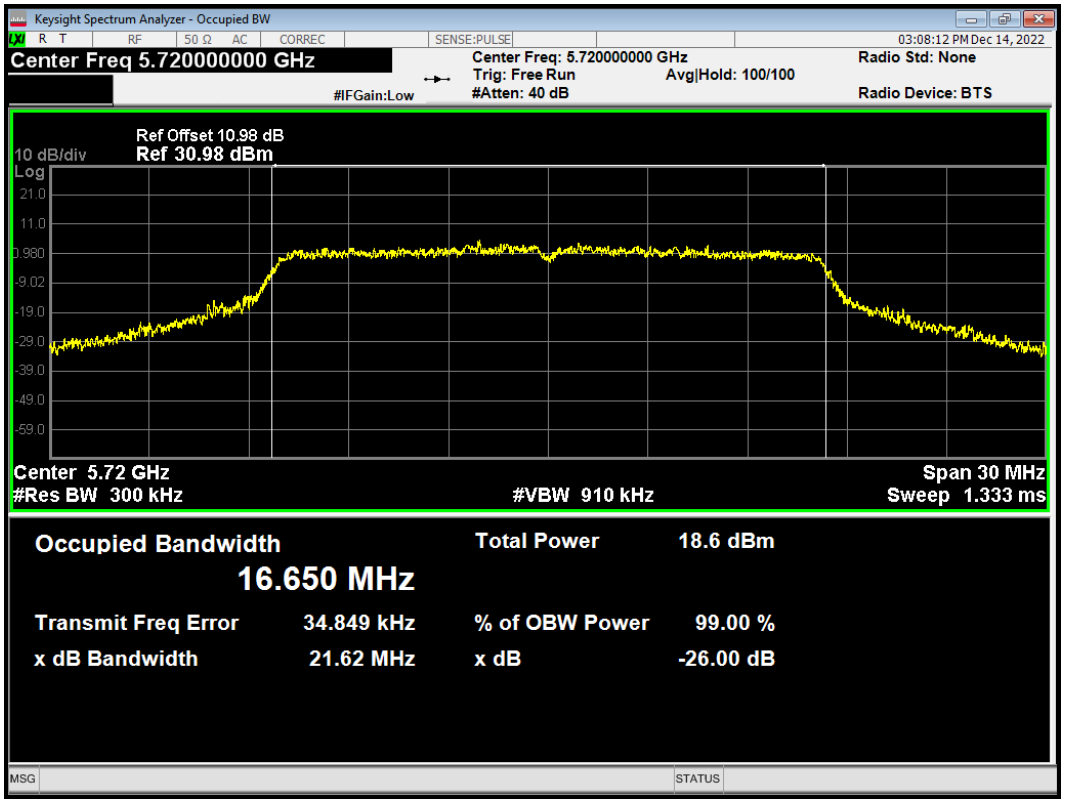
OBW 802.11a 5580MHz



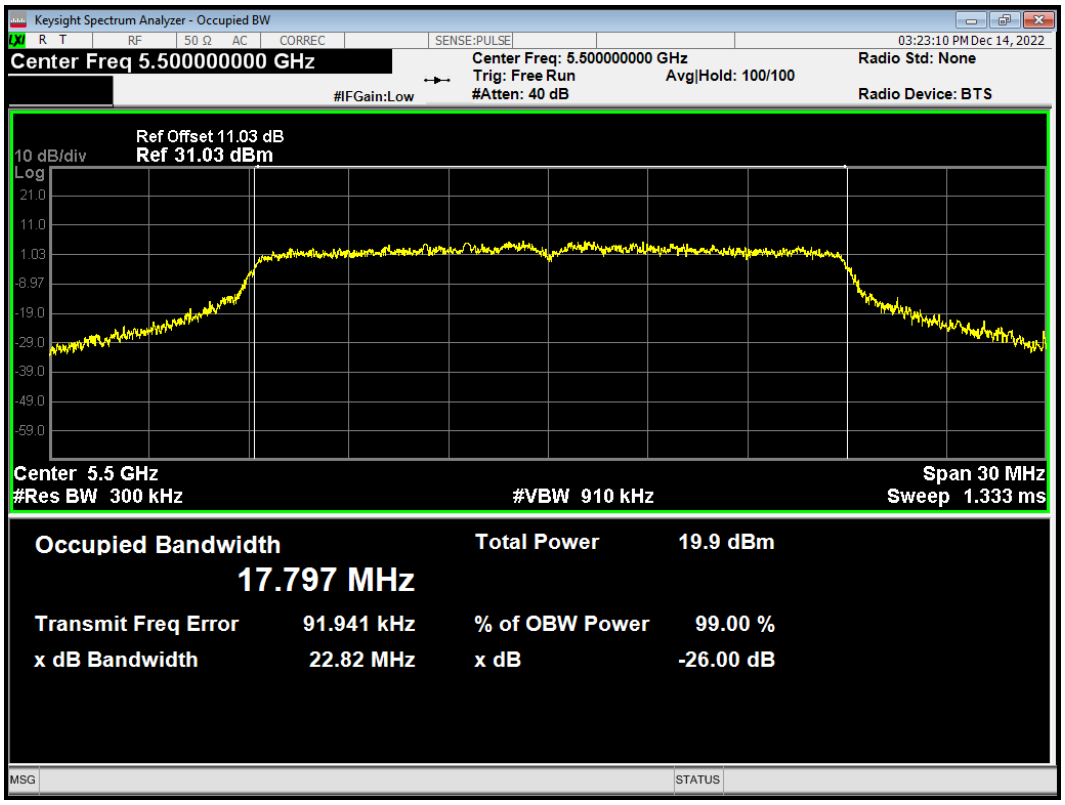
OBW 802.11a 5700MHz



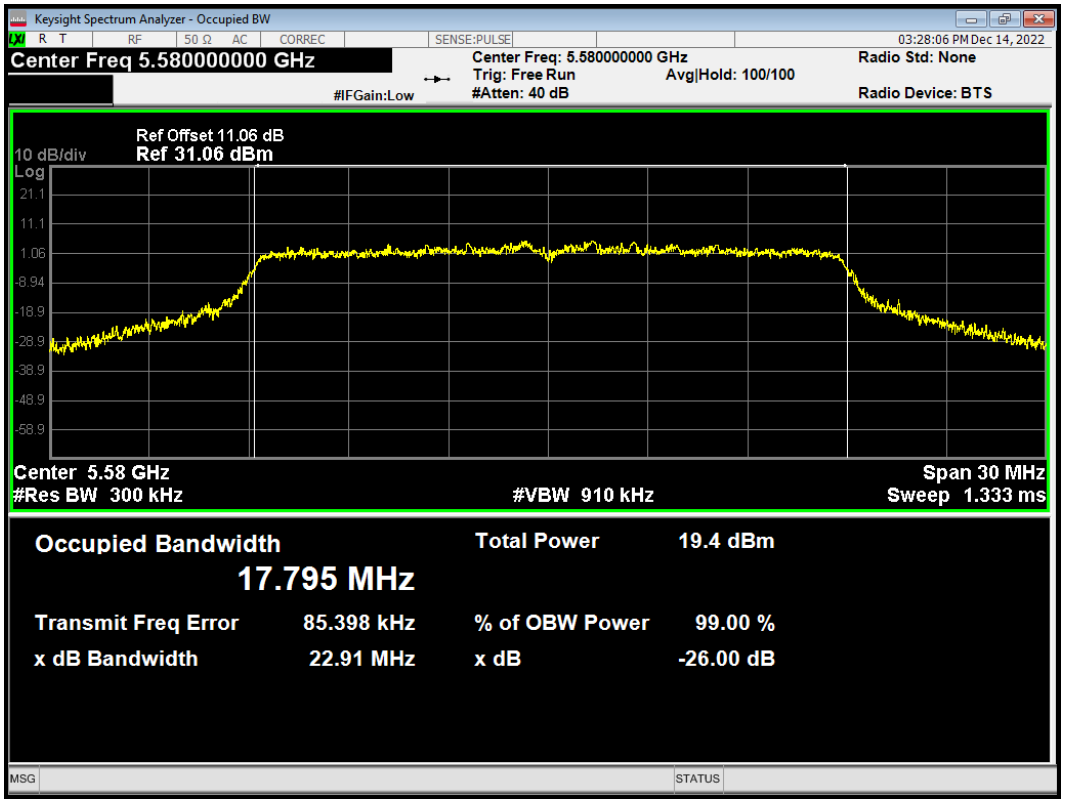
OBW 802.11a 5720MHz



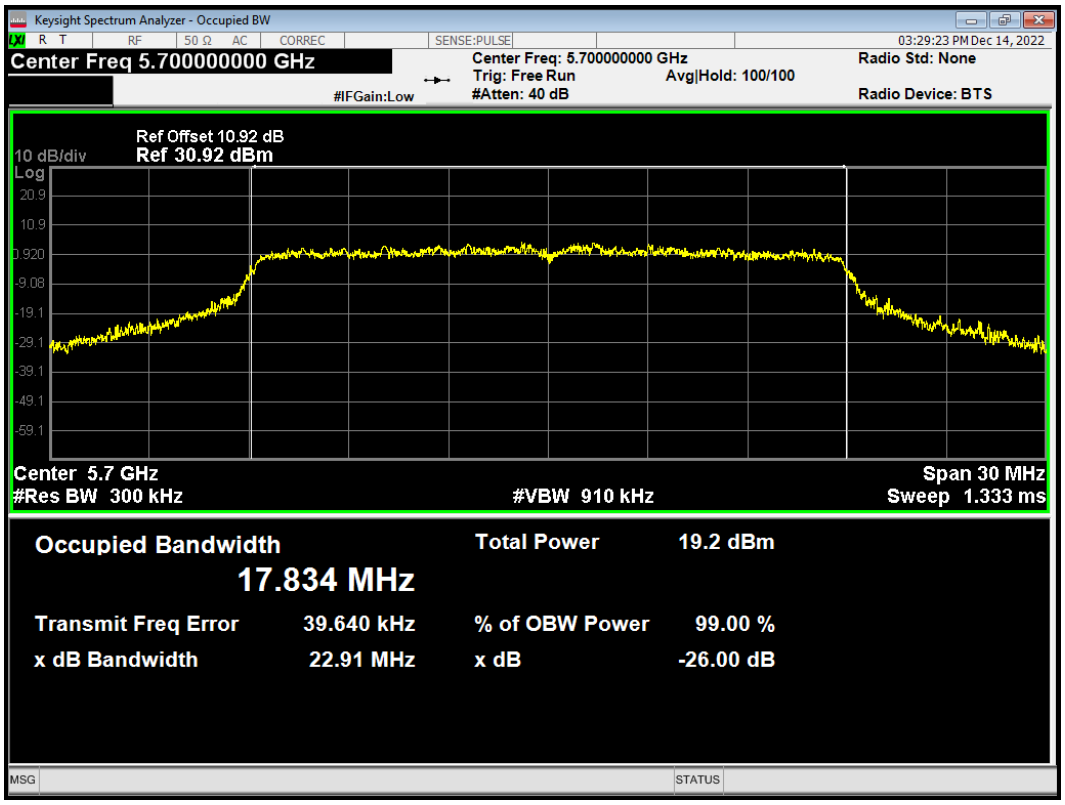
OBW 802.11ac(VHT20) 5500MHz



OBW 802.11ac(VHT20) 5580MHz



OBW 802.11ac(VHT20) 5700MHz



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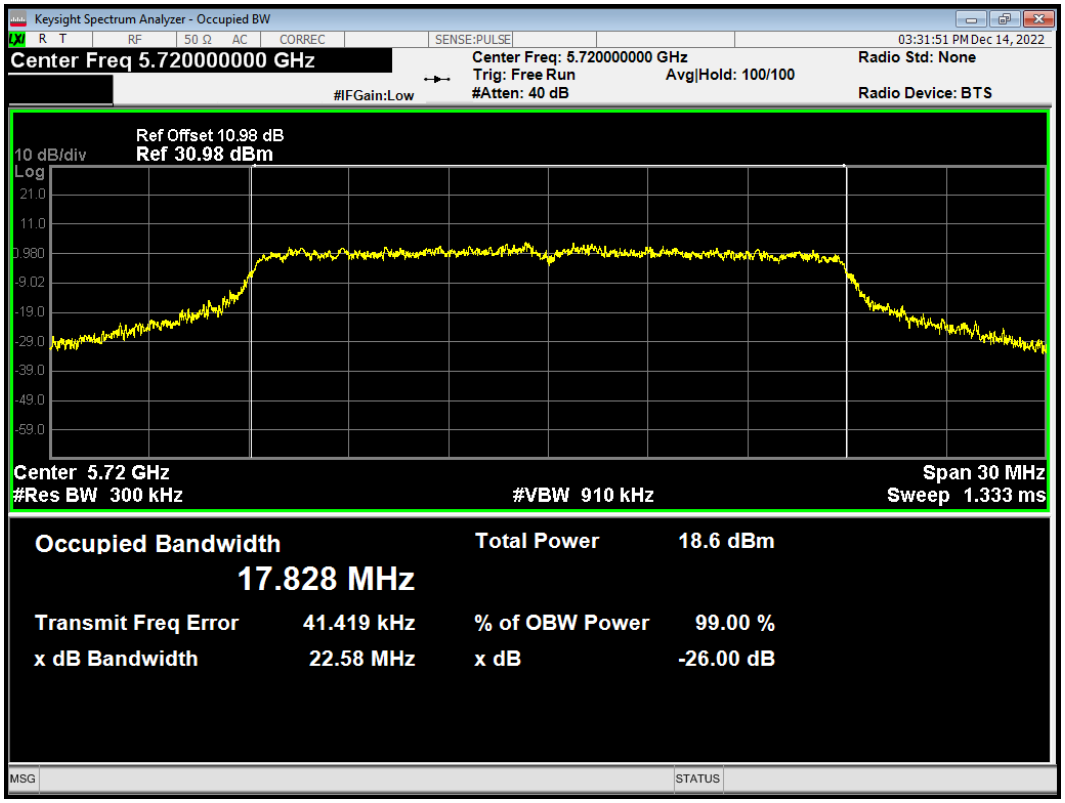
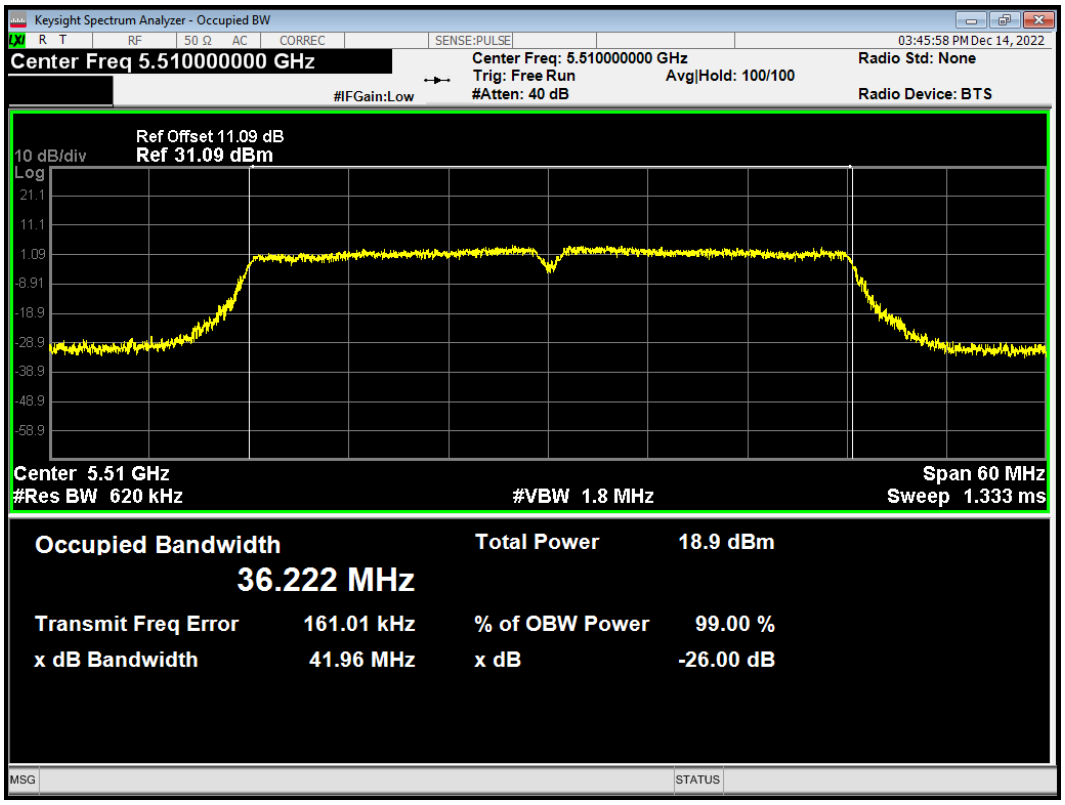


OBW 802.11ac(VHT40) 5510MHz



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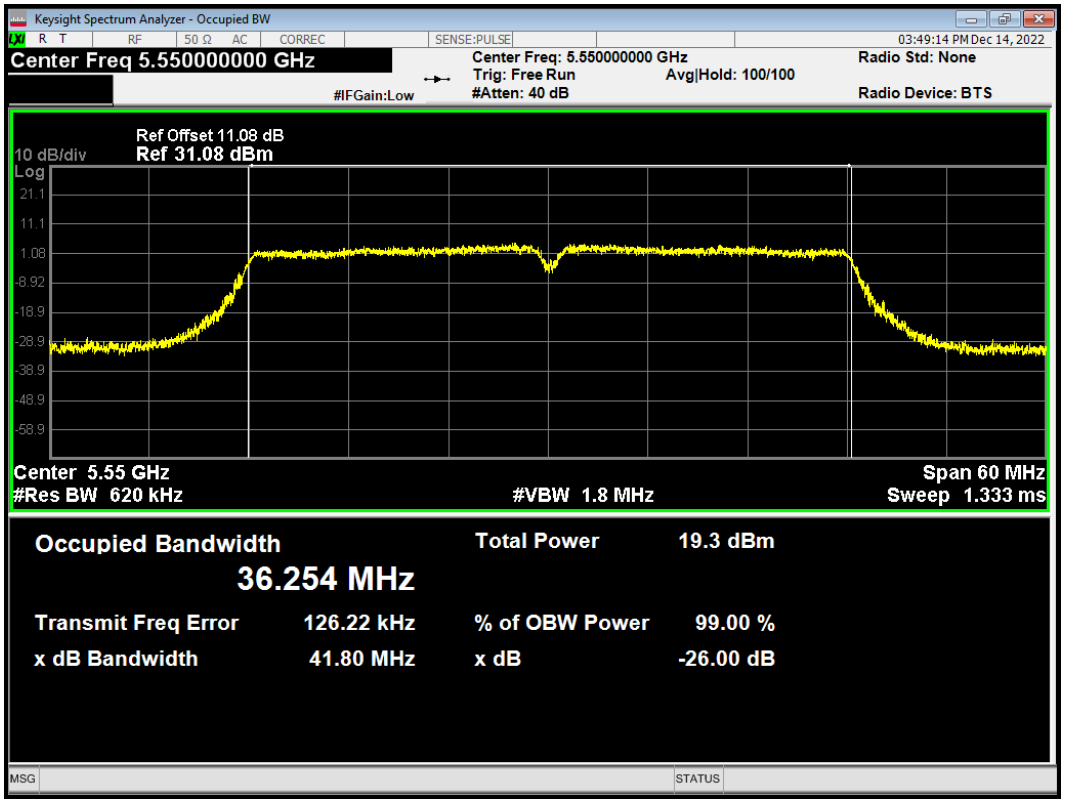
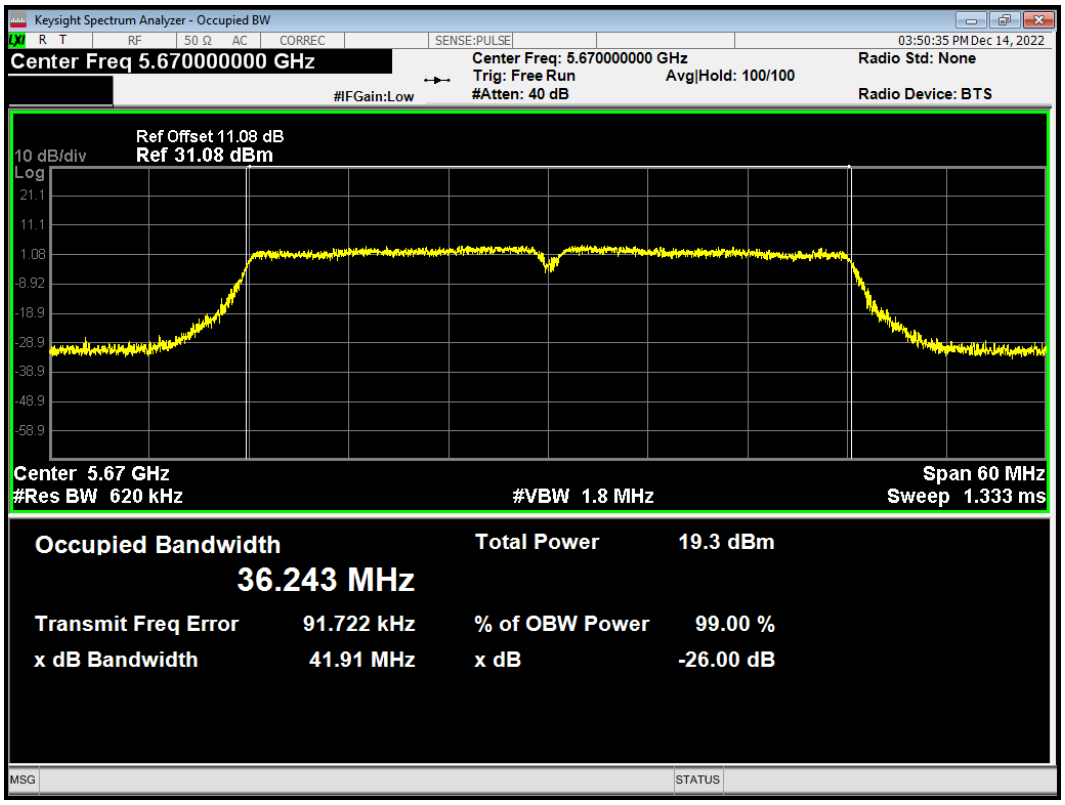
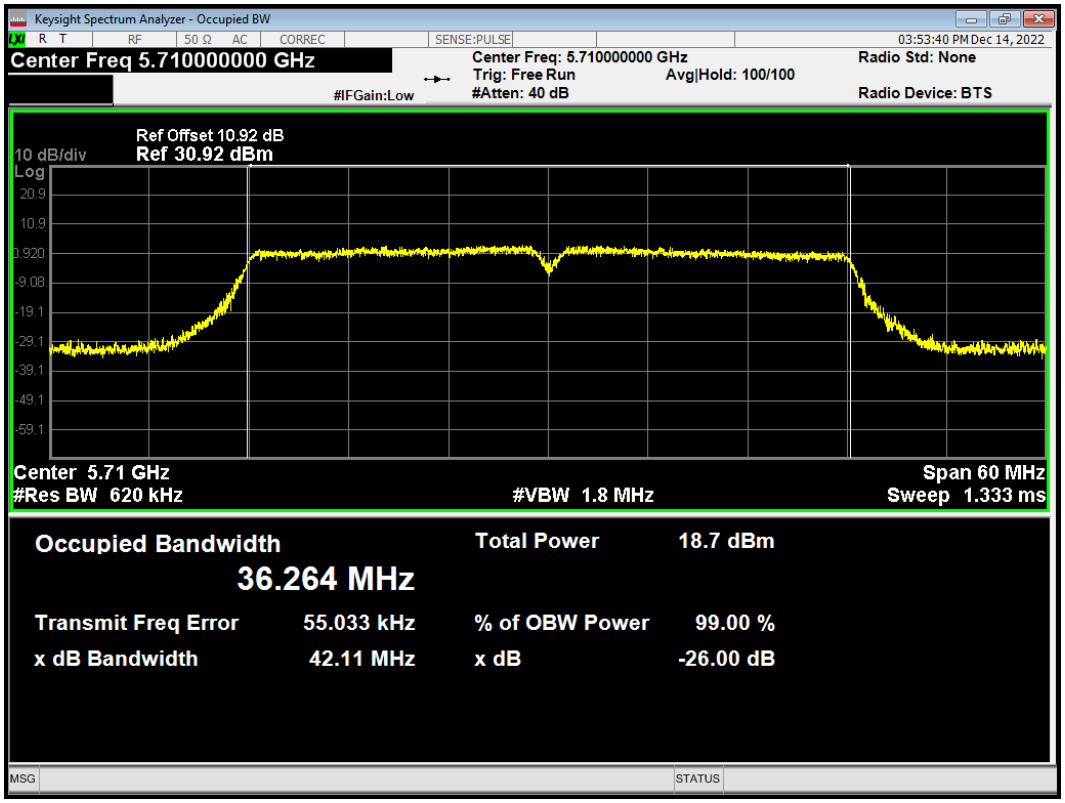


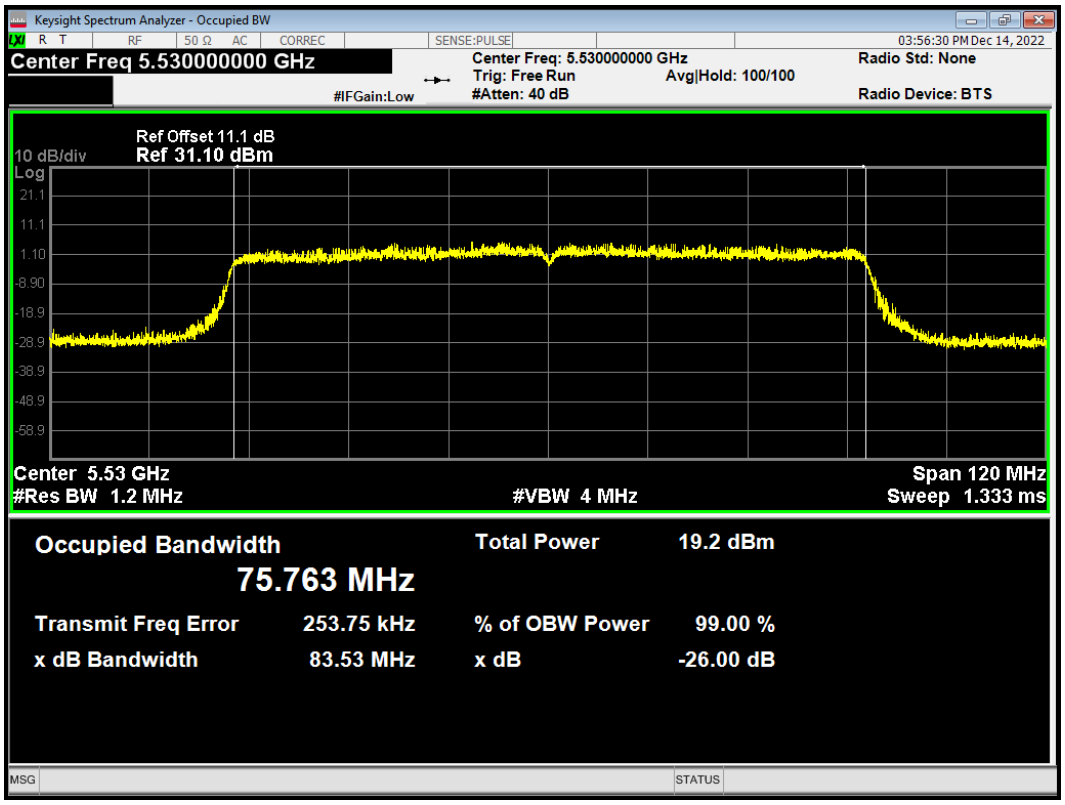
OBW 802.11ac(VHT40) 5670MHz



OBW 802.11ac(VHT40) 5710MHz



OBW 802.11ac(VHT80) 5530MHz



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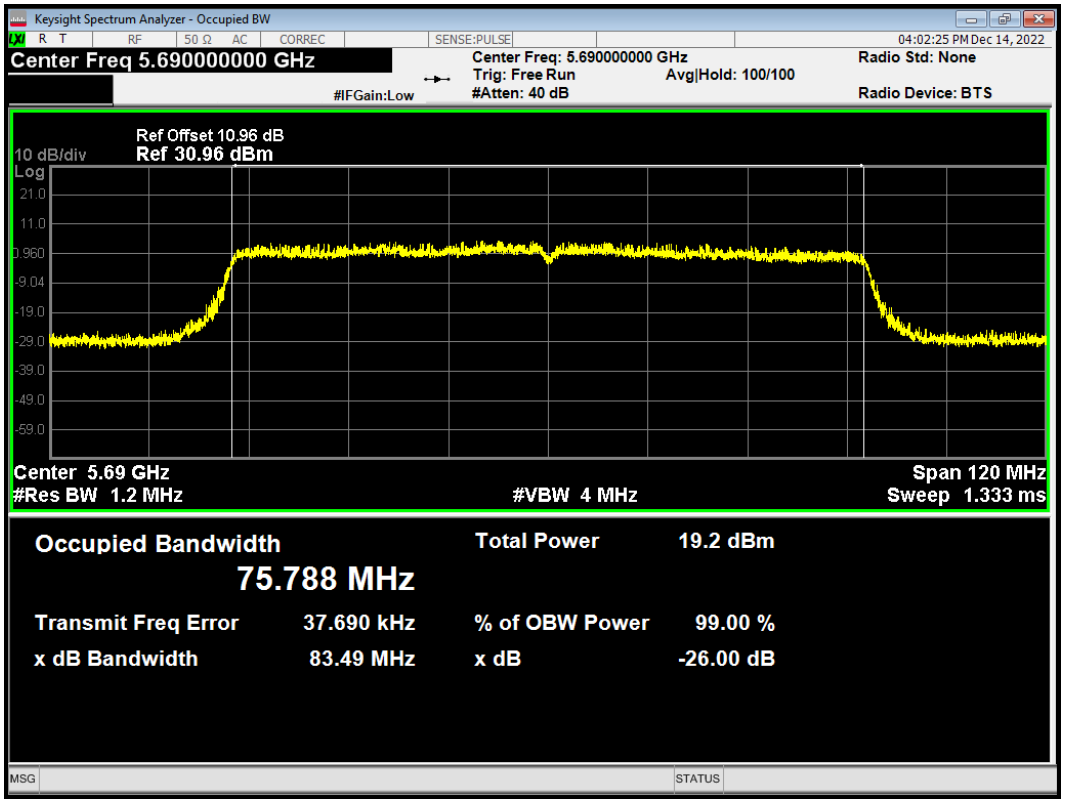
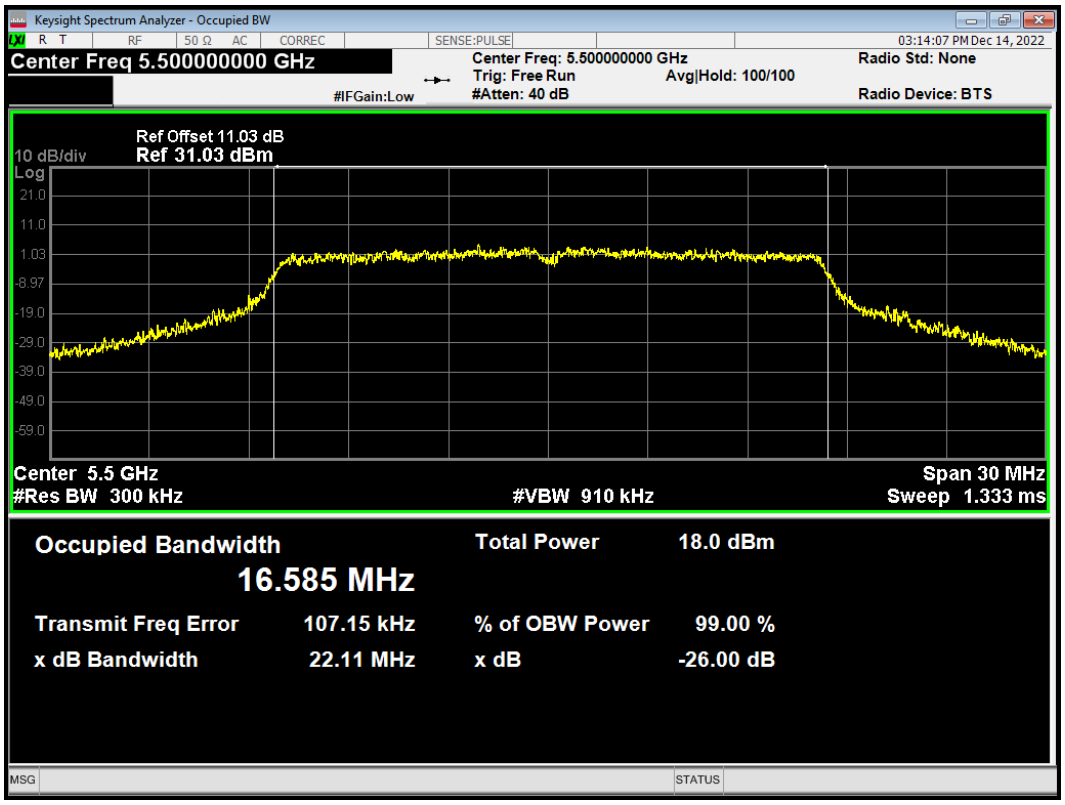
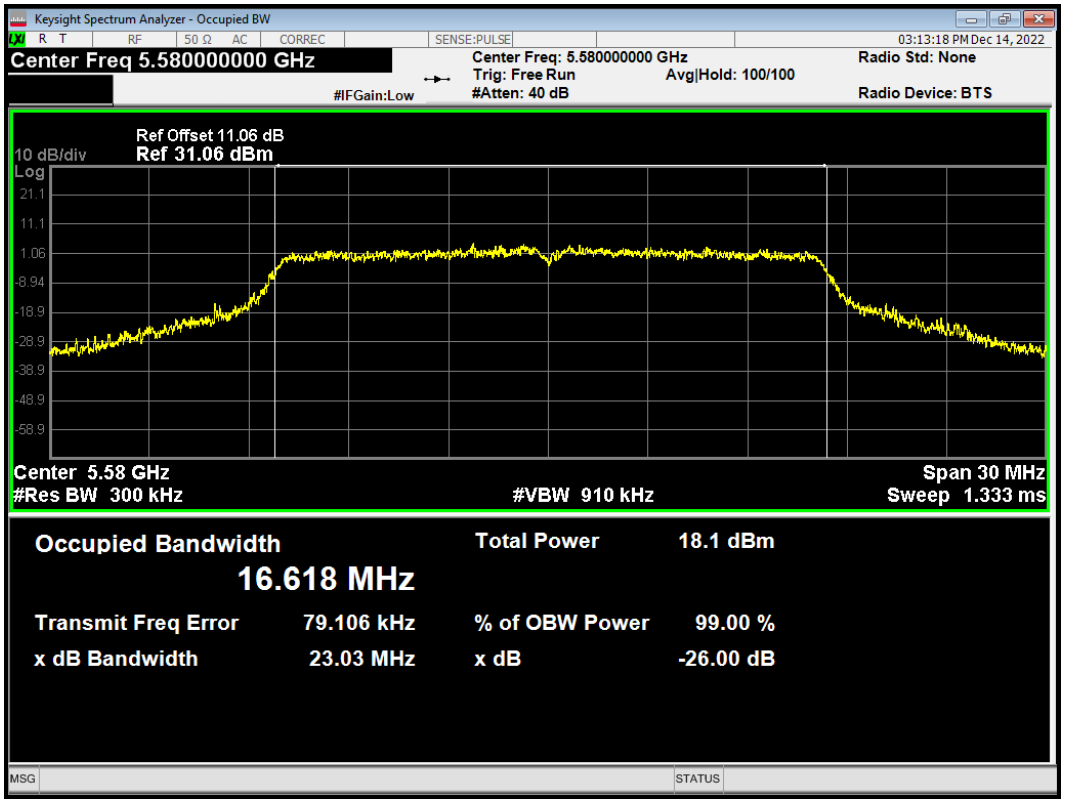


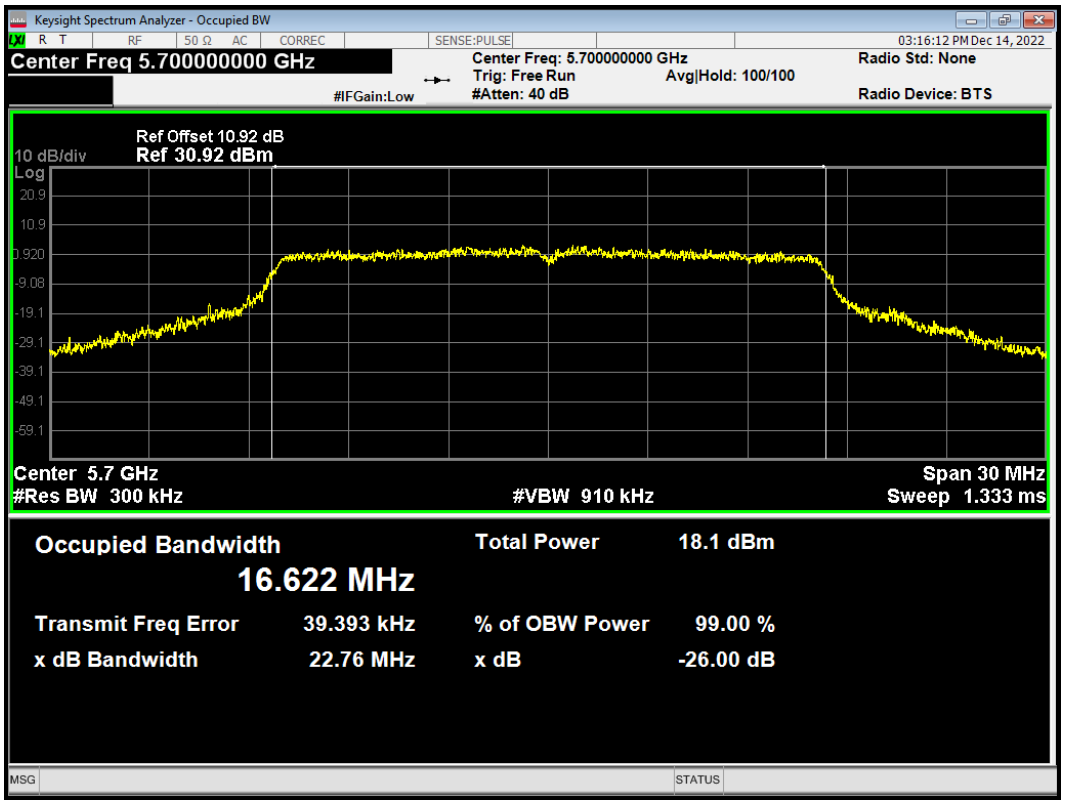
OBW 802.11n(HT20) 5500MHz



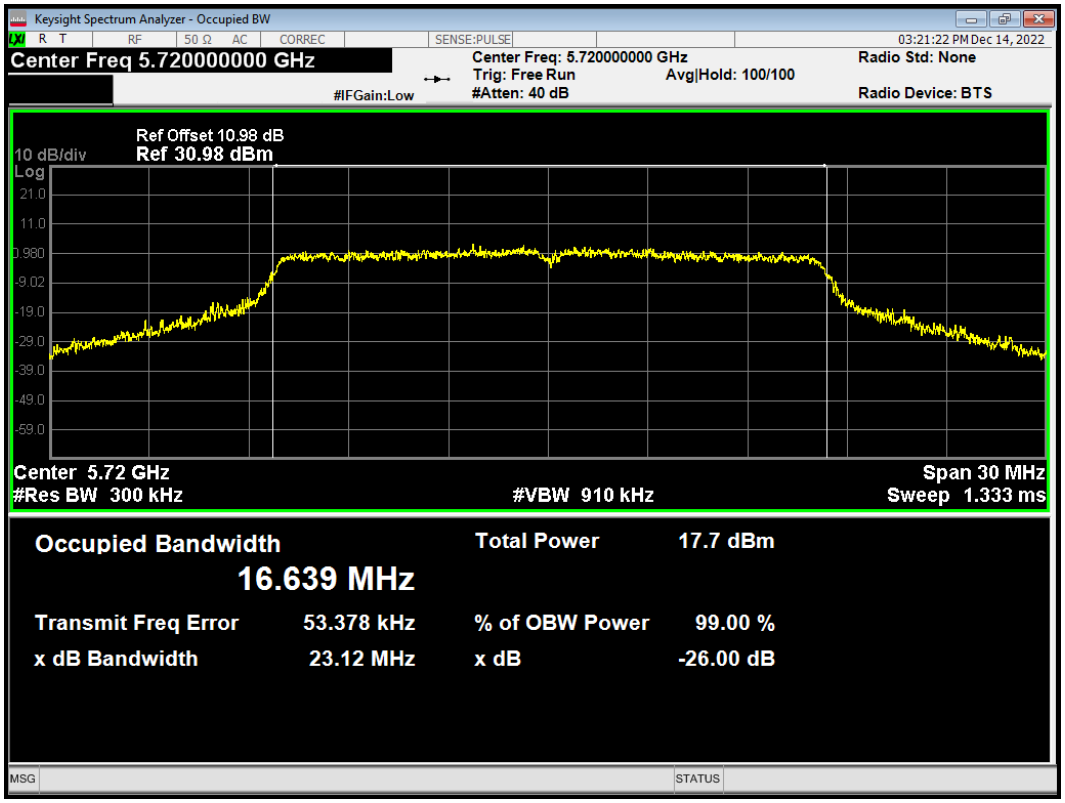
OBW 802.11n(HT20) 5580MHz



OBW 802.11n(HT20) 5700MHz



OBW 802.11n(HT20) 5720MHz



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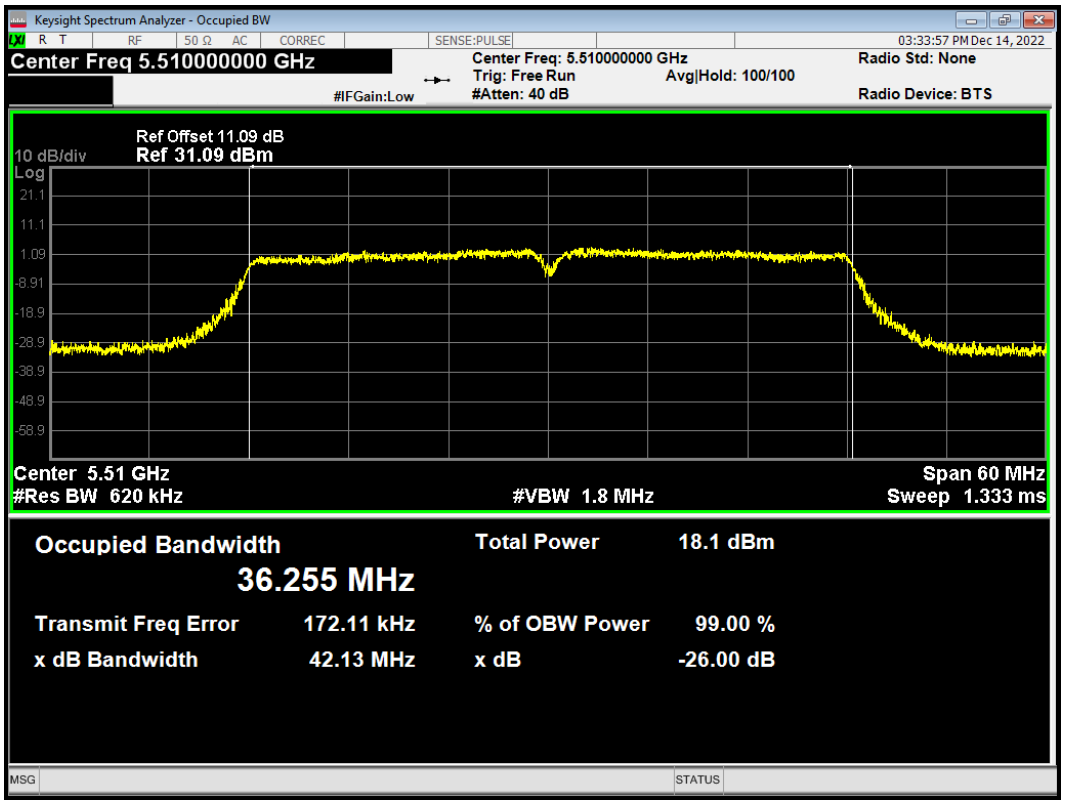
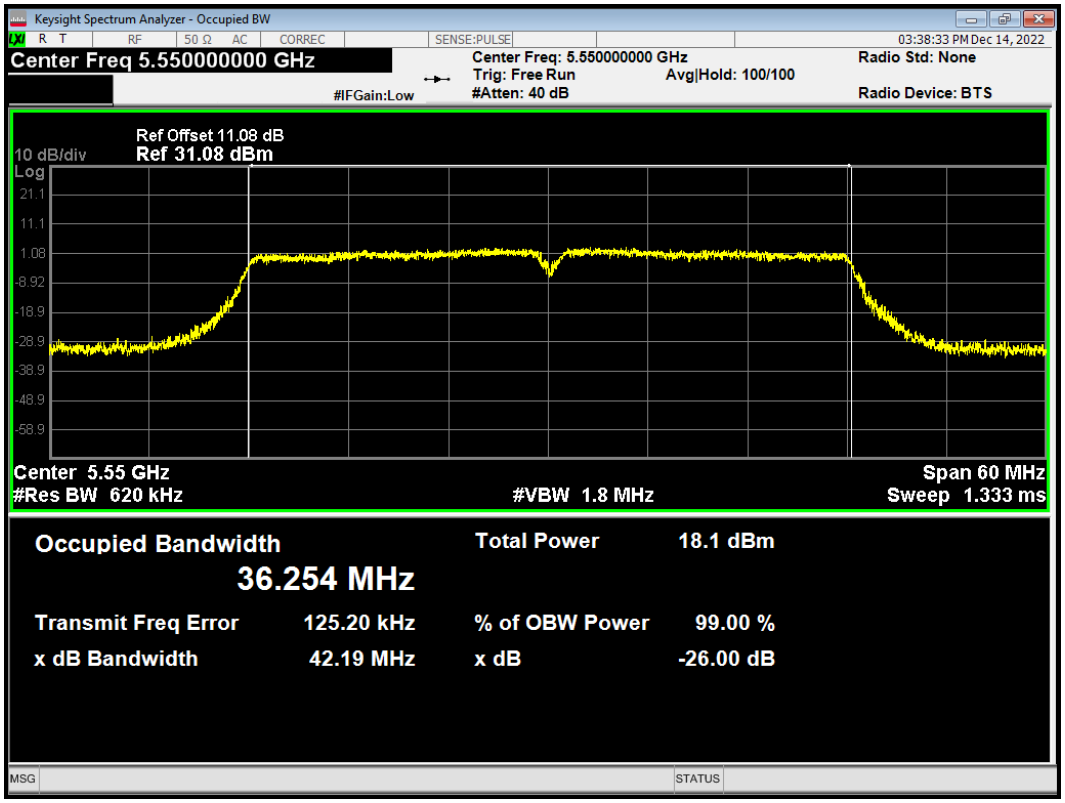
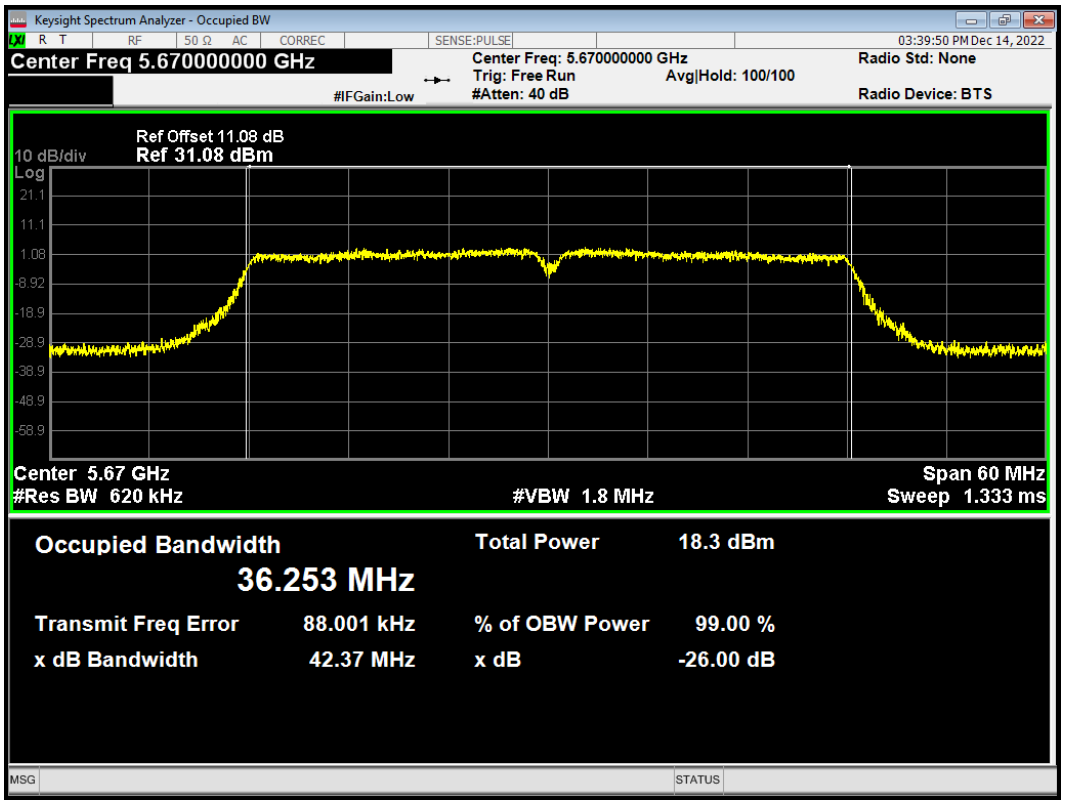


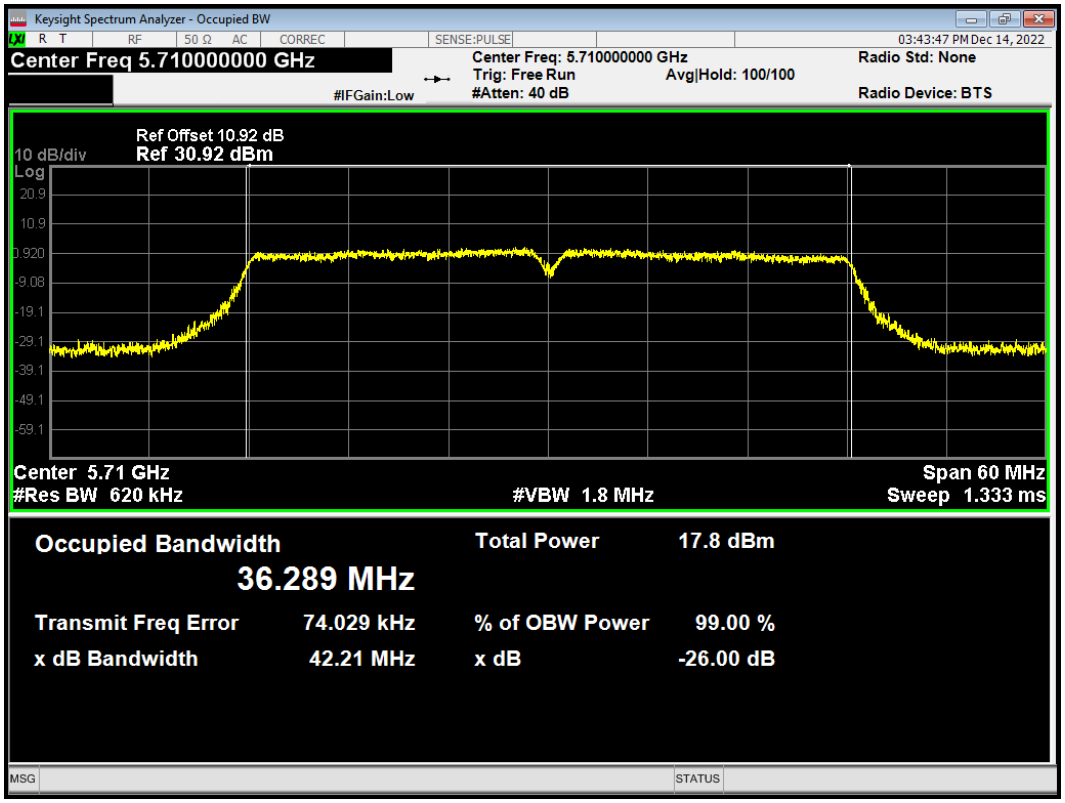
OBW 802.11n(HT40) 5550MHz



OBW 802.11n(HT40) 5670MHz



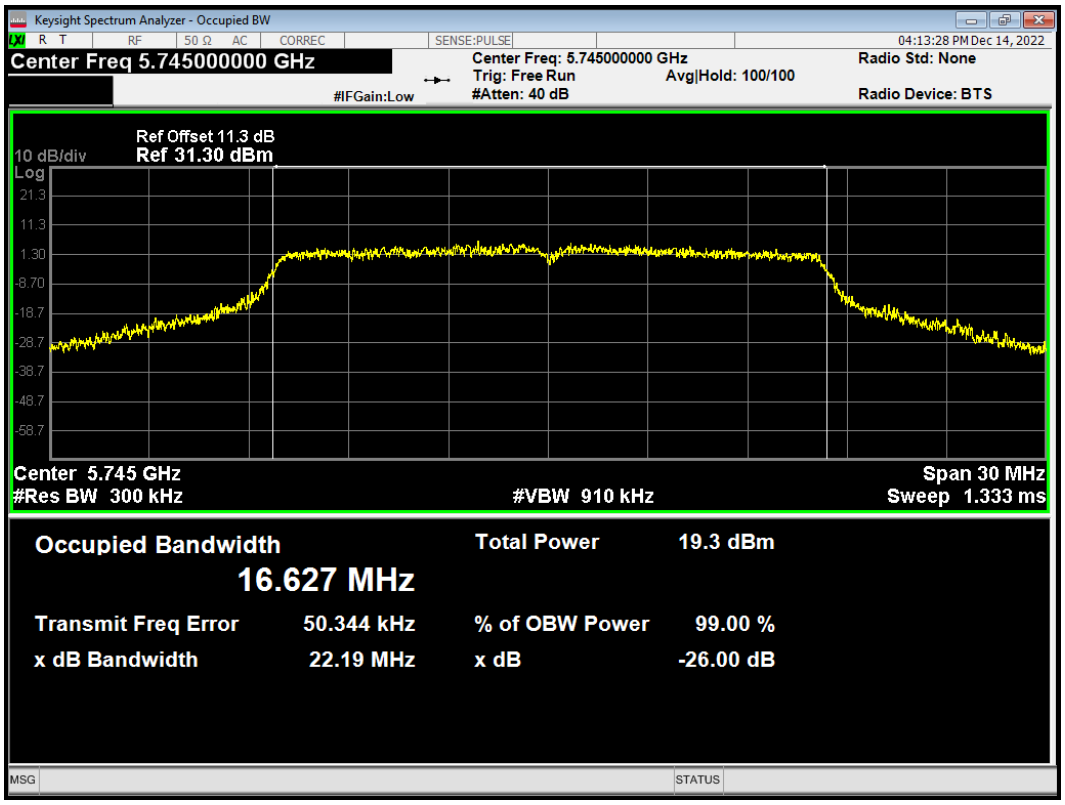
OBW 802.11n(HT40) 5710MHz



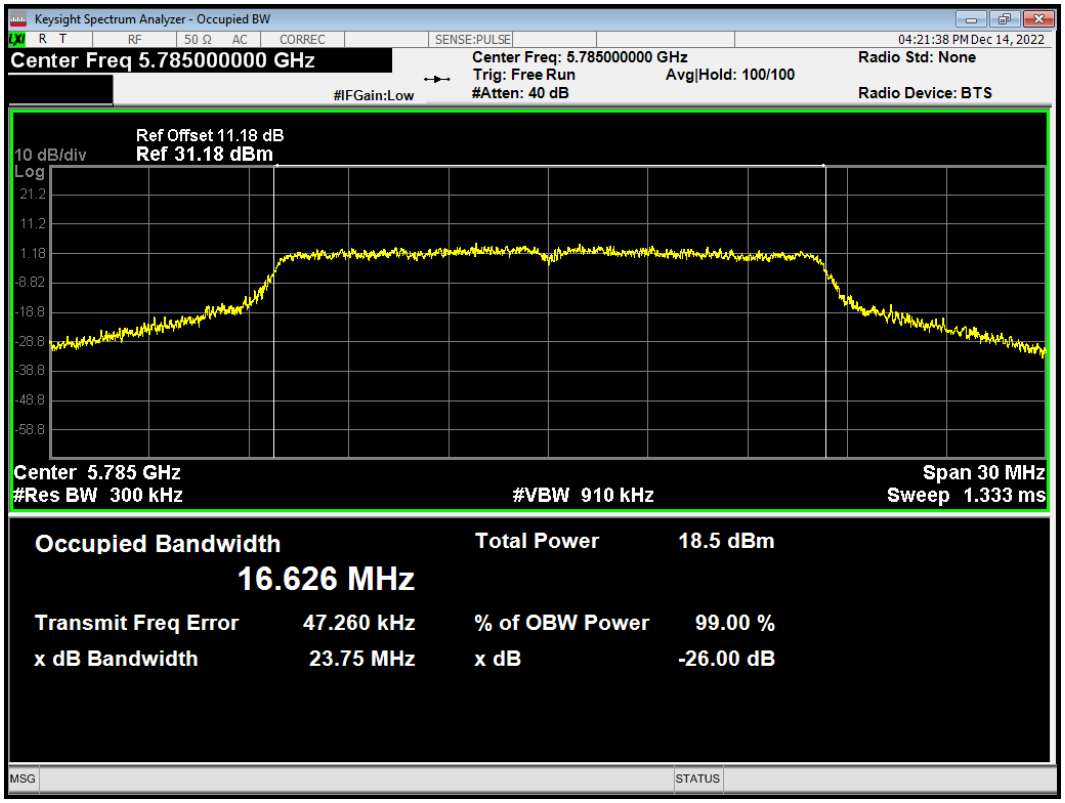
U-NII-3

99% bandwidth

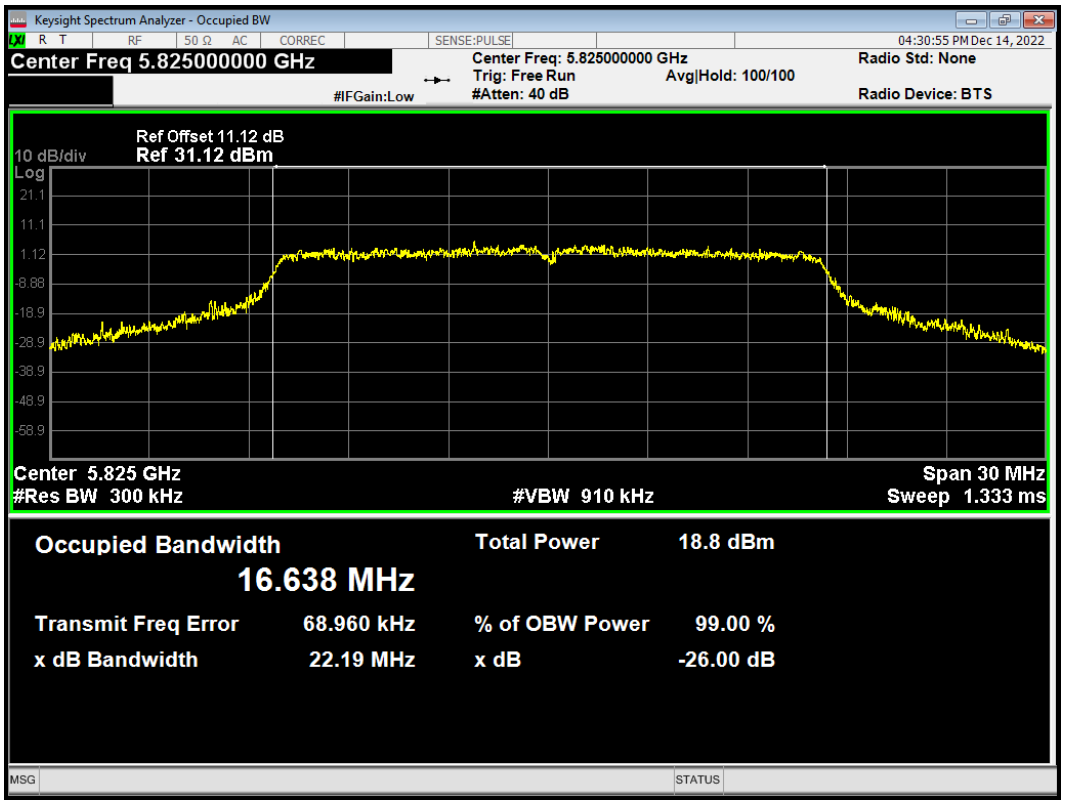
OBW 802.11a 5745MHz



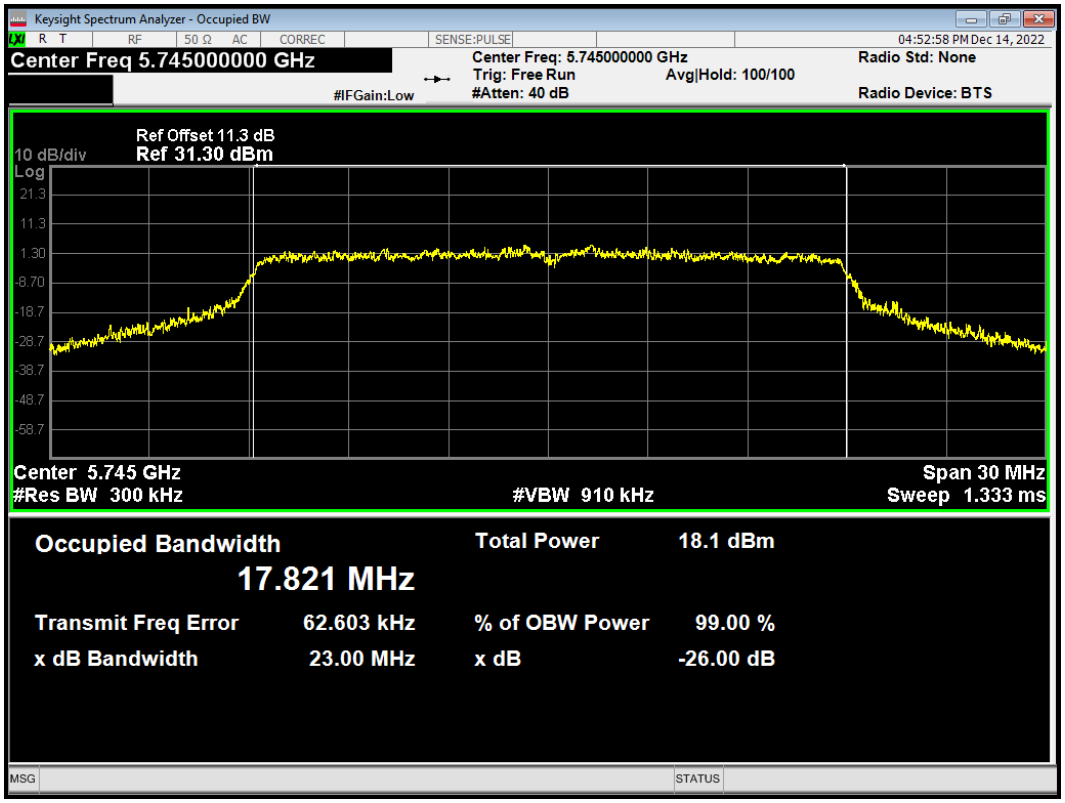
OBW 802.11a 5785MHz



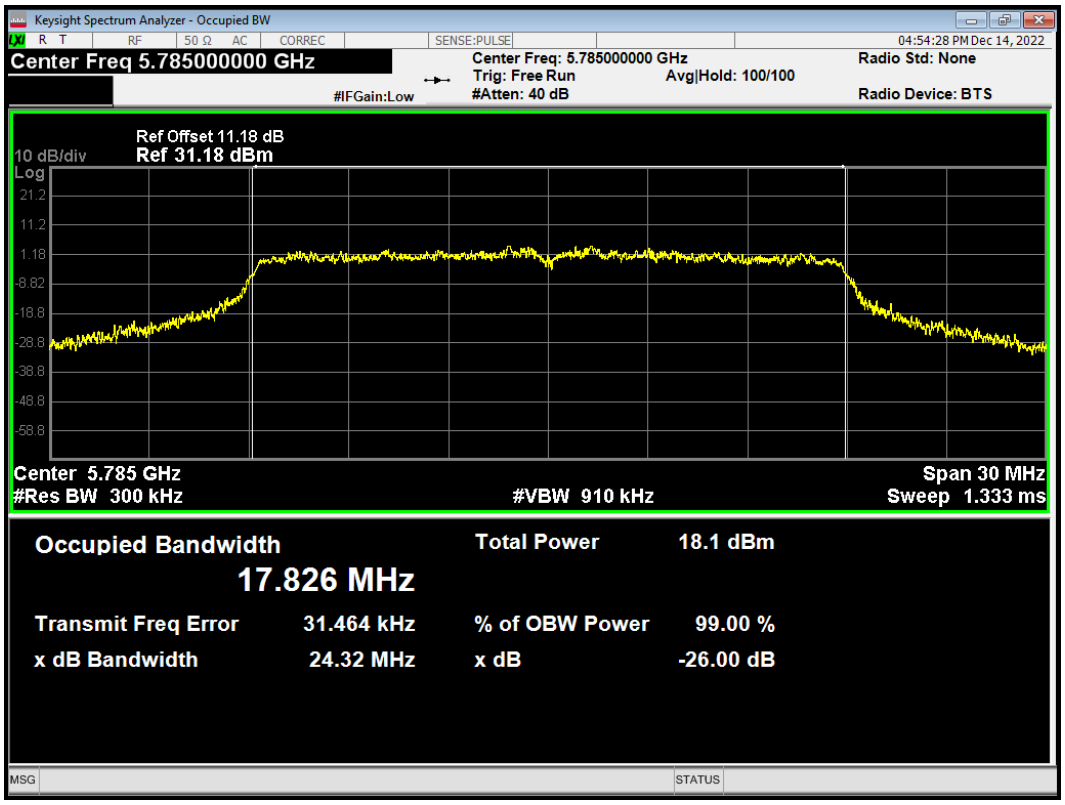
OBW 802.11a 5825MHz



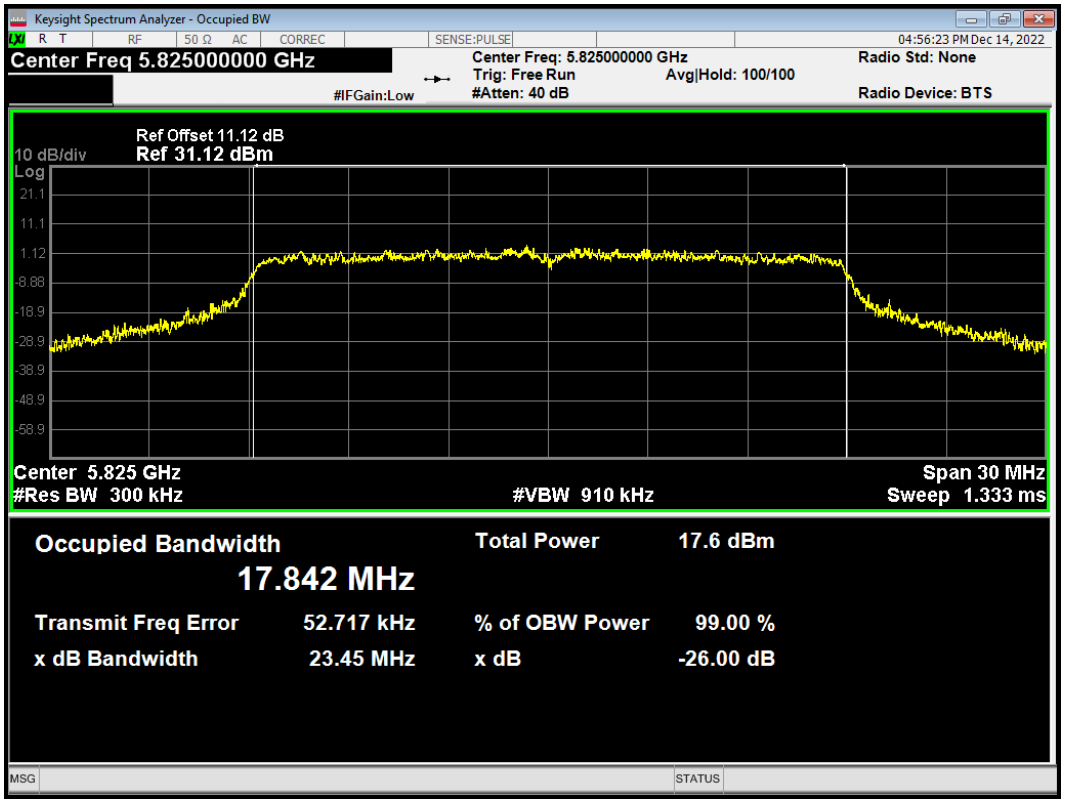
OBW 802.11ac(VHT20) 5745MHz



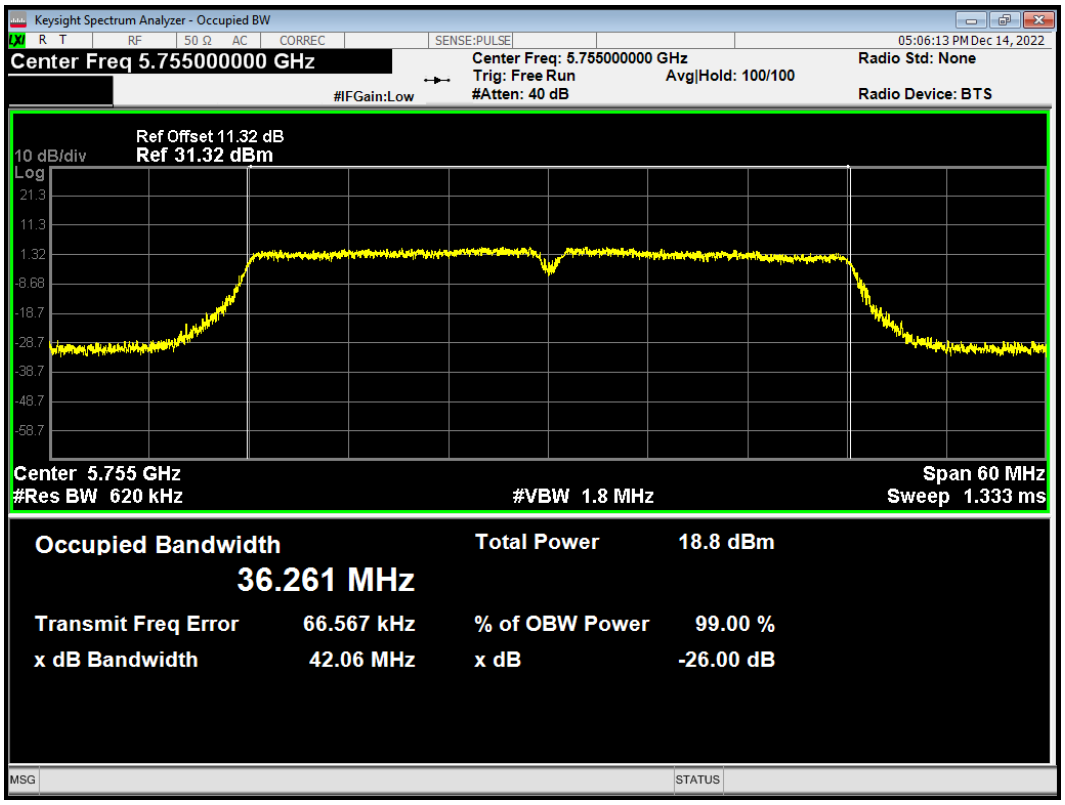
OBW 802.11ac(VHT20) 5785MHz



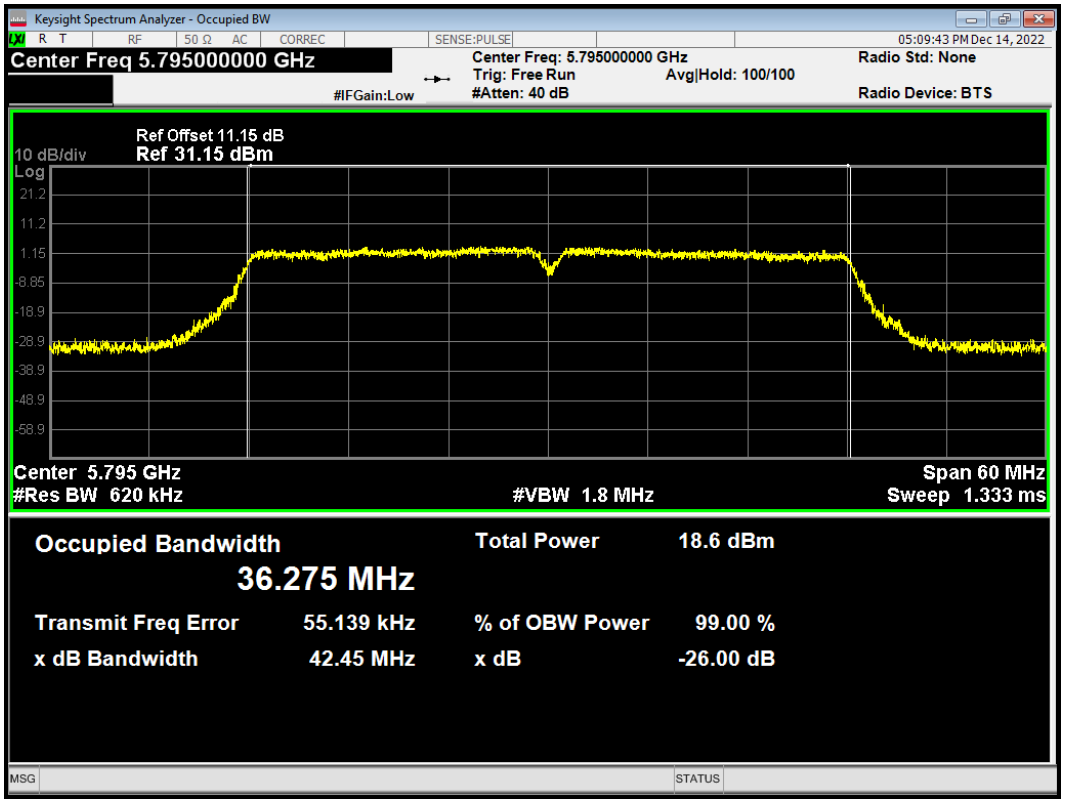
OBW 802.11ac(VHT20) 5825MHz



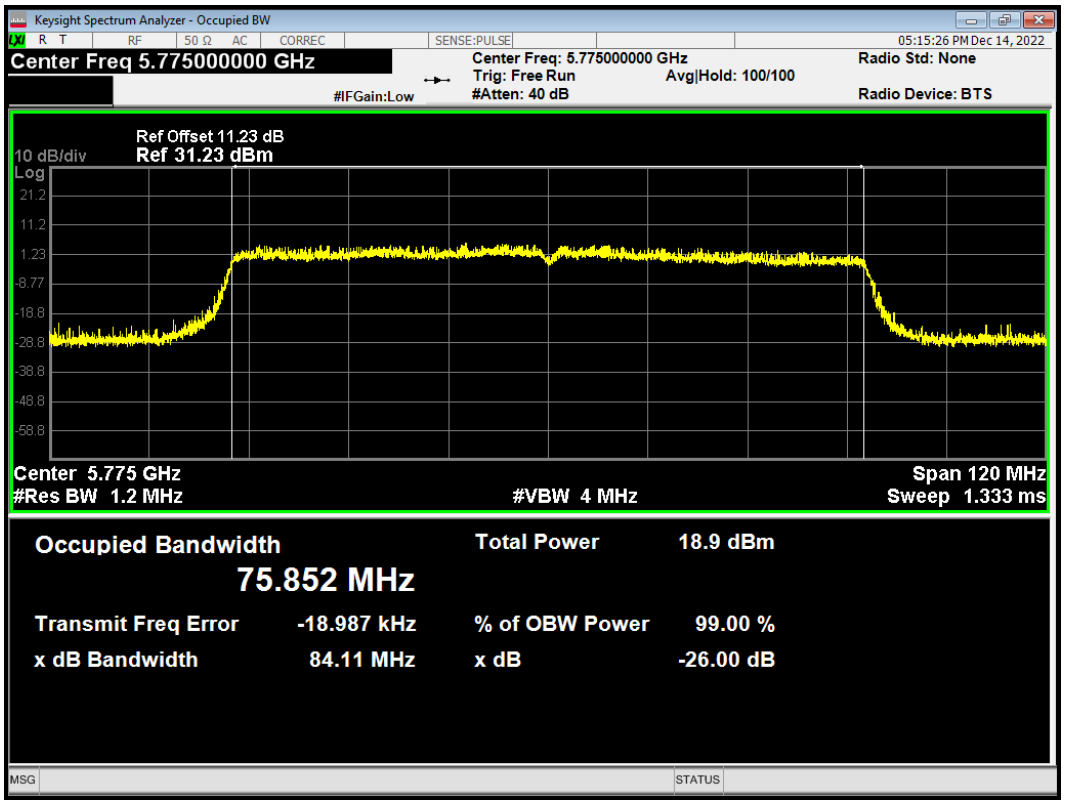
OBW 802.11ac(VHT40) 5755MHz



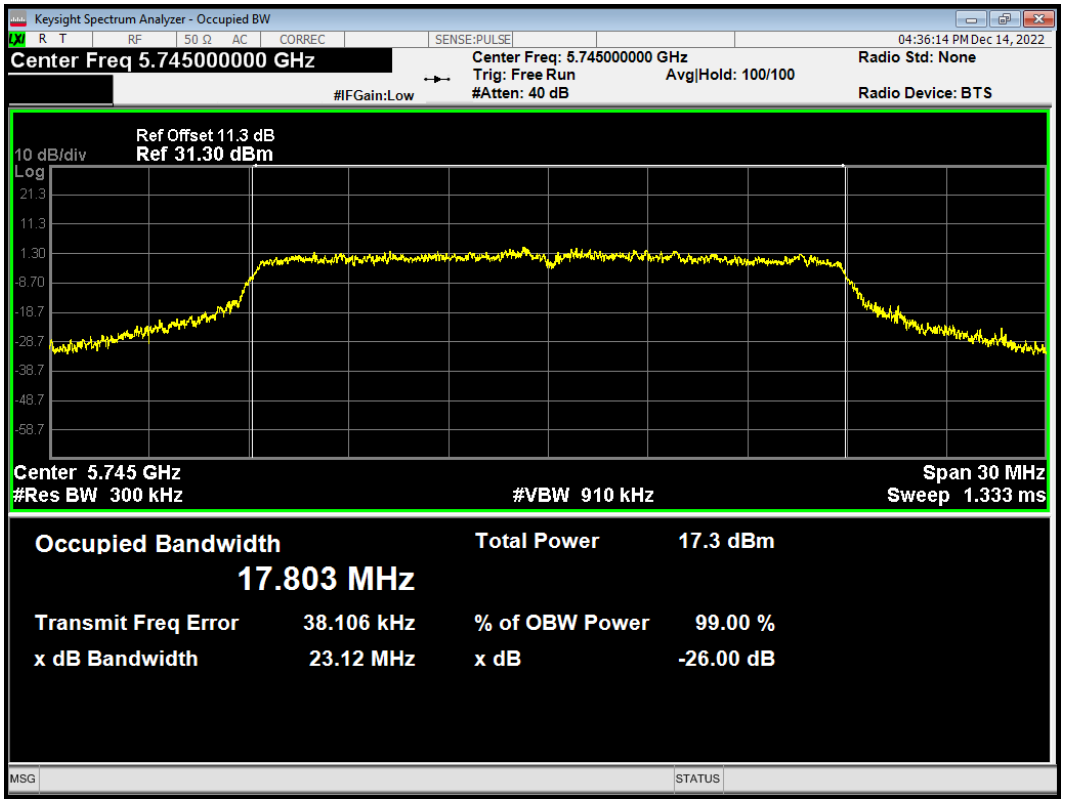
OBW 802.11ac(VHT40) 5795MHz



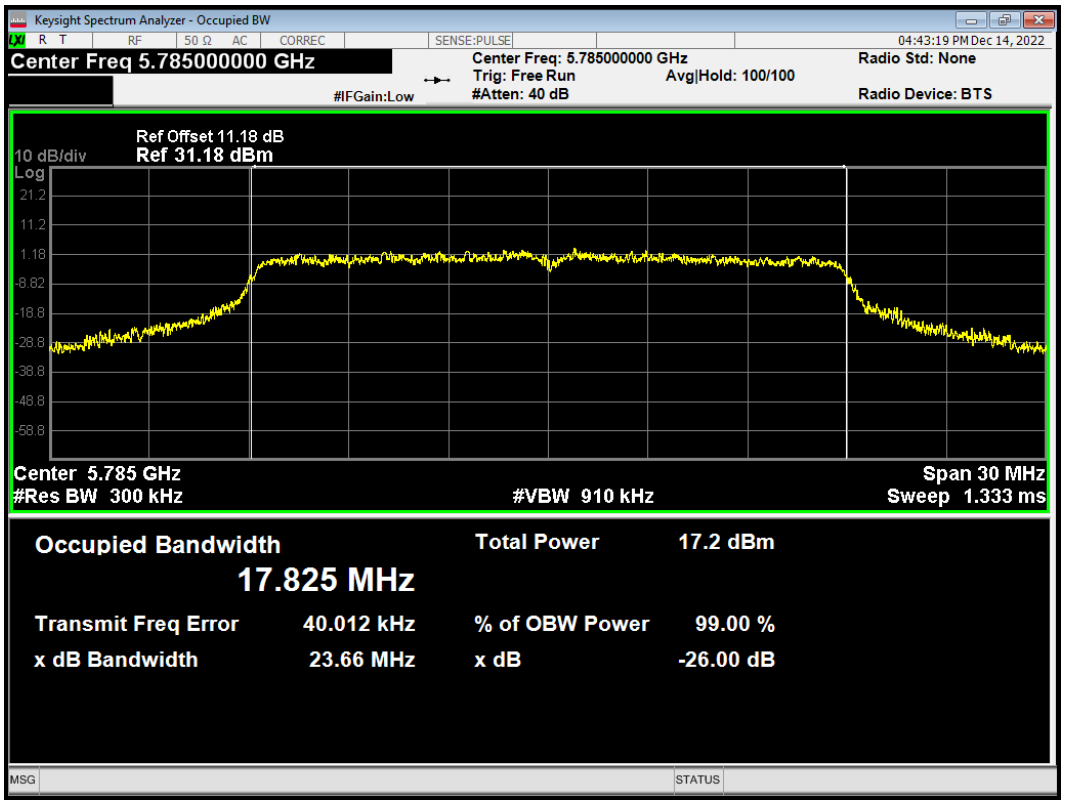
OBW 802.11ac(VHT80) 5775MHz



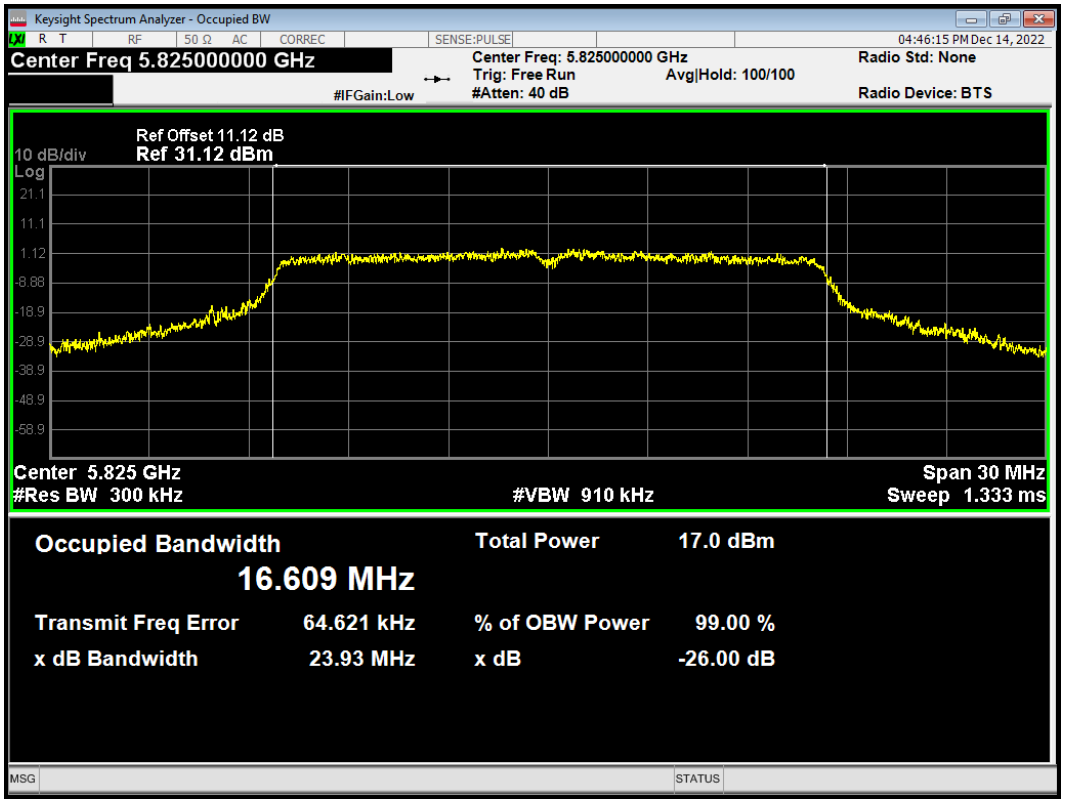
OBW 802.11n(HT20) 5745MHz



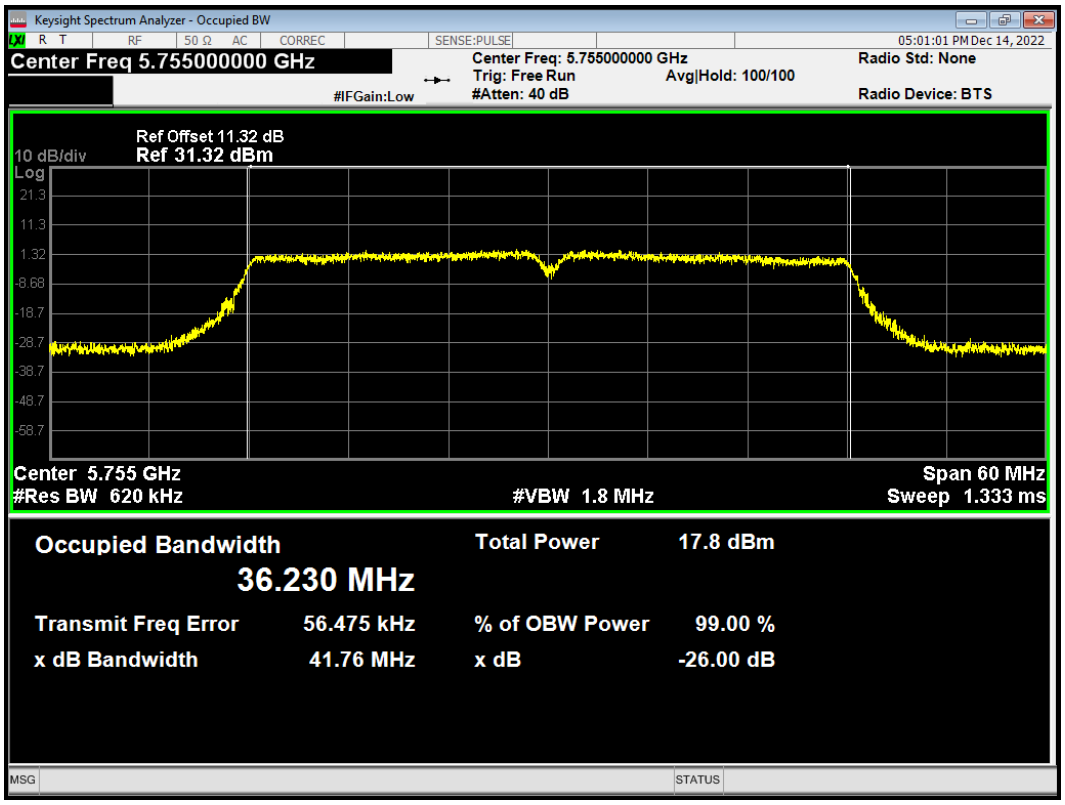
OBW 802.11n(HT20) 5785MHz



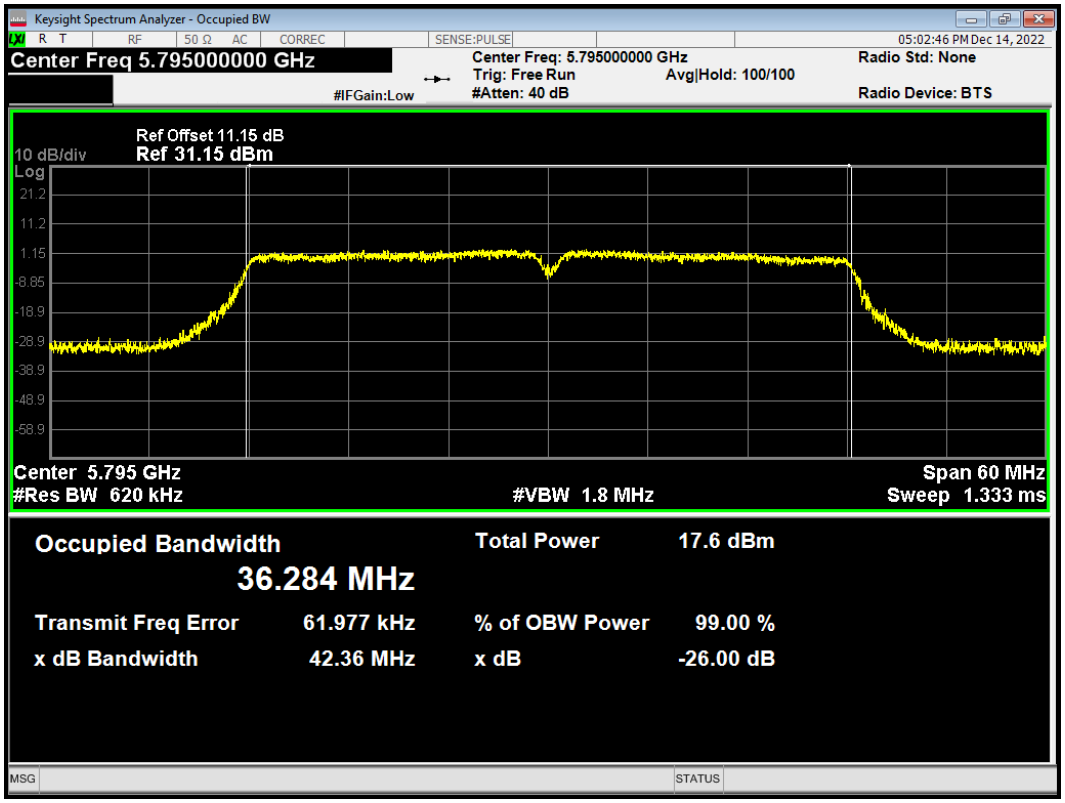
OBW 802.11n(HT20) 5825MHz



OBW 802.11n(HT40) 5755MHz

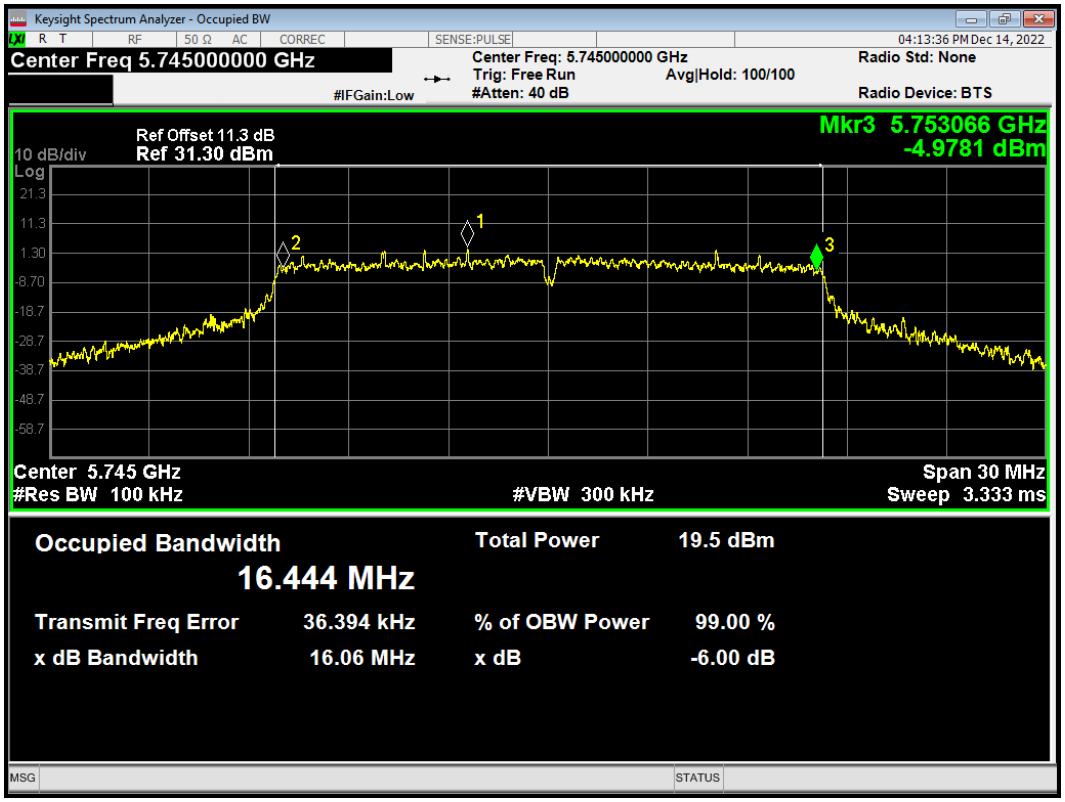


OBW 802.11n(HT40) 5795MHz

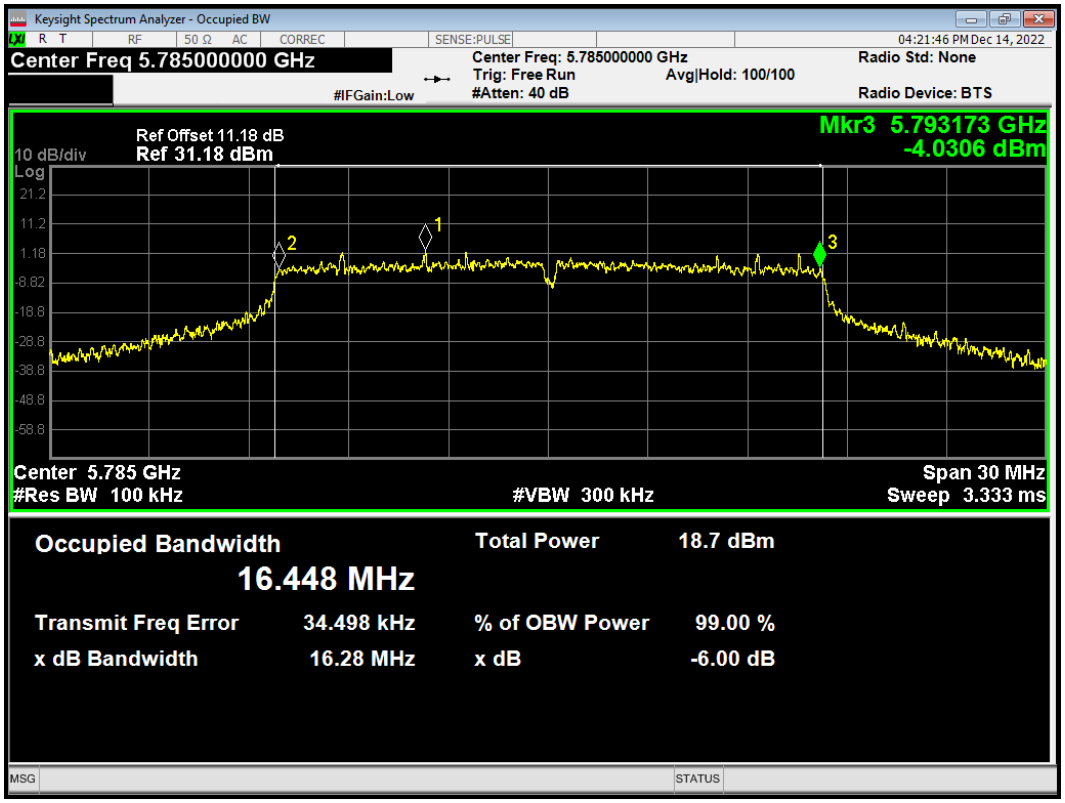


Minimum 6 dB bandwidth

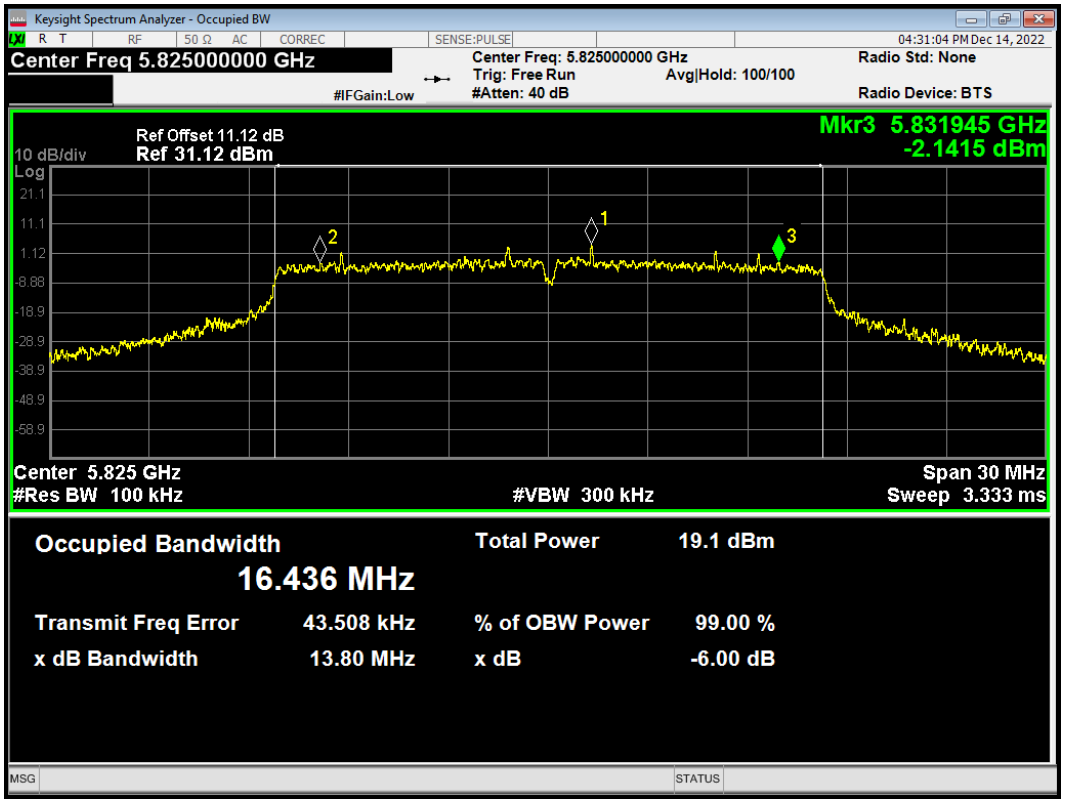
-6dB Bandwidth 802.11a 5745MHz



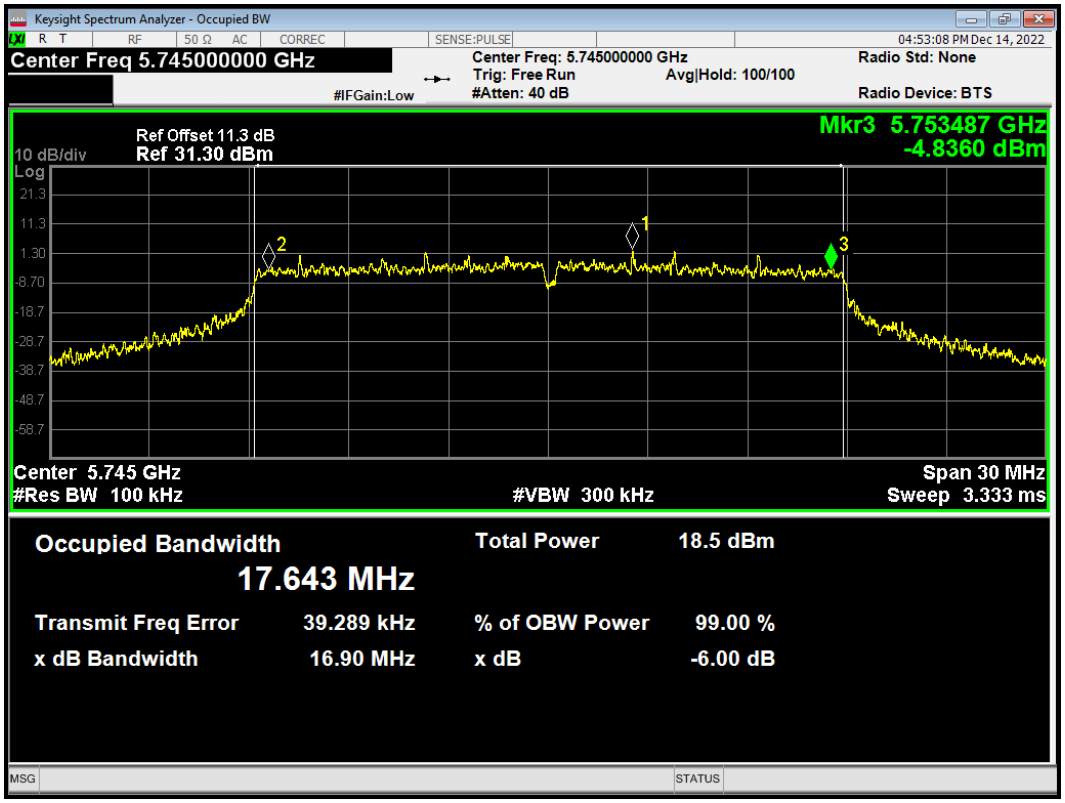
-6dB Bandwidth 802.11a 5785MHz



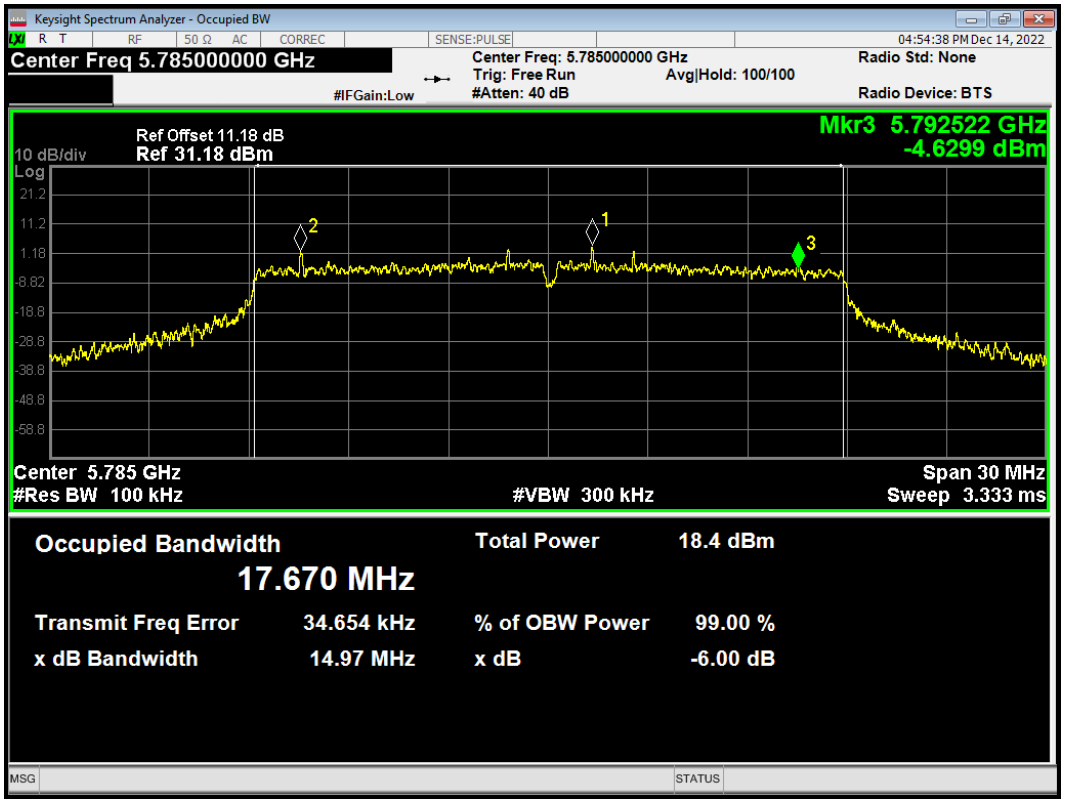
-6dB Bandwidth 802.11a 5825MHz



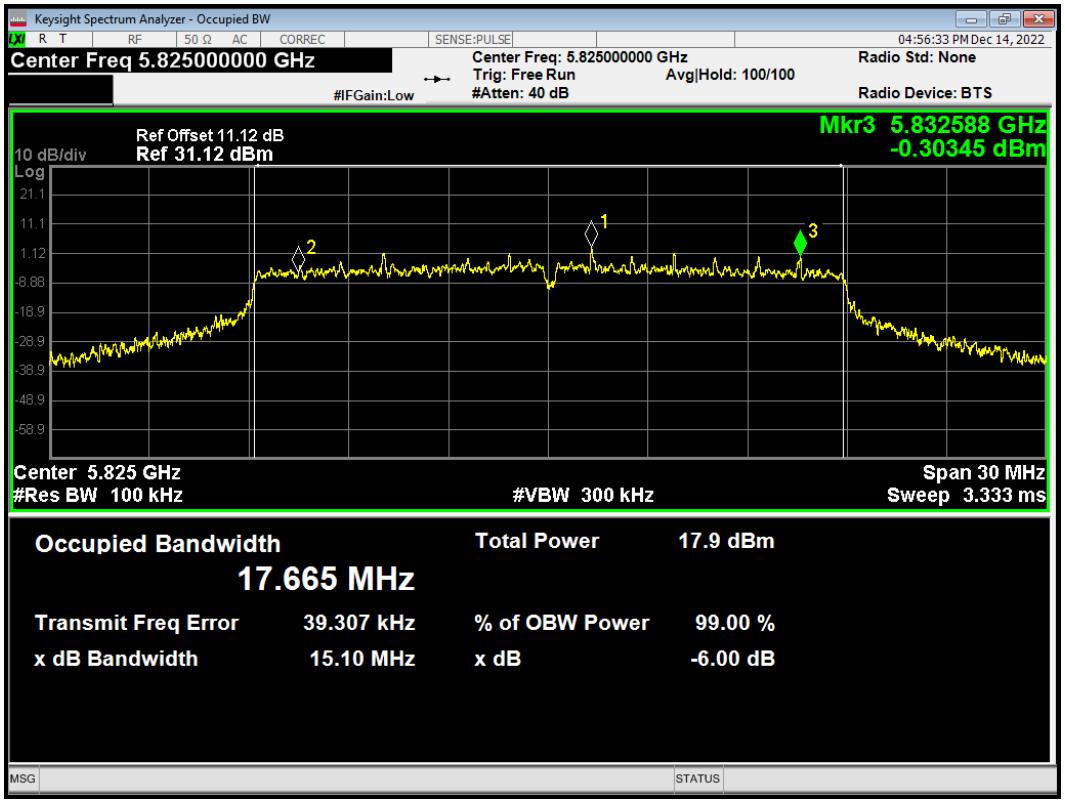
-6dB Bandwidth 802.11ac(VHT20) 5745MHz



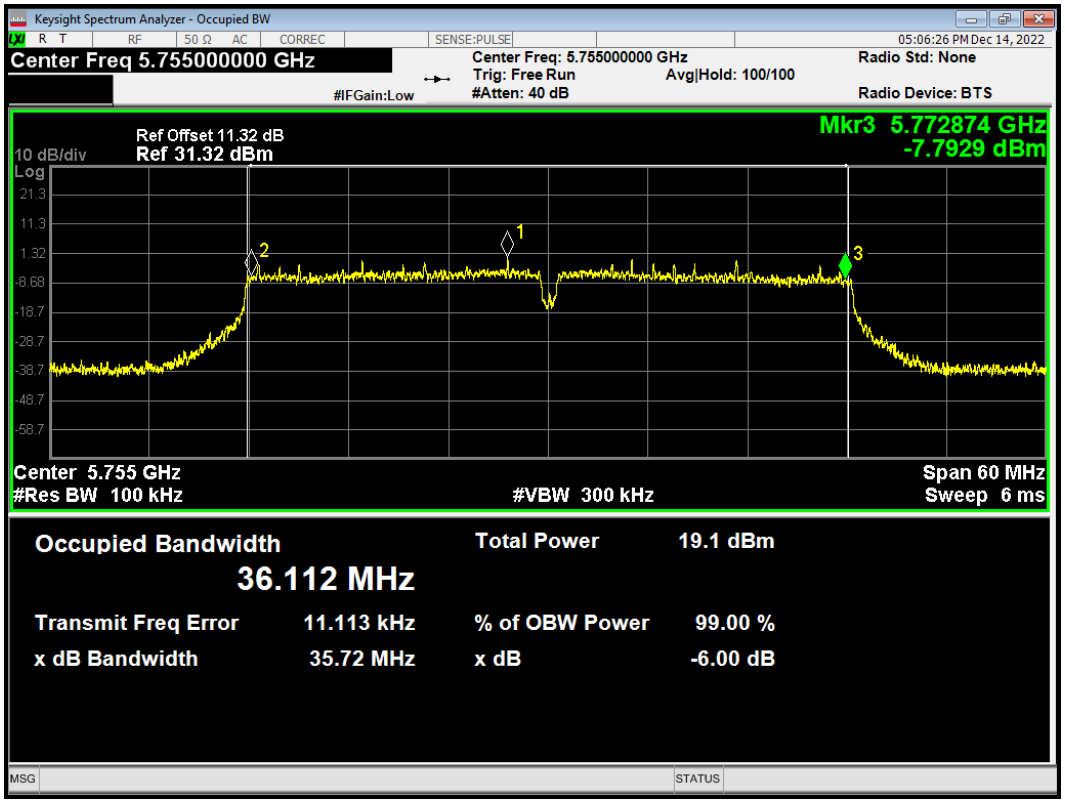
-6dB Bandwidth 802.11ac(VHT20) 5785MHz



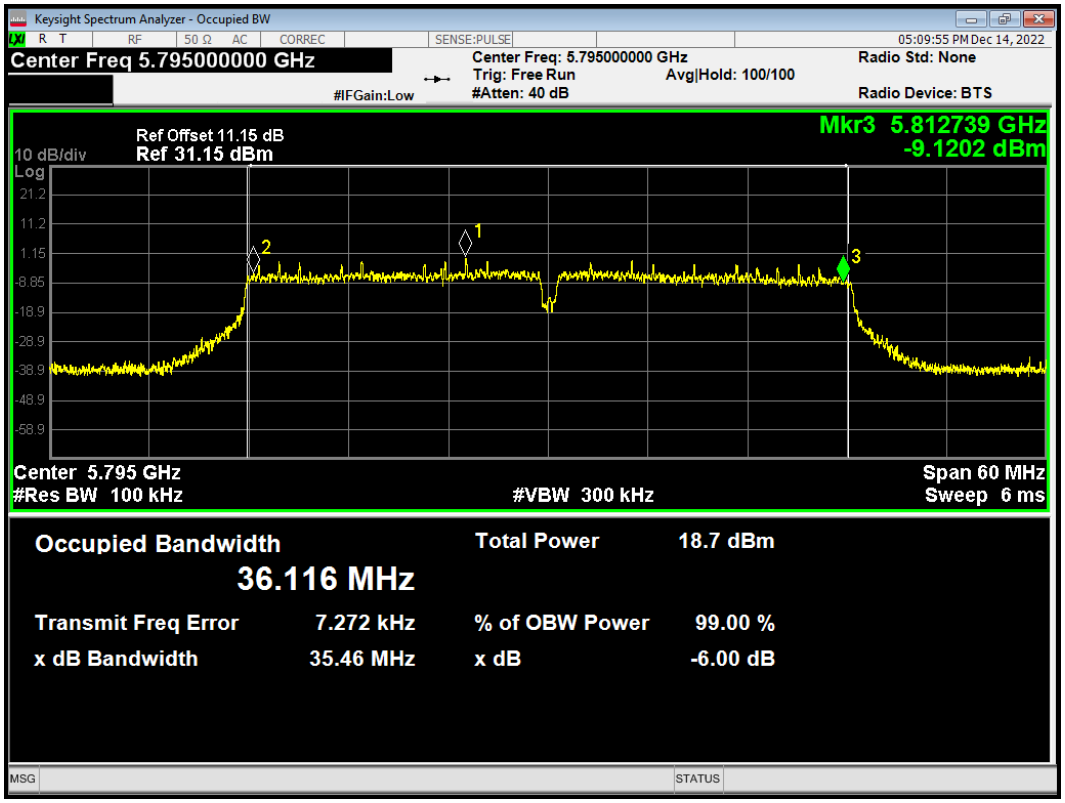
-6dB Bandwidth 802.11ac(VHT20) 5825MHz



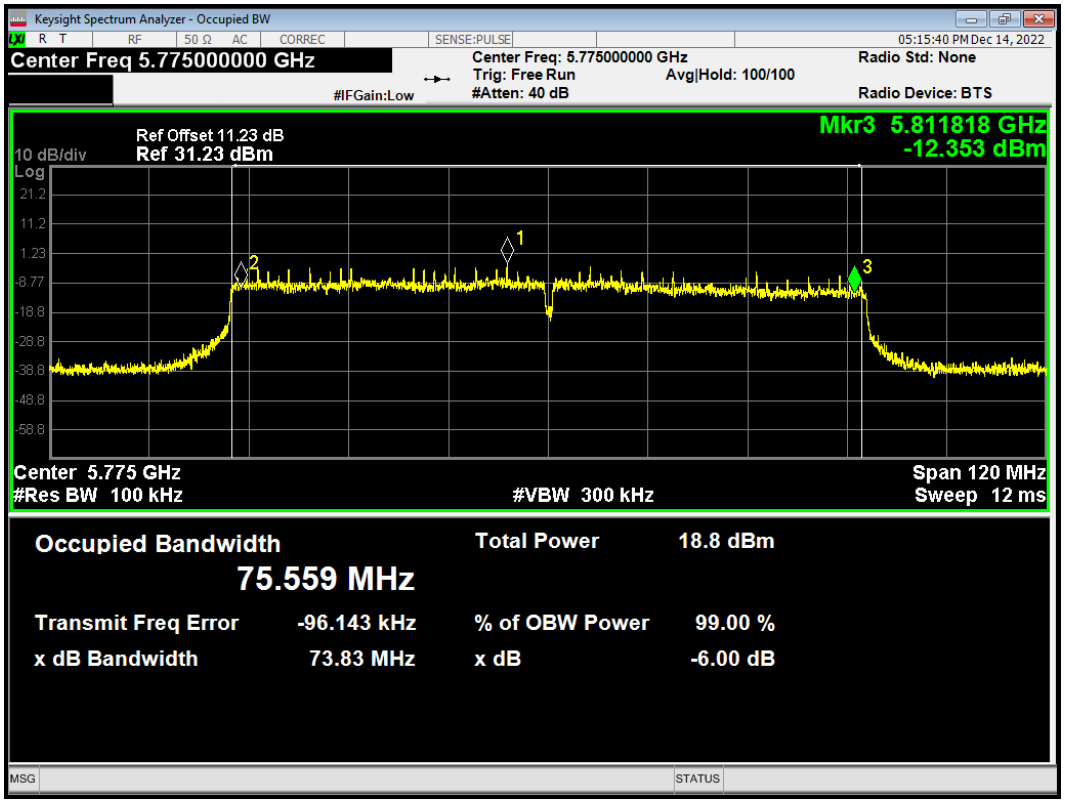
-6dB Bandwidth 802.11ac(VHT40) 5755MHz



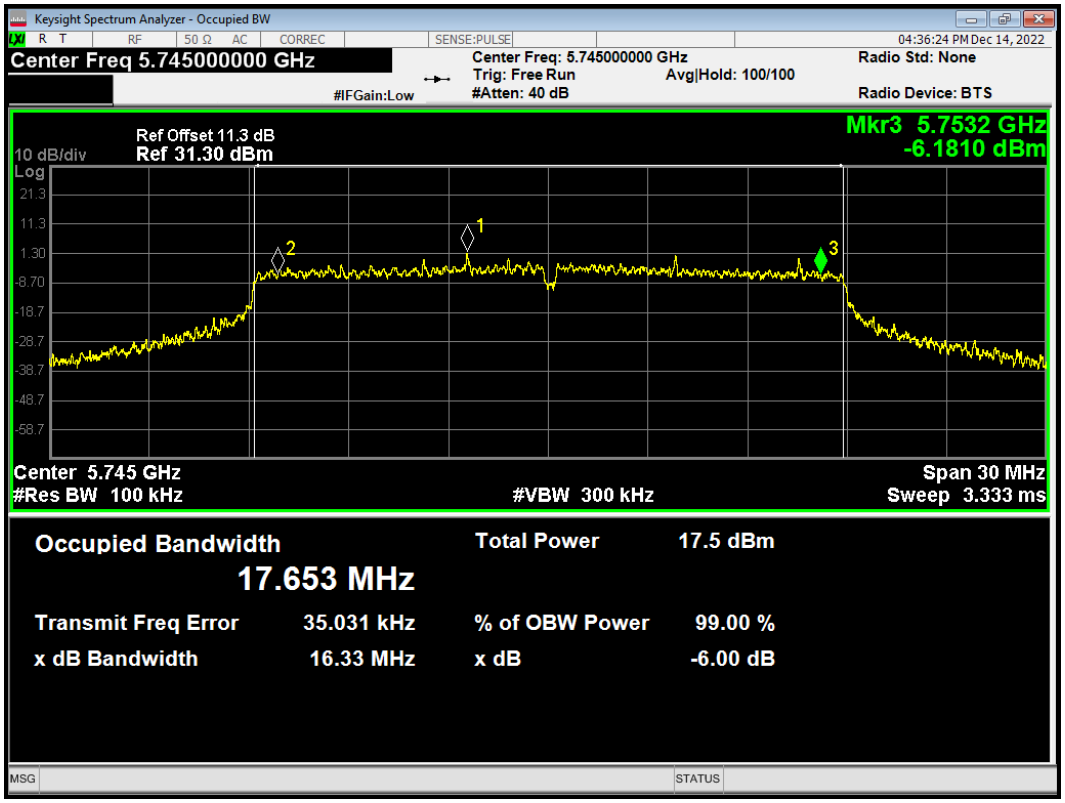
-6dB Bandwidth 802.11ac(VHT40) 5795MHz



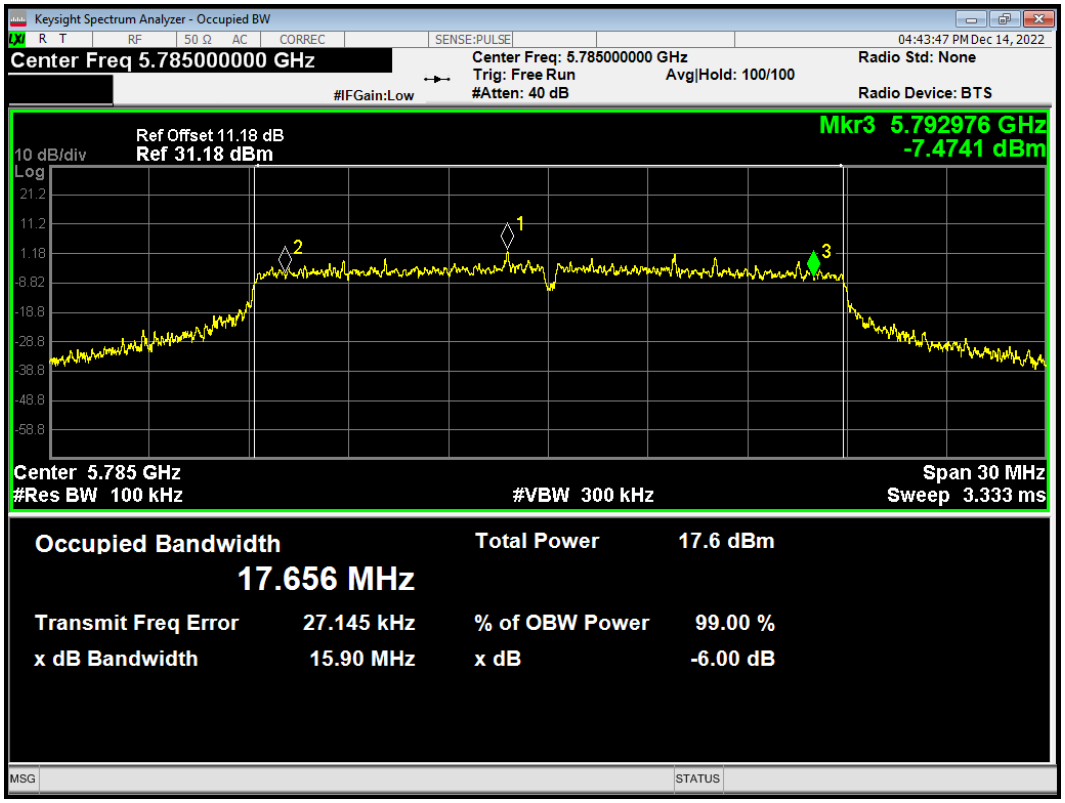
-6dB Bandwidth 802.11ac(VHT80) 5775MHz



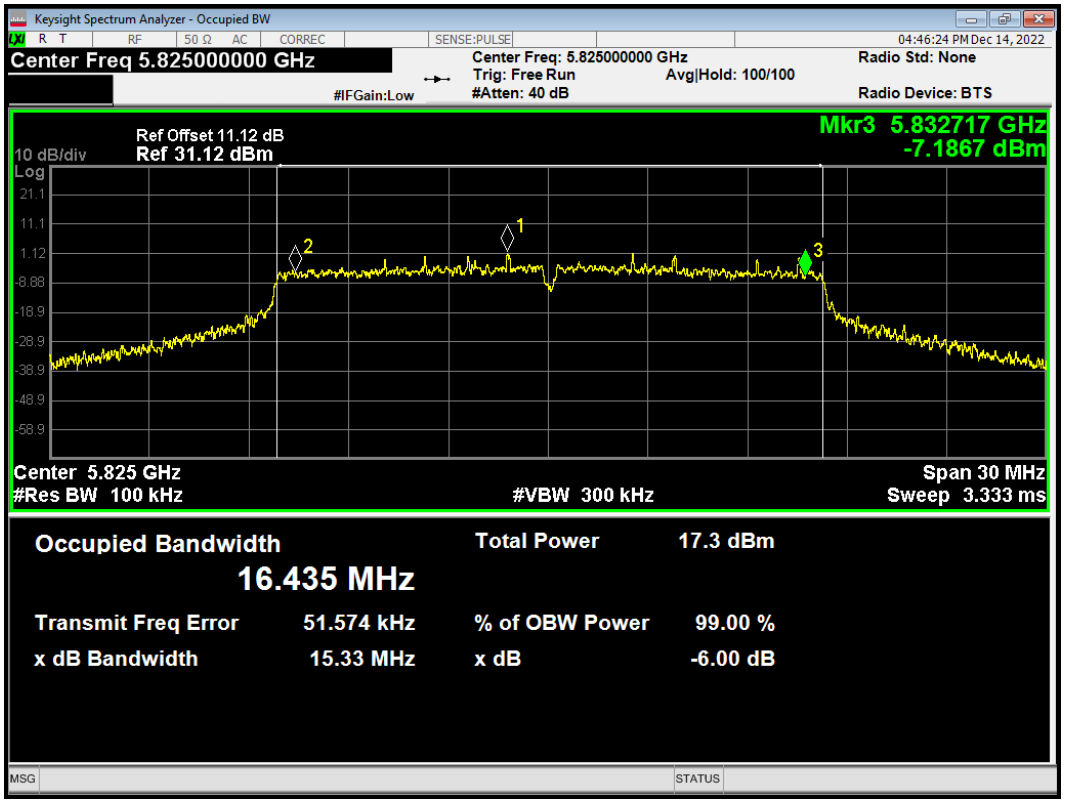
-6dB Bandwidth 802.11n(HT20) 5745MHz



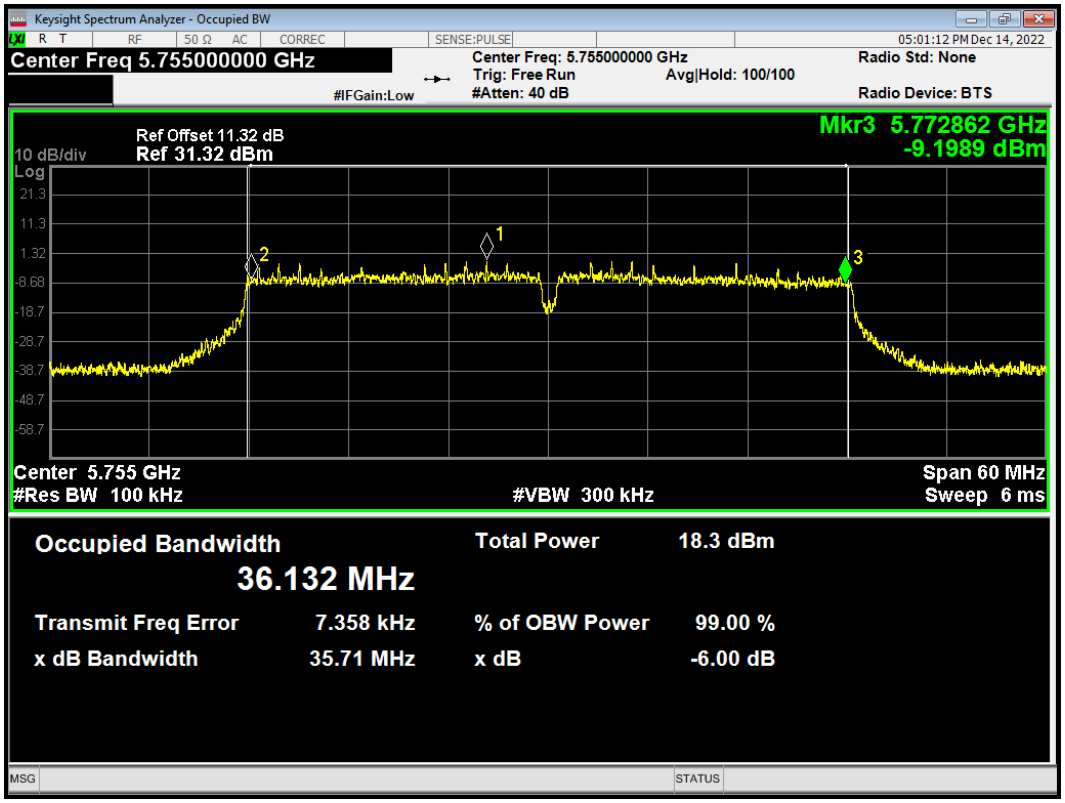
-6dB Bandwidth 802.11n(HT20) 5785MHz



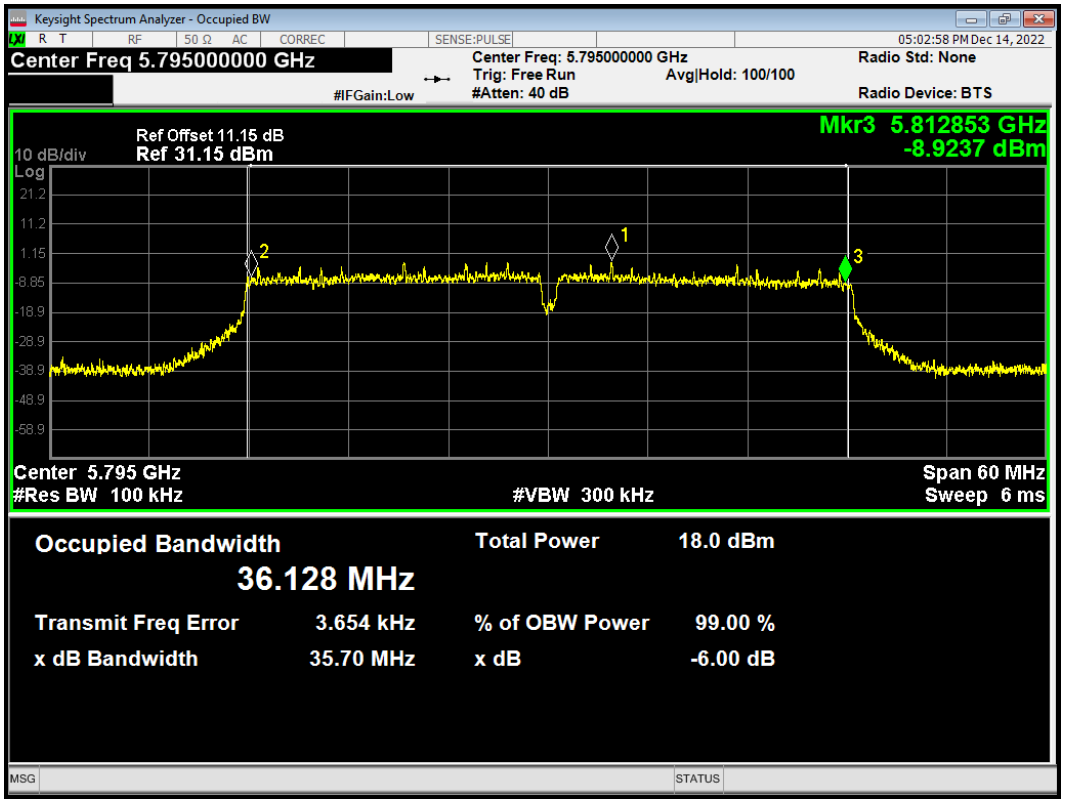
-6dB Bandwidth 802.11n(HT20) 5825MHz



-6dB Bandwidth 802.11n(HT40) 5755MHz



-6dB Bandwidth 802.11n(HT40) 5795MHz



5.2. Average Power Output

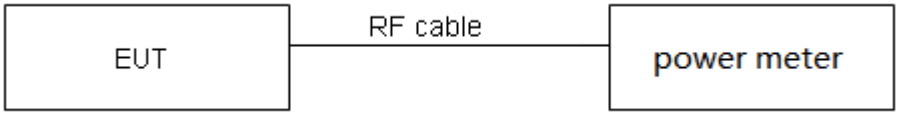
Ambient condition

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	0.96	0.16
802.11ac VHT20	0.98	0.00
802.11ac VHT40	0.96	0.16
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	15	15	CH42	13
CH40	17	16	17	CH46	17	17	/	/
CH48	17	16	17	/	/	/	/	/
CH52	17	17	17	CH54	17	17	CH58	15
CH60	17	17	17	CH62	15	15	/	/
CH64	17	17	17	/	/	/	/	/
CH100	17	15	17	CH102	14	15	CH106	15
CH116	17	15	16	CH110	14	15	/	
CH140	17	16	17	CH134	14	15	CH138	16
CH144	17	16	17	CH142	15	16	/	/
CH149	18	16	17	CH151	16	17	CH155	17
CH157	18	17	18	CH159	17	18	/	/
CH165	20	18	19	/	/	/	/	/

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	22.32	24.49>24	24
		60/5300	22.04	24.43>24	24
		64/5320	22.62	24.54>24	24
	802.11n HT20	52/5260	22.95	24.61>24	24
		60/5300	22.69	24.56>24	24
		64/5320	22.82	24.58>24	24
	802.11n HT40	54/5270	42.15	27.25>24	24
		62/5310	42.22	27.25>24	24
	802.11ac VHT20	52/5260	23.19	24.65>24	24
		60/5300	24.50	24.89>24	24
		64/5320	23.09	24.63>24	24
	802.11ac VHT40	54/5270	42.13	27.25>24	24
		62/5310	41.93	27.23>24	24
	802.11ac VHT80	58/5290	90.51	30.57>24	24
U-NII-2C	802.11a	100/5500	21.52	24.33>24	24
		116/5580	22.48	24.52>24	24
		140/5700	22.80	24.58>24	24
		144/5720	21.62	24.35>24	24
	802.11n HT20	100/5500	22.11	24.45>24	24
		116/5580	23.03	24.62>24	24
		140/5700	22.76	24.57>24	24
		144/5720	23.12	24.64>24	24
	802.11n HT40	102/5510	42.13	27.25>24	24
		110/5550	42.19	27.25>24	24
		134/5670	42.37	27.27>24	24
		142/5710	42.21	27.25>24	24
	802.11ac VHT20	100/5500	22.82	24.58>24	24
		116/5580	22.91	24.60>24	24
		140/5700	22.91	24.60>24	24
		144/5720	22.58	24.54>24	24
	802.11ac VHT40	102/5510	41.96	27.23>24	24
		110/5550	41.80	27.21>24	24
		134/5670	41.91	27.22>24	24
		142/5710	42.11	27.24>24	24
	802.11ac VHT80	106/5530	83.53	30.22>24	24
		138/5690	83.49	30.22>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	10.89	10.89	24	PASS
	40/5200	11.15	11.15	24	PASS
	48/5240	11.15	11.15	24	PASS
802.11n HT20	36/5180	9.96	9.96	24	PASS
	40/5200	10.18	10.18	24	PASS
	48/5240	10.59	10.59	24	PASS
802.11n HT40	38/5190	9.38	9.54	24	PASS
	46/5230	12.02	12.18	24	PASS
802.11ac VHT20	36/5180	11.17	11.17	24	PASS
	40/5200	11.22	11.22	24	PASS
	48/5240	11.70	11.70	24	PASS
802.11ac VHT40	38/5190	9.12	9.28	24	PASS
	46/5230	11.80	11.96	24	PASS
802.11ac VHT80	42/5210	7.54	7.86	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	11.25	11.25	24	PASS
	60/5300	11.51	11.51	24	PASS
	64/5320	11.26	11.26	24	PASS
802.11n HT20	52/5260	11.17	11.17	24	PASS
	60/5300	11.43	11.43	24	PASS
	64/5320	11.15	11.15	24	PASS
802.11n HT40	54/5270	11.95	12.11	24	PASS
	62/5310	10.30	10.46	24	PASS
802.11ac VHT20	52/5260	11.21	11.21	24	PASS
	60/5300	11.47	11.47	24	PASS
	64/5320	11.21	11.21	24	PASS
802.11ac VHT40	54/5270	11.96	12.12	24	PASS
	62/5310	10.02	10.18	24	PASS
802.11ac VHT80	58/5290	9.63	9.95	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	14.18	14.18	24	PASS
	116/5580	14.63	14.63	24	PASS
	140/5700	13.40	13.40	24	PASS
	144/5720	12.03	12.03	24	PASS
802.11n HT20	100/5500	12.12	12.12	24	PASS
	116/5580	12.21	12.21	24	PASS
	140/5700	12.39	12.39	24	PASS
	144/5720	11.12	11.12	24	PASS
802.11n HT40	102/5510	11.98	12.14	24	PASS
	110/5550	11.84	12.00	24	PASS
	134/5670	12.16	12.32	24	PASS
	142/5710	11.29	11.45	24	PASS
802.11ac VHT20	100/5500	14.03	14.03	24	PASS
	116/5580	13.53	13.53	24	PASS
	140/5700	13.38	13.38	24	PASS
	144/5720	11.84	11.84	24	PASS
802.11ac VHT40	102/5510	12.73	12.89	24	PASS
	110/5550	13.16	13.32	24	PASS
	134/5670	13.03	13.19	24	PASS
	142/5710	12.18	12.34	24	PASS
802.11ac VHT80	106/5530	12.25	12.57	24	PASS
	138/5690	12.18	12.50	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	5.74	5.74	30	PASS
	149/5745	13.49	13.49	30	PASS
	157/5785	12.72	12.72	30	PASS
	165/5825	13.01	13.01	30	PASS
802.11n HT20	144/5720	5.10	5.10	30	PASS
	149/5745	11.47	11.47	30	PASS
	157/5785	11.35	11.35	30	PASS
	165/5825	11.22	11.22	30	PASS
802.11n HT40	142/5710	0.57	0.73	30	PASS
	151/5755	11.71	11.87	30	PASS
	159/5795	11.48	11.64	30	PASS
802.11ac VHT20	144/5720	5.89	5.89	30	PASS
	149/5745	12.24	12.24	30	PASS
	157/5785	12.35	12.35	30	PASS
	165/5825	11.84	11.84	30	PASS
802.11ac VHT40	142/5710	1.64	1.80	30	PASS
	151/5755	12.73	12.89	30	PASS
	159/5795	12.53	12.69	30	PASS
802.11ac VHT80	138/5690	-1.98	-1.66	30	PASS
	155/5775	11.91	12.23	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	5199.990332	5199.984543	5199.974984	5199.971287
3.8	-10	5199.999535	5199.980010	5199.972744	5199.969870
3.8	0	5199.998475	5199.979307	5199.972685	5199.964003
3.8	10	5199.997701	5199.975870	5199.965274	5199.961274
3.8	20	5199.996756	5199.971893	5199.962993	5199.952425
3.8	30	5199.992669	5199.963779	5199.954254	5199.944882
3.8	40	5199.989906	5199.955857	5199.950262	5199.937300
3.8	50	5199.985625	5199.950403	5199.945736	5199.931870
3.7	20	5199.985089	5199.947634	5199.942762	5199.928994
4.4	20	5199.979375	5199.938984	5199.933246	5199.921781
Max. ΔMHz		-0.020625	-0.061016	-0.066754	-0.078219
PPM		-3.966346	-11.733846	-12.837308	-15.042115

Voltage (V)	Temperature (°C)	U-NII-2A Test Results			
		5300MHz			
		1min	2min	5min	10min
3.8	-20	5299.997542	5299.996751	5299.990484	5299.984022
3.8	-10	5299.995541	5299.994447	5299.983750	5299.983952
3.8	0	5299.991889	5299.988933	5299.979251	5299.981854
3.8	10	5299.989365	5299.988148	5299.970632	5299.972169
3.8	20	5299.982319	5299.983877	5299.968791	5299.968287
3.8	30	5299.981933	5299.981356	5299.965821	5299.967988
3.8	40	5299.977827	5299.974789	5299.960985	5299.961881
3.8	50	5299.971315	5299.973014	5299.958841	5299.956930
3.7	20	5299.967082	5299.971958	5299.953052	5299.947622
4.4	20	5299.958870	5299.969535	5299.950134	5299.943367
Max. ΔMHz		-0.041130	-0.030465	-0.049866	-0.056633
PPM		-7.760377	-5.748113	-9.408679	-10.685472

Voltage (V)	Temperature (°C)	U-NII-2C Test Results			
		5580MHz			
		1min	2min	5min	10min
3.8	-20	5579.994419	5579.985922	5579.979616	5579.975127
3.8	-10	5579.992917	5579.983984	5579.979084	5579.968876
3.8	0	5579.985031	5579.979212	5579.969848	5579.967598
3.8	10	5579.981580	5579.971057	5579.961860	5579.957915
3.8	20	5579.977884	5579.962638	5579.958706	5579.953904
3.8	30	5579.972349	5579.961626	5579.954226	5579.945986
3.8	40	5579.971868	5579.954001	5579.944772	5579.940540
3.8	50	5579.969440	5579.945964	5579.939151	5579.939808
3.7	20	5579.960289	5579.942725	5579.929760	5579.934566
4.4	20	5579.953995	5579.942376	5579.926498	5579.926447
Max. ΔMHz		-0.046005	-0.057624	-0.073502	-0.073553
PPM		-8.244624	-10.326882	-13.172401	-13.181541

Voltage (V)	Temperature (°C)	U-NII-3 Test Results			
		5785MHz			
		1min	2min	5min	10min
3.8	-20	5785.006683	5784.998915	5784.990510	5784.980850
3.8	-10	5785.002842	5784.989235	5784.982836	5784.973566
3.8	0	5785.000220	5784.984282	5784.977926	5784.969114
3.8	10	5784.998274	5784.981118	5784.973824	5784.967936
3.8	20	5784.991510	5784.976399	5784.968716	5784.967003
3.8	30	5784.989716	5784.971065	5784.964457	5784.961105
3.8	40	5784.980867	5784.968052	5784.955598	5784.955232
3.8	50	5784.979464	5784.959810	5784.951555	5784.949415
3.7	20	5784.969814	5784.950793	5784.942374	5784.942730
4.4	20	5784.960152	5784.944344	5784.941002	5784.940740
Max. ΔMHz		-0.039848	-0.055656	-0.058998	-0.059260
PPM		-6.888159	-9.620743	-10.198444	-10.243734

5.4. Power Spectral Density

Ambient condition

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

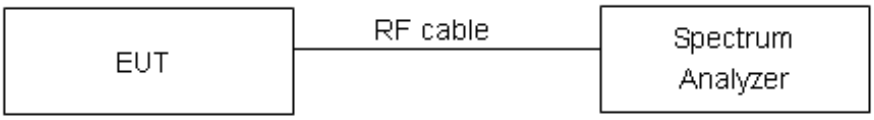
Method of Measurement

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	-0.85	-0.85	11	PASS
	40	0.91	0.91	11	PASS
	48	-0.20	-0.20	11	PASS
802.11n HT20	36	-0.25	-0.25	11	PASS
	40	-0.02	-0.02	11	PASS
	48	0.35	0.35	11	PASS
802.11n HT40	38	-3.83	-3.67	11	PASS
	46	-1.39	-1.23	11	PASS
802.11ac VHT20	36	1.04	1.04	11	PASS
	40	1.22	1.22	11	PASS
	48	1.51	1.51	11	PASS
802.11ac VHT40	38	-4.30	-4.14	11	PASS
	46	-1.20	-1.04	11	PASS
802.11ac VHT80	42	-8.39	-8.07	11	PASS

U-NII-2A

Mode	Channel Number	Read Value (dBm /MHz)	Power Spectral Density (dBm /MHz)	Limit (dBm /MHz)	Conclusion
802.11a	52	1.44	1.44	11	PASS
	60	1.63	1.63	11	PASS
	64	1.48	1.48	11	PASS
802.11n HT20	52	0.76	0.76	11	PASS
	60	1.41	1.41	11	PASS
	64	0.99	0.99	11	PASS
802.11n HT40	54	-0.94	-0.78	11	PASS
	62	-2.82	-2.66	11	PASS
802.11ac VHT20	52	1.35	1.35	11	PASS
	60	1.46	1.46	11	PASS
	64	1.45	1.45	11	PASS

802.11ac VHT40	54	-1.67	-1.51	11	PASS
	62	-2.99	-2.83	11	PASS
802.11ac VHT80	58	-6.51	-6.19	11	PASS

U-NII-2C

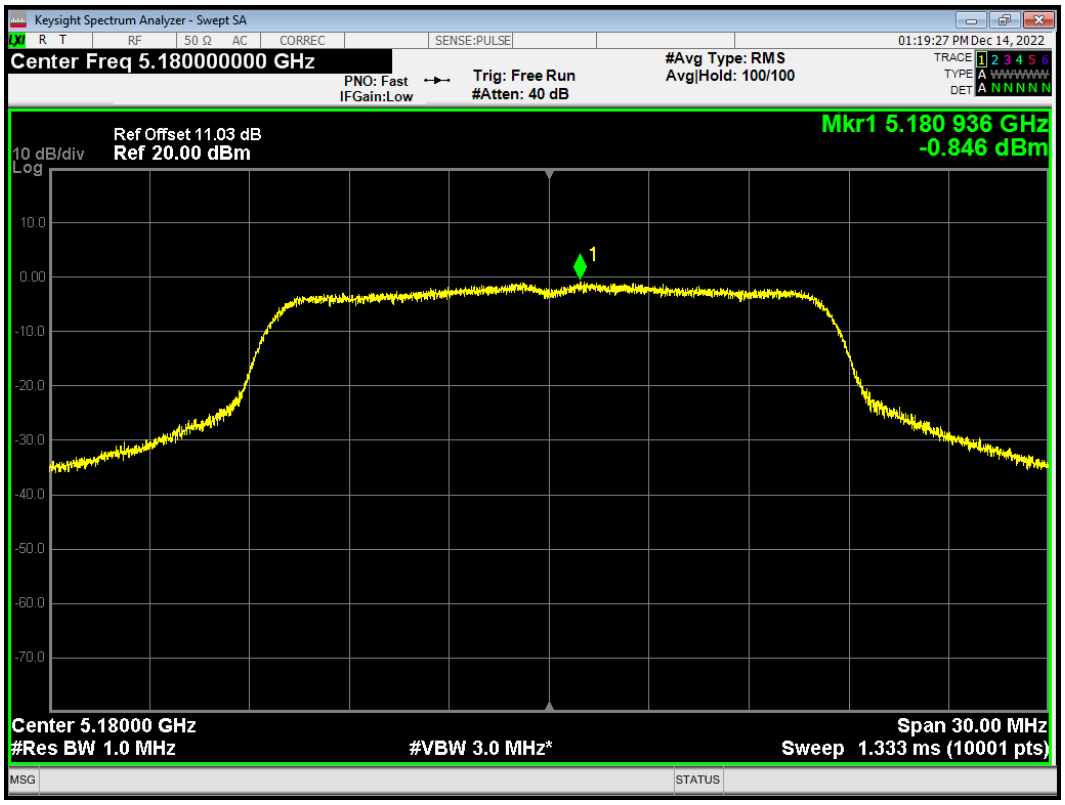
Mode	Channel Number	Read Value (dBm /MHz)	Power Spectral Density (dBm /MHz)	Limit (dBm /MHz)	Conclusion
802.11a	100	4.16	4.16	11	PASS
	116	4.75	4.75	11	PASS
	140	3.49	3.49	11	PASS
	144	2.77	2.77	11	PASS
802.11n HT20	100	2.4	2.40	11	PASS
	116	2.57	2.57	11	PASS
	140	2.44	2.44	11	PASS
	144	2.02	2.02	11	PASS
802.11n HT40	102	-1.12	-0.96	11	PASS
	110	-1.33	-1.17	11	PASS
	134	-1.11	-0.95	11	PASS
	142	-1.54	-1.38	11	PASS
802.11ac VHT20	100	3.95	3.95	11	PASS
	116	3.41	3.41	11	PASS
	140	3.3	3.30	11	PASS
	144	3.03	3.03	11	PASS
802.11ac VHT40	102	-0.3	-0.14	11	PASS
	110	-0.01	0.15	11	PASS
	134	0.1	0.26	11	PASS
	142	-0.23	-0.07	11	PASS
802.11ac VHT80	106	-3.96	-3.64	11	PASS
	138	-3.84	-3.52	11	PASS

U-NII-3

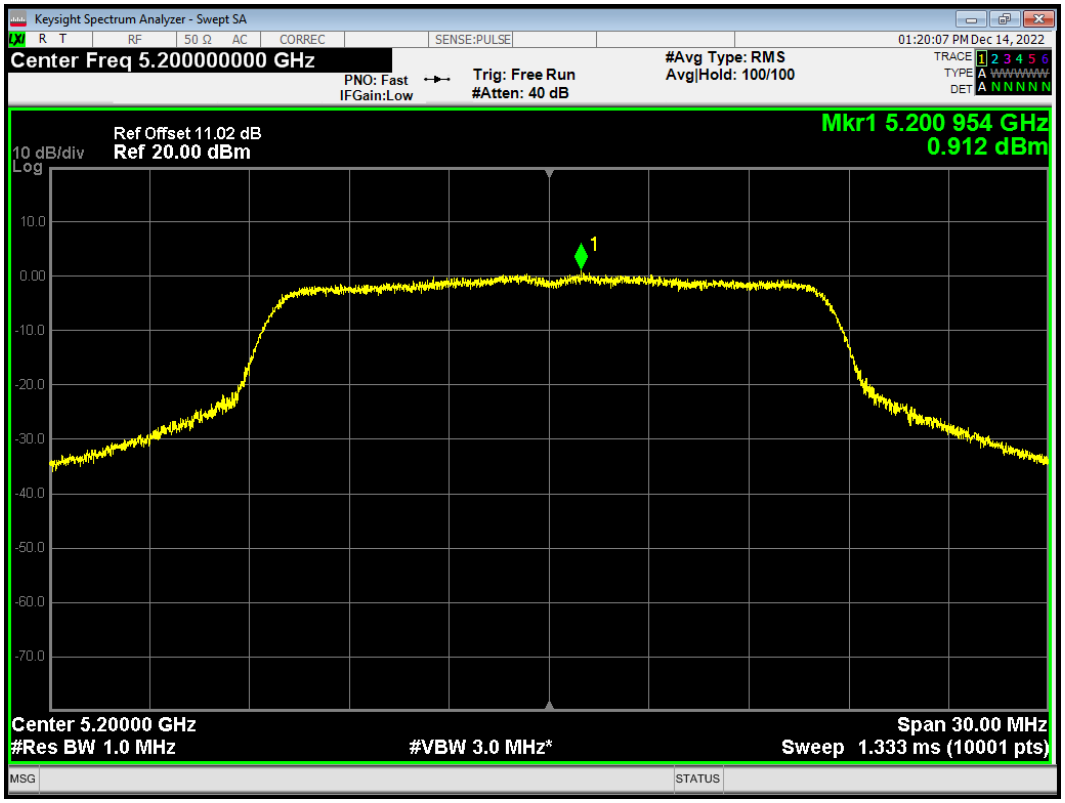
Mode	Channel Number	Read Value (dBm/470kHz)	Power Spectral Density (dBm/500kHz)	Limit (dBm/500kHz)	Conclusion
802.11a	144	-1.35	-1.08	30	PASS
	149	0.47	0.74	30	PASS
	157	-0.41	-0.14	30	PASS
	165	-0.14	0.13	30	PASS
802.11n HT20	144	-2.7	-2.43	30	PASS
	149	-1.97	-1.70	30	PASS
	157	-1.82	-1.55	30	PASS
	165	-1.75	-1.48	30	PASS
802.11n HT40	142	-6.8	-6.37	30	PASS
	151	-4.67	-4.24	30	PASS
	159	-4.95	-4.52	30	PASS
802.11ac VHT20	144	-1.64	-1.37	30	PASS
	149	-0.97	-0.70	30	PASS
	157	-1.02	-0.75	30	PASS
	165	-1.47	-1.20	30	PASS
802.11ac VHT40	142	-5.5	-5.07	30	PASS
	151	-3.68	-3.25	30	PASS
	159	-4.27	-3.84	30	PASS
802.11ac VHT80	138	-8.91	-8.32	30	PASS
	155	-7.21	-6.62	30	PASS
Note: PSD=Read Value+Duty cycle correction factor +10*log(500/470) correction factor					

U-NII-1

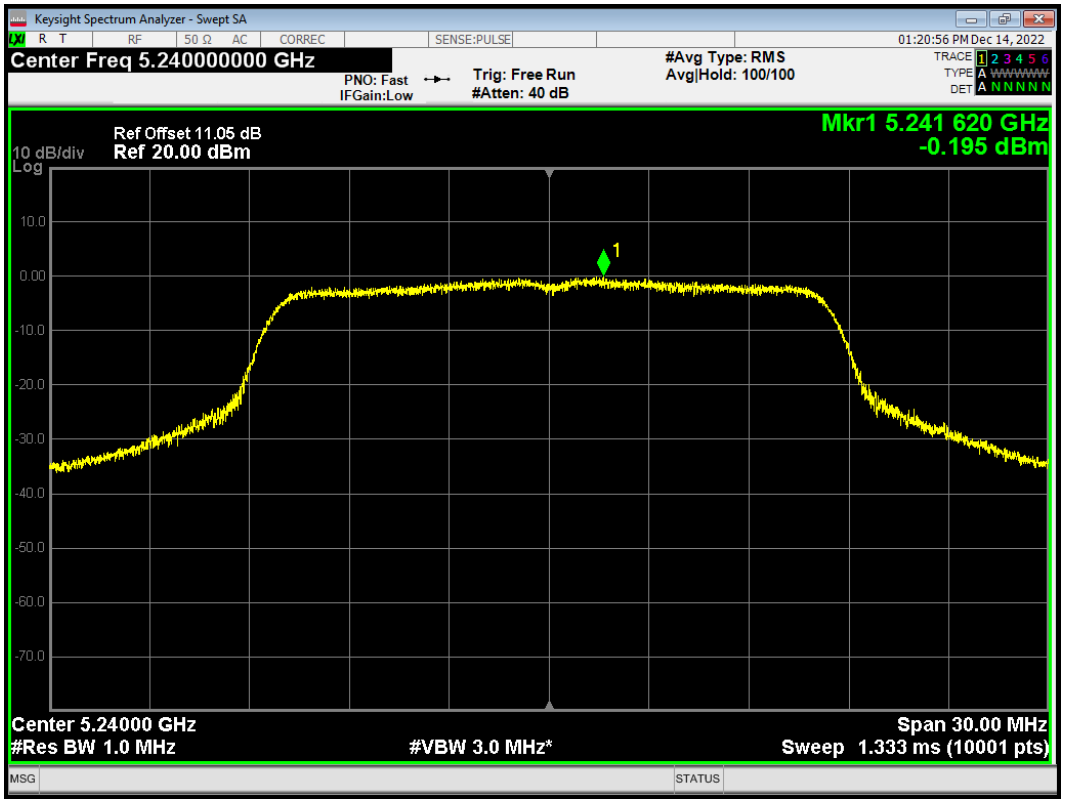
PSD 802.11a 5180MHz



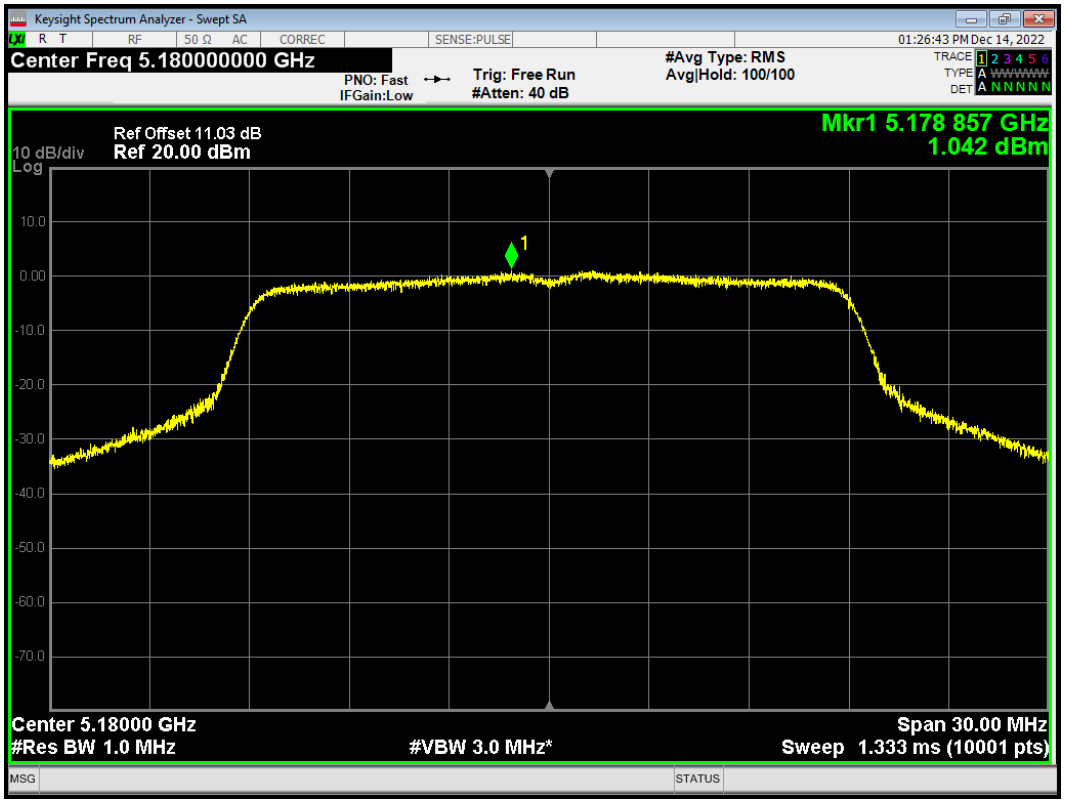
PSD 802.11a 5200MHz



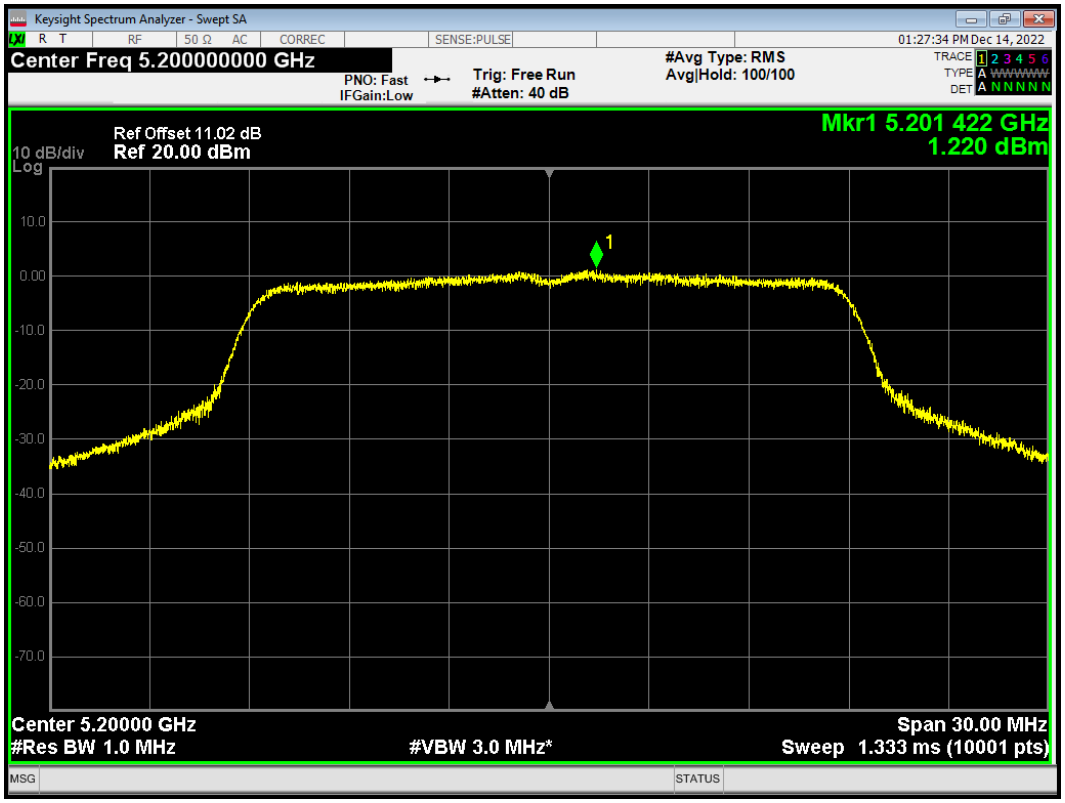
PSD 802.11a 5240MHz



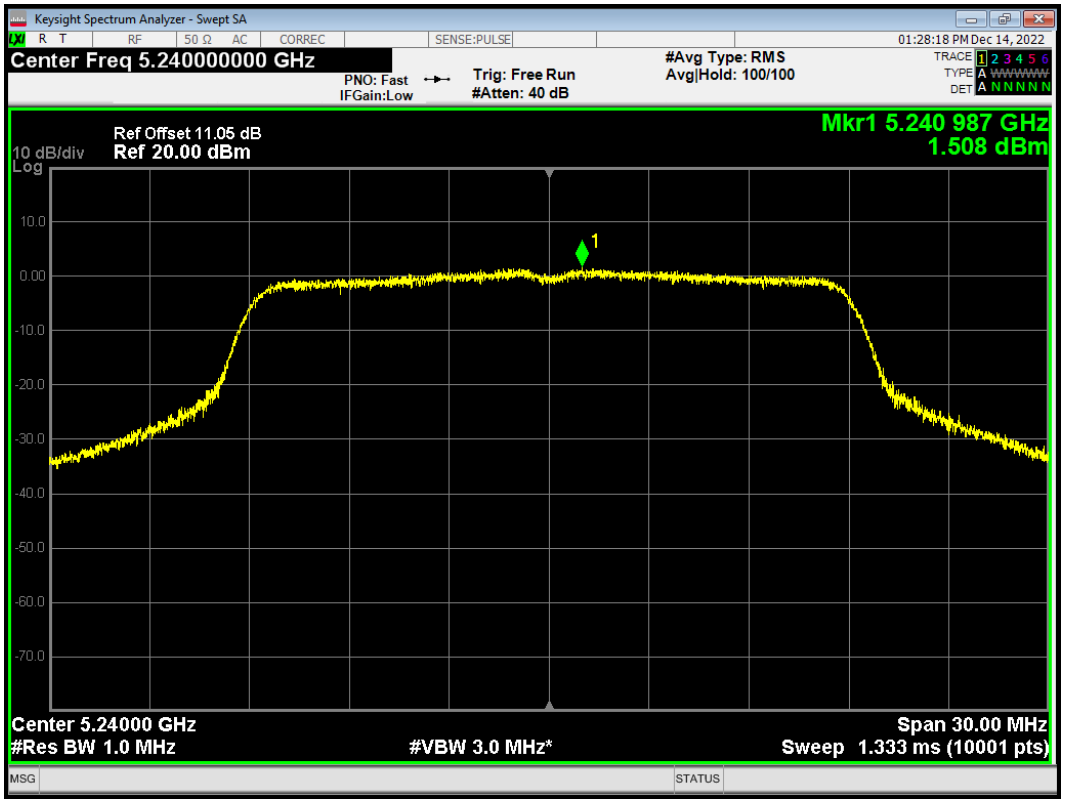
PSD 802.11ac(VHT20) 5180MHz



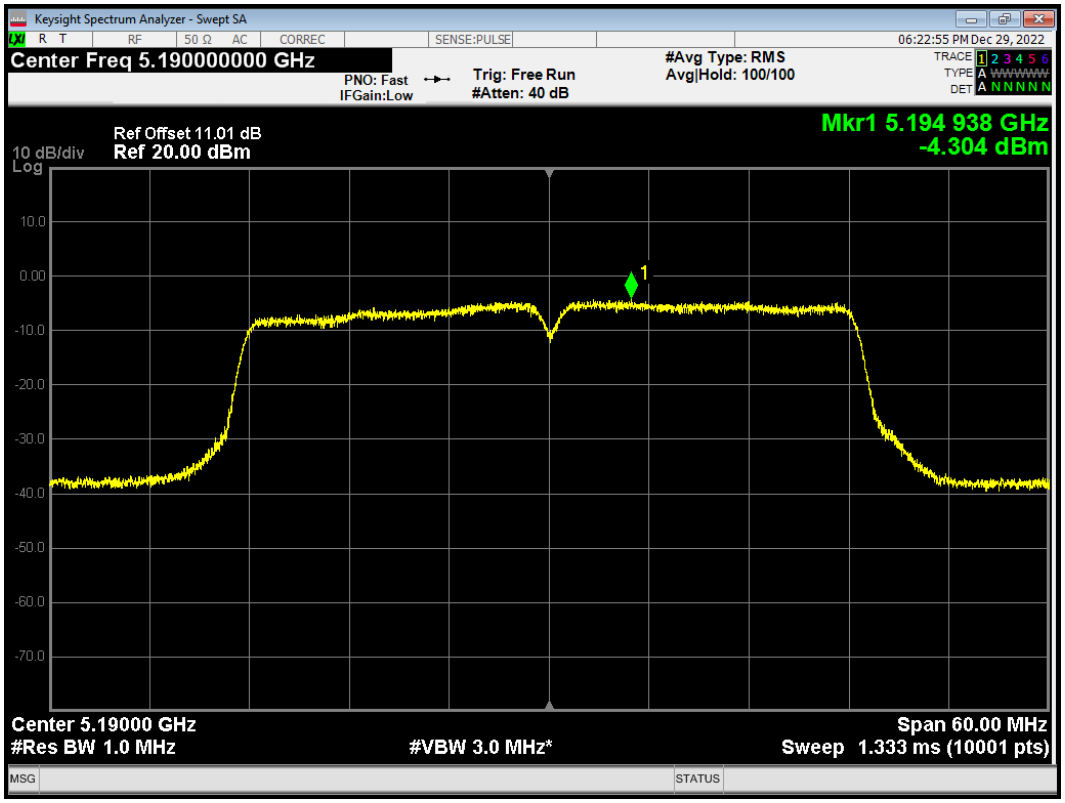
PSD 802.11ac(VHT20) 5200MHz



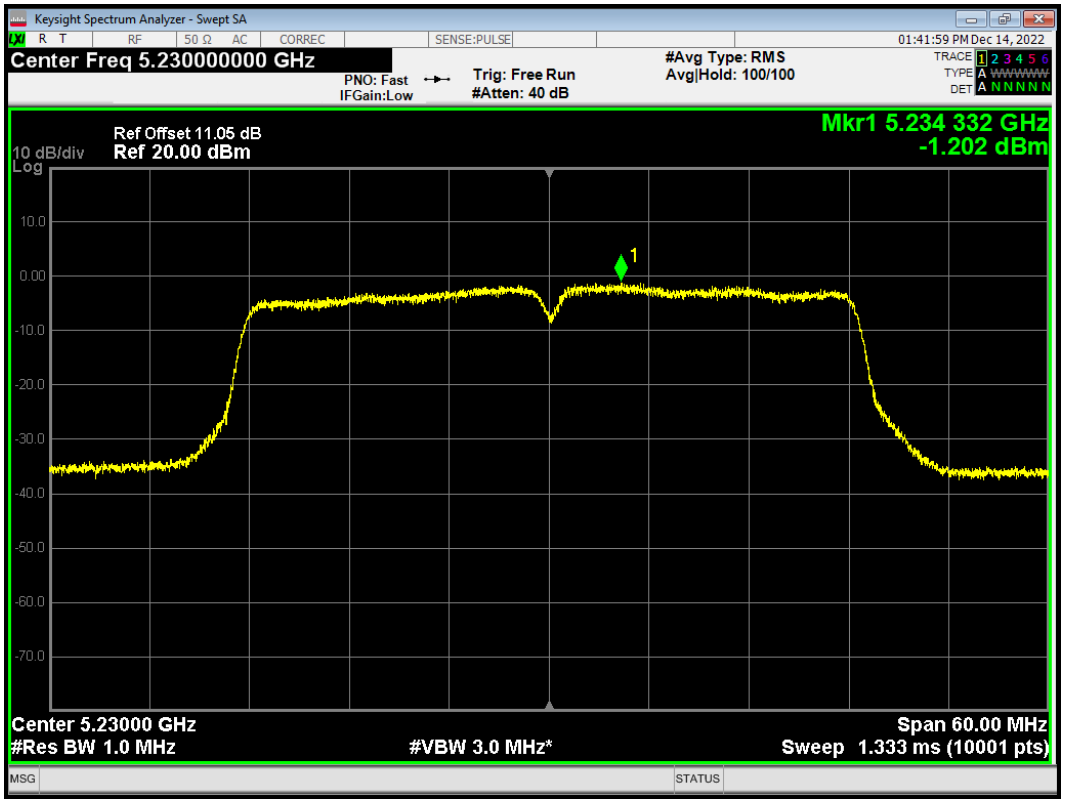
PSD 802.11ac(VHT20) 5240MHz



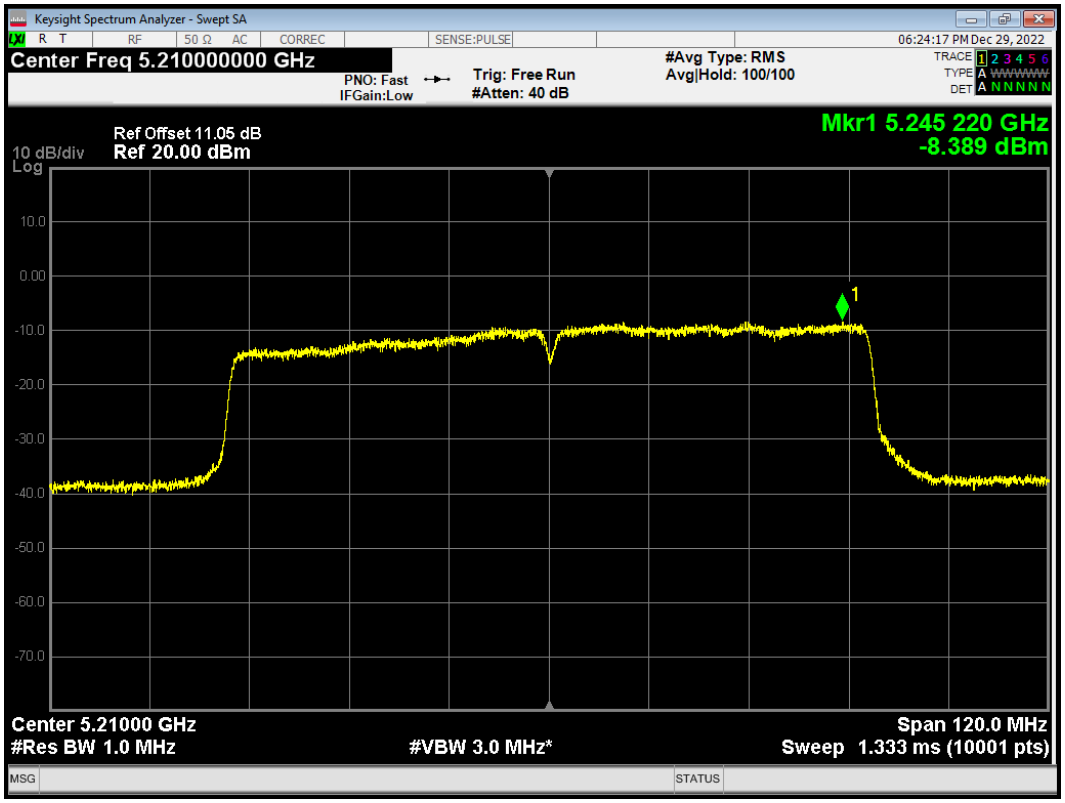
PSD 802.11ac(VHT40) 5190MHz



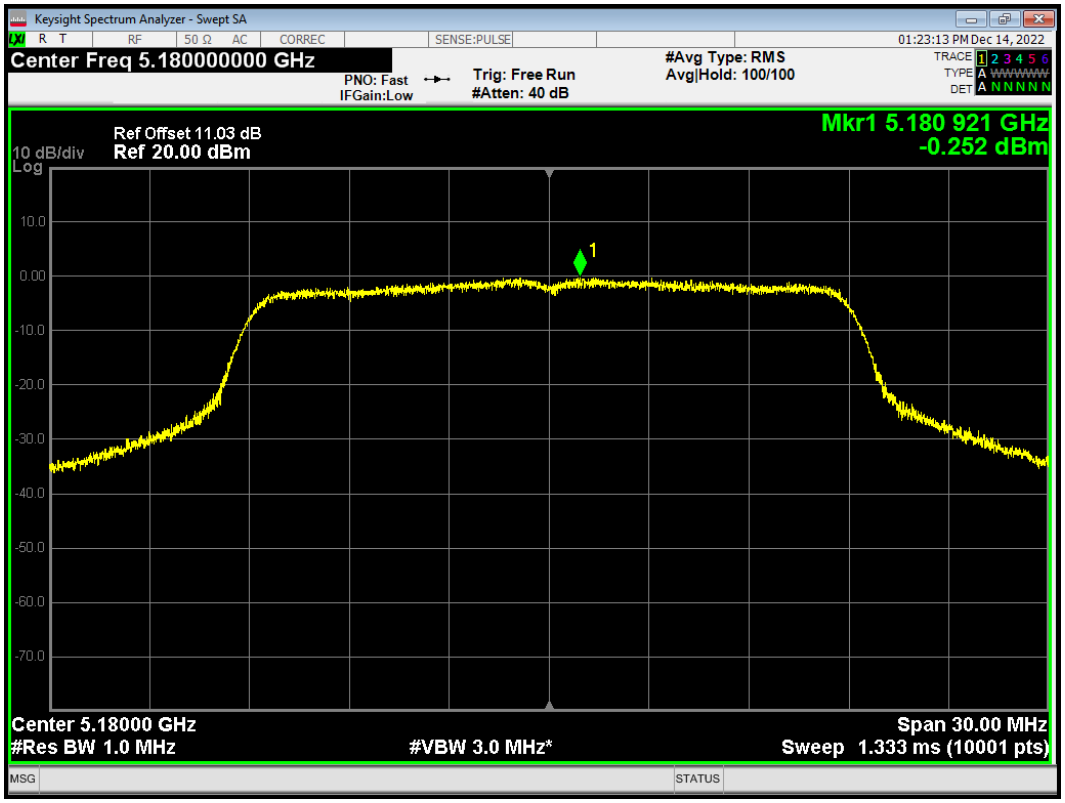
PSD 802.11ac(VHT40) 5230MHz



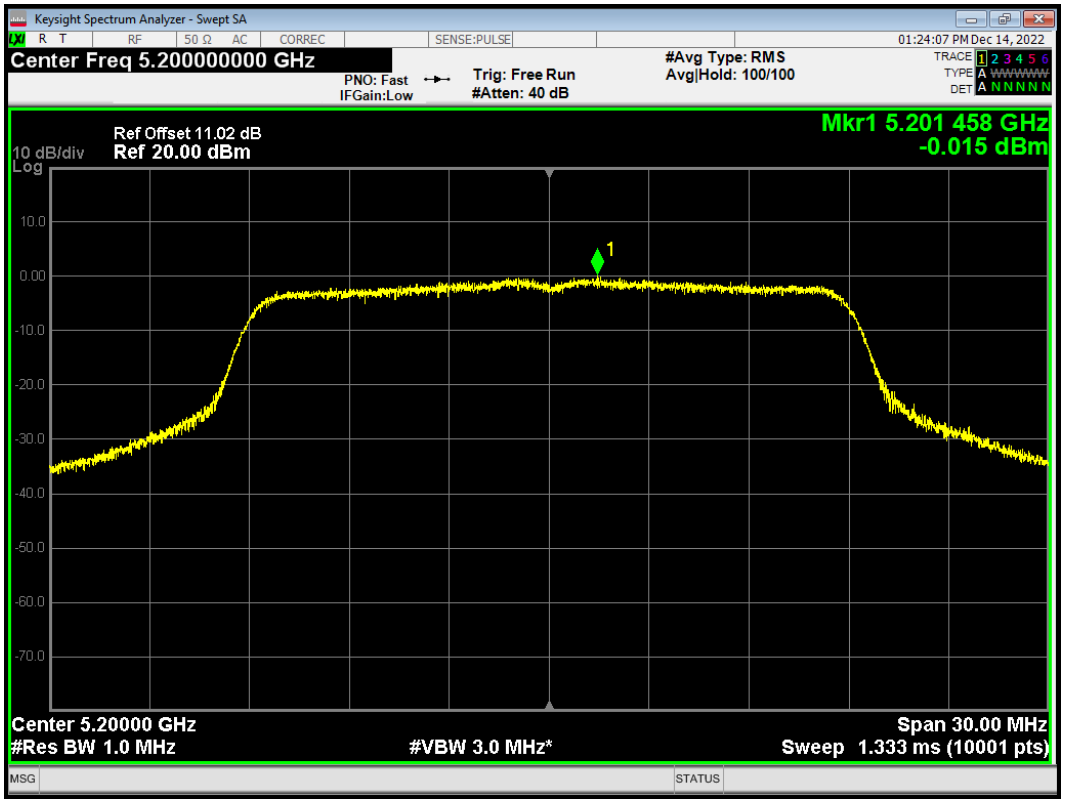
PSD 802.11ac(VHT80) 5210MHz



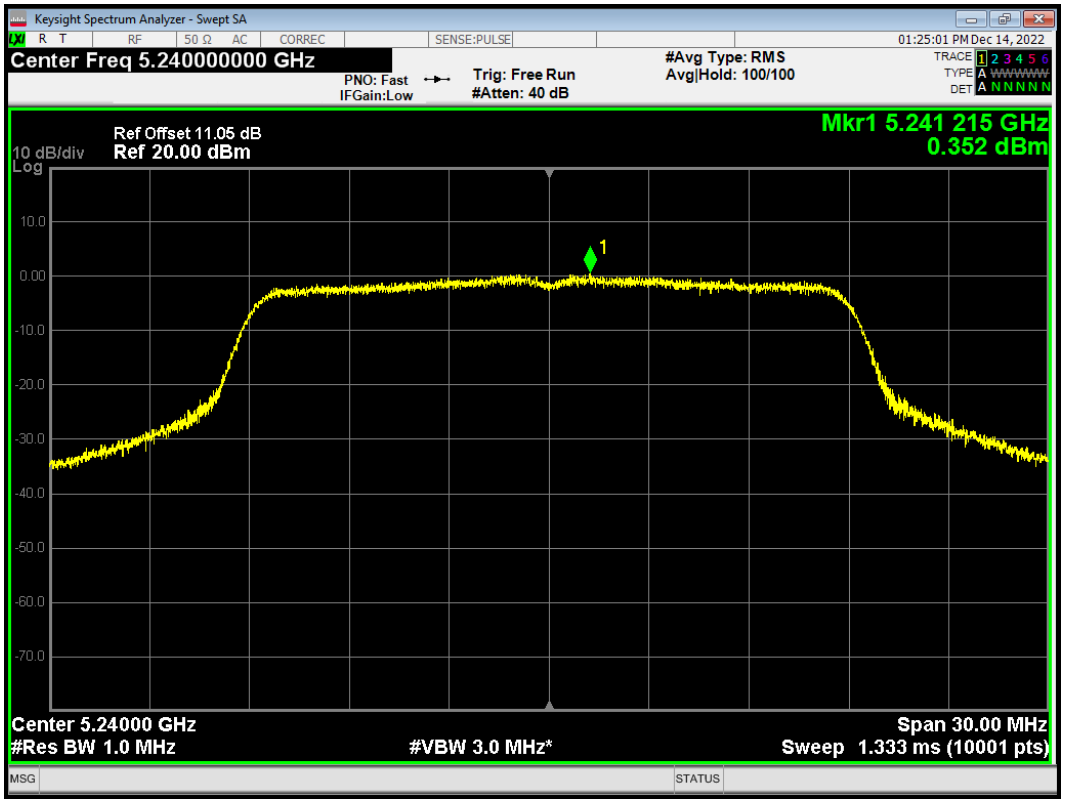
PSD 802.11n(HT20) 5180MHz



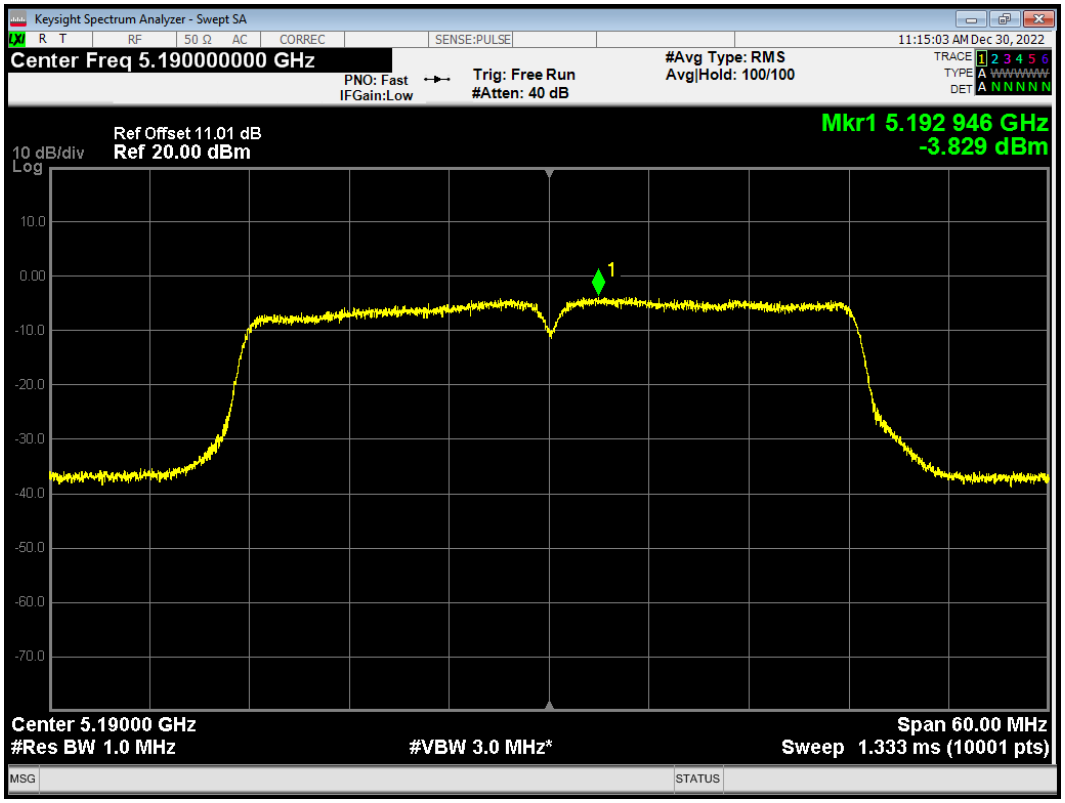
PSD 802.11n(HT20) 5200MHz



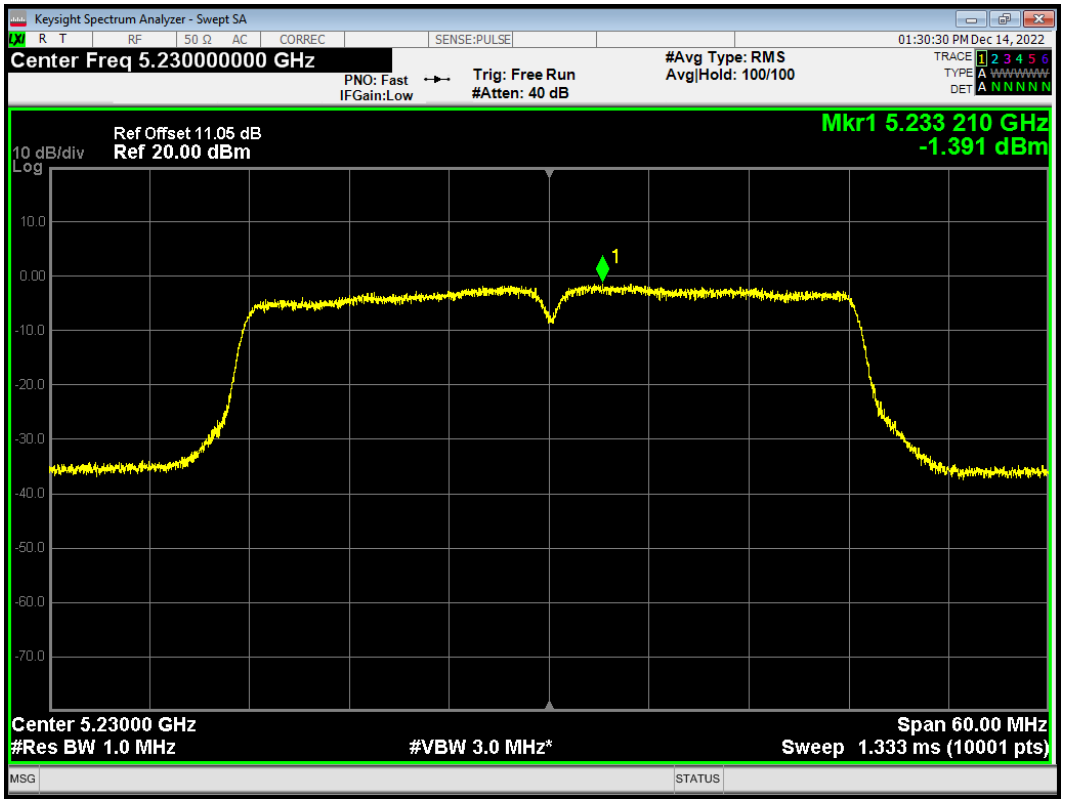
PSD 802.11n(HT20) 5240MHz



PSD 802.11n(HT40) 5190MHz

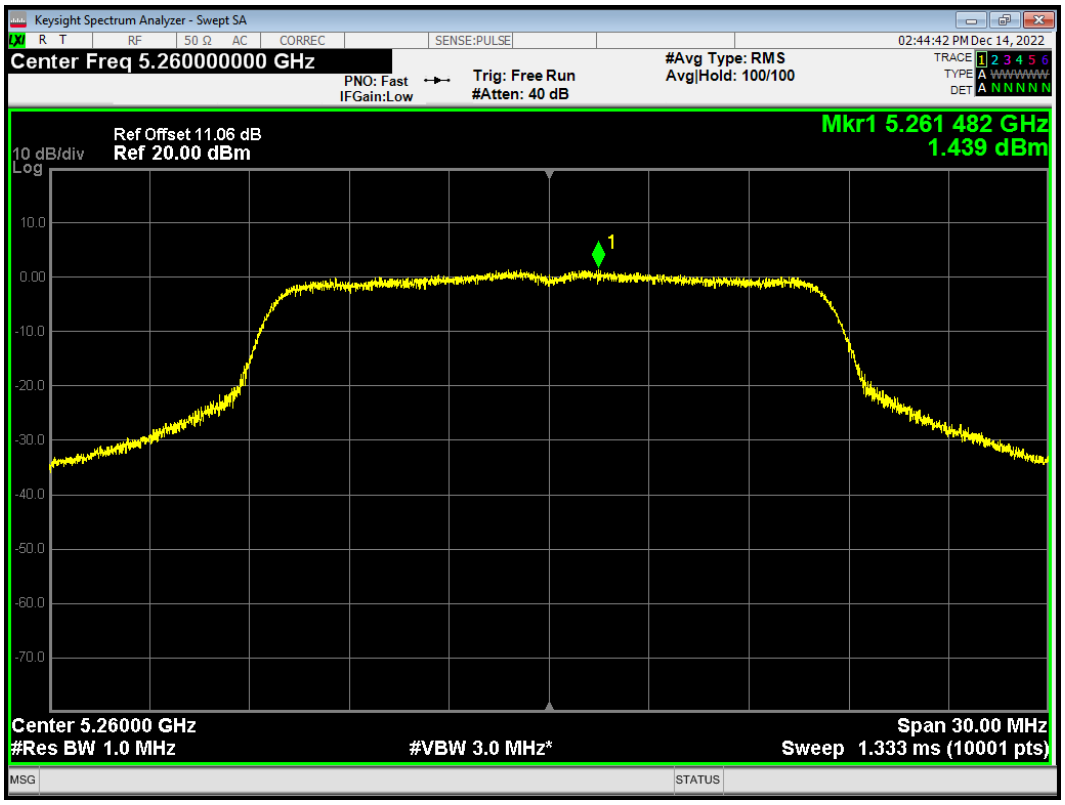


PSD 802.11n(HT40) 5230MHz

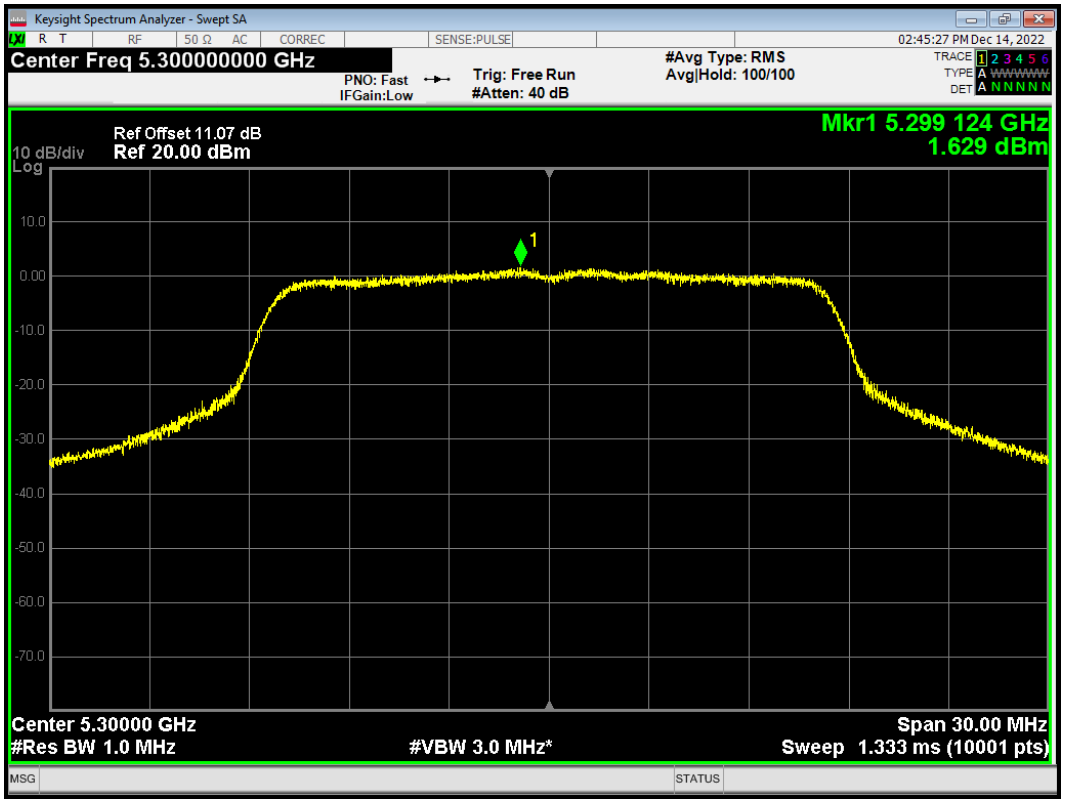


U-NII-2A

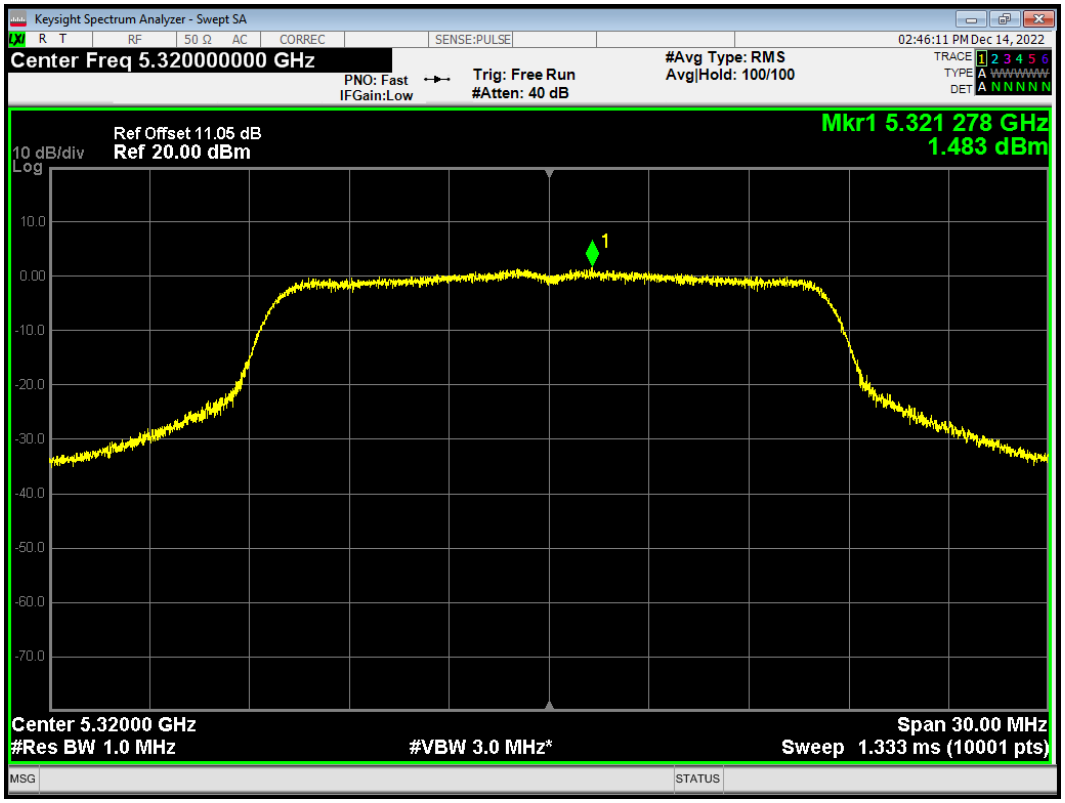
PSD 802.11a 5260MHz



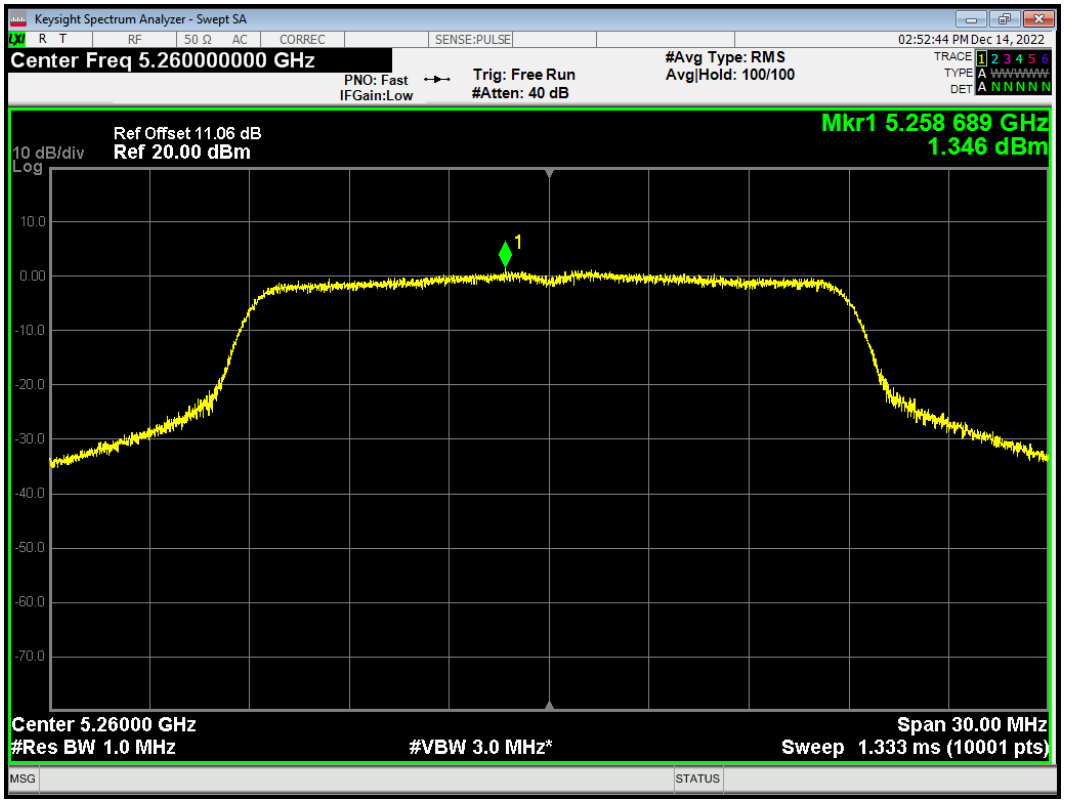
PSD 802.11a 5300MHz



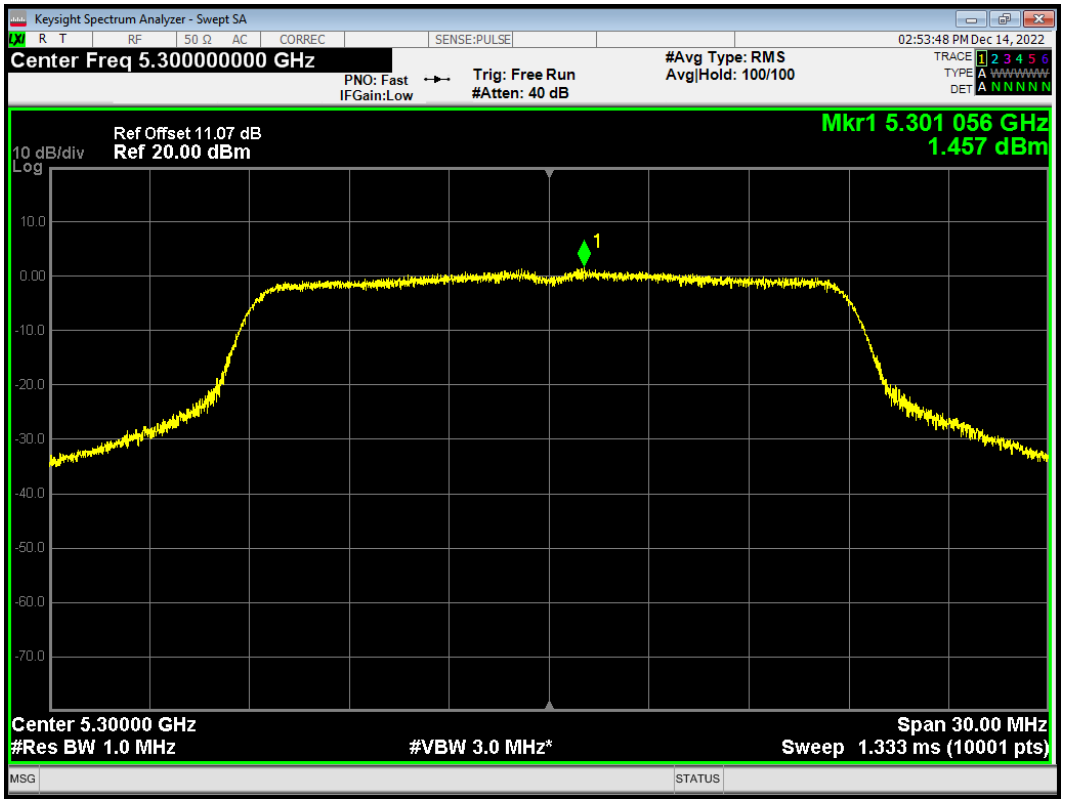
PSD 802.11a 5320MHz



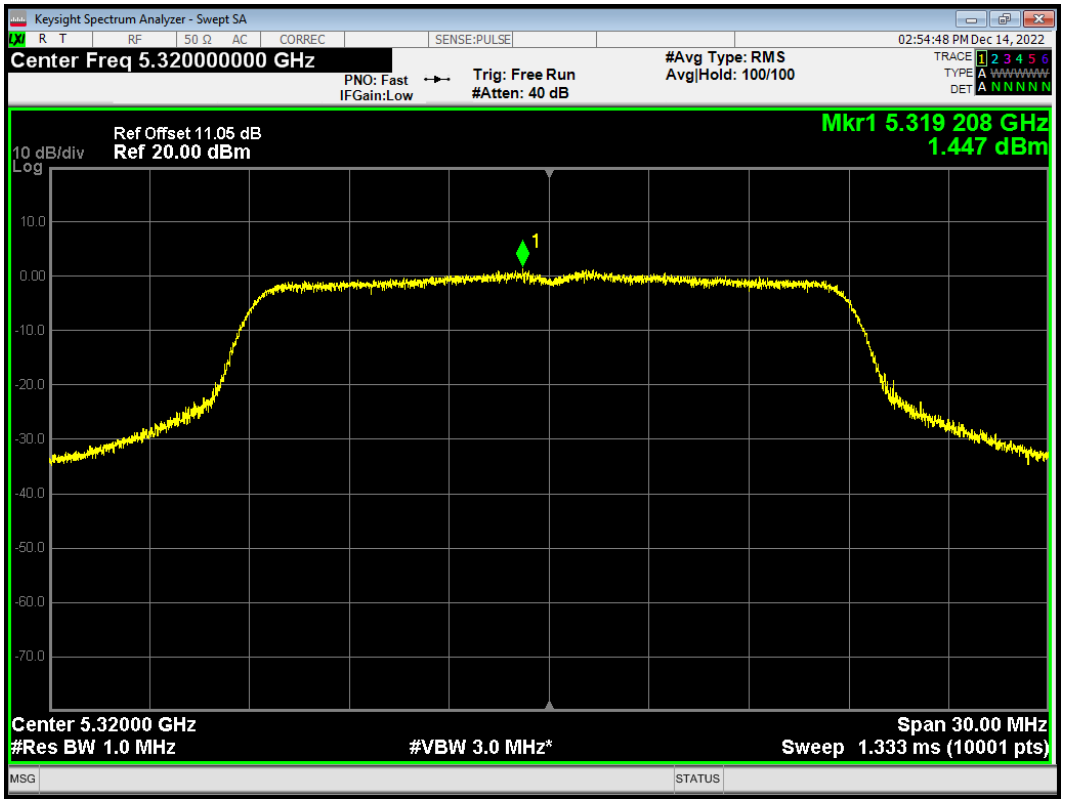
PSD 802.11ac(VHT20) 5260MHz



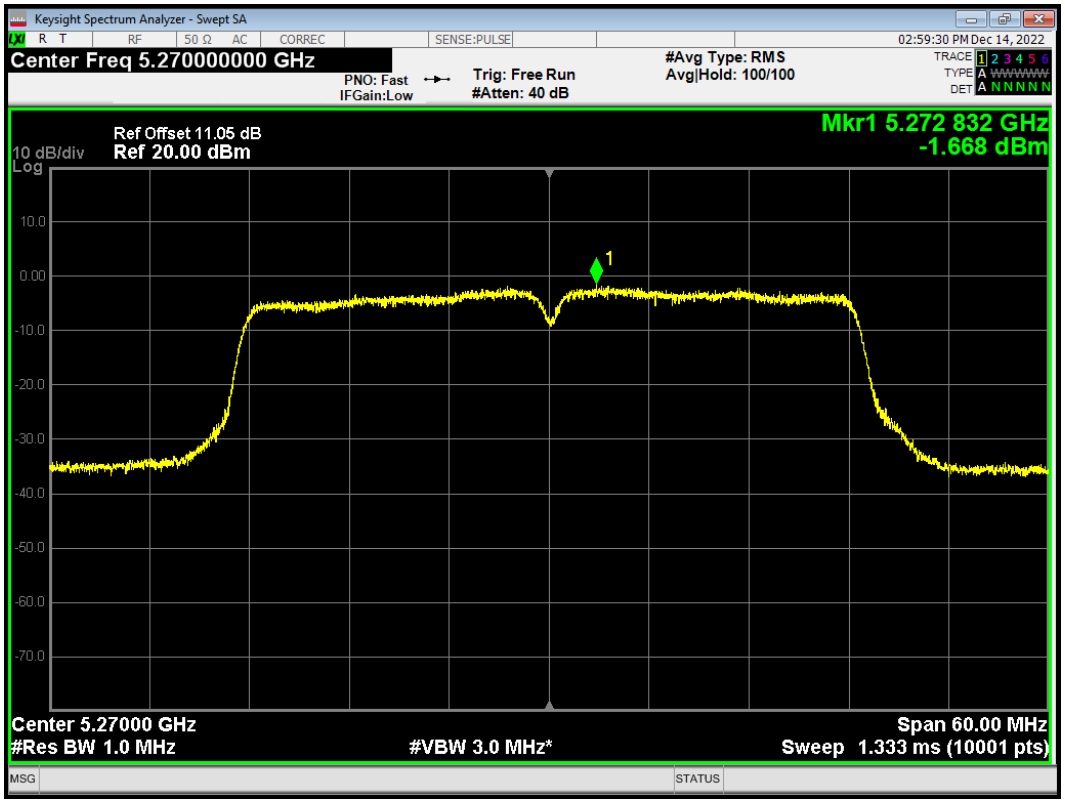
PSD 802.11ac(VHT20) 5300MHz



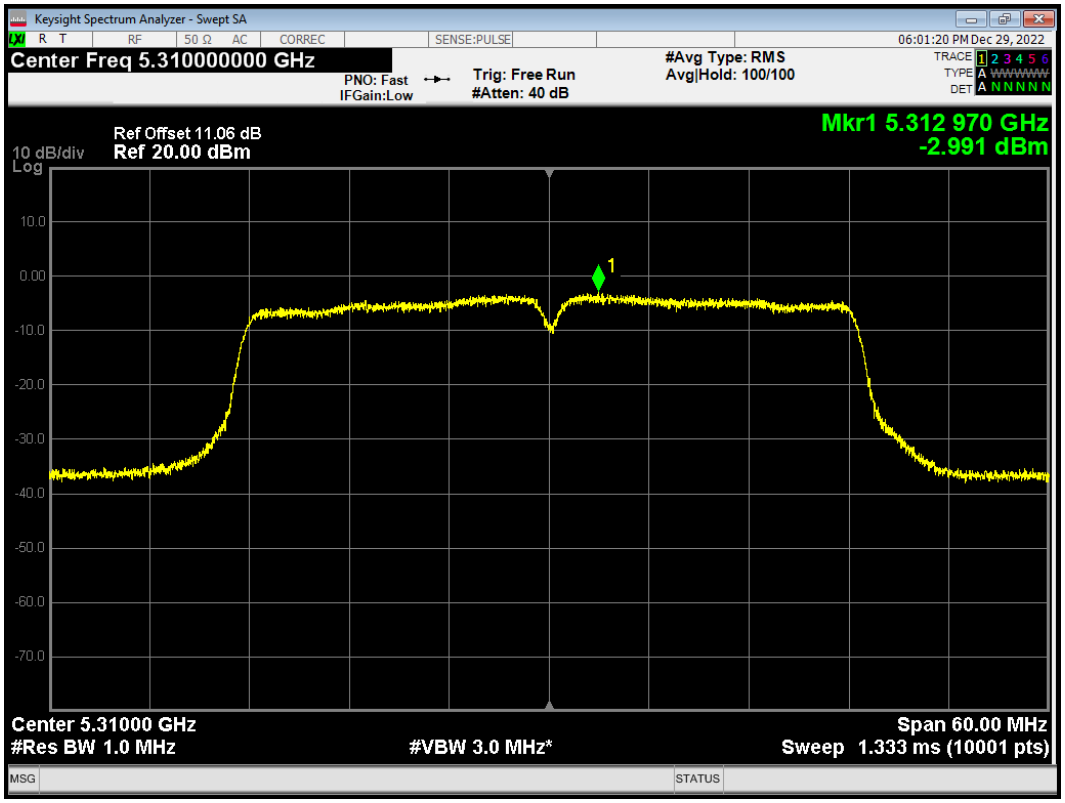
PSD 802.11ac(VHT20) 5320MHz



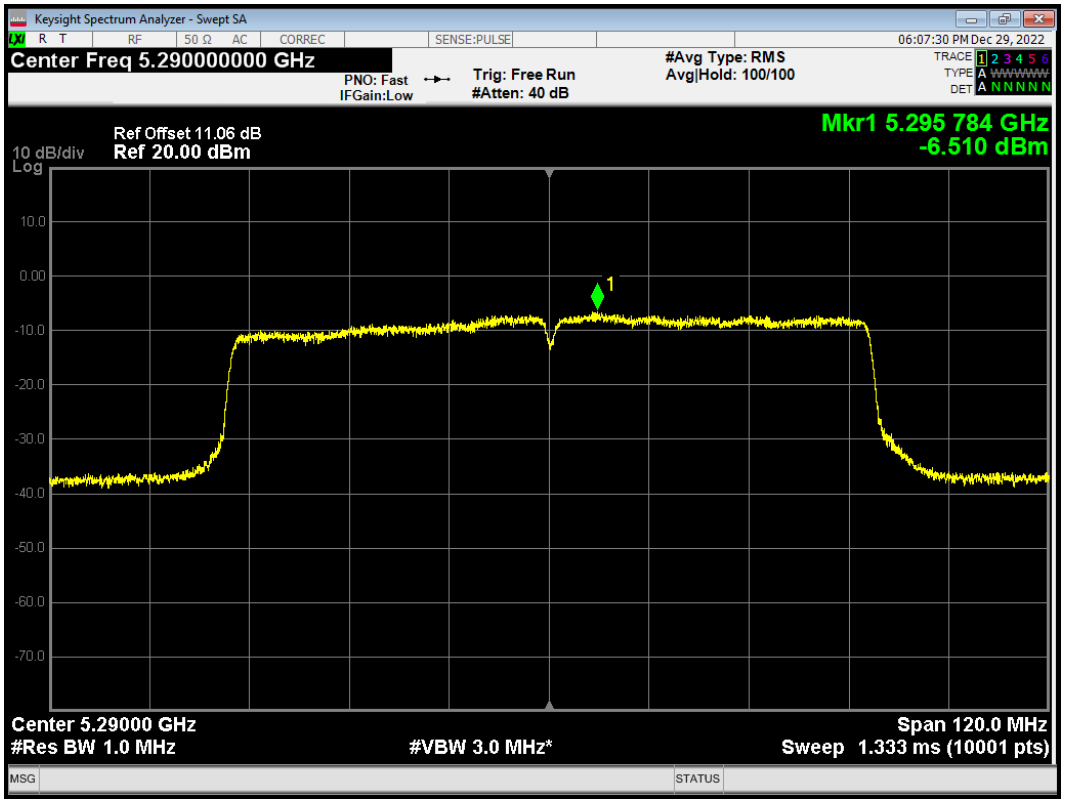
PSD 802.11ac(VHT40) 5270MHz



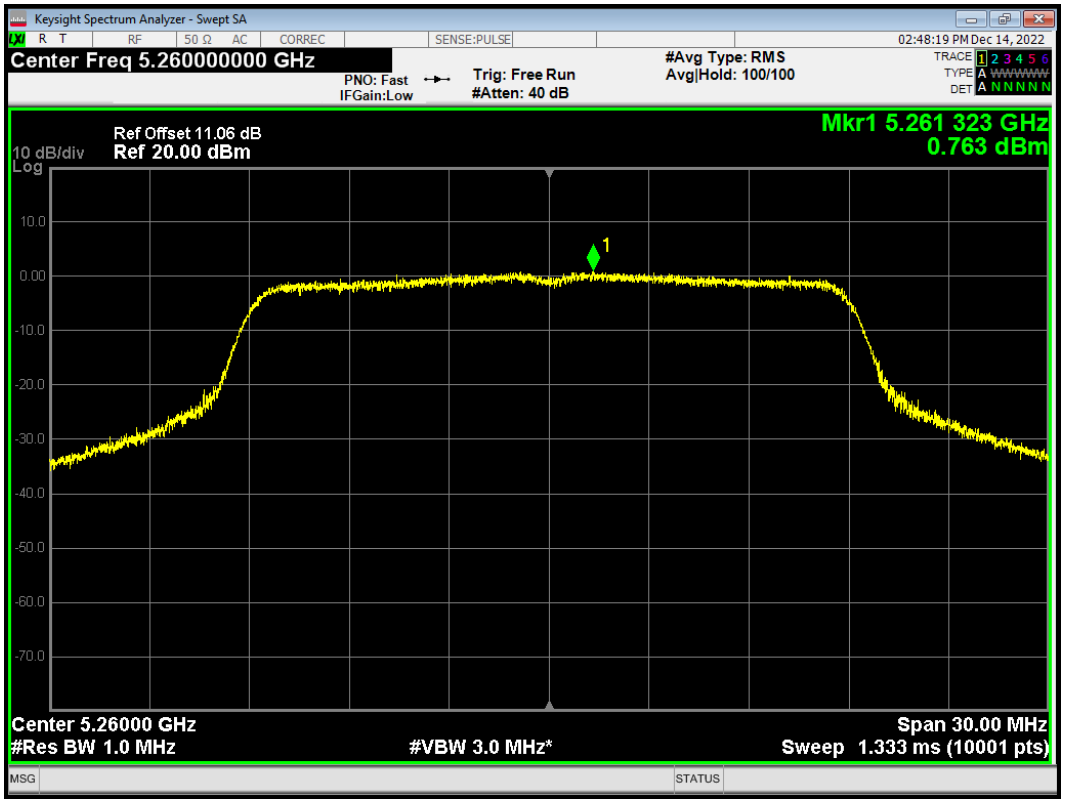
PSD 802.11ac(VHT40) 5310MHz



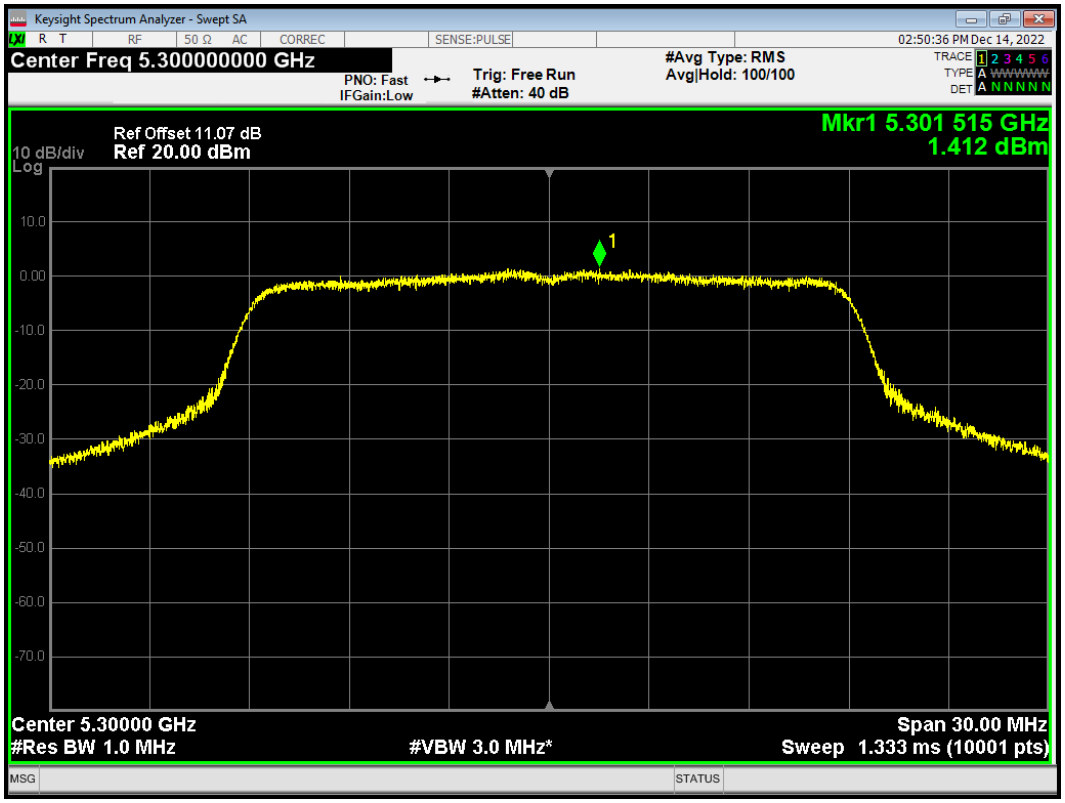
PSD 802.11ac(VHT80) 5290MHz



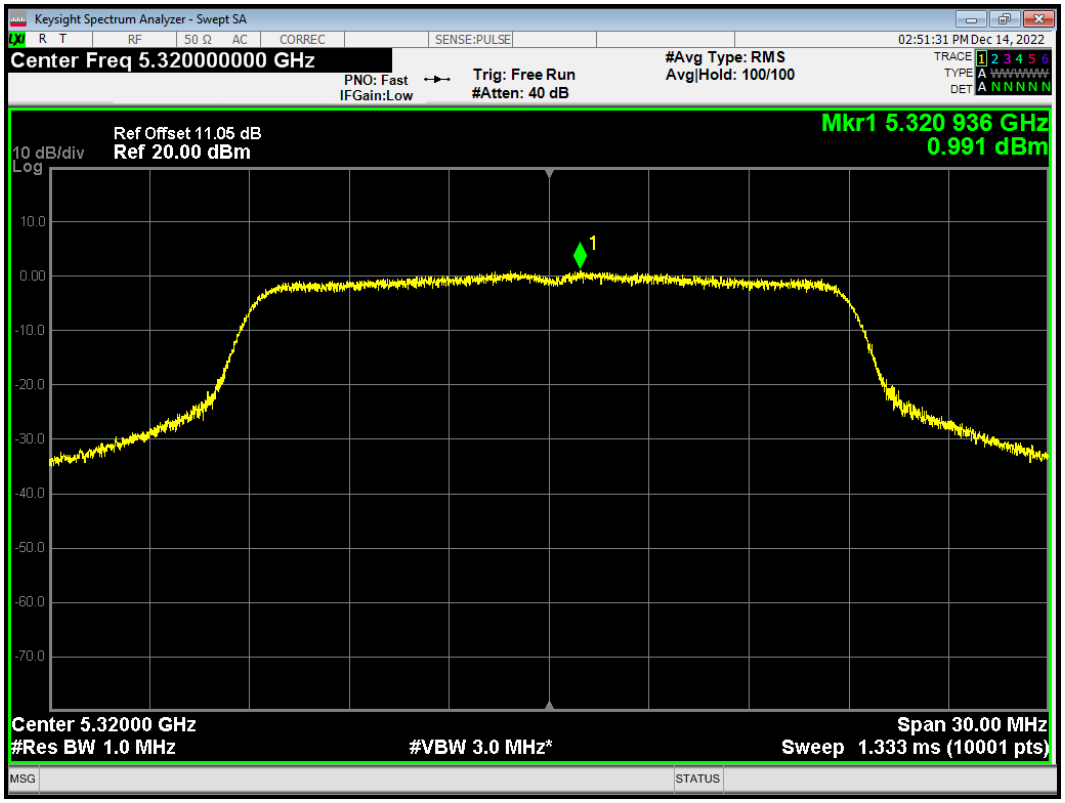
PSD 802.11n(HT20) 5260MHz



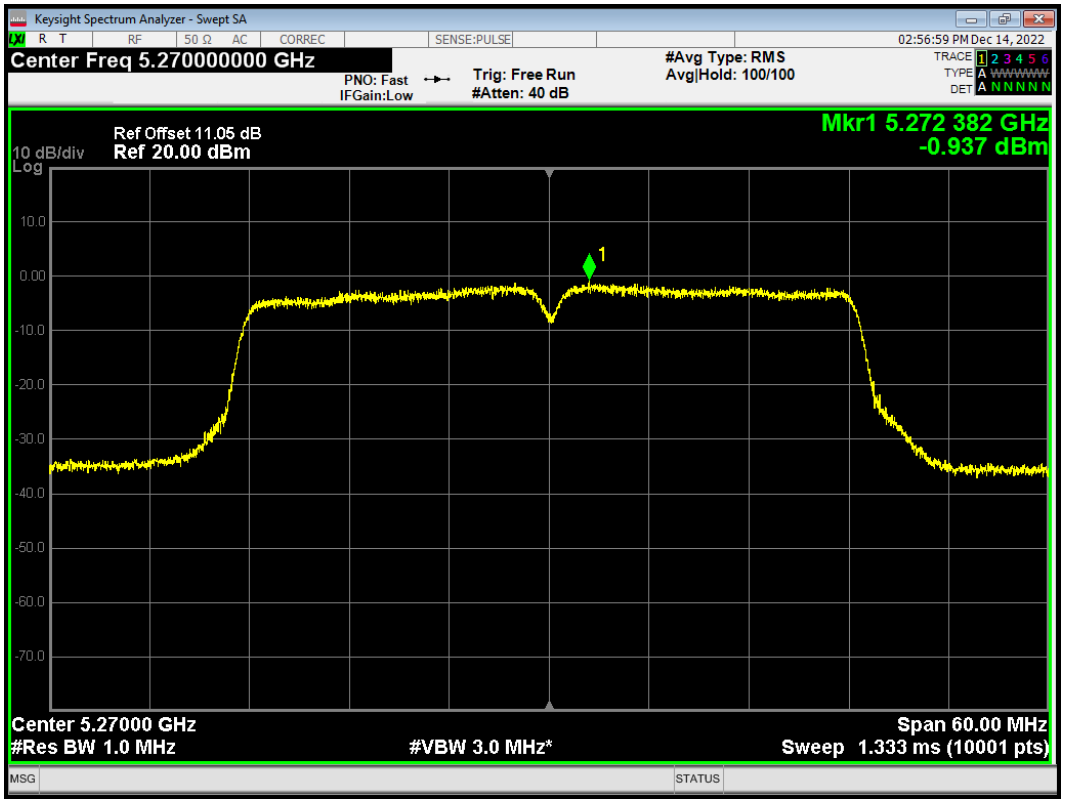
PSD 802.11n(HT20) 5300MHz



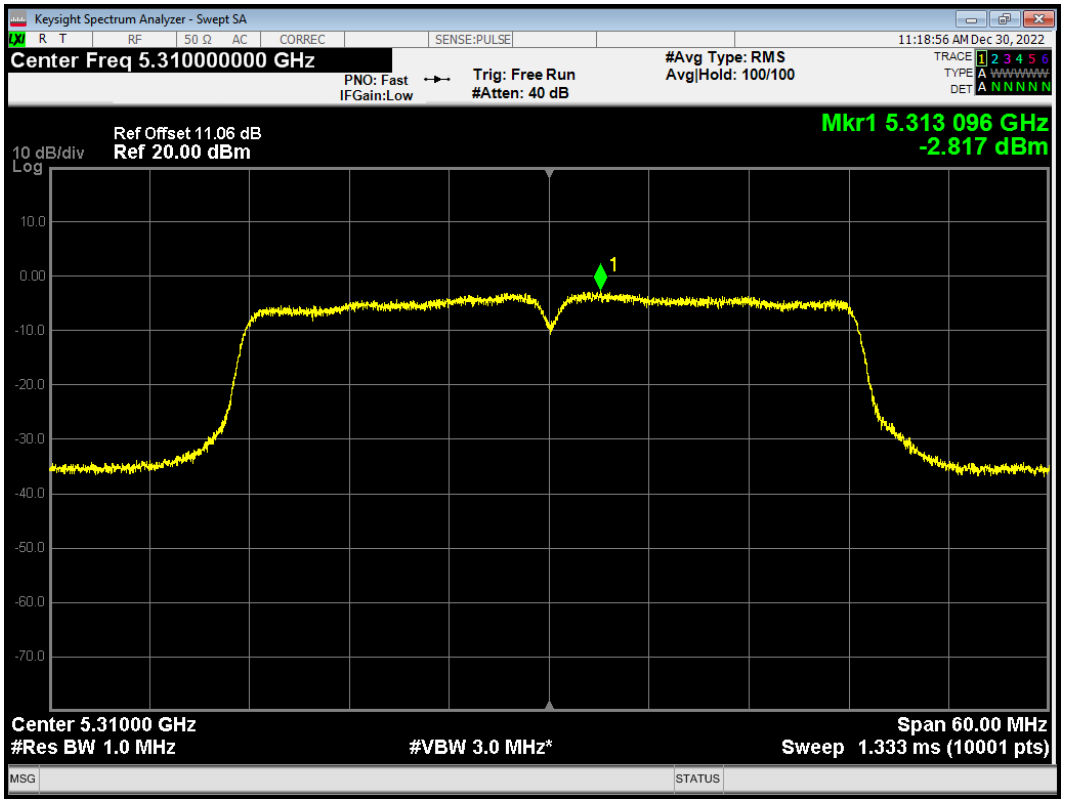
PSD 802.11n(HT20) 5320MHz



PSD 802.11n(HT40) 5270MHz

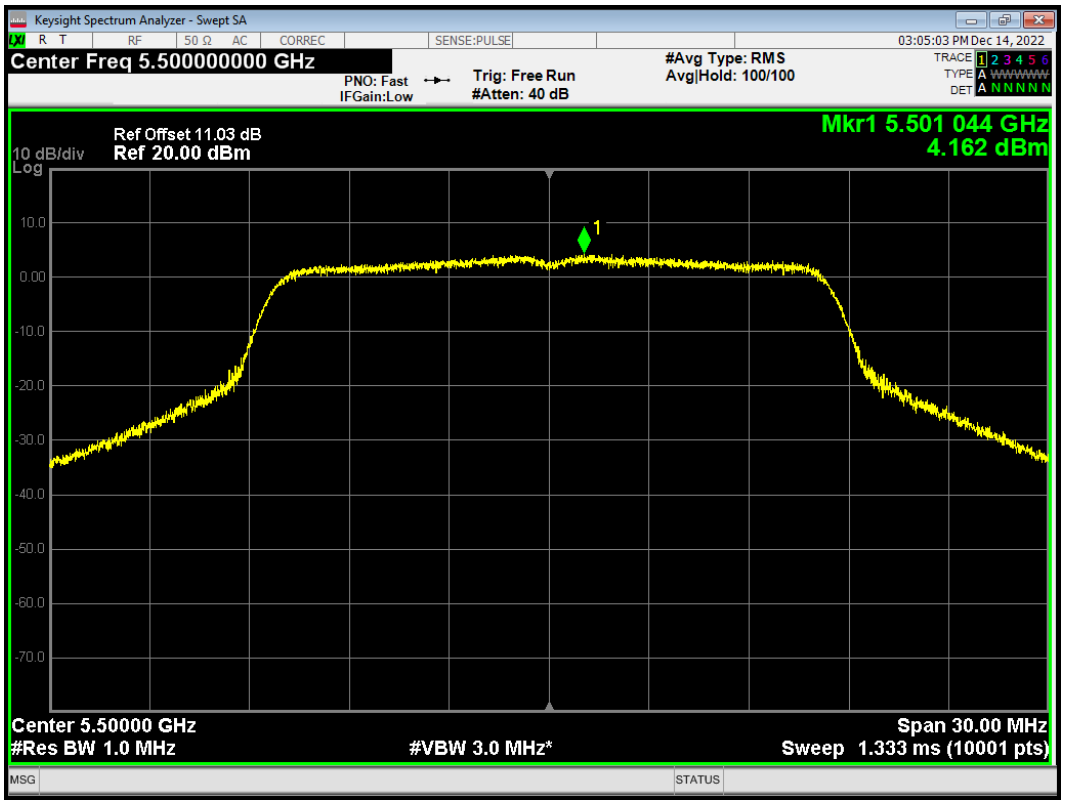


PSD 802.11n(HT40) 5310MHz

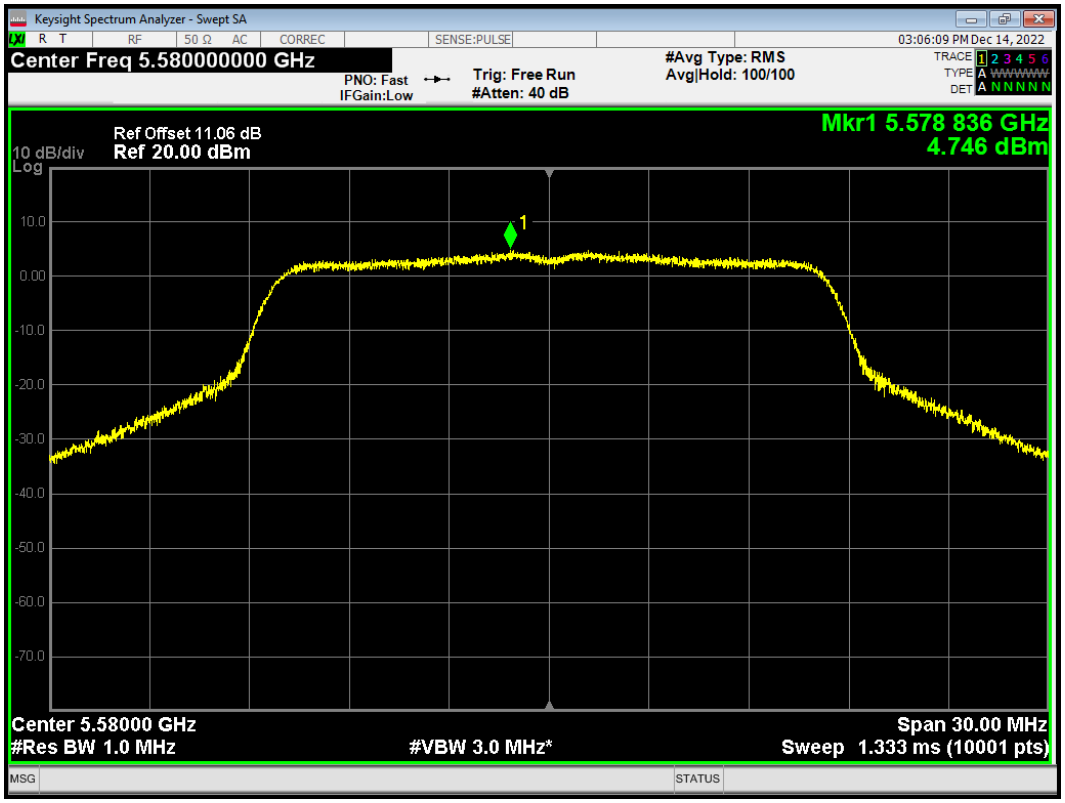


U-NII-2C

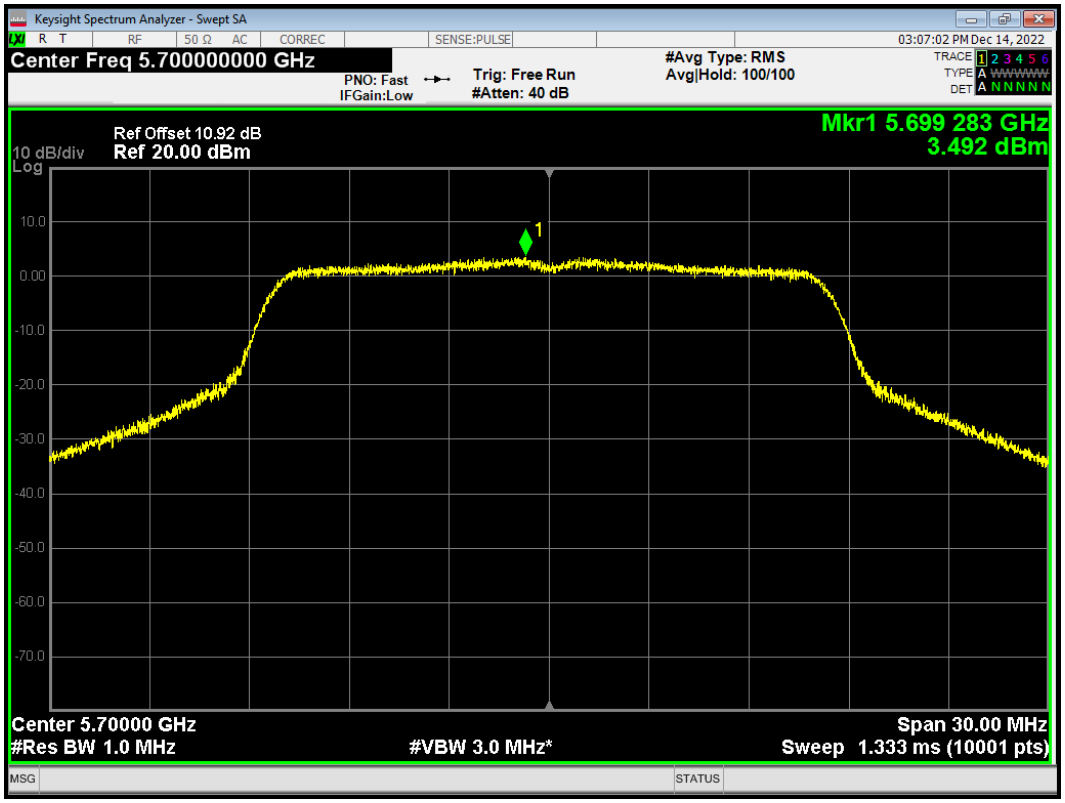
PSD 802.11a 5500MHz



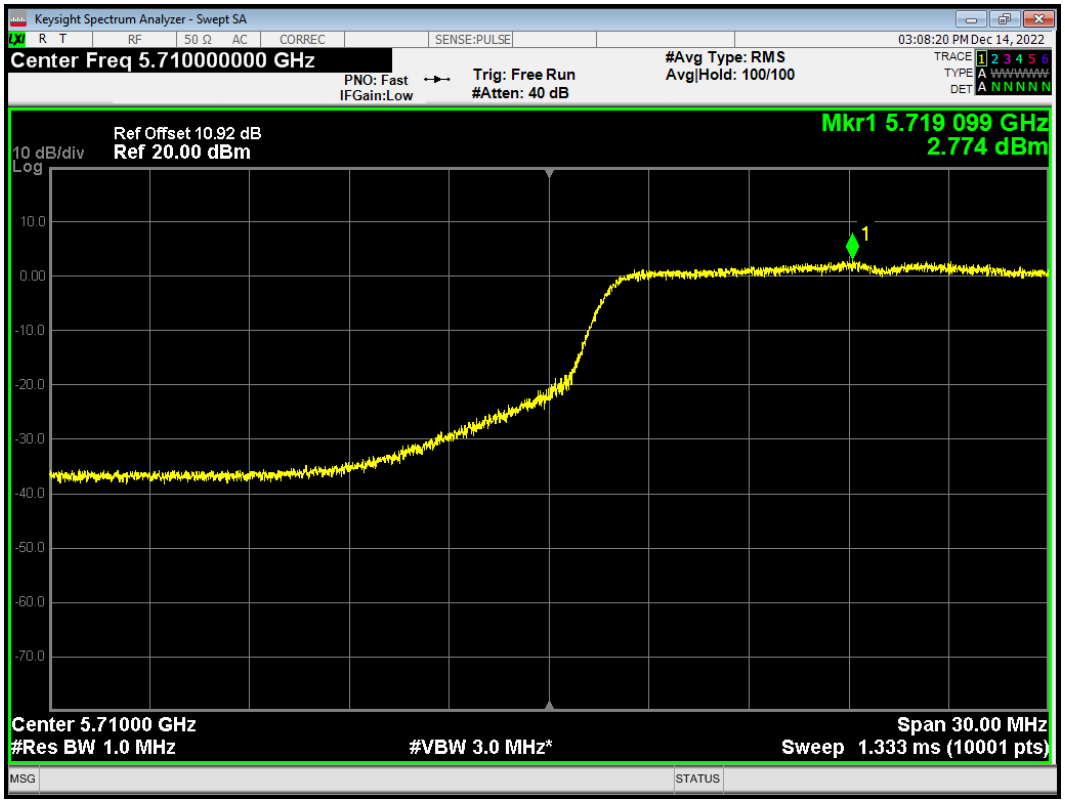
PSD 802.11a 5580MHz



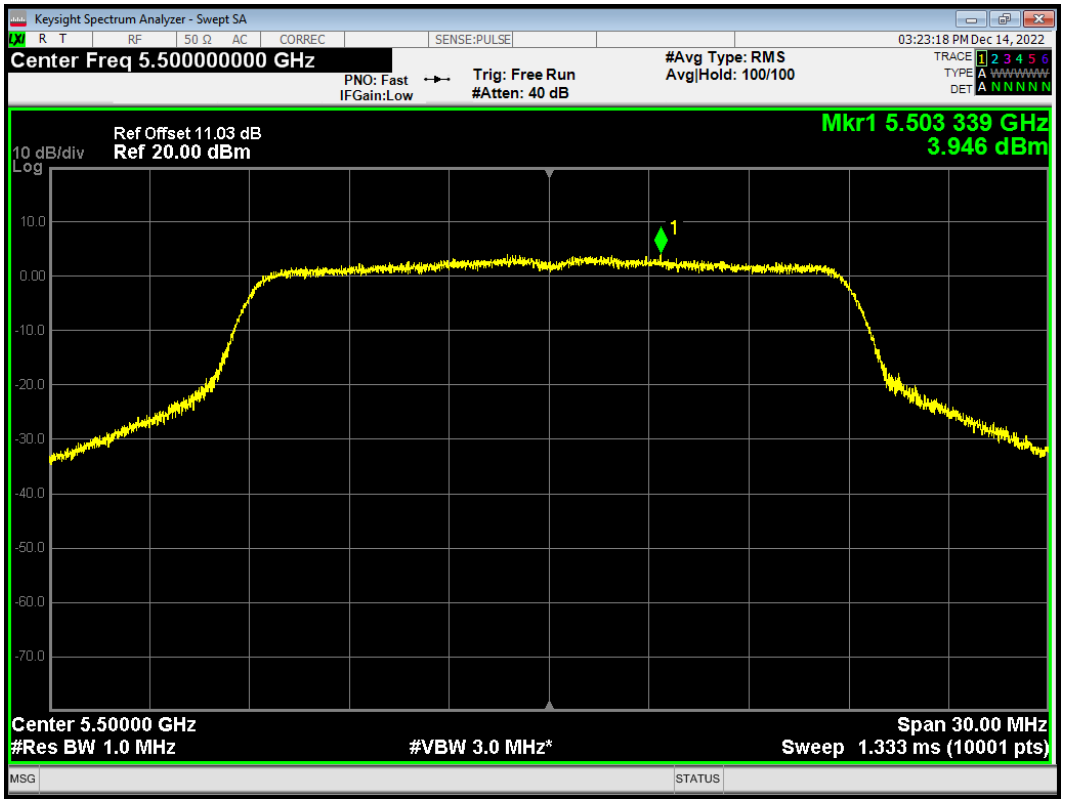
PSD 802.11a 5700MHz



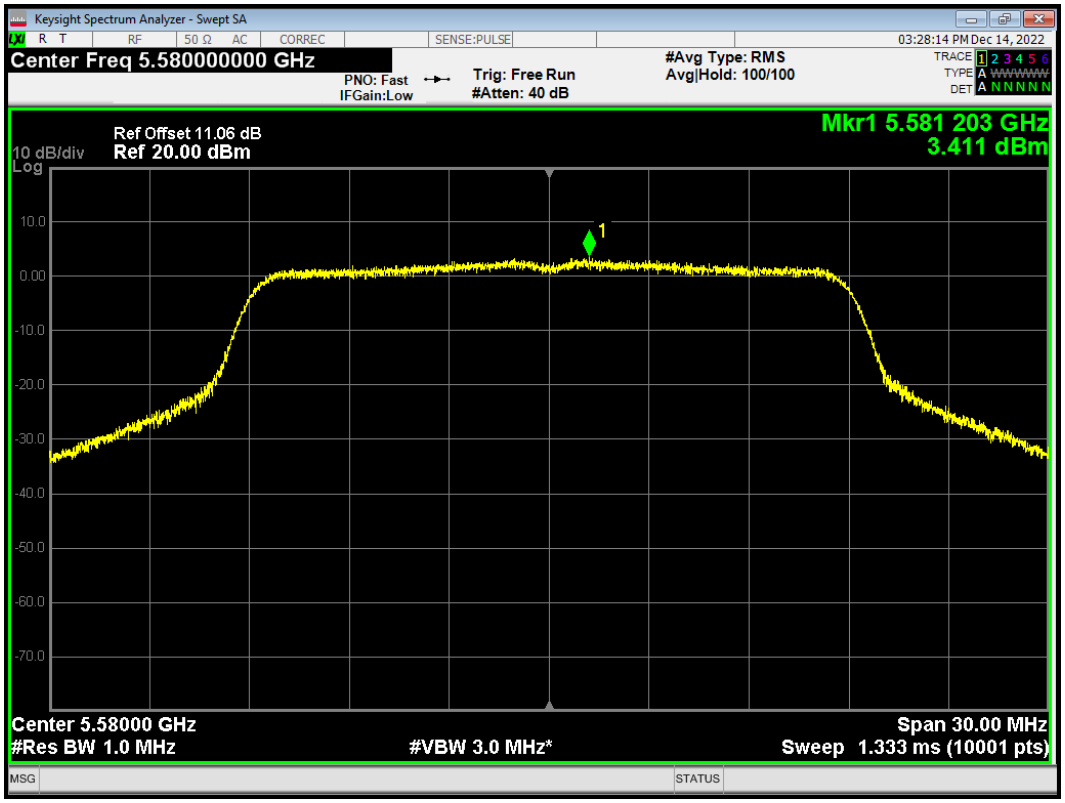
PSD 802.11a 5720MHz



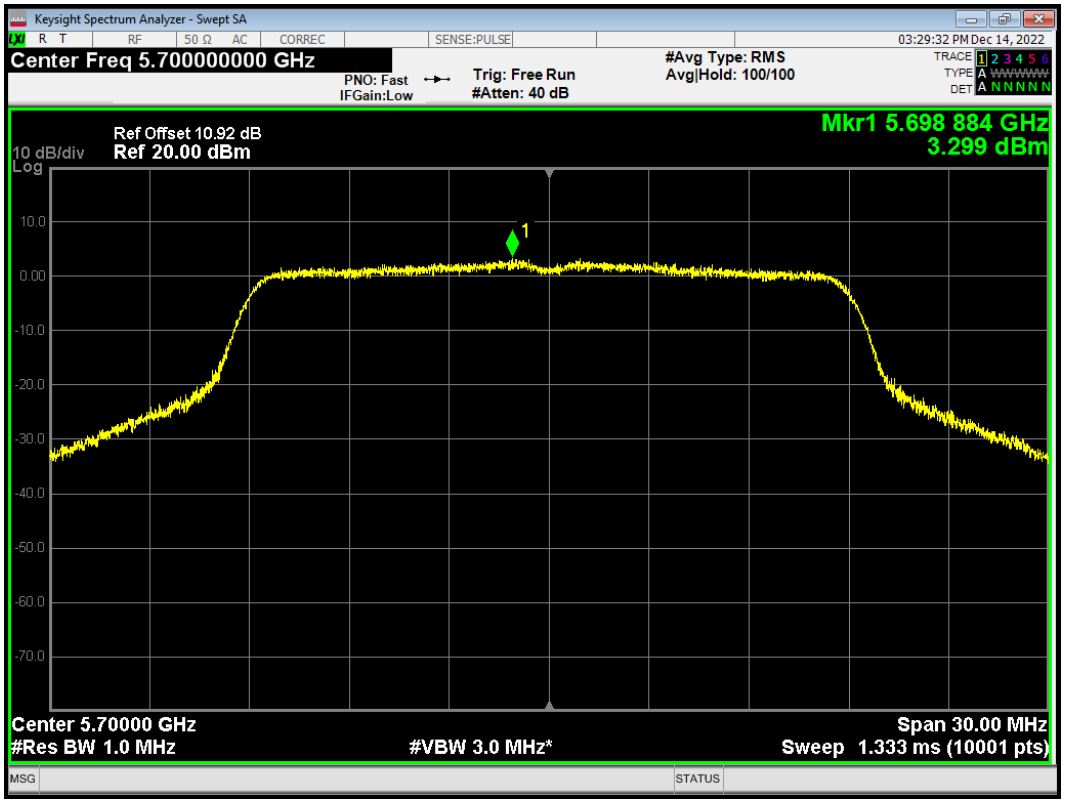
PSD 802.11ac(VHT20) 5500MHz



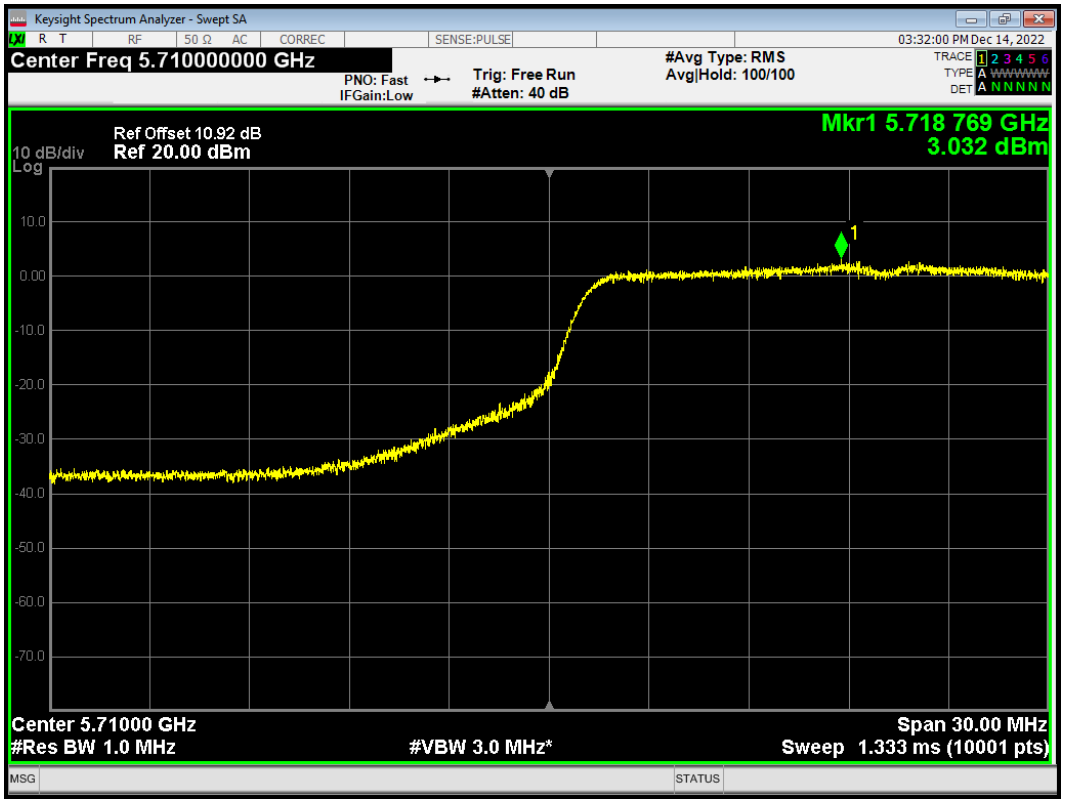
PSD 802.11ac(VHT20) 5580MHz



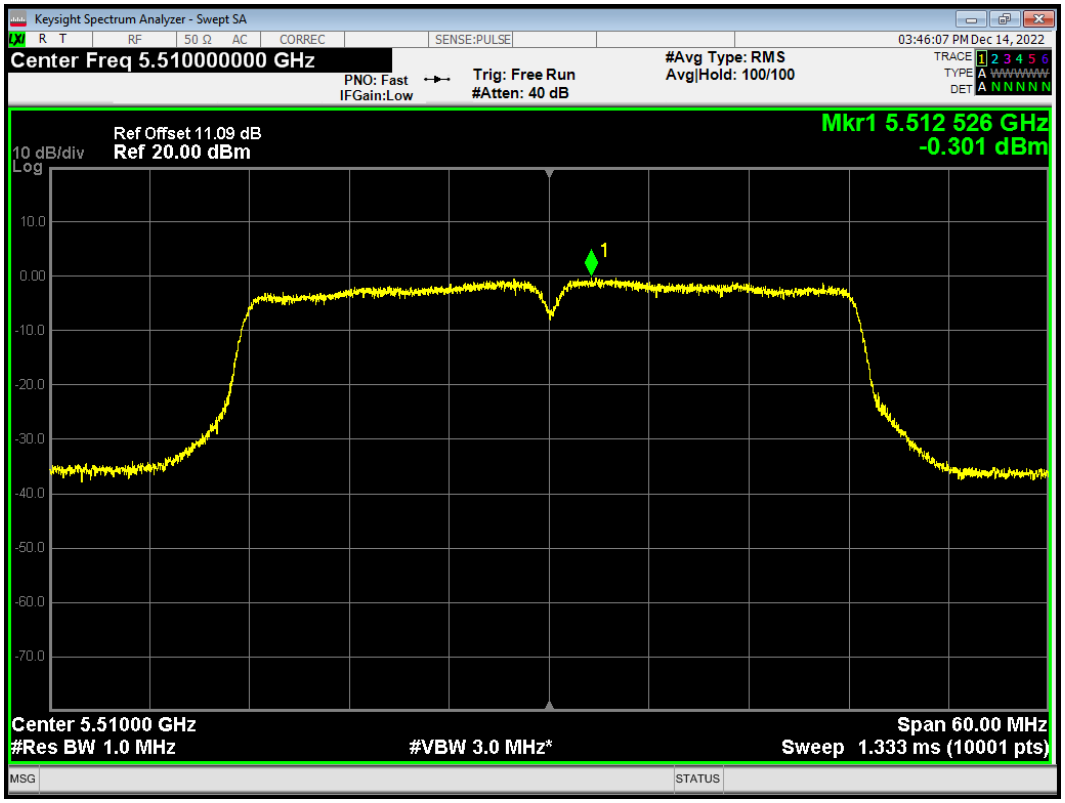
PSD 802.11ac(VHT20) 5700MHz



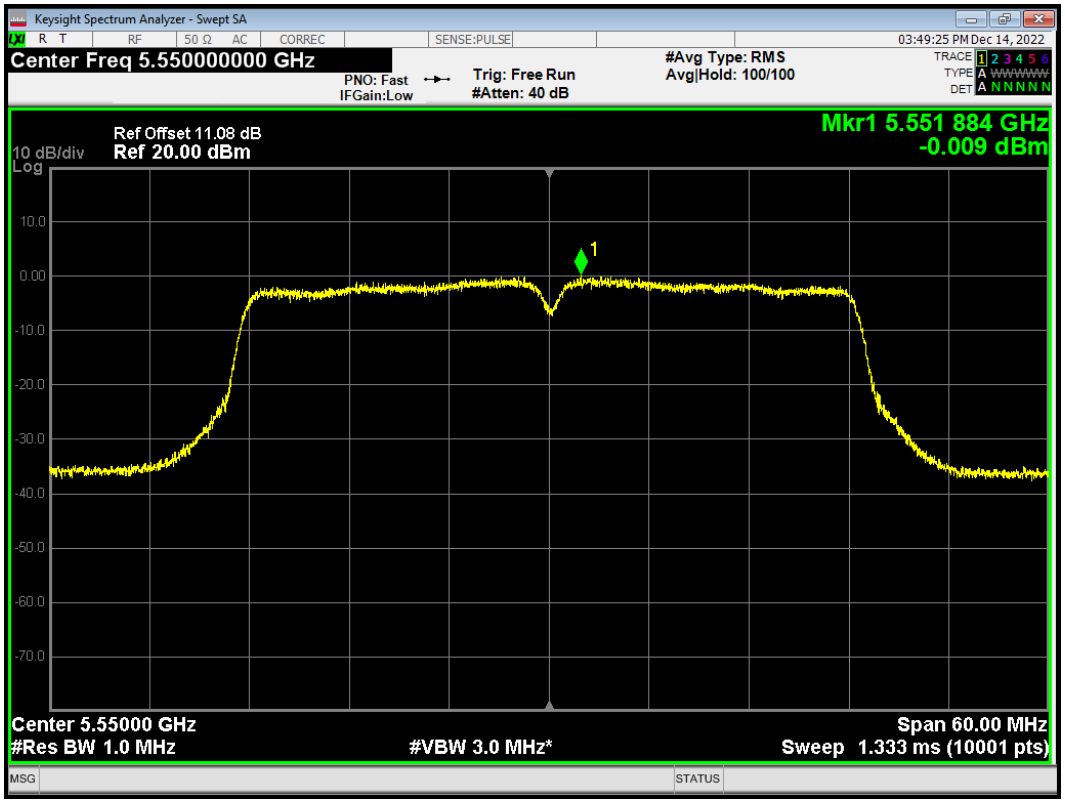
PSD 802.11ac(VHT20) 5720MHz



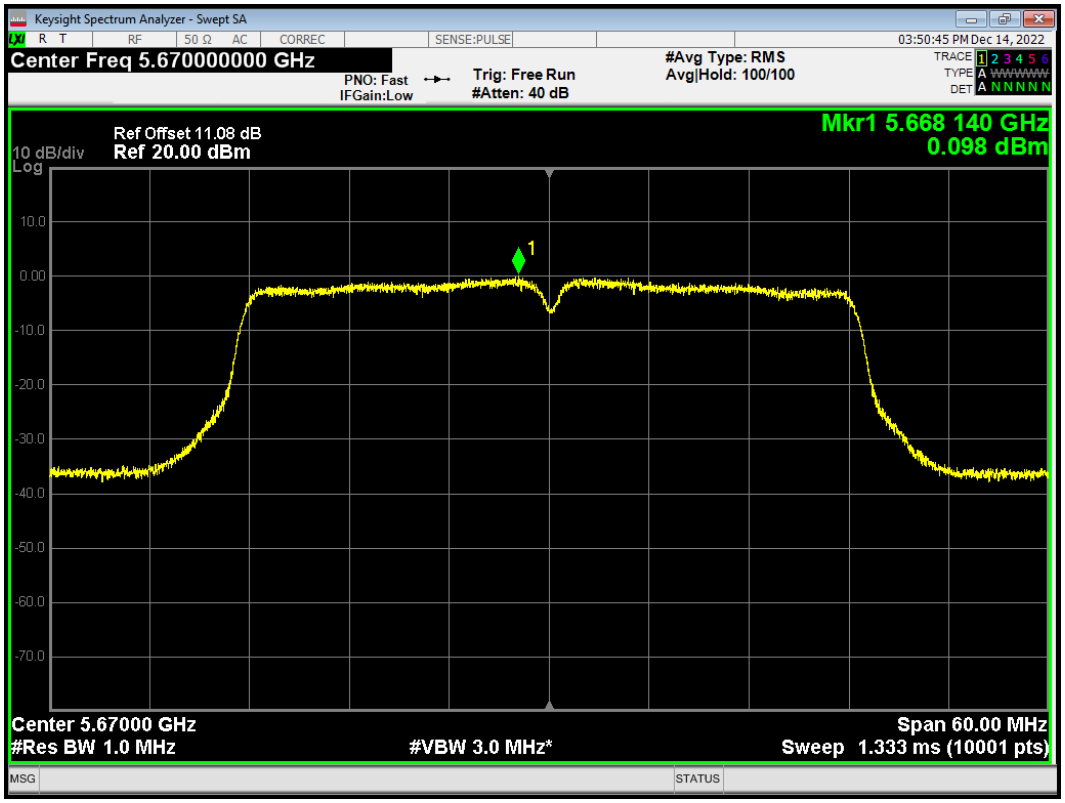
PSD 802.11ac(VHT40) 5510MHz



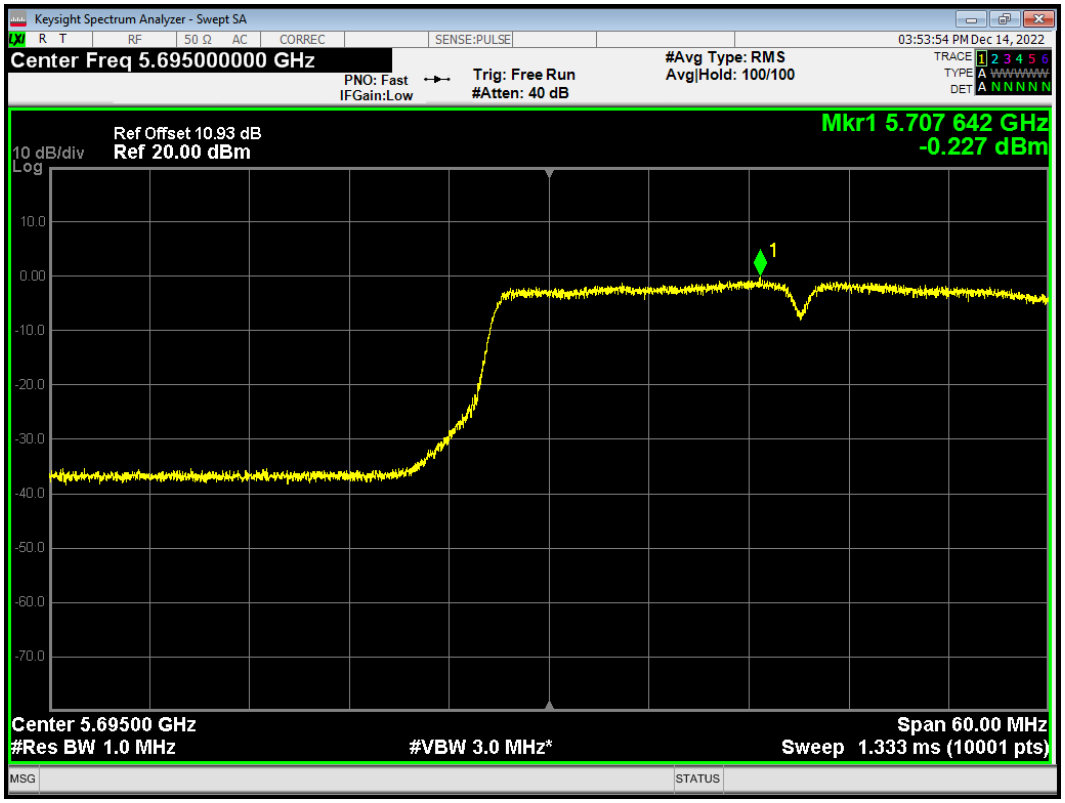
PSD 802.11ac(VHT40) 5550MHz



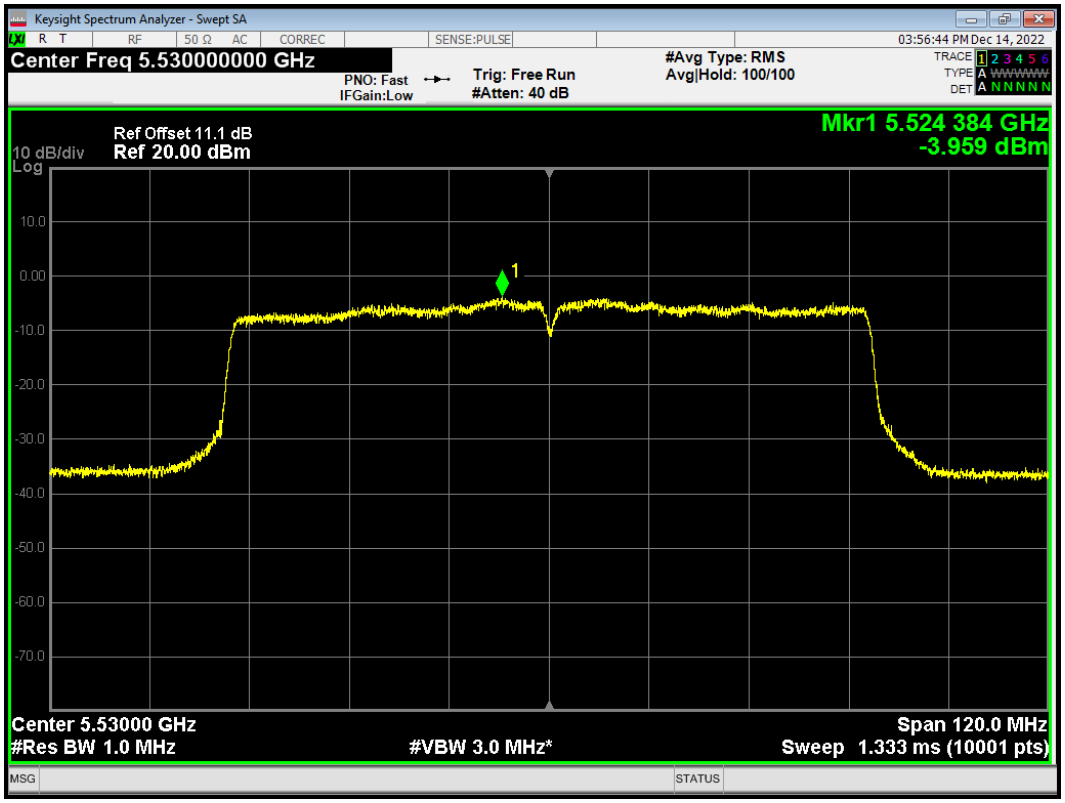
PSD 802.11ac(VHT40) 5670MHz



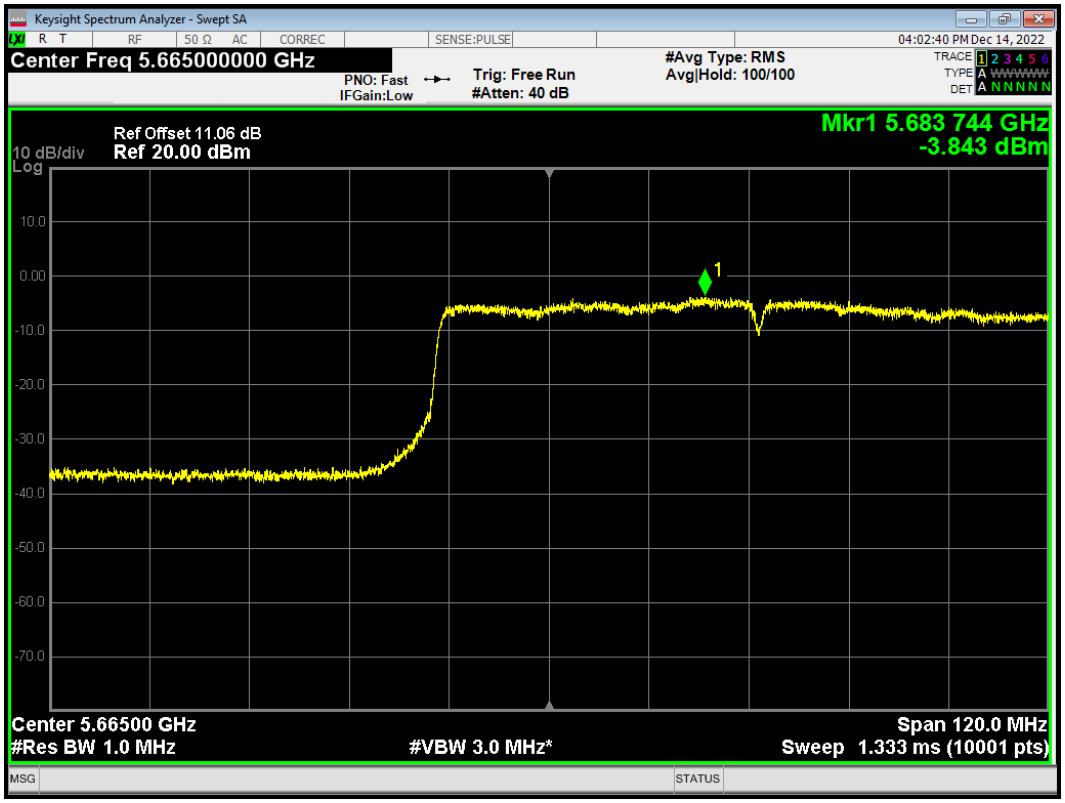
PSD 802.11ac(VHT40) 5710MHz



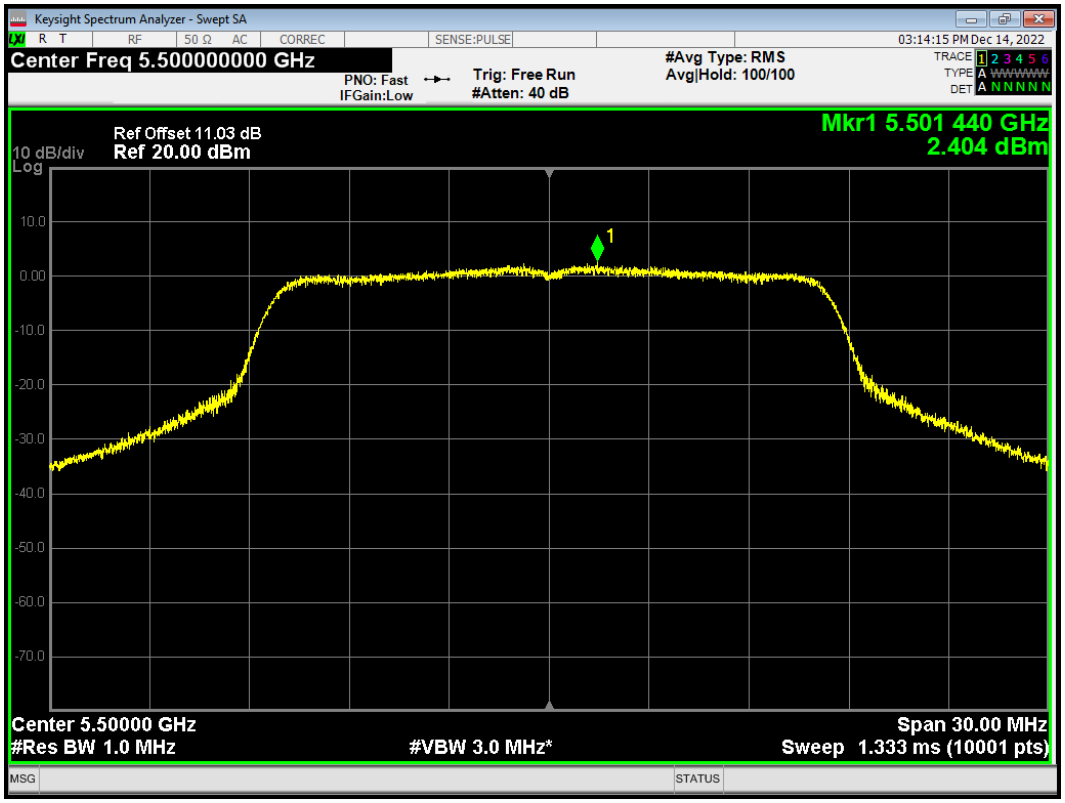
PSD 802.11ac(VHT80) 5530MHz



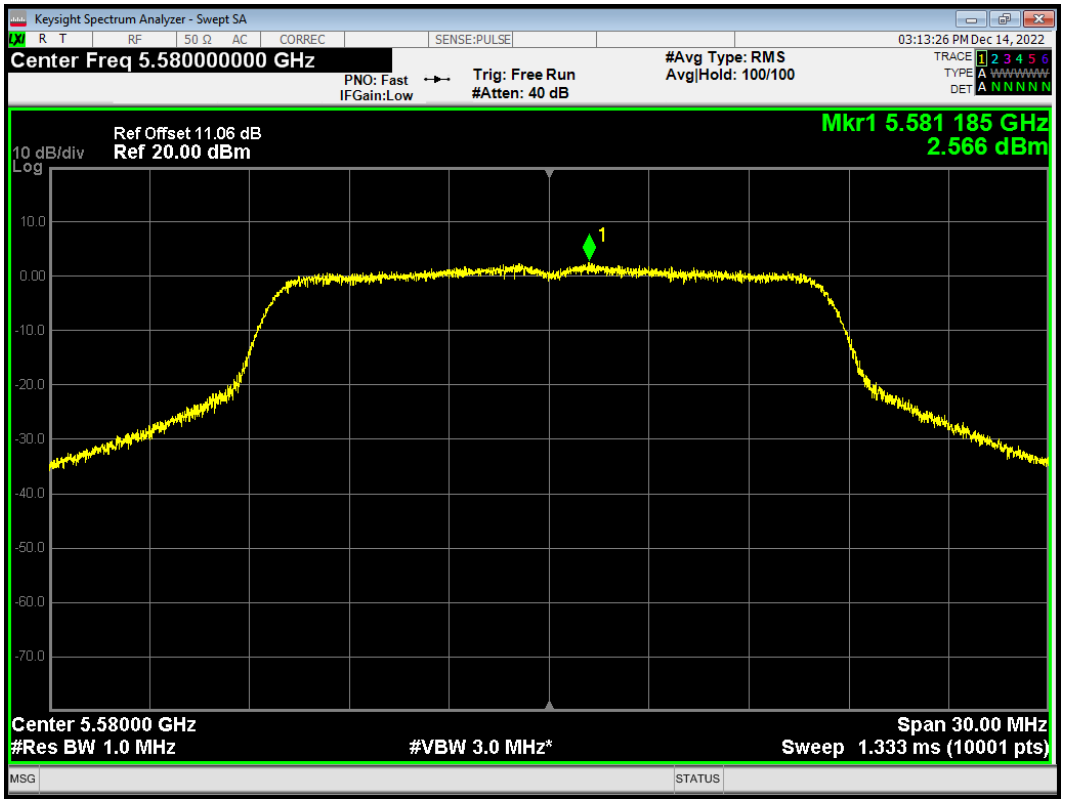
PSD 802.11ac(VHT80) 5690MHz



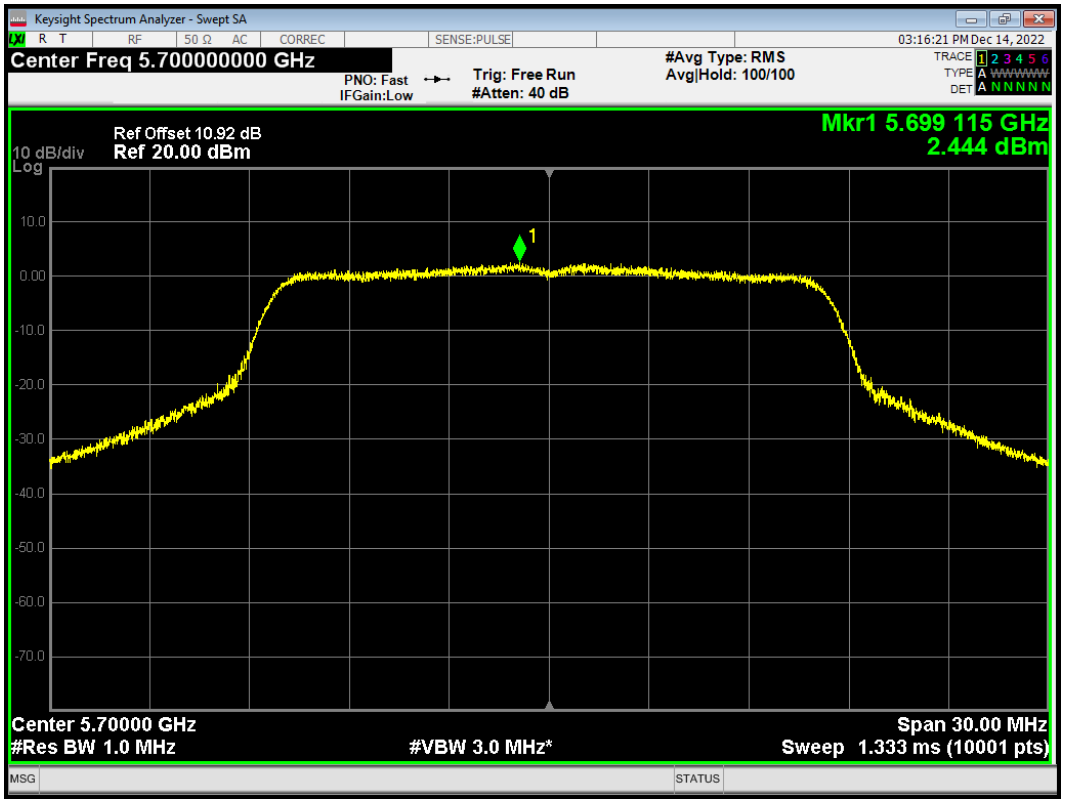
PSD 802.11n(HT20) 5500MHz



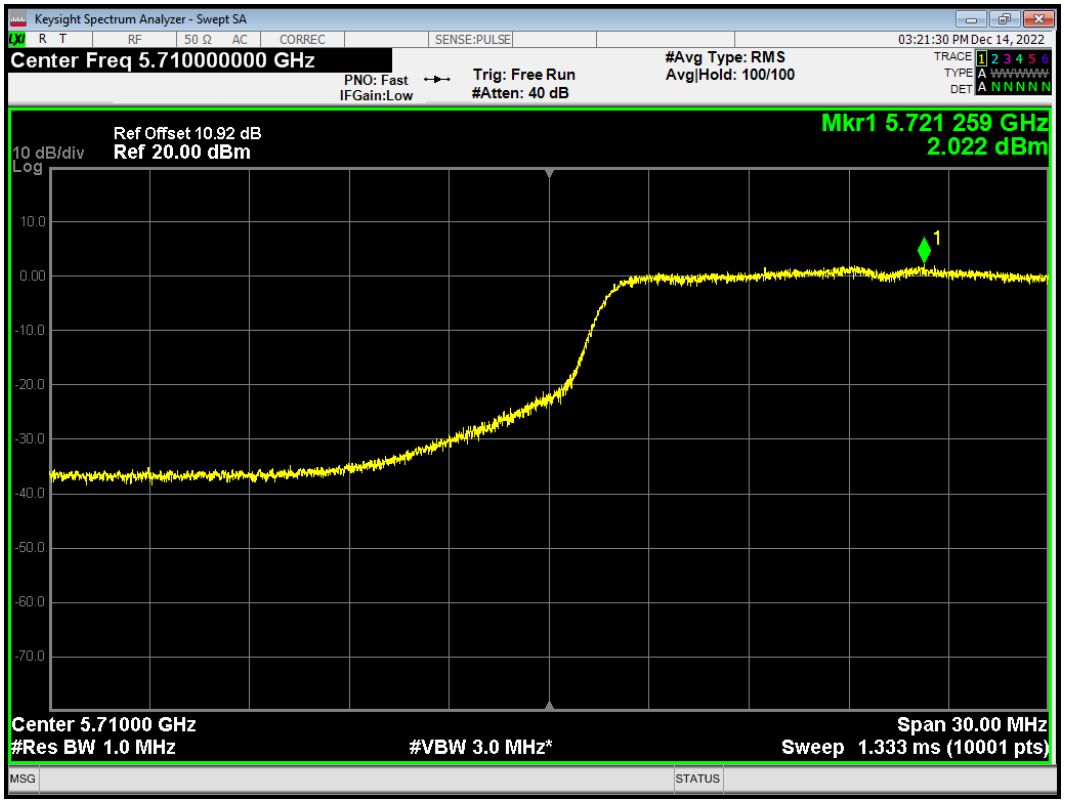
PSD 802.11n(HT20) 5580MHz



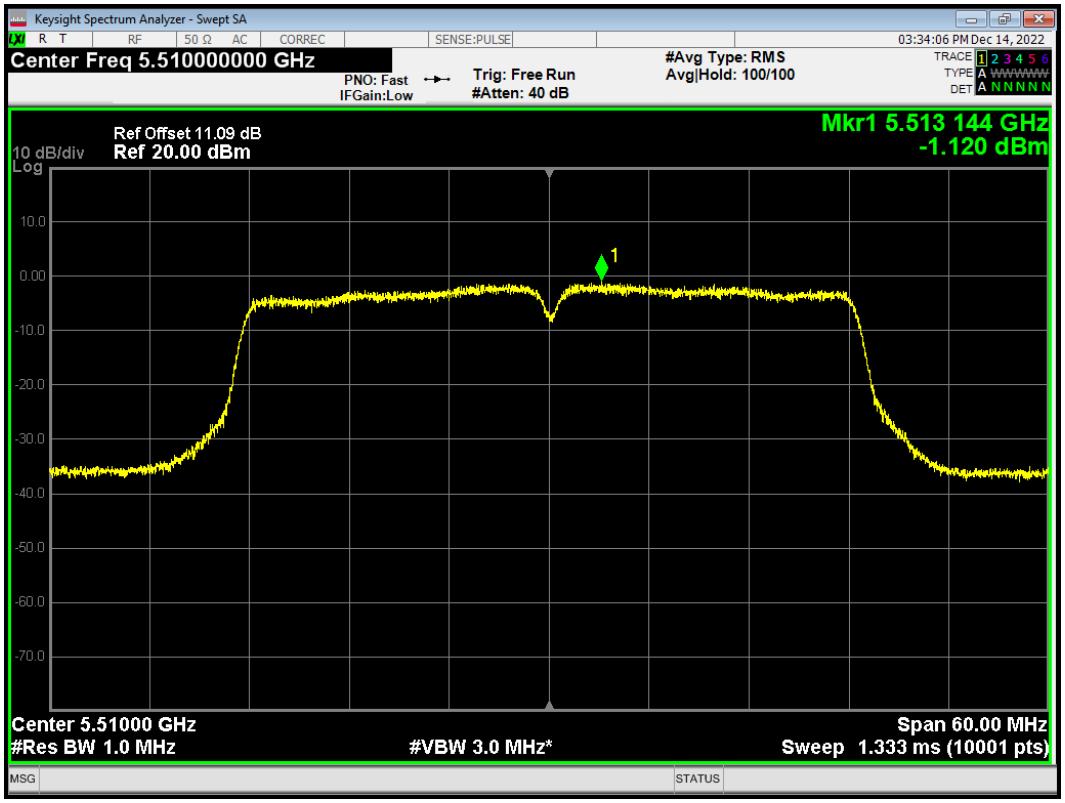
PSD 802.11n(HT20) 5700MHz



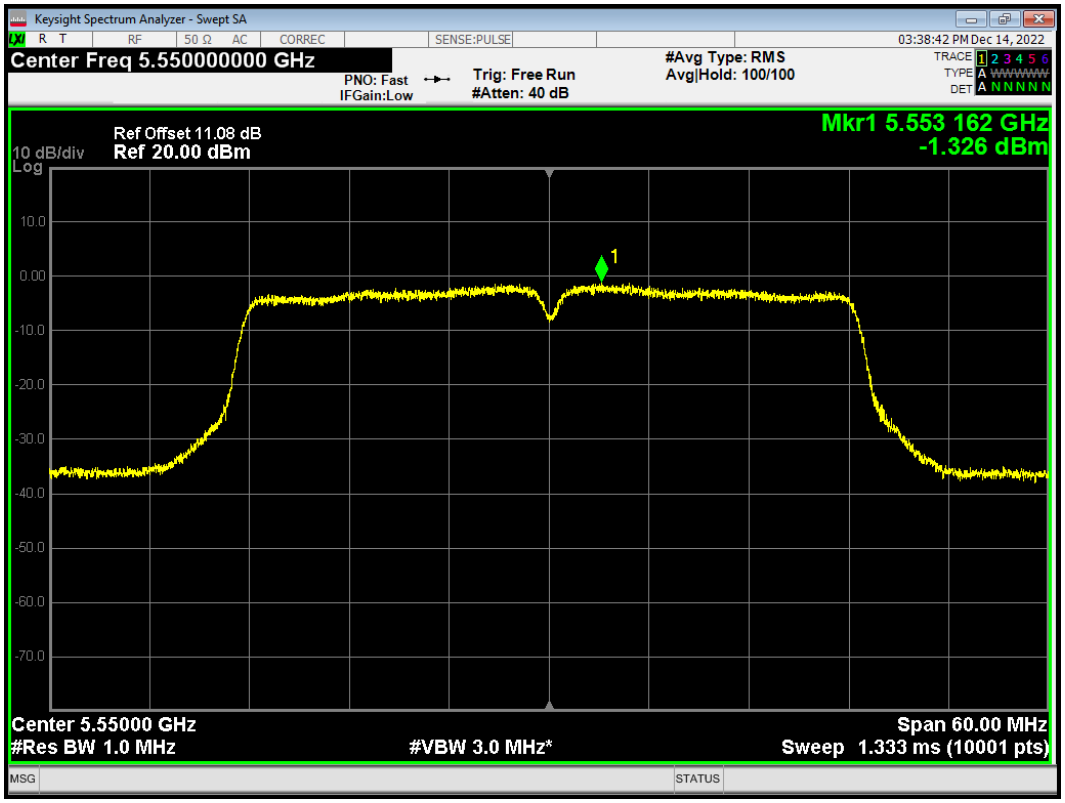
PSD 802.11n(HT20) 5720MHz



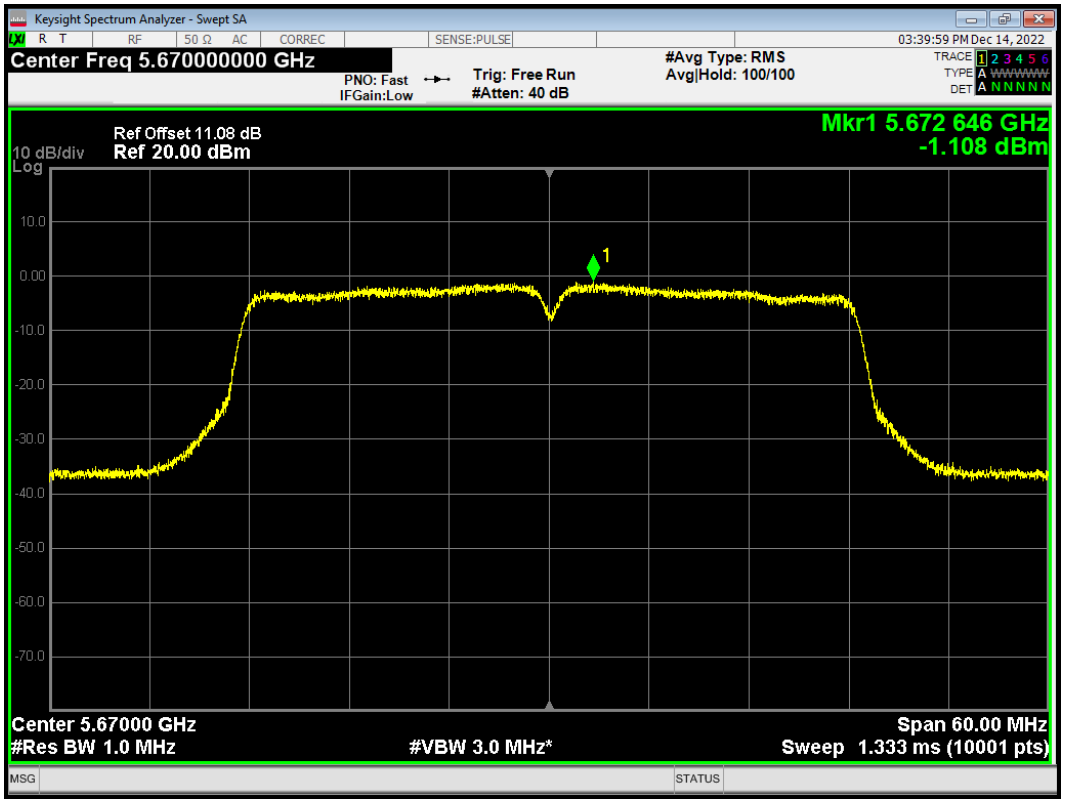
PSD 802.11n(HT40) 5510MHz



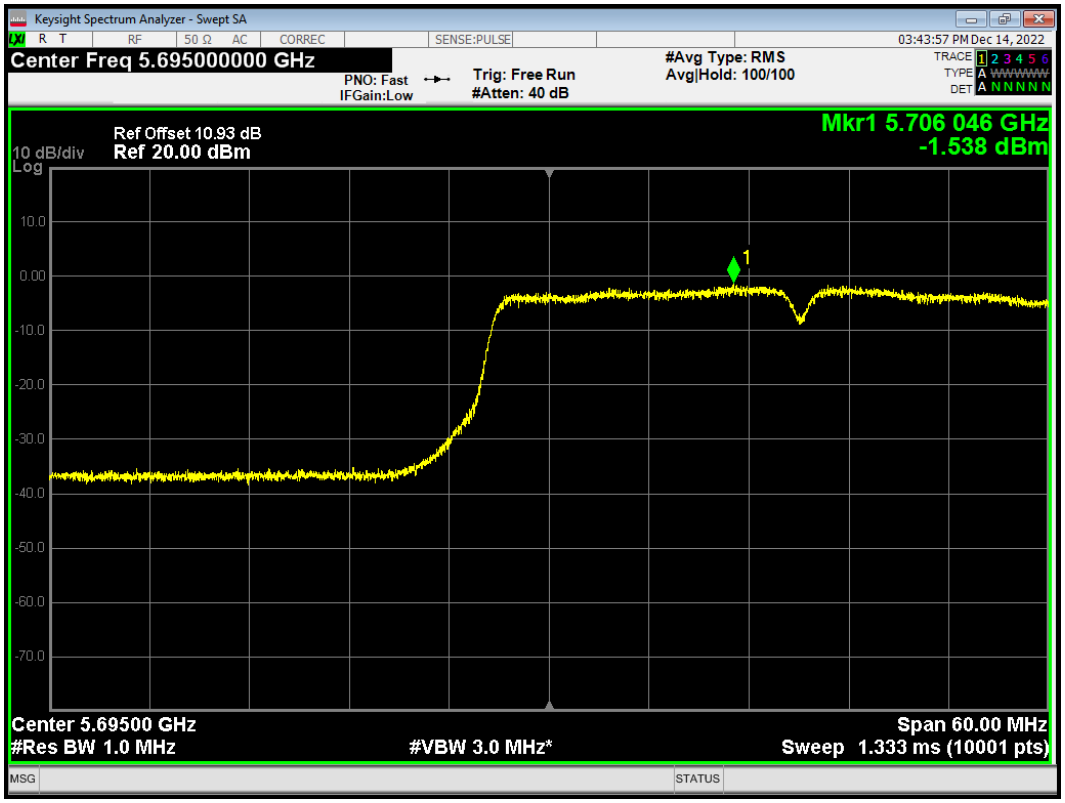
PSD 802.11n(HT40) 5550MHz



PSD 802.11n(HT40) 5670MHz

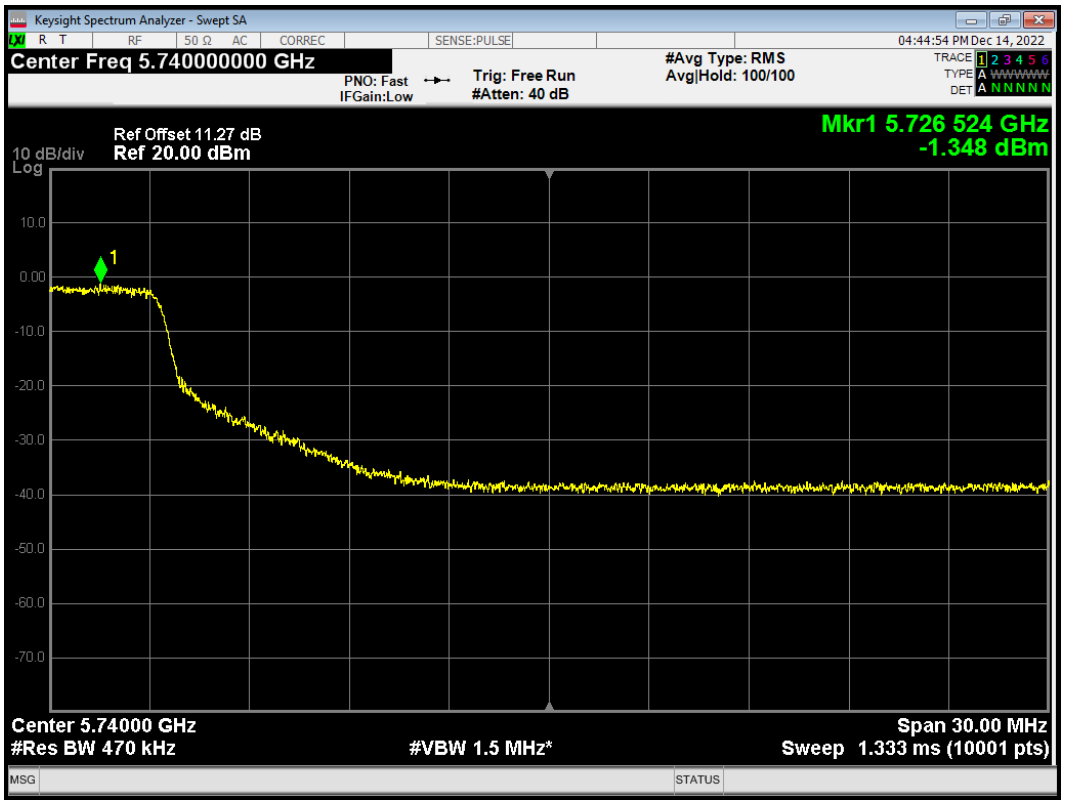


PSD 802.11n(HT40) 5710MHz

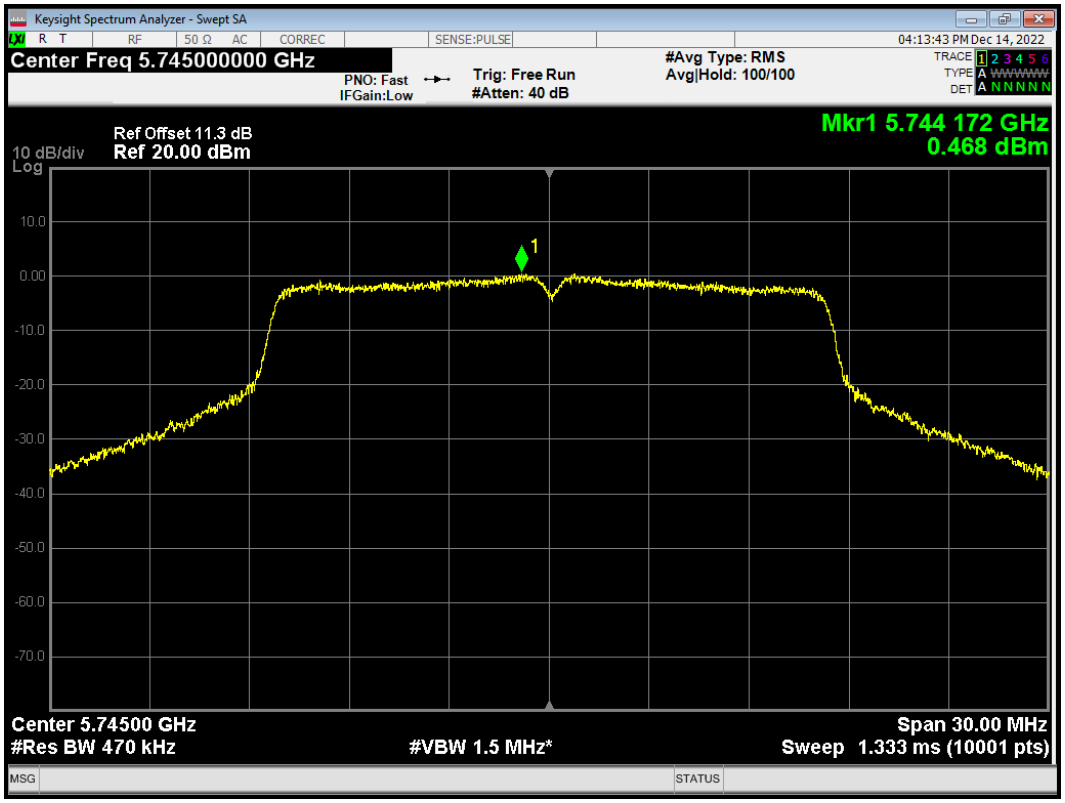


U-NII-3

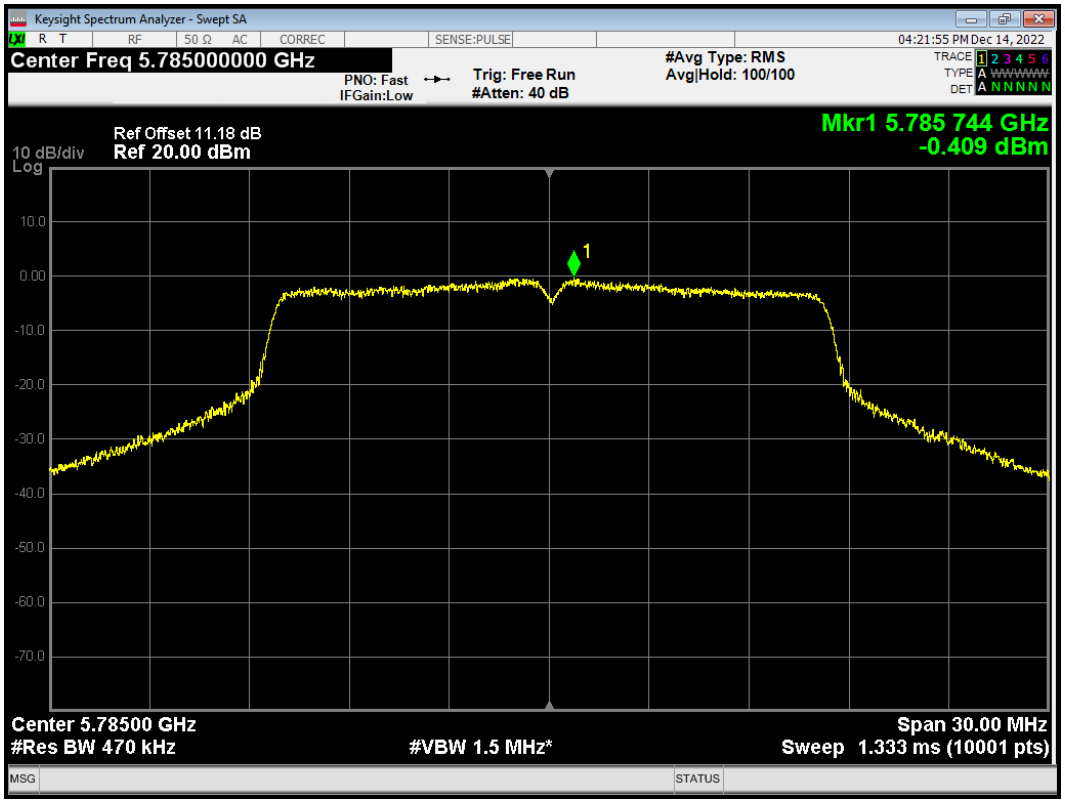
PSD 802.11a 5720MHz



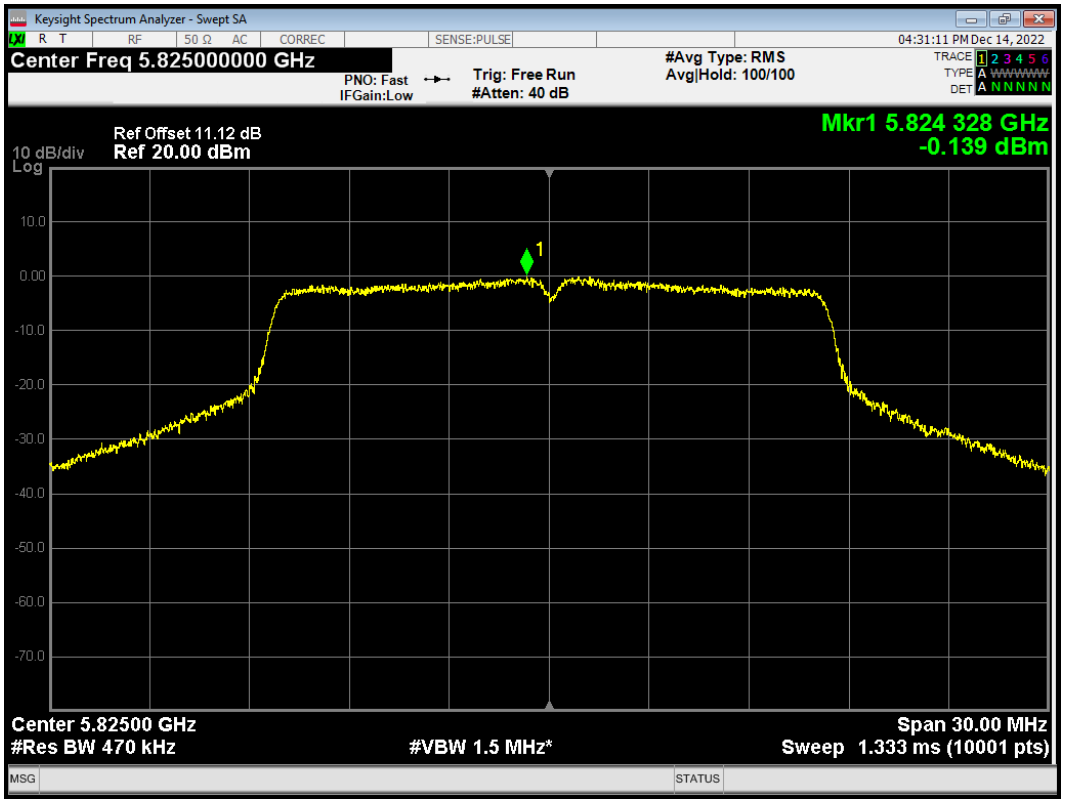
PSD 802.11a 5745MHz



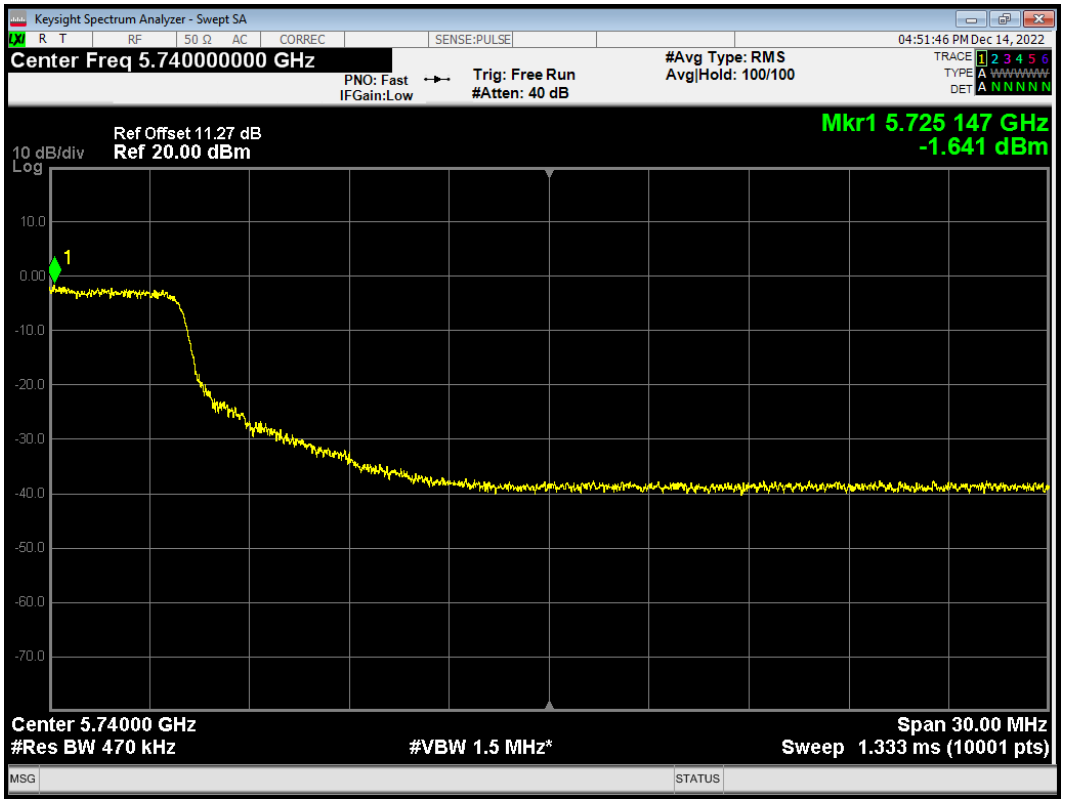
PSD 802.11a 5785MHz



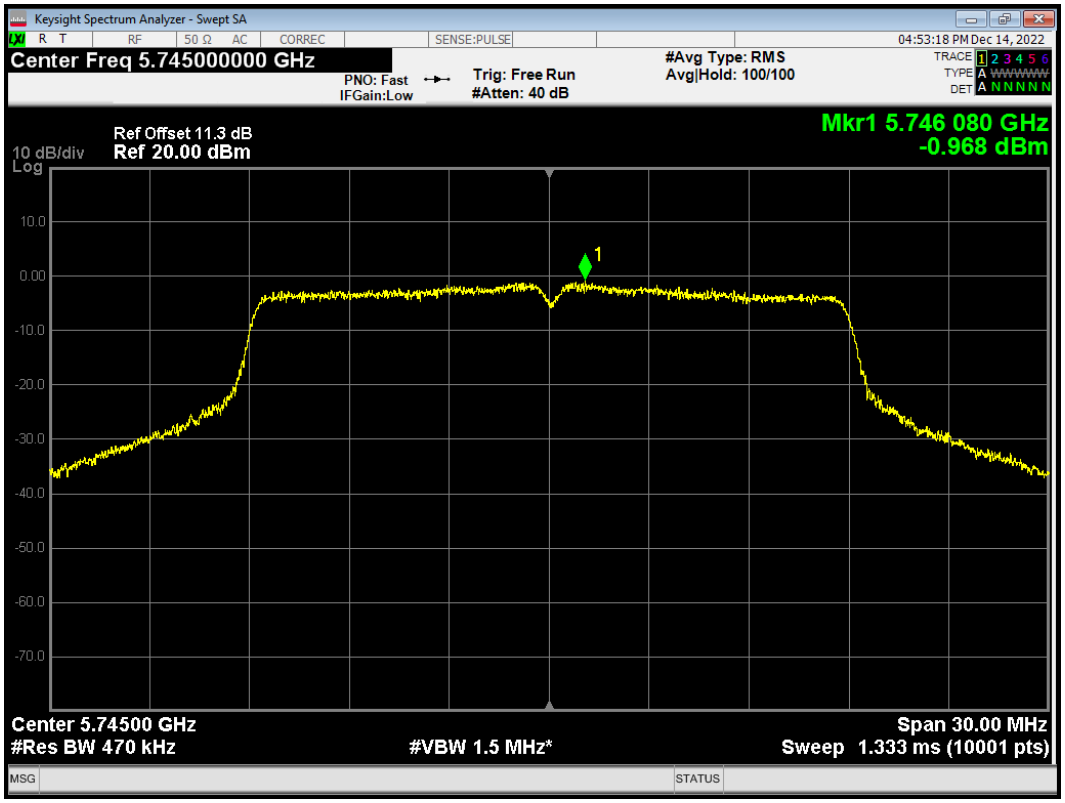
PSD 802.11a 5825MHz



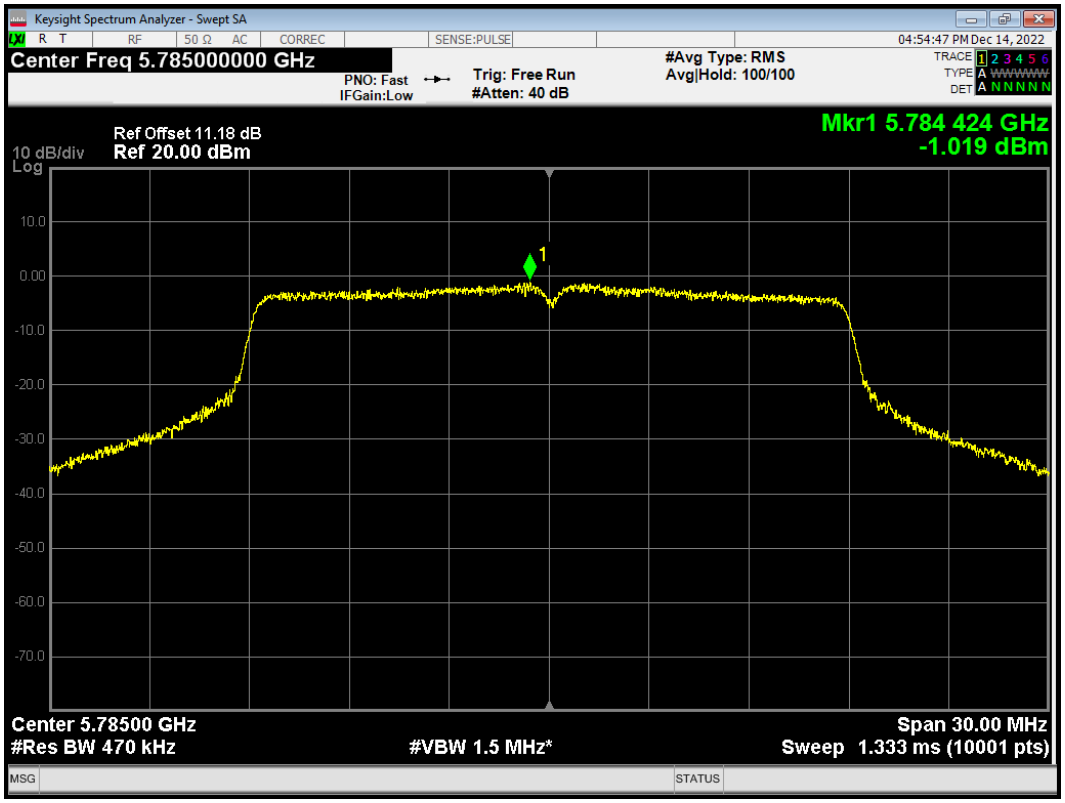
PSD 802.11ac(VHT20) 5720MHz



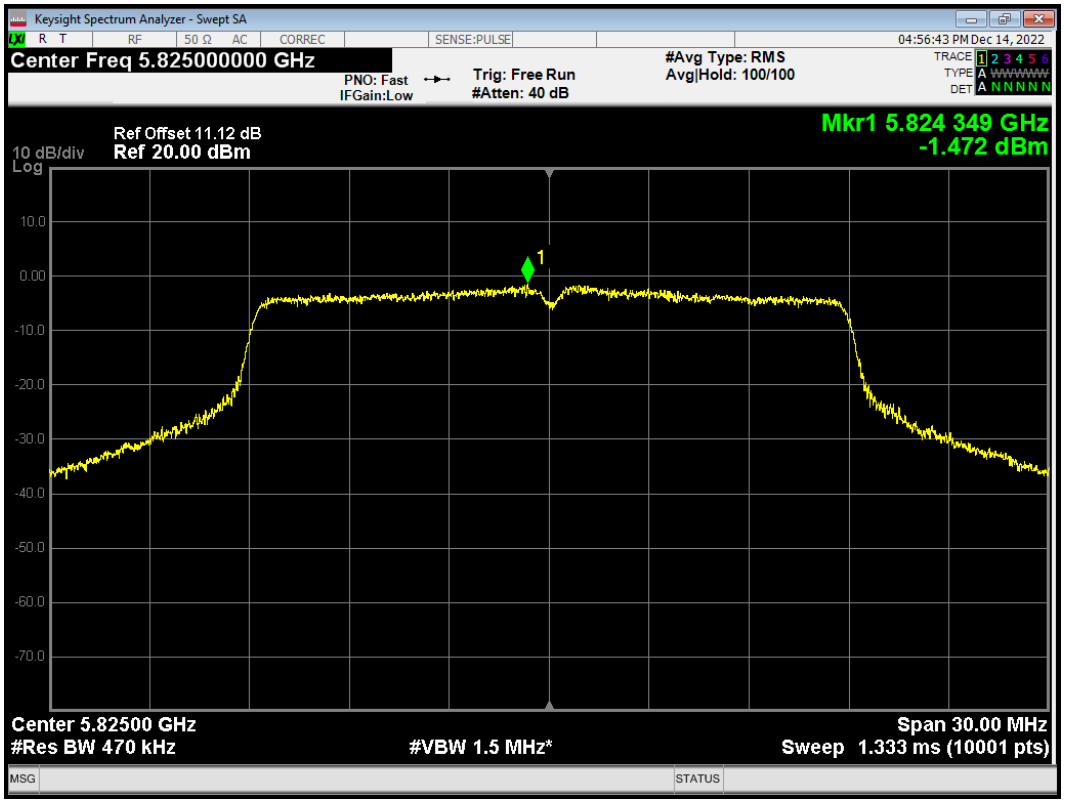
PSD 802.11ac(VHT20) 5745MHz



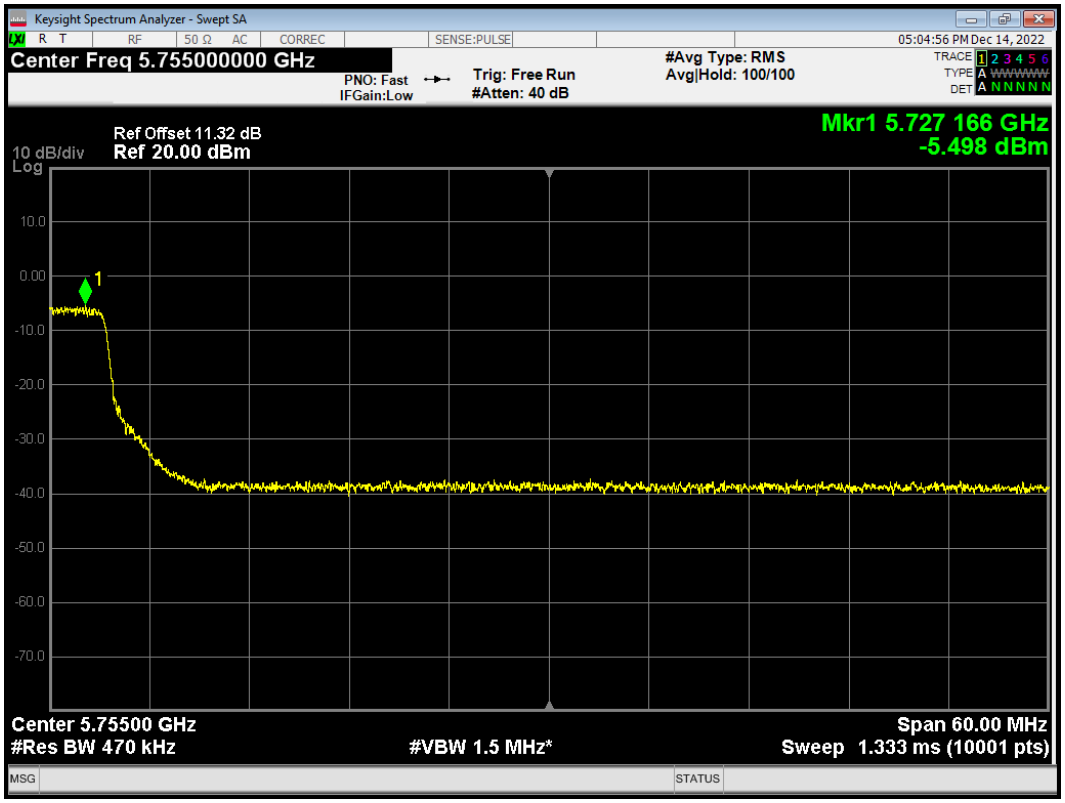
PSD 802.11ac(VHT20) 5785MHz



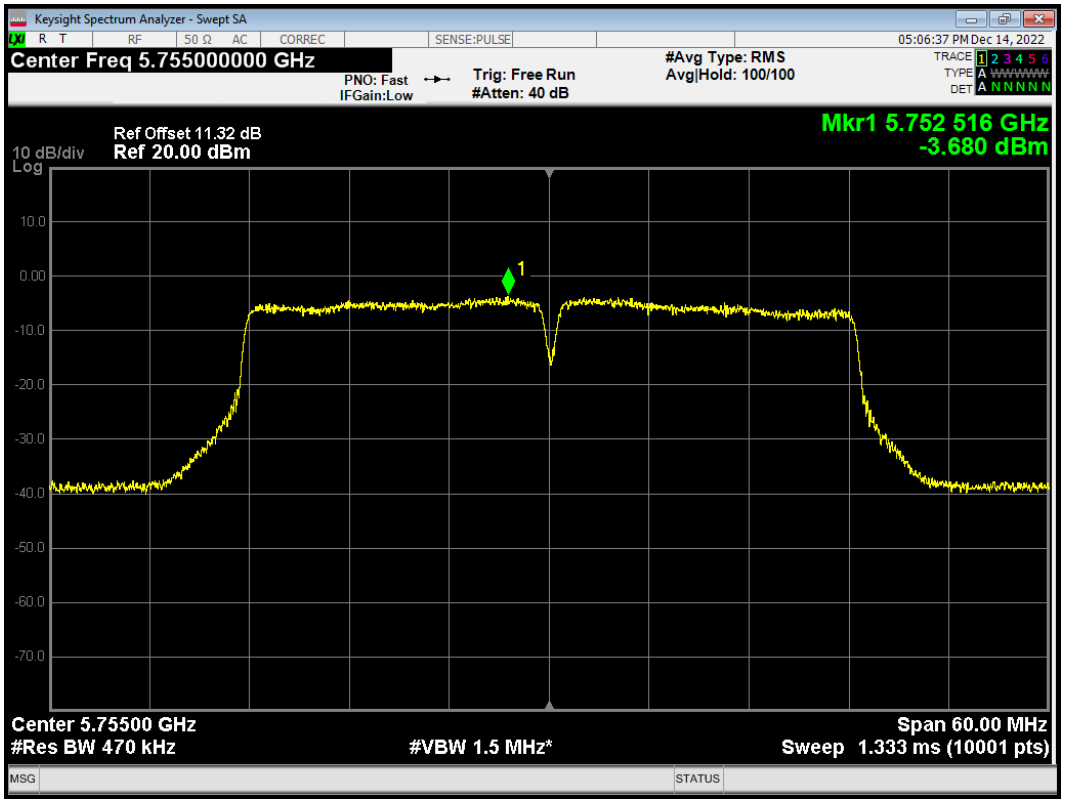
PSD 802.11ac(VHT20) 5825MHz



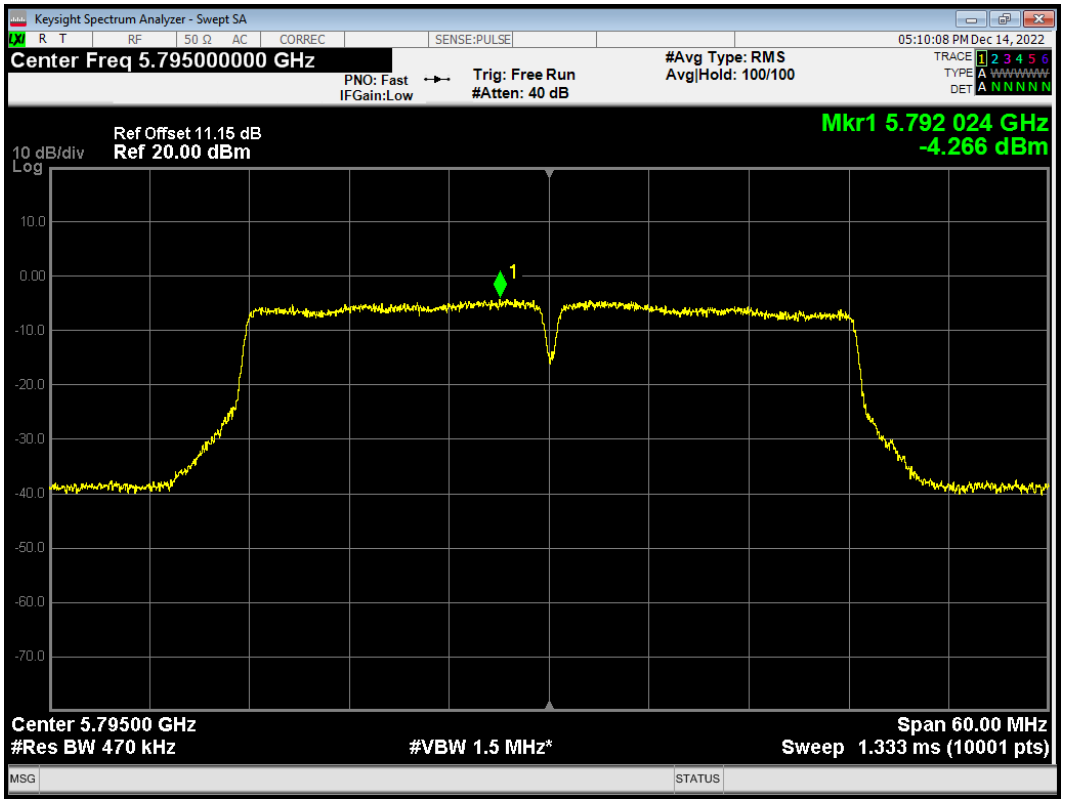
PSD 802.11ac(VHT40) 5710MHz



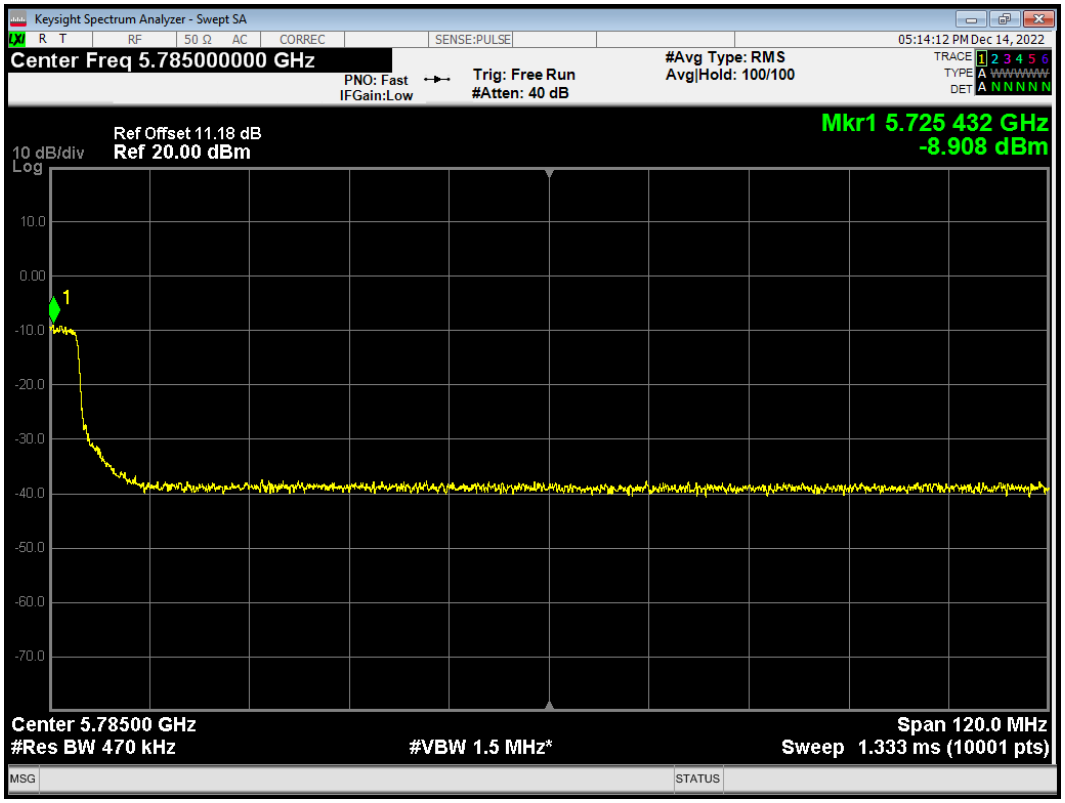
PSD 802.11ac(VHT40) 5755MHz



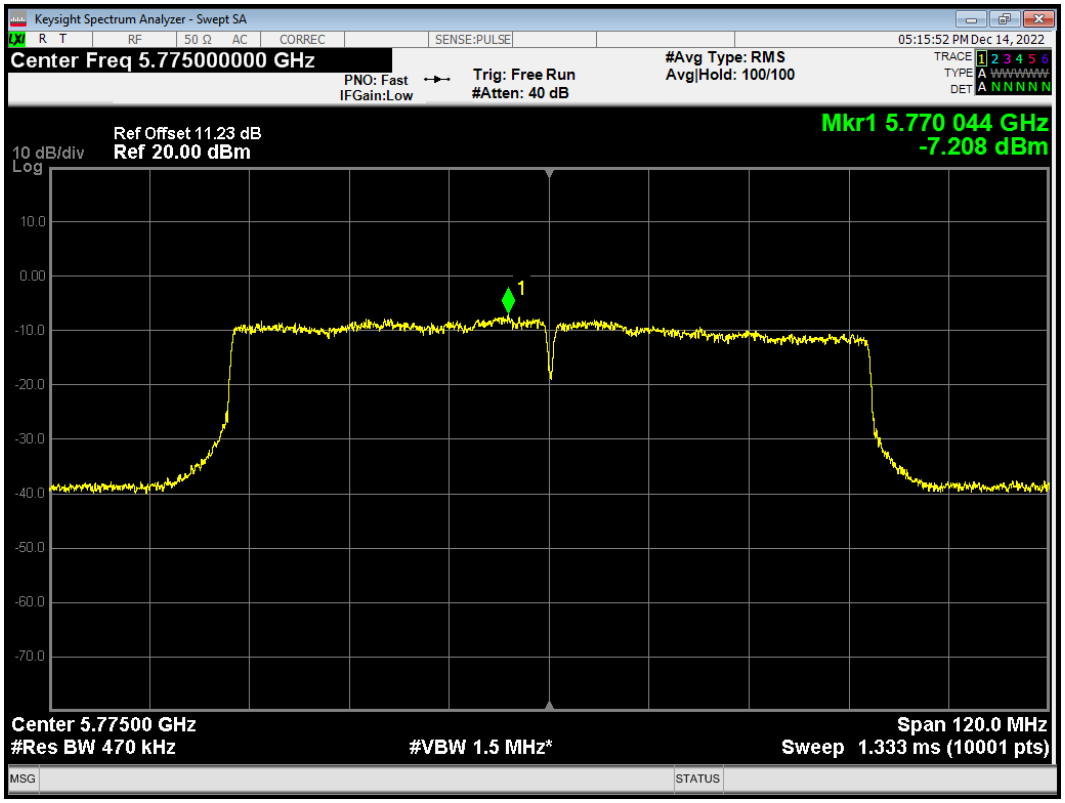
PSD 802.11ac(VHT40) 5795MHz



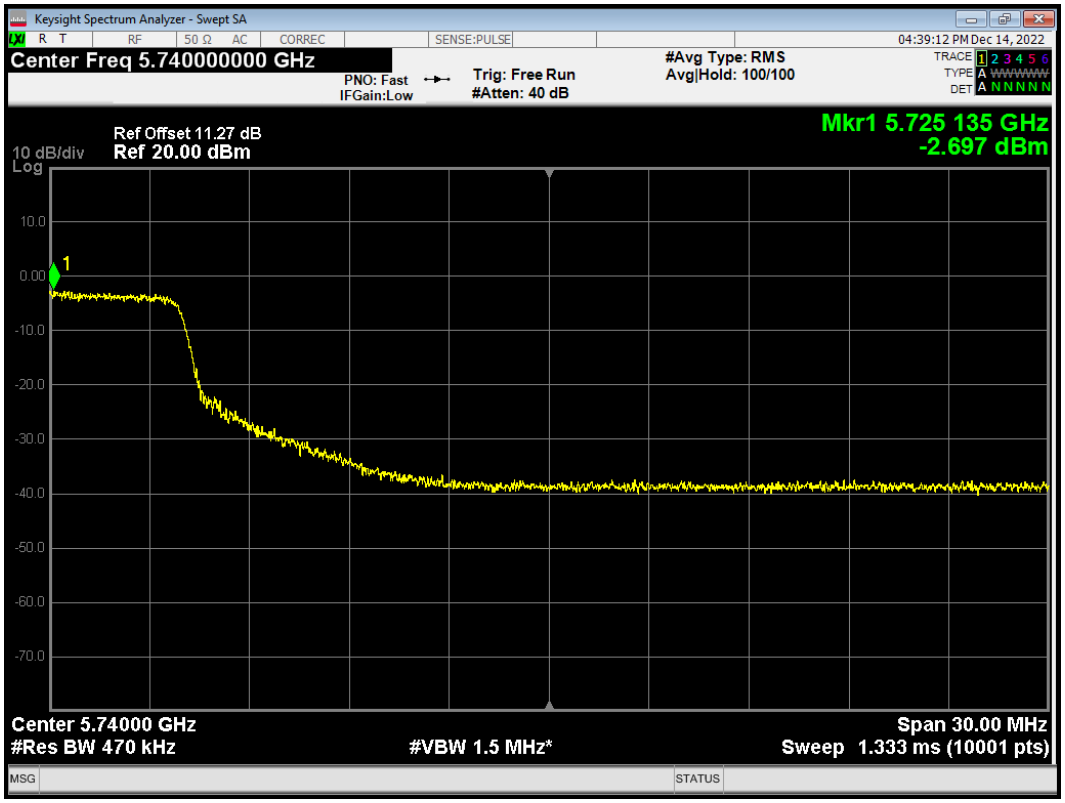
PSD 802.11ac(VHT80) 5690MHz



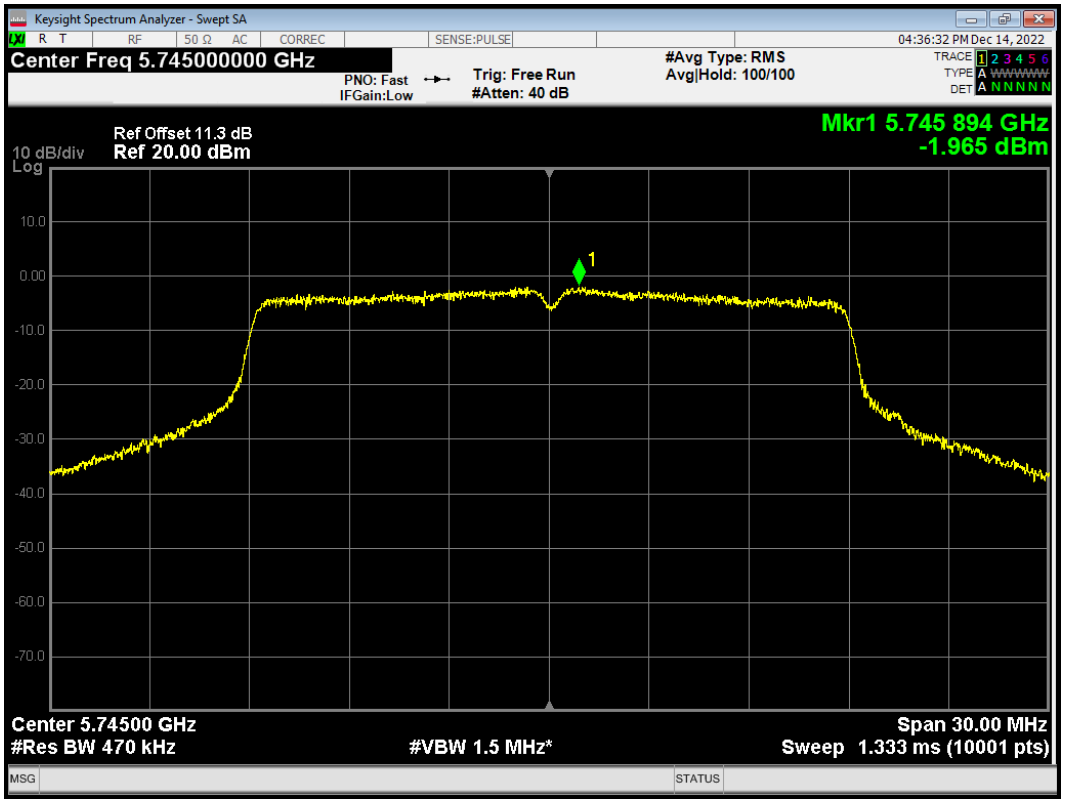
PSD 802.11ac(VHT80) 5775MHz



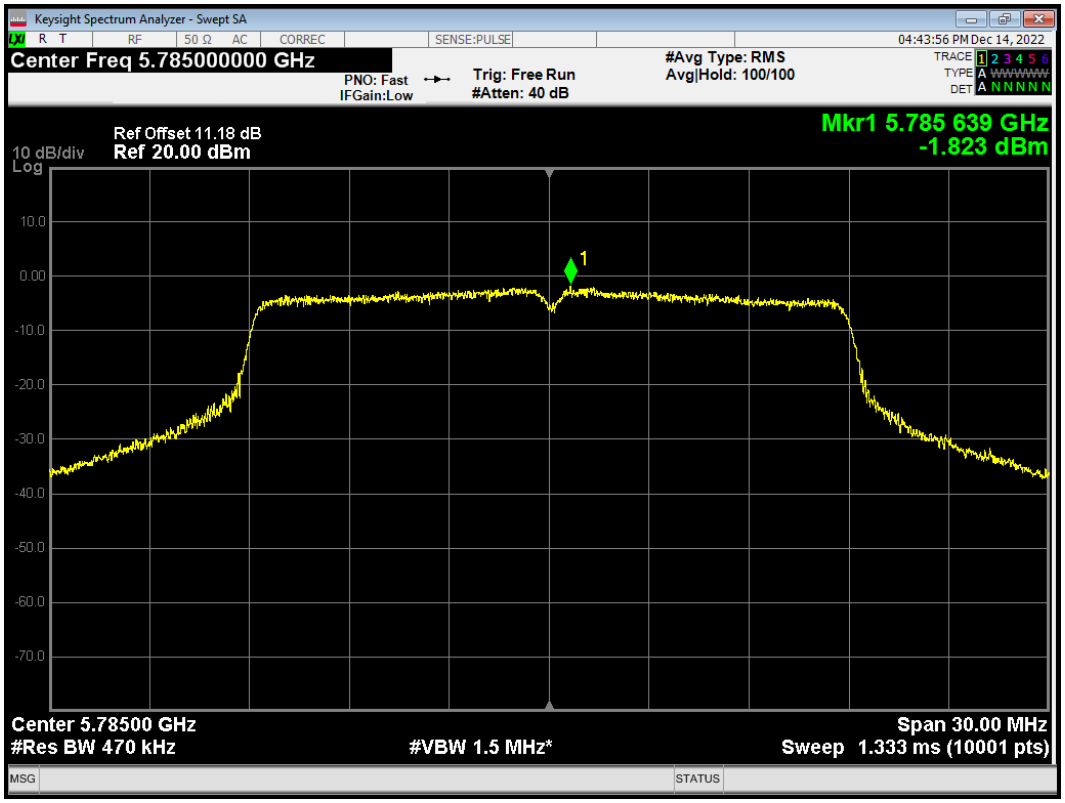
PSD 802.11n(HT20) 5720MHz



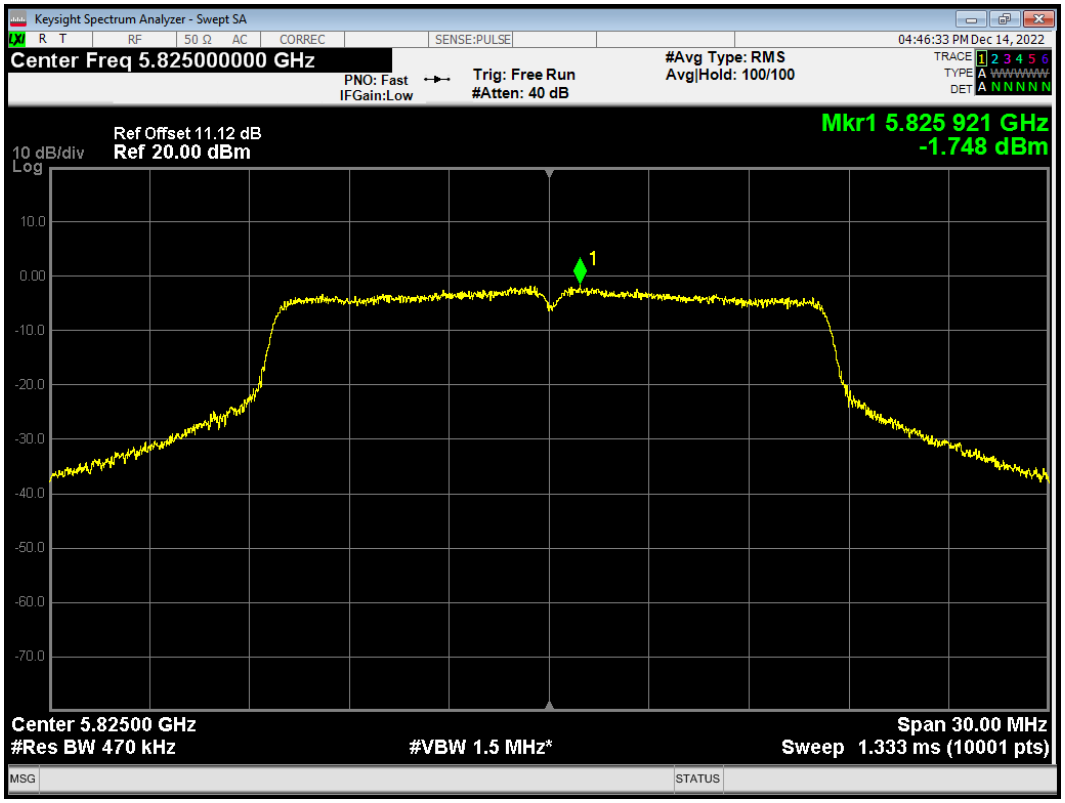
PSD 802.11n(HT20) 5745MHz



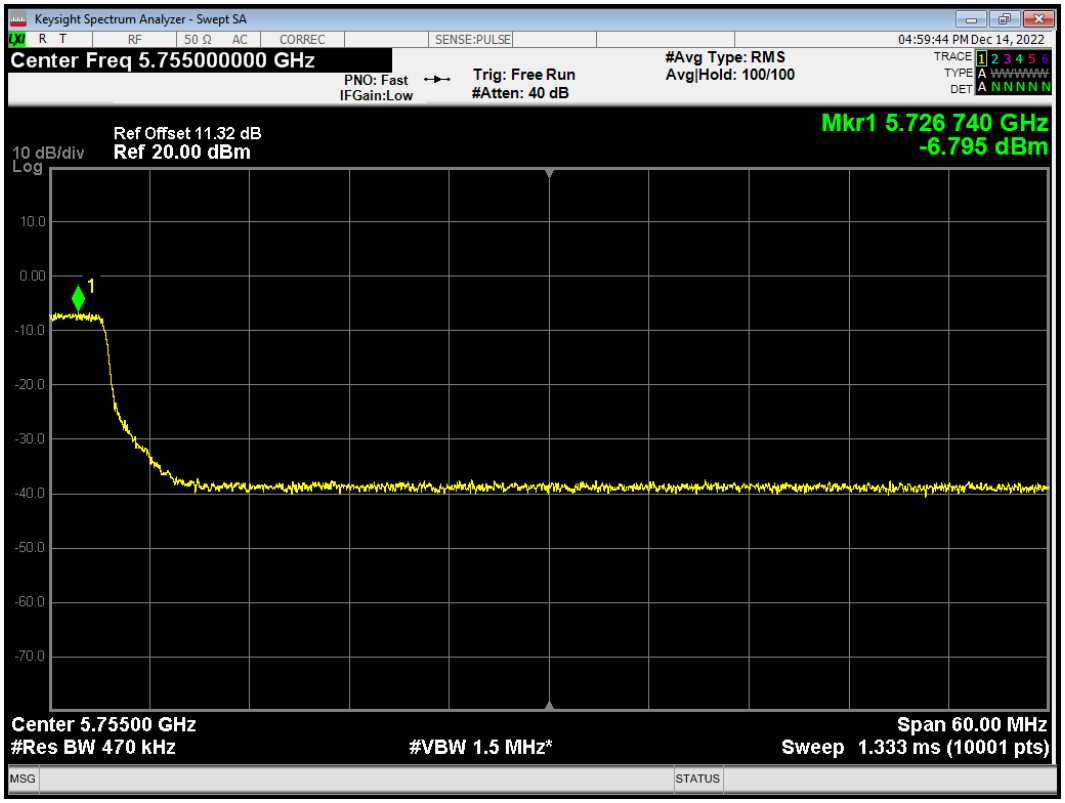
PSD 802.11n(HT20) 5785MHz



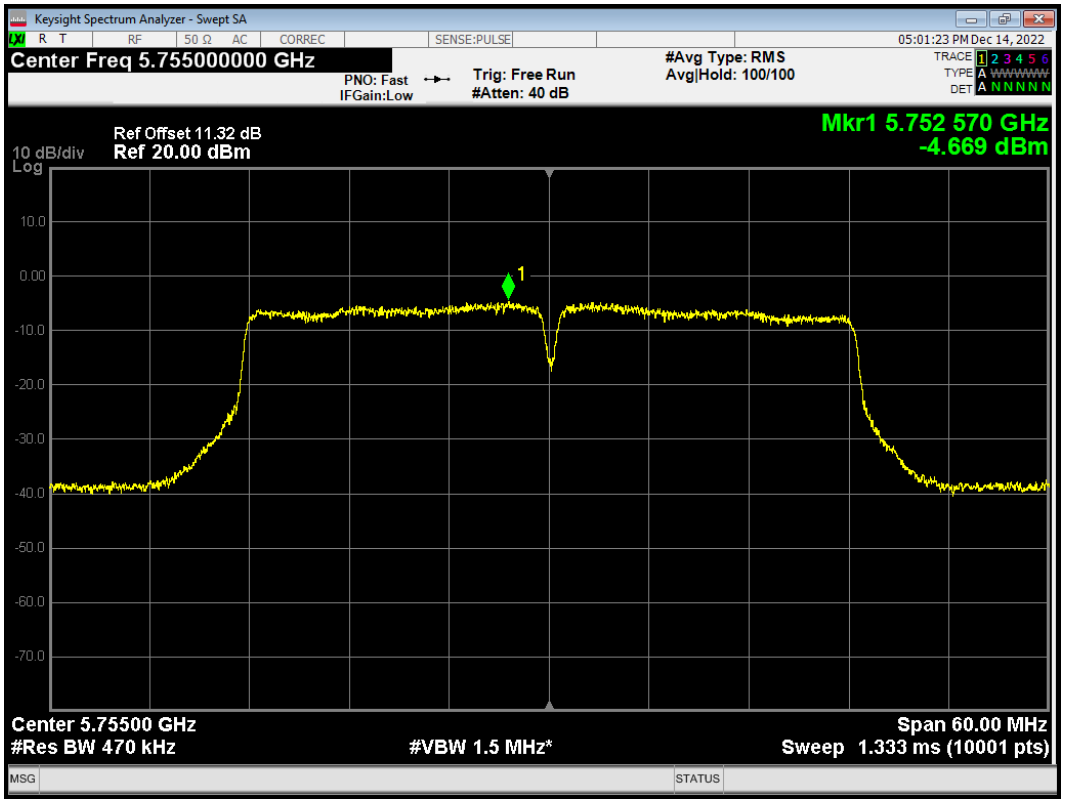
PSD 802.11n(HT20) 5825MHz



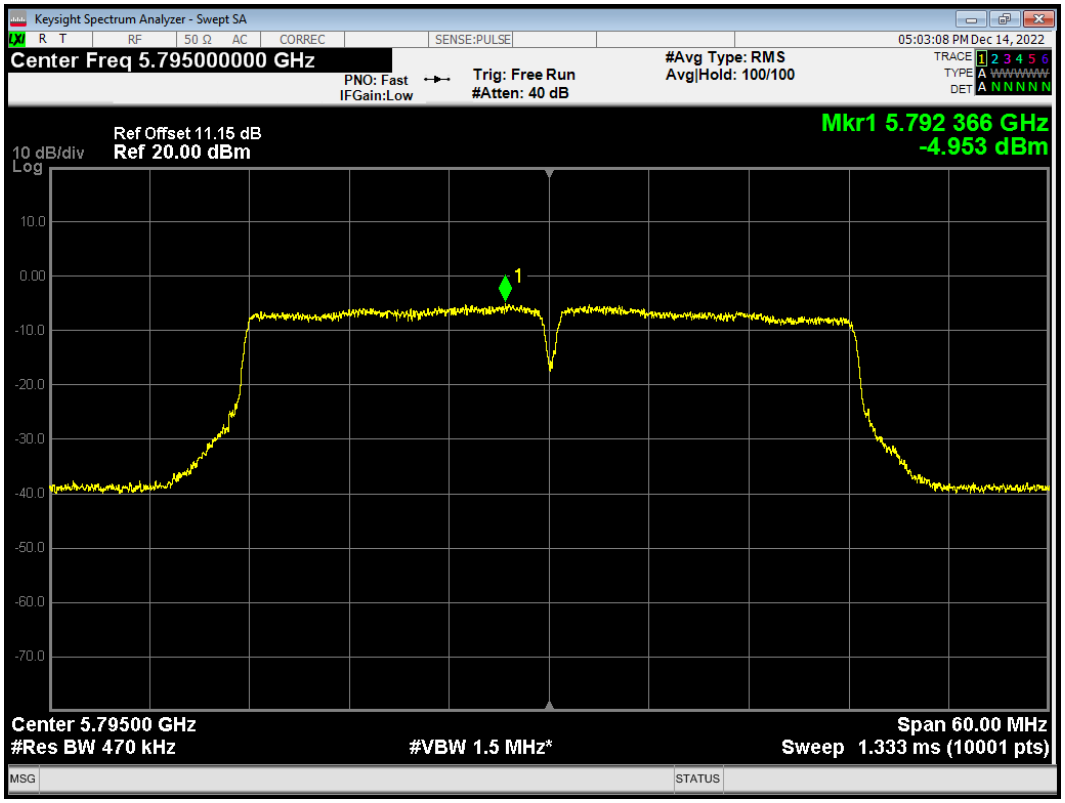
PSD 802.11n(HT40) 5710MHz



PSD 802.11n(HT40) 5755MHz



PSD 802.11n(HT40) 5795MHz



5.5. Unwanted Emission

Ambient condition

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

Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.10. The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna. The radiated emissions measurements were made in a typical installation configuration.
Sweep the whole frequency band range from 9kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

During the test, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing.
Set the spectrum analyzer in the following:
9kHz~150 kHz
RBW=200Hz, VBW=1kHz/ Sweep=AUTO
150 kHz~30MHz
RBW=9KHz, VBW=30KHz,/ Sweep=AUTO
Below 1GHz
RBW=100kHz / VBW=300kHz / Sweep=AUTO
a) Peak emission levels are measured by setting the instrument as follows:
Above 1GHz
PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO
b) Average emission levels are measured by setting the instrument as follows:
Above 1GHz
AVERAGE: RBW=1MHz / VBW=3MHz / Sweep=AUTO
c) Detector: The measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.
d) Averaging type = power (i.e., rms) (As an alternative, the detector and averaging type may be set for linear voltage averaging. Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.)
e) Sweep time = auto.
f) Perform a trace average of at least 100 traces if the transmission is continuous. If the transmission is not continuous, then the number of traces shall be increased by a factor of 1 / D, where D is the duty cycle. For example, with 50% duty cycle, at least 200 traces shall be averaged. (If a specific

emission is demonstrated to be continuous—i.e., 100% duty cycle—then rather than turning ON and OFF with the transmit cycle, at least 100 traces shall be averaged.)

g) If tests are performed with the EUT transmitting at a duty cycle less than 98%, then a correction factor shall be added to the measurement results prior to comparing with the emission limit, to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

1) If power averaging (rms) mode was used in the preceding step e), then the correction factor is [10 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 3 dB shall be added to the measured emission levels.

2) If linear voltage averaging mode was used in the preceding step e), then the correction factor is [20 log (1 / D)], where D is the duty cycle. For example, if the transmit duty cycle was 50%, then 6 dB shall be added to the measured emission levels.

3) If a specific emission is demonstrated to be continuous (100% duty cycle) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

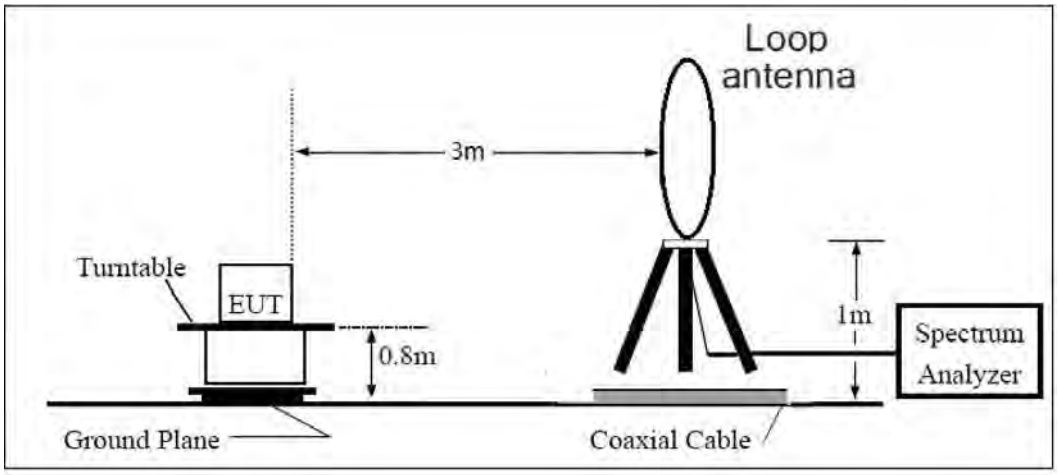
Reduce the video bandwidth until no significant variations in the displayed signal are observed in subsequent traces, provided the video bandwidth is no less than 1 Hz. For regulatory requirements that specify averaging only over the transmit duration (e.g., digital transmission system [DTS] and Unlicensed National Information Infrastructure [U-NII]), the video bandwidth shall be greater than [1 / (minimum transmitter on time)] and no less than 1 Hz.

The field strength of spurious 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 stand-up position (Z axis) and the loop antenna is vertical, others antenna are vertical and horizontal.

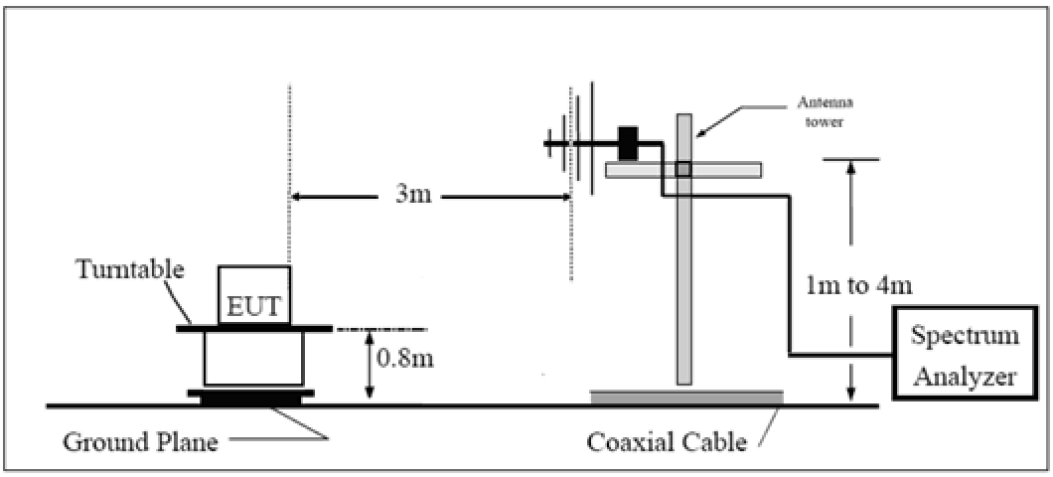
The test is in transmitting mode.

Test setup

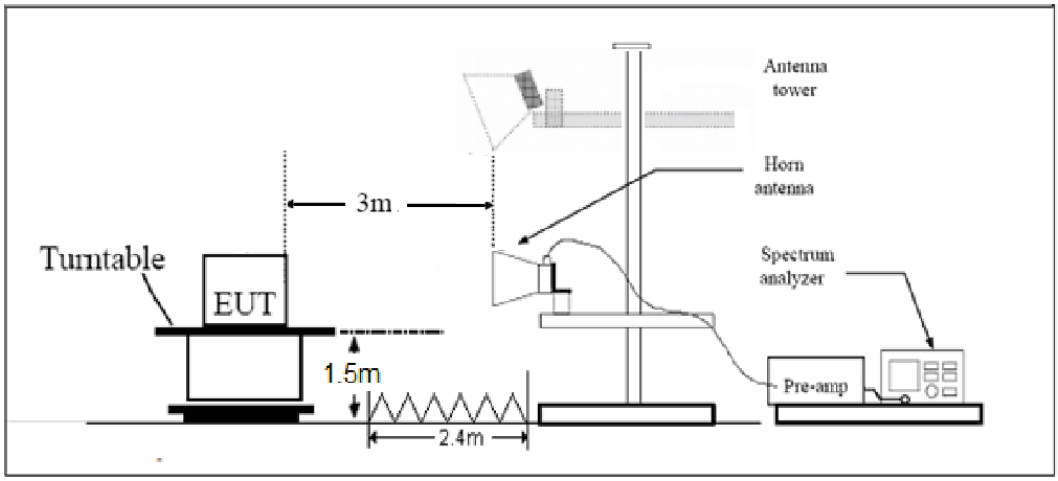
9KHz~ 30MHz



30MHz~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

(1) For transmitters operating in the 5725-5850 MHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(2) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz(68.2dBμV/m).

(3) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz(68.2dBμV/m).

(4) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz(68.2dBμV/m).

Note: the following formula is used to convert the EIRP to field strength

§1、E[dBμV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and

d = distance at which field strength limit is specified in the rules;

§2、E[dBμV/m] = EIRP[dBm] + 95.2, for d = 3 meters

(5) Unwanted spurious emissions fallen in restricted bands per FCC Part15.205 shall comply with the general field strength limits set forth in § 15.209 as below table.

Frequency of emission (MHz)	Field strength(μV/m)	Field strength(dBμV/m)
0.009–0.490	2400/F(kHz)	/
0.490–1.705	24000/F(kHz)	/
1.705–30.0	30	/
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960	500	54

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor k = 1.96.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.17 dB
200MHz-1GHz	4.84 dB
1-18GHz	4.35 dB
18-26.5GHz	5.90 dB
26.5GHz~40GHz	5.92 dB

Test Results:

The modulation and bandwidth are similar for 802.11n mode for 20MHz/40MHz and 802.11ac mode for V20MHz/V40MHz, therefore investigated worst case to representative mode in test report.

A symbol (dB礦/m) in the test plot below means (dBμV/m)

The signal beyond the limit is carrier.

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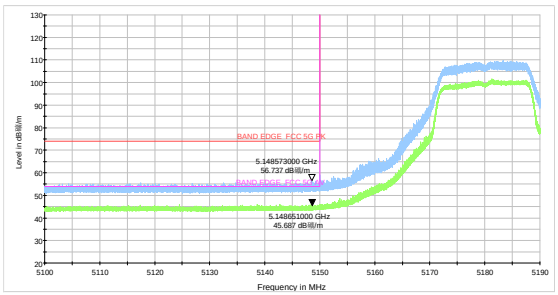
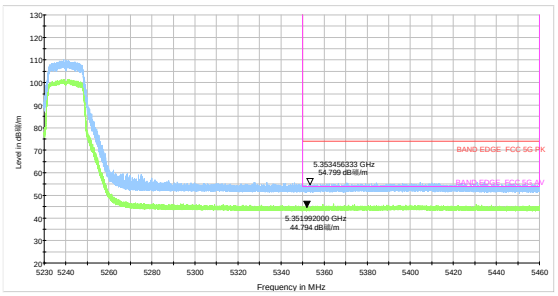
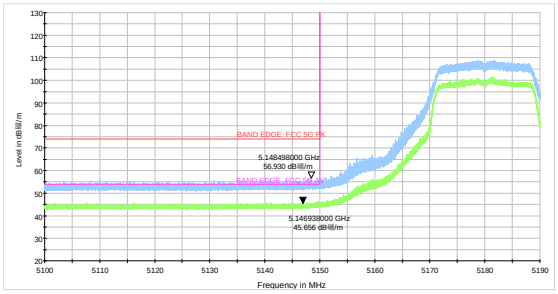
802.11a-Channel 36: Peak + Average



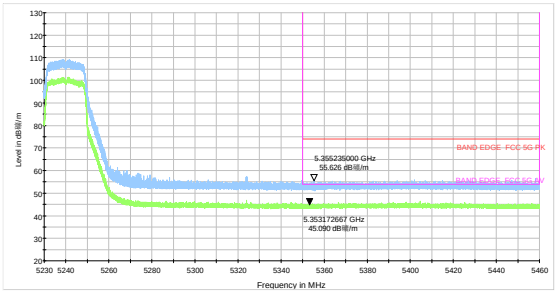
802.11a-Channel 48: Peak + Average



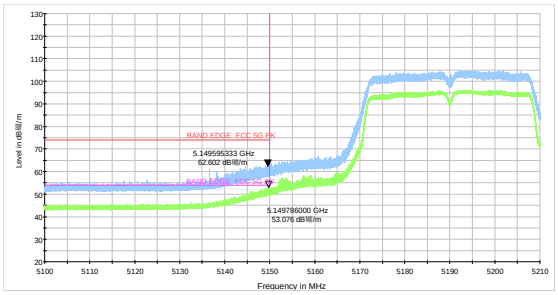
802.11ac VHT20 -Channel 36: Peak + Average



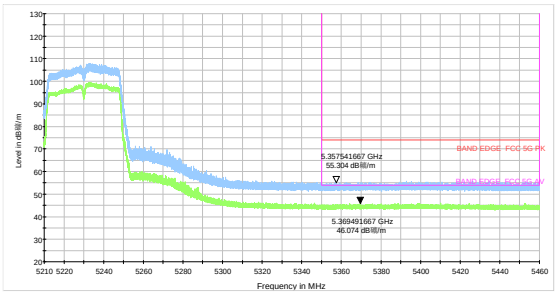
802.11ac VHT20 -Channel 48: Peak + Average



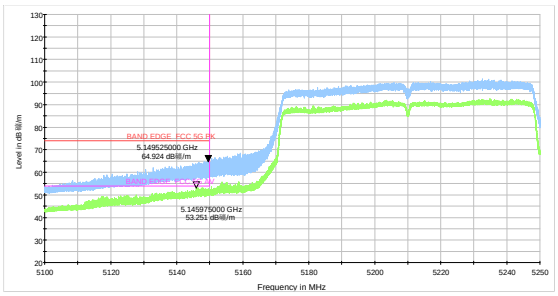
802.11ac VHT40-Channel 38: Peak + Average



802.11ac VHT40-Channel 46: Peak + Average



802.11ac VHT80 –Channel 42: Peak + Average



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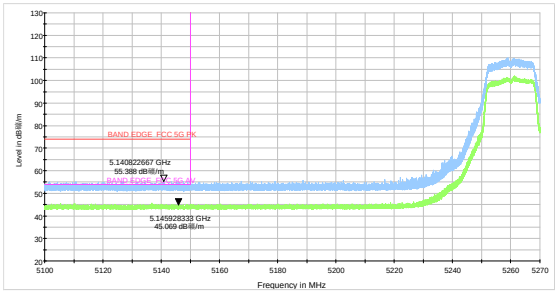
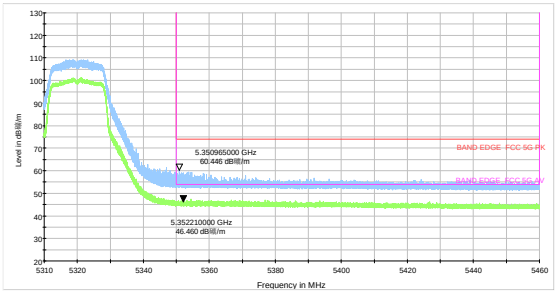
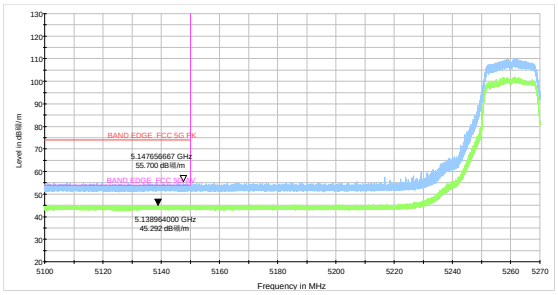
802.11a-Channel 52: Peak + Average



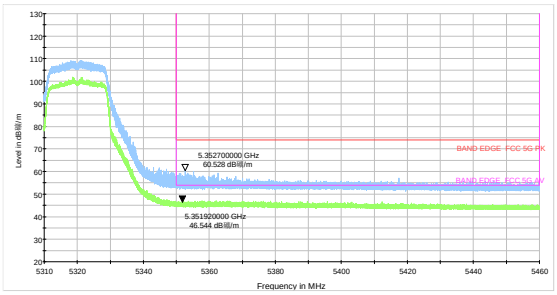
802.11a-Channel 64: Peak + Average



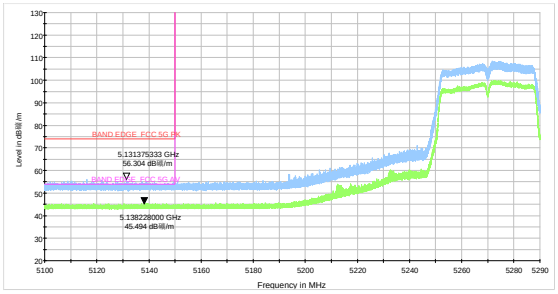
802.11ac VHT20 -Channel 52: Peak + Average



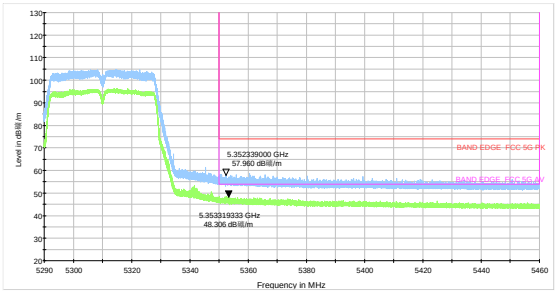
802.11ac VHT20 -Channel 64: Peak + Average



802.11ac VHT40-Channel 54: Peak + Average



802.11ac VHT40-Channel 62: Peak + Average



802.11ac VHT80 –Channel 58: Peak + Average