TEST REPORT

Dt&C Co., Ltd.
42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 17042
Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC2312-0164(1)

2. Customer

- Name (FCC) : MOTREX CO., LTD.
- Address (FCC) : Seoyoung Bldg. 25, Hwangsaeul-ro 258beon-gil,Bundang-gu, Seongnam-si, Gyeonggi-do,South Korea

3. Use of Report : FCC Original Grant

4. Product Name / Model Name : SMART DISPLAY / MH300L-K01
FCC ID : BP9-MH300LK01

5. FCC Regulation(s): Part 15.407
Test Method used: KDB789033 D02v02r01, KDB662911 D01v02r01, ANSI C63.10-2013

6. Date of Test : 2023.10.10 ~ 2023.11.28

7. Location of Test : ☒ Permanent Testing Lab ☐ On Site Testing

8. Testing Environment : See appended test report.

9. Test Result : Refer to the attached test result.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test report is not related to KOLAS accreditation.

Affirmation	Tested by Name : SeokHo Han (Signature)	Technical Manager Name : JaeJin Lee (Signature)

2024 . 01 . 03 .

Dt&C Co., Ltd.

If this report is required to confirmation of authenticity, please contact to report@dtnc.net

Test Report Version

Test Report No.	Date	Description	Revised by	Reviewed by
DRTFCC2312-0164	Dec. 08, 2023	Initial issue	JaeHyeok Bang	JaeJin Lee
DRTFCC2312-0164(1)	Jan. 03, 2024	Correct typo	SeokHo Han	JaeJin Lee

CONTENTS

1. General Information

1.1. Description of EUT

Equipment Class	Unlicensed National Information Infrastructure TX(NII)
Product Name	SMART DISPLAY
Model Name	MH300L-K01
Add Model Name	-
Firmware Version Identification Number	Rev 0.1
EUT Serial Number	No Specified
Power Supply	DC 12 V
Modulation Technique	OFDM
Antenna Specification	Antenna Type: Chip Antenna Antenna Gain: Refer to the clause 3 in test report.

Band	Mode	Tx. frequency(MHz)	Max. conducted power(dBm)
U-NII 1	802.11a	5 180 ~ 5 240	15.57
	802.11n(HT20)	5 180 ~ 5 240	**16.70**
	802.11ac(VHT20)	5 180 ~ 5 240	16.61
	802.11n(HT40)	5 190 ~ 5 230	12.85
	802.11ac(VHT40)	5 190 ~ 5 230	12.74
	802.11ac(VHT80)	5 210	10.57
U-NII 3	802.11a	5 745 ~ 5 825	14.61
	802.11n(HT20)	5 745 ~ 5 825	**15.55**
	802.11ac(VHT20)	5 745 ~ 5 825	15.44
	802.11n(HT40)	5 755 ~ 5 795	11.68
	802.11ac(VHT40)	5 755 ~ 5 795	11.58
	802.11ac(VHT80)	5 775	9.93

1.2. Declaration by the applicant / manufacturer

N/A

1.3. Testing Laboratory

Dt&C Co., Ltd.		
The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of Part 2.948 according to ANSI C63.4-2014. **- FCC & IC MRA Designation No. : KR0034** **- ISED#: 5740A**		
www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

1.4. Testing Environment

Ambient Condition	
▪ Temperature	+21 ℃ ~ +24 ℃
▪ Relative Humidity	+40 % ~ +43 %

1.5. Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

Parameter	Measurement uncertainty
Antenna-port conducted emission	1.0 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz Below)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated emission (1 GHz ~ 18 GHz)	4.8 dB (The confidence level is about 95 %, k = 2)
Radiated emission (18 GHz Above)	4.9 dB (The confidence level is about 95 %, k = 2)

1.6. Test Equipment List

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	23/06/23	24/06/23	MY46471622
Spectrum Analyzer	Agilent Technologies	N9020A	22/12/16	23/12/16	MY48011700
Spectrum Analyzer	Agilent Technologies	N9020A	23/06/23	24/06/23	US47360812
Spectrum Analyzer	KEYSIGHT	N9030B	22/12/16	23/12/16	MY55480168
Receiver	Rohde Schwarz	ESCI3	23/06/23	24/06/23	100798
DC Power Supply	Agilent Technologies	66332A	23/06/23	24/06/23	US37474125
DC Power Supply	SM techno	SDP30-5D	23/06/23	24/06/23	305DMG288
Multimeter	FLUKE	17B+	22/12/16	23/12/16	36390701WS
Signal Generator	Rohde Schwarz	SMBV100A	22/12/16	23/12/16	255571
Signal Generator	ANRITSU	MG3695C	22/12/16	23/12/16	173501
Thermohygrometer	BODYCOM	BJ5478	22/12/16	23/12/16	120612-1
Thermohygrometer	BODYCOM	BJ5478	22/12/16	23/12/16	120612-2
Thermohygrometer	BODYCOM	BJ5478	23/06/23	24/06/23	N/A
Loop Antenna	ETS-Lindgren	6502	22/04/22	24/04/22	00203480
Hybrid Antenna	Schwarzbeck	VULB 9160	22/12/16	23/12/16	3362
Horn Antenna	ETS-Lindgren	3117	23/06/23	24/06/23	00143278
Horn Antenna	A.H.Systems Inc.	SAS-574	23/06/23	24/06/23	155
PreAmplifier	tsj	MLA-0118-B01-40	22/12/16	23/12/16	1852267
PreAmplifier	tsj	MLA-1840-J02-45	23/06/23	24/06/23	16966-10728
PreAmplifier	H.P	8447D	22/12/16	23/12/16	2944A07774
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-15000-40SS	23/06/23	24/06/23	8
High Pass Filter	Wainwright Instruments	WHKX10-2838-3300-18000-60SS	23/06/23	24/06/23	1
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	23/06/23	24/06/23	3
Attenuator	Hefei Shunze	SS5T2.92-10-40	23/06/23	24/06/23	16012202
Attenuator	Aeroflex/Weinschel	56-3	23/06/23	24/06/23	Y2370
Attenuator	SMAJK	SMAJK-2-3	23/06/23	24/06/23	3
Attenuator	SMAJK	SMAJK-2-3	23/06/23	24/06/23	2
Attenuator	Aeroflex/Weinschel	86-10-11	23/06/23	24/06/23	408
Power Meter & Wide Bandwidth Sensor	Anritsu	ML2496A MA2411B	22/12/16	23/12/16	1338004 1911481
Cable	Dt&C	Cable	23/01/04	24/01/04	G-2
Cable	HUBER+SUHNER	SUCOFLEX 100	23/01/04	24/01/04	G-3
Cable	Dt&C	Cable	23/01/04	24/01/04	G-4
Cable	OMT	YSS21S	23/01/04	24/01/04	G-5
Cable	Junkosha	MWX241	23/01/03	24/01/03	mmW-1
Cable	Junkosha	MWX241	23/01/03	24/01/03	mmW-4
Cable	HUBER+SUHNER	SUCOFLEX100	23/01/04	24/01/04	M-01
Cable	HUBER+SUHNER	SUCOFLEX100	23/01/04	24/01/04	M-02
Cable	JUNKOSHA	MWX241/B	23/01/04	24/01/04	M-03
Cable	JUNKOSHA	J12J101757-00	23/01/04	24/01/04	M-07
Cable	HUBER+SUHNER	SUCOFLEX106	23/01/04	24/01/04	M-09
Cable	Radiall	TESTPRO3	23/01/04	24/01/04	RFC-70
Test Software (Radiated)	tsj	EMI Measurement	NA	NA	Version 2.00.0185

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017.
Note2: The cable is not a regular calibration item, so it has been calibrated by Dt&C itself.

2. Test Methodology

The measurement procedures described in the ANSI C63.10-2013 and the guidance provided in KDB789033 D02v02r01 were used in measurement of the EUT.

The EUT was tested per the guidance of KDB789033 D02v02r01. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the test mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E.

2.3. General Test Procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB789033 D02v02r01.

So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB789033 D02v02r01. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on KDB789033 D02v02r01.

The EUT is placed on a non-conductive table, which is 0.8 m above ground plane. For emission measurements above 1 GHz, the table height is 1.5 m. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 1 m or 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axis.

2.4. Instrument Calibration

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

2.5. Description of Test Modes

The EUT has been tested with the operating condition for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting.

Transmitting Configuration of EUT

Mode	SISO		MIMO (CDD)	MIMO (SDM)
	Ant 1	Ant 2	Ant 1 & 2	Ant 1 & 2
	Data rate			
802.11a	6~54Mbps	6~54Mbps	6~54Mbps	-
802.11n(HT20)	MCS 0 ~ 7	MCS 0 ~ 7	MCS 0 ~ 7	MCS 8 ~ 15
802.11ac(VHT20)	MCS 0 ~ 8(1SS)	MCS 0 ~ 8(1SS)	MCS 0 ~ 8(1SS)	MCS 0 ~ 8(2SS)
802.11n(HT40)	MCS 0 ~ 7	MCS 0 ~ 7	MCS 0 ~ 7	MCS 8 ~ 15
802.11ac(VHT40)	MCS 0 ~ 9(1SS)	MCS 0 ~ 9(1SS)	MCS 0 ~ 9(1SS)	MCS 0 ~ 9(2SS)
802.11ac(VHT80)	MCS 0 ~ 9(1SS)	MCS 0 ~ 9(1SS)	MCS 0 ~ 9(1SS)	MCS 0 ~ 9(2SS)

Note1: SDM = Spatial Diversity Multiplexing, CDD = Cycle Delay Diversity, SS = Spatial Streams

EUT Operation test setup

- Test Software: Tera Term 4.104.0.0

- Power setting: Refer to the table below.

Band	802.11a		
	Channel	Frequency (MHz)	Power Setting
U-NII 1	36	5 180	11
	40	5 200	11
	48	5 240	11
U-NII 3	149	5 745	11
	157	5 785	11
	165	5 825	11

Band	802.11n(HT20) / 802.11ac(VHT20)		
	Channel	Frequency (MHz)	Power Setting
U-NII 1	36	5 180	12
	40	5 200	12
	48	5 240	12
U-NII 3	149	5 745	12
	157	5 785	12
	165	5 825	12

Band	802.11n(HT40) / 802.11ac(VHT40)		
	Channel	Frequency (MHz)	Power Setting
U-NII 1	38	5 190	8
	46	5 230	8
U-NII 3	151	5 755	8
	159	5 795	8

Band	802.11ac(VHT80)		
	Channel	Frequency (MHz)	Power Setting
U-NII 1	42	5 210	7
U-NII 3	155	5 775	7

Tested Mode

Test Mode		ANT configuration	Worst data rate
TM 1	802.11a	CDD Multiple transmitting	6Mbps
TM 2	802.11n(HT20)	CDD Multiple transmitting	MCS0
TM 3	802.11n(HT40)	CDD Multiple transmitting	MCS0
TM 4	802.11n(HT80)	CDD Multiple transmitting	MCS0

Note 1: The worst case data rate is determined as above test mode according to the power measurements.

3. Antenna Requirements

▣ **According to Part 15.203**

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

The antenna is permanently attached on the device.
Therefore this E.U.T complies with the requirement of Part 15.203

Directional antenna gain:

Bands	SISO		MIMO (CDD) Note 1.	MIMO (SDM) Note 2
	ANT 1 [dBi]	ANT 2 [dBi]	Directional Gain[dBi]	Directional Gain[dBi]
U-NII 1	-0.85	-0.78	2.20	-0.81
U-NII 3	-0.77	-0.21	2.52	-0.48

Note 1. Directional gain(correlated signal with unequal antenna gain and equal transmit power)
$10 \log [(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N^{ANT}]$ dBi

Note 2. Directional gain(completely uncorrelated signal with unequal antenna gain and equal transmit power)
$10 \log [(10^{G1/10} + 10^{G2/10} + \ldots + 10^{GN/10}) / N^{ANT}]$ dBi

4. Summary of Test Result

FCC Part Section(s)	Test Description	Limit	Test Condition	Status Note 1
15.407(a)	Emission Bandwidth (26 dB Bandwidth)	N/A	Conducted	C
15.407(a)	Maximum Conducted Output Power	Part 15.407(a) (Refer to section 5.3)		C
15.407(a)	Maximum Power Spectral Density	Part 15.407(a) (Refer to section 5.4)		C
15.407(h)	Dynamic Frequency Selection	Part 15.407(h)		NA Note 3
15.205 15.209 15.407(b)	Unwanted Emissions	Part 15.209, 15.407(b) (Refer to section 5.5)	Radiated	C
15.207	AC Conducted Emissions	Part 15.207 (Refer to section 5.6)	AC Line Conducted	NA Note 4
15.203	Antenna Requirements	Part 15.203 (Refer to section 3)	-	C

Note 1: **C** = Comply **NC** = Not Comply **NT** = Not Tested **NA** = Not Applicable
Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS.
Note 3: This device supports U-NII-1, U-NII 3 band only.
Note 4: This device is installed in a car. Therefore the power source is a battery of car.

5. TEST RESULT

5.1. Emission Bandwidth (26 dB Bandwidth)

▣ Test Requirements

- Emission Bandwidth (26 dB Bandwidth)

The bandwidth at 26 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The 26 dB bandwidth is used to determine the conducted output power limit.

▣ Test Configuration

Refer to the APPENDIX I.

▣ Test Procedure

- Emission Bandwidth (26 dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB789033 D02v02r01**.

1. Set resolution bandwidth (RBW) = approximately **1 %** of the EBW.
2. Set the video bandwidth **(VBW) > RBW**.
3. Detector = **Peak**.
4. Trace mode = **max hold**.

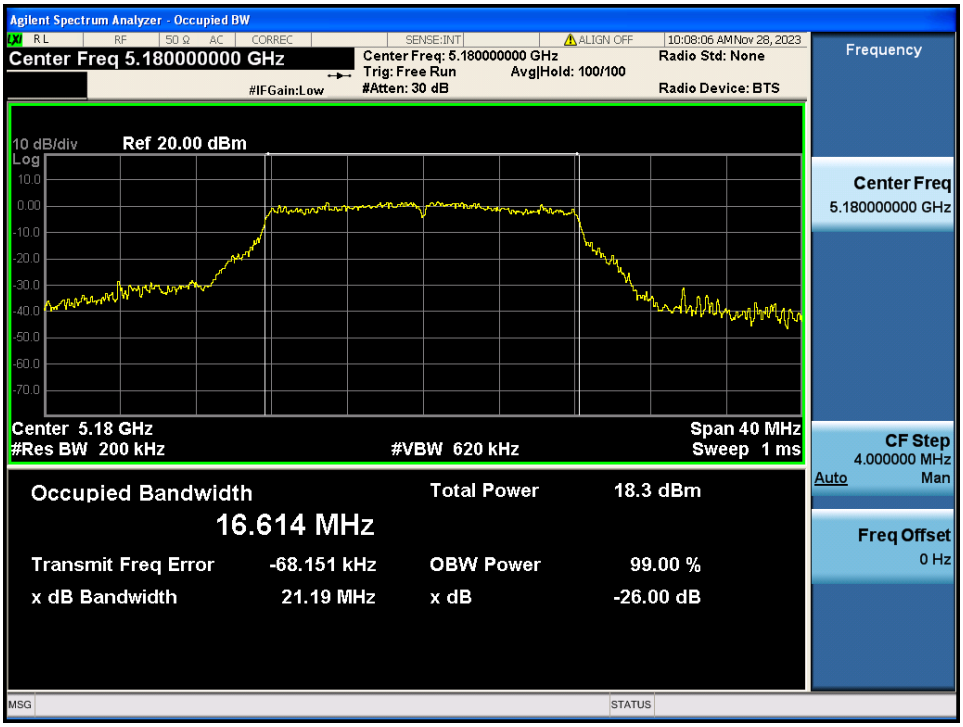
Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1 %.

▣ Test Results: Comply

Test Mode	Band	Channel	Frequency(MHz)	26 dB BW(MHz)	
				ANT 1	ANT 2
TM 1	U-NII 1	36	5 180	21.19	21.45
		40	5 200	20.92	21.05
		48	5 240	20.84	20.79
TM 2	U-NII 1	36	5 180	21.13	21.06
		40	5 200	21.06	21.25
		48	5 240	21.44	21.10
TM 3	U-NII 1	38	5 190	39.72	39.10
		46	5 230	39.39	38.96
TM 4	U-NII 1	42	5 210	81.26	81.07

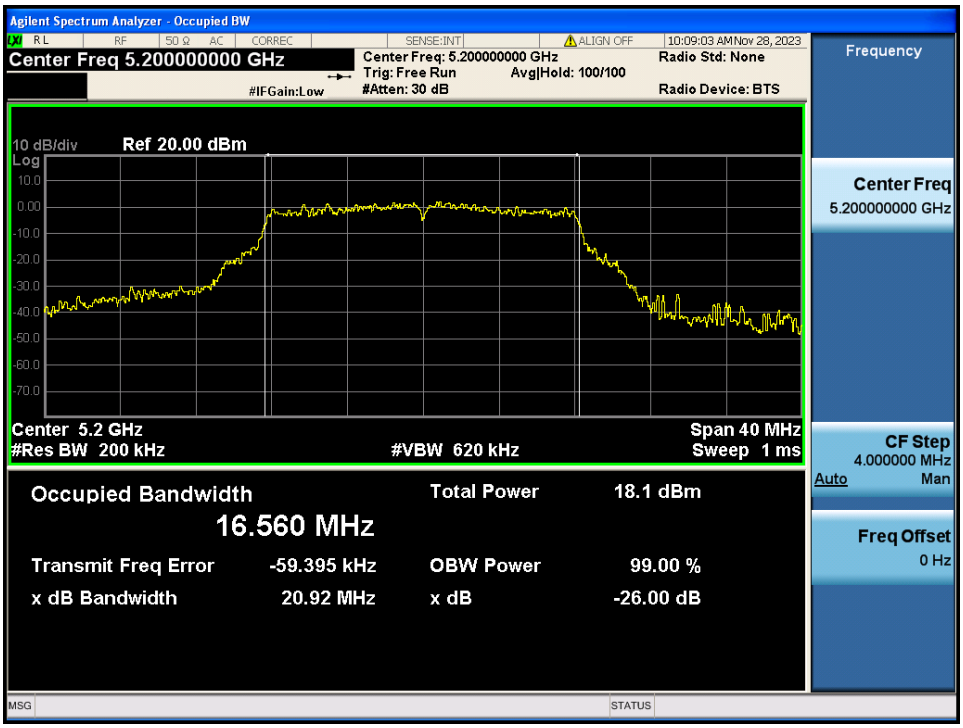
26 dB Bandwidth

Test Mode: TM 1 & ANT 1 & Ch.36



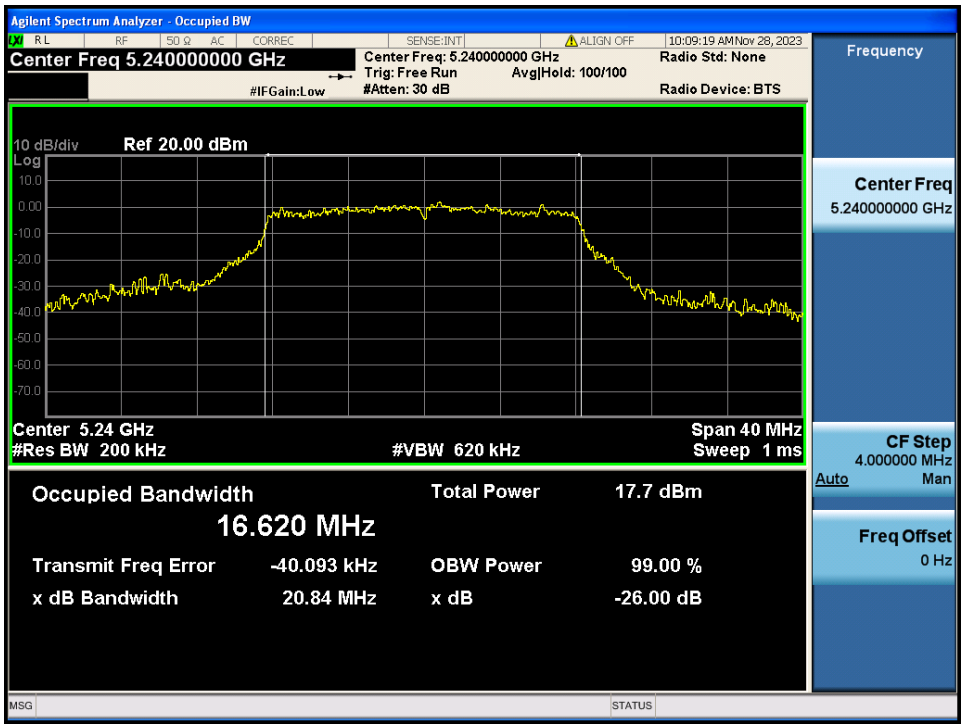
26 dB Bandwidth

Test Mode: TM 1 & ANT 1 & Ch.40



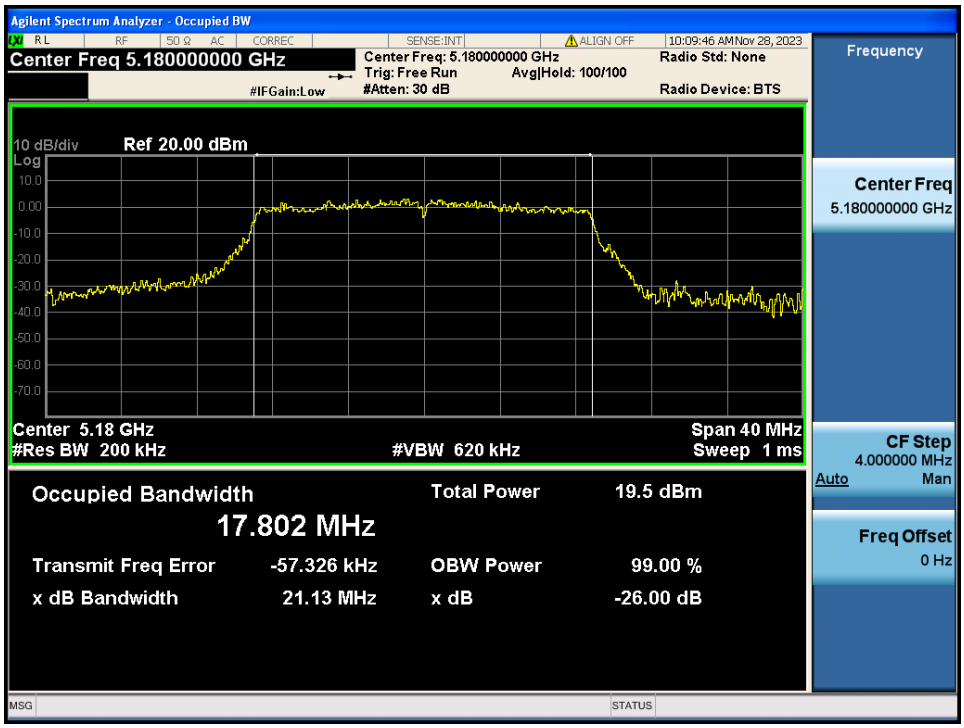
26 dB Bandwidth

Test Mode: TM 1 & ANT 1 & Ch.48



26 dB Bandwidth

Test Mode: TM 2 & ANT 1 & Ch.36



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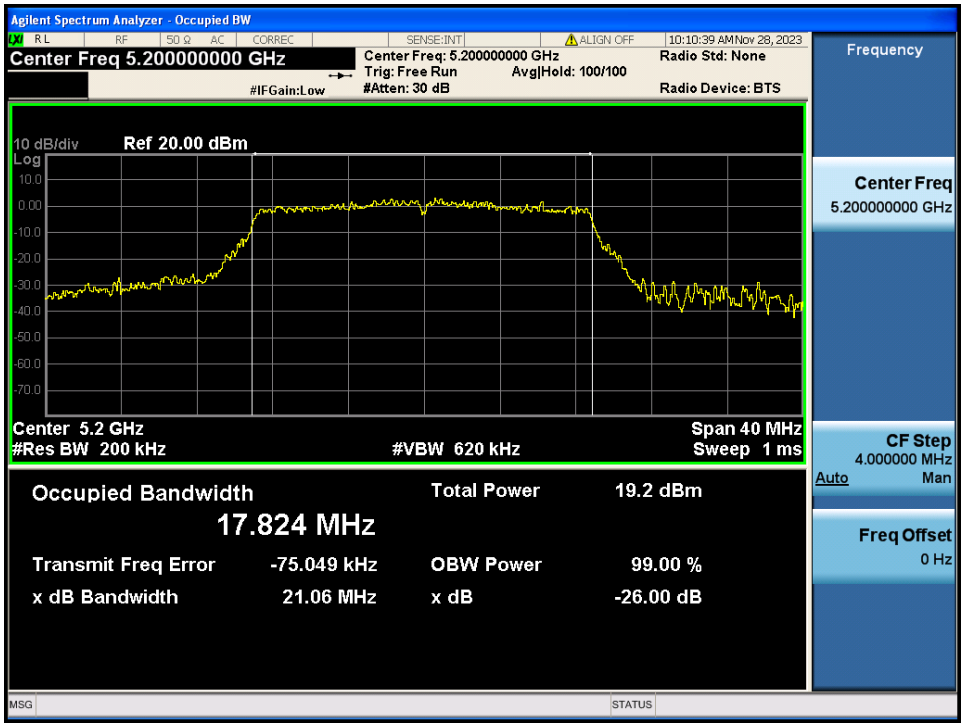

26 dB Bandwidth

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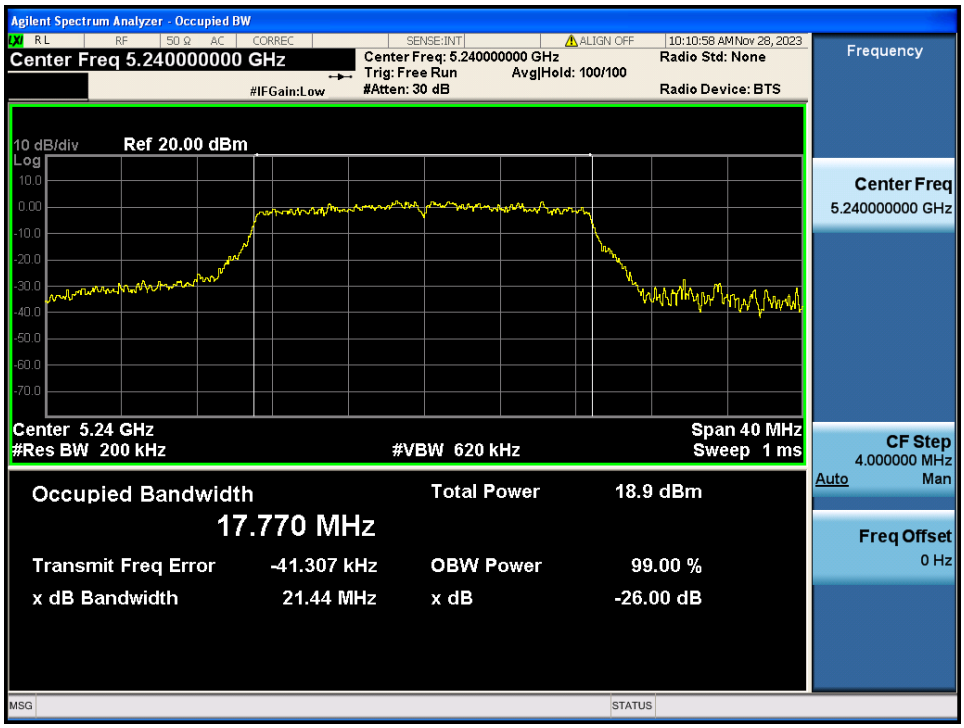
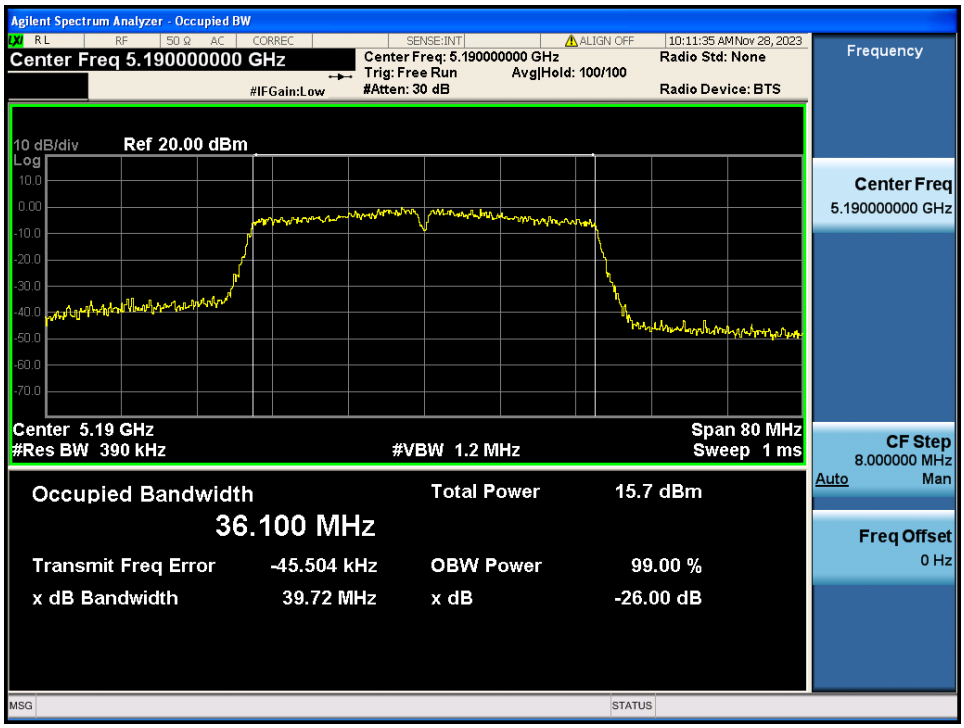


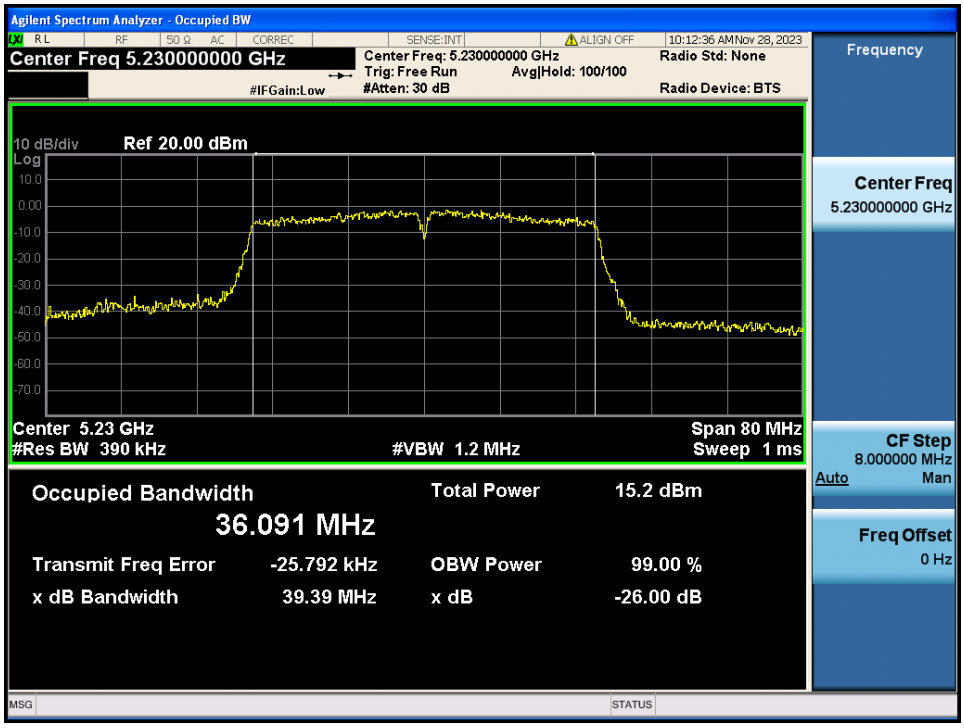
26 dB Bandwidth

Test Mode: TM 3 & ANT 1 & Ch.38



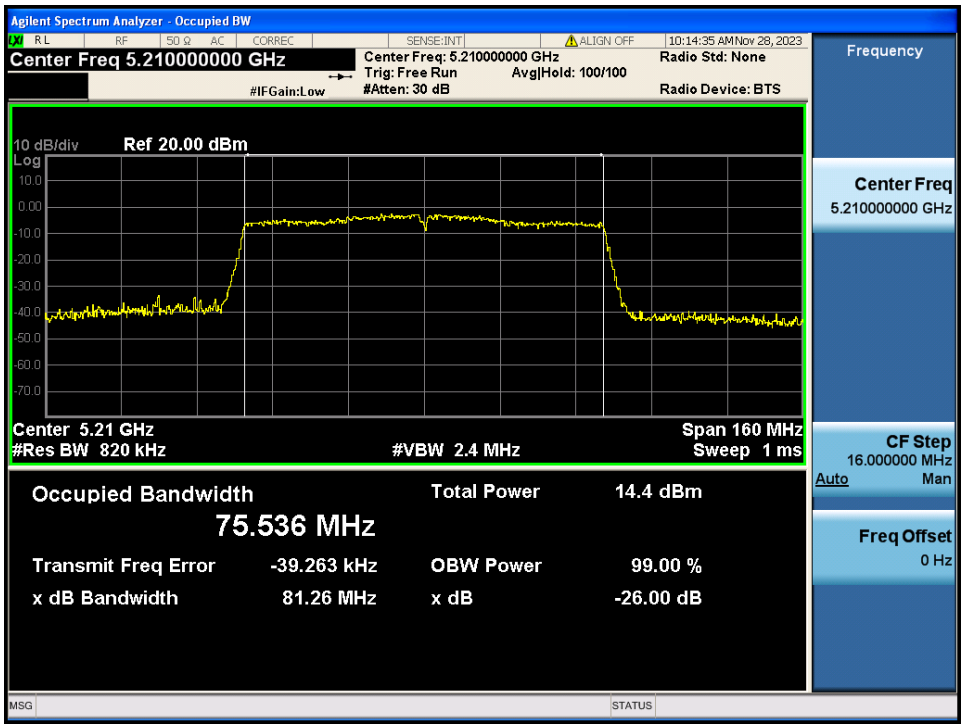
26 dB Bandwidth

Test Mode: TM 3 & ANT 1 & Ch.46



26 dB Bandwidth

Test Mode: TM 4 & ANT 1 & Ch.42



26 dB Bandwidth

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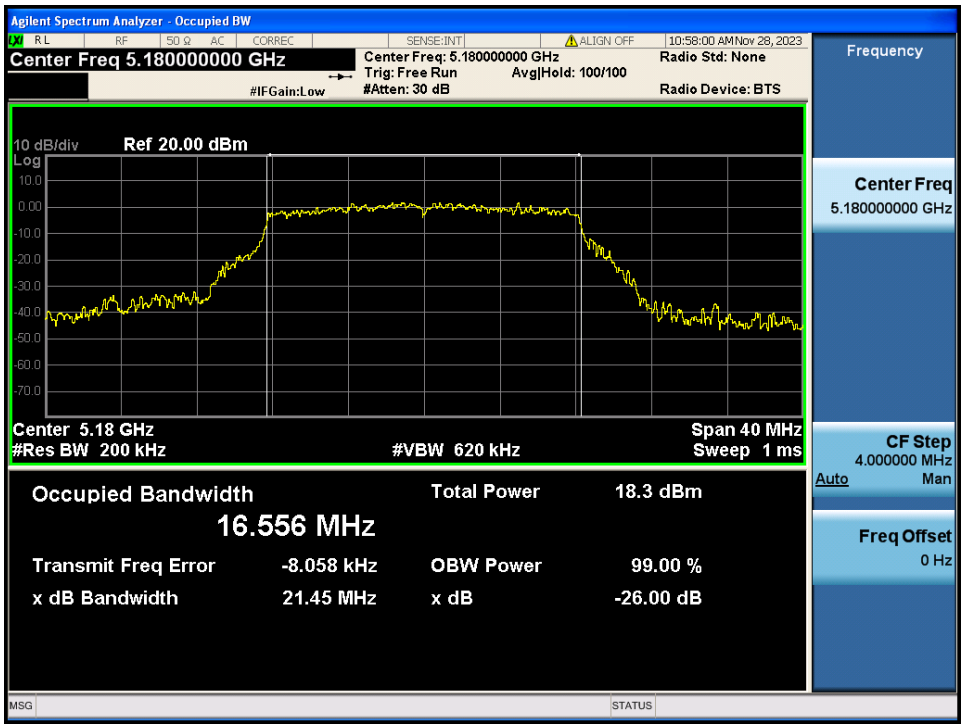

26 dB Bandwidth

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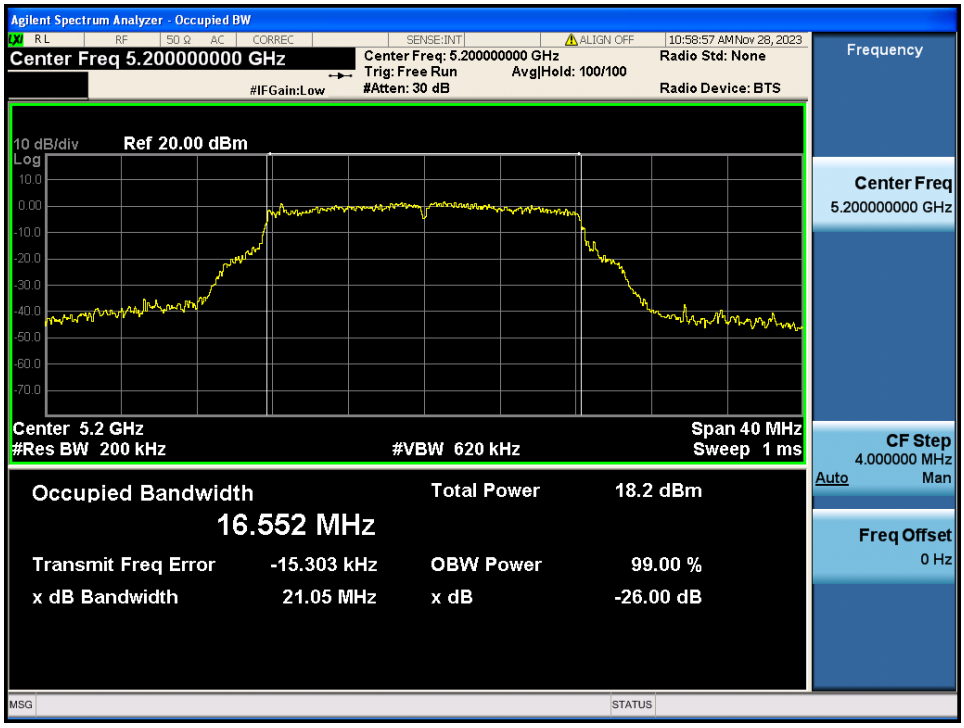
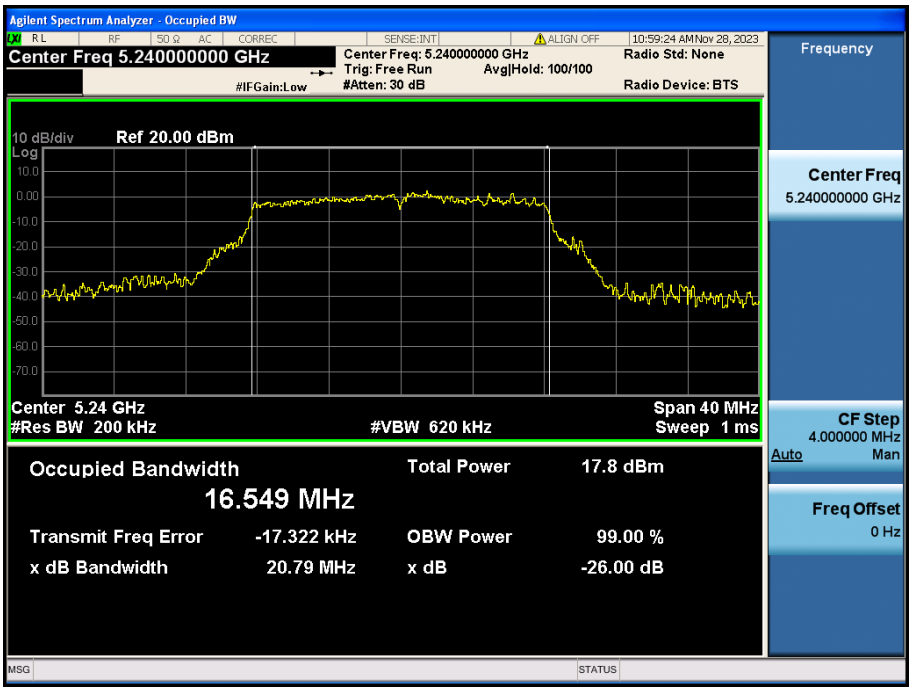


26 dB Bandwidth

Test Mode: TM 1 & ANT 2 & Ch.48



26 dB Bandwidth

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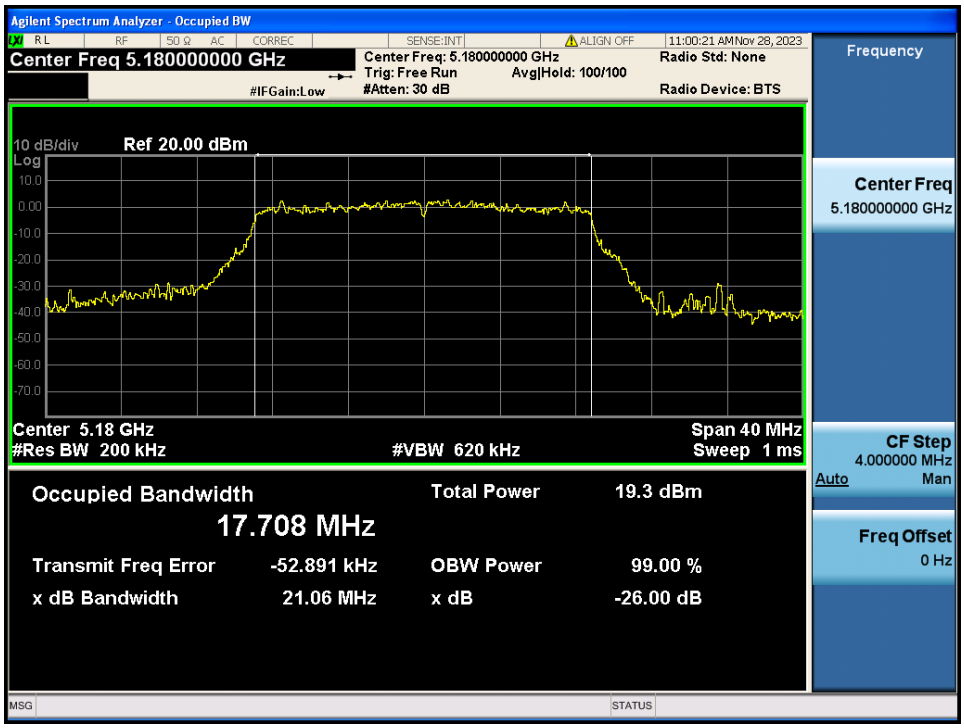

26 dB Bandwidth

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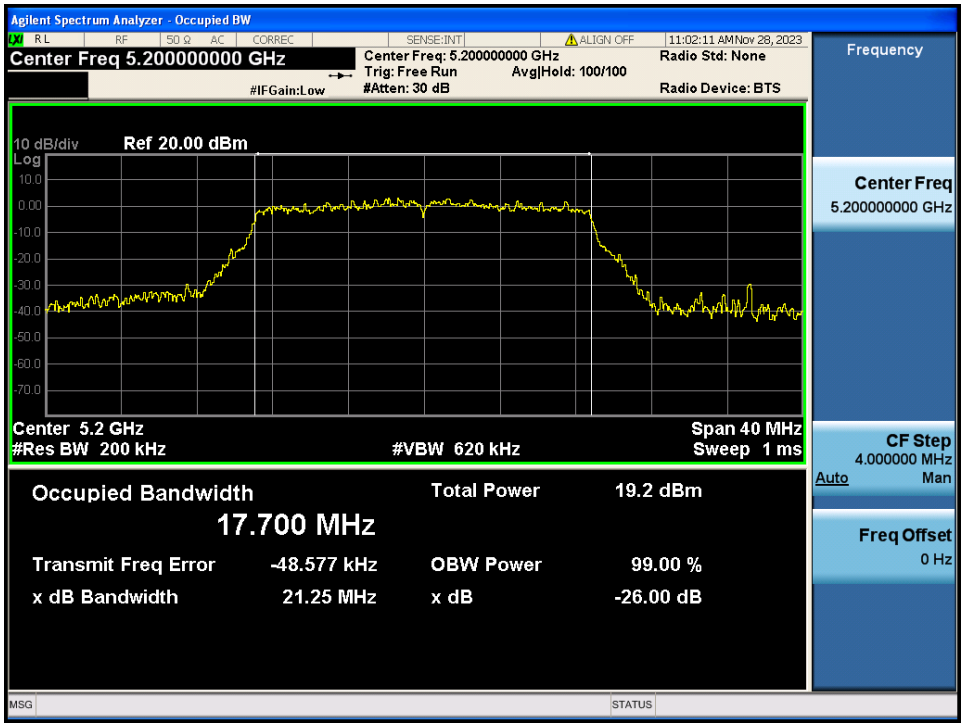
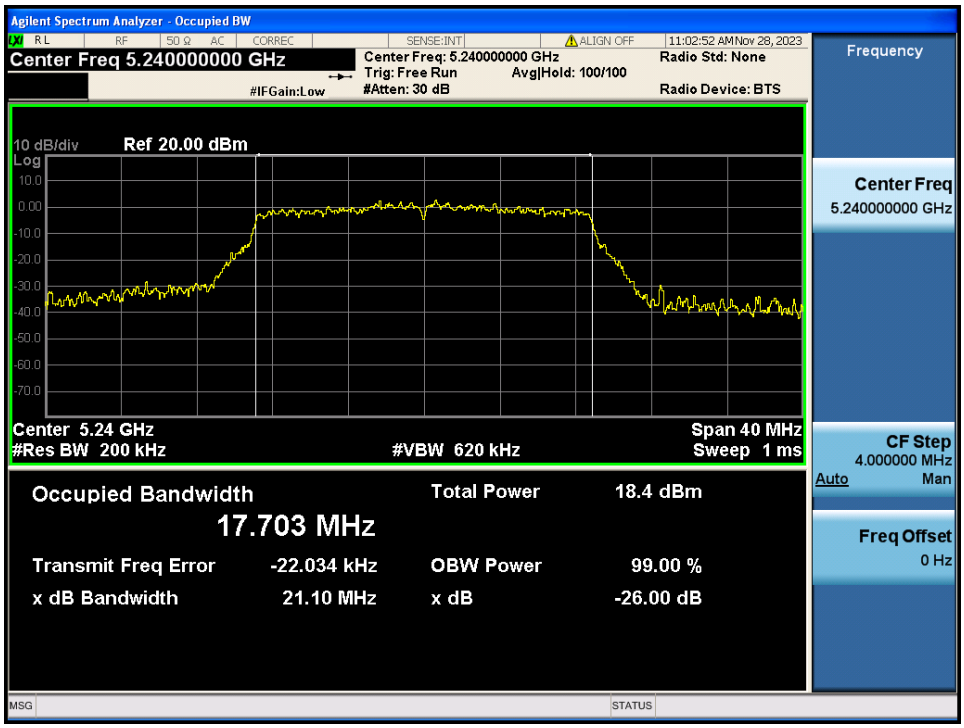


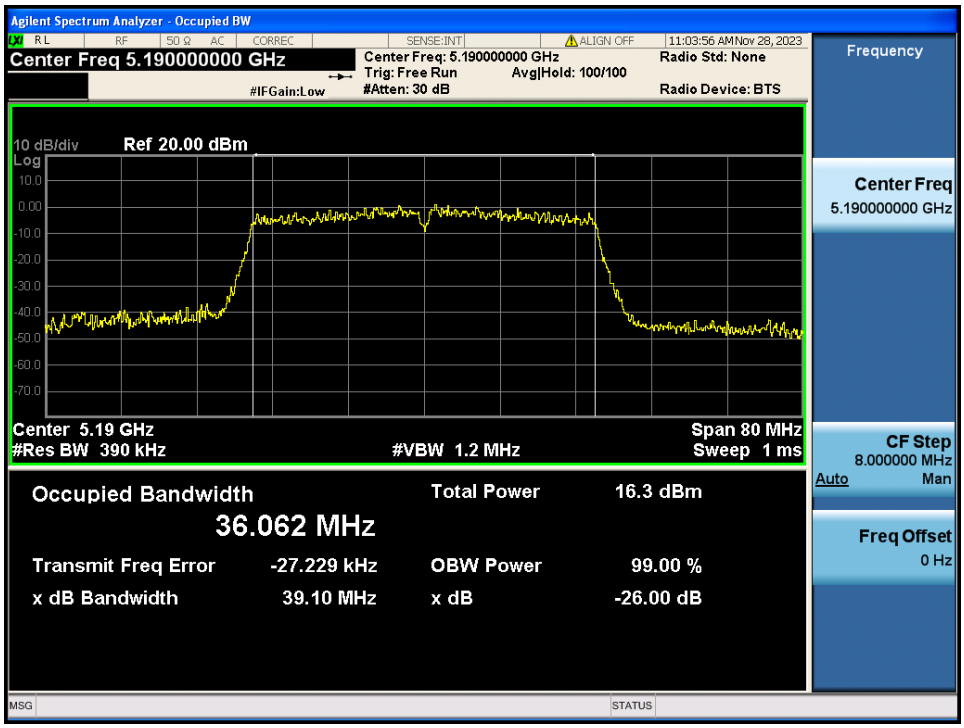
26 dB Bandwidth

Test Mode: TM 2 & ANT 2 & Ch.48



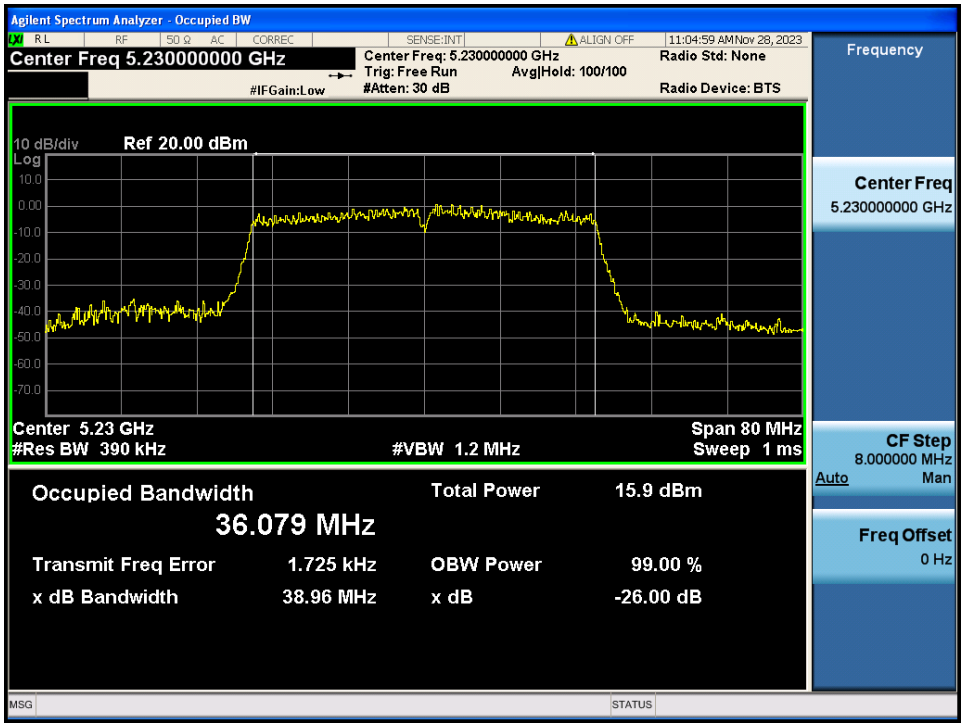
26 dB Bandwidth

Test Mode: TM 3 & ANT 2 & Ch.38



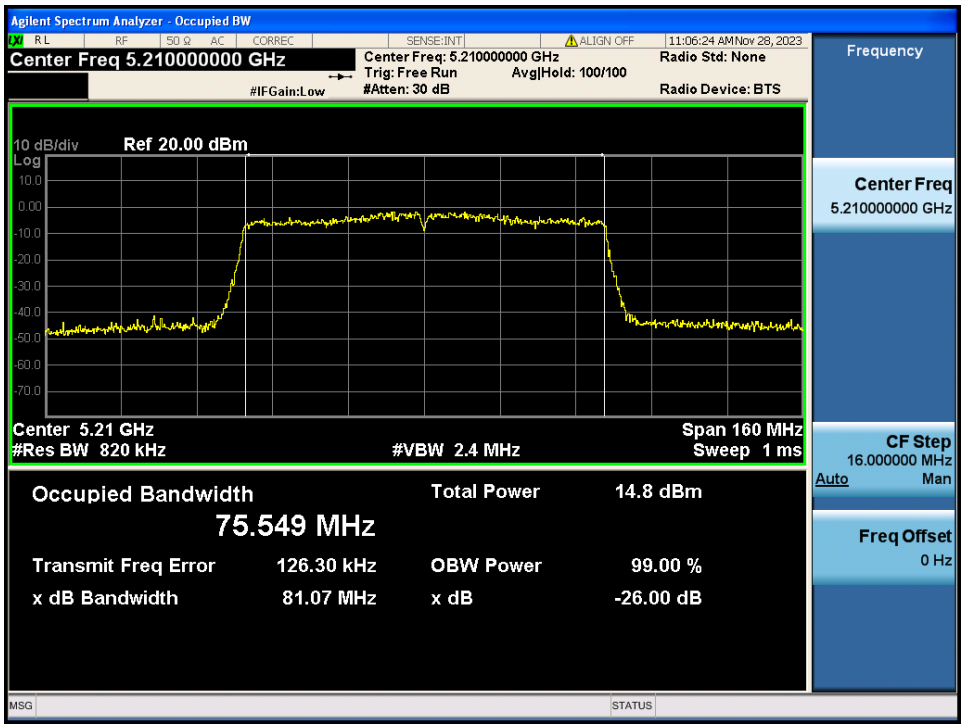
26 dB Bandwidth

Test Mode: TM 3 & ANT 2 & Ch.46



26 dB Bandwidth

Test Mode: TM 4 & ANT 2 & Ch.42



5.2. Minimum Emission Bandwidth (6 dB Bandwidth)

▣ Test Requirements

- Emission Bandwidth (6 dB Bandwidth)

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

▣ Test Configuration

Refer to the APPENDIX I.

▣ Test Procedure

- Emission Bandwidth (6 dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB789033 D02v02r01**.

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth **≥ 3 x RBW**.
3. Detector = **Peak**.
4. Trace mode = **max hold**.

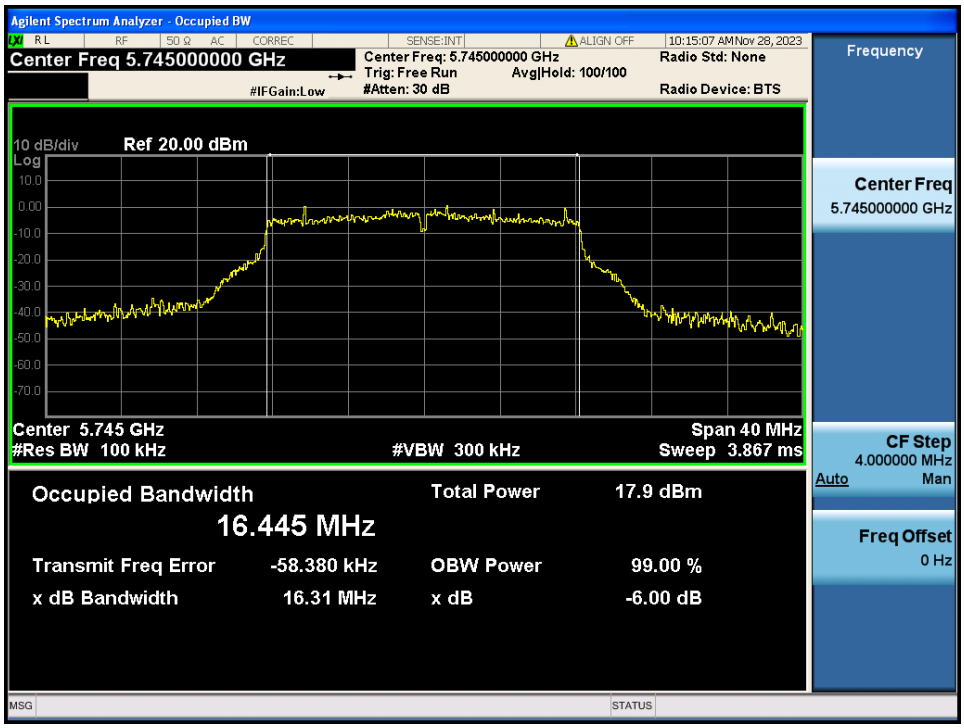
   Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

▣ **Test Results: Comply**

Test Mode	Band	Channel	Frequency(MHz)	6 dB BW(MHz)	
				ANT 1	ANT 2
TM 1	U-NII 3	149	5 745	16.31	16.34
		157	5 785	16.38	16.35
		165	5 825	16.36	16.38
TM 2	U-NII 3	149	5 745	17.58	17.62
		157	5 785	17.58	17.61
		165	5 825	17.58	17.35
TM 3	U-NII 3	151	5 755	35.44	35.25
		159	5 795	35.76	35.69
TM 4	U-NII 3	155	5 775	75.33	75.81

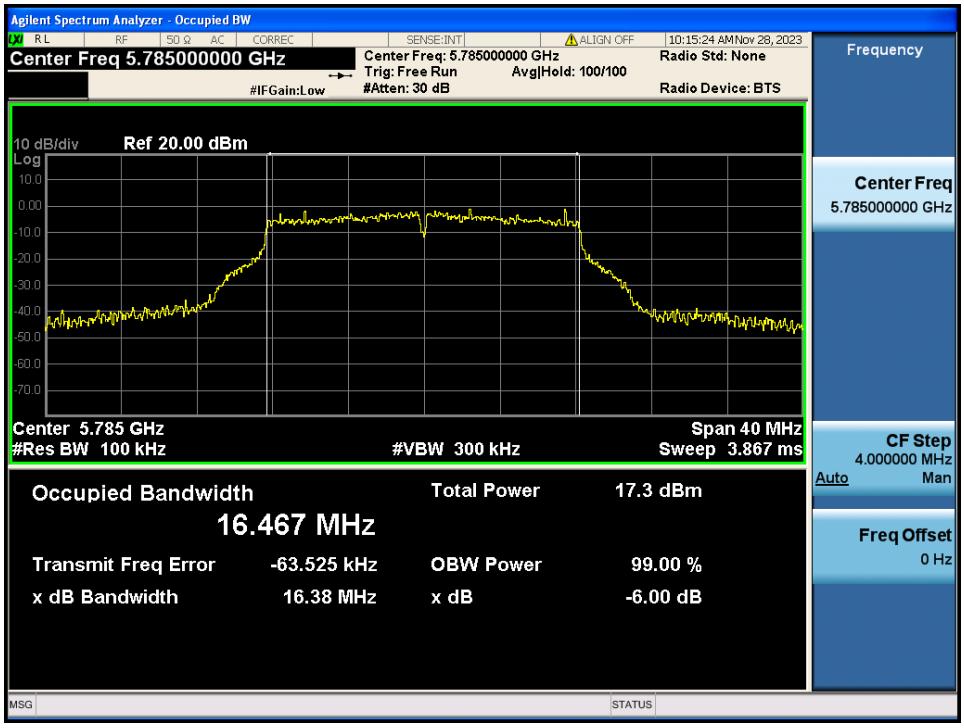
6 dB Bandwidth

Test Mode: TM 1 & ANT 1 & Ch.149



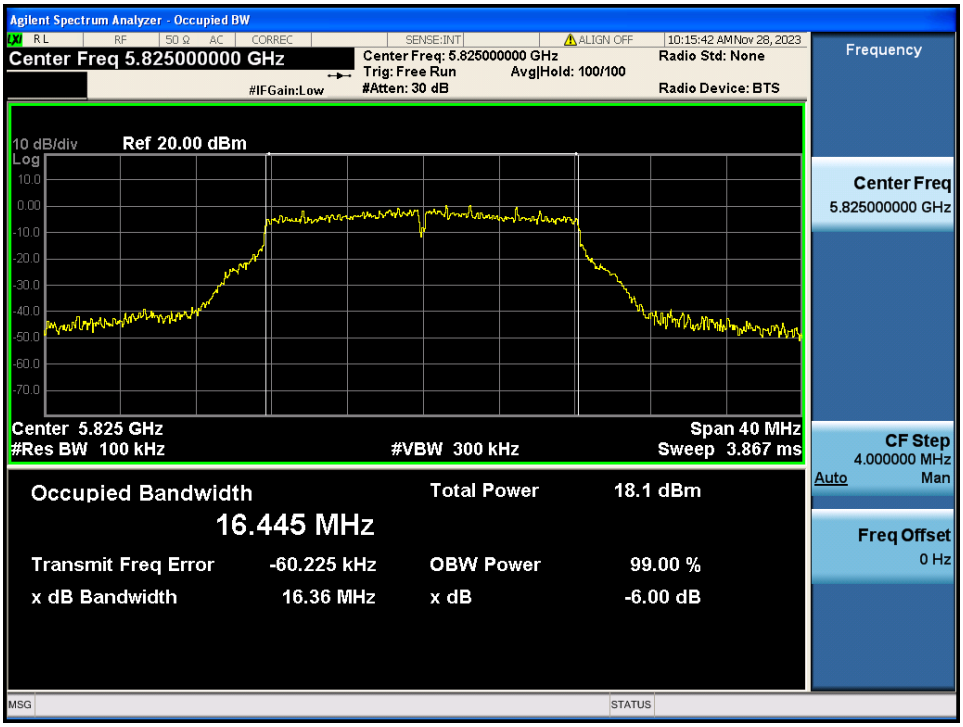
6 dB Bandwidth

Test Mode: TM 1 & ANT 1 & Ch.157



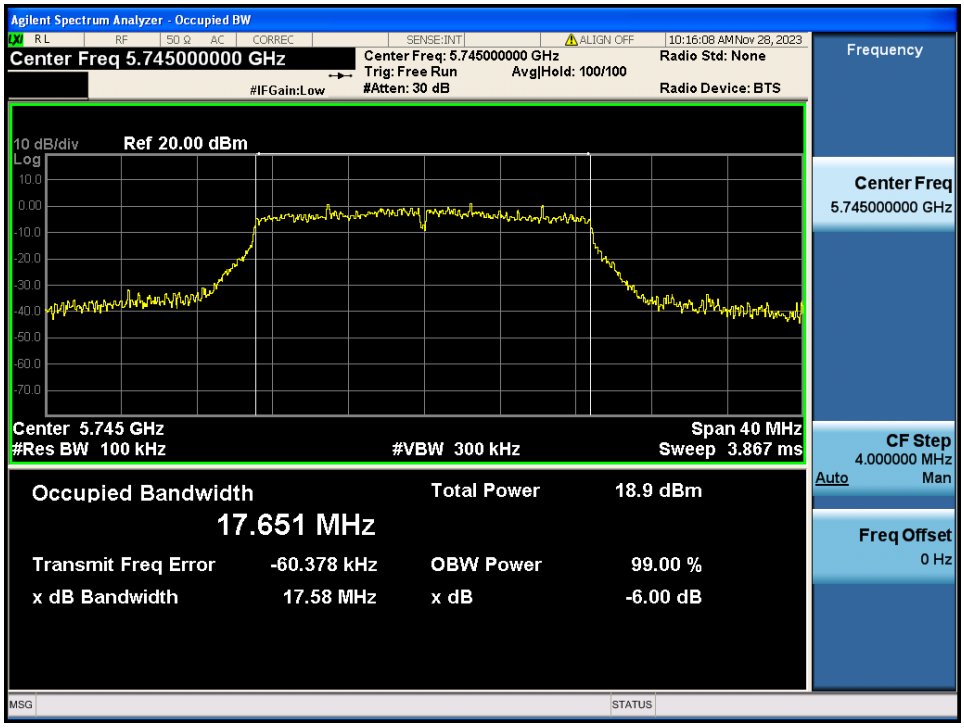
6 dB Bandwidth

Test Mode: TM 1 & ANT 1 & Ch.165



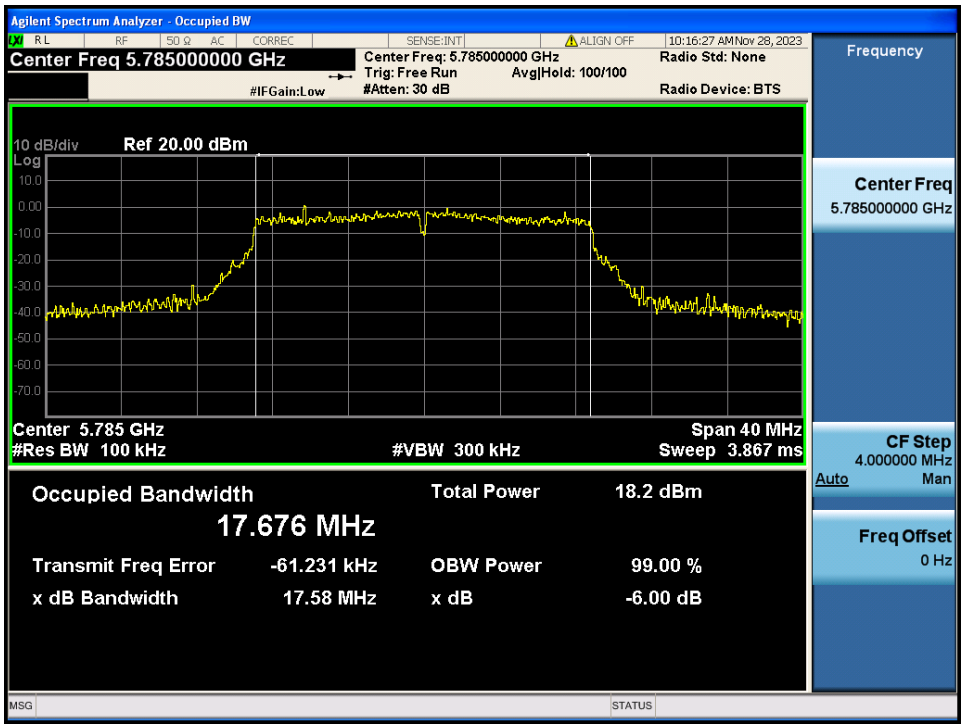
6 dB Bandwidth

Test Mode: TM 2 & ANT 1 & Ch.149



6 dB Bandwidth

Test Mode: TM 2 & ANT 1 & Ch.157

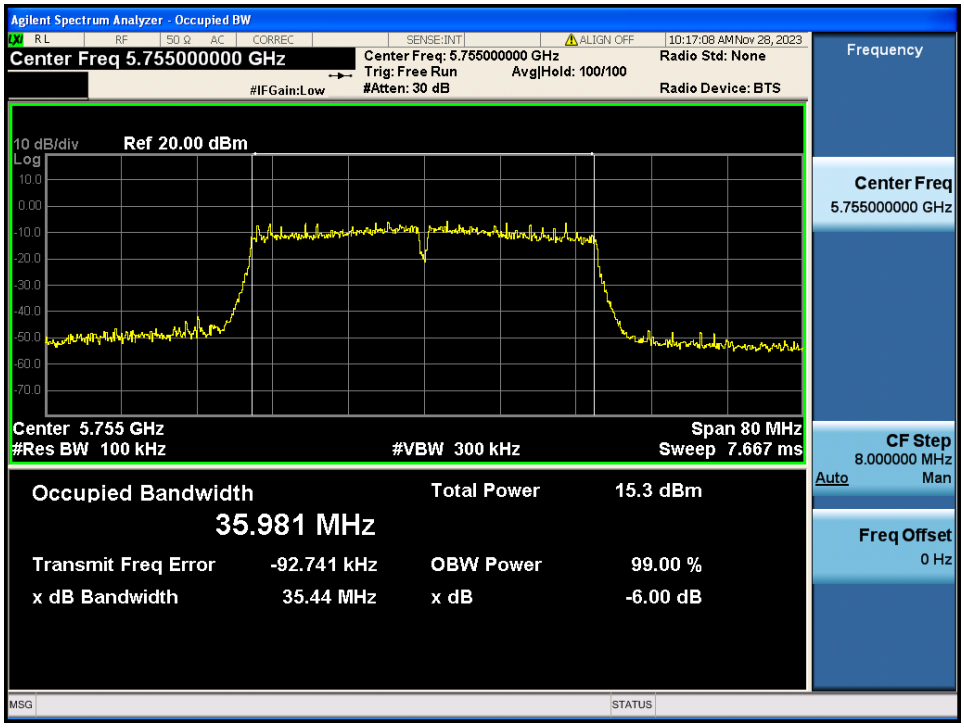


6 dB Bandwidth

Test Mode: TM 2 & ANT 1 & Ch.165

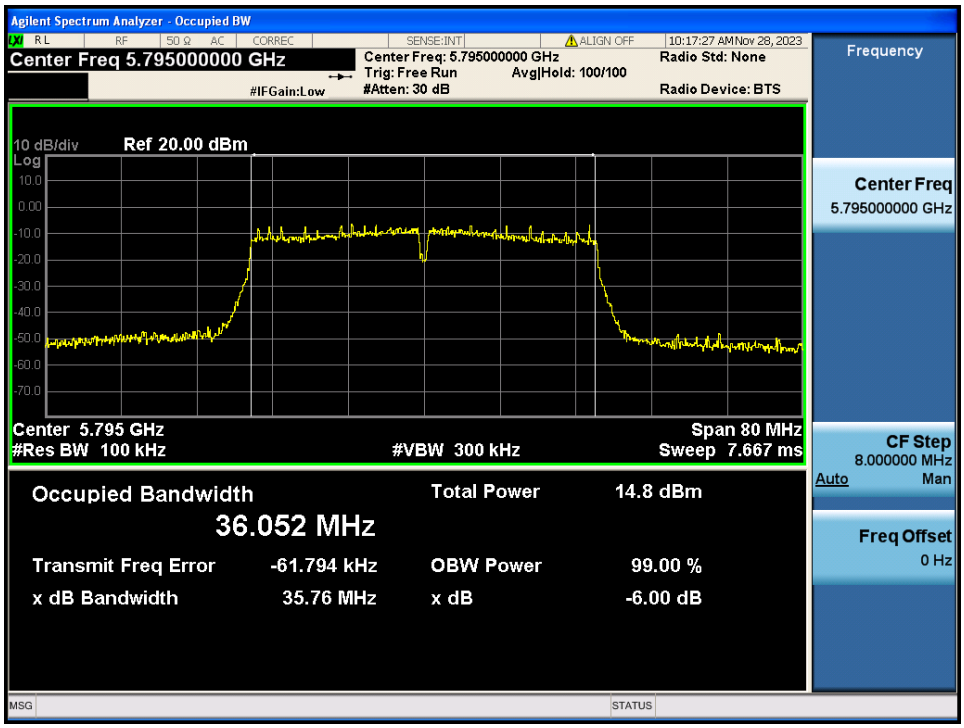
6 dB Bandwidth

Test Mode: TM 3 & ANT 1 & Ch.151



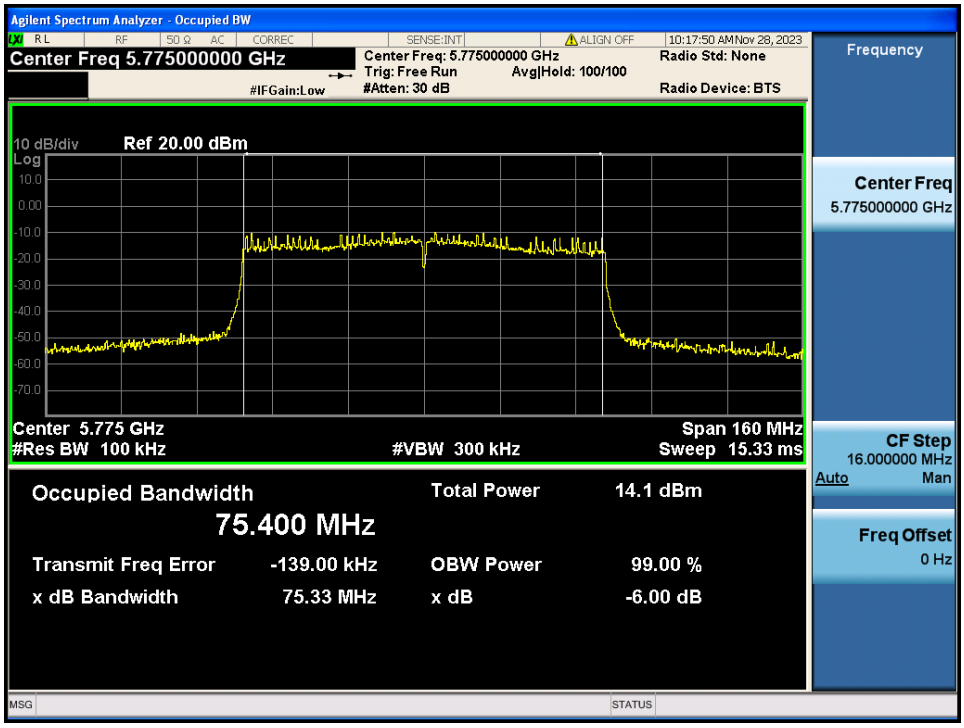
6 dB Bandwidth

Test Mode: TM 3 & ANT 1 & Ch.159



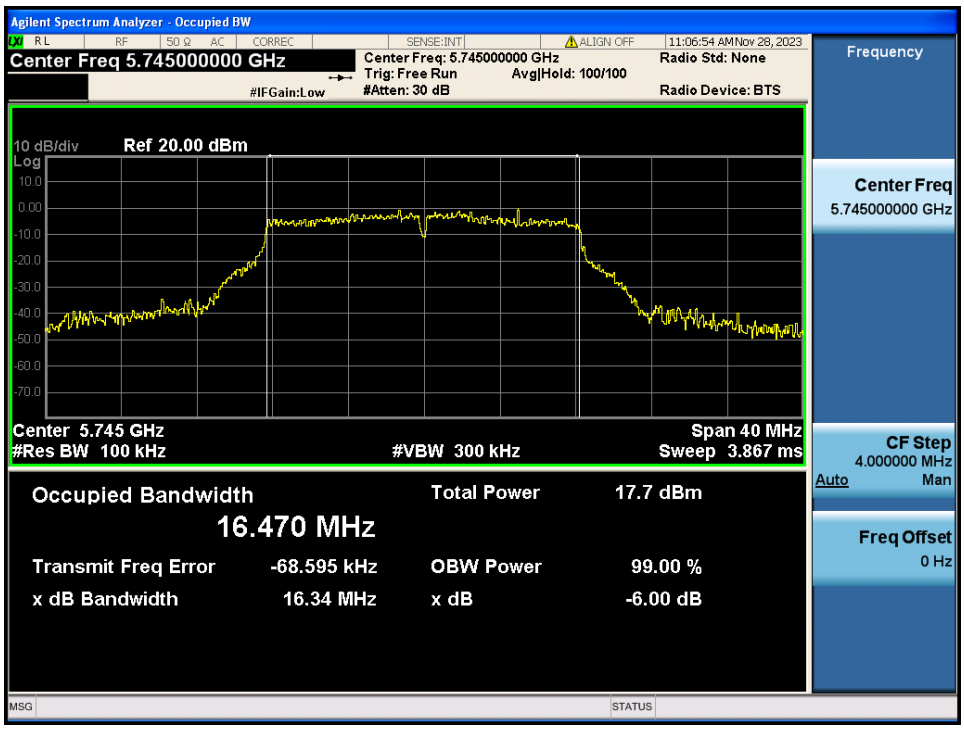
6 dB Bandwidth

Test Mode: TM 4 & ANT 1 & Ch.155



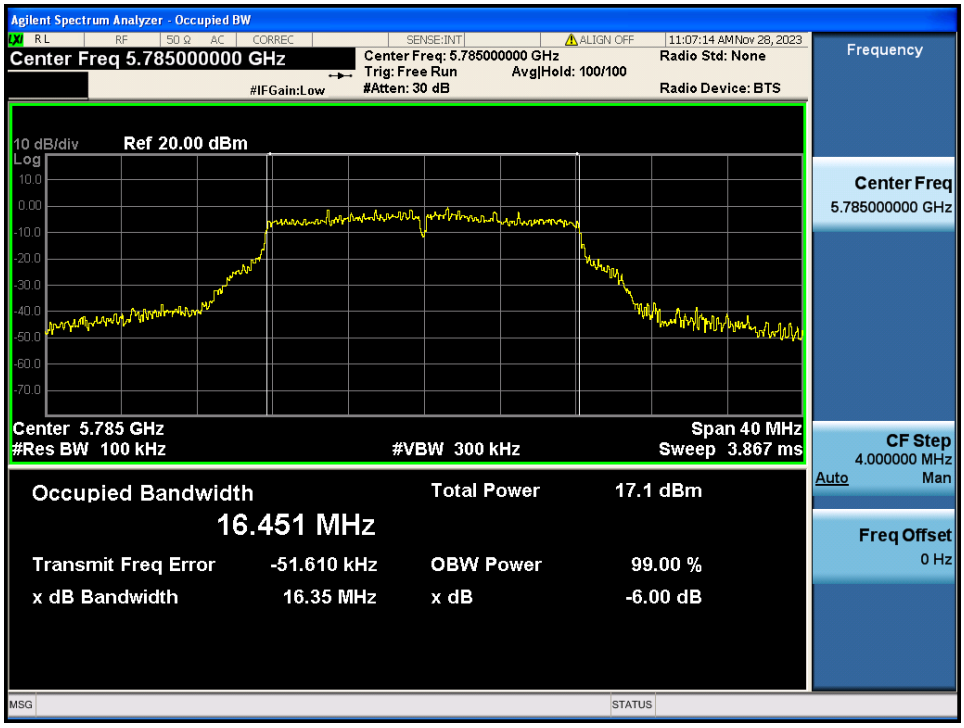
6 dB Bandwidth

Test Mode: TM 1 & ANT 2 & Ch.149



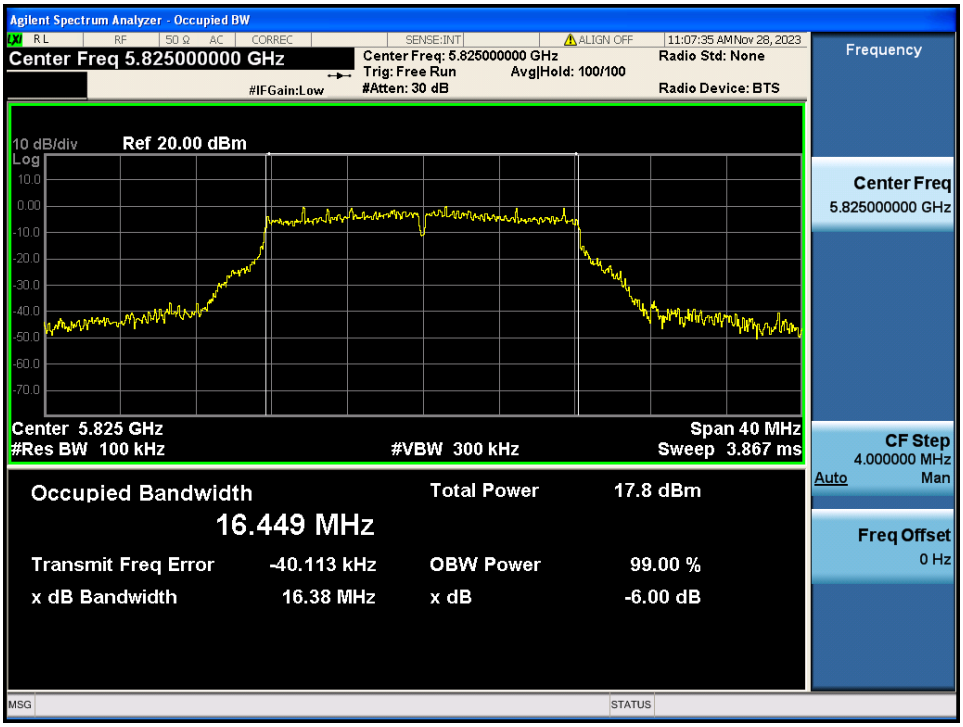
6 dB Bandwidth

Test Mode: TM 1 & ANT 2 & Ch.157



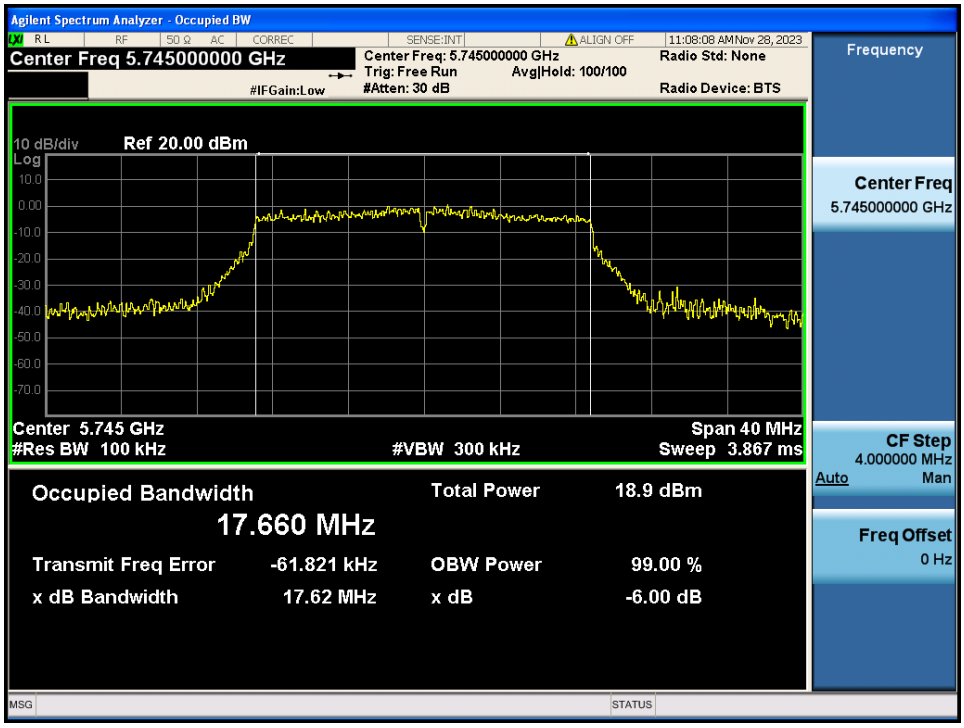
6 dB Bandwidth

Test Mode: TM 1 & ANT 2 & Ch.165



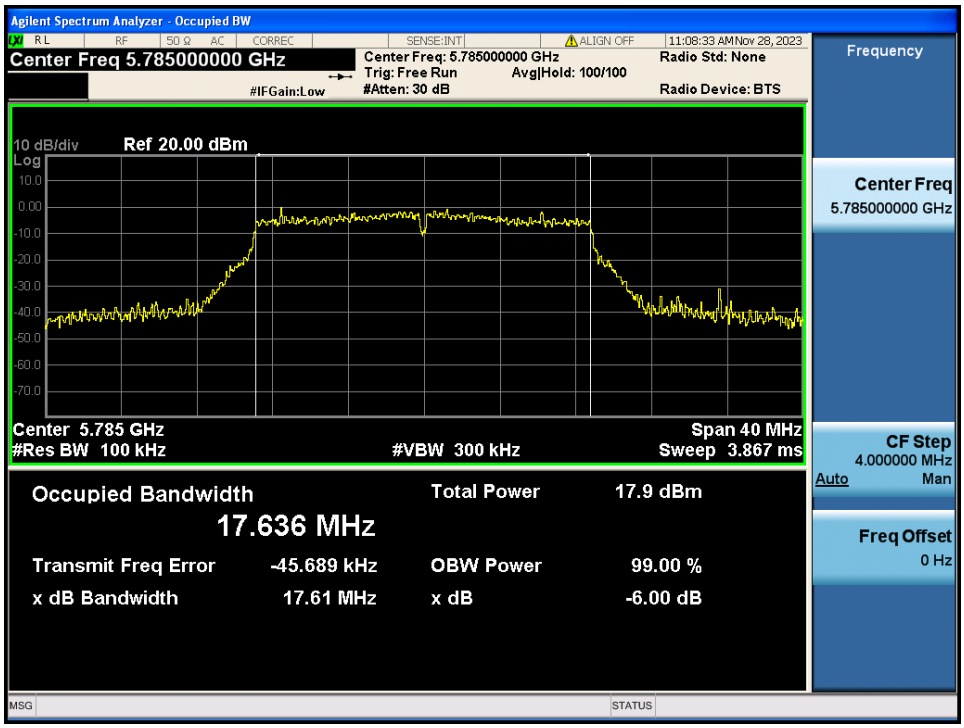
6 dB Bandwidth

Test Mode: TM 2 & ANT 2 & Ch.149



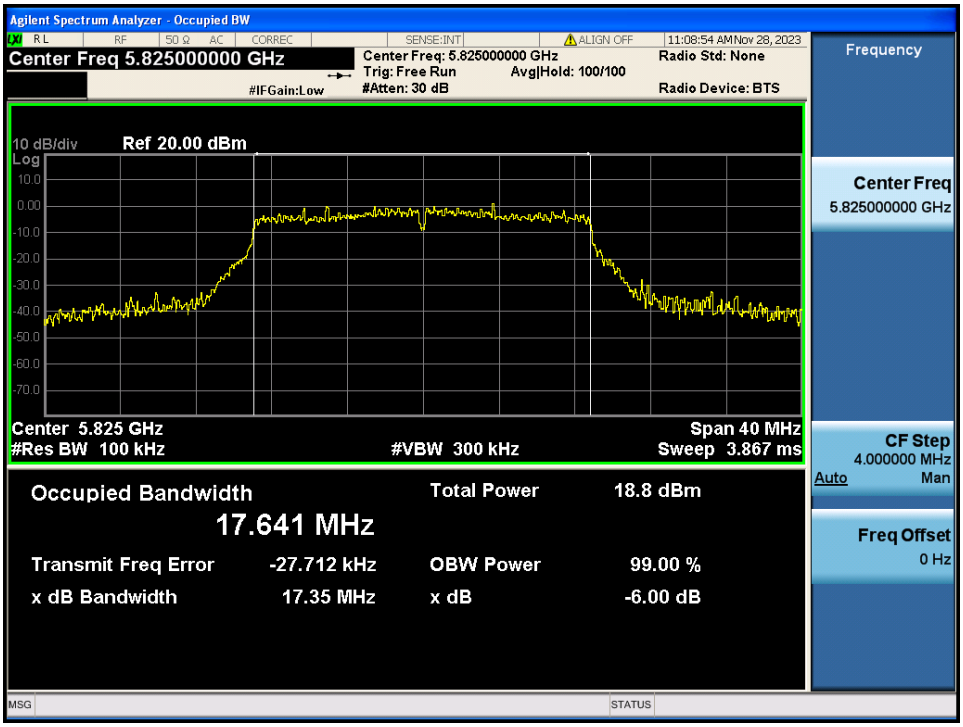
6 dB Bandwidth

Test Mode: TM 2 & ANT 2 & Ch.157



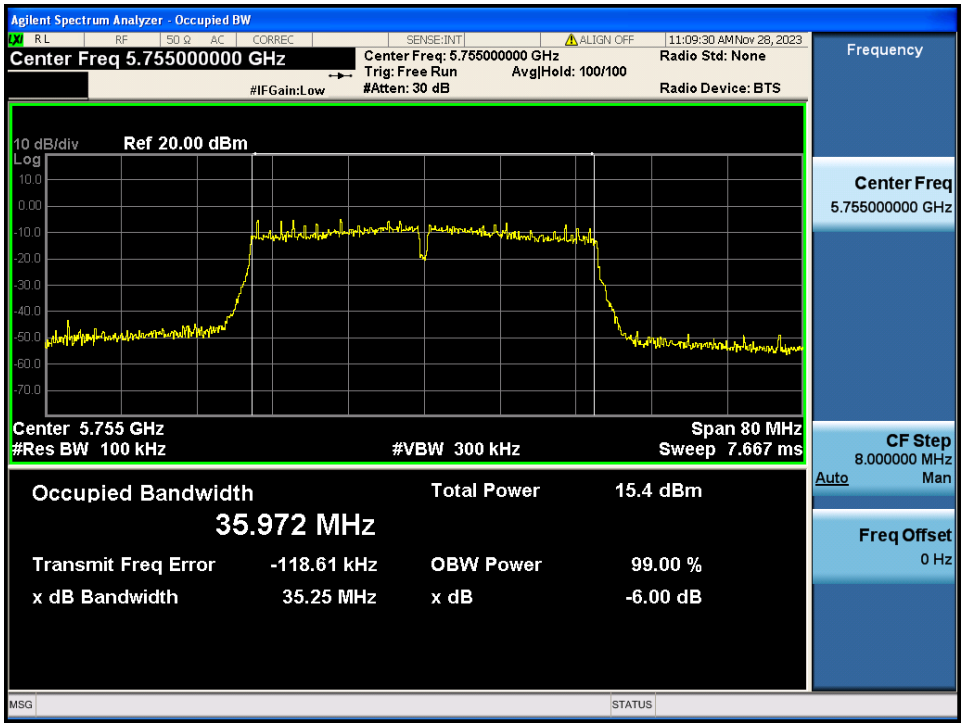
6 dB Bandwidth

Test Mode: TM 2 & ANT 2 & Ch.165



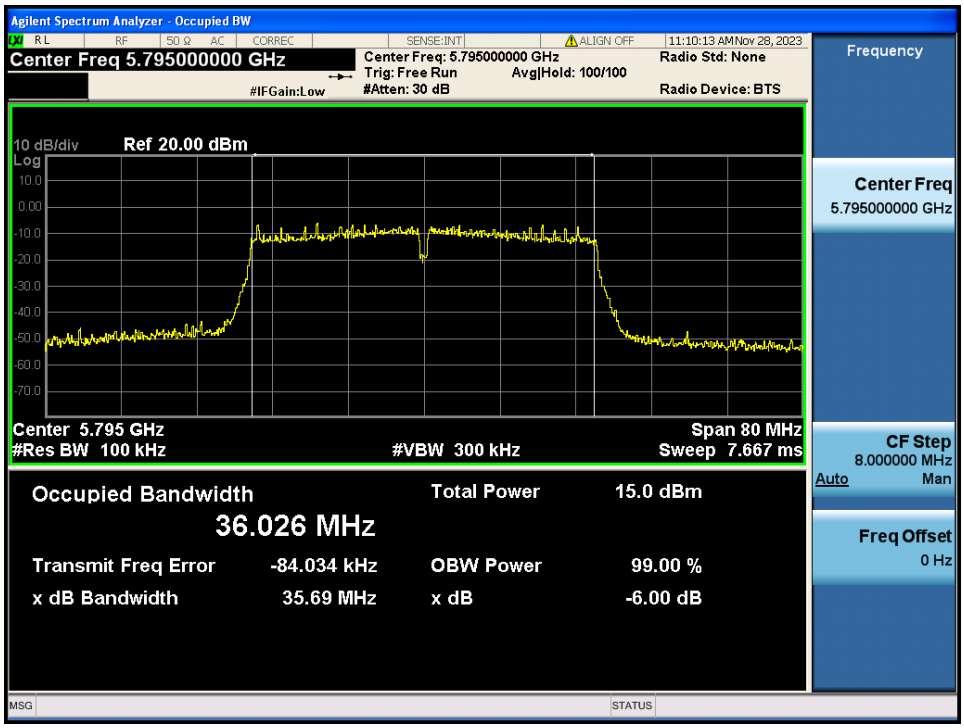
6 dB Bandwidth

Test Mode: TM 3 & ANT 2 & Ch.151



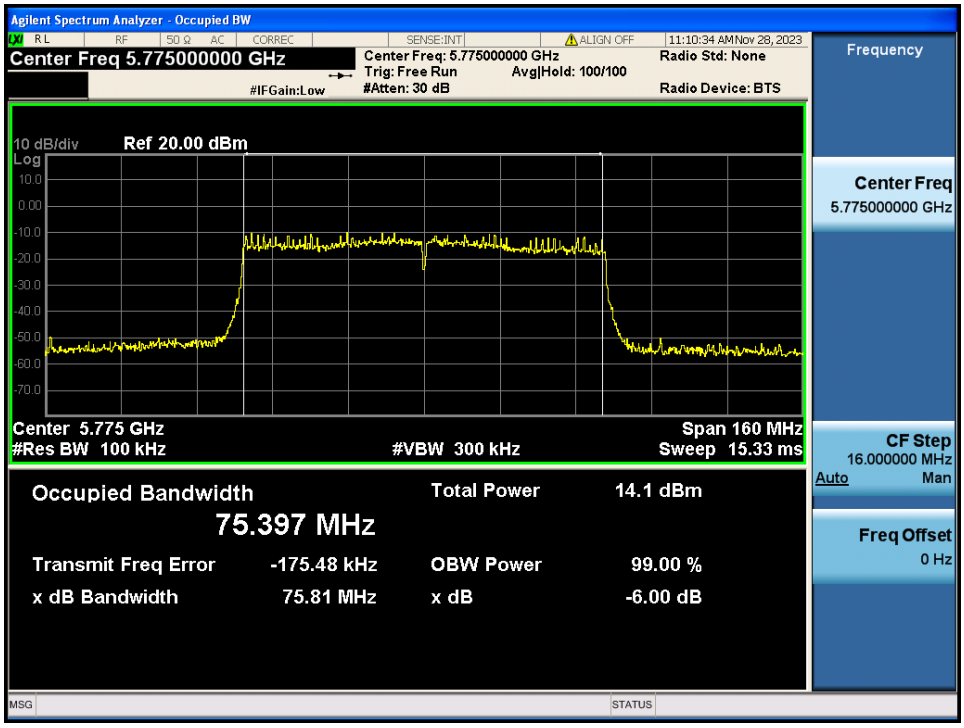
6 dB Bandwidth

Test Mode: TM 3 & ANT 2 & Ch.159



6 dB Bandwidth

Test Mode: TM 4 & ANT 2 & Ch.155



5.3. Maximum Conducted Output Power

▣ Test Requirements

Part. 15.407(a)

(1) For the band 5.15 GHz - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 GHz - 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. 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 GHz - 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. 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 GHz - 5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. 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 mobile and portable client devices in the 5.15 GHz - 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. 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 GHz - 5.35 GHz and 5.47 GHz - 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. 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 GHz - 5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. 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. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. 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.

▣ Test Configuration

Method PM-G

▣ Test Procedure

Method PM-G of KDB789033 D02v02r01

Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

▣ **Test Results: Comply**

- Output Power : CDD

Mode	Band	Channel	Frequency (MHz)	Test Result [dBm]		
				ANT 1	ANT 2	SUM
802.11a	U-NII 1	36	5 180	12.41	12.57	15.50
		40	5 200	12.43	12.68	15.57
		48	5 240	12.57	12.54	15.57
	U-NII 3	149	5 745	11.52	11.61	14.58
		157	5 785	11.51	11.66	14.60
		165	5 825	11.42	11.78	14.61
802.11n (HT20)	U-NII 1	36	5 180	13.58	13.72	16.66
		40	5 200	13.58	13.79	16.70
		48	5 240	13.41	13.39	16.41
	U-NII 3	149	5 745	12.41	12.48	15.46
		157	5 785	12.63	12.45	15.55
		165	5 825	12.47	12.38	15.44
802.11ac (VHT20)	U-NII 1	36	5 180	13.49	13.61	16.56
		40	5 200	13.49	13.71	16.61
		48	5 240	13.30	13.32	16.32
	U-NII 3	149	5 745	12.28	12.32	15.31
		157	5 785	12.51	12.34	15.44
		165	5 825	12.42	12.27	15.36
802.11n (HT40)	U-NII 1	38	5 190	9.63	10.04	12.85
		46	5 230	9.43	10.08	12.78
	U-NII 3	151	5 755	8.45	8.87	11.68
		159	5 795	8.34	8.67	11.52
802.11ac (VHT40)	U-NII 1	38	5 190	9.49	9.95	12.74
		46	5 230	9.36	10.02	12.71
	U-NII 3	151	5 755	8.37	8.77	11.58
		159	5 795	8.27	8.61	11.45
802.11ac (VHT80)	U-NII 1	42	5 210	7.38	7.74	10.57
	U-NII 3	155	5 775	6.84	6.99	9.93

- Output Power : SDM

Mode	Band	Channel	Frequency (MHz)	Test Result [dBm]		
				ANT 1	ANT 2	SUM
802.11n (HT20)	U-NII 1	36	5 180	13.50	13.66	16.59
		40	5 200	13.43	13.64	16.55
		48	5 240	13.28	13.31	16.31
	U-NII 3	149	5 745	12.28	12.42	15.36
		157	5 785	12.54	12.33	15.45
		165	5 825	12.42	12.30	15.37
802.11ac (VHT20)	U-NII 1	36	5 180	13.38	13.52	16.46
		40	5 200	13.38	13.63	16.52
		48	5 240	13.22	13.23	16.24
	U-NII 3	149	5 745	12.16	12.22	15.20
		157	5 785	12.45	12.28	15.38
		165	5 825	12.27	12.17	15.23
802.11n (HT40)	U-NII 1	38	5 190	9.63	10.04	12.85
		46	5 230	9.43	10.08	12.78
	U-NII 3	151	5 755	8.45	8.87	11.68
		159	5 795	8.34	8.67	11.52
802.11ac (VHT40)	U-NII 1	38	5 190	9.49	9.95	12.74
		46	5 230	9.36	10.02	12.71
	U-NII 3	151	5 755	8.37	8.77	11.58
		159	5 795	8.27	8.61	11.45
802.11ac (VHT80)	U-NII 1	42	5 210	7.38	7.74	10.57
	U-NII 3	155	5 775	6.84	6.99	9.93

5.4. Maximum Power Spectral Density

▣ Test requirements

Part. 15.407(a)

(1) For the band 5.15 GHz - 5.25 GHz.

(i) For an outdoor access point operating in the band 5.15 GHz - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band. note1

(ii) For an indoor access point operating in the band 5.15 GHz - 5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 MHz band. note1

(iii) For fixed point-to-point access points operating in the band 5.15 GHz - 5.25 GHz, transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

(iv) For mobile and portable client devices in the 5.15 GHz - 5.25 GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 MHz band. note1

(2) For the 5.25 GHz - 5.35 GHz and 5.47 GHz - 5.725 GHz bands, the peak power spectral density shall not exceed 11 dBm in any 1 MHz band. note1

(3) For the band 5.725 GHz - 5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band.note1,note2

Note1: If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note2: Fixed point - to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information.

▣ Test Configuration

Refer to the APPENDIX I.

▣ **Test Procedure**

Maximum Power Spectral Density is measured using Measurement Procedure **of KDB789033 D02v02r01**

1) Create an average power spectrum for the EUT operating mode being tested by following the instructions in section II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA - 1, SA - 2, SA - 3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power…”. (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)

2) Use the peak search function on the instrument to find the peak of the spectrum and record its value.

3) Make the following adjustments to the peak value of the spectrum, if applicable:

a) If Method SA - 2 or SA - 2 Alternative was used, add 10 log(1 / x), where x is the duty cycle, to the peak of the spectrum.

b) If Method SA - 3 Alternative was used and the linear mode was used in step II.E.2.g (viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.

4) The result is the Maximum PSD over 1 MHz reference bandwidth.

5) For devices operating in the bands 5.15 GHz - 5.25 GHz, 5.25 GHz - 5.35 GHz, and 5.47 GHz - 5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in §15.407(a). For devices operating in the band 5.725 GHz - 5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:

a) Set RBW ≥ 1 / T, where T is defined in section II.B.1.a). (Refer to Appendix II)

b) Set VBW ≥ 3 RBW.

c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10 log(500 kHz / RBW) to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add 10 log(1 MHz / RBW) to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.

e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

▣ **Test Results: Comply**

- Multiple transmitting

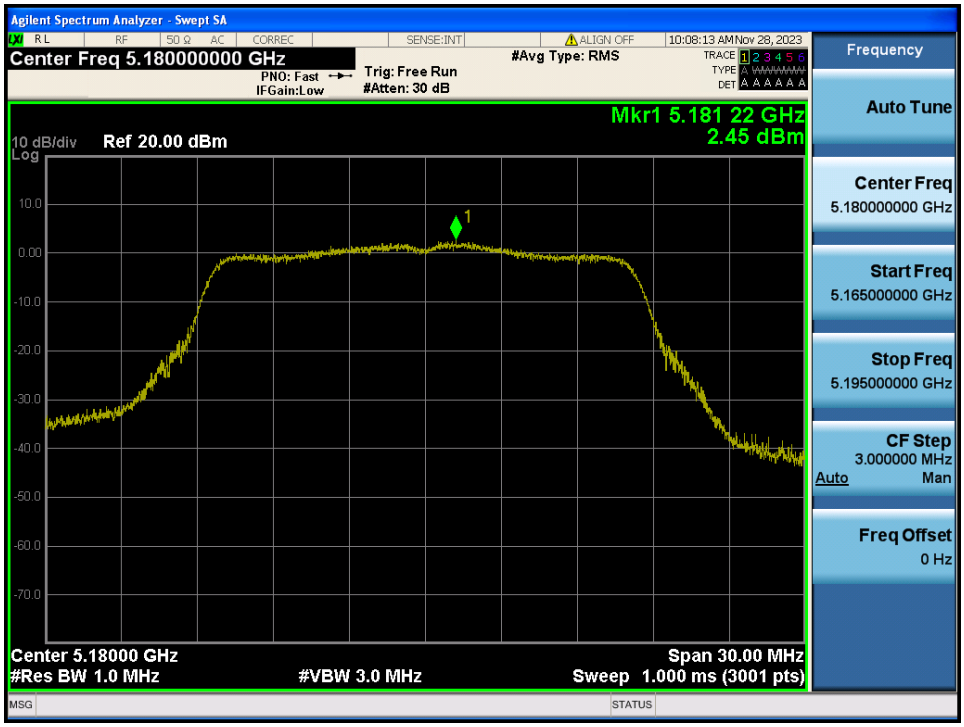
Mode	Band	Channel	Frequency [MHz]	Reading [dBm]		DCCF [dB]	Test Result [dBm]
				ANT 1	ANT 2		ANT1+ANT2+DCCF
TM 1	U-NII 1	36	5 180	2.45	2.51	0.21	5.70
		40	5 200	2.17	2.27		5.44
		48	5 240	1.71	2.50		5.34
TM 2	U-NII 1	36	5 180	3.08	3.45	0.22	6.50
		40	5 200	2.99	2.69		6.07
		48	5 240	2.54	2.16		5.58
TM 3	U-NII 1	38	5 190	-3.56	-3.42	0.45	-0.03
		46	5 230	-4.07	-3.92		-0.53
TM 4	U-NII 1	42	5 210	-9.47	-9.08	0.87	-5.39

Mode	Band	Channel	Frequency [MHz]	Reading [dBm]		DCCF [dB]	Test Result [dBm]
				ANT 1	ANT 2		ANT1+ANT2+DCCF
TM 1	U-NII 3	149	5 745	-1.26	-1.61	0.21	1.79
		157	5 785	-1.90	-2.32		1.12
		165	5 825	-1.02	-1.33		2.05
TM 2	U-NII 3	149	5 745	-0.51	-0.72	0.22	2.62
		157	5 785	-1.38	-1.54		1.77
		165	5 825	-0.31	-1.06		2.56
TM 3	U-NII 3	151	5 755	-7.64	-8.13	0.45	-4.42
		159	5 795	-8.19	-8.15		-4.71
TM 4	U-NII 3	155	5 775	-13.28	-13.47	0.87	-9.49

Note 1: Power Spectral Density = Reading(Measurement Data) + DCCF
Note 2: Where, DCCF = Duty Cycle Correction Factor
For DCCF(Duty Cycle Correction Factor) please refer to appendix II.

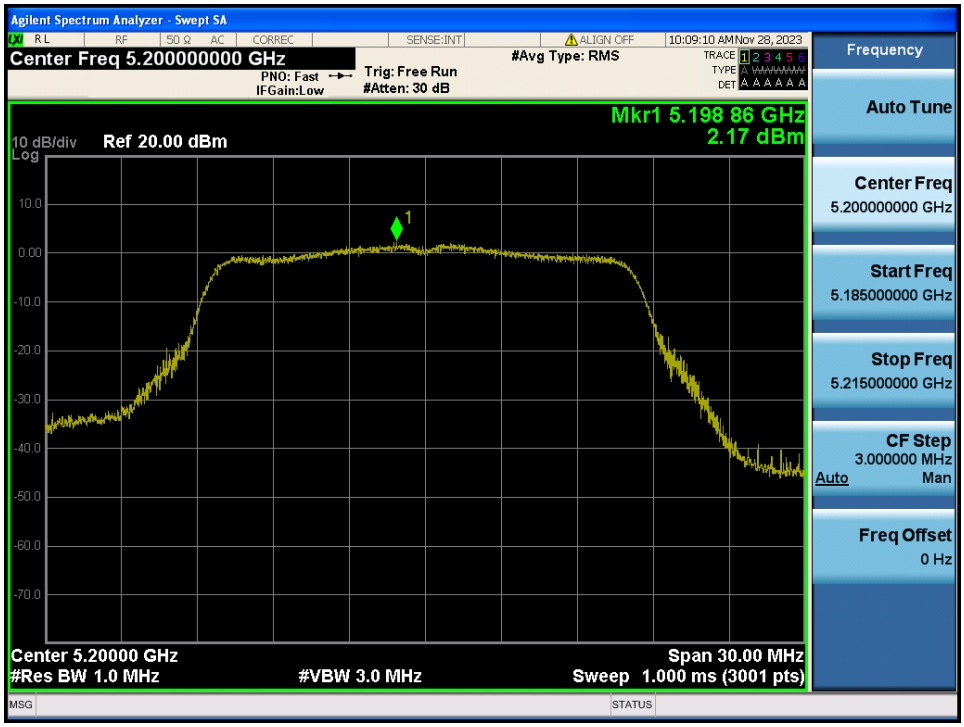
Maximum Power Spectral Density

Test Mode: TM 1 & ANT 1 & Ch.36

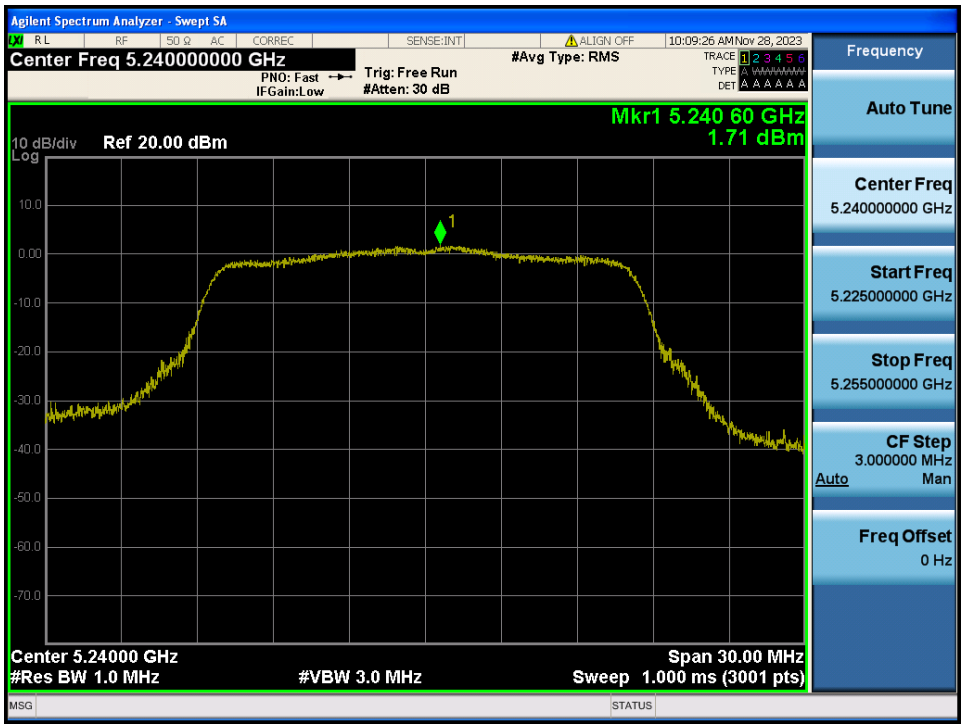


Maximum Power Spectral Density

Test Mode: TM 1 & ANT 1 & Ch.40



Maximum Power Spectral Density Test Mode: TM 1 & ANT 1 & Ch.48

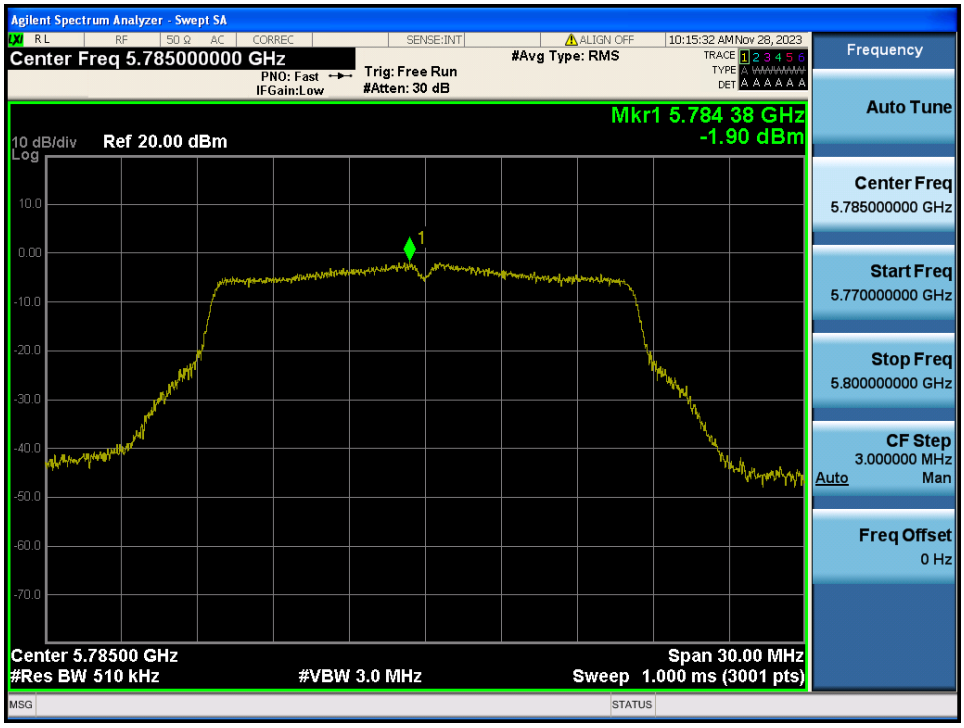


Maximum Power Spectral Density

Test Mode: TM 1 & ANT 1 & Ch.149

Maximum Power Spectral Density

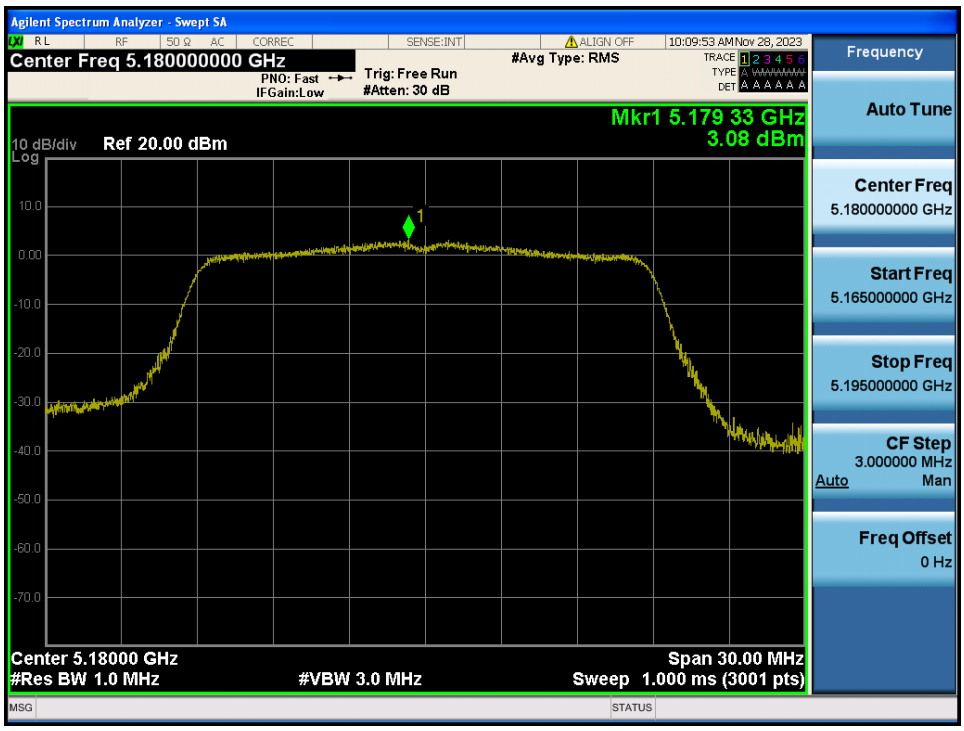
Test Mode: TM 1 & ANT 1 & Ch.157



Maximum Power Spectral Density Test Mode: TM 1 & ANT 1 & Ch.165

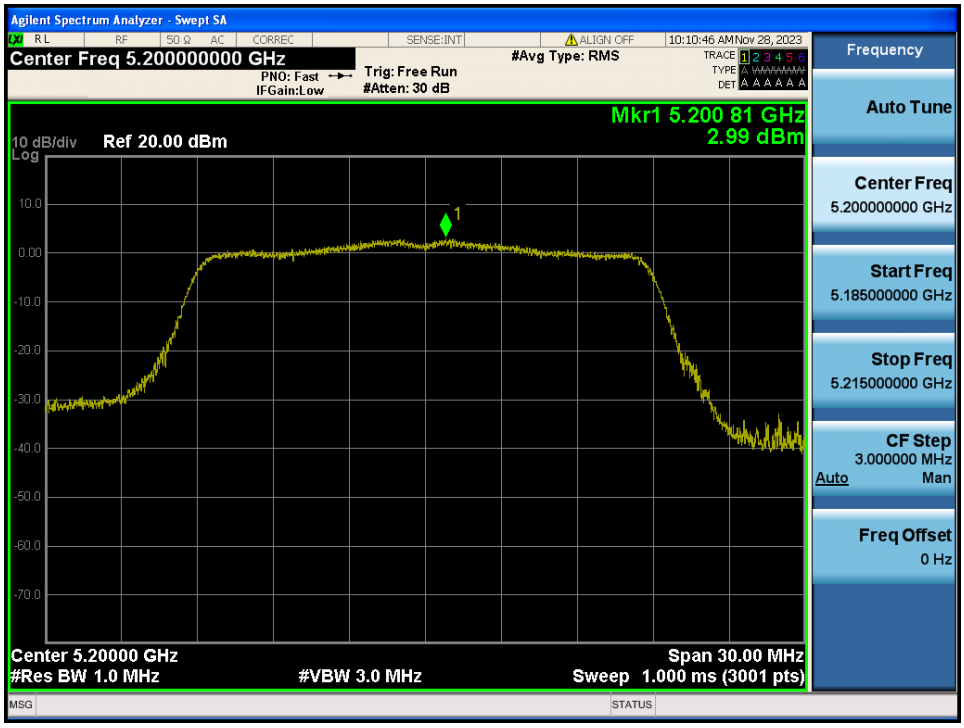
Maximum Power Spectral Density

Test Mode: TM 2 & ANT 1 & Ch.36



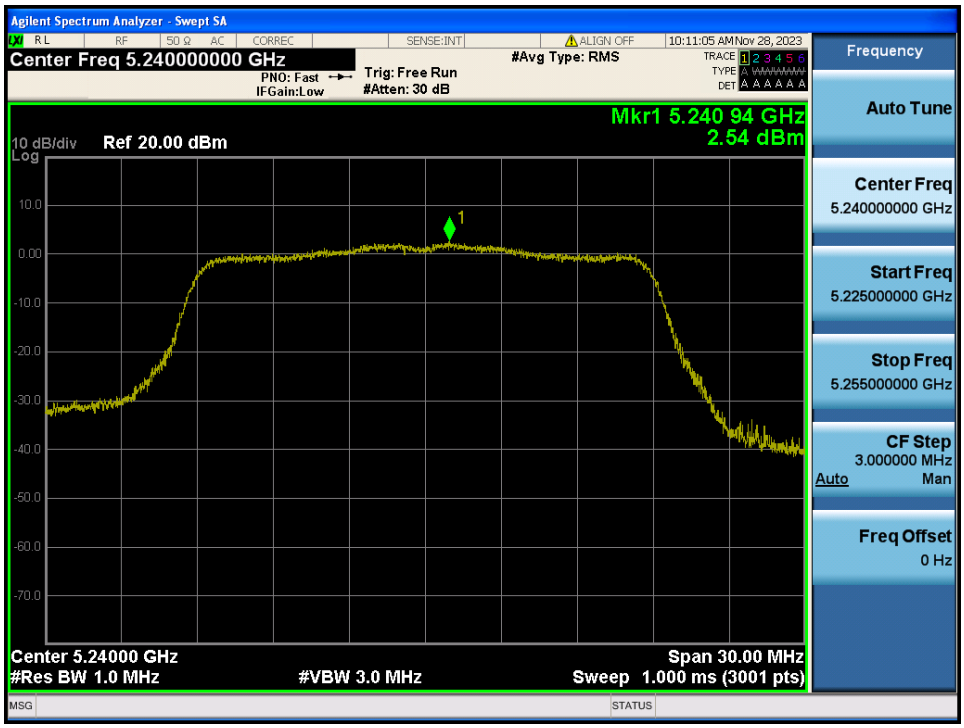
Maximum Power Spectral Density

Test Mode: TM 2 & ANT 1 & Ch.40



Maximum Power Spectral Density

Test Mode: TM 2 & ANT 1 & Ch.48



Maximum Power Spectral Density

Test Mode: TM 2 & ANT 1 & Ch.149

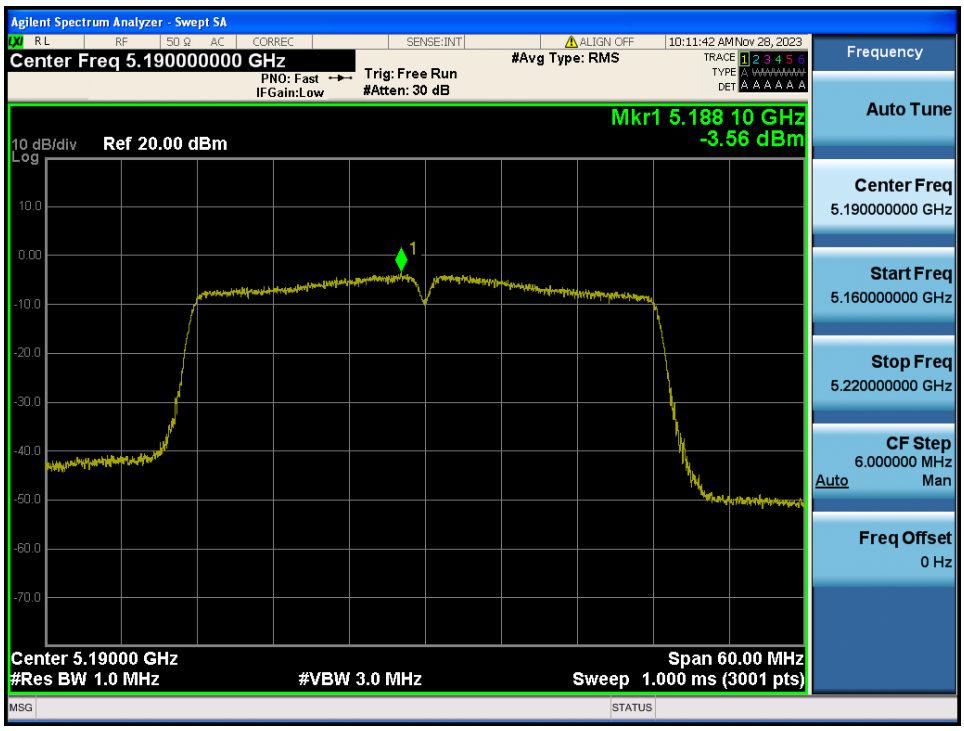
Maximum Power Spectral Density

Test Mode: TM 2 & ANT 1 & Ch.157

Maximum Power Spectral Density Test Mode: TM 2 & ANT 1 & Ch.165

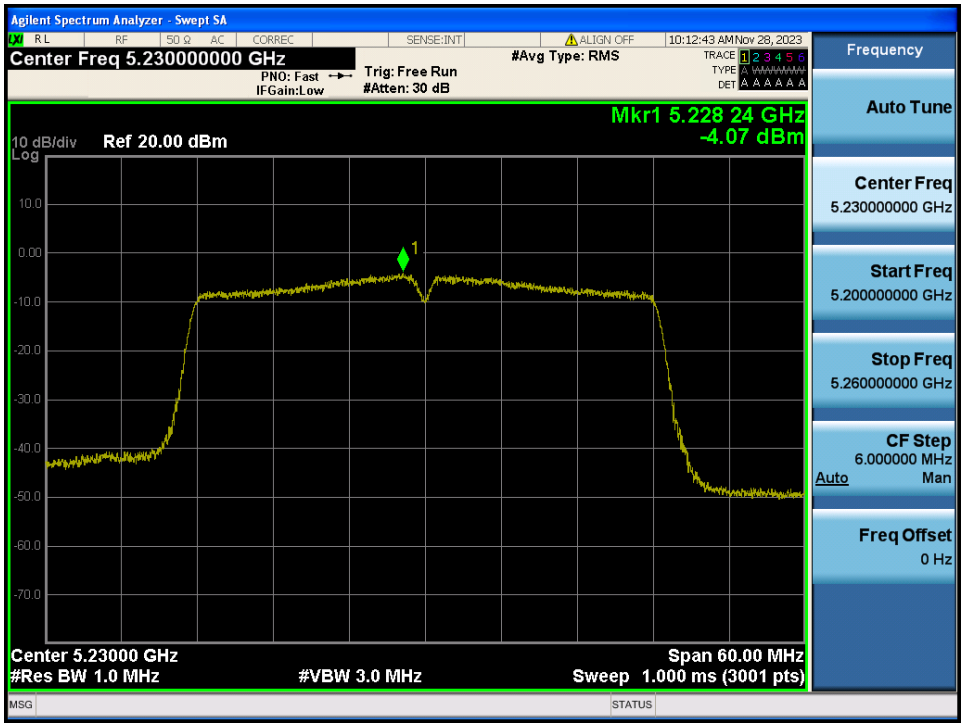
Maximum Power Spectral Density

Test Mode: TM 3 & ANT 1 & Ch.38



Maximum Power Spectral Density

Test Mode: TM 3 & ANT 1 & Ch.46

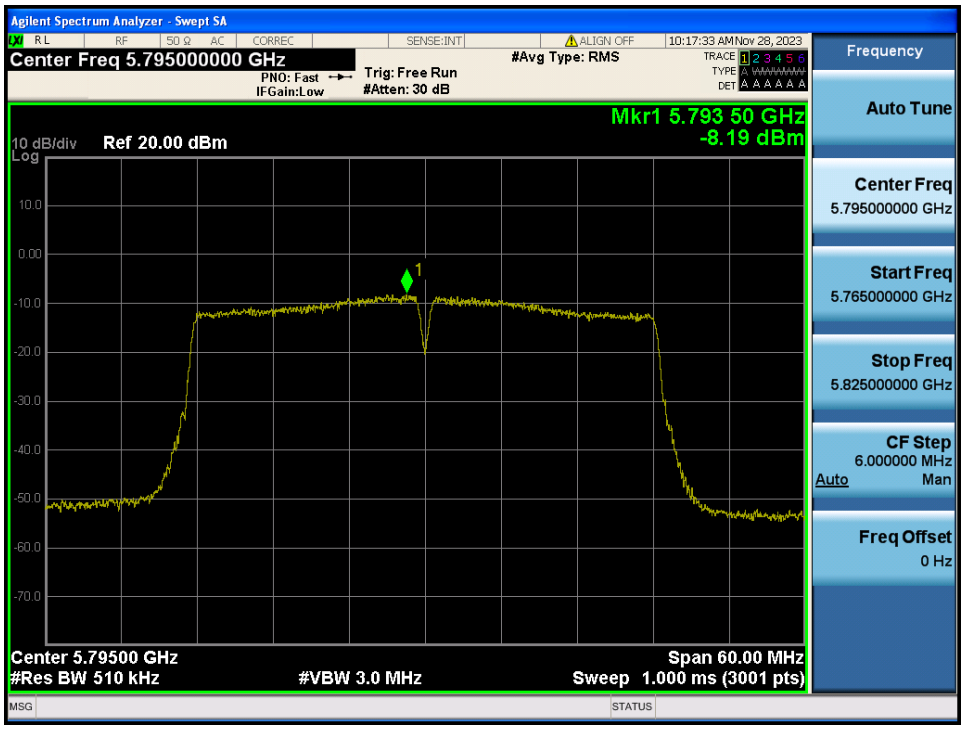


Maximum Power Spectral Density

Test Mode: TM 3 & ANT 1 & Ch.151

Maximum Power Spectral Density

Test Mode: TM 3 & ANT 1 & Ch.159

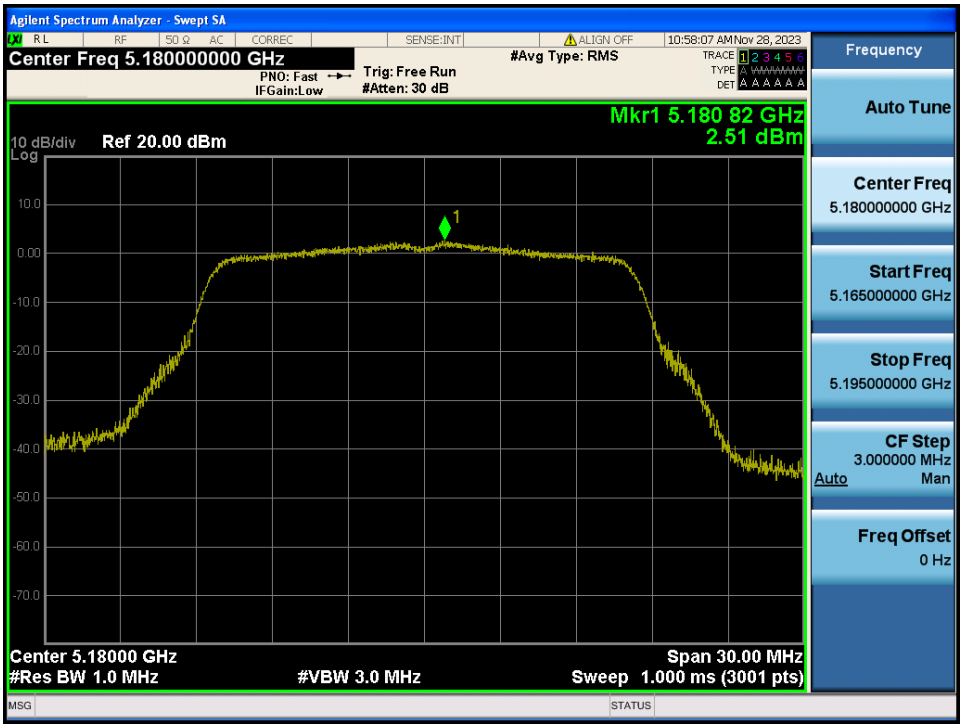


Maximum Power Spectral Density Test Mode: TM 4 & ANT 1 & Ch.42

Maximum Power Spectral Density Test Mode: TM 4 & ANT 1 & Ch.155

Maximum Power Spectral Density

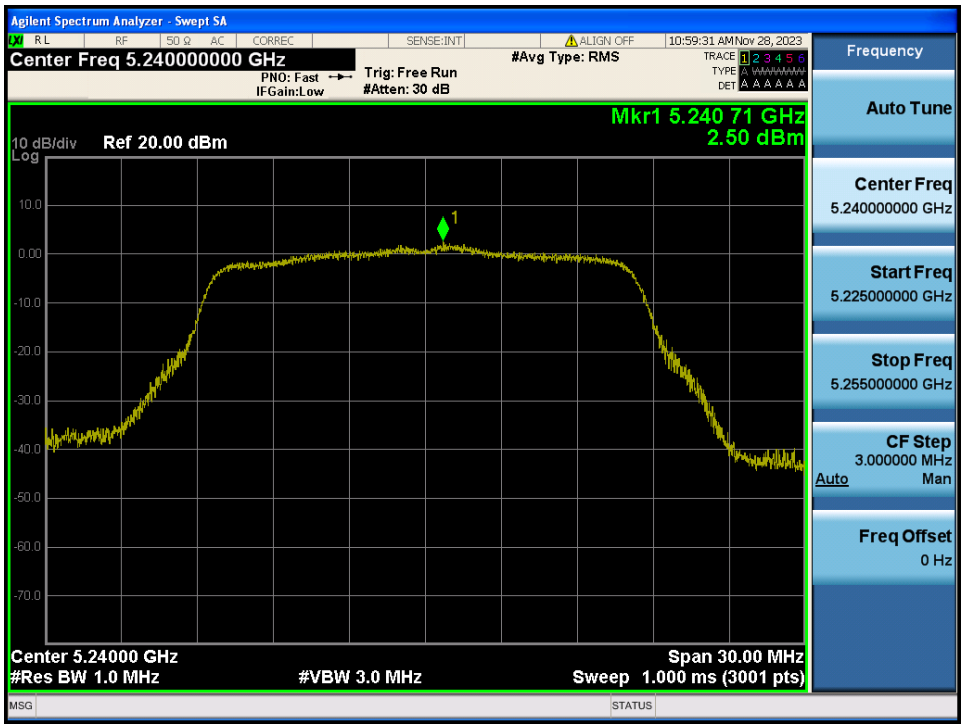
Test Mode: TM 1 & ANT 2 & Ch.36



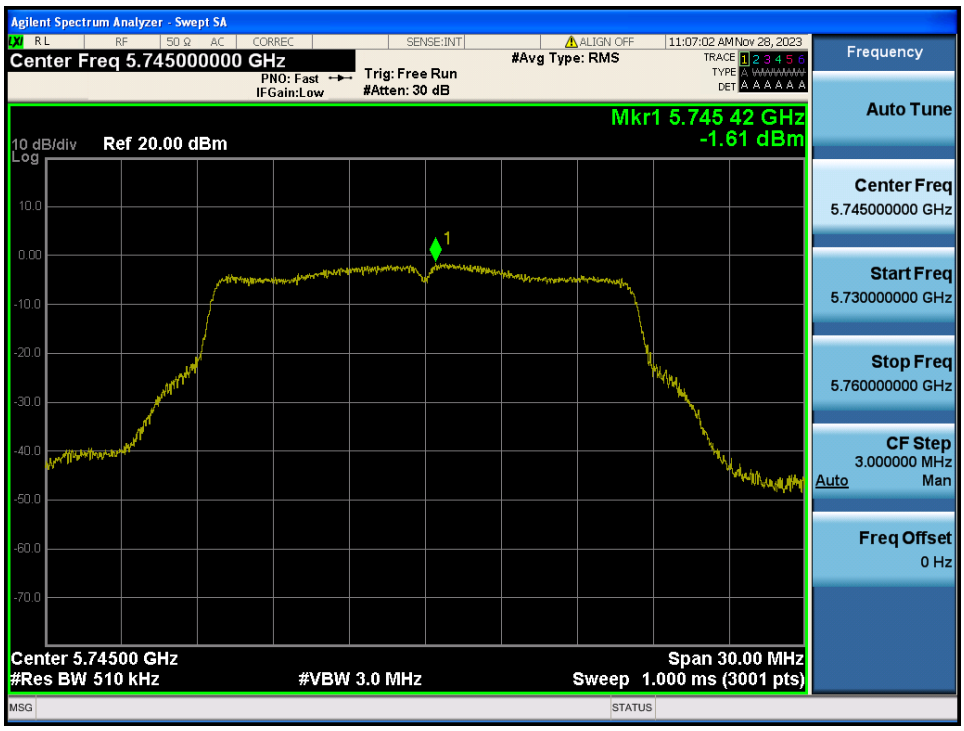
Maximum Power Spectral Density

Test Mode: TM 1 & ANT 2 & Ch.40

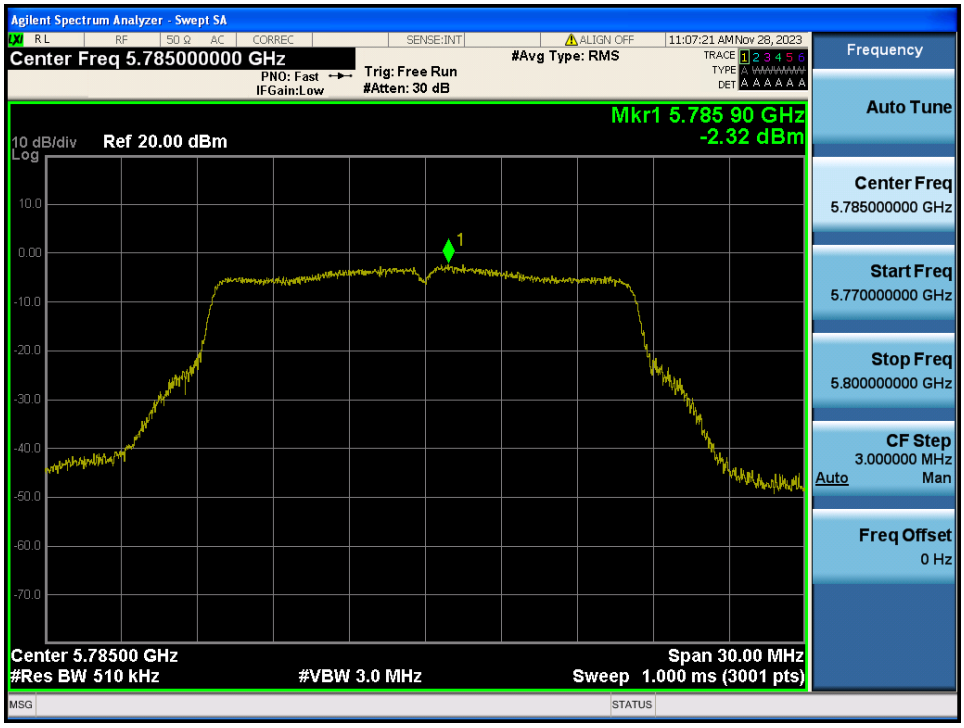
Maximum Power Spectral Density Test Mode: TM 1 & ANT 2 & Ch.48



Maximum Power Spectral Density Test Mode: TM 1 & ANT 2 & Ch.149

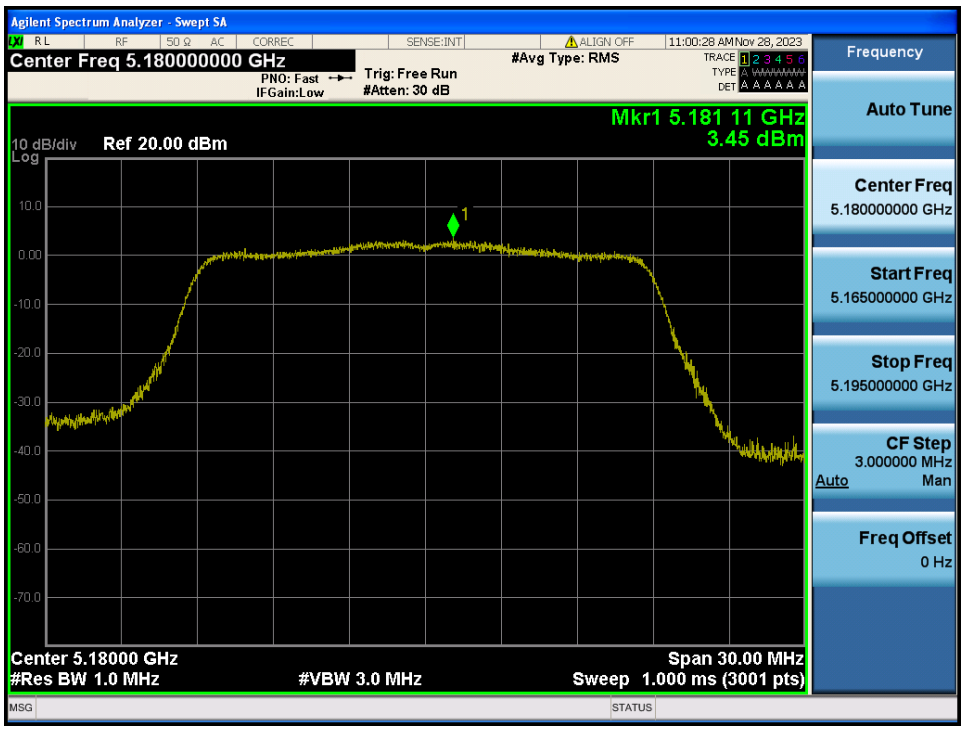


Maximum Power Spectral Density Test Mode: TM 1 & ANT 2 & Ch.157

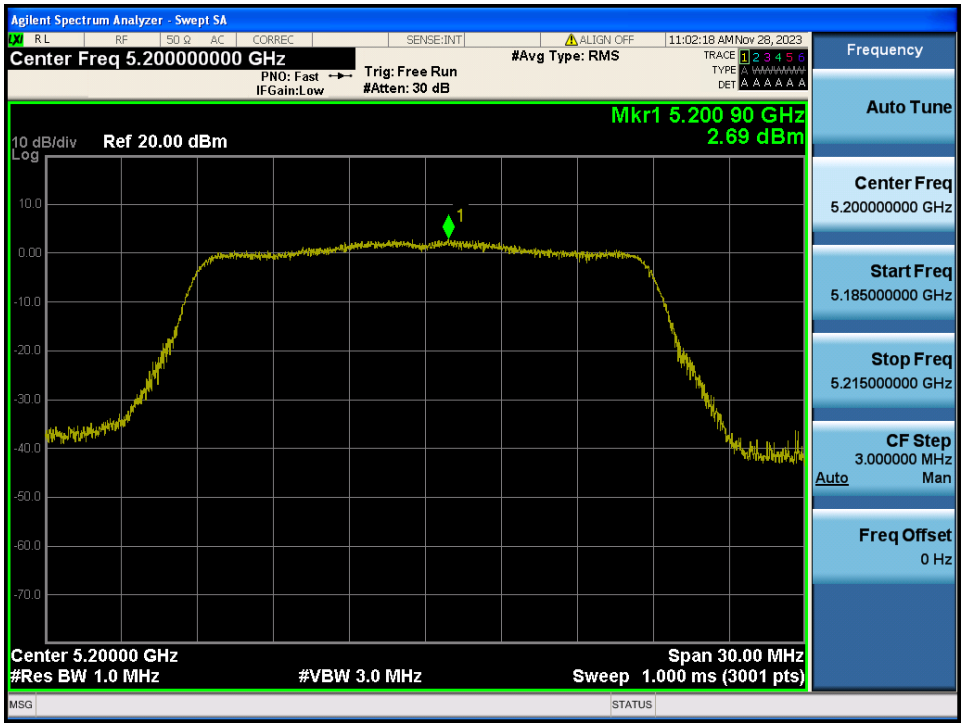


Maximum Power Spectral Density Test Mode: TM 1 & ANT 2 & Ch.165

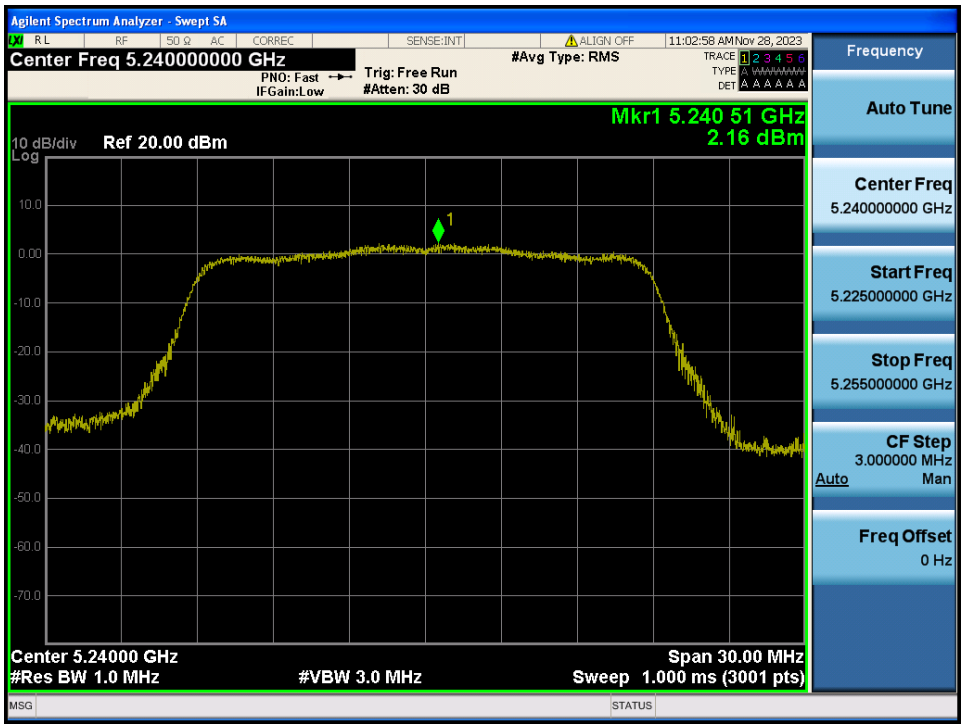
Maximum Power Spectral Density Test Mode: TM 2 & ANT 2 & Ch.36



Maximum Power Spectral Density Test Mode: TM 2 & ANT 2 & Ch.40



Maximum Power Spectral Density Test Mode: TM 2 & ANT 2 & Ch.48

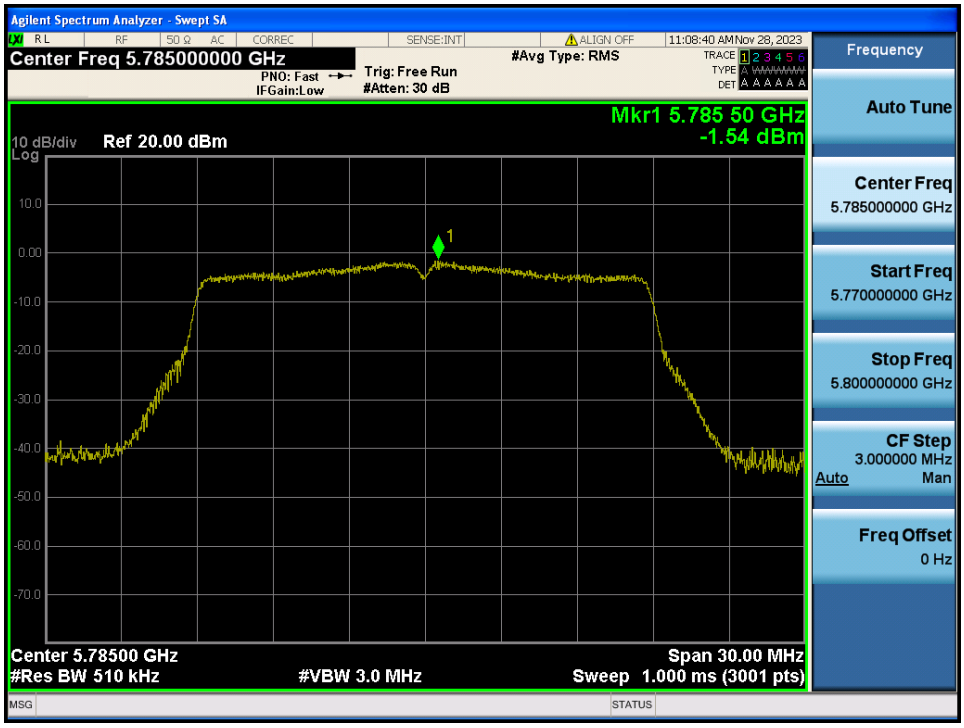


Maximum Power Spectral Density

Test Mode: TM 2 & ANT 2 & Ch.149

Maximum Power Spectral Density

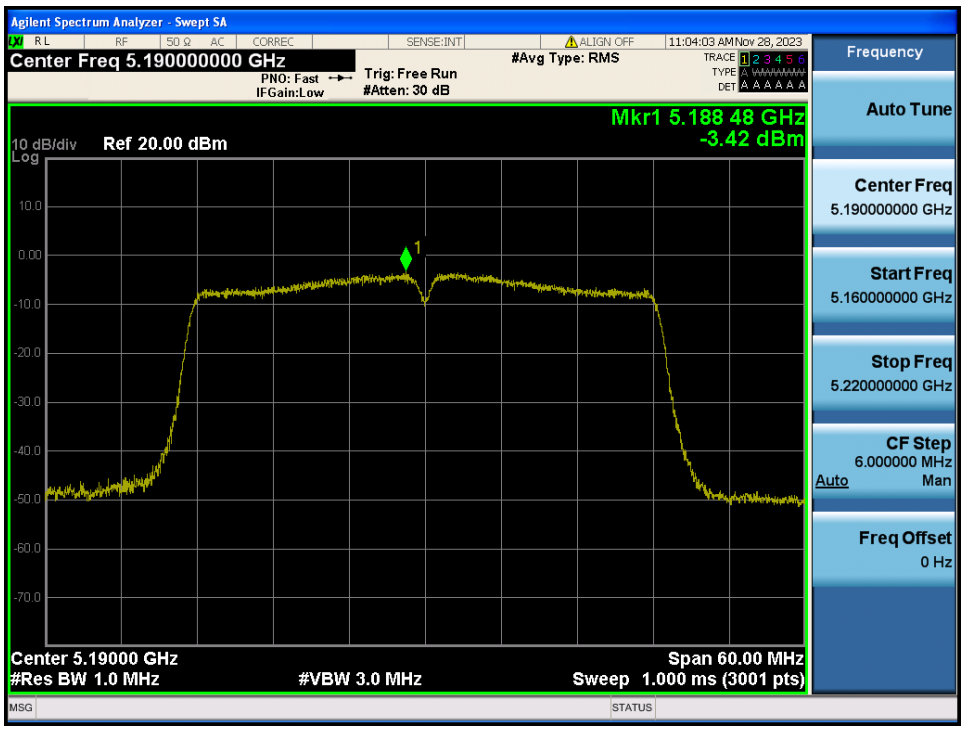
Test Mode: TM 2 & ANT 2 & Ch.157



Maximum Power Spectral Density Test Mode: TM 2 & ANT 2 & Ch.165

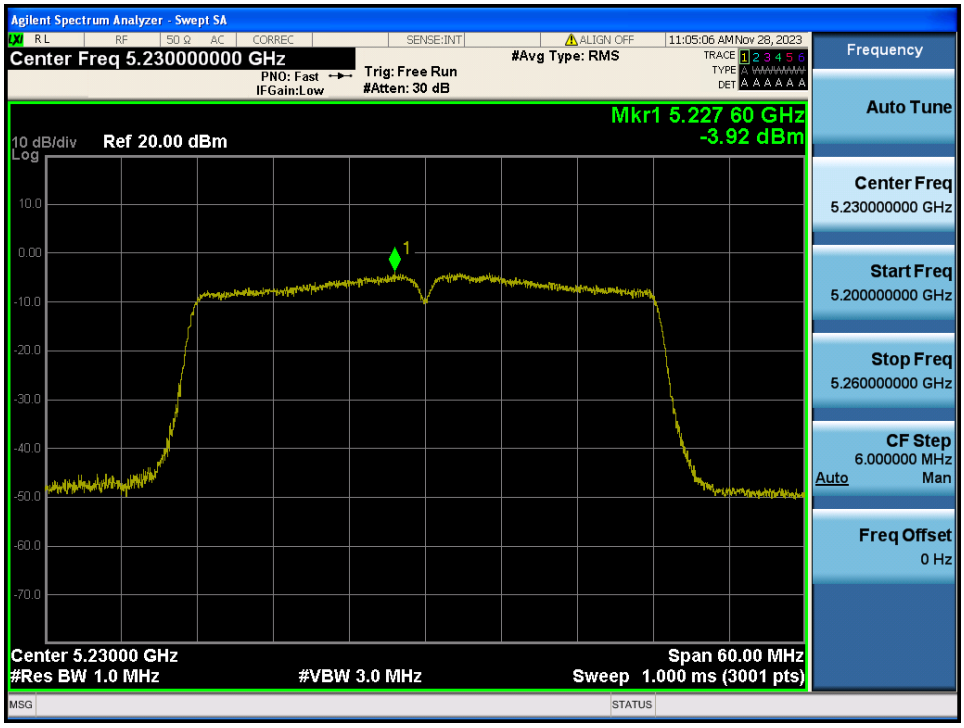
Maximum Power Spectral Density

Test Mode: TM 3 & ANT 2 & Ch.38



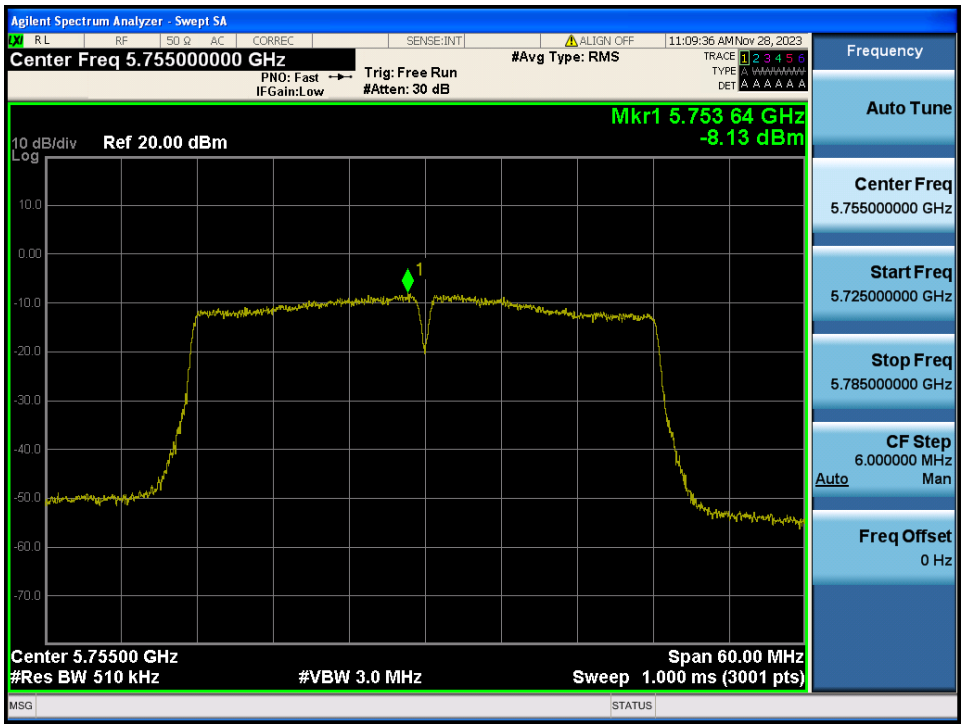
Maximum Power Spectral Density

Test Mode: TM 3 & ANT 2 & Ch.46



Maximum Power Spectral Density

Test Mode: TM 3 & ANT 2 & Ch.151



Maximum Power Spectral Density

Test Mode: TM 3 & ANT 2 & Ch.159

Maximum Power Spectral Density

Test Mode: TM 4 & ANT 2 & Ch.42

Maximum Power Spectral Density

Test Mode: TM 4 & ANT 2 & Ch.155