RF TEST REPORT

Applicant	Quectel Wireless Solutions Co., Ltd.
FCC ID	XMR202302AF31G
Product	Wi-Fi & Bluetooth Module
Model	AF31G
Report No.	R2211A1014-R1V2
Issue Date	June 9, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (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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Version	Revision description	Issue Date
Rev.0	Initial issue of report.	April 28, 2023
Rev.1	Update the image on page 148.	May 24, 2023
Rev.2	Update data.	June 9, 2023
Note: This revised report (Report No.: R2211A1014-R1V2) supersedes and replaces the previously issued report (Report No.: R2211A1014-R1V1). Please discard or destroy the previously issued report and dispose of it accordingly.		

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Summary of Measurement Results

Number	Test Case	Clause in FCC rules	Verdict
1	Maximum output power	15.247(b)(3)	PASS
2	99% Bandwidth and 6dB Bandwidth	15.247(a)(2) C63.10 6.7	PASS
3	Power spectral density	15.247(e)	PASS
4	Band Edge	15.247(d)	PASS
5	Spurious RF Conducted Emissions	15.247(d)	PASS
6	Unwanted Emissions	15.247(d),15.205,15.209	PASS
7	Conducted Emissions	15.207	PASS
Date of Testing: February 16, 2023 ~ April 6, 2023 and June 7, 2023 ~ June 9, 2023 Date of Sample Received: February 15, 2023			
Note: 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.			

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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 measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform 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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2. General Description of Equipment Under Test

2.1. Applicant and Manufacturer Information

Applicant	Quectel Wireless Solutions Co., Ltd.
Applicant address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233
Manufacturer	Quectel Wireless Solutions Co., Ltd.
Manufacturer address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233

2.2. General Information

EUT Description		
Model	AF31G	
SN	E1C22KA19000889	
Hardware Version	R1.0	
Software Version	NA	
Power Supply	External power supply	
Antenna Type	External Antenna	
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)	
Directional Gain	For Power: 4.35 dBi	
	For PSD: 7.36dBi	
additional beamforming gain	NA	
Operating Frequency Range(s)	802.11b/g/n(HT20): 2412 ~ 2462 MHz 802.11n(HT40): 2422 ~ 2452 MHz Bluetooth LE V5.0: 2402 ~2480 MHz	
Modulation Type	802.11b: DSSS 802.11g/n(HT20/HT40): OFDM Bluetooth LE: GFSK	
Max. Output Power	Wi-Fi 2.4G: 19.34 dBm Bluetooth LE: 3.60dBm	
Auxiliary test equipment		
Antenna	Manufacturer	FOXCONN
	Model	ACE-Antenna
	Antenna Gain	Antenna 1: 3.67 dBi
		Antenna 2: 4.35 dBi
		Bluetooth LE: 3.67 dBi

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Note: 1.The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.
2. The antenna gain is provided by the manufacturer.
3. The antenna is for testing only and will not be sold with the equipment

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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 15C (2022) Radio Frequency Devices

ANSI C63.10-2013

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02

KDB 662911 D01 Multiple Transmitter Output v02r01

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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 (H axis) and the loop antenna is vertical, the others are vertical and horizontal. 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.

Test Mode	Data Rate
Bluetooth LE	1Mbps

Test Mode	Data Rate		
	Antenna 1	Antenna 2	CDD/MIMO
802.11b	1 Mbps	1 Mbps	1 Mbps
802.11g	6 Mbps	6 Mbps	6 Mbps
802.11n HT20	MCS0	MCS0	MCS8
802.11n HT40	MCS0	MCS0	MCS8

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The worst case Antenna mode for each of the following tests for Wi-Fi:

Test Cases	Antenna 1	Antenna 2	CDD/MIMO
Maximum output power	O	O	O
6dB Bandwidth	--	--	O
Band Edge	--	--	O
Power Spectral Density	O	O	O
Spurious RF Conducted Emissions	--	--	O
Unwanted Emissions	--	--	O
Conducted Emission	--	--	802.11g
Note: “O”: test all bands			

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5. Test Case Results

5.1. Maximum output power

Ambient Condition

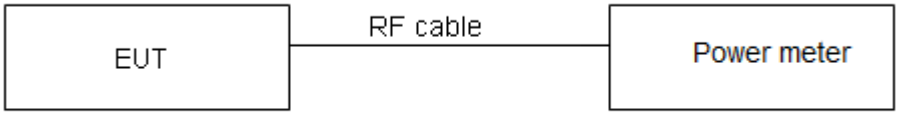
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

During the process of the testing, The EUT was connected to Power meter with a known loss. The EUT is max power transmission with proper modulation.

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

Test Setup



Limits

Rule Part 15.247 (b) (3) specifies that " For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz: 1 Watt."

Average Output Power	≤ 1W (30dBm)

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.

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Test Results

Power Index					
Channel	**802.11b**	**802.11g**	**802.11n HT20**	**Channel**	**802.11n HT40**
CH1	17	14	12	**CH3**	6
CH2	--	17	17	**CH4**	8
CH6	17	17	17	**CH5**	10
CH9	--	17	17	**CH6**	13
CH10	--	16	16	**CH7**	9
CH11	17	13	12	**CH8**	8
--	--	--	--	**CH9**	7

Test Mode	Duty cycle	Duty cycle correction Factor(dB)
802.11b	0.976	0.11
802.11g	0.974	0.11
802.11n HT20	0.978	0.10
802.11n HT40	0.955	0.20
Note: when Duty cycle≥0.98, Duty cycle correction Factor not required.		

Test Mode	Duty cycle	Duty cycle correction Factor(dB)
Bluetooth LE	0.654	1.847
Note: when Duty cycle≥0.98, Duty cycle correction Factor not required.		

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
Bluetooth LE	2402/CH0	0.61	2.46	30	PASS
	2440/CH19	1.75	3.60	30	PASS
	2480/CH39	1.06	2.91	30	PASS

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SISO ANT1

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11b	2412/CH1	15.90	16.00	30	PASS
	2437/CH6	16.37	16.48	30	PASS
	2462/CH11	15.58	15.68	30	PASS
802.11g	2412/CH1	12.78	12.89	30	PASS
	2417/CH2	16.18	16.29	30	PASS
	2437/CH6	16.32	16.43	30	PASS
	2452/CH9	16.20	16.31	30	PASS
	2457/CH10	15.02	15.13	30	PASS
	2462/CH11	11.92	12.03	30	PASS
802.11n HT20	2412/CH1	10.22	10.32	30	PASS
	2417/CH2	15.96	16.06	30	PASS
	2437/CH6	16.00	16.10	30	PASS
	2452/CH9	15.99	16.09	30	PASS
	2457/CH10	14.76	14.86	30	PASS
	2462/CH11	10.70	10.80	30	PASS
802.11n HT40	2422/CH3	4.79	4.99	30	PASS
	2427/CH4	7.14	7.34	30	PASS
	2432/CH5	9.08	9.28	30	PASS
	2437/CH6	15.64	15.84	30	PASS
	2442/CH7	8.29	8.49	30	PASS
	2447/CH8	7.36	7.56	30	PASS
	2452/CH9	6.41	6.61	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

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SISO ANT2

Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11b	2412/CH1	16.61	16.72	30	PASS
	2437/CH6	16.07	16.17	30	PASS
	2462/CH11	16.02	16.13	30	PASS
802.11g	2412/CH1	13.71	13.83	30	PASS
	2417/CH2	16.82	16.93	30	PASS
	2437/CH6	16.02	16.13	30	PASS
	2452/CH9	16.14	16.25	30	PASS
	2457/CH10	15.03	15.14	30	PASS
	2462/CH11	12.32	12.43	30	PASS
802.11n HT20	2412/CH1	11.39	11.49	30	PASS
	2417/CH2	16.50	16.60	30	PASS
	2437/CH6	15.74	15.84	30	PASS
	2452/CH9	15.84	15.94	30	PASS
	2457/CH10	14.81	14.91	30	PASS
	2462/CH11	11.05	11.14	30	PASS
802.11n HT40	2422/CH3	6.24	6.44	30	PASS
	2427/CH4	8.55	8.75	30	PASS
	2432/CH5	10.43	10.63	30	PASS
	2437/CH6	12.79	12.99	30	PASS
	2442/CH7	9.11	9.31	30	PASS
	2447/CH8	8.37	8.57	30	PASS
	2452/CH9	6.73	6.93	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

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CDD/MIMO

Network Standards	Carrier frequency (MHz)	Output Power (dBm)				Total Power (dBm)	Limit (dBm)	Conclusion
		Antenna 1		Antenna 2				
		Average Power Measured (dBm)	Average Power with duty factor (dBm)	Average Power Measured (dBm)	Average Power with duty factor (dBm)			
802.11b	2412/CH1	15.83	15.94	16.59	16.70	19.34	30	PASS
	2437/CH6	16.27	16.38	16.03	16.14	19.27	30	PASS
	2462/CH11	15.47	15.58	15.92	16.03	18.82	30	PASS
802.11g	2412/CH1	12.90	13.00	13.86	13.97	16.52	30	PASS
	2417/CH2	16.26	16.37	16.89	17.00	19.70	30	PASS
	2437/CH6	16.14	16.25	15.94	16.04	19.16	30	PASS
	2452/CH9	16.15	16.26	16.02	16.12	19.20	30	PASS
	2457/CH10	14.94	15.05	15.04	15.15	18.11	30	PASS
	2462/CH11	11.93	12.03	12.35	12.46	15.26	30	PASS
802.11n HT20	2412/CH1	11.60	11.70	11.59	11.69	14.70	30	PASS
	2417/CH2	16.02	16.22	16.66	16.76	19.51	30	PASS
	2437/CH6	15.87	15.87	15.71	15.81	18.85	30	PASS
	2452/CH9	15.87	15.87	15.78	15.88	18.88	30	PASS
	2457/CH10	14.72	14.72	14.78	14.87	17.81	30	PASS
	2462/CH11	10.76	10.85	11.18	11.28	14.08	30	PASS
802.11n HT40	2422/CH3	5.03	5.23	6.26	6.46	8.90	30	PASS
	2427/CH4	7.58	7.78	8.71	8.91	11.39	30	PASS
	2432/CH5	9.76	9.96	10.66	10.86	13.45	30	PASS
	2437/CH6	13.04	13.24	13.04	13.24	16.25	30	PASS
	2442/CH7	8.66	8.86	8.99	9.19	12.04	30	PASS
	2447/CH8	8.43	8.63	8.07	8.27	11.47	30	PASS
	2452/CH9	6.57	6.77	6.60	6.80	9.80	30	PASS

Note: 1.Average Power with duty factor = Average Power Measured +Duty cycle correction factor

2. For Total Power, according to KDB 662911 D01 Multiple Transmitter Output v02r01 1),

The Total Power $=10\log(10^{(\text{Power antenna1 in dBm}/10)}+10^{(\text{Power antenna2 in dBm}/10)})$.

3. The manufacturer declared the $N_{ss}=1$. According to KDB 662911 D01 Multiple Transmitter Output v02r01 F)2)f)(ii): If antenna gains are not equal, the user may use either of the following methods to calculate directional gain, provided that each transmit antenna is driven by only one spatial stream: Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

Directional gain = $G_{ANT\ MAX}$ + Array Gain,

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT};

Array Gain = 5 log(N_{ANT}/N_{SS}) dB or 3 dB, whichever is less, for 20-MHz channel widths with $N_{ANT} \geq 5$.

So directional gain = $G_{ANT\ MAX}$ + Array Gain =4.35+0=4.35 dBi<6dBi. So the power limit is 30dBm

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5.2. 99% Bandwidth and 6dB Bandwidth

Ambient Condition

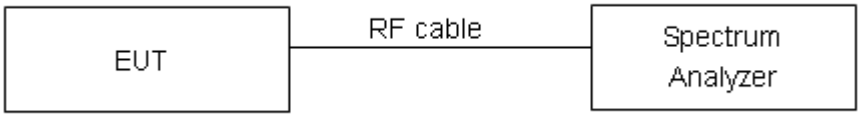
Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

The EUT was connected to the spectrum analyzer through an external attenuator (20dB) and a known loss cable. RBW is set to 100 kHz; VBW is set to 300 kHz on spectrum analyzer.
Dector=Peak, Trace mode=max hold.

The EUT was connected to the spectrum analyzer through a known loss cable. The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value.

Test Setup



Limits

Rule Part 15.247 (a) (2) specifies that “Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.”

minimum 6 dB bandwidth	≥ 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.

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Test Results:

Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412	13.329	7.572	500	PASS
	2437	13.322	8.075	500	PASS
	2462	13.254	8.070	500	PASS
802.11g	2412	16.321	16.313	500	PASS
	2417	16.293	15.805	500	PASS
	2437	16.322	15.548	500	PASS
	2452	16.279	15.026	500	PASS
	2457	16.285	13.979	500	PASS
	2462	16.338	15.445	500	PASS
802.11n HT20	2412	17.452	15.001	500	PASS
	2417	17.443	17.087	500	PASS
	2437	17.450	15.072	500	PASS
	2452	17.403	15.799	500	PASS
	2457	17.410	14.766	500	PASS
	2462	17.458	13.253	500	PASS
802.11n HT40	2422	35.994	34.972	500	PASS
	2427	35.934	32.552	500	PASS
	2432	35.975	31.589	500	PASS
	2437	35.867	35.089	500	PASS
	2442	35.842	32.937	500	PASS
	2447	35.863	35.102	500	PASS
	2452	35.820	28.776	500	PASS
Bluetooth LE	2402	1.066	0.664	500	PASS
	2440	1.065	0.660	500	PASS
	2480	1.056	0.670	500	PASS

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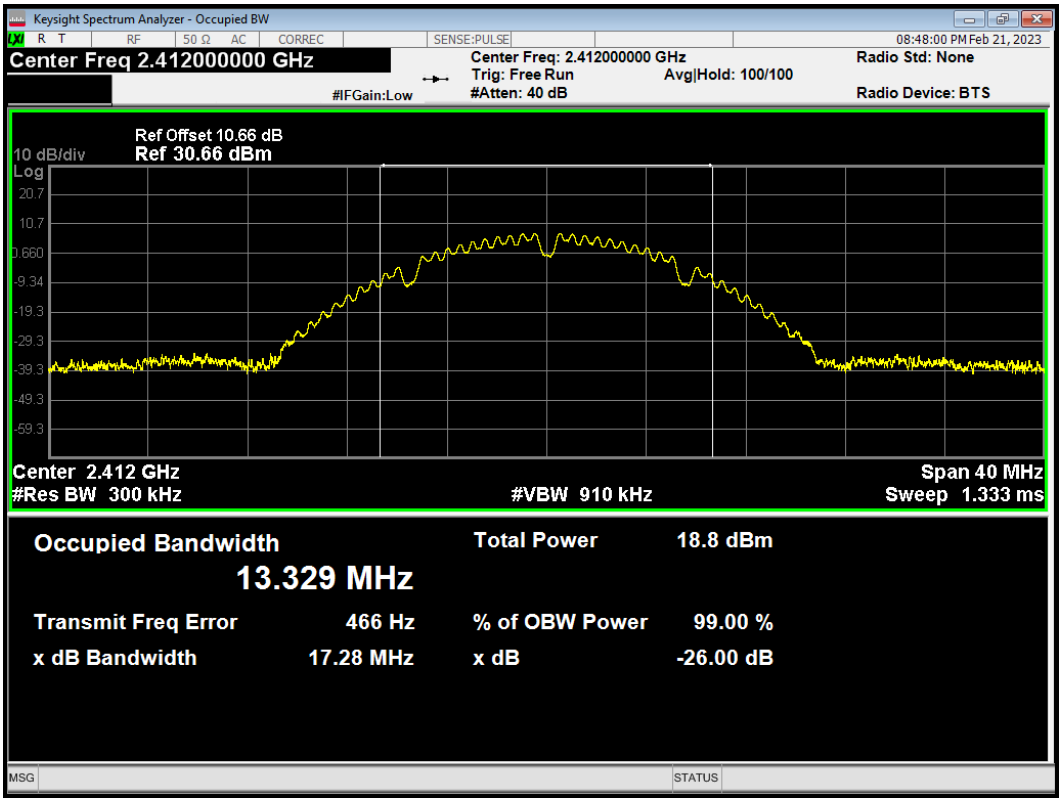
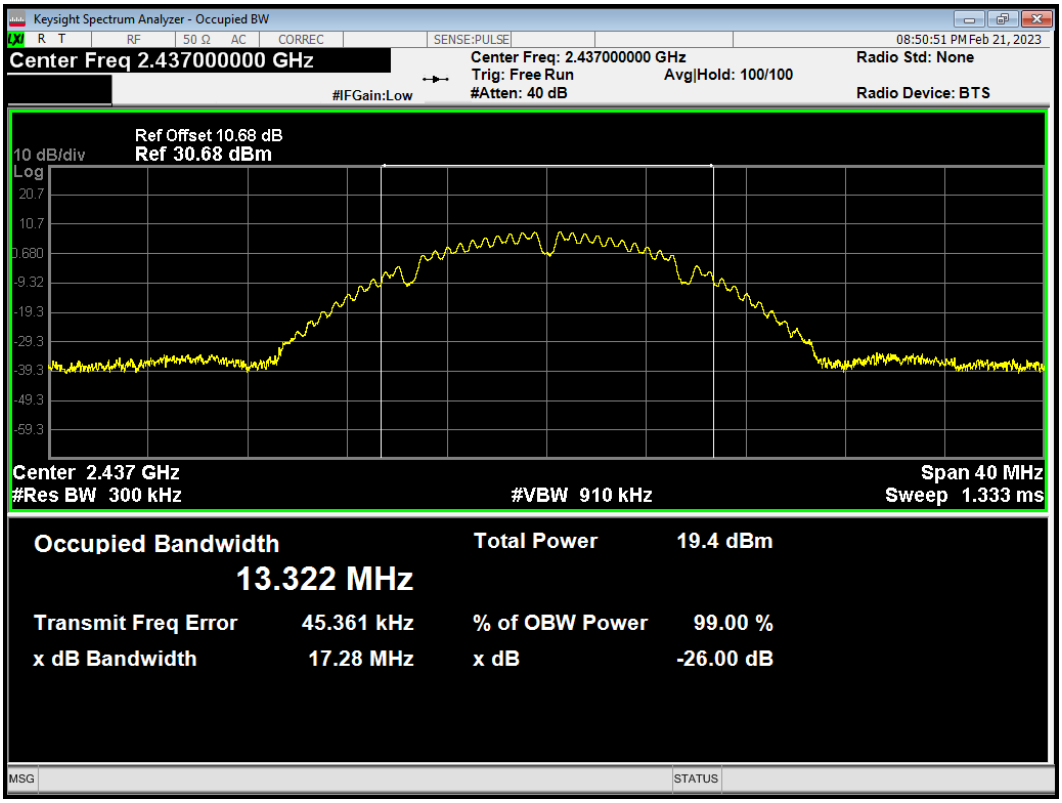
99%bandwidth

OBW 802.11b 2412MHz



OBW 802.11b 2437MHz



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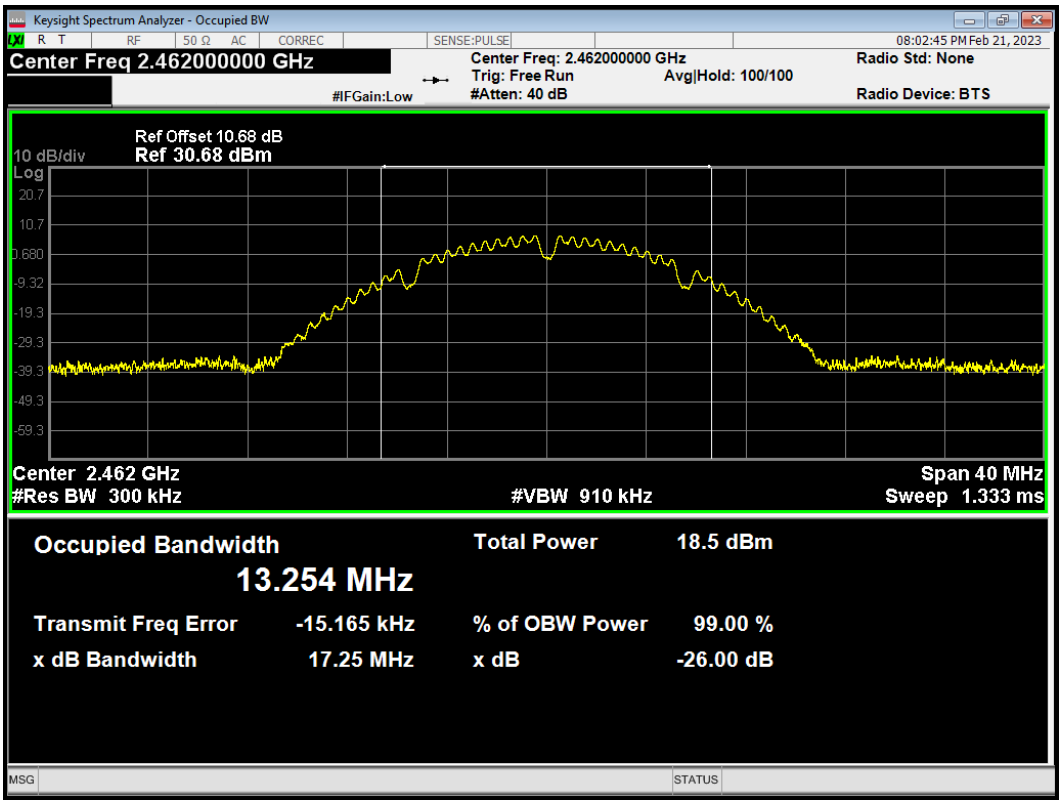
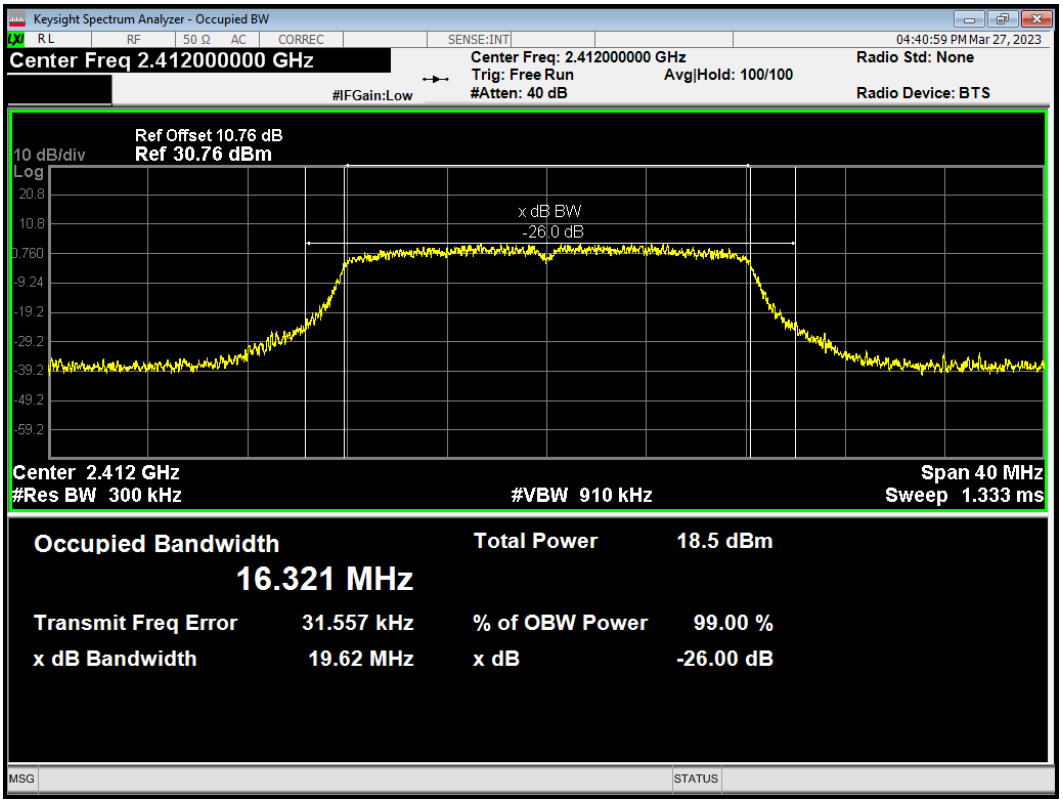
OBW 802.11b 2462MHz



OBW 802.11g 2412MHz



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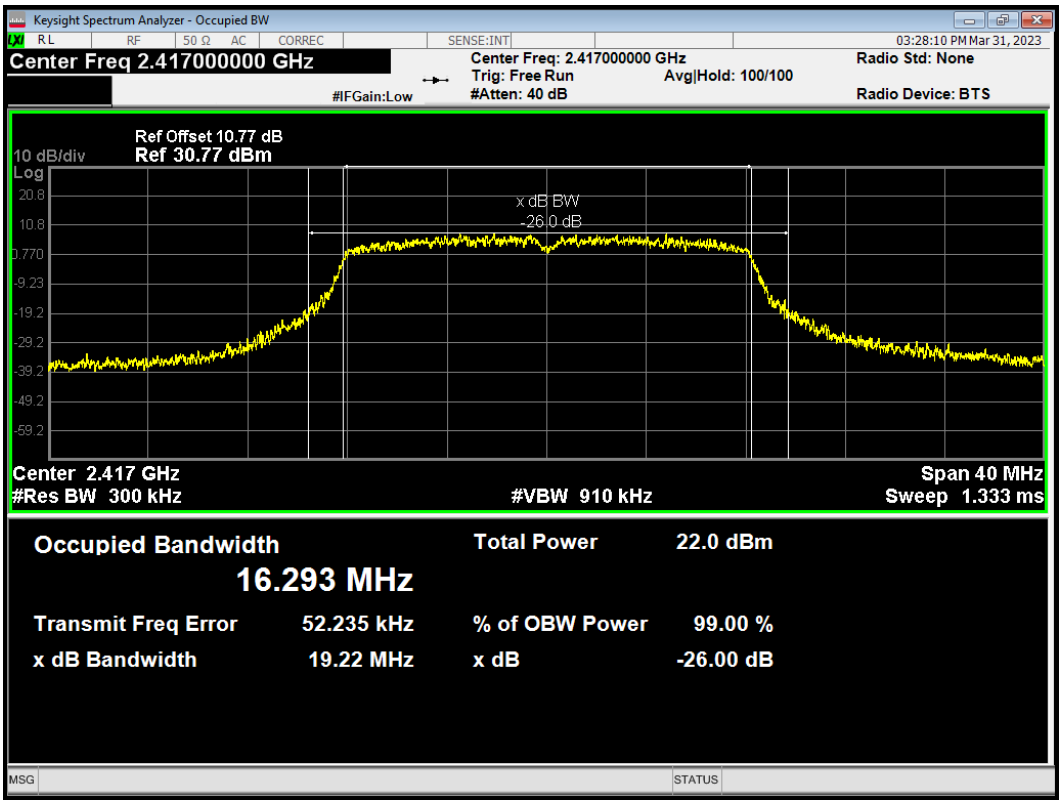
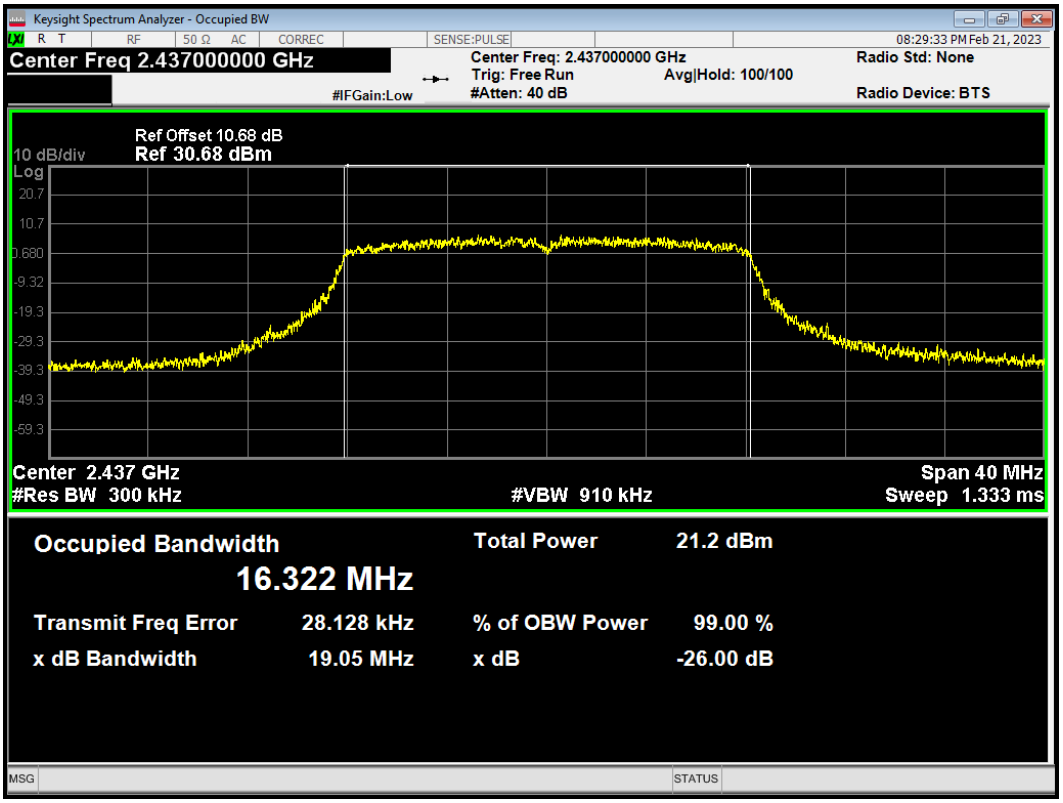
OBW 802.11g 2417MHz



OBW 802.11g 2437MHz



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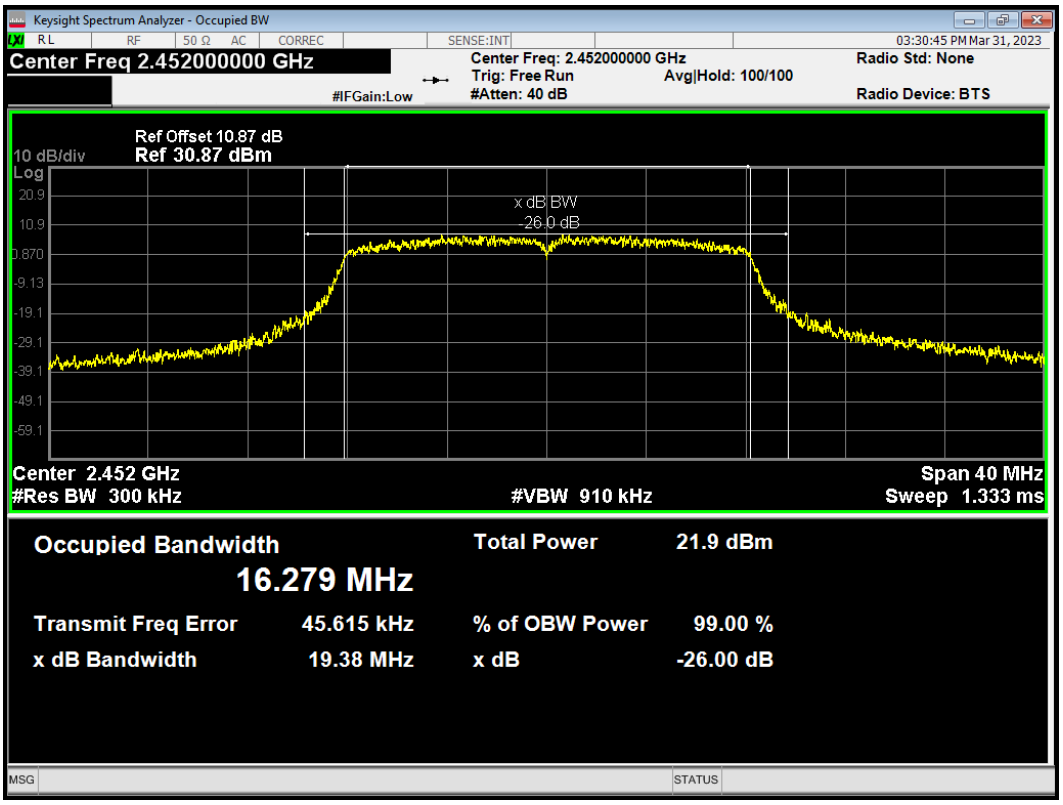
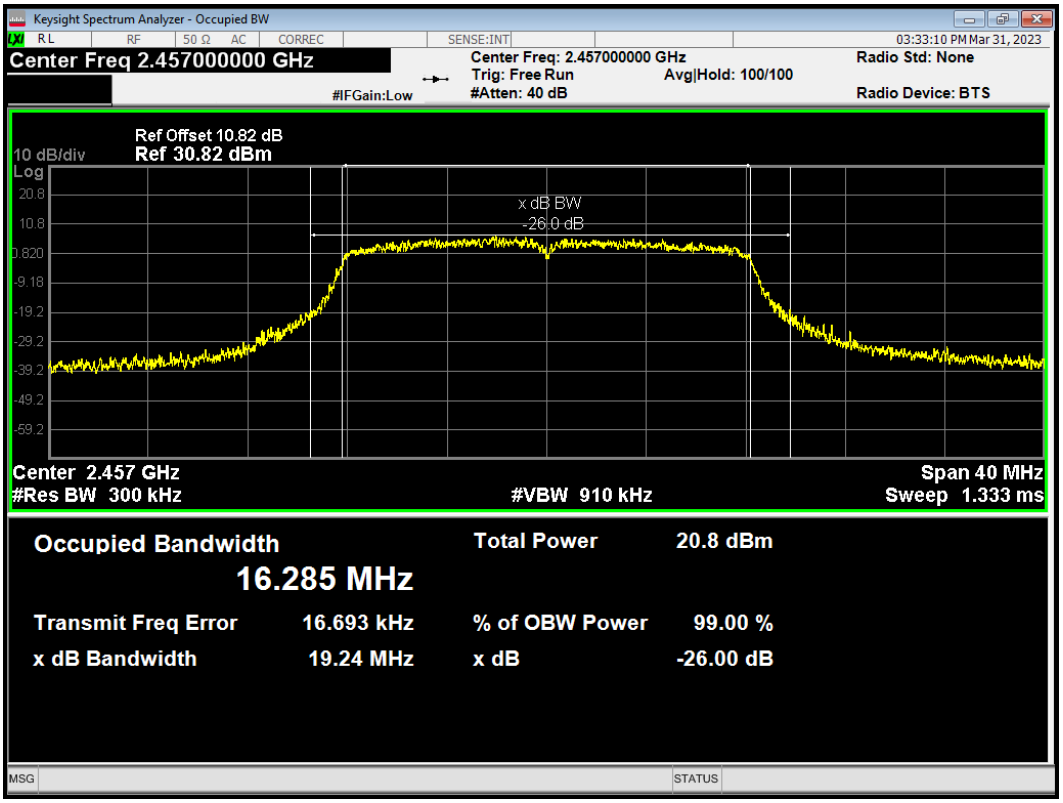
OBW 802.11g 2452MHz



OBW 802.11g 2457MHz



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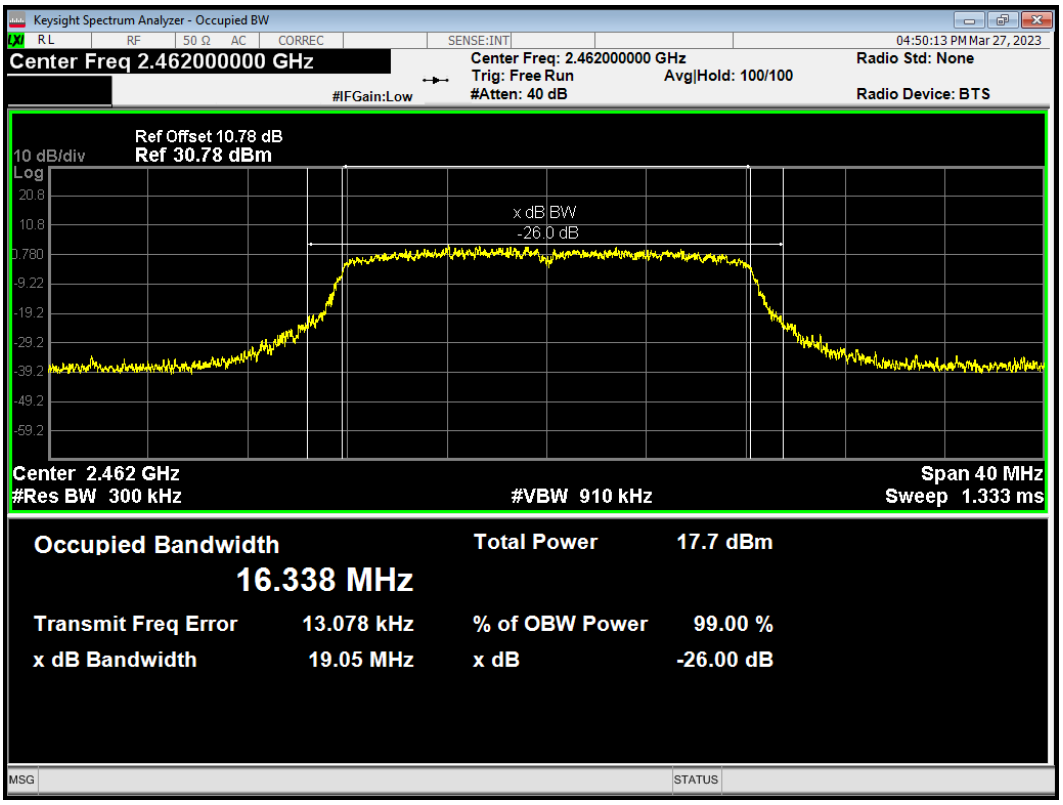
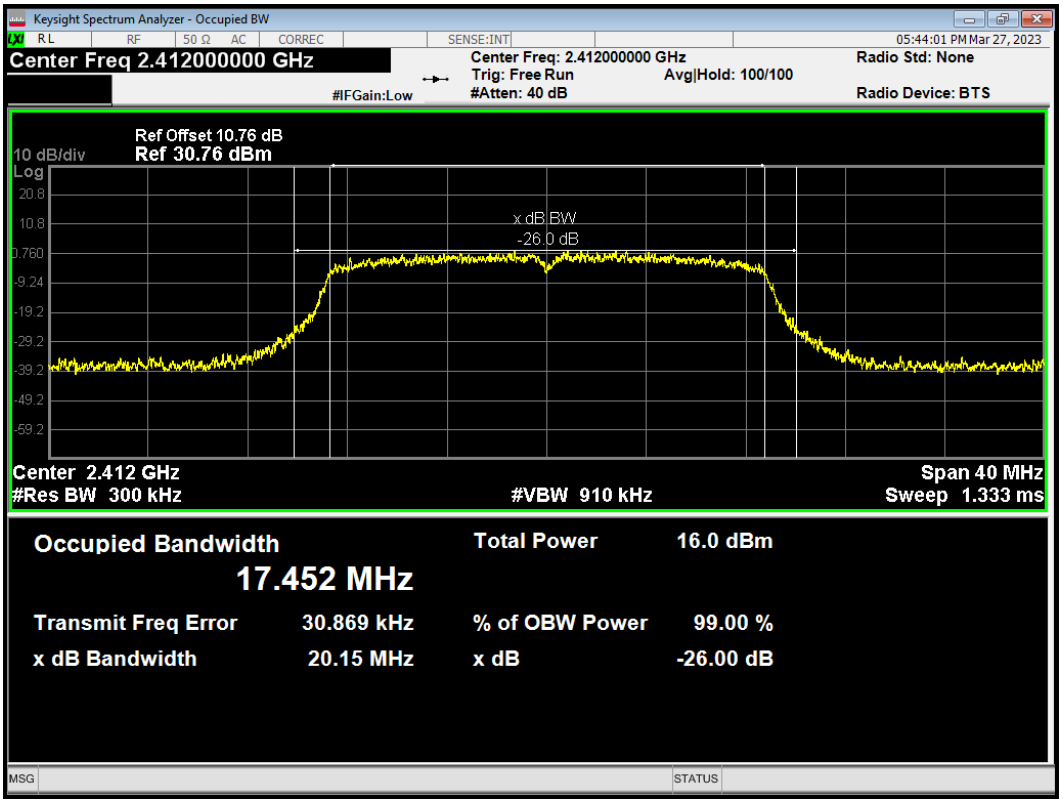
OBW 802.11g 2462MHz



OBW 802.11n(HT20) 2412MHz



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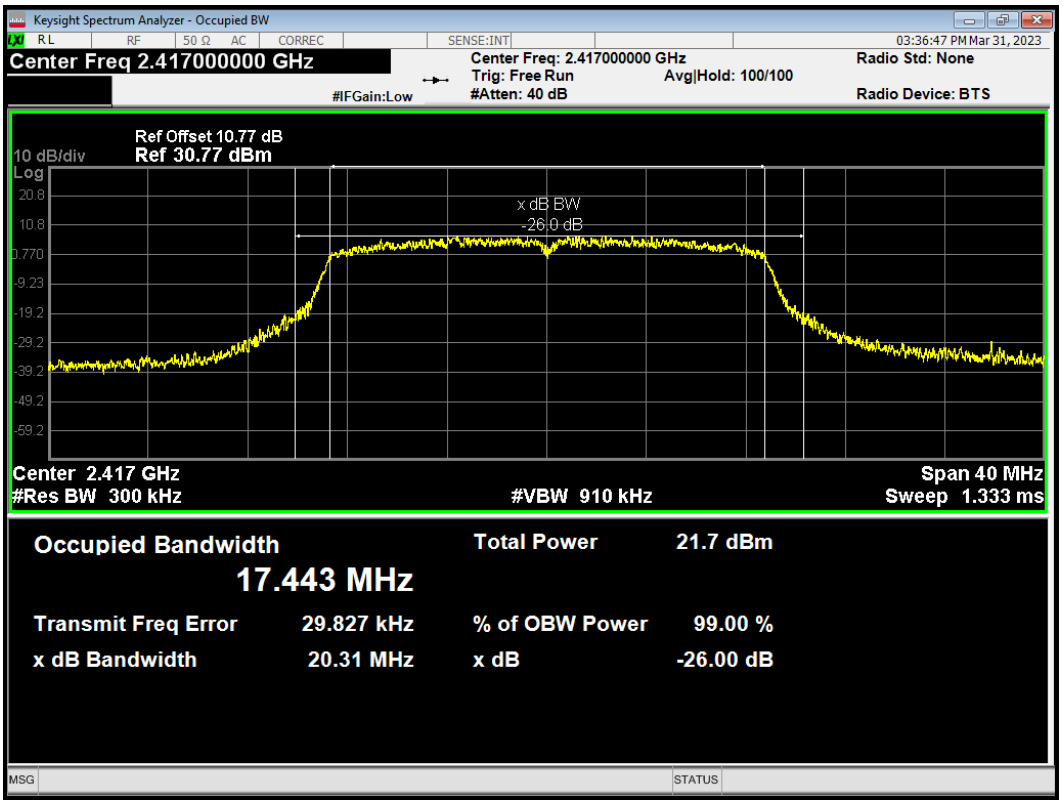
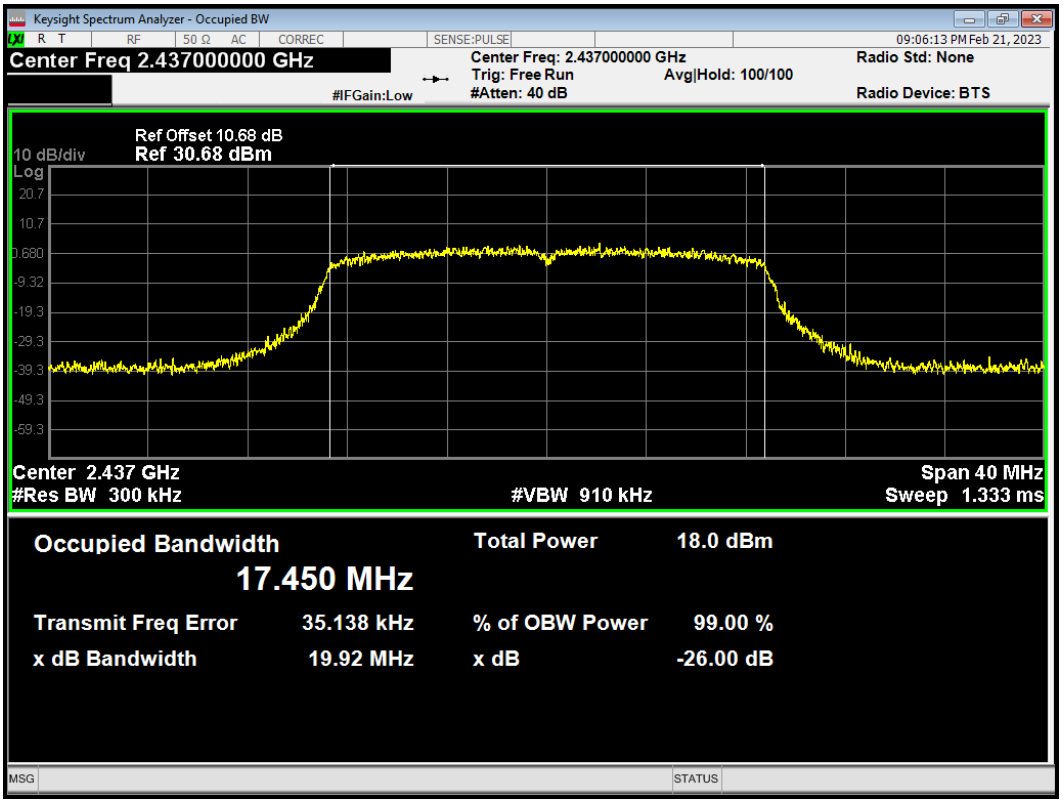
OBW 802.11n(HT20) 2417MHz



OBW 802.11n(HT20) 2437MHz



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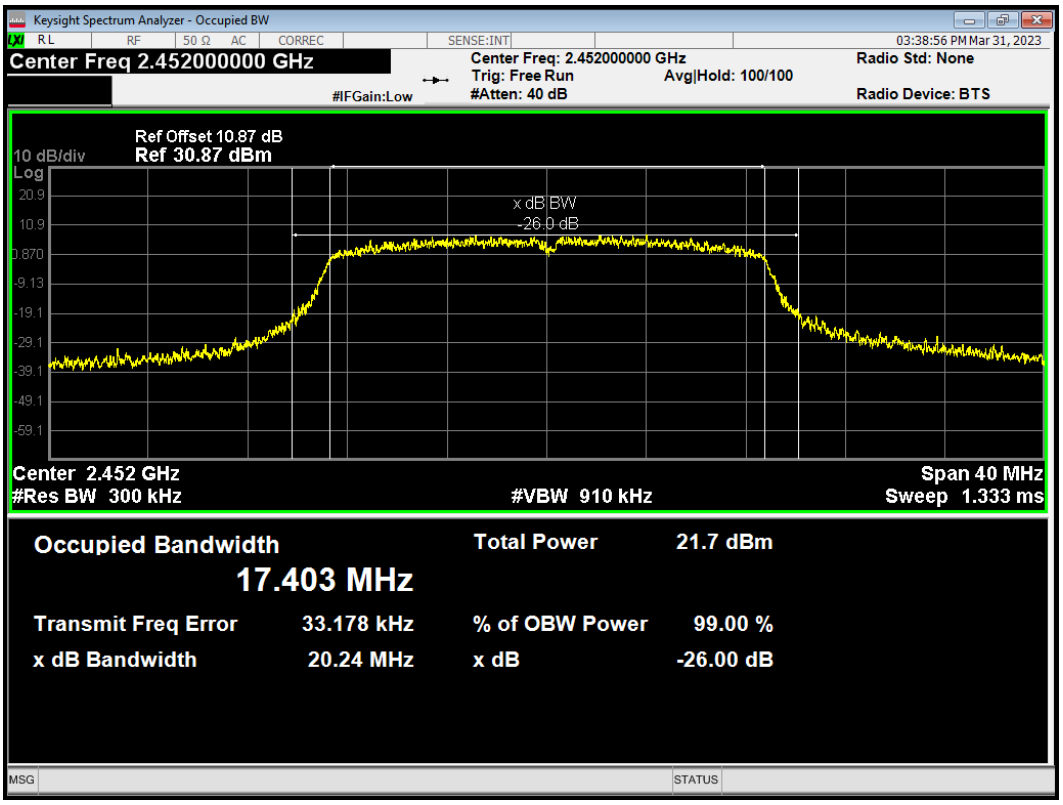

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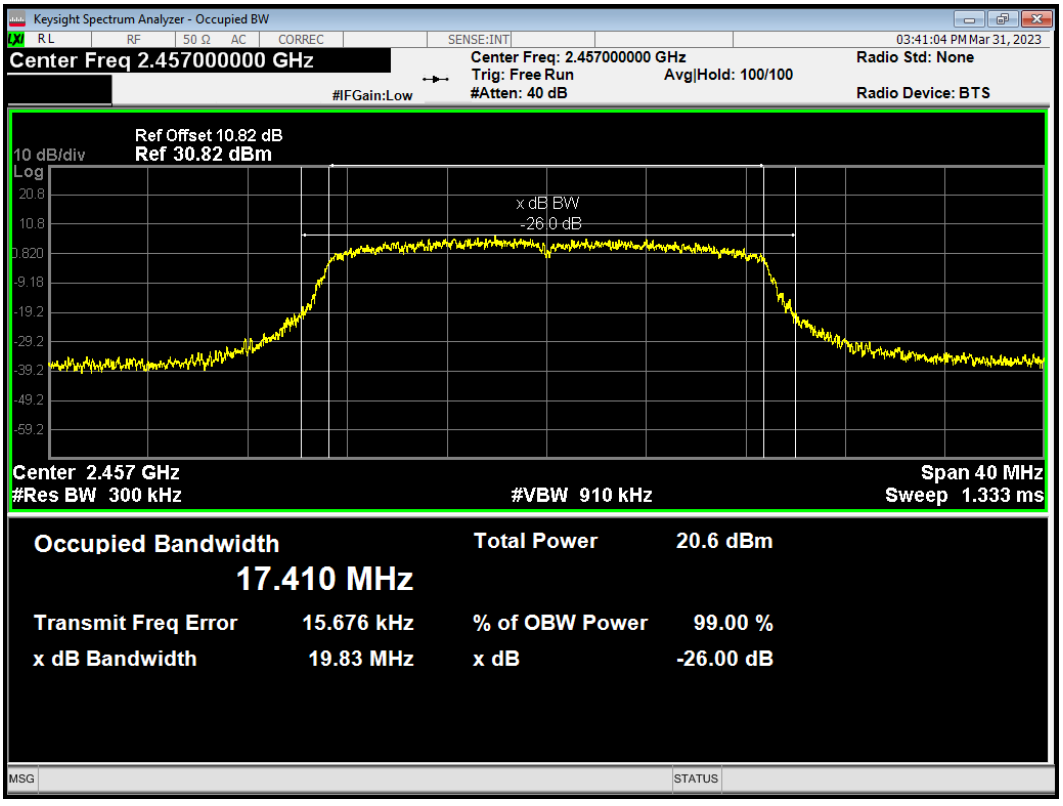

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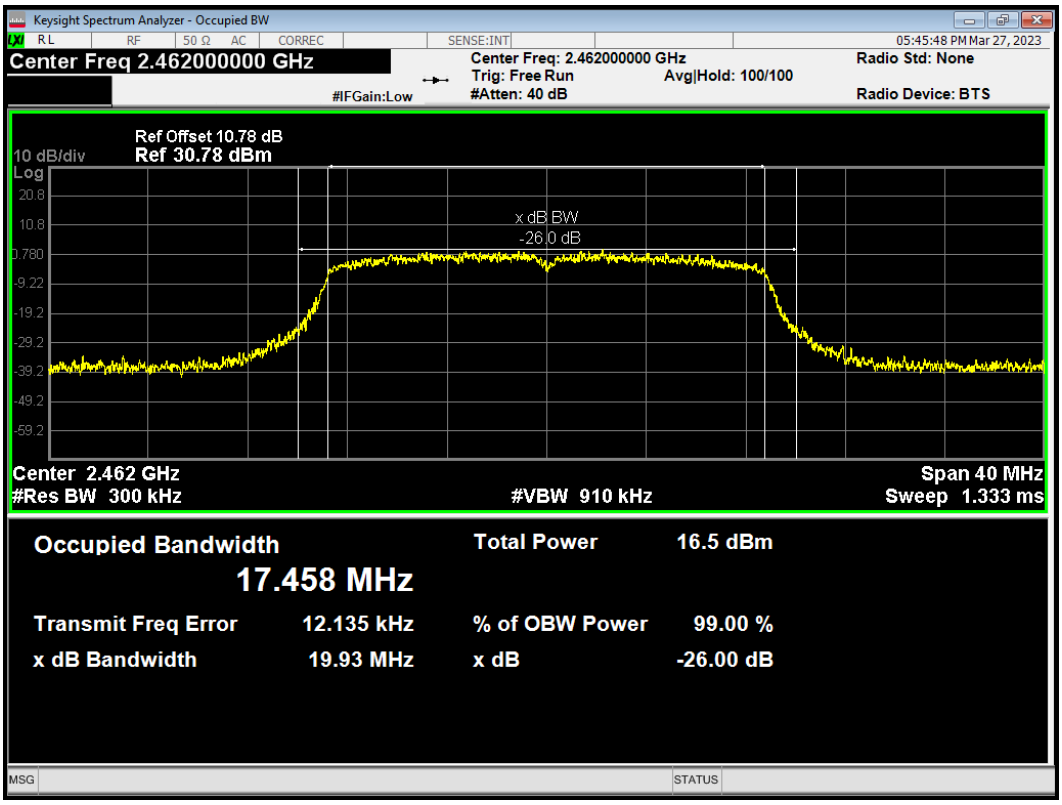
OBW 802.11n(HT20) 2462MHz



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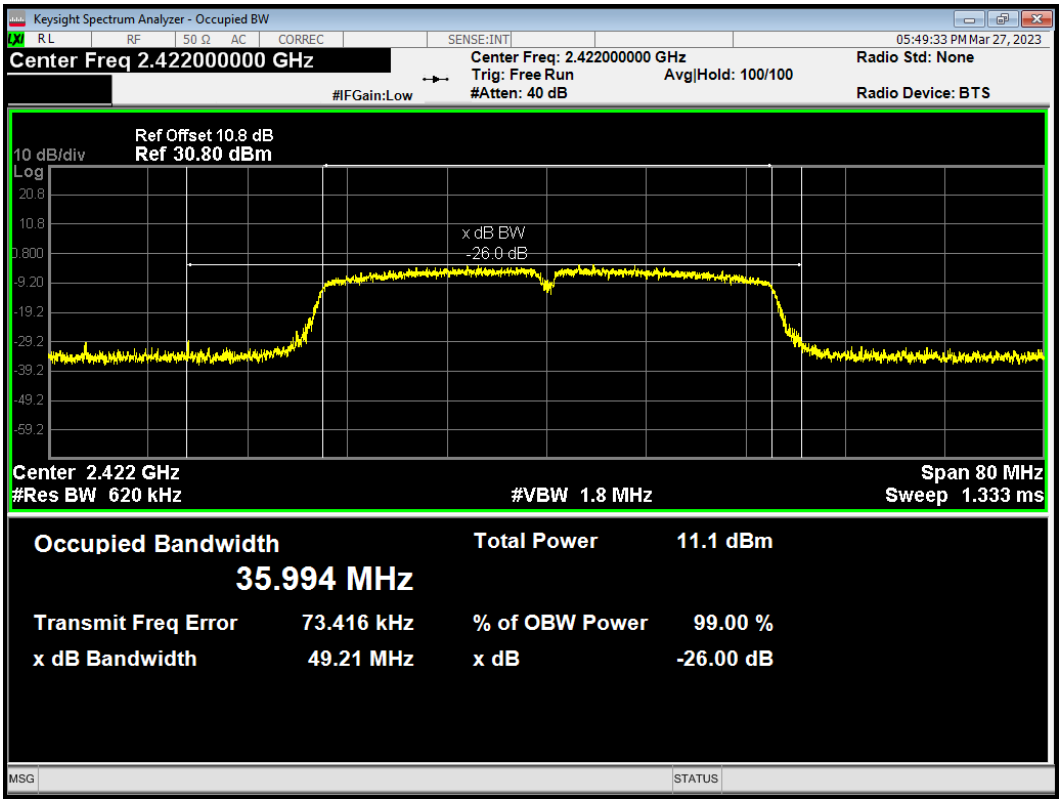

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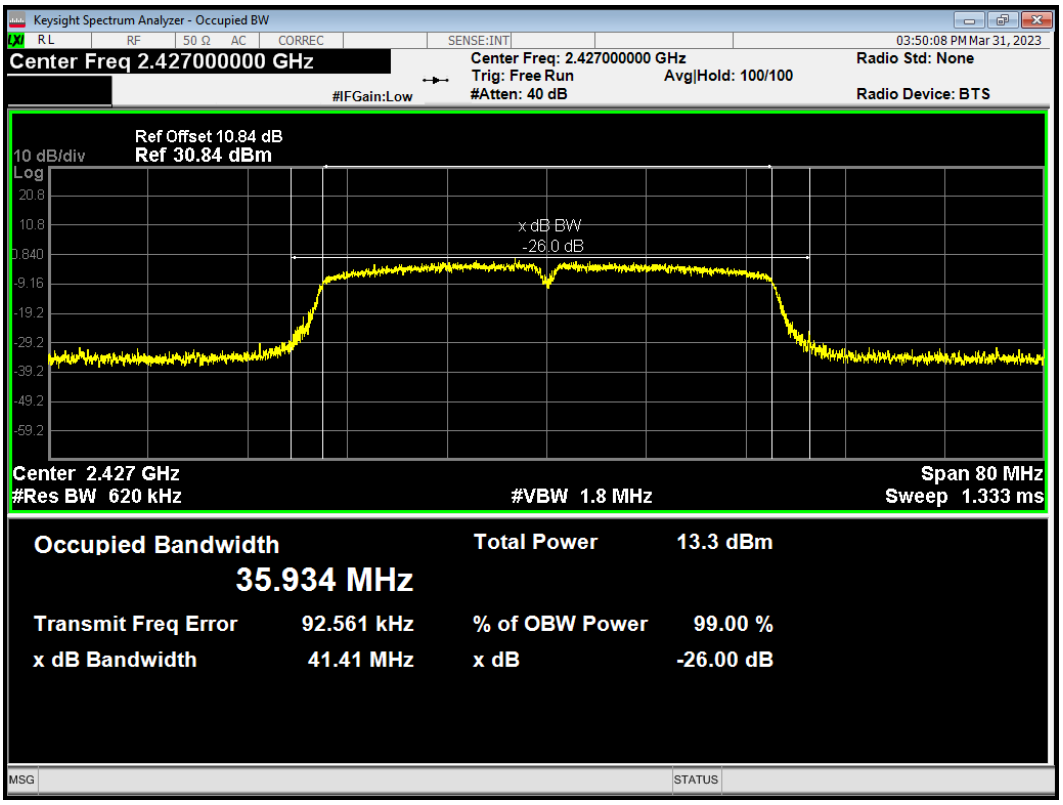
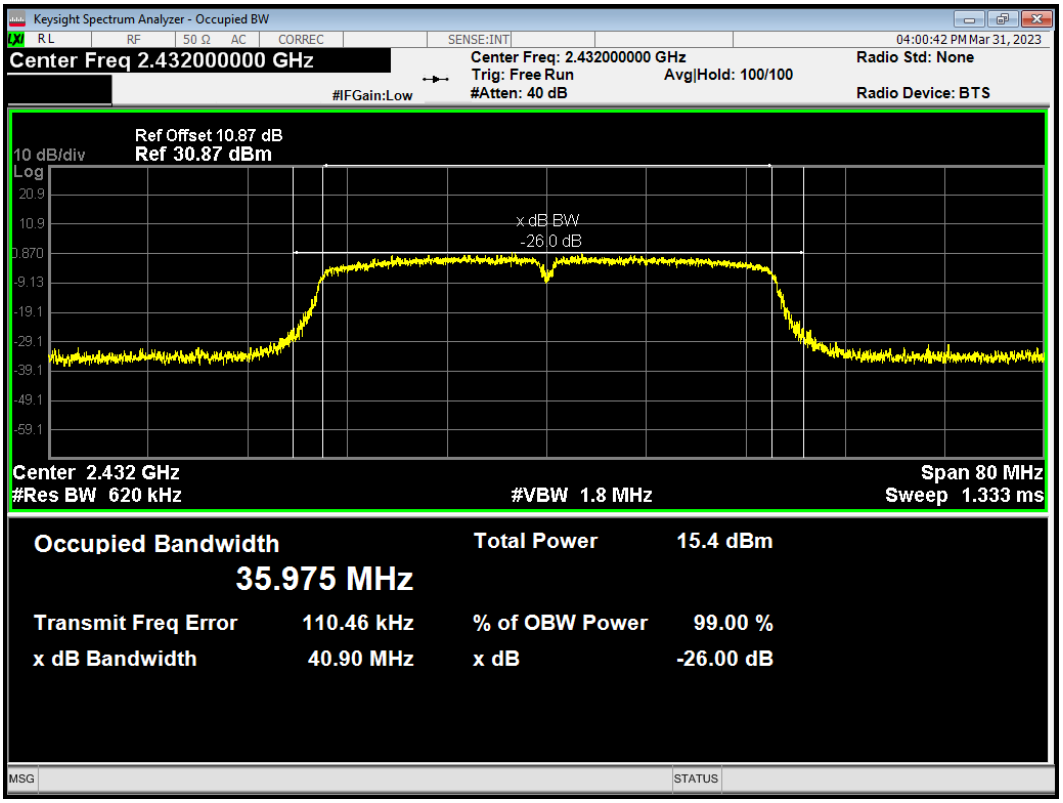
OBW 802.11n(HT40) 2427MHz



OBW 802.11n(HT40) 2432MHz



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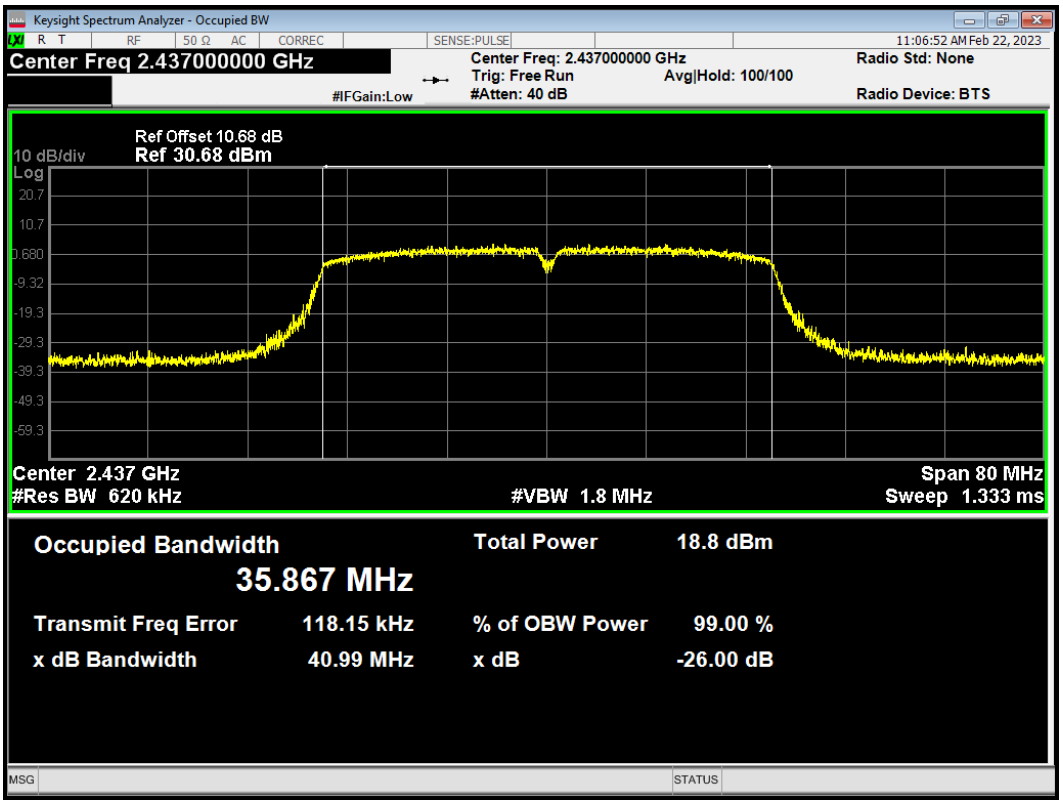
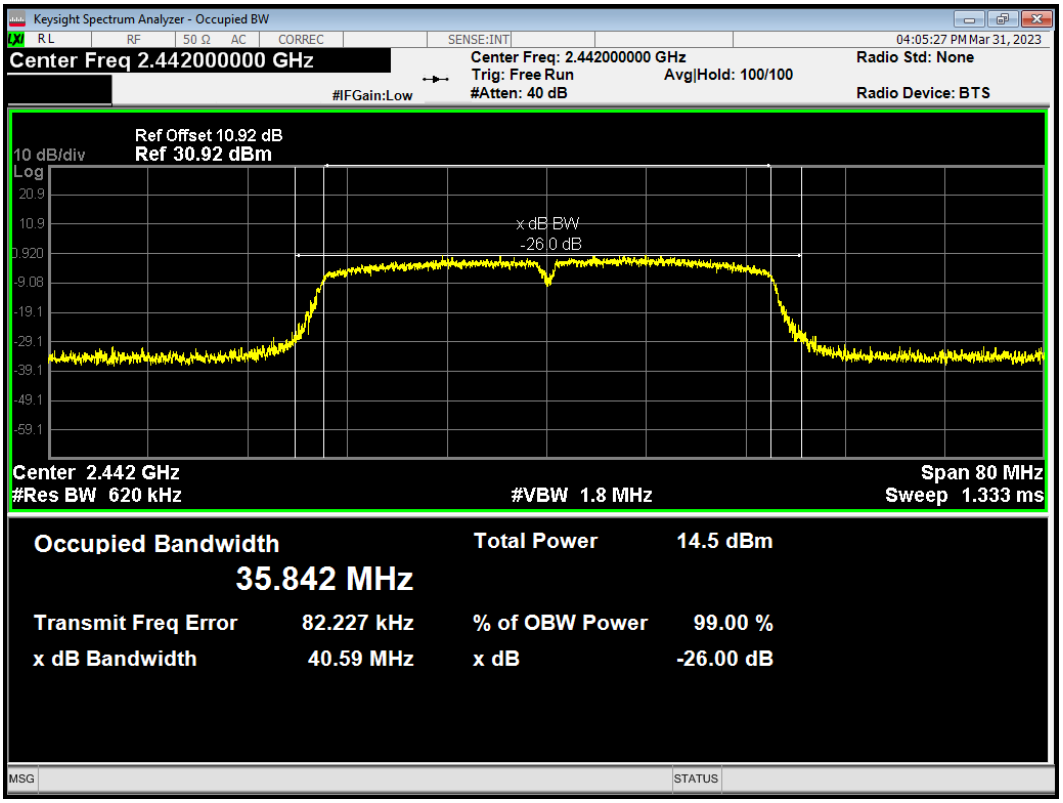
OBW 802.11n(HT40) 2437MHz



OBW 802.11n(HT40) 2442MHz



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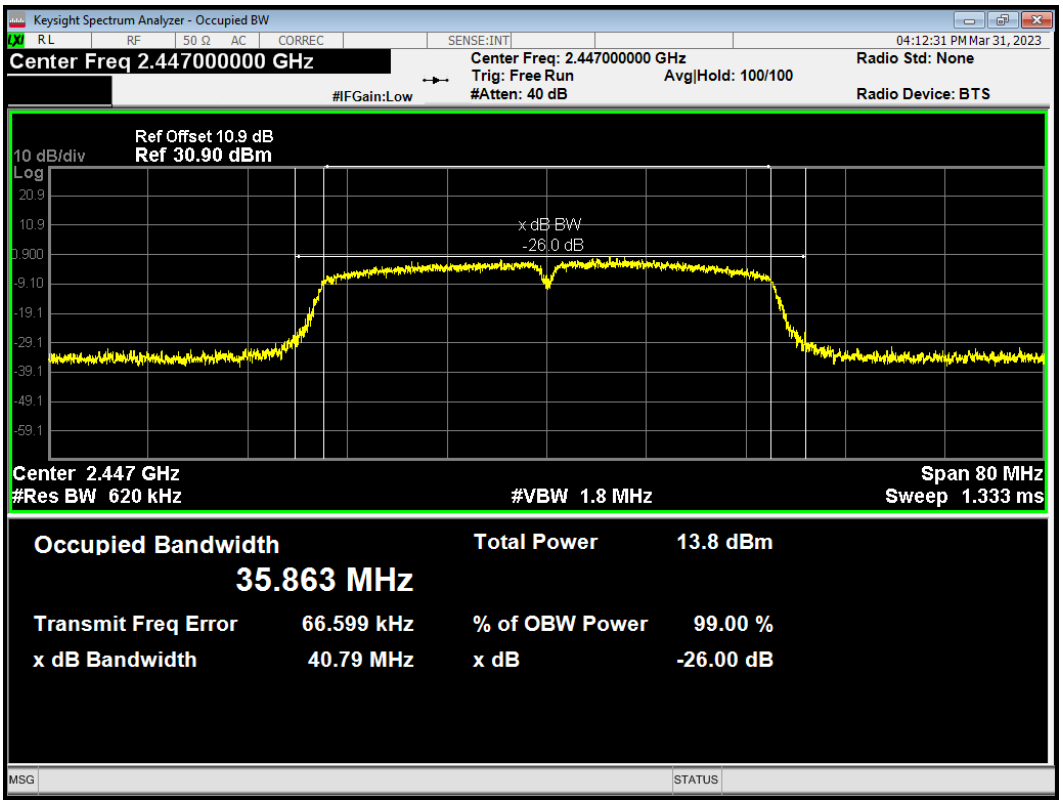
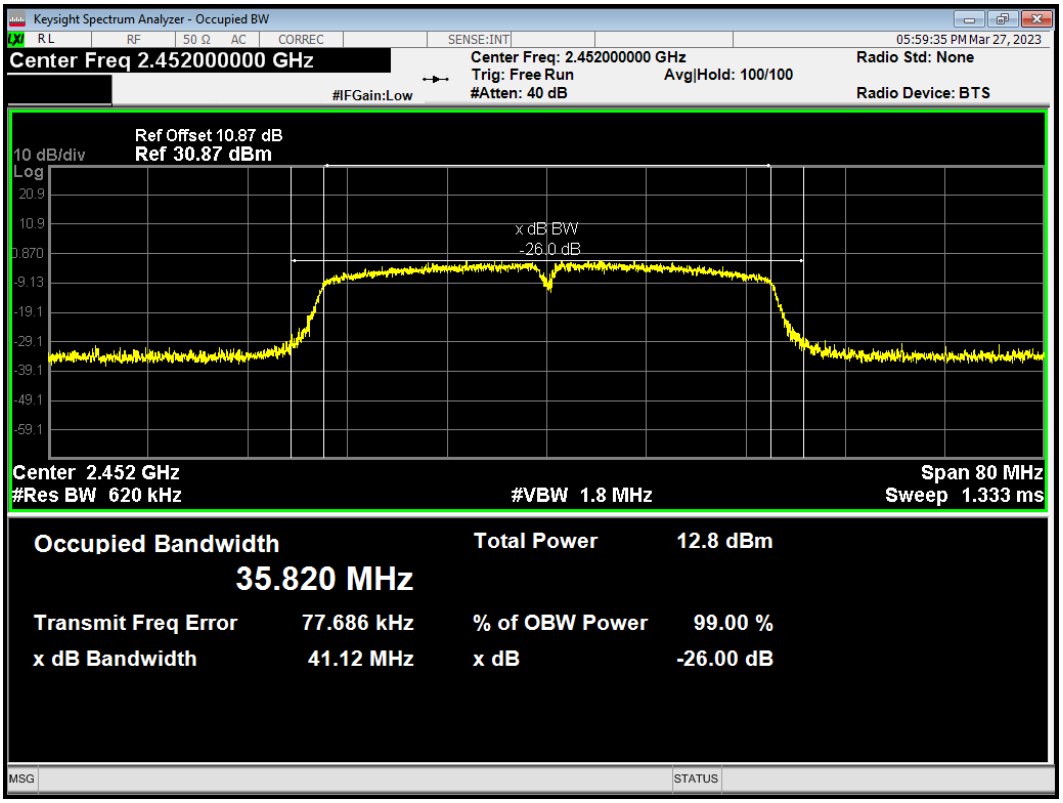
OBW 802.11n(HT40) 2447MHz



OBW 802.11n(HT40) 2452MHz



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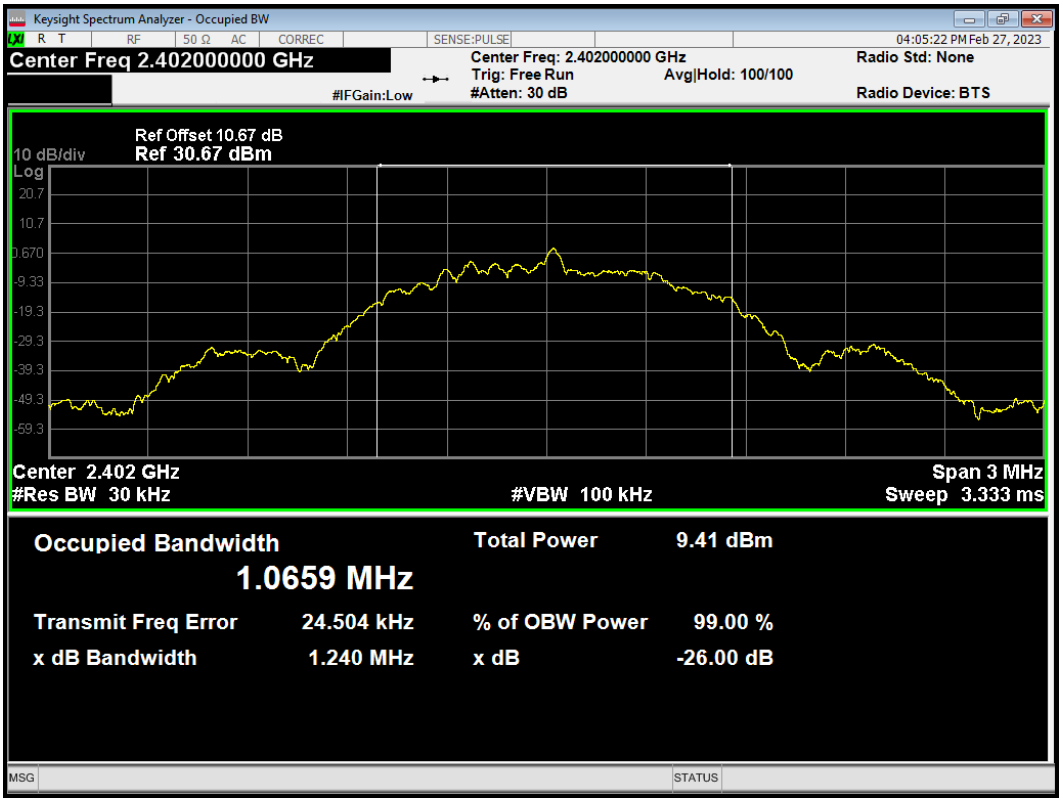
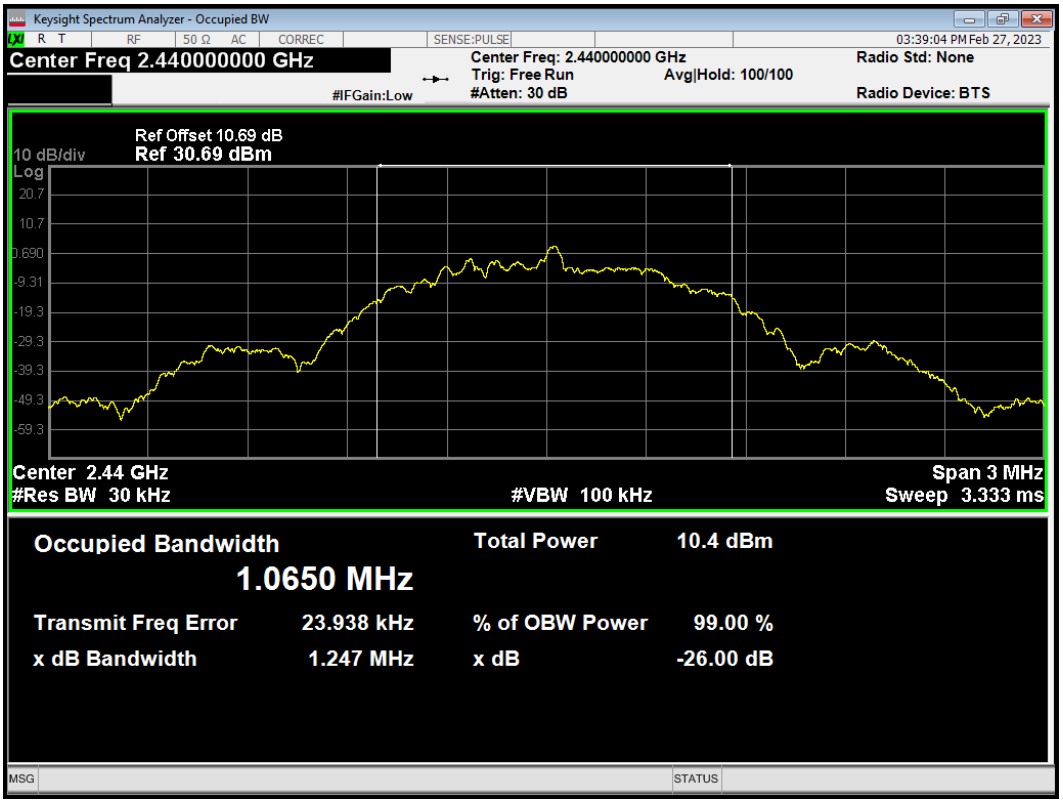
Bluetooth LE

OBW Bluetooth LE 2402MHz



OBW Bluetooth LE 2440MHz



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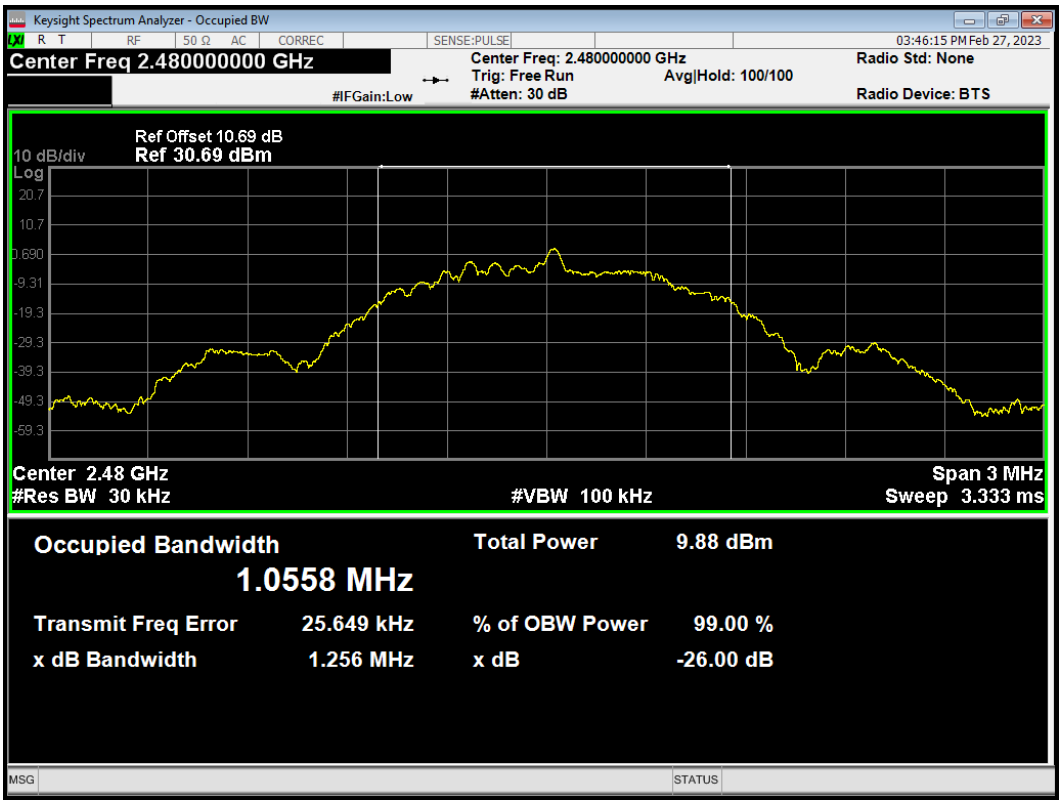
OBW Bluetooth LE 2480MHz



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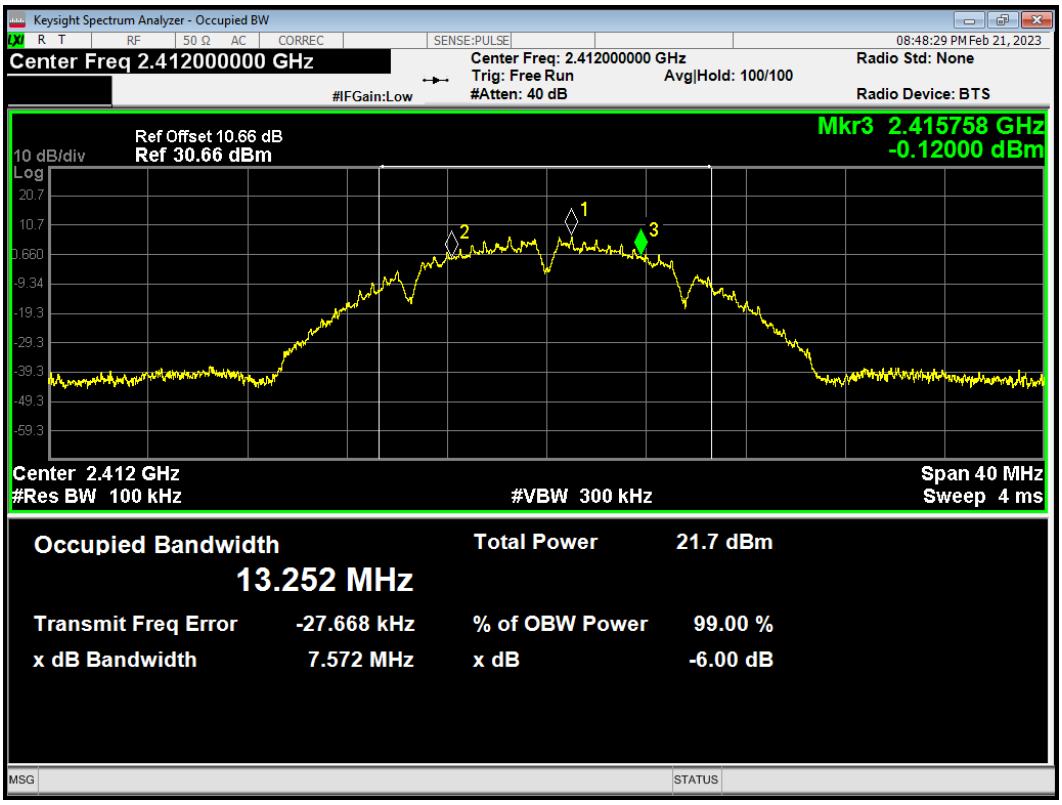
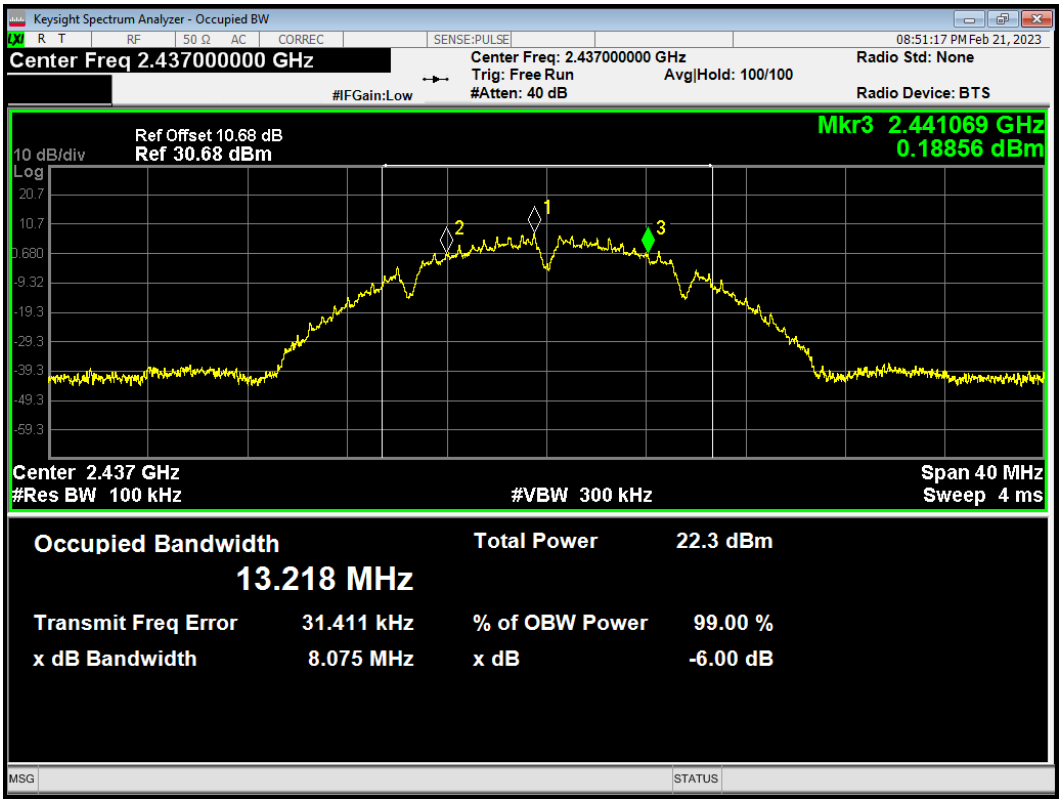
-6dB Bandwidth 802.11b 2412MHz



-6dB Bandwidth 802.11b 2437MHz



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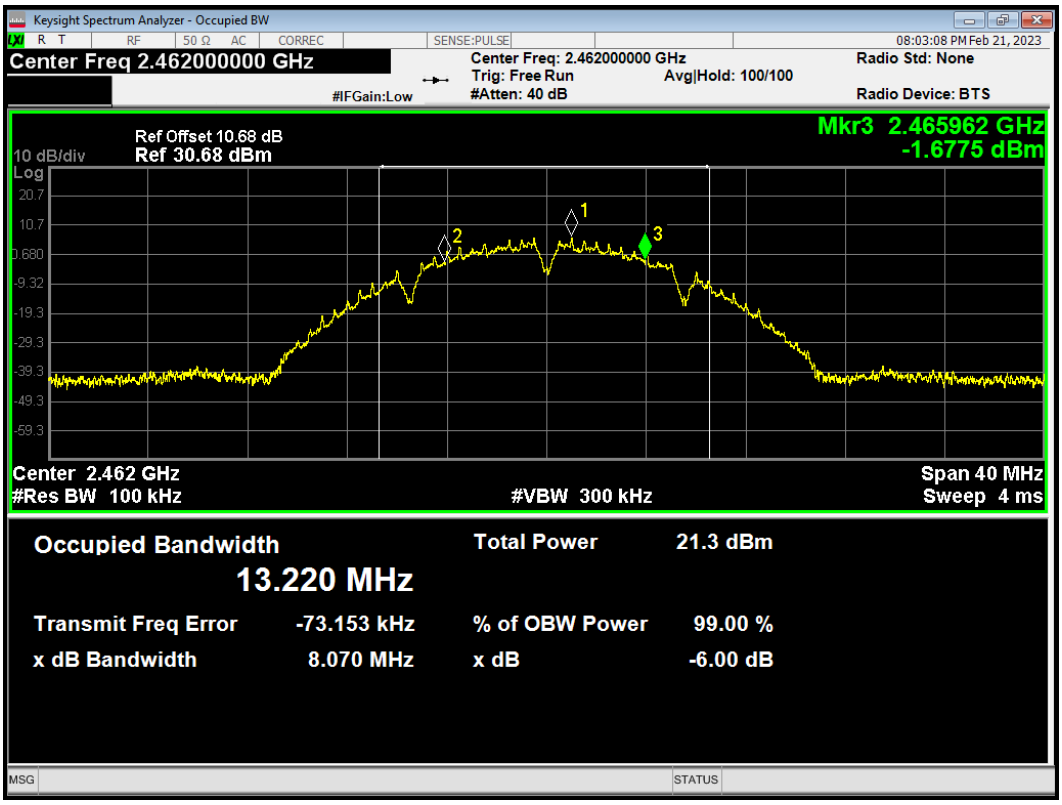
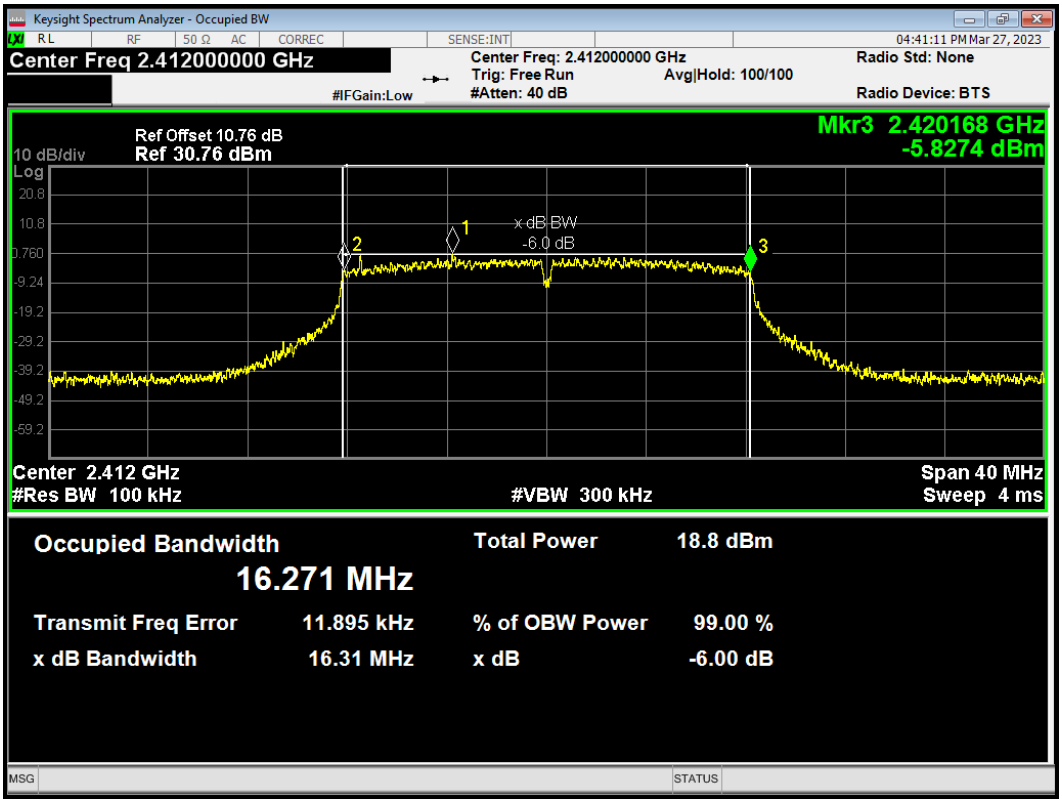
-6dB Bandwidth 802.11b 2462MHz



-6dB Bandwidth 802.11g 2412MHz



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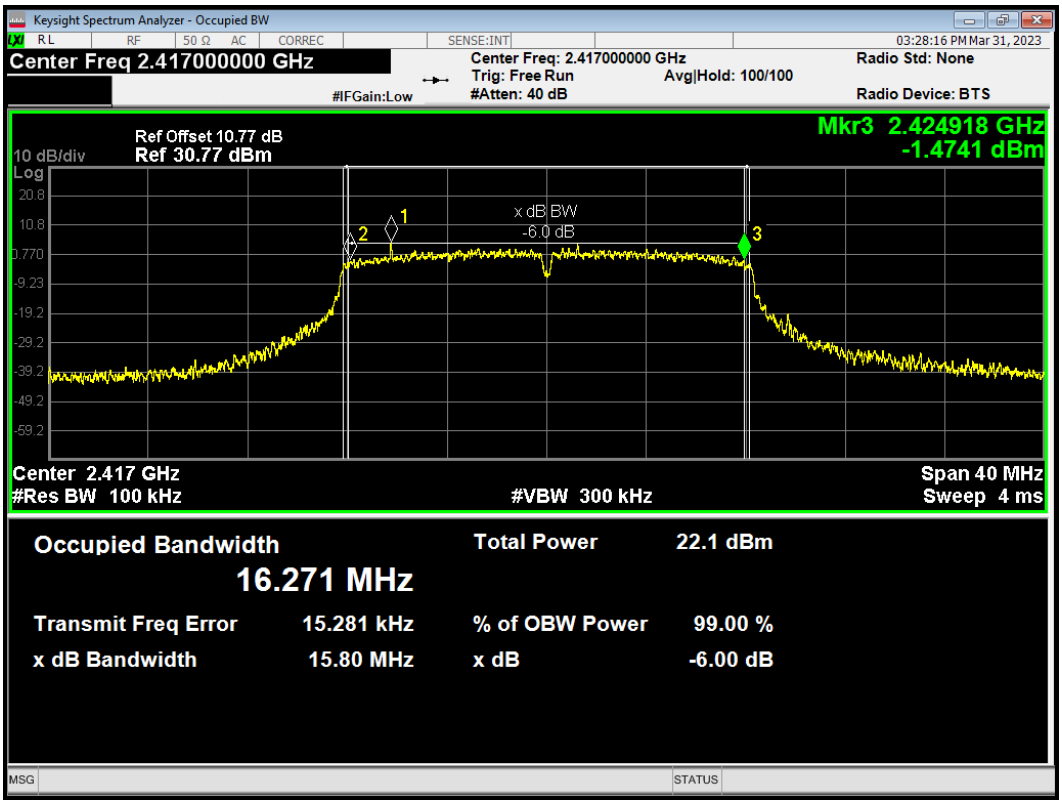
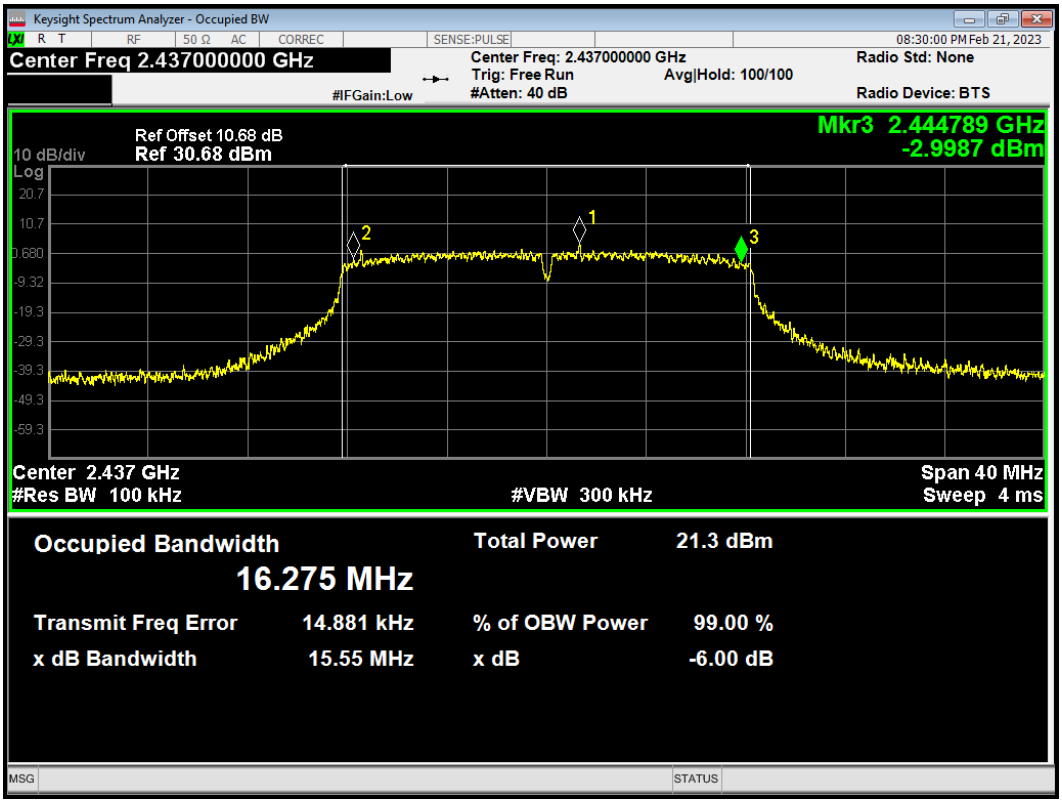
-6dB Bandwidth 802.11g 2417MHz



-6dB Bandwidth 802.11g 2437MHz



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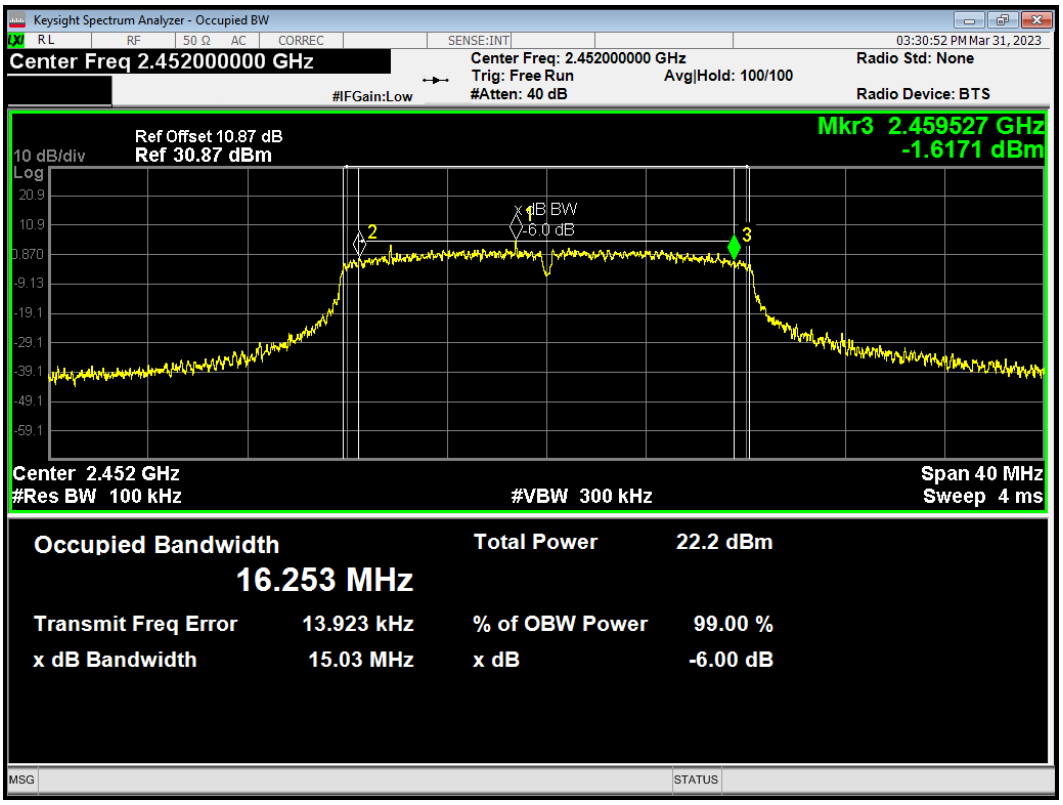
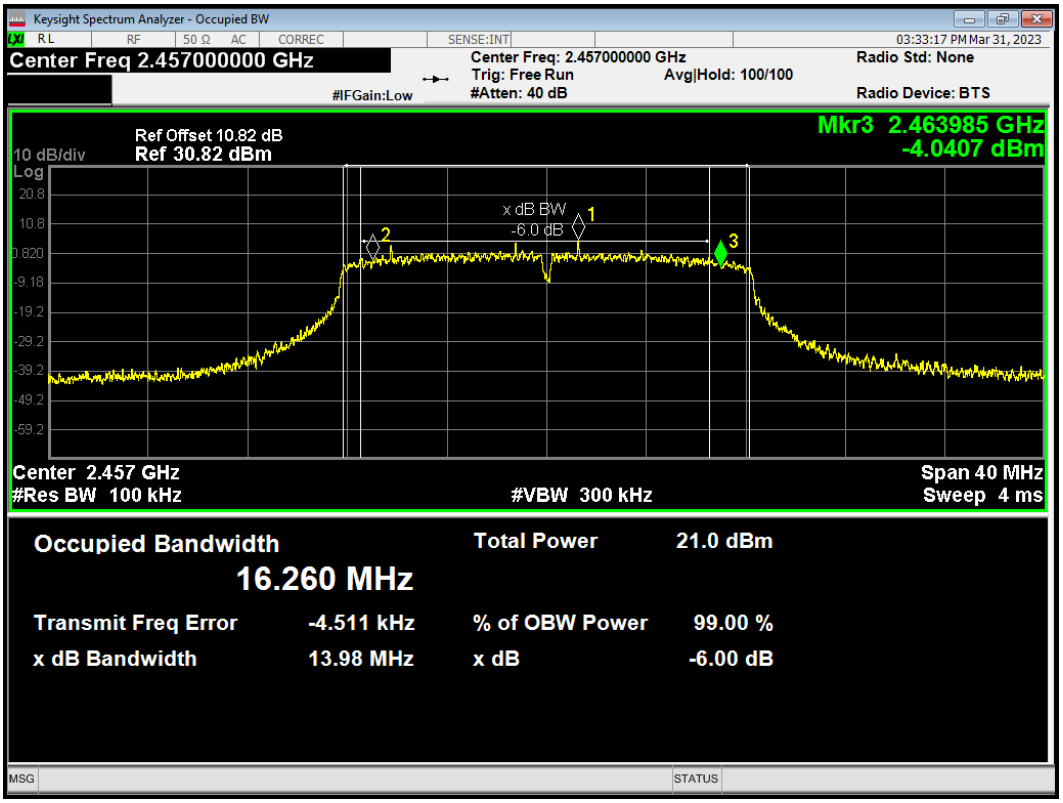
-6dB Bandwidth 802.11g 2452MHz



-6dB Bandwidth 802.11g 2457MHz



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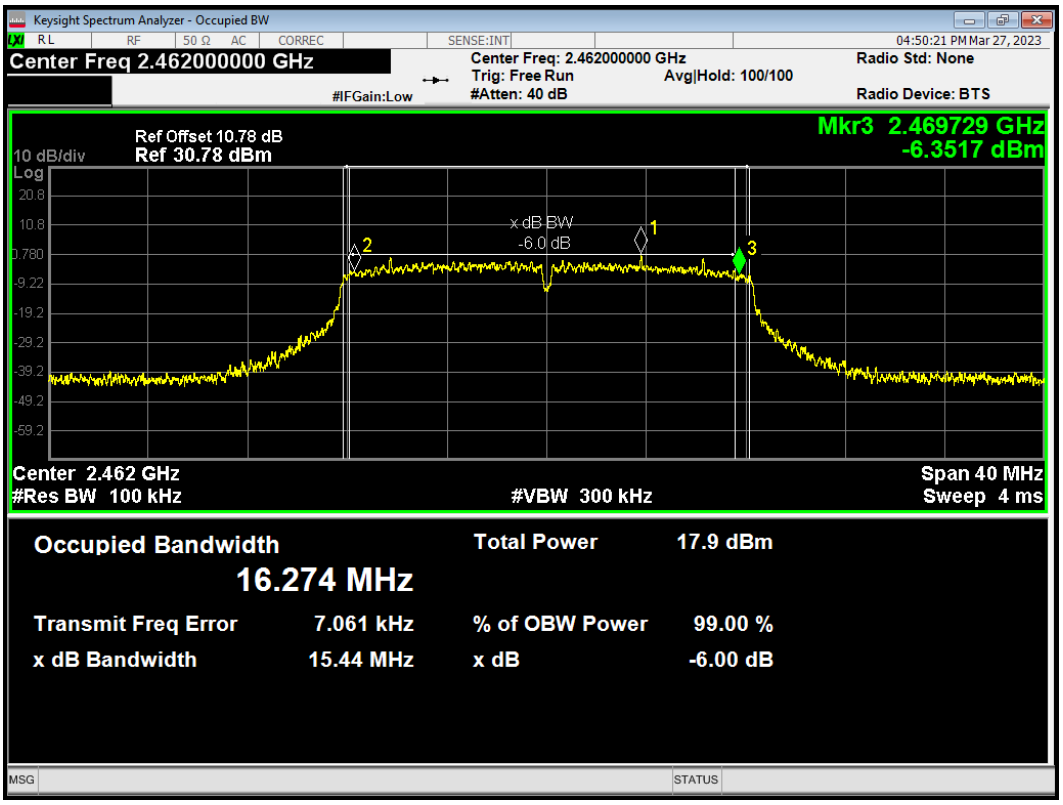
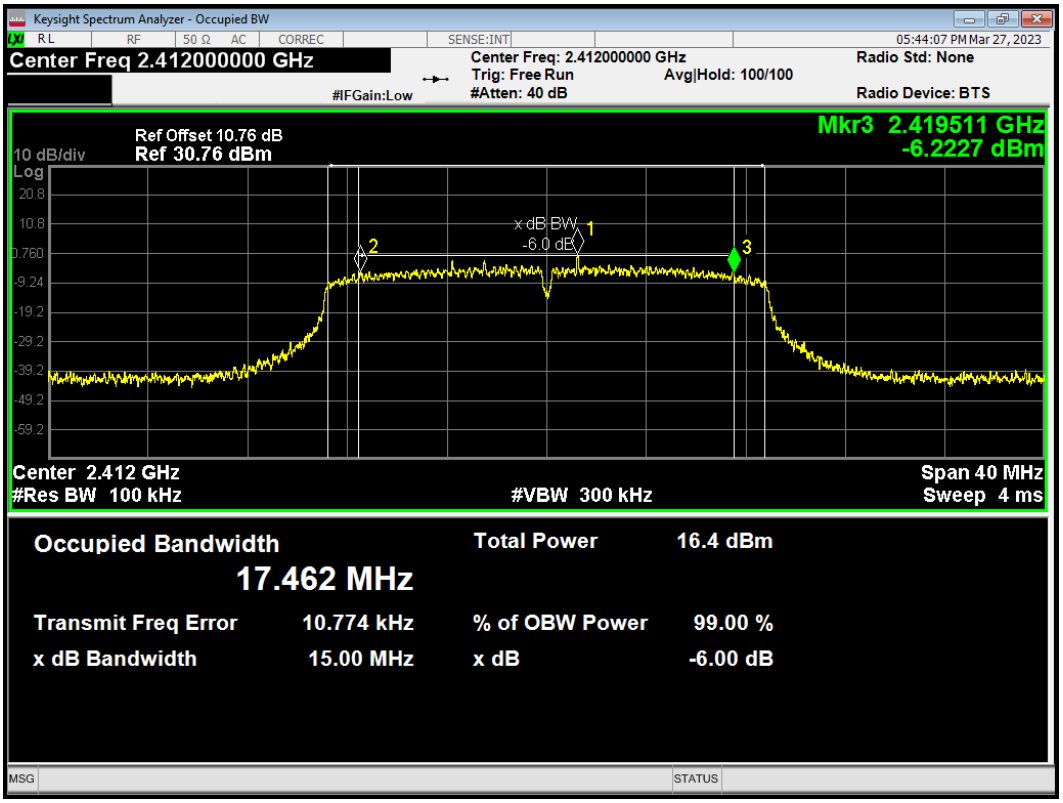
-6dB Bandwidth 802.11g 2462MHz



-6dB Bandwidth 802.11n(HT20) 2412MHz



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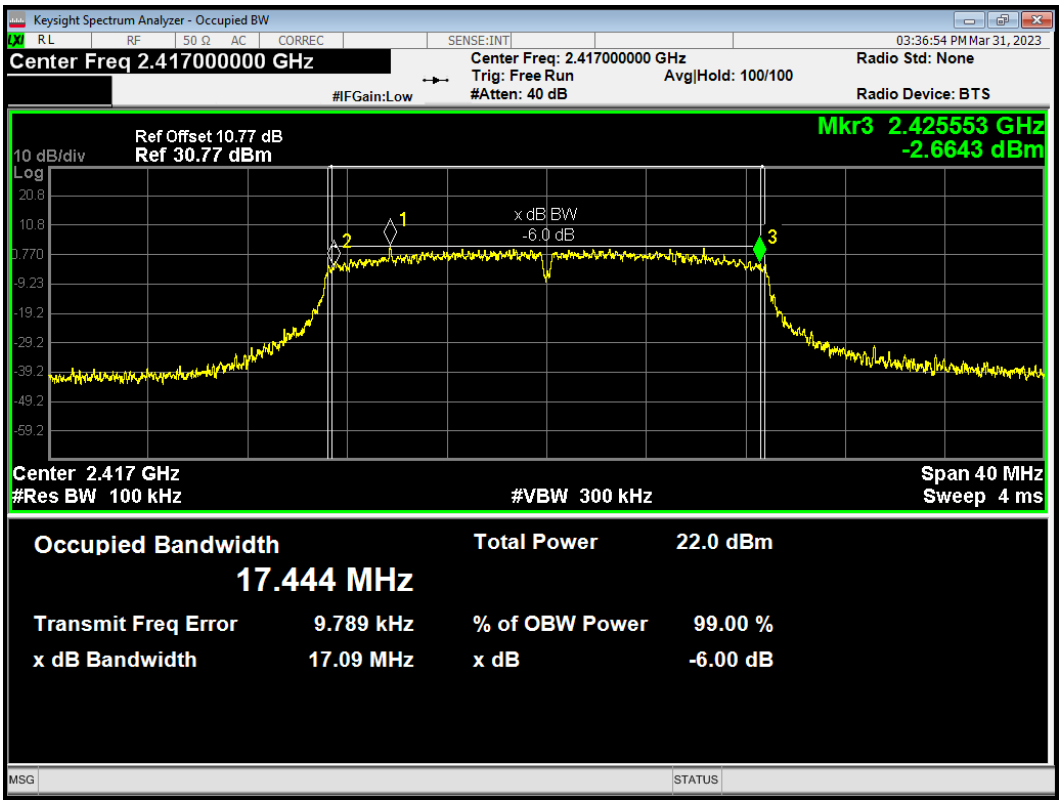
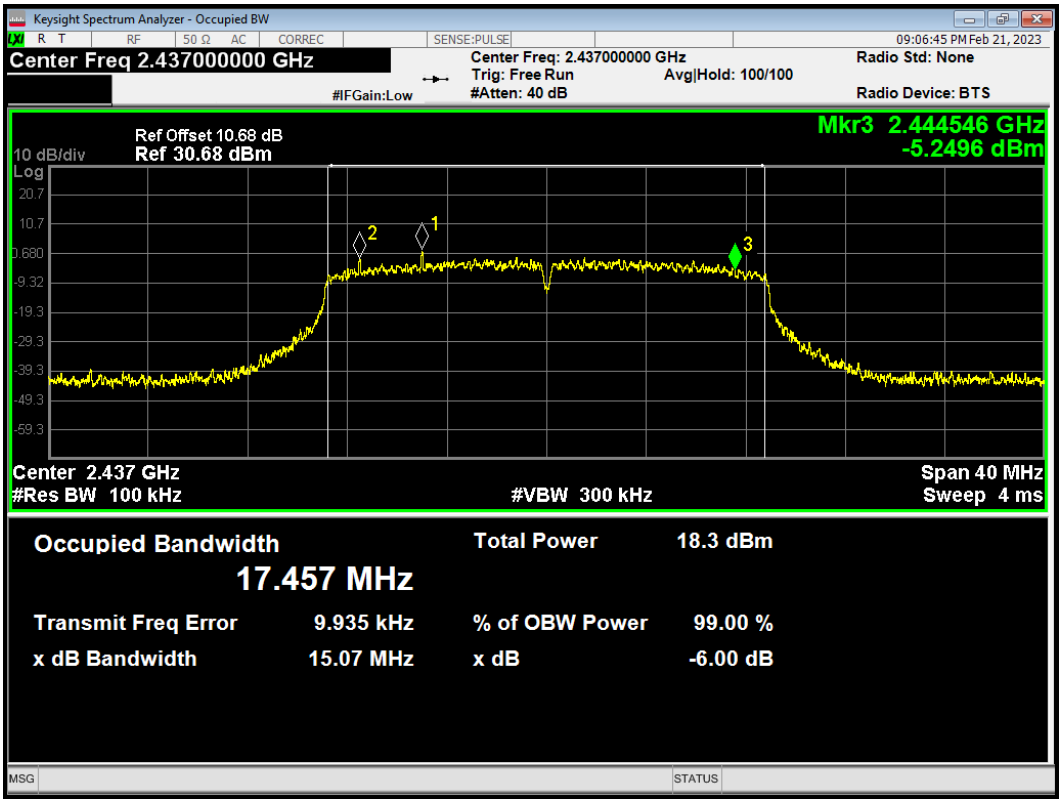
-6dB Bandwidth 802.11n(HT20) 2417MHz



-6dB Bandwidth 802.11n(HT20) 2437MHz



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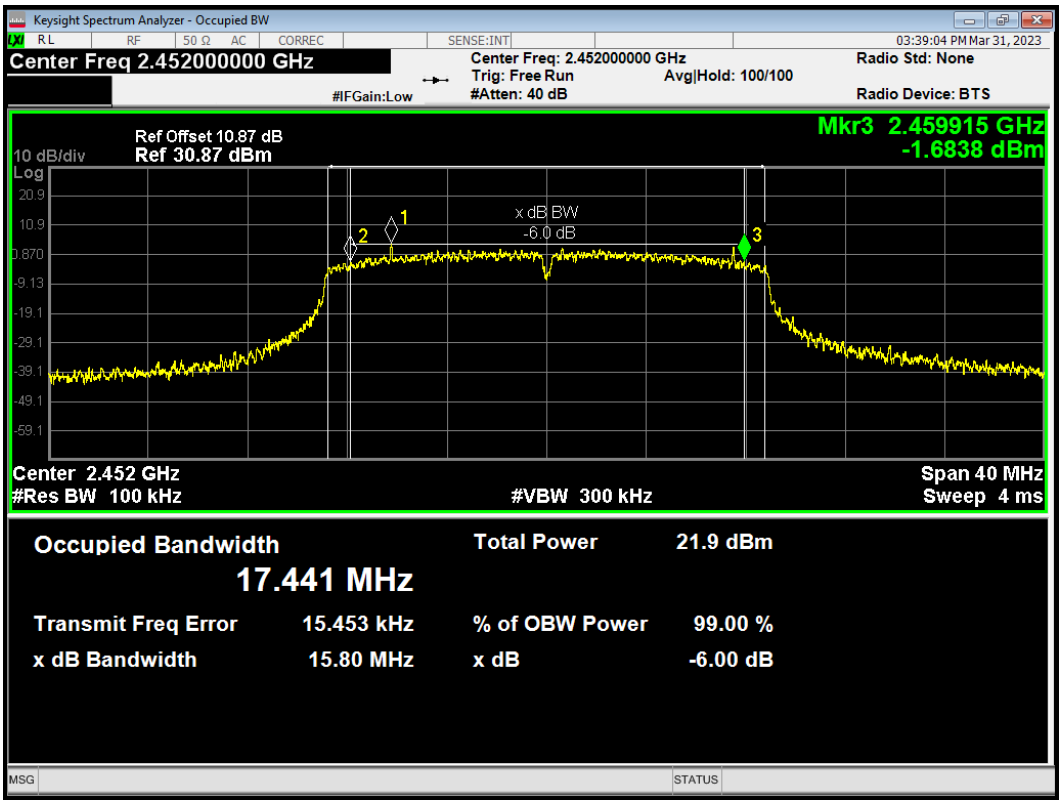
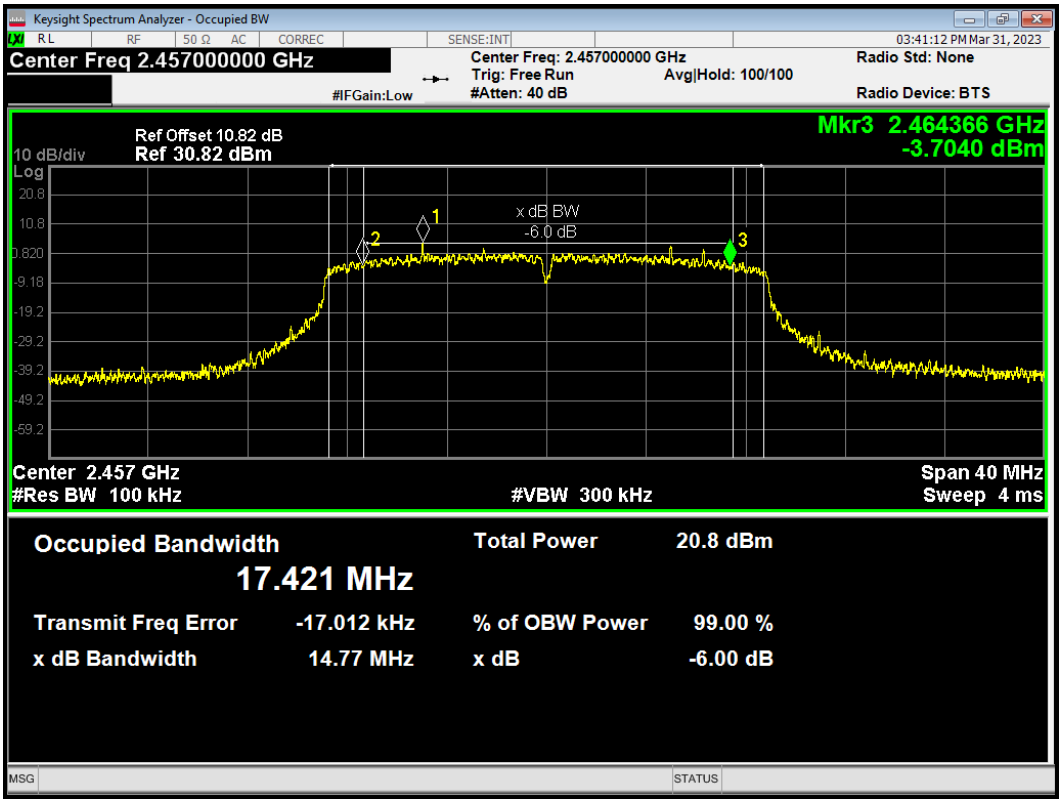
-6dB Bandwidth 802.11n(HT20) 2452MHz



-6dB Bandwidth 802.11n(HT20) 2457MHz



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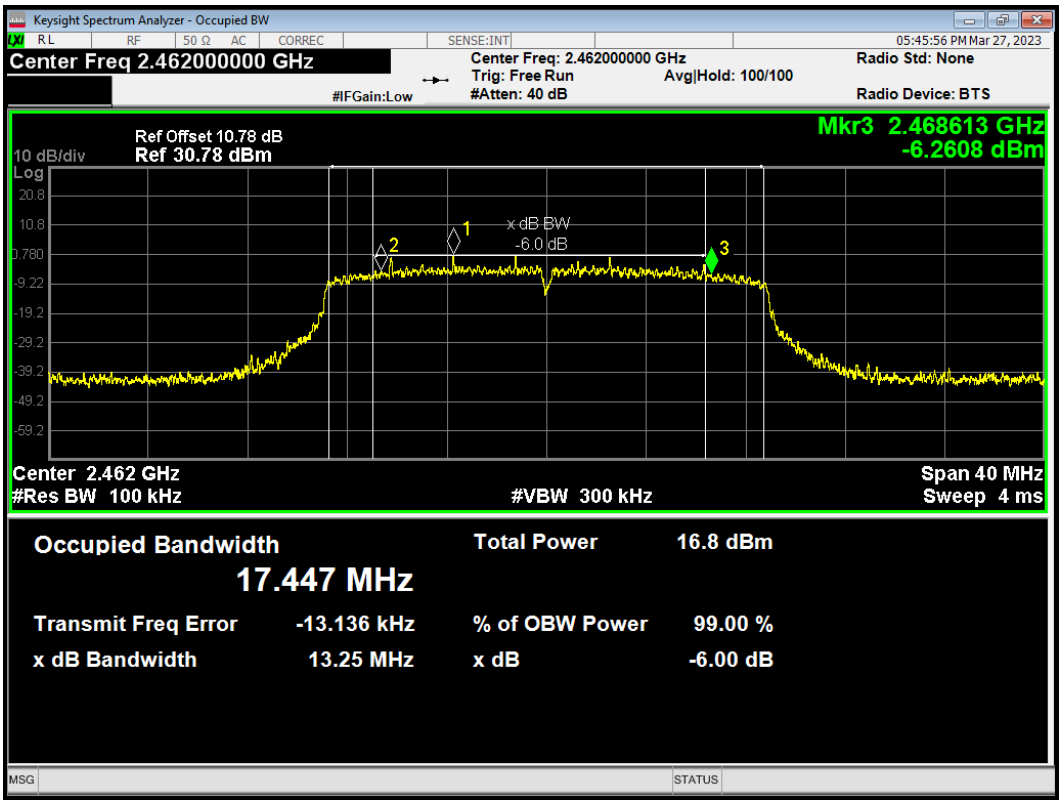
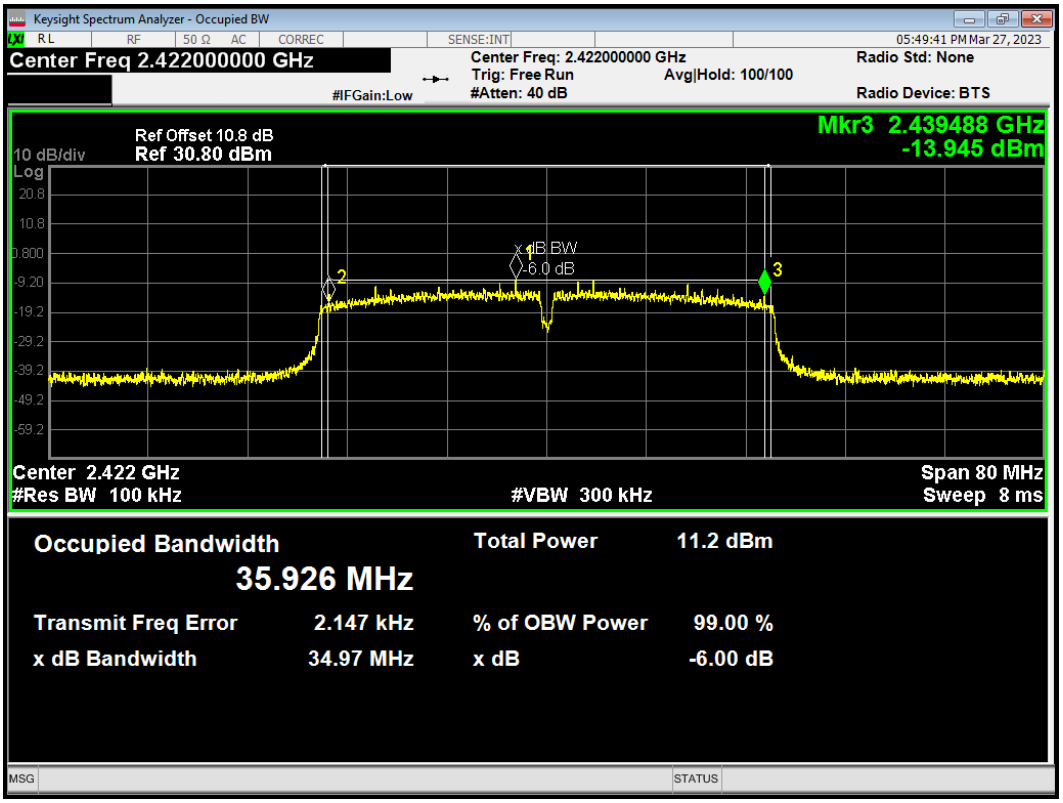
-6dB Bandwidth 802.11n(HT20) 2462MHz



-6dB Bandwidth 802.11n(HT40) 2422MHz



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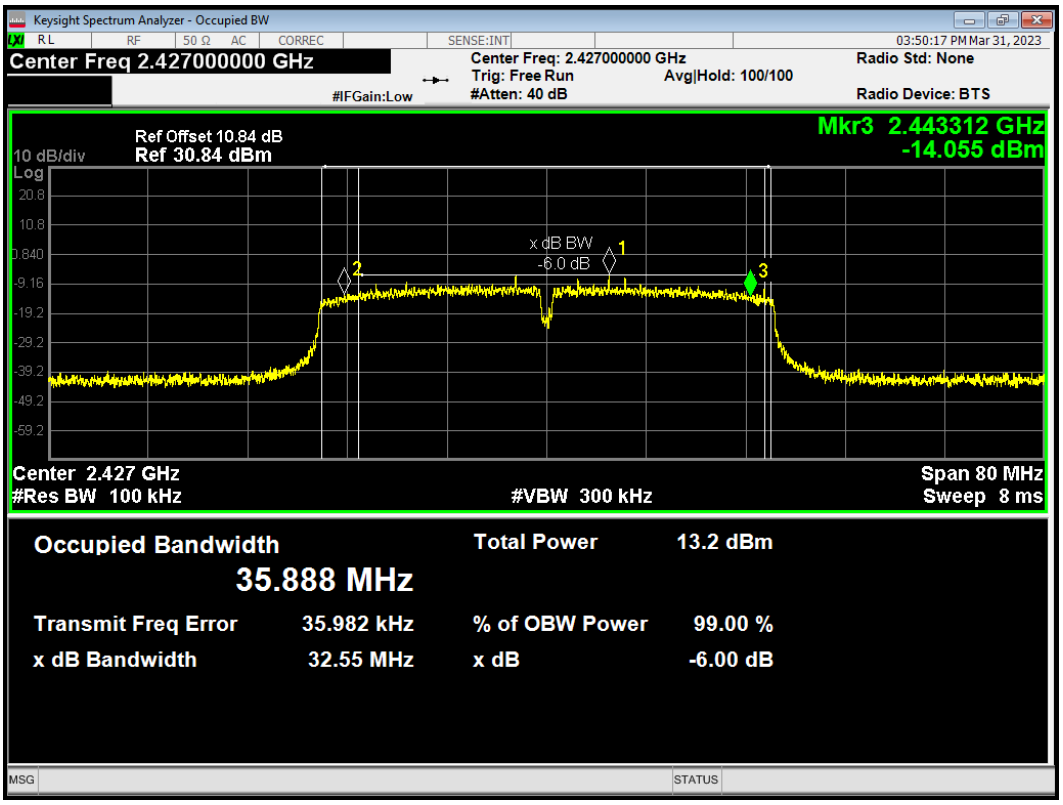
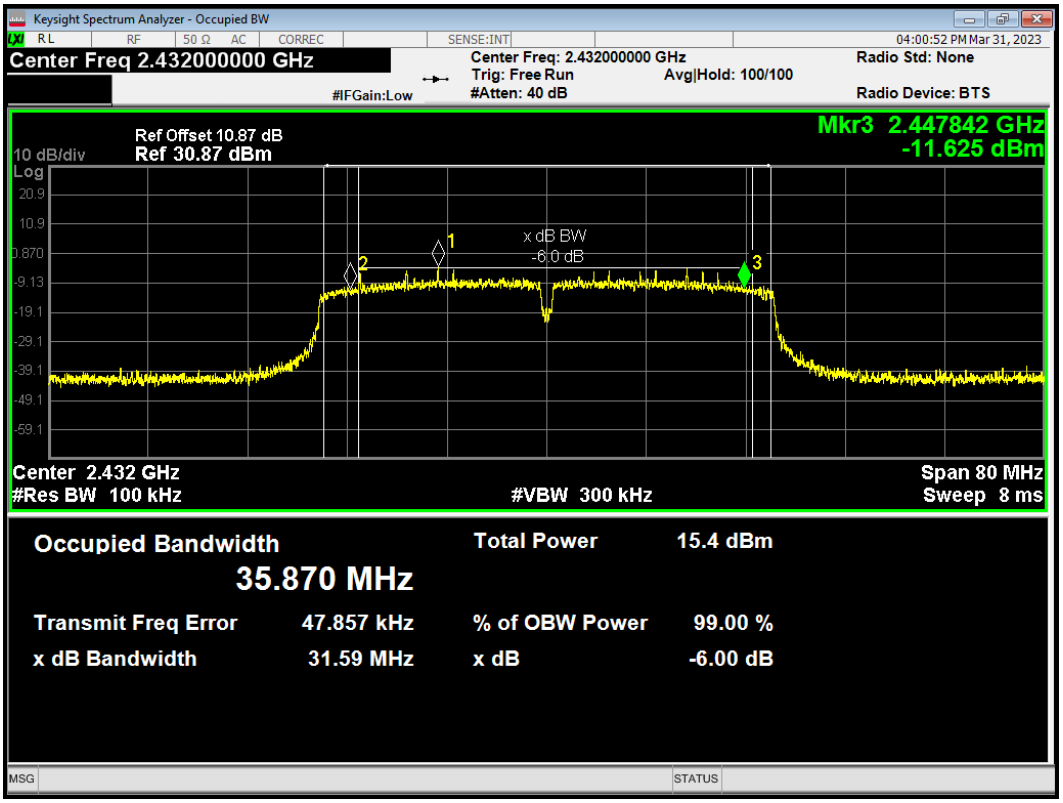
-6dB Bandwidth 802.11n(HT40) 2427MHz



-6dB Bandwidth 802.11n(HT40) 2432MHz



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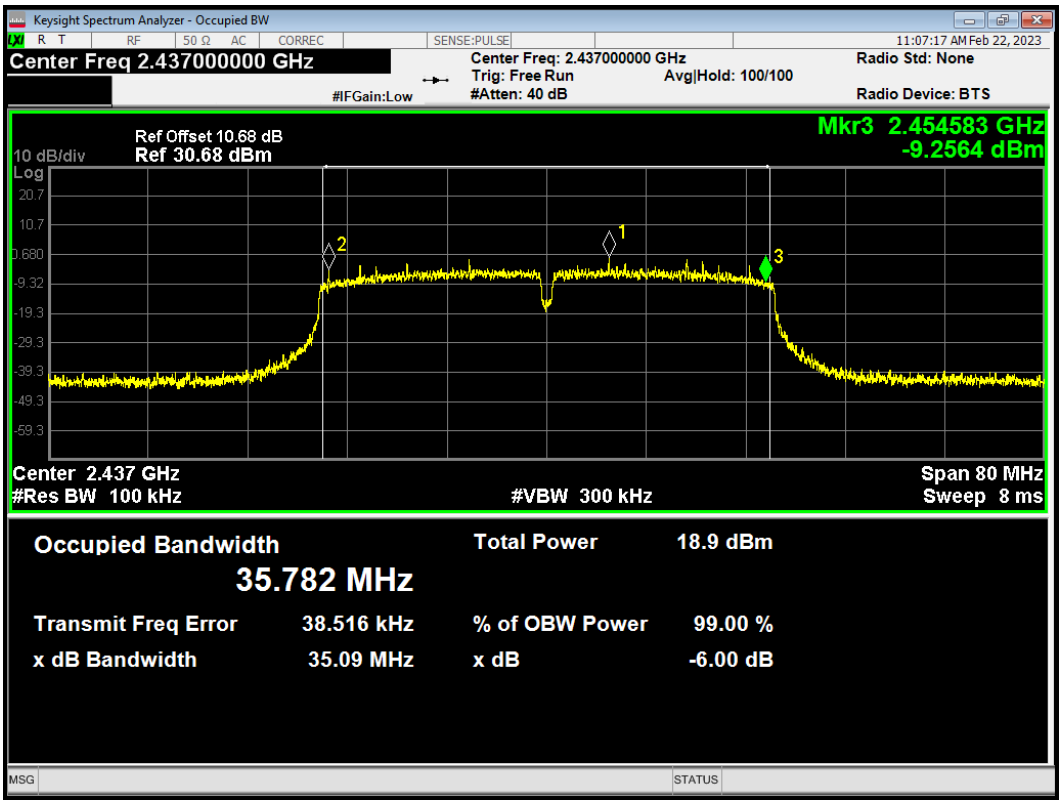
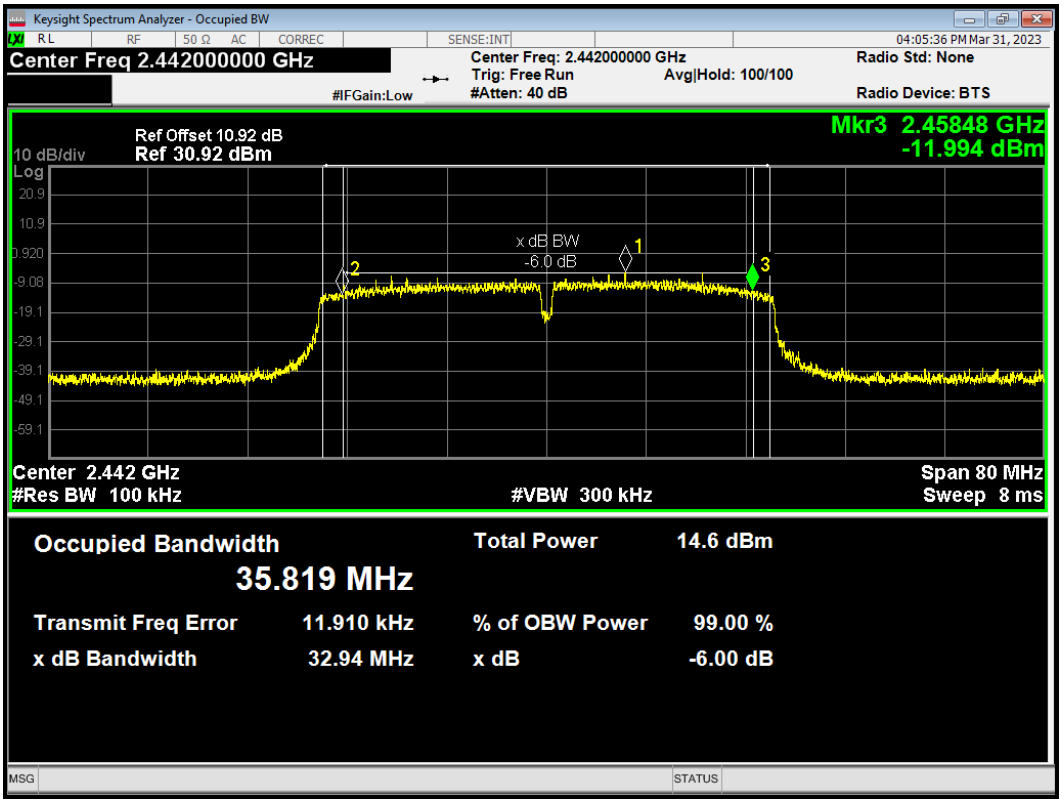
-6dB Bandwidth 802.11n(HT40) 2437MHz



-6dB Bandwidth 802.11n(HT40) 2442MHz



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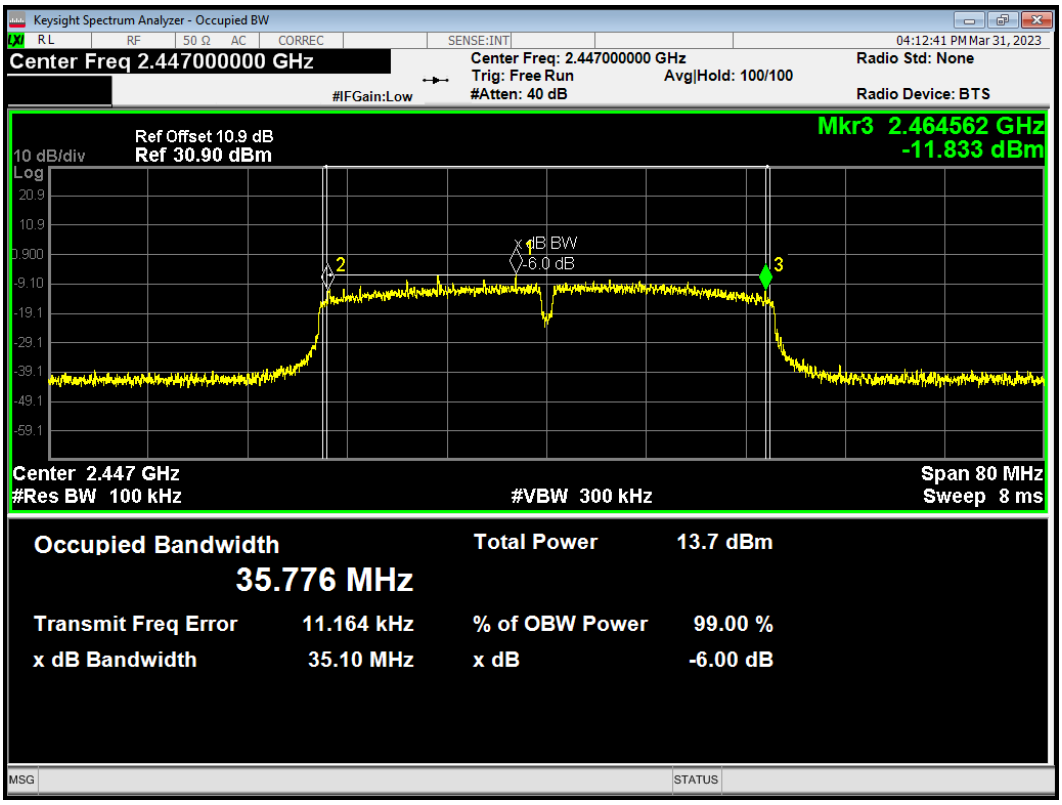
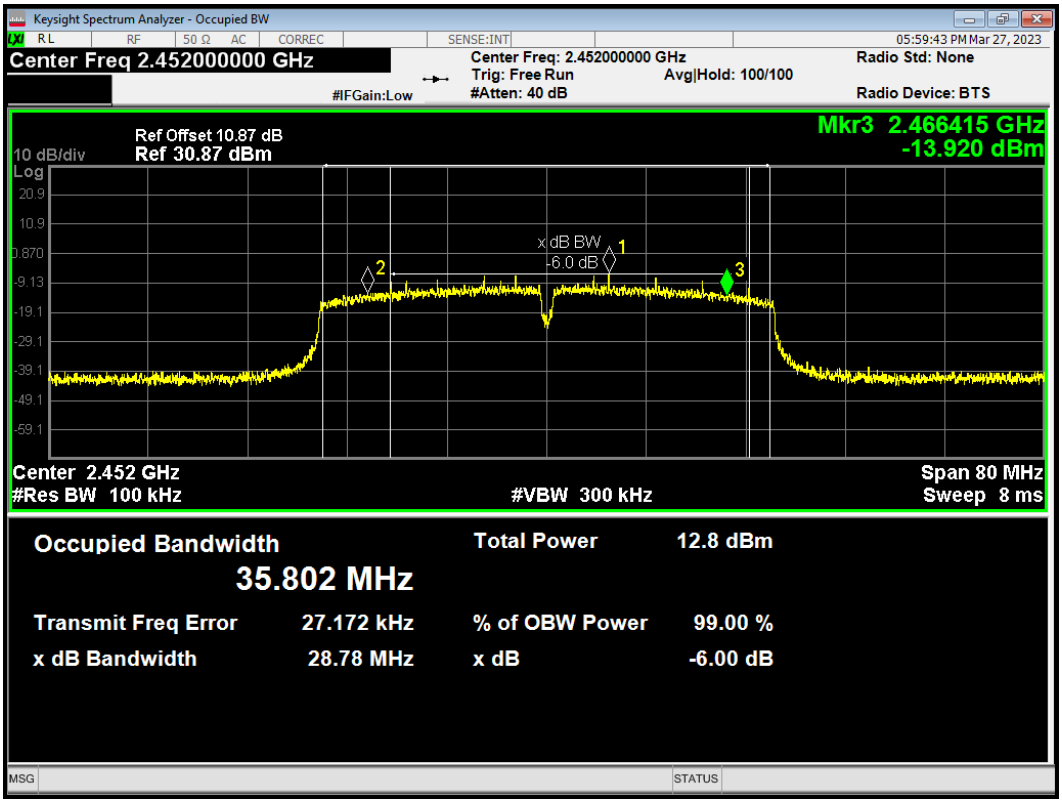
-6dB Bandwidth 802.11n(HT40) 2447MHz



-6dB Bandwidth 802.11n(HT40) 2452MHz



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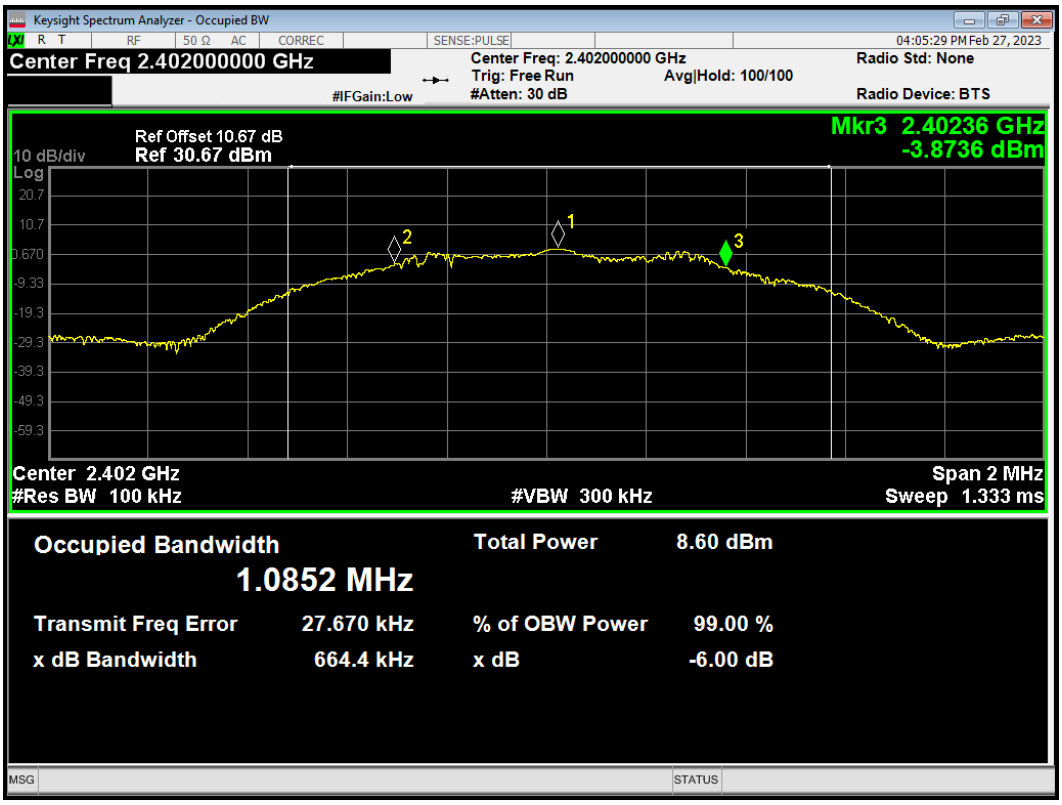
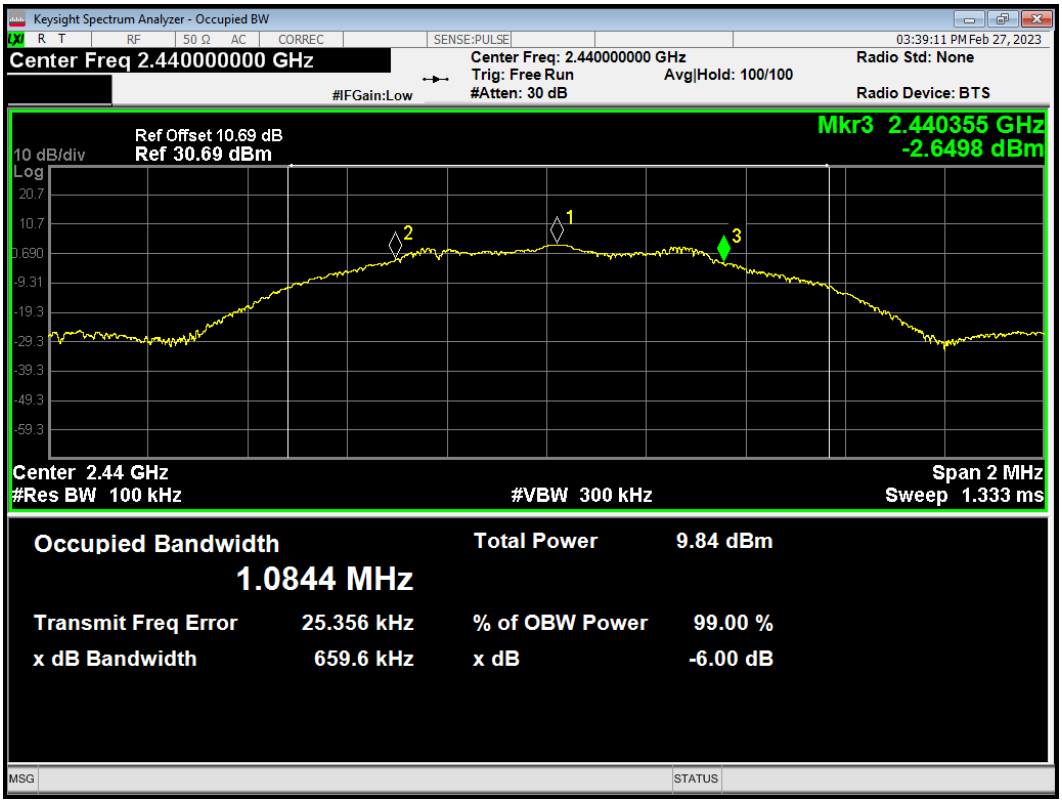
-6dB Bandwidth Bluetooth LE 2402MHz



-6dB Bandwidth Bluetooth LE 2440MHz



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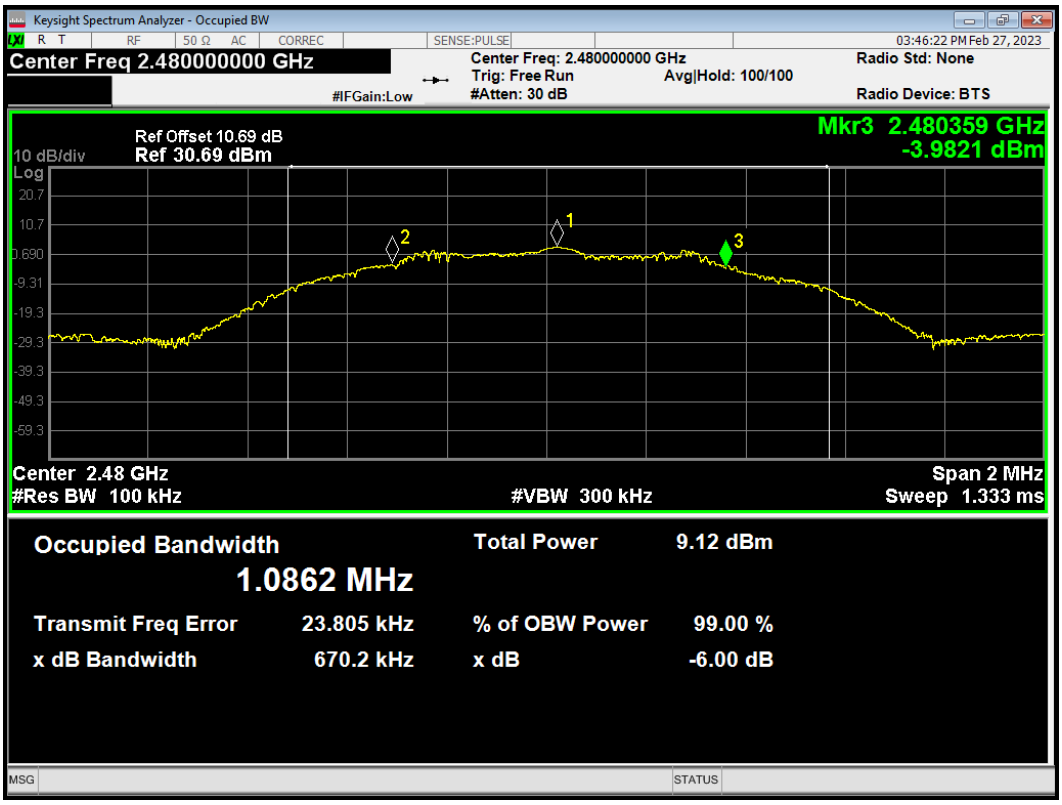
-6dB Bandwidth Bluetooth LE 2480MHz



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5.3. Band Edge

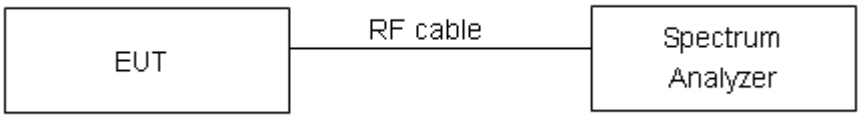
Ambient Condition

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 the band edge of the lowest and highest channels were measured. The peak detector is used and RBW is set to 100 kHz and VBW is set to 300 kHz on spectrum analyzer. Spectrum analyzer plots are included on the following pages.

Test Setup



Limits

Rule Part 15.247(d) specifies that “In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.” If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.”

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
2GHz-3GHz	1.407 dB

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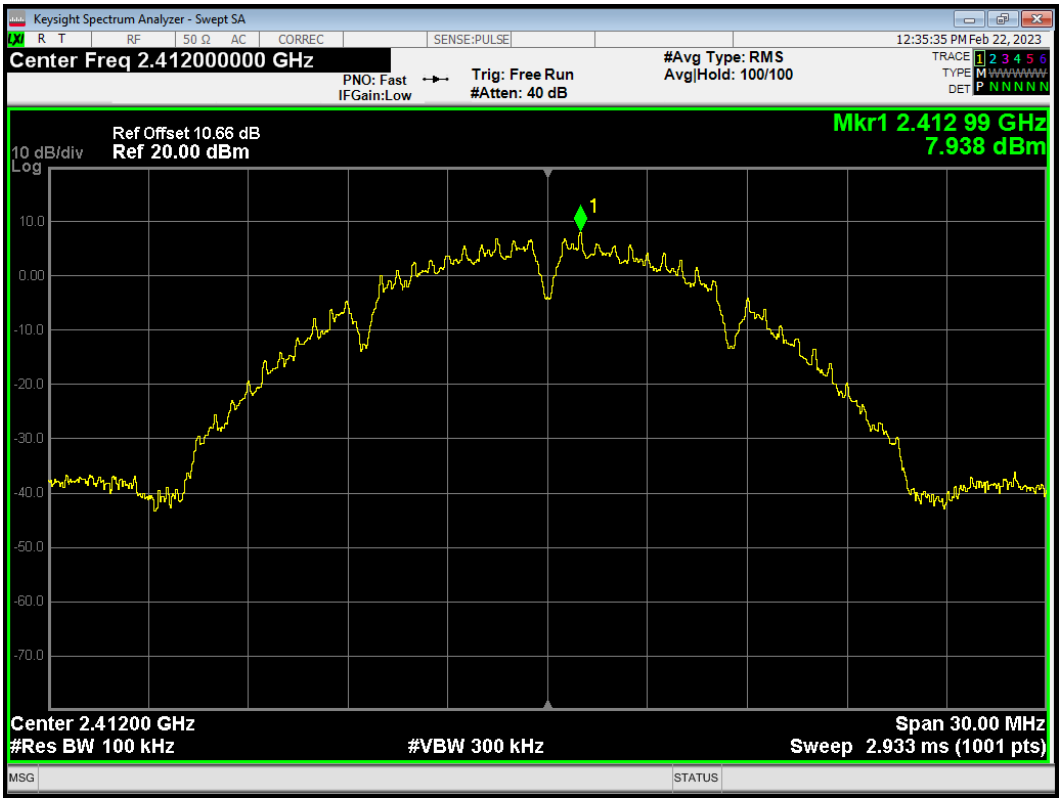
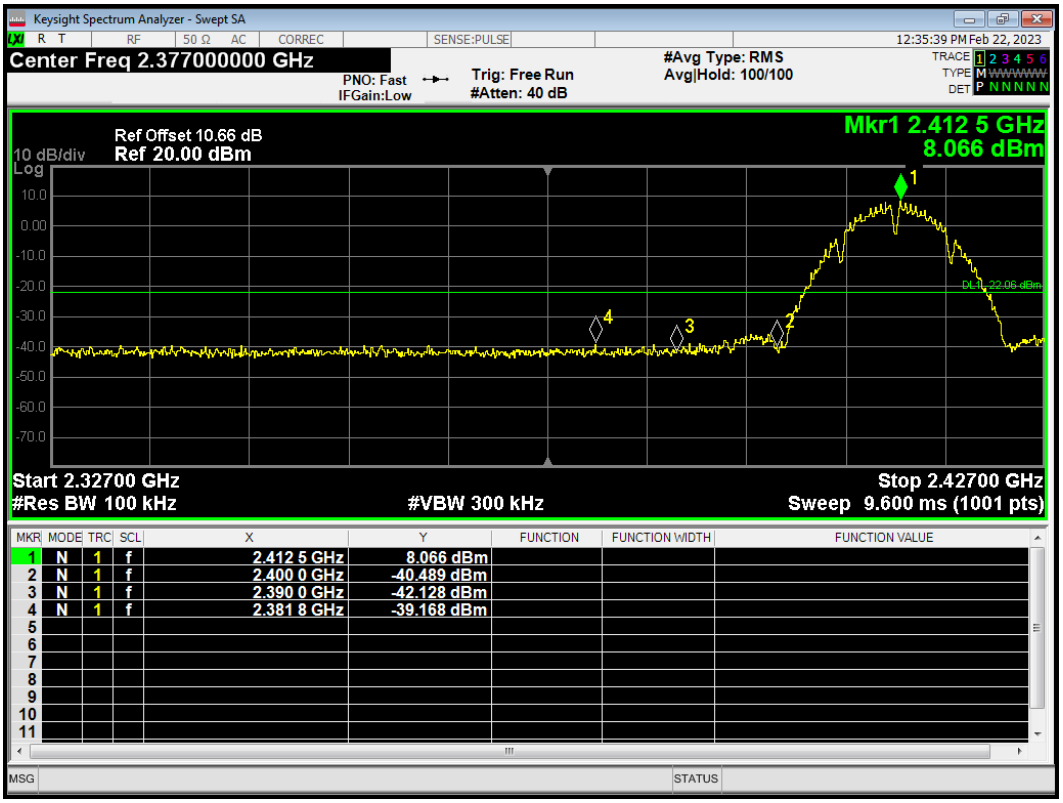
Test Results: PASS

Band Edge 802.11b 2412MHz Ref



Band Edge 802.11b 2412MHz Emission



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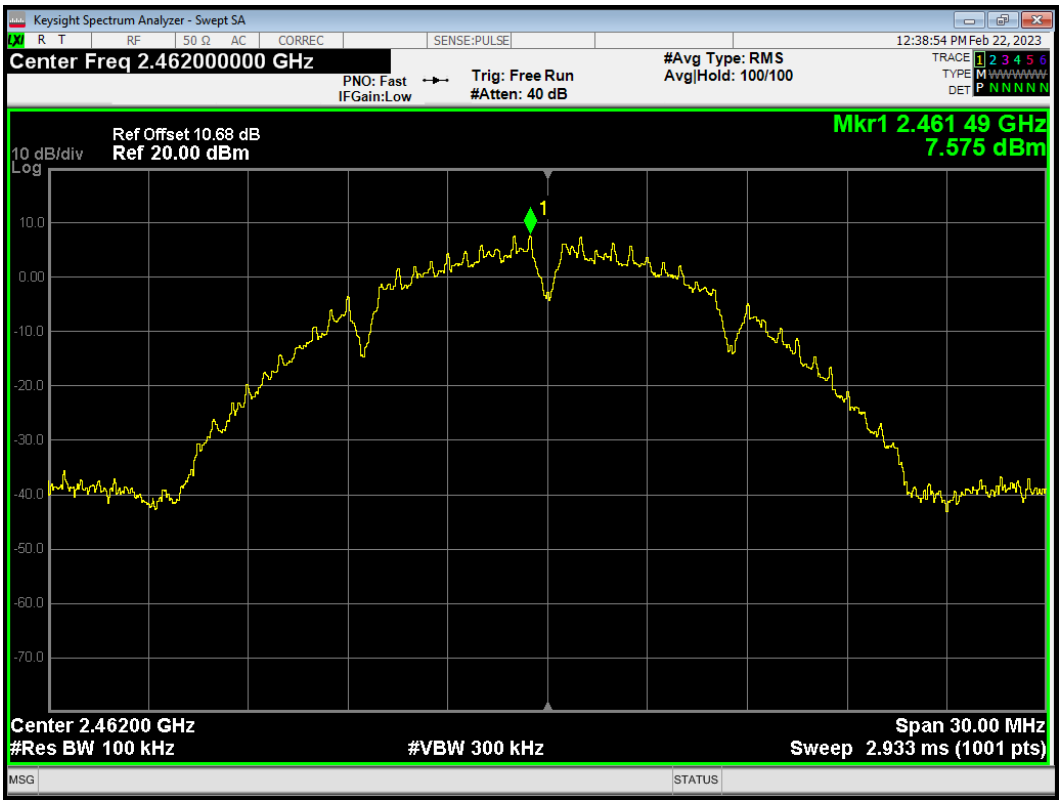
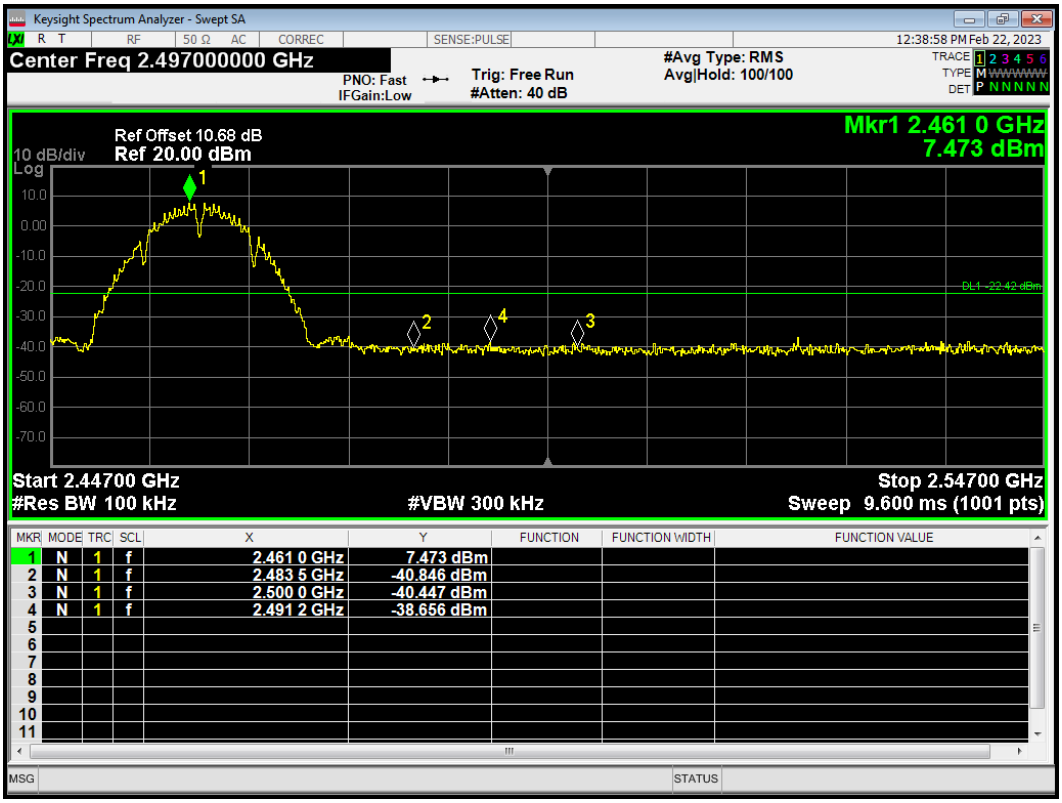
Band Edge 802.11b 2462MHz Ref



Band Edge 802.11b 2462MHz Emission



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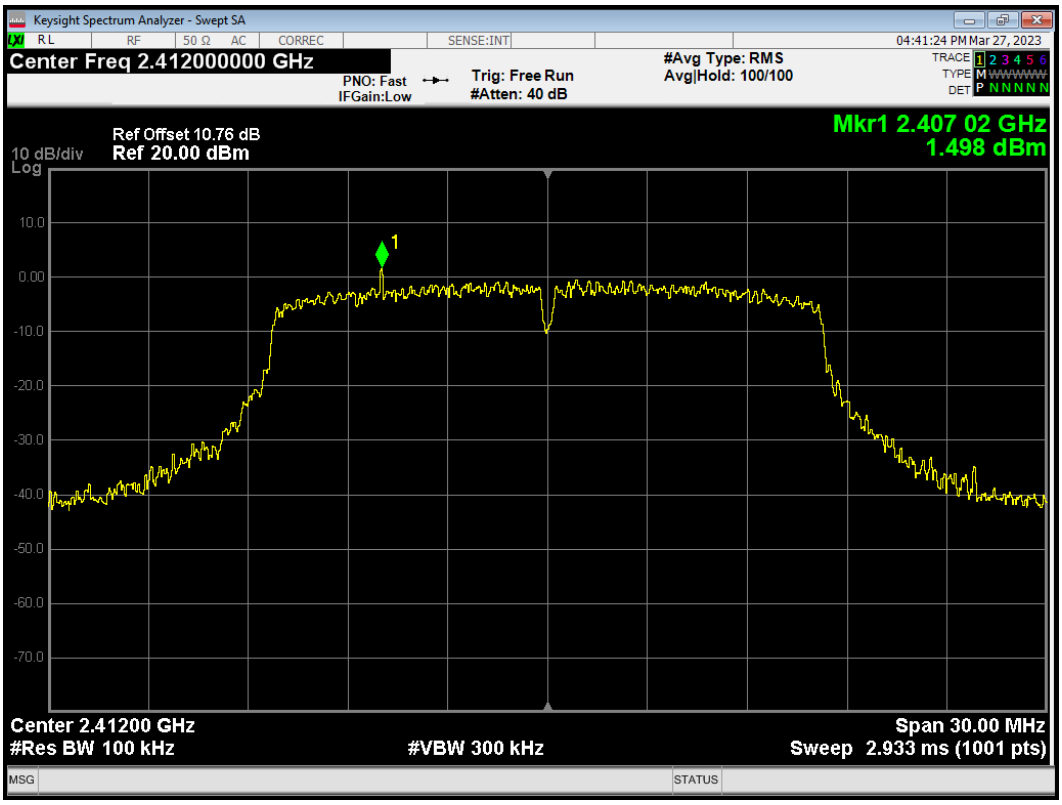
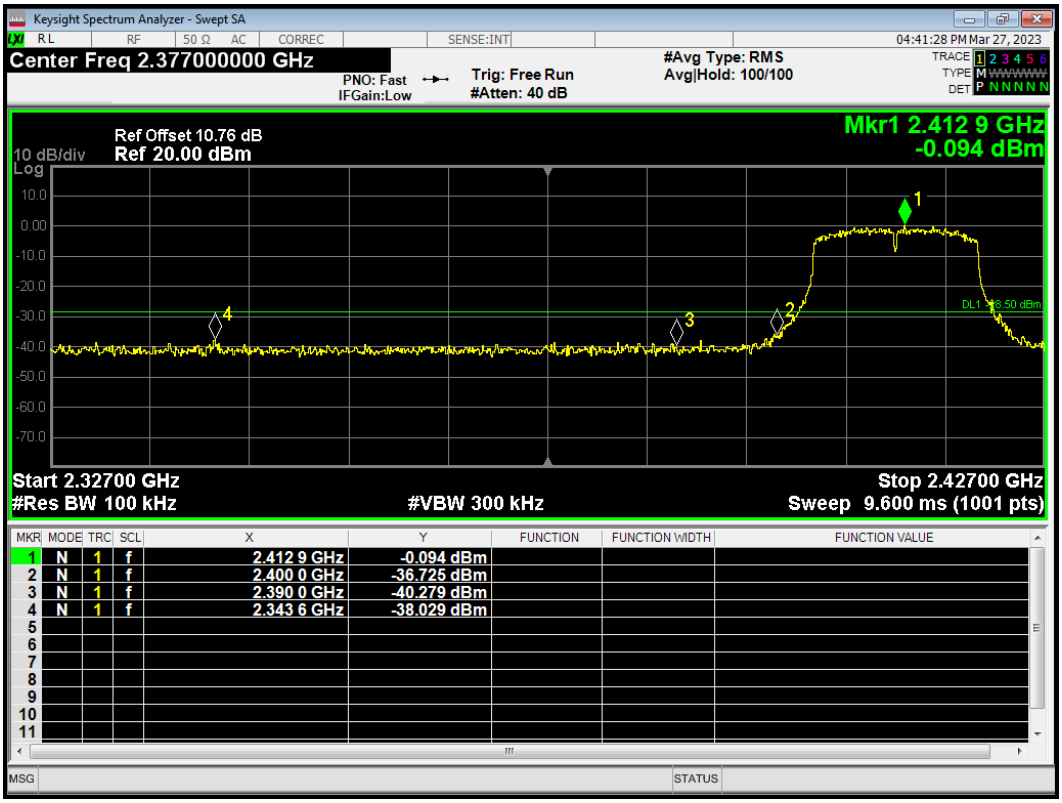
Band Edge 802.11g 2412MHz Ref



Band Edge 802.11g 2412MHz Emission



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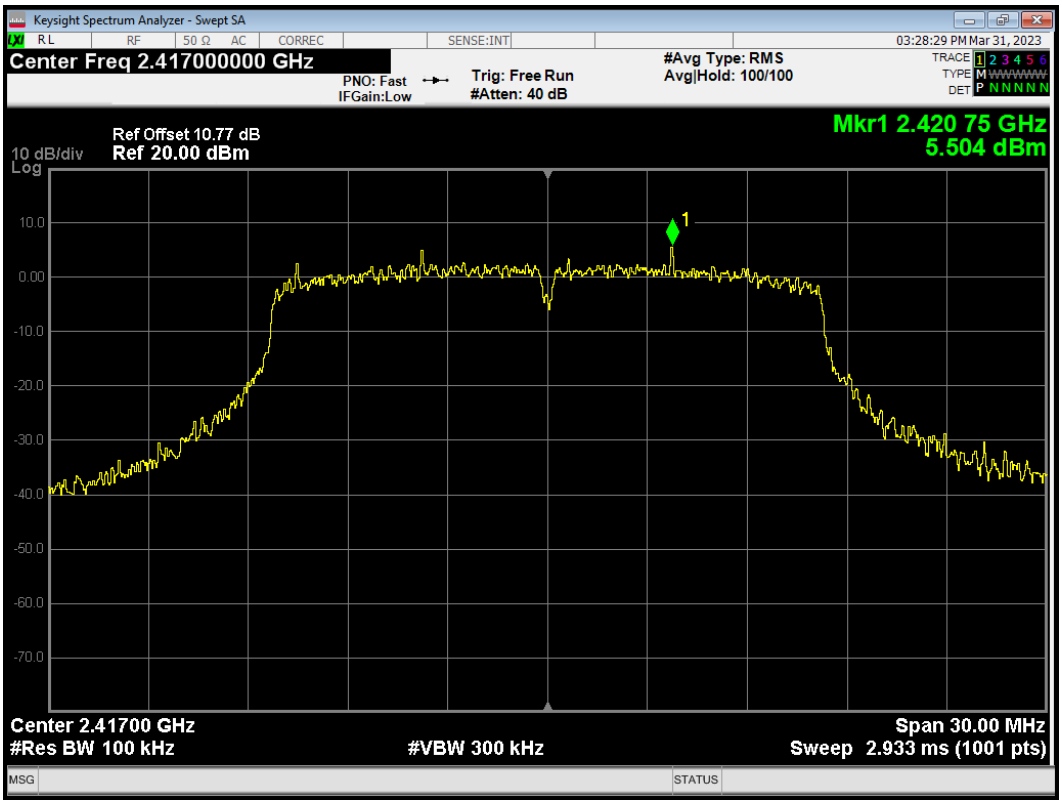
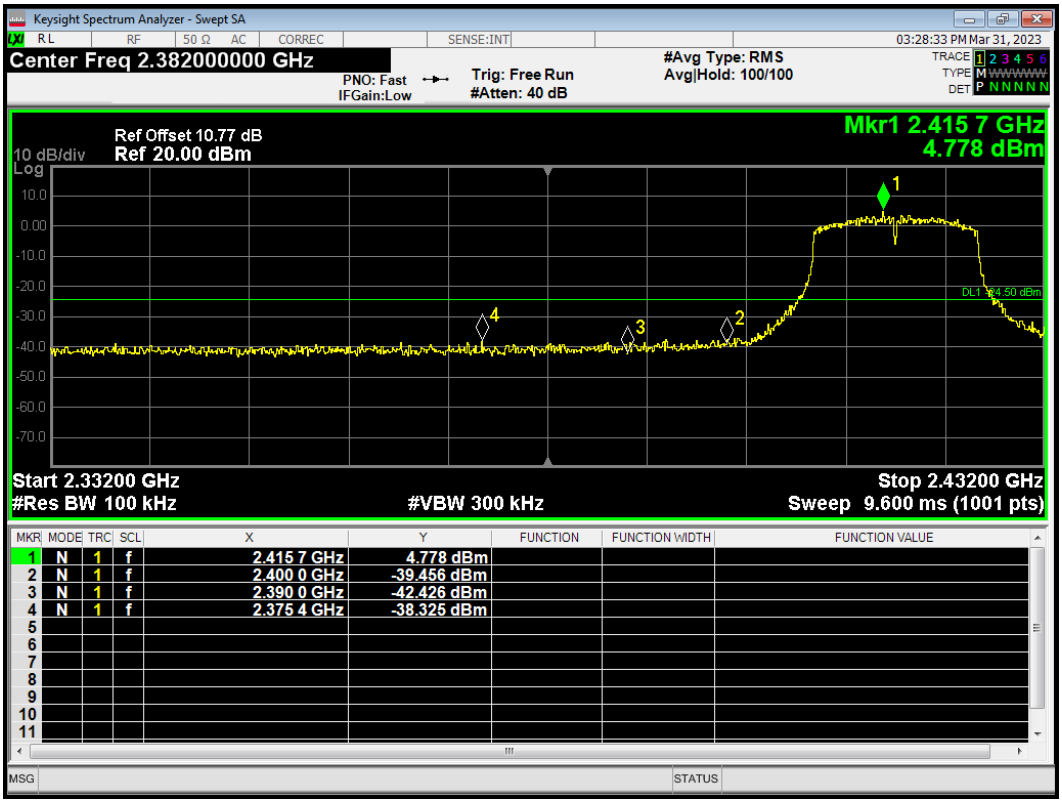
Band Edge 802.11g 2417MHz Ref



Band Edge 802.11g 2417MHz Emission



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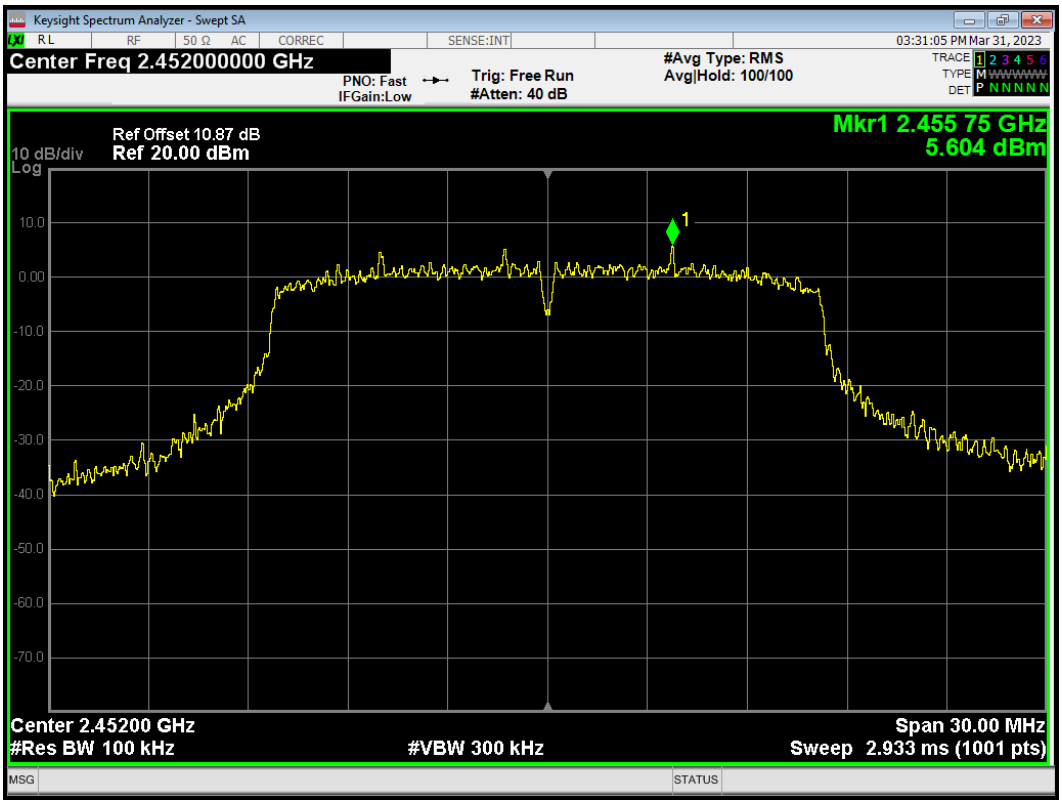

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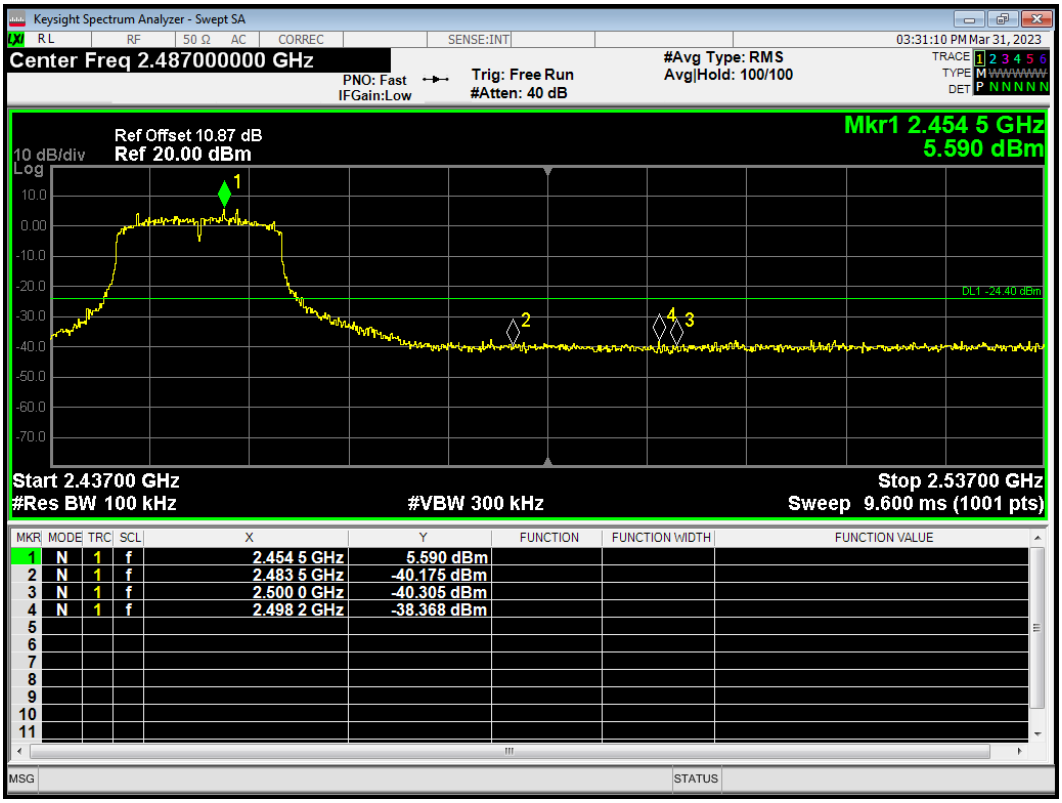

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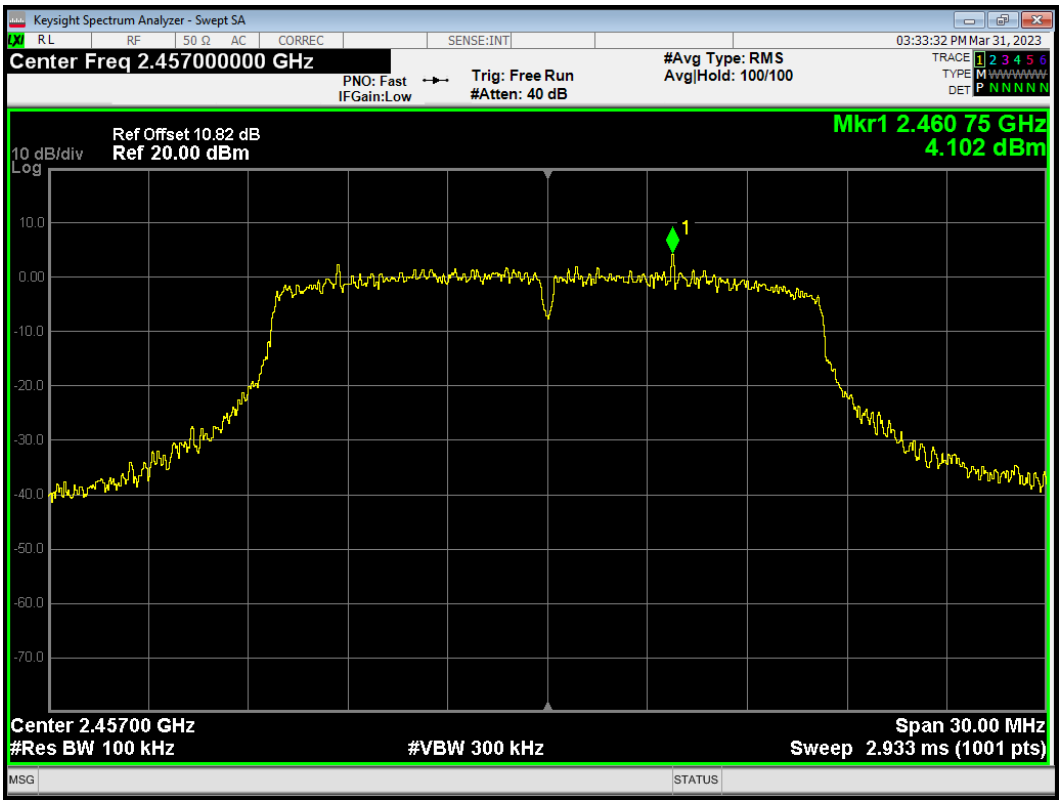
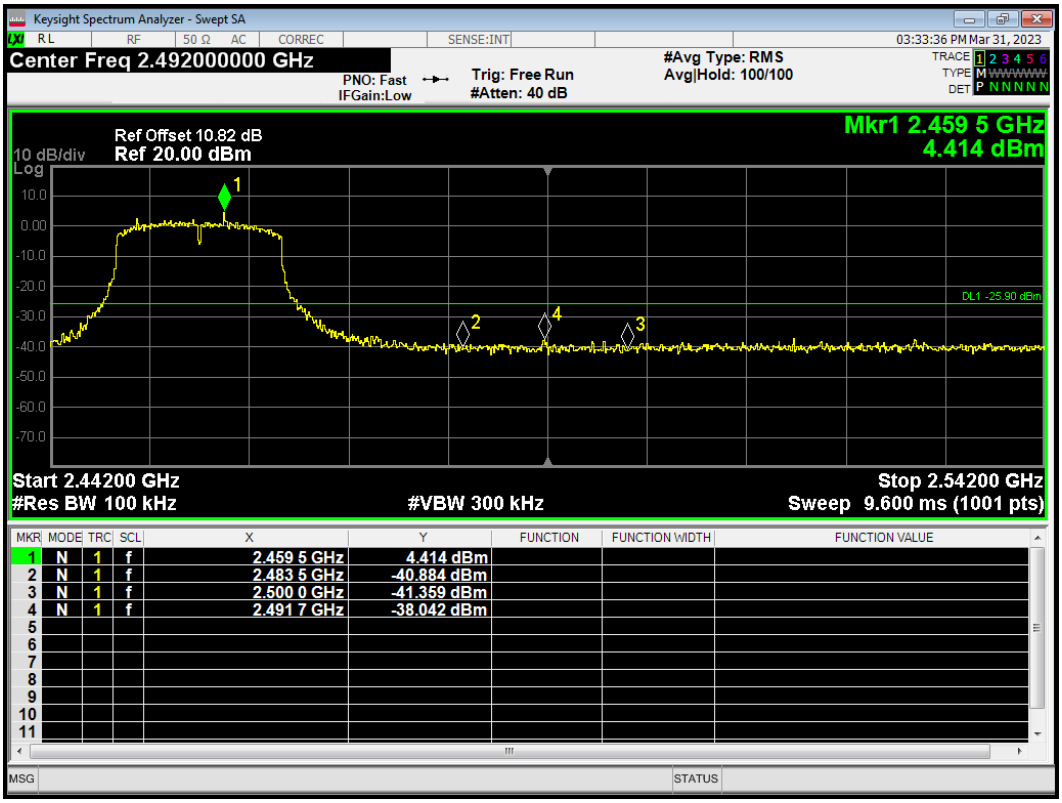
Band Edge 802.11g 2457MHz Ref



Band Edge 802.11g 2457MHz Emission



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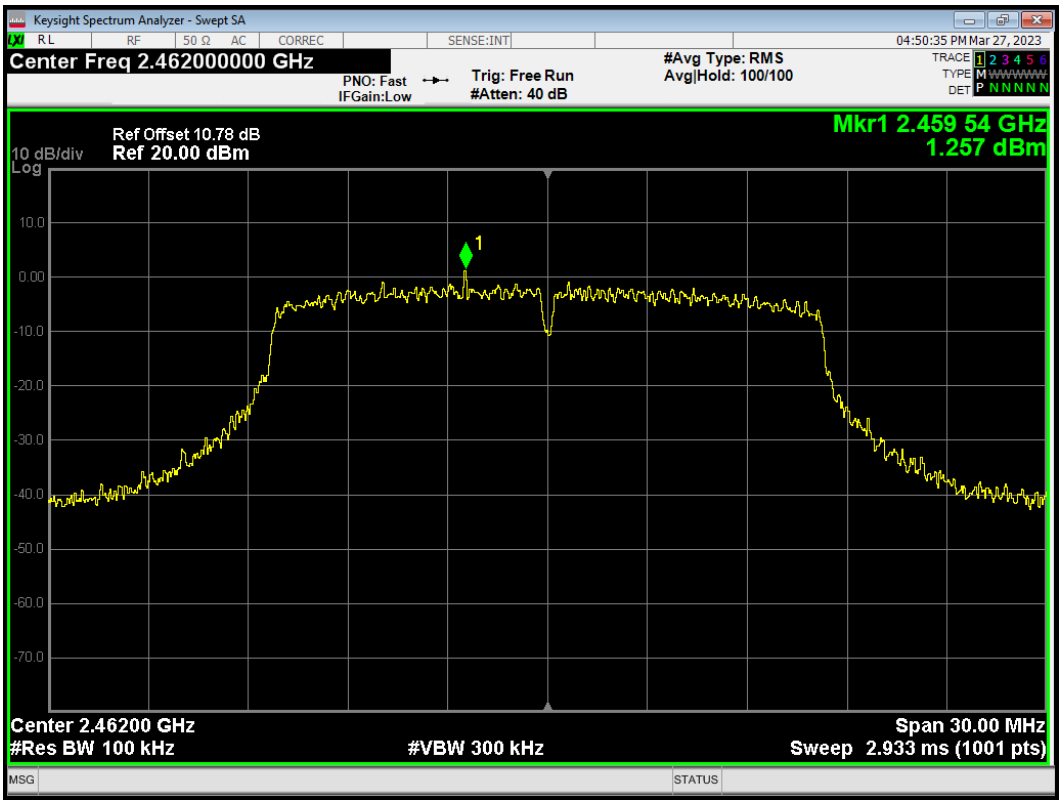
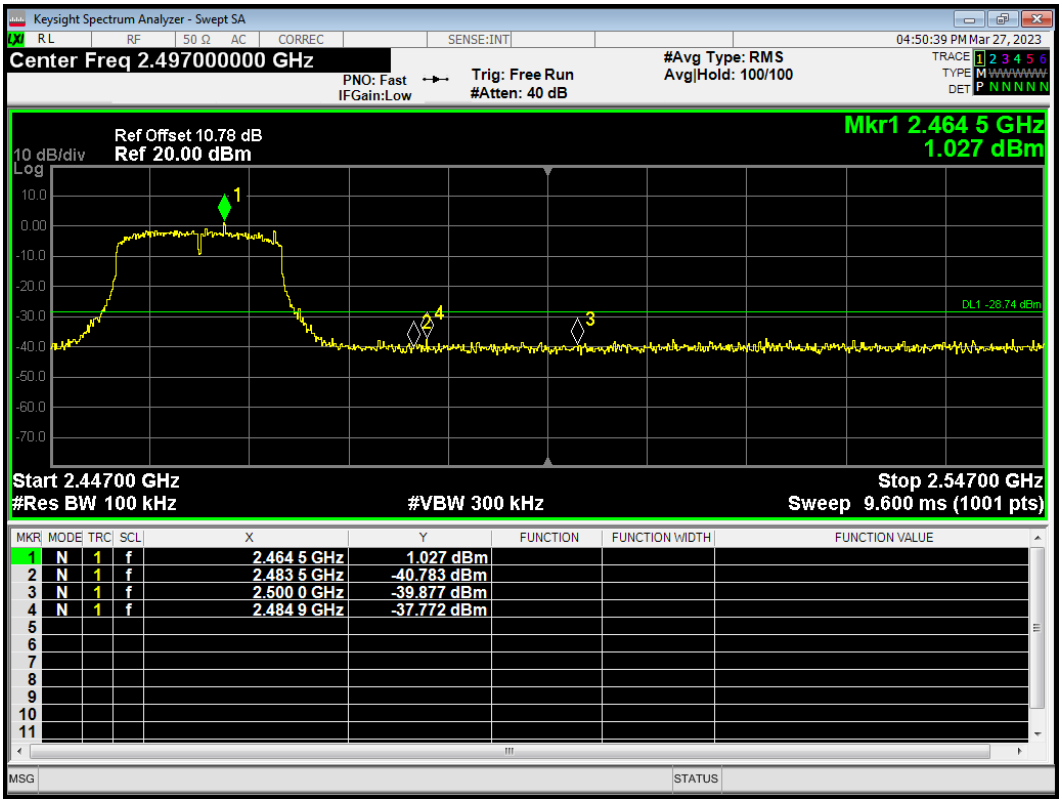
Band Edge 802.11g 2462MHz Ref



Band Edge 802.11g 2462MHz Emission



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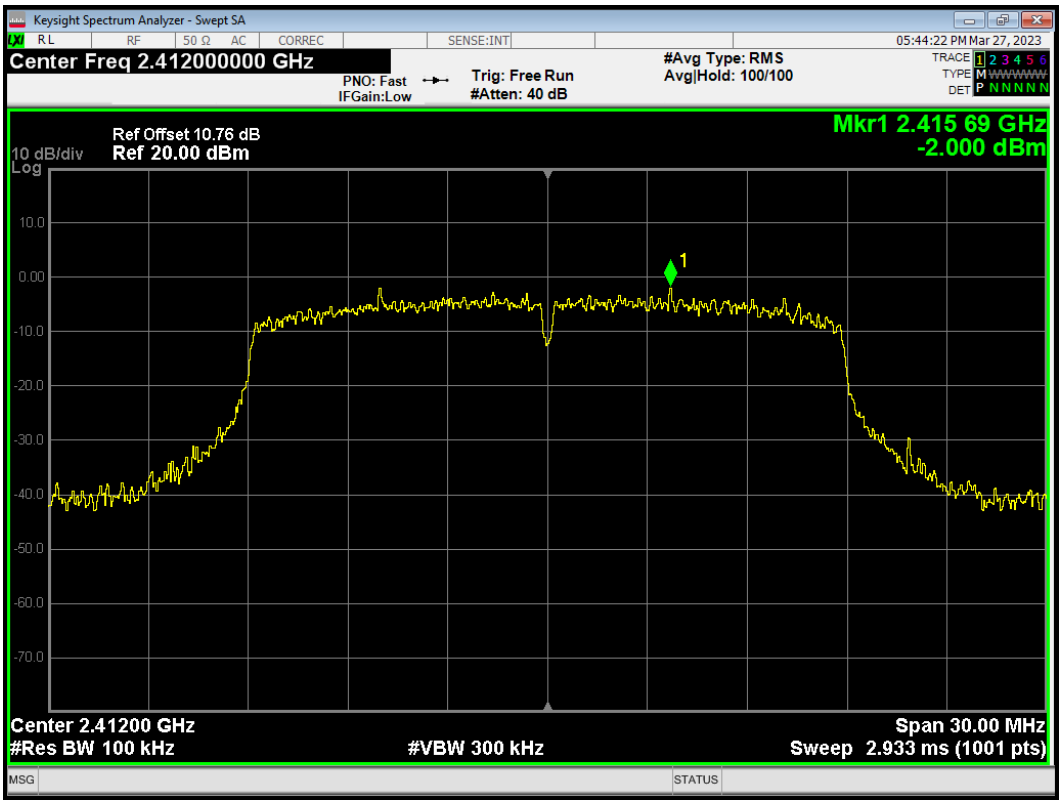
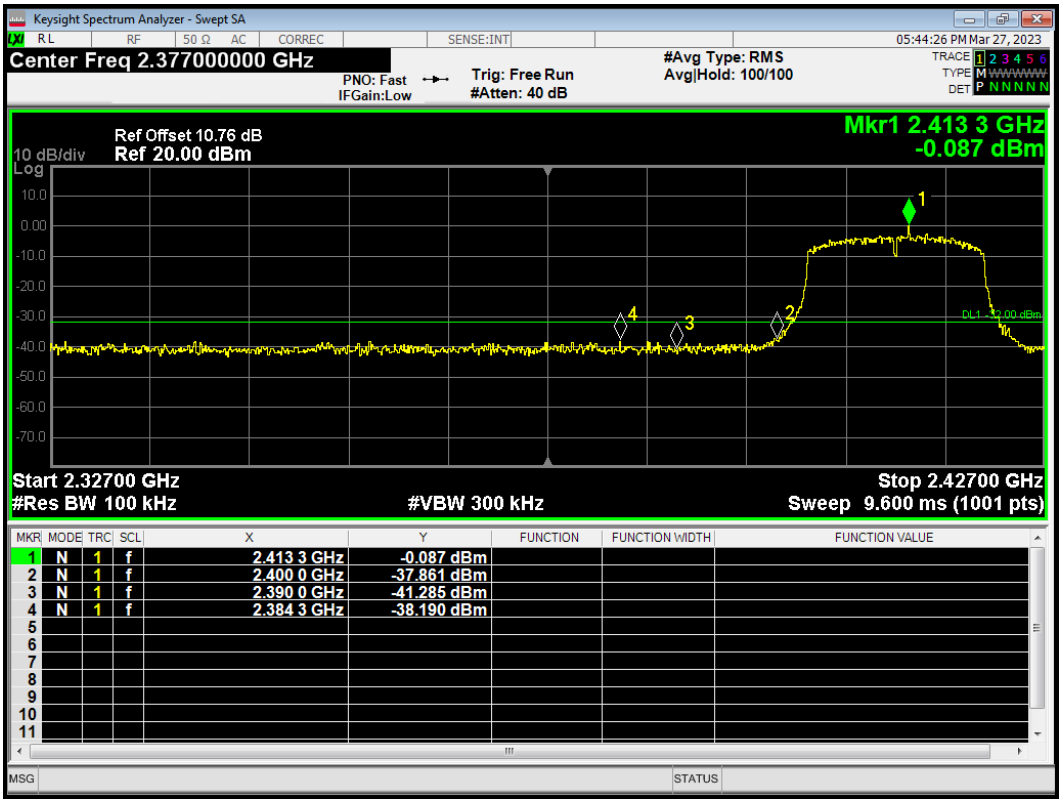
Band Edge 802.11n(HT20) 2412MHz Ref



Band Edge 802.11n(HT20) 2412MHz Emission



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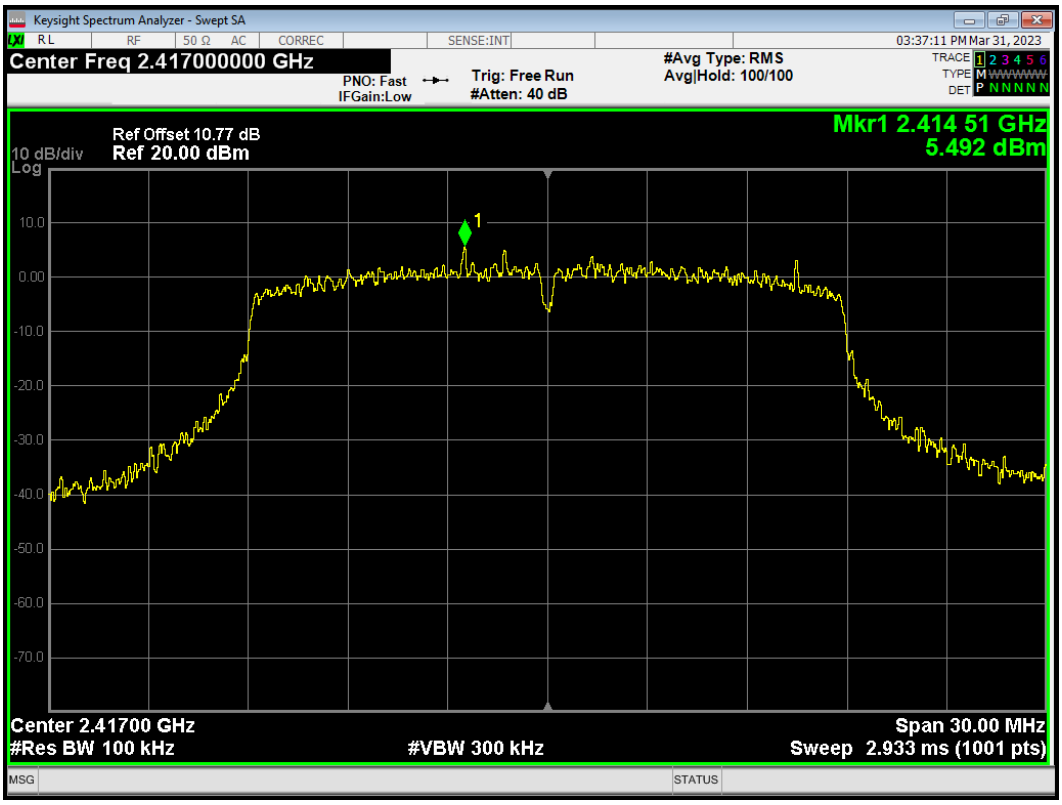
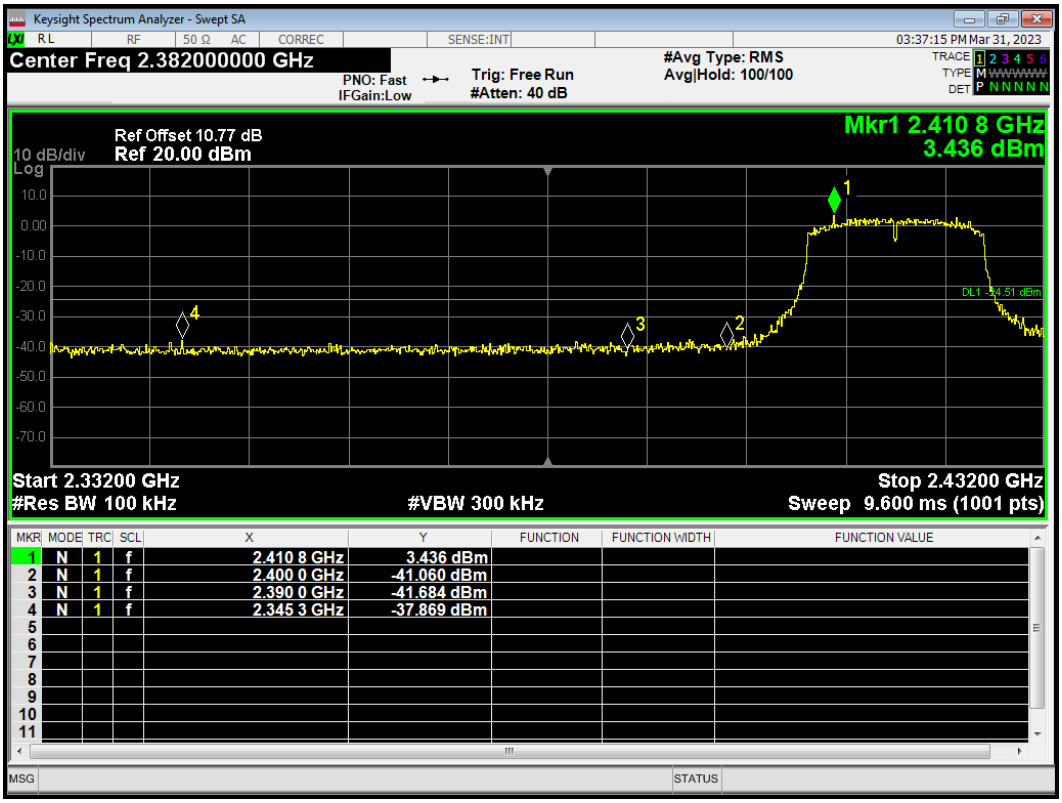
Band Edge 802.11n(HT20) 2417MHz Ref



Band Edge 802.11n(HT20) 2417MHz Emission



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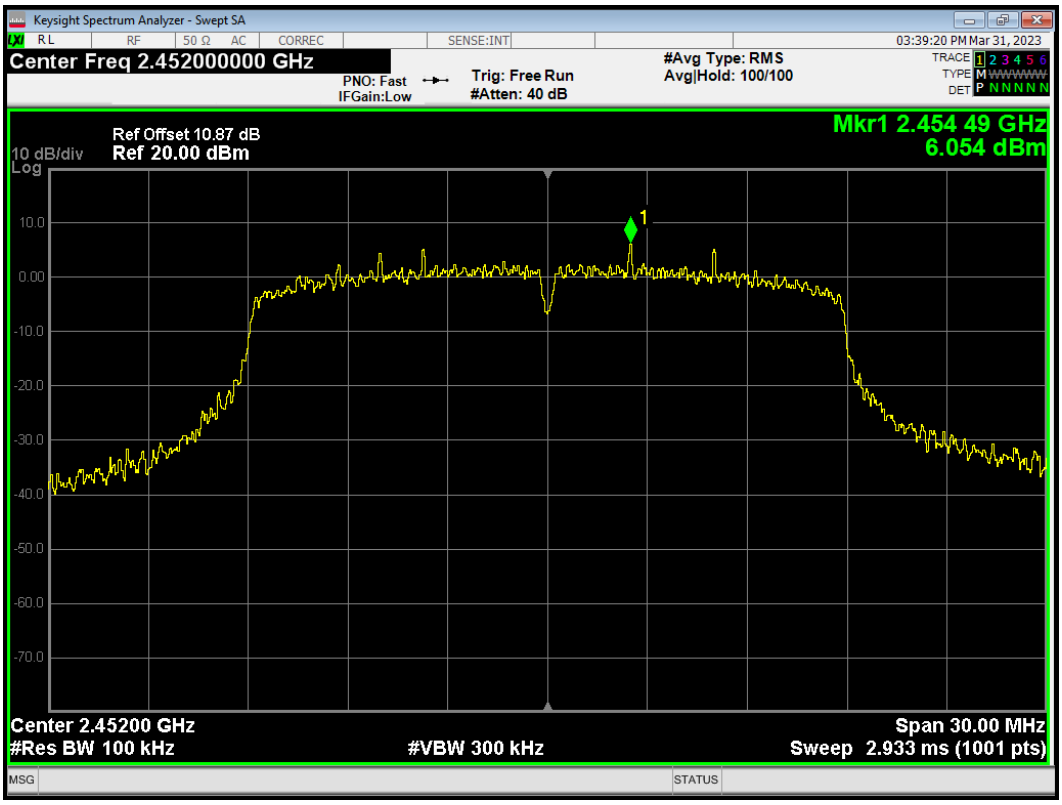
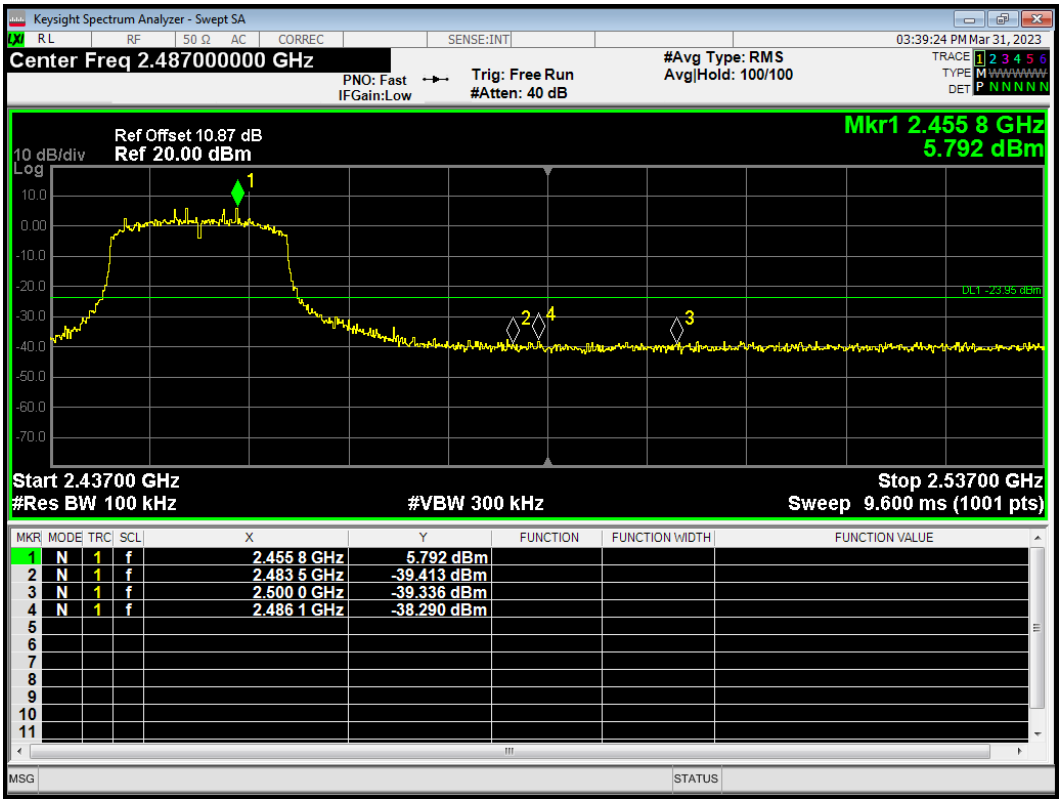
Band Edge 802.11n(HT20) 2452MHz Ref



Band Edge 802.11n(HT20) 2452MHz Emission



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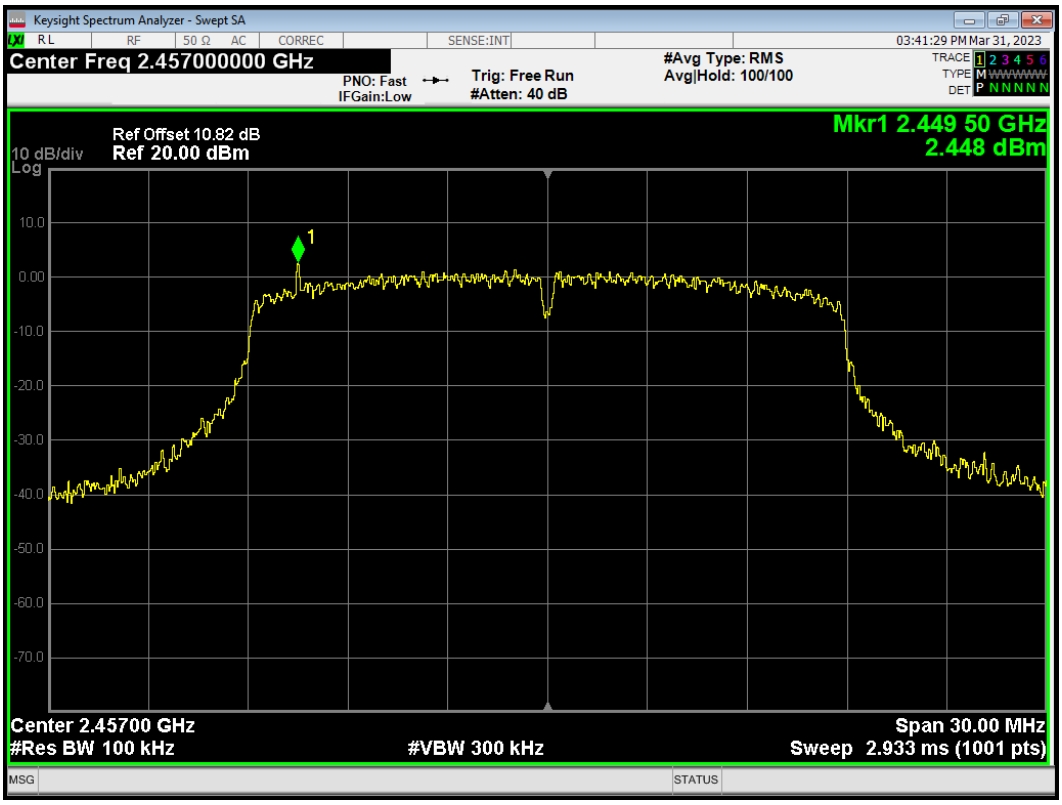
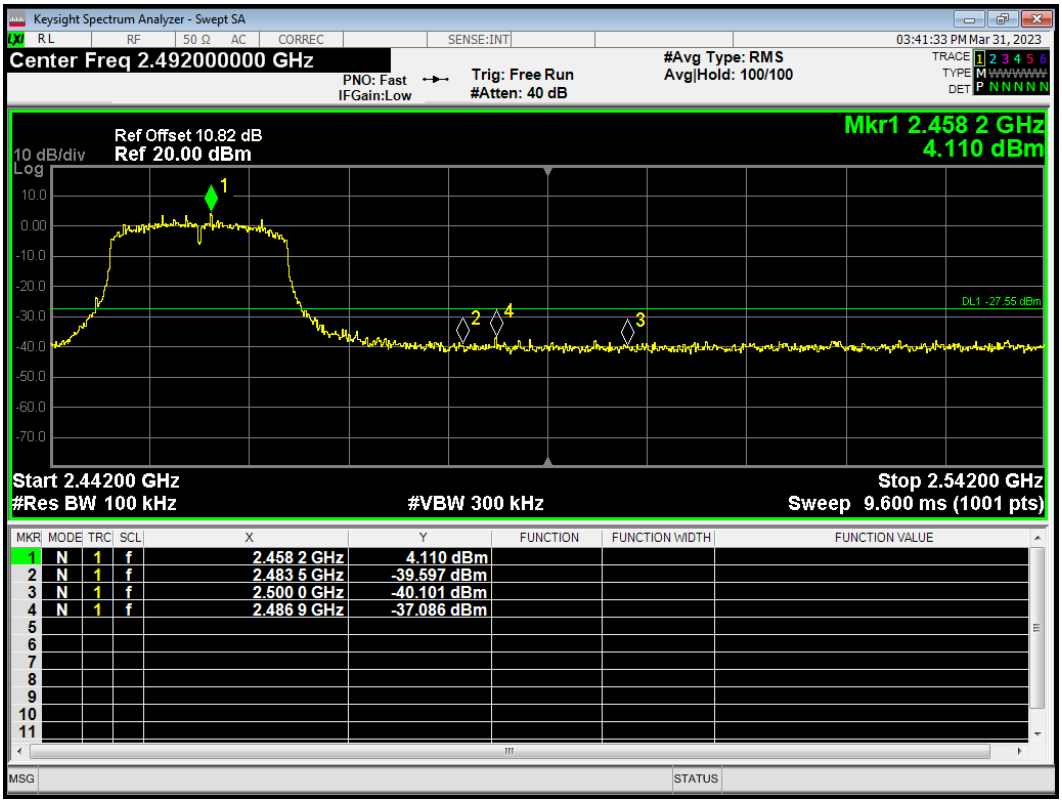
Band Edge 802.11n(HT20) 2457MHz Ref



Band Edge 802.11n(HT20) 2457MHz Emission



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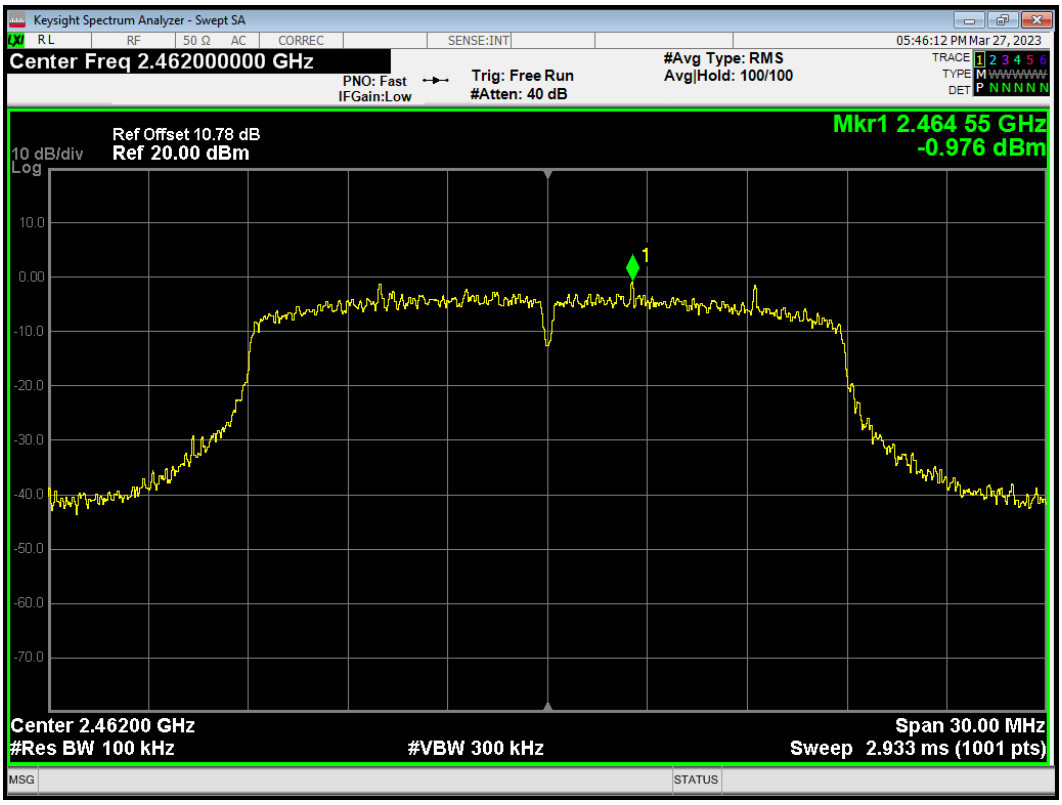
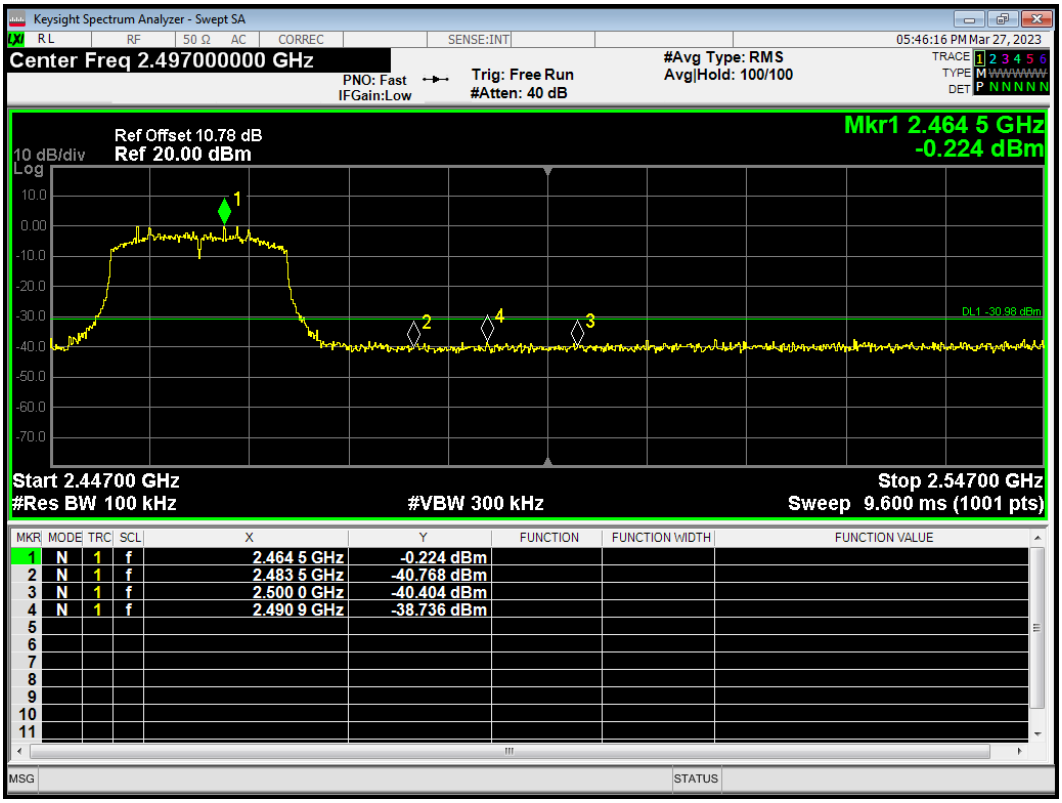
Band Edge 802.11n(HT20) 2462MHz Ref



Band Edge 802.11n(HT20) 2462MHz Emission



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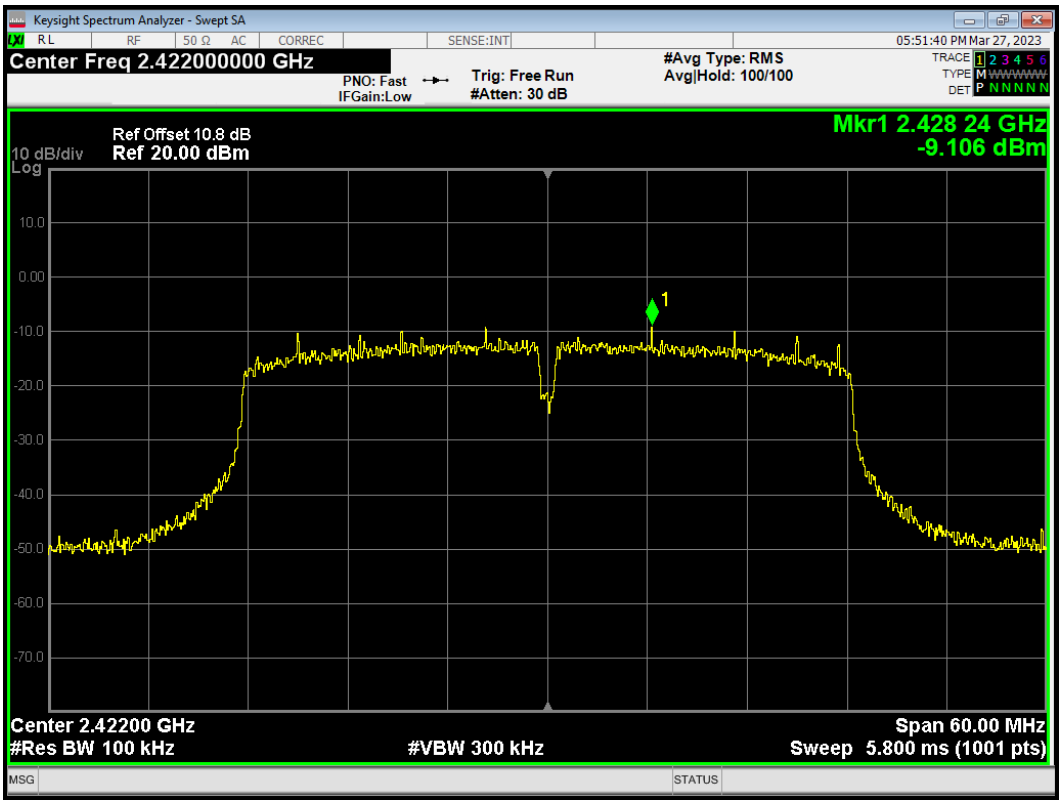
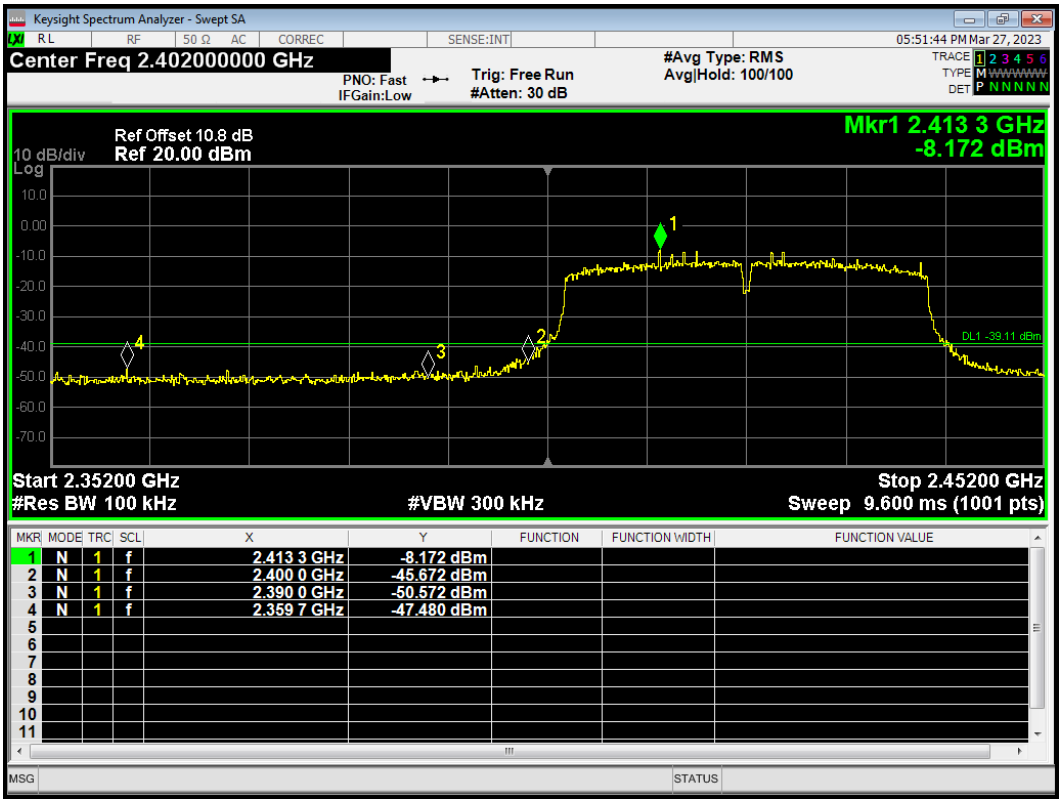
Band Edge 802.11n(HT40) 2422MHz Ref



Band Edge 802.11n(HT40) 2422MHz Emission



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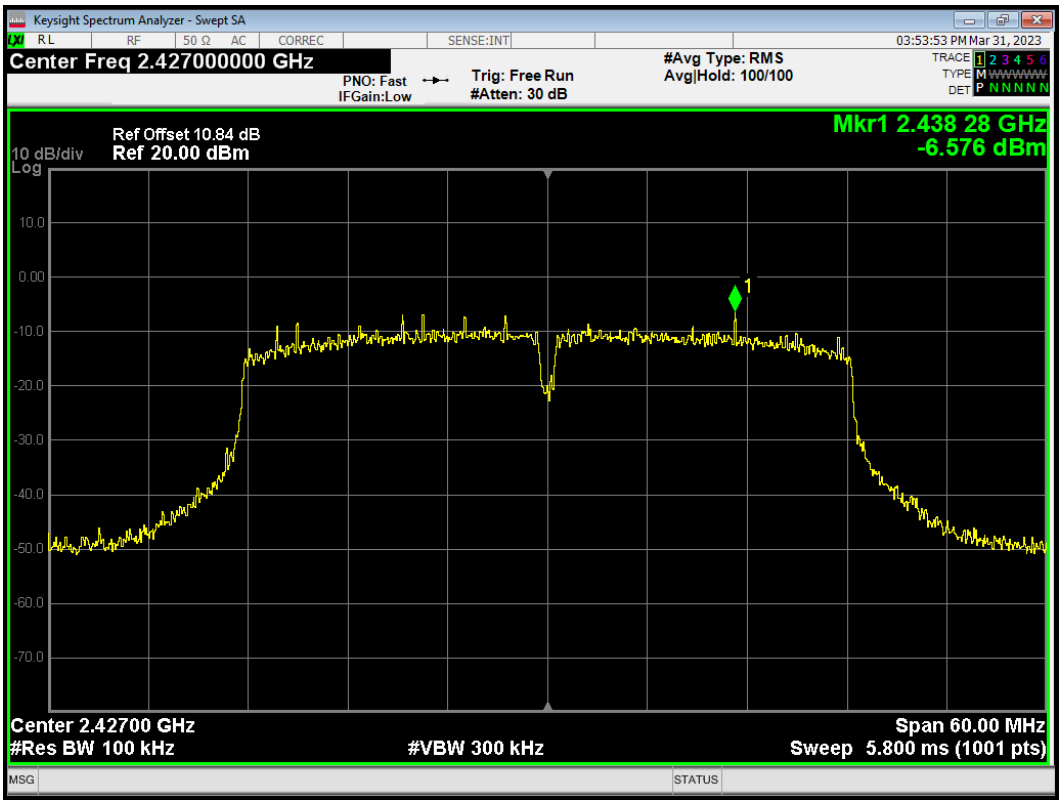
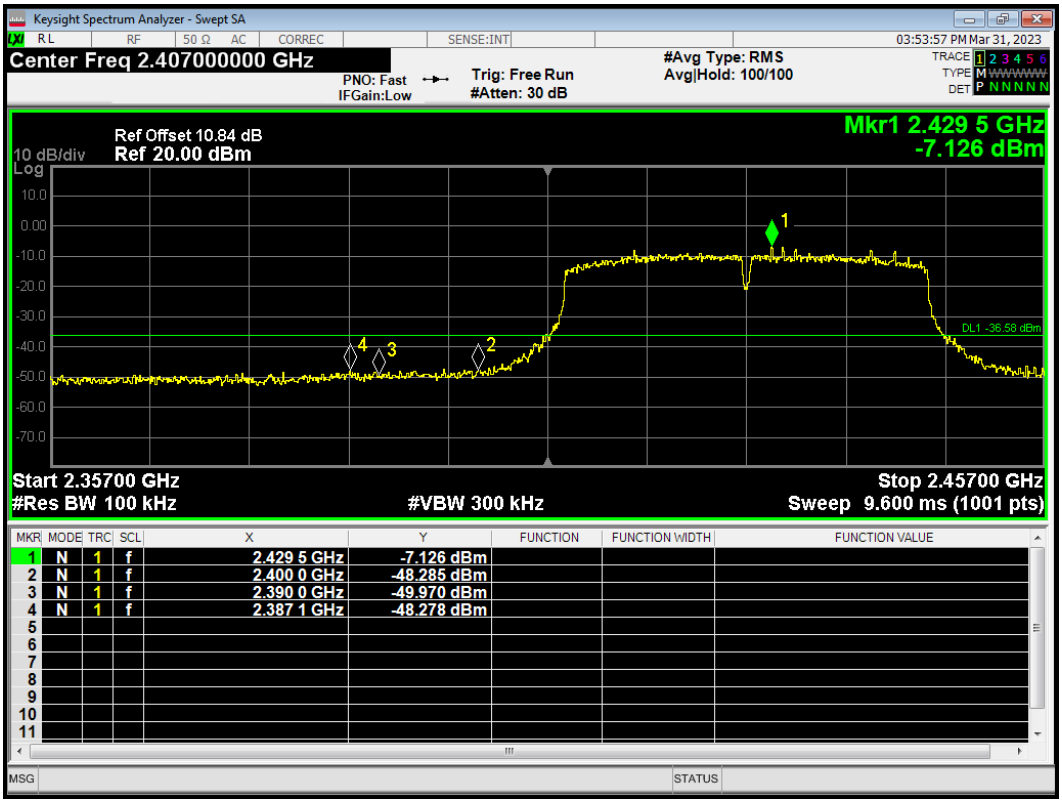
Band Edge 802.11n(HT40) 2427MHz Ref



Band Edge 802.11n(HT40) 2427MHz Emission



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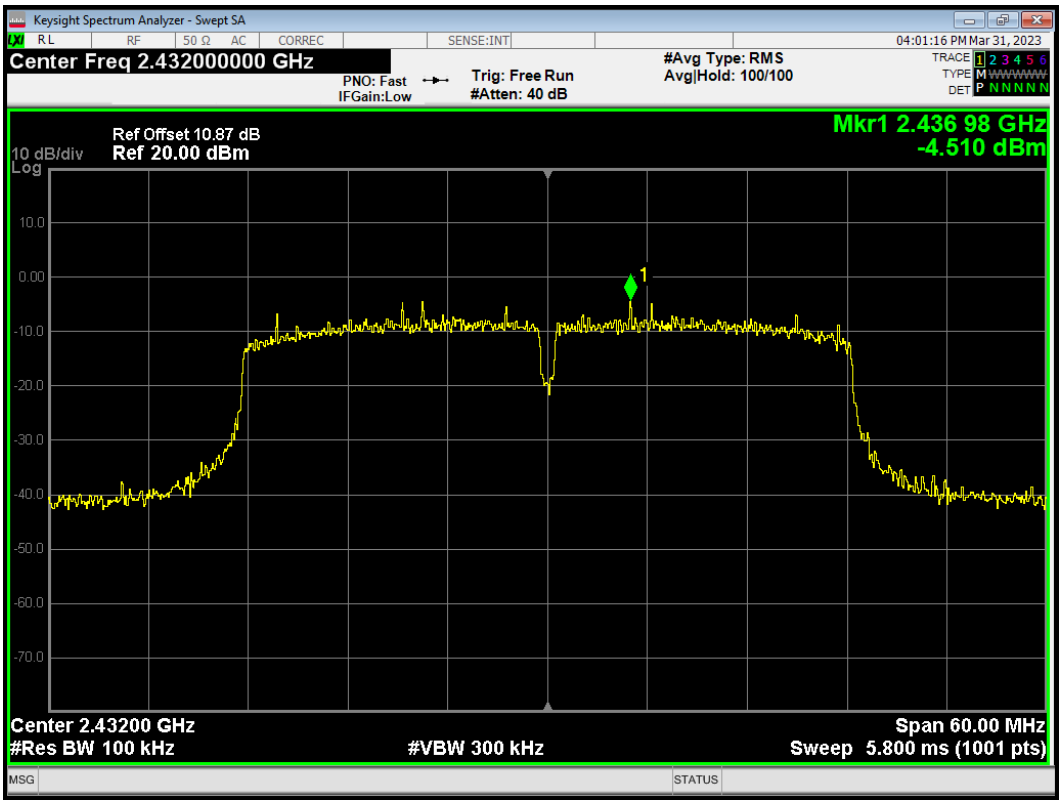
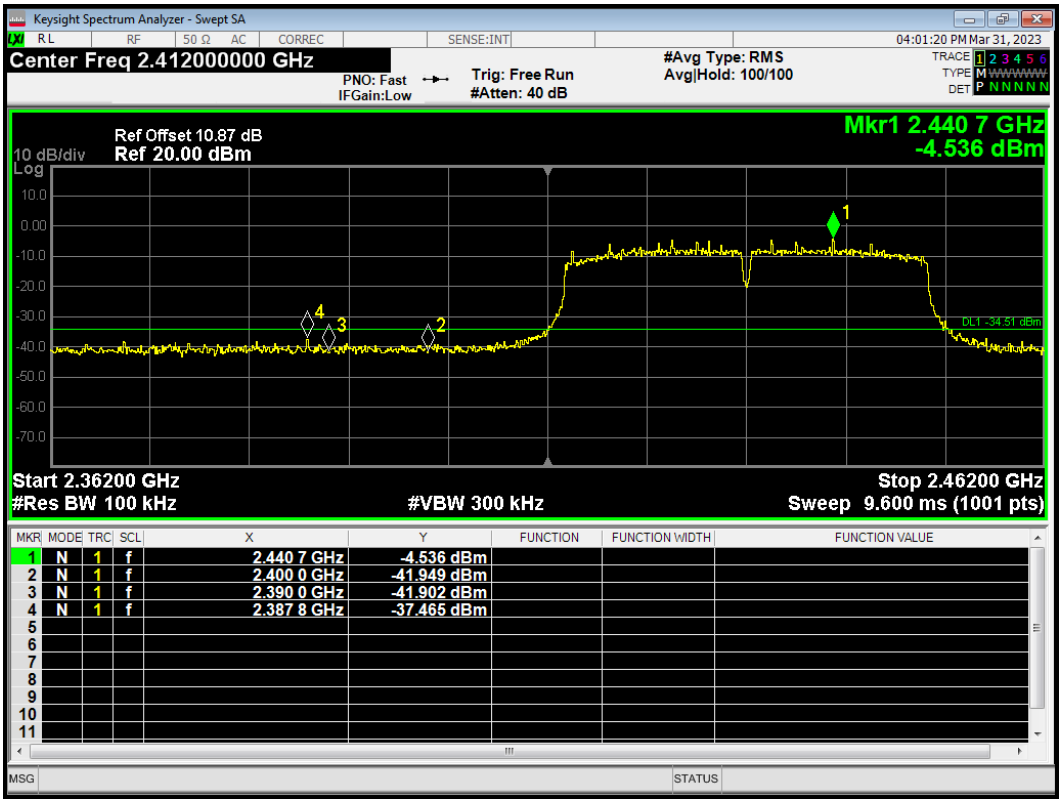
Band Edge 802.11n(HT40) 2432MHz Ref



Band Edge 802.11n(HT40) 2432MHz Emission



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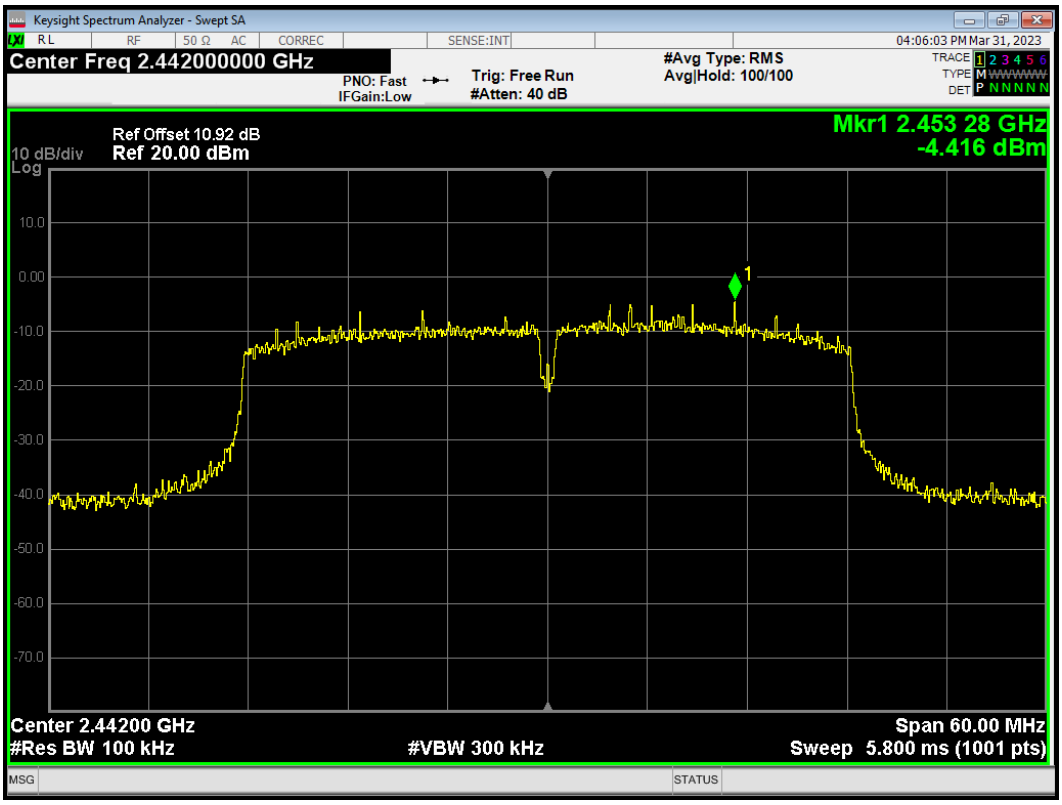
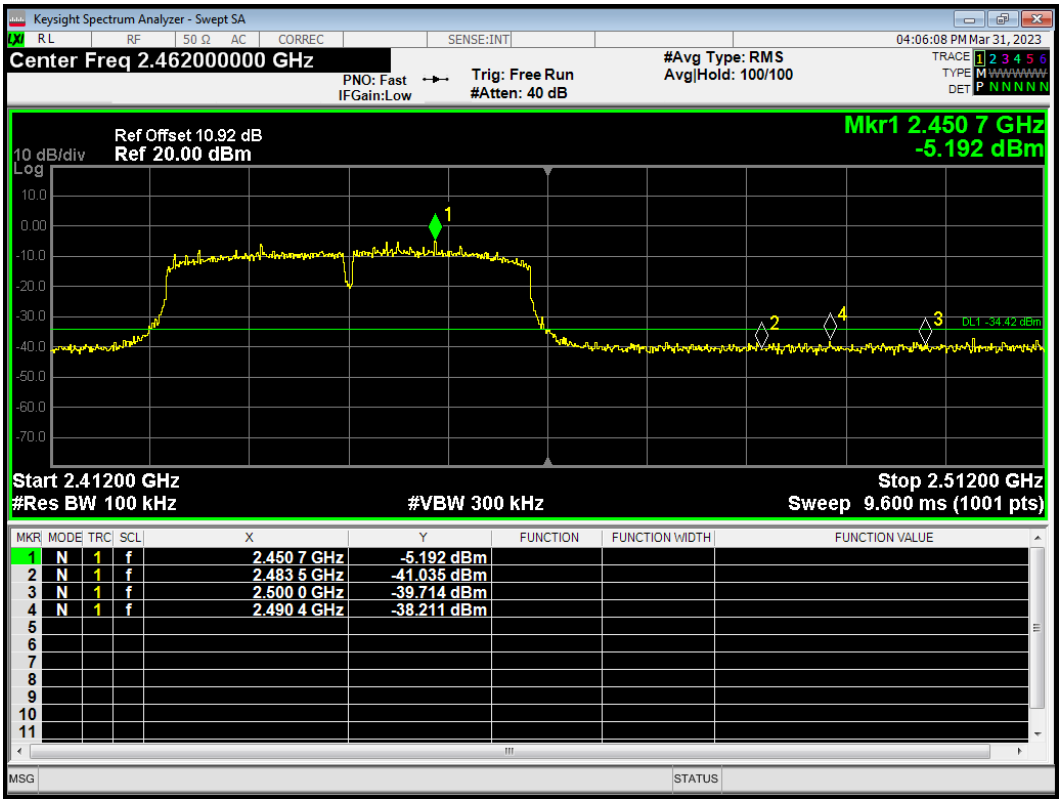
Band Edge 802.11n(HT40) 2442MHz Ref



Band Edge 802.11n(HT40) 2442MHz Emission



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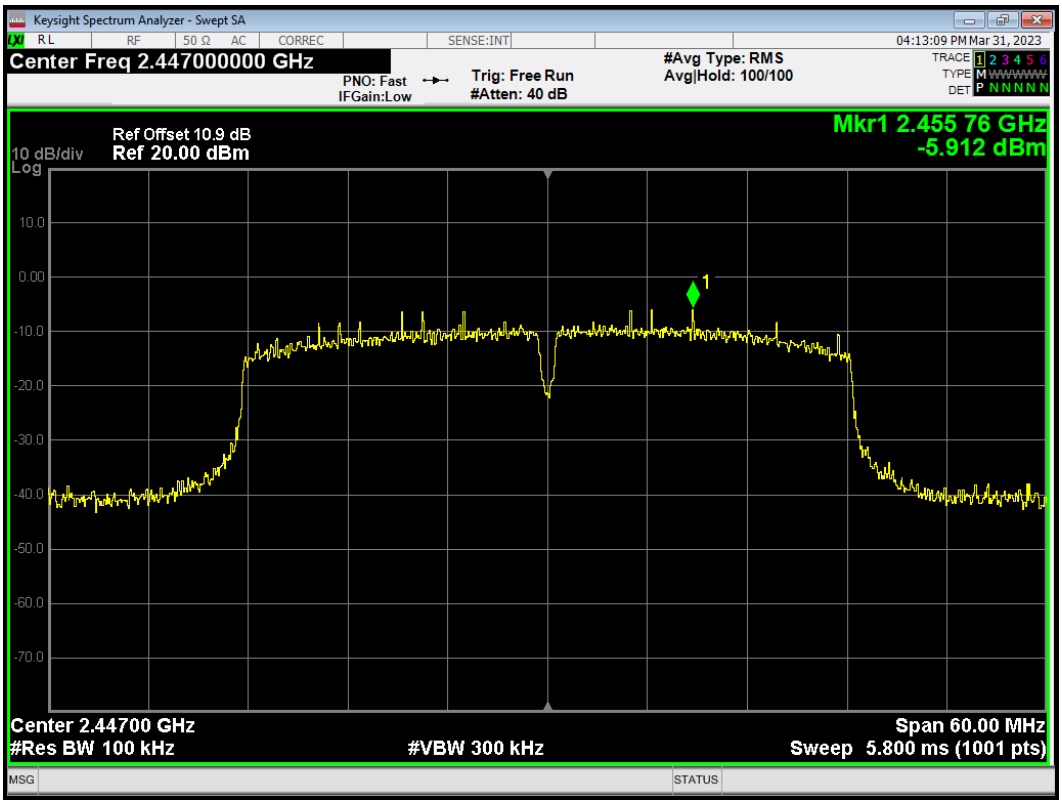
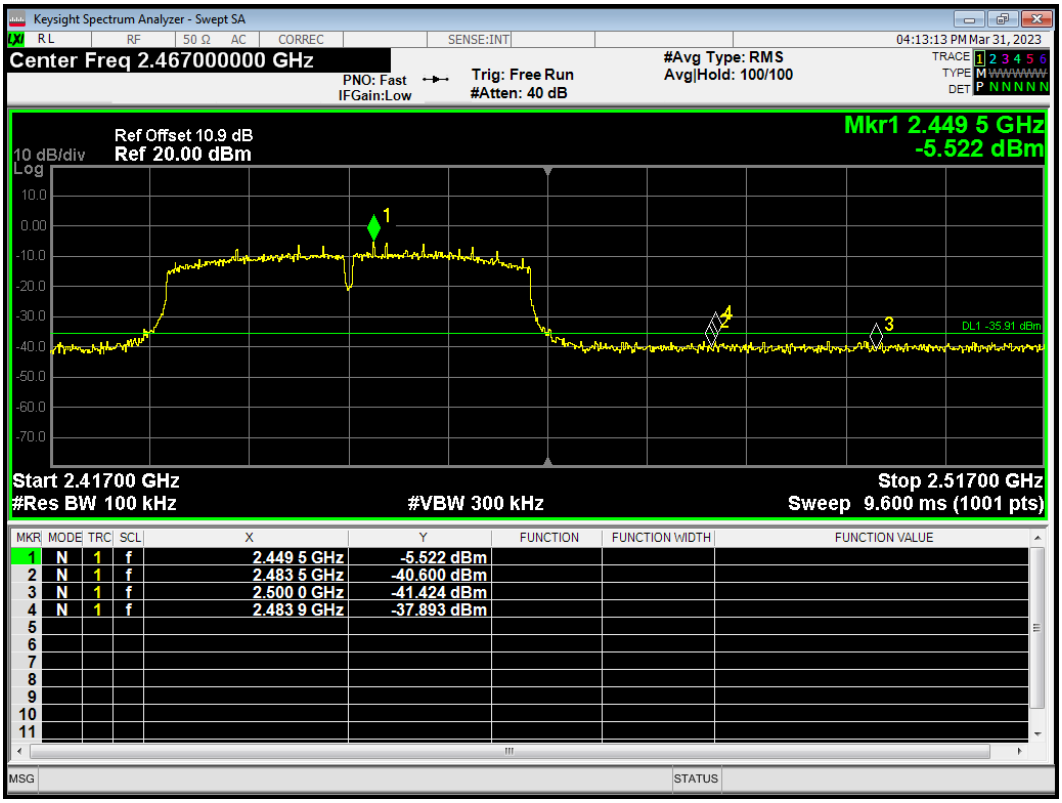
Band Edge 802.11n(HT40) 2447MHz Ref



Band Edge 802.11n(HT40) 2447MHz Emission



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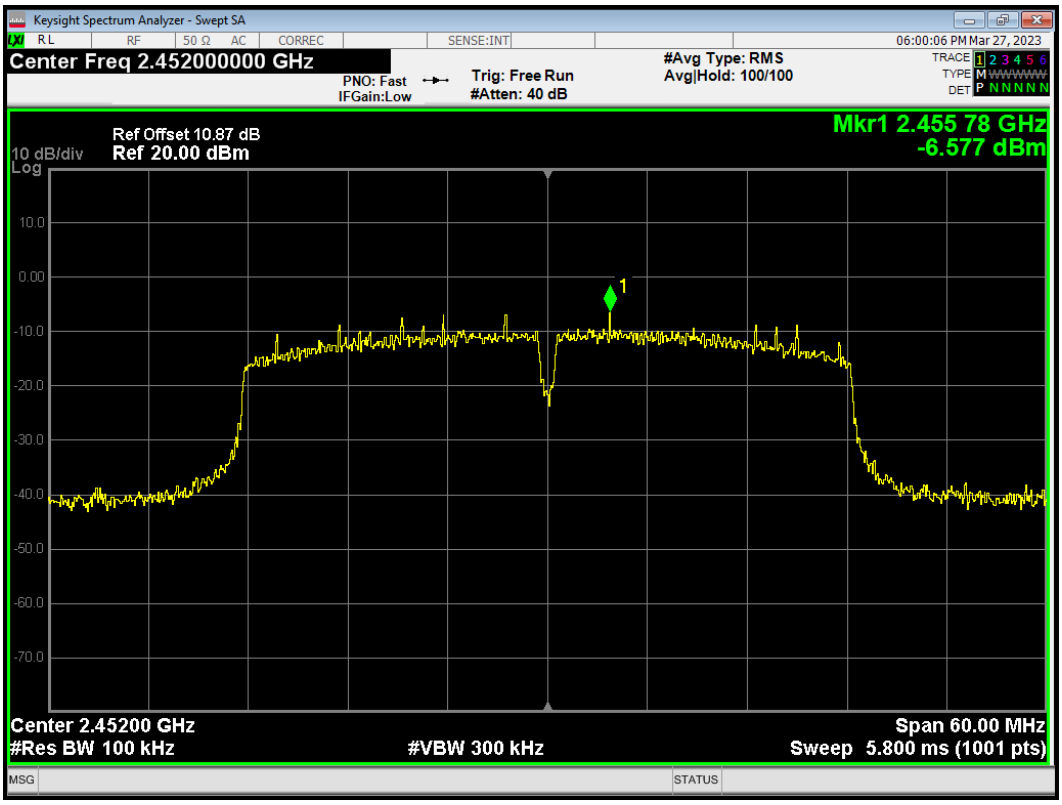
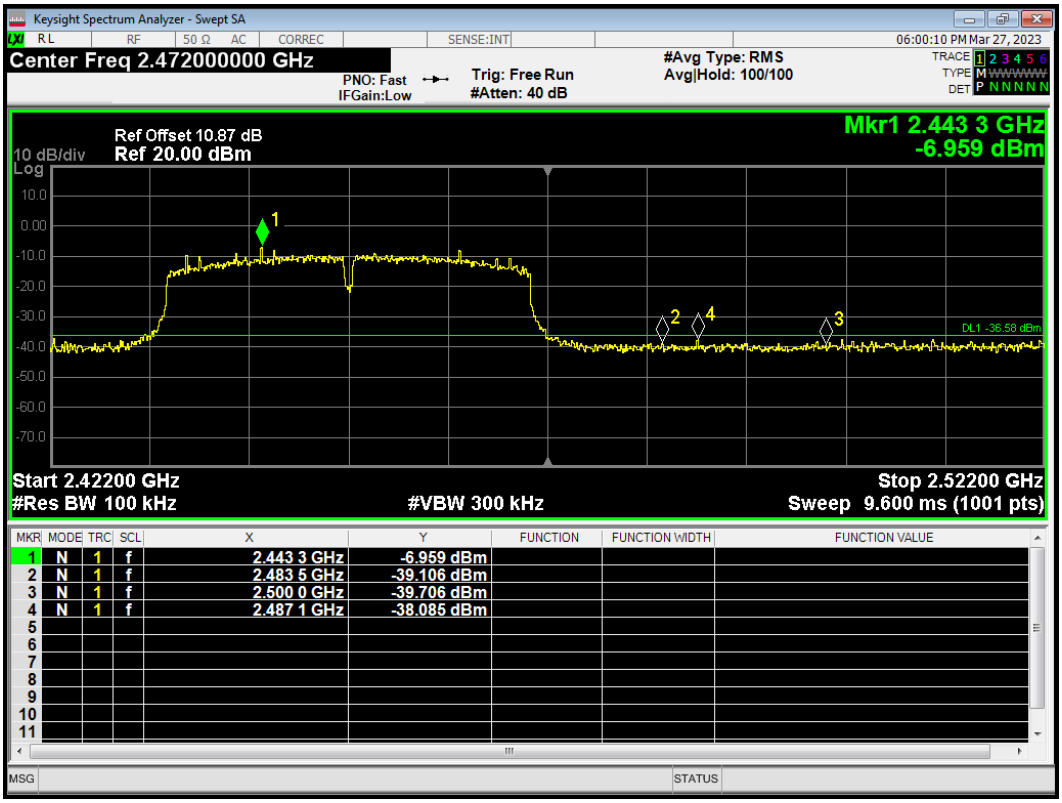
Band Edge 802.11n(HT40) 2452MHz Ref



Band Edge 802.11n(HT40) 2452MHz Emission



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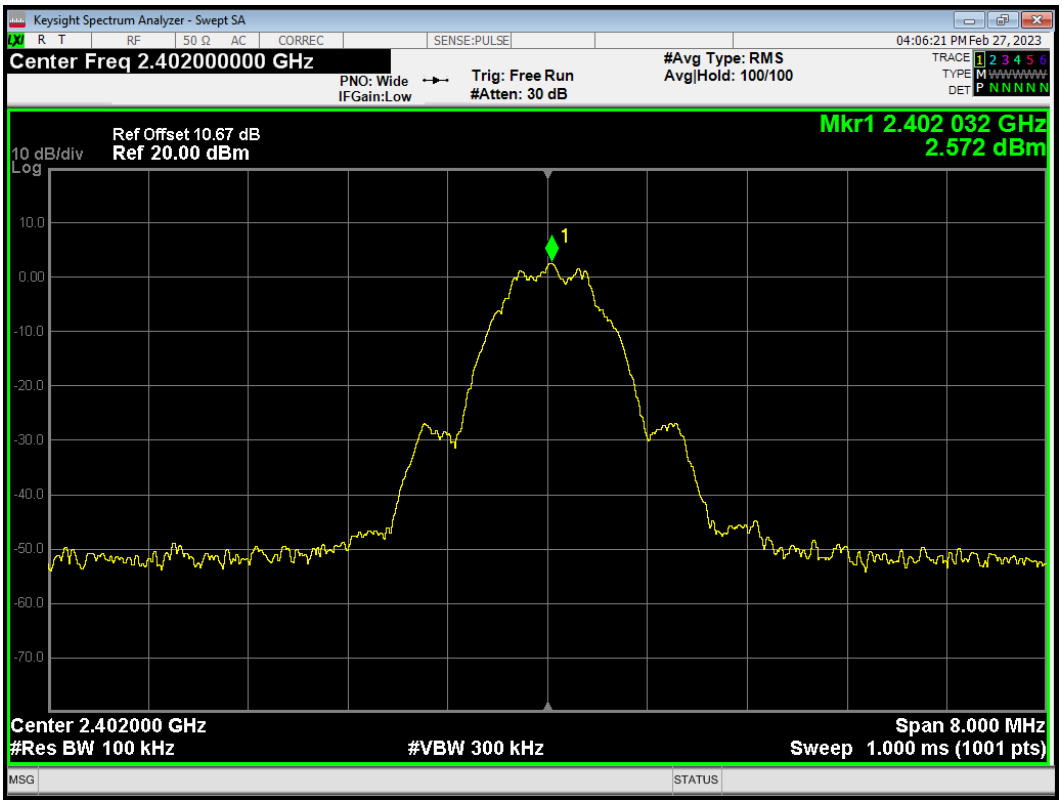
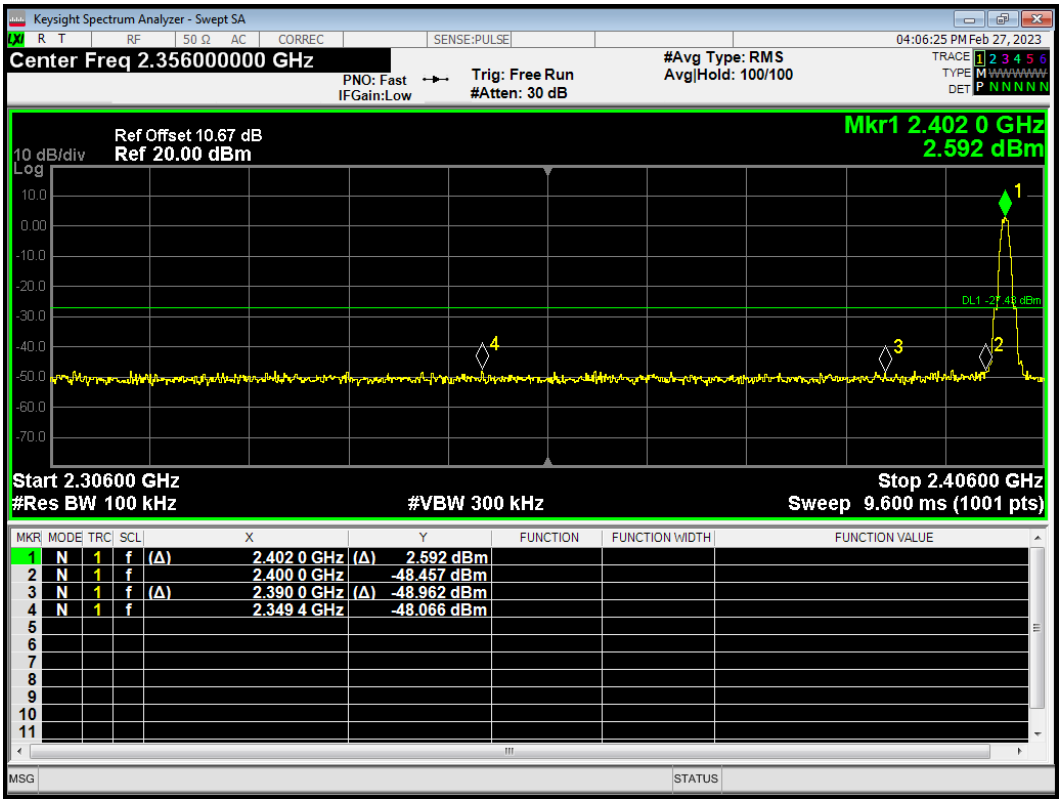
Band Edge Bluetooth LE 2402MHz Ref



Band Edge Bluetooth LE 2402MHz Emission



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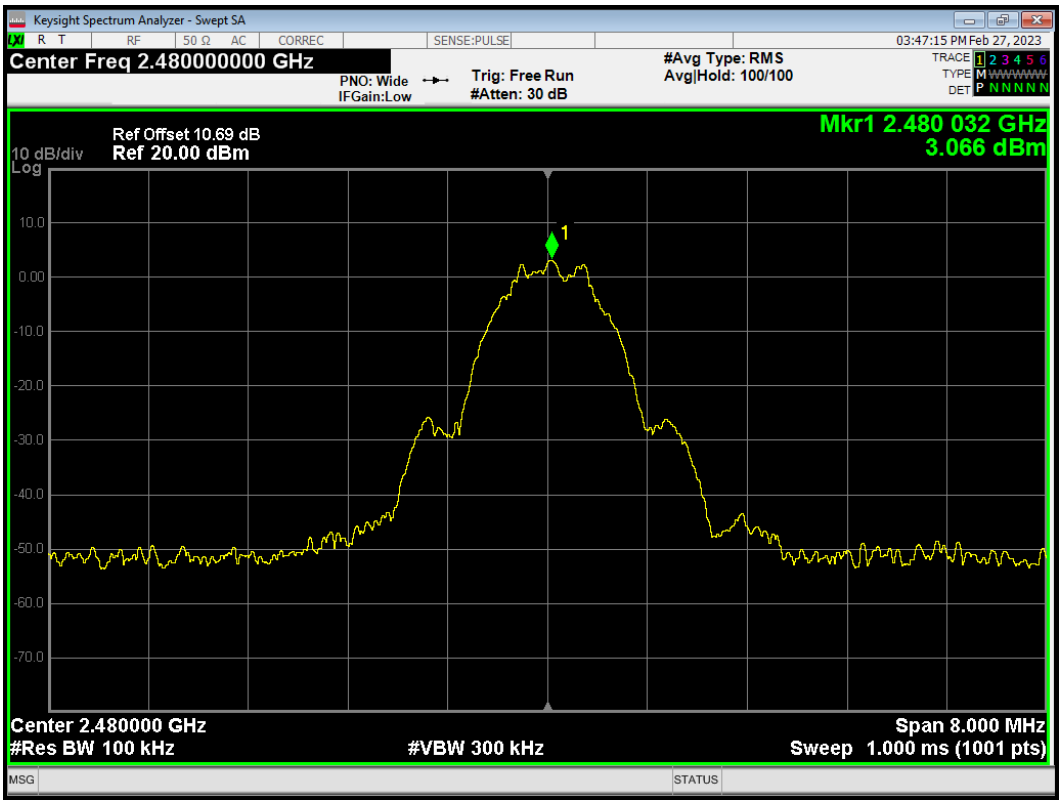
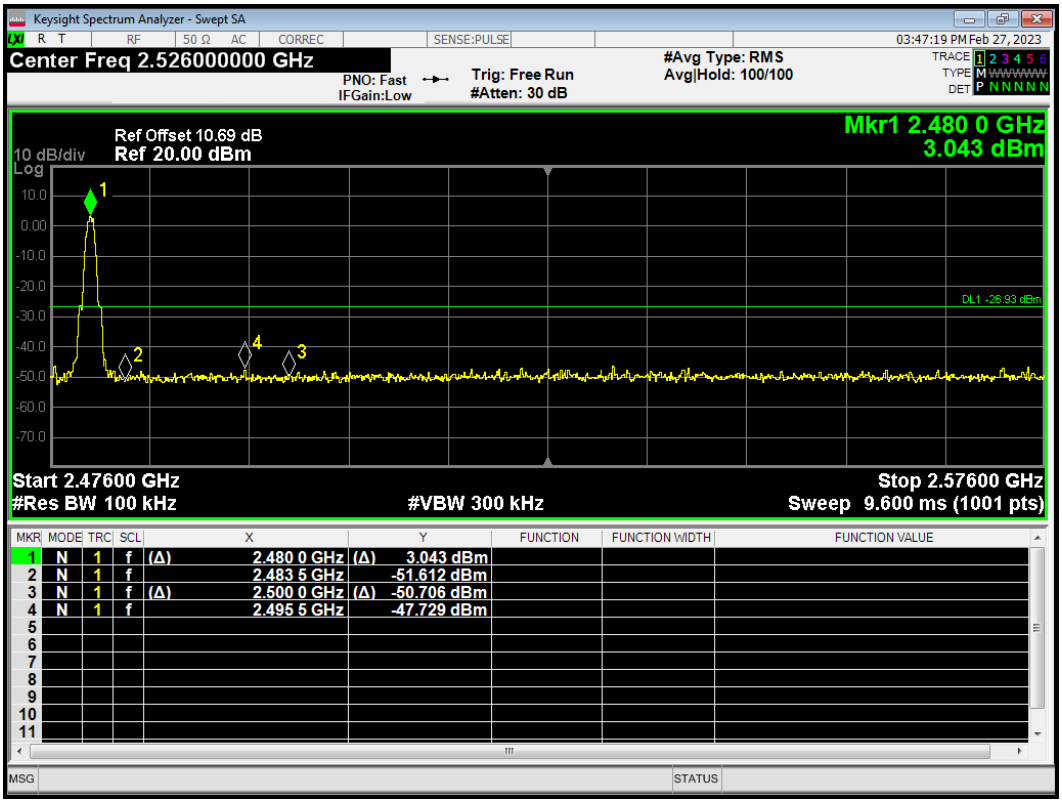
Band Edge Bluetooth LE 2480MHz Ref



Band Edge Bluetooth LE 2480MHz Emission



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5.4. Power Spectral Density

Ambient Condition

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

Method of Measurement

During the process of the testing, The EUT was connected to Spectrum Analyzer with a known loss. The EUT is max power transmission with proper modulation.

Method AVGPSD-2 was used for this test.

a) Measure the duty cycle (D)of the transmitter output signal as described in 11.6

b) Set instrument center frequency to DTS channel center frequency

c) Set span to at least 1.5 times the OBW

d) Set RBW to:3kHz≤RBW≤100Kh

e) Set VBW≥[3x RBW]

f) Detector= power averaging (rms) or sample detector (when rms not available)

g) Ensure that the number of measurement points in the sweep ≥ [2 X span/RBW]

h) Sweep time =auto couple

i) Do not use sweep triggering; allow sweep to "free run”

j) Employ trace averaging (rms) mode over a minimum of 100 traces

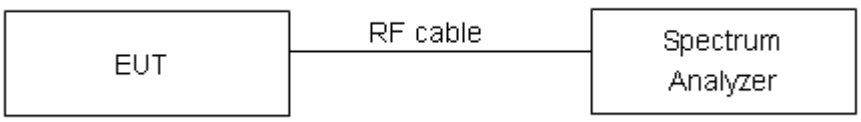
k) Use the peak marker function to determine the maximum amplitude level

l) Add [10 log(1/ D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time

m) If measured value exceeds requirement specified by regulatory agency then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced)

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

Test setup



Limits

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Rule Part 15.247(e) specifies that" For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. ''

Limits	≤ 8 dBm / 3kHz

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.

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Test Results:

Test Mode	Channel Number	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
Bluetooth LE	2402/CH0	-16.77	-14.92	8	PASS
	2440/CH19	-16.17	-14.32	8	PASS
	2480/CH39	-16.47	-14.62	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

SISO ANT1

Test Mode	Channel Number	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	2412/CH1	-4.90	-14.79	8	PASS
	2437/CH6	-4.92	-14.81	8	PASS
	2462/CH11	-5.53	-15.42	8	PASS
802.11g	2412/CH1	-11.35	-21.24	8	PASS
	2417/CH2	-7.82	-17.71	8	PASS
	2437/CH6	-7.67	-17.56	8	PASS
	2452/CH9	-7.06	-16.95	8	PASS
	2457/CH10	-8.90	-18.79	8	PASS
	2462/CH11	-12.11	-22.00	8	PASS
802.11n HT20	2412/CH1	-13.44	-23.34	8	PASS
	2417/CH2	-8.07	-17.97	8	PASS
	2437/CH6	-7.78	-17.68	8	PASS
	2452/CH9	-7.87	-17.77	8	PASS
	2457/CH10	-8.82	-18.72	8	PASS
	2462/CH11	-13.06	-22.96	8	PASS
802.11n HT40	2422/CH3	-21.90	-31.70	8	PASS
	2427/CH4	-19.88	-29.68	8	PASS
	2432/CH5	-18.30	-28.10	8	PASS
	2437/CH6	-11.56	-21.36	8	PASS
	2442/CH7	-18.52	-28.32	8	PASS
	2447/CH8	-19.32	-29.12	8	PASS
	2452/CH9	-20.33	-30.13	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*log10(3 / 30)					

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SISO ANT2

Test Mode	Channel Number	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	2412/CH1	-4.73	-14.62	8	PASS
	2437/CH6	-4.97	-14.86	8	PASS
	2462/CH11	-5.00	-14.89	8	PASS
802.11g	2412/CH1	-10.12	-20.01	8	PASS
	2417/CH2	-7.08	-16.97	8	PASS
	2437/CH6	-7.78	-17.67	8	PASS
	2452/CH9	-7.86	-17.75	8	PASS
	2457/CH10	-8.48	-18.37	8	PASS
	2462/CH11	-11.69	-21.58	8	PASS
802.11n HT20	2412/CH1	-12.24	-22.14	8	PASS
	2417/CH2	-7.41	-17.31	8	PASS
	2437/CH6	-8.19	-18.09	8	PASS
	2452/CH9	-7.98	-17.88	8	PASS
	2457/CH10	-9.04	-18.94	8	PASS
	2462/CH11	-12.82	-22.72	8	PASS
802.11n HT40	2422/CH3	-20.33	-30.13	8	PASS
	2427/CH4	-18.63	-28.43	8	PASS
	2432/CH5	-16.90	-26.70	8	PASS
	2437/CH6	-14.30	-24.10	8	PASS
	2442/CH7	-17.45	-27.25	8	PASS
	2447/CH8	-18.37	-28.17	8	PASS
	2452/CH9	-19.70	-29.50	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*log10(3 / 30)					

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CDD/MIMO

Test Mode	Channel Number	Power Spectral Density				Total PSD (dBm /3kHz)	Limit (dBm / 3kHz)	Conclusion
		Antenna 1		Antenna 2				
		Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)			
802.11b	2412/CH1	-5.45	-15.34	-5.02	-14.91	-12.11	6.64	PASS
	2437/CH6	-4.52	-14.41	-5.26	-15.15	-11.76	6.64	PASS
	2462/CH11	-5.75	-15.64	-5.21	-15.10	-12.35	6.64	PASS
802.11g	2412/CH1	-11.17	-21.06	-10.06	-19.95	-17.46	6.64	PASS
	2417/CH2	-7.72	-17.61	-6.76	-16.65	-14.10	6.64	PASS
	2437/CH6	-8.01	-17.90	-8.08	-17.97	-14.93	6.64	PASS
	2452/CH9	-7.68	-17.57	-7.96	-17.85	-14.70	6.64	PASS
	2457/CH10	-8.97	-18.86	-8.85	-18.74	-15.79	6.64	PASS
	2462/CH11	-11.89	-21.78	-11.73	-21.62	-18.69	6.64	PASS
802.11n HT20	2412/CH1	-12.98	-22.88	-12.53	-22.43	-19.64	6.64	PASS
	2417/CH2	-7.60	-17.50	-7.34	-17.24	-14.36	6.64	PASS
	2437/CH6	-8.32	-18.22	-8.32	-18.22	-15.21	6.64	PASS
	2452/CH9	-7.71	-17.61	-8.15	-18.05	-14.82	6.64	PASS
	2457/CH10	-8.95	-18.85	-9.06	-18.96	-15.90	6.64	PASS
	2462/CH11	-13.30	-23.20	-12.92	-22.82	-20.00	6.64	PASS
802.11n HT40	2422/CH3	-20.93	-30.73	-20.72	-30.52	-27.61	6.64	PASS
	2427/CH4	-19.55	-29.35	-18.53	-28.33	-25.80	6.64	PASS
	2432/CH5	-17.59	-27.39	-16.62	-26.42	-23.87	6.64	PASS
	2437/CH6	-13.93	-23.73	-13.89	-23.69	-20.70	6.64	PASS
	2442/CH7	-18.32	-28.12	-17.77	-27.57	-24.83	6.64	PASS
	2447/CH8	-17.91	-27.71	-18.92	-28.72	-25.17	6.64	PASS
	2452/CH9	-20.16	-29.96	-19.95	-29.75	-26.84	6.64	PASS

Note: 1.Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*LOG10(3 / 30)

2. For Total PSD, according to KDB 662911 D01 Multiple Transmitter Output v02r01 2)a),the power spectral density=$10\log(10^{(\text{PSD antenna1 in dBm/10})}+10^{(\text{PSD antenna2 in dBm/10})})$

3. The manufacturer declared the N_{ss}=1. According to KDB 662911 D01 Multiple Transmitter Output v02r01 F)2)f)(ii): If antenna gains are not equal, the user may use either of the following methods to calculate directional gain, provided that each transmit antenna is driven by only one spatial stream: Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain.

Directional gain = $G_{ANT\ MAX}$ + Array Gain. For PSD measurements on all devices, Array Gain=10log(Nant/Nss)dB, so directional gain=$G_{ANT\ MAX}$+Array Gain=4.35+10log(2/1)=7.36 >6dBi.

So the PSD limit is 8+6-MAX(6, directional gain) dBm=6.64 dBm

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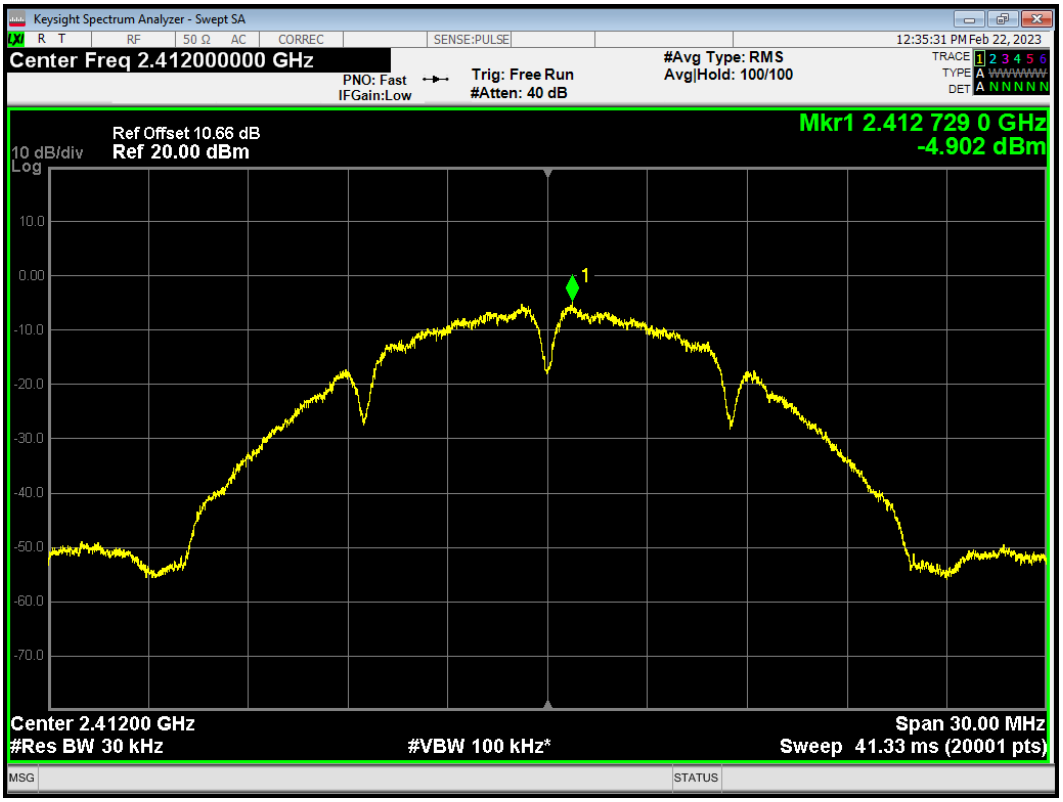
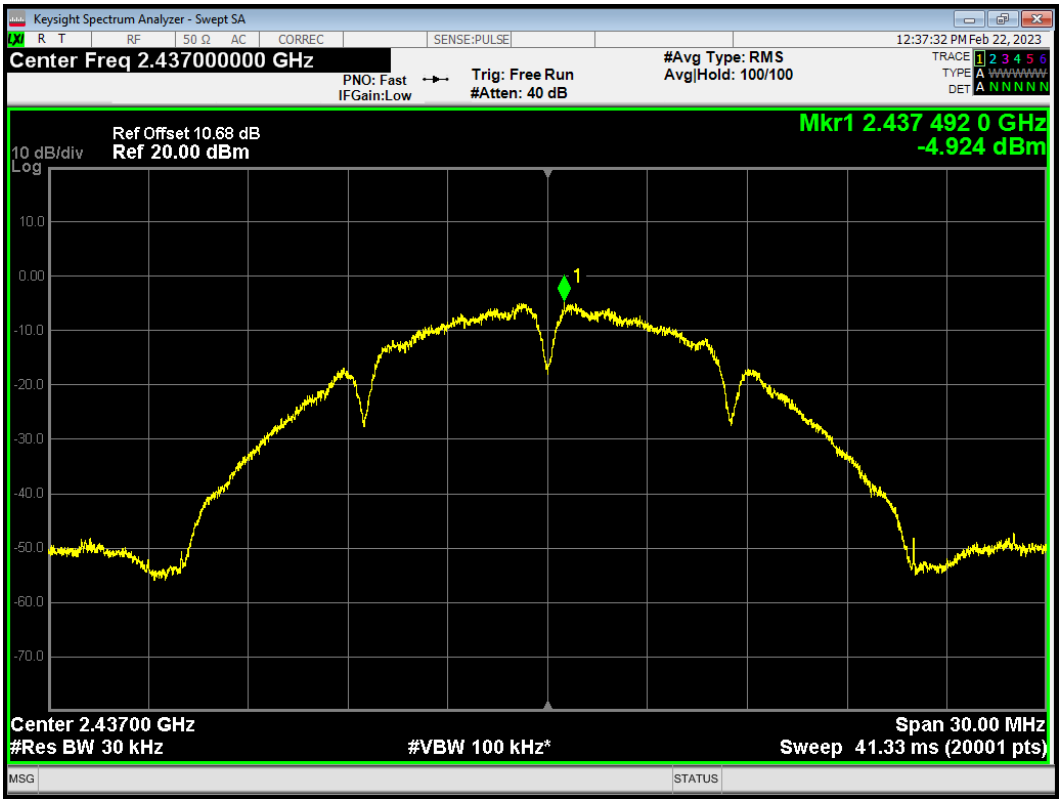
SISO ANT1

PSD 802.11b 2412MHz



PSD 802.11b 2437MHz



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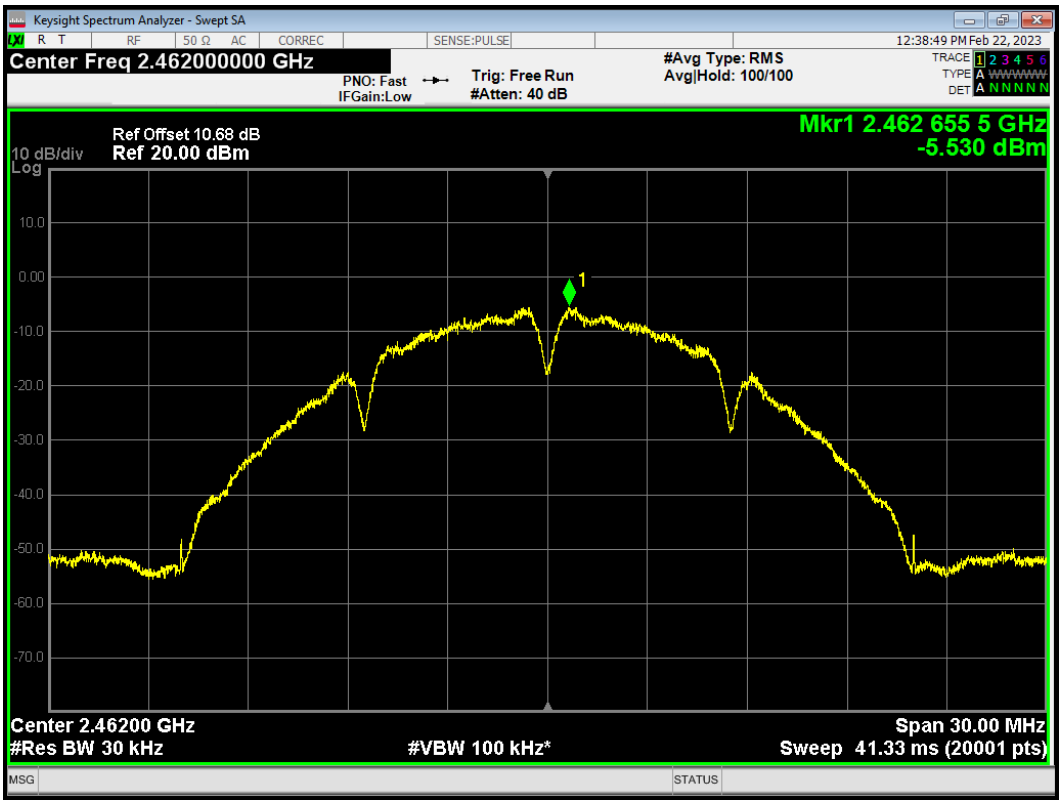
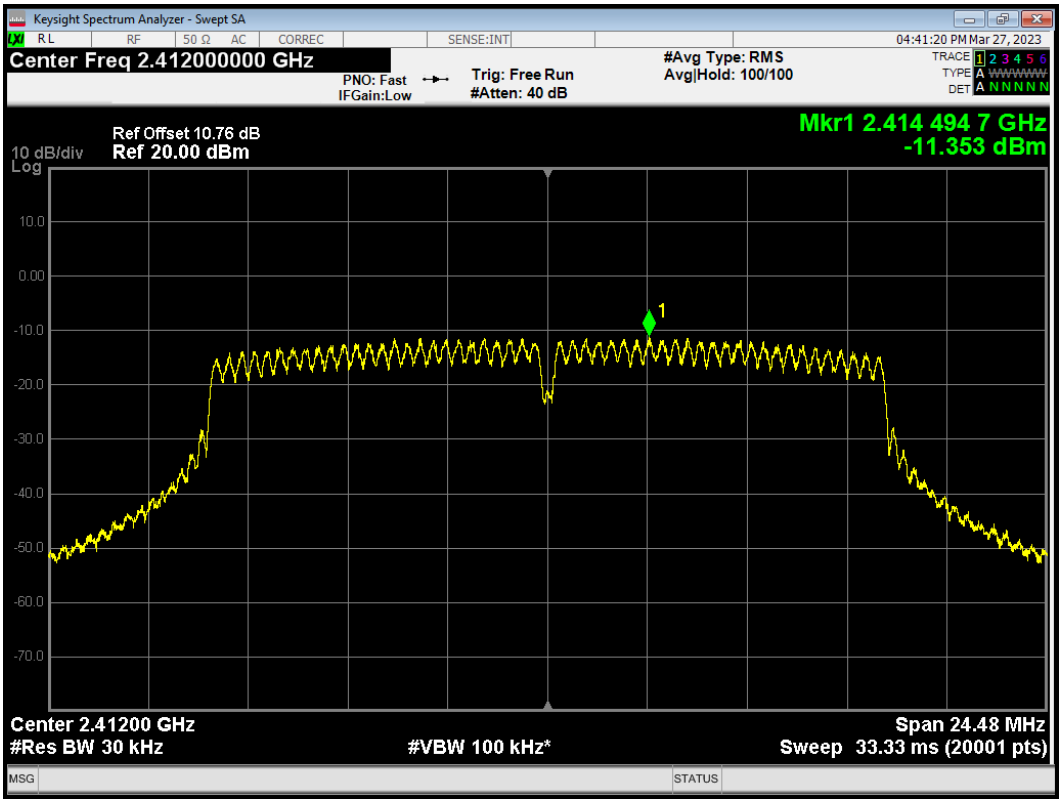
PSD 802.11b 2462MHz



PSD 802.11g 2412MHz



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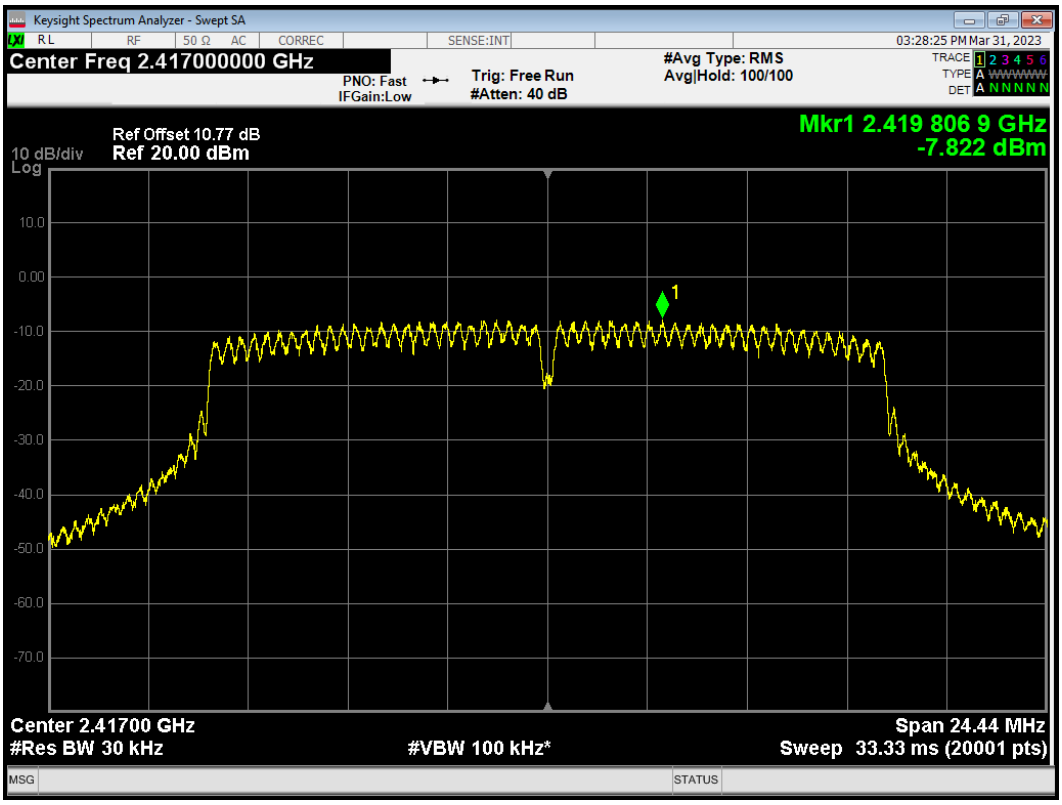
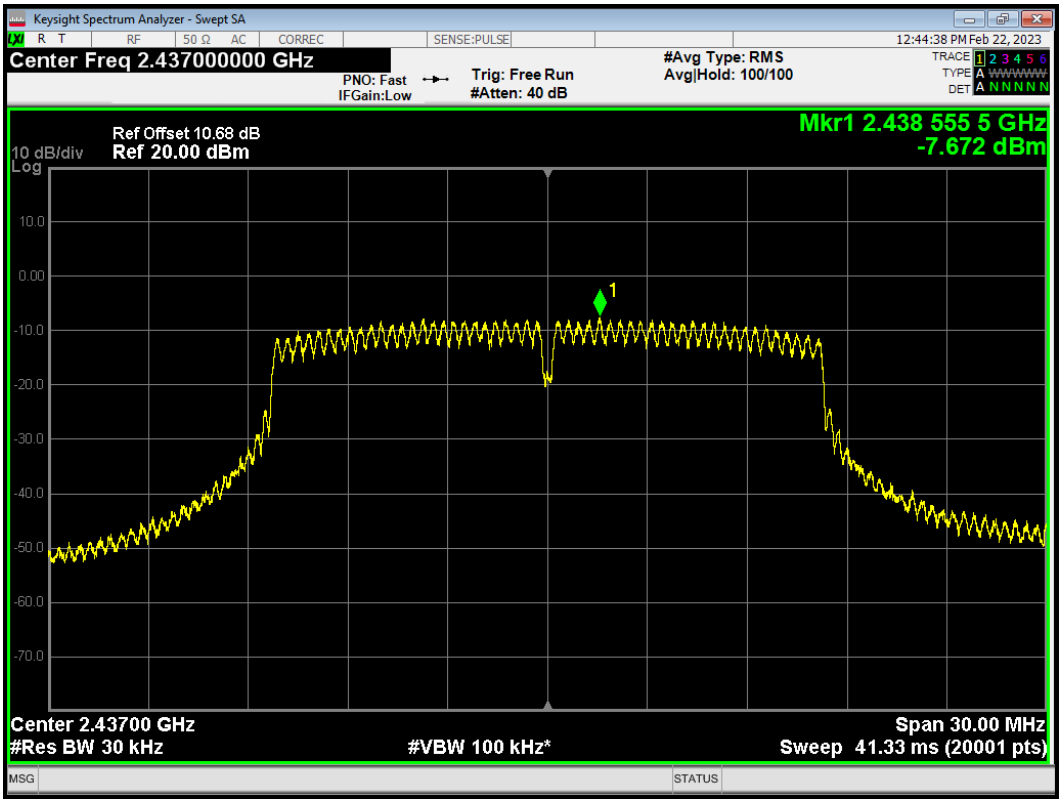
PSD 802.11g 2417MHz



PSD 802.11g 2437MHz



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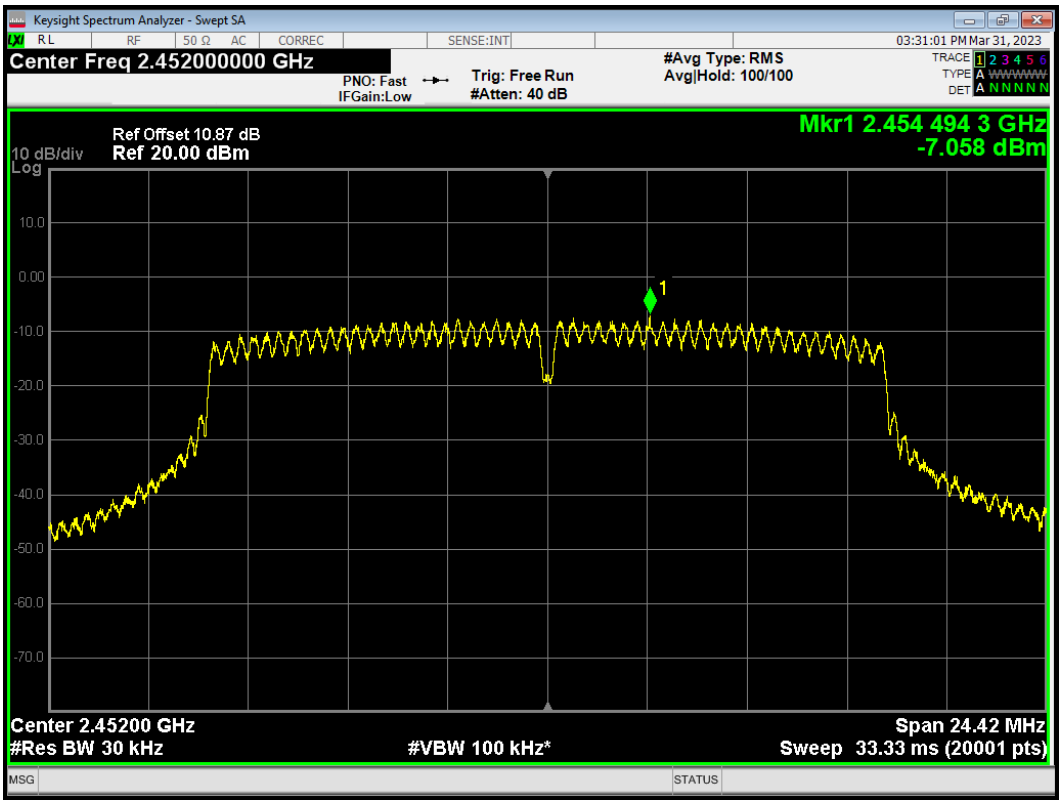
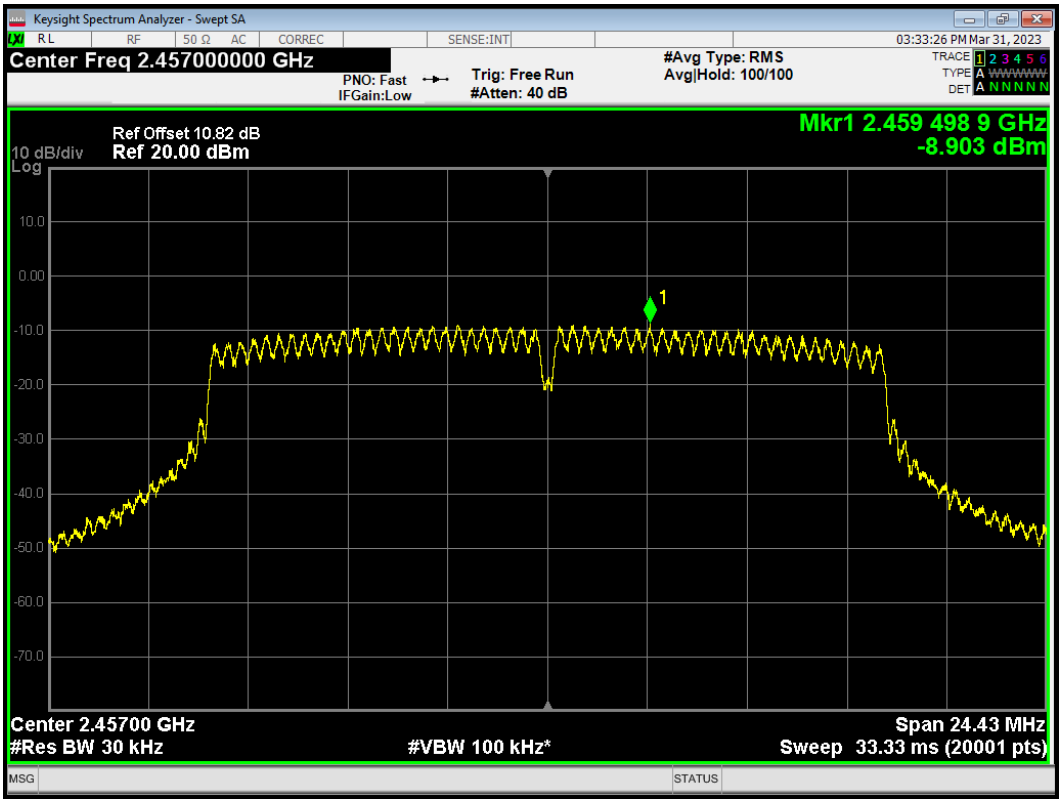
PSD 802.11g 2452MHz



PSD 802.11g 2457MHz



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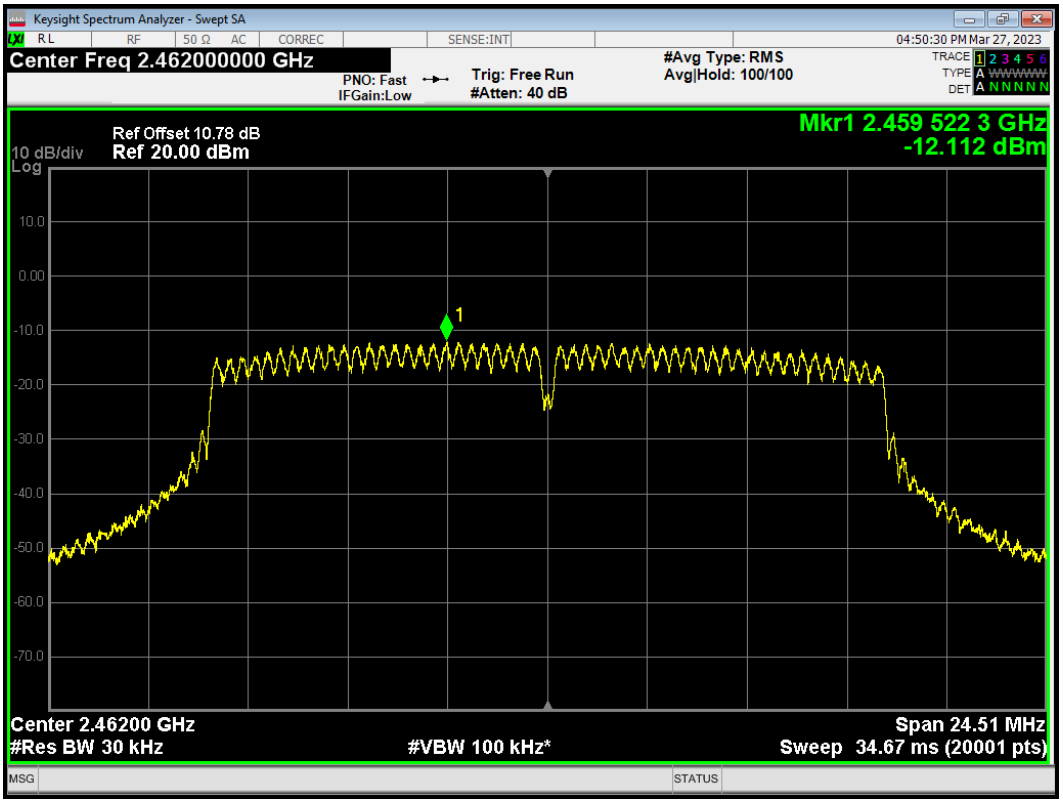
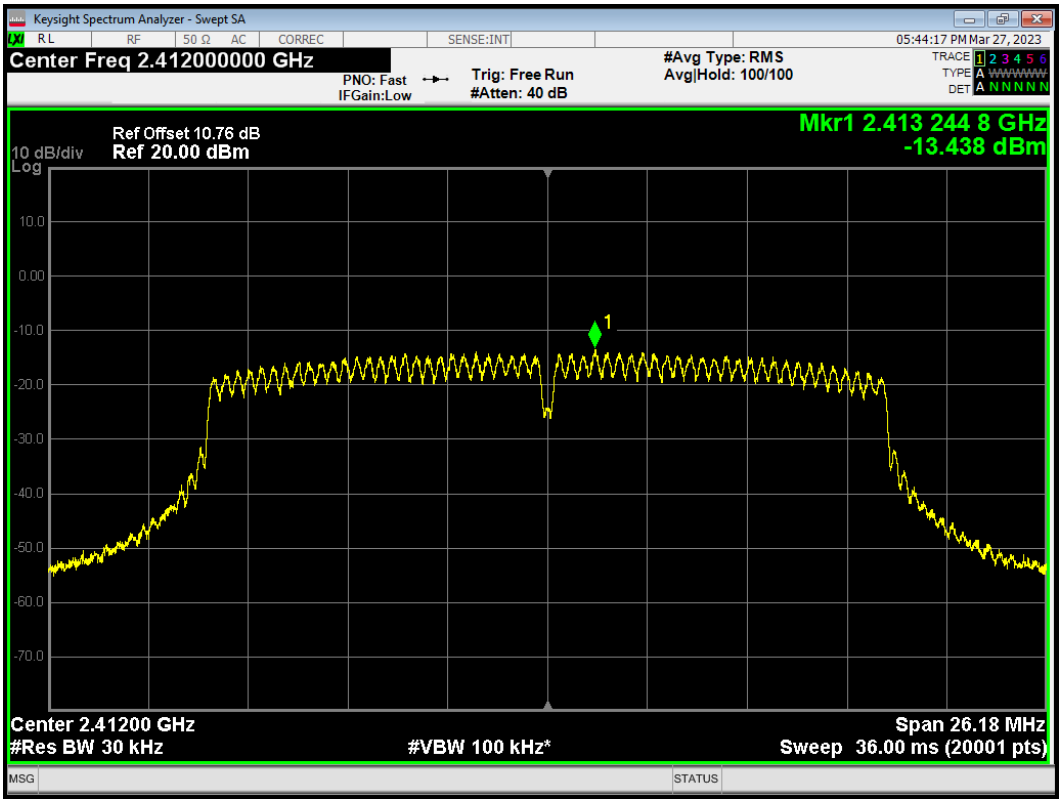
PSD 802.11g 2462MHz



PSD 802.11n(HT20) 2412MHz



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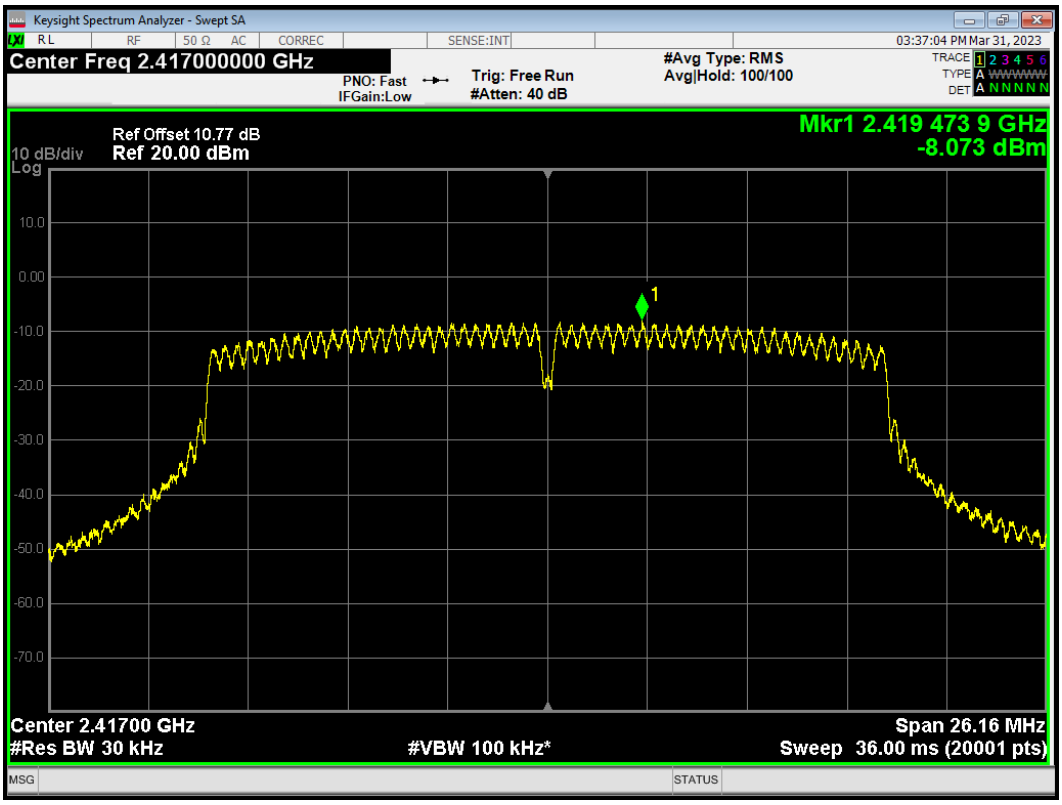
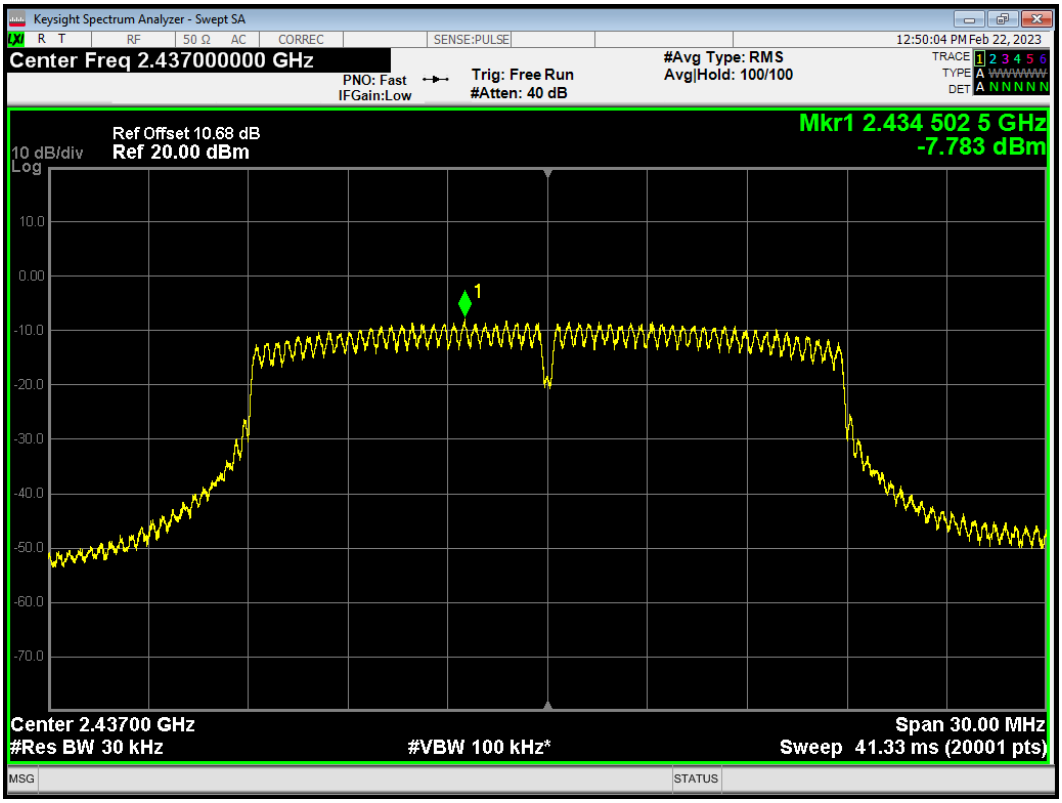
PSD 802.11n(HT20) 2417MHz



PSD 802.11n(HT20) 2437MHz



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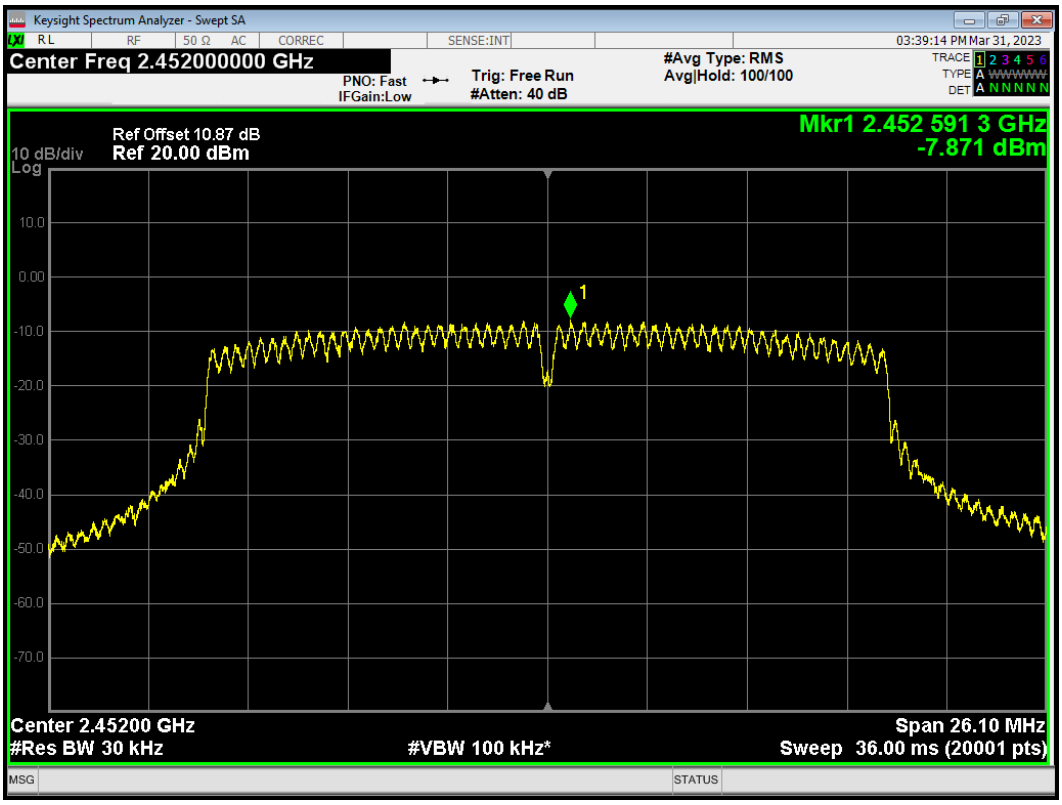
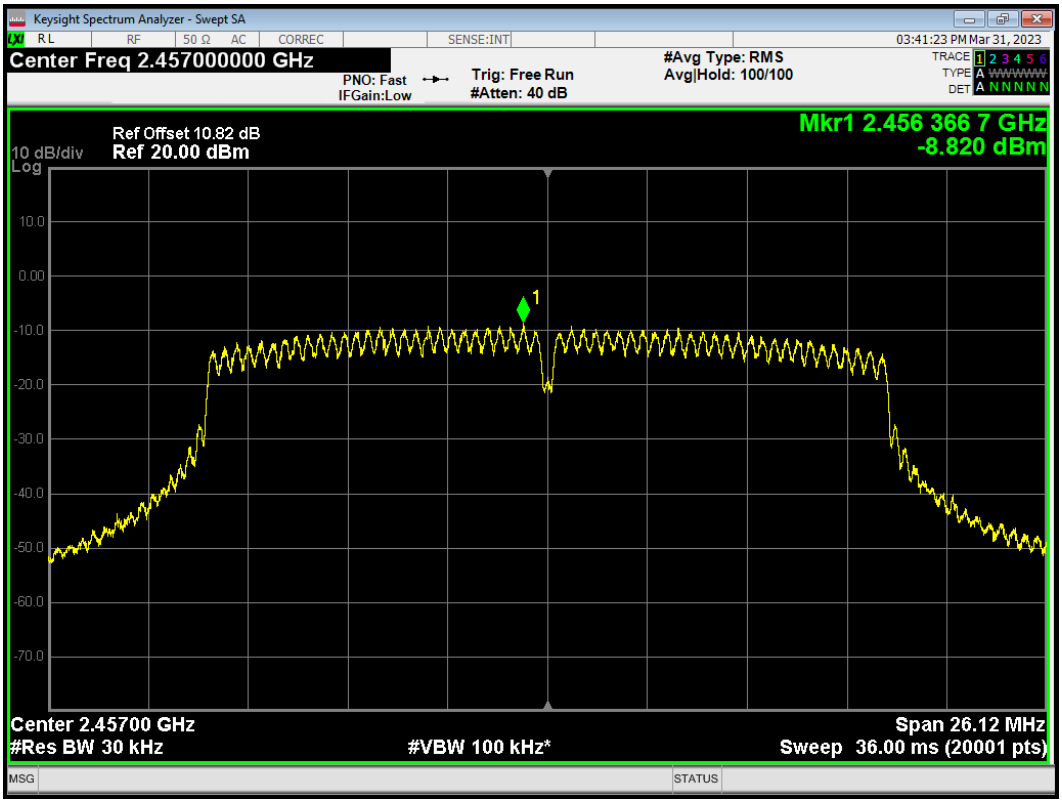
PSD 802.11n(HT20) 2452MHz



PSD 802.11n(HT20) 2457MHz



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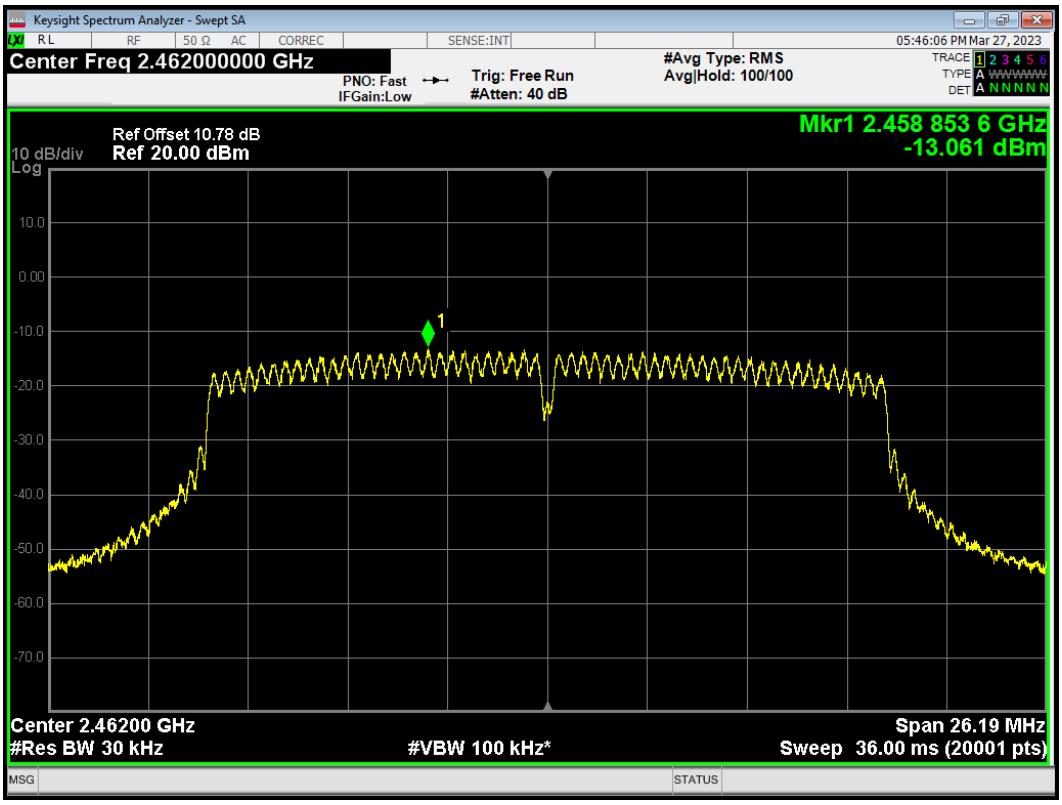
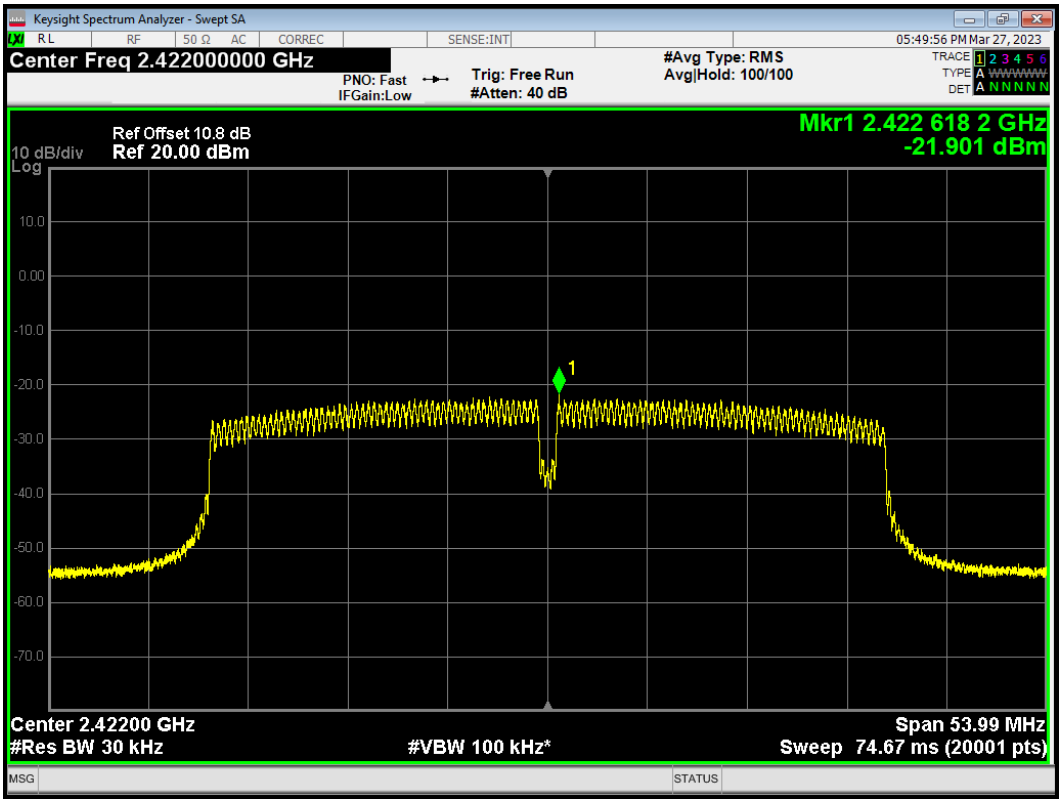
PSD 802.11n(HT20) 2462MHz



PSD 802.11n(HT40) 2422MHz



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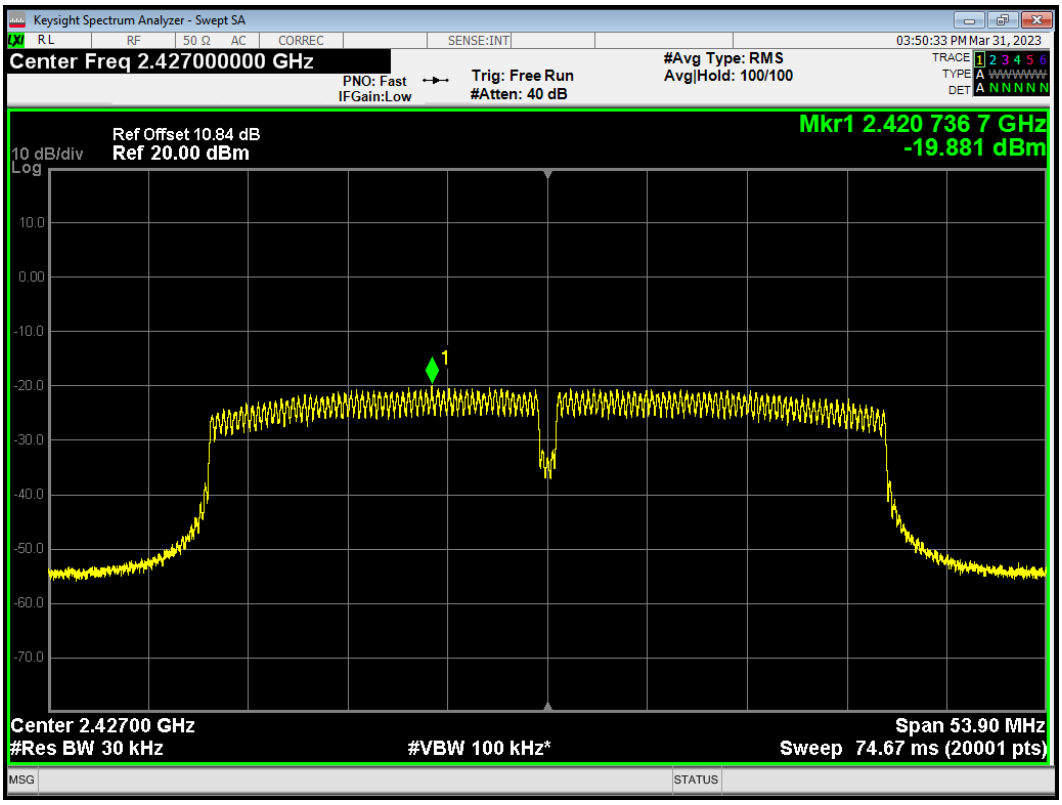
PSD 802.11n(HT40) 2427MHz



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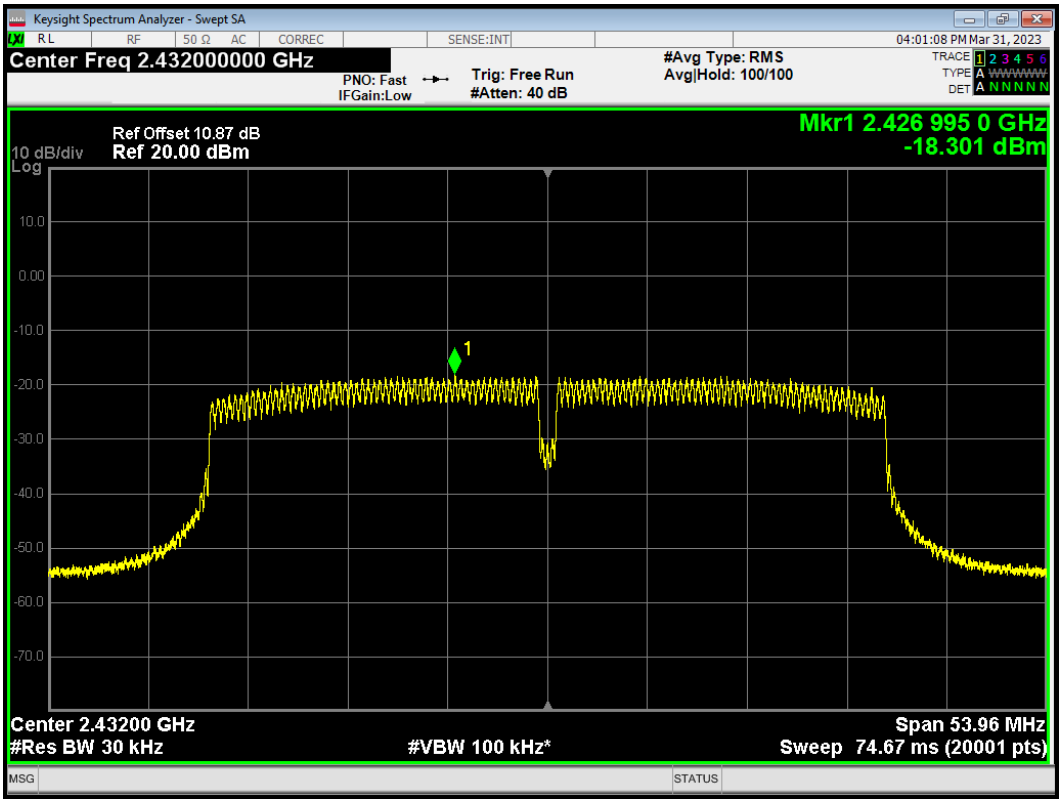

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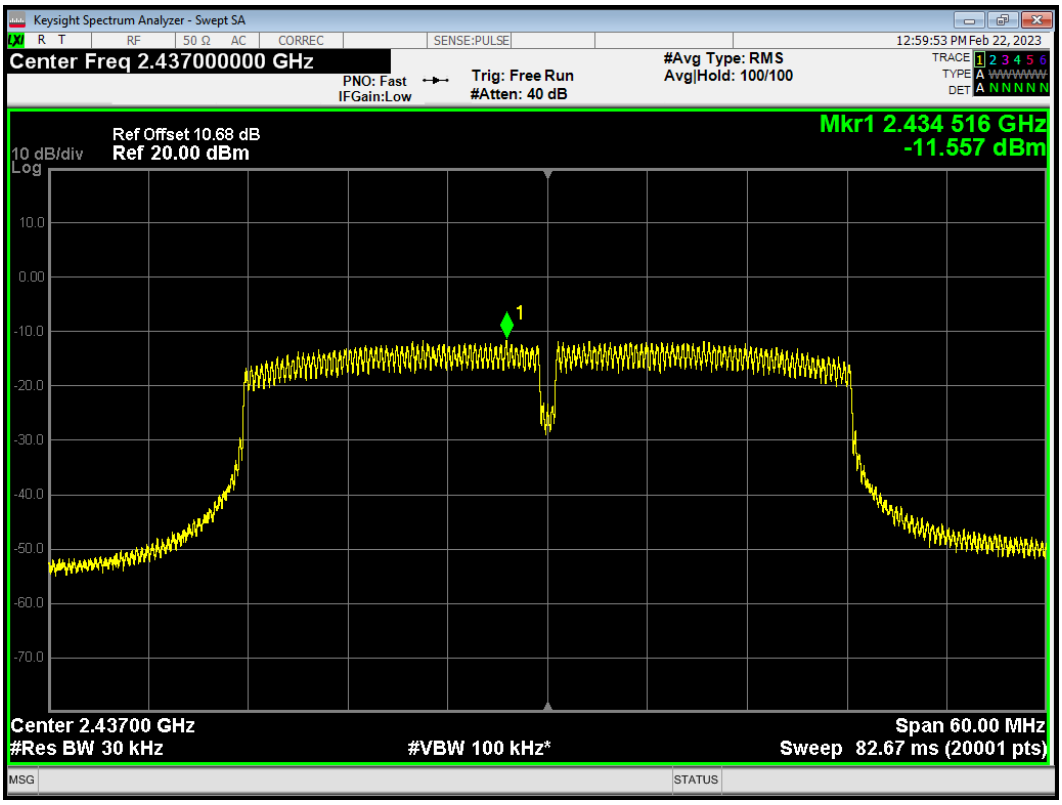
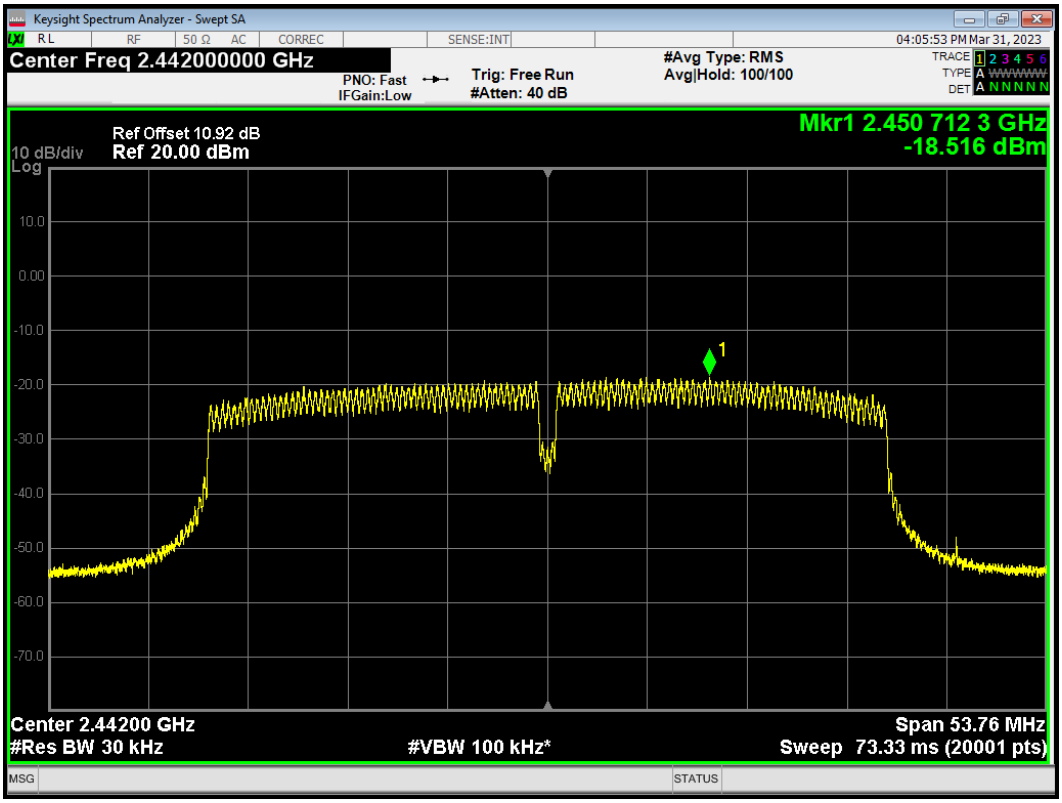
PSD 802.11n(HT40) 2437MHz



PSD 802.11n(HT40) 2442MHz



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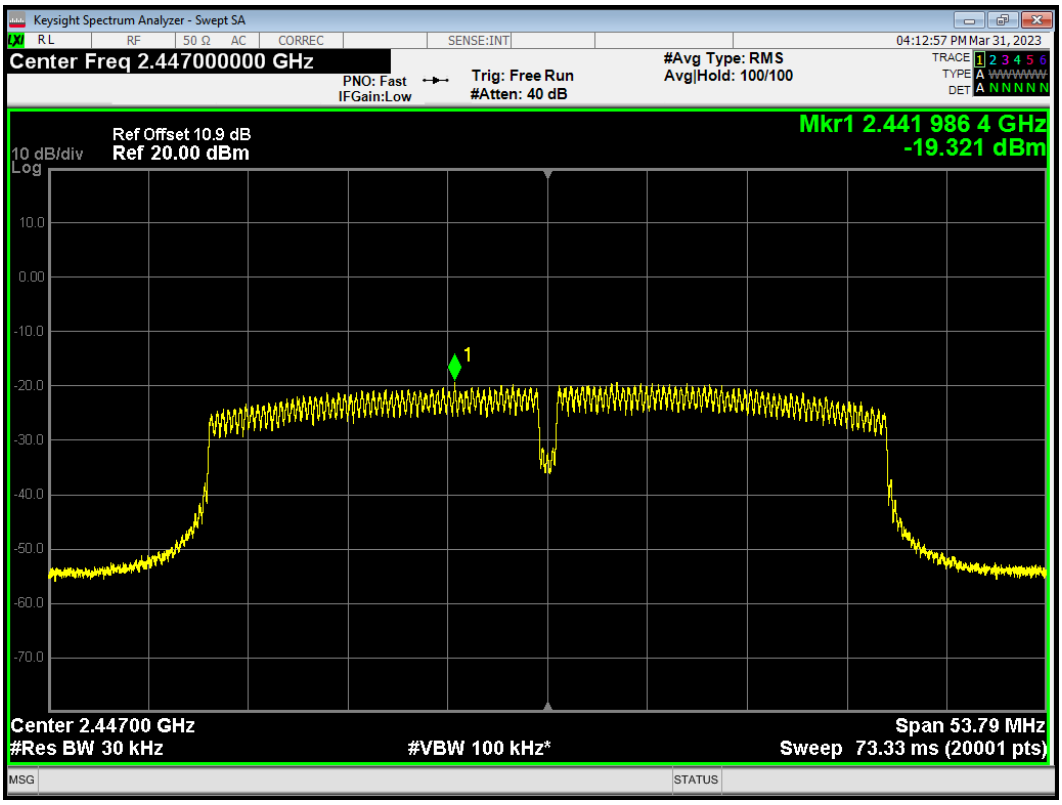
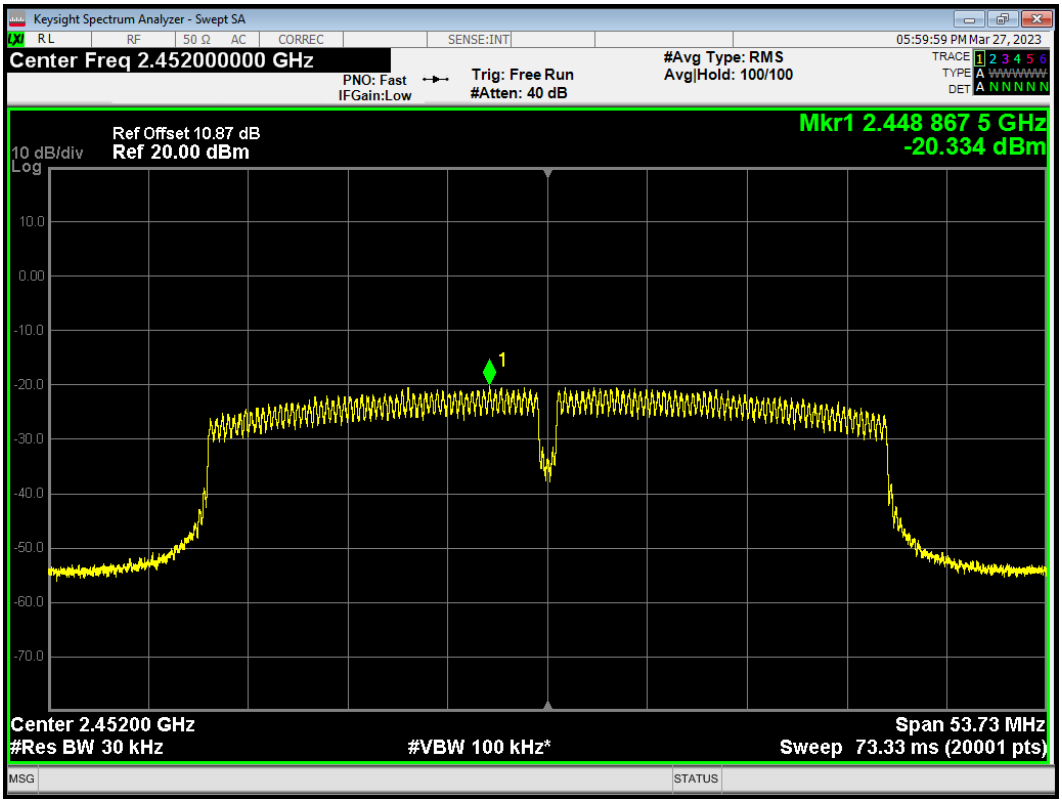
PSD 802.11n(HT40) 2447MHz



PSD 802.11n(HT40) 2452MHz



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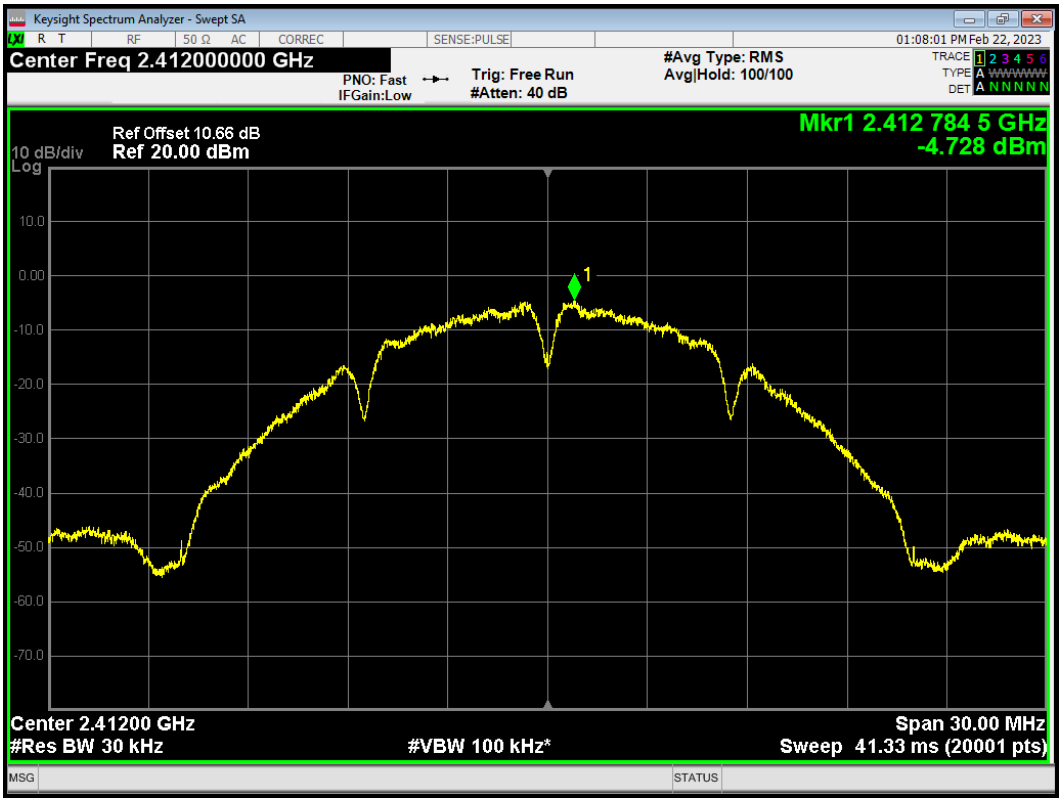
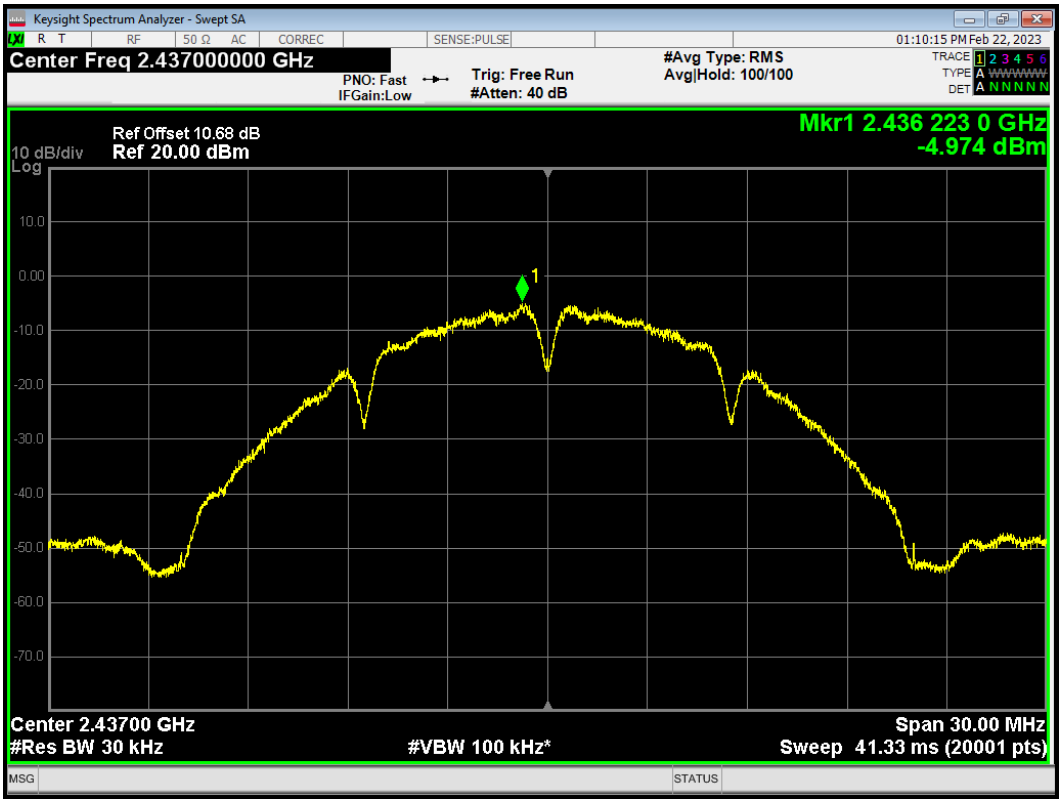
SISO ANT2

PSD 802.11b 2412MHz



PSD 802.11b 2437MHz



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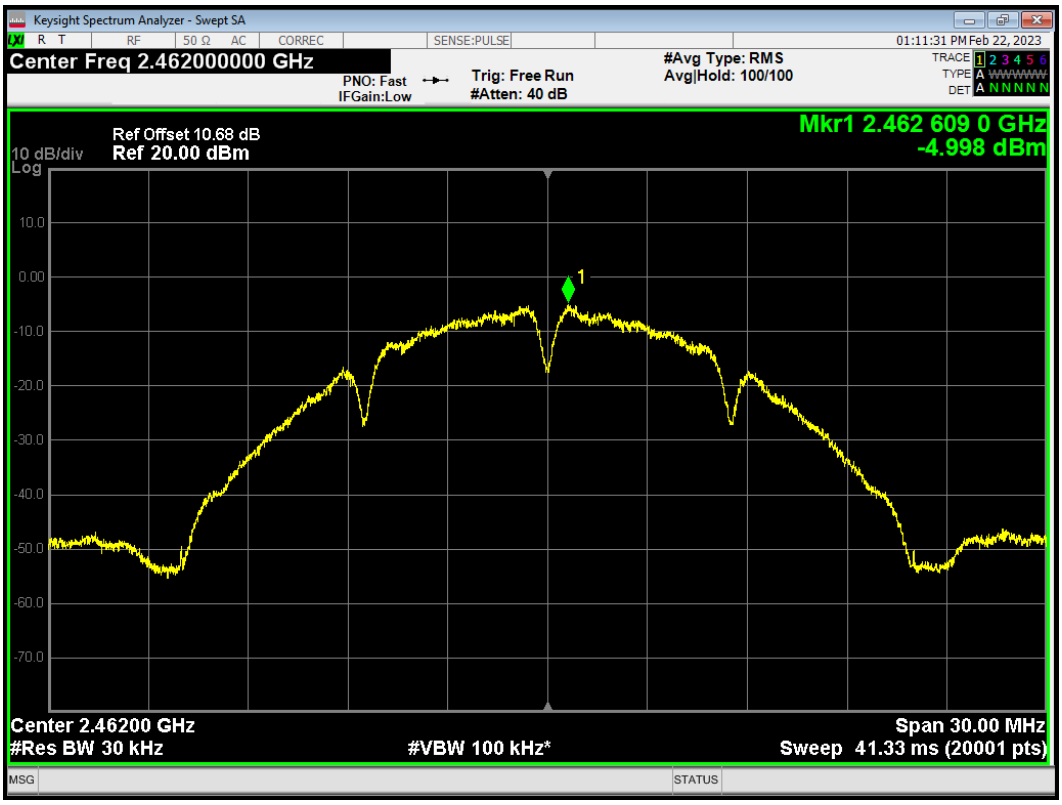
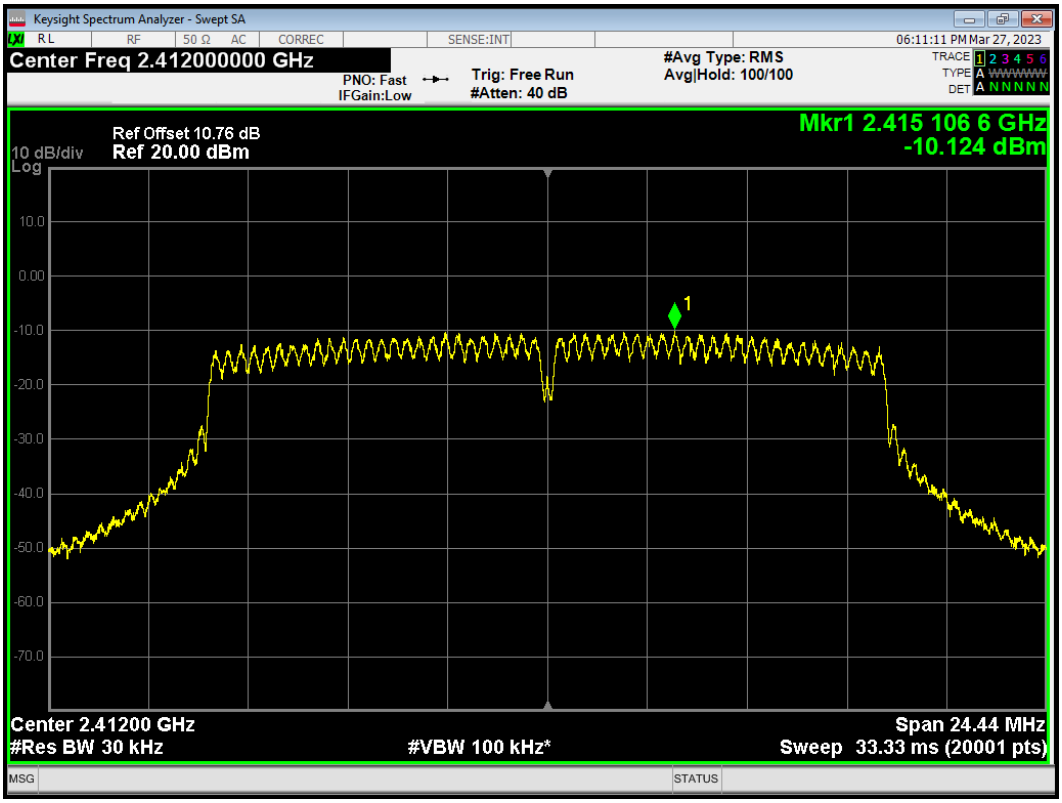
PSD 802.11b 2462MHz



PSD 802.11g 2412MHz



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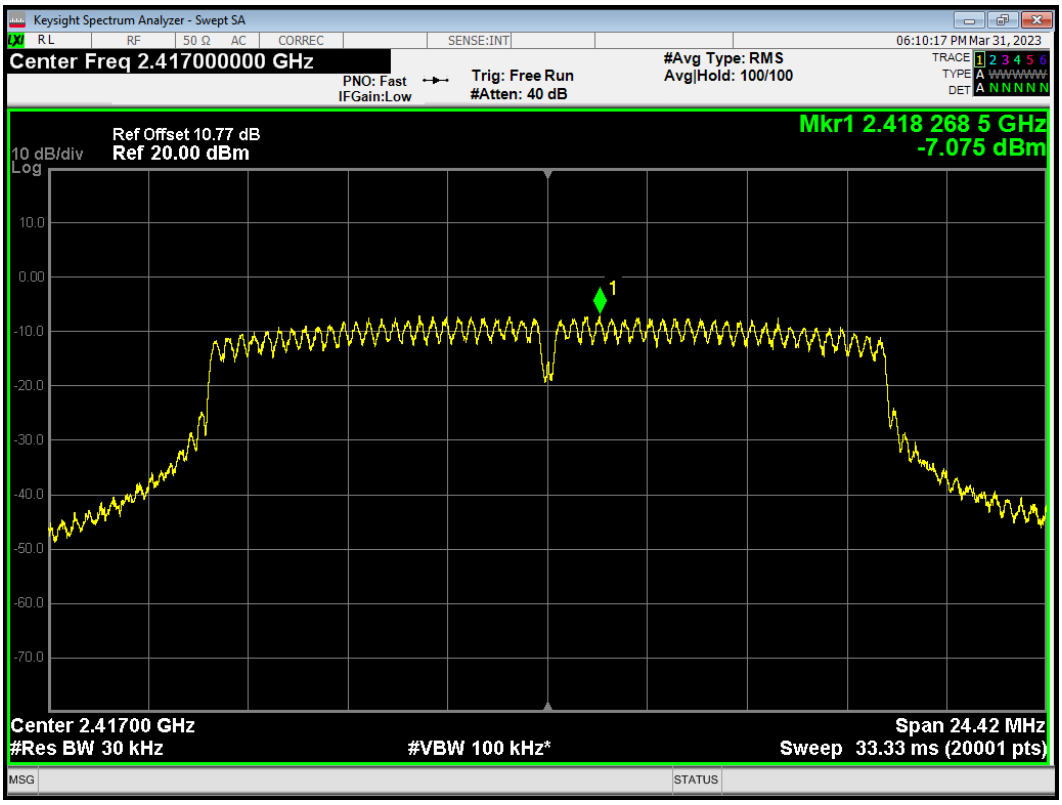
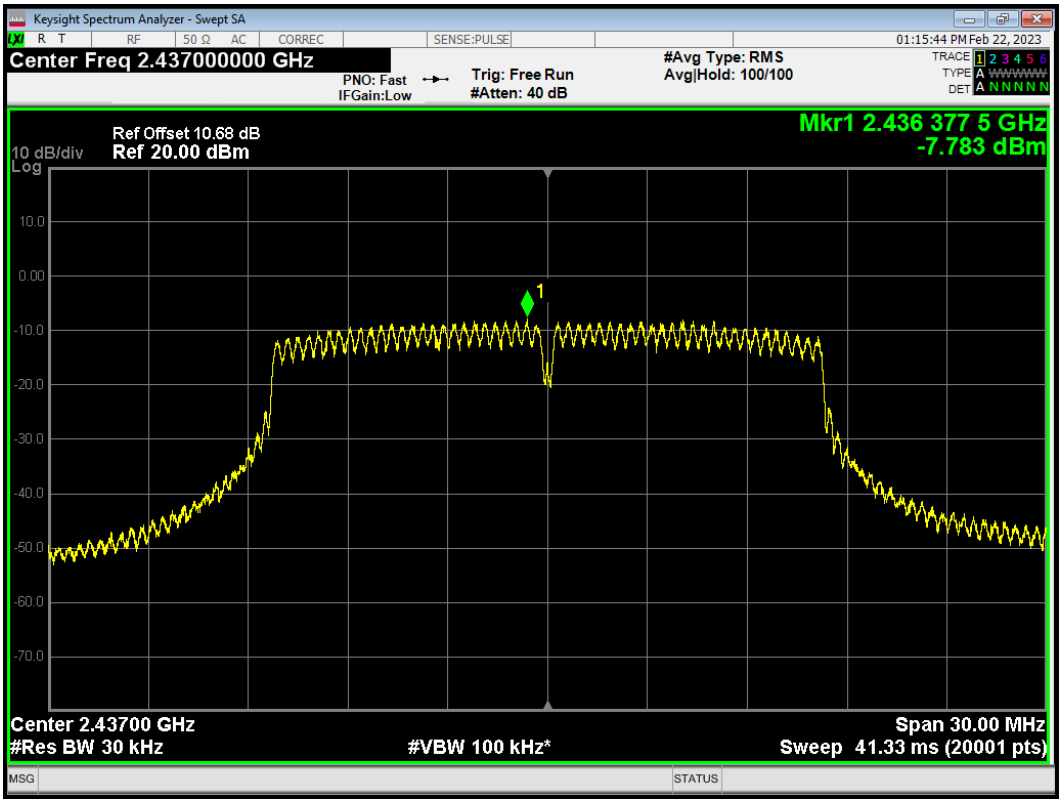
PSD 802.11g 2417MHz



PSD 802.11g 2437MHz



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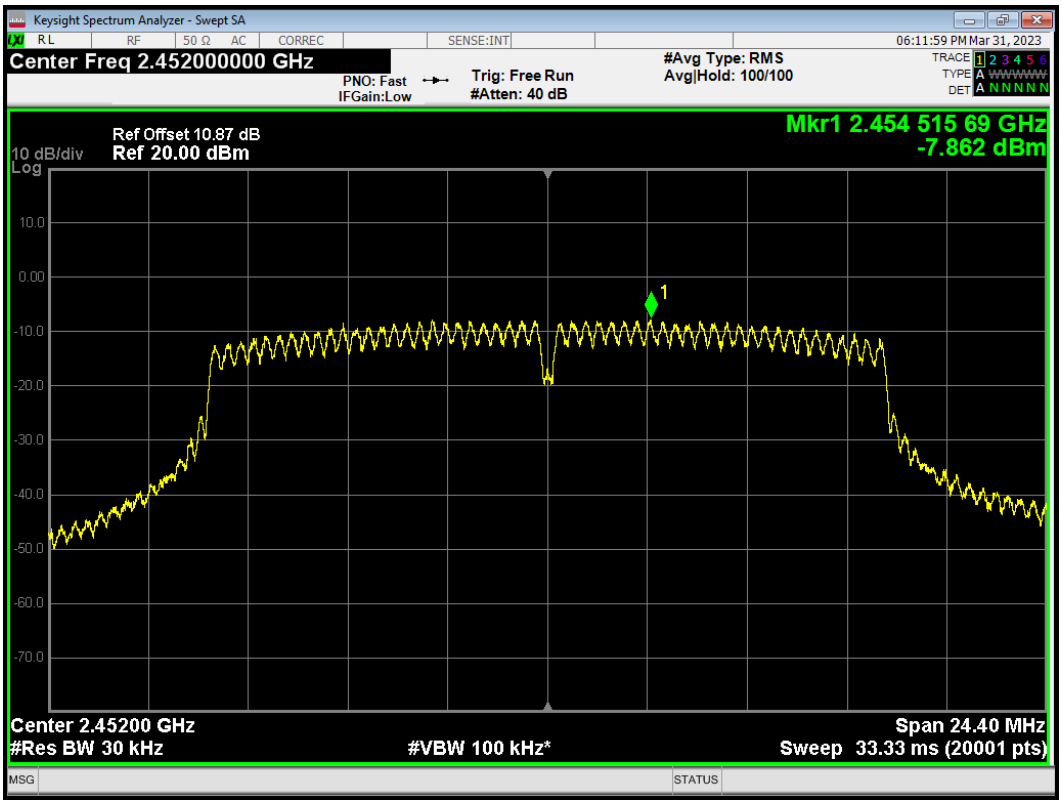
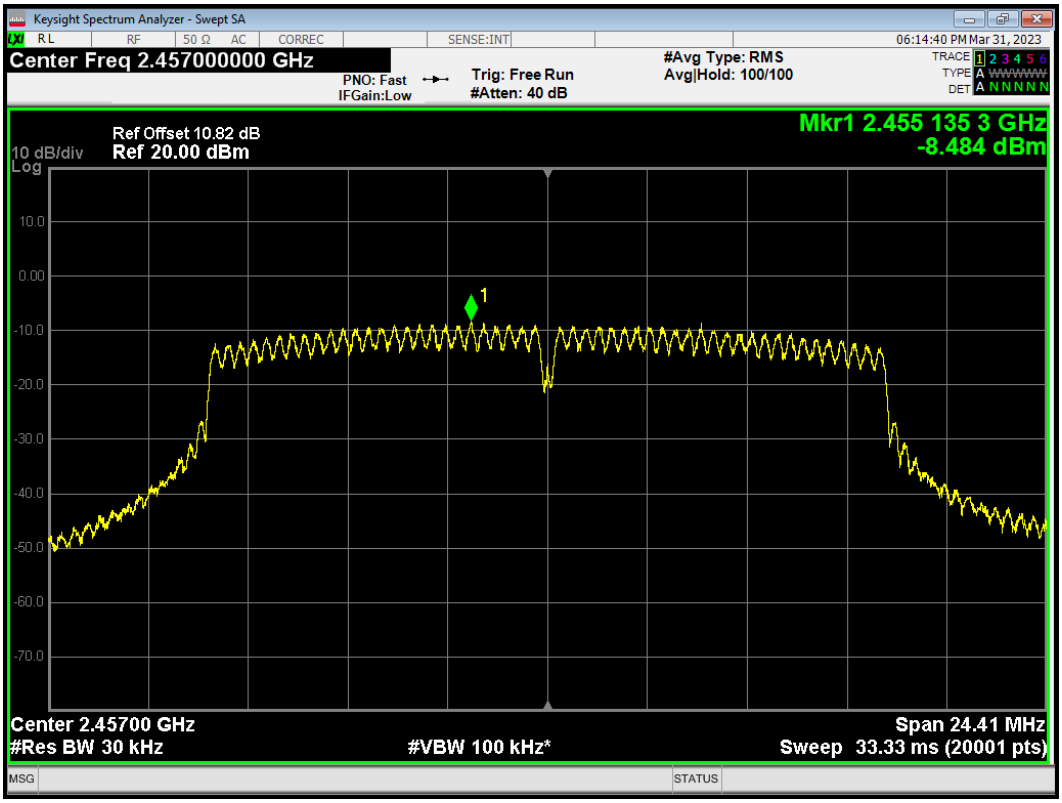
PSD 802.11g 2452MHz



PSD 802.11g 2457MHz



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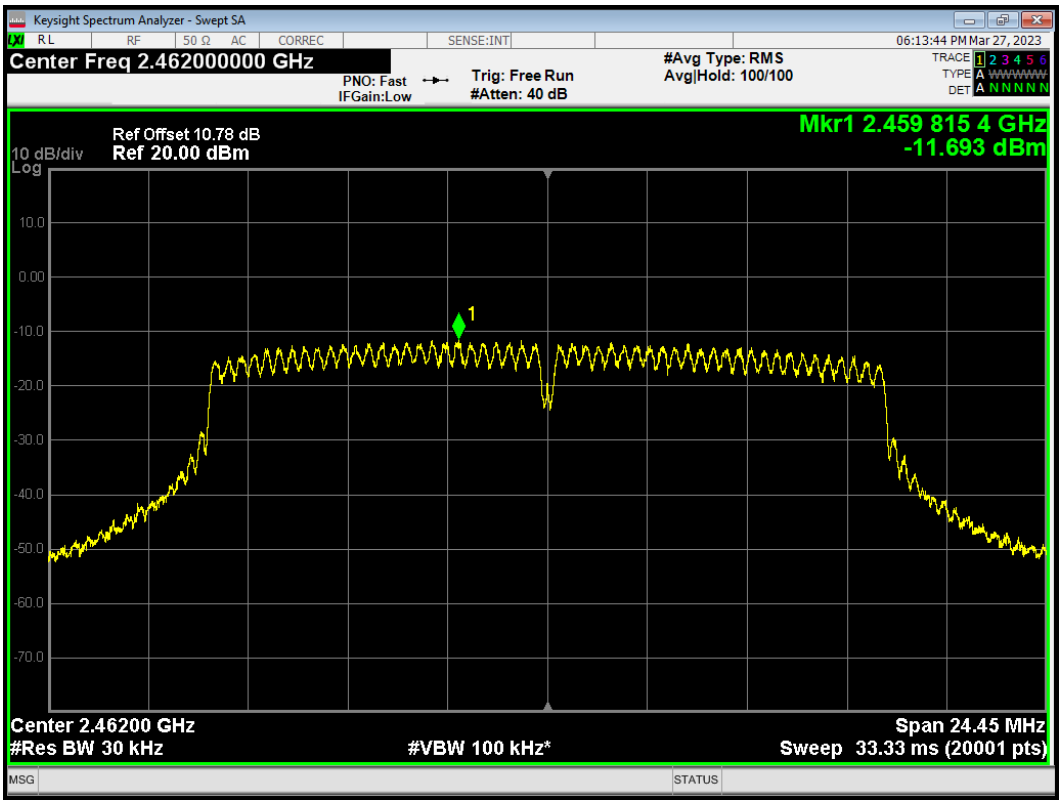
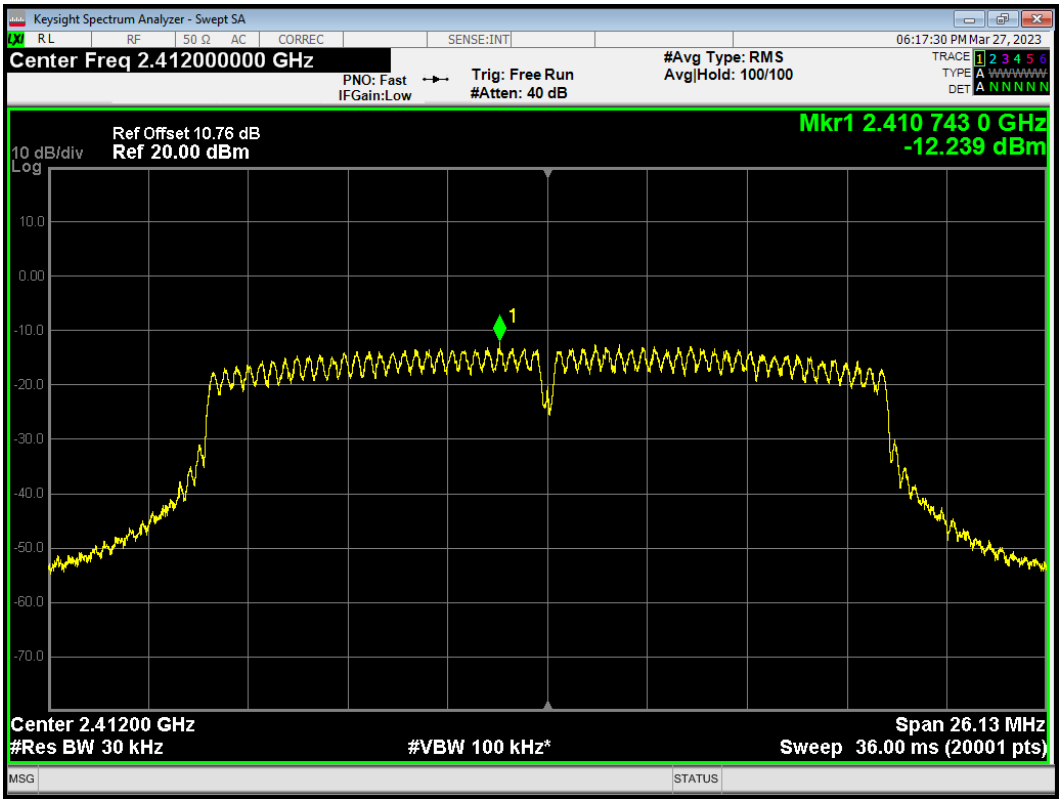
PSD 802.11g 2462MHz



PSD 802.11n(HT20) 2412MHz



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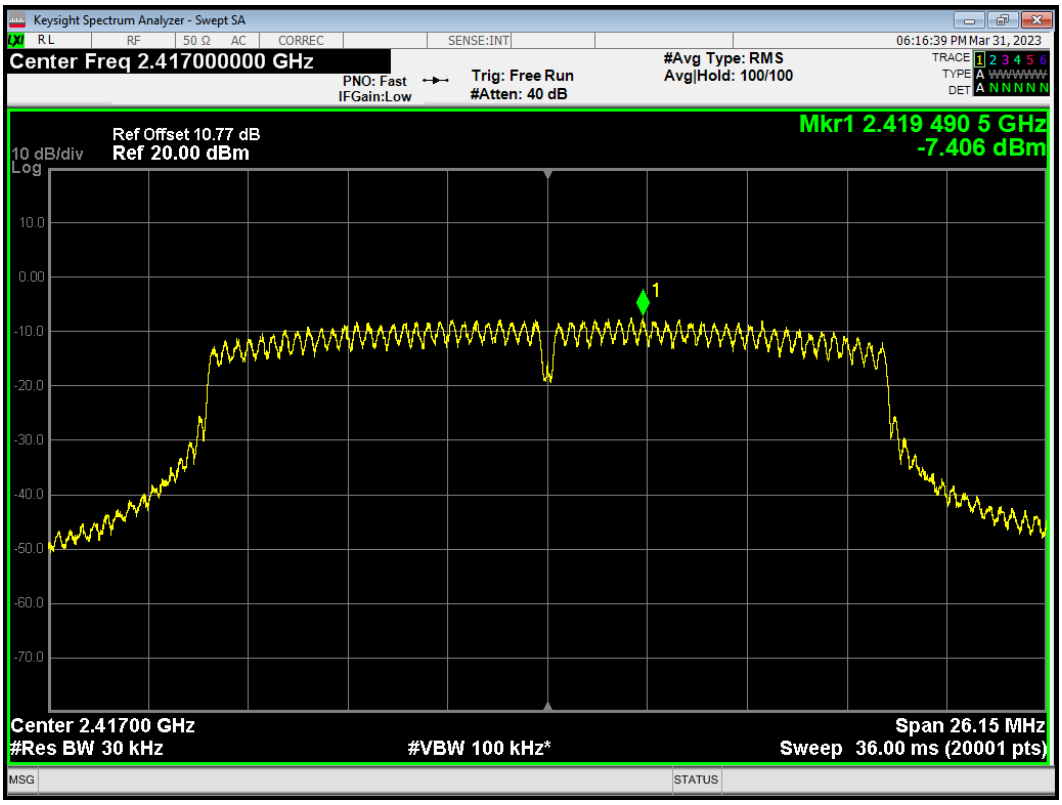
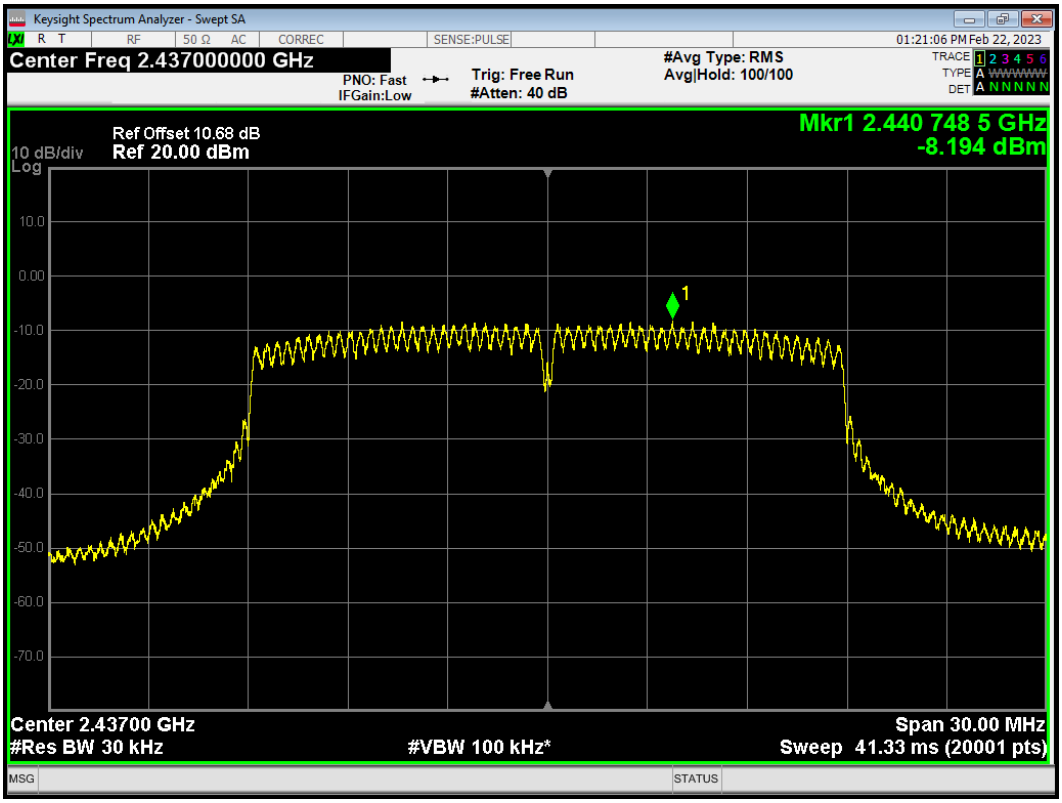
PSD 802.11n(HT20) 2417MHz



PSD 802.11n(HT20) 2437MHz



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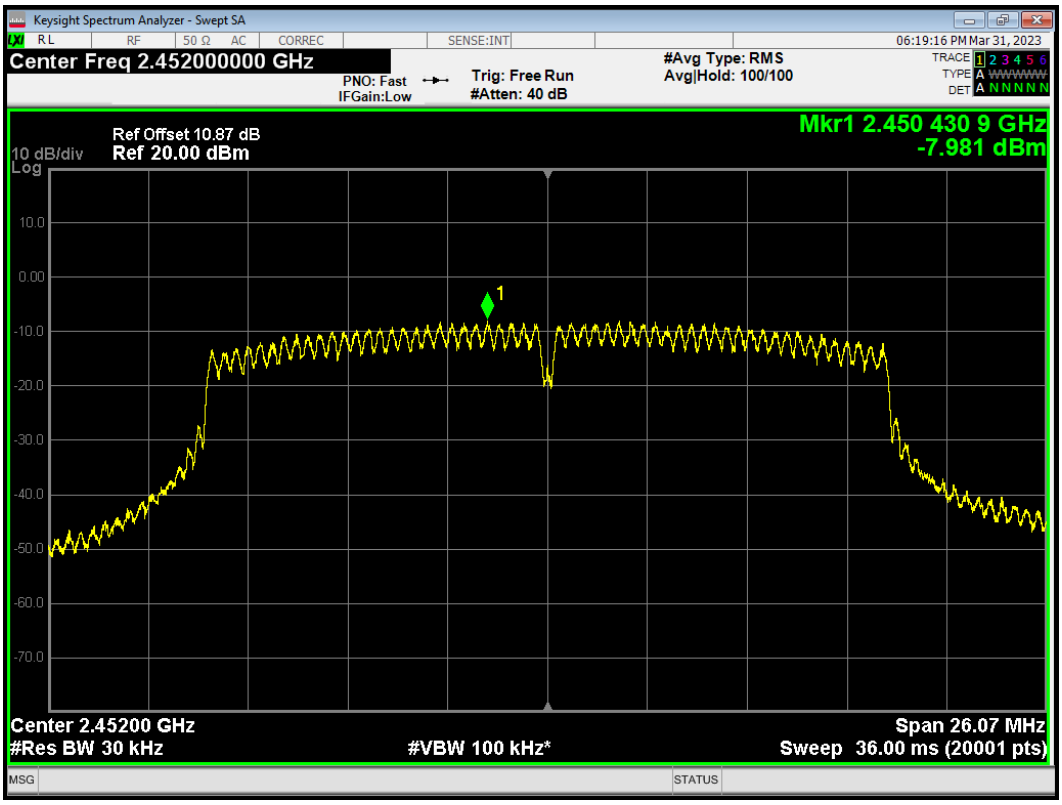
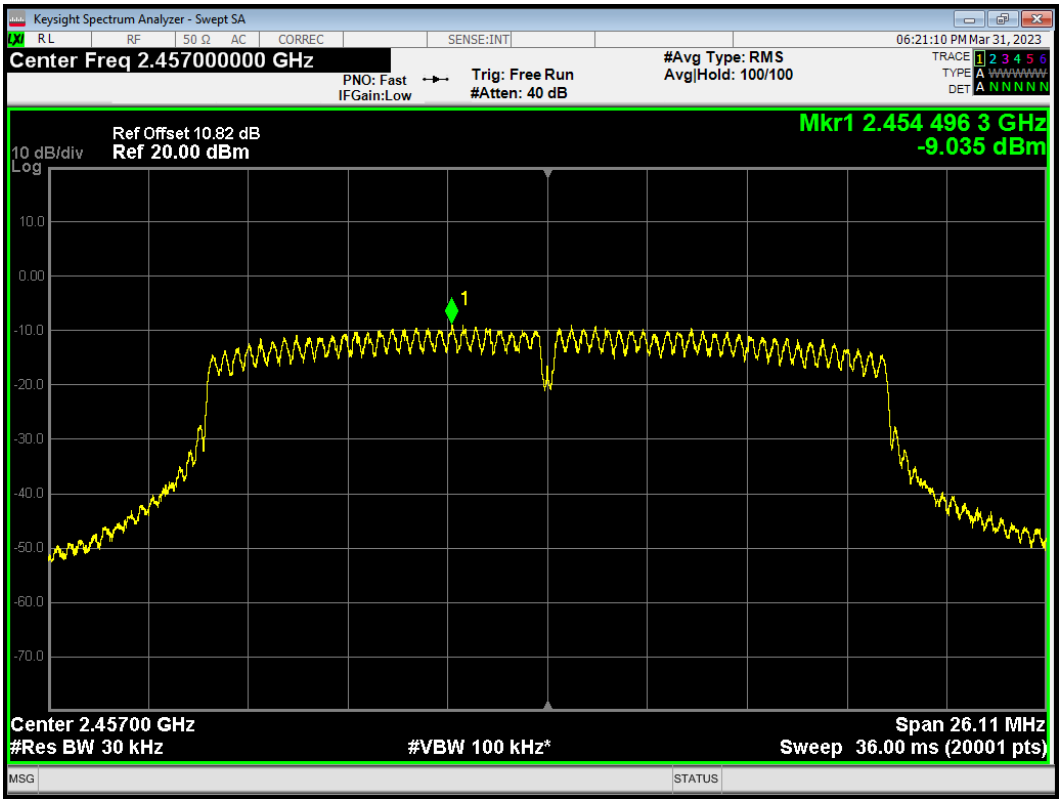
PSD 802.11n(HT20) 2452MHz



PSD 802.11n(HT20) 2457MHz



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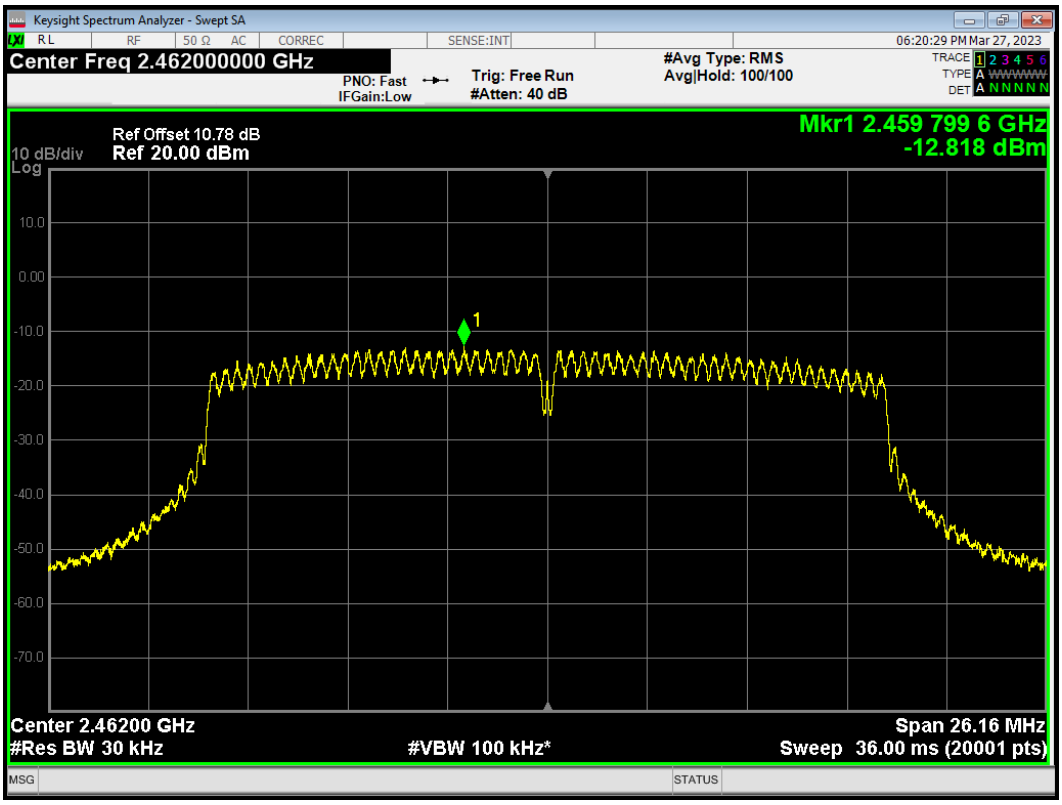
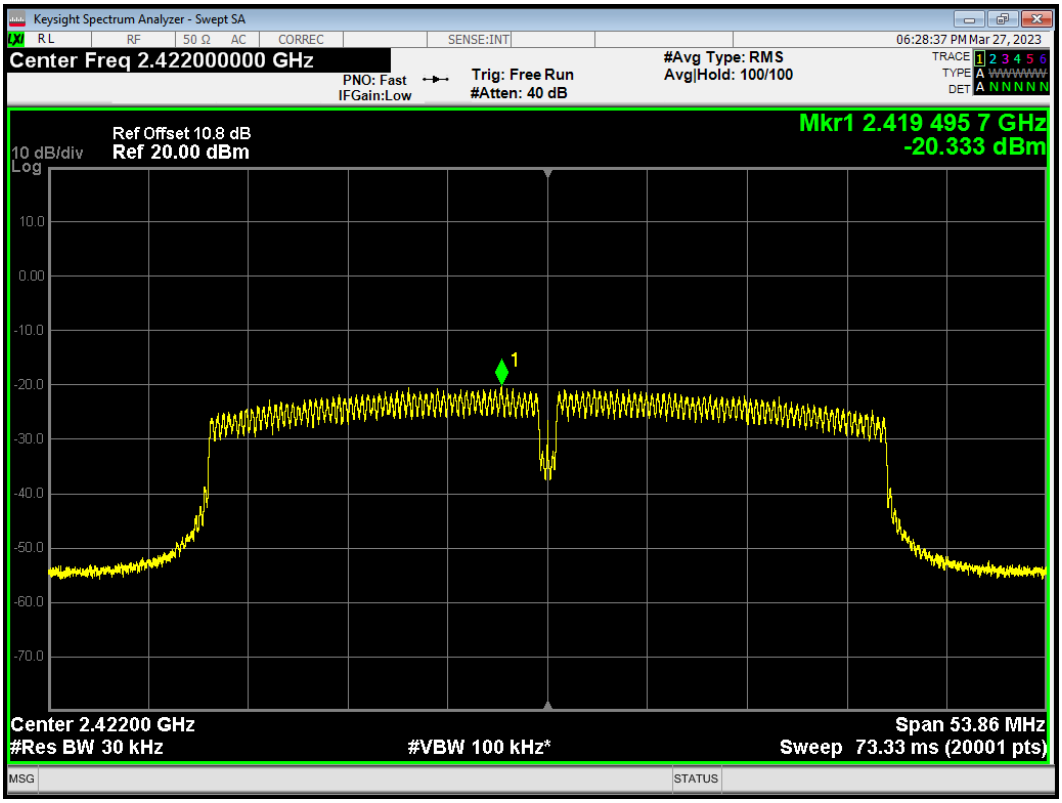
PSD 802.11n(HT20) 2462MHz



PSD 802.11n(HT40) 2422MHz



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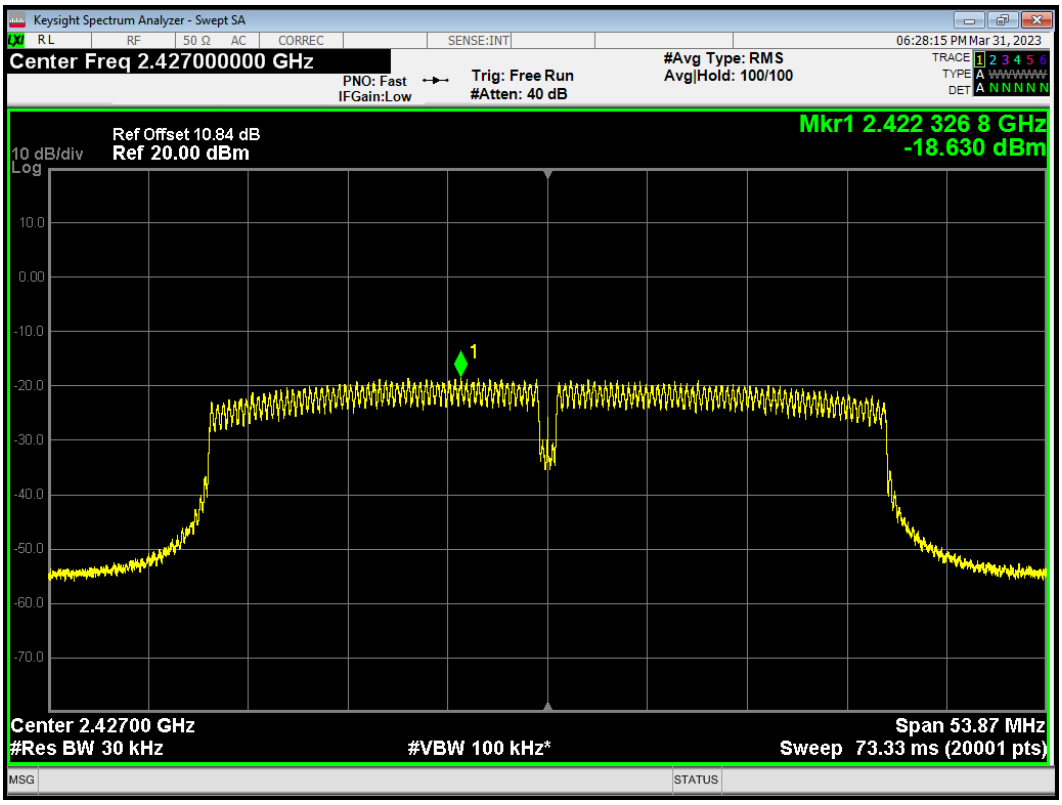
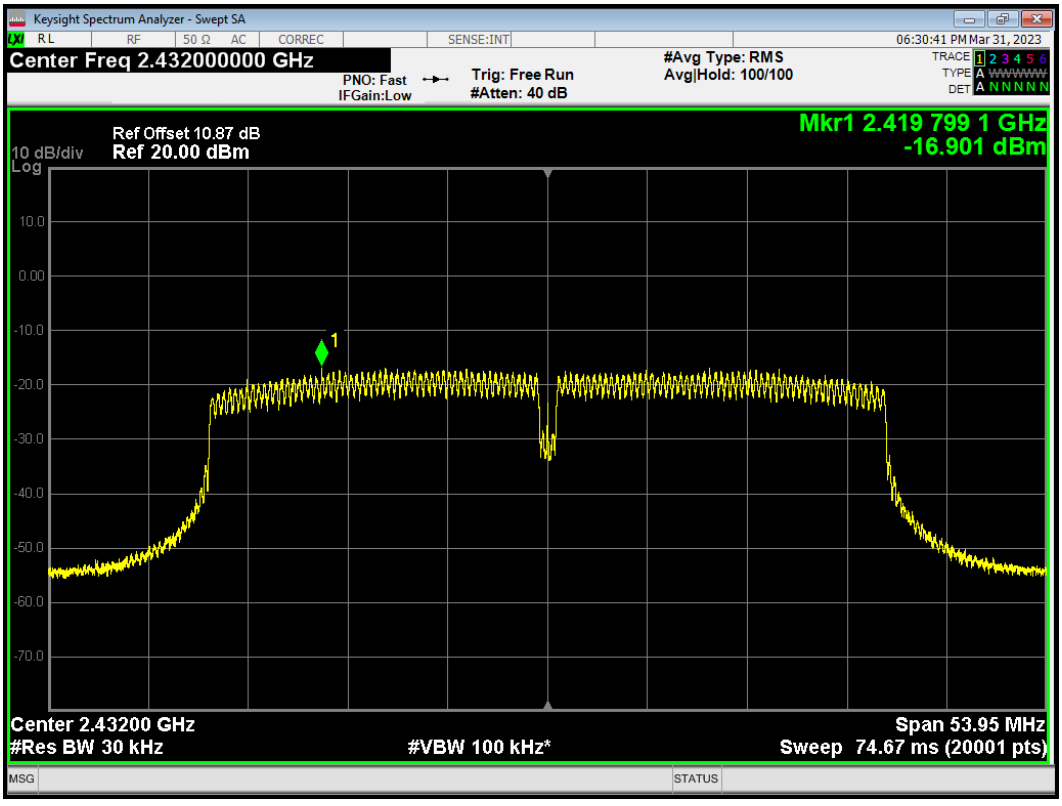
PSD 802.11n(HT40) 2427MHz



PSD 802.11n(HT40) 2432MHz



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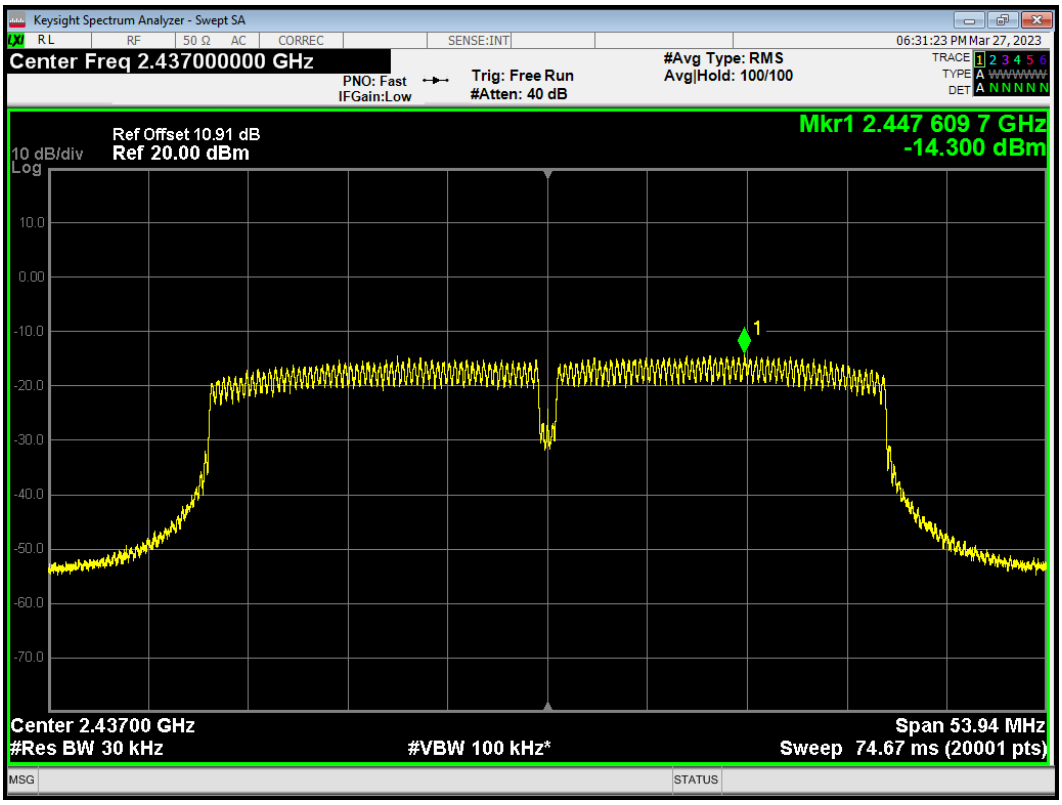
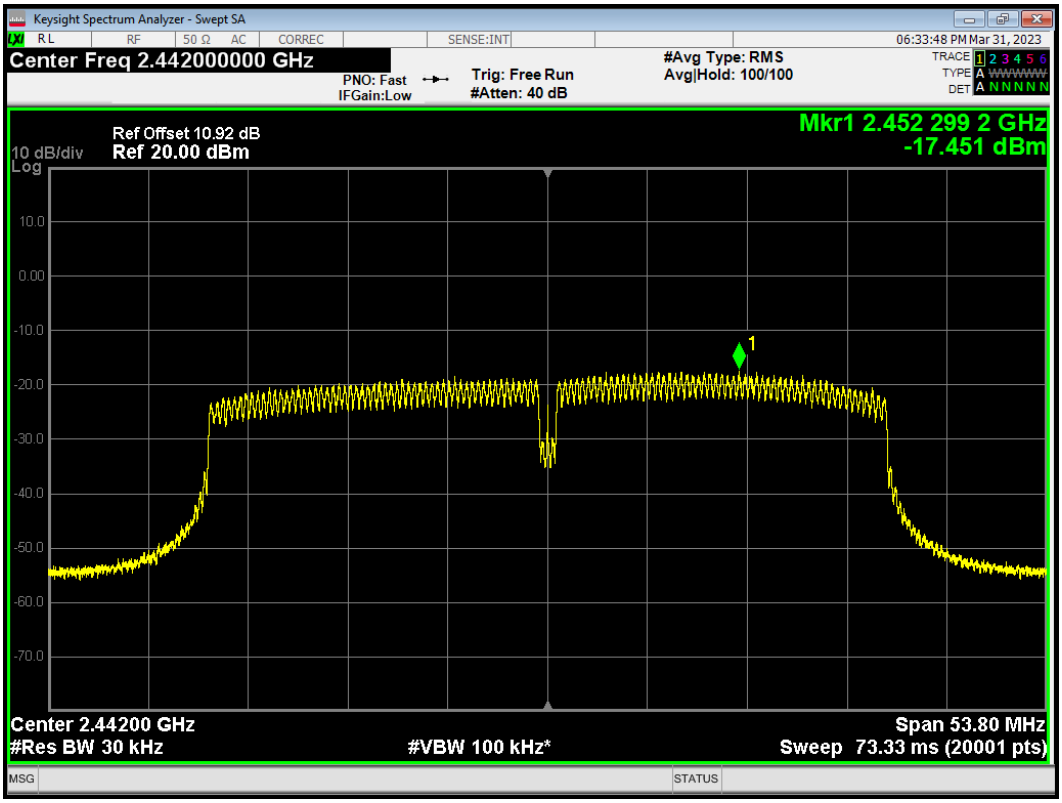
PSD 802.11n(HT40) 2437MHz



PSD 802.11n(HT40) 2442MHz



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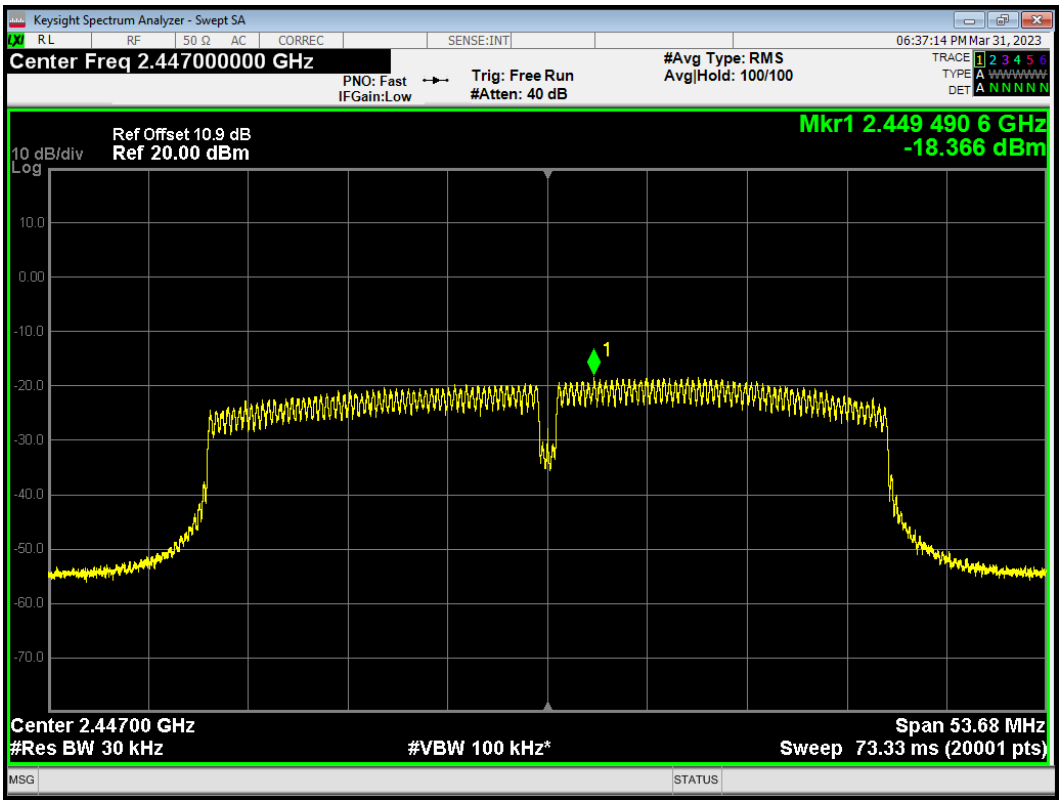
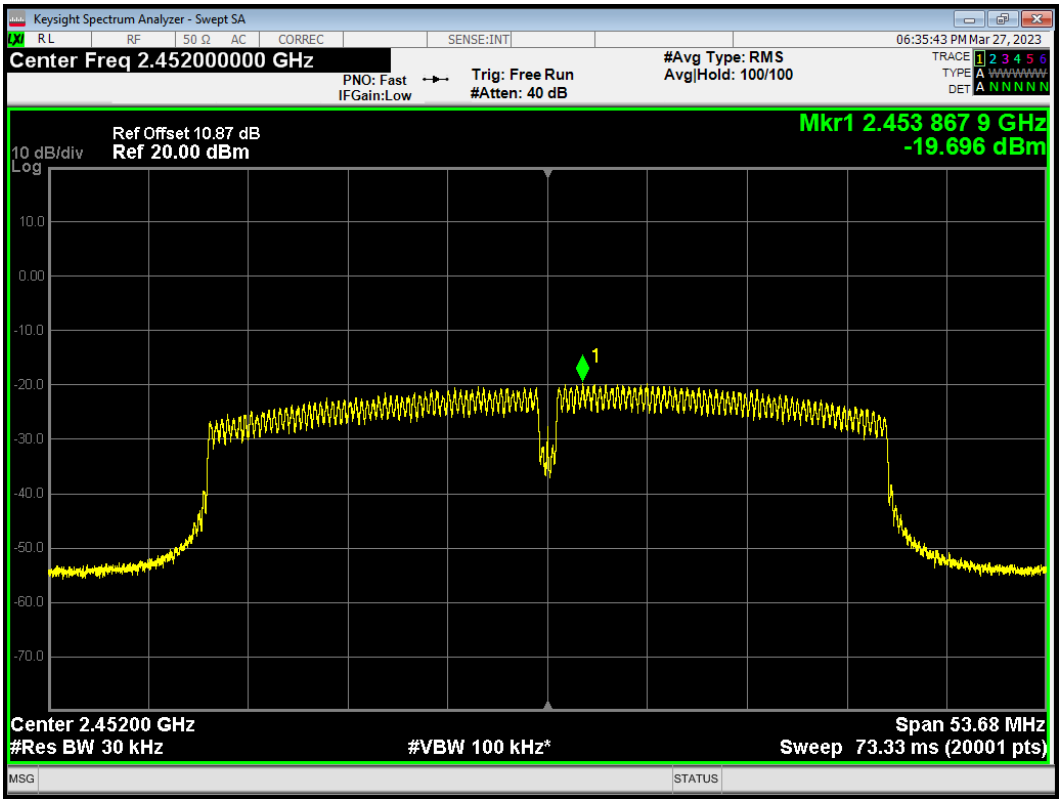
PSD 802.11n(HT40) 2447MHz



PSD 802.11n(HT40) 2452MHz



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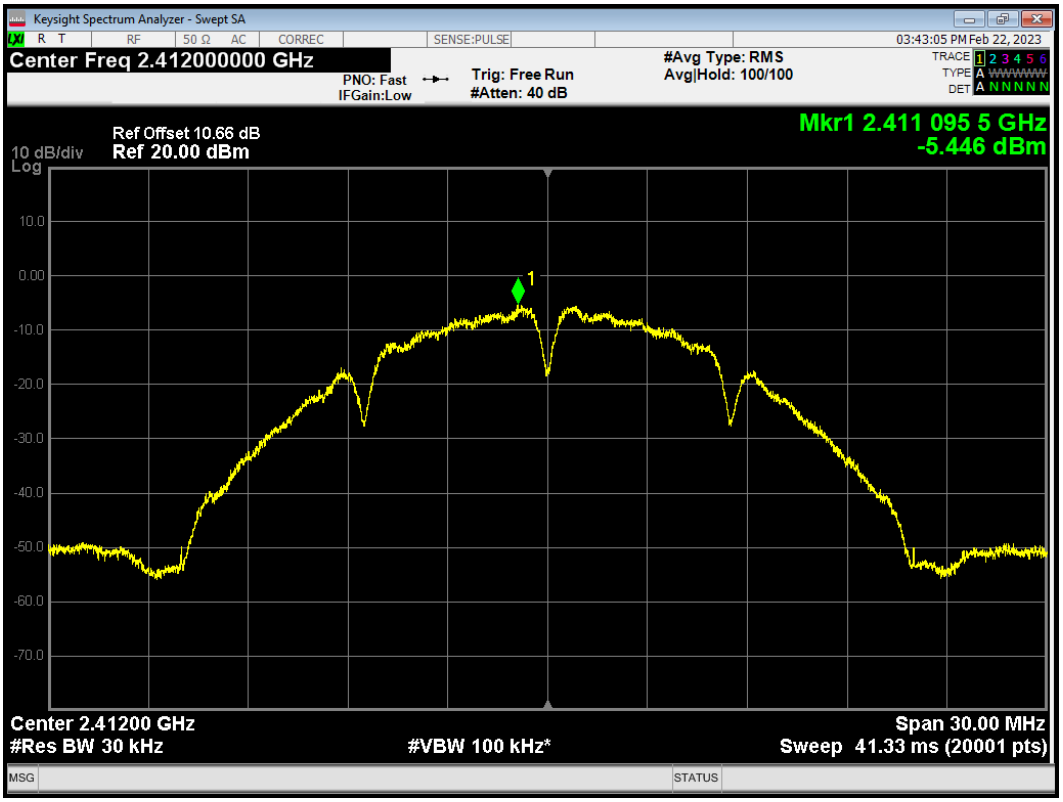
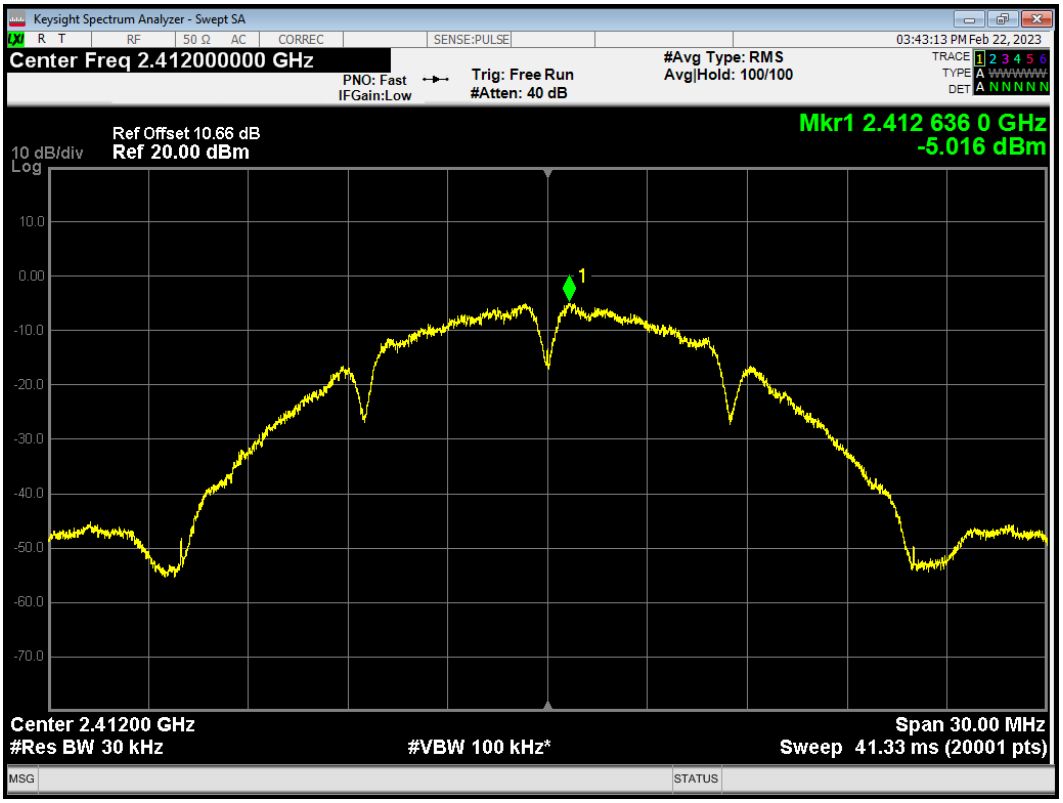
CDD/MIMO

PSD 802.11b 2412MHz



PSD 802.11b 2412MHz Ant2



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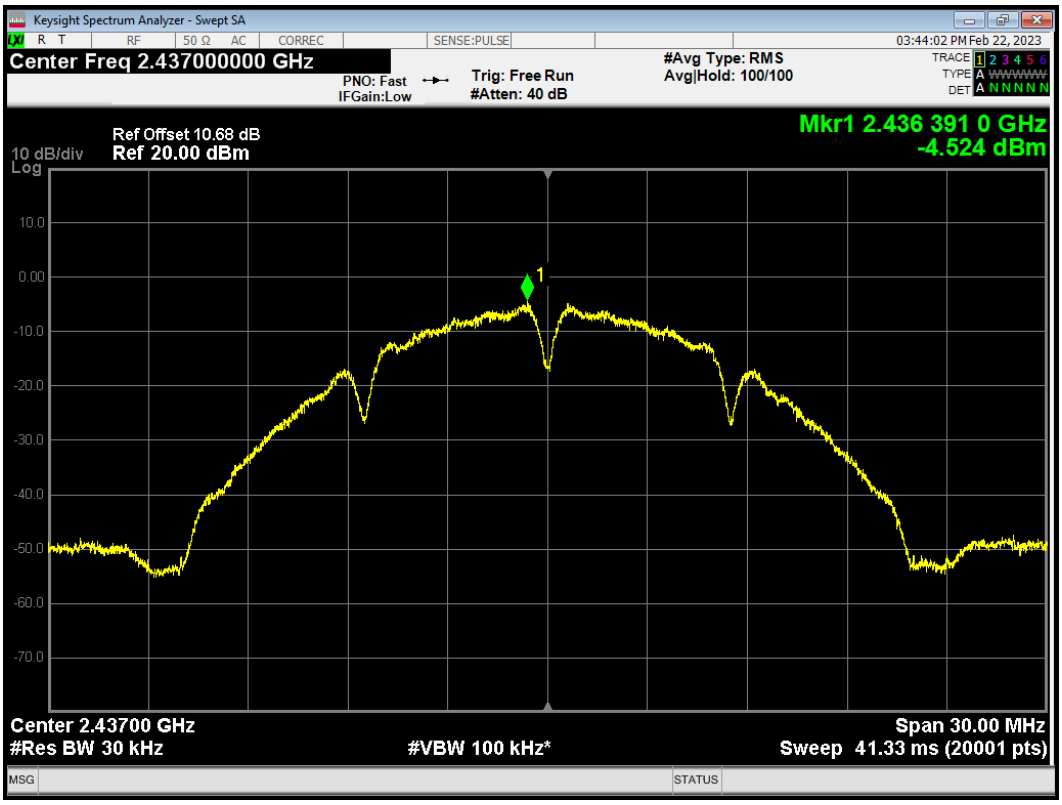
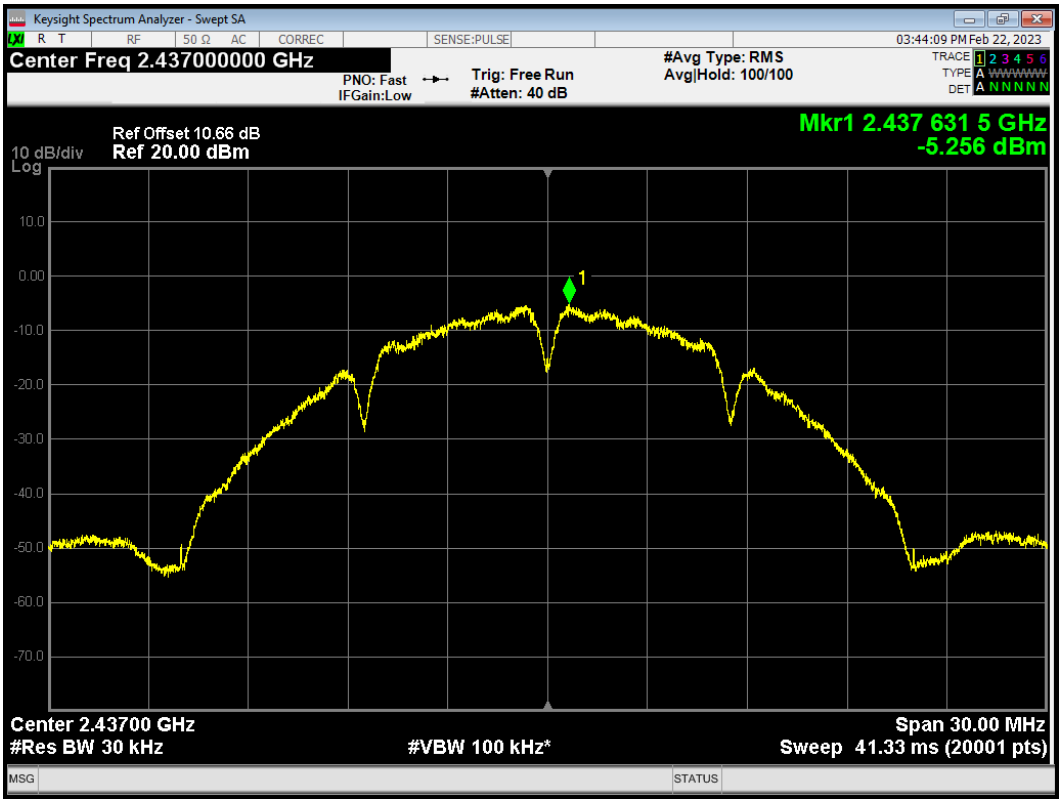
PSD 802.11b 2437MHz



PSD 802.11b 2437MHz Ant2



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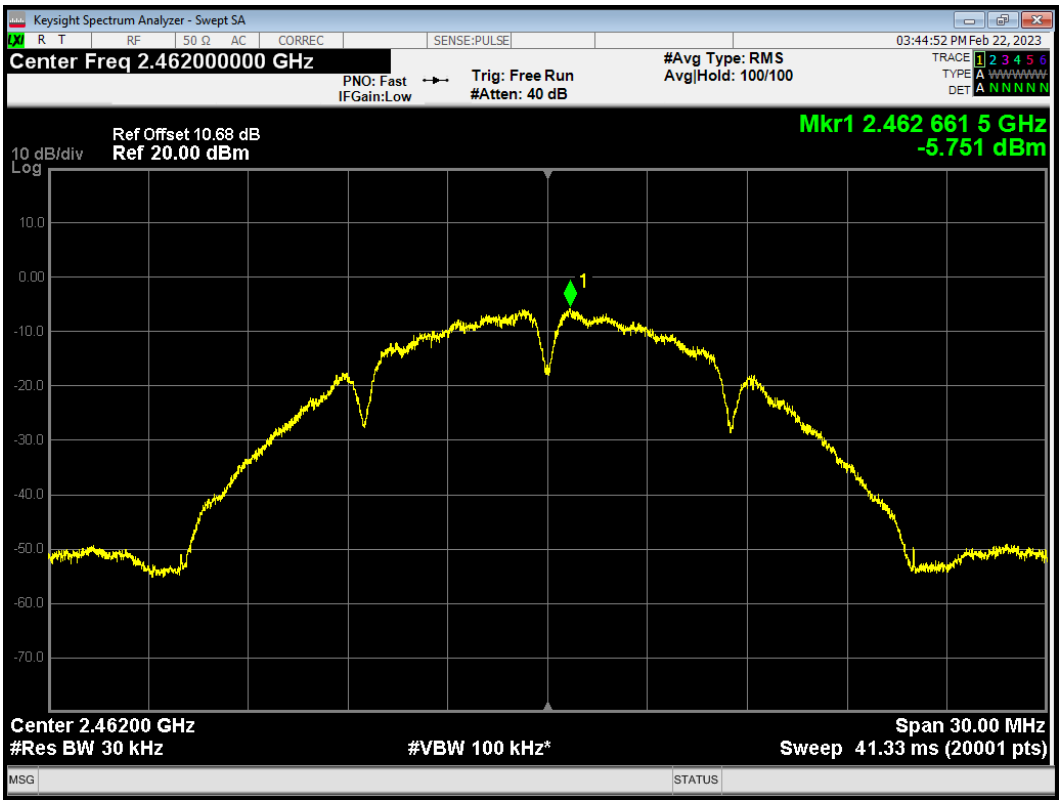
PSD 802.11b 2462MHz



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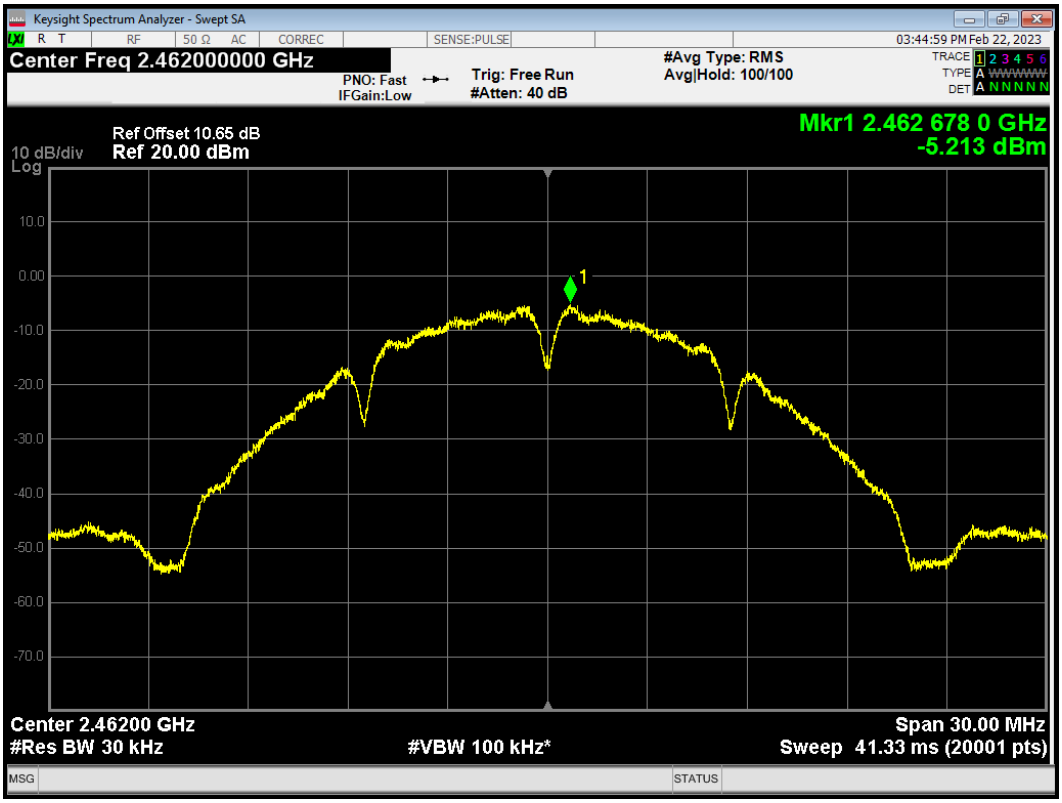

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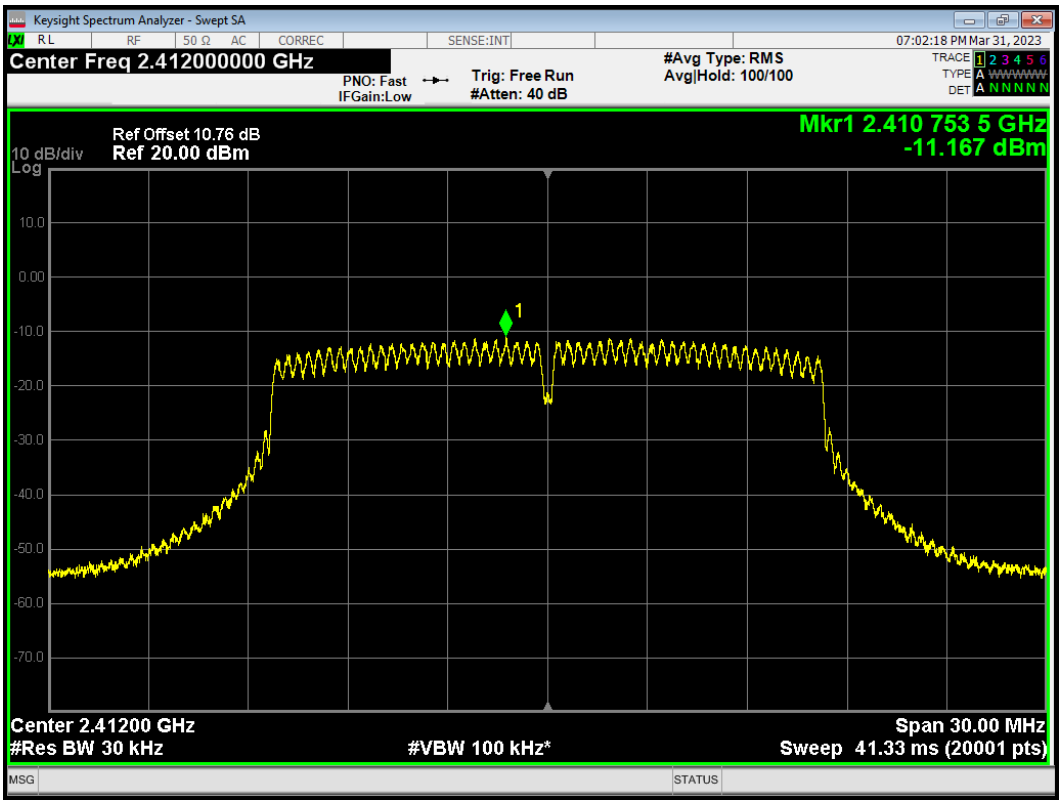
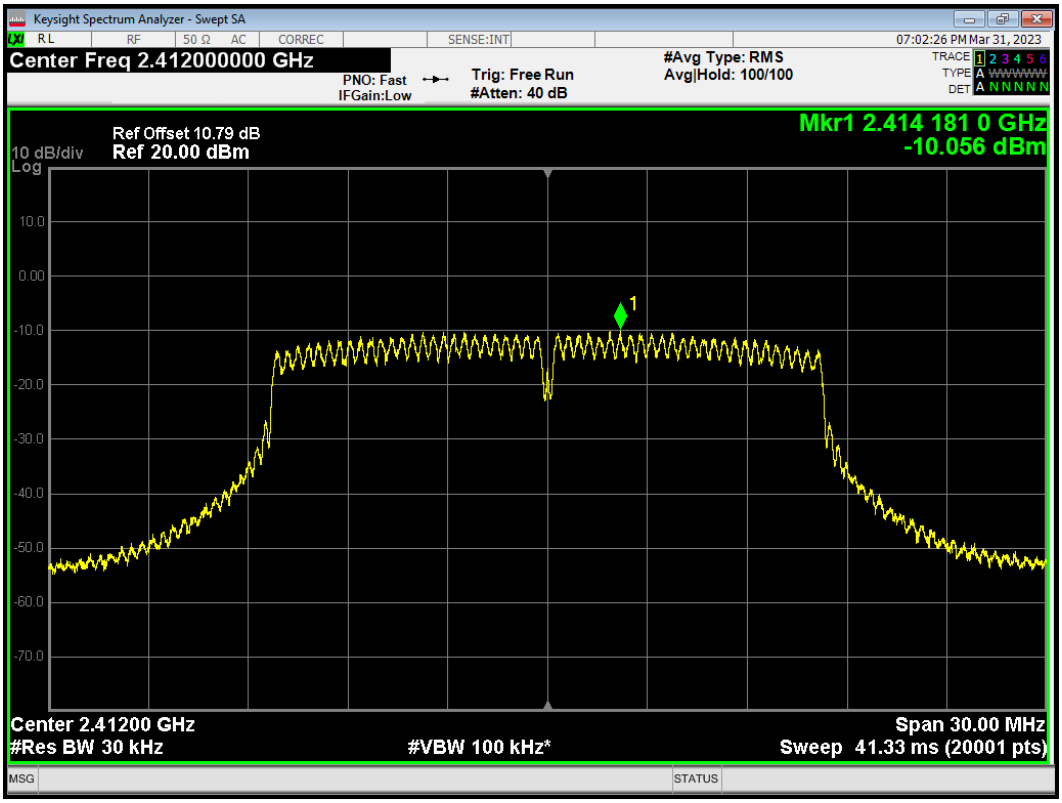
PSD 802.11g 2412MHz



PSD 802.11g 2412MHz Ant2



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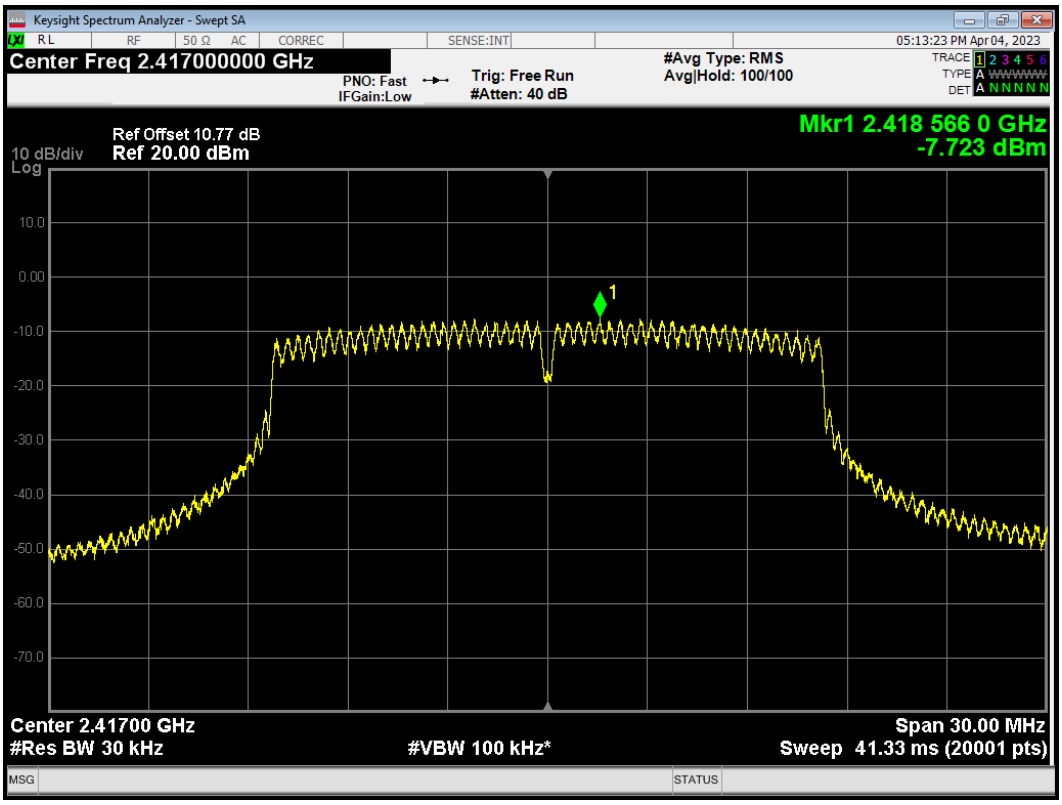
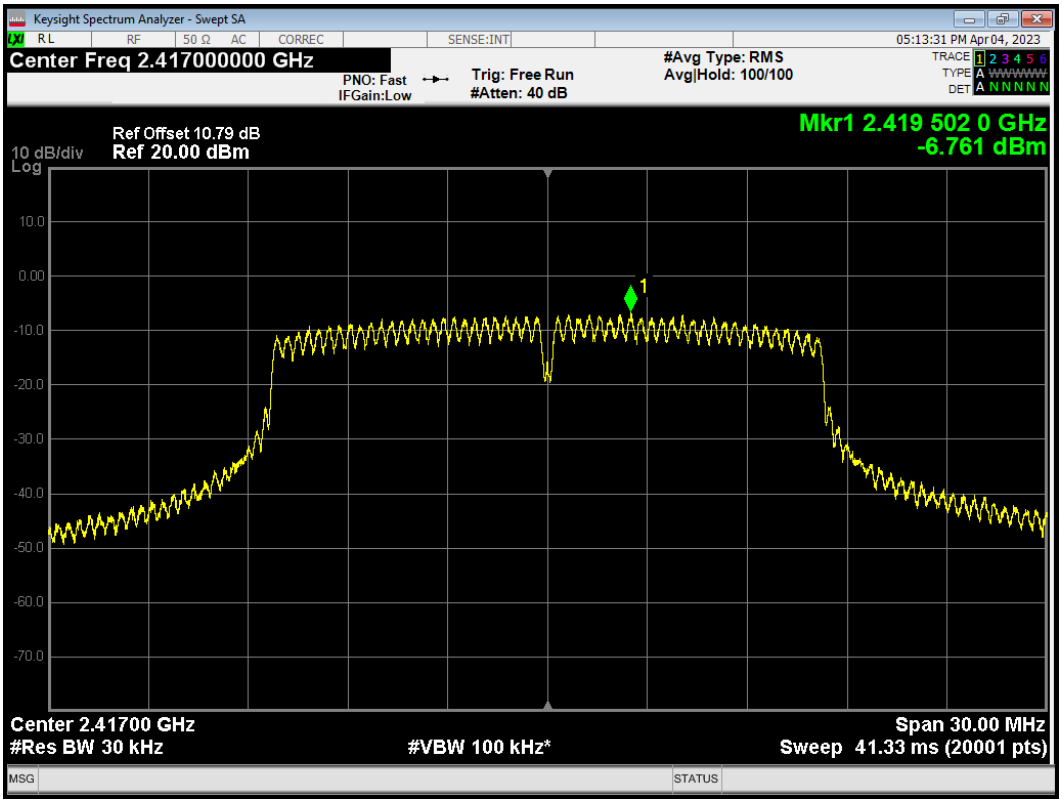
PSD 802.11g 2417MHz



PSD 802.11g 2417MHz Ant2



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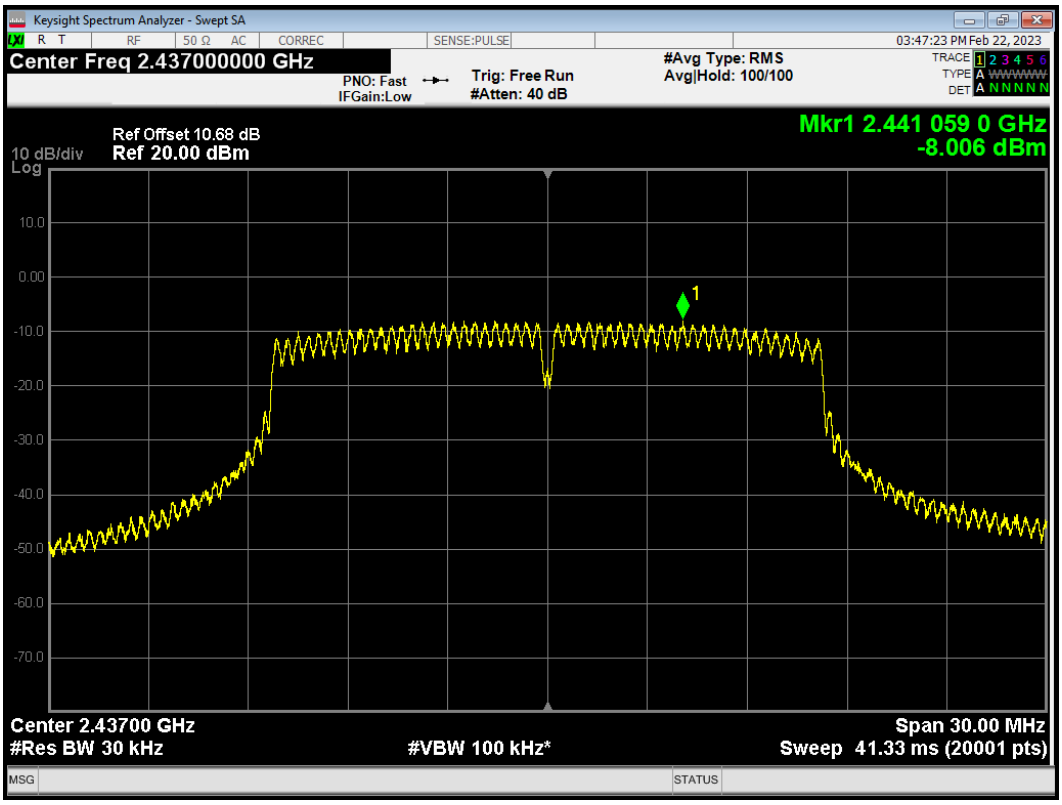
PSD 802.11g 2437MHz



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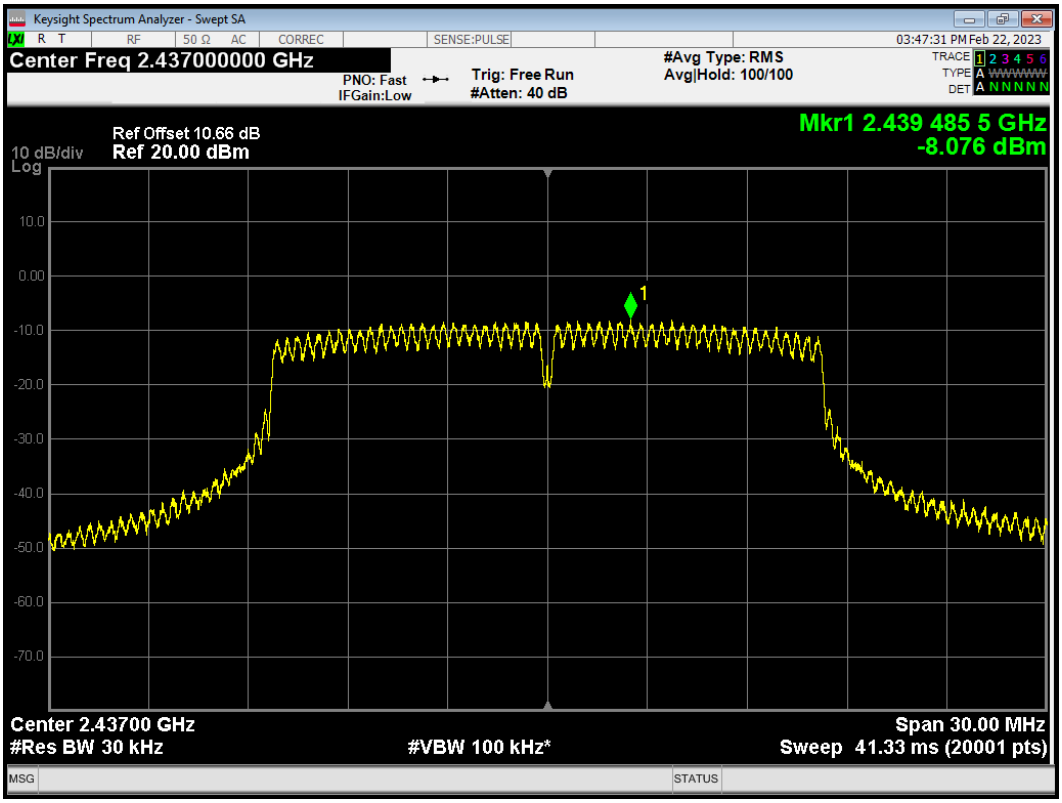

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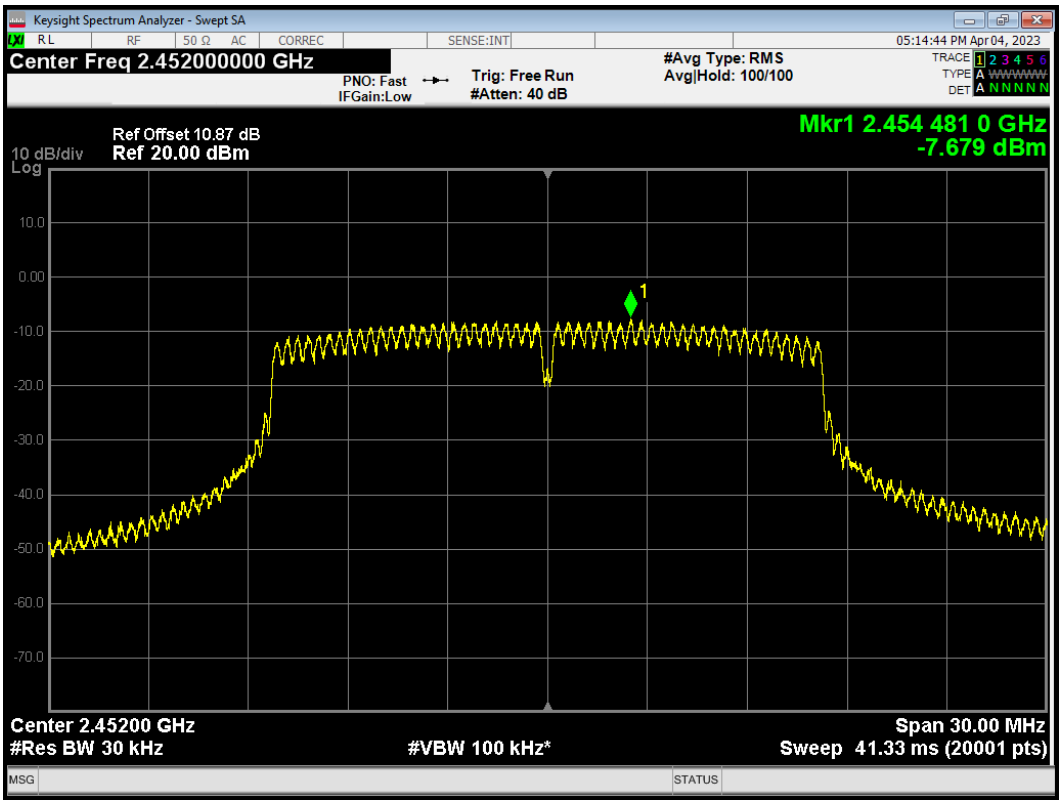
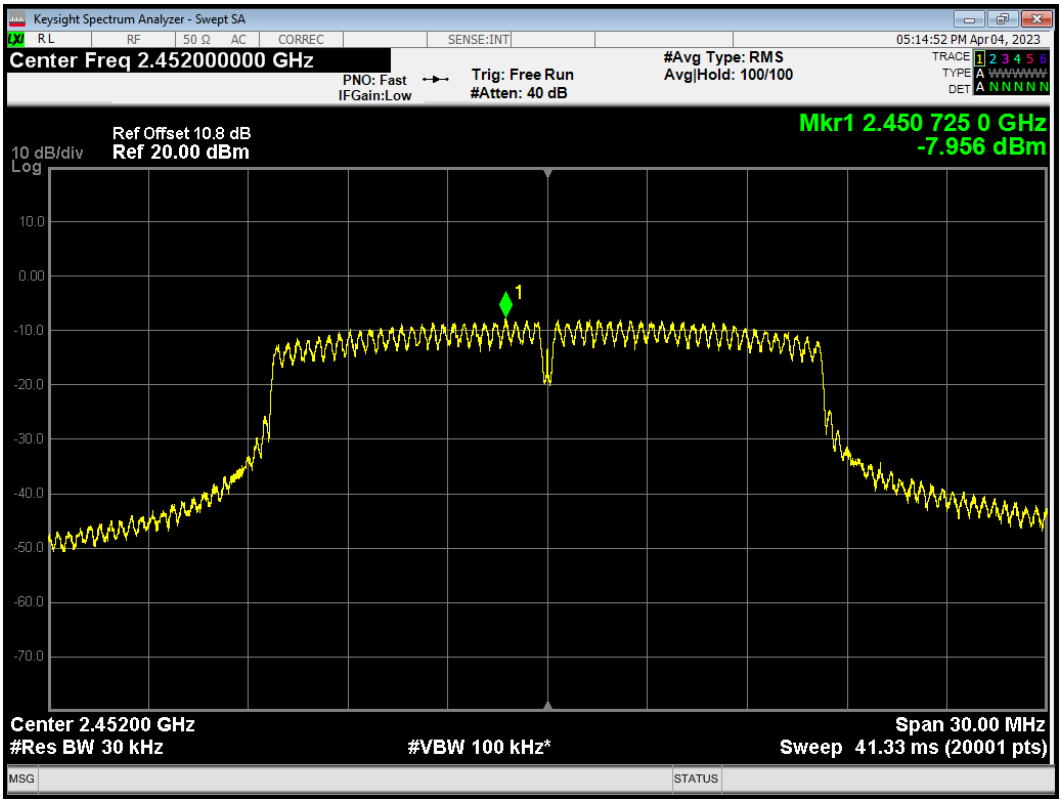
PSD 802.11g 2452MHz



PSD 802.11g 2452MHz Ant2



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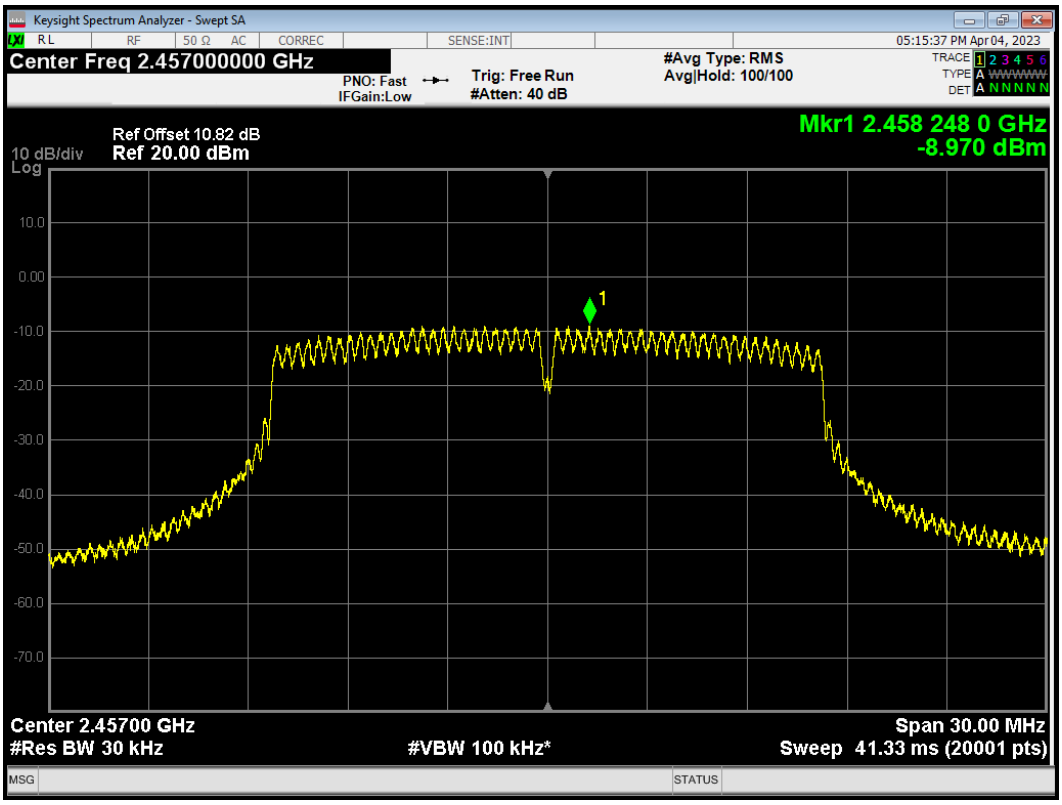
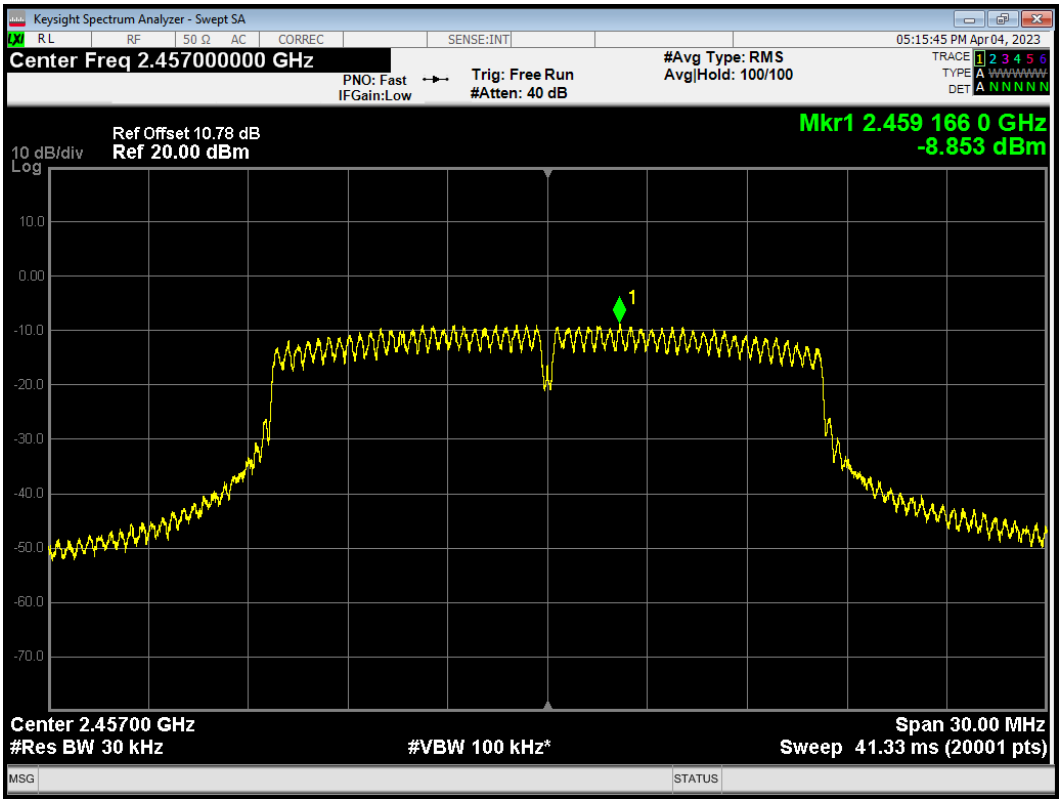
PSD 802.11g 2457MHz



PSD 802.11g 2457MHz Ant2



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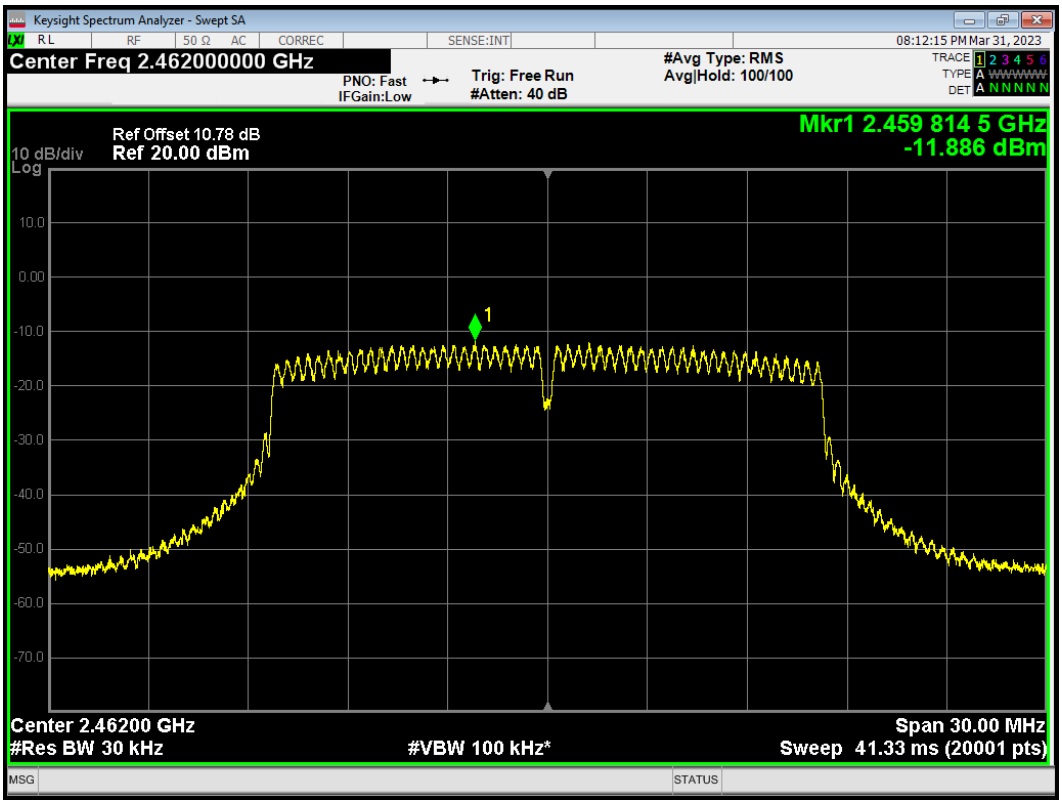
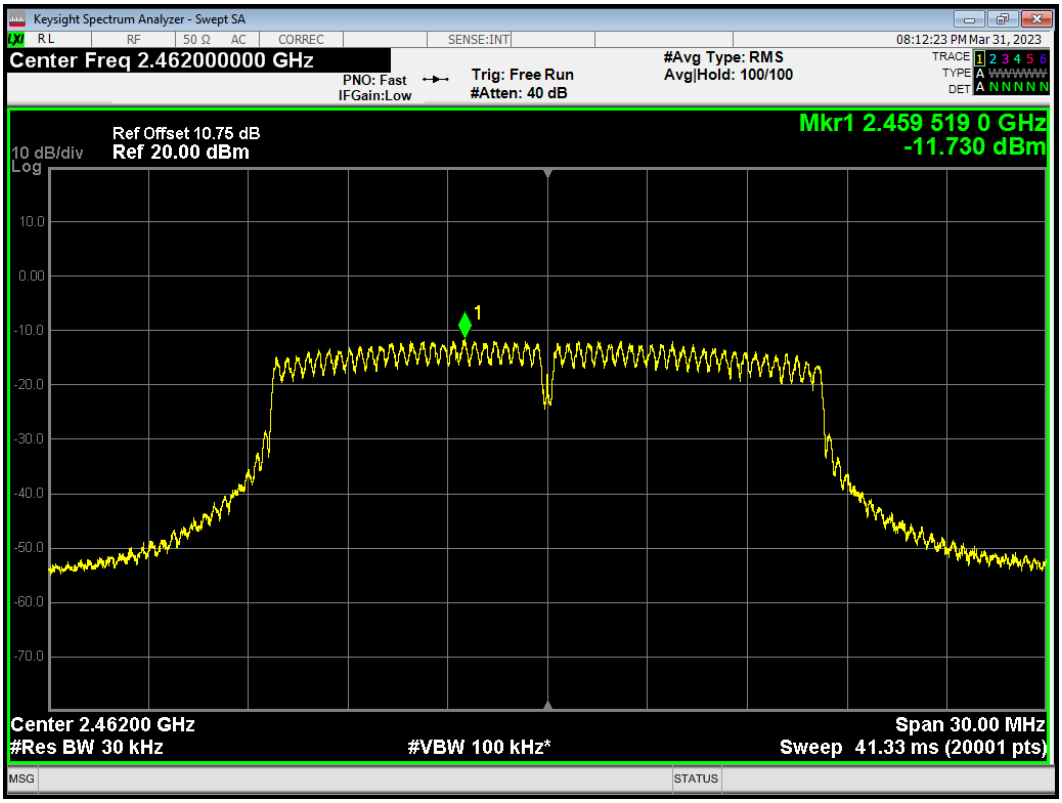
PSD 802.11g 2462MHz



PSD 802.11g 2462MHz Ant2



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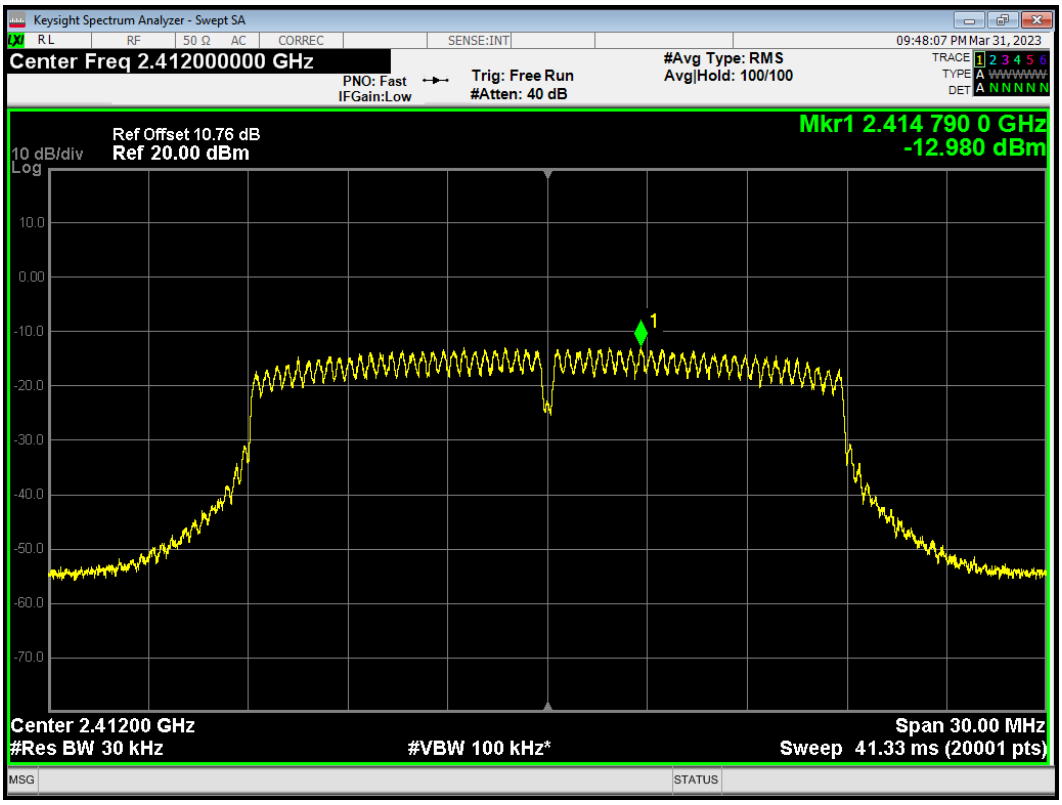
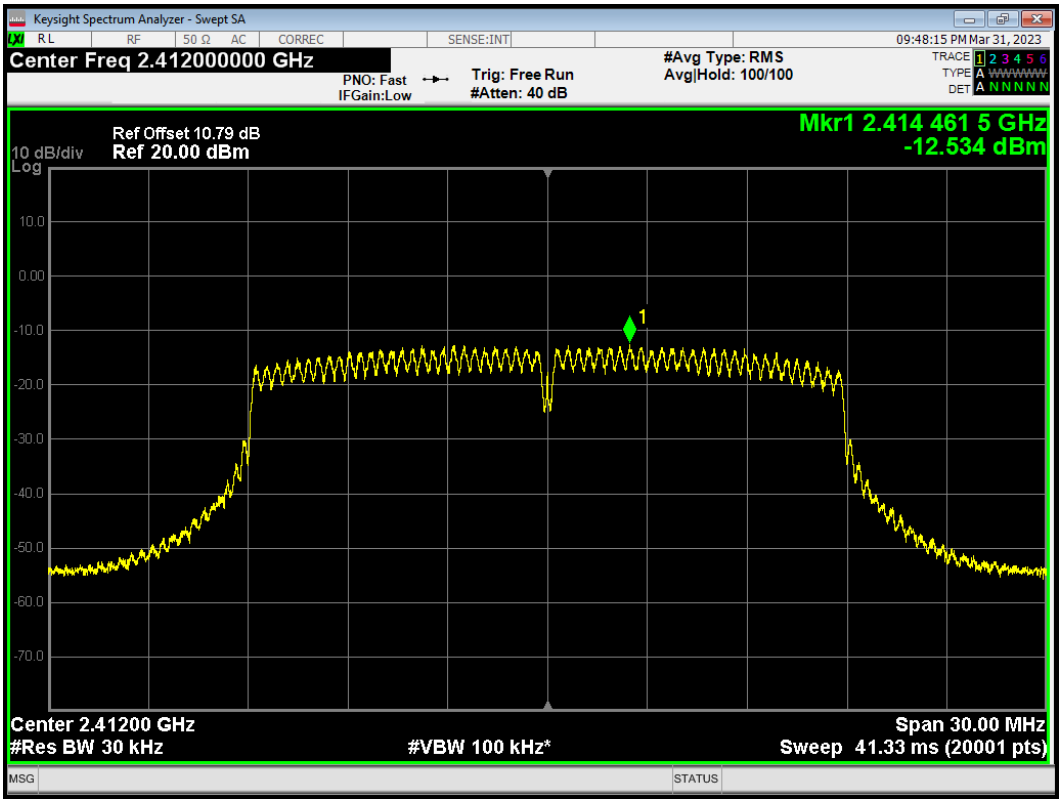
PSD 802.11n(HT20) 2412MHz



PSD 802.11n(HT20) 2412MHz Ant2



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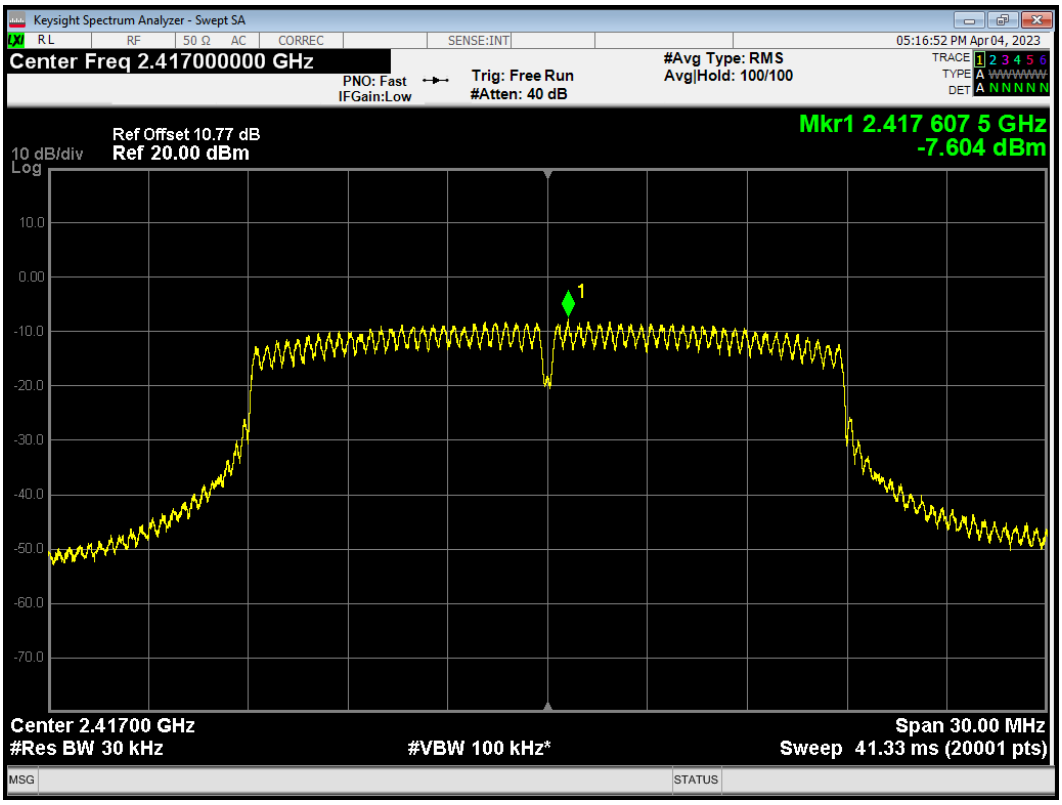
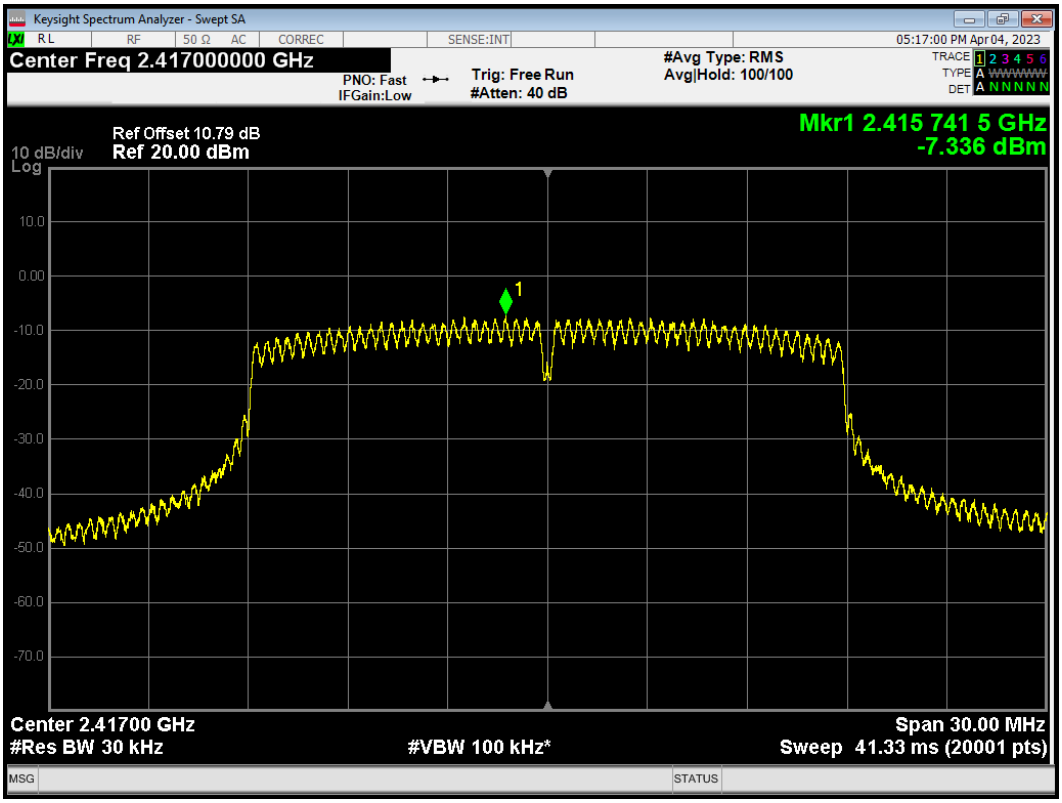
PSD 802.11n(HT20) 2417MHz



PSD 802.11n(HT20) 2417MHz Ant2



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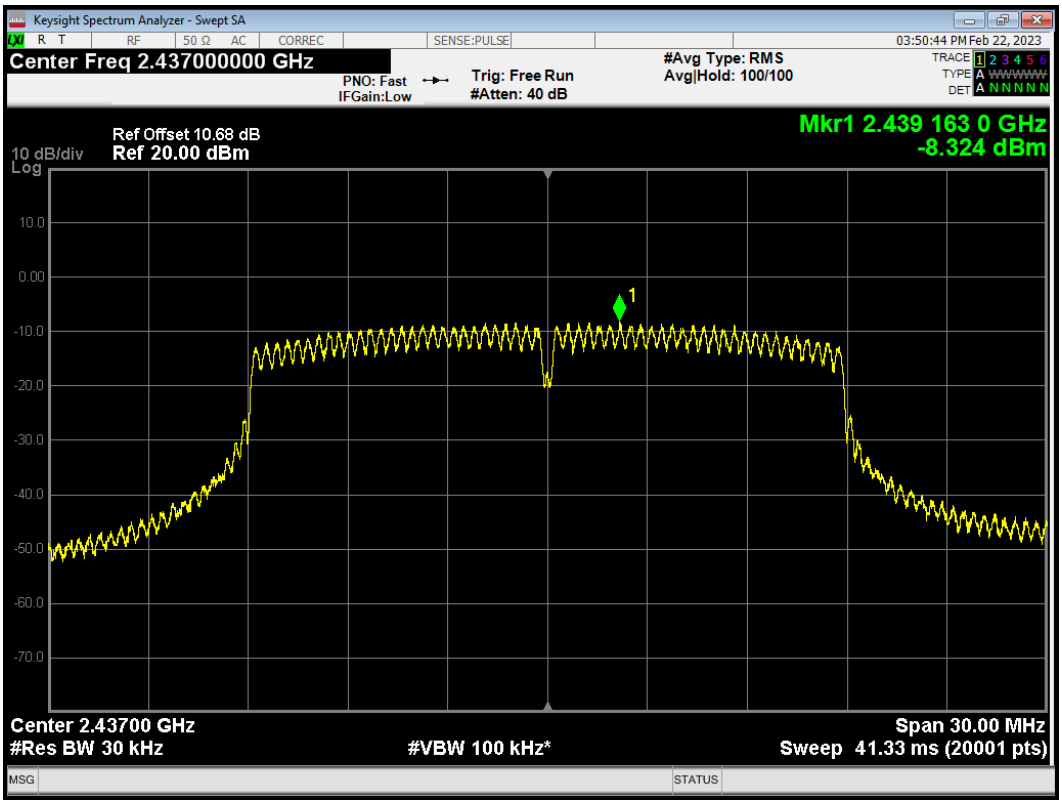
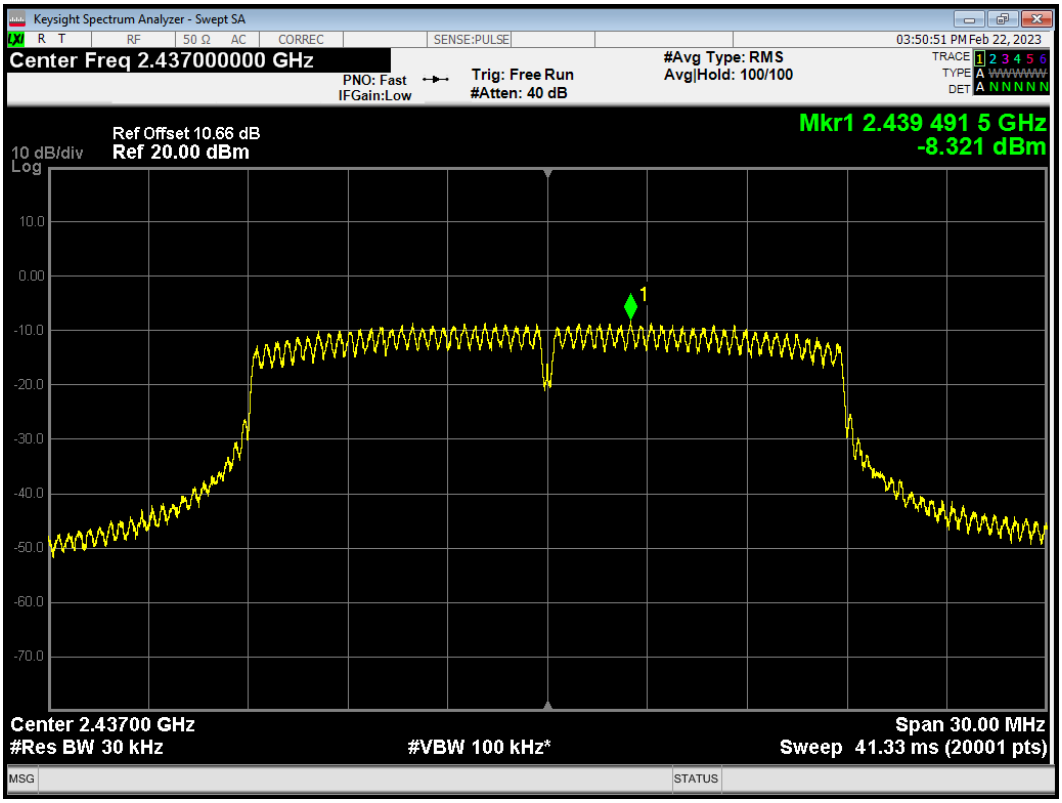
PSD 802.11n(HT20) 2437MHz



PSD 802.11n(HT20) 2437MHz Ant2



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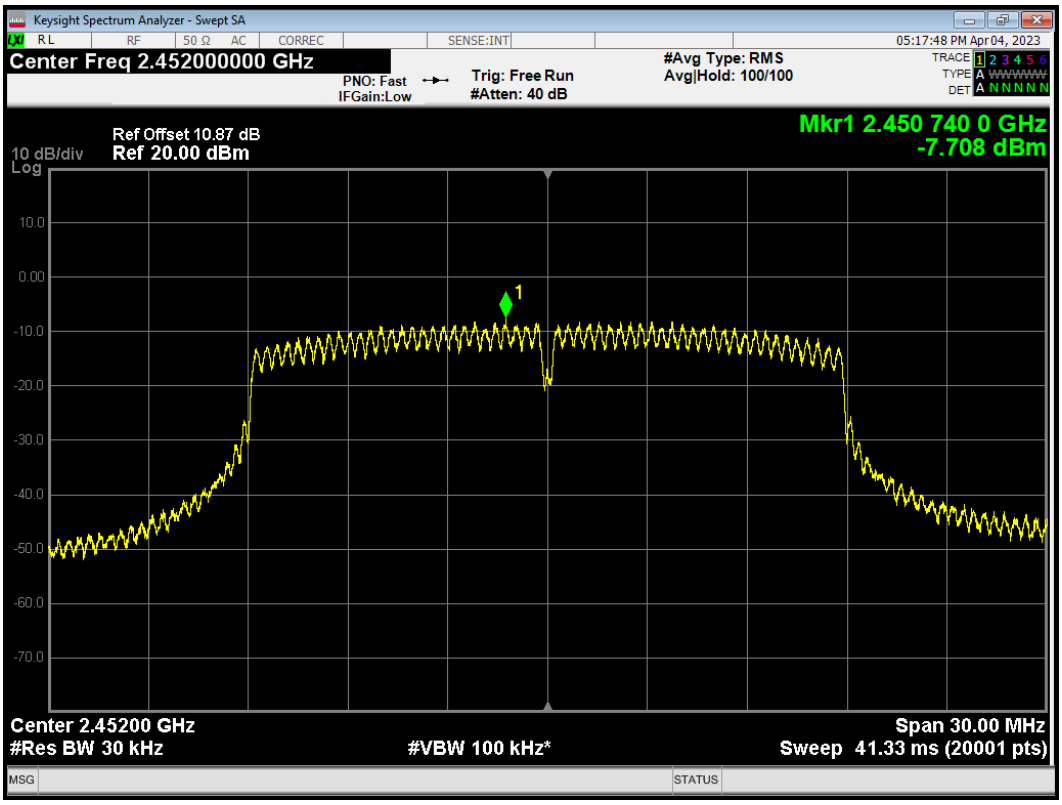
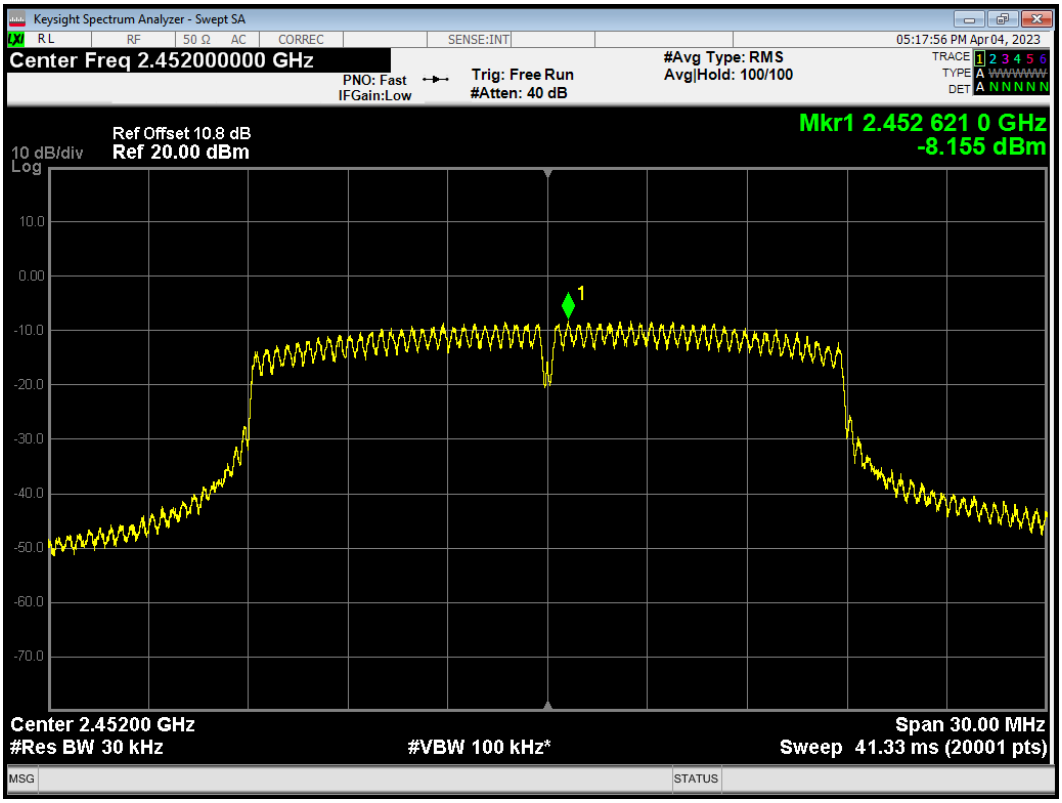
PSD 802.11n(HT20) 2452MHz



PSD 802.11n(HT20) 2452MHz Ant2



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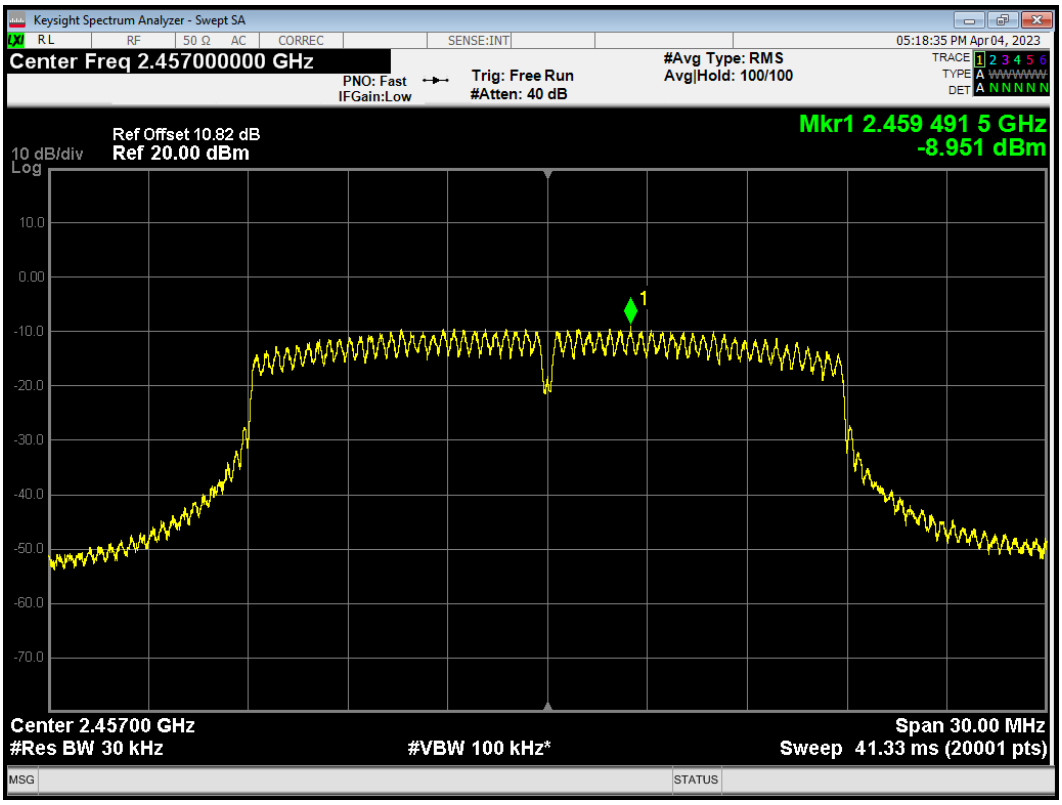
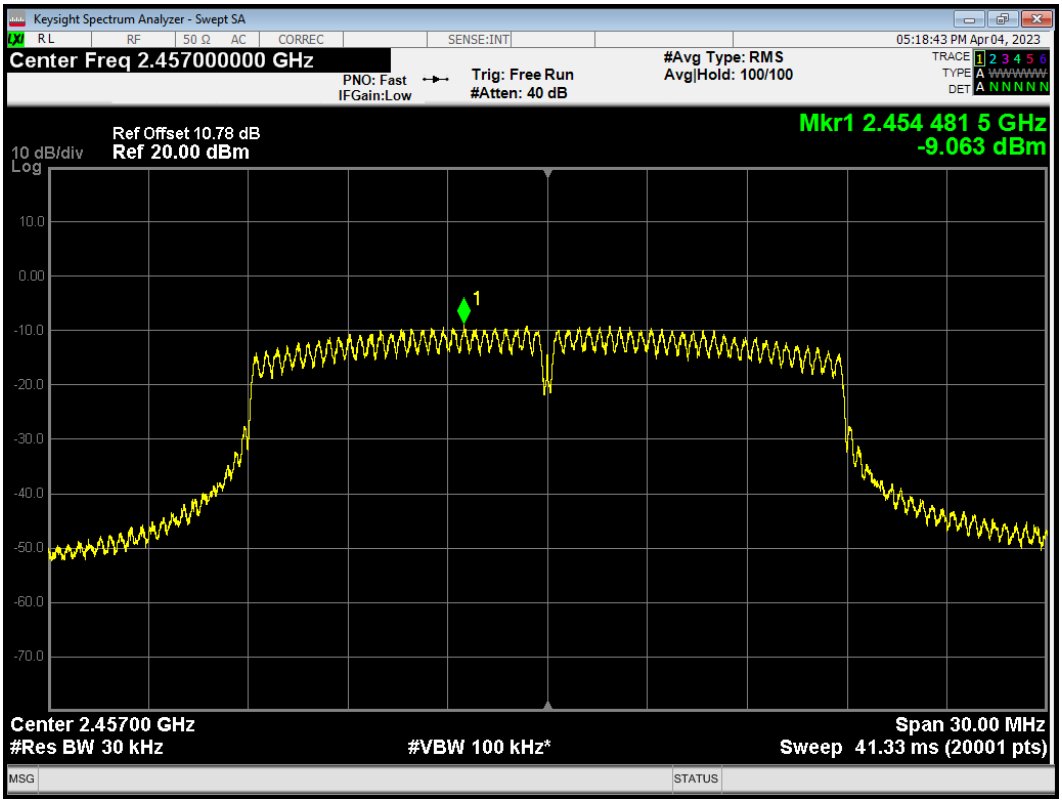
PSD 802.11n(HT20) 2457MHz



PSD 802.11n(HT20) 2457MHz Ant2



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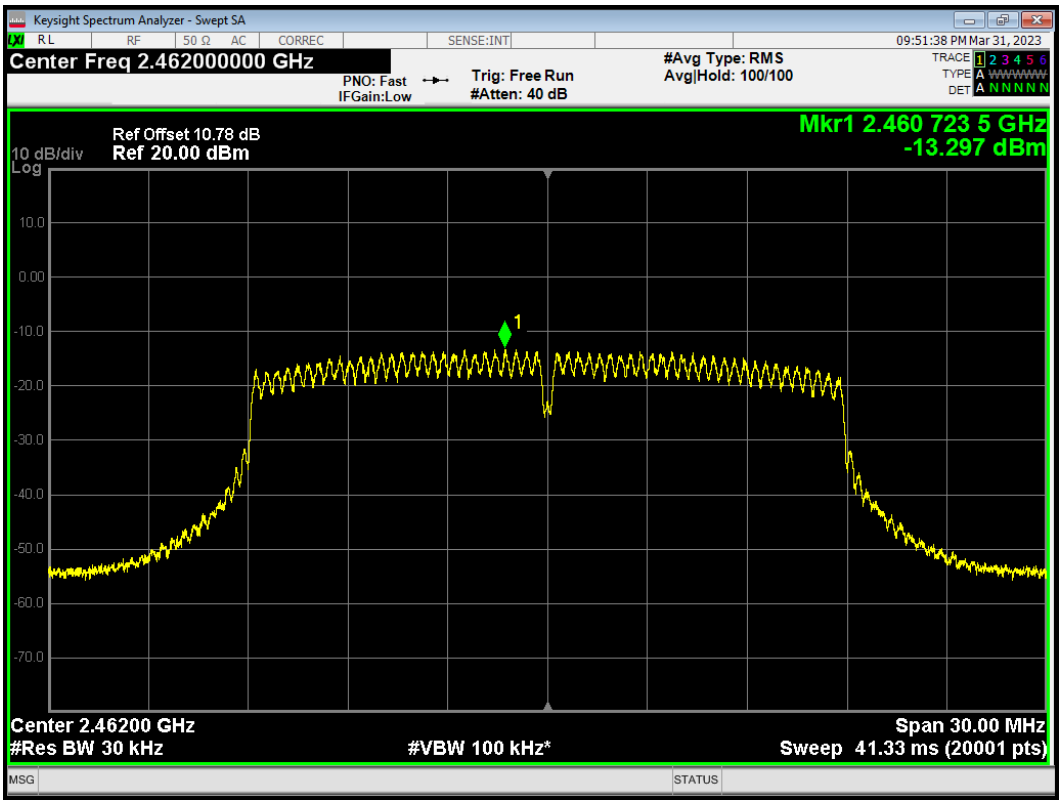
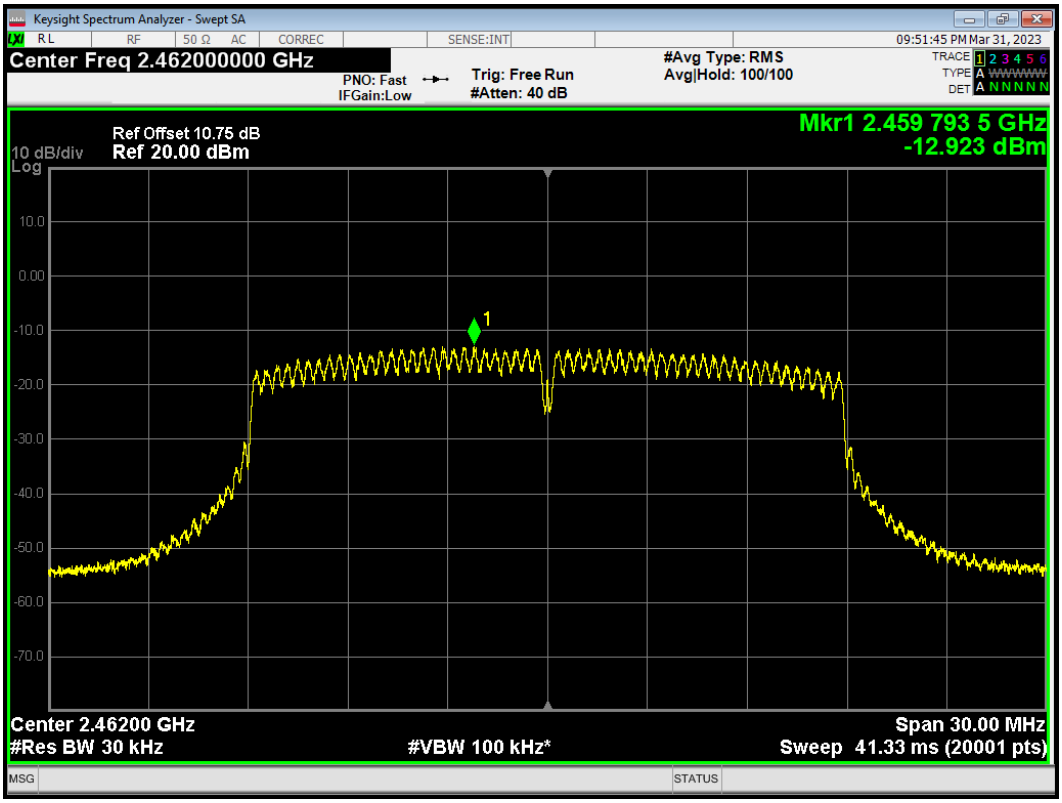
PSD 802.11n(HT20) 2462MHz



PSD 802.11n(HT20) 2462MHz Ant2



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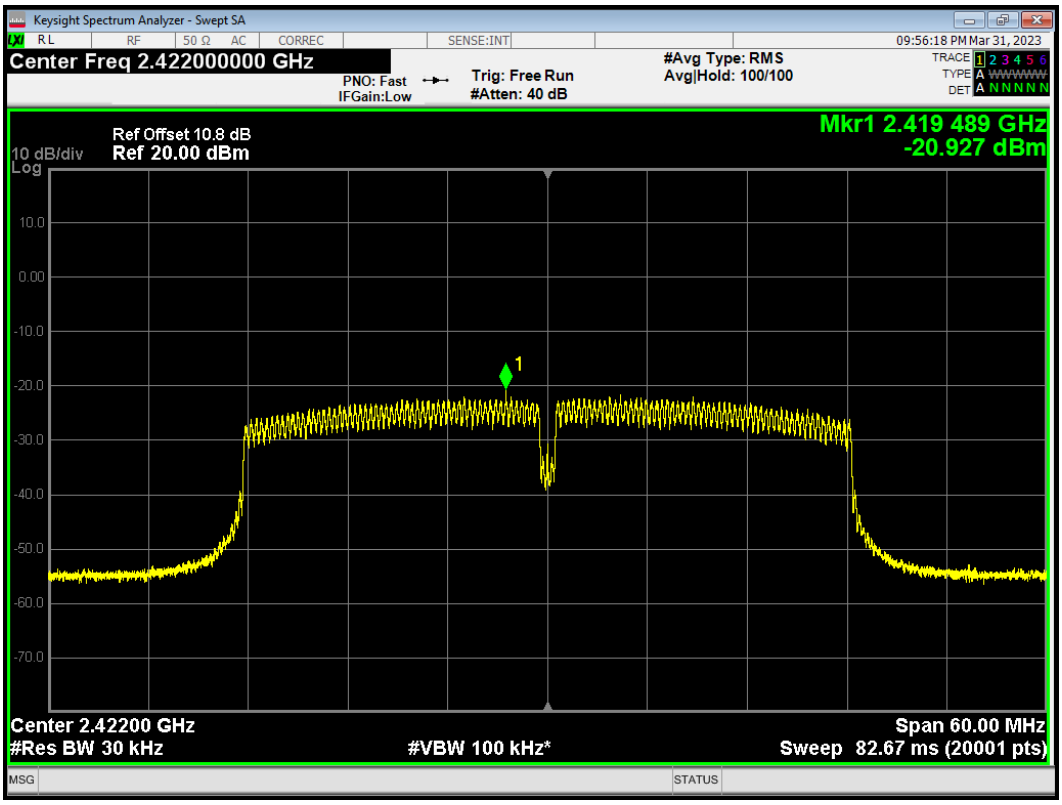
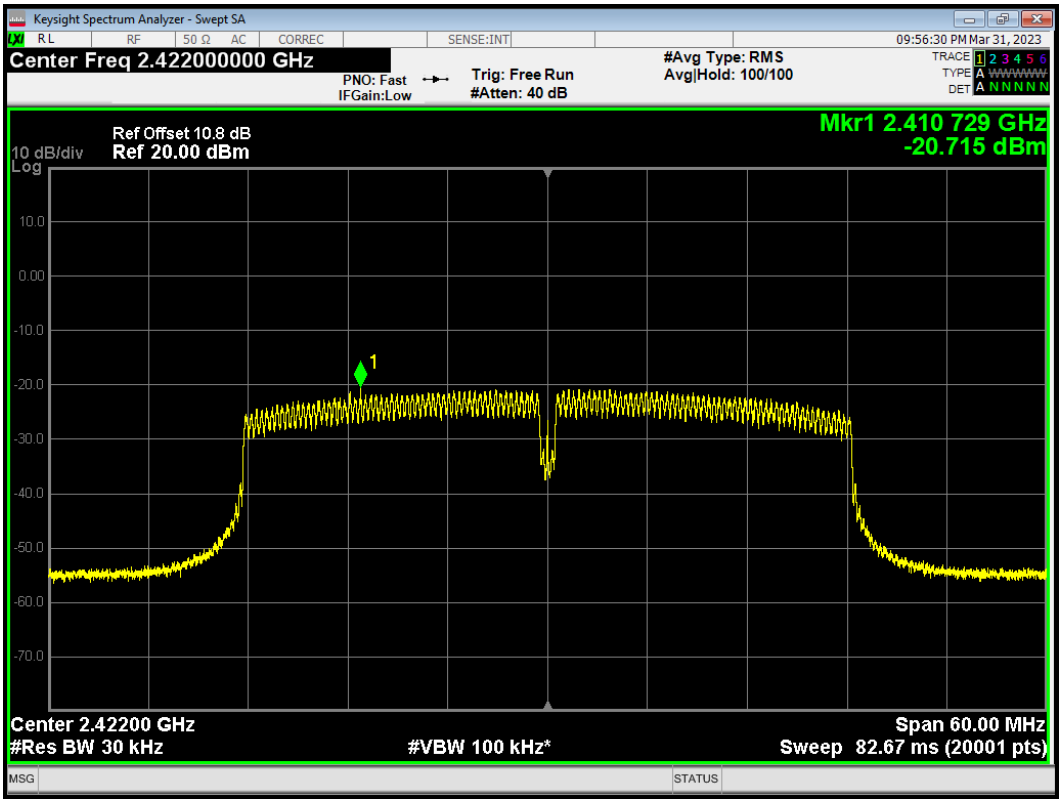
PSD 802.11n(HT40) 2422MHz



PSD 802.11n(HT40) 2422MHz Ant2



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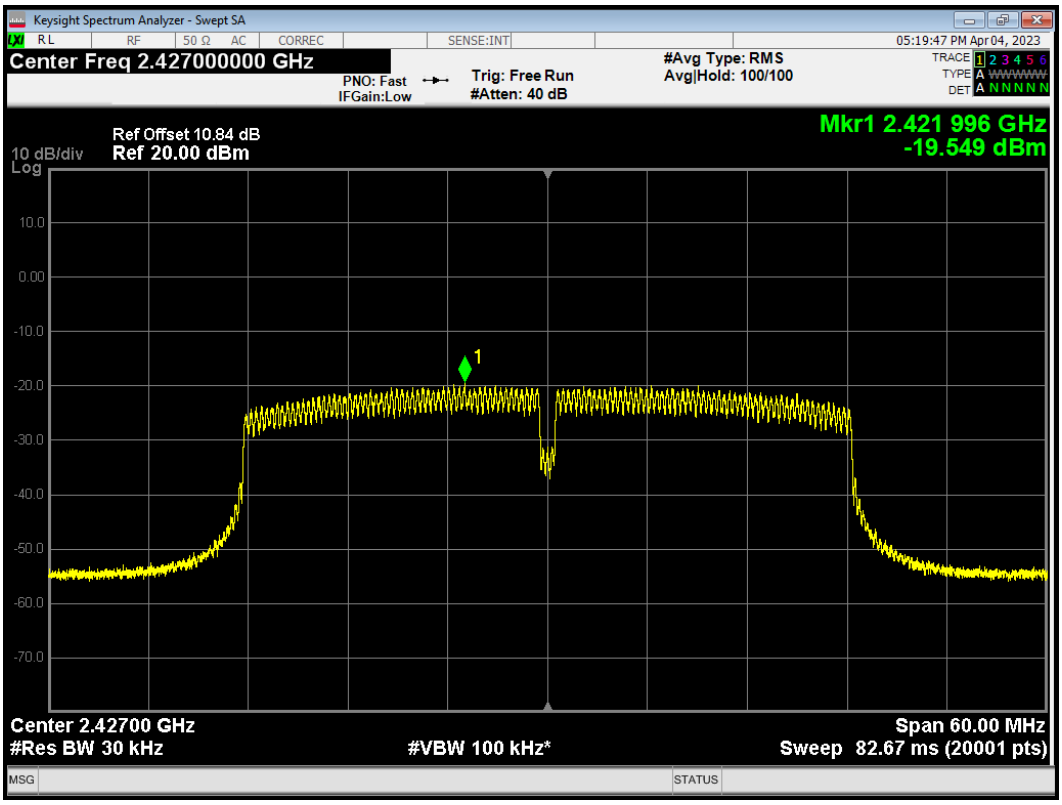
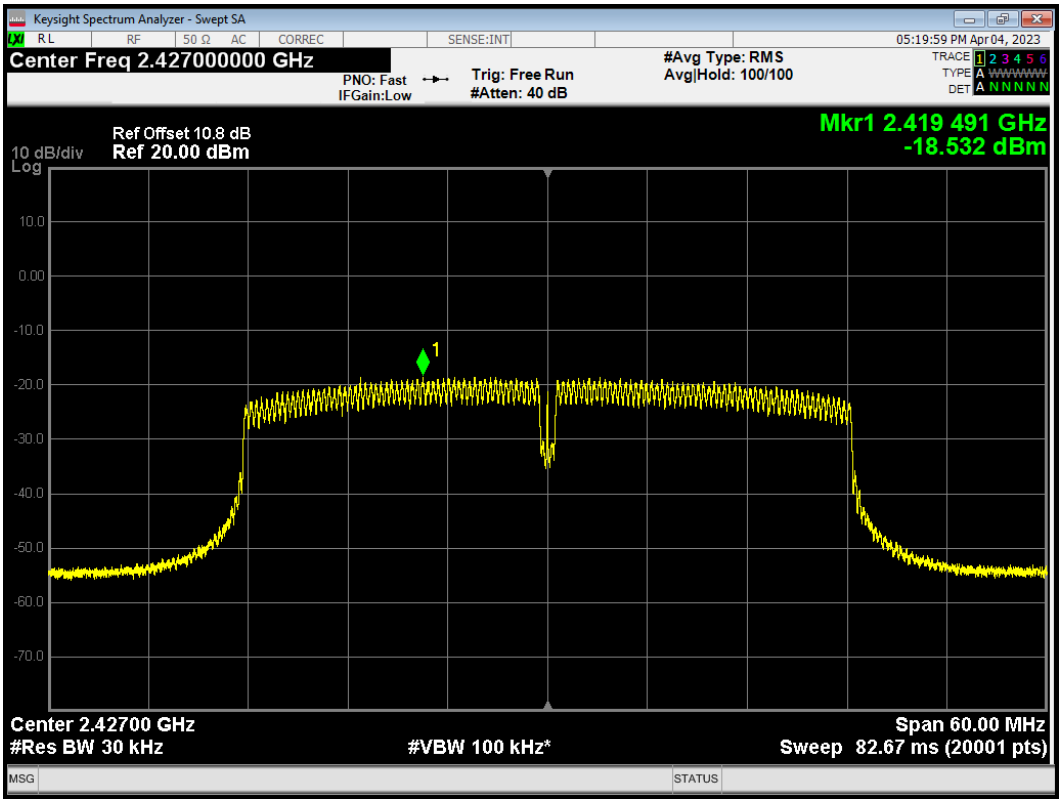
PSD 802.11n(HT40) 2427MHz



PSD 802.11n(HT40) 2427MHz Ant2



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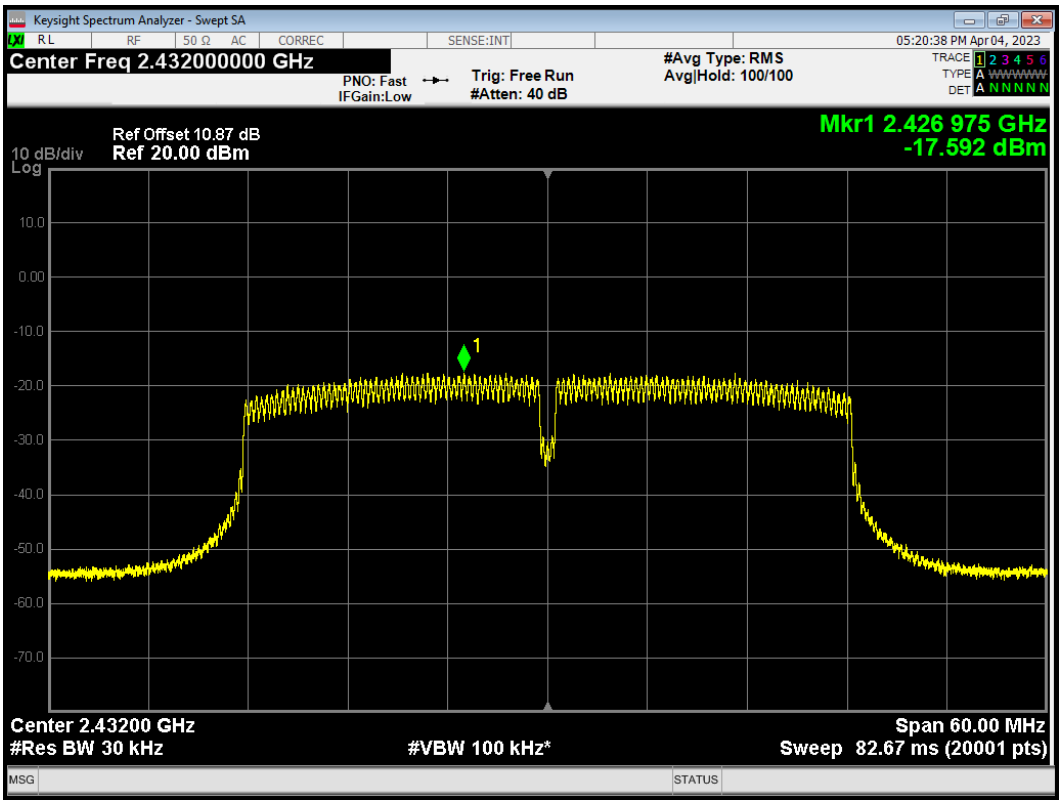
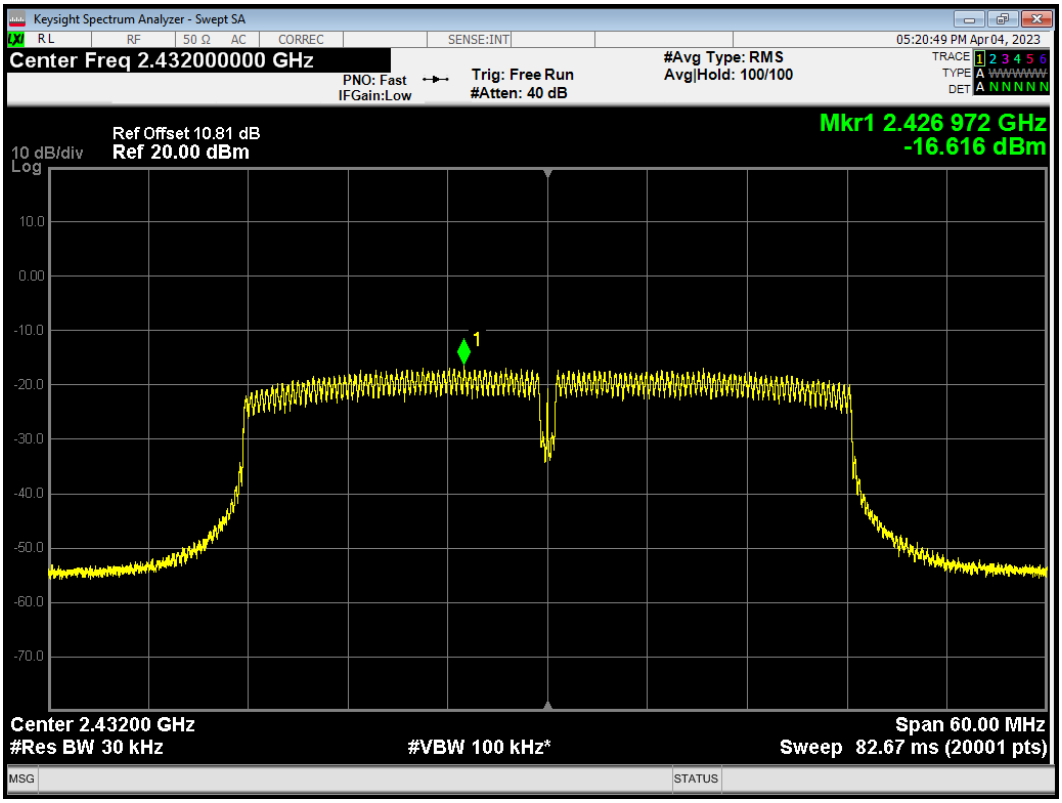
PSD 802.11n(HT40) 2432MHz



PSD 802.11n(HT40) 2432MHz Ant2



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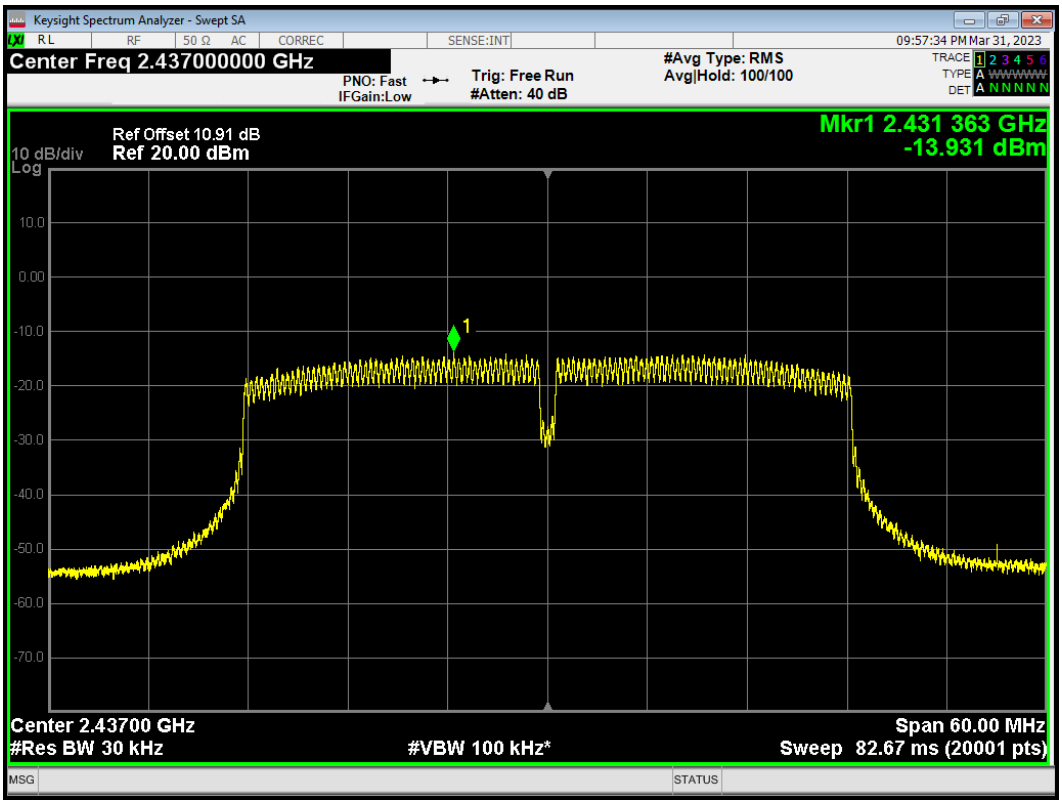
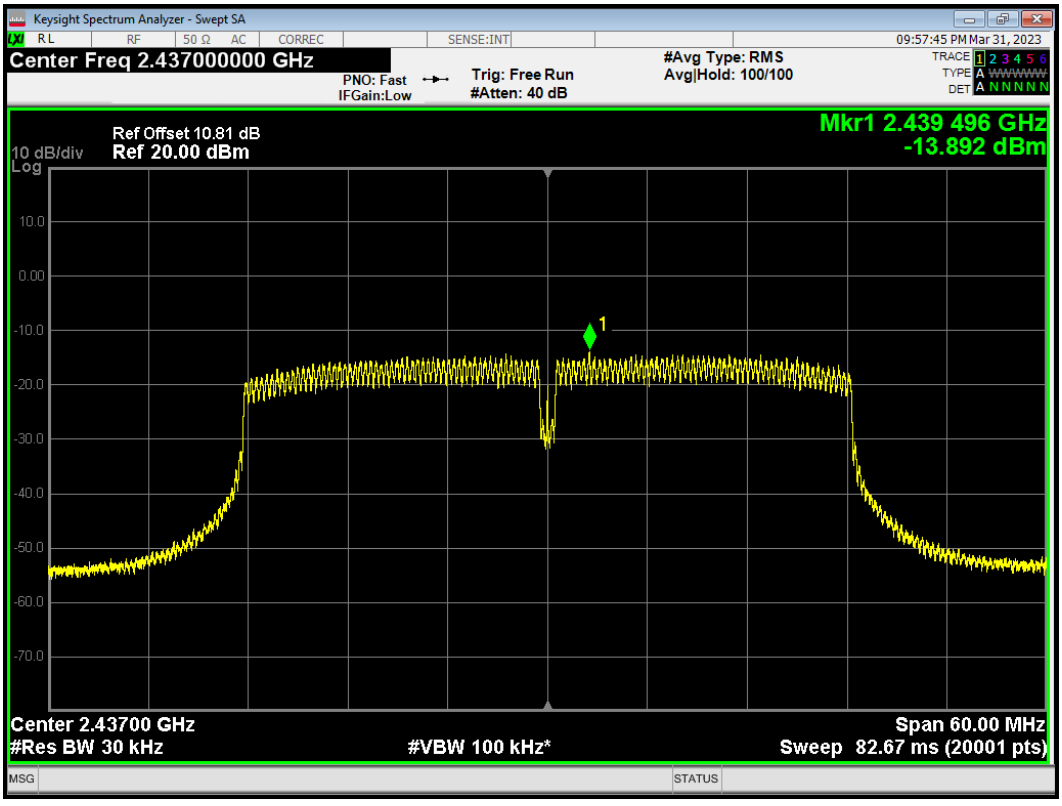
PSD 802.11n(HT40) 2437MHz



PSD 802.11n(HT40) 2437MHz Ant2



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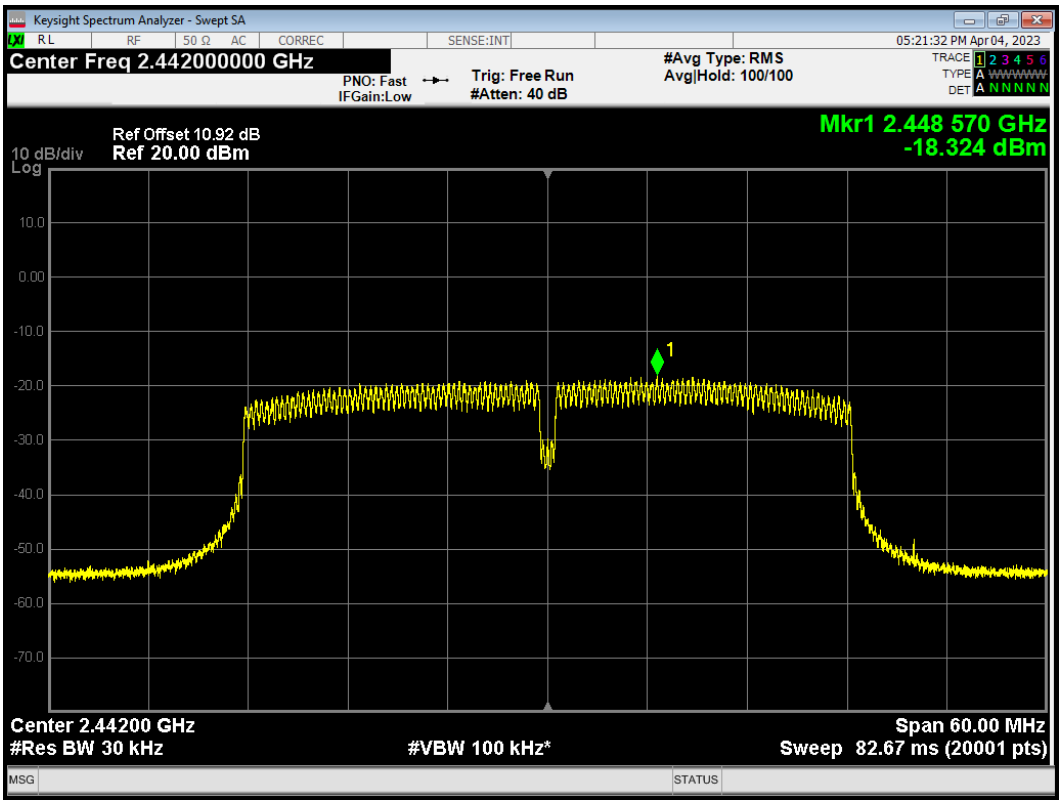
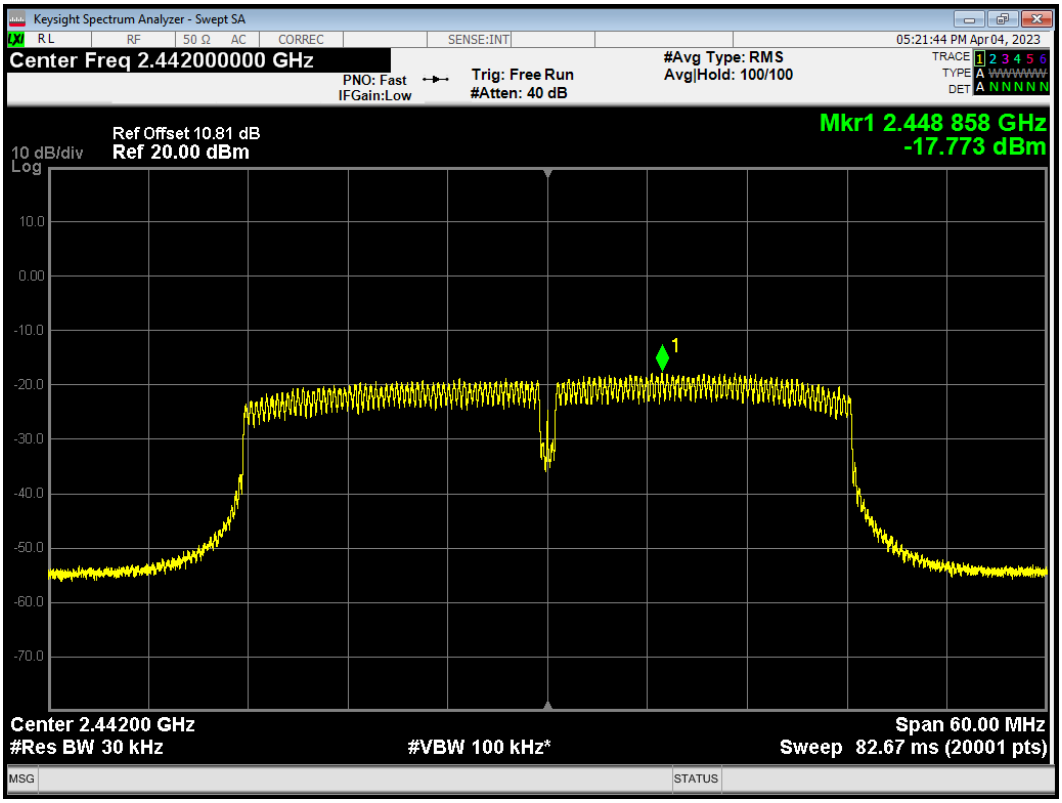
PSD 802.11n(HT40) 2442MHz



PSD 802.11n(HT40) 2442MHz Ant2



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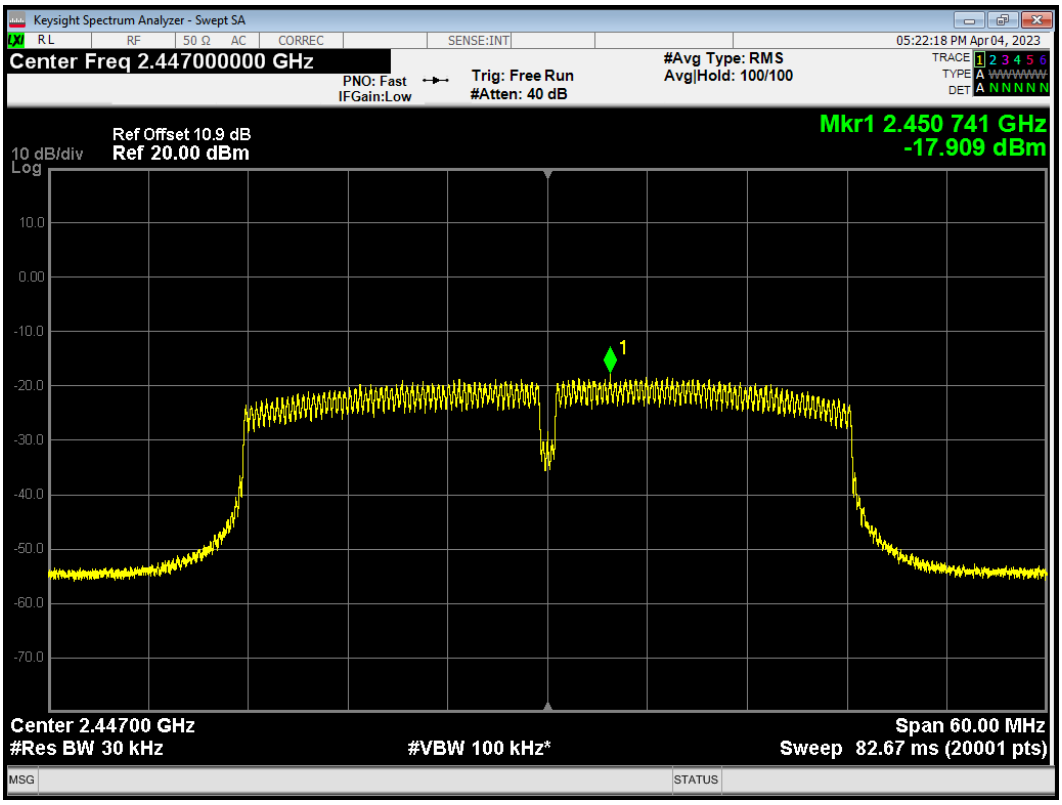
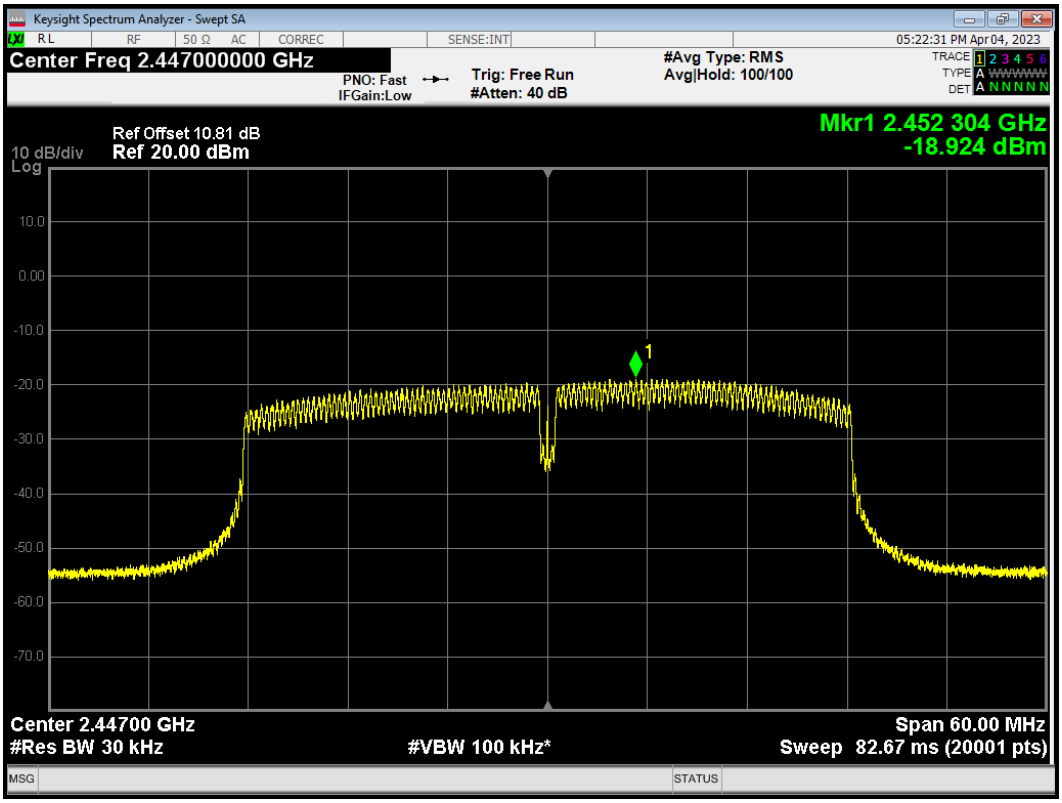
PSD 802.11n(HT40) 2447MHz



PSD 802.11n(HT40) 2447MHz Ant2



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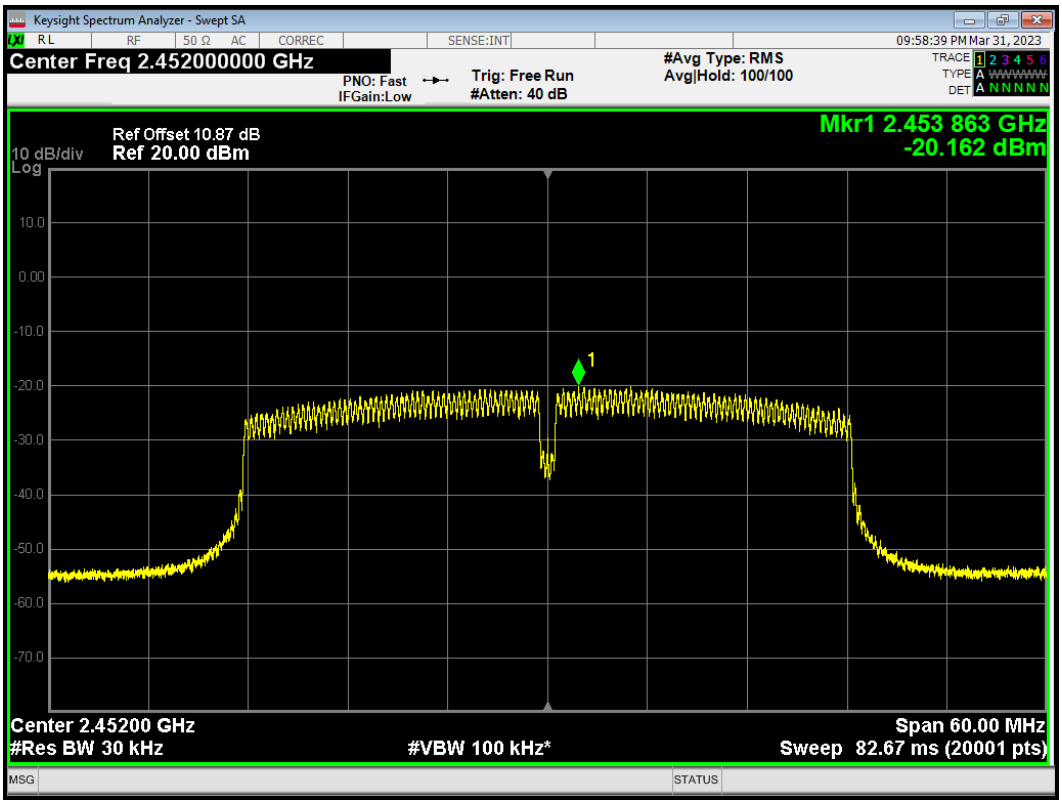
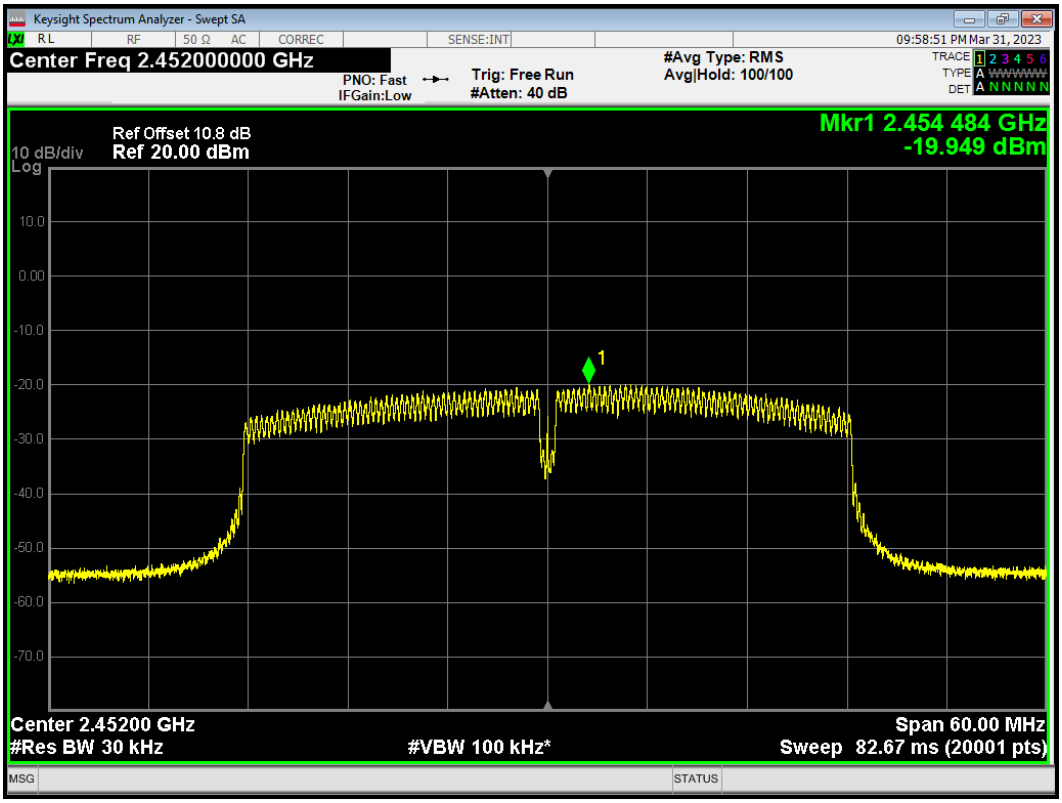
PSD 802.11n(HT40) 2452MHz



PSD 802.11n(HT40) 2452MHz Ant2



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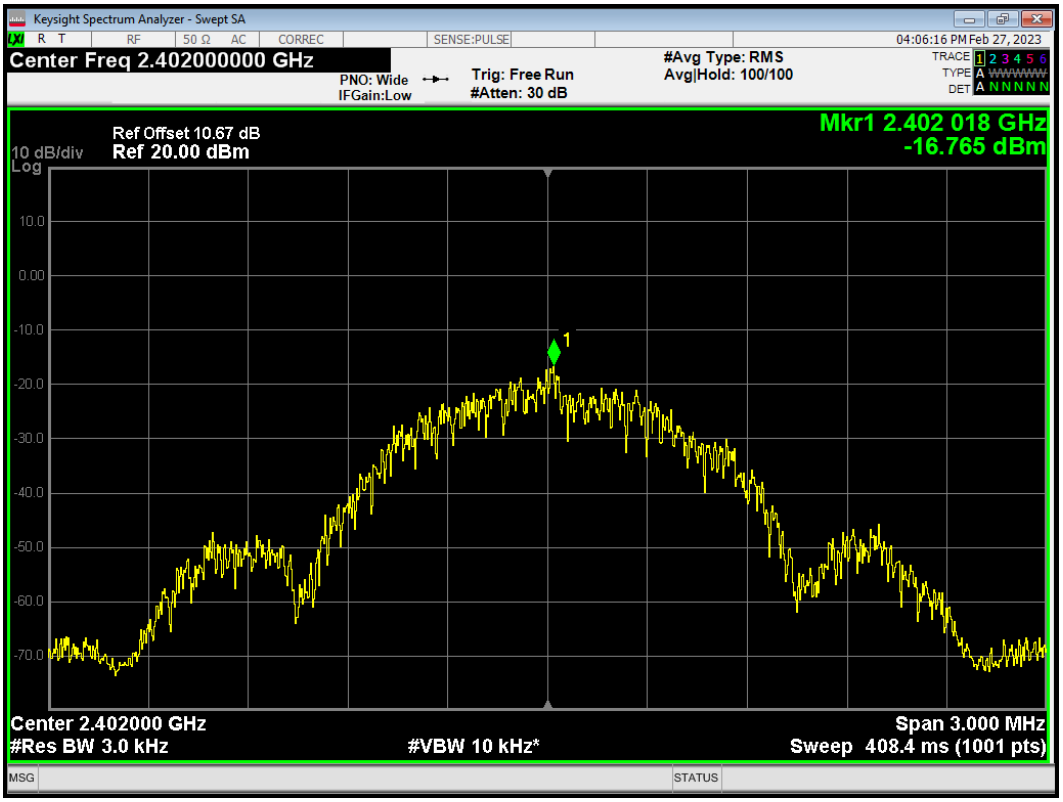
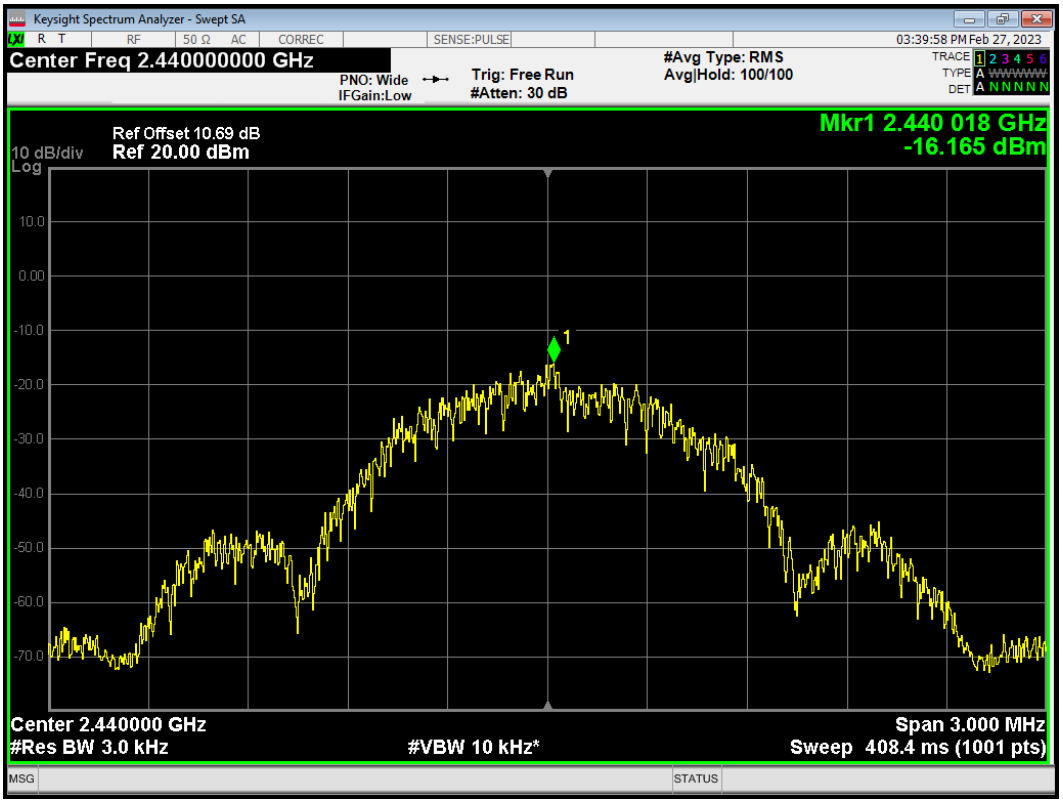
Bluetooth LE

PSD Bluetooth LE 2402MHz



PSD Bluetooth LE 2440MHz



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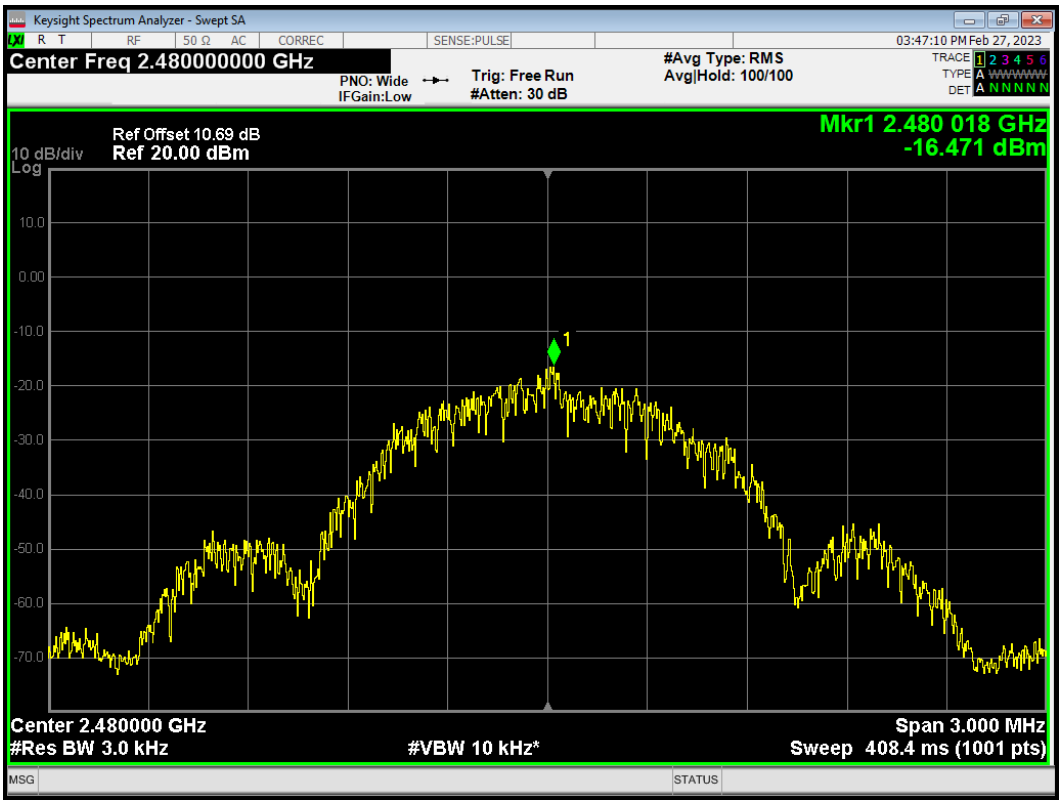
PSD Bluetooth LE 2480MHz



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