FCC Test Report

Report No.: AGC05877220313FE05

FCC ID	:	2APA9-CMSXJ33B
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	IMILAB Doorbell Hub
BRAND NAME	:	IMILAB
MODEL NAME	:	CMWG33B
APPLICANT	:	Shanghai Imilab Technology Co., Ltd.
DATE OF ISSUE	:	Apr. 06, 2022
STANDARD(S) **TEST PROCEDURE(S)**	:	FCC Part 15.247
REPORT VERSION	:	V1.0

Attestation of Global Compliance (Shenzhen) Co., Ltd

REPORT REVISE RECORD

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Apr. 06, 2022	Valid	Initial Release

TABLE OF CONTENTS

1. VERIFICATION OF CONFORMITY

Applicant	Shanghai Imilab Technology Co., Ltd.
Address	Room 001A, Floor 11, Block 1, No. 588 Zixing Road, Minhang District, Shanghai, China
manufacturer	Shanghai Imilab Technology Co., Ltd.
Address	Room 001A, Floor 11, Block 1, No. 588 Zixing Road, Minhang District, Shanghai, China
Product Designation	IMILAB Doorbell Hub
Brand Name	IMILAB
Test Model	CMWG33B
Date of test	Mar.24, 2022 to Apr. 06, 2022
Deviation	No any deviation from the test method
Condition of Test Sample	Normal
Test Result	Pass
Report Template	AGCRT-US-BGN/RF

We hereby certify that:

The above equipment was tested by Attestation of Global Compliance (Shenzhen) Co., Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 (2013) and the energy emitted by the sample EUT tested as described in this report is in compliance with radiated emission limits of FCC Rules Part 15.247.

Prepared By	John Zeng (Project Engineer)	Apr. 06, 2022
Reviewed By	Calvin Liu (Reviewer)	Apr. 06, 2022
Approved By	Max Zhang (Authorized Officer)	Apr. 06, 2022

2. GENERAL INFORMATION

2.1. PRODUCT DESCRIPTION

The EUT is designed as “IMILAB Doorbell Hub”. It is designed by way of utilizing the DSSS and OFDM technology to achieve the system operation.

A major technical description of EUT is described as following

Equipment Type	WLAN 2.4G
Frequency Band	2400MHz ~ 2483.5MHz
Operation Frequency	2412MHz ~ 2462MHz
Output Power (Average)	IEEE 802.11b:15.66dBm; IEEE 802.11g:14.88dBm; IEEE 802.11n(HT20):14.52dBm; IEEE 802.11n(HT40):14.07dBm
Output Power (Peak)	IEEE 802.11b:19.30dBm; IEEE 802.11g:24.42dBm; IEEE 802.11n(HT20):24.06dBm; IEEE 802.11n(HT40):19.01dBm
Output Power (MIMO)	IEEE 802.11n(HT20):17.23dBm(Average); IEEE 802.11n(HT40):16.91dBm(Average)
Modulation	802.11b:DQPSK, DBPSK, CCK 802.11g/n: 64-QAM, 16-QAM, QPSK, BPSK
Data Rate	802.11b: 1/2/5.5/11Mbps 802.11g: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 300Mbps
Number of channels	11
Hardware Version	V3
Software Version	V1.0
Antenna Designation	PIFA antenna (Comply with requirements of the FCC part 15.203)
Antenna Gain	2dBi
Number of transmit chain	2(802.11b/g/n all used two antennas,802.11n support MIMO)
Power Supply	AC120V

2.2. TABLE OF CARRIER FREQUENCYS

Frequency Band	Channel Number	Frequency
2400~2483.5MHZ	1	2412 MHZ
	2	2417 MHZ
	3	2422 MHZ
	4	2427 MHZ
	5	2432 MHZ
	6	2437 MHZ
	7	2442 MHZ
	8	2447 MHZ
	9	2452 MHZ
	10	2457 MHZ
	11	2462 MHZ

Note: For 20MHz bandwidth system use Channel 1 to Channel 11. For 40MHz bandwidth system use Channel 3 to Channel 9

2.3. IEEE 802.11N MODULATION SCHEME

MCS Index	Nss	Modulation	R	NBPSC	NCBPS		NDBPS		Data rate(Mbps)	
									800nsGI	
					20MHz	40MHz	20MHz	40MHz	20MHz	40MHz
0	1	BPSK	1/2	1	52	108	26	54	6.5	13.5
1	1	QPSK	1/2	2	104	216	52	108	13.0	27.0
2	1	QPSK	3/4	2	104	216	78	162	19.5	40.5
3	1	16-QAM	1/2	4	208	432	104	216	26.0	54.0
4	1	16-QAM	3/4	4	208	432	156	324	39.0	81.0
5	1	64-QAM	2/3	6	312	648	208	432	52.0	108.0
6	1	64-QAM	3/4	6	312	648	234	489	58.5	121.5
7	1	64-QAM	5/6	6	312	648	260	540	65.0	135.0

Symbol	Explanation
NSS	Number of spatial streams
R	Code rate
NBPSC	Number of coded bits per single carrier
NCBPS	Number of coded bits per symbol
NDBPS	Number of data bits per symbol
GI	Guard interval

2.4. RELATED SUBMITTAL(S) / GRANT (S)

This submittal(s) (test report) is intended for **FCC ID: 2APA9-CMSXJ33B** filing to comply with the FCC Part 15 requirements.

2.5. TEST METHODOLOGY

KDB 558074 D01 15.247 Meas Guidance v05: Guidance for compliance measurements on Digital transmissio n system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules
ANSI C63.10:2013: American National Standard for Testing Unlicensed Wireless Devices

2.6. SPECIAL ACCESSORIES

Refer to section 5.2.

2.7. EQUIPMENT MODIFICATIONS

Not available for this EUT intended for grant.

2.8. ANTENNA REQUIREMENT

This intentional radiator is designed with a permanently attached antenna of an antenna to ensure that no antenna other than that furnished by the responsible party shall be used with the device.
For more information of the antenna, please refer to the APPENDIX B: PHOTOGRAPHS OF EUT.

3. MEASUREMENT UNCERTAINTY

The reported uncertainty of measurement y ±U, where expended uncertainty U is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Item	Measurement Uncertainty
Uncertainty of Conducted Emission for AC Port	U_c = ±3.1 dB
Uncertainty of Radiated Emission below 1GHz	U_c = ±4.0 dB
Uncertainty of Radiated Emission above 1GHz	U_c = ±4.8 dB
Uncertainty of total RF power, conducted	U_c = ±0.8 dB
Uncertainty of RF power density, conducted	U_c = ±2.6 dB
Uncertainty of spurious emissions, conducted	U_c = ±2 %
Uncertainty of Occupied Channel Bandwidth	U_c = ±2 %

4. DESCRIPTION OF TEST MODES

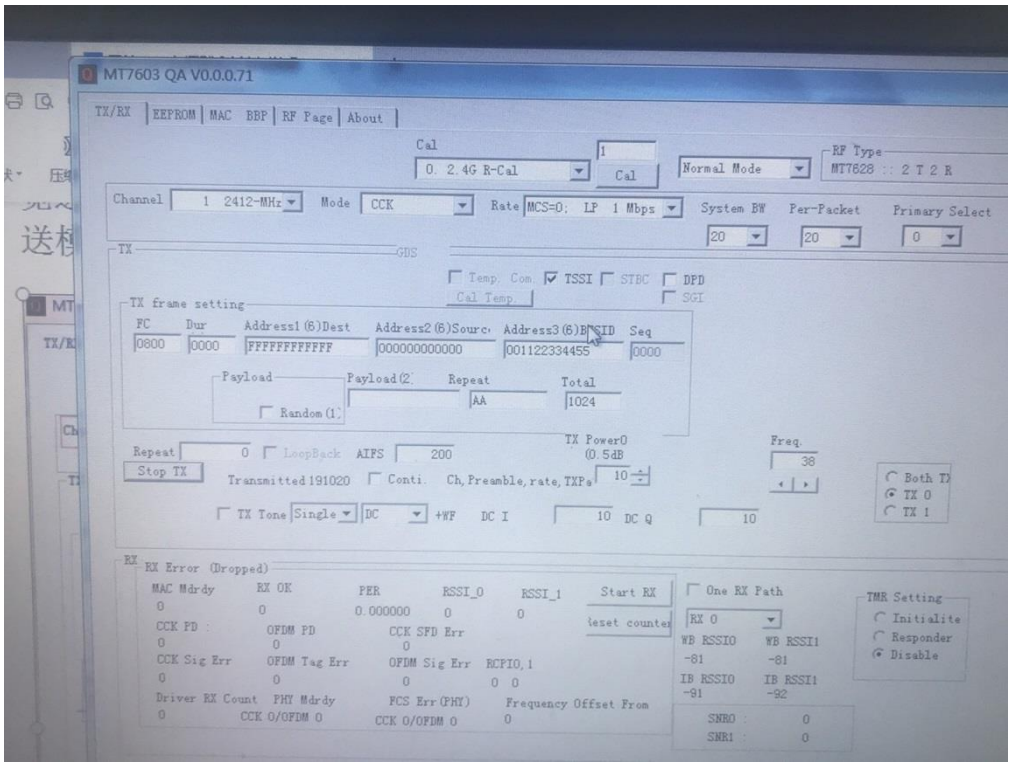
NO.	TEST MODE DESCRIPTION
1	Low channel transmitting (TX)
2	Middle channel transmitting (TX)
3	High channel transmitting (TX)

Note:
Transmit by 802.11b with Date rate (1/2/5.5/11)
Transmit by 802.11g with Date rate (6/9/12/18/24/36/48/54)
Transmit by 802.11n (20MHz) with Date rate (6.5/13/19.5/26/39/52/58.5/65)
Transmit by 802.11n (40MHz) with Date rate (13.5/27/40.5/54/81/108/121.5/135)
The test channel for 20MHZ bandwidth system is channel 1, 6 and 11.
The test channel for 40MHZ bandwidth system is channel 3, 6 and 9.

Note:

1. The EUT has been set to operate continuously on the lowest, middle and highest operation frequency Individually, and the EUT is operating at its maximum duty cycle>or equal 98%
2. All modes under which configure applicable have been tested and the worst mode test data recording in the test report, if no other mode data.

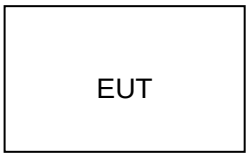
Software Setting



5. SYSTEM TEST CONFIGURATION

5.1. CONFIGURATION OF EUT SYSTEM

Configure:



5.2. EQUIPMENT USED IN EUT SYSTEM

Item	Equipment	Model No.	ID or Specification	Remark
1	IMILAB Doorbell Hub	CMWG33B	2APA9-CMSXJ33B	EUT

5.3. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.247(b)(3)	Output Power	Compliant
§15.247(a)(2)	6 dB Bandwidth	Compliant
§15.247	Conducted Spurious Emission	Compliant
§15.247(e)	Maximum Conducted Output Power Spectral Density	Compliant
§15.209	Radiated Emission	Compliant
§15.247(d)	Band Edges	Compliant
§15.207	Line Conduction Emission	Compliant

6. TEST FACILITY

Test Site	Attestation of Global Compliance (Shenzhen) Co., Ltd
Location	1-2/F, Building 19, Junfeng Industrial Park, Chongqing Road, Heping Community, Fuhai Street, Bao'an District, Shenzhen, Guangdong, China
Designation Number	CN1259
FCC Test Firm Registration Number	975832
A2LA Cert. No.	5054.02
Description	Attestation of Global Compliance(Shenzhen) Co., Ltd is accredited by A2LA

TEST EQUIPMENT OF CONDUCTED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESPI	101206	May 15, 2021	May 14, 2022
LISN	R&S	ESH2-Z5	100086	Jun. 09, 2021	Jun. 08, 2022
Test software	R&S	ES-K1(Ver.V1.71)	N/A	N/A	N/A

TEST EQUIPMENT OF RADIATED EMISSION TEST

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Due
TEST RECEIVER	R&S	ESCI	10096	May 15, 2021	May 14, 2022
EXA Signal Analyzer	Aglient	N9010A	MY53470504	Nov. 17, 2021	Nov. 16, 2022
2.4GHz Fliter	Micro-tronics	087	N/A	Mar. 22, 2022	Mar. 21, 2024
Attenuator	Weinachel Corp	58-30-33	N/A	Sep. 03, 2020	Sep. 02, 2022
Horn antenna	SCHWARZBECK	BBHA 9170	#768	Oct. 31, 2021	Oct. 30, 2023
Active loop antenna (9K-30MHz)	ZHINAN	ZN30900C	00034609	May 22, 2020	May 21, 2022
Double-Ridged Waveguide Horn	ETS LINDGREN	3117	00034609	Apr. 23, 2021	Apr. 22, 2022
Broadband Preamplifier	ETS LINDGREN	3117PA	00225134	Sep. 03, 2020	Sep. 02, 2022
ANTENNA	SCHWARZBECK	VULB9168	D69250	Jan. 08, 2020	Jan. 07, 2023
Test software	Tonscend	JS32-RE (Ver.2.5)	N/A	N/A	N/A

7. OUTPUT POWER

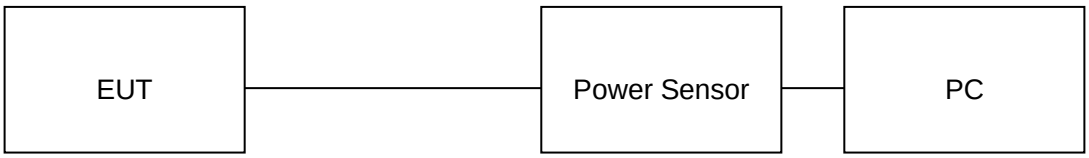
7.1. MEASUREMENT PROCEDURE

For average power test:

1. Connect EUT RF output port to power sensor through an RF attenuator.
2. Connect the power sensor to the PC.
3. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
4. Record the maximum power from the software.

Note：The EUT was tested according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements.

7.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)



7.3. LIMITS AND MEASUREMENT RESULT

Test Data of Conducted Output Power-antenna 1					
Test Mode	Test Channel (MHz)	Average Power (dBm)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
802.11b	2412	15.66	18.11	≤30	Pass
	2437	15.38	17.94	≤30	Pass
	2462	15.41	17.71	≤30	Pass
802.11g	2412	14.63	20.41	≤30	Pass
	2437	13.91	20.19	≤30	Pass
	2462	14.88	20.09	≤30	Pass
802.11n20	2412	14.27	19.96	≤30	Pass
	2437	14.52	19.83	≤30	Pass
	2462	13.93	19.74	≤30	Pass
802.11n40	2422	13.64	19.01	≤30	Pass
	2437	13.50	18.82	≤30	Pass
	2452	14.07	18.13	≤30	Pass

Test Data of Conducted Output Power-antenna 2					
Test Mode	Test Channel (MHz)	Average Power (dBm)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
802.11b	2412	15.13	19.30	≤30	Pass
	2437	15.23	17.47	≤30	Pass
	2462	15.40	18.70	≤30	Pass
802.11g	2412	14.85	19.86	≤30	Pass
	2437	13.69	19.79	≤30	Pass
	2462	14.60	24.42	≤30	Pass
802.11n20	2412	13.91	19.46	≤30	Pass
	2437	13.84	19.37	≤30	Pass
	2462	14.50	24.06	≤30	Pass
802.11n40	2422	14.00	18.61	≤30	Pass
	2437	12.91	18.29	≤30	Pass
	2452	13.73	17.71	≤30	Pass

Test Data of Conducted Output Power-antenna 1+2					
Test Mode	Test Channel (MHz)	Average Power (dBm)	Peak Power (dBm)	Limits (dBm)	Pass or Fail
802.11n20	2412	17.10	22.73	⩽30	Pass
	2437	17.20	22.62	⩽30	Pass
	2462	17.23	25.43	⩽30	Pass
802.11n40	2422	16.83	21.82	⩽30	Pass
	2437	16.23	21.57	⩽30	Pass
	2452	16.91	20.94	⩽30	Pass

8. BANDWIDTH

8.1. MEASUREMENT PROCEDURE

6dB bandwidth:

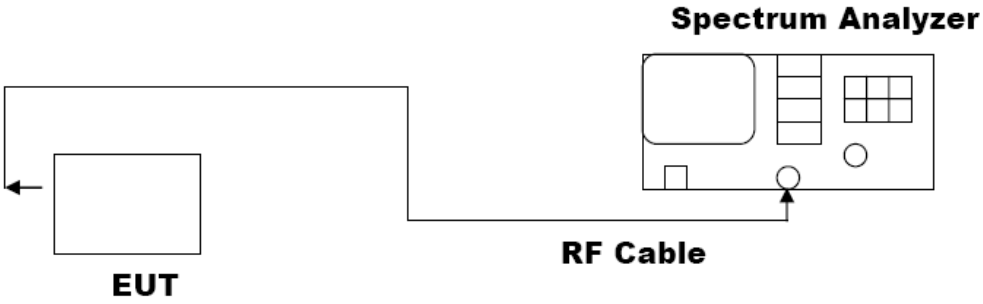
1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2. Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set SPA Centre Frequency = Operation Frequency, RBW= 100 kHz, VBW≥3×RBW.
4. Set SPA Trace 1 Max hold, then View.

Occupied bandwidth:

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set Span = approximately 2 to 5 times the 20 dB bandwidth, centered on a hoping channel
   The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW; Sweep = auto; Detector function = peak
4. Set SPA Trace 1 Max hold, then View.

Note: The EUT was tested according to ANSI C63.10 for compliance to FCC PART 15.247 requirements.

8.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

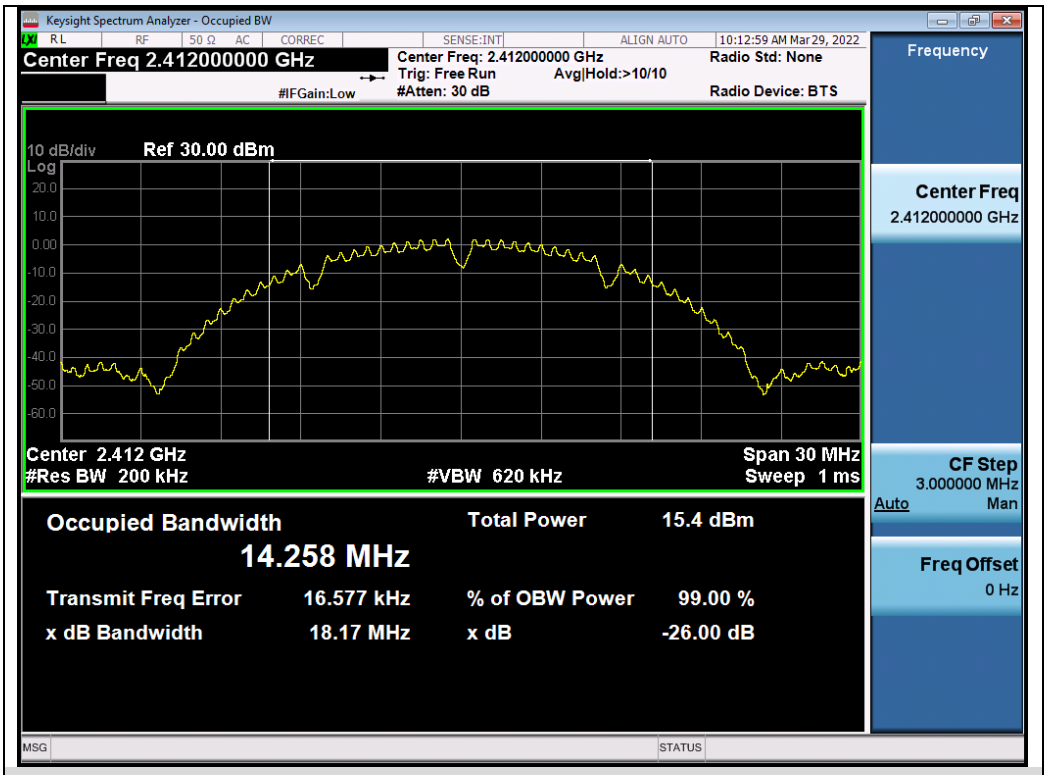


8.3. LIMITS AND MEASUREMENT RESULTS

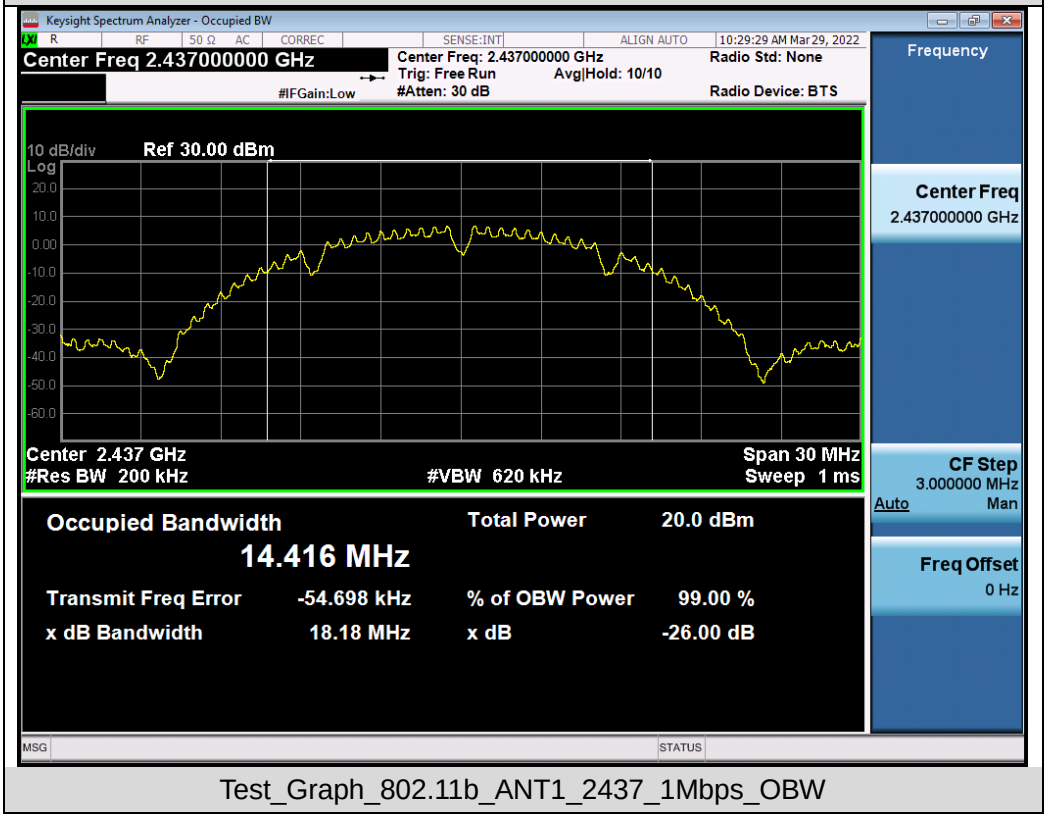
Test Data of Occupied Bandwidth and DTS Bandwidth-antenna 1					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-6dB Bandwidth (MHz)	Limits (MHz)	Pass or Fail
802.11b	2412	14.258	9.769	≥0.5	Pass
	2437	14.416	10.03	≥0.5	Pass
	2462	14.451	10.02	≥0.5	Pass
802.11g	2412	16.508	15.10	≥0.5	Pass
	2437	16.451	15.10	≥0.5	Pass
	2462	16.449	15.08	≥0.5	Pass
802.11n20	2412	17.502	15.11	≥0.5	Pass
	2437	17.497	15.11	≥0.5	Pass
	2462	17.504	15.11	≥0.5	Pass
802.11n40	2422	35.815	35.03	≥0.5	Pass
	2437	35.815	33.82	≥0.5	Pass
	2452	35.855	32.57	≥0.5	Pass

Test Data of Occupied Bandwidth and DTS Bandwidth-antenna 2					
Test Mode	Test Channel (MHz)	99% Occupied Bandwidth (MHz)	-6dB Bandwidth (MHz)	Limits (MHz)	Pass or Fail
802.11b	2412	13.927	8.318	≥0.5	Pass
	2437	13.977	8.317	≥0.5	Pass
	2462	13.995	8.320	≥0.5	Pass
802.11g	2412	16.444	15.09	≥0.5	Pass
	2437	16.440	15.11	≥0.5	Pass
	2462	16.586	15.38	≥0.5	Pass
802.11n20	2412	17.488	15.10	≥0.5	Pass
	2437	17.501	15.09	≥0.5	Pass
	2462	17.641	15.04	≥0.5	Pass
802.11n40	2422	35.823	35.07	≥0.5	Pass
	2437	35.844	35.05	≥0.5	Pass
	2452	35.873	35.09	≥0.5	Pass

Test Graphs of Occupied Bandwidth



Test_Graph_802.11b_ANT1_2412_1Mbps_OBW



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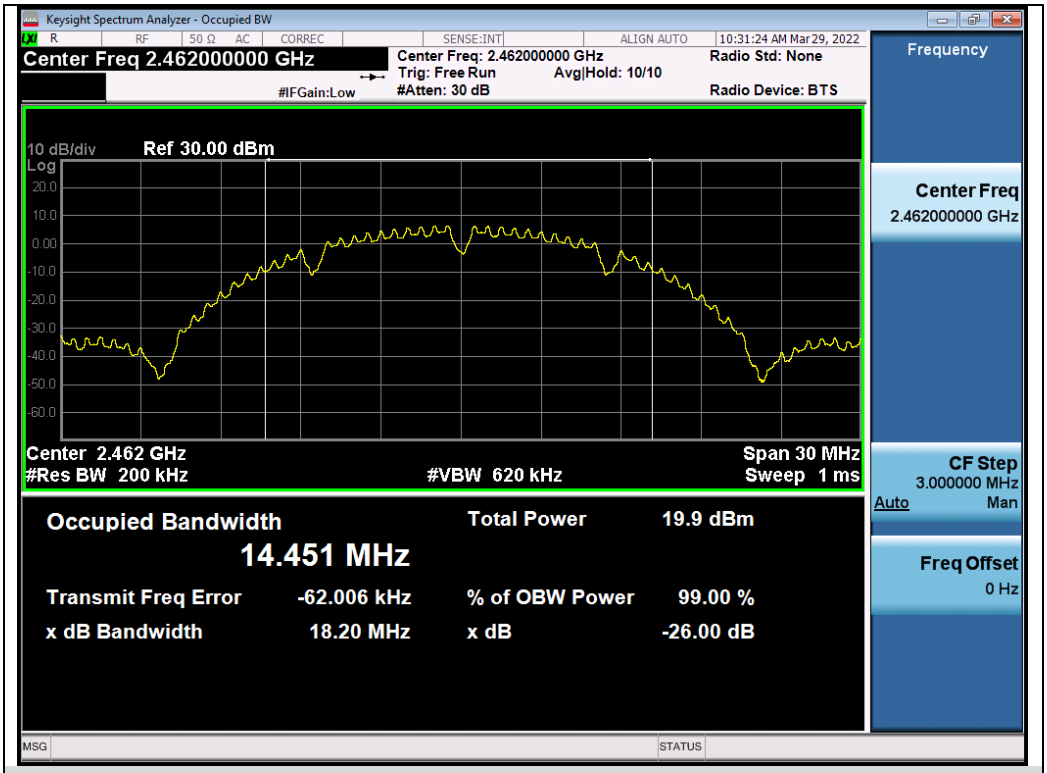

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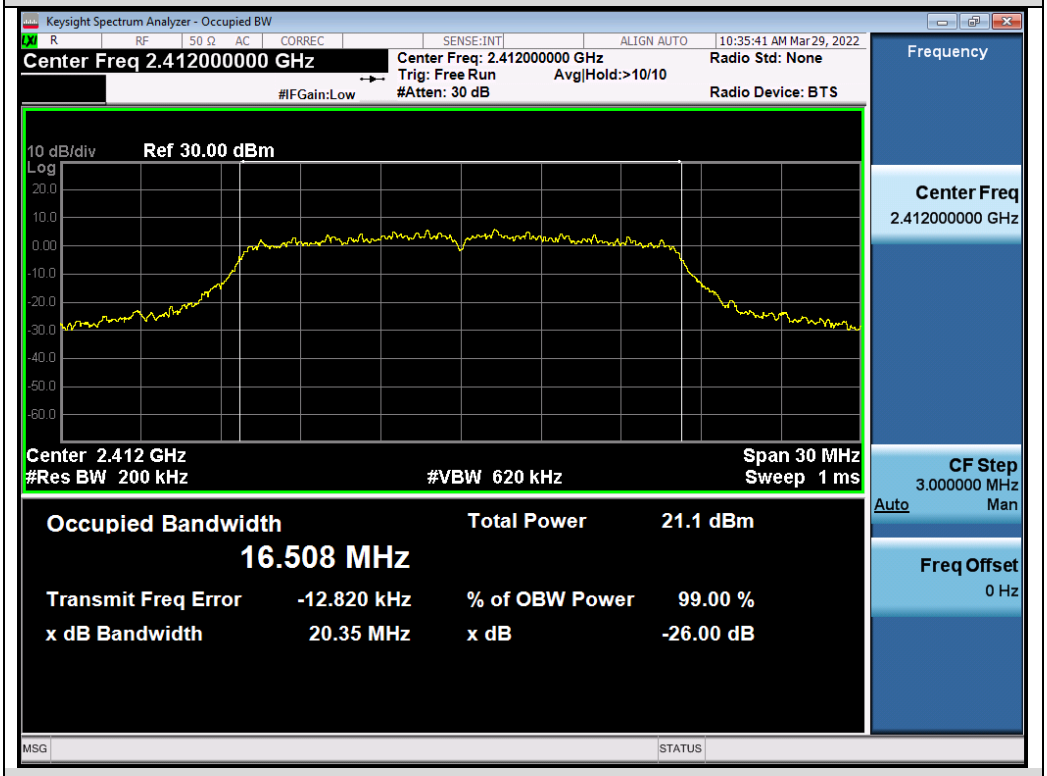

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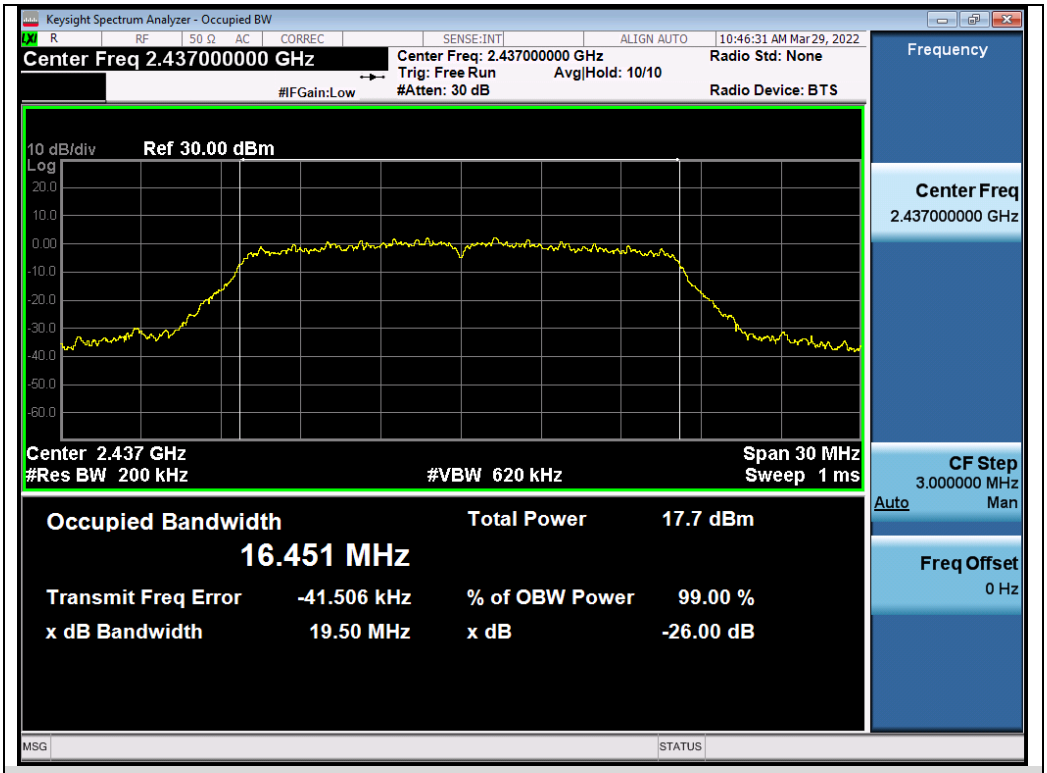

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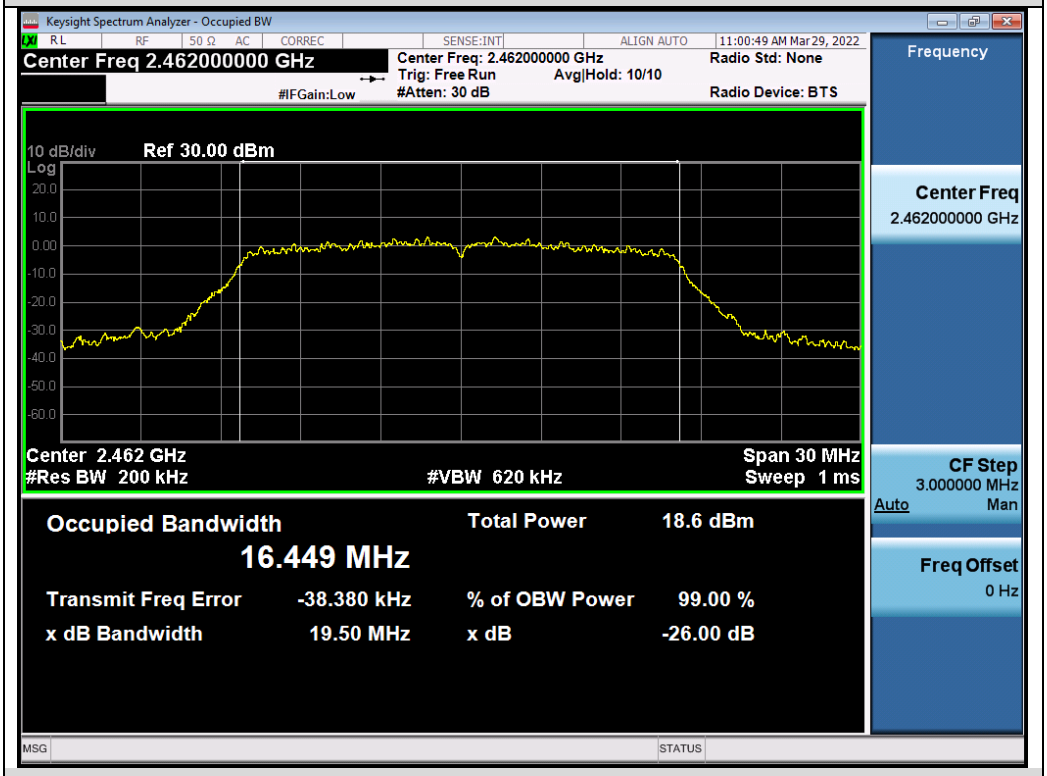

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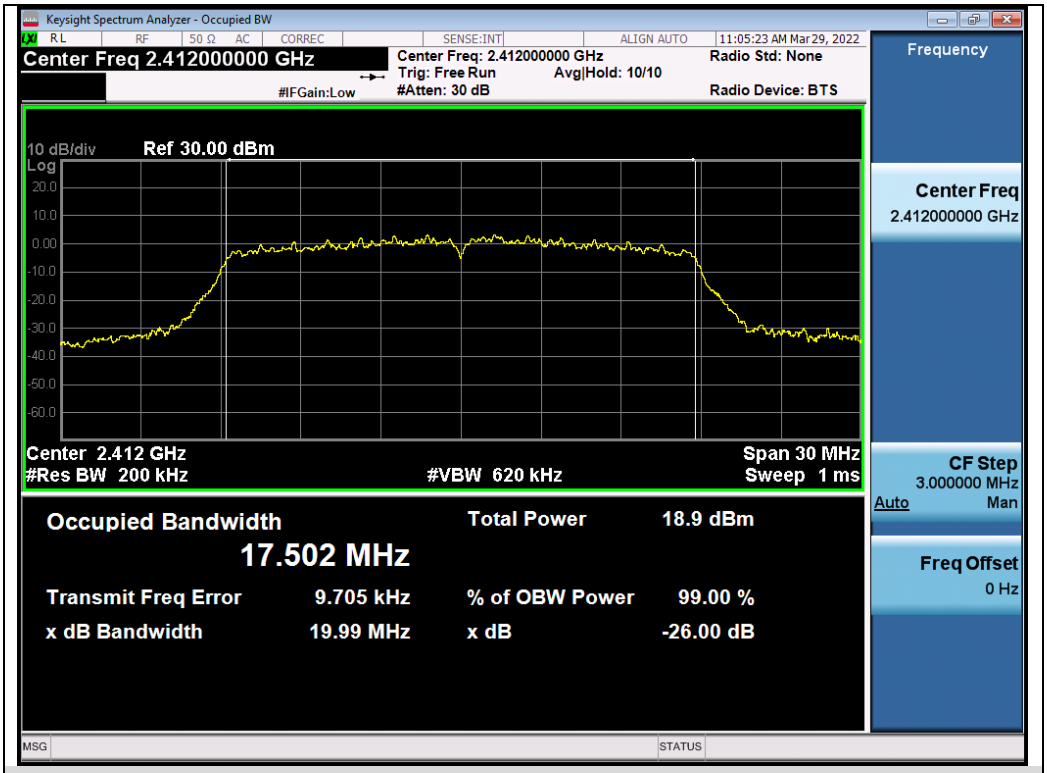

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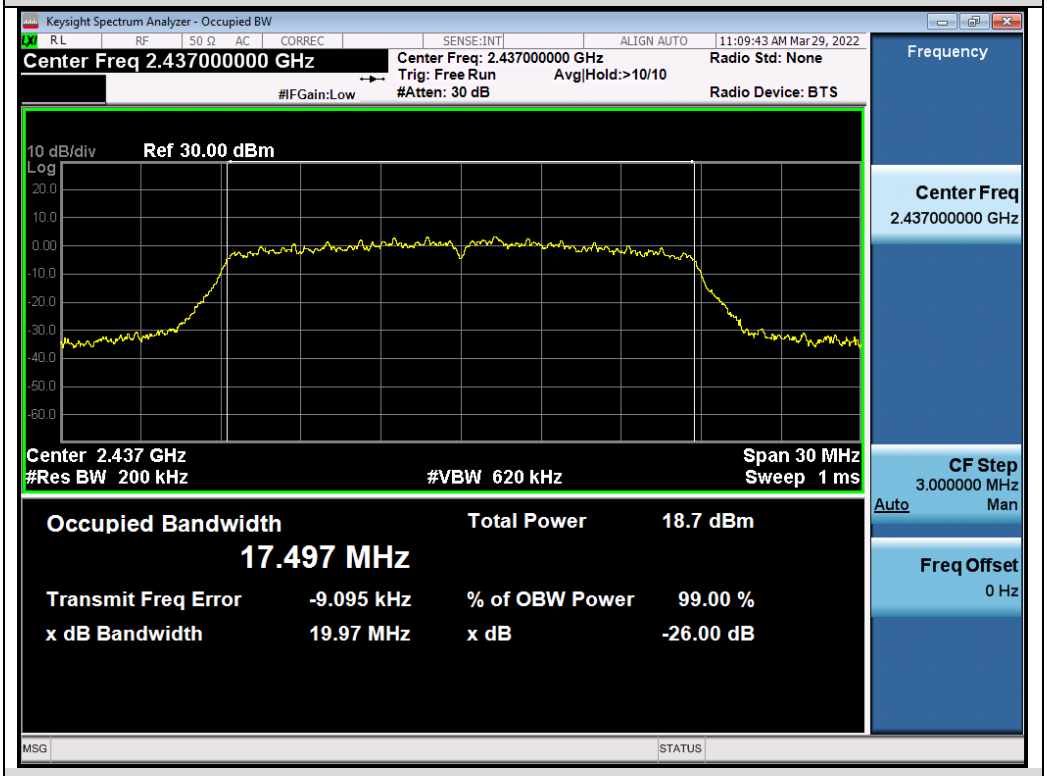

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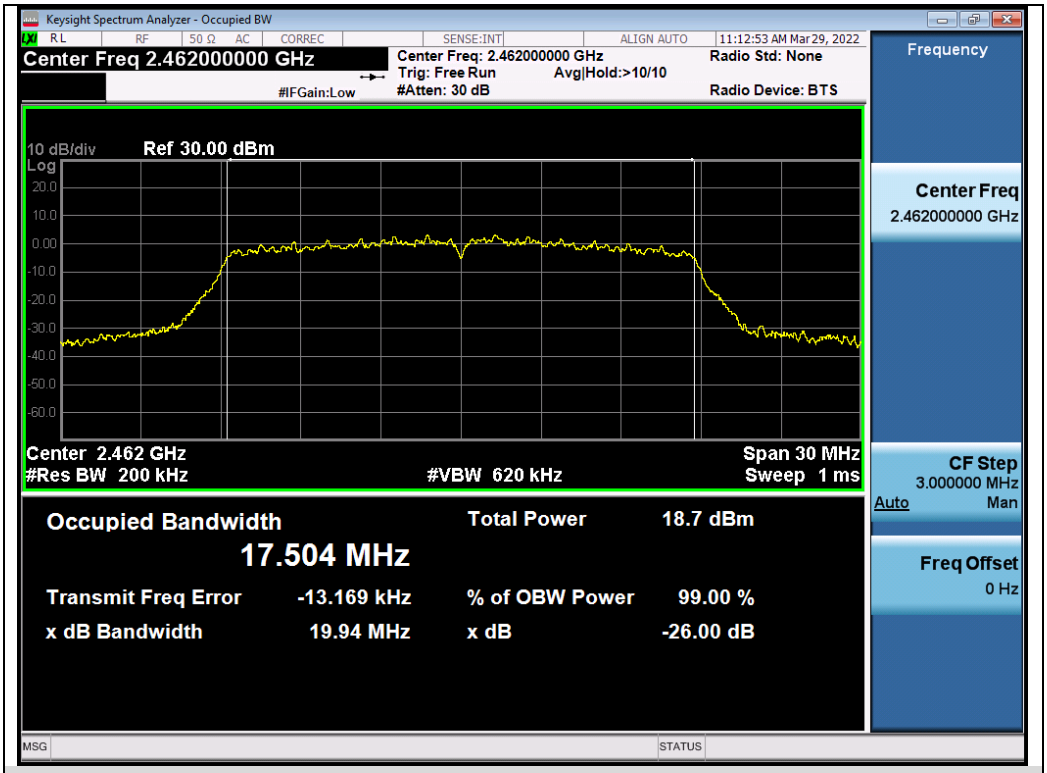

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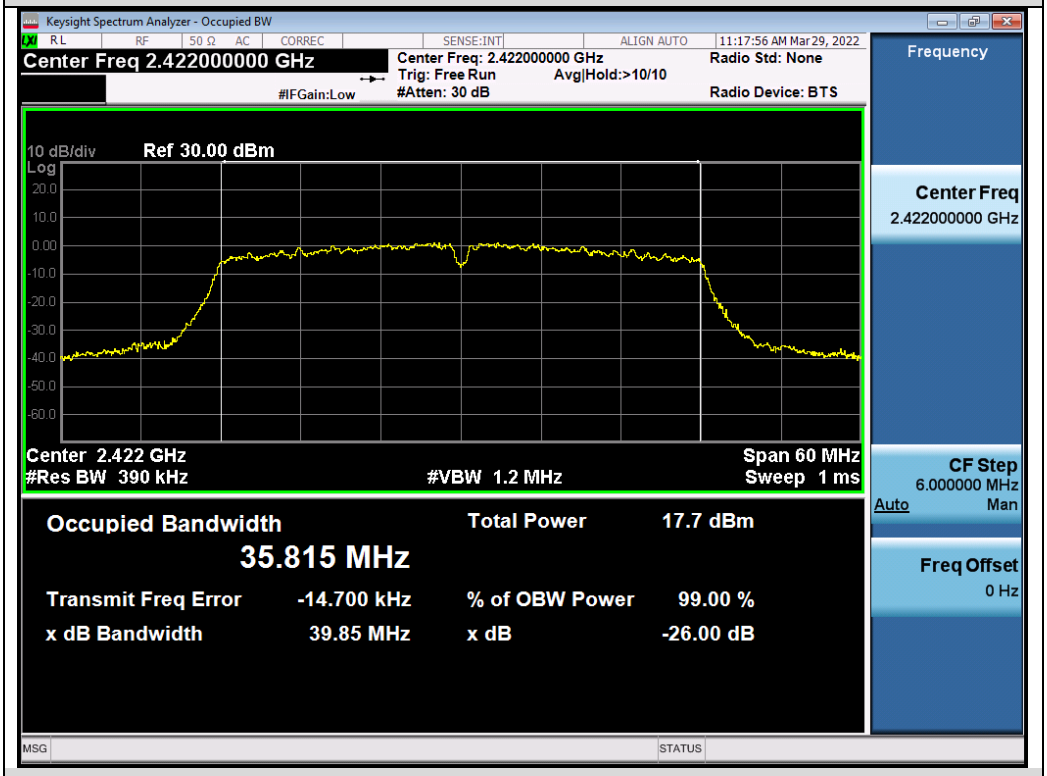

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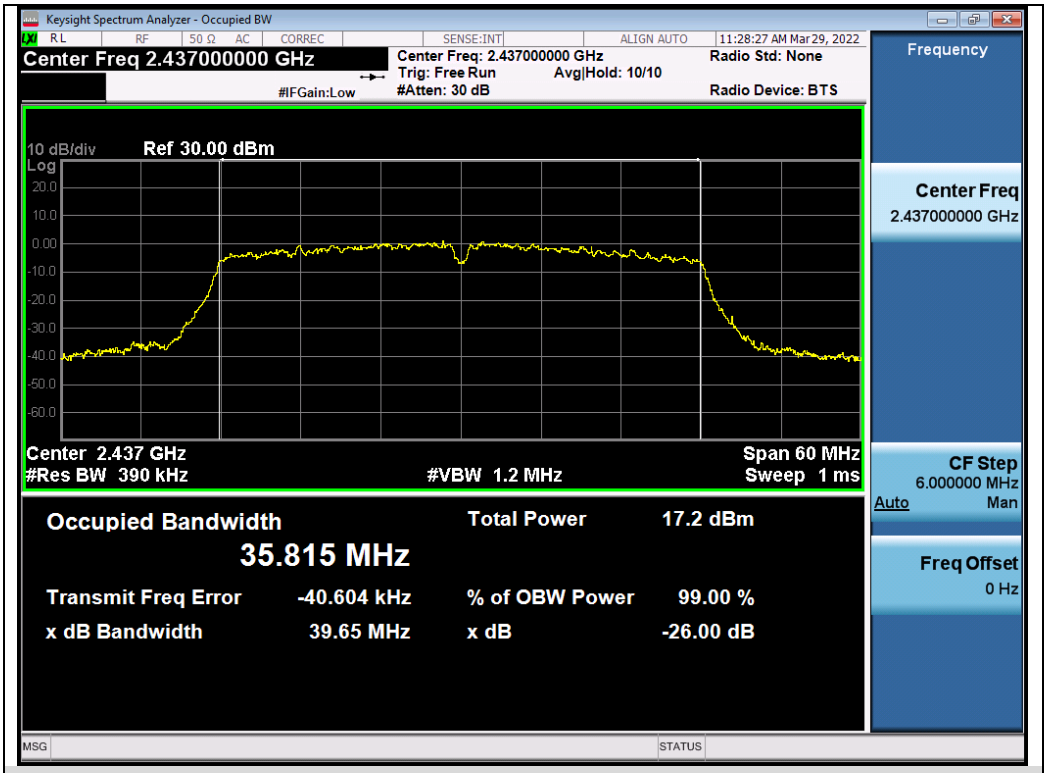

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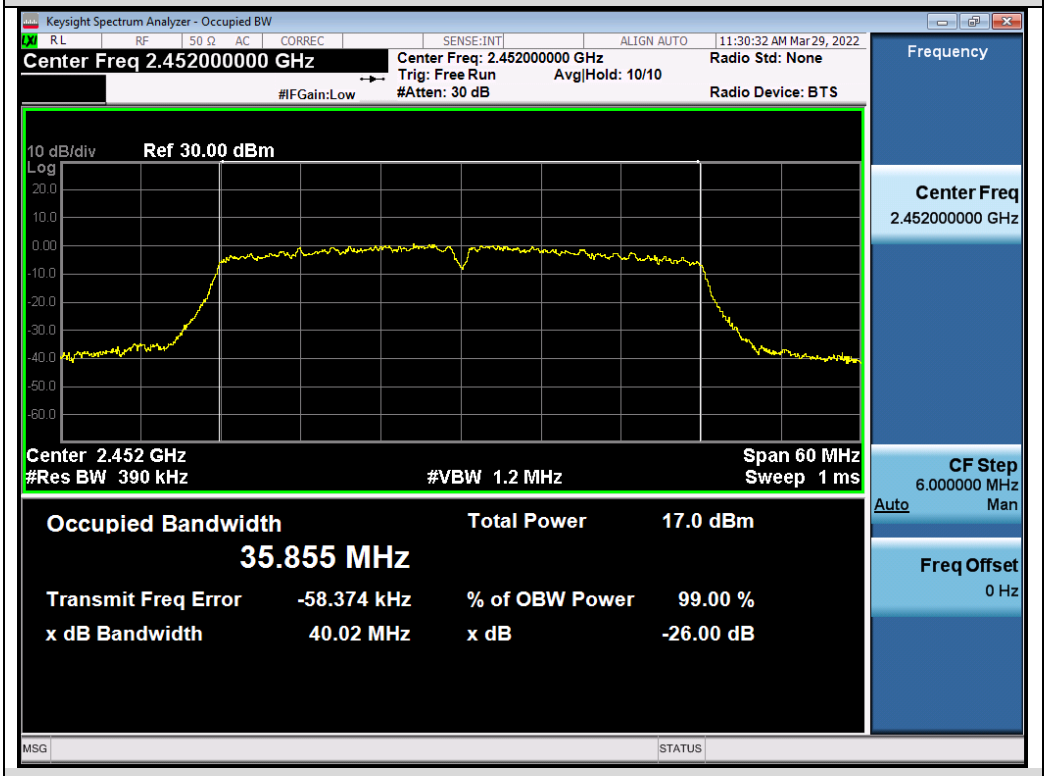

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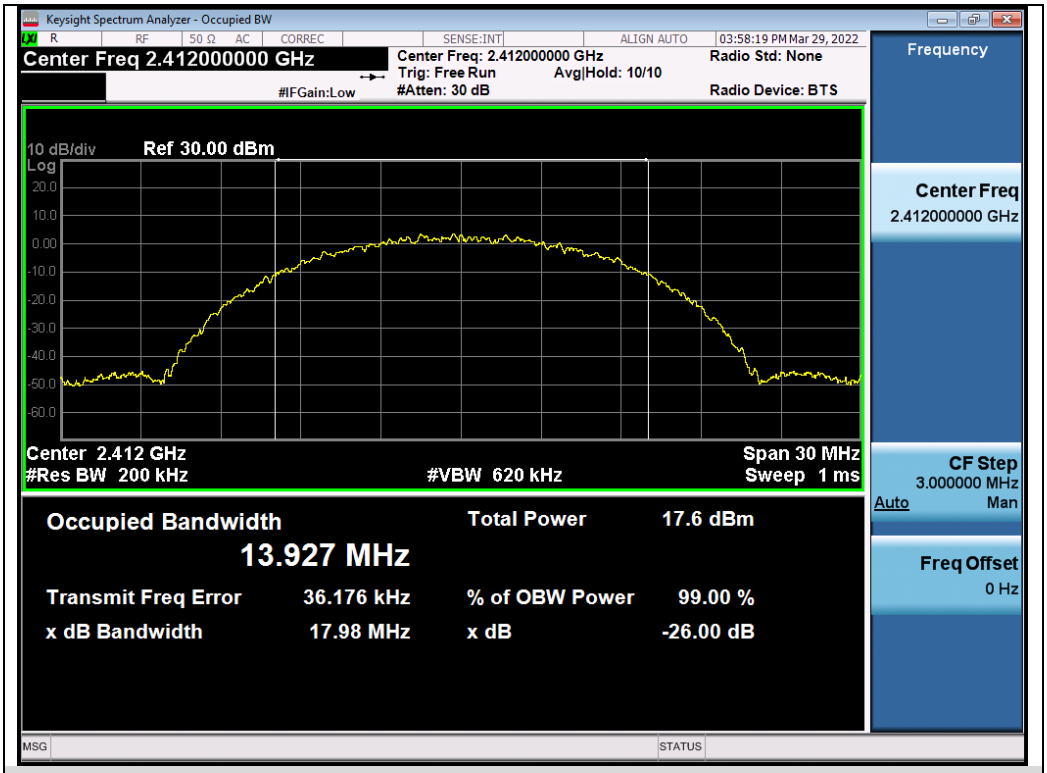

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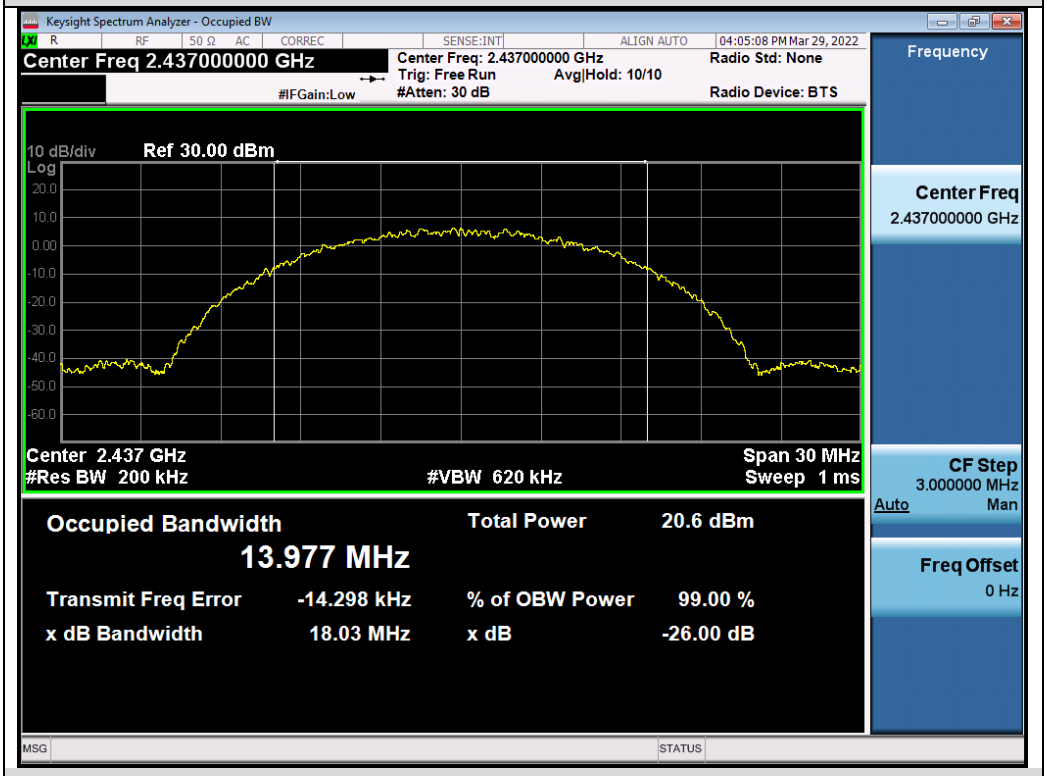

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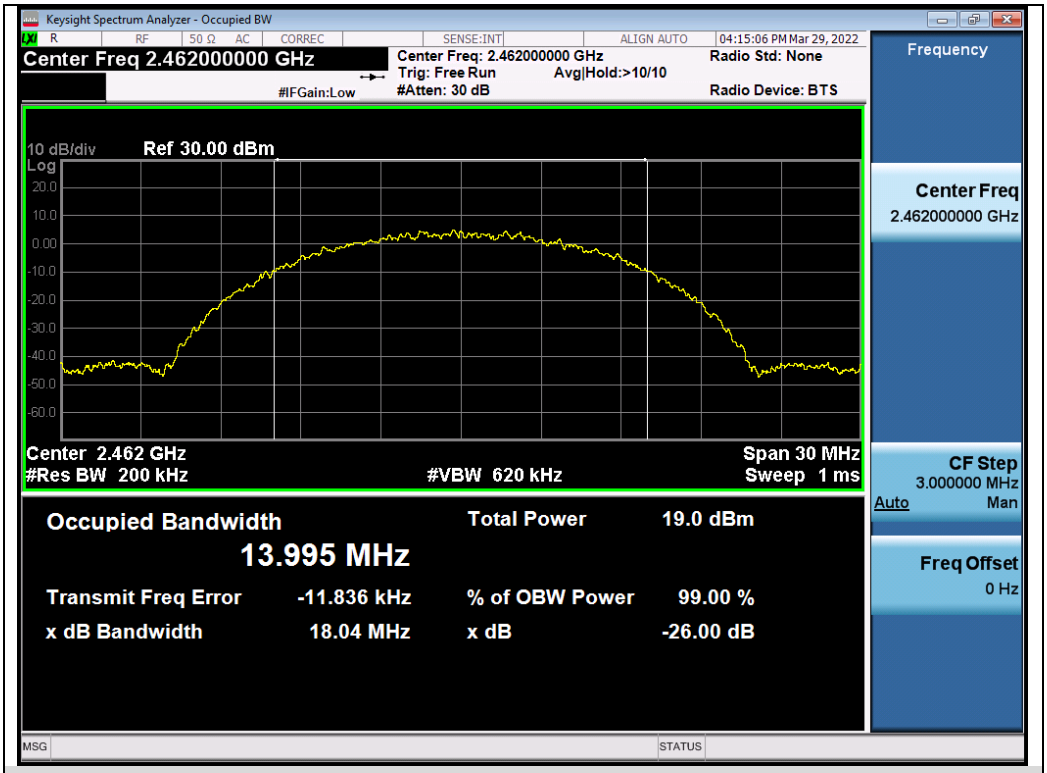

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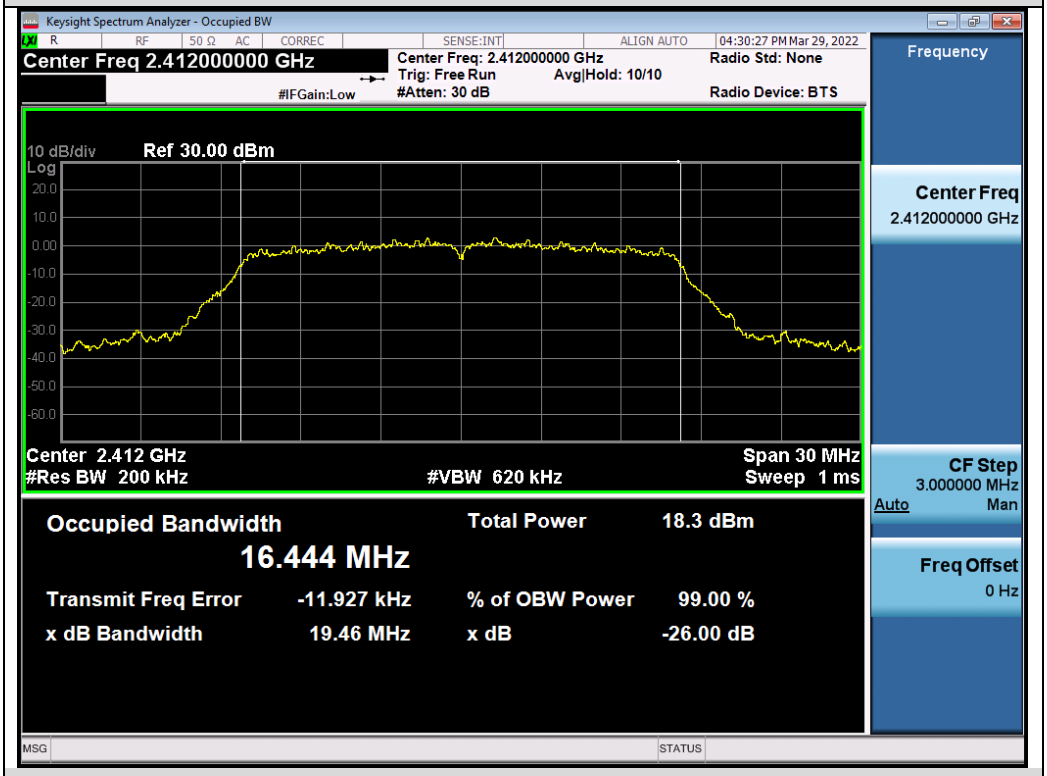
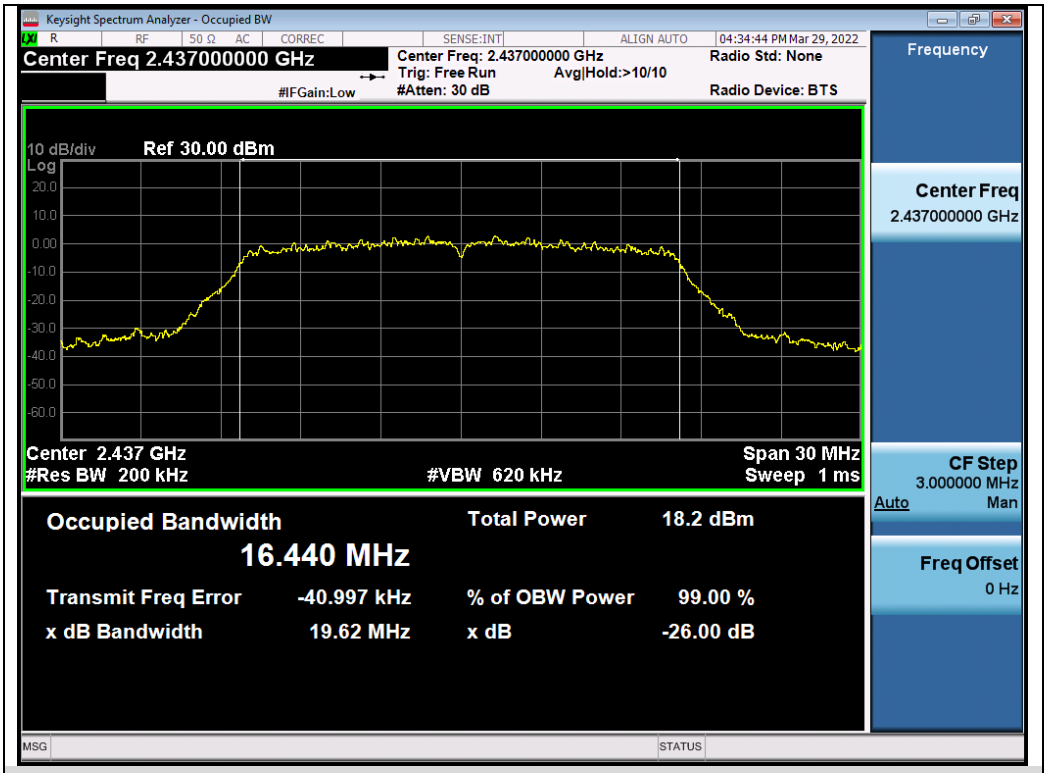
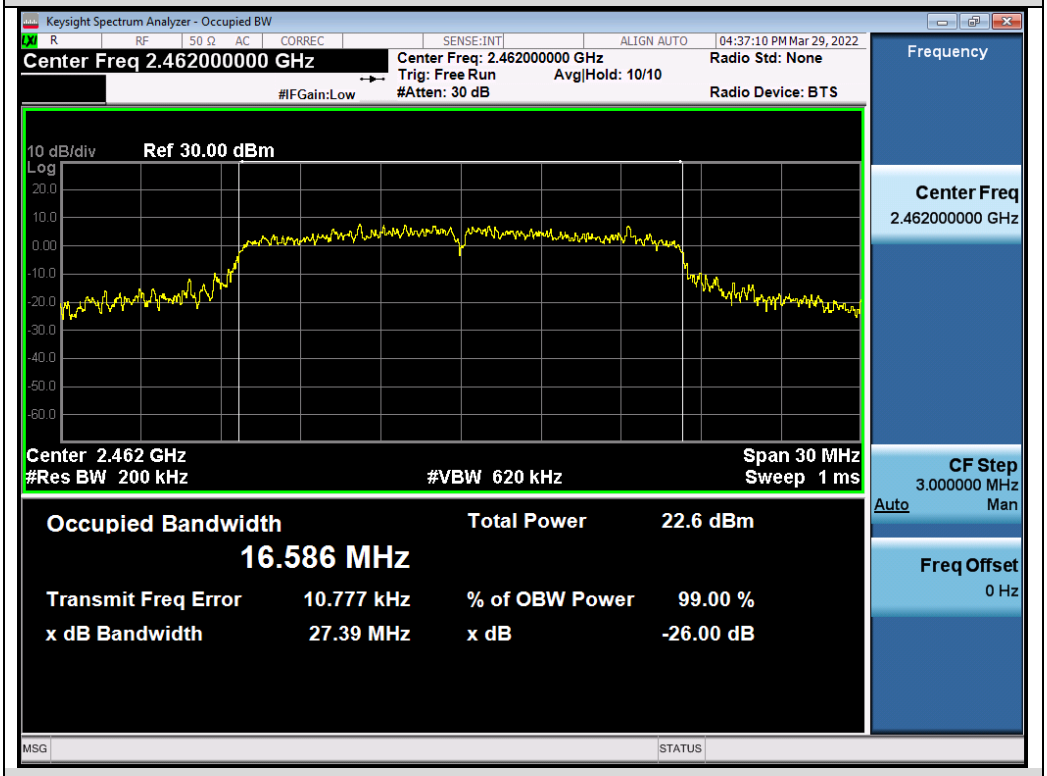


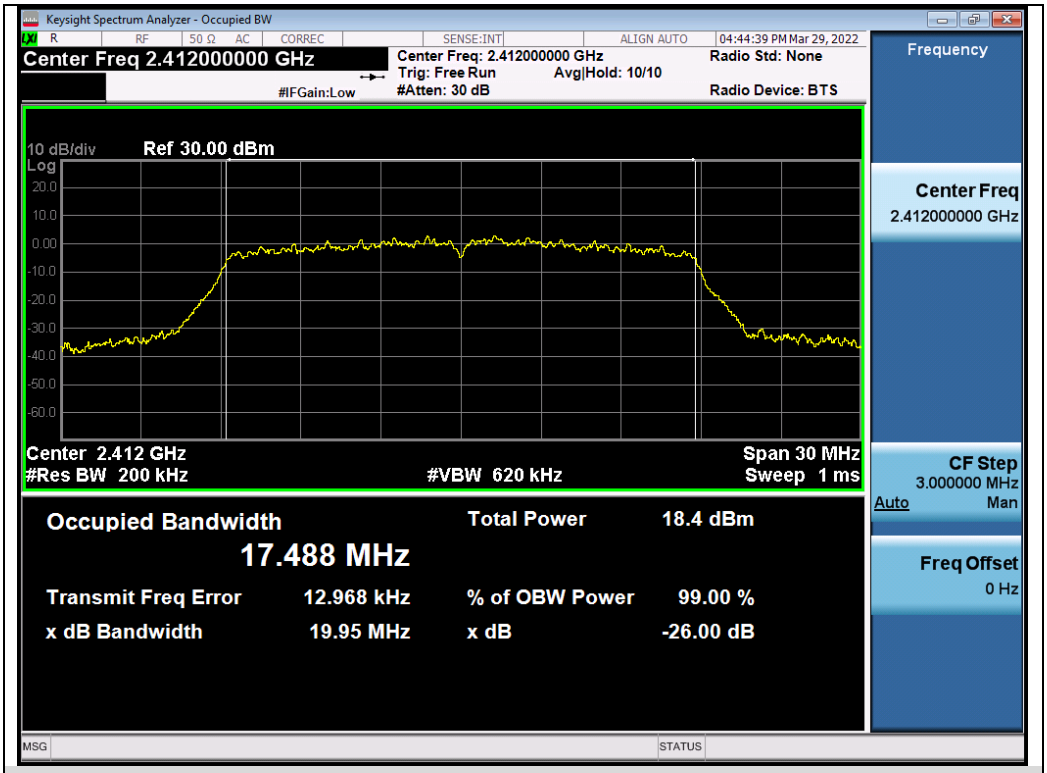
Test_Graph_802.11g_ANT2_2412_6Mbps_OBW



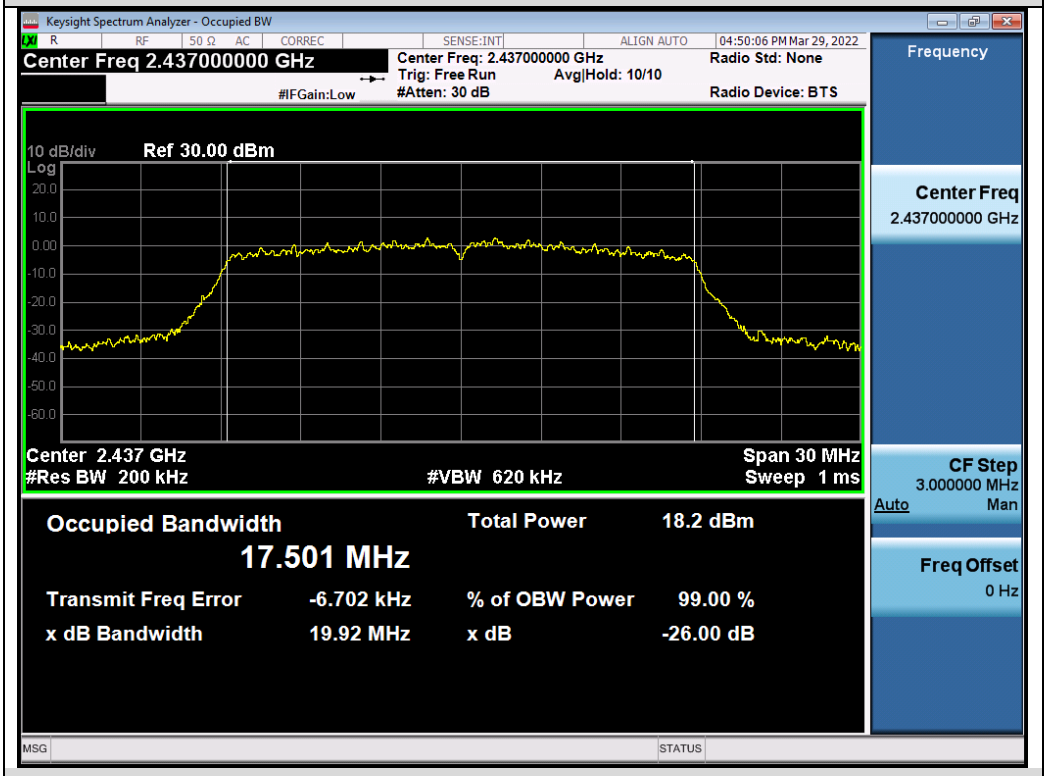
Test_Graph_802.11g_ANT2_2437_6Mbps_OBW



Test_Graph_802.11g_ANT2_2462_6Mbps_OBW



Test_Graph_802.11n20_ANT2_2412_MCS0_OBW



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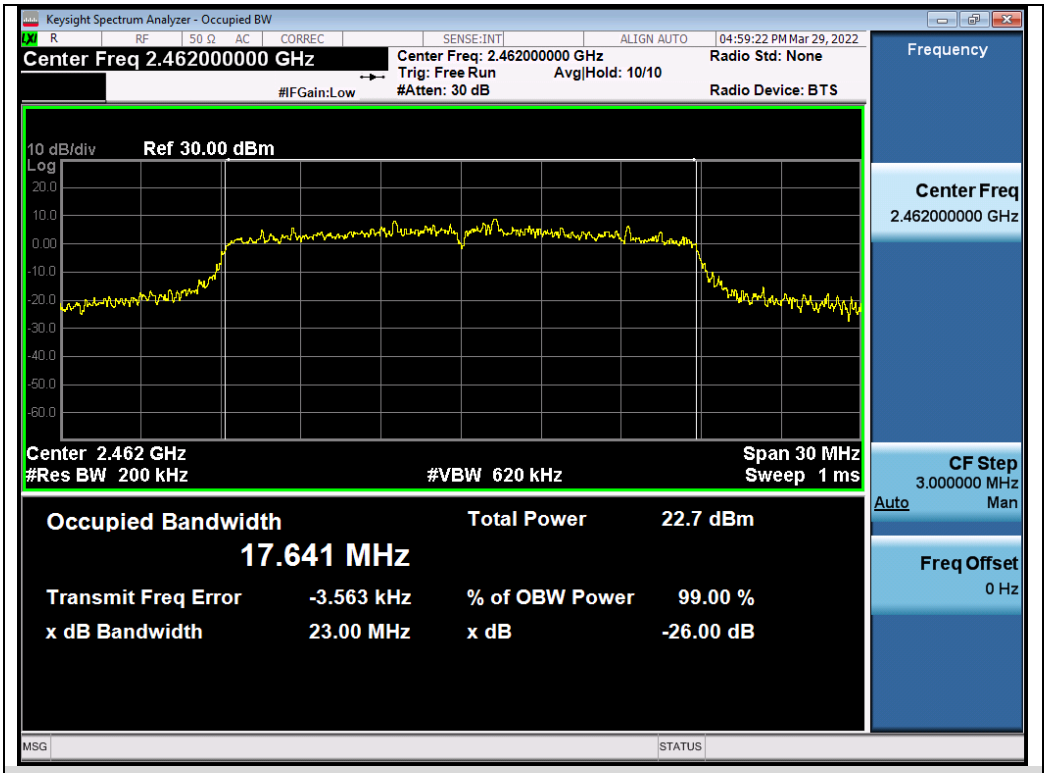
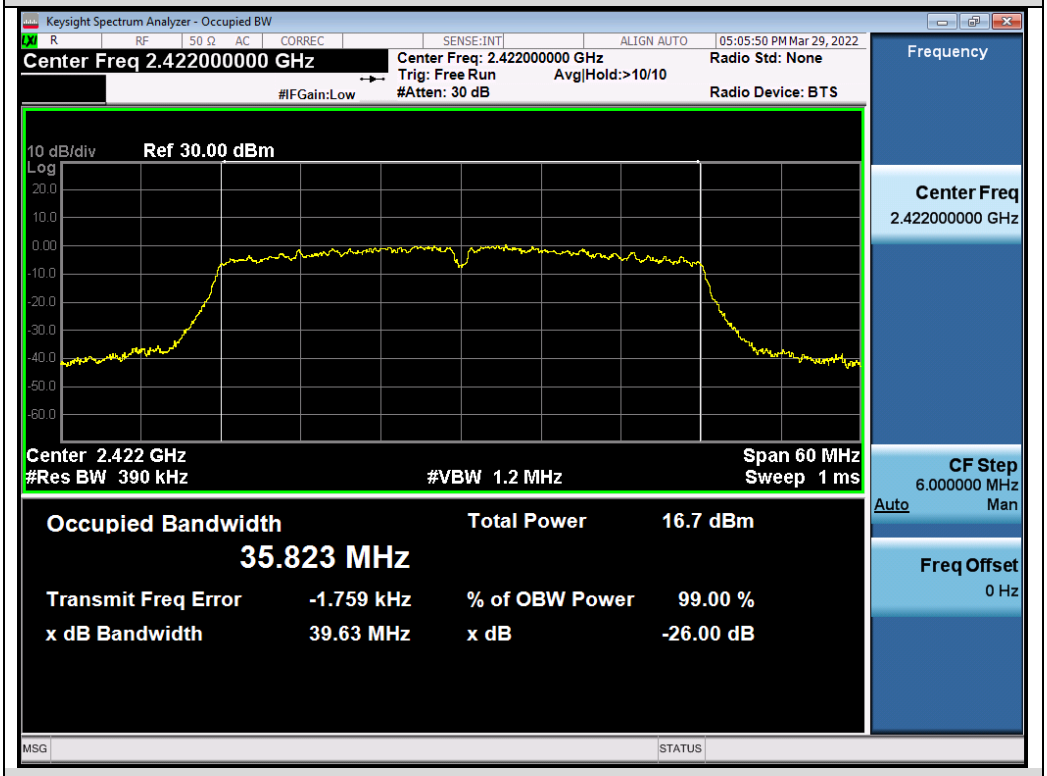
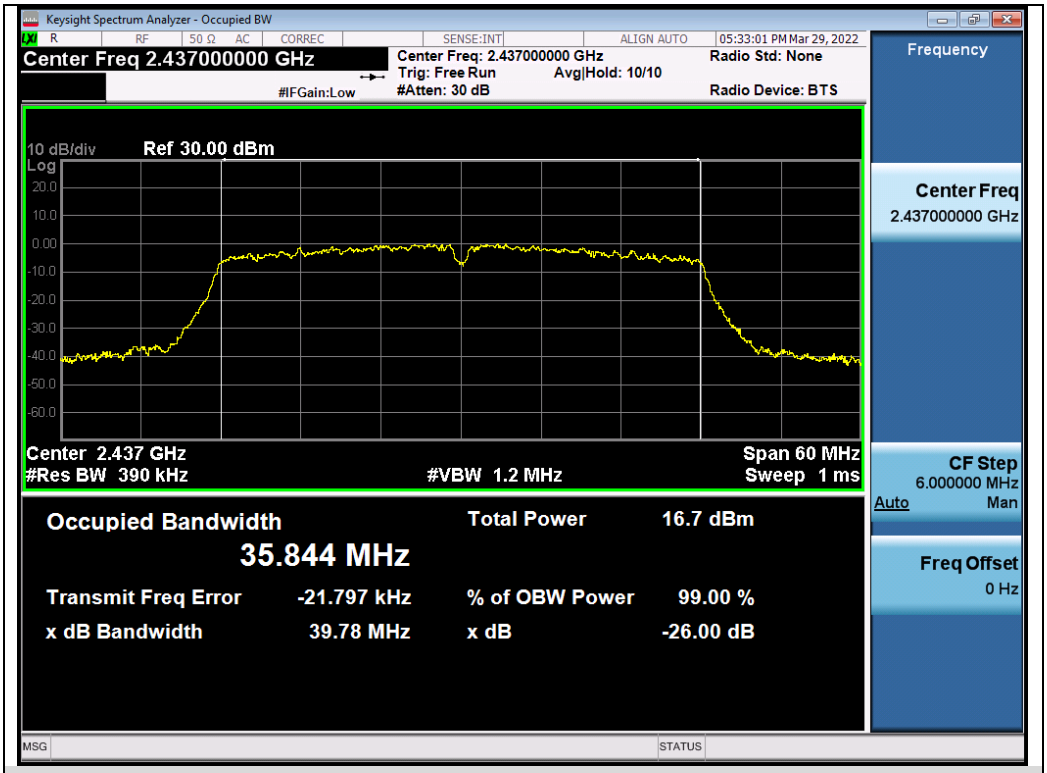


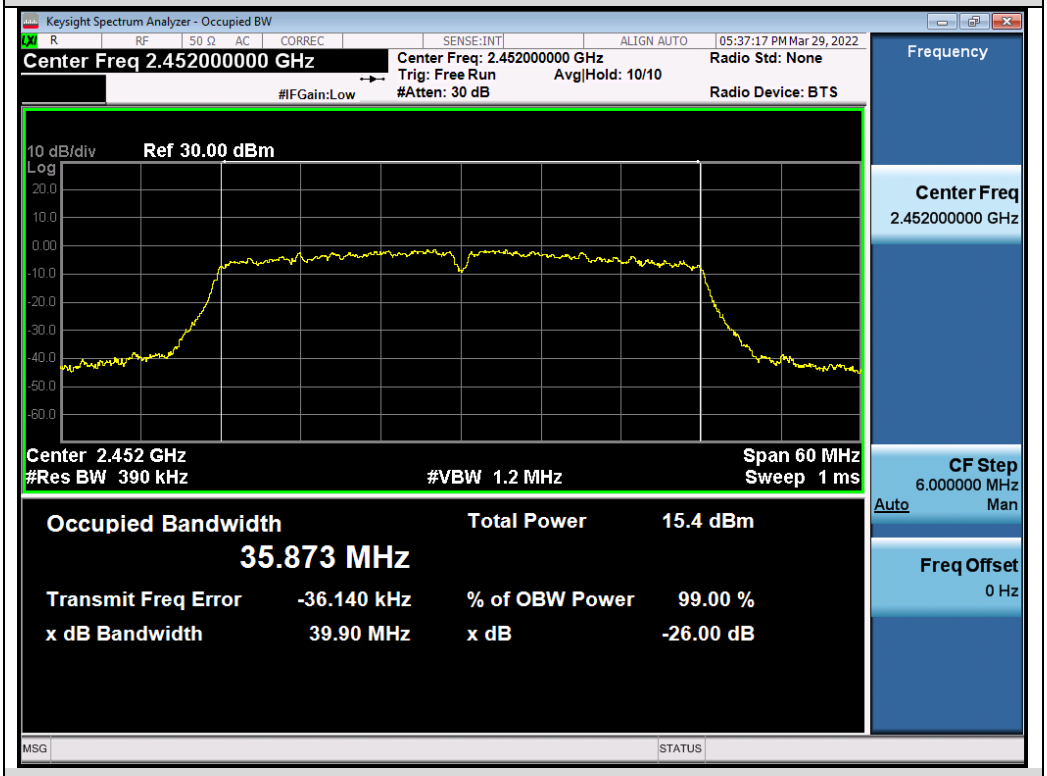
Test_Graph_802.11n20_ANT2_2462_MCS0_OBW



Test_Graph_802.11n40_ANT2_2422_MCS0_OBW



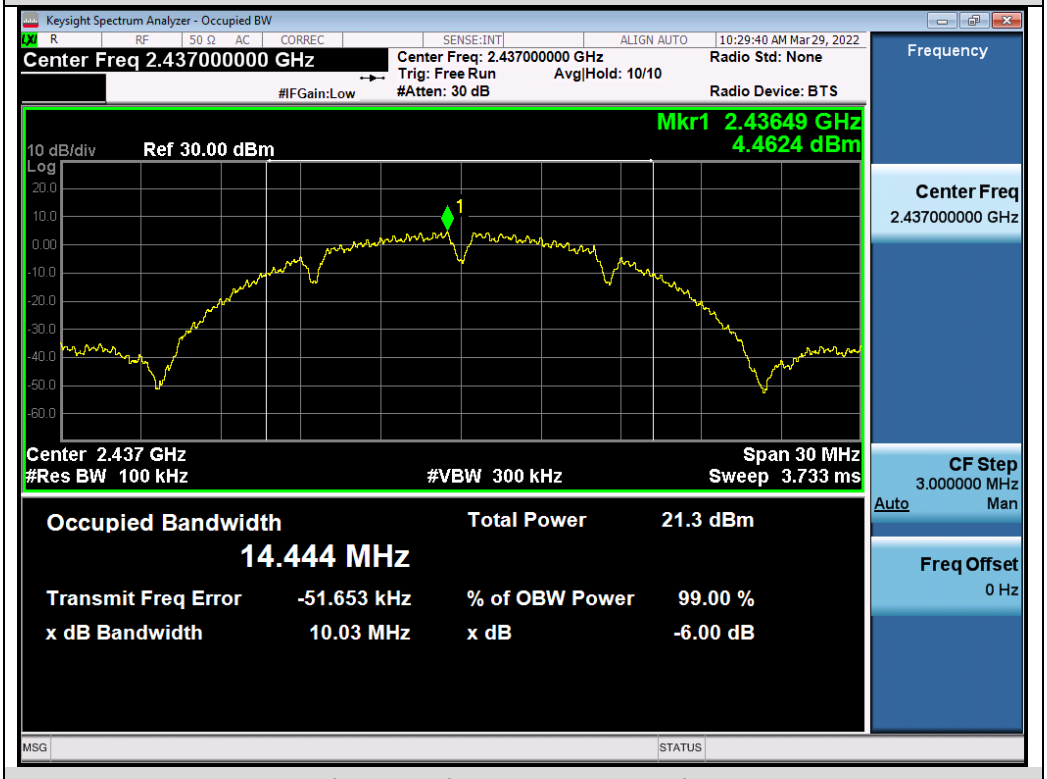
Test_Graph_802.11n40_ANT2_2437_MCS0_OBW



Test_Graph_802.11n40_ANT2_2452_MCS0_OBW

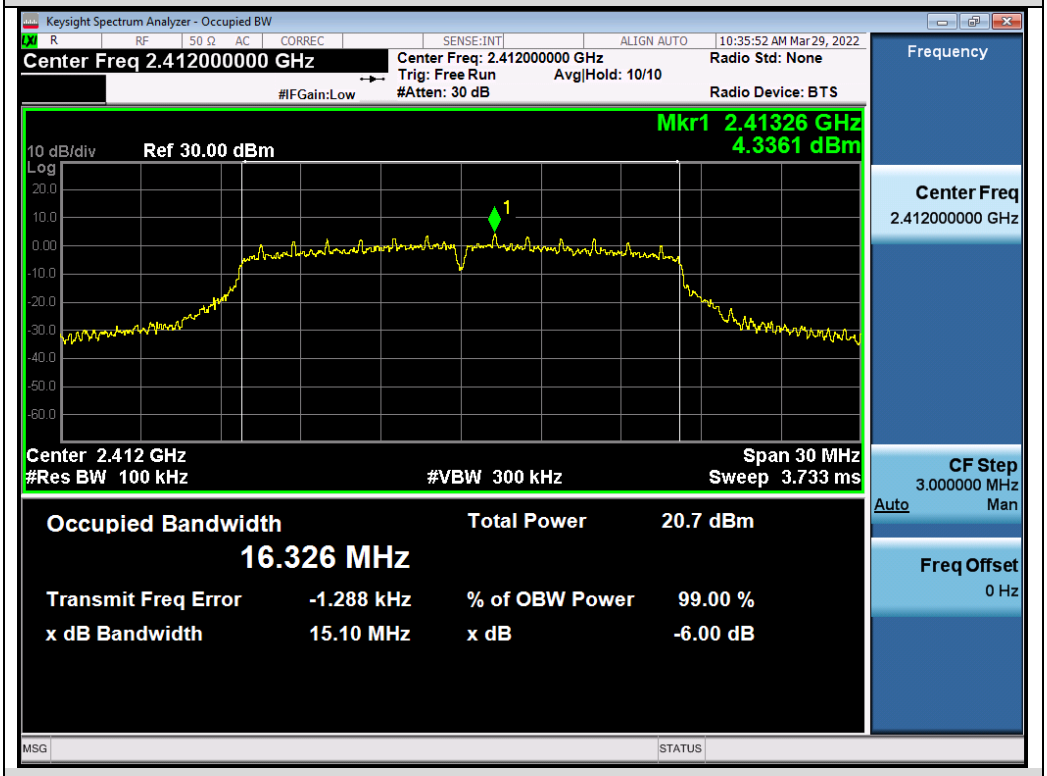
Test Graphs of DTS Bandwidth

Test_Graph_802.11b_ANT1_2412_1Mbps_DTSBW

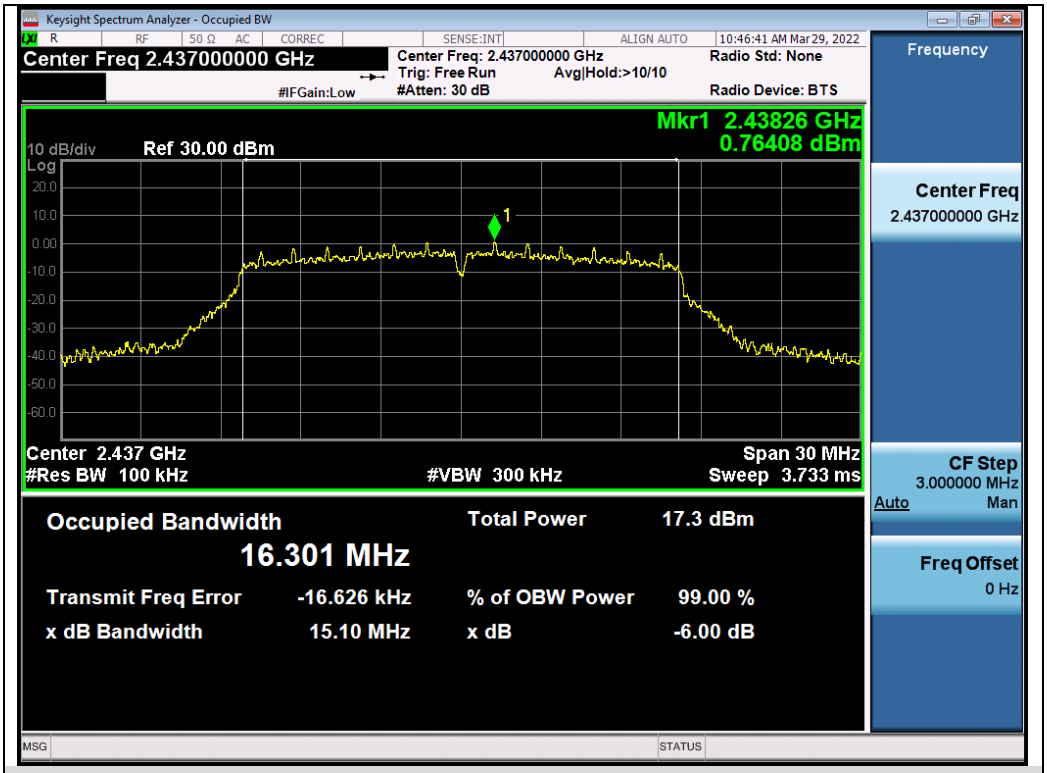


Test_Graph_802.11b_ANT1_2437_1Mbps_DTSBW

Test_Graph_802.11b_ANT1_2462_1Mbps_DTSBW



Test_Graph_802.11g_ANT1_2412_6Mbps_DTSBW



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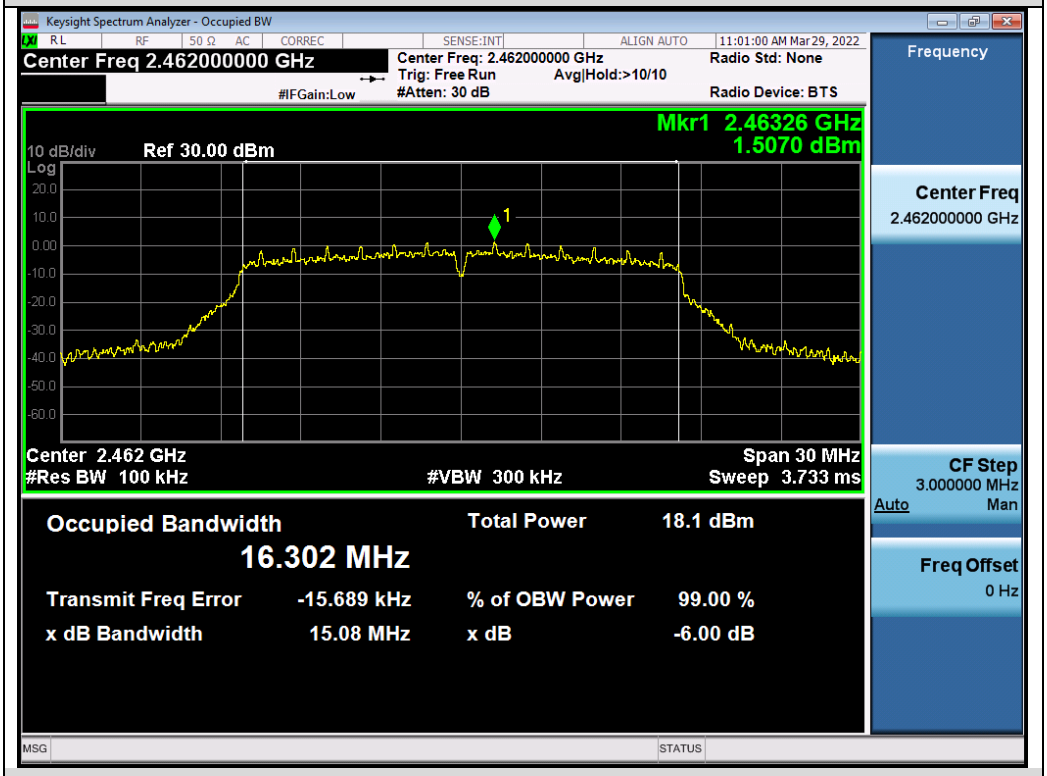
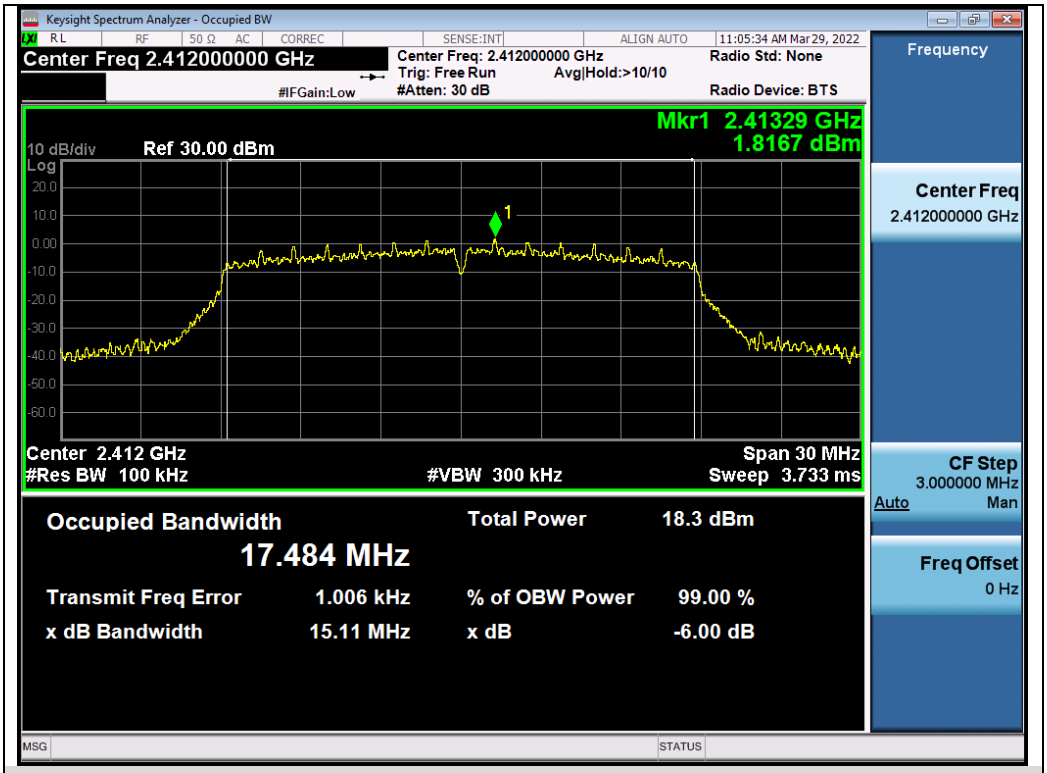
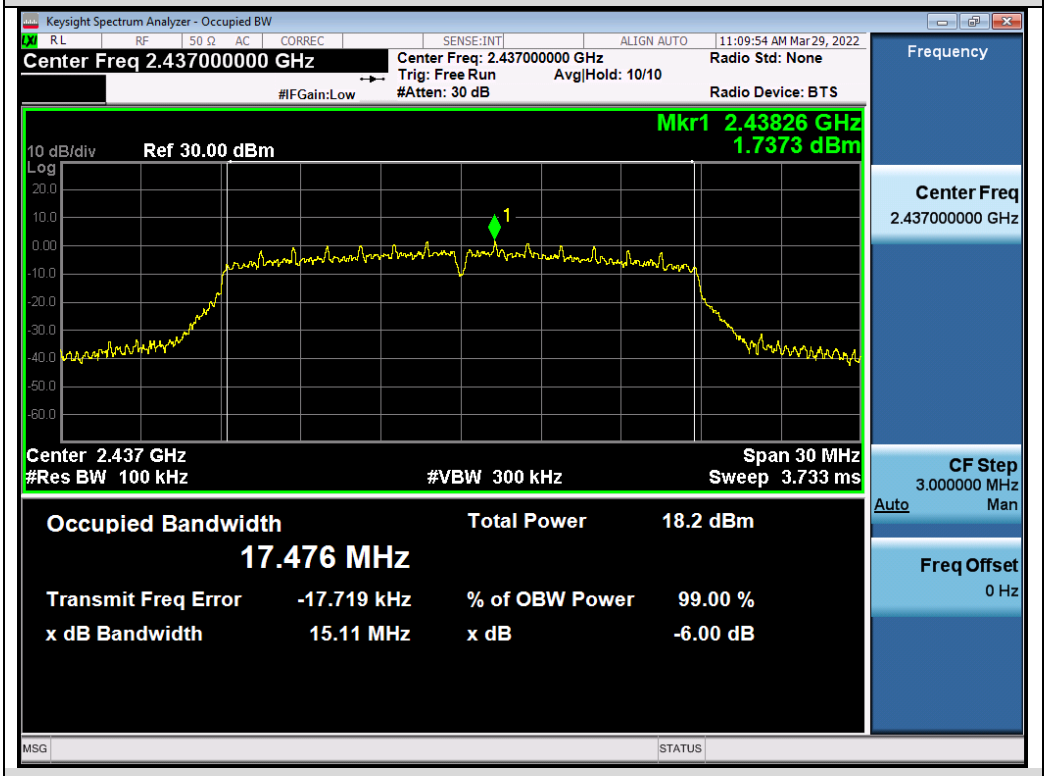


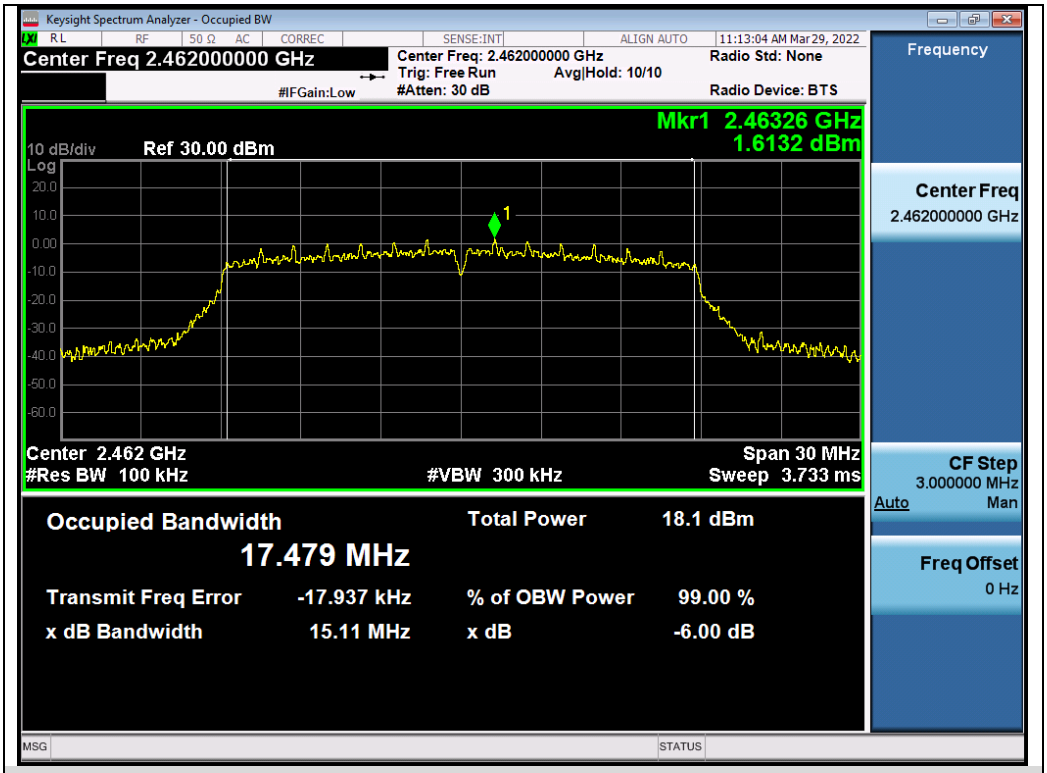
Test_Graph_802.11g_ANT1_2462_6Mbps_DTSBW



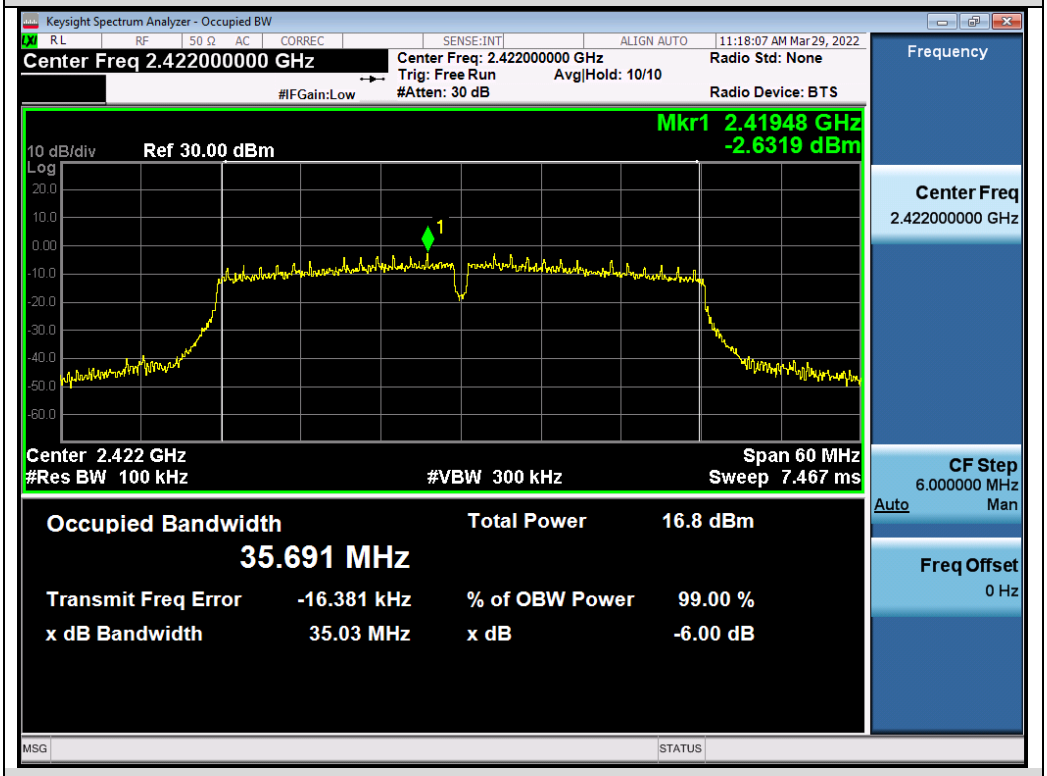
Test_Graph_802.11n20_ANT1_2412_MCS0_DTSBW



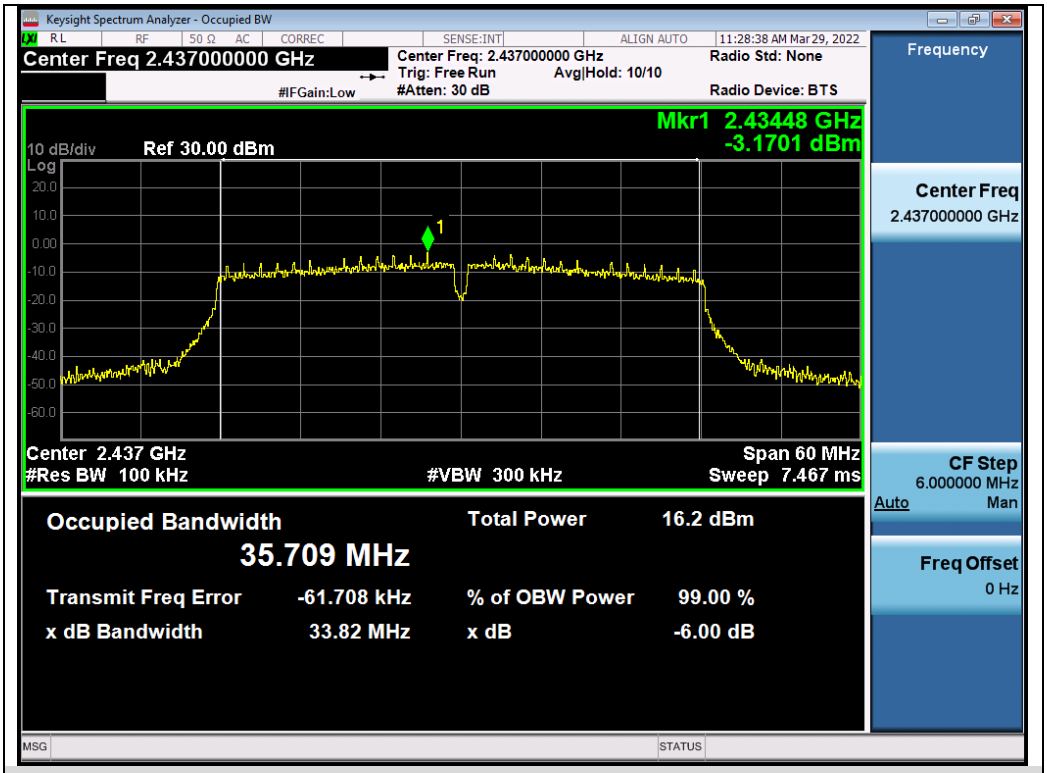
Test_Graph_802.11n20_ANT1_2437_MCS0_DTSBW



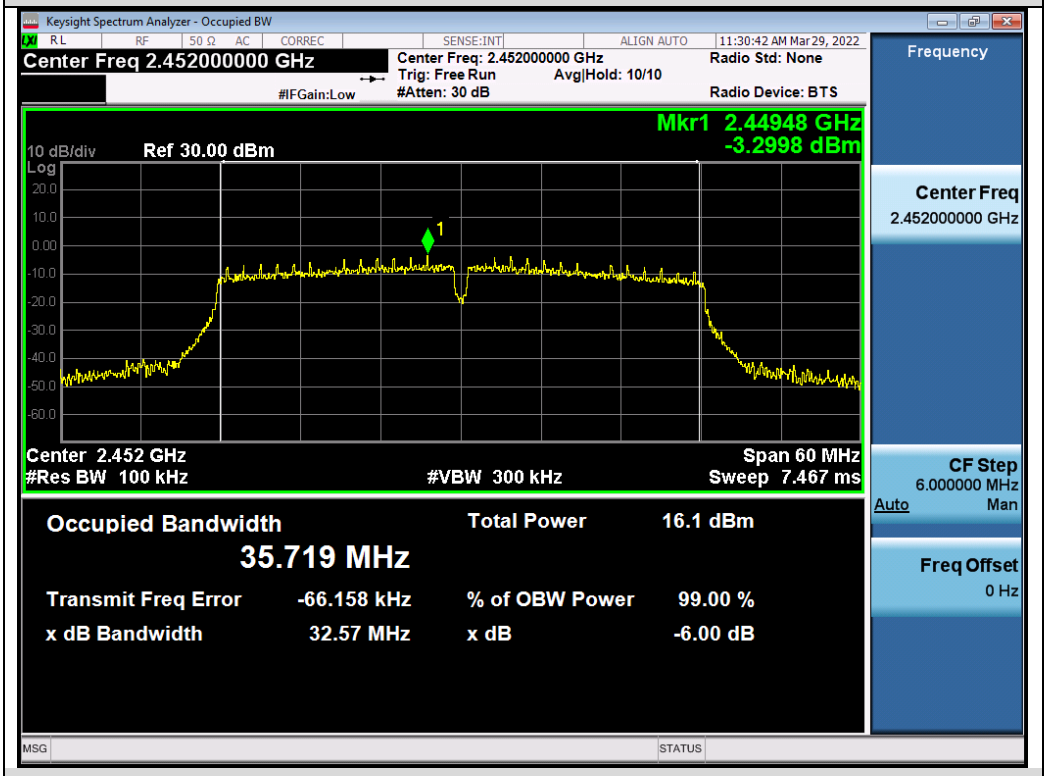
Test_Graph_802.11n20_ANT1_2462_MCS0_DTSBW



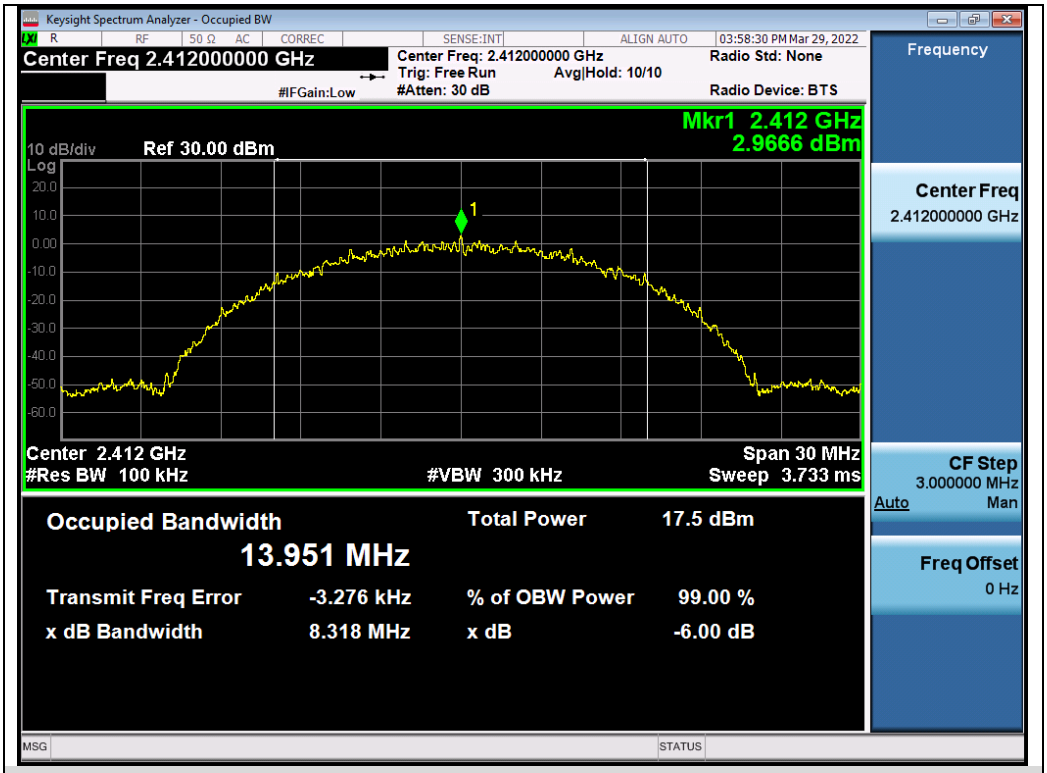
Test_Graph_802.11n40_ANT1_2422_MCS0_DTSBW



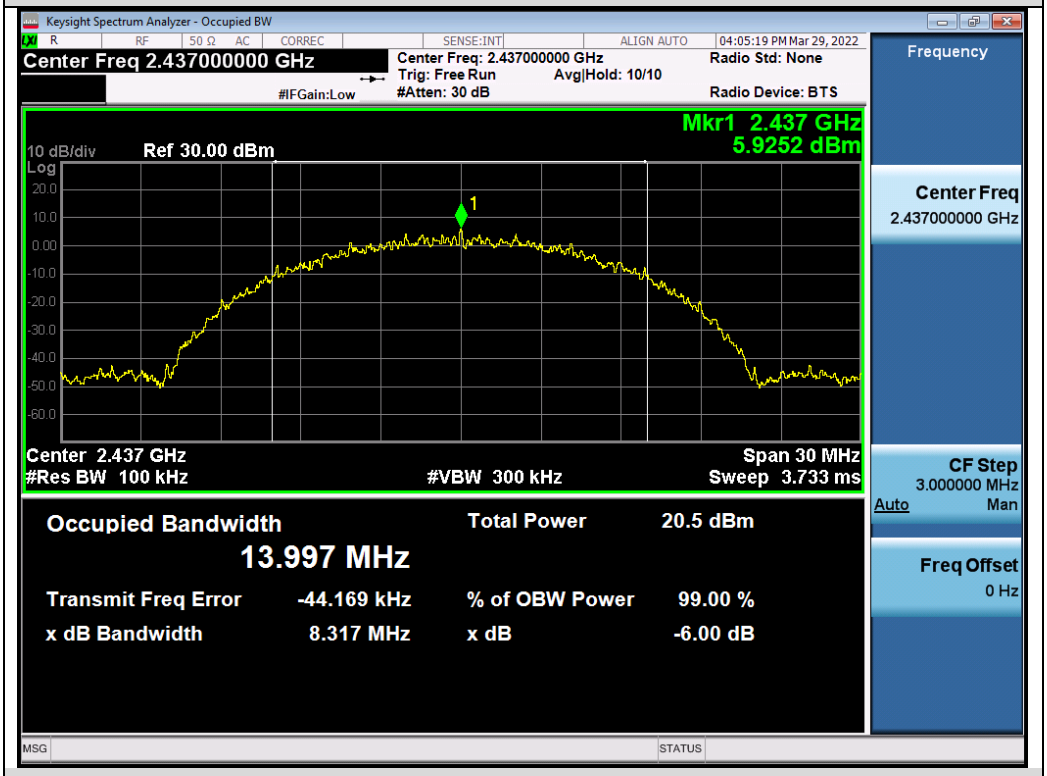
Test_Graph_802.11n40_ANT1_2437_MCS0_DTSBW



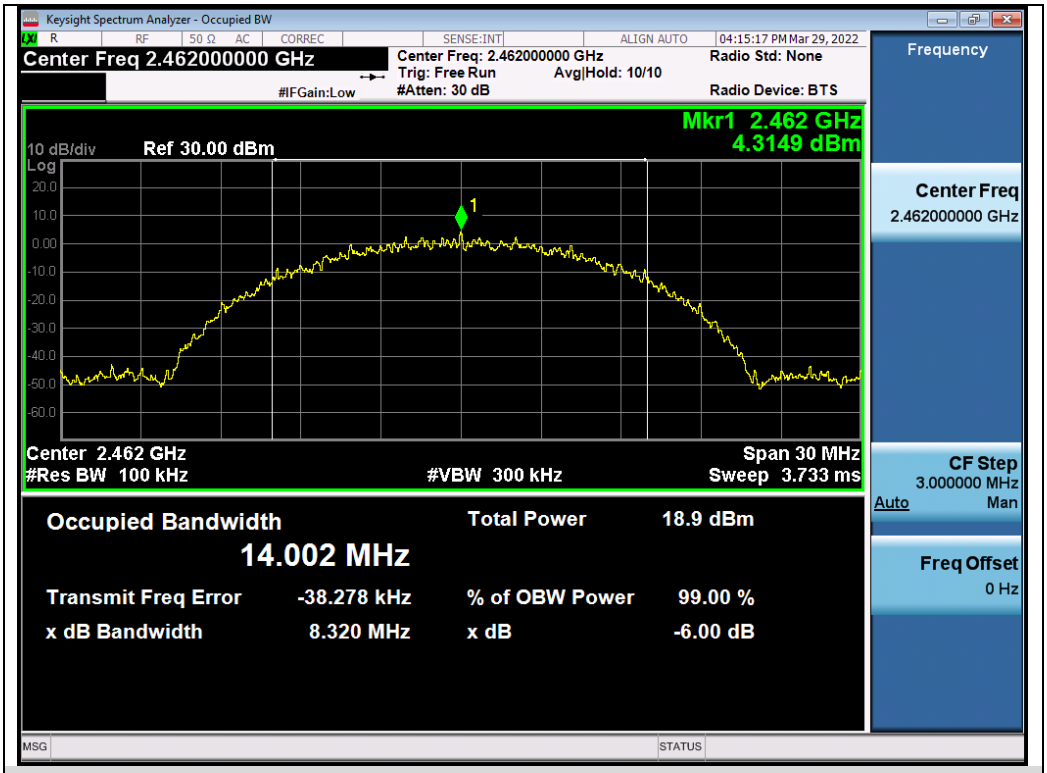
Test_Graph_802.11n40_ANT1_2452_MCS0_DTSBW



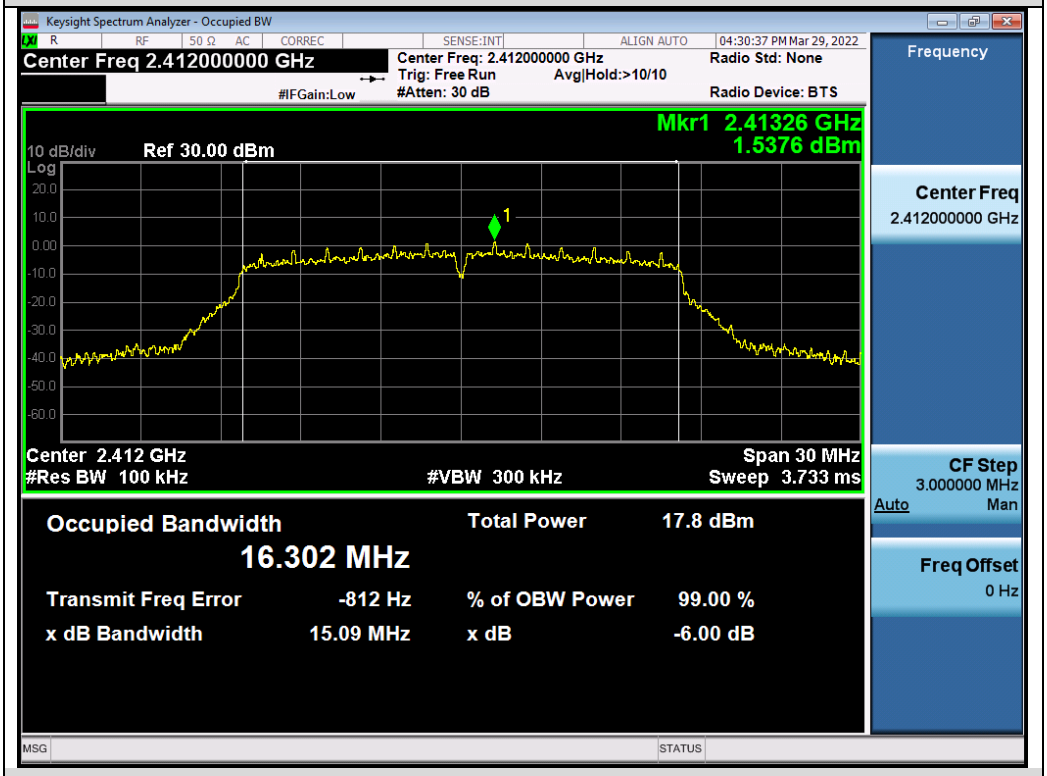
Test_Graph_802.11b_ANT2_2412_1Mbps_DTSBW



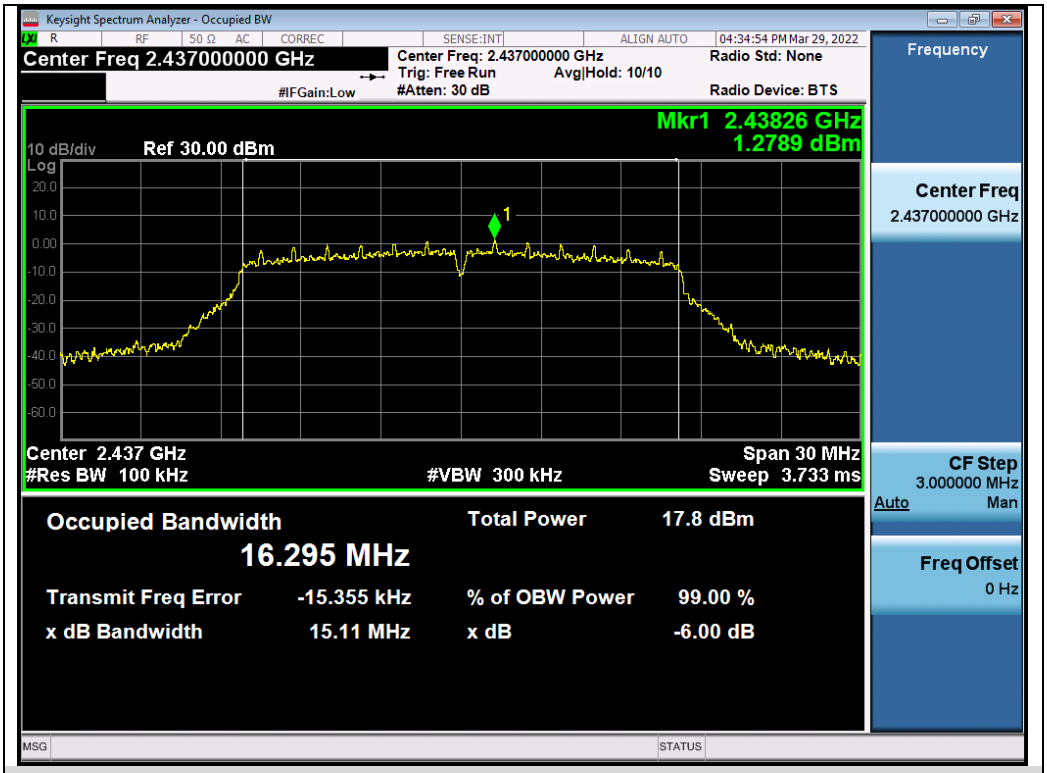
Test_Graph_802.11b_ANT2_2437_1Mbps_DTSBW



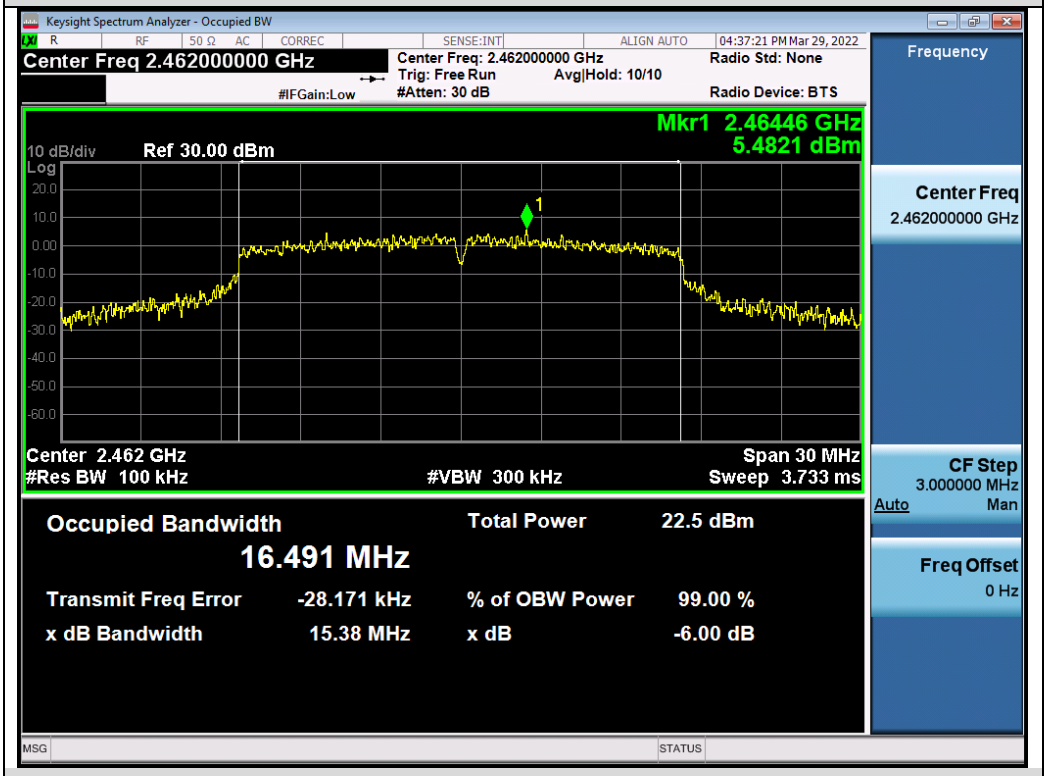
Test_Graph_802.11b_ANT2_2462_1Mbps_DTSBW



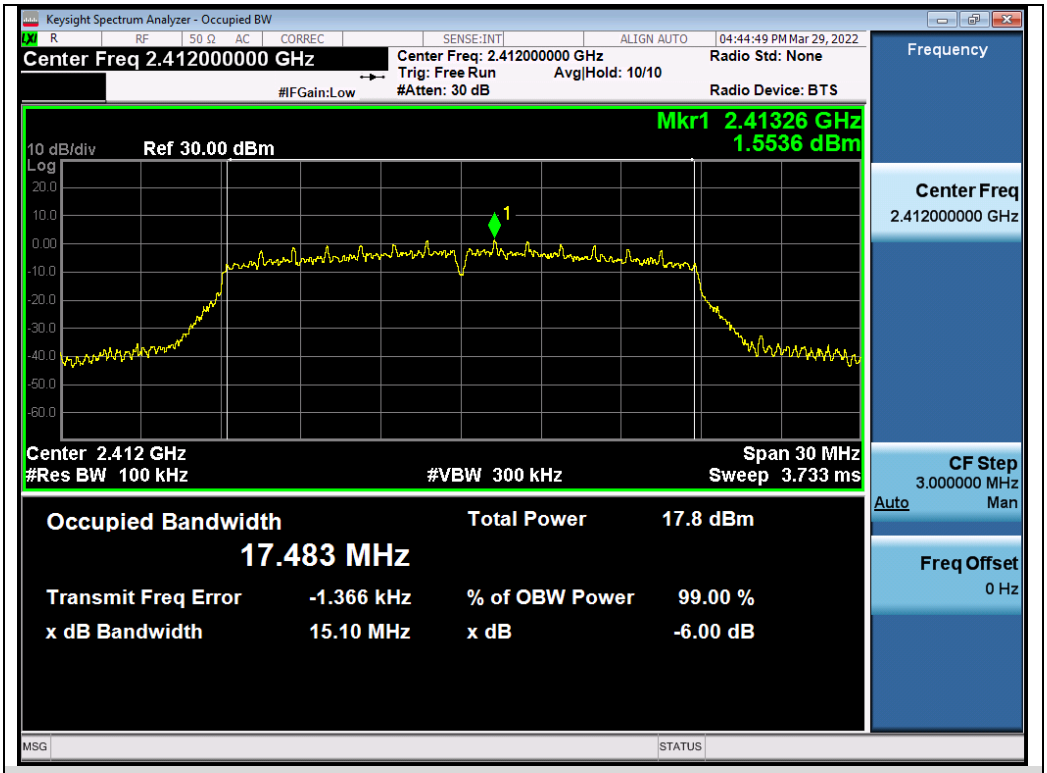
Test_Graph_802.11g_ANT2_2412_6Mbps_DTSBW



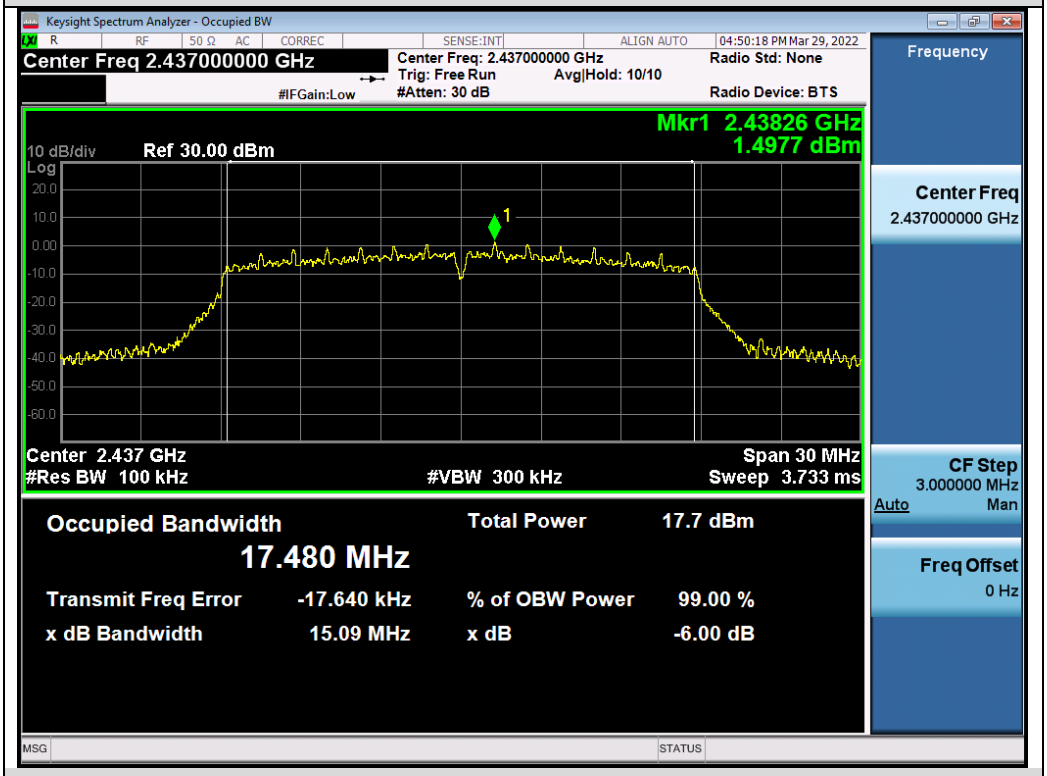
Test_Graph_802.11g_ANT2_2437_6Mbps_DTSBW



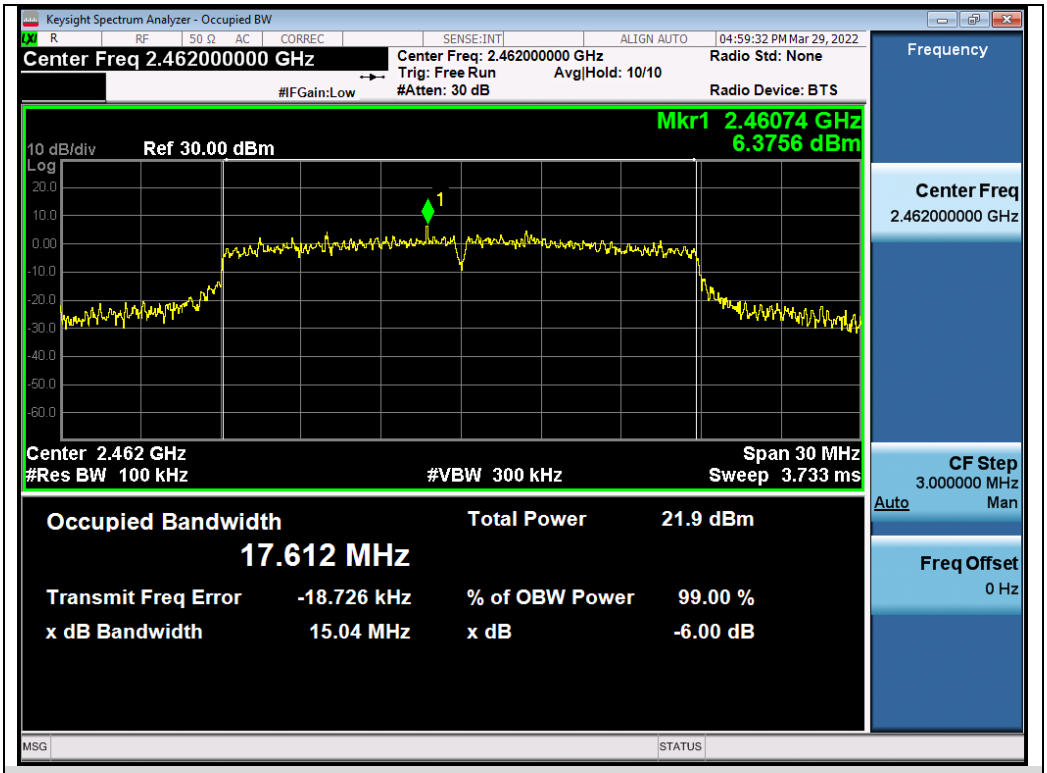
Test_Graph_802.11g_ANT2_2462_6Mbps_DTSBW



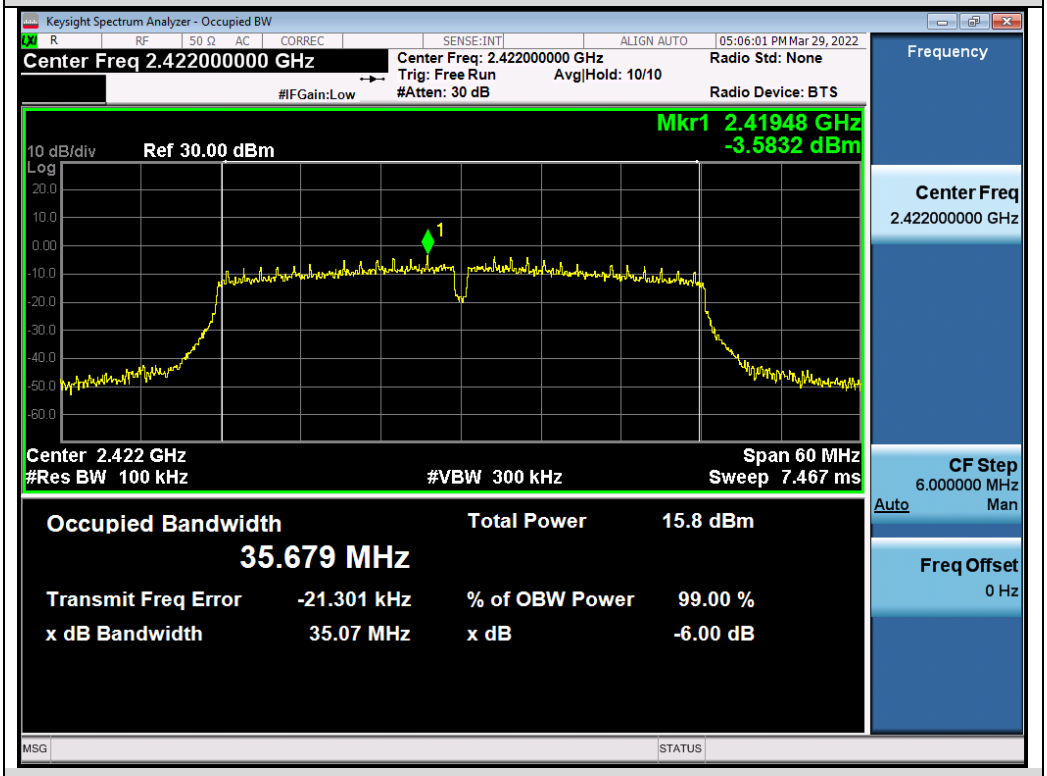
Test_Graph_802.11n20_ANT2_2412_MCS0_DTSBW



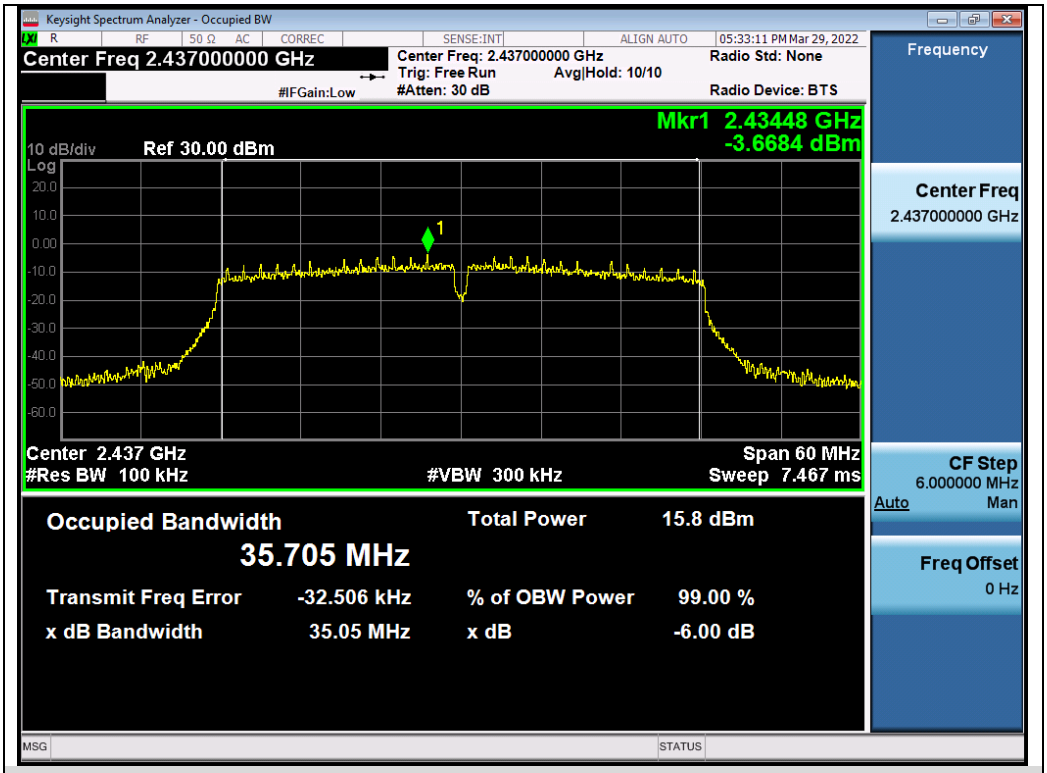
Test_Graph_802.11n20_ANT2_2437_MCS0_DTSBW



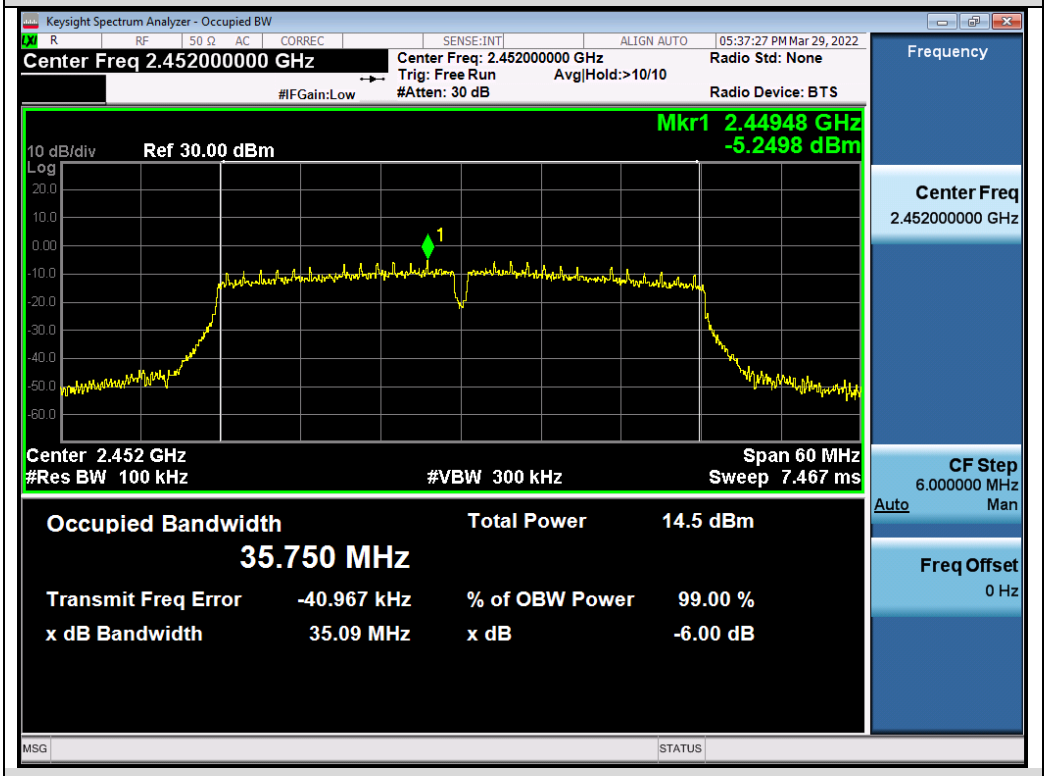
Test_Graph_802.11n20_ANT2_2462_MCS0_DTSBW



Test_Graph_802.11n40_ANT2_2422_MCS0_DTSBW



Test_Graph_802.11n40_ANT2_2437_MCS0_DTSBW



Test_Graph_802.11n40_ANT2_2452_MCS0_DTSBW

9. CONDUCTED SPURIOUS EMISSION

9.1. MEASUREMENT PROCEDURE

1. Connect EUT RF output port to the Spectrum Analyzer through an RF attenuator
2, Set the EUT Work on the top, the middle and the bottom operation frequency individually.
3. Set SPA Trace 1 Max hold, then View.

Note: The EUT was tested according to ANSI C63.10 (2013) for compliance to FCC 47CFR 15.247 requirements. Owing to satisfy the requirements of the number of measurement points, we set the RBW=1MHz, VBW＞RBW, scan up through 10th harmonic, and consider the tested results as the worst case, if the tested results conform to the requirement, we can deem that the real tested results(set the RBW=100KHz, VBW＞RBW) are conform to the requirement.

9.2. TEST SET-UP (BLOCK DIAGRAM OF CONFIGURATION)

The same as described in section 8.2.

9.3. MEASUREMENT EQUIPMENT USEDJN

The same as described in section 6.

9.4. LIMITS AND MEASUREMENT RESULT

LIMITS AND MEASUREMENT RESULT		
Applicable Limits	**Measurement Result**	
	Test Data	**Criteria**
In any 100 KHz Bandwidth Outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produce by the intentional radiator shall be at least 20 dB below that in 100KHz bandwidth within the band that contains the highest level of the desired power. In addition, radiation emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in§15.209(a))	At least -20dBc than the limit Specified on the BOTTOM Channel	PASS
	At least -20dBc than the limit Specified on the TOP Channel	PASS

Note: The limits reference level is according to the test plot of -6dB bandwidth.