RF TEST REPORT

Applicant	Xiaomi Communications Co., Ltd.
FCC ID	2AFZZRA68G
Product	Mobile Phone
Brand	Redmi
Model	23117RA68G
Report No.	R2309A0986-R5
Issue Date	October 24, 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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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 6.9	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: September 23, 2023 ~ October 7, 2023 Date of Sample Received: September 20, 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

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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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E-mail:	xukai@ta-shanghai.com

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2. General Description of Equipment Under Test

2.1. Applicant and Manufacturer Information

Applicant	Xiaomi Communications Co., Ltd.
Applicant address	#019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085
Manufacturer	Xiaomi Communications Co., Ltd.
Manufacturer address	#019, 9th Floor, Building 6, 33 Xi'erqi Middle Road, Haidian District, Beijing, China, 100085

2.2. General Information

EUT Description			
Model	23117RA68G		
IMEI	Conducted	IMEI 1: 863357060096302 IMEI 2: 863357060096310	
	Radiated	Radiated Emission	IMEI 1: 863357060105648 IMEI 2: 863357060105655
		Conducted Emission	IMEI 1: 863357060104481 IMEI 2: 863357060106499
Hardware Version	135100N6M0A01		
Software Version	MIUI 14		
Antenna Type	PIFA Antenna		
Antenna Connector	A permanently attached antenna (meet with the standard FCC Part 15.203 requirement)		
Antenna Gain	-3.6 dBi		
Additional Beamforming Gain	NA		
Operating Frequency Range(s)	802.11b/g/n(HT20): 2412 ~ 2462 MHz Bluetooth LE V5.2: 2402 ~2480 MHz		
Modulation Type	802.11b: DSSS 802.11g/n: OFDM Bluetooth LE: GFSK		
Max. Output Power	Wi-Fi 2.4G: 18.83 dBm Bluetooth LE: -1.01 dBm		
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.			

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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

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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 (Y 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(Low Energy)	1Mbps; 2Mbps
Bluetooth (Low Energy) (S=2)	500kbps
Bluetooth (Low Energy) (S=8)	125kbps
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0

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5. Test Case Results

5.1. Maximum output power

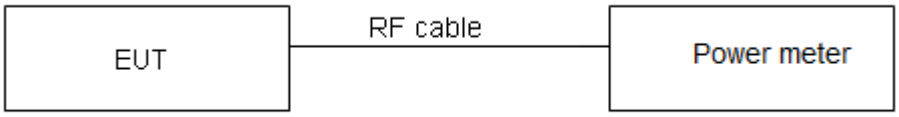
Ambient Condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

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.

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

Bluetooth LE Power setting: default

Power Index			
Channel	**802.11b**	**802.11g**	**802.11n HT20**
CH1	19	18	18
CH6	19	18	18
CH11	19	18	18

Test Mode	Duty cycle	Duty cycle correction Factor (dB)
802.11b	0.997	0.000
802.11g	0.977	0.100
802.11n HT20	0.975	0.110
Bluetooth LE (1M)	0.851	0.700
Bluetooth LE (2M)	0.571	2.430
Bluetooth LE (S=2)	0.910	0.410
Bluetooth LE (S=8)	0.974	0.110
Note: when Duty cycle⩾0.98, Duty cycle correction Factor not required.		

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Test Mode	Carrier frequency (MHz))/ Channel	Average Power Measured (dBm)	Average Power with duty factor (dBm)	Limit (dBm)	Conclusion
802.11b	2412/CH 1	18.76	18.76	30	PASS
	2437/CH 6	18.83	18.83	30	PASS
	2462/CH11	18.73	18.73	30	PASS
802.11g	2412/CH 1	17.61	17.71	30	PASS
	2437/CH 6	17.95	18.05	30	PASS
	2462/CH11	17.81	17.92	30	PASS
802.11n HT20	2412/CH 1	17.51	17.62	30	PASS
	2437/CH 6	17.73	17.84	30	PASS
	2462/CH11	17.42	17.53	30	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	-2.59	-1.89	30	PASS
	2440/CH19	-1.71	-1.01	30	PASS
	2480/CH39	-2.22	-1.52	30	PASS
Bluetooth (Low Energy) (2M)	2404/CH1	-4.29	-1.86	30	PASS
	2440/CH19	-3.58	-1.15	30	PASS
	2478/CH38	-3.99	-1.56	30	PASS
Bluetooth (Low Energy) (S=2)	2402/CH0	-2.38	-1.97	30	PASS
	2440/CH19	-1.46	-1.05	30	PASS
	2480/CH39	-2.17	-1.76	30	PASS
Bluetooth (Low Energy) (S=8)	2402/CH0	-2.08	-1.97	30	PASS
	2440/CH19	-1.17	-1.06	30	PASS
	2480/CH39	-1.80	-1.69	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

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5.2. 99% Bandwidth and 6dB Bandwidth

Ambient Condition

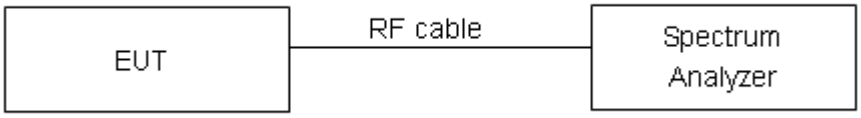
Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

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	12.995	7.569	500	PASS
	2437	13.079	9.040	500	PASS
	2462	13.159	7.528	500	PASS
802.11g	2412	16.651	14.229	500	PASS
	2437	16.591	14.113	500	PASS
	2462	16.692	15.406	500	PASS
802.11n HT20	2412	17.739	15.918	500	PASS
	2437	17.700	15.112	500	PASS
	2462	17.763	14.988	500	PASS
Bluetooth (Low Energy) (1M)	2402	1.042	0.680	500	PASS
	2440	1.044	0.659	500	PASS
	2480	1.042	0.662	500	PASS
Bluetooth (Low Energy) (2M)	2404	2.080	1.268	500	PASS
	2440	2.079	1.308	500	PASS
	2478	2.087	1.166	500	PASS
Bluetooth (Low Energy) (S=2)	2402	1.031	0.690	500	PASS
	2440	1.029	0.665	500	PASS
	2480	1.022	0.675	500	PASS
Bluetooth (Low Energy) (S=8)	2402	1.057	0.683	500	PASS
	2440	1.054	0.682	500	PASS
	2480	1.059	0.682	500	PASS

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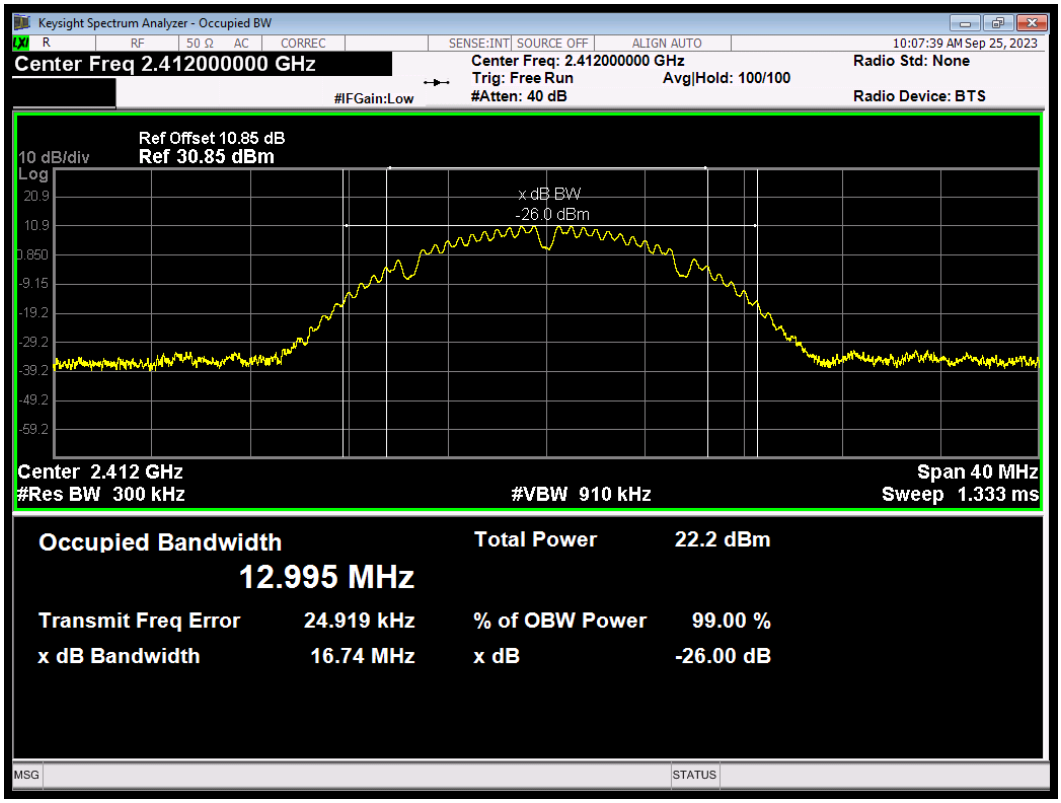
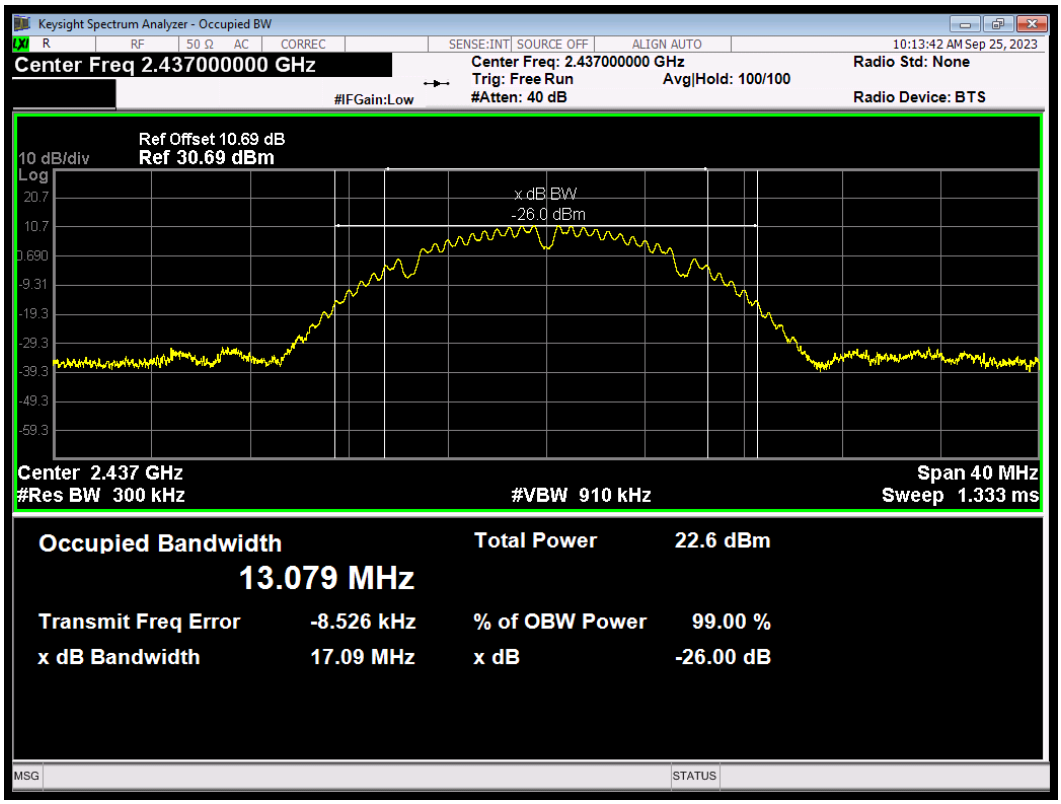
99%bandwidth

OBW 802.11b 2412MHz



OBW 802.11b 2437MHz



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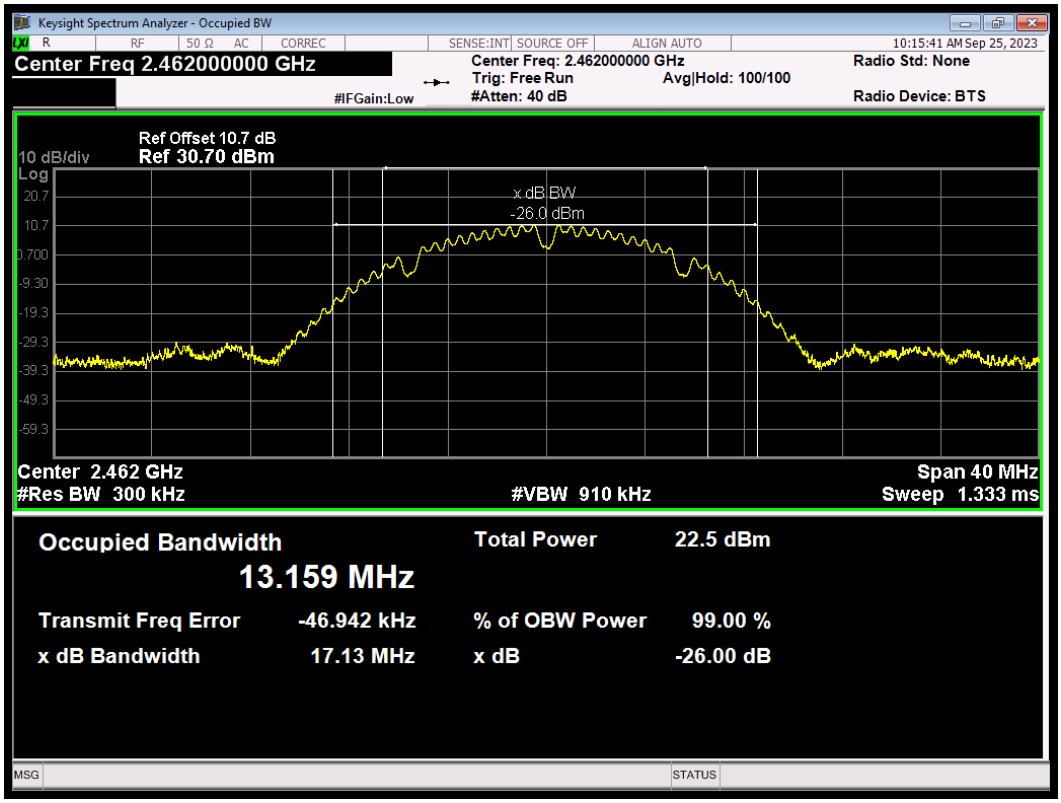
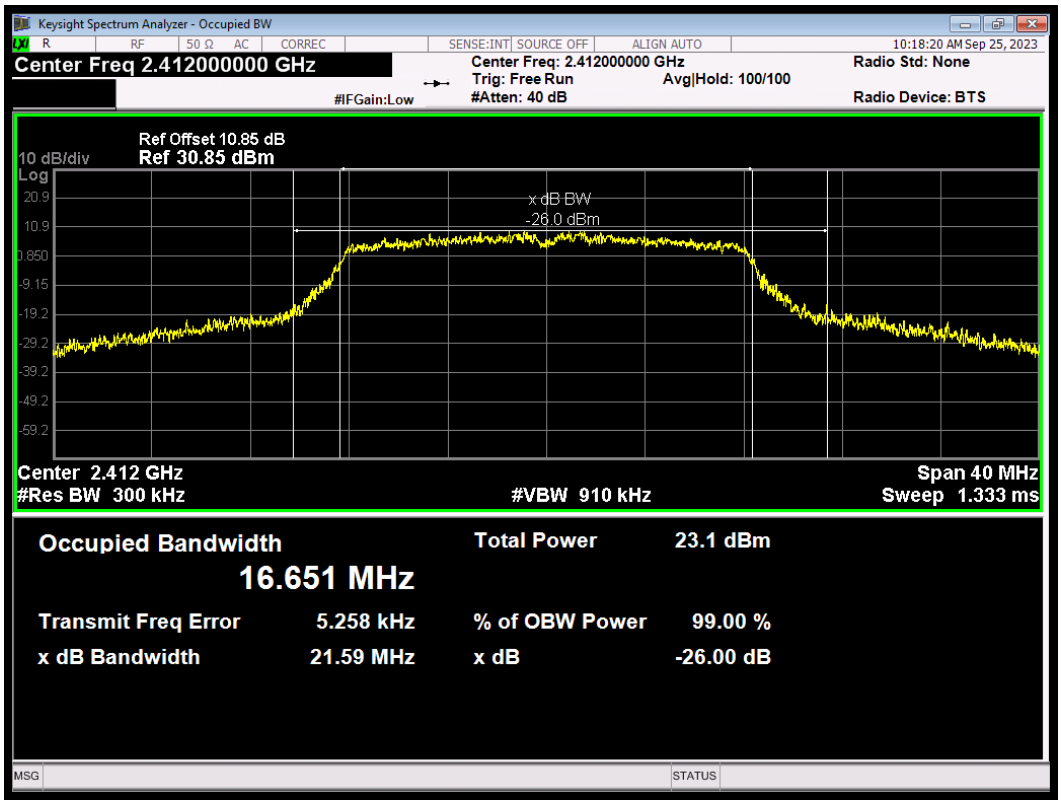
OBW 802.11b 2462MHz



OBW 802.11g 2412MHz



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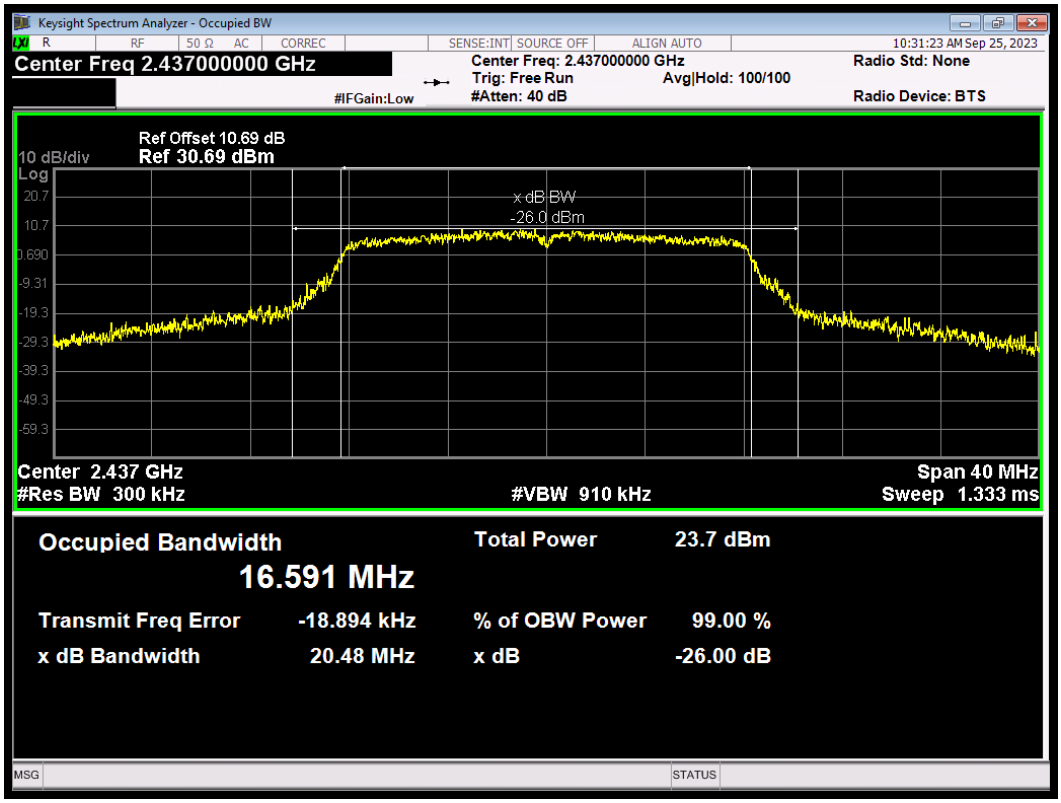
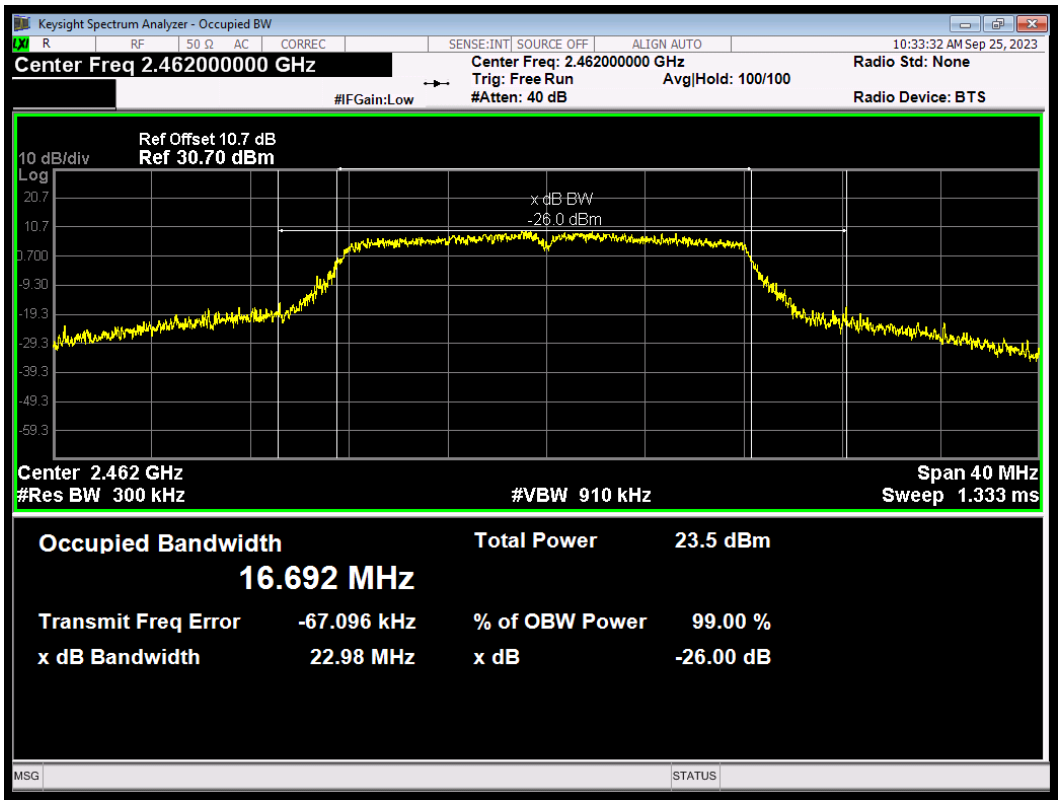
OBW 802.11g 2437MHz



OBW 802.11g 2462MHz



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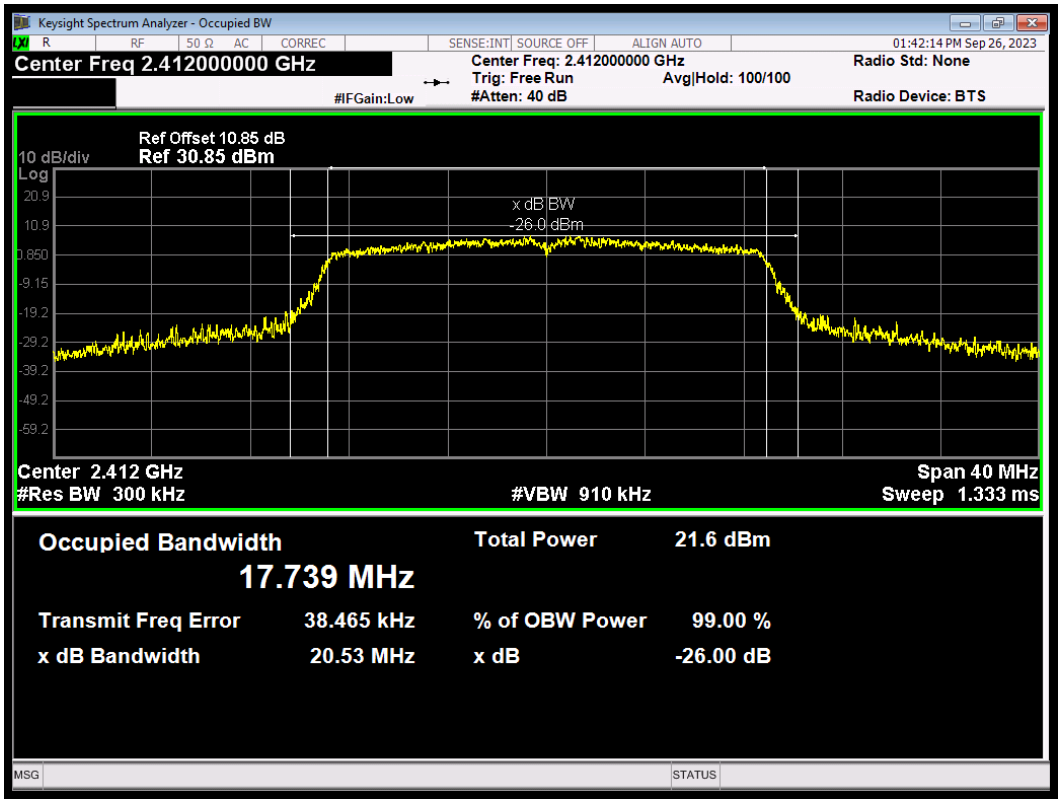
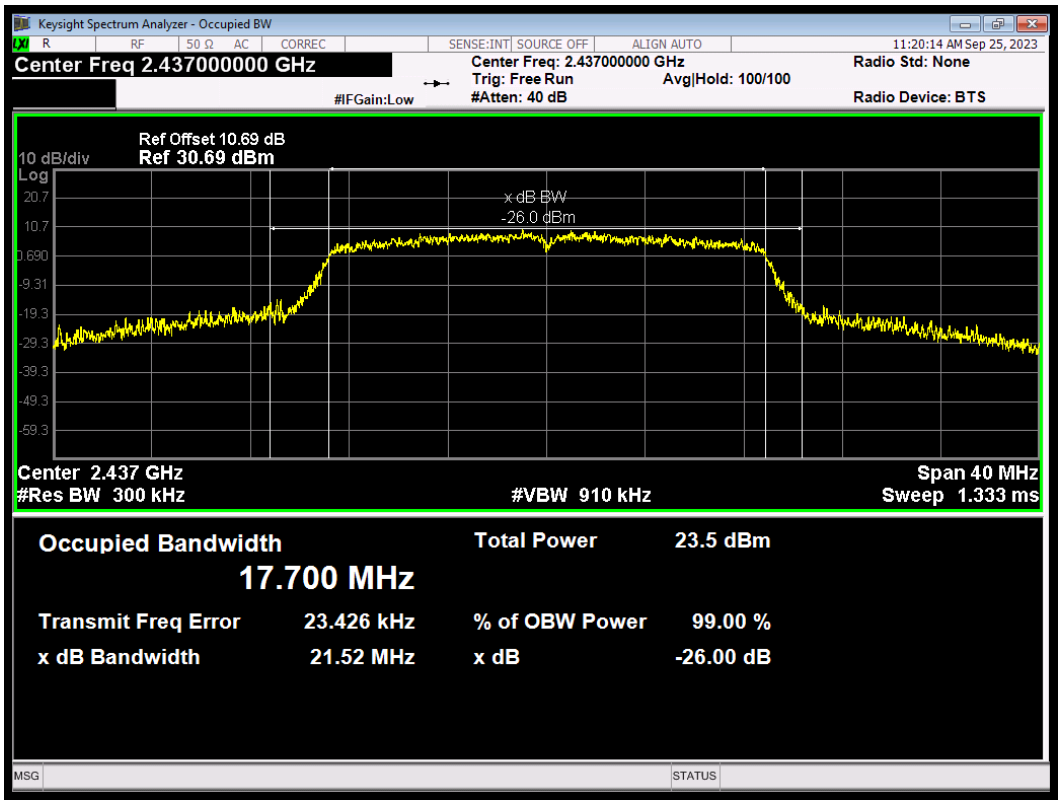
OBW 802.11n(HT20) 2412MHz



OBW 802.11n(HT20) 2437MHz



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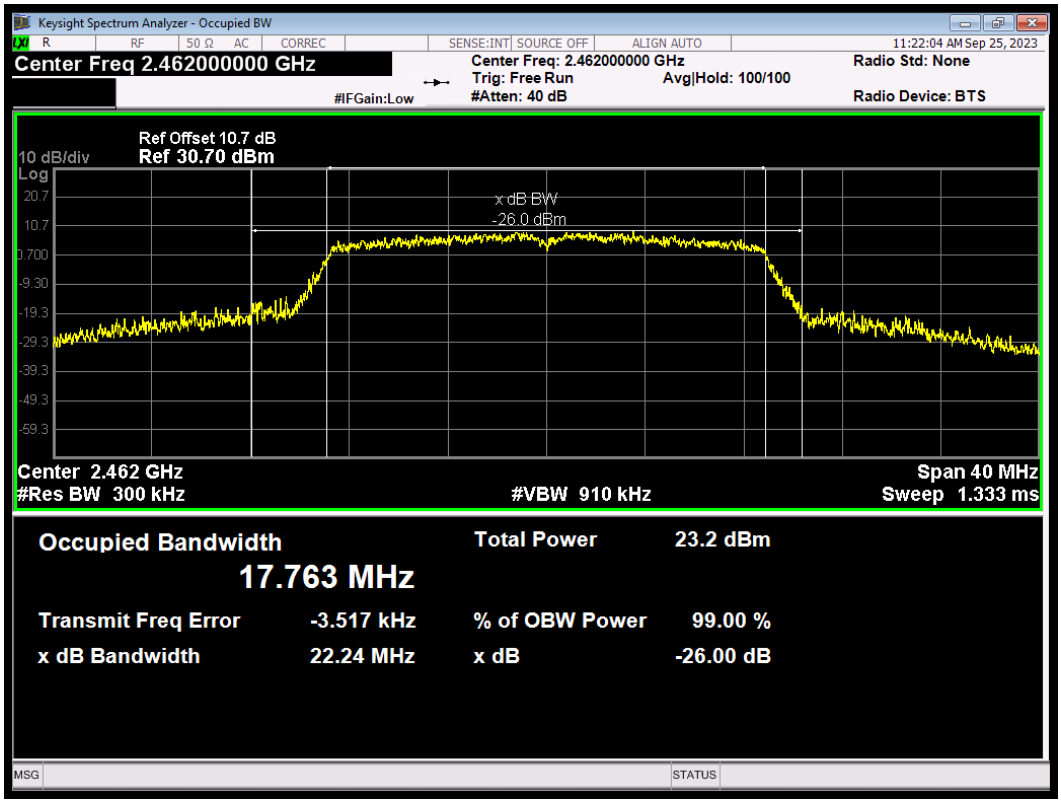
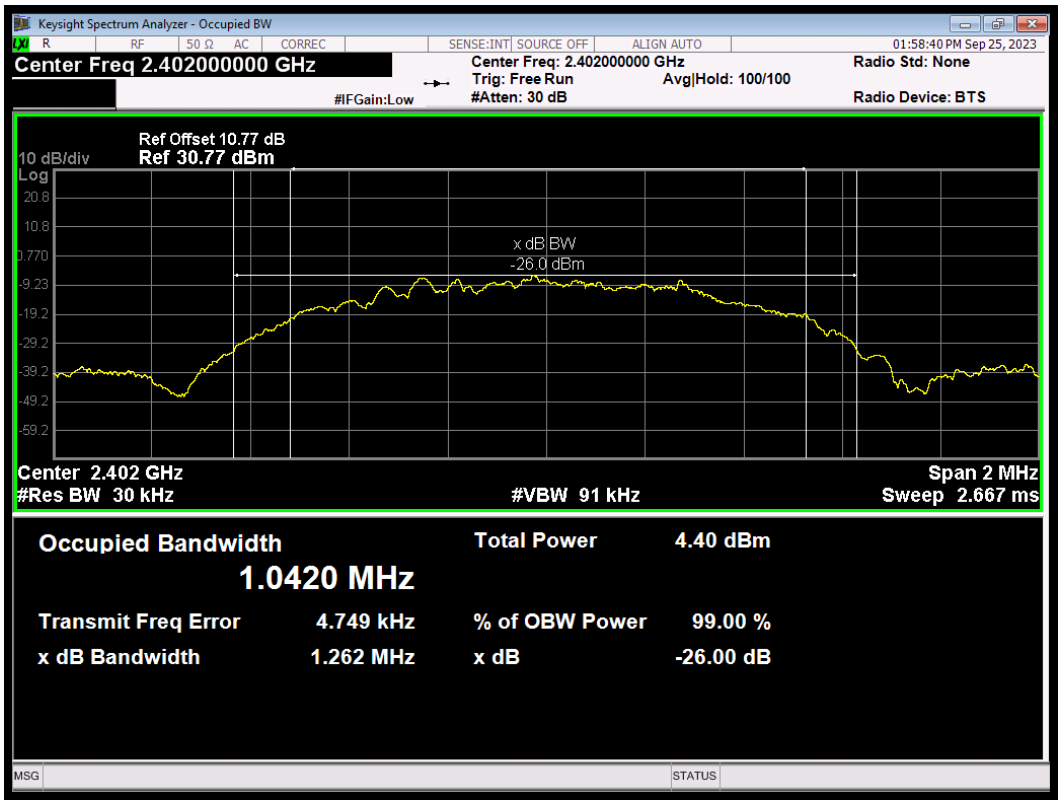
OBW 802.11n(HT20) 2462MHz



OBW BLE (1M) 2402MHz



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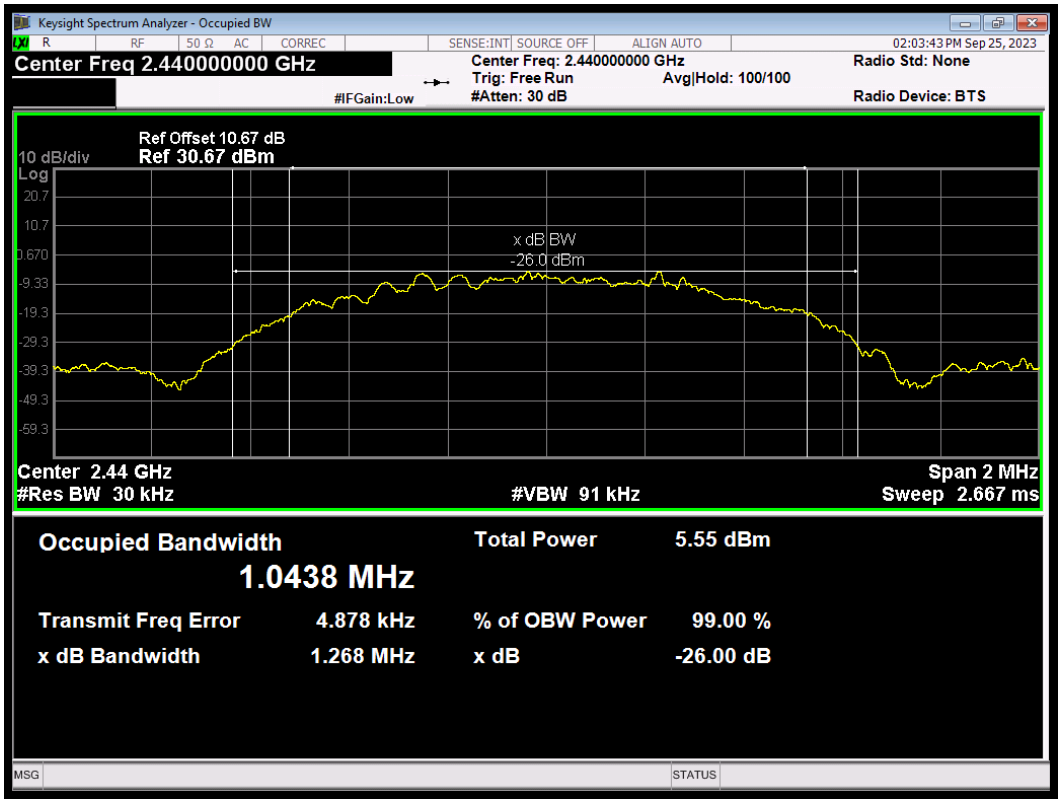
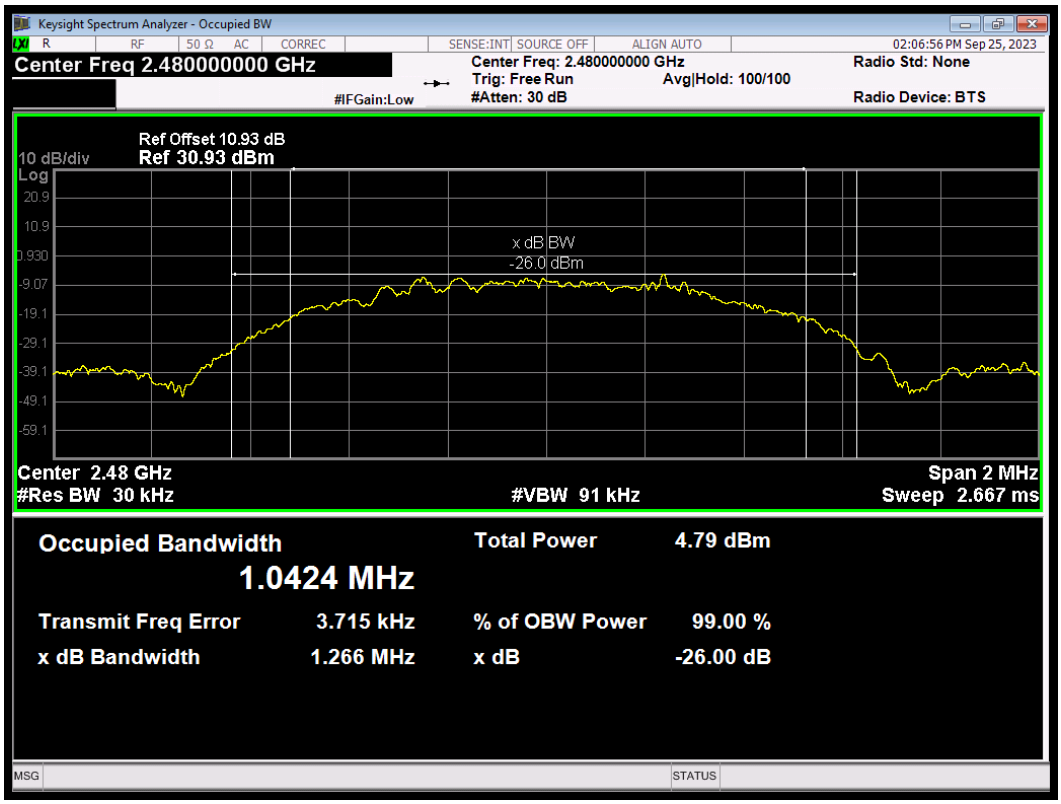
OBW BLE (1M) 2440MHz



OBW BLE (1M) 2480MHz



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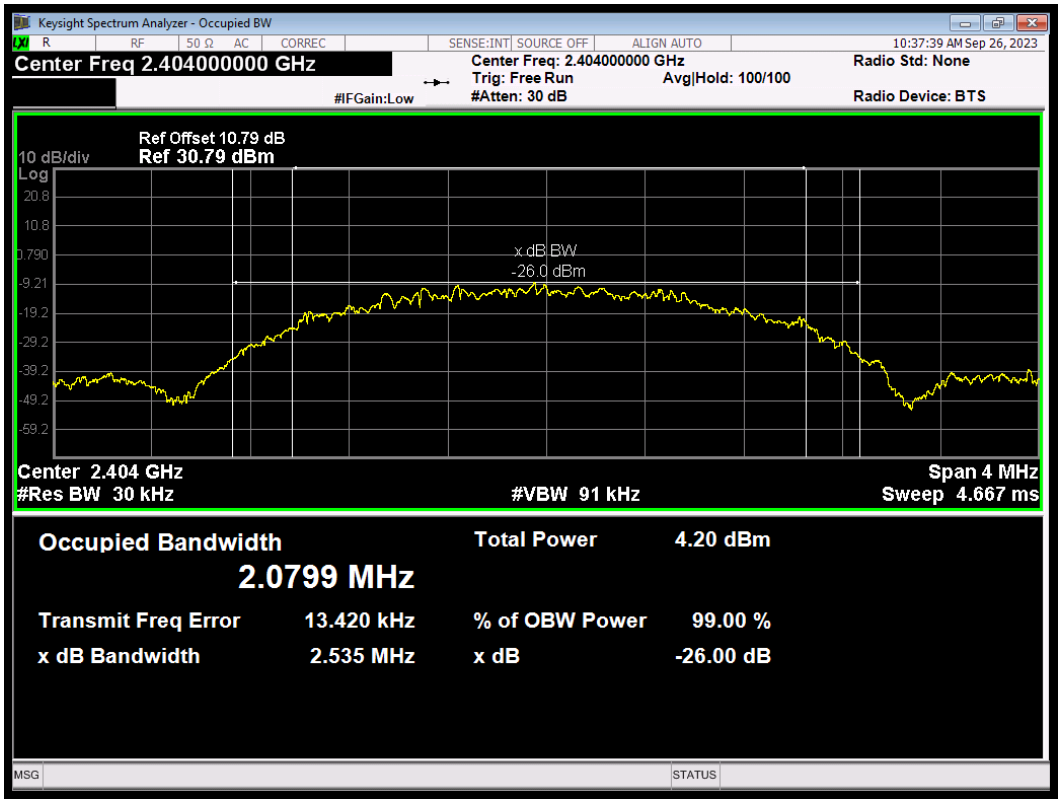
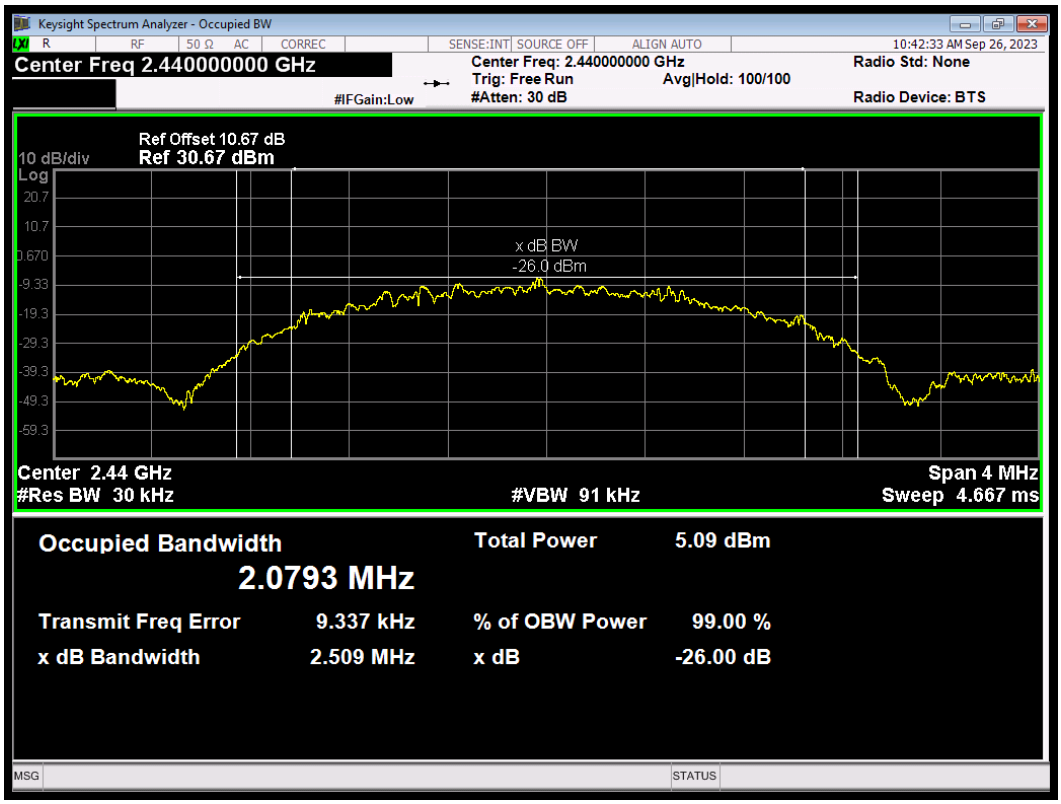
OBW BLE (2M) 2404MHz



OBW BLE (2M) 2440MHz



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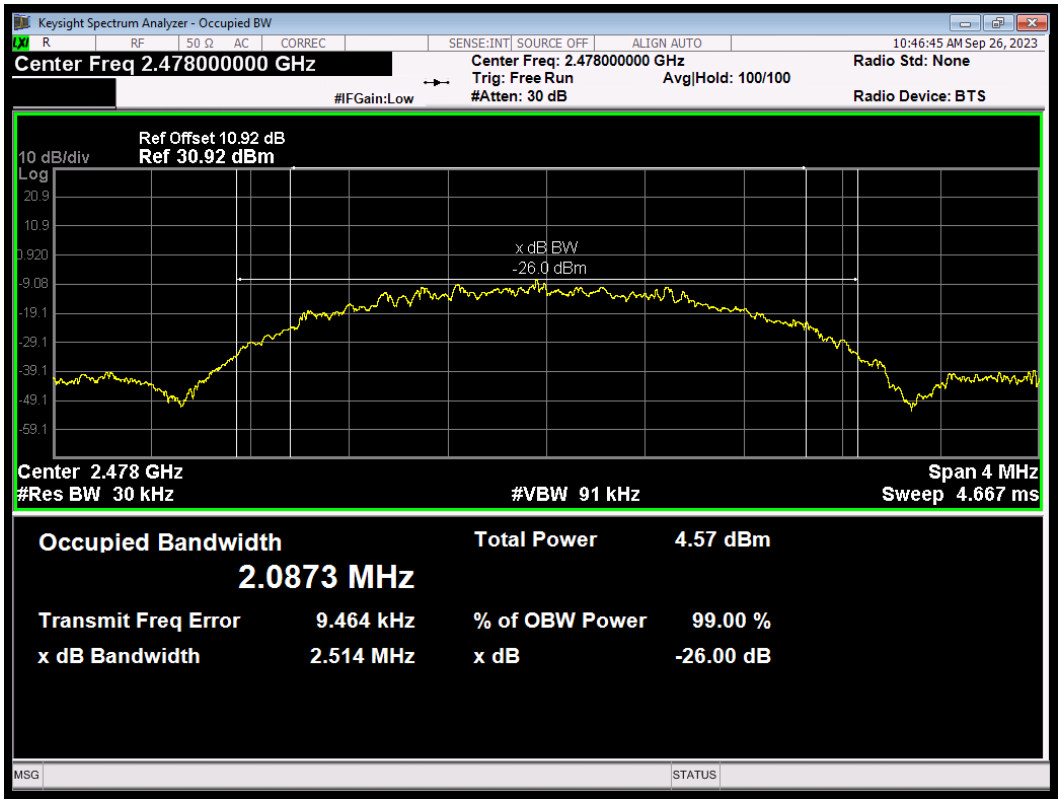
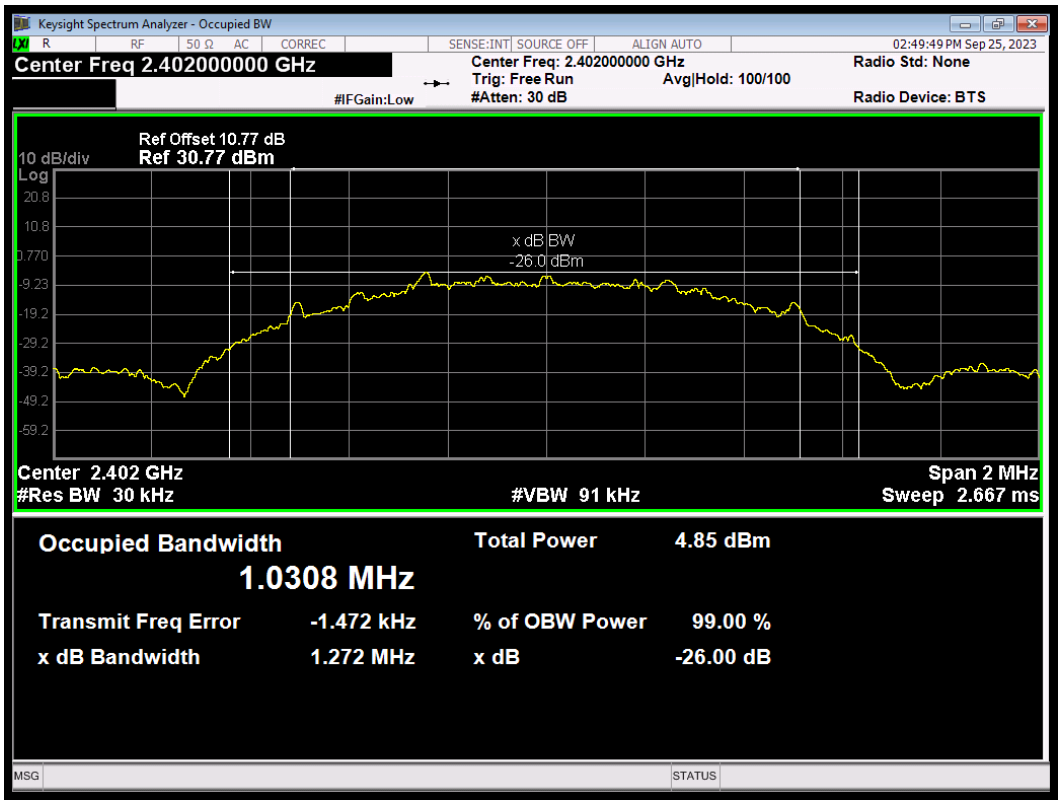
OBW BLE (2M) 2478MHz



OBW BLE (S=2) 2402MHz



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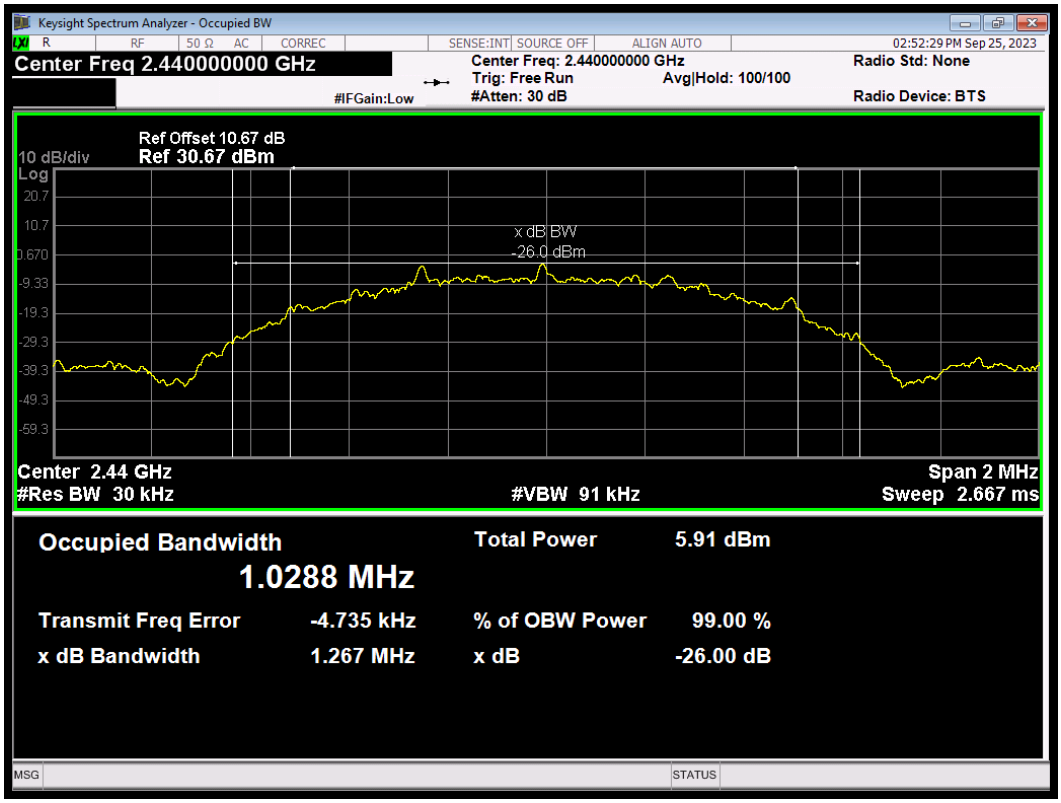
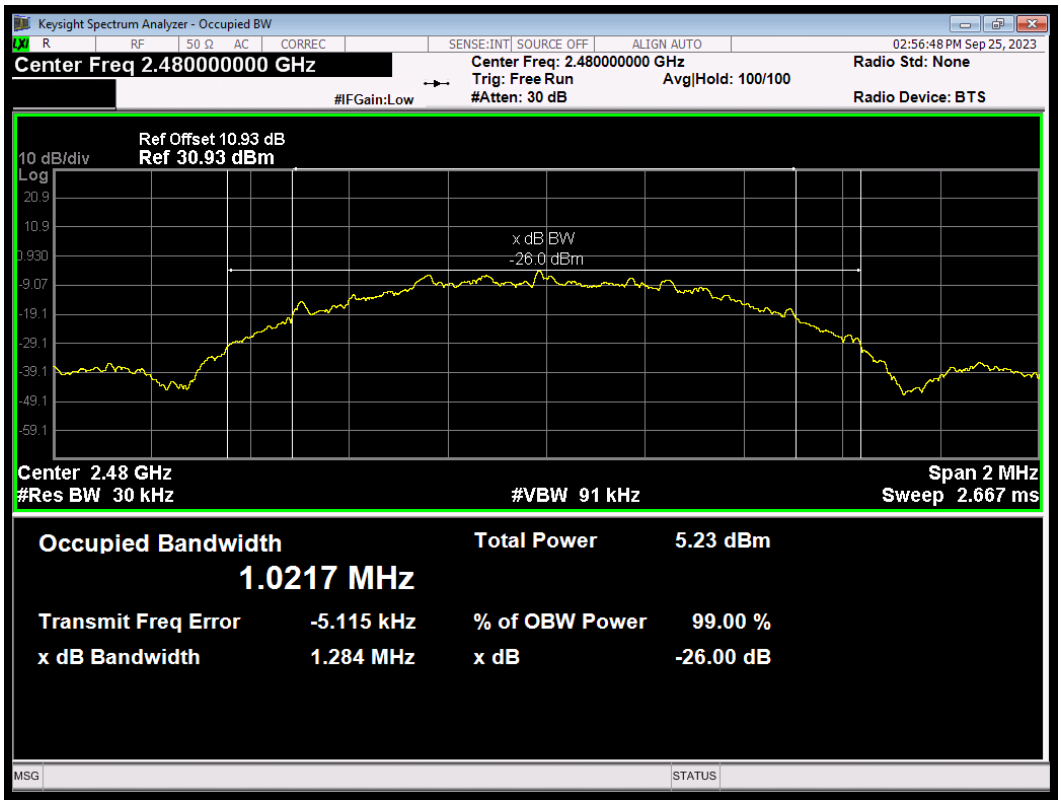
OBW BLE (S=2) 2440MHz



OBW BLE (S=2) 2480MHz



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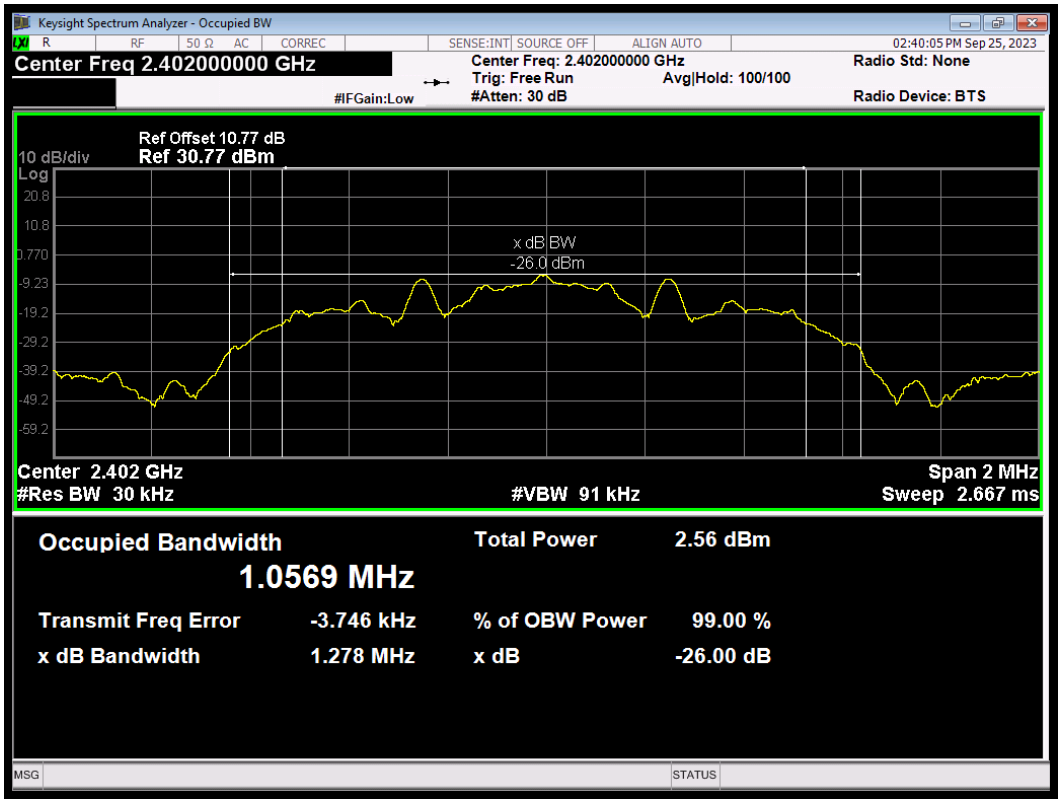
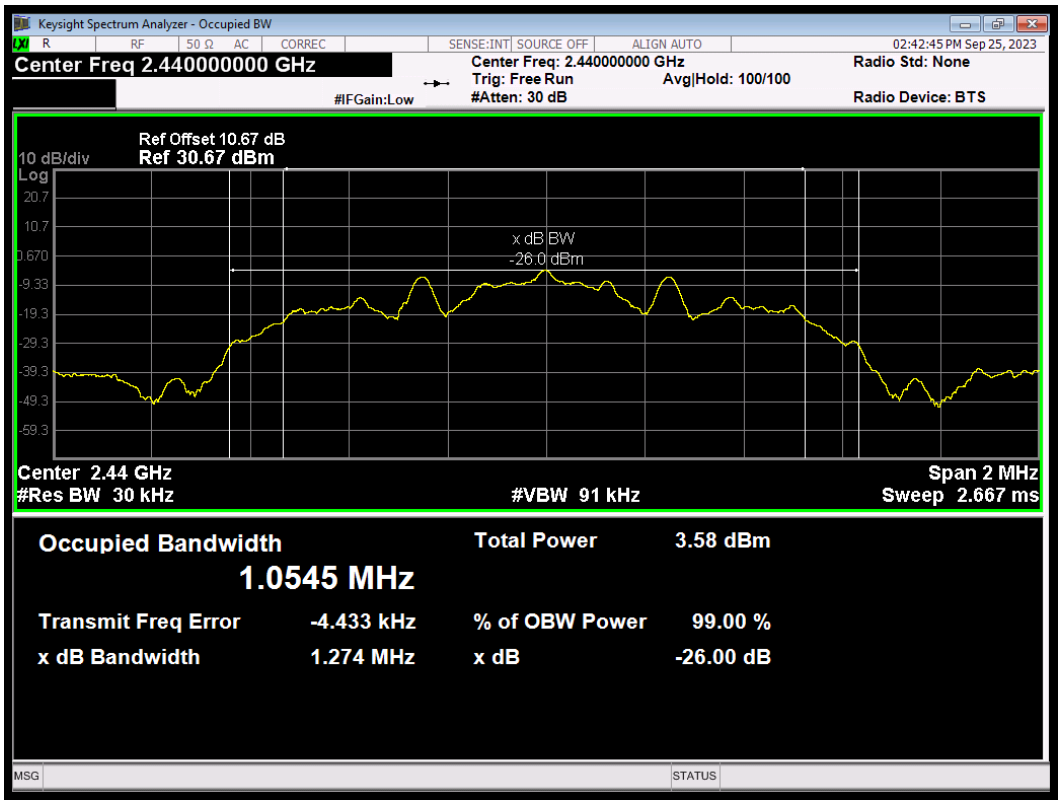
OBW BLE (S=8) 2402MHz



OBW BLE (S=8) 2440MHz



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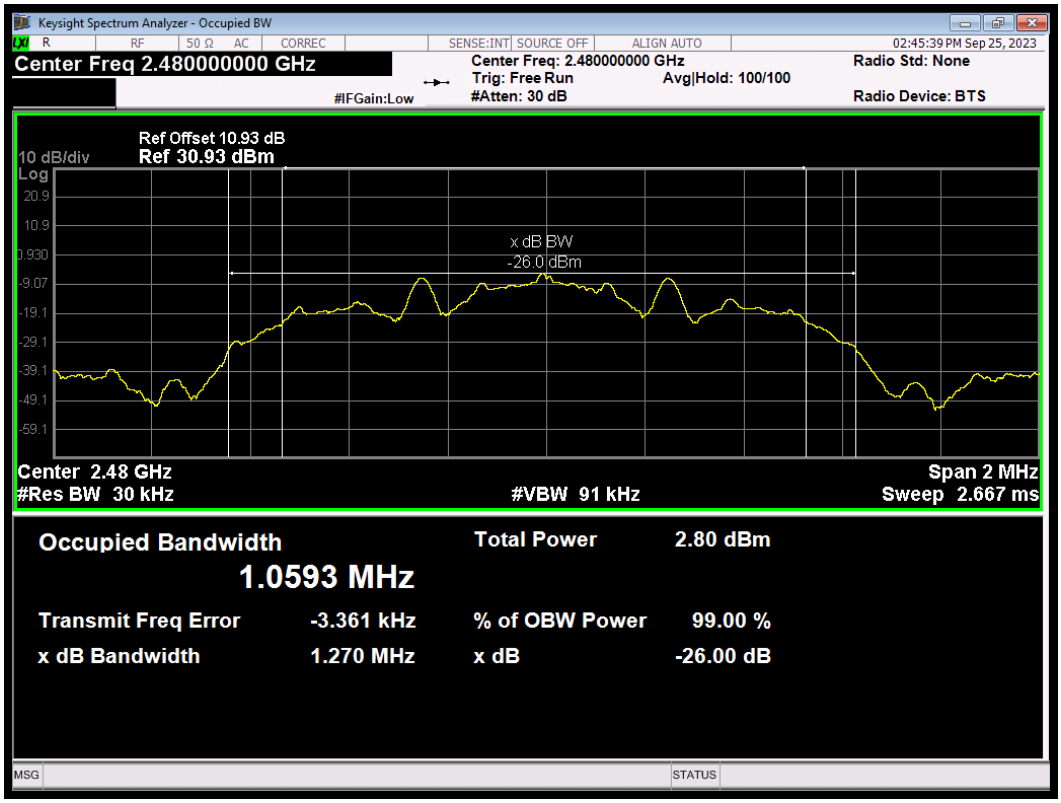
OBW BLE (S=8) 2480MHz



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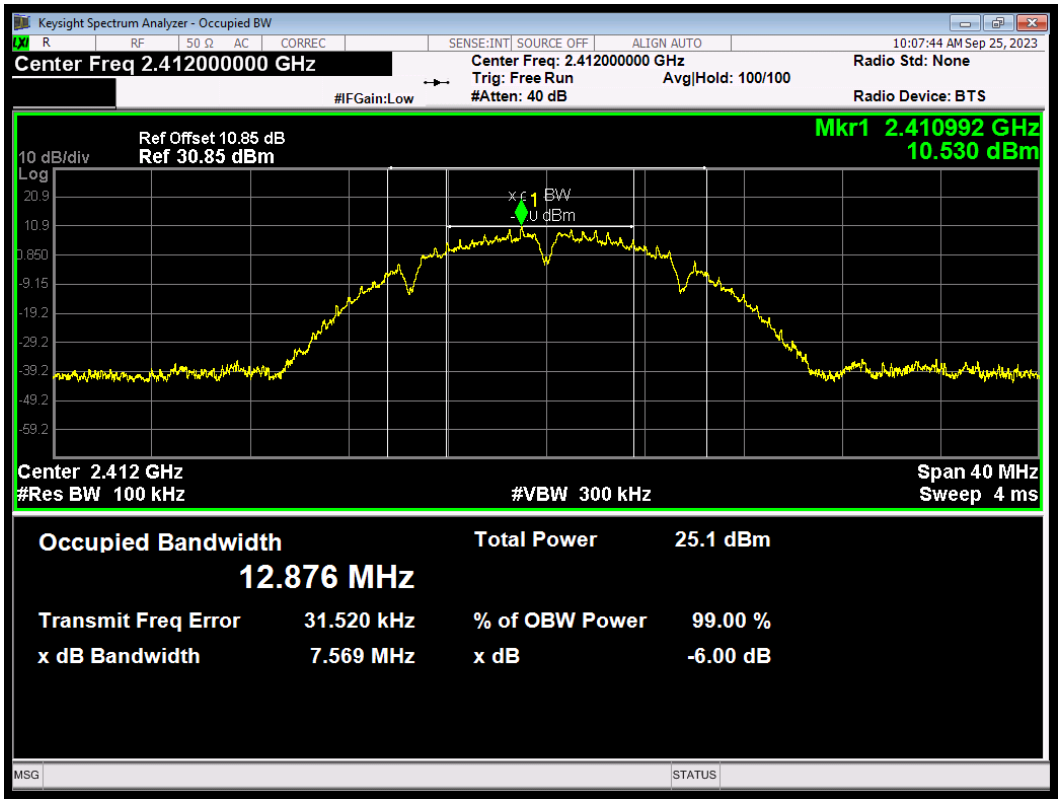
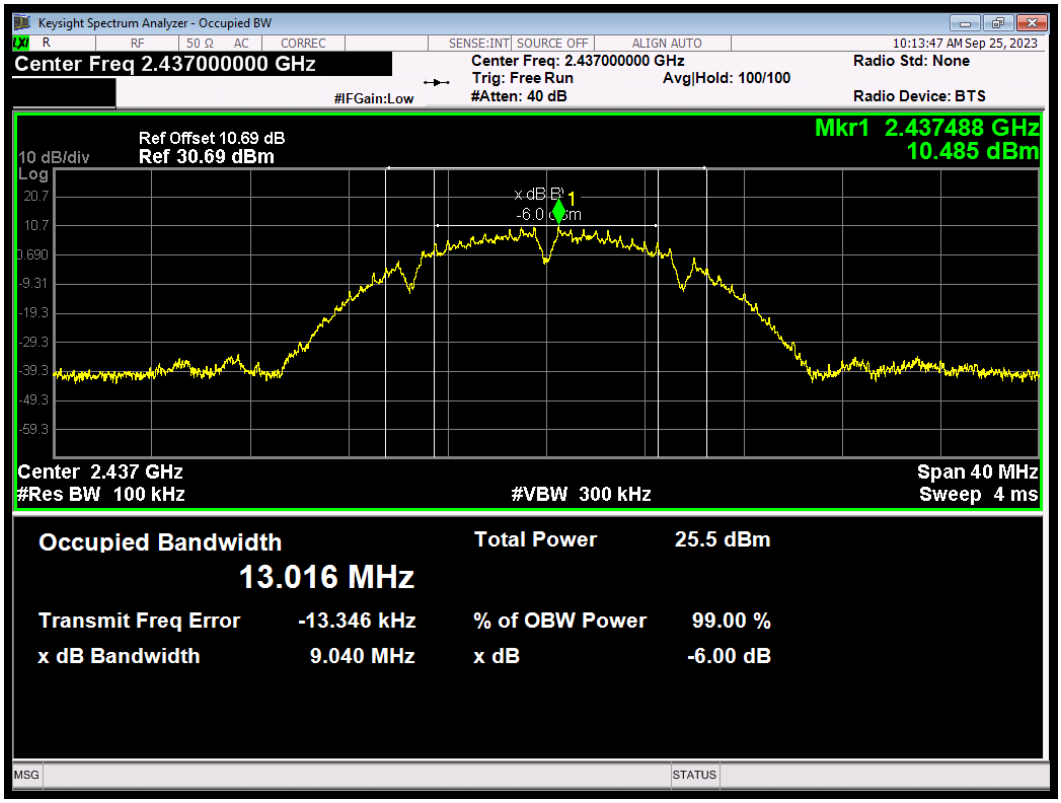
6 dB bandwidth

-6dB Bandwidth 802.11b 2412MHz



-6dB Bandwidth 802.11b 2437MHz



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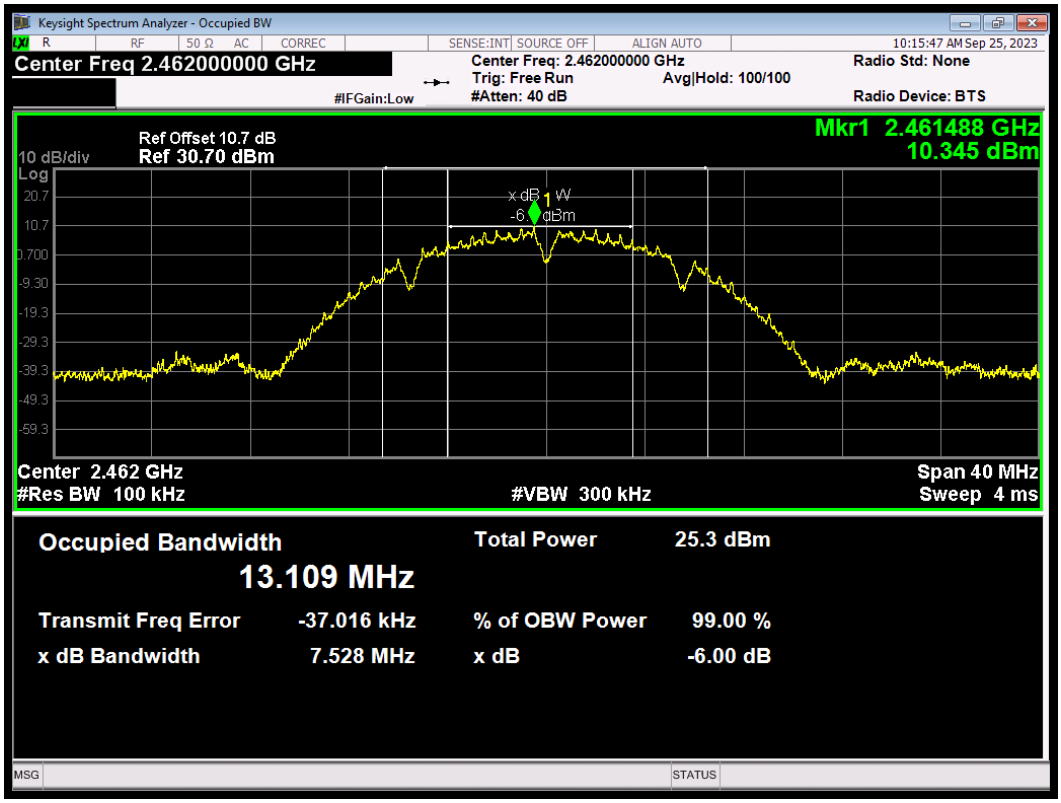
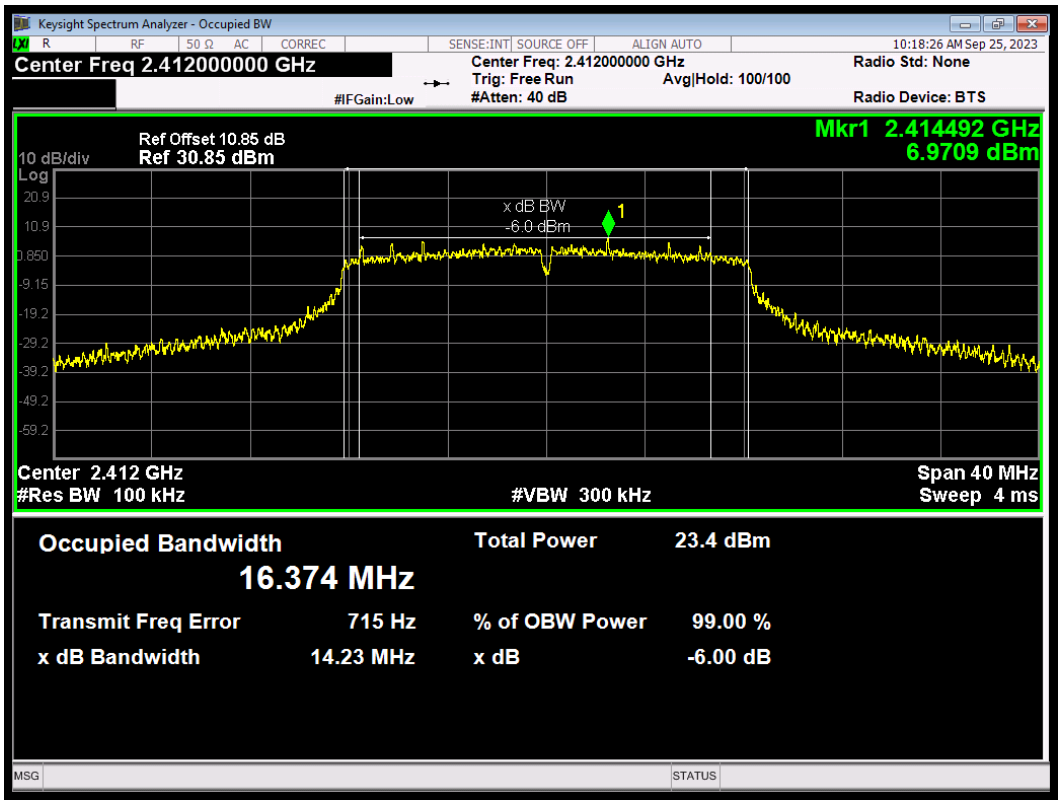
-6dB Bandwidth 802.11b 2462MHz



-6dB Bandwidth 802.11g 2412MHz



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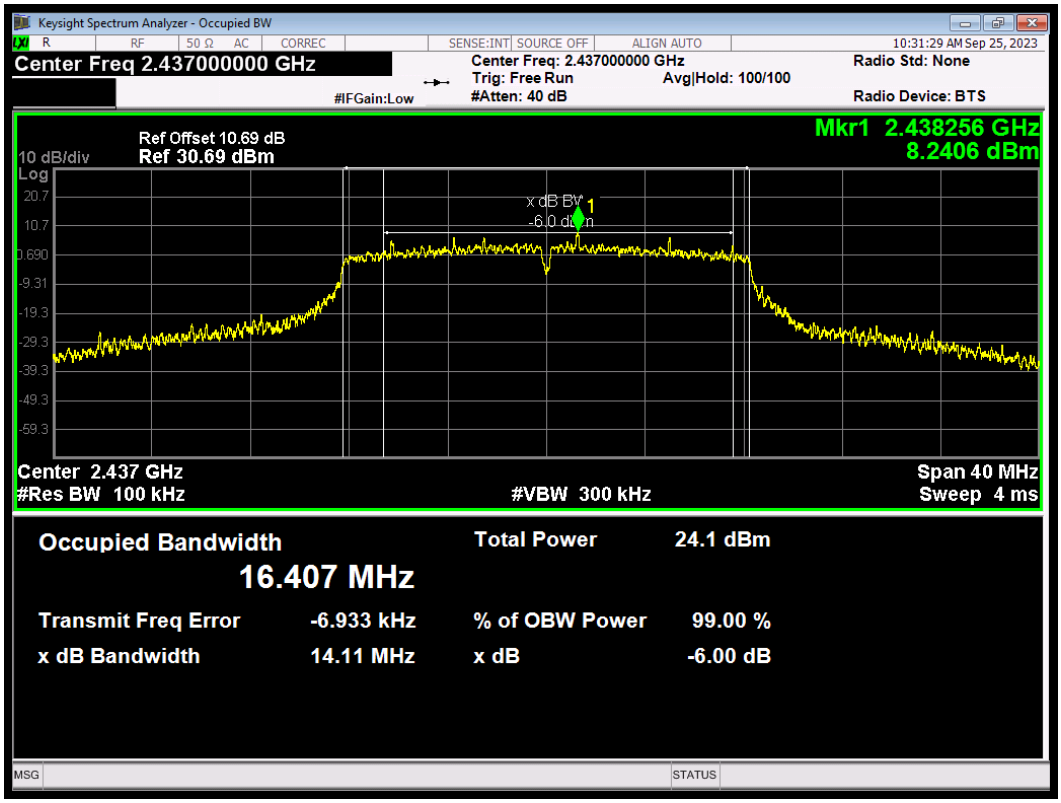
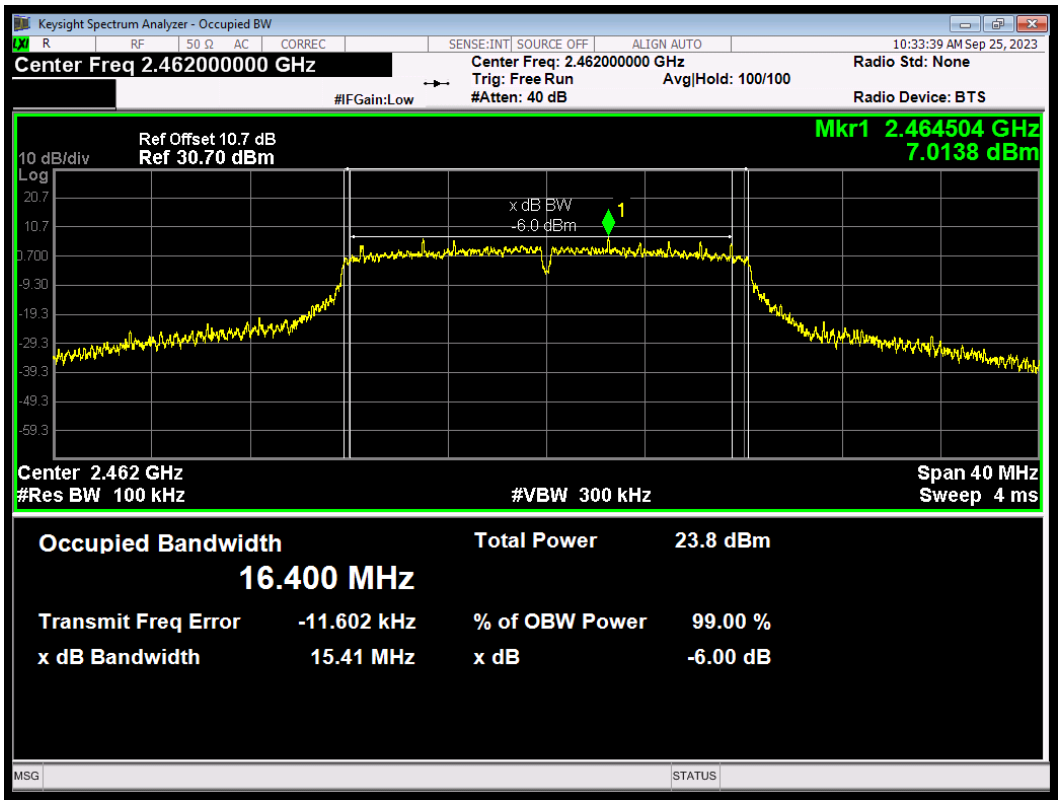
-6dB Bandwidth 802.11g 2437MHz



-6dB Bandwidth 802.11g 2462MHz



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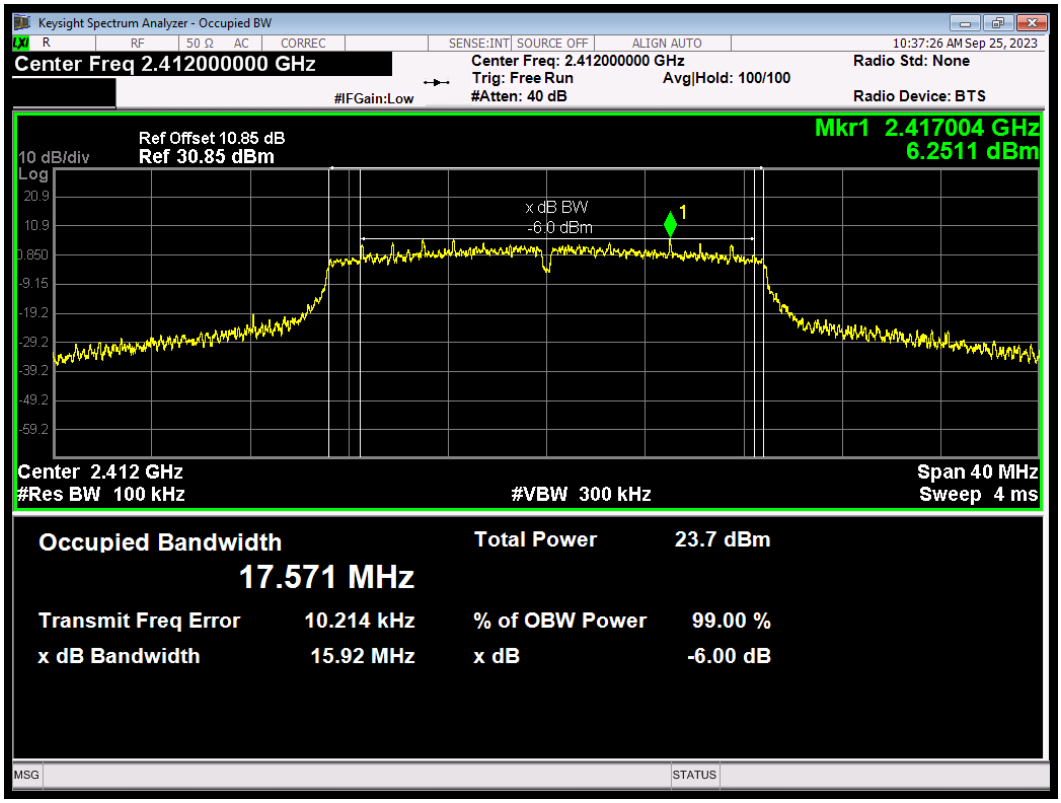
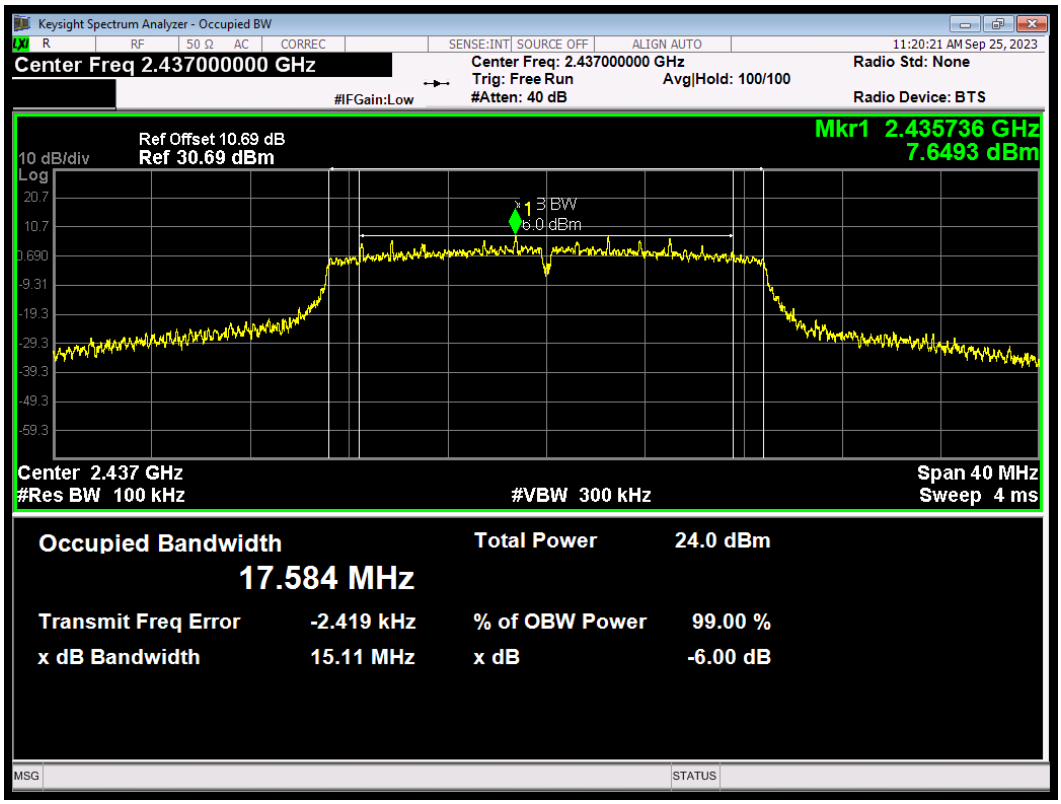
-6dB Bandwidth 802.11n(HT20) 2412MHz



-6dB Bandwidth 802.11n(HT20) 2437MHz



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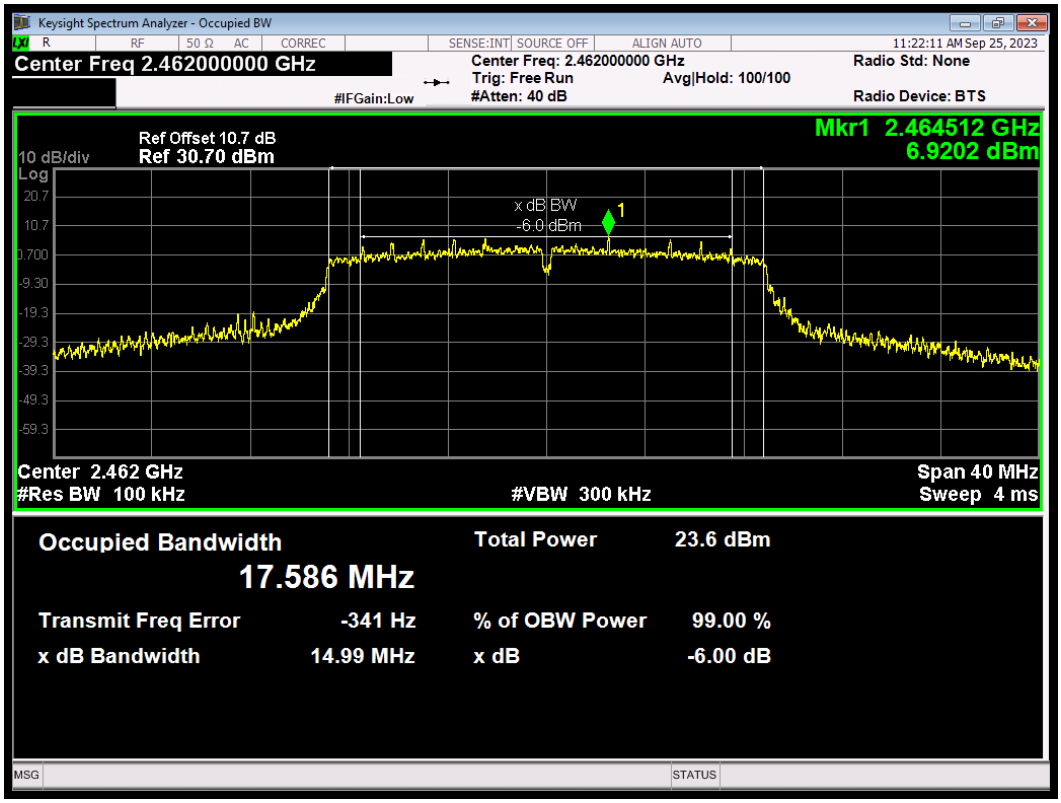
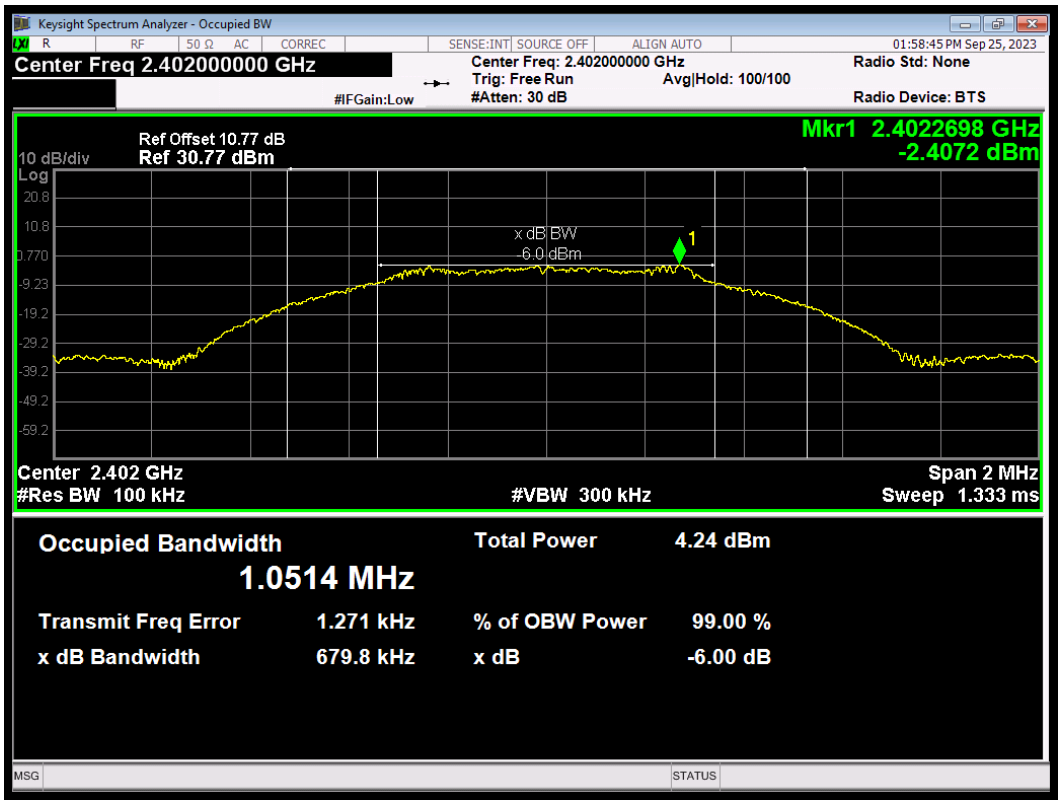
-6dB Bandwidth 802.11n(HT20) 2462MHz



-6dB Bandwidth BLE (1M) 2402MHz



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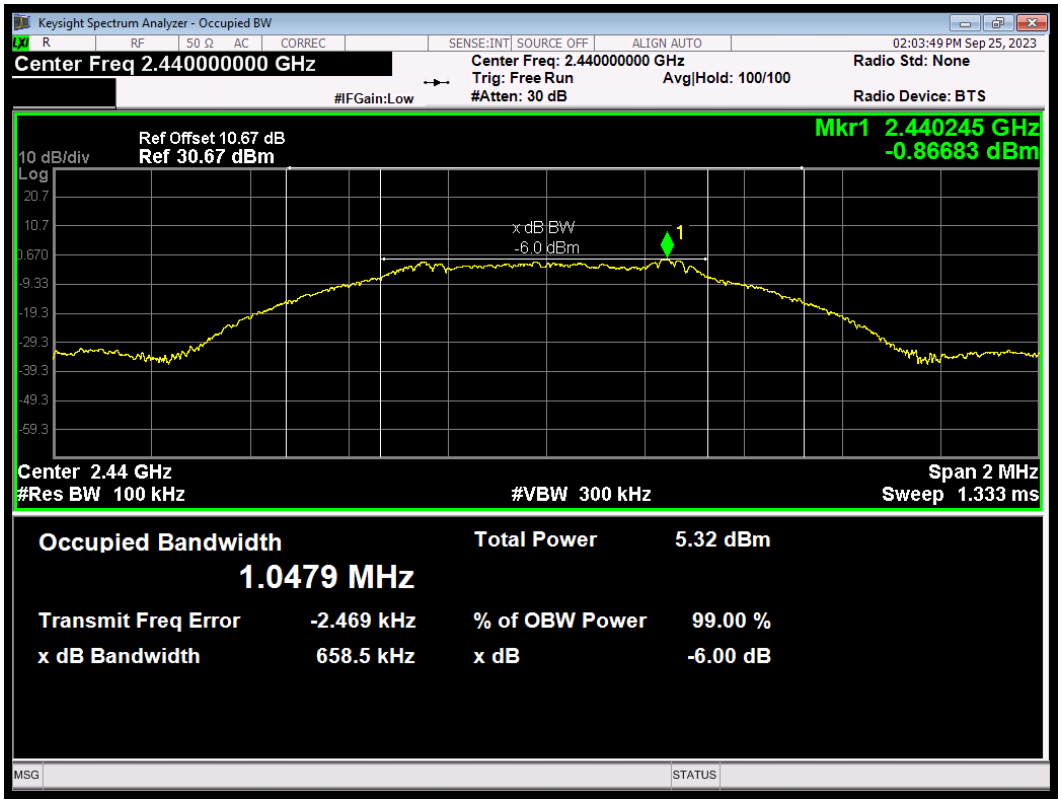
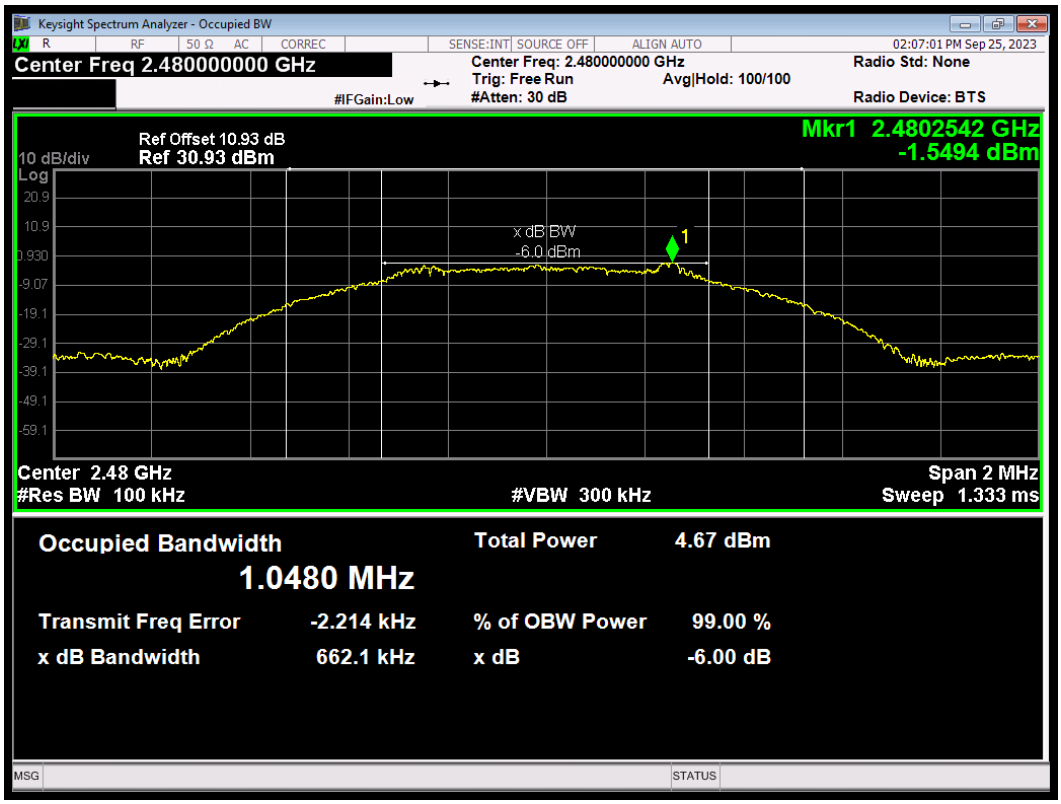
-6dB Bandwidth BLE (1M) 2440MHz



-6dB Bandwidth BLE (1M) 2480MHz



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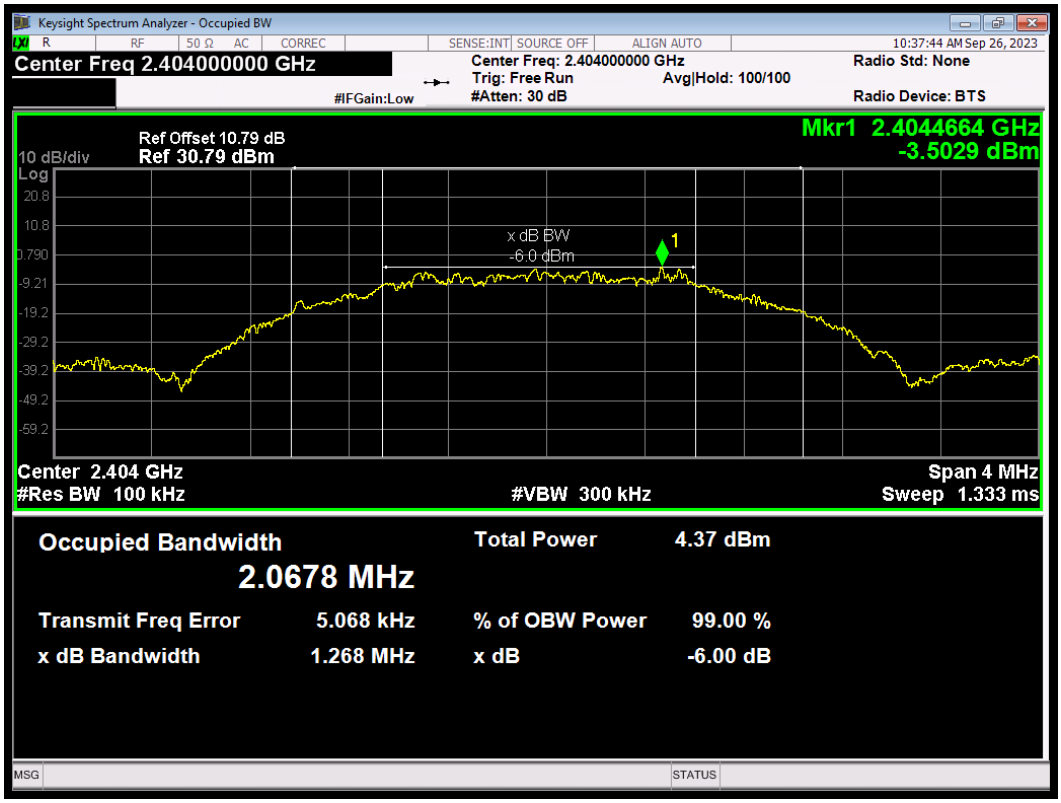
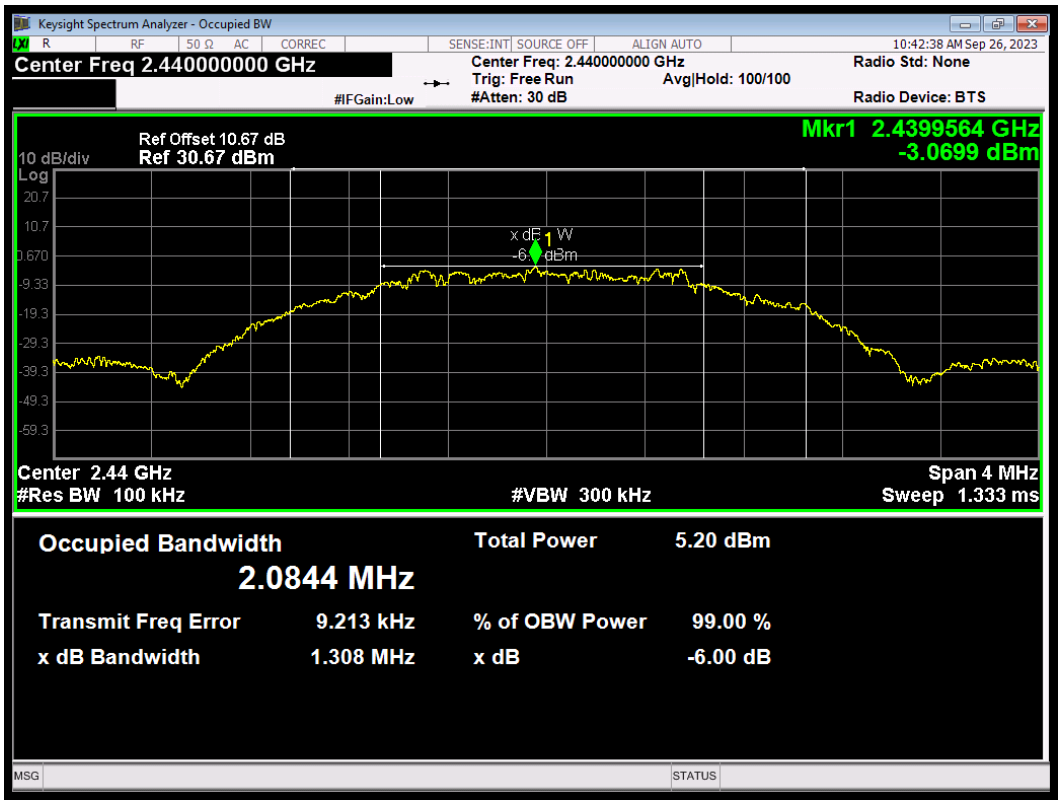
-6dB Bandwidth BLE (2M) 2404MHz



-6dB Bandwidth BLE (2M) 2440MHz



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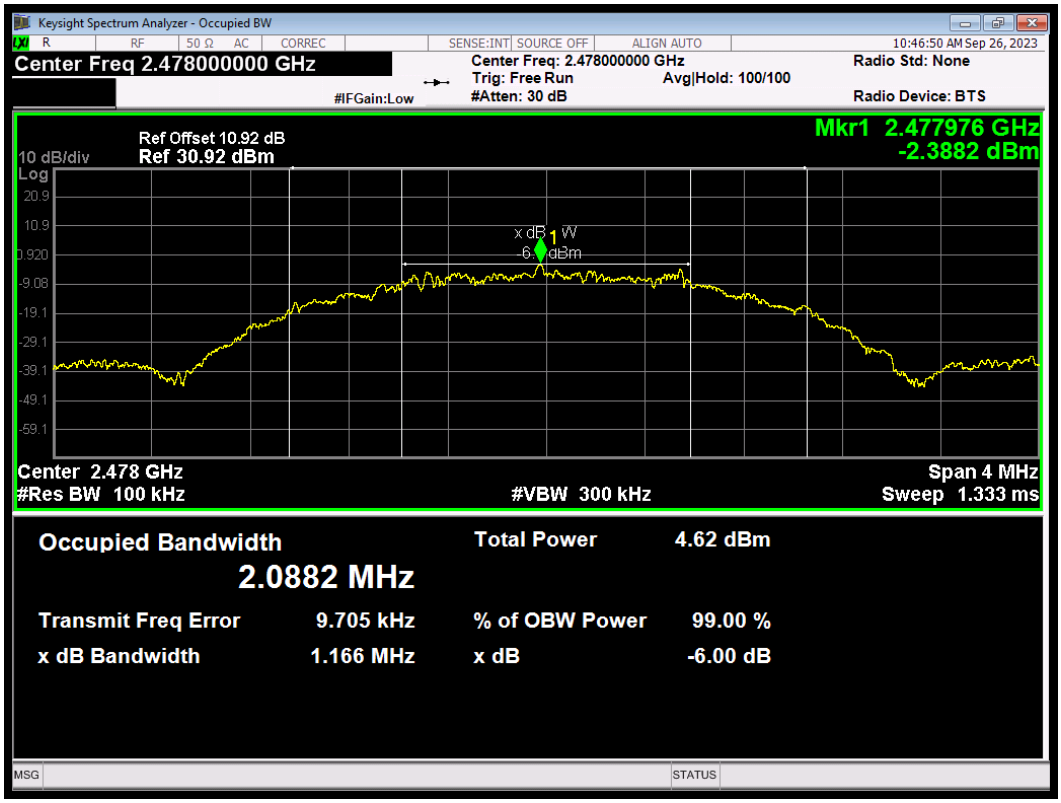
-6dB Bandwidth BLE (2M) 2478MHz



-6dB Bandwidth BLE (S=2) 2402MHz

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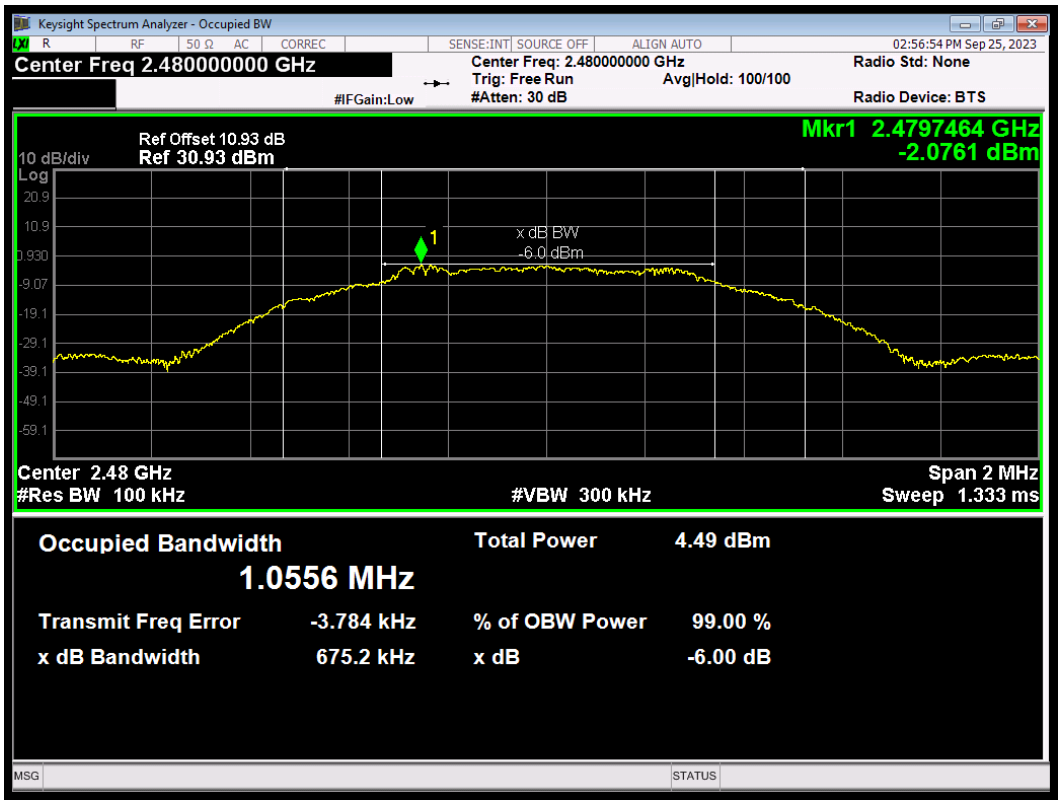
-6dB Bandwidth BLE (S=2) 2440MHz

-6dB Bandwidth BLE (S=2) 2480MHz



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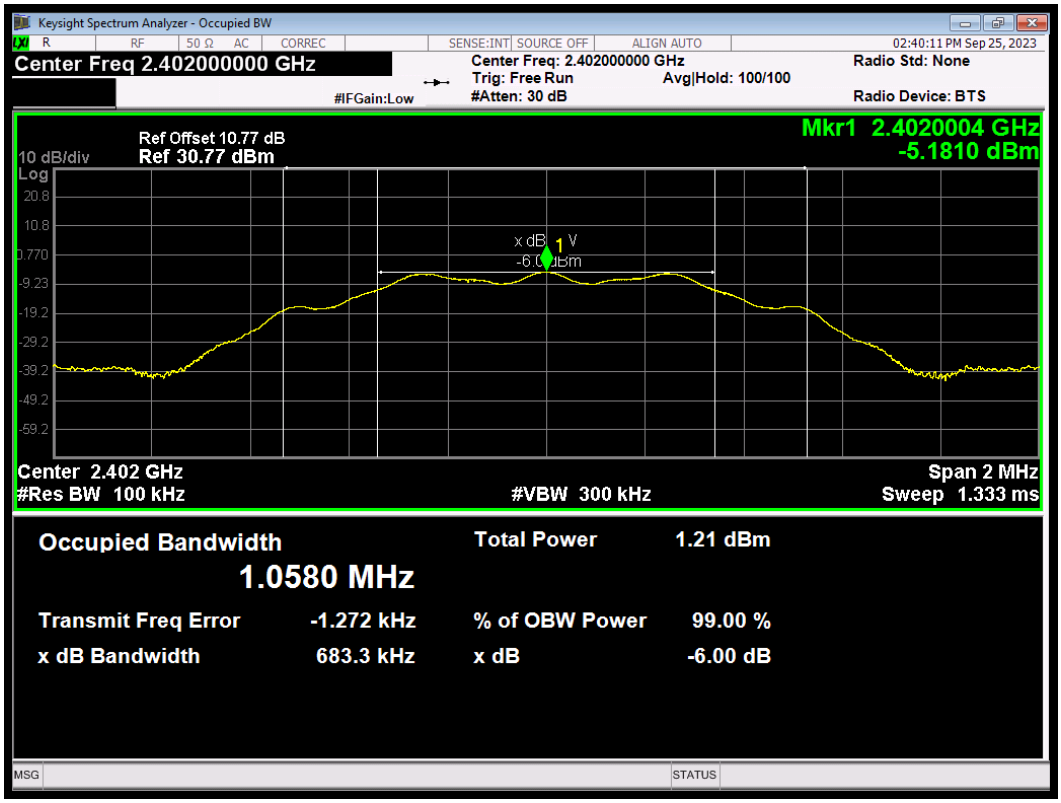
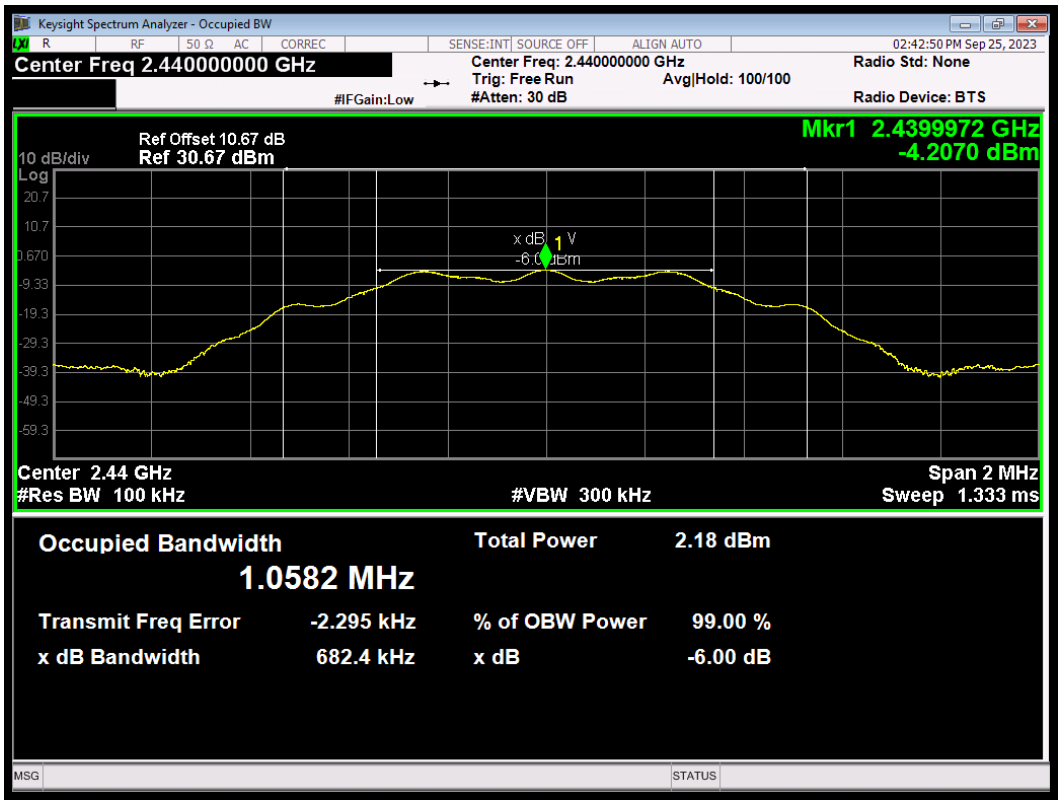
-6dB Bandwidth BLE (S=8) 2402MHz



-6dB Bandwidth BLE (S=8) 2440MHz



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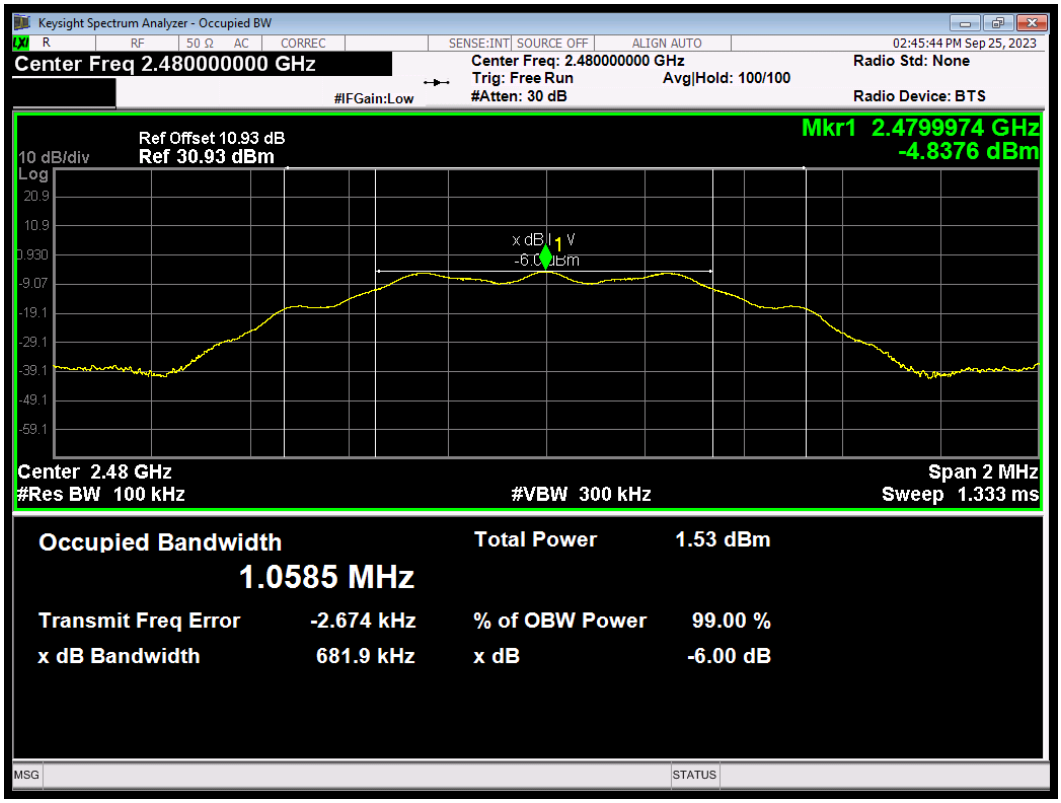
-6dB Bandwidth BLE (S=8) 2480MHz



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5.3. Band Edge

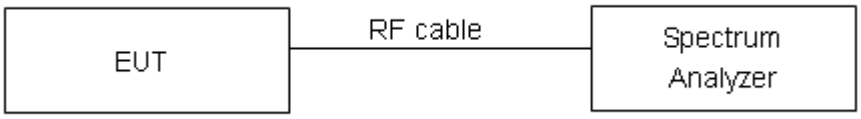
Ambient Condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

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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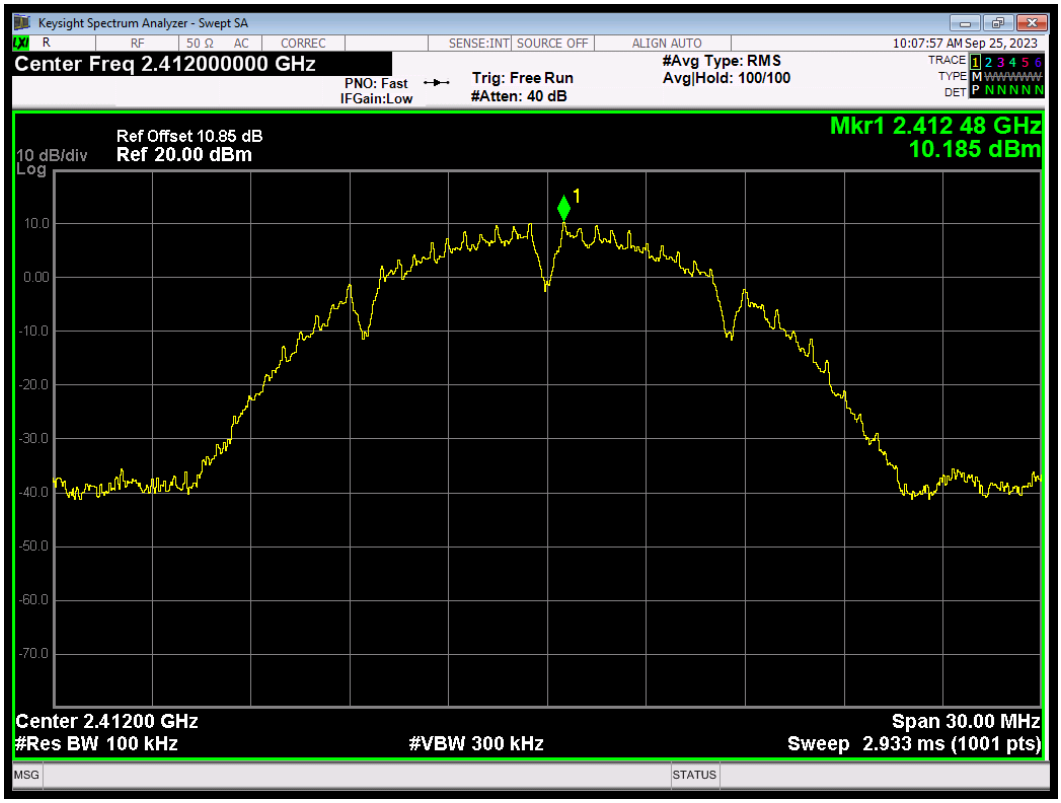
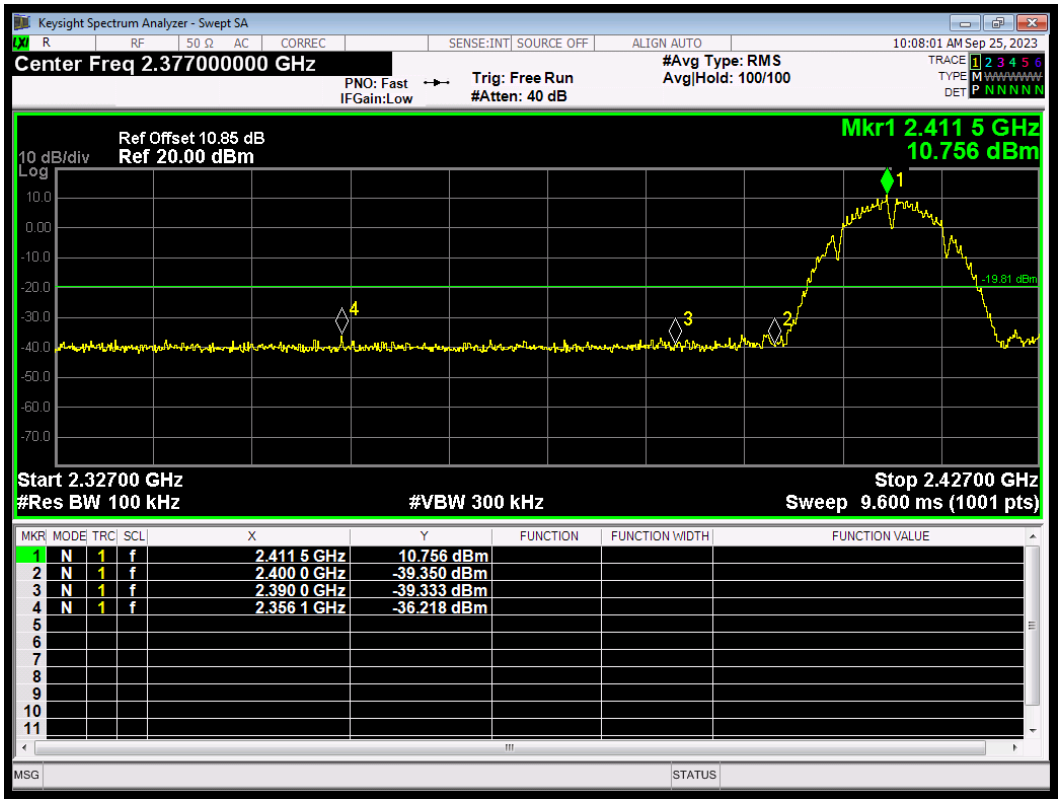
Test Results: PASS

Band Edge 802.11b 2412MHz Ref



Band Edge 802.11b 2412MHz Emission



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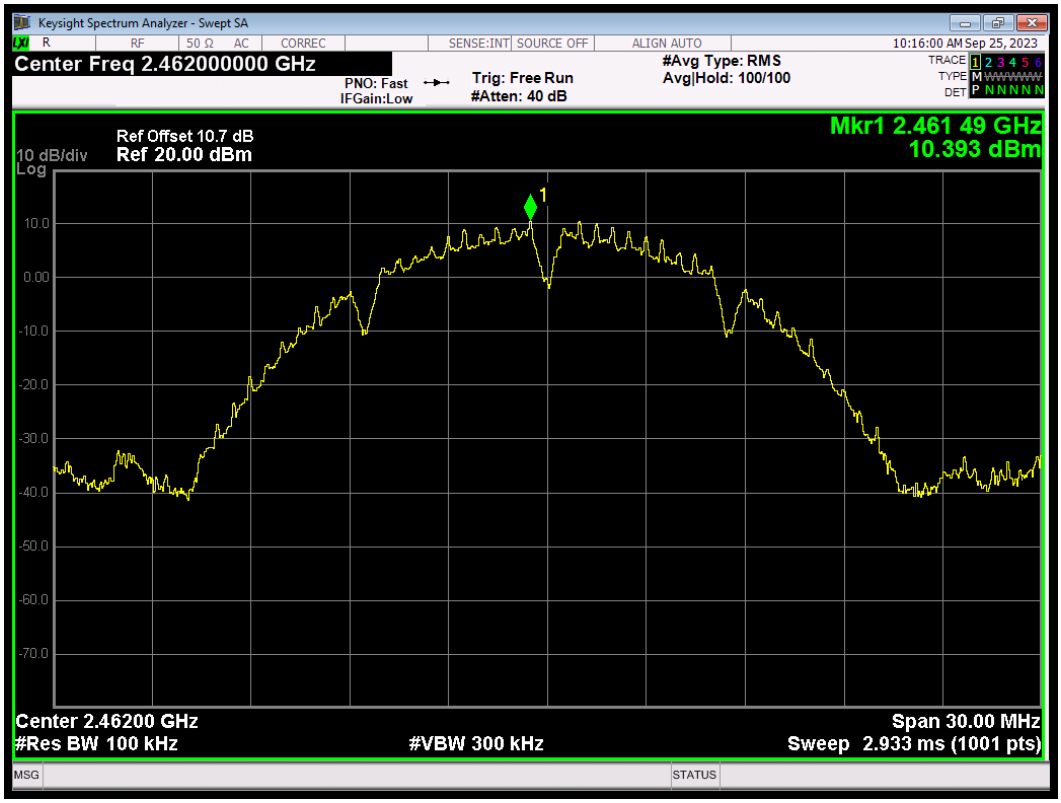
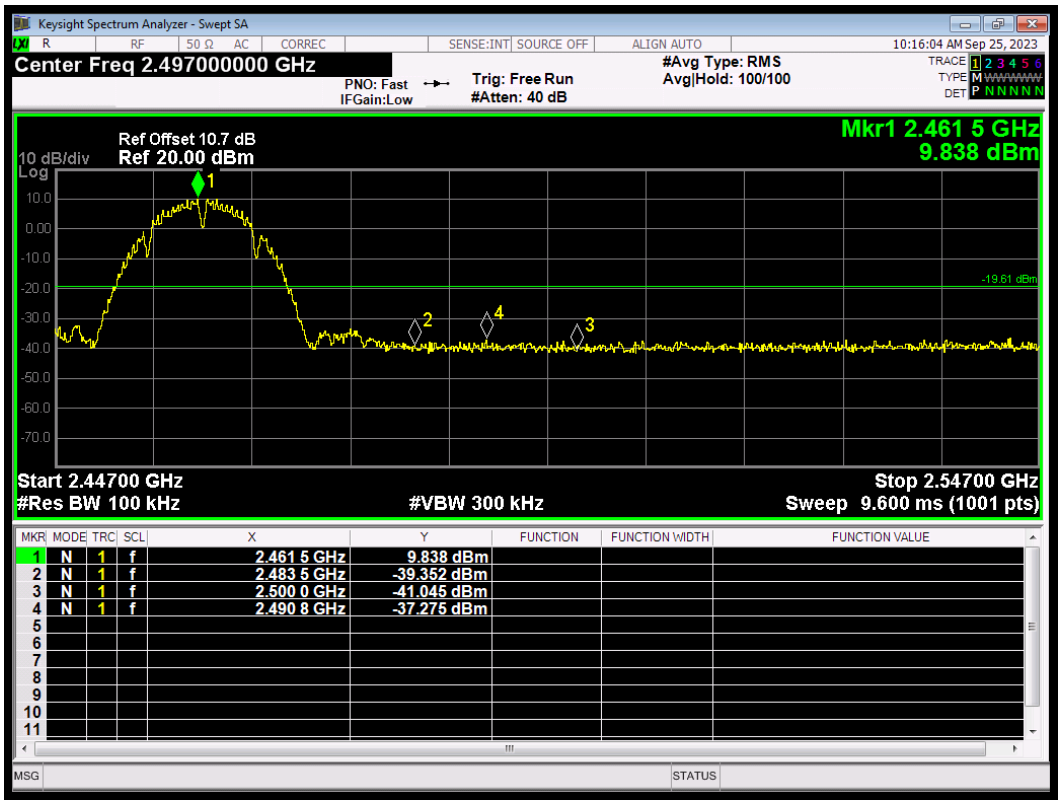
Band Edge 802.11b 2462MHz Ref



Band Edge 802.11b 2462MHz Emission



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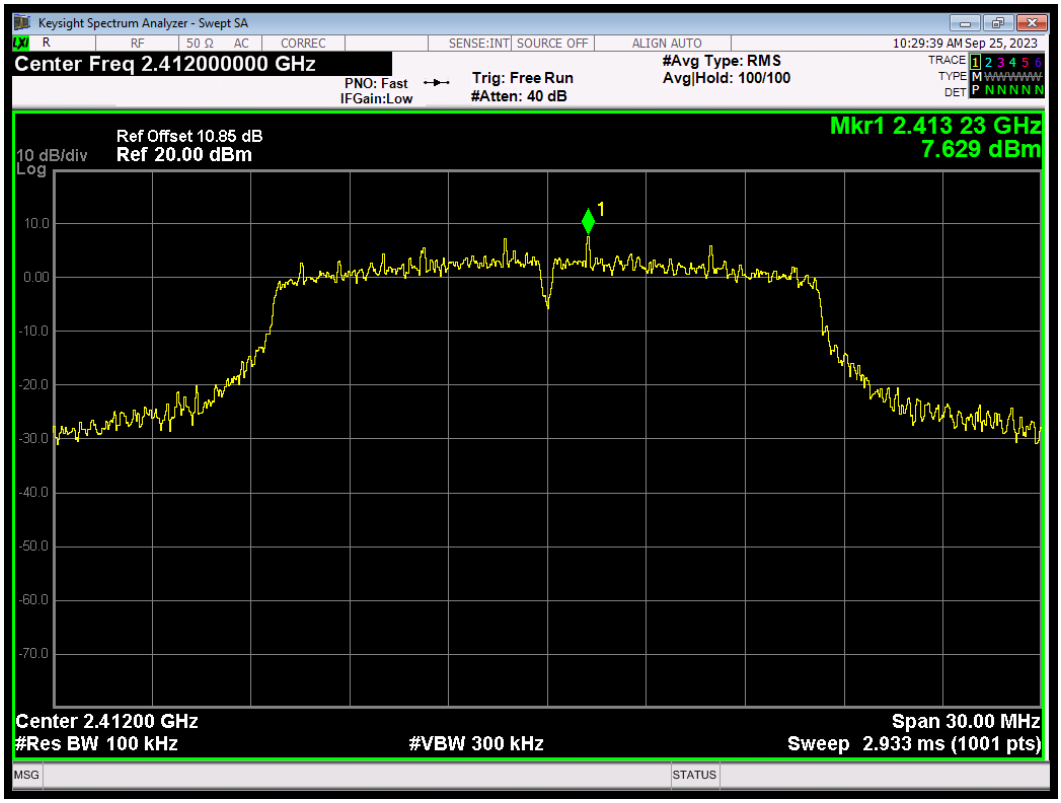
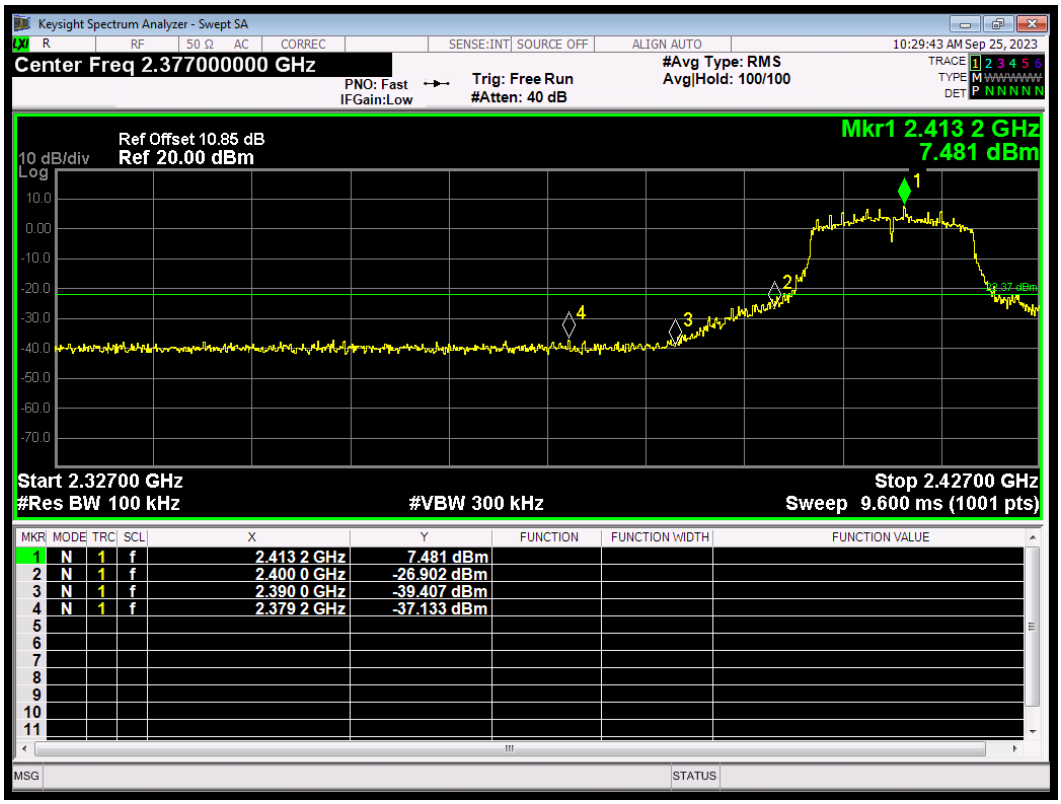
Band Edge 802.11g 2412MHz Ref



Band Edge 802.11g 2412MHz Emission



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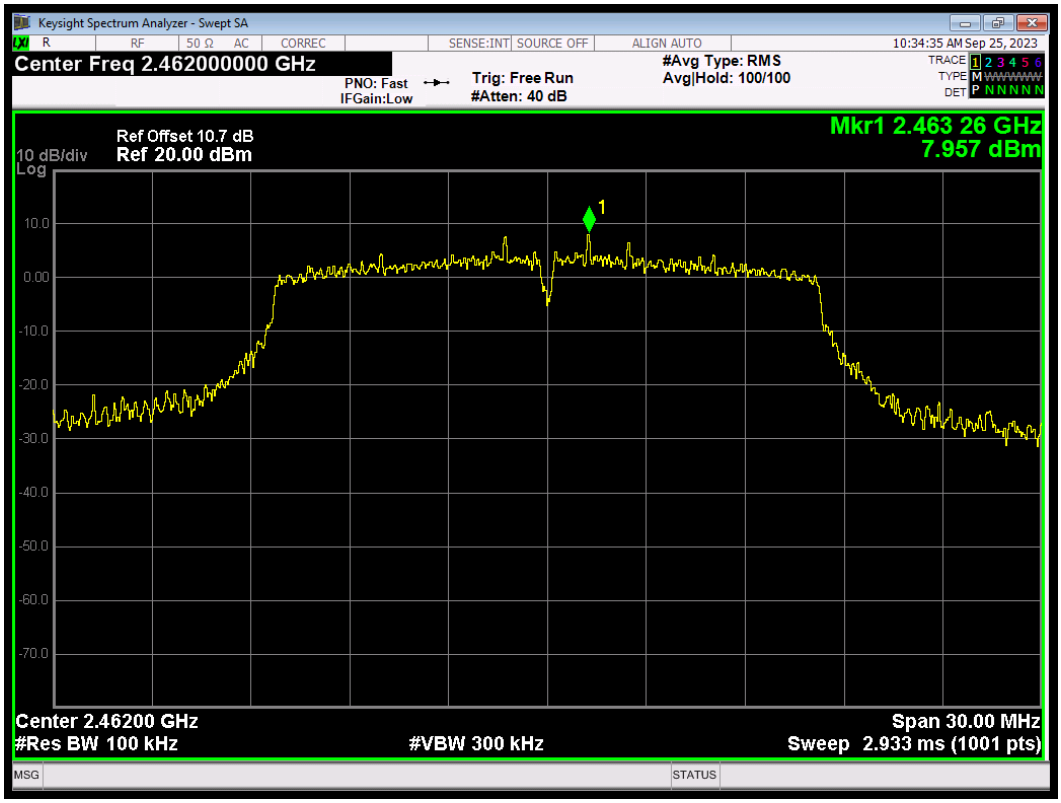
Band Edge 802.11g 2462MHz Ref



Band Edge 802.11g 2462MHz Emission

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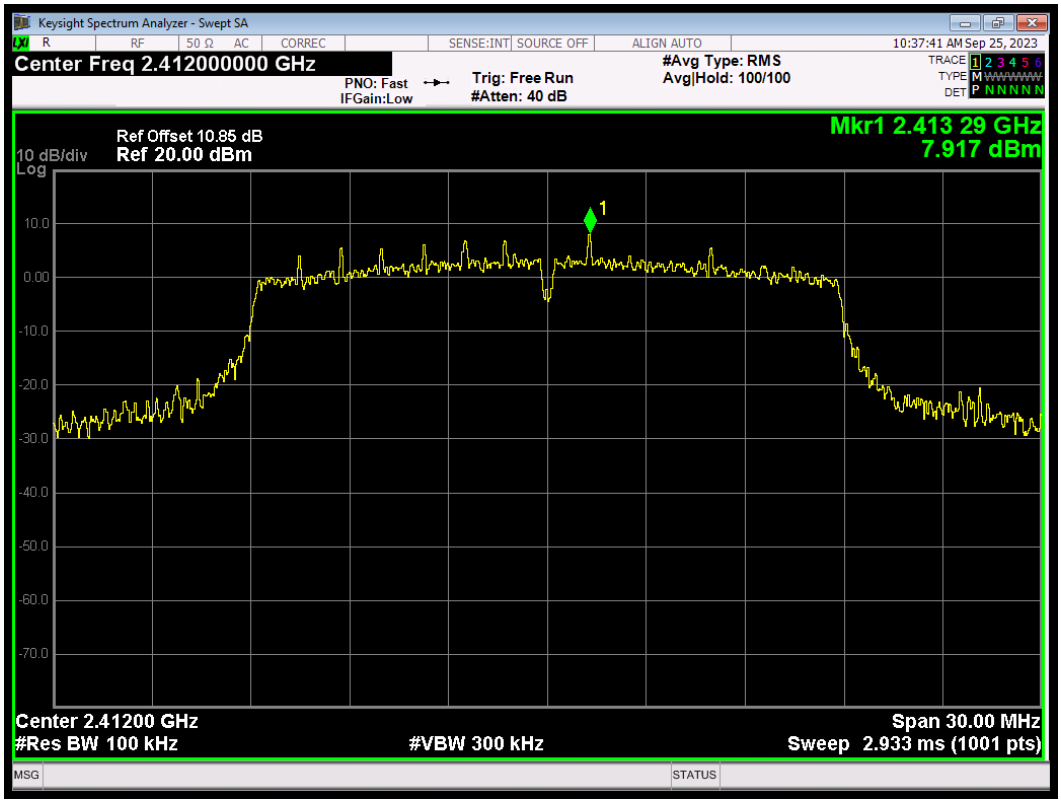
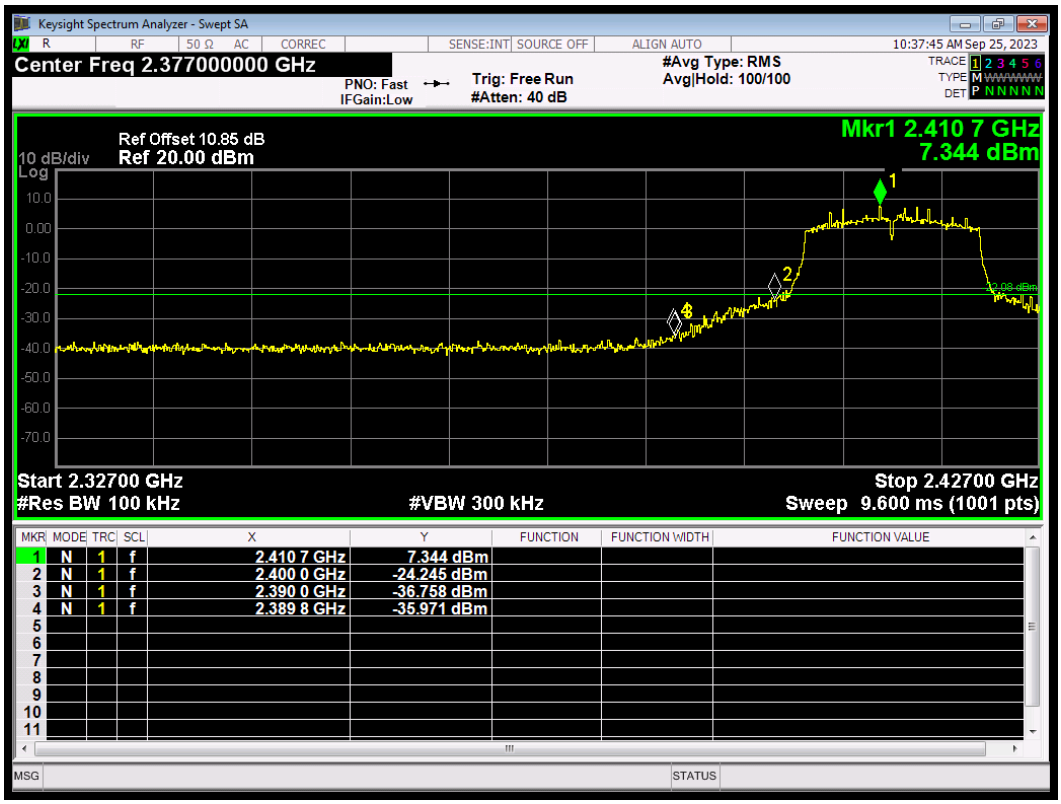
Band Edge 802.11n(HT20) 2412MHz Ref



Band Edge 802.11n(HT20) 2412MHz Emission



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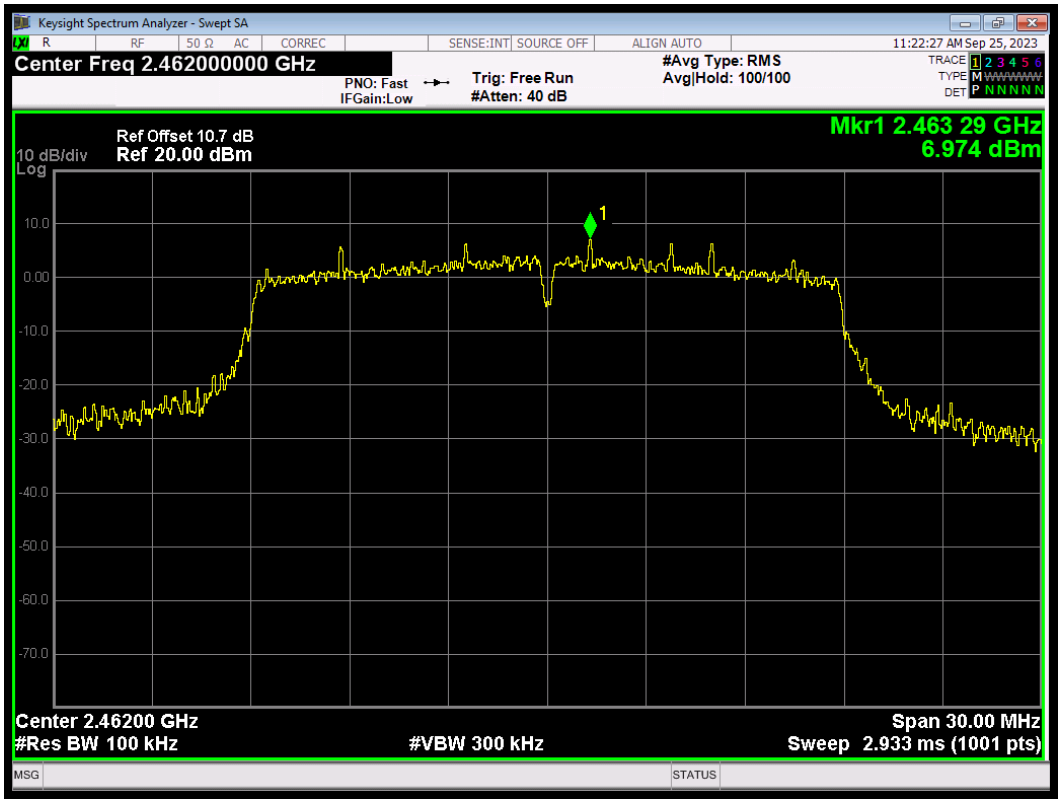
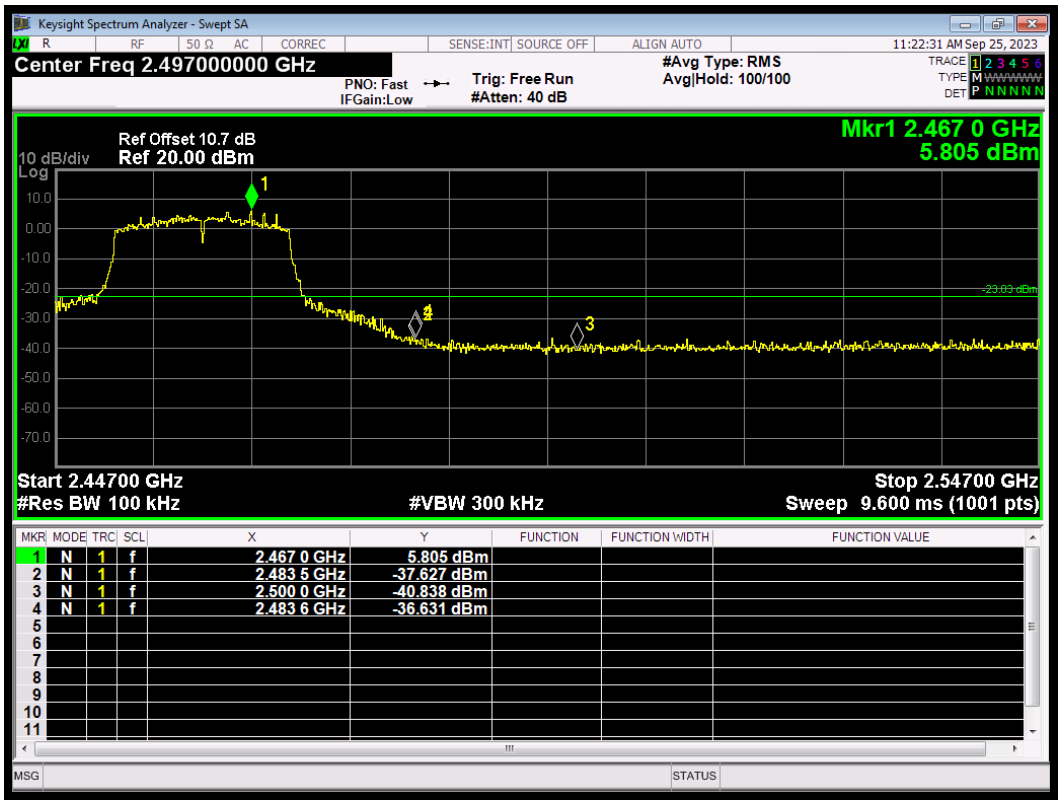
Band Edge 802.11n(HT20) 2462MHz Ref



Band Edge 802.11n(HT20) 2462MHz Emission



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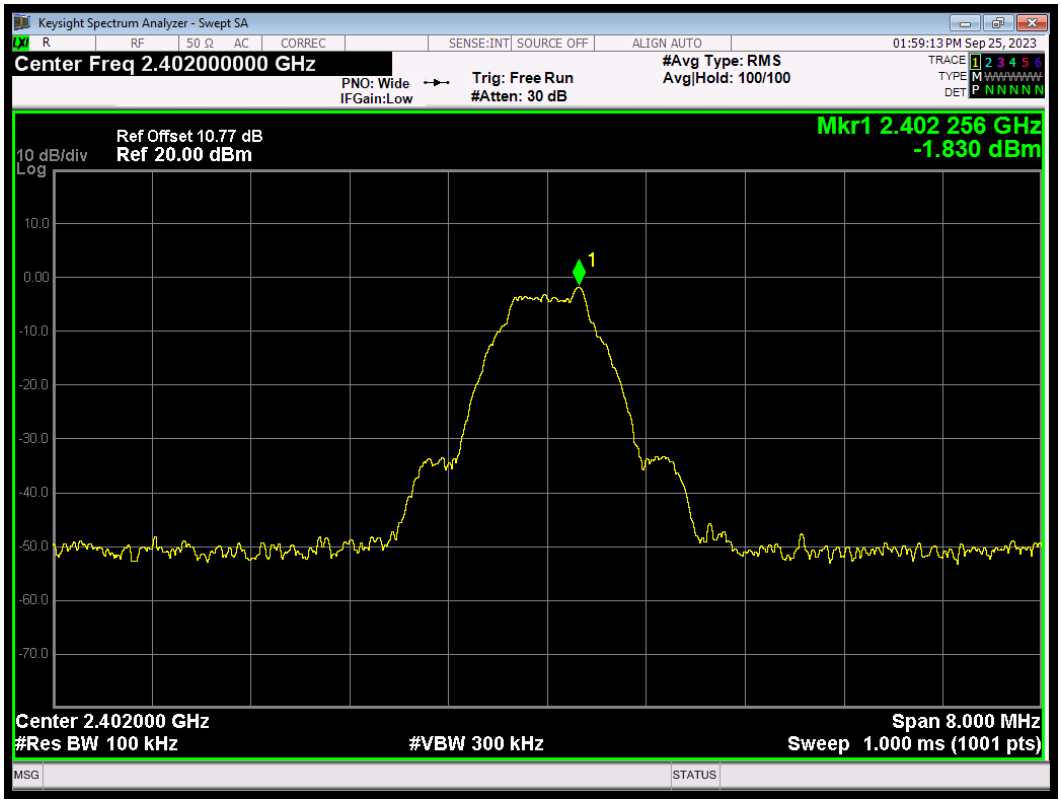
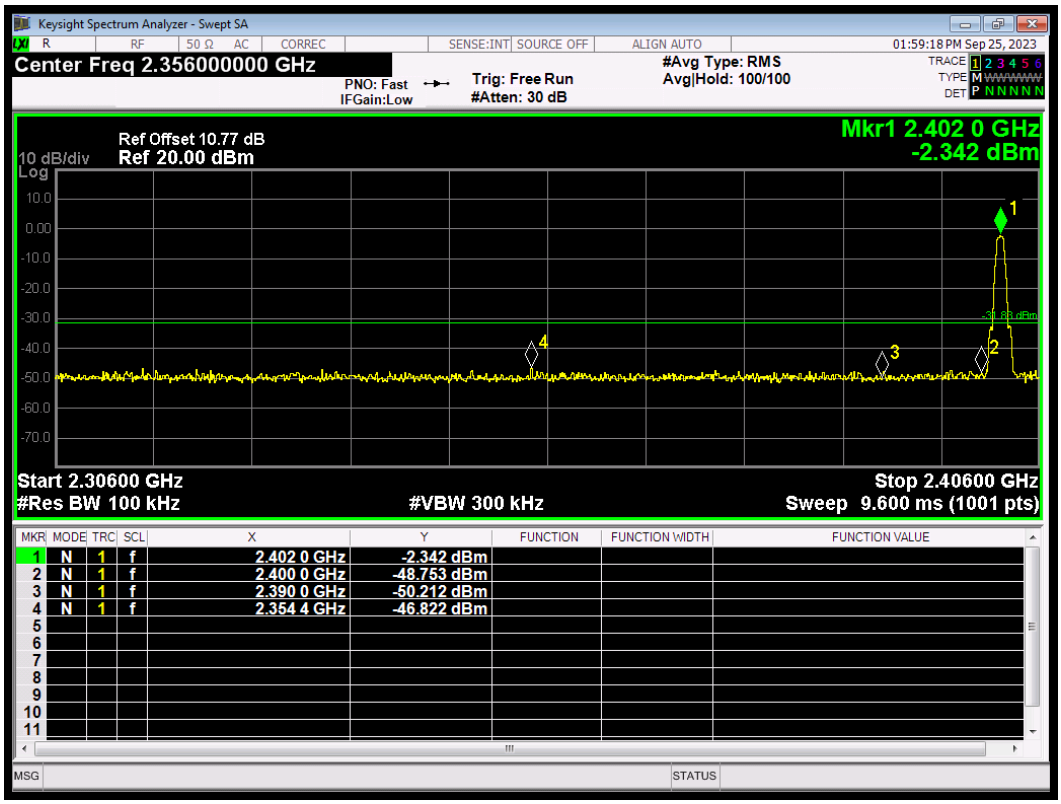
Band Edge BLE (1M) 2402MHz Ref



Band Edge BLE (1M) 2402MHz Emission



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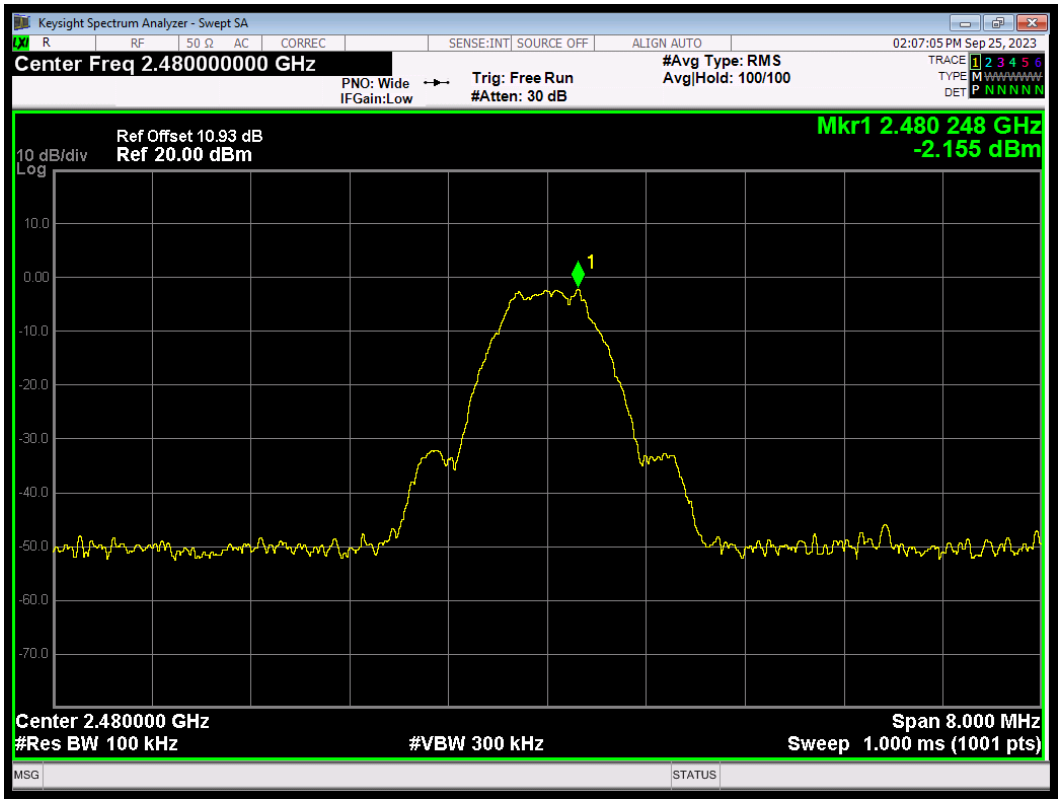
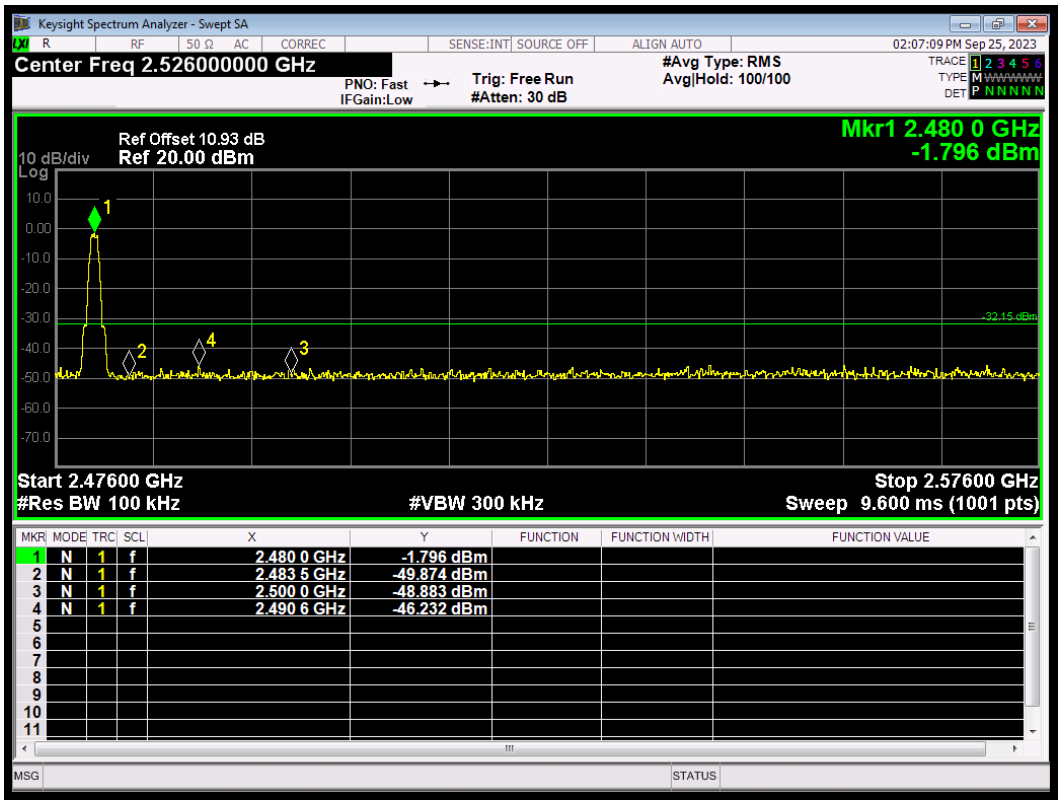
Band Edge BLE (1M) 2480MHz Ref



Band Edge BLE (1M) 2480MHz Emission



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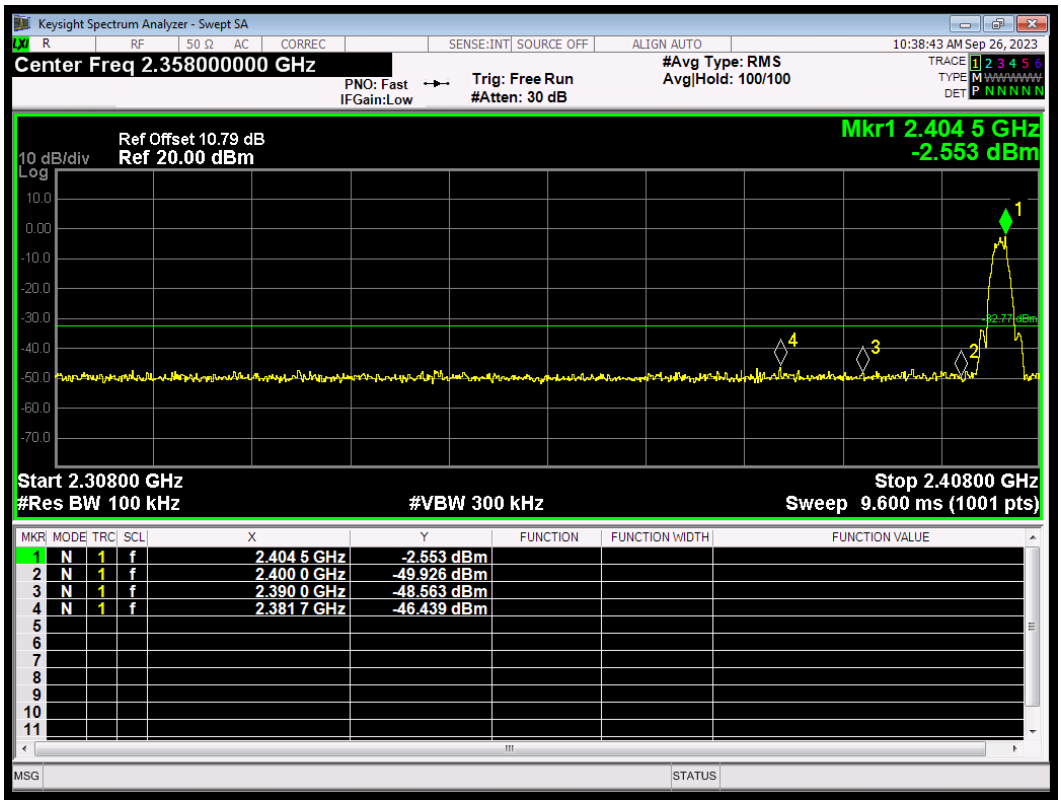
Band Edge BLE (2M) 2404MHz Ref

Band Edge BLE (2M) 2404MHz Emission



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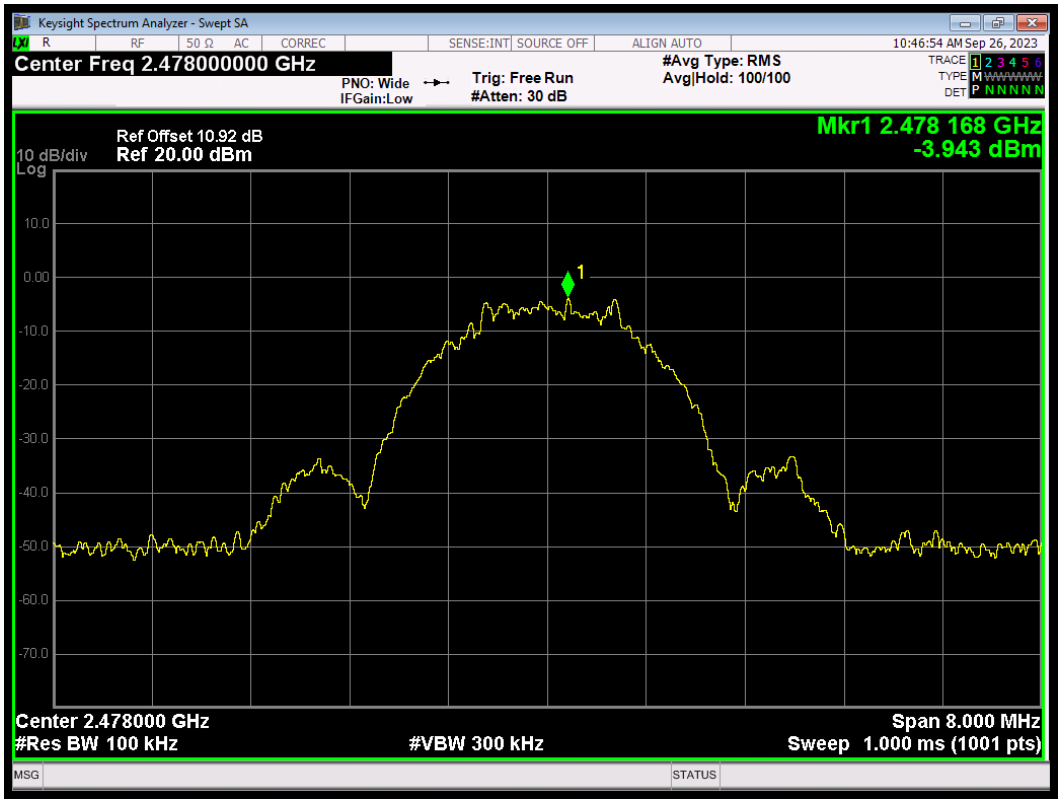
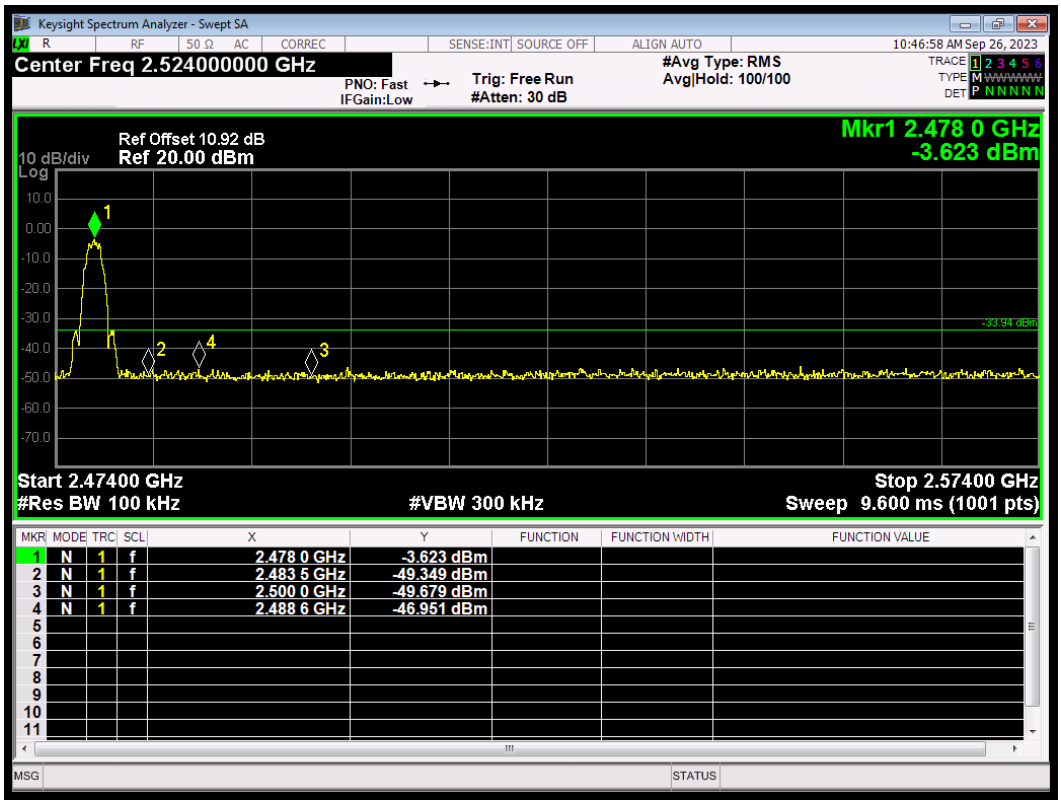
Band Edge BLE (2M) 2478MHz Ref



Band Edge BLE (2M) 2478MHz Emission



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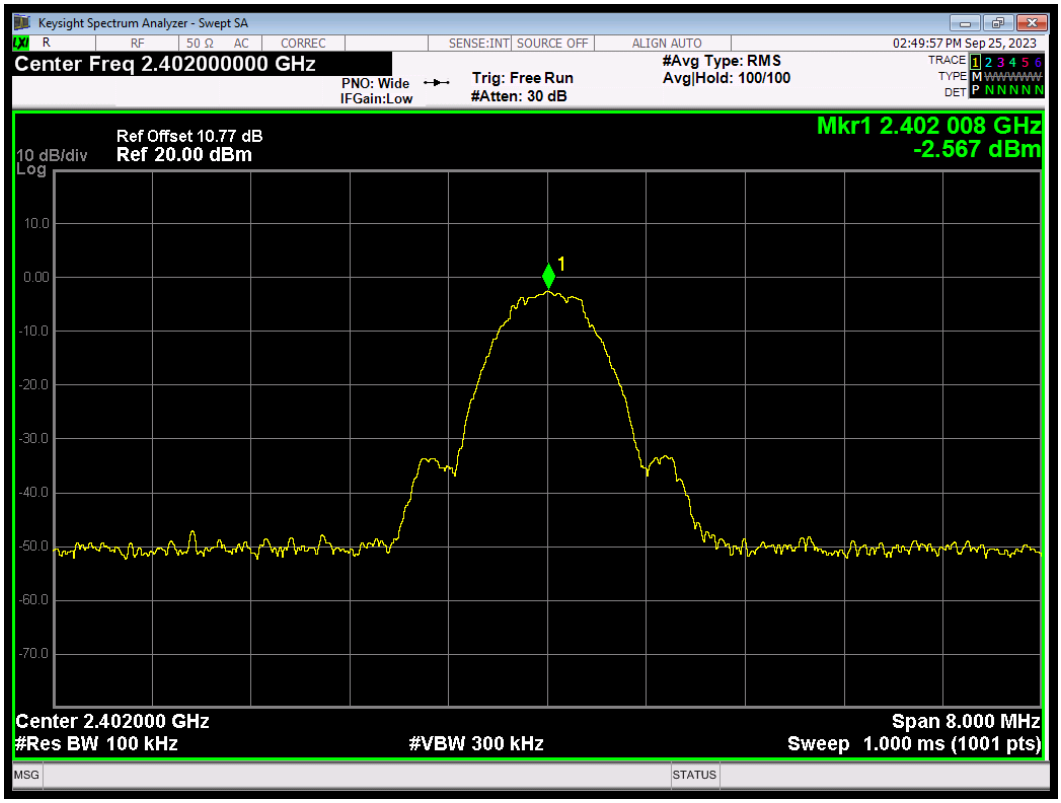
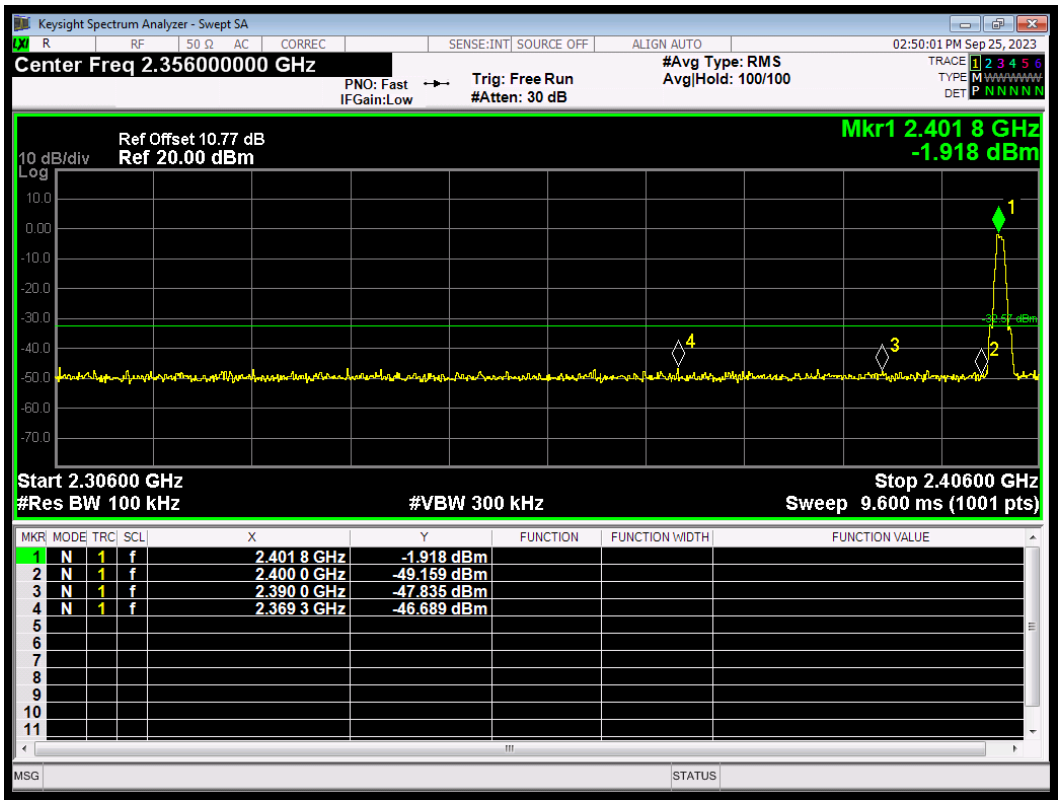
Band Edge BLE (S=2) 2402MHz Ref



Band Edge BLE (S=2) 2402MHz Emission



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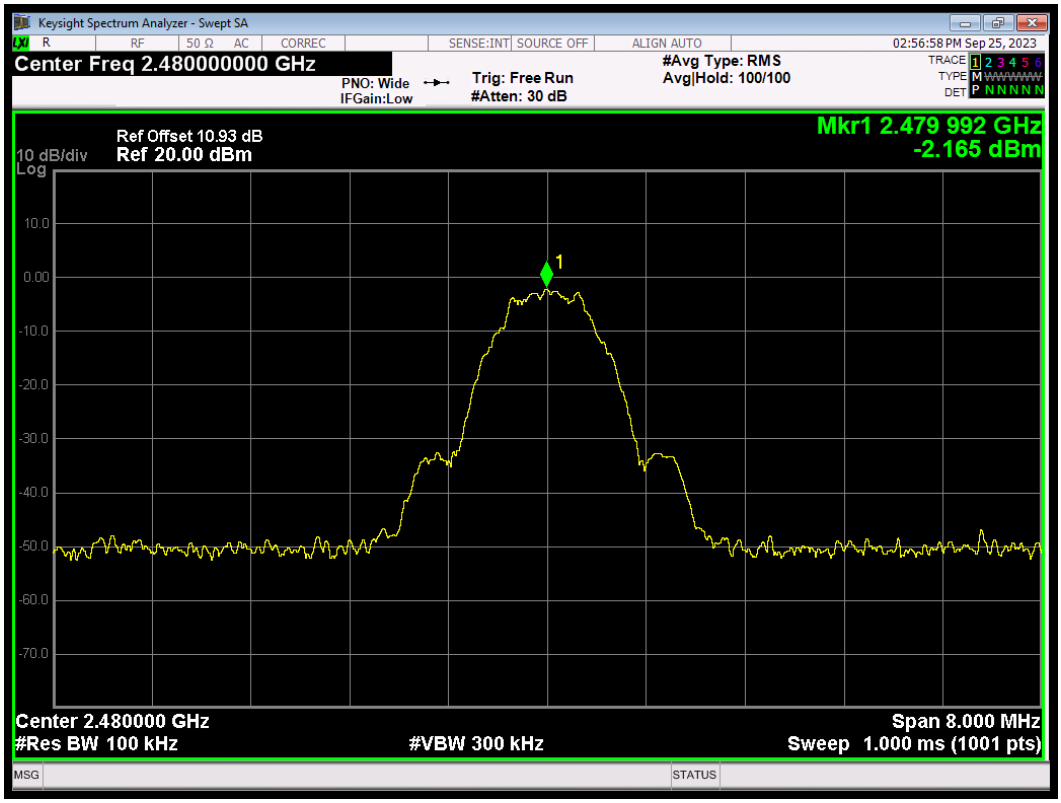
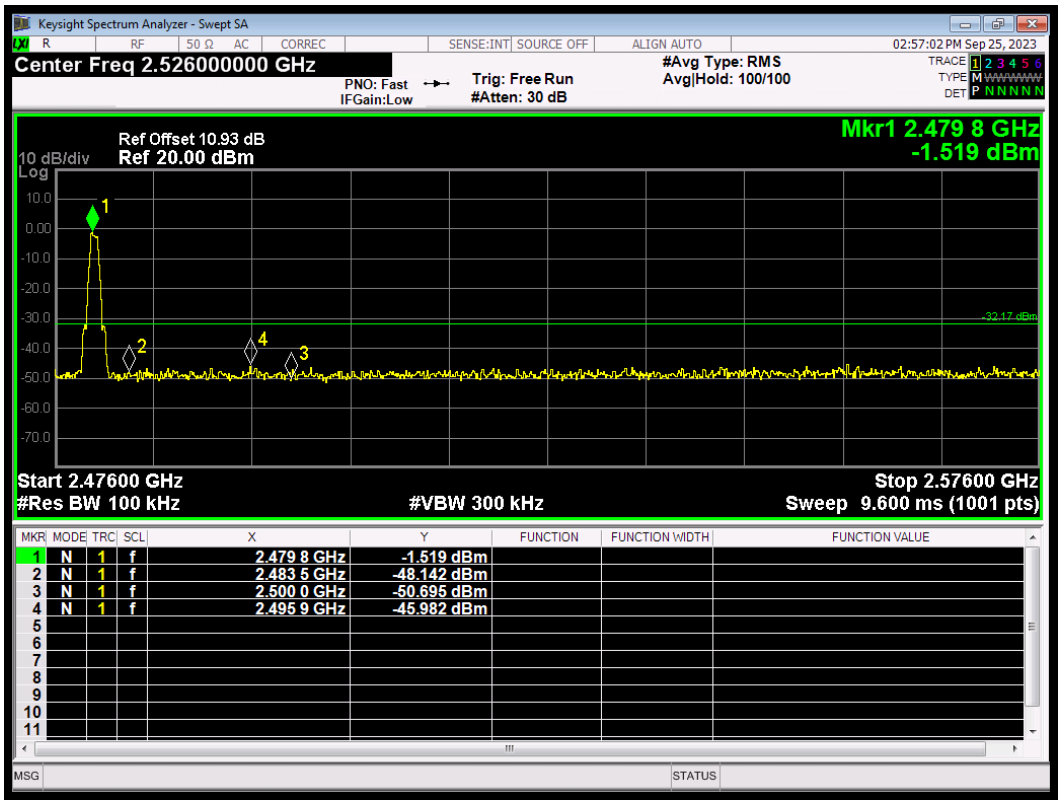
Band Edge BLE (S=2) 2480MHz Ref



Band Edge BLE (S=2) 2480MHz Emission



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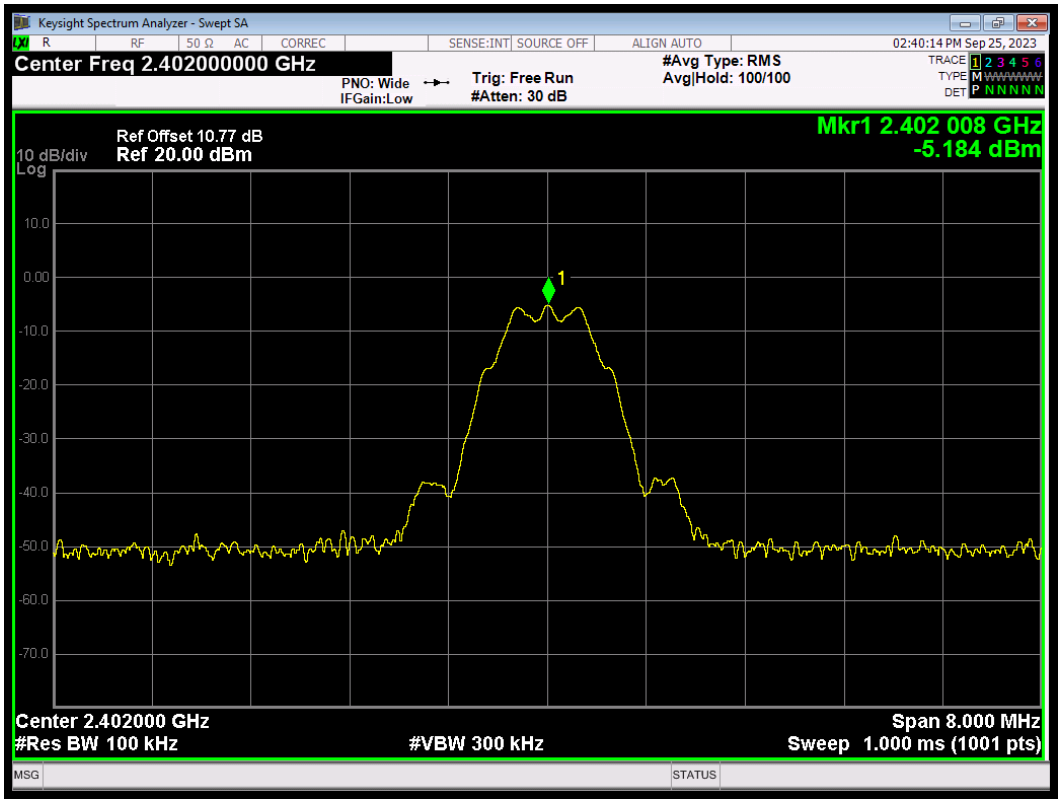
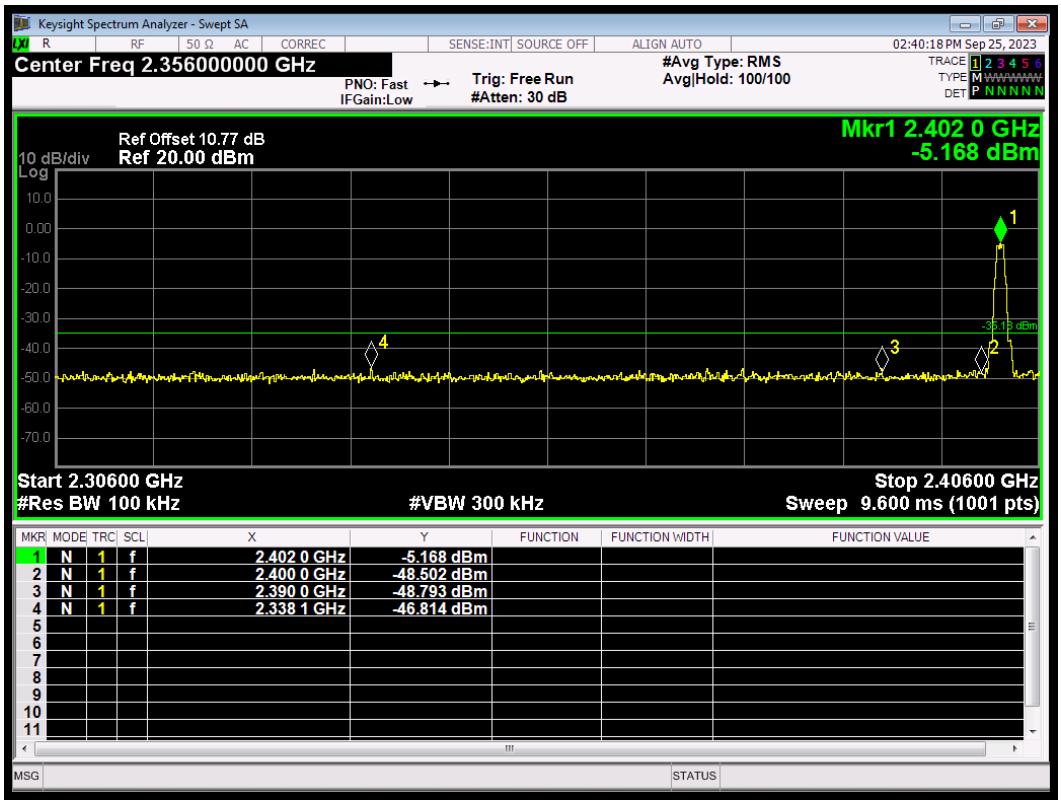
Band Edge BLE (S=8) 2402MHz Ref



Band Edge BLE (S=8) 2402MHz Emission



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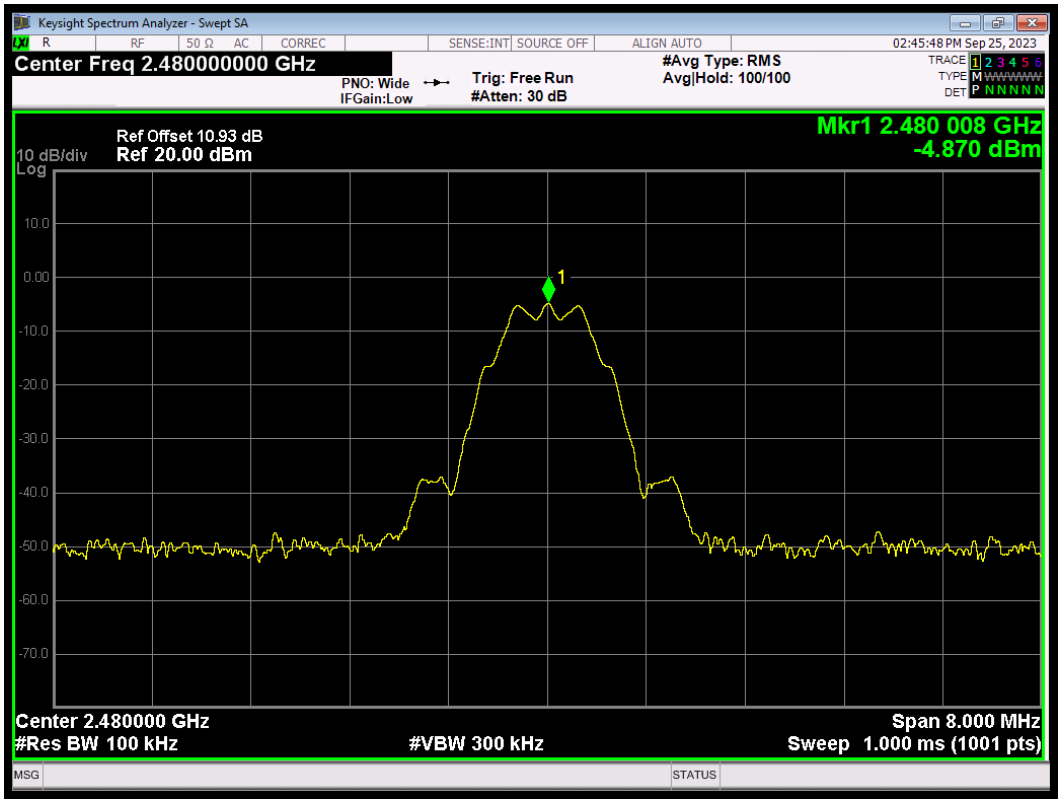
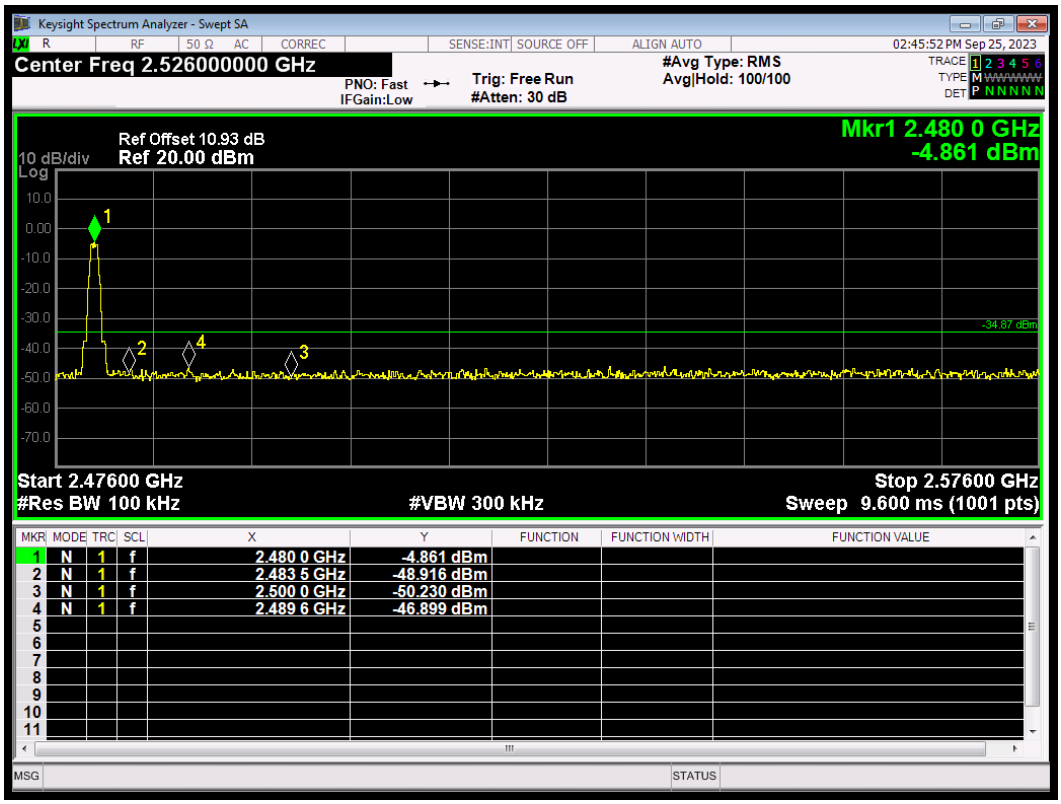
Band Edge BLE (S=8) 2480MHz Ref



Band Edge BLE (S=8) 2480MHz Emission



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5.4. Power Spectral Density

Ambient Condition

Temperature	Relative humidity
20°C ~ 25°C	45% ~ 50%

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-1 was used for this test.

a) Set instrument center frequency to DTS channel center frequency

b) Set span to at least 1.5 times the OBW

c) Set RBW to:3kHz⩽RBW⩽100kHz

d) Set VBW⩾[3x RBW]

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

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

g) Sweep time auto couple

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

i) Use the peak marker function to determine the maximum amplitude level.

j) If the measured value exceeds requirement, 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)

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⩽100kHz

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

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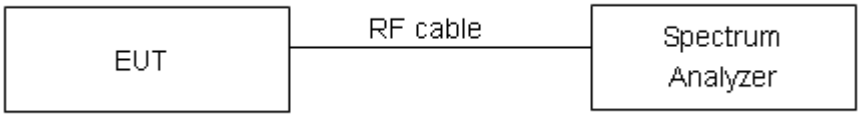
l) Add [10 log(1/ D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time

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)

Test setup



Limits

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	Carrier frequency (MHz))/ Channel	Read Value (dBm / 30kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
802.11b	2412/CH 1	-2.55	-12.55	8	PASS
	2437/CH 6	-2.54	-12.54	8	PASS
	2462/CH11	-2.56	-12.56	8	PASS
802.11g	2412/CH 1	-6.20	-16.10	8	PASS
	2437/CH 6	-5.21	-15.11	8	PASS
	2462/CH11	-5.44	-15.34	8	PASS
802.11n HT20	2412/CH 1	-6.08	-15.97	8	PASS
	2437/CH 6	-5.61	-15.50	8	PASS
	2462/CH11	-6.13	-16.02	8	PASS
Note: Power Spectral Density (dBm/3kHz) =Read Value+Duty cycle correction factor + 10*log10(3/30)					

Test Mode	Carrier frequency (MHz))/ Channel	Read Value (dBm / 3kHz)	Power Spectral Density (dBm / 3kHz)	Limit (dBm / 3kHz)	Conclusion
Bluetooth (Low Energy) (1M)	2402/CH0	-23.70	-23.00	8	PASS
	2440/CH19	-22.87	-22.17	8	PASS
	2480/CH39	-23.80	-23.10	8	PASS
Bluetooth (Low Energy) (2M)	2404/CH1	-28.35	-25.92	8	PASS
	2440/CH19	-27.03	-24.60	8	PASS
	2478/CH38	-27.80	-25.37	8	PASS
Bluetooth (Low Energy) (S=2)	2402/CH0	-20.35	-19.94	8	PASS
	2440/CH19	-18.30	-17.89	8	PASS
	2480/CH39	-19.95	-19.54	8	PASS
Bluetooth (Low Energy) (S=8)	2402/CH0	-9.30	-9.19	8	PASS
	2440/CH19	-8.03	-7.92	8	PASS
	2480/CH39	-8.51	-8.40	8	PASS
Note: Power Spectral Density =Read Value+Duty cycle correction factor					

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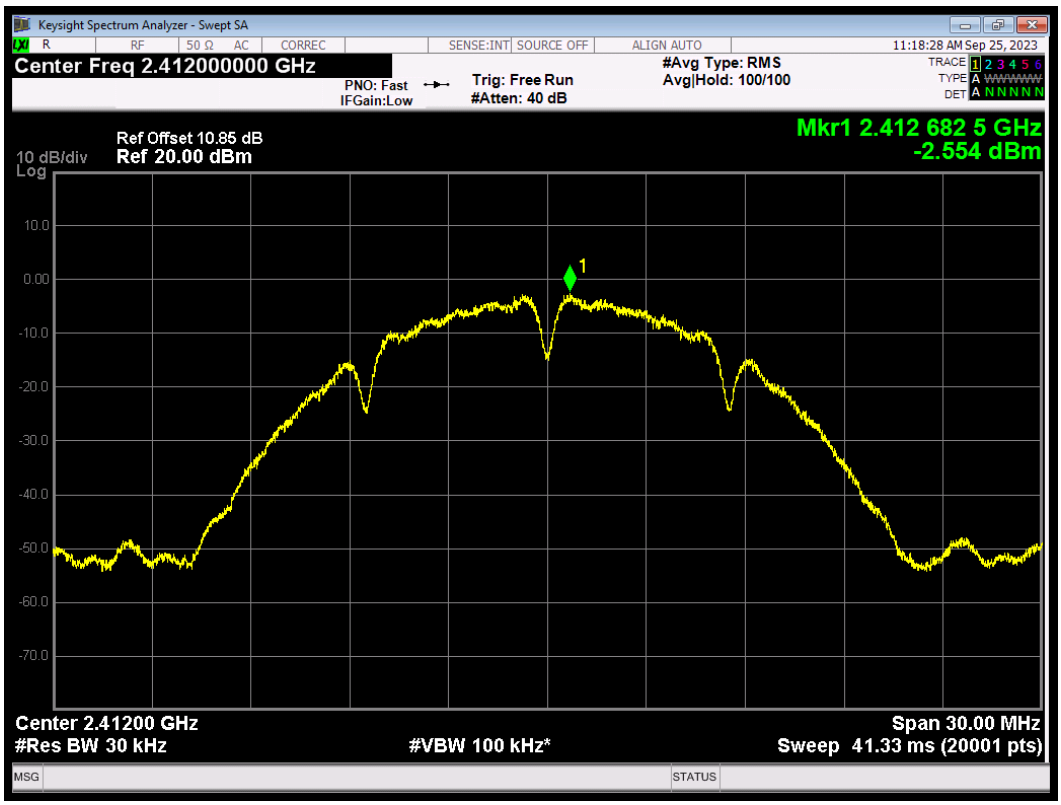
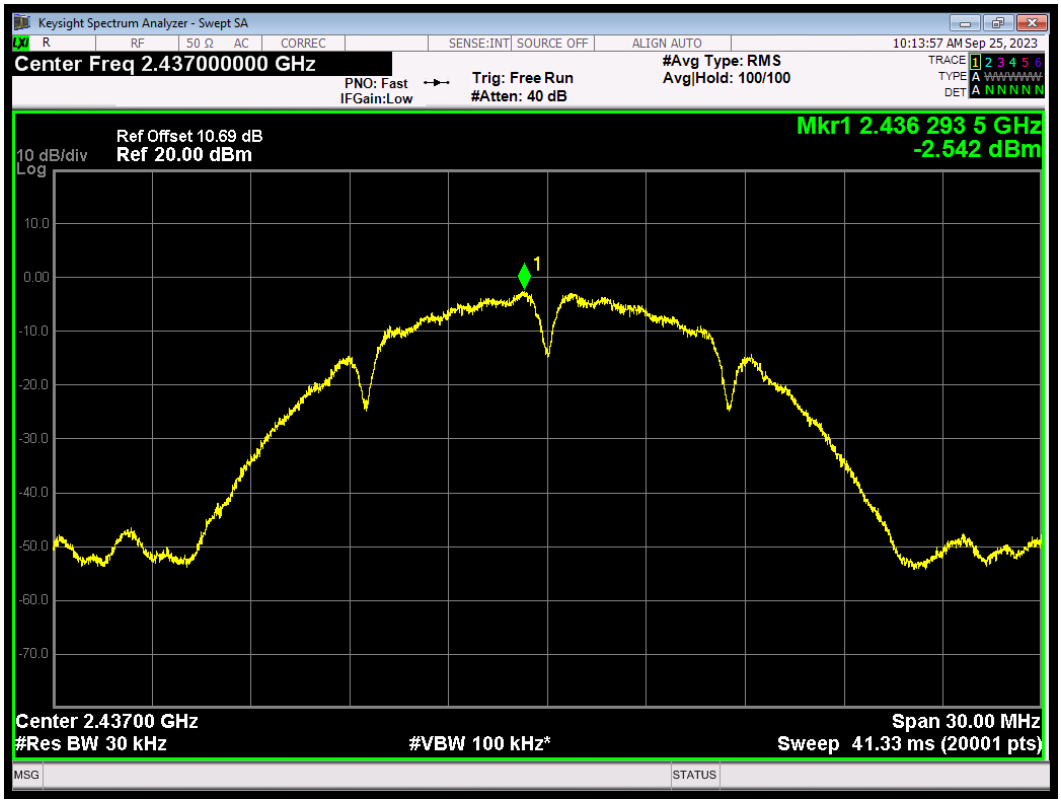
PSD 802.11b 2412MHz



PSD 802.11b 2437MHz



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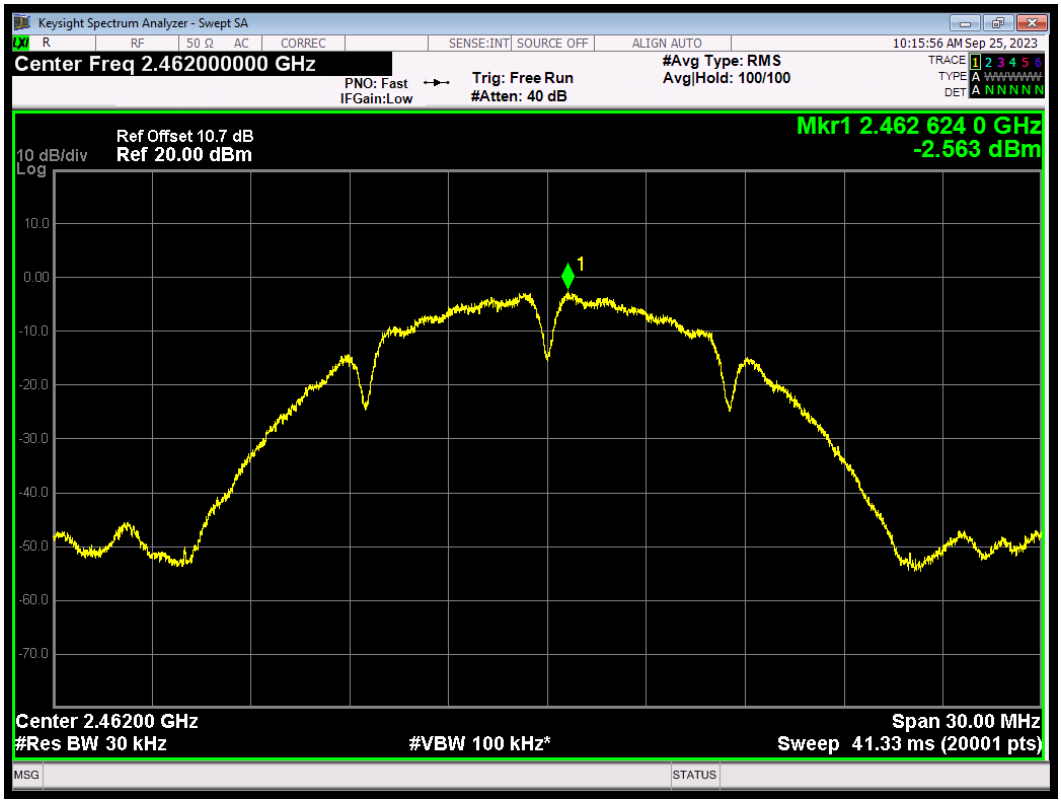
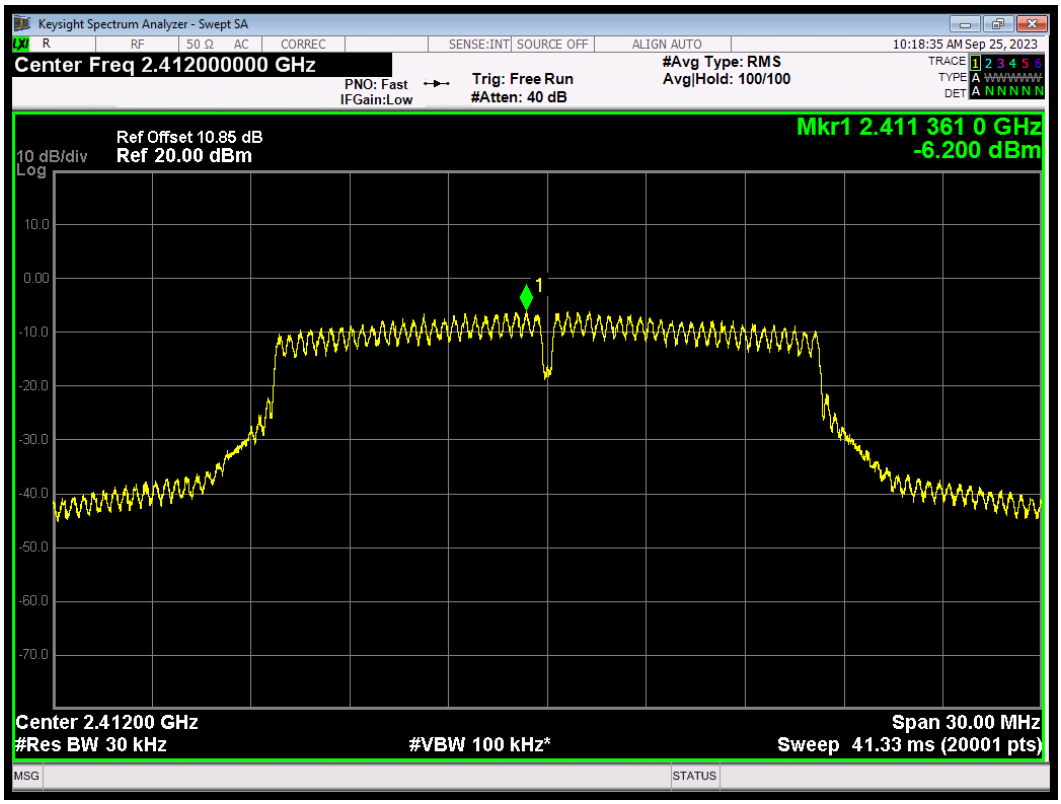
PSD 802.11b 2462MHz



PSD 802.11g 2412MHz



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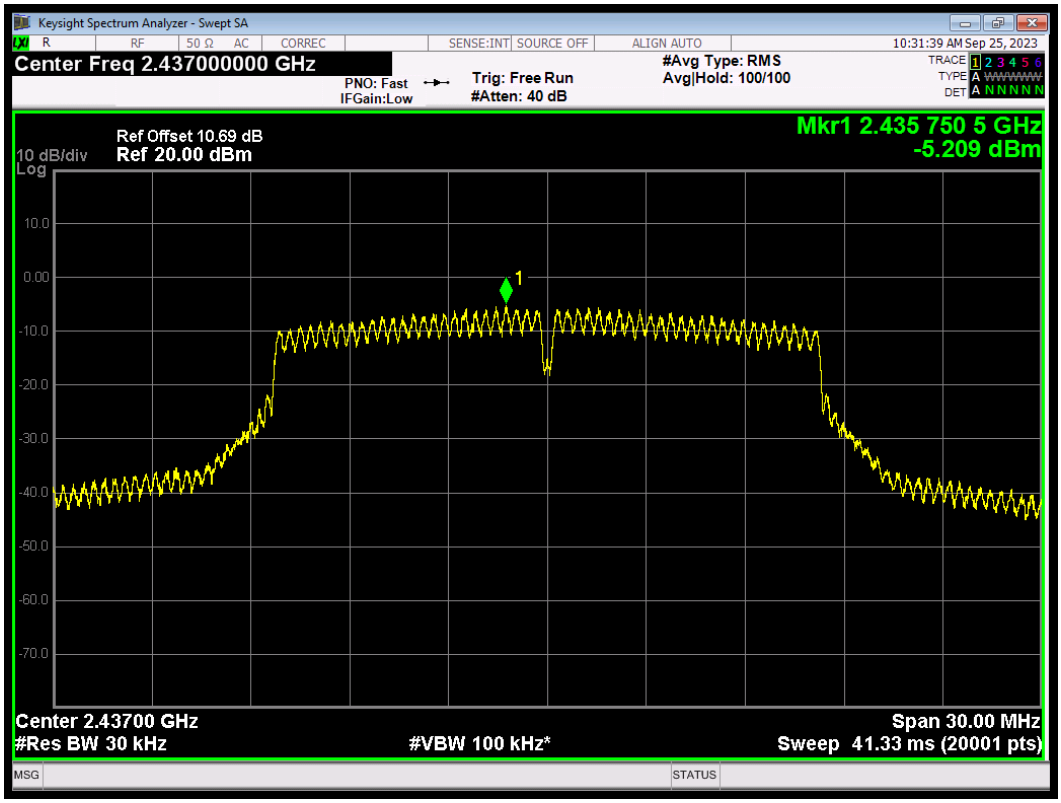
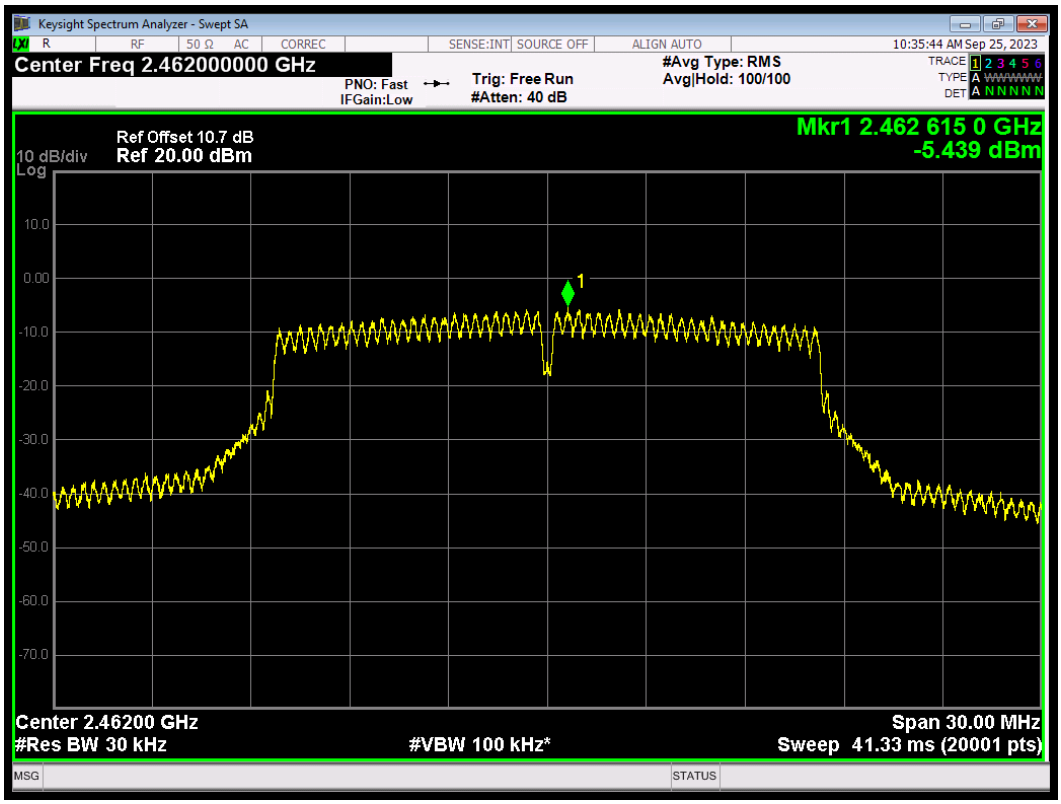
PSD 802.11g 2437MHz



PSD 802.11g 2462MHz



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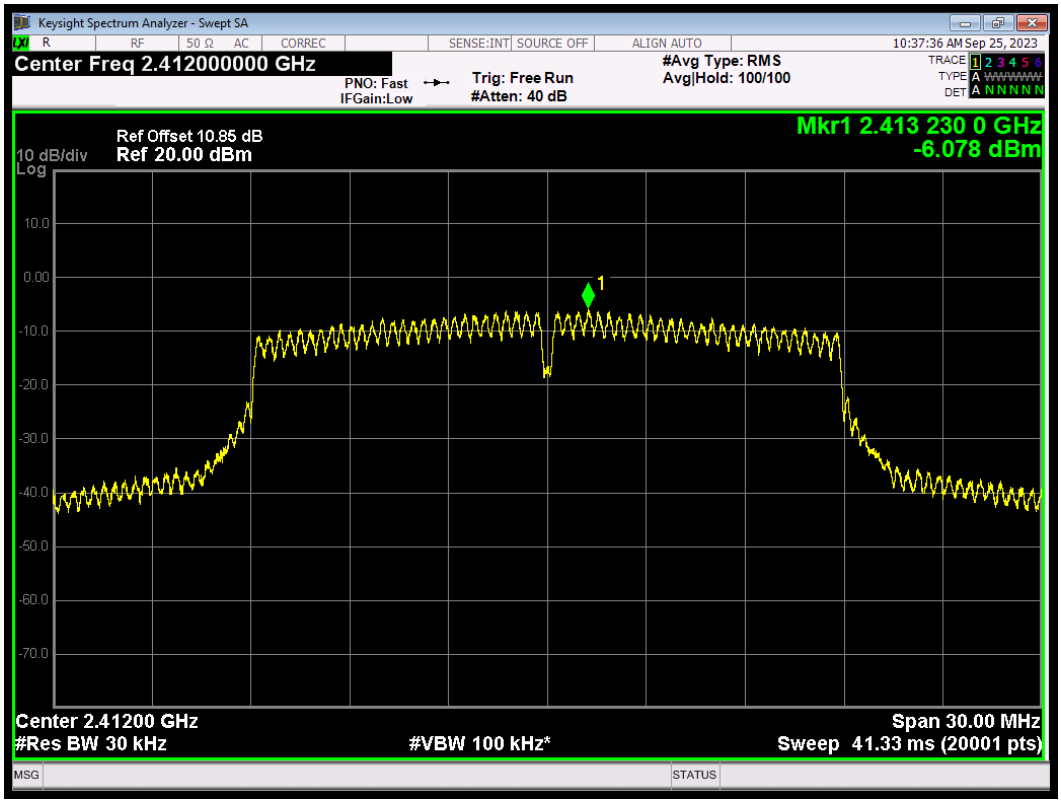
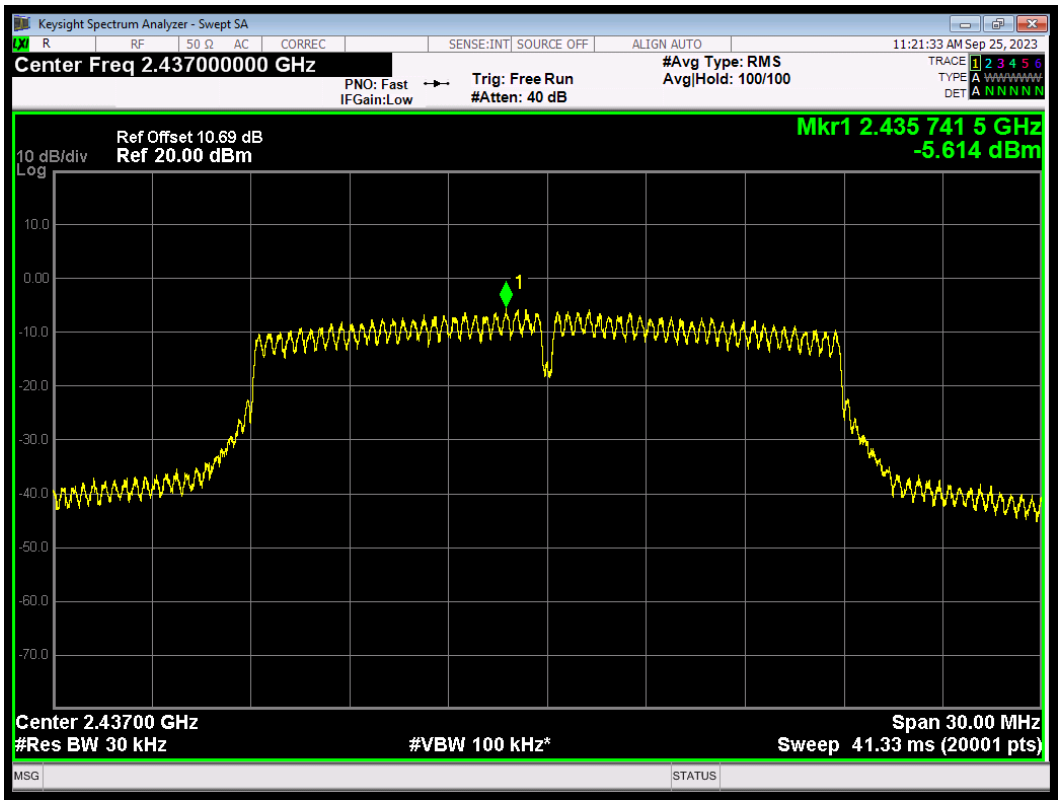
PSD 802.11n(HT20) 2412MHz



PSD 802.11n(HT20) 2437MHz



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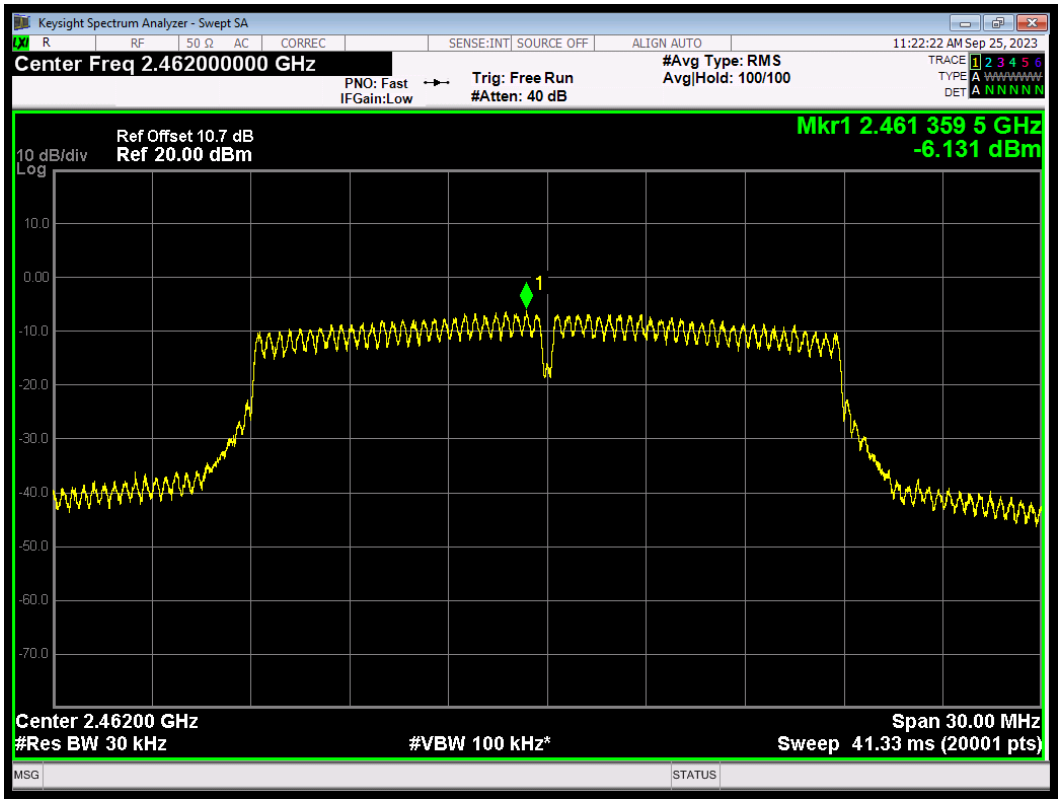
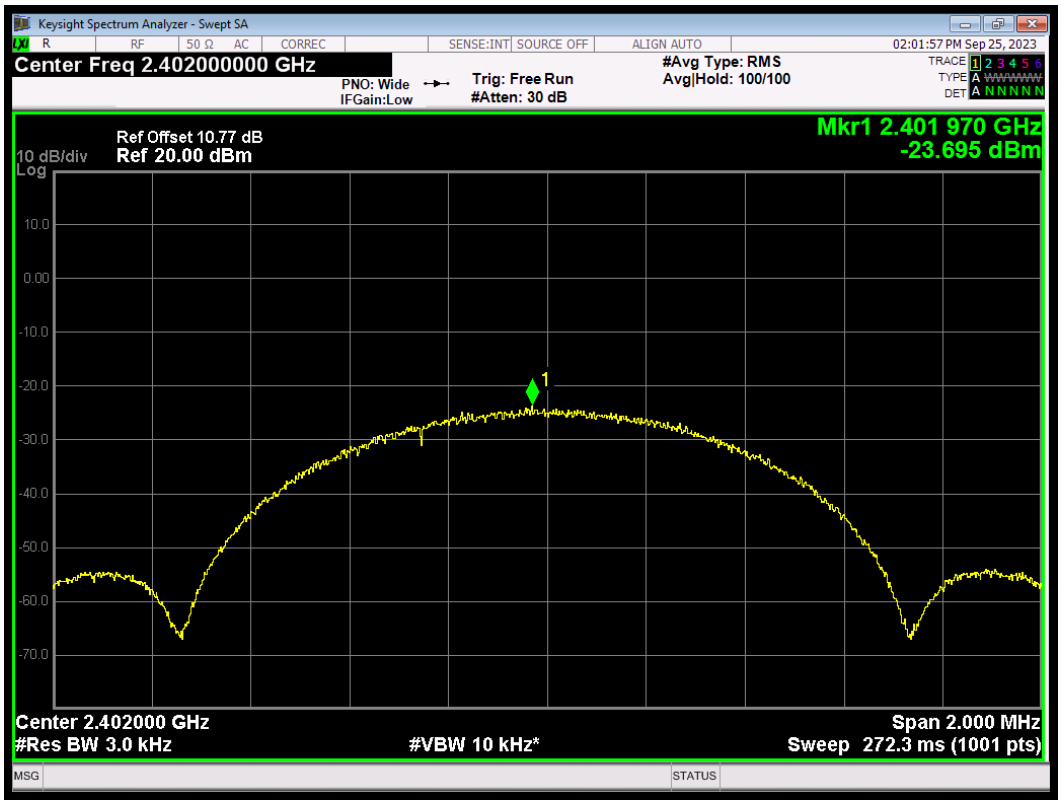
PSD 802.11n(HT20) 2462MHz



PSD BLE (1M) 2402MHz



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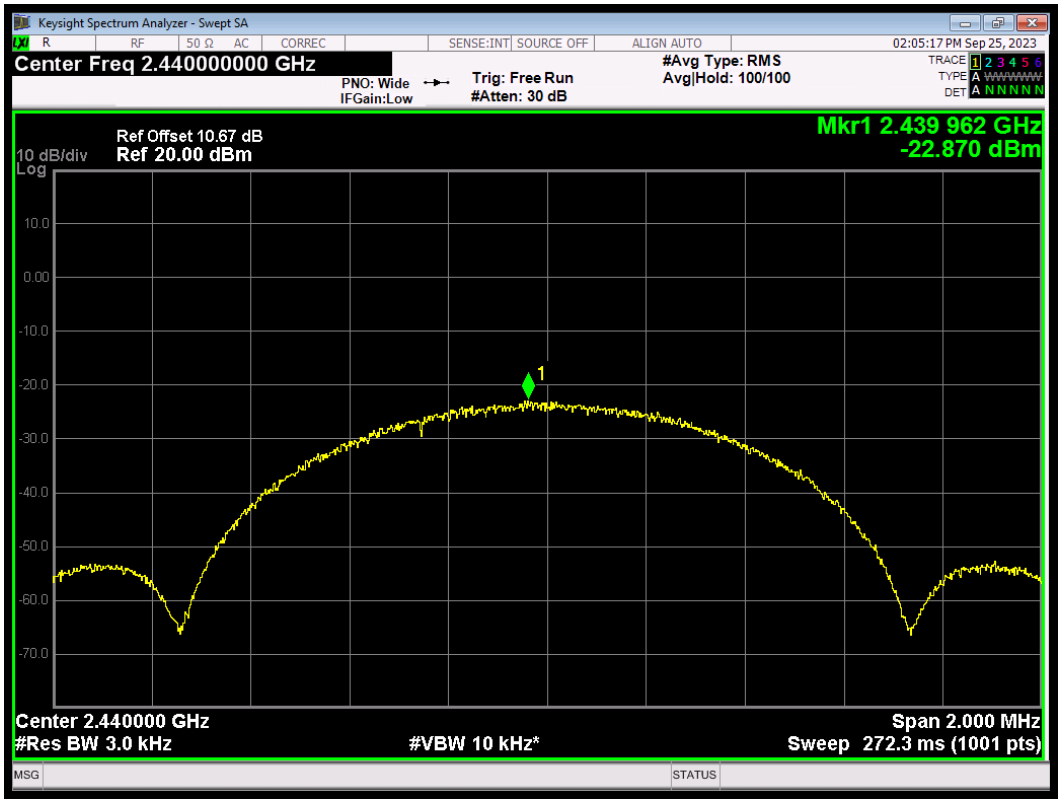
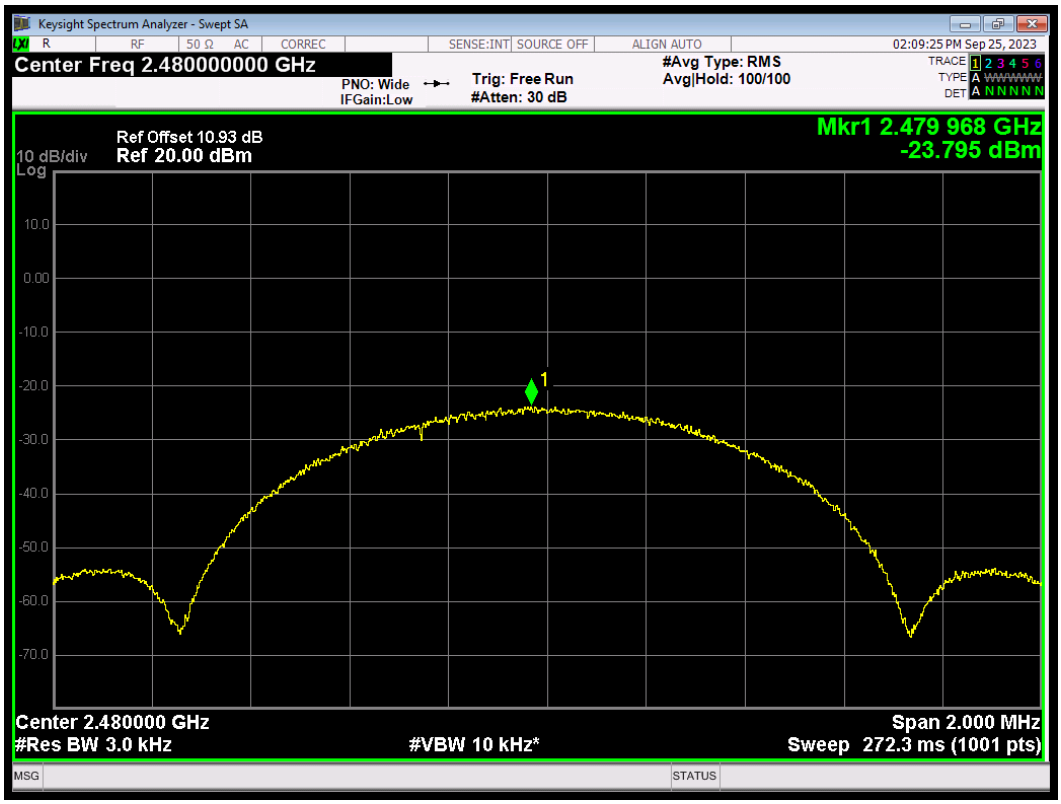
PSD BLE (1M) 2440MHz



PSD BLE (1M) 2480MHz



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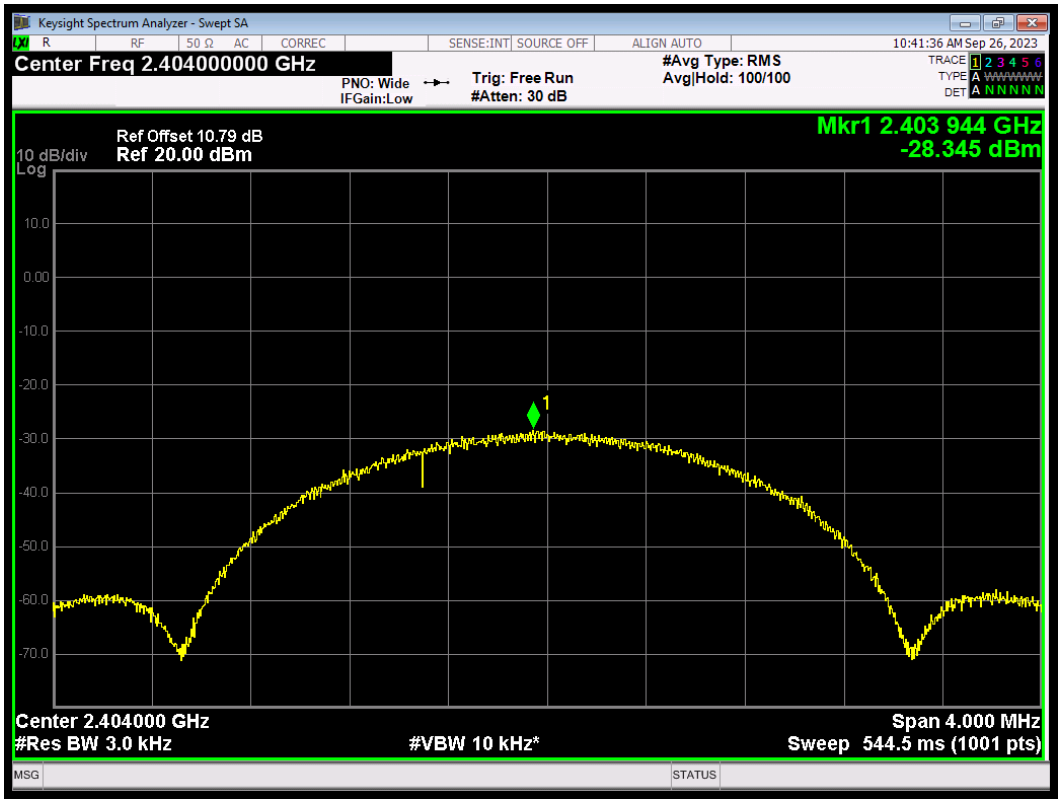
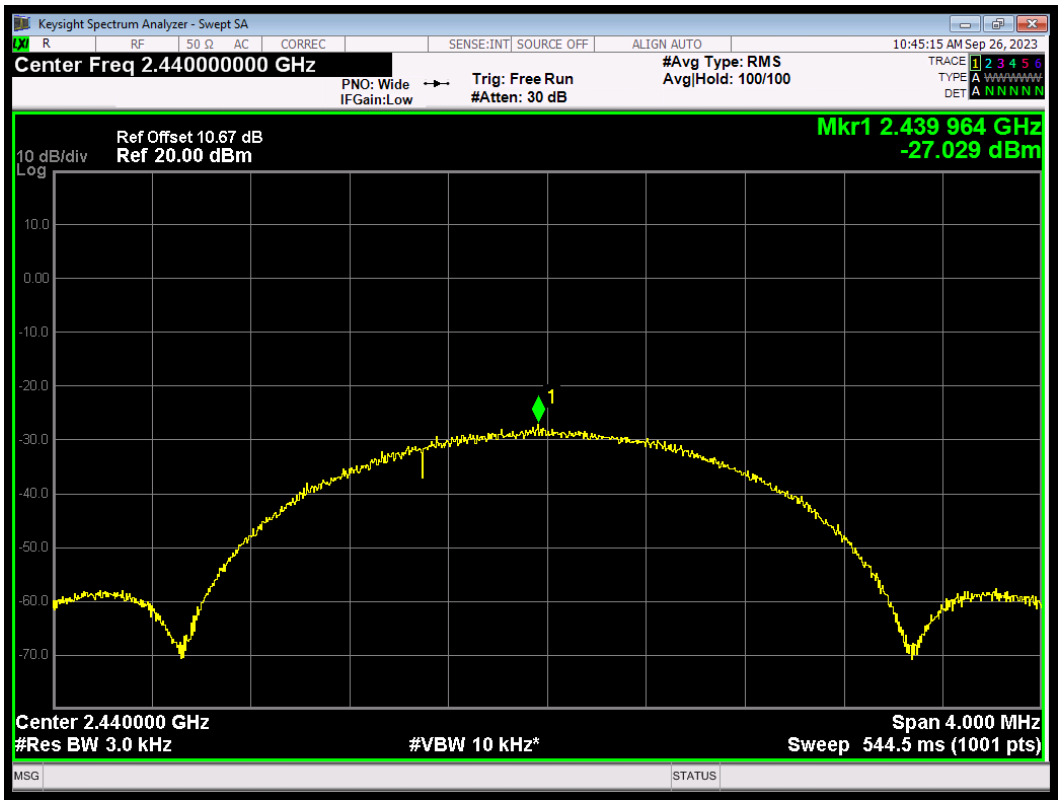
PSD BLE (2M) 2404MHz



PSD BLE (2M) 2440MHz



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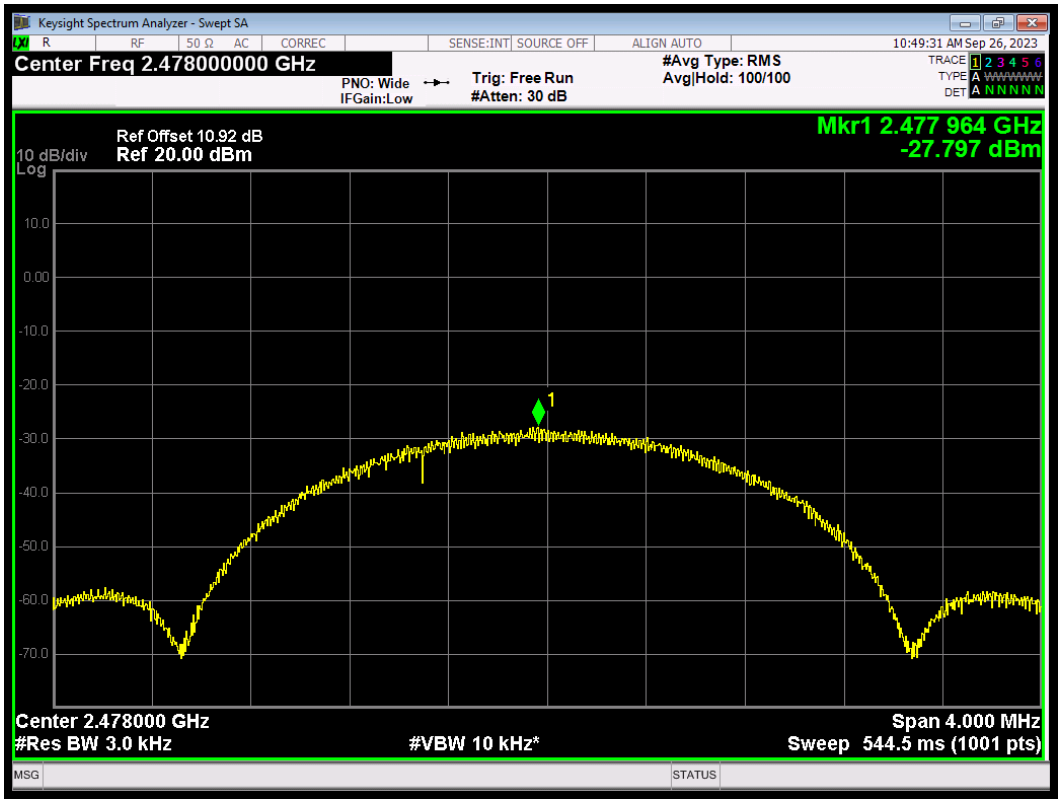
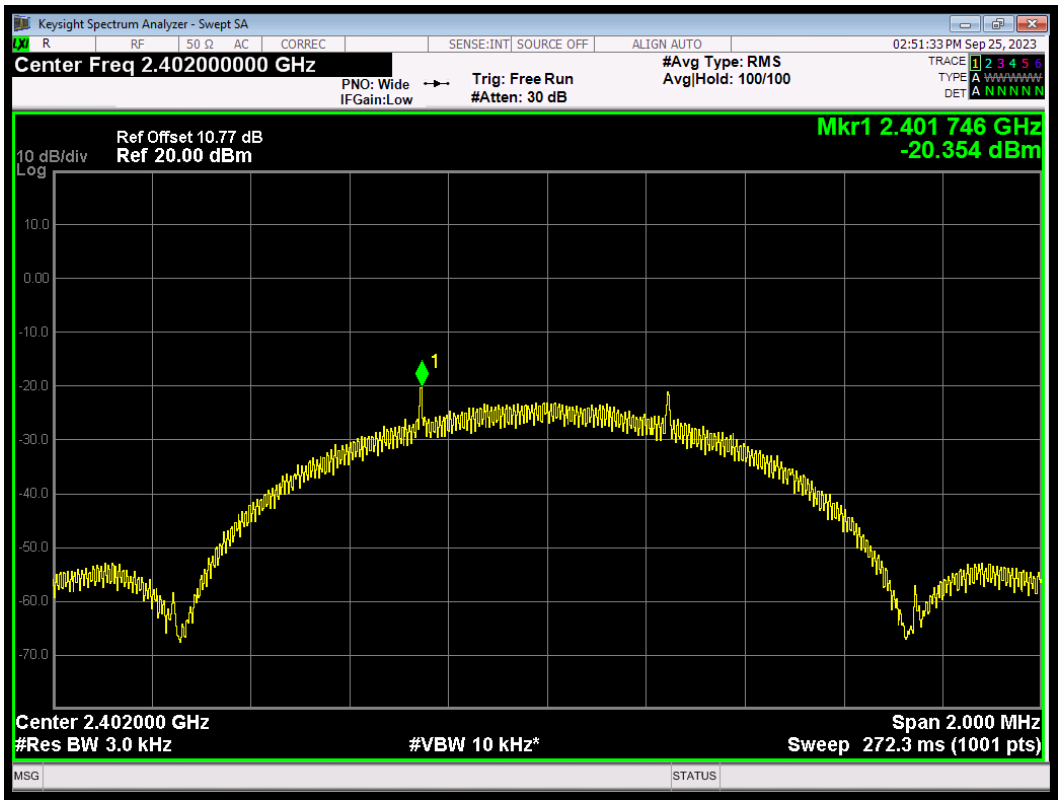
PSD BLE (2M) 2478MHz



PSD BLE (S=2) 2402MHz



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