

RF TEST REPORT

Applicant	Quectel Wireless Solutions Company Limited
FCC ID	XMR2023FCS960KN
Product	Wi-Fi & Bluetooth Module
Brand	Quectel
Model	FCS960K-N
Report No.	R2308A0883-R1V2
Issue Date	March 27, 2024

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15C (2023)**. 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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Version	Revision Description	Issue Date
Rev.0	Initial issue of report.	March 12, 2024
Rev.1	Update description.	March 20, 2024
Rev.2	Update data.	March 27, 2024
Note: This revised report (Report No.: R2308A0883-R1V2) supersedes and replaces the previously issued report (Report No.: R2308A0883-R1V1). Please discard or destroy the previously issued report and dispose of it accordingly.		

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	NA
Date of Testing: December 20, 2023 ~ March 4, 2024			
Date of Sample Received: August 28, 2023			
<p>Note: NA = Not Applicable.</p> <p>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.</p>			

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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Website: <https://www.eurofins.com/electrical-and-electronics>
E-mail: Kain.Xu@cpt.eurofinscn.com

2. General Description of Equipment Under Test

2.1. Applicant and Manufacturer Information

Applicant	Quectel Wireless Solutions Company Limited
Applicant address	Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China, 200233
Manufacturer	Quectel Wireless Solutions Company Limited
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	FCS960K-N
SN	Conducted: P1D23C804002063 Radiated: E1N23G40F000056
Hardware Version	R1.0
Software Version	NA
Power Supply	External power supply
Antenna Type	External Antenna
Antenna Connector	RP SMA Male (meet with the standard FCC Part 15.203 requirement)
Antenna Gain	Wi-Fi 2.4G: 0.73 dBi Bluetooth LE: 0.73 dBi
Additional Beamforming Gain	NA
Operating Frequency Range(s)	802.11b/g/n(HT20)/ax(HE20): 2412 ~ 2462 MHz 802.11n(HT40)/ax(HE40): 2422 ~ 2452 MHz Bluetooth LE V5.4: 2402 ~2480 MHz
Modulation Type	802.11b: DSSS 802.11g/n: OFDM 802.11ax: OFDM (Only Support Full Ru) Bluetooth LE: GFSK
Max. Output Power	Wi-Fi 2.4G: 18.05 dBm Bluetooth LE: 6.65 dBm
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.	

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 (2023) Radio Frequency Devices

ANSI C63.10-2013

Reference standard:

KDB 558074 D01 15.247 Meas Guidance v05r02

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 (vertical), lie-down position (horizontal). The worst emission was found in stand-up position (vertical) 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
802.11n HT40	MCS0
802.11ax HE20	MCS0
802.11ax HE40	MCS0

5. Test Case Results

5.1. Maximum output power

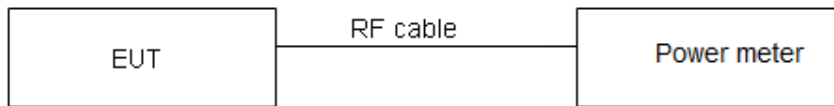
Ambient Condition

Temperature	Relative humidity
15°C ~ 35°C	20% ~ 80%

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	$\leq 1W$ (30dBm)
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.44$ dB.

Test Results

Power Index							
Channel	802.11b	802.11g	802.11n HT20	802.11ax HE20	Channel	802.11n HT40	802.11ax HE40
CH1	18	16	15	15	CH3	14	14
CH6	18	17	17	16	CH6	17	16
CH11	17	15	13	14	CH9	14	14

Power Index	
Channel	Bluetooth (Low Energy)
CH0	default
CH19	default
CH39	default

Test Mode	Duty cycle	Duty cycle correction Factor (dB)
802.11b	0.893	0.490
802.11g	0.576	2.400
802.11n HT20	0.833	0.800
802.11n HT40	0.827	0.820
802.11ax HE20	0.790	1.020
802.11ax HE40	0.790	1.020
Bluetooth LE (1M)	0.849	0.710
Bluetooth LE (2M)	0.568	2.460
Bluetooth LE (S=2)	0.909	0.410
Bluetooth LE (S=2)	0.974	0.120
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
802.11b	2412/CH 1	17.05	17.54	30	PASS
	2437/CH 6	17.56	18.05	30	PASS
	2462/CH11	15.30	15.79	30	PASS
802.11g	2412/CH 1	14.62	17.02	30	PASS
	2437/CH 6	14.93	17.33	30	PASS
	2462/CH11	13.32	15.72	30	PASS
802.11n HT20	2412/CH 1	14.32	15.12	30	PASS
	2437/CH 6	16.46	17.26	30	PASS
	2462/CH11	12.45	13.25	30	PASS
802.11n HT40	2422/CH3	13.49	14.31	30	PASS
	2437/CH6	16.23	17.05	30	PASS
	2452/CH9	13.37	14.19	30	PASS
802.11ax HE20	2412/CH 1	14.61	15.63	30	PASS
	2437/CH 6	15.02	16.04	30	PASS
	2462/CH11	12.61	13.63	30	PASS
802.11ax HE40	2422/CH3	13.49	14.51	30	PASS
	2437/CH6	15.25	16.27	30	PASS
	2452/CH9	12.90	13.92	30	PASS
Bluetooth (Low Energy) (1M)	2402/CH0	5.43	6.14	30	PASS
	2440/CH19	5.20	5.91	30	PASS
	2480/CH39	5.94	6.65	30	PASS
Bluetooth (Low Energy) (2M)	2402/CH0	3.70	6.16	30	PASS
	2440/CH19	3.48	5.94	30	PASS
	2480/CH39	4.09	6.55	30	PASS
Bluetooth (Low Energy) (S=2)	2402/CH0	5.73	6.14	30	PASS
	2440/CH19	5.49	5.90	30	PASS
	2480/CH39	6.17	6.58	30	PASS
Bluetooth (Low Energy) (S=8)	2402/CH0	6.06	6.18	30	PASS
	2440/CH19	5.76	5.88	30	PASS
	2480/CH39	6.46	6.58	30	PASS
Note: Average Power with duty factor = Average Power Measured +Duty cycle correction factor					

5.2. 99% Bandwidth and 6dB Bandwidth

Ambient Condition

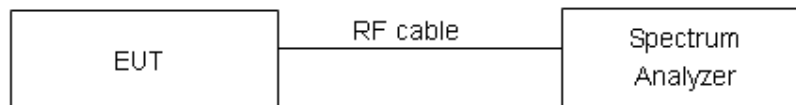
Temperature	Relative humidity
15°C ~ 35°C	20% ~ 80%

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
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Measurement Uncertainty

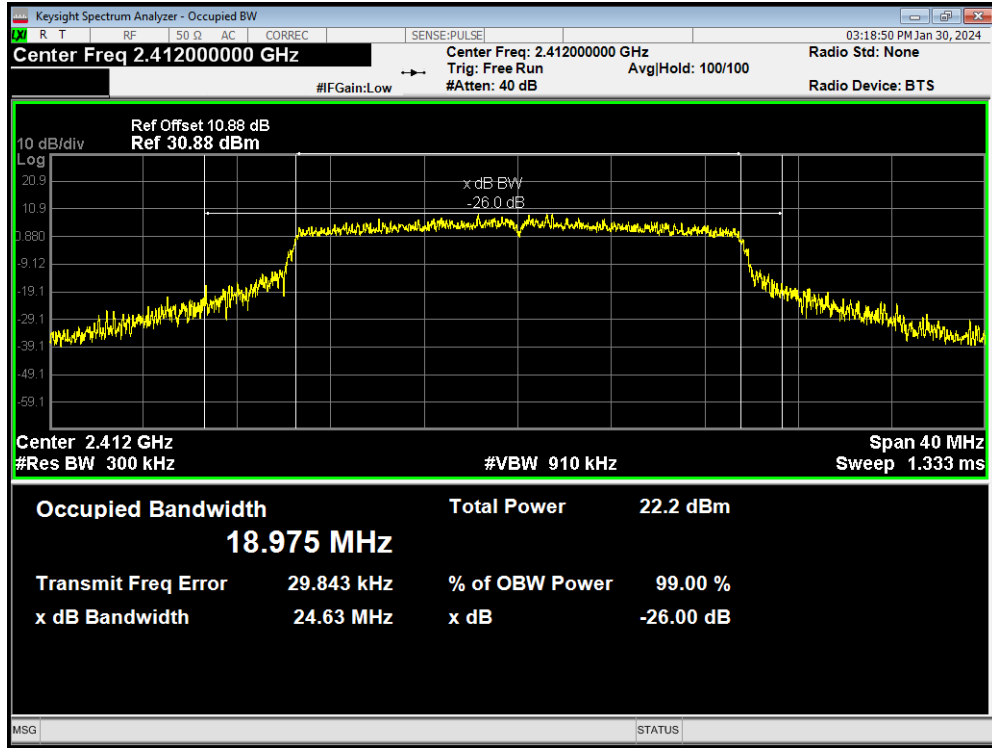
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 936$ Hz.

Test Results:

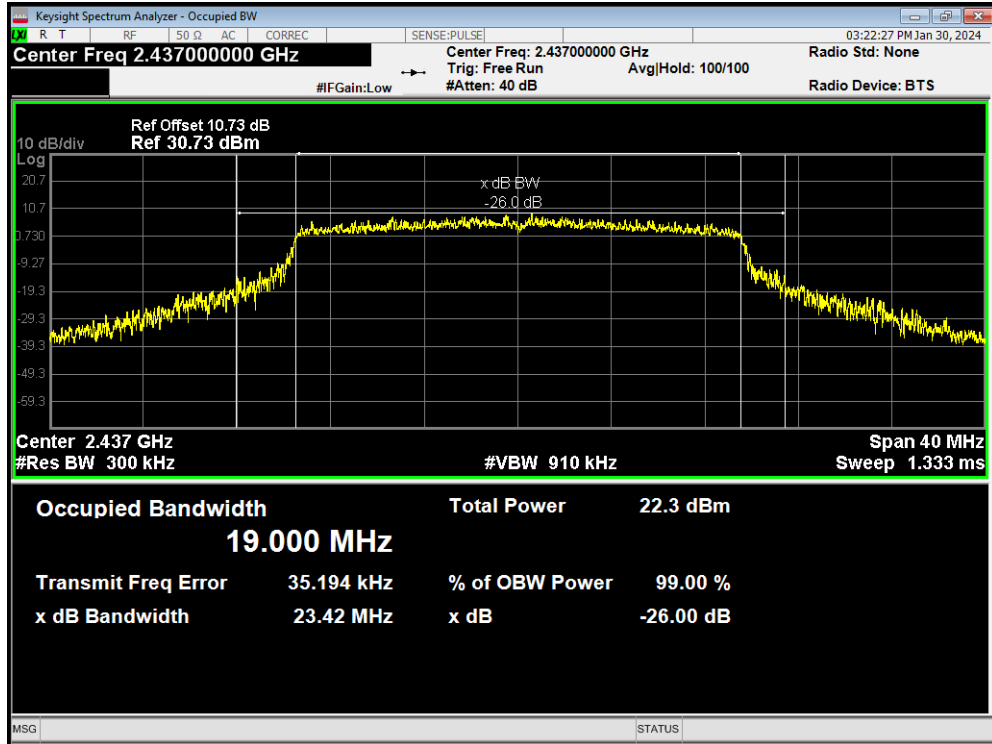
Test Mode	Carrier frequency (MHz)	99% bandwidth (MHz)	Minimum 6 dB bandwidth (MHz)	Limit (kHz)	Conclusion
802.11b	2412	11.912	8.022	500	PASS
	2437	12.009	7.570	500	PASS
	2462	11.795	7.577	500	PASS
802.11g	2412	16.717	15.046	500	PASS
	2437	16.789	16.319	500	PASS
	2462	16.722	16.326	500	PASS
802.11n HT20	2412	17.949	17.289	500	PASS
	2437	17.909	17.079	500	PASS
	2462	17.894	17.564	500	PASS
802.11n HT40	2422	36.344	31.753	500	PASS
	2437	36.297	35.827	500	PASS
	2452	36.323	35.046	500	PASS
802.11ax HE20	2412	18.975	17.951	500	PASS
	2437	19.000	18.506	500	PASS
	2462	19.026	17.872	500	PASS
802.11ax HE40	2422	37.715	37.589	500	PASS
	2437	37.680	34.546	500	PASS
	2452	37.665	35.939	500	PASS
Bluetooth (Low Energy) (1M)	2402	1.022	0.709	500	PASS
	2440	1.027	0.702	500	PASS
	2480	1.030	0.706	500	PASS
Bluetooth (Low Energy) (2M)	2402	2.049	1.176	500	PASS
	2440	2.058	1.197	500	PASS
	2480	2.058	1.240	500	PASS
Bluetooth (Low Energy) (S=2)	2402	1.021	0.656	500	PASS
	2440	1.029	0.661	500	PASS
	2480	1.010	0.658	500	PASS
Bluetooth (Low Energy) (S=8)	2402	1.056	0.668	500	PASS
	2440	1.063	0.668	500	PASS
	2480	1.059	0.669	500	PASS

99%bandwidth

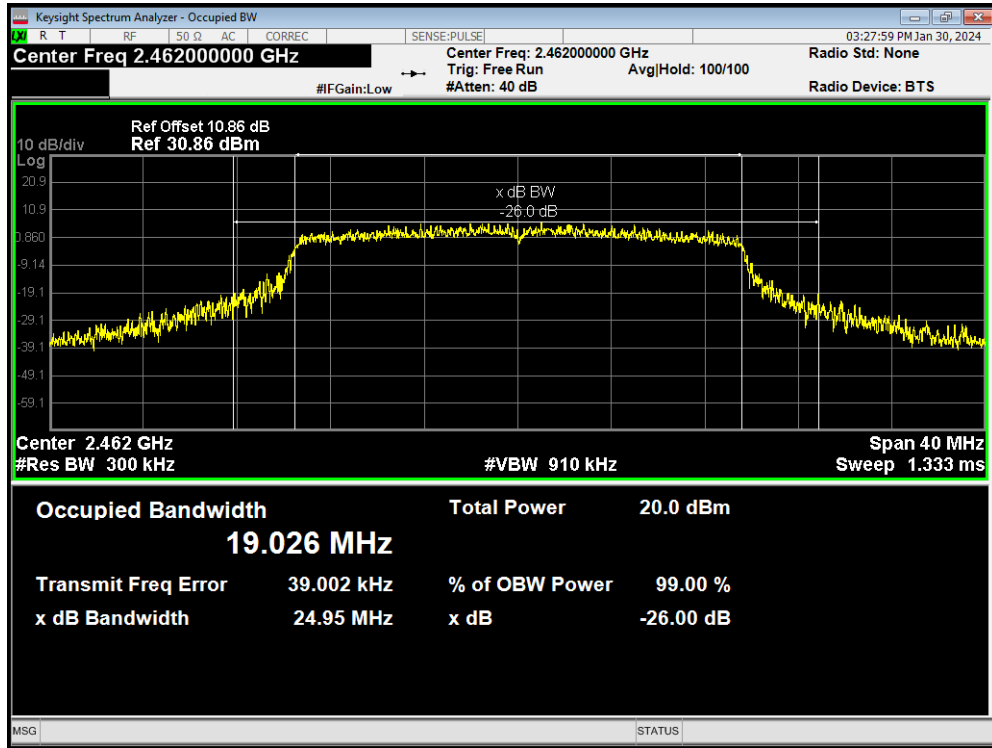
OBW 802.11ax(HE20) 2412MHz



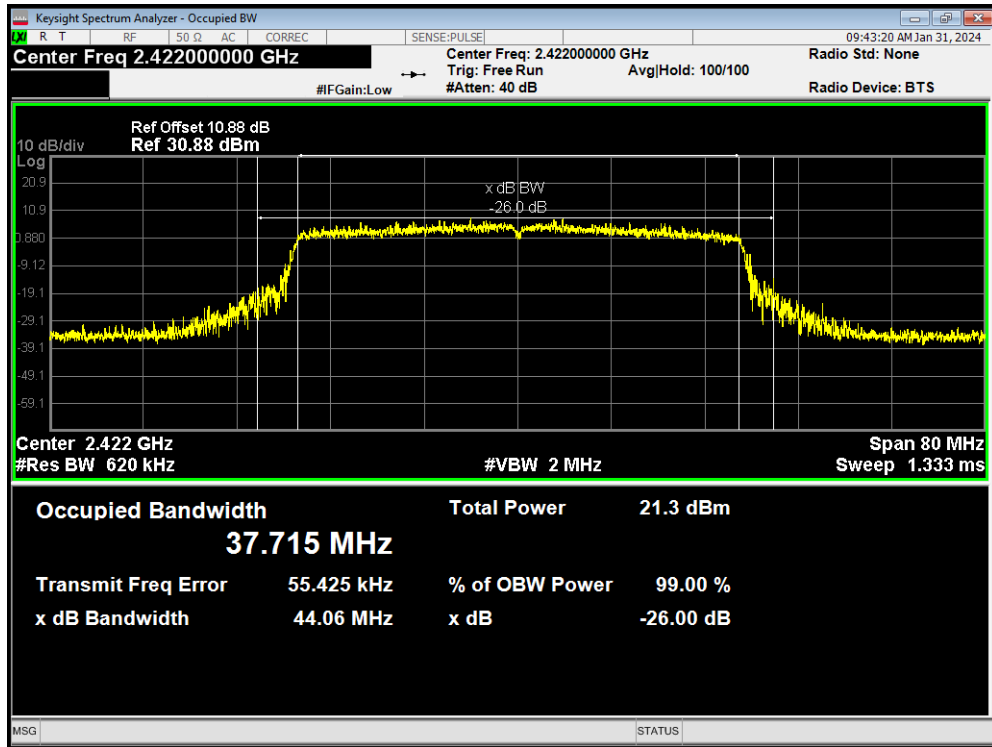
OBW 802.11ax(HE20) 2437MHz



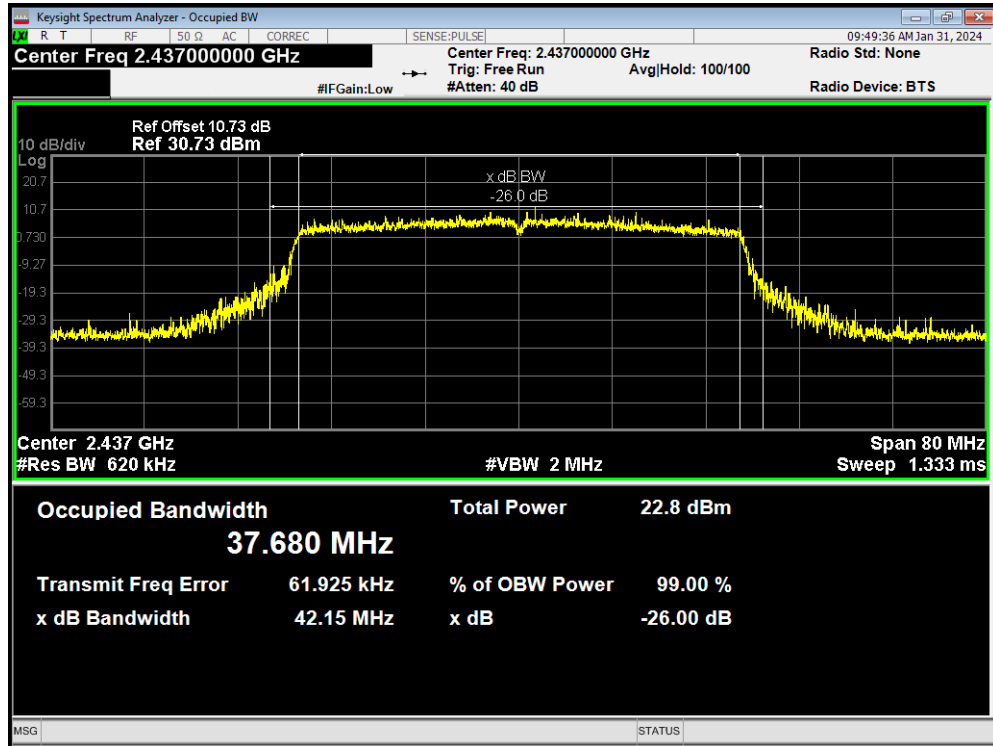
OBW 802.11ax(HE20) 2462MHz



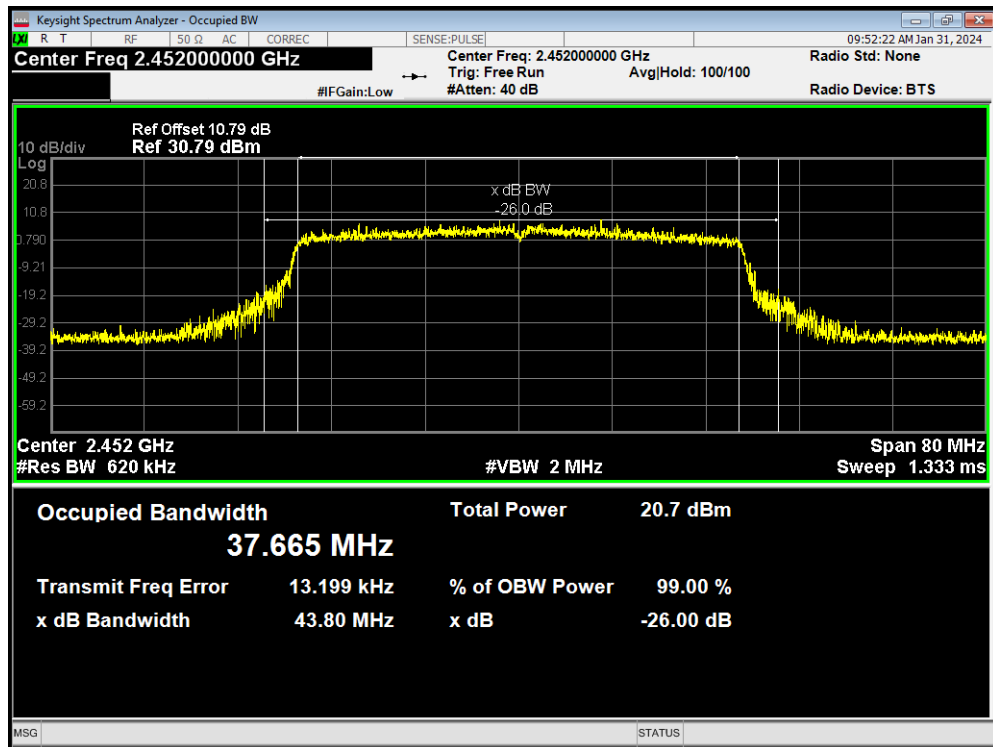
OBW 802.11ax(HE40) 2422MHz



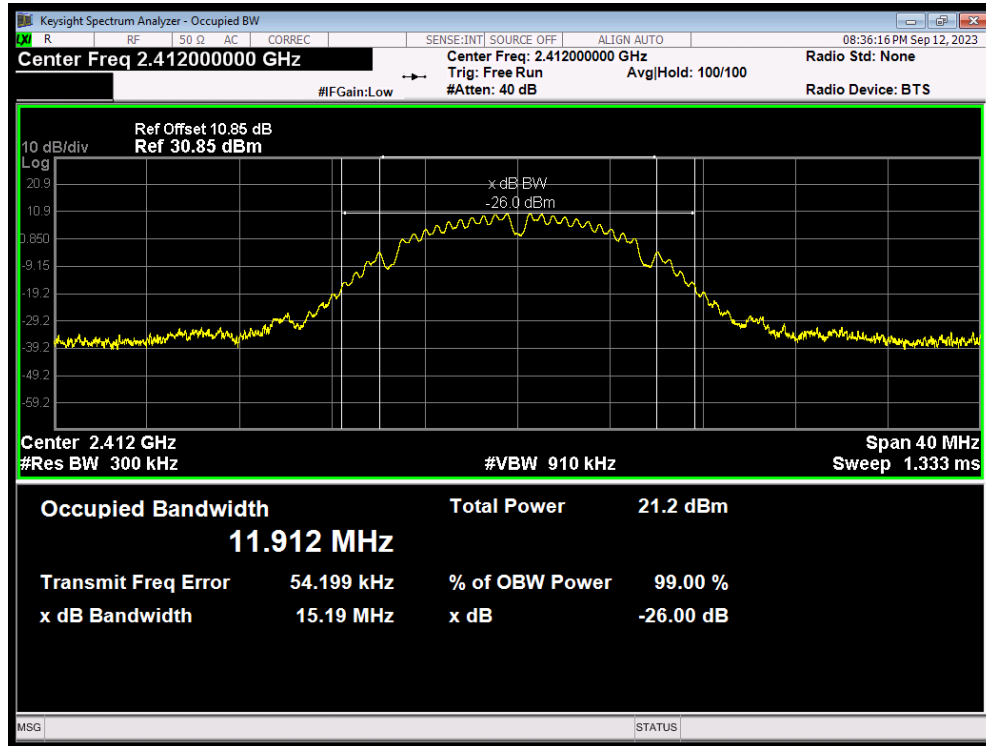
OBW 802.11ax(HE40) 2437MHz



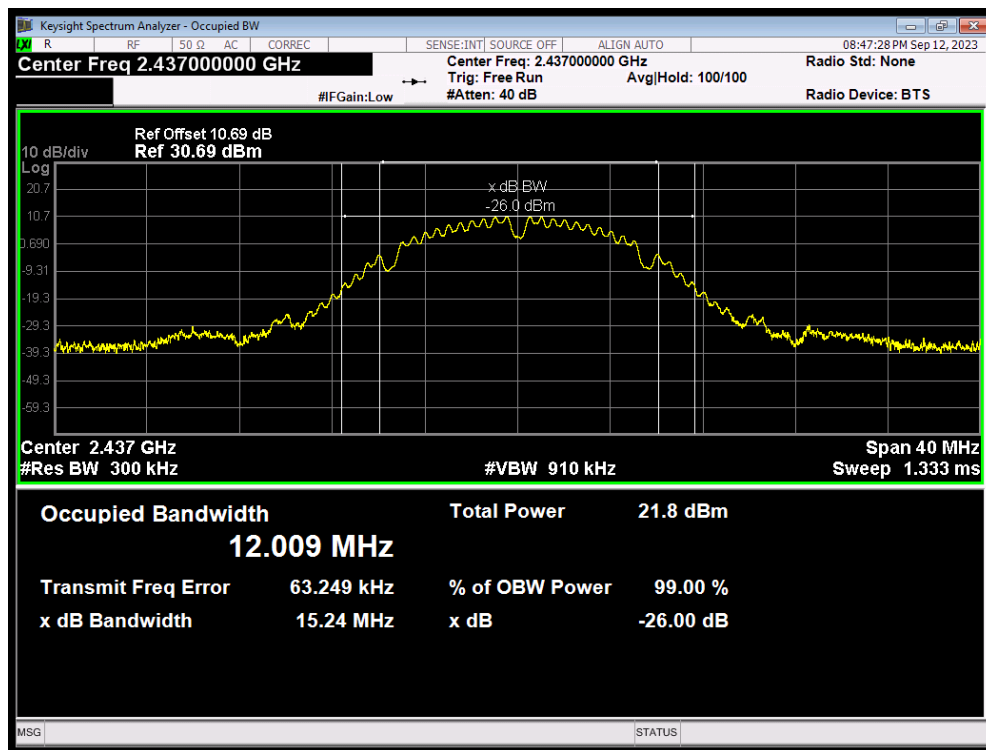
OBW 802.11ax(HE40) 2452MHz



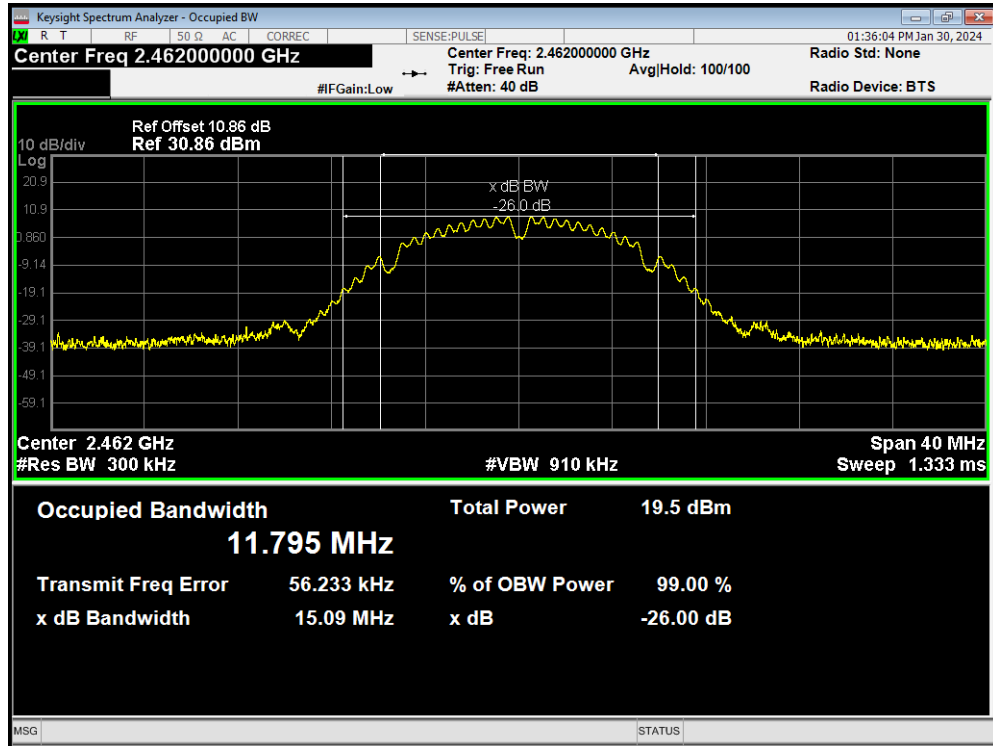
OBW 802.11b 2412MHz



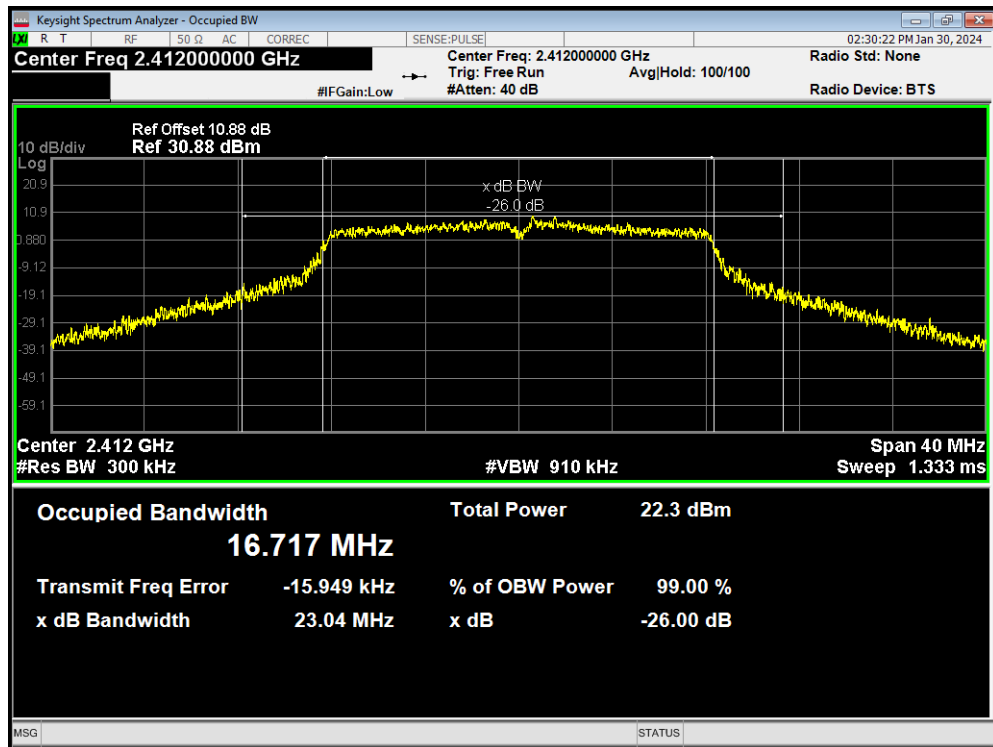
OBW 802.11b 2437MHz



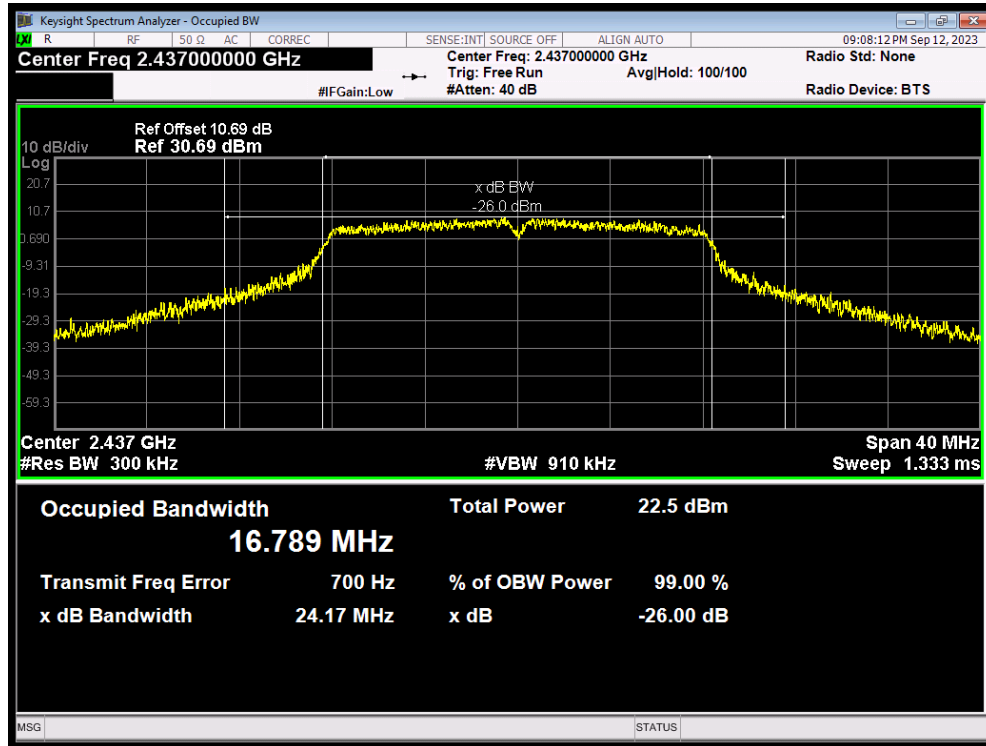
OBW 802.11b 2462MHz



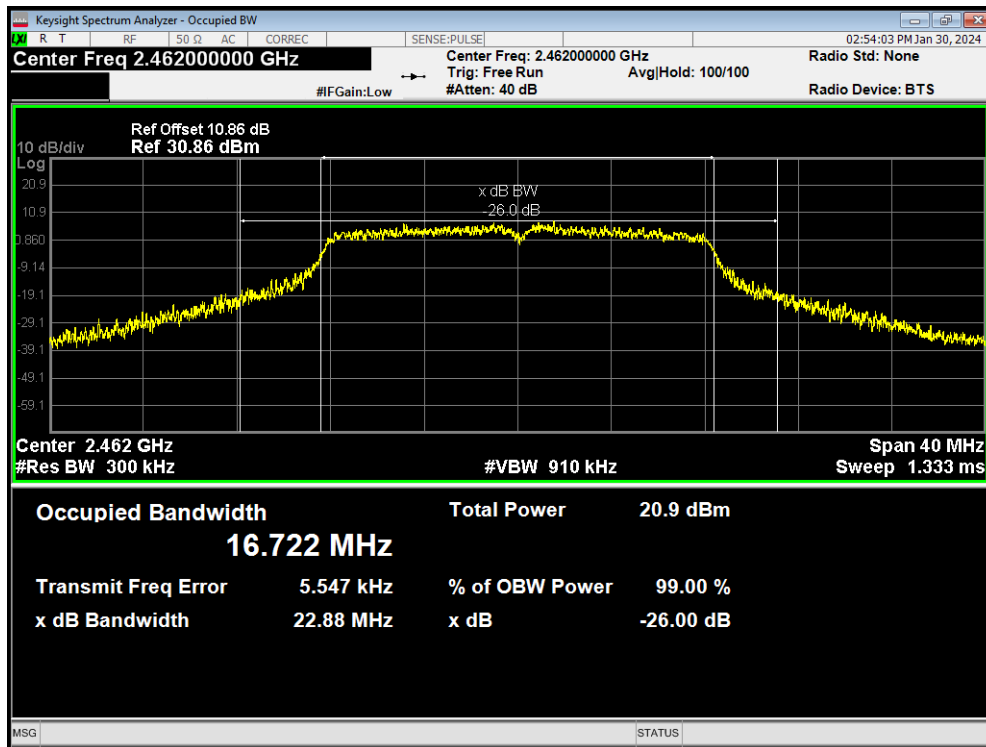
OBW 802.11g 2412MHz



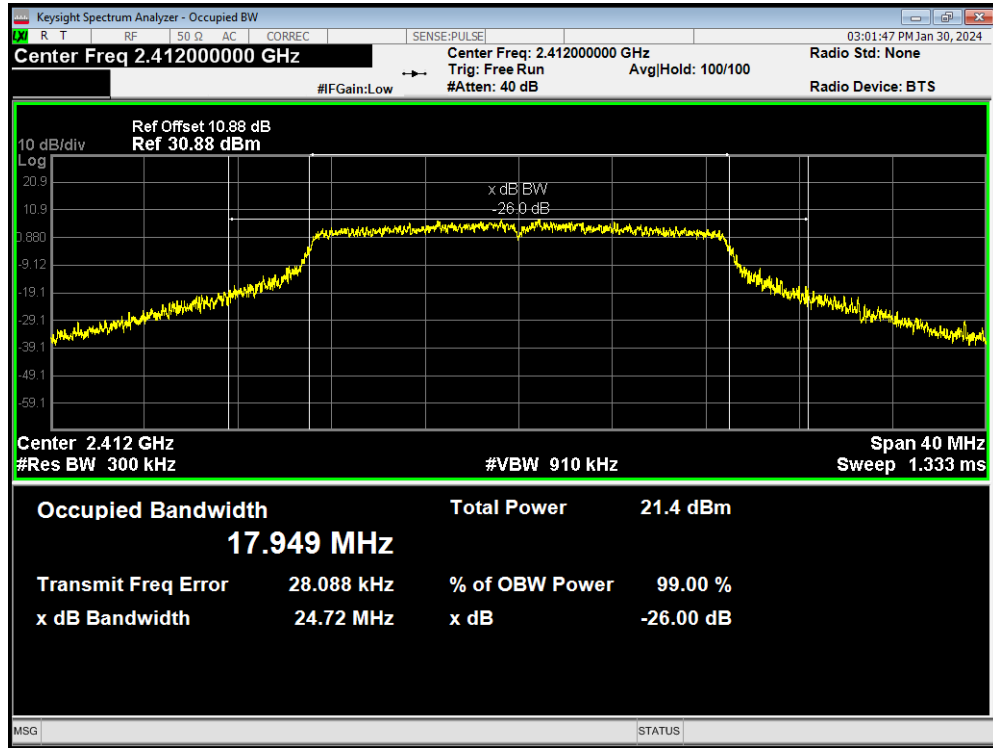
OBW 802.11g 2437MHz



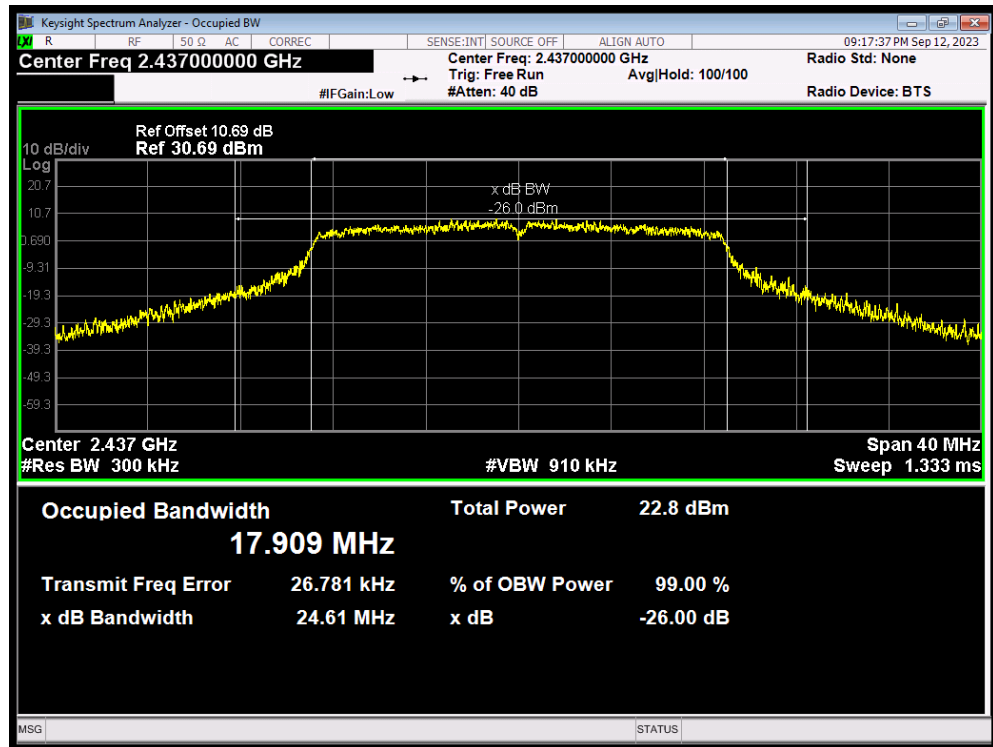
OBW 802.11g 2462MHz



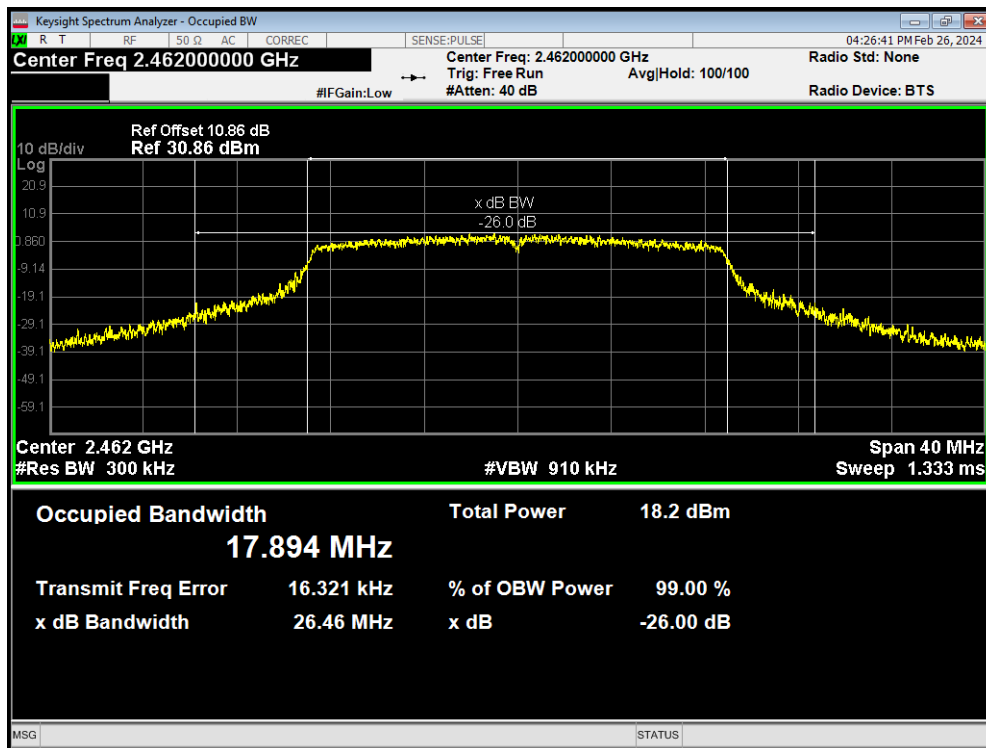
OBW 802.11n(HT20) 2412MHz



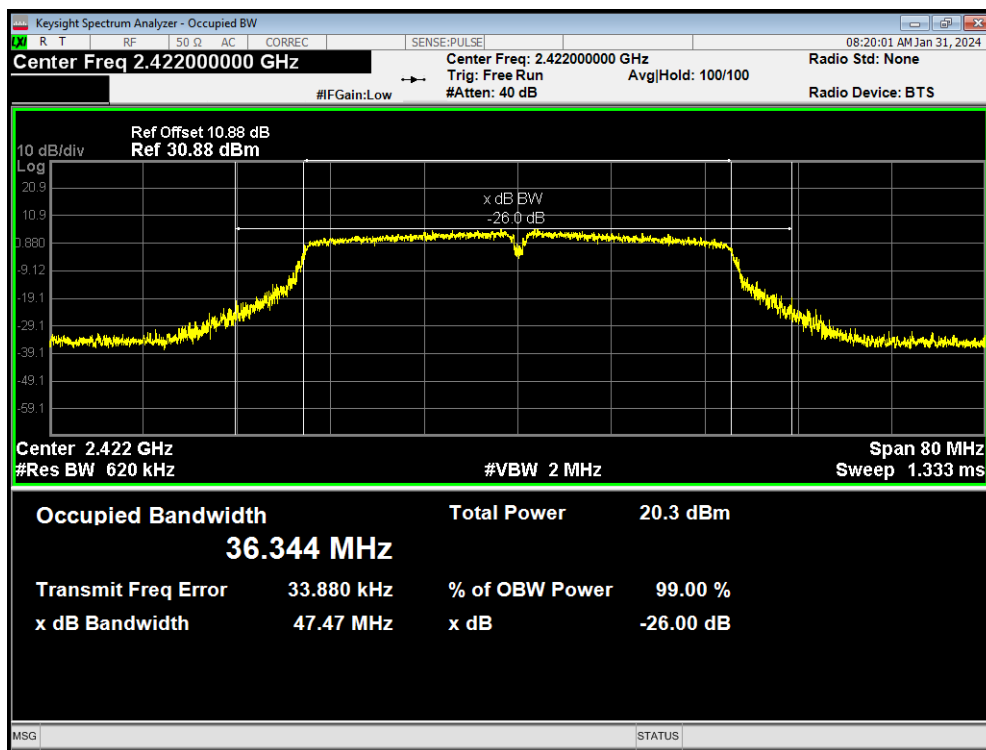
OBW 802.11n(HT20) 2437MHz



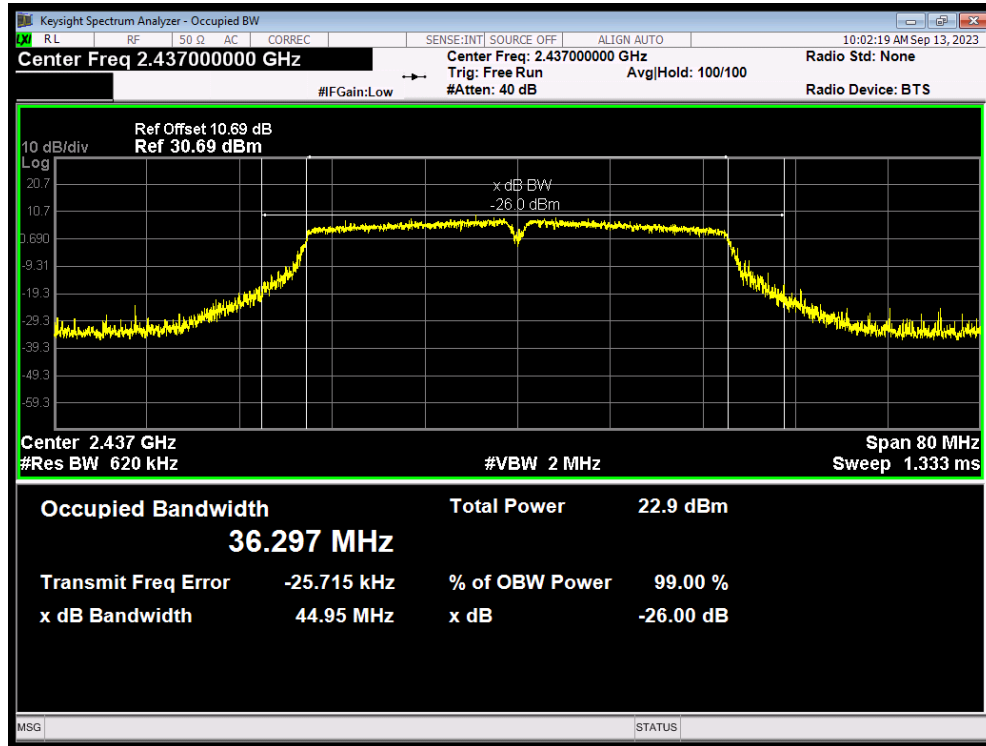
OBW 802.11n(HT20) 2462MHz



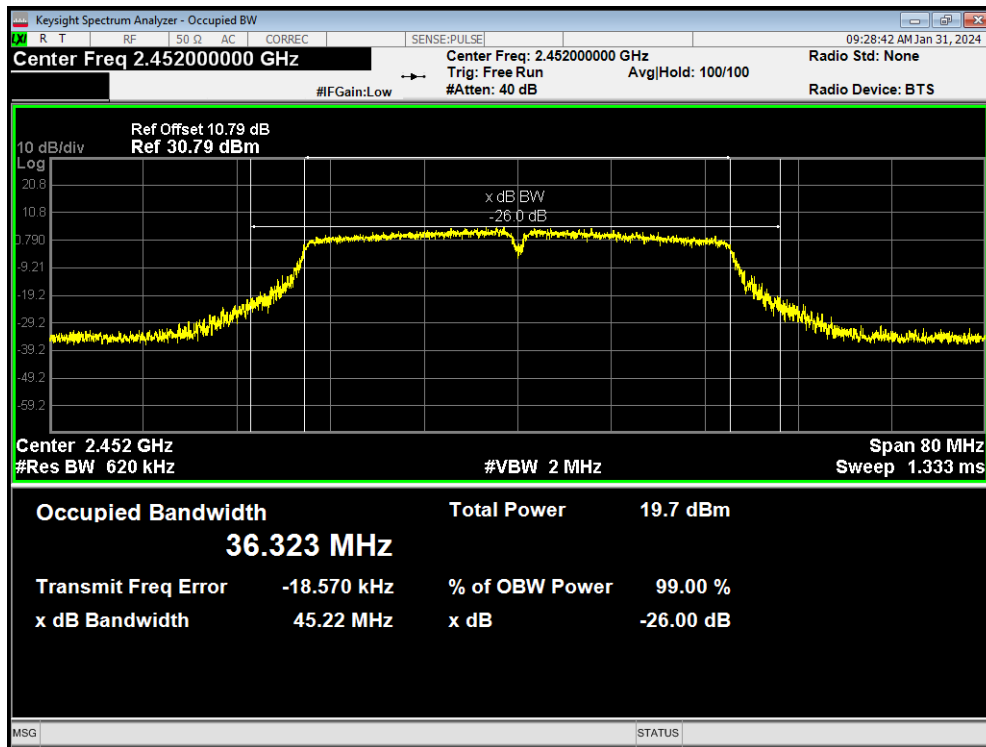
OBW 802.11n(HT40) 2422MHz



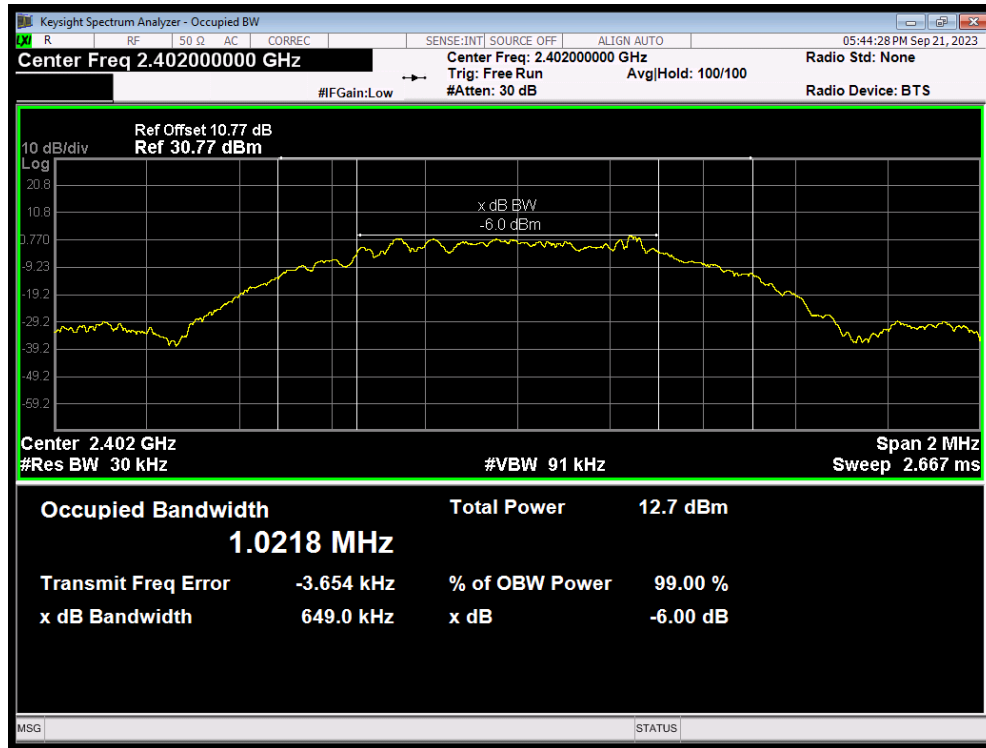
OBW 802.11n(HT40) 2437MHz



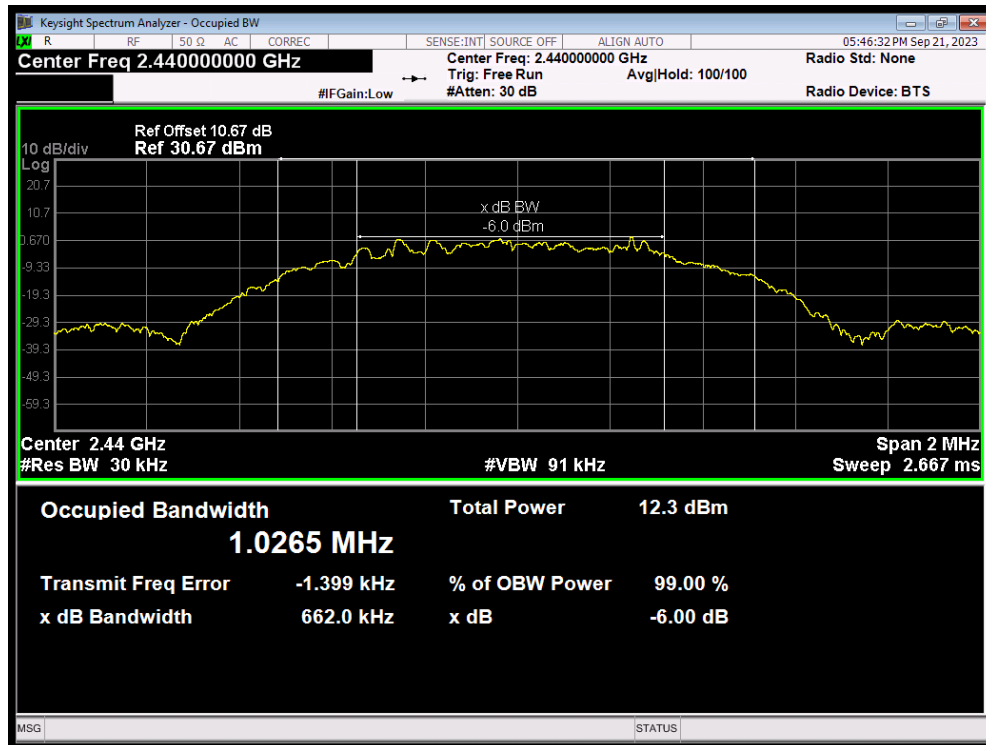
OBW 802.11n(HT40) 2452MHz



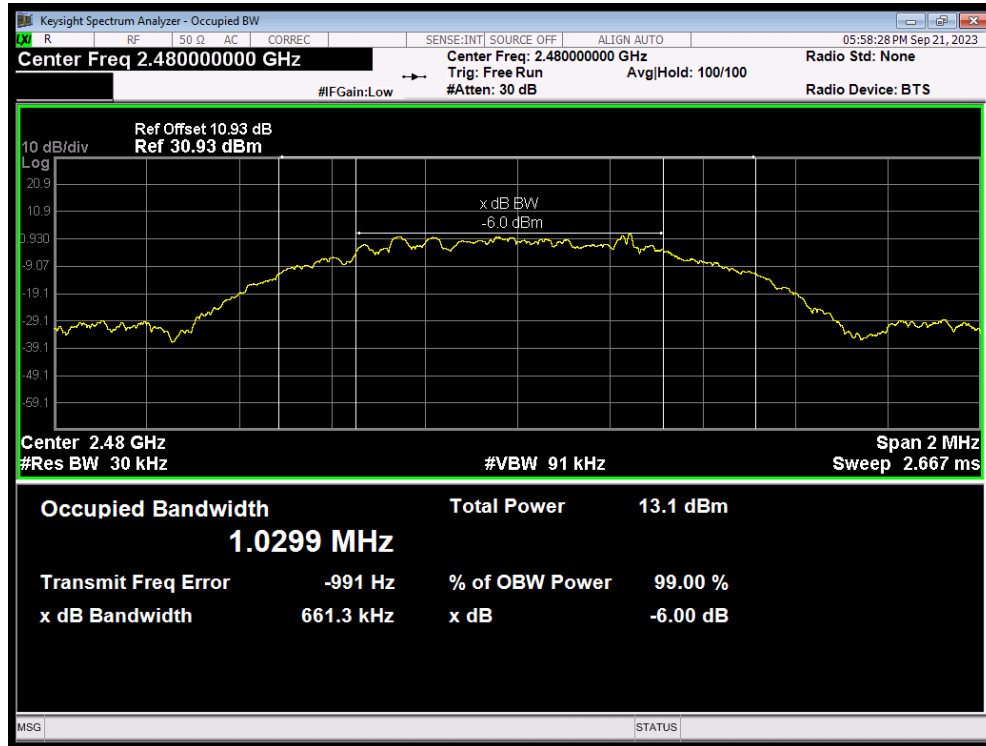
OBW Bluetooth LE(1M) 2402MHz



OBW Bluetooth LE(1M) 2440MHz



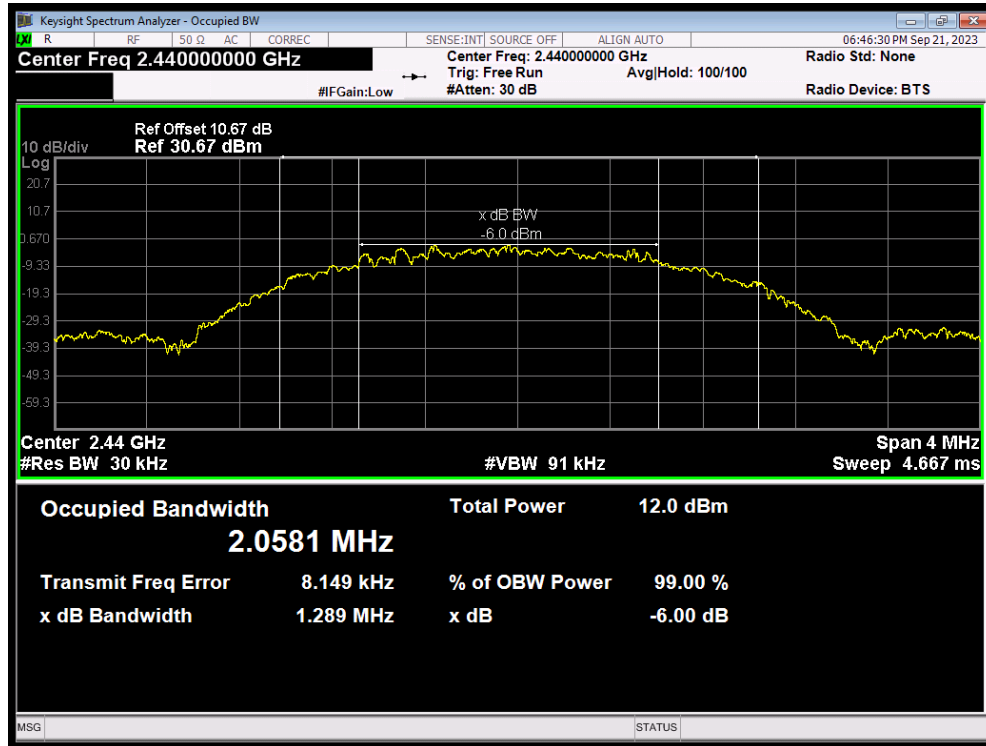
OBW Bluetooth LE(1M) 2480MHz



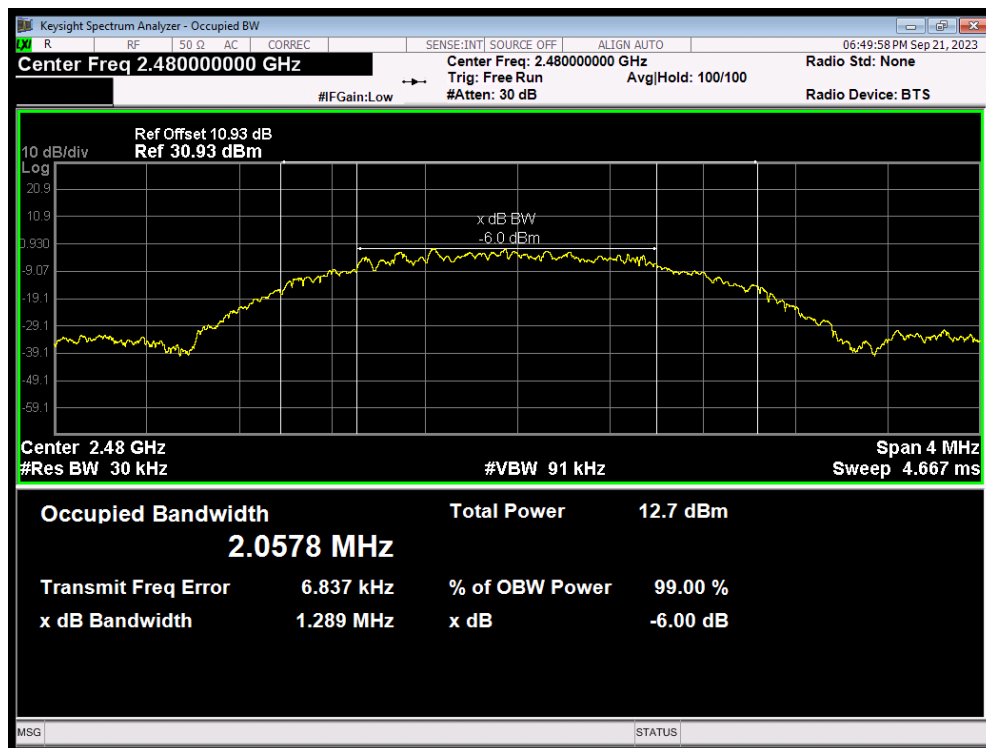
OBW Bluetooth LE(2M) 2402MHz



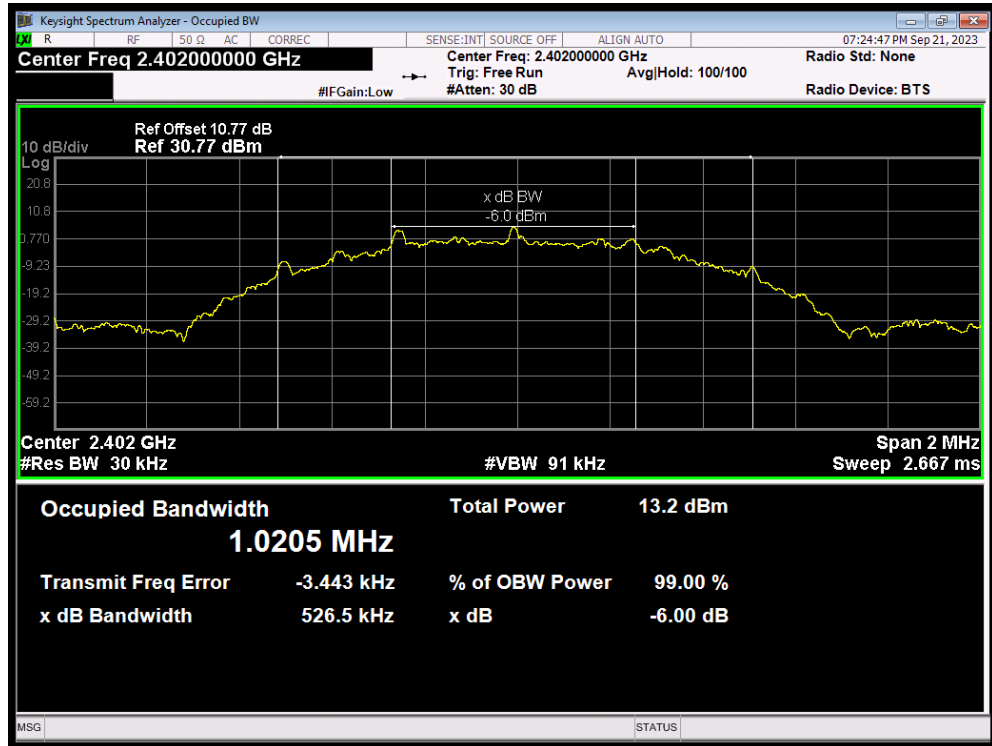
OBW Bluetooth LE(2M) 2440MHz



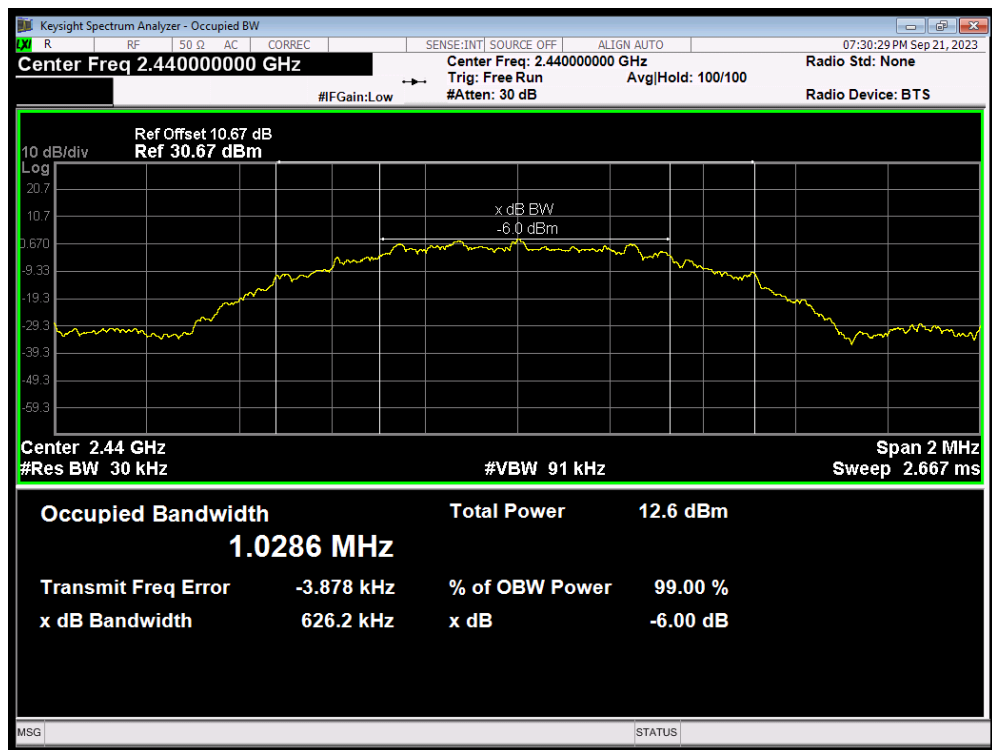
OBW Bluetooth LE(2M) 2480MHz



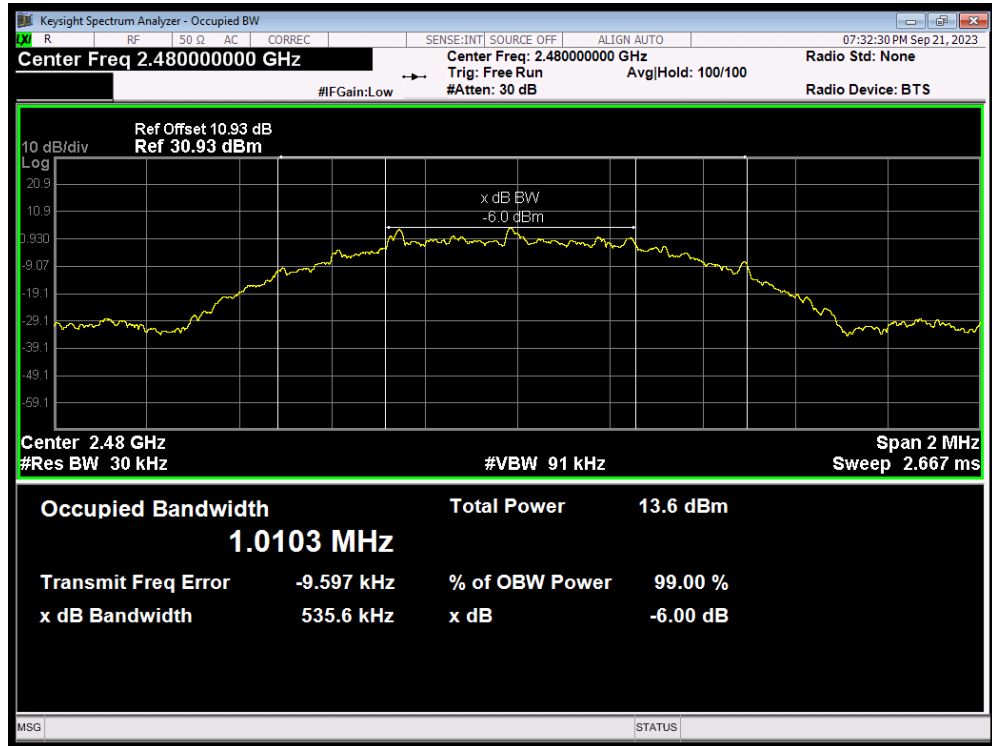
OBW Bluetooth LE(S=2) 2402MHz



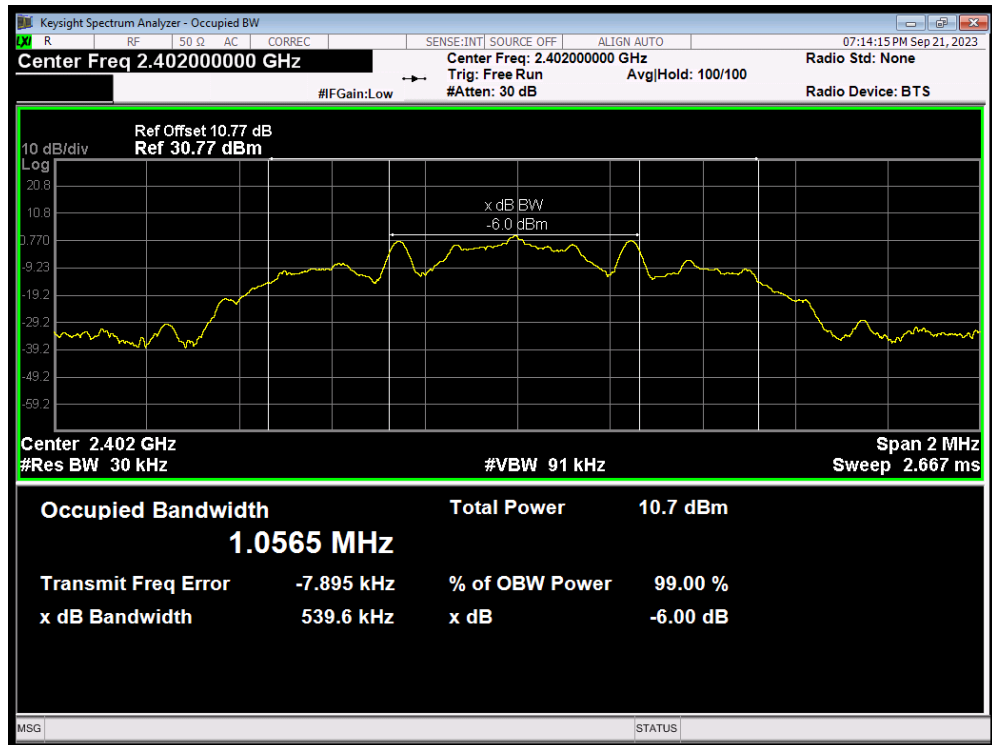
OBW Bluetooth LE(S=2) 2440MHz



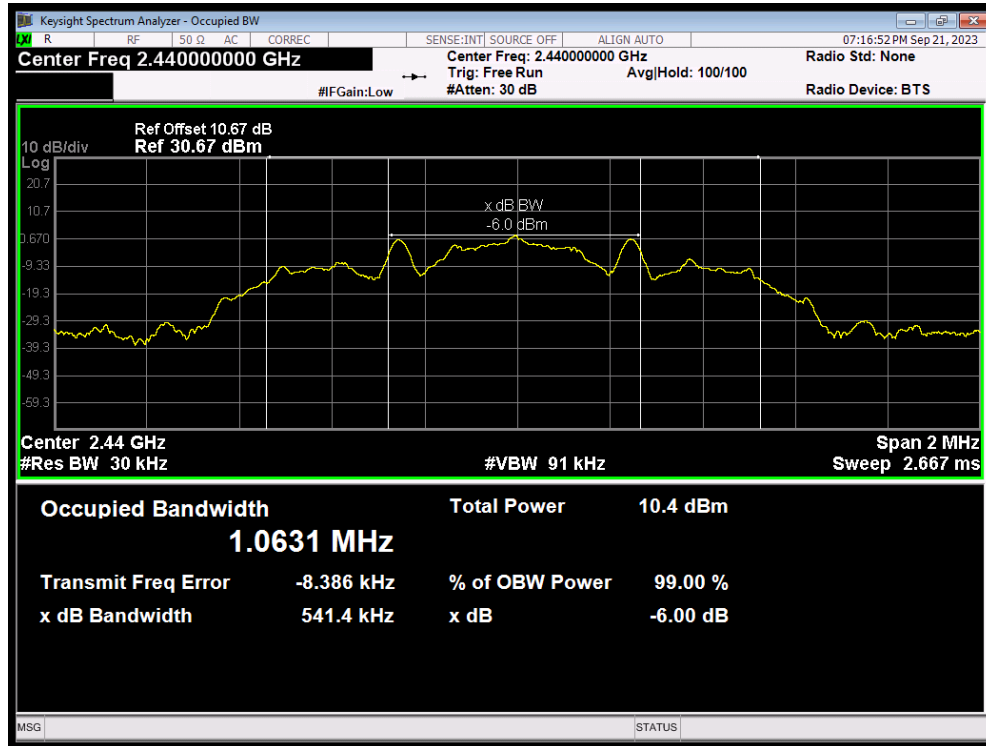
OBW Bluetooth LE(S=2) 2480MHz



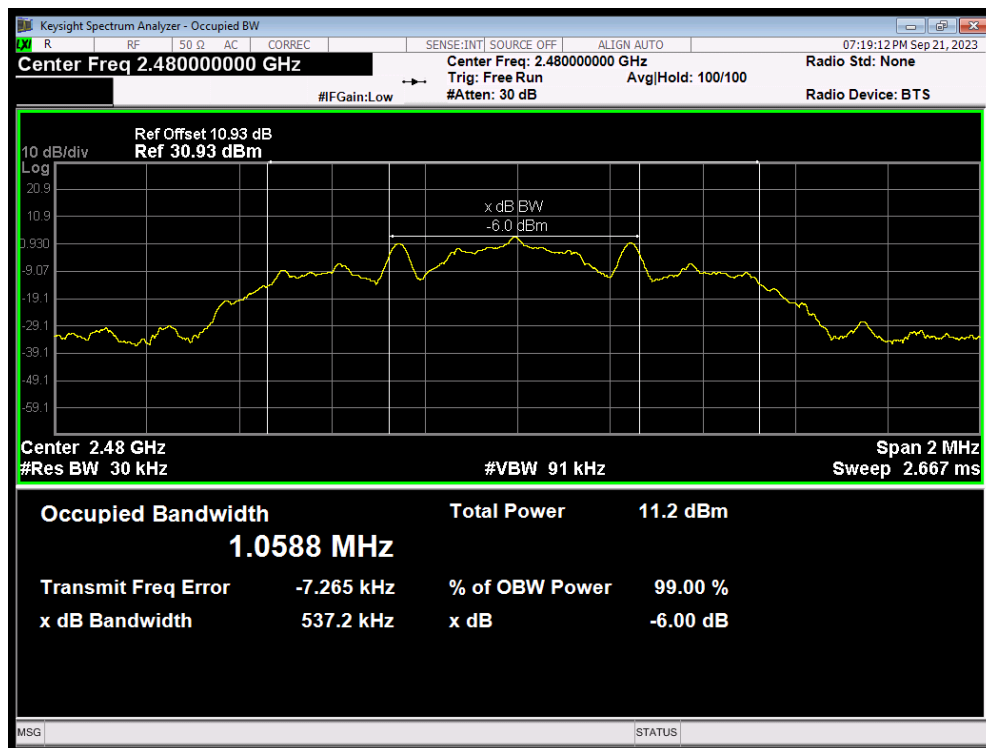
OBW Bluetooth LE(S=8) 2402MHz



OBW Bluetooth LE(S=8) 2440MHz

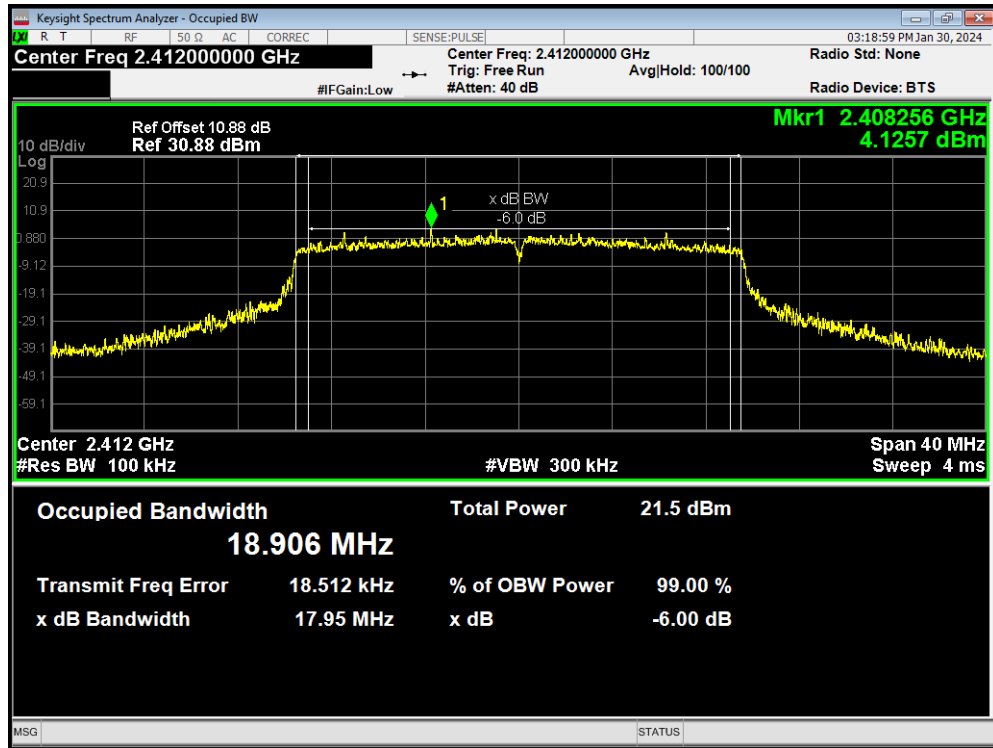


OBW Bluetooth LE(S=8) 2480MHz

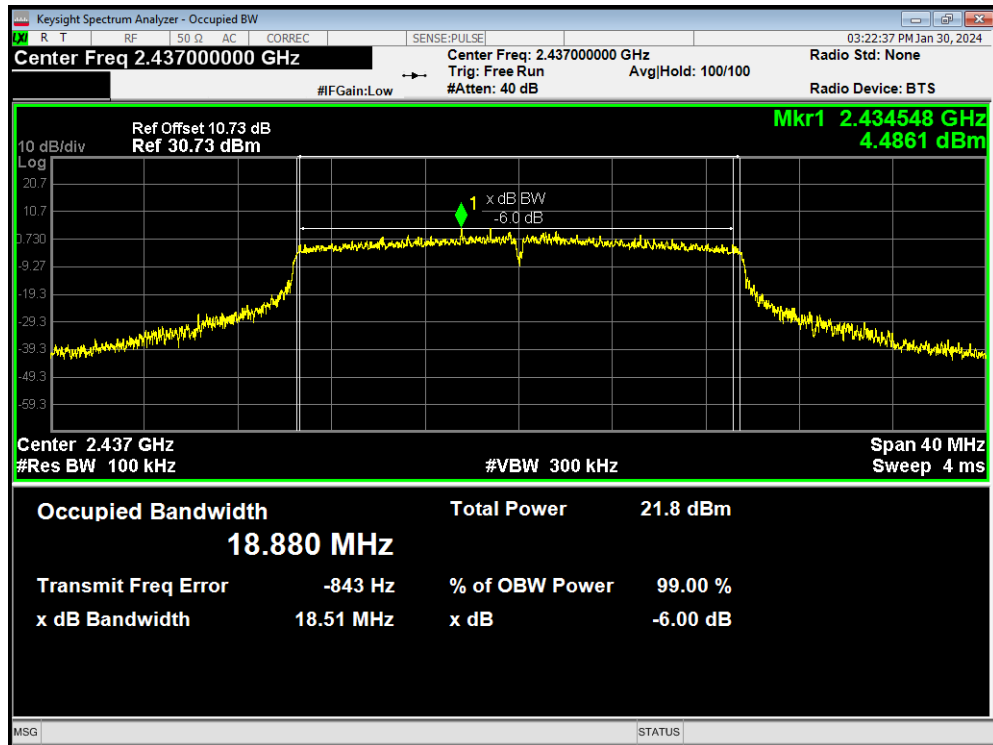


6 dB bandwidth

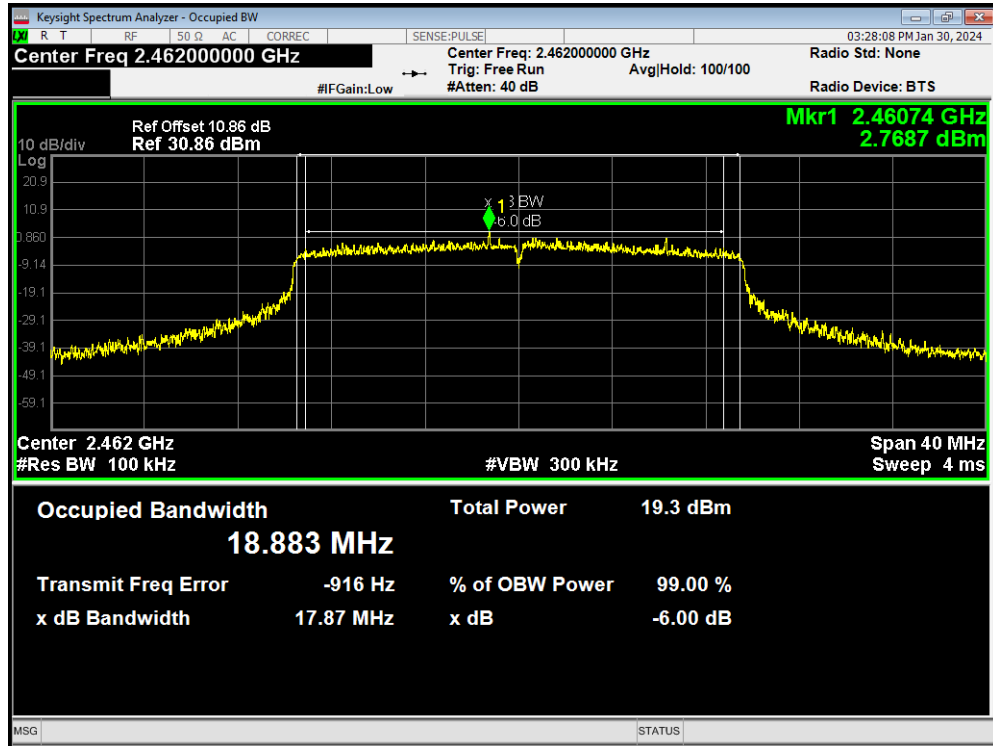
-6dB Bandwidth 802.11ax(HE20) 2412MHz



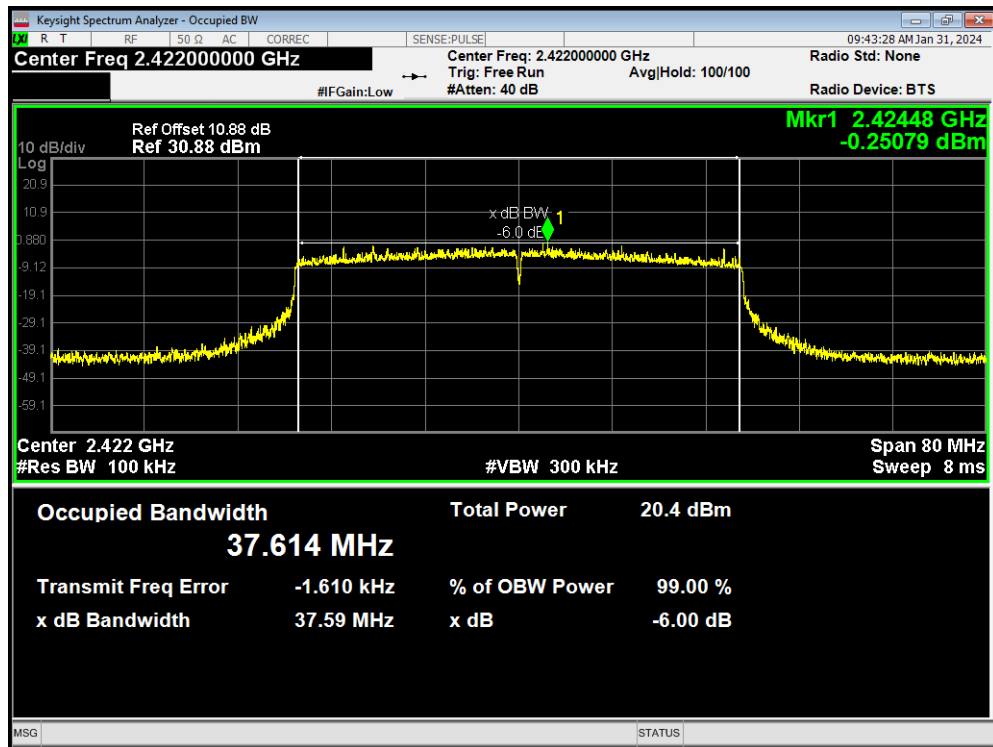
-6dB Bandwidth 802.11ax(HE20) 2437MHz



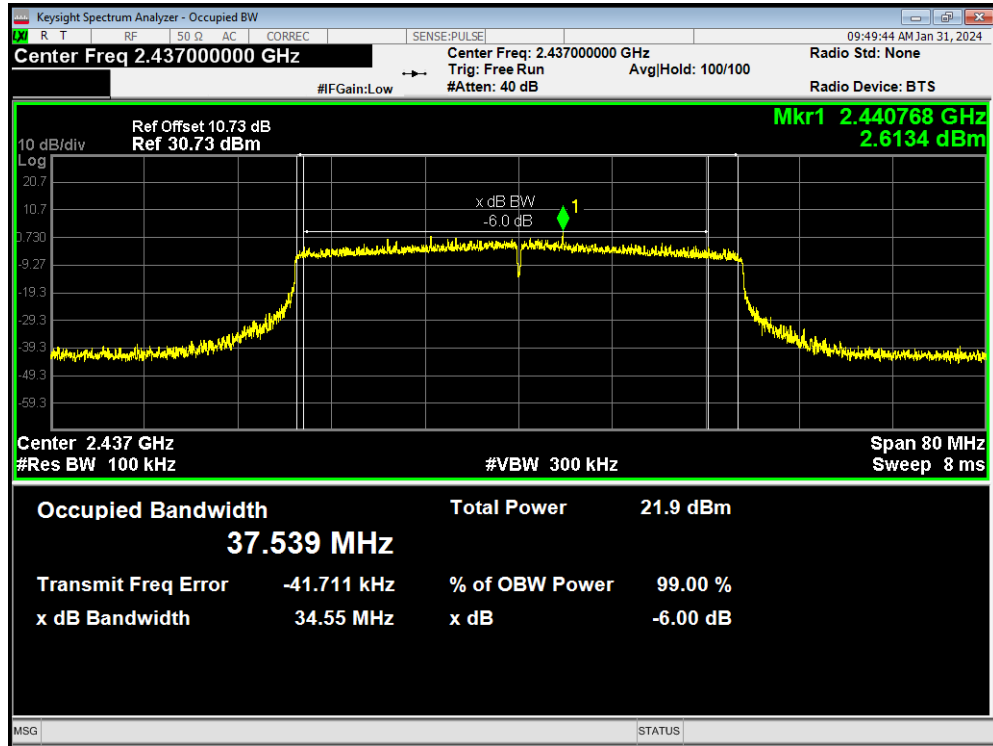
-6dB Bandwidth 802.11ax(HE20) 2462MHz



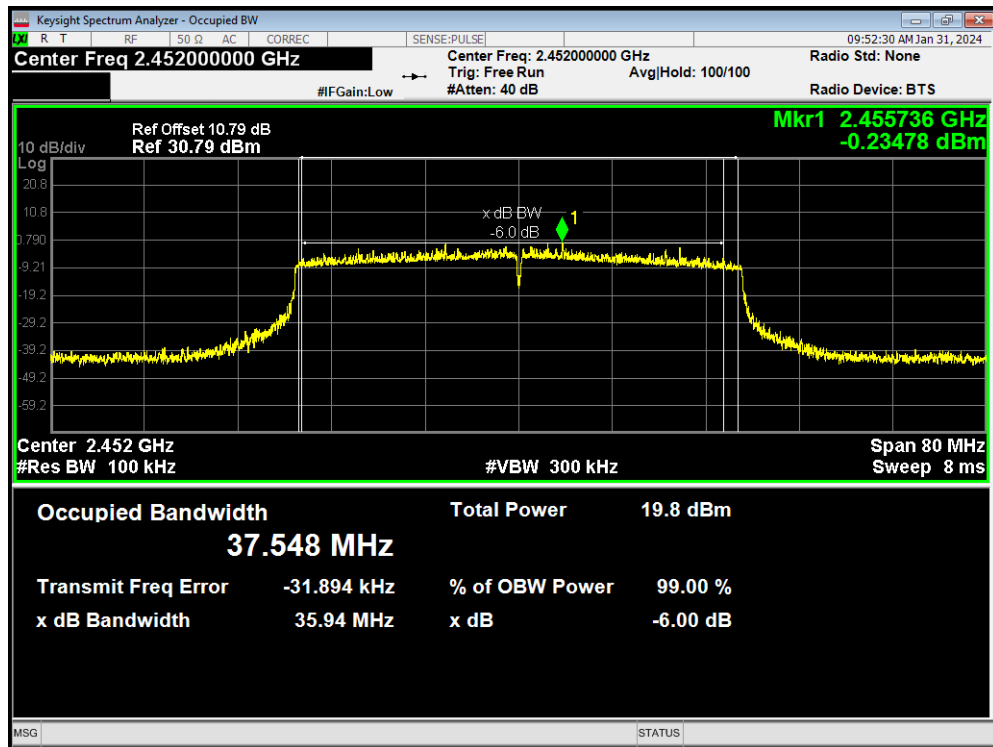
-6dB Bandwidth 802.11ax(HE40) 2422MHz



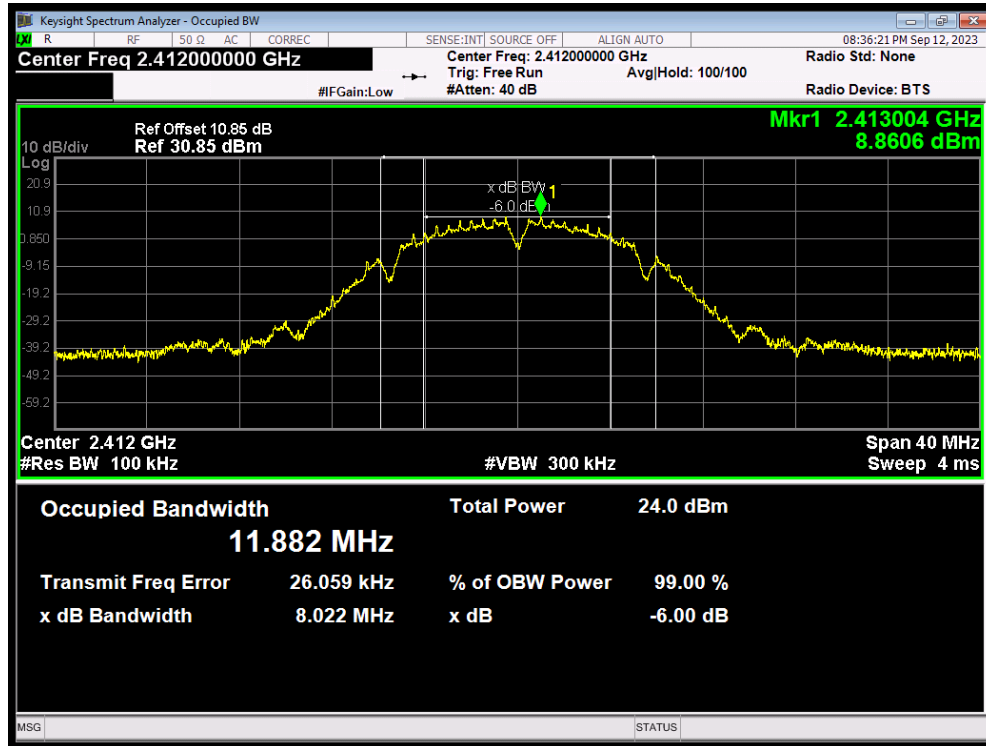
-6dB Bandwidth 802.11ax(HE40) 2437MHz



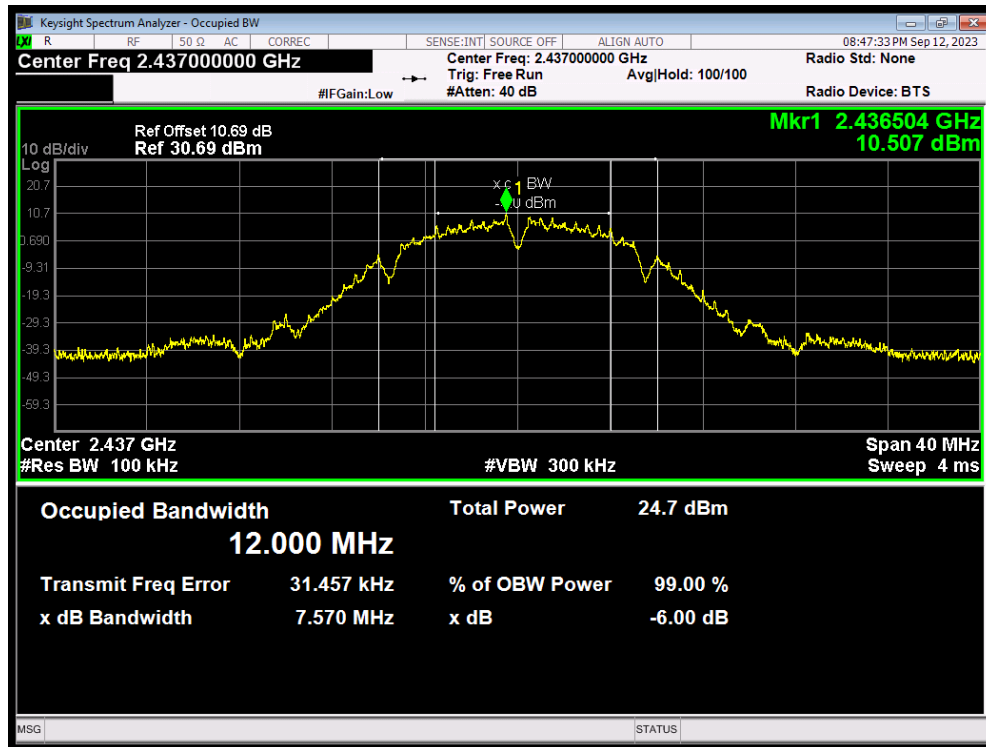
-6dB Bandwidth 802.11ax(HE40) 2452MHz



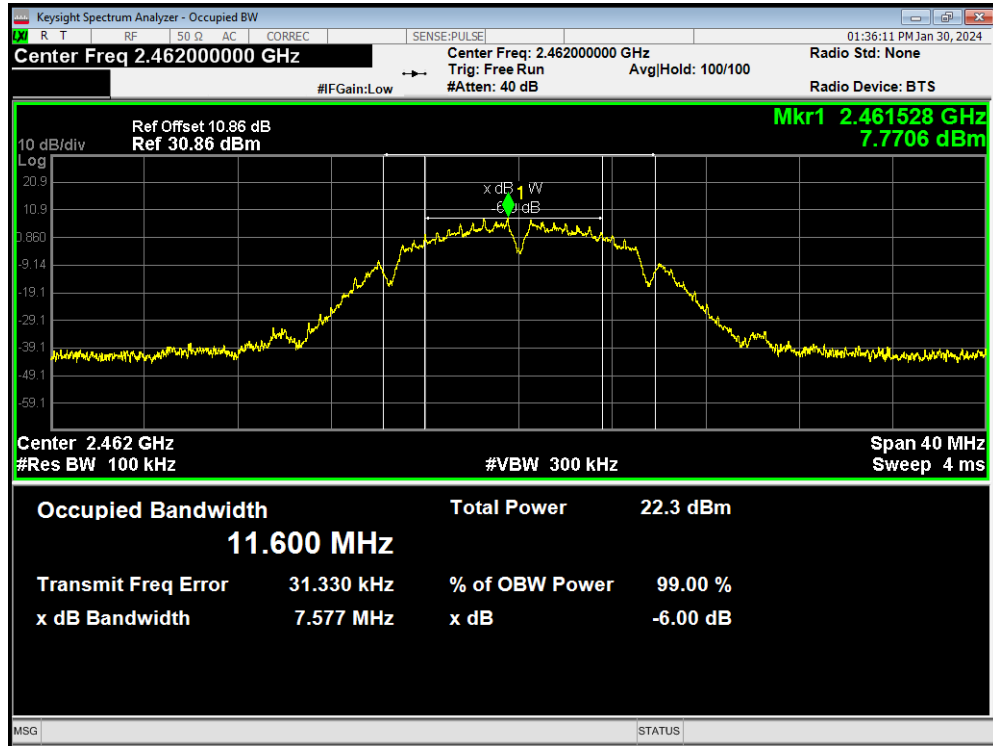
-6dB Bandwidth 802.11b 2412MHz



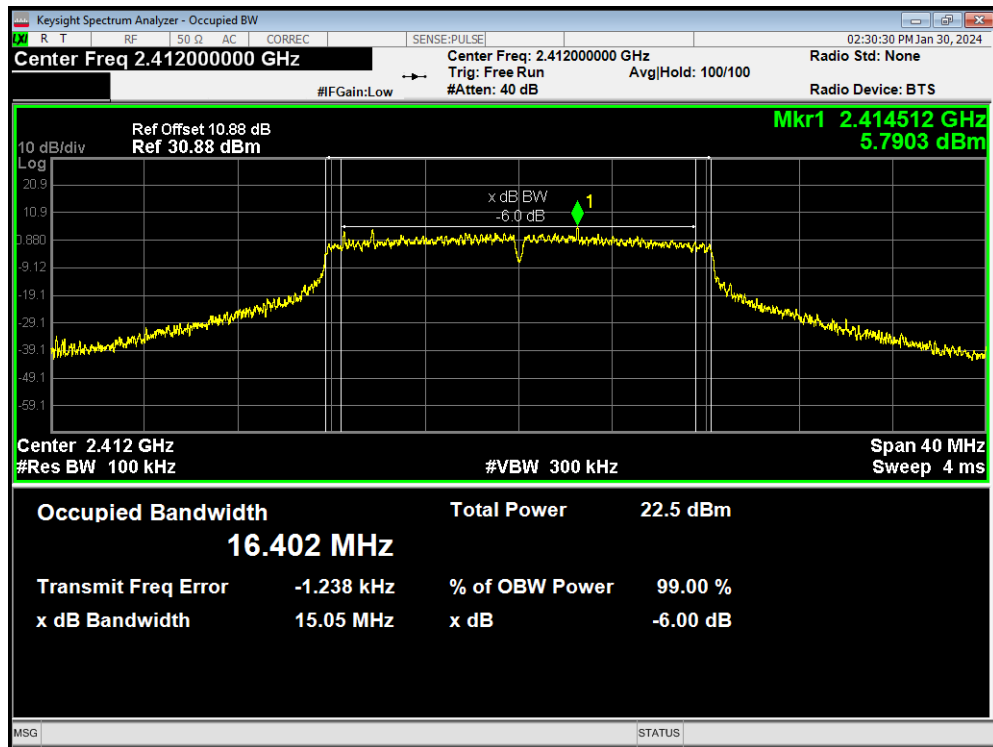
-6dB Bandwidth 802.11b 2437MHz



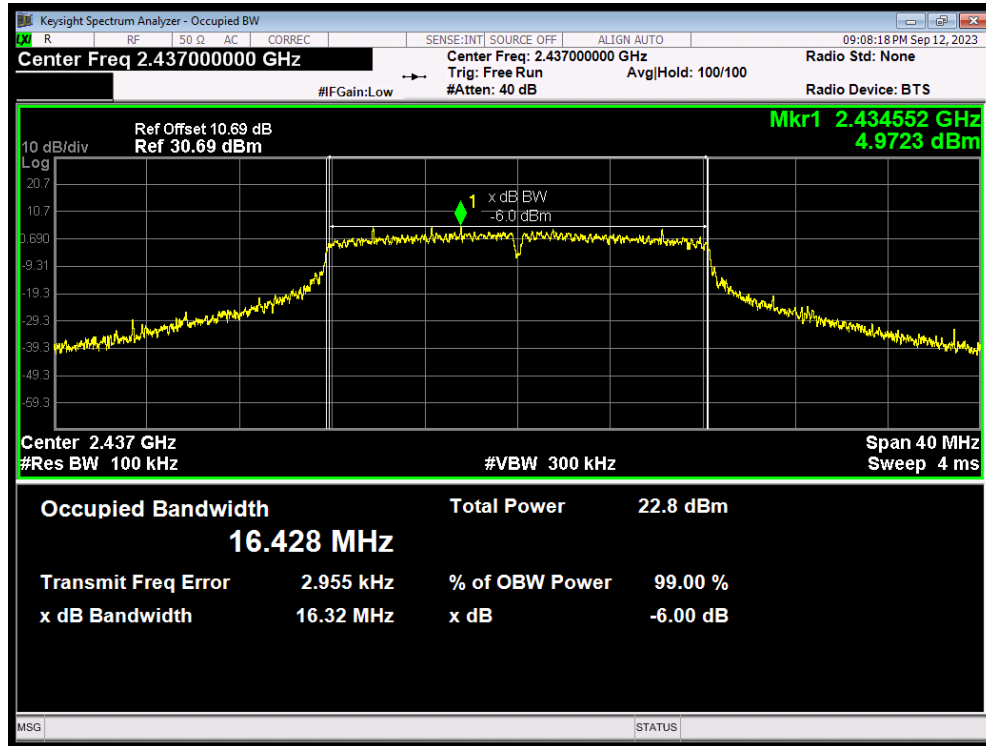
-6dB Bandwidth 802.11b 2462MHz



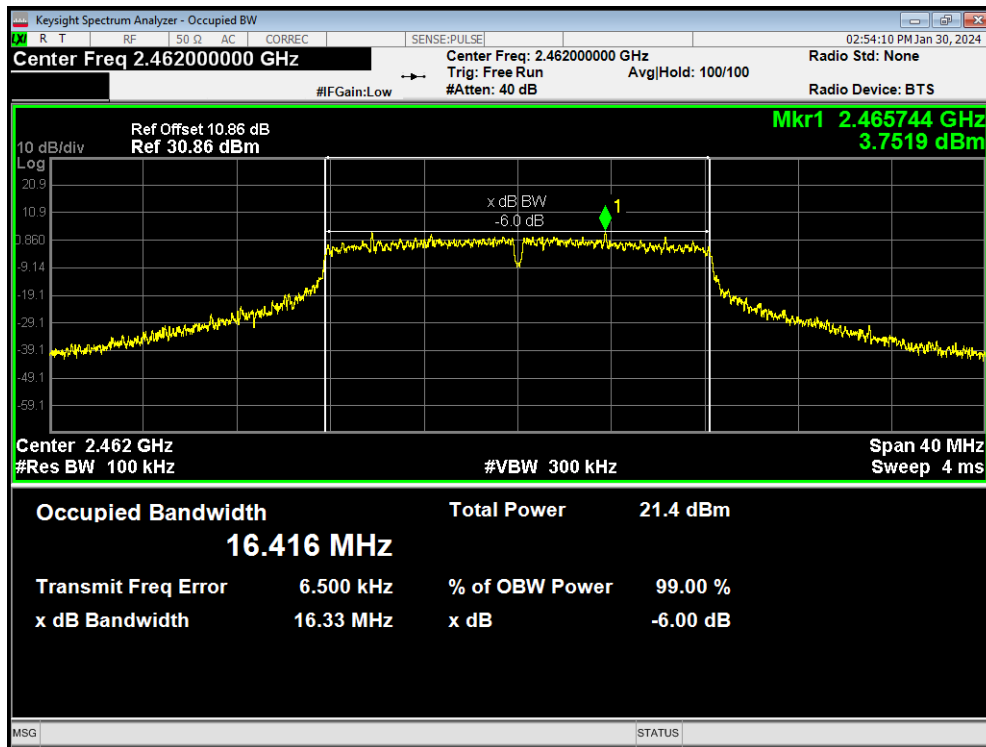
-6dB Bandwidth 802.11g 2412MHz



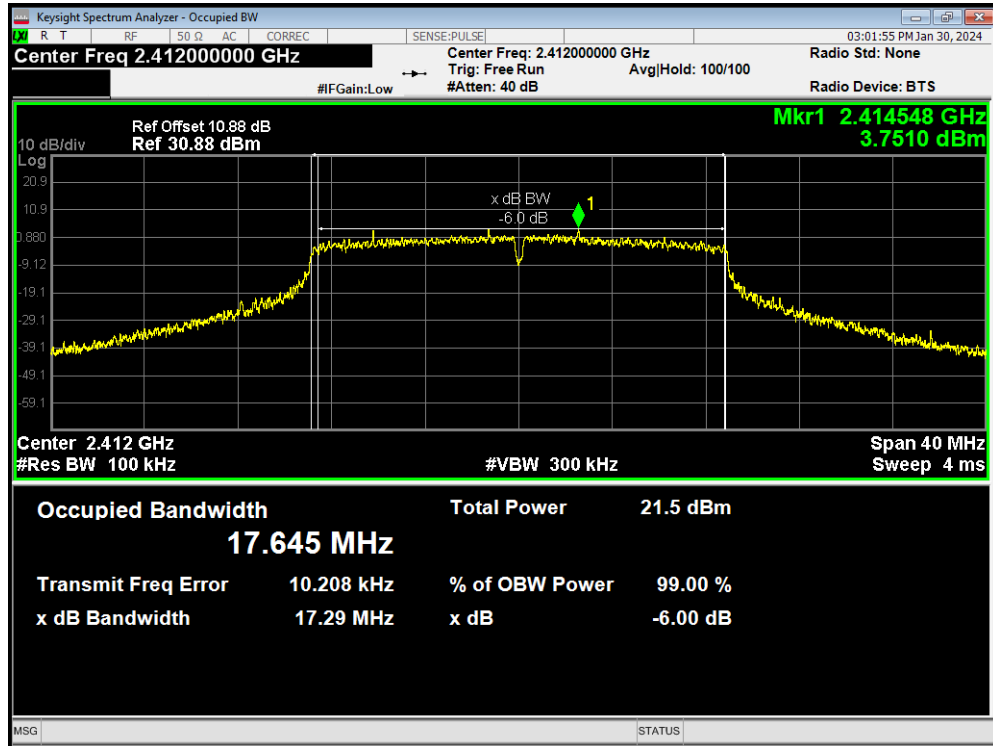
-6dB Bandwidth 802.11g 2437MHz



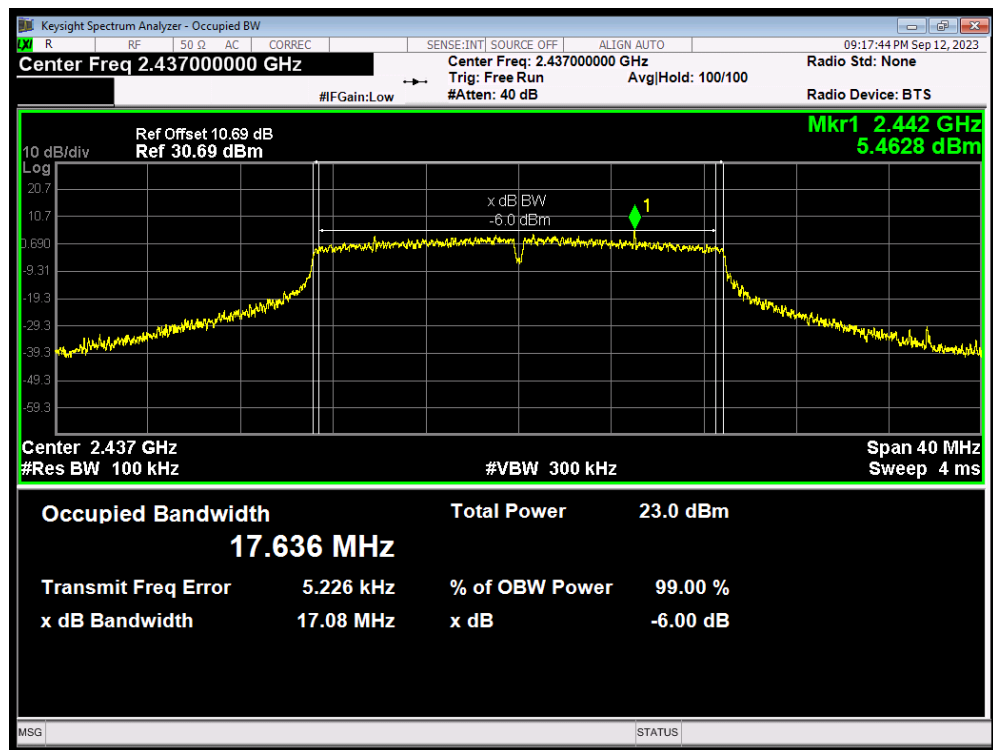
-6dB Bandwidth 802.11g 2462MHz



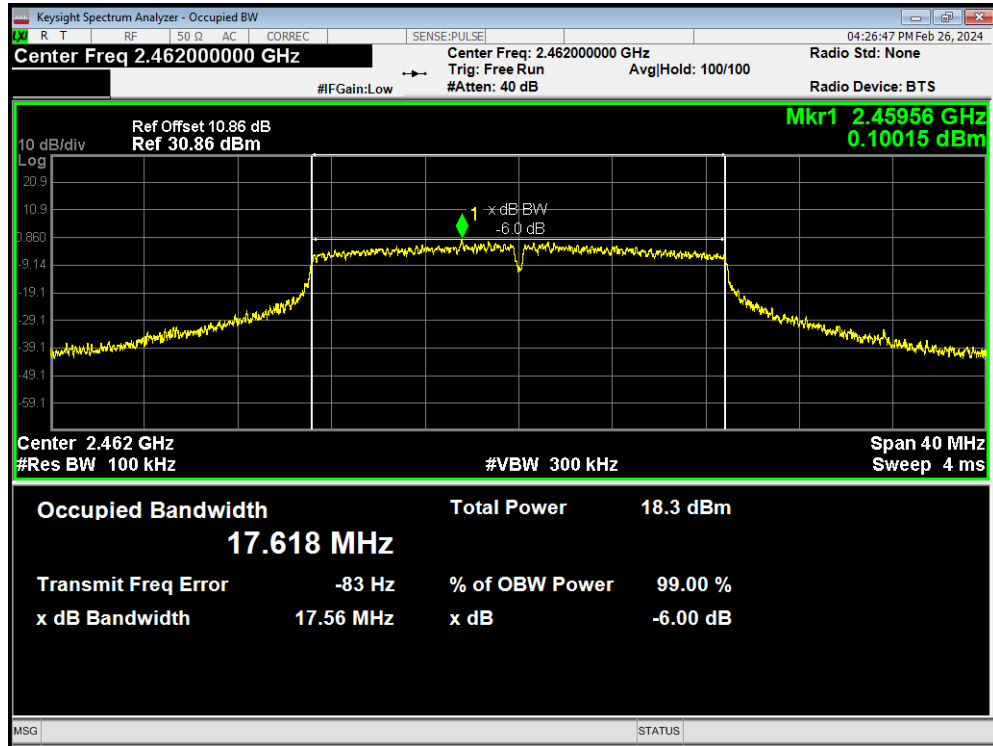
-6dB Bandwidth 802.11n(HT20) 2412MHz



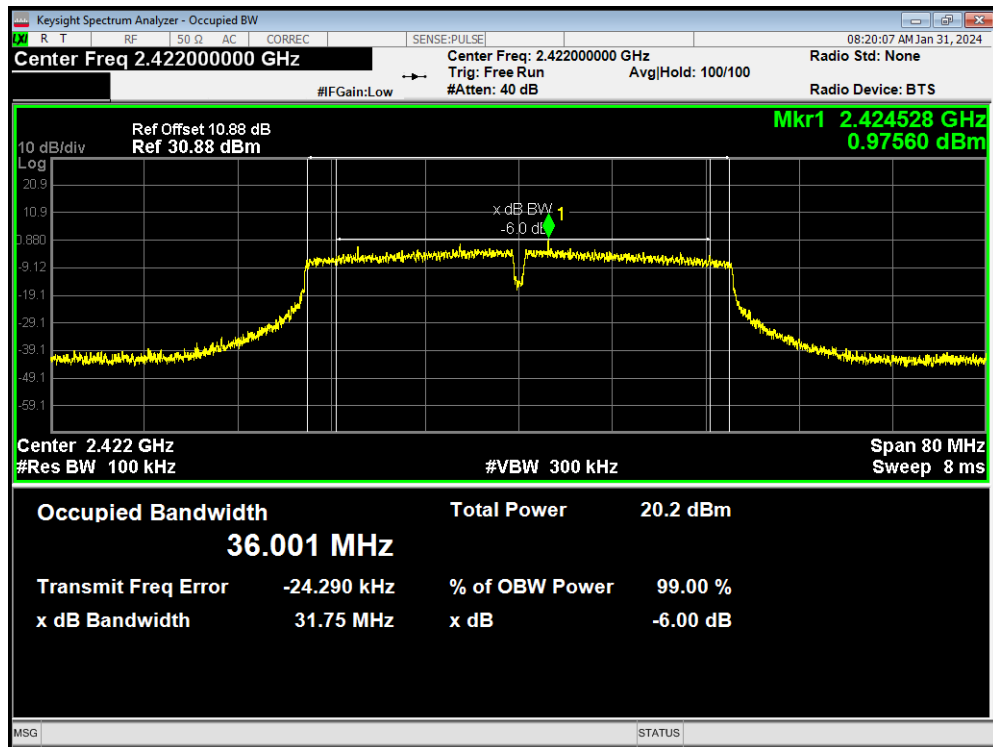
-6dB Bandwidth 802.11n(HT20) 2437MHz



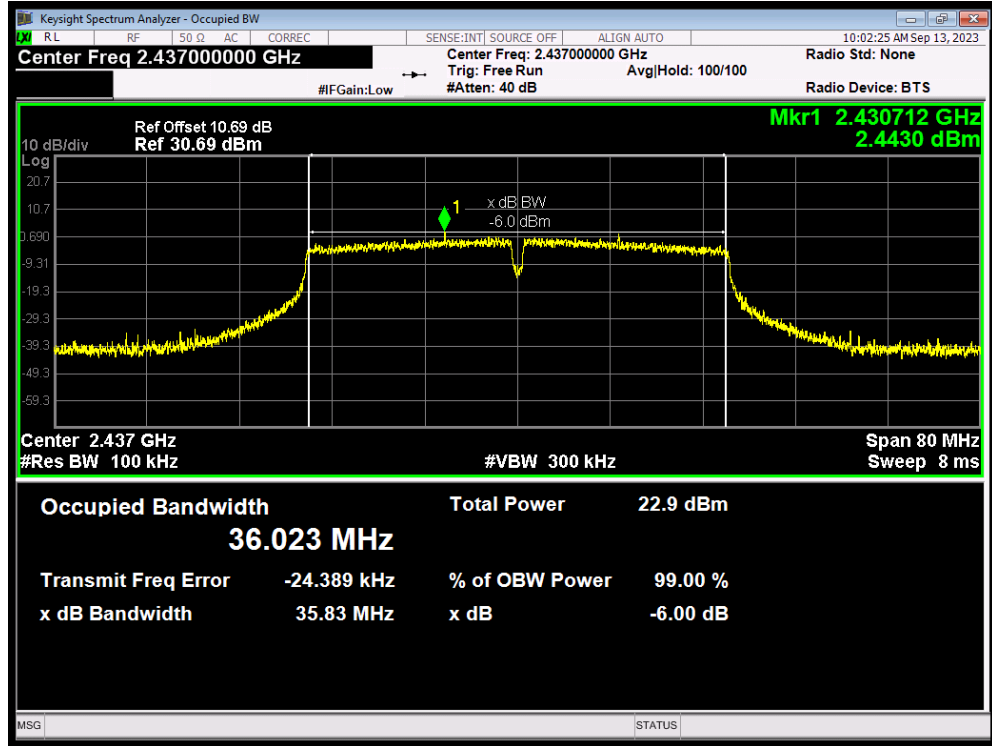
-6dB Bandwidth 802.11n(HT20) 2462MHz



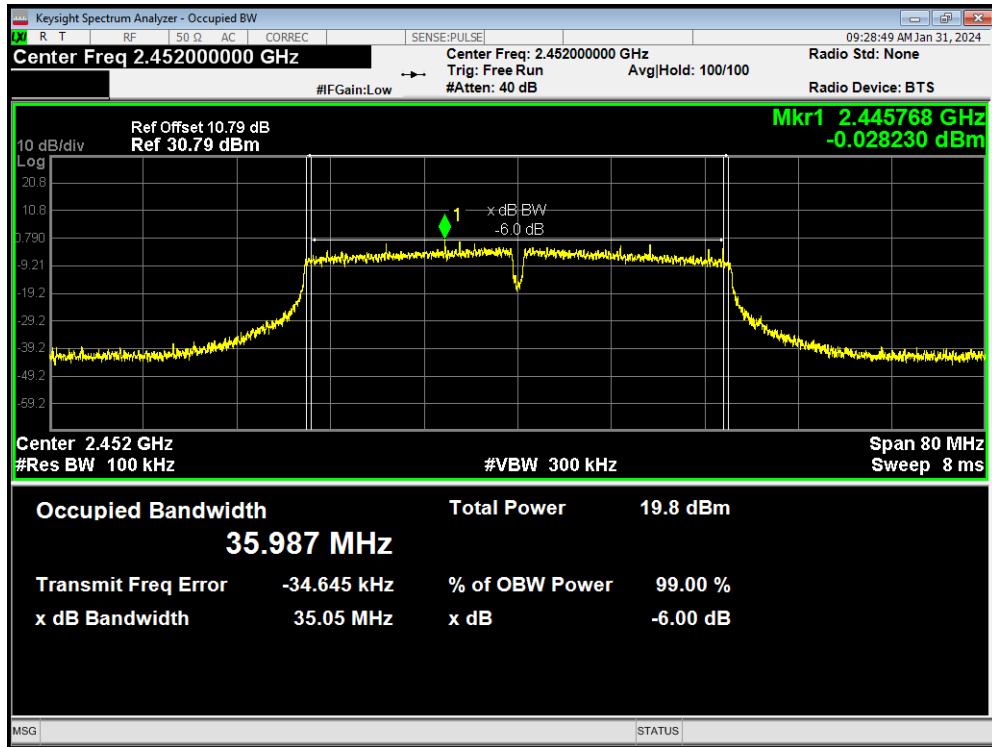
-6dB Bandwidth 802.11n(HT40) 2422MHz



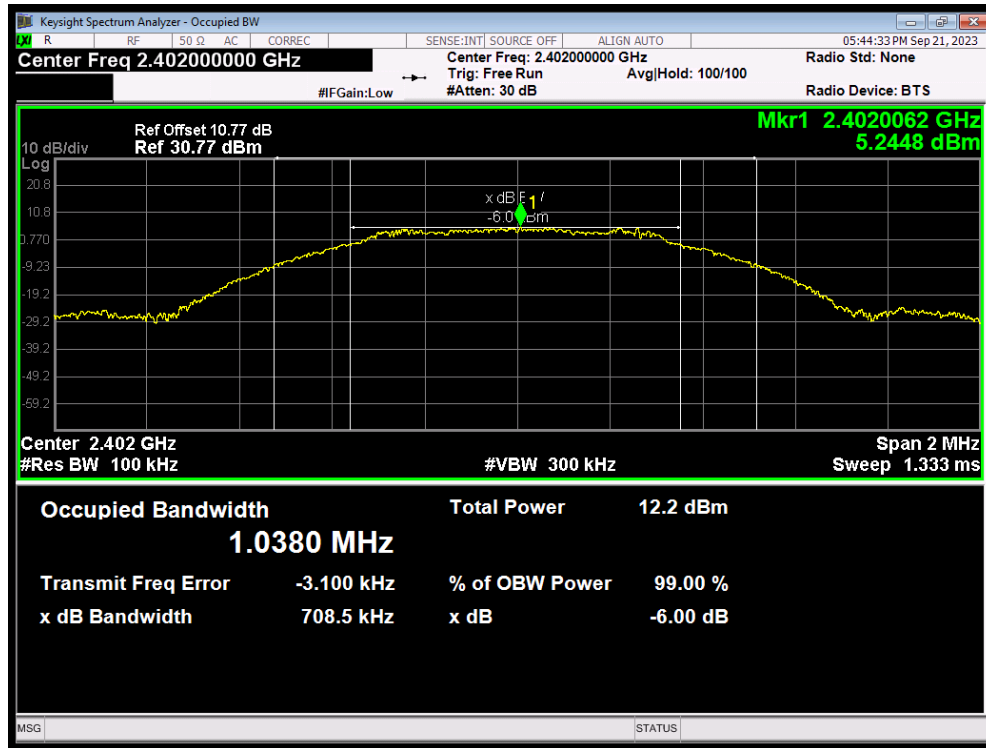
-6dB Bandwidth 802.11n(HT40) 2437MHz



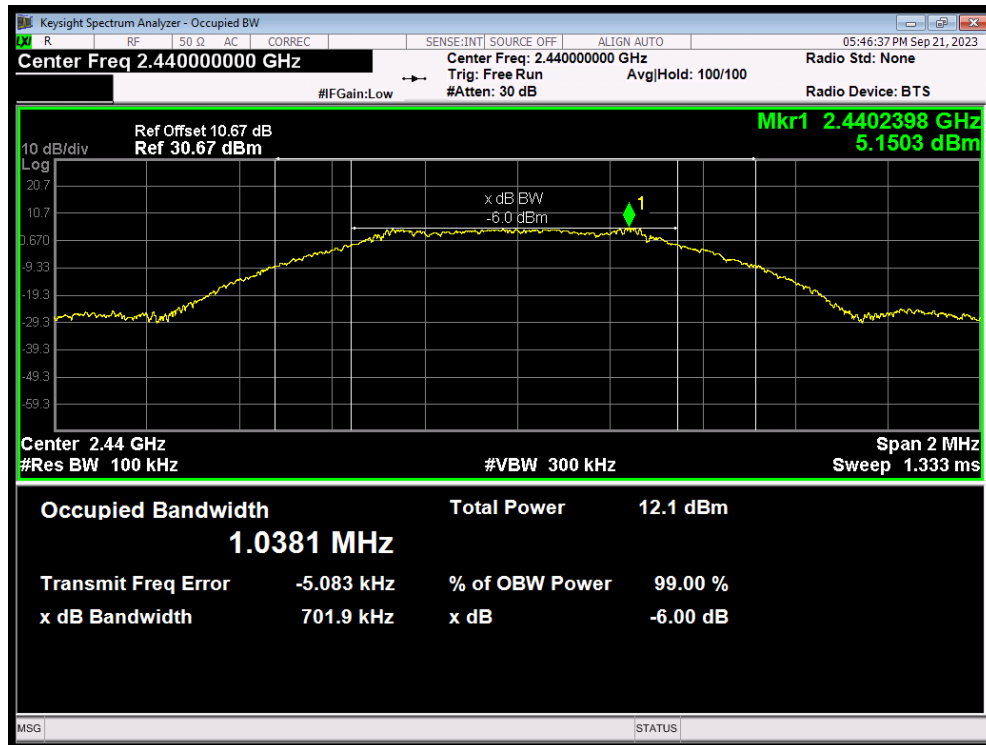
-6dB Bandwidth 802.11n(HT40) 2452MHz



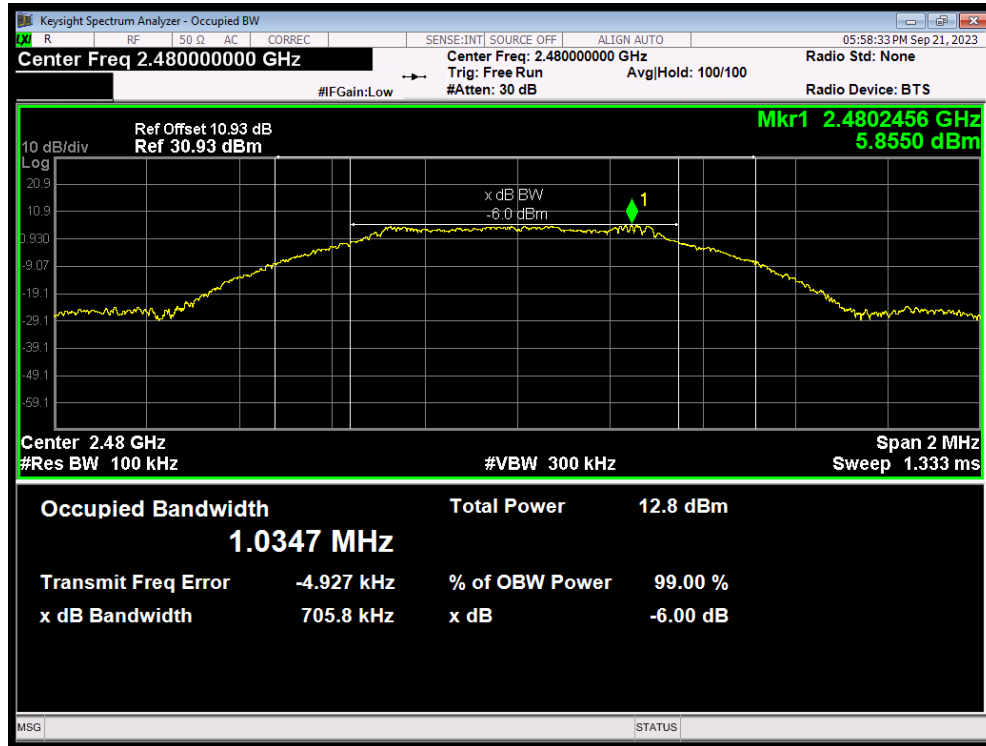
-6dB Bandwidth Bluetooth LE(1M) 2402MHz



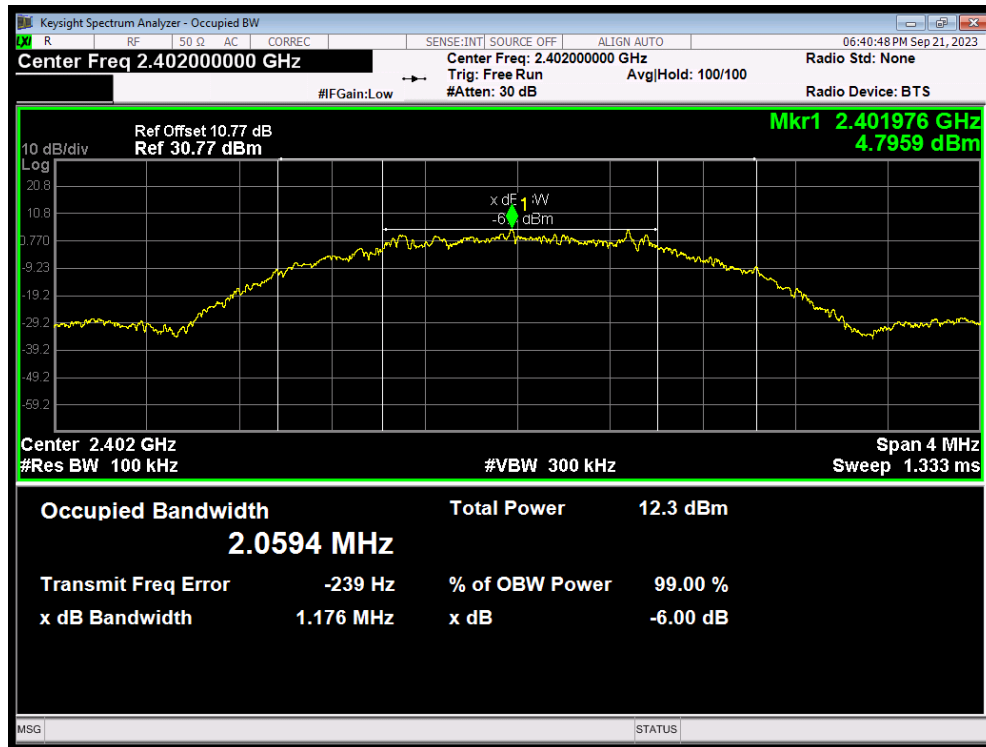
-6dB Bandwidth Bluetooth LE(1M) 2440MHz



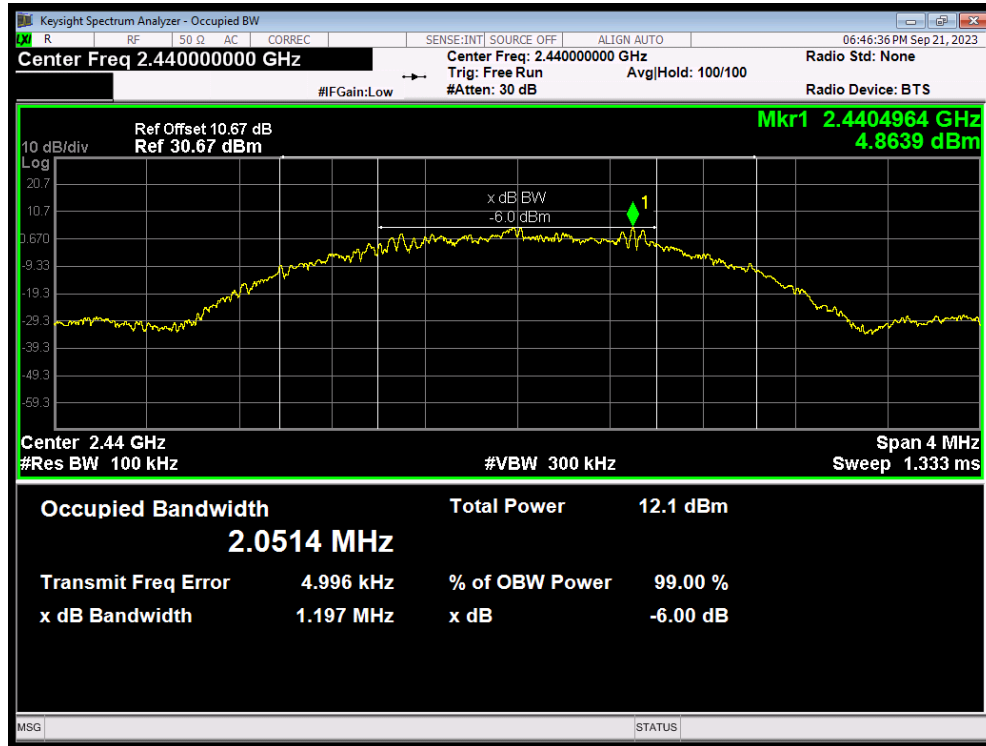
-6dB Bandwidth Bluetooth LE(1M) 2480MHz



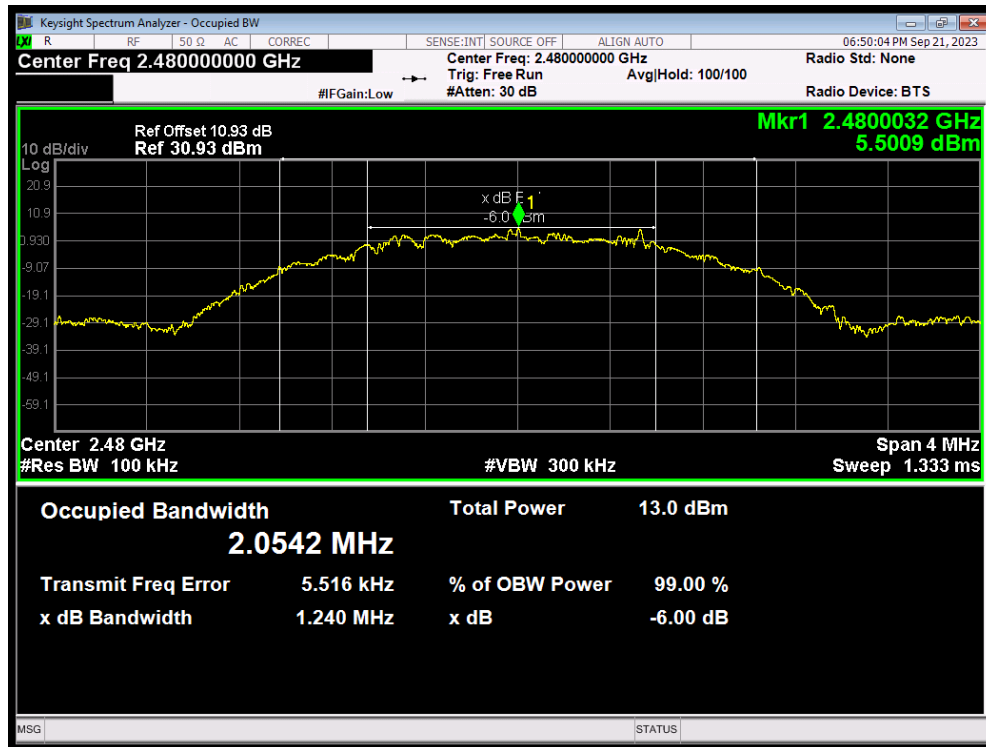
-6dB Bandwidth Bluetooth LE(2M) 2402MHz



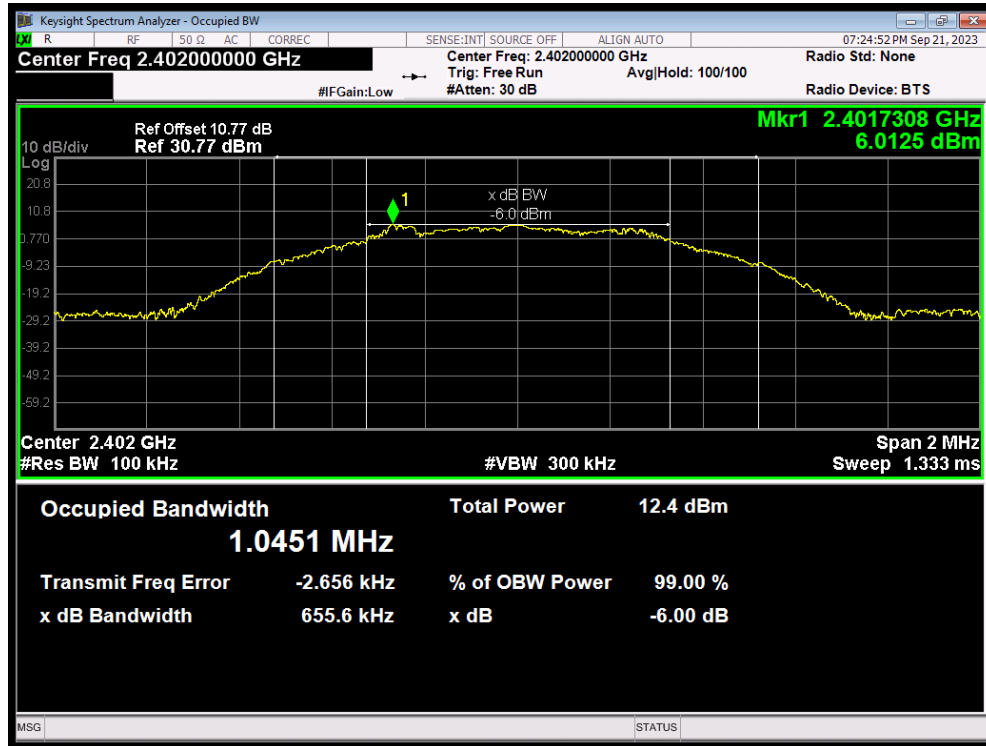
-6dB Bandwidth Bluetooth LE(2M) 2440MHz



-6dB Bandwidth Bluetooth LE(2M) 2480MHz



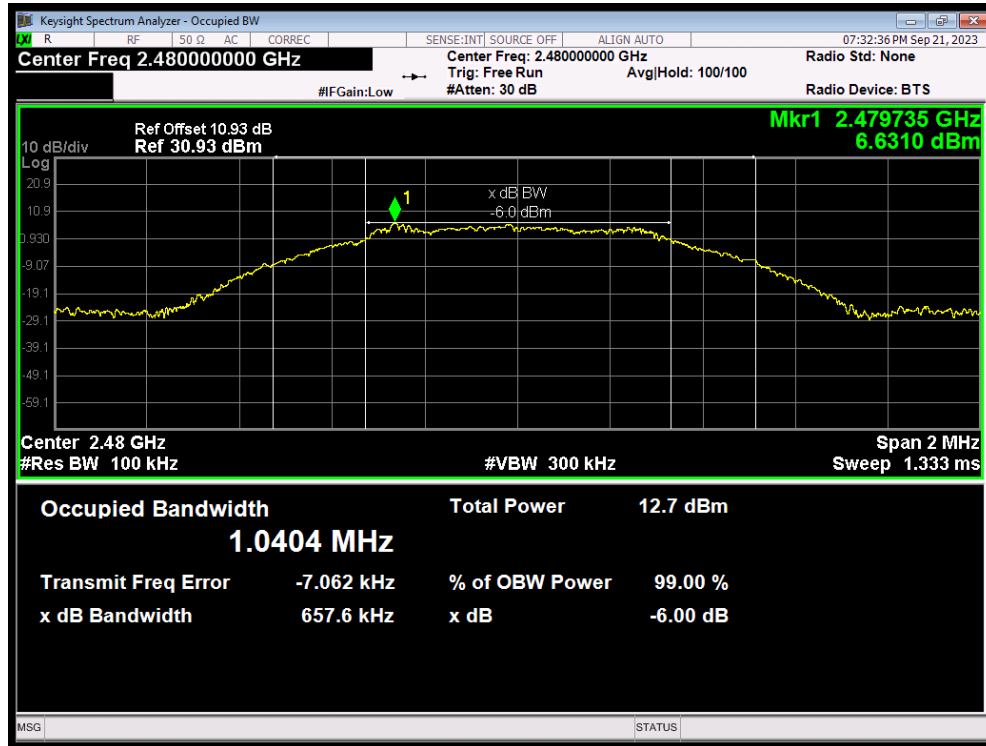
-6dB Bandwidth Bluetooth LE(S=2) 2402MHz



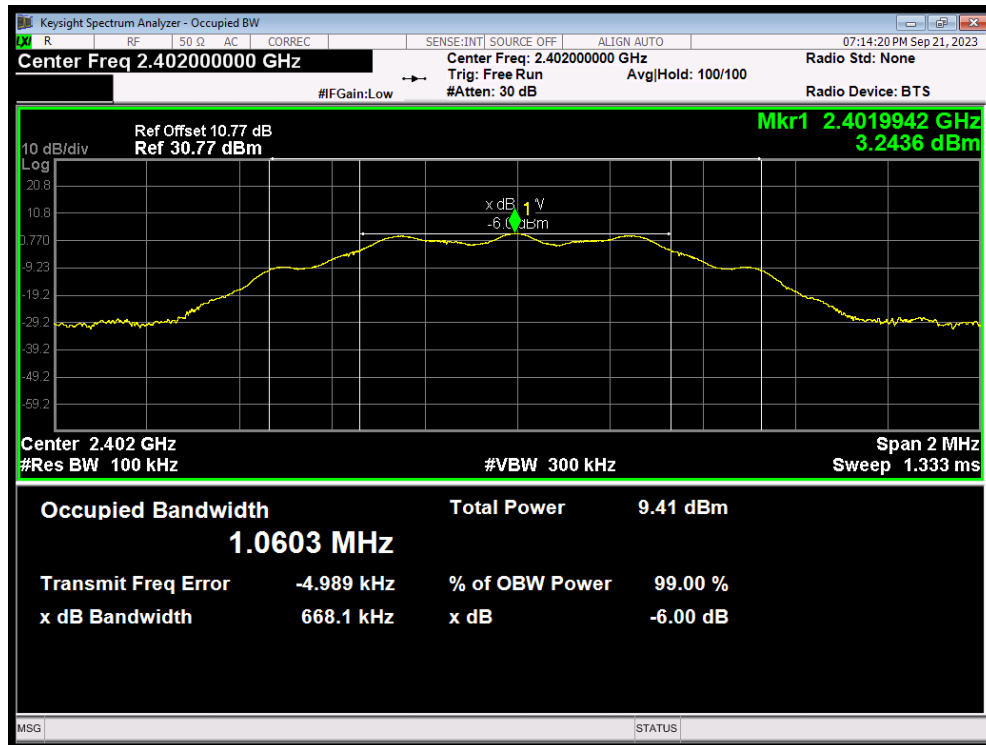
-6dB Bandwidth Bluetooth LE(S=2) 2440MHz



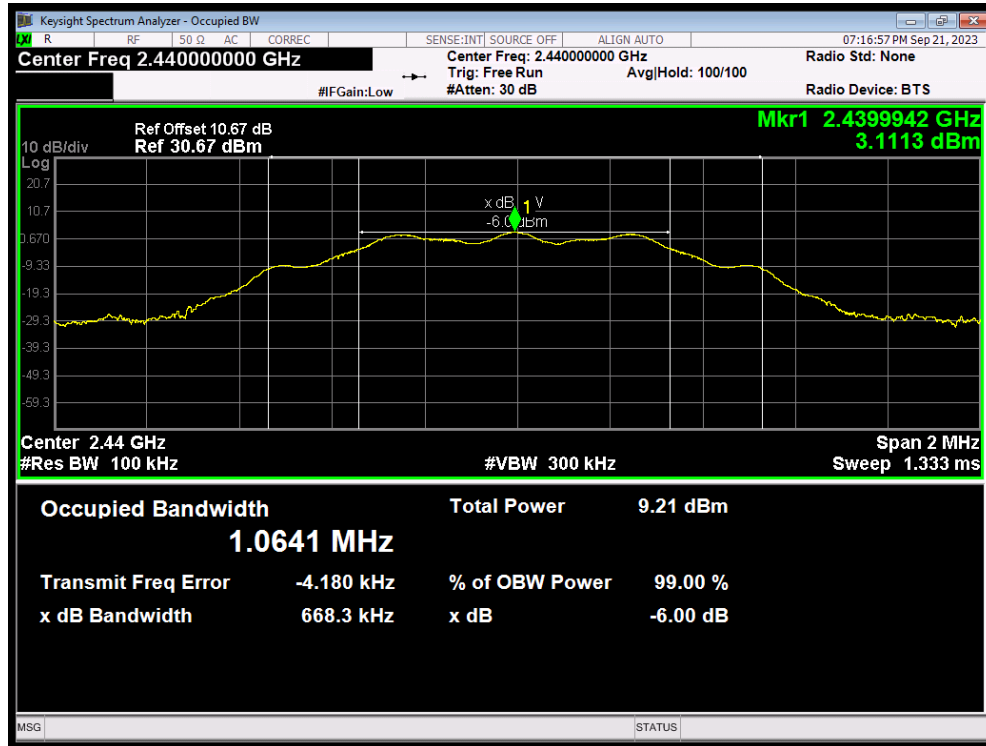
-6dB Bandwidth Bluetooth LE(S=2) 2480MHz



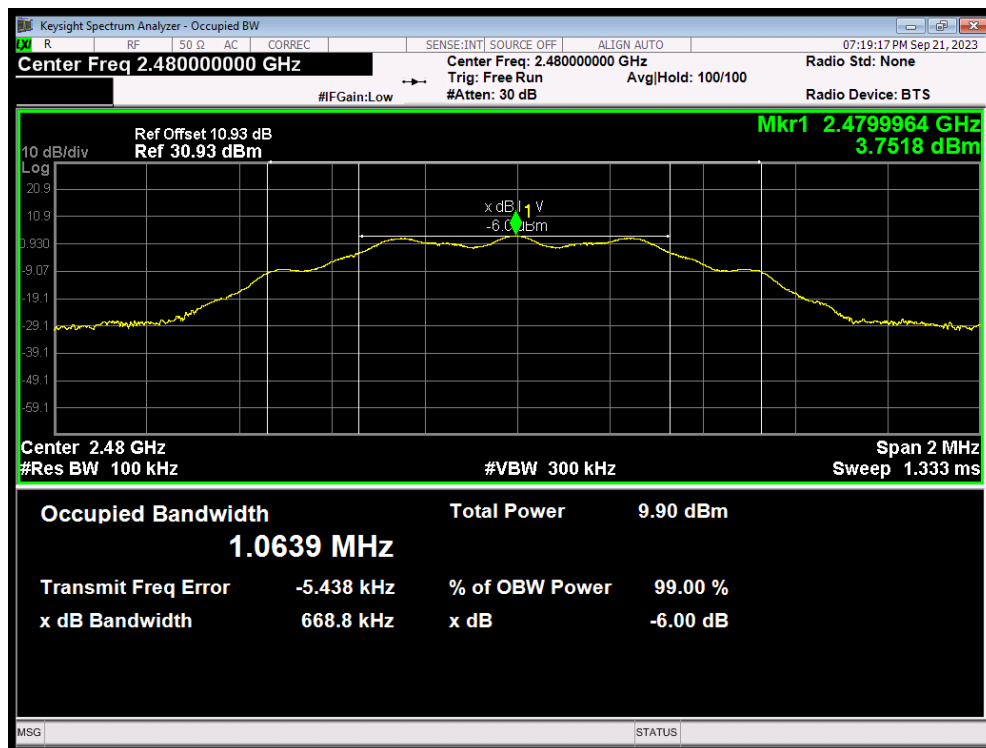
-6dB Bandwidth Bluetooth LE(S=8) 2402MHz



-6dB Bandwidth Bluetooth LE(S=8) 2440MHz



-6dB Bandwidth Bluetooth LE(S=8) 2480MHz



5.3. Band Edge

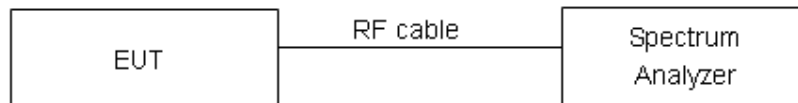
Ambient Condition

Temperature	Relative humidity
15°C ~ 35°C	20% ~ 80%

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.”

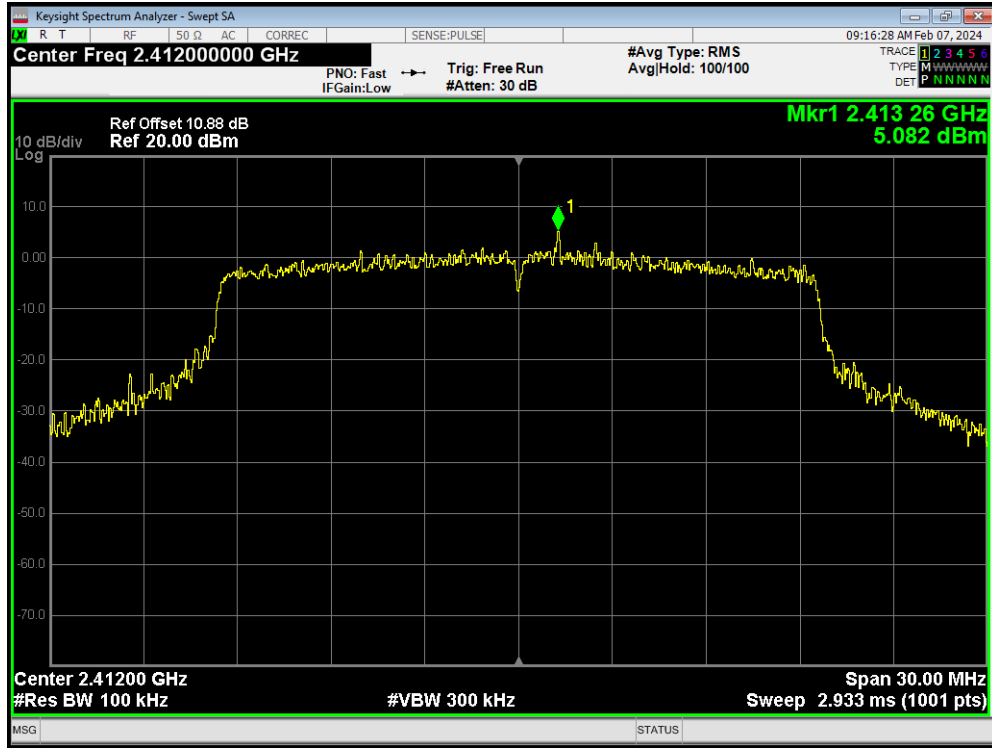
Measurement Uncertainty

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

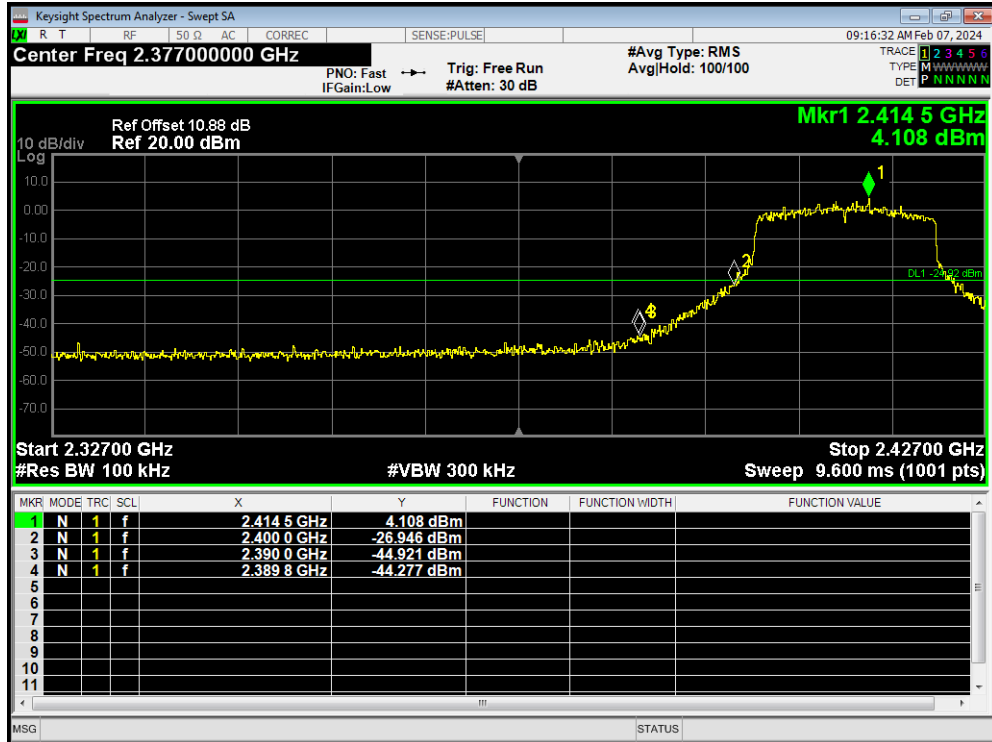
Frequency	Uncertainty
2GHz-3GHz	1.407 dB

Test Results: PASS

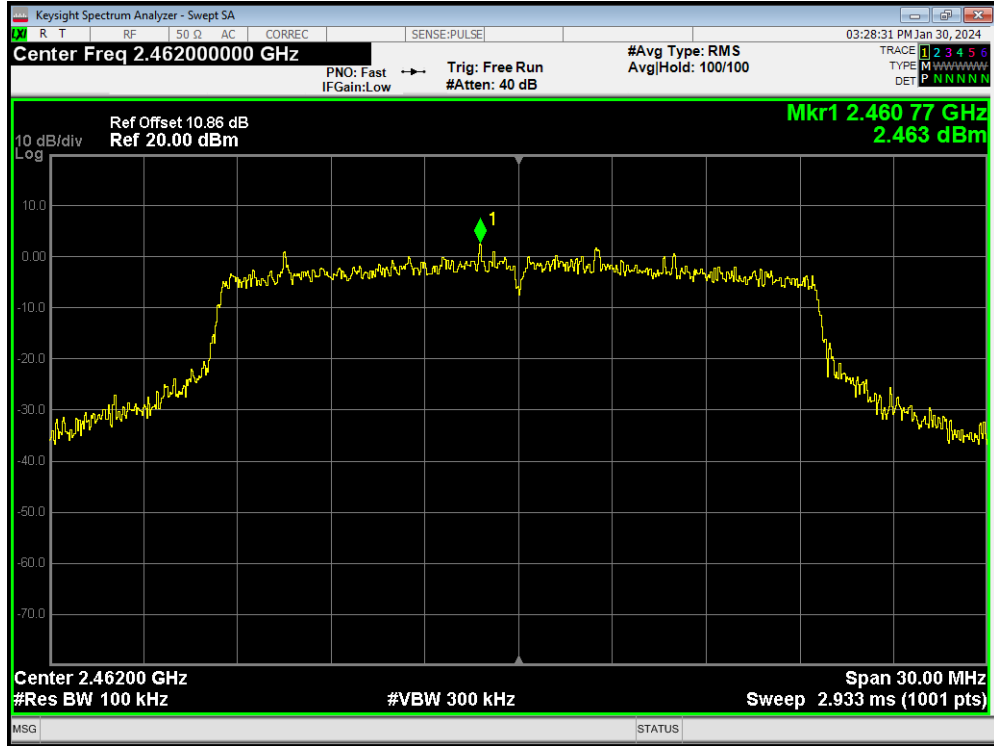
Band Edge 802.11ax(HE20) 2412MHz Ref



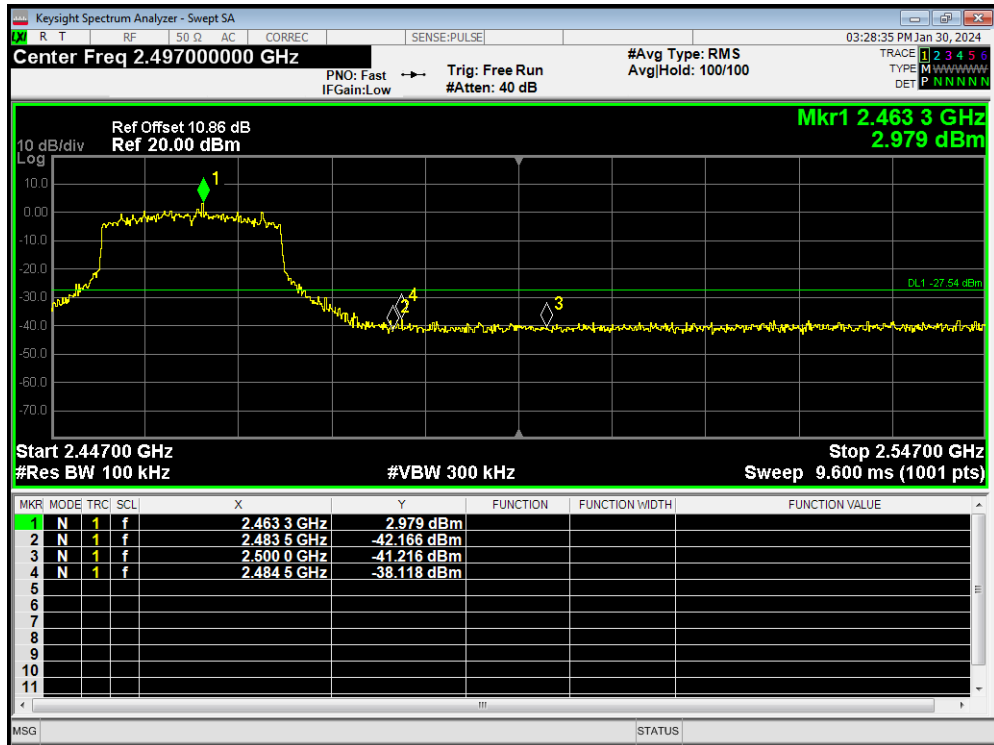
Band Edge 802.11ax(HE20) 2412MHz Emission



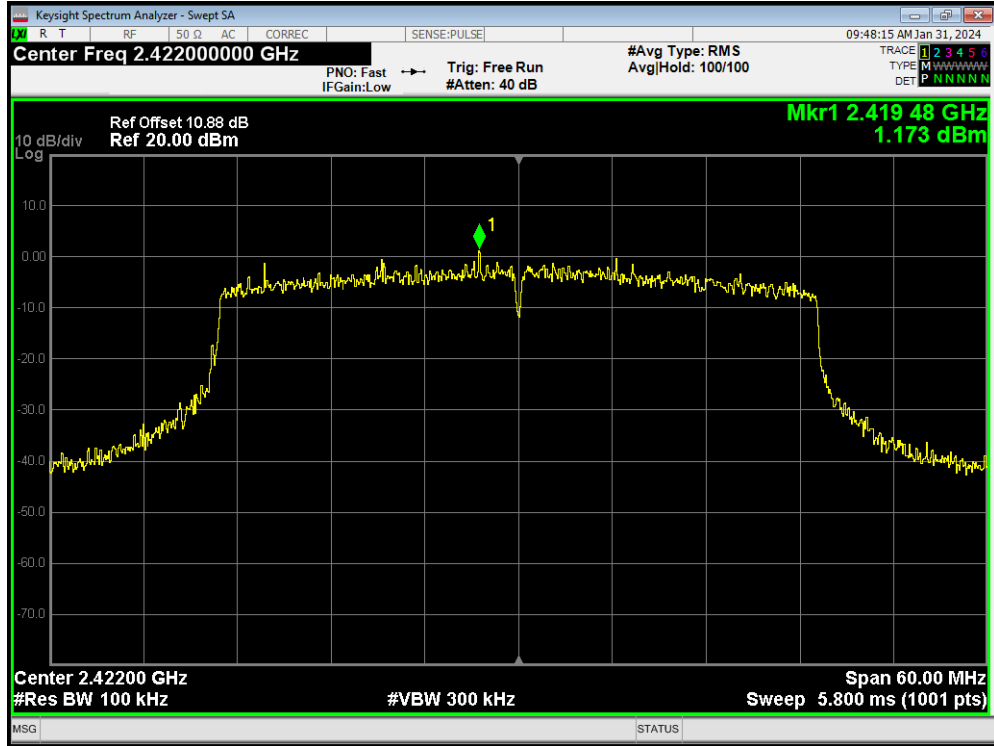
Band Edge 802.11ax(HE20) 2462MHz Ref



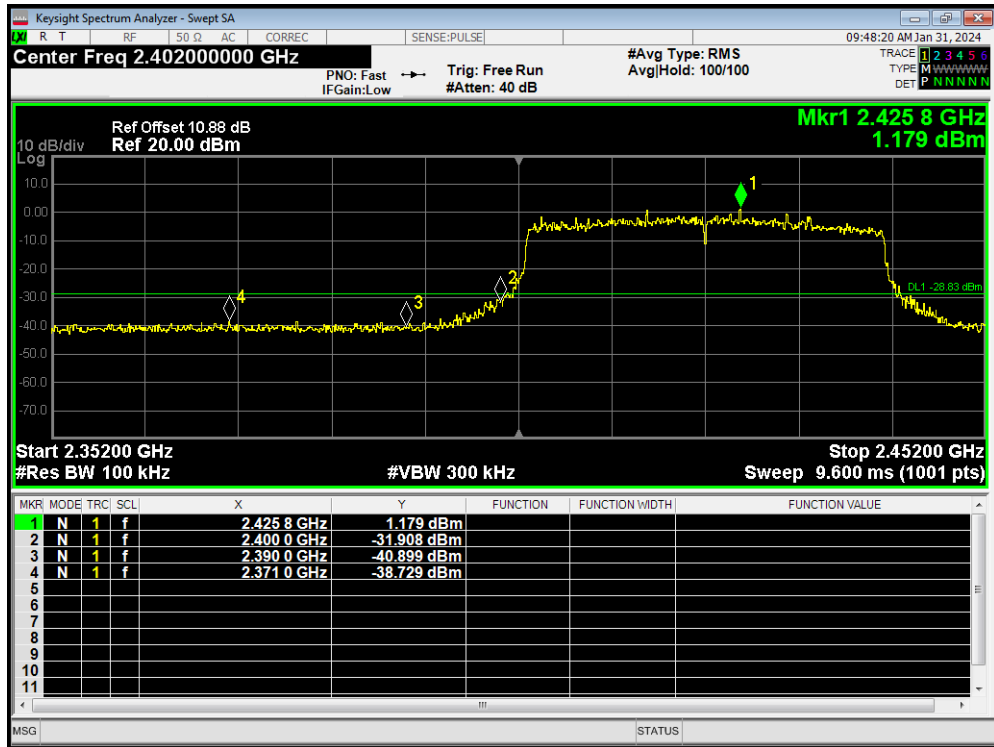
Band Edge 802.11ax(HE20) 2462MHz Emission



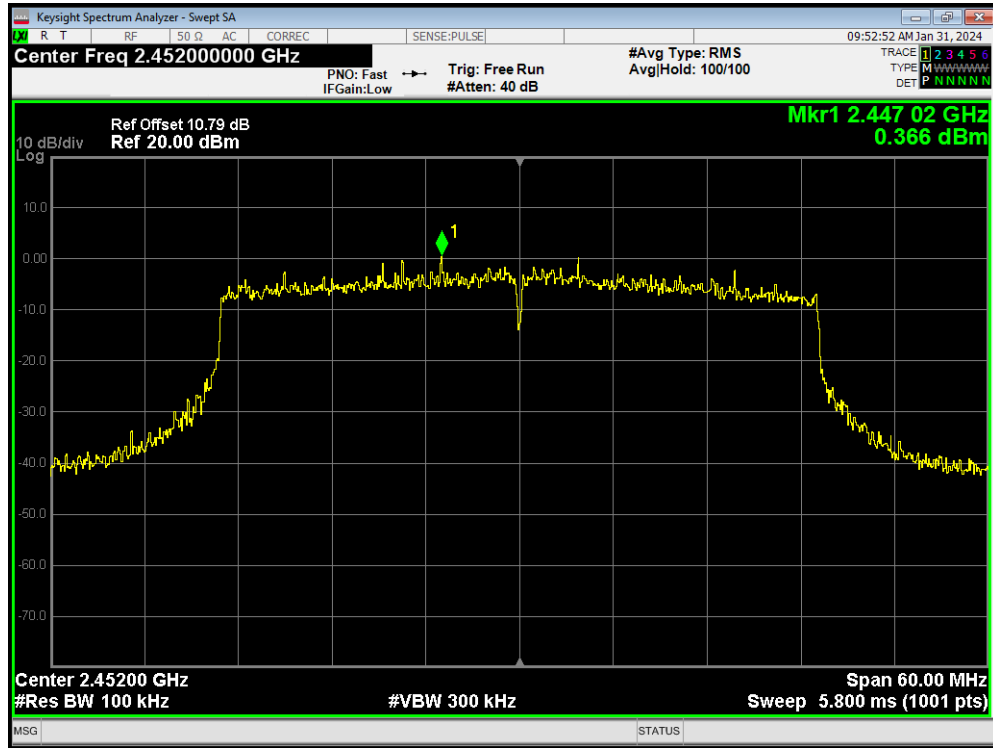
Band Edge 802.11ax(HE40) 2422MHz Ref



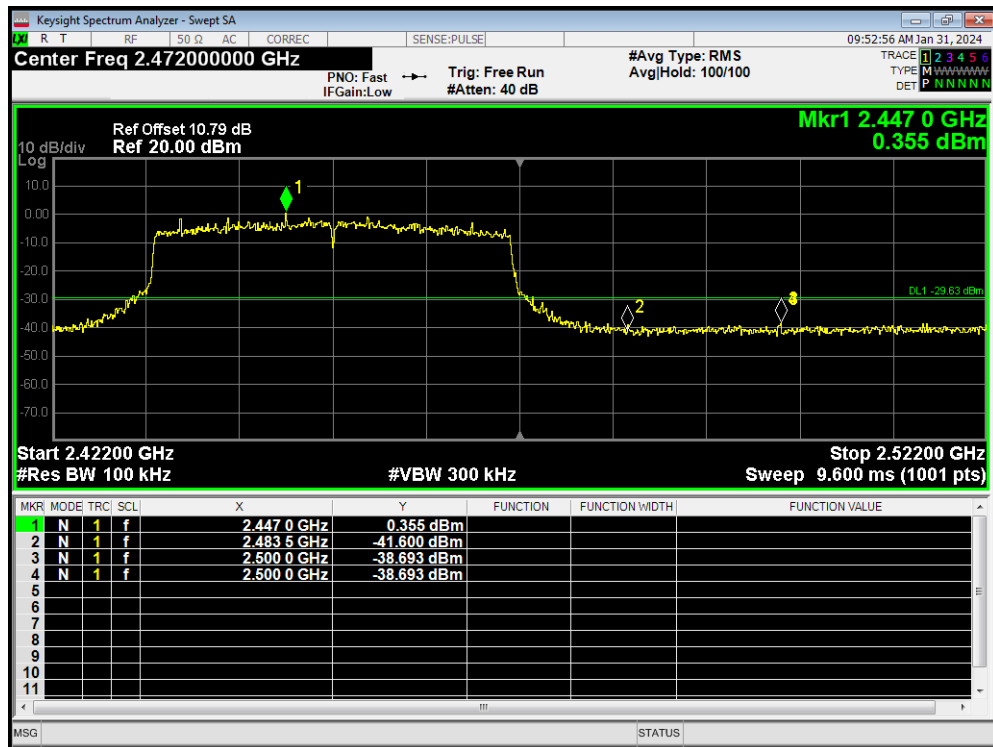
Band Edge 802.11ax(HE40) 2422MHz Emission



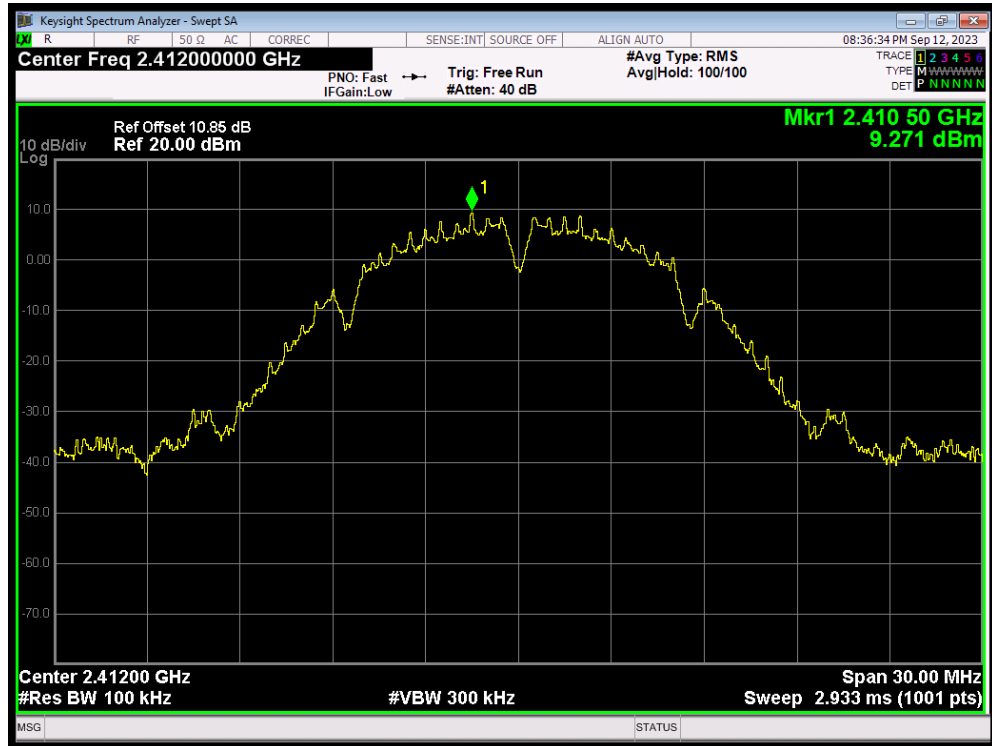
Band Edge 802.11ax(HE40) 2452MHz Ref



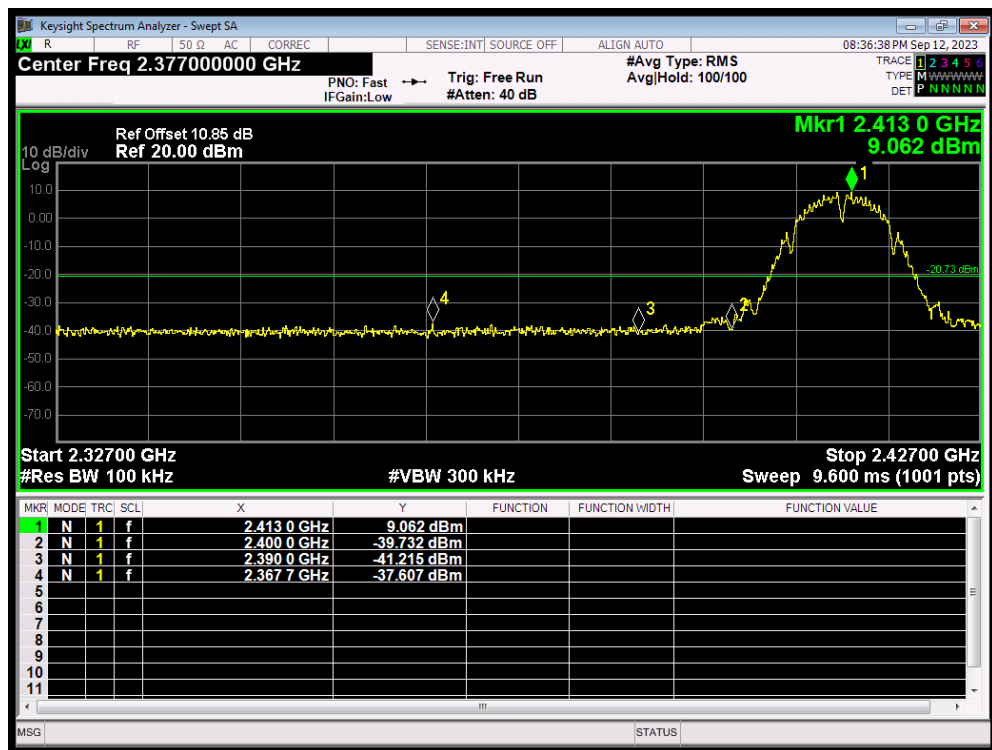
Band Edge 802.11ax(HE40) 2452MHz Emission



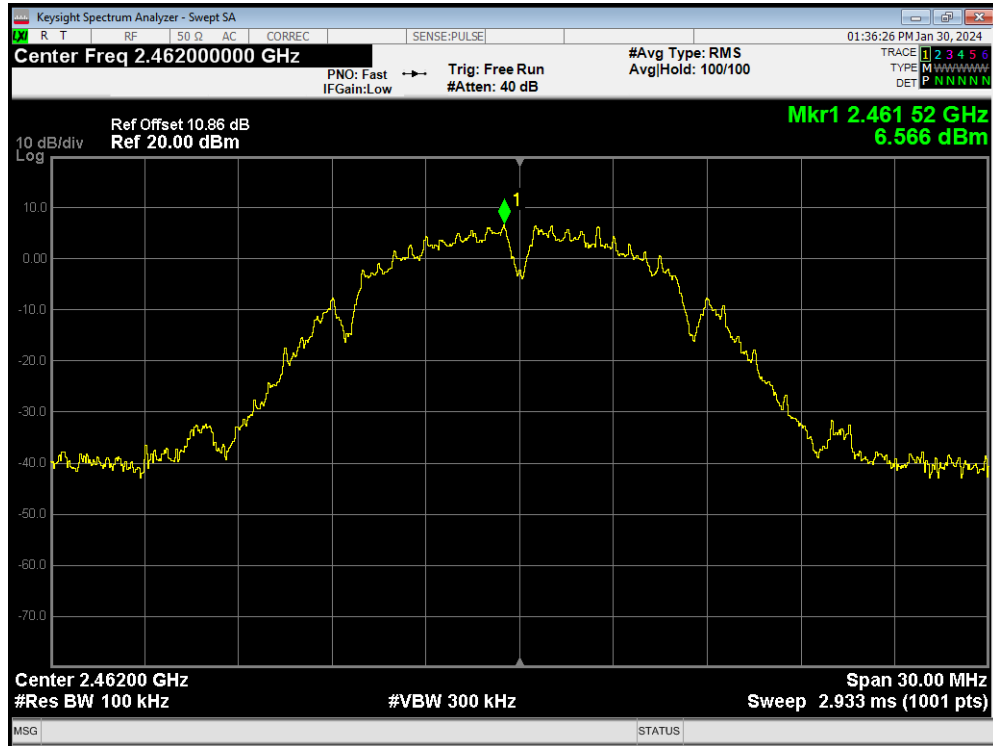
Band Edge 802.11b 2412MHz Ref



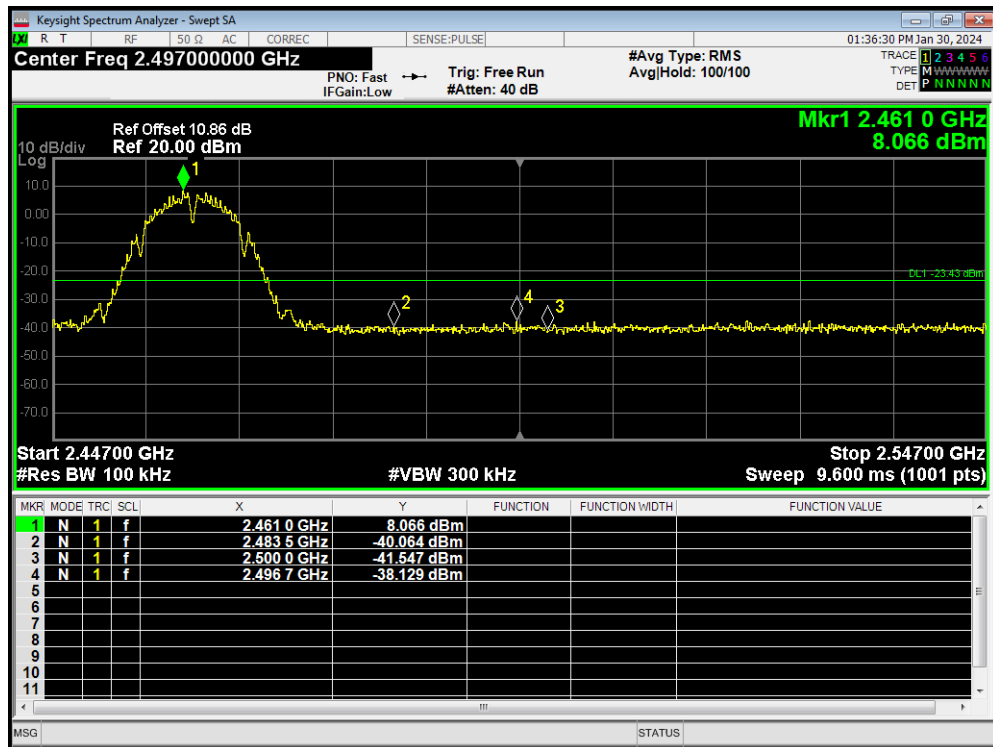
Band Edge 802.11b 2412MHz Emission



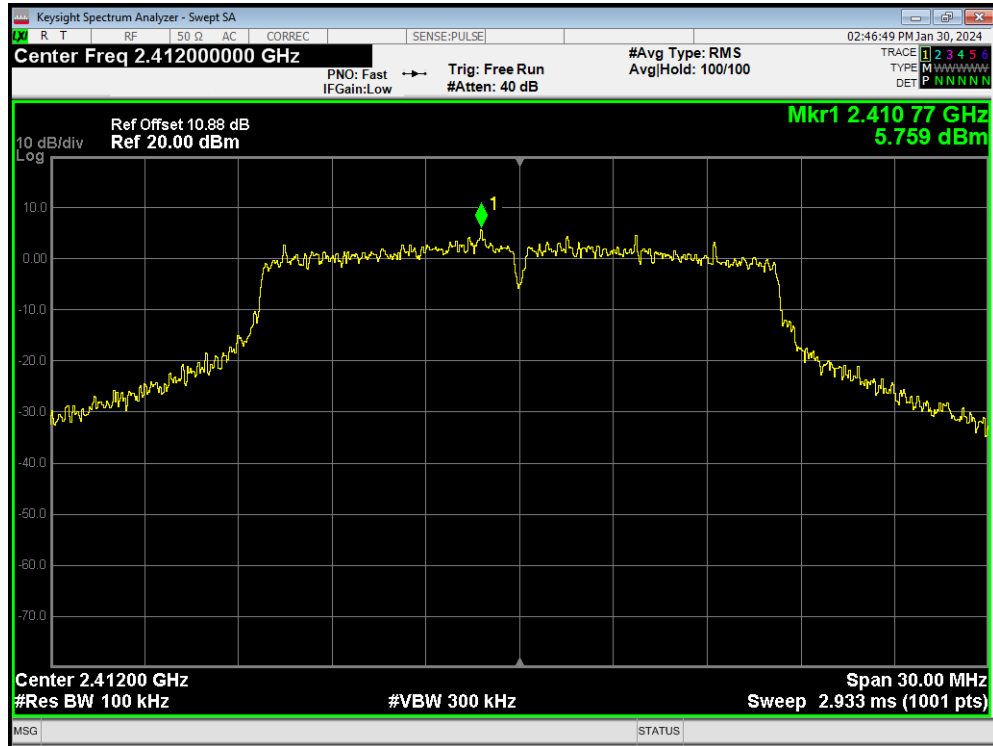
Band Edge 802.11b 2462MHz Ref



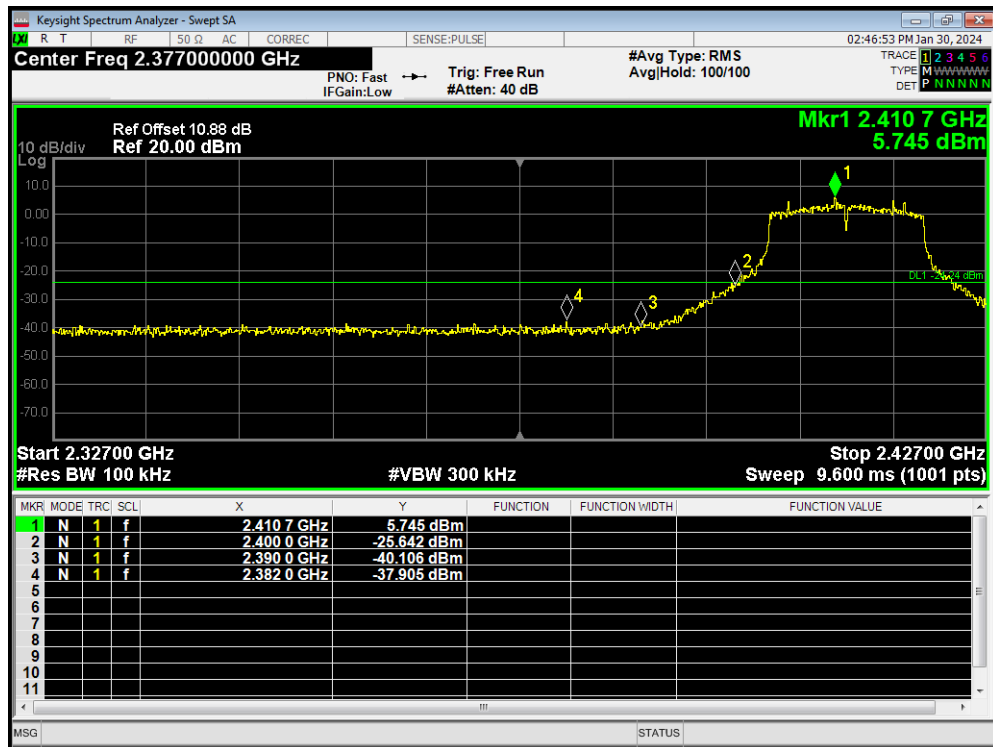
Band Edge 802.11b 2462MHz Emission



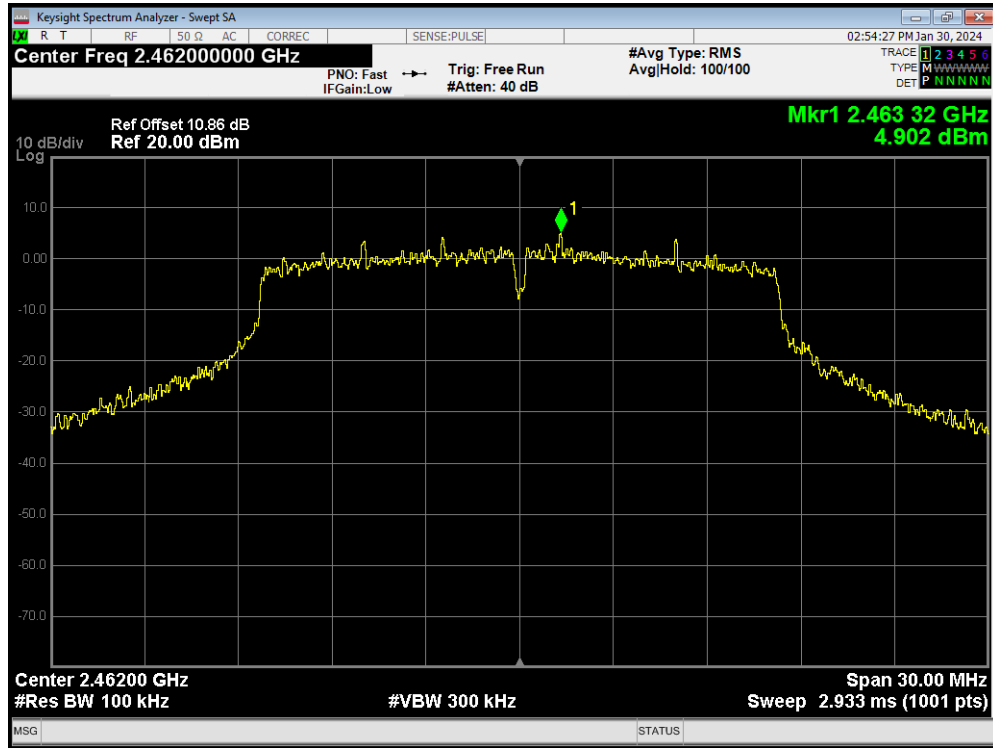
Band Edge 802.11g 2412MHz Ref



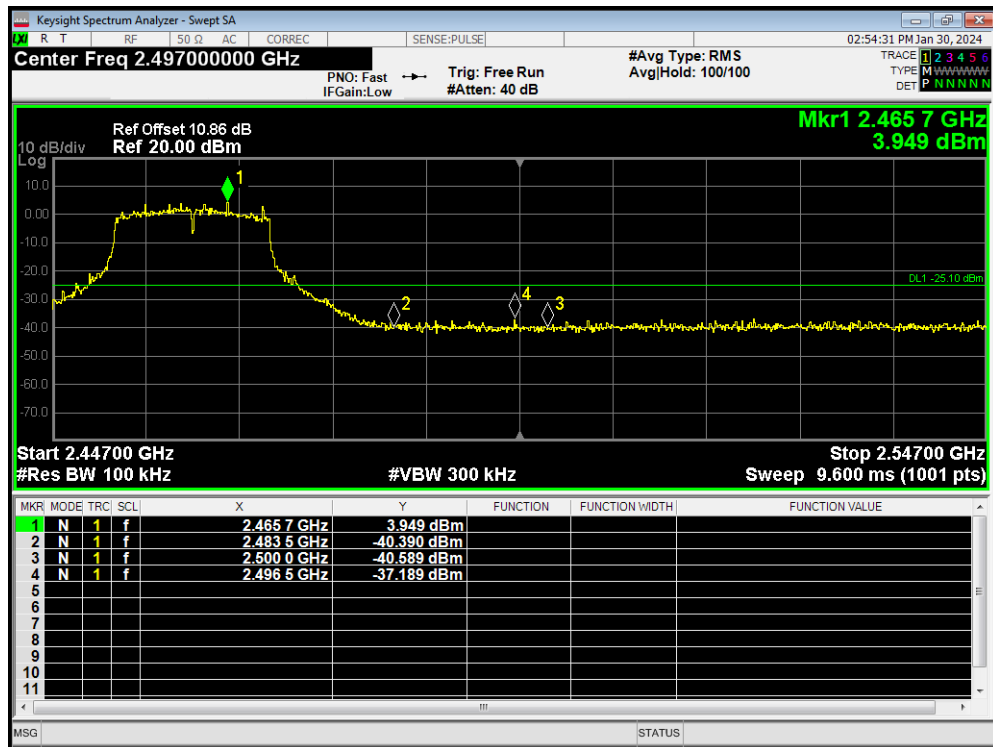
Band Edge 802.11g 2412MHz Emission



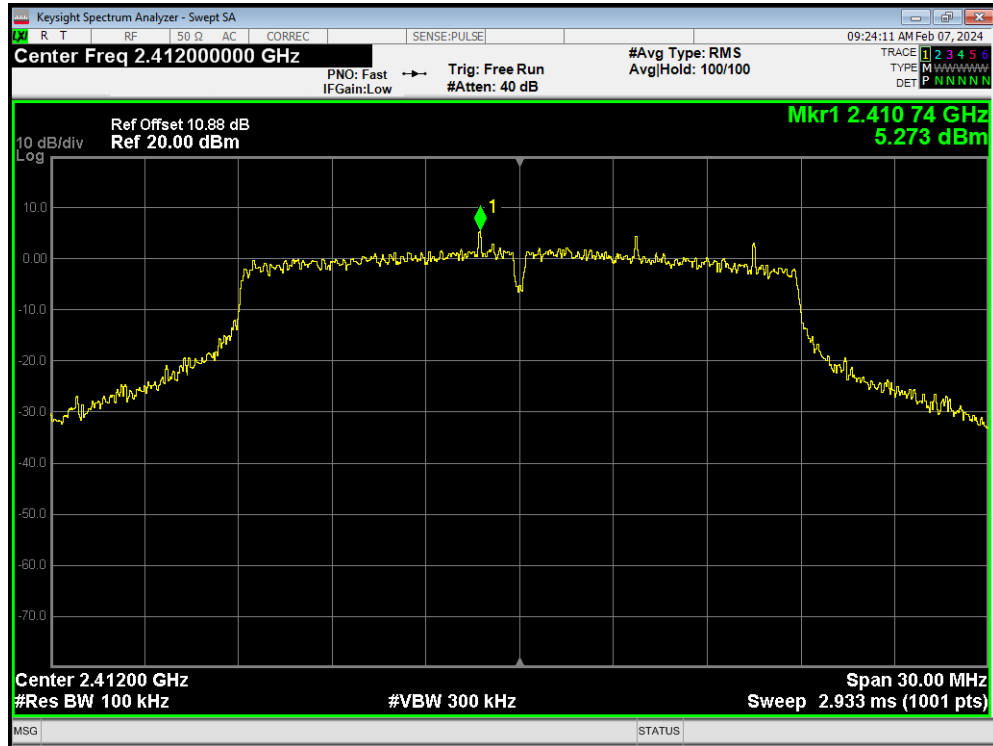
Band Edge 802.11g 2462MHz Ref



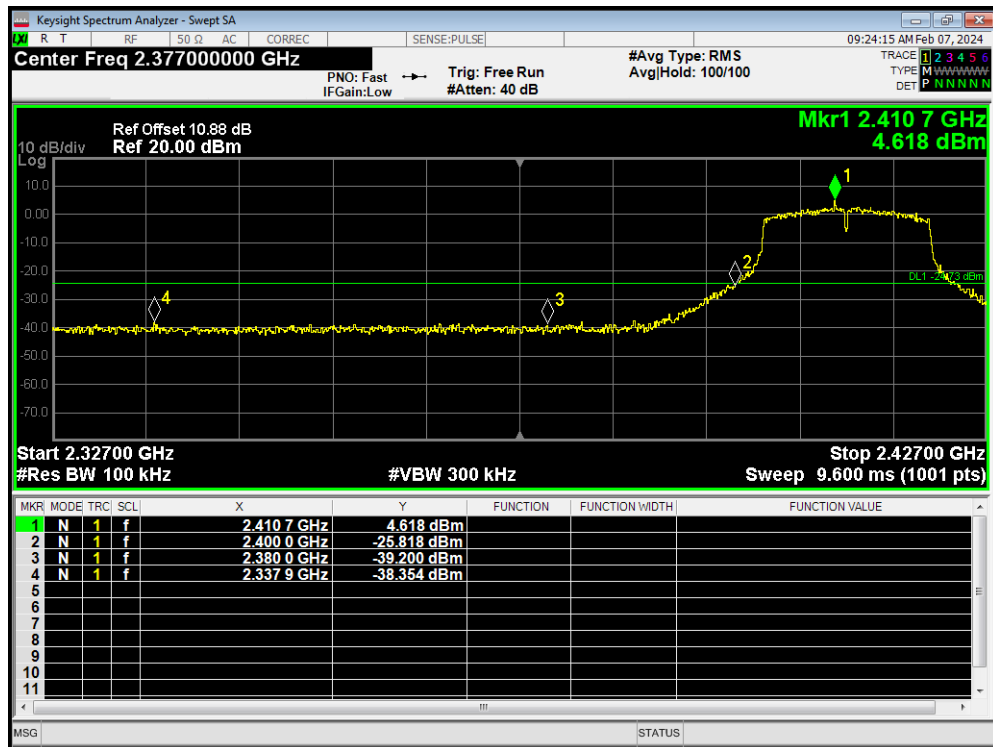
Band Edge 802.11g 2462MHz Emission



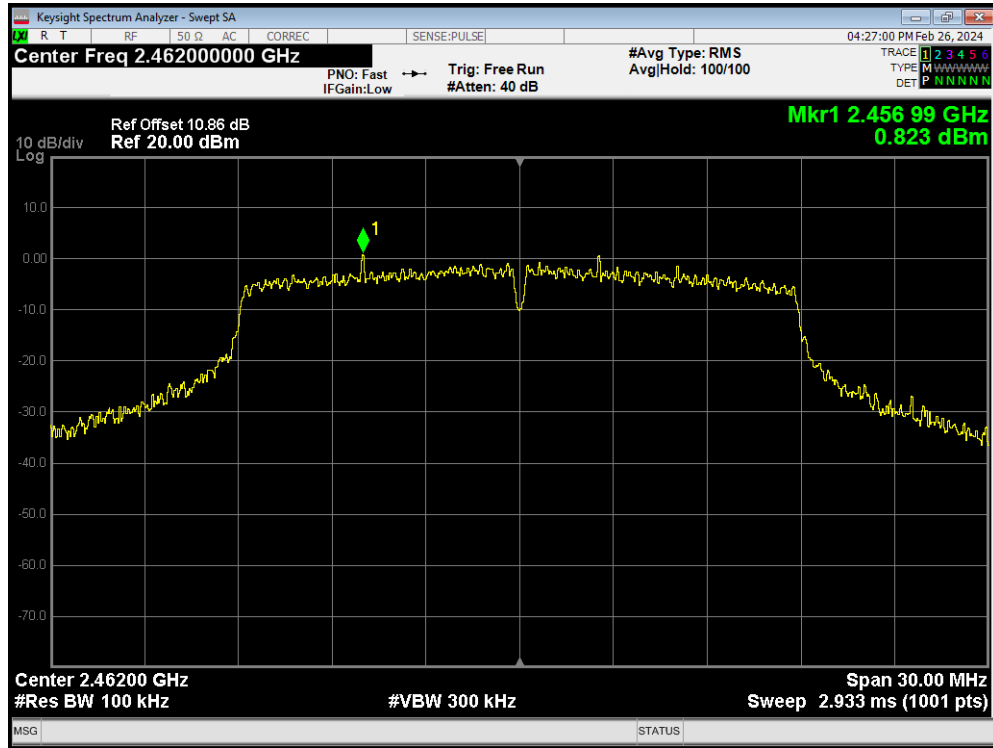
Band Edge 802.11n(HT20) 2412MHz Ref



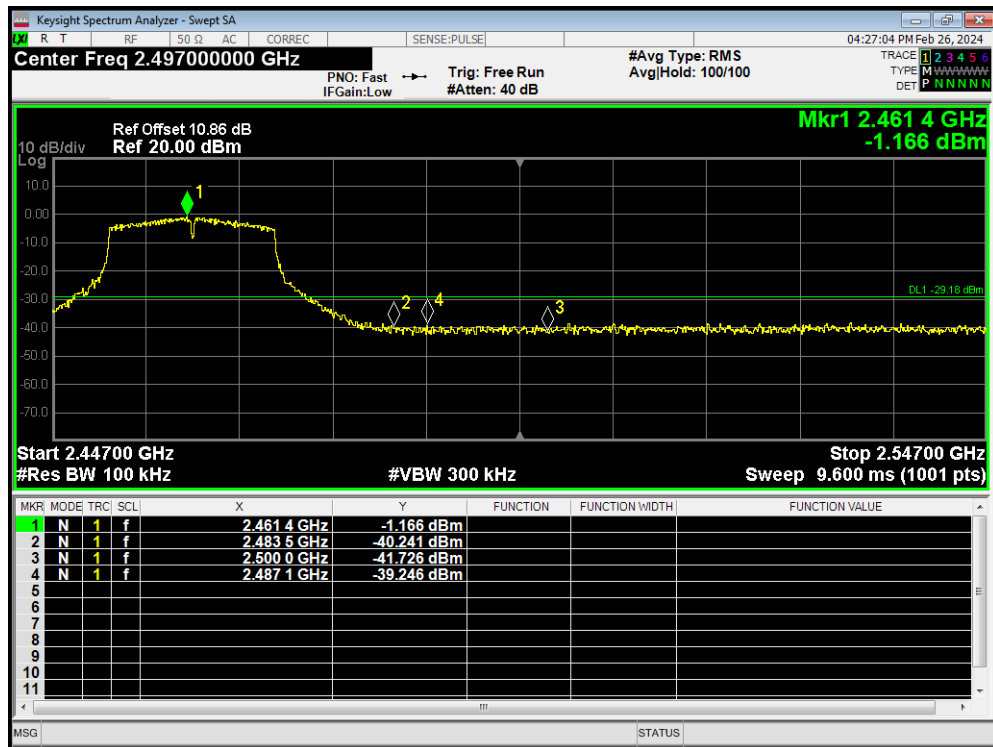
Band Edge 802.11n(HT20) 2412MHz Emission



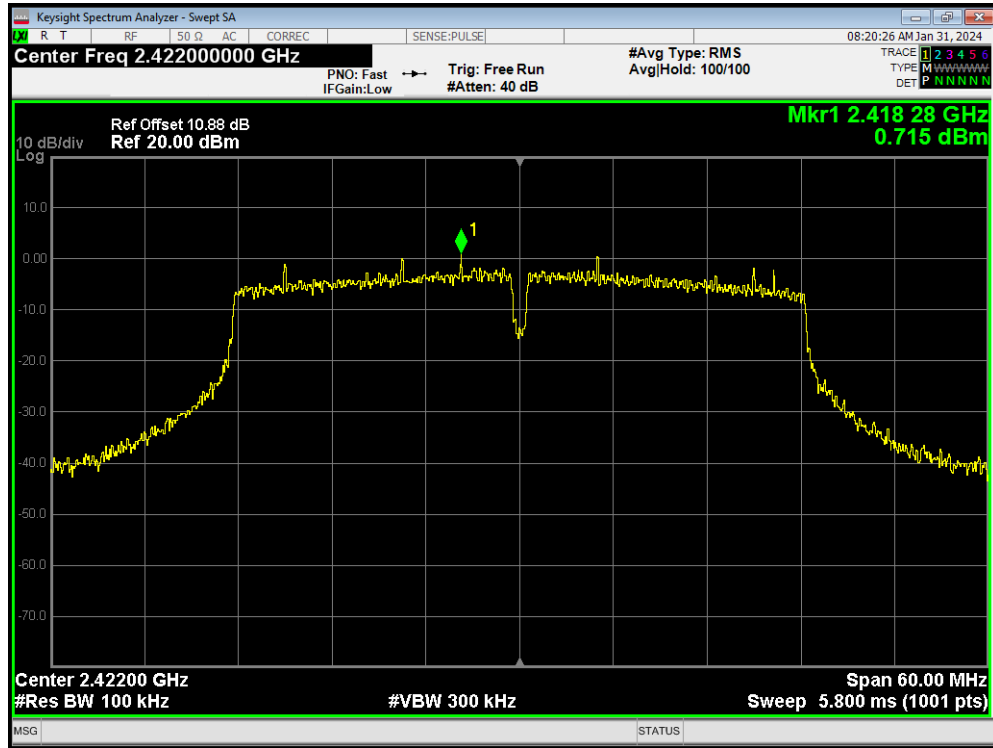
Band Edge 802.11n(HT20) 2462MHz Ref



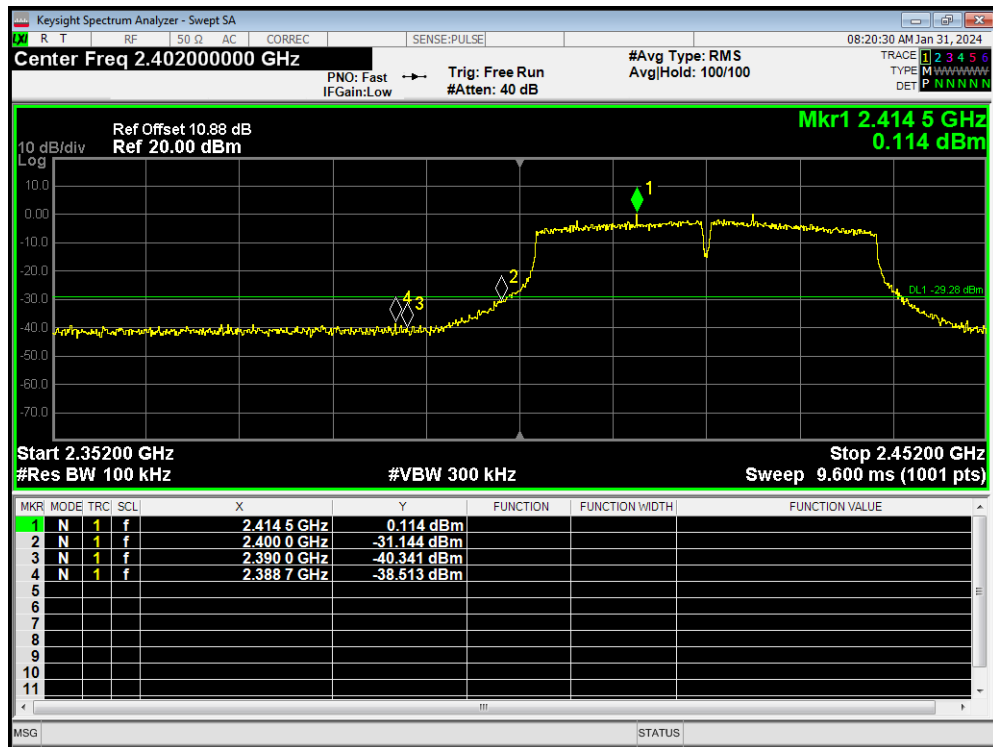
Band Edge 802.11n(HT20) 2462MHz Emission



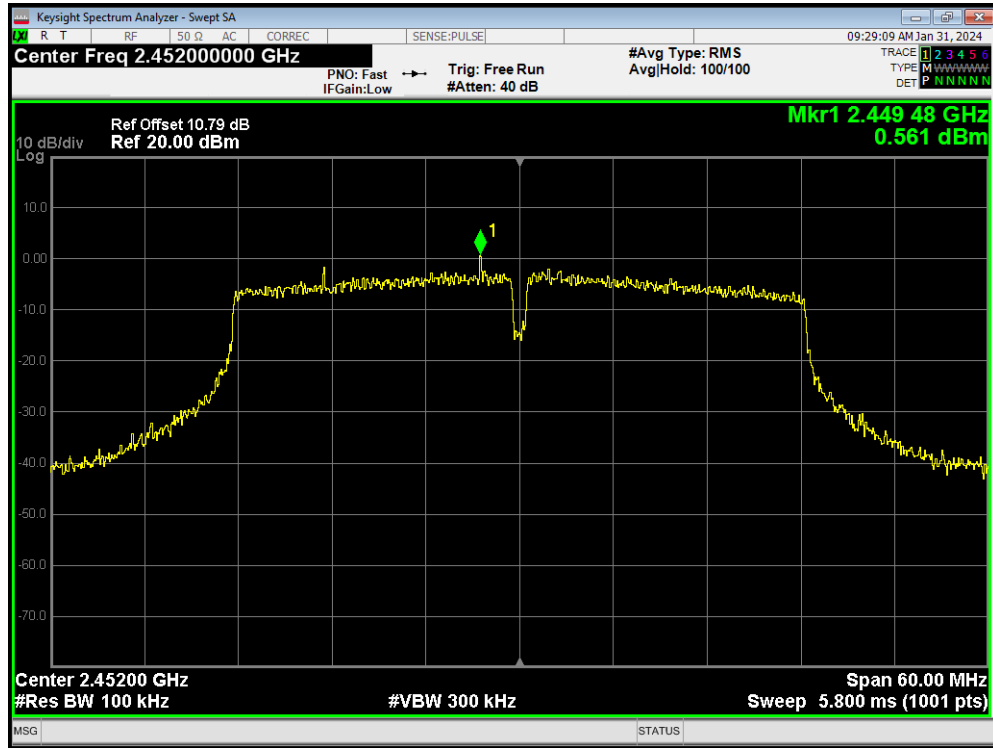
Band Edge 802.11n(HT40) 2422MHz Ref



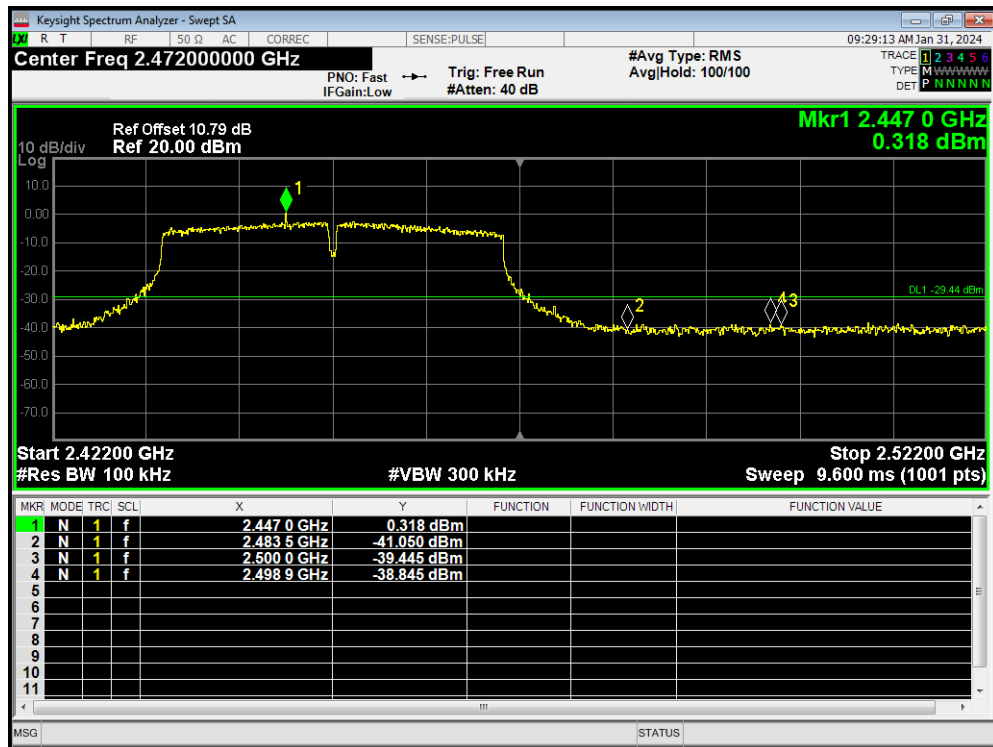
Band Edge 802.11n(HT40) 2422MHz Emission



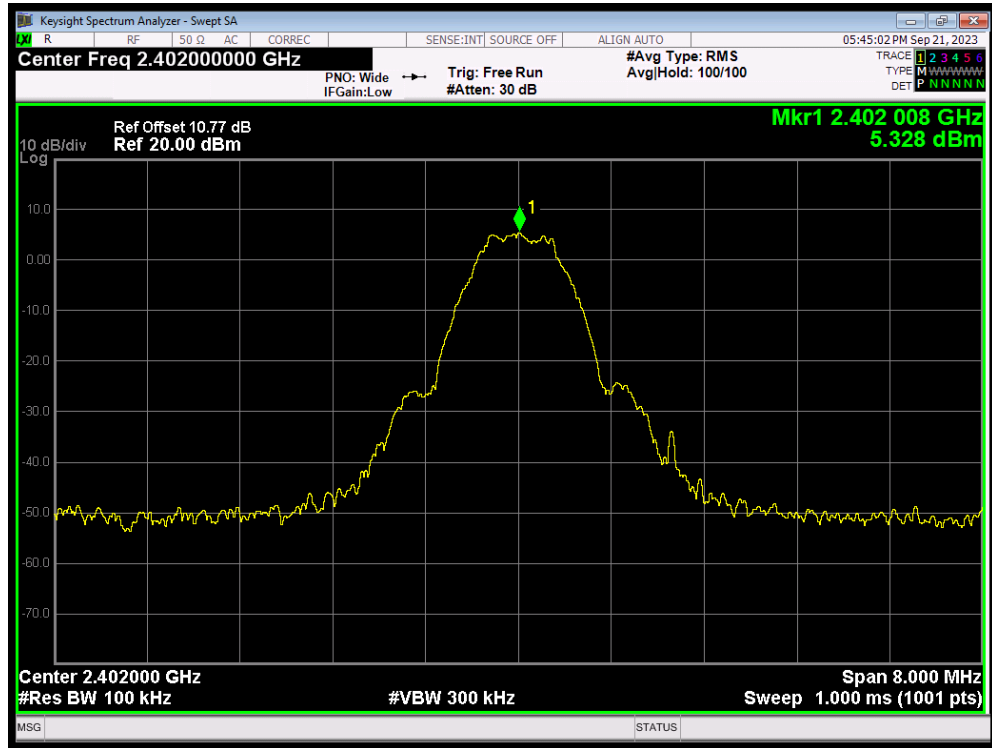
Band Edge 802.11n(HT40) 2452MHz Ref



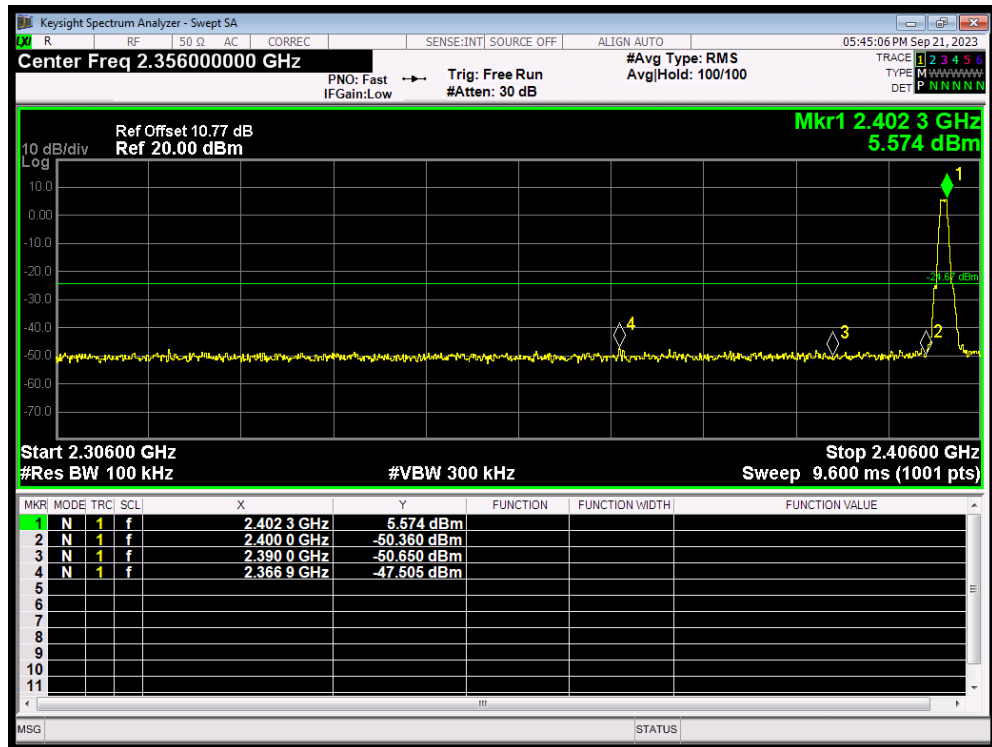
Band Edge 802.11n(HT40) 2452MHz Emission



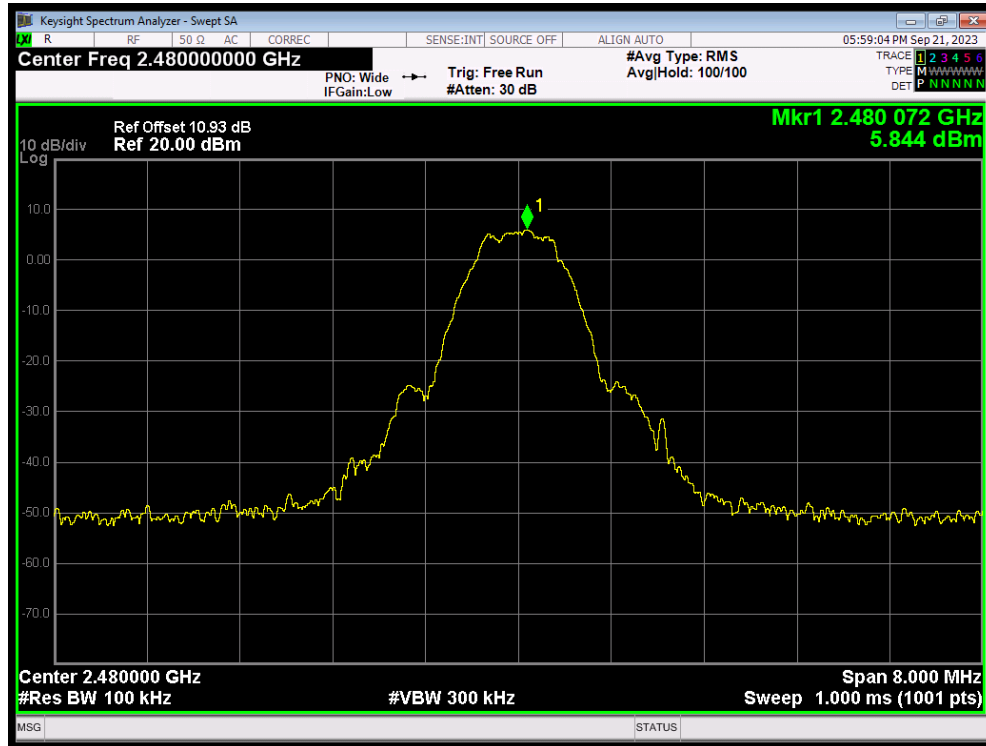
Band Edge Bluetooth LE(1M) 2402MHz Ref



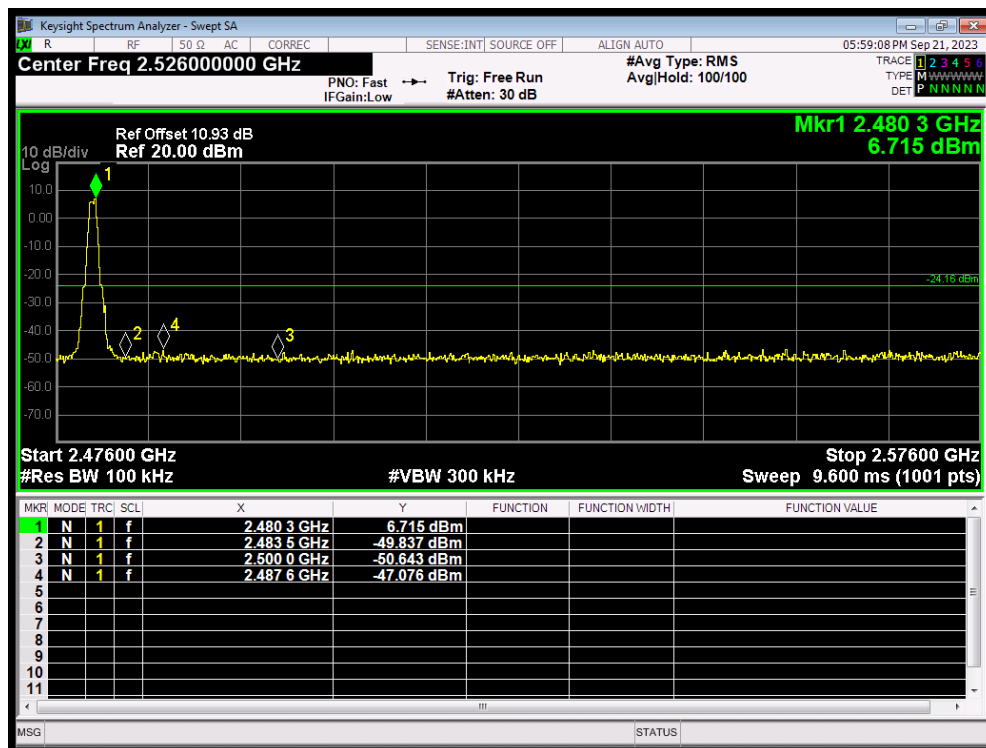
Band Edge Bluetooth LE(1M) 2402MHz Emission



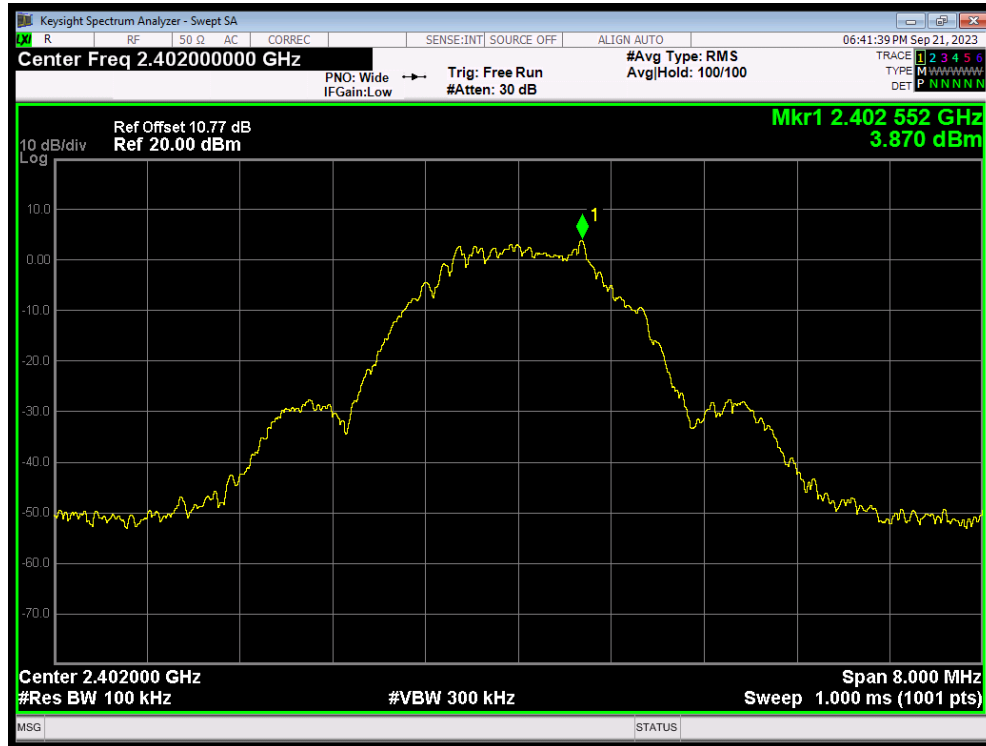
Band Edge Bluetooth LE(1M) 2480MHz Ref



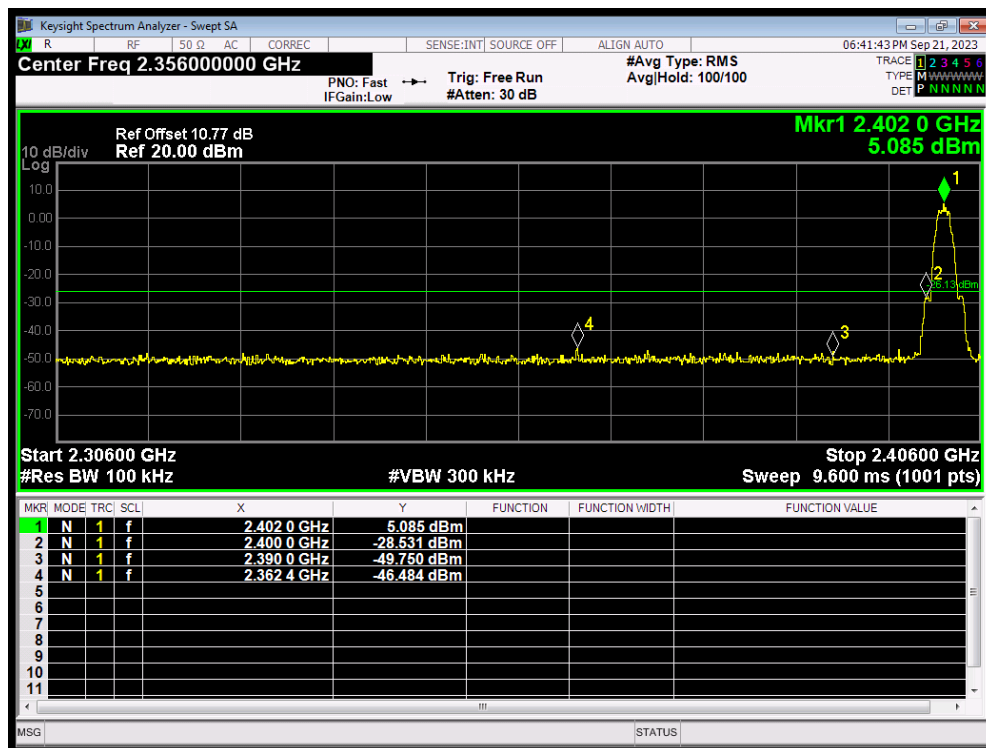
Band Edge Bluetooth LE(1M) 2480MHz Emission



Band Edge Bluetooth LE(2M) 2402MHz Ref



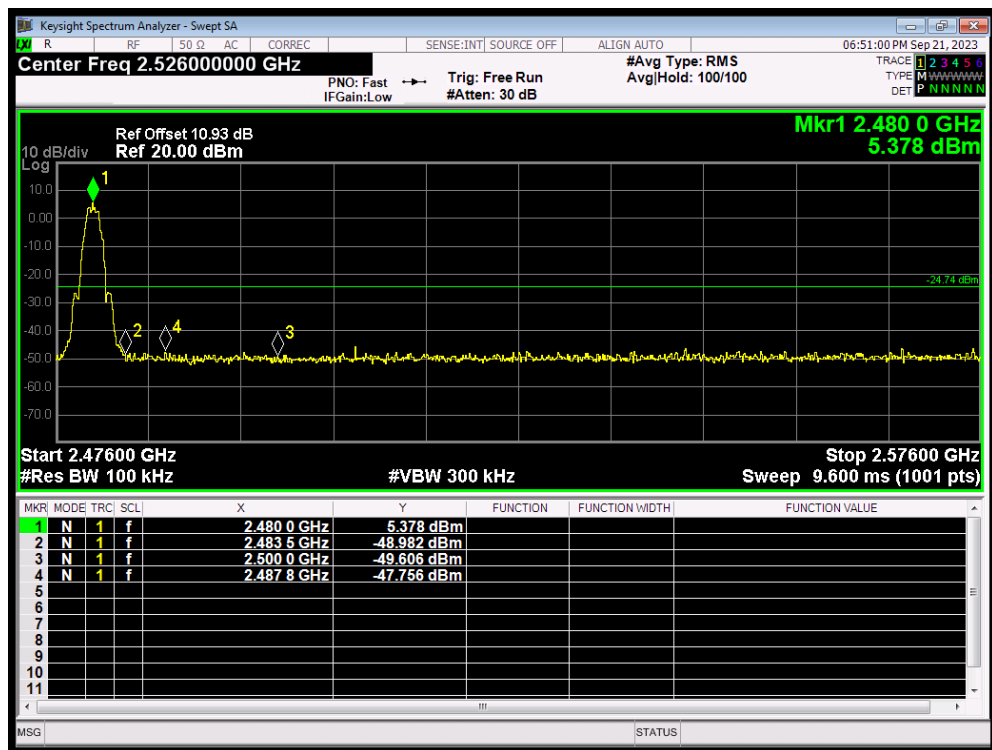
Band Edge Bluetooth LE(2M) 2402MHz Emission



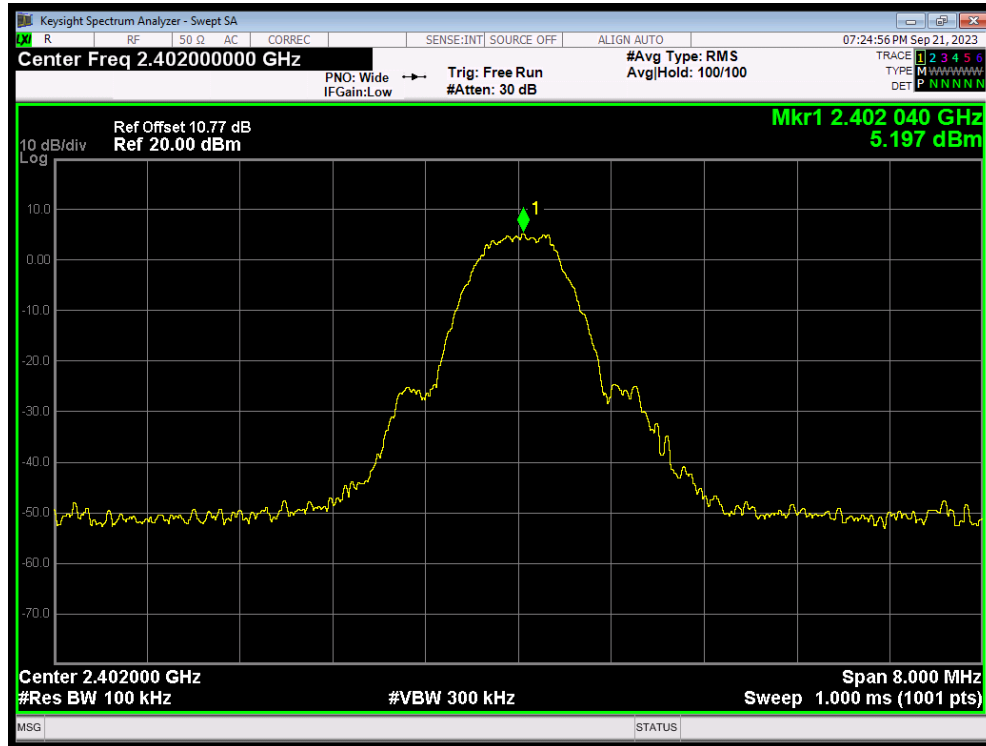
Band Edge Bluetooth LE(2M) 2480MHz Ref



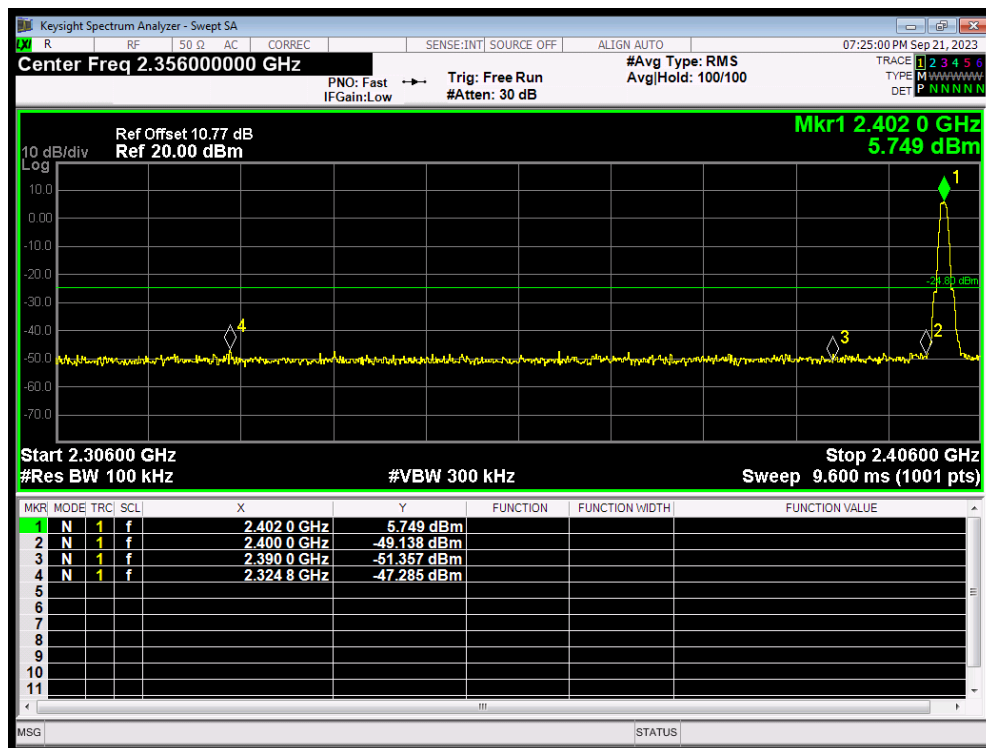
Band Edge Bluetooth LE(2M) 2480MHz Emission



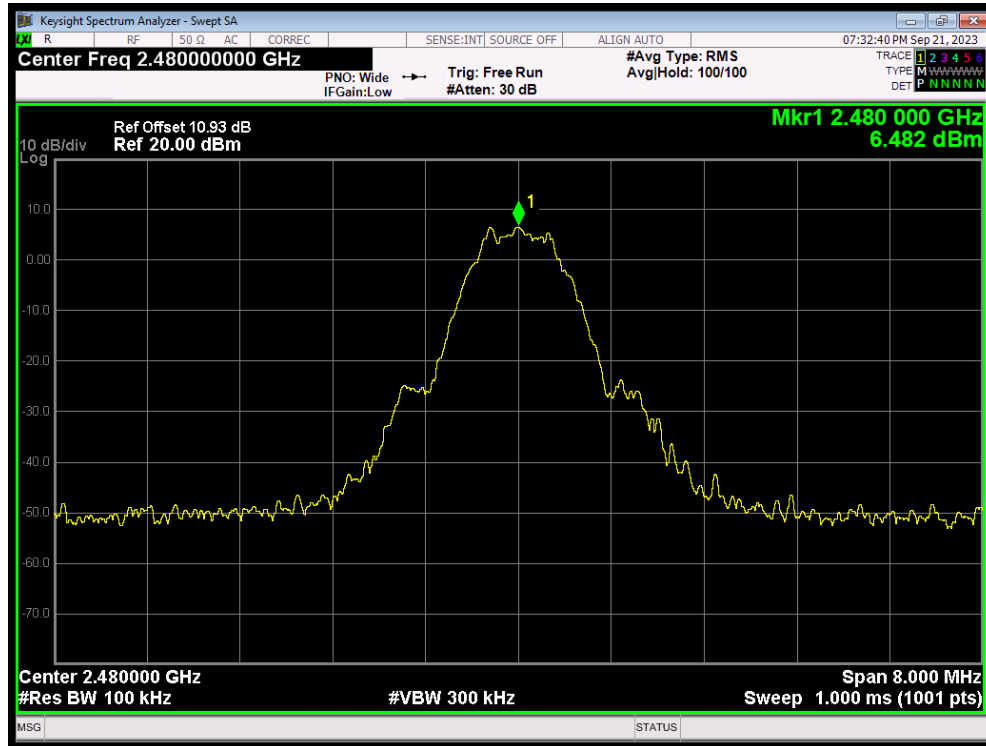
Band Edge Bluetooth LE(S=2) 2402MHz Ref



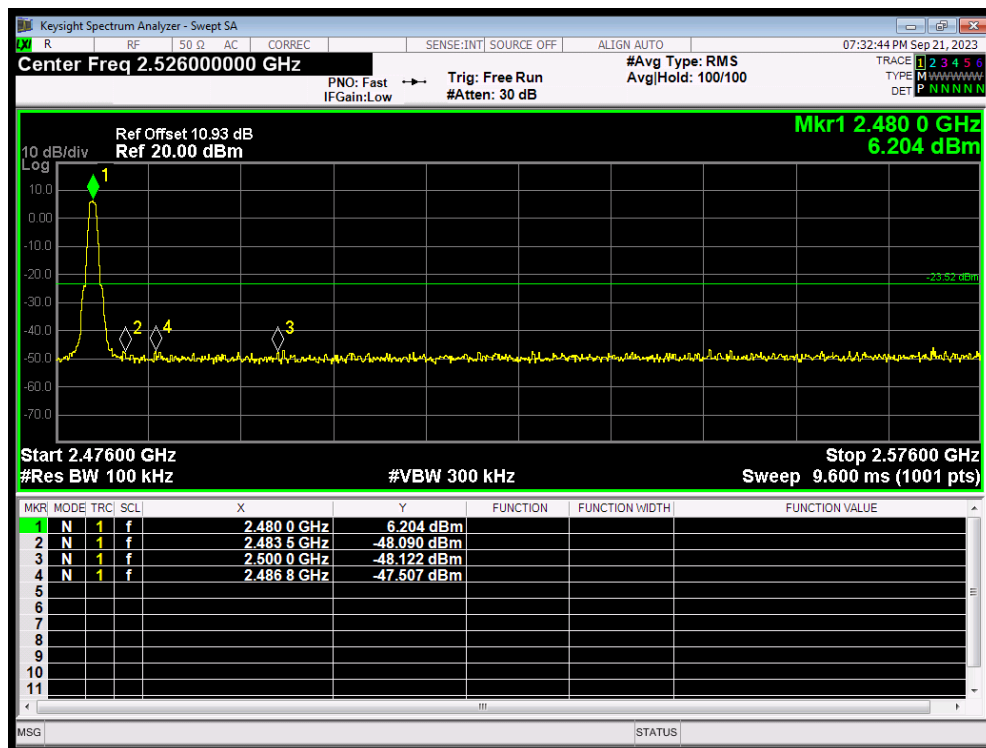
Band Edge Bluetooth LE(S=2) 2402MHz Emission



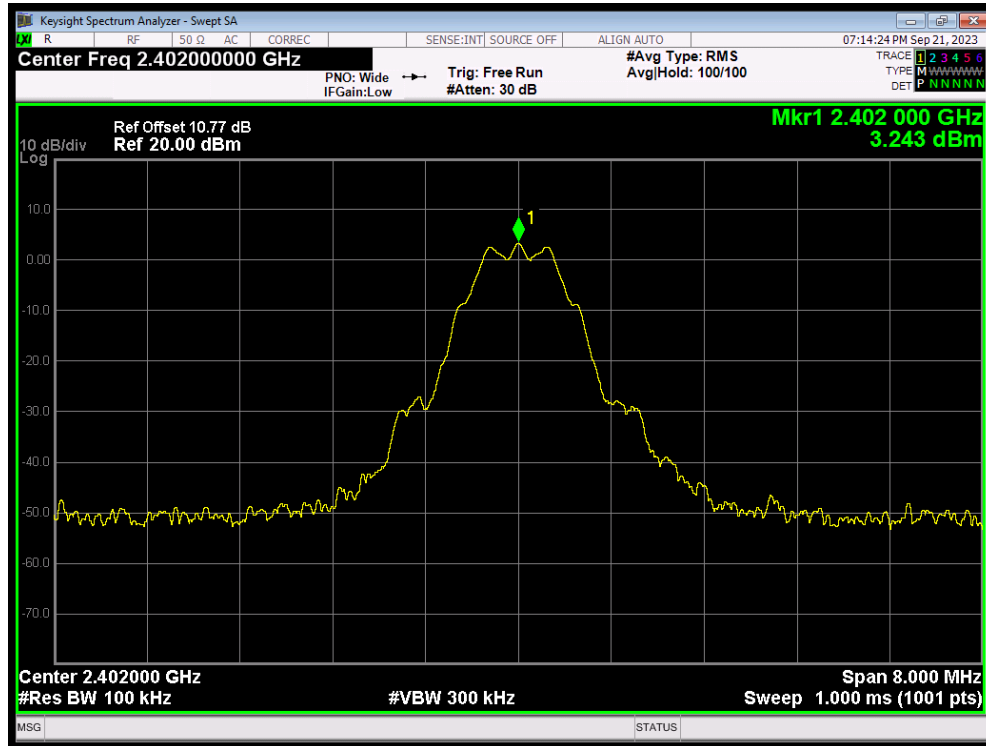
Band Edge Bluetooth LE(S=2) 2480MHz Ref



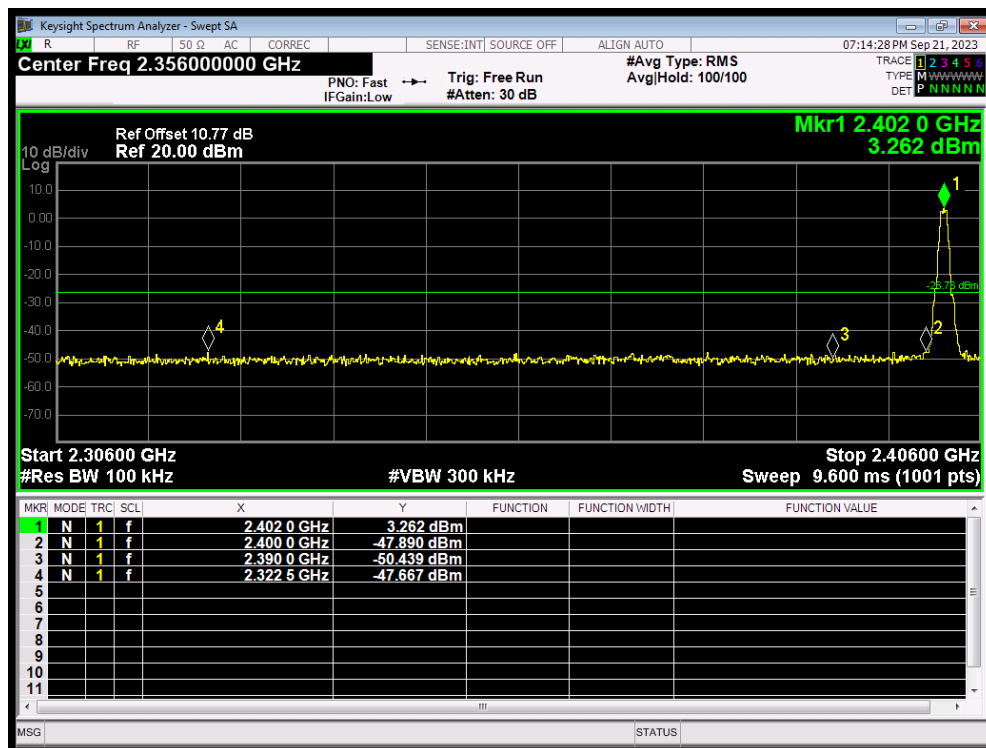
Band Edge Bluetooth LE(S=2) 2480MHz Emission



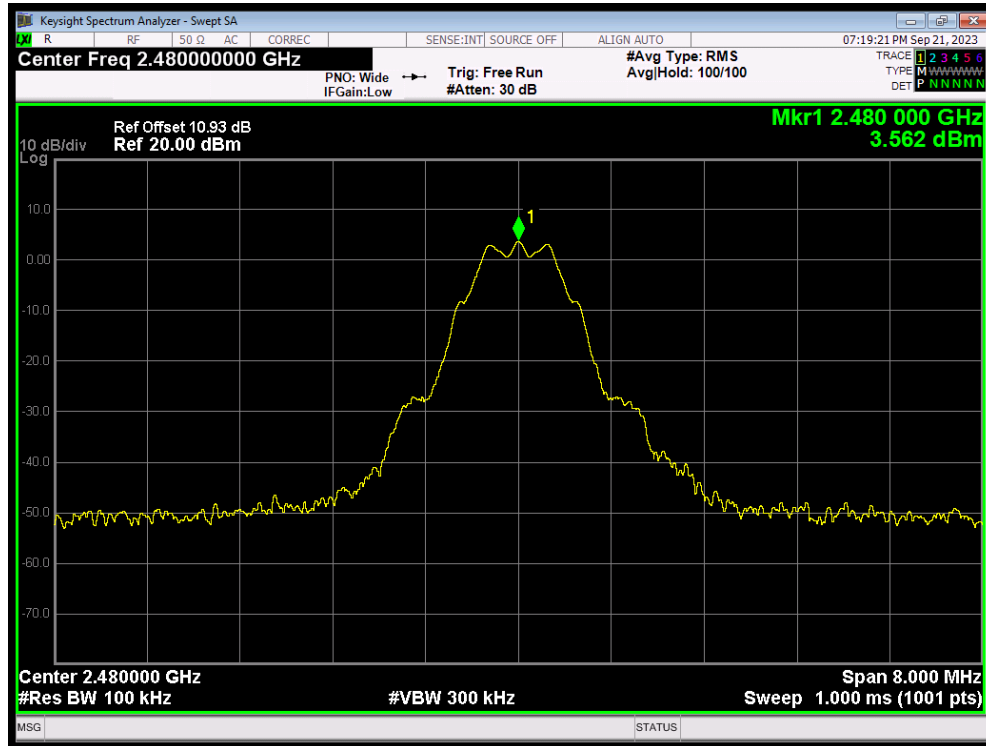
Band Edge Bluetooth LE(S=8) 2402MHz Ref



Band Edge Bluetooth LE(S=8) 2402MHz Emission



Band Edge Bluetooth LE(S=8) 2480MHz Ref



Band Edge Bluetooth LE(S=8) 2480MHz Emission

